ENGINE GENERAL INFORMATION

0A

TABLE OF CONTENTS

CLEANNESS 2

ENGINE ASSEMBLY 7

LH side view 7
RH side view 7
Front view 8
Fan belt 8

ENGINE CONTROLS 9

ECU related components 9
Engine control system 10
Electrical components and pre heating system 12

INTAKE SYSTEM 13

EXHAUST SYSTEM 14

LUBRICATION SYSTEM 15

COOLING SYSTEM 16

FUEL SYSTEM 17

Fuel supply system 18

MAINTENANCE AND REPAIR 19

Maintenance and lubrication 19
Guidelines for service work safety 20

OWNER INSPECTIONS AND SERVICES 25

While operating the vehicle 25
At each fuel fill 25
At least twice a month 25
At least monthly 25
At least twice a year 26
Each time the oil is changed 26
At least annually 26

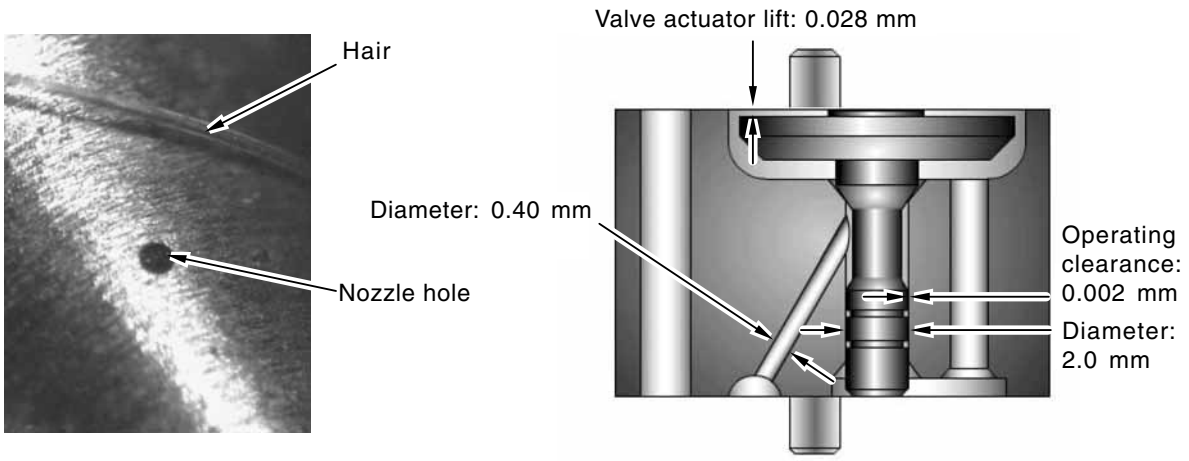
STANDARD BOLTS SPECIFICATIONS . 27

CLEANNESS

Cleanness of DI Engine Fuel System and Service Procedures

The fuel system for DI engine consists of transfer (low pressure) line and high pressure line. Its highest pressure reaches over 1600 bar. Some components in injector and HP pump are machined at the micrometer 100 μm of preciseness. The pressure regulation and injector operation are done by electric source from engine ECU. Accordingly, if the internal valve is stucked due to foreign materials, injector remains open. Even in this case, the HP pump still operates to supply high pressurized fuel. This increases the pressure to combustion chamber (over 250 bar) and may cause fatal damage to engine.

You can compare the thickness of injector nozzle hole and hair as shown in below figure (left side). The right side figure shows the clearance between internal operating elements.



The core elements of fuel system has very high preciseness that is easily affected by dust or very small foreign material. Therefore, make sure to keep the preliminary works and job procedures in next pages. If not, lots of system problems and claims may arise.

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EFFECTIVE DATE	
AFFECTED VIN	

Job Procedures

1. Always keep the workshop and lift clean (especially, from dust).
2. Always keep the tools clean (from oil or foreign materials).
3. Wear a clean vinyl apron to prevent the fuzz, dust and foreign materials from getting into fuel system. Wash your hands and do not wear working gloves.
4. Follow the below procedures before starting service works for fuel system.

Carefully listen the symptoms and problems from customer.

↓

Visually check the leaks and vehicle appearance on the wiring harnesses and connectors in engine compartment.

↓

Perform the diagnosis proceee with SCAN-100
(refer to “DI10 DIAGNOSIS” section in this manual).

↓

Locate the fault. If the cause is from fuel system (from priming pump to injector, including return line), follow the step 1 through step 3 above.

5. If the problem is from HP pump, fuel supply line or injector, prepare the clean special tools and sealing caps to perform the diagnosis for DI engine fuel system in “DIAGNOSIS” section in this manual. At this point, thoroughly clean the related area in engine compartment.

NOTICE

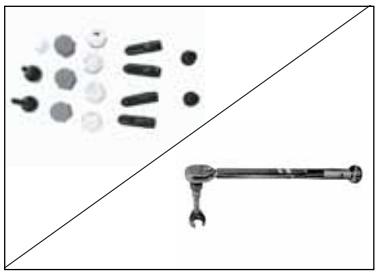
- **Clean the engine compartment before starting service works.**



Tool kit for high pressure line



Took kit for low pressure line



Removal tool box and cap kits

6. Follow the job procedures. If you find a defective component, replace it with new one.

Disconnect the negative battery cable.

↓

For safety reasons: check pressure is low before opening the HP systems (pipes)

↓

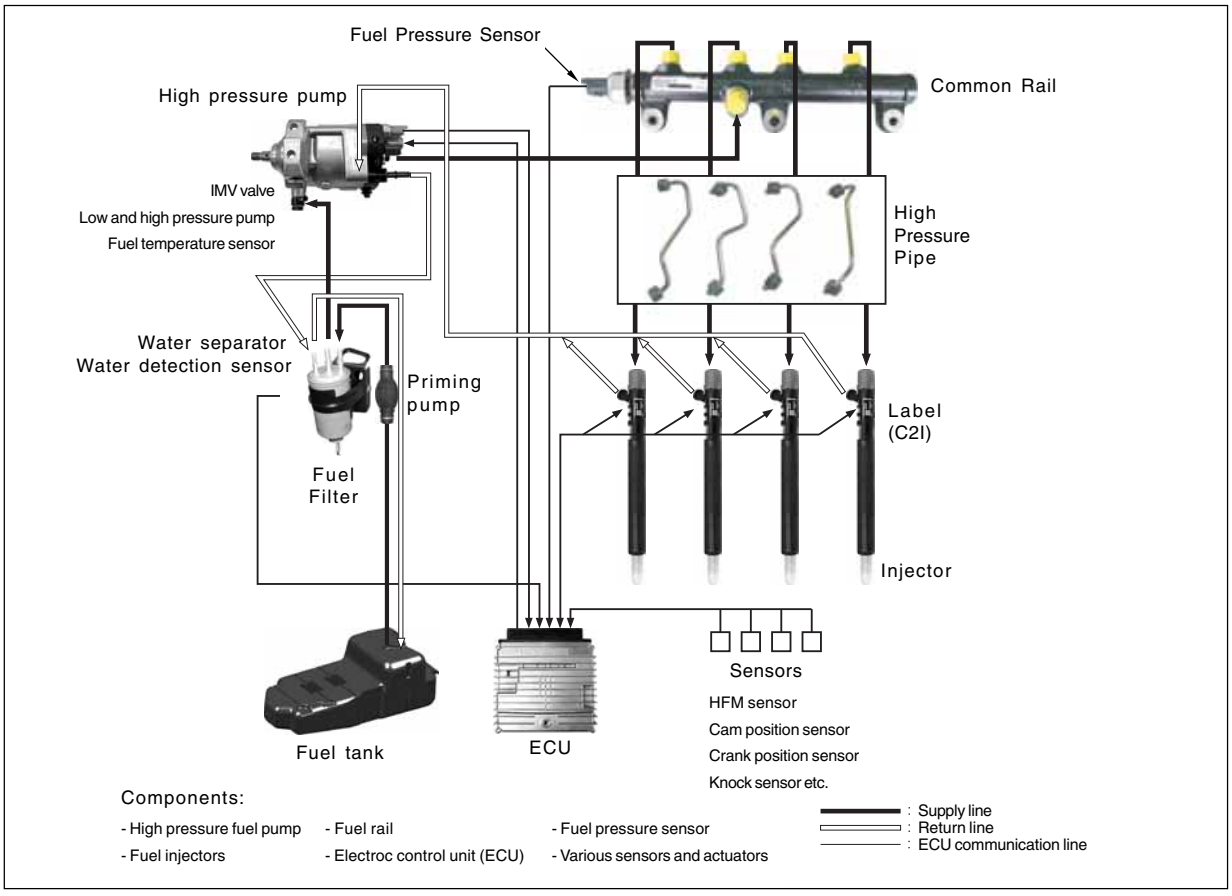
Use special tools and torque wrench to perform the correct works.

Once disconnected, the fuel pipes between HP pump and fuel rail and between fuel rail and each injector should be replaced with new ones. The pipes should be tightened to specified tightening torques during installation. Over or under torques out of specified range may cause damages and leaks at connections. Once installed, the pipes have been deformed according to the force during installtion, therefore they are not reusable.

The copper washer on injector should be replaced with new one. The injector holder bolt should be tightened to specified tightening torque as well. If not, the injection point may be deviated from correct position, and it may cause engine disorder.

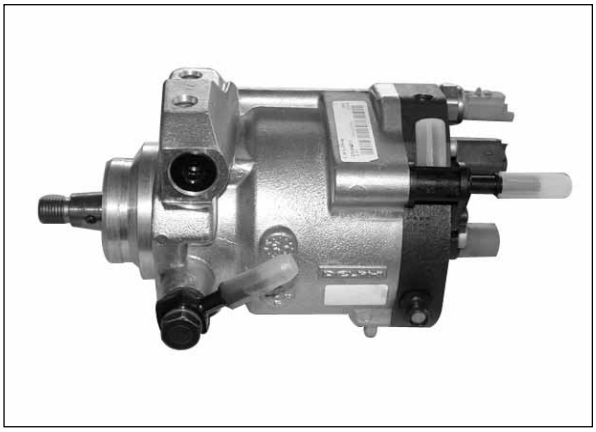
↓

Plug the disconnected parts with sealing caps, and remove the caps immediately before replacing the components.



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EFFECTIVE DATE	
AFFECTED VIN	

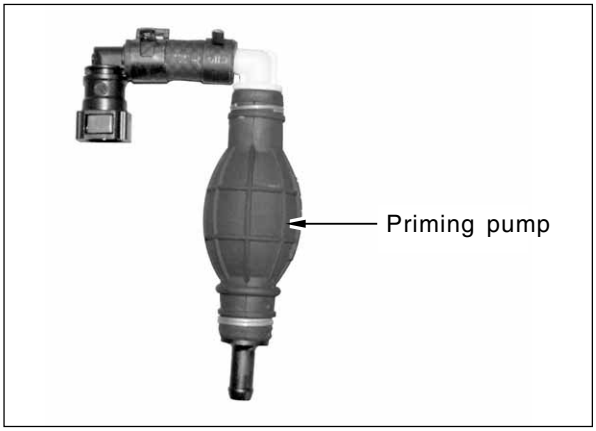
7. Plug the removed components with clean and undamaged sealing caps and store it into the box to keep the conditions when it was installed.
8. Clear the high pressure offset value by SCAN-100 after replacing the high pressure pump.



9. To supply the fuel to transfer line of HP pump press the priming pump until it becomes hard.

NOTICE

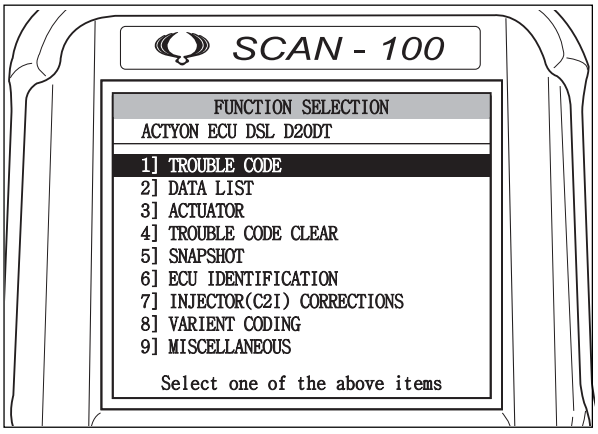
- **Do not crank engine before having filled pump.**



10. Check the installed components again and connect the negative battery cable. Start the engine and check the operating status.
11. With SCAN-100, check if there are current faults and erase the history faults.

NOTE

- **For details, refer to "Diagnosis table".**



DI Engine and Its Expected Problems and Remedies Can be Caused by Water in Fuel

▶ SYSTEM SUPPLEMENT AGAINST PARAFFIN SEPARATION.

In case of Diesel fuel, paraffin, one of the elements, can be separated from fuel during winter and then can stick on the fuel filter blocking fuel flow and causing difficult starting finally. Oil companies supply summer fuel and winter fuel by differentiating mixing ratio of kerosene and other elements by region and season. However, above phenomenon can be happened if stations have poor facilities or sell improper fuel for the season.
In case of DI engine, purity of fuel is very important factor to keep internal preciseness of HP pump and injector. Accordingly, more dense mesh than conventional fuel filter is used. To prevent fuel filter internal clogging due to paraffin separation, SYMC is using fuel line that high pressure and temperature fuel injected by injector returns through fuel filter to have an effect of built-in heater (see fuel system).

▶ SYSTEM SUPPLEMENT AND REMEDY AGAINST WATER IN FUEL

As mentioned above, some gas stations supply fuel with excessive than specified water. In the conventional IDI engine, excessive water in the fuel only causes dropping engine power or engine hunting. However, fuel system in the DI engine consists of precise components so water in the fuel can cause malfunctions of HP pump due to poor lubrication of pump caused by poor coating film during high speed pumping and bacterization (under long period parking). To prevent problems can be caused by excessive water in fuel, water separator is installed inside of fuel filter. When fuel is passing filter, water that has relatively bigger specific gravity is accumulated on the bottom of the filter.



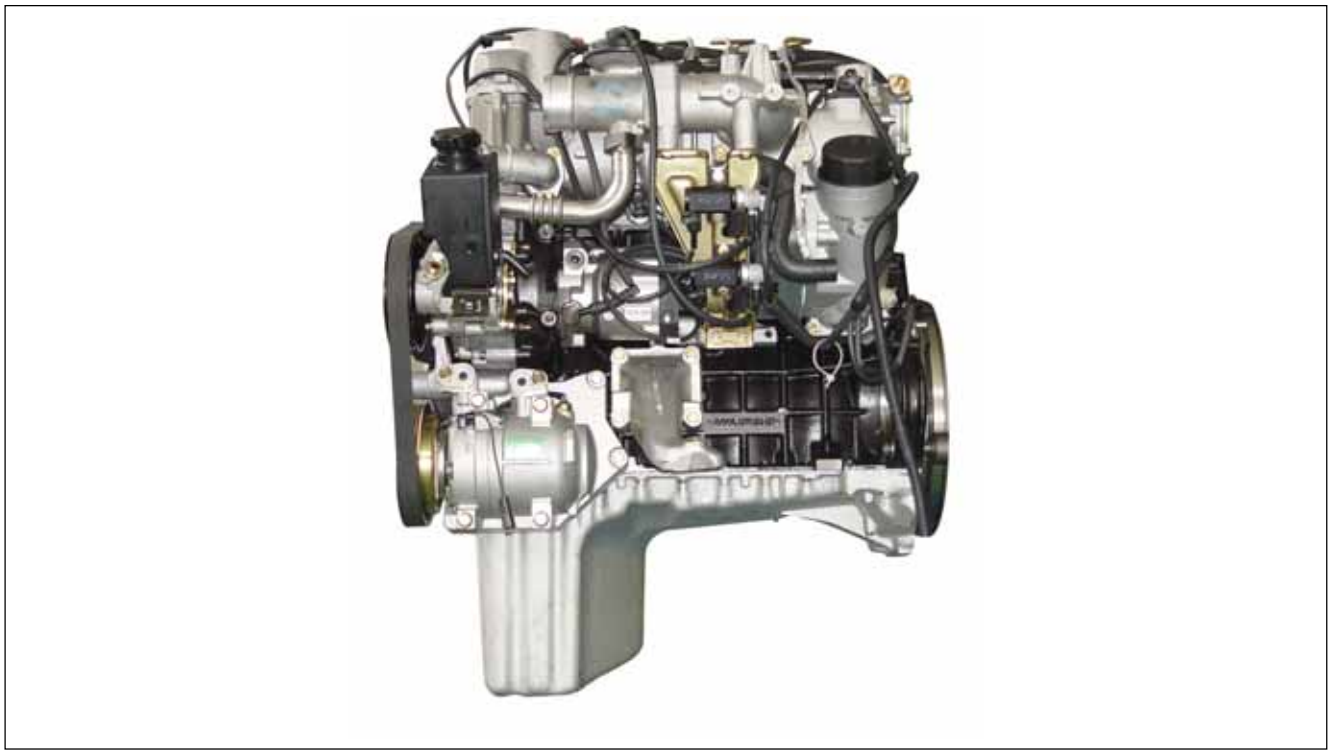
If water in the separator on the fuel filter exceeds a certain level, it will be supplied to HP pump with fuel, so the engine ECU turns on warning light ( ) on the meter cluster and buzzer if water level is higher than a certain level.

Due to engine layout, a customer cannot easily drain water from fuel filter directly, so if a customer checks in to change engine oil, be sure to perform water drain from fuel filter. (See fuel system for details.)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ENGINE ASSEMBLY

LH SIDE VIEW



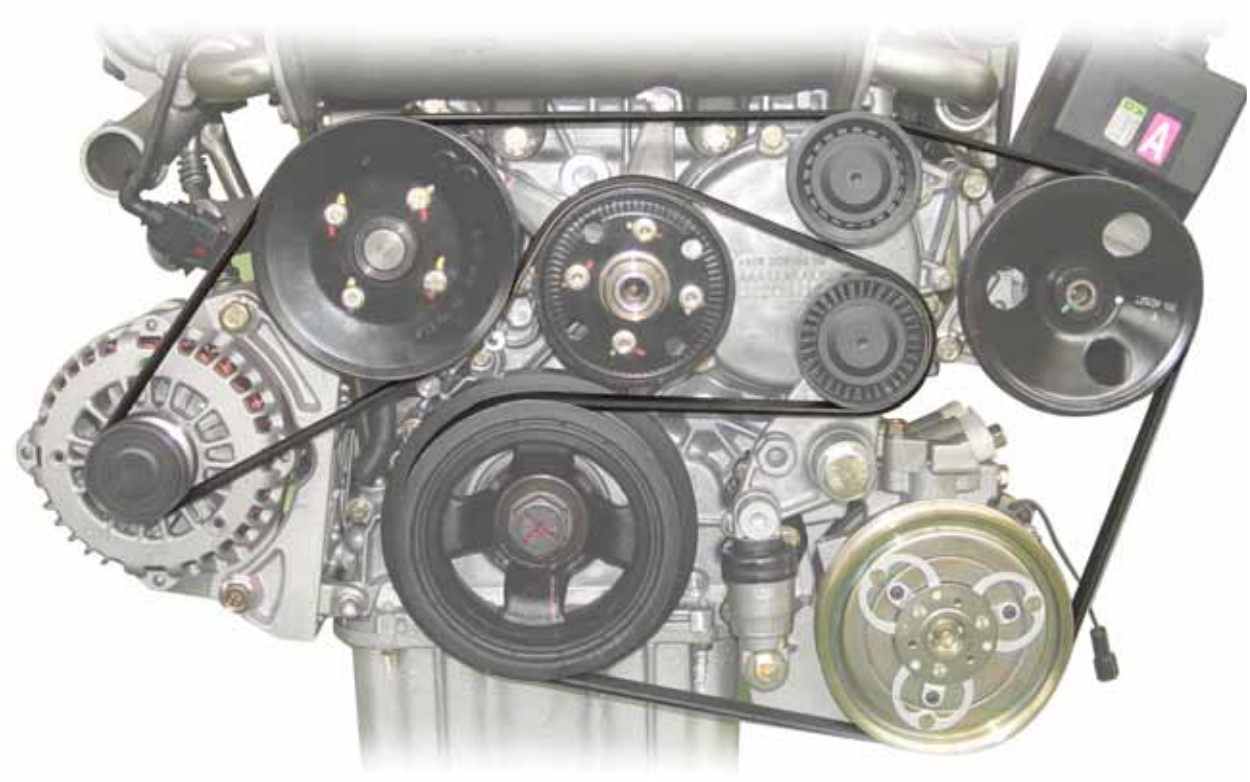
RH SIDE VIEW



FRONT VIEW



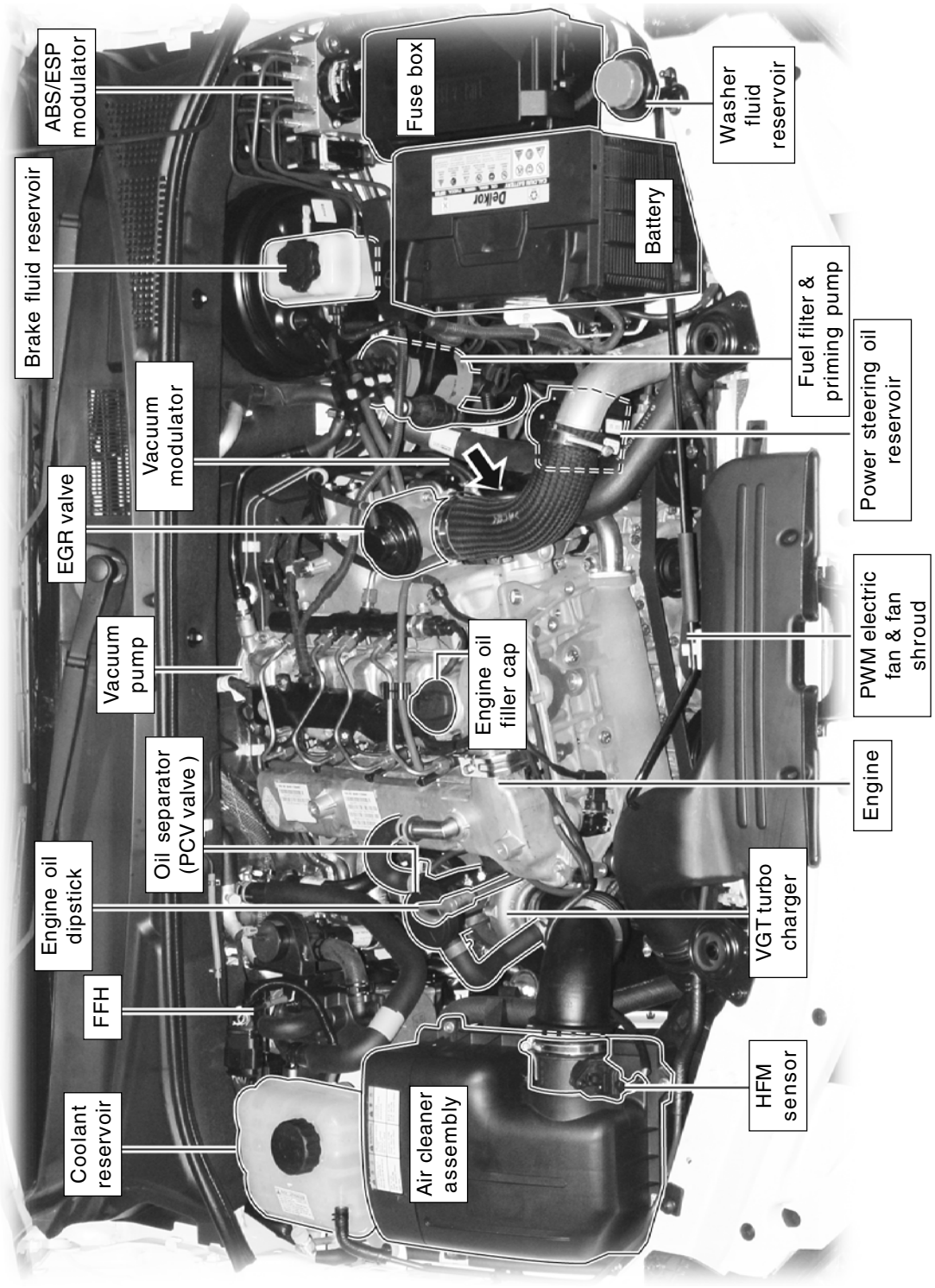
FAN BELT



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AFFECTED VIN	

ENGINE CONTROLS

ECU RELATED COMPONENTS



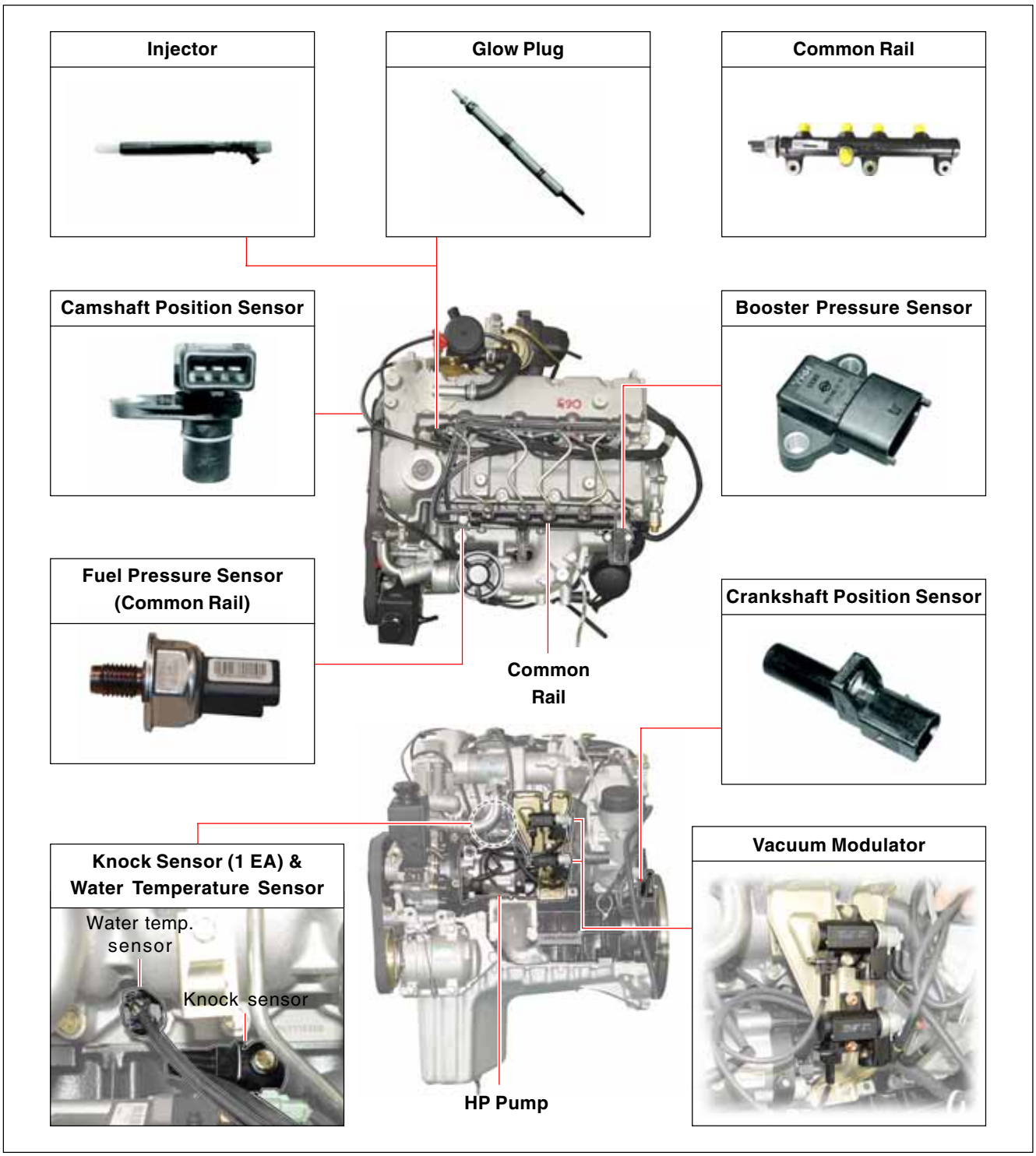
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AFFECTED VIN	

ENGINE CONTROL SYSTEM

The figures below show the components in the D20DT engine.

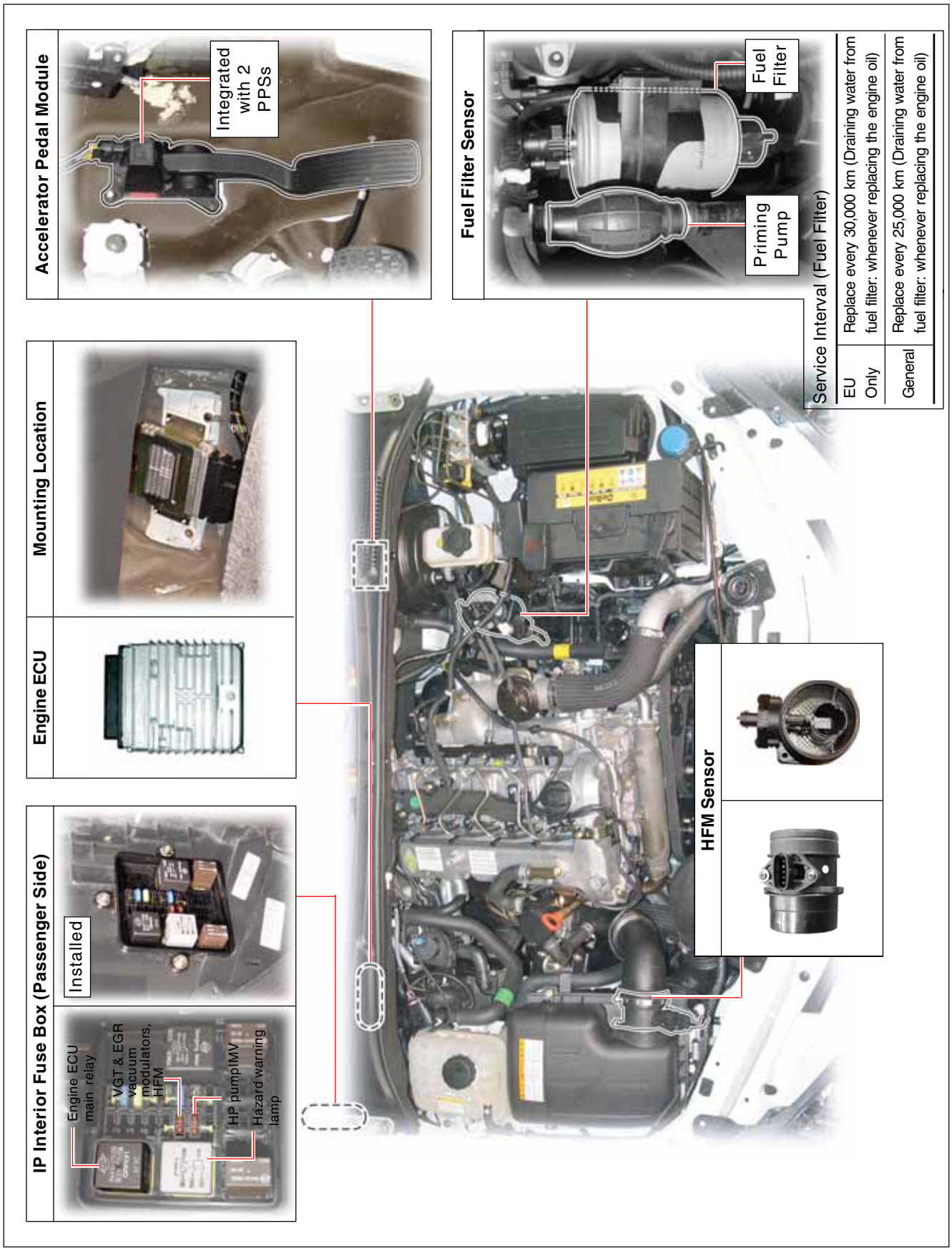
▶ Engine Control System

Major Sensors and Components

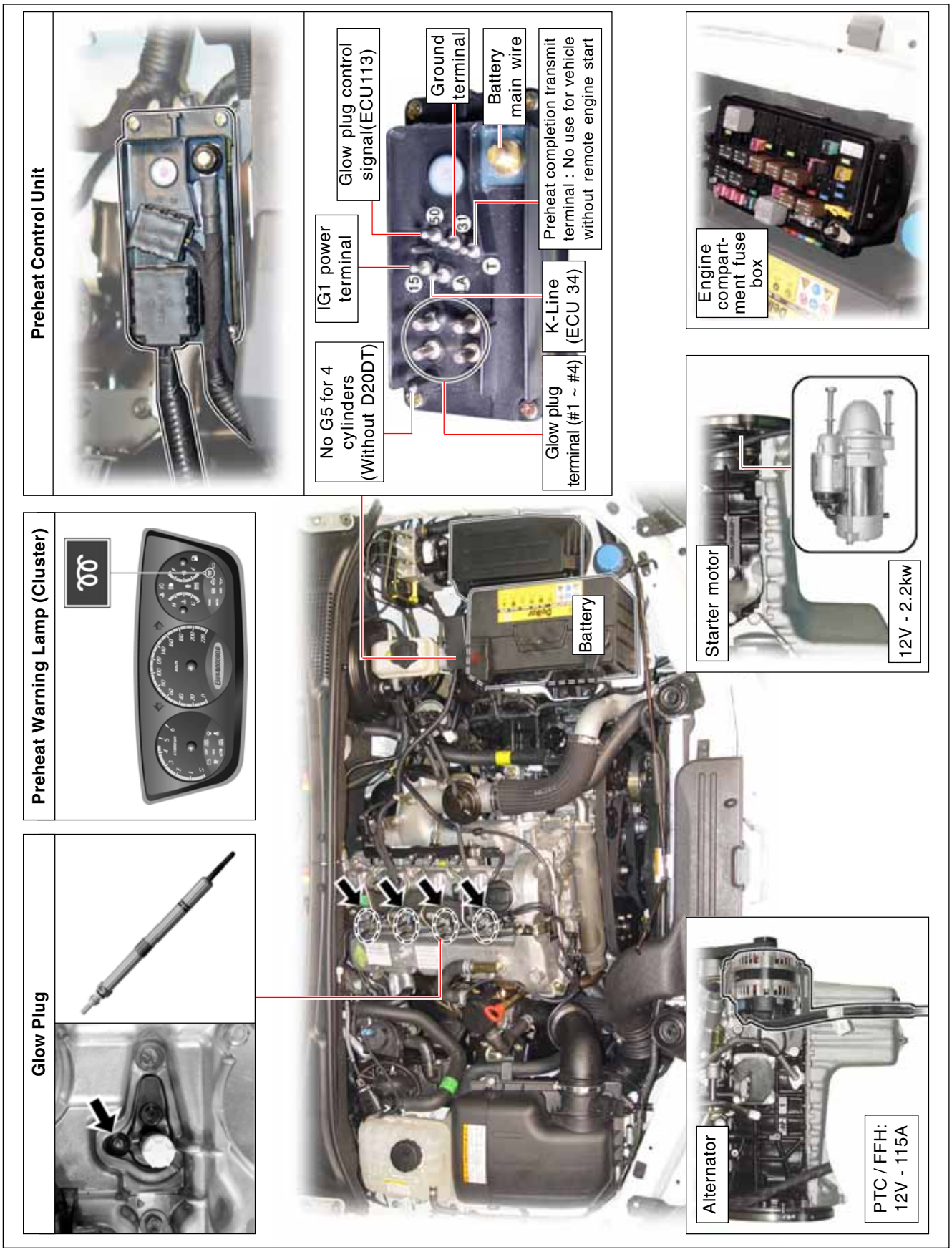


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EFFECTIVE DATE	
AFFECTED VIN	

Engine Accessories Related to ECU

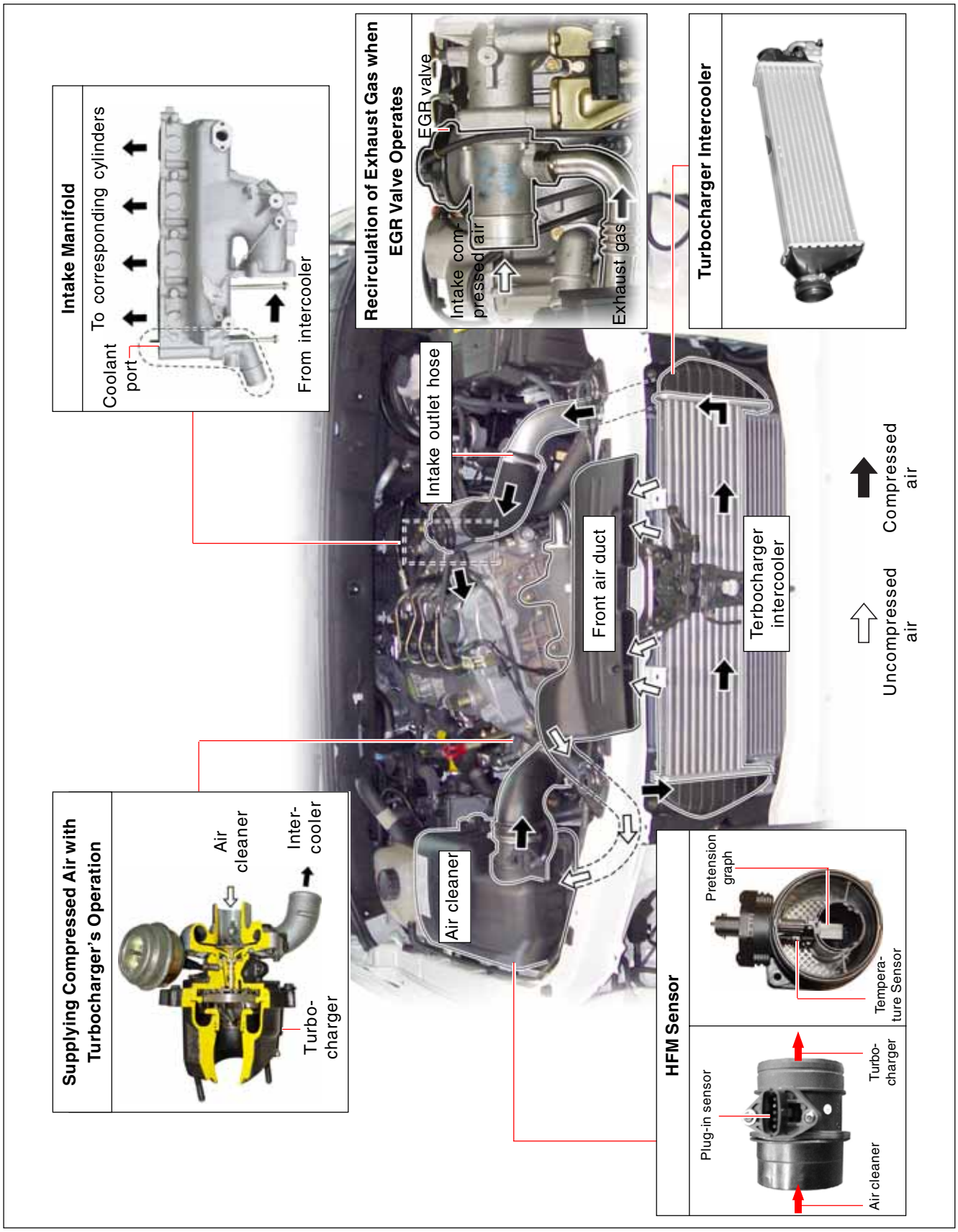


ELECTRICAL COMPONENTS AND PRE HEATING SYSTEM



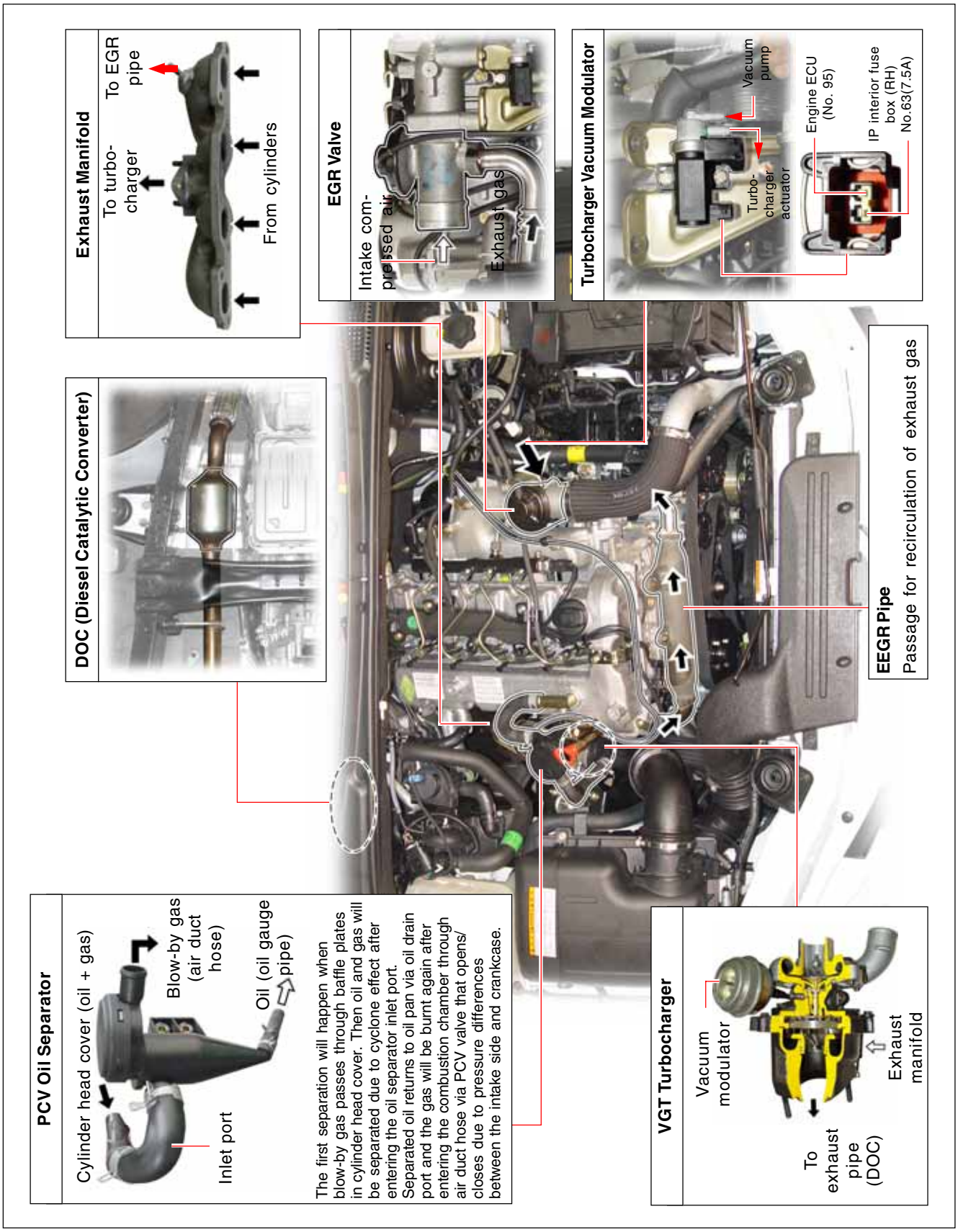
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INTAKE SYSTEM



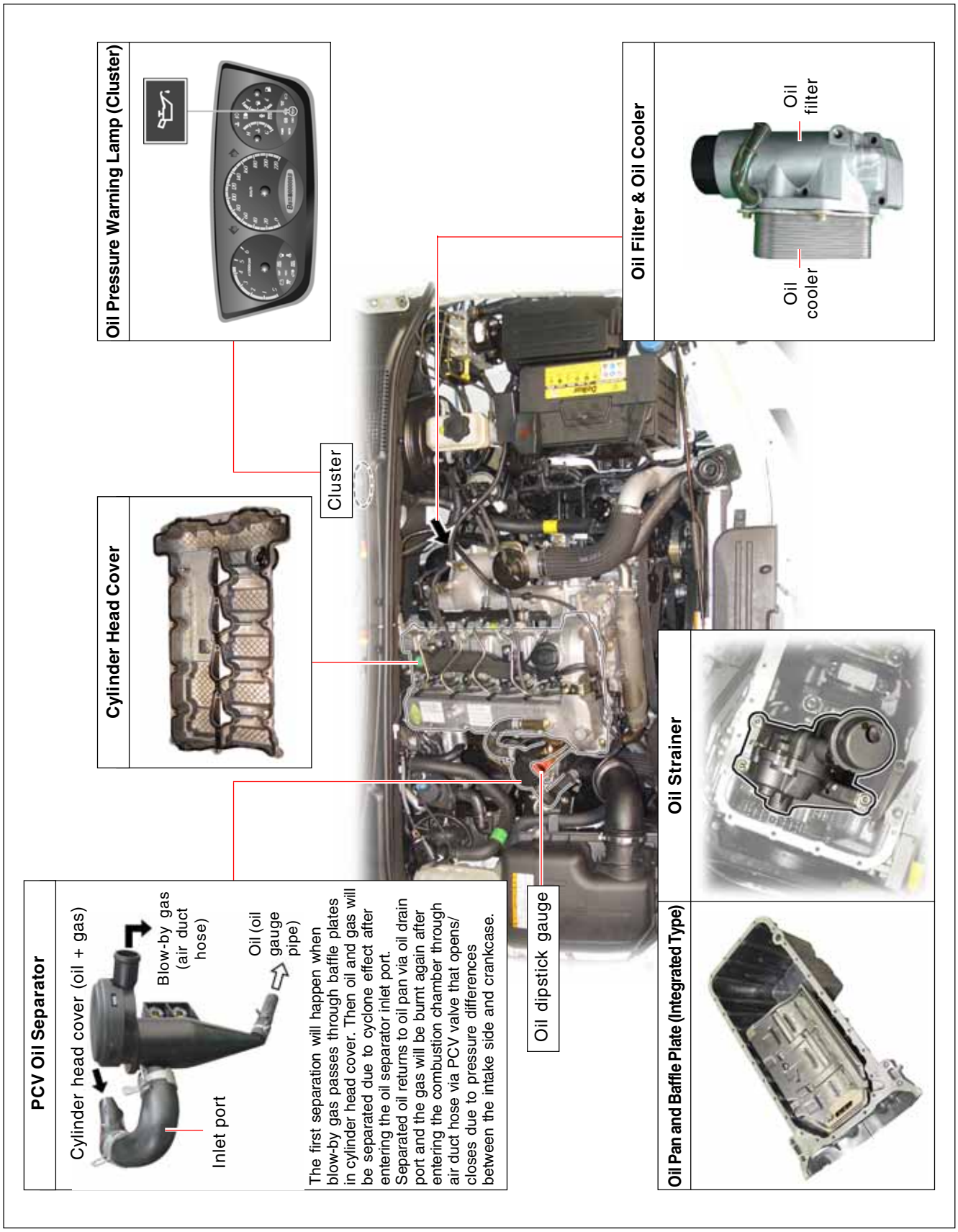
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AFFECTED VIN	

EXHAUST SYSTEM



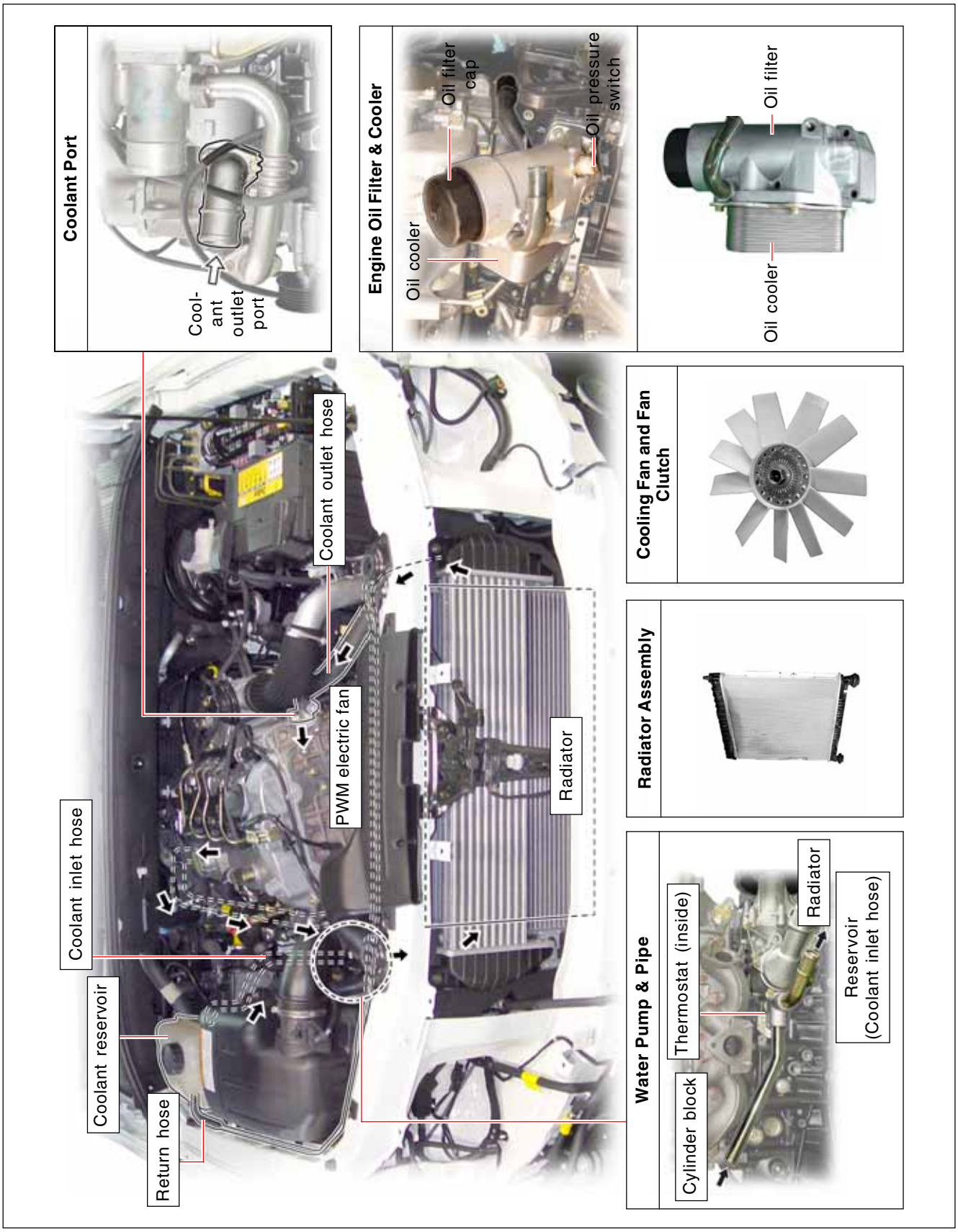
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AFFECTED VIN	

LUBRICATION SYSTEM



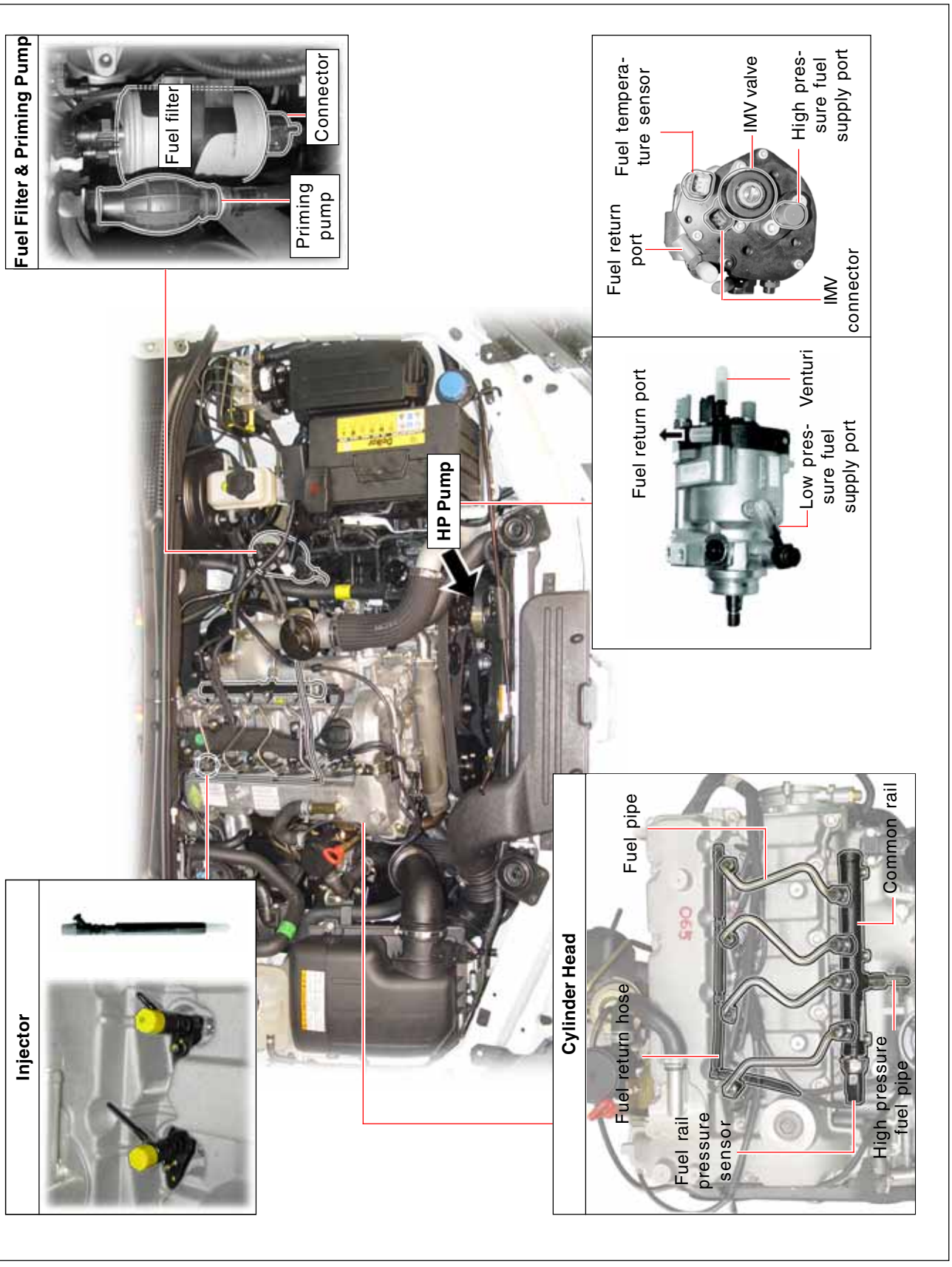
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AFFECTED VIN	

COOLING SYSTEM



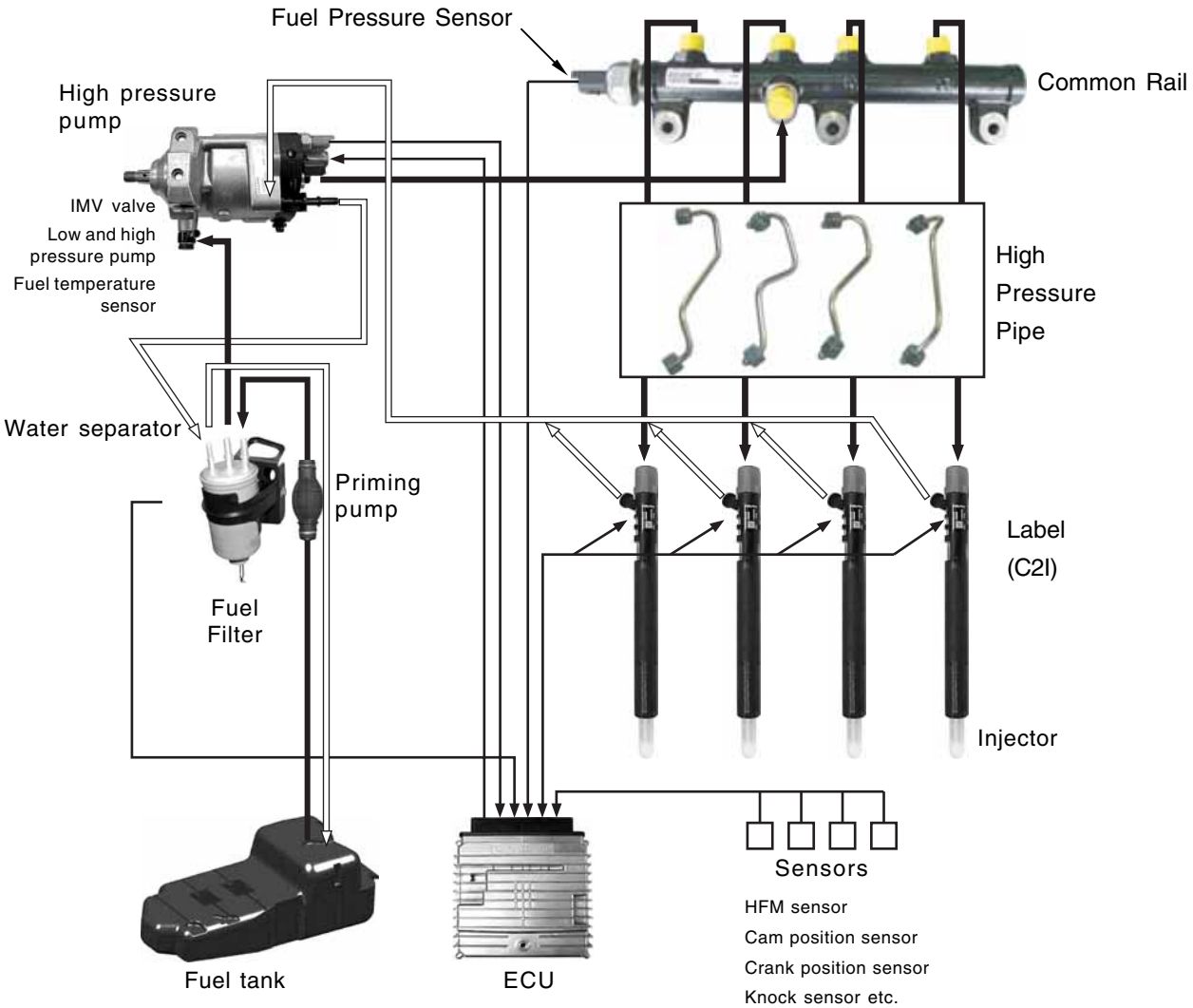
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

FUEL SYSTEM



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

FUEL SUPPLY SYSTEM



According to input signals from various sensors, engine ECU calculates driver's demand (position of the accelerator pedal) and then controls overall operating performance of engine and vehicle on that time.

ECU receives signals from sensors via data line and then performs effective engine air-fuel ratio controls based on those signals. Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's demand) through electrical signal that is generated by variable resistance changes in accelerator pedal sensor. Air flow (hot film) sensor detects intake air volume and sends the signals to ECU. Especially, the engine ECU controls the air-fuel ratio by recognizing instant air volume changes from air flow sensor to decrease the emissions (EGR valve control). Furthermore, ECU uses signals from coolant temperature sensor and air temperature sensor, booster pressure sensor and barometric sensor as compensation signal to respond to injection starting, pilot injection set values, various operations and variables.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MAINTENANCE AND REPAIR

MAINTENANCE AND LUBRICATION

▶ Normal Vehicle Use

The maintenance instructions contained in the maintenance schedule are based on the assumption that the vehicle will be used for the following reasons:

1. To carry passengers and cargo within the limitation of the tire inflation prassure. Refer to “Wheels and Tire” in section 4H.
2. To be driven on reasonable road surfaces and within legal operating limits.

▶ Explanation of Scheduled Maintenance Services

The services listed in the maintenance schedule are further explained below. When the following maintenance services are performed, make sure all the parts are replaced and all the necessary repairs are done before driving the vehicle. Always use the proper fluid and lubricants.

Engine Oil and Oil Filter Change

Always use above the API SH grade or recommended engine oil.

Engine Oil Viscosity

Engine oil viscosity (thickness) has an effect on fuel economy and cold weather operation. Lower viscosity engine oils can provide better fuel economy and cold weather performance; however, higher temperature weather conditions require higher viscosity engine oils for satisfactory lubrication. Using oils of any viscosity other than those viscosities recommended could result in engine damage.

Cooling System Service

Drain, flush and refill the system with new coolant. Refer to “Recommended Fluids And Lubricants” in this section.

Air Cleaner Element Replacement

Clean the air cleaner element every.

1. Gasoline Engine: 15,000 km (10,000 miles)
2. Diesel Engine: 10,000 km (6,000 miles)

Replace the air cleaner element every.

1. Gasoline Engine: 60,000 km (36,000 miles)
2. Diesel Engine: 30,000 km (18,000 miles)

Replace the air cleaner more often under dusty conditions.

Fuel Filter Replacement

Replace the engine fuel filter every.

1. Gasoline Engine: 60,000 km (36,000 miles)
2. Diesel Engine: 30,000 km (18,000 miles)

Spark Plug Replacement

Replace spark plugs with same type.

1. Type: BOSCH: F8DC4
   BERU: 14F-8DU4
   Champion: C11YCC
2. Gap: 0.8 ± 0.1 mm

Spark Plug Wire Replacement

Clean wires and inspect them for burns, cracks or other damage. Check the wire boot fit at the Distributor and at the spark plugs. Replace the wires as needed.

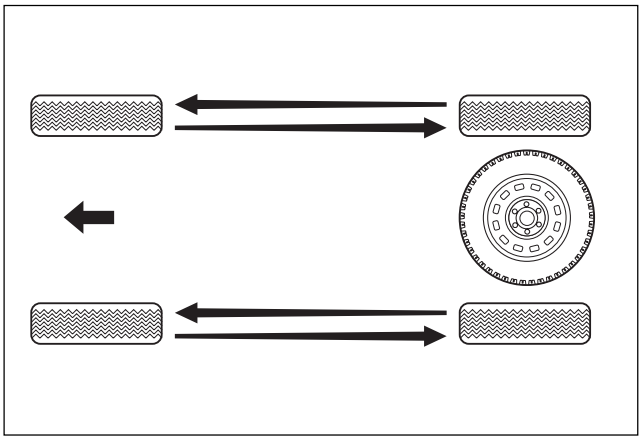
Brake System Service

Check the disc brake pads or the drum brake linings. Check the pad and the lining thickness carefully.

Tire and Wheel Inspection and Rotation

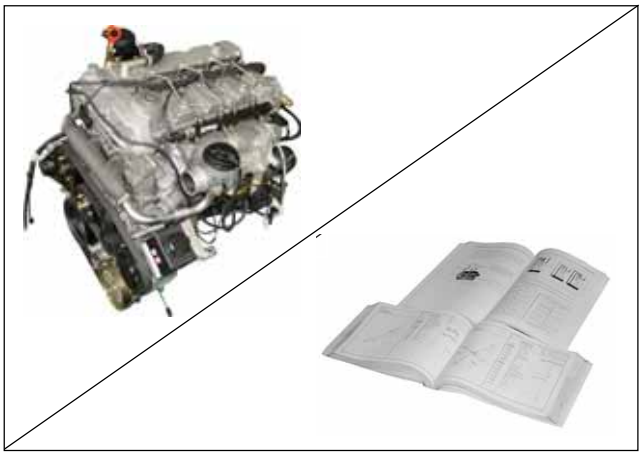
Check the tires for abnormal wear or damage. To equalize wear and obtain maximum tire life, rotate the tires. If irregular or premature wear exists, check the wheel alignment and check for damaged wheels. While the tires and wheels are removed, inspect the brakes.

Tire Rotation (Left-hand Drive Type)



GUIDELINES FOR SERVICE WORK SAFETY

▶ General



To maintain and operate the vehicle under optimum state by performing safe service works, the service works should be done by following correct methods and procedures.

Accordingly, the purpose of this manual is to prevent differences that can be caused by personal working method, skill, ways and service procedures and to allow prompt/correct service works.

Note, Notice

While using this manual, there are a lot of Note or Notice having below meaning.

NOTE

- **Note means detailed description of supplementary information on work procedure or skill.**

NOTICE

- **Notice means precautions on tool/device or part damages or personal injuries that can occur during service works.**

However, above references and cautions cannot be inclusive measures, so should have habits of taking concerns and cautions based on common senses.

▶ Cautions on Inspection/Service

NOTICE

During service works, be sure to observe below general items for your safety.

- **For service works, be sure to disconnect battery negative (-) terminal if not starting and inspection.**
- **While inspecting vehicle and replacing various consumable parts, be sure to take caution not to damage vehicle and injure people.**
- **Engine and transmission may be hot enough to burn you. So inspect related locations when they cooled down enough.**
- **If engine is running, keep your clothing, tools, hair and hands away from moving parts.**
- **Even when the ignition key is turned off and positioned to LOCK, electrical fan can be operated while working on near around electrical fan or radiator grille if air conditioner or coolant temperature rises.**
- **Every oil can cause skin trouble. Immediately wash out with soap if contacted.**
- **Painted surface of the body can be damaged if spilled over with oil or anti-freeze.**
- **Never go under vehicle if supported only with jack.**
- **Never near the battery and fuel related system to flames that can cause fire like cigarette.**
- **Never disconnect or connect battery terminal or other electrical equipment if ignition key is turned on.**
- **While connecting the battery terminals, be cautious of polarities (+, –) not to be confused.**
- **There are high voltage and currency on the battery and vehicle wires. So there can be fire if short-circuited.**
- **Do not park while running the engine in an enclosed area like garage. There can be toxication with CO, so make sufficient ventilation.**
- **The electrical fan works electrically. So the fan can be operated unexpectedly during working causing injuries if the ignition key is not in LOCK position. Be sure to check whether ignition key is in LOCK position before work.**
- **Be careful not to touch hot components like catalytic converter, muffler and exhaust pipe when the engine is running or just stopped. They may burn you badly.**

▶ Guidelines on Engine Service

To prevent personal injuries and vehicle damages that can be caused by mistakes during engine and unit inspection/repair and to secure optimum engine performance and safety after service works, basic cautions and service work guidelines that can be easily forgotten during engine service works are described in.

Cautions before service works

1. Before work on engine and each electrical equipment, be sure to disconnect battery negative (-) terminal.
2. Before service works, be sure to prepare the works by cleaning and aligning work areas.
3. Always position the ignition switch to OFF if not required. If not, there can be electrical equipment damages or personal injuries due to short-circuit or ground by mistake.
4. There should be no leak from fuel injection system (HP pump, fuel hose, high pressure pipe) of the D20DT & D27DT engine. So they should be protected from foreign materials.
5. While removing the engine, do not position the jack and others under the oil pan or engine. To secure the safety, use only safety hook on the engine.

Engine and accessories

Engine has a lot of precise portions so tightening torque should be correct during disassembly/assembly and removal/installation and service work should be done in clean ways during disassembly/assembly.

Maintaining working area clean and cautious service administration is essential element of service works while working on the engine and each section of the vehicle. So the mechanics should well aware of it.

1. While removing the engine, related parts (bolts, gaskets, etc.) should be aligned as a group.
2. While disassembling/assembling internal components of the engine, well aware of disassembly/assembly section in this manual and clean each component with engine oil and then coat with oil before installation.
3. While removing engine, drain engine oil, coolant and fuel in fuel system to prevent leakage.
4. During service work of removal/installation, be sure to check each connected portions to engine not to make interference.

Fuel and lubrication system

Painted surface of the body can be damaged or rubber products (hoes) can be corroded if engine oil and fuel are spilled over. If spilled over engine, foreign materials in air can be accumulated on the engine damaging fuel system.

1. If work on the fluid system such as fuel and oil, working area should be well ventilated and mechanic should not smoke.
2. Gasket or seal on the fuel/lubrication system should be replaced with new and bolts and nuts should be tightened as specified.
3. After removal/installation works, be sure to check whether there is leak on the connecting section.

If fine dust or foreign material enters into DI engine's fuel system, there can be serious damages between HP pump and injectors. So, be sure to cover removed fuel system components with cap and protect removed parts not to be contaminated with dirt. (Refer to cleanness in this manual while working on DI engine fuel system)

Electrical equipment

Electrical equipment should be handled more carefully. Currently, the engine is equipped with a lot of electrical equipments so there can be engine performance drops, incomplete combustion and other abnormals due to short and poor contact. Mechanics should well aware of vehicle's electrical equipment.

1. If have to work on the electrical equipment, be sure to disconnect battery negative (-) terminal and position the ignition switch to off if not required.
2. When replacing electrical equipment, use the same genuine part and be sure to check whether ground or connecting portions are correctly connected during installation. If ground or connecting portion is loosened, there can be vehicle fire or personal injury.

During Service Work - Inspection

1. Before lifting up the vehicle with lift, correctly support the lifting points and lift up.
2. When using a jack, park the vehicle on the level ground and block front and rear wheels. Position the jack under the frame and lift up the vehicle and then support with chassis stand before service work.
3. Before service work, be sure to disconnect battery negative (-) terminal to prevent damages by bad wire and short.



4. If service from interior of the vehicle, use protection cover to prevent damage and contamination of seat and floor.
5. Brake fluid and anti-freeze can damage painted surface of body. So carefully handle them during service work.



6. Use recommended and specified tools to increase efficiency of service work.
7. Use only genuine spare parts.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

8. Never reuse cotter pin, gasket, O-ring, oil seal, lock washer and self-locking nut. Replace them with new.

   If reused, normal functions cannot be maintained.
9. Align the disassembled parts in clean according to disassembling order and group for easy assembling.
10. According to installing positions, the bolts and nuts have different hardness and design. So be careful not to mix removed bolts and nuts each other and align them according installing positions.
11. To inspect and assemble, clean the parts.
12. Securely clean the parts that related with oil not to be affected by viscosity of oil.
13. Coat oil or grease on the driving and sliding surfaces before installing parts.
14. Use sealer or gasket to prevent leakage if necessary.
15. Damaged or not, never reuse removed gasket. Replace with new and cautious on installing directions.
16. Tighten every bolt and nut with specified torque.
17. When service work is completed, check finally whether the work is performed properly or the problem is solved.
18. If work on the fuel line between priming pump and injector (including return line), be sure to cover the removed parts with cap and be careful not to expose the connecting passage and removed parts to external foreign materials or dust. (Refer to cleanness.)
19. If remove high pressure fuel supply pipe between HP pump and fuel rail and high pressure fuel pipe between fuel rail and each injector, be sure to replace them with new.





During Service Work for Electric Devices

NOTICE

- **Be careful not to modify or alter electrical system and electrical device. Or there can be vehicle fire or serious damage.**

1. Be sure to disconnect battery negative (-) terminal during every service work. Before disconnecting battery negative (-) terminal, turn off ignition key.
2. Replace with specified capacity of fuse if there is bad, blown or short circuited fuse. If use electrical wire or steel wire other than fuse, there can be damages on the various electrical systems. If replaced with over-capacity fuse, there can be damages on the related electrical device and fire.
3. Every wire on the vehicle should be fastened securely not to be loosened with fixing clip.
4. If wires go through edges, protect them with tape or other materials not to be damaged.
5. Carefully install the wires not to be damaged during installation/removal of parts due to interference.
6. Be careful not to throw or drop each sensor or relay.
7. Securely connect each connector until hear a “click” sound.

▶ Lifting Positions

1. 4-post lift

As illustrated, position the vehicle on the 4-post lift securely and block the front and rear of each tire not to move during working.

NOTICE

During lifting, be sure to check whether vehicle is empty.

- **Board-on lift connection device installed in front of vehicle should be positioned in front of sill locating under the front door.**
- **Install lift connecting device on the edge of front and rear of board-on lift.**

WARNING

- **Be sure to use attachment during lifting to prevent the lift from contacting with body floor.**
- **While lifting the vehicle, widen the lift floor as far as possible to stabilize between vehicle front and rear. When fixing the lift floor, be careful not to contact with brake tube and fuel lines.**

2. Safety jack and safety stand

If lift up the vehicle with safety jack and stand, should be more careful during works.

WARNING

- **Never be under the vehicle if supported with only jack. If have to be under the vehicle, be sure to use safety block.**
- **Use wheel block in front and rear of every wheel.**

OWNER INSPECTIONS AND SERVICES

WHILE OPERATING THE VEHICLE

Horn Operation

Blow the horn occasionally to make sure it works. Check all the button locations.

Brake System Operation

Be alert for abnormal sounds, increased brake pedal travel or repeated puling to one side when braking. Also, if the brake warning light goes on, or flashes, something may be wrong with part of the brake system.

Exhaust System Operation

Be alert to any changes in the sound of the system or the smell of the fumes. These are signs that the system may be leaking or overheating. Have the system inspected and repaired immediately.

Tires, Wheels and Alignment Operation

Be alert to any vibration of the steering wheel or the seats at normal highway speeds. This may mean a wheel needs to be balanced. Also, a pull right or left on a straight, level road may show the need for a tire pressure adjustment or a wheel alignment.

Steering System Operation

Be alert to changes in the steering action. An inspection is needed when the steering wheel is hard to turn or has too much free play, or is unusual sounds are noticed when turning or parking.

Headlamp Aim

Take note of the light pattern occasionally. Adjust the headlights if the beams seem improperly aimed.

AT EACH FUEL FILL

A fluid loss in any (except windshield washer) system may indicate a problem. Have the system inspected and repaired immediately.

Engine Oil Level

Check the oil level and add oil if necessary. The best time to check the engine oil level is when the oil is warm.

1. After stopping the engine, wait a few minutes for the oil to drain back to the oil pan.
2. Pull out the oil level indicator (dip stick).
3. Wipe it clean, and push the oil level indicator back down all the way.
4. Pull out the oil level indicator and look at the oil level on it.
5. Add oil, if needed, to keep the oil level above the lower mark. Avoid overfilling the engine, since this may cause engine damage.
6. Push the indicator all the way back down into the engine after taking the reading.

If you check the oil level when the oil is cold, do not run the engine first. The cold oil will not drain back to the pan fast enough to give a true oil level reading.

Engine Coolant Level and Condition

Check the coolant level in the coolant reservoir tank and add coolant if necessary. Inspect the coolant. Replace dirty or rusty coolant.

Windshield Washer Fluid Level

Check the washer fluid level in the reservoir. Add fluid if necessary.

AT LEAST TWICE A MONTH

Tire And Wheel Inspection and Pressure Check

Check the tire for abnormal wear or damage. Also check for damaged wheels. Check the tire pressure when the tires are cold (check the spare also, unless it is a stowaway).

Maintain the recommended pressures. Refer to “Wheels and Tire” is in section 4H.

AT LEAST MONTHLY

Lamp Operation

Check the operation of the license plate lamp, the headlamps (including the high beams), the parking lamps, the fog lamps, the taillamp, the brake lamps, the turn signals, the backup lamps and the hazard warning flasher.

Fluid Leak Check

Periodically inspect the surface beneath the vehicle for water, oil, fuel or other fluids, after the vehicle has been parked for a while. Water dripping from the air conditioning system after use is normal. If you notice fuel leaks or fumes, find the cause and correct it at once.

AT LEAST TWICE A YEAR

Power Steering System Reservoir Level

Check the power steering fluid level. Keep the power steering fluid at the proper level. Refer to Section 4G, Power Steering System.

Brake Master Cylinder Reservoir Level

Check the fluid and keep it at the proper level. A low fluid level can indicate worn disc brake pads which may need to be serviced. Check the breather hole in the reservoir cover to be free from dirt and check for an open passage.

Weather-Strip Lubrication

Apply a thin film silicone grease using a clean cloth.

EACH TIME THE OIL IS CHANGED

Brake System Inspection

This inspection should be done when the wheels are removed for rotation. Inspect the lines and the hoses for proper hookup, binding, leaks, cracks, chafing, etc. Inspect the disc brake pads for wear. Inspect the rotors for surface condition. Inspect other brake parts, the parking brake, etc., at the same time. Inspect the brakes more often if habit or conditions result in frequent braking.

Steering, Suspension and Front Drive Axle Boot And Seal Inspection

Inspect the front and rear suspension and the steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect the power steering line and the hoses for proper hookup, binding, leaks, cracks, chafing, etc. Clean and inspect the drive axle boot and seals for damage, tears or leakage. Replace the seals if necessary.

Exhaust System Inspection

Inspect the complete system (including the catalytic converter if equipped). Inspect the body near the exhaust system. Look for broken, damaged, missing, or out-of-position parts as well as open seams, holes, loose connections, or other conditions which could cause heat buildup in the floor pan or could let exhaust fumes seep into the trunk or passenger compartment.

Drain the Water from Fuel Filter

When the water level inside water separator in fuel filter exceeds a certain level, water separator warning light comes on and buzzer sounds. Also, the driving force of the vehicle decreases.
If these conditions occur, immediately drain the water from fuel filter & water separator.

Hood Latch Operation

When opening the hood, note the operation of the secondary latch. It should keep the hood from opening all the way when the primary latch is released. The hood must close firmly.

AT LEAST ANNUALLY

Lap and Shoulder Belts Condition and Operation

Inspect the belt system including: the webbing, the buckles, the latch plates, the retractor, the guide loops and the anchors.

Movable Head Restraint Operation

On vehicles with movable head restraints, the restraints must stay in the desired position.

Spare Tire and Jack Storage

Be alert to rattles in the rear of the vehicle. The spare tire, all the jacking equipment, and the tools must be securely stowed at all times. Oil the jack ratchet or the screw mechanism after each use.

Key Lock Service

Lubricate the key lock cylinder.

Body Lubrication Service

Lubricate all the body door hinges including the hood, the fuel door, the rear compartment hinges and the latches, the glove box and the console doors, and any folding seat hardware.

Underbody Flushing

Flushing the underbody will remove any corrosive materials used for ice and snow removal and dust control. At least every spring clean the underbody. First, loosen the sediment packed in closed areas of the vehicle. Then flush the underbody with plain water.

Engine Cooling System

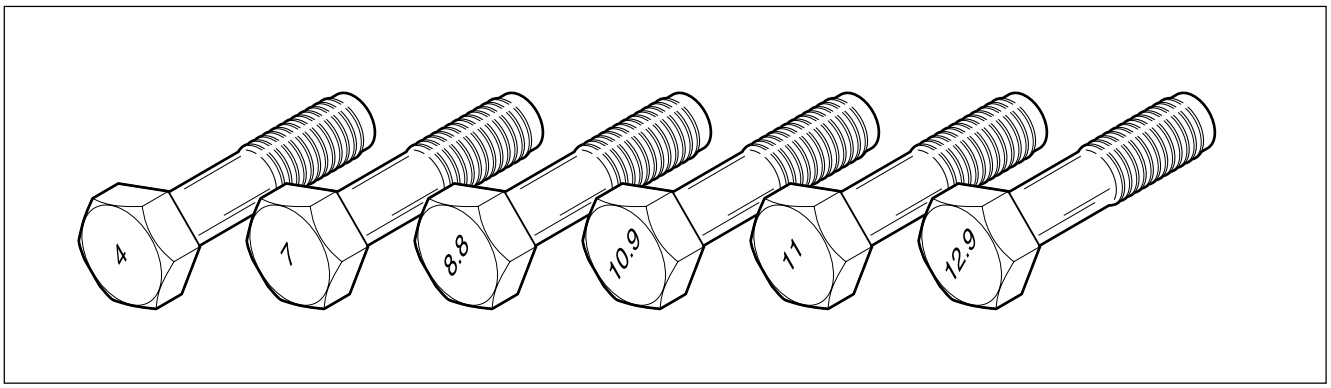
Inspect the coolant and freeze protection fluid. If the fluid is dirty or rusty, drain, flush and refill the engine cooling system with new coolant. Keep the coolant at the proper mixture in order to ensure proper freeze protection, corrosion protection and engine operating temperature. Inspect the hoses. Replace the cracked, swollen, or deteriorated hoses. Tighten the clamps.

Clean the outside of the radiator and the air conditioning condenser. Wash the filler cap and the neck. Pressure test the cooling system and the cap in order to help ensure proper operation.

STANDARD BOLTS SPECIFICATIONS

Bolt*	Torque (Nm / lb-in)					
	Standard			Limit		
	4T	7T	9T	4T	7T	9T
M3 × 0.5	0.5 Nm (4.5 lb-in)	0.9 Nm (8 lb-in)	1.3 Nm (12 lb-in)	0.7 Nm (6.3 lb-in)	1.2 Nm (11 lb-in)	17 Nm (15 lb-in)
M4 × 0.7	1.2 Nm (11 lb-in)	2.0 Nm (18 lb-in)	3.0 Nm (27 lb-in)	1.6 Nm (14 lb-in)	2.6 Nm (23 lb-in)	4.0 Nm (36 lb-in)
M5 × 0.8	2.4 Nm (22 lb-in)	4.0 Nm (36 lb-in)	5.6 Nm (50 lb-in)	3.1 Nm (28 lb-in)	5.2 Nm (47 lb-in)	7.6 Nm (68 lb-in)
M6 × 1.0	4.0 Nm (36 lb-in)	6.7 Nm (60 lb-in)	9.7 Nm (87 lb-in)	5.4 Nm (49 lb-in)	9.0 Nm (81 lb-in)	12.7 Nm (114 lb-in)
M8 × 1.25	8.6 Nm (77 lb-in)	15.7 Nm (12 lb-in)	22.5 Nm (17 lb-in)	12.7 Nm (9 lb-in)	20.6 Nm (15.2 lb-in)	30.4 Nm (22 lb-in)
M10 × 1.25	18.6 Nm (14 lb-in)	32.3 Nm (24 lb-in)	46.0 Nm (34 lb-in)	25.5 Nm (19 lb-in)	42.1 Nm (31 lb-in)	60.8 Nm (31 lb-in)
M10 × 1.5	18.6 Nm (14 lb-in)	30.4 Nm (22 lb-in)	44.1 Nm (33 lb-in)	24.5 Nm (18 lb-in)	41.2 Nm (30 lb-in)	58.8 Nm (44 lb-in)
M12 × 1.25	34.3 Nm (25 lb-in)	56.8 Nm (42 lb-in)	82.3 Nm (61 lb-in)	45.0 Nm (33 lb-in)	75.5 Nm (56 lb-in)	107.8 Nm (80 lb-in)
M12 × 1.75	32.3 Nm (24 lb-in)	53.9 Nm (40 lb-in)	77.4 Nm (57 lb-in)	43.1 Nm (32 lb-in)	71.5 Nm (53 lb-in)	98.0 Nm (73 lb-in)
M14 × 1.5	54.0 Nm (40 lb-in)	89.2 Nm (66 lb-in)	127.4 Nm (94 lb-in)	71.6 Nm (53 lb-in)	117.6 Nm (87 lb-in)	166.6 Nm (123 lb-in)
M16 × 1.5	81.3 Nm (60 lb-in)	107.8 Nm (80 lb-in)	196.0 Nm (145 lb-in)	107.8 Nm (80 lb-in)	186.2 Nm (138 lb-in)	264.6 Nm (196 lb-in)
M18 × 1.5	117.6 Nm (87 lb-in)	196.0 Nm (145 lb-in)	284.2 Nm (210 lb-in)	156.8 Nm (116 lb-in)	264.6 Nm (196 lb-in)	372.4 Nm (276 lb-in)
M20 × 1.5	166.6Nm (123 lb-in)	274.4 Nm (203 lb-in)	392.0 Nm (290 lb-in)	215.6 Nm (160 lb-in)	362.6 Nm (268 lb-in)	519.4 Nm (384 lb-in)
M22 × 0.5	225.4Nm (167 lb-in)	372.4 Nm (276 lb-in)	529.2 Nm (392 lb-in)	294.0 Nm (218 lb-in)	490.0 Nm (362 lb-in)	705.6 Nm (522 lb-in)
M24 × 1.5	284.2 Nm (210 lb-in)	480.2 Nm (355 lb-in)	686.0 Nm (508 lb-in)	382.2 Nm (283 lb-in)	637.0 Nm (471 lb-in)	921.2 Nm (682 lb-in)
M24 × 2.0	274.4 Nm (203 lb-in)	460.6 Nm (341 lb-in)	666.4 Nm (493 lb-in)	372.4 Nm (276 lb-in)	617.4 Nm (457 lb-in)	891.8 Nm (660 lb-in)

*Diameter X pitch in millimeters



1. Metric bolt strength is embossed on the head of each bolt. The strength of bolt can be classified as 4T, 7T, 8.8T, 10.9T, 11T and 12.9T in general.
2. Observe standard tightening torque during bolt tightening works and can adjust torque to be proper within 15 % if necessary. Try not to over max. allowable tightening torque if not required to do so.
3. Determine extra proper tightening torque if tightens with washer or packing.
4. If tightens bolts on the below materials, be sure to determine the proper torque.
   1) Aluminum alloy: Tighten to 80 % of above torque table.
   2) Plastics: Tighten to 20 % of above torque table.

ENGINE ASSEMBLY

01

TABLE OF CONTENTS

STRUCTURE AND FUNCTION DESCRIPTIONS .. 2

Major components in engine and engine compartment 2
Engine structure 3
Specifications and performance curve 5

DIAGNOSTIC INFORMATION AND PROCEDURE ... 8

Oil leak diagnosis 8
Compression pressure test 9
Cylinder pressure leakage test 11
Tightening torque 12

REMOVAL AND INSTALLATION OF ENGINE 15

Removal and installation of engine assembly 15
Engine accessories 20

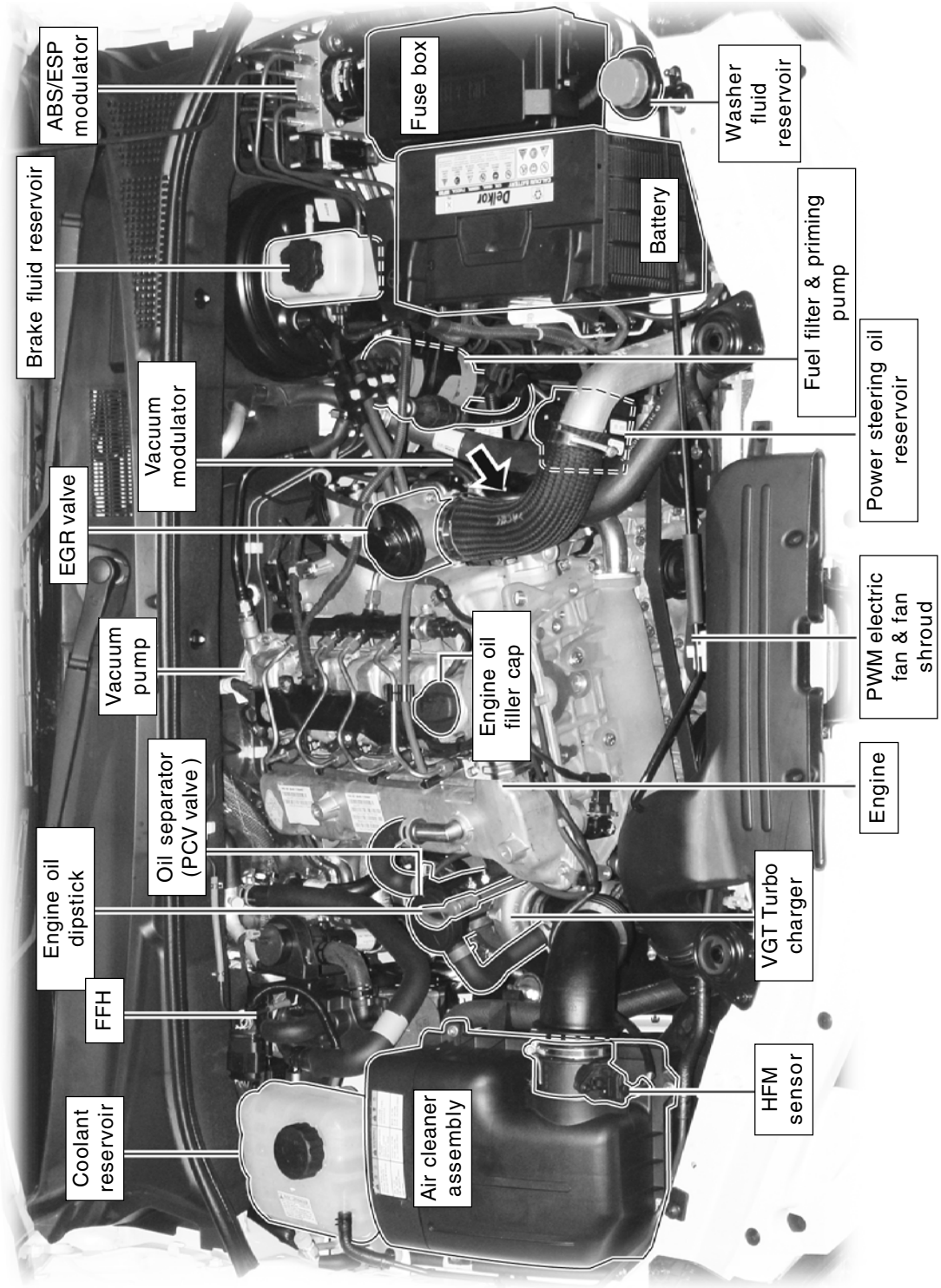
DISASSEMBLY AND REASSEMBLY 24

Components and special tools 24
Inspection before disassembly and reassembly 26
Engine accessories 27
Engine overhaul 42

STRUCTURE AND FUNCTION DESCRIPTIONS

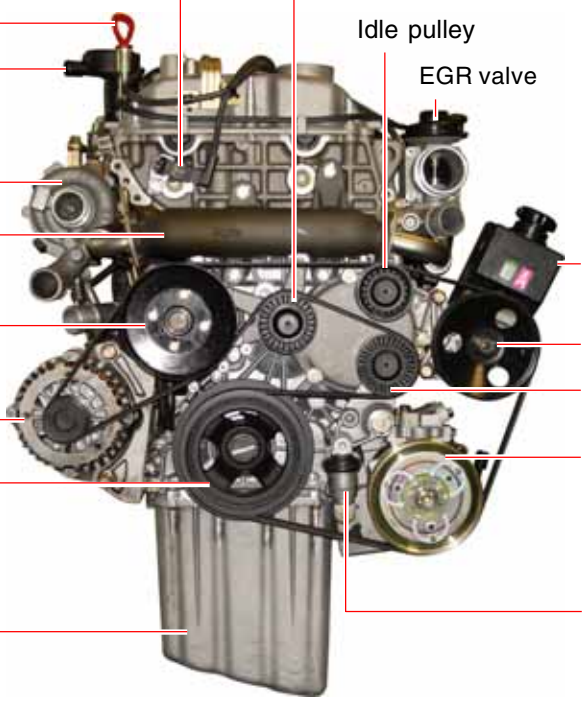
MAJOR COMPONENTS IN ENGINE AND ENGINE COMPARTMENT

The electronically controlled advanced D20DT engine that has high pressure fuel system has been introduced to this vehicle. It satisfies the strict emission regulation and provides improved output and maximum torque.

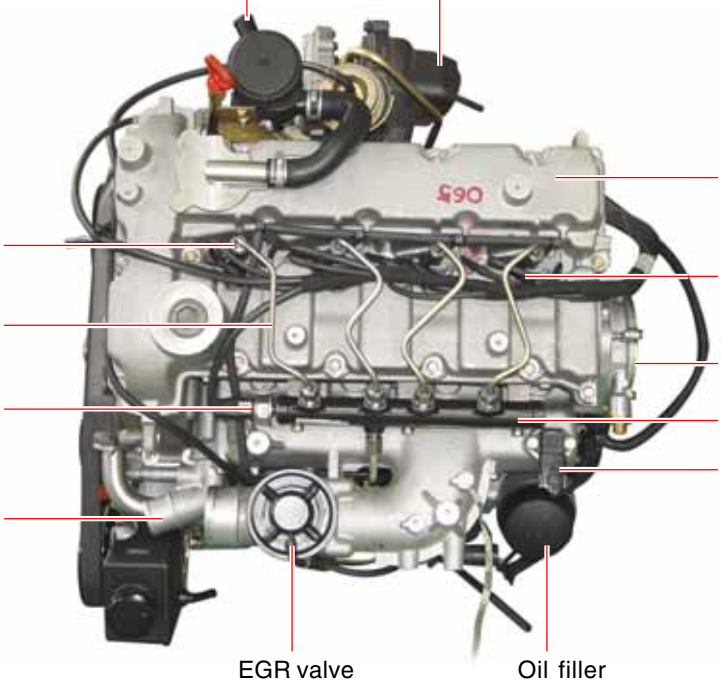


ENGINE STRUCTURE

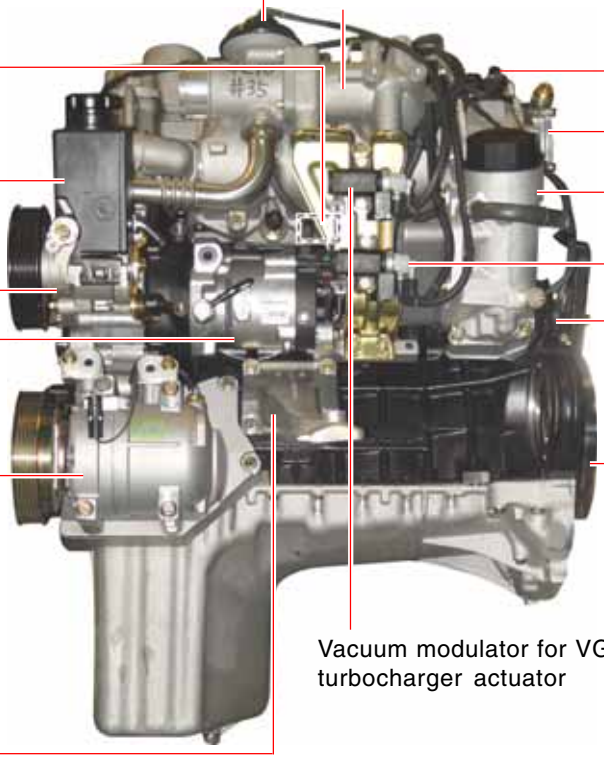
Front View



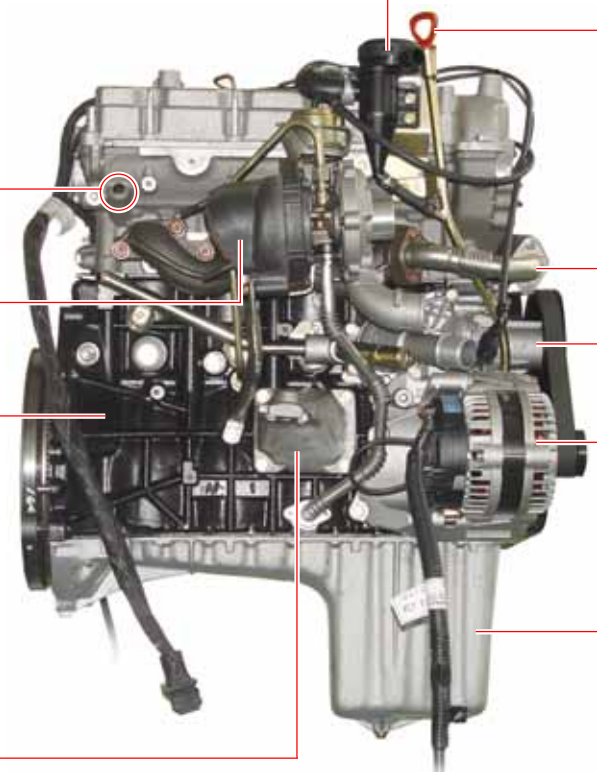
Top View



Right Side View



Left Side View



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EFFECTIVE DATE	
AFFECTED VIN	

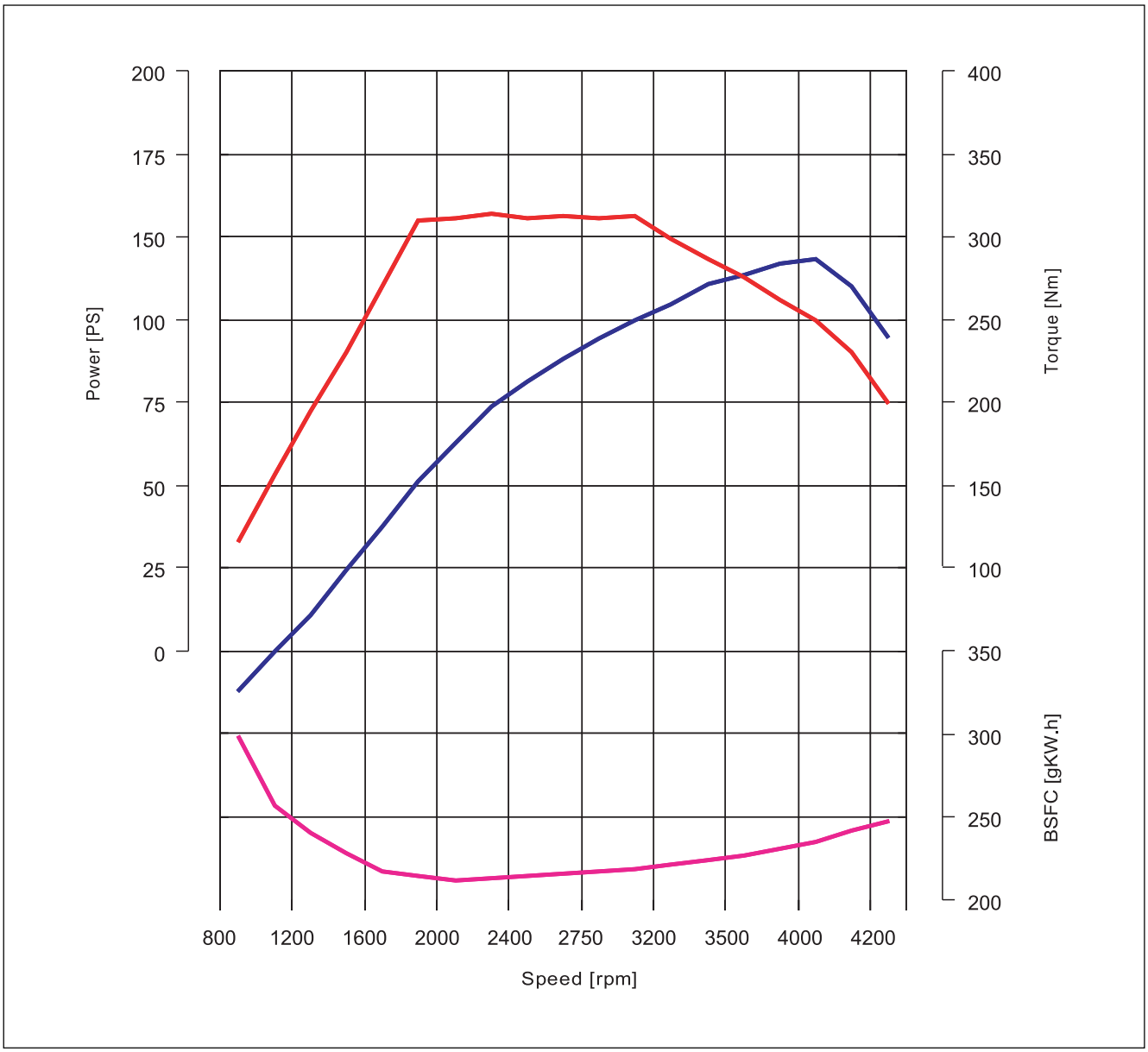
SPECIFICATIONS AND PERFORMANCE CURVE

▶ Specifications

Description			D20DT
Engine	Type/Number of cylinders		D20DT/4-cylinder
Cylinder	Inner diameter (mm)		86.2
	Stroke (mm)		85.6
Displacement (cc)			1998
Compression ratio			17.5:1
Maximum output (ps/rpm)			141/4,000
Maximum torque (Nm/rpm)			310/1,800 ~ 2,750
Idle speed	For Manual Transmission		780 ± 50 rpm
	For Automatic Transmission		780 ± 50 rpm
Valve	Intake	Opens (BTDC)	9°
		Closes (ABDC)	26°
	Exhaust	Opens (BBDC)	38°
		Closes (ATDC)	16°
Camshaft	Type		DOHC
Fuel system	Fuel type		Low sulfur diesel
	Fuel pump type		Vane pump in HP pump
	Fuel supply pressure		HP pump inlet port: max. 400 mbar HP pump outlet port (with IMV fully open): over 1,050 bar
	Water separation in fuel filter		at every 10,000 km
	Fuel tank capacity (ℓ)		75
Lubrication system	Oil specification		SAE 10W40, 5W40 (MB Sheet 229.1, 229.3 approved oil)
	Lubrication type		Forced delivery
	Oil filter type		Full flow, filter element type
	Oil capacity (ℓ)		≒ 7.5
Cooling system	Cooling type		Water cooling type
	Cooling fan operation type		Belt operated type
	Thermostat (Fully Open: 100°C)	Opening temperature (°C)	85
		Type	WAX pellet type
	Coolant capacity (ℓ)		≒ 11.5

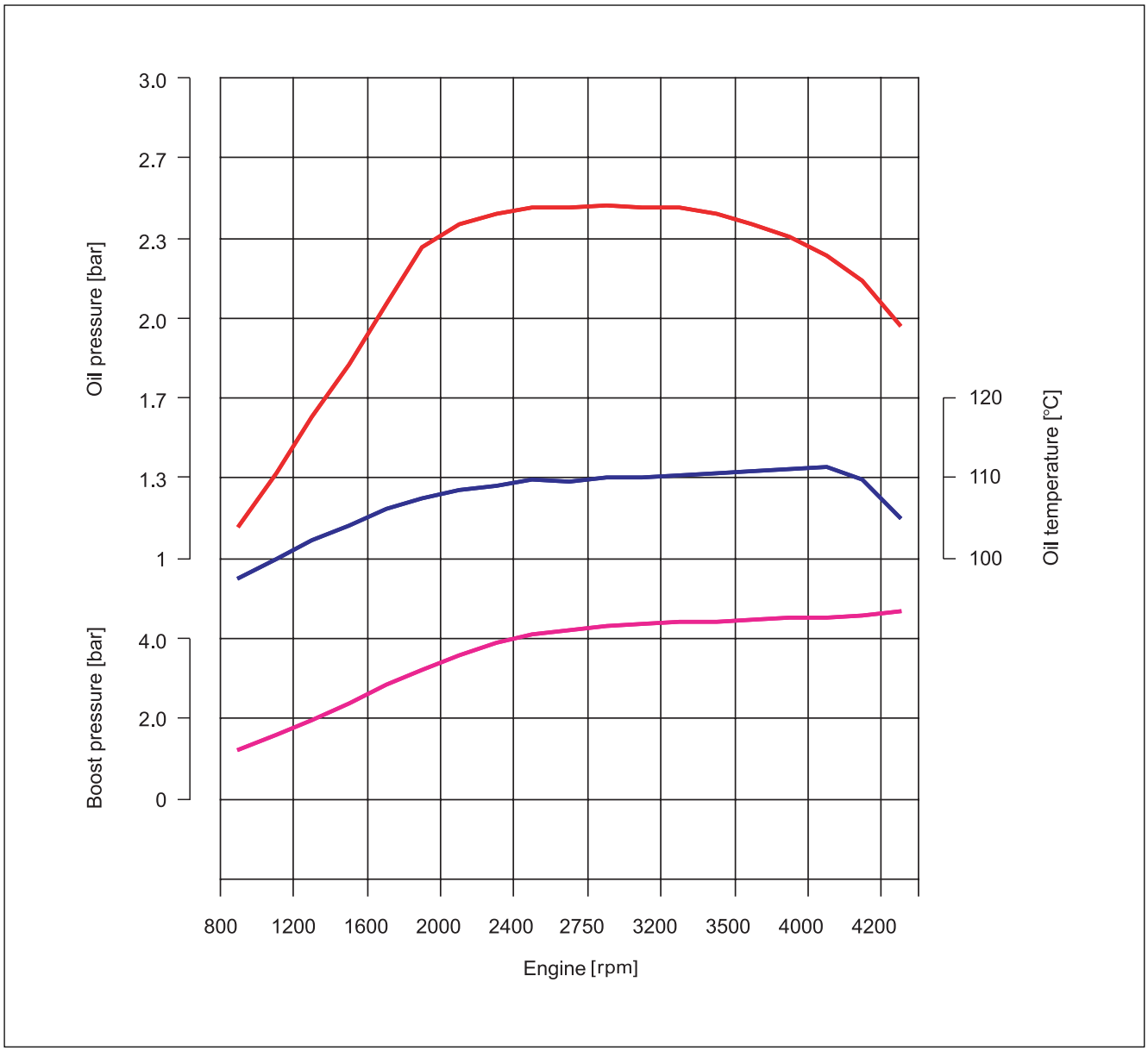
▶ Engine Performance Curve

Output and Torque



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Oil Temperature/Pressure and Boost Pressure



DIAGNOSTIC INFORMATION AND PROCEDURE

OIL LEAK DIAGNOSIS

Most fluid oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedures may help you in locating and repairing most leaks.

▶ Finding the Leak

1. Identify the fluid. Determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
2. Identify where the fluid is leaking from.
   1) After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper.
   2) Wait a few minutes.
   3) You should be able to find the approximate location of the leak by the drippings on the paper.
3. Visually check around the suspected component. Check around all the gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.
4. If the leak still cannot be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent.
   1) Clean the area well.
   2) Dry the area.
   3) Operate the vehicle for several miles at normal operating temperature and varying speeds.
   4) After operating the vehicle, visually check the suspected component.
   5) If you still cannot locate the leak, try using the powder or black light and dye method.

▶ Powder Method

1. Clean the suspected area.
2. Apply an aerosol-type powder (such as foot powder) to the suspected area.
3. Operate the vehicle under normal operating conditoins.
4. Visually inspect the suspected component. You should be able to trace the leak path over the white powder surface to the source.

▶ Black Light and Dye Method

A dye and light kit is available for finding leaks, Refer to the manufacturer's directions when using the kit.

1. Pour the specified amount of dye into the engine oil fill tube.
2. Operate the vehicle normal operating conditions as directed in the kit.
3. Direct the light toward the suspected area. The dyed fluid will appear as a yellow path leading to the source.

▶ Repairing the Leak

Once the origin of the leak has been pinpointed and traced back to its source, the cause of the leak must be determined in order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check for the following conditions and correct them as they may cause a leak.

▶ Gaskets

1. The fluid level/pressure is too high.
2. The crankcase ventilation system is malfunctioning.
3. The fasteners are tightened improperly or the threads are dirty or damaged.
4. The flanges or the sealing surface is warped.
5. There are scratches, burrs or other damage to the sealing surface.
6. The gasket is damaged or worn.
7. There is cracking or porosity of the component.
8. An improper seal was used (where applicable).

Seals

1. The fluid level/pressure is too high.
2. The crankcase ventilation system is malfunctioning.
3. The seal bore is damaged (scratched, burred or nicked).
4. The seal is damaged or worn.
5. Improper installation is evident.
6. There are cracks in the components.
7. The shaft surface is scratched, nicked or damaged.
8. A loose or worn bearing is causing excess seal wear.

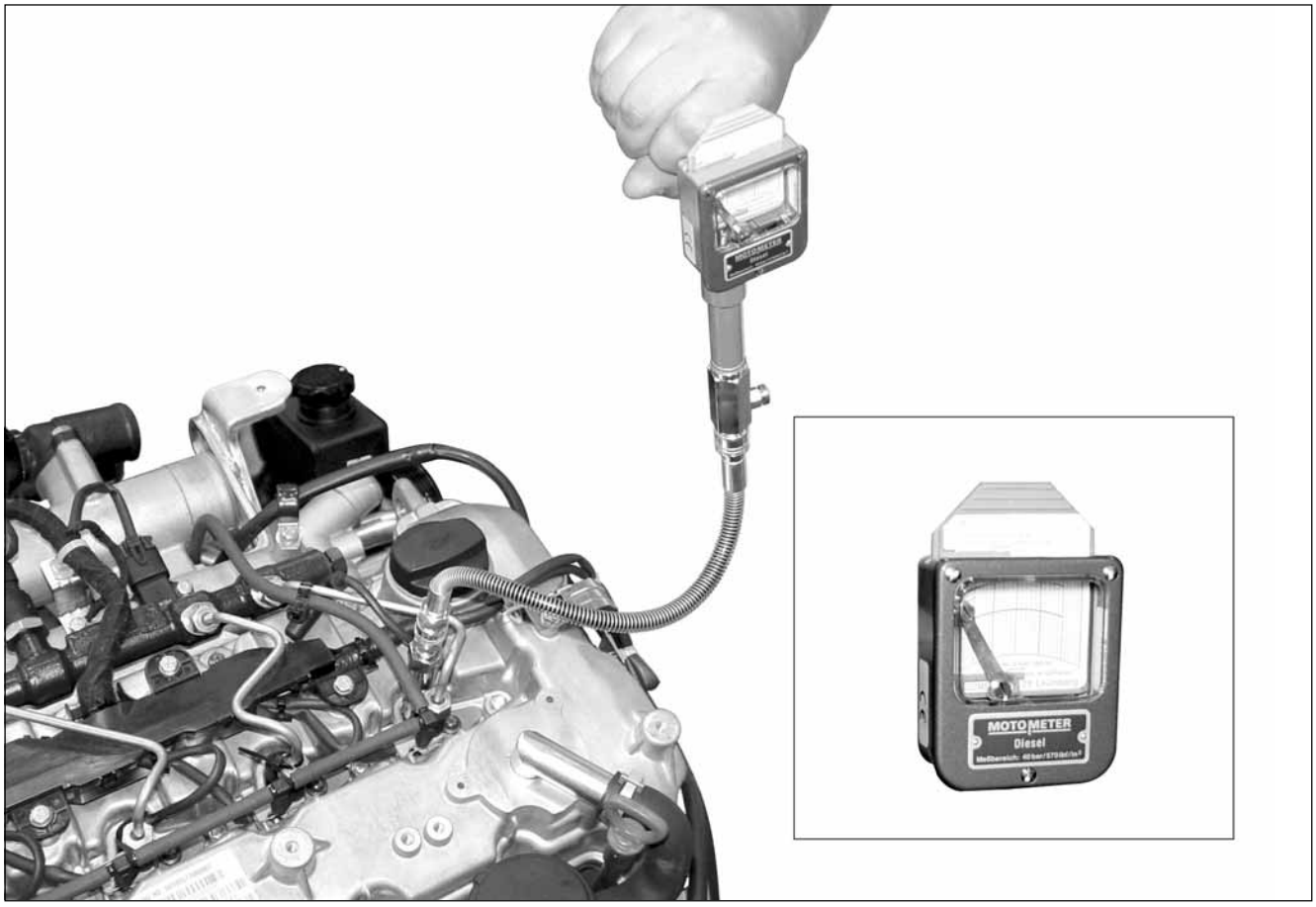
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EFFECTIVE DATE	
AFFECTED VIN	

COMPRESSION PRESSURE TEST

The compression pressure test is to check the conditions of internal components (piston, piston ring, intake and exhaust vale, cylinder head gasket). This test provides current engine operating status.

NOTICE

- **Before cranking the engine, make sure that the test wiring, tools and persons are keeping away from moving components of engine (e.g., belt and cooling fan).**
- **Park the vehicle on the level ground and apply the parking brake.**
- **Do not allow anybody to be in front of the vehicle.**



▶ Specifications

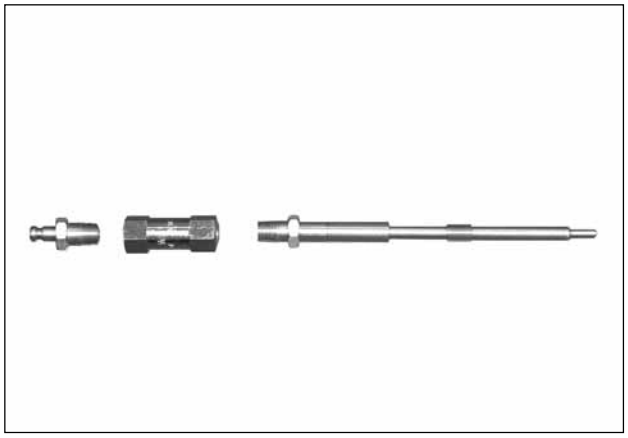
Compression ratio		18 : 1
Test temperature		at normal operating temperature (80°C)
Compression pressure	Normal value	32 bar
	Minimum value	18 bar
Permissible pressure difference between individual cylinders		Max. 3 bar

▶ Measuring Procedure

NOTICE

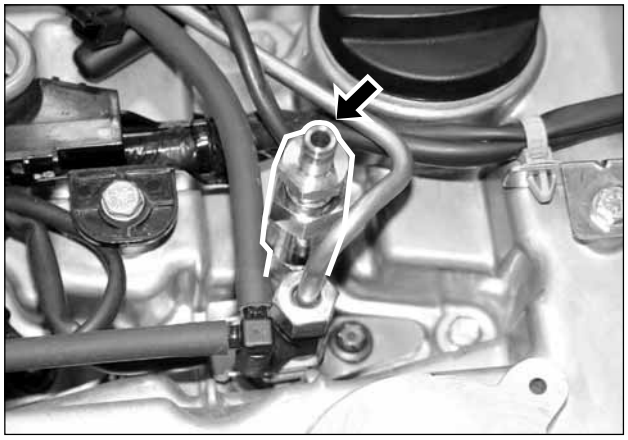
- **Disconnect the fuel rail pressure sensor connector to cut off the fuel injection.**
- **Discharge the combustion residues in the cylinders before testing the compression pressure.**
- **Apply the parking brake before cranking the engine.**

1. Warm the engine up to normal operating temperature (80°C).
2. Disconnect the fuel rail pressure sensor connector to cut off the fuel injection.
3. Place the diagram sheet to compression pressure tester.



4. Remove the glow plugs and install the compression pressure tester into the plug hole.

Tightening torque (Tester)	15 Nm



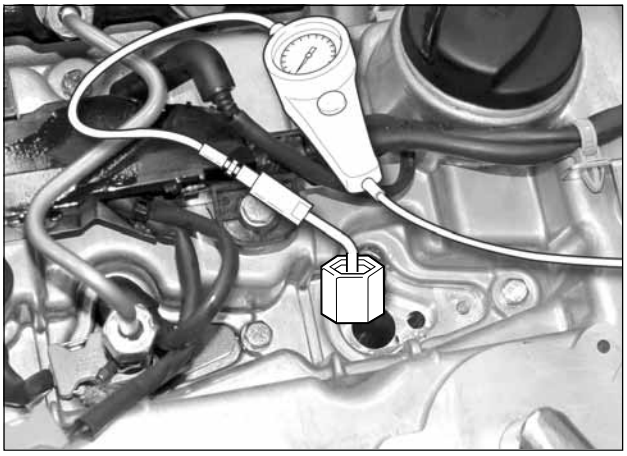
5. Crank the engine for approx. 10 seconds by using the start motor.
6. Record the test result and measure the compression pressure of other cylinders with same manner.
7. If the measured value is not within the specifications, perform the cylinder pressure leakage test.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

CYLINDER PRESSURE LEAKAGE TEST

If the measured value of the compression pressure test is not within the specifications, perform the cylinder pressure leakage test.



▶ Permissible Pressure Leakage

Test temperature	at normal operating temperature (80°C)
At whole engine	Max. 25 %
At valve and cylinder head gasket	Max. 10 %
At piston ring	Max. 20 %

NOTICE

- **Perform the pressure leakage test in order (1 - 2 - 3 - 4)**
- **Do not test the cylinder pressure leakage with wet type test procedure. (do not inject the engine oil into the combustion chamber)**

TIGHTENING TORQUE

NO.	Name	Size	Quantity	Tightening Torque (Nm)
1	Main bearing cap	M11 x 67	10	55 ± 5 120° ± 10°
2	Connecting rod cap	M9 x 51	8	40 ± 5 90° ± 10°
3	Rear cover	M6 x 20	6	10 ± 1
4	Oil pump	M8 x 35SOC	3	25 ± 2.5
5	T.G.C.C	M6 x 40	6	10 ± 1
		M6 x 60	3	10 ± 1
		M6 x 70	2	10 ± 1
6	Flywheel	M10 x 22	8	45 ± 5 90° ± 10°
7	Crankshaft hub	M20 x 85	1	200 180° ± 10°
8	Oil pan	M6 x 20	20	10 ± 1
		M6 x 35	3	10 ± 1
		M6 x 85	3	10 ± 1
		M8 x 40	4	25 ± 2.5
9	High pressure pump mounting bolt	M8 x 55	3	25 ± 2.5
10	High pressure pump main nut (intershaft)	M14 x 1.5	1	65 ± 5
11	Cylinder head	M8 x 25	2	25 ± 2.5
		M8 x 50	2	
		M10 x 158	1	85 ± 5
		M10 x 177	9	270° + 10°
12	Camshaft sprocket (Intake)	M11 x 40	1	25 ± 2.5 90° ± 10°
13	Camshaft sprocket (Exhaust)			
14	Chain tensioner	M24	1	65 ± 5
15	Auto tensioner	M12 x 90 (UP)	1	82 ± 6
		M8 x 45 (LOWER)	1	32 ± 3
16	Water pump assembly	M6 x 50	7	10 ± 1
17	Water pump pulley	M6 x 10	4	10 ± 1
18	Hot water inlet pipe assembly	M6 x 12	2	10 ± 1
19	Alternator bracket	M8 x 80	1	25 ± 2.5
		M8 x 34	2	25 ± 2.5
		M8 x 30	2	25 ± 2.5
20	Alternator	M10 x 90	1	46 ± 4.6
		M10 x 116	1	46 ± 4.6

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

NO.	Name	Size	Quantity	Tightening Torque (Nm)
20	Air conditioner compressor bracket assembly	M8 x 25	1	25 ± 2.5
		M8 x 60	3	25 ± 2.5
22	Air conditioner compressor sub bracket assembly	M6 x 16	1	10 ± 1.0
		M8 x 20	1	25 ± 2.5
23	Intake manifold	M8 x 50	5	25 ± 2.5
		M8 x 133	5	25 ± 2.5
24	Acoustic cover bracket	M6 x 16	2	25 ± 2.5
		M8 x 105	1	25 ± 2.5
25	Knock sensor	M8 x 28	1	20 ± 2.6
26	Camshaft position sensor	M8 x 14	1	12 ± 1.7
27	Booster pressure sensor	M6 x 20	2	10 ± 1.0
28	Exhaust manifold stud bolt	M8 x 46	8	15 ± 1.5
		M8 x 35	2	15 ± 1.5
29	Exhauster manifold nut	M8	8	40 ± 4.0
30	Turbo charger assembly	M8	3	25 ± 2.5
31	Turbocharger hollow bolt	M10 x 1.0	1	18 ± 1.8
32	Turbocharger oil feed pipe	M16 (Cylinder block side)	1	25 ± 2.5
33	Turbocharger support bar (nut)	M8	1	23 ± 2.3
34	Turbocharger support bar (bolt)	M8 x 20	1	25 ± 2.5
35	Turbocharger return pipe	M6 x 16 (T/C side)	2	10 ± 1.0
		M6 x 16 (Cylinder block side)	2	10 ± 1.0
36	EGR valve assembly	M6 x 25	4	10 ± 1.0
37	EGR-LH pipe nut	M8	2	35 ± 3.5
38	EGR-RH pipe nut	M6 x 16	2	10 ± 1.0
39	EGR center bolt	M6 x 16	4	10 ± 1.0
40	EGR center pipe	M8 x 25	2	25 ± 2.5
		M8 x 30	2	25 ± 2.5
41	Glow plug	M5	5	15 ± 3.0
42	Vacuum pump	M6 x 20	3	10 ± 1.0
		M6 x 25	5	10 ± 1.0
43	Cooling fan bracket assembly	M6 x 55	1	10 ± 1.0
		M6 x 85	3	10 ± 1.0
44	Cylinder head cover	M6 x 35	18	10 ± 1.0
45	Vacuum modulator	M6 x 16	4	10 ± 1.0
46	Oil dipstick tube	M6 x 16	1	10 ± 1.0
47	Oil filter assembly	M8 x 35	1	25 ± 2.5
		M8 x 55	2	25 ± 2.5
		M8 x 125	1	25 ± 2.5

NO.	Name	Size	Quantity	Tightening Torque (Nm)
48	Fuel rail assembly	M8 x 35	2	25 ± 2.5
49	Injector	M6 x 60	4	10 ± 1.0 180° + 20°
50	Fuel pipe clip (H-C)	M14	2	40 ± 4.0
51	Fuel pipe clip (C-I)	M14	8	40 ± 4.0
52	Crankshaft position sensor	M6 x 14	1	0.8 ± 0.4
		GAP	-	0.7 ± 1.5 mm
53	Power steering pump	M8 x 100	2	25 ± 2.5
54	Head screw plug	-	1	25 ± 2.5
55	Cam shaft cap bolt	M8 x 60	20	25 ± 2.5
56	Piston topping	-	-	0.765 ~ 1.055 mm
57	Connecting rod end play	-	-	0.500 ~ 1.500 mm
58	Cam shaft end play	-	-	0.100 ~ 0.350 mm
59	Crank shaft end play	-	-	0.100 ~ 0.254 mm

REMOVAL AND INSTALLATION OF ENGINE

REMOVAL AND INSTALLATION OF ENGINE ASSEMBLY

▶ Removal

Preceding Work

1. Disconnect the negative battery cable.
2. Drain the engine coolant.







Summary of Engine Removal

Remove the engine accessories, front bumper and radiator. Unscrew the engine mounting bolts (17 mm) at both sides and remove the engine assembly.



▶ Removal and Installation

Preceding Work

1. Disconnect the negative battery cable and remove the skid plate under the engine compartment.



Installation Notice

Tightening torque	12 ± 1.2 Nm

2. Drain the engine coolant.

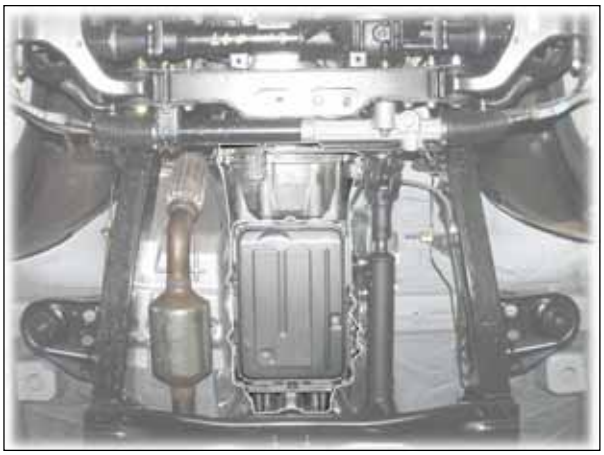


NOTICE

- **Use only the designated container to collect the coolant. Store it in a safe place and observe the regulation when disposing.**
- **Use only Ssangyong genuine engine coolant when refilling.**

3. Remove the transmission and transfer case assembly.

   Be careful not to spill the oil from the oil lines when disconnecting them in the vehicle with automatic transmission.

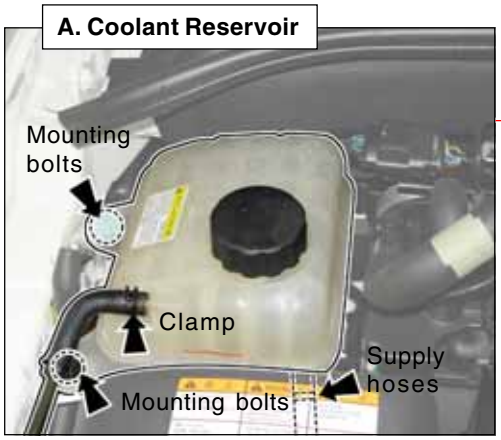


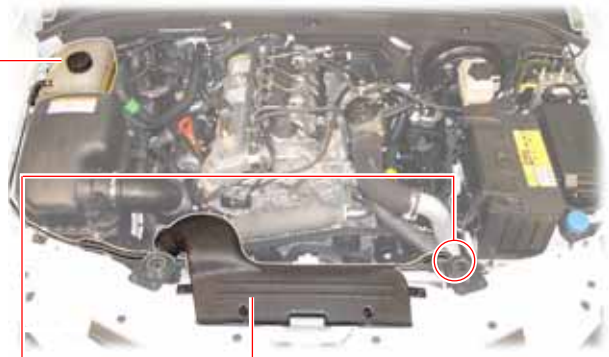
4. Remove the engine hood assembly (refer to “Body” section).



5. Remove the coolant reservoir (A), coolant return hose (B) and air cleaner front air duct (C).

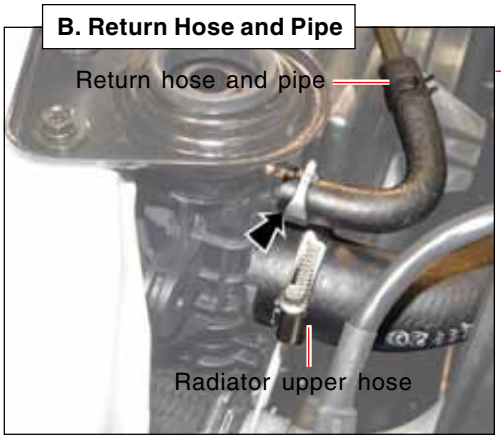
A. Coolant Reservoir





Unscrew the mounting bolts (10 mm), disconnect the return/supply hoses, and remove the coolant reservoir.

B. Return Hose and Pipe



Release the clamps on the reservoir and radiator and remove the return hose and pipe.

C. Air Cleaner Front Duct



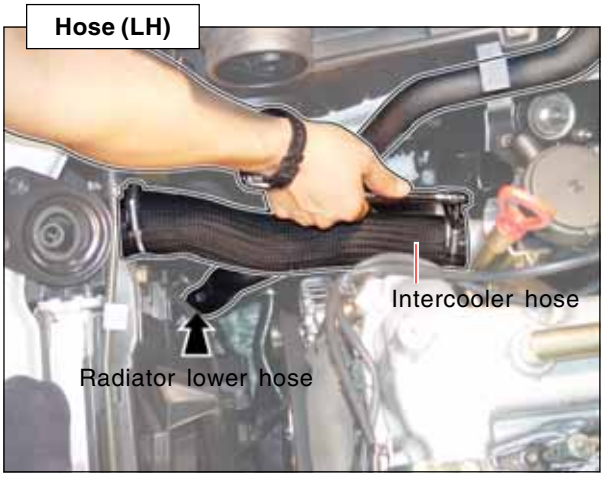
Unscrew the mounting bolts (10 mm), release the hose clamps, and remove the air cleaner front duct.

6. Remove the air cleaner intake hose and HFM sensor.

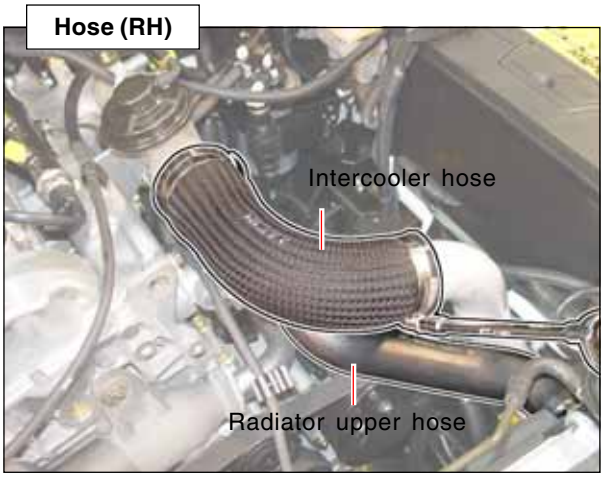


7. Remove the left intercooler hose and the lower hose of the radiator. Remove the right intercooler hose and the upper hose of the radiator.

Hose (LH)



Hose (RH)



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AFFECTED VIN	

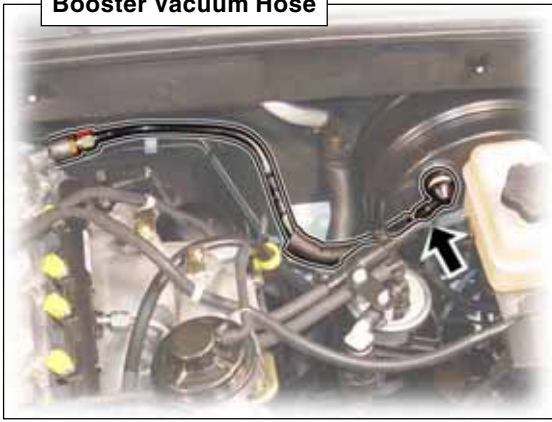
ENGINE ACCESSORIES

Remove/disconnect the accessories as below (no specific sequence):

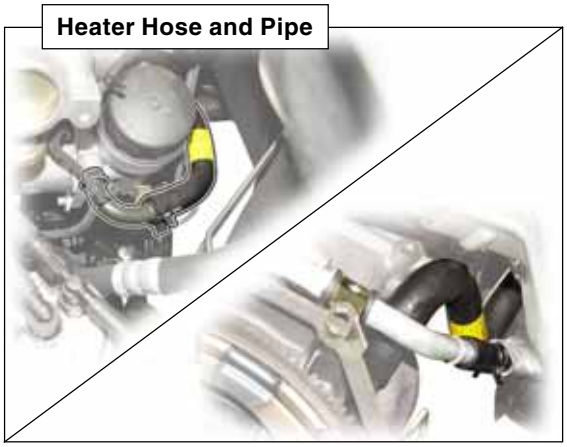
Engine Main Wiring Connector



Booster Vacuum Hose



Heater Hose and Pipe





Alternator Wiring Harness



Battery Cable and Battery Assembly



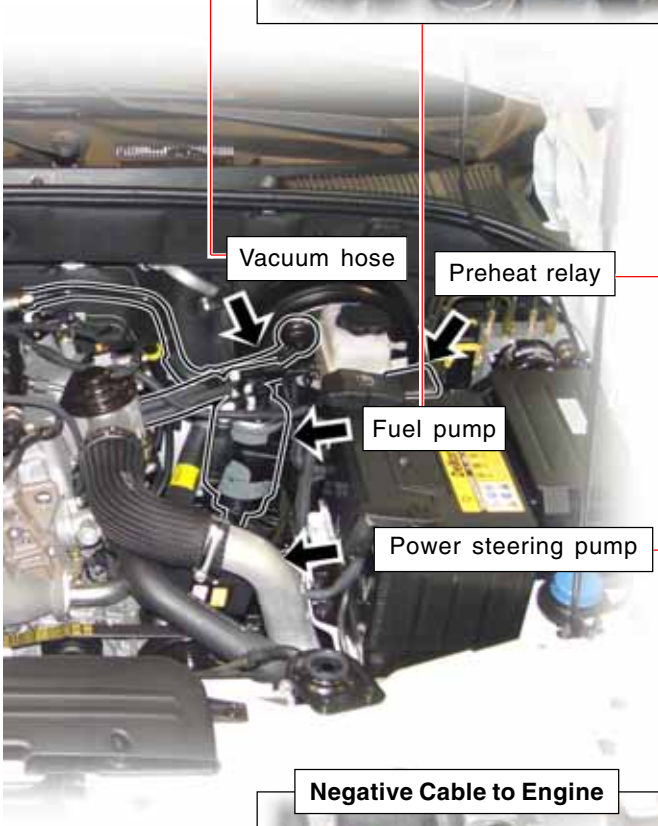
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Fuel Filter Hose

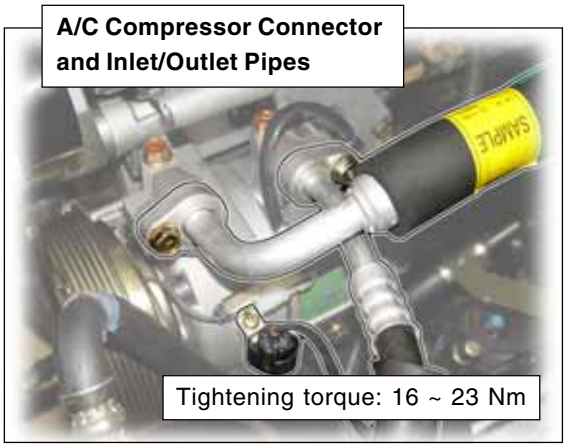


Preheat Control Unit Connector

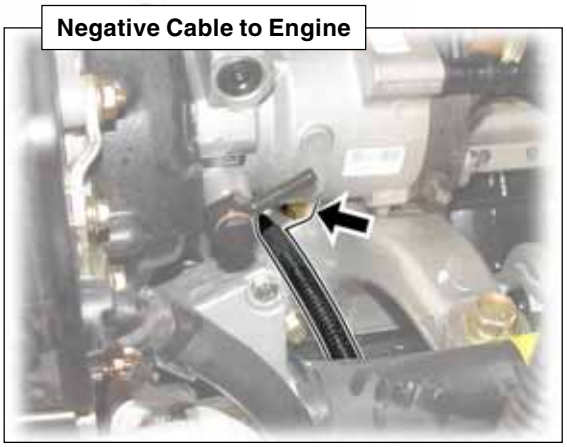




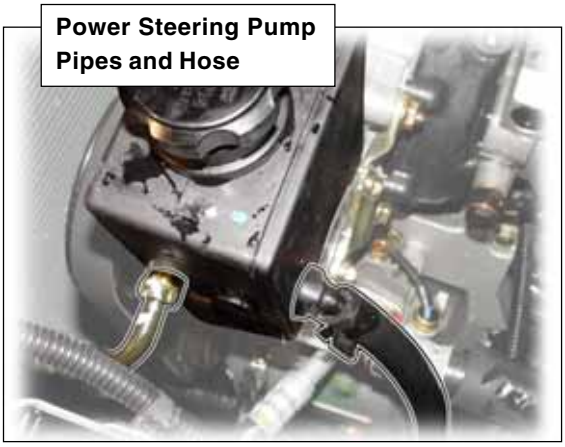
A/C Compressor Connector and Inlet/Outlet Pipes



Negative Cable to Engine



Power Steering Pump Pipes and Hose



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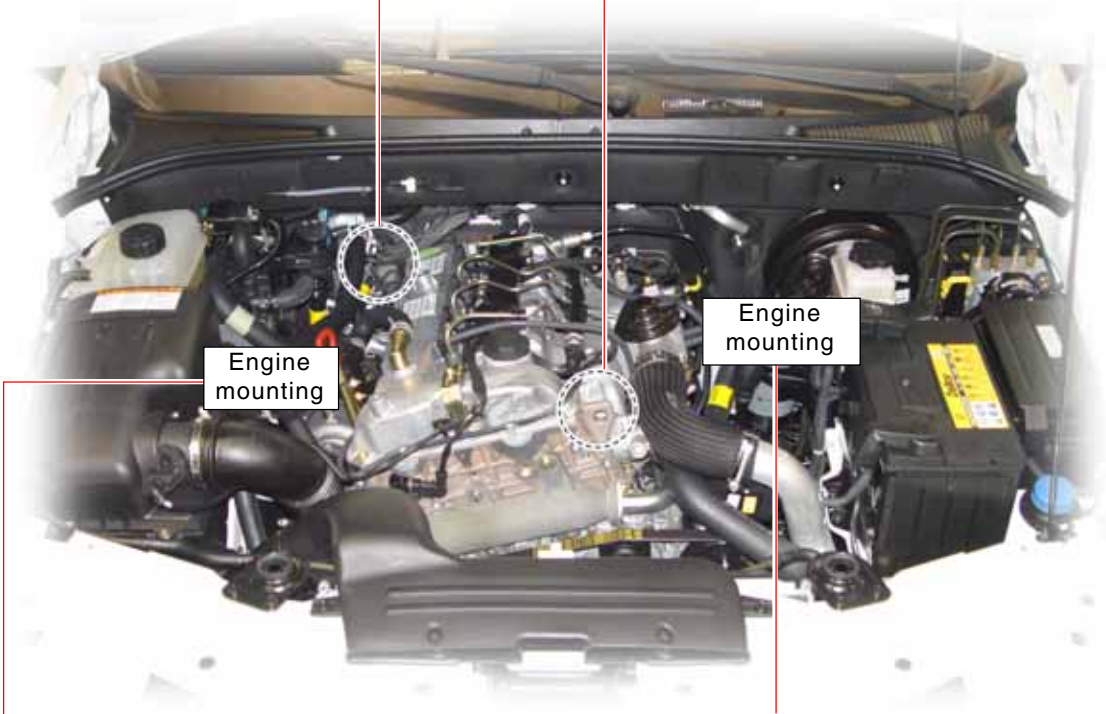
Remove two engine mounting bolts (LH/RH) and remove the engine assembly using the engine jack.

Rear bracket for engine removal



Front bracket for engine removal





LH mounting (lower side of VGT)

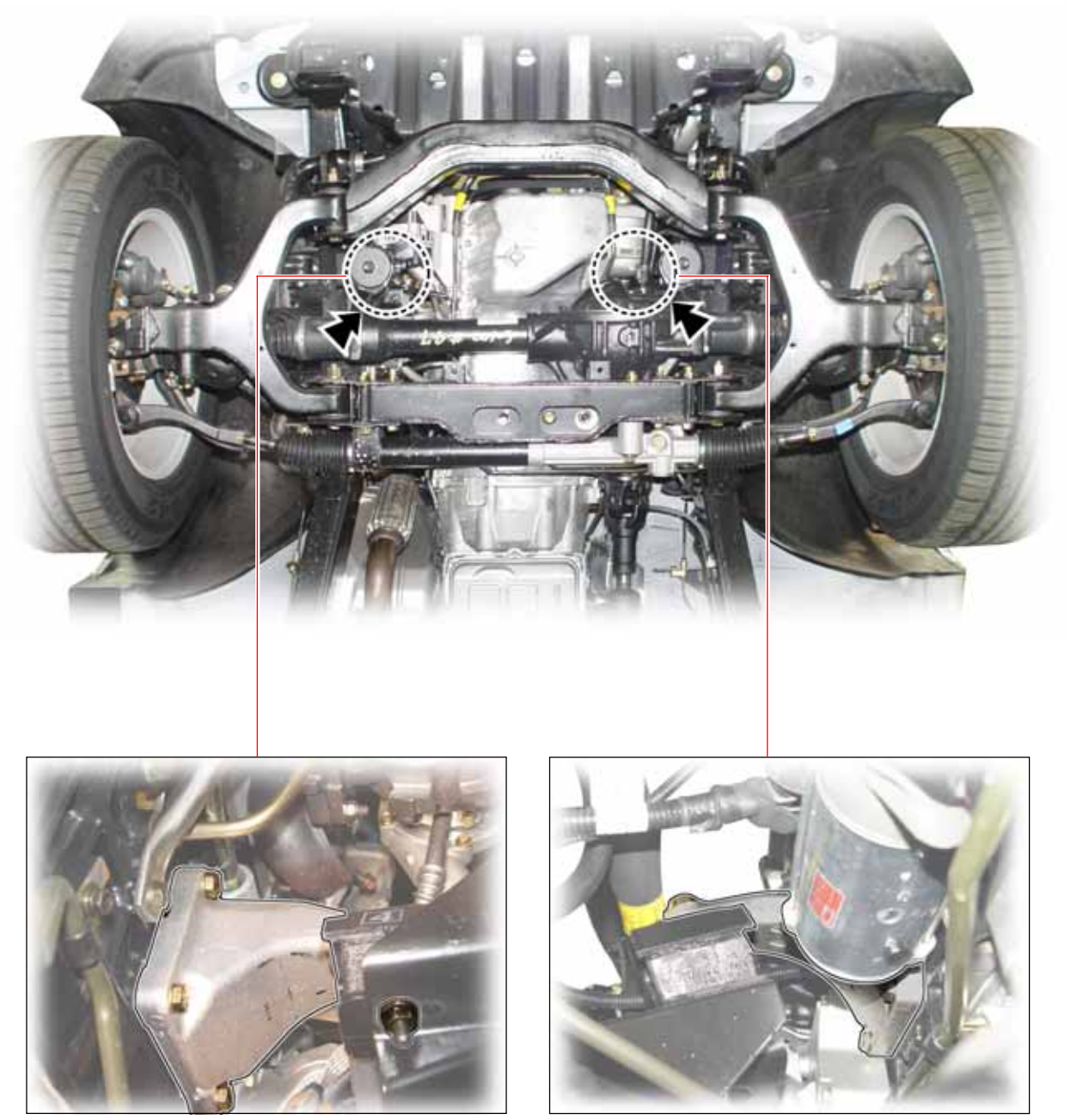


RH mounting (lower side of HP pump)



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Mounting Location in Underbody

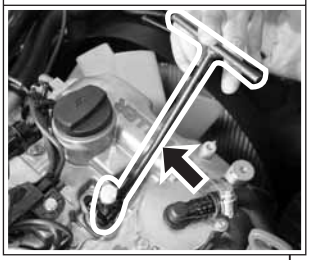


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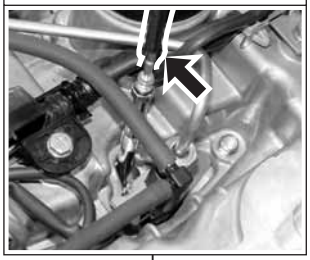
DISASSEMBLY AND REASSEMBLY

COMPONENTS AND SPECIAL TOOLS

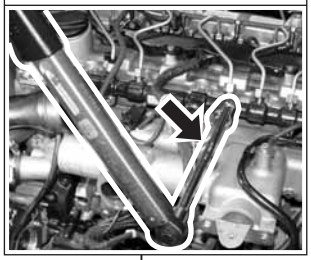
Injector Puller
Y99220072B



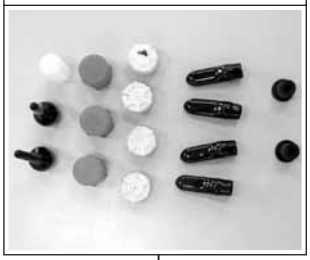
Glow Plug Wrench
Y99220132B



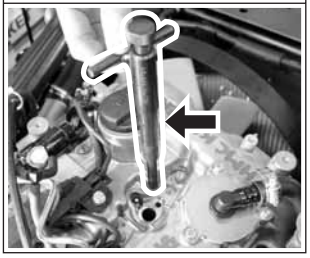
Fuel Pipe Wrench



Sealing Caps
665 995 5844

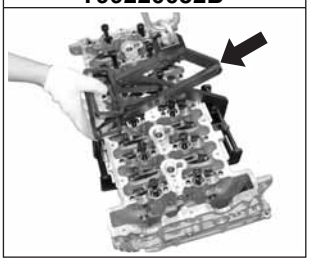


Injector Copper Washer Puller
Y99220022B

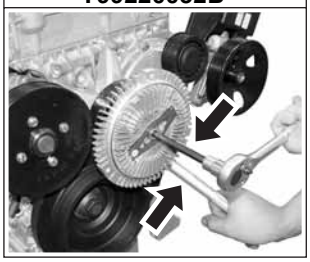




Valve Remover/Installer
Y99220082B



Pulley Lock/Wrench
Y99220052B



Engine Lock
602 589 00 40 00



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Glow Plug Socket





Removal/Installation Device for HP Pump



Removal/Installation Socket for High Pressure Pipe



Head Bolt Wrench



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INSPECTION BEFORE DISASSEMBLY AND REASSEMBLY

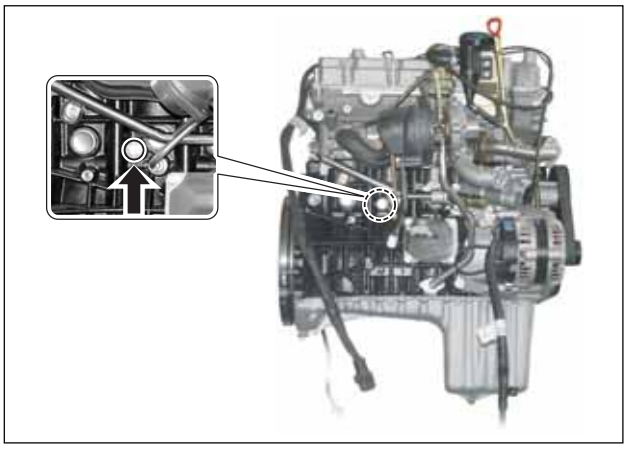
Preparations and Preceding Works

1. Remove the cylinder block drain plug and seal and completely drain the residual coolant from the cylinder block.

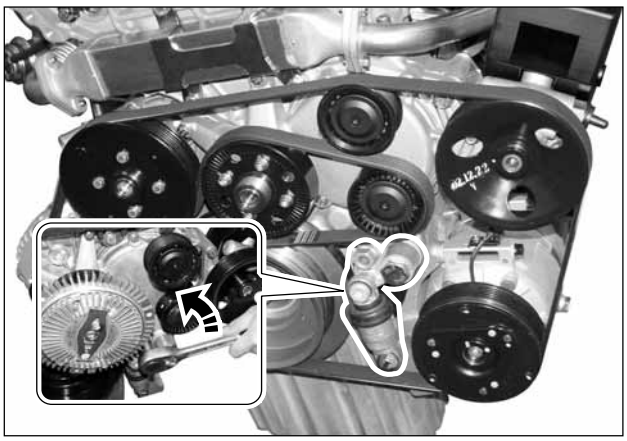
   Installation Notice

Tightening torque	30 Nm

   Replace the seal with new one once removed.



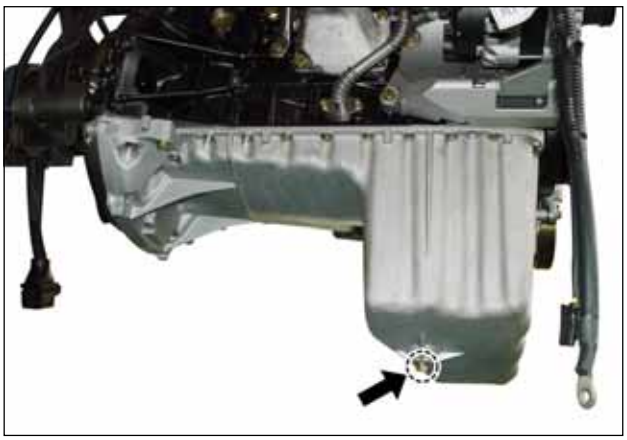
2. When the fan belt is installed, gently pump the belt shock absorber mounting bolt (M19) 3 times.
3. Take off the fan belt while pushing the mounting bolt (M19).



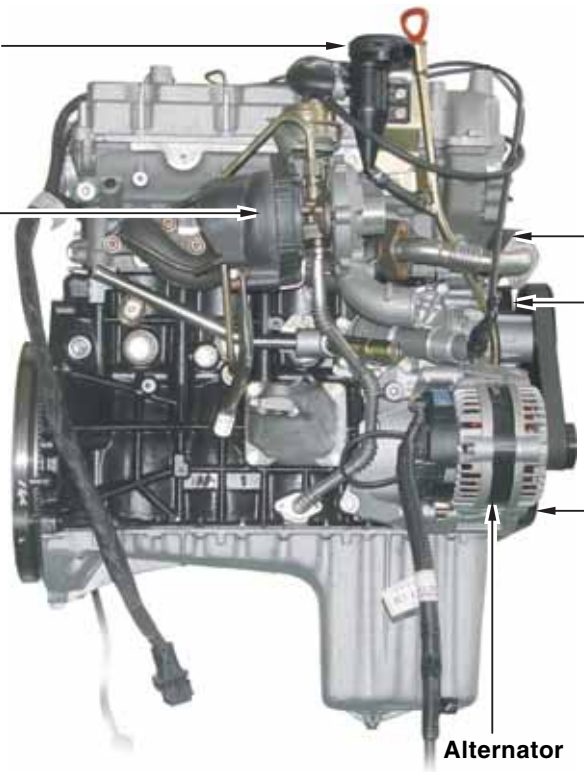
4. Loosen the oil drain plug and completely drain the engine oil.

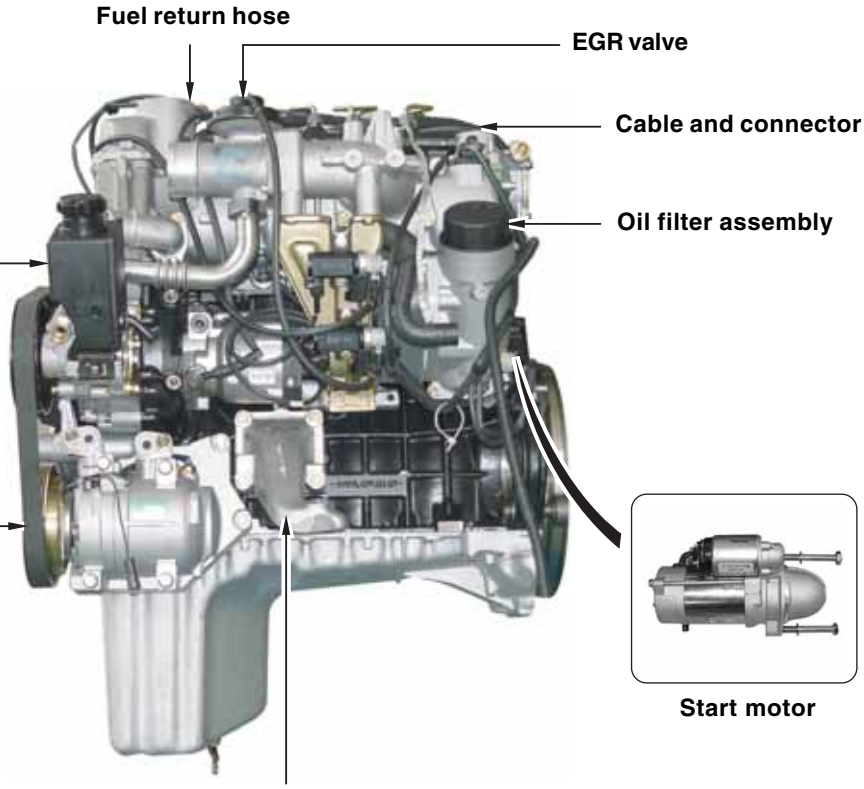
   Installation Notice

Tightening torque	25 ± 2.5 Nm



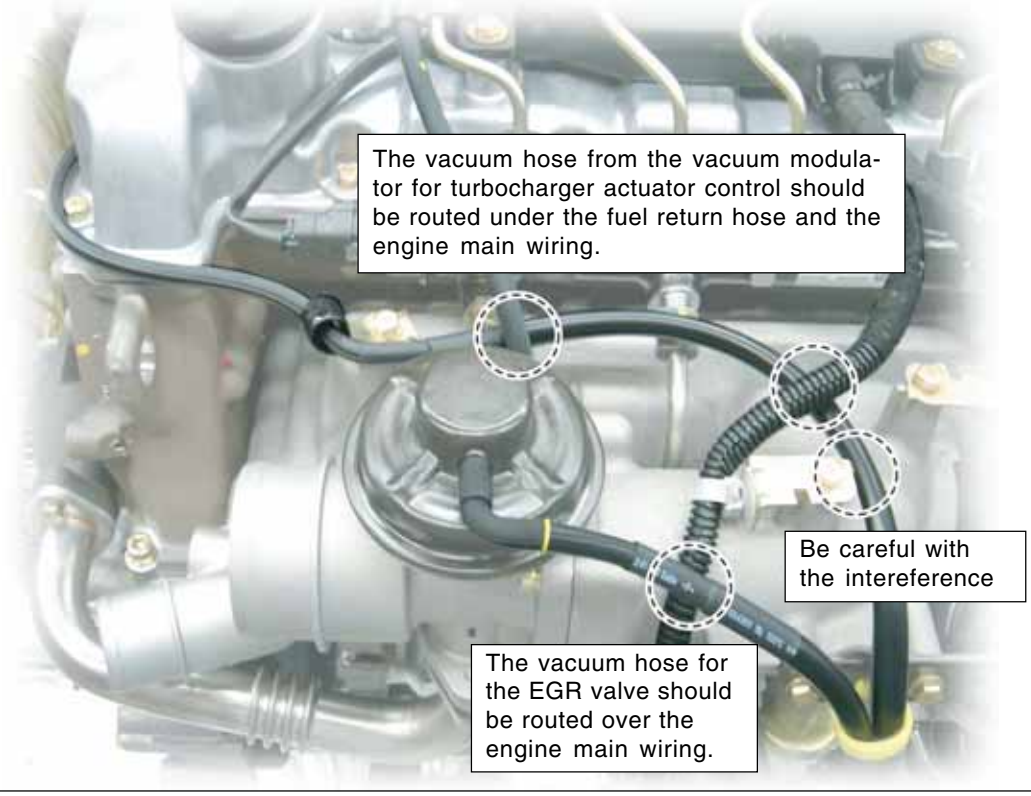
ENGINE ACCESSORIES



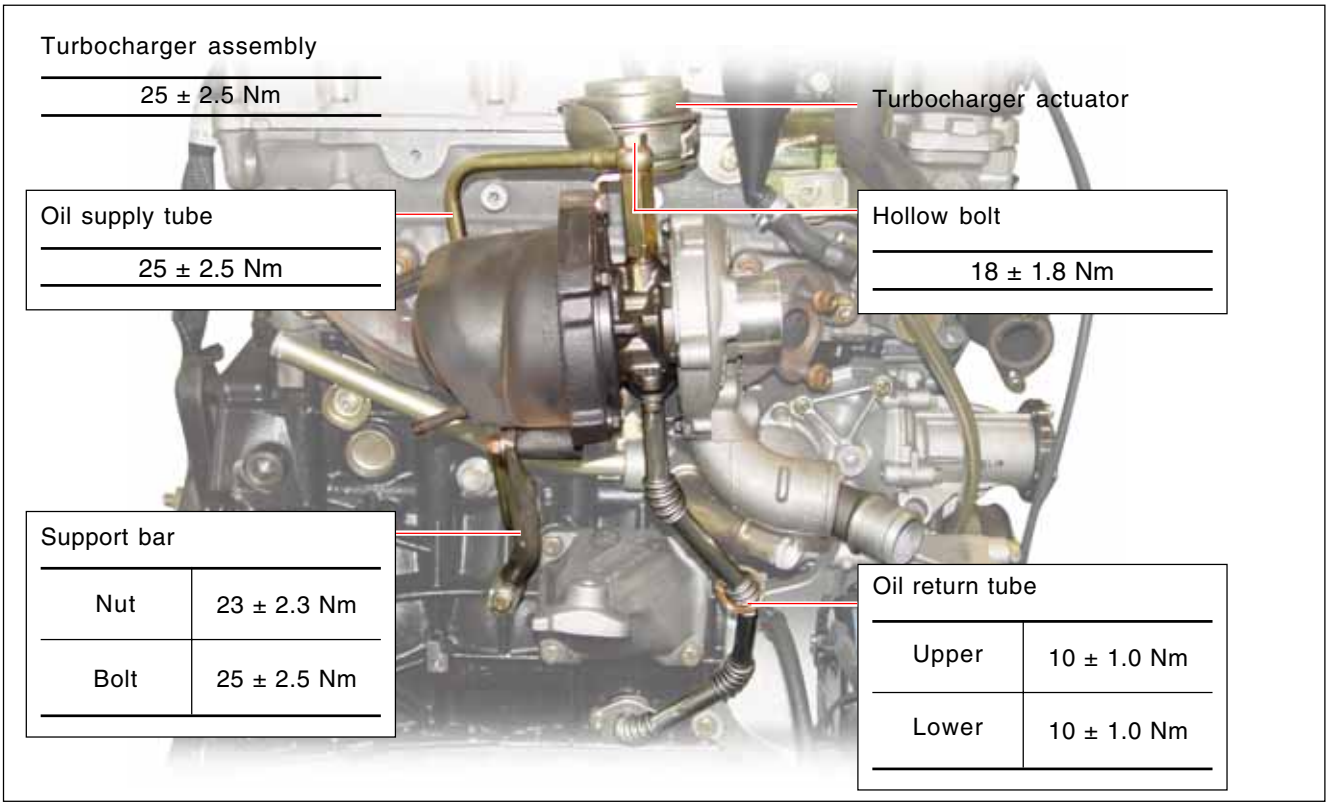


▶ Cautions When Installing the Engine

1. Connection of vacuum hose

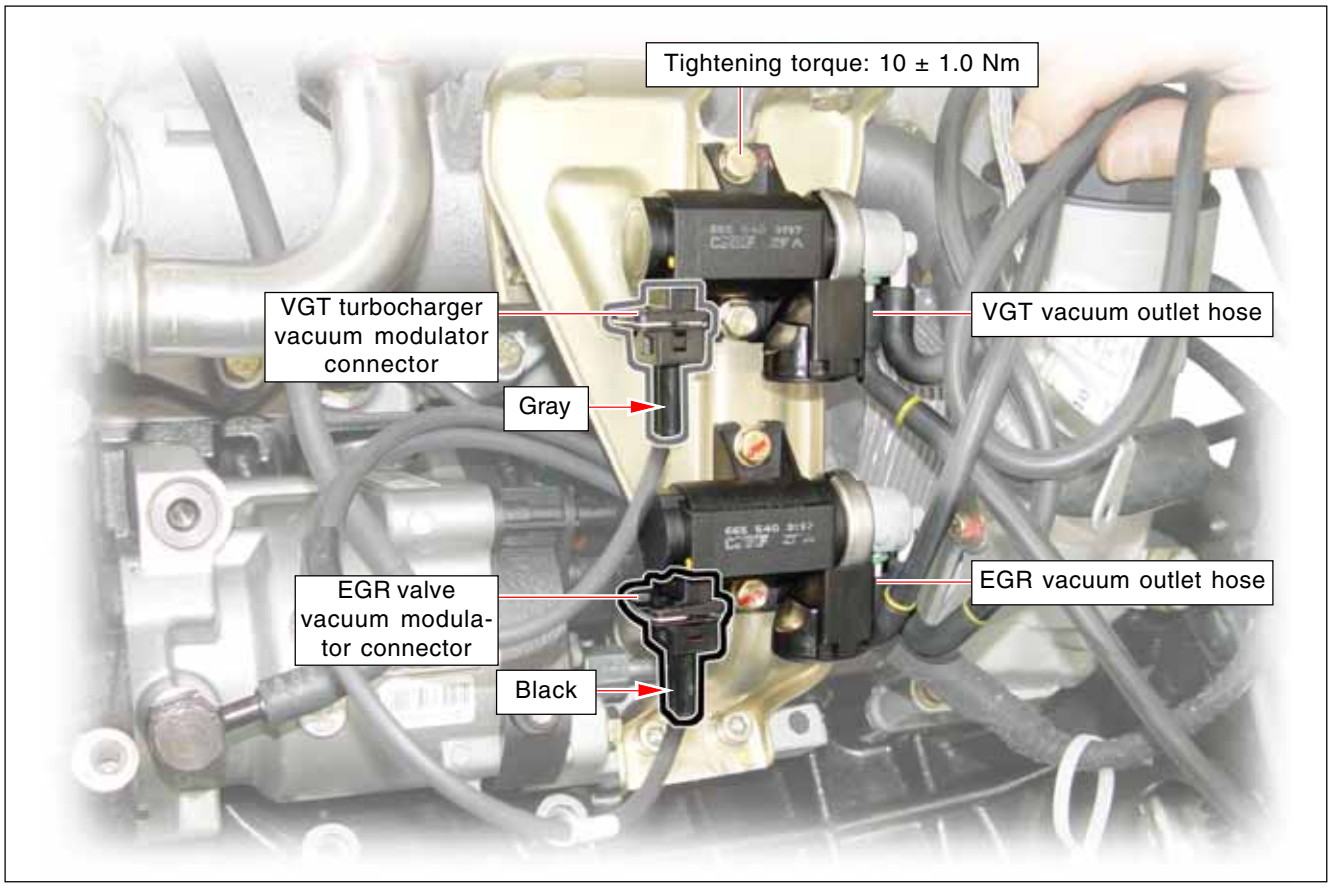


2. Tightening torque of oil pipes on VGT



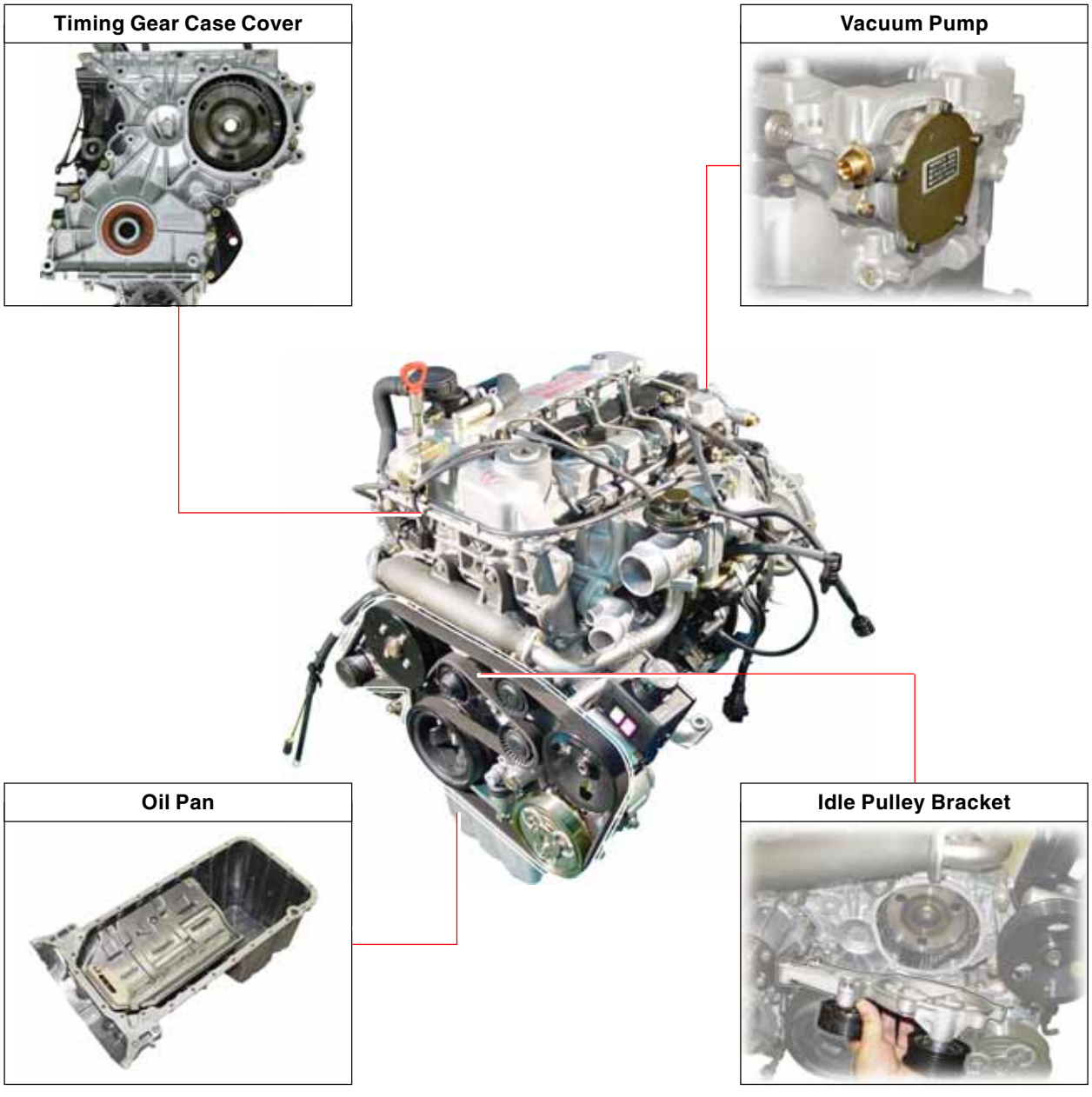
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AFFECTED VIN	

3. Vacuum modulator



▶ Sealant for Engine

Applied Locations



1. **Sealant specification:**
   - **DB 2210 (Drei Bond)**
   - **Part number: 661 989 56 A0**
   - **Characteristic: It is hardened twice faster than Loctite 5900.**
2. **Precautions:**
   - **Never use Loctite 5900 on DI engine.**
   - **Be careful not to clog the oil hole with sealant when installing the vacuum pump.**

The engine accessories can be removed without any specific order. In general, remove the components from top to bottom. However, be careful not to splash the lubricants to engine and body when disassembly. Especially, avoid getting into other components.

▶ Removal and Installation Order of Major Accessories

1. Vacuum Modulator
2. Engine Cables and Connectors
3. Fuel Hoses
3-1. EGR Valve Assembly
4. Oil Filter Assembly
4-1. Belt Tensioning Assembly
5. Power Steering Pump Assembly
6. Air Conditioner Compressor Assembly
7. PCV Valve Assembly + Oil Dipstick Tube
8. Turbo Charger → Alternator Assembly

1) Camshaft Position Sensor
2) Crankshaft Position Sensor
3) Injector Fuel Line Connector
4) Glow Plug Connector
5) Fuel Return Hose
6) High/Low Pressure Hoses in HP Pump
7) Ground Cables
8) Fuel Pressure Sensor Connector
9) Booster Pressure Sensor Connector
10) Knock Sensor Connector
11) Coolant Temperature Sensor Connector
12) HP Pump: Fuel Temperature Sensor (Green)
IMV (Brown)

1. Remove the fuel pipes.
   1) Remove the fuel supply pipes between each cylinder and common rail with a special tool.



Installation Notice

Tightening torque	40 ± 4.0 Nm

NOTICE

- **Plug the openings of injector nozzle and common rail with sealing caps after removed the fuel pipes.**



NOTICE

- **Replace the pipes with new ones. Be careful not to be mixed the fuel pipes because the pipe appearance of D27DT (#1 and #3 cylinders and #2 and #4) are same each other.**



   2) Remove the high fuel pressure pipe mounting bolts with a special tool.
      - High fuel pressure supply pipe at common rail side



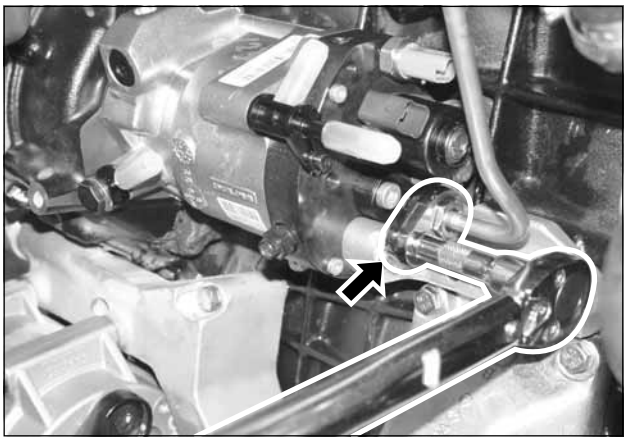
Installation Notice

Tightening torque	40 ± 4 Nm

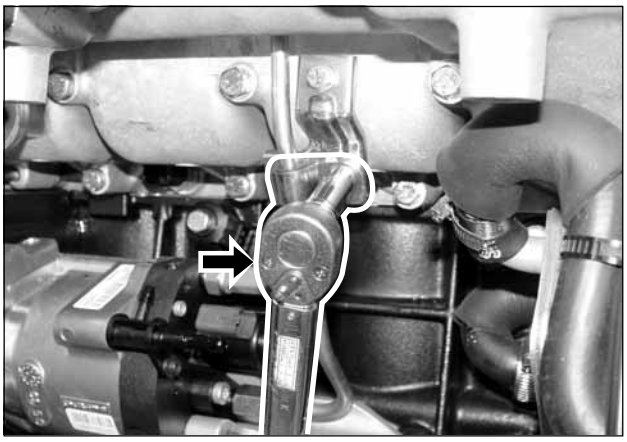
3) High fuel pressure supply pipe at HP pump side

Installation Notice

Tightening torque	40 ± 4.0 Nm



4) Unscrew the bracket mounting bolts and remove the high fuel pressure supply pipes.

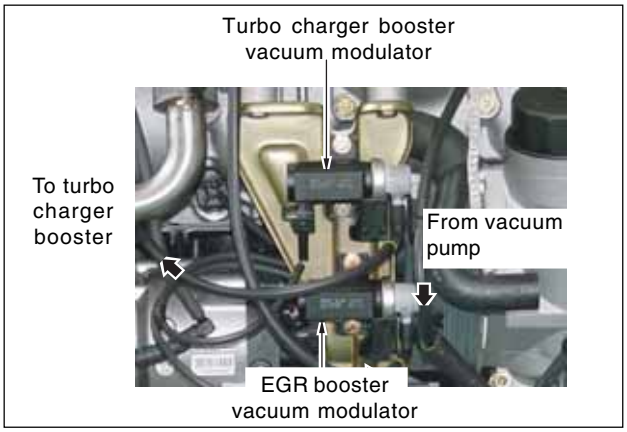


NOTE
- **Special tool: Fuel pipe remover and installer**



2. Disconnect the vacuum hoses and module cables from the vacuum modulator.

NOTICE
- **Put the installation marks on the modulator hoses and connectors.**



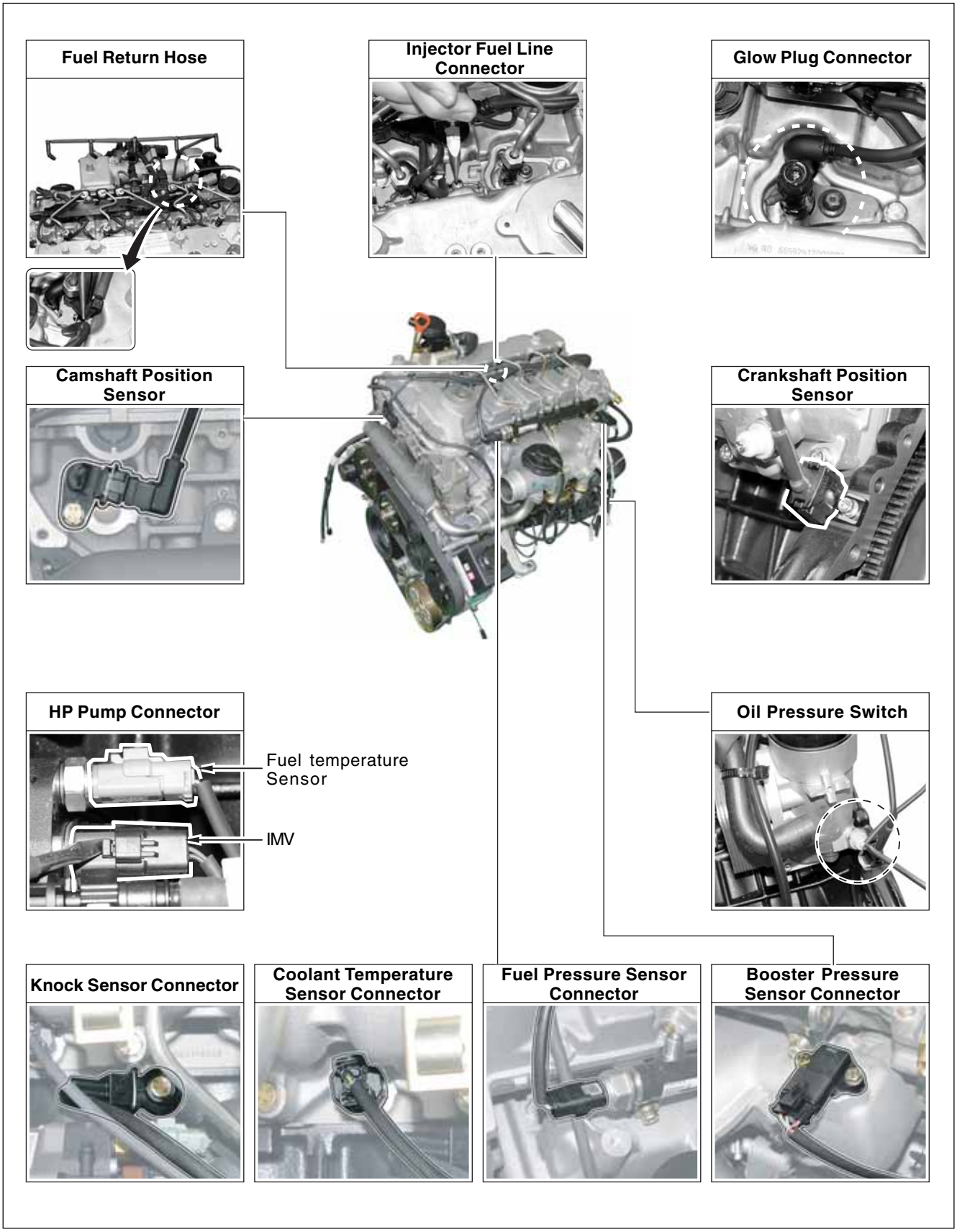
1) Remove the vacuum modulator bracket. (Upper: 10 M x 2, Lower: 10M x 2)

Installation Notice

Upper bolt	25 ± 2.5 Nm
Lower bolt	25 ± 2.5 Nm



3. Disconnect the wiring harnesses and connectors from the engine.



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AFFECTED VIN	

1) Remove the cable assembly from the engine.



IMPORTANT

- **If possible, remove the cables after removing the fuel pipes. It makes the operation easier and protect the cables and connectors.**

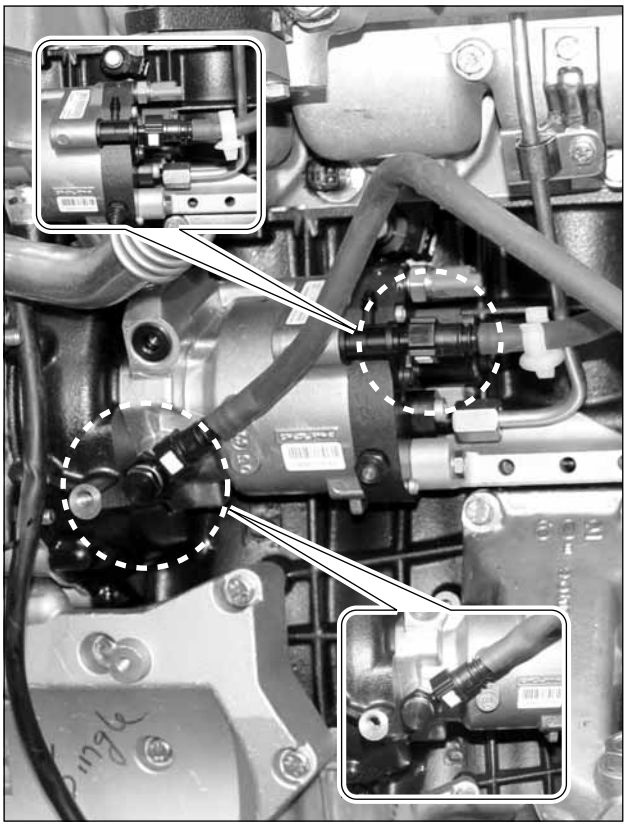
IMPORTANT

- **Remove the cable screws and ground cable, and then remove the engine cable assembly.**

NOTICE

- **Be careful not to damage the HP pump connecting pipe (venturi) while removing the fuel hose from the HP pump.**

4. Disconnect the high and low fuel pressure hoses from the HP pump.



NOTICE

- **Be careful not to damage the hose connections.**
- **Plug the openings in HP pump immediately after disconnecting the hoses.**

5. Remove the EGR valve and EGR valve pipe.
   1) Disconnect the vacuum hose from the EGR valve.
   2) Unscrew the EGR valve bolts and EGR #1 pipe connecting bolts and remove the EGR valve and steel gasket.



Installation Notice	D20DT
EGR valve bolt	10 ± 1.0 Nm, M6
EGR valve and center pipe bolt	10 ± 1.0 Nm, M6

3) Remove the EGR valve #1 pipe.

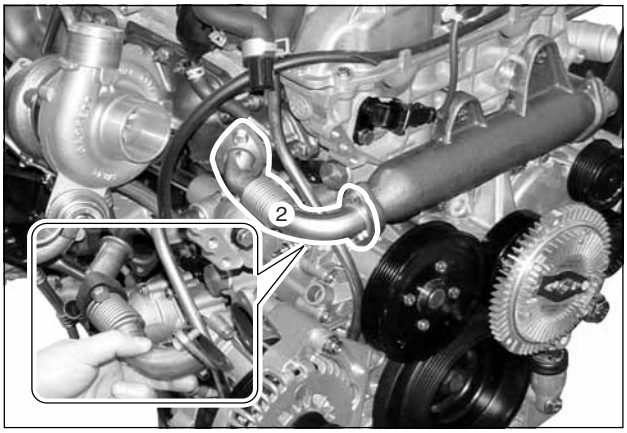


Installation Notice

Center pipe mounting bolt	25 ± 2.5 Nm
Center pipe and #1 pipe bolt and nut	35 ± 3.5 Nm

- ***The EGR #2 pipe should be replaced with new one.***

4) Unscrew the EGR valve #3 pipe (2) mounting bolts and remove the pipe from the exhaust manifold.

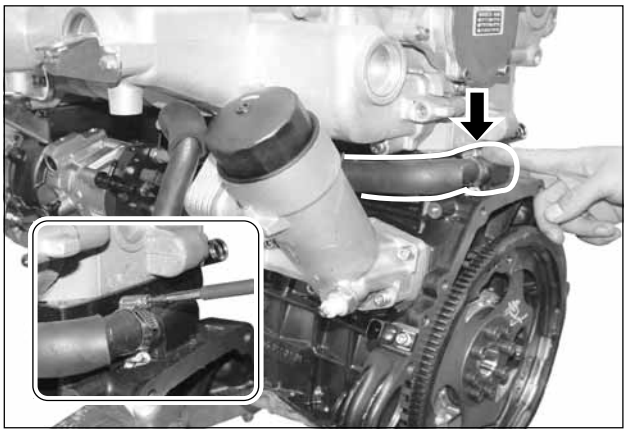


Installation Notice

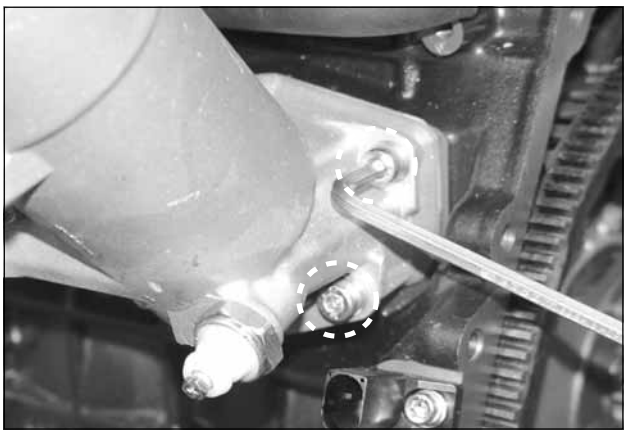
Tightening torque	Nut 35 ± 3.5 Nm
	Bolt 10 ± 1.0 Nm

- ***The EGR #3 pipe should be replaced with new one.***
- ***Make sure that the convex surface of new steel gasket is facing to the bolts.***

6. Remove the oil filter assembly.
   1) Remove the oil cooler hose.



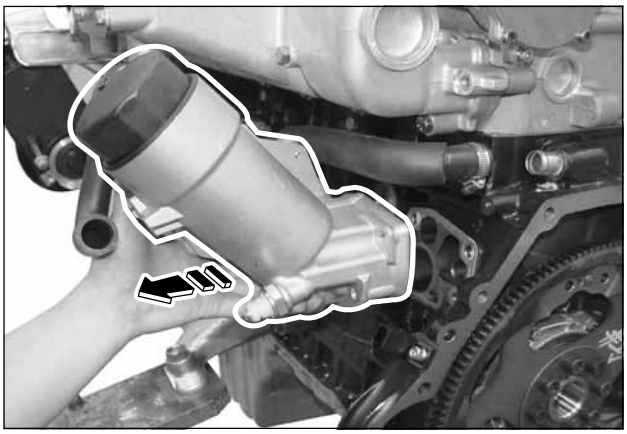
2) Remove the oil filter assembly mounting bolts.



NOTICE

- **Be careful not to flow out the residual oil from the engine. If flown out, immediately wipe it out.**

3) Remove the oil filter assembly from the cylinder block.



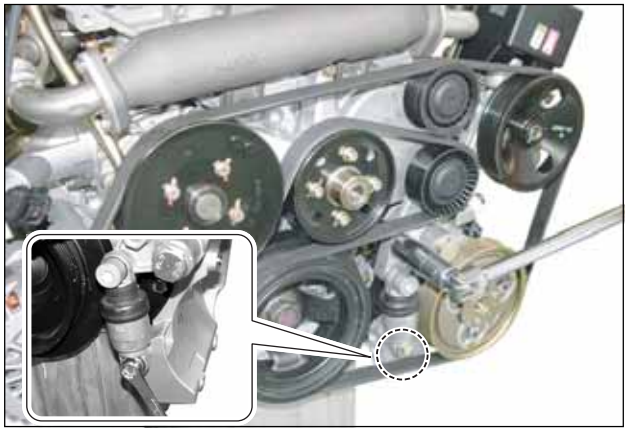
Installation Notice

- ***Replace the oil filter gasket with new one.***

Tightening torque	25 ± 2.5 Nm

7. Remove the belt tensioning device.

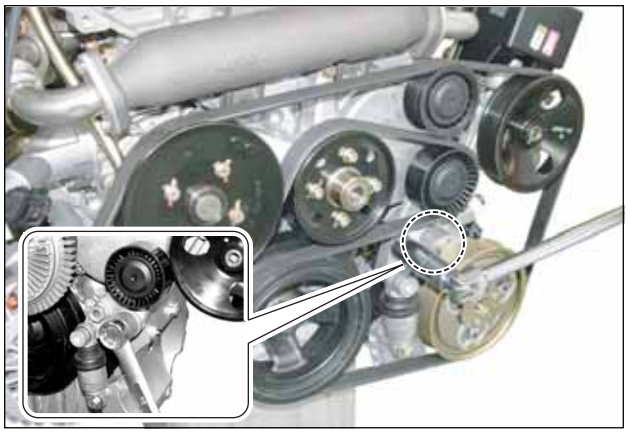
1) Remove the shock absorber lower mounting bolt.



Installation Notice

Tightening torque	32 ± 3 Nm

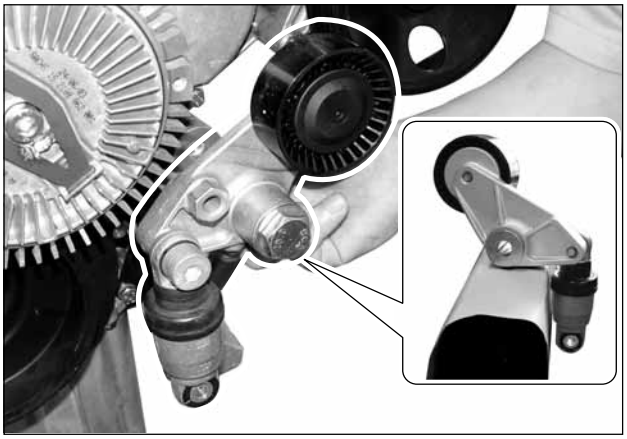
2) Remove the shock absorber upper mounting bolt.



Installation Notice

Tightening torque	82 ± 6 Nm

3) Remove the belt tensioning device.



NOTICE

- **To prevent the oil leaks, store the removed shock absorber assembly with standing up.**
- **For air bleeding, pump the shock absorber around 3 times after installation.**
- **Be careful not to damage the rubber parts of the shock absorber when removing.**
- **To prevent the oil leaks, remove the bolts from bottom to top section. On the contrary, when installing, tighten the bolts from top to bottom section.**

8. Remove the power steering pump assembly.
   1) Remove the power steering pump mounting bolts.

Installation Notice

Tightening torque	25 ± 2.5 Nm

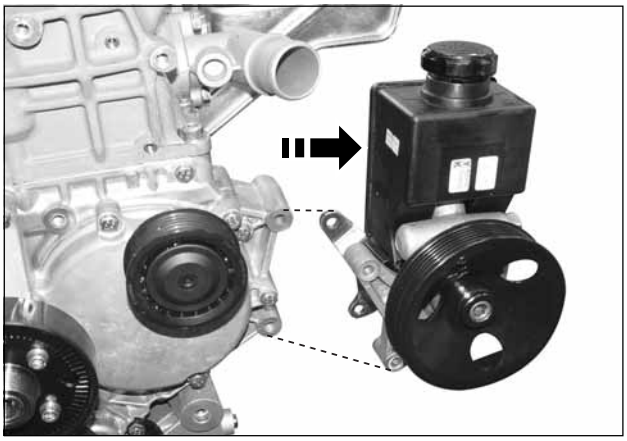
- ***Be careful not to flow out the oil.***



   2) Remove the power steering pump assembly from the engine.

NOTICE

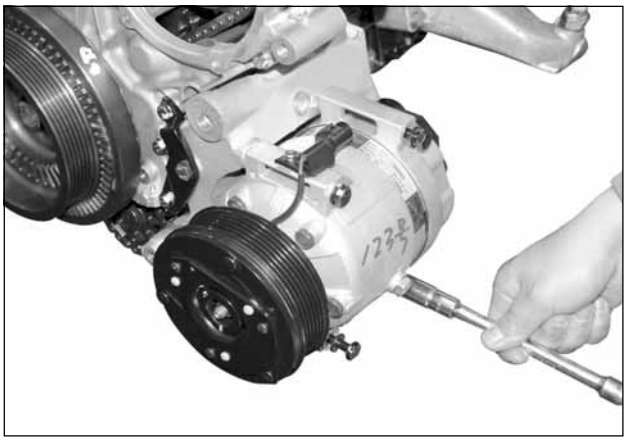
- **To prevent the oil leaks, store the removed power steering pump assembly with standing up.**



9. Remove the air conditioner compressor assembly.
   1) Unscrew the bolts and remove the air conditioner compressor assembly.

Installation Notice

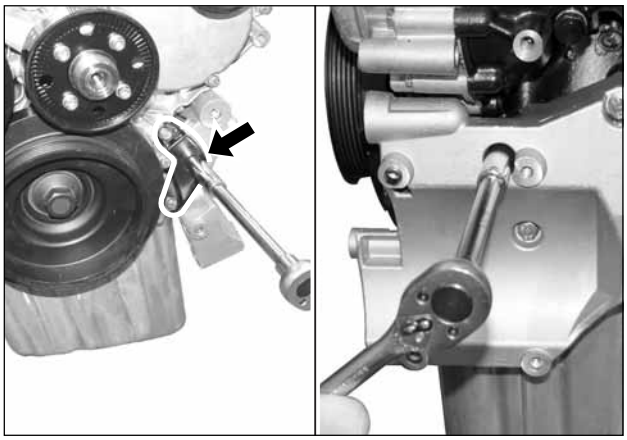
Tightening torque	25 ± 2.5 Nm



   2) Unscrew the bolts and remove the air conditioner mounting bracket.

Installation Notice

Front bolt	25 ± 2.5 Nm
Side bolt	25 ± 2.5 Nm



10. Remove the PCV valve assembly.
    1) Remove the PCV valve hose.



    2) Remove the PCV valve hose connected to the engine oil hose.



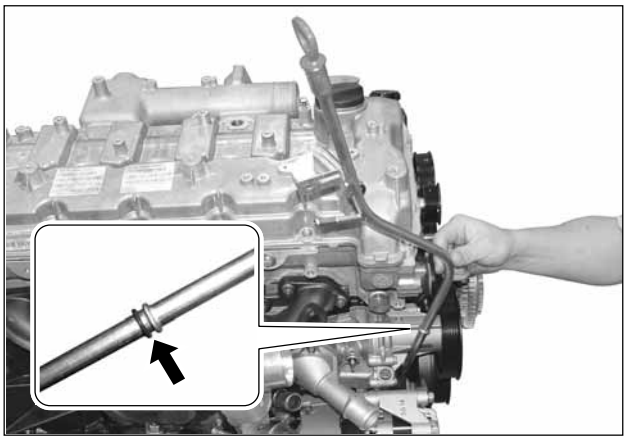
    3) Unscrew the PCV valve mounting bolts and remove the PCV valve assembly.



Installation Notice

Tightening torque	10 ± 1.0 Nm

11. Remove the oil dipstick tube assembly.
    Unscrew the bracket bolts and remove the dipstick tube with O-ring.



NOTICE

- **Insert new O-ring into the oil dipstick tube before installation.**

Installation Notice

Tightening torque	10 ± 1.0 Nm



12. Remove the turbo charger assembly.
    1) Unscrew the bolts and remove the oil supply pipe.

Installation Notice

Upper bolt (M19)	25 ± 2.5 Nm
Lower bolt (M17)	20 ± 2.0 Nm



    2) Unscrew the bolts and remove the oil return pipe.

Installation Notice

- Make sure to install the gasket with correct direction.

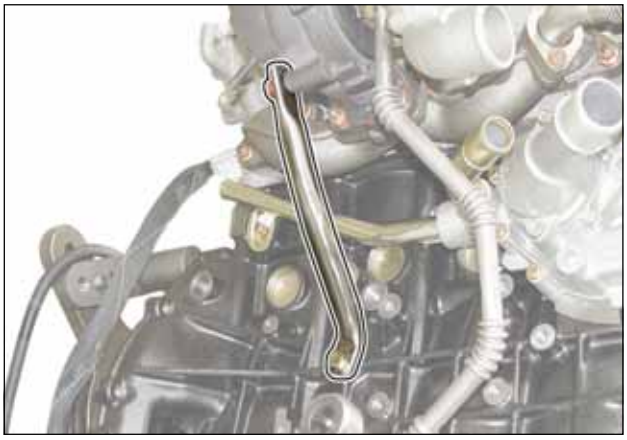
Tightening torque	10 ± 1.0 Nm



    3) Unscrew the turbo charger mounting bracket bolts.

Installation Notice

Tightening torque	25 ± 2.5 Nm



4) Unscrew the turbo charger mounting bolts to exhaust manifold.

Installation Notice

Tightening torque	25 ± 2.5 Nm

NOTICE
- **Use only 12 1/2 wrench.**



5) Remove the turbo charger assembly.

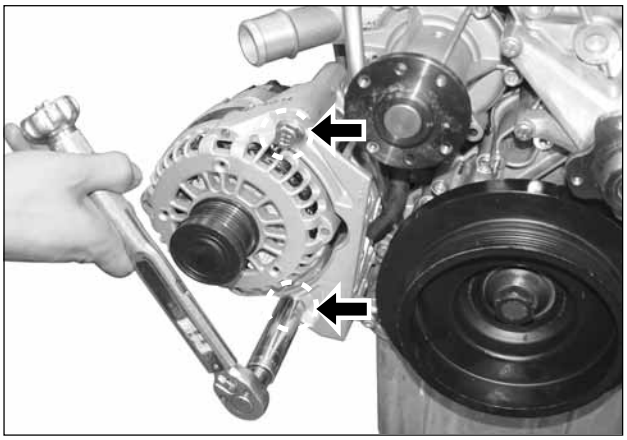


13. Remove the alternator assembly.
    1) Unscrew the bolts and remove the alternator.

NOTICE
- **Alternator Capacity: 140 A**

Installation Notice

Tightening torque	46 ± 4.6 Nm



2) Remove the alternator mounting bracket.

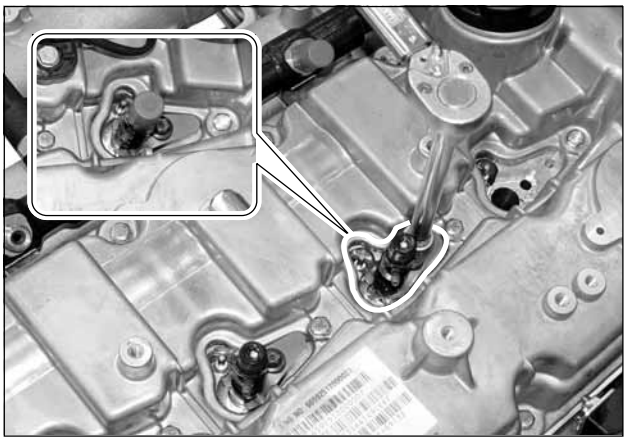
Installation Notice

M13 bolt	25 ± 2.5 Nm
Torx 6 bolt	25 ± 2.5 Nm



ENGINE OVERHAUL

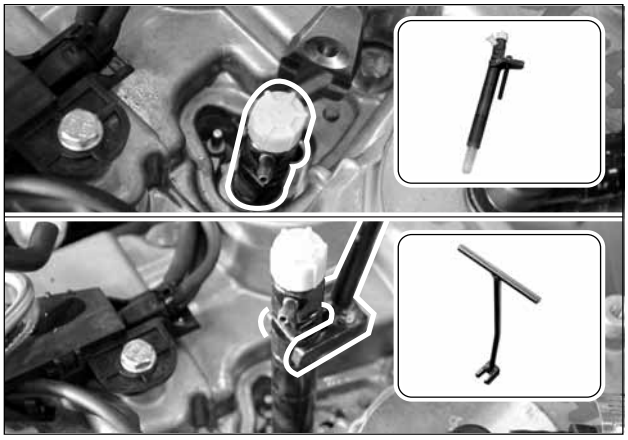
1. Unscrew the injector nozzle holder bolts (12-sided) and remove the injector bracket.



Installation Notice

Tightening torque	9 ± 1.0 Nm, 190° + 10°

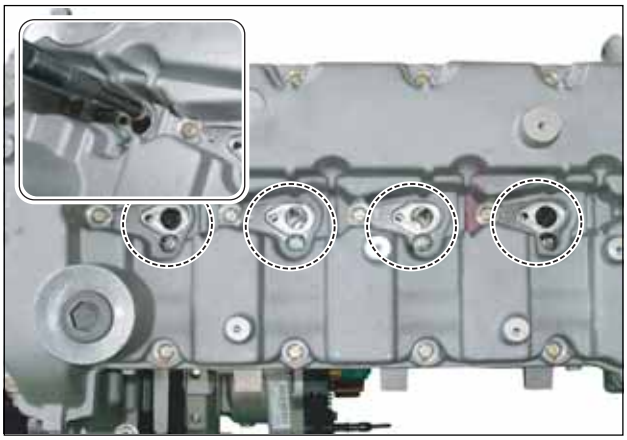
2. Remove the injectors with a injector extractor (special tool).



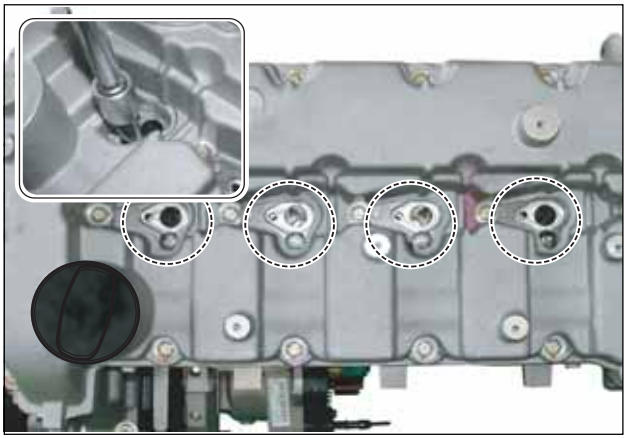
NOTICE

- **Be careful not to take off the sealing caps on the injectors and fuel system.**
- **Replace the copper washers with new ones when installing.**

3. If the copper washer is in injector hole, remove it with a special tool as shown in the figure.



4. Remove the glow plugs with a special tool.



Installation Notice

Tightening torque	15 ~ 18 Nm

5. Unscrew the Torx bolts and remove the common rail from the engine.

Installation Notice

Tightening torque	25 ± 2.5 Nm

NOTICE

- **Plug the openings with sealing cap.**



6. Remove the booster sensor from the engine.

Installation Notice

Tightening torque	10 ± 1.0 Nm

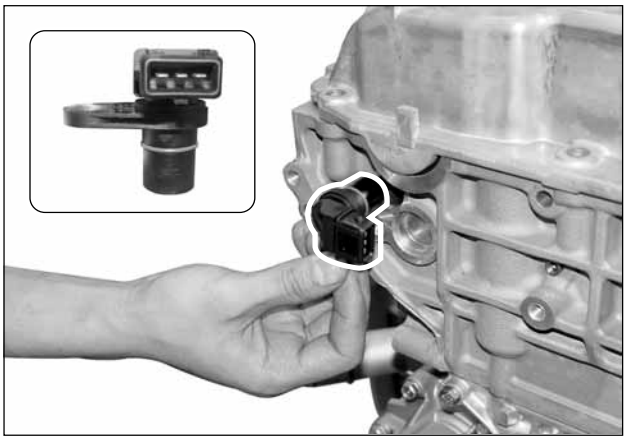


7. Unscrew the bolt and remove the camshaft position sensor.

Installation Notice

Tightening torque	12 ± 2 Nm

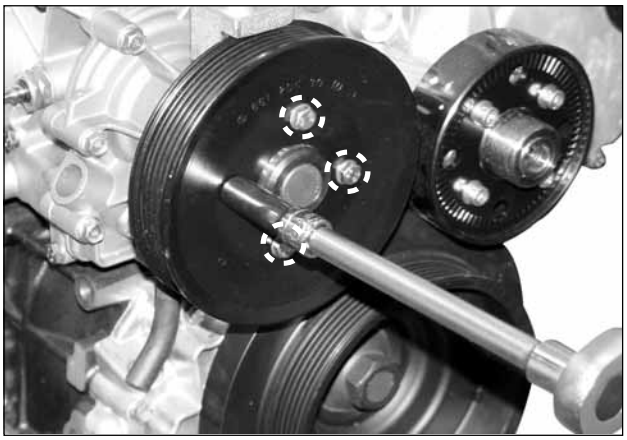
Apply Loctite on the thread before installation.



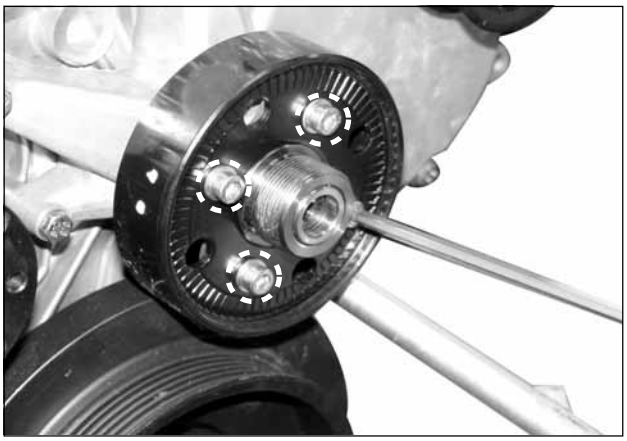
8. Unscrew the bolts and remove the cooling fan pulley while holding it with a special tool.

Installation Notice

Tightening torque	10 ± 1.0 Nm



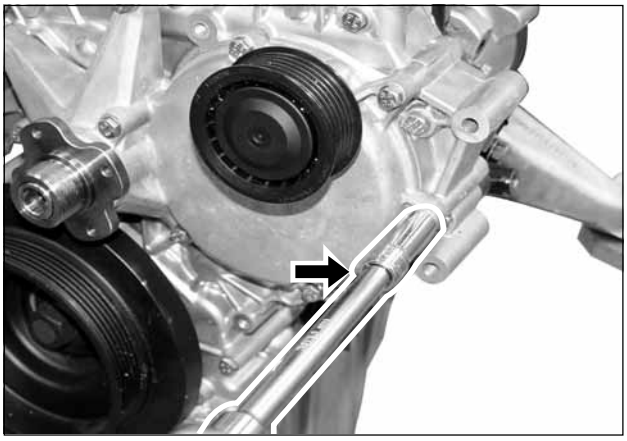
9. Remove the cooling fan belt idle pulley while holding it with a special tool.



Installation Notice

Tightening torque	10 ± 1.0 Nm

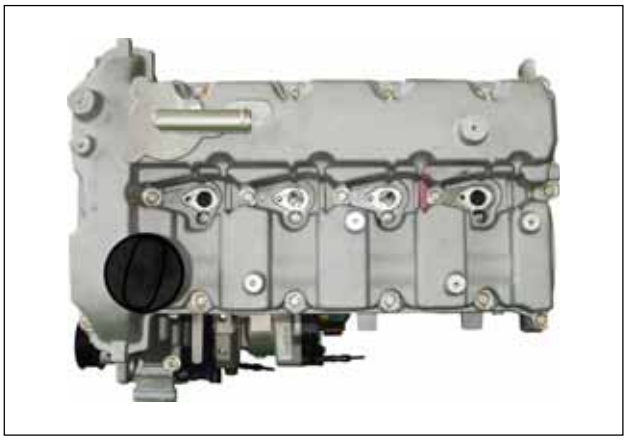
10. Unscrew the bolts and remove the cooling fan bracket assembly (timing chain cover).



Installation Notice

Tightening torque	10 ± 1.0 Nm

11. Unscrew the bolts and remove the cylinder head cover.



Installation Notice

Tightening torque	10 ± 1.0 Nm

12. Turn over the engine and remove the oil pan.



Installation Notice

Tightening torque	Nm
M6 x 20: 24 EA	10 ± 1.0
M6 x 35: 3 EA	10 ± 1.0
M6 x 85: 3 EA	10 ± 1.0
M8 x 40: 4 EA	25 ± 2.5

NOTICE

- **Remove the oil seal residues from the oil pan and apply the liquid gasket on the parting surface.**



13. Unscrew the nuts and remove the exhaust manifold.

Installation Notice

Tightening torque	40 ± 4.0 Nm



NOTICE

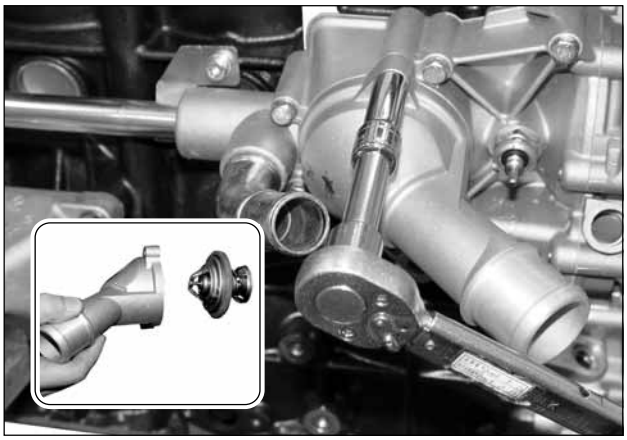
- **The exhaust manifold gasket is removed along with the exhaust manifold. Mark the installation direction to prevent wrong installation. Otherwise, it may cause a sealing trouble.**

14. Unscrew the bolts and remove the thermostat.

Installation Notice

Tightening torque	10 ± 1.0 Nm

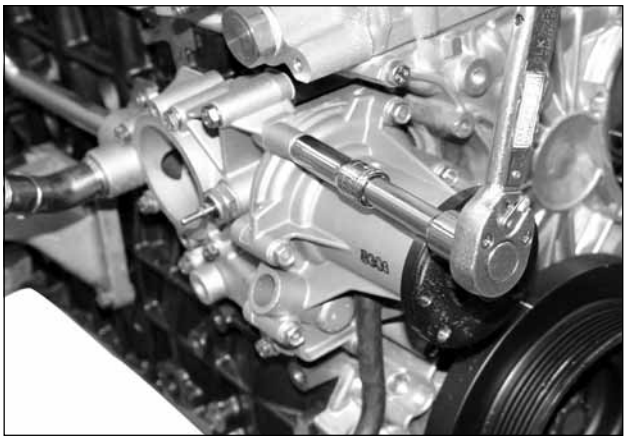
- ***Be careful not to flow out the residual coolant.***



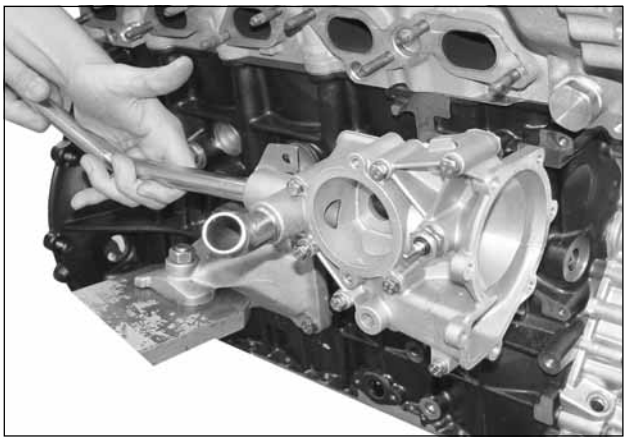
15. Unscrew the bolts and remove the water pump.

Installation Notice

Tightening torque	10 ± 1.0 Nm



16. Unscrew the bolts and remove the water pump housing.



Installation Notice

Tightening torque	10 ± 1.0 Nm

- ***Be careful not to flow out the residual coolant.***

17. Unscrew the bolts and remove the coolant inlet port from the intake manifold.



Installation Notice

Tightening torque	25 ± 2.5 Nm

- ***Be careful not to get the coolant into the intake manifold and engine.***

18. Unscrew the bolts and remove the intake manifold assembly.



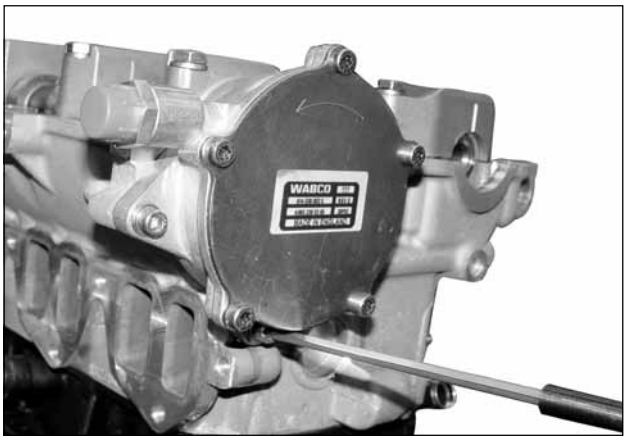
Installation Notice

Tightening torque	25 ± 2.5 Nm

NOTICE

- **Replace the gasket with new one once removed.**

19. Remove the vacuum pump from the cylinder head.



Installation Notice

Tightening torque	10 ± 1.0 Nm

20. Install the engine lock (special tool) onto the flywheel ring gear so that the engine will not rotate.

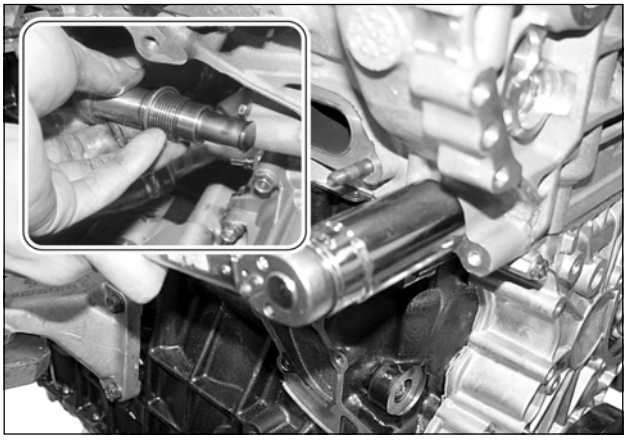


21. Remove the chain tensioner.

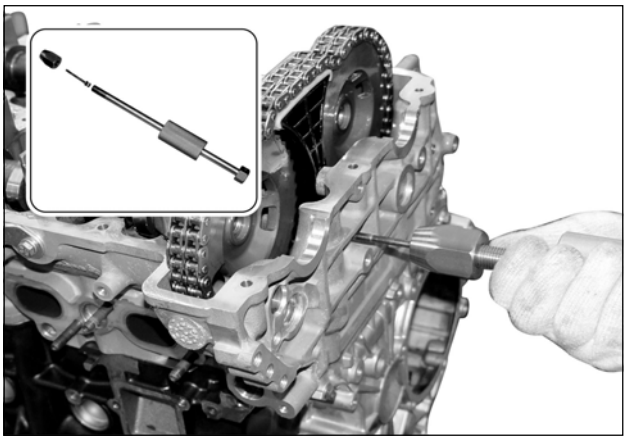
※ **Preceding Works:** removal of EGR pipe and oil dipstick tube

Installation Notice

Tightening torque	65 ± 5.0 Nm



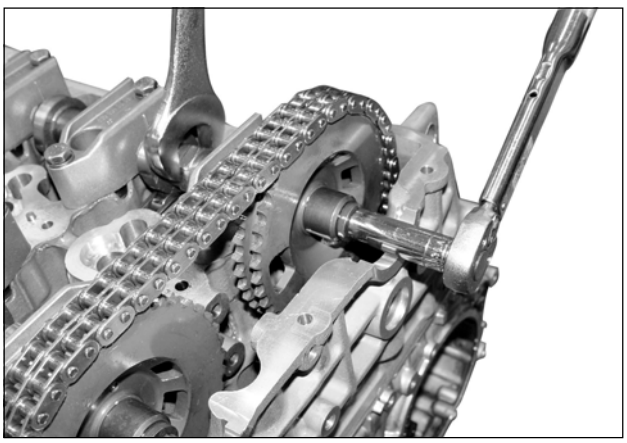
22. Pull out the lock pin and remove the upper chain guide bracket.



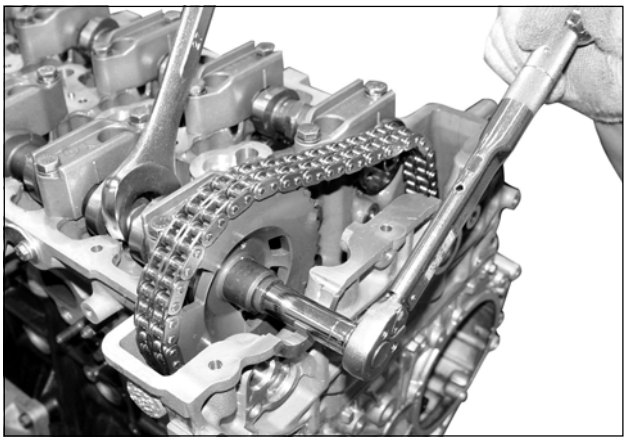
23. Unscrew the bolt and remove the intake camshaft sprocket.

Installation Notice

Tightening torque	25 ± 2.5 Nm, 90° ± 10°



24. Unscrew the bolt and remove the exhaust camshaft sprocket.

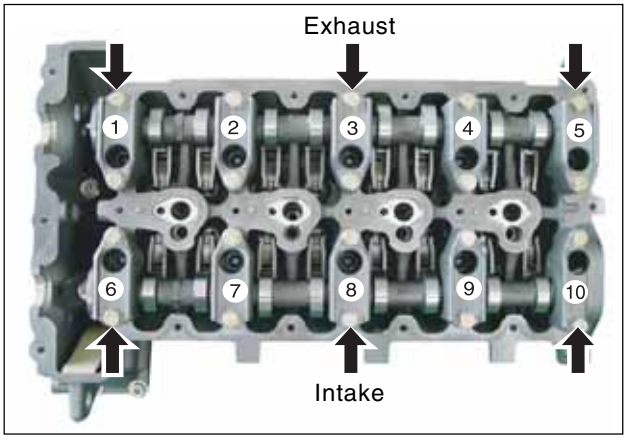


Installation Notice

Tightening torque	25 ± 2.5 Nm, 90° ± 10°

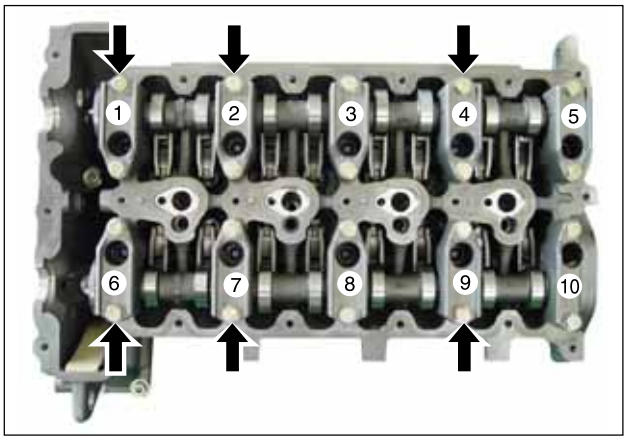
25. Remove the camshaft bearing cap bolts so that the tightening force can be relieved evenly.
    - Intake: #6, #8, #10
    - Exhaust: #1, #3, #5

    However, there is no specific removal sequence.



    - Intake: #7, #9
    - Exhaust: #2, #4

    Do not remove the bolts at a time completely. Remove them step by step evenly or camshaft can be seriously damaged.



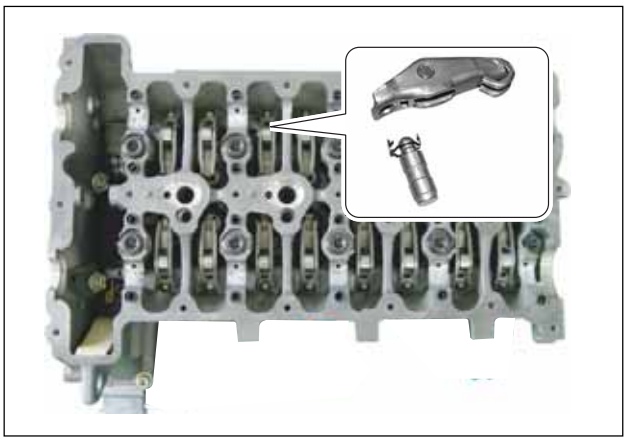
Installation Notice

Tightening torque	25 ± 2.5 Nm

26. Remove the intake and exhaust camshafts from the cylinder head.



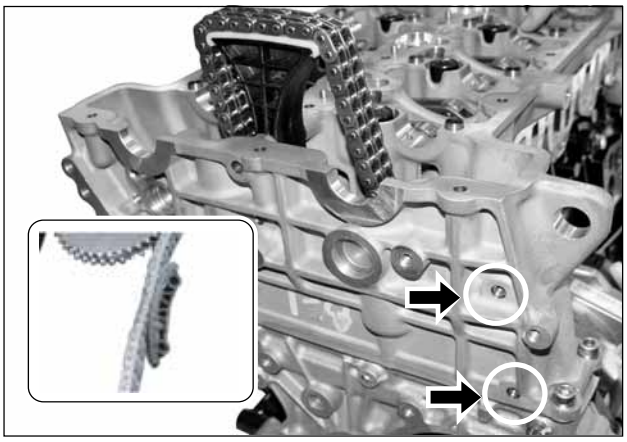
27. Remove the finger follower and the HLA device.



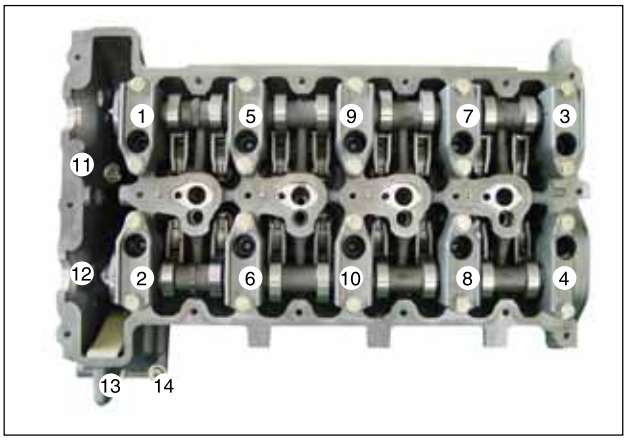
NOTICE

- **Avoid contact with hot metal parts when removing the HLA device immediately after stopping the engine.**
- **Be careful not to be contaminated by foreign materials.**
- **To prevent the oil leaks, store the removed finger follower and HLA device with standing up.**
- **If the HLA can be easily pressed in by hand, it indicates the oil inside of HLA has been flown out. In this case, replace it with new one.**

28. Pull out the pin and remove the timing chain guide from the engine.



29. Remove the cylinder head bolts according to the numerical sequence.

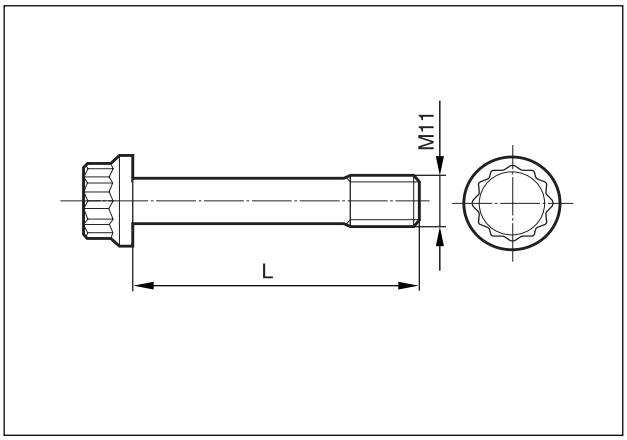


Installation Notice

Tightening torque	Nm
M8 x 25: 2 EA	25 ± 2.5
M8 x 50: 2 EA	25 ± 2.5
M12 x 177: 11 EA	85 ± 5 Nm, 3 x 90° + 10°
M12 x 158: 1 EA (Vacuum pump side)	

30. Measure the length of cylinder head bolts.

If the maximum length is exceeded by 2 mm, replace the cylinder head bolt.

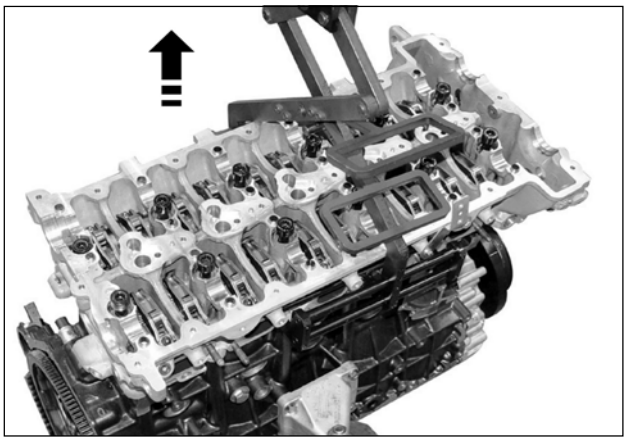


Length when new	Maximum Limit
177 mm	179 mm
158 mm	160 mm

31. Remove the cylinder head.

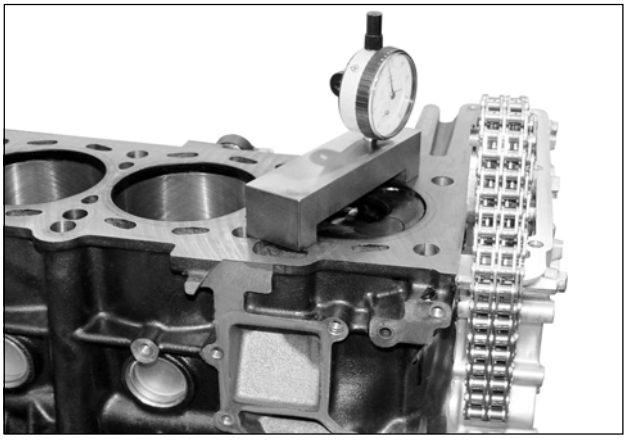
NOTICE

- **Inspect the cylinder head surface.**
- **Store the removed injectors and glow plugs so that they will not be damaged.**



32. Measure the piston protrusion from the parting surface.

    Specified Value: 0.765 ~ 1.055 mm

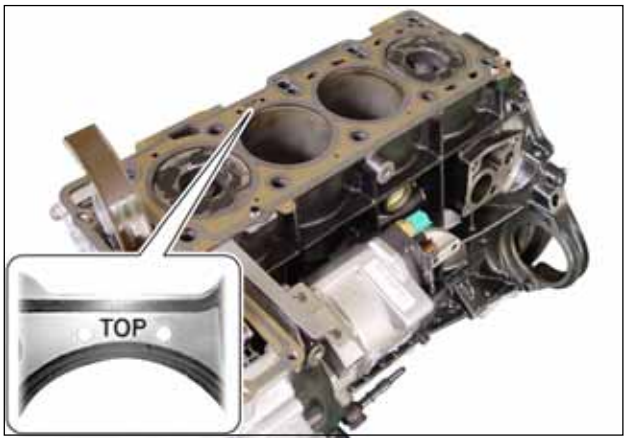


33. Remove the cylinder head gasket.

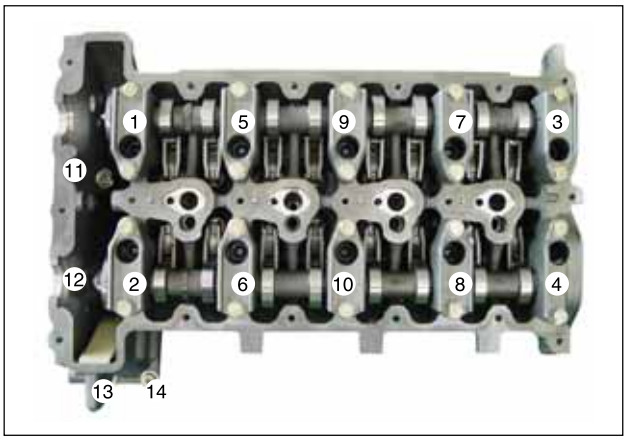
Installation Notice

- ***Replace the cylinder head gasket with new one. Make sure to place the "TOP" mark upward.***

1. ***Put the steel gasket on the cylinder block and position the cylinder head.***
2. ***Tighten the cylinder head bolts to specified torque and torque angle.***



Tightening torque	Step 1 20 ± 2.0 Nm
	Step 2 85 ± 5.0 Nm
	Step 3 90 ± (3 times) + 10°



- ***Apply the oil on the bolt thread when installing.***
- ***Always insert new washer first.***
- ***The bolts (12) at vacuum pump side are shorter than others.***

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EFFECTIVE DATE	
AFFECTED VIN	

34. Turn over the engine and remove the baffle plate.

Installation Notice

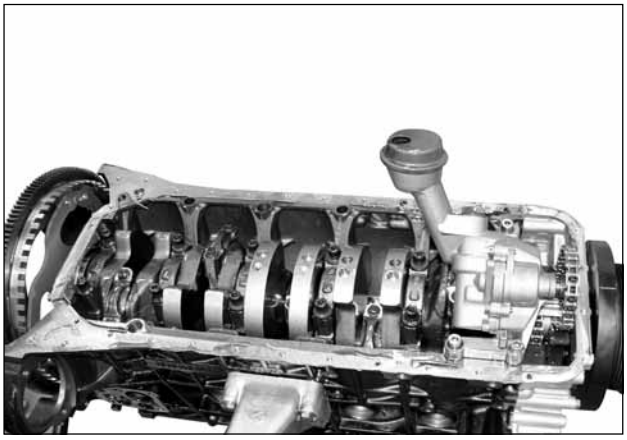
Tightening torque	10 ± 1.0 Nm



35. Unscrew the bolts and remove the oil strainer assembly.

Installation Notice

Tightening torque	25 ± 2.5 Nm

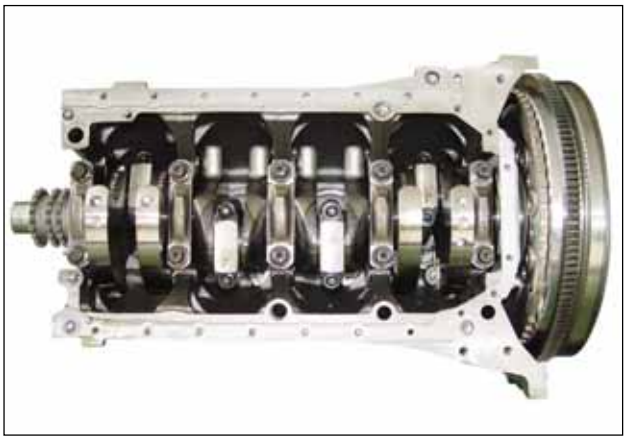


36. Remove the piston assembly from the cylinder block.
    1) Unscrew the bearing cap bolts.

Installation Notice

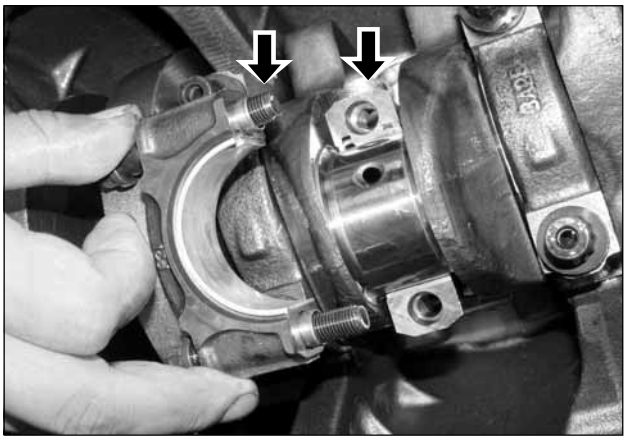
Step 1	55 ± 5.0 Nm
Step 2	90° + 10°

Tighten the bolts from #1 cap.



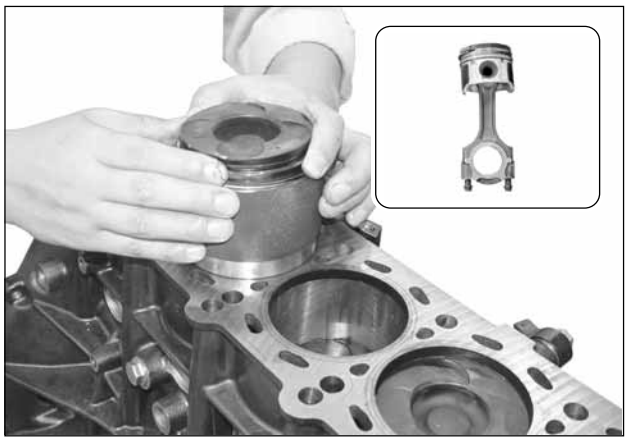
NOTICE

- **Align the oil grooves in bearing cap and connecting rod.**



    2) Remove the bearing caps and lower bearing shells.

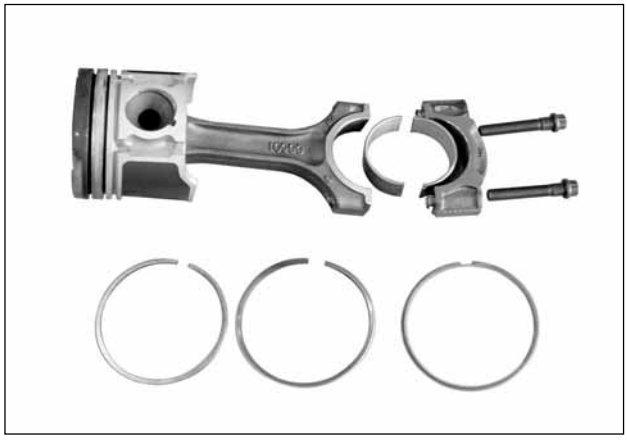
3) Remove the piston assembly through the cylinder.



NOTICE

- **Do not mix up upper and lower crankshaft bearing shells.**

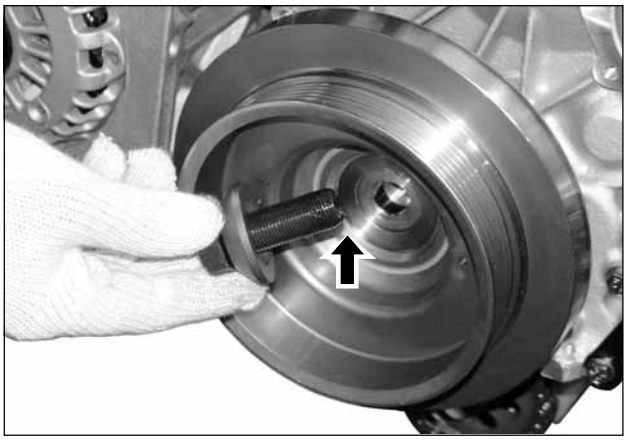
4) Remove the snap ring piston pin from the piston.
5) Disassemble the piston and connecting rod.
6) Remove the piston rings from the piston.



NOTICE

- **Replace the piston ring, bearing and snap ring with new ones.**

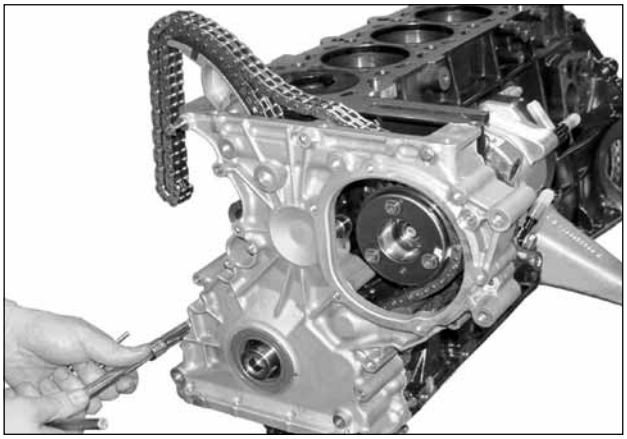
37. Lock the flywheel and remove the center bolt and crankshaft pulley.



Installation Notice

Tightening torque	200 ± 20 Nm, 180° + 10°

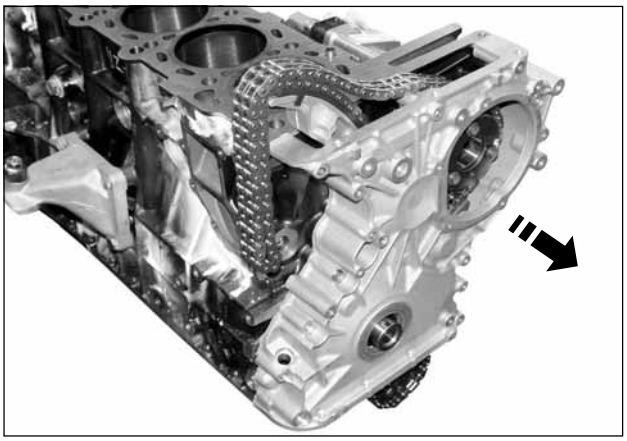
38. Remove the timing chain cover assembly.
    1) Remove the cover bolts.



Installation Notice

Tightening torque	10 ± 1.0 Nm

2) Hold the timing chain and remove the timing chain cover by tapping it with a rubber hammer and a screwdriver.



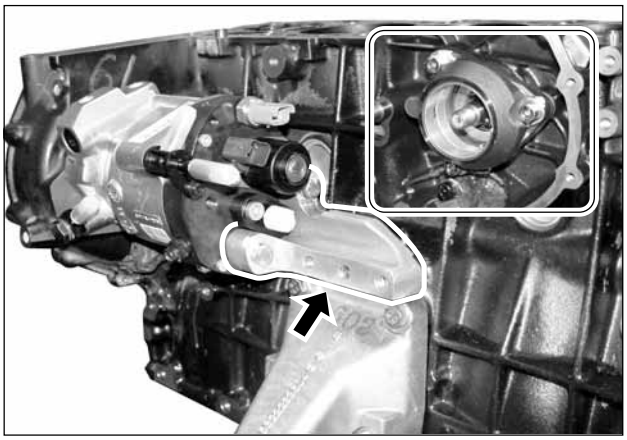
NOTICE

- **Apply the sealant on the parting surface.**

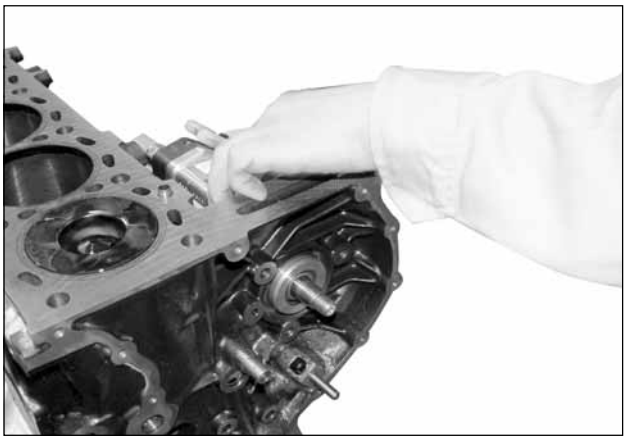
39. Remove the timing chain guide rail and timing chain.



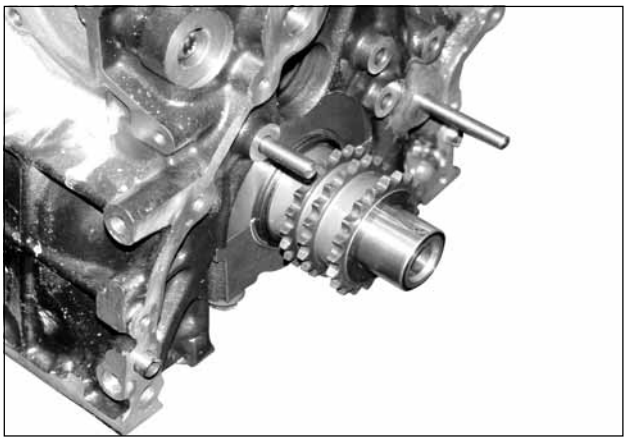
40. Remove the HP pump bolts and the HP pump bracket bolts.



1) Remove the HP pump assembly.



41. Remove the crankshaft sprocket with a special tool.



42. Remove the flywheel and the crankshaft strainer.

Installation Notice

Tightening torque	45 ± 5.0 Nm, 90° + 10°

43. Unscrew the bolts and remove the crankshaft bearing caps.

Installation Notice

Tightening torque	55 ± 5.0 Nm, 90° + 10°



NOTICE

- **Remove the bearing cap bolts from inside to outside with a pair.**
- **Do not mix up the crankshaft bearing caps and shells.**



NOTE

- **Install in the reverse order of removal.**
- **Tighten the fasteners with the specified tightening torques.**
- **Replace the gaskets and bearings with new ones.**
- **Make sure to install the gaskets in correct direction.**

ENGINE HOUSING

02

TABLE OF CONTENTS

CYLINDER HEAD/CYLINDER BLOCK 2

Cylinder head 2
Camshaft assembly 14
Timing chain assembly 23
Cylinder block 27

CRANKSHAFT 30

Arrangement of thrust washers and bearings 31
Torsional vibration damper 36
Disassembly and reassembly 37

FLYWHEEL 40

Dual mass flywheel (DMF, manual transmission equipped vehicle) 40

PISTON AND CONNECTING ROD 42

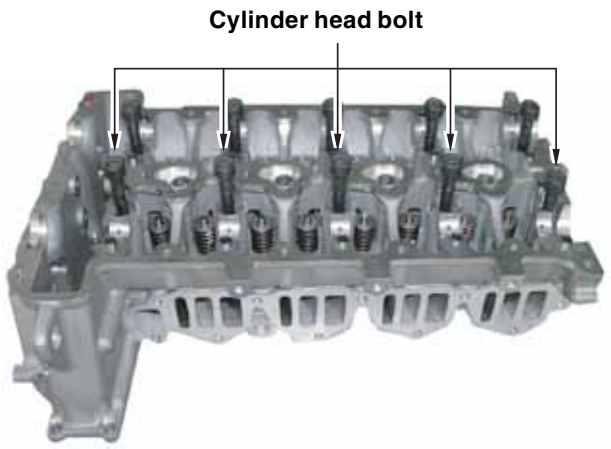
Piston ring 43
Cylinder inner diameter and piston size 44
Disassembly and reassembly 45

HIGH PRESSURE PUMP (HPP) 49

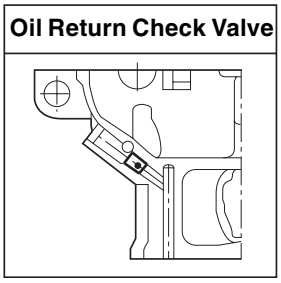
Components locator 49
Disassembly and reassembly 52

CYLINDER HEAD/CYLINDER BLOCK

CYLINDER HEAD

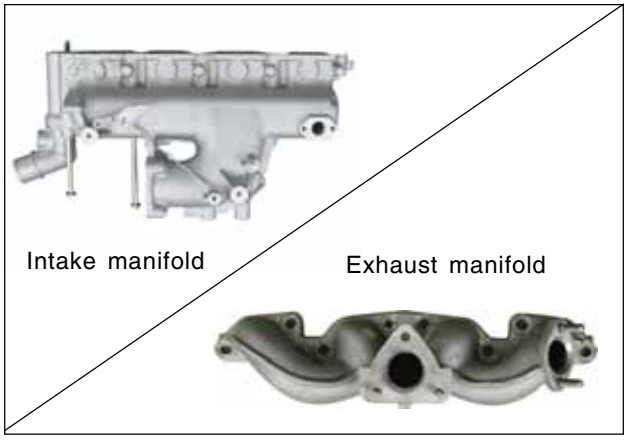






▶ System Characteristics

1. 4-valve DOHC valve mechanism
2. Swirl and tangential port
3. 4-bolt type cylinder head bolt
4. Water jacket integrated casting
5. Integrated chain housing and cylinder head
6. Oil gallery: drilled and sealing with cap and screw plug



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

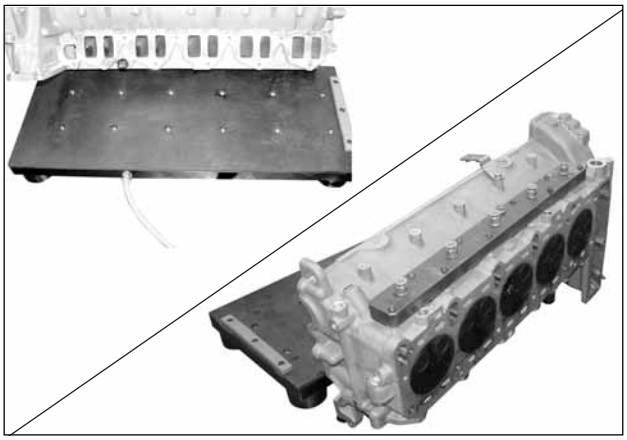
▶ Cylinder Head Pressure Leakage Test

※ **Preceding Works:**

1. Removal of cylinders
2. Removal of intake and exhaust manifold
3. Removal of valves

Test Procedures

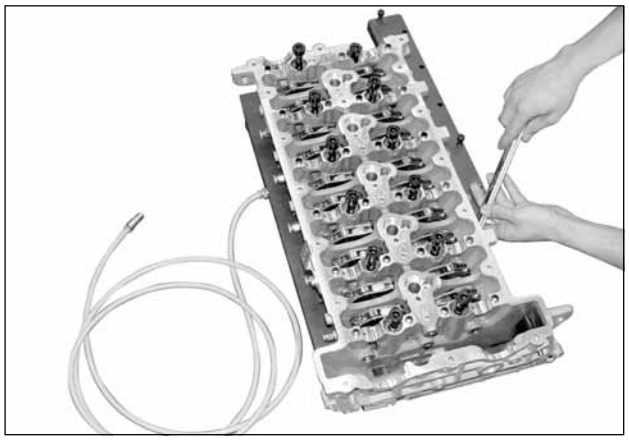
1. Place the pressure plate on a flat-bed work bench.



2. Install the cylinder head on the pressure plate.

Tightening torque	60 Nm

3. Immerse the cylinder head with the pressure plate into warm water (approx. 60°C) and pressurize with compressed air to 2 bar.



NOTICE

- **Examine the cylinder head for air bubbling. If the air bubbles are seen, replace the cylinder head.**

▶ Cylinder Head Mating Surface Check

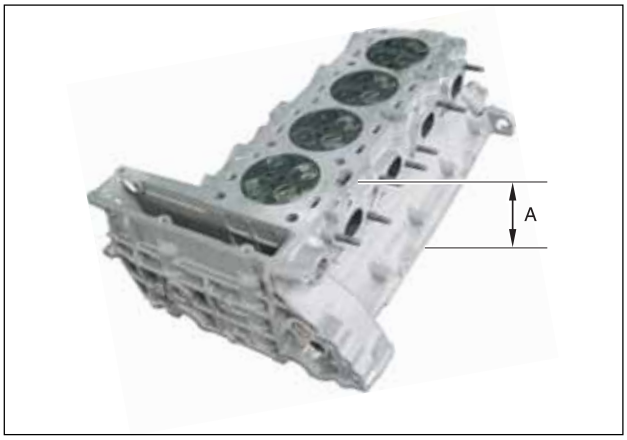
Specifications

Height “A” (cylinder head parting surface - cylinder head cover parting surface)		140.9 ~ 141.1 mm
Minimum height after machining		140.9 mm
Flatness	In longitudinal direction	0.075 mm
	In transverse direction	0.075 mm
Permissible variation of parallelism of top parting surface to bottom in longitudinal direction		within 0.1 mm
Peak-to-valley height		0.004 mm
Valve recess “a”	Intake valve	0.74 ~ 0.86 mm
	Exhaust valve	-0.15 ~ 0.15 mm

Measurement

1. Measure the cylinder head height “A”.

Limit	Over 140.9 mm

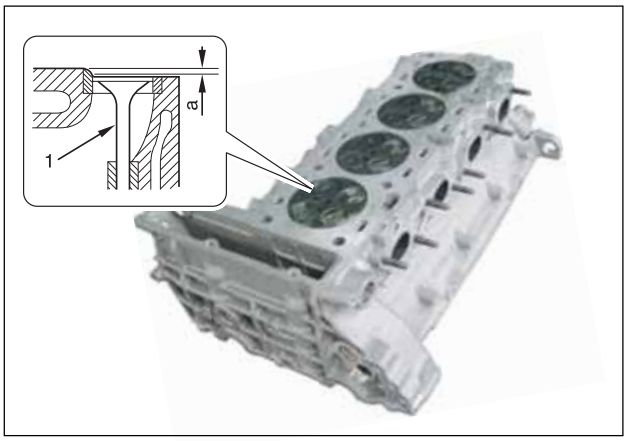


NOTICE

- **If the height is less than the limit, the cylinder head must be replaced.**

2. Insert the valves into the valve guides and measure the recesses.

Valve recess “a”	Intake Valve 0.74 ~ 0.86
	Exhaust Valve -0.15 ~ 0.15



NOTICE

- **If the measured value is out of the specified range, machine the valve seat as much as necessary until the specified value is achieved.**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Cylinder Head

▶ Disassembly

※ **Preceding Works:**

1. Disconnect the negative battery cable.
2. Apply the parking brake and place the chocks under the tires. (transmission “N” position)

1. Remove the EGR pipe.



2. Disconnect the injector fuel lines, connector and preglow plug connector. Remove the cylinder head cover.

CAUTION

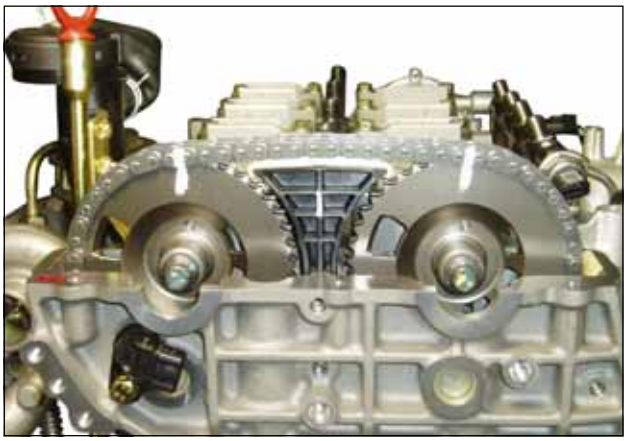
- **Cover the openings of fuel line with the protective caps.**



3. Rotate the crankshaft pulley to align the OT marks.
   1) Align the mark (notch) on sprocket for cylinder No.1 (exhaust) and for cylinder No.6 (intake). (align the cylinder No.1 OT)



4. Mark on the timing chain, intake camshaft sprocket and exhaust camshaft sprocket for timing setting during installation.



5. Remove the chain tensioner after removing the EGR pipe and oil dipstick.



6. Remove the high pressure pump and mark on the high pressure pump sprocket.



7. Remove the camshaft position sensor.



8. Hold the camshafts and remove the intake camshaft sprocket and exhaust camshaft sprocket.



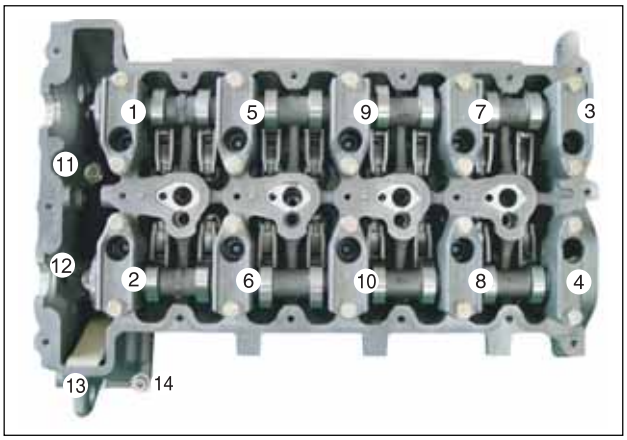
9. Remove the upper guide rail with a sliding hammer.



10. Remove the oil cooler and the intake manifold.

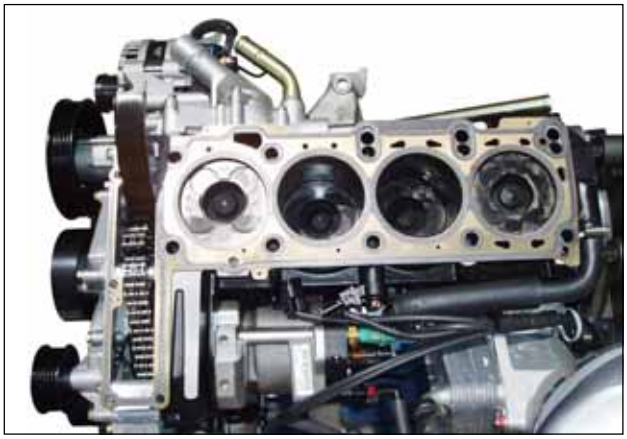


11. Remove the cylinder head bolts according to the numerical sequence.
    1) M8 x 25: 2EA
    2) M8 x 50: 2EA
    3) M12 x 177: 9EA
    4) M12 x 158: 1EA (vacuum pump side)



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

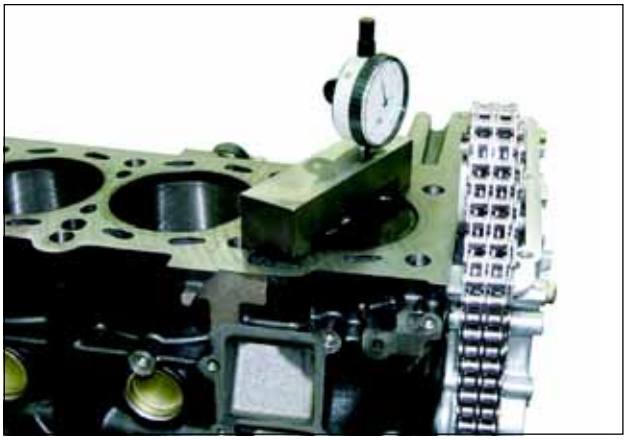
12. Remove the cylinder head.



CAUTION

- **Inspect the cylinder head mating surface.**
- **Store the removed injectors and glow plugs so that they will not be damaged.**
- **If there is a sign of oil leakage on the cylinder head gasket, replace it with new one.**

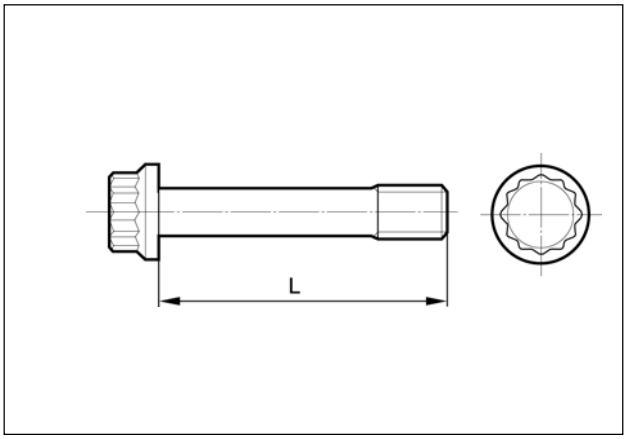
13. Measure the piston protrusion from the mating surface.



Standard	0.765 ~ 1.055 mm

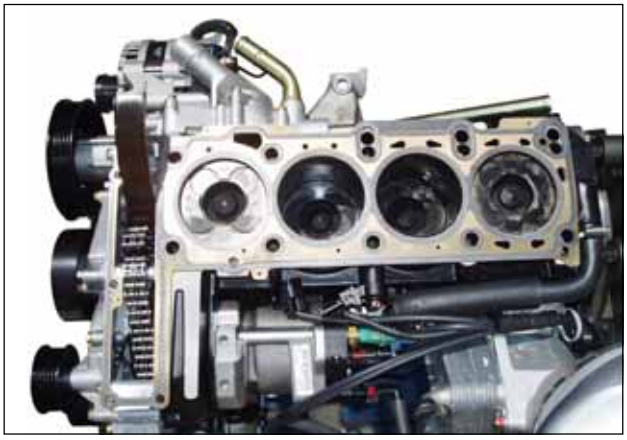
▶ Reassembly

1. Measure the length of cylinder head bolts.
   1) If the maximum length is exceeded by 2 mm, replace the cylinder head bolt.



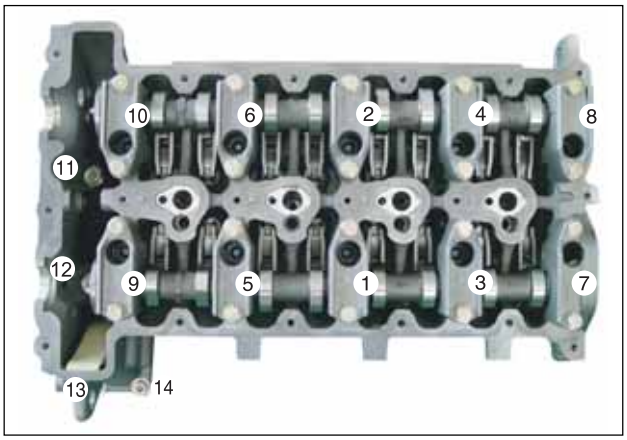
2. Install the cylinder head with the steel gasket.

NOTICE
- **Make sure to place the "TOP" mark upward.**



3. Tighten the cylinder head bolts to specified torque and torque angle.

Tightening torque	Step 1: 20 ± 2.0 Nm
	Step 2: 85 ± 5.0 Nm
	Step 3: 360° (120° x 3) + 10°



NOTICE
- **Apply the oil on the bolt thread when installing.**
- **Always insert new washer first.**
- **The bolts at vacuum pump side are shorter than others.**

4. Pull the timing chain over the cylinder head and install the upper guide rail.



NOTICE
- **Make sure that the convex surface of upper guide rail faces to front side**
- **Be careful not to alter the timing point of high pressure pump.**

5. Install the intake and exhaust camshaft sprockets and the timing chain.

Tightening torque	25 Nm + 90°



NOTICE

- **If the sprocket bolt is stretched over 0.9 mm, replace it with new one.**
- **Always install the intake camshaft sprocket first.**

1) Make sure that the upper guide rail is installed with proper direction.



2) Make sure that the timing chain is securely seated on the guide rails.



NOTICE

- **Make sure that the markings on camshaft sprocket and timing chain are aligned.**

6. Install the chain tensioner.

Tightening torque	65 ± 5.0 Nm



NOTICE

- **Make sure that the EGR steel gasket is properly installed.**

7. Rotate the crankshaft pulley two revolutions and ensure that the OT mark on the crankshaft pulley and the OT mark on the camshaft pulley are aligned.



NOTICE

- **If the markings are not aligned, reinstall the cylinder head.**

8. Install the cylinder head cover and the high pressure pump housing.



NOTICE

- **Apply the sealant on the bolt threads when installing the high pressure pump.**

9. Remove the protective caps from the injector and install the new fuel supply pipes.



NOTICE

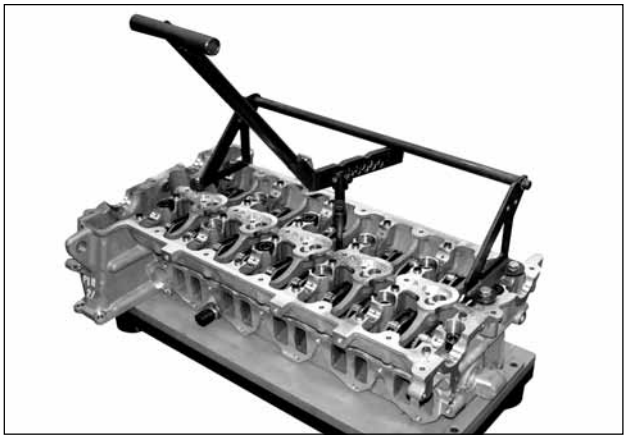
- **The fuel pipes are not reusable to keep the cleanness and parts damage.**

Intake/Exhaust-Removal/Installation

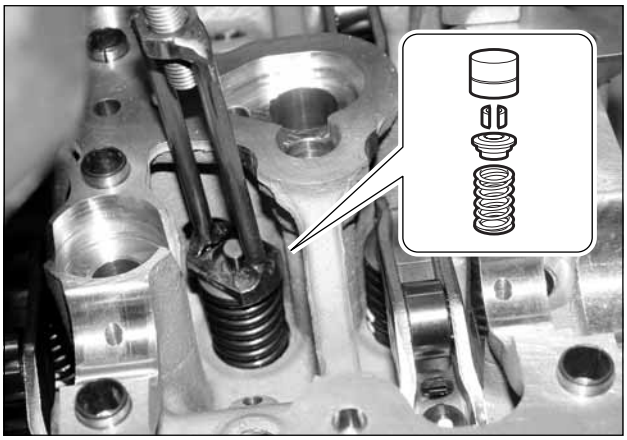
1. Remove the cylinder head assembly.



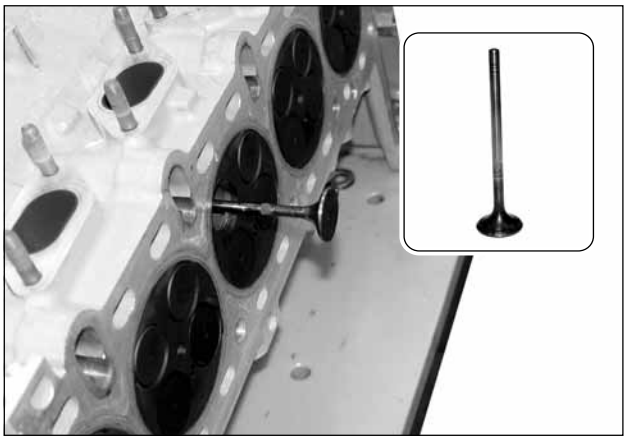
2. Install the removed cylinder head on the assembly board (special tool) and set the supporting bar and lever (special tool) on the cylinder head.



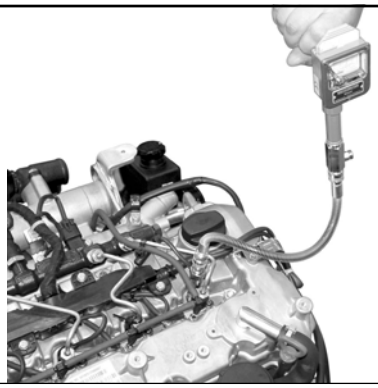
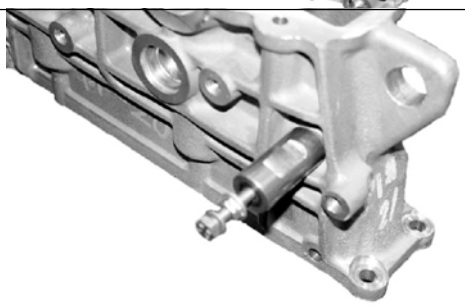
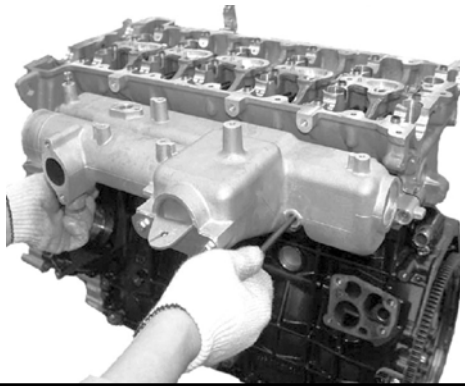
3. Push the valve spring seat down with the lever and remove the valve cotter, valve seat and valve spring.



4. Remove the valves from the cylinder head.



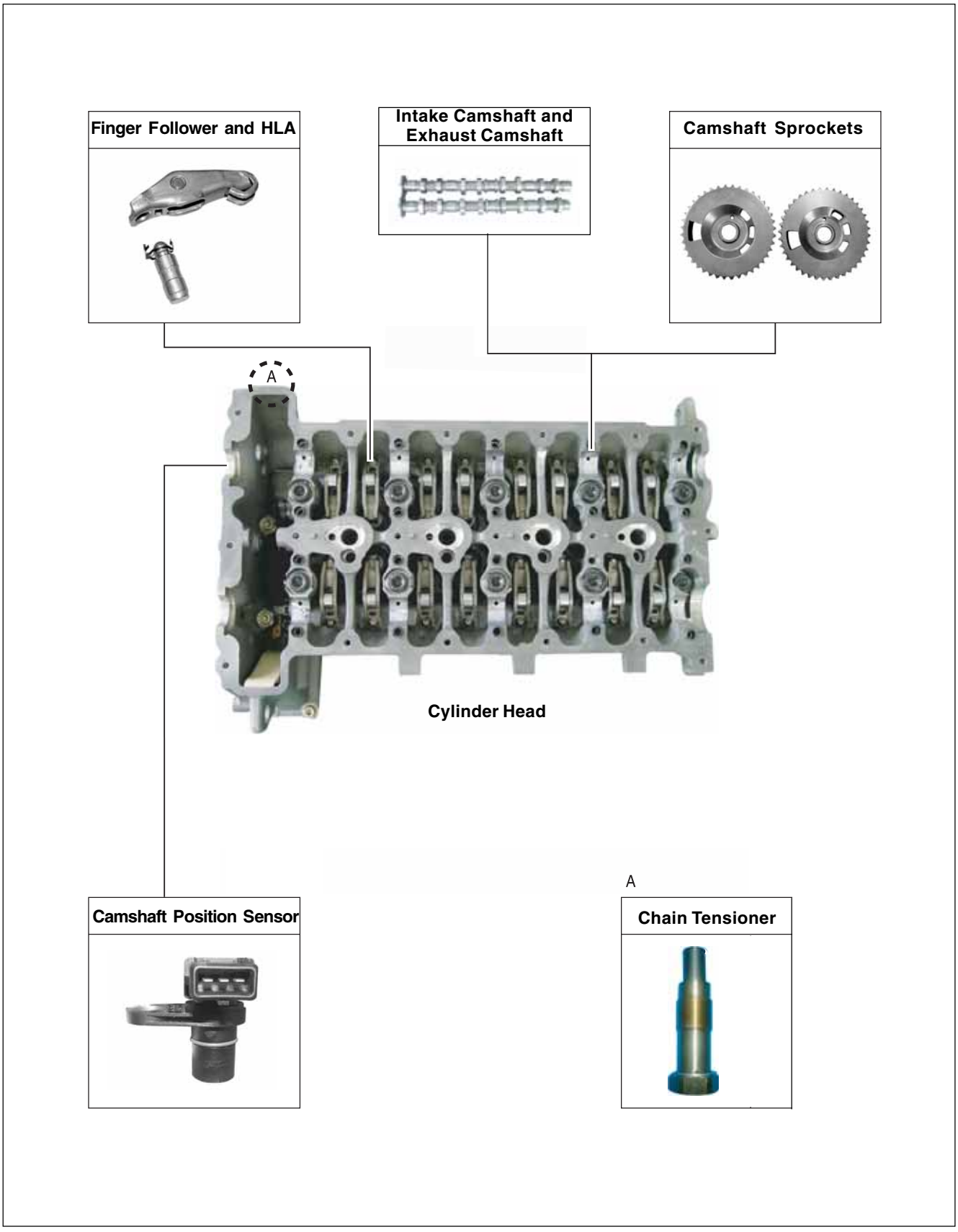
▶ Special Tools and Equipment

Name and Part Number	Application
Y99220092B Compression pressure measuring adapter and gauge 	
Y99220082B Supporting bar and lever 	
Y99220162B Guide pin extractor 	
Y99220112B Intake manifold guide pin 	

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EFFECTIVE DATE	
AFFECTED VIN	

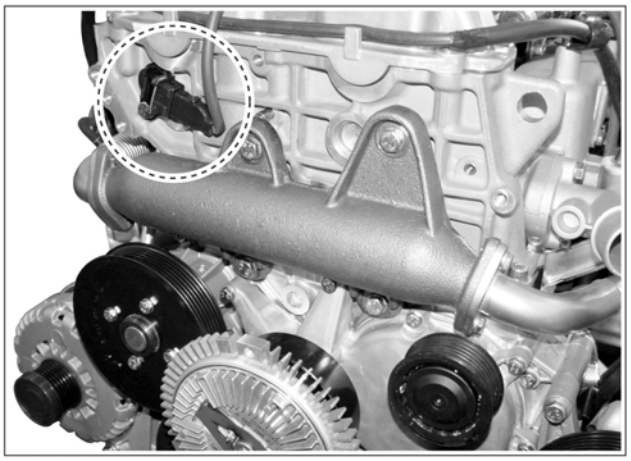
CAMSHAFT ASSEMBLY

※ **Preceding Work:** Removal of cylinder head cover

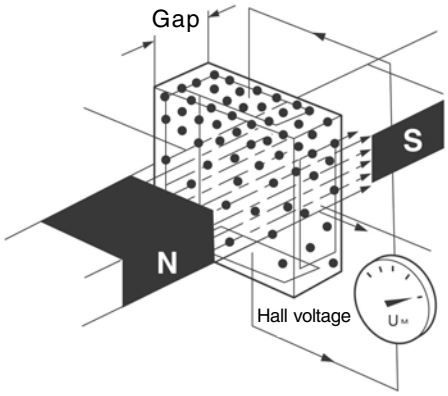


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EFFECTIVE DATE	
AFFECTED VIN	

▶ Camshaft Position Sensor



<Location of Camshaft Position Sensor>



<Operation Principle of Hall Sensor>

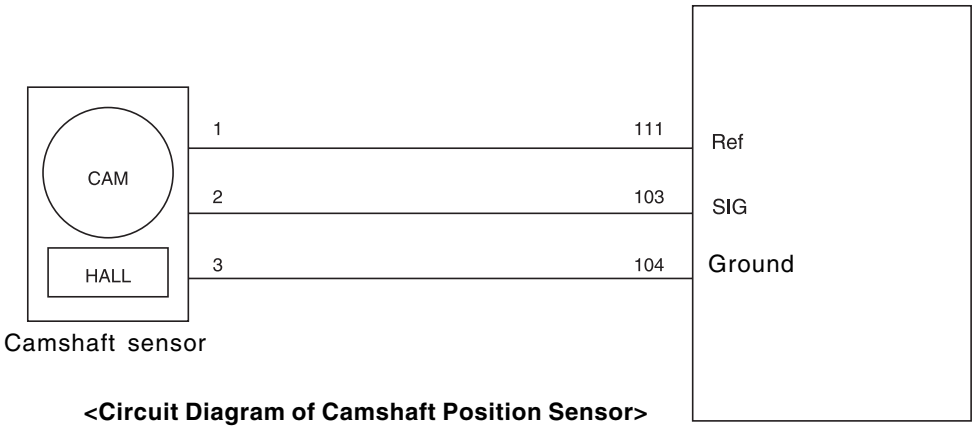
The camshaft position sensor uses hall-effect to set the camshaft position and metallic-magnetic-material sensor end is attached on the camshaft and then rotates with it. If sensor protrusion passes camshaft position sensor's semi-conductor wafer, magnetic field changes direction of electron on the semi-conductor wafer to the current flow direction that passes through wafer from the right angle. When operation power is supplied from camshaft position sensor, camshaft hall sensor generates signal voltage. The signal voltage will be 0V if protrusion and camshaft position sensor are near and 5 V if apart.

ECU can recognize that the No. 1 cylinder is under compression stroke by using this voltage signal (hall voltage).

The rotating speed of camshaft is half of the crankshaft and controls engine's intake and exhaust valves. By installing sensor on the camshaft, can recognize specific cylinder's status, compression stroke or exhaust stroke, by using camshaft position when the piston is moving toward TDC (OT). Especially when started first, it is difficult to calculate the stroke of a specific cylinder with only crankshaft position sensor.

Accordingly, camshaft position sensor is necessary to identify the cylinders correctly during initial starting. However, when engine is started, ECU learns every cylinder of the engine with crankshaft position sensor signals so can run the engine even though the camshaft position sensor is defective during engine running.

Pulse generation	Cam angle ± 6°
Sensor air gap	0.45 ~ 1.80 mm
Tightening torque	10 ~ 14 Nm
Operating temperature	- 40 ~ 130°C



<Circuit Diagram of Camshaft Position Sensor>

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EFFECTIVE DATE	
AFFECTED VIN	

Disassembly

※ **Preceding Works:**

1. Disconnect the negative battery cable.
2. Apply the parking brake and place the chocks under the tires. (transmission “N” position)

1. Remove the EGR pipe.



2. Disconnect the injector fuel lines, connector and preglow plug connector. Remove the cylinder head cover.

CAUTION

- **Cover the openings of fuel line with the protective caps.**

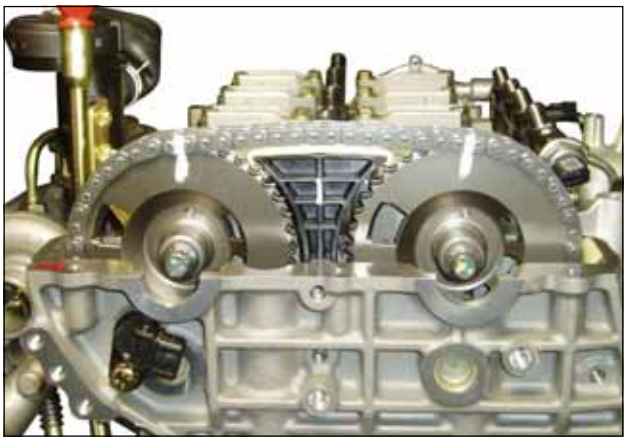


3. Rotate the crankshaft pulley to align the OT marks.
   1) Align the mark (notch) on sprocket for cylinder No.1 (exhaust) and for cylinder No.6 (intake). (align the cylinder No.1 OT)

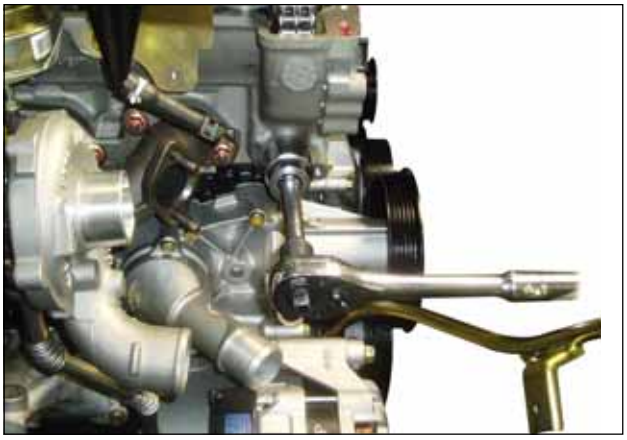


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EFFECTIVE DATE	
AFFECTED VIN	

4. Mark on the timing chain, intake camshaft sprocket and exhaust camshaft sprocket for timing setting during installation.



5. Remove the chain tensioner after removing the EGR pipe and oil dipstick.



6. Remove the high pressure pump and mark on the high pressure pump sprocket.



7. Remove the camshaft position sensor.

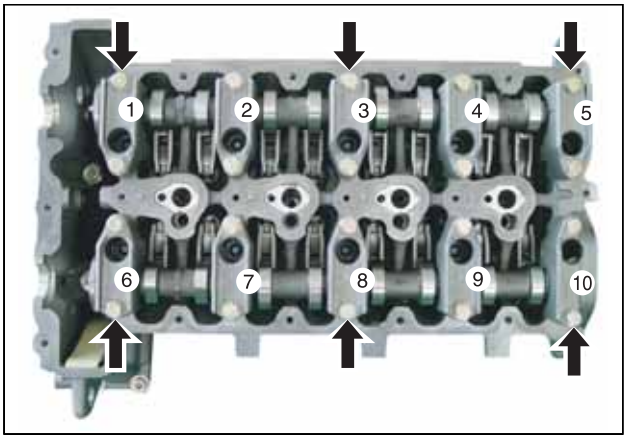


8. Hold the camshafts and remove the intake camshaft sprocket and exhaust camshaft sprocket.

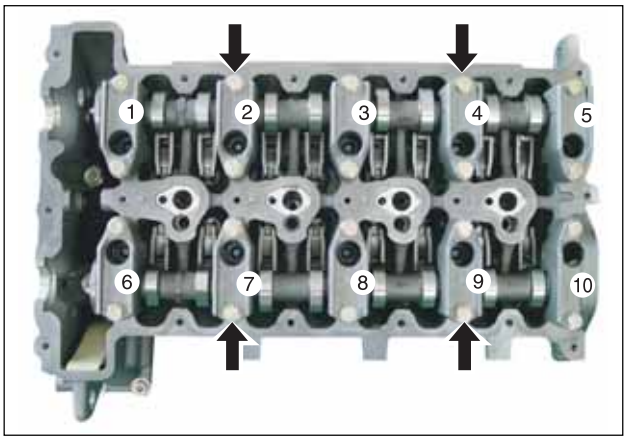


9. Remove the camshaft bearing cap bolts so that the tightening force can be relieved evenly.
   1) Exhaust: #1, #3, #5
   2) Intake: #6, #8, #10

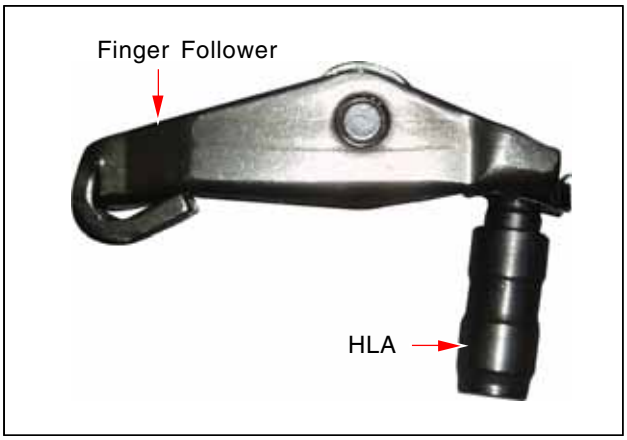
   However, there is no specific removal sequence.



   3) Do not remove the bolts at a time completely. Remove them step by step evenly or camshaft can be seriously damaged.
   4) Remove the exhaust camshafts and then remove the intake camshaft.
      - Exhaust: #2, #4
      - Intake: #7, #9



10. Remove the finger follower and the HLA device.



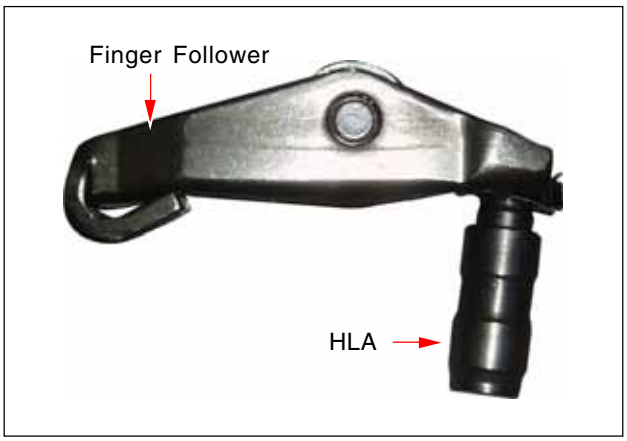
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Reassembly

1. Install the HLA device and finger follower. Check the HLA device with the diagnosis procedures before installation.

NOTICE

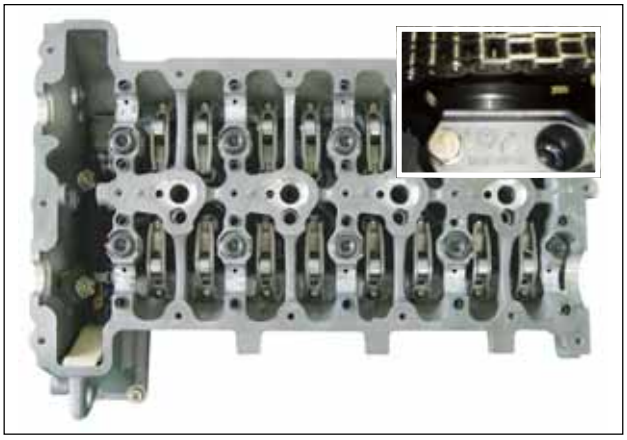
- **Perform the air bleeding process if it has been stored for a extended period of time.**
- **Make sure that it is properly installed on the locating pin.**



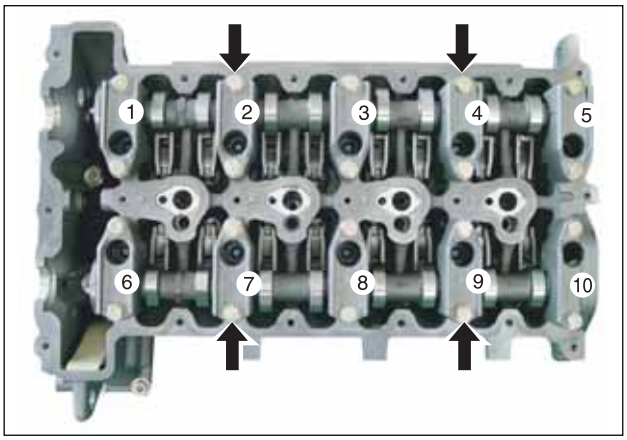
2. Place the bearing cap with the OT marks on both camshafts facing upward.

NOTICE

- **Apply the sealant on the cap (#12) for the vacuum pump when installing.**
  Part number: 661 989 56 A0 (DB2210)
- **Apply the oil on the bearing journals before installation.**

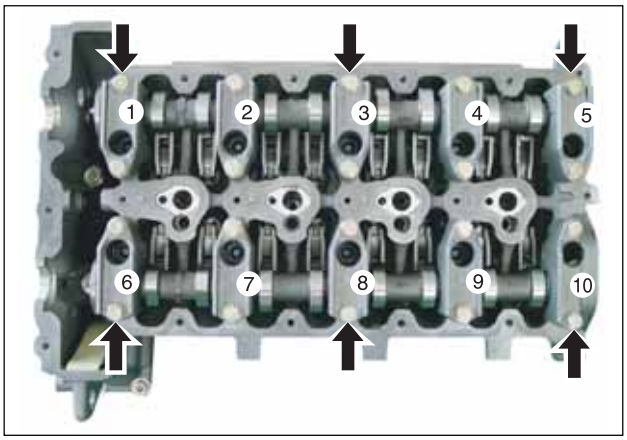


3. Tighten the camshaft bearing cap bolts.
   1) Intake: #7, #9
   2) Exhaust: #2, #4



   3) Intake: #6, #8, #10
   4) Exhaust: #1, #3, #5

Tightening torque	25 Nm



NOTICE

- **Check the finger follower positions and align if needed.**

4. Install the intake and exhaust camshaft sprockets and the timing chain.

Tightening torque	25 Nm + 90°



NOTICE

- **If the sprocket bolt is stretched over 0.9 mm, replace it with new one.**
- **Always install the intake camshaft sprocket first.**

1) Make sure that the upper guide rail is installed with proper direction.



2) Make sure that the timing chain is securely seated on the guide rails.

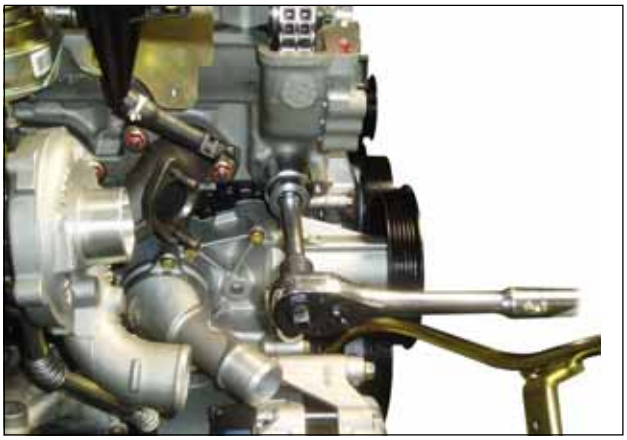


NOTICE

- **Make sure that the markings on camshaft sprocket and timing chain are aligned.**

5. Install the chain tensioner.

Tightening torque	65 ± 5.0 Nm



NOTICE

- **Make sure that the EGR steel gasket is properly installed.**

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AFFECTED VIN	

6. Rotate the crankshaft pulley two revolutions and ensure that the OT mark on the crankshaft pulley and the OT mark on the camshaft pulley are aligned.



NOTICE

- **If the markings are not aligned, reinstall the cylinder head.**

7. Install the cylinder head cover and the high pressure pump housing.



NOTICE

- **Apply the sealant on the bolt threads when installing the high pressure pump.**

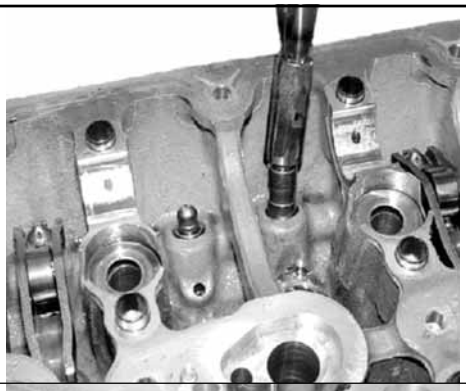
8. Remove the protective caps from the injector and install the new fuel supply pipes.



NOTICE

- **The fuel pipes are not reusable to keep the cleanness and parts damage.**

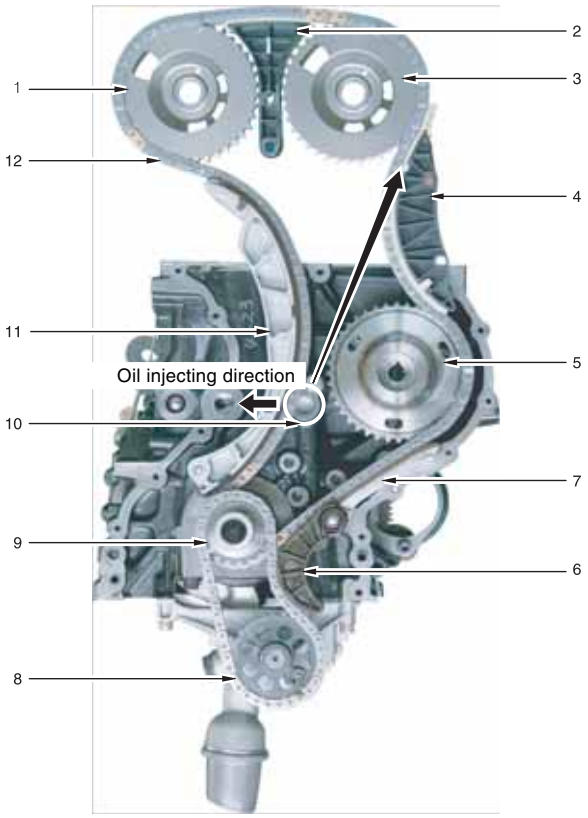
▶ Special Tools and Equipment

Name and Part Number	Application
Y99220152B HLA remover 	
Y99220142B Stem seal installer 	

TIMING CHAIN ASSEMBLY

▶ Chain Drive System

System Layout

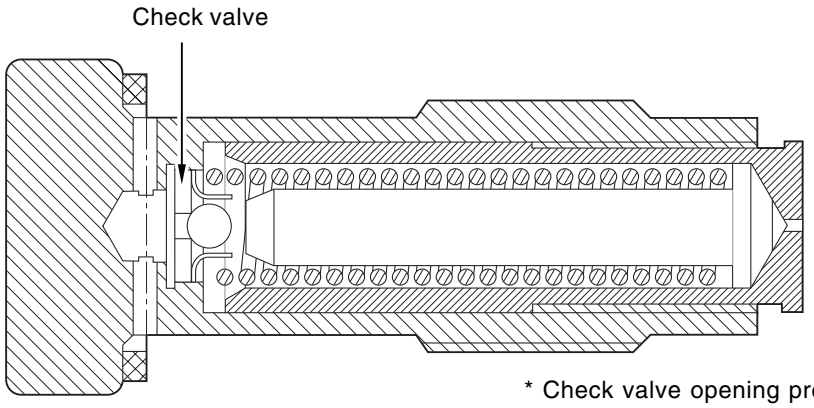


1. Exhaust camshaft sprocket
2. Upper guide rail
3. Intake camshaft sprocket
4. Clamping guide rail
5. HP pump sprocket
6. Lower guide rail
7. Oil pump tensioner
8. Oil pump sprocket
9. Crankshaft sprocket
10. Oil nozzle
11. Tensioner guide rail
12. Chain tensioner

Chain

1. Chain type: Double Bush
2. Pitch: 9.525 mm
3. Load limits: 19,000 N
4. No. of links: 148 EA
5. Overall length: 1409.7 mm
6. Replace when the chain is extended by 0.5 % from overall length (Replace if extended by over 7.0485 mm)

Chain Tensioner



* Check valve opening pressure: 0.2 ~ 0.5 bar

The major function of tensioner is optimizing the movement of chain drive system by using spring constant and oil pressure in the tensioner.

The tensioner performs function of adjusting chain tension to be always tight, not loose, while engine running. By doing so, can reduce wears of each guide rail and sprocket.

Tightening torque	65 ± 5.0 Nm (Installed on the cylinder head)

Guide Rail

Guide rail is used to optimize the movement of chain drive system like tensioner.

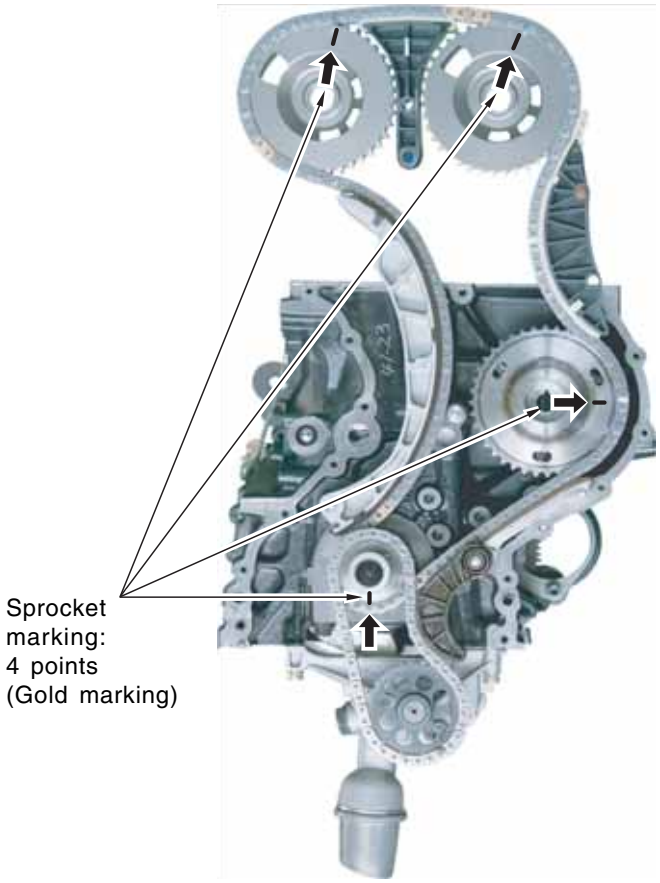
Guide rail can prevent chain slap when chain is extended and reduce chain wears.

Guide rail is needed especially when the distance between the sprockets are too long.

The material is plastic.

1. Location of guide rail
   1) Tensioner guide rail: Between crankshaft sprocket and exhaust camshaft sprocket
   2) Upper guide rail: Between exhaust camshaft sprocket and intake camshaft sprocket
   3) Clamping guide rail: Between intake camshaft sprocket and HP pump sprocket
   4) Lower guide rail: Between HP pump sprocket and crankshaft sprocket

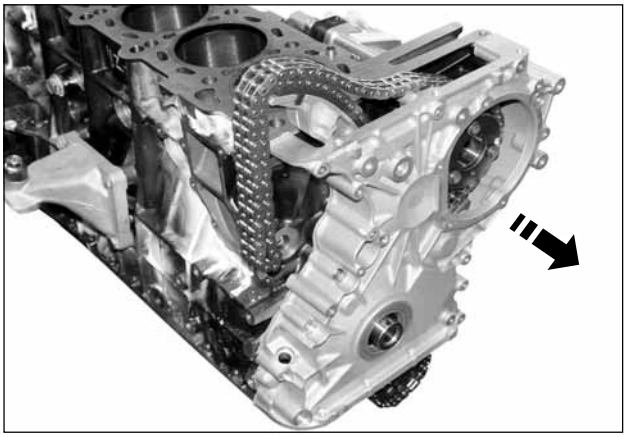
Timing Setting



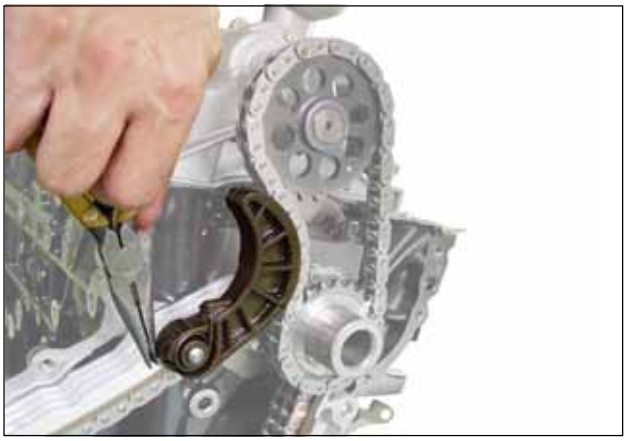
1. Check marking links on the chain (Gold marking)
2. Locate a point with two continuous marking links and align it to a marking on crankshaft sprocket (△)
3. Align respective marking link to each camshaft sprocket (intake and exhaust) marking (△)
4. Align another marking link to HP pump sprocket marking (△)

Removal and Installation

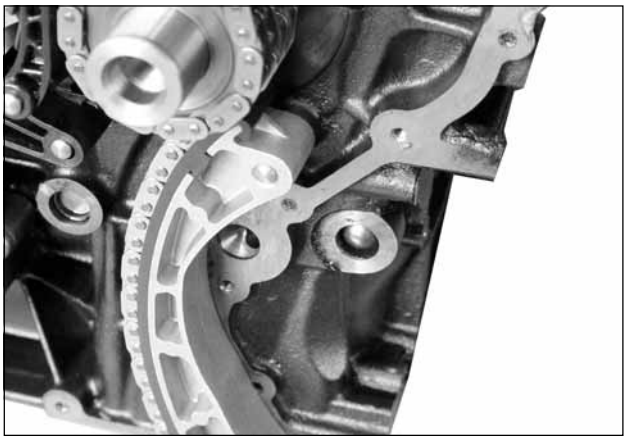
1. Remove the cylinder head assembly.
2. Remove the oil pan.
3. Remove the chain guide rail with a sliding hammer.
4. Remove the chain cover.



5. Remove the oil pump drive chain.
6. Remove the upper guide rail while pushing the retaining spring with a screwdriver.
7. Remove the lower guide rail.
8. Remove the oil pump drive chain.



9. Remove the tensioner guide rail.
10. Remove the timing chain.
11. Install in the reverse order of removal.



NOTICE

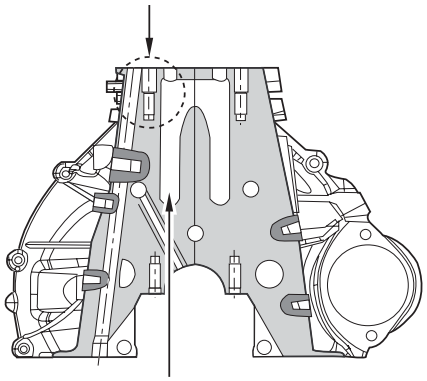
- **Thoroughly clean the removed components before installing.**

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EFFECTIVE DATE	
AFFECTED VIN	

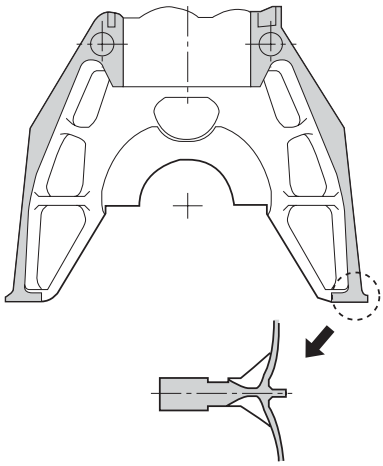
CYLINDER BLOCK



Deep head bolt thread to prevent the deformation at cylinder bore surfaces



Water jacket design to increase the cooling efficiency



Cambering type skirt to reduce the noise

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▶ System Characteristics

1. Rib design by considering strength against engine vibrations and weight
2. Cambering type skirt design on case housing wall to reduce the engine noise
3. Water jacket design to increase the cooling efficiency of cylinder bore bridge
4. Deep head bolt thread to prevent the deformation at cylinder bore surfaces
5. Reinforcement of strength
   1) Main bearing housing / Main bearing cap
   2) Extended main bearing cap bolt
6. Reducing the noise, vibration and harshness (NVH)
   1) Minimize the vibration by adding external ribs
   2) Adding the ribs around oil pan mating surface

▶ Knock Sensor

Two knock sensors are located on the cylinder block (intake manifold side).

To detect engine vibration under abnormal combustion, knock sensor has piezoelectric element fixed on the vibration plate and this vibration plate is fixed on the base. If happens knocking, pistons or connecting rods vibrate and occurs heavy sounds that hit metal. Knock sensor is used to detect those knockings caused by abnormal combustions. It controls idling stabilities and turns on the engine warning light when detects injector damages. And also controls pilot injection very precisely during MAP learning.

When knock sensor is defective, engine ECU corrects injection timing based on MAP values like engine speed, intake air volume and coolant temperature.

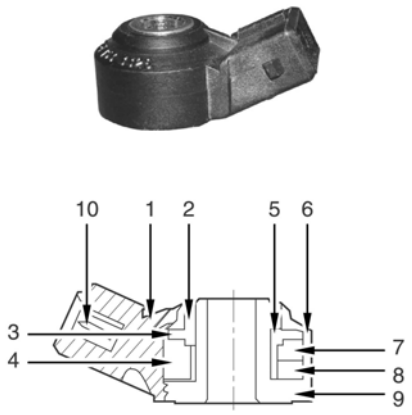
※ Before checking the knock sensor unit, be sure to check the tightening torque of the sensor and connector connecting conditions.

Insulating resistance	Min. 1 MΩ
Resonance frequency	25 kHz
Operating temperature	- 40 ~ 150°C
Output voltage	26 ± 8 mV/g (at 5 kHz)
	22 ~ 37 mV/g (3 ~ 10 kHz)
	22 ~ 57 mV/g (10 ~ 20 kHz)
Tightening torque	20 ± 5 Nm

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



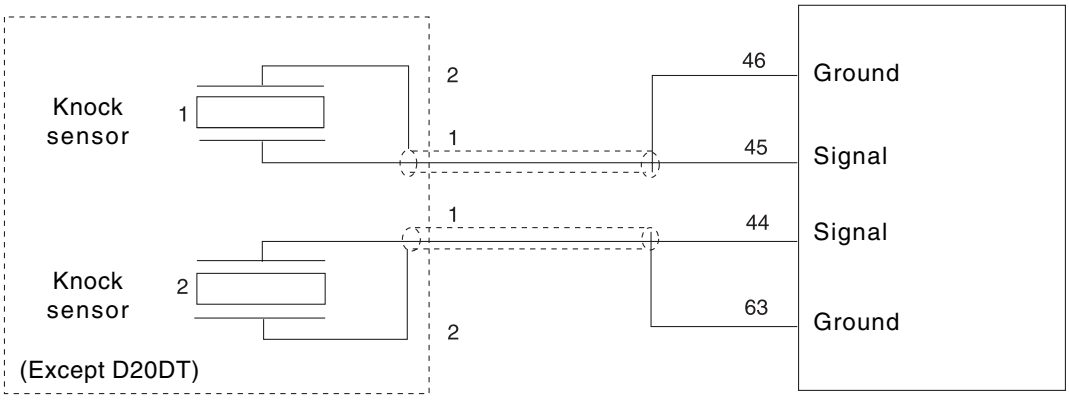
<Location of Knock Sensor>



1. Sensor housing
2. Nut
3. Disc spring
4. Weight
5. Insulation disc
6. Upper contact plate
7. Piezo element
8. Lower contact plate
9. Body
10. Terminal

NOTICE

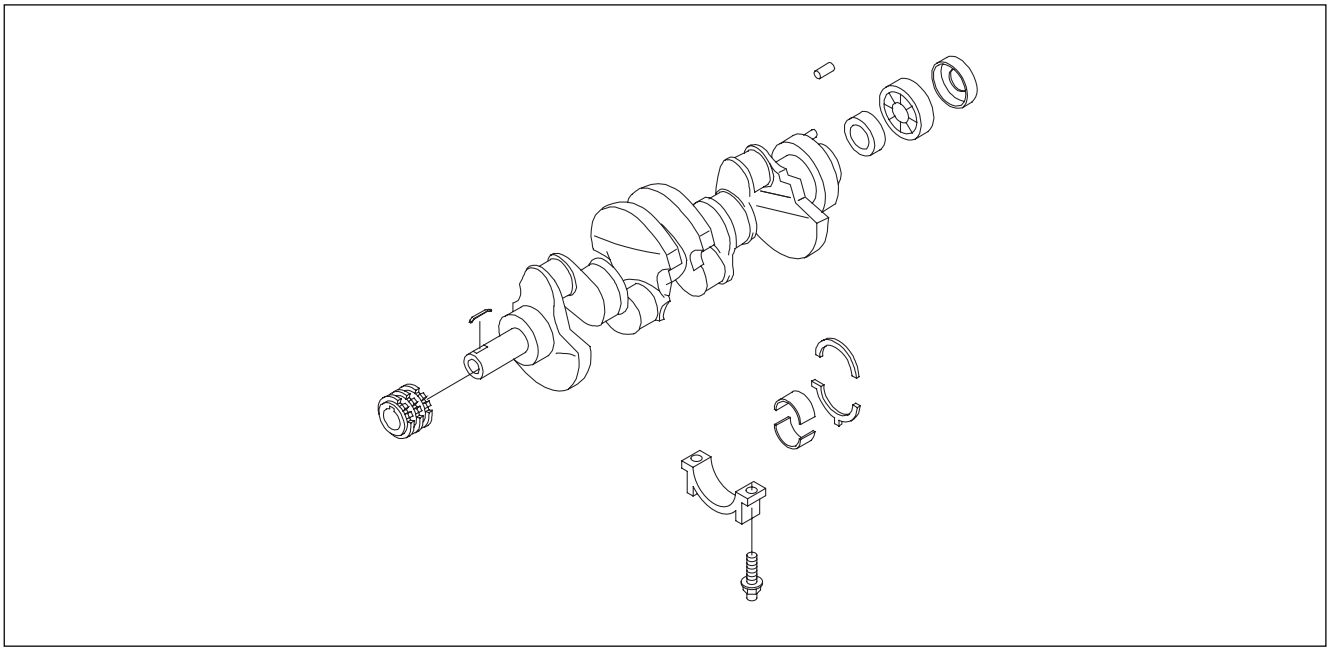
- **The knock sensor should be tightened with the specified tightening torque. Otherwise, the engine output may be decreased and the "ENGINE CHECK" warning lamp may come on. The internal resistance of the sensor is approx. 4.7 kW.**



<Circuit Diagram of Knock Sensor>

CRANKSHAFT

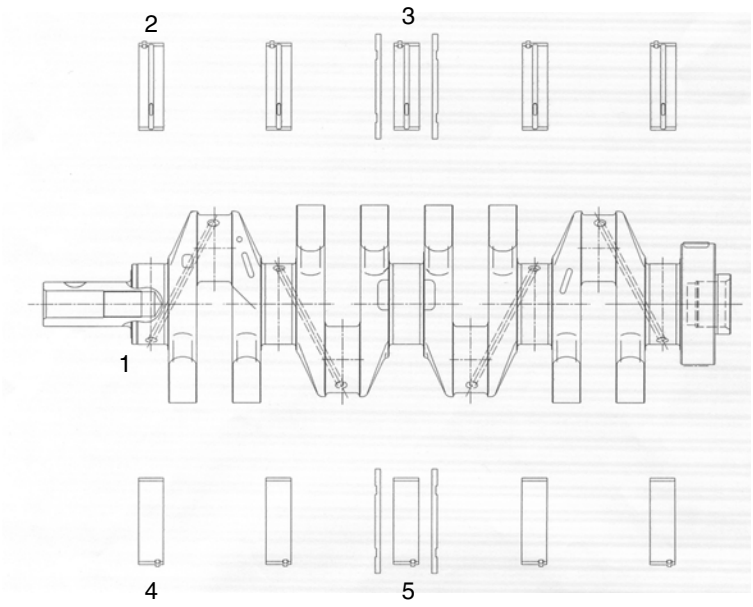
※ **Preceding Works:** Removal of end cover
Removal of pistons
Removal of crankshaft sprocket



1. Crankshaft main bearing shells, upper
2. Upper thrust bearing
3. Crankshaft
4. Crankshaft main bearing shells, lower
5. Lower thrust bearing
6. Crankshaft main bearing cap
7. Crankshaft thrust bearing cap
8. 12-sided stretch bolt ..... 55 ± 5.0 Nm, 90° + 10°

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EFFECTIVE DATE	
AFFECTED VIN	

ARRANGEMENT OF THRUST WASHERS AND BEARINGS



1. Crankshaft
2. Crankshaft main bearing shells, upper
3. Upper thrust bearing
4. Crankshaft main bearing shells, lower
5. Lower thrust bearing

NOTICE

- **The clearance between bearing shell and bore and between bearing shell and journal are various. Refer to the table on next page to select bearings when installing.**

▶ Dimensions of Crankshaft Main Bearing

Color	Crankshaft Journal	Upper Main Bearing	Lower Main Bearing
Blue	61.965 ~ 61.960	2.260 ~ 2.255	2.260 ~ 2.255
Yellow	61.960 ~ 61.955	2.265 ~ 2.260	2.265 ~ 2.260
Red	61.955 ~ 61.950	2.270 ~ 2.265	2.270 ~ 2.265
White	61.950 ~ 61.945	-	2.275 ~ 2.270
Violet	61.945 ~ 61.940	-	2.280 ~ 2.275

▶ Bearing Clearance

(mm)

Description		Crankshaft Bearing	Thrust Bearing
Radial clearance	When new	0.027 ~ 0.051	0.026 ~ 0.068
	Wear limit	Max. 0.070	Max. 0.080
Axial clearance	When new	0.100 ~ 0.254	-
	Wear limit	Max. 0.300	-

▶ Matching the Fit Bearing Journal Width to Thrust Washers

(mm)

Fit bearing Journal Width	Thrust Washer Thickness
26.300 ~ 26.333	2.15
26.400 ~ 26.433	2.20
26.500 ~ 26.533	2.25
26.700 ~ 26.733	2.35
26.800 ~ 26.833	2.40

NOTICE

- **Measure the crankshaft axial clearance and correct if necessary with appropriate thrust washers.**
- **Thrust washers of the same thickness must be installed on both sides of the fit bearing.**

▶ Matching the Crankshaft Bearing Shells to Basic Bearing Bore in Crankcase

Marking of Basic Bearing Bore in Lower Mating Surface	Relevant Crankshaft Bearing Shell With Color Coding
1 punch mark or blue	blue or white - blue
2 punch marks or yellow	yellow or white - yellow
3 punch marks or red	red or white - red

▶ Matching Crankshaft Bearing Shells to Basic Bearing Journal of Crankshaft

Marking of Bearing Journals on Crank Webs	Relevant Crankshaft Bearing Shell With Color Coding
blue or white - blue	blue or white - blue
yellow or white - blue	yellow or white - yellow
red or white - blue	red or white - red

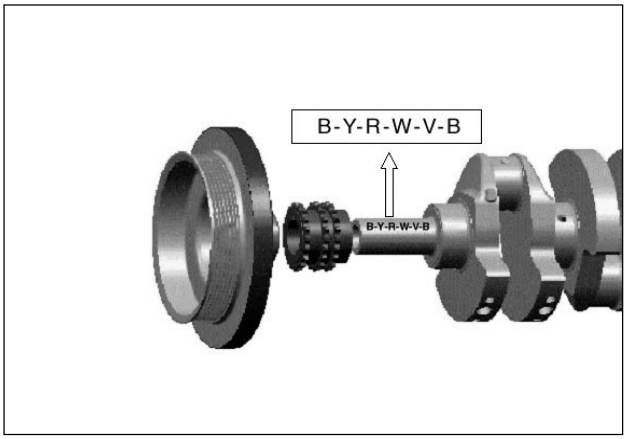
▶ Selection of Upper Main Bearing Shell

Punch Mark	Color
•	Blue
• •	Yellow
• • •	Red

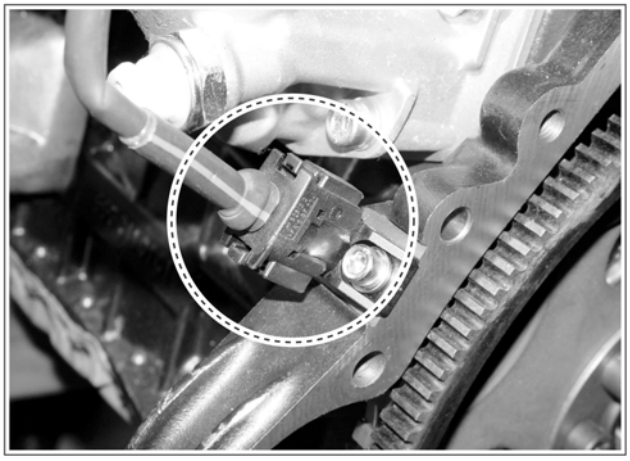


▶ Selection of Lower Main Bearing Shell

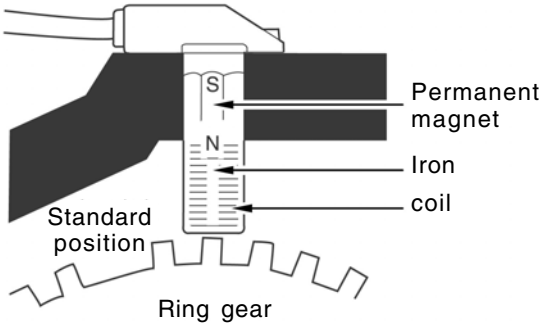
Mark	Color
B	Blue
Y	Yellow
R	Red
W	White
V	Violet



▶ Crankshaft Position Sensor



<Location of Crankshaft Position Sensor>

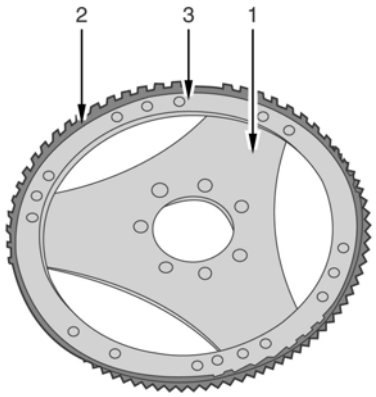


<Structure of Crankshaft Position Sensor>

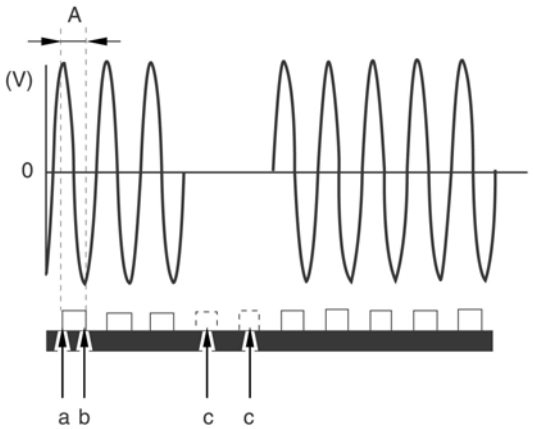
The crankshaft position sensor is located near to flywheel on the rear of cylinder block. It generates AC voltage between increment type driven plate that fixed on flywheel inside. The sensor consists of soft iron core that winded copper wire on permanent magnet and generates sign wave AC voltage when magnetism on the sensor wheel passes the sensor.

When the crankshaft rotates, '+' signal will be generated from near the front edge and '-' signal will be generated from near the rear edge among teeth on the driven plate near to crankshaft position. The AC voltage increases as the engine speed increases, however, no signal occurs from the 2-missing-tooth on the increment type driven plate. By using these teeth, ECU recognizes TDC of No. 1 and 5 cylinders.

ECU converts the alternative signals into digital signals to recognize crankshaft position, piston position and engine speed. The piston position that coupled with crankshaft is main factor in calculating injection timing. By analyzing the reference position and camshaft position sensor, can recognize No. 1 cylinder and calculate the crankshaft speed.



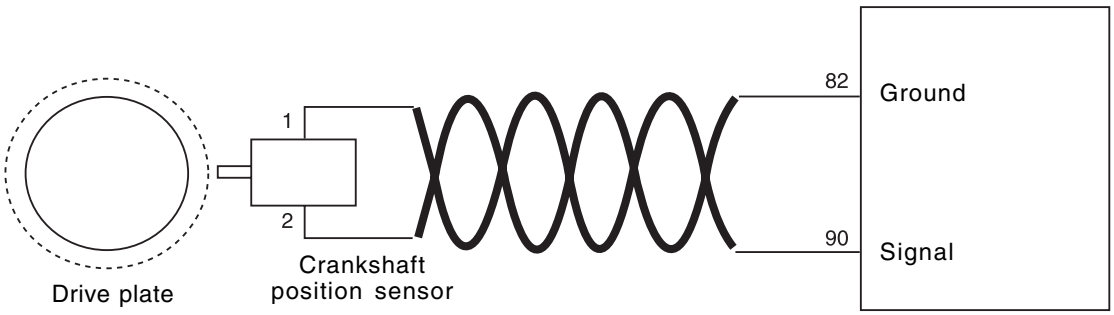
<Drive Plate>



A. Distance between '+' max. voltage and '-' max. voltage

a. Front edge
b. Rear edge
c. 2-missing-tooth

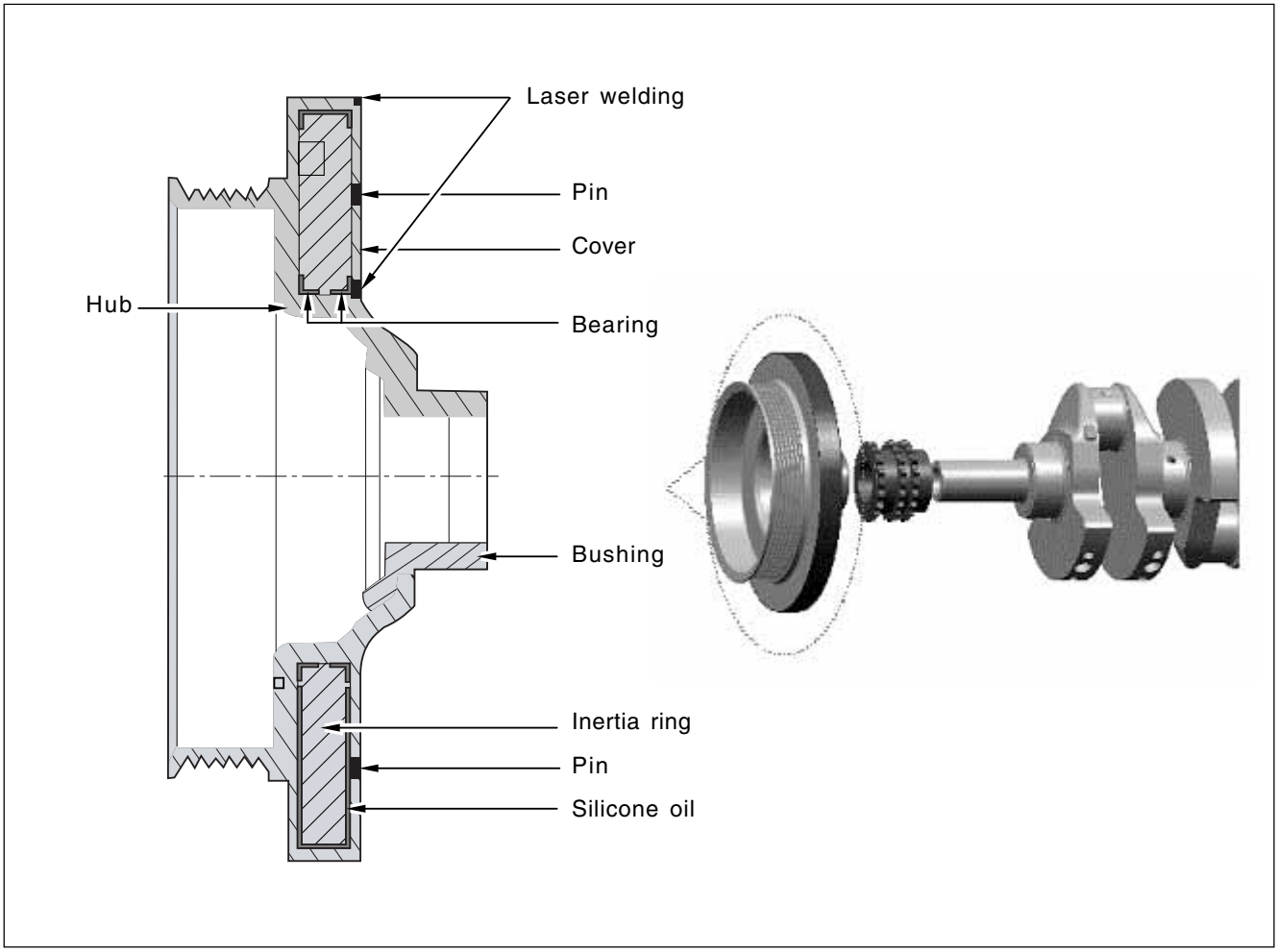
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<Circuit Diagram of Crankshaft Position Sensor>

Output voltage (1 ~ 150 V)	Min. voltage: 1.0 V (40 rpm, air gap: 1.3 mm)
	Max voltage: 150 V (7000 rpm, air gap: 0.3 mm)
Sensor unit coil resistance (Ω)	1,090 ± 15 %
Sensor air gap	0.7 ~ 1.5 mm
Operating temperature	- 40 ~ 150°C
Tightening torque	6 ~ 8 Nm

TORSIONAL VIBRATION DAMPER



▶ System Description

1. Components: Hub, inertia ring, cover, bearing, bushing, silicone oil
2. Functions: The crankshaft pulley optimizes the drive system by reducing the amount of torsional vibration in crankshaft. Conventional rubber damper is limited in changing materials (rubbers) to absorb vibration, but this crankshaft pulley (viscous damper), using silicone oil, takes advantage of less changing viscosity according to the temperature.

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AFFECTED VIN	

DISASSEMBLY AND REASSEMBLY

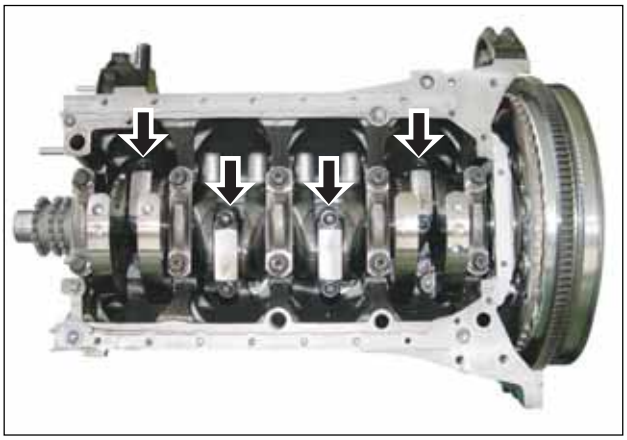
1. Unscrew the bolts and remove the connecting rod journal bearing and bearing caps.



NOTICE

- **Position the #1 piston at TDC and remove the piston connecting rod journal bearing caps.**

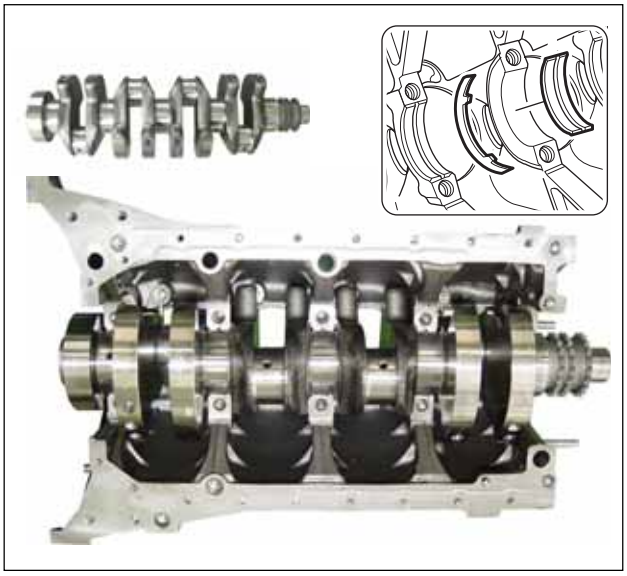
2. Remove the bearing cap bolts.
3. Remove the bearing caps.



NOTICE

- **The crankshaft bearing caps are marked with stamped numbers. Start to remove from the crankshaft pulley side.**
- **Do not mix up the bearing shells.**

4. Remove the bearing caps and lower thrust bearing.
5. Separate the lower bearing shells from the bearing caps.



6. Remove the crankshaft.
7. Remove the upper thrust washers.
8. Remove the upper bearing shells from the crankcase.

NOTICE

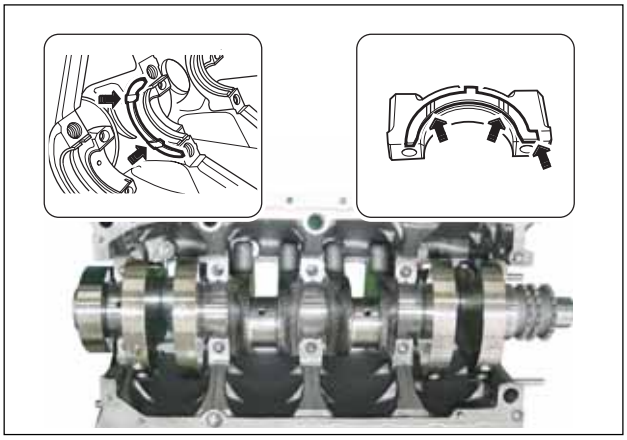
- **Do not mix up the bearing shells.**

Crankshaft - Reassembly

1. Thoroughly clean the oil galleries and check the journal section and bearings. Replace if necessary.



2. Coat the upper thrust washers with oil and insert into the crankcase so that the oil grooves are facing the crank webs (arrow).
3. Coat the lower thrust washers with oil and insert into the crankcase so that the oil grooves are facing the crank webs (arrow).

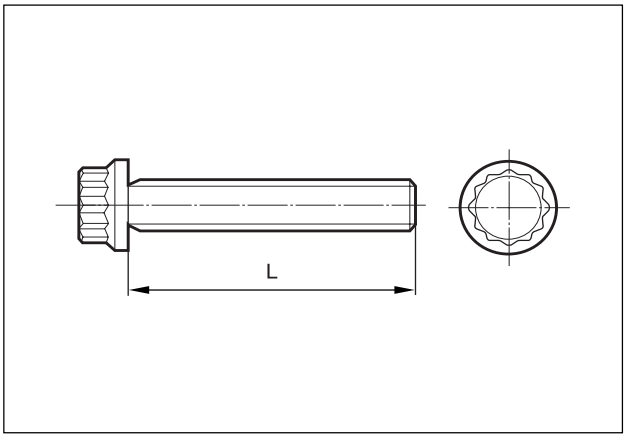


NOTICE

- **The retaining lugs should be positioned in the grooves (arrow).**

NOTICE

- **If the maximum permissible length of L= 63.8 mm is exceeded, the 12-sided stretch bolts should be replaced.**



4. Coat the new crankshaft with engine oil and place it on the crankcase.
5. Install the crankshaft bearing caps according to the markings and tighten the bolts.



Installation Notice

Tightening torque	55 ± 5 Nm + 90° + 10°

- ***Install from #1 cap.***

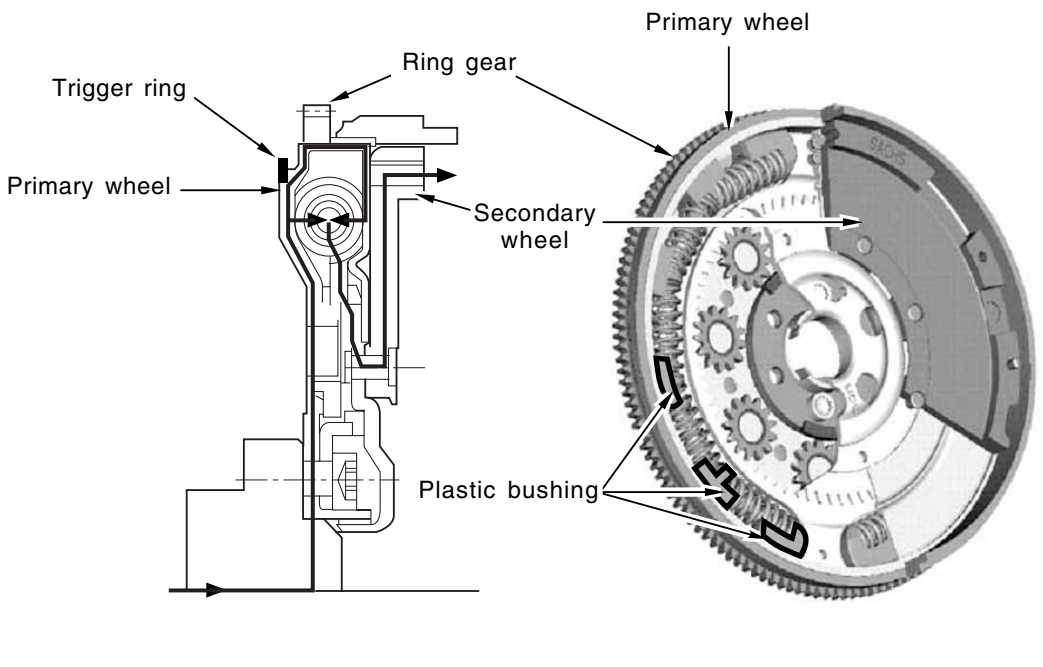
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AFFECTED VIN	

6. Position the #1 piston at TDC and install the crankshaft.
7. Install the piston connecting rod journal to the crankshaft journal and tighten the bolts.
8. Measure the crankshaft bearing axial clearance.
   1) When new: 0.100 ~ 0.266 mm
   2) When used: 0.300 mm
9. Rotate the crankshaft by hand and check whether it rotates smoothly.



FLYWHEEL

DUAL MASS FLYWHEEL (DMF, MANUAL TRANSMISSION EQUIPPED VEHICLE)



▶ System Description

This flywheel is installed to the rear end of crankshaft and transfers the output from the engine to the power train mechanism. When starting the engine, this drive the crank train mechanism initially by using the power from the start motor. Also, DMF measure the crankshaft speed, sends the signals to ECU, and controls the ignition timing.



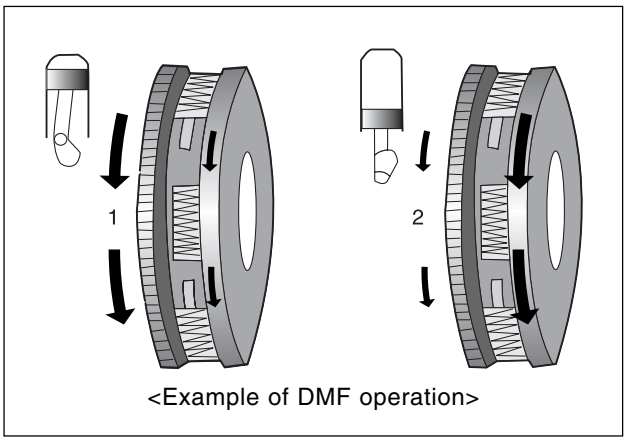
Conventional flywheel **DMF**

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▶ Structure

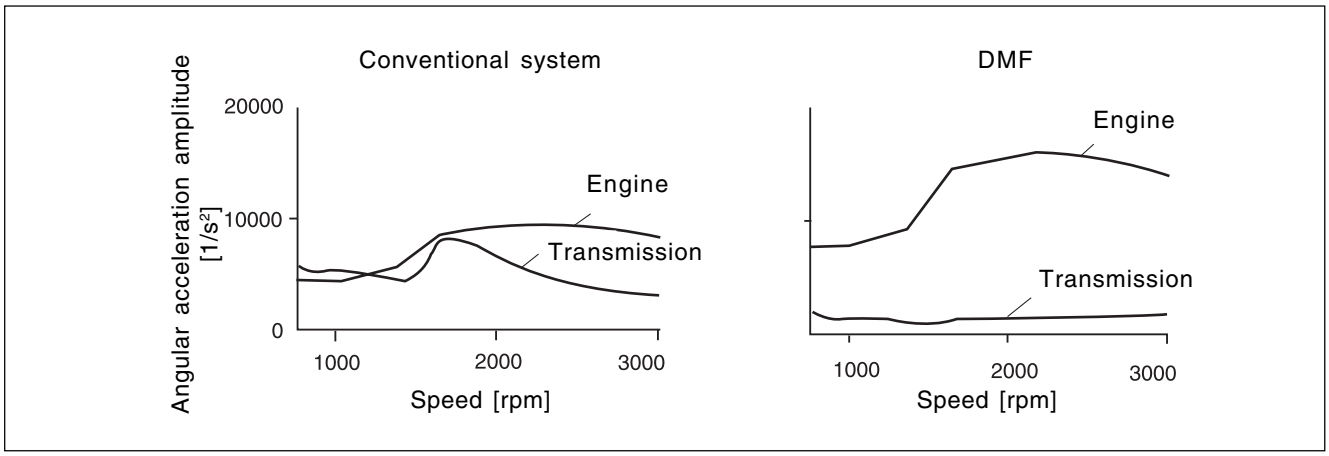
Function and characteristics

1. When the output changes from the engine is high during power stroke (①): The damper absorbs the shocks to reduce the changes to transmission.
2. When the output changes from the engine is low during compression stroke (②): The damper increases the torque changes to clutch.



<Example of DMF operation>

<Torque change curve of engine and drive shaft>



▶ System Characteristics

Function

1. Filters irregularities of engine: The secondary flywheel operates almost evenly so does not cause gear noises
2. The mass of the primary flywheel is less than conventional flywheel so the engine irregularity increases more (less pulsation absorbing effect)
3. Transmission protection function: Reduces the torsional vibration to powertrain (transmission) by reducing the irregularity of engine

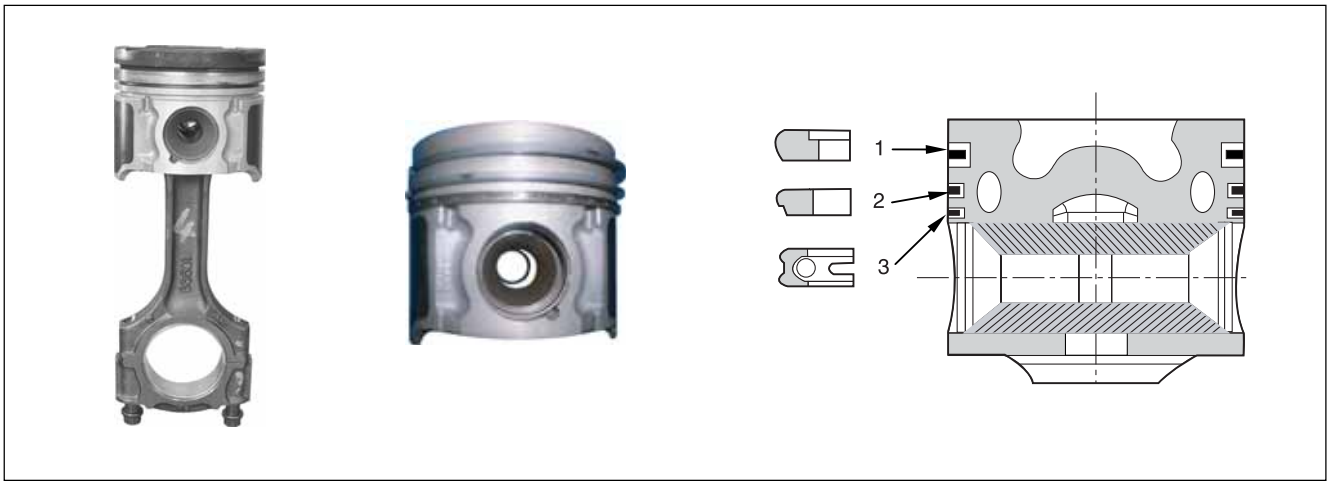
Characteristics of DMF

1. Reduced vibration noise from the powertrain by blocking the torsional vibrations
2. Enhanced vehicle silence and riding comforts: reduced engine torque fluctuation
3. Reduced shifting shocks
4. Smooth acceleration and deceleration

Advantages of DMF

1. Improved torque response by using 3-stage type spring: Strengthens the torque response in all ranges (low, medium, and high speed) by applying respective spring constant at each range.
2. Stable revolution of the primary and secondary wheel by using planetary gear: Works as auxiliary damper against spring changes
3. Less heat generation due to no direct friction against spring surface: Plastic material is covered on the spring outer surface
4. Increased durability by using plastic bushing (extends the lifetime of grease)

PISTON AND CONNECTING ROD



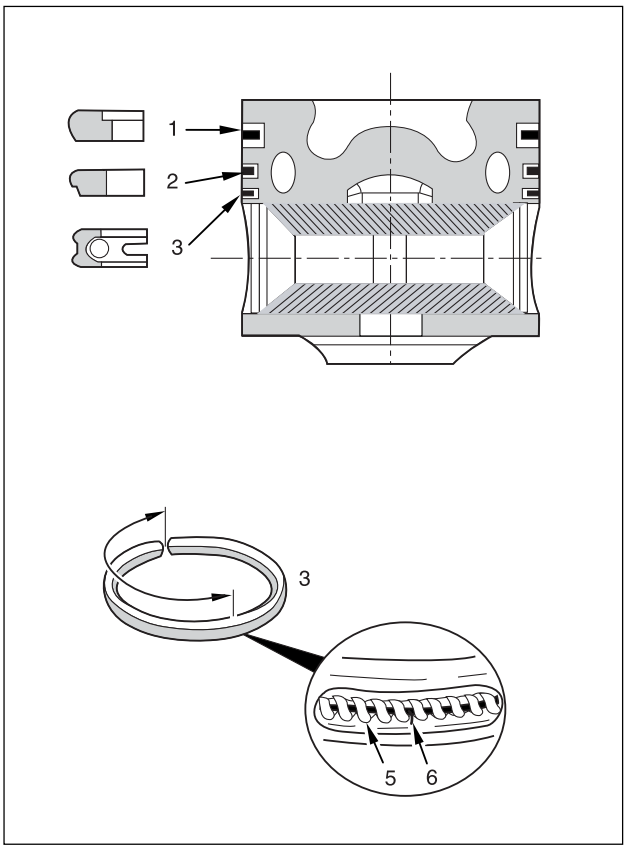
1. No.1 compression ring
2. No.2 compression ring
3. Oil ring

Description	ENG
Cylinder bore diameter	ϕ 86.2 $_{(0\sim0.018)}$ mm
Piston outer diameter (D1)	ϕ 86.133 $_{(\pm0.009)}$ mm
Clearance between bore and piston	74 ㎛
Piston cooling gallery	Applied
Pin offset	0.15 mm (Thrust)
Compression ratio	17.5 : 1
Length of piston pin	71.2 mm
Material of top ring / coating	Steel / Gas nitride
Tightening torque of connecting rod bolt	40 ± 5.0 Nm, 90° + 10°
Permissible weight difference of connecting rod	4 g
Thickness of connecting rod bearing (Red)	1.806 ~ 1.809 mm
Thickness of connecting rod bearing (Yellow)	1.809 ~ 1.812 mm
Thickness of connecting rod bearing (Blue)	1.812 ~ 1.815 mm

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AFFECTED VIN	

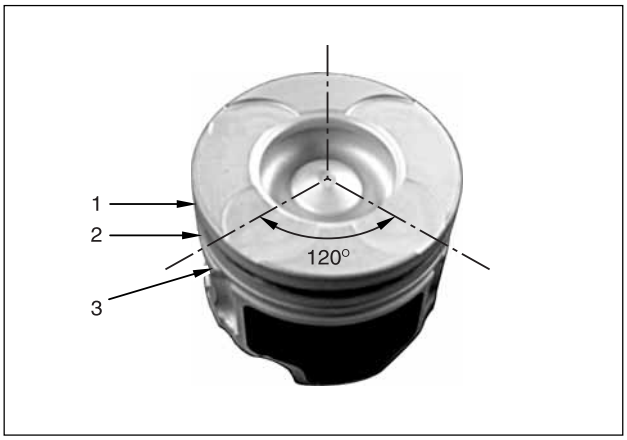
PISTON RING

1. No.1 compression ring
2. No.2 compression ring
3. Oil ring
5. Coil spring and oil control ring
6. Hook spring



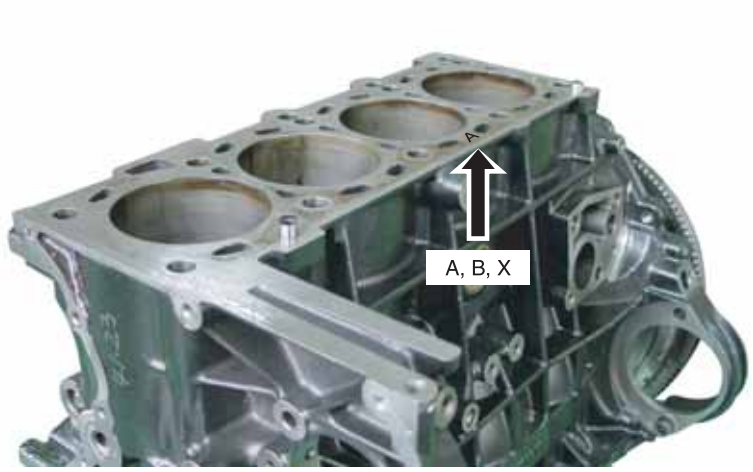
▶ Replacement of Piston Ring

1. Measure piston ring end gap.
   1) Piston ring end gap (mm)
      1st groove: 0.20 ~ 0.35
      2nd groove: 0.20 ~ 0.35
      3rd groove: 0.20 ~ 0.40
   2) Clearance between piston ring and piston (mm)
      1st compression ring: 0.075 ~ 0.119
      2nd compression ring: 0.050 ~ 0.090
      3rd oil ring: 0.030 ~ 0.070



3. Install the piston so that “Y” marking on piston head is facing in the direction of travel. Arrange the piston ring ends to be 120° apart.
4. Adjust the hook spring joint in the oil ring 180° away from the ring end.

CYLINDER INNER DIAMETER AND PISTON SIZE



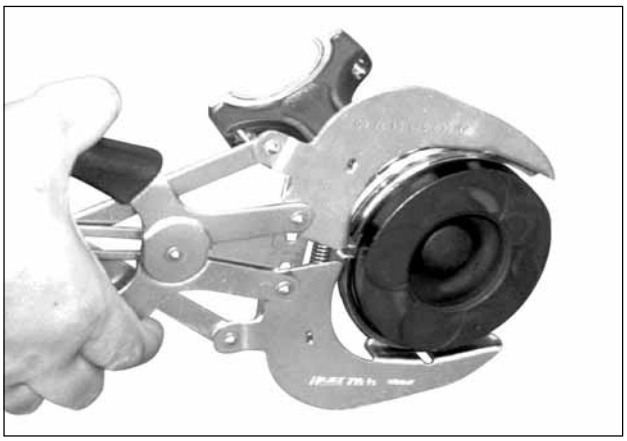
(Unit : mm)

Code	Used piston	Cylinder Diameter	Piston Diameter
A	A or X	86.200 ~ 86.206	86.124 ~ 86.130
X	A, B or X	86.206 ~ 86.212	86.129 ~ 86.137
B	B or X	86.212 ~ 86.218	86.136 ~ 86.142
+ 5	+ 5	86.250 ~ 86.260	86.167 ~ 86.181
+ 10	+ 10	86.300 ~ 86.310	86.217 ~ 86.231

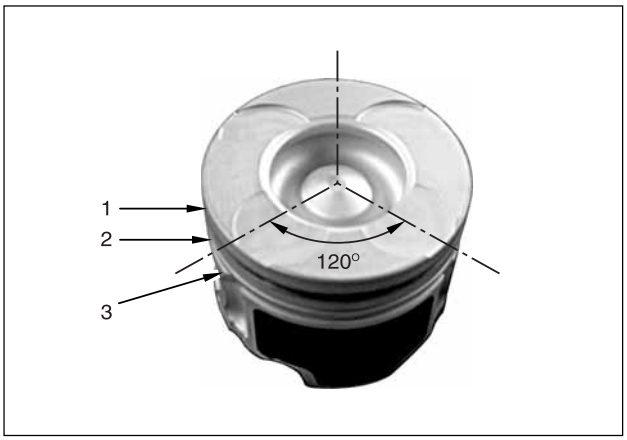
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DISASSEMBLY AND REASSEMBLY

1. Install the compression ring and oil ring on the piston with a special tool.



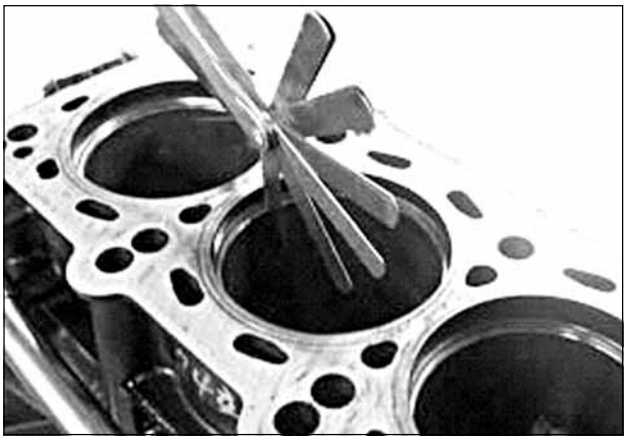
※ Arrange the piston ring ends to be 120° apart.



NOTICE

- **Install the No.1 and No.2 pistons so that "Y" marking on piston head is facing upward.**
- **No.1 piston ring is thicker than No.2 piston ring.**
- **Arrange the oil ring end to opposite position of current ring end.**
- **Oil ring is not directional.**
- **Make sure that the piston ring end is not aligned to axial direction and lateral direction.**

2. Check the clearance of piston oil ring and compression ring with a thickness gauge and adjust if necessary.



1st groove	0.20 ~ 0.35 mm
2nd groove	0.20 ~ 0.35 mm
3rd groove	0.20 ~ 0.40 mm

Piston ring end play (mm)

1st groove: 11.0 mm

2nd groove: 10.5 mm

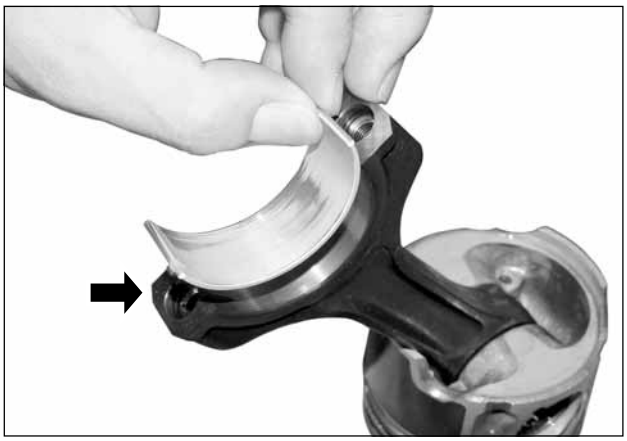
3rd groove: 7.0 mm

3. Check the clearance of piston rings with a thickness gauge and adjust if necessary.



No.1 compression ring	0.075 ~ 0.119 mm
2nd compression ring	0.050 ~ 0.090 mm
3rd oil ring	0.040 ~ 0.080 mm

4. Fit the piston onto connecting rod so that the marking on piston crown and locking slot are facing to straight ahead direction.



NOTICE

- **Install the piston so that the piston recess (marking) or the stamped surface of connecting rod is facing to straight ahead direction.**

5. Lubricate piston pin and push in by hand.



NOTICE

- **Do not heat up the piston.**

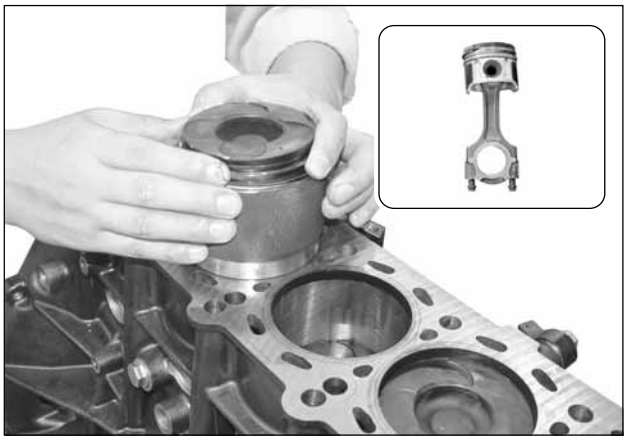
6. Place new snap rings into the grooves.

NOTICE

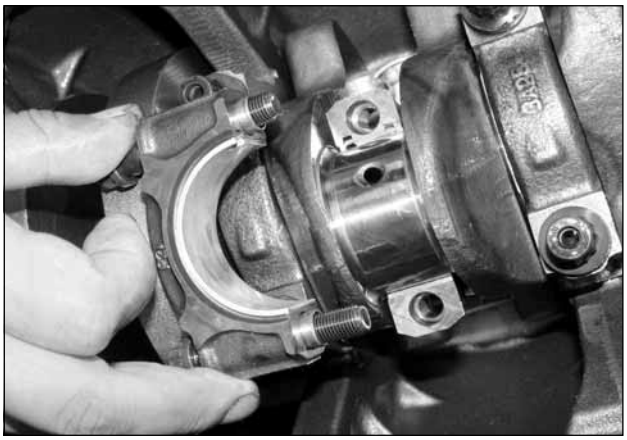
- **The snap rings should be replaced with new one.**

7. Lubricate the cylinder bore, connecting rod bearing journals, connecting rod bearing shells and pistons.

8. Push piston into the cylinder with a wooden stick.



9. Insert connecting rod bearing shells.

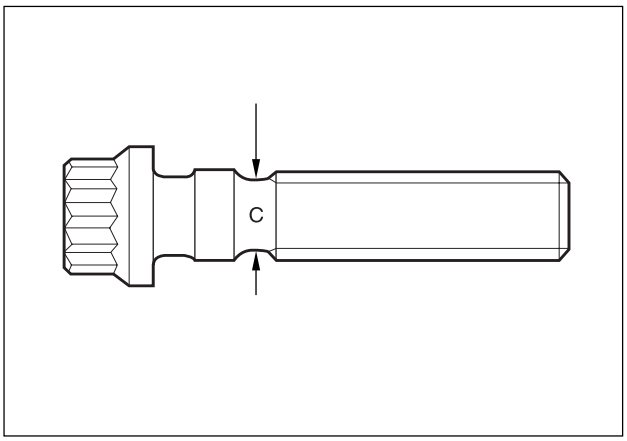


NOTICE

- **The upper and lower connecting rod bearings have same appearance. Therefore, make sure to check the part number before replacing them.**
- **Install bearing rod bearing cap so that the retaining lugs are on the same side of the connecting rod bearing.**

10. Measure stretch shaft diameter of the connecting rod bolts.

Limit “C”	7.1 mm



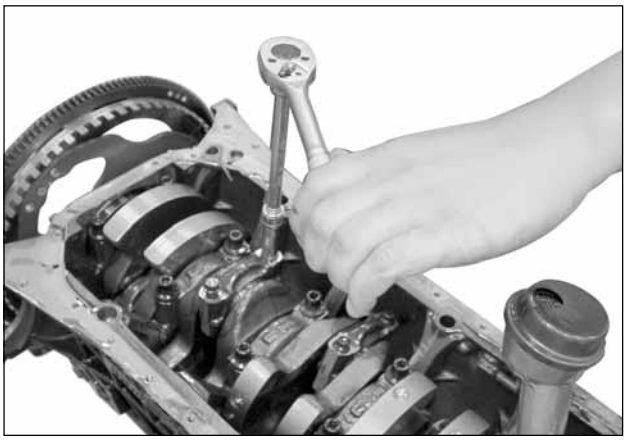
11. Lubricate the new connecting rod bolts and tighten.

Installation Notice

Tightening torque	40 ± 5.0 Nm, 90° + 10°

- End play of connecting rod cap

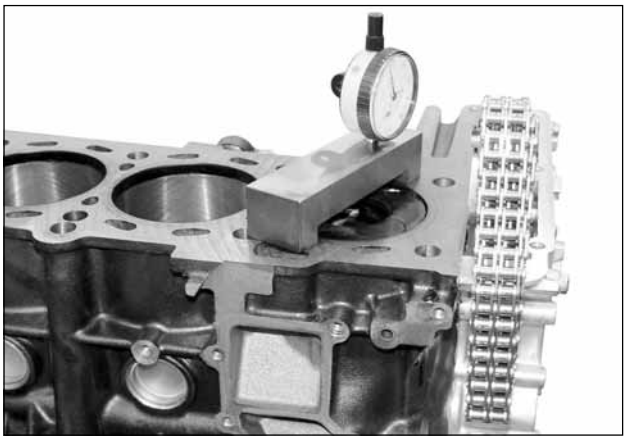
Specified value	0.5 ~ 1.5 mm



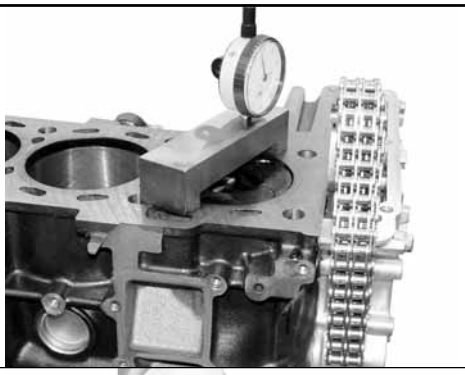
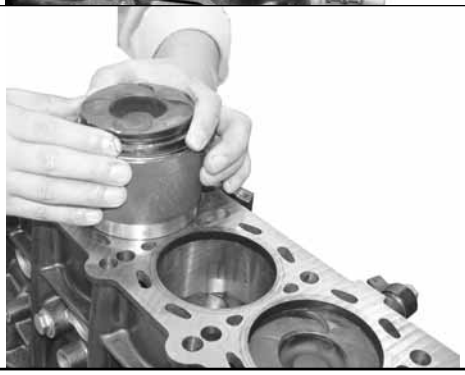
12. Position piston to TDC and measure the distance between piston and mating surface of crankcase.

Permissible piston protrusion	0.765 ~ 1.055 mm

- Measure at both ends of axial direction.

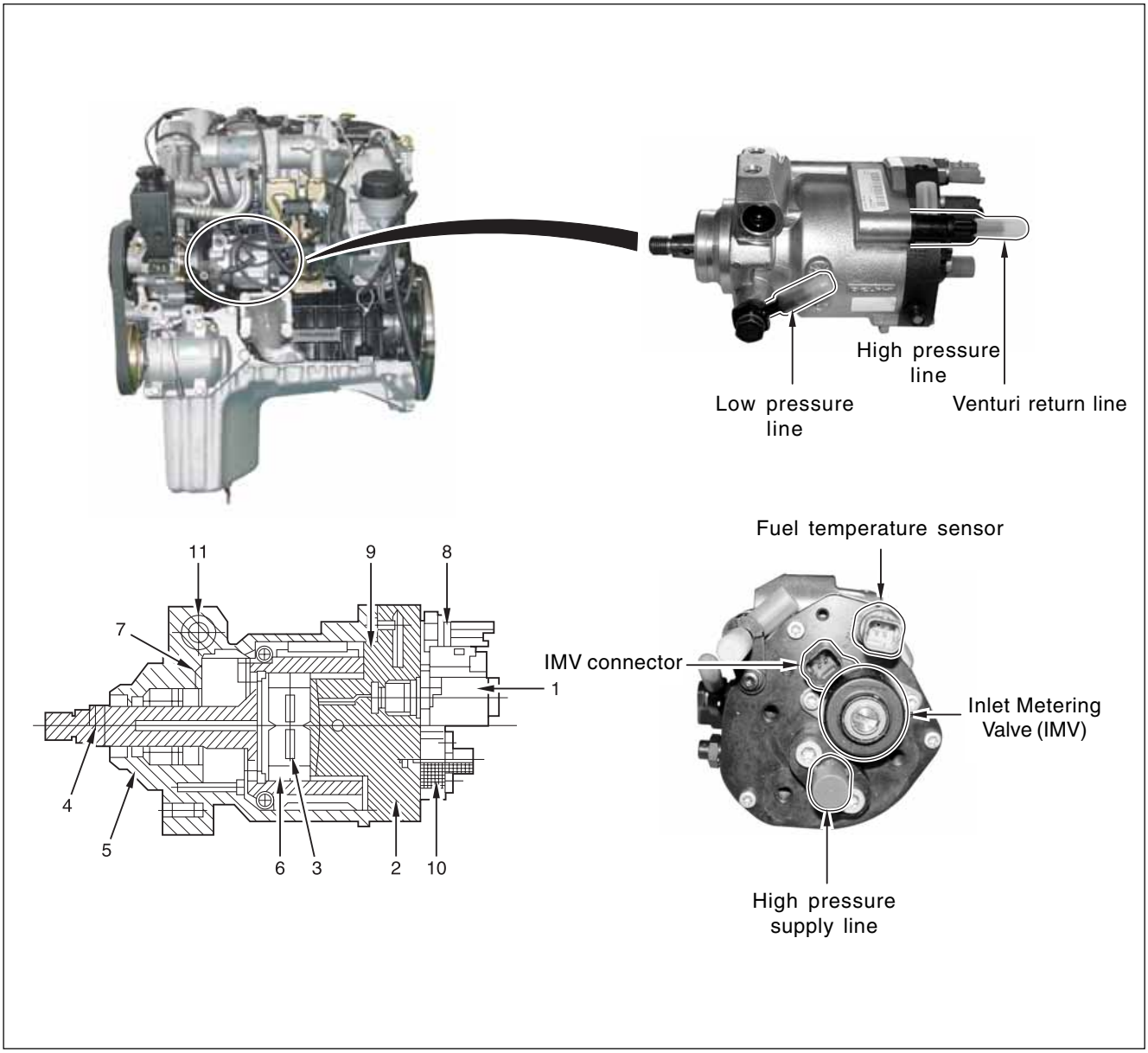


▶ Special Tools and Equipment

Name and Part Number	Application
Y99220122B Piston protrusion measuring jig 	
Y99220172B Piston insertion jig 	

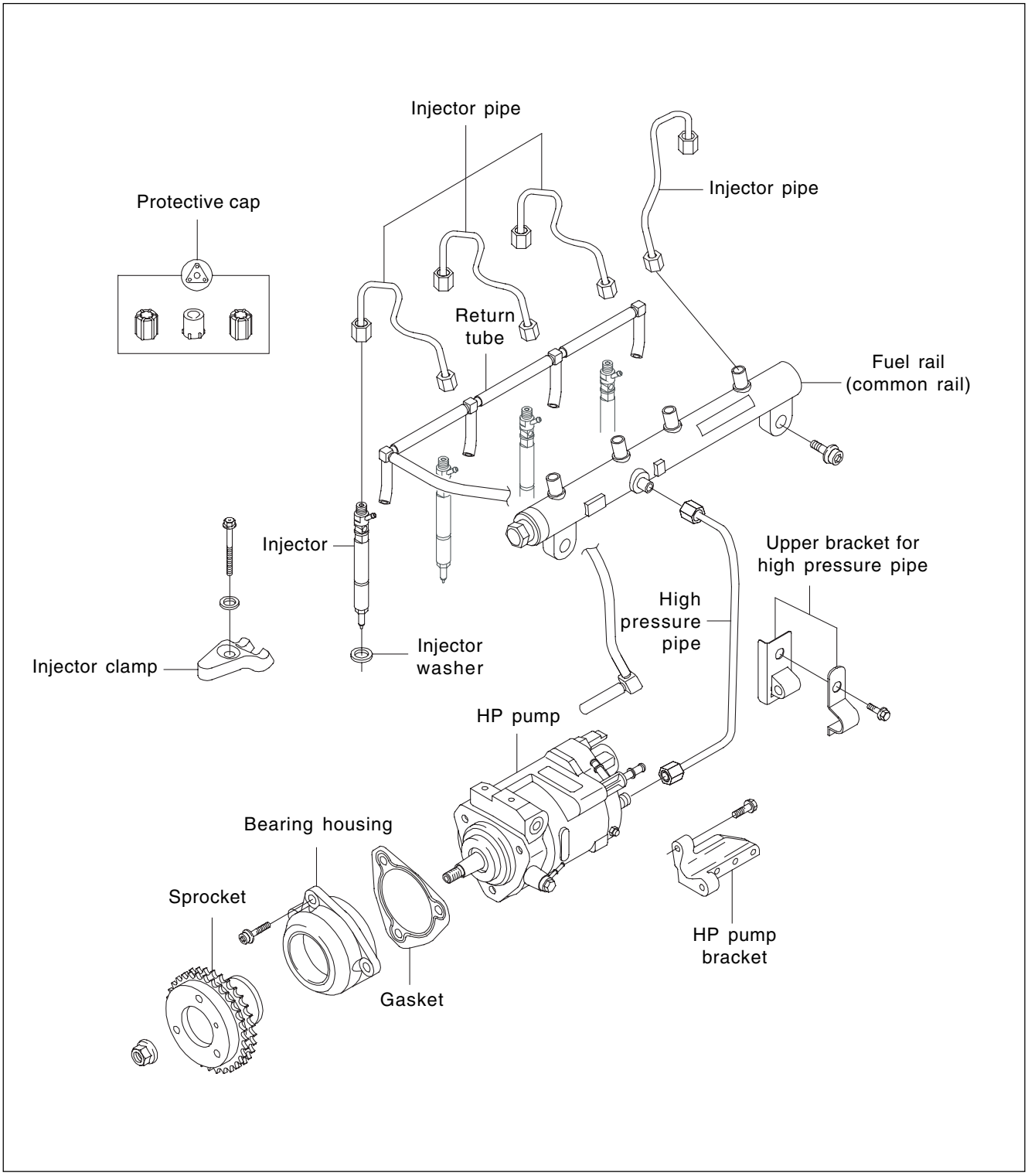
HIGH PRESSURE PUMP (HPP)

COMPONENTS LOCATOR



1. Inlet Metering Valve (IMV)
2. Hydraulic pressure head
3. Plunger
4. Drive shaft and cam ring
5. Housing
6. Roller and shoe
7. Low pressure pump
8. Fuel temperature sensor
9. Venting
10. High fuel pressure supply line
11. Pressure regulator

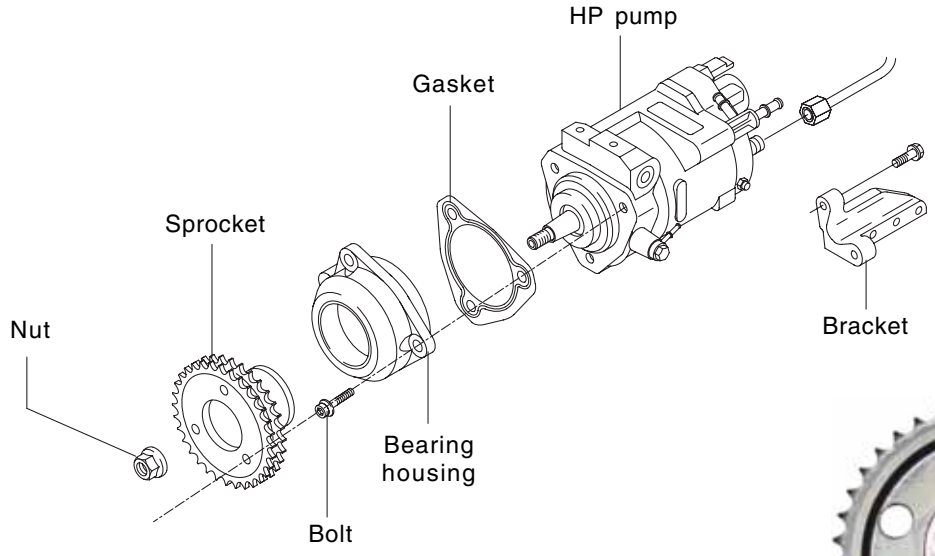
▶ High Pressure Pump and Fuel System



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AFFECTED VIN	

▶ Installation of High Pressure Pump

Vehicle with Engine





DISASSEMBLY AND REASSEMBLY



※ Preceding Works:

1. Removal of fan belt (including cooling fan and fan clutch) and fan shroud
2. Removal of intake manifold assembly
3. Removal of water pump pulley
4. Removal of auto tensioner
5. Removal of EGR pipe
6. Removal of oil dipstic gauge

NOTICE

- **To prevent oil leaks, store the removed auto tensioner it upright position.**
- **Be careful not to damage the rubber bellows.**
- **Plug the oil ports for HP pump with sealing caps.**

▶ HP Pump - without SST

Disassembly

※ **Preceding Works:**

1. Disconnect the negative battery cable.
2. Apply the parking brake and place the chocks under the tires. (transmission “N” position)

1. Turn the auto tensioner counterclockwise and remove the fan belt.



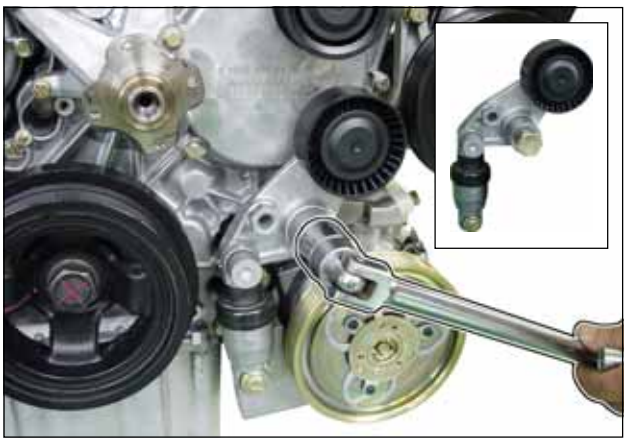
NOTICE

- **Slacken the pulley bolt.**

2. Remove the engine belt pulleys.
   1) Cooling fan pulley
   2) Coolant pump pulley



3. Unscrew lower bolt (13 mm) and upper bolt (24 mm) and remove the auto tensioner.



NOTICE

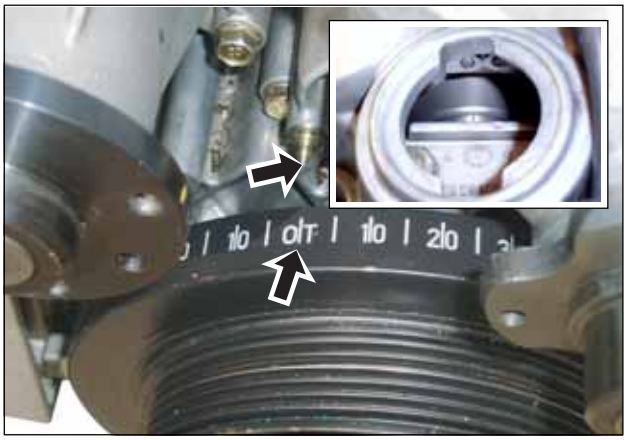
- **To prevent oil leaks, store the removed auto tensioner in upright position.**
- **Pump the auto tensioner several times before installing it.**

4. Remove the high pressure pump housing.

※ **Preceding Work:** Remove the No.2 EGR pipe.



5. Align the OT mark by rotating the crankshaft.
   1) Open the oil filler cap and check if the OT mark on crankshaft is aligned to the notch on the camshaft.



6. Unscrew the bolts and remove the vacuum modulator bracket.
   1) Disconnect the high pressure pump and vacuum modulator connector.
   2) Disconnect the fuel lines to high pressure pump.
   3) Plug the openings of pipes and ports with protective caps to keep the cleanness of the fuel system.
   4) Remove the high pressure fuel pipe between HP pump and common rail.



7. Rotate the crankshaft clockwise so that the HP pump sprocket holes are aligned to the bolt holes.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

8. Hold the HP pump sprocket and slacken the center bolt.



9. Slacken three HP pump mounting bolts until they rest on the sprocket.



10. Loosen the HP pump center nut by tapping it with a hammer.

NOTICE

- **Tap the center bolt with a hammer after tightening.**
- **Make sure that the center bolt is securely tightened.**

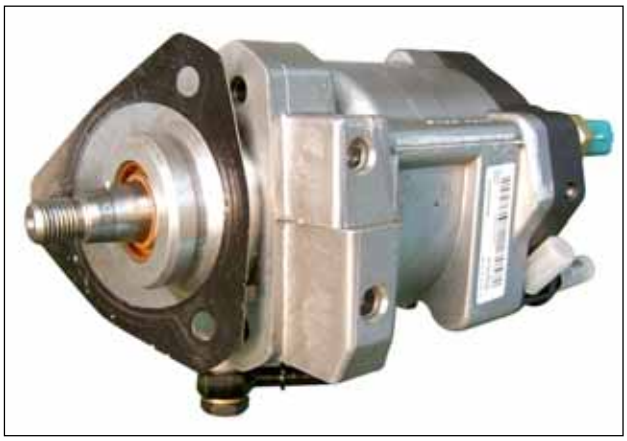


11. Remove the remaining bolts with the same manner and remove the high pressure pump.



Reassembly

1. Replace the HP pump gasket with new one (cannot be reused).



2. Tighten the HP pump bolts.

Tightening torque	25 Nm



3. Hold the HP pump sprocket and tighten the center nut.

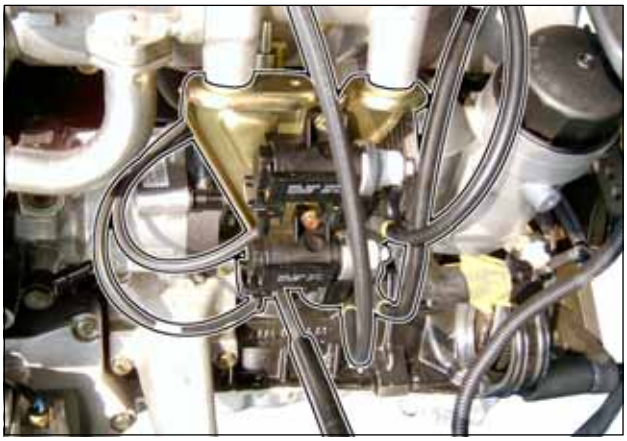
Tightening torque	65 Nm



NOTICE

- **The center nut should be replaced once removed (cannot be reused).**
- **Tighten the center nut with the specified tightening torque.**

4. Install the vacuum modulator bracket.



NOTICE

- **Replace the fuel lines to HP pump with new ones (cannot be reused).**
- **Make sure that the connectors are installed to the correct locations. (RR: white tape)**

5. Apply the sealant to the HP pump housing and tighten the bolts.

NOTICE

- **Sealant (DB2210): 661 989 56 A0**



6. Install the auto tensioner and belt pulleys.

Tightening torque	① 82 ± 6.0 Nm
	② 32 Nm



7. Rotate the crankshaft pulley two revolutions and ensure that the OT mark on the crankshaft pulley and the OT mark on the camshaft pulley are aligned.

NOTICE

- **Open the oil filler cap and check if the OT mark on crankshaft is aligned to the notch on the camshaft.**



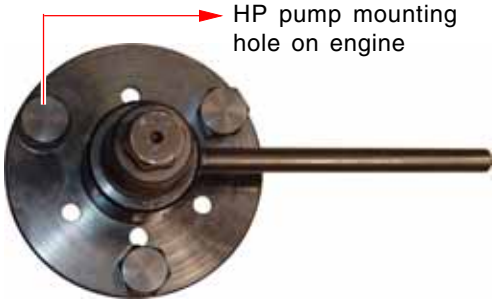
▶ HP Pump - with SST

Special Service Tool



SST Installation





HP Pump Installation





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AFFECTED VIN	

※ **Preceding Works:**

1. Disconnect the negative battery cable. (If necessary, remove the battery.)
2. Remove the front air duct assembly.
3. Remove the PWM electric fan.



NOTICE

- **To prevent from the oil leaking, put the removed auto tensioner in up-light position.**
- **Be careful not to damage the rubber bellows when removing the auto tensioner.**
- **Plug all fuel supply ports with seal caps (including removed ones).**

Removal

1. Take off the fan belt while turning the auto tensioner counterclockwise.





2. Remove the auto tensioner from the engine.





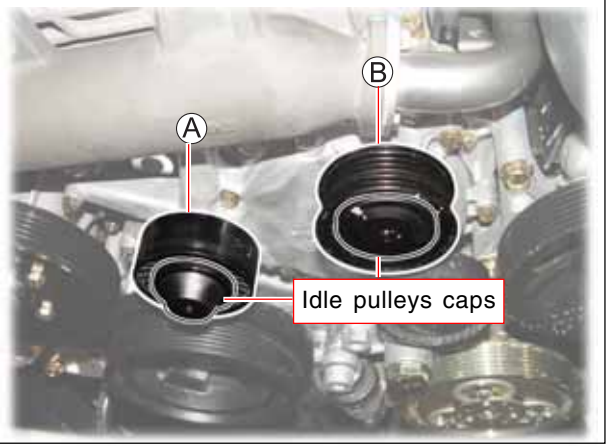
* To prevent from the oil leaking, put the removed auto tensioner in up-light position.

3. Unscrew four bolts and remove the water pump pulley.

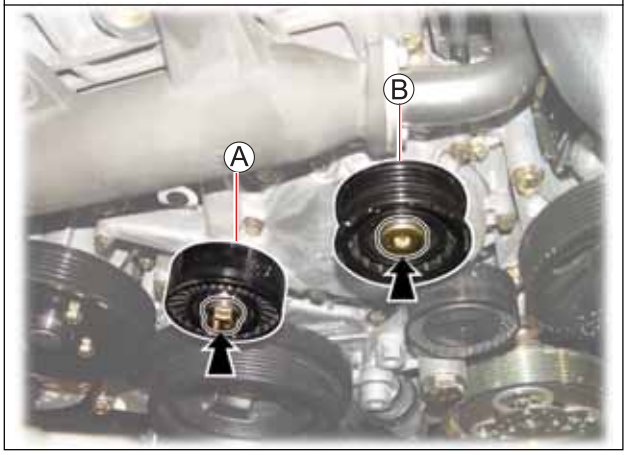


4. Open the caps (A, B) and unscrew the mounting bolts to remove the idle pulleys (A, B).

Open Caps



Unscrew Mounting Bolts



5. Remove the idle bracket.

Unscrew Mounting Bolt

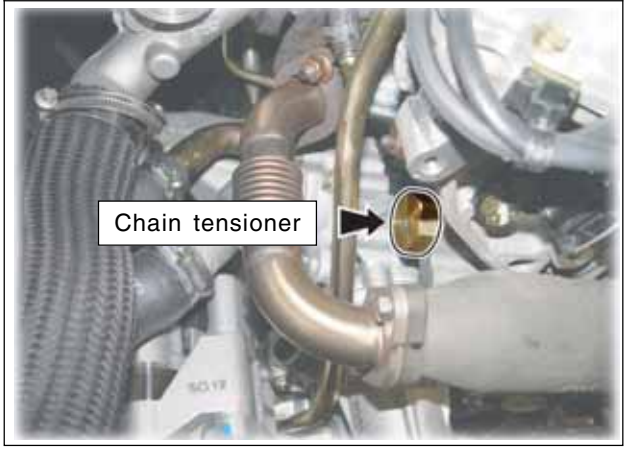


Remove Idle Bracket

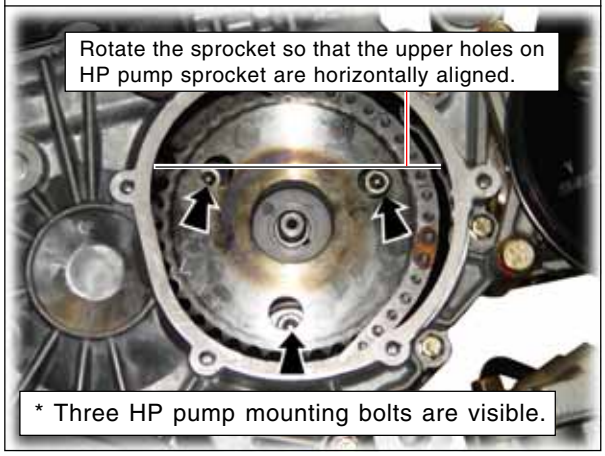


6. Remove the oil separator and EGR cooler pipe. Remove the chain tensioner and rotate the crankshaft so that the upper holes on HP pump sprocket are horizontally aligned. (At this moment, the holes on sprocket are aligned to mounting bolts for HP pump.)

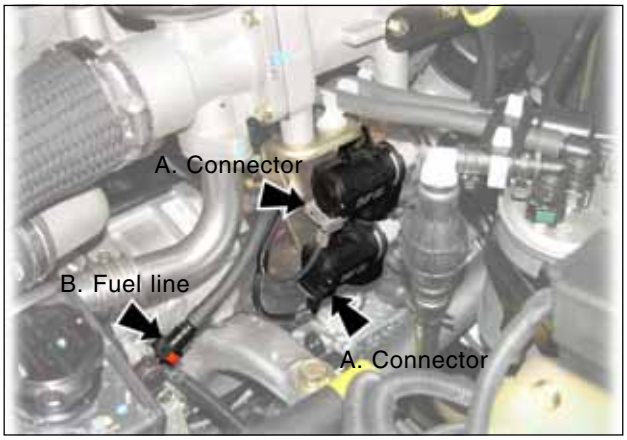
Remove Chain Tensioner



HP Pump Sprocket



7. Remove the vacuum modulator bracket.
   A. Disconnect the vacuum modulator connector and fuel line.
   B. Disconnect the fuel line to high pressure pump. (To keep cleanness, plug the opening with a sealing cap.)



8. Remove the center nut on high pressure pump and loosen three hexagon bolts.

Center Nut



Mounting Bolts



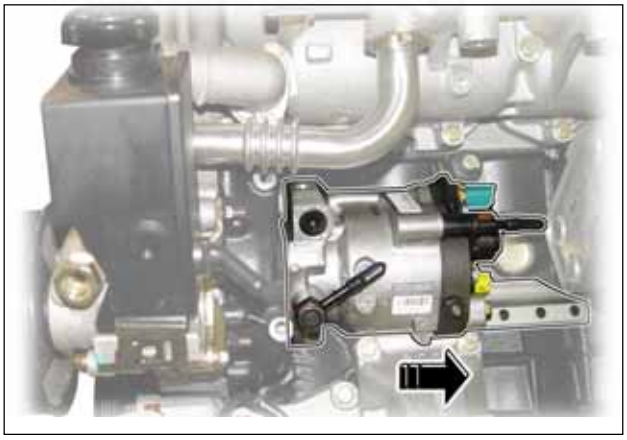
9. Install the special service tool on the high pressure pump sprocket.





10. Separate the sprocket from the high pressure pump by turning the center bolt on special service tool.





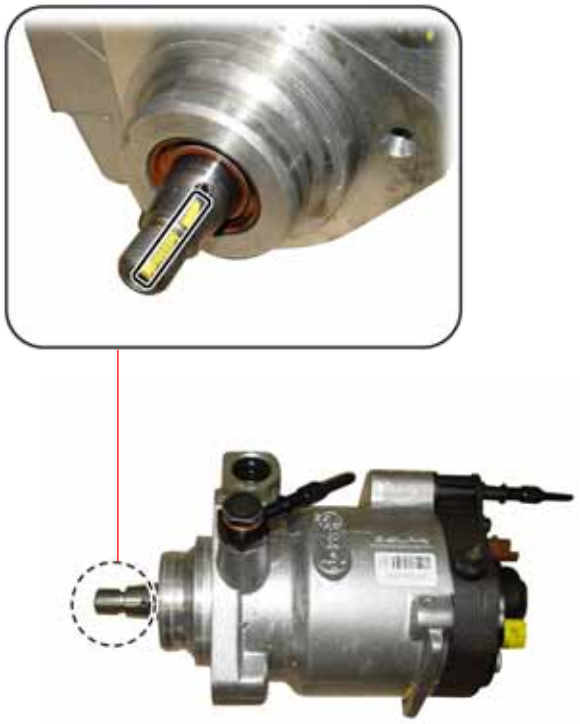
11. Remove the special service tool and unscrew three mounting bolts to remove the high pressure pump.

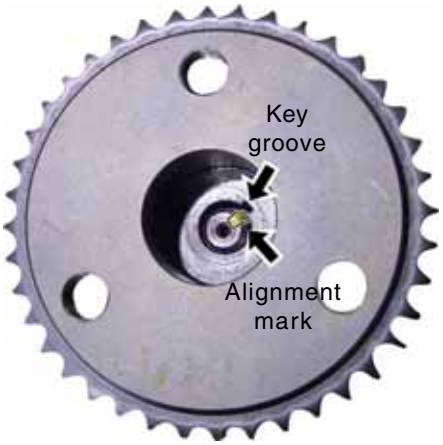




NOTE

1. The gasket for high pressure pump cannot be reused. It should be replaced with new one if removed.
2. Place an alignment mark on the high pressure pump shaft and key.





Installation

1. Install in the reverse order of removal. (However, temporarily tighten three mounting bolts first, then fully tighten the center bolt, mounting bolts and center nut in order.

Tightening torque

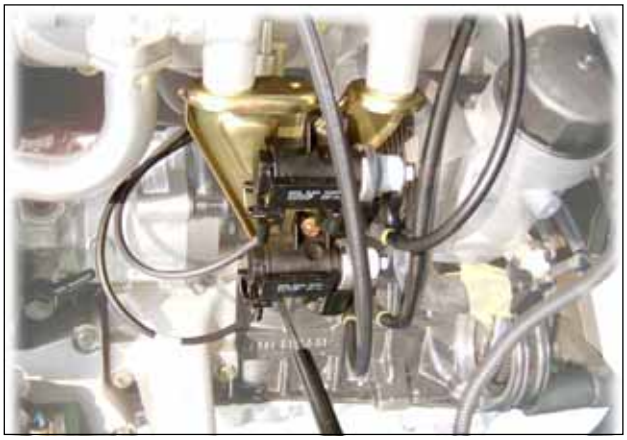
Hexagon mounting bolt	25 ± 2.5 Nm
Center nut	65 ± 5 Nm



2. Install the vacuum modulator bracket.

NOTICE

- **The vacuum modulator connector and vacuum hose should be connected to correct positions. The wiring with white tape should face to the rear-end of engine.**



3. Apply the specified sealant (DB2210: 661 989 56 A0) and tighten the bolts to the specified tightening torque.
4. Install the accessories.



INTAKE SYSTEM

03

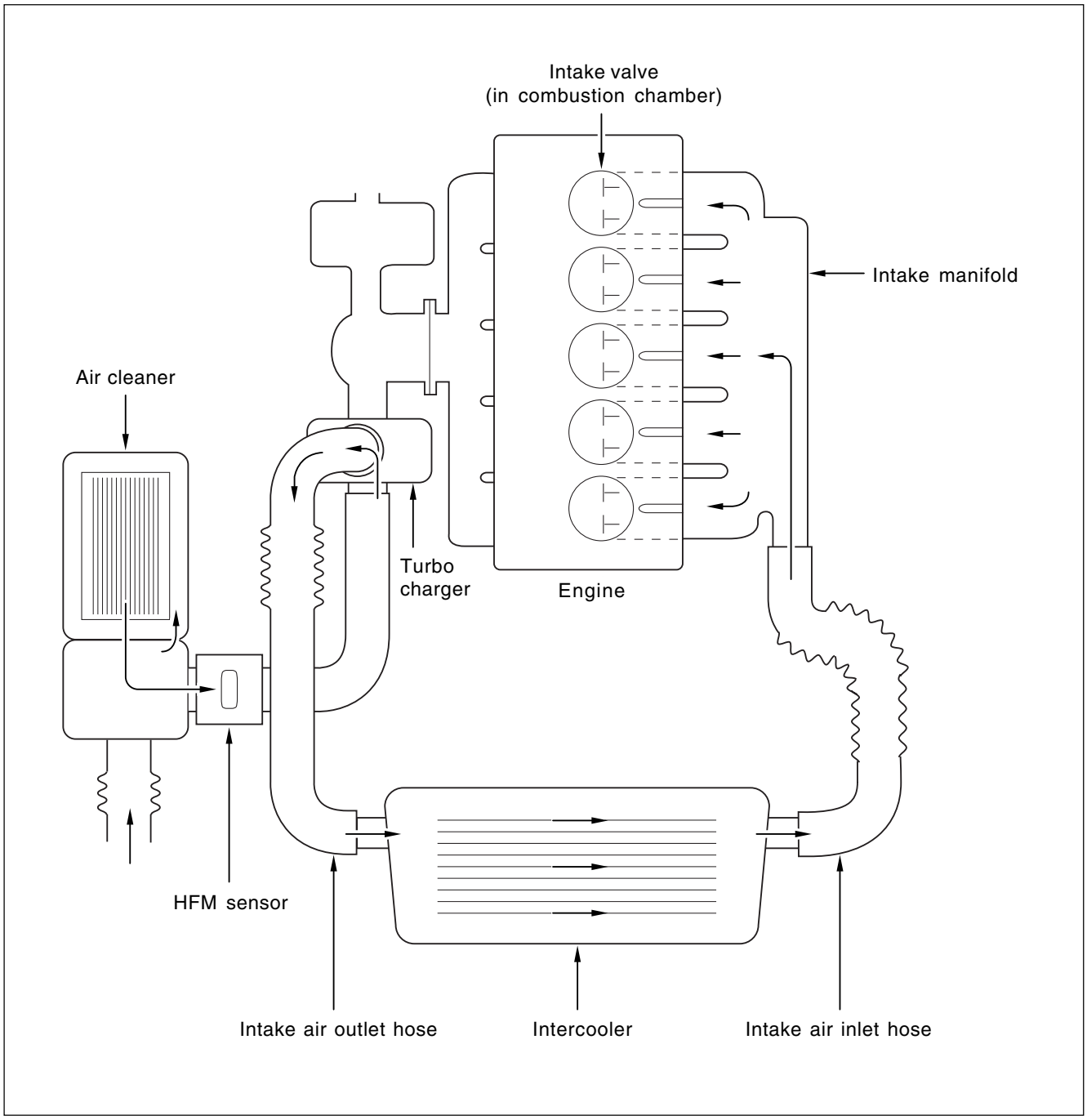
TABLE OF CONTENTS

AIR FLOWS 3

INTAKE SYSTEM LAYOUT 4

Work flow of intake system 4
Components 7
Precautions when installing intake system 9
Air flow sensor (hot film air mass sensor) 13
Intercooler 17
Intake manifold assembly 20

AIR FLOWS

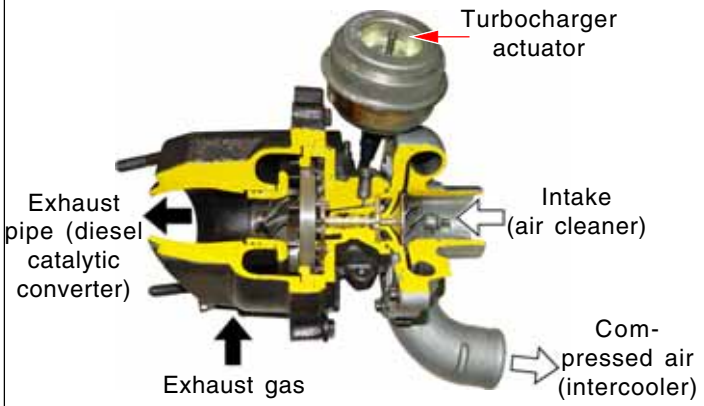

Intake valve
(in combustion chamber)
Intake manifold
Air cleaner
Turbo
charger
Engine
HFM sensor
Intake air outlet hose
Intercooler
Intake air inlet hose

INTAKE SYSTEM LAYOUT

WORK FLOW OF INTAKE SYSTEM

Air Cleaner → HFM Sensor → VGT Turbo-charger → Inter-cooler → Intake Manifold → Combus-tion Chamber in Engine

VGT Turbocharger



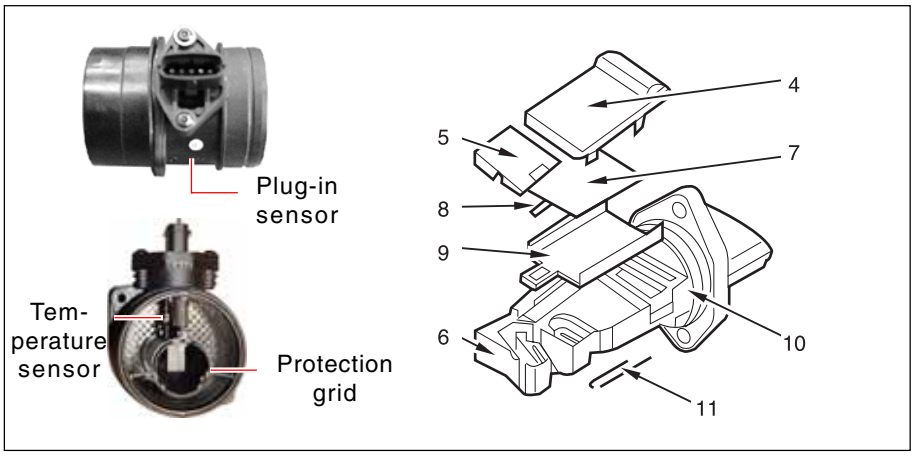


HFM Sensor

The HFM sensor is installed in the air intake passage between the air cleaner and the intake manifold. It measures the air volume supplied to the combustion chamber and the air temperature.

Major Functions

- It controls the EGR feedback.
- It controls the pressure control valve for the turbocharger booster.

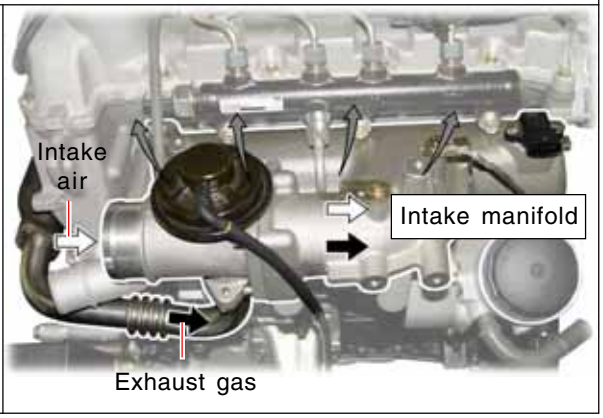


1. Plug-in sensor
2. Cylinder housing
3. Protection grid
4. Hybrid cover
5. Measuring duct cover
6. Housing
7. Hybrid
8. Sensor
9. Mounting plate
10. O-ring
11. Temperature sensor

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AFFECTED VIN	

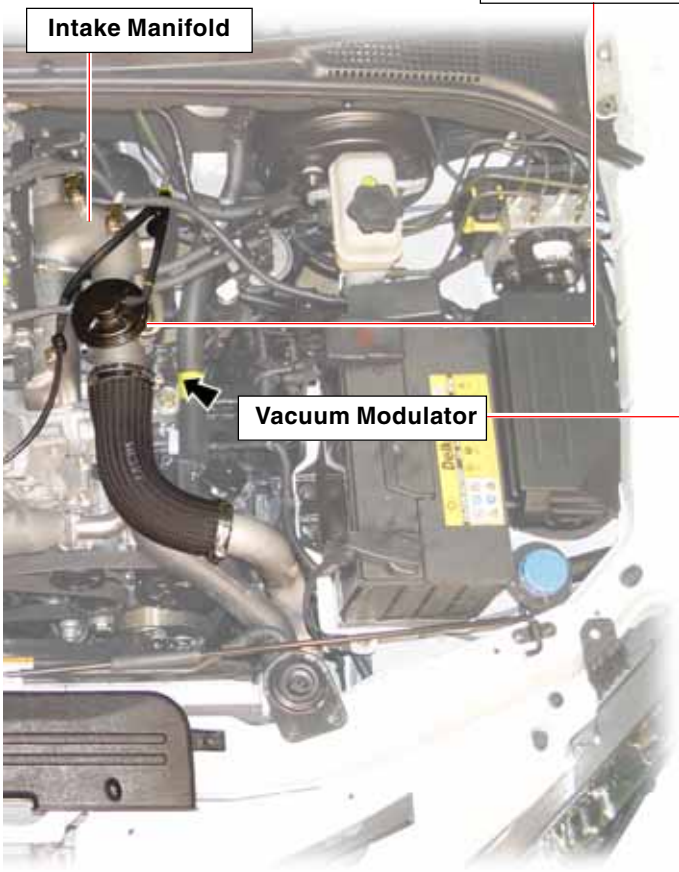
EGR Valve and Its Location (* For details, refer to "EGR" section.)

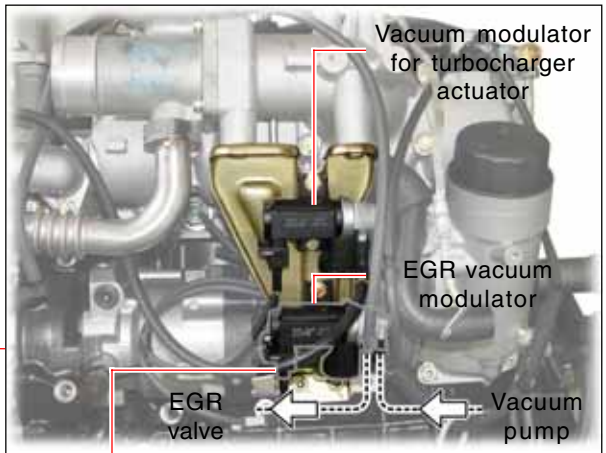




Intake Manifold

Vacuum Modulator







IP interior fuse (RH) No.63-7.5A

Engine ECU No. 96

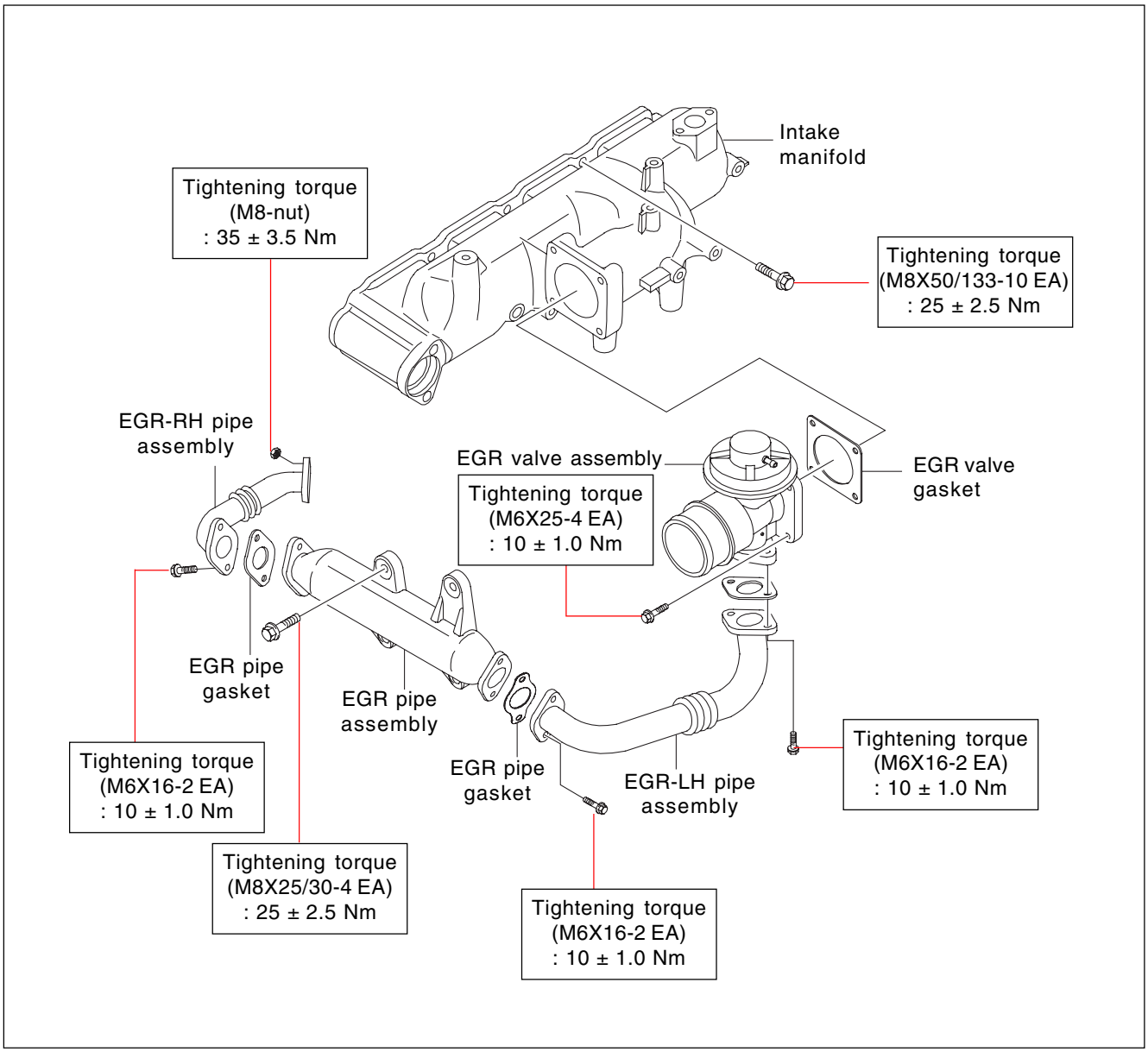
Turbocharger Intercooler

The charging efficiency may be lowered or the knocking may happen as the intake air is heated and the density of air is lowered. The intercooler is the device which cools the supercharged air.



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▶ Layout



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COMPONENTS

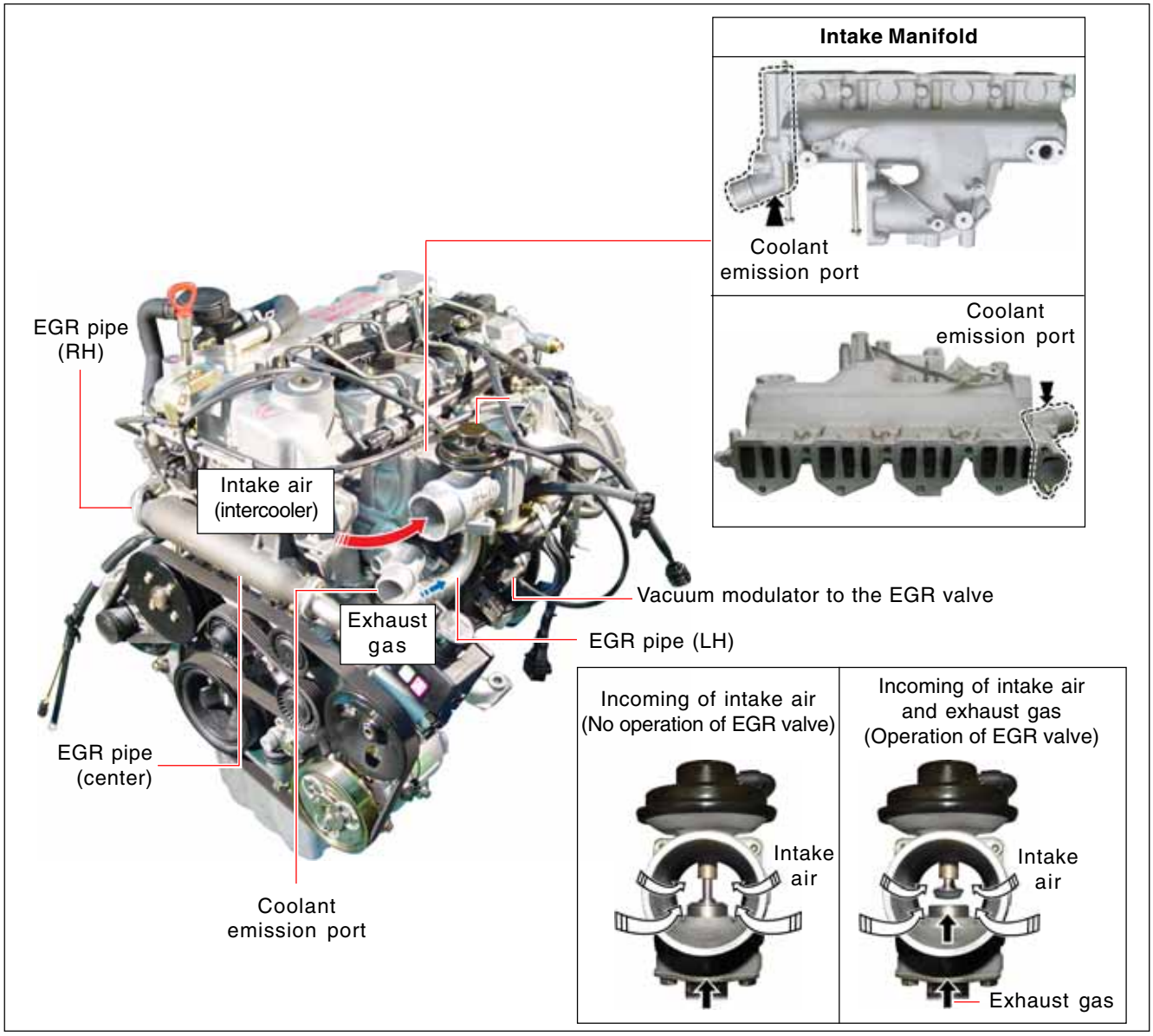
▶ Intake Manifold Assembly

The intake manifold assembly is built for the optimized mixture of the EGR gas in the intake chamber when the compressed air in the turbocharger is sent to the intake port. The intake port is composed of the dual port (tangential and helical port) which increases the swirl ratio in mid/low operating range, improves acceleration/fuel consumption and decreases particle materials. However, there are some differences in the form of the EGR valve and 4-cylinder engine.

NOTICE

- **The inlet port and coolant outlet port is integrated together. Therefore, be careful not to let the residual coolant in the manifold enter the inlet port when removing the intake manifold. Also, replace the gasket with a new one and tighten it to the specified torque (25 ± 2.5 Nm).**

The SUS + Rubber coating is applied to the intake manifold gasket to prevent the air leakage and optimize the sealing effect.



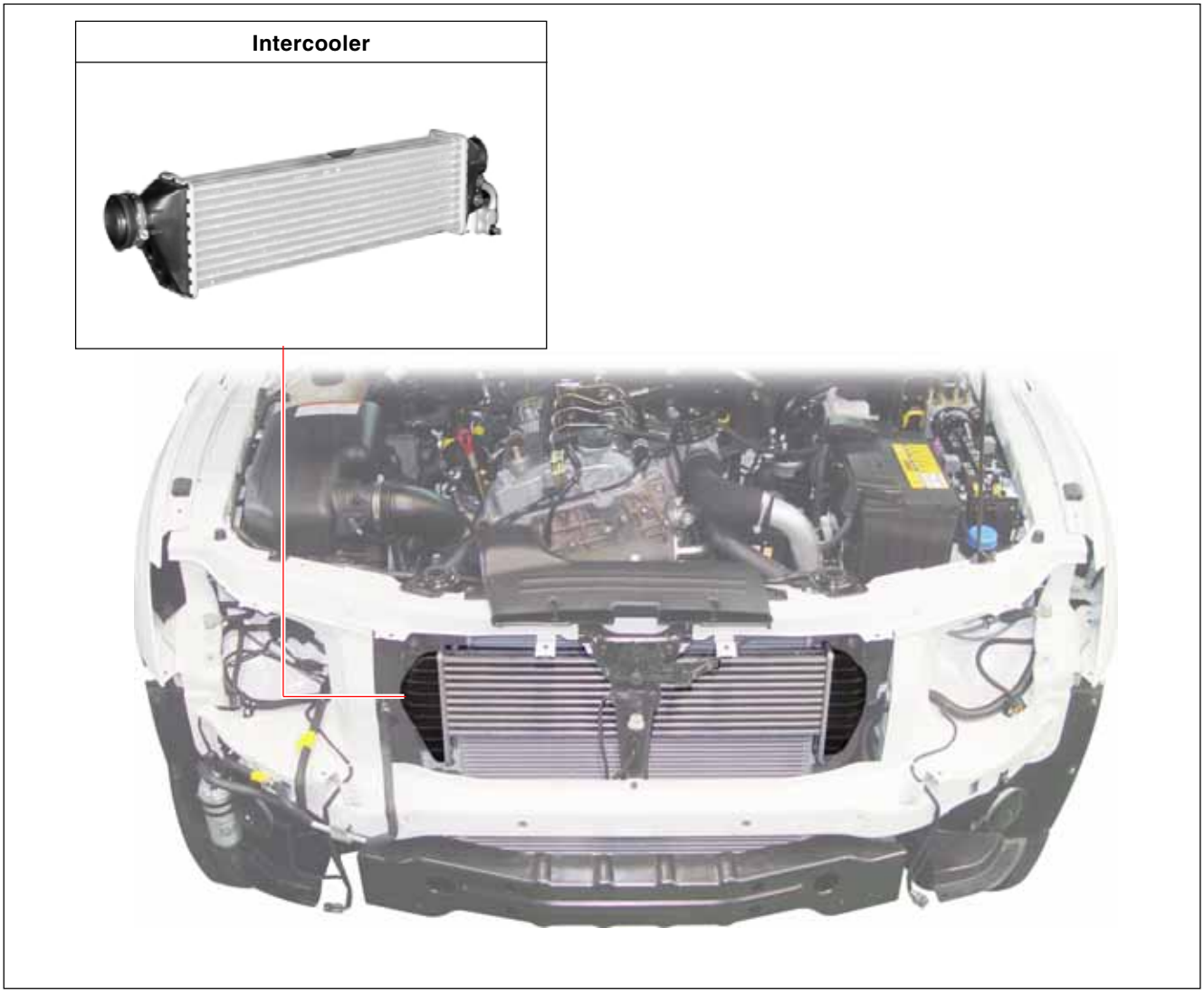
▶ Turbocharger Intercooler Assembly

The turbocharger is designed to improve the engine power by introducing more air (oxygen) into the engine.

However, the intake air is heated during the compression process in the turbocharger compressor and the density is lowered.

The intercooler is the device which cools (50 ~ 60°C) the air entering the engine from high temperature (100 ~ 110°C) to maintain the turbocharging efficiency.

Thus, more air is entered the cylinder than the engine only with the turbocharger to give more power.



Removal and Installation

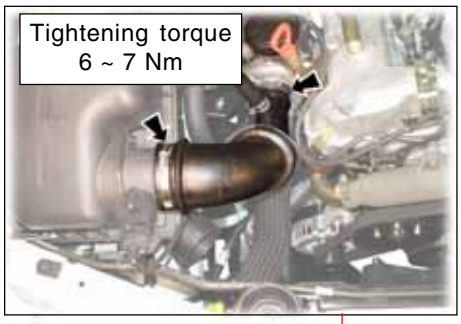
For removal and installation procedures, refer to the "Cooling system" section in DI engine service manual.

PRECAUTIONS WHEN INSTALLING INTAKE SYSTEM

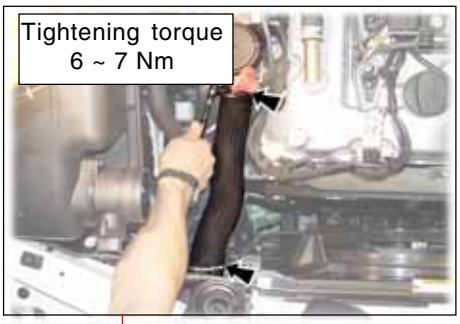
Intake (Inlet/Outlet) Hose and EGR Pipe

The clamps of hoses and EGR pipe should be tightened to the specified tightening torque when installing the engine assembly or servicing on the air cleaner duct, the turbocharger and the intercooler.

1. Hose between air cleaner and turbocharger

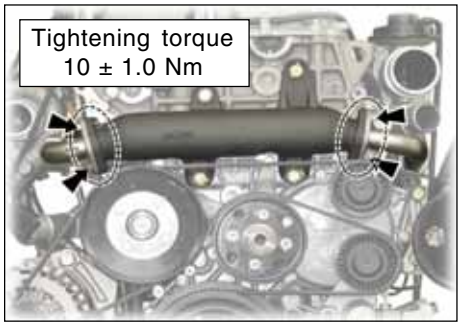


2. Hose between turbocharger and intercooler





3. Connections of EGR pipe



4. Fixing clamps on inlet hose (intake manifold and intercooler)



Precautions When Installing

: The clamps on the hoses should be tightened to the specified tightening torque when installing the engine assembly or servicing on the air cleaner duct, the turbocharger and the intercooler.

1. Symptoms

: Insufficient engine power, smoke or noise when accelerating (whistle noise).

2. Cause

: Clamp is out of place due to the turbocharging pressure or inproper tightening torque.

3. Correction

- Check if the clamp is out of place or the intercooler is leaking.
- Always observe the tightening torque when installing the related parts.
- Do not use a screwdriver. Always use a torque wrench when tightening the clamps.

Tightening torque of intake hose clamp	6 ~ 7 Nm

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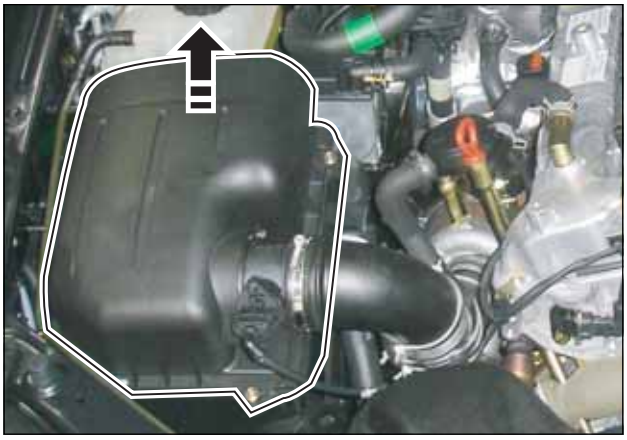
Air Cleaner Element - Replacement

※ **Preceding Work:** Disconnection of negative battery cable

1. Disconnect the HFM sensor connector.
2. Loosen the locking clamp and remove the intake duct.



3. Unscrew the screws and remove the air cleaner cover.



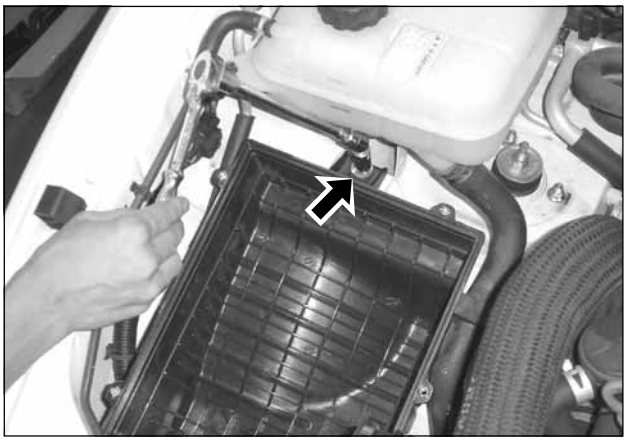
4. Remove the air cleaner element. Clean or replace the element as required.



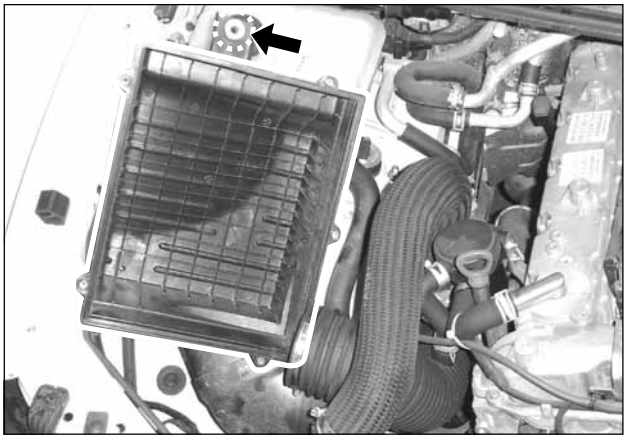
Air Cleaner Housing - Removal and Installation

※ **Preceding Work:** Removal of air cleaner cover

1. Set aside the return hose and remove the coolant reservoir bolts.



2. Remove the air cleaner housing bolts.
3. Install in the reverse order of removal.



Air Cleaner Housing/Element - Check

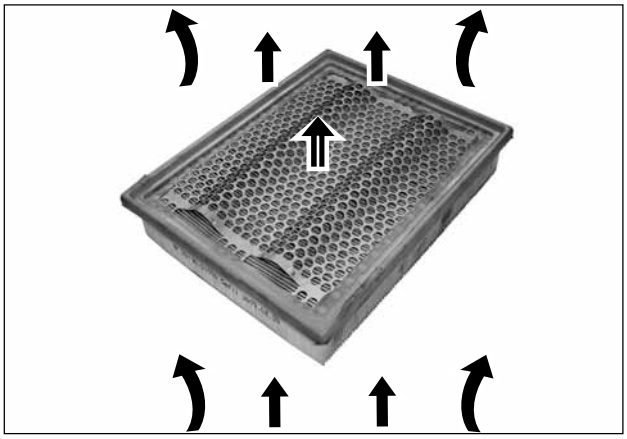
1. Check the air cleaner body, cover and packing for deformation, corrosion and damage.
2. Check the air duct for damage.
3. Check the air cleaner element for clogging, contamination and damage. If the element is partially clogged, remove the dust or foreign materials with the compressed air. If the contamination is severe, replace it with new one. Also, be careful not to contaminate during the replacement.



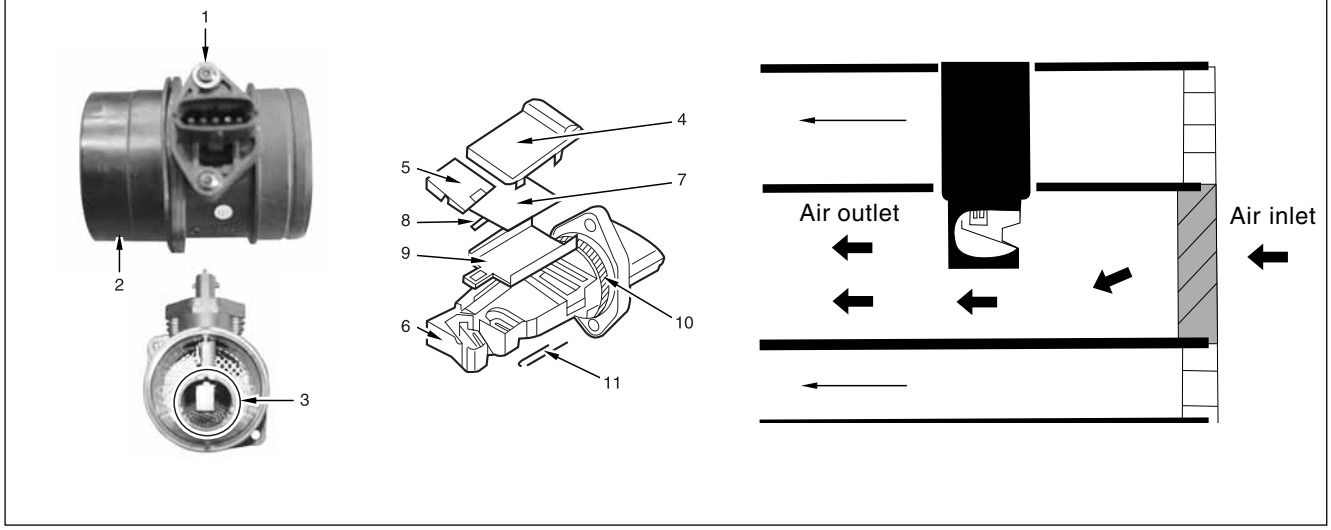
4. Check the air cleaner housing for clogging, contamination and damage.
5. If the inside of housing is contaminated, remove the contaminants.

NOTICE

- **When cleaning the air cleaner with compressed air, direct the air from inside (engine) to outside (ambient air). Otherwise, contaminants can get into the engine.**



AIR FLOW SENSOR (HOT FILM AIR MASS SENSOR)



1. Plug-in sensor
2. Cylinder housing
3. Protection grid
4. Hybrid cover
5. Measuring duct cover
6. Housing
7. Hybrid
8. Sensor
9. Mounting plate
10. O-ring
11. Temperature sensor

▶ General

Application

The micro-mechanical HFM6 hot-film air mass sensor with flow direction detection by pulsating mass air flow has been conceived for load recording with internal combusion engines with petrol and diesel fuel injection.

The HFM6 installation is effected in the air intake system between the air filter and the throttle device, in the case of supercharged engines between the air cleaner and the supercharger. The HFM6 is installed either as a plug-in sensor in an existing part of the airducting, such as, e.g. the air cleaner housing, or as pre-assembled plug-in sensor module including cylinder housing.

Depending on the required air flow rate of the combustion engine, various cylinder housing sizes are provided.

The HFM6 also records, in addition to the air mass taken in by the engine, the temperature of the air taken in.

The HFM6 may only be operated with a suitable control unit.

Design and Function

The hot-film air mass sensor is a thermal flowmeter. The sensor element with its temperature sensors and the heating area is exposed to the air mass flow. Through a metering channel on the plug-in sensor housing a portion of the air flow from the cylinder housing is routed past a sensor element.

A thin diaphragm is generated on the silicon-based sensor element by means of etching. A heating resistor and various temperature sensors are laid out on this diaphragm. The heating area is located in the centre of the diaphragm, which is controlled to an excess temperature using a heating resistor and a temperature sensor. The degree of this excess

temperature depends on the temperature of the air flowing in. Without incoming air flow, the temperature at the diaphragm edges declines in an approximately linear fashion. Temperature sensors are located symmetrically in relation to the heating area upstream and downstream of the heating area. When there is no incoming flow, these sensors indicate the same temperature. With incoming flow, the part of the diaphragm upstream of the heating area is cooled down due to heat transfer in the boundary layer. The downstream temperature sensor approximately retains its temperature, due to the air heated up in the heating area.

The temperature sensors indicate a temperature difference which is dependent upon amount and direction of the incoming flow. The difference signal of the temperature sensor is evaluated as a resistance bridge.

Digital signal processing takes place after digitising the resistor bridge voltage and the intake air temperature sensor signal. This enables temperature compensation on the basis of the chip temperature and a standardization of the output characteristic curve.

The plug-in sensor housing contains the electronic module with the evaluation circuit for the sensor.

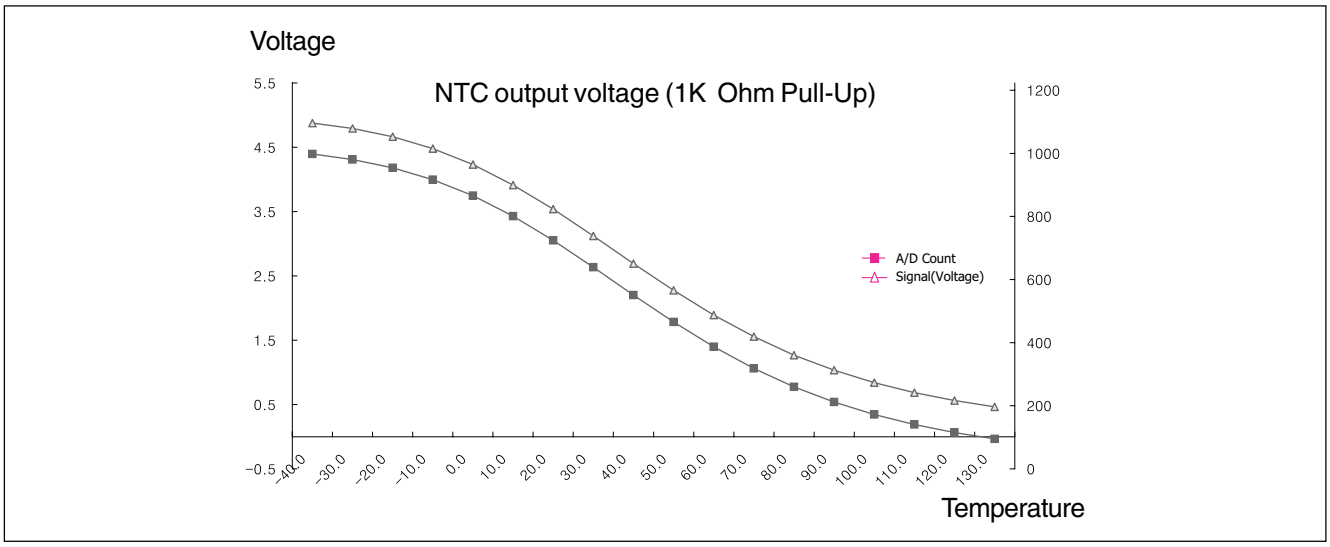
Intake Air Temperature

The Intake Air Temperature (IAT) sensor is a part of Hot Film Air Mass (HFM) sensor and is a thermistor, a resistor which changes value based on the temperature of the air entering the engine. Low temperature produces a high resistance, while high temperature causes a low resistance as the following table.

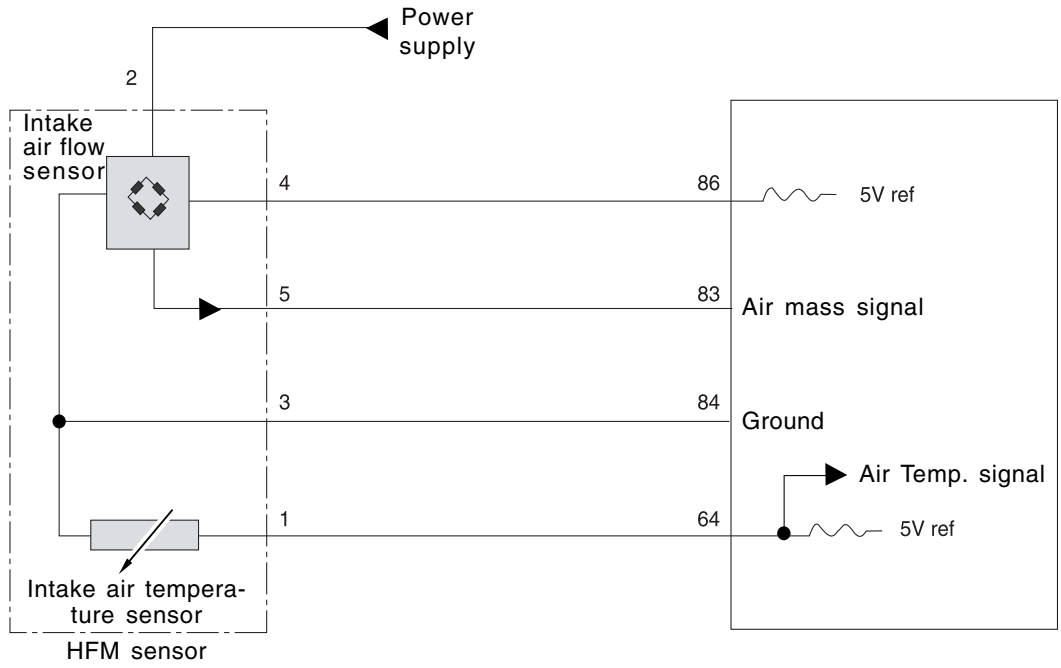
The ECM provides 5 volts to the IAT sensor through a resistor in the ECM and measures the change in voltage to determine the IAT. The voltage will be high when the manifold air is cold and low when the air is hot. The ECM knows the intake IAT by measuring the voltage.

The IAT sensor is also used to control spark timing when the manifold air is cold.

Temp. (°C)	R min.(Ω)	R nom. (Ω)	R max. (Ω)
-40	35,140	39,260	43,760
-20	12,660	13,850	15,120
0	5,119	5,499	5,829
20	2,290	2,420	2,551
40	1,096	1,166	1,238
60	565	609	654
80	312	340	370
100	184	202	222
120	114	127	141
130	91	102	114

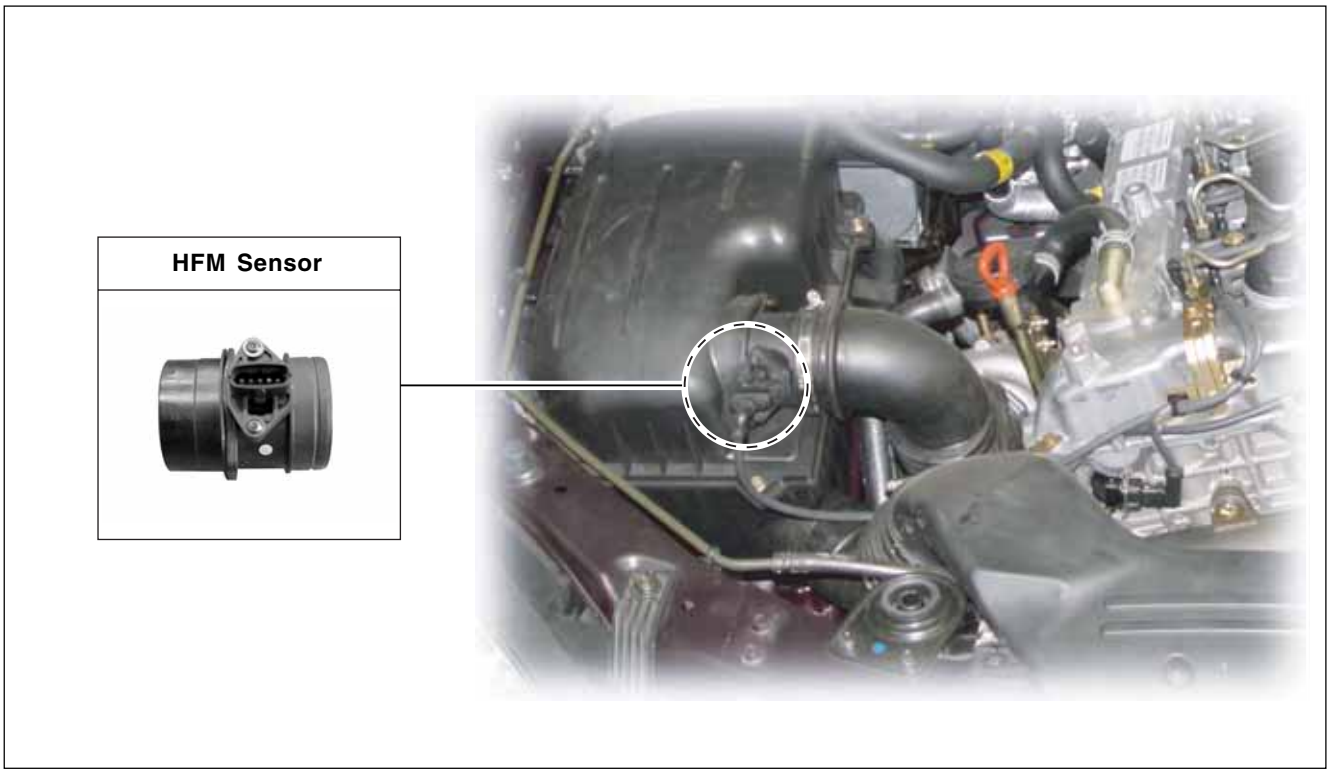


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<Circuit Diagram of HFM Sensor>

HFM Sensor - Removal and Installation

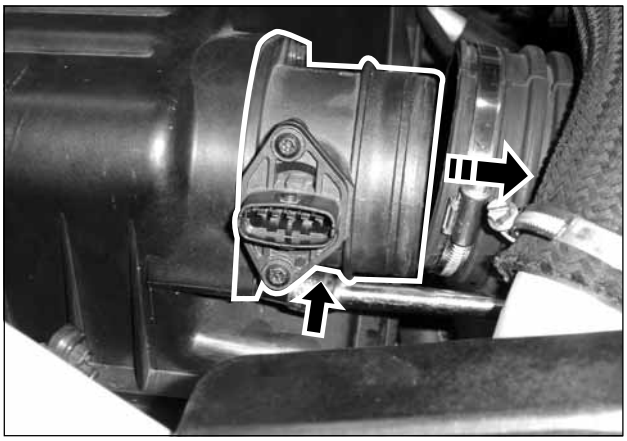


※ **Preceding Work:** Disconnection of negative battery cable

1. Disconnect the HFM sensor connector.
2. Loosen the clamps on the air cleaner and the turbo charger and remove the duct.



3. Unscrew the bolts and remove the HFM sensor assembly.



Installation Notice

Tightening torque	4 ~ 5 Nm

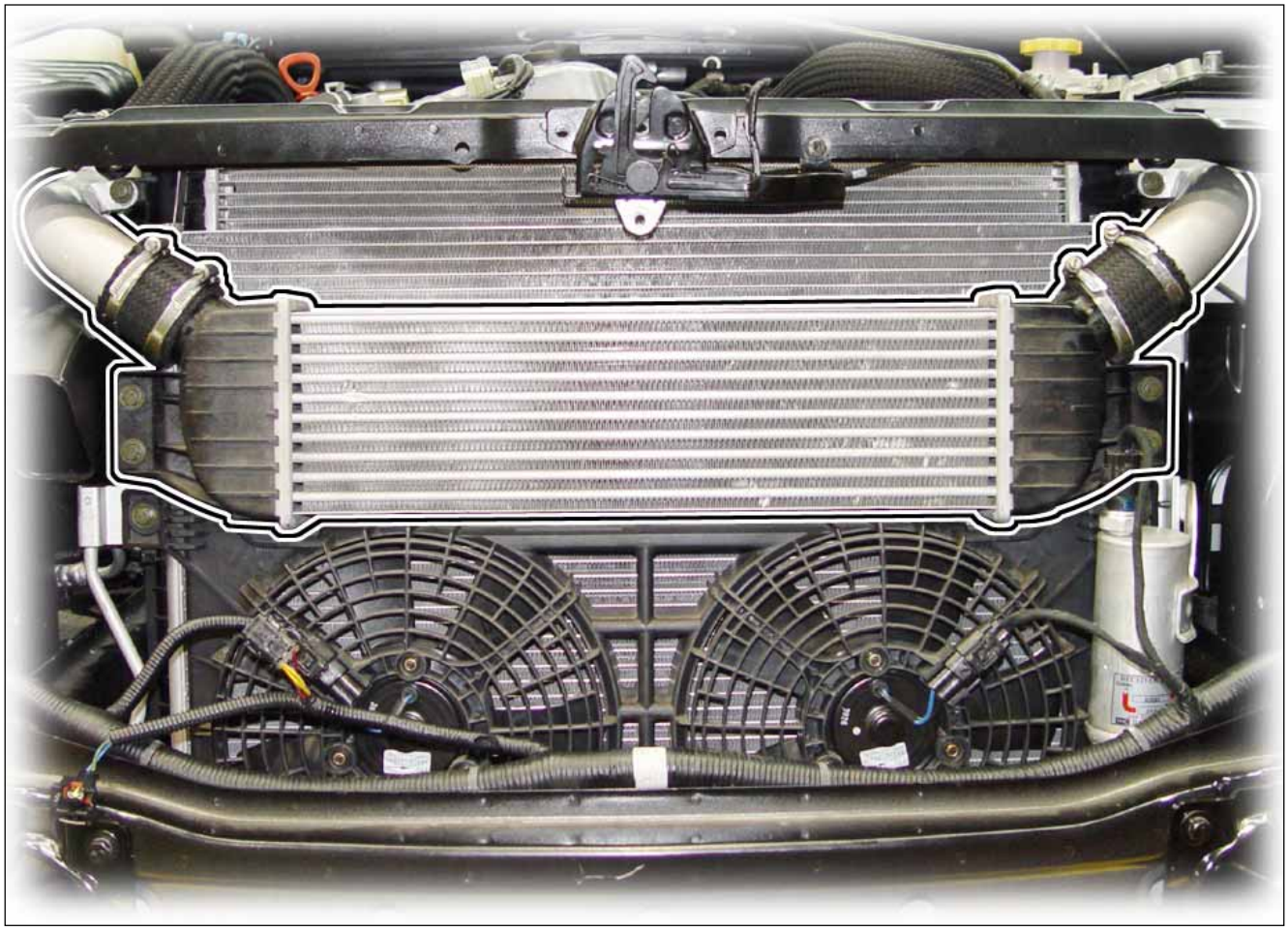
4. Install the reverse order of removal.

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AFFECTED VIN	

INTERCOOLER

The turbo charger is designed to improve the engine power by introducing more air (oxygen) into the engine. However, the intake air is heated (100 ~ 110°C) during the compression process in turbo charger compressor and the density is lowered.

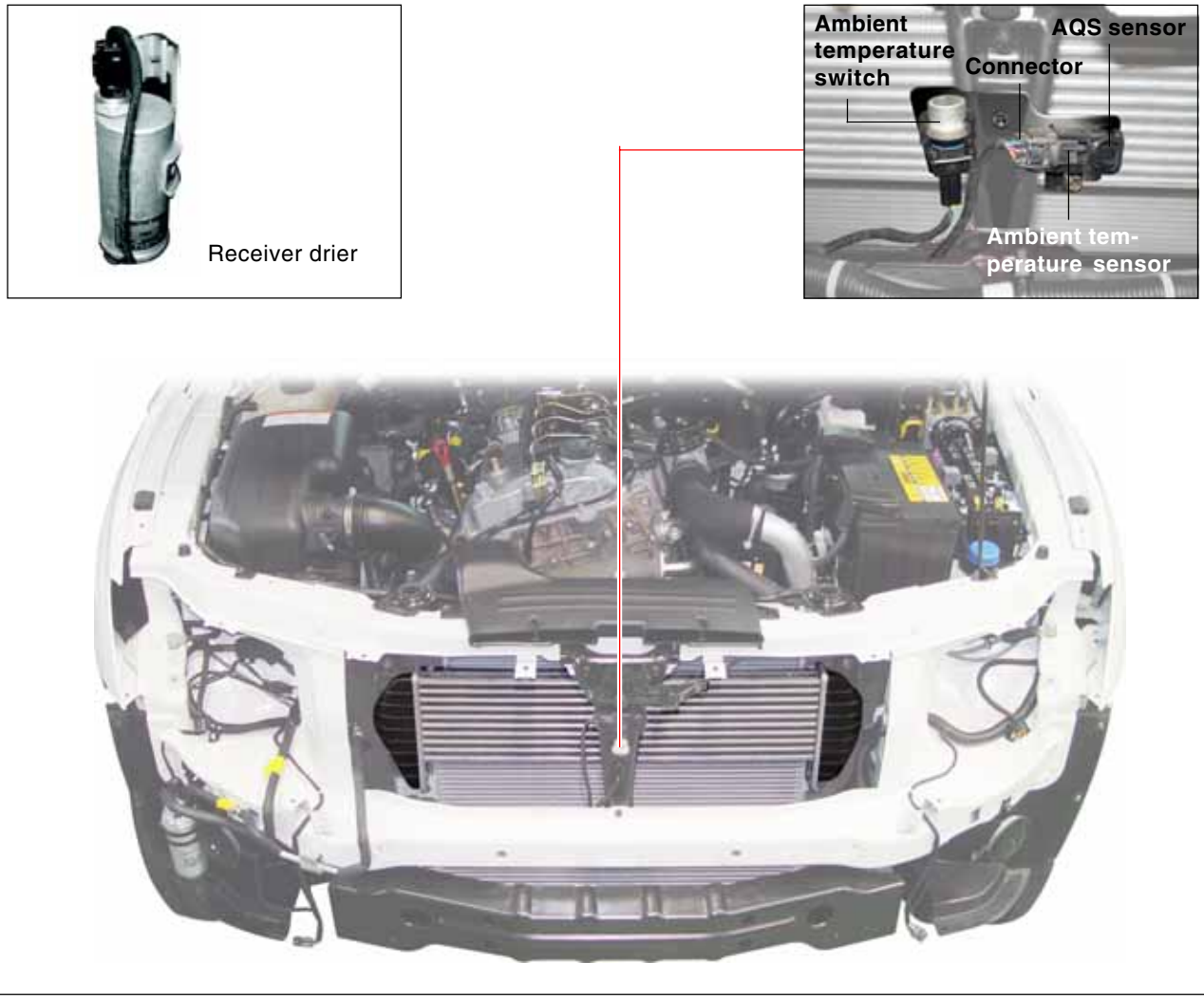
The intercooler is the device which cools (50 ~ 60°C) the air entering the engine. Cold air has more oxygen molecules than warm air. Thus cooler air gives more power and better fuel economy.



1. Intercooler

Intercooler - Removal and Installation

1. Disconnect all wiring harnesses and related connectors from the front side of radiator assembly.



2. Remove the front end center member.



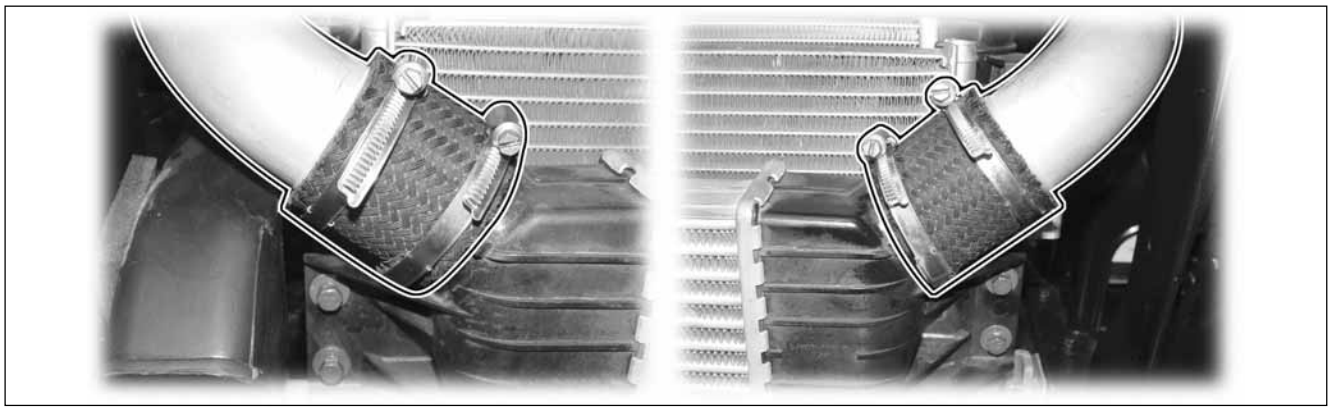
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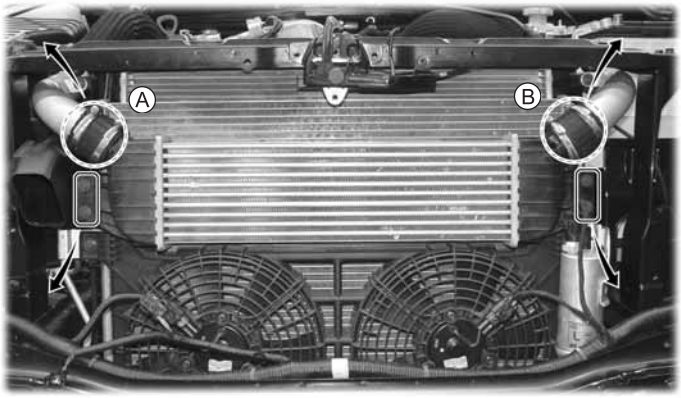
3. Remove the hood latch cable and remove the radiator support upper member.



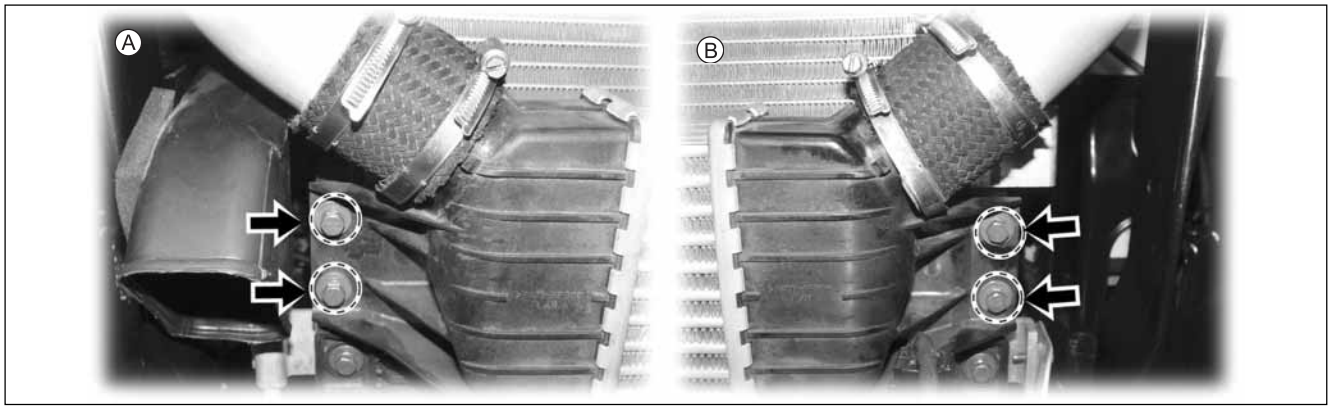
4. Remove the intercooler inlet hose and outlet hose.

Tightening torque	6 ~ 7 Nm



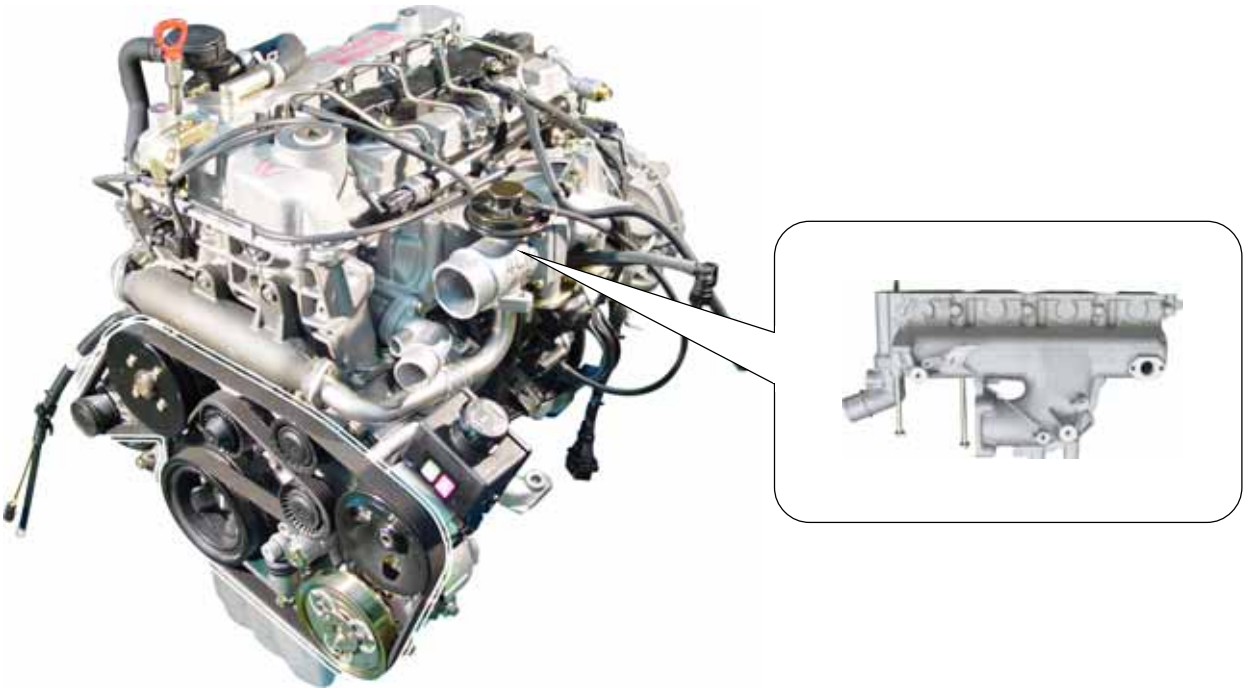


5. Unscrew the bolts and remove the intercooler assembly.



6. Install in the reverse order of removal.

INTAKE MANIFOLD ASSEMBLY

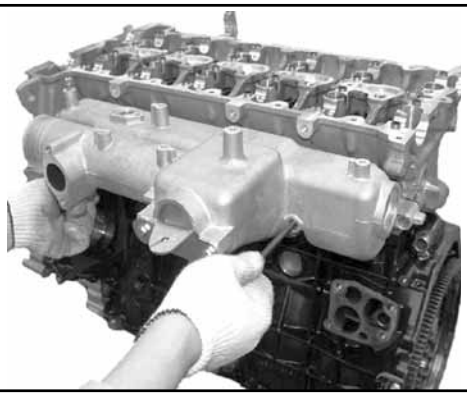


▶ System Characteristics

1. Shape that delivers the required capacity of compressed air from turbo charger to inlet port
2. Optimized EGR gas mixture in inlet chamber
3. Maximized intake efficiency with helical and tangential inlet port
   1) Improving the swirl ratio in low and mid operating range
   2) Improving the acceleration/fuel economy and reducing the maintenance in low and mid operating range
4. Integrated inlet port and coolant outlet port

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Special Tools and Equipment

Name and Part Number	Application
Y99220112B Intake manifold guide pin 	Installation of intake manifold 

Intake Manifold - Removal/Installation

※ **Preceding Work:** Disconnection of negative battery cable



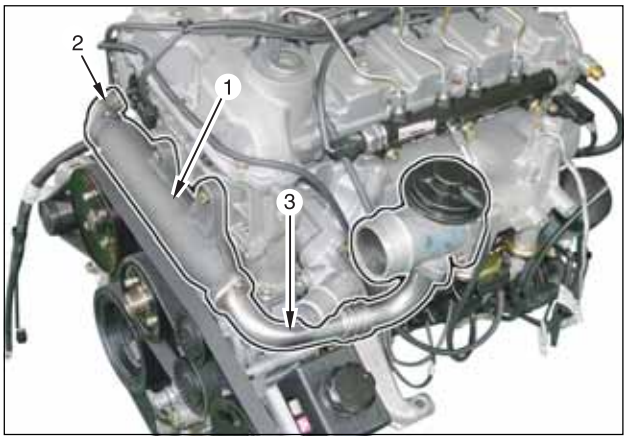
1. Lift up the vehicle and remove the skid plate.
2. Open the coolant reservoir cap and loosen the drain cock to drain the coolant.



3. Remove the air inlet hose (1) from intake manifold.
4. Loosen the clamp and remove the coolant inlet hose (2).



5. Remove the coolant inlet port housing.
6. Remove the vacuum hose from EGR valve.
7. Remove the EGR valve mounting bolts and gasket. Remove the EGR exhaust pipe (primary) mounting bolts and gasket.



NOTICE

- **Replace the pipes (2, 3) at both sides of EGR cooler (1) and gaskets with new ones.**
- **Make sure that the convex surface of gasket is facing to the pressurized direction.**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

8. Remove the brackets and connectors from top section of the engine.
   1) Vacuum hose bracket in turbo charger
   2) Booster pressure sensor
   3) Main wiring bracket
   4) Ground cable bracket
   5) Fuel pressure sensor connector

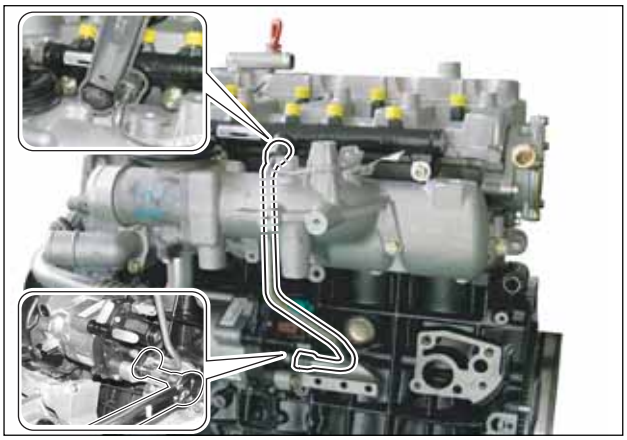


9. Unscrew the bolts and remove the vacuum modulator bracket.

Installation Notice

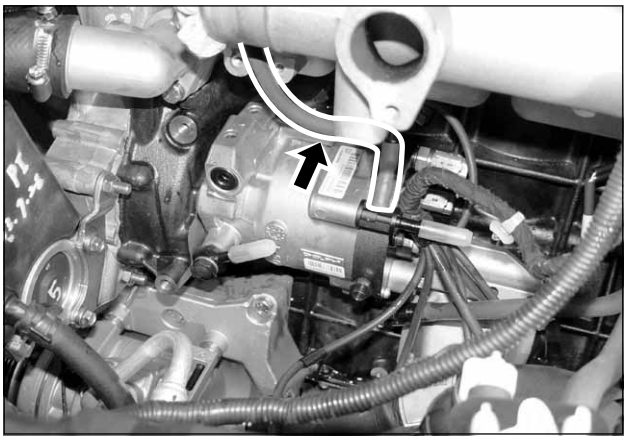
Tightening torque	9.0 Nm

10. Remove the HP pump fuel supply line bolts.
11. Remove the HP pump fuel supply line mounting bracket.
12. Remove the HP pump fuel return line at fuel filter.



NOTICE
- **Plug the openings of pipes and ports with sealing caps to keep the cleanness of the fuel system.**
- **Replace the pipes with new one once removed.**

13. Remove the injector return line at HP pump.



NOTICE
- **Be careful not to damage the pipes to HP pump.**
- **Plug the fuel return port of the HP pump with a sealing cap.**

14. Remove the intake manifold mounting bolts.



Installation Notice

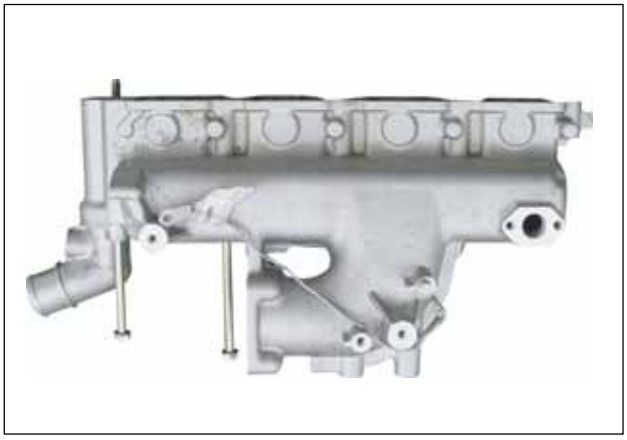
Tightening torque	25 ± 2.5 Nm

Check the length of the bolts before installation.

M8 x 45: 6EA

M8 x 130: 6EA

15. Lift up the vehicle and remove the propeller shaft joint bolts.
16. Unscrew the bolt in oil filter and remove the intake manifold and gasket.



NOTICE

- **Replace the gasket with new one.**
- **Make sure that the residual coolant in intake manifold gets into the inside of inlet port.**

17. Install in the reverse order of removal.

NOTICE

- **Replace the gasket with new one.**
- **If replaced only gasket without any other service operation, completely remove the coolant and other contaminants from the engine before installation.**

EXHAUST SYSTEM

04

TABLE OF CONTENTS

EXHAUST SYSTEM LAYOUT 2

Components locator 2
Exhaust gas flows 3
Turbo charger assembly 5
VGT (Variable Geometry Turbocharger) 24

EGR VALVE AND VACUUM MODULATOR 38

EGR system 38
EGR valve and turbo charger actuator control vacuum circuit ... 39

VACUUM MODULATOR 42

Composition 42
Removal and Installation of EGR Valve 43
Removal and Installation of vacuum modulator assembly 48
Electrical circuit related to vacuum modulator 50

EXHAUST SYSTEM AND MUFFLER 54

Muffler 54
System overview 55

EXHAUST SYSTEM LAYOUT

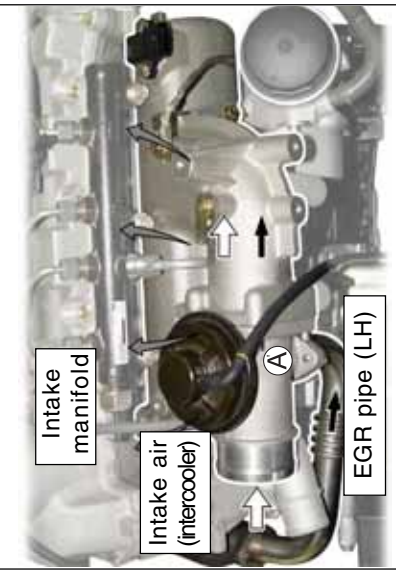
COMPONENTS LOCATOR

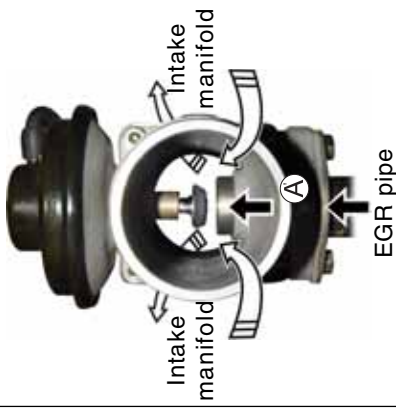


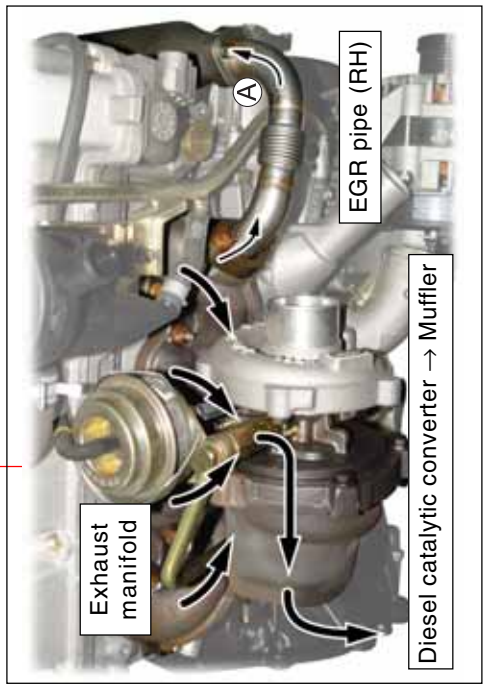
Exhaust Manifold



EGR Valve and Installation Location

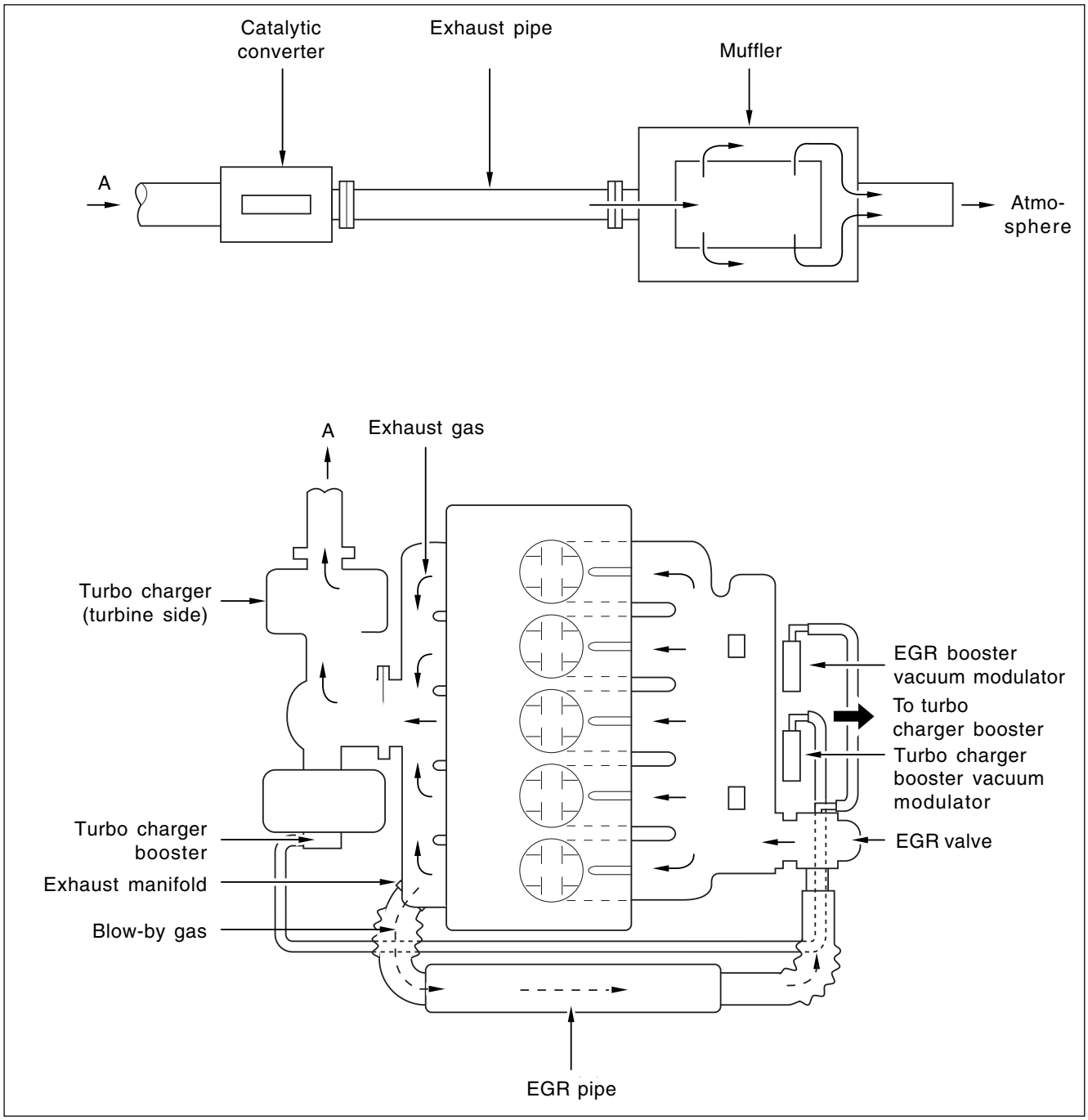


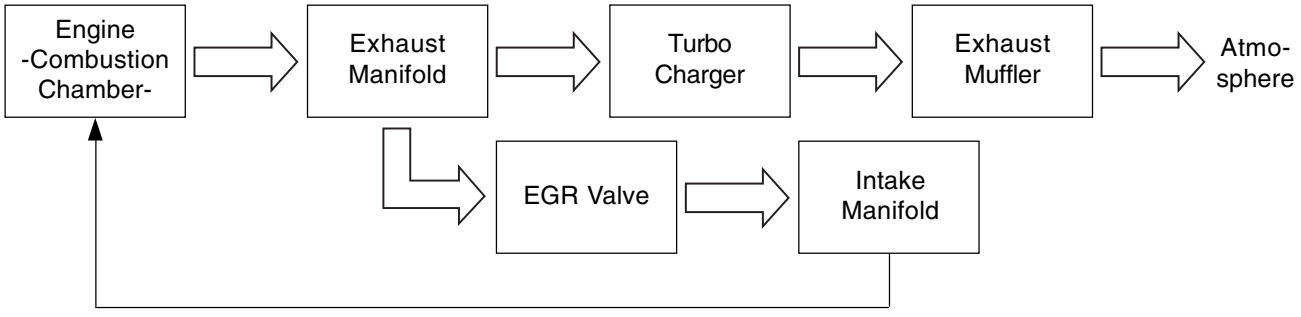




CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

EXHAUST GAS FLOWS





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Exhaust Manifold - Removal and Installation

1. Remove the two intake hoses from the turbo charger.



2. Remove the turbo charger assembly (refer to Turbo Charger section).



3. Remove the #3 pipe of EGR valve from the exhaust manifold.

Installation Notice

Tightening torque	35 ± 3.5 Nm

- ***The #3 pipe of EGR valve is exposed to the high temperature and pressure of exhaust gas. Replace the gasket and pipe with new ones. Otherwise, it may cause the leakage of exhaust gas.***



4. Unscrew the nuts and remove the exhaust manifold and gasket.

Installation Notice

Tightening torque	40 ± 4.0 Nm

- ***Replace the gasket with new one.***

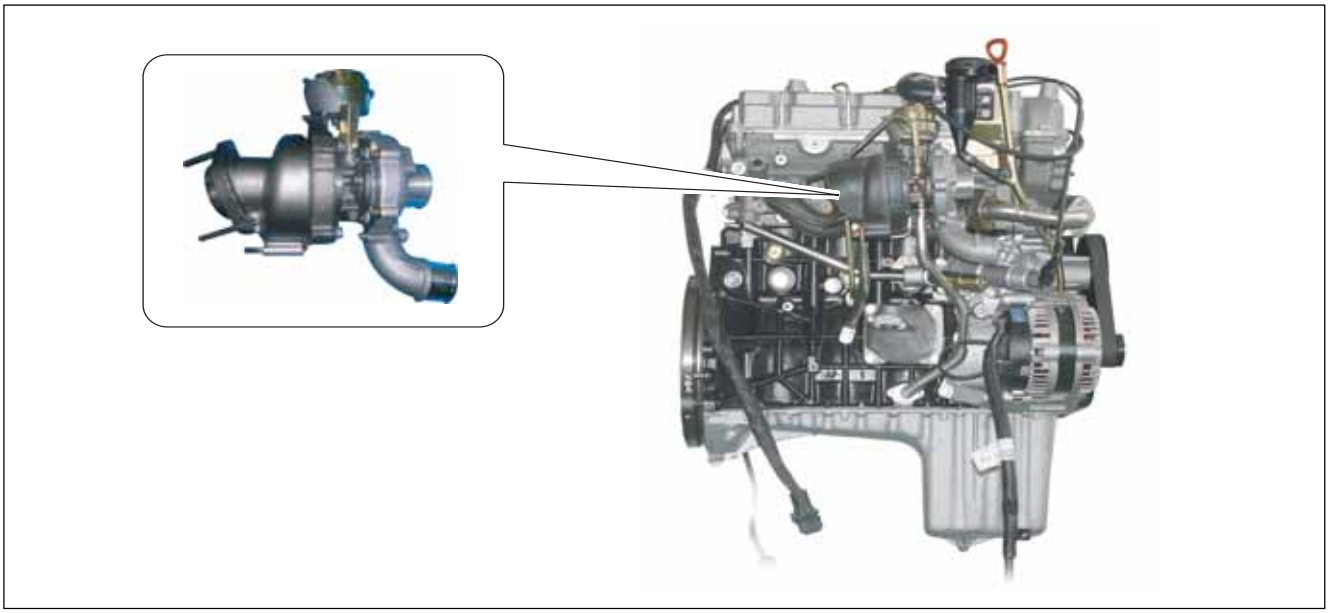
5. Install in the reverse order of removal.



TURBO CHARGER ASSEMBLY

The turbo charger is an air pump installed on the intake manifold. It enhances power and increases torque power of engine to increase the fuel consumption rate. The engine without turbo charger cannot get as much power output as it inducts air by the means of vacuum being generated from descending strokes of the piston. Therefore, by installing the turbo charger on the intake manifold, it supplies great amounts of air to the cylinder increasing the volume efficiency and, subsequently, enhances output power.

Also, as the engine's power enhances, it increases the torque power and improves the fuel consumption rate. The regular turbo charger operates by utilizing the pressure from the exhaust gas and the other, called Super Charger, operates by utilizing power from the engine. When the turbo charger is installed, weight of the engine increases by 10 to 15 % whereas the output power increases by 35 to 45 %.

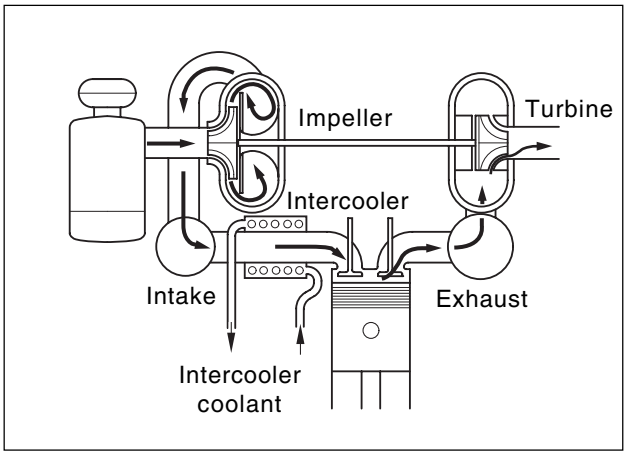


▶ Operating Principle of Turbo Charger

The turbo charger has one shaft where at each ends are installed with two turbines having different angles to connect one end of housing to the intake manifold and the other end to the exhaust manifold. As the turbine, at exhaust end, is rotated by exhaust gas pressure the impeller, at intake end, gets rotated to send air around center of the impeller, being circumferentially accelerated by the centrifugal force, into the diffuser.

The air, which has been introduced to the diffuser having a passage with big surface, transforms its speed energy into the pressure energy while being supplied to the cylinder improving the volume efficiency. Also, the exhaust efficiency improves as the exhaust turbine rotates. The turbo charger is often referred to as the exhaust turbine turbo charger.

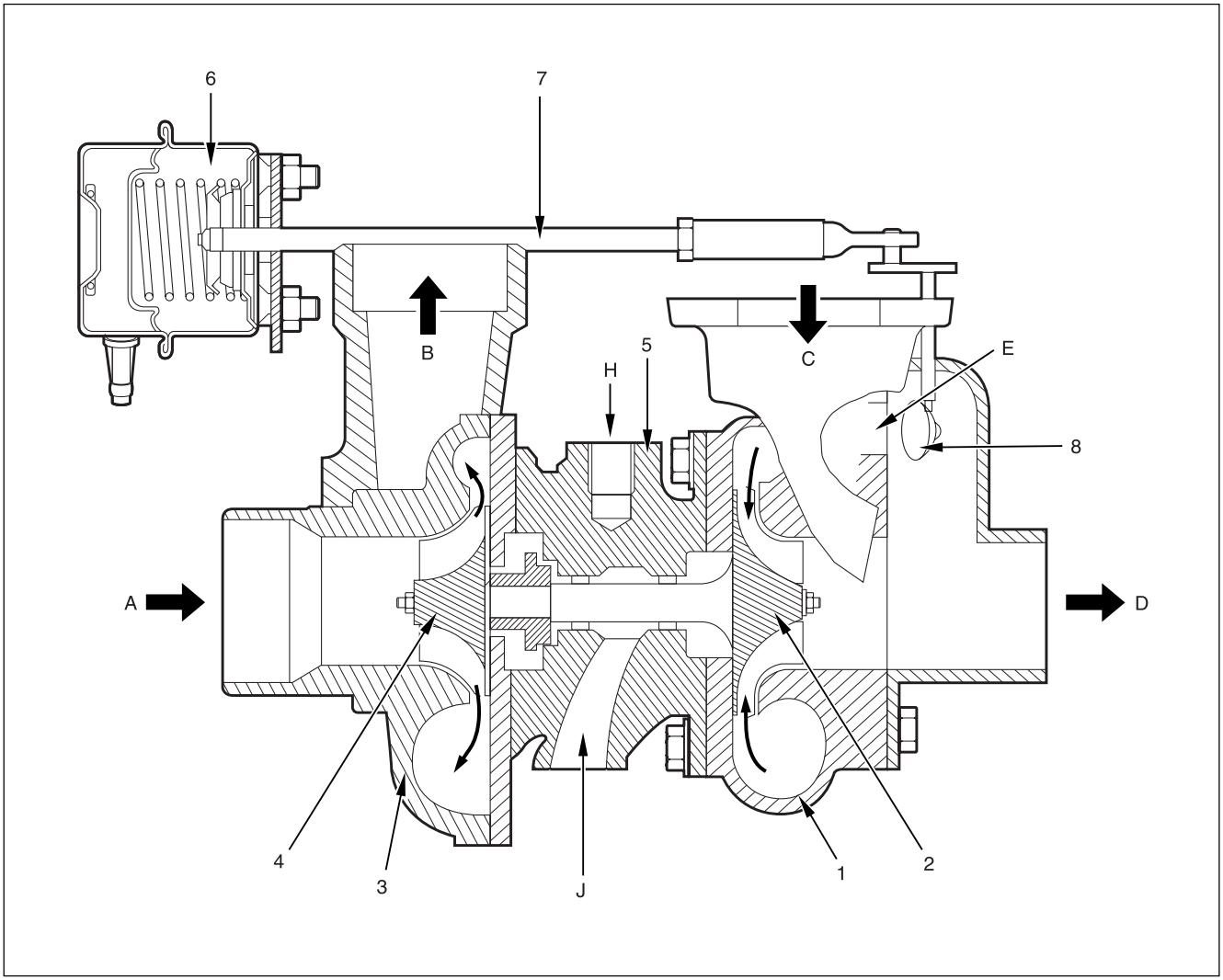
Diffuser: With the meaning of spreading out it is a device that transforms fluid's speed energy into the pressure energy by enlarging the fluid's passage to slow down the flow.



▶ Construction of Turbo Charger

The turbine wheel in turbo charger and compressor wheel are installed at each side of the shaft. It is comprised with the shaft supporting center housing (supporting the compressor with two float journal bearings), the turbine side parts of turbine wheel, shroud and turbine housing, and the compressor side parts of compressor wheel, back plate and compressor housing.

1. The turbine rotates turbine wheel by receiving exhaust gas energy from the engine.
2. The compressor receives torque energy from the turbine and the compressor wheel inducts air to force it inside of the cylinder.



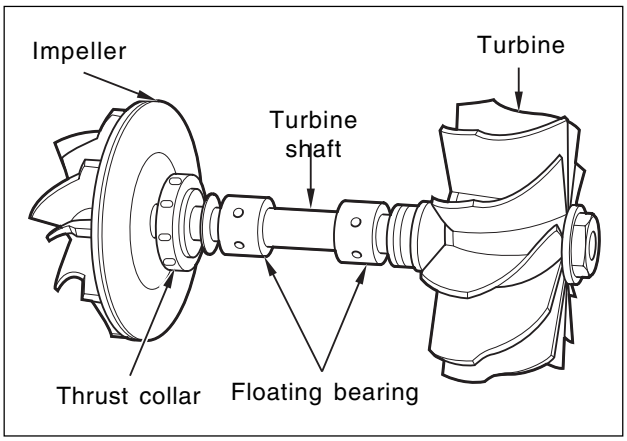
1. Turbine housing
2. Turbine wheel
3. Compressor housing
4. Compressor wheel
5. Center housing
6. Turbo charger booster pressure control valve
7. Control link
8. Bypass flap

A. Air inlet (from atmosphere)
B. Air flow
C. Exhaust gas inlet (from cylinder)
D. Exhaust gas outlet (to atmosphere)
E. Exhaust gas bypass passage
H. Oil supply opening
J. Oil return line

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

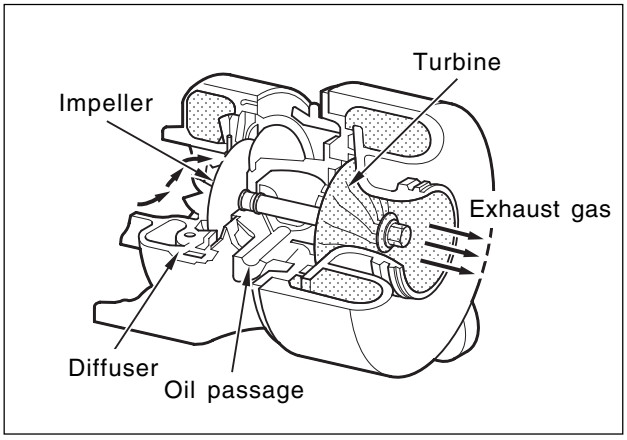
▶ Impeller

The impeller is wings (wheel) installed on the intake end and performs the role of pressurizing air into the cylinder.



The radial type has the impeller plate arranged in straight line at the center of shaft and, compared to the backward type, is being widely used as it is simple, easy to manufacture and appropriate for high speed rotation. As the impeller rotates in the housing with the diffuser installed in it, the air receives centrifugal force to be accelerated in the direction of housing's outer circumference and flows into the diffuser.

As surface of the passage increases, air flown into the diffuser transforms its speed energy into pressure energy and flows into the intake manifold where the pressurized air is supplied to cylinder each time the intake valve of cylinder opens up. Therefore, the efficiency of compressor is determined by the impeller and diffuser.



▶ Turbine

The turbine is wings installed at the exhaust end where, by the pressure of exhaust gas, it rotates the compressor and performs the role of transforming heat energy of exhaust gas into torque energy. The radial type is used as the turbine's wings. Therefore, during operation of the engine, the turbine receives temperature of exhaust gas and it rotates in high speed, it requires to have sufficient rigidity and heat resisting property.

During operation of the engine, exhaust gas discharged through the exhaust valve of each cylinder makes turbine rotate by coming in contact with the turbine's wings from the outer circumference within housing of the turbine and is exhausted through the exhaust manifold. At the same time, as the impeller is on the same shaft, it rotates.

▶ Floating Bearing

Floating Bearing is a bearing, which supports the turbine shaft that rotates at about 10,000 to 15,000 rpm. It could be rotated freely between the housing and the shaft as it gets lubricated by oil being supplied from the engine.

NOTICE

- **Stopping the engine immediately after driving at high speed stops oil from being supplied to the bearing and may cause it to get burnt. Therefore, the engine must be stopped after cooling the turbo system by sufficiently idling the engine.**

▶ Booster Pressure Control Valve Unit (Turbo Charger Actuator)

In order to reduce discharging of hazardous exhaust gas and to avoid the engine's overrun the turbo charger must be appropriately controlled. The maximum turbo charging pressure must be controlled as excessive increase in the pressure and power output can cause critical damages to the engine. In order to control these, the booster pressure control valve is installed on the turbo charger.

The difference of the booster pressure control between the existing IDI engine and DI engine is that in IDI engine, booster pressure of the intake manifold operates the booster pressure control valve connected directly to the turbo charger whereas in DI engine, the control is achieved by utilizing vacuum modulator (vacuum from a vacuum pump) designed to control the booster pressure control valve. It operates booster pressure control valve by supplying electrical power to the vacuum modulator having the amount of air being flown into the HFM sensor from the engine's ECU as the base signal.

Refer to the EGR section in following pages for the function of turbo charger and HFM sensor in exhaust system.

Booster pressure control valve unit and vacuum modulator



Turbo charger booster

Turbo charger booster vacuum modulator

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Diagnosis and Maintenance for Turbo Charger System

Cautions During Driving

The following lists cautions to take during test drive and on the turbo charger vehicle, which must be considered during the operation;

1. It's important not to drastically increase the engine rpm starting the engine. It could make rotation at excessive speed even before the journal bearing is lubricated and when the turbo charger rotates in poor oil supply condition, it could cause damage of bearing seizure within few seconds.
2. If the engine is running radically after replacing the engine oil or oil filter brings poor oil supply condition. To avoid this, it's necessary to start off after idling the engine for about 1 minute allowing oil to circulate to the turbo charger after the replacement.
3. When the engine is stopped abruptly after driving at high speed, the turbo charger continues to rotate in condition where the oil pressure is at '0'. In such condition, an oil film between the journal bearing and the housing shaft journal section gets broken and this causes abrasion of the journal bearing due to the contact of metal parts. The repeat of such condition significantly reduces life of the turbo charger. Therefore, the engine should be stopped possibly in the idle condition.

NOTICE

- **After string for long period of time during winter season or in the low temperature condition where the fluidity of engine oil declines, the engine, before being started, should be cranked to circulate oil and must drive after checking the oil pressure is in normal condition by idling the engine for few minutes.**

Inspection of Turbo Charger

When problem occurs with the turbo charger, it could cause engine power decline, excessive discharge of exhaust gas, outbreak of abnormal noise and excessive consumption of oil.

1. Inspection when installed
   1) Check the bolts and nuts for looseness or missing
   2) Check the intake and exhaust manifold for looseness or damage
   3) Check the oil supply pipe and drain pipe for damages
   4) Check the housing for crack and deterioration
2. Inspection of turbine in turbo charger

   Remove the exhaust pipe at the opening of the turbine and check, with a lamp, the existence of interference of housing and wheel, oil leakage and contamination (at blade edge) of foreign materials.
   1) Interference: In case where the oil leak sign exists, even the small traces of interferences on the turbine wheel mean, most of times, that abrasion has occurred on the journal bearing. Must inspect after overhauling the turbo charger.
   2) Oil Leakage: Followings are the reasons for oil leakage condition;
      - Problems in engine: In case where the oil is smeared on inner wall section of the exhaust gas opening.
      - Problems in turbo charger: In case where the oil is smeared on only at the exhaust gas outlet section.

NOTICE

- **Idling for long period of time can cause oil leakage to the turbine side due to low pressure of exhaust gas and the rotation speed of turbine wheel. Please note this is not a turbo charger problem.**

3) Oil Drain Pipe Defect

In case where oil flow from the turbo charger sensor housing to the crank case is not smooth would become the reason for leakage as oil builds up within the center housing. Also, oil thickens (sludge) at high temperature and becomes the indirect reason of wheel hub section. In such case, clogging and damage of the oil drain pipe and the pressure of blow-by gas within the crank case must be inspected.

4) Damages from Foreign Materials

When the foreign materials get into the system, it could induce inner damage as rotating balance of the turbo charger gets out of alignment.

Inspection of Turbine

Thoroughly check the followings.

NOTICE

- **Must absolutely not operate the turbo charger with the compressor outlet and inlet opened as it could damage the turbo charger or be hazardous during inspection.**

1. Interference: In case where is trace of interference or smallest damage on the compressor wheel means, most of times, that abrasion has occurred on the journal bearing. Must inspect after the overhaul.
2. Oil Leakage: The reason for oil leakage at the compressor section is the air cleaner, clogged by substances such as dust, causes the compressor inlet negative pressure;
   1) Rotating in high speed at no-load for extended period of time can cause oil leakage to the compressor section as oil pressure within the center housing gets higher than pressure within the compressor housing.
   2) Overuse of engine break (especially in low gear) in down hill makes significantly low exhaust gas energy compared to the time where great amount of air is required during idling conditions of the engine. Therefore, amount of air in the compressor inlet increases but the turbo charge pressure is not high, which makes negative pressure at the compressor section causing the oil leakage within the center housing.

NOTICE

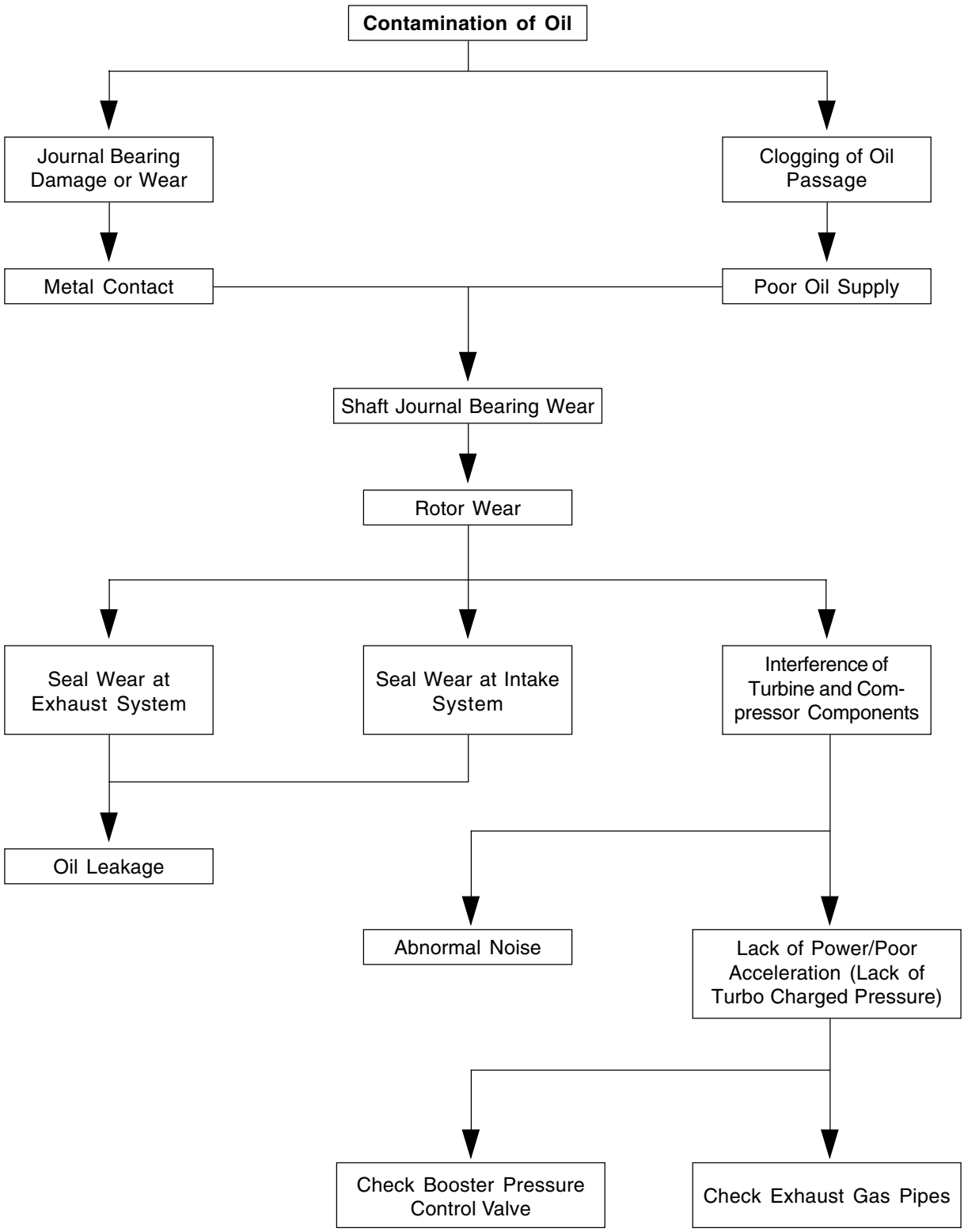
- **No problem will occur with the turbo charger if above conditions are found in early stage but oil leaked over long period of time will solidify at each section causing to breakout secondary defects.**

3. Damages by foreign materials: In case where the compressor wheel is damaged by foreign materials requires having an overhaul. At this time, it's necessary to check whether the foreign materials have contaminated intake/exhaust manifold or inside of engine.

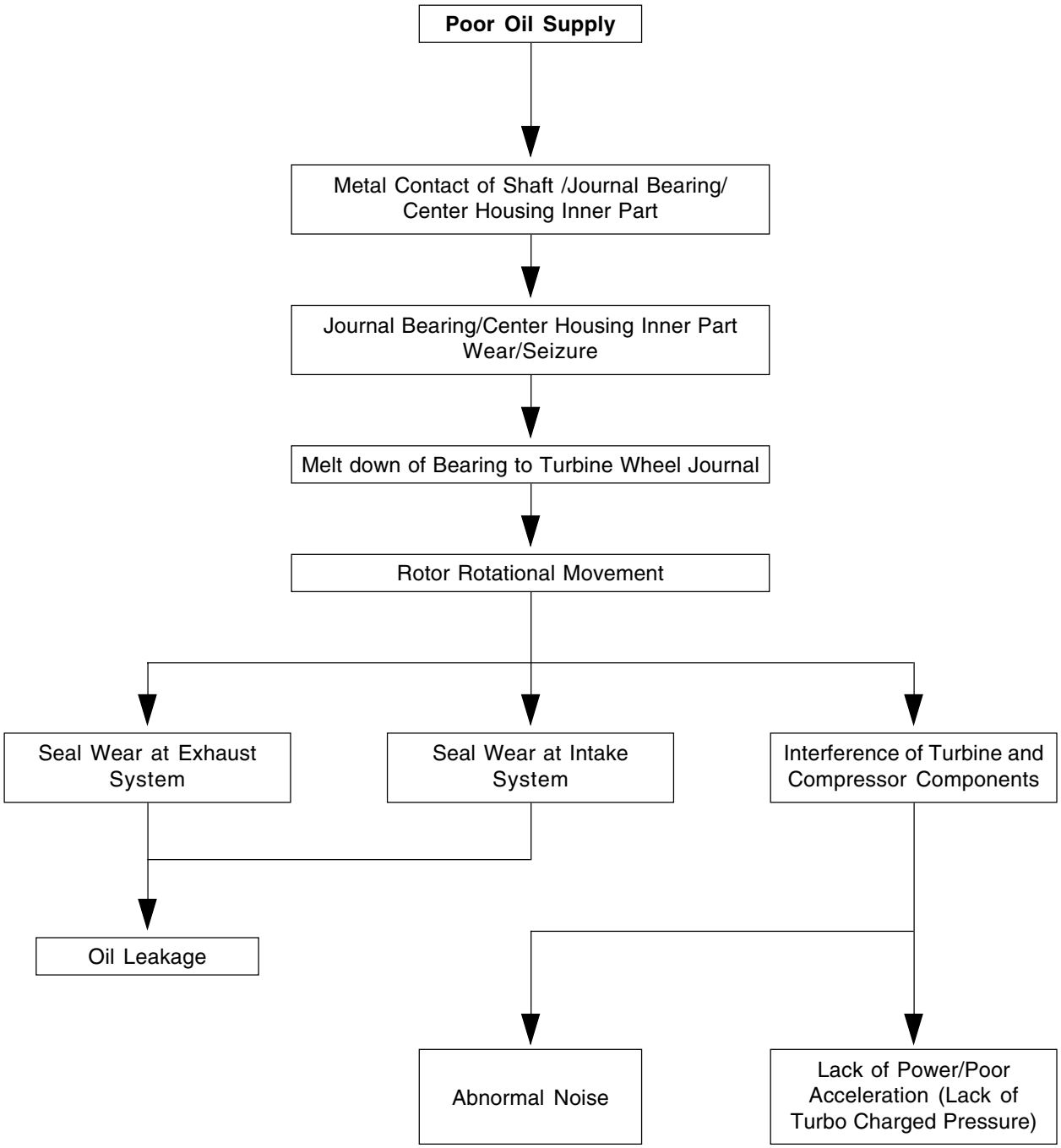
Path of Turbo Charger Defect

The following tries to understand the defects that can occur with vehicle installed with the turbo charger and to manage the reasons of such defects.

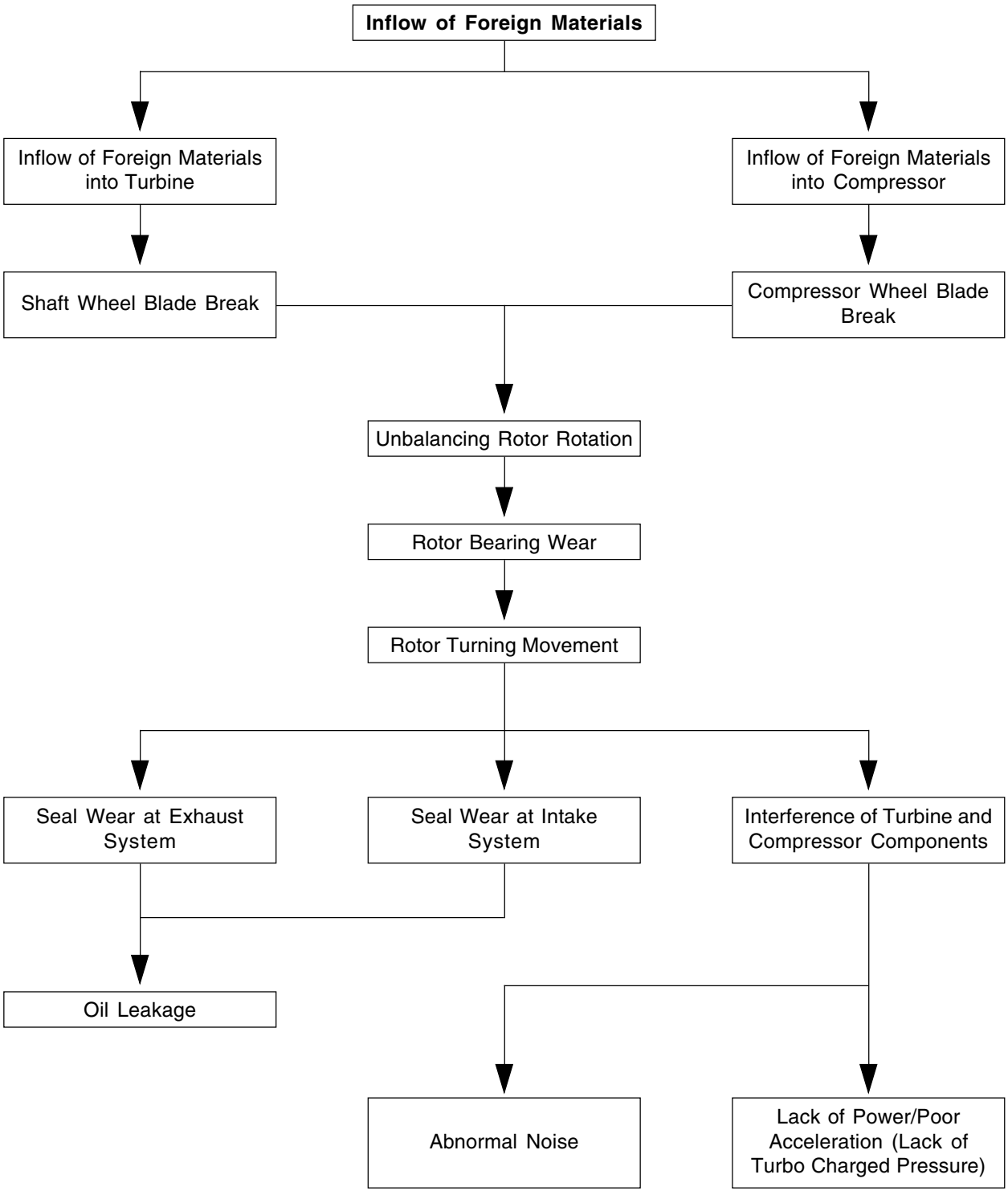
1. In case where oil pan/oil pipe has been contaminated, oil filter is defected and where adhesive of gaskets has been contaminated into the oil line.



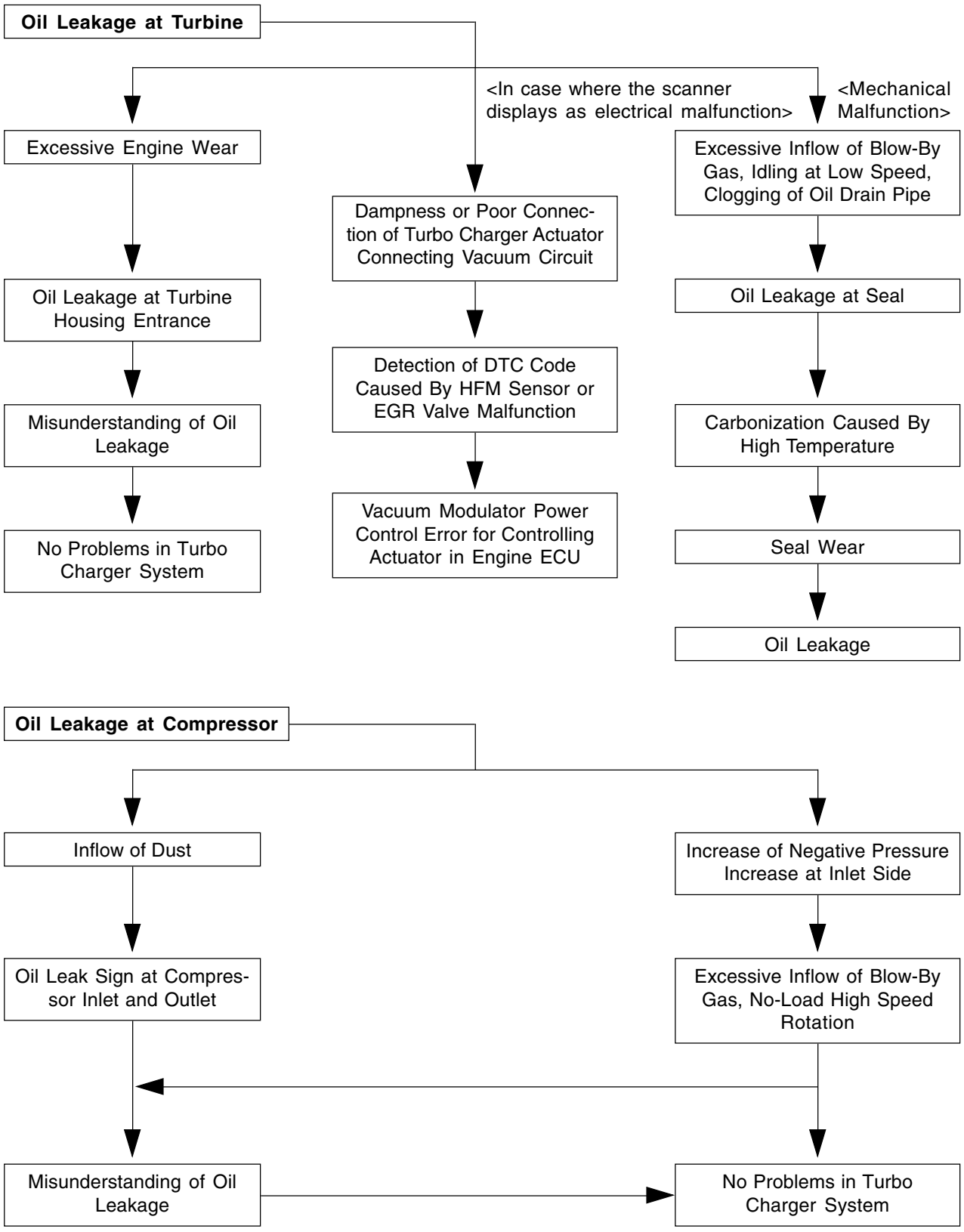
2. Oil Pump Defect: Rapid over-loaded driving after replacing oil filter and oil and clogging of oil line.



3. Turbine Side: Inflow of foreign materials from engine
Compressor Side: such as air filter, muffler and nut



4. Defects caused by reasons other than that of the turbo charger.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

How to Diagnose

The followings are cautions to take in handling defects of turbo charger, which must be fully aware of;

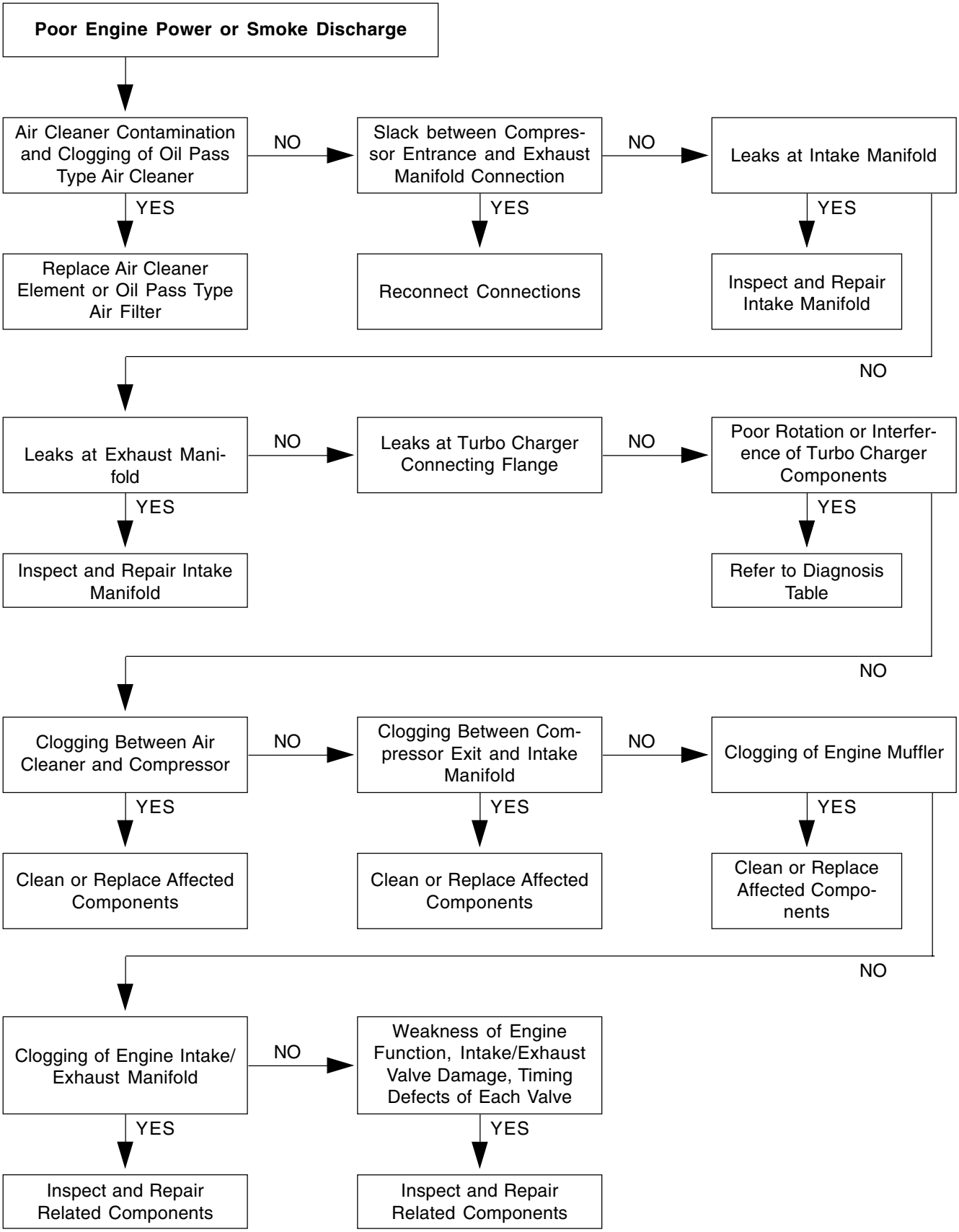
Cautions When Examining the Defects:

1. After stopping the engine, check whether the bolts on pipe connecting section are loose as well as the connecting condition of vacuum port and modulator, which is connected to the actuator.
2. During idling of the engine, check for leakage in the connecting section of pipe (hoses and pipes, duct connections, after the turbo charger) by applying soap water. The leakage condition in the engine block and turbine housing opening can be determined by the occurrence of abnormal noise of exhaust.
3. By running the engine at idle speed, abnormal vibration and noise can be checked. Immediately stop the engine when abnormal vibration and noise is detected and make thorough inspection whether the turbo charger shaft wheel has any damages as well as checking the condition of connections between pipes.
4. In case where the noise of engine is louder than usual, there is possibility of dampness in the areas related with air cleaner and engine or engine block and turbo charger. And it could affect the smooth supply of engine oil and discharge.
5. Check for damp condition in exhaust gas when there is sign of thermal discoloration or discharge of carbon in connecting area of the duct.
6. When the engine rotates or in case where there is change in noise level, check for clogging of air cleaner or air cleaner duct or if there is any significant amount of dust in the compressor housing.
7. During the inspection of center housing, inspect inside of the housing by removing the oil drain pipe to check for sludge generation and its attachment condition at shaft area or turbine side.
8. Inspect or replace the air cleaner when the compressor wheel is damaged by inflow of foreign materials.
9. Inspect both side of the turbo charger wheel after removing inlet and outlet pipe of the turbo charger.
   1) Is the rotation smooth when the rotor is rotated by hand?
   2) Is the movement of bearing normal?
   3) Inspect whether there has been any signs of interference between two wheels.

NOTICE

- **It's important not to drive the engine when the intake manifold hose has been removed.**

Diagnosis and Measure



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Before Diagnosis

The base of making diagnosis on the EGR related system is the inspection on the connections of the vacuum hoses in related system as the first priority. When abnormal condition occurs with the EGR system, the basic approach is, as described in prior sentence, making detail inspections of vacuum circuits of each system before connecting the scan tool or vacuum tester. It is necessary to manually check on the connections if there are any slacks or loose circuits even if the visual inspection shows vacuum hose as being connected. If there are not any problems then the next inspection area is the connections of the system connectors. Most problems with the occurrence of system malfunction are from conditions of vacuum line and connector connections and the causes from the malfunction of mechanical mechanism is actually very few.

For example, when there are no problems with basic components, let's assume that there is a vehicle having vacuum leak from connection slack in the vacuum line between EGR vacuum modulator and EGR valve. This vehicle, due to the driving condition or, according to the circumstances, smog or other conditions, could create customer's complaint and by connecting the scanning device could display as the malfunction of the EGR valve's potentiometer.

As previously explained, this car has a separate controller to control the HUBER EGR and, in accordance with various input element, the controller controls EGR valve by regulating the force of vacuum being applied to the EGR valve through PWM control. At this time, the controller has to receive feedback whether the EGR valve operates correctly according to the value sent to the EGR modulator and this role is performed by the EGR potentiometer located at top section of the EGR valve.

In other word, the controller sent correct output value to the EGR vacuum modulator but, due to the leakage of vacuum, signal of required value can not be received from the EGR potentiometer causing to display as malfunction of related parts.

As a reference, the EGR valve of diesel vehicle (DI Engine) controlling from the engine ECU to EGR system has different shape than the HUBER EGR valve because the EGR valve's operation signal in the DI engine is performed by the HFM sensor instead of the EGR potentiometer.

This principle is that when the EGR valve opens up to flow exhaust gas into the intake unit the amount of fresh air, comparatively, will be reduced. The DI engine ECU receives feedback signal of change in amount of air being passed through the HFM sensor according to the opening amount of the EGR valve.

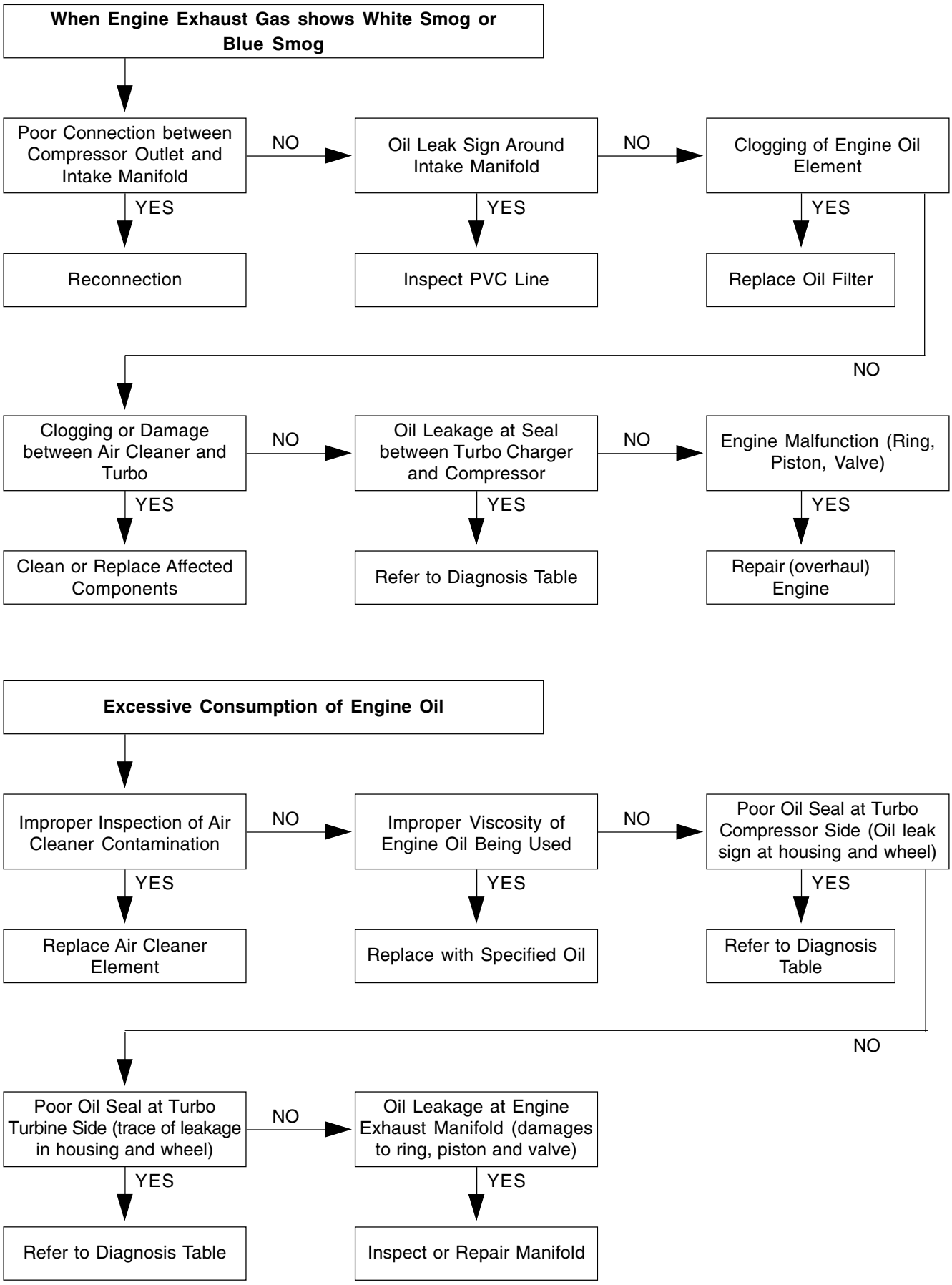


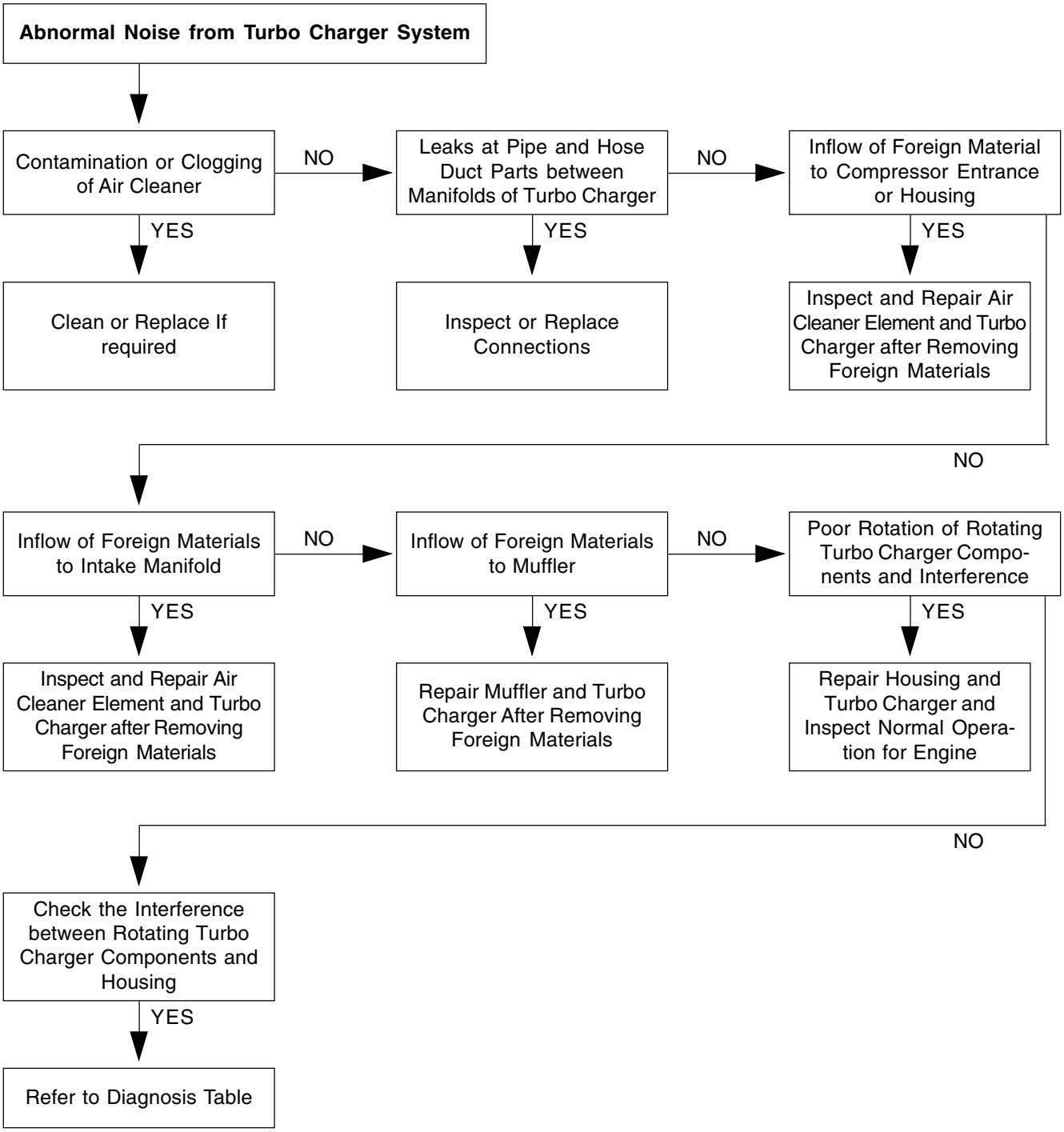
HUBER EGR System for IDI Engine
(Including the EGR Valve Potentiometer)

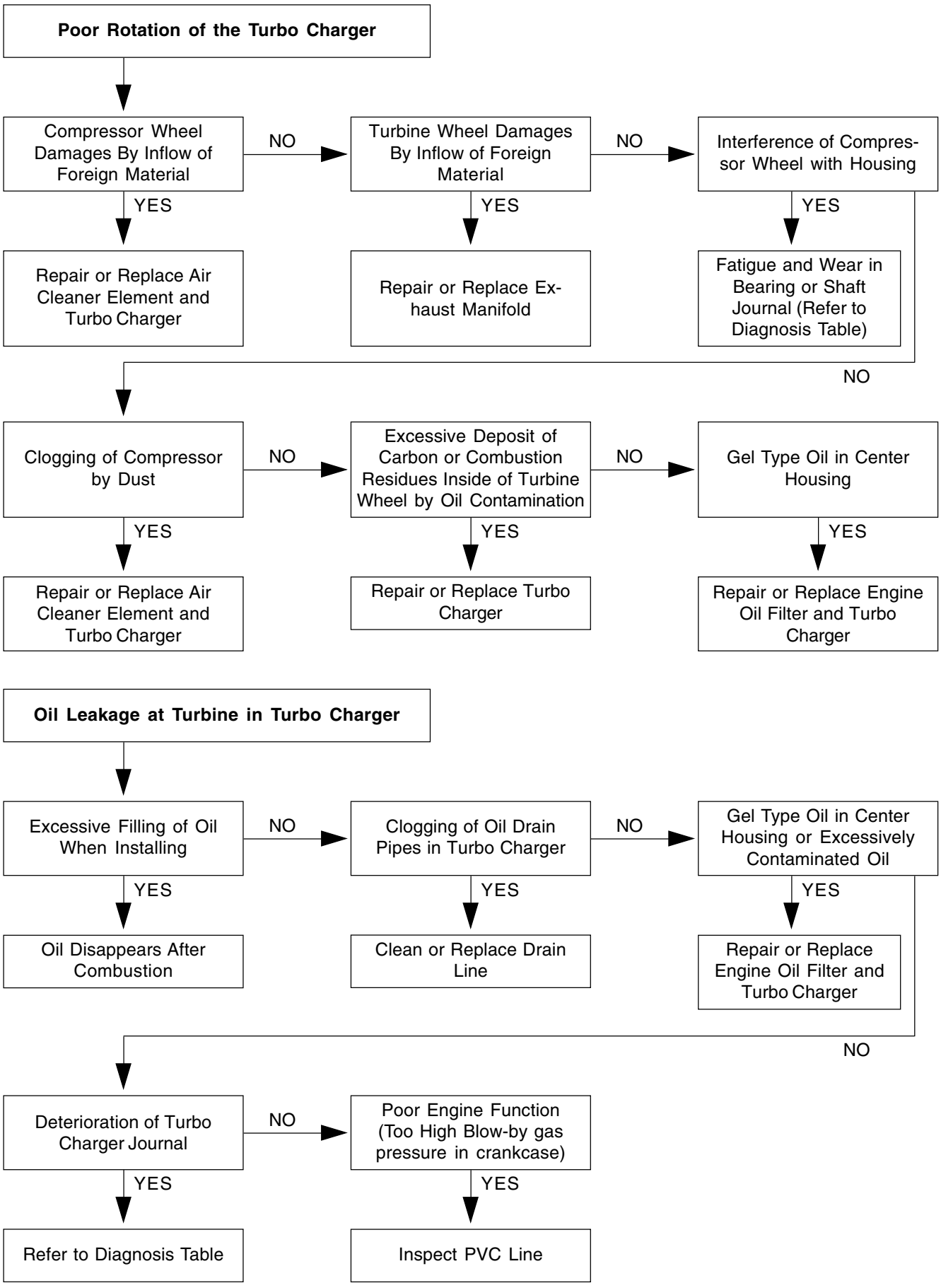
The other big difference between the HUBER EGR and EGR controller for DI engine is that from two vacuum modulator, one is same as being the modulator for EGR valve whereas the HUBER EGR system's the other modulator controls ALDA of injection pump and the DI engine's the other modulator controls waist gate of the turbo charger.

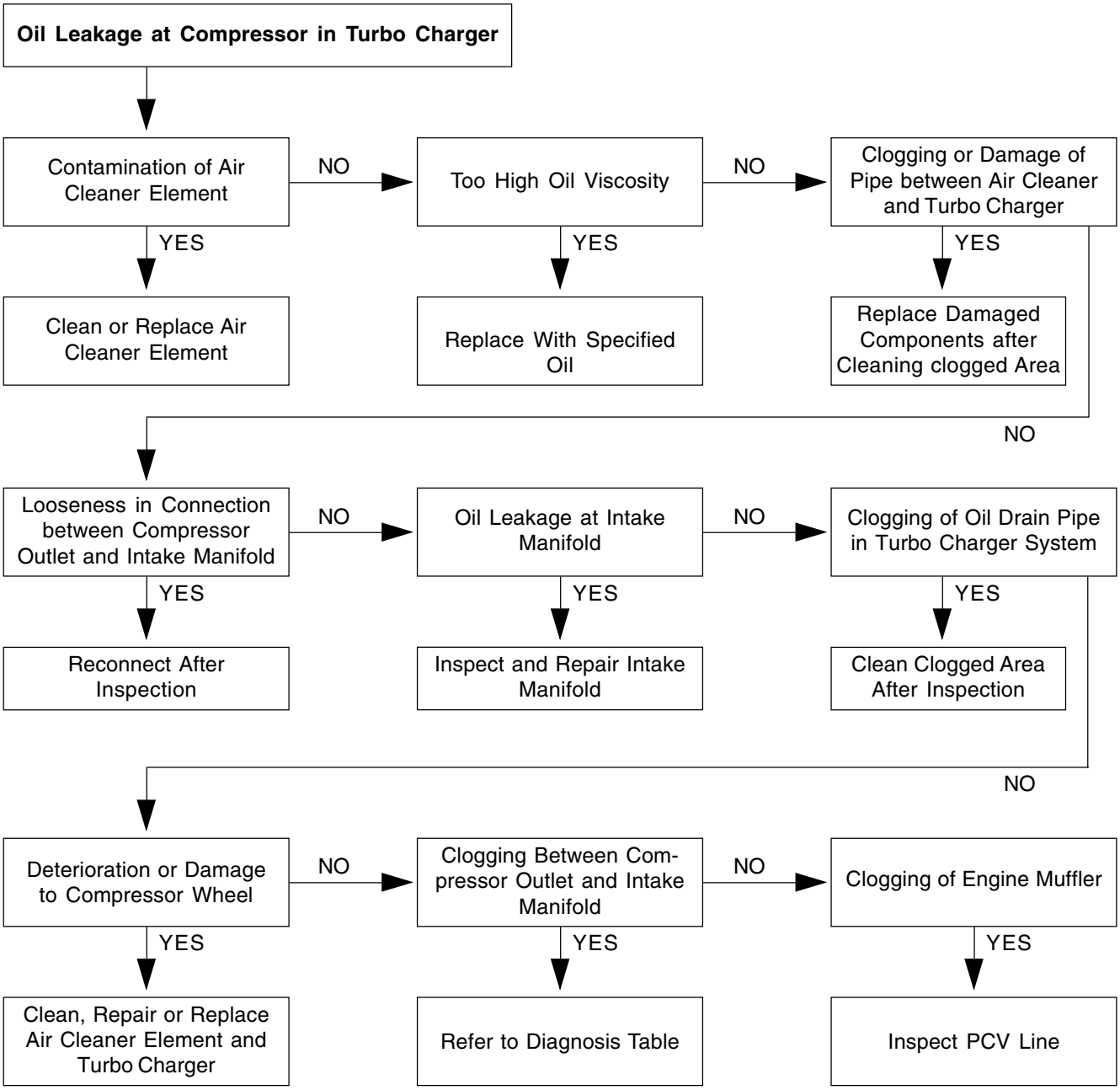
This difference is in accordance with the difference in fuel injection method where the IDI engine has mechanical injection system and DI engine is capable of making electronically controlled fuel injection.

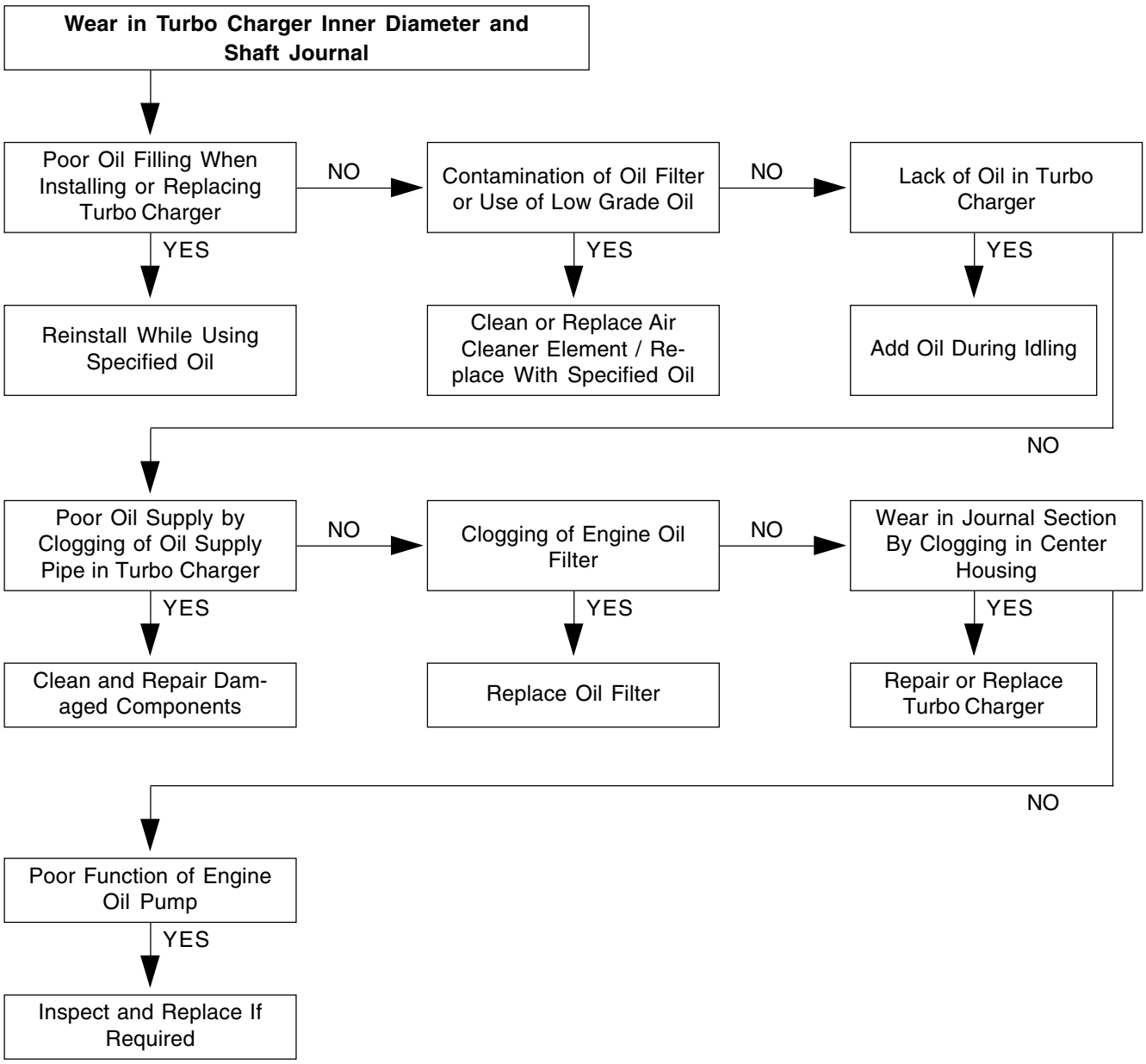
In other word, to reduce the amount of the fuel injection in no-load rapid acceleration mode, the IDI engine's HUBER EGR utilizes solenoid valve to disconnect the connection circuit between intake manifold and ALDA causing negative pressure to occur in the vacuum modulator to reduce the amount of fuel injection. When DI engine, basing input signal from the related sensors such as acceleration pedal sensor and engine RPM, recognizes that current mode is the no-load rapid acceleration mode it reduces the amount of fuel injection by sending short electrical signal to the injector. Therefore, disregarding the modulator for the EGR valve in DI engine, one must keep in mind that the other modulator is used to control the booster pressure valve in turbo charger.


When Engine Exhaust Gas shows White Smog or Blue Smog
Poor Connection between Compressor Outlet and Intake Manifold
NO
Oil Leak Sign Around Intake Manifold
NO
Clogging of Engine Oil Element
YES
YES
YES
Reconnection
Inspect PVC Line
Replace Oil Filter
NO
Clogging or Damage between Air Cleaner and Turbo
NO
Oil Leakage at Seal between Turbo Charger and Compressor
NO
Engine Malfunction (Ring, Piston, Valve)
YES
YES
YES
Clean or Replace Affected Components
Refer to Diagnosis Table
Repair (overhaul) Engine
Excessive Consumption of Engine Oil
Improper Inspection of Air Cleaner Contamination
NO
Improper Viscosity of Engine Oil Being Used
NO
Poor Oil Seal at Turbo Compressor Side (Oil leak sign at housing and wheel)
YES
YES
YES
Replace Air Cleaner Element
Replace with Specified Oil
Refer to Diagnosis Table
NO
Poor Oil Seal at Turbo Turbine Side (trace of leakage in housing and wheel)
NO
Oil Leakage at Engine Exhaust Manifold (damages to ring, piston and valve)
YES
YES
Refer to Diagnosis Table
Inspect or Repair Manifold


Abnormal Noise from Turbo Charger System
Contamination or Clogging of Air Cleaner
NO
Leaks at Pipe and Hose Duct Parts between Manifolds of Turbo Charger
NO
Inflow of Foreign Material to Compressor Entrance or Housing
YES
YES
YES
Clean or Replace If required
Inspect or Replace Connections
Inspect and Repair Air Cleaner Element and Turbo Charger after Removing Foreign Materials
NO
Inflow of Foreign Materials to Intake Manifold
NO
Inflow of Foreign Materials to Muffler
NO
Poor Rotation of Rotating Turbo Charger Components and Interference
YES
YES
YES
Inspect and Repair Air Cleaner Element and Turbo Charger after Removing Foreign Materials
Repair Muffler and Turbo Charger After Removing Foreign Materials
Repair Housing and Turbo Charger and Inspect Normal Operation for Engine
NO
Check the Interference between Rotating Turbo Charger Components and Housing
YES
Refer to Diagnosis Table


Poor Rotation of the Turbo Charger
Compressor Wheel Damages By Inflow of Foreign Material
NO
Turbine Wheel Damages By Inflow of Foreign Material
NO
Interference of Compressor Wheel with Housing
YES
YES
YES
Repair or Replace Air Cleaner Element and Turbo Charger
Repair or Replace Exhaust Manifold
Fatigue and Wear in Bearing or Shaft Journal (Refer to Diagnosis Table)
NO
Clogging of Compressor by Dust
NO
Excessive Deposit of Carbon or Combustion Residues Inside of Turbine Wheel by Oil Contamination
NO
Gel Type Oil in Center Housing
YES
YES
YES
Repair or Replace Air Cleaner Element and Turbo Charger
Repair or Replace Turbo Charger
Repair or Replace Engine Oil Filter and Turbo Charger
Oil Leakage at Turbine in Turbo Charger
Excessive Filling of Oil When Installing
NO
Clogging of Oil Drain Pipes in Turbo Charger
NO
Gel Type Oil in Center Housing or Excessively Contaminated Oil
YES
YES
YES
Oil Disappears After Combustion
Clean or Replace Drain Line
Repair or Replace Engine Oil Filter and Turbo Charger
NO
Deterioration of Turbo Charger Journal
NO
Poor Engine Function (Too High Blow-by gas pressure in crankcase)
YES
YES
Refer to Diagnosis Table
Inspect PVC Line


Oil Leakage at Compressor in Turbo Charger
Contamination of Air Cleaner Element
NO
Too High Oil Viscosity
NO
Clogging or Damage of Pipe between Air Cleaner and Turbo Charger
YES
YES
YES
Clean or Replace Air Cleaner Element
Replace With Specified Oil
Replace Damaged Components after Cleaning clogged Area
NO
Looseness in Connection between Compressor Outlet and Intake Manifold
NO
Oil Leakage at Intake Manifold
NO
Clogging of Oil Drain Pipe in Turbo Charger System
YES
YES
YES
Reconnect After Inspection
Inspect and Repair Intake Manifold
Clean Clogged Area After Inspection
NO
Deterioration or Damage to Compressor Wheel
NO
Clogging Between Compressor Outlet and Intake Manifold
NO
Clogging of Engine Muffler
YES
YES
YES
Clean, Repair or Replace Air Cleaner Element and Turbo Charger
Refer to Diagnosis Table
Inspect PCV Line



※ For other diagnosis, refer to Diagnosis section.

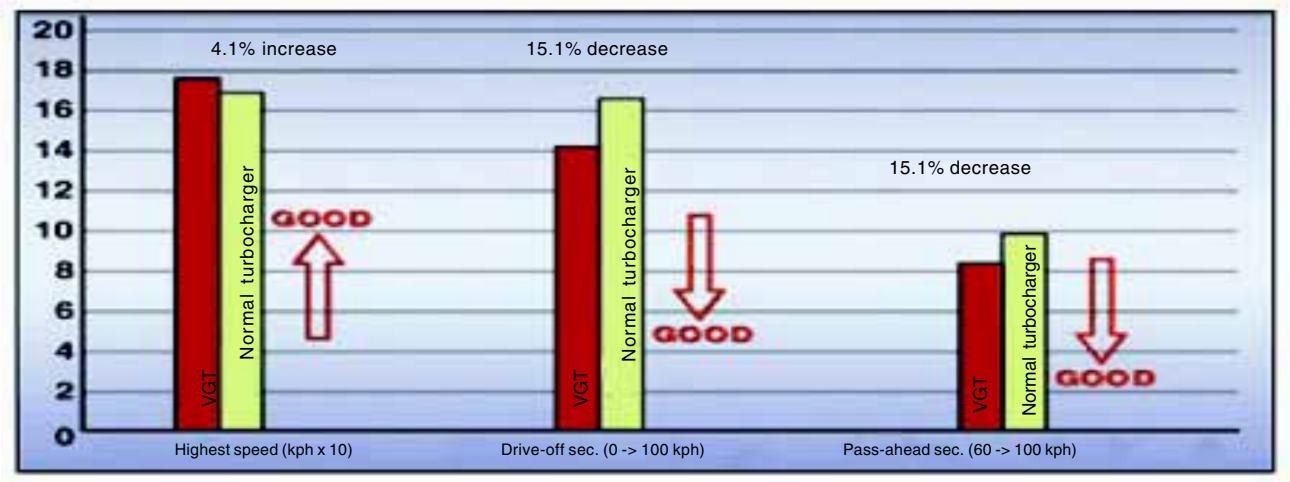
VGT (VARIABLE GEOMETRY TURBOCHARGER)

▶ Overview

VGT is a certain type of turbocharger system that increases the intake air volume by using the exhaust air flow.

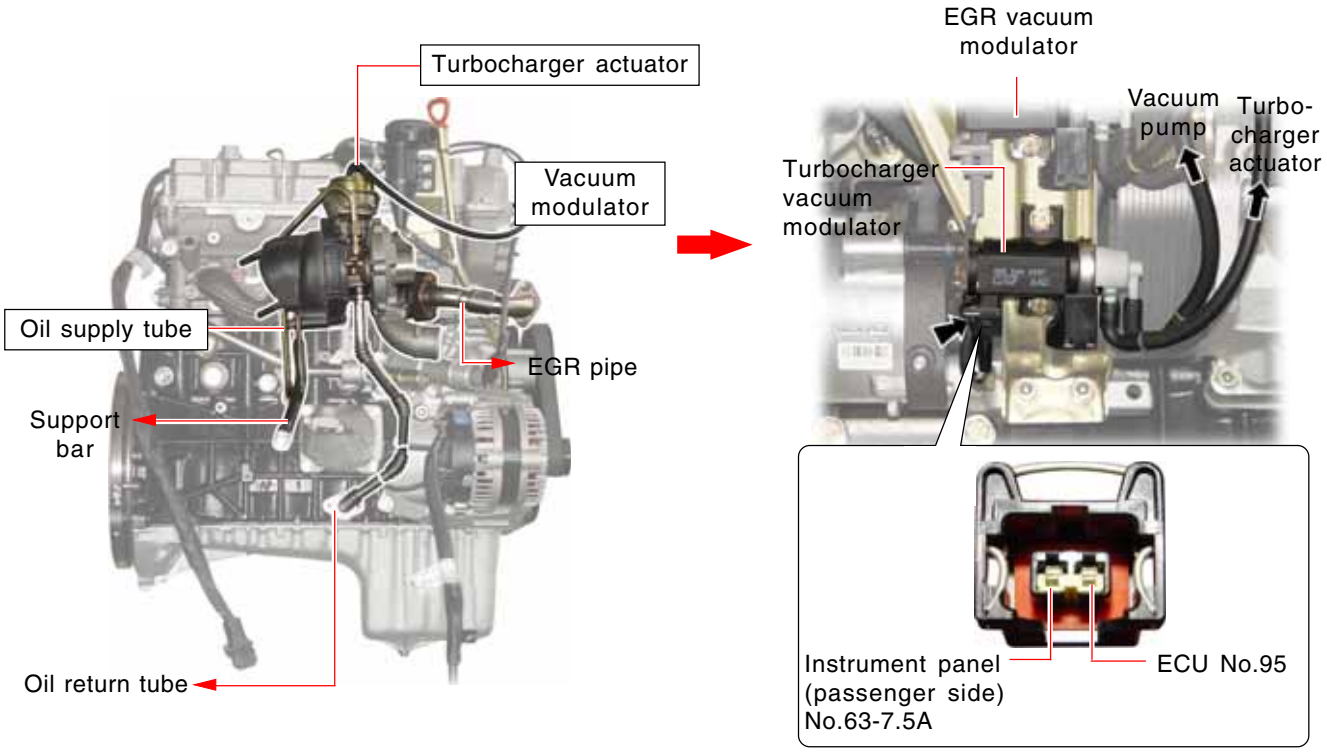
The following chart shows the comparison values between a normal turbocharger and VGT regarding highest speed, drive-off performance and pass-ahead acceleration.

1. Enhanced highest speed: 4.1% of the highest speed increases compared to normal turbocharger.
2. Enhanced drive-off performance: The time taken to reach from 0 kph to 100 kph decreases 15.1% compared to normal turbocharger.
3. Enhance pass-ahead performance: This is evaluated by measuring the time taken to reach from 60 kph to 100 kph. The shorter it is the better performance.

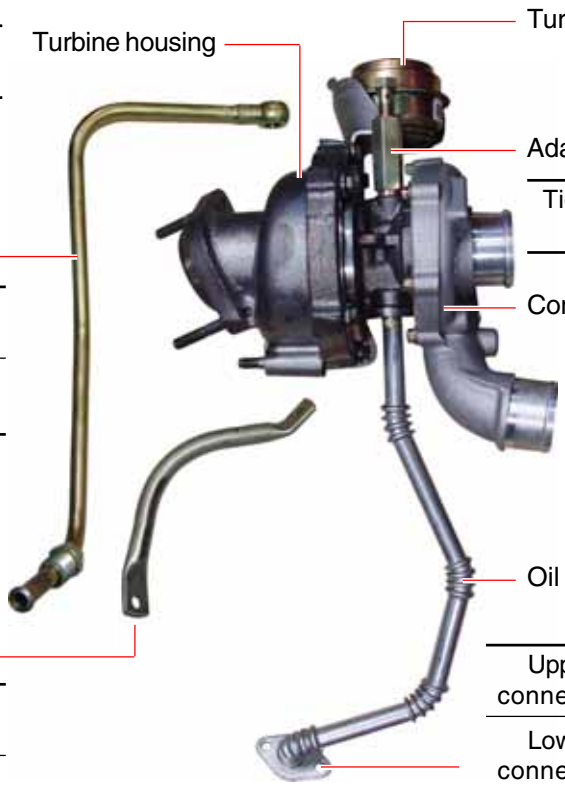


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AFFECTED VIN	

Structure

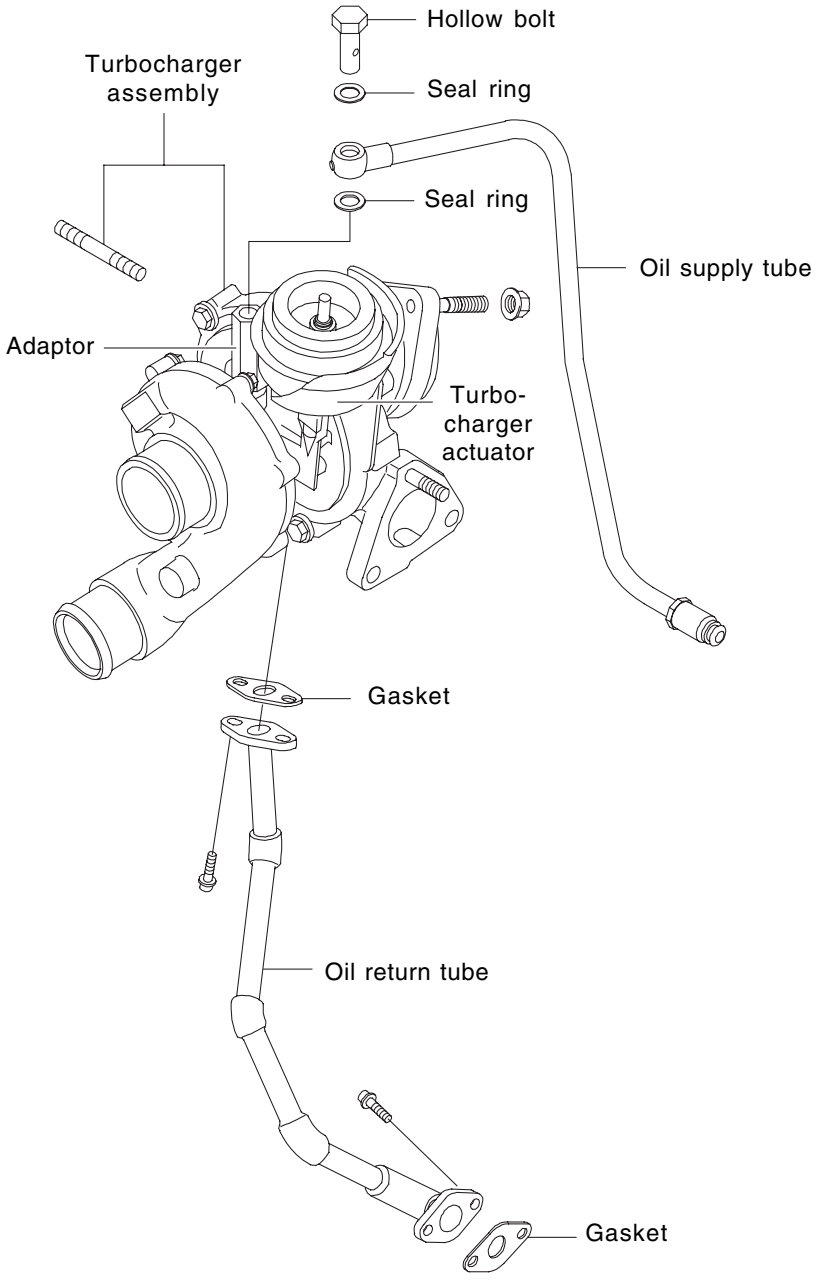


Tightening Torque



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▶ Components of VGT



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Components



Bearing housing and center housing:

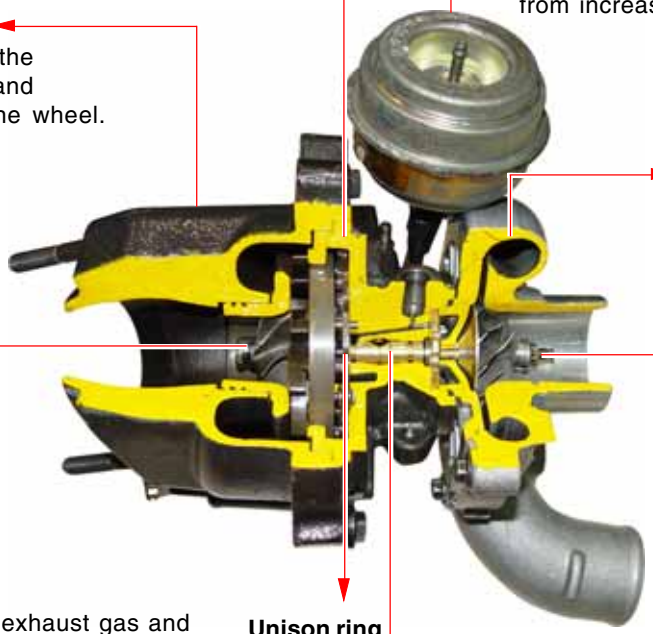
This encloses the bearing, seal, oil recirculation path and turbocharger shaft.

VGT actuator:

This prevent the turbocharged pressure from increasing over the specified value.

Turbine housing:

This is located on the exhaust manifold and encloses the turbine wheel.



Compressor housing:

This induces the fresh air to the compressor wheel and supplies the compressed air to the intercooler through the hose.

Turbine wheel:

This is rotated by exhaust gas and connected to the compressor wheel through turbocharger shaft.

Unison ring

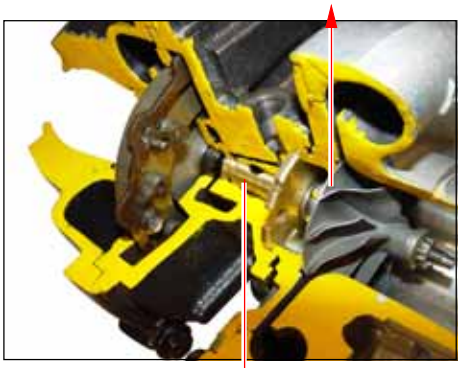
Compressor wheel (Impeller):

This is rotated by turbine wheel connected through turbocharger shaft, and compresses and draws the fresh air.



Turbocharger shaft:

This is located within center housing and connects the turbine wheel to the compressor wheel.

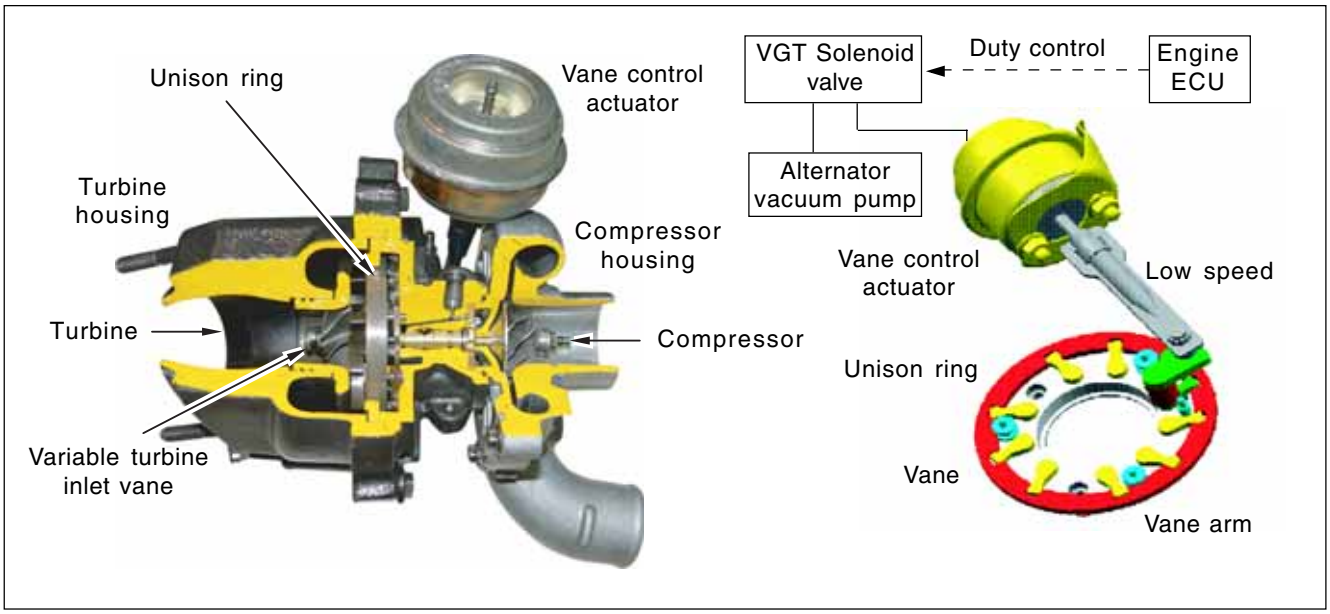


Floating bearing:

Turbocharger rotates at very high speed (100,000 ~ 150,000 rpm). To prevent the turbocharger from being damaged, floating bearing is used for this system. This is lubricated by engine oil. If the engine stops when the turbocharger is still hot, the bearing may be stuck because the oil cannot be supplied. After high speed driving, run the engine at idle speed until the turbocharger cools down.

▶Components

In VGT system, the turbine and compressor are installed on a same shaft. And on the turbine shaft, 11 variable inlet vanes are installed to change the flow of exhaust gas. Also, the round unison ring is mounted behind vanes to activate all vanes concurrently. The turbine housing and compressor housing are installed to cover the turbine and compressor, and the vane control actuator is installed to activate the unison ring towards the turbine housing.



Unison ring

The unison ring is designed to be capable to rotate either clockwise or counterclockwise and to connect to the vane control actuator.

Variable turbine inlet vane

The variable turbine inlet vane is connected through the unison ring and vane arm, 11 vanes are rotated when the actuator is activated. 11 vanes are used as a passage for the exhaust gas led to the turbine inlet. According to their rotation, the flow passage area of exhaust gas varies. At low speed, the flow passage is narrowed and the flow speed of the exhaust gas increases, resulting in increasing the delivery energy of turbine. At high speed, the flow passage is widened and the much exhaust gas is generated, resulting in considerably increasing the delivery energy of turbine.

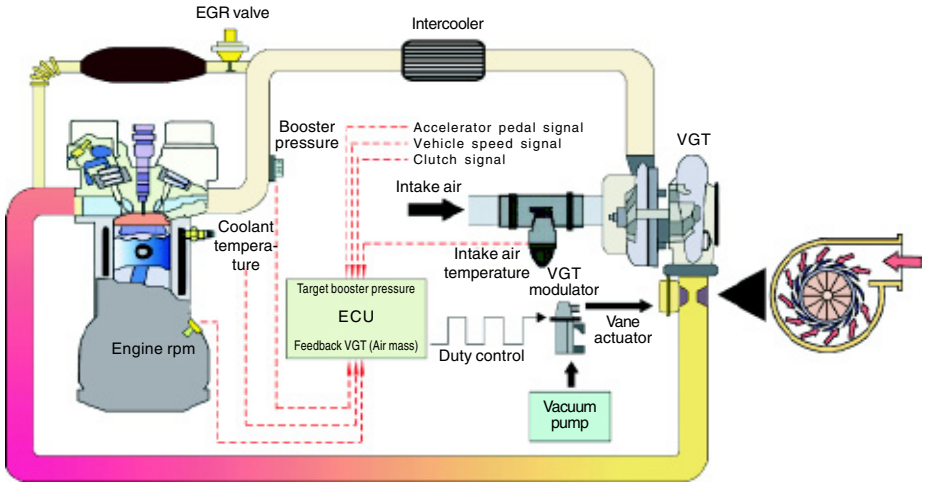
Vane control actuator

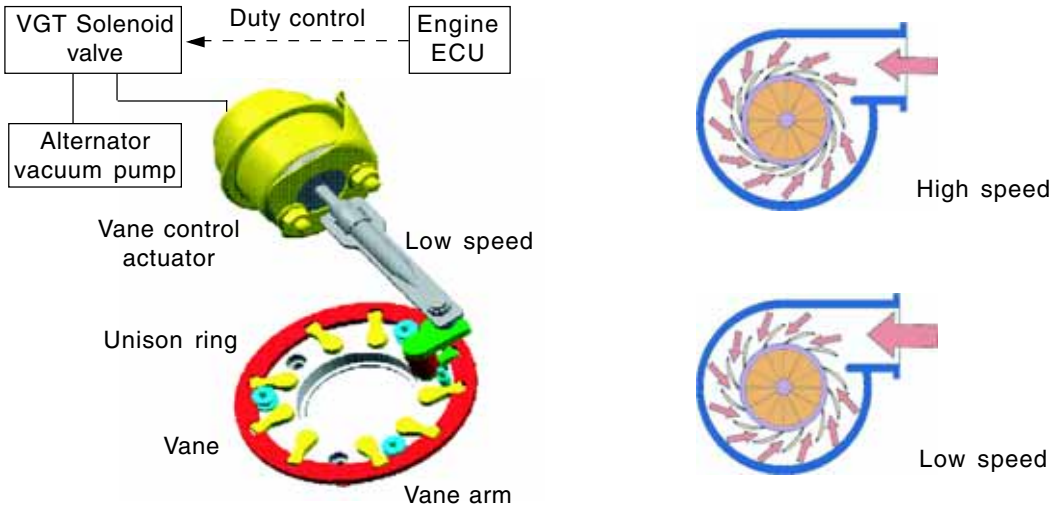
The vane control actuator is connected to the VGT solenoid valve duty-controlled by the engine computer (ECU) via the vacuum hose. Therefore, the duty rate of the solenoid valve is changed by ECU according to the operating conditions and accordingly the movement of the actuator is controlled.

▶Principles

How it works at low speed

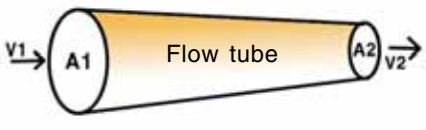
Normal turbocharger can't get the turbo effect because the amount of exhaust gas is not much and the flow speed is slow in a low speed zone, but VGT allows the flow passage of exhaust gas to narrow, resulting in increasing the flow speed of exhaust gas and running the turbine quickly and powerfully. Therefore, as VGT can inhale more air than normal turbocharger, it can give the benefit of the increased output even in a low speed zone.



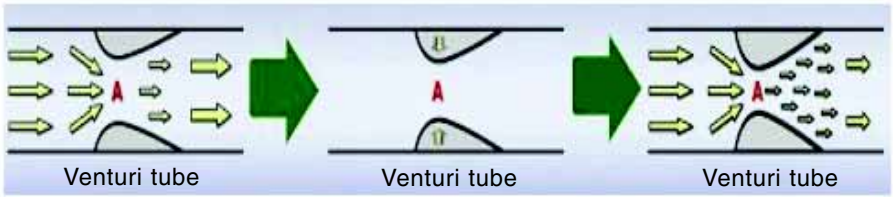


Basic principle at low speed

At low speed, it utilizes the principle of venturi. For example, when air flows through the venturi tube, the flow speed is faster and the pressure is lower at the point "A". In this case, if the inner diameter of venturi is more narrowed, the flow speed is so much faster (refer to the equation).

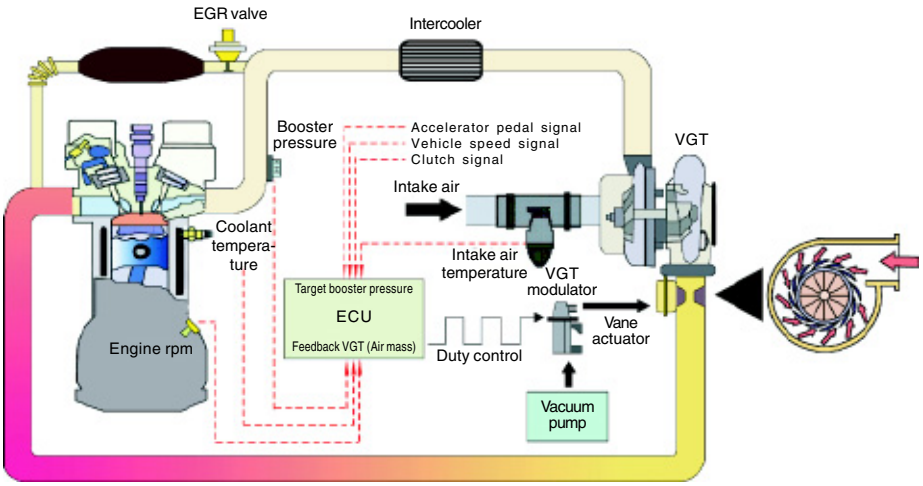


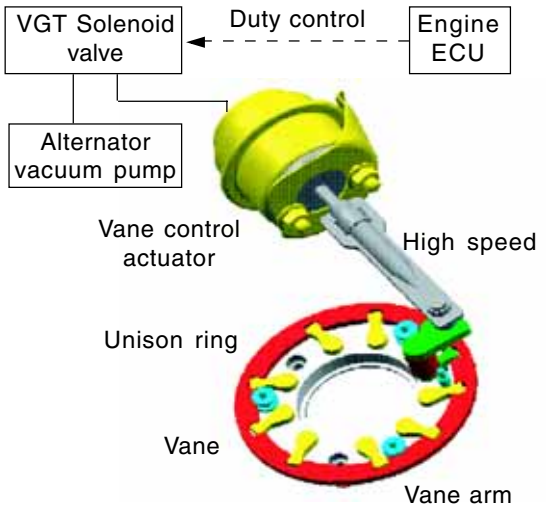
V1 x A1 = V2 x A2 = Constant

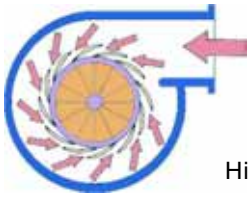


How it works at low speed

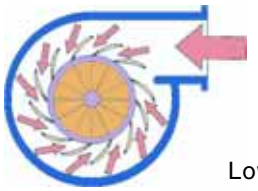
In a high speed zone, the amount of exhaust gas increases and it is accompanied with a great force. Therefore, if the inner diameter of venturi is more widened, the turbine in the turbocharger by the releasing force of abundant exhaust gas can deliver a more increased energy to the compressor. The output will increase in submission to the increase of intake air volume.







High speed



Low speed

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Controlling VGT system

The VGT control system checks the engine revolution, accelerator pedal value, atmospheric pressure, booster pressure, water temperature, intake air temperature, vehicle speed and clutch switch signal to determine the driving conditions of a vehicle.

The booster pressure map that is targeted on according to the engine revolution and fuel injection volume is determined inside of ECU. The ECU drives the vane control actuator to control the booster pressure, by controlling the solenoid valve to 300 Hz of frequency and the duty value. This helps to maintain the engine at its optimum condition.

Take a note that the booster pressure sensor is adopted, which is designed to perform the feedback control for matching the booster pressure targeted by ECU by measuring the booster pressure actually. The feedback control allows more accurate controlling.

8 Conditions for inhibiting VGT operation

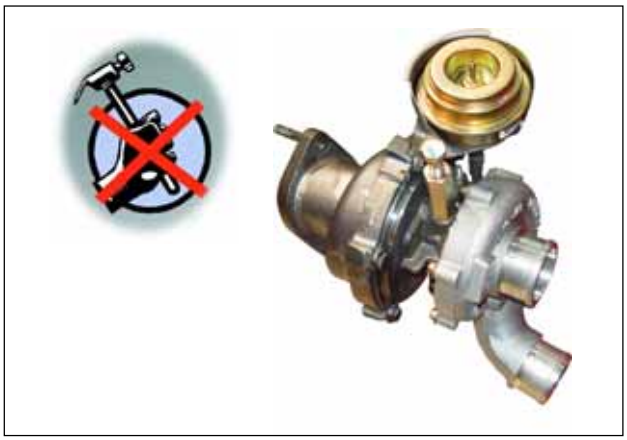
1. If the engine speed is less than 700 rpm
2. If the coolant temperature is below approx. 0?
3. If any part related to the EGR is defective
4. If the VGT actuator is defective
5. If the booster pressure sensor is defective
6. If the mass flow sensor is defective
7. If the throttle flap is defective
8. If the accelerator pedal sensor is defective

If any of above conditions is met, ECU will not control the VGT system.

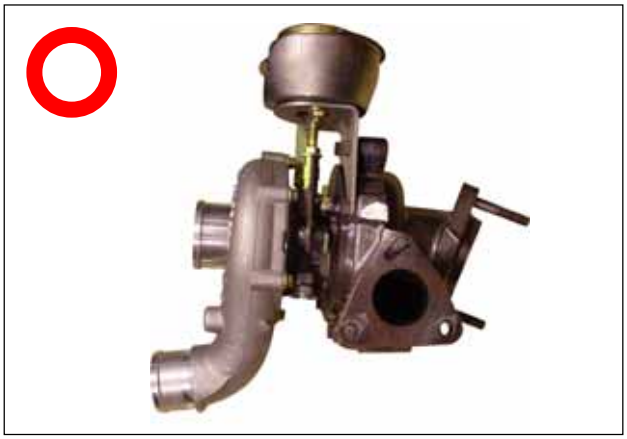
▶ Notes and Check for VGT

Notes When Handling VGT

1. The turbocharger is sensitive to excessive vibration coming from external impact. When exposed to excessive impact or vibration, the inside mechanism may be damaged even though the outside is intact.



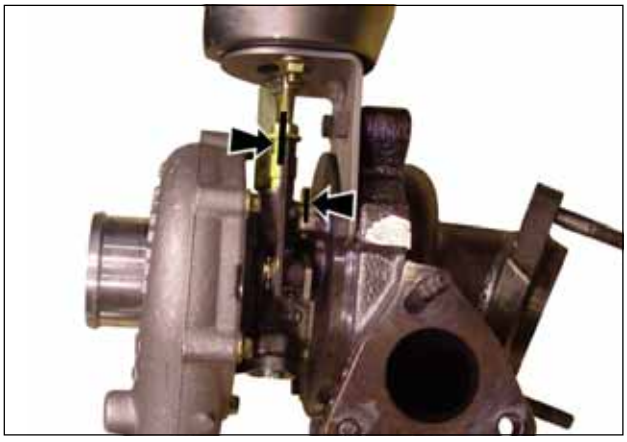
2. The turbocharger should be kept horizontally. If there is much engine oil in the turbocharger and it is kept vertically with the turbine housing downward, the engine oil may be provided to variable mechanism assembled towards the turbine housing, which may lead to a malfunction of the variable mechanism.





3. Never re-adjust the adjusting screw marked with yellow paint or the axial end of actuator. Renew them if you found looseness of the screw or actuator axle, because they are shipped after precisely adjusting from the factory.

4. Do not move or assemble the actuator axle by grasping it in hands. The actuator axle may be deformed, which affects the precisely adjusted value.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. After installing to the engine, replenish a small amount of clean engine oil to the inlet before connecting the oil inlet pipe of the turbocharger.
6. Do not let any metal debris enter when installing to the engine.
7. The engine oil may be provided to the compressor housing if you rapidly operate the turbocharger with excessive revolutions immediately after installing to the engine.
   1) Do not raise the engine rpm rapidly after starting the engine.
   2) Do not raise the engine rpm rapidly after renewing the engine oil and filter element.
   3) Do not stop the turbocharger rapidly after operating at high engine speed.



Check and Service

The turbocharger is rarely out of order or damaged unless the engine is operated in abnormal conditions. Therefore, it is not necessary to additionally check the turbocharger according to mileage or operation hours. It is sufficient to simply maintain or service the engine thoroughly.

The following symptoms occur if there is a fault in the turbocharger:

1. reduced engine output
2. noisy engine operation
3. excessive engine oil consumption
4. excessive exhaust gas emitting

The symptoms may be due to a fault of the engine, not the turbocharger. In most cases, you can check the cause of the fault visually before removing the turbocharger from the engine.

Check Procedures

1. Firstly, check conditions of the engine because the fault may be due to the engine, not the turbocharger.
2. Then, check conditions of the turbocharger as follows:
   1) whether the compressor is damaged by metal debris or foreign materials.
   2) whether the turbine is damaged by metal debris or foreign materials.
   3) whether there is no contact between the wheel and the housing (check the bearing for damage).
   4) whether there is damages or influences by hot temperature.

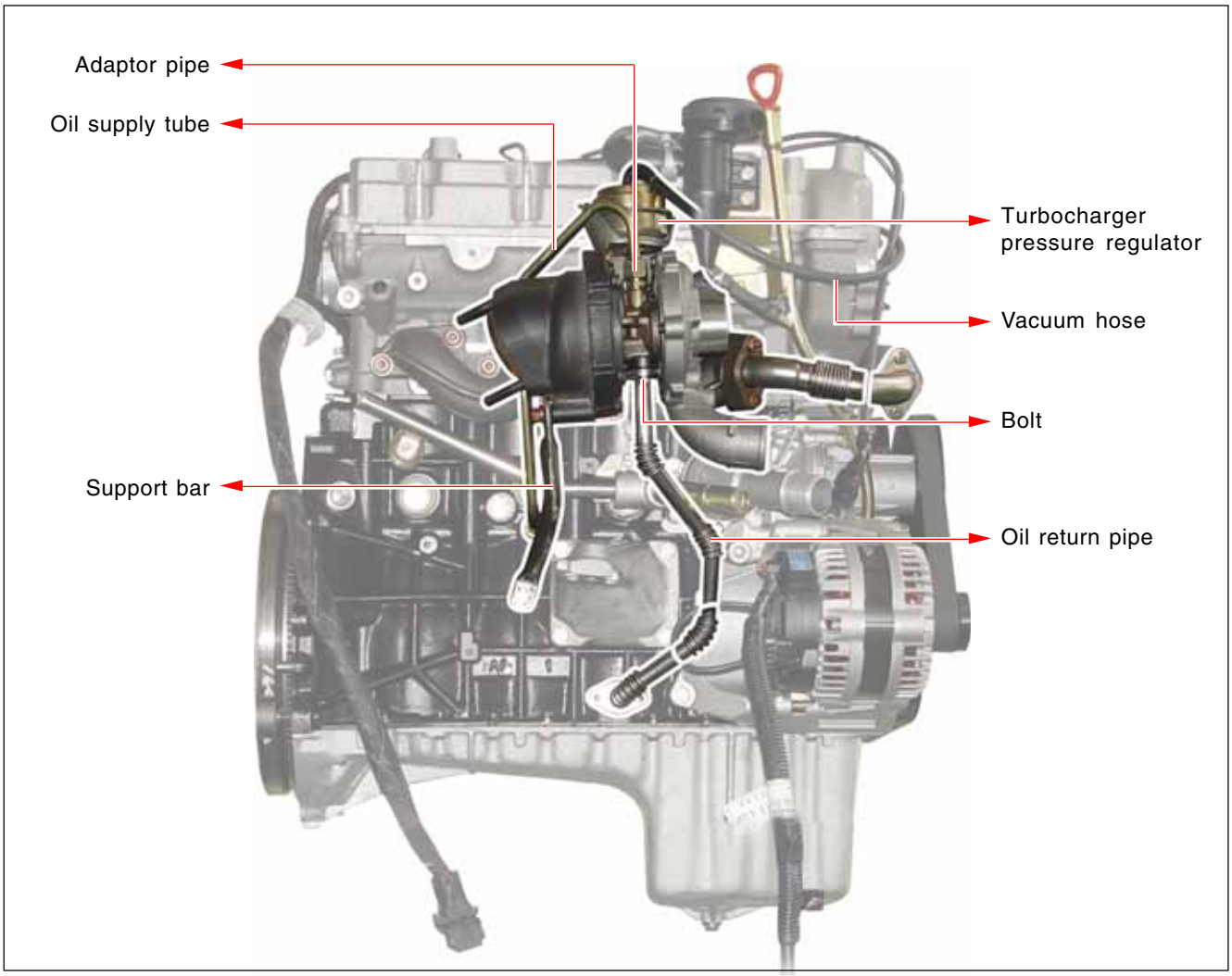
Diagnosis and Servicing

1. Operation conditions of actuator's diaphragm: It is impossible to control the turbocharger when the operation is poor.
2. Leaking of the turbocharger housing: More engine oil is consumed when leaking.
3. Damage on the turbocharger bearing: Noise can be heard during the turbocharger is operating (The whole turbocharger may be damaged when the bearing is damaged).

▶ Removal and Installation

Basically, the turbocharger should be serviced at Ssangyong Authorized Service Center.

When eliminating the carbon deposit from the turbine wheel during the service procedure, use only soft brush or solvent other than sand paper or metallic tools.



Cautions When Removing/Installing

1. Use only the turbocharger with same specifications.
2. Replace the gasket and sealing with new ones once removed.
3. Tighten the fasteners with specified tightening torque.
4. Change the engine oil before starting the engine.
5. If suspected, check the oil supply pressure.
6. Check if the turbine nozzle actuator operates properly.

Removal and Installation of Turbocharger

※ **Preceding Work:** 1. Remove the negative battery cable.
2. Drain the engine oil by removing the drain plug of the oil pan.

1. Remove the intake hose assembly by removing the clamp on the inlet hose of of the air cleaner.



A. Hose to oil separator



B.HFM sensor connector



2. Remove the intercooler hose of turbocharger.

Tightening torque	6 ~ 7 Nm



A.Turbocharger connection



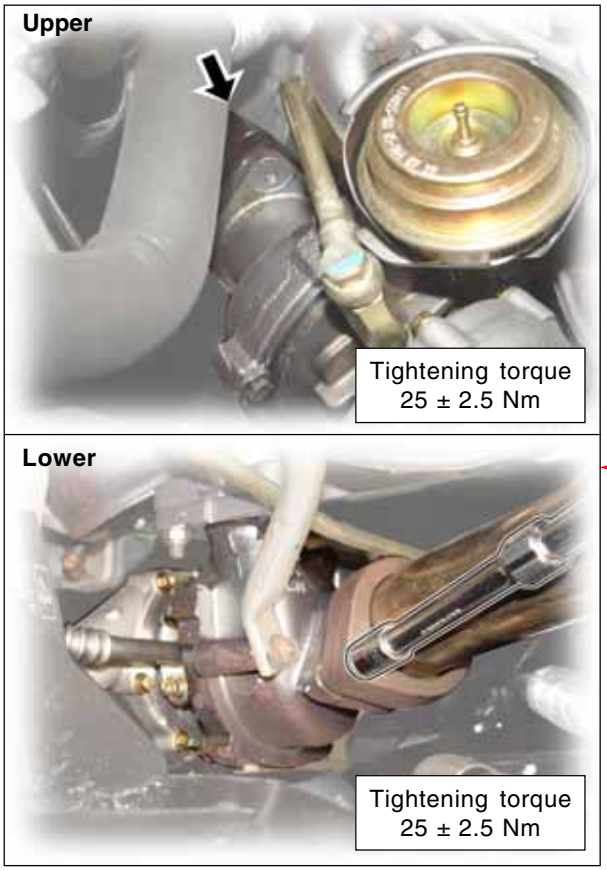
B.Connecting section of the intercooler side.

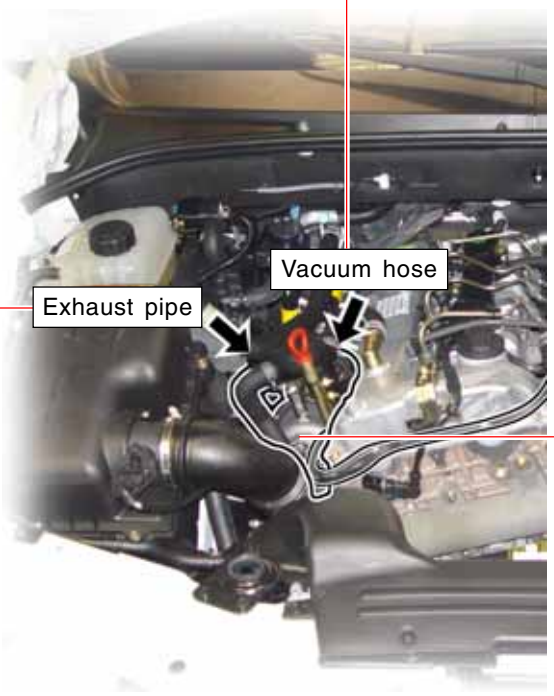


3. Disconnect the vacuum hose from the turbocharger.

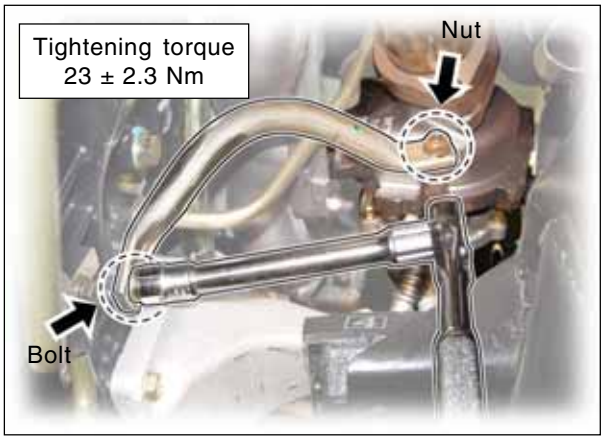


4. Remove two mounting nuts on the exhaust pipe of the turbocharger.

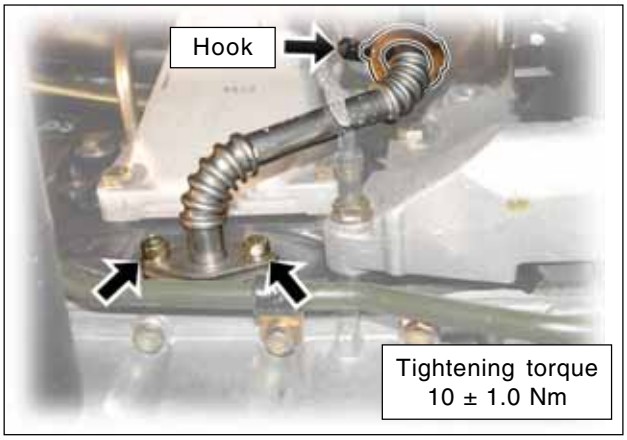




5. Remove the support bar mounting bolt and nut from the turbocharger to remove the support bar.



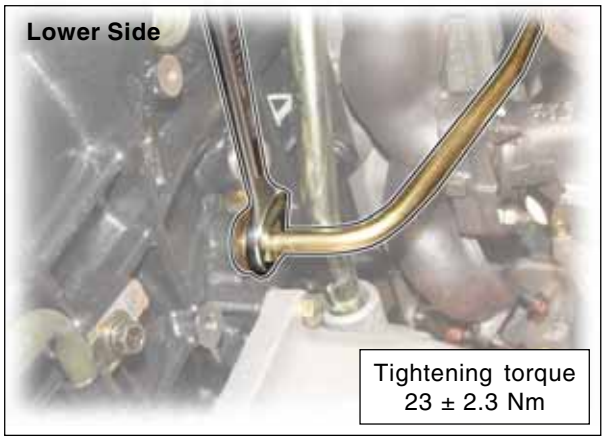
6. Separate the hook for engine ground cable and remove the lower mounting bolts from the oil return pipe.



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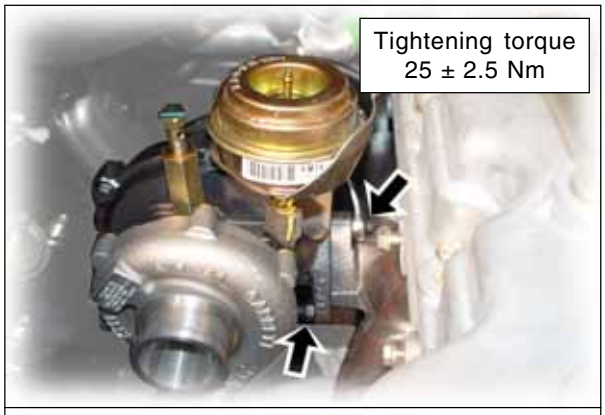
7. Remove the hollow bolt from the oil supply pipe of the turbocharger and remove the pipe.







8. Remove three mounting nuts from the exhaust manifold of turbocharger.





9. Remove the turbocharger assembly.





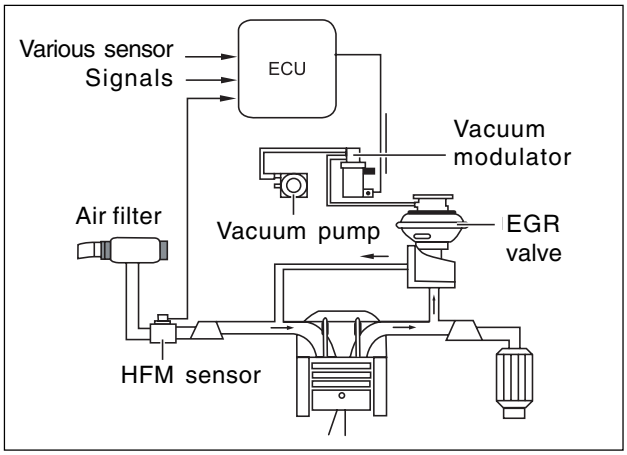
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EGR VALVE AND VACUUM MODULATOR

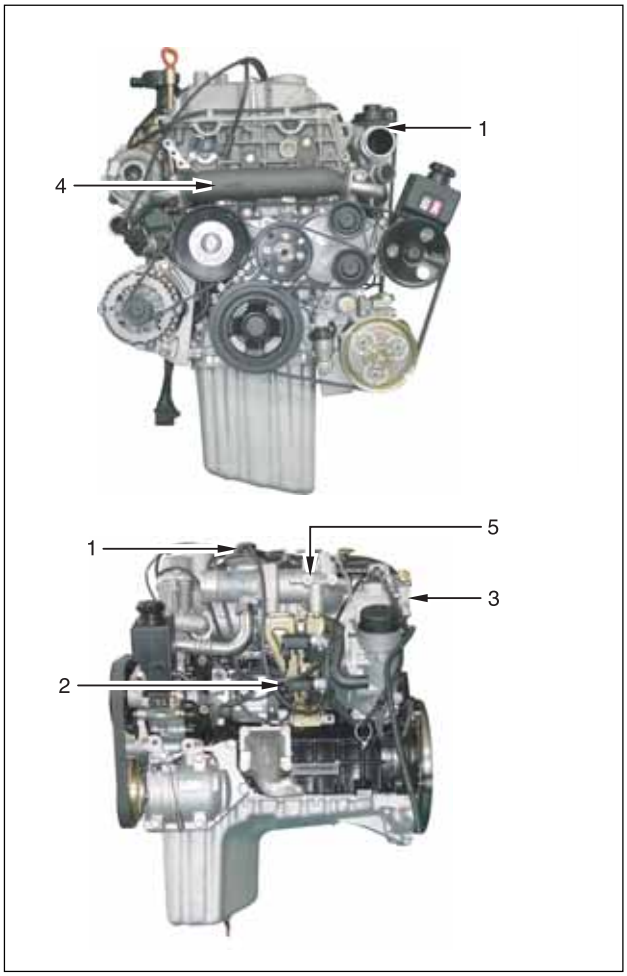
EGR SYSTEM

▶ General Information

EGR system controls the opening value of EGR valve by transmitting electrical signal (PWM control) from the engine ECU to vacuum modulator. Also, the engine ECU receives the feedback signals of the amount of air flowing through the HFM sensor.



1. EGR valve
2. Vacuum modulator
3. Vacuum pump
4. EGR center pipe (EGR cooler)
5. Intake manifold



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EGR VALVE AND TURBO CHARGER ACTUATOR CONTROL VACUUM CIRCUIT

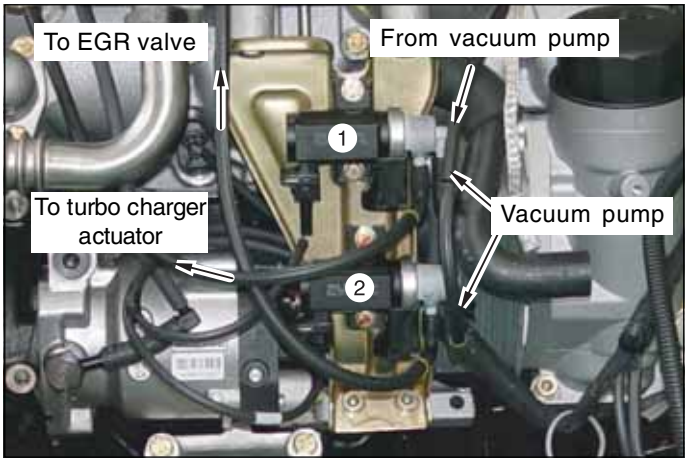
▶ Vacuum Modulator

The biggest difference between the vacuum circuit and layout of the HUBER EGR system after K2004 has been introduced is the location of the vacuum modulator for EGR valve control and the function of the other modulator. In case of EGR equipped vehicle (IDI Engine), it performs the role of controlling the PLA of injection pump whereas, in DI engine, it controls the turbo charger actuator.

DI engine vacuum modulator

1. Turbo charger booster vacuum modulator
2. EGR valve vacuum modulator

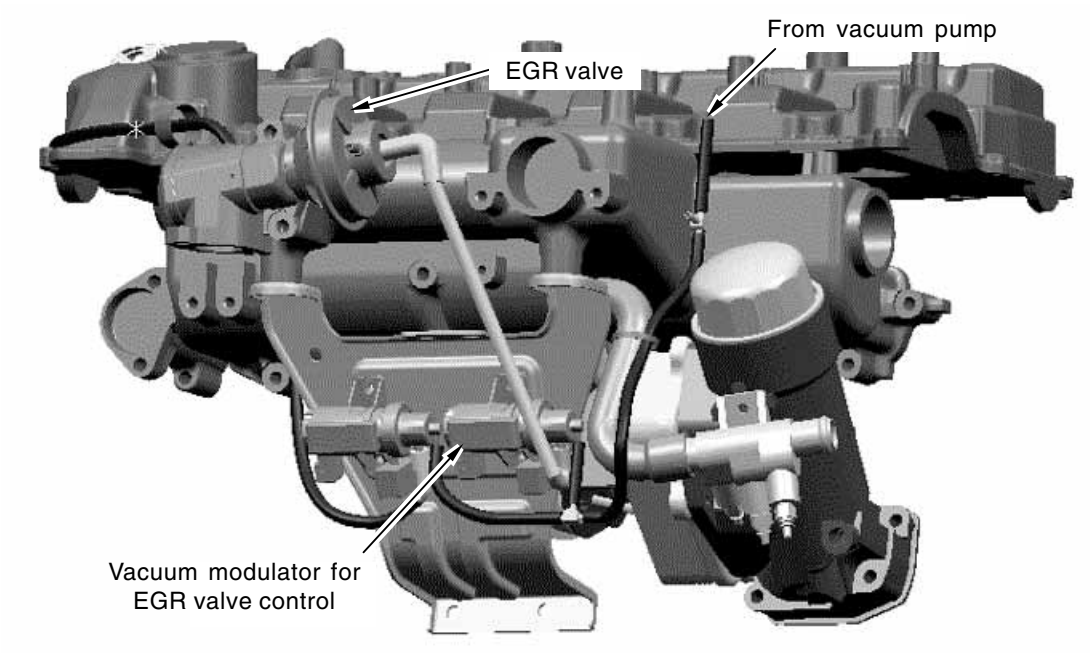
① To Turbo Charger Actuator (Gray)
② To EGR Valve (Black)



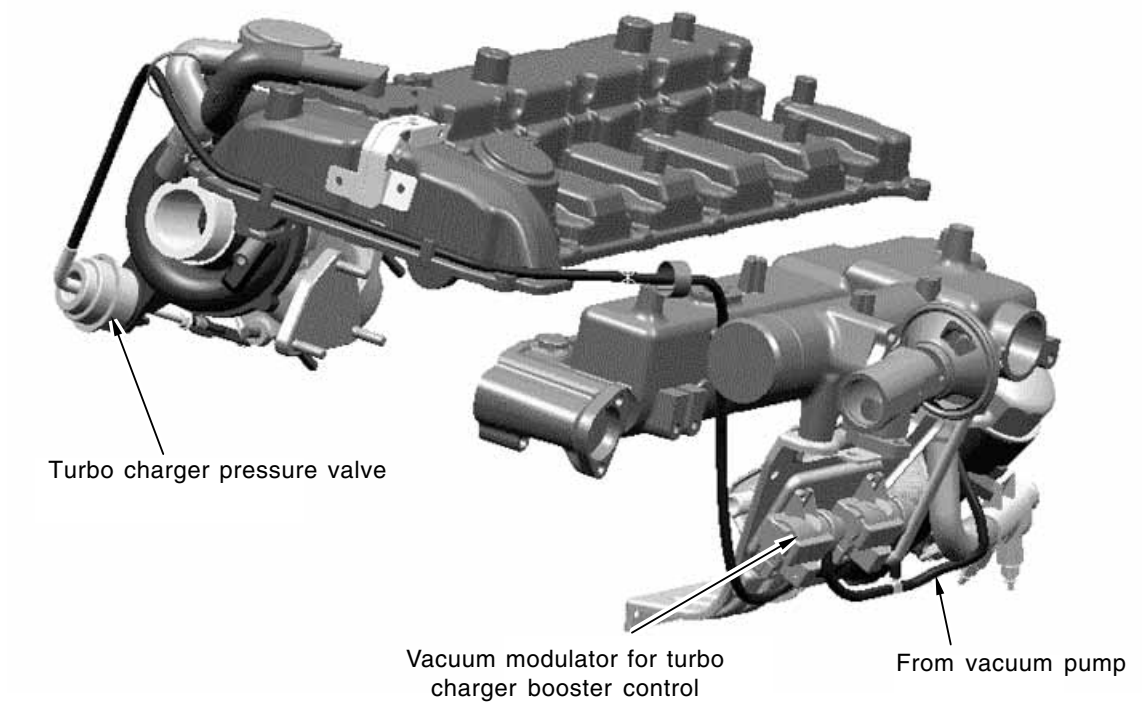
▶ Vacuum Modulator and Vacuum Hose

Below figures illustrate vacuum hoses and related parts of EGR or turbo where wrong or poor connection of vacuum hose would display condition of engine irregularity and defect diagnostic codes on the scan tool.

Related with EGR valve

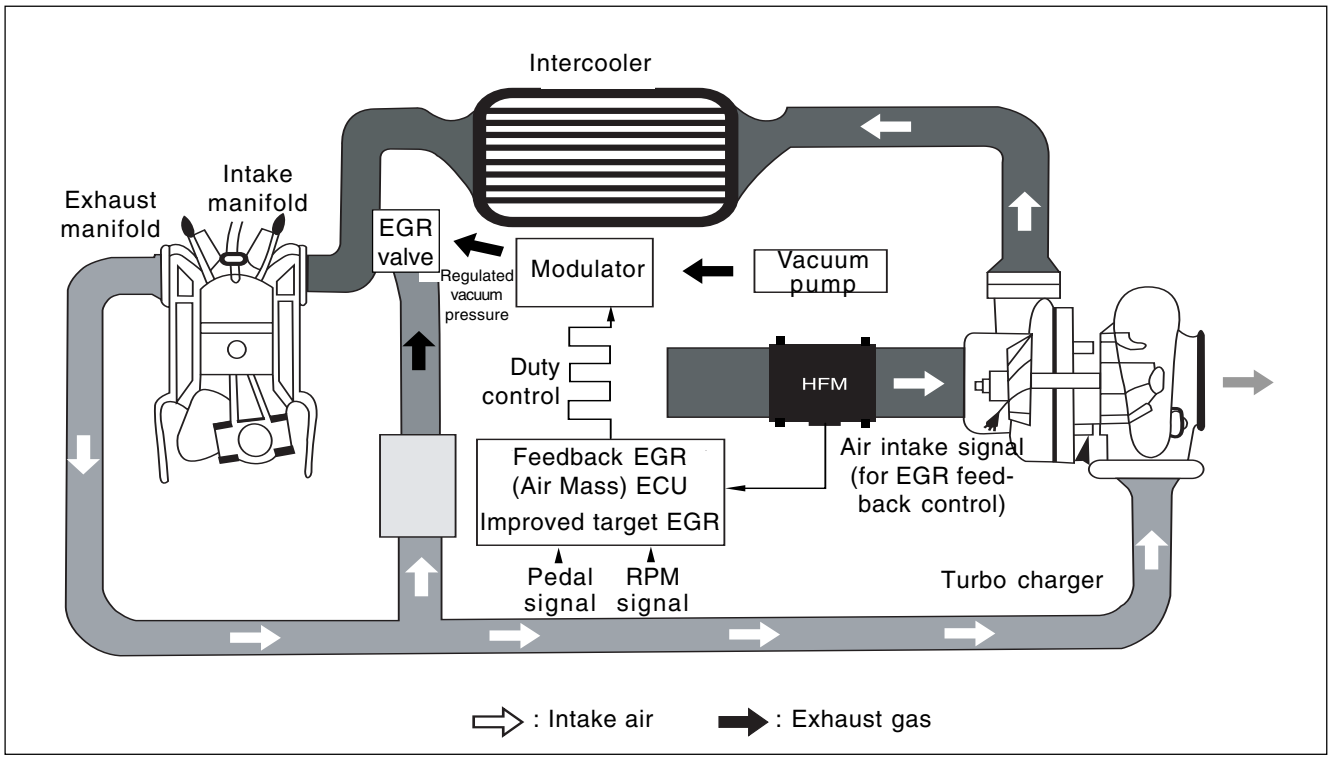


Related with turbo charger actuator



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▶ EGR System Diagram



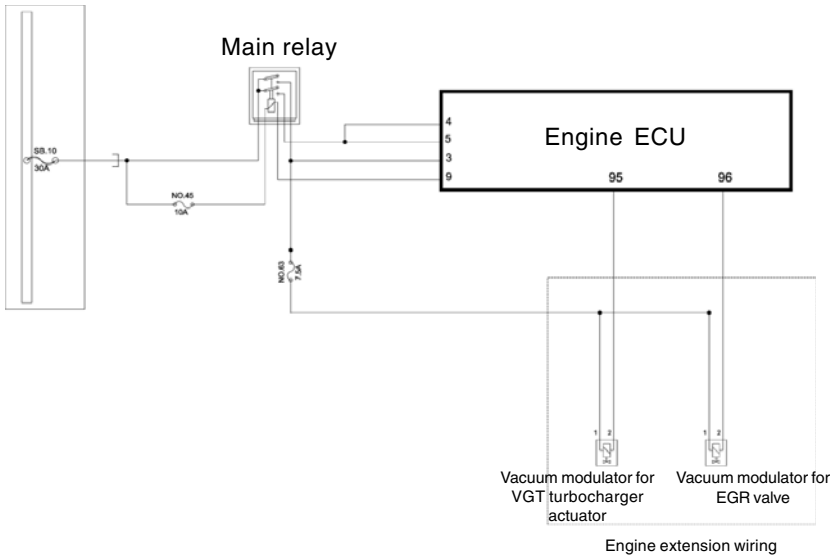
EGR valve

EGR valve recirculates some of exhaust gases to intake system to reduce toxic NOx from engine according to ECU signals.

1. EGR valve opening point : -220~250 mmHg

EGR modulator

According to ECU signals, the vacuum modulator drives EGR valve by controlling vacuum pressure that is generated by vacuum pump with PWM type controls.

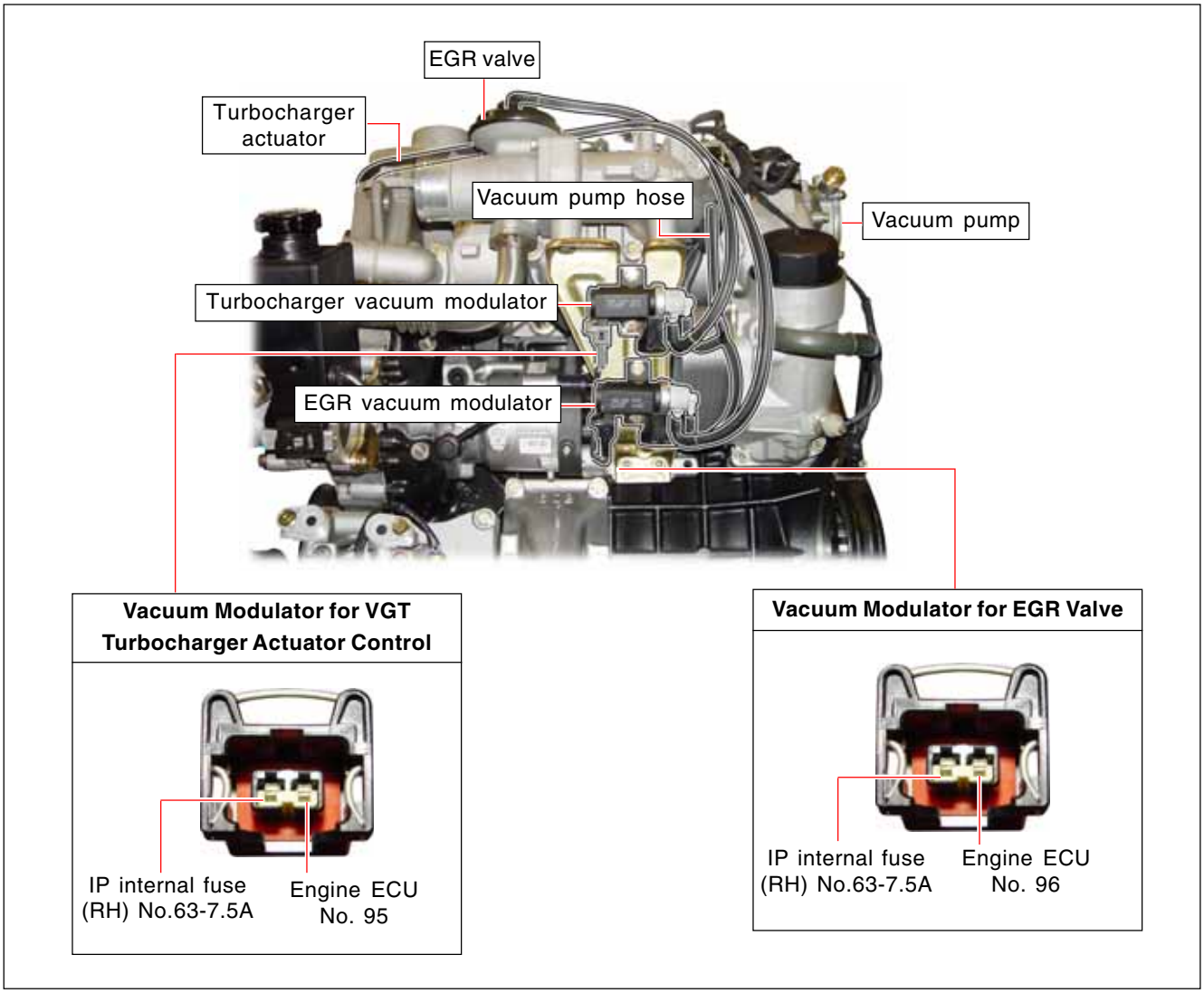


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VACUUM MODULATOR

COMPOSITION

▶Layout



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AFFECTED VIN	

REMOVAL AND INSTALLATION OF EGR VALVE

▶EGR Valve and Pipe

1. Remove the inlet hose to the intake manifold and disconnect the vacuum hose of the EGR valve.

Inlet hose to Intake Manifold

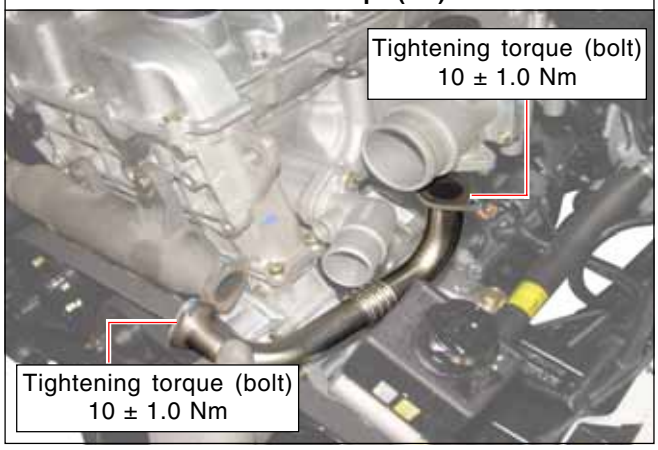


Vacuum Hose to EGR Valve



2. Remove the mounting bolt/nut to remove the left pipe of the EGR valve and unscrew four hexagon bolts to remove the EGR valve assembly.

EGR Valve Pipe (LH)

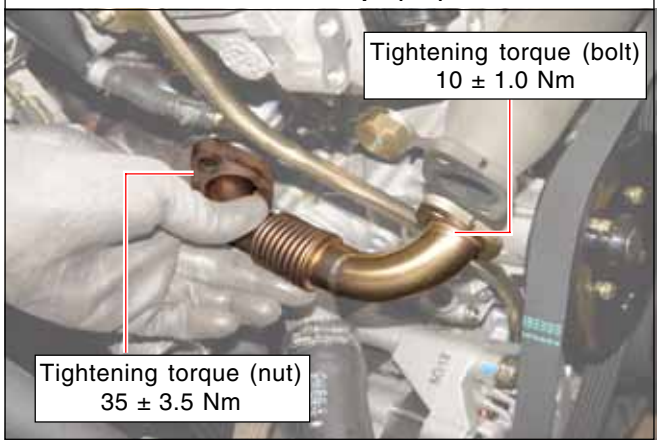


EGR Valve Assembly

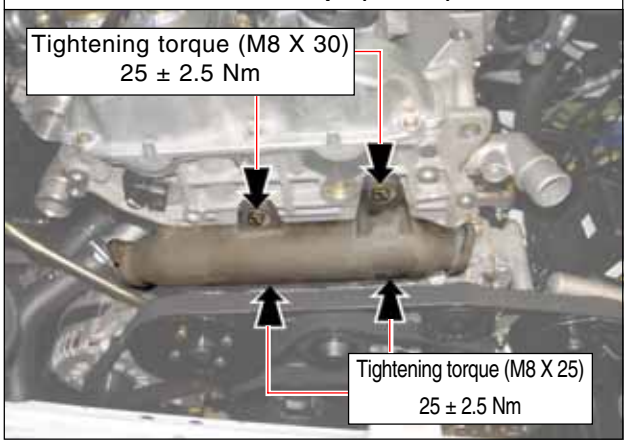


3. Remove the right pipe of the EGR valve and remove the center pipe.

EGR Valve Pipe (RH)



EGR Valve Pipe (Center)

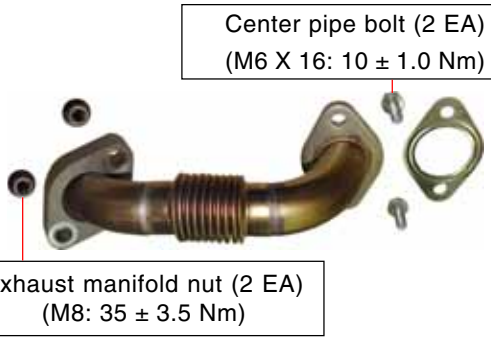


4. Install in the reverse order of removal.

NOTICE

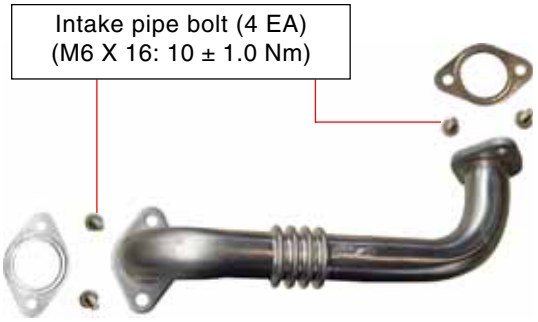
1. **Observe the tightening torque of the bolts and nuts when installing pipes.**
2. **Replace the gaskets of the pipes with new ones. The protruding side should face to pressurized section.**

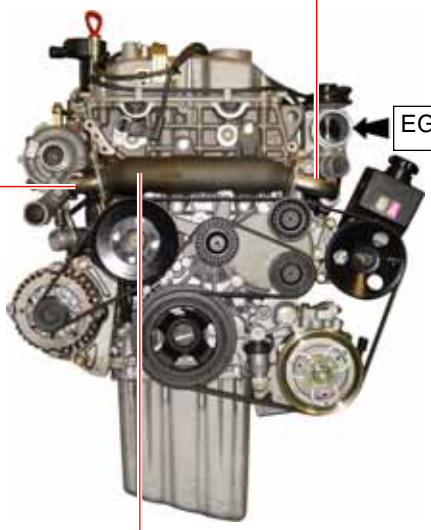
EGR RH Pipe and Gasket



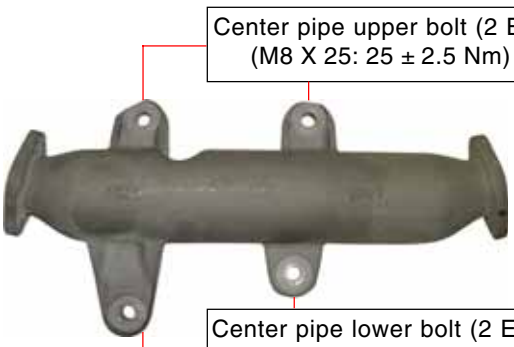
* M8 mounting nut should be replaced with new one.

EGR LH Pipe and Gasket

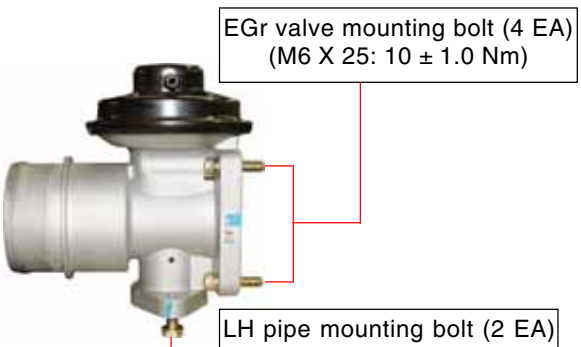




Center Pipe



EGR Valve



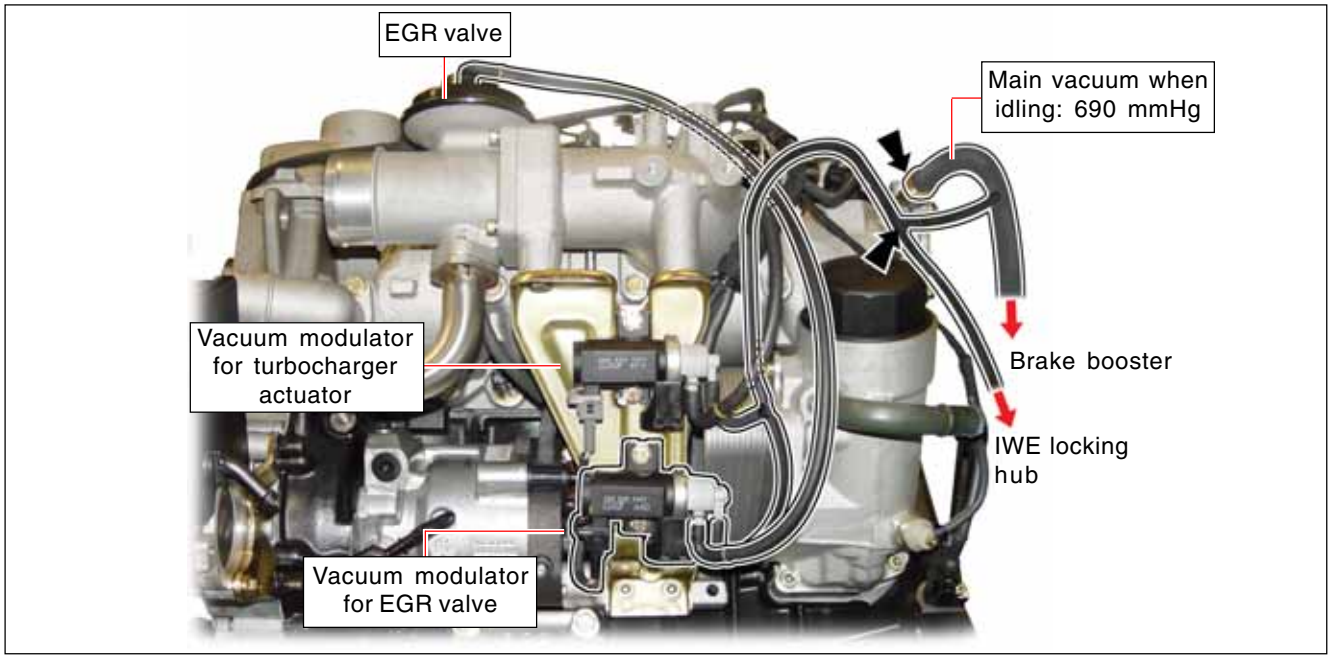
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▶Inspection for EGR System

If the EGR system is malfunctioning, the engine power may be decreased or the exhaust gas may be increased. If these happen, troubleshoot the system according to the following procedures.

1. Inspection for EGR vacuum system

Check the EGR vacuum system (engine vacuum pump - vacuum modulator for controlling EGR valve - EGR valve) for malfunction. Specifically, check the vacuum hose, connections, kinked hose and leaks due to interference with surrounding components. Also check the EGR vacuum modulator's wiring connector. Make sure that the vacuum system source functions properly by checking the engine vacuum pump for leakage.



2. EGR related DTC check using SCAN-100

Connect the SCAN-100 to the CAN module and check if there is any DTC related to EGR.

If DTC is appeared, it may be due to the vacuum system. Therefore, check the EGR system again.



▶ DTC Related to EGR System

P0400 **Faulty EGR valve control**

P1405 **Short circuit to EGR vacuum modulator (GND)**

P1406 **Short circuit to EGR vacuum modulator (B+)**

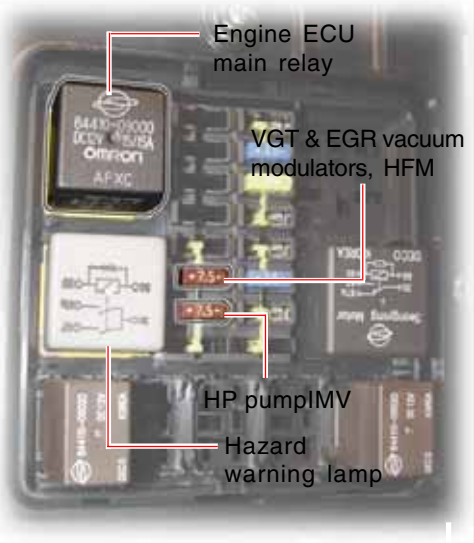
All DTCs are related to EGR valve vacuum modulator. Therefore, check the power supply and ground condition by performing the following electrical check for EGR valve vacuum modulator.

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EFFECTIVE DATE	
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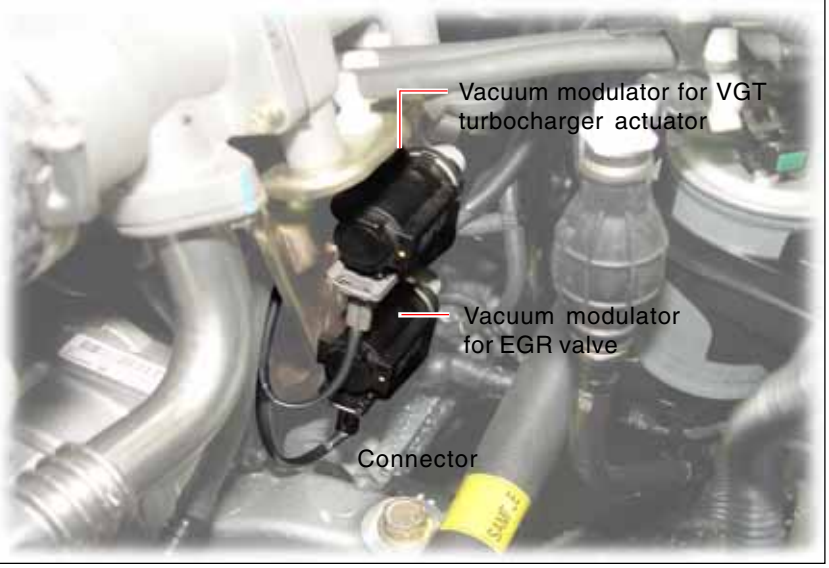
3. Electrical check for EGR valve vacuum modulator

The EGR valve vacuum modulator is supplied with power from the main relay and fuse No. 63 (7.5 A) in the interior fuse box which is located in the instrument panel (RH). Therefore, those relays and fuses should be checked first. The vacuum modulator for the VGT turbocharger actuator is installed on the top of the vacuum modulator for EGR valve. Both are supplied with the same power and controlled (duty cycle) by engine ECU. The following is the procedure for checking the power supplied to the vacuum modulator.

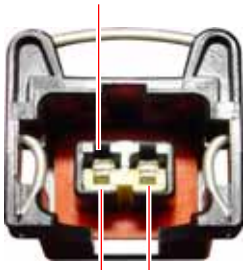
IP Interior Fuse Box (Passenger Side)



Vacuum Modulator



Connector



Installtion of multimeter



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AFFECTED VIN	

4. EGR valve check

If there is no problem found so far, check the EGR valve as a unit.

The EGR valve is working as a passage for exhaust gas. It may not operate due to the contamination by the carbon or other foreign materials.

Check the unit according to the following procedures.

1. Remove the intake inlet hose.



2. Connect the vacuum tester to EGR valve.



3. Check if EGR valve starts to open when the vacuum gauge indicates approx. 220 ~ 250 mmHg.





4. Check the conditions of EGR valve.

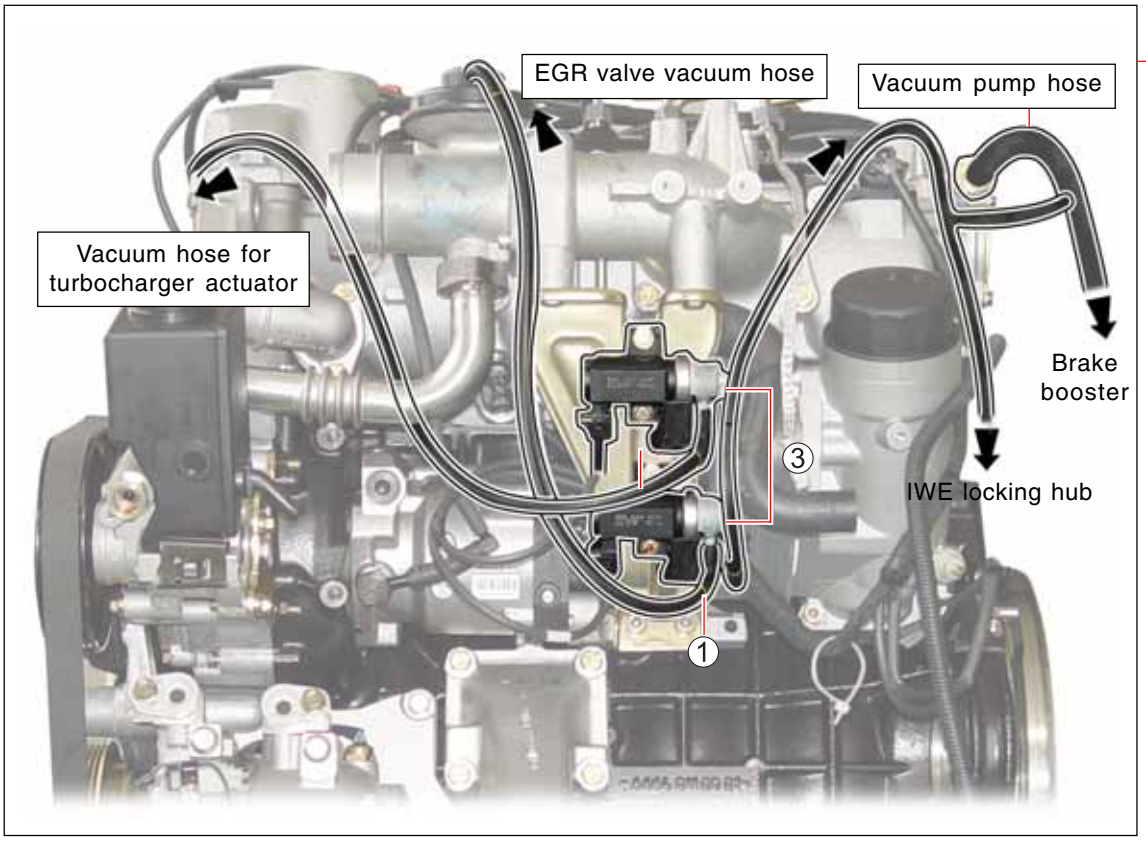


If the valve is severely contaminated, completely wipe it out with soft cloth. Be careful not to damage it.

REMOVAL AND INSTALLATION OF VACUUM MODULATOR ASSEMBLY

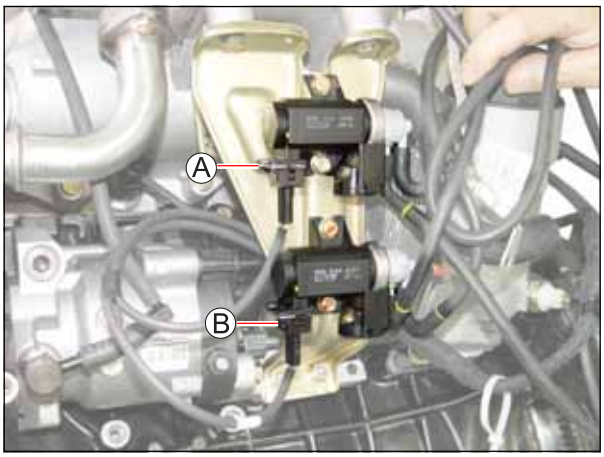
Removal and Installation

1. Separate the vacuum hose to EGR valve (1), the vacuum hose to turbocharger (2) and the vacuum hose to vacuum pump (3) in turn.





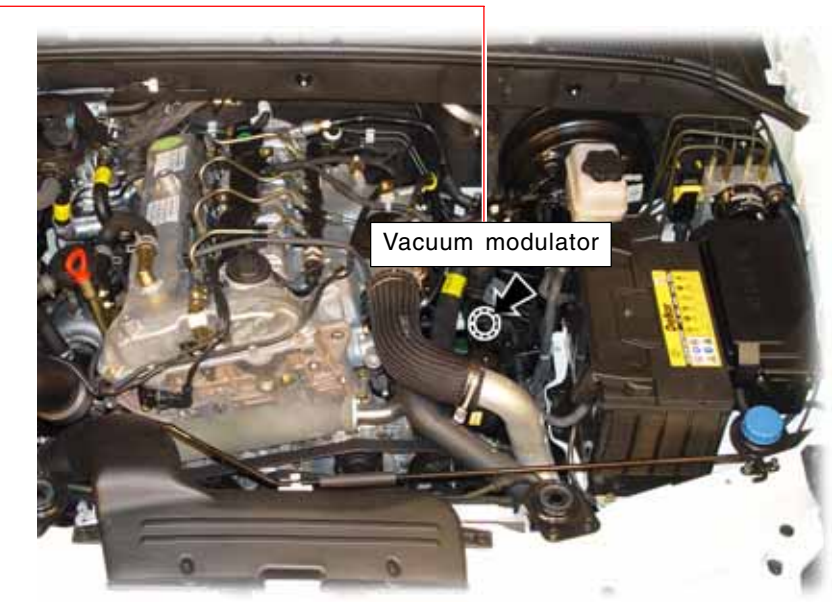
2. Disconnect the vacuum modulator connectors to turbocharger (A) and EGR valve (B).



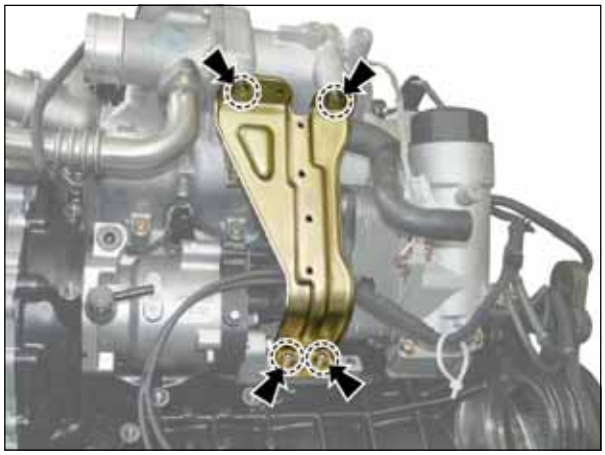
3. Unscrew the mounting bolts and remove the vacuum modulators.



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EFFECTIVE DATE	
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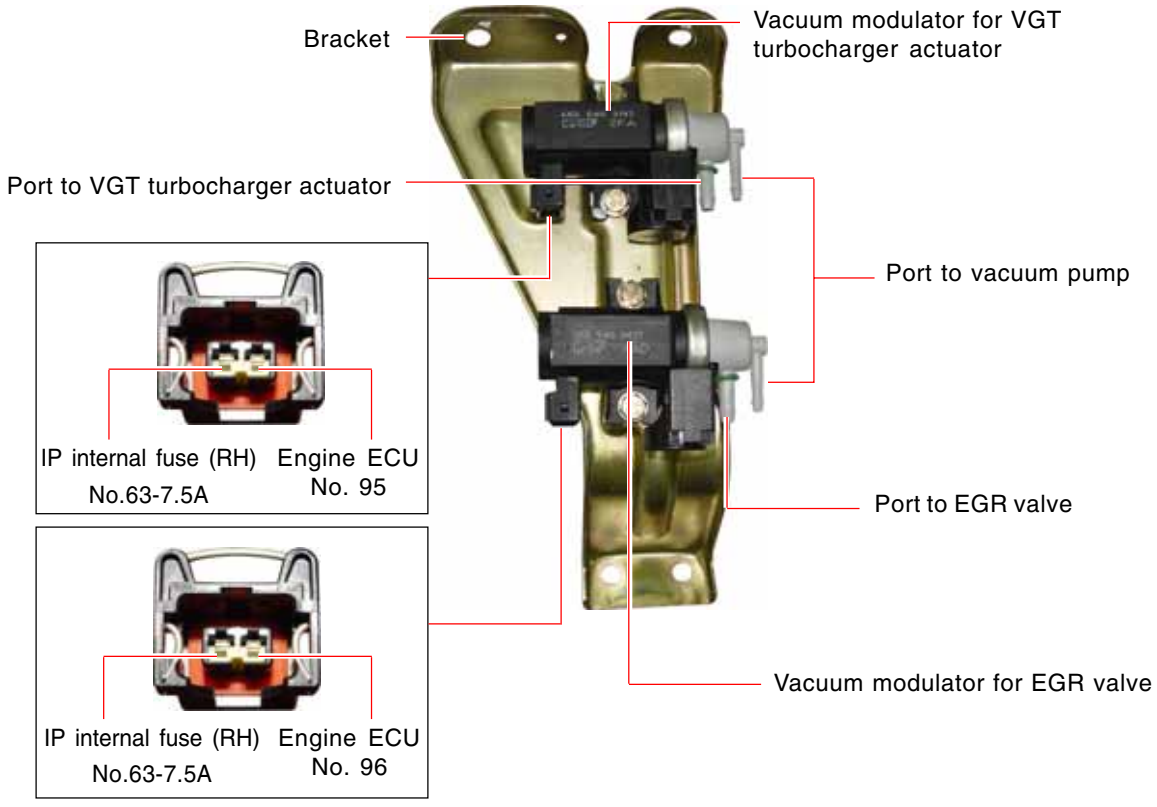


4. Unscrew the mounting bolts and remove the vacuum modulator bracket.



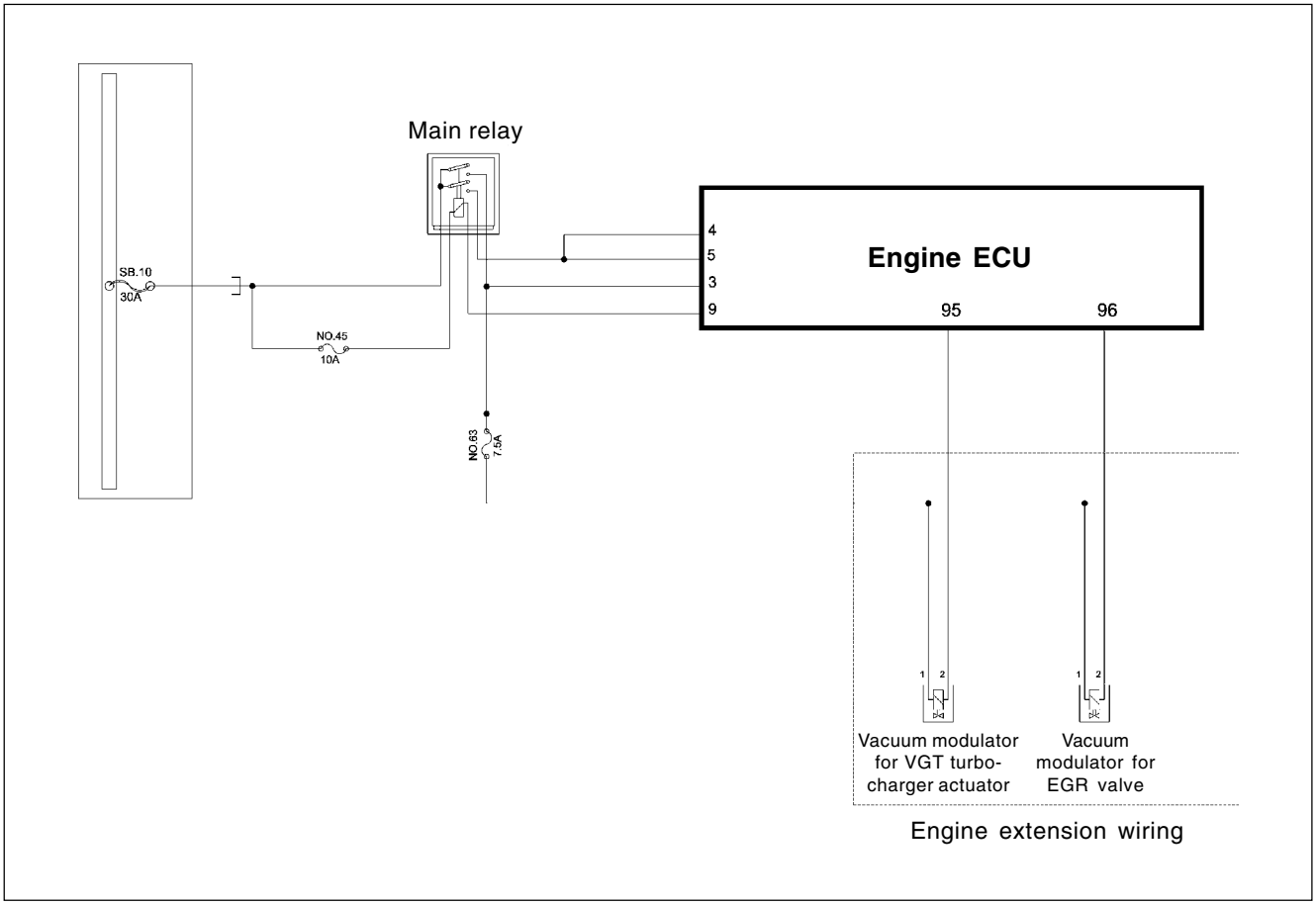
5. Install in the reverse order of removal.

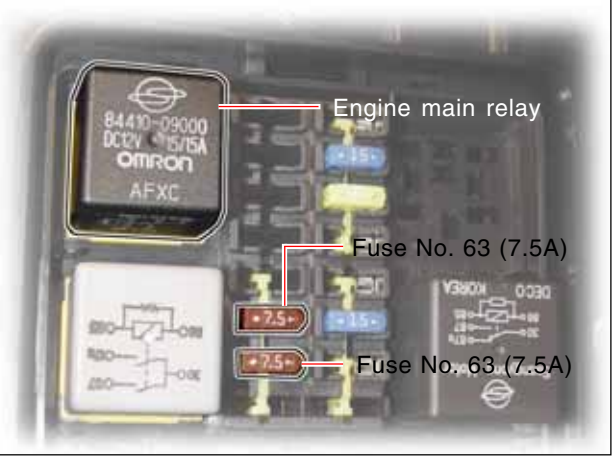
Components



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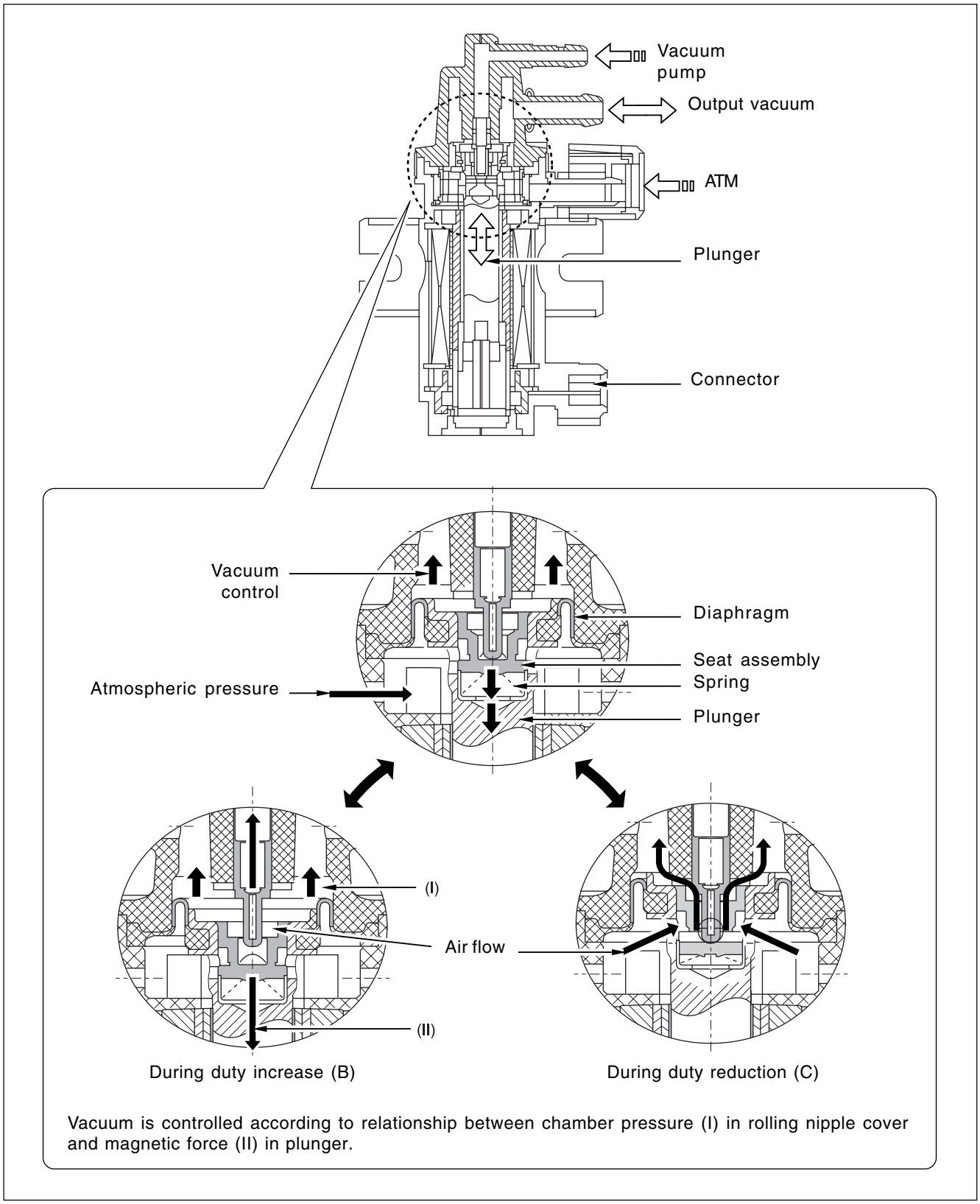
ELECTRICAL CIRCUIT RELATED TO VACUUM MODULATOR



IP Fuse Box (Passenger Side)	Engine Main Relay & Fuse No. 63
	

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▶ Operation Principle of Vacuum Modulator

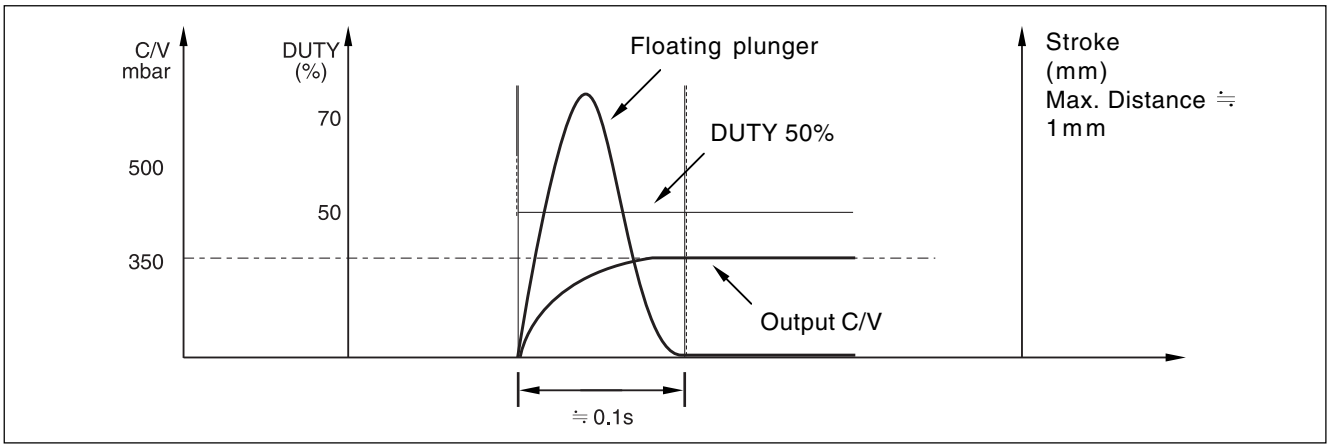


Vacuum is controlled according to relationship between chamber pressure (I) in rolling nipple cover and magnetic force (II) in plunger.

According to ECU signals, the solenoid valve controls the vacuum pressure that is generated by vacuum pump (-900 ± 20 mbar) with PWM type control and drives the mechanical EGR valve and turbo charger.

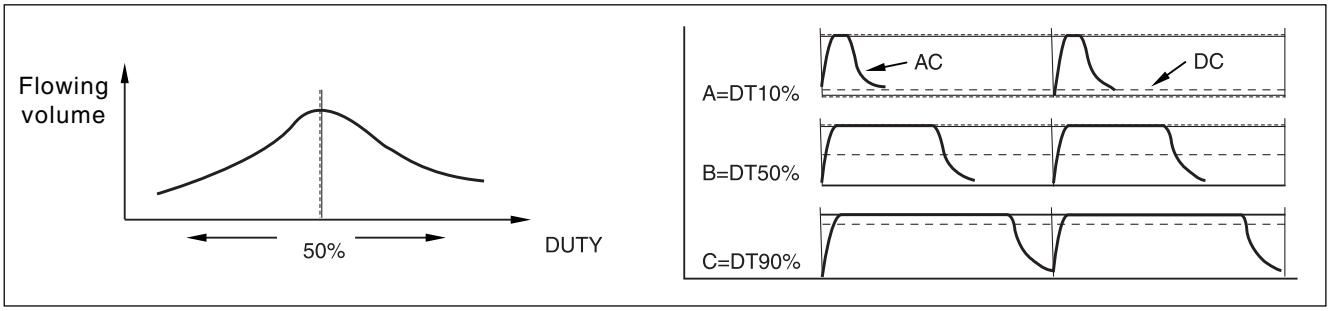
Operating principle: Balance between original vacuum pressure and magnetic forcs (see aboe figure)

1. Normal state (Fig. A): Original vacuum and seat section, 3 stoppers keep sealing
2. Duty up state (Fig. B): Original vacuum pressure is connected to inside of diaphragm chamber
3. Duty down state (Fig. C): Increased diaphragm chamber pressure is connected to atmosphere to compensate the pressure.

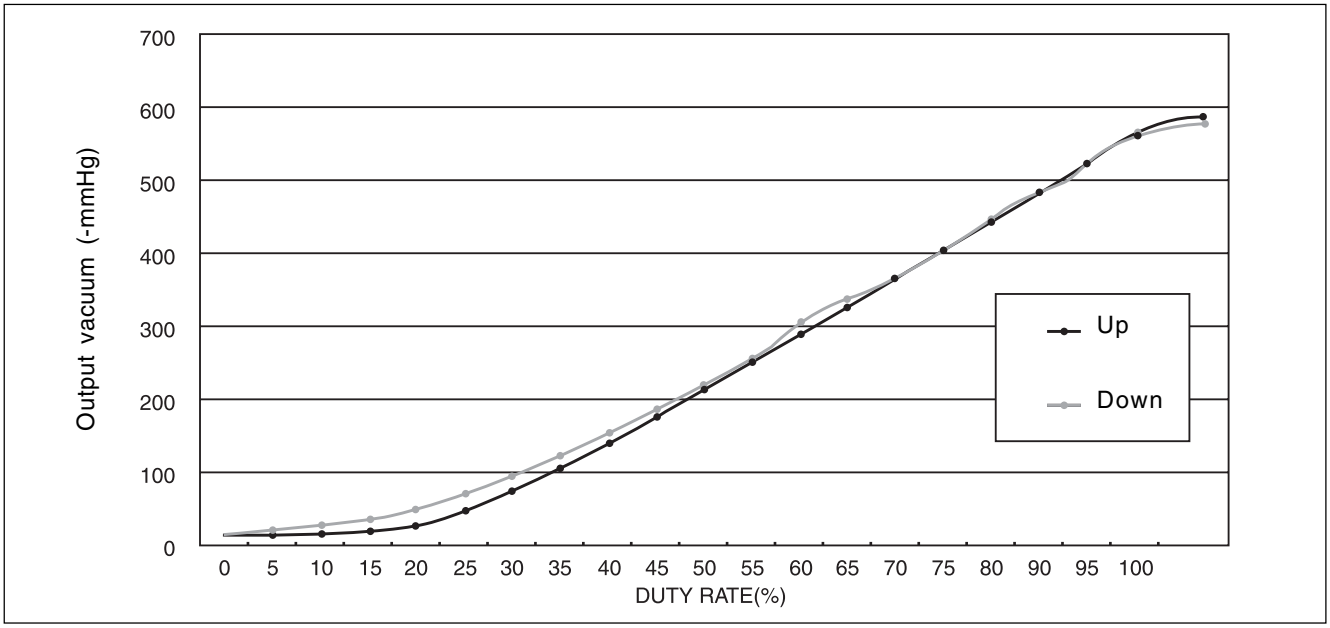


⇒ Operating principles when duty is applied from 0 to 50 %

Vacuum consumption: Compared to 50 % of duty, ON/OFF periods are most unstable and vacuum consumption is most high.



Output characteristics



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EFFECTIVE DATE	
AFFECTED VIN	

Operating conditions

1. Engine is running
2. Engine RPM is within a specified range. (EGR OFF under high RPM range)
3. Engine torque is within a specified range. (EGR OFF under high torque range)
4. Vehicle speed is within a specified range. (EGR OFF under high speed range)
5. Atmospheric pressure is within a specified range. (EGR OFF under high altitude and low atmospheric pressure)
6. Coolant temperature is within a specified range. (EGR OFF under high or low temperature)
7. EGR OFF under extended period of idling.

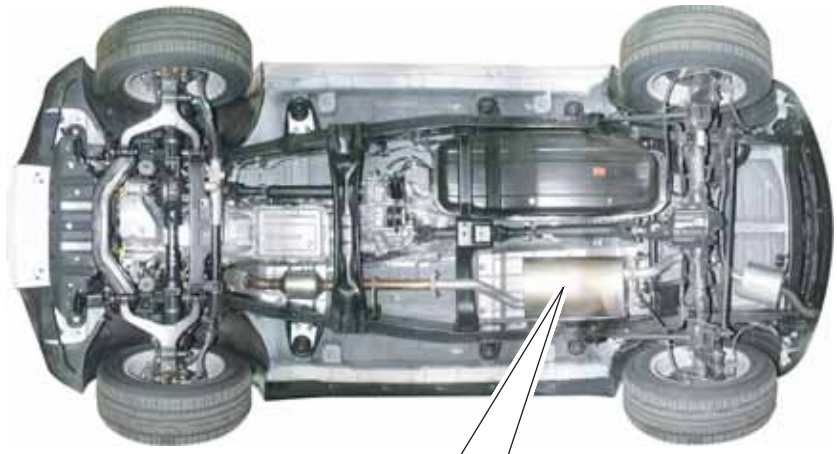
Control logic

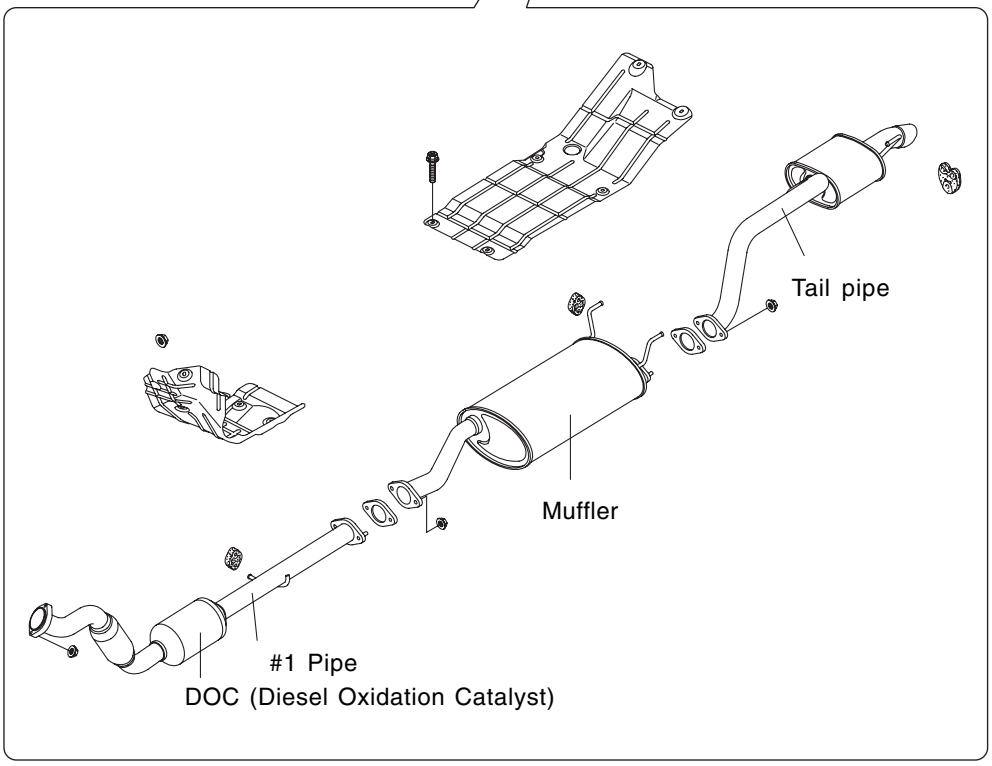
1. Main map: EGR volume is controlled based on intake air volume
2. Auxiliary map
   1) Coolant temperature (Coolant temperature sensor)
   2) Engine rpm (Crankshaft position sensor)
   3) Engine load (TPS): Detection of sharp acceleration
   4) Intake air temperature (HFM): Decreases when over 60°C
   5) Atmospheric pressure (Barometric sensor): Compensation of altitude
3. Compensation value of auxiliary map will be increased/decreased based on main map then ECU calculates EGR volume finally to regulate the vacuum duty that applies to the vacuum modulator to control EGR valve openings.

Shut-off conditions

1. Engine rpm: over 2,950 rpm
2. Vehicle speed: over 105 km/h
3. Coolant temperature: over 100°C or below 10°C
4. Idle period: over 50 seconds

EXHAUST SYSTEM AND MUFFLER





MUFFLER

The muffler is located at the middle of the exhaust pipe and reduces the pulse noise and the tail pipe noise by eliminating the flowing resistance from the exhaust gas.

The important elements of the muffler are volume, construction and location.

SYSTEM OVERVIEW

▶ Exhaust System

Check the complete exhaust system and the nearby body areas and trunk lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections, or other deterioration which could permit exhaust fumes to seep into the trunk may be an indication of a problem in one of these areas. Any defects should be corrected immediately.

NOTICE

- **When you are inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to avoid possible overheating of the floor panel and possible damage to the passenger compartment insulation and trim materials.**

▶ DOC (Diesel Oxidation Catalyst)

DOC (Diesel Oxidation Catalyst) is the purification device to reduce the toxic emissions from the exhaust gas from the engine. By using the chemical reaction, the amount of toxic gas such as NOx can be reduced.

NOTICE

- **To prevent damage of DOC, never contact the lift pad when lifting up the vehicle.**

▶ Muffler

Aside from the exhaust manifold connection, the exhaust system uses a flange and seal joint design rather than a slip joint coupling design with clamp and U-bolts. If hole, open seams, or any deterioration is discovered upon inspection of the front muffler and pipe assembly, the complete assembly should be replaced. The same procedure is applicable to the rear muffler assembly. Heat shields for the front and rear muffler assembly and catalytic converter protect the vehicle and the environment from the high temperatures that the exhaust system develops.

▶ Heat Shield

The heat shield protects the vehicle and components from the high heat generated from the exhaust system.

In this vehicle, the heat shield to block the heat from DOC is installed to the underbody, and the heat shield to block the heat from the rear muffler is installed to the underbody between the fuel tank and the rear muffler.

▶ Hanger

The hanger is to support the components.

If the ganger is not properly installed, it may cause the vibration that is very difficult to diagnose. Therefore, install the hanger to the correct location so that the exhaust system cannot contact to the underbody and other components.

▶ DOC (Diesel Oxidation Catalyst)

System and principle

Oxidation catalytic technology for diesel engine is basically the same with it of gasoline engine used before development of 3 primary catalyst (2 primary catalyst), and its effect and performance were already proved.

DOC (Diesel Oxidation Catalyst) reduces HO and CO contained exhaust gas over 80 %, and removes SOF (Soluble Organic Fraction) over 50 ~ 80 %, but because its portion in total PM is low, it reduces approx, 20 ~ 40 % of TPM (Total Particulate Material).

Because of low reducing rate for PM of DOC, in order to guarantee safety rate of PM regulation, this technology is being used mainly. And it should keep over 80% of PM reducing rate, and at present it plays a role as a transition stage.

And also it reduces diesel odor and black smoke, platinum or palladium are being used as a catalyst.

On the other hand, it is a problem that it makes the reaction of oxidation, which SO_2 produce SO_3 and H_2SO_4 by reacting to oxygen in exhaust gas, if temperature of exhaust gas becomes over 300°C, and this produced gas is very harmful to human body. To prevent is, previously it is requested that the sulfur content rate of fuel should be below 0.05 %, and in the future it is being expected to keep it below 0.01 %.

Catalytic converter structure

The Catalytic converter of monolith type consists of 2 walled metal bodies which is made of Cordierite.

The principal element of converter consists of the materials like Alumina or oxidized Serume in order to apply to Ceramic Monolith. Washer coat operates first, and catalytic metal elements (Pt, Pd, Ph) operates to washer coat next.

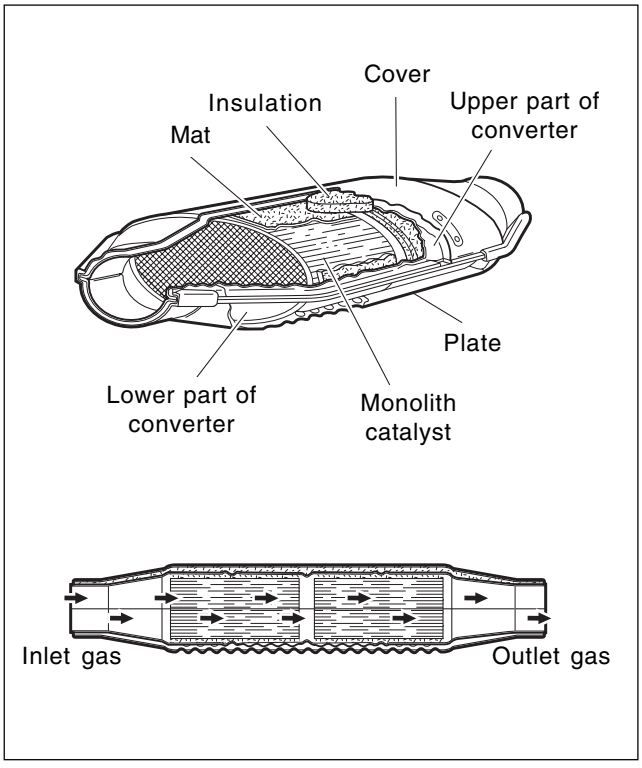
Monolith type is lighter than other types, easy to manufacture and quickly approaches to proper temperature.

Washer coat is used to make a contact surface with exhaust gas bigger by adhering closely to small holes of inner layer.

If a lead compound or phosphorus adheres to the surface and the temperature rises, its surface is decreased.

The total area of general monolith converter is about 45,000 ~ 500,000 ft^3. (10 times of a football field)

Generally Alumina (AL_2O^3) is used as a raw material and its 7 phases of gamma, delta, theta have big areas and high stability for the temperature, and nowadays gamma Alumina is used usually.



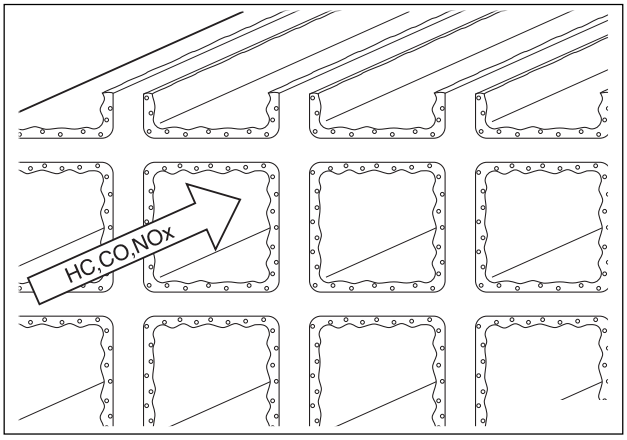
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EFFECTIVE DATE	
AFFECTED VIN	

Catalytic converter and temperature

Catalytic converter has the normal function of purification at a range of the temperature. Because it has a weak point of decreasing of the purification rate in the condition of continuous high temperature, it should keep the temperature range of 400 to 500°C for normal condition. HC purification rate becomes better according to the increase of temperature in the normal range of temperature. CO purification rate becomes the best near the temperature of 450°C, and NOx does so near the temperature of 400 to 500°C.

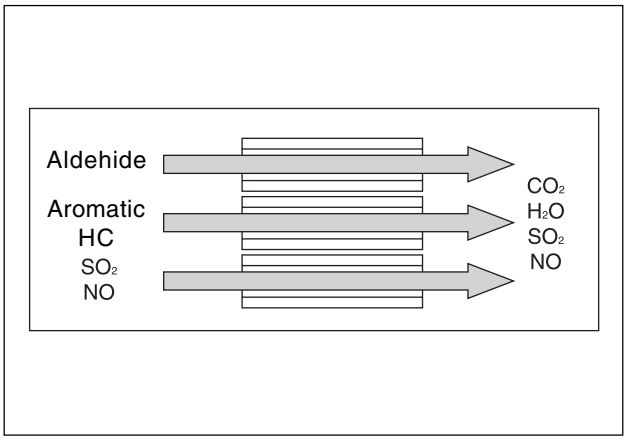
Purification of catalytic converter

1. Adhesion of soluble organic fraction (SOF) below 180°C
2. Purification of soluble organic fraction (SOF) over 180°C

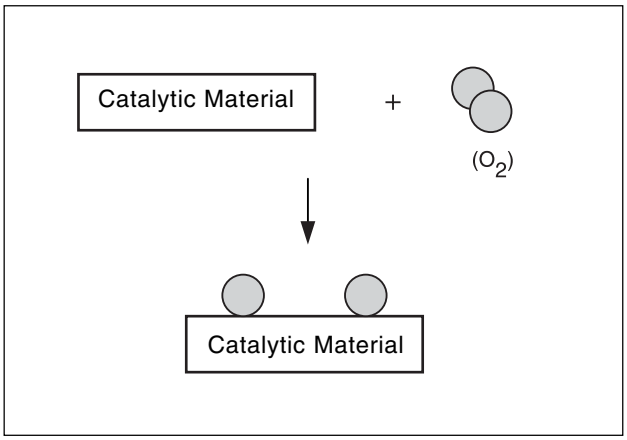


Chemical reaction formula

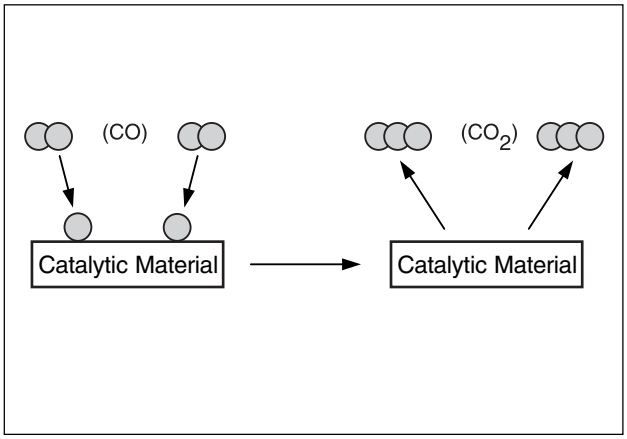
1. SOF (HC) + O2 ..... O2 +H2O
2. 2CO + O2 ..... 2CO2
3. 2C2H6 + 7O2 ..... 4CO2 + 6H2O



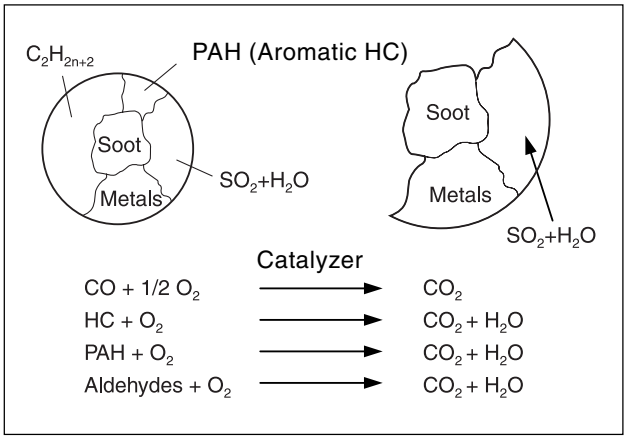
6. Oxygen adheres to catalytic material : below 180°C



5. Catalytic material supplies each CO and HC with O2 for their oxidation : above 180°C



6. Catalytic material conversion process by DOC



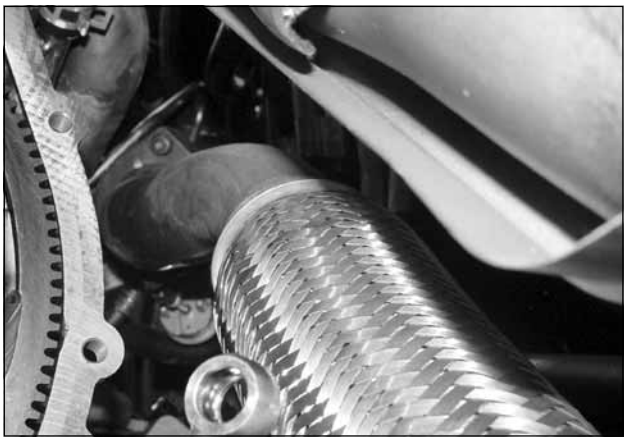
Method for reduction of NOx

NOx is generated a great deal in case that combustion temperature and excess air factor are high. EGR valve can decrease NOx (30 to 35% decrease) by making temperature of combustion chamber fall by means of exhaust gas re-circulation.

MEMO

Exhaust Pipe - Removal and Installation

1. Remove the upper bolts at turbo charger.

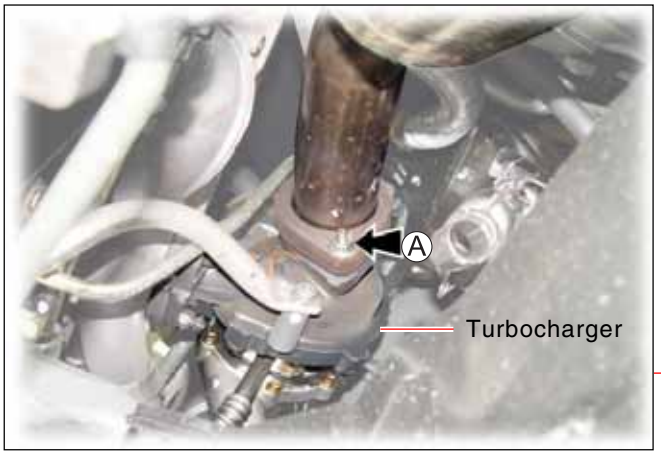


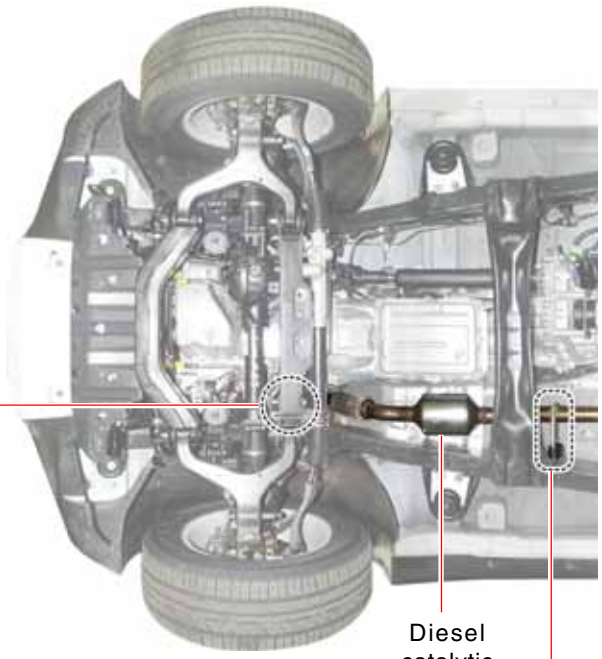
NOTICE

- **Use the universal type wrench.**

2. No.1 Exhaust Pipe

A. Unscrew two mounting bolts/nuts from the upper side (turbocharger).





3. Diesel catalytic converter (Rear)

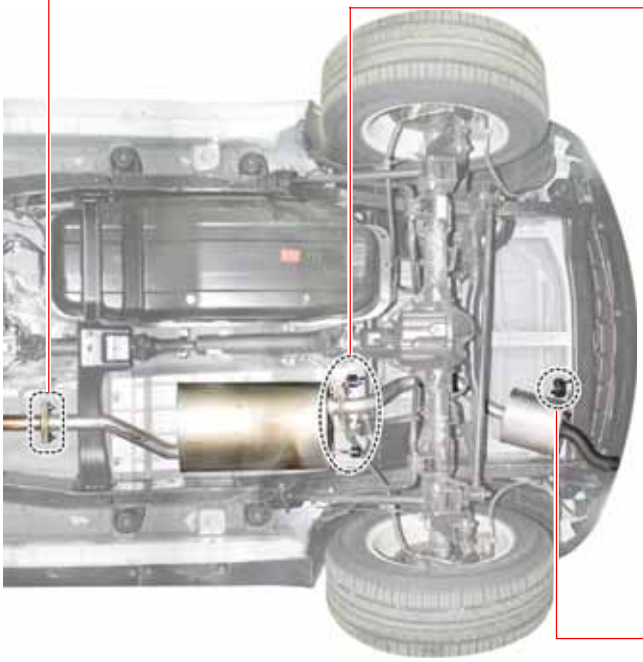
A. Remove the pipe mounting rubber using a screwdriver.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

B. Remove two lower mounting bolts/nuts and the gasket.





4. No.2 Exhaust Pipe and Muffler
   - Remove two mounting bolts/nuts from the muffler side and remove the pipe mounting rubber using a screwdriver.



5. No.3 Exhaust Pipe and Muffler
   - Remove the pipe mounting rubber using a screwdriver.



LUBRICATION SYSTEM

05

TABLE OF CONTENTS

LUBRICATION SYSTEM 2

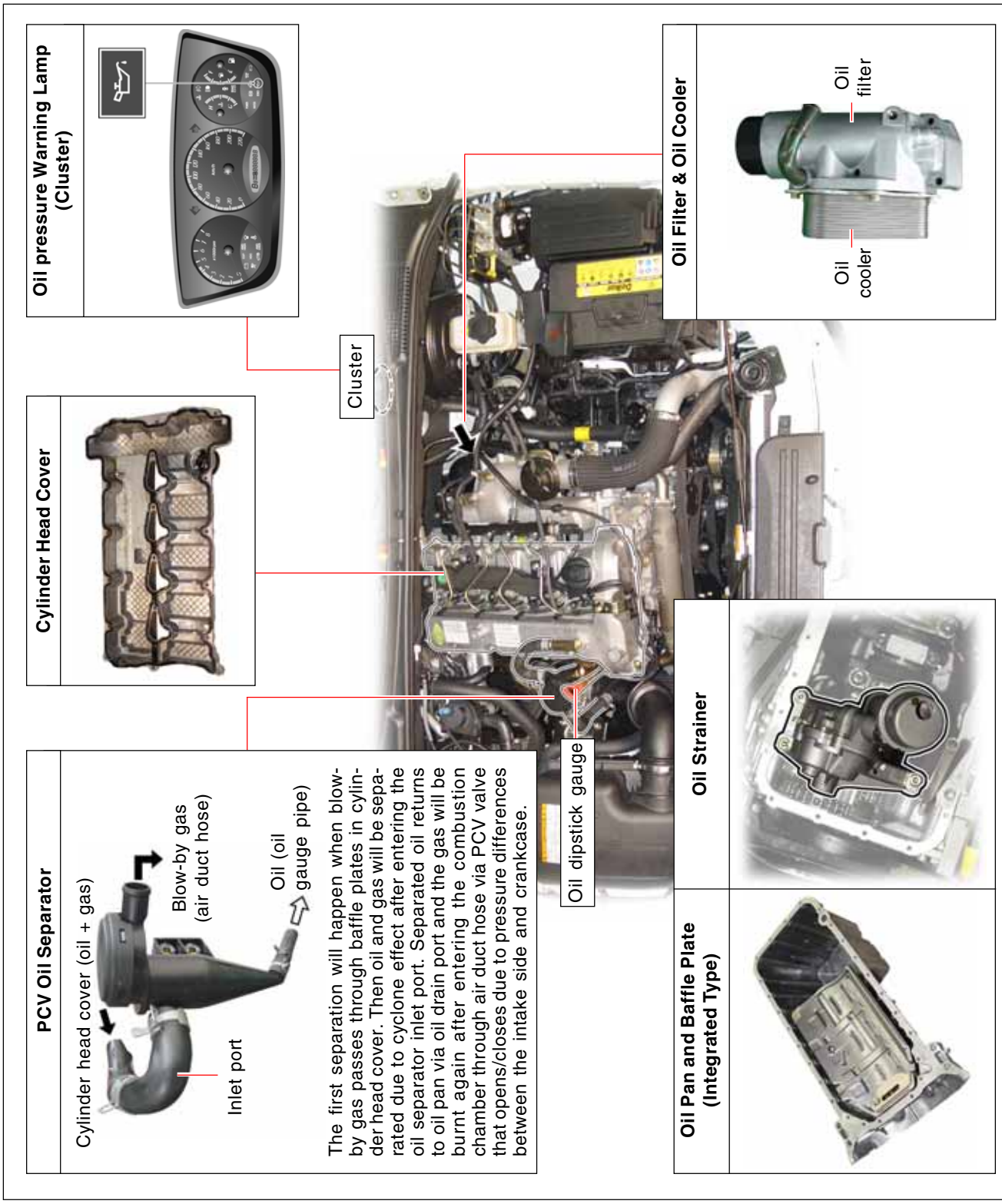
Layout and overview 2
Lubrication system layout 3
Lubrication diagram 4
Specifications 5
Engine oil change 9
Oil spray nozzle 13
Oil pan assembly 14
Removal and installation of oil pan and oil pump 15

TROUBLE DIAGNOSIS 19

LUBRICATION SYSTEM

LAYOUT AND OVERVIEW

▶Lubrication System

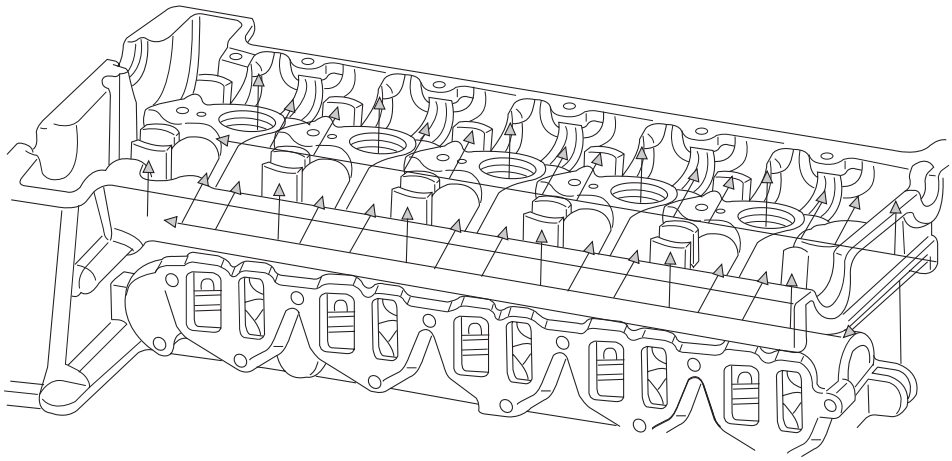


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

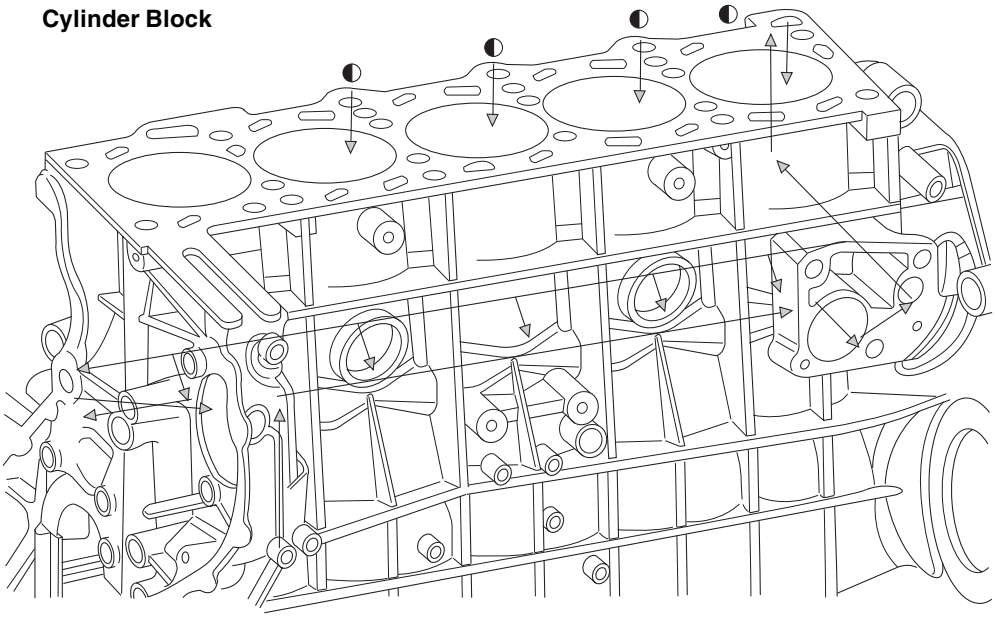
LUBRICATION SYSTEM LAYOUT

Main oil gallery: ϕ 16
Hole to cylinder head: ϕ 9
Main bearing hole: ϕ 7
Chain and injection pump: ϕ 7
Return hole: ϕ 14
Chain nozzle: ϕ 1
HP pump bearing: ϕ 6

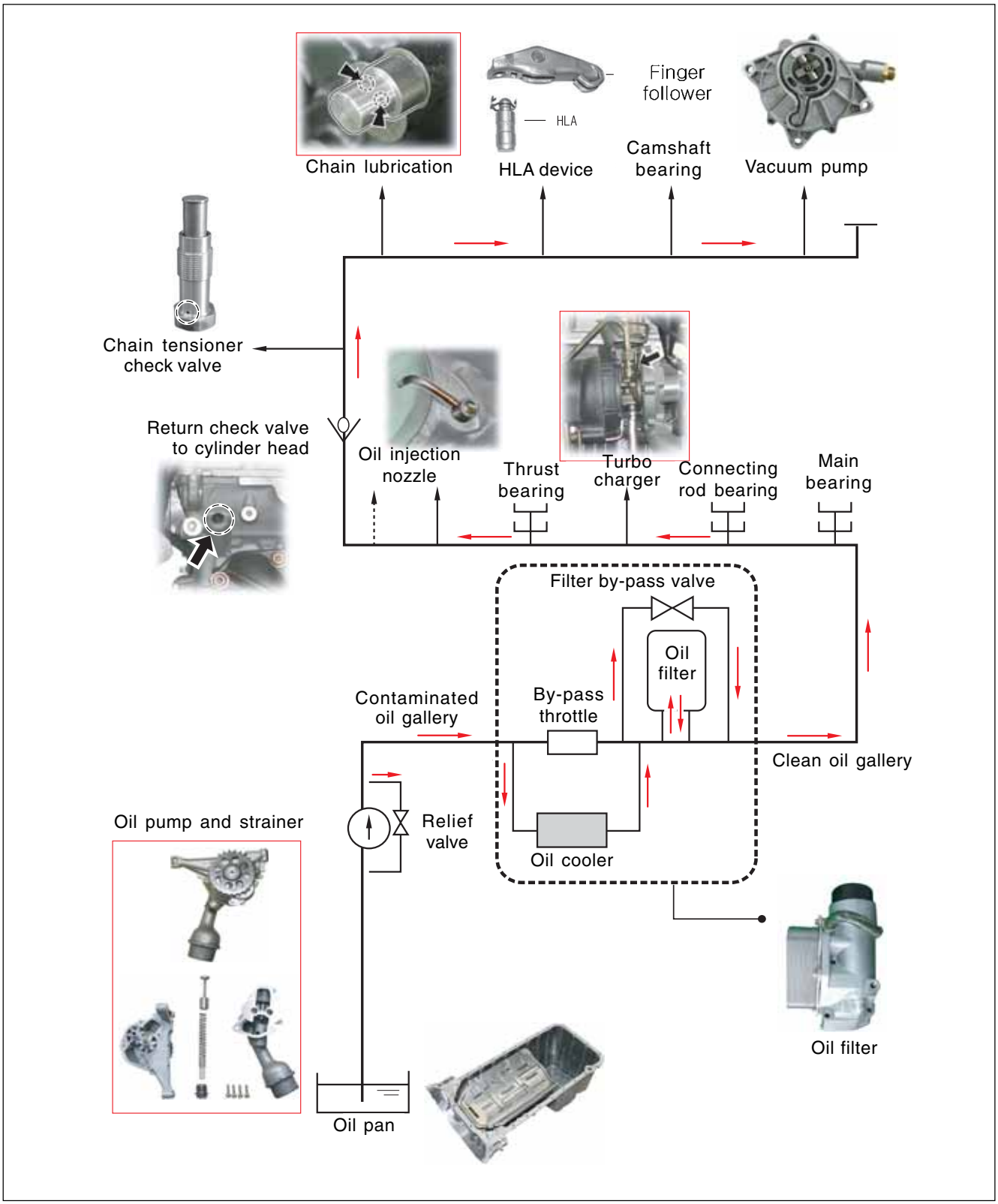
Cylinder Head



Cylinder Block



LUBRICATION DIAGRAM



※ 1. Opening pressure of by-pass valve in oil filter: 3 ± 0.4 bar

2. To prevent instant oil shortage after stopping the engine, the return check valve is installed in oil supply line of cylinder head.

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EFFECTIVE DATE	
AFFECTED VIN	

SPECIFICATIONS

Engine oil	Specification	Approved by MB Sheet 229.1 or 229.3 Viscosity: See MB Sheet 224.1
	Capacity	6.8 ~ 8.3 liter
	Service interval	Initial change: 5,000 km, Change every 10,000 km or 12 months (Frequently check the oil level and add if needed. And, every 5,000 km or 6 months under severe conditions)
Engine oil filter		Same interval with engine oil
Oil relief valve opening pressure		5.8 ± 0.3 bar

※ Severe Condition:

1. When most trips include extended idling and/or frequent low-speed operation as in stop-and-go traffic.
2. When most trips are less than 6 km (Operating when outside temperatures remain below freezing and when most trips are less than 16 km)
3. When operating in dusty, sandy and salty areas
4. In hilly or moutainous terrain
5. When doing frequent trailer towing

▶ Oil Pressure Switch

1. Operating temperature: -40 ~ 140°C
2. Operating pressure: 0.3 ~ 0.55 bar
3. Permissible pressure: 10 bar



▶ Oil Pump

Oil	Relief Valve Opening Pressure
MB SHEET 229.1/3 SAE 10W 40, 5W 40	5.8 ± 0.3 bar

1. Enlarged pump capacity: Width of tooth (pump gear): 33 mm
2. Increased number of teeth (sprocket): 26



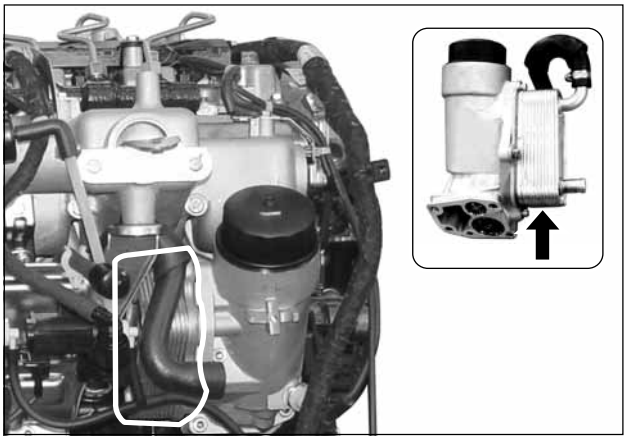
▶ Oil Cooler

1. Oil cooler mounting bolt: M6 x 16: 4

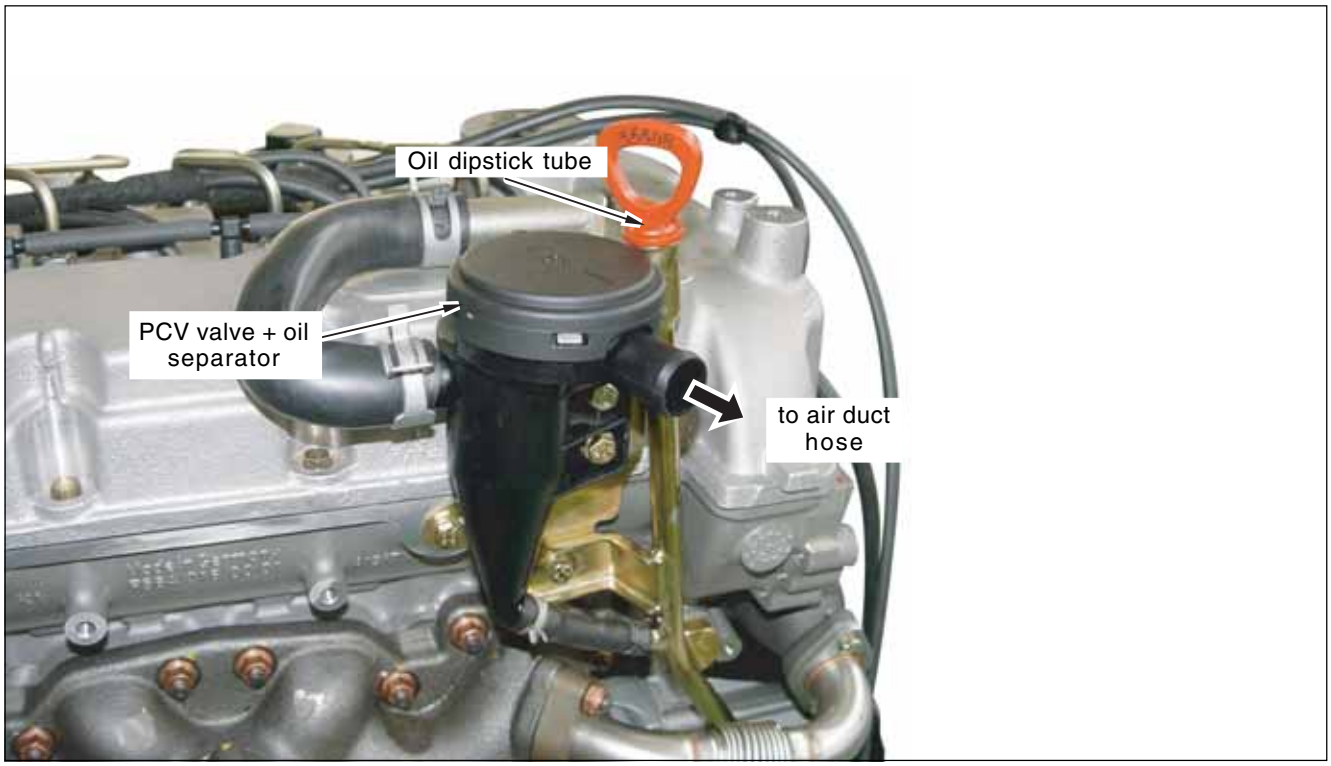
Installation Notice

Tightening torque	10 Nm

2. Replace two oil cooler gaskets with new ones when the oil cooler has been removed.

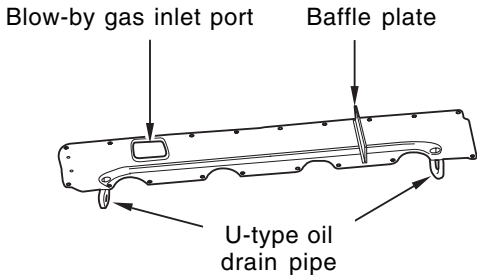


▶ Blow-by Gas Reduction Device



▶ Cylinder Head Cover





Baffle plate assembly: The baffle plates in cylinder head cover separates oil and gas from blow-by gas, and controls the blow-by gas speed to send only gas to separator.

▶ Oil Separator



The first separation will happen when blow-by gas passes through baffle plates in cylinder head cover; then oil and gas will be separated due to cyclone effect after entering the oil separator inlet port. Separated oil returns to oil pan via oil drain port and the gas will be burnt again after entering the combustion chamber through air duct hose via PCV valve that opens/closes due to pressure differences between the intake side and crankcase.

▶ Engine Oil Pressure Check

Check the oil level and quality before checking the oil pressure.

1. Drain the engine oil.
2. Disconnect the oil pressure switch connector and remove the switch.
3. Install the oil pressure gauge into the switch hole. Start the engine and let it run until the coolant temperature reaches at normal operating temperature (80 ~ 90°C).
4. Raise the engine speed by 2000 rpm and measure the engine oil pressure.

Specified oil pressure	2.5 ~ 3.0 kg/cm^2 (2000 rpm)

5. Install the switch and engage the connector.

NOTICE

- **Apply the Loctite onto the thread of the switch and check for oil leaks.**

Tightening torque	120 ~ 160 kg/cm^2

ENGINE OIL CHANGE

Change interval: Initial change 5,000 km, Change every 10,000 km or 12 months

Frequently check and add if needed. Shorten the change interval under severe conditions.

Severe condition:

1. When most trips include extended idling and/or frequent low-speed operation as in stop-and-go traffic.
2. When most trips are less than 6 km (Operating when outside temperatures remain below freezing and when most trips are less than 16 km)
3. When operating in dusty, sandy and salty areas
4. In hilly or moutainous terrain
5. When doing frequent trailer towing

NOTICE

- **Water separation from the fuel filter should be performed when changing the engine oil.**

▶ Engine Oil Changing Procedures



1. Park the vehicle on the level ground and warm up the engine until it reaches normal operating temperature.
2. Stop the engine and wait around 5 minutes. Remove the oil filler cap, oil filter and oil drain plug to drain the oil.

NOTICE

- **After driving, the engine oil temperature may be high enough to burn you. Wait until the oil is cooled down.**

3. Install new oil filter and tighten the drain plug with specified tighten torque.

Oil drain plug	25 ± 2.5 Nm

NOTICE

- **Over-tightening may cause oil leaks.**
- **Replace the drain plug washer with new one.**

4. Fill the engine oil through the oil filler opening.

NOTICE

- **The oil should not go above the upper mark on the dipstick. This would lead, for example, to increased oil consumption, fouling of the spark plugs and excessive formation of carbon residue.**

5. Close the oil filler cap and start the engine.
6. Stop the engine again and check the oil level. Add the engine oil if needed and check for the oil leaks.

Engine oil filter change

1. For changing procedures, refer to the “Lubrication System” section in this manual.
   1) Lubricate the engine oil gasket with engine oil before installation.
   2) Tighten it with the specified tightening torque.

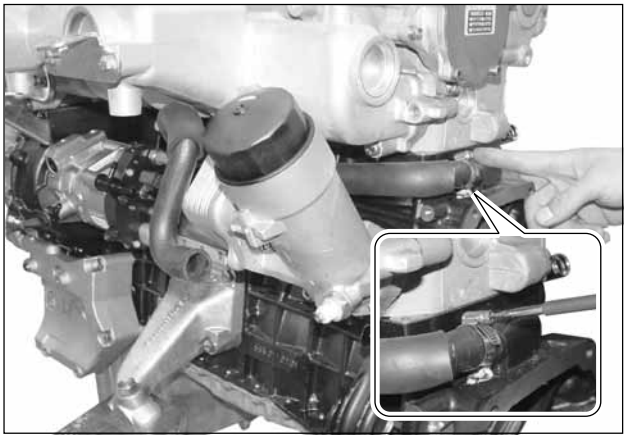
Oil filter	25 ± 2.5 Nm



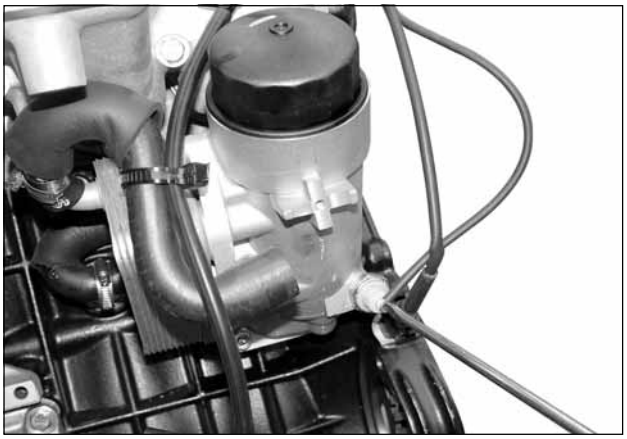
Oil Filter and Cooler - Removal and Installation

※ **Preceding Works:**
1. Draining of engine oil
2. Removal of EGR vacuum modulator bracket

1. Remove the oil cooler hoses (supply and return lines).



2. Disconnect the ground cable from the oil pressure switch.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Remove the oil cooler and filter mounting bolt.

Installation Notice

Tightening torque	23 ± 2.3 Nm

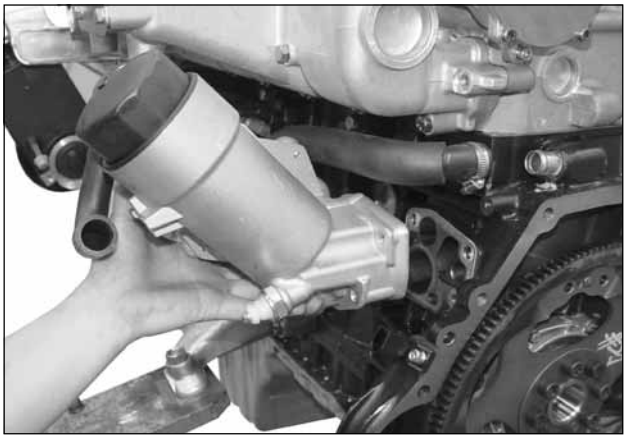
- ***Pay attention to the length of bolts.***



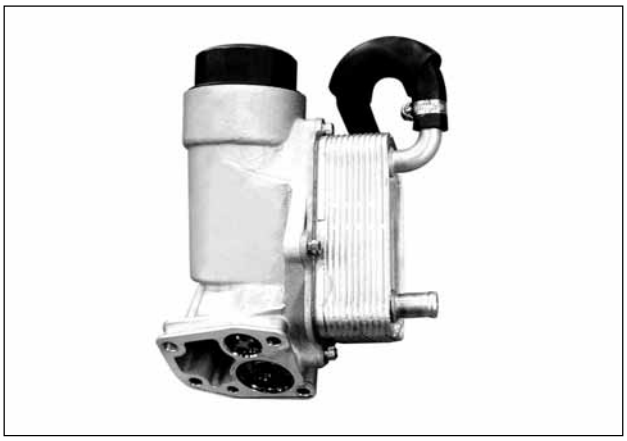
4. Remove the oil cooler and filter assembly from the cylinder block.

NOTICE

- **The oil cooler and filter assembly cannot be replaced separately.**

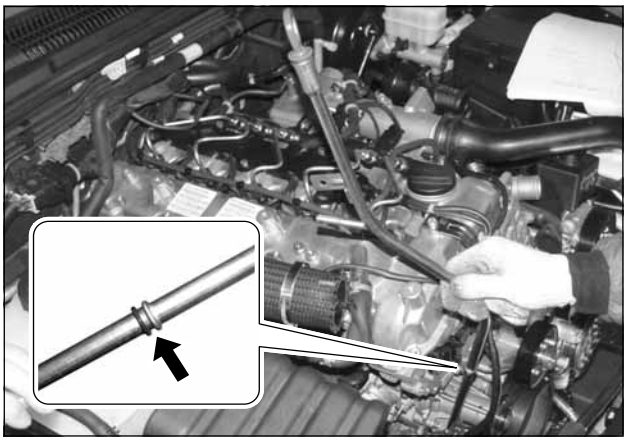


5. Install in the reverse order of removal.



Oil Dipstick Guide Tube - Removal and Installation

1. Pull out the engine oil dipstick.
2. Remove the EGR valve pipe (No.3).



Installation Notice

Tightening torque	35 ± 3.5 Nm

- ***Replace the pipe with new one.***

3. Unscrew the bolt and remove the oil dipstick guide tube.

Installation Notice

Tightening torque	10 Nm

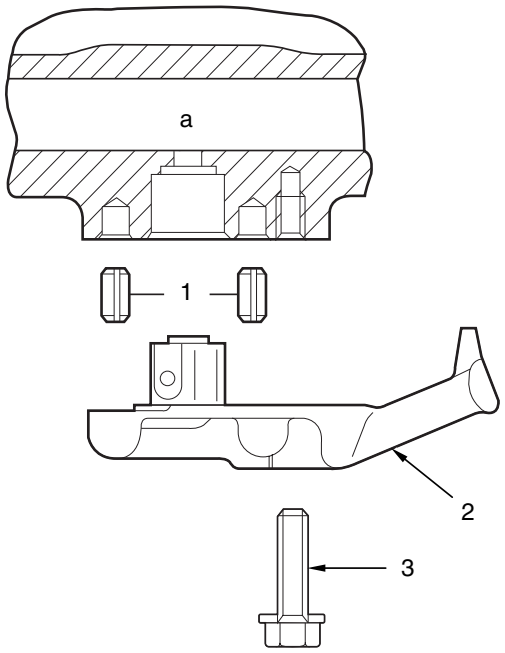
- ***Replace the O-ring with new one.***

4. Install in the reverse order of removal.

NOTICE

- **After installation, check for oil leaks.**

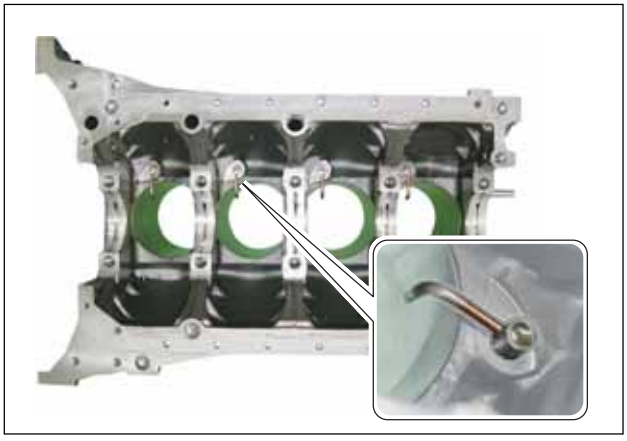
OIL SPRAY NOZZLE



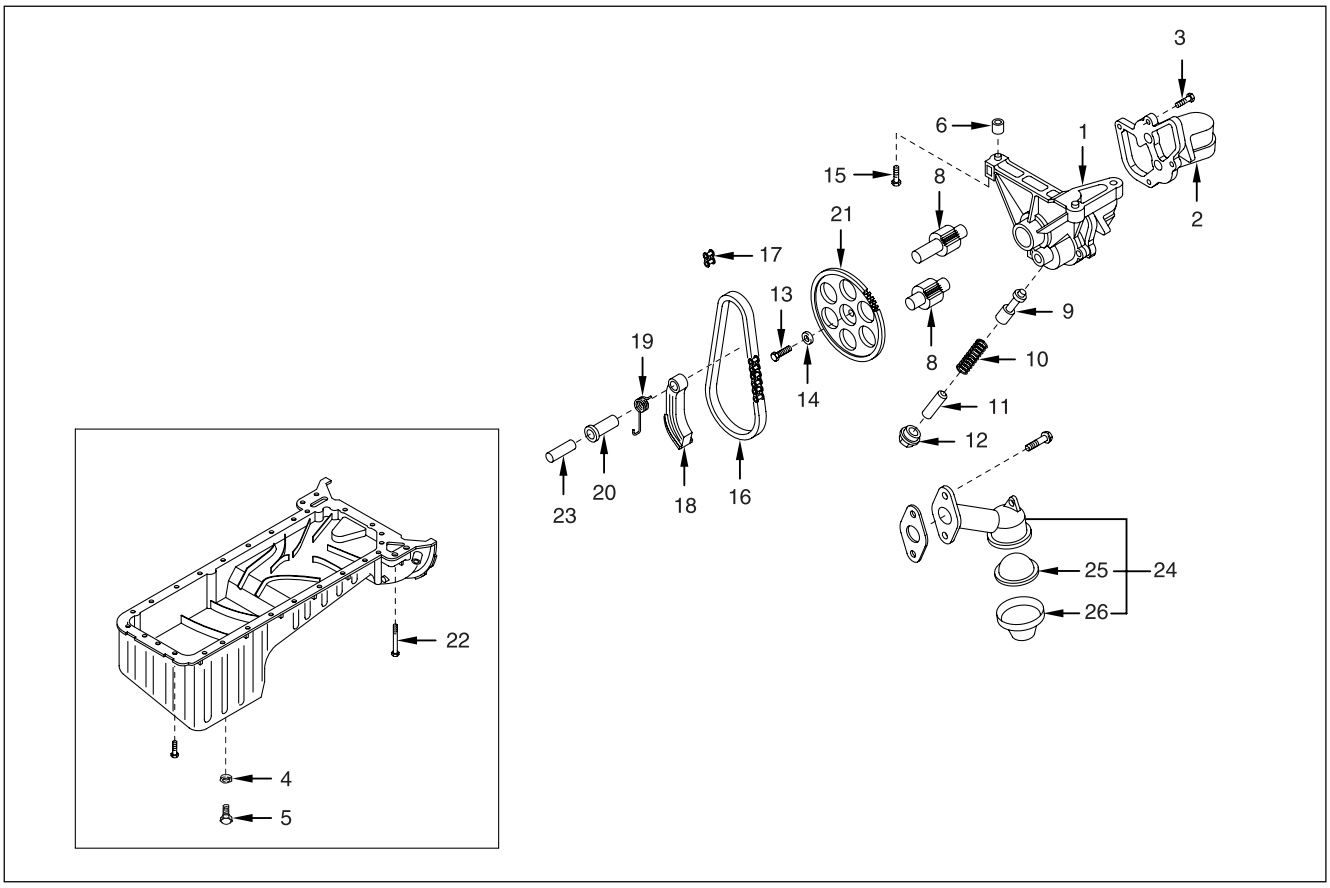
1. Fitting sleeve
2. Oil spray nozzle
3. Combination bolt ..... 10 Nm
a. Oil duct

Disassembly

1. Remove the oil pan or crankshaft.
2. Unscrew the bolts and remove the nozzle.



OIL PAN ASSEMBLY



1. Oil pump
2. Oil pump cover
3. Bolt
4. Drain plug washer
5. Drain plug ..... 25 ± 2.5 Nm (replace the washer)
6. Spring pin
7. Oil pump drive shaft
8. Oil pump driven shaft
9. Oil pump relief valve piston
10. Spring
11. Oil pump relief valve pin
12. Oil pump relief valve plug
13. Bolt ..... 10 Nm
14. Washer
15. Bolt
16. Oil pump roller chain
17. Oil pump chain lock link
18. Oil pump chain tensioner
19. Oil pump chain spring
20. Bush
21. Oil pump sprocket
22. Bolt
23. Cylindrical pin
24. Oil pump sprocket assy
25. Oil pump screen assy
26. Basket

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

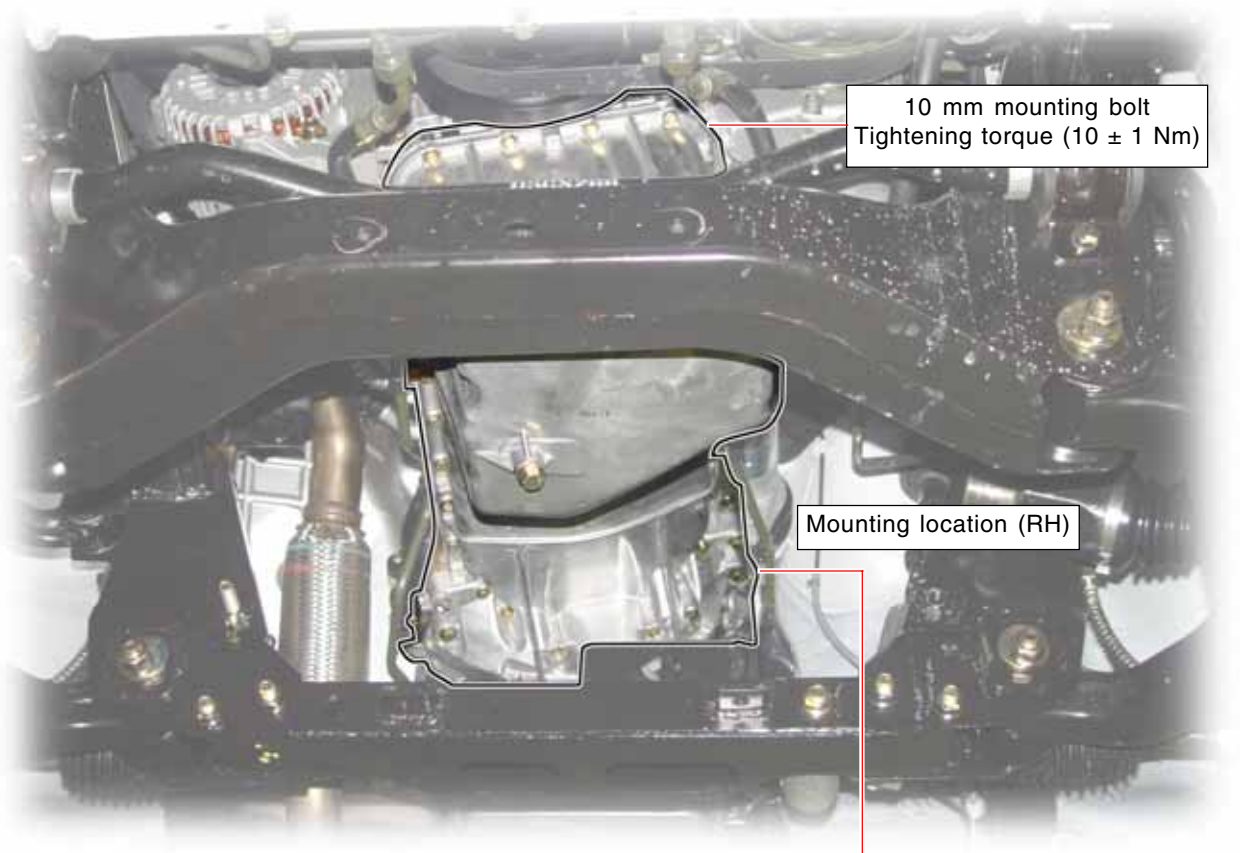
REMOVAL AND INSTALLATION OF OIL PAN AND OIL PUMP

※ **Preceding Work:**

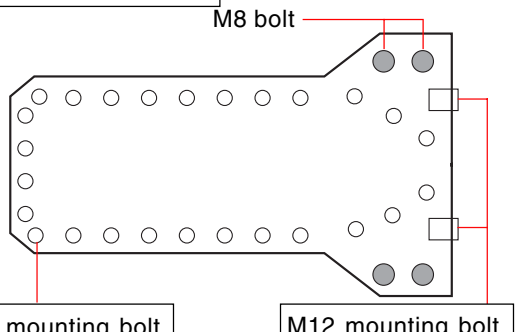
1. Remove the negative battery cable.
2. Drain the engine oil from the drain plug of the oil pan. (Store the drained engine oil in the specified container.)
3. Remove the front axle assembly. (For details, refer to “Chassis” section.)

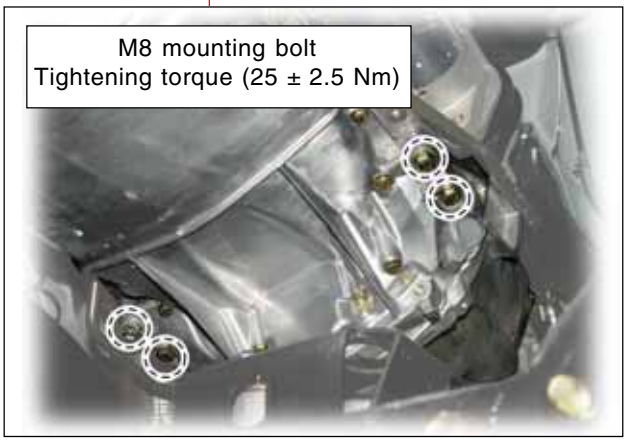
Oil Pan Assembly

1. Unscrew the mounting bolt from the oil pan and separate the oil pan using a rubber hammer.



Mounting Location (RH)





2. Remove the oil pan by lowering it to the front side (front bumper side).

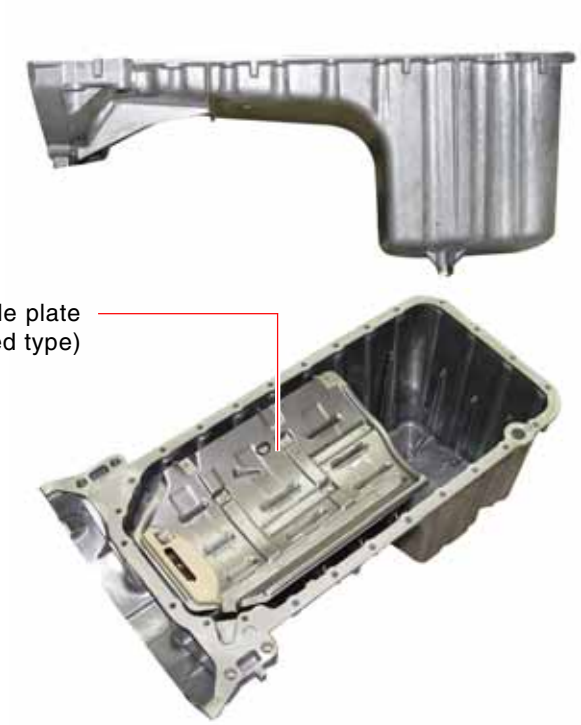
NOTICE

- **Be careful of the residual oil in the oil pan.**





Oil Pan Assembly

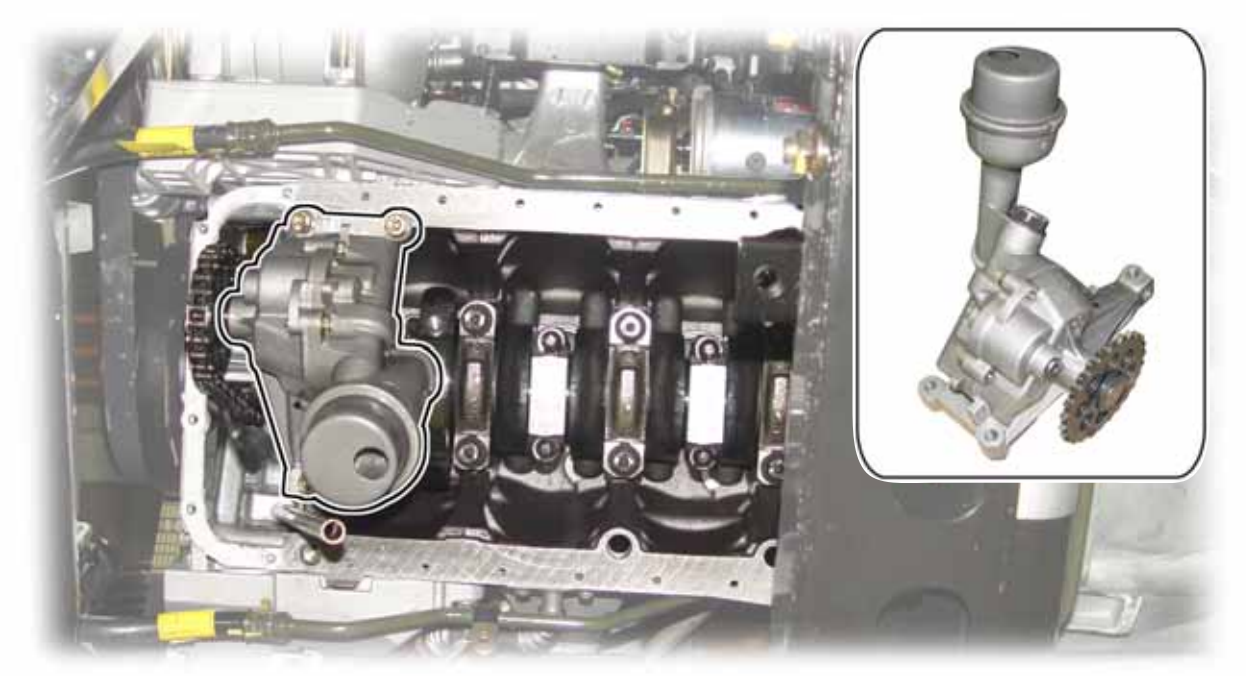


When Installing

1. **Wash out the oil pan to remove any foreign material.**
2. **Apply the specified sealant to the oil pan evenly (DB 2210: 661 989 56 A0).**
3. **Tighten the mounting bolt on the oil pan to the specified torque.**

Oil Pump and Oil Strainer

※ **Preceding Work:** Remove the oil pan assembly.



1. Unscrew three mounting hexagon bolts to remove the oil pump assembly.

Hexagon Mounting Bolt (6 mm)



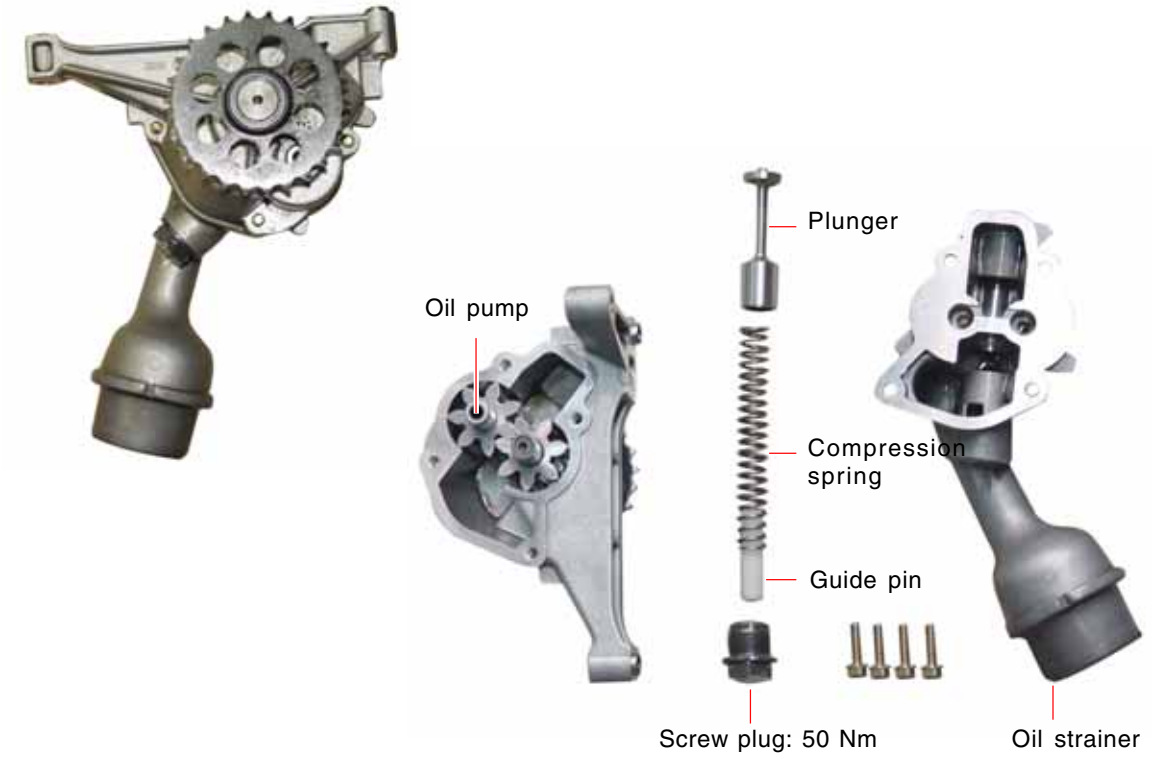
Removal



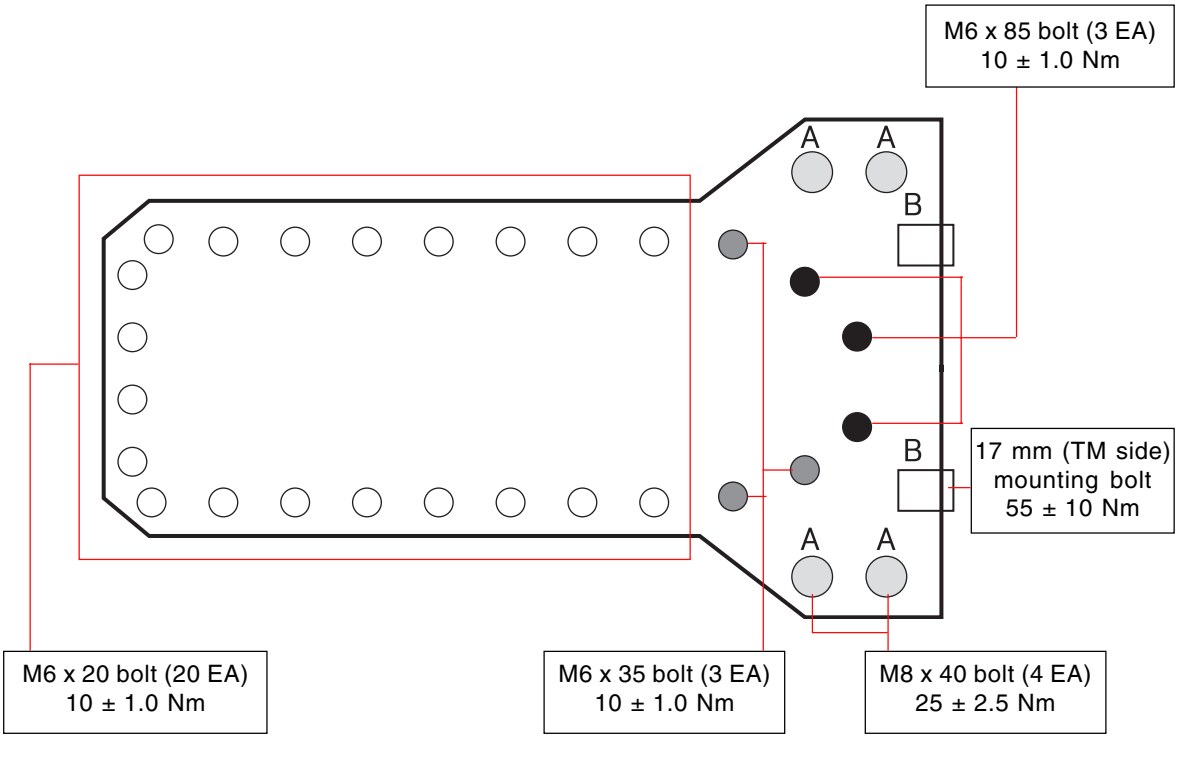
NOTICE

- **Add the engine oil through the top of the oil pump when reinstalling the oil pump and the oil strainer.**

Oil Pump Components



Mounting Bolt of Oil Pan and Tightening Torque



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

TROUBLE DIAGNOSIS

Symptom	Cause	Action
Excessive oil consumption	• Loosened oil drain plug	• Retighten
	• Loosened oil pan bolts	• Retighten
	• Poor sealing at oil seal	• Replace
	• Loosened oil filter	• Retighten
	• Loosened oil pressure switch	• Retighten
	• Poor sealing at camshaft front oil seal	• Replace
	• Poor sealing at crankshaft front oil seal	• Replace
	• Poor sealing at crankshaft rear oil seal	• Replace
	• Poor sealing at cylinder head cover gasket	• Replace
	• Damaged cylinder head cover gasket	• Replace
	• Oil intrusion into combustion chamber	• Clean
	• Stuck piston ring	• Remove carbon or replace ring
	• Worn piston or cylinder	• Boring or replace
	• Worn piston ring or ring groove	• Replace piston and piston ring
	• Improper position of ring cut-outs	• Adjust
	• Worn or damaged valve mechanism	• Replace
	• Oil leaks	• Repair
	• Defective turbo charger	• Check
Low engine oil pressure	Defective lubrication system	
	• Improper viscosity	• Replace with specified oil
	• Loosened oil pressure switch	• Retighten
	• Low engine oil level	• Add
	• Poor oil pump	• Replace
	• Worn or damaged oil pump relief valve	• Replace
	• Clogged oil filter or oil strainer	• Replace or clean
	• Oil leaks	• Repair

COOLING SYSTEM

06

TABLE OF CONTENTS

COOLING SYSTEM 2

ENGINE COOLING SYSTEM 3

Specifications 12

INSPECTION AND REPAIR 13

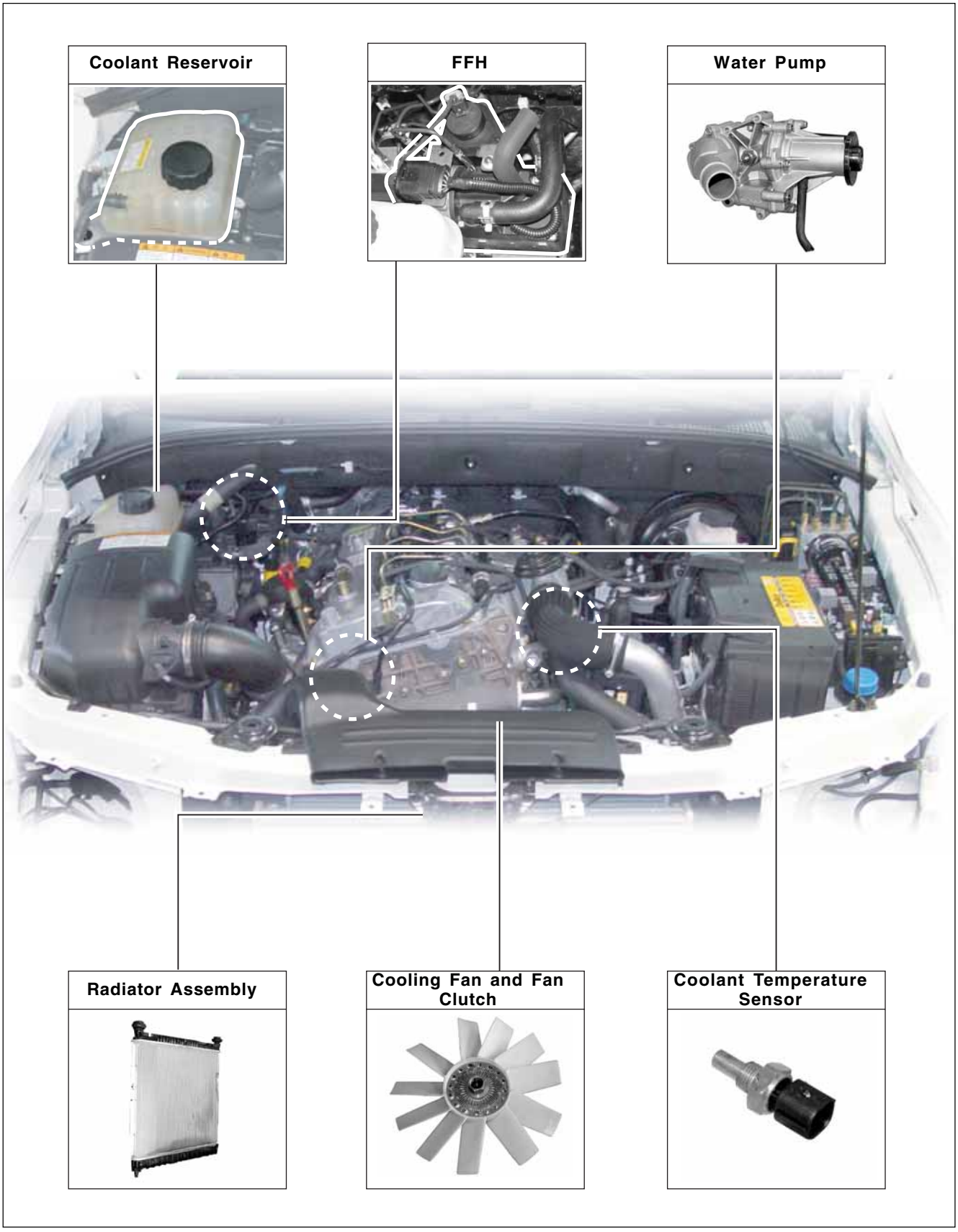
Inspection 13

REMOVAL AND INSTALLATION 15

PREHEATING SYSTEM 34

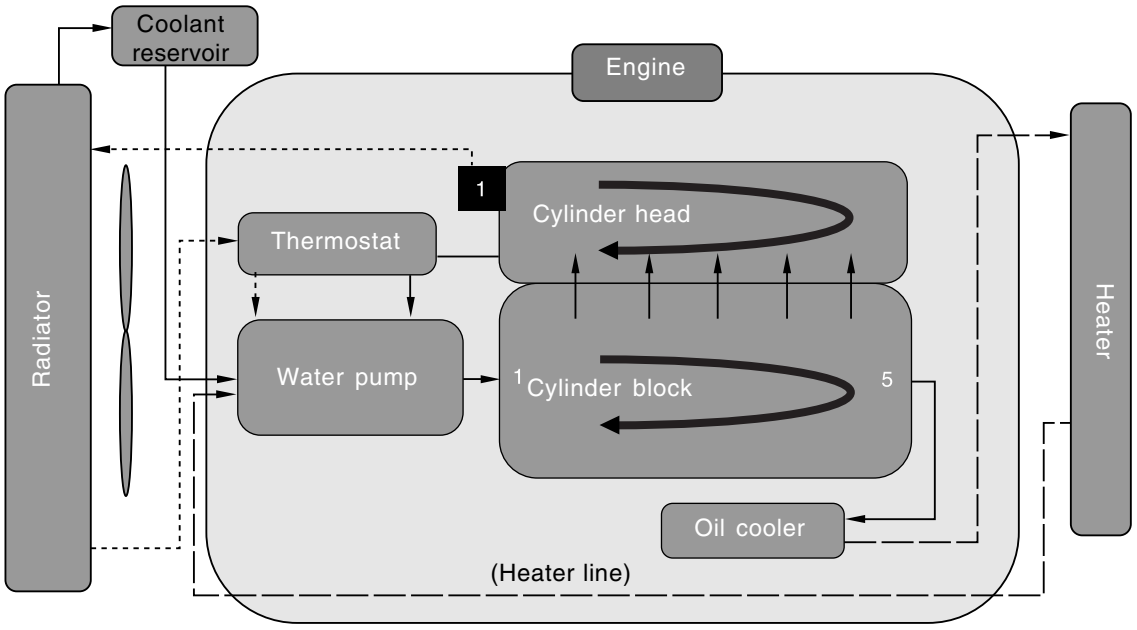
Overview 35
Preheating relay 35
Preheating system diagram 36
Preglow plug 40

COOLING SYSTEM

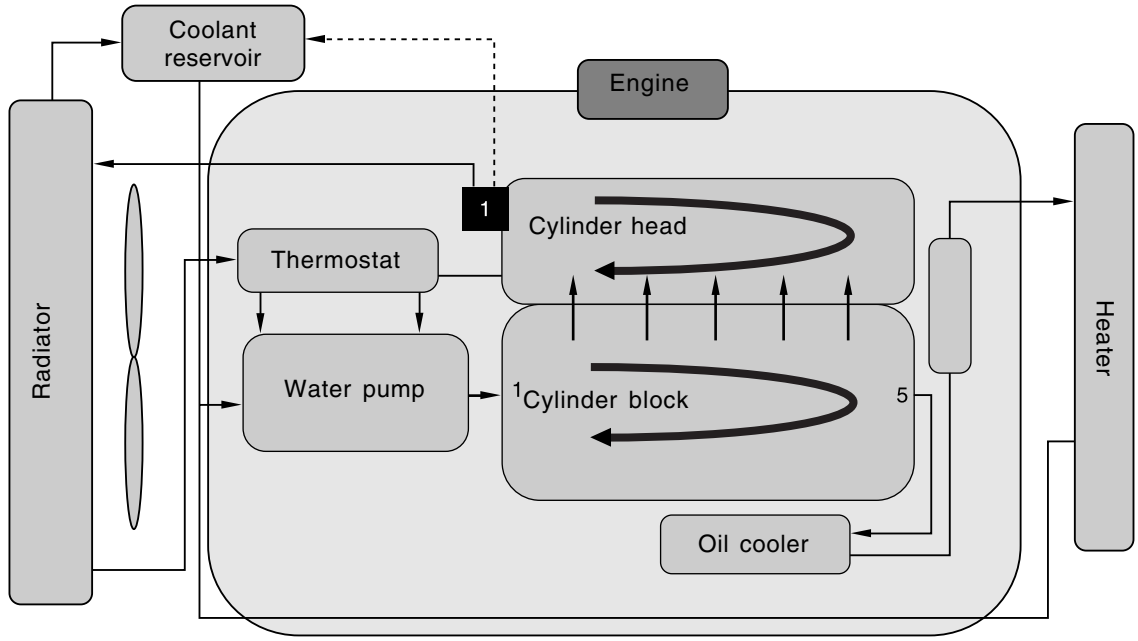


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ENGINE COOLING SYSTEM



<PTC Engine Coolant Flows>



<FFH Engine Coolant Flows>

- Cylinder block side
  Block #5 → Oil cooler → Heater → Heater water pump inlet pipe → Water pump
- Cylinder head side
  Cylinder head → Coolant outlet port (intake #1) → Radiator → Water pump

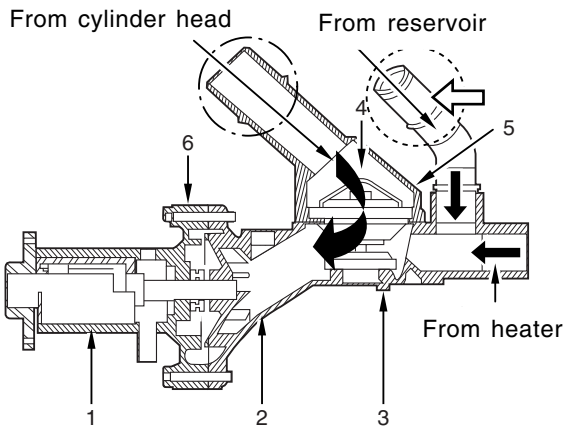
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EFFECTIVE DATE	
AFFECTED VIN	

▶ Function Description



1. Cylinder head coolant outlet port is integrated into intake manifold. (in front of cylinder #1)
   : Improved shape and gasket material to prevent coolant from leaking





2. In OM 600 engine, coolant inflows through the heater line rear section (cylinder #4 and #5) of cylinder head. However, in D27DT engine, coolant inflows from cylinder block through oil cooler (refer to coolant flows layout in previous page).
   : It prevents cooling efficiency from decreasing due to coolant separation between cylinder #4 and #5.

3. In OM 600 engine, the cooling fan is installed with water pump, however, in case of D27DT engine, it is connected to water pump with an additional pulley.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Radiator

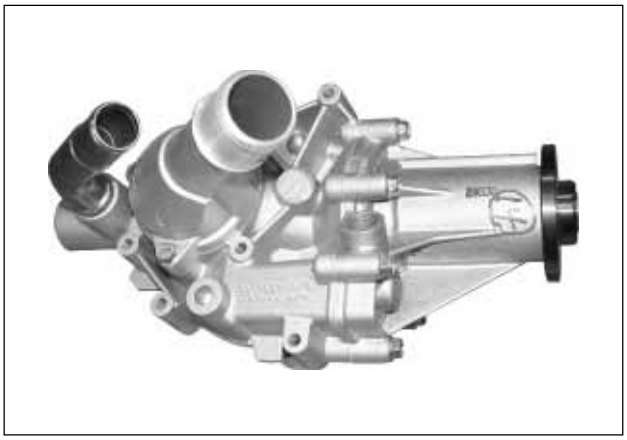
This vehicle has a lightweight tube-and-fin aluminum radiator. Be careful not to damage the radiator core when servicing.



Water pump

The belt-driven centrifugal water pump consists of an impeller, a drive shaft, and a belt pulley. The impeller is supported by a completely sealed bearing.

The water pump is serviced as an assembly and, therefore, cannot be disassembled.



Coolant reservoir

NOTICE

- **Scalding hot coolant and steam could be blown out under pressure, which could cause serious injury. Never remove the coolant reservoir cap when the engine and radiator are hot.**



The coolant reservoir is a transparent plastic reservoir, similar to the windshield washer reservoir. The coolant reservoir is connected to the radiator by a hose and to the engine cooling system by another hose. As the vehicle is driven, the engine coolant heats and expands. The portion of the engine coolant displaced by this expansion flows from the radiator and the engine into the coolant reservoir. The air trapped in the radiator and the engine is degassed into the coolant reservoir.

When the engine stops, the engine coolant cools and contracts. The displaced engine coolant is then drawn back into the radiator and the engine. This keeps the radiator filled with the coolant to the desired level at all times and increases the cooling efficiency. Maintain the coolant level between the MIN and MAX marks on the coolant reservoir when the system is cold.

▶ Thermostat



A wax pellet-type thermostat controls the flow of the engine coolant through the engine cooling system. The thermostat is mounted in the water pump housing. The thermostat stops the flow of the engine coolant from the engine to the radiator to provide faster warm-up, and to regulate the coolant temperature. The thermostat remains closed while the engine coolant is cold, preventing circulation of the engine coolant through the radiator. At this point, the engine coolant is allowed to circulate only throughout the heater core to warm it quickly and evenly. As the engine warms, the thermostat opens. This allows the engine coolant to flow through the radiator where the heat is dissipated. This opening and closing of the thermostat permits enough engine coolant to enter the radiator to keep the engine within proper engine temperature operating limits. The wax pellet in the thermostat is hermetically sealed in a metal case. The wax element of the thermostat expands when it is heated and contracts when it is cooled. As the vehicle is driven and the engine warms, the engine coolant temperature increases. When the engine coolant reaches a specified temperature, the wax pellet element in the thermostat expands and exerts pressure against the metal case, forcing the valve open. This allows the engine coolant to flow through the engine cooling system and cool the engine. As the wax pellet cools, the contraction allows a spring to close the valve.

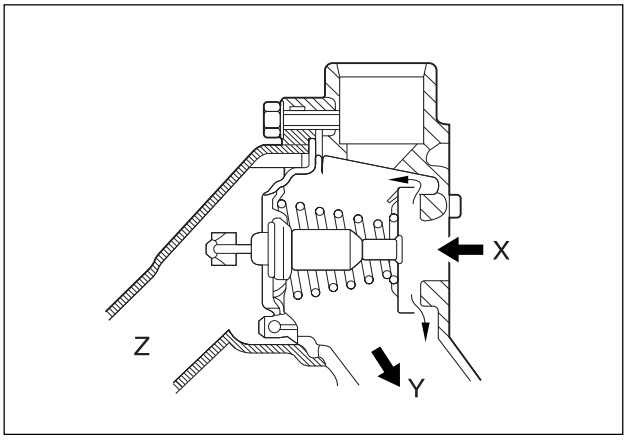
The thermostat begins to open at 85°C and is fully open at 100°C. The thermostat closes at 85°C.

Thermostat	Operating Temperature (°C)	Opening Value (mm)
Begins to open	85°C	0.1 mm
Fully open	100°C	8 mm

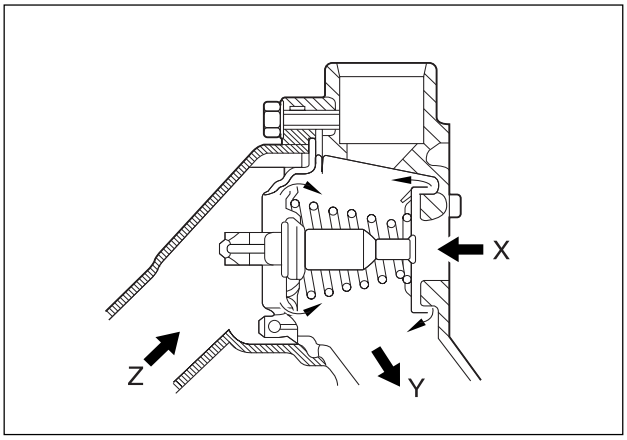
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

When closed (up to 85°C)

X. from cylinder head
Y. to crankcase
Z. from radiator

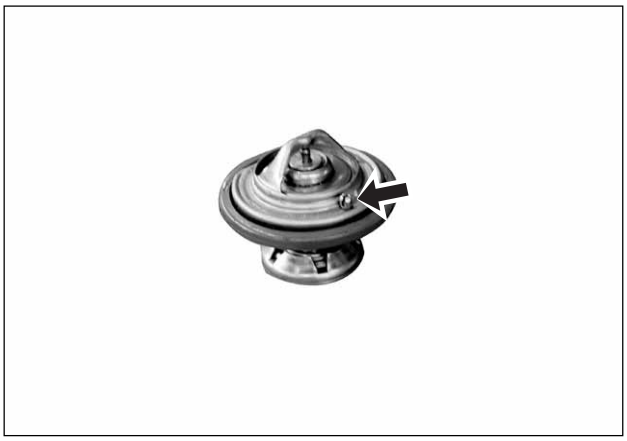


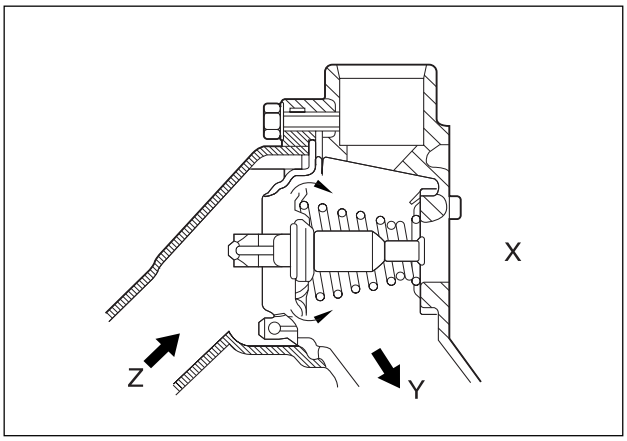
When partially opened (85°C ~ 100°C)



When fully opened (above 100°C)

If the cooling system is fully filled with, the coolant is automatically bled through ball valve (arrow) in thermostat.





Viscous fan clutch

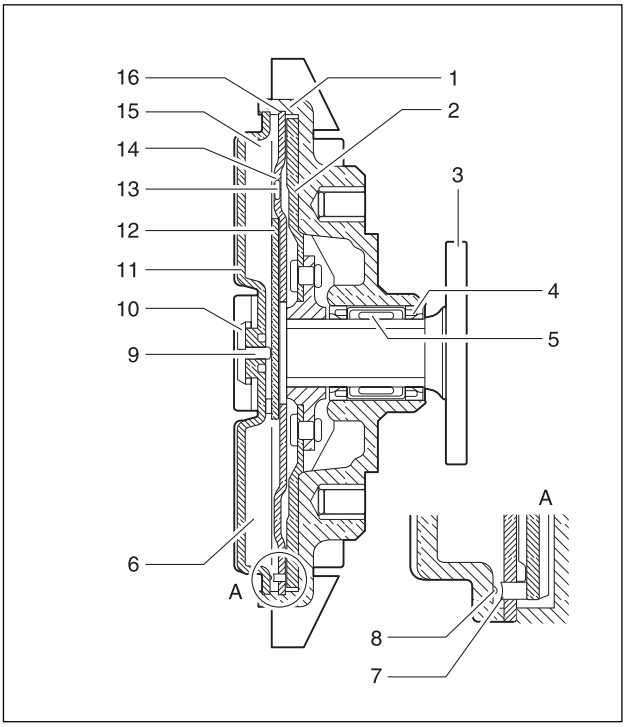
The cooling speed increases approx. 1,000 rpm with wind noise when the engine speed is 4,000 to 4,500 rpm and the coolant temperature is 90 to 95°C.

NOTICE

- **Keep hands, tools, and clothing away from the engine cooling fans to help prevent personal injury. This fan is electric and can turn on even when the engine is not running.**

NOTICE

- **If a fan blade is bent or damaged in any way, no attempt should be made to repair or reuse the damaged part. A bent or damaged fan assembly should always be replaced with a new one to prevent possible injury.**



1. Clutch housing
2. Drive disc
3. Flange
4. Seal ring
5. Needle bearing
6. Cooling fan
7. Oil scraper
8. Spring
9. Pin
10. Bi-metal
11. Bracket cover
12. Separator disc
13. Supply port
14. Lever valve
15. Oil chamber
16. Operating chamber

The cooling fans are mounted behind the radiator in the engine compartment. The electric cooling fans increase the flow of air across the radiator fins and across the condenser on air conditioner. The fan is 320 mm in diameter with five blades to aid the airflow through the radiator and the condenser. An electric motor attached to the radiator support drives the fan.

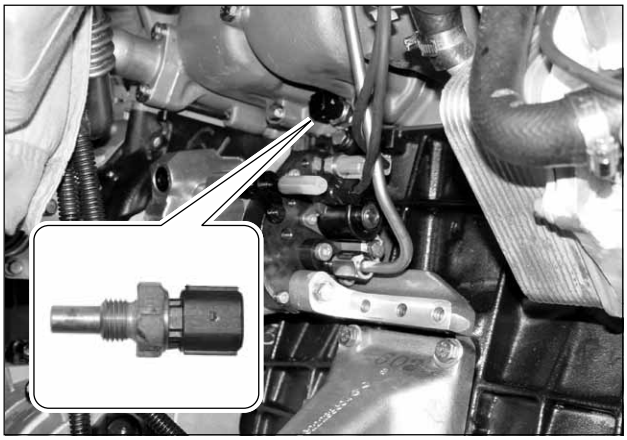
1. A/C Off or Non-AC Model
   1) The cooling fan operates at low speed when the coolant temperature reaches 95°C and at high speed when the coolant temperature reaches 100°C.
   2) The cooling fan is turned from high speed to low speed at 97°C and turns off at 90°C.
2. A/C On
   1) The ECU will turn the cooling fan on at high speed when the A/C system is on.



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EFFECTIVE DATE	
AFFECTED VIN	

Engine coolant temperature sensor

The Engine Coolant Temperature (ECT) sensor uses a temperature to control the signal voltage to the Engine Control Unit (ECU).



▶ Coolant Level Check

NOTICE

- **Scalding hot coolant and steam could be blown out under pressure, which could cause serious injury. Never remove the coolant reservoir cap when the engine and radiator are hot.**
- **Take precautions to prevent antifreeze coming in contact with the skin, eyes or vehicle body. If contact happens, rinse affected areas immediately with plenty of water.**

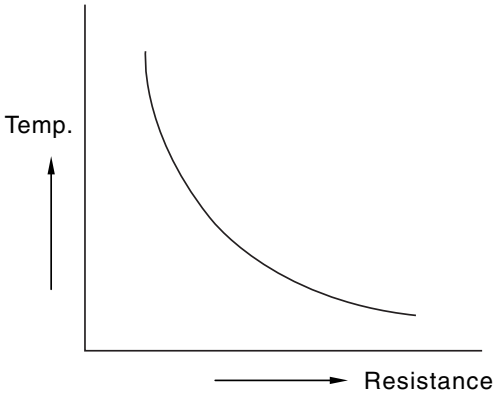
1. Place the vehicle on a level ground and check the coolant level through the coolant reservoir.
2. Add if needed. Change the coolant if necessary.



▶ Coolant Temperature Sensor



<Coolant Temperature Sensor>



<Output Characteristics of Coolant Temperature Sensor>

Coolant temperature sensor is a NTC resister that sends coolant temperature to ECU.

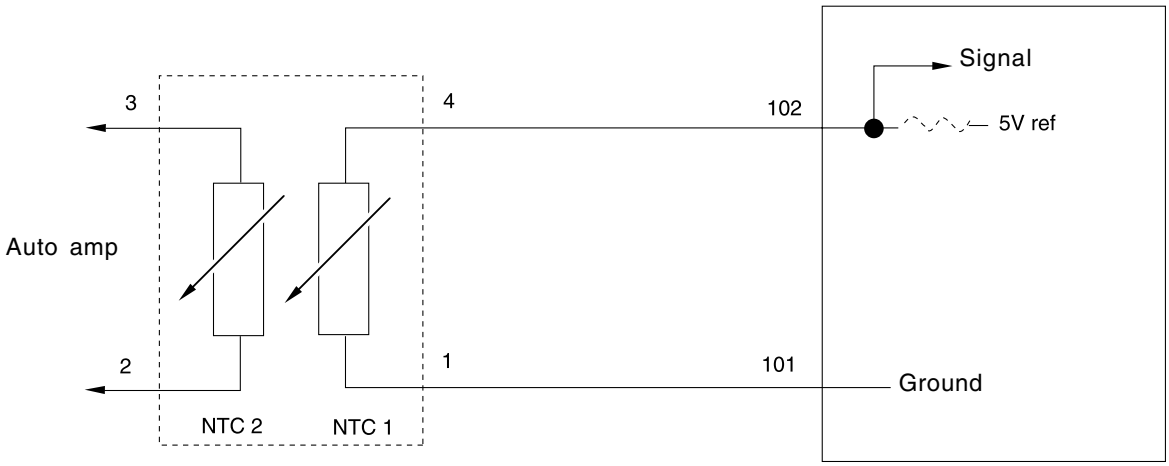
NTC resister has characteristics that if the engine temperature rises, the resistance lowers so the ECU detects lowering signal voltages.

If the fuel injected into the engine through injector has more turbulence, then combusts very well. However, if engine temperature is too low, the fuel injected as foggy state forms big compounds causing incomplete combustion. So the sensor detects coolant temperature and changes coolant temperature changes into voltage then sends to ECU to increase the fuel volume during cold start for better starting. And detects engine overheating for fuel volume reduction to protect the engine.

ECU functions as below with coolant temperature sensor signals.

1. When engine is cold, controls fuel volume to correct idle speed
2. When engine is overheated, controls electrical fan and A/C compressor to protect the engine
3. Sends information for emission control

Temperature	NTC 1 Resistance (Ω)	NTC 2 Resistance (Ω)
20	2,550	6,062
50	826	1,800
80	321	638
120	123	200



<Coolant Temperature Sensor Circuit>

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Trouble Diagnosis

Symptom	Cause	Action
Low coolant level	• Leaks in radiator	• Replace radiator
	• Leaks in coolant reservoir	• Replace coolant reservoir
	• Leaks in heater core	• Replace heater
	• Leaks in hose connection	• Reconnect hose or replace clamp
	• Damaged coolant hose	• Replace hose
	• Leaks in water pump gasket	• Replace gasket
	• Leaks in water pump internal seal	• Replace water pump
	• Leaks in coolant inlet cap	• Replace water inlet cap gasket
	• Leaks in thermostat housing	• Replace thermostat sealing
	• Improper tightening torque of cylinder head	• Retighten
	• Damaged cylinder head gasket	• Replace cylinder head gasket
Excessively high coolant temperature	• Coolant leaks (too low coolant level)	• Add coolant
	• Improper coolant mixture ratio	• Check coolant concentration
	• Kinked coolant hose	• Repair or replace hose
	• Defective thermostat	• Replace thermostat
	• Defective water pump	• Replace water pump
	• Defective radiator	• Replace radiator
	• Defective coolant reservoir and cap	• Replace coolant reservoir or cap
	• Cracks on cylinder head or cylinder block	• Replace cylinder head or cylinder block
	• Clogged coolant passages in cylinder head or cylinder block	• Clean coolant passages
	• Clogged radiator core	• Clean radiator core
	• Improper operation of cooling fan	• Replace cooling fan or repair related circuit
	• Faulty temperature sensor or defective harness	• Replace sensor or repair related circuit
Excessively low coolant temperature	• Stuck thermostat (with open)	• Replace thermostat
	• Improper operation of cooling fan	• Replace cooling fan or repair related circuit
	• Faulty temperature sensor or defective harness	• Replace sensor or repair related circuit

SPECIFICATIONS

Description		Unit	Specification
Cooling system	Type	-	Water cooling forced circulation
Coolant	Capacity	ℓ	11.3
Thermostat	Type	-	Wax pellet type
	Initial opening temperature	℃	85
	Fully opening temperature	℃	100
	Fully closing temperature	℃	83
	Stroke	mm	min. 8
Cooling fan	Blades		5
	Diameter	mm	320 (2)
	Low speed ON temp	℃	91
	Low speed OFF temp	℃	88
	High speed ON temp	℃	95
	High speed OFF temp	℃	92
	High speed ON temp. (By A/C pressure)	psi	270
Coolant reservoir	Pressure valve opening pressure	Kg/cm^2	1.2 ~ 1.5
	Vacuum valve opening pressure	Kg/cm^2	0.1
Water pump	Type	-	Centrifugal
	Impeller diameter	mm	72.3
	Impeller blades		10
Radiator	Type	-	Down-flow
	Core width	mm	701
	Core height	mm	372
	Core thickness	mm	18
	Minimum radiation capability	Kcal/h	45,000
Coolant temperature sensor	Resistance (at 20°C)	KΩ	3.33 ~ 3.78
	Resistance (at 80°C)	KΩ	0.32 ~ 0.35
Anti-freeze agent	Type	–	ALUTEC-P78
	Mixture ratio (water and anti-freeze)	–	50 : 50

INSPECTION AND REPAIR

INSPECTION

Cooling System

1. Release the pressure from coolant reservoir by loosening one notch of coolant reservoir cap, and then remove the cap.



NOTICE

- **Scalding hot coolant and steam could be blown out under pressure, which could cause serious injury. Never remove the coolant reservoir cap when the before the temperature goes down below 90°C.**

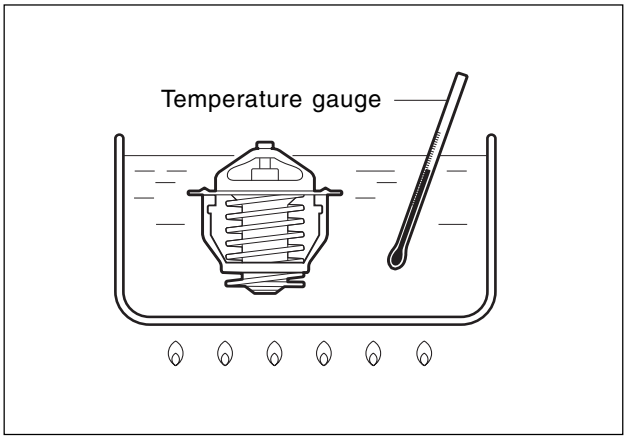
2. Add the coolant up to upper mark (arrow) on the reservoir.
3. Install the tester to the coolant reservoir and apply the pressure of 1.4 bar.
4. Check the coolant hoses, pipes and connections for leaks after the pointer of the tester drops. Replace or retighten as required.



Thermostat

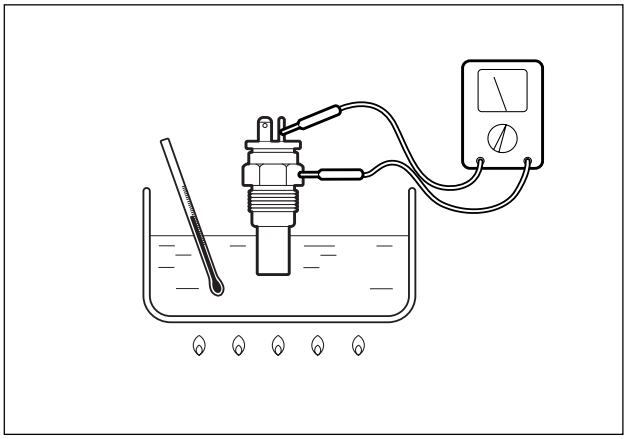
Immerse the thermostat into the water. Heat the water and check the valve opening temperature.

Valve opening temperature	DI Engine: 85 ± 2°C



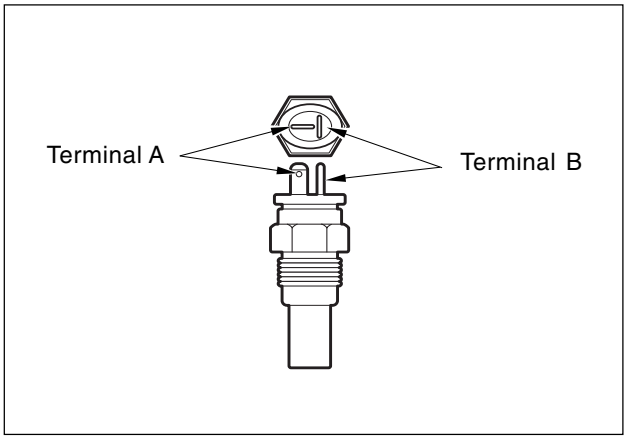
Coolant Temperature Gauge Unit

1. Immerse the senor unit into the water. Heat the water and check the resistance.



2. If the measured resistance is out of specified value, replace the gauge unit.
3. Measure the resistance between terminal A and gauge unit housing, and terminal B and gauge unit housing.

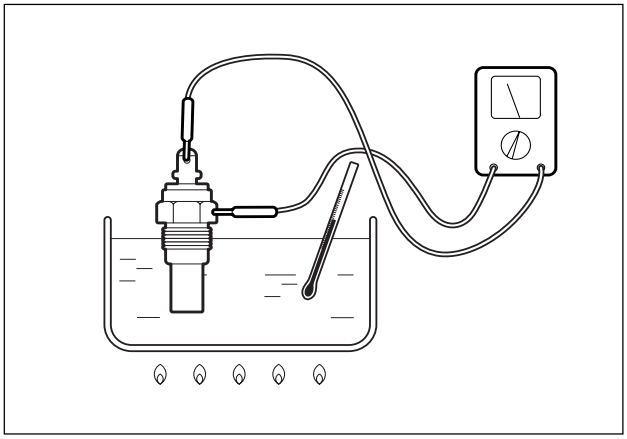
Terminal A (for coolant temp.)	0.4 Ω / 79°C
	23.8 Ω / 115°C
Terminal B (for glow plug)	24.8 Ω / -20°C
	3.25 Ω / 20°C



Thermostat

1. Immerse the thermostat into the oil. Heat the oil until it reaches the specified temperature and check if the coolant temperature switch is turned “OFF”.

Coolant temperature at point A	113 ± 3°C
Coolant temperature at point B	116°C



NOTICE

- **Use only engine oil for this inspection. Stir the oil during heating it. Never heat the oil over required temperature.**

REMOVAL AND INSTALLATION

Coolant Hose (Inlet/Outlet)

※ **Preceding Work:** Draining of coolant

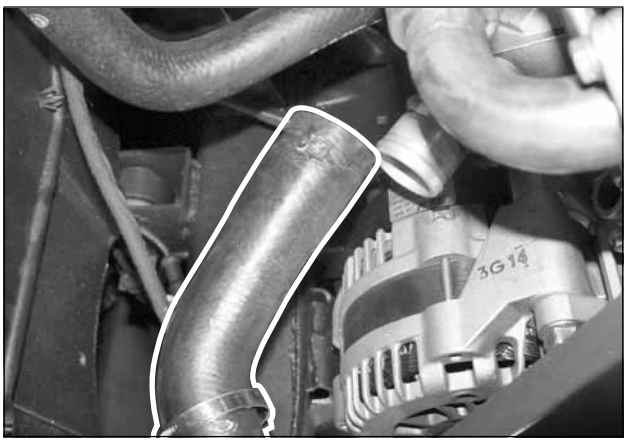
1. Loosen the clamp and remove the coolant outlet hose (engine to radiator).



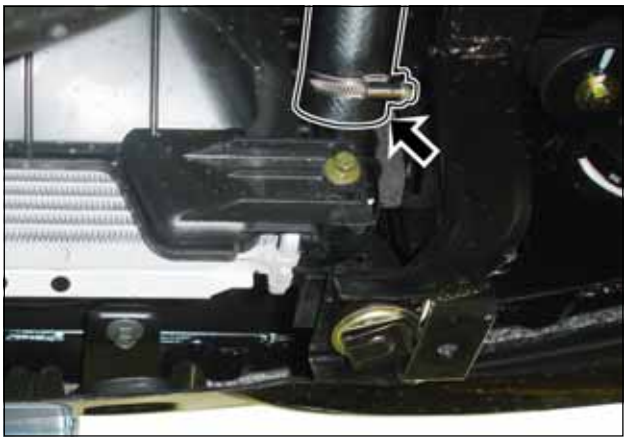
2. Disconnect the HFM sensor connector.
3. Remove the air intake duct from the air cleaner.



4. Loosen the clamp and remove the coolant inlet hose (radiator to thermostat housing).



5. Lift up the vehicle and remove the skid plate.
6. Loosen the clamp and remove the lower inlet hose.



Shroud and Cooling Fan/Clutch

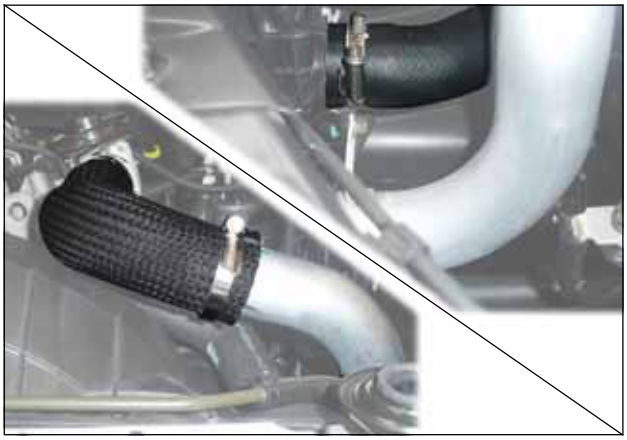
※ **Preceding Work:**

1. Draining of coolant
2. Removal of coolant inlet and outlet hose



1. Remove the air cleaner duct.

2. Release the clamps and remove the intake hose.
3. Unscrew the fan shroud mounting bolts.



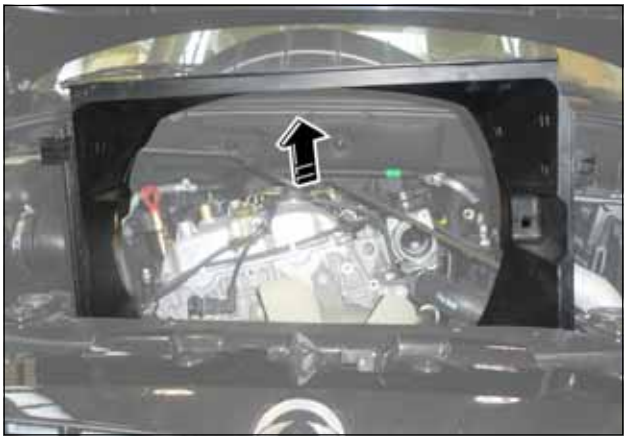
5. Unscrew the center bolt and remove the cooling fan clutch while holding the pulley with counter holder (special tool).

Installation Notice

Tightening torque	45 ± 4.5 Nm

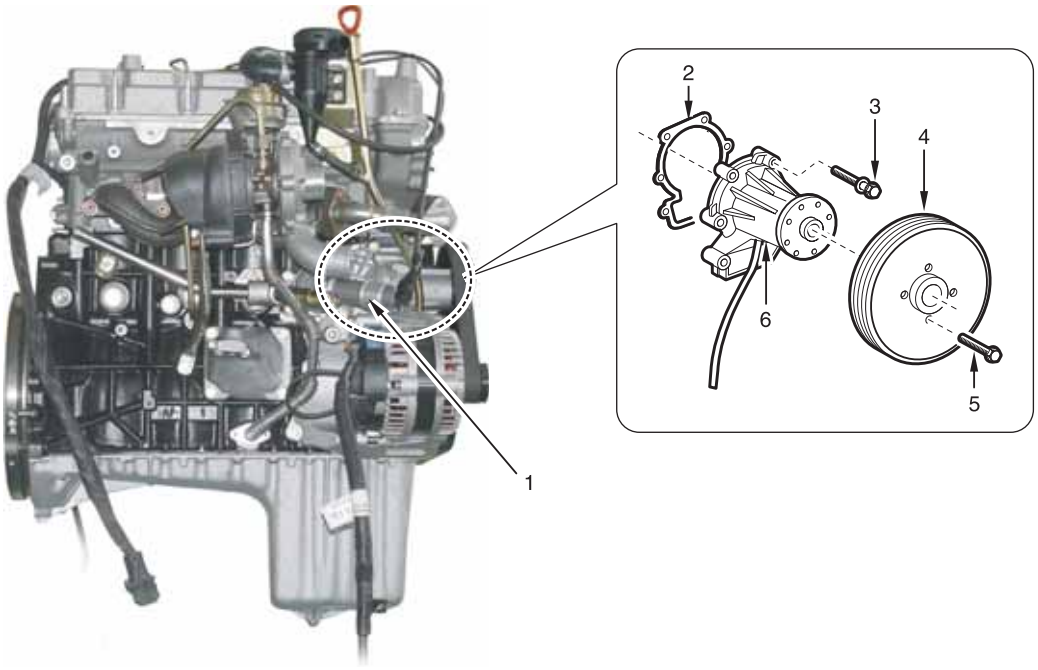


6. Remove the shroud.
7. Install in the reverse order of removal.



Water Pump - Assembly

※ **Preceding Works:** 1. Draining of coolant
2. Removal of V-belt
3. Removal of shroud
4. Removal of cooling fan



1. Thermostat housing
2. Gasket ..... Replace
3. Bolt ..... 10 Nm
4. Belt pulley
5. Bolt ..... 10 Nm
6. Water pump bearing housing

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

1. Remove the V-belt while pressing down the auto tensioner adjusting bolt.



2. Unscrew the bolts and remove the EGR pipe and bracket.

Installation Notice

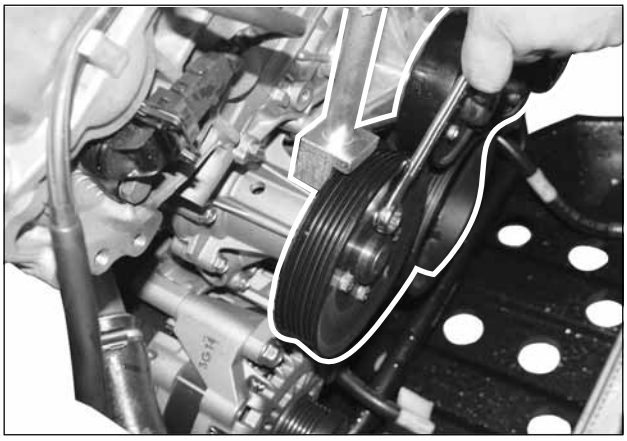
Tightening torque	23 ± 2.3 Nm



3. Unscrew the bolts and remove the belt pulley while holding the belt pulley with a special tool.

Installation Notice

Tightening torque	10 Nm

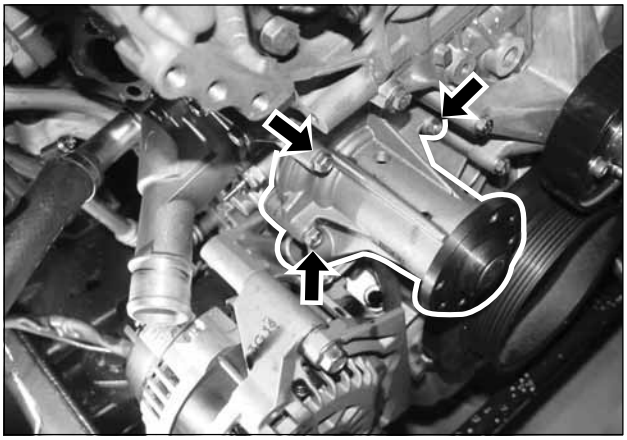


NOTICE

- **Replace the O-ring in oil dipstick with new one.**
- **Plug the oil dipstick hole with a cap not to get the foreign materials into the engine.**



5. Unscrew the bolts and remove the water pump assembly.



Installation Notice

Tightening torque	10 Nm

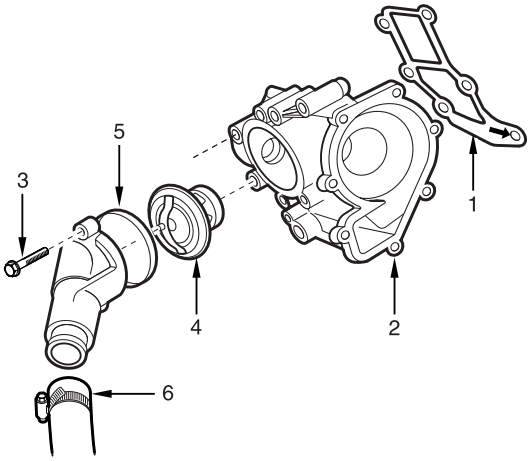
NOTICE

- **Remove the gasket residues from the sealing surface and replace the gasket with new one.**

6. Install in the reverse order of removal.

Thermostat

※ **Preceding Works:**
1. Draining of coolant
2. Removal of V-belt
3. Removal of cooling fan
4. Removal of intake duct (air cleaner to turbo charger)





1. Gasket ..... Replace
2. Water pump housing
3. Bolt ..... 10 Nm
4. Thermostat
5. Seal
6. Coolant hose

1. Unscrew the bolts and remove the thermostat housing.



Installation Notice

Tightening torque	10 ± 1.0 Nm

2. Remove the thermostat.
3. Install in the reverse order of removal.

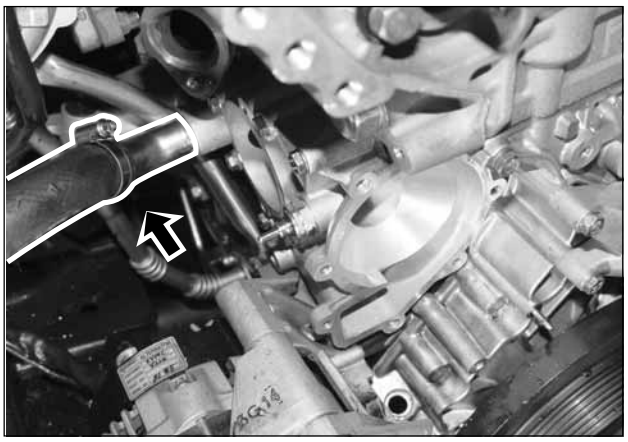


Water Pump Housing

※ **Preceding Works:**

1. Removal of water pump assembly
2. Removal of thermostat assembly

1. Remove the heater hose.



2. Unscrew the bolts and remove the alternator.

Installation Notice

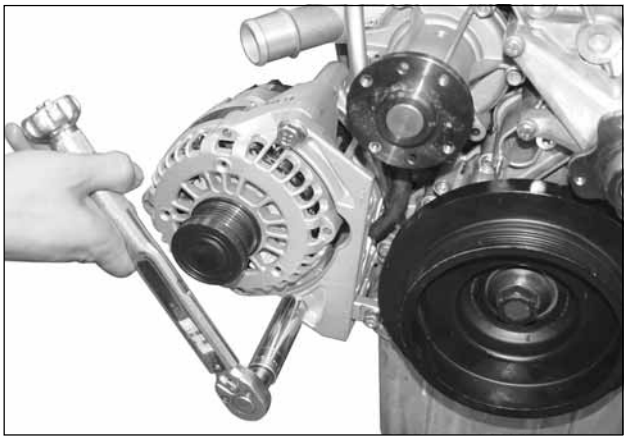
Tightening torque	46 ± 4.6 Nm



3. Unscrew the bolts and remove the alternator bracket.

Installation Notice

Tightening torque	25 ± 2.5 Nm



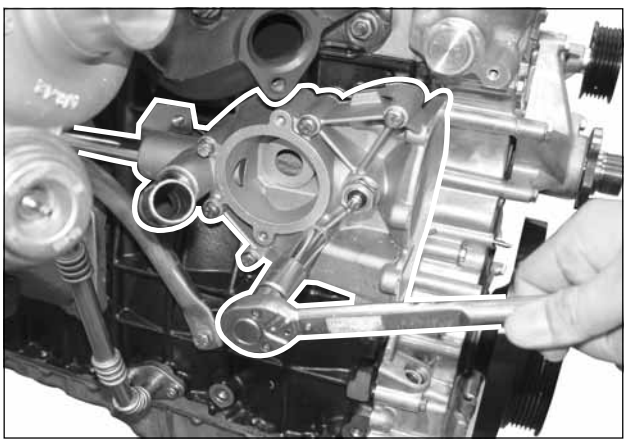
4. Unscrew the bolts and remove the water pump housing.

Installation Notice

Tightening torque	10 ± 1.0 Nm

NOTICE

- **Be careful not to damage the O-ring in coolant outlet pipe (cylinder head side).**
- **Remove the gasket residues from the sealing surface and replace the gasket with new one.**



5. Install in the reverse order of removal.

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EFFECTIVE DATE	
AFFECTED VIN	

Radiator

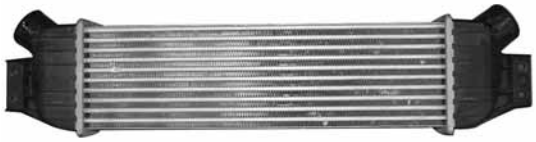
▶ Components of Radiator Module

Related Components (Assembly): Intercooler, Electric Fans, Condenser, Radiator

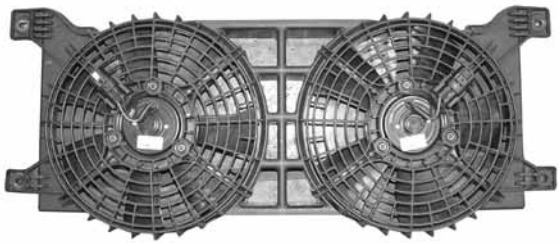
※ **Preceding Works:**

1. Disconnection of negative battery cable
2. Removal of front bumper assembly
3. Discharge of refrigerant
4. Draining of engine coolant

▶ Removal Procedure



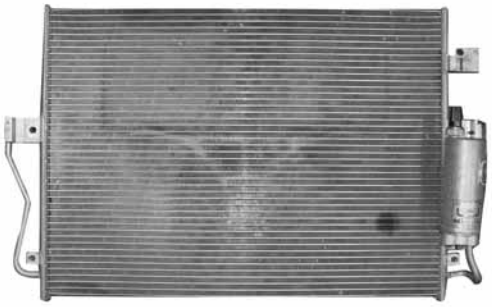
Intercooler



Electric Fans



Radiator



Condenser

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Radiator and Intercooler

※ **Preceding Works:**

1. Collect the refrigerant from A/C system.
2. Remove the lower cover.
3. Drain the engine coolant into the designated container.



NOTICE

- **Store the refrigerant and engine coolant in a safe place.**

▶ Removal and Installation

1. Remove the air cleaner duct.



2. Disconnect the intercooler hoses.

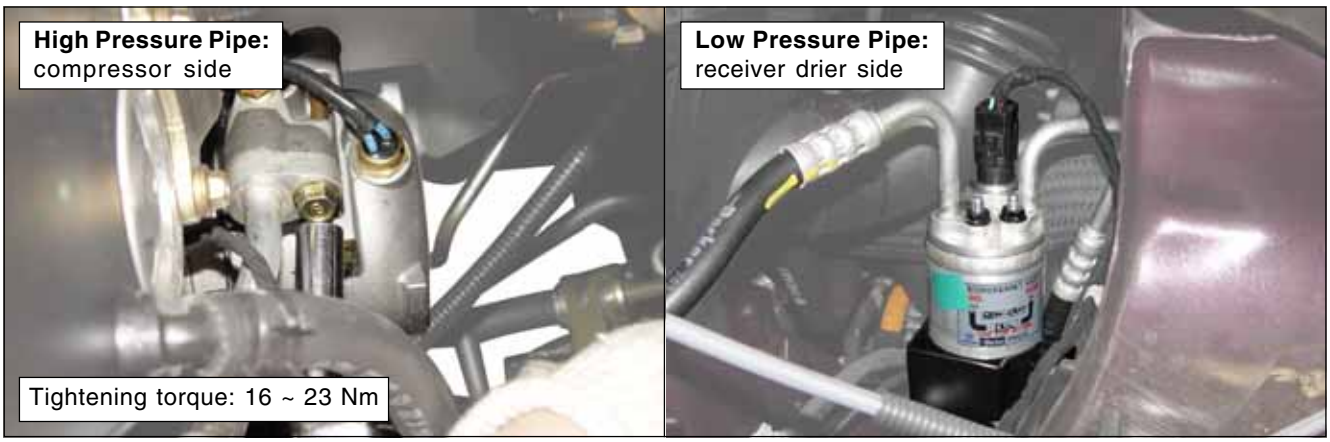




3. Remove the inlet, outlet and return hoses.



4. Remove A/C hose and condenser pipe.



NOTICE

- **Plug the openings of the pipes with sealing caps.**

5. Unscrew the bolts and remove the radiator brackets.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. Remove the transmission oil cooler pipes.

Installation Notice

Tightening torque	25 ~ 35 Nm

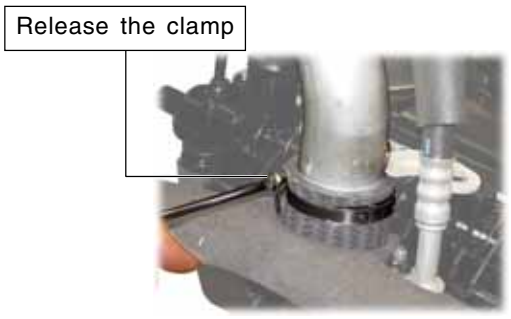


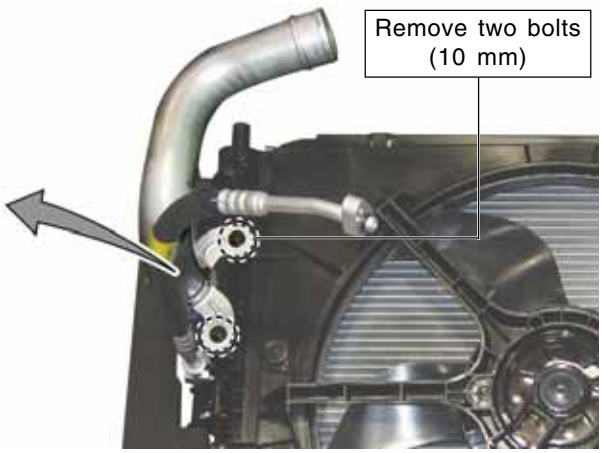
7. Pull out the fixing clips and remove the radiator.



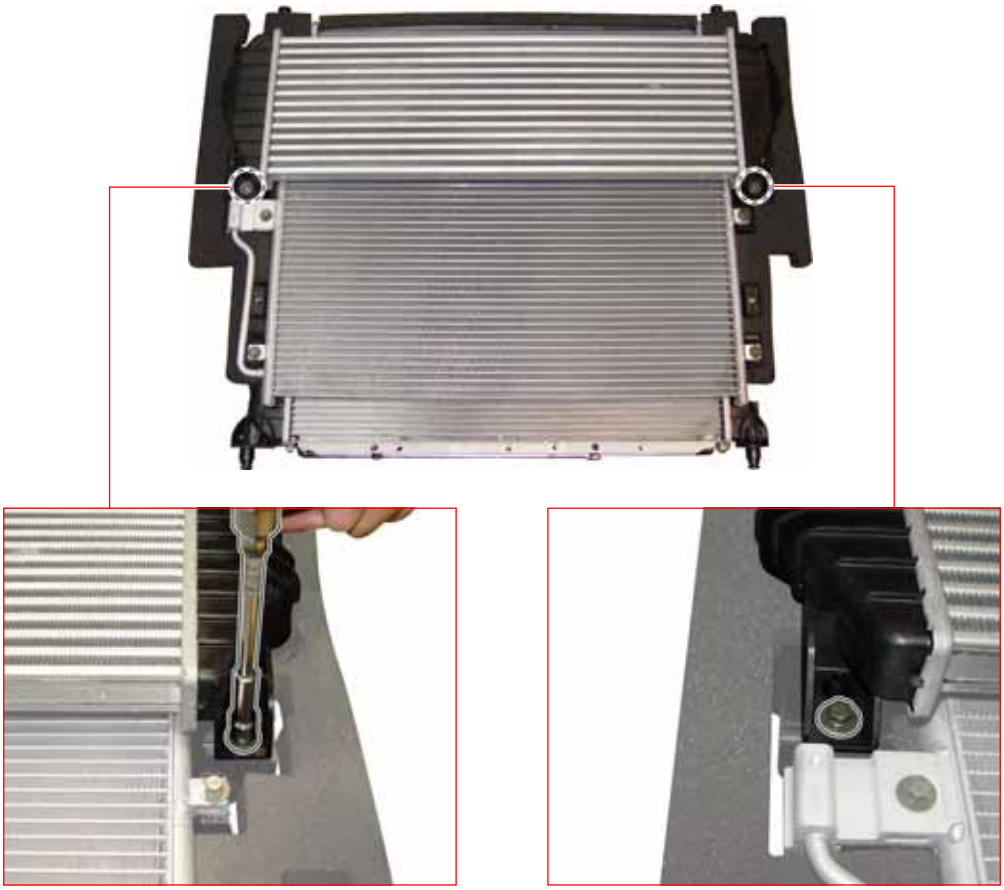
8. Remove the outlet pipe from the intercooler.

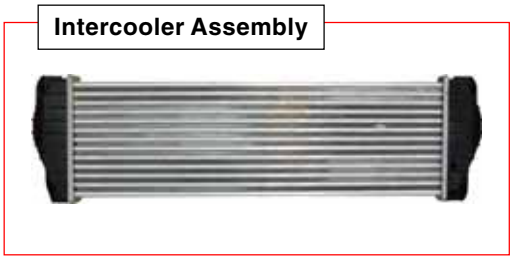
Tightening torque	6 ~ 7 Nm





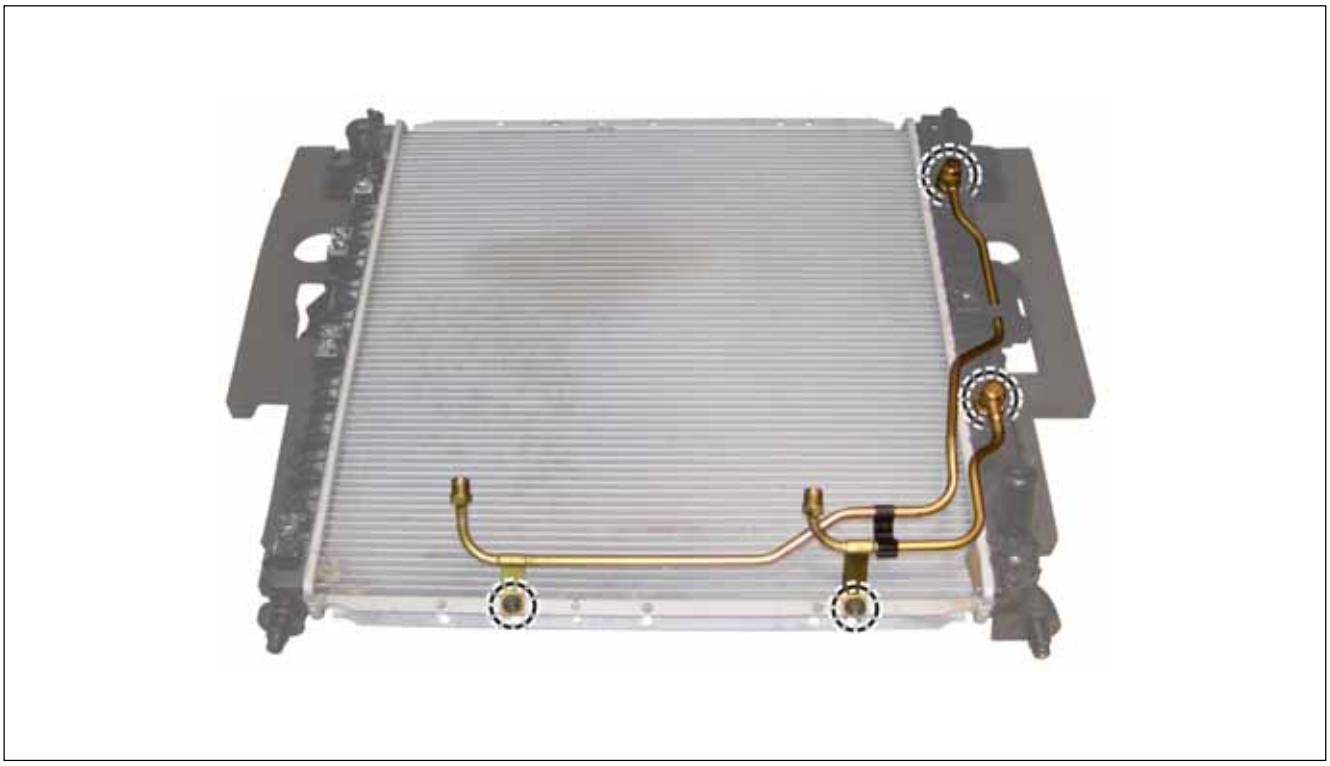
9. Unscrew the upper/lower mounting bolts (10 mm) and remove the intercooler from the radiator.



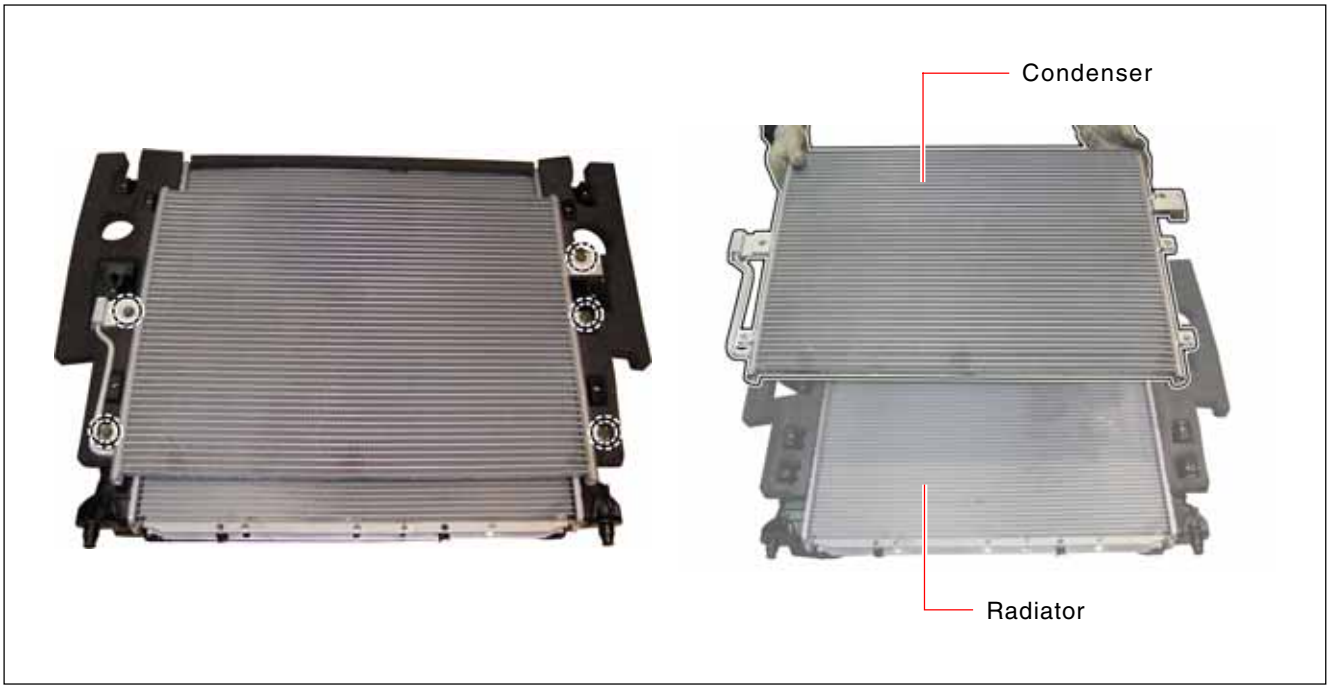


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

10. Remove the T/M oil cooler pipes from the radiator.



11. Unscrew five bolts (10 mm) and remove the condenser assembly from the radiator.



Replacement of Fan Belt

※ **Preceding Work:** Disconnect the negative battery cable.



1. Turn the fan belt adjusting bolt (19 mm) counterclockwise.





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. Remove the fan belt.



Fan Belt Arrangement



Coolant Reservoir

1. Drain the coolant.
2. Remove the hoses.



3. Unscrew the bolts and remove the coolant reservoir.



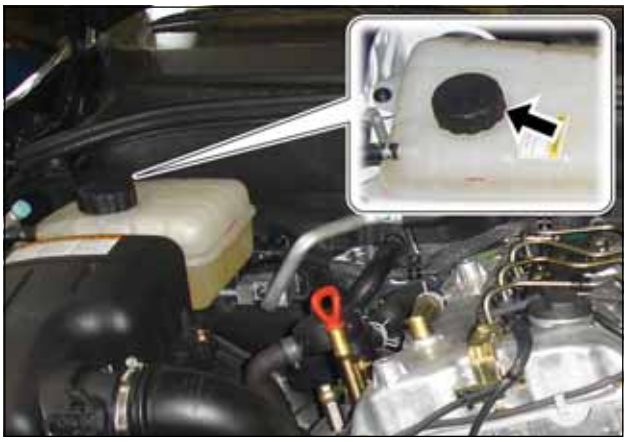
Installation Notice

Tightening torque	7 Nm

4. Install in the reverse order of removal.

Draining and Adding of Coolant

1. Release the pressure from coolant reservoir by loosening one notch of coolant reservoir cap, and then remove the cap.



NOTICE

- **Scalding hot coolant and steam could be blown out under pressure, which could cause serious injury. Never remove the coolant reservoir cap when the before the temperature goes down below 90°C.**

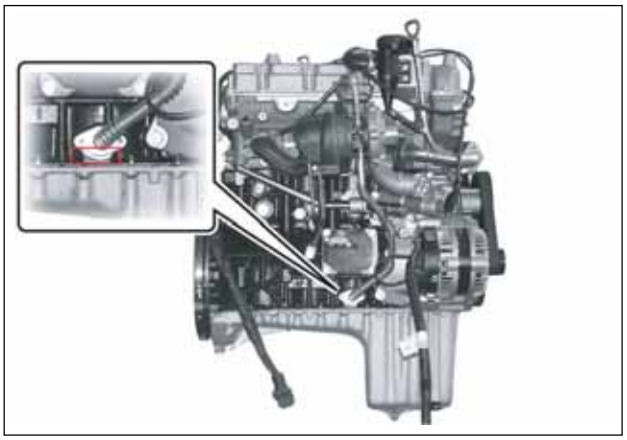
2. Loosen the drain plug in bottom of radiator and drain the coolant.



NOTICE

- **Collect the drained coolant with a proper container.**

3. Remove the drain plug and seal in the cylinder block and drain the coolant.
4. Replace the seal with new one and install the drain plug.



Installation Notice

Tightening torque	30 Nm

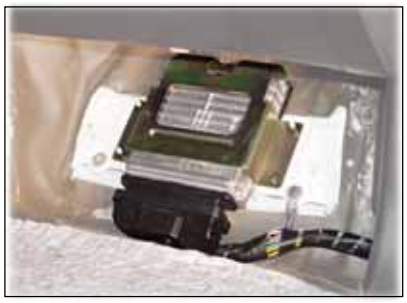
5. Install the drain plug in bottom of radiator.
6. Add the coolant through the coolant reservoir.

NOTICE

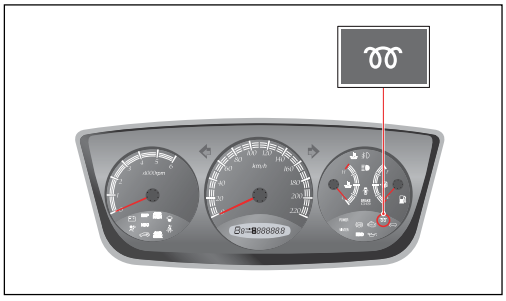
- **Keep the coolant mixture ratio of 50:50 (water : anti-freezer).**
- **Add the coolant until the water flows out through the overflow hose.**

7. Warm up the engine until the thermostat begins to open and check if the coolant level is at “FULL” mark on the reservoir. Add if necessary.

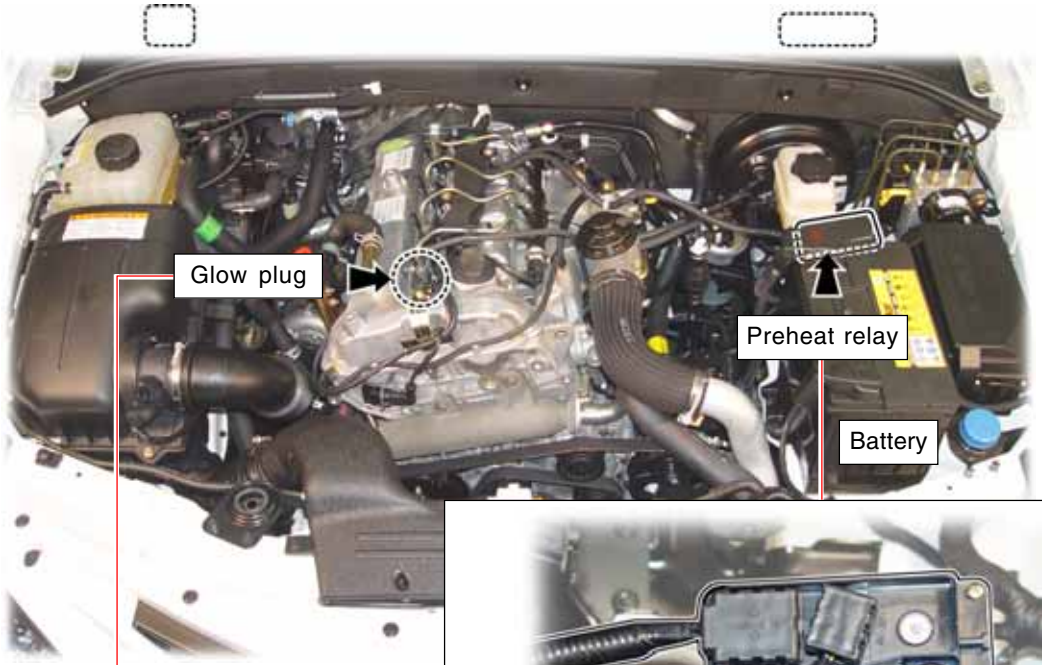
PREHEATING SYSTEM



ECU

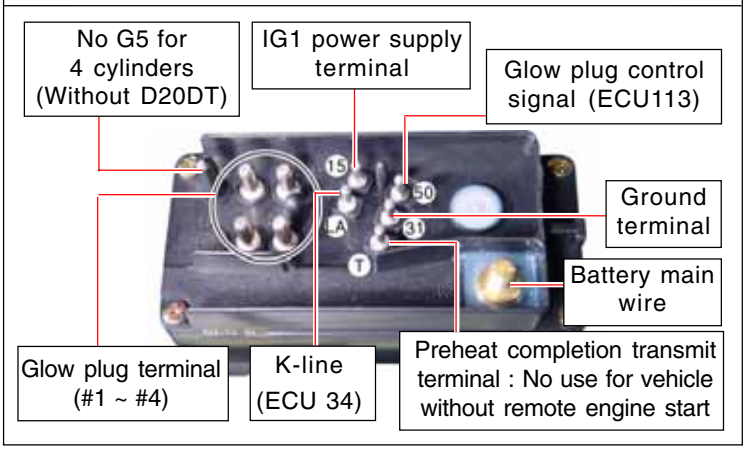


Glow Indicator (Meter Cluster)









CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

OVERVIEW

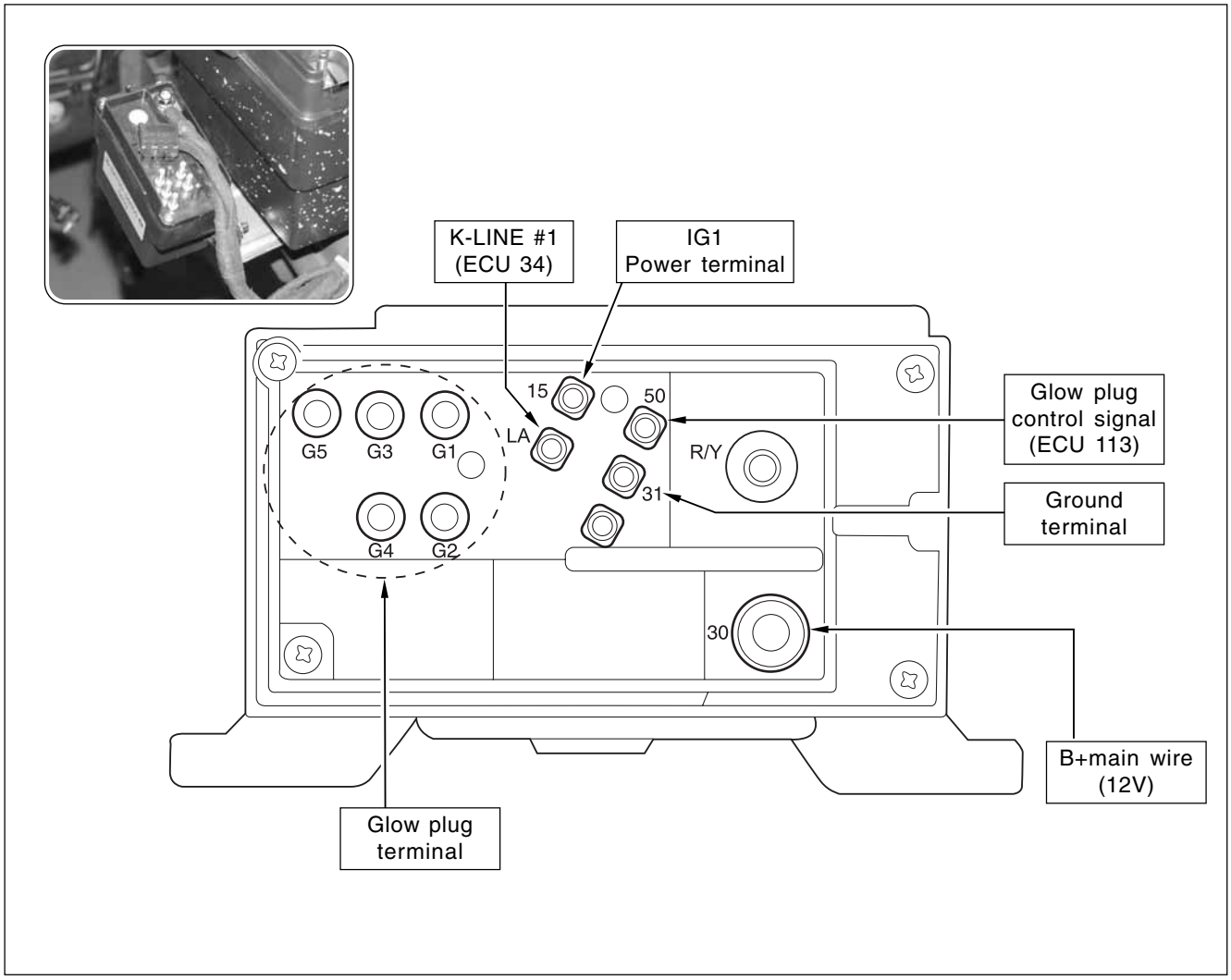
Glow plug is installed on the cylinder head (combustion chamber) in the D20DT preheating control unit system. Cold starting performance has improved and exhaust gas during cold starting has reduced.

ECU receives coolant temperature and engine speed to control; after monitoring the engine preheating/post heating and glow plug diagnosis function, the fault contents will be delivered to ECU.

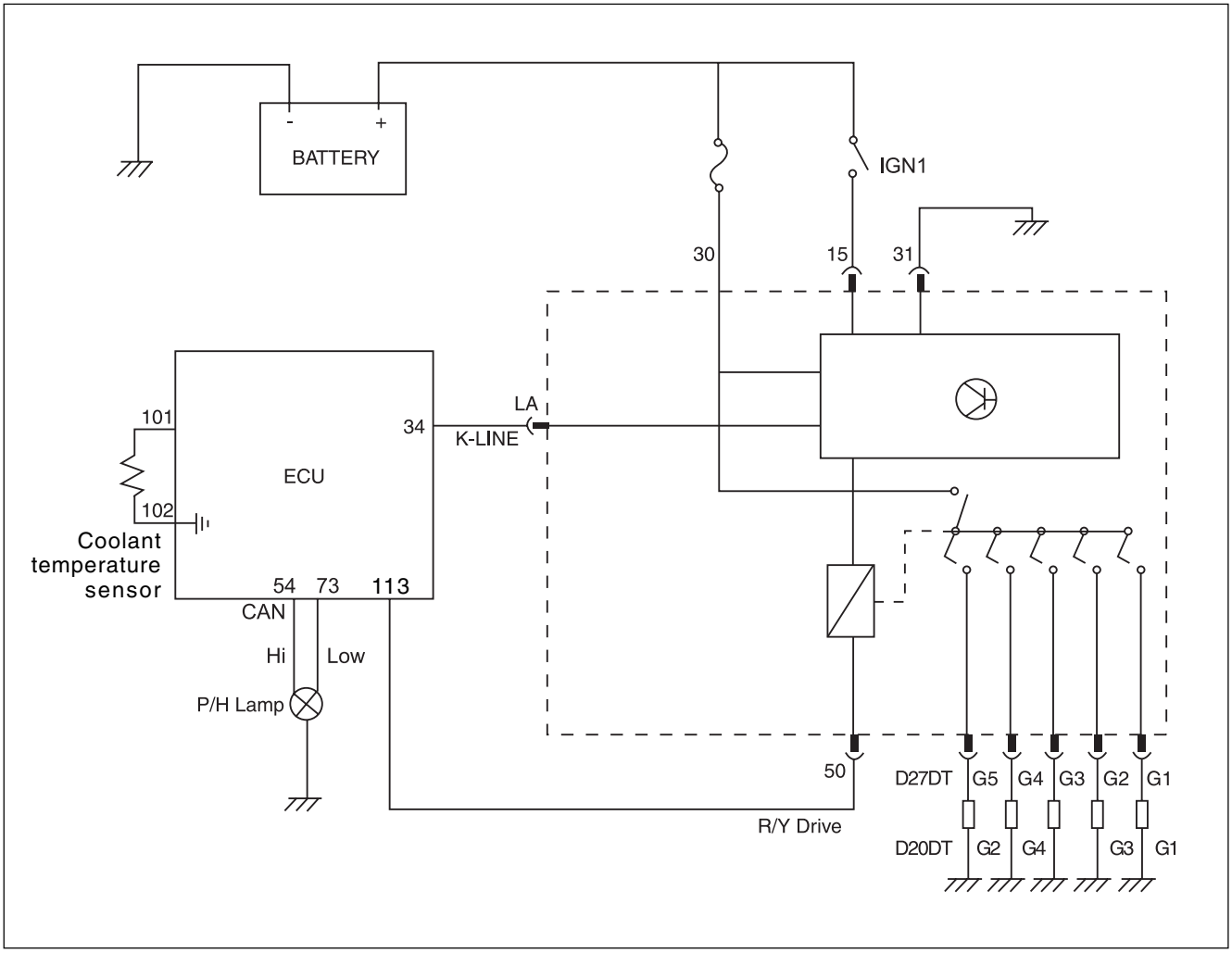
1. Engine preheating/post heating functions
2. Preheating relay activation by ECU controls
   1) Senses engine temperature and controls the preheating/after heating time
   2) Glow indicator
3. K-LINE for information exchanges between preheating unit and ECU
   1) Transmits preheating unit self-diagnosis results to ECU
   2) Transmits glow plug diagnosis results and operating status to ECU

PREHEATING RELAY

▶ Structure



PREHEATING SYSTEM DIAGRAM



▶ Specifications

Description	Specification
Rated voltage	DC 12 V
Operating voltage range	DC 8 ~ 15 V
Operating range	- 40 ~ + 100°C
Relay operating voltage	Over 6.5 V
Relay releasing voltage	Over 1.5 V
Relay coil resistance	11.3 Ω
Voltage drop	Below 150 mV at each glow plug (at 16A of current)
Parasitic current	MAX 1 mA

▶ Function

Preheating system controls and checks following functions and operating conditions.

Pre-Heating

1. The power will be supplied to the glow plugs by ECU controls when the power is supplied to the IG terminal from the battery and there are normal communications with ECU within 2 seconds. The surface of glow plug will be heated up to 850°C very quickly to aid combustion by vaporizing air-fuel mixture during compression stroke.
2. Preheating time is controlled by ECU.

Post-heating

1. When the engine is started, post-heating starts by ECU controls. The idle rpm will be increased to reduce toxic smoke, pollutants and noises.
2. Post-heating time is controlled by ECU.

Checking glow plugs

1. Check each glow plug for short in circuit
2. Check each glow plug for open in circuit due to overvoltage
3. Check glow plug for short to ground

Forceful relay shut-down

1. When glow plug is shorted to ground

K-Line communication

1. ECU sends the results to preheating time control relay through K-Line to start communication.
2. Preheating time control relay sends messages including self-diagnosis data for glow plugs to ECU.
3. Glow plug makes communication only as response to demand.
4. When power is supplied, ECU starts self-diagnosis within 2 seconds.
5. Under the following conditions, communication error occurs.
   1) When there is no response from glow plug module within 2 seconds
   2) When an error is detected in checksum
   3) Less byte is received

DTC

DTC	Defective	Detailed description
P1678	Glow plug open	Preheat control driver open
P1679	Glow plug short	Preheat control driver short
P1680	Glow plug - short to ground	Preheat control driver is short to ground
P1676	Glow plug communication fault	Communication fault between ECU and preheat controller
P1677	Defective glow plug controller	Communication fault between ECU and preheat controller
P0671	Defective No. 3 glow plug	No. 3 glow plug open
P0672	Defective No. 4 glow plug	No. 4 glow plug open
P0673	Defective No. 5 glow plug	No. 5 glow plug open (N/A for D20DT engine)
P0674	Defective No. 1 glow plug	No. 1 glow plug open
P0675	Defective No. 2 glow plug	No. 2 glow plug open

Operating time

Pre-heating	Coolant Temp.	-35 °C	-25 °C	-20 °C	-10 °C	0 °C	10 °C	20 °C
	Operating Time	31 sec	22 sec	19 sec	17 sec	14 sec	0 sec	0 sec
	Operating Conditions	• IG: “ON” • B+ : below 15.2V			Release Conditions	• After operating time elapsed • IG: “OFF” • When engine cranking		
Post-heating	Coolant Temp.	-30 °C	-20 °C	-10 °C	0 °C	10 °C	20 °C	35 °C
	Operating Time	115 sec	80 sec	30 sec	19 sec	11 sec	11 sec	0 sec
	Operating Conditions	• After engine starting			Release Conditions	• After operating time elapsed • Torque : 190/170 Nm • Speed: 2100/2050 rpm		
Glow Indicator	Coolant Temp.	-30 °C	-25 °C	-20 °C	-10 °C	0 °C	10 °C	20 °C
	Operating Time	18 sec	16 sec	10 sec	5 sec	2 sec	0 sec	0 sec
	Operating Conditions	• IG: “ON”			Release Conditions	• When engine cranking		

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Removal and Installation

1. Turn the ignition switch to “OFF” position and disconnect the negative battery cable.
2. Set aside the harnesses on the cylinder head.



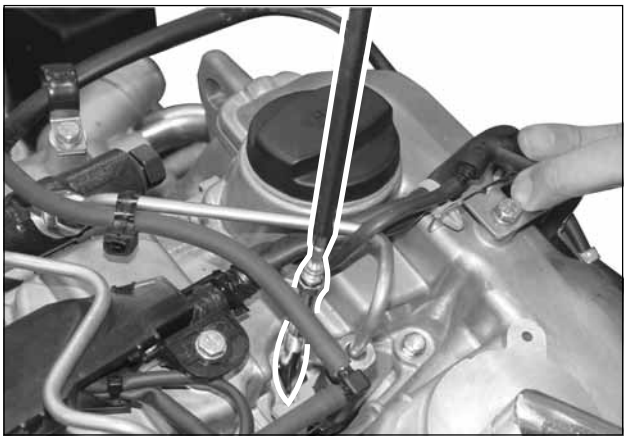
3. Disconnect the glow plug connectors and loosen the glow plugs.

Installation Notice

Tightening torque	15 Nm



4. Remove the glow plugs from the cylinder head with a special tool. Plug the openings of the glow plugs with sealing caps.



PREGLOW PLUG

Two versions of preglow plugs are used in this vehicle.

Always use only the designated version with correct color mark on insulator surface.

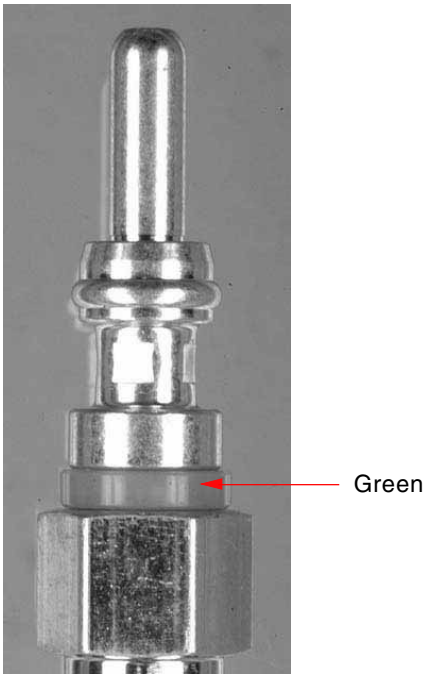
▶Specifications

BERU version

Color mark on insulator surface: Green

Tip diameter: ϕ 4

Resistance: 680 ± 110 mΩ at 20 ± 2°C

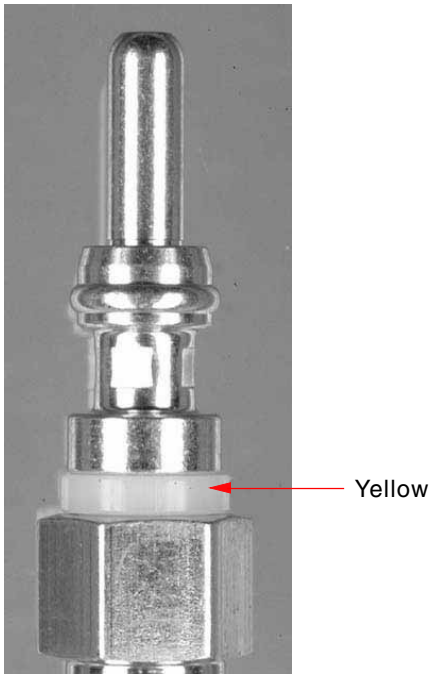


NGK version

Color mark on insulator surface: Yellow

Tip diameter: ϕ 3.5

Resistance: 1400 ± 300 mΩ at 20 ± 2°C



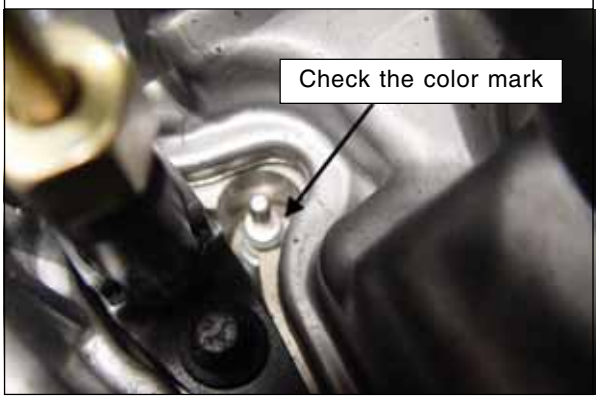
The color mark on insulator surface may be invisible due to the carbon contamination. To check the color easily, disconnect the harness connector and clean the preglow plug mounting area with carbon cleaner.

Wait for a while and blow out the area with a compressed air.

Clean and Blow Out



Check the Color Mark



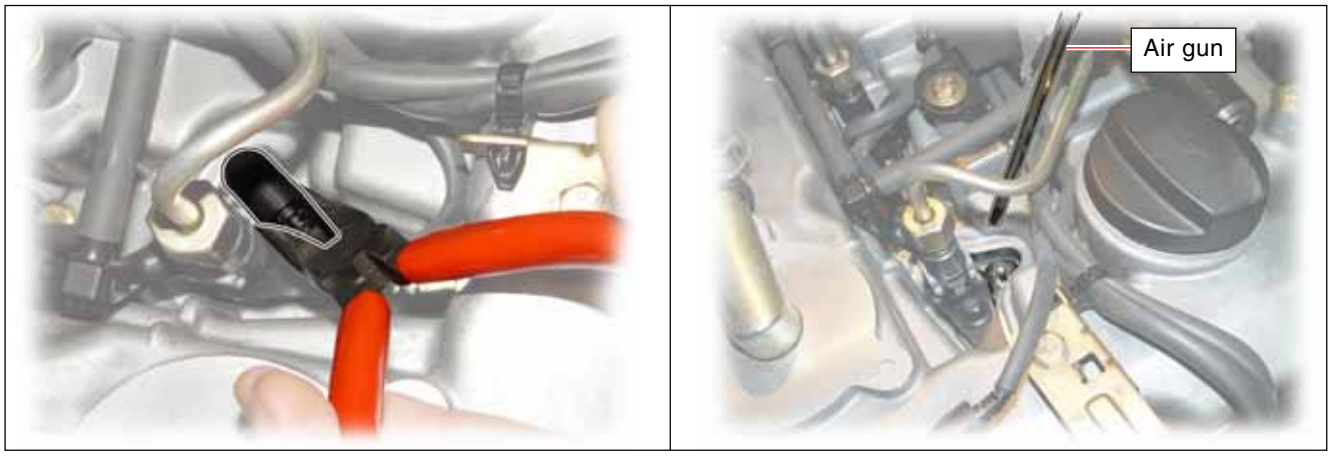
▶Preparations for Replacing Preglow Plug

Torque wrench, Air gun (small), Carbon cleaner (Product name: IPO CHOKE & CARBURATOR CLEANER, Model name: PRO NO 5007, Manufacturer: Sunbo), Engine oil, Preglow plug wrench (special service tool), Long nose pliers

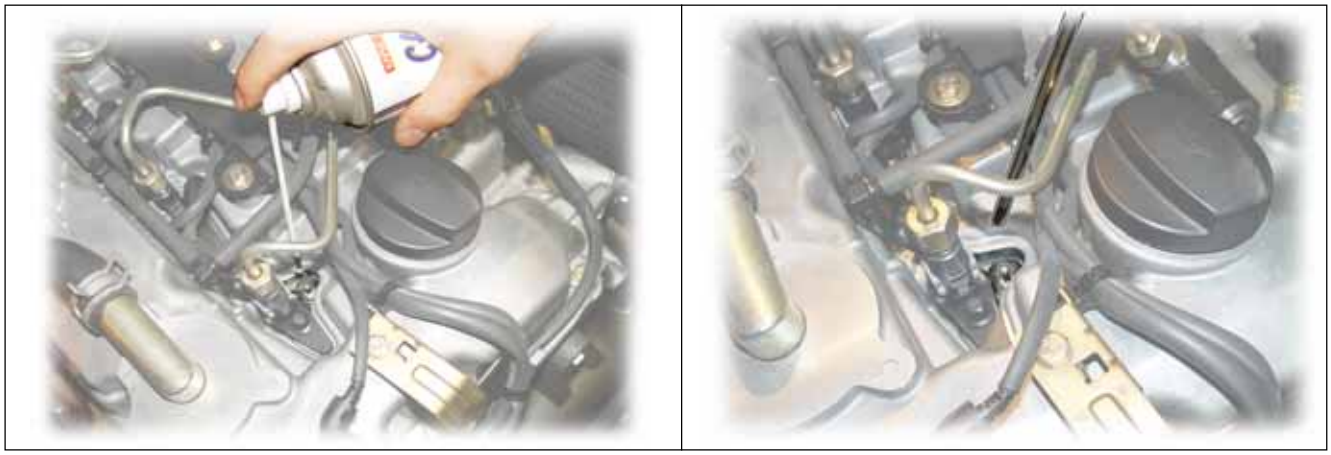
▶Removal and Installation of Preglow Plug

※ **Preceding Work:** Disconnect the negative battery cable.

1. Disconnect the wiring harness with long nose pliers and clean the preglow mounting area with the compressed air (using air gun).



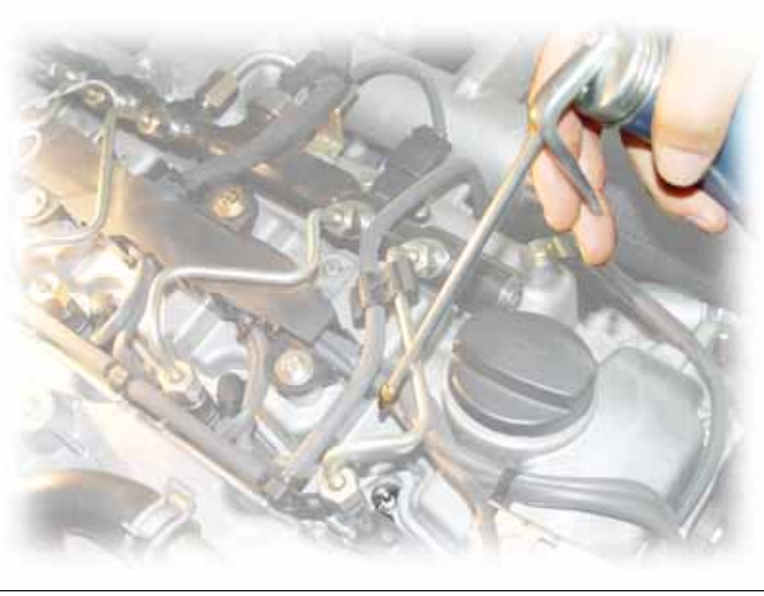
2. Spray the carbon cleaner into the gap between preglow plug and cylinder head and wait for 10 minutes. Remove the dirt and foreign materials completely with the compressed air (using air gun)..



NOTICE

- **At this moment, check the color mark on insulator surface and bring the same version of preglow plug for replacement. (BERU: Green, NGK: Yellow)**

3. To avoid damage, apply the engine oil into the gap between preglow plug and cylinder head and wait for 5 minutes.



4. Remove the preglow plug with torque wrench. (tightening torque: 15 ± 3 Nm)

NOTICE

- **To prevent the preglow plug from breaking, carefully turn the wrench with the torque below 20 Nm.**
- **Never use the air impact tool or other tools.**



5. Thoroughly remove the foreign materials from the preglow plug hole. If needed, use the carbon cleaner or air gun.

▶Remarks

1. Required tools

Carbon Cleaner	Torque Wrench (max. 25 Nm)
	

Preglow plug wrench - Special Service Tool (10 mm)
Part number: Y99220132B



2. Preglow plug circuit check
   1) Check the preglow plug trouble code with SCAN-100.
   2) SCAN-100 can display only one trouble code. Check whether each preglow plug circuit is open with multi-tester.



FUEL SYSTEM

07

TABLE OF CONTENTS

CAUTIONS FOR DI ENGINE 2

FUEL SYSTEM 5

Fuel injection system 5
Fuel transfer line 11
Inlet Metering Valve (IMV) 13
High fuel pressure line 16
Injector 38

CAUTIONS FOR DI ENGINE

This chapter describes the cautions for DI engine equipped vehicle. This includes the water separation from engine, warning lights, symptoms when engine malfunctioning, causes and actions.

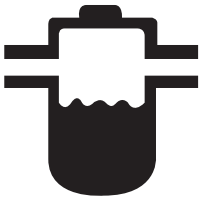
▶ DI Engine

Comparatively conventional diesel engines, DI engine controls the fuel injection and timing electrically, delivers high power and reduces less emission.

▶ System Safety Mode

When a severe failure has been occurred in a vehicle, the system safety mode is activated to protect the system. It reduces the driving force, restricts the engine speed (rpm) and stops engine operation. Refer to “Diagnosis” section in this manual.

▶ Water Separator Warning Light



When the water level inside water separator in fuel filter exceeds a certain level (approx. 39 cc), this warning light comes on and buzzer sounds.

Also, the driving force of the vehicle decreases (torque reduction). If these conditions occur, immediately drain the water from fuel filter.

For the draining procedures, please refer to “How to drain the water from fuel filter” section.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

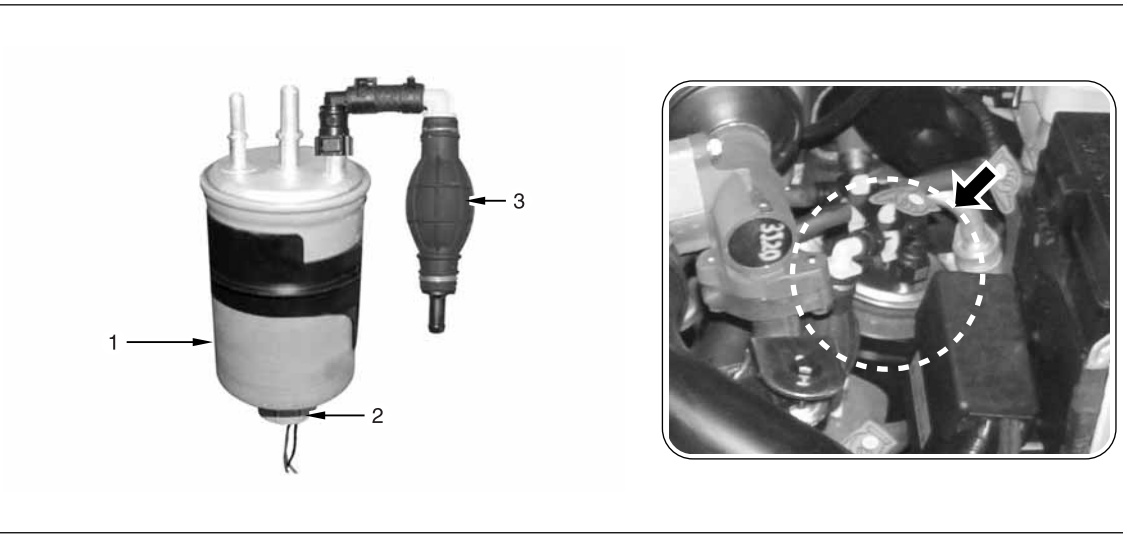
▶ Priming Pump

The priming pump installed in fuel pump is the device to fill the fuel into the fuel filter. When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

▶ Conditions for Using Priming Pump

1. **After run out of fuel**
2. **After draining the water from fuel separator**
3. **After replacing the fuel filter**

▶ Fuel Filter and Water Separator



1. Fuel filter
2. Water drain plug
   (water separating operation: every 10,000 km)
3. Priming pump

NOTICE

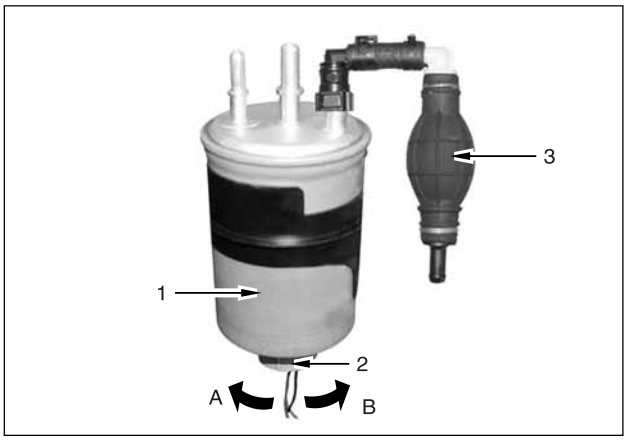
- **When replaced the fuel filter or drained the water from fuel filter, press the priming pump until it becomes rigid before starting the engine.**
- **The water drain from fuel filter should be performed whenever changing the engine oil.**

▶ Draining the Water From Fuel Filter

1. Place the water container under the fuel filter.



2. Turn the drain plug (2) to “A” direction to drain the water.
3. Wait until a certain amount of fuel gets out from the port, then turn the drain plug to “B” direction to tighten it.



NOTICE

- **Be careful not to be injured by surrounding equipment during the working procedures.**

4. Press the priming pump until it becomes rigid.
5. Start the engine and check the conditions.



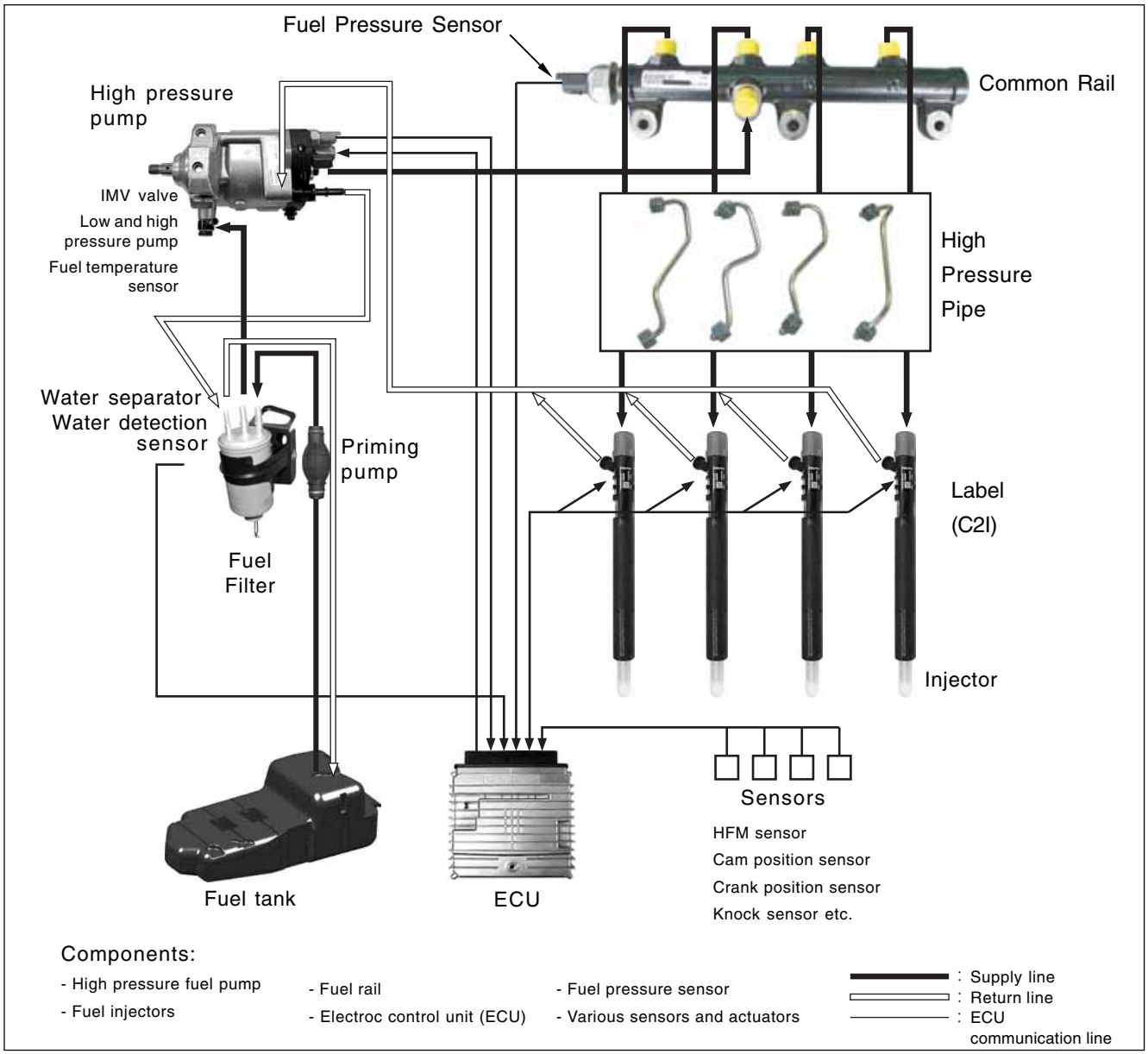
WARNING

- **If the priming pump is not properly operated, air may get into the fuel line. It may cause starting problem or fuel system problem. Make sure to perform the job in step 4.**

FUEL SYSTEM

FUEL INJECTION SYSTEM

▶ Electronic Control of Fuel System

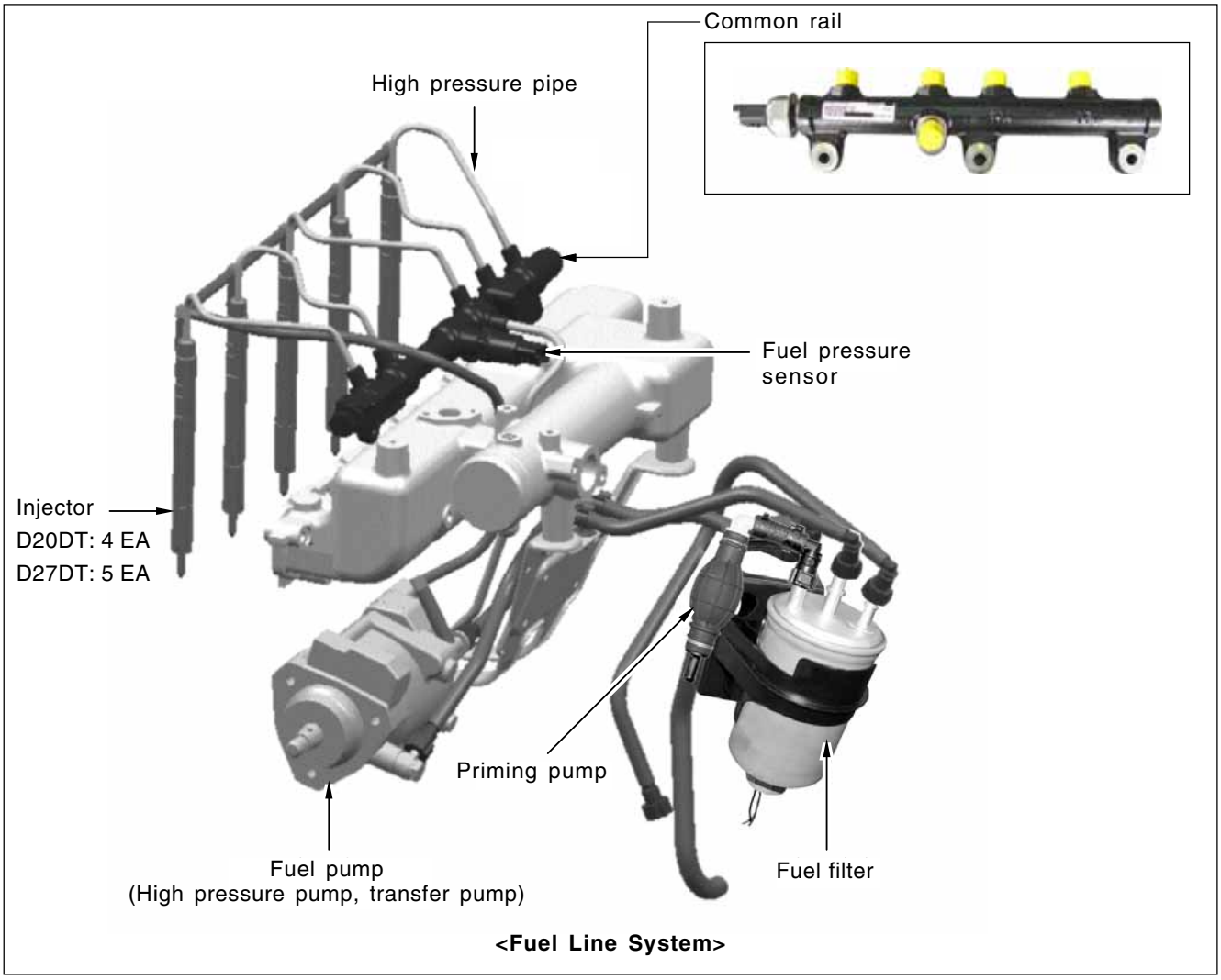


According to input signals from various sensors, engine ECU calculates driver's demand (position of the accelerator pedal) and then controls overall operating performance of engine and vehicle on that time.

ECU receives signals from sensors via data line and then performs effective engine air-fuel ratio controls based on those signals. Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's demand) through electrical signal that is generated by variable resistance changes in accelerator pedal sensor. Air flow (hot film) sensor detects intake air volume and sends the signals to ECU. Especially, the engine ECU controls the air-fuel ratio by recognizing instant air volume changes from air flow sensor to decrease the emissions (EGR valve control). Furthermore, ECU uses signals from coolant temperature sensor and air temperature sensor, booster pressure sensor and atmospheric pressure sensor as compensation signal to respond to injection starting, pilot injection set values, various operations and variables.

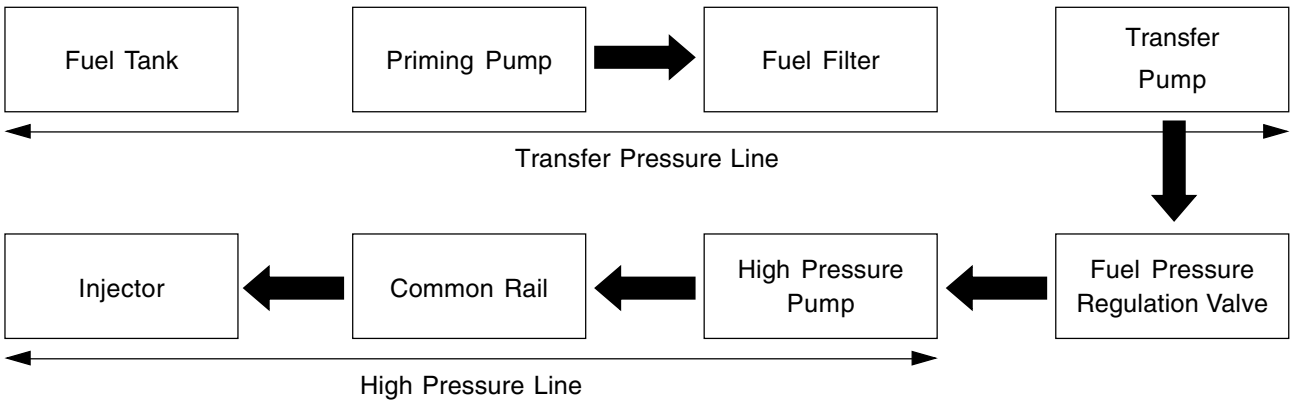
▶ Composition of Fuel System

Components in fuel system are designed to generate and distribute high pressure, and they are controlled electronically by engine ECU. Accordingly, fuel system is completely different from injection pump type fuel supply system on the conventional Diesel engine. The fuel injection system in common rail engine is composed of transfer pressure section that transfers fuel in low pressure, high pressure section that transfers fuel in high pressure and ECU control section.



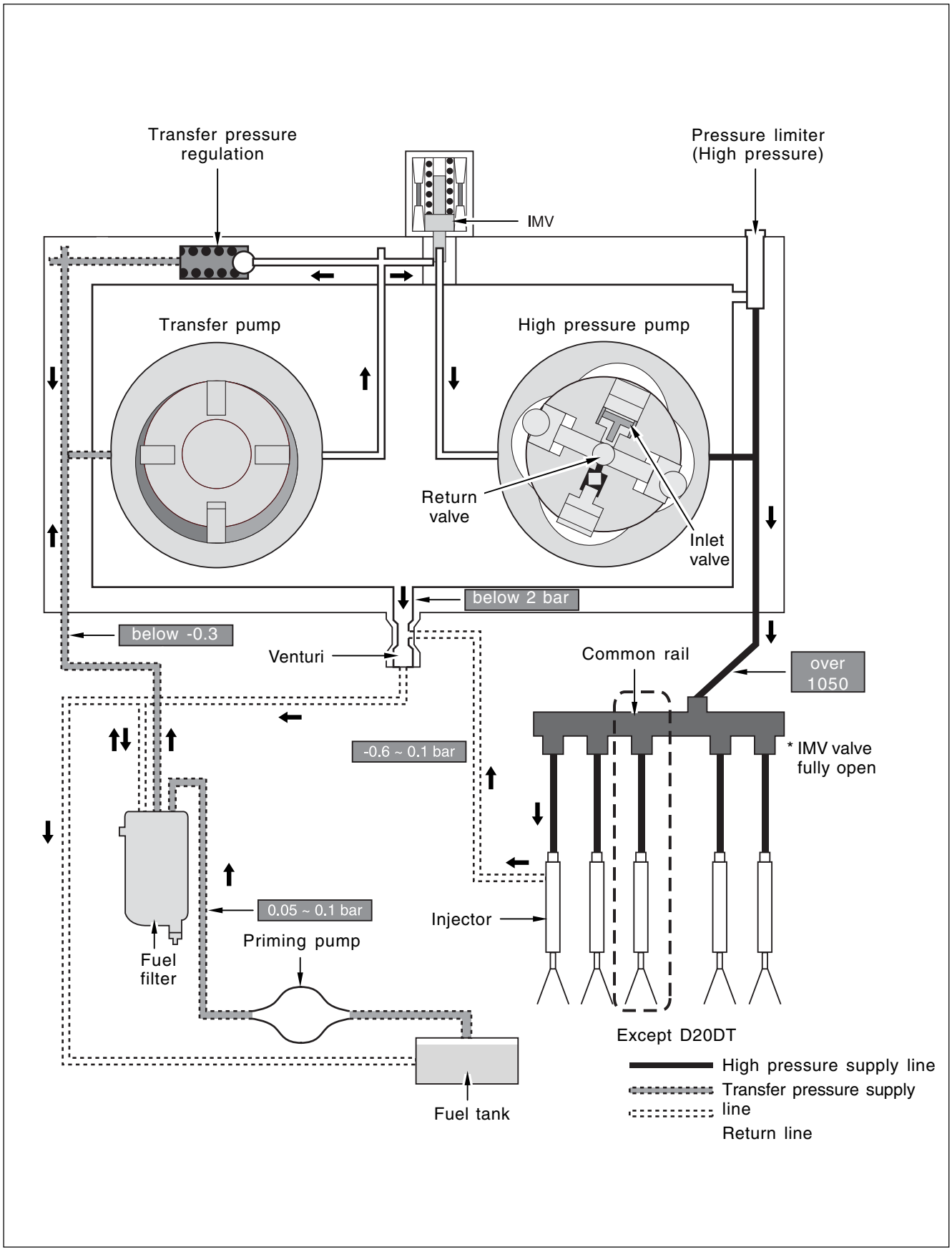
<Fuel Line System>

Fuel route



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▶ Hydranlic Cycle in Fuel Line (Tramsfer and High Pressure Line)



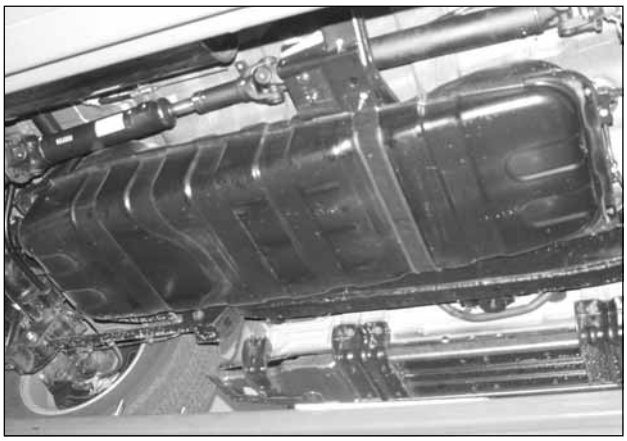
▶ Components of Low Pressure Transfer Line

Low pressure stage is to supply sufficient fuel to high pressure section and components are as below.

1. Fuel tank (including strainer)
2. Hand priming pump
3. Fuel filter
4. Transfer pump
5. Other low pressure fuel hoses

Fuel tank

Fuel tank is made of anti-corrosion material and its allowable pressure is 2 times of operating pressure (more than min. 0.3 bar). It has protective cap and safety valve to prevent excessive pressure building. Also, to supply fuel smoothly, it has structure to prevent fuel from leaking in shocks, slopes and corners and.



Priming pump

If fuel runs out during driving or air gets into fuel line after fuel filter replacement, it may cause poor engine starting or damage to each component. Therefore, the hand priming pump is installed to bleed air from transfer line.

When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

1. After run out of fuel
2. After draining the water from fuel separator
3. After replacing the fuel filter

Press the priming pump until it becomes rigid before starting the engine.



Fuel filter

It requires more purified fuel supply than conventional diesel engine. If there are foreign materials in the fuel, fuel system including pump components, delivery valve and injector nozzles may be damaged.

Fuel filter purifies fuel before it reaches to high pressure pump to help proper operations in high pressure pump. And more, it separates water from fuel to prevent water from getting into FIE system (high pressure line).



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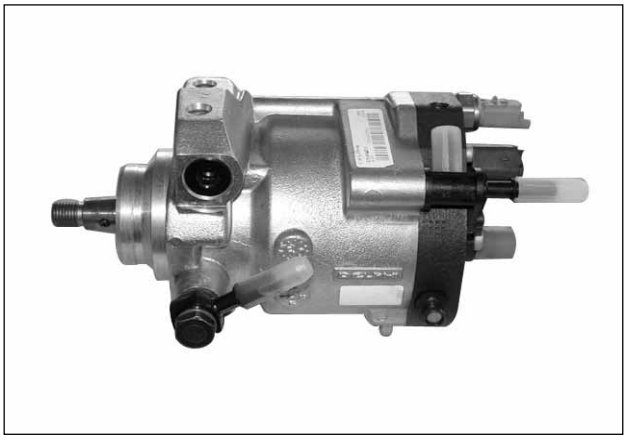
▶ Components of High Pressure Transfer Line

In the high pressure section, sufficient fuel pressure that injectors requires will be generated and stored. The components are as below:

1. High pressure pump
2. Rail pressure sensor
3. Pressure limit valve
4. Common rail
5. High pressure pipe
6. Injector
7. Fuel pressure regulating valve (IMV)

High pressure pump

This is plunger pump that generates high pressure; and driven by crankshaft with timing chain. The high pressure pump increases system pressure of fuel to approx. 1,600 bar and this compressed fuel is transferred to high pressure accumulator (common rail) in tube through high pressure line.



Common rail

It stores fuel transferred from high pressure pump and also stores actual high pressure of fuel. Even though the injectors inject fuel from the rail, the fuel pressure in the rail is maintained to a specific value. It is because the effect of accumulator is increased by unique elasticity of fuel. Fuel pressure is measured by rail pressure sensor. And the fuel pressure regulating valve (IMV, Inlet Metering Valve) included in high pressure pump housing keeps pressure to a desired level.



High pressure pipe (fuel pipe)

Fuel line transfers high pressure fuel. Accordingly, it is made of steel to endure intermittent high frequency pressure changes that occur under maximum system pressure and injection stops. Injection lines between rail and injectors are all in the same length; it means the lengths between the rail and each injector are the same and the differences in length are compensated by each bending.



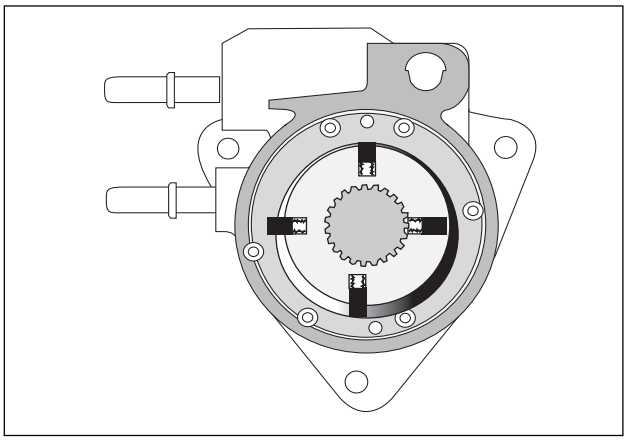
Injectors

The fuel injection device is composed of electrical solenoid valve, needle and nozzle and controlled by engine ECU. The injector nozzle opens when solenoid valve is activated to directly inject the fuel into combustion chamber in engine. When injector nozzle is open, remaining fuel after injection returns to fuel tank through return line. Pressure limit valve, fuel returned by low pressure and fuel used for high pressure pump lubrication also return to fuel tank through return line.



Transfer pump

The transfer pump is included in the housing of the high pressure pump. The transfer pump is the volumetric blade type pump. To deliver the continuously required fuel volume, the pump transfers fuel from the fuel tank to high pressure pump.



Fuel filter replacement

1. Fuel filter change interval: every 30,000 km
2. Water separation interval: every 10,000 km (same with engine oil change interval)
3. Never reuse the removed fuel filter

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FUEL TRANSFER LINE

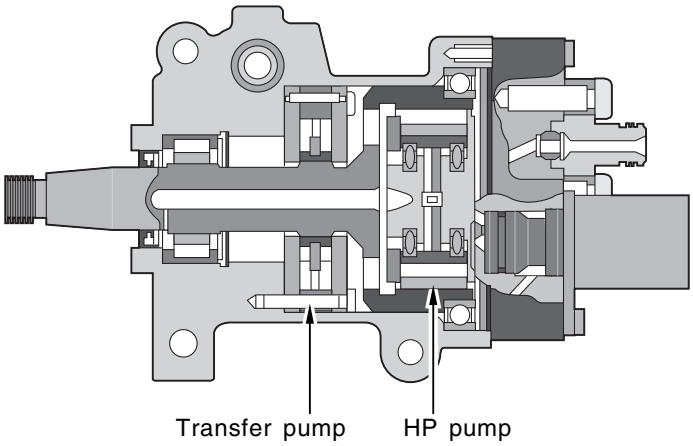
▶ Transfer Pump

Description

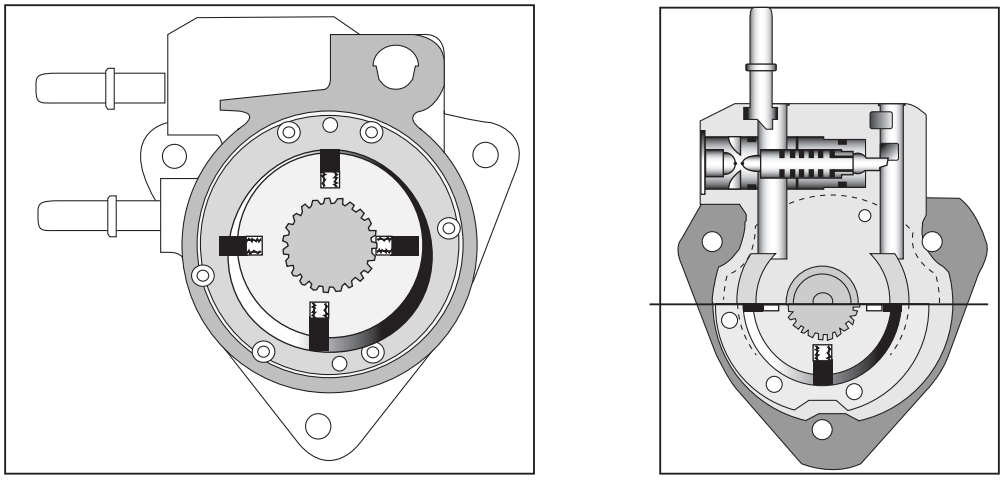
The transfer pump is the device to provide sufficient fuel to high fuel pressure line and is mechanical type feed pump that is driven by timing chain linked to crankshaft. This mechanical type feed pump is subject to air inflow, therefore, a hand priming pump is installed to bleed air from fuel transfer line.

The transfer pump is included in the housing of the HP pump. The transfer pump is the volumetric blade type pump and consists of the following components:

1. A rotor turned by the shaft of the HP pump. The connection is provided by splines.
2. An eccentric liner fixed to the housing of the HP pump by 6 Torx bolts. The liner is positioned by two off-set pins in order to prevent any assembly errors.
3. Four blades set at 90°. Each blade is held against the liner by a coil spring.
4. The inlet and outlet orifice.

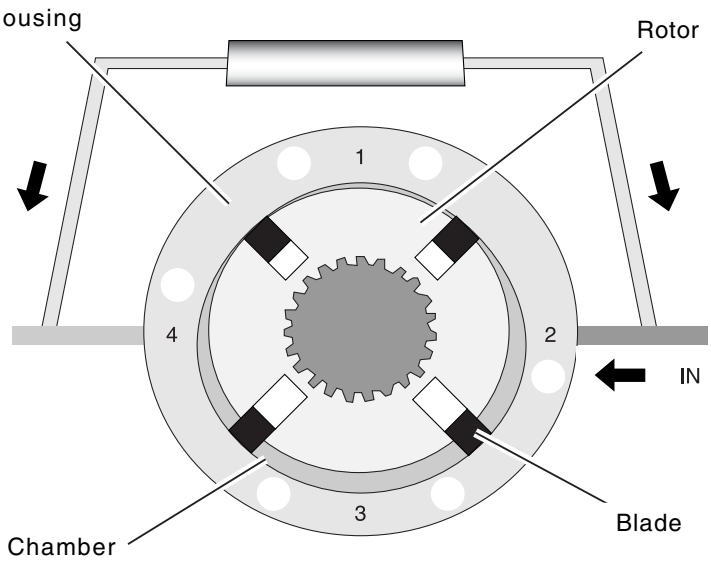


<Sectional Diagram of Fuel Pump>



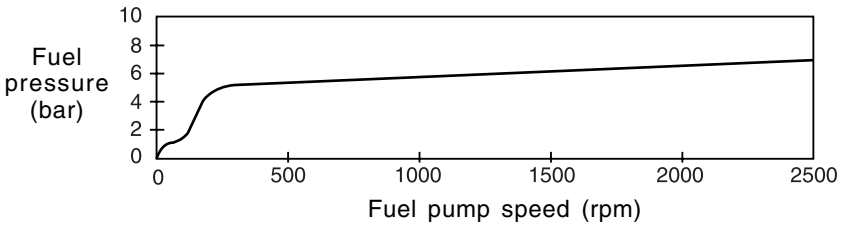
<Sectional Diagram of Transfer Pump>

Principle of operation



Consider the chamber between the rotor, the liner and two successive blades (refer to above figure).

1. When the chamber is in position 1, the volume of the chamber is minimal. The changes in volume according to the angle of rotation of the rotor are small.
2. The rotor makes a quarter turn clockwise. The previous chamber is now in position 2.
   The inlet orifice is uncovered. The volume contained in the chamber quickly rises. The pressure inside the chamber drops sharply. Fuel is drawn into the chamber.
3. The rotor continues to rotate. It is now in position 3. The inlet and outlet orifices are now sealed off. The volume area controlled by the rotor, the liner and the two blades is at the maximum. The changes in volume according to the angle of rotation of the rotor are small.
4. The rotor continues to rotate. It is finally in position 4. The outlet orifice is uncovered. The volume area controlled by the rotor, the liner and the blades decreases quickly. The pressure inside the chamber rises sharply. The fuel is expelled under pressure. The depression caused by the transfer pump's rotation is sufficient to draw in diesel fuel through the filter. The transfer pump is driven by the shaft of the HP pump, transfer pressure thus rises with engine speed. A regulating valve allows the transfer pressure to be maintained at a practically constant level (about 6 bar) throughout the whole range of engine operations by returning some of the fuel to the pump inlet.



Characteristics of the transfer pump

Regulating pressure	6 bar
Volume controlled	5.6 cm^3/revolution
Flow	90 ℓ/h at 300 rpm pump
	650 ℓ/h at 2,500 rpm pump
Intake capacity	65 mbar at 100 rpm pump

INLET METERING VALVE (IMV)

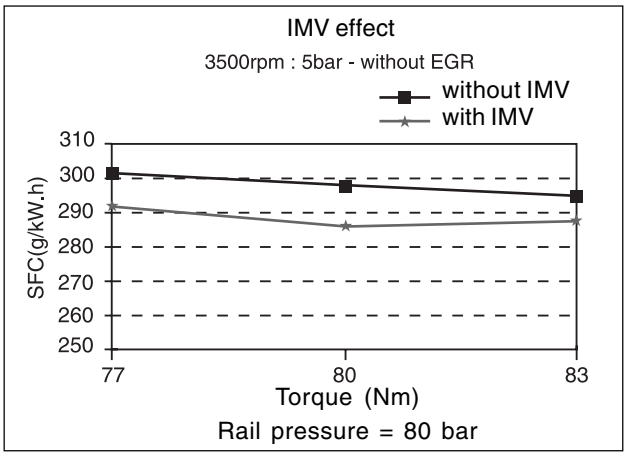
▶ Overview

The LP actuator, also called the inlet metering valve, is used to control the rail pressure by regulating the amount of fuel which is sent to the pumping element of the HP pump.

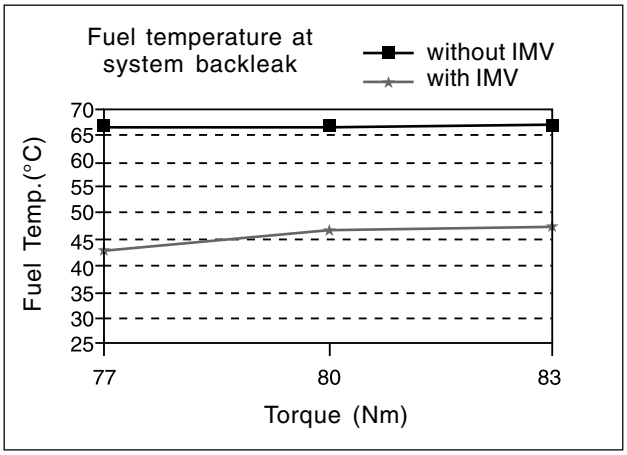


This actuator has two purposes:

1. Firstly, it allows the efficiency of the injection system to be improved, since the HP pump only compresses the amount of fuel necessary to maintain in the rail the level of pressure required by the system as a function of the engine's operating conditions.



2. Secondary, it allows the temperature to be reduced in the fuel tank. When the excess fuel is discharged into the back leak circuit, the pressure reduction in the fluid (from rail pressure down to atmospheric pressure) gives off a large amount of heat. This leads to a temperature rise in the fuel entering the tank. In order to prevent too high a temperature being reached, it is necessary to limit the amount of heat generated by the fuel pressure reduction, by reducing the back leak flow. To reduce the back leak flow, it is sufficient to adapt the flow of the HP pump to the engine's requirements throughout its operating range.

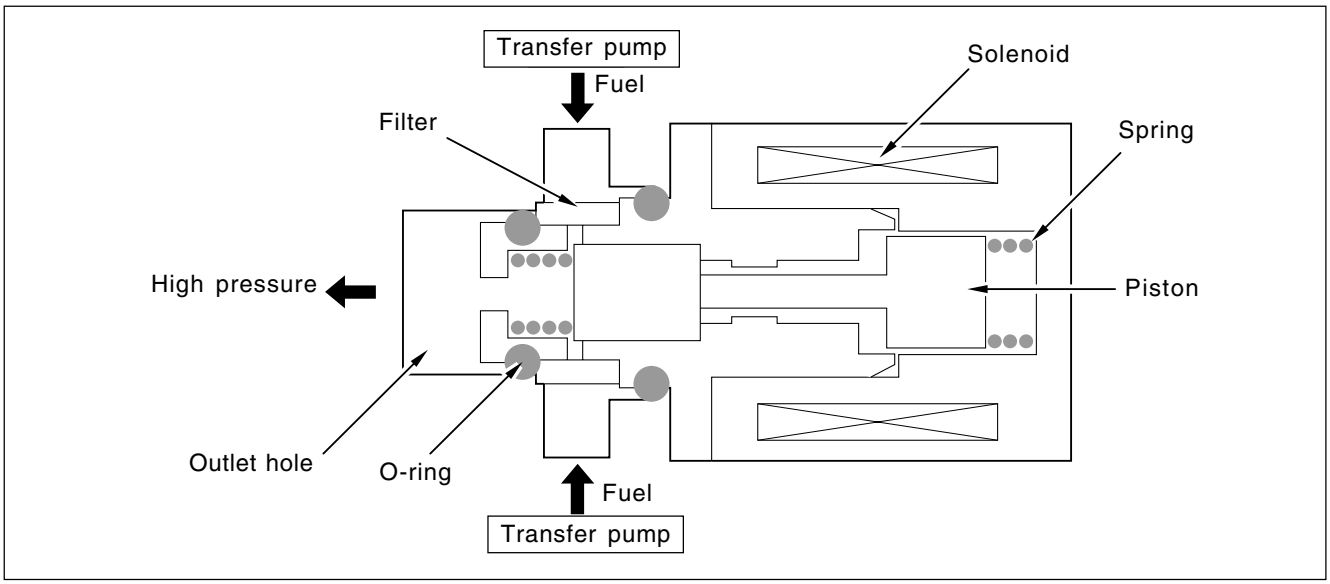


▶ Composition of IMV

The IMV is located on the hydraulic head of the pump. It is fed with fuel by the transfer pump via two radial holes. A cylindrical filter is fitted over the feed orifices of the IMV. This makes it possible to protect not only the LP actuator, but also all the components of the injection system located downstream of the IMV.

The IMV consists of the following components:

1. A piston held in the fully open position by a spring.
2. A piston filter located at inlet.
3. Two O-rings ensuring pressure tightness between the hydraulic head and the body of the IMV.
4. A body provided with two radial inlet holes and an axial outlet hole.
5. Coil



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AFFECTED VIN	

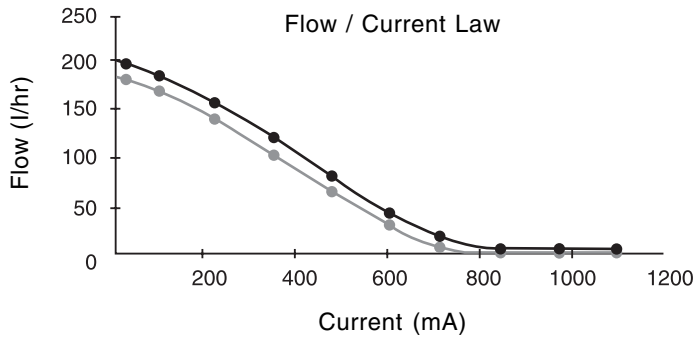
▶ Principle of Operation

The LP actuator is used to proportion the amount of fuel sent to the pumping element of the HP pump in such a way that the pressure measured by the HP sensor is equal to the pressure demand sent out by the ECU. At each point of operation, it is necessary to have:

- Flow introduced into the HP pump = Injected flow + Injector backleak flow + injector control flow

The IMV is normally open when it is not being supplied with fuel. It cannot therefore be used as a safety device to shut down the engine if required.

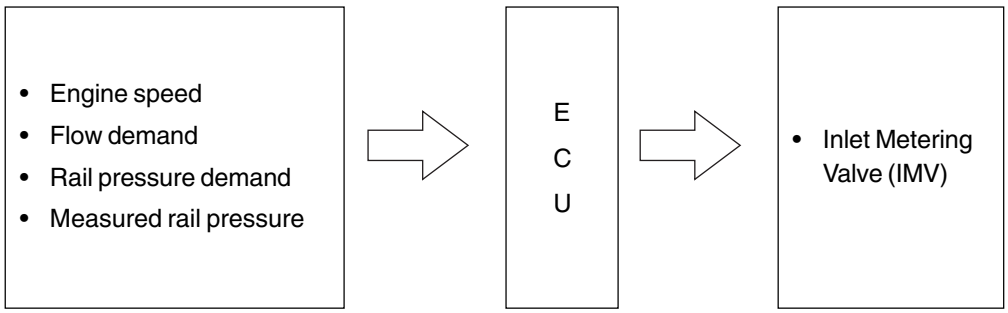
The IMV is controlled by current. The flow/current law is represented below.



Specifications

Piston stroke	1.4 mm
Diameter of holes	3.4 mm
Coil resistance	5.4 Ω (at 25°C)
Power supply	Battery voltage (It is prohibited to supply the IMV directly at the battery voltage during the diagnostic test)
Max. current	1 A
Weight	260 g
Operating temperature	40°C < T < 125°C
Fluid temperature	40°C < T < 90°C
Control logic	Normally open without power (The flow decreases as the current rises).

- ECU determines the value of the current to be sent to the IMV according to:



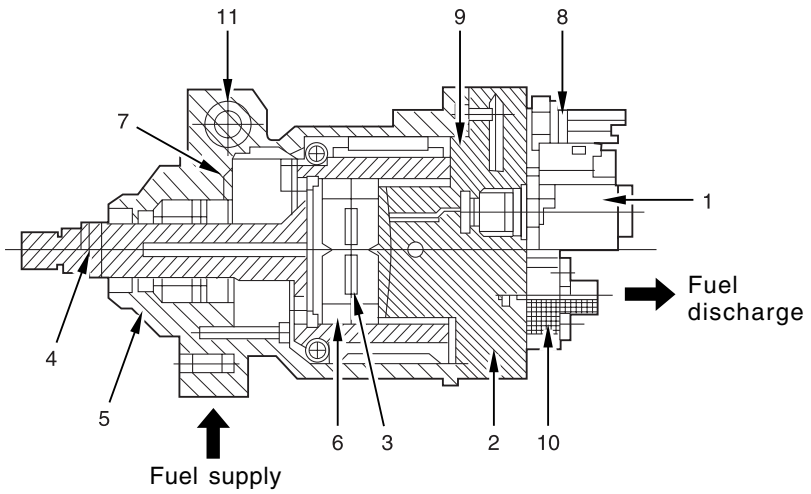
HIGH FUEL PRESSURE LINE

▶ High Pressure Pump

Description

This pump generates high fuel pressure and is driven by timing chain (radial plunger principle). This pump pressurizes the fuel to approx. 1600 bar and sends this high pressurized fuel to high pressure accumulator (common rail) via high pressure line.

It is possible to extend the pumping phase in order to considerably reduce drive torque, vibration and noise since the pump no longer determines the injection period. The differences from conventional rotary pumps lies in the fact that it is no longer the hydraulic head rotor which turns inside the cam, but the cam which turns around the hydraulic head. Thus, any problems of dynamic pressure tightness are eliminated because the high pressure is generated in the fixed part of the pump.



1. IMV (Inlet Metering Valve)
2. Hydraulic Head
3. Plunger
4. Drive shaft and cam ring
5. Housing
6. Roller and shoe
7. Transfer pump
8. Fuel temperature sensor
9. Vent
10. High fuel pressure - OUT
11. Pressure regulator

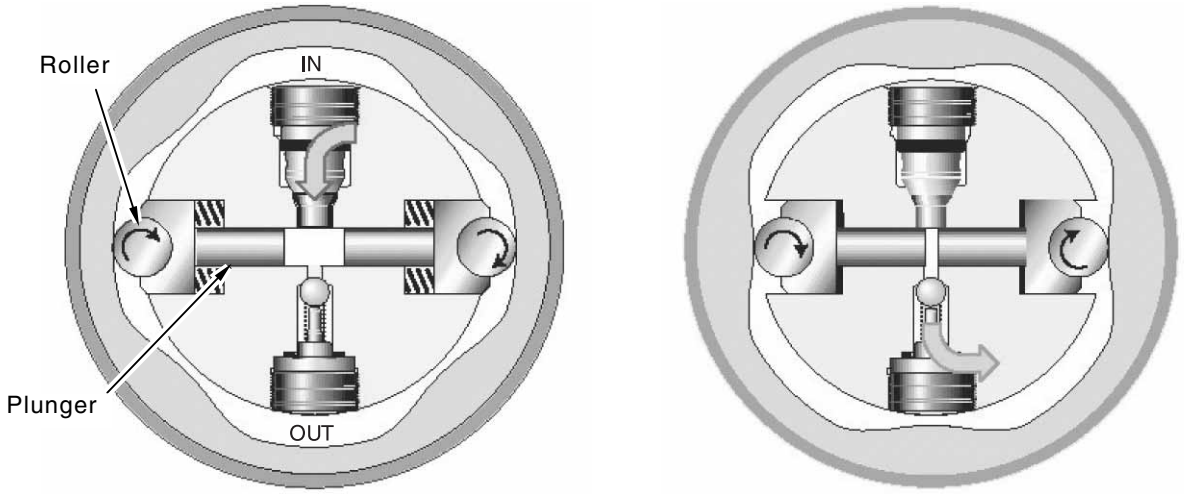
Specifications

1. Maximum operating pressure: 1600 ± 150 bar
2. Operating pressure limit: 2100 bar
3. Maximum sealing pressure: when using a plug instead of PRV, no leaks around pump outlet port (when applying 2500 bar of constant pressure)
4. Fuel pressure at inlet (pressure regulating valve): 6 bar
5. Operating temperature: Continuously operating within temperature range of -30°C ~ 120°C in engine compartment
6. Inflowing fuel temperature: The maximum inflowing fuel temperature is 85°C (continuously able to operate)
7. Pump inlet pressure: Relative pressure Max. 048 bar (to end of filter's lifetime)
8. Driving torque: 15 Nm / 1600 bar
9. Gear ratio (engine: pump): 0.625
10. Lubrication: - Inside lubrication (rear bearing): Fuel
    - Outside lubrication (front bearing): Engine oil

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AFFECTED VIN	

Principle of operation

1. During the filling phase, the rollers are kept in contact with the cam by means of coil springs mounted on either side of each shoe. The transfer pressure is sufficient to open the inlet valve and to move the pumping plungers apart. Thus, the dead volume between the two plungers fills with fuel.
2. When the diametrically opposite rollers simultaneously encounter the leading edge of the cam, the plungers are pushed towards each other.
3. As soon as the pressure becomes higher than the transfer pressure, the inlet valve closes. When the pressure becomes higher than the pressure inside the rail, the delivery valve opens. Consequently, the fuel is pumped under pressure into the rail.
4. During the input phase, transfer pressure pushes back the inlet valve. Fuel enters the body of the pumping element. The valve closes as soon as the pressure in the pumping element becomes higher than the transfer pressure.
5. During the input phase, the ball of the delivery valve is subject to the rail pressure on its outer face and to the transfer pressure on its inner face. Thus the ball rests on its seat, ensuring the pressure tightness of the body of the pumping element. When the pressure in the element becomes higher than the pressure in the rail, the ball is unbalanced and it opens. Fuel is then pumped into the rail at high pressure.

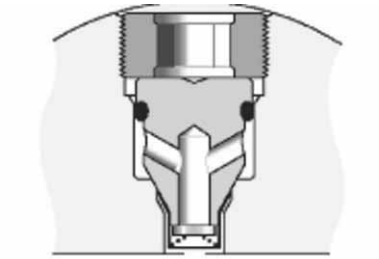


<Fuel Input> <Pressurize>

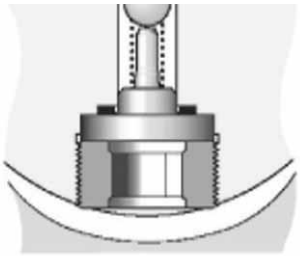
This high pressure pump generates the driving torque with low peak torque to maintain the stress to driving components. This torque is smaller than that of conventional injection pump, thus, only a small load will be applied to pump. The required power to drive pump is determined by set pressure for rail and pump speed (delivery flow). Note that the fuel leakage or defective pressure control valve may affect the engine output.

Inlet valve and delivery valve

During the input phase, transfer pressure pushes back the inlet valve. Fuel enters the body of the pumping element. Under the effect of the transfer pressure, the two plungers are forced apart. When the rollers simultaneously encounter the leading edge of the cam, pressure suddenly rises in the body. Of the pumping element. The valve closes as soon as the pressure in the pumping element becomes higher than the transfer pressure. During the input phase, the ball of the delivery valve is subject to the rail pressure on its outer face and to the transfer pressure on its inner face. Thus the ball rests on its seat, ensuring the pressure tightness of the body of the pumping element. When the two diametrically opposite rollers encounter the leading edges of the cam, the plungers are forced together and pressure quickly rises in the body of the pumping element. When the pressure in the element becomes higher than the pressure in the rail, the ball is unbalanced and it opens. The spring calibration is negligible compared with the pressure forces. Fuel is then pumped into the rail at high pressure.



<Inlet Valve>



<Delivery Valve>

Lubrication and cooling of the HP pump

Lubrication and cooling of the pump are provided by the fuel circulation. The minimum flow required to ensure adequate operation of the pump is 50 ℓ/h.

Phasing of the HP pump

Conventional fuel injection pumps ensure pressurizing and distribution of the fuel to the different injectors. It is essential to set the pump in such a way that the injection occurs at the required place during the cycle. The HP pump of the common rail system is no longer used for the fuel distribution, it is therefore not necessary to set the pump in relation to the engine.

Nevertheless, the setting or phasing of the pump offers two advantages:

1. It allows the torque variations of the camshaft and the pump to be synchronized in order to reduce the stresses on the timing belt.
2. It allows pressure control to be improved by synchronizing peak pressures produced by the pump with pressure-drops caused by each injection.

This phasing allows pressure stability to be improved, which helps to reduce the difference in flow between the cylinders.

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AFFECTED VIN	

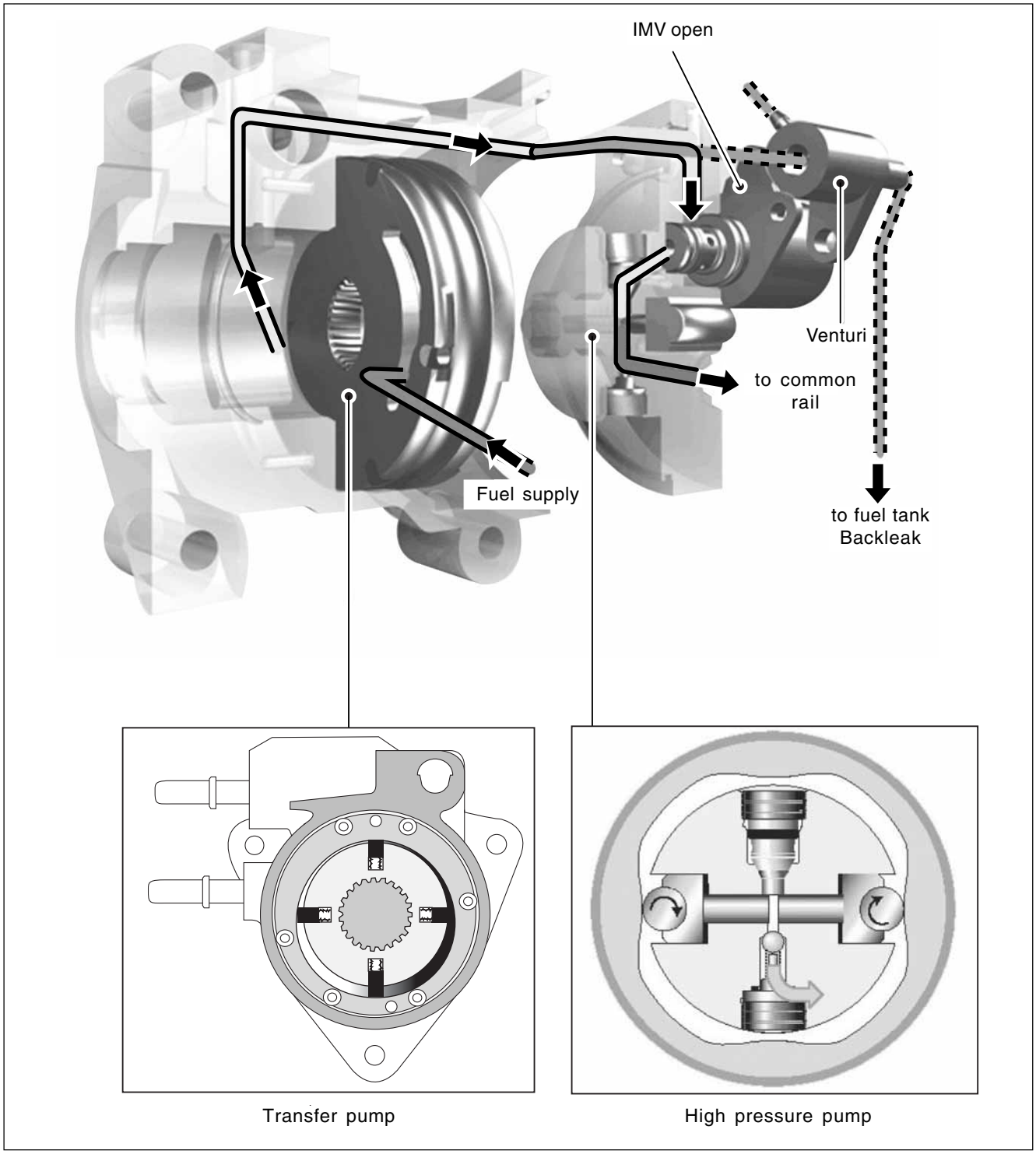
▶ HP Pump Fuel Route

The fuel passed through the fuel filter is sent to the transfer pump via the HP inlet pump. this fuel passes through the transfer pump by the transferring pressure and maintains the predefined value by the regulating valve in HP pump.

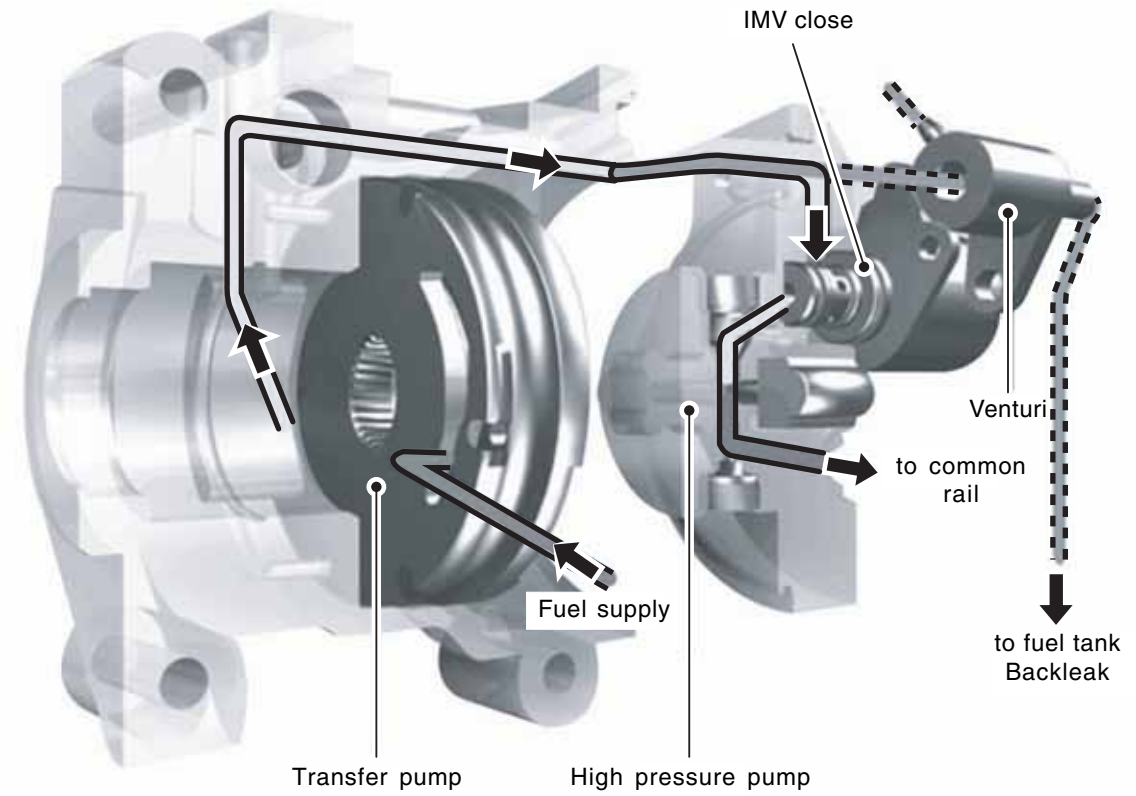
Also, this fuel gets into the IMV that controls only the fuel to the high pressure pump.

The below figure describes the pump operations when acceleration and deceleration.

When need high fuel pressure (acceleration)



When do not need high fuel pressure (deceleration)



The fuel is sent to the high pressure side (hydraulic head) and compressed by the plunger. And, goes into the common rail through the high pressure pipe.

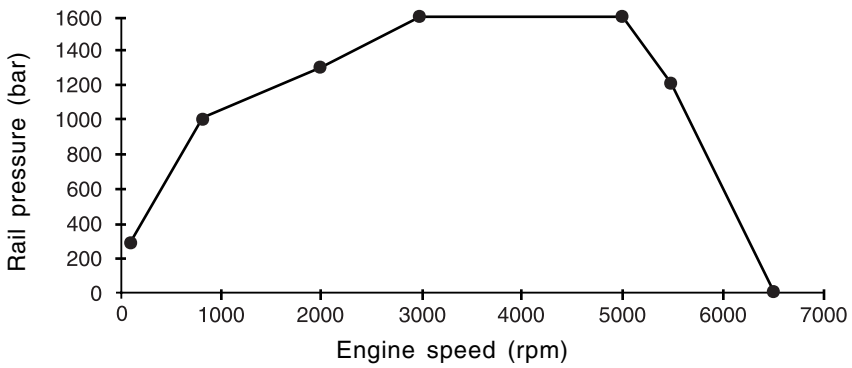
The IMV installed in the high pressure side (hydraulic head) of HP pump precisely controls the fuel amount and delivers the rail pressure feedback same as required amount.

The IMV is controlled by ECU.

Performance curve of HP pump

The time required to obtain a sufficient pressure in the rail to enable the engine to start depends on the volume of the system (definition of the rail, length of the pipes, etc.). The aim is to reach a pressure of 200 bars in 1.5 revolutions (3rd compression).

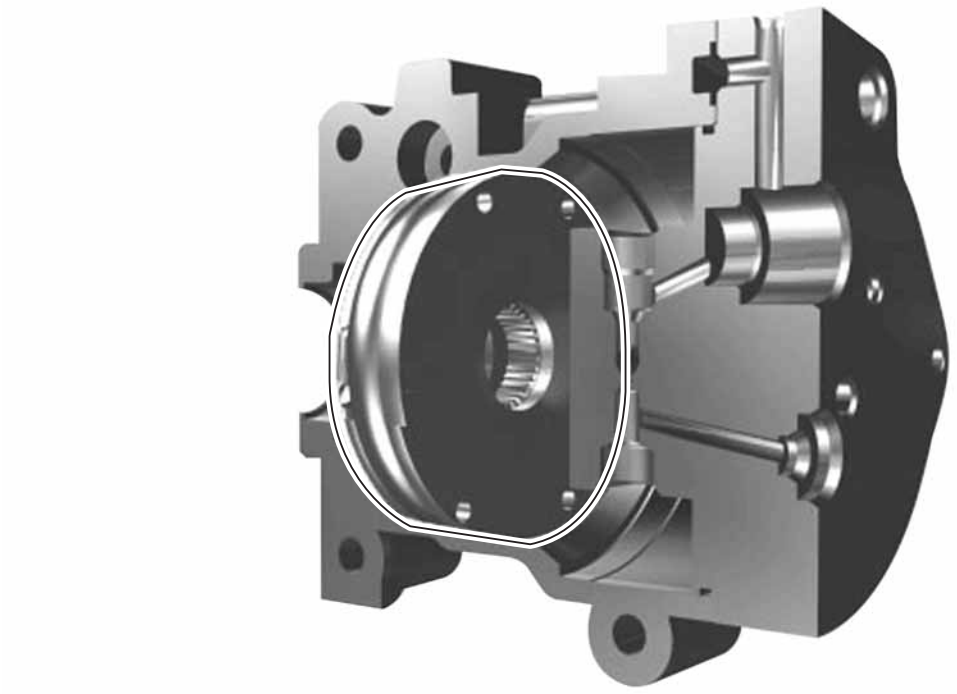
- Maximum operating pressure: 1600 ± 150 bar



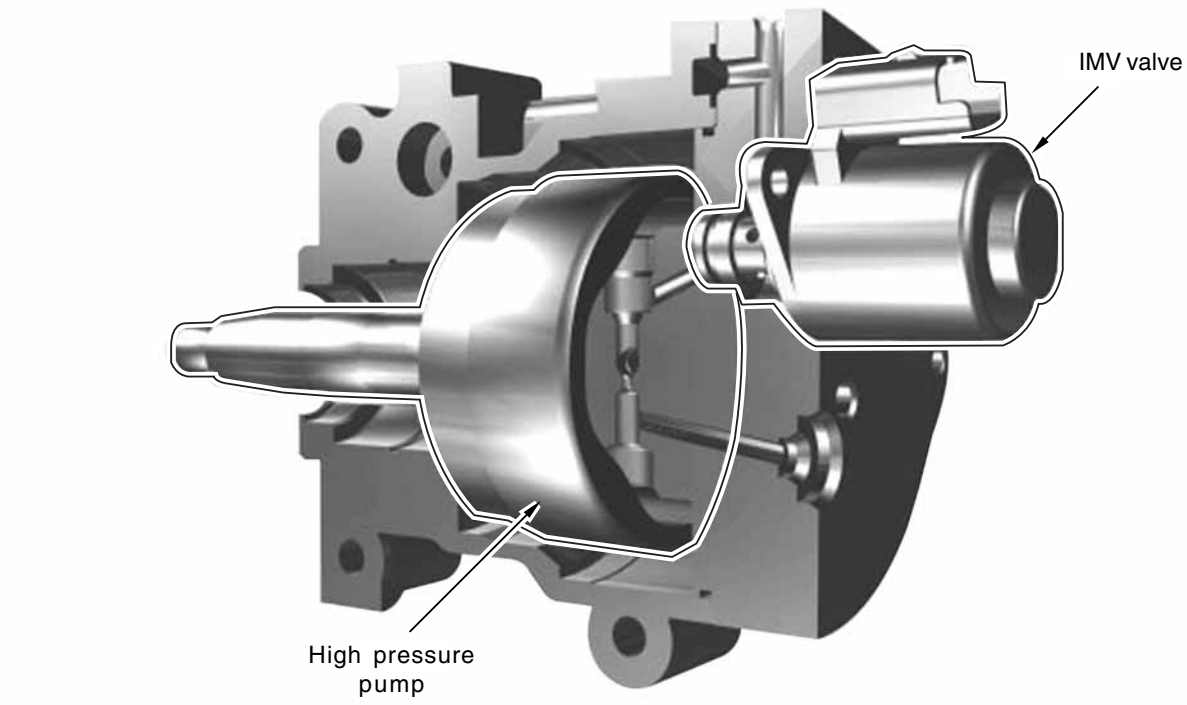
<Pressure Curve of HP Pump>

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▶ Sectional View of HP Pump

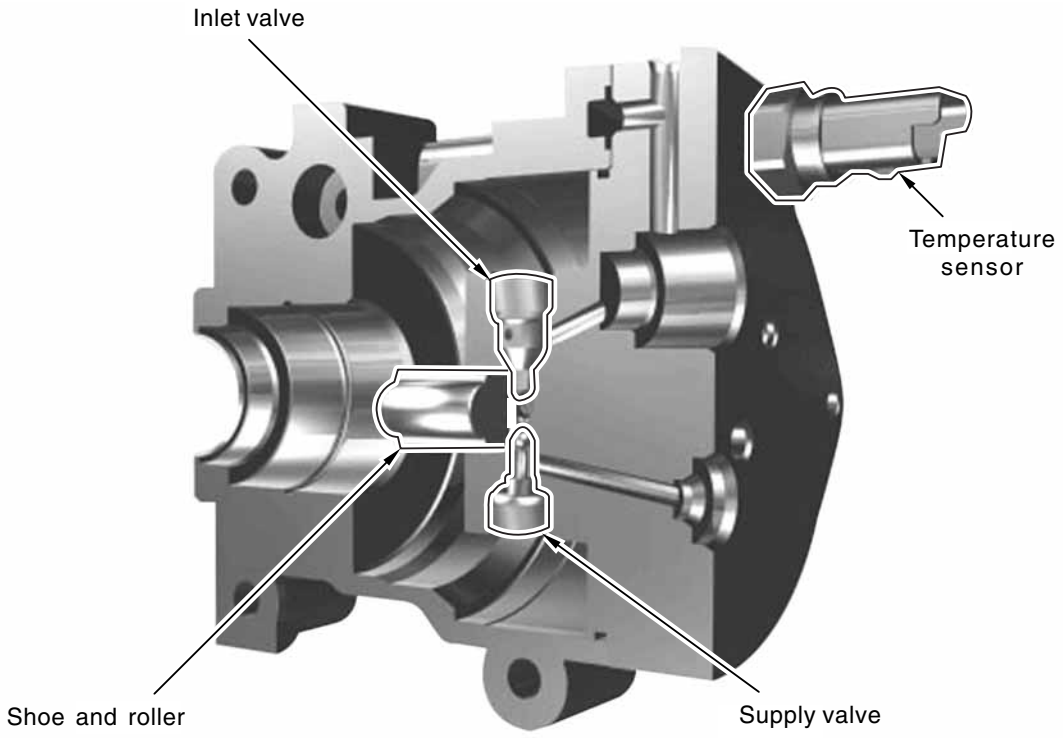


<Transfer Pump>

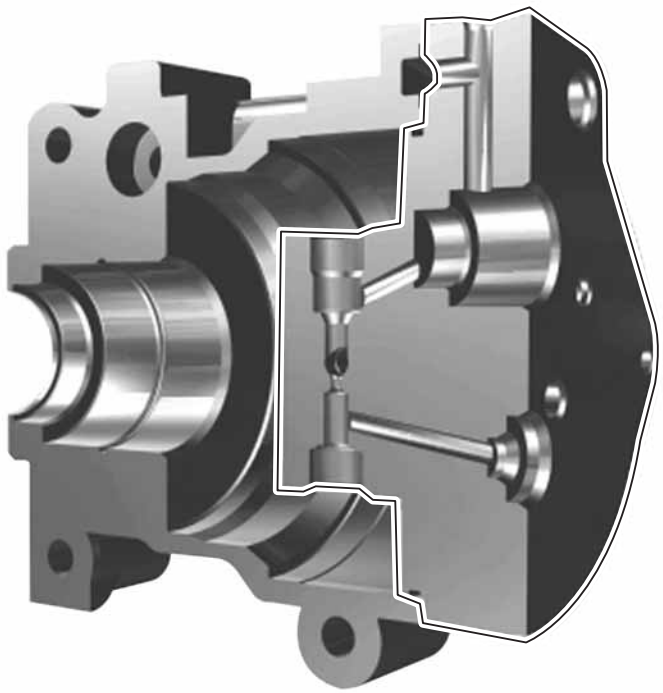


<IMV Valve and High Pressure Pump (Drive Shaft)>

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<Inlet Valve, Outlet Valve, Shoe and Roller, Temperature Sensor>



<Hydraulic Head>

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AFFECTED VIN	

▶ Removal and Installation

Removal

※ **Preceding Works:**

1. Disconnect the negative battery cable.
2. Apply the parking brake and place the chocks under the tires. (transmission "N" position)

1. Turn the auto tensioner counterclockwise and remove the fan belt.

NOTICE

- **Slacken the pulley bolt.**



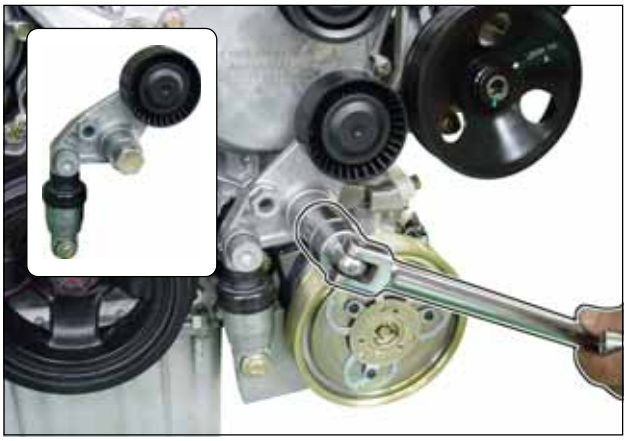
2. Remove the engine belt pulleys.
   1) Cooling fan pulley
   2) Coolant pump pulley
   3) Idle pulley



3. Unscrew lower bolt (13 mm) and upper bolt (24 mm) and remove the auto tensioner.

NOTICE

- **To prevent oil leaks, store the removed auto tensioner in upright position.**
- **Pump the suto tensioner several times before installing it.**

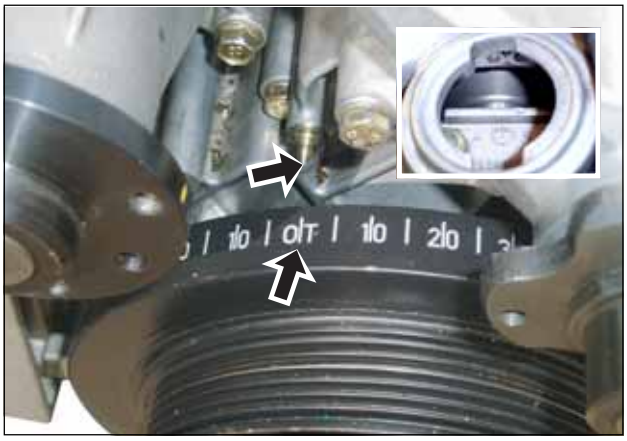


6. Remove the high pressure pump housing.

※ **Preceding Work:** Remove the No.2 EGR pipe.



7. Align the OT mark by rotating the crankshaft.
   1) Open the oil filler cap and check if the OT mark on crankshaft is aligned to the notch on the camshaft.



8. Unscrew the bolts and remove the vacuum modulator bracket.
   1) Disconnect the high pressure pump and vacuum modulator connector.
   2) Disconnect the fuel lines to high pressure pump.
   3) Plug the openings of pipes and ports with protective caps to keep the cleanness of the fuel system.
   4) Remove the high pressure fuel pipe between HP pump and common rail.



9. Rotate the crankshaft clockwise so that the HP pump sprocket holes are aligned to the bolt holes.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

8. Hold the HP pump sprocket and slacken the center bolt.



9. Slacken three HP pump mounting bolts until they rest on the sprocket.



10. Loose the HP pump center nut by tapping it with a hammer.

NOTICE

- **Tap the center bolt with a hammer after tightening.**
- **Make sure that the center bolt is securely tightened.**



11. Remove the remaining bolts with the same manner and remove the high pressure pump.



Installation

1. Replace the HP pump gasket with new one (cannot be reused).



2. Tighten the HP pump bolts.

Tightening torque	25 Nm



3. Hold the HP pump sprocket and tighten the center nut.

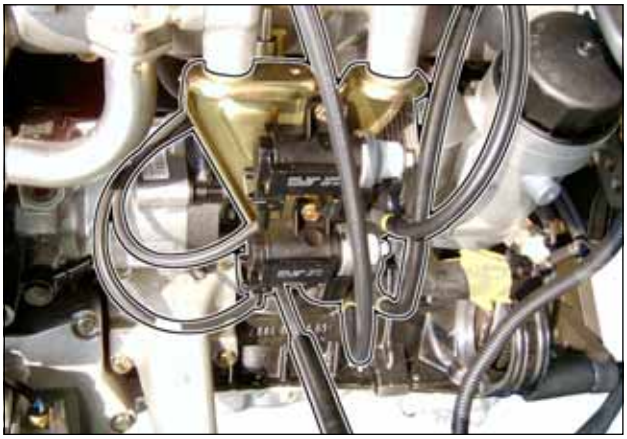
Tightening torque	65 Nm



NOTICE

- **The center nut should be replaced once removed (cannot be reused).**
- **Tighten the center nut with the specified tightening torque.**

4. Install the vacuum modulator bracket.



NOTICE

- **Replace the fuel lines to HP pump with new ones (cannot be reused).**
- **Make sure that the connectors are installed to the correct locations. (The wiring end with white tape**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. Apply the sealant to the HP pump housing and tighten the bolts.



NOTICE

- **Sealant (DB2210): 661 989 56 A0**

6. Install the auto tensioner and belt pulleys.



7. Rotate the crankshaft pulley two revolutions and ensure that the OT mark on the crankshaft pulley and the OT mark on the camshaft pulley are aligned.



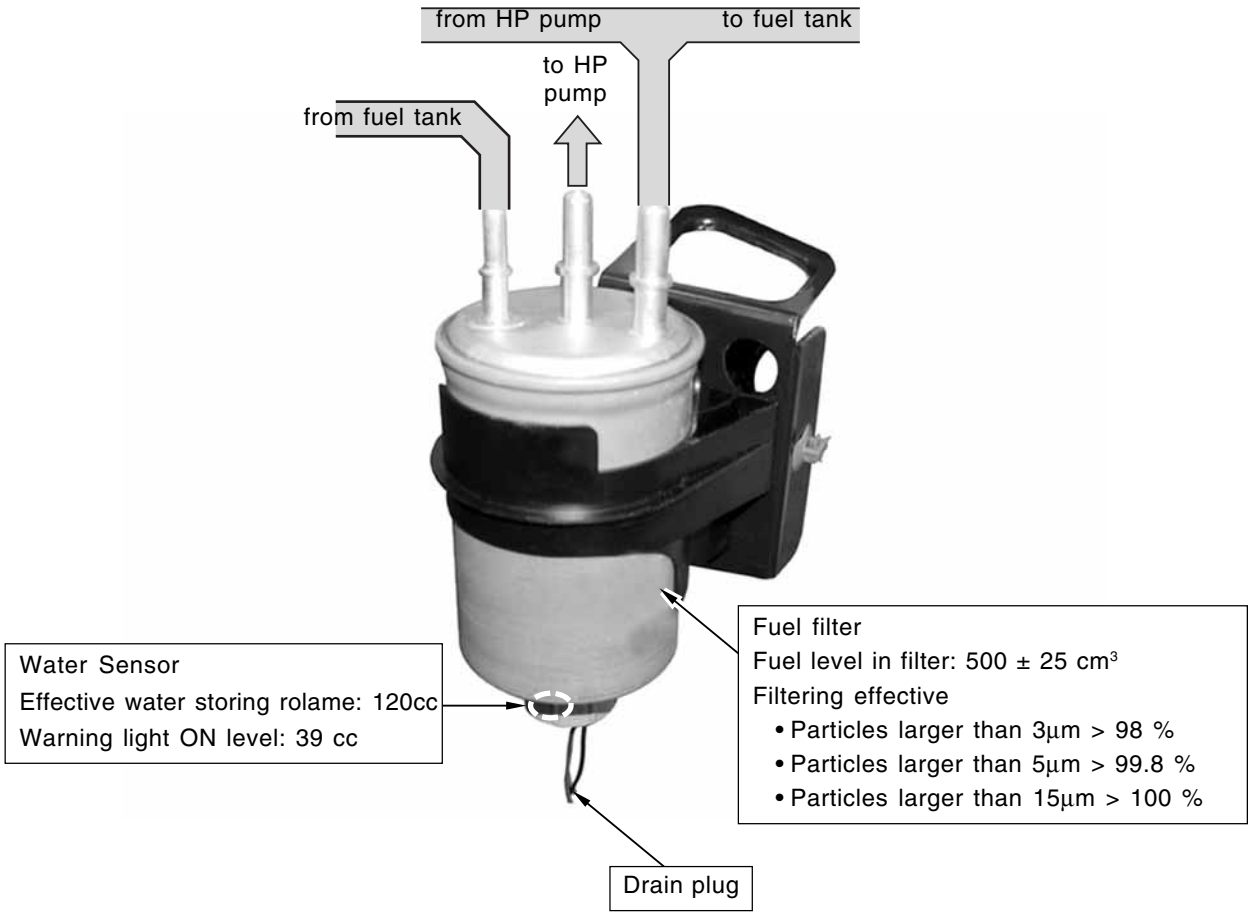
NOTICE

- **Open the oil filler cap and check if the OT mark on crankshaft is aligned to the notch on the camshaft.**

▶ Fuel Filter

Function

Foreign materials in fuel can damage the pump components, transfer valve and injectors. Therefore, the high pressure direct injection engine must use fuel filter. Otherwise, the operation performance will drop dramatically. And, diesel fuel may contain water due to condensation by temperature changes and this condensation water can damage the system by corroding the injection system. Thus, the common rail engine should have function that can drain water periodically.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Change Interval: 30,000 km

Water separation and storage function

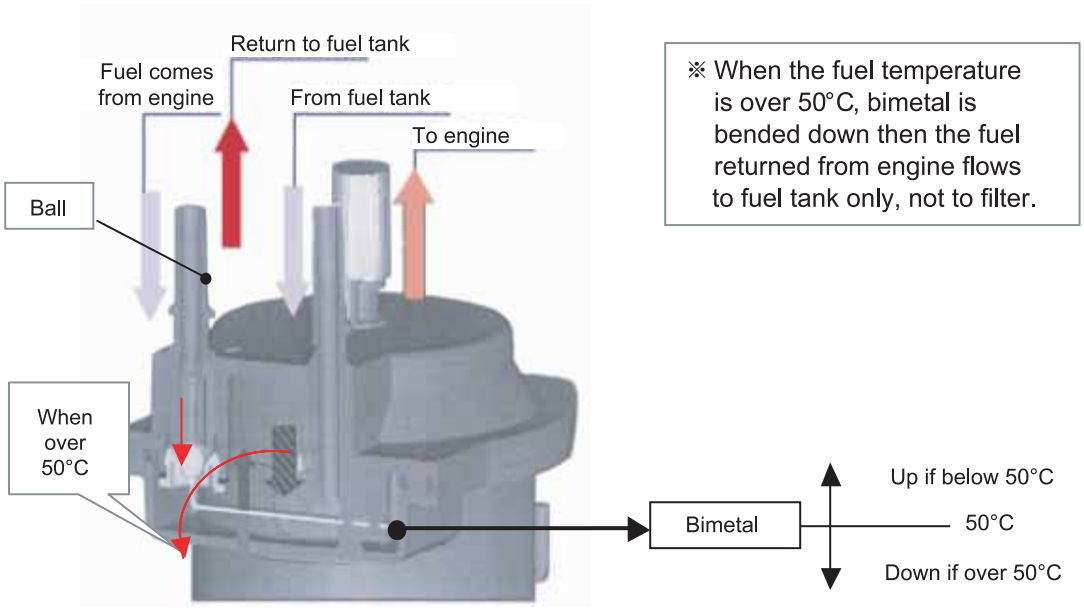
1. Function: It separates the condensation water from diesel fuel to prevent the water from getting into FIE system, and results in protection of FIE system. (manual drain)
2. Water reserve capacity: 124 cc
3. Water warning light turning on level: 39 cc
4. Water drain interval: When changing engine oil or every 20,000 km

Water sensor

It is integrated in the filter and sends signal to ECU when water level reaches at a specified value (over 75 cc) in the filter to let the driver drain the water.

Fuel De-Waxing – Improving starting performance in cold weather

Due to characteristics of diesel fuel, some of fuel components solidify during cold winter under below a specific temperature (-15°C). When those symptoms happen, engine may stall; however, some of the fuel (temperature rises due to high compression) in the HP pump in D27DT engine return to the filter to warm up fuel when temperature is below 50°C by improving cold start performance during cold winter.



<Fuel flow in the fuel filter>

Removal and Installation

1. Disconnect the fuel supply and return hoses.

NOTICE

- **Plug the openings of hoses and fuel filter with sealing caps.**
- **Ensure that the hoses are connected to correct positions.**



2. Loosen the bracket bolts and disconnect the hose from the drain plug.
3. Remove the fuel filter.
4. Install in the reverse order of removal.
5. Press the priming pump until it becomes rigid to deliver the fuel to the transfer line of HP pump.



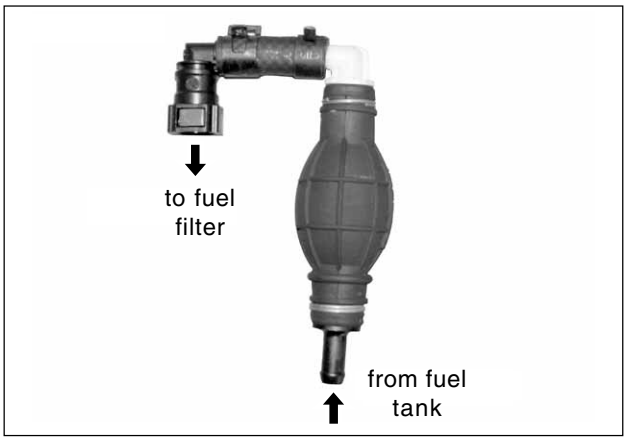
▶ Priming Pump

If fuel runs out during driving or air gets into fuel line after fuel filter replacement, it may cause poor engine starting or damage to each component. Therefore, the hand priming pump is installed to bleed air from transfer line.

When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

Conditions for using Priming Pump

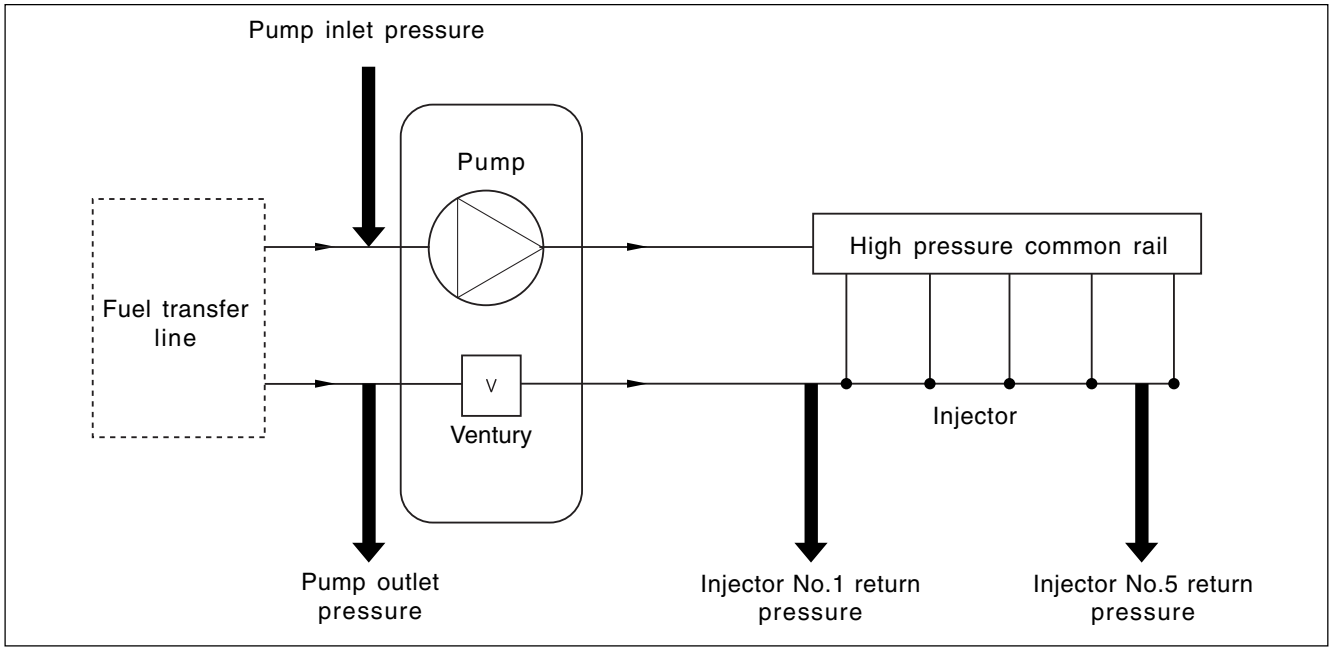
1. After run out of fuel
2. After draining the water from fuel separator
3. After replacing the fuel filter



NOTICE

- **When the fuel filter is replaced, the fuel in the fuel tank should be transferred to the filter by using priming pump. So never transfer the fuel in the fuel tank to the filter by driving HP pump with cranking the engine.**

▶ Relations Between Pressure and Temperature in Fuel Transfer Line



1. The fuel transfer line is the line between fuel tank and HP pump inlet port. The pressure on this line affects the lifetime of fuel filter.
2. Temperature of fuel transfer line
   1) Pump inlet temperature is less than 80°C.
   2) Above figure shows the temperature changes in each section caused by temperature changes in pump inlet section; the temperature of fuel pump inlet is up to 80°C.
   And, diesel fuel has lubrication effects due to its viscosity. Thus, the fuel is also used for pump lubrication. However, this lubrication performance drops as the temperature rises. Accordingly, when the fuel temperature is over 50°C, 100% of fuel is returned to fuel tank to cool down the temperature and then increase the lubrication effects of fuel and prevent heat damage on each section of high fuel pressure line.

▶ High Pressure Accumulator (Common Rail)



Description

The high pressure accumulator reserves the high pressure fuel. Simultaneously, the pressure changes due to the delivery from HP pump and the fuel injection is diminished by rail volume. This high pressure accumulator is commonly used in all cylinders. Even when a large amount of fuel leaks, the common rail maintains its internal pressure. This ensures that the injection pressure can be maintained from when the injector opens.

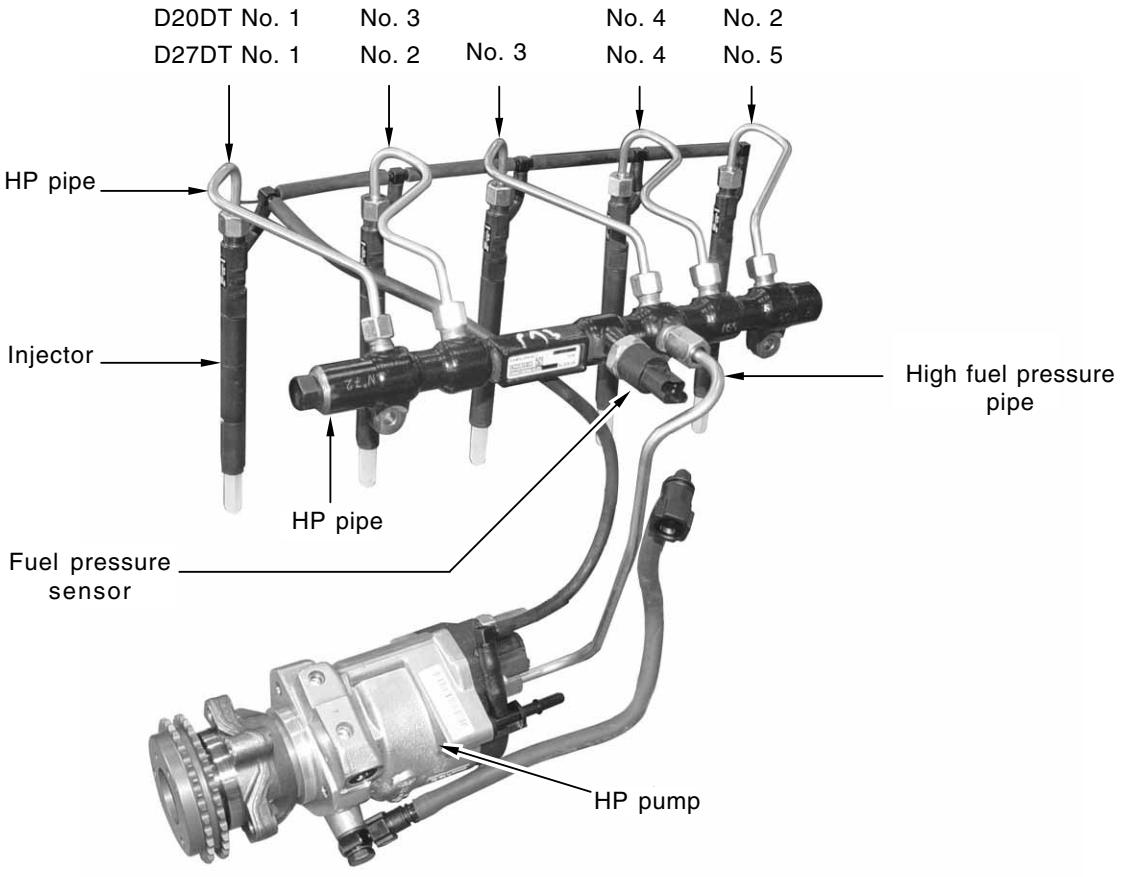
Function

1. Relieve the pressure pulsation
2. Provide pressure information to ECU (fuel pressure sensor)

Specifications

1. Material: Forged Steel
2. Dimension:
   - Volume: 19.5 ± 1cc
   - Length: Max. 345.11 mm
   - Outer diameter: 27 mm
3. Fuel pressure sensor Integrated type
   1) Sensor input voltage: 5 ± 0.1V
   2) Sensor output signal voltage:
      - 4.055 ± 0.125 V ≅ 1600 ± 15 bar
      - 0.5 ± 0.04 V ≅ 0 bar
4. Operating pressure range
   1) Normal condition: 0 ~ 1800 bar
   2) Exceptional condition: available within 1800 ~ 2100 bar
   3) Bursting pressure: over 2500 bar
5. Ambient temperature:
   1) available within -40°C ~ 125°C
   2) Spontaneous max. temperature after engine stops: 140°C (acceptable against total 15 hours)
6. Fluid temperature: -40 ~ 100°C under normal operating conditions
7. Removal and installation: 10 times without any damage

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EFFECTIVE DATE	
AFFECTED VIN	



<High Pressure Accumulator>

▶ High Fuel Pressure Pipe

1. Function: Resistant to pressure changes, tightness against surroundings, supplying fuel through pump, rail and injector with high pressure
2. Material: Steel (Zn Plated)
3. Common: Cylinder 1, 2, 3, 4
4. Internal pressure
   1) Internal operating pressure: 0 ~ 1600 bar during its lifetime
   2) Spontaneous max. pressure when restoring: 2100 bar (max. total period: 20 hours)
   3) Bursting pressure: over 2500 bar
5. To keep cleanness and tightness, the high pressure pipe assembly should be used only once.

NOTICE

- **Make sure to replace the removed high fuel pressure pipes.**
- **Tighten the fasteners with the specified tightening torque.**

Removal and Installation

※ **Preceding Work:** Removal of engine cover

1. Disconnect the fuel pressure sensor connector.



NOTICE
- **Replace the fuel pipes with new ones.**
- **Plug the openings of hole in the common rail with sealing caps.**

2. Unscrew the nuts and remove the fuel supply main pipe from the fuel line.



Installation Notice

Tightening torque	40 ± 1.0 Nm

NOTICE
- **Replace the fuel pipes with new ones.**
- **Plug the openings of hole in the common rail with sealing caps.**

3. Unscrew the high fuel pressure line nuts and remove the fuel pipes.

Installation Notice

Tightening torque	40 ± 1.0 Nm

NOTICE
- **Replace the fuel pipes with new ones.**
- **Plug the openings of hole in the common rail with sealing caps.**

4. Unscrew the bolts and remove the common rail asssembly.



Installation Notice

Tightening torque	25 ± 2.5 Nm

NOTICE
- **Replace the fuel pipes with new ones.**
- **Plug the openings of hole in the common rail with sealing caps.**

5. Install in the reverse order of removal.

▶ Fuel Pressure Sensor

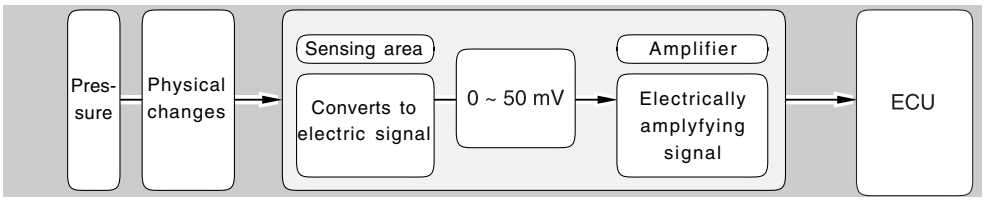


Fuel pressure sensor on the center of common rail detects instant fuel pressure changes and then sends to ECU. When received these signals, ECU uses them to control fuel volume and injection time.

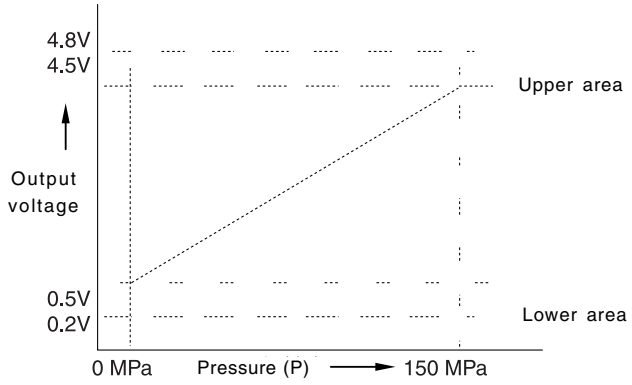
The fuel in the rail reaches to sensor diaphragm via blind hole in the pressure sensor and the pressure signal converts to electrical signal. The signal measured by sensor will be amplified to input to ECU.

This piezo element type sensor changes pressure into electrical signal. Accordingly, when the shape of diaphragm changes, electrical resistance in the layers on the diaphragm changes then can measure 0.5 ~ 5 V.

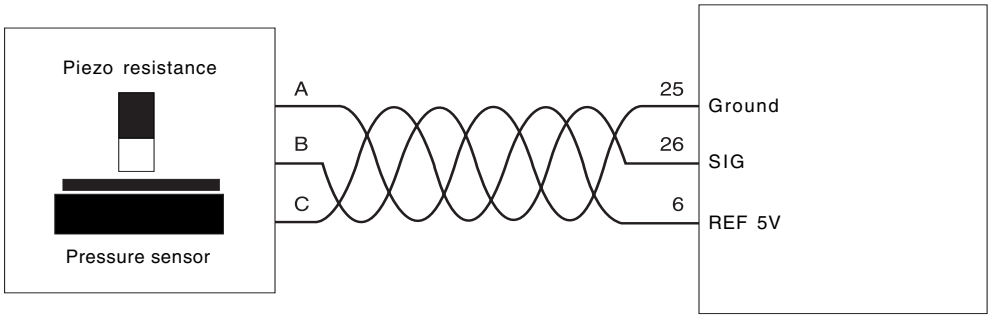
1. Sensor input voltage: 5 ± 0.1 V
2. Output signal voltage of sensor
   1) 4.055 ± 0.125 V: 1600 ± 15 bar
   2) 0.5 ± 0.04 V: 0 bar



<Operation Principle of Fuel Pressure Sensor>



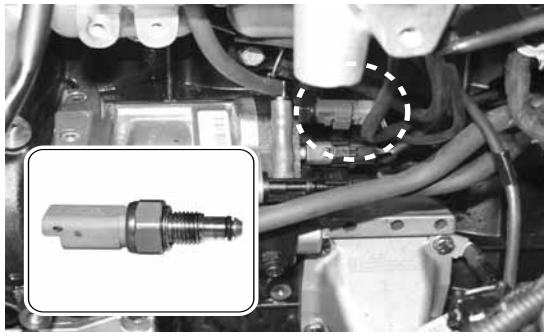
<Sensor Voltage>



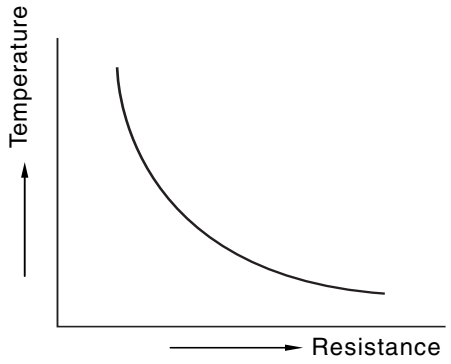
<Circuit Diagram of Fuel Pressuer Sensor>

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Fuel Temperature Sensor



<Fuel Temperature Sensor>

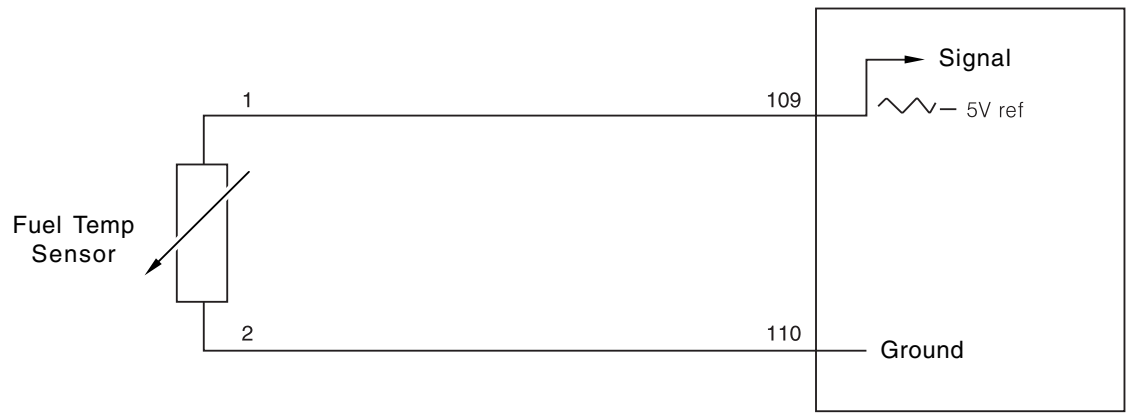


<Output Characteristics of Fuel Temperature Sensor>

Fuel temperature sensor is a NTC resistor that sends fuel temperature to ECU.

In case of NTC resistor, the resistance lowers if engine temperature rises so the ECU detects lowering signal voltages.

Fuel temperature sensor is installed on the fuel return line to correct pressure after measuring fuel temperature. 5V is supplied to the sensor and voltage drop by temperature is delivered to ECU to measure the fuel temperature through analog-digital converter (ADC).



<Circuit Diagram of Fuel Temperature Sensor>

▶ HFM Sensor

Refer to “Intake System”

▶ Crankshaft Position Sensor

Refer to “Engine Assembly”

▶ Knock Sensor

Refer to “Engine Assembly”

▶ Camshaft Position Sensor

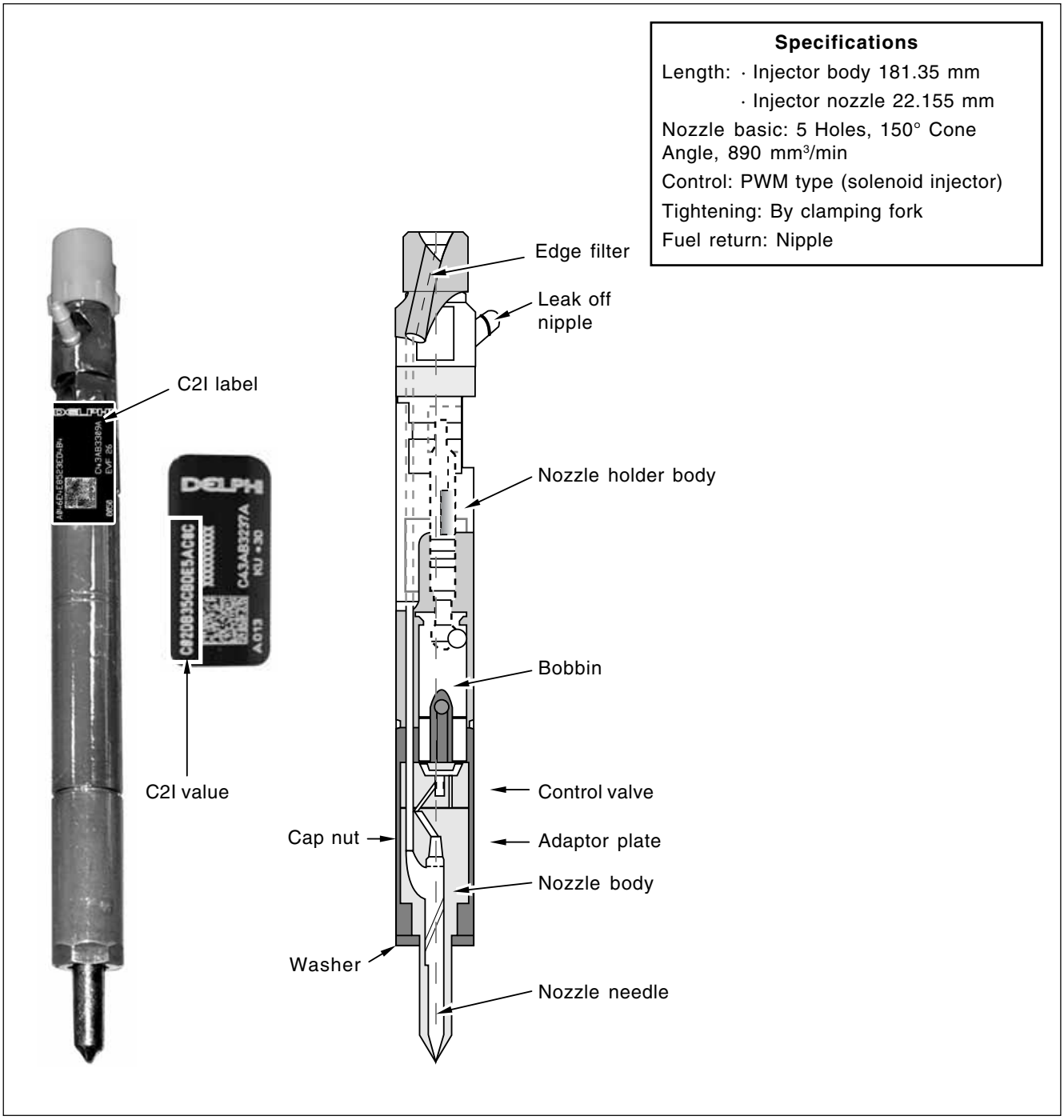
Refer to “Engine Assembly”

INJECTOR

The C21 labels including injector characteristics are attached in each injector. These C21 values should be input to ECU by using Scan-i when replacing the ECU or injectors.

Special cautions:

1. Plug the openings of hoses and pipes with the sealing caps.
2. Replace the copper washer in injector with new one.
3. Tighten the injector holder bolts with the specified tightening torque.
4. Be careful not to drop the injector.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

The maximum injection pressures are approximately 1,600 bar. The forces to be overcome in order to lift the needle of the injector are therefore very large. Because of this, it is impossible to directly control the injector by using an electromagnetic actuator, unless very high currents are used, which would be incompatible with the reaction times required for the multiple injections. The injector is therefore indirectly controlled by means of a valve controlling the pressurizing or discharging of the control chamber located above the needle:

1. When the needle is required to lift (at the start of injection): the valve is opened in order to discharge the control chamber into the back leak circuit.
2. When the needle has to close (at the end of injection): the valve closes again so that pressure is re-established in the control chamber.

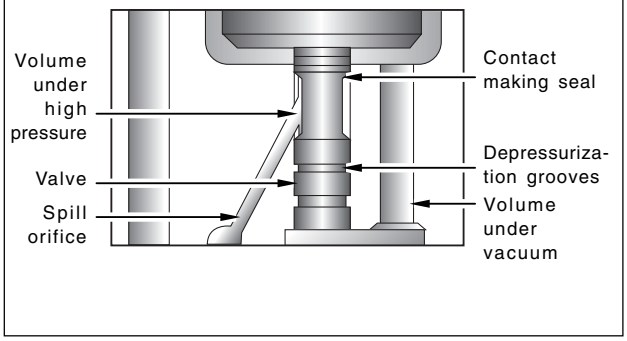
Valve

In order to guarantee response time and minimum energy consumption:

1. The valve must be as light as possible.
2. The valve stroke must be as short as possible.
3. The effort needed to move the valve must be minimal, which means that the valve must be in hydraulic equilibrium in the closed position.

Spring pressure ensures contact between the valve and its seat. To lift the valve, it is therefore required to overcome the force being applied by this spring.

Valve

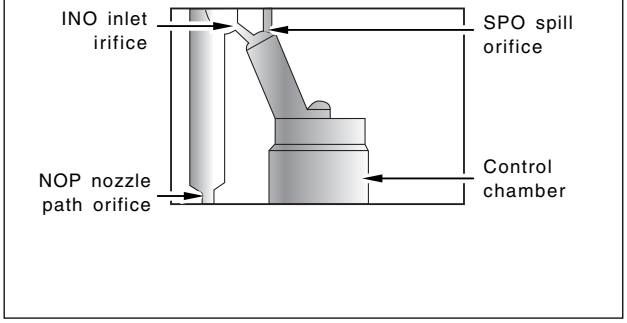


Spacer

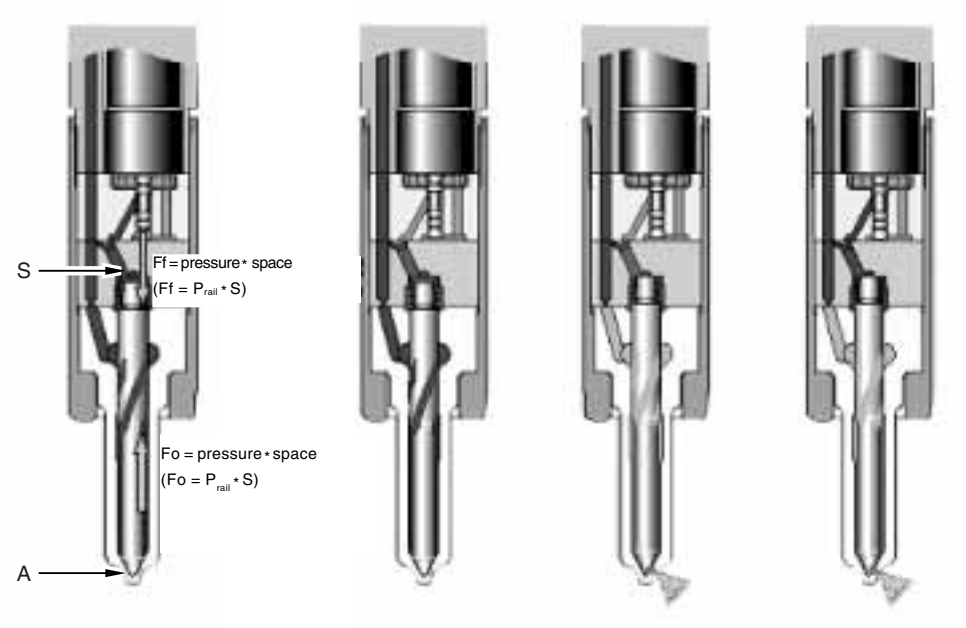
The spacer is situated underneath the valve support. It integrates the control chamber and the three calibrated orifice which allow operation of the injector. These orifices are:

1. The injector supply orifice (Nozzle Path Orifice: NPO)
2. The control chamber discharge orifice (Spill Orifice: SPO)
3. The control chamber filling orifice (Inlet Orifice: INO)

Spacer



▶ Principle of Operation



Valve closed	Valve opens	Valve closes	Valve closed
Needle closed	Needle closed	Needle open	Needle closed
No injection	No injection	End of injection	No injection

Injector at rest

The valve is closed. The control chamber is subject to the rail pressure.

The pressure force applied by the fuel onto the needle is:

$$Ff = S * P_{rail}$$

The needle is closed and hence there is no fluid circulation through the NPO orifice. While static, the nozzle produces no pressure drop. The cone of the needle is therefore subject to the rail pressure. The force applied by the fuel to the needle is:

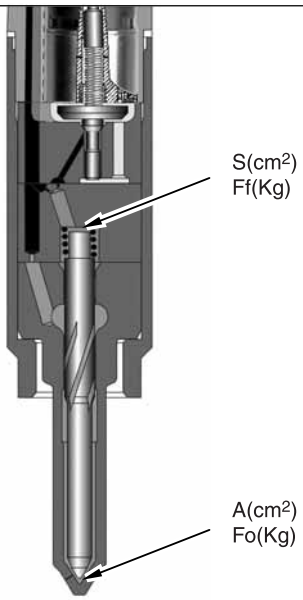
$$Fo = A * P_{rail}$$

Since Ff > Fo, the needle is held in the closed position. There is no injection.

Solenoid valve control

When the solenoid valve is energized, the valve opens. The fuel contained in the control chamber is expelled through the discharge orifice known as the Spill Orifice (SPO).

As soon as Ff > Fo, the needle remains held against its seat and there is no injection.



* S: The area of the flat upper surface of the injector's needle
* A: The area of the needle surface situated above the section of contact between the needle and its seat
* Ff: The force applied by the fuel onto section "S"
* Fo: The force applied by the fuel onto section "A"

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Start of injection

As soon as Ff < Fo, or in other words:

$$P_{control} < P_{rail} * A/S$$

The needle lifts and injection begins. As long as the valve is open, the injector's needle remains lifted. When injection begins, fuel circulation is established to feed the injector. The passage of the fuel through the inlet orifice of the injector (similar to a nozzle) leads to a pressure drop which depends on the rail pressure.

When the rail pressure is at its highest (1600 bar), this pressure drop exceeds 100 bar. The pressure applied to the cone of the needle (the injection pressure) is therefore lower than the rail pressure.

End of injection

As soon as the solenoid valve is de-energized, the valve closes and the control chamber is filled. Since the needle is open, the thrust section areas situated on either side of the needle is therefore to apply different pressures to each of these faces. The pressure in the control chamber cannot exceed the rail pressure, so it is therefore necessary to limit the pressure applied to the needle's cone. This pressure limitation is achieved by the NPO orifice which produces a pressure drop when fuel is passing through it.

$$Prail * S \geq (Prail - \triangle P) * S$$

When static, this pressure drop is zero. When the pressure in the control chamber becomes higher than the pressure applied to the needle's cone, the injection stops.

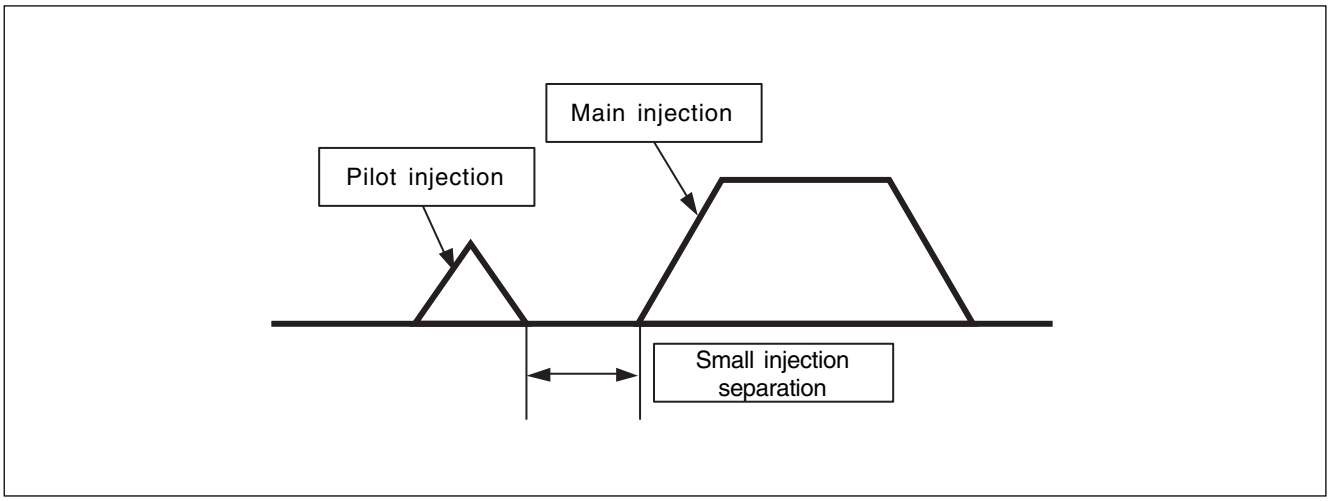
▶ Fuel Pressure

Fuel pressure

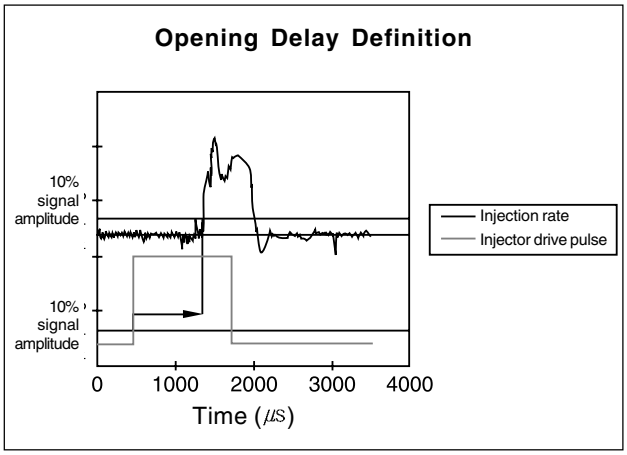
1. Minimum operating pressure: start injection over 100 bar
2. Maximum operating pressure: 1,600 bar (max. operating pressure in normal conditions)
3. Operating pressure limit: 2,100 bar

Maximum fuel volume at each injector cycle

1. Pilot Injection ≤ 5 mm^3
2. Main Injection ≤ 85 mm^3 (within 200 ~ 1,600 bar)

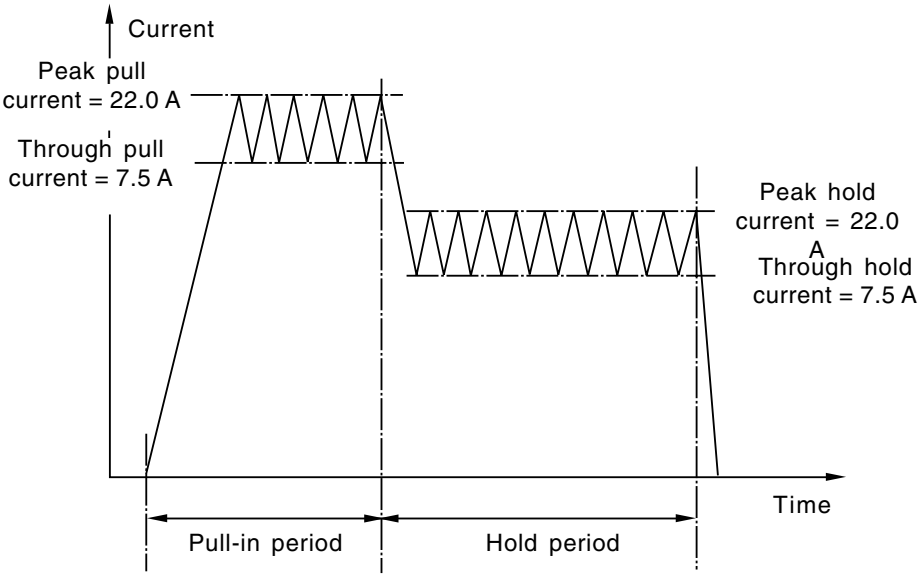


3. Small injection separation: min. 200㎲
   (duration between the end of pilot injection and start of main injection)
4. Opening Delay
   : Delayed time from applying operating voltage to start of injection
5. Adjustment of feedback injection volume: C2I



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Injector Control



The control current of the coil takes the following form:

1. The low current allows the Joule effect losses in the ECU and injector to be reduced. The call current is higher than the hold current because during the hold phase.
2. The air gap between the valve and the coil is reduced and the electromagnetic force to be applied to the valve can thus be reduced. It is no longer necessary to overcome the valve inertia.

NOTE

- **Joule Effect: Heat capacity (H) = 0.24 I^2RT**

▶ Fuel Injection

Other than conventional diesel engine, common diesel engine use two steps injection as follows:

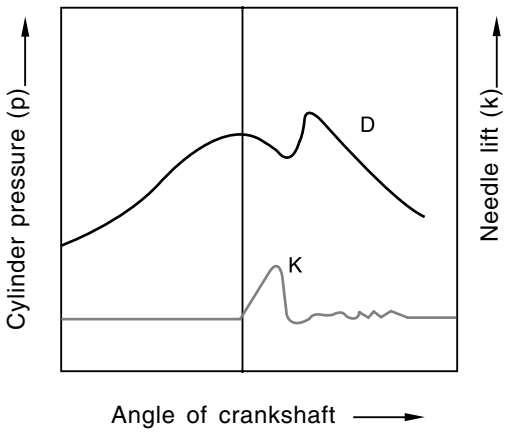
1. Pilot Injection
2. Main Injection

In above two step injection, the fuel injection volume and injection timing is calibrated according to fuel pressure and fuel temperature.

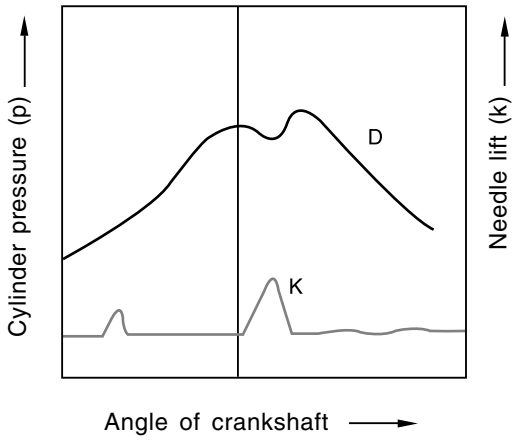
Pilot injection

Before starting main injection, a small amount of fuel is injected to help proper combustion. This injection is for reducing the engine noise and vibration.

In other words, it makes the pressure increase in combustion chamber during combustion smooth to reduce the engine noise and vibration (suppressing the surging). Basic values for pilot injection are adjusted according to the coolant temperature and intake air pressure.



<Characteristic Curve of Discharge without Pilot Injection>

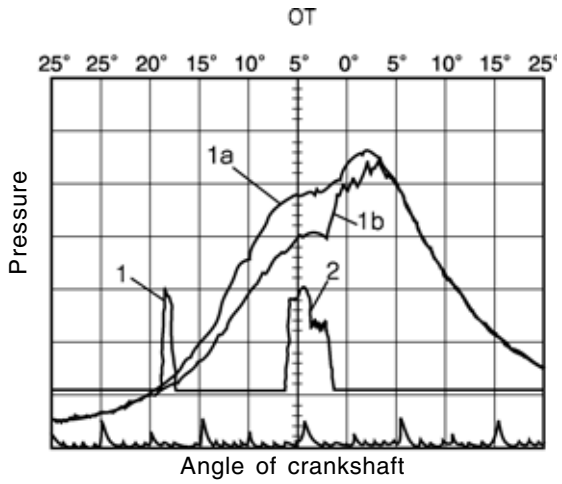


<Characteristic Curve of Discharge with Pilot Injection>

Main injection

Actual output from engine is achieved by main injection.

The main injection determines the pilot injection has been occurred, then calculates the injection volume. Accelerator pedal sensor, engine rpm, coolant temperature, intake air temperature and atmospheric pressure are basic date to calculate the fuel injection volume in main injection.



1. Pilot injection
2. Main injection

1a. Ignition pressure with pilot injection

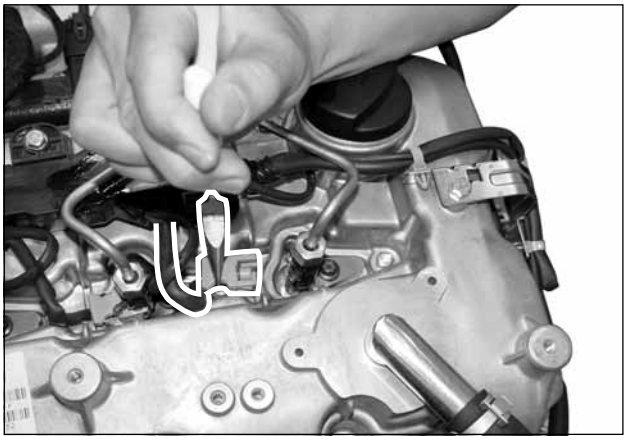
2a. Ignition pressure without pilot injection

<Characteristic Curve of Combustion Chamber Pressure During Pilot Injection>

Removal and Installation

※ **Preceding Work:** Removal of engine cover

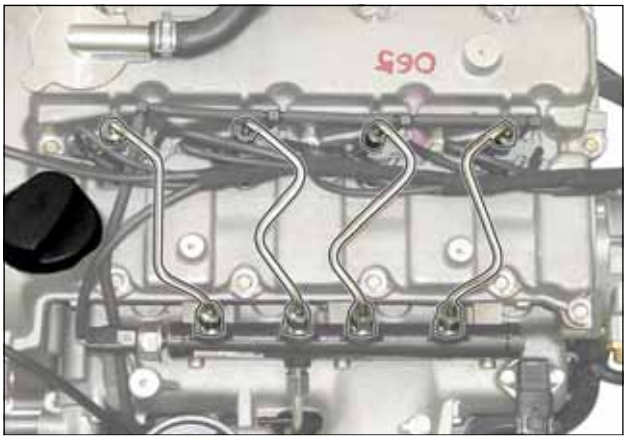
1. Disconnect the injector return hose.



NOTICE
- **Plug the openings with sealing caps.**

2. Remove the relevant connector for the injector.

3. Unscrew the bolts and remove the fuel pipes.

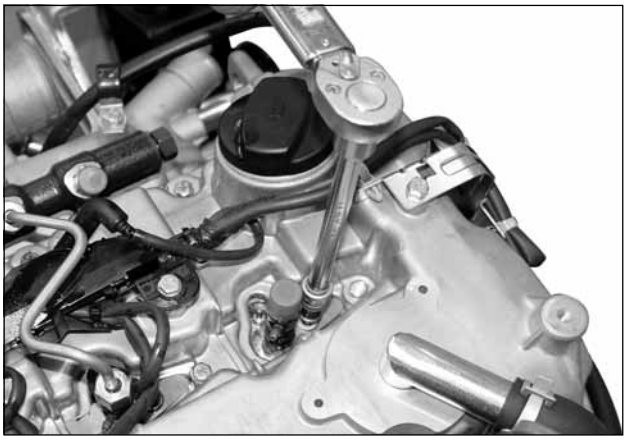


Installation Notice

Tightening torque	40 ± 4 Nm

NOTICE
- **Replace the fuel pipes with new ones.**
- **Plug the openings of the common rail with sealing caps.**

4. Unscrew the injector holder bolts.



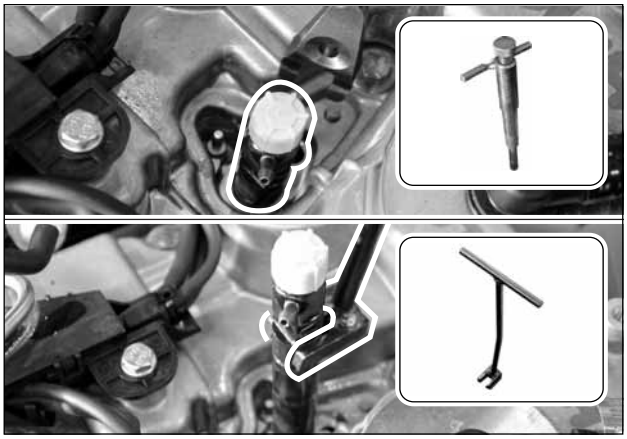
Installation Notice

Tightening torque	9 ± 1.0 Nm
	190° + 10°

Replace the bolts with new ones.

5. Disconnect the injector holder.

6. Remove the injectors with a special tool.

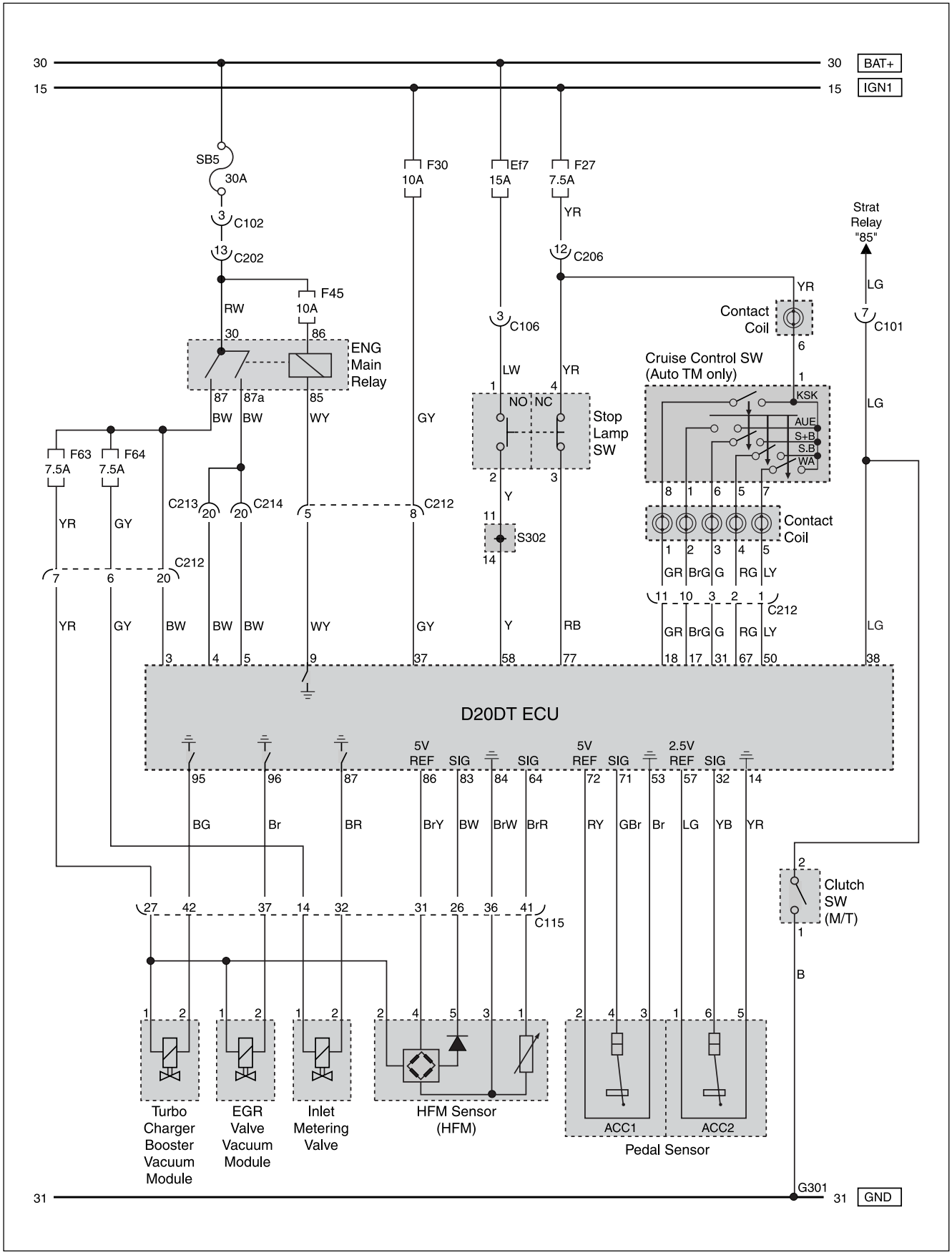


NOTICE
- **Plug the openings of the injectors with sealing caps.**
- **Pull the dropped washer out from the engine with a special tool.**

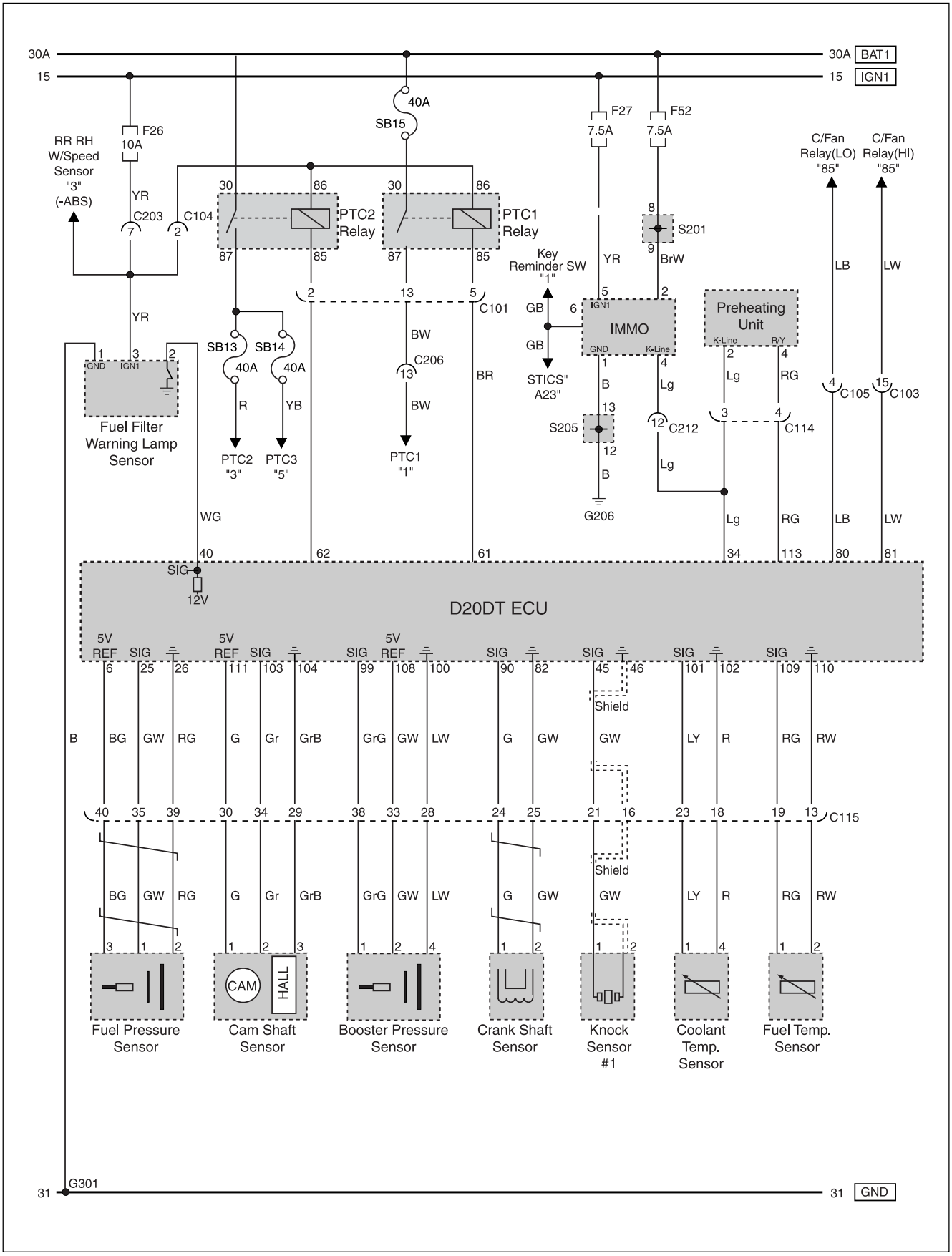
7. Install in the reverse order of removal.

NOTICE
- **Replace the copper washer, holder bolts and fuel supply pipes with new ones.**

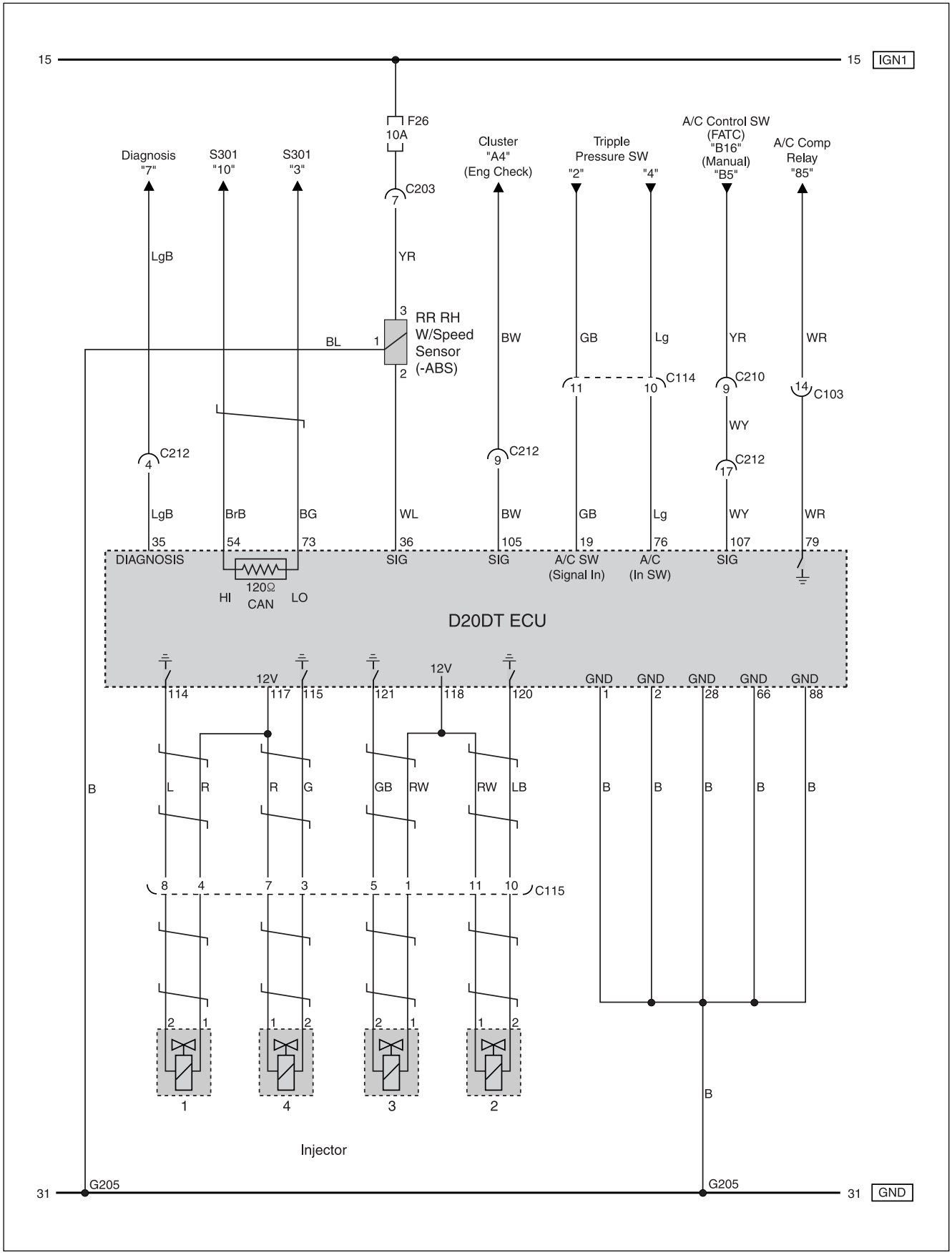
▶ Circuit Diagram



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EFFECTIVE DATE	
AFFECTED VIN	



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ENGINE CONTROL SYSTEM

08

TABLE OF CONTENTS

SENSORS FOR DIAGNOSIS 2

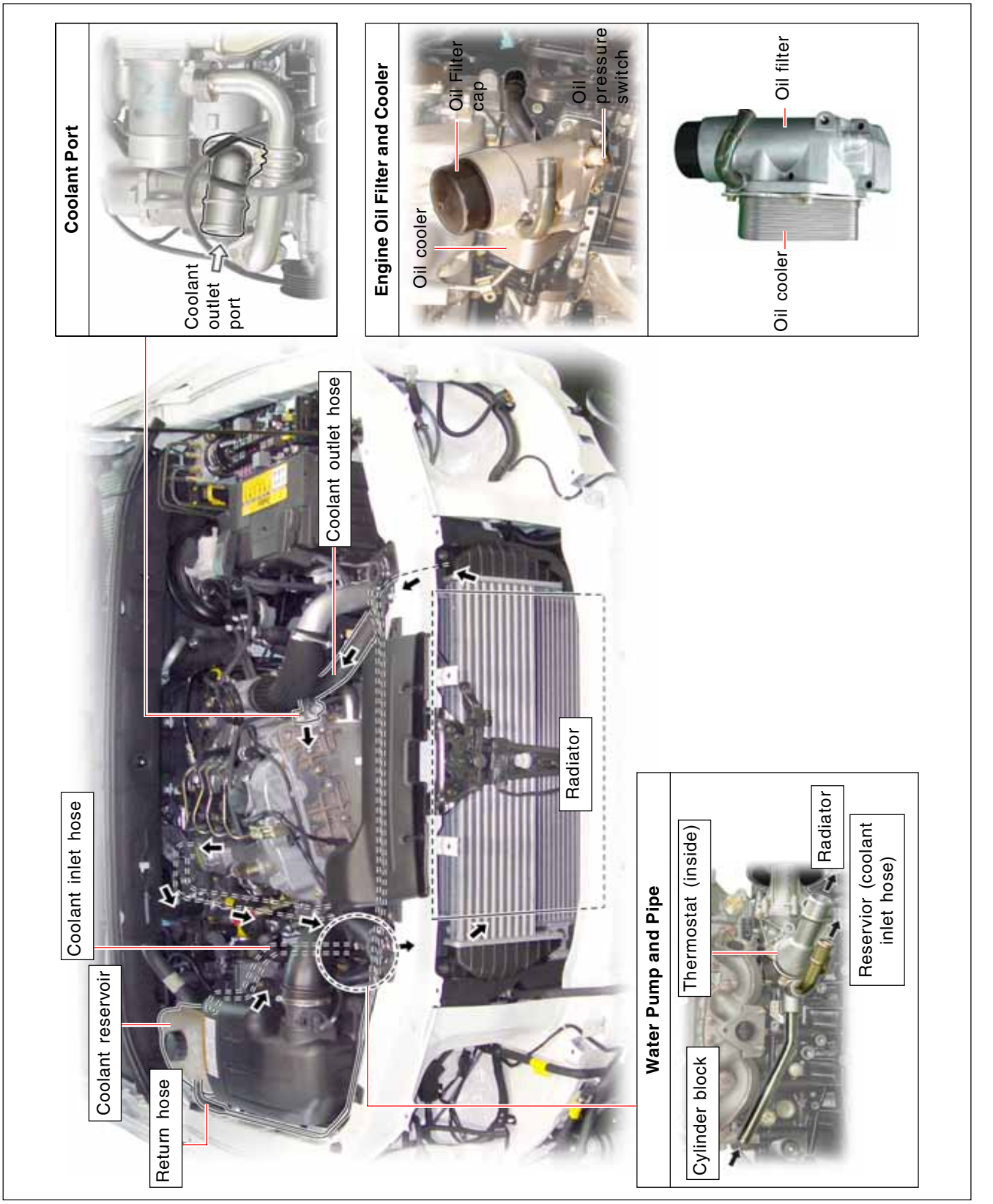
Engineecu and other components 2
Top view 3
Side view 4

ENGINE CONTROL SYSTEM 5

ECU 5
Fuel pressure control 11
Fuel injection control 12
Fuel flow control 13
Individual Injector calibration (C2I) 18
Minimum drive pulse (MDP) learning 20

SENSORS FOR DIAGNOSIS

ENGINE ECU AND OTHER COMPONENTS



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

TOP VIEW

Fuel Pressure Sensor

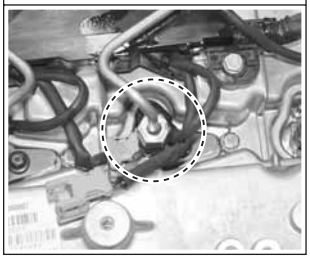


Booster Pressure Sensor

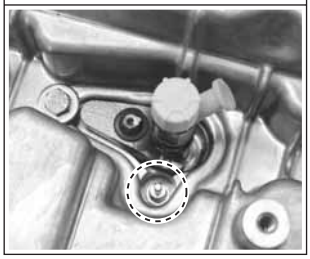




Injectors (4 EA)

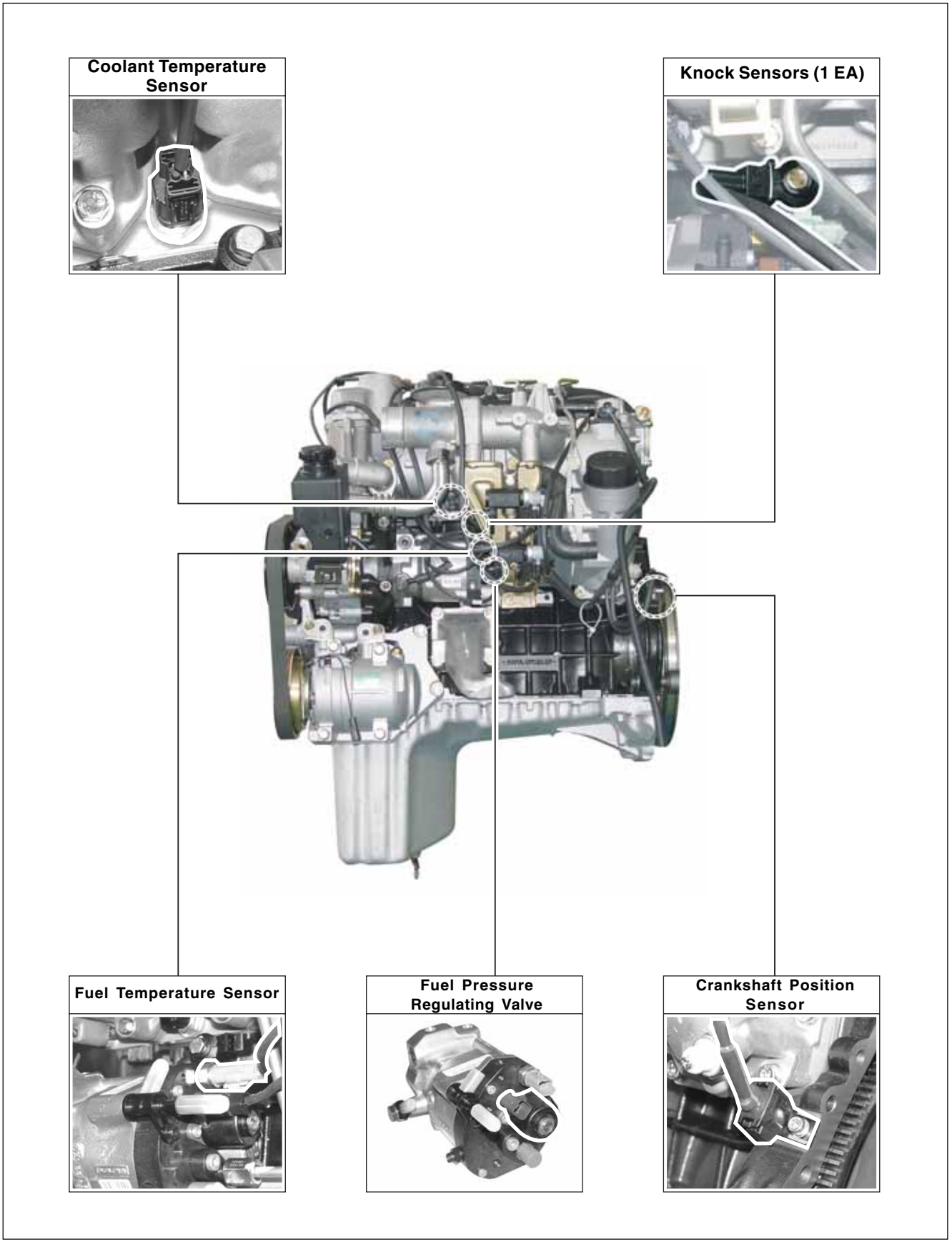


Glow Plugs (4 EA)



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SIDE VIEW



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EFFECTIVE DATE	
AFFECTED VIN	

ENGINE CONTROL SYSTEM

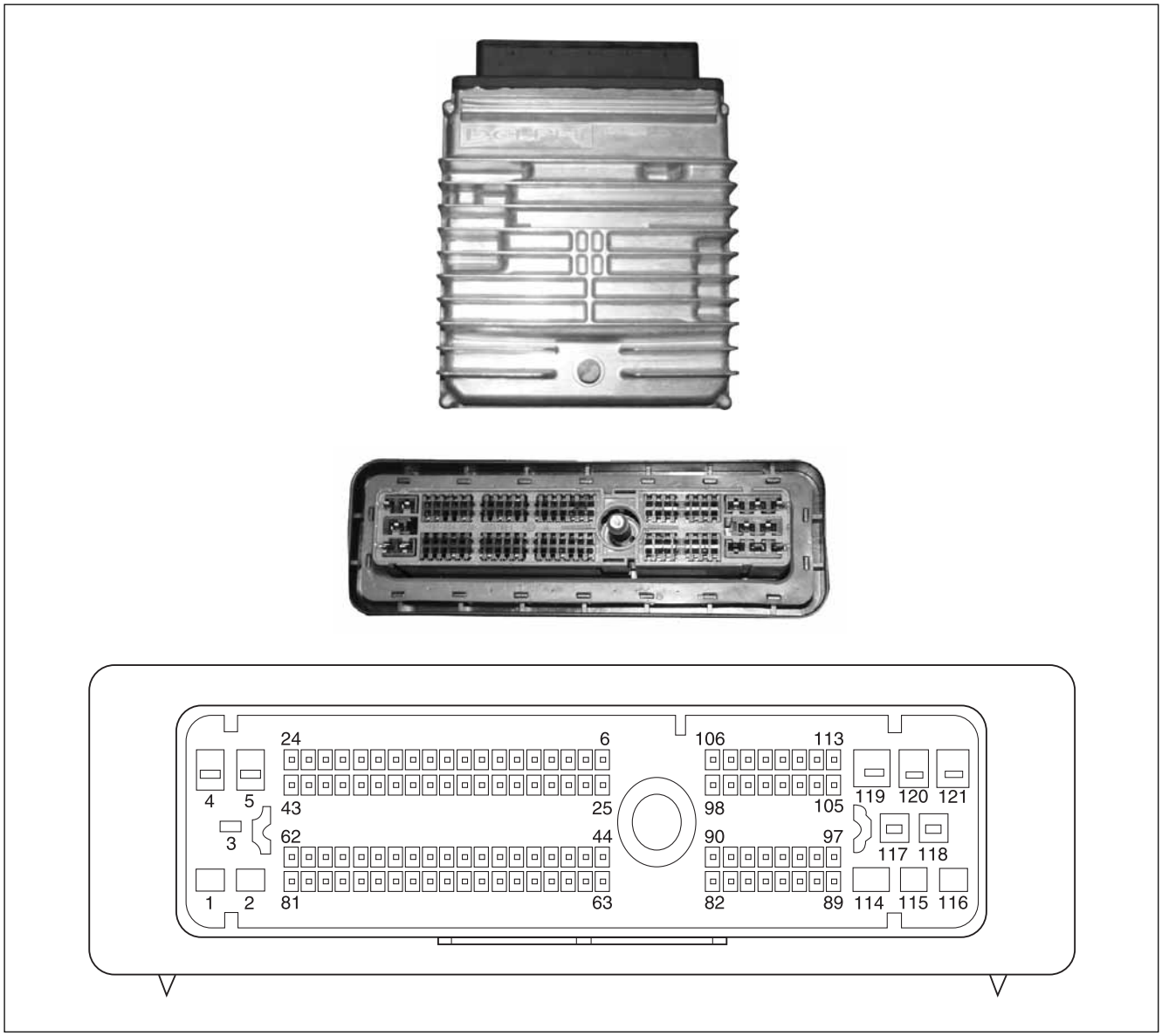
ECU

According to input signals from various sensors, engine ECU calculates driver's demand (position of the accelerator pedal) and then controls overall operating performance of engine and vehicle on that time.

ECU receives signals from sensors through data line and then performs effective engine air-fuel ratio controls based on those signals.

Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's demand) through electrical signal that generated by variable resistance changes in accelerator pedal sensor.

Air flow (hot film) sensor detects intake air volume and then transmits to ECU. Especially, the engine ECU controls the air-fuel ratio by recognizing instant air volume changes through air flow sensor to pursue low emission gases (EGR valve control). Furthermore, the ECU uses signals from coolant temperature and air temperature sensor, booster pressure sensor and atmospheric pressure sensor as compensation signal to respond to injection start and pilot injection set values and to various operations and variables.

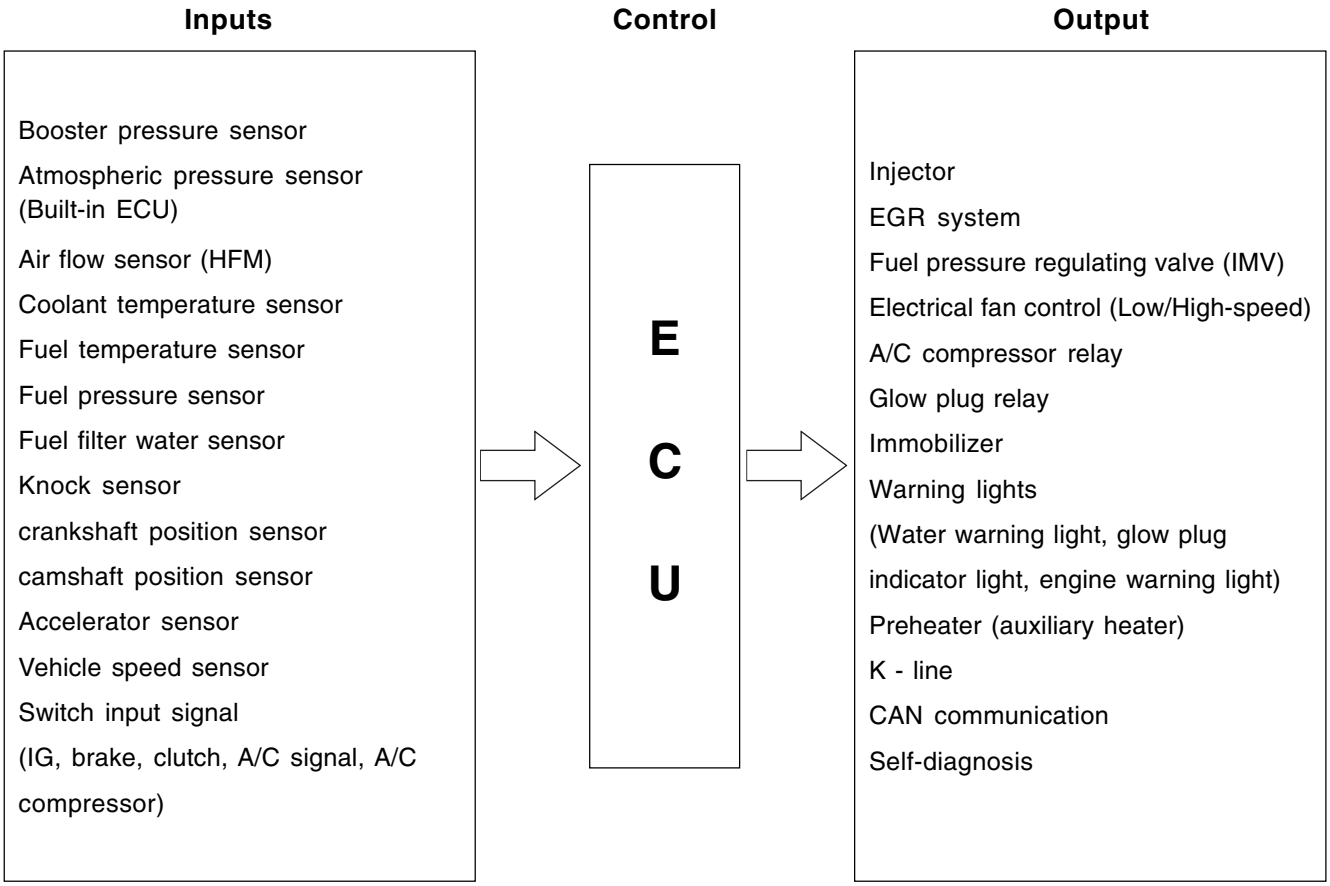


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Pin No.	Description	Pin No.	Description
1	Engine ground	40	Fuel filter water detection sensor
2	Engine ground	41	RPM signal output
3	Main power (IG 1)	42	
4	Main power (IG 1)	43	
5	Main power (IG 1)	44	Knock sensor signal (#2)
6	Rail pressure sensor power supply	45	Knock sensor signal (#1)
7		46	Knock sensor ground (#1)
8		47	
9	ECU power hold relay	48	
10		49	
11		50	Auto cruise result signal
12	ABD signal	51	
13		52	
14	ACC 2 sensor ground	53	ACC 1 sensor ground
15		54	CAN- H1
16		55	
17	Auto cruise OFF	56	
18	Auto cruise safety switch	57	ACC 2 sensor power supply
19	A/C pressure signal	58	Brake lamp switch
20	Fuel filter water detection warning lamp	59	
21	Remote starter output	60	Vehicle speed indication lamp
22	Glow plug control	61	Preheater #1
23	Glow plug warning lamp	62	Preheater #2
24		63	Knock sensor ground (#2)
25	Rail pressure sensor signal	64	HFM sensor (air temperature sensor)
26	Rail pressure sensor ground	65	
27		66	Engine ground
28	Engine ground	67	Auto cruise deceleration signal
29		68	
30		69	
31	Auto cruise acceleration signal	70	
32	ACC 2 sensor signal	71	ACC 1 sensor signal
33		72	ACC 1 sensor power supply
34	K-LINE #1	73	CAN -LO
35	K-LINE #2	74	
36	Vehicle speed sensor signal input	75	
37	IG 1	76	A/C cycling pressure switch
38	Clutch pedal switch	77	Brake pedal switch
39		78	Trip computer

Pin No.	Description	Pin No.	Description
79	A/C relay	101	Coolant temperature signal
80	Cooling fan LOW	102	Coolant temperature sensor ground
81	Cooling fan HIGH	103	Camshaft position sensor signal
82	Crankshaft position sensor (-)	104	Camshaft position sensor ground
83	HFM sensor (air mass sensor)	105	Engine check warning lamp
84	HFM sensor (ground)	106	
85		107	Blower switch
86	HFM sensor (power supply)	108	Booster pressure sensor power supply
87	IMV (fuel pressure regulating valve)	109	Fuel temperature sensor signal
88	Engine ground	110	Fuel temperature sensor ground
89		111	Camshaft position sensor power supply
90	Crankshaft position sensor (+)	112	Immobilizer
91		113	Engine check warning lamp
92		114	Injector #1
93		115	Injector #4
94		116	Injector #3
95	Waste gate actuator	117	Injector ground (#1, 3, 4)
96	EGR valve	118	Injector ground (#2, 5)
97		119	
98		120	Injector #5
99	Booster pressure sensor signal	121	Injector #2
100	Booster pressure sensor ground		

▶ ECU Inputs·Outputs



▶ Structure and Function of ECU

Function of ECU

ECU receives and analyzes signals from various sensors and then modifies those signals into permissible voltage levels and analyzes to control respective actuators.

ECU microprocessor calculates injection period and injection timing proper for engine piston speed and crankshaft angle based on input data and stored specific map to control the engine power and emission gas.

Output signal of the ECU microprocessor drives pressure control valve to control the rail pressure and activates injector solenoid valve to control the fuel injection period and injection timing; so controls various actuators in response to engine changes. Auxiliary function of ECU has adopted to reduce emission gas, improve fuel economy and enhance safety, comforts and conveniences. For example, there are EGR, booster pressure control, autocruise (export only) and immobilizer and adopted CAN communication to exchange data among electrical systems (automatic T/M and brake system) in the vehicle fluently. And Scanner can be used to diagnose vehicle status and defectives.

Operating temperature range of ECU is normally -40 ~ +85°C and protected from factors like oil, water and electro-magnetism and there should be no mechanical shocks.

To control the fuel volume precisely under repeated injections, high current should be applied instantly so there is injector drive circuit in the ECU to generate necessary current during injector drive stages.

Current control circuit divides current applying time (injection time) into full-in-current-phase and hold-current-phase and then the injectors should work very correctly under every working condition.

▶ Control Function of ECU

1. Controls by operating stages

   : To make optimum combustion under every operating stage, ECU should calculate proper injection volume in each stage by considering various factors.

2. Starting injection volume control

   : During initial starting, injecting fuel volume will be calculated by function of temperature and engine cranking speed.

   Starting injection continues from when the ignition switch is turned to ignition position to till the engine reaches to allowable minimum speed.

3. Driving mode control

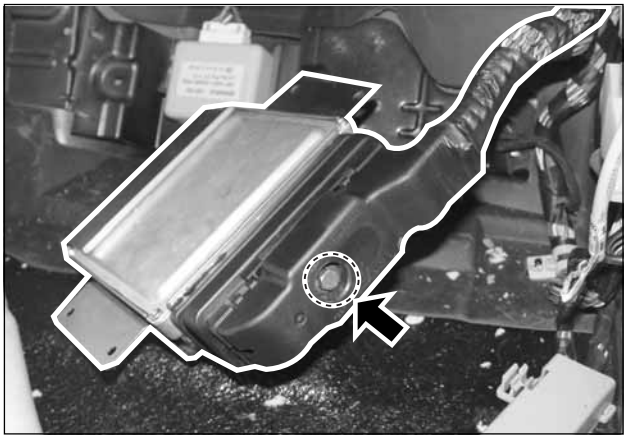
   : If the vehicle runs normally, fuel injection volume will be calculated by accelerator pedal travel and engine rpm and the drive map will be used to match the drivers inputs with optimum engine power.

ECU - Removal and Installation

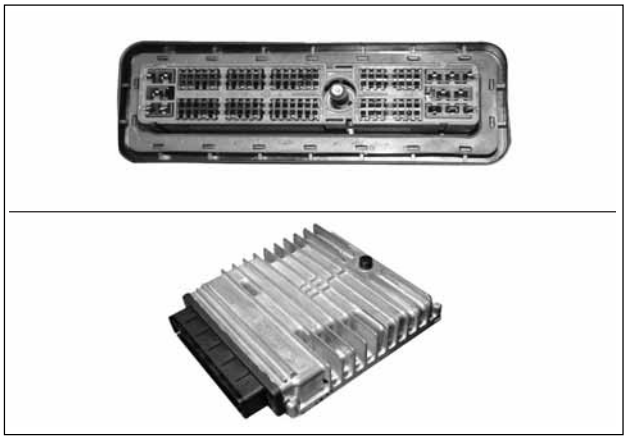
1. Flip up the front passenger's seat and remove the ECU cover nuts.
2. Remove the ECU bracket nuts.



3. Unscrew the ECU connect bolt and remove the ECU assembly.



4. Install in the reverse order of removal.
5. Backup the below data with Scan-i when replacing the ECU.
   1) Current ECU data
   2) Vehicle Identification Number (VIN)
   3) Variant coding data
   4) Then, input the data into new ECU. For immobilizer equipped vehicle, additional coding operation is necessary.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

FUEL PRESSURE CONTROL

▶ Fuel Pressure Control Elements

Pressure control consists of 2 principle modules.

1. Determines rail pressure according to engine operating conditions.
2. Controls IMV to make the rail pressure to reach to the required value.

Pressure in the fuel rail is determined according to engine speed and load on the engine. The aim is to adapt the injection pressure to the engine's requirements.

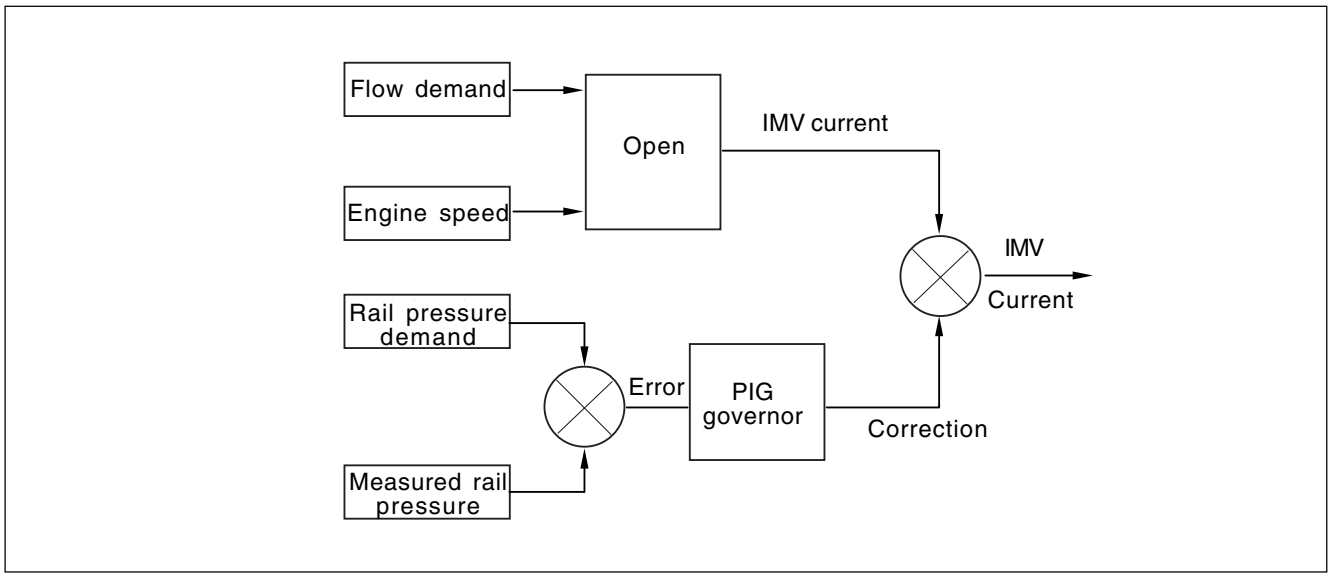
1. When engine speed and load are high
   : The degree of turbulence is very great and the fuel can be injected at very high pressure in order to optimize combustion.
2. When engine speed and load are low
   : The degree of turbulence is low. If injection pressure is too high, the nozzle's penetration will be excessive and part of the fuel will be sprayed directly onto the sides of the cylinder, causing incomplete combustion. So there occurs smoke and damages engine durability.

Fuel pressure is corrected according to air temperature, coolant temperature and atmospheric pressure and to take account of the added ignition time caused by cold running or by high altitude driving. A special pressure demand is necessary in order to obtain the additional flow required during starts. This demand is determined according to injected fuel and coolant temperature.

▶ Fuel Pressure Control

Rail pressure is controlled by closed loop regulation of IMV. A mapping system – open loop – determines the current which needs to be sent to the actuator in order to obtain the flow demanded by the ECU. The closed loop will correct the current value depending on the difference between the pressure demand and the pressure measured.

1. If the pressure is lower than the demand, current is reduced so that the fuel sent to the high pressure pump is increased.
2. If the pressure is higher than the demand, current is increased so that the fuel sent to the high pressure pump is reduced.



FUEL INJECTION CONTROL

▶ Fuel Injection Control

Injection control is used in order to determine the characteristics of the pulse which is sent to the injectors.
Injection control consists as below.

1. Injection timing
2. Injection volume
3. Translating fuel injection timing and injection volume into values which can be interpreted by the injector driver.
   1) a reference tooth (CTP)
   2) the delay between this tooth and the start of the pulse (Toff)
   3) the pulse time (Ton)

Main injection timing control

The pulse necessary for the main injection is determined as a function of the engine speed and of the injected flow.
The elements are;

1. A first correction is made according to the air and coolant temperatures.

   This correction makes it possible to adapt the timing to the operating temperature of the engine. When the engine is warm, the timing can be retarded to reduce the combustion temperature and polluting emissions (NOx). When the engine is cold, the timing advance must be sufficient to allow the combustion to begin correctly.
2. A second correction is made according to the atmospheric pressure.

   This correction is used to adapt the timing advance as a function of the atmospheric pressure and therefore the altitude.
3. A third correction is made according to the coolant temperature and the time which has passed since starting.

   This correction allows the injection timing advance to be increased while the engine is warming up (initial 30 seconds). The purpose of this correction is to reduce the misfiring and instabilities which are liable to occur after a cold start.
4. A fourth correction is made according to the pressure error.

   This correction is used to reduce the injection timing advance when the pressure in the rail is higher than the pressure demand.
5. A fifth correction is made according to the rate of EGR.

   This correction is used to correct the injection timing advance as a function of the rate of exhaust gas recirculation. When the EGR rate increases, the injection timing advance must in fact be increased in order to compensate for the fall in termperature in the cylinder.

During starting, the injection timing must be retarded in order to position the start of combustion close to the TDC. To do this, special mapping is used to determine the injection timing advance as a function of the engine speed and of the water temperature. This requirement only concerns the starting phase, since once the engine has started the system must re-use the mapping and the corrections described previously.

Pilot injection timing control

The pilot injection timing is determined as a function of the engine speed and of the total flow.
The elements are;

1. A first correction is made according to the air and coolant temperatures.

   This correction allows the pilot injection timing to be adapted to the operating temperature of the engine.
2. A second correction is made according to the atmospheric pressure.

   This correction is used to adapt the pilot injection timing as a function of the atmospheric pressure and therefore the altitude.

During the starting phase, the pilot injection timing is determined as a function of the engine speed and of the coolant temperature.

FUEL FLOW CONTROL

▶ Main Flow Control

The main flow represents the amount of fuel injected into the cylinder during the main injection. The pilot flow represents the amount of fuel injected during the pilot injection.

The total fuel injected during 1 cycle (main flow + pilot flow) is determined in the following manner.

: The driver's demand is compared with the value of the minimum flow determined by the idle speed controller.

1. When the driver depress the pedal, it is his demand which is taken into account by the system in order to determine the fuel injected.
2. When the driver release the pedal, the idle speed controller takes over to determine the minimum fuel which must be injected into the cylinder to prevent the enigne from stalling.

It is therefore the greater of these 2 values which is retained by the system. This value is then compared with the lower flow limit determined by the ASR trajectory control system. As soon as the injected fuel becomes lower than the flow limit determined by the ASR trajectory control system, the antagonistic torque (engine brake) transmitted to the drive wheels exceeds the adherence capacity of the vehicle and there is therefore a risk of the drive wheels locking. The system thus chooses the greater of these 2 values (main flow & pilot flow) in order to prevent any loss of control of the vehicle during a sharp deceleration.

This value is then compared with the flow limit determined by the cruise control. As soon as the injected fuel becomes lower than the flow limit determined by the cruise control, the vehicle's speed falls below the value required by the driver. The system therefore chooses the greater of these 2 values in order to maintain the speed at the required level.

This valve is then compared with the flow limit determined by the flow limitation strategy. This strategy allows the flow to be limited as a function of the operating conditions of the engine. The system therefore chooses the smaller of these 2 values in order to protect the engine. This value is then compared with the fuel limit determined by the ASR trajectory control system.

As soon as the injected fuel becomes higher than the fuel limit determined by the ASR trajectory control system, the engine torque transmitted to the wheels exceeds the adhesion capacity of the vehicle and there is a risk of the drive wheels skidding. The system therefore chooses the smaller of the two values in order to avoid any loss of control of the vehicle during accelerations.

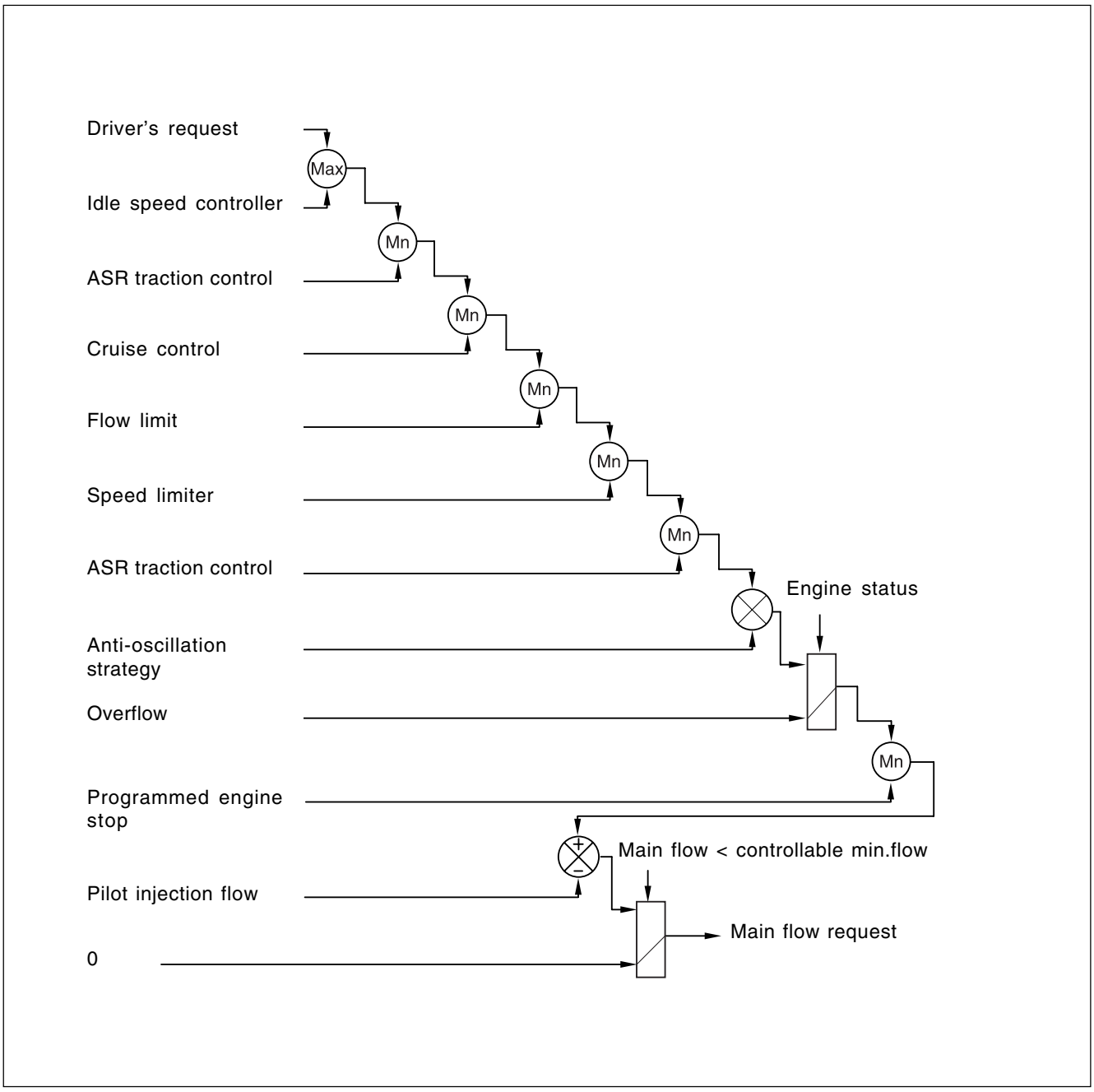
The anti-oscillation strategy makes it possible to compensate for fluctuations in engine speed during transient conditions. This strategy leads to a fuel correction which is added to the total fuel of each cylinder. The correction is determined before each injection as a function of the instantaneous engine speed.

A switch makes it possible to change over from the supercharge fuel to the total fuel according to the state of the engine.

1. Until the stating phase has finished, the system uses the supercharged fuel.
2. Once the engine changes to normal operation, the system uses the total fuel.

The main fuel is obtained by subtracting the pilot injection fuel from the total fuel.

A mapping determines the minimum fuel which can control an injector as a function of the rail pressure. As soon as the main fuel falls below this value, the fuel demand changes to 0 because in any case the injector is not capable of injecting the quantity demand.



▶ Driver Demand

The driver demand is the translation of the pedal position into the fuel demand. It is calculated as a function of the pedal position and of the engine speed. The driver demand is filtered in order to limit the hesitations caused by rapid changes of the pedal position. A mapping determines the maximum fuel which can be injected as a function of the driver demand and the rail pressure. Since the flow is proportional to the injection time and to the square root of the injection pressure, it is necessary to limit the flow according to the pressure in order to avoid extending the injection for too long into the engine cycle. The system compares the driver demand with this limit and chooses the smaller of the 2 values. The driver demand is then corrected according to the coolant temperature. This correction is added to the driver demand.

▶ Idle Speed Controller

The idle speed controller consists of 2 principal modules:

1. The first module determines the required idle speed according to:
   1) The operating conditions of the engine (coolant temperature, gear engaged)
   2) Any activation of the electrical consumers (power steering, air conditioning, others)
   3) The battery voltage
   4) The presence of any faults liable to interface with the rail pressure control or the injection control. In this case, the accelerated idle speed is activated to prevent the engine from stalling when operating in degraded mode.
   5) It is possible to increase or to reduce the required idle speed with the aid of the diagnostic tool.
2. The second module is responsible for providing closed loop control of the engine's idle speed by adapting the minimum fuel according to the difference between the required idle speed and the engine speed.

▶ Flow Limitation

The flow limitation strategy is based on the following strategies:

1. The flow limitation depending on the filling of the engine with air is determined according to the engine speed and the air flow. This limitation allows smoke emissions to be reduced during stabilized running.
2. The flow limitation depending on the atmospheric pressure is determined according to the engine speed and the atmospheric pressure. It allows smoke emissions to be reduced when driving at altitude.
3. The full load flow curve is determined according to the gear engaged and the engine speed. It allows the maximum torque delivered by the engine to be limited.
4. A performance limitation is introduced if faults liable to upset the rail pressure control or the injection control are detected by the system. In this case, and depending on the gravity of the fault, the system activates:
   1) Reduced fuel logic 1: Guarantees 75 % of the performance without limiting the engine speed.
   2) Reduced fuel logic 2: Guarantees 50 % of the performance with the engine speed limited to 3,000 rpm.
   3) Reduce fuel logic 3: Limits the engine speed to 2,000 rpm.

The system chooses the lowest of all these values.

A correction depending on the coolant temperature is added to the flow limitation. This correction makes it possible to reduce the mechanical stresses while the engine is warming up. The correction is determined according to the coolant temperature, the engine speed and the time which has passed since starting.

Superchager Flow Demand

The supercharge flow is calculated according to the engine speed and the coolant temperature. A correction depending on the air temperature and the atmospheric pressure is made in order to increase the supercharge flow during cold starts. It is possible to alter the supercharge flow value by adding a flow offset with the aid of the diagnostic tool.

▶ Pilot Flow Control

The pilot flow represents the amount of fuel injected into the cylinder during the pilot injection. This amount is determined according to the engine speed and the total flow.

1. A first correction is made according to the air and water temperature.

   This correction allows the pilot flow to be adapted to the operating temperature of the engine. When the engine is warm, the ignition time decreases because the end-of-compression temperature is higher. The pilot flow can therefore be reduced because there is obviously less combustion noise when the engine is warm.
2. A second correction is made according to the atmospheric pressure.

This correction is used to adapt the pilot flow according to the atmospheric pressure and therefore the altitude.

During starting, the pilot flow is determined on the basis of the engine speed and the coolant temperature.

▶ Cylinder Balancing Strategy

Balancing of the point to point flows

The pulse of each injector is corrected according to the difference in instantaneous speed measured between 2 successive injectors.

1. The instantaneous speeds on two successive injections are first calculated.
2. The difference between these two instantaneous speeds is then calculated.
3. Finally, the time to be added to the main injection pulse for the different injectors is determined. For each injector, this time is calculated according to the initial offset of the injector and the instantaneous speed difference.

Detection of an injector which has stuck closed

The cylinder balancing strategy also allows the detection of an injector which has stuck closed. The difference in instantaneous speed between 2 successive injections then exceeds a predefined threshold. In this case, a fault is signaled by the system.

▶ Accelerometer Strategy

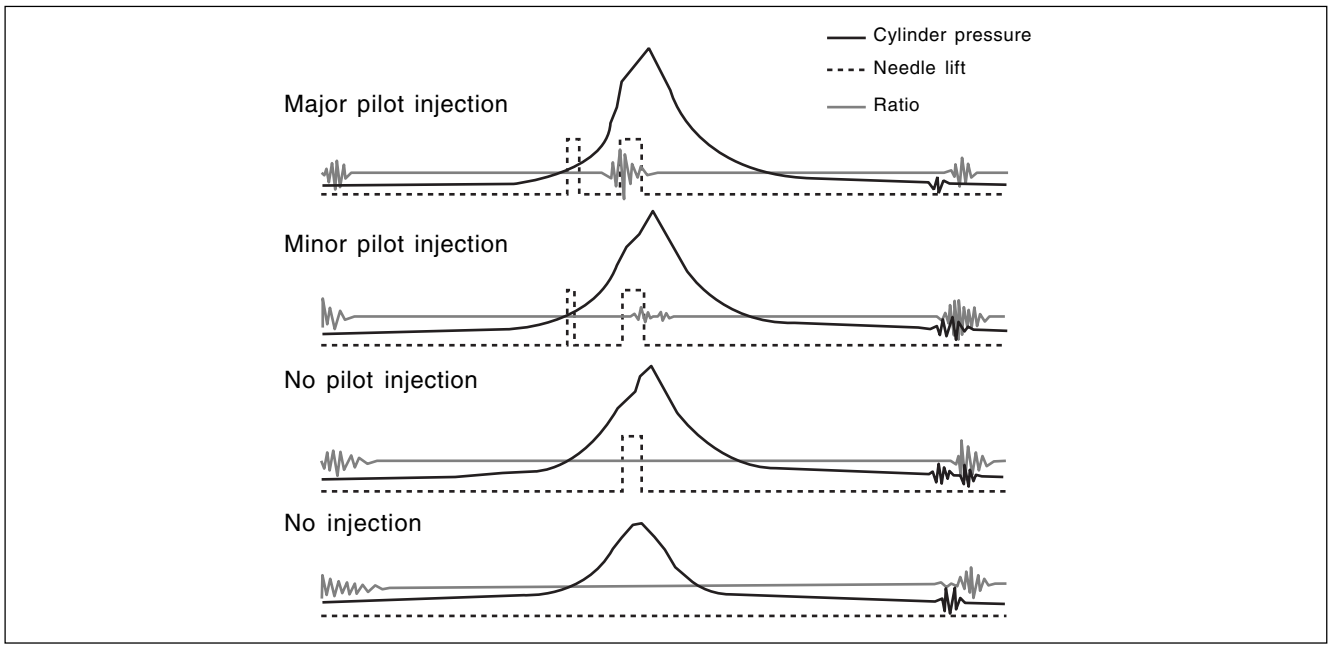
Resetting the pilot injection

The accelerometer is used to reset the pilot injection flow in closed loop for each injector. This method allows the correction of any injector deviations over a period of time. The principle of use of the accelerometer is based on the detection of the combustion noises.

The sensor is positioned in such a way as to receive the maximum signal for all the cylinders. The raw signals from the accelerometer are processed to obtain a variable which quantifies the intensity of the combustion. This variable, known as the ratio, consists of the ratio between the intensity of the background noise and the combustion noise.

1. A first window is used to establish the background noise level of the accelerometer signal for each cylinder. This window must therefore be positioned at a moment when there cannot be any combustion.
2. The second window is used to measure the intensity of the pilot combustion. Its position is such that only the combustion noises produced by the pilot injection are measured . It is therefore placed just before the main injection.

The accelerometer does not allow any evaluation of the quantity injected. However, the pulse value will be measured when the injector starts injection and this pulse value is called the MDP (Minimum Drive Pulse). On the basis of this information, it is possible to efficiently correct the pilot flows. The pilot injection resetting principle therefore consists of determining the MDP, in other words the pulse corresponding to the start of the increase in value of the ratio (increase of vibration due to fuel combustion).



This is done periodically under certain operating conditions. When the resetting is finished, the new minimum pulse value replaces the value obtained during the previous resetting. The first MDP value is provided by the C2I. Each resetting then allows the closed loop of the MDP to be updated according to the deviation of the injector.

Detection of leaks in the cylinders

The accelerometer is also used to detect any injector which may have stuck open. The detection principle is based on monitoring the ratio. If there is a leak in the cylinder, the accumulated fuel self-ignites as soon as the temperature and pressure conditions are favorable (high engine speed, high load and small leak).

This combustion is set off at about 20 degrees before TDC and before main injection.

The ratio therefore increases considerably in the detection window. It is this increase which allows the leaks to be detected. The threshold beyond which a fault is signaled is a percentage of the maximum possible value of the ratio. Because of the severity of the recovery process (engine shut-down), the etection must be extremely robust.

An increase in the ratio can be the consequence of various causes:

1. Pilot injection too strong
2. Main combustion offset
3. Fuel leak in the cylinder

If the ratio becomes too high, the strategy initially restricts the pilot injection flow and retards the main injection. If the ratio remains high despite these interventions, this shows that a real leak is present, a fault is signaled and the engine is shut down.

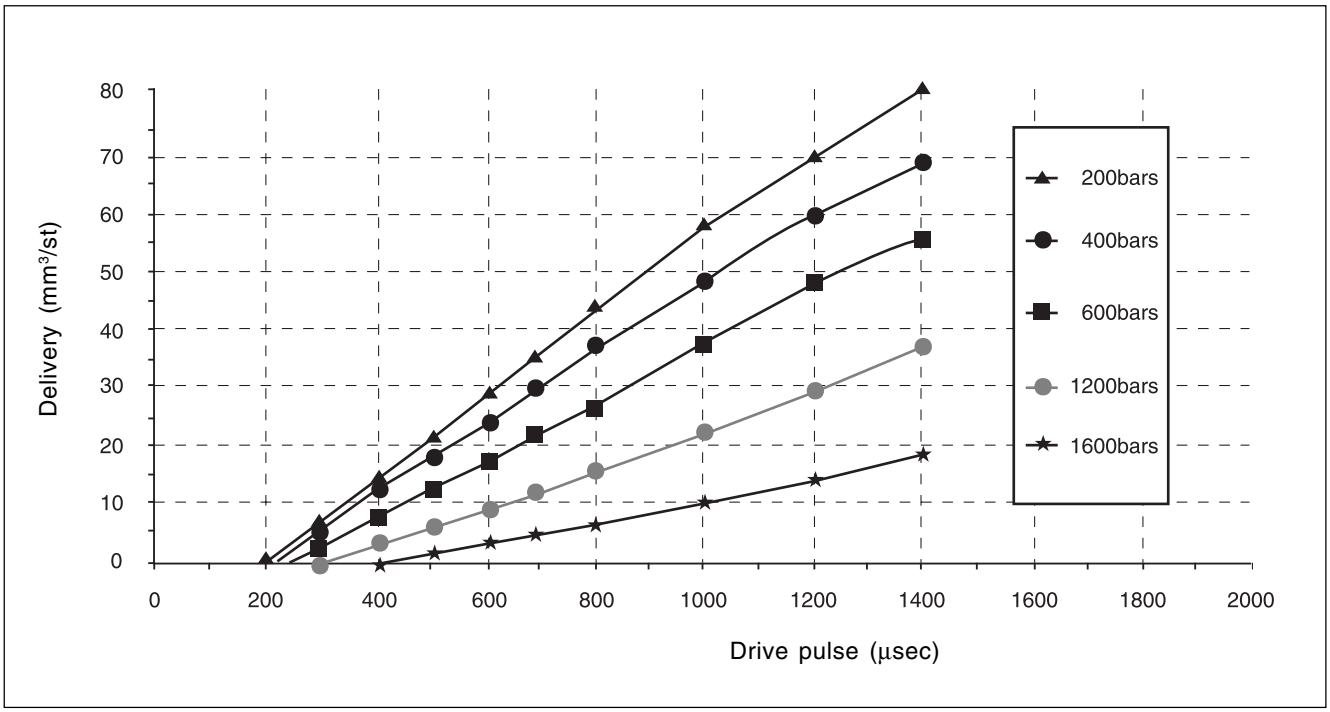
Detection of an accelerometer fault

This strategy permits the detection of a fault in the sensor or in the wiring loom connecting the sensor to the ECU. It is based on detection of the combustion. When the engine is idling, the detection window is set too low for the combustion caused by the main injection. If the ratio increases, this shows that the accelerometer is working properly, but otherwise a fault is signaled to indicate a sensor failure. The recovery modes associated with this fault consist of inhibition of the pilot injection and discharge through the injectors.

INDIVIDUAL INJECTOR CALIBRATION (C2I)

Injected fuel is proportional to square root of injection time and rail pressure.

It is function between pulse and rail pressure and fuel injection curve is called injector characteristics curve having the following shape.



Common rail injectors are very accurate components. They are able to inject fuel delivery between 0.5 to 100 mg/str under pressure varying from 150 to 1600 bar.

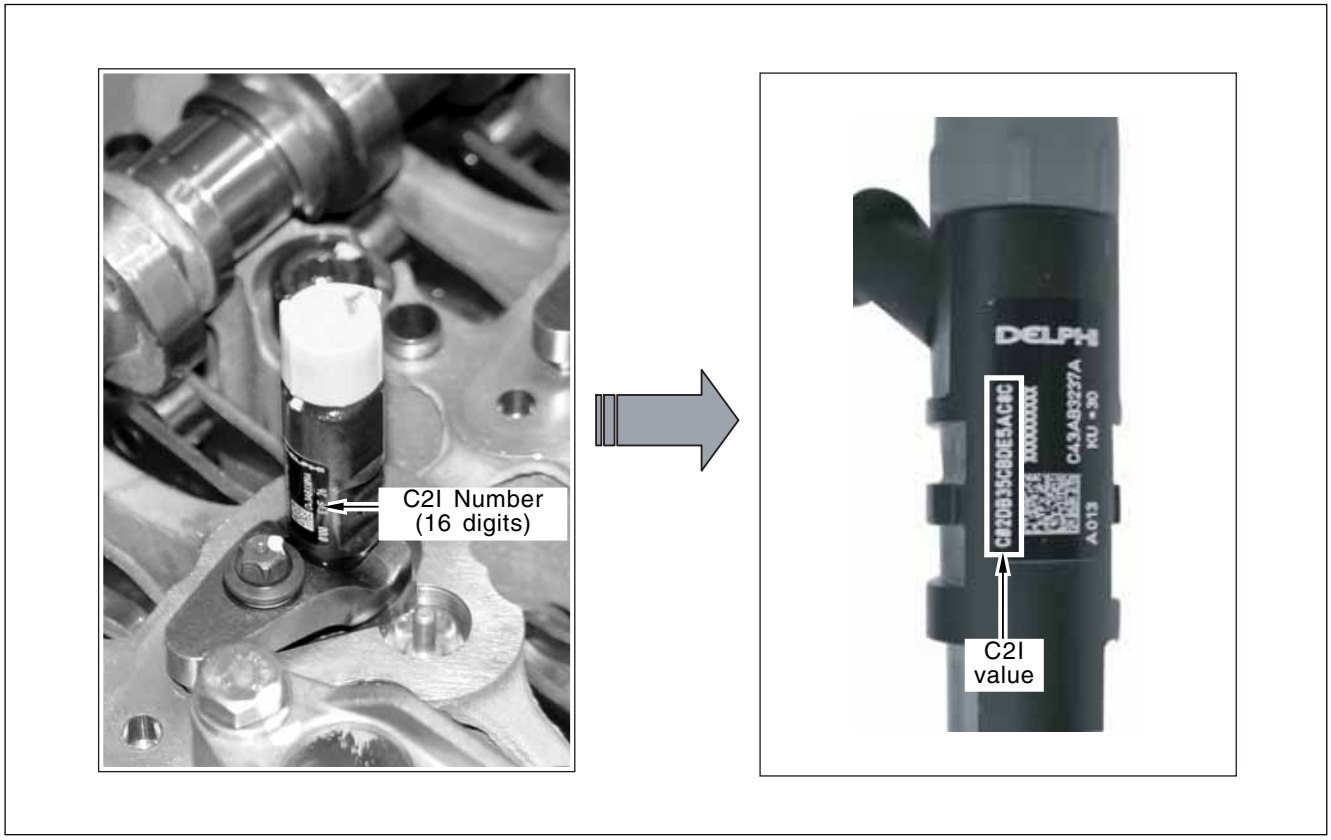
This high level of accuracy requires very low machining tolerances (few µm).

Nevertheless, due to the machining dispersion, the loss of charge through the functional orifices, the friction between moving parts and electromagnetic field level are different from one injector to the other. So, the difference of fuel delivery for the same pressure and the same pulse can reach 5 mg/str from one injector to the other. It is impossible to control efficiently the engine with such a dispersion between the different injectors. It is necessary to add a correction that allows injecting the demanded fuel delivery whatever the initial hydraulic characteristics of the injector is. The method consists in correcting the pulse that is applied to the injector with an offset that depends on the initial hydraulic map of the injector. So, the pulse should be corrected according to characteristics of each injector.

C2I is composed of models on these characteristics of injectors.

C2I consists of 16-digit; composed of numbers from 1 to 9 and alphabets from A to F. ECU remembers C2I, characteristics of each injector, to make the most optimal fuel injection.

1. When replacing the injector, C2I code on the top of new injector should be input into ECU because the ECU is remembering the injector's C2I value. If C2I is not input, engine power drops and occurs irregular combustion.
2. When ECU is replaced, C2I code of every injector should be input. If not, cannot accelerate the vehicle even when the accelerator pedal is depressed.



※ For coding of C2I, refer to "Diagnosis" section

MINIMUM DRIVE PULSE (MDP) LEARNING

When the pulse value that the injector starts injection is measured, it is called mininum drive pulse (MDP). Through MDP controls, can correct pilot injections effectively. Pilot injection volume is very small, 1 ~ 2 mm/str, so precise control of the injector can be difficult if it gets old. So there needs MDP learning to control the very small volume precisely through learning according to getting older injectors.

▶ Learning Conditions

Coolant temperature	> 75°C
Vehicle speed	> 50 Km/h (over 5 seconds)
Intake manifold pressure	> 0.7 bar
Engine speed	> 2,500 rpm
Battery voltage	10 V < MDP < 16 V
Fuel temperature	0 < fuel temperature < 80 °C
Initial MDP learning on each injector	5 seconds

▶ Trouble Codes

Trouble code	Description	Diagnosis
P1171	Fault MDP learning on injector No. 1	• Check each injector
P1172	Fault MDP learning on injector No. 2	
P1173	Fault MDP learning on injector No. 3	
P1174	Fault MDP learning on injector No. 4	
P1175	Fault MDP learning on injector No. 5	

▶ Accelerator Pedal Sensor



<Location of Accelerator Pedal Sensor>



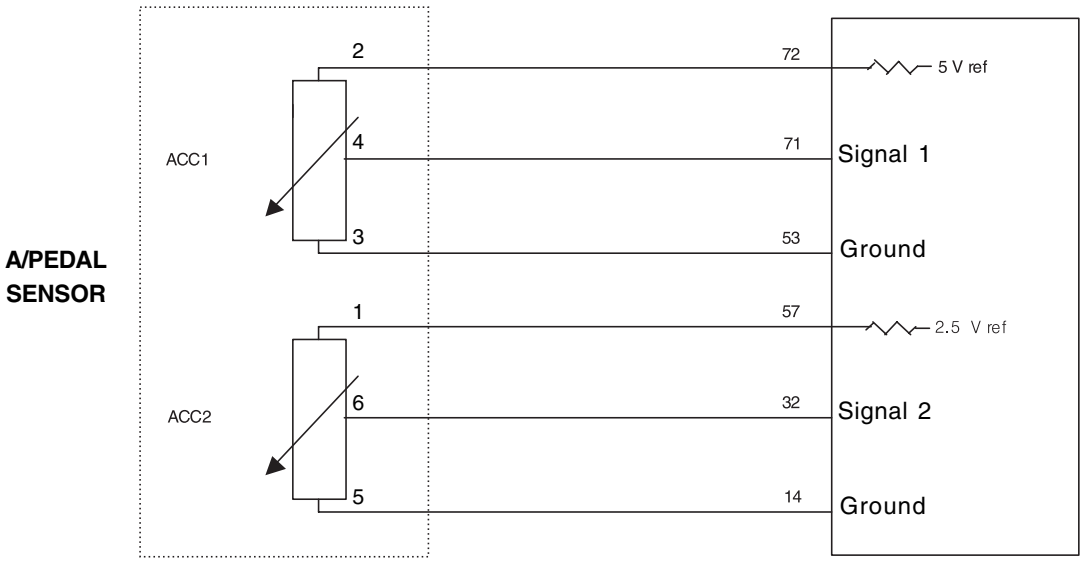
<When Depressing the Accelerator Pedal and Brake Pedal Simultaneously>

Accelerator pedal sensor changes accelerator pedal position into electrical signal and then sends to ECU to let know the driver's demand. There are 2 sensors in the accelerator pedal sensor. Accelerator pedal No.1 (ACC 1) sensor signal determines fuel injection volume and injection timing during driving, and accelerator pedal No. 2 (ACC 2) sensor signal compares whether the No. 1 sensor signal value is correct.

If accelerator pedal No. 1 and 2 sensors are defective, ECU remembers defect code, and acceleration responses are getting bad and engine rpm hardly increases.

NOTICE

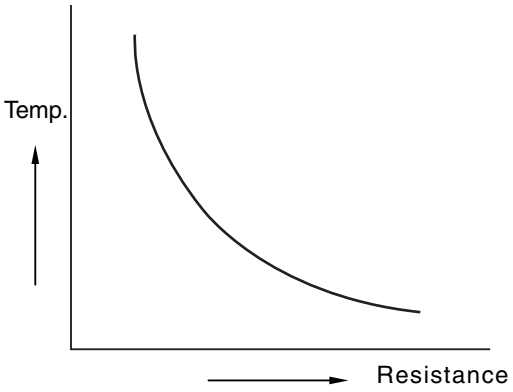
- **When depressing the accelerator pedal and brake pedal simultaneously while driving, the acceleration response will be diminished abruptly and cannot drive with over 70 km/h even though depressing the accelerator pedal to its end. At this time, the trouble code of "P-1124 Accelerator pedal sensor stuck" is stored into ECU. If depressing the accelerator pedal over 3 times, it will be resumed to normal condition.**
- **For detailed information, refer to "Diagnosis" section in this manual.**



▶ Coolant Temperature Sensor



<Coolant Temperature Sensor>



<Output Characteristics of Coolant Temperature Sensor>

Coolant temperature sensor is a NTC resister that sends coolant temperature to ECU.

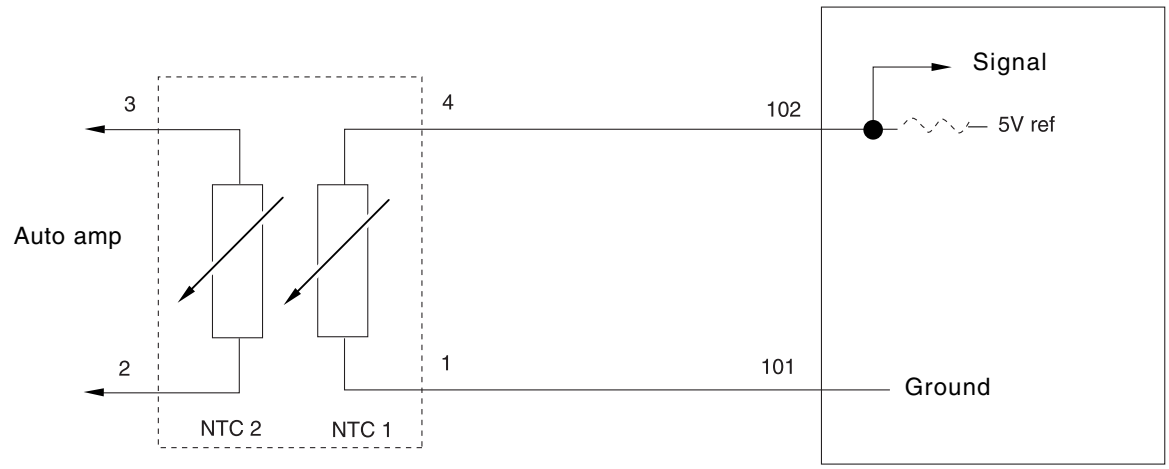
NTC resister has characteristics that if the engine temperature rises, the resistance lowers so the ECU detects lowering signal voltages.

If the fuel injected into the engine through injector has more turbulence, then combusts very well. However, if engine temperature is too low, the fuel injected as foggy state forms big compounds causing incomplete combustion. So the sensor detects coolant temperature and changes coolant temperature changes into voltage then sends to ECU to increase the fuel volume during cold start for better starting. And detects engine overheating for fuel volume reduction to protect the engine.

ECU functions as below with coolant temperature sensor signals.

1. When engine is cold, controls fuel volume to correct idle speed.
2. When engine is overheated, controls electrical fan and A/C compressor to protect the engine.
3. Sends information for emission control.

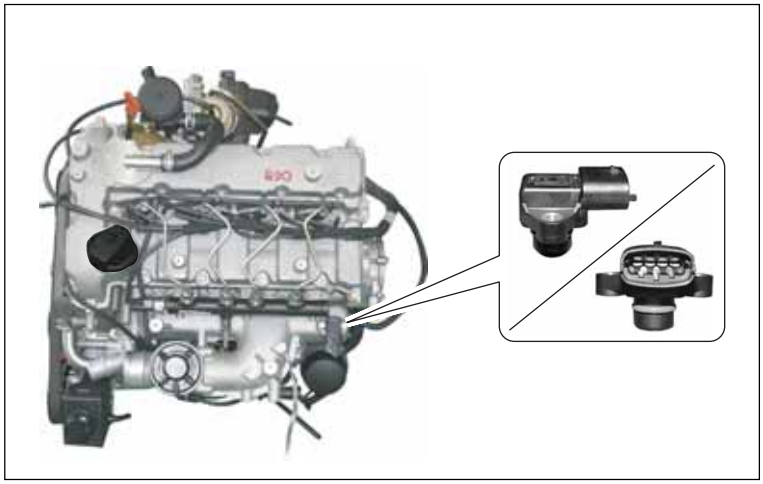
Temperature (°C)	NTC 1 Resistance (Ω)	NTC 2 Resistance (Ω)
20	2,449	6,062
50	826	1,800
80	321	638
120	123	200



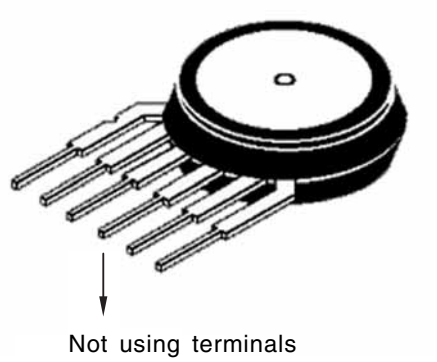
<Circuit Diagram of Coolant Temperature Sensor>

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Boost Pressure Sensor



<Location of Boost Pressure Sensor>



<Boost Pressure Sensor>

Boost pressure sensor uses piezo element and uses only 3 terminals out of 6.

It sets fuel injection timing and corrects fuel injection volume according to atmospheric pressure.

The other function is determining EGR operation stops.

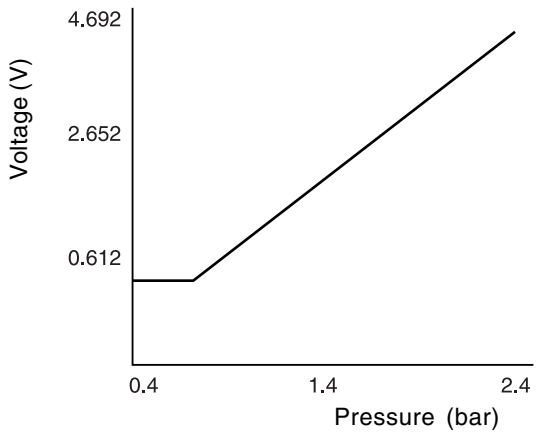
1. Output voltage calculation

   $V_O = V_S \times (P \times 0.004 - 0.04)$

   V_O : Output voltage

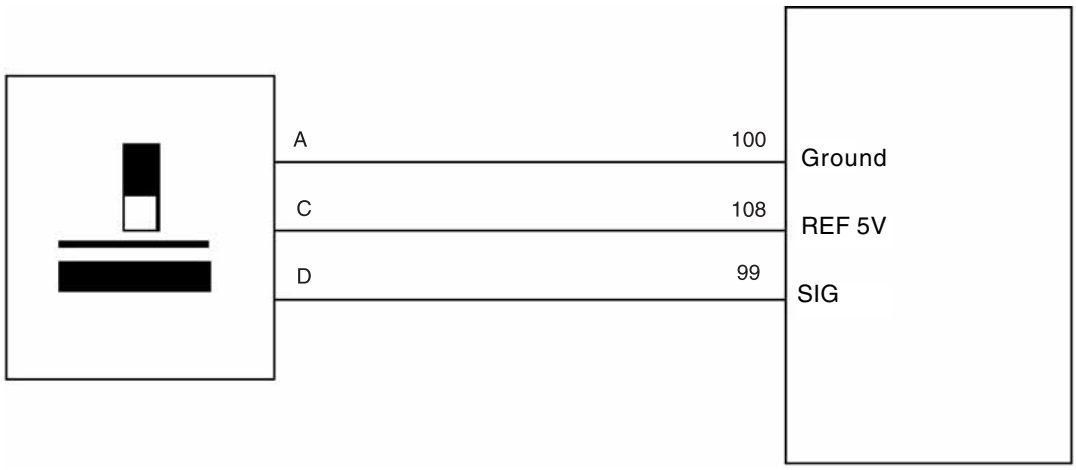
   V_S : Supply voltage

   P : Applying voltage



<Output Characteristics of Sensor>

Performance proofing pressure range	20 ~ 250 KPa
Performance proofing temperature range	- 40 ~ 110°C
Storage proofing temperature range	- 40 ~ 125°C
Performance proofing supply voltage	4.85 ~ 5.35 V
Max. consuming current	10 mA (supply voltage at 5.35 V)
Responsibility	$T_R \leq$ 7ms
Tightening torque	10 Nm



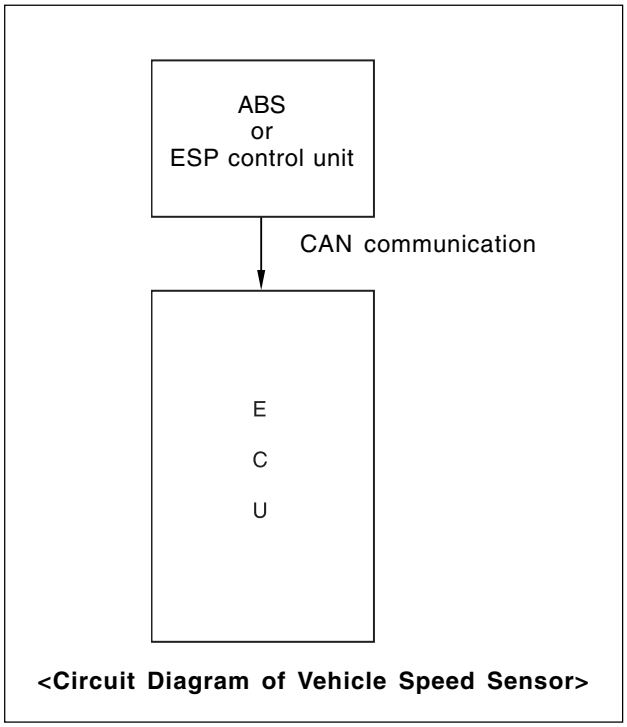
<Circuit Diagram of Booster Pressure Sensor>

▶ Vehicle Speed Sensor

The ABS or ESP control unit sends the vehicle speed signals to ECU. ECU uses these signals to calculate the vehicle speed and meter cluster shows signals as vehicle speed.

Function

1. Limits idle control correction duty range
2. Controls cooling fan
3. Cuts fuel injection if exceeds max. speed
4. Controls vehicle shifting feeling
5. Used for exhaust gas control mode



<Circuit Diagram of Vehicle Speed Sensor>

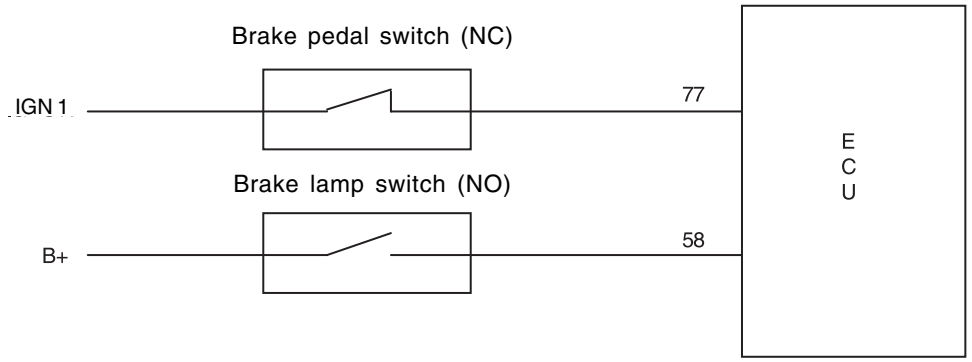
▶ Barometric Sensor

It is built-in the ECU and detects absolute pressure of atmosphere to correct fuel injection timing and injection volume according to altitude.

▶ Other switches

Brake switch

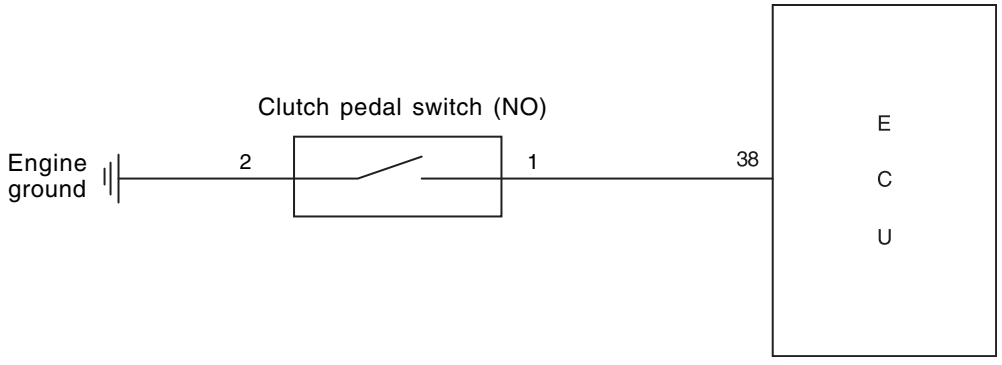
Brake switch detects brake pedal operations and then sends to engine ECU. It has dual structure with 2 combined switches and there are brake switch 1 and 2. When these 2 signals are input, engine ECU recognizes as normal brake signals. These switch signals are related with accelerator pedal sensor operations and used to control the fuel volume during braking. It means there are no problems in operating accelerator pedal when the brake pedal is operated but the fuel volume reduces if operates brake pedal while the accelerator pedal is depressed.



<Brake Switch Circuit>

Clutch pedal switch

Clutch pedal switch is installed on the upper of the clutch and sends clutch pedal operations to engine ECU. Contact type switch allows engine ECU to recognize the shifting points to correct the fuel volume. It means it corrects fluctuation happens during gear shifting. Another different function is canceling auto cruise function if equipped (auto cruise control - equipped for export).



<Clutch Pedal Switch Circuit>

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ELECTRIC DEVICES AND SENSORS

09

TABLE OF CONTENTS

ELECTRIC DEVICES AND SENSORS 2

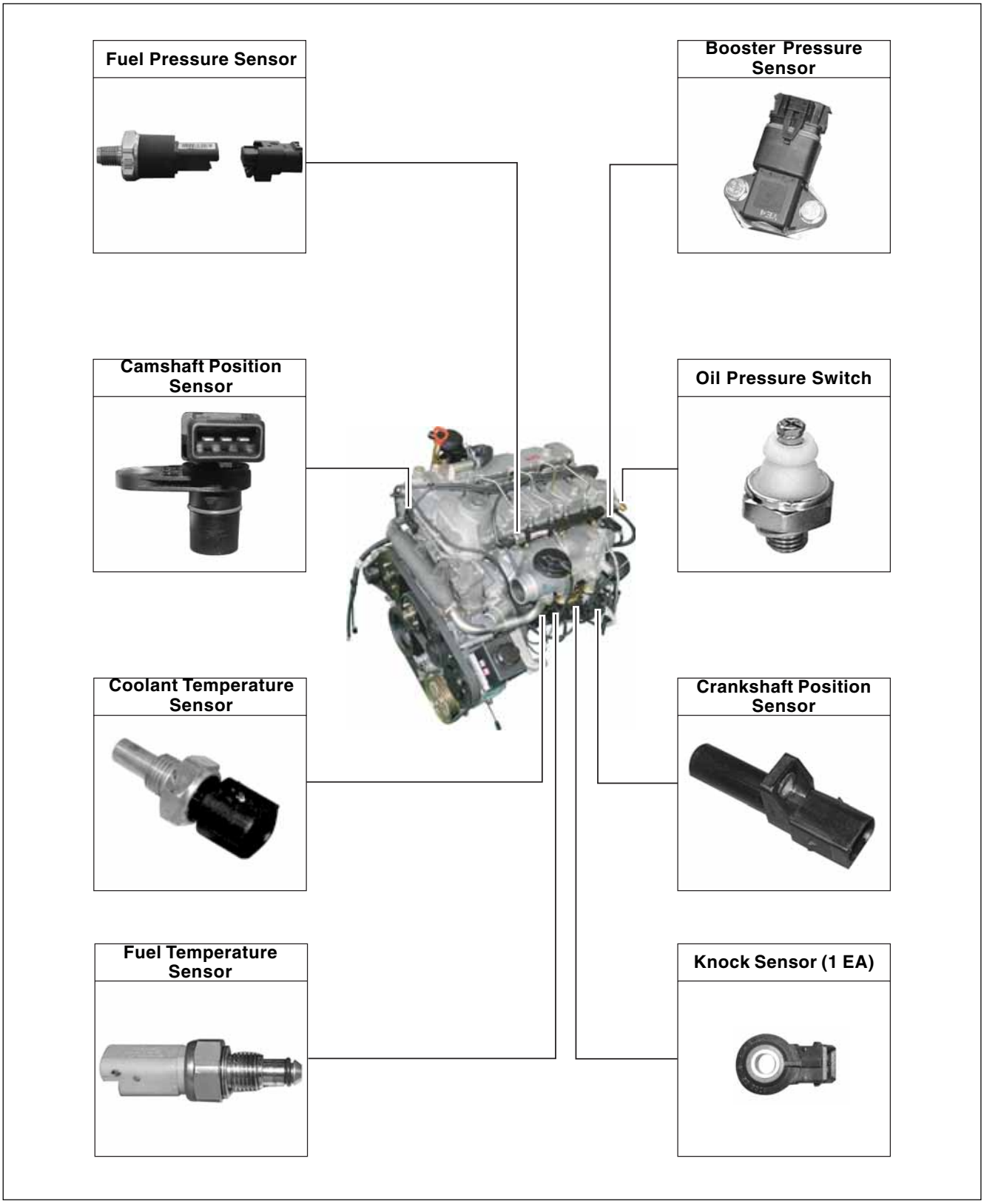
Sensors in engine compartment 2
Electric devices in engine compartment 3
Specifications 4
Circuit diagram of preheating system 5
Circuit diagram of starting and alternator 6

TROUBLE DIAGNOSIS 7

General 7
Alternator 9
Starter 10

ELECTRIC DEVICES AND SENSORS

SENSORS IN ENGINE COMPARTMENT



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

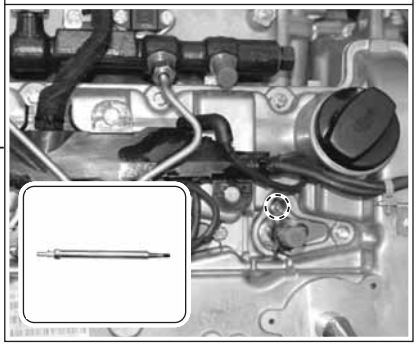
ELECTRIC DEVICES IN ENGINE COMPARTMENT

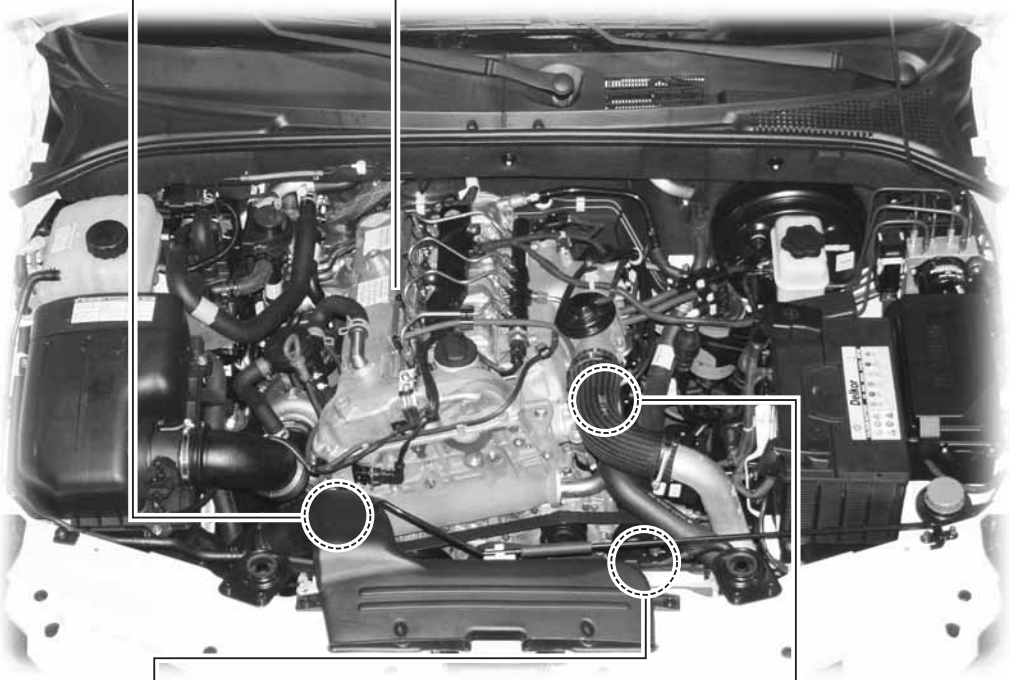
Alternator



* Capacity
PTC equipped vehicle
: 12V - 140A
FFH equipped vehicle
: 12V - 115A

Glow Plug





Air Conditioner Compressor



Starter



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

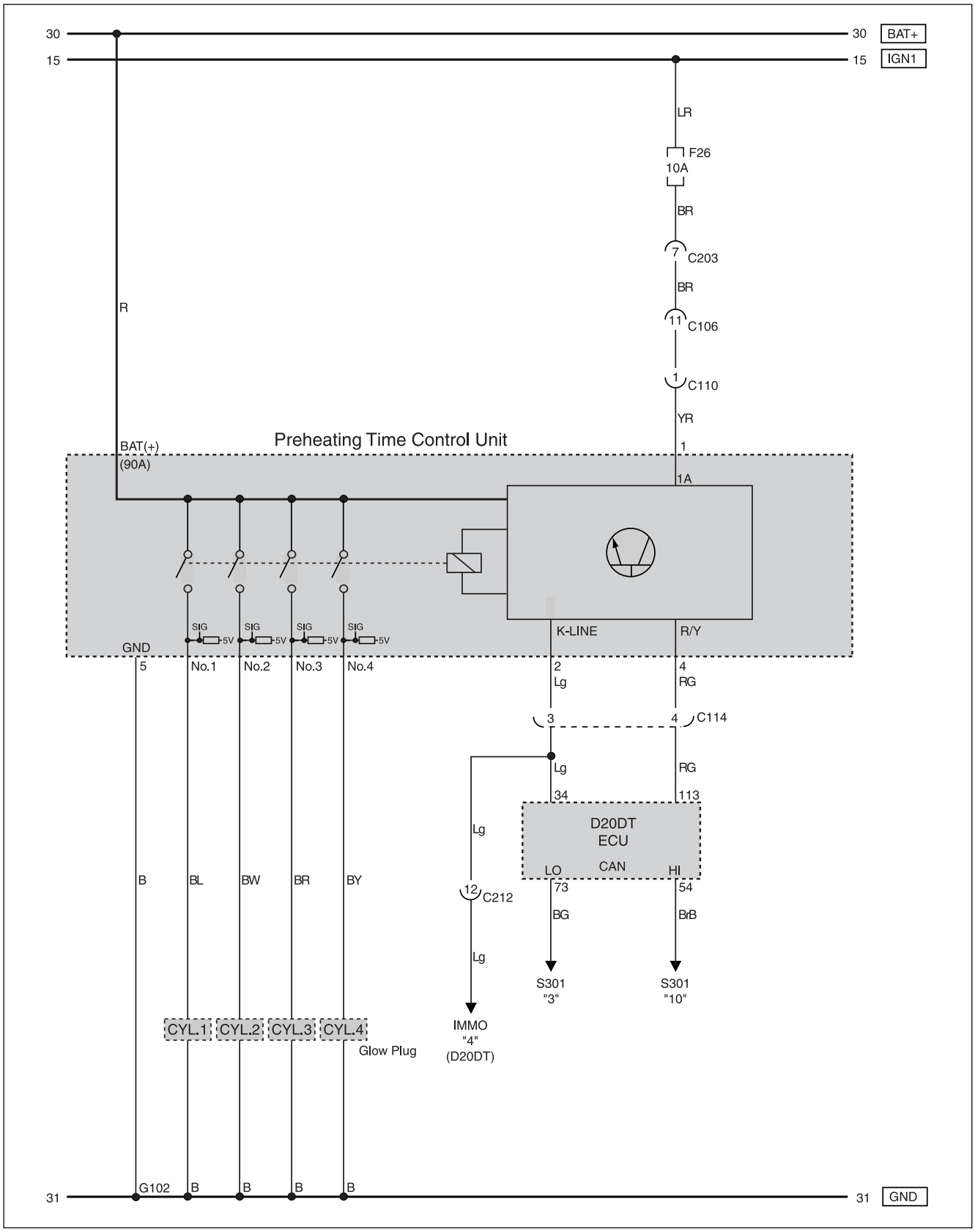
SPECIFICATIONS

Description			Unit	Specification
Starter	Type		-	WP220
	Output power		Kw	2.2
	No load test ≅ 12 volts		A	160
	Drive pinion speed at no load		rpm	4500
	Drive pinion speed at load		rpm/A	1700/430
	Brush length		mm	18
	Armature diameter		mm	55
	Armature run-out		mm	0.1
	Segment groove depth		mm	21.7
Alternator	Type		-	CS128D
	Output voltage / current		V/A	PTC equipped vehicle: 12V-140A FFH equipped vehicle: 12V-115A
	Regulator type		-	←
	Regulating voltage		V	14.6
	Brush	Length	mm	12.5
		Quantity	-	2
		Wear limit	mm	7
Battery	Type		-	M F
	Capacity		AH	12V - 90AH
Glow plug	Reserved capatity		RC	160
	Type		-	Seized type
	Rated voltage		-	11.5
	Circuit connection		-	Parallel
	Preheating time		sec	Max. 60 (at -35°C)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

CIRCUIT DIAGRAM OF PREHEATING SYSTEM

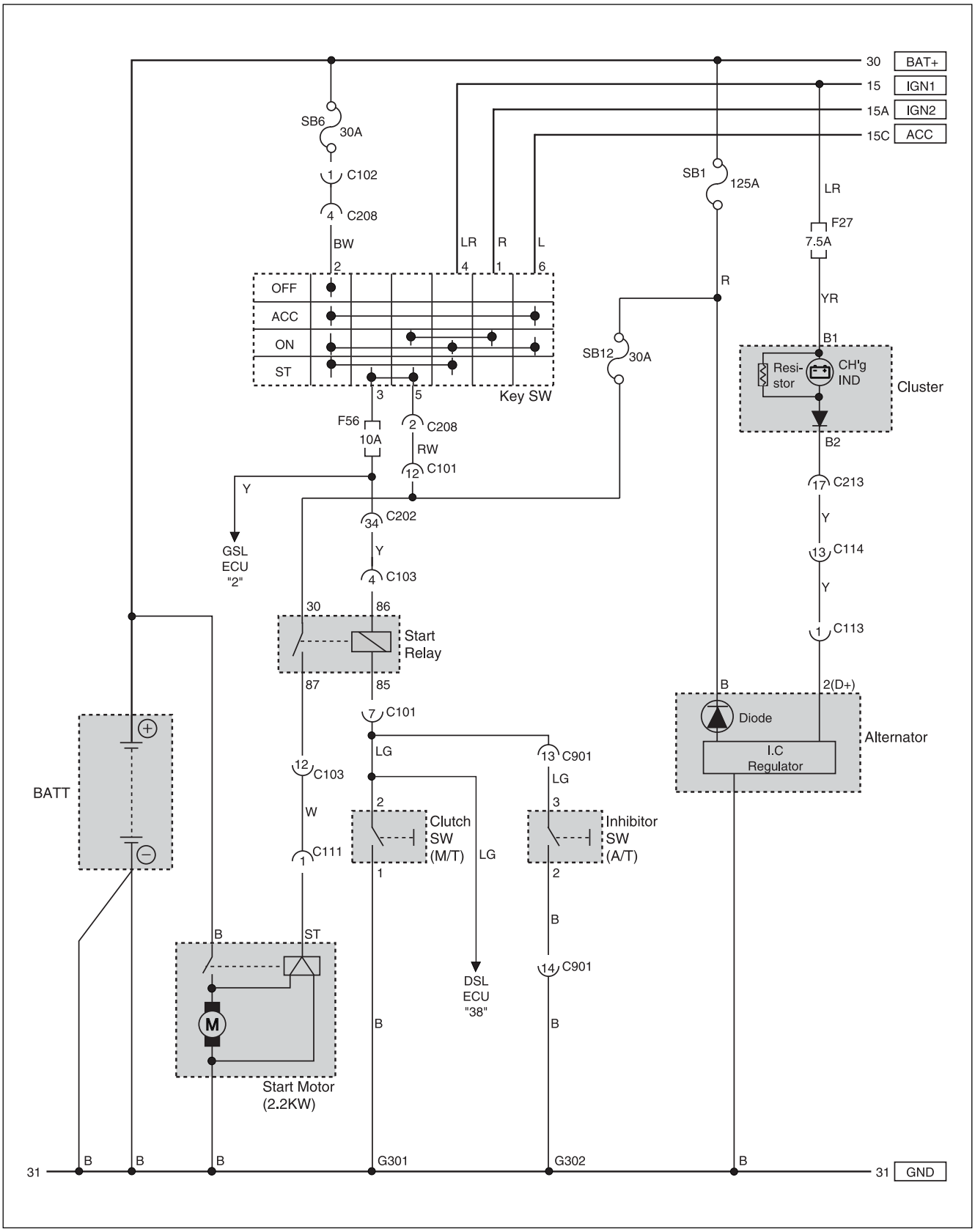
▶ PREHEATING



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

CIRCUIT DIAGRAM OF STARTING AND ALTERNATOR

▶ STARTING & CHARGING



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

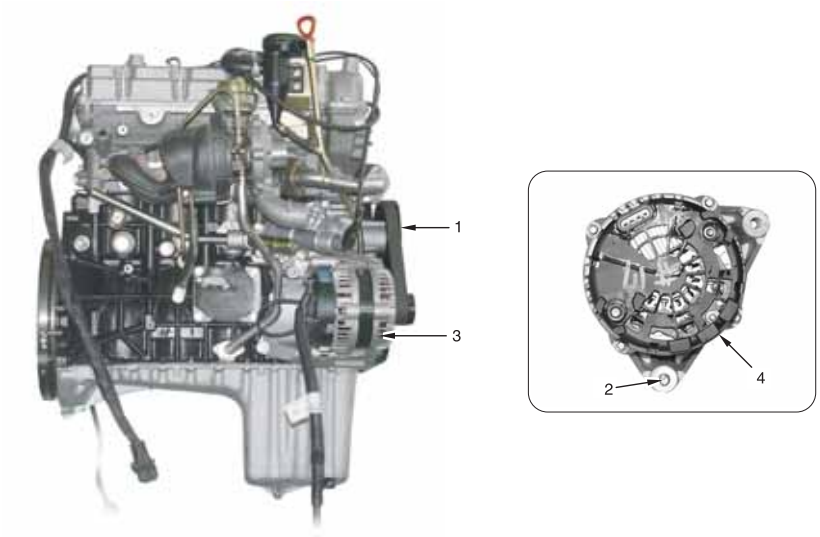
TROUBLE DIAGNOSIS

GENERAL

Condition	Probable Cause	Correction
No crank	• Low battery voltage.	• Charging the battery or replace the battery.
	• Battery cable is loose, corroded, or damaged.	• Repair or replace the battery cable.
	• Faulty starter motor or starter motor circuit is open.	• Repair or replace the starter motor/starter motor circuit.
	• Faulty ignition switch.	• Replace the ignition switch.
	• Ground short.	• Repair the ground short.
Crank ok, but too slow	• Low battery voltage.	• Charging the battery or replace the battery.
	• Battery. • Battery cables are loose, corroded, or damaged.	• Repair or replace the battery cable.
	• Faulty starter motor.	• Repair or replace the starter motor.
Starter motor does not stop	• Faulty starter motor.	• Repair or replace the starter motor.
	• Faulty ignition switch.	• Replace the ignition switch.
Starter motor running, but not cranking	• Broken the clutch pinion gear or faulty starter motor.	• Replace the starter motor.
	• Broken the flywheel ring gear.	• Replace the flywheel.
	• Connected circuit is open.	• Repair the open circuit.
Battery discharge	• Loosen the generator drive belt.	• Adjust the belt tension or replace the belt.
	• The circuit is open or a short.	• Repair the open or a short circuit.
	• Battery run down.	• Replace the battery.
	• Open ground circuit.	• Repair the open ground circuit.
Charging indicator lamp does not work when the ignition switch on (engine does not work)	• Charging indicator lamp is blown or fuse is blown.	• Repair or replace the charging indicator lamp/fuse.
	• Faulty ignition switch.	• Replace the ignition switch.
	• Generator ground circuit is open or a short.	• Repair the circuit.
Charging indicator lamp does not put out lights after starting the engine	• Battery cable is corroded or damaged.	• Repair or replace the battery cable.
	• Loosen the generator drive belt.	• Adjust the belt tension or replace the belt.
	• Faulty wiring harness.	• Repair the wiring harness.
Battery over charging	• Generator voltage regulator faulty	• Replace generator
	• Voltage detecfing wiring faulty	• Repair wiring

Symptom	Cause	Action
Hard engine starting	• Ignition coil faulty	• Replace ignition coil
	• Distributor (including optical sensor) faulty	• Replace distribator (or sensor)
	• Spark plug malfuntion	• Replace spark plug or adjust clearance
	• Ignition timing faulty (spark plug light is normal)	• Resetting valve timing
Unstable engine idling	• Spark plug malfunction	• Replace spark plug or adjust clearance
	• Ignition coil faulty	• Replace ignition coil
	• Ignition timing faulty	• Resetting valve timing
Enging acceralation malfunction	• Ignition timing faulty	• Resetting valve timing

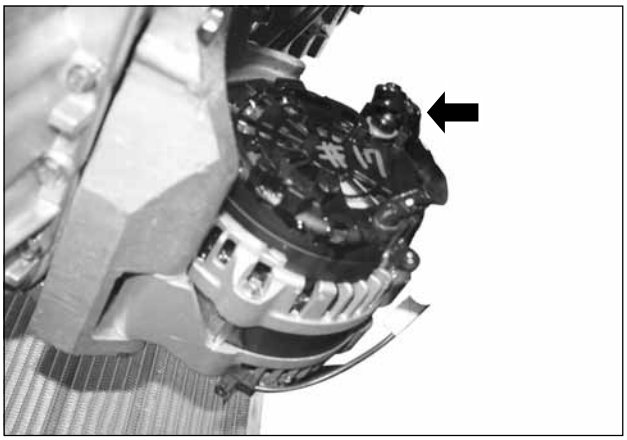
ALTERNATOR



1. Cooling fan
2. Bolt ..... 45 Nm
3. Alternator
4. Plug connection

Removal and Installation

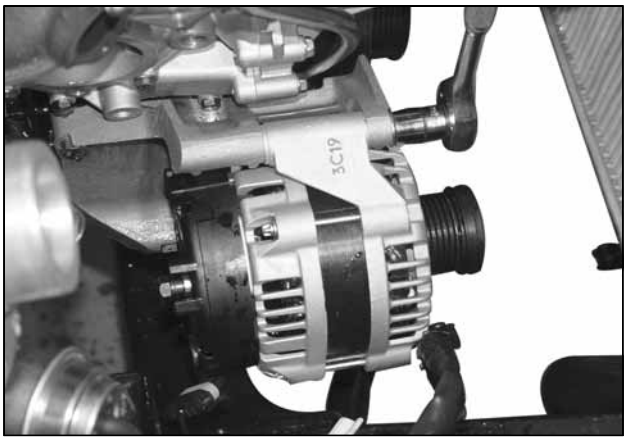
1. Disconnect the negative battery cable.
2. Remove the plug connection.



3. Unscrew the bolts and remove the alternator.

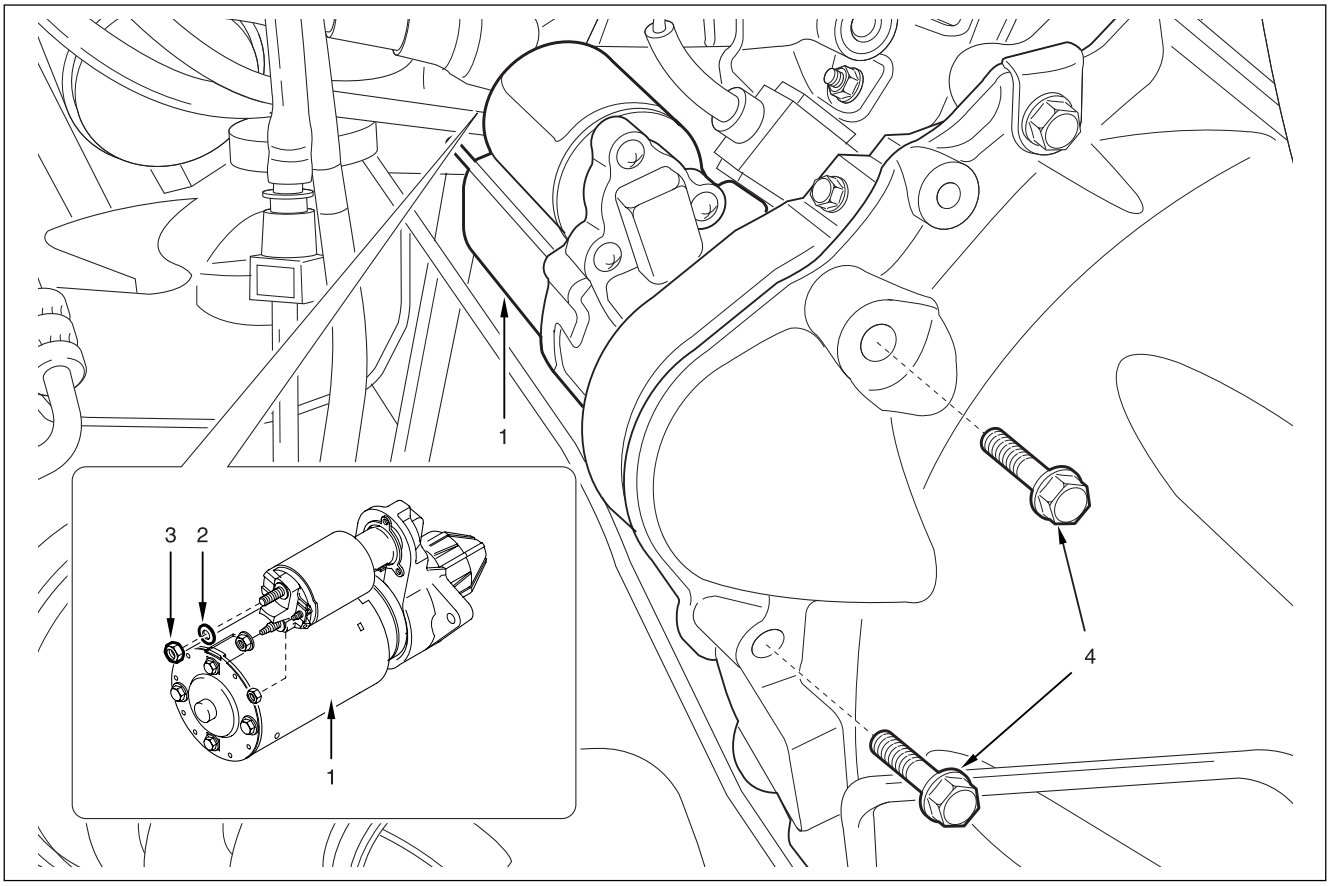
Installation Notice

Tightening torque	45 Nm



4. Install in the reverse order of removal.

STARTER

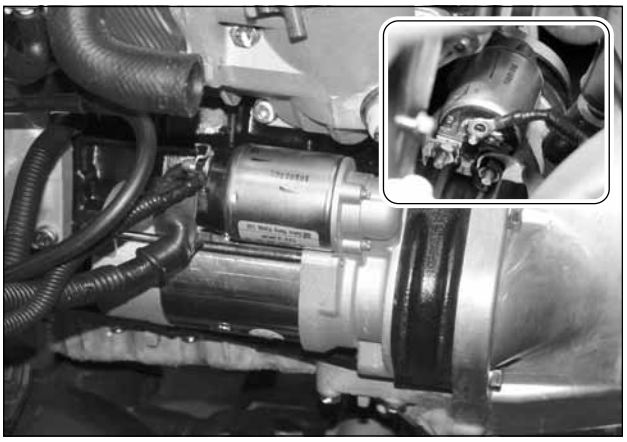


1. Starter
2. Washer
3. Nut ..... 15 Nm
4. Bolt ..... 48 Nm

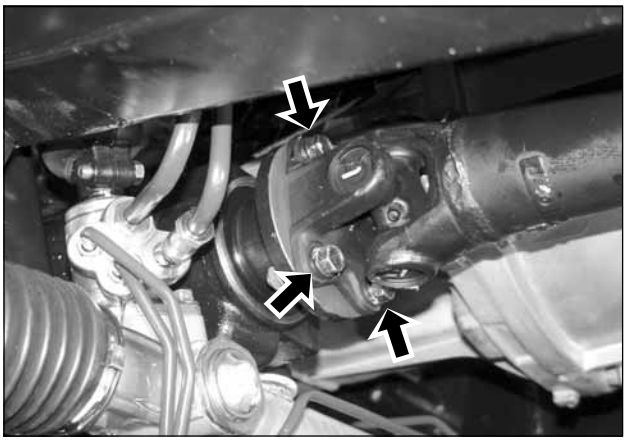
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Removal and Installation

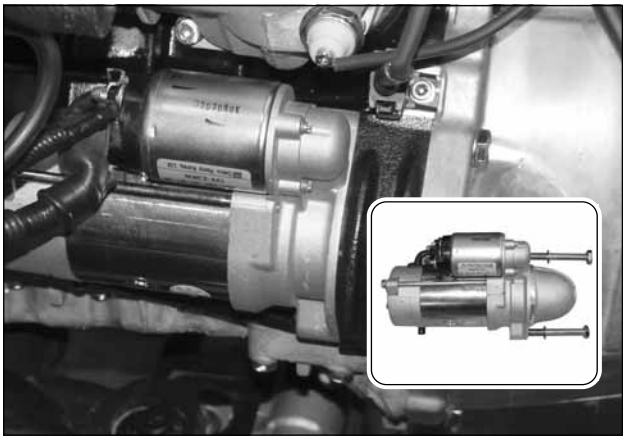
1. Disconnect the negative battery cable.
2. Disconnect the starter terminal.



3. Lift up the vehicle and remove the front propeller shaft mounting bolts.



4. Remove the upper and lower mounting bolts.



5. Install in the reverse order of removal.

SCAN-100

TABLE OF CONTENTS

SCAN-100 GENERAL 3

SCAN LOAD 3

D-CARD DOWNLOAD 4

REPROGRAM 8

ENTERING DIAGNOSIS PROCEDURES 28

FUNCTION SELECTION 30

SCAN-100 GENERAL

SCAN LOAD

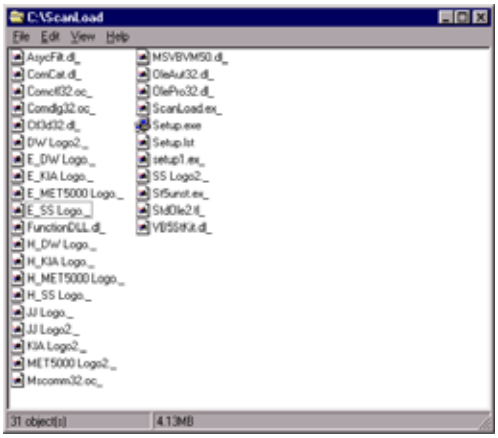
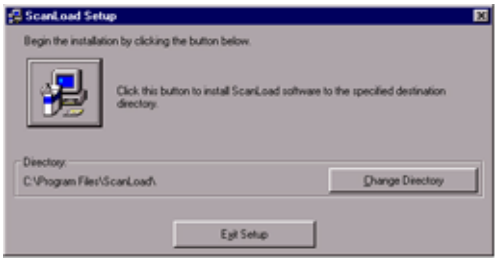
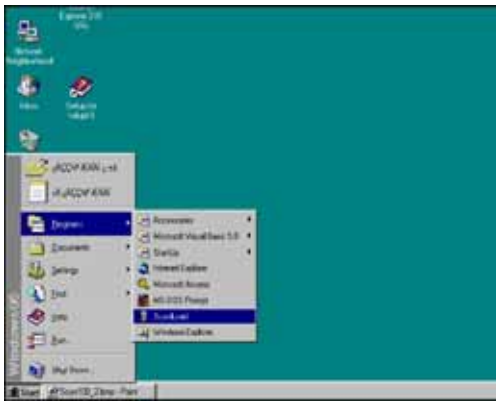
1. Introduction

This SCANLOAD program is designed to write an operating program to your program card of SCAN-100.

2. Installation

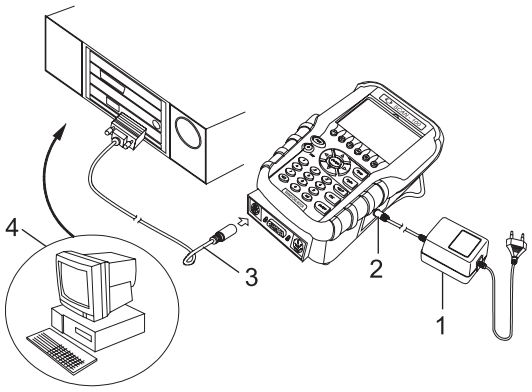
In order to install SCANLOAD, the previous requirements should be satisfied in your computer.

In addition, windows 98 also should be installed. If the windows configuration is not set up, Complete installing the windows, and then follow the procedure of the below.

Screen Flow	Description
	Make a directory ”SCANLOAD” in hard disk. Copy a given program, and execute a “setup.exe”.
	Click the button  , to install the program in the target directory.
	Execute the program, after finishing installing setup program.

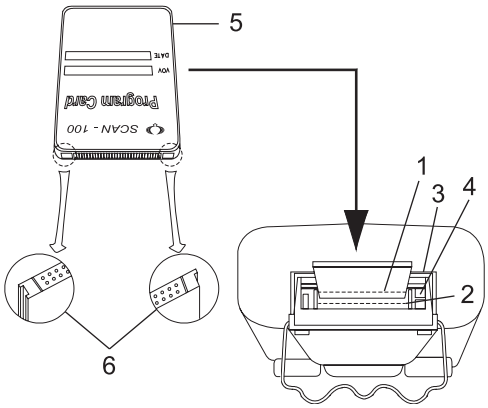
D-CARD DOWNLOAD

1. Connecting SCAN-100 to PC



1. AC/DC Power Supply
2. DC Power Jack
3. RS-232 communication cable
4. PC Terminal

2. Inserting Program Card into SCAN-100



1. Program Card Slot
2. Memory Card Slot
3. Hinged Body
4. Card Eject Button
5. Program Card
6. Notches

1. Inserting program card : Insert the card with label(SCAN-100 program card ver.) side up and to the direction of arrow. Push this card all the way to the end. And if the card is inserted in a wrong way, the card may not be set in the slot.

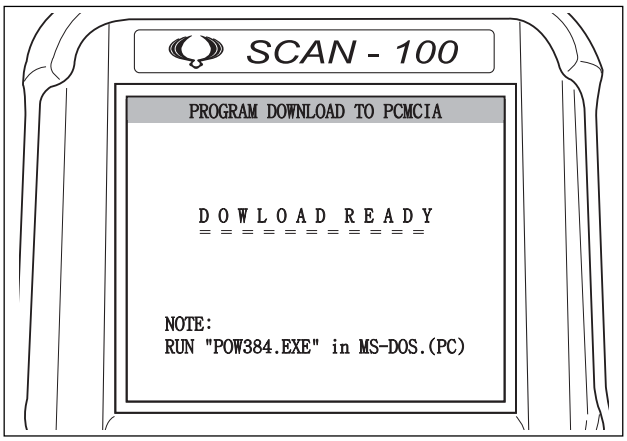
2. “PCMCIA” cards and memory capacities.

   PCMCIA card is consist of FLASH memory. SCAN-100 has two kinds of PCMCIA card; program card and data memory card.

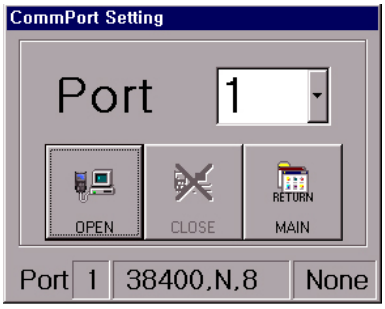
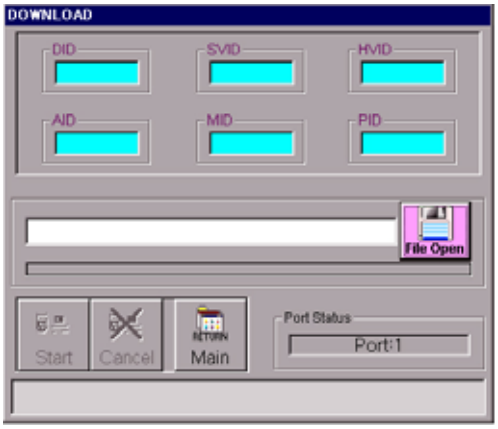
Program card:	This card contains the operation program of SCAN-100.
Data memory card:	This is used for recording a traveling data, a wave data, etc.
Capacities of program card:	It is able to extend its memory capacity up to 16MByte, and its basic memory is 2MByte.
Capacities of data memory card:	It is able to extend its memory capacity up to 10MByte.

3. Selecting Download Mode of SCAN-100

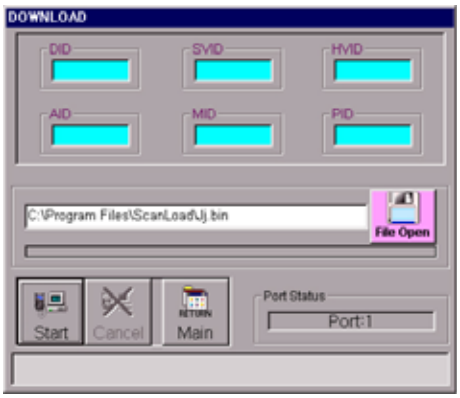
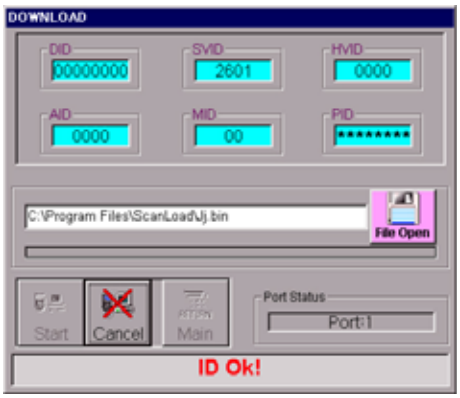
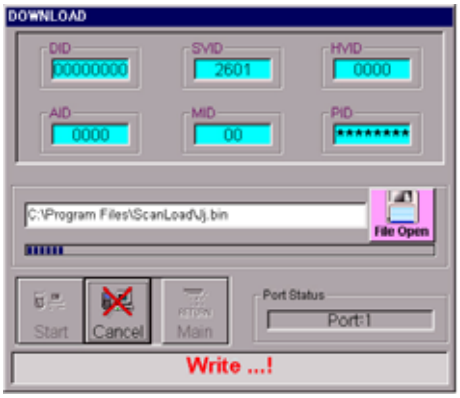
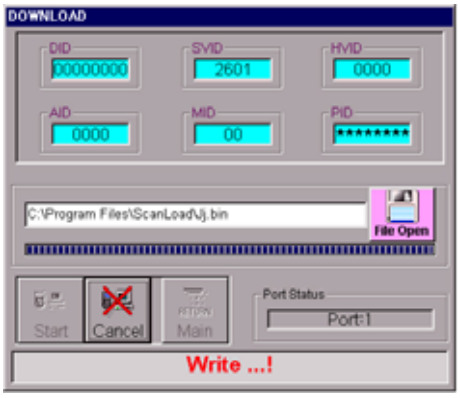
1. Connect communication port of PC to left input port of SCAN-100 by using a download communication cable.
2. Press “PWR” key after pushing a hotkey (“YES” + “NO” + “2”).
3. Perform a SCANLOAD program.



4. Perform Scanload

Screen Flow	Description
	Click the button  , in an initial screen.
	Select the communication port connected to SCAN-100.
	Basic screen of download mode. Click the button  .
	Select a file which you wish to write, and click the button  .

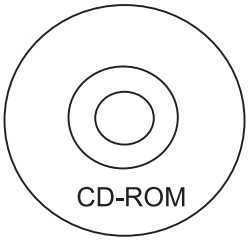
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AFFECTED VIN	

Screen Flow	Description
	Click the button  .
	If the ID of a selecting file is same to the SCAN-100's ID, then **ID Ok!** is indicated. if not, then it shows  message.
	Write a selecting file to program card of SCAN-100.
	If the download is completed, Then you get a  message.

REPROGRAM

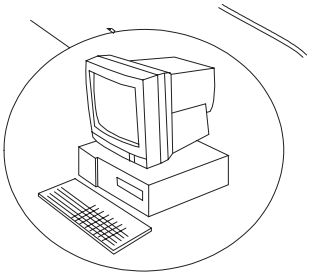
1. Reprogramming Flow Chart

STEP I



Reprogramming data file provided from SYMC.
(R-CARD reprogramming data)

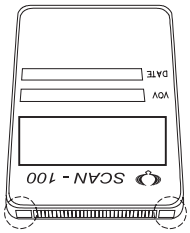
STEP II



Update the D-CARD program, if necessary
(PC to D-CARD)

1. Refer to “SCANLOAD USER’S GUIDE” in supplied CD-ROM inside SCAN-100 kit box.

STEP III



Download the reprogramming data to the R-CARD
(PC to R-CARD)

1. R-CARD DOWNLOAD (PC to SCAN-100) ... 2
2. R-CARD DATA ERASE (SCAN-100) 6
3. R-CARD DATA VIEW (SCAN-100) 6

STEP IV



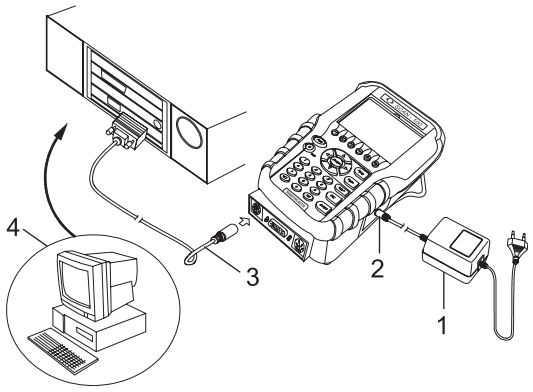
Reprogramming the ECU (SCAN-100 to ECU)

1. ECU REPROGRAM (SCAN-100 to ECU) 7

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

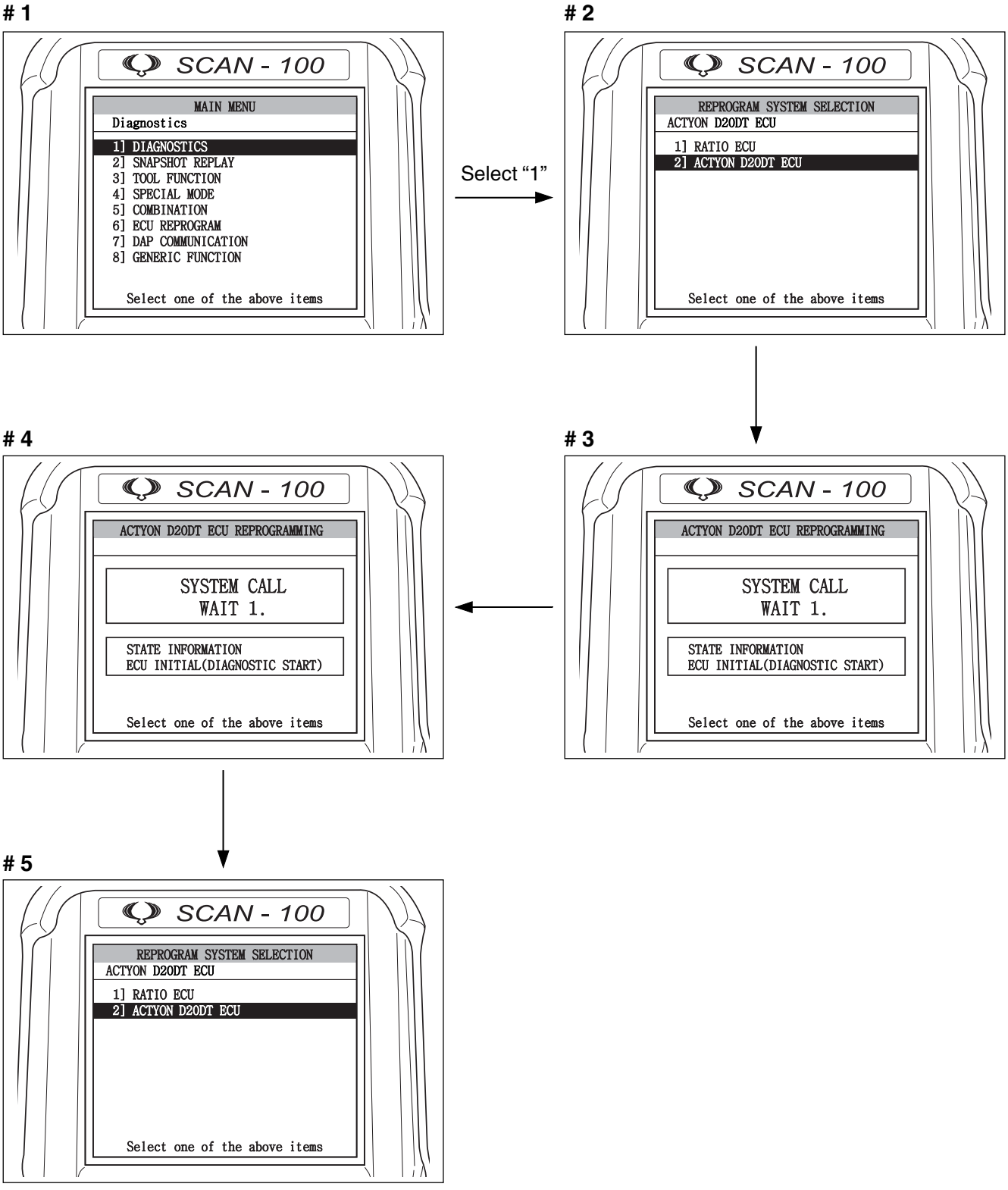
2. R-Card Download (PC to SCAN-100)

1. Check and see if the D-Card exist in the upper slot (Slot “A”) of SCAN-100.
2. Check and see if the R-Card exist in the lower slot (Slot “B”) of SCAN-100.
3. Connecting the SCAN-100 to PC



1. SCAN-100 AC/DC Power Supply
2. DC Power Jack
3. RS-232 Communication Cable
4. PC Terminal

4. Press the POWER ON the SCAN-100 and process the steps as below.



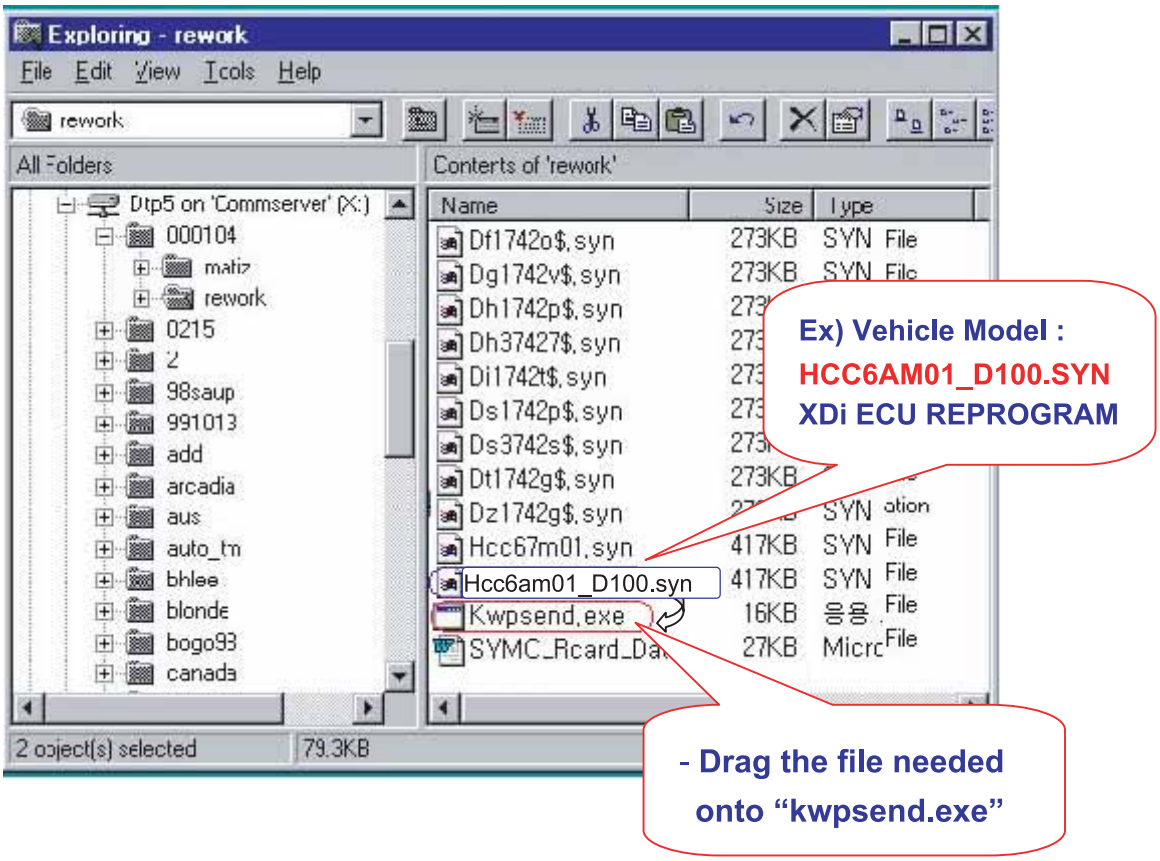
(Fig. 1-1)

If your SCAN-100 display above screen (fig.1-1), please go to the next step.

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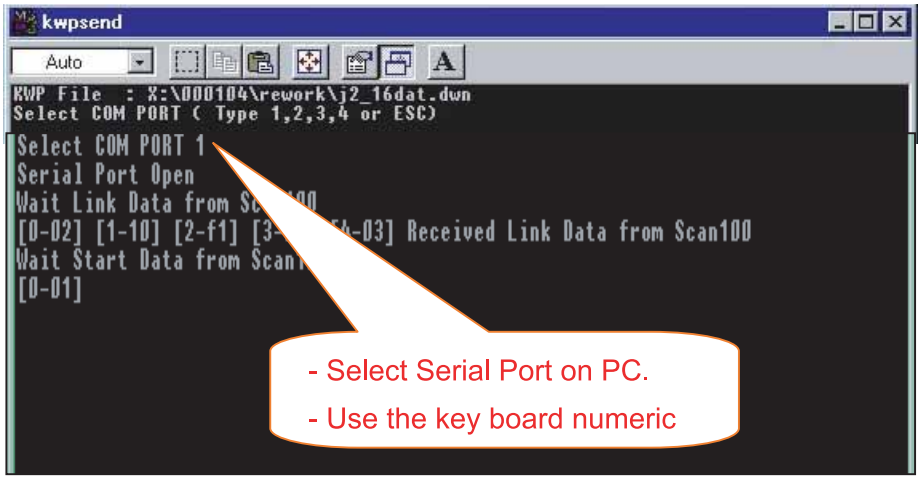
5. Select the file to be matched with your vehicle model and drag it onto the “KWPSEND.EXE” file.

7



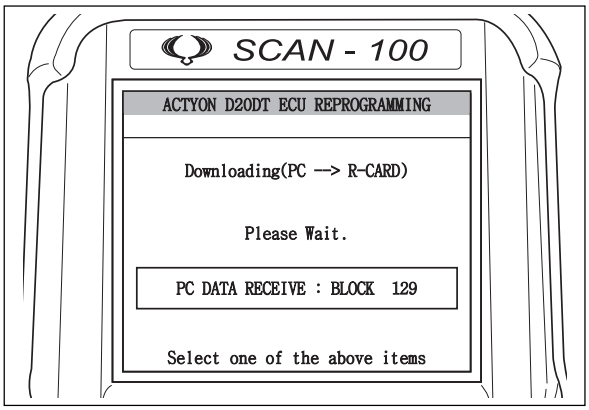
6. Key-in the number of the COM PORT connected with SCAN-100 in the key board

8



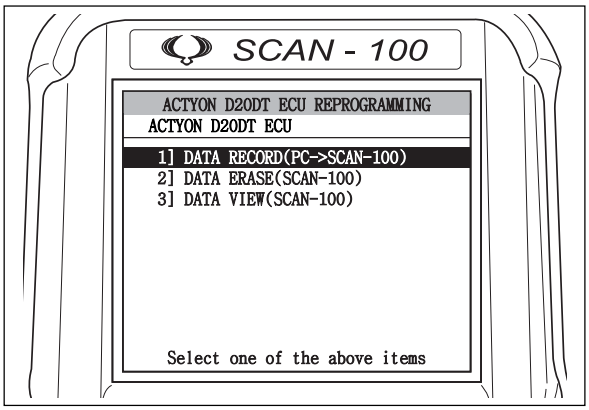
7. The SACN 100 shows below figure (Fig. 1-2) while successful downloading

1



Select "2"

2



(Fig. 1-2)

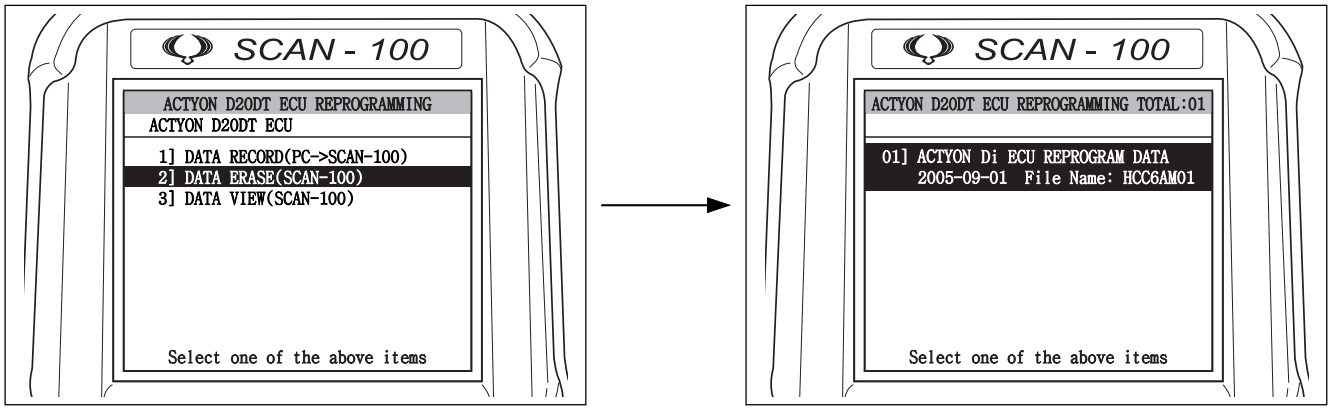
8. Repeat the Step 4 through Step 7 for downloading the reprogramming data of the other vehicle model.

No.	VEHICLE MODEL	FILE NAME	VEHICLE STATUS
1	CHAIRMAN 2.3 NAG (A/T)	DT1742G$.SYN	T1
2	CHAIRMAN 2.3 BTRA (A/T)	DZ1742G$.SYN	Z1
3	CHAIRMAN 2.8	DF1742O$.SYN	F1
4	CHAIRMAN 3.2	DG1742V$.SYN	G1
5	REXTON 2.8	DI1742T$.SYN	I1
6	REXTON 3.2 GENERAL AREA	DH1742P$.SYN	H1
7	REXTON 3.2 WESTERN EUROPE (EURO III REGULATION)	DH37427$.SYN	H3
8	MUSSO/KORANDO 3.2 GENERAL AREA	DS1742P$.SYN	S1
9	MUSSO/KORANDO 3.2 WESTERN EUROPE (EURO III REGULATION)	DS3742S$.SYN	S3
10	KYRON D20DT ECU	HCC6AM01.SYN	

3. R-Card Data Erase (SCAN-100)

This mode is to erase the data saved in R-CARD of SCAN-100

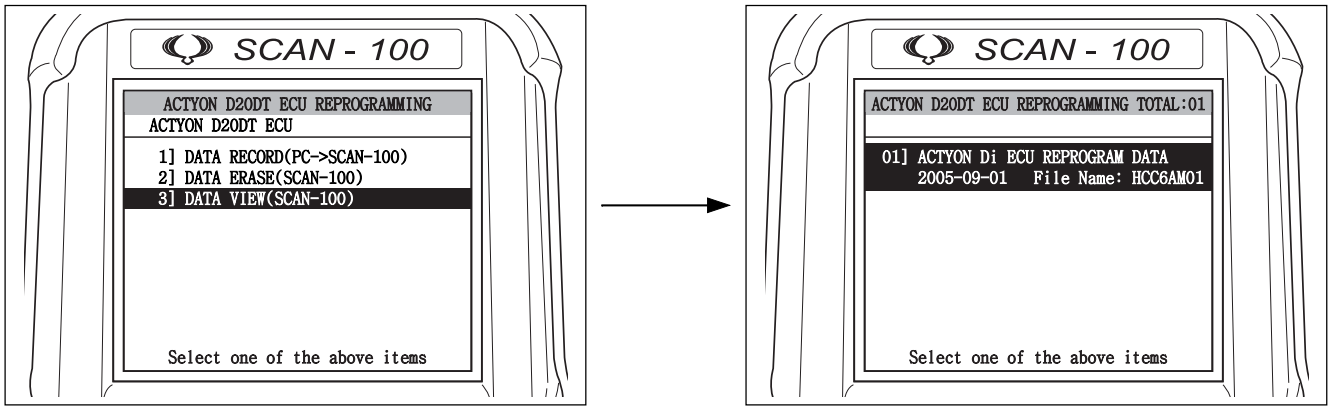
Input the number you want to erase directly or move the cursor to which you want to erase and press "ENTER" key.



It is possible data scroll using the "▲, ▼" key.

4. R-Card Data View (SCAN-100)

This mode is to confirm data which is saved in R-CARD of SCAN-100.

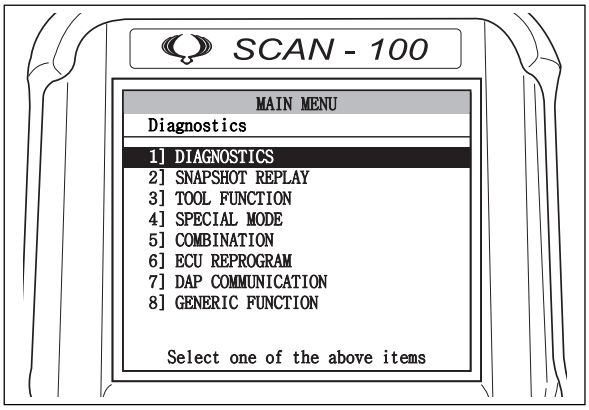


It is possible data scroll using the "▲, ▼" key.

5. ECU Reprogram (SCAN-100 to ECU) - DSL

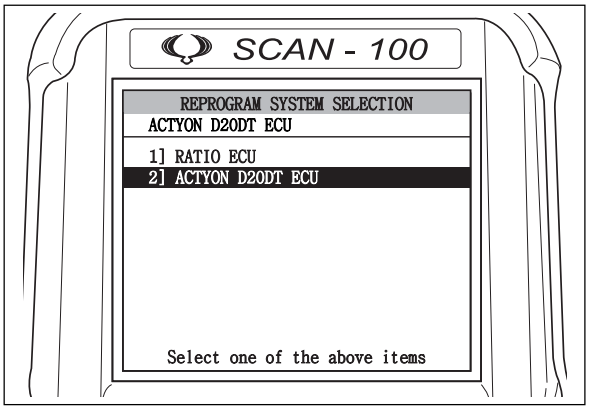
1. Check the vehicle to be reprogrammed.
2. Connect the SCAN-100 to the diagnostic connector of the vehicle.

1

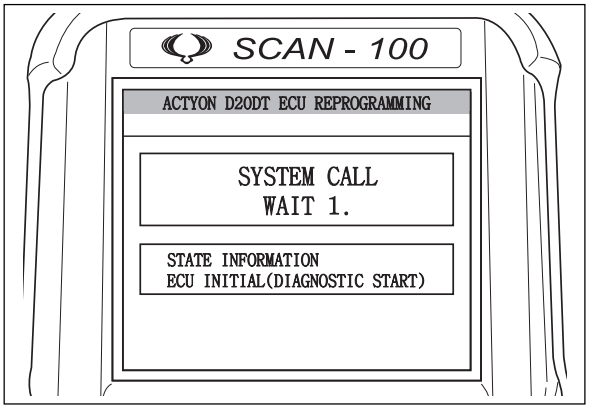


Select "1"

2

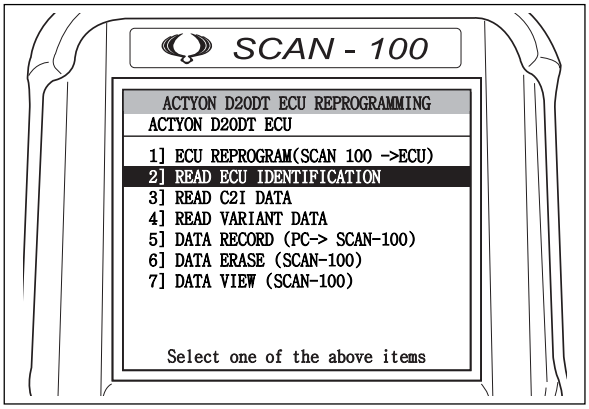


3



after 1sec.

4



Check the ECU S/W Number

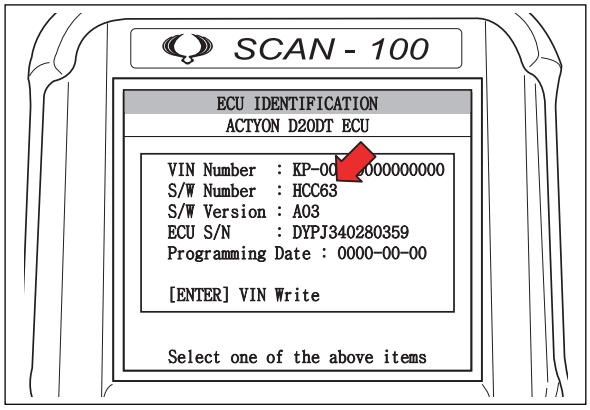
Next page

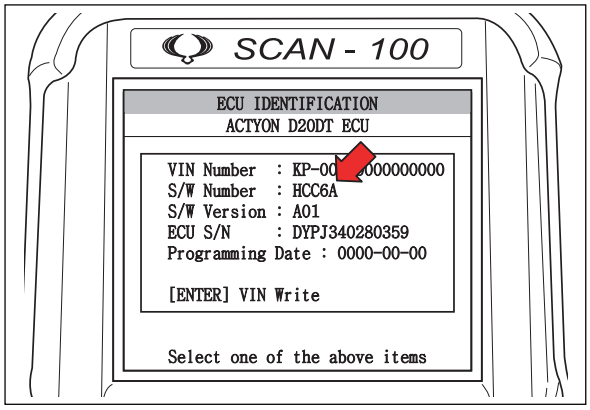
Preceding page

S/W Number: HCC63, HCC67 or HCC69

S/W Number: HCC6A

5





after 1sec.

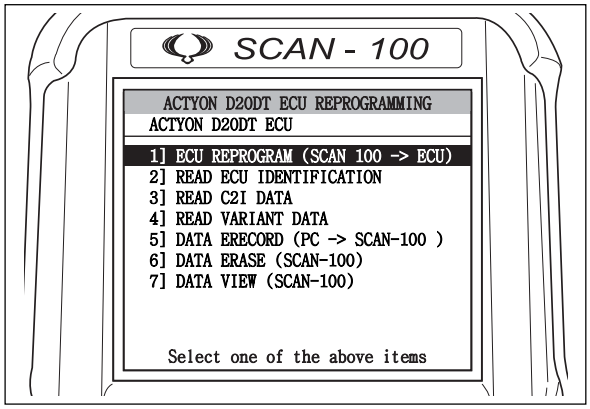
If the S/W Number is HCC6A,

Not necessary, already updated

Select “6”

Exit the ECU REPRORGRAMMING PROCEDURE

6



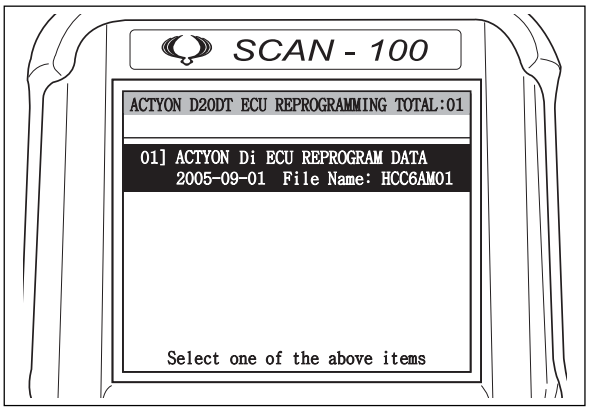
after 1sec.

Next page

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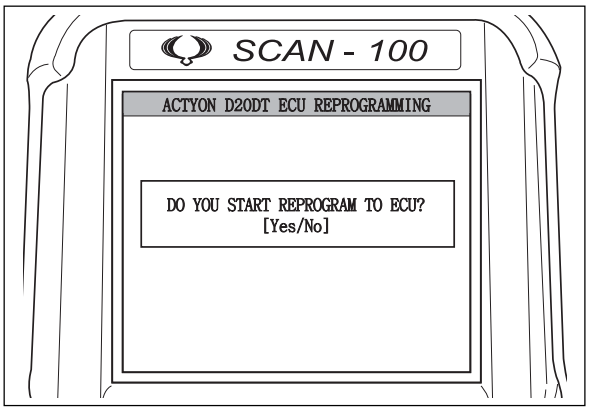
Select “1”

7



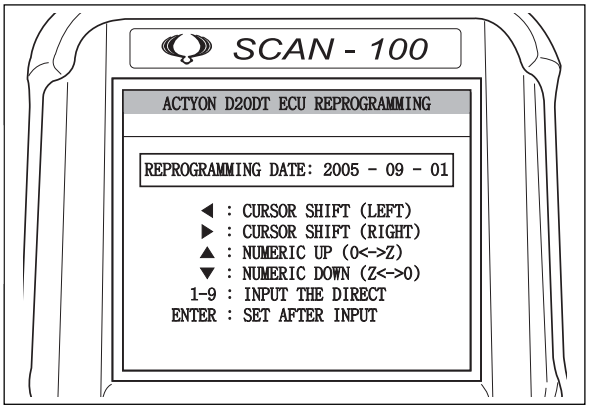
ENTER

8



“Yes”

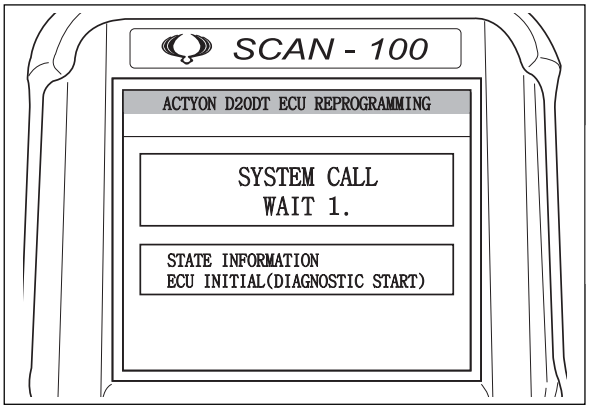
9



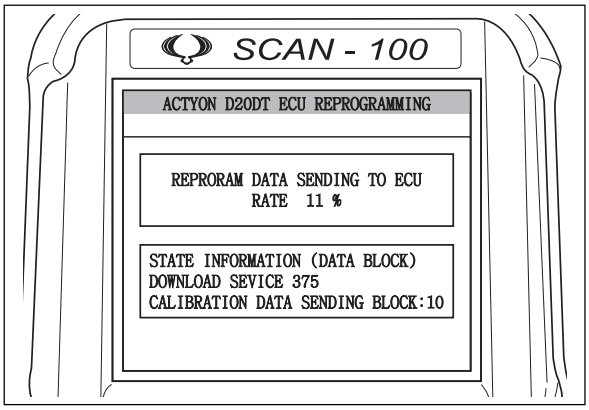
Input the reprogramming date

ENTER

10

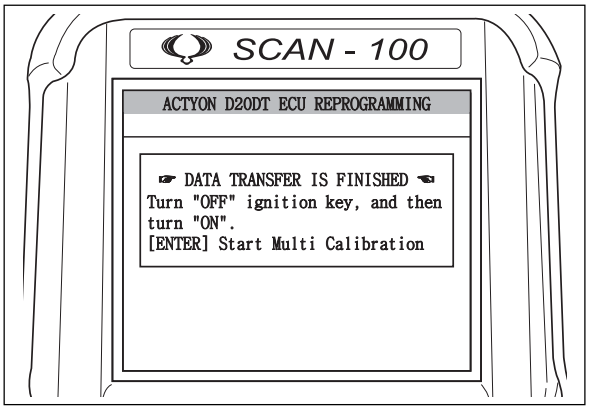


11



After Finish

12



Next page

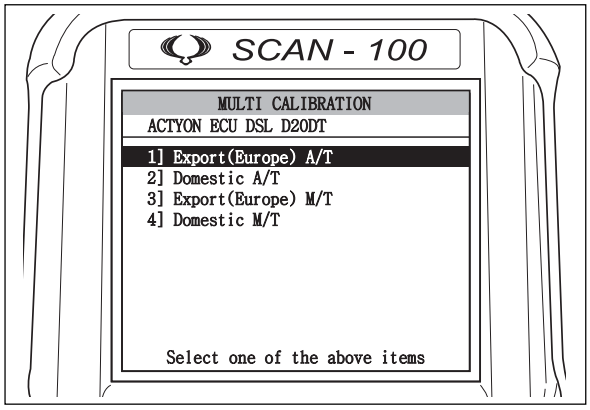
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EFFECTIVE DATE	
AFFECTED VIN	

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CAUTION

- **Take care that do not power off and disconnect the scan tool when the boot block is reprogrammed. ECU can be damaged.**

13



If the target vehicle has the automatic transmission, you have to select No. 1(Euro Ver.) or No.2 (Non Euro Ver.)

If the target vehicle has the manual transmission, you have to select No. 3 (Euro Ver.) or No.4 (Non Euro Ver.)

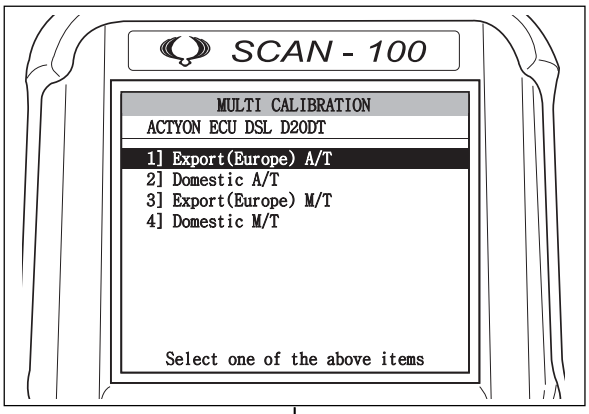
Next page

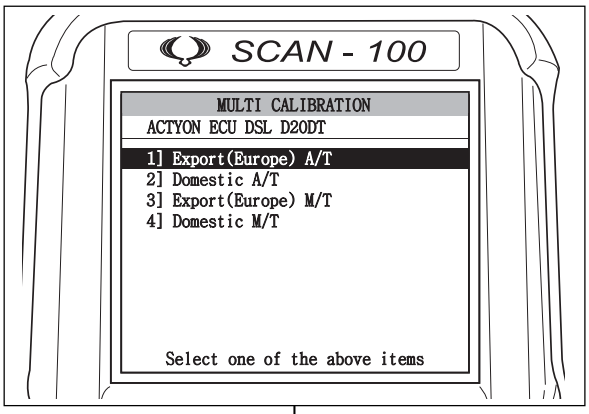
Preceding page

A/T Vehicle

M/T Vehicle

14

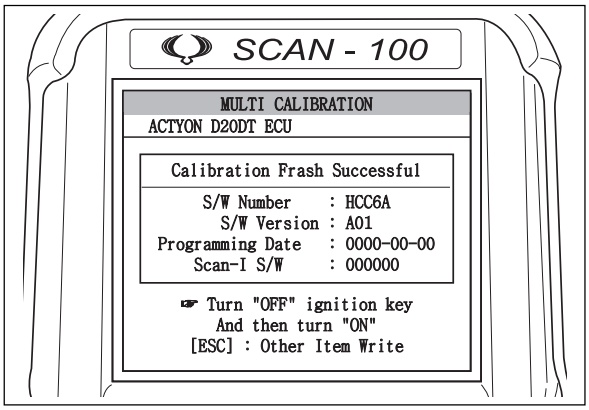




A/T Vehicle

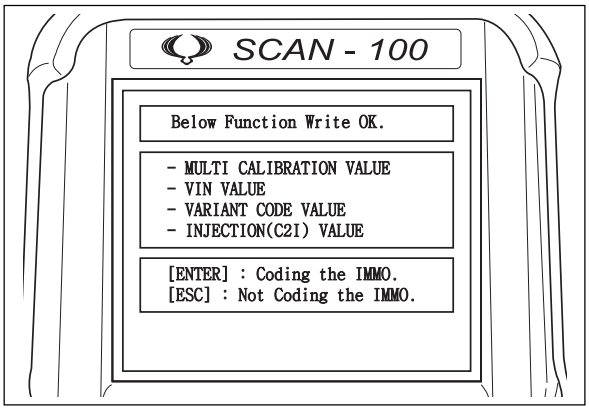
M/T Vehicle

15



Press
"ESC"

16



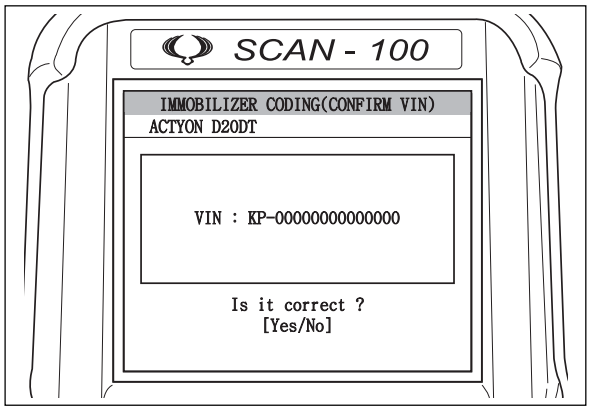
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EFFECTIVE DATE	
AFFECTED VIN	

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With Immobilizer system
=> Press “ENTER”

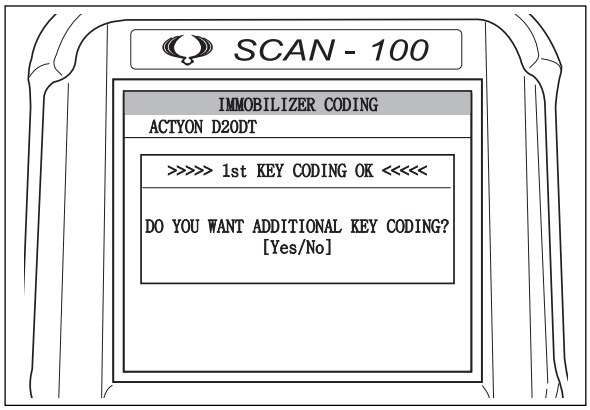
Without Immobilizer
System => Press “ESC”

17



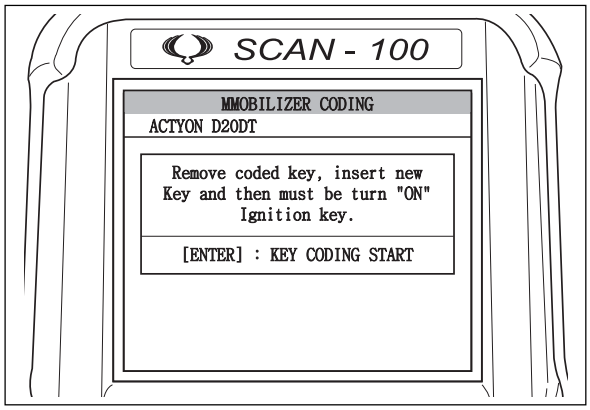
“Yes”

18



“Yes”

19



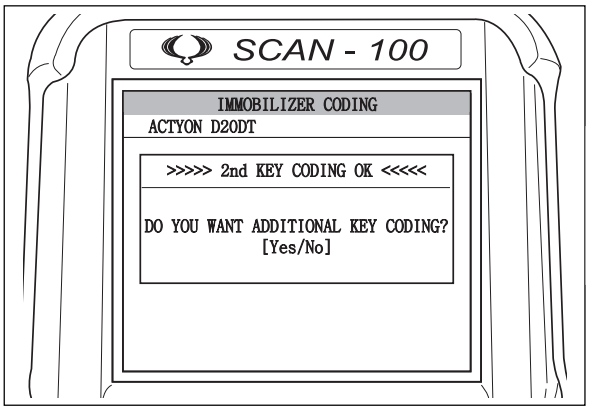
Next page

Next page

Preceding page

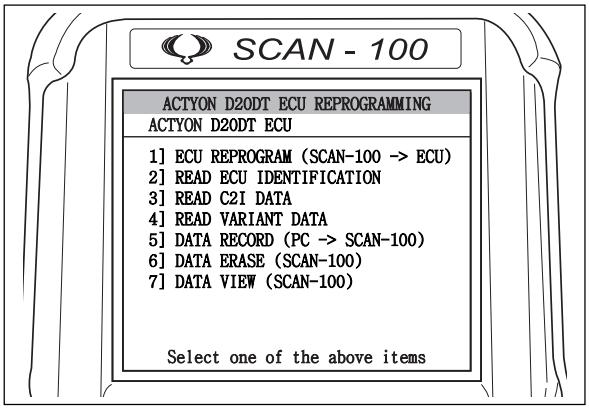
Preceding page

20



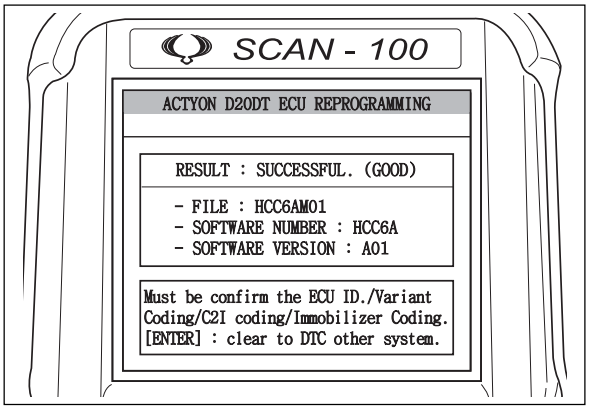
"No"

22



"ENTER"

21

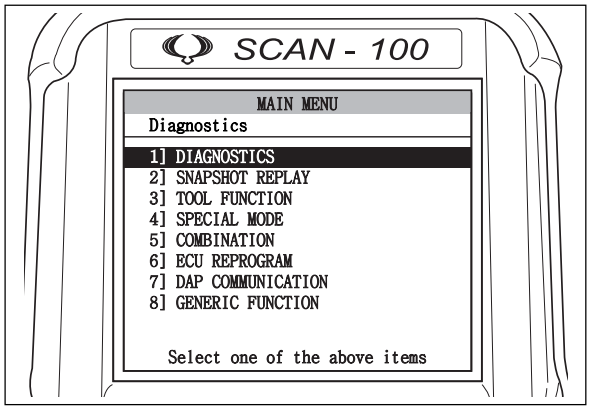


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EFFECTIVE DATE	
AFFECTED VIN	

6. ECU Reprogram (SCAN-100 to ECU) - GSL

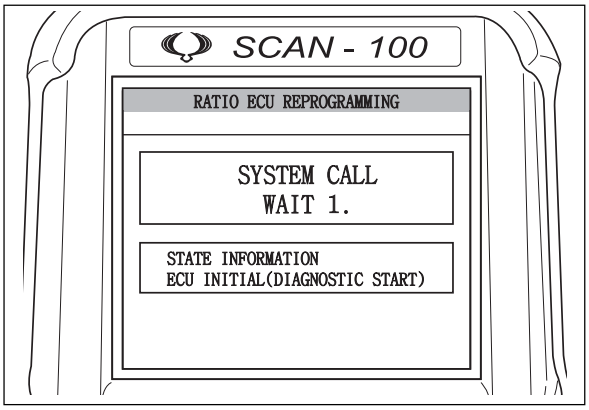
1. Check the vehicle to be reprogrammed.
2. Connect the SCAN-100 to the diagnostic connector of the vehicle.

1



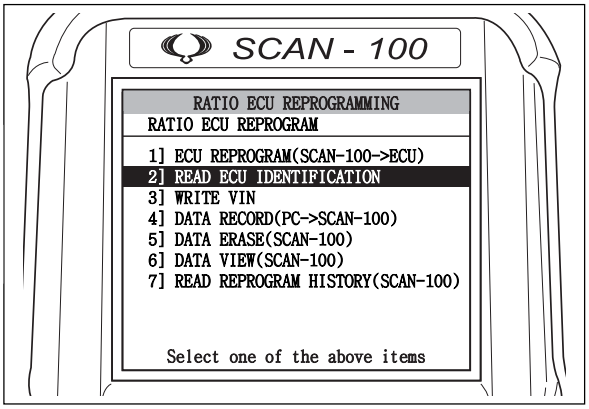
Select “1”

2



after 1sec.

3



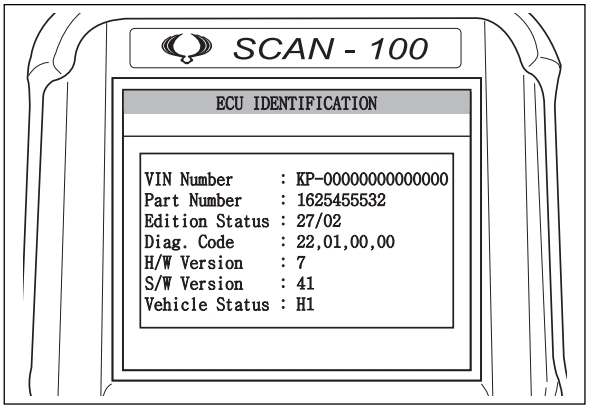
Check the “Vehicle Status” is H1 or h1

Next page

Next page

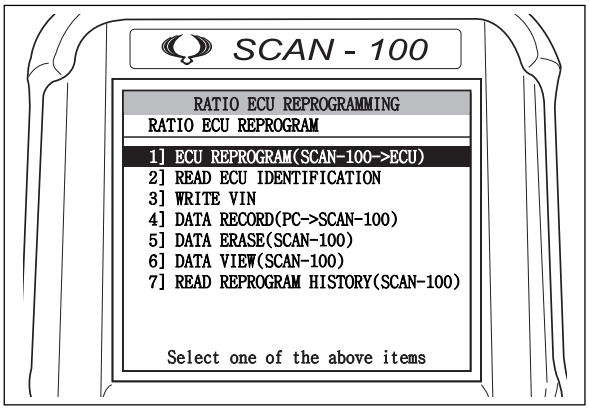
Preceding page

4



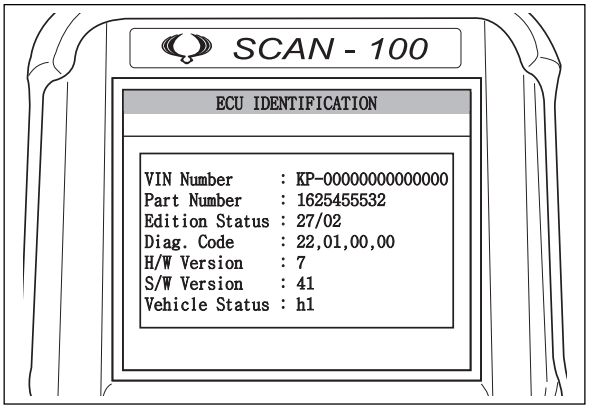
If vehicle status is H1 (Large Alphabet), start reprogram

5



Next page

Preceding page



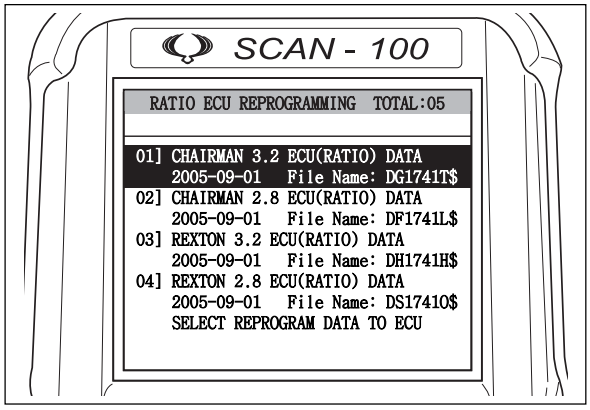
If the vehicle status is h1 (Small Alphabet),

DO NOT REPROGRAM !!!

Exit the ECU REPRORGRAMMING PROCEDURE

Preceding page

6

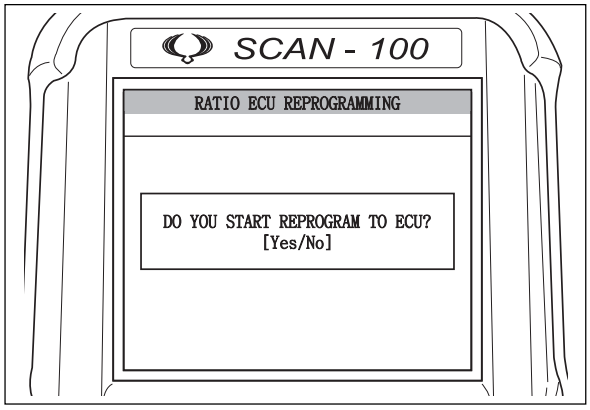


It is possible data scroll using the "▲, ▼" key.

05] MUSSO / KORANDO 3.2 ECU(RATIO)

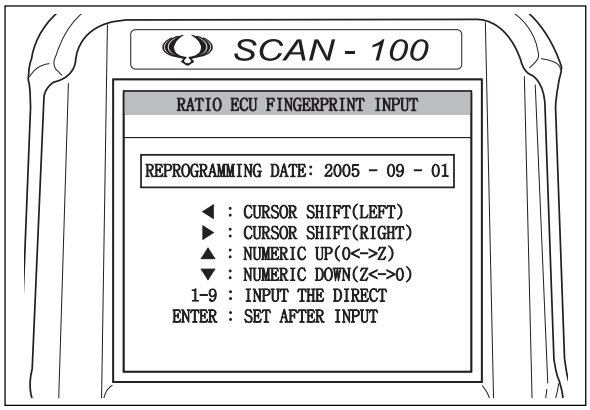
Select Vehicle

7



Select "Yes"

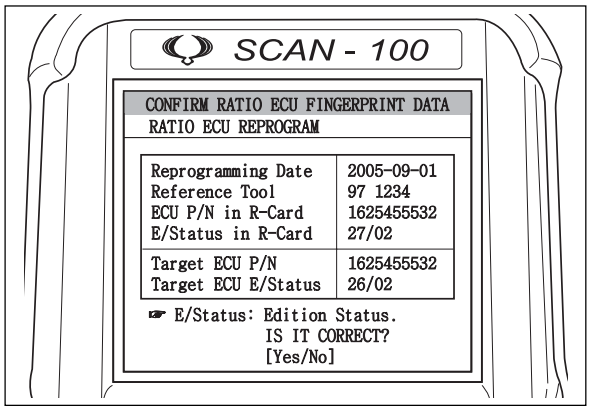
8



Input the reprogramming date

"ENTER"

9



Confirm the P/N of ECU and Reprogramming

Date

ECU P/N	
- CHAIRMAN 2.8	: 162 545 7532
- CHAIRMAN 3.2	: 162 545 7332
- REXTON 2.8	: 162 545 7932
- REXTON 3.2	: 162 545 5532
- MUSSO/KORNAND 3.2	: 162 545 6232

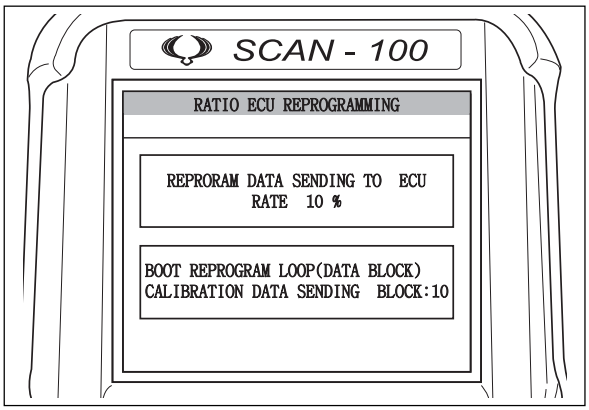
Select "Yes"
Start to Reprogram

Select "No"
Select the correct ECU version

Next page

Preceding page

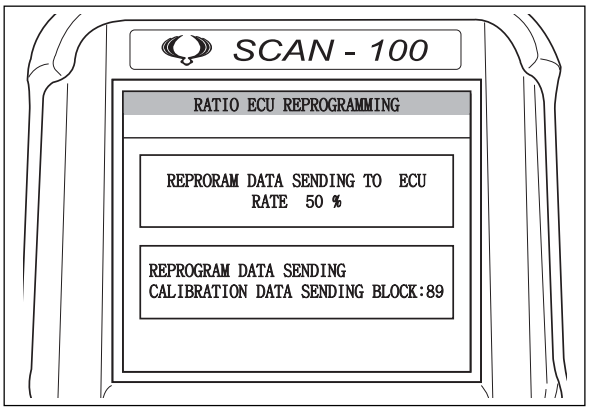
10



(BOOT BLOCK REPROGRAM)

After Finish

11



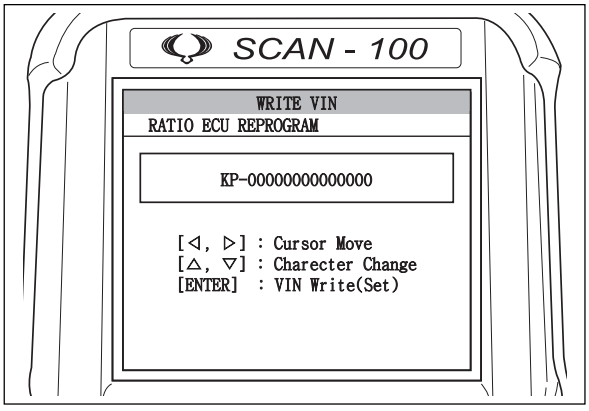
(S/W BLOCK REPROGRAM)

CAUTION

- **Take care that do not power off and disconnect the scan tool when the boot block is reprogrammed. Error on boot block lead to replacement the ECU**

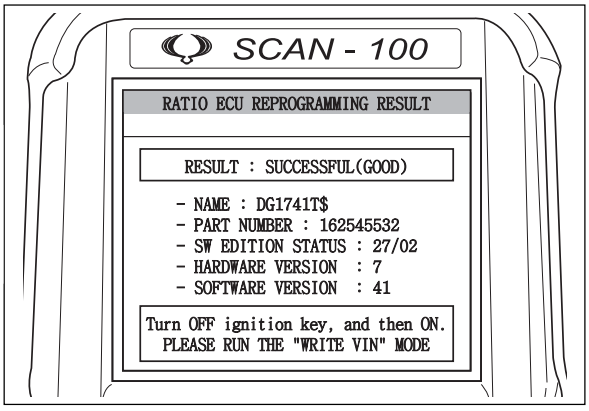
Reprogram OK

13



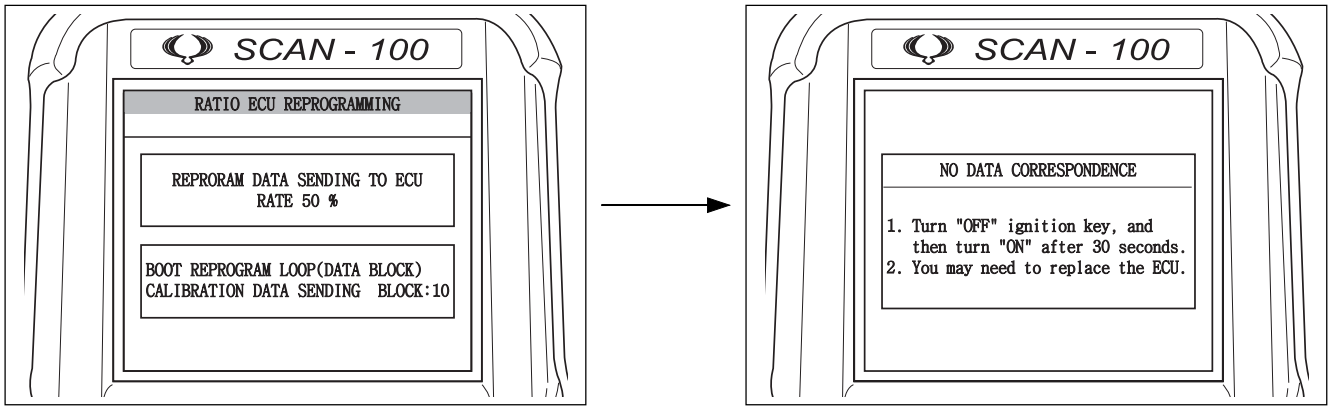
Press Any Key

12

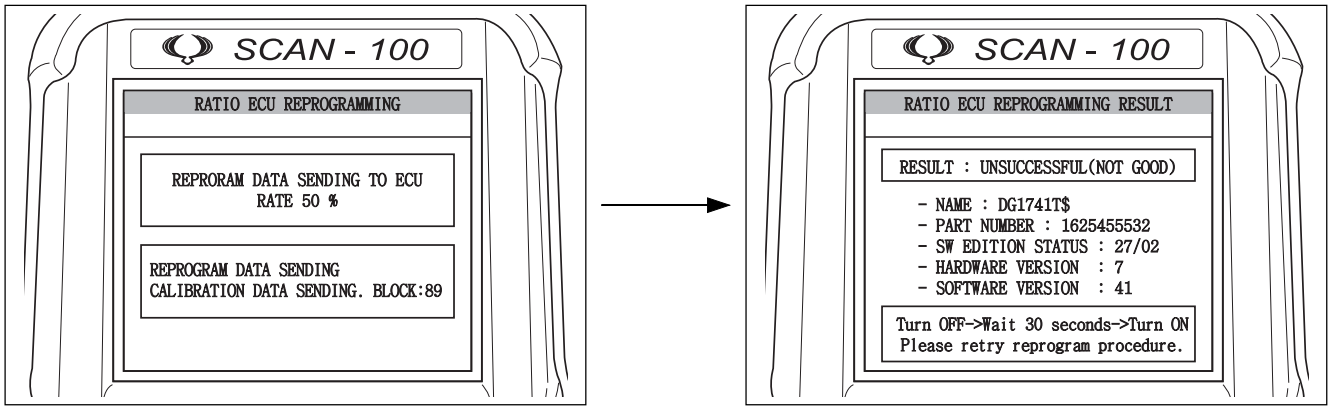


In Case of Unsuccessful (Not Good)

CASE 1: Error when “The Boot Block” is reprogrammed.

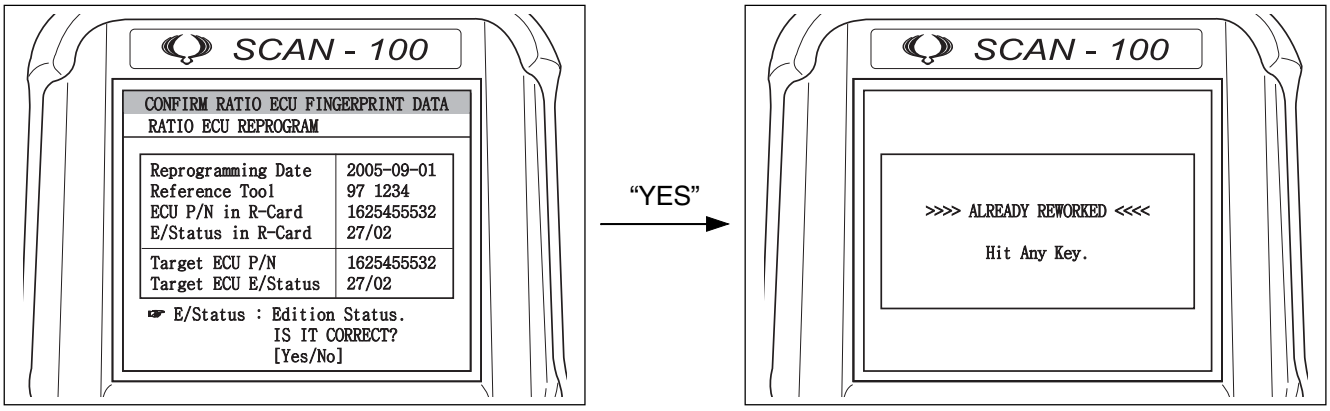


CASE 2: Error when “The S/W Block” is reprogrammed.

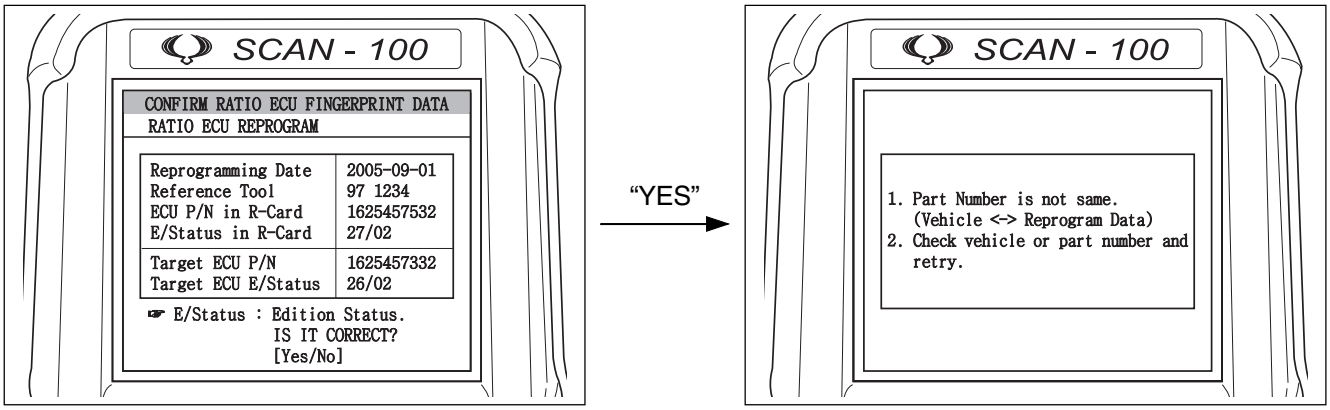


In Case of Reprogram not Allowed.

CASE 1: When ECU is already reprogrammed.

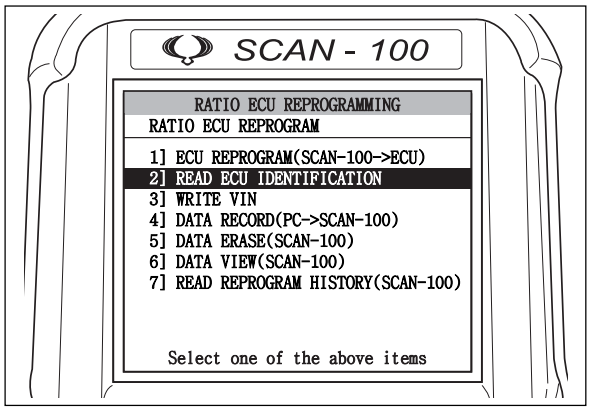


CASE 2: When Part Number(ECU S/W Type) is not same of ECU and selected data.

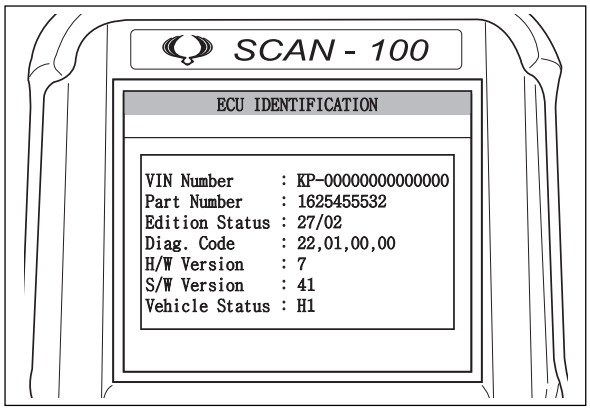


☞ When press "ESC" key, Return to main menu. ☜

Read ECU Identification



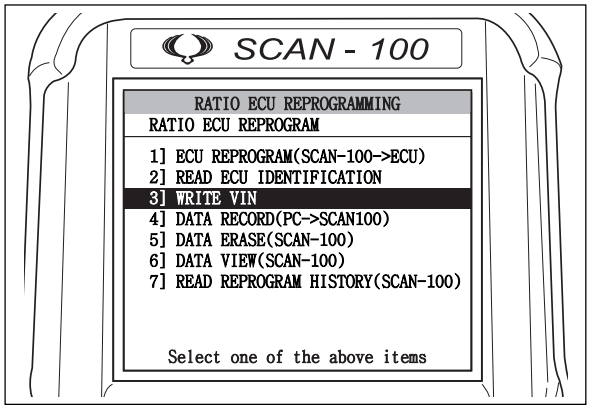
Select “2”



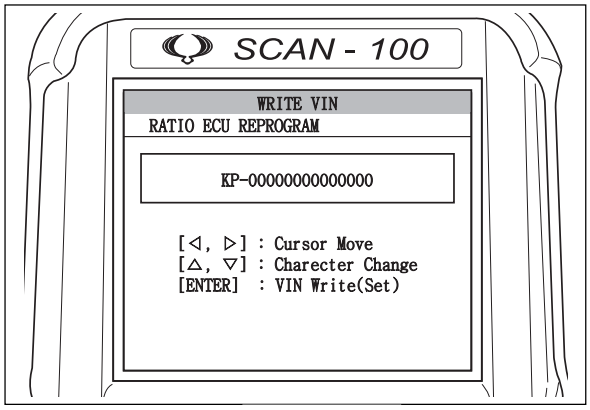
VEHICLE STATUS

- CHAIRMAN 2.8 : F1
- CHAIRMAN 3.2 : G1
- REXTON 2.8 : I1
- REXTON 3.2 : H1
- MUSSO/KORNAND 3.2 : S1

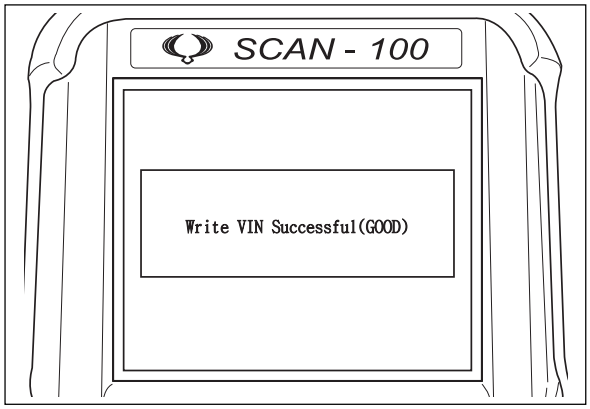
Write VIN



Select “3”

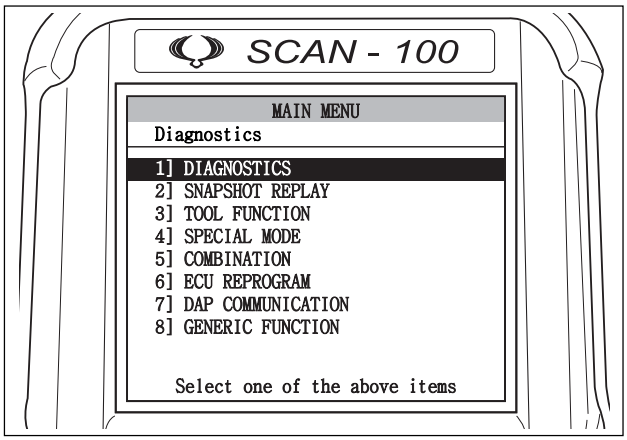


Select “Yes”

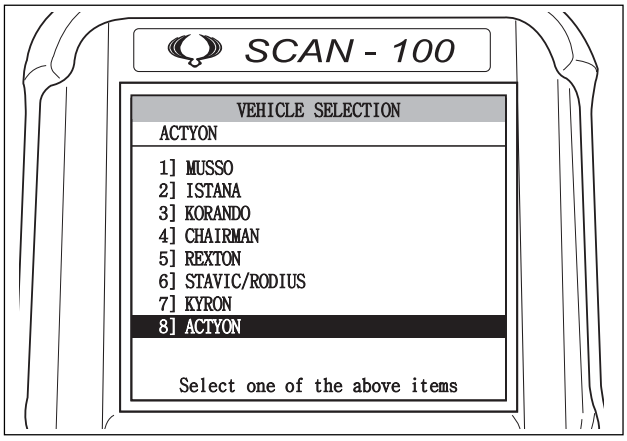


ENTERING DIAGNOSIS PROCEDURES

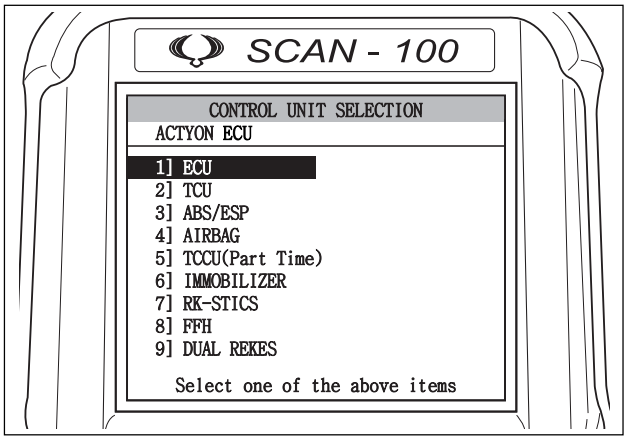
1. Select “1] DIAGNOSIS” and press “ENTER” in “MAIN MENU” screen.



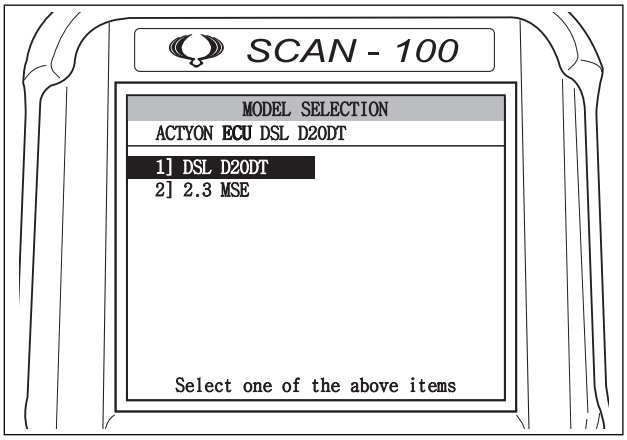
2. Select “7] KYRON” and press “ENTER” in “VEHICLE SELECTION” screen.



3. Select “1] ECU” and press “ENTER” in “CONTROL UNIT SELECTION” screen.

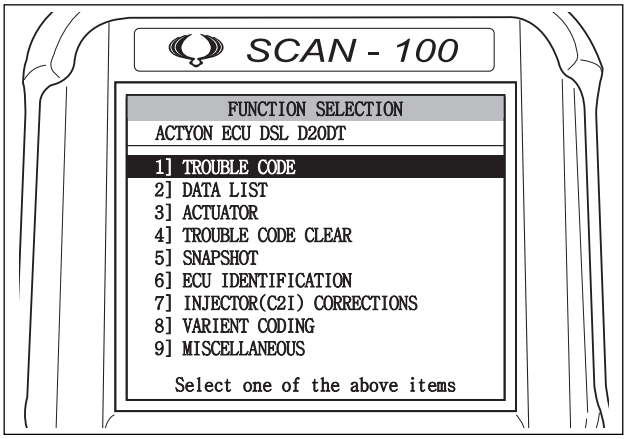


4. Select “1] DSL D20DT" in [MODEL SELECTION] screen and press “ENTER” .



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AFFECTED VIN	

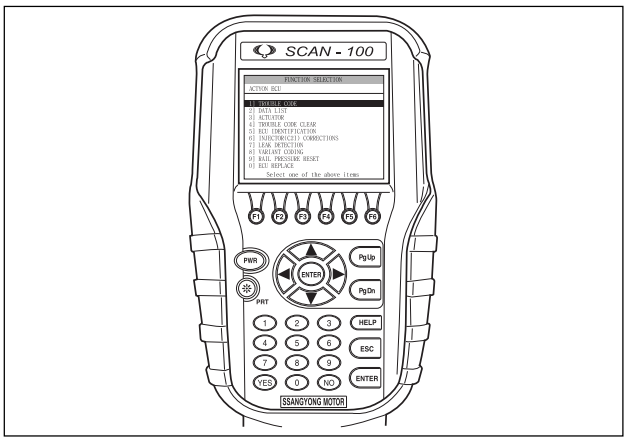
5. The “FUNCTION SELECTION” screen is displayed.



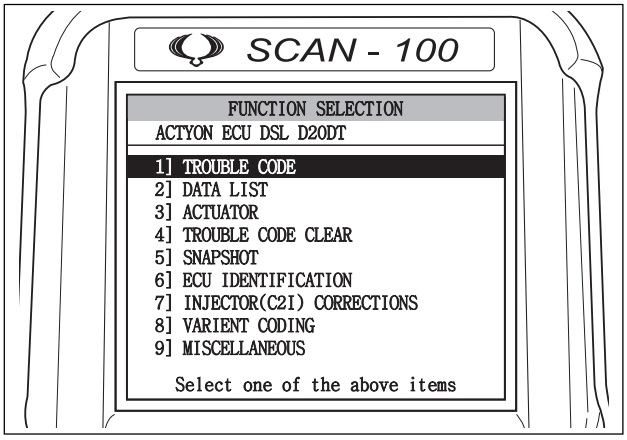
FUNCTION SELECTION

Check the Trouble Code

※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”



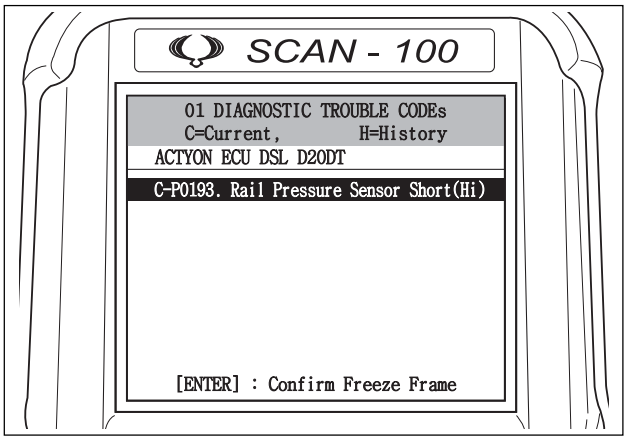
1. Select “1] TROUBLE CODE” and press “ENTER” in “FUNCTION SELECTION” screen.



2. The “DIAGNOSTIC TROUBLE CODEs” screen is displayed and it shows the trouble.

NOTE

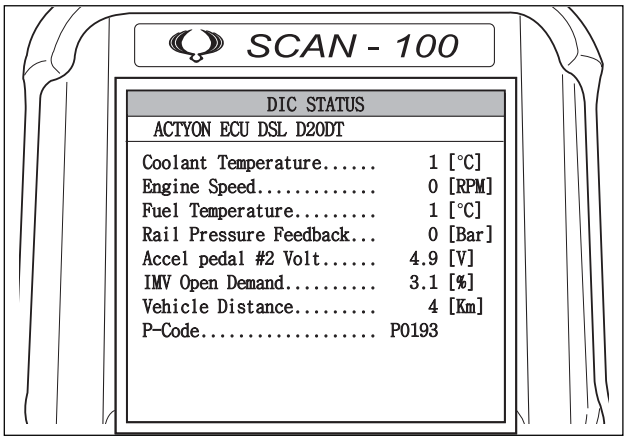
- **If there is not any fault, “NO TROUBLE DETECTED” message appears.**



3. When selecting a trouble code, then

   if you press “(ENTER)”: Displays the sensor data for the detected trouble (Freeze Frame Mode).

   if you press “(HELP)”: Displays the help tips for the detected trouble.



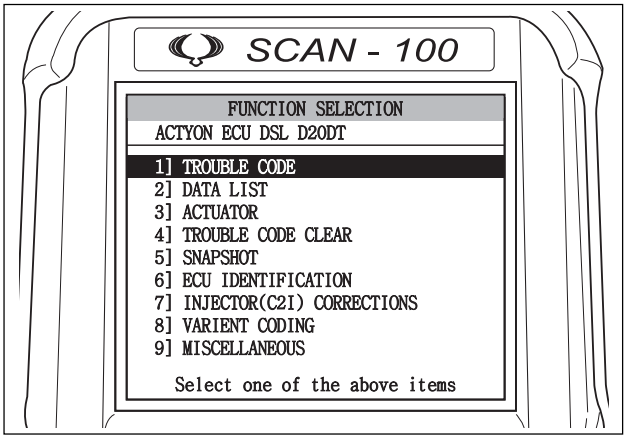
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Sensor Data Check

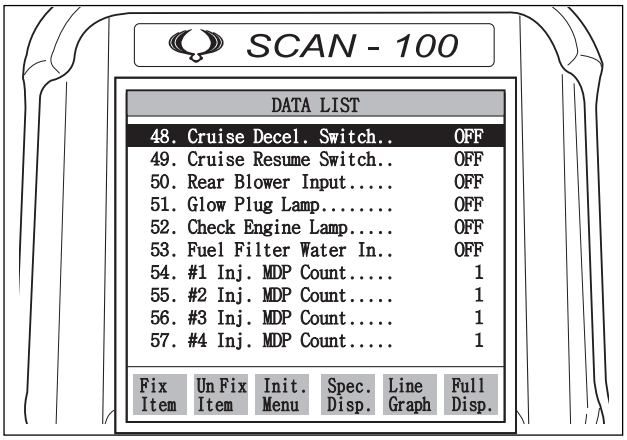
※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”



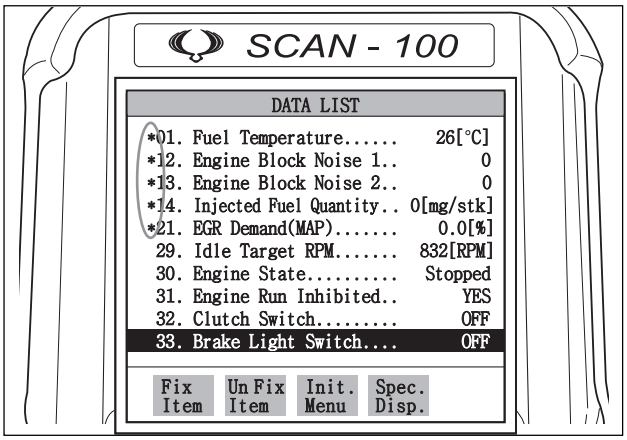
1. Select “2] DATA LIST” and press “ENTER” in “FUNCTION SELECTION” screen.



2. The screen shows approx. 57 sensor data.



3. Select the items you want to see and press “F1” key to freeze them.

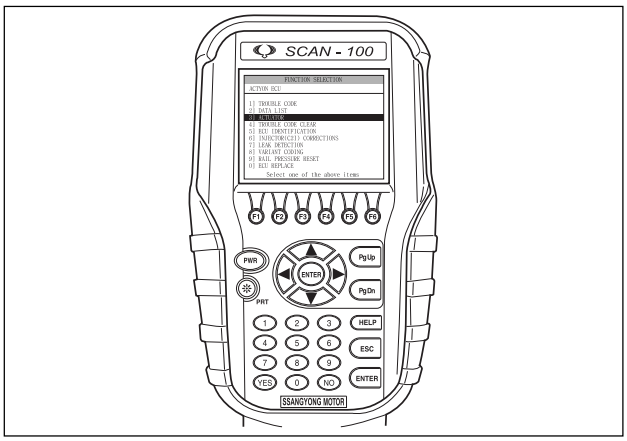


NOTE

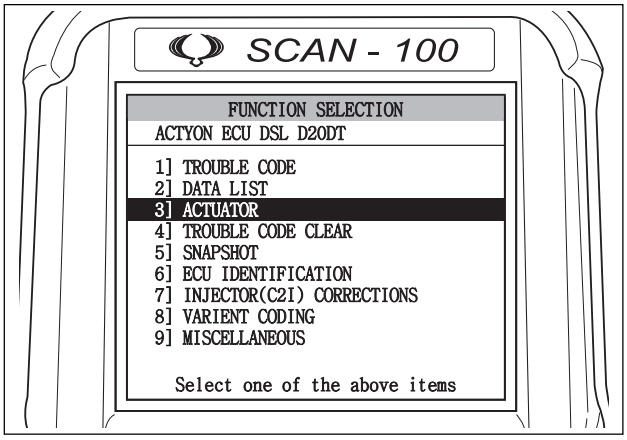
- **You can freeze up to 5 items (*: selected items).**

Actuator Check

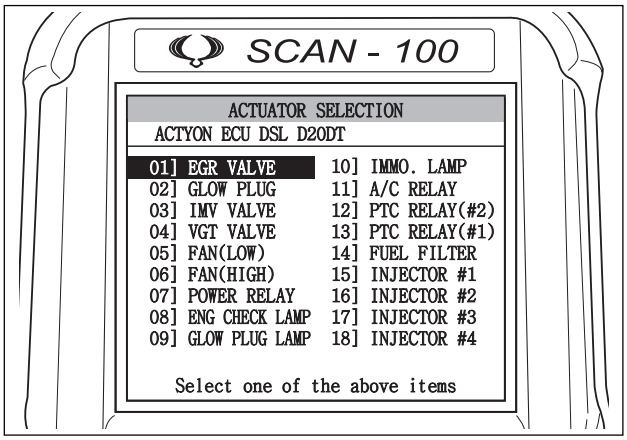
※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”



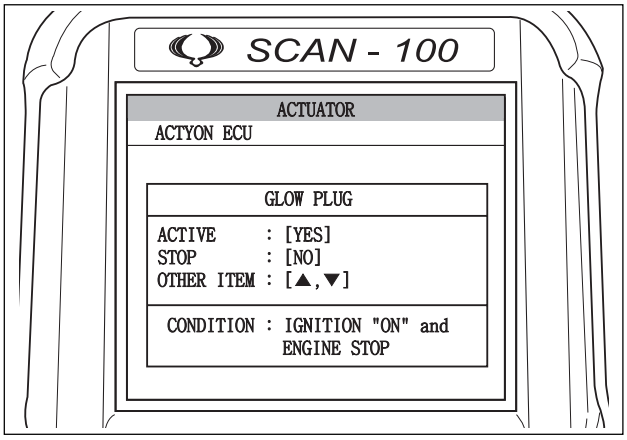
1. Select “3] ACTUATOR” and press “ENTER” in “FUNCTION SELECTION” screen.



2. The screen shows 19 items. Select the item you want to see and press “ENTER”.

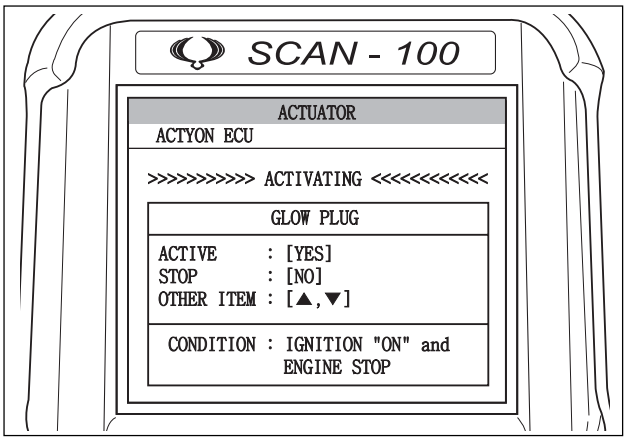


3. For example, if you select “02] GLOW PLUG” item and press “ENTER”, the screen as shown in figure is displayed.

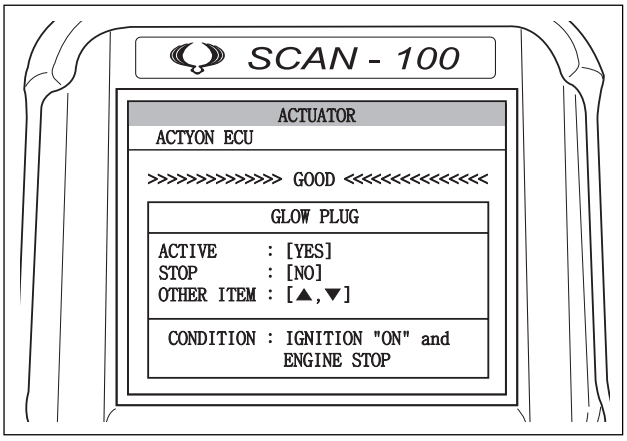


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EFFECTIVE DATE	
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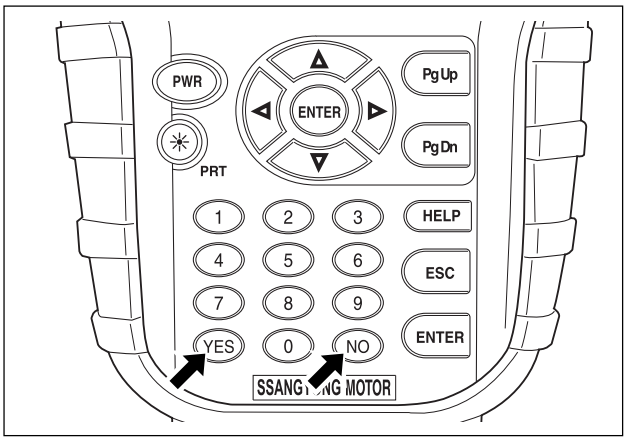
4. If you want to operate the glow plug relay, press "YES" key. The "ACTIVATING" message appears and the relay operation alarm sounds.



5. If the system operates normally, Scan-100 displays "GOOD".

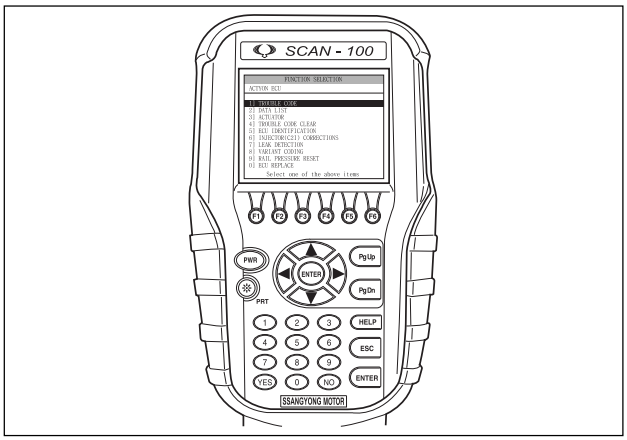


6. If you want to stop the operation press "NO" key in keyboard.

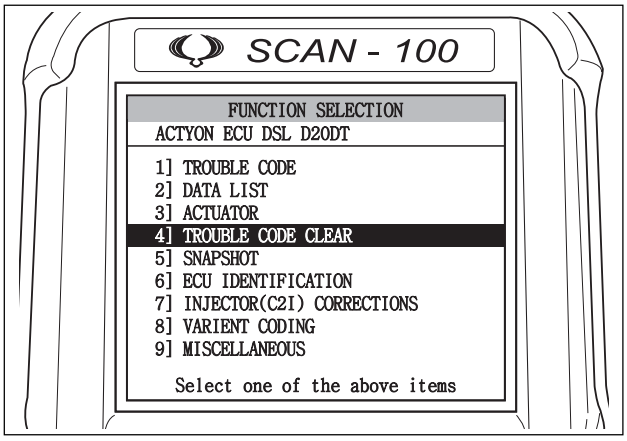


Trouble Code Clear

※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”

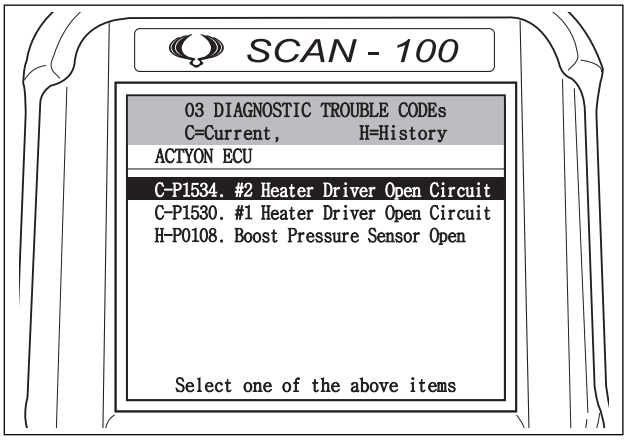


1. Select “1] TROUBLE CODE” and press “ENTER” in “FUNCTION SELECTION” screen.

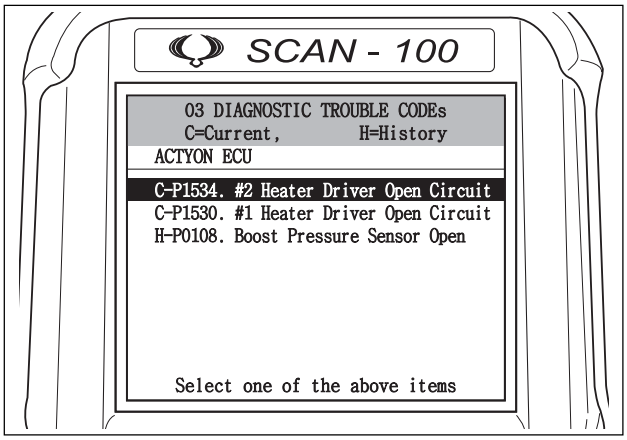


2. The “DIAGNOSTIC TROUBLE CODEs” screen is displayed and it shows the trouble.

NOTE
- **C = Current trouble, H = History trouble**

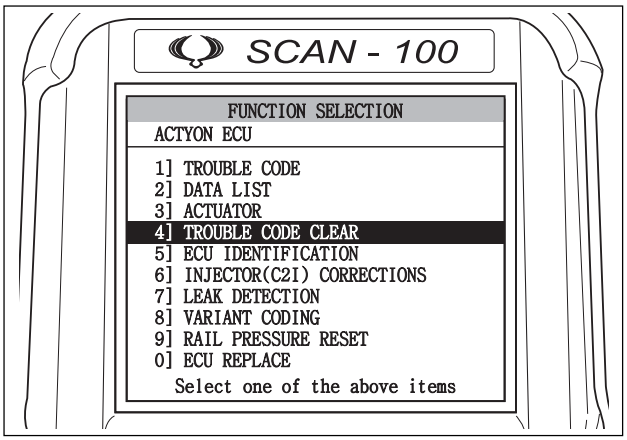


3. Fix the trouble and go back to “1] TROUBLE CODE” screen and check if the trouble has been changed to “H (History trouble code)” code.

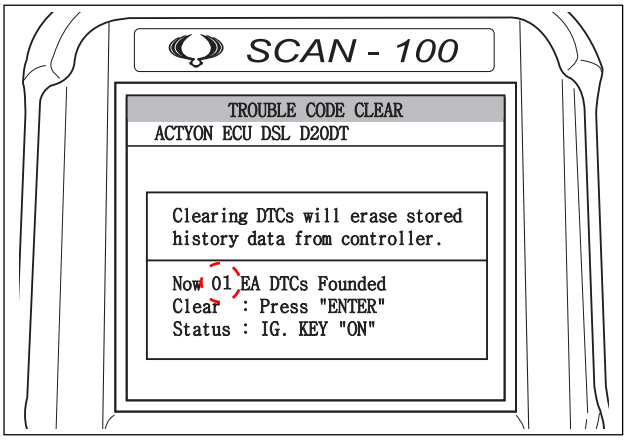


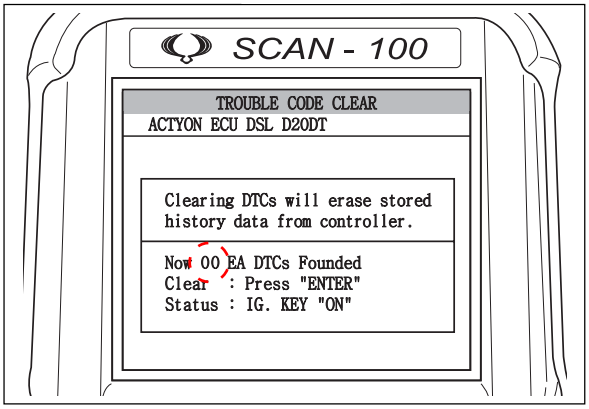
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. If the trouble has been change to “H (History trouble code)” code, press “ESC” key to go back to “FUNCTION SELECTION” screen. In this screen, select “4] TROUBLE CODE CLEAR” and press “ENTER”.



5. The “TROUBLE CODE CLEAR” screen is displayed. If you press “ENTER”, only the history trouble codes will be cleared.



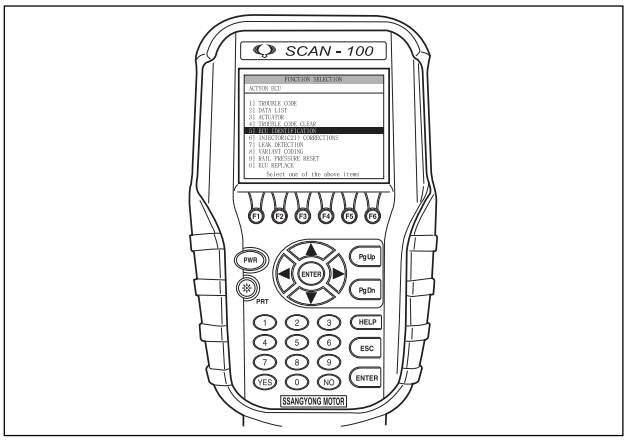


NOTE

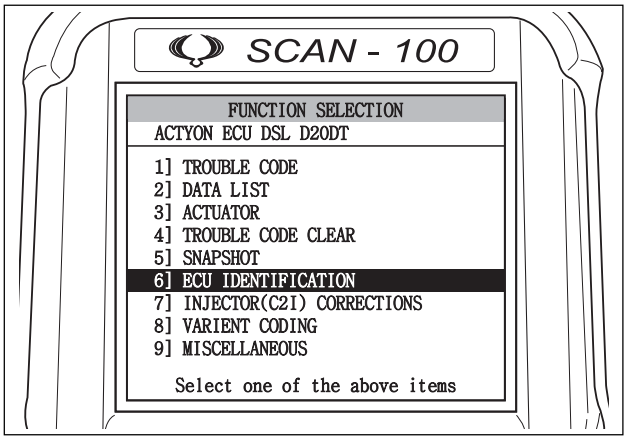
- **Current trouble codes will not be cleared.**
- **Check the trouble codes after clearing the trouble codes.**

ECU Identification

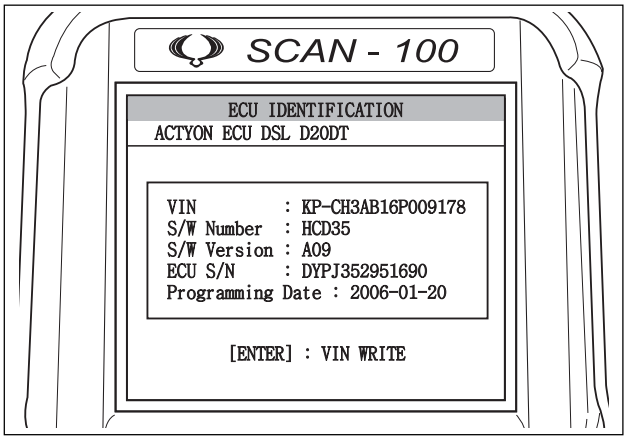
※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”



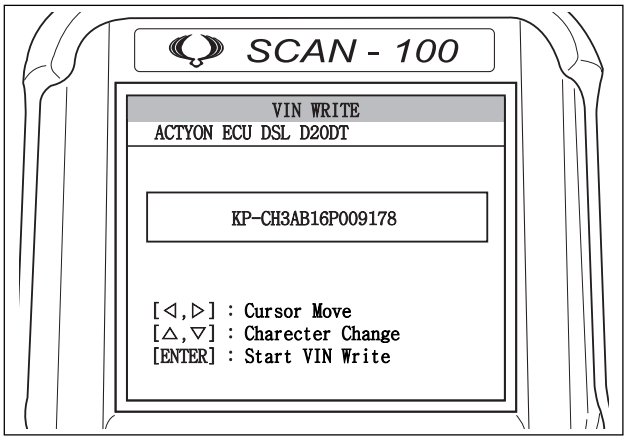
1. Select “5] ECU IDENTIFICATION” and press “ENTER” in “FUNCTION SELECTION” screen.



2. The “ECU IDENTIFICATION” screen that shows the VIN, ECU software number, ECU software version and programming date is displayed.



3. If you replaced the ECU, press “ENTER” to input the vehicle identification number.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Injector (C2I) Corrections

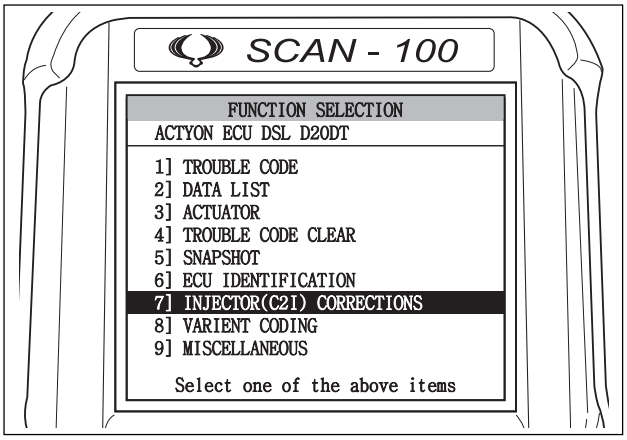
※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”

NOTICE

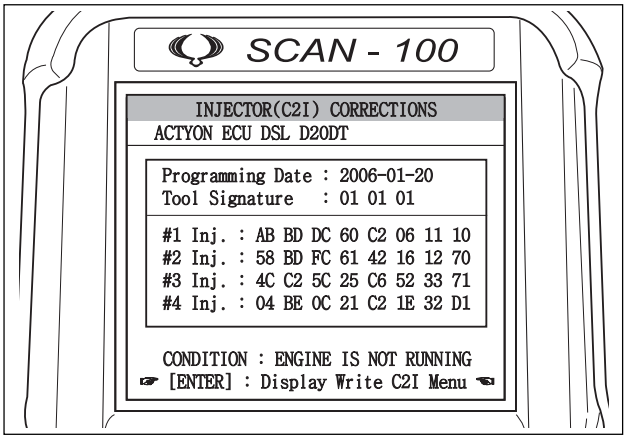
- **If the injector/ECU has been replaced or the injector system defective is suspected, go to C2I Coding item and check the injector and coded injector C2I value.**



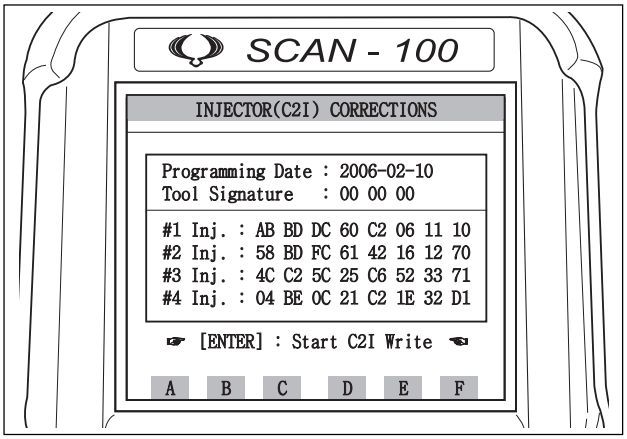
1. Select “6] INJECTOR (C2I) CORRECTIONS” and press “ENTER” in “FUNCTION SELECTION” screen.



2. The “INJECTOR (C2I) CORRECTIONS” screen that shows current C2I coding values of #1 to #4 injector is displayed.



3. If you replaced the ECU, enter the C2I value of the relevant injector.

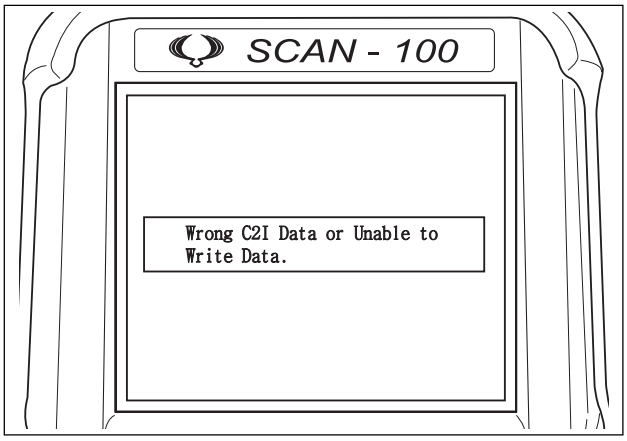


NOTE

- **The C2I value of replacing injector is recorded in the label.**
- **C2I coding number: 16 digits (ex, B1 B9 D4 1B 43 C6 0E 4F)**



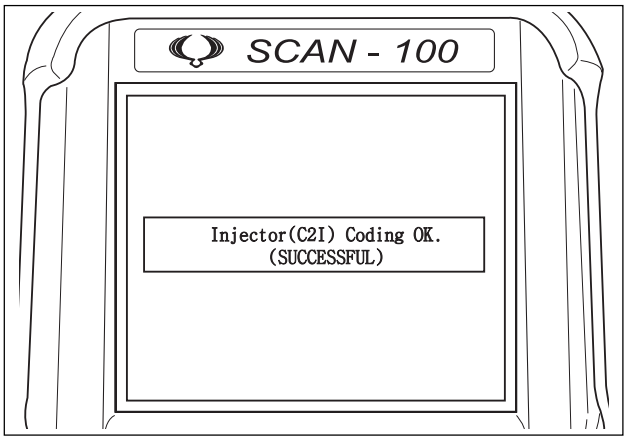
1) If you enter the invalid C2I value of the relevant injector, the message as shown in figure appears with alarm sound.



NOTE

- **If you want to go back to previous screen, press "ESC" key. You can see the previous C2I value.**

2) If you enter the valid C2I value of the relevant injector, the message as shown in figure appears with alarm sound.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

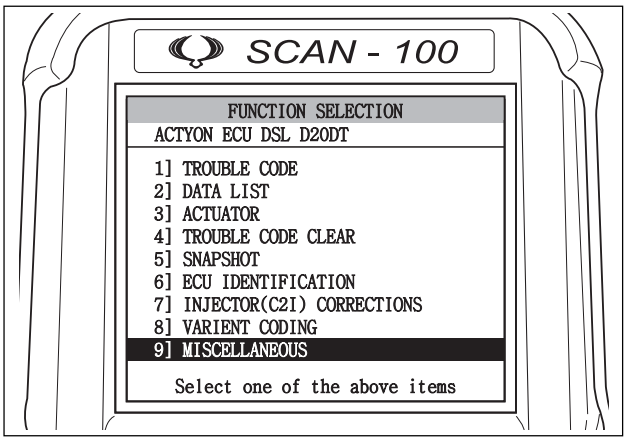
Leak Detection

※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”

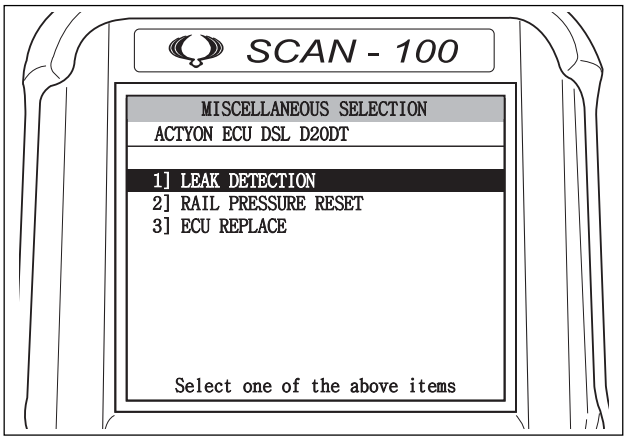
NOTE

- **This item is for checking the high fuel pressure after the IMV supply line of HP pump in DI engine fuel system. If you still suspect that the fuel pressure system is defective even after no trouble is detected, perform the fuel pressure test again by using a fuel pressure tool kit.**

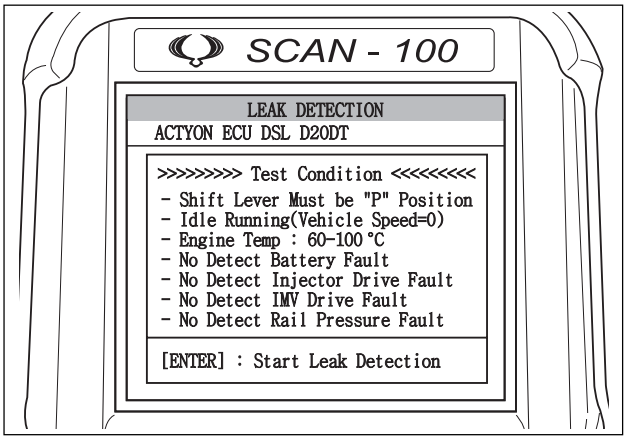




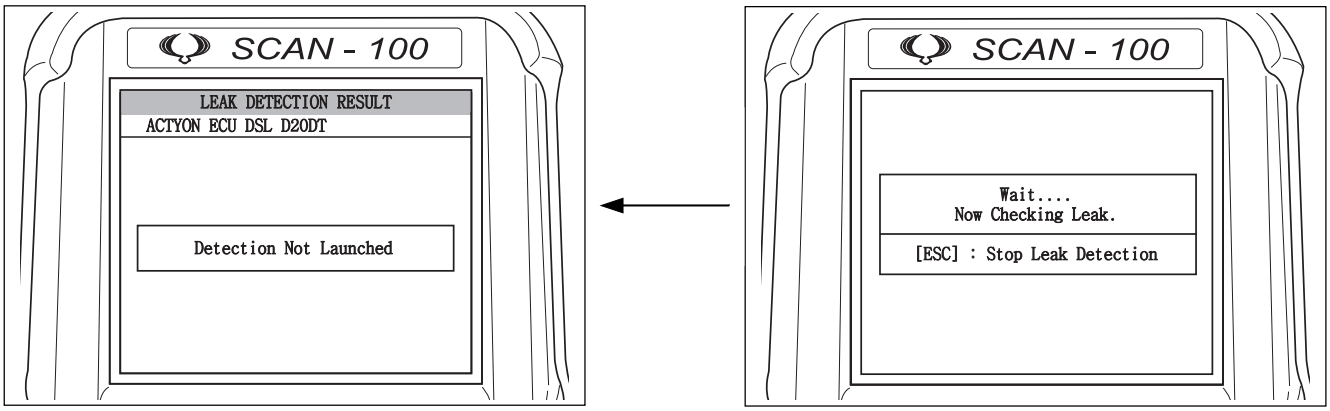
1. Select “1] LEAK DETECTION” and press “ENTER” in “FUNCTION SELECTION” screen.



2. The “LEAK DETECTION” screen that shows the checking conditions as shown in figure is displayed.



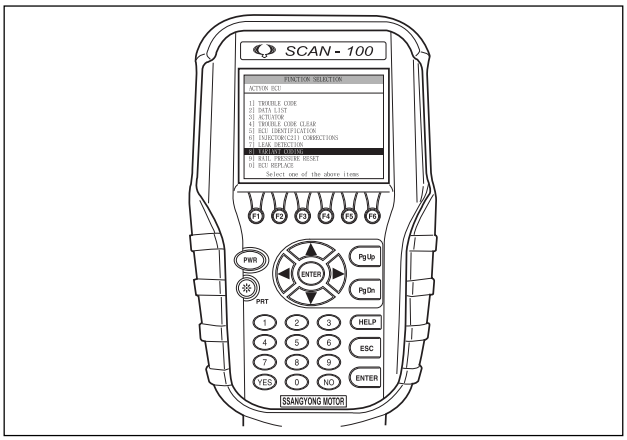
Preceding page



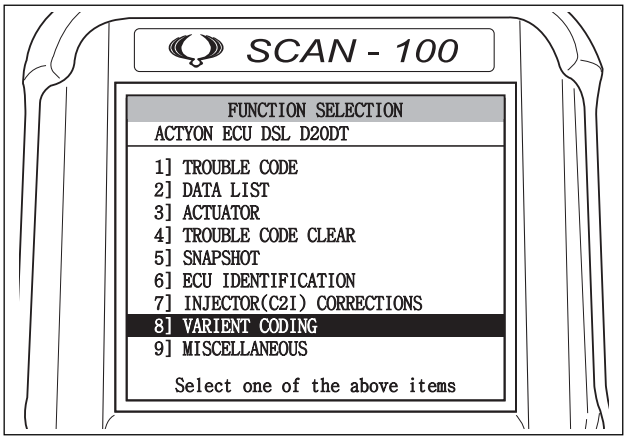
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Variant Coding

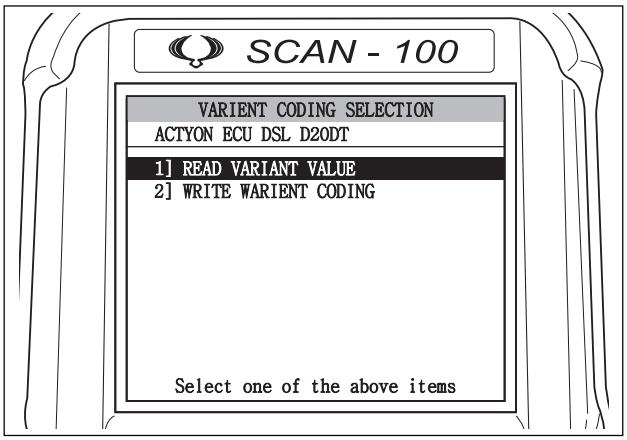
※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”



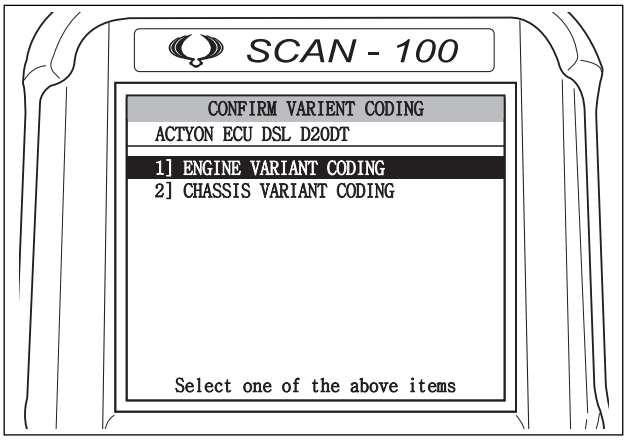
1. Select “8] VARIANT CODING” and press “ENTER” in “FUNCTION SELECTION” screen.



2. When the “VARIANT CODING” screen is displayed, select “1] READ VARIANT VALUE” and press “ENTER”.

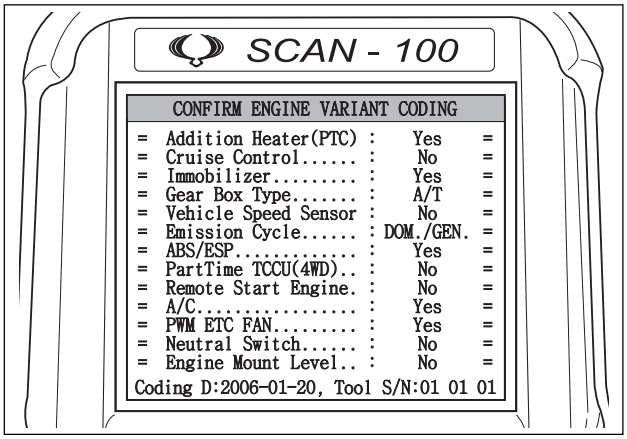


3. Select “1] ENGINE VARIANT CODING” and press “ENTER” in “FUNCTION SELECTION” screen.

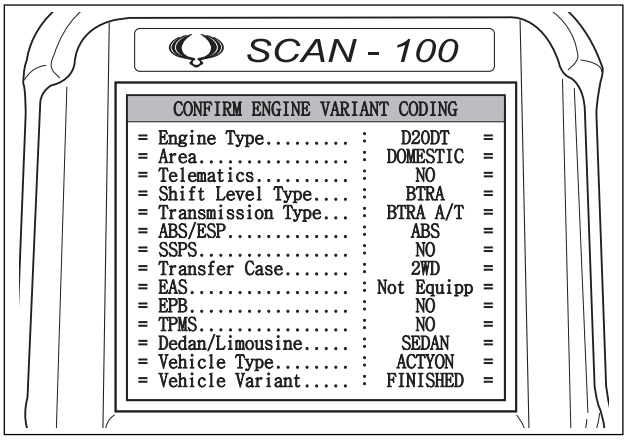


4. The “VARIANT CODING” screen that shows currently equipped devices is displayed.

ENGINE



CHASSIS



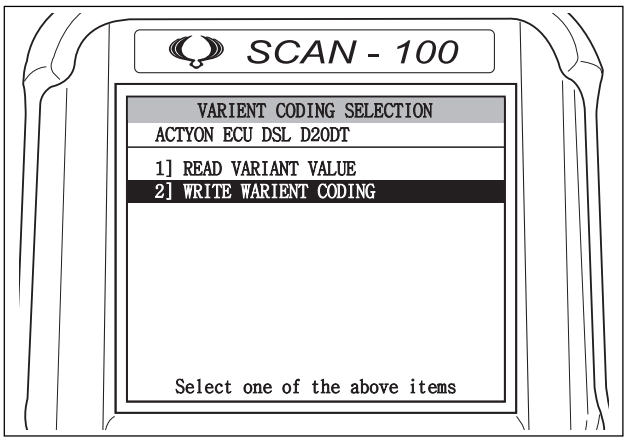
Engine Related Coding Item

Variant Coding Item	Selection	Description
ECU coding completed	NO/YES	"YES" is automatically selected.
Supplementary heater (PTC)	NO/YES	Select "YES" only for the vehicle with PTC type supplementary heater (in DI engine).
Auto cruise	NO/YES	Select "YES" only for the vehicle with auto cruise system.
Immobilizer	NO/YES	Select "YES" only for the vehicle with immobilizer system.
Remote starter	NO/YES	No remote starter system is applied to this model. However, must select "NO" to confirm that this vehicle doesn't have remote starter.
Vehicle speed signal	CAN/WIRE	CAN Select.
ABS or ESP	NO/YES	Select "YES" only for the vehicle with ABS or ESP system.
TOD/Part time TC (4WD)	NO/YES	Select "YES" only for the vehicle with part time TC system.
Air conditioner	NO/YES	Select "YES" only for the vehicle with A/C system. (W/O Aircon : NO)
Neutral signal input (M/T "N" signal)	NO/YES(WIRE)/CAN	Select "CAN" only for the vehicle with M/T neutral switch.

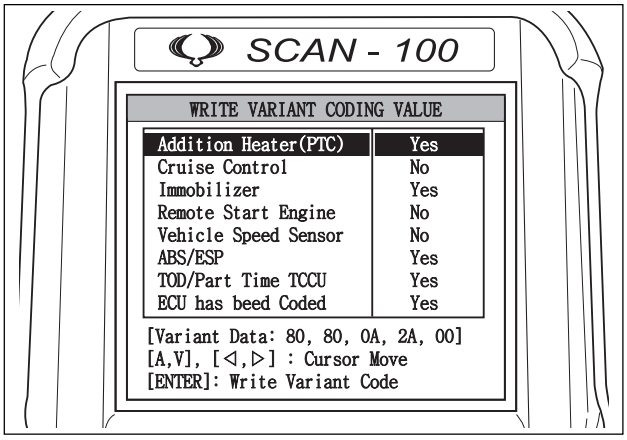
Chassis Related Coding Item

Variant Coding Item	Selection	Description
Engine model	D20DT/G23D	Select the appropriate engine.
DOM/EXP	DOM/GENERAL/EU	Select the region.
Telematics	Yes/No	W/ Telematics: Yes W/O Telematics: No
Selector lever	MT/DC5AT/BTRA AT	Select the appropriate system.
Transmission	ION(BTRA)/DC LEVER/DURA LEVER	Select the appropriate selector lever. (For DI engine equipped vehicle, select "ION (BTRA)")
ABS/EBS	NA/ABS/TCS/ESP	Select the appropriate system.
SSPS	NO/YES	Select "YES" only for the vehicle with ECPS system.
Transfer case (4WD)	NA/TOD/PT 4WD/ AWD/PT 4WD (W/O 4L)	Select the appropriate system.
Sedan/Limousine	SEDAN/LIMOUSINE	Select "SEDAN" - Automatic coding.
Vehicle type	ACTYON	Select "ACTYON" - Automatic coding.
Coding	CODING COMPLETED	Select the coding status.
EAS	NA/ECS/EAS(2)/EAS(4)	Select the appropriate system.
EPB	NO/YES	Select "Yes" only for the vehicle with EPB system. - Automatic coding
TPMS	NO/YES	Select "YES" only for the vehicle with TPMS system.

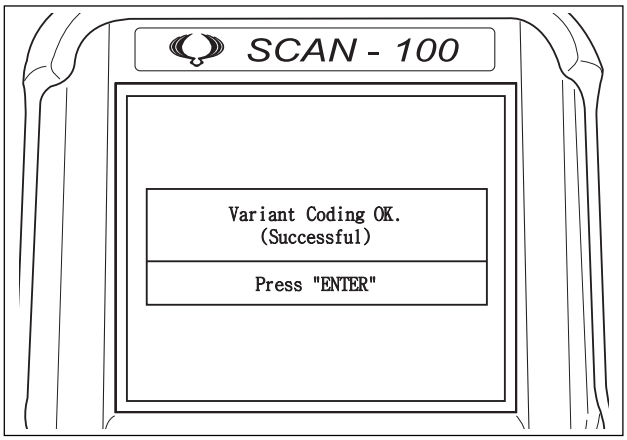
4. If you need to change the variant coding, press "ESC" key to go back to "VARIANT CODING" screen. In the screen, select "2] WRITE VARIANT CODING" and press "ENTER".



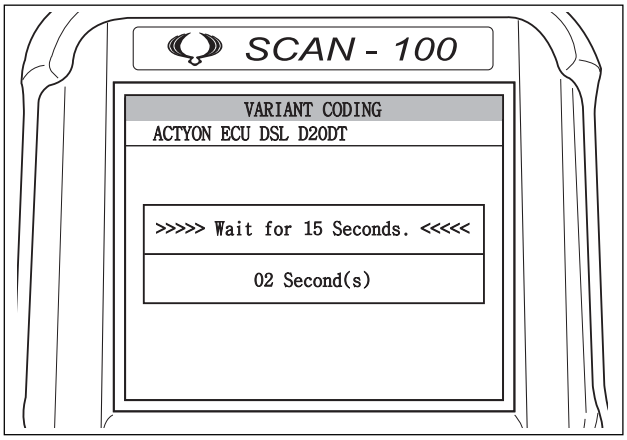
5. When the "WRITE VARIANT CODING VALUE" screen is displayed, change the item by using arrow keys.



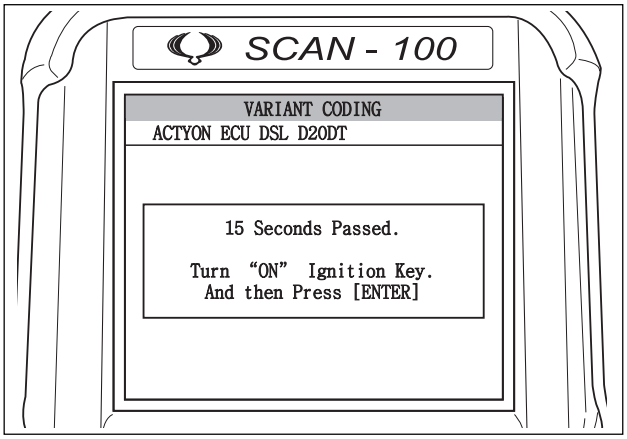
6. If you press "ENTER", the message as shown in figure appears. And, then "VARIANT CODING" screen is displayed.



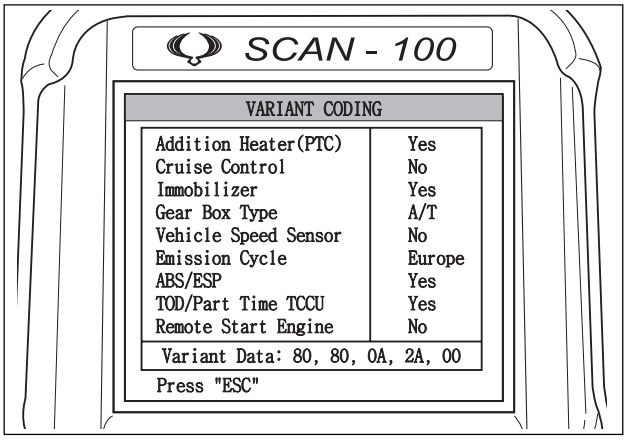
7. Follow the instructions on the display of Scan-100.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



8. Select “READ VARIANT VALUE” to see the coding coded value.

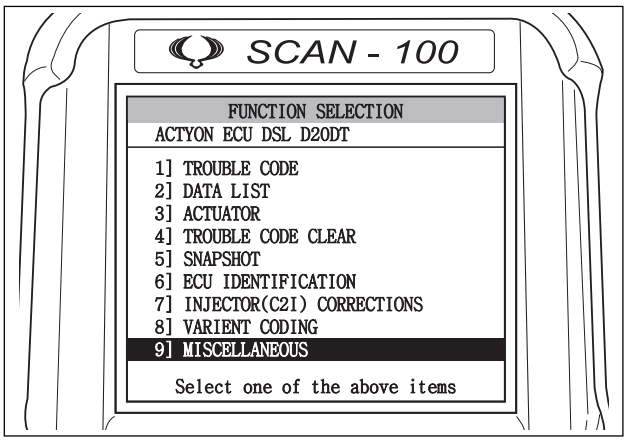


*** Chassis variant coding should be done in the same procedures as for Engine variant coding.**

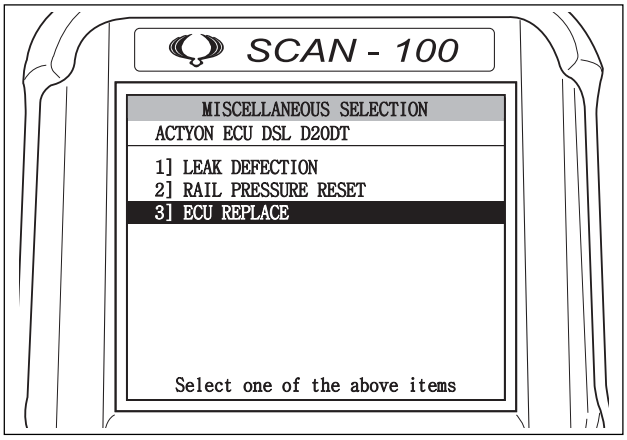
ECU Replace

※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”

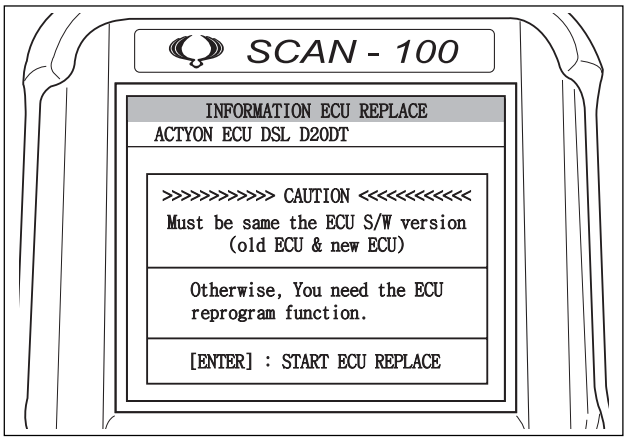
1. Select “9] MISCELLANEOUS” and press “ENTER” in “FUNCTION SELECTION” screen.



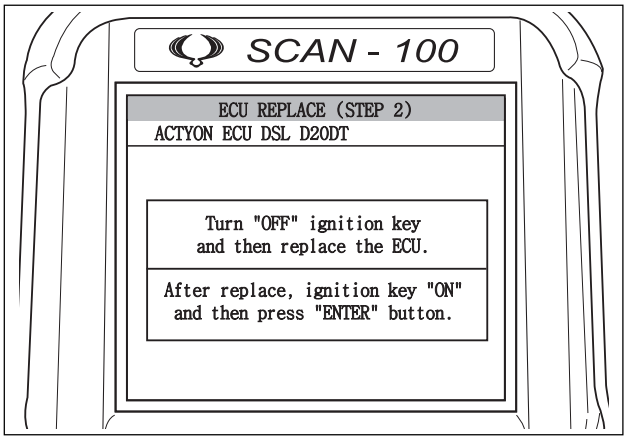
2. Select “3] ECU REPLACE” and press “ENTER” in “FUNCTION SELECTION” screen.



3. Before starting ECU replace, check the ECU S/W version of old ECU and new ECU.



4. When the “ECU REPLACE (STEP 2)” screen is displayed followed by “ECU REPLACE (STEP 1) screen, turn the ignition “OFF” and remove the currently installed ECU.

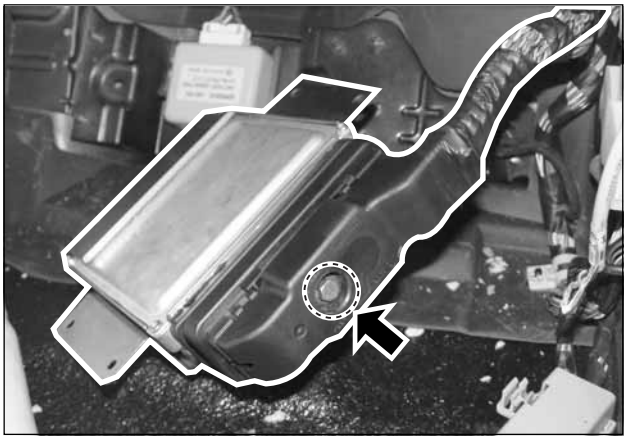


NOTICE

- **Do not turn off the Scan-100 at this time.**
- **Record the below data:**
  1) **Vehicle identification number**
  2) **Variant coding value**
  3) **C2I coding value**
  4) **Multi calibration**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. Install the new ECU.



6. If you turn the ignition switch to “ON” position and press “(ENTER)”, the message as shown in figure 1 (system initialization) appears, and then “MULTI CALIBRATION” screen (figure 2) is displayed.

figure 1

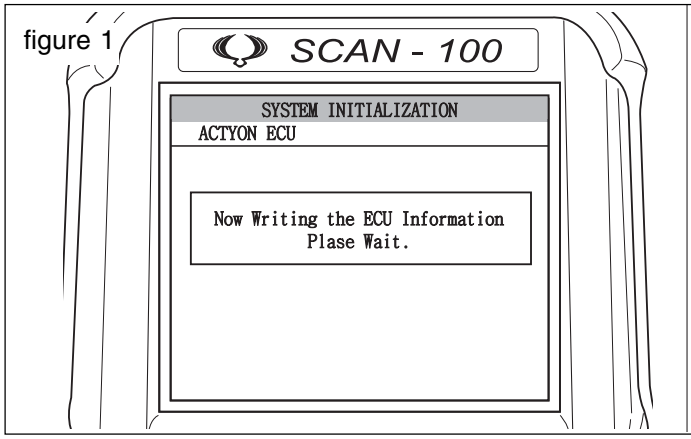
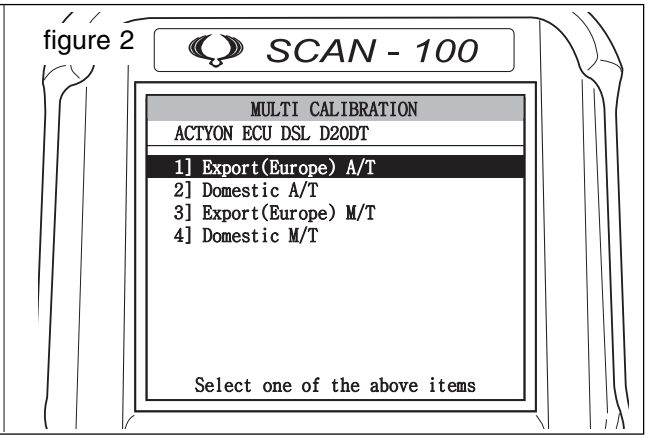
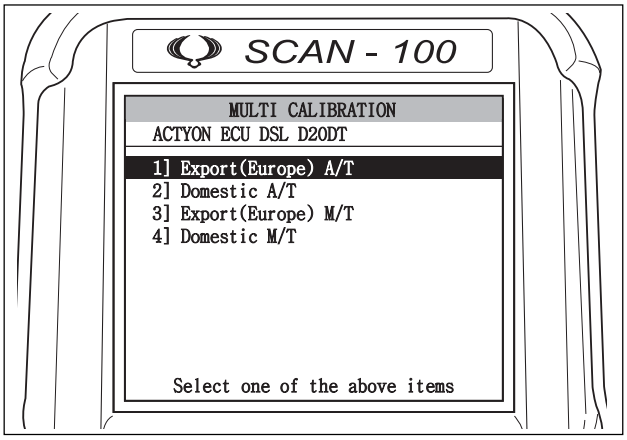


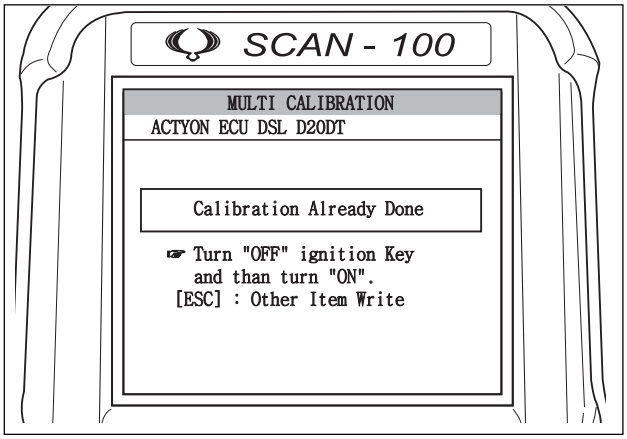
figure 2



7. In “MULTI CALIBRATION” screen, select the relevent model.



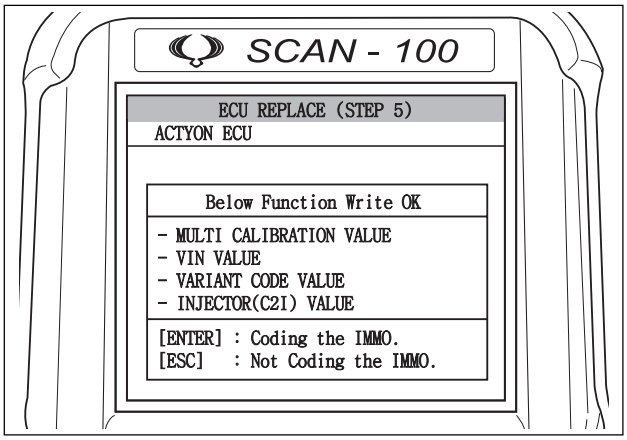
8. When you press "ENTER", the processing message as shown in figure appears.



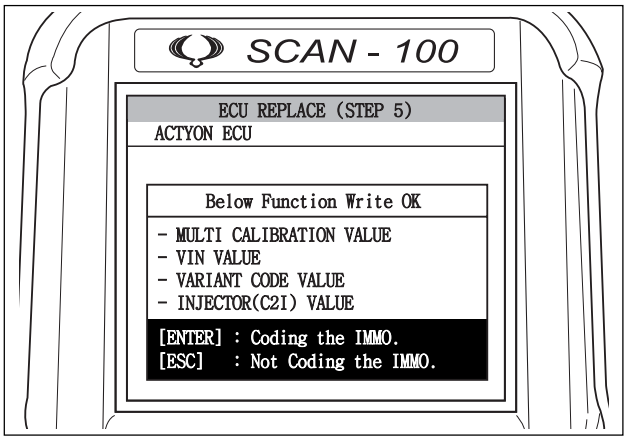
9. If the multi calibration is completed successfully, "ECU REPLACE (STEP 5) screen is displayed.

   Backup data:

   1) Multi calibration value
   2) VIN value
   3) Variant code value
   4) Injector (C2I) value

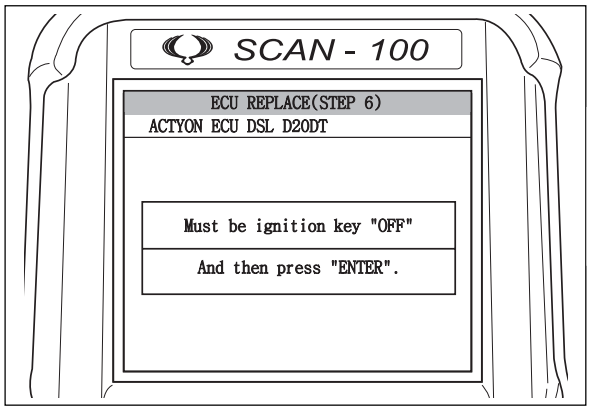


10. In immobilizer equipped vehicle, the immobilizer coding should be done after completed the multi calibration.

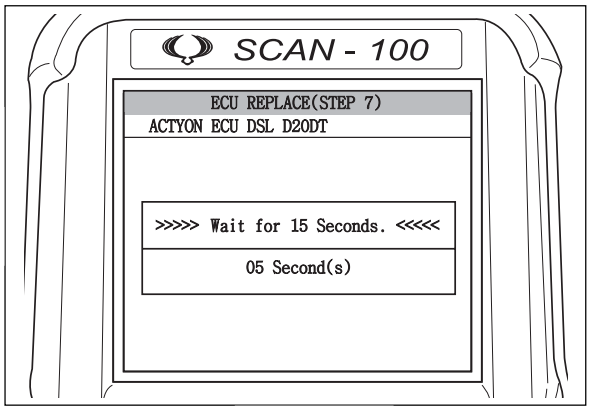


11. Press "ENTER" for the vehicle equipped with immobilizer system.
12. Follow the instructions on the display of Scan-100.
    - Identification of VIN number
    - Immobilizer coding

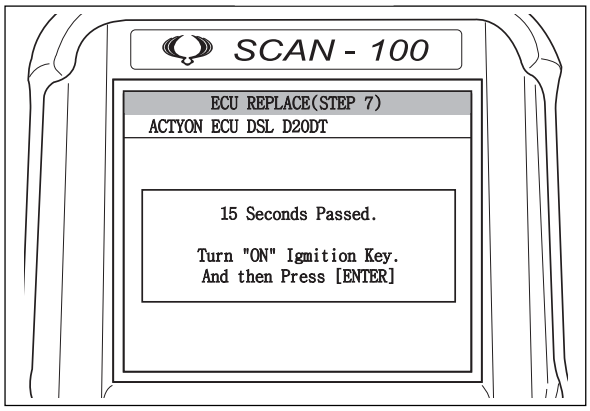
1



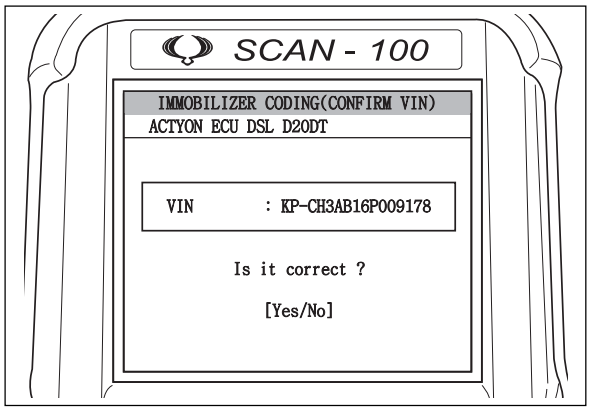
2



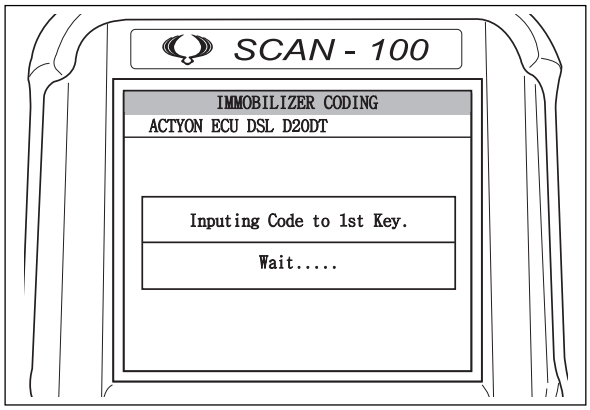
3



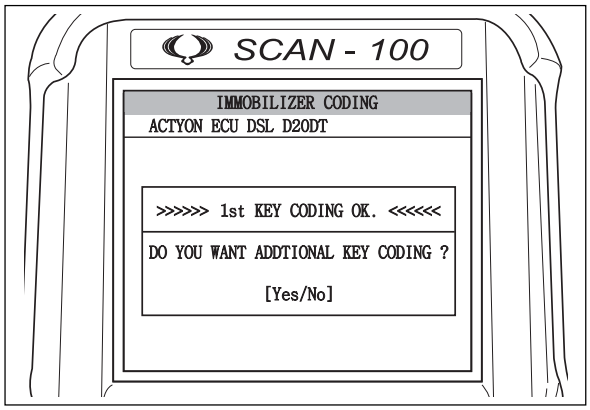
4



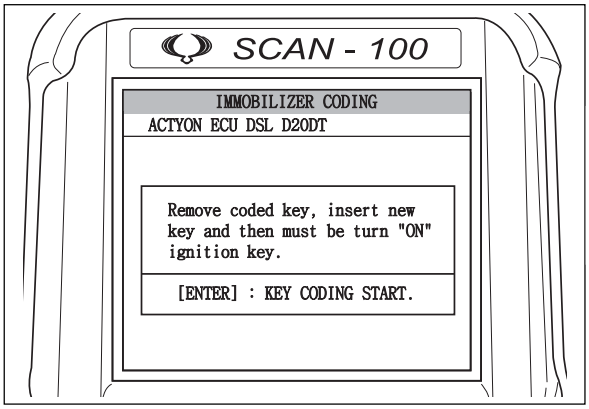
5



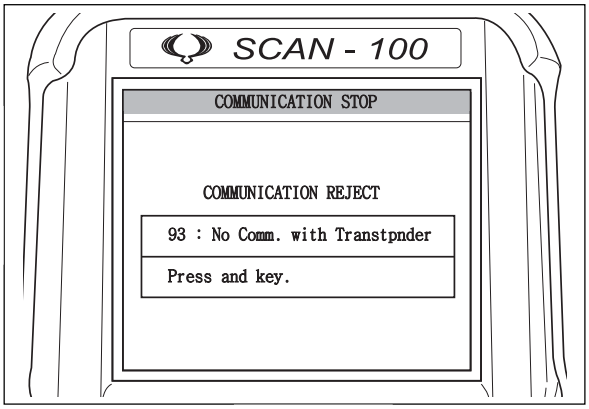
6



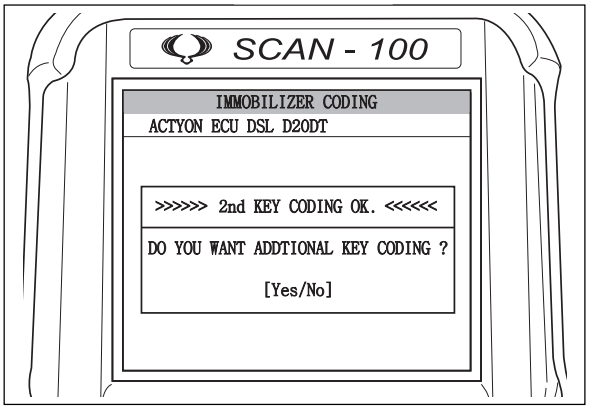
7


SCAN - 100
IMMOBILIZER CODING
ACTYON ECU DSL D20DT
Remove coded key, insert new key and then must be turn "ON" ignition key.
[ENTER] : KEY CODING START.

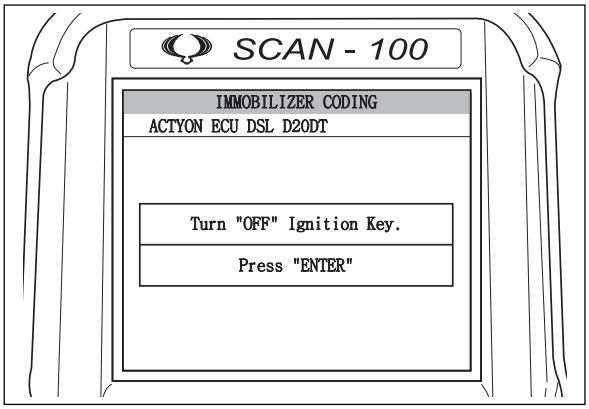
8


SCAN - 100
COMMUNICATION STOP
COMMUNICATION REJECT
93 : No Comm. with Transtpnder
Press and key.

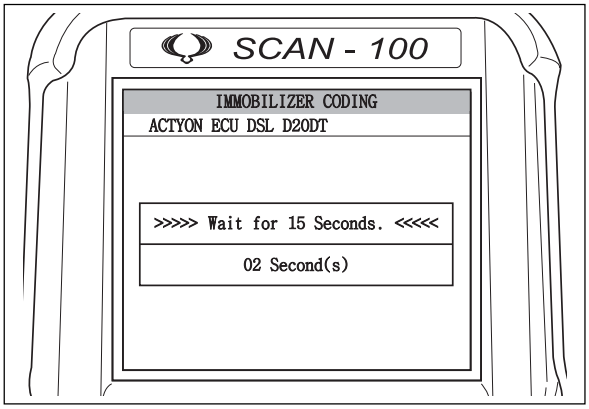
9


SCAN - 100
IMMOBILIZER CODING
ACTYON ECU DSL D20DT
>>>>>> 2nd KEY CODING OK. <<<<<<
DO YOU WANT ADDTIONAL KEY CODING ?
[Yes/No]

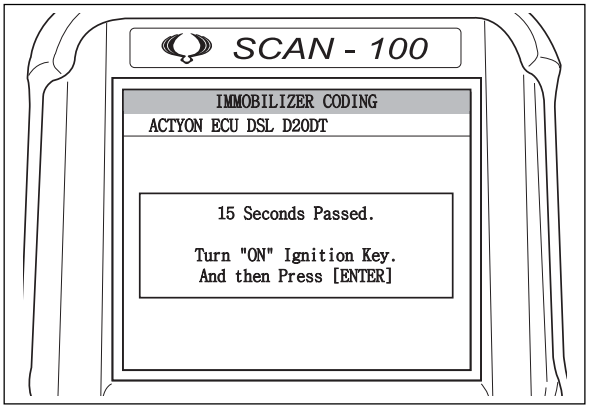
10


SCAN - 100
IMMOBILIZER CODING
ACTYON ECU DSL D20DT
Turn "OFF" Ignition Key.
Press "ENTER"

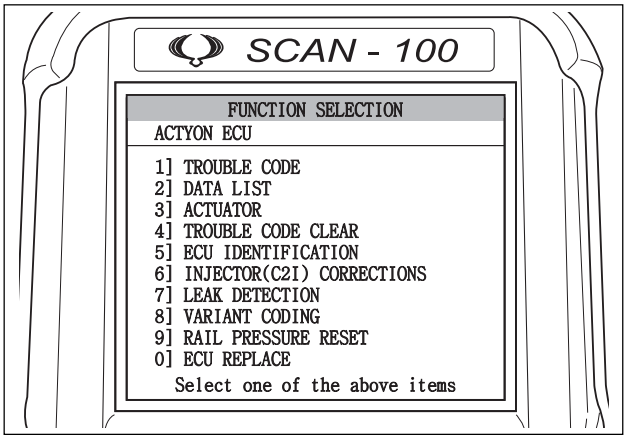
11


SCAN - 100
IMMOBILIZER CODING
ACTYON ECU DSL D20DT
>>>>> Wait for 15 Seconds. <<<<<
02 Second(s)

12


SCAN - 100
IMMOBILIZER CODING
ACTYON ECU DSL D20DT
15 Seconds Passed.
Turn "ON" Ignition Key.
And then Press [ENTER]

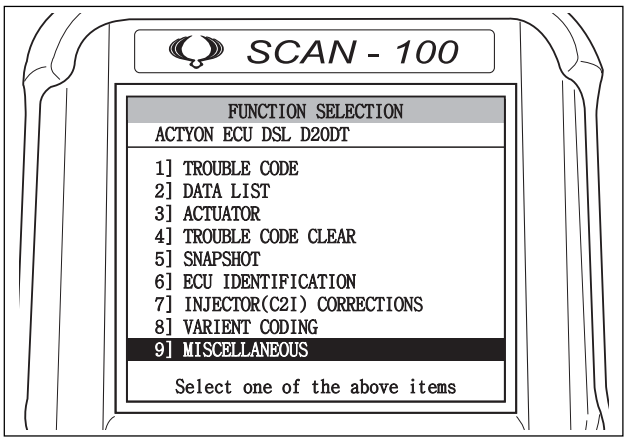
13. Press "ENTER" to return to "MAIN MENU" screen.



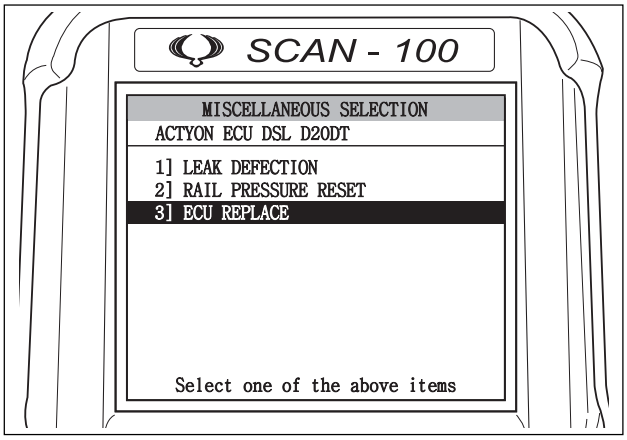
ECU Replace (Scan-100 Communication is not available)

If the Scan-100 communication is not available due to ECU failure, replace the ECU as follows.

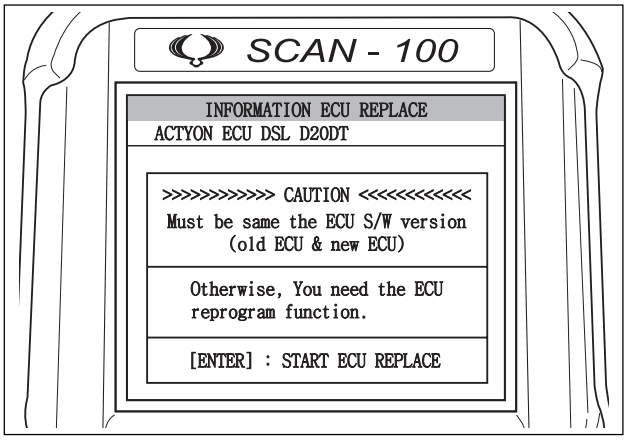
1. Replace the ECU with new one.



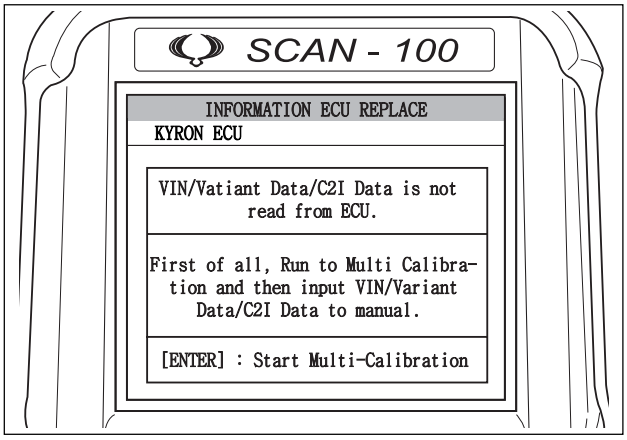
2. Select “3] ECU REPLACE” and press “ENTER” in “FUNCTION SELECTION” screen.



3. If the versions of ECUs are not matched, program the new ECU after replacement.

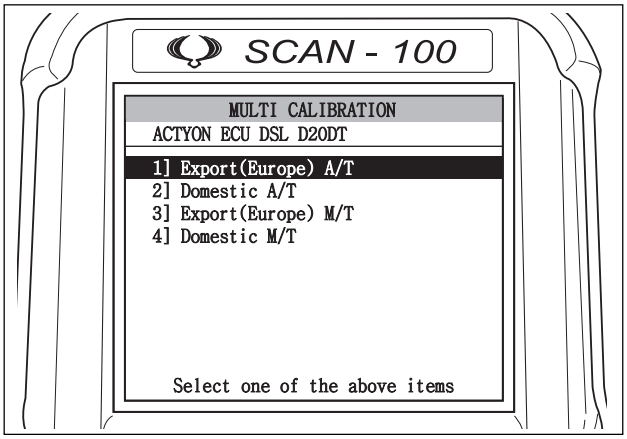


4. VIN/Variant Data/C21 Data is not read from ECU. Press “ENTER” to run the multi calibration.

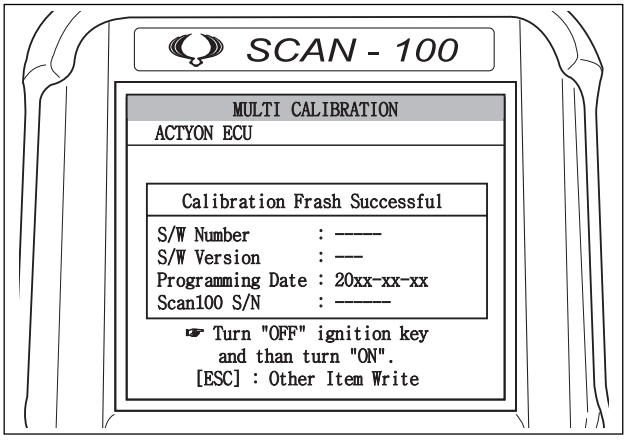


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

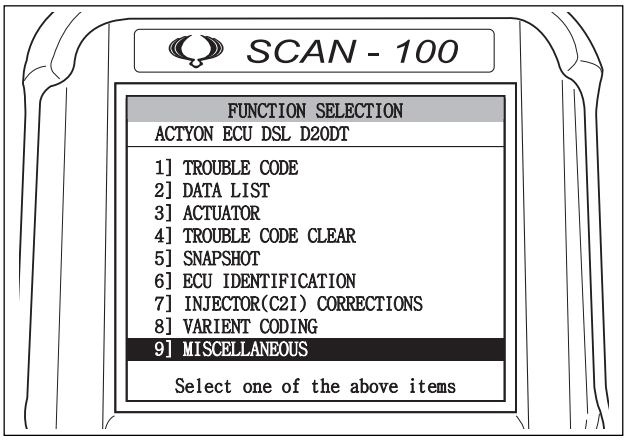
5. Select the appropriate model in “MULTI CALIBRATION SELECTION” screen.
   1) Vehicle with A/T: 2] Dom/Gen A/T
   2) Vehicle with M/T: 4] Dom/Gen M/T



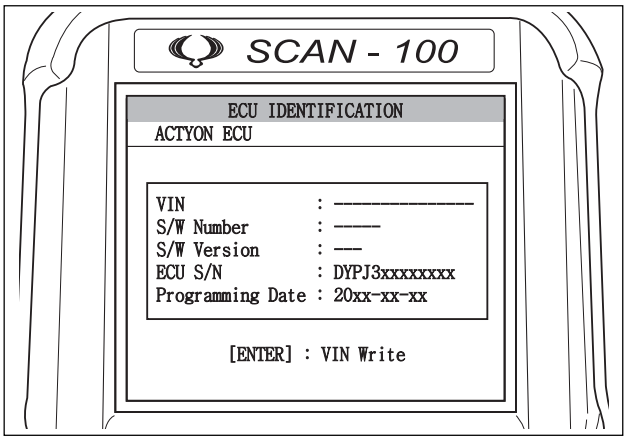
6. If the multi calibration is completed successfully, the message screen shown in the figure is displayed.
7. The VIN/Variant Data/C21 Data should be input manually.



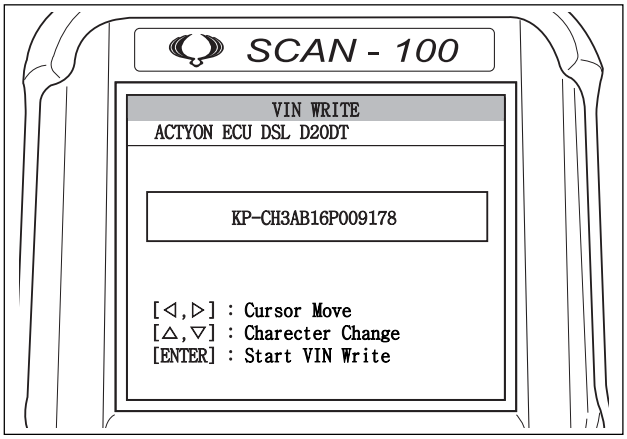
8. To enter the data, press “ESC” on the screen in Step 5 and go back to main screen.
9. To enter the VIN, select “5] ECU IDENTIFICATION” and press “(ENTER)”.



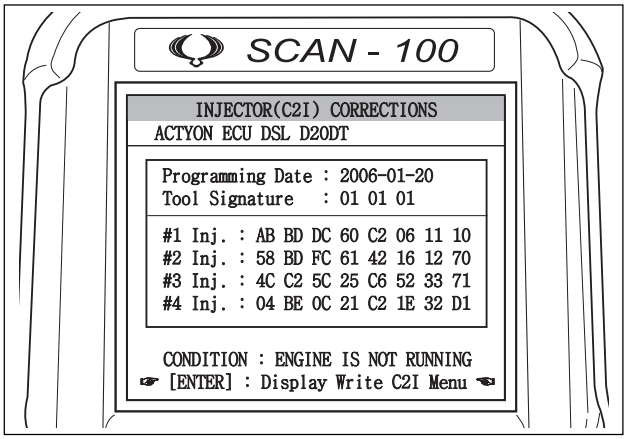
10. Press “(ENTER)” and enter the VIN again.



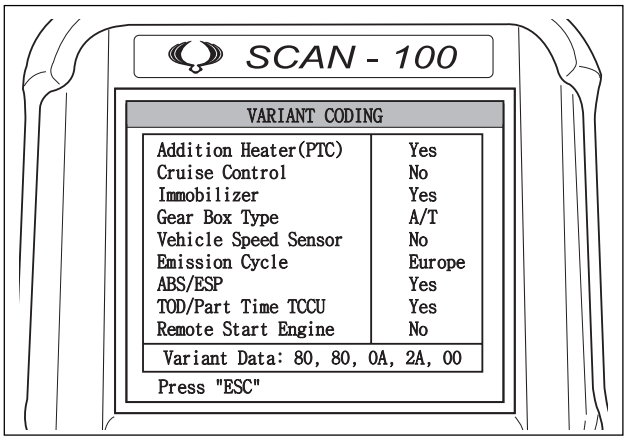
11. Enter the VIN into the number plate on the screen. To change the number to the character, use the arrow keys.



12. Select “6] INJECTOR (C2I) CORRECTIONS” and press “ENTER” in “FUNCTION SELECTION” screen. Remove the engine acoustic cover and enter the 16 digits code on each injector label for all of five injectors. If any of digits is wrong, you should enter full code again. Make sure that the VIN code is correct. The nearest injector from the radiator is number 1 and the number goes higher as it moves away.



13. Select “8] VARIANT CODING” and press “PRESS” in “FUNCTION SELECTION” screen. When the “VARIANT CODING” screen is displayed, select “2] WRITE VARIANT CODING” and press “PRESS”. When the “WRITE VARIANT CODING” screen is displayed, change the item by using arrow keys.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Rail Pressure Reset

Rail Pressure Reset Procedures

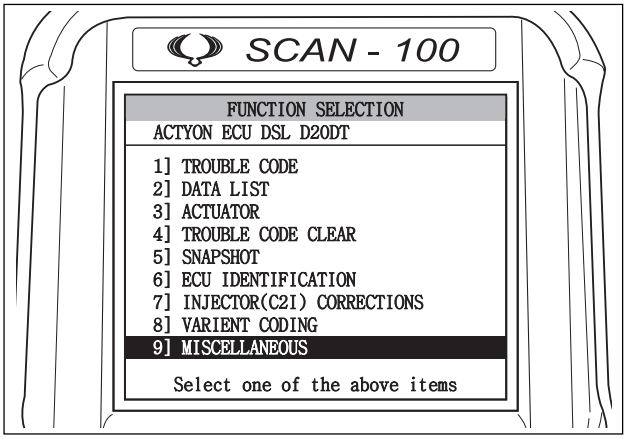
The engine ECU needs a specific amount of fuel according to the fuel supply lines and vehicle driving conditions.

However, if the fuel supply (pressure) is not achieved due to, for instance, defective fuel system, ECU designates the offset value to the high pressure pump to compensate it.

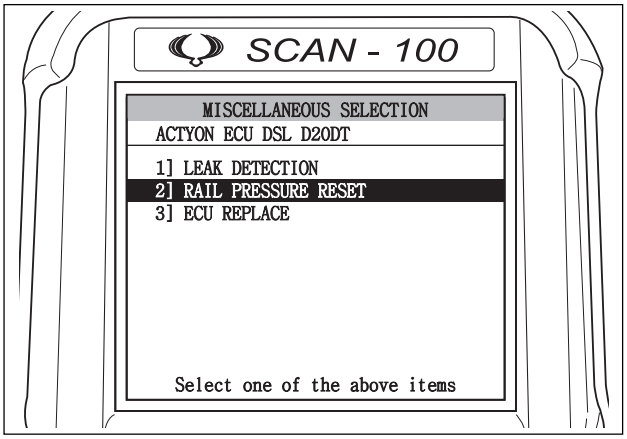
The fuel supply pressure varies according to the offset value and the engine output could be decreased due to this variation. When the engine output decreases, check whether all rail pressure offset values is set to 0 in the Rail Pressure Reset screen in SCAN-100. If the setting value is not 0, measure the fuel pressure with a tester. If any defective is found, repair the affected components and reset the rail pressure offset value to 0.

The rail pressure reset procedures should be done after replacing any high pressure pump and fuel system related components.

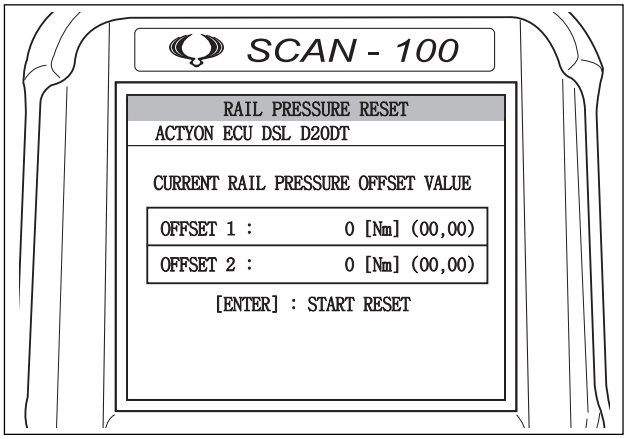
1. Select the vehicle model.



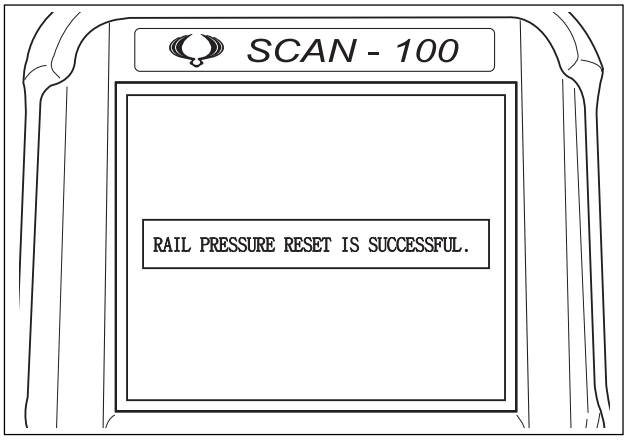
2. Select “2] RAIL PRESSURE RESET” in “FUNCTION SELECTION” screen.



3. Enter the current rail pressure value and press [ENTER] to reset the offset value.



4. The screen returns back to step 3 after displaying the [RAIL PRESSURE RESET IS SUCCESSFUL] message.



NOTICE

- **If the offset value is not set to 0, check the fuel pressure and other DTC generations before starting the rail pressure reset operation.**

TROUBLE DIAGNOSIS TABLE

INDEX OF DTC 4
Trouble diagnosis table 7

INDEX OF DTC

P0102 Low HFM Sensor Signal (Circuit Open) 7
P0103 High HFM Sensor Signal (Circuit Short) 7
P0100 Air Mass Flow (HFM) Malfunction (Vref) 8
P0344 Cam Position Sensor Malfunction (Cam Signal Missing) 8
P0341 Cam Position Sensor Malfunction (Poor Synchronization) 8
P0219 Too Small Clearance of Crank Angle Sensor 8
P0336 Too Large Clearance of Crank Angle Sensor 9
P0372 Crank Angle Sensor Malfunction 9
P1107 Barometric Sensor (Low) 9
P1108 Barometric Sensor (High) 9
P1105 Barometric Sensor Circuit Short (Vref) 9
P0562 Low Battery Voltage 10
P0563 High Battery Voltage 10
P0560 Battery Voltage Malfunction 10
P0109 Low Booster Pressure Sensor Signal 11
P0106 High Booster Pressure Sensor Signal 11
P0107 Booster Pressure Sensor Open/GND Short 12
P0108 Booster Pressure Sensor Short 12
P0105 Supply Voltage Fault to Booster Pressure Sensor 13
P1106 Booster Pressure Sensor Malfunction 13
P1109 Booster Pressure Sensor Initial Check Fault 14
P0571 Brake Pedal Switch Fault 14
P1572 Brake Lamp Signal Fault 15
P1571 Brake Lamp Signal Fault 15
P1286 Low Resistance for Injector #1 wiring harness 15
P1287 High Resistance for Injector #1 wiring harness 16
P1288 Low Resistance for Injector #2 wiring harness 16
P1289 High Resistance for Injector #2 wiring harness 16
P1292 Low Resistance for Injector #4 wiring harness 17
P1293 High Resistance for Injector #4 wiring harness 17
P1294 Low Resistance for Injector #5 wiring harness (only D27DT) 17
P1295 High Resistance for Injector #5 wiring harness (only D27DT) 18
P1290 Low Resistance for Injector #3 wiring harness 18
P1291 High Resistance for Injector #3 wiring harness 18
P0704 Clutch switch malfunction 18
P1115 Coolant Temperature Sensor Malfunction 19
P0118 Coolant Temperature Sensor Malfunction - Short 19
P0117 Coolant Temperature Sensor Malfunction - Open 20
P0115 Supply Voltage Fault to Coolant Temperature Sensor 20
P0685 Main Relay Malfunction 20
P1405 EGR Solenoid Valve Malfunction - Short to ground 20
P1406 EGR Solenoid Valve Malfunction - Short to +Batt 20
P1480 Condenser Fan #1 Circuit Malfunction - Open 21
P1481 Condenser Fan #1 Circuit Malfunction - Short 21
P1482 Condenser Fan #1 Circuit Malfunction - Short to Ground 21
P1526 Condenser Fan #2 Circuit Malfunction - Open 21
P1527 Condenser Fan #2 Circuit Malfunction - Short 21
P1528 Condenser Fan #2 Circuit Malfunction - Short to Ground 21
P0325 Accelerometer #1 (Knock Sensor) Malfunction 22
P0330 Accelerometer #2 (Knock Sensor) Malfunction (only D27DT) 22
P1611 Injector Bank #1 Malfunction - Low Voltage 22
P1612 Injector Bank #1 Malfunction - High Voltage 23
P1618 Injector Bank #2 Malfunction - Low Voltage 23
P1619 Injector Bank #2 Malfunction - High Voltage 23
P0263 Injector #1 Balancing Fault 24
P0266 Injector #2 Balancing Fault 24
P0272 Injector #4 Balancing Fault 24
P0275 Injector #5 Balancing Fault (only D27DT) 24
P0269 Injector #3 Balancing Fault 24
P0201 Injector #1 Circuit Open 24
P0202 Injector #2 Circuit Open 24
P0204 Injector #4 Circuit Open 25
P0205 Injector #5 Circuit Open (only D27DT) 25
P0203 Injector #3 Circuit Open 25
P1201 Injector #1 Circuit Short 25
P1202 Injector #2 Circuit Short 25
P1204 Injector #4 Circuit Short 25
P1205 Injector #5 Circuit Short (only D27DT) 25
P1203 Injector #3 Circuit Short 26
P0182 Fuel temperature sensor - Short to Ground 26
P0183 Fuel temperature sensor - Short to B+ 26
P0180 Fuel temperature sensor - Vref 27
P1678 Glow Plug Drive Malfunction - Open 27

P1679 Glow Plug Drive Malfunction - Short 27
P1680 Glow Plug Drive Malfunction - Short to Ground 27
P1530 #1 Heater operating circuit - Open 27
P1531 #1 Heater operating circuit - Short to B+ 28
P1532 #1 Heater operating circuit - Short to Ground 28
P1534 #2 Heater operating circuit - Open 28
P1535 #2 Heater operating circuit - Short to B+ 28
P1536 #2 Heater operating circuit - Short to Ground 28
P1254 Maximum Rail Pressure Control Malfunction (IMV Fault) 29
P1253 Minimum Rail Pressure Control Malfunction (IMV Fault) 29
P1256 Too Small Transfer Pressure Fuel in Rail Pressure System 30
P1257 Too Large Transfer Pressure Fuel in Rail Pressure System 30
P1258 Too Small High Pressure Fuel in Rail Pressure System 31
P1259 Too Large High Pressure Fuel in Rail Pressure System 31
P1191 Pressure Build Up - Too Slow 32
P0255 IMV Driver Circuit Malfunction - Open 32
P0251 IMV Driver Circuit Malfunction - Short 32
P0253 IMV Driver Circuit Malfunction - Short to Ground 32
P0112 Intake Air Temperature Circuit Malfunction - Open 34
P0110 Intake Air Temperature Circuit Malfunction - Source Power Problem 35
P1171 #1 Injector MDP Malfunction 35
P1172 #2 Injector MDP Malfunction 35
P1174 #4 Injector MDP Malfunction 36
P1175 #5 Injector MDP Malfunction (only D27DT) 36
P1173 #3 Injector MDP Malfunction 36
P1252 Too High IMV Pressure 36
P1120 Accelerator Pedal Sensor #1 Malfunction 36
P1121 Accelerator Pedal Sensor #2 Malfunction 37
P1122 Accelerator Pedal Sensor Malfunction (Limp Home Mode) 37
P1123 Accelerator Pedal Sensor Malfunction (Reducde Torque Mode) 37
P1124 Accelerator Pedal Sensor Malfunction - Stuck 37
P0122 Accelerator Pedal Sensor #1 Malfunction - Open 37
P0123 Accelerator Pedal Sensor #1 Malfunction - Short 37
P0120 Accelerator Pedal Sensor #1 Malfunction - Supply Voltage Fault 38
P0222 Accelerator Pedal Sensor #2 Malfunction - Open 38
P0223 Accelerator Pedal Sensor #2 Malfunction - Short 38
P0220 Accelerator Pedal Sensor #2 Malfunction - Supply Voltage Fault 38
P0192 Fuel Rail Pressure Sensor Malfunction - Open 39
P0193 Fuel Rail Pressure Sensor Malfunction - Short 39
P0190 Supply Voltage Fault to Fuel Rail Pressure Sensor 39
P0191 Fuel Rail Pressure Sensor Signal Fault 40
P1192 Fuel Rail Pressure Sensor Initial Signal Fault - Low 40
P1193 Fuel Rail Pressure Sensor Initial Signal Fault - High 40
P1190 Fuel Rail Pressure Sensor Initial Signal Fault 41
P0215 Main Relay Fault - Stuck 41
P1500 Vehicle Speed Fault 41
P0642 ECU Supply Voltage 1 Fault - Low (5 V) 41
P0643 ECU Supply Voltage 1 Fault - High (5 V) 42
P0641 ECU Supply Voltage 1 Fault (5 V) 42
P0652 ECU Supply Voltage 2 Fault - Low (5 V) 42
P0653 ECU Supply Voltage 2 Fault - High (5 V) 42
P0651 ECU Supply Voltage 2 Fault (5 V) 42
P0698 ECU Supply Voltage Fault - Low (2.5 V) 43
P0699 ECU Supply Voltage Fault - High (2.5 V) 43
P0697 ECU Supply Voltage Fault (2.5 V) 43
P0245 Turbo Charger Actuator Circuit Fault - Short 43
P0246 Turbo Charger Actuator Circuit Fault - Short to B+ 43
P0606 ECU Watchdog Fault 43
P1607 ECU Injector Cut Fault 43
P1600 ECU Shut Down Fault 44
P1601 ECU Fault 44
P1602 ECU Fault 44
P1614 ECU C2I/MDP Fault 44
P1615 ECU Fault 44
P1616 ECU Fault 44
P1606 ECU Fault 44
P1620 ECU Fault 44
P1621 ECU Fault 44
P1622 ECU Fault 44
P1148 Accelerometer (Knock Sensor) Learning Fault 45
P0400 EGR Control Valve Fault 45
P1235 VGT Operation Fault 45
P1608 ECU Fault 45
P0335 No Crank Signals 45
P1170 Torque Trim Fault - High 45
P1676 Glow Plug Communication Fault 46
P1677 Glow Plug Controller Fault 46

P0671 #3 Glow Plug Fault - Open 46
P0672 #4 Glow Plug Fault - Open 46
P0673 #5 Glow Plug Fault - Open (only D27DT) 46
P0674 #1 Glow Plug Fault - Open 47
P0675 #2 Glow Plug Fault - Open 47
P1671 #3 Glow Plug Fault - Short (B+) 47
P1672 #4 Glow Plug Fault - Short (B+) 47
P1673 #5 Glow Plug Fault - Short (B+) (only D27DT) 47
P1674 #1 Glow Plug Fault - Short (B+) 47
P1675 #2 Glow Plug Fault - Short (B+) 48
P0700 TCU Signal Fault 48
P1540 Air Conditioner Operating Circuit Fault - Open 48
P1541 Air Conditioner Operating Circuit Fault - Short 48
P1542 Air Conditioner Operating Circuit Fault - Short to Ground 48
P1149 Too High Water Level in Fuel Filter 48
P1634 Immobilizer Fault (refer to immobilizer section) 48
P1635 No response from Immobilizer (refer to immobilizer section) 48
P1630 Wrong response from Immobilizer (refer to immobilizer section) 49
P1631 Immobilizer Fault (refer to immobilizer section) 49
P1632 Immobilizer Fault (refer to immobilizer section) 49
P1633 Immobilizer Fault (refer to immobilizer section) 49
P0633 Immobilizer Fault (refer to immobilizer section) 49
P1636 Immobilizer Fault (refer to immobilizer section) 50
P1102 High HFM Sensor Signal 50
P1103 Low HFM Sensor Signal 50
P1501 Variant coding failure (vehicle speed) 50
P1503 Vehicle speed sensor input failure 50
P0600 CAN BUS failure 50
P0602 Vehicle speed sensor coding failure 50
P0608 ABS/ESP coding failure 50
P0613 TCU coding failure 50
P0644 CAN cluster failure 50
P1565 Auto cruise switch failure (Acceleration) 51
P1566 Auto cruise switch failure (OFF) 51
P1567 Auto cruise switch failure 51
P1568 Auto cruise switch failure (Deceleration) 51
P1569 Auto cruise switch failure (Safety) 51
P3040 ECU internal failure 51
P3041 ECU internal failure (only D27DT) 51
P1657 Engine mount control failure (Open) 51
P1658 Engine mount control failure (Short to B+) 51
P1659 Engine mount control failure (Short to ground) 51
P0805 Abnormal neutral signal 51

TROUBLE DIAGNOSIS TABLE

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0102	Low HFM Sensor Signal (Circuit Open)	- HFM sensing values are lower than minimum sensing values. - Check the resistance in HFM sensor. - Check the ECU wiring harness (open and poor contact). • Check the ECU pin #83 and #84 for open circuit. - Actual air mass flow vs. Output voltages. • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.						
P0103	High HFM Sensor Signal (Circuit Short)	- HFM sensing values are higher than maximum sensing values. - Check the resistance in HFM sensor. - Check the ECU wiring harness (open and poor contact). • Check the ECU pin #83 and #84 for open circuit. - Actual air mass flow vs. Output voltages. • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0100	Air Mass Flow (HFM) Malfunction (Vref)	- The external power supply is faulty. • Check the external power supply. • Check the sensor wiring harness (open, short, poor contact). - Actual air mass flow vs. Output voltages. • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.						
P0344	Cam Position Sensor Malfunction (Cam Signal Missing)	- No cam recognition signal (missing events). - Check the source voltage of cam position sensor (ECU pin #111) (specified value: 4.5 ~ 12 V). - Check the sensor wiring harness for ECU pin #103 and #104 (open, short, poor contact). - Check the cam position sensor. - Measure the air gap: 0.2 ~ 1.8 mm - Replace the ECU if required.						O
P0341	Cam Position Sensor Malfunction (Poor Synchronization)	- Not synchronized with Crank angle signal. - Check the source voltage of cam position sensor (specified value: 4.5 ~ 12 V). - Check the sensor wiring harness for ECU pin #103 and #104 (open, short, poor contact). - Check the cam position sensor. - Measure the air gap: 0.2 ~ 1.8 mm - Replace the ECU if required.						O
P0219	Too Small Clearance of Crank Angle Sensor	- Crank angle signal faults or clearance too close. - Check the sensor wiring harness for ECU pin #90 and #82 (open, short, poor contact). - Check the resistance of crank angle sensor: 1090 Ω ± 15 %. - Measure the air gap: 0.3 ~ 1.3 mm • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. • Drive plate (A/T), DMF (M/T) - Replace the ECU if required.						O

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0336	Too Large Clearance of Crank Angle Sensor	- Air gap of crank angle sensor is abnormal. - Check the sensor wiring harness for ECU pin #90 and #82 (open, short, poor contact). - Check the resistance of crank angle sensor: 1090 Ω ± 15 %. - Measure the air gap: 0.3 ~ 1.3 mm • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. • Drive plate (A/T), DMF (M/T) - Replace the ECU if required.						O
P0372	Crank Angle Sensor Malfunction	- Even though cam position recognition is normal, no crank angle signal recognition (missing tooth). - Check the sensor wiring harness for ECU pin #90 and #82 (open, short, poor contact). - Check the resistance of crank angle sensor: 1090 Ω ± 15 %. - Measure the air gap: 0.3 ~ 1.3 mm • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. • Drive plate (A/T), DMF (M/T) - Replace the ECU if required.						O
P1107	Barometric Sensor (Low)	- Out of range about barometric sensor (short to ground). - Actual barometric pressure vs. Output voltages. • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU.						
P1108	Barometric Sensor (High)	- Out of range about barometric sensor (short to B+). - Actual barometric pressure vs. Output voltages. • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU.						
P1105	Barometric Sensor Circuit Short (Vref)	- Out of range about barometric sensor (over voltage). - Actual barometric pressure vs. Output voltages. • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0562	Low Battery Voltage	- Malfunction in recognition of system source voltage (Lower than threshold). • Less than minimum 8 Volts in 2000 rpm below • Less than 10 Volts in 2000 rpm above. - Check the battery wiring harness for ECU pin #3, #4 and #5 (open, short, poor contact). - Check the battery main relay and fuse. - Check the body ground. - Measure the resistance between body ground and ECU ground. • Repair the ECU ground if the resistance is high. - Replace the ECU if required.	O					
P0563	High Battery Voltage	- Malfunction in recognition of system source voltage (Higher than threshold). • More than minimum 16 Volts in 2000 rpm below - Check the battery wiring harness for ECU pin #3, #4 and #5 (open, short, poor contact). - Check the alternator. - Check the body ground. - Measure the resistance between body ground and ECU ground. • Repair the ECU ground if the resistance is high. - Replace the ECU if required.	O					
P0560	Battery Voltage Malfunction	- Malfunction in recognition of system source voltage (A/D converter faults). • Less than minimum 8 Volts in 2000 rpm below • Less than 10 Volts in 2000 rpm above. - Check the battery wiring harness for ECU pin #3, #4 and #5 (open, short, poor contact). - Check the battery main relay and fuse. - Check the body ground. - Measure the resistance between body ground and ECU ground. • Repair the ECU ground if the resistance is high. - Replace the ECU if required.	O					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0109	Low Booster Pressure Sensor Signal	- Out of signal range about boost pressure sensor at Ignition key-On and Engine Stop (Lower than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction						
P0106	High Booster Pressure Sensor Signal	- Out of signal range about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0107	Booster Pressure Sensor Open/GND Short	- Out of signal range about boost pressure sensor at Engine running condition (Lower than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction						
P0108	Booster Pressure Sensor Short	- Out of signal range about boost pressure sensor at Engine running condition (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545~2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction						

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0105	Supply Voltage Fault to Booster Pressure Sensor	- Out of range of supply voltages about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #100 and #108 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction						
P1106	Booster Pressure Sensor Malfunction	- Out of range of supply voltages about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1109	Booster Pressure Sensor Initial Check Fault	- Implausible signal values or range about boost pressure sensor at Engine running condition (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction						
P0571	Brake Pedal Switch Fault	- The brake pedal switch or light switch is faulty. • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake and light switch wiring harness. - Check the supply voltage to brake and light switch (12 V). - Check the brake and light switch for contact. - Check the ECU wiring harness for ECU pin #77 and #58 (short, poor contact). - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1572	Brake Lamp Signal Fault	- The brake pedal switch or light switch is faulty. • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake pedal switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake pedal and light switch wiring harness. - Check the supply voltage to brake pedal and light switch (12 V). - Check the brake pedal and light switch for contact. - Check the ECU wiring harness for ECU pin #58 (open, short, poor contact). - Replace the ECU if required.						
P1571	Brake Lamp Signal Fault	- The brake pedal switch is faulty. • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake pedal switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake pedal switch wiring harness. - Check the supply voltage to brake pedal switch (12 V). - Check the brake pedal switch for contact. - Check the ECU wiring harness for ECU pin #77 (open, short, poor contact). - Replace the ECU if required.						
P1286	Low Resistance for Injector #1 wiring harness	- Out of range about wiring harness resistance for Injector #1. • Low: Less than 0.115 Ω (injector circuit open) - Check the injector #1 wiring harness and electric isolation. - Check the injector #1 wiring harness for open circuit. • If the pin in injector #1 is defective, replace injector #1 and perform C2I coding, then check again. • If the pin in injector #1 is not defective, check the ECU wiring harness. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1287	High Resistance for Injector #1 wiring harness	- Out of range about wiring harness resistance for Injector #1. • High: More than 0.728 Ω (injector circuit short) - Check the injector #1 wiring harness and electric isolation. - Check the injector #1 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #1 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.						
P1288	Low Resistance for Injector #2 wiring harness	- Out of range about wiring harness resistance for Injector #2. • Low: Less than 0.115 Ω (injector circuit open) - Check the injector #2 wiring harness and electric isolation. - Check the injector #2 wiring harness for open circuit. • If the pin in injector #2 is defective, replace injector #2 and perform C2I coding, then check again. • If the pin in injector #2 is not defective, check the ECU wiring harness. - Replace the ECU if required.						
P1289	High Resistance for Injector #2 wiring harness	- Out of range about wiring harness resistance for Injector #2. • High: More than 0.728 Ω (injector circuit short) - Check the injector #2 wiring harness and electric isolation. - Check the injector #2 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #2 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1292	Low Resistance for Injector #4 wiring harness	- Out of range about wiring harness resistance for Injector #4. • Low: Less than 0.115 Ω (injector circuit open) - Check the injector #4 wiring harness and electric isolation. - Check the injector #4 wiring harness for open circuit. • If the pin in injector #4 is defective, replace injector #4 and perform C2I coding, then check again. • If the pin in injector #4 is not defective, check the ECU wiring harness. - Replace the ECU if required.						
P1293	High Resistance for Injector #4 wiring harness	- Out of range about wiring harness resistance for Injector #4. • High: More than 0.728 Ω (injector circuit short) - Check the injector #4 wiring harness and electric isolation. - Check the injector #4 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #4 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.						
P1294	Low Resistance for Injector #5 wiring harness (only D27DT)	- Out of range about wiring harness resistance for Injector #5. • Low: Less than 0.115 Ω (injector circuit open) - Check the injector #5 wiring harness and electric isolation. - Check the injector #5 wiring harness for open circuit. • If the pin in injector #5 is defective, replace injector #5 and perform C2I coding, then check again. • If the pin in injector #5 is not defective, check the ECU wiring harness. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1295	High Resistance for Injector #5 wiring harness (only D27DT)	- Out of range about wiring harness resistance for Injector #5. • High: More than 0.728 Ω (injector circuit short) - Check the injector #5 wiring harness and electric isolation. - Check the injector #5 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #5 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.						
P1290	Low Resistance for Injector #3 wiring harness	- Out of range about wiring harness resistance for Injector #3. • Low: Less than 0.115 Ω (injector circuit open) - Check the injector #3 wiring harness and electric isolation. - Check the injector #3 wiring harness for open circuit. • If the pin in injector #3 is defective, replace injector #3 and perform C2I coding, then check again. • If the pin in injector #3 is not defective, check the ECU wiring harness. - Replace the ECU if required.						
P1291	High Resistance for Injector #3 wiring harness	- Out of range about wiring harness resistance for Injector #3. • High: More than 0.728 Ω (injector circuit short) - Check the injector #3 wiring harness and electric isolation. - Check the injector #3 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #3 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.						
P0704	Clutch switch malfunction	- The clutch switch is faulty (Manual Transmission Only). - Check the switch wiring harness. • Check the ECU pin #38 for open, short and poor contact. - Check the switch supply voltage and operations. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1115	Coolant Temperature Sensor Malfunction	- Implausible values of coolant temperature (If the temperature is below the limits values after warm up). - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual coolant temp. vs. Resistance • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (open, short and poor contact). • ECU pin #101 and #102 - Visually check the sensor and replace if required. - Check the thermostat, water pump radiator related coolant route (thermostat stuck). - Replace the ECU if required.						
P0118	Coolant Temperature Sensor Malfunction - Short	- Malfunction in recognition of coolant temperature • More than maximum values (Circuit Short) • External power supply malfunction - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual coolant temp. vs. Resistance • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (short and poor contact). • ECU pin #101 and #102 - Visually check the sensor and replace if required. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0117	Coolant Temperature Sensor Malfunction - Open	- Malfunction in recognition of coolant temperature • Less than minimum values (Circuit Open) • External power supply malfunction - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual coolant temp. vs. Resistance • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (open and poor contact). • ECU pin #101 and #102 - Visually check the sensor and replace if required. - Replace the ECU if required.						
P0115	Supply Voltage Fault to Coolant Temperature Sensor	- Check if the supply voltage of approx. 12 V is applied.						
P0685	Main Relay Malfunction	- The the main relay is unexpectedly high/low state (ECU is supplied after 3 seconds). - Relay resistance: 92 ± 9 Ω (at 20°C) - Check the relay wiring harness (open, short and poor contact). • Check for open and short: ECU pin #9. - If the forced operation is not available, replace the ECU.						
P1405	EGR Solenoid Valve Malfunction - Short to ground	- Out of range about EGR gas: High. • EGR controller circuit: Open or short to ground - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check the EGR solenoid valve. - Check the EGR valve for stick. - Check the resistance of EGR actuator: 15.4 Ω. - Check the ECU wiring harness for open and short. • ECU pin #96						
P1406	EGR Solenoid Valve Malfunction - Short to +Batt	- Out of range about EGR gas: Low. • EGR controller circuit: Short to battery - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check the EGR solenoid valve. - Check the EGR valve for stick. - Check the resistance of EGR actuator: 15.4 Ω - Check the ECU wiring harness for open and short. • ECU pin #96						

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1480	Condenser Fan #1 Circuit Malfunction - Open	- Condenser fan #1: Open - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #80 - If the forced operation is not available after replacing the relay, replace the ECU.						
P1481	Condenser Fan #1 Circuit Malfunction - Short	- Condenser fan #1: Short - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #80 - If the forced operation is not available after replacing the relay, replace the ECU.						
P1482	Condenser Fan #1 Circuit Malfunction - Short to Ground	- Condenser fan #1: Short to ground. - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #80 - If the forced operation is not available after replacing the relay, replace the ECU.						
P1526	Condenser Fan #2 Circuit Malfunction - Open	- Condenser fan #2: Open - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #81 - If the forced operation is not available after replacing the relay, replace the ECU.						
P1527	Condenser Fan #2 Circuit Malfunction - Short	- Condenser fan #2: Short - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #81 - If the forced operation is not available after replacing the relay, replace the ECU.						
P1528	Condenser Fan #2 Circuit Malfunction - Short to Ground	- Condenser fan #2: Short to ground - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #81 - If the forced operation is not available after replacing the relay, replace the ECU.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0325	Accelerometer #1 (Knock Sensor) Malfunction	- The signal / noise ratio is too low about accelerometer # 1. - Check the accelerometer wiring harness and tightening torque. • Tightening torque: 20 ± 5 Nm - Check the ECU wiring harness for open and short. • ECU pin #45 and #46 - If the trouble still exists even after replacing the accelerometer, replace the ECU.						
P0330	Accelerometer #2 (Knock Sensor) Malfunction (only D27DT)	- The signal / noise ratio is too low about accelerometer # 2. - Check the accelerometer wiring harness and tightening torque. • Tightening torque: 20 ± 5 Nm - Check the ECU wiring harness for open and short. • ECU pin #44 and #63 - If the trouble still exists even after replacing the accelerometer, replace the ECU.						
P1611	Injector Bank #1 Malfunction - Low Voltage	- Malfunction of injector (#1, #4, #3) circuit (Low): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #1: Open and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. - Replace the ECU if required.						

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1612	Injector Bank #1 Malfunction - High Voltage	- Malfunction of injector (#1, #4, #3) circuit (High): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #1: Short and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. - Replace the ECU if required.						O
P1618	Injector Bank #2 Malfunction - Low Voltage	- Malfunction of injector (#2, #5) circuit (Low): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #2: Open and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. - Replace the ECU if required.						
P1619	Injector Bank #2 Malfunction - High Voltage	- Malfunction of injector (#2, #5) circuit (High): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #2: Short and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. - Replace the ECU if required.						O

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0263	Injector #1 Balancing Fault	- Injector #1 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).						
P0266	Injector #2 Balancing Fault	- Injector #2 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).						
P0272	Injector #4 Balancing Fault	- Injector #4 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).						
P0275	Injector #5 Balancing Fault (only D27DT)	- Injector #5 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).						
P0269	Injector #3 Balancing Fault	- Injector #3 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).						
P0201	Injector #1 Circuit Open	- Injector #1 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #117, #114). - Replace the ECU if required.						O
P0202	Injector #2 Circuit Open	- Injector #2 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #118, #121). - Replace the ECU if required.						O

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0204	Injector #4 Circuit Open	- Injector #4 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #117, #115). - Replace the ECU if required.						O
P0205	Injector #5 Circuit Open (only D27DT)	- Injector #5 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #118, #120). - Replace the ECU if required.						O
P0203	Injector #3 Circuit Open	- Injector #3 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #117, #116). - Replace the ECU if required.						O
P1201	Injector #1 Circuit Short	- Injector #1 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #117, #114). - Replace the ECU if required.						
P1202	Injector #2 Circuit Short	- Injector #2 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #118, #121). - Replace the ECU if required.						
P1204	Injector #4 Circuit Short	- Injector #4 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #117, #115). - Replace the ECU if required.						
P1205	Injector #5 Circuit Short (only D27DT)	- Injector #5 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #118, #120). - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1203	Injector #3 Circuit Short	- Injector #3 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #117, #116). - Replace the ECU if required.						
P0182	Fuel temperature sensor - Short to Ground	- The sensing values are higher than specified values for fuel temperature sensor. (More than maximum sensing values 140°C - Circuit Short) - Actual fuel temp. vs. Resistance • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. • ECU pin: #109, #110 - Check the ECU wiring and replace the ECU if required.						
P0183	Fuel temperature sensor - Short to B+	- The sensing values are lower than specified values for fuel temperature sensor. (Less than maximum sensing values - 40°C - Circuit Open) - Actual fuel temp. vs. Resistance • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. • ECU pin: #109, #110 - Check the ECU wiring and replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0180	Fuel temperature sensor - Vref	- The power source circuit is faulty for fuel temperature sensor. (Fuel temperature sensor is mounted in high pressure pump) - Actual fuel temp. vs. Resistance • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. • ECU pin: #109, #110 - Check the ECU wiring and replace the ECU if required.						
P1678	Glow Plug Drive Malfunction - Open	- Glow plug circuit malfunction: Open. - Check the glow plug wiring harness for open. • ECU pin #113 - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required.						
P1679	Glow Plug Drive Malfunction - Short	- Glow plug circuit malfunction: Short. - Check the glow plug wiring harness for open. • ECU pin #113 - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required.						
P1680	Glow Plug Drive Malfunction - Short to Ground	- Glow plug circuit malfunction: Short to ground. - Check the glow plug wiring harness for open. • ECU pin #113 - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required.						
P1530	#1 Heater operating circuit - Open	- #1 heater circuit malfunction: Open. - Check the wiring harness for open. • ECU pin #61 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1531	#1 Heater operating circuit - Short to B+	- #1 heater circuit malfunction: Short. - Check the wiring harness for short. • ECU pin #61 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.						
P1532	#1 Heater operating circuit - Short to Ground	- #1 heater circuit malfunction: Short to ground. - Check the wiring harness for short. • ECU pin #61 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.						
P1534	#2 Heater operating circuit - Open	- #2 heater circuit malfunction: Open. - Check the wiring harness for open. • ECU pin #62 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.						
P1535	#2 Heater operating circuit - Short to B+	- #2 heater circuit malfunction: Short. - Check the wiring harness for short. • ECU pin #62 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.						
P1536	#2 Heater operating circuit - Short to Ground	- #2 heater circuit malfunction: Short to ground. - Check the wiring harness for short. • ECU pin #62 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.						

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1254	Maximum Rail Pressure Control Malfunction (IMV Fault)	- Rail pressure faults: Too high - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the high pressure fuel lines, fuel rails and high pressure pipes for leaks. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						
P1253	Minimum Rail Pressure Control Malfunction (IMV Fault)	- Rail pressure faults: Too low - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the high pressure fuel lines, fuel rails and high pressure pipes for leaks. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						O

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1256	Too Small Transfer Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						
P1257	Too Large Transfer Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1258	Too Small High Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						
P1259	Too Large High Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1191	Pressure Build Up - Too Slow	- The pressure build up during cranking is too slow. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						O
P0255	IMV Driver Circuit Malfunction - Open	- IMV driver circuit malfunction: Open - Check the IMV wiring harness. • Check the ECU pin #87 for open. - Check the ECU wiring harness. - Check the IMV resistance. • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.			O		O	
P0251	IMV Driver Circuit Malfunction - Short	- IMV driver circuit malfunction: Short - Check the IMV wiring harness. • Check the ECU pin #87 for short. - Check the ECU wiring harness. - Check the IMV resistance. • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.			O		O	
P0253	IMV Driver Circuit Malfunction - Short to Ground	- IMV driver circuit malfunction: Short to ground - Check the IMV wiring harness. • Check the ECU pin #87 for short to ground. - Check the ECU wiring harness. - Check the IMV resistance. • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.			O		O	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
		- The intake air temperature sensing value is lower than maximum value of 150°C: Open - Check the supply voltage to sensor. • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. • Check the source power circuit for short to ground. - Check the sensor resistance. • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. • Check the ECU pin #64 and #84 for open. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0112	Intake Air Temperature Circuit Malfunction - Open	- The intake air temperature sensing value is lower than maximum value of 150°C: Open - Check the supply voltage to sensor. • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. • Check the source power circuit for short to ground. - Check the sensor resistance. • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. • Check the ECU pin #64 and #84 for open. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0110	Intake Air Temperature Circuit Malfunction - Source Power Problem	- The intake air temperature sensing value is lower than minimum value or higher than maximum value, or the external power to HFM sensor is faulty. - Check the supply voltage to sensor. • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. • Check the source power circuit for short to ground. - Check the sensor resistance. • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. • Check the ECU pin #64 and #84 for open and short. - Replace the ECU if required.						
P1171	#1 Injector MDP Malfunction	- The #1 injector MDP is faulty. - C2I coding check - Check fault code - No fault condition, vehicle speed 70 KPH - Coolant temp. 75°C above condition try again - Replace the injector and perform C2I coding again.						
P1172	#2 Injector MDP Malfunction	- The #2 injector MDP is faulty. - C2I coding check - Check fault code - No fault condition, vehicle speed 70 KPH - Coolant temp. 75°C above condition try again - Replace the injector and perform C2I coding again.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1174	#4 Injector MDP Malfunction	- The #4 injector MDP is faulty. - C2I coding check - Check fault code - No fault condition, vehicle speed 70 KPH - Coolant temp. 75°C above condition try again - Replace the injector and perform C2I coding again.						
P1175	#5 Injector MDP Malfunction (only D27DT)	- The #5 injector MDP is faulty. - C2I coding check - Check fault code - No fault condition, vehicle speed 70 KPH - Coolant temp. 75°C above condition try again - Replace the injector and perform C2I coding again.						
P1173	#3 Injector MDP Malfunction	- The #3 injector MDP is faulty. - C2I coding check - Check fault code - No fault condition, vehicle speed 70 KPH - Coolant temp. 75°C above condition try again - Replace the injector and perform C2I coding again.						
P1252	Too High IMV Pressure	- The rail pressure is excessively high. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						
P1120	Accelerator Pedal Sensor #1 Malfunction	- The potentiometer 1 is not plausible with potentiometer 2. - Check the supply voltage to sensor. - Check the wiring harness. • Check the ECU pin #71, 53 and #32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.	O					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1121	Accelerator Pedal Sensor #2 Malfunction	- The potentiometer 2 is not plausible with potentiometer 1. - Check the supply voltage to sensor. - Check the wiring harness. • Check the ECU pin #71, 53 and #32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.	O					O
P1122	Accelerator Pedal Sensor Malfunction (Limp Home Mode)	- When triggering limp home mode. - Check the supply voltage to sensor. - Check the wiring harness. • Check the ECU pin #72, 71, 53 and #57, 32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.					O	O
P1123	Accelerator Pedal Sensor Malfunction (Reducde Torque Mode)	- When triggering reduced torque mode. - Check the supply voltage to sensor. - Check the wiring harness. • Check the ECU pin #72, 71, 53 and #57, 32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required	O					O
P1124	Accelerator Pedal Sensor Malfunction - Stuck	- The accelerator pedal sensor is stuck. - Check the brake switch wiring harness and operations. - Check the accelerator pedal operations. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.					O	
P0122	Accelerator Pedal Sensor #1 Malfunction - Open	- Out of range about potentiometer 1 of pedal sensor: lower than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #71, #53 for open and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O					O
P0123	Accelerator Pedal Sensor #1 Malfunction - Short	- Out of range about potentiometer 1 of pedal sensor: higher than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #71, #53 for short and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0120	Accelerator Pedal Sensor #1 Malfunction - Supply Voltage Fault	- The 5 V supply voltage is faulty. - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #72, #53 for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O					
P0222	Accelerator Pedal Sensor #2 Malfunction - Open	- Out of range about potentiometer 2 of pedal sensor: lower than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #32, #14 for open and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O					O
P0223	Accelerator Pedal Sensor #2 Malfunction - Short	- Out of range about potentiometer 2 of pedal sensor: higher than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #32, #14 for short and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O					
P0220	Accelerator Pedal Sensor #2 Malfunction - Supply Voltage Fault	- The 2.5 V supply voltage is faulty. - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #57, #14 for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0192	Fuel Rail Pressure Sensor Malfunction - Open	- The fuel rail pressure sensing values are lower than specified values. • Minimum sensing values: - 112 bar (Open) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for open and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O					
P0193	Fuel Rail Pressure Sensor Malfunction - Short	- The fuel rail pressure sensing values are higher than specified values. • Maximum sensing values: 1,600 bar (Short) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055± 0.125V • Output voltage at atmospheric pressure: 0.5±0.04V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for short and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O					
P0190	Supply Voltage Fault to Fuel Rail Pressure Sensor	- The supply voltage to fuel rail pressure sensor is faulty. - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055± 0.125V • Output voltage at atmospheric pressure: 0.5±0.04V - Check the sensor and ECU wiring harness. • Check the ECU pin #6, #26 for open and short. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0191	Fuel Rail Pressure Sensor Signal Fault	- The rail pressure drop is too high. - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #6, #26 for open and short. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O					O
P1192	Fuel Rail Pressure Sensor Initial Signal Fault - Low	- The rail pressure sensor initial values are lower than specified values with the ignition “ON”. • Minimum sensing values: - 9 0 bar (Open) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for open and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O					
P1193	Fuel Rail Pressure Sensor Initial Signal Fault - High	- The rail pressure sensor initial values are higher than specified values with the ignition “ON”. • Maximum sensing values: 90 bar (Short) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for short and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O					

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AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1190	Fuel Rail Pressure Sensor Initial Signal Fault	- The rail pressure sensor initial values are higher or lower than specified values with the ignition “ON”. • Maximum sensing values: 90 bar (Short) • Minimum sensing values: - 90 bar (Open) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for open and short. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O					O
P0215	Main Relay Fault - Stuck	- The main relay is stuck ; Shut down. - Resistance of main relay: 92 Ω ± 9 Ω (at 20°C) - Check the main relay wiring harness. - Check the ECU wiring harness. • Check the ECU pin #3, 4, 5 for open and short. - If the forced operation is not available, replace the ECU. - Check the fuse for main relay						
P1500	Vehicle Speed Fault	- The vehicle speed signal through CAN communication is faulty. - Check the CAN communication line for open and short. - Check the ABS/ESP and TCU communication lines. - Check the ECU wiring harness. - Replace the ECU if required.						
P0642	ECU Supply Voltage 1 Fault - Low (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1 - Check the wiring harnesses. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0643	ECU Supply Voltage 1 Fault - High (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1 - Check the wiring harnesses. - Replace the ECU if required.						
P0641	ECU Supply Voltage 1 Fault (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1 - Check the wiring harnesses. - Replace the ECU if required.						
P0652	ECU Supply Voltage 2 Fault - Low (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.			O		O	O
P0653	ECU Supply Voltage 2 Fault - High (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.			O		O	
P0651	ECU Supply Voltage 2 Fault (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.			O		O	

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AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0698	ECU Supply Voltage Fault - Low (2.5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 2.5 V - Check the supply voltage to each sensor • Supply voltage (2.5 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required.						
P0699	ECU Supply Voltage Fault - High (2.5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 2.5 V - Check the supply voltage to each sensor • Supply voltage (2.55 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required.						
P0697	ECU Supply Voltage Fault (2.5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 2.5 V - Check the supply voltage to each sensor • Supply voltage (2.55 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required.						
P0245	Turbo Charger Actuator Circuit Fault - Short	- The waste gate driver circuit is short to ground or open - Check the actuator wiring harness. - Check the solenoid valve. - Check the ECU wiring harness. • Check the ECU pin #95 for open and short. - Replace the ECU if required.	O					
P0246	Turbo Charger Actuator Circuit Fault - Short to B+	- The turbo charger actuator power source circuit is short. - Check the actuator wiring harness. - Check the solenoid valve. - Check the ECU wiring harness for short and poor contact. - Replace the ECU if required.	O					O
P0606	ECU Watchdog Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						O
P1607	ECU Injector Cut Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						O

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1600	ECU Shut Down Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						O
P1601	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						O
P1602	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						O
P1614	ECU C2I/MDP Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check C2I code - Check the ECU. - Replace the ECU if required.					O	O
P1615	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O	O
P1616	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O	O
P1606	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O	O
P1620	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O	O
P1621	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O	O
P1622	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O	O

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1148	Accelerometer (Knock Sensor) Learning Fault	- Check if the MDP is successful. - Check the accelerometer (knock sensor) sensor and wiring harness. - Replace the ECU if required.		O				
P0400	EGR Control Valve Fault	- When the EGR emission is more than specified value. • The EGR controller circuit is open or short to ground. • The EGR controller is short to battery. - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check if the EGR valve is stuck. - Check the resistance of EGR valve: 15.4 Ω. - Check the ECU wiring harness. • Check the ECU pin #96 for open and short.						
P1235	VGT Operation Fault	- The boost pressure control is faulty. - Check the air intake system. - Check the supply voltage to sensor. - Check the wiring harness and the ECU wiring harness. - Replace the ECU if required.	O					
P1608	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						O
P0335	No Crank Signals	- Refer to P0372.						O
P1170	Torque Trim Fault - High	- Refer to P0372.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1676	Glow Plug Communication Fault	- The communication between ECU and glow controller is faulty. - Check the communication line between ECU and glow controller. - Check the glow plug wiring harness. - Check the resistance of glow plug: below 1 Ω. - Check the glow controller. - Check the ECU wiring harness. • Check the ECU pin #34 for short to ground. - Replace the ECU if required.						
P1677	Glow Plug Controller Fault	- glow controller is faulty. - Check the communication line between ECU and glow controller. - Check the glow plug wiring harness. - Check the resistance of glow plug: below 1Ω. - Check the glow plug relay. - Check the ECU wiring harness. • Check the ECU pin #34 for short to ground. - Replace the ECU if required.						
P0671	#3 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required.						
P0672	#4 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required.						
P0673	#5 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0674	#1 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1Ω. - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required.						
P0675	#2 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required.						
P1671	#3 Glow Plug Fault - Short (B+)	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required.						
P1672	#4 Glow Plug Fault - Short (B+)	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required.						
P1673	#5 Glow Plug Fault - Short (B+)	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required.						
P1674	#1 Glow Plug Fault - Short (B+)	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1675	#2 Glow Plug Fault - Short (B+)	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required.						
P0700	TCU Signal Fault	- The communication between ECU and TCU is faulty. - Check the communication line between ECU and TCU. - Check the ECU pin #54, 73 for open and short. - Replace the ECU or TCU if required.						
P1540	Air Conditioner Operating Circuit Fault - Open	- Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required.						
P1541	Air Conditioner Operating Circuit Fault - Short	- Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required.						
P1542	Air Conditioner Operating Circuit Fault - Short to Ground	- Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required.						
P1149	Too High Water Level in Fuel Filter	- Drain the water from fuel filter.		O				
P1634	Immobilizer Fault (refer to immobilizer section)	- No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna. - Replace the ECU if required.						
P1635	No response from Immobilizer (refer to immobilizer section)	- No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna. - Replace the ECU or immobilizer if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1630	Wrong response from Immobilizer (refer to immobilizer section)	- The invalid key is inserted or no communication between transponder and immobilizer (no response from transponder). - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.						
P1631	Immobilizer Fault (refer to immobilizer section)	- The immobilizer is not operating. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.						
P1632	Immobilizer Fault (refer to immobilizer section)	- No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.						
P1633	Immobilizer Fault (refer to immobilizer section)	- No key coding. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.						
P0633	Immobilizer Fault (refer to immobilizer section)	- Key memory is not available (permissible - 5). - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1636	Immobilizer Fault (refer to immobilizer section)	- Severe trouble is not defined. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.						
P1102	High HFM Sensor Signal	- HFM sensing values are higher than specified sensing values (not circuit failure but sensor failure).						
P1103	Low HFM Sensor Signal	- HFM sensing values are lower than specified sensing values (not circuit failure but sensor failure).						
P1501	Variant coding failure (vehicle speed)	- If the vehicle speed is below 15 km/h (even over 1,600 rpm of engine speed) when the “Vehicle speed sensor” coding is “YES” (Non-ABS vehicle), the vehicle speed input failure appears. - If the “Vehicle speed sensor” coding is “NO” (CAN, ABS/ESP vehicle), the trouble code does not appear. - Check the “Vehicle speed sensor” coding.						
P1503	Vehicle speed sensor input failure	- If the pulse from speed pulse ring is more than specified value during the specified interval when the “Vehicle speed sensor” coding is “YES” (Non-ABS vehicle), the vehicle speed sensor failure appears. - Specified pulse: 52 pulses/1 revolution - Check the “Vehicle speed sensor” coding.						
P0600	CAN BUS failure	- CAN related device in ECU is defective. - CAN communication between units is failure.						
P0602	Vehicle speed sensor coding failure	- Even though the ESP or TCCU is not installed in the vehicle, the vehicle speed signal is sent through CAN communication.						
P0608	ABS/ESP coding failure	- ABS/ESP variant coding is failure. - CAN communication is failure.						
P0613	TCU coding failure	- TCU variant coding is failure. - CAN communication between units is failure.						
P0644	CAN cluster failure	- CAN cluster is failure. - CAN communication between units is failure.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1565	Auto cruise switch failure (Acceleration)	- Auto cruise acceleration switch or related wiring harness is defective.						
P1566	Auto cruise switch failure (OFF)	- Auto cruise OFF switch or related wiring harness is defective.						
P1567	Auto cruise switch failure	- Auto cruise switch or related wiring harness is defective.						
P1568	Auto cruise switch failure (Deceleration)	- Auto cruise deceleration switch or related wiring harness is defective.						
P1569	Auto cruise switch failure (Safety)	- Auto cruise safety switch or related wiring harness is defective.						
P3040	ECU internal failure	- ECU internal failure						
P3041	ECU internal failure (only D27DT)	- ECU internal failure						
P1657	Engine mount control failure (Open)	- Engine mount level control circuit is failure.						
P1658	Engine mount control failure (Short to B+)	- Engine mount level control circuit is short to B+.						
P1659	Engine mount control failure (Short to ground)	- Engine mount level control circuit is short to ground.						
P0805	Abnormal neutral signal	- The “Neutral” signal from manual transmission is sent to CAN cluster. Then, CAN cluster sends this signal to ECU via CAN communication line. - ECU cannot determine where the signal problem is; in neutral switch, wiring or CAN communication line. - Check the neutral switch wiring harness.						

ION (BTRA) AUTO TRANSMISSION

TABLE OF CONTENTS

DESCRIPTION AND OPERATION 2

Ion (BTRA) automatic transmission 2
Specifications 4
Shift pattern diagram 5
Operators interfaces 6
Control systems 7
Electronic control system 7
Hydraulic control system 13
Accelerator pedal sensor 13
Hydraulic control circuit 14
Power train system 18
Power flows 22
Park and neutral 23
Reverse 25
Manual 1 27
Drive 1 29
Drive 2 and manual 2 31
Drive 3 and manual 3 33
Drive 3 lock up and manual 3 lock up 35
Drive 4 (overdrive) 37
Drive 4 lock up 39

DIAGNOSTIC INFORMATION AND PROCEDURES 41

DIAGNOSIS 41

Basic knowledge required 41
Functional check procedure 41
Transmission fluid level service procedure 42
Fluid leak diagnosis and repair 43
Electrical / garage shift test 44
Road test procedure 44
Electronic adjustments 44

SYMPTOM DIAGNOSIS 45

Drive faults 45
Faulty shift pattern 46
Shift quality faults 48
After teardown faults 50

REPAIR INSTRUCTIONS 52

ON-VEHICLE SERVICE 52

Ion automatic transmission assembly 52
Valve body 54

UNIT REPAIR 56

Rebuild warnings 56
Disassembly procedure 57
Assembly procedure 67
Front and rear band adjustment 95
Gear shift control lever 98
Removal and installation of TCU 99
Fastener tightening specifications 100

TROUBLE CODE DIAGNOSIS 101

Diagnostic trouble codes 101
TCU diagnostic system overview 101
Clearing trouble codes 101
Circuit diagram of TCU 111
Connector end view 112

SPECIAL TOOLS AND EQUIPMENT .. 113

DESCRIPTION AND OPERATION

ION (BTRA) AUTOMATIC TRANSMISSION

The ION (BTR) Four Speed Automatic Transmission is an electronically controlled overdrive four speed unit with a lock-up torque converter. The lock-up torque converter results in lower engine speeds at cruise and eliminates unnecessary slippage. These features benefit the customer through improved fuel economy and noise reduction.

Of primary significance is the Transmission Control Module (TCM) which is a microprocessor based control system.

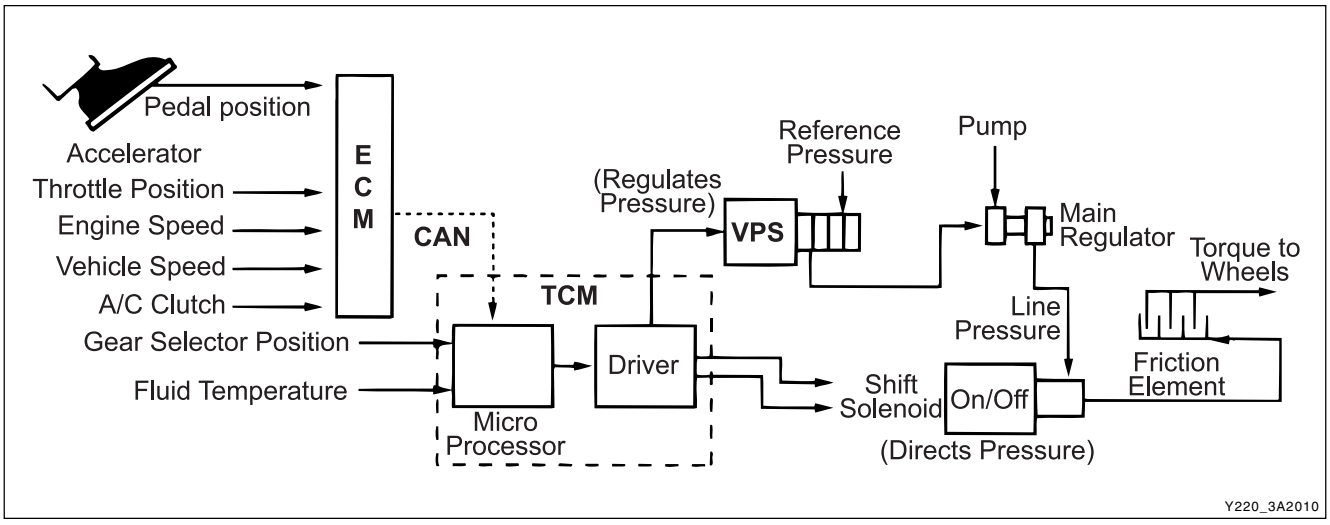
	Max. Power (kW)	Configuration
320	160	260 mm Torque Converter-Wide Ratio Gear Set Splined Output for Transfer Case

The TCM utilizes throttle position, rate of throttle opening, engine speed, vehicle speed, transmission fluid temperature, gear selector position and mode selector inputs, and in some applications a Kickdown Switch to control all shift feel and shift schedule aspects.

The TCM drives a single proportional solenoid multiplexed to three regulator valves to control all shift feel aspects. The output pressure of this solenoid is controlled as a function of transmission fluid temperature to maintain consistent shift feel throughout the operating range.

Shift scheduling is highly flexible, and several independent schedules are programmed depending on the vehicle.

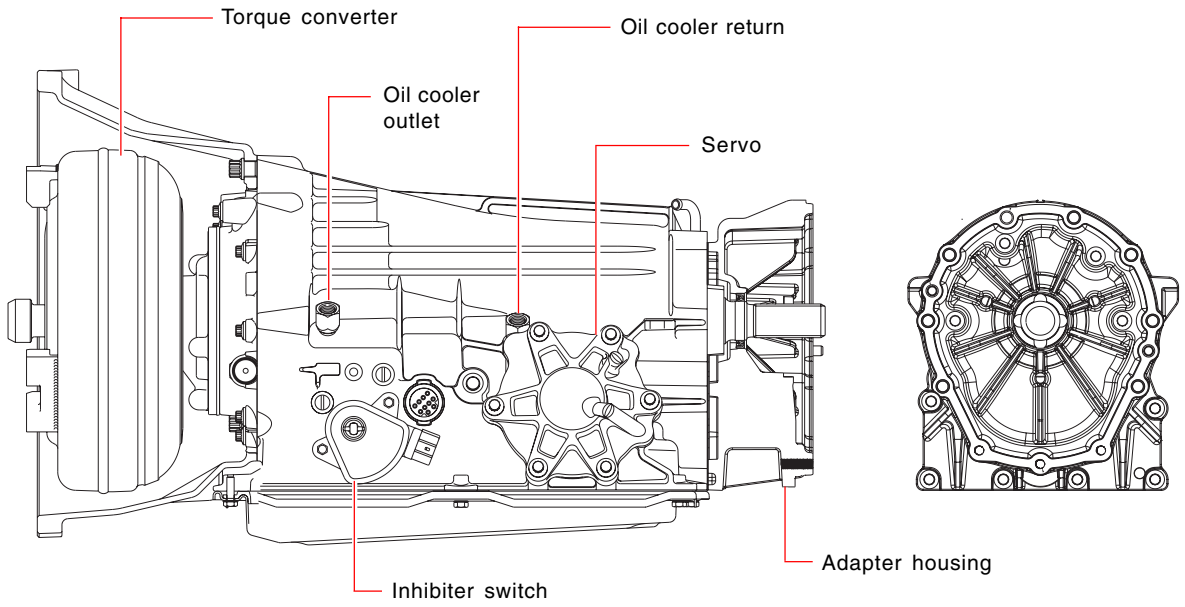
Typically the NORMAL schedule is used to maximize fuel economy and driveability, and a POWER schedule is used to maximize performance. WINTER schedule is used to facilitate starting in second gear.



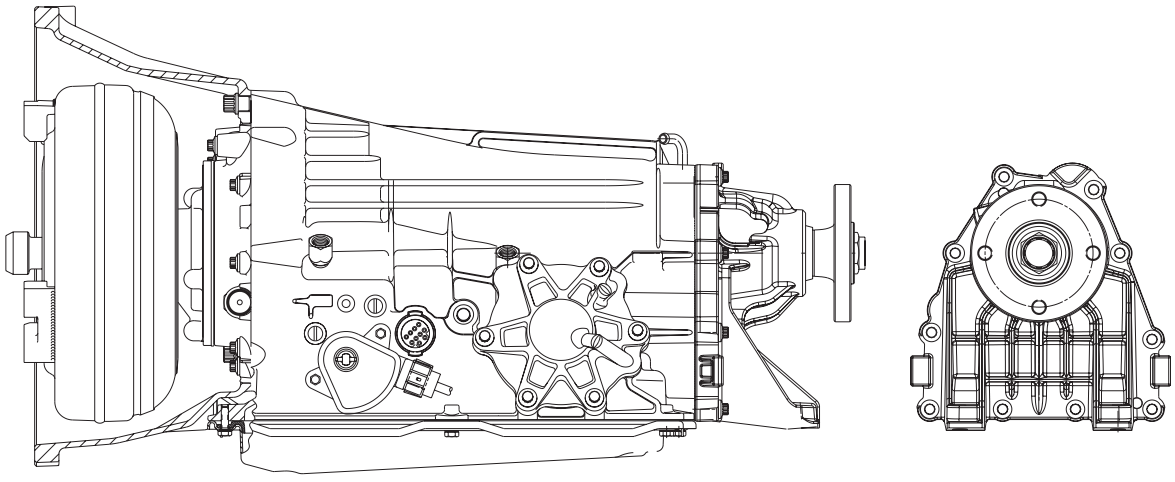
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▶ Appearance

4WD Automatic Transmission



2WD Automatic Transmission



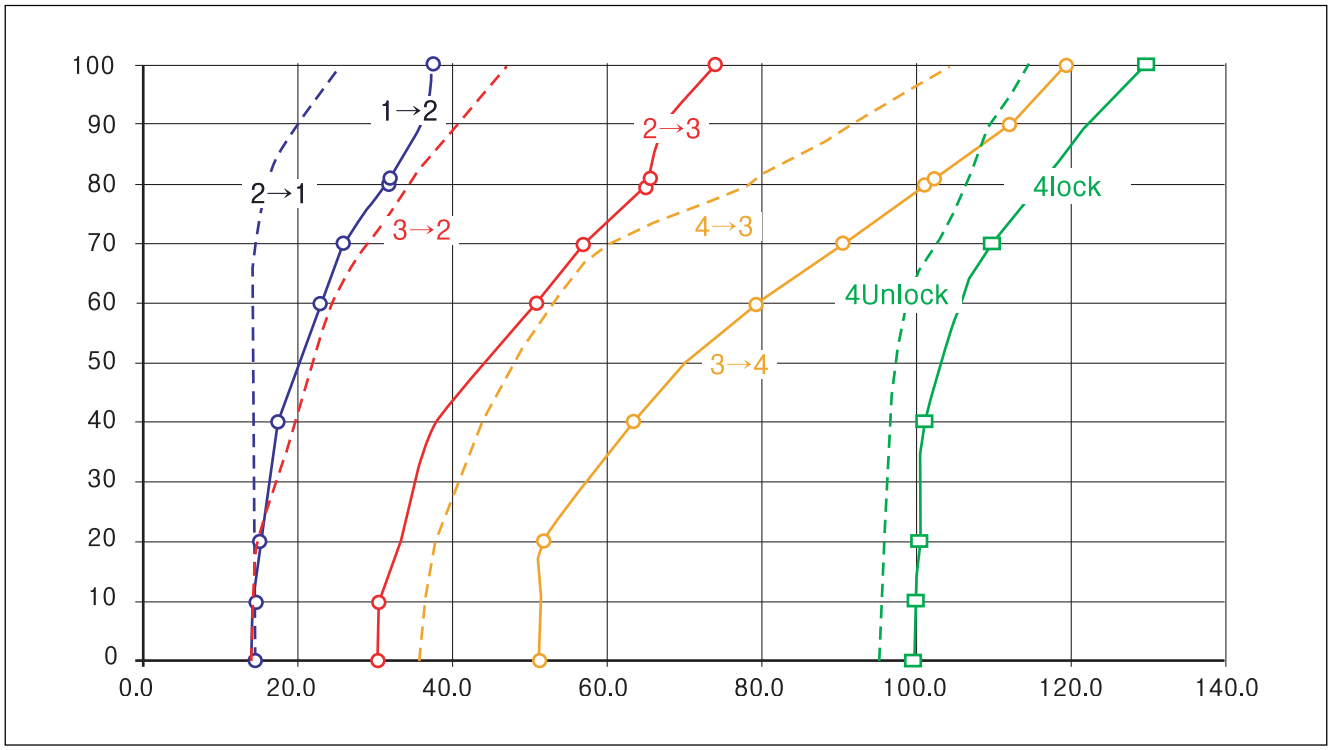
SPECIFICATIONS

Description		Specifications	Remark
Gear ratios	1st	2.742	
	2nd	1.508	
	3rd	1.000	
	4th	0.708	
	Reverse	2.428	
	Final gear ratio	4.55	
Torque converter	Diamerter	260 (mm)	
	Number of element	3 EA	
	Number of Step	1 EA	
	Number of Phase	2 EA	
Transmission component	Planetary gear set	1 EA	
	One-way clutch	3 EA	
	Multi disc clutch	4 EA	
	Band brake	2 EA	
Weight	Including oil	76 kg	
Oil	Fluid specification	CASTROL TQ 95	
	Fluid capacity	Approx. 9.5 ℓ	
Resistance of oil temperature sensor	-20°C	13,638 ~ 17,287 Ω	
	0°C	5,177 ~ 6,616 Ω	
	20°C	2,278 ~ 2,723 Ω	
	100°C	177 ~ 196 Ω	
	135°C	75 ~ 85 Ω	
Resistance of gear position sensor	1 gear position	1.0 ~ 1.4 kΩ (1.0 V)	
	2 gear position	1.8 ~ 2.2 kΩ (1.5 V)	
	3 gear position	3.0 ~ 3.4 kΩ (2.0 V)	
	D gear position	4.5 ~ 4.9 kΩ (2.5 V)	
	N gear position	6.8 ~ 7.2 kΩ (3.0 V)	
	R gear position	10.8 ~ 11.2 kΩ (3.5 V)	
	P gear position	18.6 ~ 19.0 kΩ (4.0 V)	

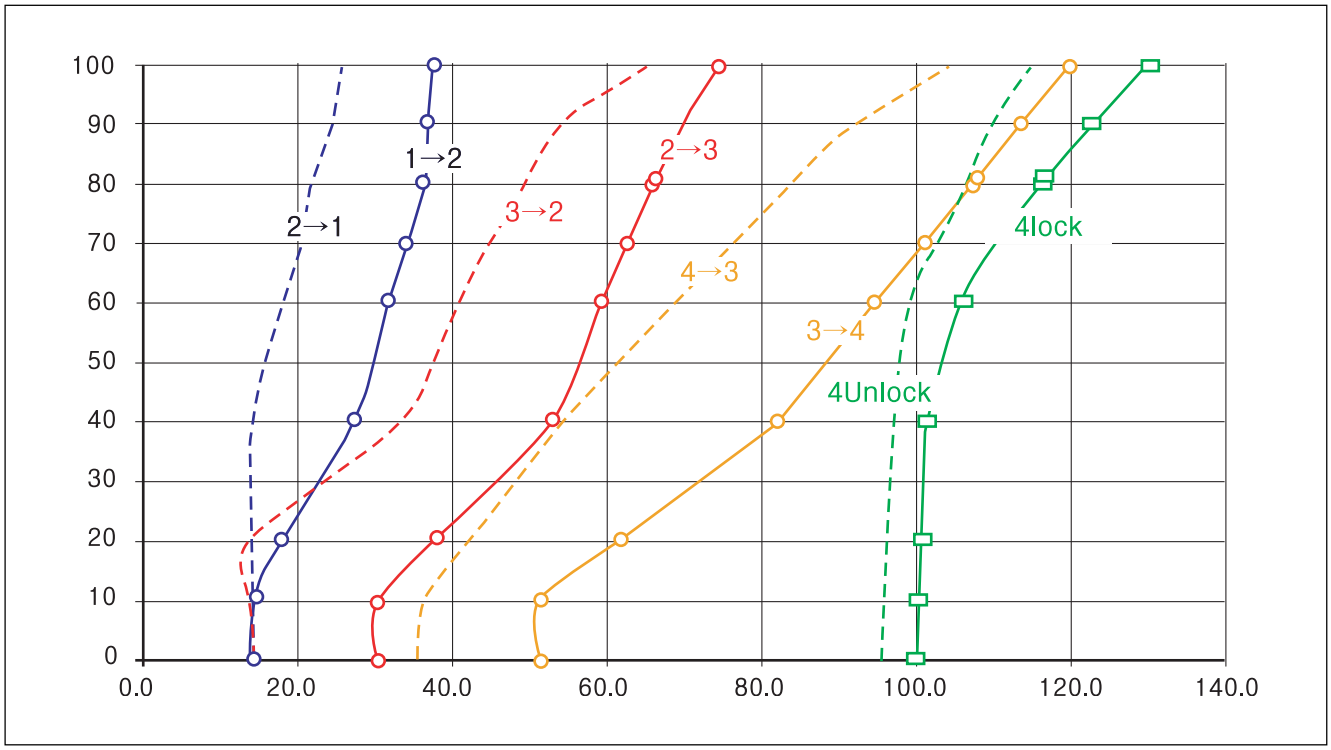
SHIFT PATTERN DIAGRAM

▶ Normal Mode

* WINTER mode has same shift pattern with NORMAL mod3e except 2nd gear drive-off.



▶ Power Mode



OPERATORS INTERFACES

There are three operator interfaces as the following;

- Gear Shift Control Lever
- Driving Mode Selector
- Indicator Light

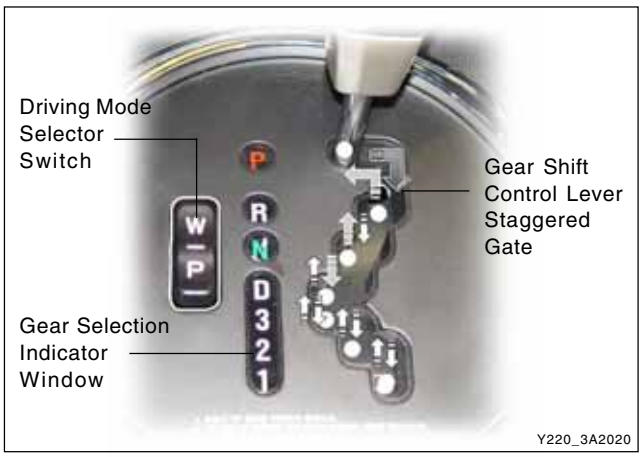
▶ Gear Shift Control Lever

The transmission uses a conventional shift control lever. The gear shift control lever can be moved from one position to another within the staggered configuration of the shift control lever gate to positively indicate the gear selection.

- P - Park position prevents the vehicle from rolling either forward or backward by locking the transmission output shaft. The inhibitor switch allows the engine to be started. For safety reasons, the parking should be used in addition to the park position. Do not select the Park position until the vehicle comes to a complete stop because it mechanically locks the output shaft.
- R - Reverse allows the vehicle to be operated in a rearward direction. The inhibitor switch enables reverse lamp operation.
- N - Neutral allows the engine to be started and operated while driving the vehicle. The inhibitor switch allows the engine to be started. There is no power transferred through the transmission in Neutral. But the final drive is not locked by the parking pawl, so thewheels are free to rotate.
- D - Overdrive range is used for all normal driving conditions. 4th gear (overdrive gear) reduces the fuel consumption and the engine noise. Engine braking is applied with reduced throttle.

  First to second (1 → 2), first to third (1 → 3), second to third (2 → 3), second to fourth (2 → 4), third to fourth (3 → 4), fourth to third (4 → 3), fourth to second (4 → 2), third to second (3 → 2), third to first (3 → 1) and second to first (2 → 1) shifts are all available as a function of vehicle speed, throttle position and the time change rate of the throttle position.

  Downshifts are available for safe passing by depressing the accelerator. Lockup clutch may be enabled in 3rd and 4th gears depending on vehicle type.
- 3 - Manual 3 provides three gear ratios (first through third) and prevents the transmission from operating in 4th gear. 3rd gear is used when driving on long hill roads or in heavy city traffic. Downshifts are available by depressing the accelerator.
- 2 - Manual 2 provides two gear ratios (first and second). It is used to provide more power when climbing hills or engine braking when driving down a steep hill or starting off on slippery roads.
- 1 - Manual 1 is used to provide the maximum engine braking when driving down the severe gradients.



▶ Driving Mode Selector

The driving mode selector consists of a driving mode selector switch and indicator light. The driving mode selector is located on the center console and allows the driver to select the driving mode.

The driving modes available to be selected vary with vehicle types. Typically the driver should have the option to select among NORMAL, POWER and WINTER modes.

When NORMAL mode is selected upshifts will occur to maximize fuel economy. When POWER mode is selected, upshifts will occur to give maximum performance and the POWER mode indicator light is switched ON.

When WINTER mode is selected, starting in second gear is facilitated, the WINTER mode indicator light is switched ON and the POWER mode indicator light is switched OFF.

▶ Indicator Light

The indicator light is located on the instrument panel.

- Auto shift indicator light comes ON when the ignition switch ON and shows the gear shift control lever posi-tion.
- POWER mode indicator light comes ON when the POWER mode is selected and when the kickdown switch is depressed.
- WINTER mode indicator light comes ON when the WINTER mode is selected.

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EFFECTIVE DATE	
AFFECTED VIN	

CONTROL SYSTEMS

BTRA M74 4WD automatic transmission consists of two control systems. One is the electronic control system that monitors vehicle parameters and adjusts the transmission performance. Another is the hydraulic control system that implements the commands of the electronic control system commands.

ELECTRONIC CONTROL SYSTEM

The electronic control system comprises of sensors, a TCM and seven solenoids. The TCM reads the inputs and activates the outputs according to values stored in Read Only Memory (ROM).

The TCM controls the hydraulic control system. This control is via the hydraulic valve body, which contains seven electromagnetic solenoids. Six of the seven solenoids are used to control the line pressure, operate the shift valves and the torque converter lock-up clutch, and to turn ON and OFF the two regulator valves that control the shift feel.

The seventh solenoid is the proportional or Variable Pressure Solenoid (VPS) which works with the two regulator valves to control shift feel.

Transmission Control Module (TCM)

The TCM is an in-vehicle micro-processor based transmission management system. It is mounted under the driver's side front seat in the vehicle cabin.

The TCM contains:

- Processing logic circuits which include a central microprocessor controller and a back-up memory system.
- Input circuits.
- Output circuits which control external devices such as the Variable Pressure Solenoid (VPS) driver, On/Off solenoid drivers, a diagnostics output and the driving mode indicator light.

Processing logic

Shift schedule and calibration information is stored in an Erasable Programmable Read Only Memory (EPROM).

Throttle input calibration constants and the diagnostics information are stored in Electrically Erasable Programmable Read Only Memory (EEPROM) that retains the memory even when power to the TCM is disconnected. TCM continuously monitors the input values and uses these, via the shift schedule, to determine the required gear state. At the same time it monitors, via the solenoid outputs, the current gear state, whenever the input conditions change such that the required gear state is different to the current gear state, the TCM initiates a gear shift to bring the two states back into line.

Once the TCM has determined the type of gearshift required the TCM accesses the shift logic, estimates the engine torque output, adjusts the variable pressure solenoid ramp pressure then executes the shift.

The TCM continuously monitors every input and output circuit for short or open circuits and operating range.

When a failure or abnormal operation is detected the TCM records the condition code in the diagnostics memory and implements a Limp Home Mode (LHM).

The actual limp home mode used depends upon the failure detected with the object to maintain maximum driveability without damaging the transmission. In general input failures are handled by providing a default value. Output failures, which are capable of damaging the transmission, result in full limp mode giving only third or fourth gear and reverse. For further details of limp modes and memory retention refer to the Diagnostic Trouble Code Diagnosis Section.

The TCM is designed to operate at ambient temperatures between - 40 and 85°C (- 40 and 185°F). It is also protected against electrical noise and voltage spikes, however all the usual precautions should be observed, for example when arc welding or jump starting.

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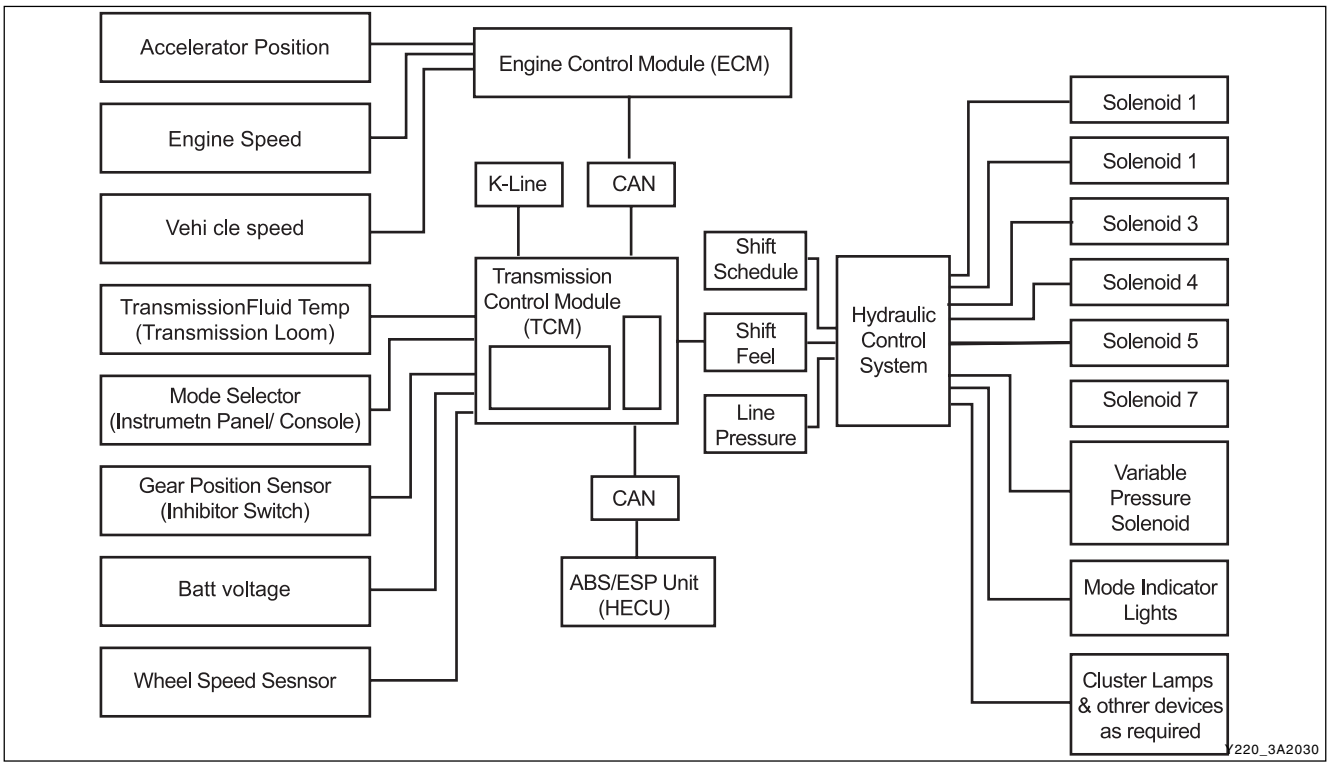
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TCM inputs

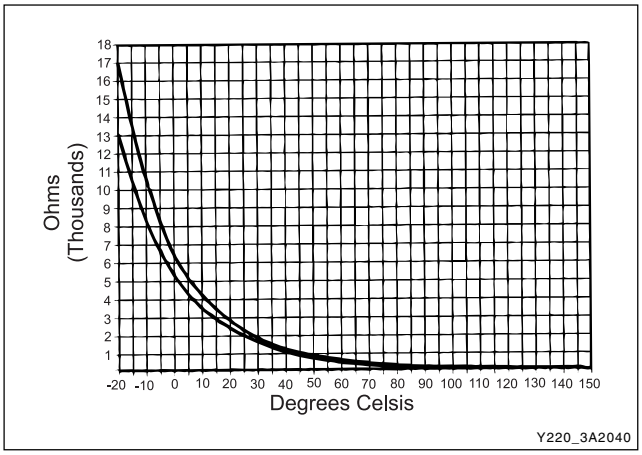
To function correctly, the TCM requires engine speed, vehicle speed, transmission fluid temperature, throttle position, gear position and Kickdown Switch inputs to determine the variable pressure solenoid current ramp and on/off solenoid states. This ensures the correct gear selection and shift feel for all driving conditions.

The inputs required by the TCM are as follows;

- Engine Speed
  The engine speed signal is derived from the Controller Area Network (CAN) via Engine Control Module (ECM).
- Vehicle Speed
  The vehicle speed sensor, which is located in the transfer case, sends the output shaft speed signal to the Engine Control Module (ECM). The information is then transferred to the TCM via the CAN.
- Transmission Fluid Temperature
  The transmission fluid temperature sensor is a thermistor located in the solenoid wiring loom within the valve body of the transmission. This sensor is a typical Negative Temperature Coefficient (NTC) resistor with low temperatures producing a high resistance and high temperatures producing a low resistance.

  If the transmission fluid temperature exceeds 135°C (275°F), the TCM will impose converter lock-up at lower vehicle speeds and in some vehicles flashes the mode indicator light. This results in maximum oil flow through the external oil cooler and eliminates slippage in the torque converter. Both these actions combine to reduce the oil temperature in the transmission.

Temperature (°C)	Resistance (Ohms)	
	Minimum	Maximum
-20	13,638	17,287
0	5,177	6,616
20	2,278	2, 723
100	117	196
135 (Overheat Mode Threshold)	75	85

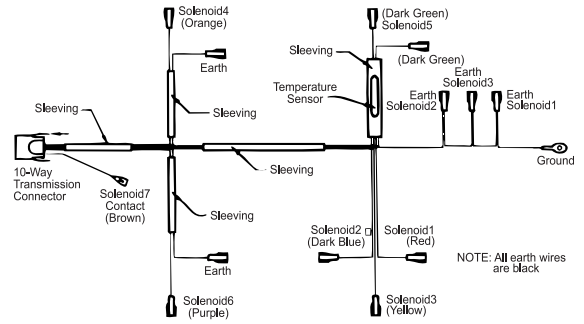


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EFFECTIVE DATE	
AFFECTED VIN	

Pin No. Codes and colors in Solenoid Loom

Pin No.	Wire Color	Connects to
1	Red	Solenoid 1
2	Blue	Solenoid 2
3	Yellow	Solenoid 3
4	Orange	Solenoid 4
5	Green	Solenoid 5
6	Violet	Solenoid 6
7	Brown	Solenoid 7
8	Green	Solenoid 5
9	White	Temperature Sensor
10	White	Temperature Sensor

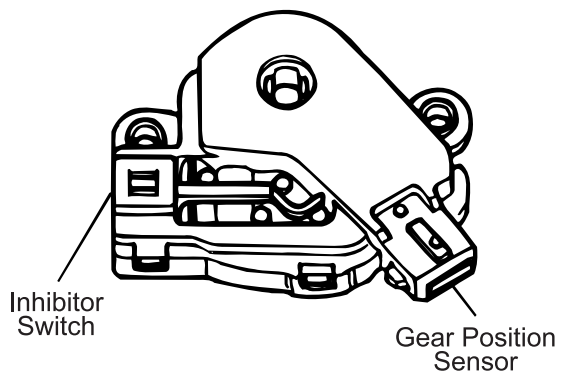
Temperature Sensor Location in Solenoid Loom



Gear position sensor

The gear position sensor is incorporated in the inhibitor switch mounted on the side of the transmission case.

The gear position sensor is a multi-function switch providing three functions;



- Inhibit starting of the vehicle when the shift lever is in a position other than Park or Neutral
- Illuminate the reverse lamps when Reverse is selected
- Indicate to the TCM which lever position has been selected by way of a varying resistance.

Readings for Resistance / Shift Lever Positions

Shift Lever Position	Resistance (kΩ)
Manual 1	1 ~ 1.4
Manual 2	21.8 ~ 2.2
Manual 3	3 3 ~ 3.4
Drive	4.5 ~ 4.9
Neutral	6.8 ~ 7.2
Reverse	10.8 ~ 11.2
Park	18.6 ~ 19

Diagnostic inputs

The diagnostic control input or K-line is used to initiate the outputting of diagnostic data from the TCM to a diagnostic test instrument. This input may also be used to clear the stored fault history data from the TCM's retentive memory. Connection to the diagnostic input of the TCM is via a connector included in the vehicle's wiring harness or computer interface.

Battery voltage monitoring input

The battery voltage monitoring input is connected to the positive side of the battery. This signal is taken from the main supply to the TCM.

If the battery voltage at the TCM falls below 11.3 V, the transmission will adopt a low voltage mode of operating in which shifts into first gear are inhibited. All other shifts are allowed but may not occur because of the reduced voltage. This condition normally occurs only when the battery is in poor condition.

If the battery voltage is greater than 16.5 V, the transmission will adopt limp home mode and all solenoids are turned OFF.

When system voltage recovers, the TCM will resume normal operation after a 30 seconds delay period.

TCM outputs

The outputs from the TCM are supplied to the components described below;

- Solenoids
- Mode Indicator Light

Solenoids

The TCM controls seven solenoids. Solenoids 1 to 6 (S1 to S6) are mounted in the valve body, while Solenoid 7 (S7) is mounted in the pump cover.

- Solenoid 1 and 2: S1 and S2 are normally open ON/OFF solenoids that set the selected gear. These solenoids determine static gear position by operating the shift valves. Note that S1 and S2 solenoids also send signal pressure to allow or prohibit rear band engagement.
- Solenoid 3 and 4: S3 and S4 are normally open ON/OFF solenoids that combine to control shift quality and sequencing. S3 switches the clutch regulator valve OFF or ON. S4 switches the front band regulator valve OFF or ON. S5 also provides the signal pressure for the converter clutch regulator valve.
- Solenoid 5: S5 is a variable pressure solenoid that ramps the pressure during gear changes. This solenoid provides the signal pressure to the clutch and band regulator, thereby controlling the shift pressures. S5 also provides the signal pressure for the converter clutch regulator valve.
- Solenoid 6: S6 is a normally open ON/OFF solenoid that sets the high/low level of line pressure. Solenoid OFF gives high pressure.
- Solenoid 7: S7 is a normally open ON/OFF solenoid that controls the application of the converter clutch. Solenoid ON activates the clutch.

Solenoid Logic for Static Gear States

Gear	S1	S2
1st	ON	ON
2nd	OFF	ON
3rd	OFF	OFF
4th	ON	OFF
Reverse	OFF	OFF
Neutral	OFF	OFF
Park	OFF	OFF

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EFFECTIVE DATE	
AFFECTED VIN	

Solenoid Operation during Gearshifts

Shift	To Initiate Shift	Typical S5 Current Ramp	To Complete Shift
1-2	S1 OFF S4 ON	750 mA to 600 mA	S4 OFF
1-3	S1 OFF S2 OFF S3 ON S4 ON	850 mA to 750 mA	S3 OFF S4 OFF
1-4	S2 OFF S3 ON S4 ON	850 mA to 750 mA	S3 OFF S4 OFF
2-3	S2 OFF S3 ON S4 ON	700 mA to 500 mA	S3 OFF S4 OFF
3-4	S1 ON S4 ON	750 mA to 600 mA	S4 OFF
4-3	S4 ON	750 mA to 900 mA	S1 OFF S4 OFF
4-2	S3 ON	750 mA to 950 mA	S1 OFF S2 ON S3 OFF
4-1	S3 ON S4 ON	600 mA to 1000 mA	S2 ON S3 OFF S4 OFF
3-2	S2 ON S4 ON	600 mA to 450 mA @ 20 kph. 550 mA to 400 mA @ 60 kph. 800 mA to 650 mA @ 100 kph.	S4 OFF
3-1	S3 ON S4 ON		S1 ON S2 ON S3 OFF
2-1	S4 ON	700 mA to 950 mA 800 mA to 950 mA	S4 OFF S1 ON S4 OFF
Conv. Clutch			
ON	S7 ON	700 mA to 400 mA	S7 OFF
OFF		600 mA to 100 mA	

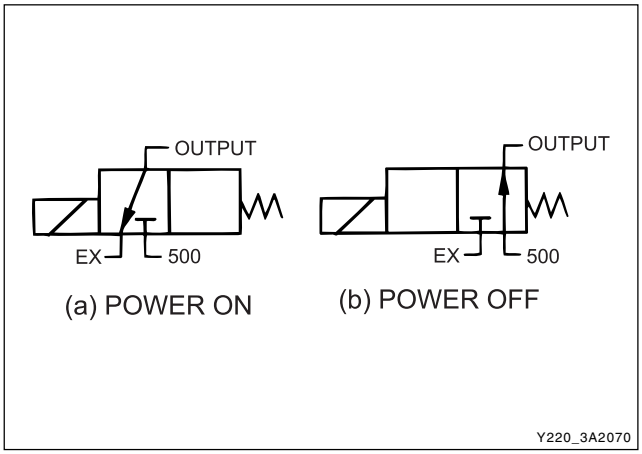
Solenoid valve symbols (ON/OFF solenoids)

The solenoid symbol shown adjacent to each solenoid on the hydraulic system schematics indicates the state of the oil flow through the solenoid valve with the power ON or OFF.

Normally open (NO) solenoid

POWER ON: Line 500 port is closed. The output port is open to exhaust at the solenoid valve.

POWER OFF: The exhaust port is closed. The output port is open to line 500.



Variable pressure solenoid multiplexing system

Friction element shifting pressures are controlled by the Variable Pressure Solenoid (VPS).

Line pressure is completely independent of shift pressure and is a function of throttle position, gear state and engine speed.

S5 is a proportional or variable pressure solenoid that provides the signal pressure to the clutch and band regulator valves thereby controlling shift pressures.

VPS pressure is multiplexed to the clutch regulator valve, the band regulator valve and the converter clutch regulator valve during automatic gearshifts.

A variable pressure solenoid produces a hydraulic pressure inversely proportional to the current applied. During a gearshift the TCM applies a progressively increasing or decreasing (ramped) current to the solenoid. Current applied will vary between a minimum oaf 200 mA and a maximum of 1000 mA. Increasing current decreases output (S5) pressure. Decreasing current increases output (S5) pressure.

Line 500 pressure, (approximately 440 to 560 kPa), is the reference pressure for the VPS, and the VPS output pressure is always below line 500 pressure.

When the VPS is at standby, that is no gearshift is taking place, the VPS current is set to 200 mA giving maximum output pressure.

Under steady state conditions the band and clutch regulator valve solenoids are switched OFF.

This applies full Line 500 pressure to the plunger and because Line 500 pressure is always greater than S5 pressure it squeezes the S5 oil out between the regulator valve and the plunger. The friction elements are then fed oil pressure equal to Line 500 multiplied by the amplification ratio.

When a shift is initiated the required ON/OFF solenoid is switched ON cutting the supply of Line 500 to the plunger.

At the same time the VPS pressure is reduced to the ramp start value and assumes control of the regulator valve by pushing the plunger away from the valve. The VPS then carries out the required pressure ramp and the timed shift is completed by switching OFF the ON/ OFF solenoid and returning the VPS to the standby pressure.

This system enables either the band or clutch or both to be electrically controlled for each gearshift.

Mode indicator light

Depending on the application, the mode indicator light may be used to indicate the mode that has been selected or if an overheat condition exists. The mode indicator light is usually located on the instrument cluster.

Communication systems

CAN

The Controller Area Network (CAN) connects various control modules by using a twisted pair of wires, to share common information. This results in a reduction of sensors and wiring. TCM obtains the actual engine speed and throttle position, vehicle speed and accelerator position etc. from ECM via CAN without any additional sensors.

K-Line

The K-line is typically used for obtaining diagnostic information from the TCM. A scan tool with a special interface is connected to the TCM via Data Link Connector (DLC) and all current faults, stored faults, runtime parameters are then available. The stored trouble codes can also be cleared by scan tool.

The K-line can be used for vehicle coding at the manufacturer's plant or in the workshop. This allows for one TCM design to be used over different vehicle mod-els.

The particular code is sent to the microprocessor via the K-line and this results in the software selecting the correct shift and VPS ramp parameters.

HYDRAULIC CONTROL SYSTEM

The hydraulic controls are located in the valve body, pump body and main case.

The valve body contains the following;

- Manual valve
- Three shift valves
- Sequence valve
- Solenoid supply pressure regulator valve
- Line pressure control valve
- Clutch apply feed regulator valve
- Band apply feed regulator valve
- Solenoid S1 to S6
- Reverse lockout valve

The pump cover contains the following;

- Primary regulator valve for line pressure
- Converter clutch regulator valve
- Converter clutch control valve
- Solenoid S7

The main case contains the following;

- B1R exhaust valve

All upshifts are accomplished by simultaneously switching on a shift valve(s), switching VPS pressure to the band and/or clutch regulator valve, and then sending the VPS a ramped current. The shift is completed by switching the regulators OFF and at the same time causing the VPS to reach maximum pressure.

All downshifts are accomplished by switching VPS pressure to the band and/or clutch regulator valve and sending a ramped current to the VPS. The shift is completed by simultaneously switching the regulators OFF, switching the shift valves and at the same time causing the VPS to return to stand-by pressure.

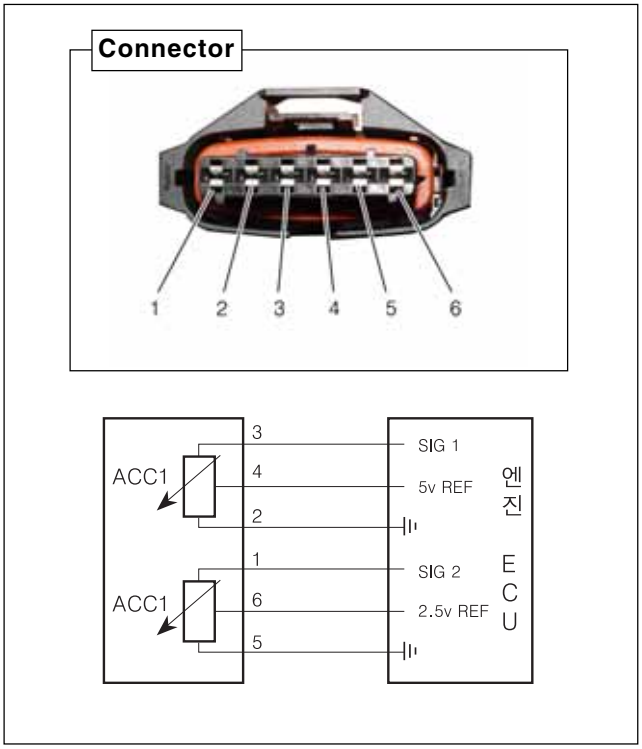
The primary regulator valve is located in the pump cover and supplies four line pressures; high and low for forward gears, and high and low for reverse. This pressure has no effect on shift quality and merely provides static clutch capacity during steady state operation. Low pressure can be obtained by activating an ON/OFF solenoid with high line pressure being the default mode.

Torque converter lock-up is initiated by toggling the converter clutch control valve with an ON/OFF solenoid.

The actual apply and release of the clutch is regulated by the VPS via the converter clutch regulator valve.

The solenoid supply pressure regulator valve provides reference pressure for all the solenoids.

ACCELERATOR PEDAL SENSOR



The accelerator pedal sensor changes the position of the accelerator pedal into the electric signal and sends the conditions that a driver requires to the engine ECU. It consists of two sensors. The signals from No.1 sensor (ACC 1) is the element to determine the amount of the fuel injection and injection timing while the signals from No. 2 sensor (ACC 2) determines if the signals from No. 1 sensor is correct by comparing them with its own signal values.

The transferred values from accelerator pedal sensors to ECU is sent to TCU via the CAN communication lines. The TCU changes the gear by determining the shift timing according to these values.

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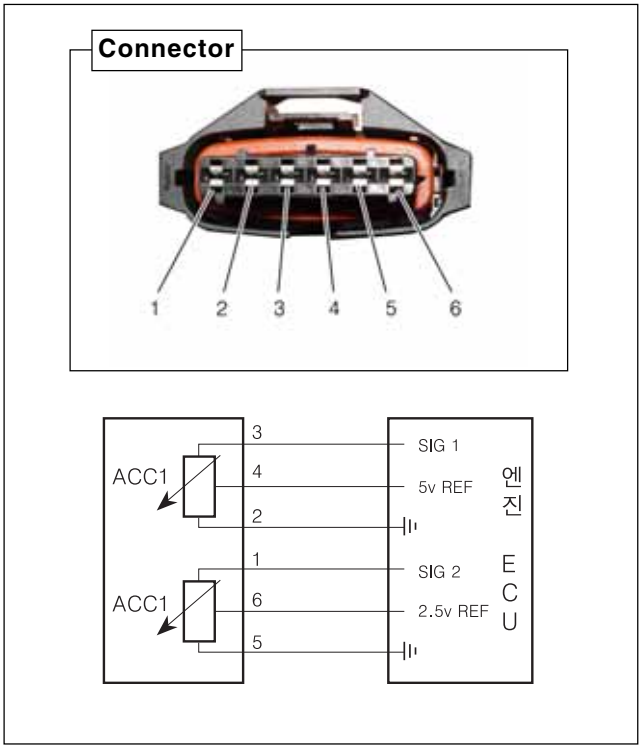
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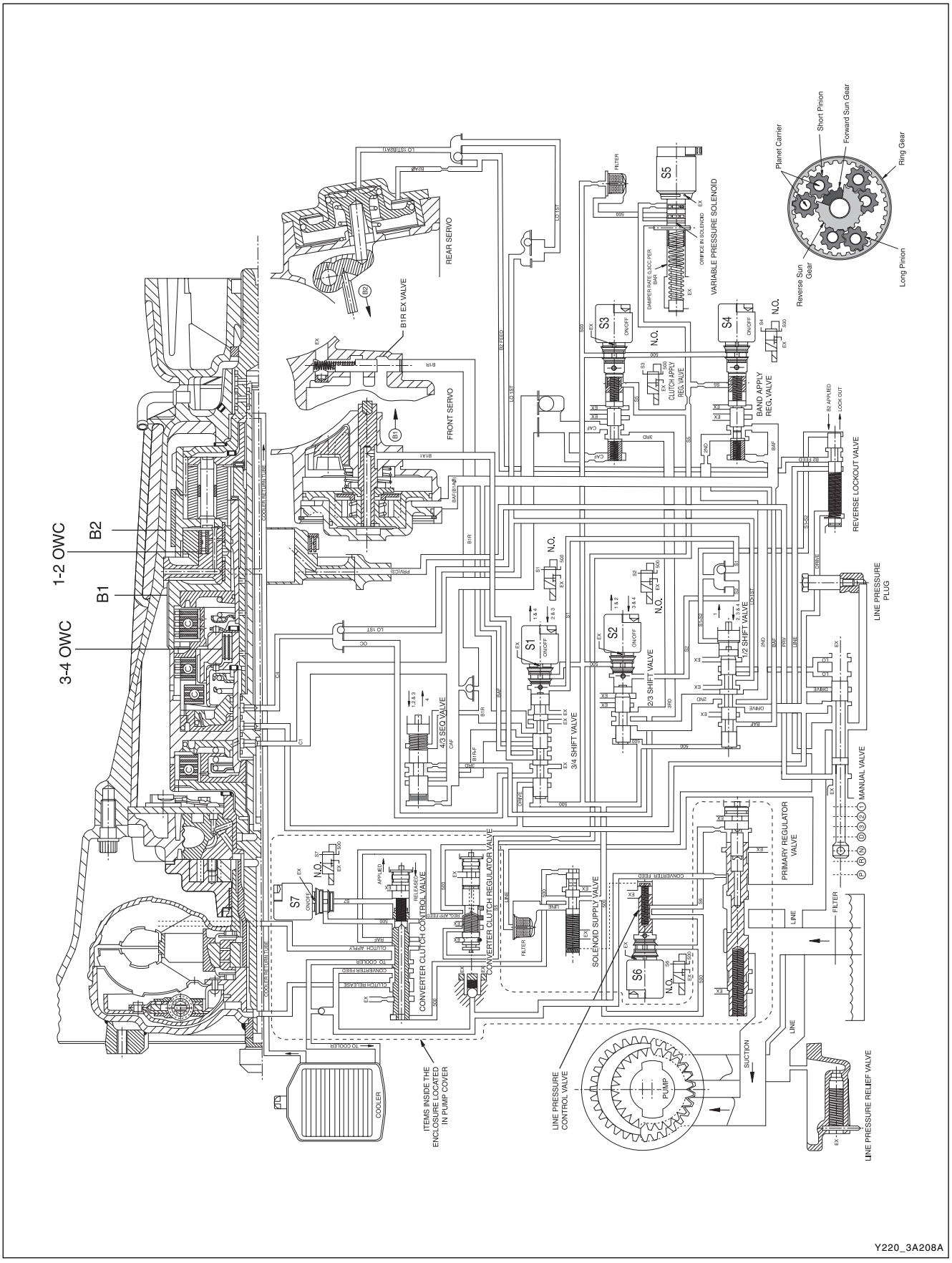
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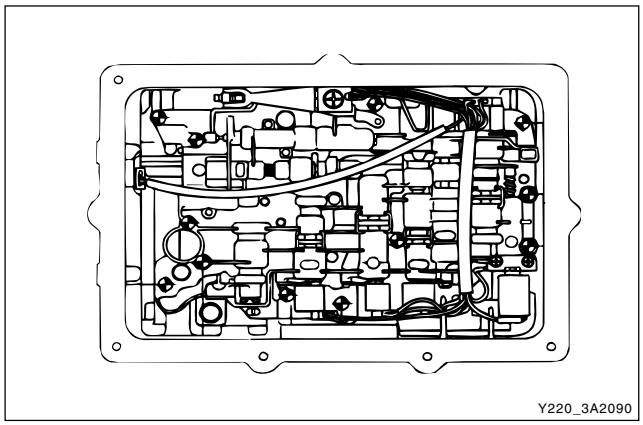
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HYDRAULIC CONTROL CIRCUIT



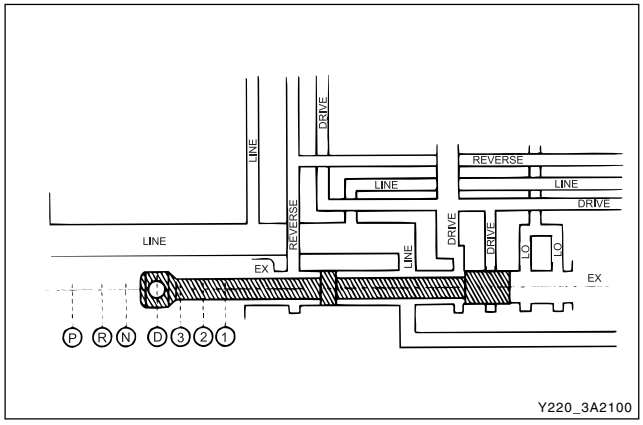
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▶ Valve Body



Manual valve

The manual valve is connected to the vehicle selector mechanism and controls the flow of oil to the forward and reverse circuits. The manual valve function is identical in all forward gear positions except that in the Manual 1 position an additional supply of oil is directed to the 1-2 shift valve for application of the rear band and the C4 overrun clutch. The manual valve directs the line pressure into the PRND fluid circuits.



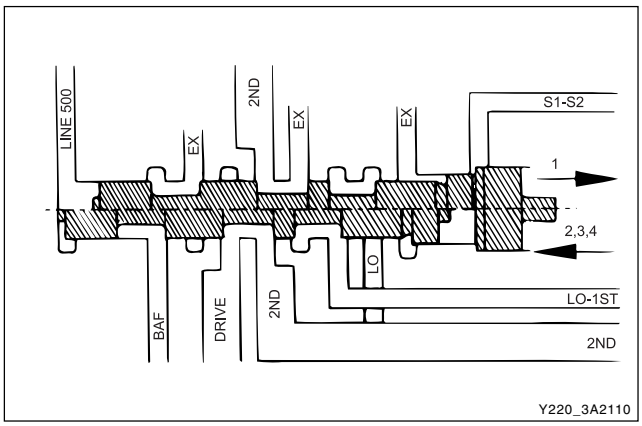
1-2 shift valve

The 1-2 shift valve is a two position valve that must be switched to the 2, 3 and 4 position in order to get any forward gear other than first gear. It is used for all 1-2 and 2-1 gearshifts.

The switching of this valve is achieved by using S1 and/or S2.

During a 1-2 gearshift drive oil from the manual valve passes through to the second gear circuit. During a 2-1 gearshift the band apply feed oil is allowed to exhaust via the 1-2 shift valve.

The 1-2 shift valve works in conjunction with the 3-4 shift valve to disengage the C4 clutch in first gear, and engage C4 in second gear. When Manual 1 is selected the C4 clutch and rear band (B2) are engaged.



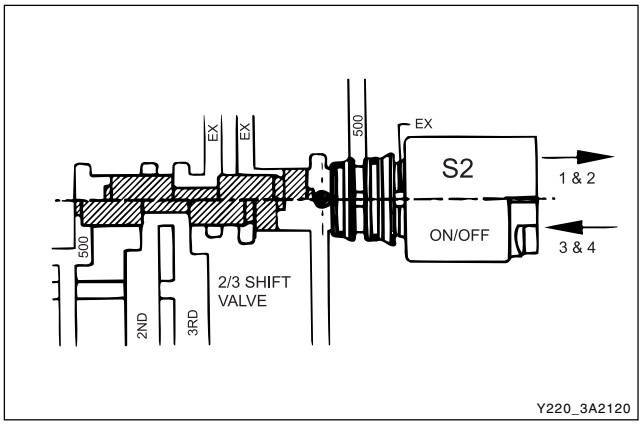
2-3 shift valve

The 2-3 shift valve is a two position valve. It is used on all 2-3 and 3-2 gearshifts.

The switching of this valve is achieved by S2 which is located at the end of the valve spool.

In the 1, 2 position, second gear oil from the 1-2 shift valve is prevented from entering the third gear circuit.

When the valve is moved to the 3, 4 position, oil from the second gear circuit is routed to the third gear circuit and the transmission is changed to third gear.



3-4 shift valve

The 3-4 shift valve is a two position valve. It is used for all 3-4 and 4-3 gearshifts.

The switching of this valve is achieved by S1 which is located at the end of the valve spool.

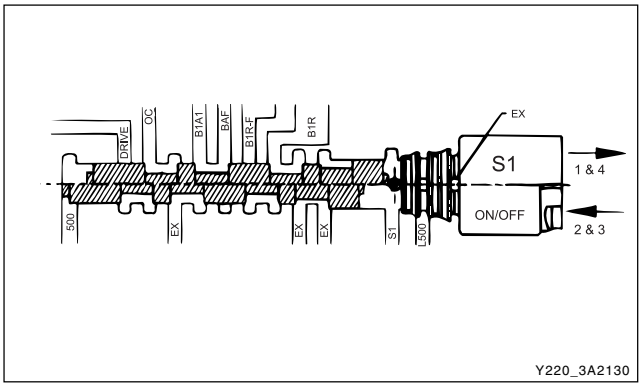
During a 3-4 gearshift the 3-4 shift valve:

- Exhausts the front band release (B1R) circuit thereby allowing the application of the front band (B1).
- Connects the inner apply area of the front servo (B1AI) to the Band Apply Feed (BAF) circuit thus allowing greater apply forces to the front band.
- Exhausts the Overrun Clutch (OC) circuit which allows the C4 clutch to disengage.

During a 4-3 gearshift, the C4 clutch is engaged and the front band (B1) is released. These actions are sequenced by the 4-3 sequence valve.

The 3-4 shift valve also switches during 1-2 and 2-1 gearshifts where its function is to apply the overrun clutch (C4) in second gear but to release it in first gear.

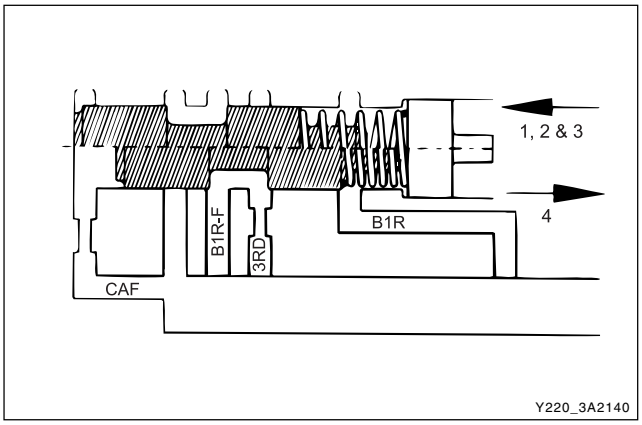
Note that the C4 clutch is applied in Manual 1 by virtue of the manual valve and the 1-2 shift valve. Refer to "1-2 Shift Valve" in this section.



4-3 sequence valve

The 4-3 sequence valve is a two position spring loaded valve. It switches during 3-4 and 4-3 gearshifts although it performs no function during the 3-4 shift.

During the 4-3 shift the 4-3 sequence valve delays the connection of the Clutch Apply Feed (CAF) circuit to the B1R circuit until the B1R circuit has been fully pressurized by using the third gear circuit. This prevents objectionable engine flare on completion of the 4-3 gearshift.



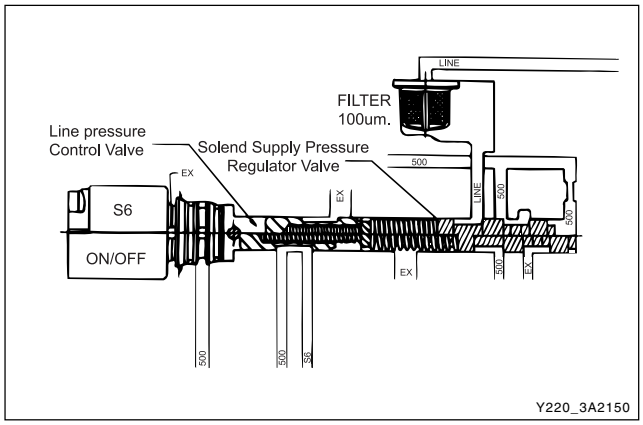
Solenoid supply pressure regulator valve

The solenoid supply pressure regulator valve supplies a constant pressure to all solenoids (S1 to S7). Line pressure is used as the feeding oil to this regulator and the output is termed line 500.

Line pressure control valve

Line pressure is controlled by S6, which acts as the line pressure control valve. When S6 pressure is applied to the end of the Primary Regulator Valve (PRV), it is opposed by spring force and causes LOW line pressure for light throttle application and cruising.

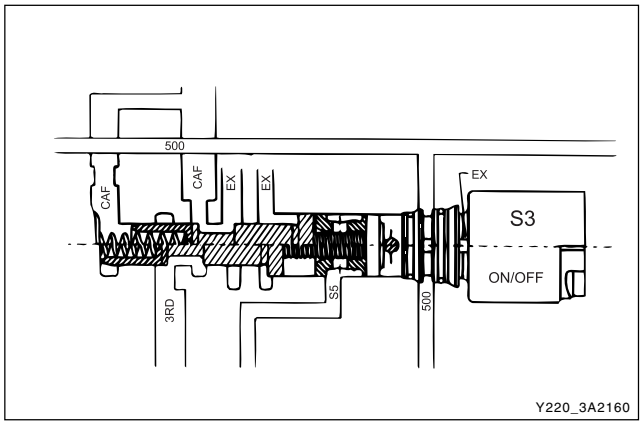
Heavy throttle application causes the normally open S6 to open (switch Off) thus closing line 500 and opening S6 to exhaust. Removal of S6 pressure from the PRV results in HIGH line pressure.



Clutch apply feed regulator valve

The clutch apply feed regulator valve is a fixed ratio (2. 25:1) valve. This valve provides a regulated pressure to the C1 clutch and controls the change rate of the clutch state to give the desired shift quality.

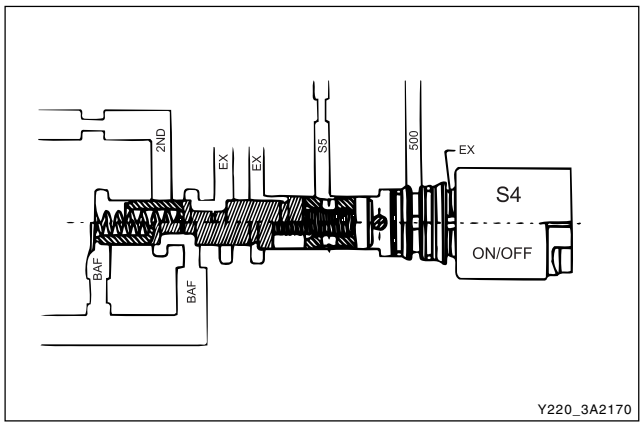
Third gear oil supplied to the valve is regulated to provide an output pressure, Clutch Apply Feed (CAF) pressure, of 2.25 times the S5 signal pressure when S3 is ON. When S3 is OFF, the output pressure is 2.25 times the line 500 pressure.



Band apply feed regulator valve

The band apply feed regulator valve is a fixed ratio (1.4: 1) valve. It provides a regulated pressure to the front servo, and controls the change rate of the front band (B1) state to give the desired shift quality.

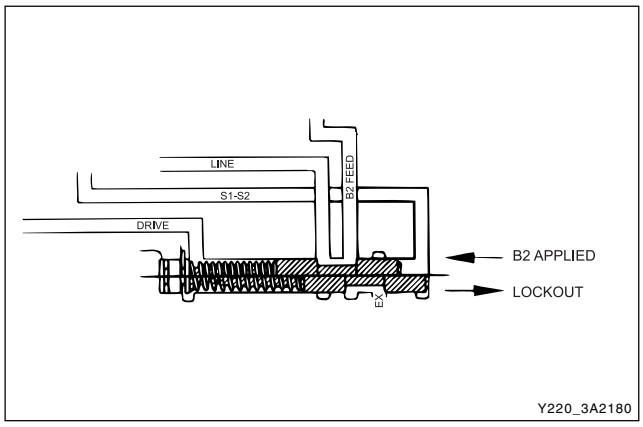
Second gear oil supplied to the valve is regulated to provide an output pressure, Band Apply Feed (BAF) pressure, of 1.4 times the S5 signal pressure when S4 is ON. When S4 is OFF the output pressure is 1.4 times the line 500 pressure.



Reverse lockout valve

The reverse lockout valve is a two position valve contained in the upper valve body. This valve uses S1-S2 pressure as a signal pressure and controls the application of the rear band (B2).

While the manual valve is in D, 3, 2 or 1 positions, drive oil is applied to the spring end of the valve, overriding any signal pressures and holding the valve in the lockout position. This prevents the application of B2 in any of the forward driving gears except M1.



When the manual valve is in P, R or N positions, drive oil is exhausted and the reverse lockout valve may be toggled by S1-S2 pressure.

B2 is applied in P, R, and N if the following conditions are satisfied;

- In P or N, vehicle speed = 3 km/h.
- In R, vehicle speed = 10 km/h.
- Engine speed = 1600 rpm.
- Throttle position = 12 %.

Under these conditions, the TCM switches solenoids S1 and S2 to OFF. The reverse lockout valve toggles under the influence of the S1-S2 pressure, to connect the line pressure to the B2 feed. Oil is fed to both the inner and outer apply areas of the rear servo piston, applying B2.

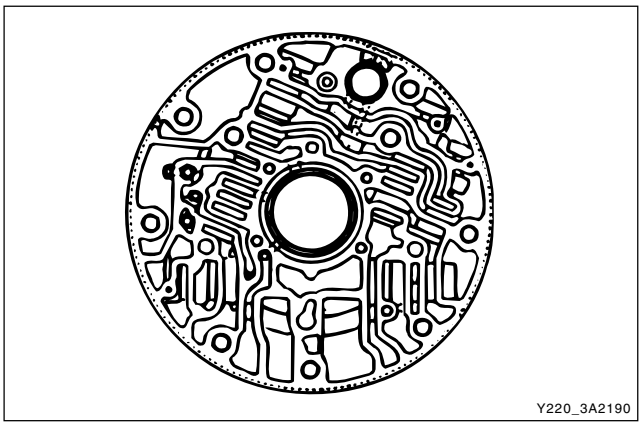
If any of the above conditions are not satisfied, the TCM switches solenoids S1 and S2 to ON.

S1- S2 pressure is exhausted and the valve is held in the lockout position by the spring. In this position, engagement of B2 is prohibited.

This feature protects the transmission from abuse by preventing the undesirable application of B2 at high speed, and by providing a reverse lockout function.

Note that if the transmission is in failure mode, the rear band will be applied at all times in P, R and N.

Pump cover



Primary regulator valve

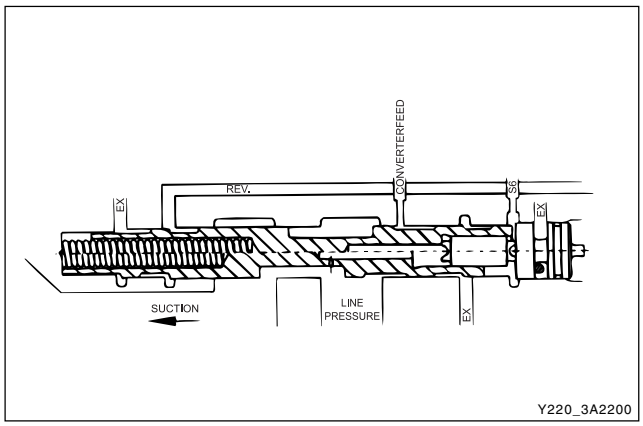
The Primary Regulator Valve (PRV) regulates the transmission line pressure (or pump output pressure). This valve gives either high or low line pressure depending on whether S6 is switched OFF or ON. When S6 is switched ON, S6 pressure is applied to the PRV moving it against spring pressure and opening the line pressure circuit to the pump suction port resulting in reduced line pressure.

Low line pressure is used during light throttle applications and cruising. Heavy throttle will cause S6 to switch OFF and thereby cause high line pressure.

This stepped line pressure control has no detrimental effect on shift feel because all shifting pressures are controlled by separate band and clutch regulator valves, and the output of S5.

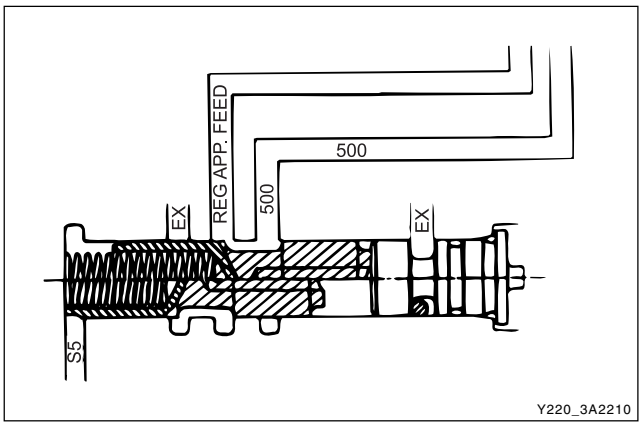
When reverse gear is selected, both the low and high line pressure values are boosted to guard against slippage. This is achieved by applying reverse oil line pressure to the PRV to assist the spring load. The other end of the valve contains ports for line pressure feedback and S6 pressure.

The PRV also regulates the supply of oil to the converter via the converter feed port. The cascade effect of the PRV ensures the first priority of the valve is to maintain line pressure at very low engine speeds. When the engine speed increases and the pump supplies an excess of oil the PRV moves to uncover the converter feed port thereby pressurizing the converter. If there is an excess of oil for the transmission's needs then the PRV moves further to allow oil to return to the suction port.



Converter clutch regulator valve

The converter clutch regulator valve regulates the pressure of the oil which applies the converter clutch. Input oil from the line 500 circuit is regulated within the valve, with the output pressure being variable according to the signal pressure from the S5 circuit. Converter clutch apply and release application is smoothed by electronically varying the S5 circuit pressure.



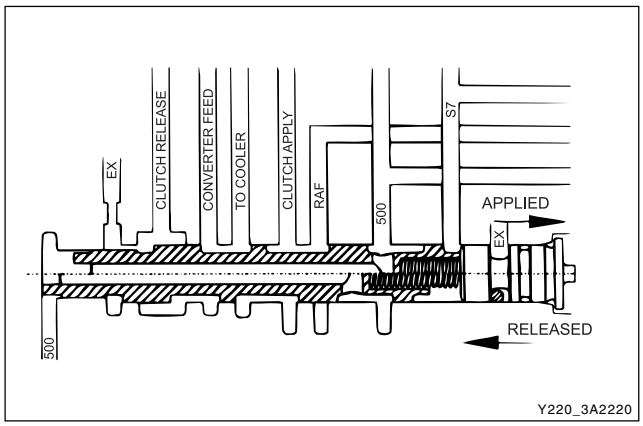
Converter clutch control valve

The converter clutch control valve is a two position valve which applies or releases the converter clutch.

The switching of this valve is governed by the signal pressure from S7.

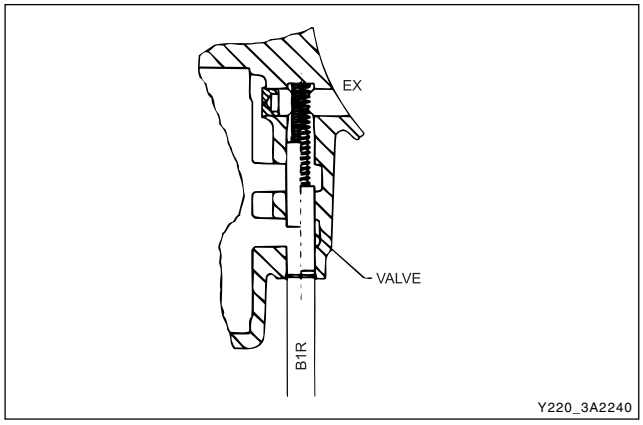
When the valve is in the OFF or released position, converter feed oil from the PRV is directed to the release side of the converter clutch. After flowing through the converter, oil returns to the converter clutch control valve and is then directed to the oil cooler.

When the valve is in the ON or applied position, regulated oil from the converter clutch regulator valve is directed to the apply side of the converter clutch. This oil remains within the converter because the converter clutch piston is sealed against the flat friction surface of the converter cover. To provide oil flow to the cooler the converter clutch control valve directs converter feed oil from the PRV directly to the cooler circuit.



B1R exhaust valve

The B1R exhaust valve is a two position spring loaded valve located in the transmission case directly adjacent to the front servo. It permits the servo release oil to be rapidly exhausted into the transmission case during application of the front band (B1). This prevents the need to force the oil back from the front servo through the valve body and through the 3-4 shift valve. The spring positions the valve to prevent oil entering the release area of the servo until the B1R circuit oil pressure reaches approximately 100 kPa.



POWER TRAIN SYSTEM

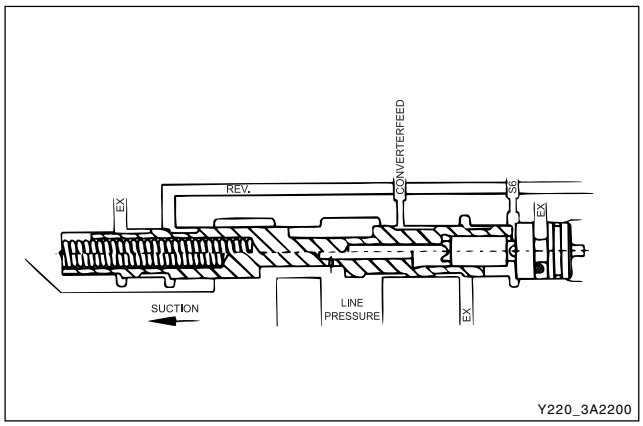
The Power Train System consists of;

- A torque converter with single face lock-up clutch
- Four multi-plate clutch assemblies
- Two brake bands
- Two one-way clutches
- Planetary gear set
- Parking mechanism

A conventional six pinion Ravigneaux compound planetary gear set is used with overdrive (fourth gear) being obtained by driving the carrier.

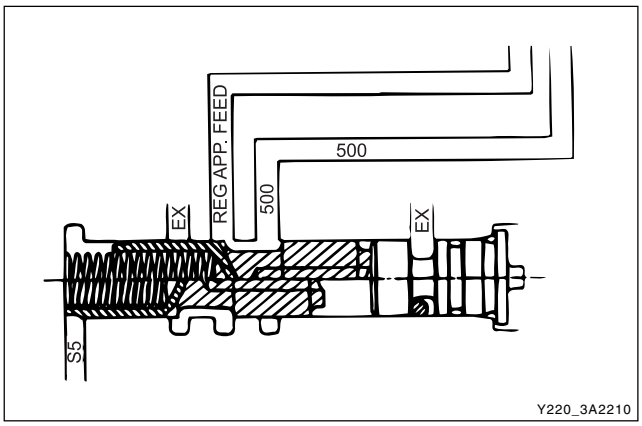
The cross-sectional arrangement is very modular in nature.

Four main sub-assemblies are installed within the case to complete the build. These subassemblies are;



Converter clutch regulator valve

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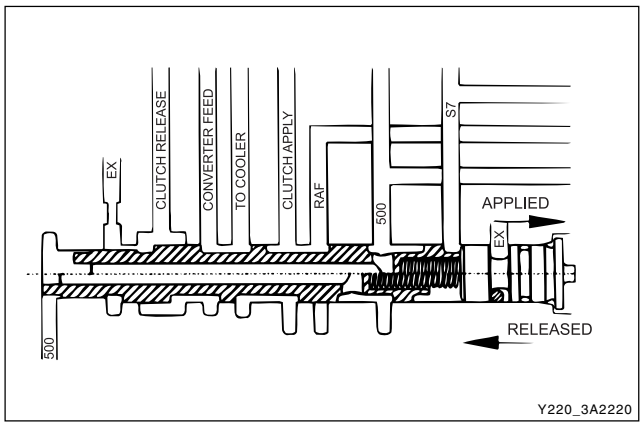
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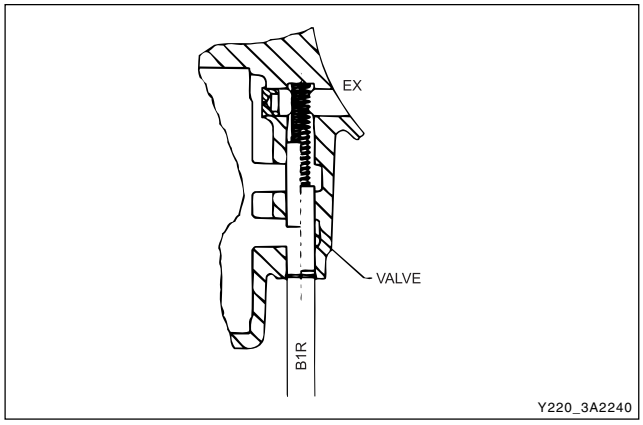
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POWER TRAIN SYSTEM

The Power Train System consists of;

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- Two brake bands
- Two one-way clutches
- Planetary gear set
- Parking mechanism

A conventional six pinion Ravigneaux compound planetary gear set is used with overdrive (fourth gear) being obtained by driving the carrier.

The cross-sectional arrangement is very modular in nature.

Four main sub-assemblies are installed within the case to complete the build. These subassemblies are;

- Gear set-sprag-centre support
- C1 -C2 -C3 -C4 clutch sub-assembly
- Pump assembly
- Valve body assembly

One, or a combination of selective washers are used between the input shaft flange and the number 4 bearing to control the transmission end float. This arrangement allows for extensive subassembly testing and simplistic final assembly during production.

A general description of the operation of the Power Train System is detailed below.

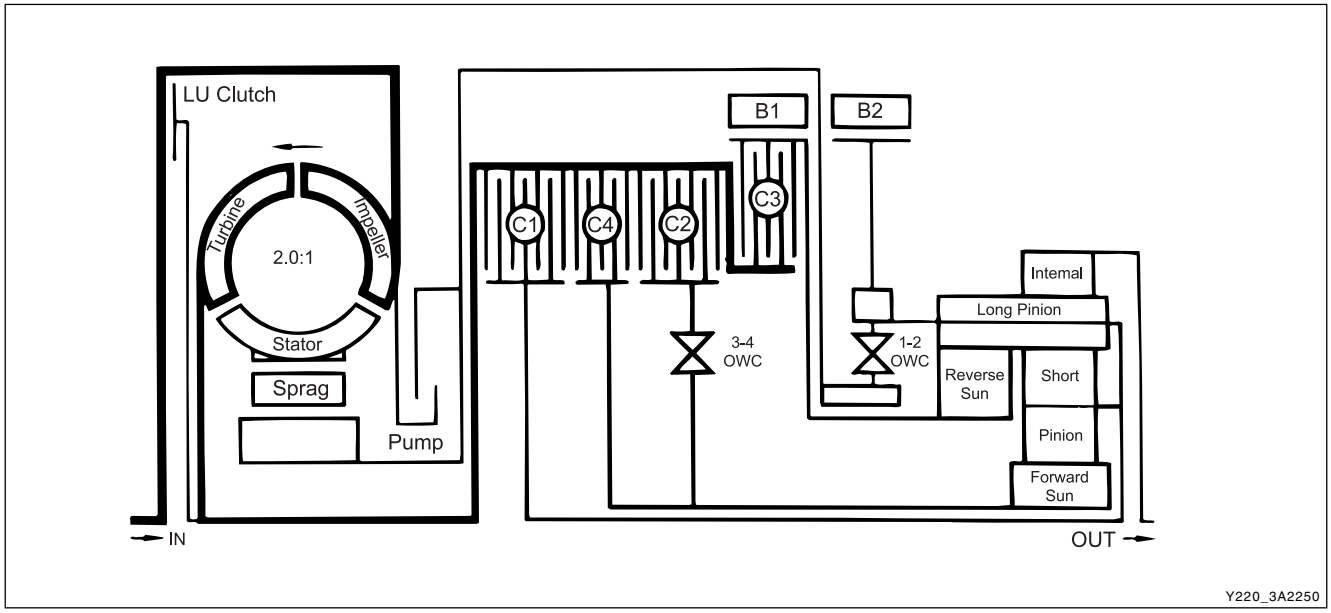
First gear is engaged by applying the C2 clutch and locking the 1-2 One Way Clutch (1-2 OWC). The 1-2 shift is accomplished by applying the B1 band and overrunning the 1-2 OWC. The 2-3 shift is accomplished by applying the C1 clutch and releasing the B1 band. The 3-4 shift is accomplished by re-applying the B1 band and overrunning the 3-4 OWC. Reverse gear is engaged by applying the C3 clutch and the B2 band.

The C4 clutch is applied in the Manual 1, 2 and 3 ranges to provide engine braking. In addition, the C4 clutch is also applied in the Drive range for second and third gears to eliminate objectionable freewheel coasting.

The B2 band is also applied in the Manual 1 range to accomplish the low-overrun shift.

Both the front and rear servos are dual area designs to allow accurate friction element matching without the need for secondary regulator valves. All the friction elements have been designed to provide low shift energies and high static capacities when used with the new low static co-efficient transmission fluids. Non-asbestos friction materials are used throughout.

		ELEMENTS ENGAGED								
Gear	**Gear Ratio**	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
First	2.741		X					X	X	
Second	1.508		X			X			X	
Third	1.000	X	X		X				X	
Fourth	0.708	X	X		X	X				X
Reverse	2.428			X			X			
Manual 1	2.741		X		X		X		X	

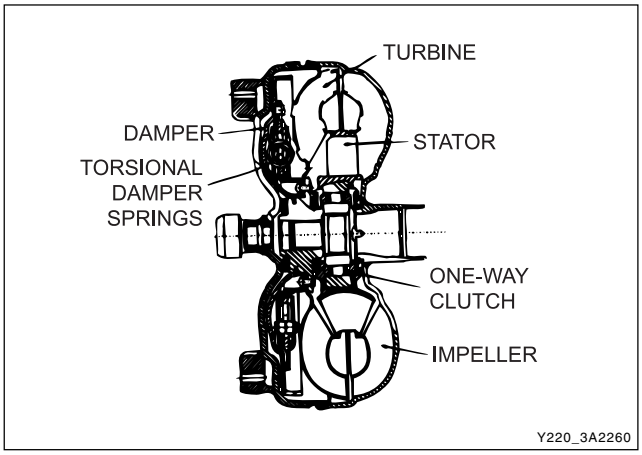


Torque converter

The torque converter consists of a turbine, stator pump, impeller and a lock-up damper and piston assembly. As in conventional torque converters, the impeller is attached to the converter cover, the turbine is splined to the input shaft and the stator is mounted on the pump housing via a one way clutch (sprag).

The addition of the damper and piston assembly en-ables the torque converter to lock-up under favorable conditions. Lock-up is only permitted to occur in third and fourth gears under specified throttle and vehicle speed conditions.

Lock-up is achieved by applying hydraulic pressure to the damper and piston assembly which couples the turbine to the converter cover, locking-up the converter and eliminating unwanted slippage. Whenever lock-up occurs, improved fuel consumption is achieved. Torsional damper springs are provided in the damper and piston assembly to absorb any engine torque fluctuations during lock-up.



Clutch packs

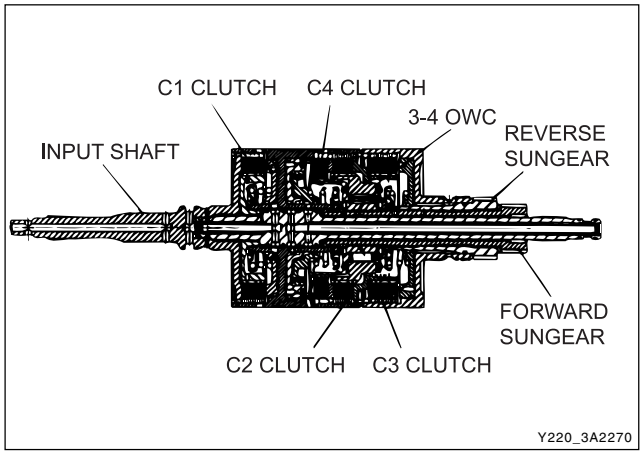
There are four clutch packs. All clutch packs are composed of multiple steel and friction plates.

C1 CLUTCH: When applied, this clutch pack allows the input shaft to drive the planet carrier. This occurs in third and fourth gears.

C2 CLUTCH: When applied this clutch pack allows the input shaft to drive the forward sun gear via the 3-4 OWC. This occurs in all forward gears.

C3 CLUTCH: When applied this clutch pack allows the input shaft to drive the reverse sun gear. This only occurs in reverse gear.

C4 CLUTCH: When applied this clutch provides engine braking on overrun. This occurs in Manual 1, 2 and 3 and also Drive 2 and Drive 3 to prevent objectionable free wheel coasting.

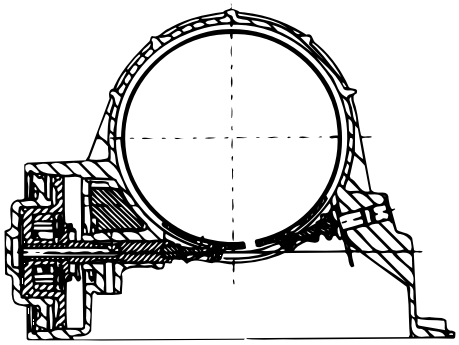


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Bands

The transmission utilizes two bands, the B1 band (sometimes known as the 2-4 band), and the B2 band (sometimes known as the low-reverse band).

The B1 band is a flexible band which is engaged by the front servo piston. B1 is activated in second and fourth gear. When activated B1 prevents the reverse sun gear from rotating by holding the C3 clutch assembly stationary. In second gear only the outer area of the apply piston is utilized. In fourth gear both areas are utilized for greater clamping force.



FRONT SERVO AND BAND

Y220_3A2280

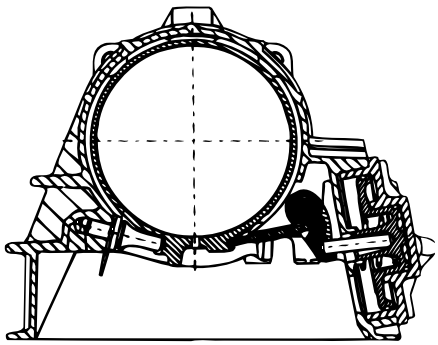
One way clutches

The transmission uses two OWCs, the 1-2 OWC and the 3-4 OWC. (Note that a third OWC is located in the torque converter, also known as a sprag.)

The 1-2 OWC is located between the planetary carrier assembly and the center support. This allows the carrier to rotate around the center support in one direction only. The one way clutch is engaged only in Drive 1.

This 3-4 OWC is located between the C4 and the C2 clutch assemblies. This allows the C2 clutch to drive the forward sun gear in first, second and third gears but unlocks in fourth gear and during overrun.

The B2 band is a solid band which is engaged by the rear servo piston. B2 is activated in Park, Reverse, Neutral and Manual 1. When activated B2 prevents the planet carrier assembly from rotating. In Manual 1 only the inner area of the apply piston is utilized. In Park, Reverse and Neutral, both areas are utilized for greater clamping force.



REAR SERVO AND BAND

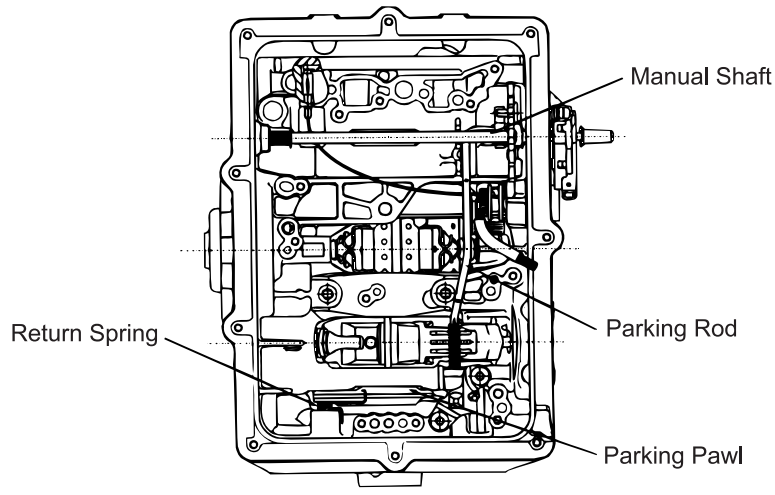
Y220_3A2290

Planetary gear set

The planetary gear set used in the transmission is a conventional six pinion Ravigneaux compound gear set.

Parking mechanism

When Park is selected the manual lever extends the park rod rearwards to engage the parking pawl. The pawl will engage the external teeth on the ring gear thus locking the output shaft to the transmission case. When Park is not selected a return spring holds the parking pawl clear of the output shaft, preventing accidental engagement of Park.



Y220_3A2300

POWER FLOWS

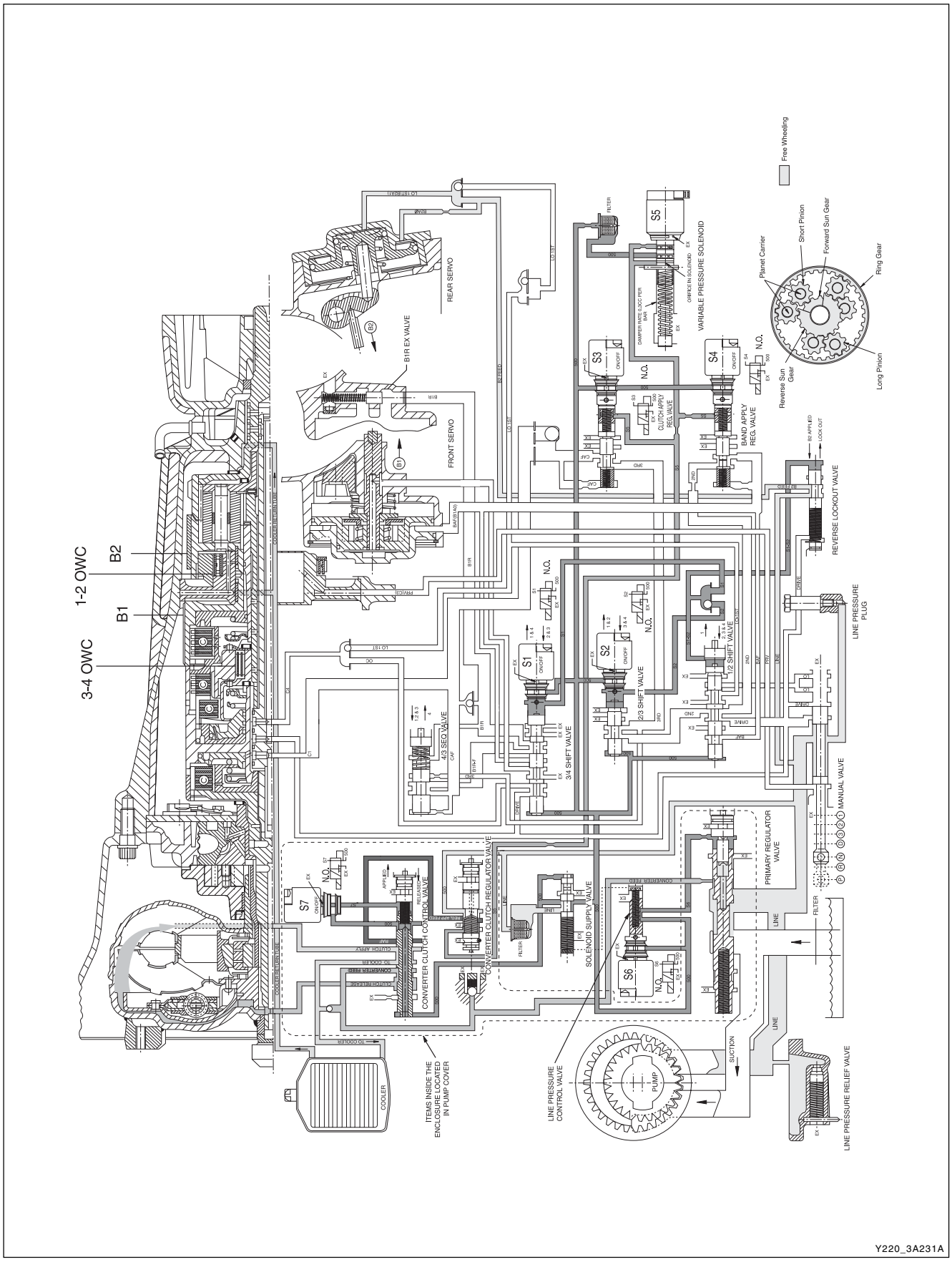
The power flows for the various transmission selections are listed below;

- Power Flow - Neutral and Park
- Power Flow - Reverse
- Power Flow - Manual 1
- Power Flow - Drive 1
- Power Flow - Drive 2
- Power Flow - Drive 3
- Power Flow - Drive 3 Lock Up
- Power Flow - Drive 4 (Overdrive)
- Power Flow - Drive 4 Lock Up

The following table details the engaged elements versus the gear selected for all transmission selections.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Park and Neutral	-	-	-	-	-	X	-	-	-
Reverse	-	-	X	-	-	X	-	-	-
Manual 1	-	X	-	X	-	X	-	X	-
Drive 1	-	X	-	-	-	-	X	X	-
Drive 2 and Manual 2	-	X	-	X	X	-	-	X	-
Drive 3 and Manual 3	X	X	-	X	-	-	-	X	-
Drive 3 Lock Up and Manual 3 Lock Up	X	X	-	-	-	-	-	X	-
Drive 4 Overdrive	X	X	-	-	X	-	-	-	-
Drive 4 Lock Up	X	X	-	-	X	-	-	-	X

PARK AND NEUTRAL



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Power flow - Park and neutral

In Park and Neutral, there is no drive to the planetary gear set. The rear band is applied to eliminate 'clunk' on engagement of the reverse gear, and to improve the low range engagement for 4WD applications. No other clutches or bands are applied.

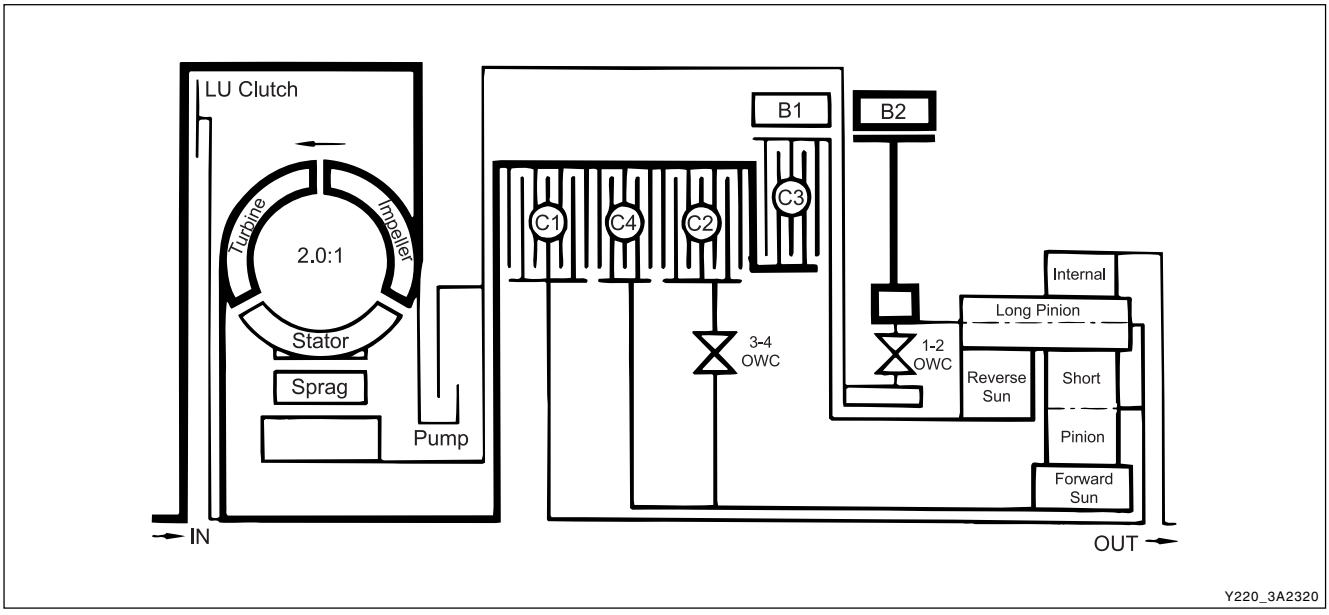
In Park the transmission is mechanically locked by engaging a case mounted pawl with teeth on the output shaft ring gear.

Control

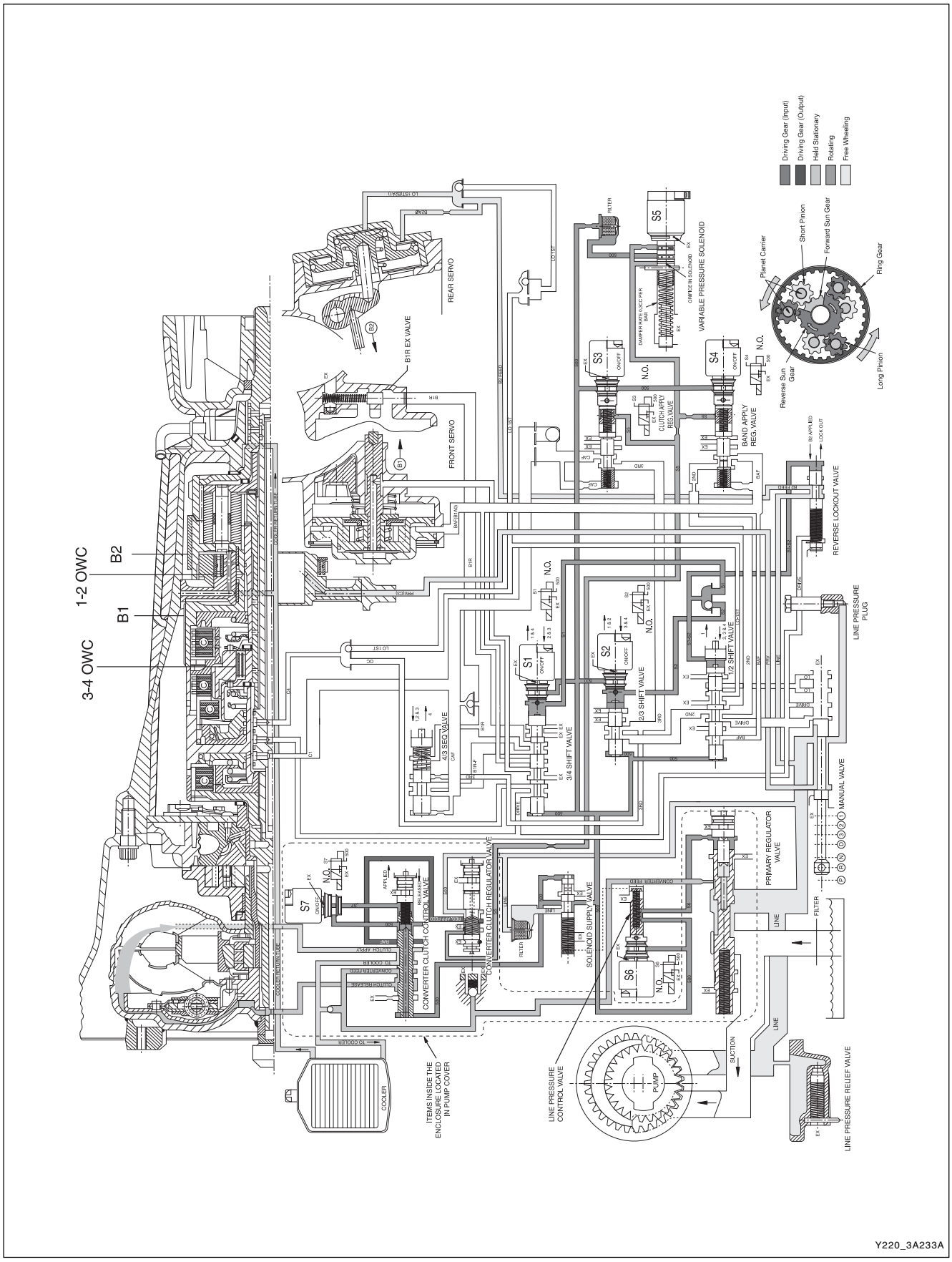
To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoids S1 and S2 are switched OFF.
- Line (pump) pressure is applied to the Primary Regulator Valve (PRV) and to the solenoid supply pressure regulator valve.
- The converter, oil cooler, and lubrication circuits are charged from the primary regulator valve.
- The line 500 circuit is charged by the solenoid supply pressure regulator valve.
- The S5 circuit is charged by the variable pressure solenoid (S5).
- Line pressure is prevented from entering the drive circuit by the manual valve.
- The B1 circuit and all clutch circuits are open to exhaust.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Park and Neutral	-	-	-	-	-	X	-	-	-



REVERSE



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Power flow - Reverse

In Reverse, transmission drive is via the input shaft and the forward clutch cylinder to the hub of the C3 clutch. The elements of the transmission function as follows;

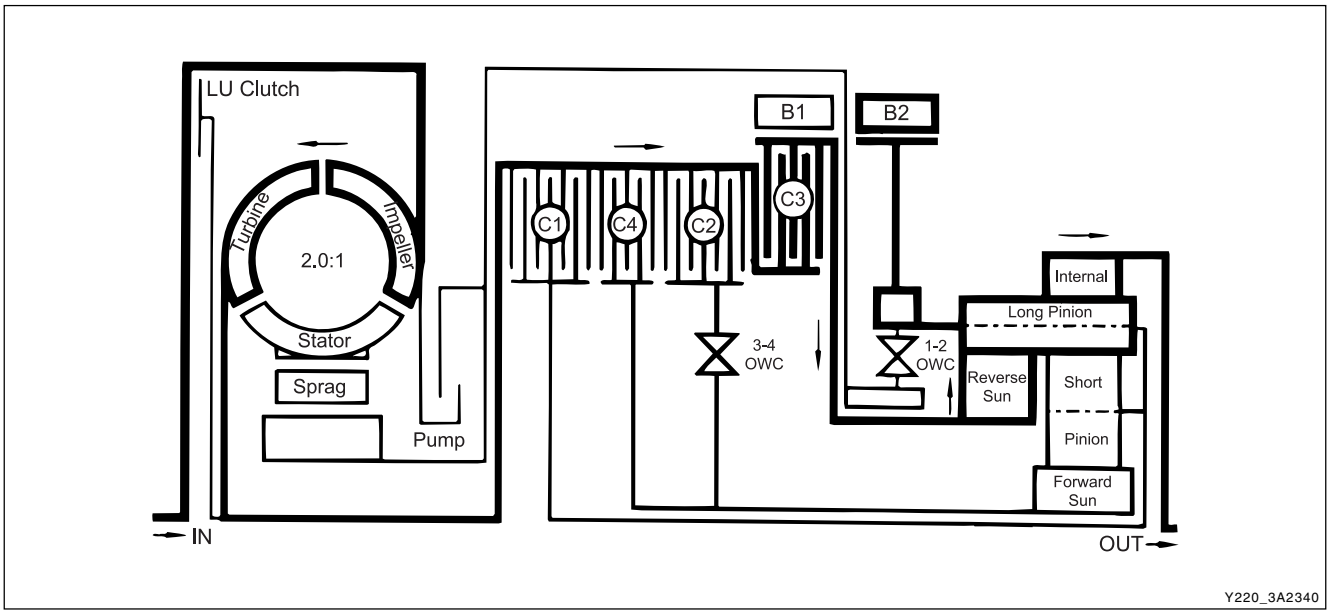
- The C3 clutch is engaged and drives the reverse sun gear in a clock-wise direction.
- The B2 band is engaged and holds the planetary gear carrier stationary causing the long pinion to rotate anti-clockwise about its axis on the pinion shaft.
- The long pinion drives the internal ring gear in the same direction.
- The internal ring being splined to the output shaft drives it in an anti-clockwise or reverse direction.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

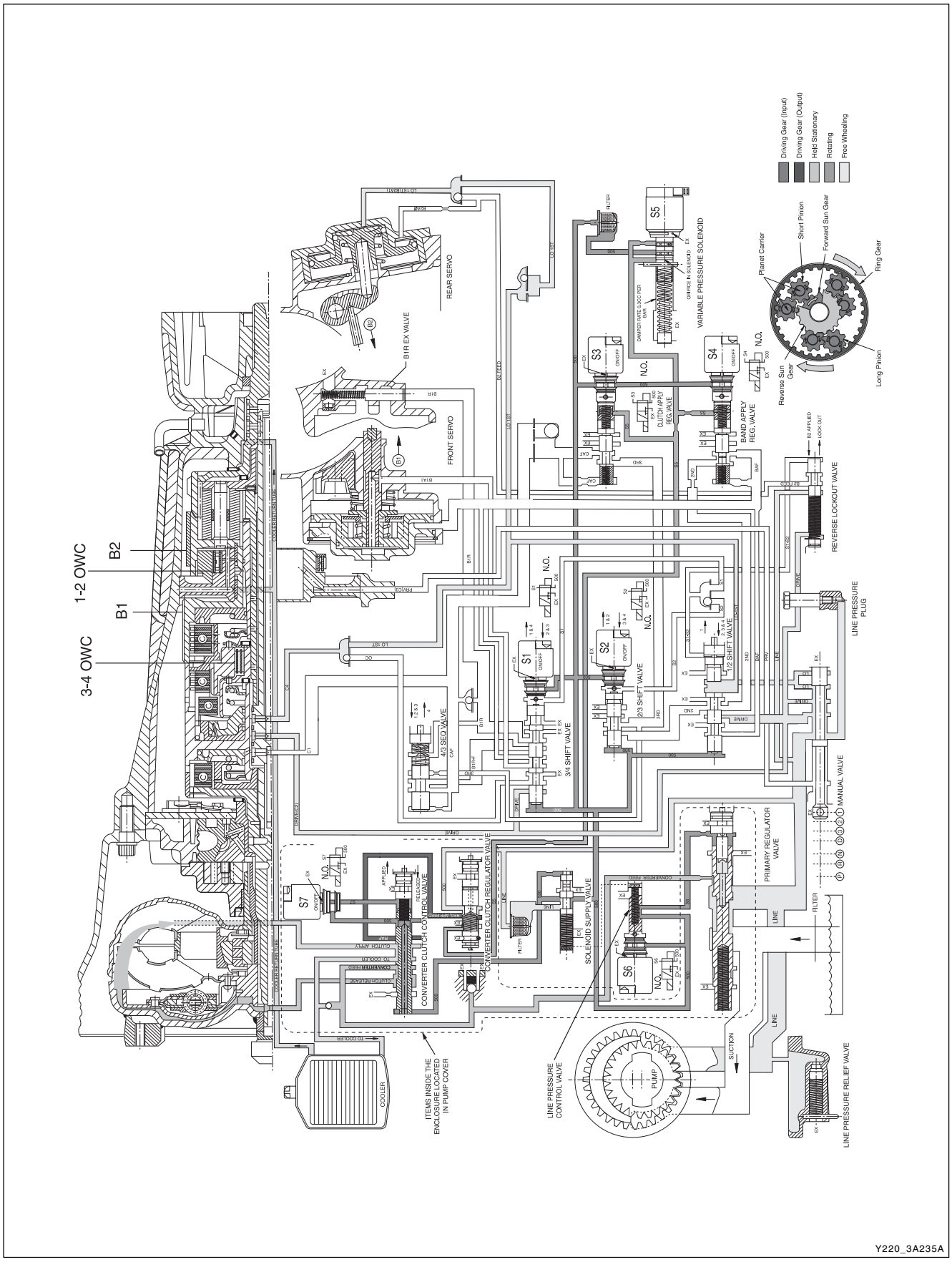
- Solenoids S1 and S2 are switched OFF.
- Line pressure is directed through the reverse lockout valve to both the inner and outer apply areas of the rear servo piston for B2 band application.
- Line pressure feeds the reverse oil circuit via the manual valve.
- Reverse oil is routed from the manual valve to the C3 clutch.
- Reverse oil is also applied to the spring end of the primary regulator valve to assist the spring and to boost the line pressure value.
- All other clutch and band apply circuits are open to exhaust.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Reverse	-	-	X	-	-	X	-	-	-



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EFFECTIVE DATE	
AFFECTED VIN	

MANUAL 1



Y220_3A235A

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Power flow - Manual 1

In Manual 1, transmission drive is via the input shaft to the forward clutch cylinder. The elements of the transmission function as follows;

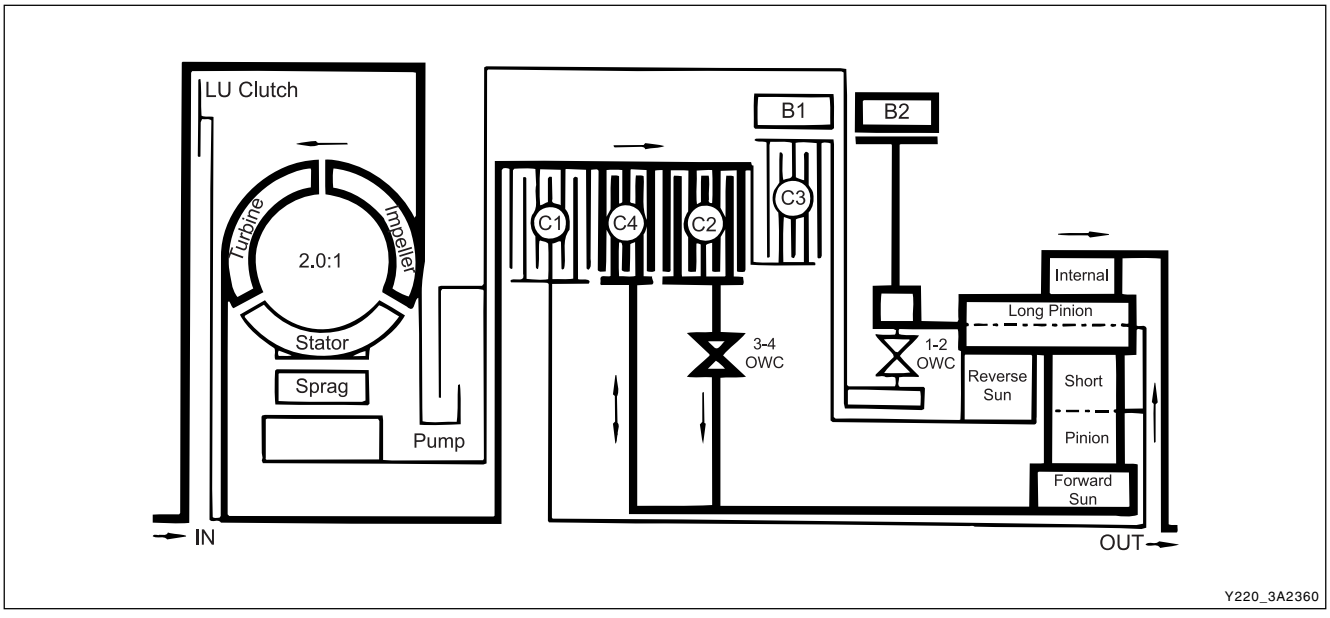
- The C2 clutch is engaged to drive the forward sun gear, via the 3-4 OWC.
- The B2 band is engaged to hold the planetary gear carrier stationary.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The long pinion rotating about its axis drives the internal ring gear and the output shaft in a clockwise or forward direction.
- The C4 clutch provides engine braking through the 3-4 OWC on overrun.

Control

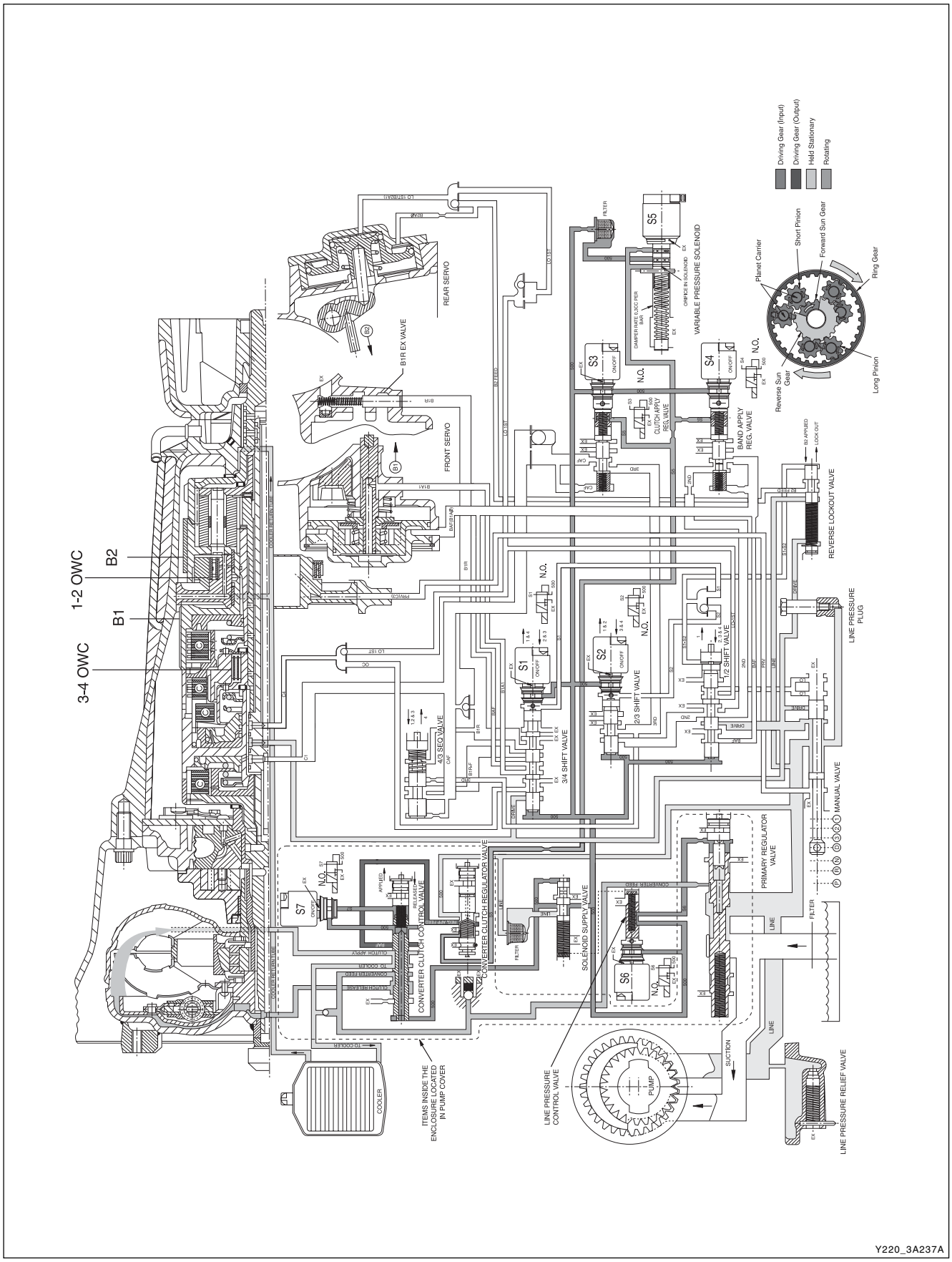
To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- Solenoids S1 and S2 are switched ON.
- The 1-2, 2-3, and 3-4 shift valves are held in their first gear positions by line 500 pressure.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.
- Lo-1st (line pressure) oil is routed through the 1-2 shift valve to the C4 clutch, and to the inner apply area of the rear servo piston for B2 band application.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Manual 1	-	X	-	X	-	X	-	X	-



DRIVE 1



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Power flow - Drive 1

In Drive 1, transmission drive is via the input shaft to the forward clutch cylinder. The elements of the transmission function as follows:

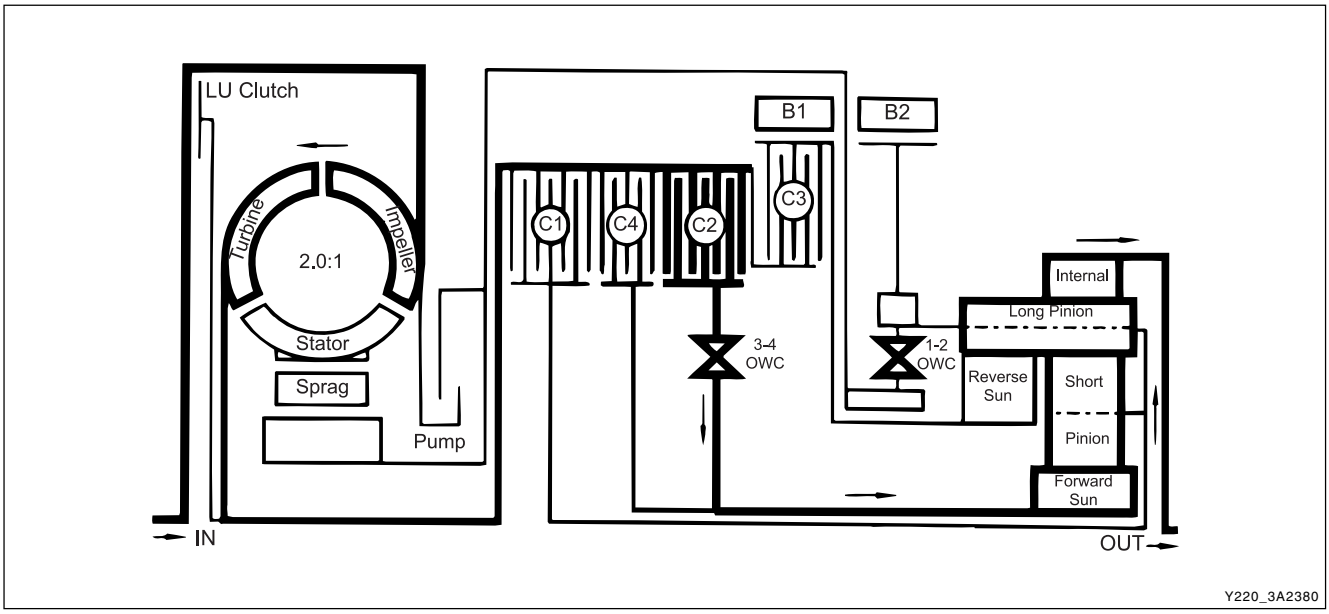
- The C2 clutch is engaged to drive the forward sun gear via the 3-4 OWC.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The 1-2 OWC prevents the planetary gear carrier from rotating under reaction force and the long pinion rotates on its axis driving the internal ring gear and output shaft in a clockwise or forward direction.
- There is no engine braking on overrun.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows:

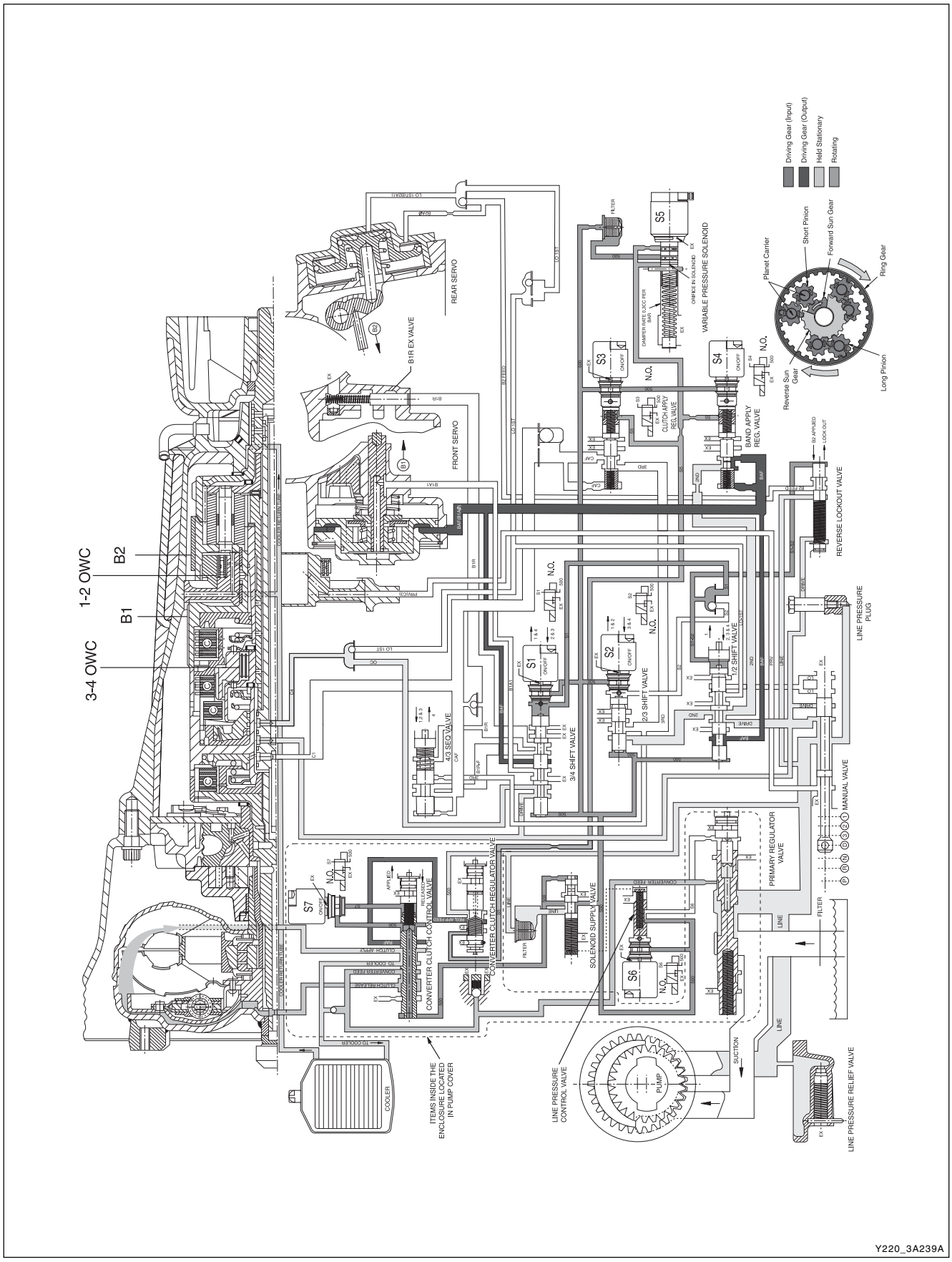
- Solenoids S1 and S2 are switched ON.
- The 1-2, 2-3, and 3-4 shift valves are held in their first gear positions by line 500 pressure.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 1	-	X	-	-	-	-	X	X	-



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DRIVE 2 AND MANUAL 2



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Power flow - Drive 2 and manual 2

In Drive 2 and Manual 2, transmission drive is via the input shaft and forward clutch cylinder. The elements of the transmission function as follows;

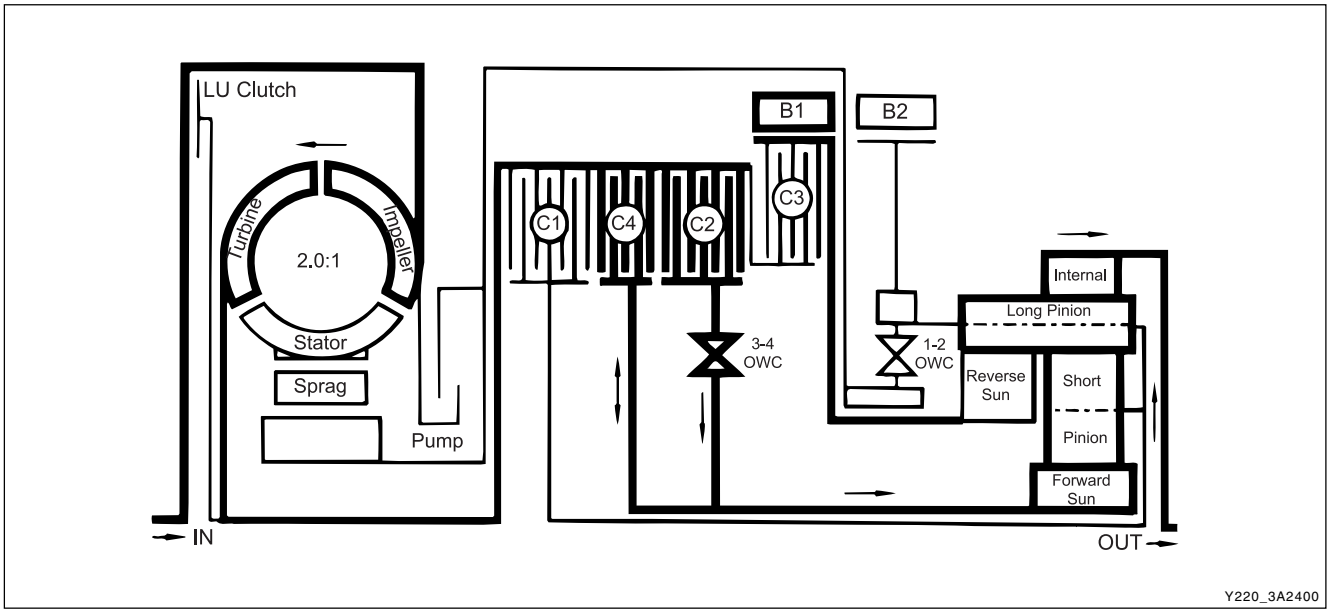
- The C2 clutch is applied to drive the forward sun gear.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The B1 band is applied holding the reverse sun gear stationary therefore the long pinion walks around the reverse sun gear taking the internal ring gear and output shaft with it in a clockwise or forward direction.
- The C4 clutch is applied to bypass the 3-4 OWC and provide engine braking on overrun.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

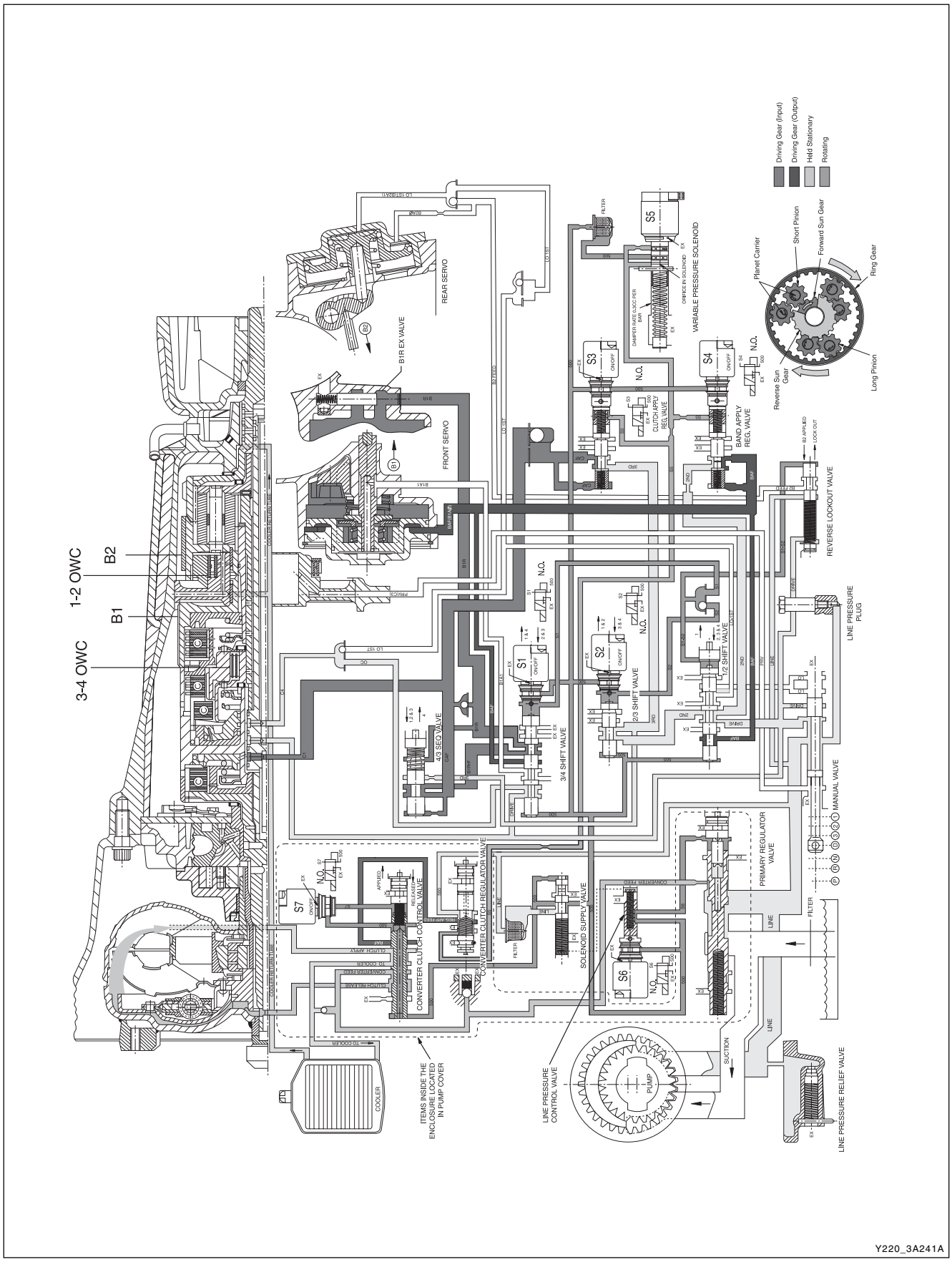
- Solenoid S1 is switched OFF. S2 is switched ON.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.
- When S1 switches OFF, S1 oil pressure, which is derived from line 500 pressure, moves the 3-4 shift valve to the left. At the same time S1 oil is directed to the 1-2 shift valve which moves the valve to the second gear position.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply regulator valve, and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ratio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to;
  - The outer apply area of the front servo
  - The 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
  - The 3-4 shift valve for use when the transmission is shifted into fourth gear
- Drive (line pressure) is routed through the 3-4 shift valve to apply the C4 clutch.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 2 and Manual 2	-	X	-	X	X	-	-	X	-



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AFFECTED VIN	

DRIVE 3 AND MANUAL 3



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AFFECTED VIN	

Power flow - Drive 3 and manual 3

In Drive 2 and Manual 2, transmission drive is via the input shaft and forward clutch cylinder. The elements of the transmission function as follows;

- The C2 clutch is engaged to drive the forward sun gear.
- The C1 clutch is engaged to drive the planet carrier.
- The short pinion drives the long pinion clockwise.
- The forward sun gear and the planet carrier are driven clockwise at the same speed therefore there is no relative motion between the sun gear and the pinions.
- The ring gear and output shaft are driven in a clockwise or forward direction at input shaft speed.
- The C4 clutch is applied to bypass the 3-4 OWC and provide engine braking on overrun.

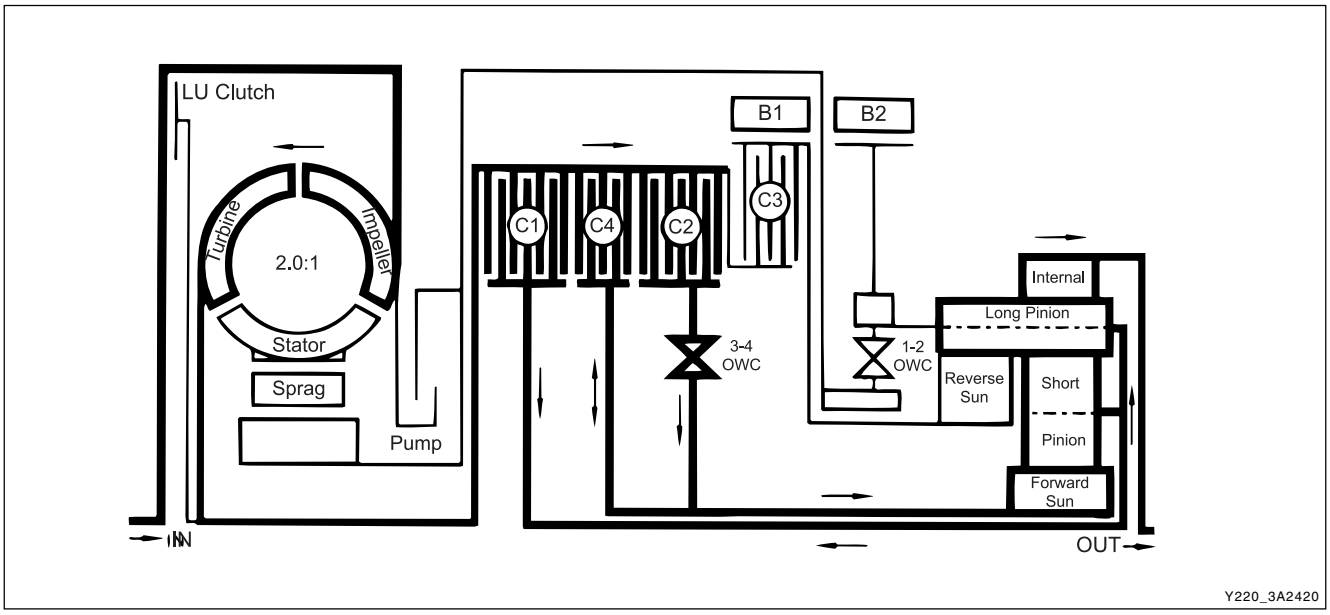
Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoid S1 is switched OFF. S2 is switched OFF.
- With S1 and S2 switched OFF, the 2-3 and 3-4 shift valves are held in the third gear position by line 500 pressure.
- The 1-2 shift valve is held in the third gear position by S1-S2 oil pressure.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply feed regulator valve and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ra-tio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to;
  - The outer apply area of the front servo
  - The 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
  - The 3-4 shift valve for use when the transmission is shifted into fourth gear
- 2nd oil at the 2-3 shift valve is directed to the 3rd oil circuit.
- 3rd oil from the 2-3 shift valve is directed to the clutch apply regulator valve, and to the 4-3 sequence valve.
- The clutch apply regulator valve supplies oil (regulated to line 500 pressure multiplied by the valve ratio) to the Clutch Apply Feed (CAF) circuit.

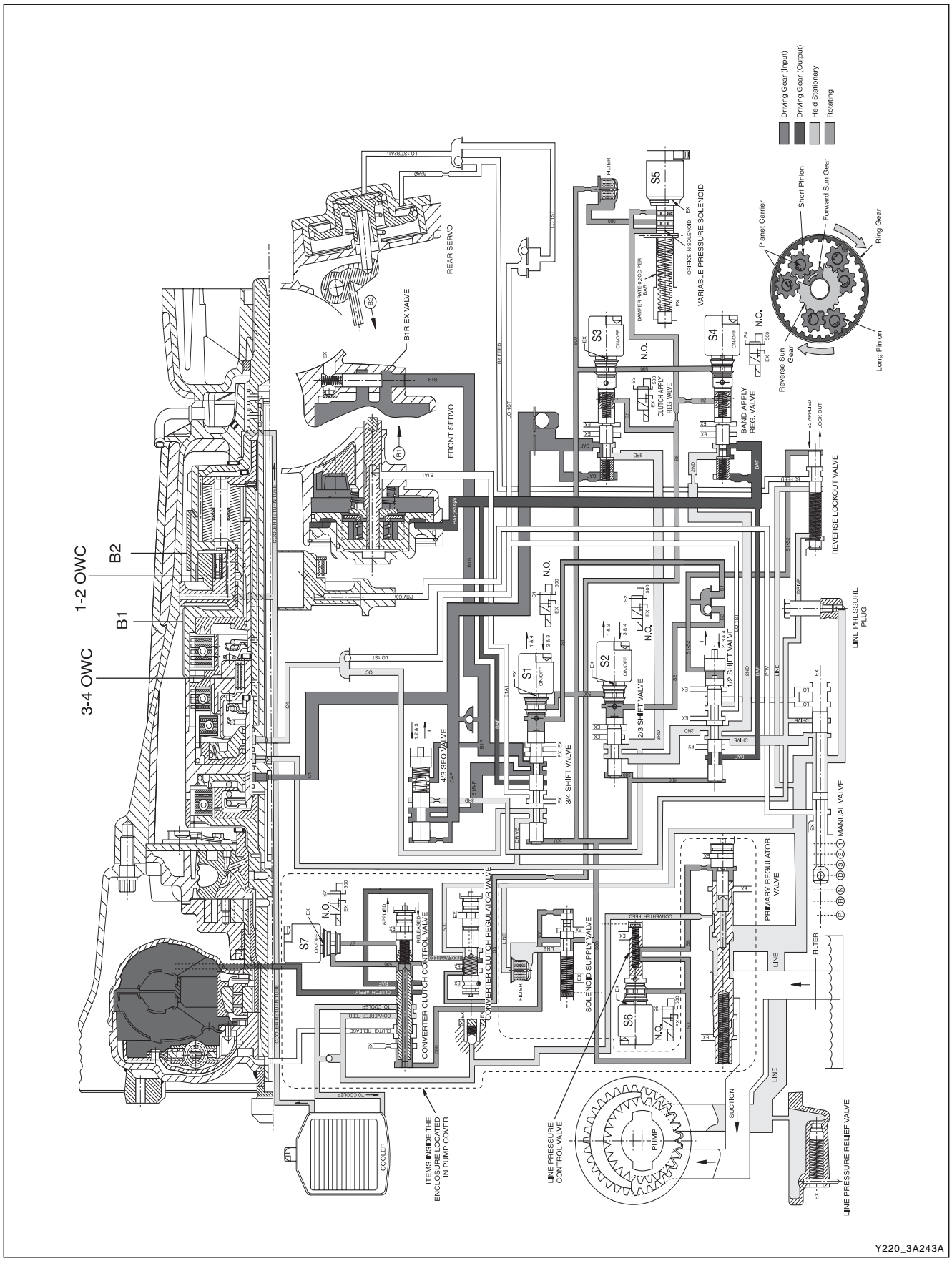
  The CAF oil is directed to;
  - The C1clutch
  - The 4-3 sequence valve
- At the 4-3 sequence valve the CAF oil becomes Band 1 Release Feed (B1R-F) oil, and is directed through the 3-4 shift valve to the spring end of the 4-3 sequence valve, and to the release side of the front servo piston to hold band 1 OFF.
- Drive (line pressure) is routed through the 3-4 shift valve to apply the C4 clutch.

Gear State	ELEMENTS ENGAGED								
	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LU CLUTCH
Drive 3 and Manual 3	X	X	-	X	-	-	-	X	-



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AFFECTED VIN	

DRIVE 3 LOCK UP AND MANUAL 3 LOCK UP



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Power flow - Drive 3 lock up and manual 3 lock up

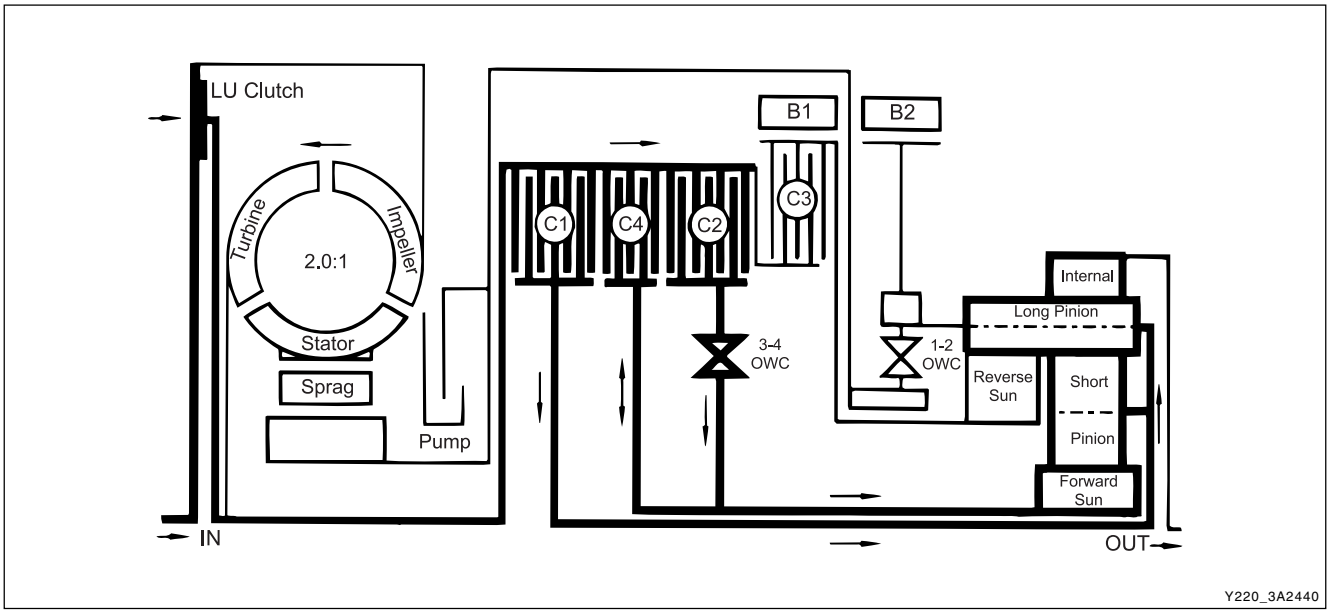
In Drive 3 Lock Up and Manual 3 Lock Up, transmission drive is the same as for Drive 3 but with the application of the converter lock up clutch to provide positive no-slip converter drive.

Control

Control for Drive 3 Lock Up and Manual 3 Lock Up is the same as for Drive 3 with the addition of the converter clutch circuit activated by solenoid S7.

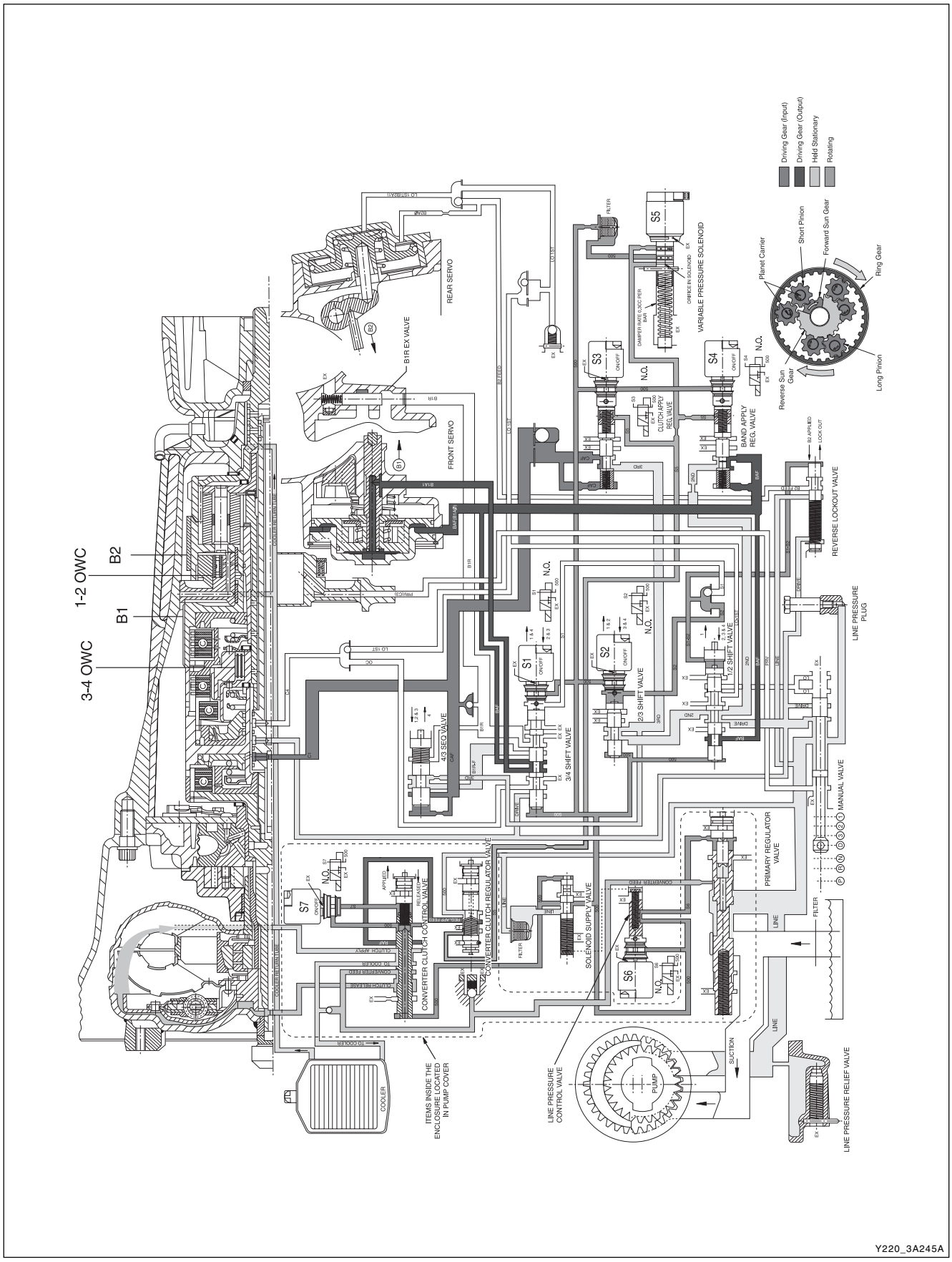
- When S7 is switched ON, S7 feed oil to the converter clutch control valve is switched OFF and allowed to exhaust through the S7 solenoid. This allows the valve to move to the clutch engage position.
- Regulated apply feed oil, drive oil at the converter clutch regulator valve, is directed by the converter clutch control valve to the engage side of the converter clutch.
- Converter clutch release oil is exhausted at the converter clutch control valve.
- Converter feed oil is re-routed by the converter clutch control valve directly to the oil cooler and lubrication circuit.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 3 Lock Up and Manual 3 Lock Up	X	X	-	X	-	-	-	X	X



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DRIVE 4 (OVERDRIVE)



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AFFECTED VIN	

Power flow - Drive 4 (Overdrive)

In Drive 4 (Overdrive), transmission drive is via the input shaft to the forward clutch cylinder.

The elements of the transmission function as follows;

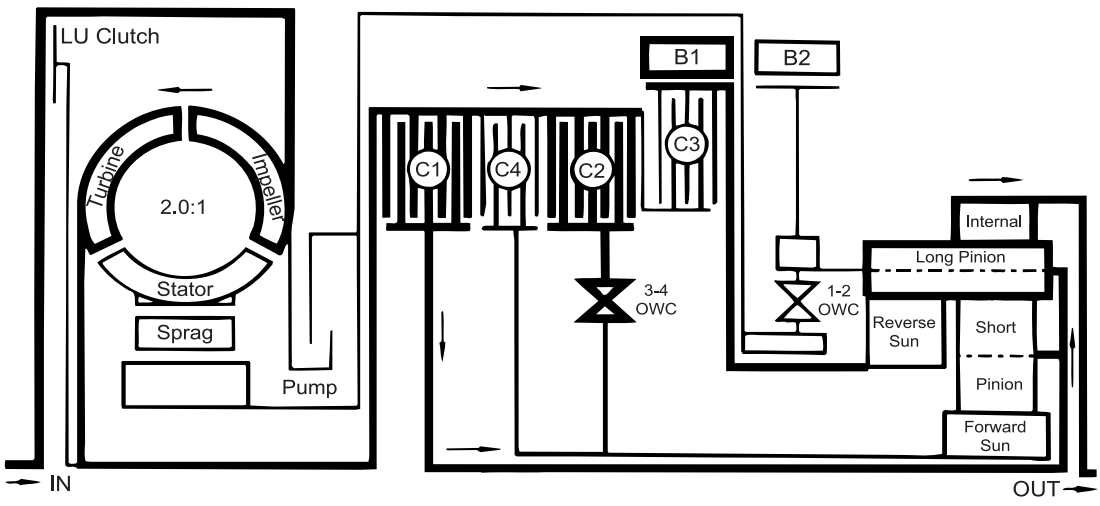
- The C1 clutch is applied to drive the planet carrier clockwise.
- The B1 band is applied to hold the reverse sun gear stationary.
- As the planet carrier tuns, the long pinion walks around the stationary reverse sun gear and rotates around its axis driving the internal ring gear and output shaft in a clockwise or forward direction at a speed faster than the input shaft i.e. in overdrive ratio.
- The forward sun gear is also driven faster than the input shaft and overruns the 3-4 OWC.
- The C2 clutch is engaged to reduce the speed differential across the 3-4 OWC.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

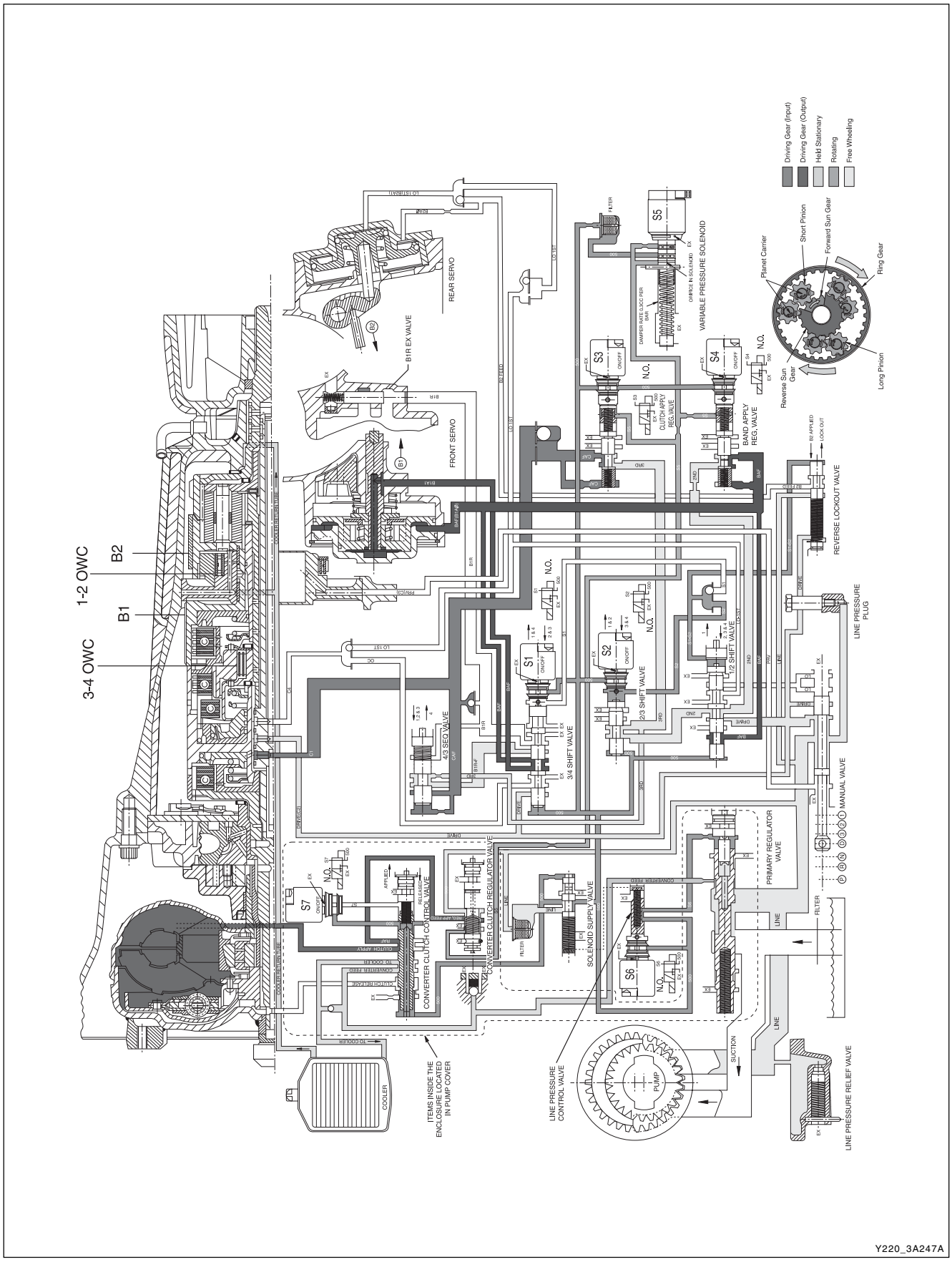
- Solenoid S1 is switched ON. S2 is switched OFF.
- With S1 switched ON, the 3-4 shift valve is held in the fourth gear position by line 500 pressure on the small end of the valve.
- With S2 switched OFF, the 2-3 shift valve is held in the fourth gear position by line 500 pressure on the large end of the valve.
- The 1-2 shift valve is held in the fourth gear position by S2 oil pressure.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply feed regulator valve, and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ra-tio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to;
  - the outer apply area of the front servo
  - the inner apply area of the front servo piston via the 3-4 shift valve
  - the 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
- 2nd oil at the 2-3 shift valve is directed to the 3rd oil circuit.
- 3rd oil from the 2-3 shift valve is directed to the clutch apply regulator valve, and to the 4-3 sequence valve.
- The clutch apply regulator valve supplies oil (regulated to line 500 pressure multiplied by the valve ratio) to the Clutch Apply Feed (CAF) circuit.
- The CAF oil is directed to;
  - the C1 clutch
  - the 4-3 sequence valve
- Drive oil (line pressure) from the manual valve engages the C2 clutch.

Gear State	ELEMENTS ENGAGED								
	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LU CLUTCH
Drive 4 Overdrive	X	X	-	-	X	-	-	-	-



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DRIVE 4 LOCK UP



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Power flow - Drive 4 lock up

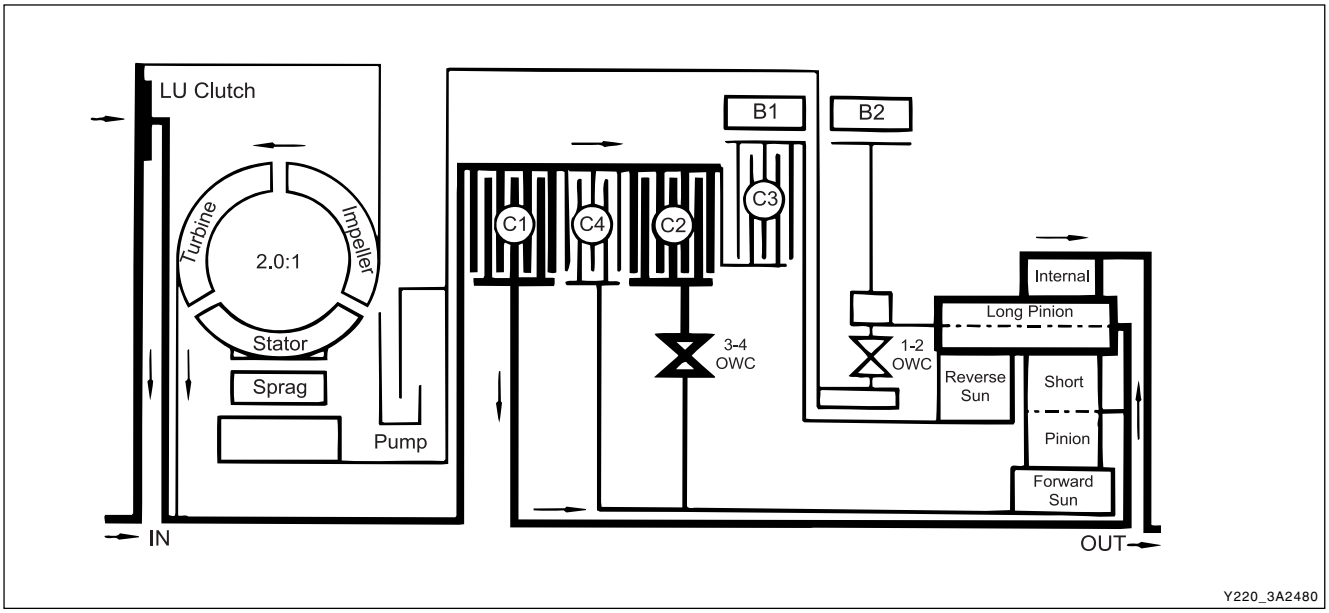
In Drive 4 Lock Up, transmission drive is the same as for Drive 4 but with the application of the converter lock up clutch to provide positive no-slip converter drive.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- When S7 is switched ON, S7 feed oil to the converter clutch control valve is switched OFF and allowed to exhaust through the S7 solenoid. This allows the valve to move to the clutch engage position.
- Regulated apply feed oil, drived from drive oil at the converter clutch regulator valve, is directed by the converter clutch control valve to the engage side of the converter clutch.
- Converter clutch release oil is exhausted at the converter clutch control valve.
- Converter feed oil is re-routed by the converter clutch control valve directly to the oil cooler and lubrication circuit.

Gear State	ELEMENTS ENGAGED								
	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LU CLUTCH
Drive 4 Lock Up	X	X	-	-	X	-	-	-	X



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EFFECTIVE DATE	
AFFECTED VIN	

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSIS

BASIC KNOWLEDGE REQUIRED

You must be familliar with some basic electronics to use this section of the Service Manual. They will help you to follow diagnostic procedures.

NOTICE

- **Lack of the basic knowledge of this transmis-sion when performing diagnostic procedures could result in incorrect diagnostic performance or damage to transmission components. Do not, under any circum-stances, attempt to diagnose a transmission problem without this basic knowledge.**

NOTICE

- **If a wire is probed with a sharp instrument and not properly sealed afterward, the wire will corrode and an open circuit will result.**

Diagnostic test probes are now available that allow you to probe individual wires without leaving the wire open to the environment. These probe devices are inexpensive and easy to install, and they permanently seal the wire from corrosion.

▶ Special Tools

You should be able to use a Digital Volt Meter (DVM), a circuit tester, jumper wires or leads and a line pressure gauge set. The functional check procedure is designed to verify the correct operation of electronic components in the transmission. This will eliminate the unnecessary removal of transmission components.

FUNCTIONAL CHECK PROCE-DURE

Begin with the Functional Check Procedure which provides a general outline of how to diagnose automatic transmission. The following functional check procedure will indicate the proper path of diagnosing the transmission by describing the basic checks and then referencing the locations of the specific checks.

- Check the fluid level according to the Fluid Level Service Procedure.
- Check the transmission fluid leak.
- Check if the transmission fluid is not burnt by smell.

NOTICE

- **The specific fluid used in this transmission turns brown during normal operation. Brown fluid does not indicate a transmission fault.**

- Ensure that the transmission is not in Limp Home Mode (LHM).
- Check the battery terminals and the earth connections for corrosion or looseness.
- Check that the cooler flow is not restricted.
- Check all electrical plug connections for tightness.
- Use on-board diagnostic tool or a scan tool to see if any transmission trouble codes have been set. Refer to the appropriate “Diagnostic Trouble Code (DTC)” information and repair the vehicle as directed. After repairing the vehicle, perform the road test and verify that the code has not set again.
- Perform the Electrical/Garage Shift Tests.
- Perform the Road Test Procedure in this section.
- Inspect the oil and check for metal or other contaminants in the oil pan.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSIS

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- Inspect the oil and check for metal or other contaminants in the oil pan.

TRANSMISSION FLUID LEVEL SERVICE PROCEDURE

This procedure is to be used when checking a concern with the fluid level in a vehicle. A low fluid level will result in slipping and loss of drive/ reverse or delay on engagement of drive/ reverse when the vehicle is cold.

The vehicle is first checked for transmission diagnostic messages on the scan tool. If the oil level is low, it is possible to register a vehicle speed signal fault.

The vehicle is to be test driven to determine if there is an abnormal delay when selecting drive or reverse, or loss of drive. One symptom of low fluid level is a momentary loss of drive when driving the vehicle around a corner. Also when the transmission fluid level is low, a loss of drive may occur when the transmission fluid temperature is low.

If there is no loss of drive when the vehicle is driven warm and a vehicle speed signal fault is registered, then fluid should be added to the transmission.

When adding or changing transmission fluid use only Castrol TQ 95 automatic transmission fluid. The use of incorrect fluid will cause the performance and durability of the transmission to be severely degraded.

▶ Fluid Level Diagnosis procedure

1. If the vehicle is at operating temperature allow the vehicle to cool down for two hours, but no greater than four hours. Or if the vehicle is at cool status, start the engine and allow the engine to idle for approximately 5 minutes or, if possible, drive the vehicle for a few kilometers. This will allow the transmission to be within the correct temperature range. Transmission fluid level should be checked at temperature 50 - 60°C (82 - 140°F).

CAUTION

- **Removal of the fluid filler plug when the transmission fluid is hot may cause injury if fluid drains from the filler hole.**

2. With the brake pedal pressed, move the gear shift control lever through the gear ranges, pausing a few seconds in each range. Return the gear shift control lever to P (Park). Turn the engine OFF.
3. Park the vehicle on a hoist, inspection pit or similar raised level surface. The vehicle must be control level to obtain a correct fluid level measurement.
4. Place a fluid container below the fluid filler plug.
5. Clean all dirt from around the fluid filler plug. Remove the fluid filler plug. Clean the filler plug and check that there is no damage to the 'O' ring.
   - If fluid drains through the filler hole the transmission may have been overfilled. When the fluid stops draining the fluid level is correct. Install the fluid filler plug and tighten it to 33 Nm (24 lb-ft).
   - If fluid does not drain through the filler hole, the transmission fluid level may be low. Install the filler pump into the filler hole. Lower the vehicle with the filler pump still connected and partially fill the fluid through the filler hole.

     Start the vehicle in P (Park) with the parking brake and the brake applied. With the engine idling, move the gear shift. control lever through the gear ranges, pausing a few seconds in each range and adding the fluid until gear application is felt.

     Return the gear shift lever to P (Park).

     Turn the engine OFF and raise the vehicle. When the three minutes passed after the engine stopped, remove the filler pump.

     Check if the fluid level is aligned with the bottom of the filler hole. If not, add a small quantity of fluid to the correct level. Install the fluid filler plug and tighten it to 33 Nm (24 lb-ft).
   - If fluid does not drain through the filler hole although adding a total of 1.5 liters, the transmission should be inspected for fluid leaks and any leaks should be fixed before setting the transmission fluid level.
6. When the fluid level checking procedure is completed, wipe any fluid around the filler plug with a rag or shop towel.

▶ Fluid Level Set After Service

1. Depending on the service procedure performed, add the following amounts of fluid through the filler plug hole prior to adjusting the fluid level:

Converter empty	9.5 liters
Converter full	4.5 liters

2. Follow steps 1 through 4 of the Fluid Level Diagnosis Procedure.
3. Clean all dirt from around the fluid filler plug. Remove the fluid filler plug. Clean the filler plug and check that there is no damage to the 'O' ring.

4. Lower the vehicle with the filler pump still connected and start the vehicle in P (Park) with the parking brake and the brake applied. With the engine idling, move the gear shift control lever through the gear ranges, pausing a few seconds in each range and adding the fluid until gear application is felt.

   Then add an additional 0.5 litres of fluid. Return the gear shift lever to P (Park). Turn the engine OFF and raise the vehicle. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
5. Drive the vehicle at 3.5 to 4.5 kilometers with light throttle so that the engine does not exceed 2500 rpm.

   This should result in the transmission temperature being in the range 50 - 60°C (82 - 140°F). With the brake applied, move the shift lever through the gear ranges, pausing a few seconds in each range at the engine idling.
6. Return the gear shift lever to P (Park).

   Turn the en-gine OFF and raise the vehicle on the hoist, if applicable, ensuring the vehicle is level. When the three minutes passed after the engine stopped, remove the filler plug.

   Check if the fluid level is aligned with the bottom of the filler hole. If not, add a small quantity of fluid to the correct level. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
7. Wipe any fluid around the filler plug with a rag or shop towel.

FLUID LEAK DIAGNOSIS AND REPAIR

The cause of most external leaks can generally be located and repaired with the transmission in the vehicle.

▶Methods for Locating Leaks

General method

1. Verify that the leak is transmission fluid.
2. Thoroughly clean the suspected leak area.
3. Drive the vehicle for approximately 25 km (15 miles) or until the transmission reaches normal operating temperature (88°C, 190°F).
4. Park the vehicle over clean paper or cardboard.
5. Turn the engine OFF and look for fluid spots on the paper.
6. Make the necessary repairs to correct the leak.

Powder method

1. Thoroughly clean the suspected leak area.
2. Apply an aerosol type powder (foot powder) to the suspected leak area.
3. Drive the vehicle for approximately 25 km (15 miles) or until the transmission reaches normal operating temperature (88°C, 190°F).
4. Turn the engine OFF.
5. Inspect the suspected leak area and trace the leak path through the powder to find the source of the leak.
6. Make the necessary repairs.

Dye and black light method

1. Add dye to the transmission through the transmission fluid filler plug. Follow the manufacturer's recommendation for the amount of dye to be used.
2. Use the black light to find the fluid leak.
3. Make the necessary repairs.

Repairing the fluid leak

Once the leak point is found the source of the leak must be determined. The following list describes the potential causes for the leak:

- Fasteners are not torqued to specification.
- Fastener threads and fastener holes are dirty or corroded.
- Gaskets, seals or sleeves are misaligned, damaged or worn.
- Damaged, warped or scratched seal bore or gasket surface.
- Loose or worn bearing causing excess seal or sleeve wear.
- Case or component porosity.
- Fluid level is too high.
- Plugged vent or damaged vent tube.
- Water or coolant in fluid.
- Fluid drain back holes plugged.

4. Lower the vehicle with the filler pump still connected and start the vehicle in P (Park) with the parking brake and the brake applied. With the engine idling, move the gear shift control lever through the gear ranges, pausing a few seconds in each range and adding the fluid until gear application is felt.

   Then add an additional 0.5 litres of fluid. Return the gear shift lever to P (Park). Turn the engine OFF and raise the vehicle. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
5. Drive the vehicle at 3.5 to 4.5 kilometers with light throttle so that the engine does not exceed 2500 rpm.

   This should result in the transmission temperature being in the range 50 - 60°C (82 - 140°F). With the brake applied, move the shift lever through the gear ranges, pausing a few seconds in each range at the engine idling.
6. Return the gear shift lever to P (Park).

   Turn the en-gine OFF and raise the vehicle on the hoist, if applicable, ensuring the vehicle is level. When the three minutes passed after the engine stopped, remove the filler plug.

   Check if the fluid level is aligned with the bottom of the filler hole. If not, add a small quantity of fluid to the correct level. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
7. Wipe any fluid around the filler plug with a rag or shop towel.

FLUID LEAK DIAGNOSIS AND REPAIR

The cause of most external leaks can generally be located and repaired with the transmission in the vehicle.

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- Fluid level is too high.
- Plugged vent or damaged vent tube.
- Water or coolant in fluid.
- Fluid drain back holes plugged.

ELECTRICAL / GARAGE SHIFT TEST

This preliminary test should be performed before a hoist or road test to make sure electronic control inputs are connected and operating. If the inputs are not checked before operating the transmission, a simple electrical condition could be misdiagnosed as a major transmission condition.

A scan tool provides valuable information and must be used on the automatic transmission for accurate diagnosis.

1. Move gear shift control lever to P (Park) and set the parking brake.
2. Connect scan tool to Data Link Connector (DLC) terminal.
3. Start engine.
4. Turn the scan tool ON.
5. Verify that the appropriate signals are present. These signals may include:
   - ENGINE SPEED
   - VEHICLE SPEED
   - THROTTLE POSITION
   - ACCEL. PEDAL POSITION
   - TRANSMISSION GEAR STATE
   - GEAR SHIFT LEVER POSITION
   - TRANSMISSION FLUID TEMPERATURE
   - CLOSED THROTTLE POSITION LEARN
   - OPEN THROTTLE POSITION LEARNT
   - CLOSED ACCEL. PEDAL POSITION LEARNT
   - OPEN ACCEL. PEDAL POSITION LEARNT
   - A/C COMPRESSOR STATUS
   - KICKDOWN SWITCH STATUS
   - 4WD STATUS
   - MODE SWITCH
   - THROTTLE POSITION VOLTAGE
   - GEAR SHIFT LEVER POSITION VOLTAGE
   - TRANS. FLUID TEMPERATURE VOLTAGE
   - A/C SWITCH
   - KICKDOWN SWITCH VOLTAGE
   - 4WD LAMP LOW VOLTAGE
   - 4WD LAMP HIGH VOLTAGE
   - MODE SWITCH VOLTAGE
   - BATTERY VOLTAGE
6. Monitor the A/C COMPRESSOR STATUS signal while pushing the A/C switch.
   - The A/C COMPRESSOR STATUS should come ON when the A/C switch is pressed, and turn OFF when the A/C switch is repushed.
7. Monitor the GEAR SHIFT LEVER POSITION signal and move the gear shift control lever through all the ranges.
   - Verify that the GEAR SHIFT LEVER POSITION value matches the gear range indicated on the instrument panel or console.
   - Gear selections should be immediate and not harsh.
8. Move gear shift control lever to neutral and monitor the THROTTLE POSITION signal while increasing and decreasing engine speed with the accelerator pedal.
   - THROTTLE POSITION should increase with engine speed.

ROAD TEST PROCEDURE

- Perform the road test using a scan tool.
- This test should be performed when traffic and road conditions permit.
- Observe all traffic regulations.

ELECTRONIC ADJUSTMENTS

Idle speed adjustments

Carry out the adjustments to the idle speed as detailed in the workshop manual.

Vehicle coding

The vehicle coding is integrated as part of the diagnostic software. A scan tool has the function to code the vehicle through the K-line.

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   - KICKDOWN SWITCH STATUS
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3. Start engine.
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5. Verify that the appropriate signals are present. These signals may include:
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   - The A/C COMPRESSOR STATUS should come ON when the A/C switch is pressed, and turn OFF when the A/C switch is repushed.
7. Monitor the GEAR SHIFT LEVER POSITION signal and move the gear shift control lever through all the ranges.
   - Verify that the GEAR SHIFT LEVER POSITION value matches the gear range indicated on the instrument panel or console.
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- Observe all traffic regulations.

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Idle speed adjustments

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The vehicle coding is integrated as part of the diagnostic software. A scan tool has the function to code the vehicle through the K-line.

SYMPTOM DIAGNOSIS

DRIVE FAULTS

Condition	Possible Causes	Action
No Drive in D	• Insufficient auto transmission fluid.	• Check the fluid level. Top up as necessary.
	• Blocked feed in C1/C2 cylinder.	• Inspect and clean C1/C2 feed.
	• "Z" link displaced.	• Reinstall/renew the 'z' link.
	• Primary Regulator Valve (PRV) jammed open.	• Remove, clean and re-install the PRV.
	• Overdrive shaft or input shaft seal rings failed.	• Inspect and replace as necessary.
	• 3-4 or 1-2 One Way Clutch (OWC) installed backwards or failed.	• Inspect and replace as necessary.
	• C2 piston broken or cracked.	• Inspect and replace as necessary.
No Drive in Reverse No engine braking in Manual 1 Engine braking in Manual 1 is OK	• Rear band or servo faulty.	• Check servo adjustment or replace rear band as necessary.
	• Failure in C3, C3 hub or C1/C2 cylinder.	• Check for failure in C3, C3 hub or C1/C2 cylinder. Repair as necessary.
	• Damaged input shaft sealing rings.	• Inspect and replace as necessary.
No drive in Drive and Reverse	• Jammed Primary Regulator Valve (PRV).	• Inspect and clean PRV.
	• Damaged/broken pump gears.	• Inspect and replace pump gears as necessary.
	• Dislodged output shaft snap ring.	• Inspect and repair as necessary.

FAULTY SHIFT PATTERN

Condition	Possible Causes	Action
2-3 shift only (no 4th or 1st)	• S1 always OFF.	• Inspect S1. Repair or replace as necessary. • Check for 12 Volts applied to S1 at all times or for wiring fault.
1-4 shift only1-3-4 (Delayed 1-2 shift)	• S1 always ON.	• Inspect S1. Repair or replace as necessary. • Check for 12 Volts applied to S1 at all times or for wiring fault.
4-3 shift only	• S2 always OFF.	• Inspect S2. Repair or replace as necessary. • Check for open circuit or wiring fault.
1-2-Neutral (1st over run)	• S2 always ON.	• Inspect S2. Repair or replace as necessary. • Check for open circuit or wiring fault.
1-3 shift only	• B1 failed. • Loose band adjustment. • Front servo piston or seal failed. • S1/S2 ball misplaced,	• Inspect and repair as necessary. • Inspect and adjust as necessary. • Inspect and repair as necessary. • Inspect and replace or refit as necessary
1-3-4 only	• Smaller “O” ring on front servo piston failed or missing. • 2-3 shift valve jammed.	• Inspect “O” ring. Refit or replace as necessary. • Inspect the 2-3 shift valve. Repair or replace as necessary.
1-2-1 only	• C1 clutch failed or slipping in 3rd and 4th. (Gives 1st in 3rd and 2nd in 4th.)	• Inspect C1 clutch. Repair or replace as necessary.
No manual 4-3, 3-2 or 2-1	• Over-run Clutch (OC) /low ball misplaced.	• Inspect ball. Refit or replace as necessary.
No manual 1st	• Rear band slipping when hot. • Reverse/Low-1st ball misplaced. • Rear servo inner “O” ring missing.	• Inspect rear band adjustment. Adjust as necessary. • Inspect ball. Refit or replace as necessary. • Inspect “O” ring. Refit or replace as necessary.
1st gear only or 2nd,3rd, and 4th only	• 1-2 shift valve jammed.	• Inspect the 1-2 shift valve. Repair or replace as necessary.
1st and 2nd only or 1st, 3rd and 4th only	• 2-3 shift valve jammed.	• Inspect the 2-3 shift valve. Repair or replace as necessary.
1st, 2nd and 4th only or 1st, 2nd, and 3rd (tied up in 3rd)	• Inhibitor switch fault, 1-2-3 only. • 3-4 shift valve jammed.	• Inspect inhibitor switch. Repair or replace as necessary. • Inspect the 3-4 shift valve. Repair or replace as necessary.

Condition	Possible Causes	Action
Harsh 2-3 shift	• Jammed band 1 release valve.	• Inspect the release valve. Repair or replace as necessary.
	• Faulty S3 or S2 solenoid.	• Inspect S3 or S2. Repair or replace as necessary.
	• Faulty clutch apply regulator valve.	• Inspect the regulator valve. Repair or replace as necessary.
	• Missing or damaged clutch apply feed ball.	• Inspect the ball. Refit or replace as necessary.
	• Damaged input shaft sealing rings.	• Inspect the sealing rings. Refit or replace as necessary.
	• Damaged C1 piston “O” rings.	• Inspect the “O” rings. Refit or replace as necessary.
	• Damaged or dislodged C1 piston bleedball.	• Inspect the bleed ball. Refit or replace as necessary.
	• Faulty S1 or S4 solenoid.	
Harsh 3-4 shift	• Jammed band 1 release valve.	• Inspect S1 or S4. Repair or replace as necessary.
	• Incorrect front band adjustment.	• Inspect the release valve. Repair or replace as necessary.
	• Damaged front servo piston “O” rings.	• Inspect the band. Adjust as necessary.
	• Faulty or damaged variable pressure solenoid (S5).	• Inspect the “O” rings. Refit or replace as necessary.
	• Faulty band apply regulator valve.	• Inspect S5. Repair or replace as necessary.
		• Inspect the regulator valve. Repair or replace as necessary.

SHIFT QUALITY FAULTS

Condition	Possible Causes	Action
All Shifts Firm	• Incorrect auto transmission fluid (ATF).	• Drain and fill with specified ATF.
	• S5 faulty won, or incorrectly fitted.	• Check that S5 is fitted correctly, or replace S5.
	• Band apply and clutch apply regulator springs misplaced.	• Inspect band apply and clutch apply regulator springs. Refit or replace as necessary
Manual 4-3-2-1 is soft delayed or missing	• Over-run Clutch (OC) /Low-1st ball misplaced.	• Inspect the ball. Refit or replace as necessary.
	• C4 clutch worn or burnt.	• Inspect C4 clutch. Replace or repair as necessary.
	• C4 wave plate not lined up with the holes in the piston.	• Check the alignment. Realign as necessary.
Firm 1-2 Hot	• S5 worn.	• Inspect S5 and replace as necessary.
4th Tied up	• Incorrect C4 pack clearance.	• Check the clearance and adjust as necessary.
	• Damaged C4 clutch.	• Inspect C4. Repair or replace as necessary.
	• Cracked C2 piston (leaking into C4).	• Inspect piston. Repair or replace as necessary.
Tied up on 2-3	• Incorrect band adjustment	• Inspect and adjust band as necessary.
	• Front servo plastic plug missing	• Replace the plug.
	• B1R spring broken.	• Replace the spring.
Flare on 2-3	• B1R spring/plug left out.	• Replace the spring/plug.
	• C1/B1R ball misplaced.	• Refit the ball.
	• C1 clutch damaged.	• Inspect the clutch. Repair the clutch as necessary.
	• Restriction in C1 feed.	• Inspect and clean C1 feed.
	• C1 piston check ball jammed.	• Replace the piston.
	• Overdrive or input shaft sealing rings damaged.	• Inspect and replace the sealing rings and/or shaft as necessary.
Slips in 4th	• C1/B1R ball misplaced.	• Inspect and replace the ball.
	• Overdrive or input shaft sealing rings damaged.	• Inspect and replace the sealing rings and/or shaft as necessary.
	• C1 clutch damaged.	• Inspect and repair the C1 clutch as necessary.
Slips in reverse, no manual 1st	• Rear band incorrectly adjusted or damage	• Inspect and adjust or replace rear band.
	• Low-1st check ball misplaced.	• Inspect and re-fit the ball.
Flare on 4-3, Flare on 3-2	• 4-3 sequence valve in backwards.	• Refit the valve.
Firm Manual low shift-high line press.	• Low-1st check ball misplaced.	• Replace the ball.

Condition	Possible Causes	Action
Harsh 1-2 shift	• Faulty inhibitor switch.	• Check the resistance. Replace the inhibitor switch as necessary.
	• Faulty throttle position sensor.	• Inspect and replace the sensor as necessary.
	• Incorrect front band adjustment.	• Inspect and adjust the band as necessary.
	• Damaged front servo piston “O” rings.	• Inspect and replace the “O” rings as necessary.
	• Faulty or damaged variable pressure solenoid (S5).	• Inspect, repair or replace S5 as necessary.
	• Faulty S1 or S4 solenoid.	• Inspect, repair or replace S1 or S4 as necessary.
	• Faulty Band Apply Regulator (BAR) valve.	• Inspect, repair or replace the BAR as necessary.
	• Misassembled front servo return spring.	• Inspect and repair as necessary.
Stalls when Drive or Reverse	• Jammed Converter Clutch Control Valve (CCCV).	• Inspect and clean CCCV.
Selected Shudder on Rolldown	• Faulty solenoid 7.	• Inspect, repair or replace as necessary.

AFTER TEARDOWN FAULTS

Condition	Possible Causes	Action
C2 burnt	• Gear shift lever linkage out of adjustment.	• Inspect, repair C2 and adjust the linkage as necessary.
	• S6 foiled - stuck low.	• Repair C2. Inspect, repair or replace S6 as necessary.
	• Overdrive/output shaft sealing rings damaged.	• Repair C2. Inspect, replace the sealing rings and/or shaft as necessary.
	• C2 piston cracked.	• Repair C2. Inspect, repair or replace the C2 piston as necessary.
C4 burnt	• Incorrect C4 pack clearance.	• Inspect C4 and repair as necessary.
		• Inspect and adjust the C4 pack clearance as necessary.
	• C4 wave plate not lined up properly.	• Repair C4. Inspect and realign the wave plate as necessary.
	• Overdrive or output shaft sealing rings damaged.	• Repair C4. Inspect and realign the sealing rings and/or shaft as necessary.
	• C2 piston cracked.	• Repair C4. Inspect and replace the C2 piston as necessary.
	• Over-run Clutch (OC) /low-1st ball misplaced.	• Repair C4. Inspect and refit the ball as necessary.
B1 burnt	• B1R spring broken.	• Inspect and repair B1 and replace the spring as necessary.
	• Input shaft sealing ring cut.	• Replace sealing ring.
	• C1/B1R ball misplaced.	• Repair B1. Refit the ball as necessary.
C1 burnt	• B1R spring left out.	• Inspect and repair C1 and replace the spring.
	• Overdrive or input shaft sealing rings damaged.	• Repair C1. Inspect and replace the sealing tongs and/or shaft as necessary.
	• C1 piston cracked.	• Repair C1. Inspect and replace the C1 piston as necessary.
	• Ball capsule jammed.	• Repair C1. Inspect and refit the capsule as necessary.
	• 4-3 sequence valve in backwards.	• Repair C1. Inspect and refit the valve as necessary.
	• Clutch Apply Feed (CAF) /B1R ball left out.	• Repair C1. Inspect and replace the ball as necessary.
B2 burnt (Slips in reverse - no manual 1st)	• Rear band incorrectly adjusted or damaged.	• Inspect and adjust the band as necessary.
	• Reverse-low/first ball misplaced.	• Inspect and refit the ball as necessary.

Condition	Possible Causes	Action
Firm converter lock or unlock	• Input shaft “O” ring missing or damaged. • Converter clutch regulator valve in backwards.	• Inspect and replace the “O” ring as necessary. • Inspect and refit the valve as necessary.
No lock up at light throttle	• Input shaft “O” ring missing or damaged. • C1 bias valve in backwards.	• Inspect and replace the “O” ring as necessary. • Inspect and refit the valve as necessary.

REPAIR INSTRUCTIONS

ON-VEHICLE SERVICE

ION AUTOMATIC TRANSMISSION ASSEMBLY

Removal and Installation

1. Remove the transfer in case of 4-wheel drive vehicle. For removal and installation of the transfer case, refer to the “Transfer Case” section.

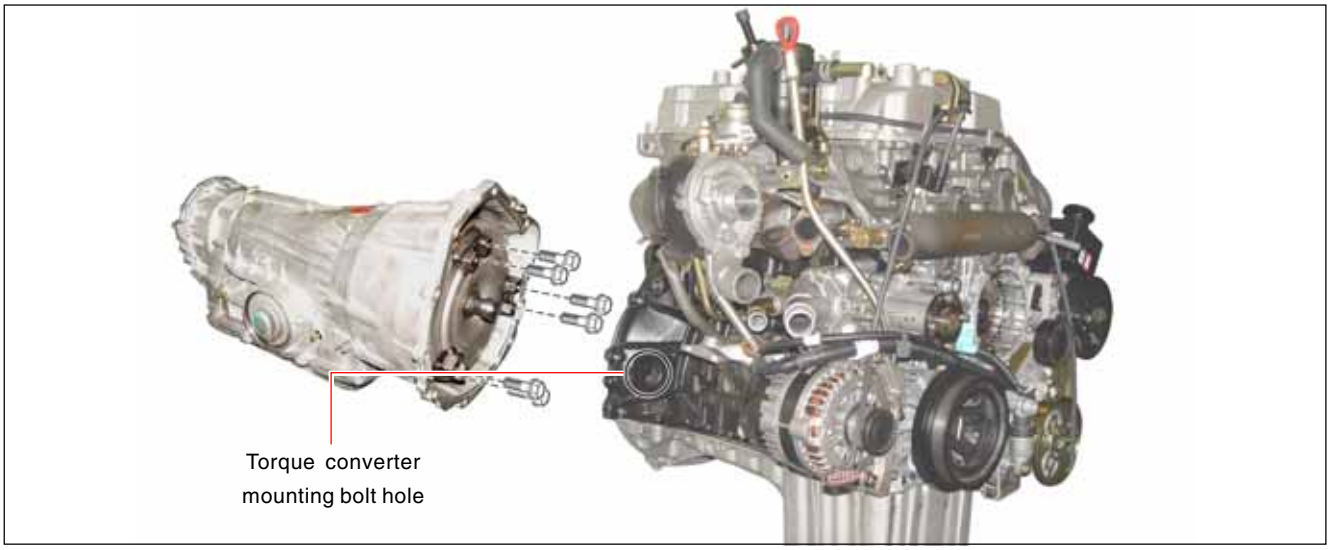
2. Disconnect the transmission connector.



3. Remove the locking pin from the shift lever onnecting rod.



4. Remove the caps from the torque converter mounting bolt hole and then remove six mounting bolts (13M) from the torque converter.

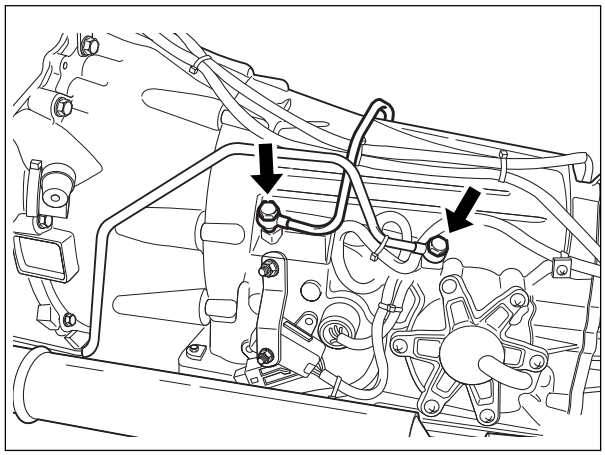


Turn the crankshaft so that each mounting bolt is placed at bolt hole, and remove one by one.

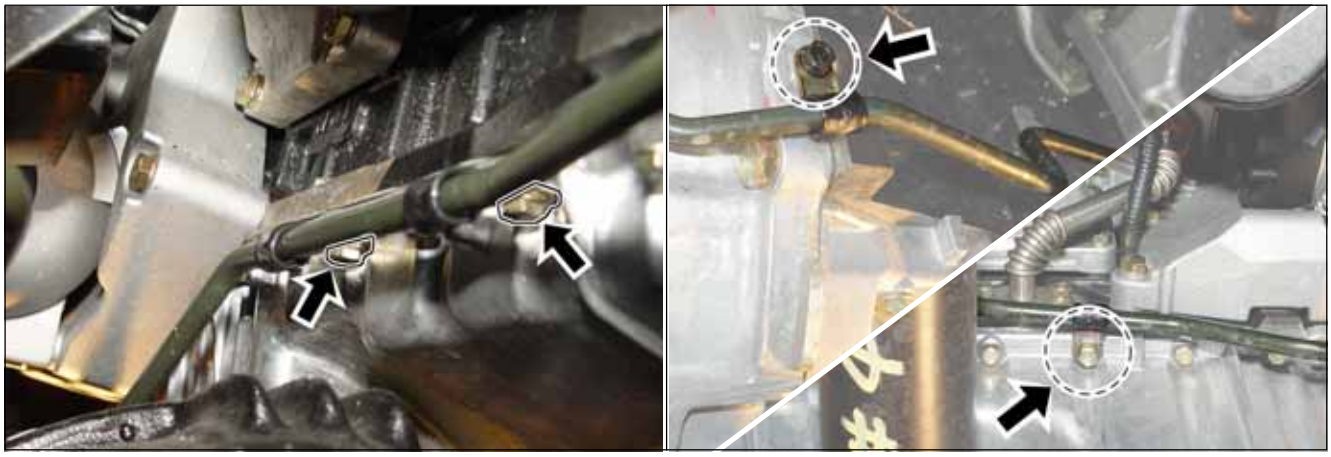
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. Remove two union bolts from the oil cooler pipe.

Tightening torque	25 ~ 35 Nm (18 ~ 26 lb-ft)

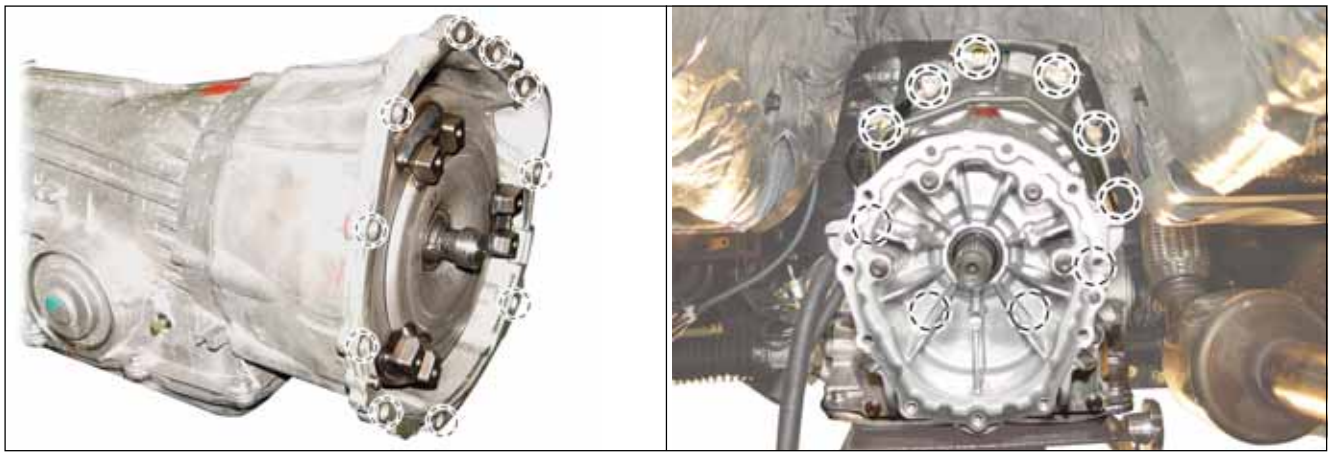


6. Remove mounting bolts from the oil cooler pipes (LH/RH).



7. Unscrew the mounting bolts and remove the automatic transmission housing.

Tightening torque	55 ~ 65 Nm (41 ~ 48 lb-ft)



VALVE BODY

Removal and Installation

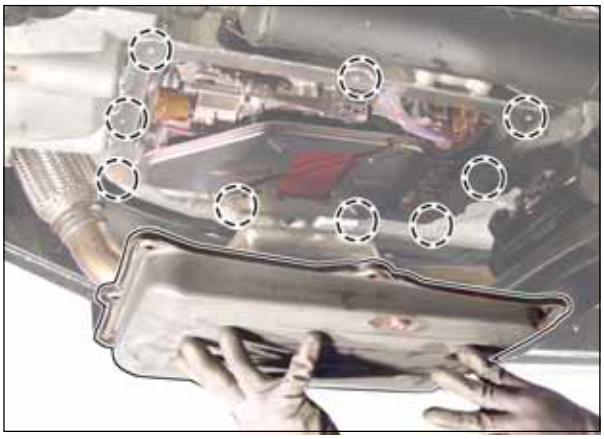
1. Remove the negative battery cable.
2. Remove the drain plug and drain the oil completely.

Tightening torque	25 ~ 35 Nm (18 ~ 26 lb-ft)



3. Unscrew nine mounting bolts and remove the oil pan.

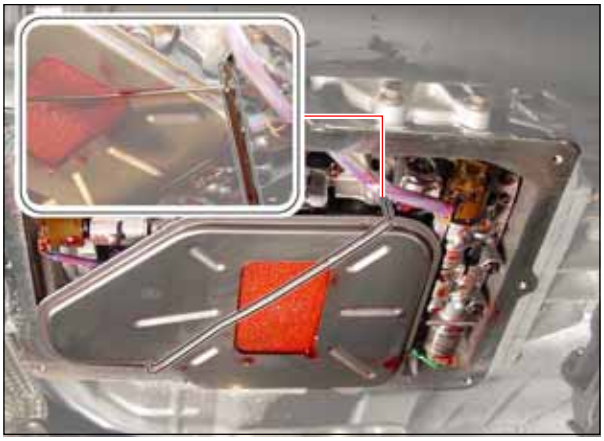
Tightening torque	4 ~ 6 Nm



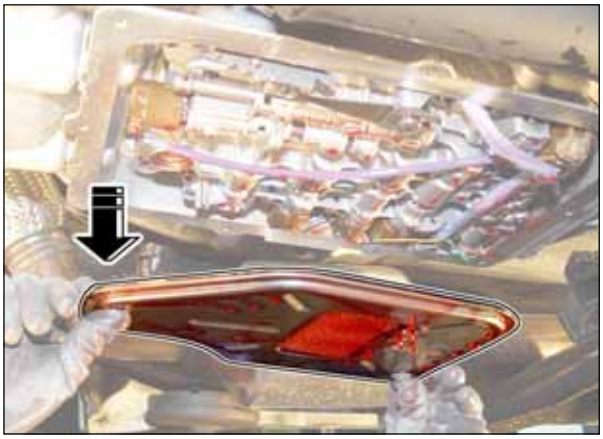
NOTICE

- **Remove the oil pan slowly while keeping its level not to spill oil from it.**

4. Remove the mounting clamp from the oil filter.

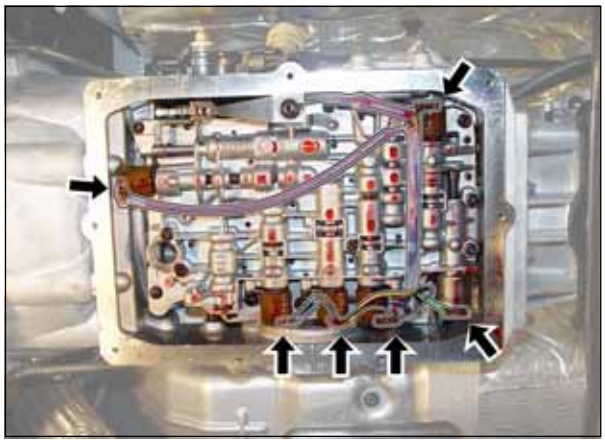


5. Remove the oil filter.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. Disconnect the solenoid valve connectors.

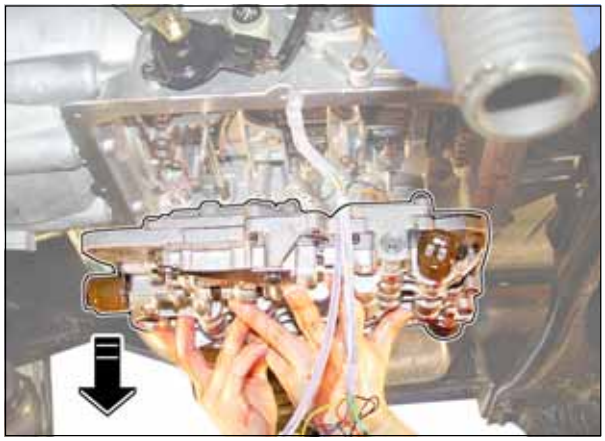


7. Remove the bolt from the valve body ground.

Tightening torque	8 ~ 13 Nm



8. Unscrew the mounting bolts and remove the valve body from the transmission.



9. Install in the reverse order of removal.



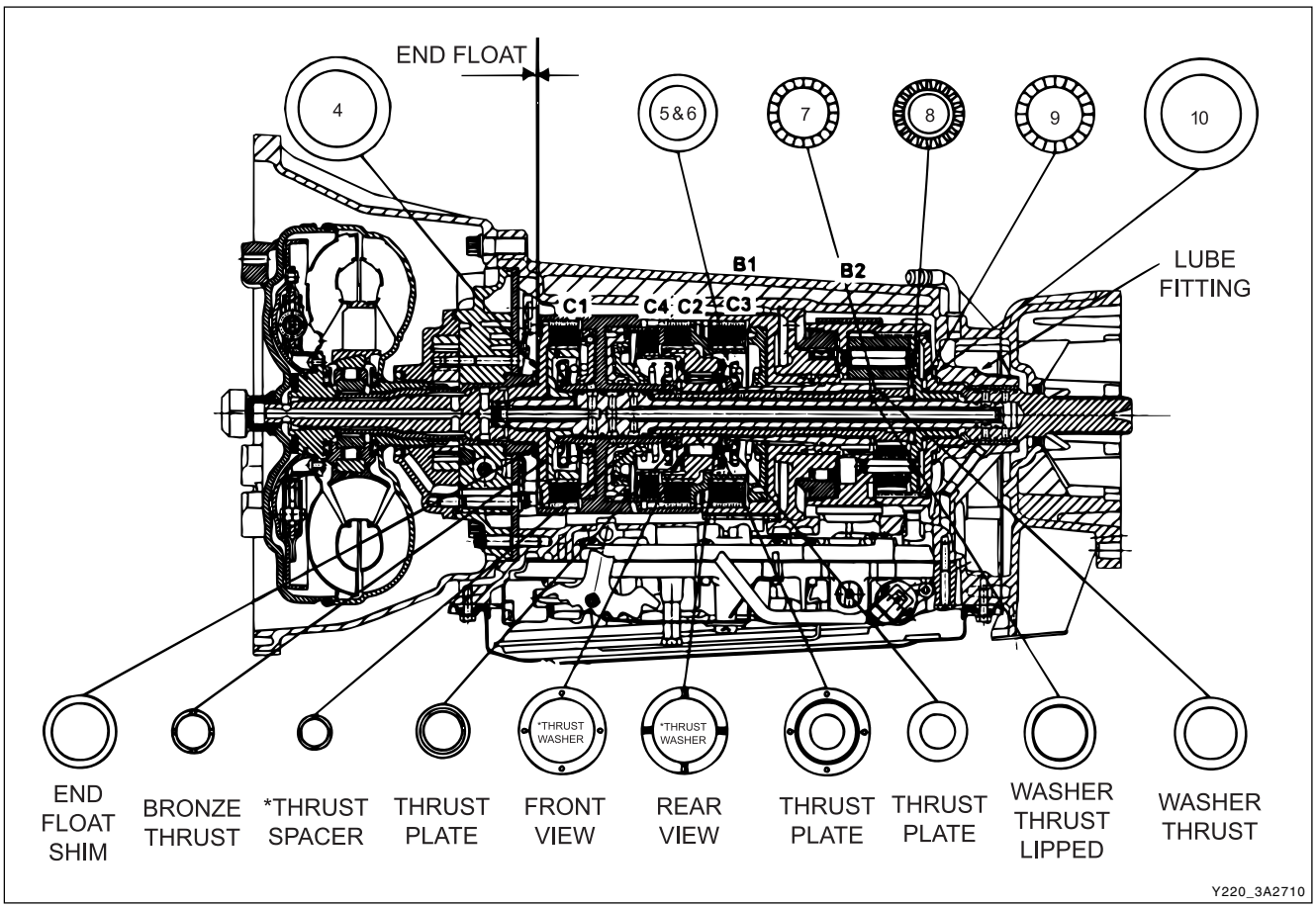


UNIT REPAIR

REBUILD WARNINGS

Prior to rebuilding a transmission system, the following warnings are to be noted.

- Ensure that, before replacing a transmission the cooler lines are flushed out to remove any debris. This can be done by applying compressed air to the rear cooler line forcing oil and any contaminants out of the front cooler line.
- The cooler flow should be checked after the transmission has been fitted. With the front cooler line connected and the rear line run into a suitable container, measure the flow over 15 seconds with the vehicle idling in park.
- The flow rate should exceed 1 liter in 15 seconds.
- Be wary of any situation where water enters the transmission. This may result in fluid foaming and leaking through the breather.
- Ensure that both earth straps (one at the battery terminal and one on the vehicle body) are connected in the vehicle before connecting the positive side of the battery.
- Follow the throttle position calibration procedure in this manual if the engine control module/ transmission control module (ECM/TCM) is swapped.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DISASSEMBLY PROCEDURE

Transmission

Tools Required

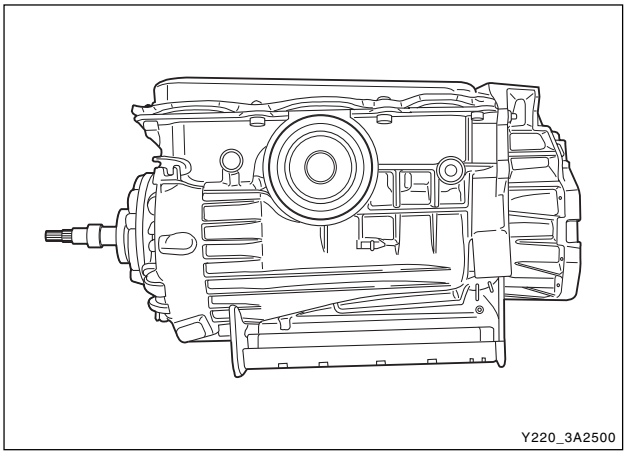
0555-336256 Transmission Bench Cradle

0555-336257 Pump Puller

NOTICE

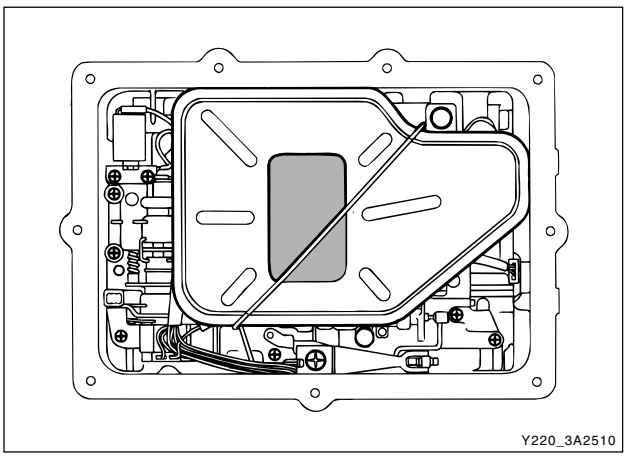
- **Remove the inhibitor switch before washing the transmission in solvent or hot wash.**
- **It is assumed that the transmission fluid has been drained when the transmission was removed from the vehicle and that the "special tools" quoted are available.**
- **The transmission is dismantled in a modular fashion, and the details of disassembly for each module are given under the appropriate subject. Refer to Special Tools Table in this chapter for details of all special tools required when performing disassembly procedures.**
- **Technicians overhauling these transmissions will also require a selection of good quality Torx bit sockets, in particular numbers 30, 40 and 50, and an 8mm, 10mm and 12 mm double hex socket.**

1. Remove the converter and the converter housing.
2. Mount the transmission on the transmission bench cradle 0555-336256.
3. Remove the oil pan and the oil pan seal.

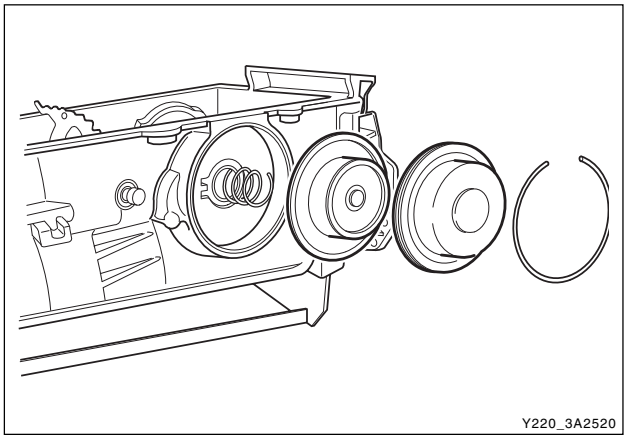


Y220_3A2500

4. Remove each end of the filter retaining clip from the valve body and remove the filter.
5. Disconnect the wires from each solenoid valve and ground and lay the wiring to one side.
6. Remove the valve body securing screws and remove the valve body from the case.



Y220_3A2510

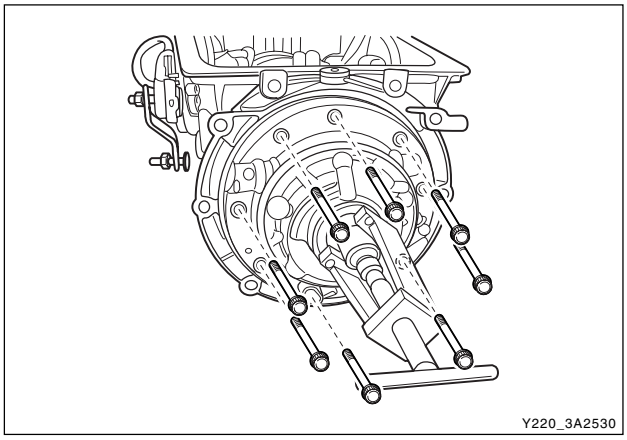

Y220_3A2520

7. Remove the front servo cover circlip.
8. Remove the front servo cover, piston and spring.

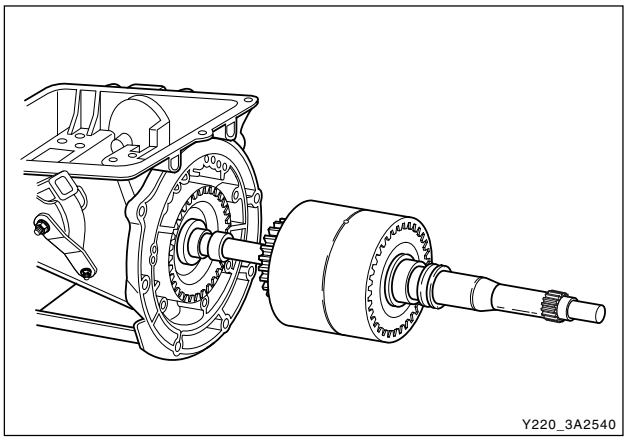
NOTICE

- **The plastic servo block is retained by the piston return spring only.**

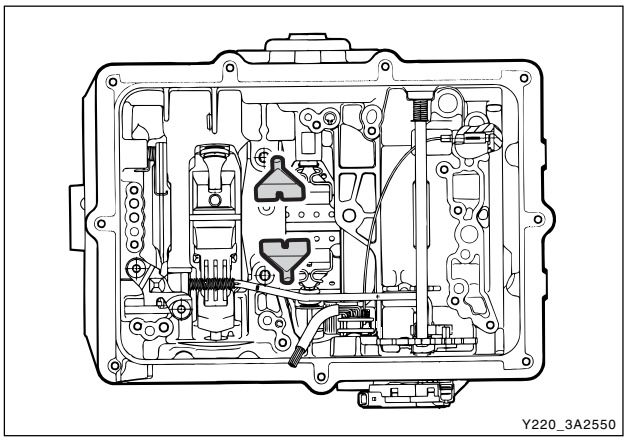
9. Remove the adaptor housing bolts and adaptor housing.


Y220_3A2530

10. Remove the pump to case bolts using a multi-hex 8 mm spanner.
11. Using the pump puller 0555-336257, remove the pump and pump cover.


Y220_3A2540

12. Remove the input shaft, forward clutch cylinder, and the overdrive shaft as an assembly, withdrawing them through the front of the case.
13. Remove the C3 clutch cylinder and sun gears.


Y220_3A2550

14. Remove the front band struts. Remove the front band.

15. Remove the two centre support retaining bolts using a T50 Torx bit.
16. Remove the centre support retaining circlip.

NOTICE

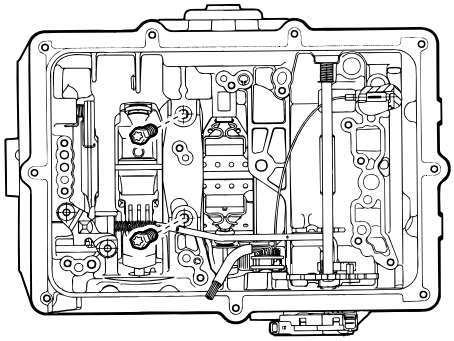
- **Do not hammer the output shaft to remove the centre support as this will cause permanent damage to the thrust bearing surfaces.**

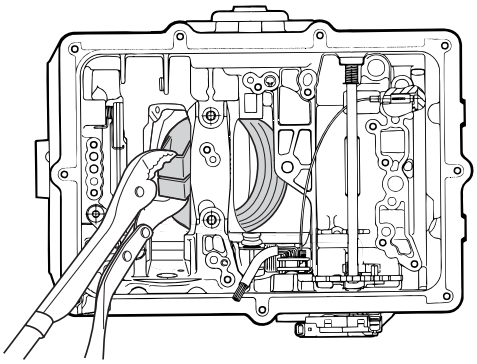
17. Remove the centre support, 1-2 one way clutch, and planetary gear set as an assembly.
18. Remove the parking rod cam plate using a T40 Torx bit.
19. Remove the rear band struts and remove the band.

NOTICE

- **Vise the both end of rear band using the plier and lean forward about 15 degrees**

20. Remove the output shaft assembly.


Y220_3A2560

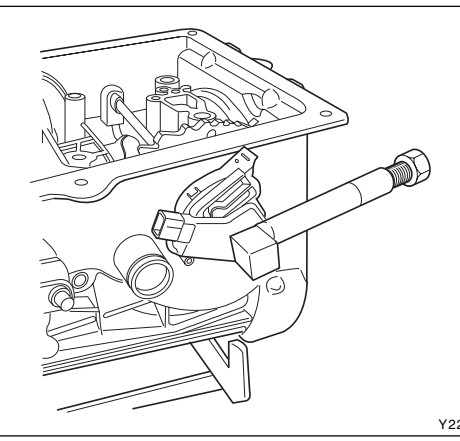

Y220_3A2570

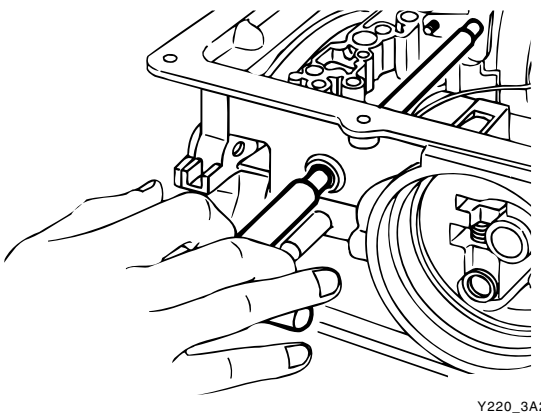
Transmission Case

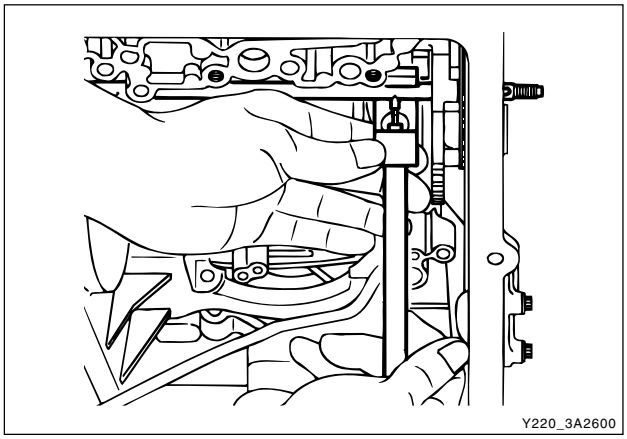
Tools Required

0555-336258 Cross Shaft Pin Remover/Installer (Detent Lever)
0555-336261 Cross Shaft Seal Remover
0555-336265 Cross Shaft Pin Remover/Installer (Inhibitor Switch)

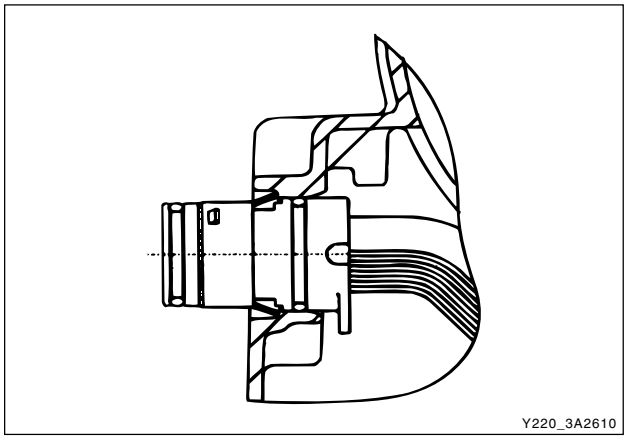
1. Remove the pin from the side of cross shaft inhibitor switch using cross shaft pin remover/installer (inhibitor switch) 0555-336265.
2. Remove the inhibitor switch bolts and inhibitor switch from the case.
3. Remove the cross shaft seals with cross shaft seal remover 0555-336261.
4. Remove the circlip from the cross shaft. Pull the shaft to release the drive pin from the selector quadrant.


Y220_3A2580

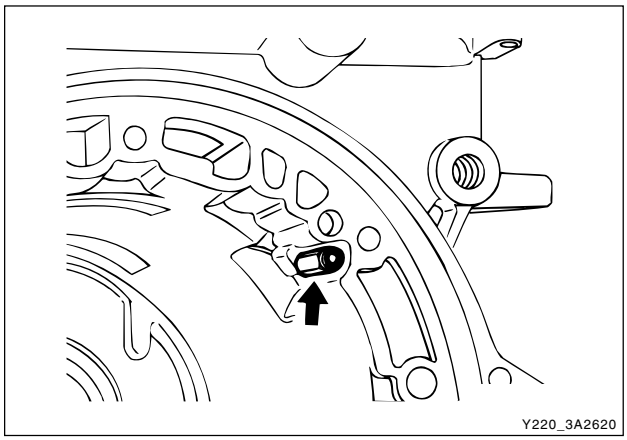

Y220_3A2590


Y220_3A2600

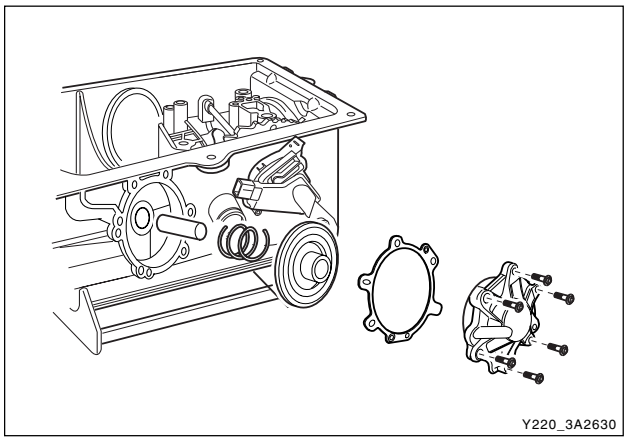
5. Using cross shaft pin remover/installer (detent lever) 0555-336258, press the pin from the cross shaft and withdraw the shaft from the case.
6. Remove the cross shaft pin and spring.
7. Remove the manual valve lever and the park rod.


Y220_3A2610

8. Depress the tangs and withdraw the 10 pin connector into the case. Remove the wiring loom assembly.


Y220_3A2620

9. Detach the No.7 solenoid valve wire from the front of the case.
10. Remove the parking pawl pivot pin and the pawl and spring from the case.
11. Remove the shaft and the rear servo lever.

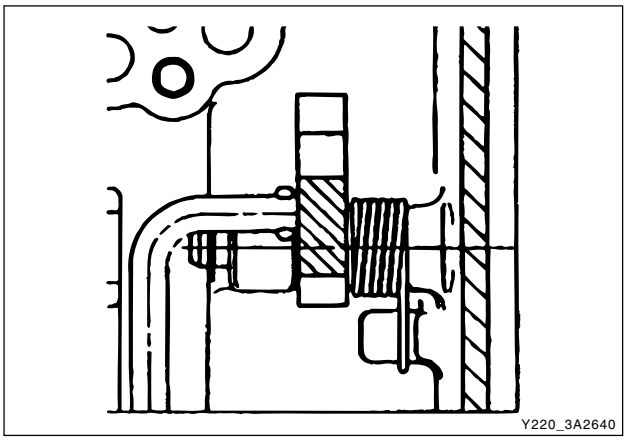

Y220_3A2630

12. Remove the rear servo cover and piston assembly.
13. Remove the B1R circlip, valve and spring.
14. Remove both band adjustment shims.
15. Inspect the output shaft bushing in the case and replace if necessary.
16. Inspect cooler line fittings and replace as necessary.
17. Inspect the case for damage.

18. To remove the park rod lever: Remove the circlip from the inner end of the pivot shaft and tap the outer end of the shaft until it moves free from the case, then using a wide shallow tapered drift as a wedge, drive the pin out from the inside of the case and remove the lever and spring.

NOTICE

- **Do not remove the park rod lever unless absolutely necessary.**

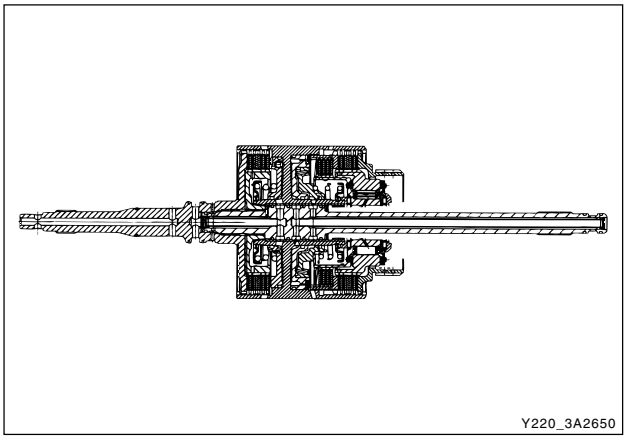

Y220_3A2640

Forward Clutch Cylinder

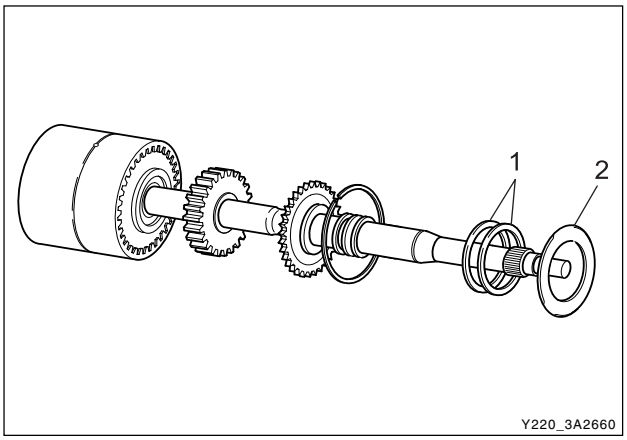
Tools Required

0555-336259 Clutch Spring Compressor

1. Place the assembly in a horizontal position.

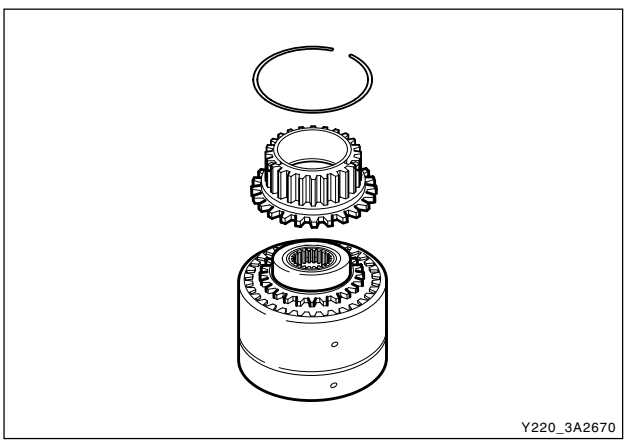

Y220_3A2650

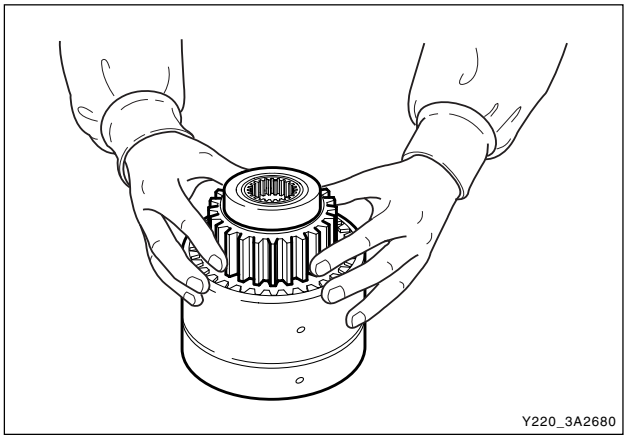
2. Remove the No. 4 needle bearing (2) and adjustment shims (1) from the input shaft.
3. Remove the circlip from the front of the clutch cylinder and remove the input shaft.
4. Remove the overdrive shaft and the C1 clutch hub assembly from the clutch cylinder.
5. Remove the C1 clutch plates from the cylinder.



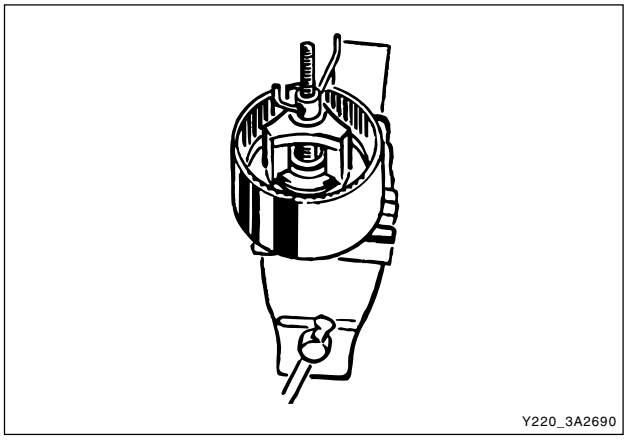
Y220_3A2660

6. Remove the circlip retaining the C3 clutch hub in the rear of the clutch cylinder and remove the hub.
7. Remove the C2/C4 clutch hub assembly and remove the No. 5 needle bearing from the C4 hub.
8. Removethe C2 clutch plates.


Y220_3A2670


Y220_3A2680

9. Invert the clutch cylinder and remove the C4 clutch sleeve, clutch plates and the two wave washers. The 3-4 one way clutch is located between the C2 and C4 clutch hubs, and the hubs may be separated by rotating one hub clockwise and withdrawing it from the other.
10. Remove the thrust block from the C4 clutch cylinder hub.

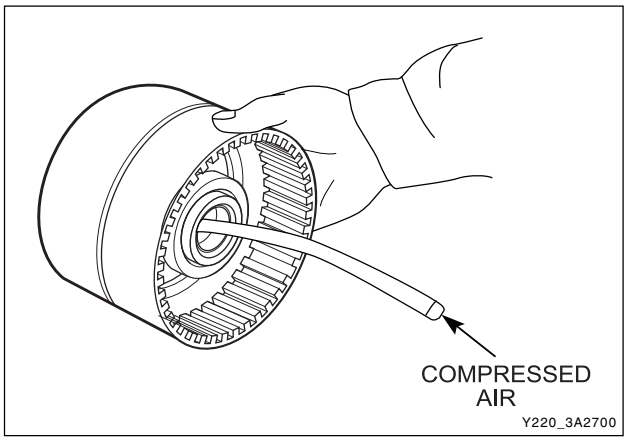

Y220_3A2690

11. Mount the clutch cylinder on clutch spring compressor 0555-336259 with the C2/C4 end uppermost and compress the piston return spring. Remove the spring retaining circlip. Release the tool and remove the circlip, keeper and spring.

Notice

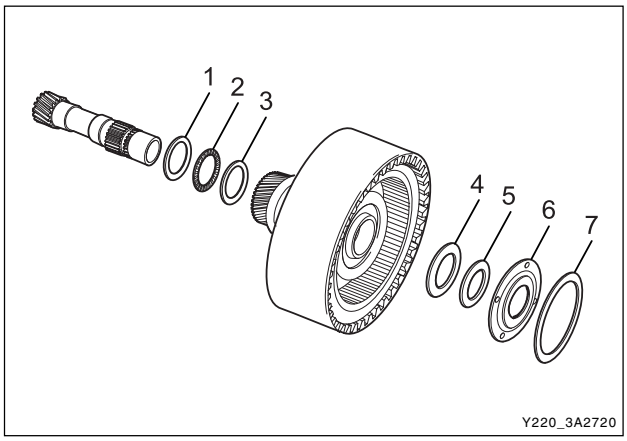
Make sure that the spring keeper is not caught in the circlip groove, and that all the spring pressure is released, before removing the tool.

12. Invert the clutch cylinder on the compressor tool and removethe C1 clutch piston return spring in asimilar manner.



Y220_3A2700

13. To remove the clutch pistons from the clutch cylinder, apply air pressure to the apply ports in the bore of the cylinder.



Y220_3A2720

C3 Clutch Cylinder

Tools Required

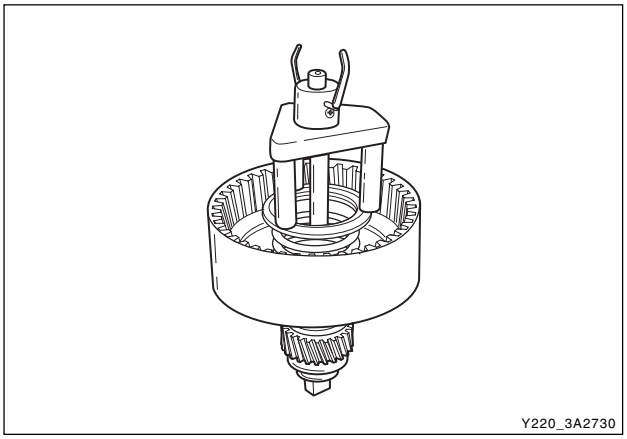
0555-336259 Clutch Spring Compressor

1. Remove the forward sun gear, No.7 needle bearing (2) thrust washer (1) and lipped thrust washer (3) from the C3 clutch cylinder.
2. Remove the thrust plate (4), No.6 needle bearing (5), thrust plate (6) and nylon thrust plate (7) from the clutch cylinder hub.
3. Remove the clutch plate retaining circlip and re-move the clutch plates.

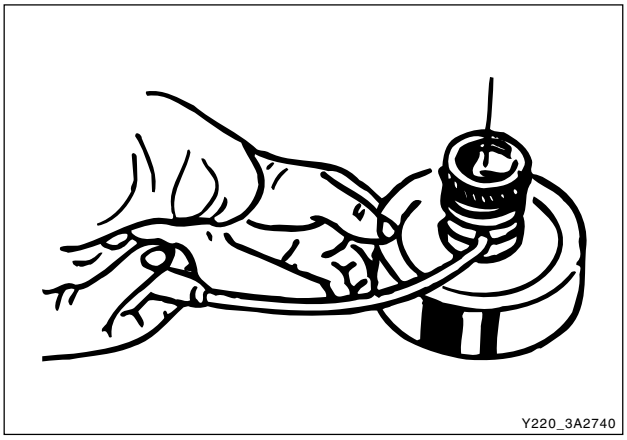
4. Mount the clutch assembly on clutch spring compressor 0555-336259 and compress the piston return spring.
5. Remove the circlip and release the spring.
6. Remove the tool, circlip, keeper and spring.

NOTICE

- **Make sure that the spring keeper has not been caught in the circlip groove, and that all spring pressure has been released, before removing the tool.**

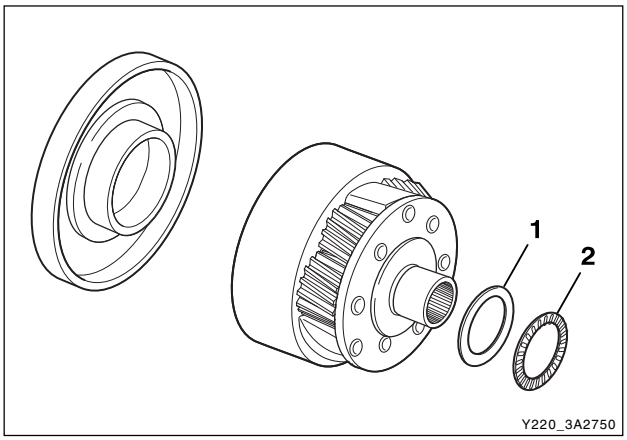


7. Remove the sealing rings from the C3 clutch cylinder.
8. To remove the clutch piston from the clutch cylinder, apply air pressure to the port between the iron sealing rings on the bearing journals of the cylinder.
9. Remove the reverse sun gear and C3 washer from the cylinder.

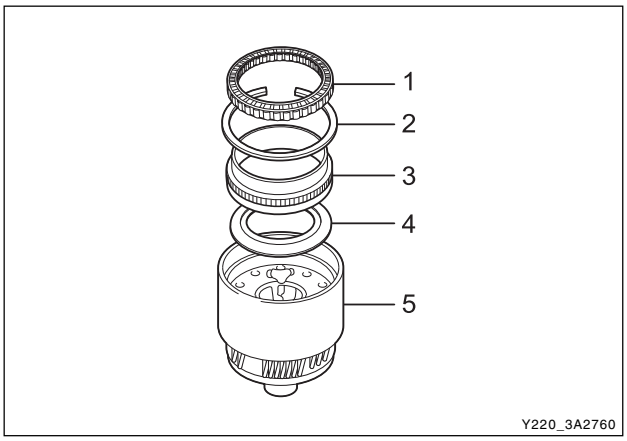


Planet Carrier Assembly and Centre Support

1. Remove the No. 9 (2) needle bearing and washer (1) from the output shaft and the planet carrier.
2. Separate the centre support from the planet carrier by rotating it anti-clockwise.



3. Lift the one way clutch (1) from the planet carrier (5).
4. Remove the circlip (2) retaining the one way clutch outer race (3) in the planet carrier and remove the race.
5. Remove the one way clutch retainer (4) from the planet carrier.

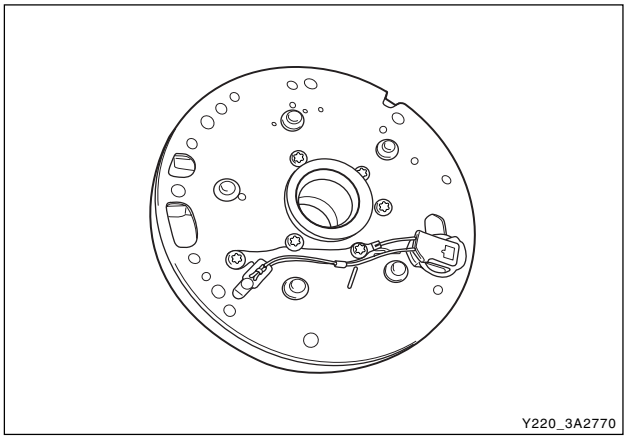


Pump

NOTICE

The following valves are housed in the pump cover:

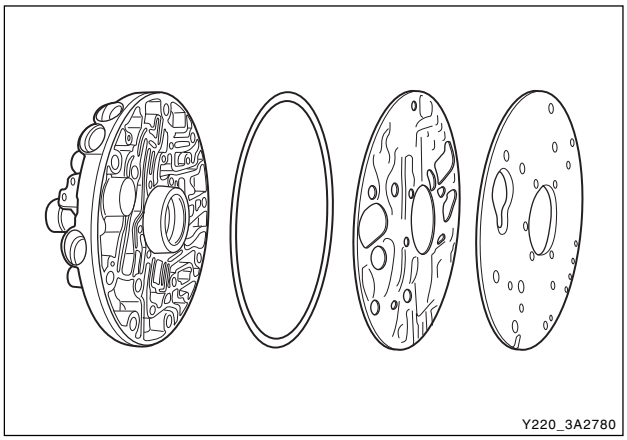
- **Solenoid valve 7**
- **Converter clutch control valve**
- **Converter clutch regulator valve**
- **Primary regulator valve**



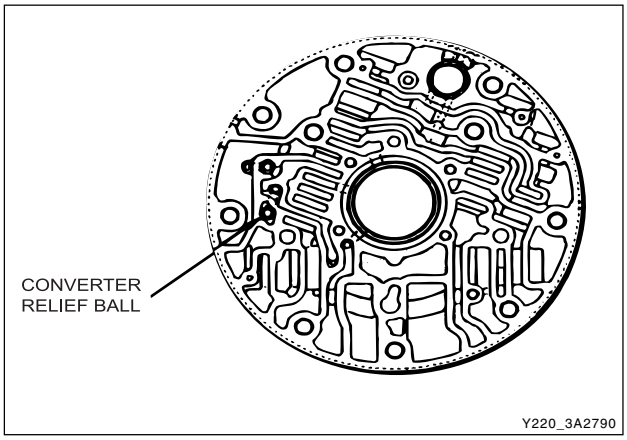
1. Remove the wiring loom retainer plate and remove solenoid valve 7 with a T30 Torx bit.
2. Remove the five washer head bolts from the cover plate using a multi-point 8 mm socket.
3. Remove the five Torx head screws from the cover plate with T30 Torx bit. Note that the long screw holds the pump body to the pump body cover.

NOTICE

- **Do not strike the converter support tube to loosen the pump body.**



4. Separate the pump body from the pump cover.
5. Remove the cover plate, gasket and seal from the cover.



6. Remove the ball check valve and one spring from the pump cover.

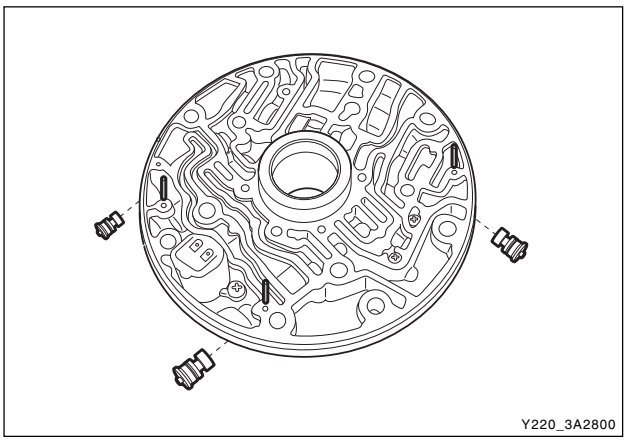
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7. Depress the plug inward and remove the retaining pin for each of the three valves.

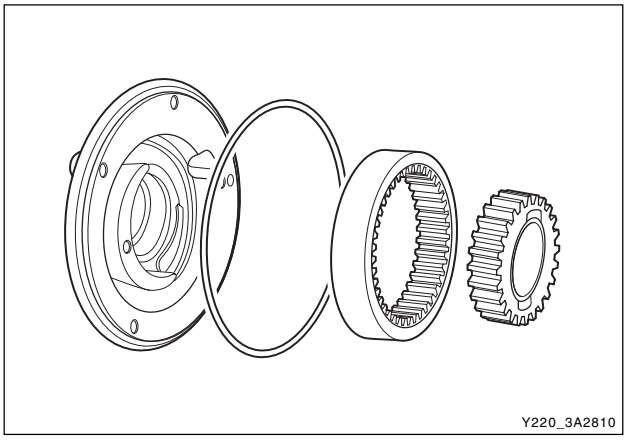
NOTICE

- **Some of the valves and plugs are preloaded by springs and may unexpectedly fall out of the cover when the pins are removed.**

8. Remove the four valves, plugs and springs.


Y220_3A2800

9. Remove the pump gears from the pump body.
10. Remove the lip seal from the front of the pump body.

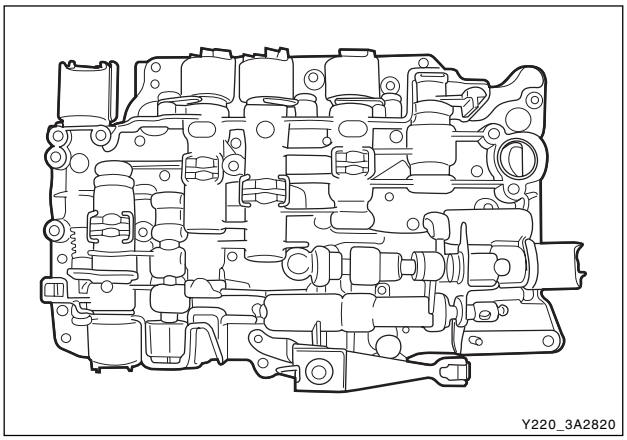

Y220_3A2810

Valve Body

1. Remove the manual valve detent spring and retainer plate using a T40 Torx bit.
2. Slide the manual valve out of the lower valve body.

NOTICE

- **Be aware that the manual valve will fall out of the valve body.**

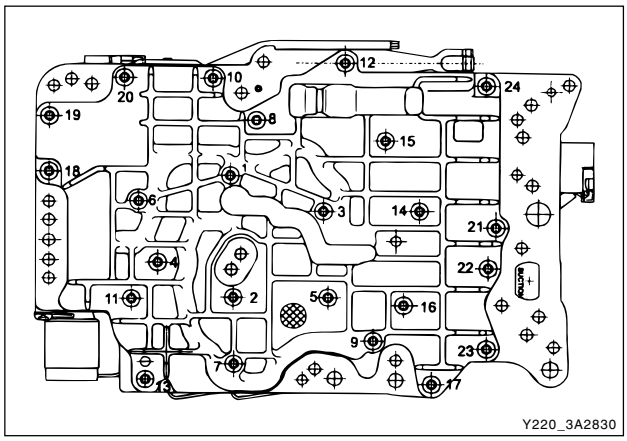

Y220_3A2820

3. Take note of the angular relationship of the solenoid valve terminals to the valve body and remove the solenoid valves 1, 2, 3, 4, 5, 6 and valve assemblies.

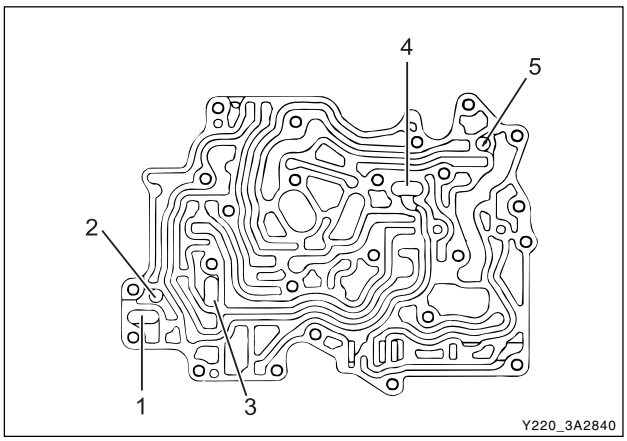
NOTICE

- **Take care that the bracket is not separated from the solenoid valve.**

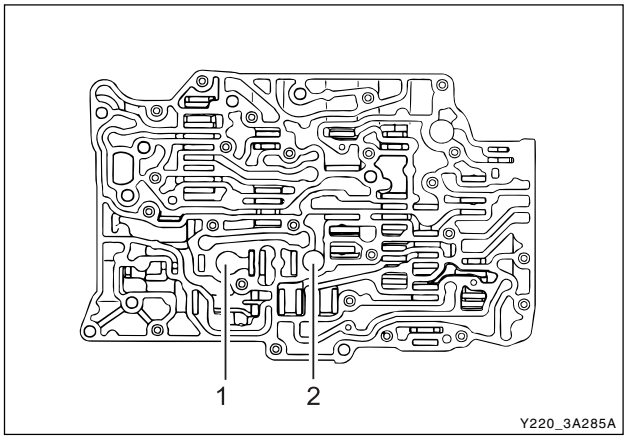
4. Place the valve body assembly on the bench with the upper body uppermost.
5. Remove the 24 clamping screws with a No. 30 Torx bit. Separate the upper and lower valve bodies by lifting the upper body and the separator plate together.
6. Turn the upper body over and place it on the bench with the separator plate uppermost.



Y220_3A2830



7. Lift the separator plate and gaskets from the upper valve body.
8. Remove the five nylon check balls exposed in the valve body.
9. Remove the retaining plate, plug, spring and re-verse lockout valve.

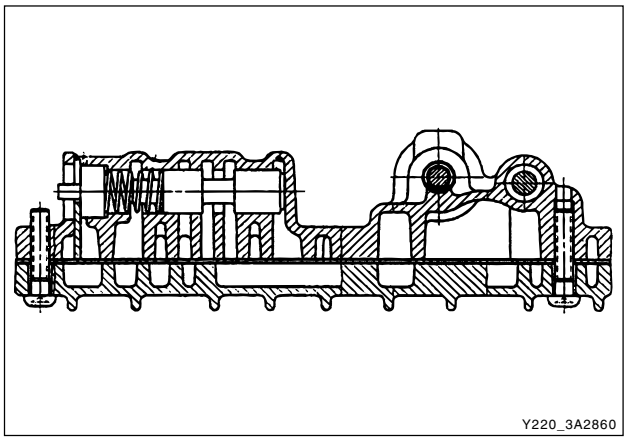


10. Remove the filter (1) and the large nylon check ball (2) from the lower valve body.
11. Remove the retaining plates and pins from the 1-2, 2-3, 3-4, BAR and CAR valves. The pins can be removed with a magnet.

NOTICE

- **Once the pins are removed, the plates are loose in the valve body and will drop out when the valve body is turned over.**

12. Remove the 1-2, 2-3 and 3-4 shift valves.

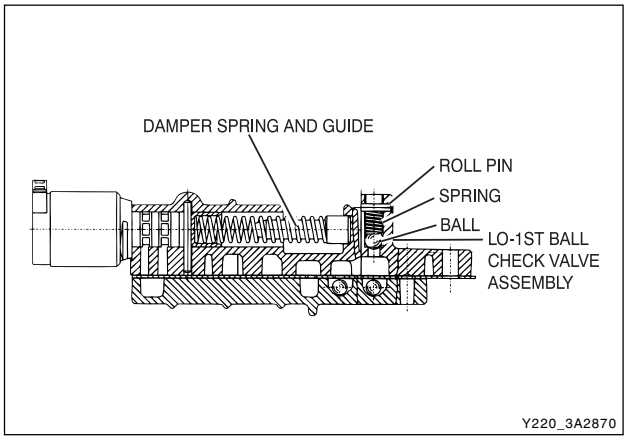


13. Depress the 4-3 sequence valve plug and remove the retaining plate.

NOTICE

- **The plug is preloaded by the spring and may unexpectedly fall out of the valve body.**

14. Remove the plug, spring and valve



15. Depress the solenoid valve 5 valve. Remove the retaining in and remove the valve, damper guide and spring.

NOTICE

- **The valve is preloaded by the spring and may unexpectedly fall out of the valve body.**

16. Depress the line pressure release valve, remove the retaining pin, disc (if fitted), spring and valve.
17. Drive out the retaining pin and remove the spring and ball check valve adjacent to the BAR valve.

ASSEMBLY PROCEDURE

Transmission

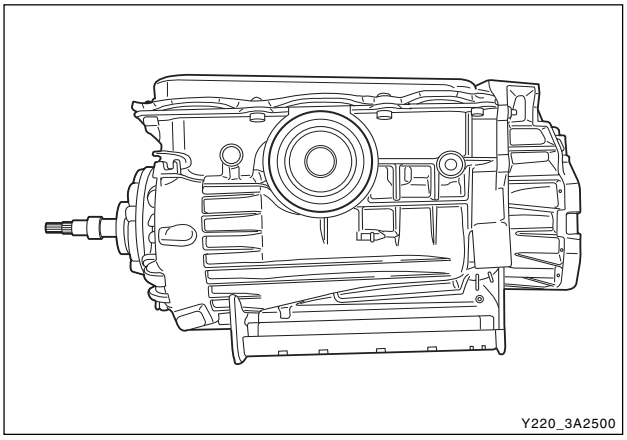
Tools Required

0555-336256 Transmission Bench Cradle
0555-336258 Cross Shaft Pin Remover/Installer (Detent Lever)
0555-336262 Cross Shaft Seal Installer
0555-336263 Cross Shaft bullet
0555-336265 Cross Shaft Pin Remover/Installer (Inhibitor Switch)

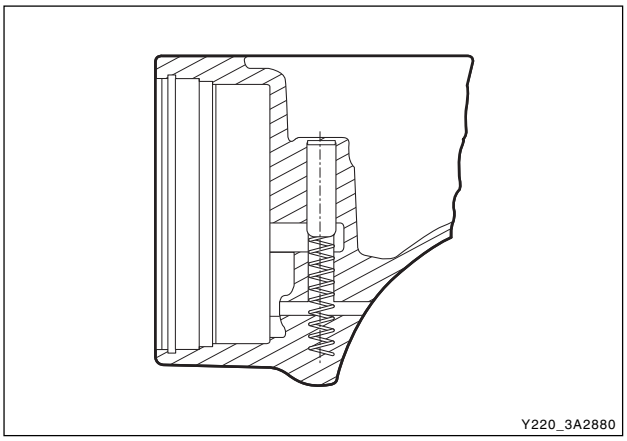
NOTICE

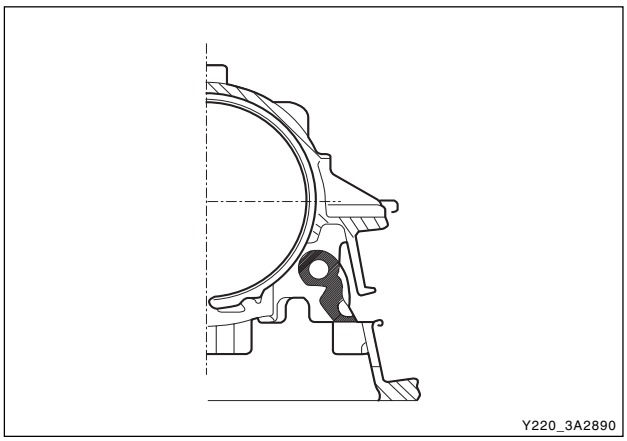
- **The transmission is assembled in modular fashion and details of assembly for each module are given under the appropriate subject.**
- **Technicians overhauling these transmissions will also require a selection of good quality Torx bit sockets, in particular numbers 30, 40 and 50, and an 8 mm, 10 mm and 12 mm double hex socket.**
- **Ensure that the B1R circlip is fitted to the case. (If this is not fitted, the valve will peen its way into and through the separator plate)**
- **Ensure that the 'E'clip is fitted to the cross shaft.**
- **Ensure that all aspects of the parking mechanism are working.**

1. Turn the transmission case upside down on the bench and mount it to the transmission bench cradle 0555-336256.
2. Install all fittings, plugs and the breather, applying a sealant where applicable, Tighten the fittings to specifications. Ensurethatthebreatheris clear, andcheckthat the lube fitting in the rear of the case is fittedand clear of obstruction.


Y220_3A2500

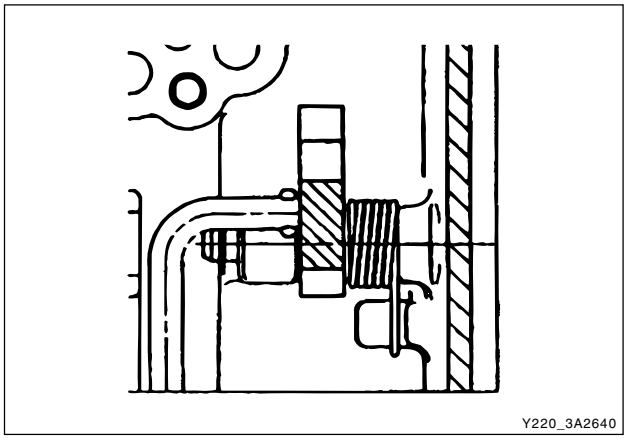
3. Assemble the B1R valve and spring, and secure with the circlip. Ensure that the circlip is completely seated in its groove.


Y220_3A2880


Y220_3A2890

4. Install the rear servo lever and pivot pin.

NOTICE
- **The lever must pivot freely on its pin.**

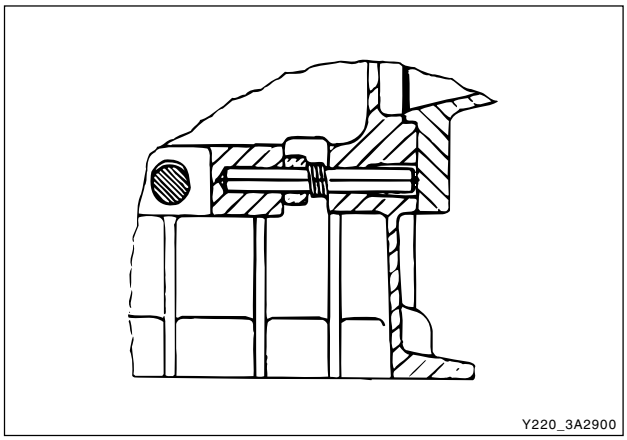

Y220_3A2640

5. Assemble the park rod lever, complete with the return spring and pivot pin, applying a small amount of sealant to the outer end of the pivot pin.

NOTICE
- **Care must be taken when applying sealant to ensure that it is not applied between the pin and the lever.**

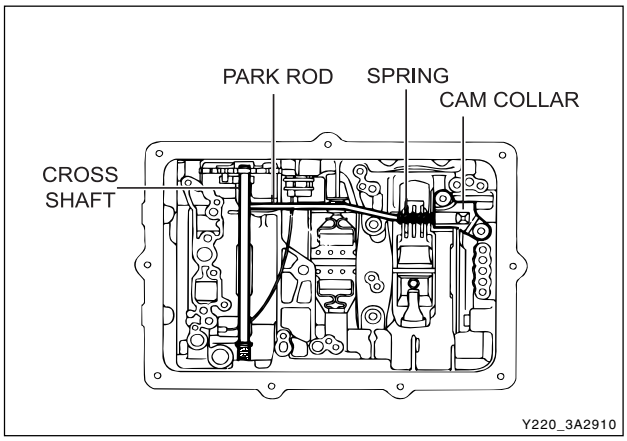
6. Secure the pivot pin with the circlip.

NOTICE
- **The lever must pivot freely on its pin and the spring must return the park rod lever to its correct location.**


Y220_3A2900

7. Install the parking pawl pivot pin and spring.

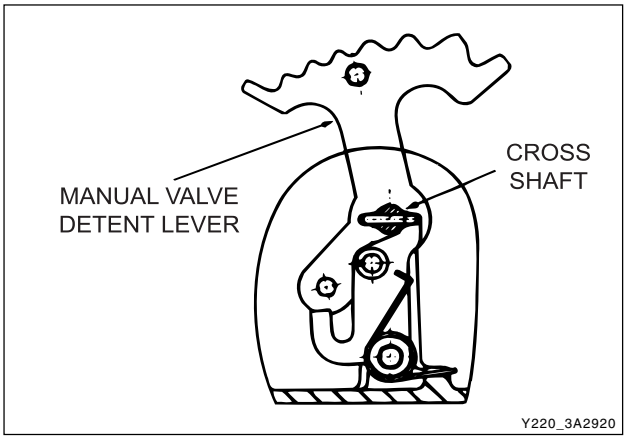
NOTICE
- **The pawl must pivot freely on its pin.**



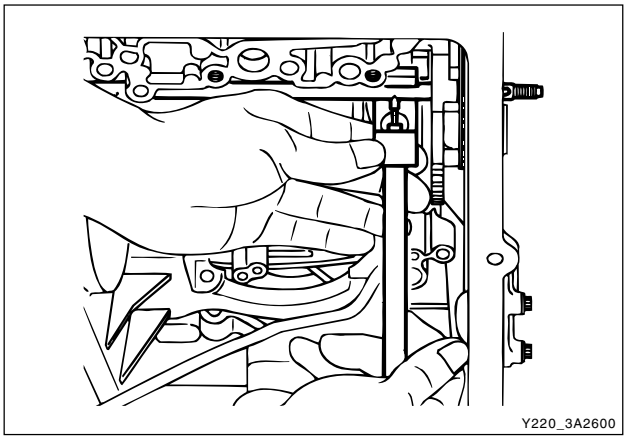
Y220_3A2910

8. Connect the park rod to the manual valve detent lever. Ensure the spring and cam collar is firmly installed on the rod.
9. Check that the cam collar slides freely on the rod.
10. Insert the cross shaft into the case, from the side opposite to the inhibitor switch, then install the antirattle spring on the shaft.

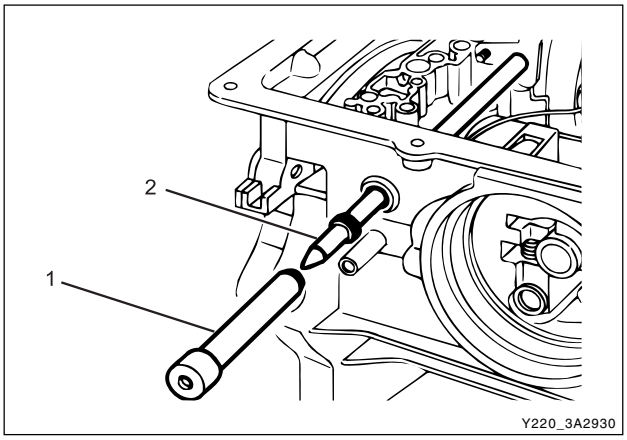
11. Poition the manual valve detent lever, aligning it with the cross-shaft bore in the case.
12. Push the shaft through the detent lever until it starts in the detent lever side of the case.



13. Install the detent lever drive pin in the shaft using cross shaft pin remover/installer (detent lever) 0555-336258 with the adaptor over the pin.
14. Press the pin into the shaft until the tool bottoms.
15. Remove the tool and fit the spring retaining circlip to the shaft.



16. Install the new cross shaft seals using cross shaft seal installer 0555-336262 (1) and cross shaft bullet 0555-336263 (2).

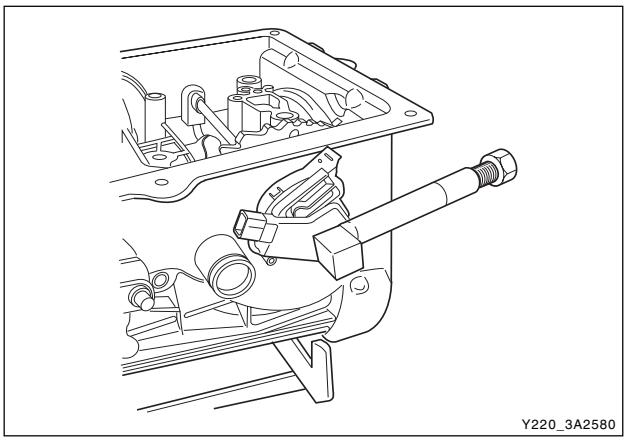


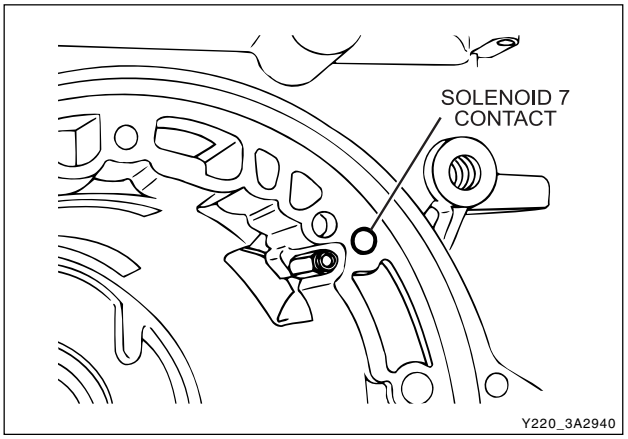
17. Install the inhibitor switch on the case. Torque the bolts as per specifications. Press the pin into the shaft until the tool bottoms using cross shaft pin installer/remover (inhibitor switch) 0555-336265.

Installation Notice

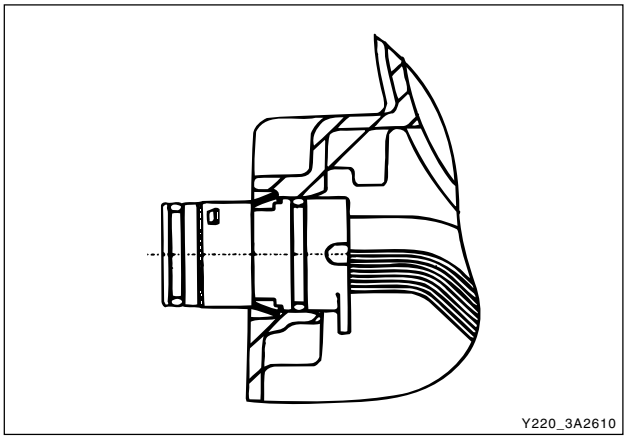
Tightening torque	4 ~ 6 Nm (35 ~ 53 lb-in)

18. Thoroughly check the terminal wiring loom for condition and continuity.

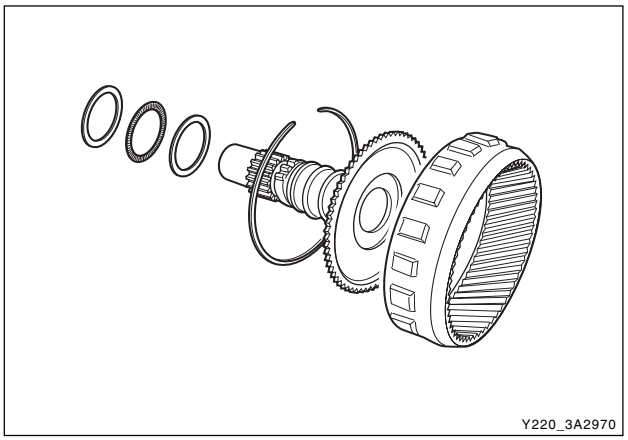




19. Position the wiring loom and locate the solenoid valve 7 contact and terminal in the pump mounting flange at the front of the case. The solenoid valve 7 wire is routed under the park rod and cross shaft in the case.

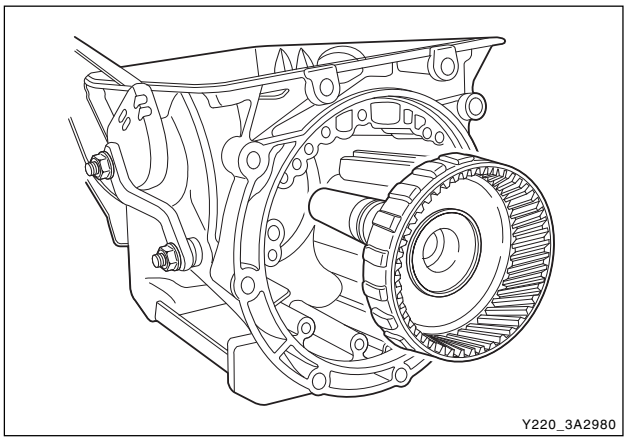


20. Install the 10 pin connector in the case engaging the tangs on the connector in the notches in case.



Output Shaft and Gear Assembly

1. Check that the output shaft bush is not worn or damaged. Replace if necessary.
2. Check for damage to parking pawl teeth on the ring gear. Replace if necessary.
3. Check that the sealing ring grooves have not been damaged.
4. Lubricate the sealing rings with automatic transmission fluid.
5. Assemble the sealing rings to the output shaft with the scarf cut uppermost.
6. If previously dismantled, assemble the ring gear to the output shaft and secure with circlip. Ensure that the circlip is firmly seated in its groove.
7. Install the No. 10 needle bearing assembly onto the output shaft using petroleum jelly.
8. Carefully install the output shaft assembly in the case to prevent damage to the sealing rings.

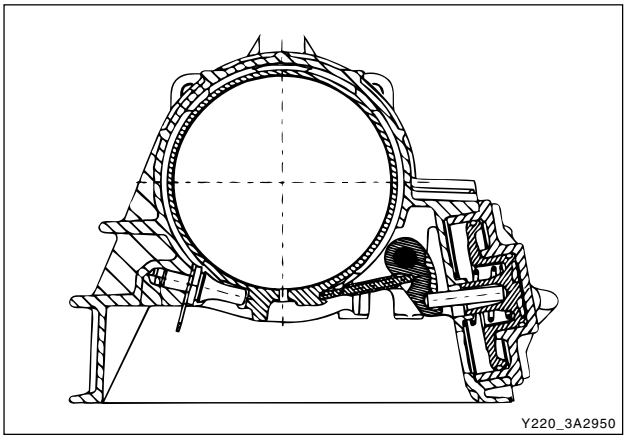


Rear Band Assembly

1. Check the rear band for any cracks or damage along the lining and metal backing.
2. Install the reaction anchor strut into the main case, without shims.
3. Carefully install the rear band into the transmission case and ensure that it is properly fitted in the case.

NOTICE

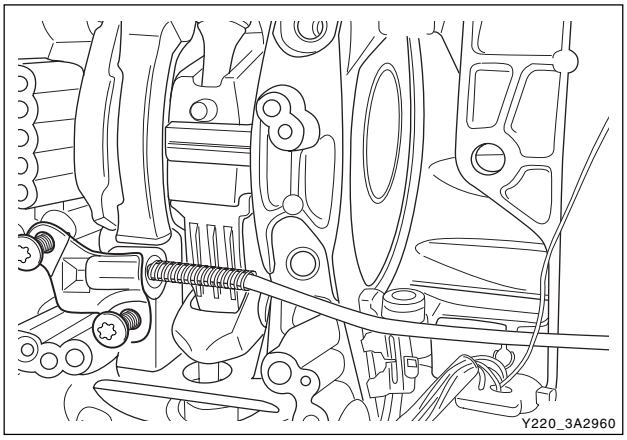
- **If fitting a new band, soak the new band in automatic transmission fluid for a minimum of five minutes prior to assembly.**


Y220_3A2950

4. Position the apply strut on the rear band then engage the apply strut in the servo lever.
5. Install the cam plate and tighten the screws to specification.

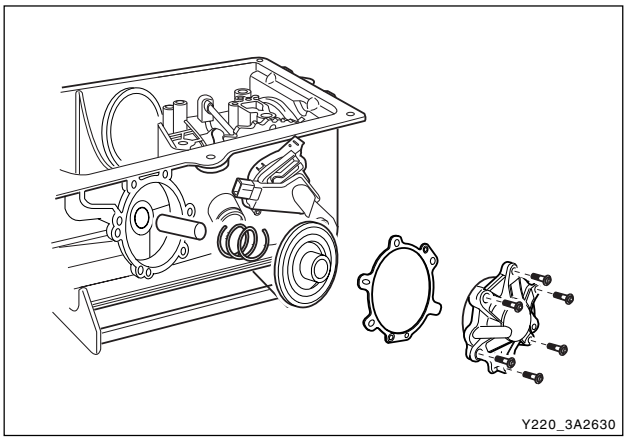
Installation Notice

Tightening torque	16 ~ 22 Nm (12 ~ 16 lb-ft)


Y220_3A2960

Rear Servo Assembly

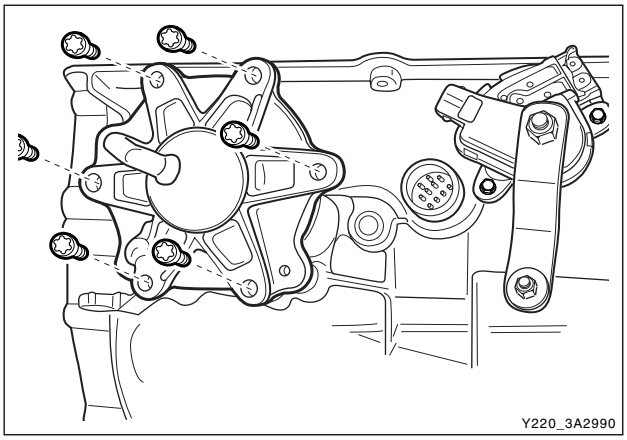
1. Check the servo piston “O” rings and gasket for any damage.
2. Lubricate the servo piston “O” rings with automatic transmission fluid, and fit the “O” rings to the piston grooves.
3. Assembly the piston to the cover, ensuring that “O” ring compression is adequate but not excessive.
4. Align the spring on the piston spigot, then position the rear servo rod into the spigot.


Y220_3A2630

5. Assemble the gasket to the cover and fit the assembly to the case.

NOTICE

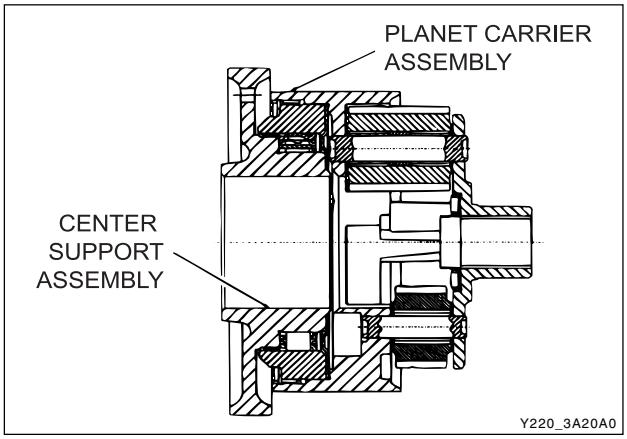
- **Do not use petroleum jelly on the gasket.**


Y220_3A2990

6. Apply additional Loctite 202 or equivalent as required to the rear servo to case bolts. Install the bolts and tighten to specification.

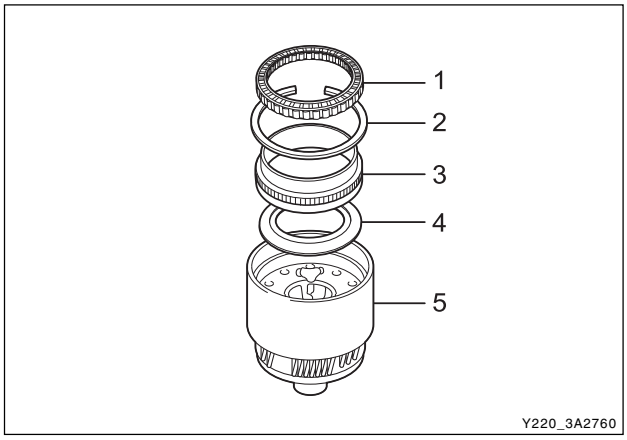
Installation Notice

Tightening torque	30 ~ 35 Nm (22 ~ 26 lb-ft)

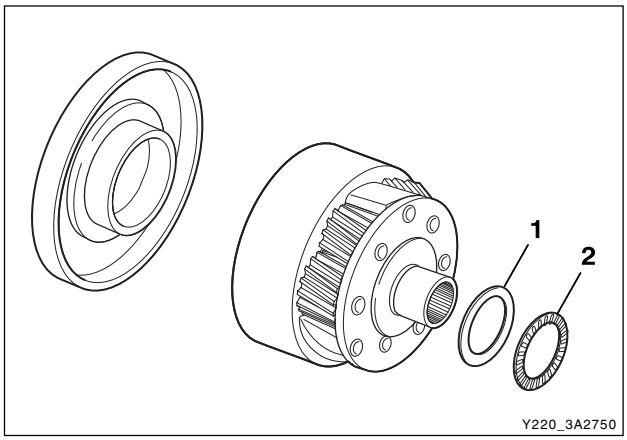


Planet Carrier Assembly and Centre Support

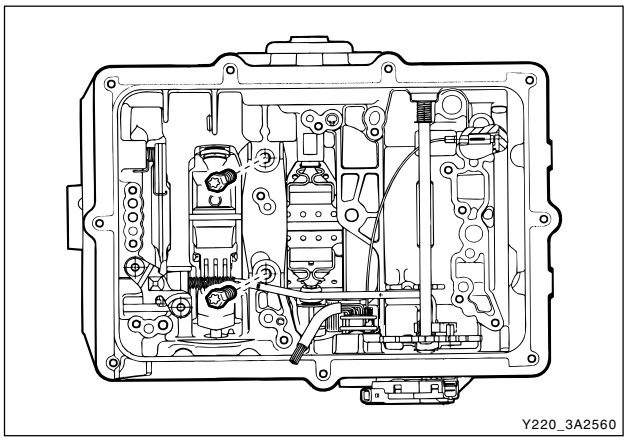
1. Check the carrier and planet assembly for any damage or irregularity and ensure that all pinions rotate freely and that the pinion end float is within 0. 10 mm ~ 0.50 mm.



2. Install the One Way Clutch (OWC) retainer (1) to the planet carrier with the inner edge pointing downwards. Inspect the OWC race and the sprag assemblies for wear or damage. Replace if necessary.
3. Install the outer (3) race in the drum. Press the race to the bottom of the drum and install the retaining circlip (2). Ensure the circlip is firmly seated in its groove.
4. Install the OWC (1) into the outer race with the lip edge uppermost. Lubricate the sprags with automatic transmission fluid.



5. Check that the plugs are fitted to the centre support, then assemble the centre support into the OWC, ensuring that the support will rotate in an anti-clockwise direction only.
6. Lubricate the No. 9 needle bearing and washer with petroleum jelly and fit them to the rear face of the planet carrier.



7. Install the planet assembly and the centre support into the case, and align the centre support mounting bolt holes.
8. Install the centre support bolts finger tight.
9. Install the circlip retainer ensuring that the circlip is completely seated in the groove of the case.
10. Remove the centre support bolts and apply Loctite 222 or equivalent to the threads. Install the bolts and torque to specifications.

Installation Notice

Tightening torque	20 ~ 27 Nm (15 ~ 20 lb-ft)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Adaptor Housing Assembly

1. Install a new seal to the adaptor housing.
2. Position a new gasket onto the adaptor housing.

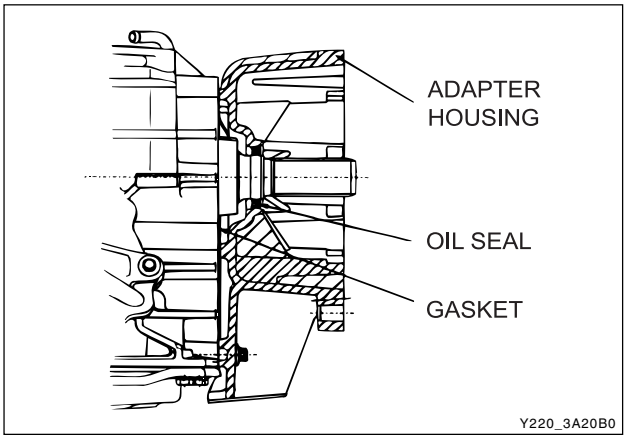
NOTICE

- **Do not use petroleum jelly to hold the gasket in position.**

3. Apply additional Loctite 202 or equivalent as required to the adapter housing bolts. Install the adaptor housing and torque the bolts to specification.

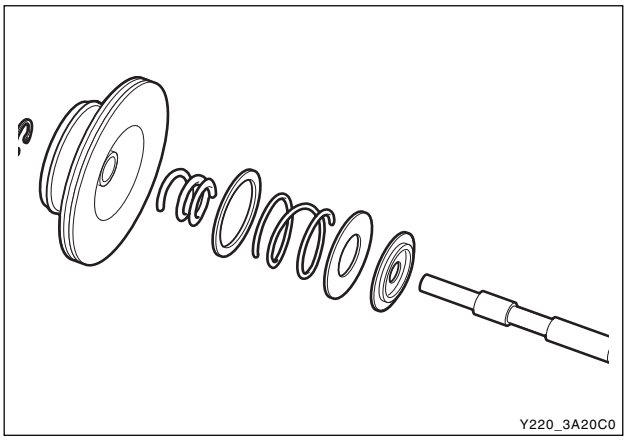
Installation Notice

Tightening torque	30 ~ 35 Nm (22 ~ 26 lb-ft)

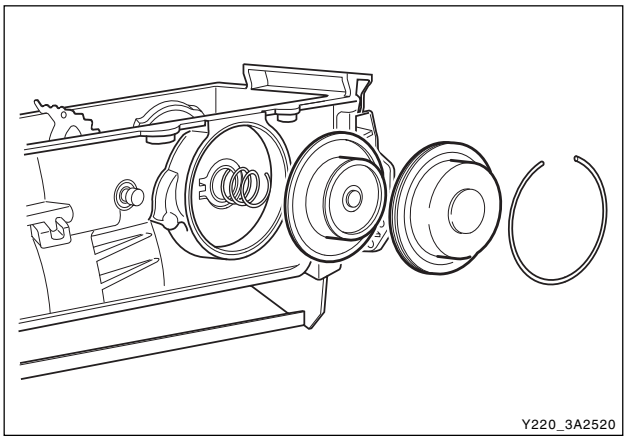


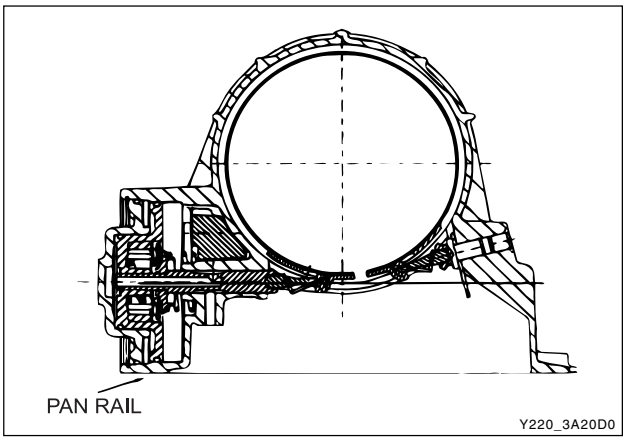
Front Servo Assembly

1. Lubricate the cover “O” ring with automatic transmission fluid and fit to the cover.
2. Lubricatethepiston “O” rings with automatic transmission fluid and fit to the piston.
3. Assemble the piston, push rod, spring, belleville washer, seat and retaining ring.
4. Fit the piston push rod assembly into the front servo cover.

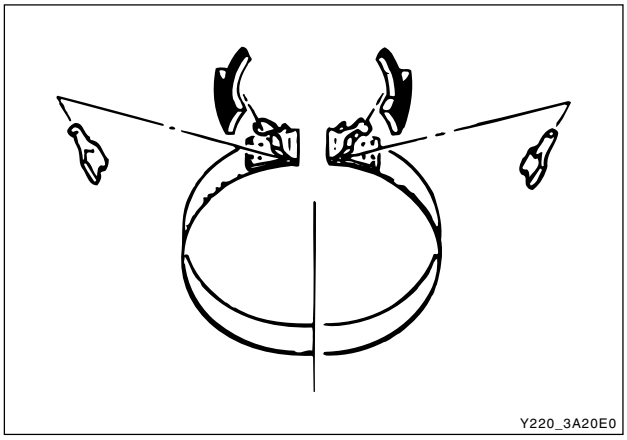


5. Install the front servo block and spring into the case.
6. Install the front servo assembly into the case.



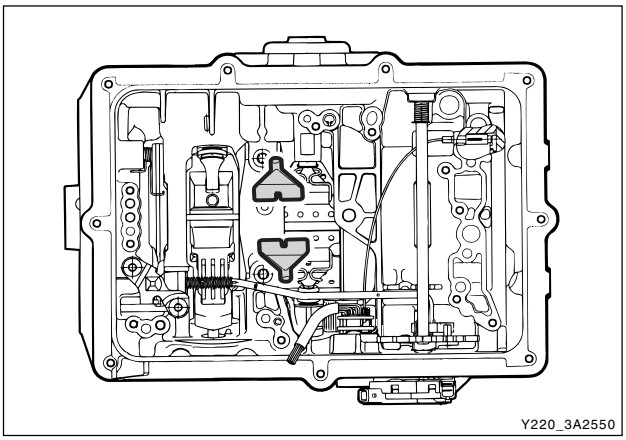


7. Compress the servo cover and fit the servo cover retaining circlip, aligning the gap with the pan rail, and ensuring that it is completely seated in its groove.



Front Band Assembly

1. Install the reaction anchor strut to the case.
2. Check the band for all cracks or damage along its lining and metal backing.
3. Position the strut retainers on the band.



4. Install the front band into the transmission case, ensuring that it is properly seated in place.

NOTICE

- **If fitting a new band, soak the band in automatic transmission fluid for a minimum of 5 minutes prior to assembly.**

5. Position the reaction strut in its retaining clip and engage it with the band and anchor strut.
6. Position the apply strut in its retaining clip and engage it with the band and the servo piston rod.

C2/C4 Clutch Assembly

Tools Required

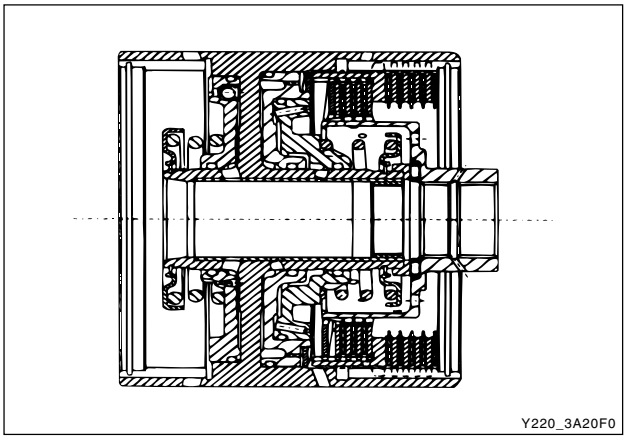
0555-336259 Clutch Spring Compressor

0555-336260 Clutch Pack Clearance Kit

NOTICE

- **Check pistons for cracks.**
- **Do not mix the clutch piston return springs.**
- **Ensure that the snap rings are fitted correctly.**

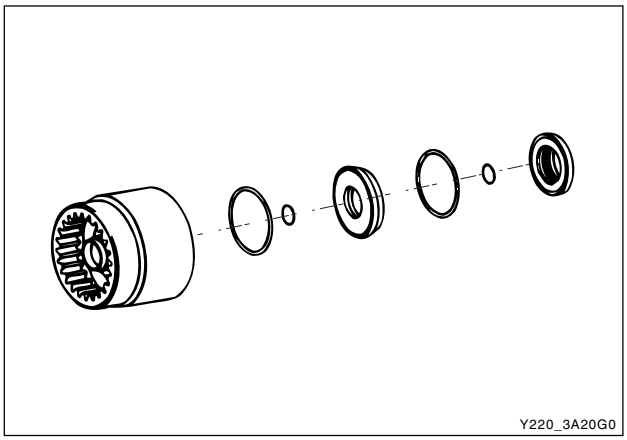
1. Check the feed orifices in the cylinder bore are clear of obstructions.
2. Check the C2 piston bleed orifices are clear of obstructions.
3. Lubricate the “O” rings with Automatic Transmission Fluid (ATF)
4. Fit the small “O” ring onto the inner groove, and the large “O” ring onto the outer groove of the piston.

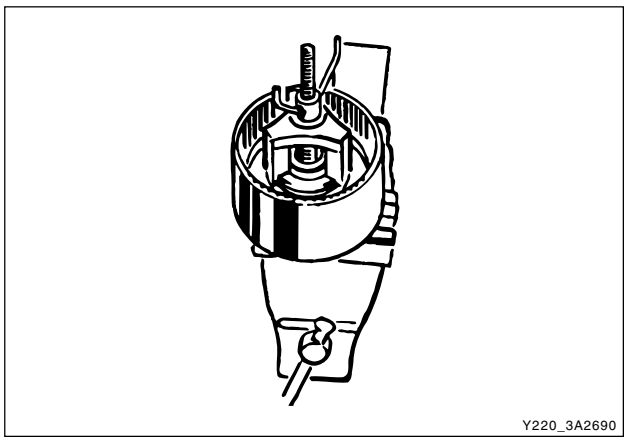


NOTICE

- **“O” rings must not be twisted in the grooves.**

5. Check the C4 piston bleed orifices are clear of obstructions.
6. Lubricate the “O” rings with ATF.
7. Fit the small “O” rings onto the inner groove and the large “O” rings onto the outer groove of the piston.
8. Position the clutch cylinder with the C2/C4 cavity facing upwards.
9. Fit the C4 piston into the C2 piston with the bleed orifices in alignment.
10. Install the C2/C4 piston assembly into the cylinder, with the piston bleed orifices aligned with the holes on the outside of the cylinder, until the outer diameter of the C2 piston enters the inner diameter of the cylinder.



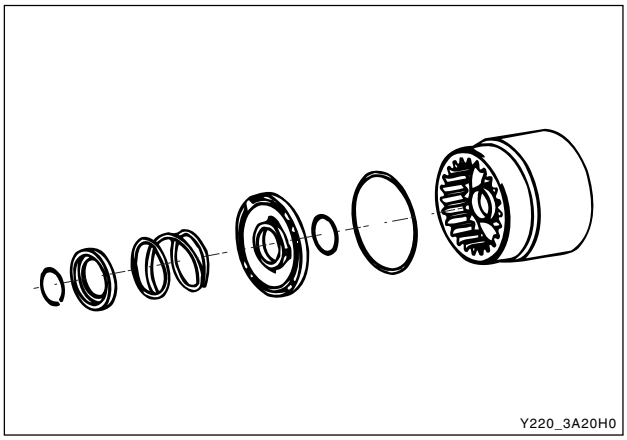

Y220_3A2690

11. Assemble the piston return spring to the piston, and fit the spring retainer over the spring.
12. Using 0555-336259 clutch spring compressor, compress the spring sufficiently to enable the installation of the retaining circlip ensuring that the circlip is firmly seated in its groove, then remove the tool.

NOTICE
- **The wire diameter of this spring is 4.3 mm.**

13. Check the C1 piston check valves are not damaged and are free to move, and that the cylinder feed orifices are clear of obstructions.
14. Lubricate the “O” rings with ATF and fit them to their respective grooves.

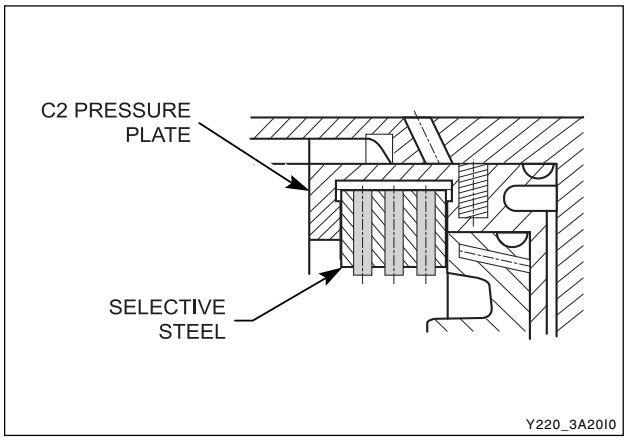
NOTICE
- **“O” rings must not be twisted in the grooves.**


Y220_3A20H0

15. Position the cylinder with the C1 cavity upwards. Install the piston into the cylinder until the outer diameter of the piston enters the inner diameter of the cylinder.
16. Install the spring and spring retainer onto the piston.
17. Using 0555-336259 clutch spring compressor, compress the spring sufficiently to enable the installation of the retaining circlip ensuring that the circlip is firmly seated in its groove, then remove the tool.

NOTICE
- **The wire diameter of this spring is 5.26 mm.**

18. Install the C2 wave washer into the cylinder with the crest of one wave covering one of the bleed orifices inthe C2 piston.

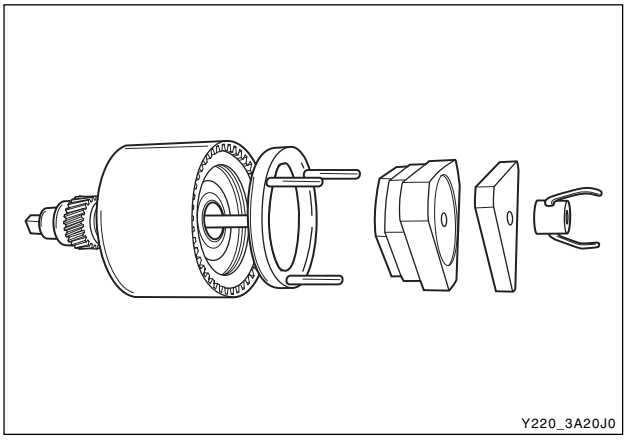


Y220_3A20I0

19. Measure and record the thickness of the flange of the C2 sleeve.
20. Install the C4 clutch plates and wave washer into the C2 actuating sleeve, with the rounded edge of the steel plates down, in the following sequence:
    - Steel plate (selective)
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Wave washer

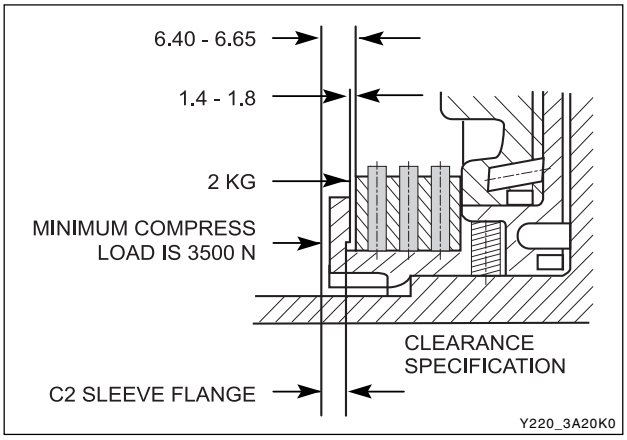
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AFFECTED VIN	

21. Holding the cylinder horizontal, install the sleeve and clutch plate assembly into the cylinder, with the crest of one wave of the washer in line with one of the holes in the outside of the cylinder, until the sleeve contacts the C2 wave washer.
22. Check the C4 clutch pack clearance using 0555-336260 clutch pack clearance kit.



NOTICE

- **With the C2 wave spring compressed, and the clutch Pack supporting a 2 kg weight, the dimension from the underside of the C2 pressure plate to the selective steel is to be between 1.4 ~ 1.8 mm. If the clutch is to be gauged from the top of the pressure plate, then the dimension is to be the actual thickness of the pressure plate plus 1.4 ~ 1.8 mm.**

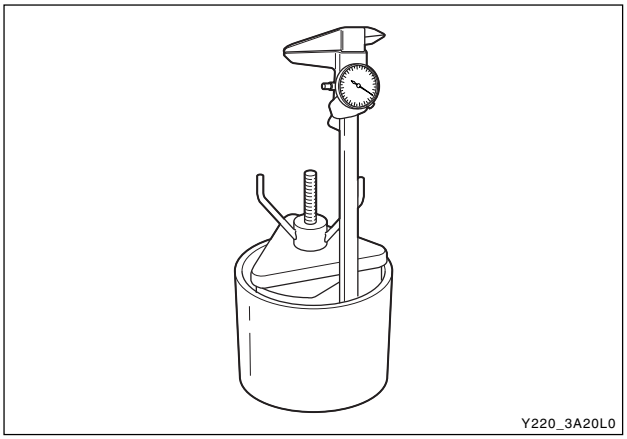


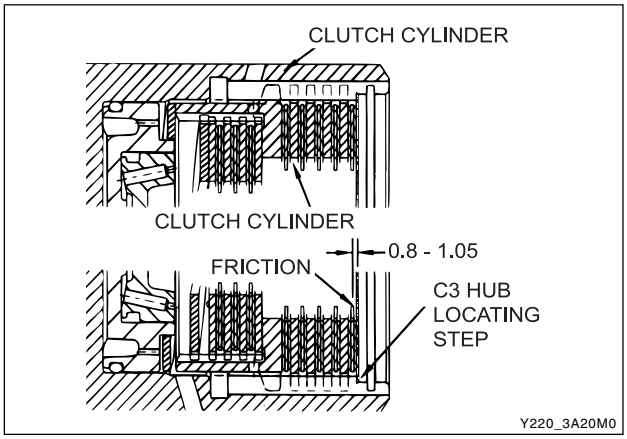
23. Use selective plates to achieve the correct specification. If new friction plates are being fitted, remove the clutch pack and soak the friction plates in ATF for a minimum of 5 minutes prior to reassembly.

NOTICE

- **The clutch pack clearance must be taken before the elements are soaked in ATF.**

24. Reassemble the sleeve and clutch pack into the cylinder. Observe the alignment of the wave washer to the hole in the cylinder.
25. Install the C2 clutch plates in the cylinder in the following sequence:
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Steel plate (0574-000013, `014, `015, `016, `019, `022), or Friction disc (0574-000012 & `017)
    - Steel plate (selective)
    - Friction disc
    - Steel plate (selective)
    - Friction disc





26. Check the clutch pack clearance using only the weight from 0555-336260 clutch pack clearance kit.

NOTICE

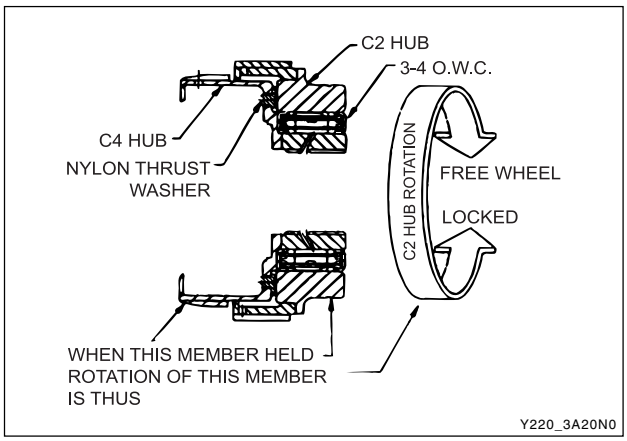
- **With the clutch pack supporting a 2 kgweight, the dimension from the C3 clutch hub locating step to the friction plate is to be between 0.80 ~ 1.05 mm.**

27. Use selective plates to achieve the correct specification. If new friction plates are being fitted, remove the clutch pack and soak the friction plates in ATF for a minimum of 5 minutes prior to reassembly.

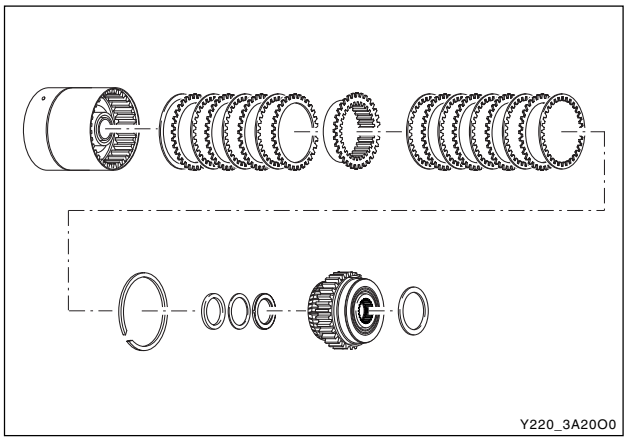
NOTICE

- **The clutch pack clearance must be taken before the elements are soaked in ATF.**

28. Lubricate and fit the 3-4 OWC and end caps to the C2 hub.



29. Align the tangs and fit the nylon thrust washer onto the C4 hub.
30. Align and fit the C4 hub to the C2 clutch and the OWC assembly.
31. Check the rotation of the C2 hub. While holding the C4 hub, the C2 hub should rotate in the clockwise direction and lockup in the anti-clockwise direction when viewed from the C2 hub.



32. Apply petroleum jelly to the No. 5 needle bearing and fit it to the C4 hub.
33. Remove the C2 clutch plates from the clutch cylinder.
34. Fit the thrust plate over the cylinder inner hub.
35. Engage the C2/C4 clutch hub assembly in the C4 clutch plates.
36. Install the C2 clutch plates.
37. Install the C3 hub and secure it with the circlip, ensuring that the circlip is firmly seated in its groove.

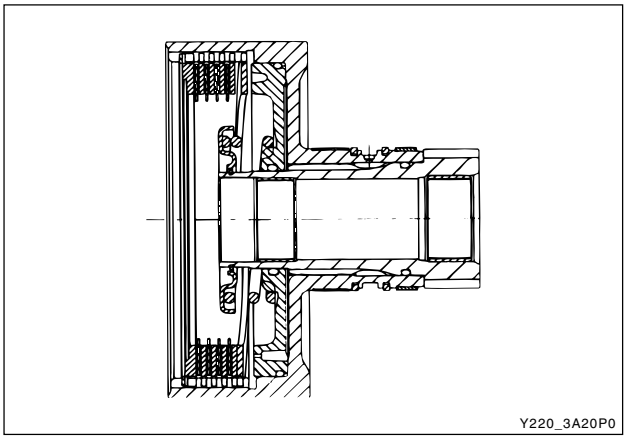
C3 Clutch and Reverse Sun Gear Assembly

Tools Required

0555-336259 Clutch Spring Compressor

0555-336260 Clutch Pack Clearance Kit

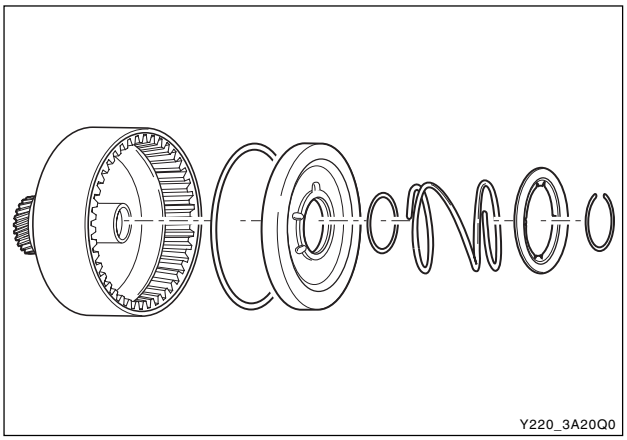
1. Check the orifices in the cylinder are clear of obstructions.
2. Check the C3 cylinder bush outside diameter and the centre support inside diameter are in good condition and not damaged. Coat the sealing rings with automatic transmission fluid and fit into the C3 cylinder grooves.
3. Check the reverse sun gear splines, grooves and thrust face for condition. Coat the "O" ring with automatic transmission fluid and fit it to the groove of the reverse sun gear.
4. Lubricate the C3 washer with petroleum jelly and fit to the inner face of the reverse sun gear.
5. Install the reverse sun gear in the C3 cylinder, ensuring that the "O" ring compression is adequate but not excessive.



NOTICE

- **"O" rings must not be twisted in the grooves.**

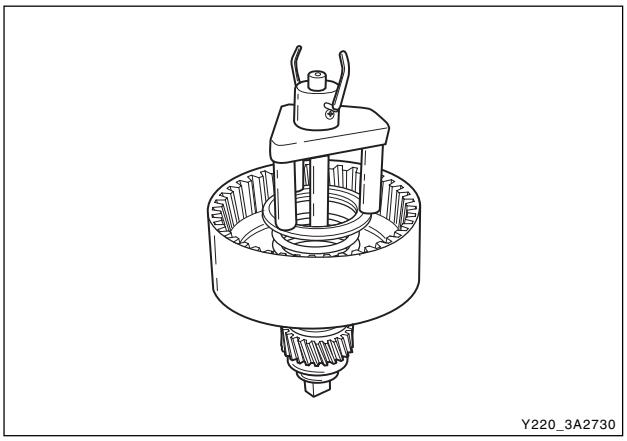
6. Coat the C3 piston "O" rings with automatic trans-mission fluid and fit the small "O" ring onto the inner ring and the large "O" ring onto the outer ring of the C3 piston.
7. Check that the bleed orifices of the piston are clean and clear of obstructions.
8. Install the C3 piston in the cylinder until the outside diameter of the piston enters the inside diameter of the cylinder.

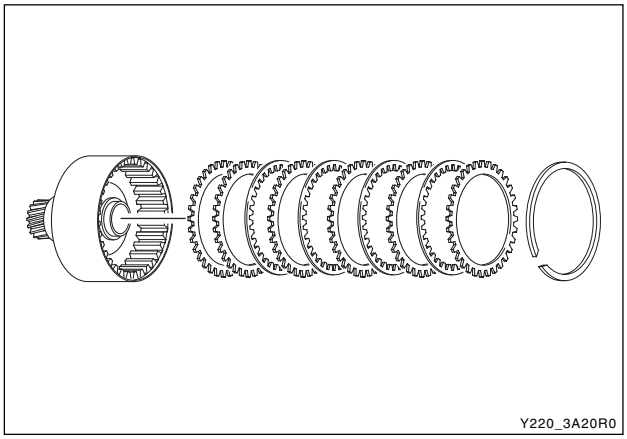


NOTICE

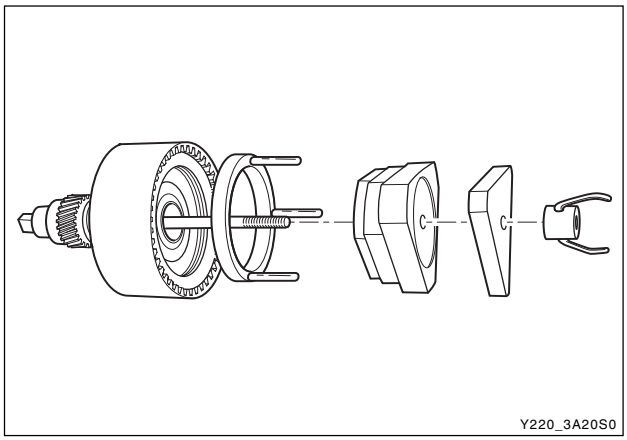
- **Take care not to cut the "O" ring.**

9. Assemble the spring and spring retainer on the piston. Using 0555-336259 clutch spring compressor compress the spring sufficiently to enable the installation of the retaining circlip, ensuring that the circlip is firmly seated in the groove, and remove the tool.
10. Fit the C3 wave plate to the C3 piston face, ensuring that one crest of the wave plate of the C3 piston face is aligned over one of the piston orifices.

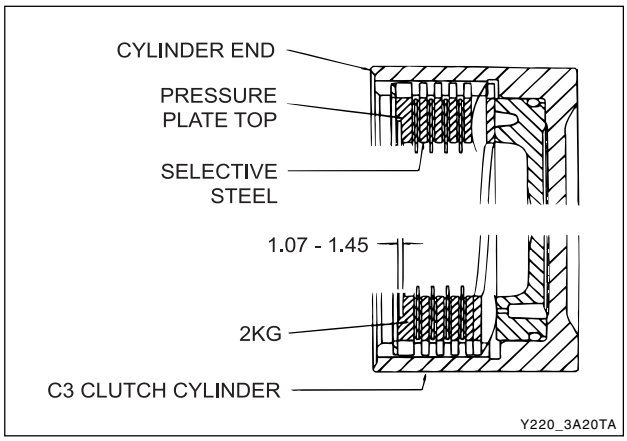



Y220_3A20R0

11. Assemble the clutch plates and discs into the cylinder in the following sequence :
    - Steel plate
    - Friction disc
    - Steel plate
    - Steel plate (0574-000013, `014, `015, `016, `019, `022), or Friction disc (0574-000012, `017)
    - Steel plate (selective)
    - Friction disc
    - Steel plate (selective)
    - Friction disc
12. Align and fit the pressure plate with the counterbore facing away from the clutch plates.


Y220_3A20S0

13. Install the circlip.
14. Check the C3 clutch clearance using 0555-336260 clutch pack clearance kit in the following manner (weight only).
    a. Place the weight on the pressure plate and measure the distance from the end of the cylinder to the top of the pressure plate.
    b. Record this figure.
    c. Remove the weight.
    d. Lift the pressure plate up against the circlip and measure the distance from the end of the cylinder to the top of the pressure plate.
    e. Record this figure.
    f. Subtract the second reading from the first reading to obtain the clutch pack clearance.



Y220_3A20TA

NOTICE

- **With the clutch pack supporting a weight of 2kg, the clearance between the snap ring and the top of the pressure plate is to be between 1.07 ~ 1.45 mm.**

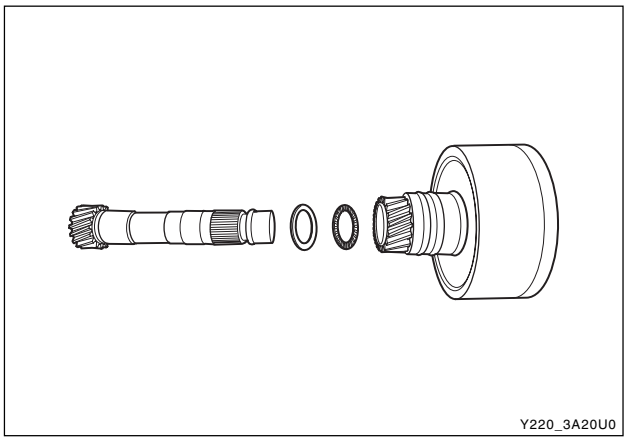
15. If new friction plates are being fitted, remove the clutch pack and soak the friction elements in automatic transmission fluid for a minimum of five minutes prior to reassembly.

NOTICE

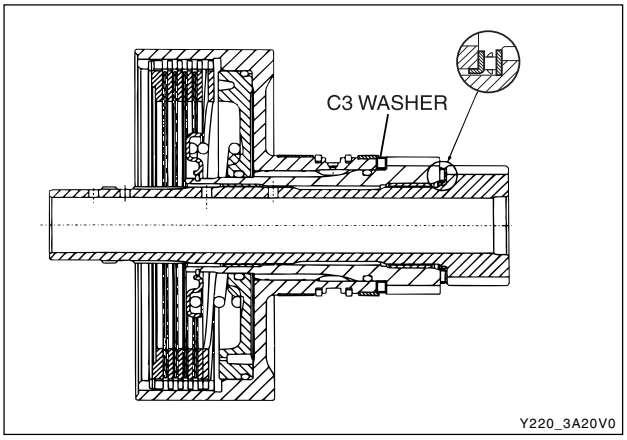
- **The clutch pack clearance must be taken before the elements are soaked in automatic transmission fluid.**

Forward Sun Gear and C3 Clutch Pack Assembly

1. Fit the No.7 needle bearing assembly over the forward sun gear, ensuring that the thrust washer is between the bearing and the sun gear.
2. Lubricate the lipped thrust plate with petroleum jelly and fit the thrust plate onto the reverse sun gear.

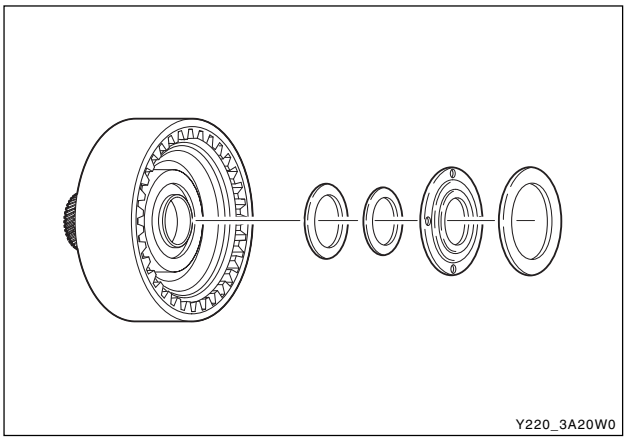

Y220_3A20U0

3. Align and fit the C3 clutch assembly over the forward sun gear.



Y220_3A20V0

4. Lubricate the No.6 needle bearing with petroleum jelly and fit it to the thrust plate. Ensure the lugs on the outside diameter of the bearing fit in the thrust plate counterbore.
5. Align and fit the plastic thrust washer to the thrust plate with petroleum jelly.
6. Install the assembly over the forward sun gear shaft against the No. 6 needle bearing.
7. Place the assembly to one side.


Y220_3A20W0

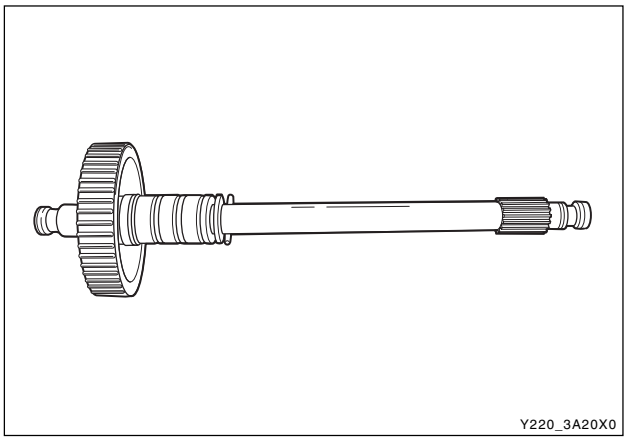
C1 Clutch Overdrive Shaft and Input Shaft Assembly

Tools Required

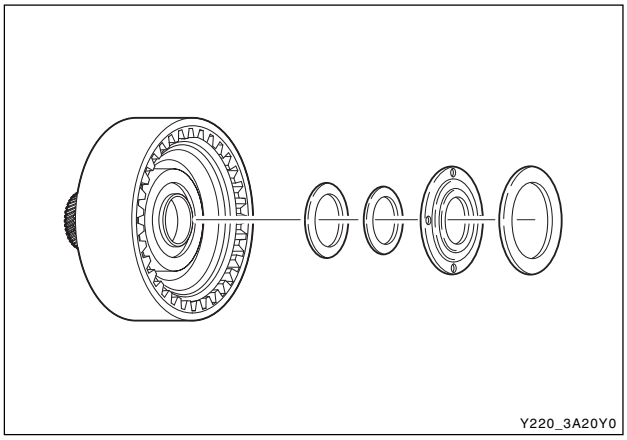
0555-336260 Clutch Pack Clearance Kit

NOTICE

- **Ensure that the snap rings are fitted correctly.**
- **Check pistons for cracks, especially the C1 piston.**
- **Do not mix clutch piston return springs.**
- **If the C1/C2 clutch packs separate from the C3 clutch pack, make sure the No. 6 bearing doesn't drop out of the bearing retainer.**



1. Check the overdrive shaft grooves for any defect.
2. Coat the sealing rings, large and small, with petroleum jelly and fit them to the overdrive shaft. The sealing rings may be held in place with a small amount of petroleum jelly.



3. Assemble the clutch plate and disc into the cylinder in the following sequence:
   - Steel plate
   - Friction disc
   - Steel plate
   - Friction disc
   - Steel plate
   - Steel plate (0574-000013, `014, `015, `016, `019, `022), or friction disc (0574-000012 & `017)
   - Steel plate (selective)
   - Friction disc
   - Steel plate (selective)
   - Friction disc

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Check the clutch pack clearance using 0555-336260 clutch pack clearance kit.
5. Use selective plates to achieve the correct specifi-cation.

NOTICE

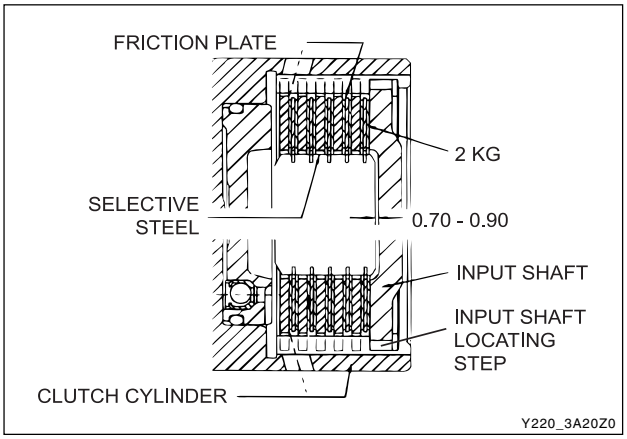
- **With the clutch pack supporting a 2 kg weight, the dimension from the input shaft locating stop to the friction disc must be 0.70 ~ 0.90 mm.**

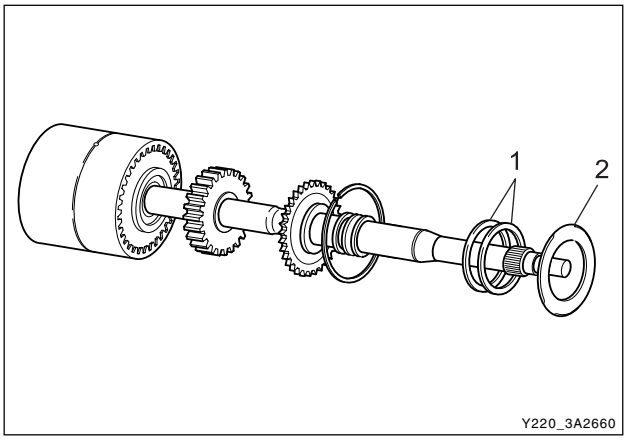
6. If new friction plates are being fitted, remove the clutch pack and soak the friction elements in automatic transmission fluid for a minimum of five minutes prior to assembly.

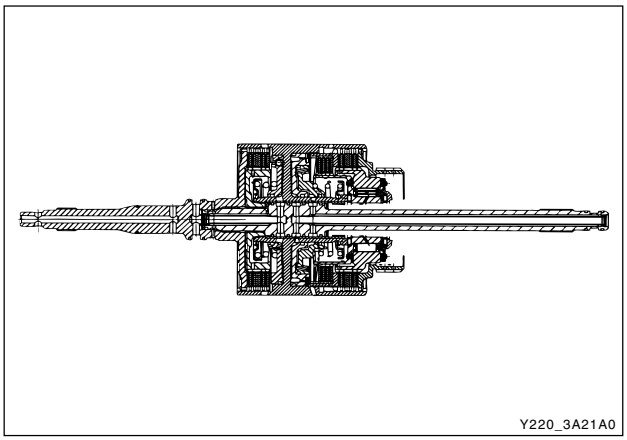
NOTICE

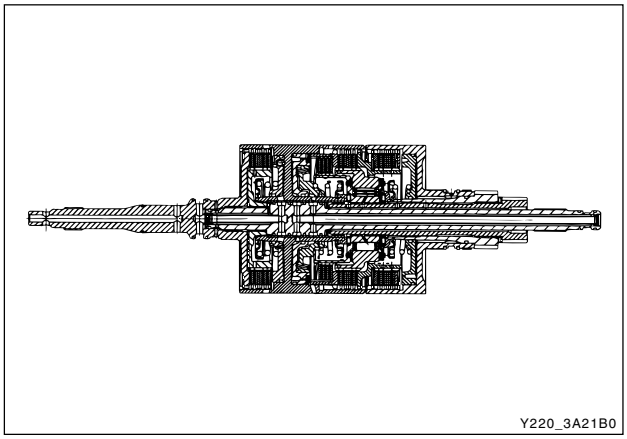
- **The clutch pack clearance must be taken before elements are soaked in automatic transmission fluid.**

7. Check the fit of the C1 clutch hub on the overdrive shaft. If it is loose, the hub and shaft assembly must be replaced.
8. Coat the small nylon thrust spacer with petroleum jelly and install it over the overdrive shaft.
9. Carefully fit the overdrive shaft into the C1 cylinder so as not to damage the sealing ring.
10. Fit the small bronze C1 hub thrust washer in place with petroleum jelly.
11. Check the input shaft for any defect. Fit the input shaft into the cylinder and secure it with the circlip, ensuring that the circlip is completely seated in the groove.
12. Coat the sealing rings with petroleum jelly and fit onto the input shaft.







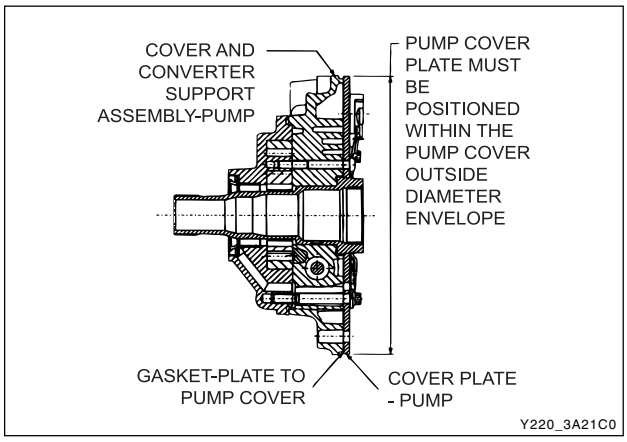

Y220_3A21B0

13. Assemble the C1/C2/C4 clutch assembly to the C3 clutch and sun gear assembly.
14. Install this assembly in the transmission case.

Pump Cover and Converter

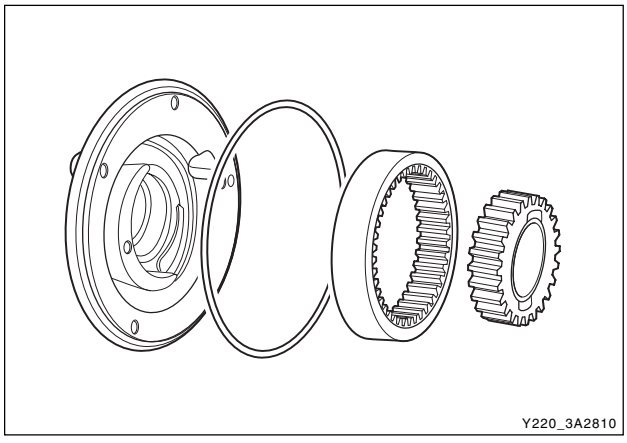
NOTICE

- **Do not wash the nose of solenoid valves in solvent.**
- **Ensure that the correct “O” ring is fitted for the application.**
- **Be careful not to damage the needle bearings on the assembly. Avoid any axial impact loads during assembly.**
- **Check the transmission end float. This will help to detect any missing parts or incorrect assembly.**



Y220_3A21C0

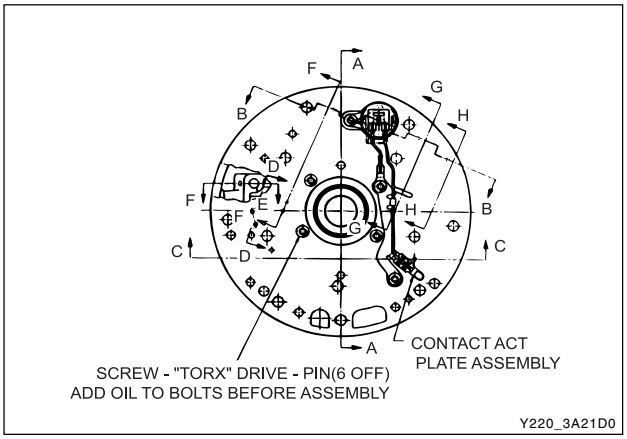
1. Check the pump body for any damage, chips or irregularity. Check that the bush is firmly staked in the drive gear.
2. Install the seal flush with the front face of the pump body.
3. Lubricate the pump bush, and the drive and driven gears, with automatic transmission fluid.


Y220_3A2810

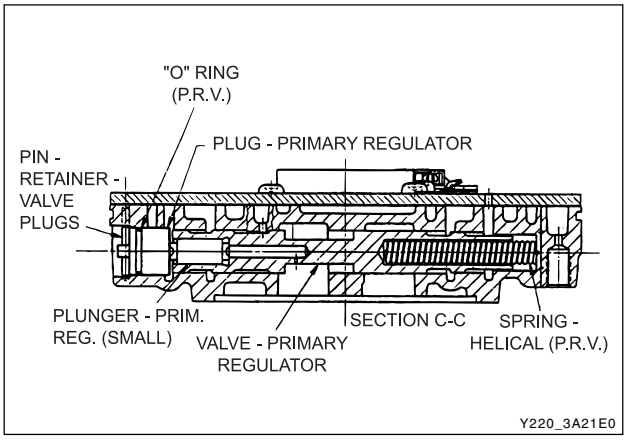
4. Install the pump driven gear and the pump drive gear into the pump body.
5. Using a straight edge and thickness gauge, check that the clearance between pump face and gears is 0.04 ~ 0.018 mm.
6. Lubricate the pump body “O” ring with automatic transmission fluid and fit it to the pump body. Put the pump body to one side.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

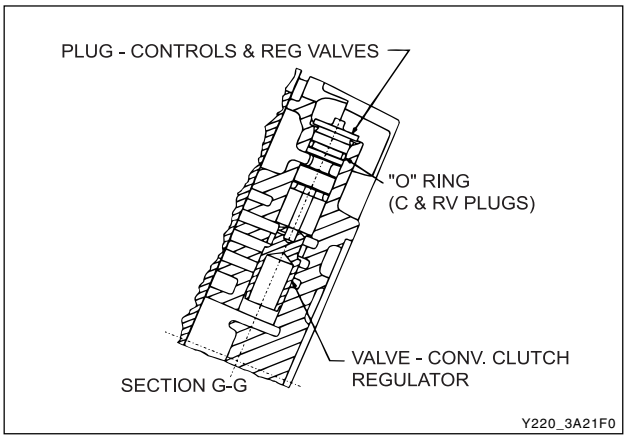
7. Ensure that the pump cover cavities, ports and holes are clean and free of any obstruction.
8. Lubricate all loose parts with automatic transmission fluid prior to assembly.



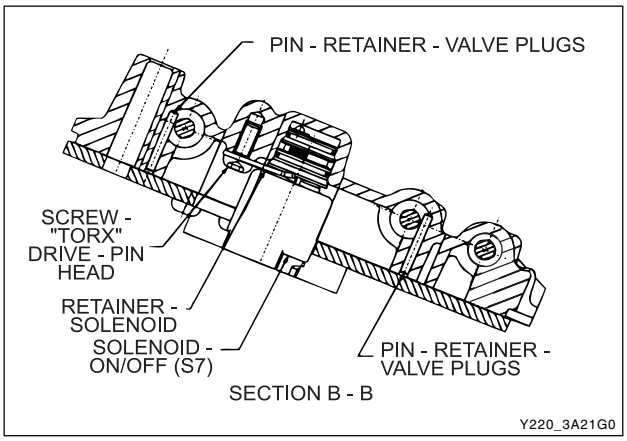
9. Assemble the primary regulator valve, spring and plunger to the pump cover, ensuring that the regulator valve slides freely, then fit the regulator valve plug and “O” ring.
10. Install the retaining pin.

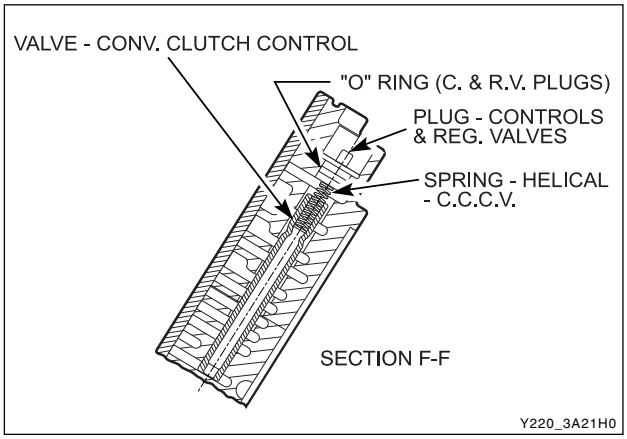


11. Install the converter clutch regulator valve, plug, spring and “O” ring.

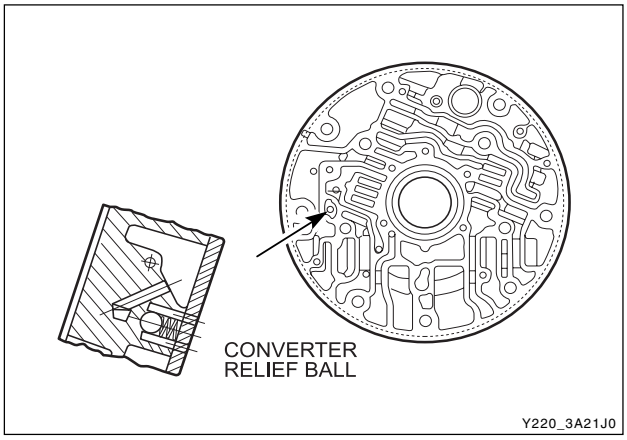


12. Install the retaining pin.

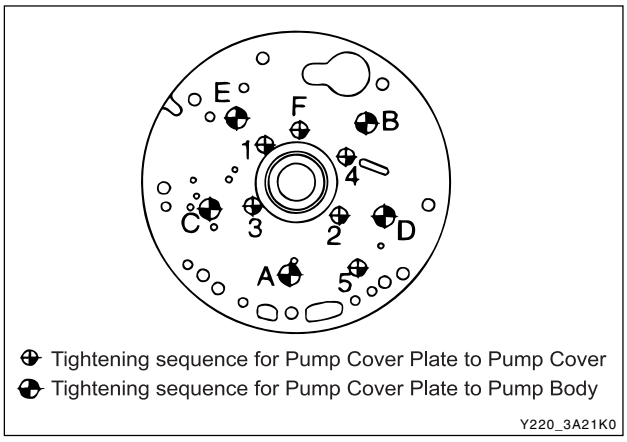




13. Install the converter clutch control valve, spring, plug, and “O” ring.
14. Install the retaining pin.



15. Install the converter release check ball and spring.
16. Install the gasket on the pump cover.



17. Install the cover plate, solenoid valve 7 with the retainer and the solenoid valve wiring retainer to the pump cover, ensuring that the periphery of the cover plate is flush with the periphery of the pump cover.
18. Tighten the screws to specification in the order. (1-5)

Installation Notice

Tightening torque	13 ~ 16 Nm (10 ~ 12 lb-ft)

19. Tighten the solenoid valve 7 screw.

Installation Notice

Tightening torque	13 ~ 16 Nm (10 ~ 12 lb-ft)

- Check that neither the wiring nor the connector protrudes excessively, in order that at assembly neither the wiring and the connector contacts or rubs on the input shaft or the C1/C2 clutch cylinder.

20. Assemble the pump to the pump cover.
21. Tighten all bolts and the crescent screw finger tight, ensuring that the pump is flush against the pump cover. Tighten the bolts and the screw to specification in the order. (A-F)

Installation Notice

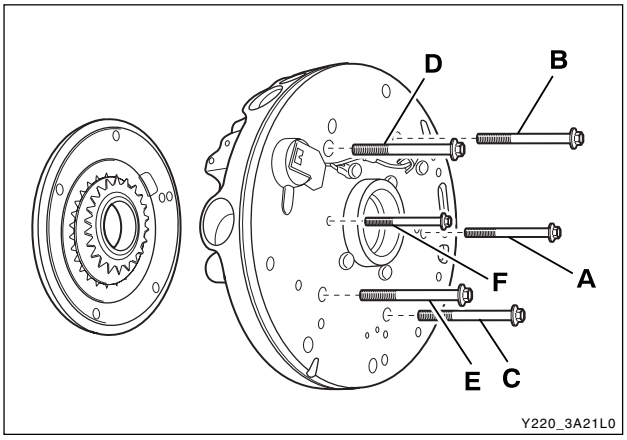
Tightening torque	Bolt (A-E): 24 ~ 27 Nm (18 ~ 20 lb-ft)
	Screw (F): 13 ~ 16 Nm (10 ~ 12 lb-ft)

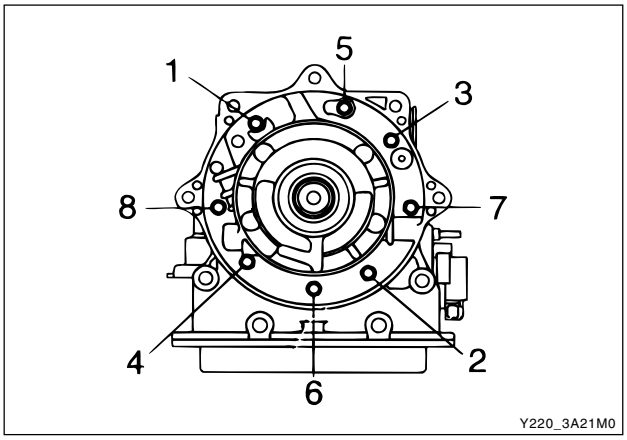
22. Install the pump to transmission case gasket onto the case.
23. Fit the “O” ring to the pump cover outer diameter.
24. Install the pump and cover assembly over the input shaft being careful not to damage the sealing rings. Apply additional Loctite 202 or equivalent as required to the pump cover to case bolts. Install and tighten bolts to specification.

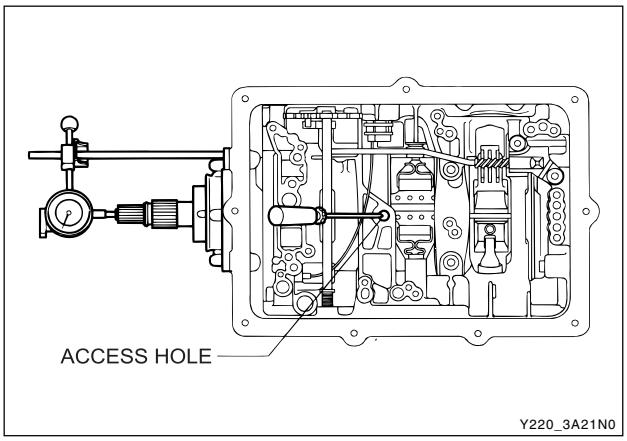
Installation Notice

Tightening torque	24 ~ 34 Nm (18 ~ 25 lb-ft)

25. Check that the transmission end float is 0.50 ~ 0.65 mm. If the unshimmed end float clearance is greater than specification, shims are to be placed between the No. 4 bearing and the input shaft bearing surface. If the end float clearance is less than 0.5 mm then the transmission has been assembled incorrectly or the parts are out of specification.
26. Perform the following steps to check the end float :
    a. Attach a dial indicator to the front of the transmission case with the stylus resting on the end of the input shaft.
    b. Apply a force of approximately 250 N or 25 kg to the input shaft.
    c. Zero the dial indicator.
    d. Place a small lever behind the forward clutch cylinder and lever the cylinder forward.
    e. The measurement recorded on the dial indicator is the transmission end float or clearance between the No.4 bearing and the converter support tube.
27. On completion of this procedure, adjust the front and rear bands to specifications. Refer to “Front and Rear Band Adjustment” in this section.



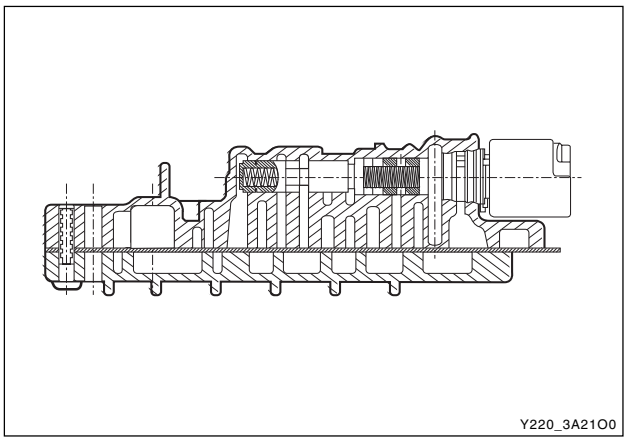




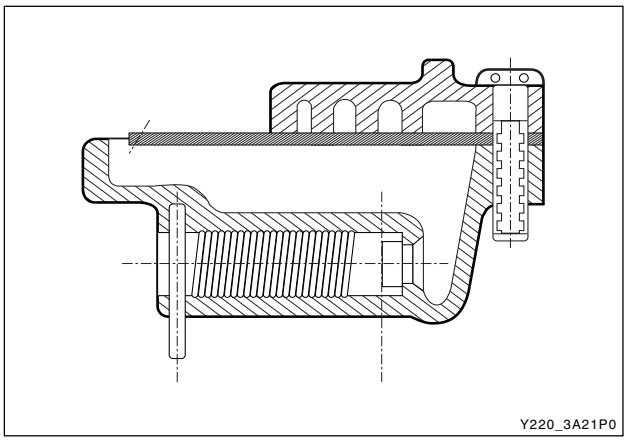
Valve Body

NOTICE

- **Do not wash the nose of solenoid valves in solvent.**
- **Be aware of ball positions in the upper valve body.**
- **Be aware of 1-2 and 3-4 shift valve positions, they can be swapped.**
- **Check the 4-3 sequence valve and spring orientation.**
- **Check that the 12 mm ball is in the lower body.**
- **Check the line pressure relief valve for swarf, and be aware of replacing the shims.**
- **When servicing the transmission, ensure that the solenoid valve 5 damper spring is not broken.**
- **Locate the detent spring central to the detent lever.**
- **Wash the upper and lower valve bodies thoroughly with cleansing solvent and blow dry.**
- **Check the valve body cavities, ports and holes for damage or obstructions.**
- **The orifices in the valve body are for stability and safeguard. Do not drill them larger.**
- **Thoroughly wash all loose components.**
- **Check that all valves slide freely in their location.**

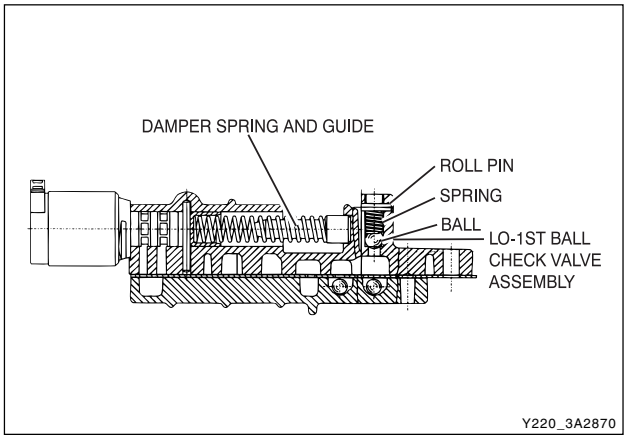


1. Install the detent lever locating pin
2. Install the Band Apply Regulator (BAR) valve, springs, plunger and retaining pin.

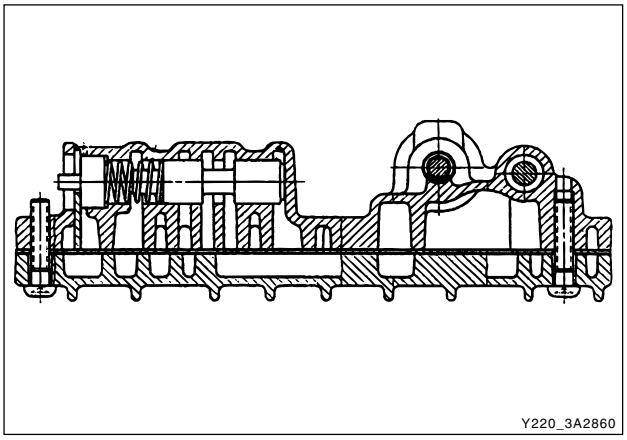


3. Install the line pressure relief valve, tapered end first, spring and disc. Secure with the retaining pin.

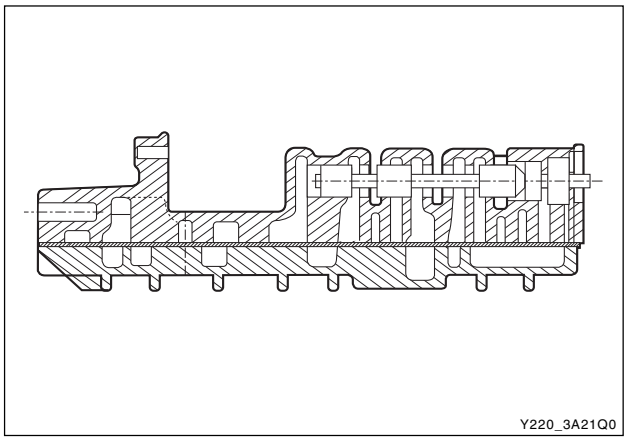
4. Install the solenoid valve 5 damper guide and spring, piston and retaining pin.



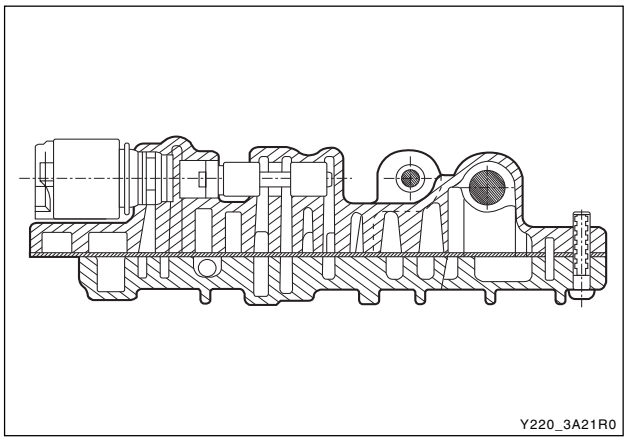
5. Install the 4-3 sequence valve, spring, plug and retaining plate.

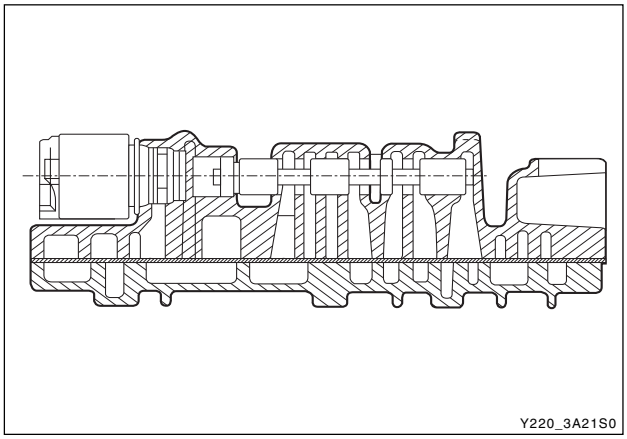


6. Install the 1-2 shift valve, plug and retaining pin.

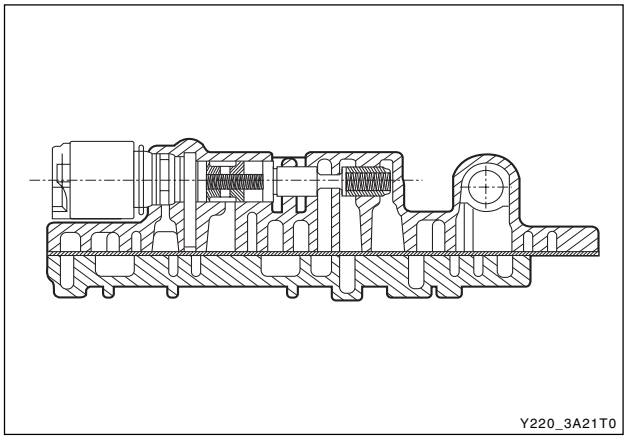


7. Install the 2-3 shift valve and retaining pin.

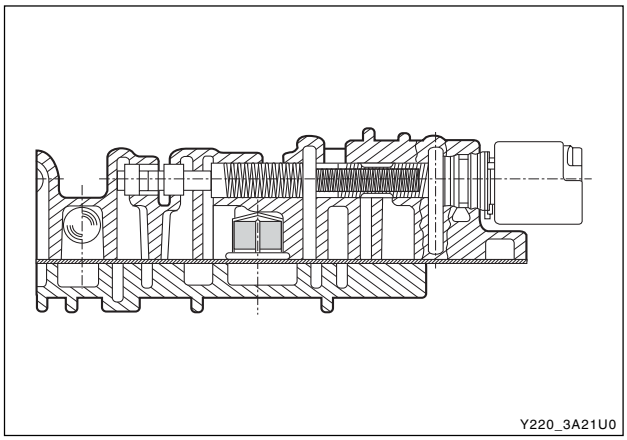




8. Install the 3-4 shift valve and retaining pin.



9. Install the Clutch Apply Regulator (CAR) valve, springs, plunger and retaining pin.

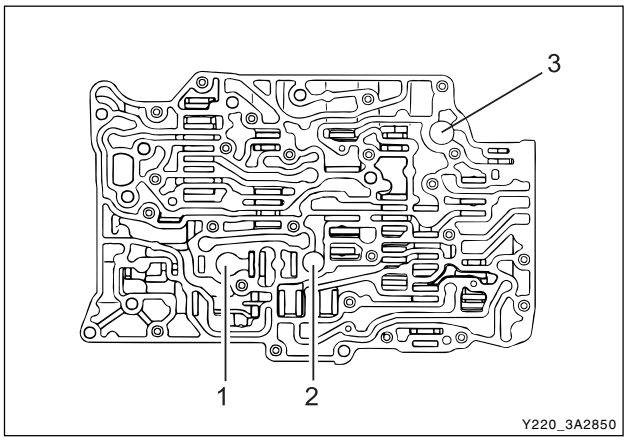


10. Install the solenoid valve supply valve, spring and retaining plate.

NOTICE

- **This aluminum valve is easily damaged.**

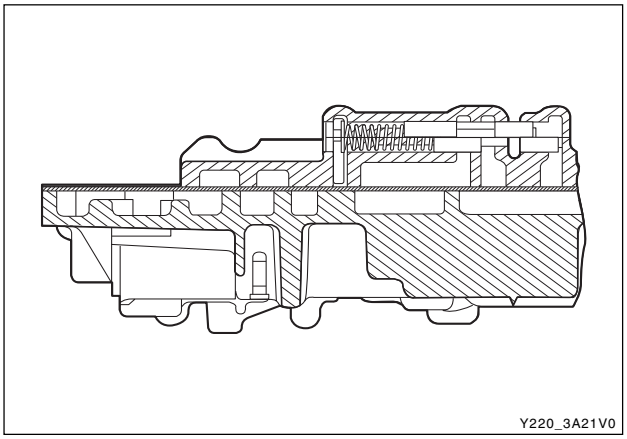
11. Install solenoid valve 6 plunger, spring and retaining pin.



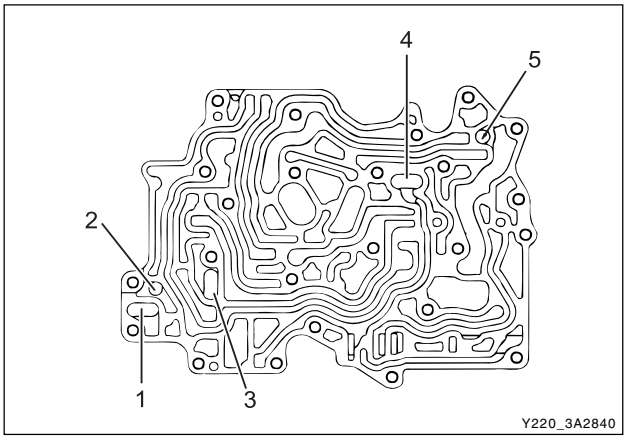
12. Position the third feed ball (large nylon) in the valve body and install the solenoid valve 6 filter.
13. Check the separator plate for burrs and damage. Repair or replace the separator plate as necessary.
14. Check the upper and lower valve body gaskets for damage. Replace the gaskets as necessary.
15. Install the lower valve body gasket on the lower valve body.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

16. Install the reverse lockout valve, spring, plug and retaining plate. Ensure that the valve is correctly oriented.



17. Position the five nylon ball checks in the upper valve body.
18. Fit the upper valve body gasket. Install the separator plate over the upper valve body.



19. Holding the separator plate to the upper valve body to prevent the check balls from falling out, install the upper valve body on the lower valve body. Install all screws finger tight then tighten the screws to specification in the prescribed sequence.

Installation Notice

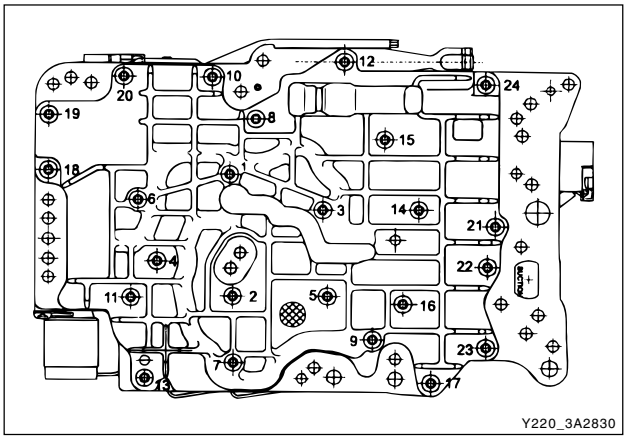
Tightening torque	11 ~ 16 Nm (8 ~ 12 lb-ft)

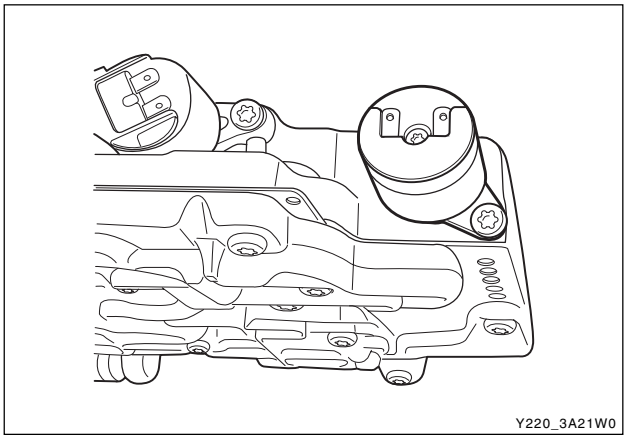
20. Install solenoid valves 1, 2, 3, 4 and 6. Ensure the solenoid valve is firmly secured by the retainer and that the screw is tightened to specification.

Installation Notice

Tightening torque	8 ~ 12 Nm (71 ~ 106 lb-in)

- The wiring loom ground wire eyelet terminal is secured beneath the solenoid valve 1 retainer.

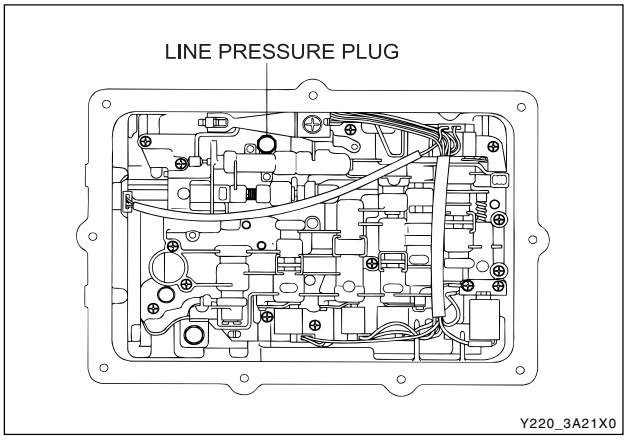



Y220_3A21W0

21. Install solenoid valve 5. Ensure that the solenoid valve is pushed firmly into the valve body by the retainer and that the screw is tightened to specification.

Installation Notice

Tightening torque	8 ~ 12 Nm (71 ~ 106 lb-in)

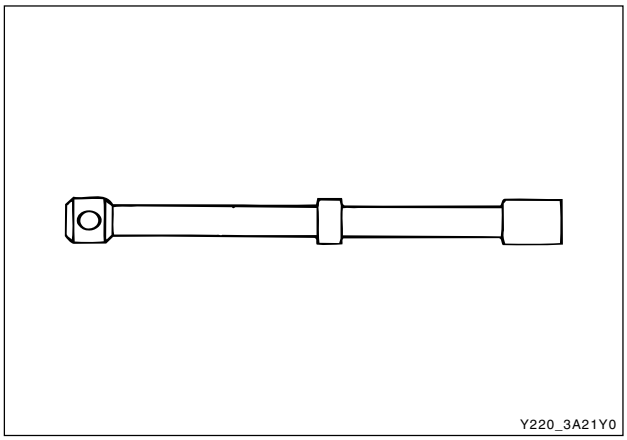


Y220_3A21X0

22. Install the detent spring assembly (spring, support plate and screw), ensuring that the screw is tight-ened to specification. Check the spring for wear or damage.

Installation Notice

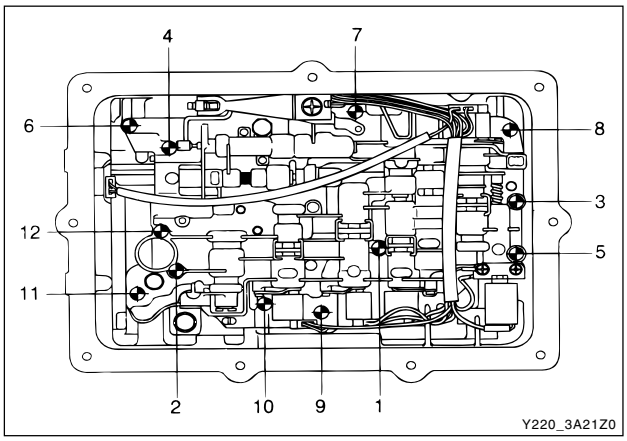
Tightening torque	20 ~ 22 Nm (15 ~ 16 lb-ft)


Y220_3A21Y0

23. Install the manual shift valve.

NOTICE

- **Be aware that the manual valve will fall out of the valve body.**



Y220_3A21Z0

24. Align the valve body assembly on the transmission case and install the manual valve lever to manual valve link. Fit the long end of the link to the manual valve first. Install the securing bolts and tighten to specification in the specified sequence.

Installation Notice

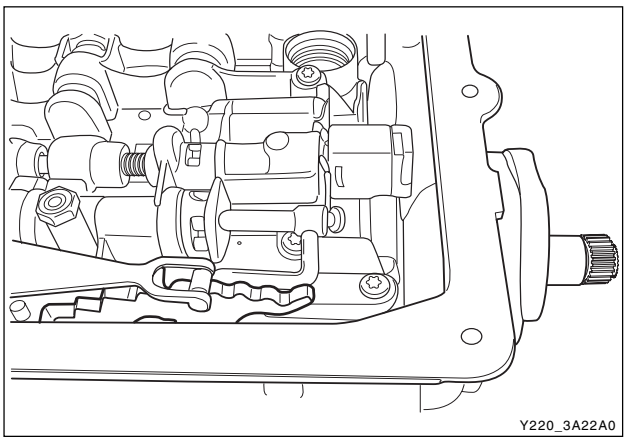
Tightening torque	8 ~ 13 Nm (71 ~ 115 lb-in)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

25. Check the alignment of the detent roller and the manual lever quadrant.
26. Connect the solenoid valve wiring as detailed below:
    Solenoid valve 1 - red
    Solenoid valve 2 - blue
    Solenoid valve 3 - yellow
    Solenoid valve 4 - orange
    Solenoid valve 5 - green
    Solenoid valve 6 - violet

NOTICE

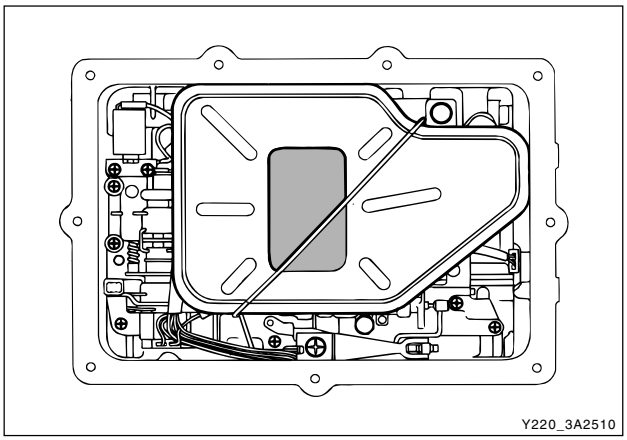
- **All hardware must be correctly installed and torqued to specification.**



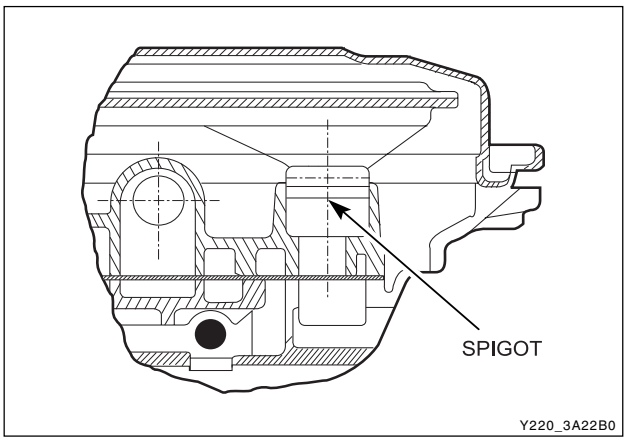
Oil Filter and Pan Assembly

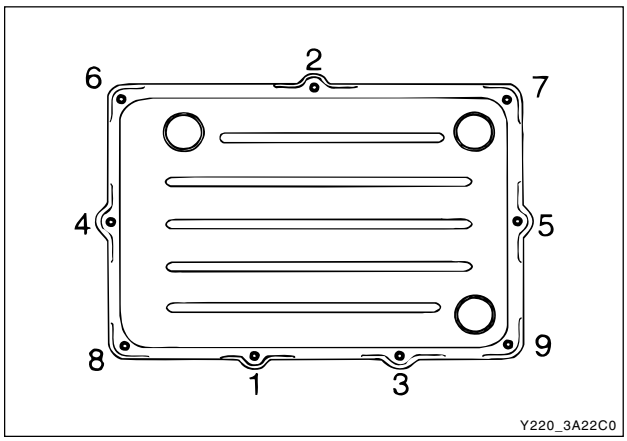
NOTICE

- **Replace the filter whenever rebuilding a transmission where a significant amount of mechanical damage has occurred.**
- **To aid the assembly of the pan gasket, use a small amount of Vaseline at the pan/gasket interface. This ensures that the gasket remains on the pan ridge. Do not over torque pan bolts as this may distort the pan and cause leaks.**
- **Ensure that the internal line pressure plus in the valve body is fitted.**



1. Lubricate the oil filter sealing ring with automatic transmission fluid.
2. Carefully assemble the oil filter to the valve body. The spigot must not lean on one side while being fitted.
3. Secure the oil filter assembly with the retainer.
4. Check that the magnet is located in the dimple in the corner of the oil pan.
5. Assemble the gasket on the pan lip. The gasket must be free of any distortion when installed.

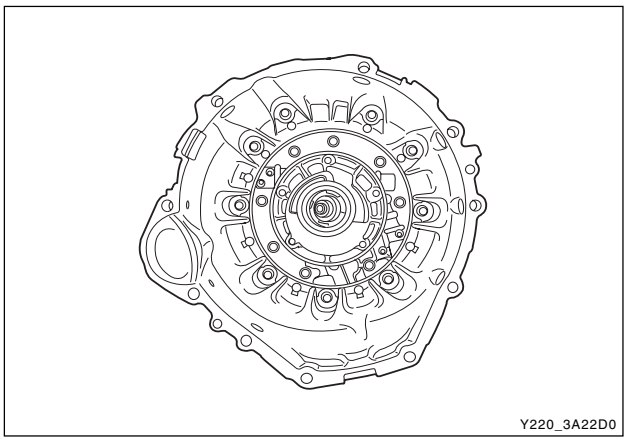




6. Fit the oil pan assembly to the transmission case and tighten the securing bolts to specification and sequence Do not over torque.

Installation Notice

Tightening torque	4 ~ 6 Nm (35 ~ 53 lb-in)



Torque Converter and Housing Assembly

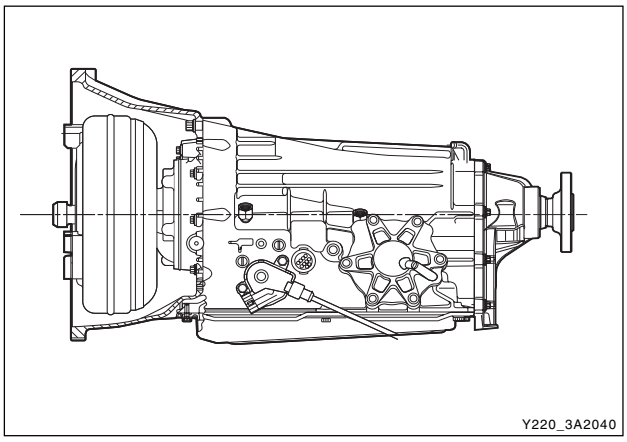
1. Locate the torque converter housing on the transmission main case.
2. Apply additional Loctite 202 or equivalent as required to the converter housing to case bolts. Install and tighten bolts to specification.

Installation Notice

Tightening torque	54 ~ 68 Nm (40 ~ 50 lb-ft)

- All the hardware must be correctly installed and torqued to specification.

3. Fit the converter ensuring that the tangs are engaged in the pump gear. Ensure that the tangs do not contact the pump seal.



Output Flange Assembly (2WD

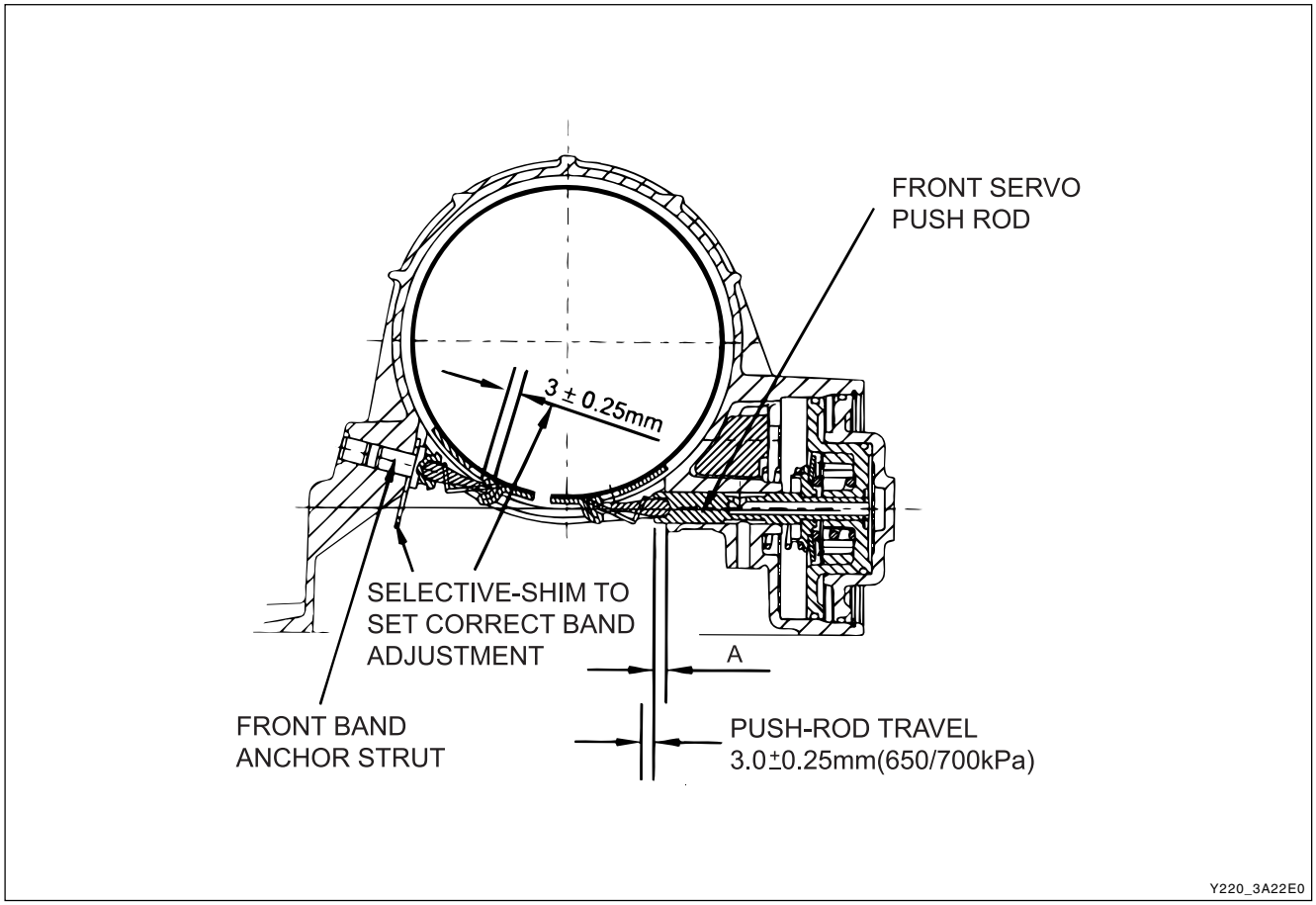
1. Position the transmission detent lever into the park position and lock the output shaft.
2. Clear the threads on the output shaft and apply Loctite 243 or equivalent as required to threads.
3. Install the flange, “O” ring and torque the nut to specification.

Installation Notice

Tightening torque	35 Nm (26 lb-ft)

FRONT AND REAR BAND ADJUSTMENT

▶ Front Band Setting Procedure



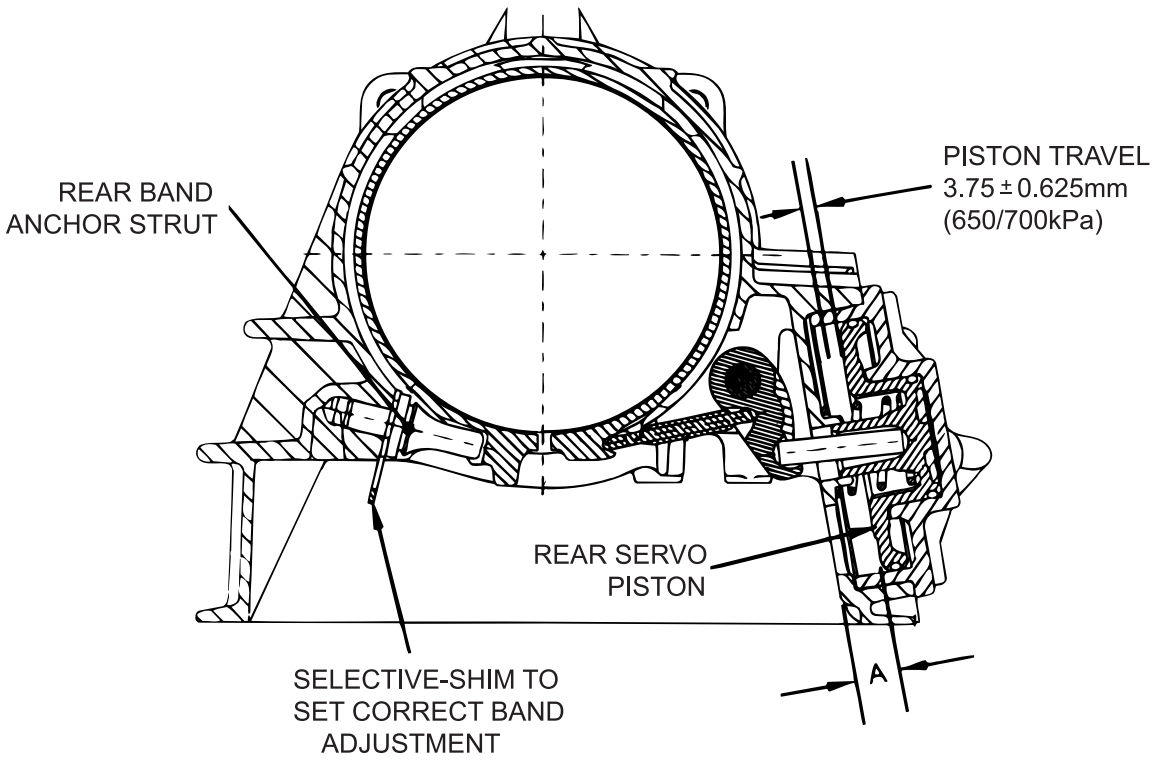
1. Measure the projection of the front servo push rod from the transmission case dimension 'A'.
   a. Apply air at 650/700 kPa to the front servo apply area (B1 outer)
   b. Measure the travel of the push rod and subtract 3 mm to find the shim size required.
   c. Release the air.

NOTICE

- **A minimum of one shim is required at all times - minimum shim size is 1 mm. The thickness of available shims are listed in the table below.**

2. Fit the selected shim(s) to the shank of the anchor strut as follows:
   a. Inspect the shim(s) for damage, wear or corrosion. Replace as necessary.
   b. The shim(s) are to be installed between the case abutment face and the anchor strut flange.
   c. The shim(s) are to be fitted by hand and under no circumstances to be hammered or forced.
   d. Shim(s) are to be pressed on by hand until an audible click is heard. The click indicates that the shim is clipped home correctly.
3. Re-check that the push rod travel. (3mm ± 0.25mm)

▶ Rear Band Setting Procedure

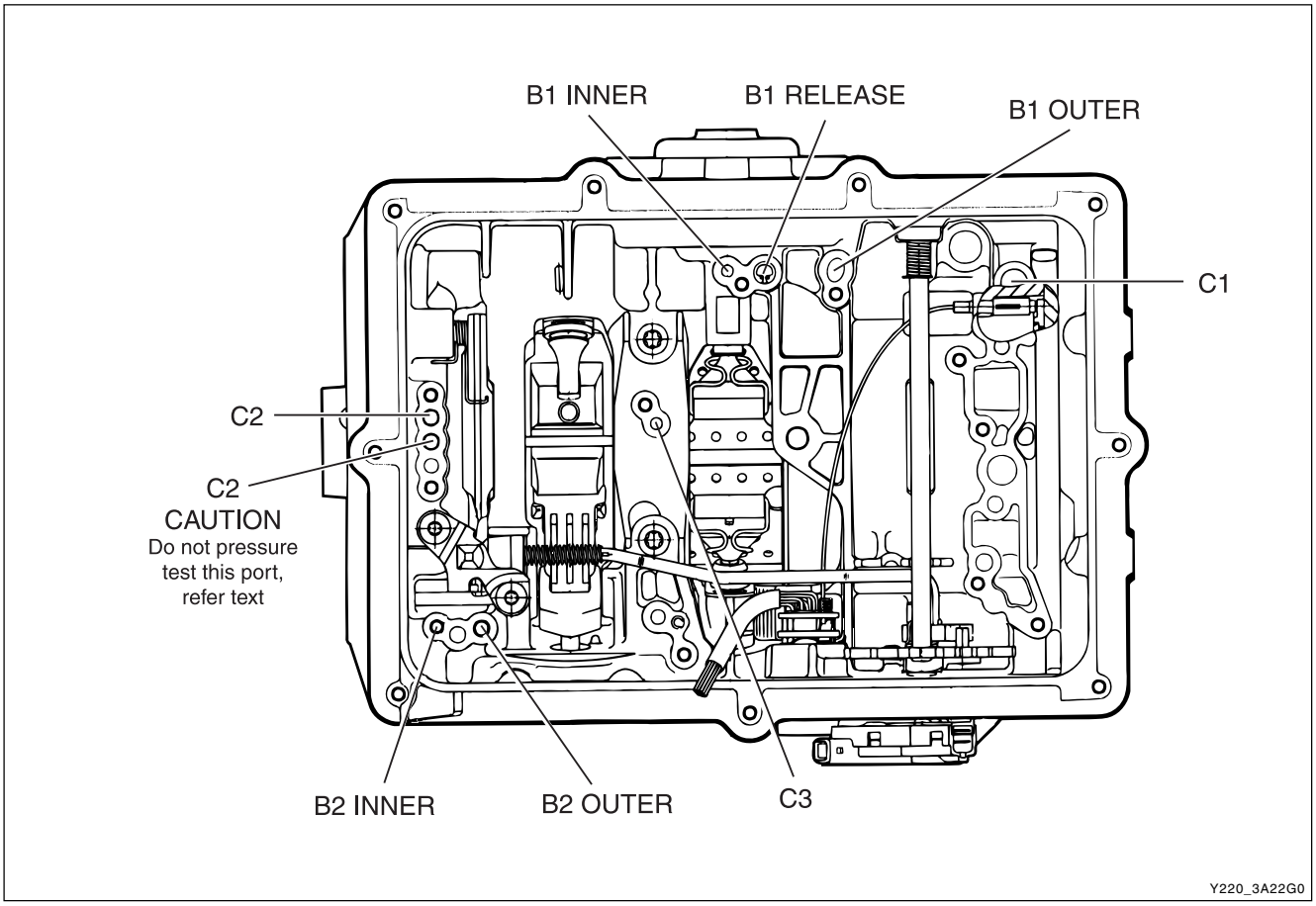


1. Measure distance “A” from the rear servo piston to the inner face of the transmission case using vernier calipers.
   a. Apply air at 650/700 kPa to the rear servo apply area (B2 outer)
   b. Measure the travel of the piston, subtract 3. 75 mm and divide the remainder by 2.5 to find shim size.
   c. Release the air.

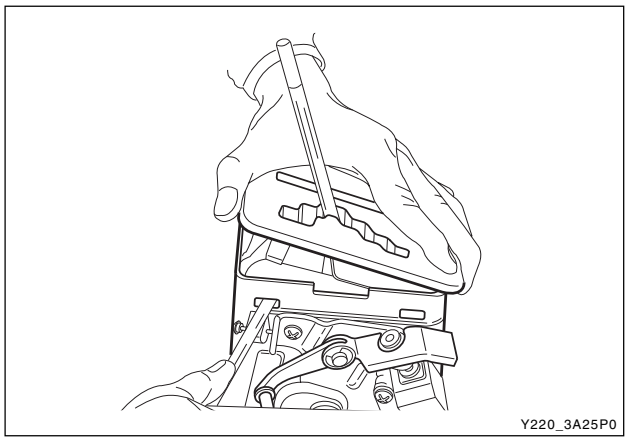
NOTICE

- **A minimum of one shim is required at all times - minimum shim size is 1 mm. The thickness of available shims are listed in the table below.**

2. Fit the selected shim(s) to the shank of the anchor strut as follows.
   a. Inspect the shim(s) for damage, wear or corrosion and replace as necessary. The shim(s) are to be installed between the case abutment face and the anchor strut flange.
   b. The shim(s) are to be fitted by hand and under no circumstances to be hammered or forced
   c. The shim(s) are to be pressed on by hand until an audible click is heard. The click indicates that the shim is clipped home correctly.
3. Re-check that the piston travel. (3.75 mm ± 0.625 mm)

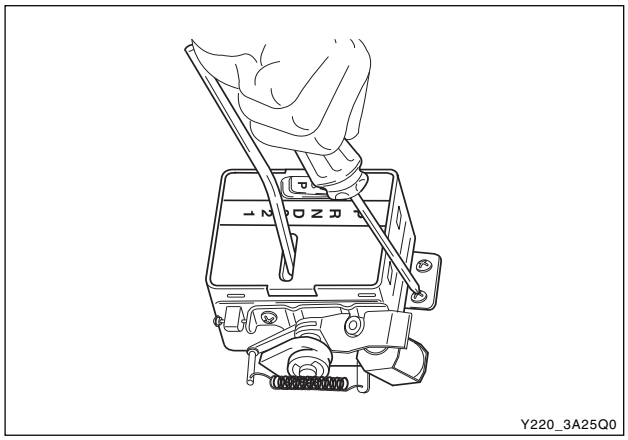

B1 INNER
B1 RELEASE
B1 OUTER
C1
C2
C2
CAUTION
Do not pressure test this port, refer text
B2 INNER
B2 OUTER
C3
Y220_3A22G0

GEAR SHIFT CONTROL LEVER


Y220_3A25P0

Disassembly and Assembly Procedure

1. Disconnect the negative battery cable.
2. Remove the gear shift control lever assembly. Refer to *Section Interior Trim.*
3. Remove the gear shift control lever knob.
4. Separate the upper and middle housing from the gear shift control lever assembly by unlocking the lock.
5. Remove the upper housing.
6. Disconnect the P position lamp by turning it from the middle housing.

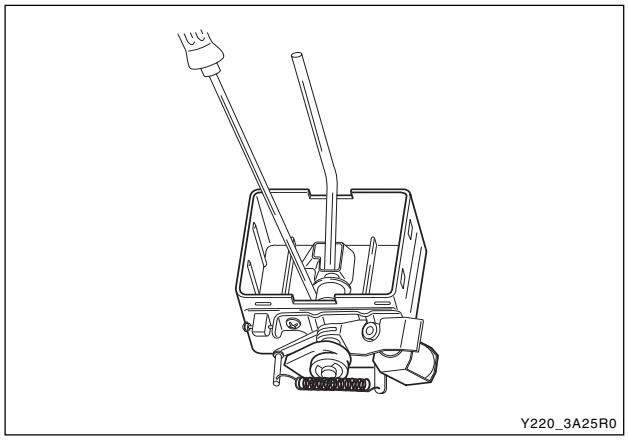


Y220_3A25Q0

7. Remove the P position switches assembly bolts.
8. Remove the middle housing with the mode selector switch wiring harness from the gear shift control lever assembly.
9. Separate the P position switches assembly with the P position lamp wiring harness from the gear shift control lever assembly.

NOTICE

- **Adjust the brake transmission shift interlock ease the operation well.**


Y220_3A25R0

10. Remove the clips supporting the springs and bushes from the pin of the pin of the gear shift control lever.
11. Remover the spring and bushes from the pin of the gear shift control lever.
12. Remove the gear shift control lever by pushing the pin.
13. Installation should follow the removal procedure in the reverse order.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

REMOVAL AND INSTALLATION OF TCU

1. Disconnect the negative battery cable.
2. Move the driver's seat forward and unfold the cut section of the carpet.



3. Remove the TCU mounting bolts (10 mm, LH/RH).

Tightening torque	10 Nm



4. Disconnect the connector and remove TCU.





FASTENER TIGHTENING SPECIFICATIONS

Application	Nm	Lb-Ft	Lb-Ft
Adaptor Housing to Case Bolts	30 ~ 35	22 ~ 26	-
Cam Plate to Case (Parking Pawl) Screws	16 ~ 22	12 ~ 16	-
Centre Support to Case Bolts	20 ~ 27	15 ~ 20	-
Detent Spring Screw	20 ~ 22	15 ~ 16	-
Extension Housing to Case Bolts	54 ~ 68	40 ~ 50	-
Front Propeller Shaft Bolts	70 ~ 80	52 ~ 59	-
Inhibitor Switch to Case Bolts	4 ~ 6	-	35 ~ 53
Oil Cooler Pipes	40 ~ 45	29 ~ 33	-
Oil Pan to Case Bolts	4 ~ 6	-	35 ~ 53
On/Off Solenoid valve Retainer Screws	8 ~ 12	-	71 ~ 106
Output Flange Nuts	35	26	-
Pump Cover Plate to Crescent Screw	13 ~ 16	10 ~ 12	-
Pump Cover Plate to Pump Cover Screws	13 ~ 16	10 ~ 12	-
Pump Cover to Case Bolts	24 ~ 34	18 ~ 25	-
Pump to Pump Cover Bolts	24 ~ 27	18 ~ 20	-
Rear Propeller Shaft Bolts	70 ~ 80	52 ~ 59	-
Rear Servo Cover to Case Bolts	30 ~ 35	22 ~ 26	-
TCM Mounting Bolt	10	-	89
Torque Converter Housing to Case Bolts	54 ~ 68	40 ~ 50	-
Torque Converter Mounting Bolts	42	31	-
Transfer Case to Transmission Housing Bolts	35 ~ 60	26 ~ 44	-
Transmission Filler Plug	30 ~ 35	22 ~ 26	-
Upper Valve Body to Lower Valve Body Screws	11 ~ 16	8 ~ 12	-
Valve Body To Case Bolts	8 ~ 13	-	71 ~ 115
Variable Pressure Solenoid valve (S5) Retainer Screw	8 ~ 12	-	71 ~ 106

TROUBLE CODE DIAGNOSIS

TCU DIAGNOSTIC SYSTEM OVERVIEW

NOTICE

- **To prevent Transmission Control Module (TCM) damage. The ignition key must be OFF when disconnection or reconnection the power to the TCM (for example bttery cable, TCM pigtail connector, TCM fuse, jumper cables, etc.).**

When the TCU detects a system fault, a Diagnostic Trouble Code (DTC) is set in the TCU. This code is present while the fault conditions are met and is stored as a 'History DTC' until cleared. Condition for setting and clearing each TCU DTC are provided in the relevant sections.

In the case where the vehicle type is certified for Eure On-Board Diagnostic (EOBD) compliance, the Engine Control Module (ECM) provides the communication link to the EOBD scan tool to pass on any EOBD relevant codes from the TCU. The table below contains a list of all supported DTCs and the classification of each for EOBD purposes. Where a type B DTC has been set in an EOBD vehicle, the response to the fault may include action by the ECM, including the illumination of the Malfunction Indicator Lamp (MIL). Refer to Engine Control, for details on EOBD system function, checks and fault clearing.

CLEARING TROUBLE CODES

TCU DTCs should be cleared after repairs have been completed. Some diagnostic tables will tell you to clear the codes before using the chart, which will help to find the cause of the problem more quickly. Always note the DTCs present before clearing - this information may be helpful in the diagnostic process.

DIAGNOSTIC TROUBLE CODES

DTC Code	Defective	Cause and Action
P0707	Low gear position sensor input	Cause: - Gear position sensor signal of the inhibitor switch is lower than the normal value (defective gear position sensor) - Specified value of gear position sensor signal: 0.87 V Symptom: - Cannot shift to 1st, 3rd and 4th gear. - Torque converter clucth stops from its operation. Action: - Check gear position sensor for short to ground. - Check inhibitor switch and TCU connector for proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P0708	High gear position sensor input	Cause: - Gear position sensor signal of the inhibitor switch is higher than the normal value (defective inhibitor switch) - Specified value of inhibitor switch: 4.12 V Symptom: - Cannot shift to 1st, 3rd and 4th gear position. - Torque converter clucth stops from its operation. Action: - Check gear position sensor for short to B+. - Check inhibitor switch and TCU connector for proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.

TROUBLE CODE DIAGNOSIS

TCU DIAGNOSTIC SYSTEM OVERVIEW

NOTICE

- **To prevent Transmission Control Module (TCM) damage. The ignition key must be OFF when disconnection or reconnection the power to the TCM (for example bttery cable, TCM pigtail connector, TCM fuse, jumper cables, etc.).**

When the TCU detects a system fault, a Diagnostic Trouble Code (DTC) is set in the TCU. This code is present while the fault conditions are met and is stored as a 'History DTC' until cleared. Condition for setting and clearing each TCU DTC are provided in the relevant sections.

In the case where the vehicle type is certified for Eure On-Board Diagnostic (EOBD) compliance, the Engine Control Module (ECM) provides the communication link to the EOBD scan tool to pass on any EOBD relevant codes from the TCU. The table below contains a list of all supported DTCs and the classification of each for EOBD purposes. Where a type B DTC has been set in an EOBD vehicle, the response to the fault may include action by the ECM, including the illumination of the Malfunction Indicator Lamp (MIL). Refer to Engine Control, for details on EOBD system function, checks and fault clearing.

CLEARING TROUBLE CODES

TCU DTCs should be cleared after repairs have been completed. Some diagnostic tables will tell you to clear the codes before using the chart, which will help to find the cause of the problem more quickly. Always note the DTCs present before clearing - this information may be helpful in the diagnostic process.

DIAGNOSTIC TROUBLE CODES

DTC Code	Defective	Cause and Action
P0707	Low gear position sensor input	Cause: - Gear position sensor signal of the inhibitor switch is lower than the normal value (defective gear position sensor) - Specified value of gear position sensor signal: 0.87 V Symptom: - Cannot shift to 1st, 3rd and 4th gear. - Torque converter clucth stops from its operation. Action: - Check gear position sensor for short to ground. - Check inhibitor switch and TCU connector for proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P0708	High gear position sensor input	Cause: - Gear position sensor signal of the inhibitor switch is higher than the normal value (defective inhibitor switch) - Specified value of inhibitor switch: 4.12 V Symptom: - Cannot shift to 1st, 3rd and 4th gear position. - Torque converter clucth stops from its operation. Action: - Check gear position sensor for short to B+. - Check inhibitor switch and TCU connector for proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.

DTC Code	Defective	Cause and Action
P0741	Torque converter clutch cannot be engaged	Cause: - Torque conver clutch cannot be engaged even when solenoid valve (S7) is operated. - The rpm of engine and output shaft is not consistent with the selected shift's gear ratio. • Allowable slip rpm of torque converter:100 rpm Symptom: - Torque converter clutch cannot be locked Action: - Check solenoid valve (S7) wiring for short to ground or open circuit. - Replace solenoicd valve (S7) if necessary. - Check T/M connector TCU connector for their proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P0742	Torque converter clutch engaged	Cause: - Torque conver clutch is engaged when solenoid valve (S7) is not operated. - The rpm of engine and output shaft is not consistent with the characteristic under the condition with torque converter not engaged. • Allowable slip rpm of torque converter < 50 rpm Symptom: - Torque converter clutch is locked. Action: - Check solenoid valve (S7) wiring for short to B+. - Replace solenoicd valve (S7) if necessary. - Check T/M connector TCU connector for their proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P0710	Defective T/M oil temperature sensor	Cause: - Oil temperature of T/M exceeds the specified value. • Oil temperature sensor voltage > 4.88 V • Oil temperature sensor voltage < 0.21 V Symptom: - Oil temperature is fixed to 120°C - Shifting impression is poor. Action: - Check T/M oil temperature sensor for short or open circuit. - Check T/M connector and TCU connector for proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds.
P0790	Defective W/N/P mode switch	Cause: - The W/N/P mode switch's connection is intermittently disconnected (the input of the mode switch changes rapidly). Symptom: - The switch is fixed to normal mode. Action: - Check W/N/P mode switch input circuit for short or open circuit. - Check W/N/P mode switch wiring. - Replace W/N/P mode switch if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds.

DTC Code	Defective	Cause and Action
P1703	Abnormal engine rpm (CAN)	Cause: - The engine rpm signal (CAN) is out of specified value or there is no engine rpm signal. • Engine rpm < 0 rpm • Engine rpm > 7000 rpm Symptom: - The engine rpm corresponding to the max. engine torque is applyed to the shifting condition. Action: - Check ECU and TCU connectors for poor contact. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds.
P1704	Abnormal output shaft rpm (CAN)	Cause: - The output shaft signal (CAN) is out of specified value or there is no output shaft signal. • Output shaft rpm < 0 rpm • Output shaft rpm > 9000 rpm - The actual vehicle speed is 0 while other signals indicate that vehicle is moving. Symptom: - Cannot shift down by limiting the engine rpm to prevent the engine from overrunning. Action: - Check ECU and TCU connectors for poor contact. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds and the rpm is over 0.
P1708	Low TCU supply voltage	Cause: - The TCU supply voltage is low or there is no measured voltage value. Symptom: - Cannot shift to 1st gear position. - Cannot shift to other gear positions due to the low supply voltage. - No. 6 solenoid valve (S6) stops from its operation. Action: - Check TCU terminal for poor contact, bending or deformation. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P1709	High TCU supply voltage	Cause: - The TCU supply voltage is high. • TCU supply voltage > 16.5 V Symptom: - All solenoid valves stop from their operation when high battery voltage is detected. - Enters into the emergency mode. Action: - Check TCU terminal for short to B+ or short to ground. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.

DTC Code	Defective	Cause and Action
P1713	Defective accelerator pedal signal (CAN)	Cause: - The accelerator pedal signal (CAN) is out of the specified value. • Accelerator pedal signal < 0 % • Accelerator pedal signal > 100 % Symptom: - Cannot shift to 4th gear position. - Torque converter clucth stops from its operation. - The interior default value is applied for shift determination (if the accelerator pedal signal is defective, ECU selects the default value and sends it and error message to TCU via CAN line). - The accelerator pedal signal is not used for P, R, N B2. Action: - Check ECU and TCU connectors for poor contact and their terminals for bend or deformation. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P1714	Defective vehicle coding	Cause: - The vehicle coding stored in EEPROM is defective (self-test when IGN ON). Symptom: - Determines the vehicle coding value via CAN communication or selects 0 for the coding value. - Shifting impression is poor. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1715	Abnormal VPS offset	Cause: - VPS (Variable pressure solenoid valve) is used for controlling clutch and band pressure while shifting. - The VPS offset stored in EEPROM is incorrect (self-test when IGN ON). • VPS offset > 120 mA Symptom: - Shifting impression is poor. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1717	Defective RAM	Cause: - RAM operates abnormally. (self-test when IGN ON) Symptom: - No output signal. - Enters into the emergency mode. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1718	Defective ROM	Cause: - The program memory is defective (self-test when IGN ON). - The calculated checksum value is not consistent with the stored checksum value. Symptom: - No output signal. - Enters into the emergency mode. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

DTC Code	Defective	Cause and Action
P1719	Abnormal CAN communication	Cause: - Cannot use information necessary for TCU via CAN communication. Symptom: - The default value is used for all CAN signals. - Enters into the emergency mode. Action: - Check ECU and TCU connectors wiring for poor contact. - Check ECU and TCU connectors' terminals for bend or deformation. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P1720	Defective EEPROM	Cause: - EEPROM memory is defective. - The calculated checksum value is not consistent with the stored checksum value or the error occurs in EEPROM communication. (self-test when IGN ON) Symptom: - Determines the vehicle coding value via CAN communication or selects 0 for the coding value. - Shifting impression is poor. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1722	Incorrect vehicle model	Cause: - Cannot detect the vehicle coding through EEPROM or CAN communication. Symptom: - Selects 0 for the coding value. - Enters into the emergency mode. Action: - Check TCU connector and terminals for poor contact. - DTC disappears after turning ignition from OFF to ON.
P1733	No. 1 solenoid valve open	Cause: - The No. 1 solenoid valve operates with the No. 2 solenoid valve to control the oil flow for the 1-2 shift valve. - The No.1 solenoid valve internal circuit or solenoid valve wiring is open. - The solenoid valve connection is short to B+. Symptom: - The No. 1 solenoid valve is OFF. - Enters into the emergency mode. Action: - Check No. 1 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.1 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

DTC Code	Defective	Cause and Action
P1734	No. 2 solenoid valve open	Cause: - The No. 2 solenoid valve operates with the No. 1 solenoid valve to control the oil flow for the 2-3 shift valve. - The No. 2 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 2 solenoid valve is OFF. - Enters into the emergency mode. Action: - Check No. 2 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.2 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1735	No. 3 solenoid valve open	Cause: - The No. 3 solenoid valve operates with the No. 4 solenoid valve to shift smoothly and control the shifting order. - The No. 3 solenoid valve turns the clutch regulator valve ON and OFF. - The No. 3 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 3 solenoid valve is OFF. - Shifting impression is poor. Action: - Check No. 3 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.3 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

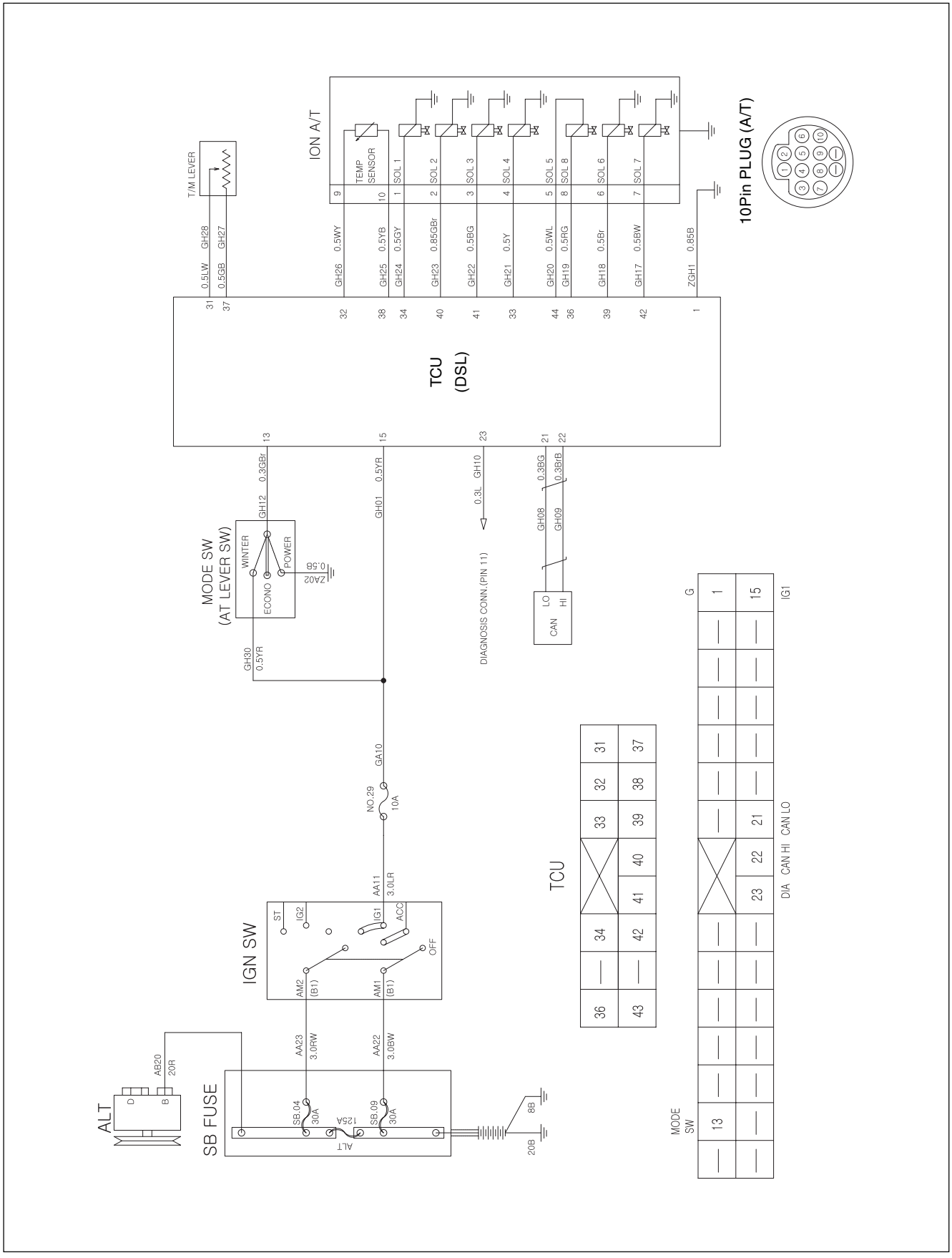
DTC Code	Defective	Cause and Action
P1736	No. 4 solenoid valve open	Cause: - The No. 4 solenoid valve operates with the No. 3 solenoid valve to shift smoothly and control the shifting order. - The No. 4 solenoid valve turns the clutch regulator valve ON and OFF. - The No. 4 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 4 solenoid valve is OFF or ON. - Shifting impression is poor. Action: - Check No. 4 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.4 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1737	No. 5 solenoid valve open	Cause: - The No. 5 solenoid valve is a variable solenoid valve to change the pressure for shifting. - The No. 5 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 4 solenoid valve is always OFF. - Shifting impression is poor. Action: - Check No. 5 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 3.6 ~ 5.5Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.5 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1738	No. 6 solenoid valve open	Cause: - The No. 6 solenoid valve is used to set the hydraulic line pressure to HIGH/LOW level. - The No. 6 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The hydraulic line pressure is high. (No. 6 solenoid valve stops its operation) - Cannot to shift to 1st gear position. Action: - Check No. 6 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 6 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

DTC Code	Defective	Cause and Action
P1739	No. 7 solenoid valve open	Cause: - The No. 7 solenoid valve controls the operation of the torque converter clutch. - The No. 7 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 7 solenoid valve stops its operation (OFF). - The torque converter clutch cannot be locked. Action: - Check No. 7 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 7 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1741	No. 1 solenoid valve short	Cause: - The No. 1 solenoid valve operates with the No. 2 solenoid valve to control the oil flow for the 1-2 shift valve. - The No. 1 solenoid valve circuit is short to ground. Symptom: - The No. 1 solenoid valve is OFF. - Enters into the emergency mode. Action: - Check No. 1 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.1 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1742	No. 2 solenoid valve short	Cause: - The No. 2 solenoid valve operates with the No. 1 solenoid valve to control the oil flow for the 2-3 shift valve. - The No. 2 solenoid valve circuit is short to ground. Symptom: - The No. 2 solenoid valve is OFF. - Enters into the emergency mode. Action: - Check No. 2 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 2 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

DTC Code	Defective	Cause and Action
P1743	No. 3 solenoid valve short	Cause: - The No. 3 solenoid valve operates with the No. 4 solenoid valve to shift smoothly and control the shifting order. - The No. 3 solenoid valve turns the clutch regulator valve ON and OFF. - The No. 3 solenoid valve circuit is short to ground. Symptom: - The No. 3 solenoid valve is OFF. - Shifting impression is poor. Action: - Check No. 3 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 3 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1744	No. 4 solenoid valve short	Cause: - The No. 4 solenoid valve operates with the No. 3 solenoid valve to shift smoothly and control the shifting order. - The No. 4 solenoid valve turns the clutch regulator valve ON and OFF. - The No. 4 solenoid valve circuit is short to ground. Symptom: - The No. 4 solenoid valve is OFF. - Shifting impression is poor. Action: - Check No. 4 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 4 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1745	No. 5 solenoid valve short	Cause: - The No. 5 solenoid valve is a variable solenoid valve to change the pressure for shifting. - The No. 5 solenoid valve circuit is short to ground. Symptom: - The No. 4 solenoid valve is always OFF. - Shifting impression is poor. Action: - Check No. 5 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 3.6 ~ 5.5Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.5 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

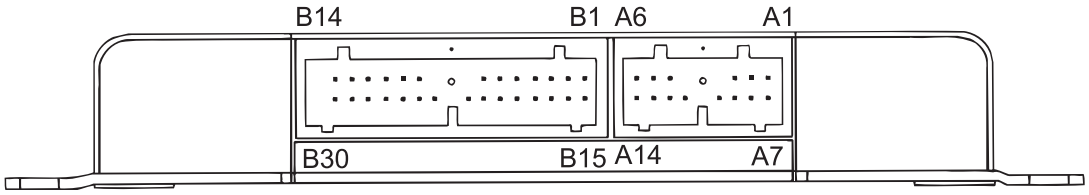
DTC Code	Defective	Cause and Action
P1746	No. 6 solenoid valve short	Cause: - The No. 6 solenoid valve is used to set the hydraulic line pressure to HIGH/LOW level. - The No. 6 solenoid valve circuit is short to ground. Symptom: - The hydraulic line pressure is high. (No. 6 solenoid valve stops its operation) - Cannot to shift to 1st gear position. Action: - Check No. 6 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value : 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 6 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1747	No. 7 solenoid valve short	Cause: - The No. 7 solenoid valve controls the operation of the torque converter clutch. - The No. 7 solenoid valve circuit is short to ground. Symptom: - The No. 7 solenoid valve stops its operation (OFF). - The torque converter clutch cannot be locked. Action: - Check No. 7 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 7 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

CIRCUIT DIAGRAM OF TCU

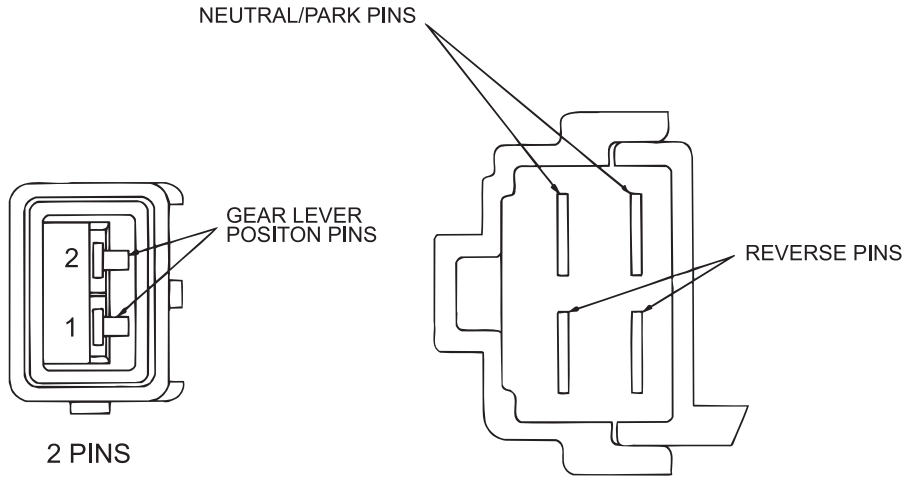


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AFFECTED VIN	

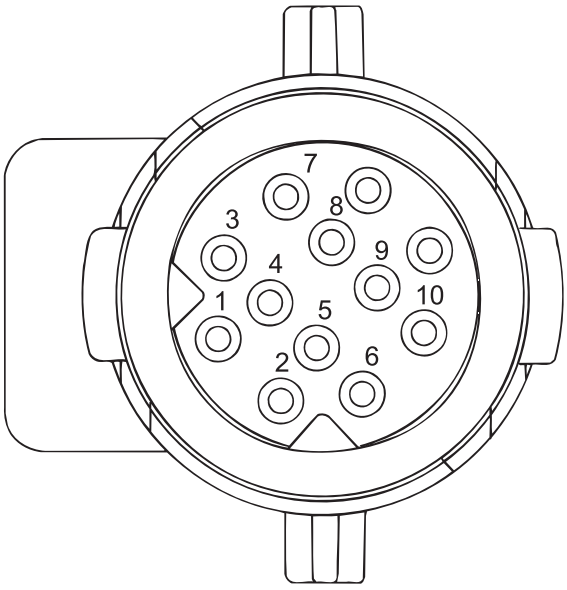
CONNECTOR END VIEW



Transmission Control Module (TCM) Pin Numbers



Inhibitor Switch Pins

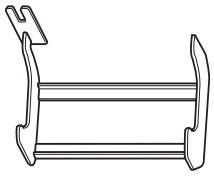
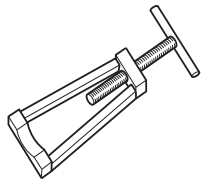
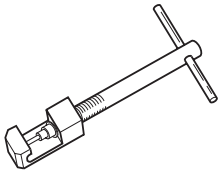
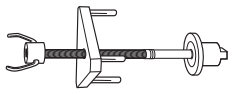
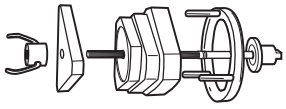
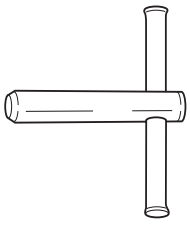
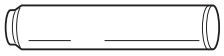
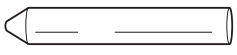


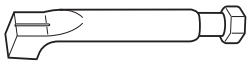
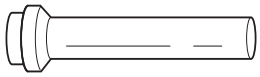
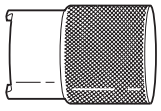
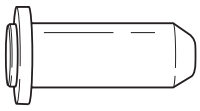
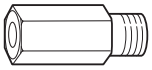
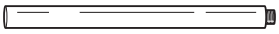
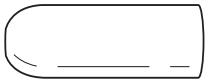
10-Way Transmission Connector

Y220_3A25O0

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	
0555 - 336256 **Transmission Bench Cradle**  Y220_3A22P0	**0555 - 336257** **Pump Puller**  Y220_3A22Q0
ss Shaft Pin **Remover / Installer (Detent Lever)**  Y220_3A22R0	**0555 - 336259** **Clutch Spring Compressor**  Y220_3A22S0
0555 - 336260 **Clutch Pack Clearance Kit**  Y220_3A22T0	**0555 - 336261** **Cross Shaft Seal Remover**  Y220_3A22U0
0555 - 336262 **Cross Shaft Seal Installer**  Y220_3A22V0	**0555 - 336263** **Cross Shaft Bullet**  Y220_3A22W0

Name and Part Number	
0555 - 336265 **Cross Shaft Pin Remover / Installer (Inhibitor Switch)**  Y220_3A22X0	**0555 - 336266** **Adaptor Housing Seal Installer**  Y220_3A22Y0
0555 - 336267 **Pump Alignment Tool**  Y220_3A22Z0	**0555 - 336268** **Pump Seal Installer**  Y220_3A23A0
0555 - 336269 **End Float Measuring Adaptor**  Y220_3A23B0	**0555 - 336270** **End Float Measuring Shaft**  Y220_3A23C0
0555 - 336302 **Output Shaft Bullet**  Y220_3A23D0	

MANUAL TRANSMISSION

3170

TABLE OF CONTENTS

GENERAL INFORMATION 3

1. Overview and characteristics of manual transmission 3
2. Manual transmision system 5

MANUAL TRANSMISSION 8

1. Location 8
2. System components 9
3. Shifting mechanism 17
4. Diagnostic information and procedures 24
5. Removal and installation (4WD) 28
6. Disassembly and reassembly 33
7. Inspection/maintenance 64
8. Special tools and equipment 67

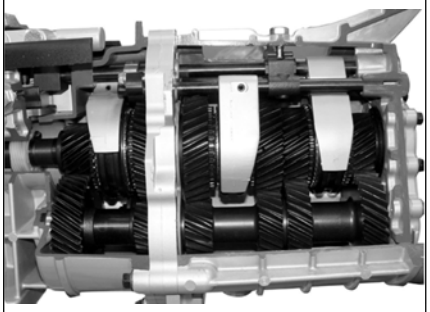
GENERAL INFORMATION

1. OVERVIEW AND CHARACTERISTICS OF MANUAL TRANSMISSION

▶ System Components

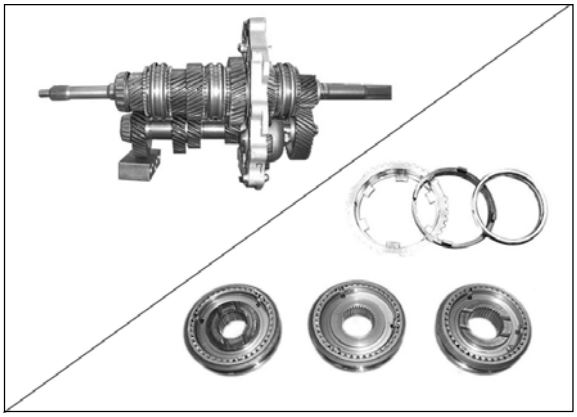


Inside



Front View





▶ Features

1. All gears are the helical type and high strength materials.

NOTE
- **The helical type gear prevents the axial gear missing and provides less noise.**

2. The semi-remote control type gear shift mechanism is used to prevent incorrect shifting.
3. To improve the shifting performance, 3-piece double cone is used for 1/2 shift.
4. The synchronizing devices are installed in 1/2, 3/4, 5/R gears. To prevent the double engagement, the independent interlock devices are installed.

NOTE
- **TSM54/52 transmission uses the inertia lock type key to make smooth gear engagement and to provide silent gear engagement.**

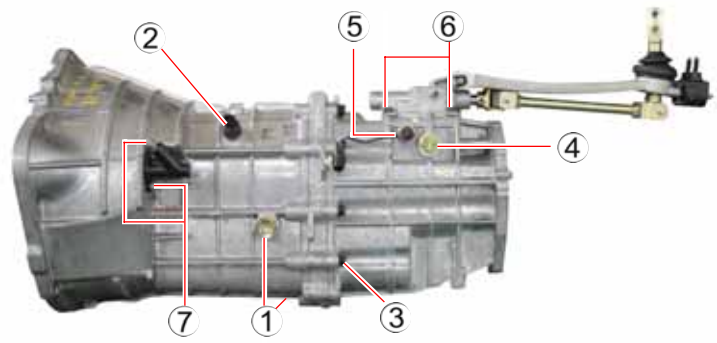
5. The clutch release system is available to use CSC (Concentric Slave Cylinder) or Fork type according to the vehicle model.

Specifications

Description			Specifications (D20DT, D27DT)
Length (mm)			628.3 mm
Distance between shafts (mm)			81 mm
Input torque (kg-m)			34.7 kg-m (340 Nm)
Transmission control type			Semi-remote
Weight (kg) - not including transmission fluid			44 kgm
Gear ratio/Gear teeth (input gear: main gear)	1st gear		4.315
	2nd gear		2.475
	3rd gear		1.536
	4th gear		1.000
	5th gear		0.807
	Reverse gear		3.919
Transmission fluid	Specification		ATF DEXRON II
	Capacity (ℓ)	2WD	3.4 ℓ
		4WD	3.6 ℓ
	Change interval		Inspect at every 10,000 km, replace at every 60,000 km (add or replace if necessary)

Tightening Torque

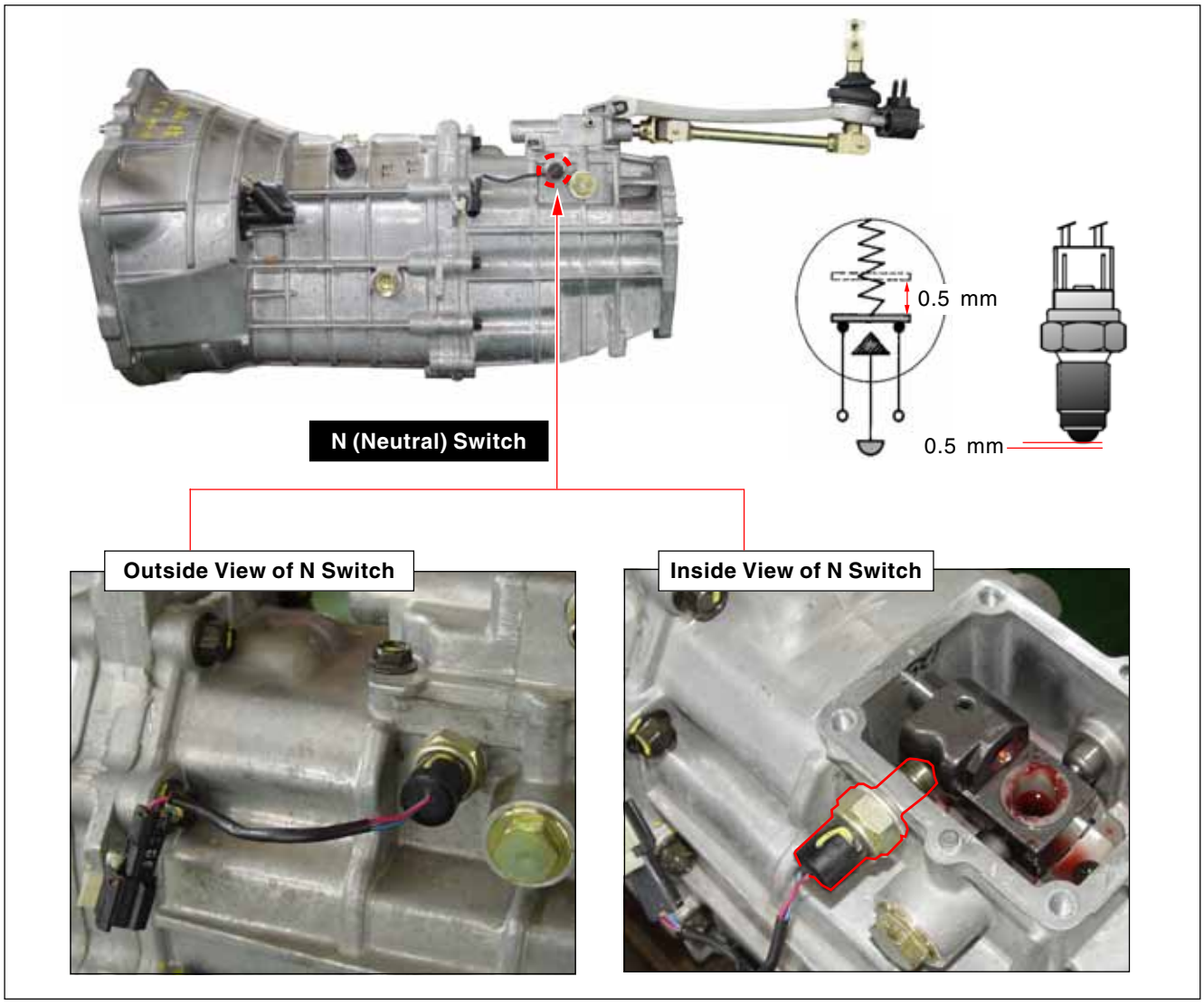
Description	Tightening Torque
1. Oil drain plug & filler plug	40 ~ 50 Nm
2. Backup lamp switch (24 mm)	30 ~ 40 Nm
3. Extension housing bolt (14 mm)	42 ~ 57 Nm
4. Extension housing spring plug (27 mm)	70 ~ 100 Nm
5. Neutral switch	30 ~ 40 Nm
6. Shift top cover bolt (12 mm)	17 ~ 26 Nm
7. Concentric slave cylinder adapter bolt	10 ~ 16 Nm



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2. MANUAL TRANSMISSION SYSTEM

▶ Neutral Switch



Function of N Switch

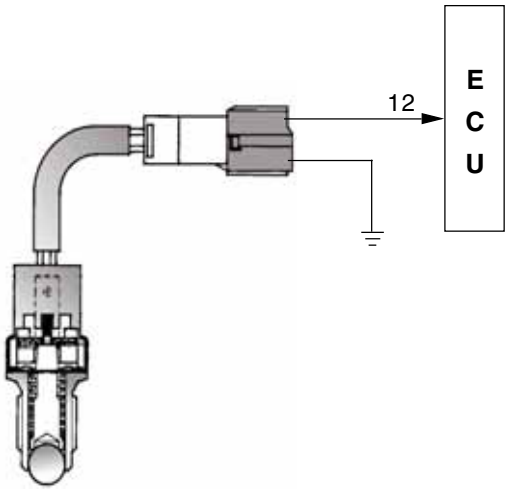
1. Aids a smooth start of the vehicle by raising the RPM during the gear shifting when the engine is cold.

When the vehicle is trying to start from the stopped state (vehicle speed below 3 km/h), the system determines the shifting timing by using the clutch switch and the N switch and raises the engine RPM (100 ~ 200 rpm). Operation conditions are as follows.

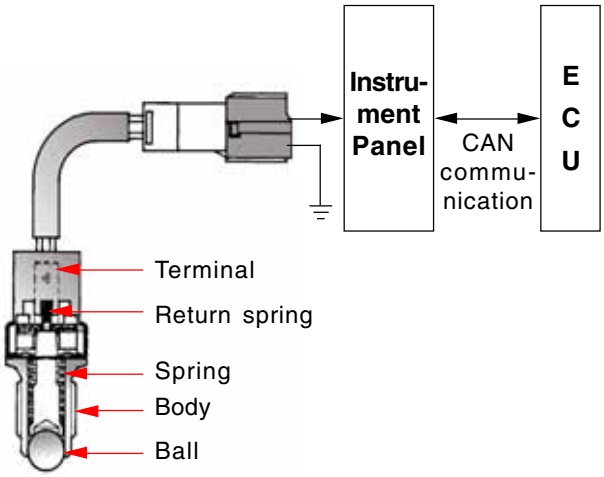
a. The vehicle speed is at the stopped state (Vehicle speed below 3km/h detection).
b. While depressing the clutch (Clutch switch detection).
c. The gear lever is at any position other than neutral (N switch detection).
d. Start the vehicle while depressing the clutch pedal (Clutch switch detection).
e. The RPM increases in accordance with the temperature of the engine coolant (Engine coolant temperature sensor detection).
   - -20°C ~ 20°C: approx. 100 rpm increase
   - 20°C ~ 60°C: approx. 100 ~ 170 rpm increase
   - Approx. 80°C (normal temperature of the engine coolant): approx. 200 rpm increase
f. When the gear has been smoothly shifted and the vehicle speed exceeds 3km/h, it returns to the previous operation interval of the engine RPM.

In case of Actyon, the N switch signal is transmitted to the instrument panel, and then the instrument panel transmits it to the engine ECU through the CAN communication.

Vehicle Made After 04.09.15



Actyon



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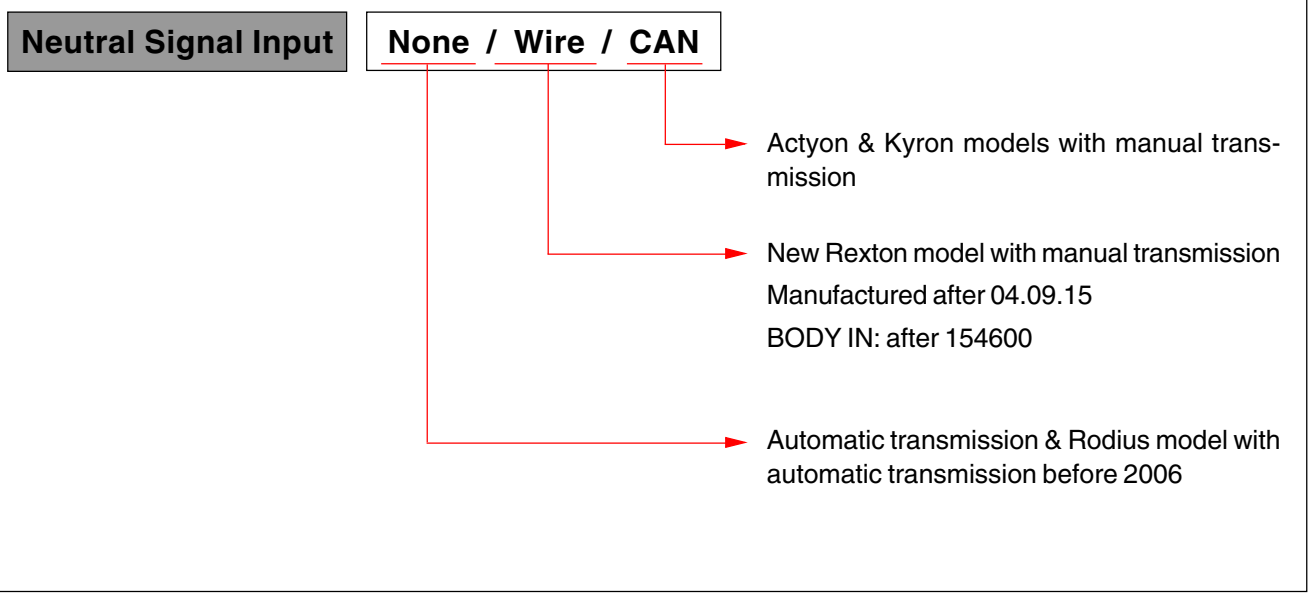
2. Detects the position of the shifting lever for the HDC operation among ABS/ESP functions.

The HDC function operates only if the M/T shift lever is in forward or reverse position. Please refer to the ABS/ESP section for the specific information related to the HDC.

Variant Coding Related to N Switch

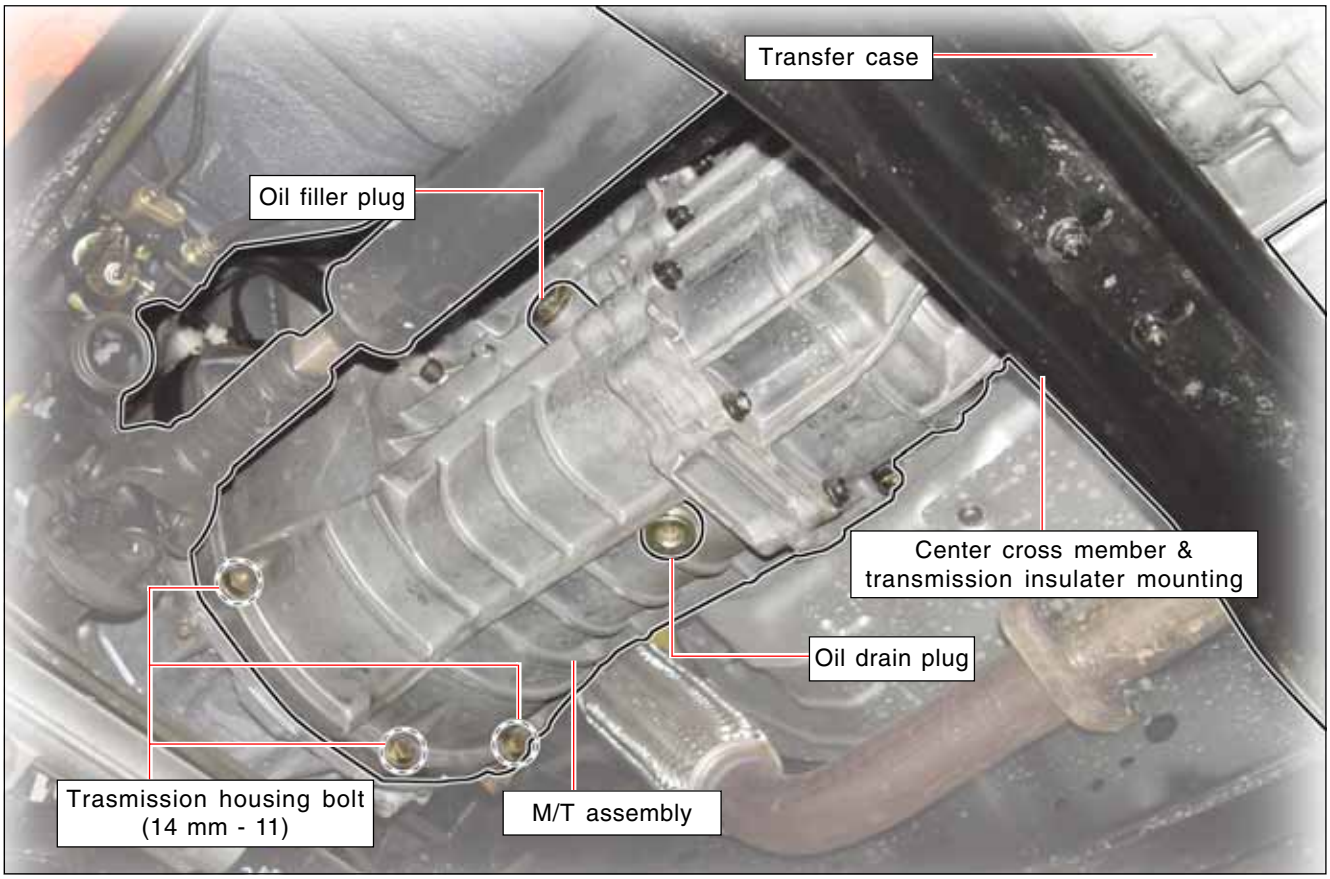
The N switch transmits information to the ECU through the CAN communication while New Rexton is connected to the ECU through wires. Thus, if you set the variant coding in the engine ECU, you must do it differently, and you must set the variant coding differently according to the vehicle category and specification as below.

Variant Coding Options

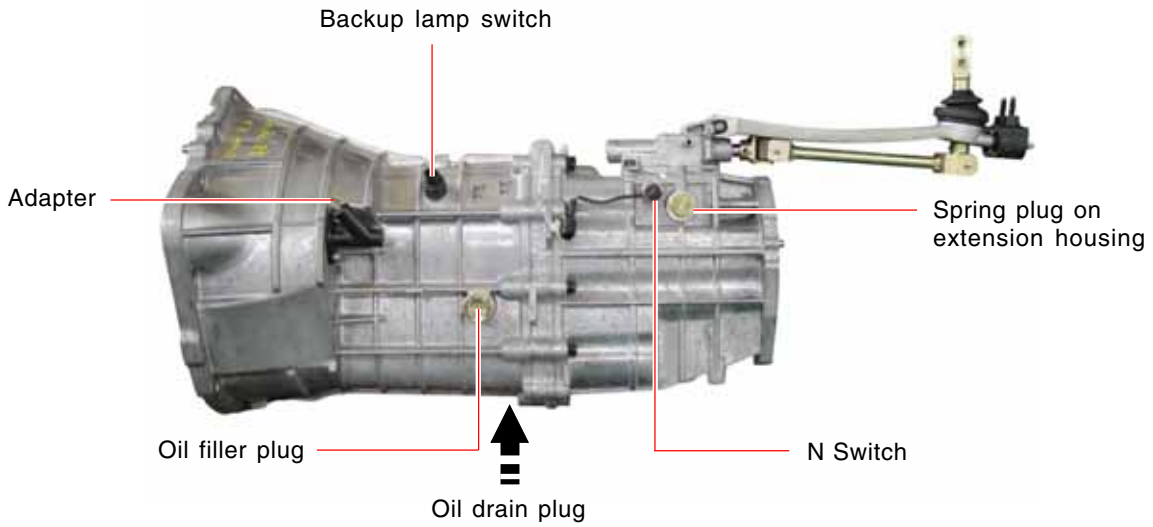


MANUAL TRANSMISSION

1. LOCATION



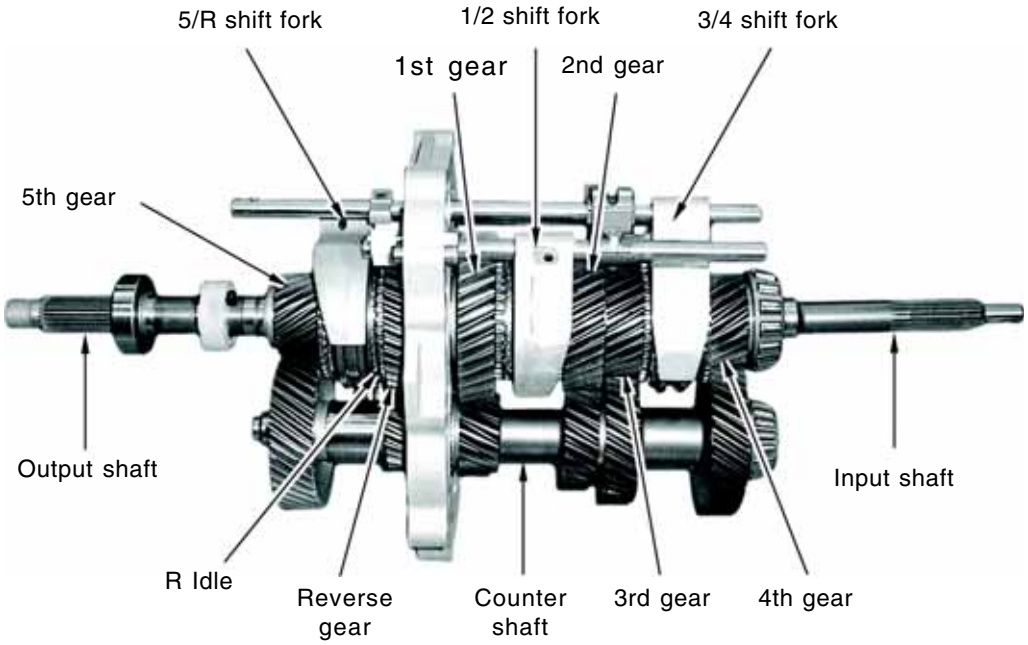
M/T Assembly



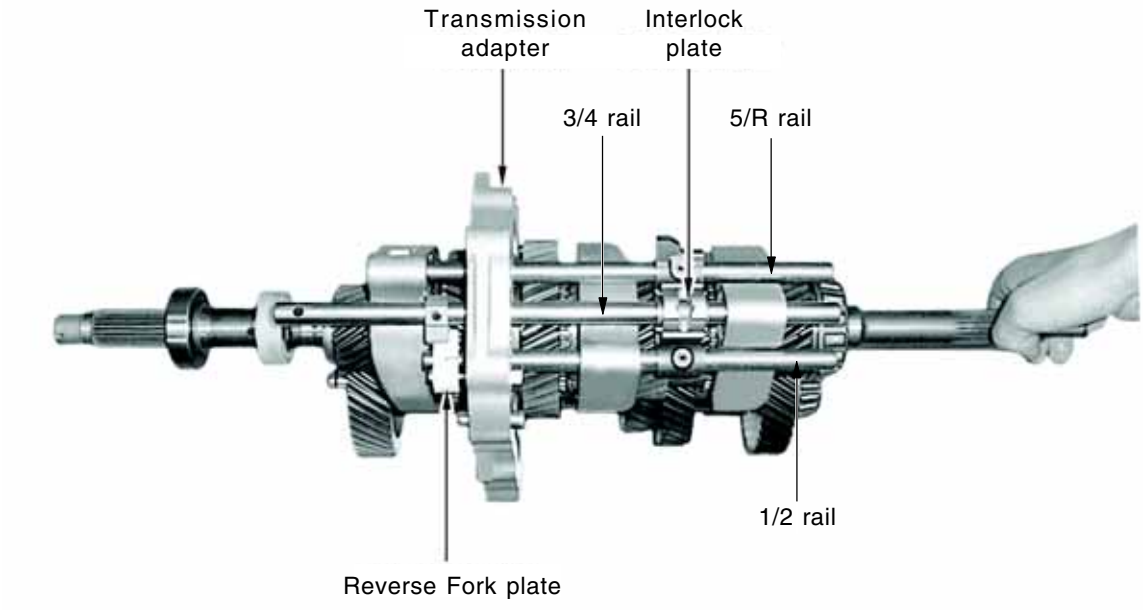
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2. SYSTEM COMPONENTS

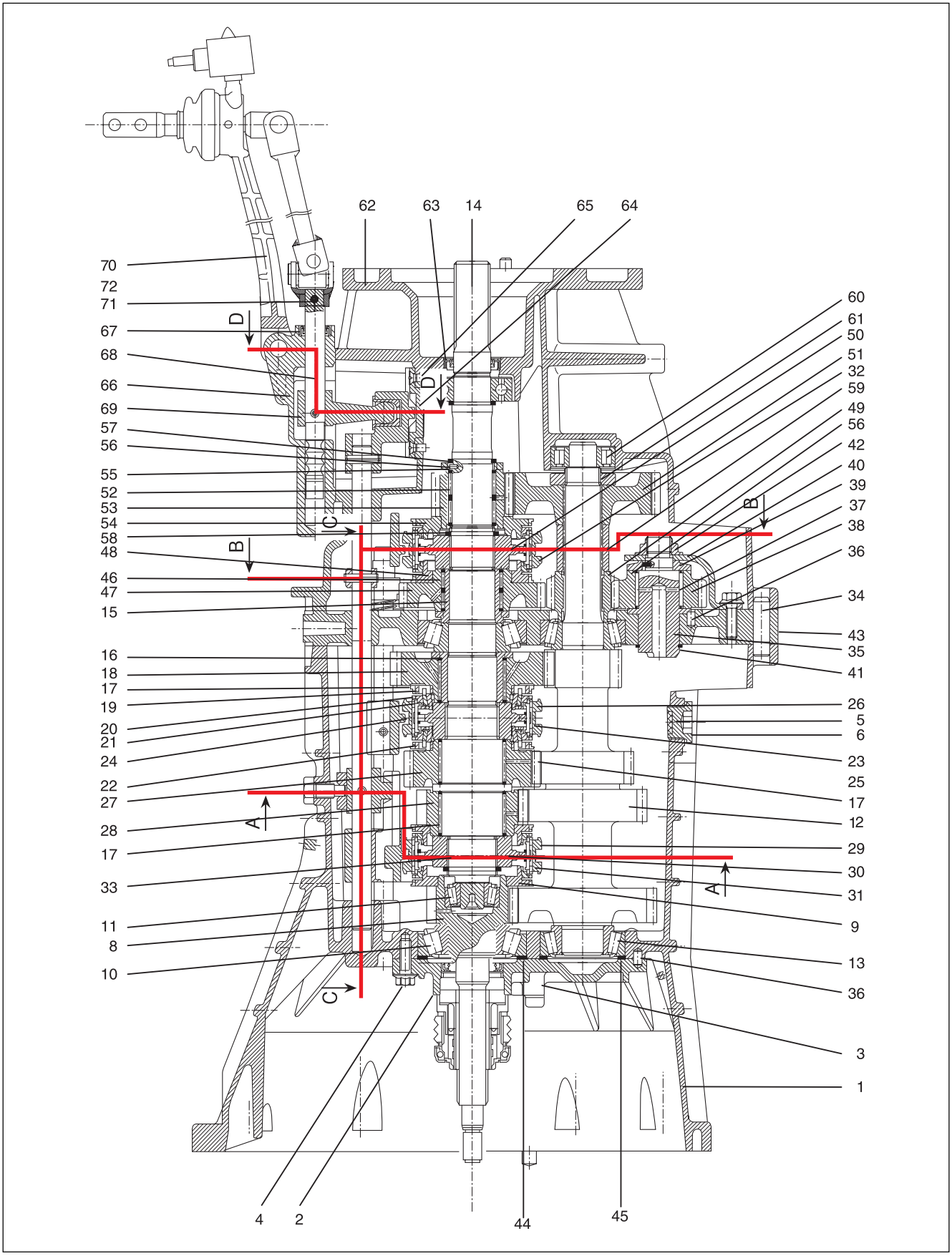
▶ Gear Combinations



▶ Shift Fork and Rail Combinations



▶ Sectional View

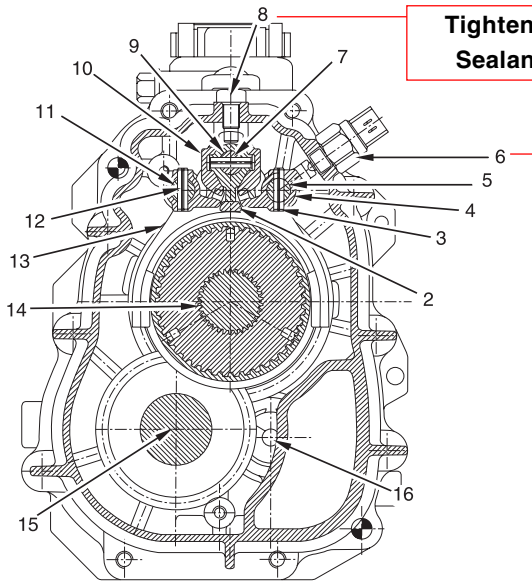


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1. Transmission housing
2. Input shaft oil seal
3. Front cover (DWF)
4. Hexagon flange bolt (17 ~ 26 Nm)
5. Oil drain plug (40 ~ 50 Nm)
6. Sealing
7. Pin
8. Input shaft
9. 4th clutch gear
10. Taper roller bearing (main)
11. Taper roller bearing
12. Counter shaft
13. Taper roller bearing (counter)
14. Output shaft
15. Inner race (reverse)
16. Inner race (1st gear)
17. Needle bearing
18. 1st gear
19. 1st clutch gear
20. Synchro outer ring (for 1st gear)
21. Synchro - middle cone
22. Synchro inner ring
23. Synchro spring
24. Synchro key
25. Synchro hub (1st & 2nd gears)
26. Double synchro sleeve
27. 2nd gear
28. 3rd gear
29. 3rd clutch gear
30. Synchro hub (3 & 4th gears)
31. Synchro ring (4/5/R)
32. Single synchro sleeve (5th & R)
33. Retainer ring (3 & 4th)
34. Adapter dowel pin
35. Reverse idler shaft
36. Dowel pin
37. Needle bearing (Reverse idler)
38. Reverse idler gear
39. Reverse idler spacer
40. Reverse idler bracket (Bolt: 30 ~ 40 Nm)
41. Retainer ring (Reverse idler)
42. Reverse lock nut (150 ~ 195 Nm)
43. Transmission adapter
44. Input shaft spacer (Bearing end play: 0 ~ 0.05 mm)
45. Counter spacer (Bearing end play: 0 ~ 0.05 mm)
46. Reverse needle bearing
47. Reverse gear
48. Reverse clutch gear
49. Reverse counter gear
50. Synchro hub (5th & R)
51. 5th counter gear
52. 5th needle bearing
53. 5th gear
54. 5th clutch gear
55. Thrust washer
56. Shift ball
57. 5th outside retainer ring
58. 5th retainer ring
59. Counter shaft bushing
60. Counter roller bearing assembly
61. Counter lock nut
62. Extension housing
63. Output shaft oil seal
64. Offset plate
65. Counter screw (4~6 Nm)
66. Top cover
67. Counter oil seal
68. Shift shaft
69. Shift lever
70. Semi-remote lever assembly
71. Pin spring
72. Pin spring

▶ Cross Sectional Diagram of Major Components

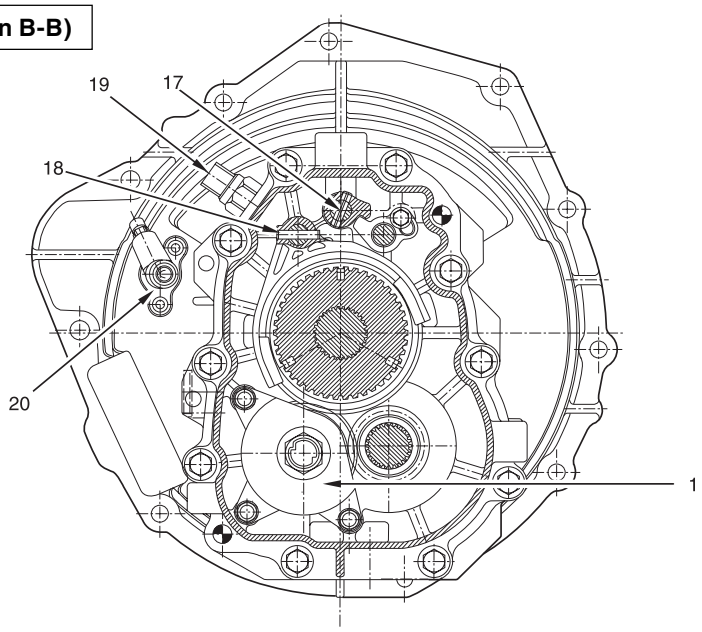
Front View (Section A-A)



Tightening Torque: 40~50 Nm
Sealant: Bond-592 LOCTITE

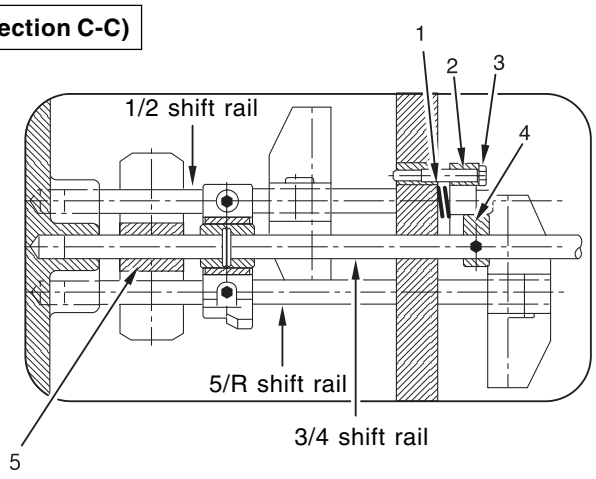
Tightening Torque: 30~40 Nm
Sealant: Bond-592 LOCTITE

Rear View (Section B-B)

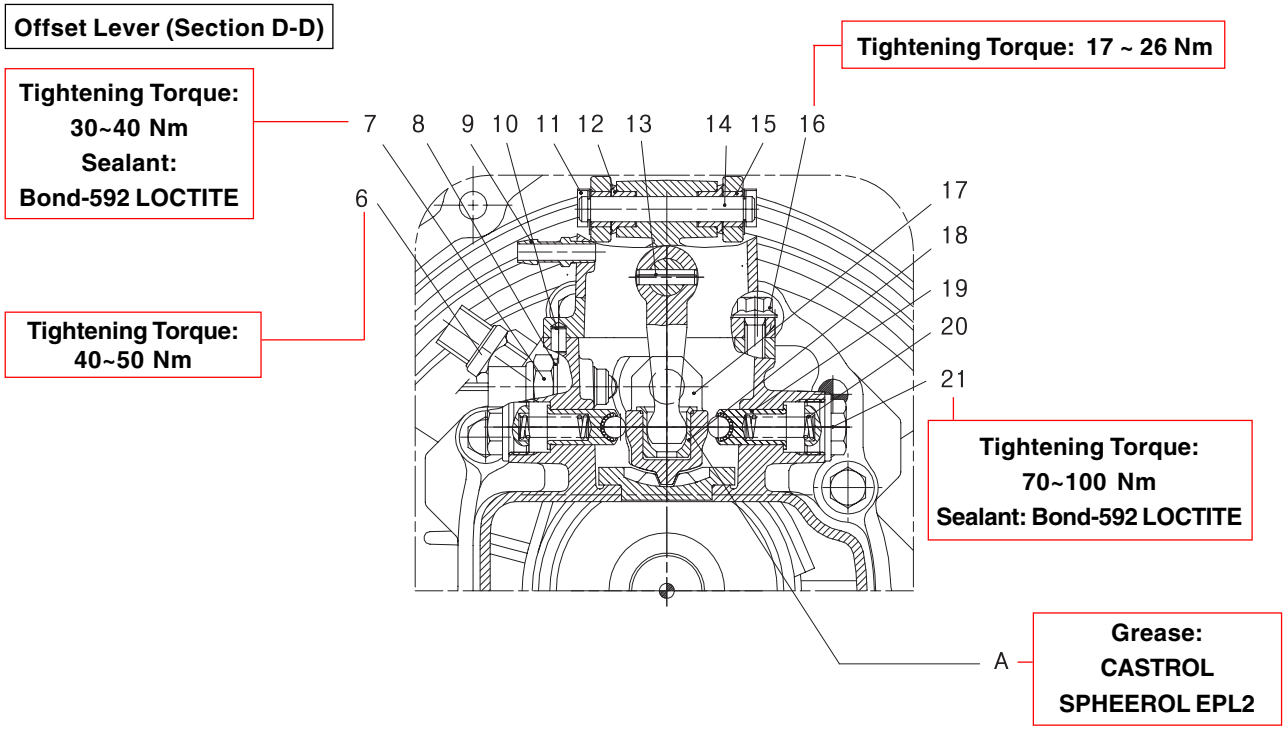


1. Reverse idler bracket (tightening torque: 30 ~ 40 Nm)
2. Shift lug (3 & 4th)
3. Spring pin (6 x 25)
4. Shift lug (5 & reverse)
5. Shift rail (5 & reverse)
6. Backup lamp switch (tightening torque: 30 ~ 40 Nm)
7. Shift rail (3 & 4th)
8. Interlock bolt (tightening torque: 40 ~ 50 Nm)
9. Shift lever
10. Interlock plate
11. Shift rail (1 & 2th)
12. Spring pin (6 x 25)
13. Shift fork (3 & 4th)
14. Input shaft
15. Counter shaft
16. Reverse idler assembly
17. Spring pin (6 x 25)
18. Spring pin (6 x 25)
19. Backup lamp switch
20. Concentric slave cylinder adapter (tightening torque: 10 ~ 16 Nm)

Shift Rail and 5/R Gear (Section C-C)



Offset Lever (Section D-D)

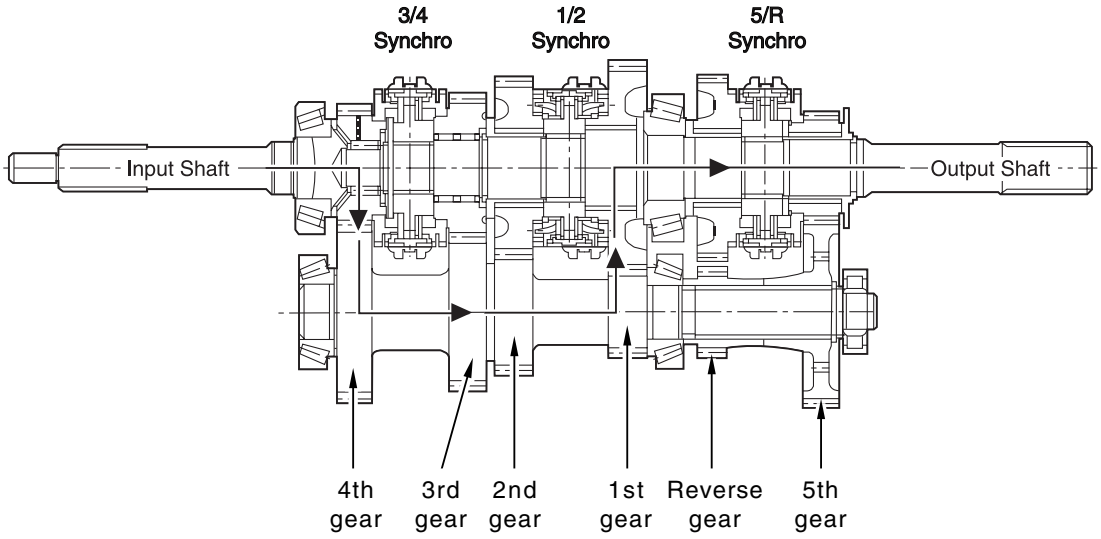


1. Reverse lock spring
2. Reverse lock plate
3. Reverse lock bolt
4. Stopper plate
5. Sliding bushing
6. Backup lamp switch
7. Neutral switch
8. Sealing
9. Air vent
10. Dowel pin
11. Washer lock
12. TGS bushing
13. Spring pin
14. TGS pin
15. TGS mounting bushing
16. Lock bolt
17. Offset lever
18. Offset lever bushing
19. Rolling plunger
20. Return spring
21. Spring plug

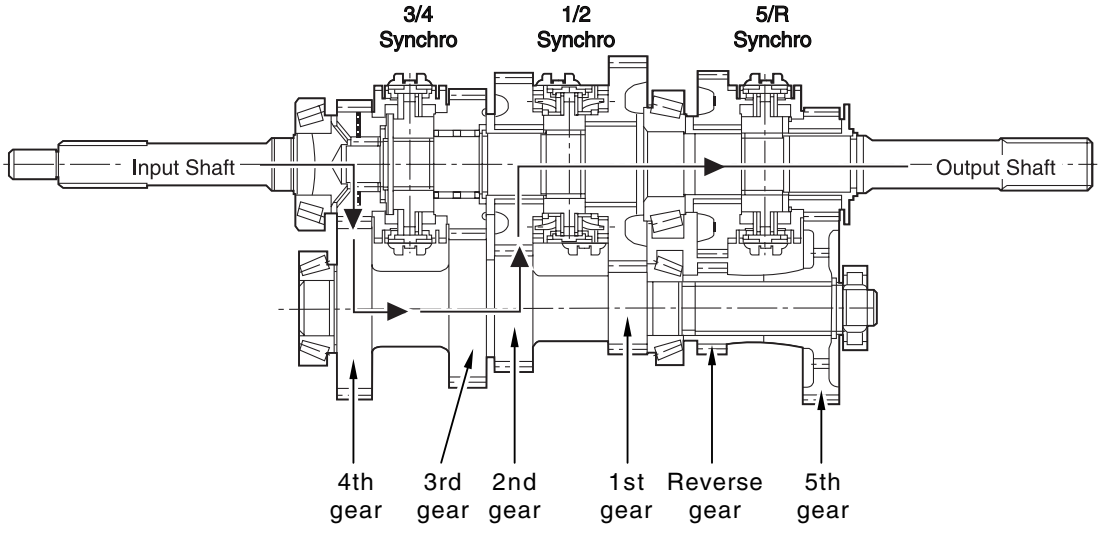
▶ Power Flows

1st & 2nd Gear - Power Flow

1st gear
Counter shaft



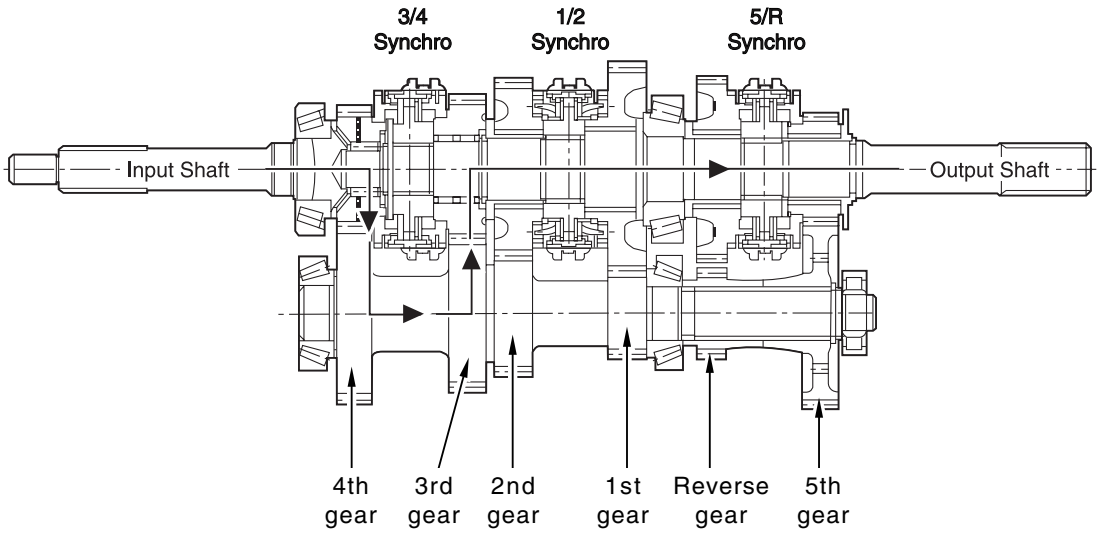
2nd gear



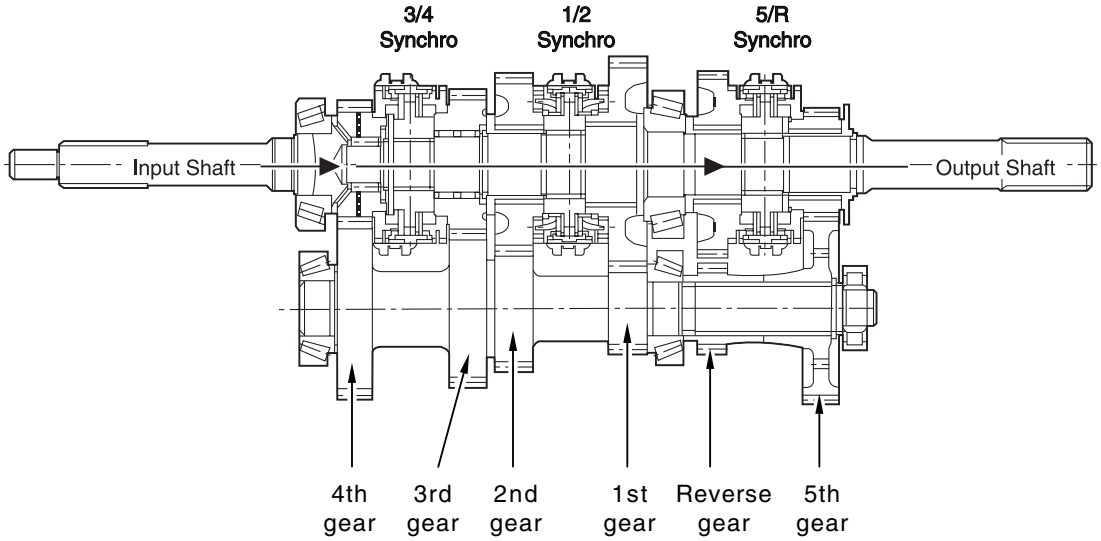
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3rd & 4th Gear - Power Flow

3rd gear



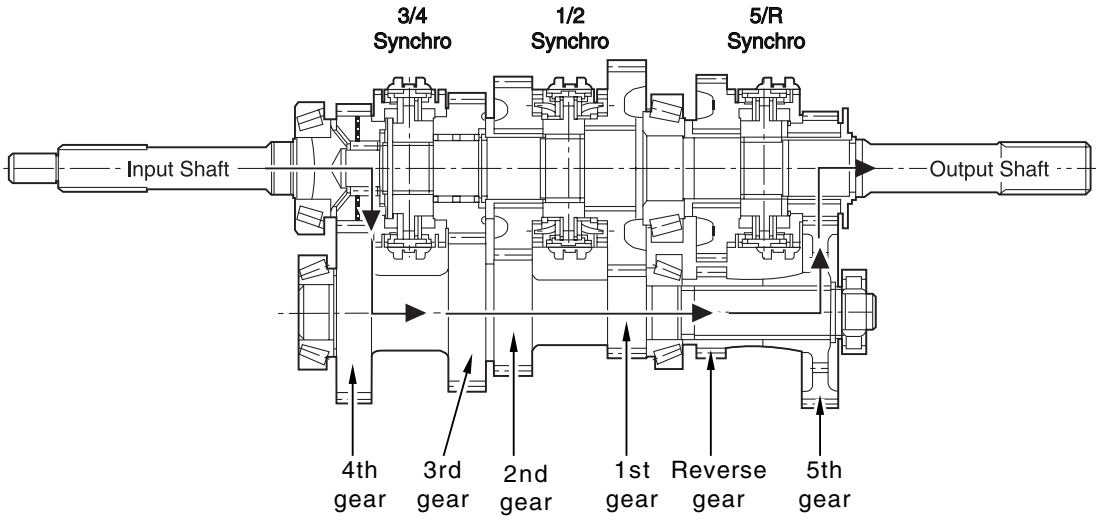
4th gear



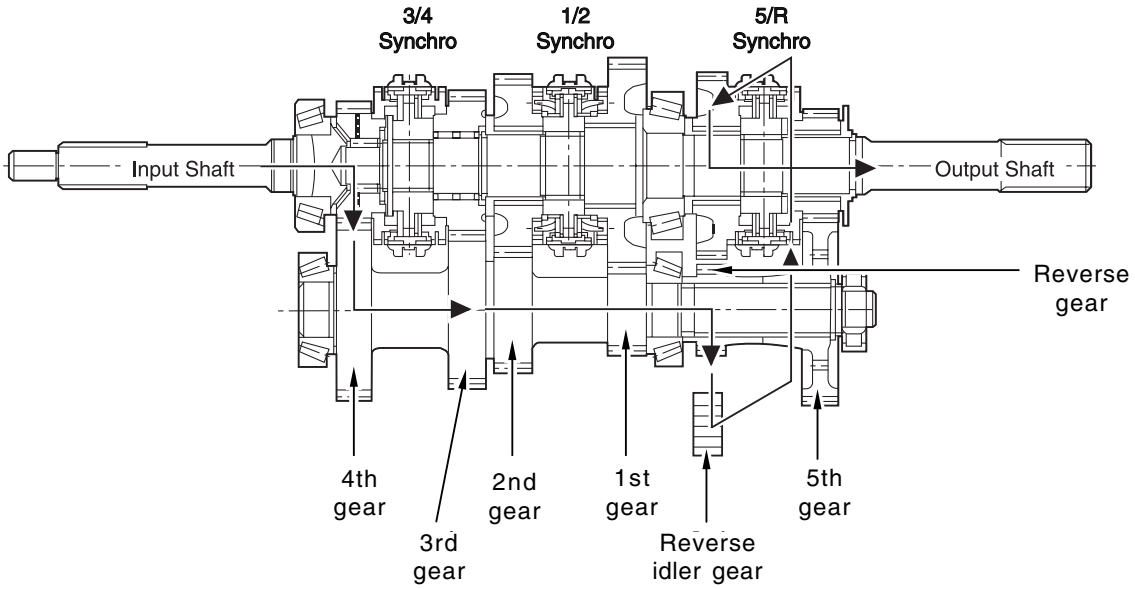
▶ Power Flows (Cont'd)

5th & Reverse Gear - Power Flow

5th gear



Reverse gear

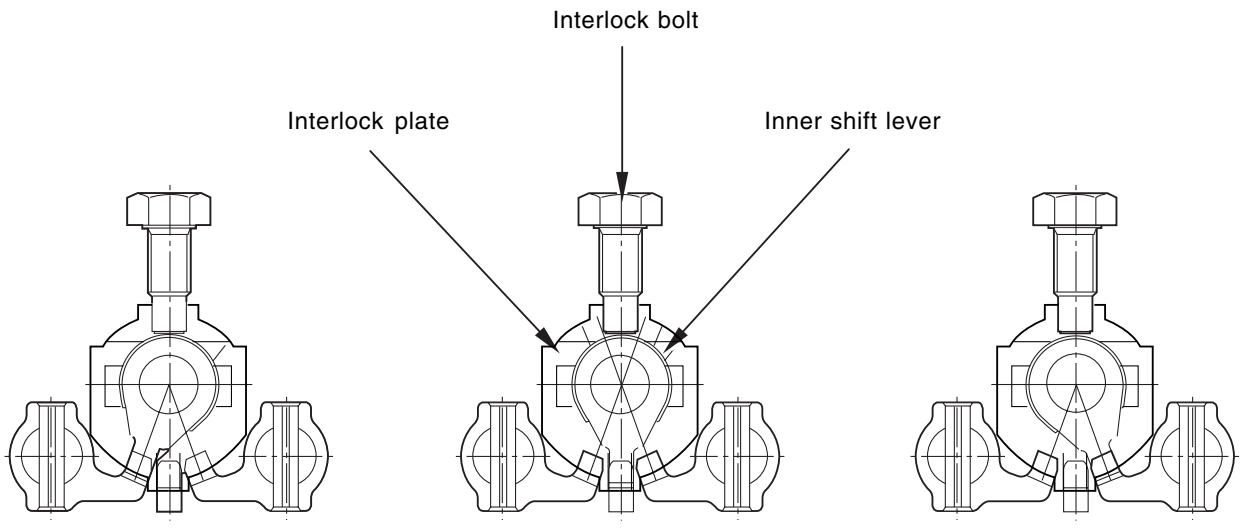


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3. SHIFTING MECHANISM

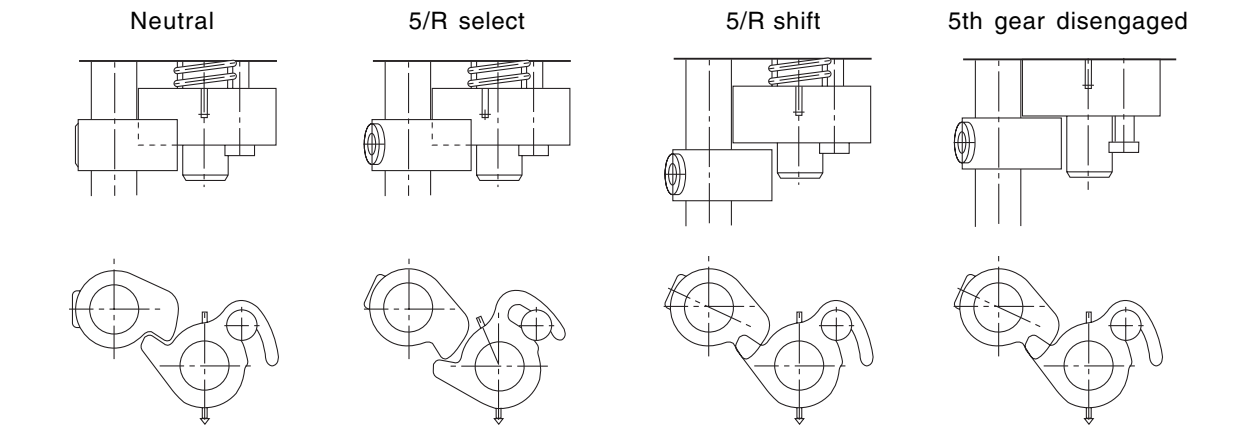
▶ Interlock System

Interlock system prevents the gears from meshing over two sets.



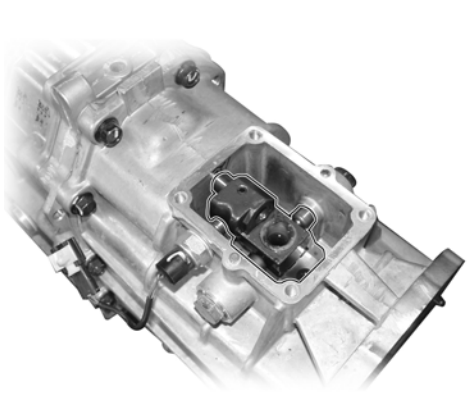
▶ Reverse Interlock System

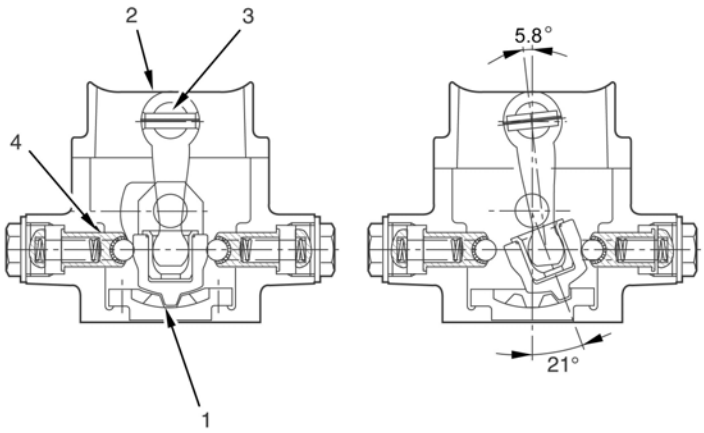
Reverse interlock system prevents the gear from shifting to reverse driving position while driving forward.



▶ Offset Lever and Rolling Plunger

To make the next shift easier, the offset lever applies a reaction force to shift lever toward center position of gear selection gate after a gear has been selected.



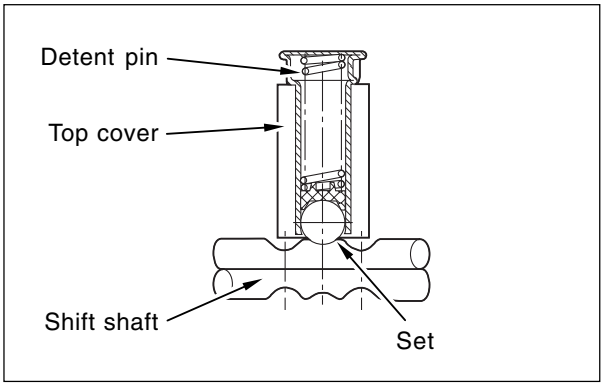


1. Offset lever
2. Shift lever
3. Shift lever
4. Rolling plunger (rolling plunger return spring and ball)

1. Shift check device

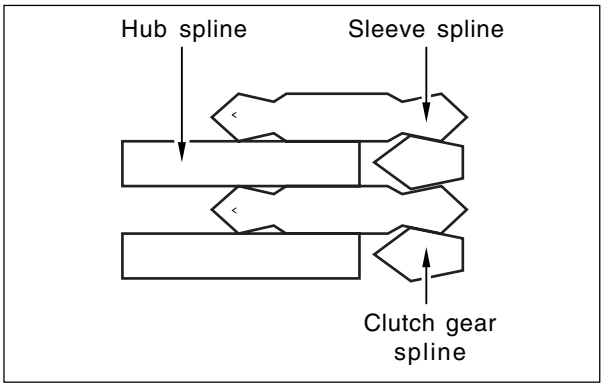
It determines the shift fork position (N or each gear) and gives a detent movement to notice a shift lever seating when operating the shift lever.

Also, it prevent the selected gear from getting out of its meshed position.



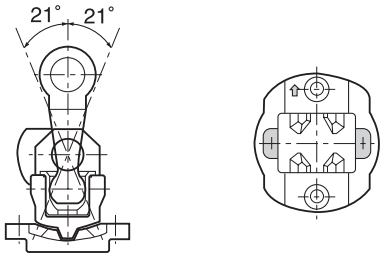
2. Gear jump out locking device

It prevents the shift lever is beyond the correct shift position while shifting.



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3. **Guiding a control direction and preventing an over stroke.**



Offset lever

Offset plate

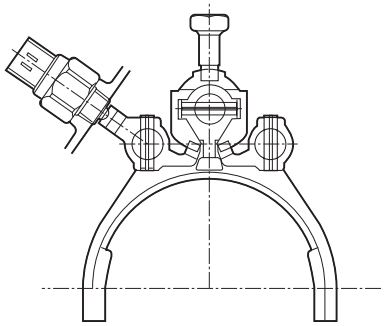
▶ Backup Lamp Switch

It is normal open type switch. Its circuit is formed when the reverse gear is selected.

NOTICE

Installation Notice

- **Sealant: Bond-592-Loctite**
- **Tightening torque: 30 Nm ~ 40 Nm**



▶ Synchronizer

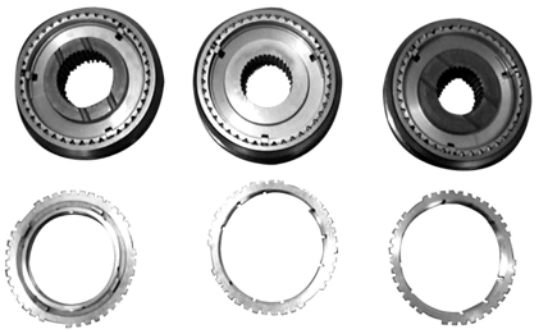
Composition

It consists of synchronizer hub, sleeve, ring, key and spring (1/2, 5/R, and 3/4 synchronizer are different from each other).

1. 3/4 and 5/R shift: Single cone type
2. 1/2 shift: Double cone type - Improving the capacity to bigger engine torque of 1/2 shift (added synchronizer inner cone and middle cone)

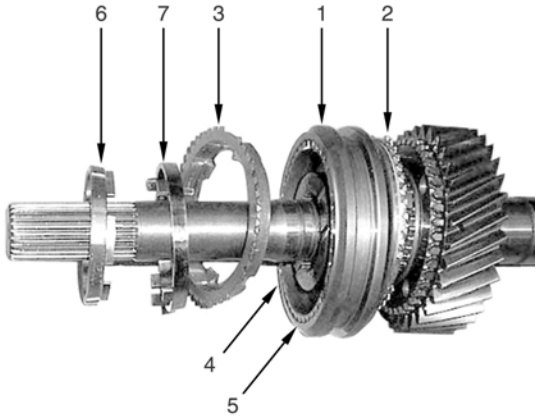
Single Cone Type





1/2 shift 3/4 shift 5/R shift

Double Cone Type





1/2 shift 3/4 shift 5/R shift

1. Synchronizer sleeve
2. Synchronizer hub
3. Synchronizer ring
4. Synchronizer key
5. Synchronizer key locking ring
6. Synchronizer inner cone
7. Synchronizer middle cone

NOTICE

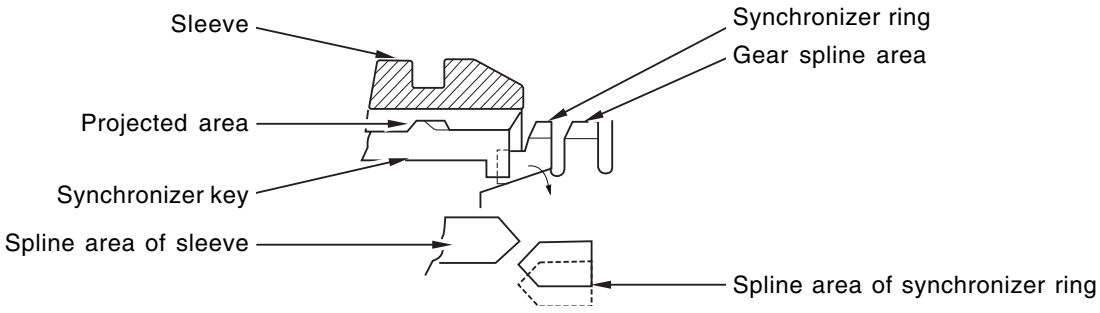
- **Be careful not to mix up the 1/2 shift synchronizer sleeve with 3/4 or 5/R shift synchronizer sleeve.**
- **The 3/4 synchronizer hub also different from 1/2 and 5/R synchronizer hub (different oil gallery).**

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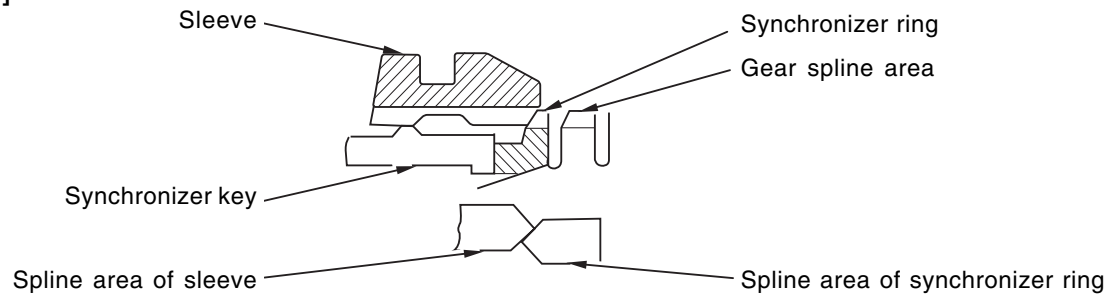
Synchronizer Element During Shift

Acone or sleeve that slides to and fro on the transmission main shaft and makes the gears rotate at the same speed to prevent clash when the gears are about to mesh. Whenever a vehicle is rolling, the transmission main shaft is truning and the clutch gear is spinning. Even though the clutch gear continues to spin until friction slows it down or stops it. Thus, when the driver shifts into another gear he/she is trying to mesh gears that may be moving at different speeds. By using synchronizers, the possibility of broken or damaged teeth is reduced and shifting effort is lowered.

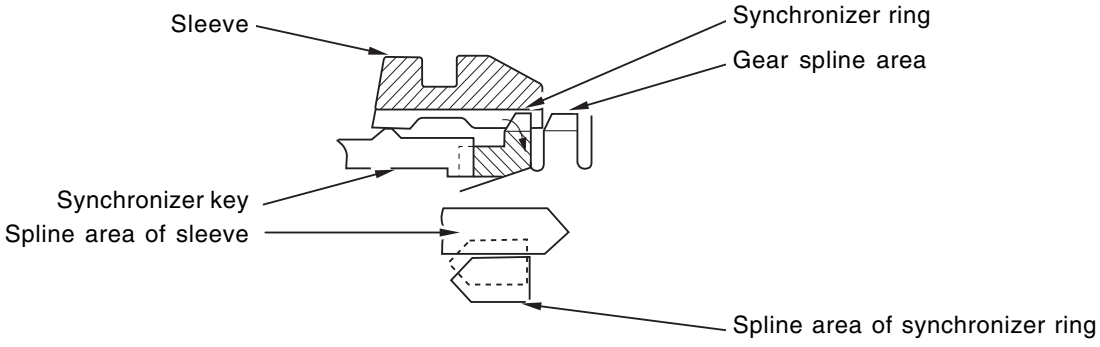
[1st step]



[2nd step]

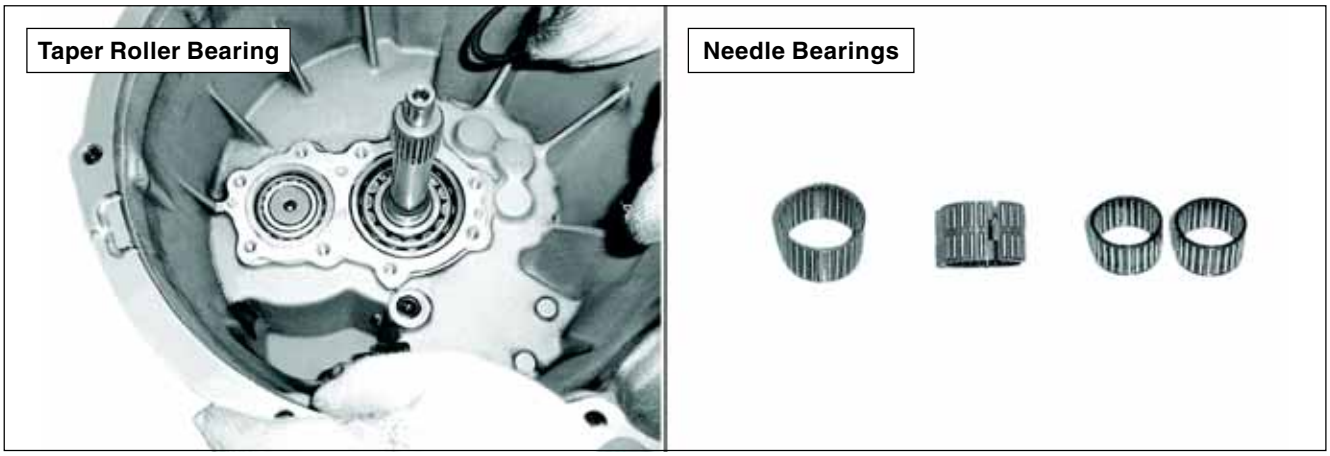


[3rd step]

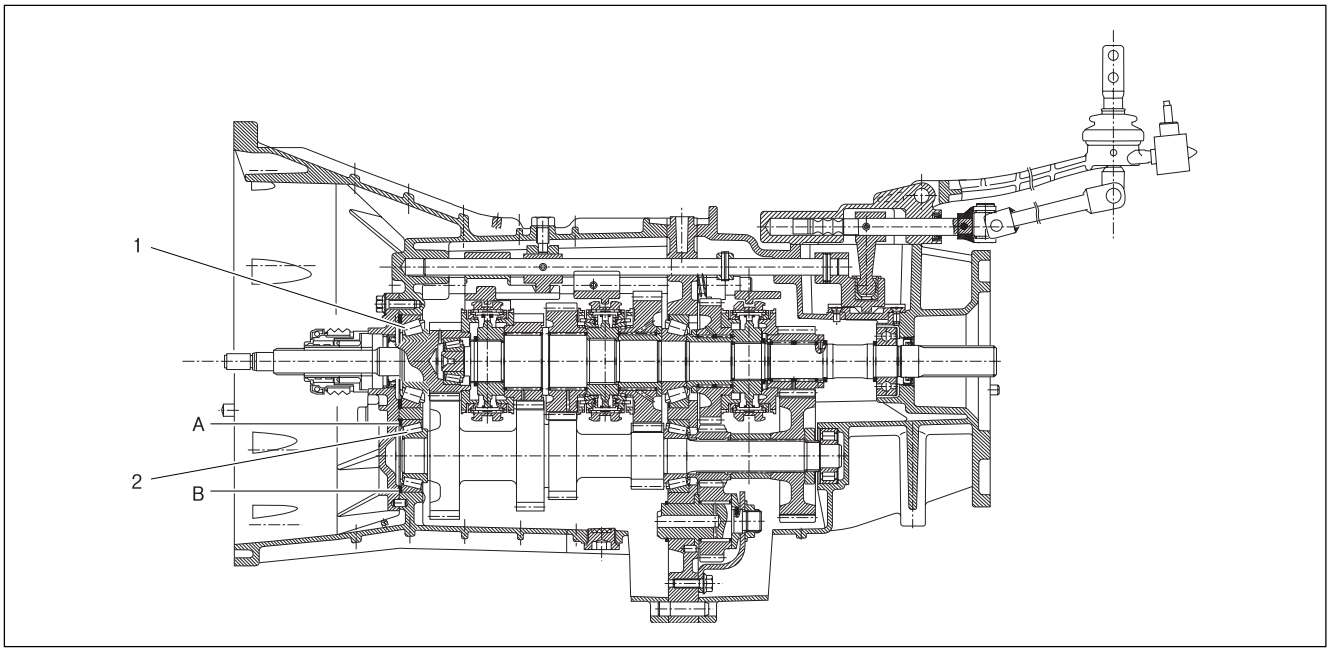


▶ Bearing

The needle bearings are introduced to each gear and the taper roller bearings are used for input and counter shaft in transmission housing.



▶ End Play of Taper Roller Bearing



1. Taper roller bearing for input shaft
2. Taper roller bearing for counter shaft

A. End play A: 0 ~ 0.05 mm
B. End play B: 0 ~ 0.05 mm

NOTICE

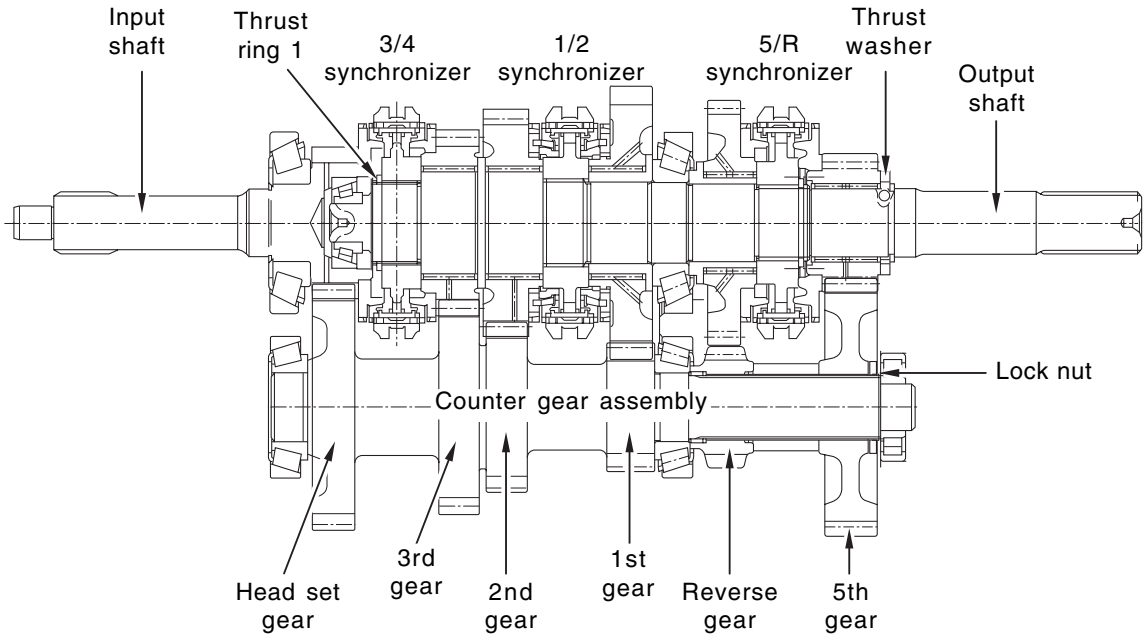
Use the following spacers to adjust the end play (A or B) between input shaft and counter shaft.
(Specified range of end play: 0 ~ 0.5 mm)

- **For input shaft: 0.75 ~ 1.45 mm (15 spacers with increment of 50 μm)**
- **For output shaft: 0.4 ~ 1.45 mm (10 spacers with increment of 50 μm)**

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EFFECTIVE DATE	
AFFECTED VIN	

▶ Thrust Ring (Washer)

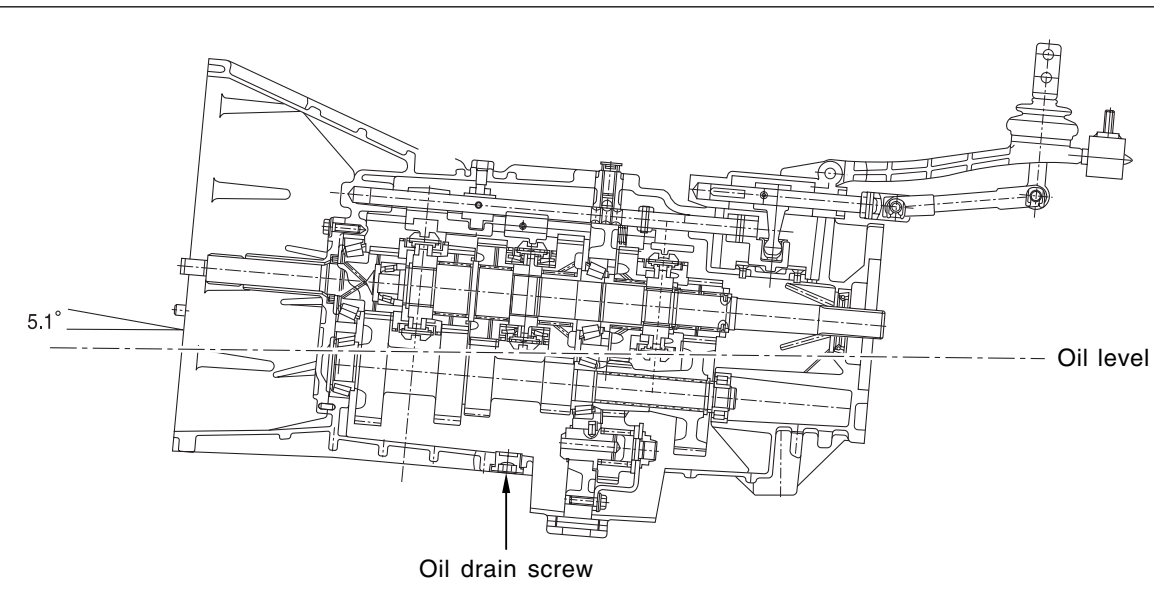
When the driving force from engine is transmitted to the output shaft of transmission, each shaft and gear assembly receive the axial force and this force acts as a resistance to rotating gears.



▶ Lubrication

Transmission oil: ATF DEXRON II.

For initial installation for taper roller bearing and needle roller bearing, lubrication for shift rail: MoS2 Grease.



NOTICE

- **Sealant on oil drain screw during installation: Bond-592 Loctite**
- **Tightening torque: 40 ~ 50 Nm**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. DIAGNOSTIC INFORMATION AND PROCEDURES

▶ Trouble Diagnosis

Symptom	Cause	Action
Can not shift (control lever moves)	Control lever assembly broken or damaged.	Replace control lever and housing assembly.
	Damaged offset lever, shift fork, selector plate or selector arm.	Remove extension, adapter or case cover. Check or replace damaged parts.
Hard shift or control lever will not move into gear	Clutch not releasing.	Adjust or replace clutch.
	Improper or low transmission oil.	Add or replace with specified oil.
	Shift or shift rail binding.	Remove extension, adapter and case cover.Check or replace damaged parts.
	Binding of sliding synchronizers or gears.	Remove extension, adapter and case cover.Check synchronizers and gears and replace damaged parts.
	When reversing, faulty backup switch.	Check or replace backup switch.
	Worn or damaged flywheel pilot bushing.	Replace pilot bushing.
Gears crash when shifting	Engine idle speed too high.	Adjust idle speed to specified speed.
	Damaged or faulty clutch.	Adjust or replace clutch.
	Pilot bearing between input shaft and output shaft binding.	Replace or check roller bearings.
	Damaged synchronizer.	Check or replace synchronizer parts.
	Bell housing misaligned.	Align bell housing and bore.
	Damaged gear(s).	Check or replace gear(s).
	Worn or damaged flywheel pilot bushing.	Replace pilot bushing.
Transmission jumps out	Loosened transmission or flywheel housing bolts, improper alignment.	Tighten bolts to specified value. Realign if necessary.
	Synchronizer damaged or excessively worn.	Check or replace synchronizer parts.
	Blocking ring damaged, worn index slots or friction surfaces worn or damaged.	Check or replace blocking ring.
	Excessive countershaft end play.	Check worn or damaged parts. Adjust shim thickness using roller bearings if necessary.
	Worn or damaged fork due to loosened shaft, rail or shifting fork.	Check for wear or damaged. Replace worn or damaged parts.
Transmission locked in one gear	Fork or offset lever loose on shaft or rail.	Replace extension, adapter or case cover. Check or replace loose parts on shaft or rail. Replace roll pin(s).
	Worn or damaged forks, offset lever, shaft or rail.	Remove extension, adapter or case cover. Check for wear or damaged. Replace damaged parts.
	Worn or damaged synchronizer.	Check worn or damaged synchronizer parts and replace if necessary.
	Worn or damaged gears.	Check worn or damaged gears and replace if necessary.

▶ Trouble Diagnosis (Cont'd)

Symptom	Cause	Action
Transmission noise	Improper or low transmission oil.	Add or drain and replace with proper oil.
	Loose bolts or other attaching parts.	Tighten as specified.
	Improper flywheel housing to engine crankshaft alignment.	Realign correctly.
	Noisy transmission bearing.	Check bearings, bearing rollers and parts for wear or damage. Replace if necessary.
	Noisy gears.	Check for worn or damaged gears (including speedometer gear). Replace if necessary.
Transmission leakage	Leakage from transmission.	Clean all exposed surfaces, then check for leaks.
	Vent or breather clogged.	Clean or replace vent or breather.
	Too much oil.	Check oil level.
	Loose bolts at sealing faces.	Tighten as specified.
	Improperly applied sealant.	Clean leaking surfaces. Reapply sealant.
	Worn or damaged oil seal.	Replace oil seal.

▶ Diagnosis Table

Application													
1 Shift Hop-out													
	2 Shift Gear Crash												
		3 Shift Block-out											
			4 Hard Shift										
				5 Noise in Reverse Gear									
					6 Noise in 5th Gear								
						7 Noise in 4th Gear							
							8 Noise in 3rd Gear						
								9 Noise in 2nd Gear					
									10 Noise in 1st Gear				
										11 Noise in All Speeds			
											12 Leak at Transmission Rear Part		
												13 Leak at Transmission Center Part	
													14 Leak at Transmission Front
Possible Faulty Part													
											●	●	Transmission Case
										●	●		Extension Housing
●			●								●	●	Shift Cover / Shift Shaft
●			●							●			Shift Control Lever
			●										Input Bearing Retainer
									●			●	Input Gear Set
●							●		●				3rd Speed Gear Set
●								●	●				2nd Speed Gear Set
				●									Reverse Speed Gear Set
●								●	●				1st Speed Gear Set
●			●						●				5th Speed Gear Set
			●						●				Clutch Housing and Release Derive
									●				Crankshaft Pilot Bushing and Release Bearing
									●				Input Bearing
									●				Main Shaft Input Bearing
●									●				Main Shaft Thrust Bearing
							●		●				3rd Speed Gear Bearing
								●	●				2nd Speed Gear Bearing
									●				1st Speed Gear Bearing
				●					●				Reverse Idler Gear Bushing
									●				Counter Shaft Front Bearing
									●				Counter Shaft Rear Bearing
●		●			●				●				Counter Shaft Thrust Bearing
										●			5th Speed Drive Gear Bearing
										●			Slip Yoke Bushing
										●			Slip Yoke Seal
										●			Speedometer Drive / Driven Gears
												●	Speedometer Driven Gear Housing
													Input Shaft Seal
●	●	●						●	●	●			1 - 2 Synchronizer Assembly
●	●	●				●	●			●			3 - 4 Synchronizer Assembly
●	●	●				●				●			5th Synchronizer Assembly

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ OIL CHECK/CHANGE

Place the vehicle on the flat and even ground and stop the engine. After 5 minutes, check the oil level.



1. Oil level plug
2. Oil drain plug

NOTICE

- **Do not check or change the oil Immediately after driving off. It may cause serious hurt.**

Place the vehicle on the flat and even ground and stop the engine. After 5 minutes, check the oil level.

1. Remove the oil level plug (1) and check the oil level.

NOTICE

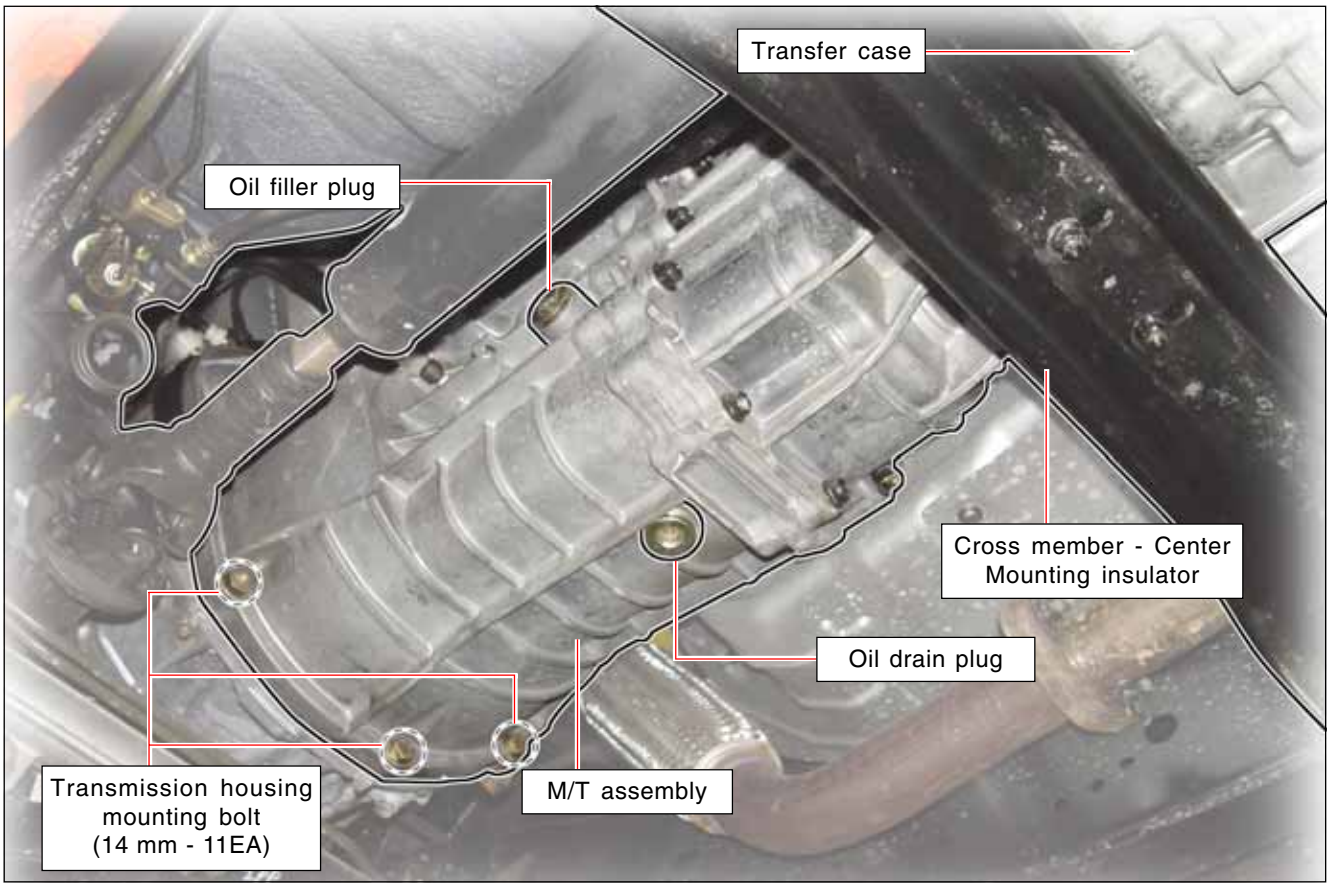
- **When installing the oil drain plug, apply sealant (Bond-592 Loctite) on the thread and tighten it to the specified torque.**

2. If needed, add the oil through the oil level plug (1).
3. Fully tighten the plug and check the oil leaks.
4. If the oil level is up to the bottom line (5 ~ 7 mm) of plug hole, it is OK.

NOTICE

- **The oil in manual transmission is major element for mechanical durability of transmission. Check the oil level with a specific interval and replace if needed.**
- **The oil replacement should be done at the qualified and authorized service station.**

5. REMOVAL AND INSTALLATION (4WD)



- When removing the manual transmission from 2WD vehicle, the removal procedure of the transfer case is not included.

Removal and Installation

※ **Preceding Work:** Disconnect the battery negative cable and remove the center console.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

1. Unscrew two bolts (1) and remove the change lever from shift lever.

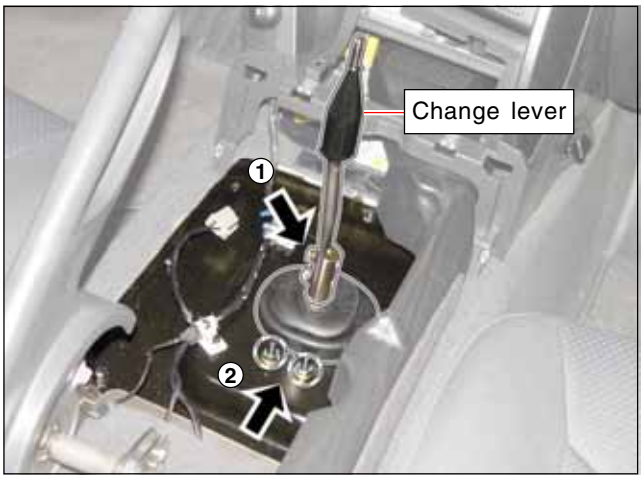
Installation Notice

Tightening torque	12 ~ 23 Nm

2. Unscrew two bolts (12 mm) (2) from semi-remote controller.

Installation Notice

Tightening torque	12 ~ 23 Nm



3. If the oil should be changed, remove the oil drain plug (A) in transmission housing and fully drain the oil. And, retighten the plug (A).

Installation Notice

Tightening torque	40 ~ 50 Nm



4. Unscrew four bolts (17 mm) and separate the rear and front propeller shafts connected to transfer case output shaft. Set aside the removed shafts not to disturb the operation.



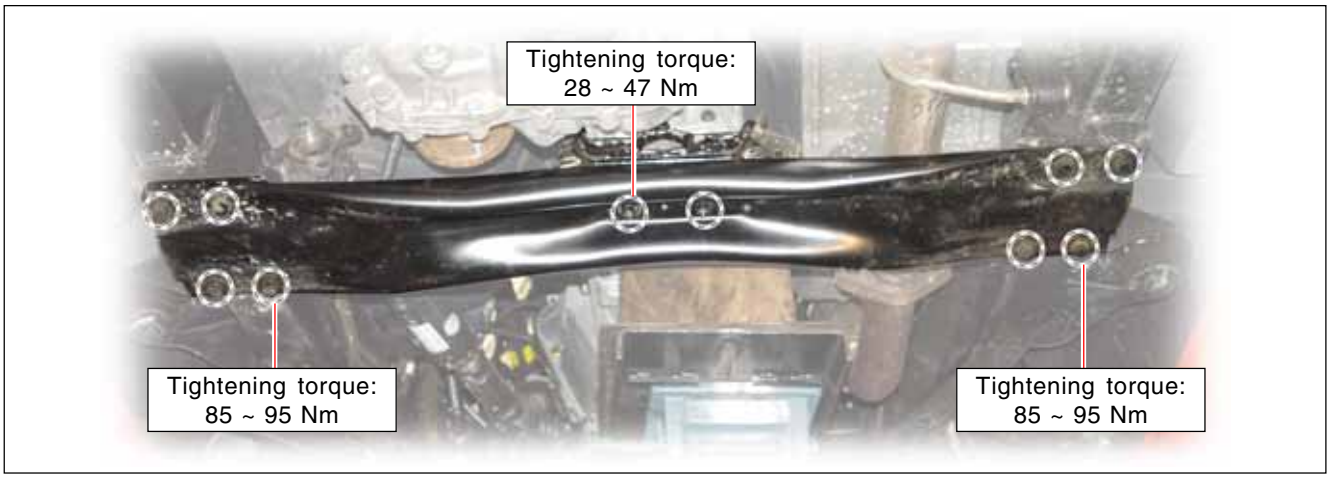


5. Disconnect the air bleeder hose, neutral switch connector, back up lamp switch connector and transfer case connectors.

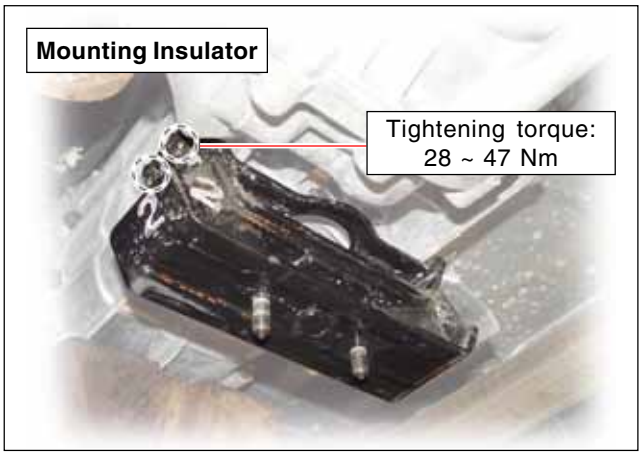


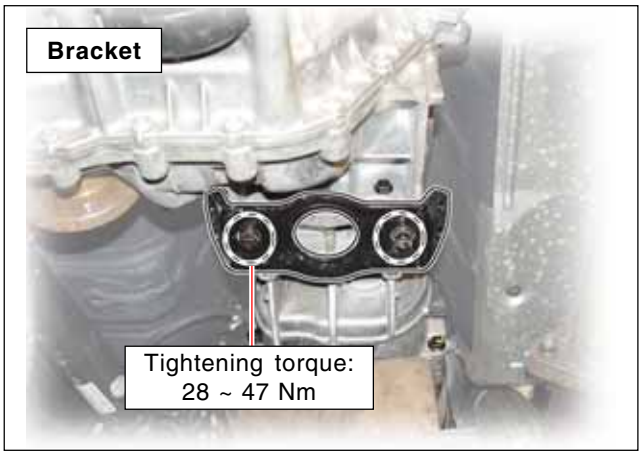


6. Support the underbody of transmission with a hydraulic jack not to deflect it and unscrew the bolts (14 mm - 4EA) and cross nuts (14 mm - 2EA) and remove the cross member.



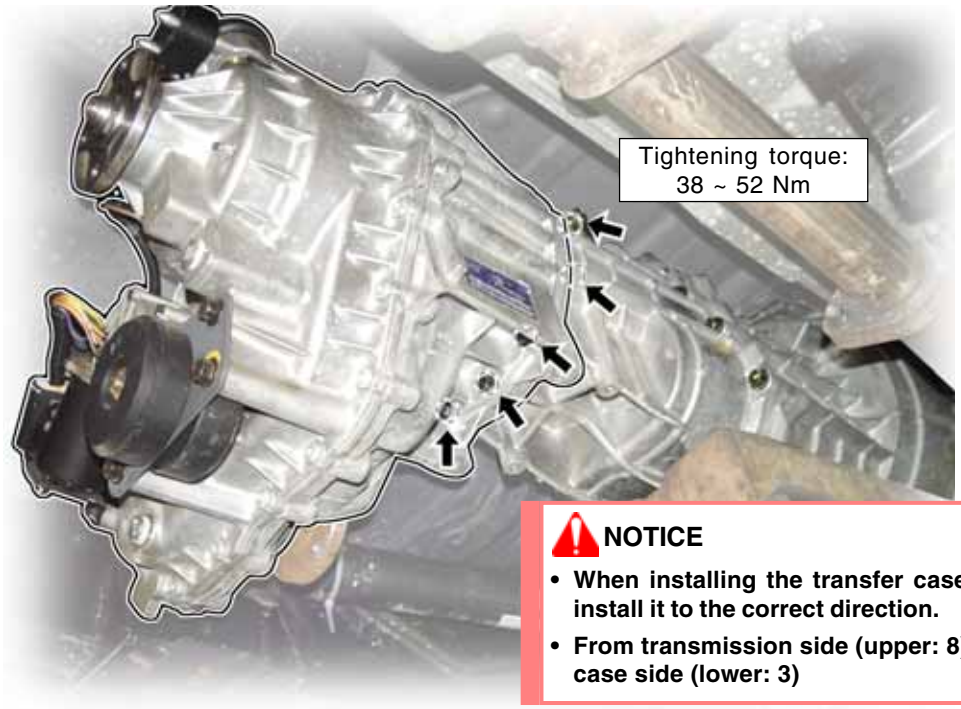
7. Unscrew two bolts (14 mm) at both sides and remove the transmission mounting insulator. Unscrew the mounting bolts (14 mm - 2 EA) at both sides and remove the mounting insulator bracket.





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

8. Unscrew eleven bolts (14 mm) and remove the transfer case with a hydraulic jack.



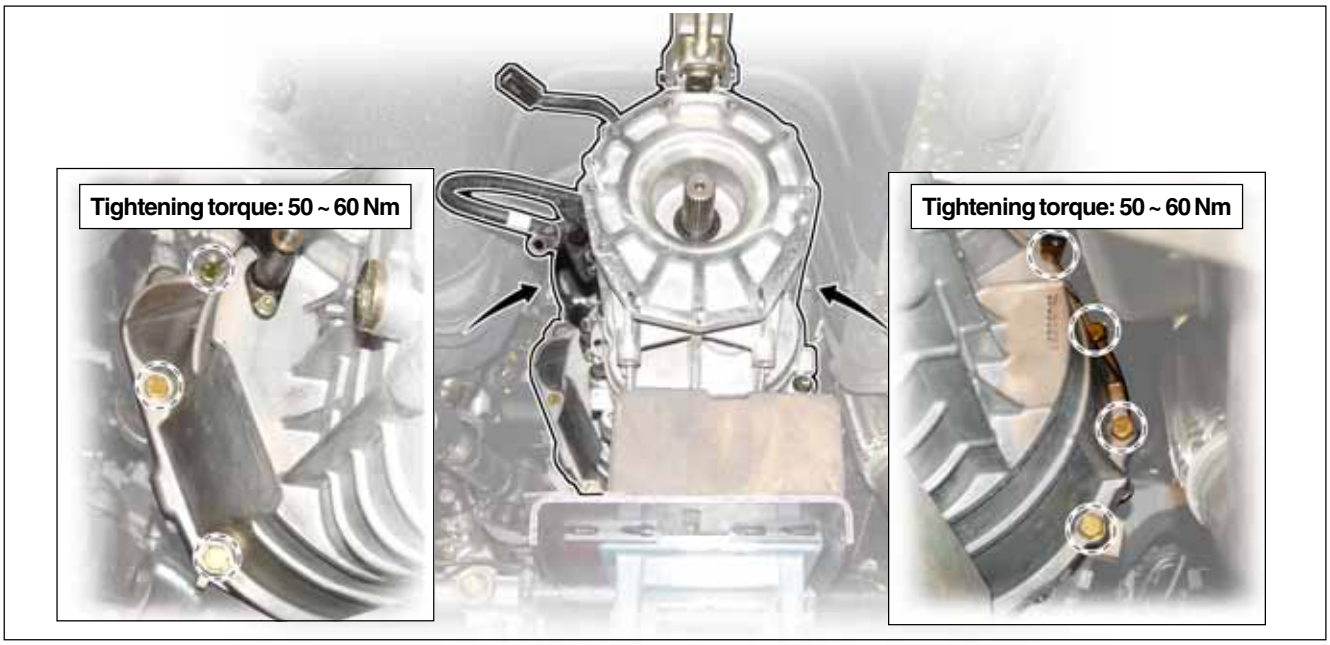
NOTICE

- **When installing the transfer case, make sure to install it to the correct direction.**
- **From transmission side (upper: 8), From transfer case side (lower: 3)**

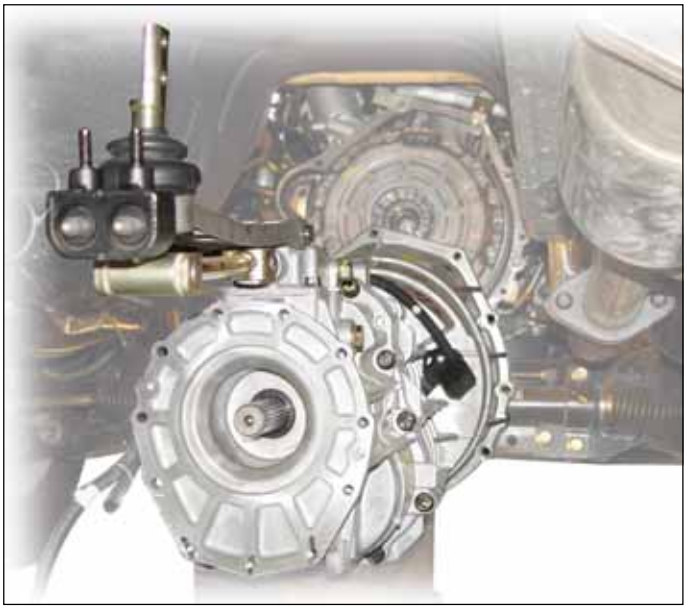
9. Separate the clutch oil hose from adapter.
   (Clamp the hose with a locking pliers after separating the clutch oil hose to prevent the oil from leaking.)



10. Support the transmission housing with a hydraulic jack and unscrew eleven transmission bolts (17 mm).



11. Carefully lower the hydraulic jack to remove the transmission assembly.



Inspection before Installation

Install in the reverse order of removal. Check the components for wear or damage before installation.

1. Check the concentric slave cylinder for abnormal wear and replace if necessary.
2. Check the pressure plate spring for wear.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. DISASSEMBLY AND REASSEMBLY

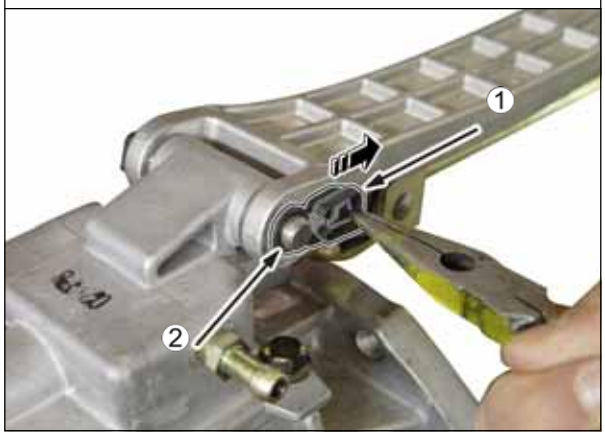
▶ MANUAL TRANSMISSION ASSEMBLY

Disassembly

1. Remove the transmission oil drain screw (hexagon, 14 mm) and completely drain the oil. Place the removed transmission on the workbench.

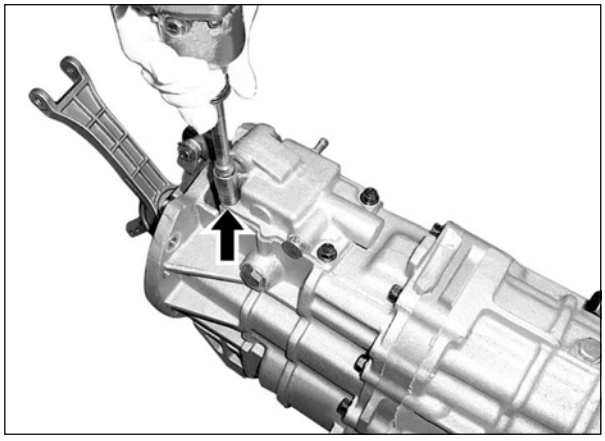


2. Pull out the lock washer (1) and remove the TGS pin (2).

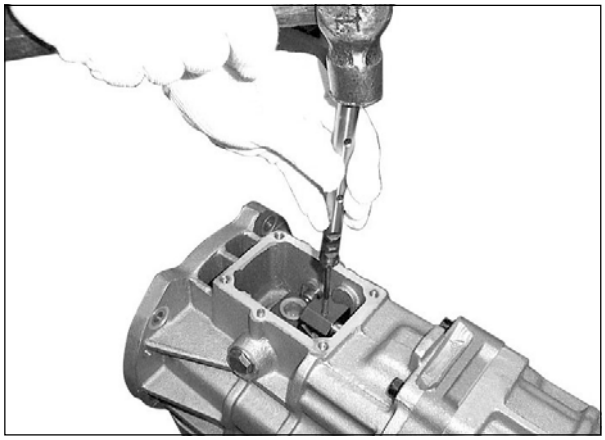


3. Push the semi remote lever rearward and unscrew the mounting bolts (4) with a wrench (12 mm) to remove the top cover.

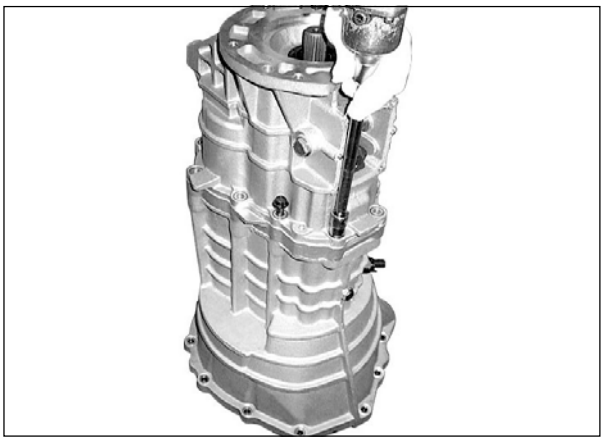
NOTE
- **Be careful not to lose the disassembled components.**



4. Tilt the offset lever and pull out the spring pin (6 x 25) to remove the offset lever.



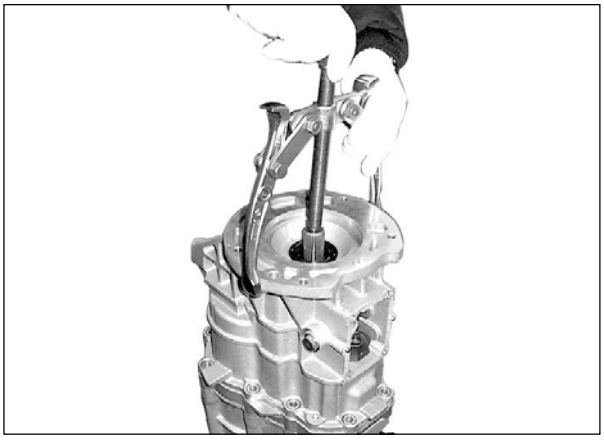
5. Remove the bolts from the extension housing with a wrench (14 mm).



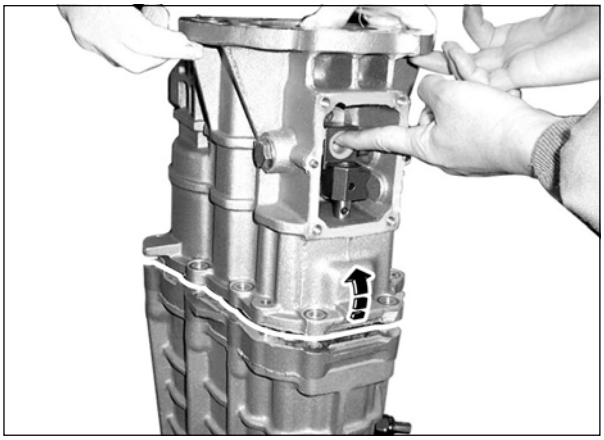
6. Remove the extension housing with a special tool.

NOTICE

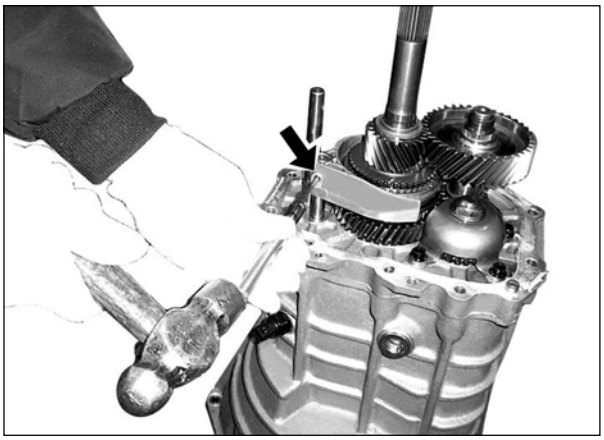
- **Remove the offset lever and rolling plunger with the extension housing. Be careful not to drop them.**



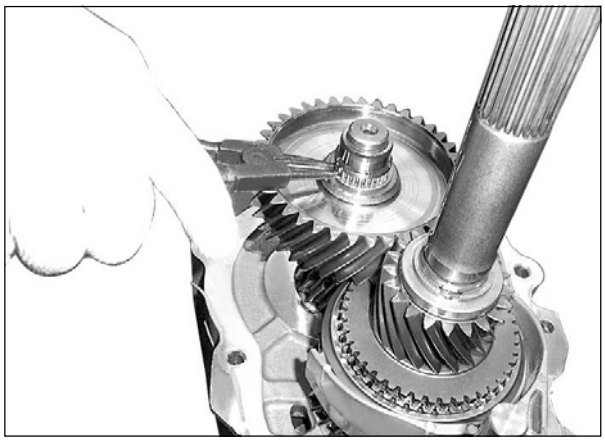
7. Remove the rear ball bearing with a puller and remove the speedometer driven gear.



8. Remove the 5/R shift fork spring pin (6 x 28).

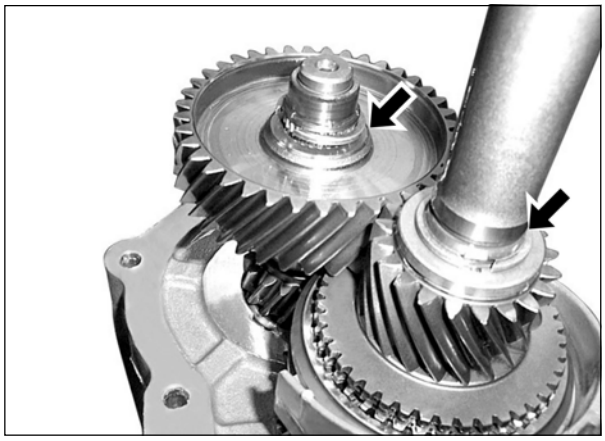


8-1. Pull the counter gear (5th gear) retainer ring out from the ring groove with a ring pliers.

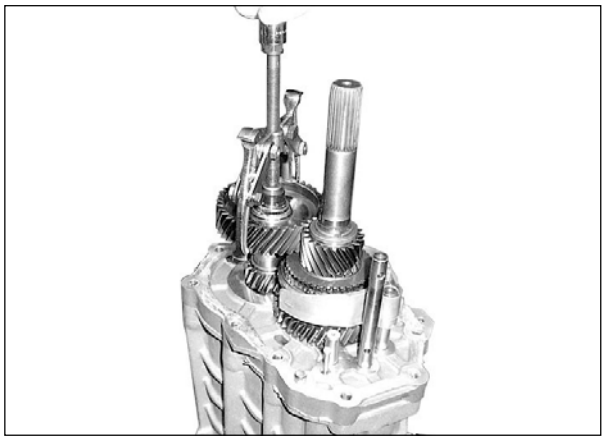


NOTICE

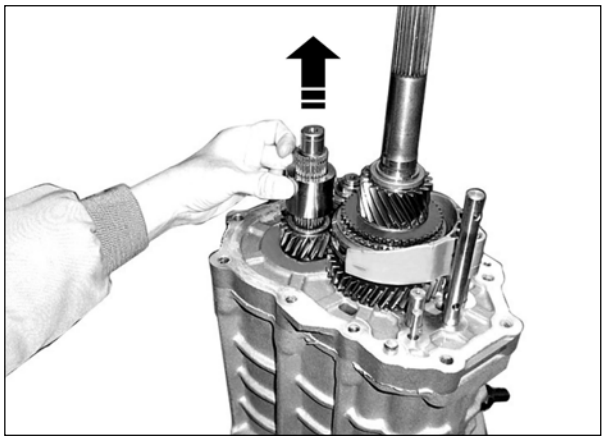
- **Be careful that the retainer ring does not pop out.**



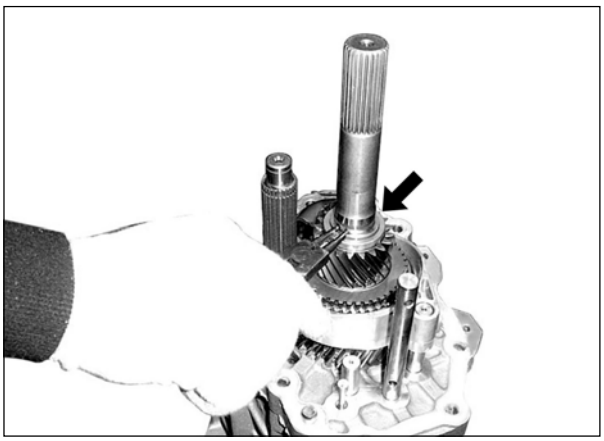
9. Spread the retainer ring and remove the 5th counter gear with a puller.



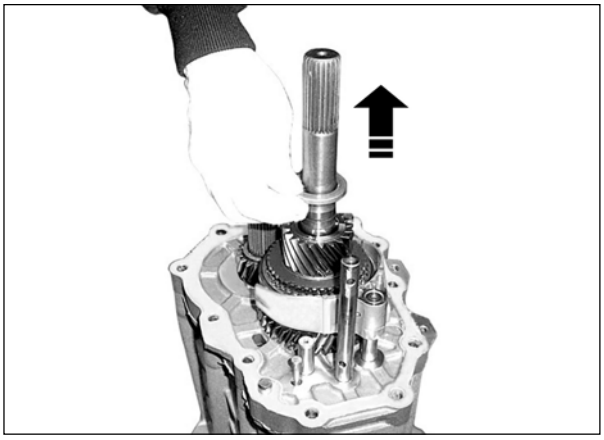
10. Remove the counter reverse spacer.



11. Remove the 5th gear retainer ring with a ring pliers.



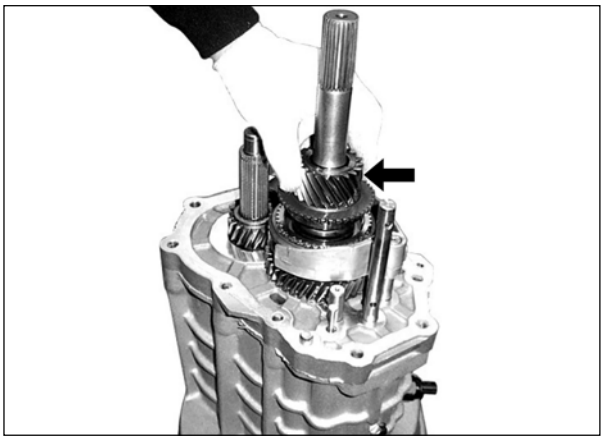
12. Remove the thrust washer from the shaft.



13. Remove the 5th gear and pull out the spring pin.

NOTICE

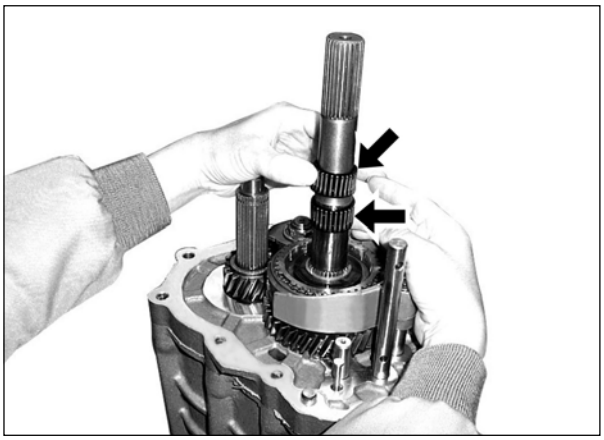
- **Be careful not to lose or mix the spring pins.**



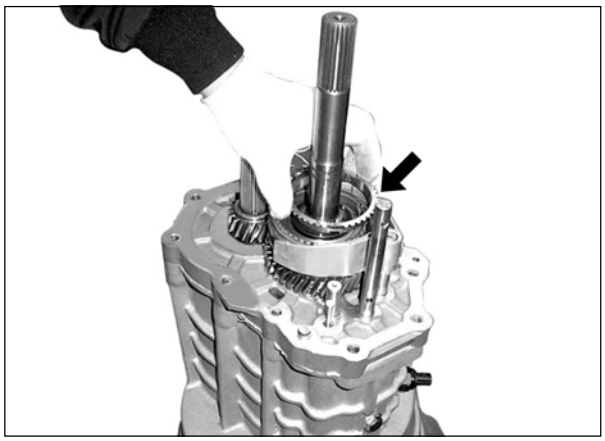
14. Remove two 5th gear needle bearings.

NOTICE

- **Be careful not to lose or mix the needle bearings.**



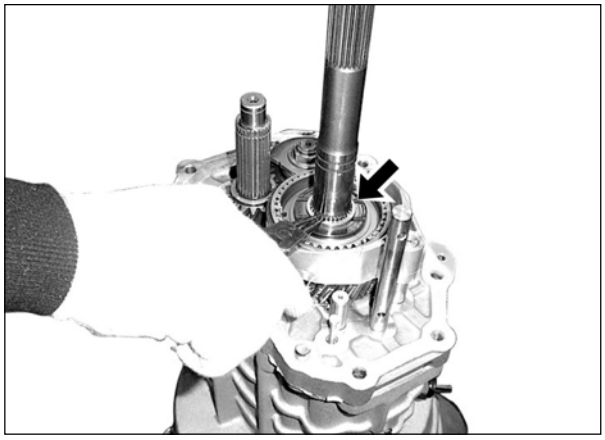
15. Remove the 5th gear synchronizer ring.



NOTICE

- **Store at a safe place not to be mixed with other synchronizer rings.**

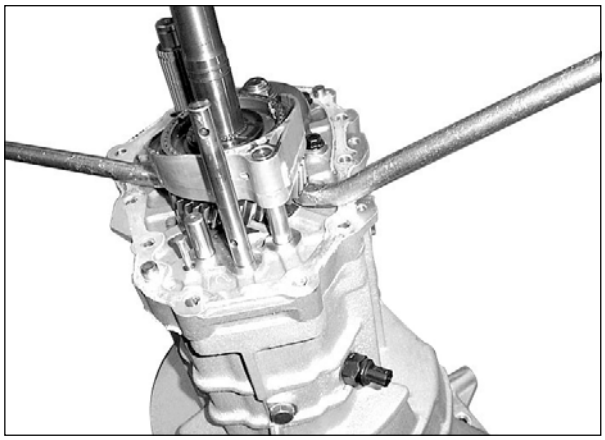
16. Remove 5/R gear retainer ring from the shaft with a ring pliers.



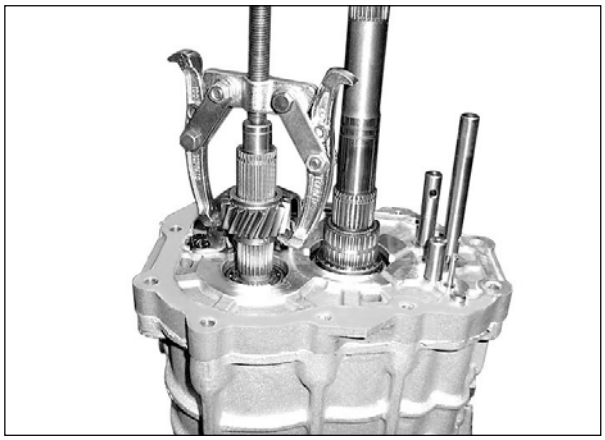
NOTICE

- **Store the ring with the relevant gear to prevent incorrect installation.**

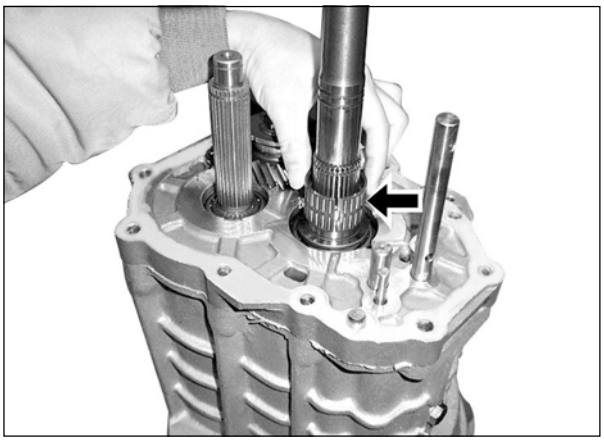
17. Remove the 5/R synchronizer hub assembly, the reverse gear and the shift fork at a time.



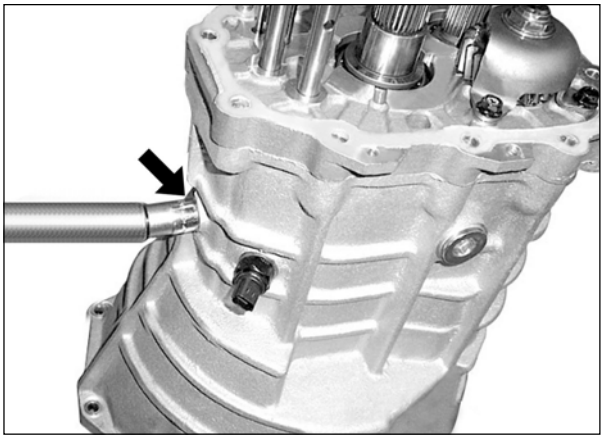
18. Remove the counter reverse gear.



19. Remove the counter reverse gear needle bearing.



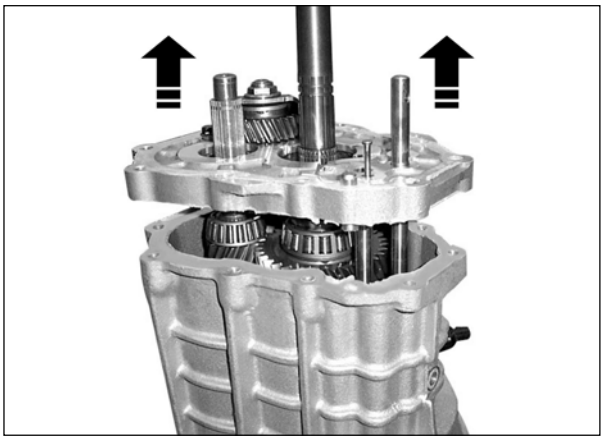
20. Remove the interlock bolt (17 mm).



21. Remove the transmission adapter from the transmission housing.

NOTICE

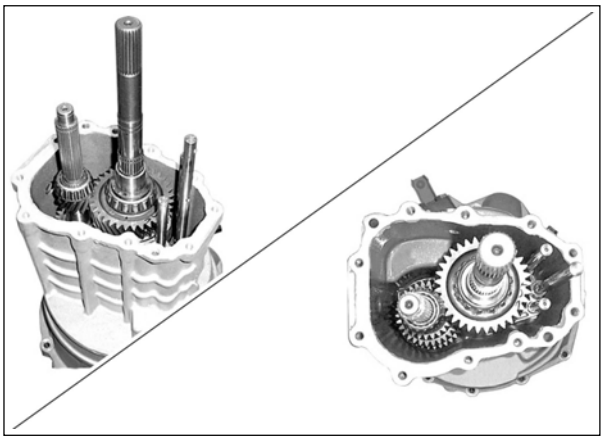
- **Be careful not to damage the adapter mating surface.**



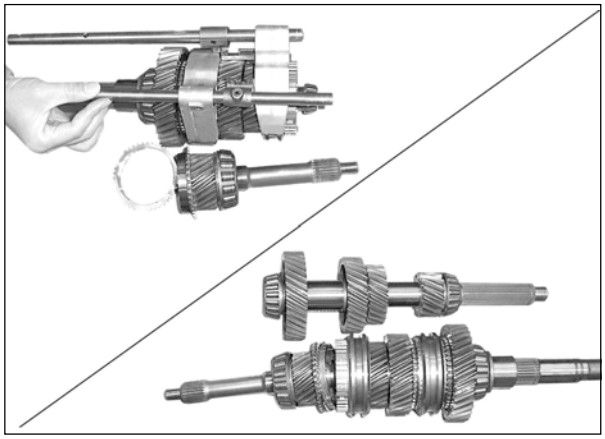
22. Remove the gear assembly from the housing.

NOTICE

- **Do not forcefully remove the gear assembly. It may damage the level grooves resulting in incorrect installation. Carefully remove the gear assembly.**



23. Remove the main and counter gear assembly.
    a. Pull out the pins from 5/R and 1/2 shift rails and remove the shift rails through the rear section of adapter.
    b. Pull out the locking pins from shift forks.



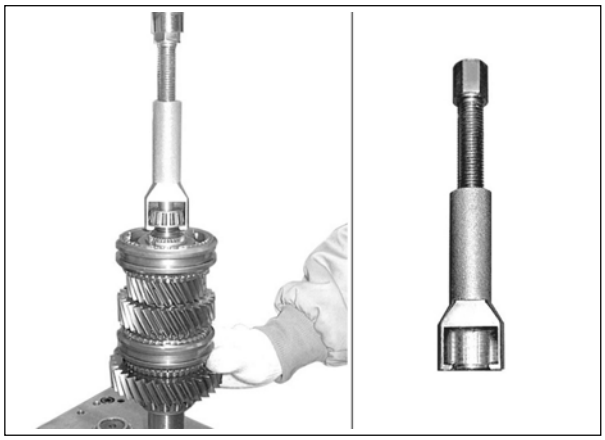
24. Remove the shift rail and shift fork. Place the output shaft and counter gear on the special tool.



25. Place the output shaft assembly with the 1st gear facing down and remove the intermediate taper roller bearing with a special tool.

NOTICE

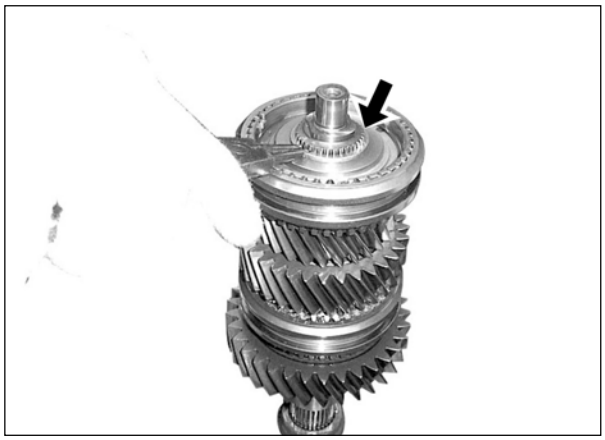
- **To prevent the bearing damage, securely seat the special tool before removing the intermediate taper roller bearing that is pressed in.**
- **Do not use general bearing puller.**



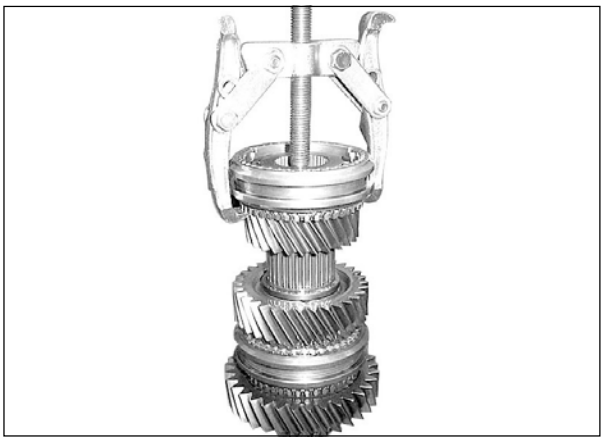
26. Remove the 3/4 gear retainer ring.

NOTICE

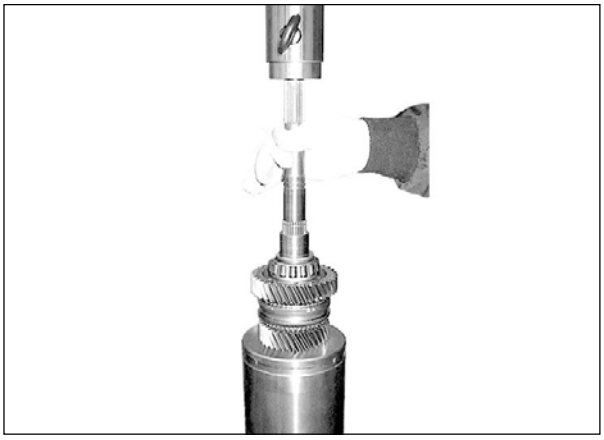
- **Be careful not to lose or mix the retainer ring.**



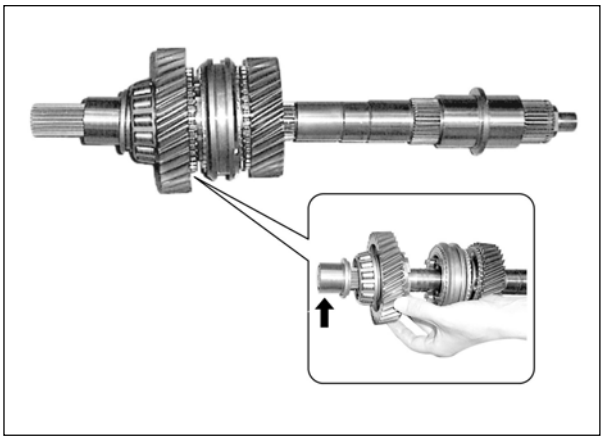
27. Remove the 3/4 gear synchronizer hub and single synchronizer sleeve and 3rd gear with a special tool. Pull out the needle bearing.



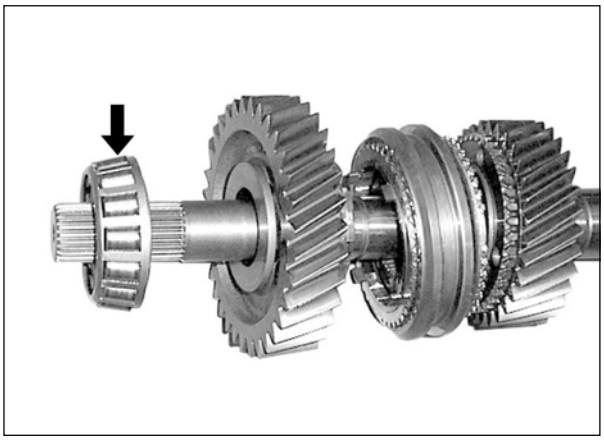
28. Loosen the 1/2 gear and hub and double synchronizer sleeve with a press.



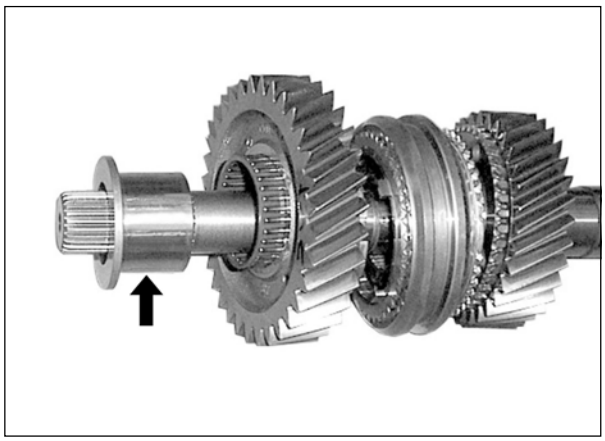
29. Remove the reverse gear inner race.



30. Remove the main taper roller bearing.



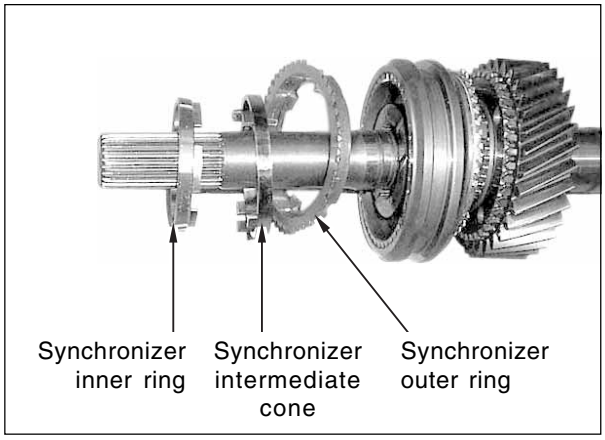
31. Remove the inner race, 1st gear and needle bearing from the shaft.



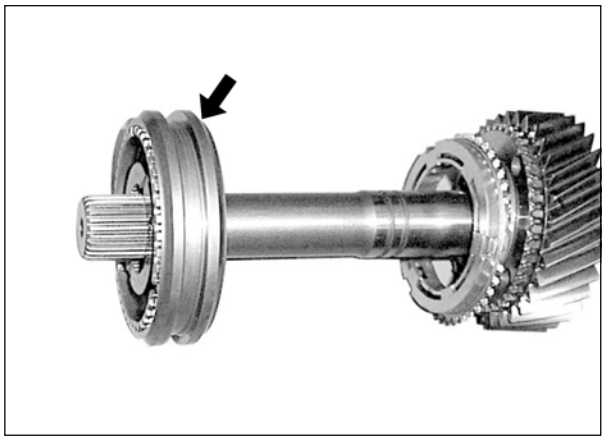
NOTICE

- **Store the disassembled gears by relevant components.**

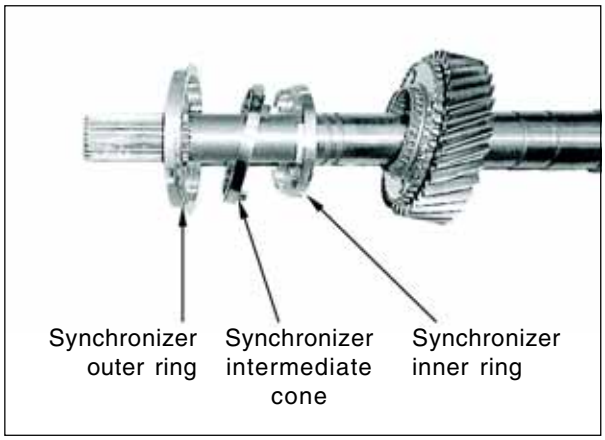
32. Remove the synchronizer inner intermediate cone and outer ring in 1st gear side.



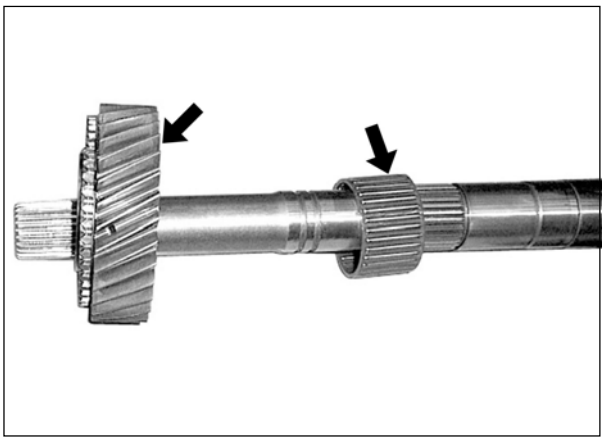
33. Remove the 1/2 gear synchronizer hub along with double synchronizer sleeve.



34. Remove the synchronizer inner ring, intermediate cone and outer ring in 2nd gear side.



35. Remove the 2nd gear and needle bearing.



36. Remove the oil seal from the extension housing.



Inspection Before Assembly

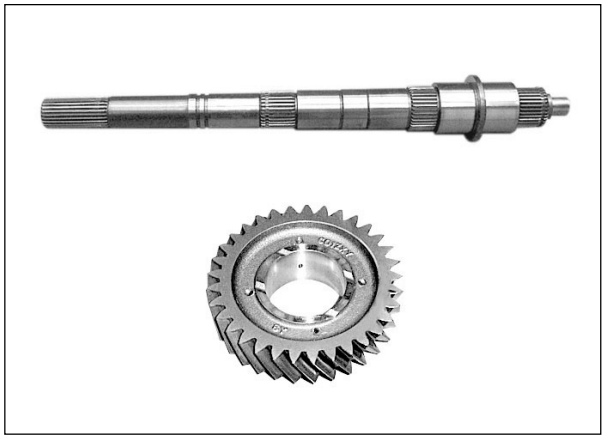
1. Clean all the disassembled components with solvent and dry them with compressed air.

   Check the components for crack, wear and damage.

   a. Case, extension housing, shift lever
   b. Input bearing retainer
   c. Counter shaft rear bearing retainer
2. Check the bearing and shaft supporting area for wear and replace if needed.
3. Check the surface conditions on:

   a. Input shaft
   b. Main shaft and gears
   c. Counter shaft and 5th drive gear

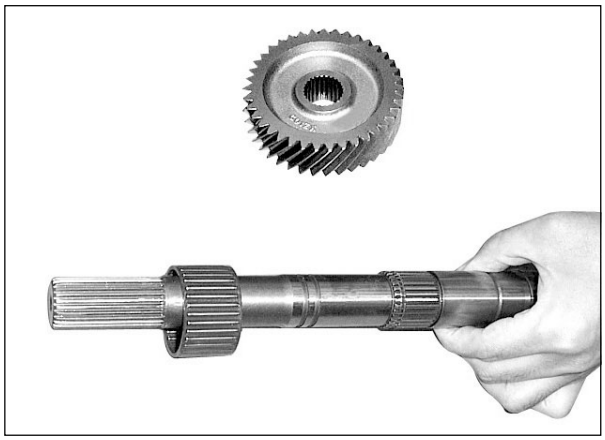




4. Reverse idler shaft and gears.

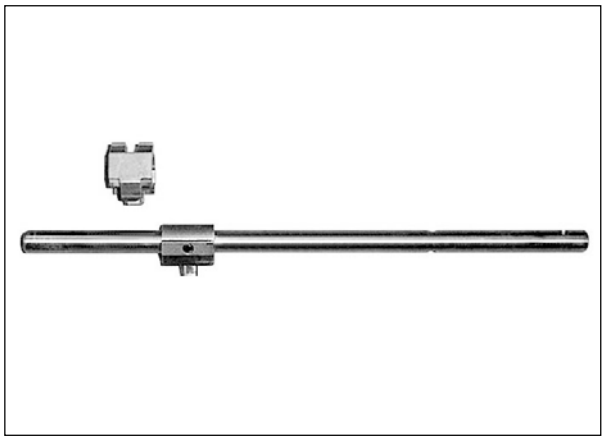
NOTICE

- **Replace the excessively worn components. Do not grind the precisely machined components.**



5. Check the following components for wear:

   a. Selector arm
   b. Interlock plate
   c. 1/2 and 3/4 shift fork
   d. Shift shaft
   e. Detent/guide plate and offset lever
   f. Each shift lever shift fork



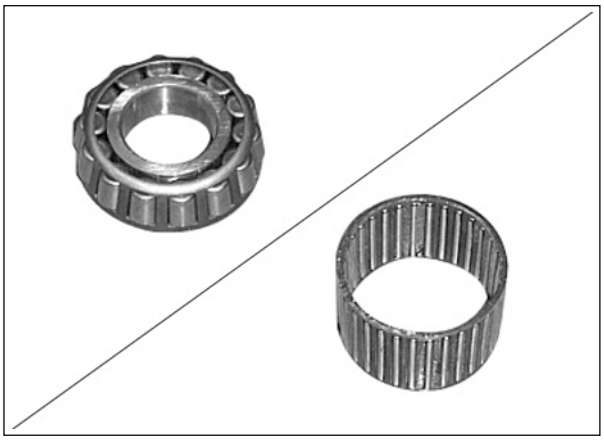
g. Hub and sleeve
h. 1/2 shift fork, pads, synchronizer sleeve



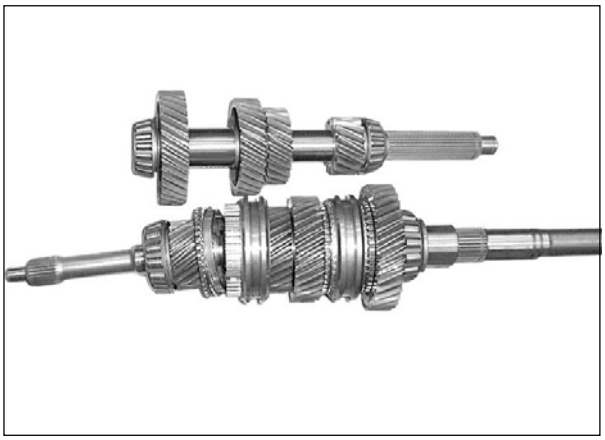
i. 3/4 shift fork, pads, synchronizer sleeve
j. 5th gear shift rail/fork, pads, synchronizer sleeve
k. Reverse fork and reverse idler gear sleeve



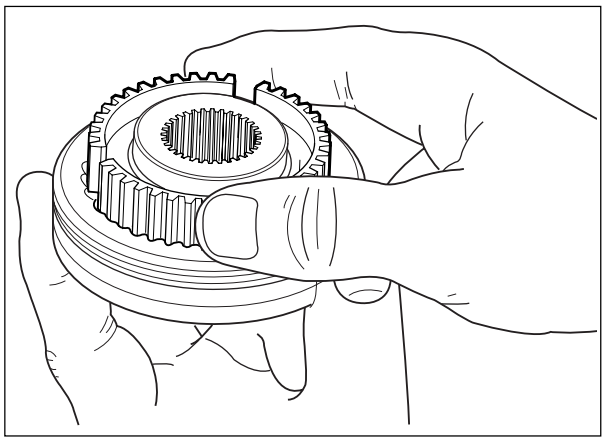
6. Check the following components for excessive wear:
   a. Crankshaft pilot bushing in front of input shaft
   b. Clutch release bearing
   c. Main shaft pilot bearing roller
   d. Main shaft thrust bearing mating surface
   e. Main shaft speed gear roller bearing
   f. Main shaft rear bearing
   g. Counter shaft front and rear bearing



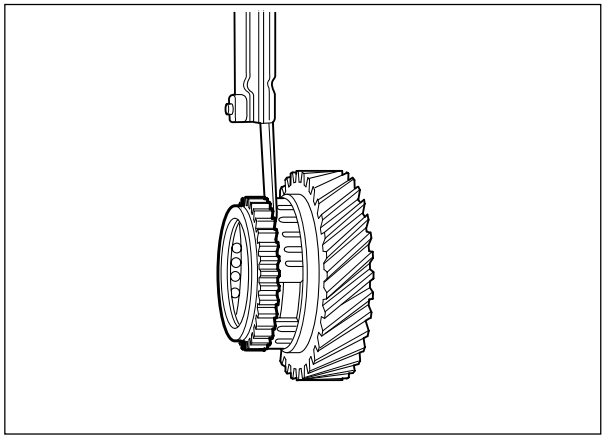
7. Check the gear sets for wear in teeth surface.
8. Check the gear sets for excessive wear, crack and break and replace if needed.



9. Check the conditions of each synchronizer sleeve and hub.
   a. Engagement of hub and sleeve
   b. Wear on cone clutch surface in synchronizer ring (brass) engaging the gears



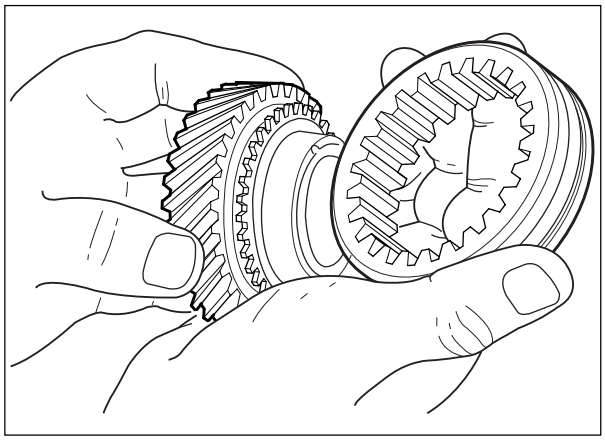
10. Measure the clearance between synchronizer ring and speed gear.
    a. New 1/2 gear synchronizer ring: 0.87 ~ 1.4 mm
    b. New 3/4 gear synchronizer ring: 0.88 ~ 1.5 mm



NOTICE

- **If the clearance is excessive, replace it with new one. Otherwise, it may cause the missing or breakage of the gears.**

11. Check the speed gear clutch and synchronizer sleeve for damage in teeth surface.
12. Check the engagement of synchronizer sleeve and speed gear clutch.



Assembly

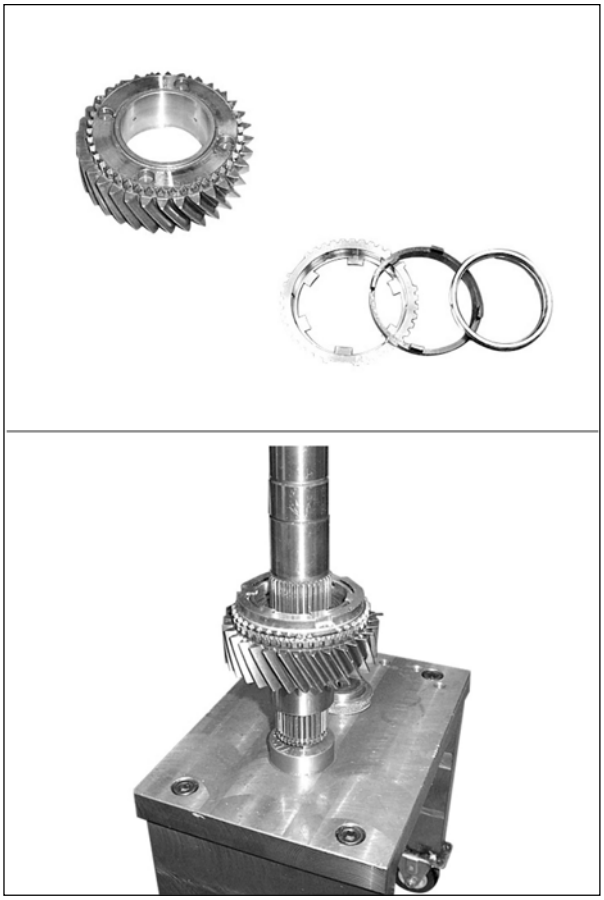
1. Install the 2nd gear needle bearing.



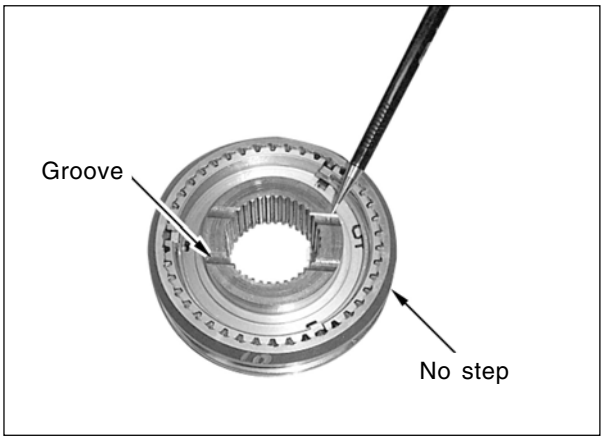
NOTICE

- **The 1st/2nd/3rd gear needle bearings have one bearing row and the sizes of them are same. The reverse needle bearing has two bearing rows. The 5th needle bearing is smaller than others and consists of two bearings.**

2. Install the 2nd gear, synchronizer outer ring, intermediate cone and inner ring in turn.



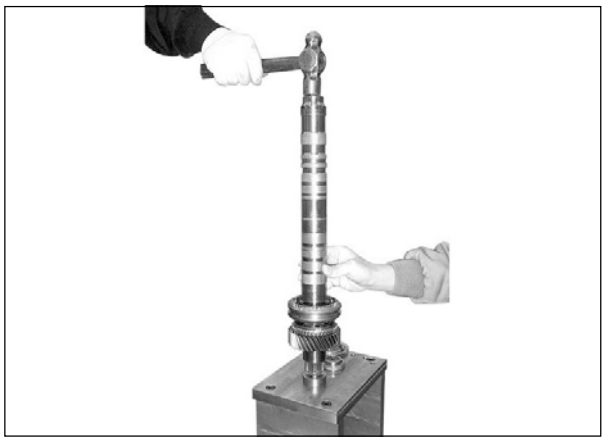
3. Insert three keys into 1/2 synchronizer hub and double synchronizer sleeve. Install the synchronizer spring in offset so that it should not be missed out.



NOTICE

- **1/2 gear double synchronizer sleeve doesn't have a step at edge. However, 3/4 and 5/R gears have it.**

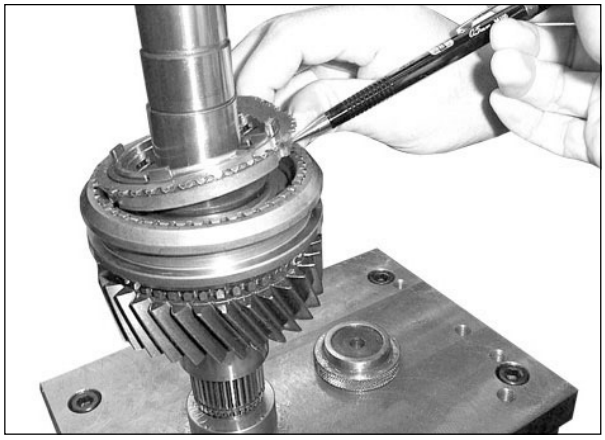
4. Install the 1/2 synchronizer hub and double synchronizer sleeve into the output shaft by using a press.



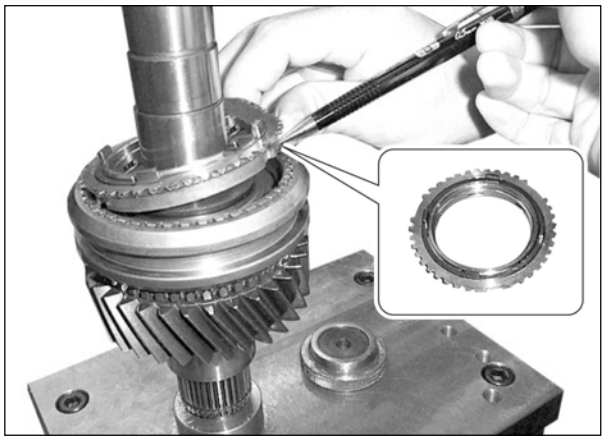
NOTICE

- **Make sure that the hub groove faces to 2nd gear. Align the synchronizer key and the synchronizer ring groove in 2nd gear.**

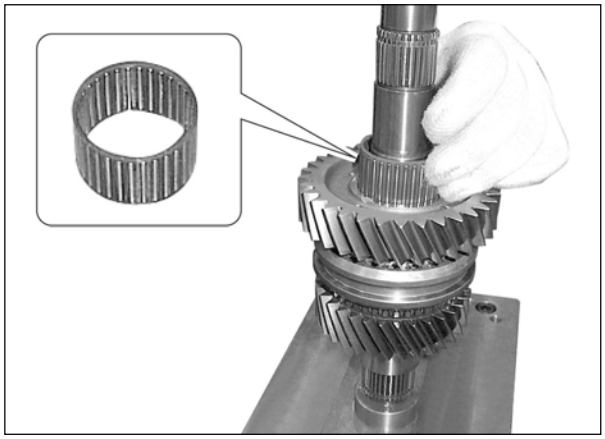
5. Install the synchronizer outer ring, intermediate cone and inner ring into the 1/2 synchronizer hub in turn.



6. Install the 1st gear.



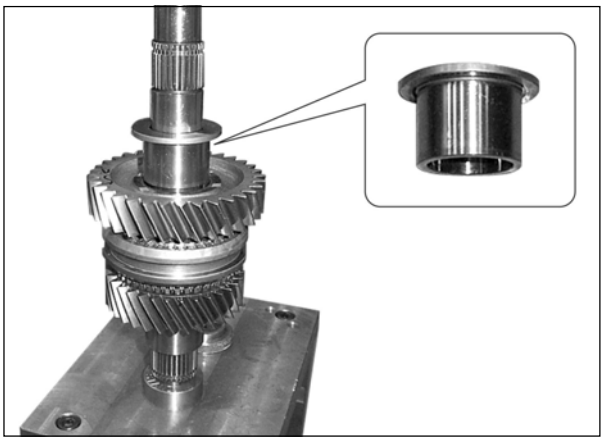
7. Install the 1st gear needle bearing.



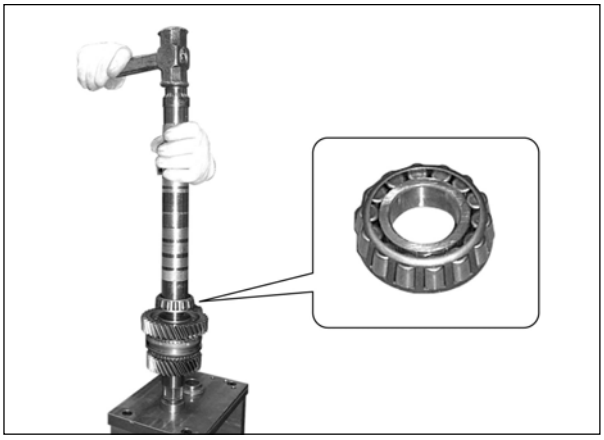
8. Install the 1st gear inner race by using a press.

NOTICE

- **The 1st inner race doesn't have a step at edge.**



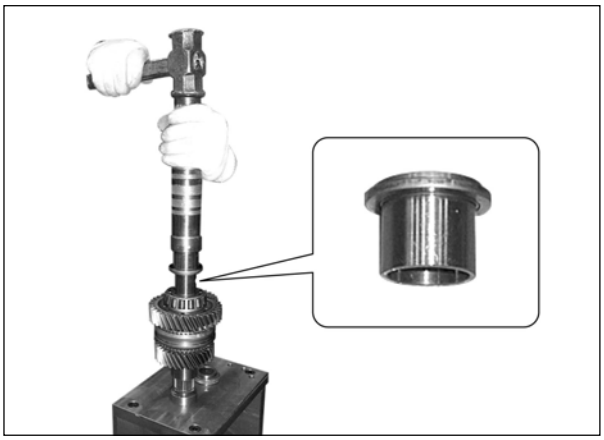
9. Install the main taper roller bearing by using a press.



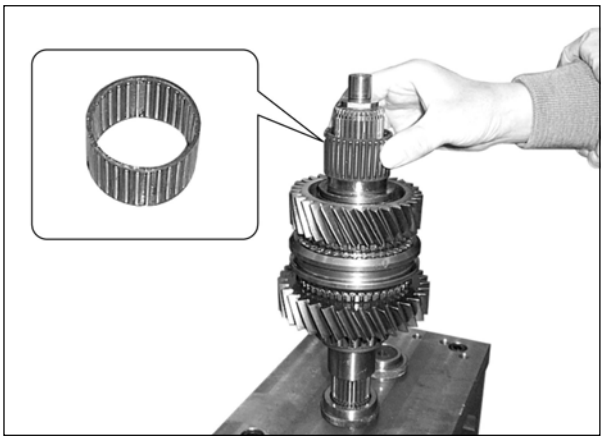
10. Install the reverse gear inner race by using a press.

NOTICE

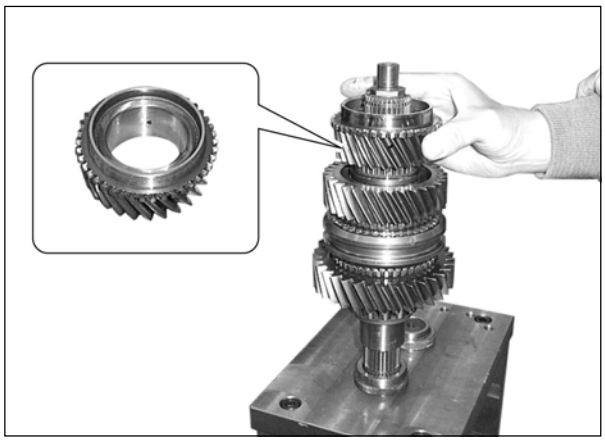
- **The reverse gear inner race has a step at edge.**



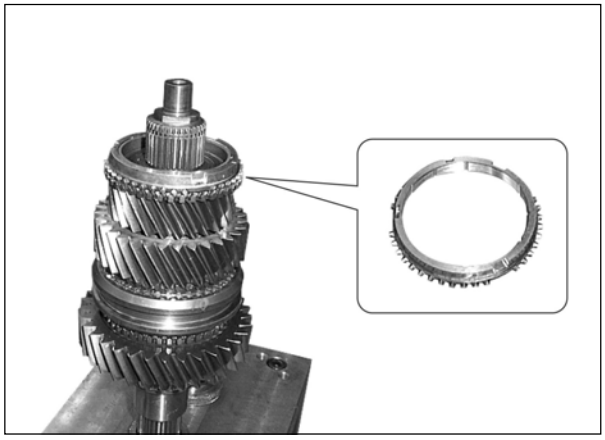
11. Place the output shaft assembly with the 1st gear facing downward and install the 3rd gear needle bearing.



12. Install the 3rd gear.



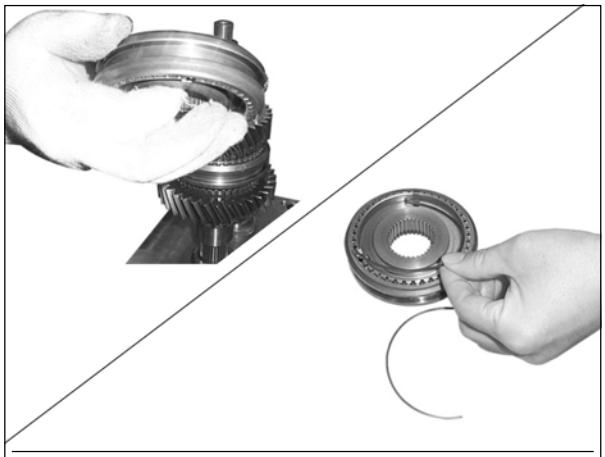
13. Install the synchronizer ring on the 3rd gear.

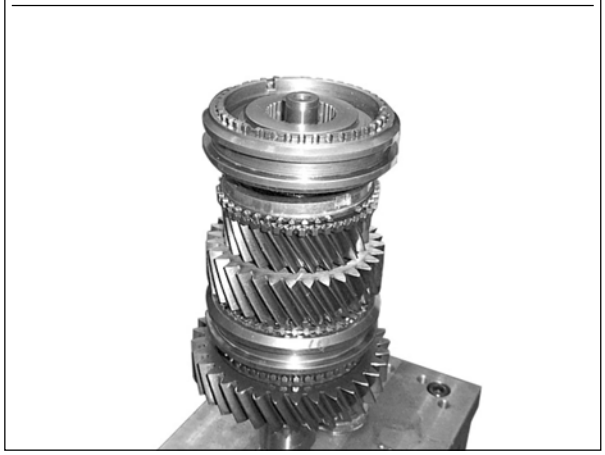


14. Insert three keys into 3/4 synchronizer hub and synchronizer sleeve. Install the synchronizer spring in offset so that it should not be missed out.

NOTICE

- **3/4 gear synchronizer sleeve have a step at edge. Place the groove in hub to face the 3rd gear and align the synchronizer key and the synchronizer ring groove in 3rd gear.**

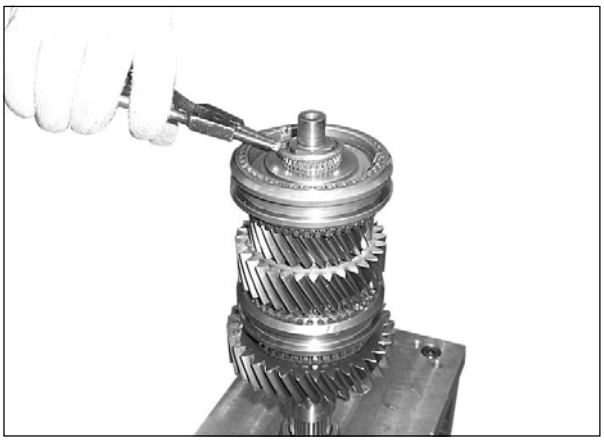




15. Install the 3/4 gear retainer ring.

NOTICE

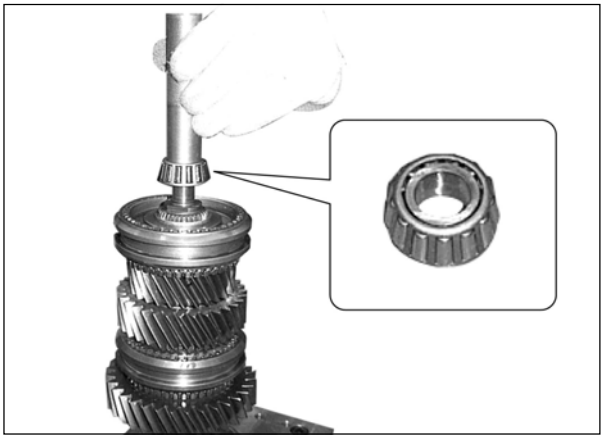
- **Adjust the end play between retainer ring and hub to a range of 0.0 to 0.5 mm by using a feeler gauge.**



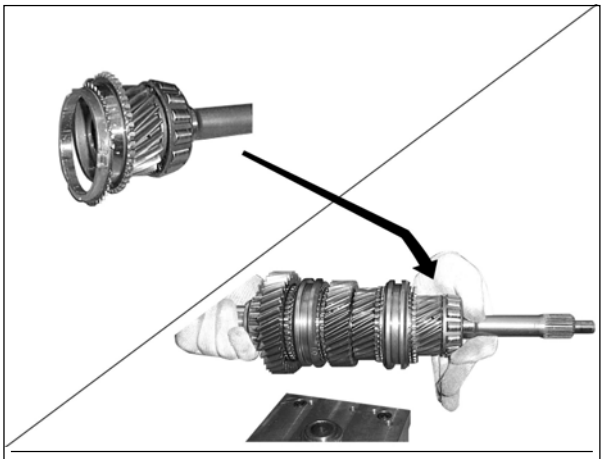
16. Install the intermediate taper roller bearing by using a press.

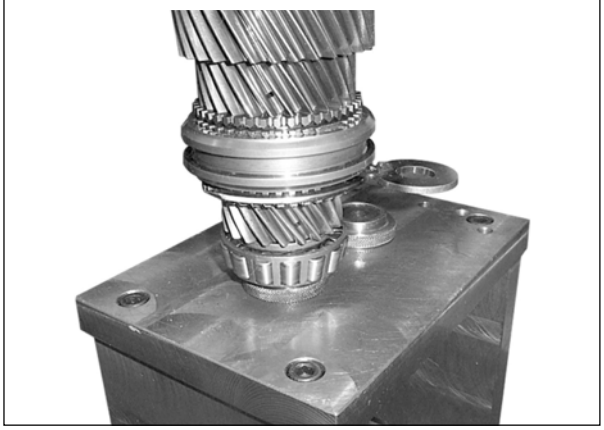
NOTICE

- **Apply the force on the inner race other than other points.**



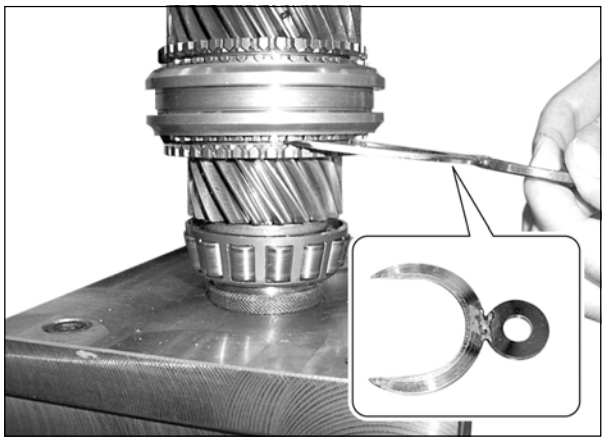
17. Install the input shaft along with the 4th synchronizer ring. Place the input shaft to face downward on the work bench.



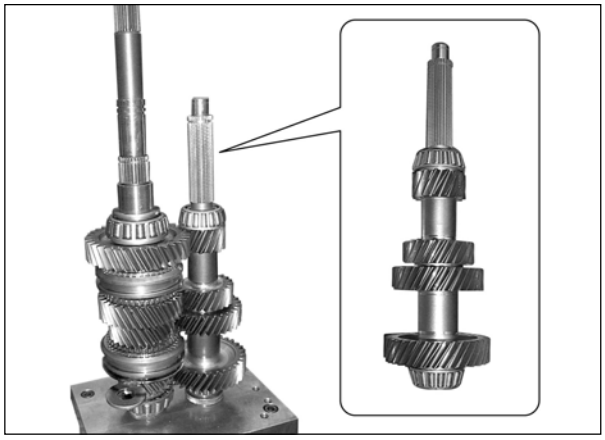


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EFFECTIVE DATE	
AFFECTED VIN	

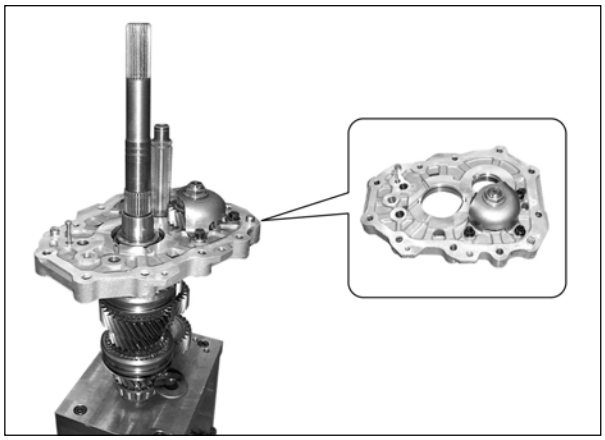
18. To relieve the load and to provide a clearance to the shaft bearing, insert a special tool.



19. Place the counter gear with input/output shaft on the workbench.



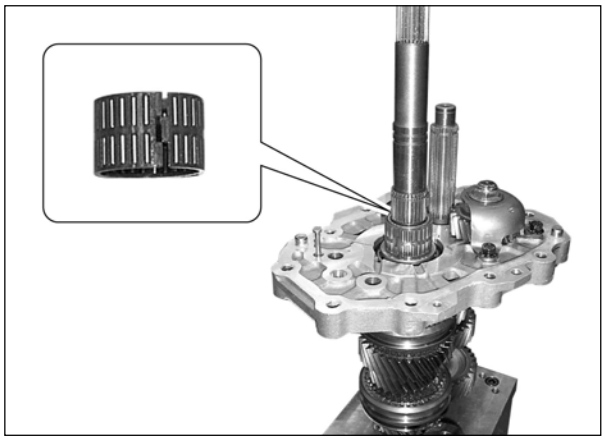
20. Install the transmission adapter on the input shaft and the counter gear.



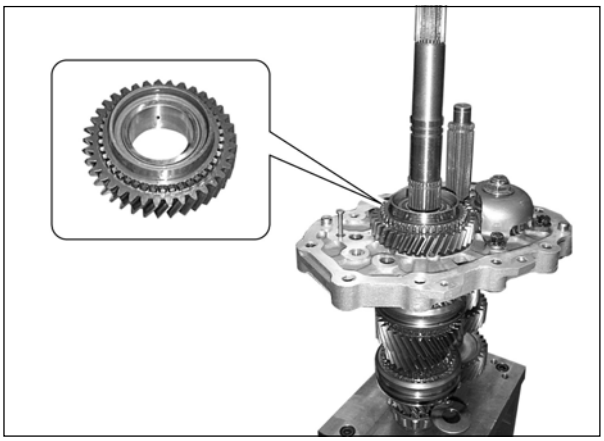
21. Install the reverse gear needle bearing.

NOTICE

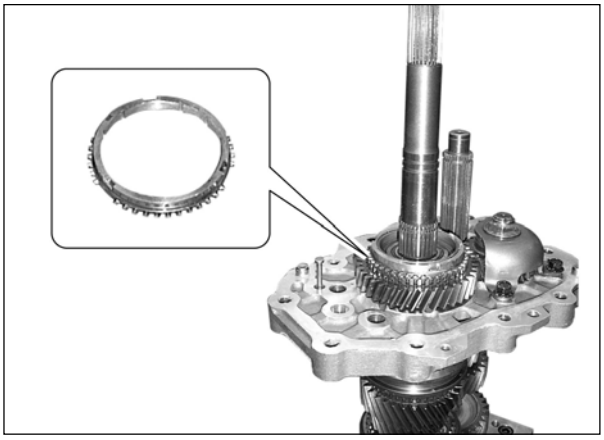
- **The reverse gear needle bearing has two bearing rows and the others consist of two bearings.**



22. Install the reverse gear in the shaft.



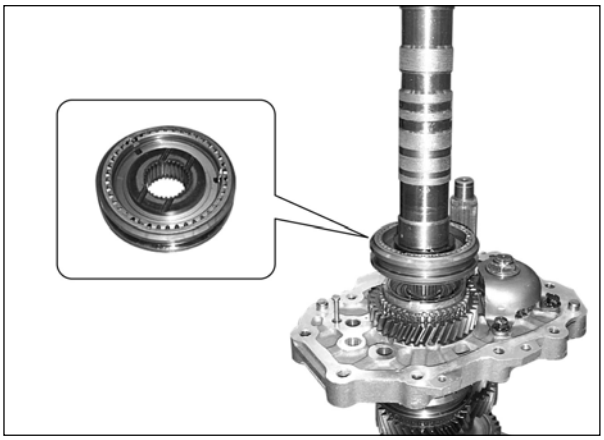
23. Install the synchronizer ring on the reverse gear.



24. Insert three keys into 5/R synchronizer hub and synchronizer sleeve. Install the synchronizer spring in offset so that it should not be missed out.

NOTICE

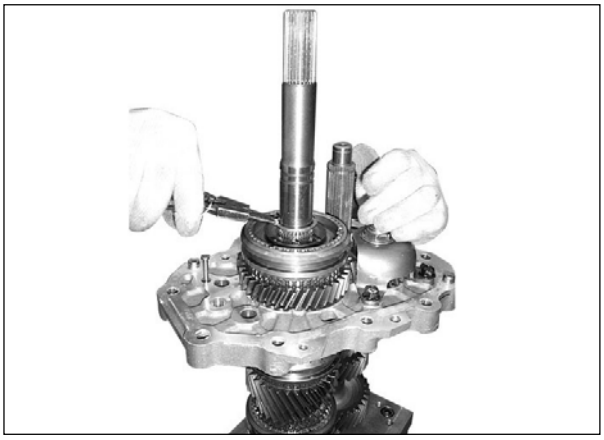
- **Place the groove in hub to face the 5th gear and align the synchronizer key and the synchronizer ring groove in reverse gear.**



25. Install the 5/R gear retainer ring.

NOTICE

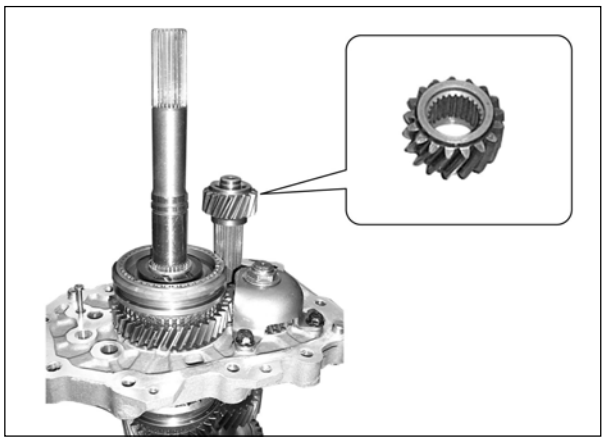
- **Adjust the end play between retainer ring and hub to a range of 0.0 to 0.5 mm by using a feeler gauge.**



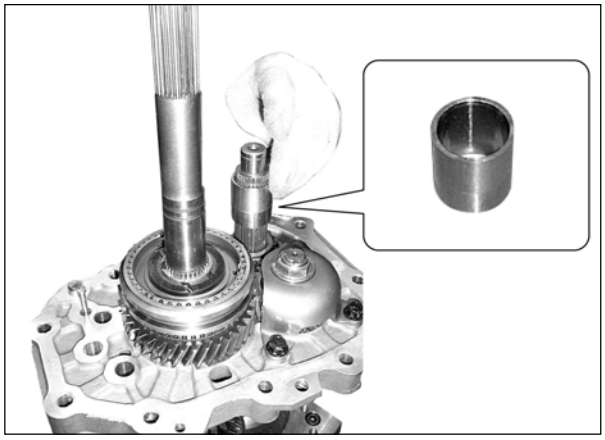
26. Install the counter reverse gear using a press.

NOTICE

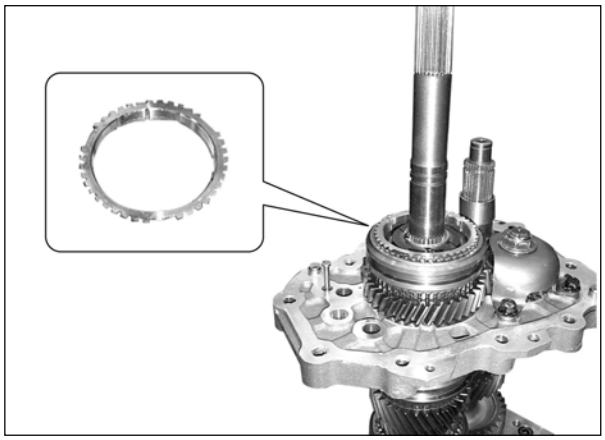
- **Place the counter reverse gear with a longer protrusion facing to the adapter.**



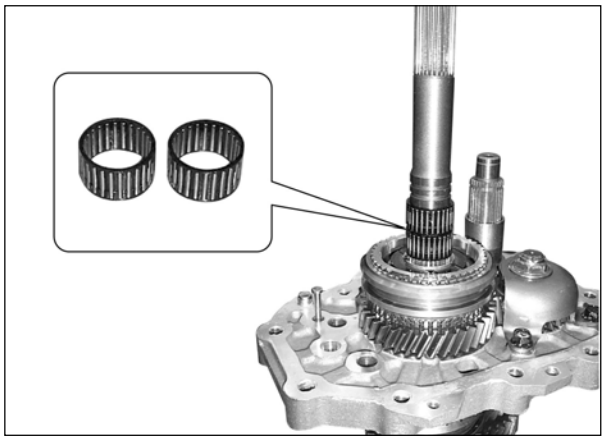
27. Install the counter reverse spacer.



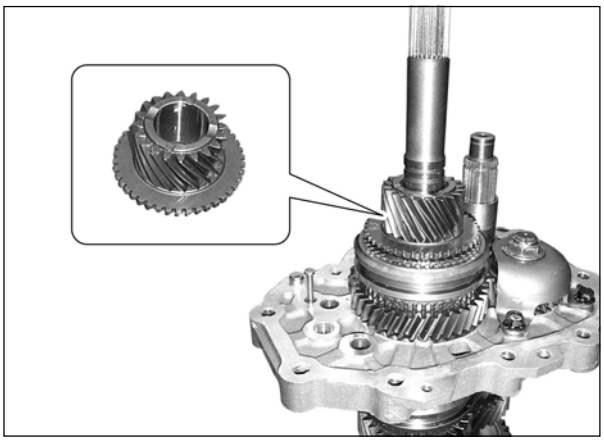
28. Install the 5th synchronizer ring.



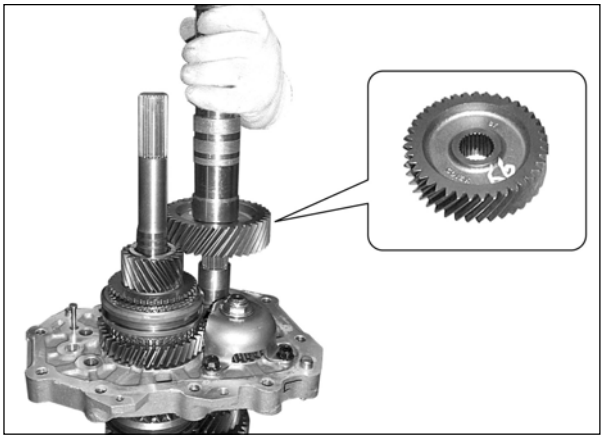
29. Install two 5th gear needle bearings in line.



30. Install the 5th gear.



31. Install the 5th counter gear using a press. At this time, place it with a longer protrusion area facing to the adapter.



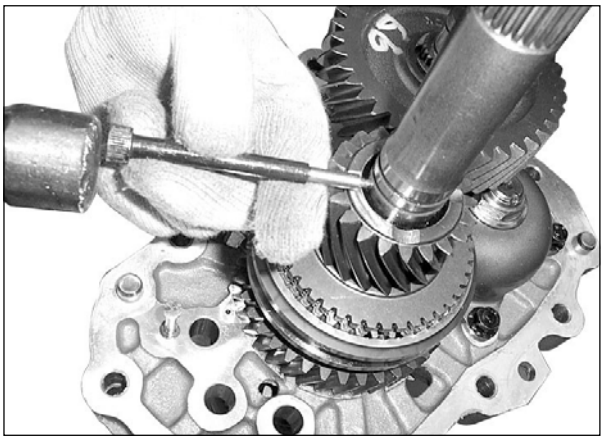
32. Install the counter 5th gear retainer ring.

NOTICE

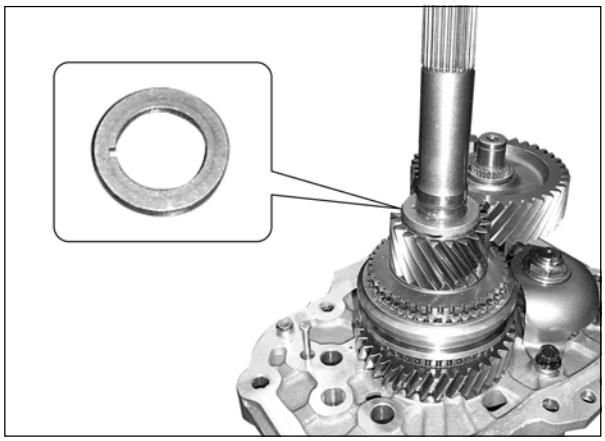
- **The retainer ring is loosened when it is removed, so retract it before installing it.**



33. Install the locking ball.



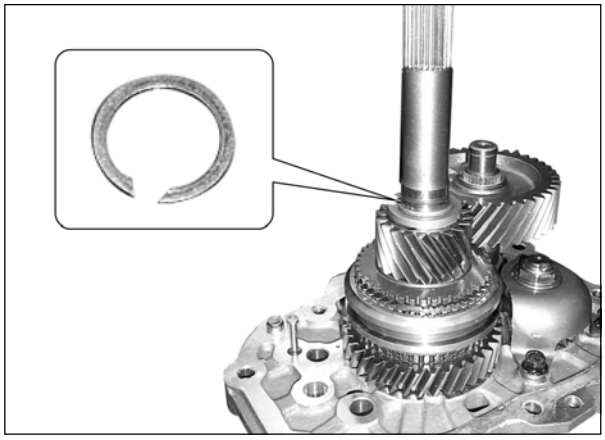
34. Install the thrust washer (t= 5.0) while aligning the key grooves.



35. Install the retainer ring.

NOTICE

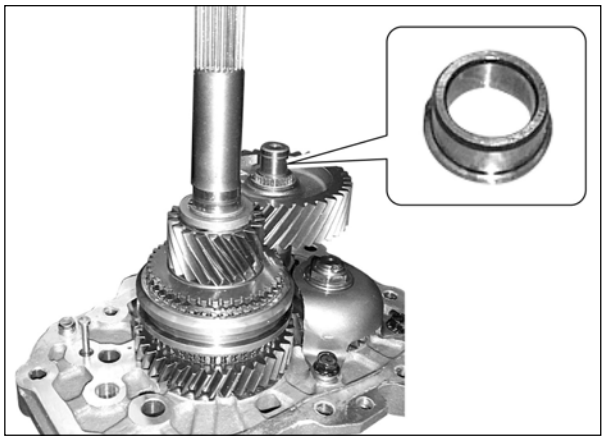
- **Adjust the end play between retainer ring and hub to a range of 0.08 to 0.22 mm using a feeler gauge.**



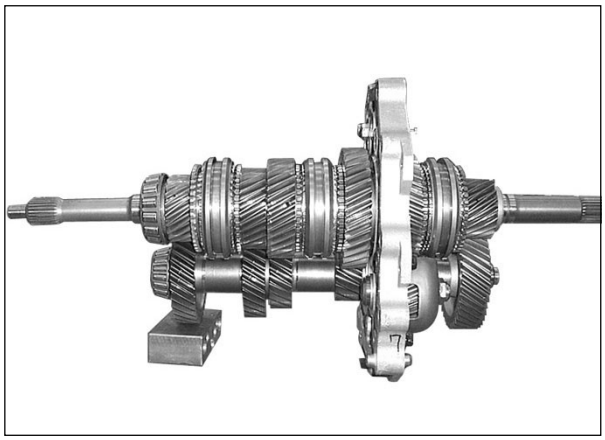
36. Install the inner race of counter roller bearing using a press.

NOTICE

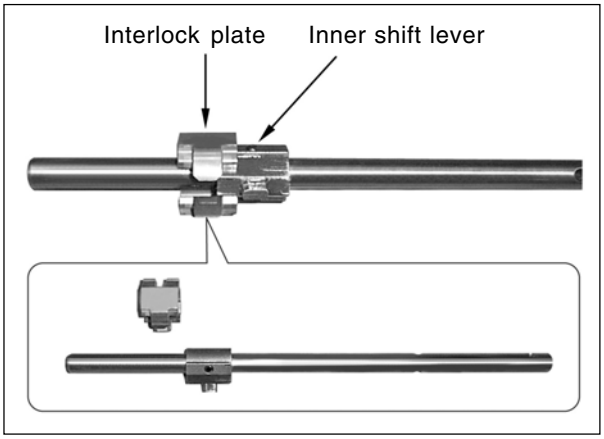
- **Place it with a protrusion area facing to the 5th gear.**



37. Place the gear assembly on a workbench in parallel.



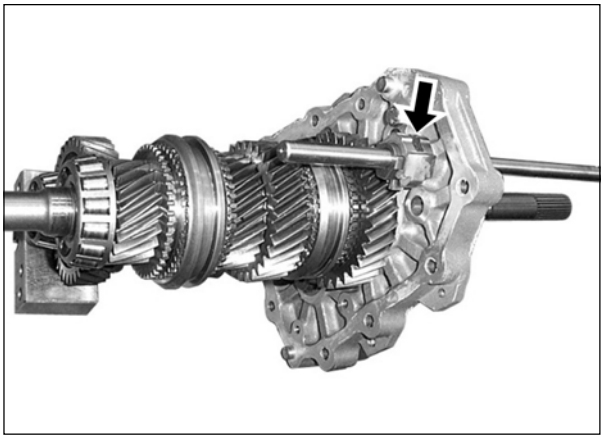
38. Install the inner shift lever and interlock plate in the 3/4 gear shift rail.



NOTICE

- **The spring pin for locking the inner shift lever is small (6 × 22) and its slot should face to the shaft.**

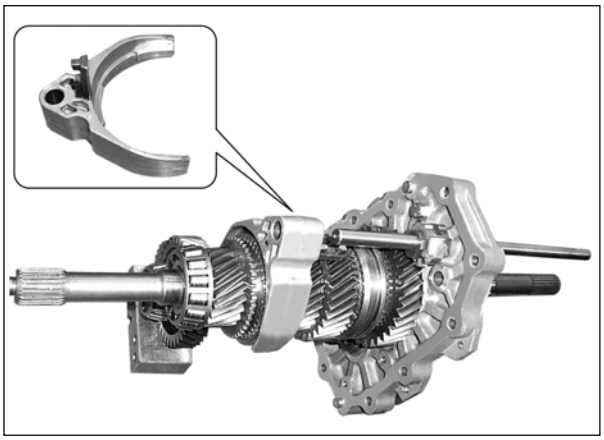
39. Install the 3/4 gear shift rail in the transmission adapter.



NOTICE

- **The longer section of the shift rail should face to the input shaft.**

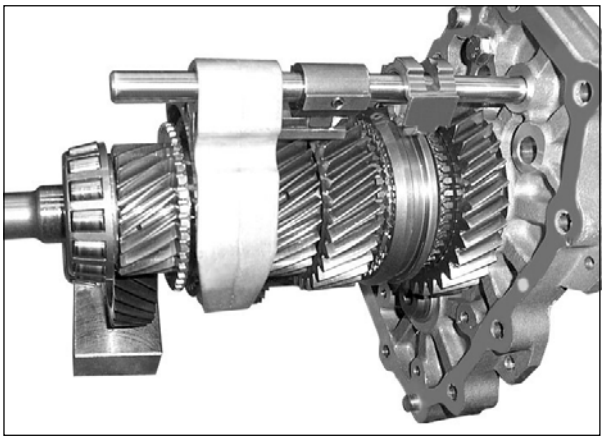
40. Install the 3/4 gear shift fork.



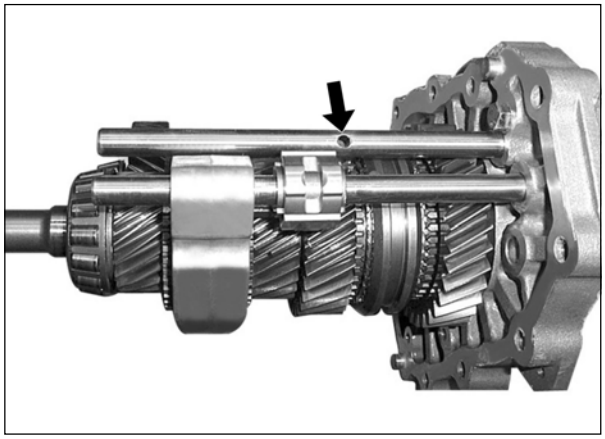
NOTICE

- **The 1/2 and 5/R shift fork are compatible, but 3/4 shift fork isn't. Also, the 3/4 shift fork is chamfered, but 1/2 and 5/R aren't.**

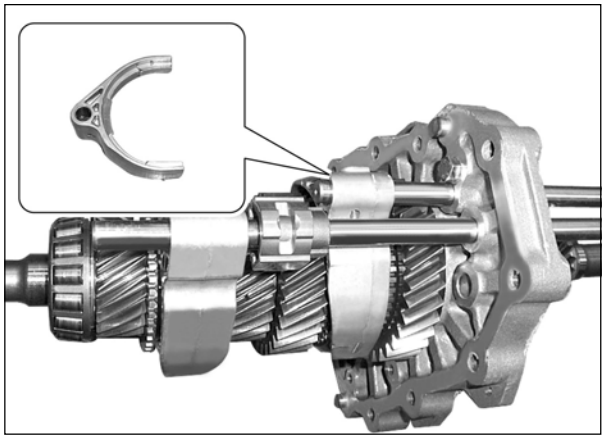
41. Install the 3/4 shift fork and shift rail while aligning the grooves.



42. Install the 1/2 gear shift rail in the transmission adapter.



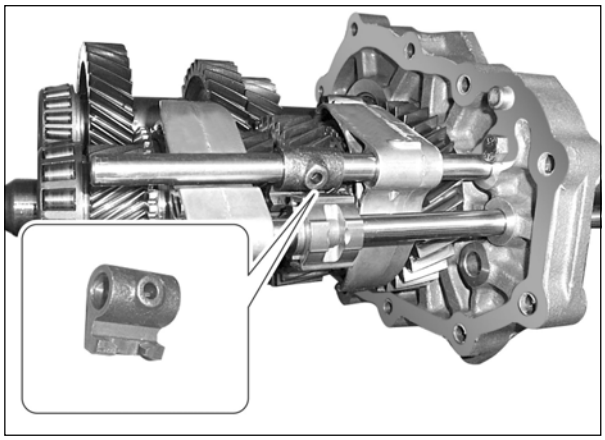
43. Partially engage the 1/2 shift fork to the shift rail.



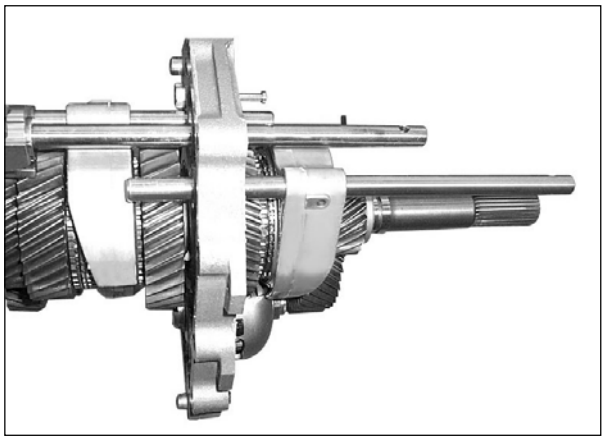
44. Install the shift lug on the 1/2 shift rail. Install the reverse lock spring, reverse lock plate and reverse lock bolts.

NOTICE

- **Align the 1/2 gear shift lug and interlock plate mating surface.**

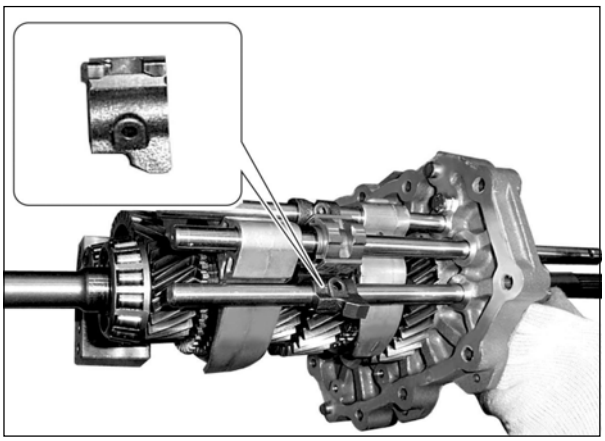


45. Partially engage the 5/R gear shift fork to the groove on shift rail.



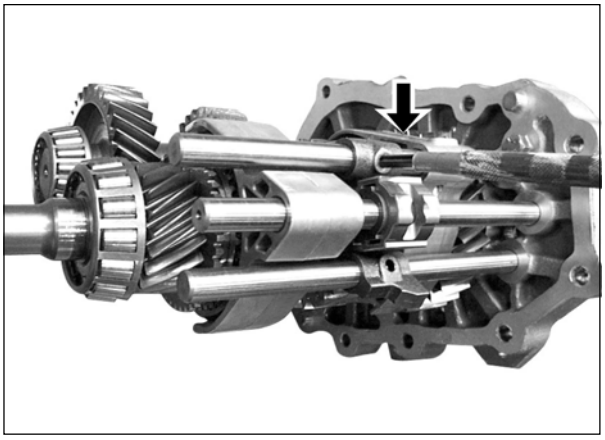
46. Install the 5/R shift lug and 5/R shift fork on the shift rail.

NOTICE
- **Align the 5/R shift lug and the interlock plate surface.**



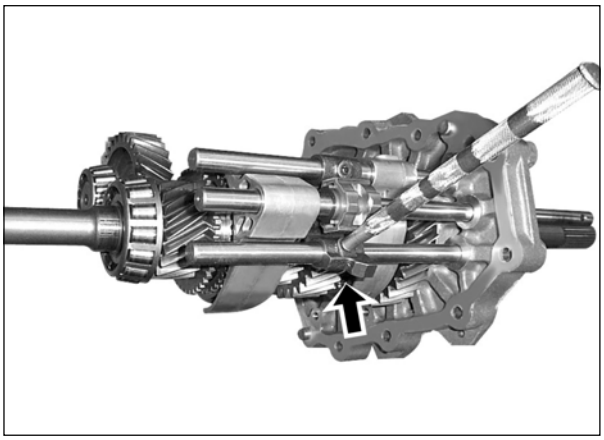
47. Install the spring pin into the 1/2 shift lug.

NOTICE
- **Place the spring pin with the pin slot facing to the shaft.**



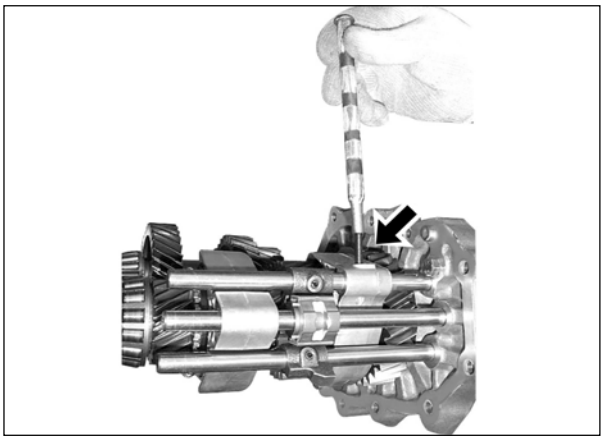
48. Install the spring pin into the 5/R shift lug.

NOTICE
- **Place the spring pin with the pin slot facing to the shaft.**

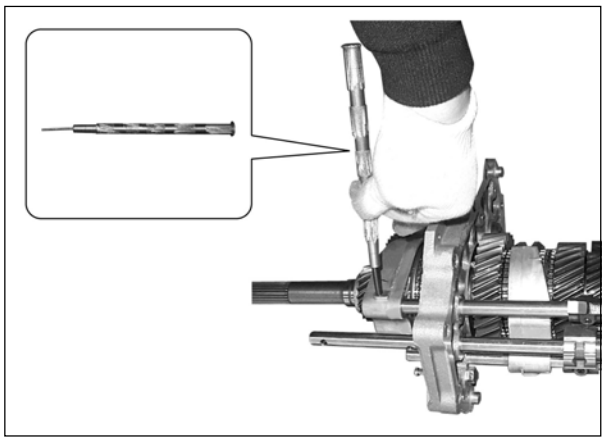


49. Install the spring pin into the 1/2 shift fork.

NOTICE
- **Place the spring pin with the pin slot facing to the shaft.**



50. Install the spring pin into the 5/R shift fork.



NOTICE

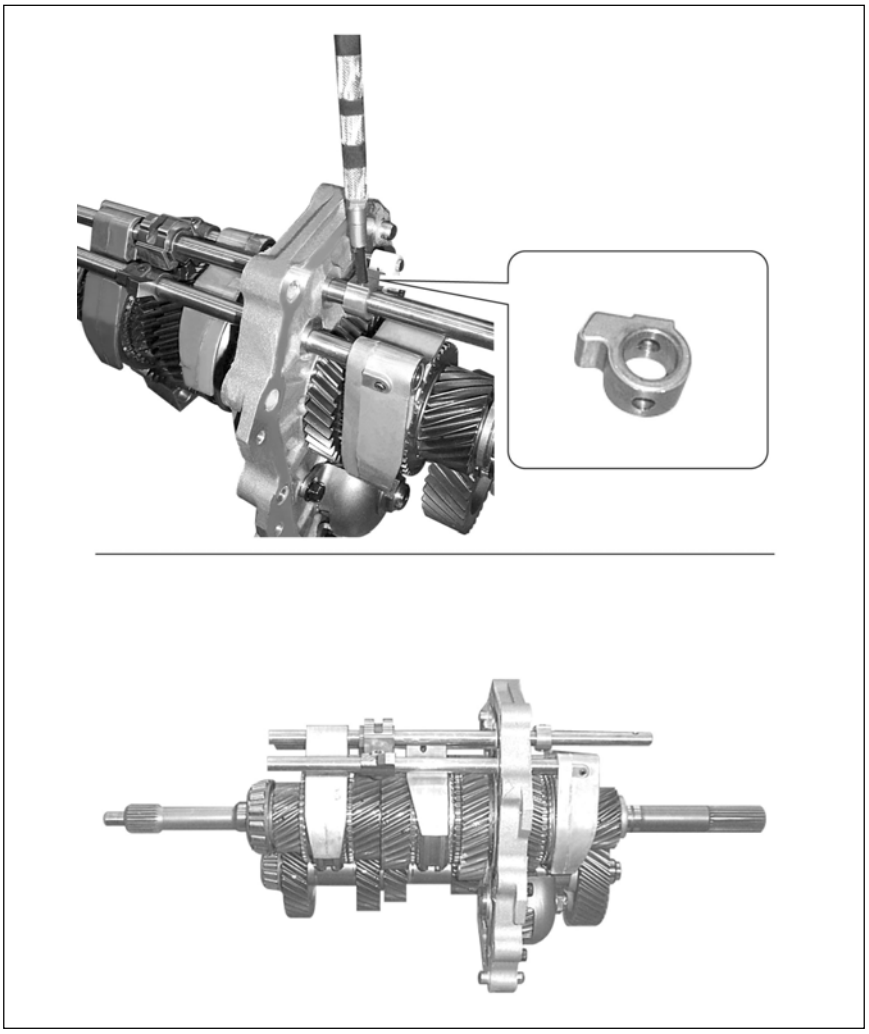
- **Place the spring pin with the pin slot facing to the shaft.**

51. Install the reverse lock plate and reverse lock spring on the 1/2 shift rail.

52. Install the stopper plate on the 3/4 shift rail and insert the spring pin (intermediate size: t= 6 x 25).

NOTICE

- **Place the spring pin with the pin slot facing to the shaft.**

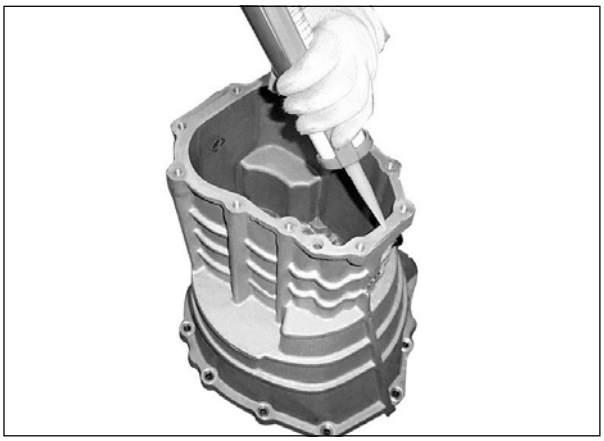


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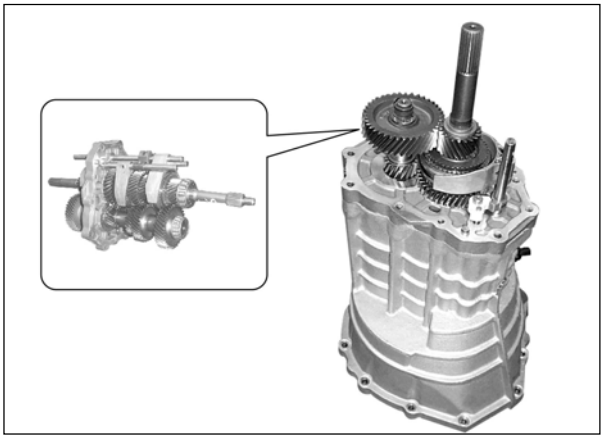
53. Apply the sealant to the transmission housing.

NOTICE

- **Sealant: Silicon sealant - bulk #732**



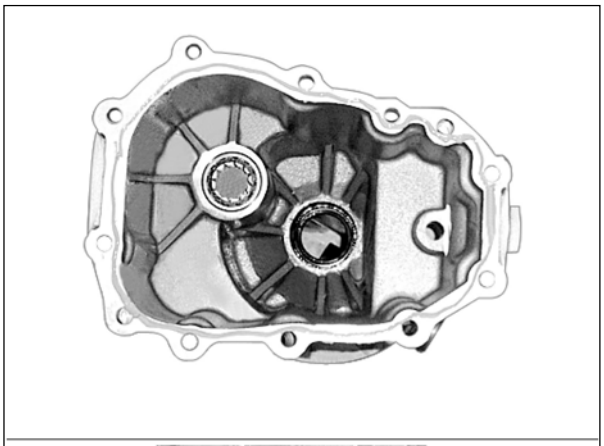
54. Install the gear assembly and the adapter to the transmission housing.
55. Install the speedometer driven gear on the output shaft and install the ball bearing using a press.

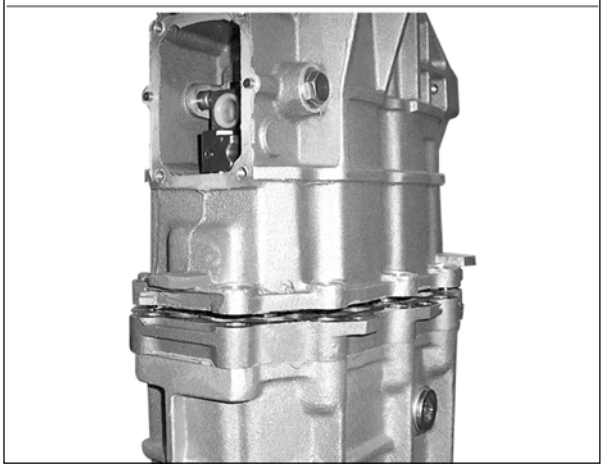


56. Apply the sealant to the extension housing.
    Press down the extension housing against the adapter.

NOTICE

- **Sealant: Silicon sealant -bulk #732**



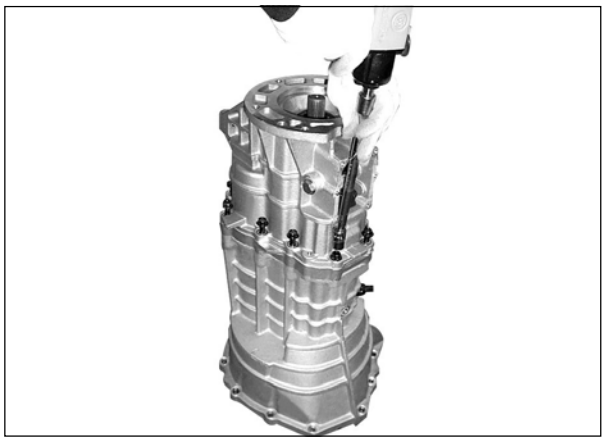


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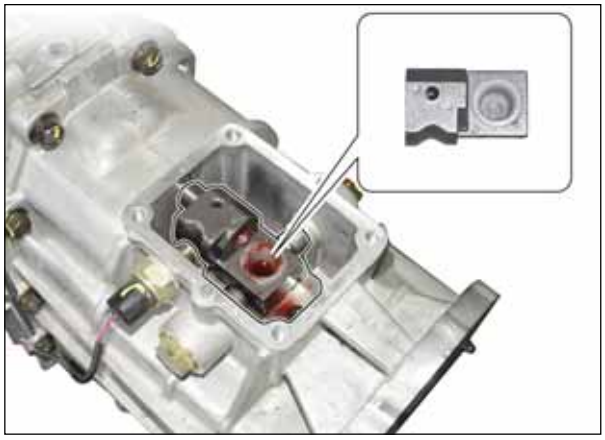
57. Tighten the extension housing bolts (14 mm-10EA).

Installation Notice

Tightening torque	42 ~ 57 Nm



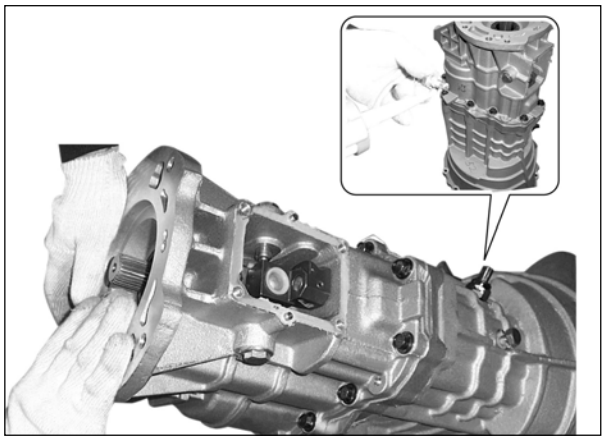
58. Insert the offset lever into the 3/4 rail and install the spring pin.
59. Apply the grease into the offset lever bushing.



60. Apply the sealant to the interlock bolt (17 mm) and insert it into the interlock plate hole.

NOTICE

- **Make sure that the gear is in neutral position. If not, the interlock bolt cannot be inserted into the interlock plate hole.**



Installation Notice

Sealant	Bond 592 loctite
Tightening torque	40 ~ 50 Nm

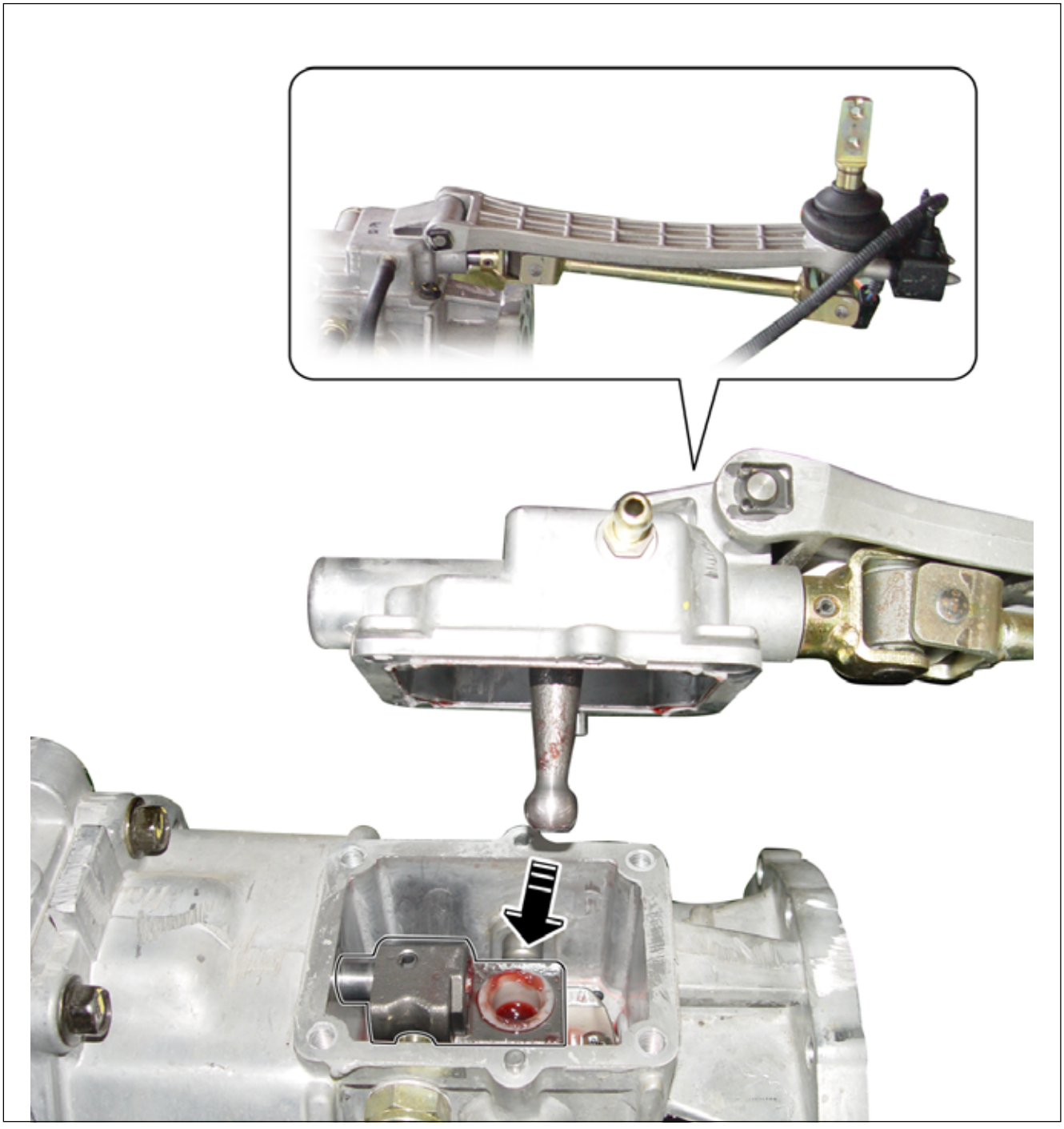
61. Apply the sealant to the top cover and install four bolts (12 mm).

NOTICE

- **Make sure that the gear is in the neutral position.**

Installation Notice

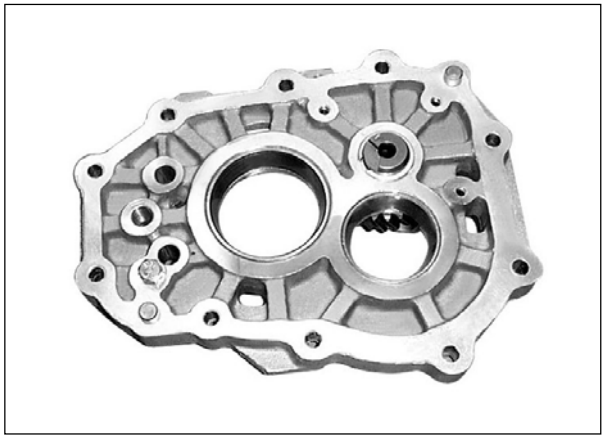
Sealant	Silicon sealant -bulk #732
Tightening torque	17 ~ 26 Nm



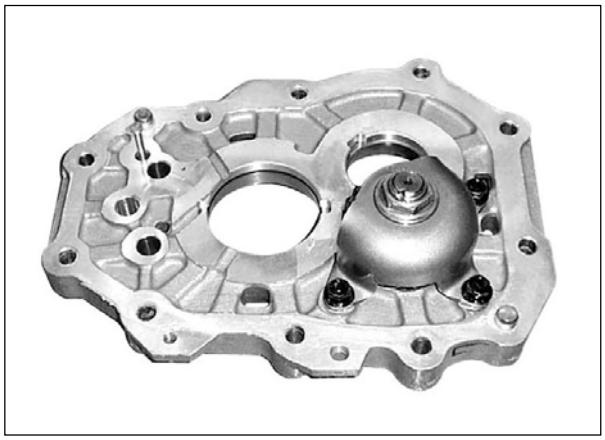
▶ Transmission Adapter

Disassembly and Assembly

1. Remove the reverse idler retainer ring.



2. Remove the components as follows and install in the reverse order of removal.
   a. Unscrew the reverse lock nut and idler bracket bolts and remove the bracket and spacer.
   b. Remove the reverse idler gear and the needle bearing.
   c. Pull out the dowel pin and remove the reverse idler shaft.



NOTICE

Tightening torque

Reverse idler bracket bolt	17 ~ 26 Nm
Reverse lock nut	70 ~ 100 Nm

▶ Backup Lamp Switch

Remove the backup lamp switch with 24 mm wrench. Apply the sealant when installing.

NOTICE

Tightening torque

Sealant	Bond-592 LOCTITE
Tightening torque	30 ~ 40 Nm





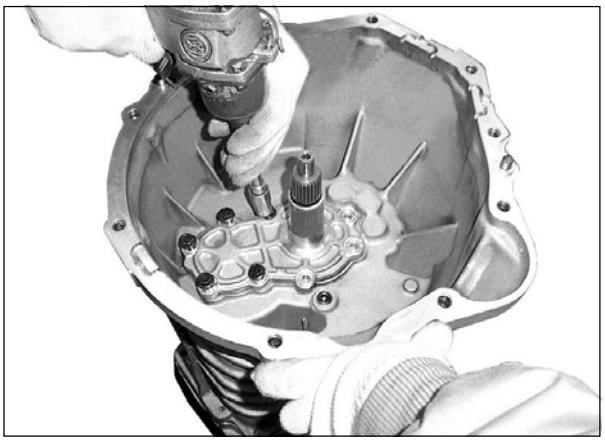
7. INSPECTION/MAINTENANCE

▶ Shim Adjustment

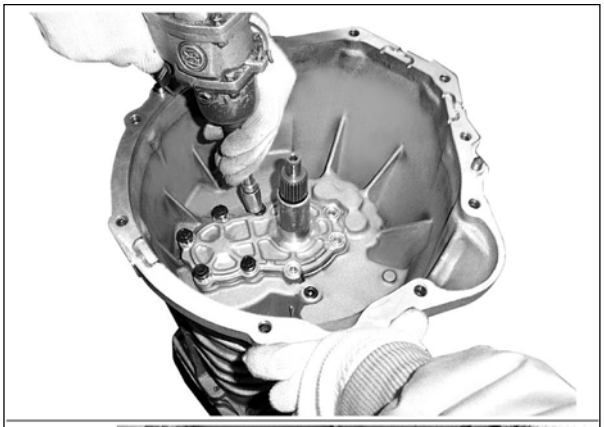
1. Unscrew nine bolts (14 mm) and remove the front fork cover.

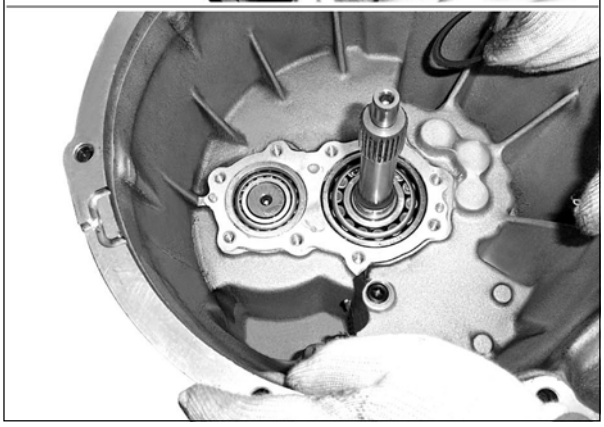
NOTICE

- **The shim adjustment is necessary when replacing the housings, counter gear, input shaft and output shaft.**

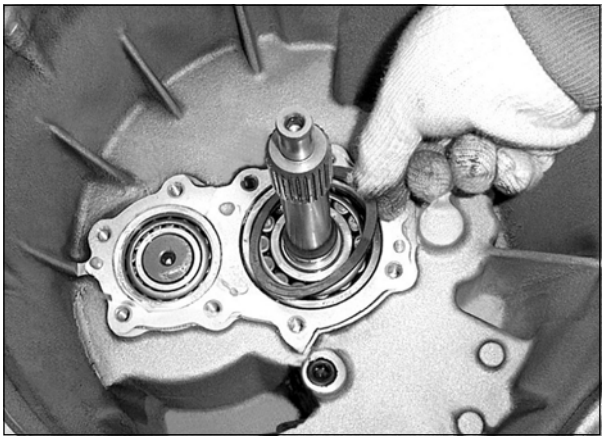


2. Separate the front fork cover from the housing.



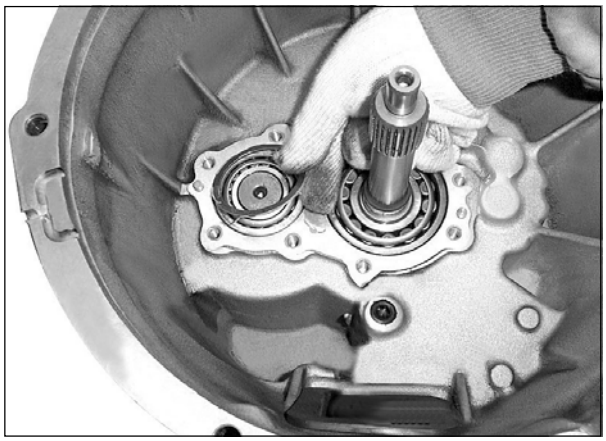


3. Remove the input spacer.

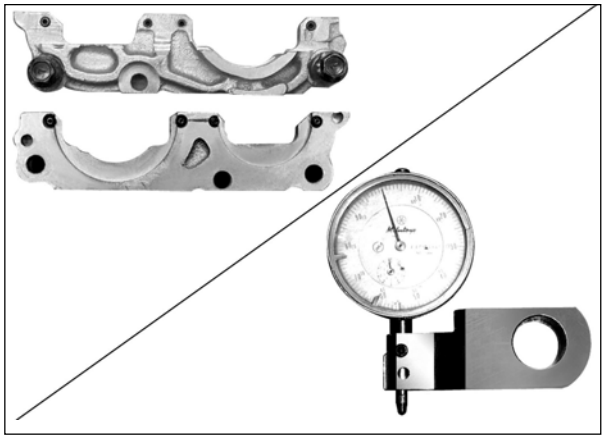


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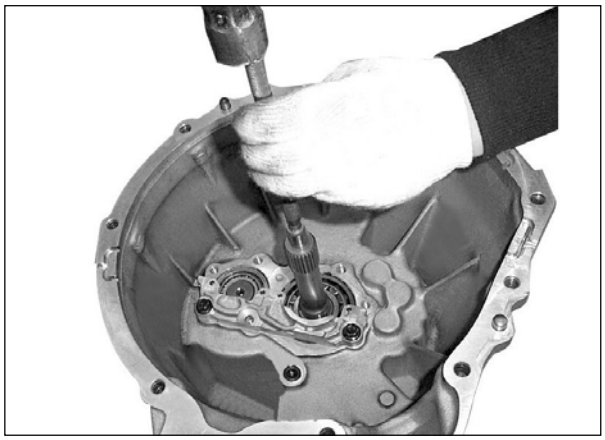
4. Remove the counter spacer.



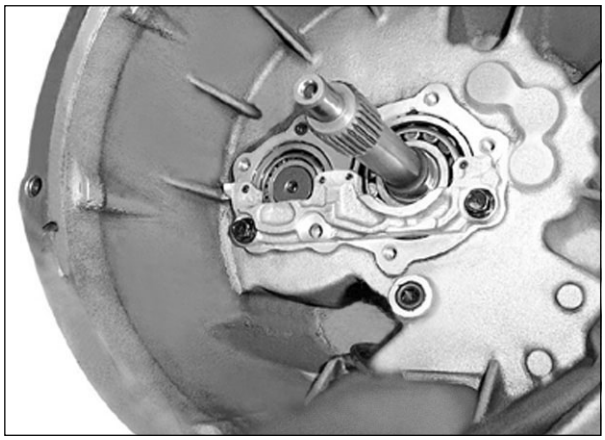
5. Prepare the special tools and dial gauge.



6. Place the transmission vertically with the output shaft facing downward and set the special tool on the counter gear and input shaft. Apply a proper force to the counter gear and input shaft so that the end plays for bearings are maximized.

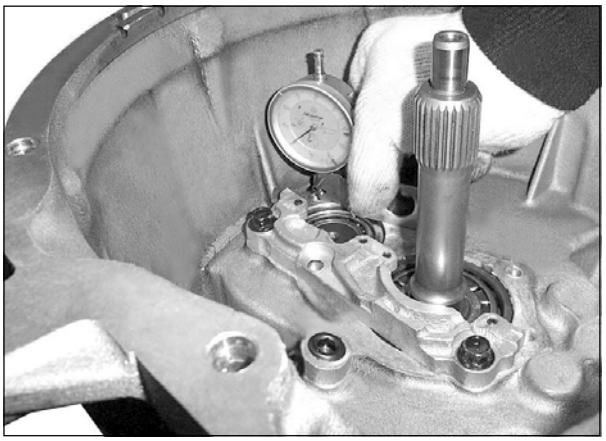


7. Tighten the adjusting bolt on the special tool to hold the bearings.



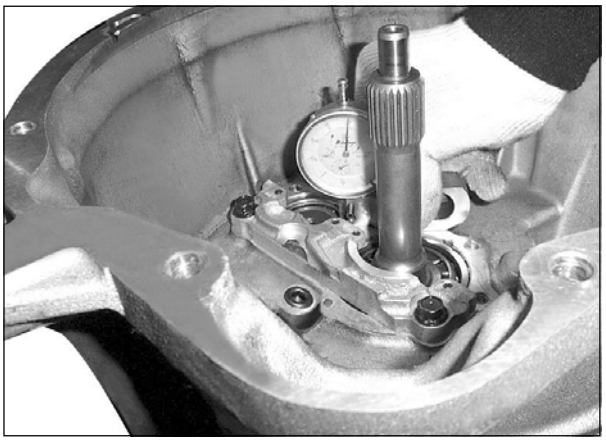
8. Set up the dial gauge on the transmission housing surface and put the gauge needle to “0” point.
9. Put the probe end of the gauge on the taper roller bearing outer race in counter gear and measure the end play.
   a. If the measured value is out of the specified range, adjust it by using spacers.

End play	0 ~ 0.05 mm



10. Put the probe end of the gauge on the main taper roller bearing race and measure the end play.
    a. If the measured value is out of the specified range, adjust it by using spacers.

End play	0 ~ 0.05 mm

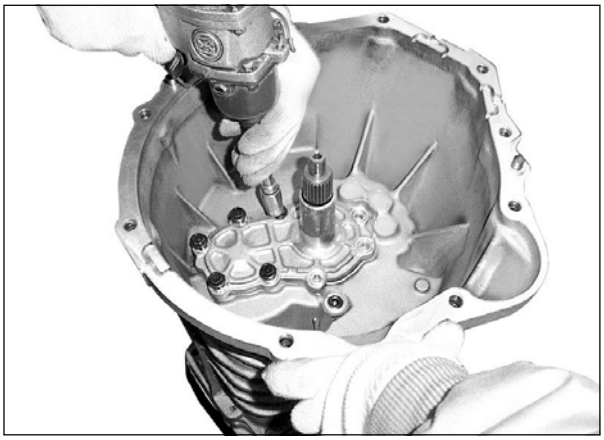


11. Apply the sealant to the front fork cover and tighten the bolts (14 mm).

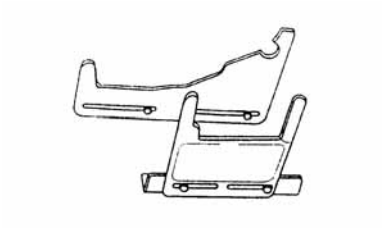
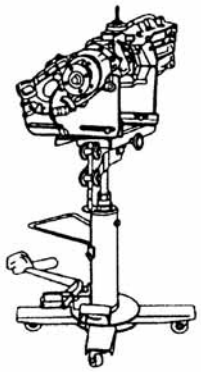
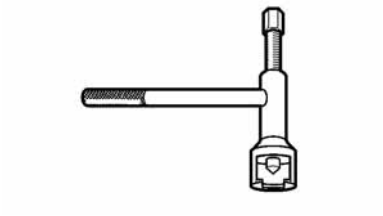
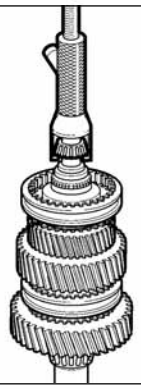
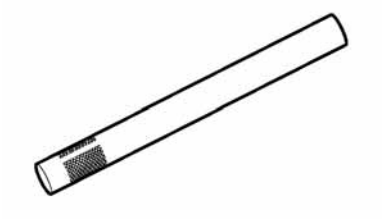
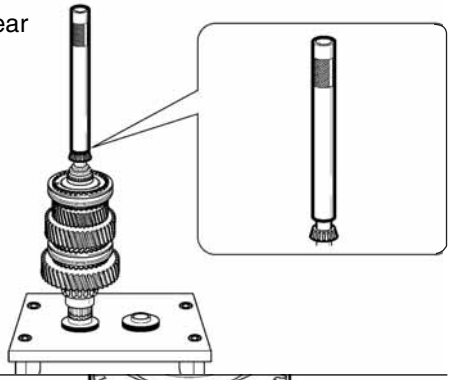
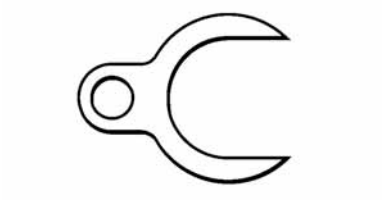
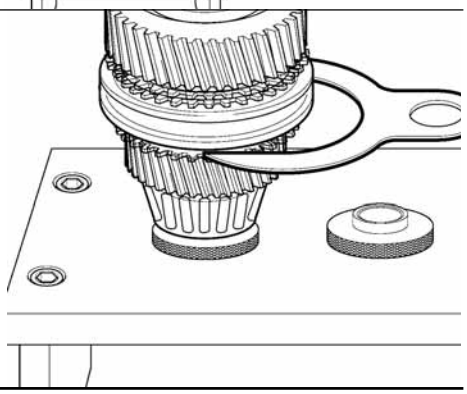
    Measure the starting torque after installation.

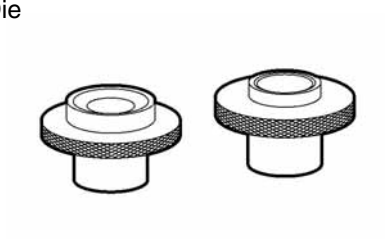
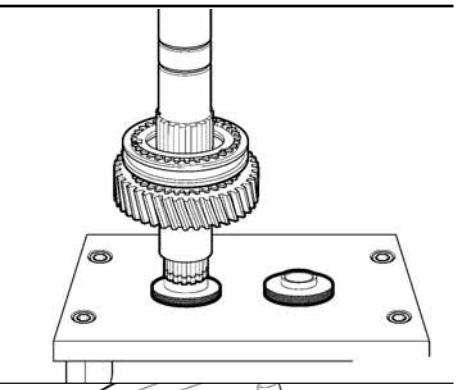
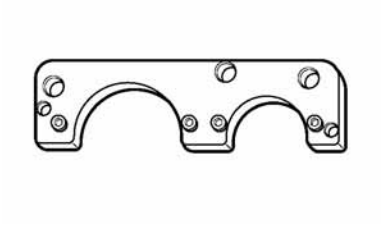
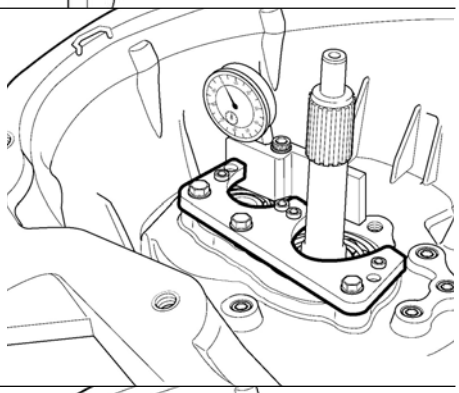
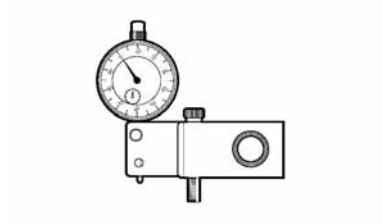
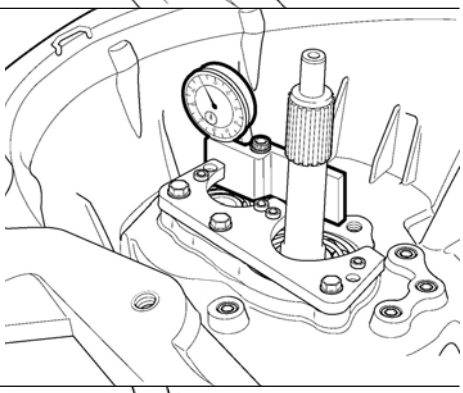
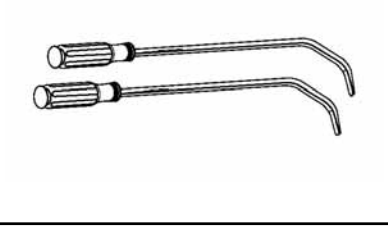
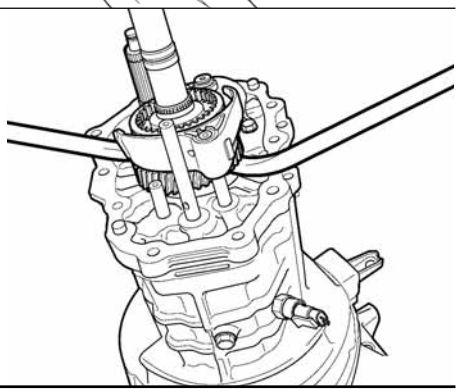
Installation Notice

Starting torque	20 ~ 25 Nm
Sealant	Silicon sealant -bulk#732
Tightening torque	17 ~ 26 Nm



8. SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
661 589 04 62 00 (W 99 31 007 0B) Transmission fixture 	Removal/installation of transmission 
W 99 31 001 1B Bearing puller 	Removal of pressed in intermediate taper roller bearing 
W 99 31 002 1B Pressure pipe 	Pressing of the bearing and gear 
W 99 31 003 1B Insert key 	Providing a space to input shaft bearing 

Name and Part Number	Application
W 99 31 004 1B Die 	Assembly of gears and bearings on the shafts 
W 99 31 005 2B Holder 	Measurement of taper roller bearing end play 
W 99 31 006 1B Dial gauge holder 	Measurement of bearing end play by installing it on the counter and main taper roller bearing outer race in manual transmission 
W 99 31 007 1B Drift 	Removal of 5/R synchronizer hub assembly, reverse gear and shift fork at one time 

PART TIME TRANSFER CASE & IWE LOCKING HUB SYSTEM

3240 / 3410

TABLE OF CONTENTS

GENERAL 2

1. Overview 2

PART TIME TRANSFER CASE 3

1. Structure 3
2. System Layout 4
3. Power Flow 5
4. Composition 8
5. Oil level check and change 14
6. General diagnosis 15
7. Removal and installation 16

TCCU (TRANSFER CASE CONTROL UNIT) 21

1. Major changes in TCCU 21
2. Transfer case block diagram 22
3. Transfer case circuit diagram 23
4. Shift Motor Connector and Magnetic Clutch Power Supply Connector 25
5. System operation 27
6. Trouble diagnosis test 30
7. Self-diagnosis test 31
8. Diagnostic trouble code 32
9. Removal and installation of TCCU 34

IWE LOCKING HUB SYSTEM 35

1. Locking hub system 35
2. Vacuum system 36
3. Components of IWE (Integrated wheel end) 37
4. Vacuum locking hub check 41
5. Removal and installation of IWE (Integrated wheel end) 44

GENERAL

1. OVERVIEW

The part time transfer case achieves direct connection from the power of the rear wheels to the power of the front wheels by the lock up hub when selecting 4WD "HIGH" and the power is supplied by the sealant chain in the transfer case.

The simple operation of switches on instrument panel allows to shift between “2H” and “4H” easily while driving. The warning lamp warns the driver when the system is defective.

The 4WD system installed on ACTYON does not have big difference in comparison to the conventional part time transfer case, but the changes in comparison to the conventional transfer case are as follows:

1. **Delete 4L (LOW 4WD)**
   - Delete the planetary gear, reduction hub and shift fork.
   - Add the coupling according to the deletion of the planetary gear.
2. **No additional coding is required when replacing TCCU.**
3. **Delete the devices (tone wheel, wiring, etc.) related to the speed sensor in the transfer case.**

   This system receives the speed signals from ABS/ESP HECU or instrument panel (for non-ABS vehicle(Note 1)) through the CAN communication.
4. **Delete the pin related to the speed sensor in the TCCU pins.**
5. **Change the wiring connector of the transfer case from 4-pin to 1-pin (supply voltage and ground related to the speed sensor)**.

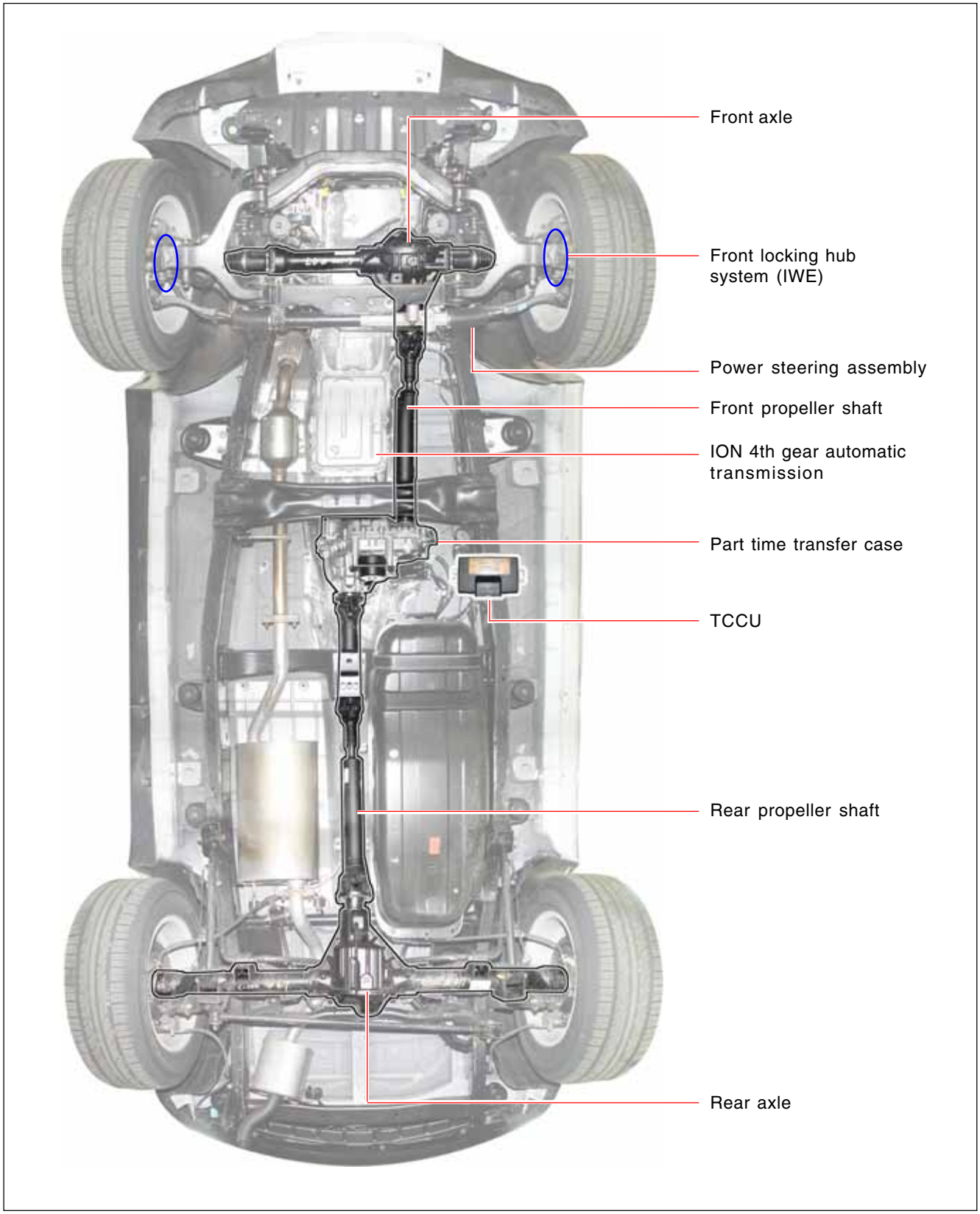
Instrument panel(Note 1) : In non-ABS vehicle, the vehicle speed sensor is installed on the rear drive axle. The engine ECU sends the speed signal to the instrument panel, and then the instrument panel provides the information to TCCU and other devices.

Specifications

Description		Part Time T/C
Total length		343 mm
Mating surface of front flange		40 mm
Weight		32.4 Kg (with oil)
Oil capacity		1.4 L
Oil specification		ATF DEXRON III
Location		Transfer case
Major elements	Housing	Part time
	Tightening bolt	11EA, M8 x 1.25
	Input shaft	A/T: External spline M/T: Internal spline

PART TIME TRANSFER CASE

1. STRUCTURE



2. SYSTEM LAYOUT



4WD switch

Shifting to 4H mode
(to 4H direction)

Shifting to 2H mode
(to 2H direction)



I/P (4WD indicator)

Shifting to 4H mode
(4WD HIGH comes on)

Shifting to 2H mode
(4WD HIGH goes off)

System defective
(4WD CHECK comes on)

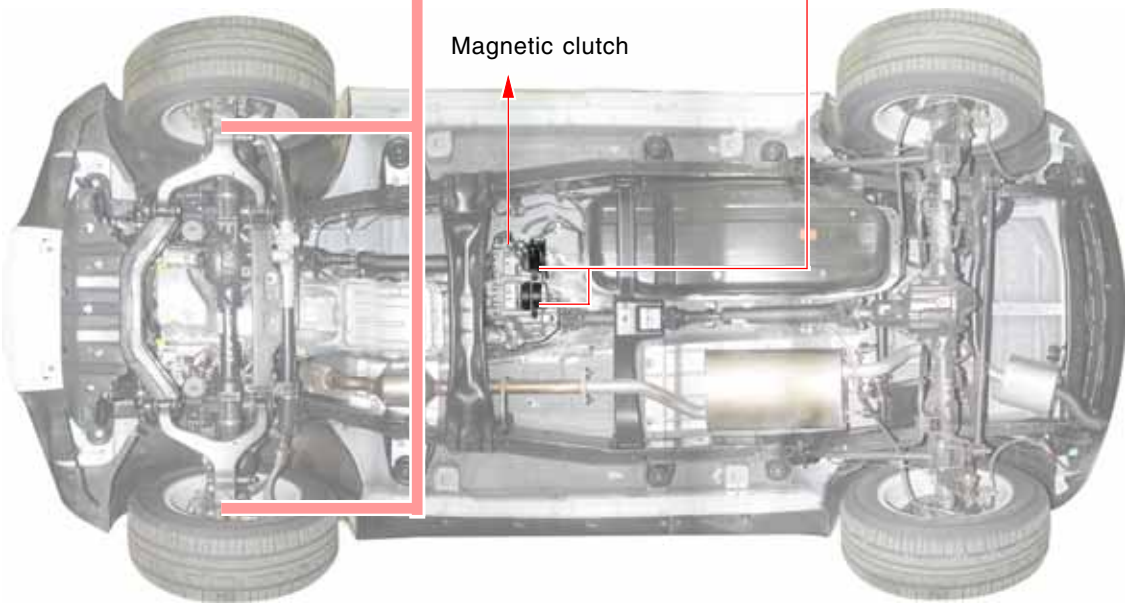
TCCU





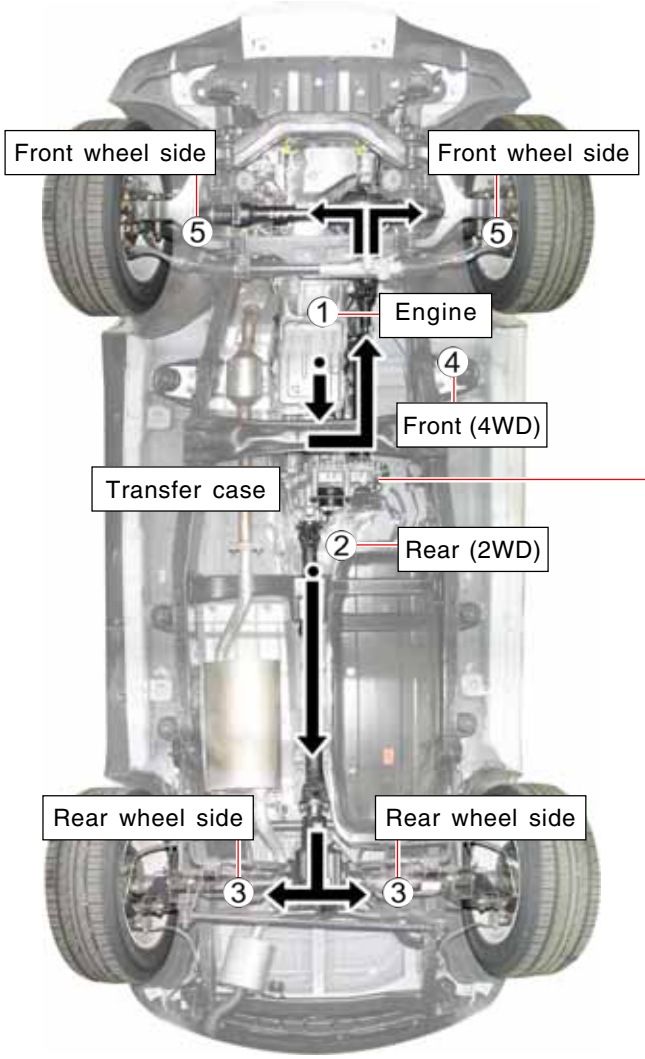
Solenoid valve

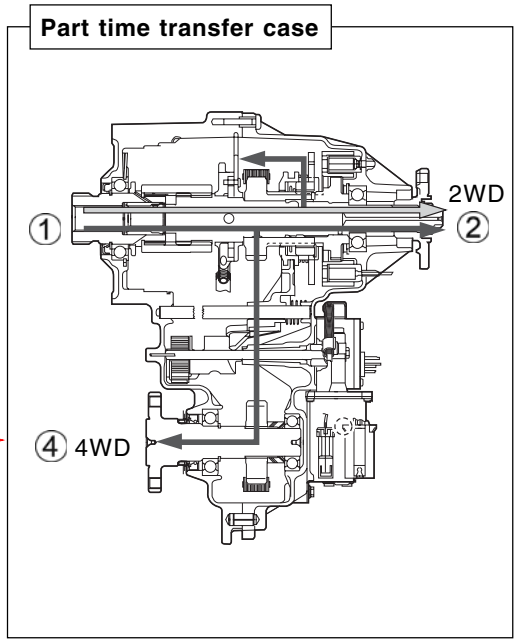
Magnetic clutch



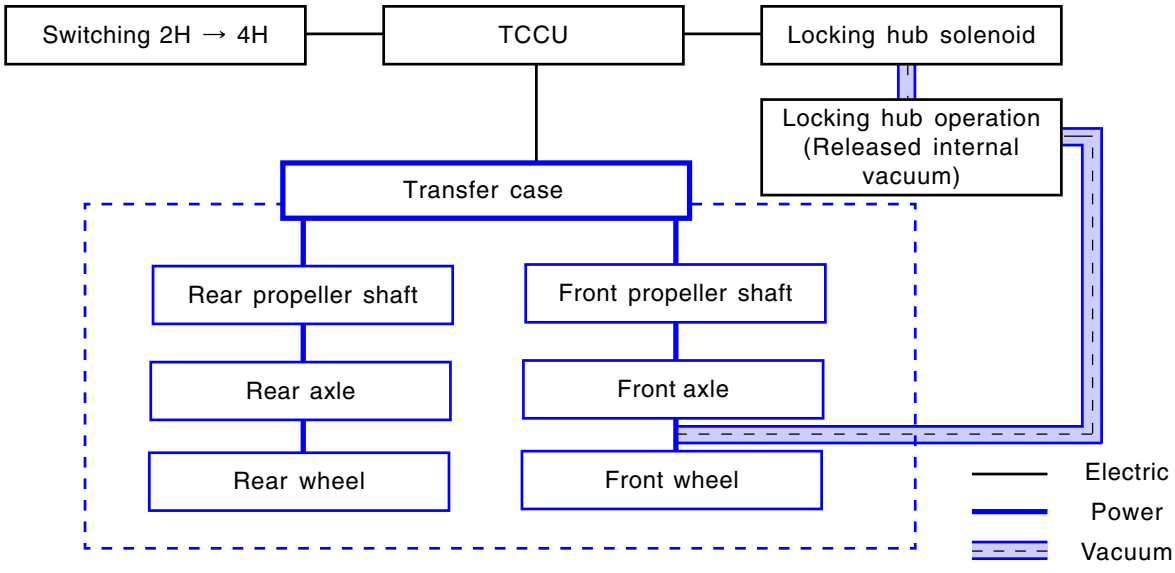
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EFFECTIVE DATE	
AFFECTED VIN	

3. POWER FLOW



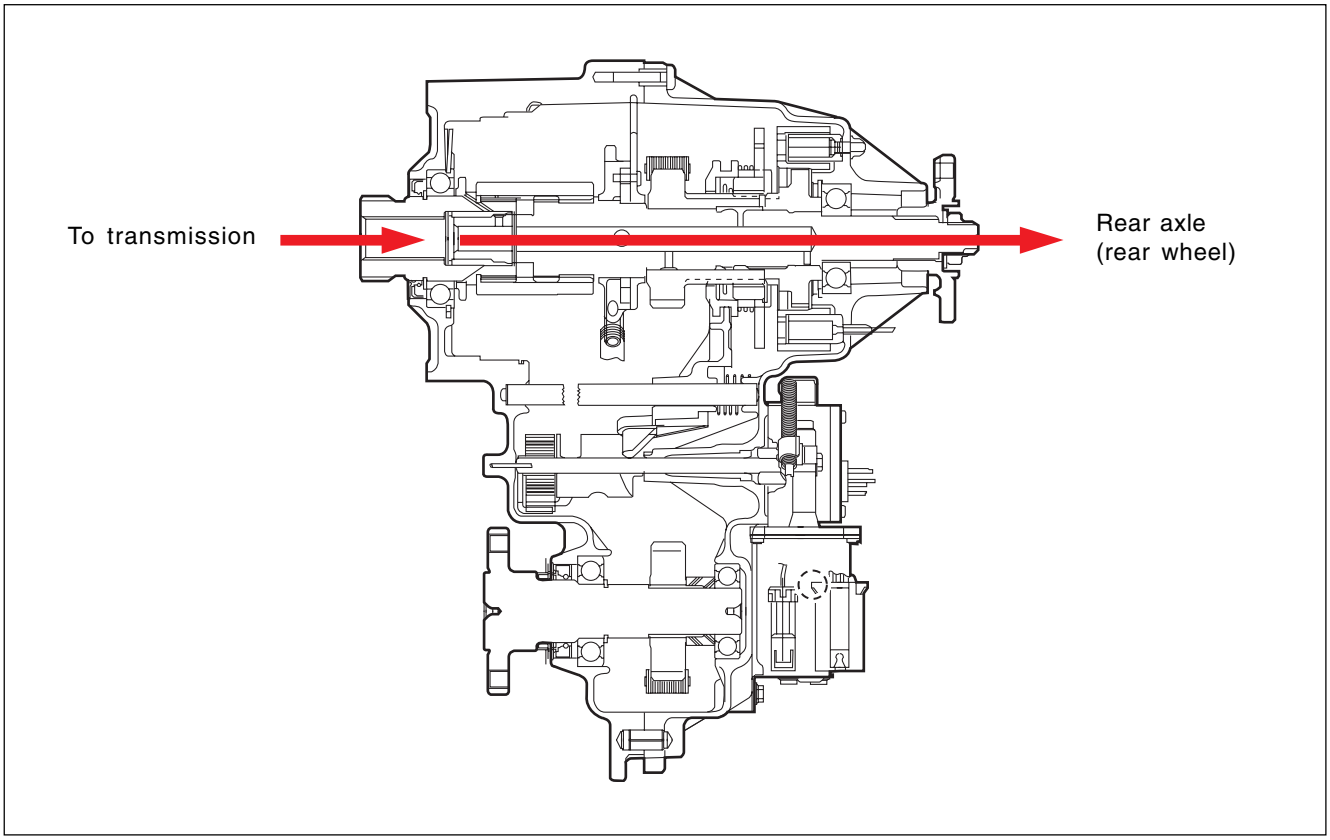


Flow Layout

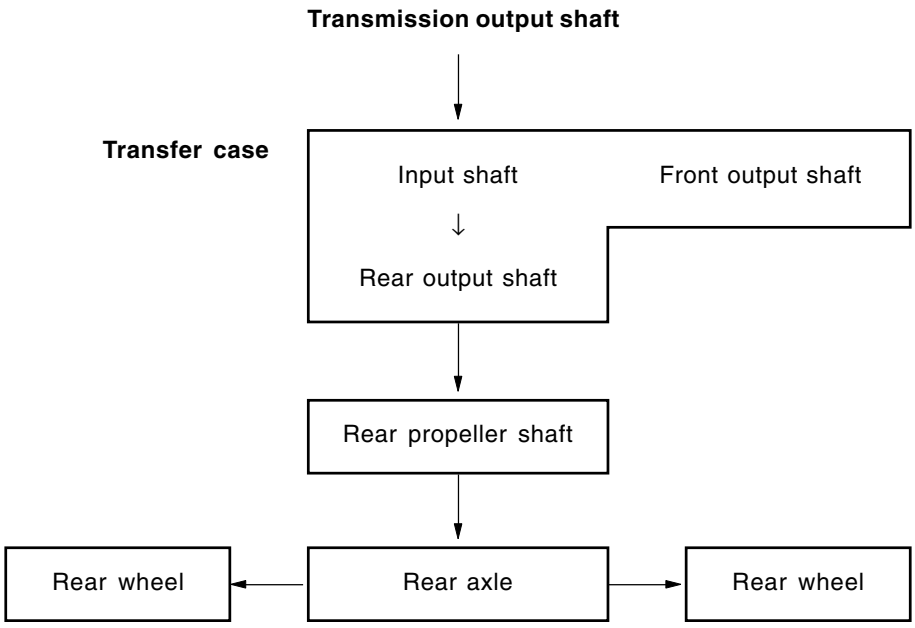


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▶ 2H Mode (Rear Wheel Drive)

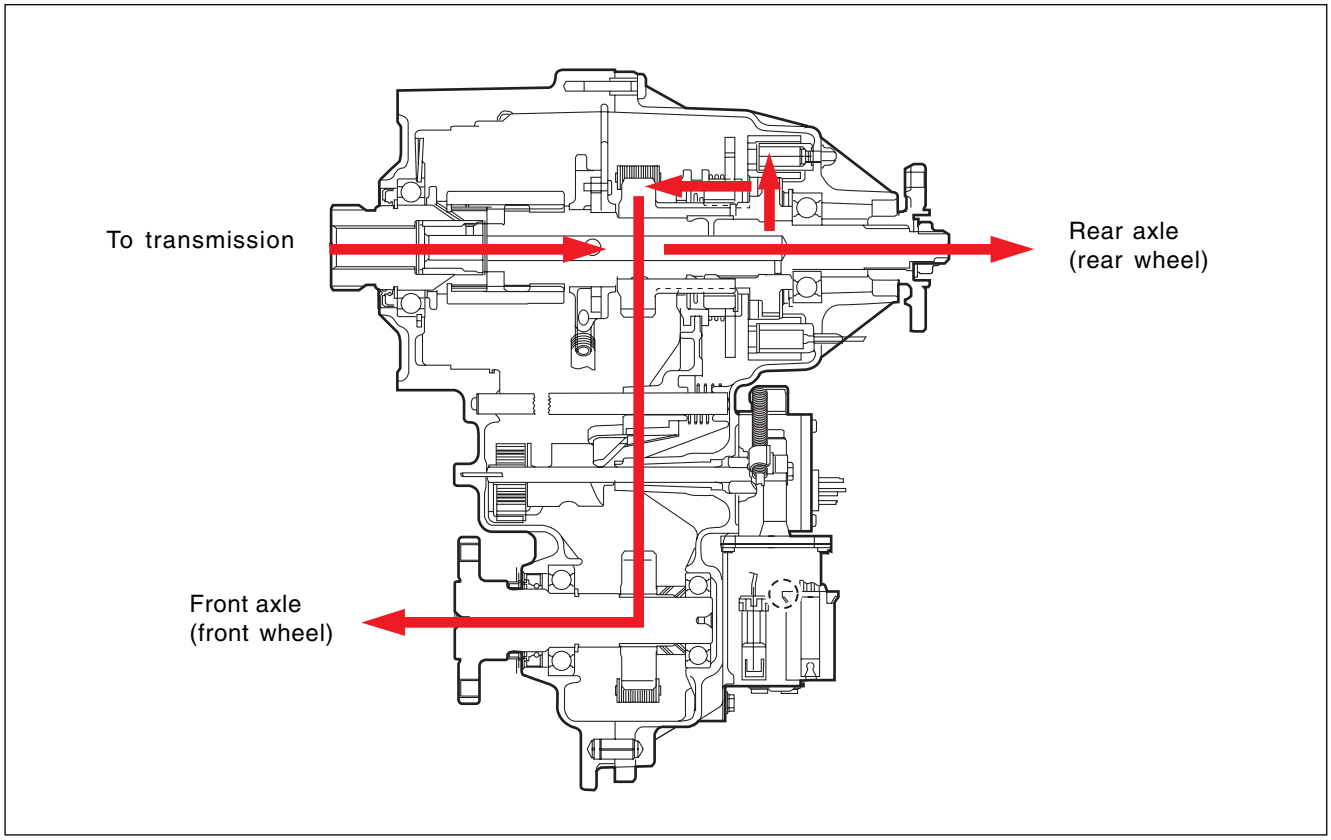


Layout

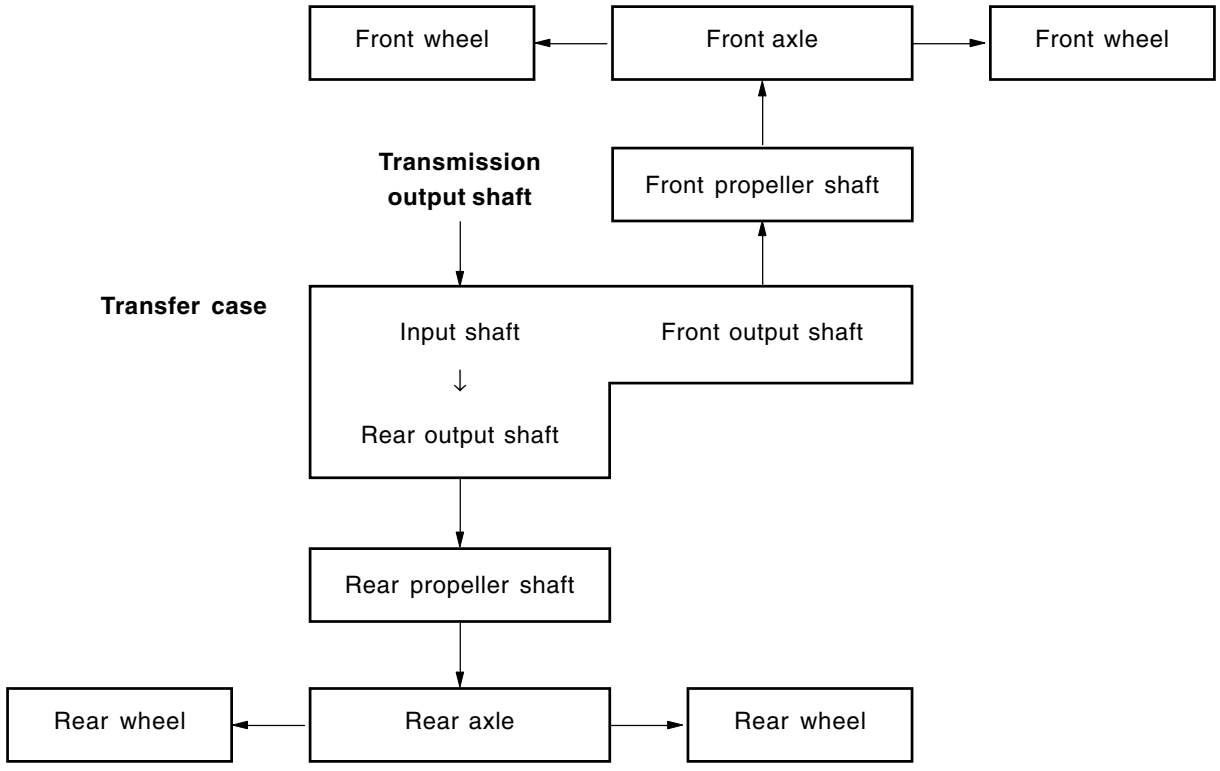


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▶ 4H Mode (4 Wheel Drive - High speed)

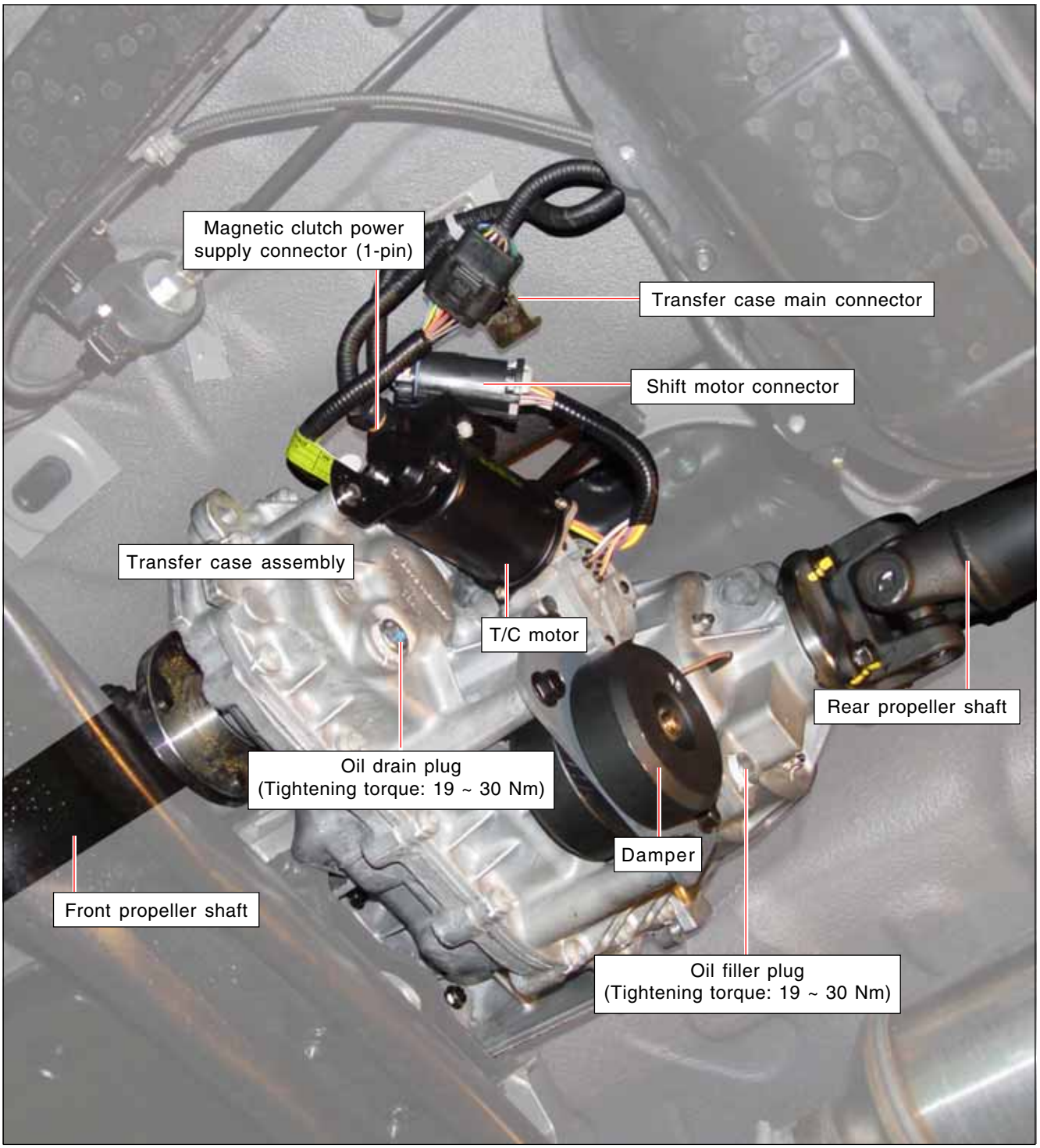


Layout



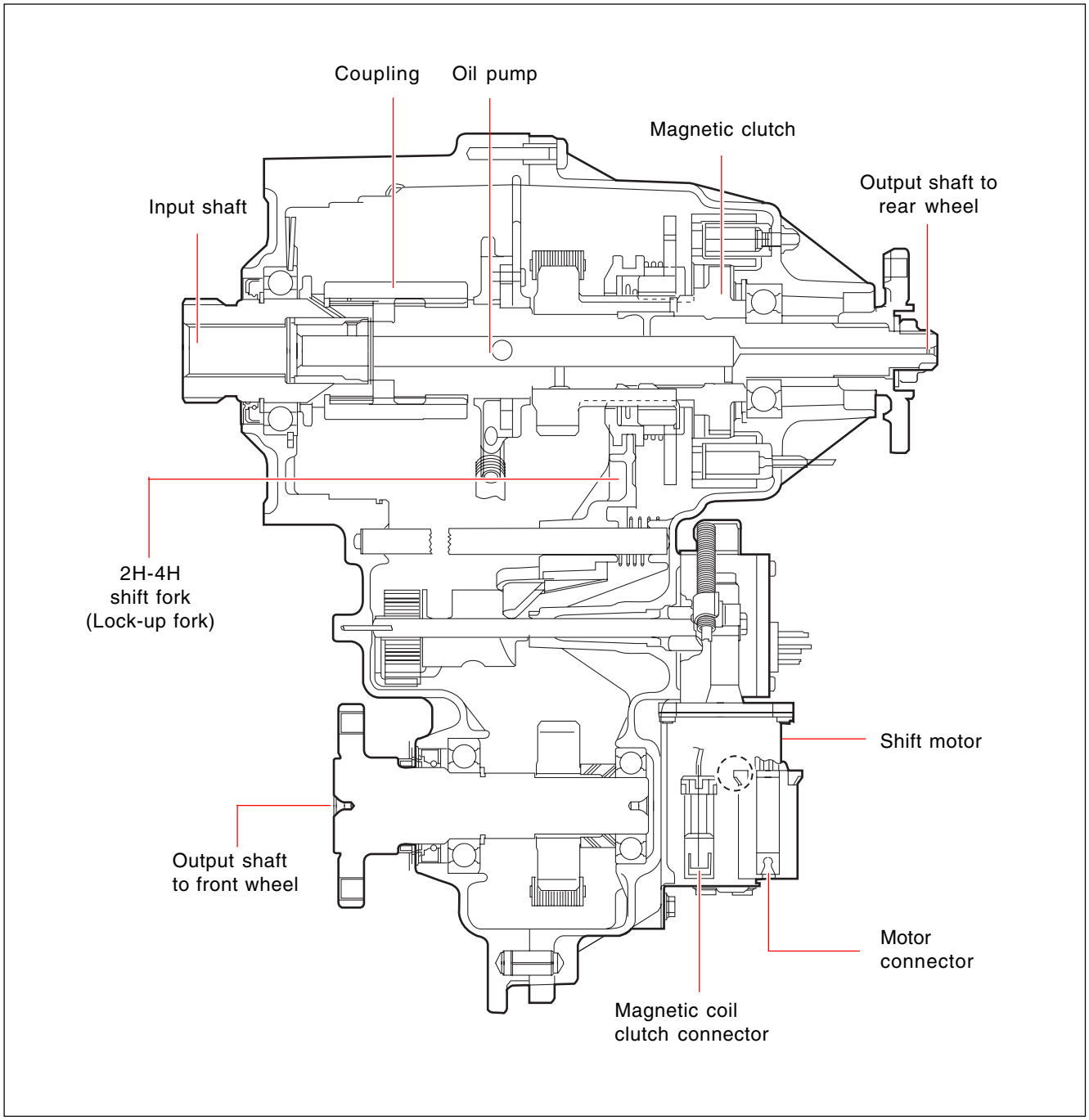
4. COMPOSITION

▶ Location



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

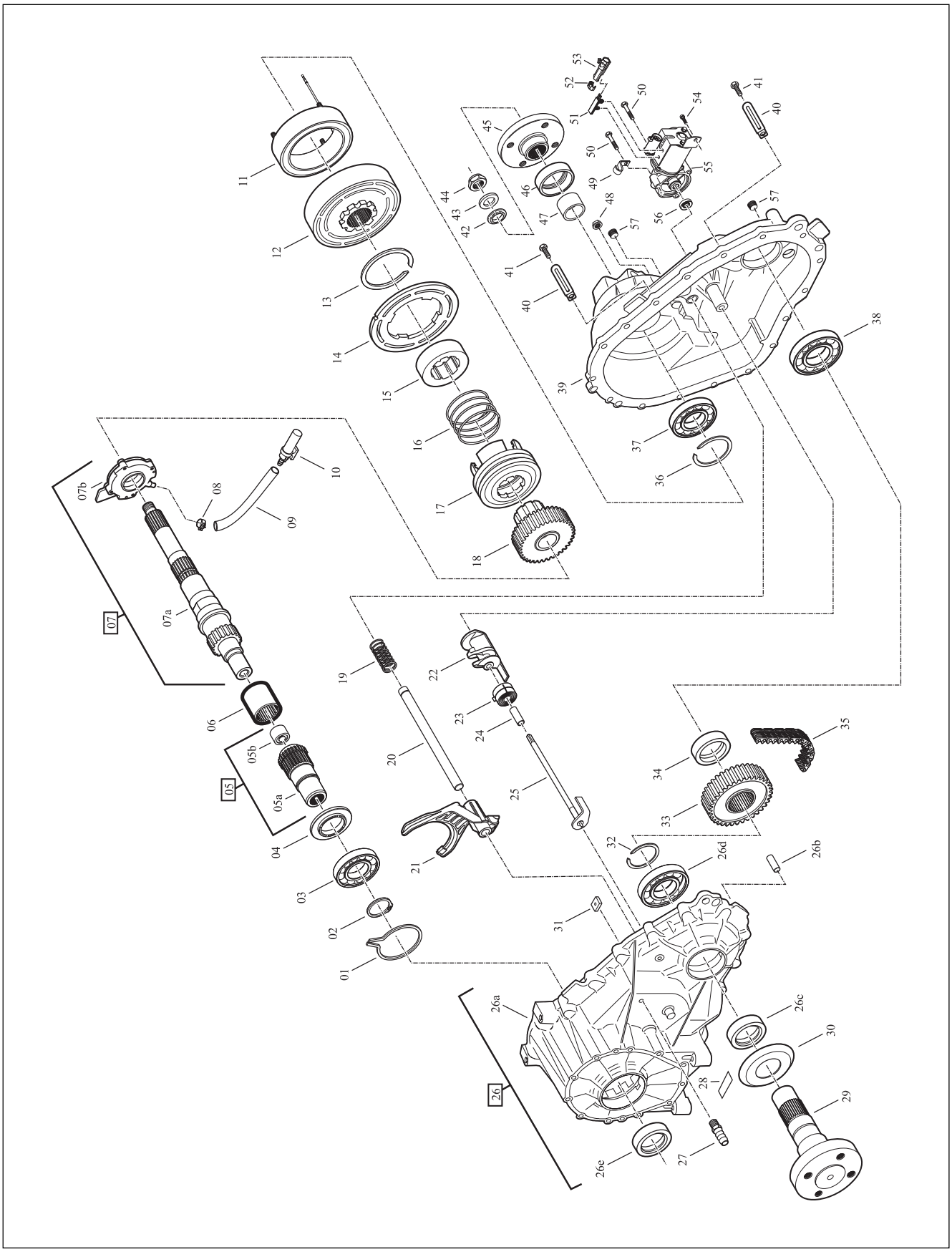
▶ Internal Structure



Difference From The Conventional Part time T/C

- Deletion of 4L (LOW 4WD), planetary gear, reduction hub and 4H-4L shift fork
- Deletion of parts related to the speed signal: speed sensor, tone wheel and wiring
- Addition of the coupling which connects the input shaft with the output shaft

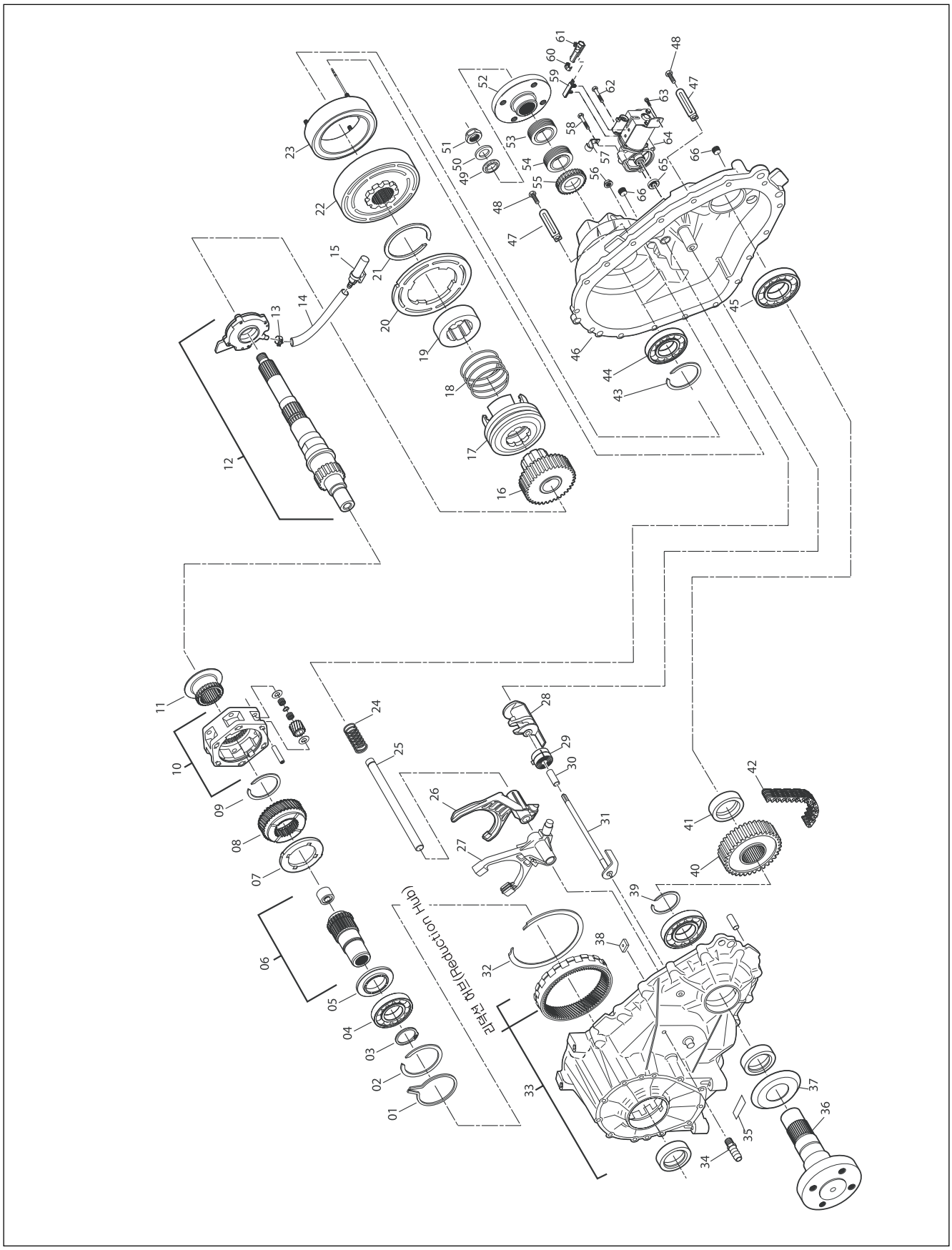
▶ Exploded View of New Transfer Case



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

1. Snap ring
2. Snap ring
3. Bearing
4. Hub
5. Input shaft assembly
   5a. Input shaft
   5b. Bearing
6. Collar
7. Main shaft assembly
   7a. Main shaft
   7b. Oil pump
8. Clamp
9. Hose
10. Filter
11. Electric coil assembly
12. Cam/Coil housing assembly
13. Snap ring
14. Armature
15. Lockup hub
16. Sleeve return spring
17. Lockup collar
18. Driving sprocket
19. Return spring
20. Shift rail
21. Shift fork
22. Electric shift cam
23. Torsion spring
24. Spacer
25. Shift shaft
26. Transfer case assembly
    26a. Transfer case
    26b. Cover dowel
    26c. Oil seal
    26d. Ball bearing
    26e. Input seal
27. Breather
28. Sticker
29. Output shaft
30. Dust deflector
31. Magnet
32. Snap ring
33. Lower sprocket
34. Spacer
35. Chain
36. Ring
37. Bearing
38. Bearing
39. Cover
40. Bendible clip
41. Bolt
42. Oil seal
43. Washer
44. Nut
45. Companion flange
46. Oil seal
47. Spacer
48. Nut
49. Clip
50. Bolt
51. Relay mounting bracket
52. Locking clip
53. Connector
54. Bolt
55. Electric motor assembly
56. Oil seal
57. Plug

▶ Exploded View for Conventional Transfer Case



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

1. Snap ring
2. Snap ring
3. Snap ring
4. Bearing
5. Hub
6. Input shaft assembly
7. Thrust plate
8. Sun gear
9. Snap ring
10. Carrier assembly
11. Reduction hub
12. Main shaft
13. Clamp
14. Hose
15. Filter assembly
16. Driving sprocket
17. Lockup collar
18. Spring
19. Lockup hub
20. Armature
21. Snap ring
22. Cam/coil housing assembly
23. Electric coil assembly
24. Return spring
25. Shift rail
26. Shift fork
27. Shift fork assembly
28. Electric shift cam
29. Spring
30. Spacer
31. Shift shaft
32. Retaining ring
33. Transfer case assembly
34. Breather
35. Name plate
36. Output shaft
37. Dust deflector
38. Magnet
39. Snap ring
40. Lower sprocket
41. Spacer
42. Chain
43. Retaining ring
44. Bearing
45. Bearing
46. Cover
47. Clip
48. Bolt
49. Clip
50. Washer
51. Nut
52. Companion flange
53. Oil seal
54. Spacer
55. Tone wheel
56. Nut
57. Clip
58. Screw
59. Clip
60. Connector lock
61. Connector
62. Bolt
63. Cap screw
64. Transfer case control motor assembly
65. Oil seal
66. Plug

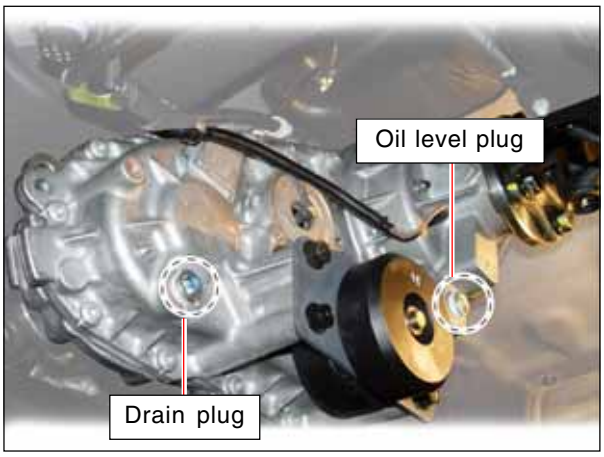
5. OIL CHECK AND CHANGE

Oil Level Check

1. Clean the oil level plug (filler plug) and surroundings.
2. Remove the oil level plug an check whether oil is spilled out.
3. Add oil if necessary. Tighten the oil level plug.

Installation Notice

Tightening torque	19 ~ 30 Nm



Oil Change

1. Clean the oil level plug (filler plug), drain plug and surroundings.
2. Place a proper container under the transfer case.
3. Remove the drain plug and then remove the oil level plug (filler plug).
4. Drain the oil and tighten the drain plug.
5. Fill the oil through the oil level plug until oil begins to drip out.

Installation Notice

Tightening torque	19 ~ 30 Nm

Cautions for Oil Level Check and Plugs

1. Be careful of hot oil when draining.
2. Do not use an impact wrench to remove or tighten the oil level plug (filler plug) or drain plug since this will damage the threads in the plug.

6. GENERAL DIAGNOSIS

Symptoms	Check	Action
Electric shift problems	• Faulty or damaged TCCU, motor, clutch or internal wirings	• Overhaul and check, replace if necessary
	• Damaged or worn shift cam, hub, fork and rail shift	• Overhaul and check for wear and damage and replace if necessary.
	• Binding shift fork, hub collar or gear	• Check sliding parts, replace if necessary.
Cannot drive front wheel when shifting to 4H	• Broken drive chain	• Check internal parts and replace drive chain.
Noise in 4WD operation	• Improper or low oil	• Drain and replace with specified oil.
	• Loosened bolts or mounted parts	• Retighten as specified.
	• Noisy T/C bearing	• Disassemble bearings and parts and check for wear or damage. Replace if necessary.
	• Gear's abnormal noise	• Check for wear and damage including speedometer gear. Replace if necessary.
Noise in 4H	• Worn or damaged sprockets or drive chain	• Disassemble and check for wear and damage. Replace if necessary.
	• Incorrect tire pressure	• Adjust tire pressure.
Transfer case oil leakage	• Cracked transfer case	• Replace the case.
	• Leakage from other parts	• Clean case and parts and check for leakage.
	• Breather clogging	• Remove breather hose and clean. Replace if necessary.
	• Improper or too much oil	• Use specified oil and adjust oil level.
	• Loosened sealing bolts	• Retighten.
	• Improperly applied sealant	• Use specified sealant and retighten.
	• Worn or damaged oil seal	• Replace oil seal.

TCCU periodically monitors the input and output while the system is in operation. When a fault is detected, the trouble code is stored into TCCU memory.

If the ignition switch is turned to "OFF", TCCU stops monitoring for input and output, however, when the ignition switch is turned to "OFF" before shifting completes, TCCU continues monitoring for input and output required for the shifting.

7. REMOVAL AND INSTALLATION

Transfer Case

1. Disconnect the motor connector from the transfer case.





2. Remove the front and rear propeller shafts by separating the front propeller shaft from transfer case and remove the rear propeller shaft completely.





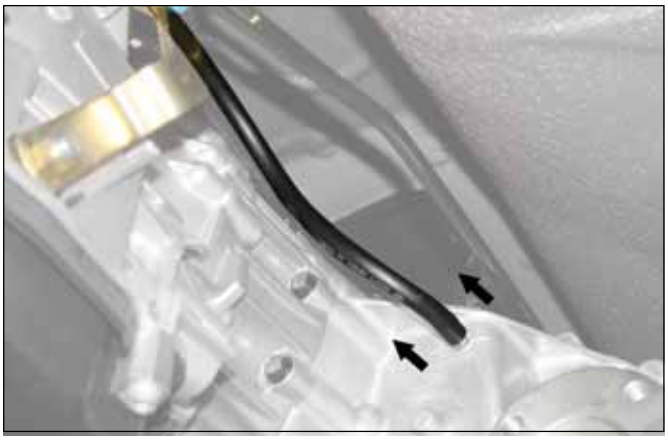
Installation Notice

Tightening torque	81 ~ 89 Nm (T/C)

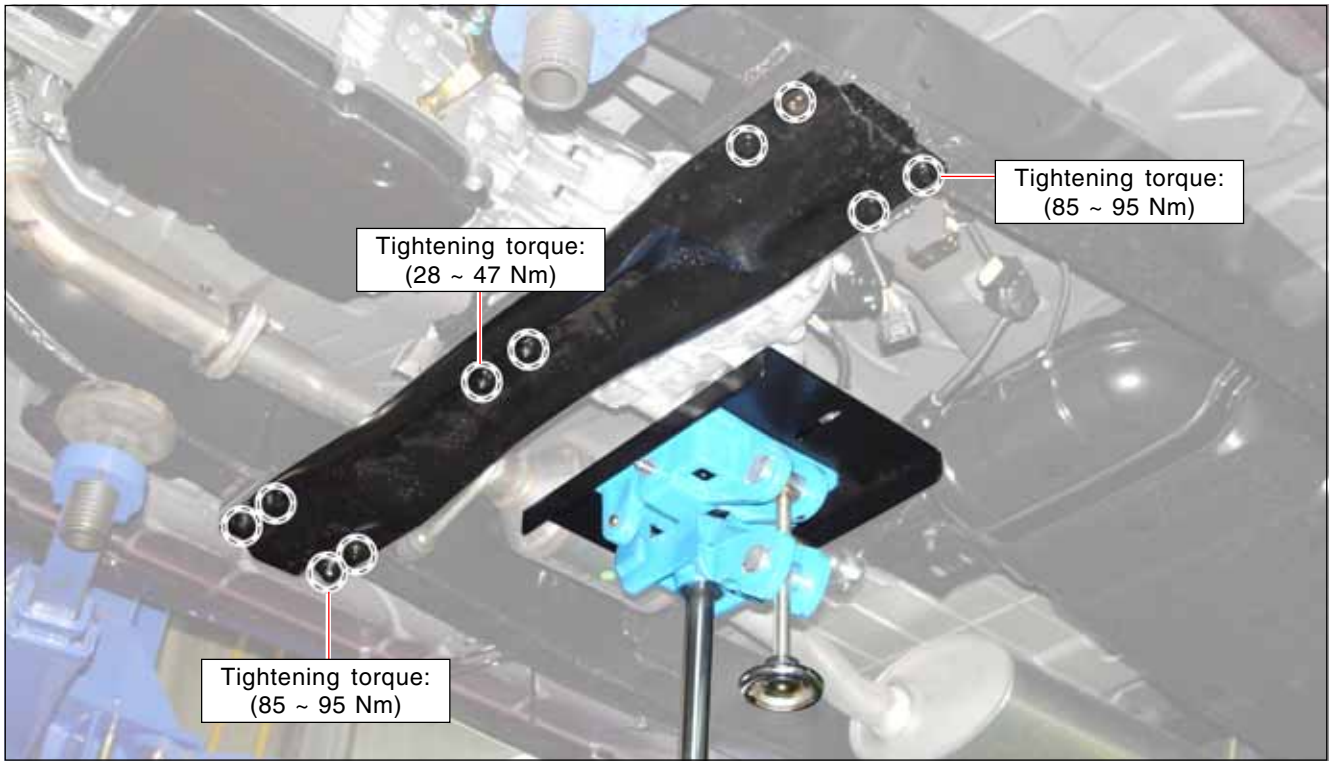
Installation Notice

Tightening torque	81 ~ 89 Nm (T/C)
	70 ~ 80 Nm (Axle)

3. Disconnect the air hose from the transfer case.



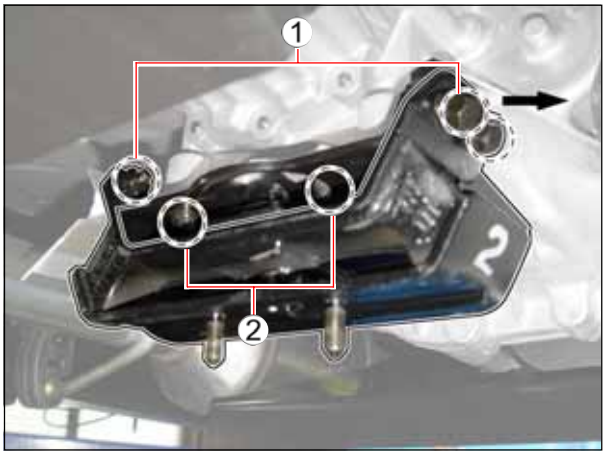
4. Place the safety jack under the transfer case and automatic transmission. Unscrew two transmission cross member bolts (14 mm) and the center bolt (14 mm), and remove the transmission cross member.



5. Unscrew two bolts (14 mm) and remove the transfer case mounting insulator and insulator bracket by removing two bolts.

Tightening torque

Mounting insulator ①	28 ~ 47 Nm
Bracket bolt ②	28 ~ 47 Nm



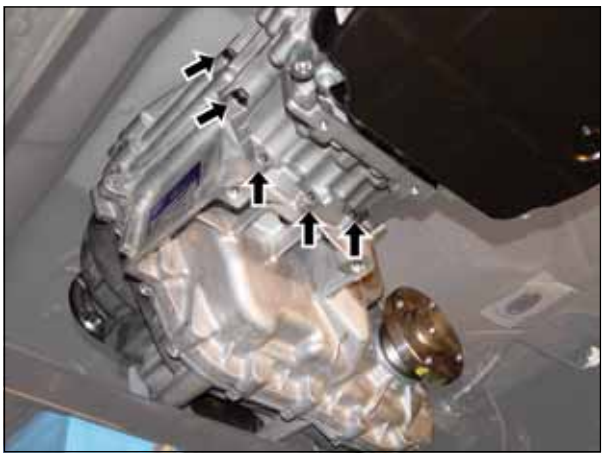
6. Unscrew eleven bolts (12 mm) and carefully remove the transfer case.

Installation Notice

Tightening torque	20 ~ 25 Nm

NOTICE

- **When installing the transfer case, make sure that the bolts are facing correct direction.**
  From transmission side (upper: 8), From transfer case side (lower: 3)



7. When installing, keep the tightening torque and install in reverse order of removal.

Side View



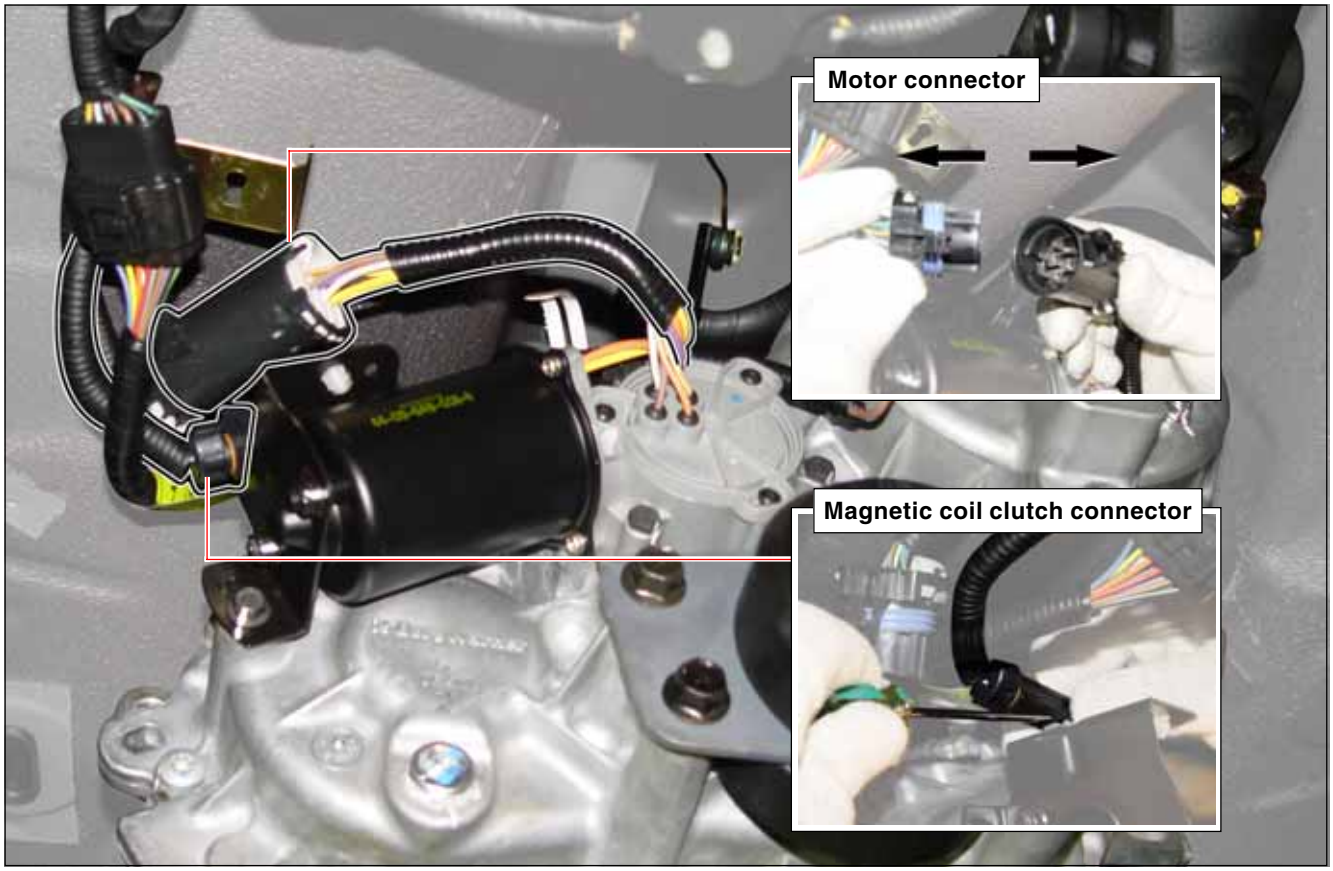
Front View



Transfer Case Motor

※ **Preceding Work:** Disconnect the negative battery cable.

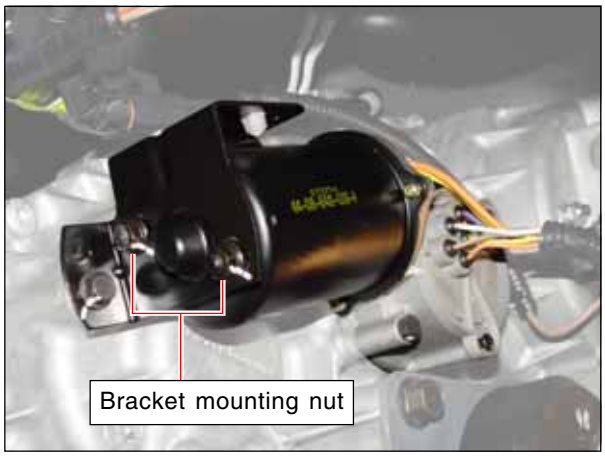
1. Disconnect the magnetic coil clutch connector and motor connector from the transfer case.
2. Unscrew the bolts and remove the transfer case motor with bracket.



3. Unscrew three transfer case motor bolts (10 mm) and a bracket bolt to remove the motor.

NOTICE

- **Remove two nuts to separate the bracket and motor.**



3. Pull the shift motor assembly out by pulling it rearward while keeping the level. Clean the mating surface of the transfer case and shift motor.



NOTICE

- **Do not disassemble the shift motor since it is replaced as an assembled unit.**

4. Apply sealant on the mating surface when installing new shift motor assembly.
5. Install in the reverse order of removal. Make sure that the mode switch selection is matched with the motor's driving position before installation.





NOTICE

- **To do that, install new shift motor on the same location that the used shift motor was on.**

TCCU (Transfer Case Control Unit)

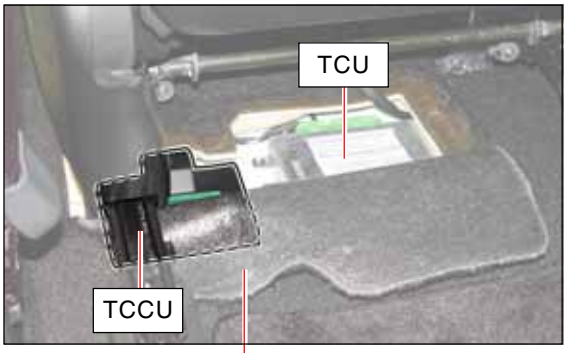
1. MAJOR CHANGES IN TCCU

TCCU controls the 4WD system and is located under the driver's seat.

The new TCCU makes some difference compared with TCCU for the conventional part time transfer case and the differences are as follows:

1. No additional coding is required when replacing TCCU.
2. Delete the devices (tone wheel, wiring etc.) related to the speed sensor in the transfer case.
3. Delete the pin related to the speed sensor from TCCU pins.
4. Change the transfer case wiring connector from No.4 pin to No.1 pin.
5. The new TCCU is available to install on the vehicle with the conventional DI engine part time TCCU.

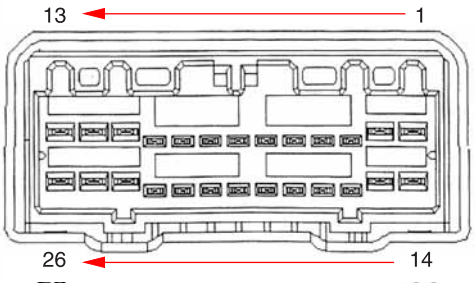
Location



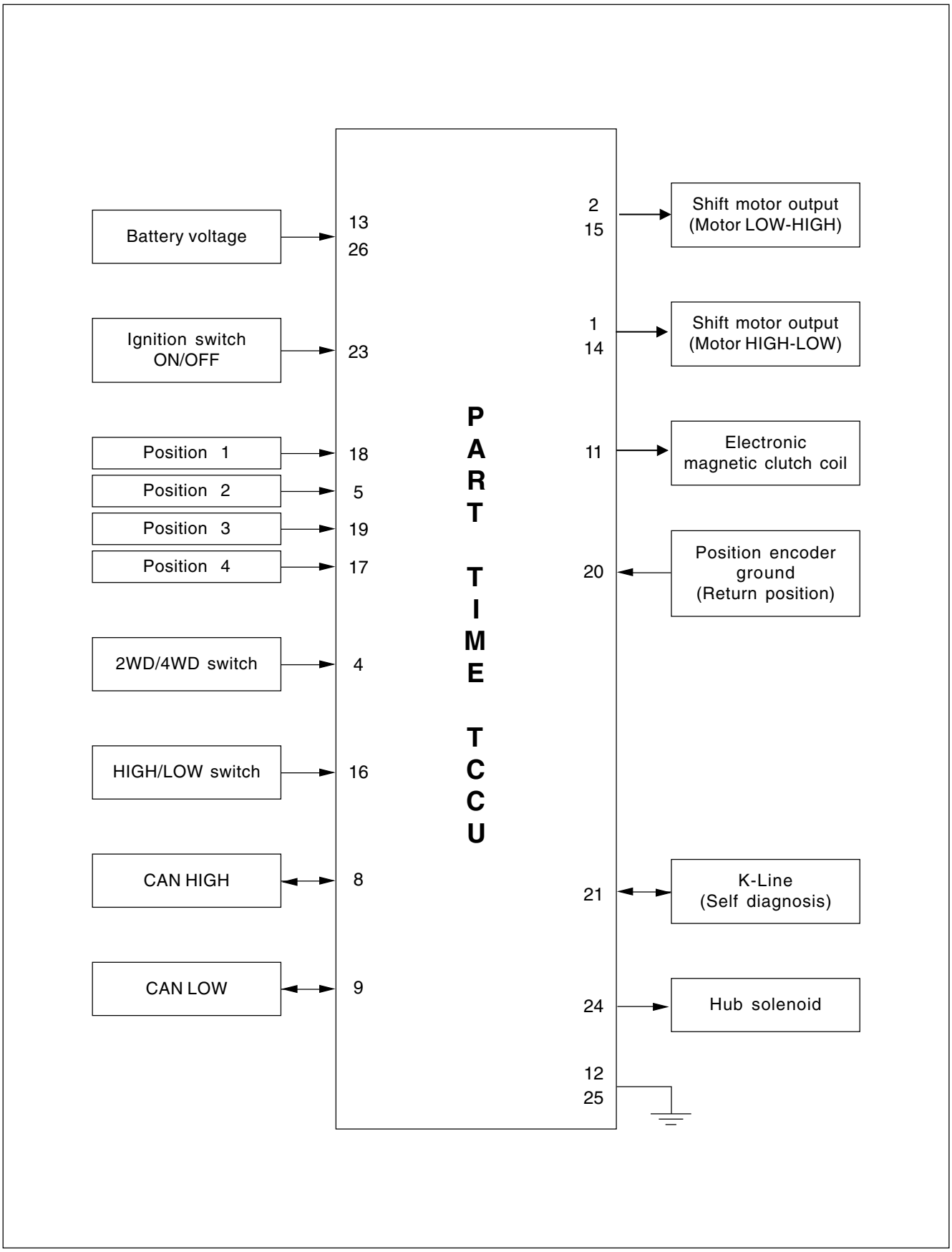




Pin Arrangement

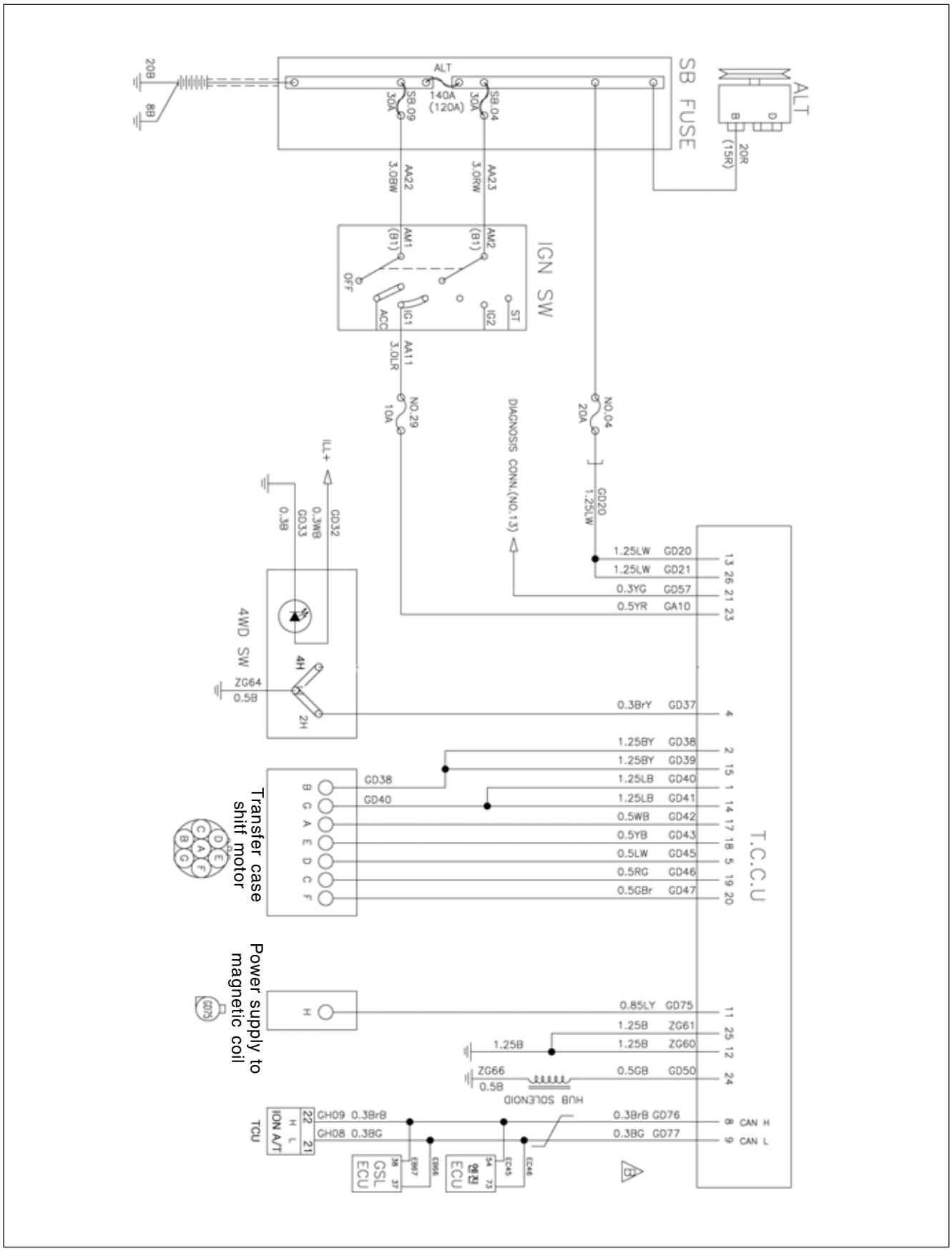


2. TRANSFER CASE BLOCK DIAGRAM

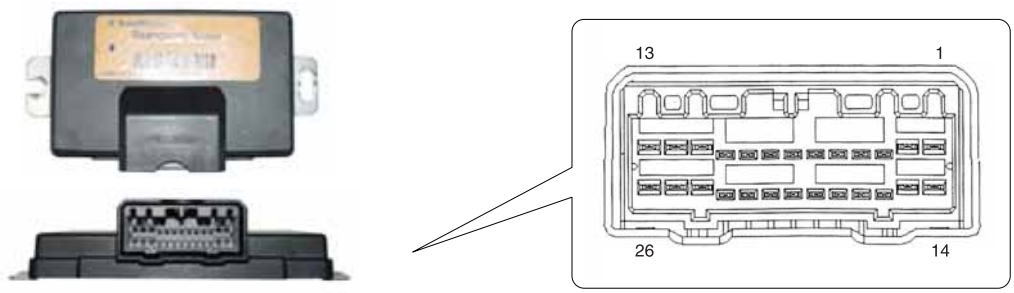


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3. CIRCUIT DIAGRAM OF TRANSFER CASE



▶ TCCU Pin Numbers and Description



T/C: Transfer Case

Pin No.	Function	Input/Output	Description
1	Motor HI - LO	Output	This is a terminal that outputs the input signal to the T/C motor during the 4WD switch operation. When switching the 2WD mode to 4WD mode, the battery power is supplied to “Motor Hi-Lo” and the opposite side is earthed, and vice versa.
2	Motor LO - HI	Output	
3	-	-	-
4	4WD switch	Input	Switch position converting (2H-4H) recognition
5	Position 2	Input	Detecting shift motor position 2 position.
6	-	-	-
7	-	-	-
8	CAN H	Both	These lines are sharing the information among the related units through the CAN communication. The differences from the conventional part time T/C models are that the speed sensing type tone wheel in T/C has been eliminated and the speed signal comes from the ABS/ESP HECU or the instrument panel.
9	CAN L		
10	-	-	-
11	EMC (Electronic magnetic clutch)	Output	Supplying the voltage to clutch coil for all shifting operations • When supplying power: Battery voltage • When no power supplied: Ground power
12	Ground	Input	Provide the ground to TCCU
13	Battery	Input	Battery voltage supplying terminal to operate the system
14	Motor High-Low	Output	Same as No.1, 2 pin
15	Motor Low-High	Output	
16	High-Low switch	Input	Recognition converting switch between 4H and 4L
17	Position 4	Input	Detecting shift motor position 4 position.
18	Position 1	Input	Detecting shift motor position 1 position.
19	Position 3		Detecting shift motor position 3 position.
20	Position return	Input	Providing the ground related to shift motor sensor plate.
21	K-Line	Both	Connected to trouble diagnosis connector
22	-	-	-
23	Ignition power	Input	Power supply terminal when ignition switch is ON
24	Solenoid power supply	Output	Locking hub system applied to KYRON makes difference in related to the conventional part time system and the vacuum supply in operating process.
25	Ground		
26	Battery		

4. CONNECTORS OF SHIFT MOTOR AND MAGNETIC CLUTCH POWER SUPPLY

▶ Shift Motor Connector



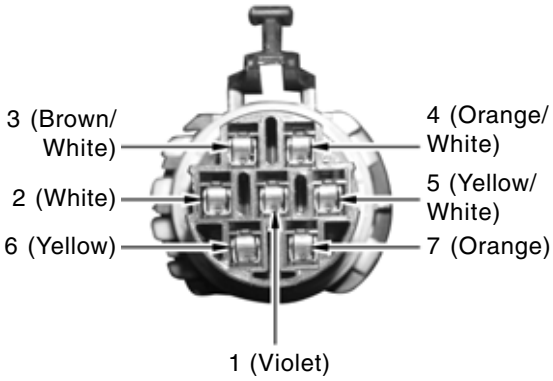
Unit



Shift Motor Connector Pin Arrangement

When selecting a position in the 4WD switch (2H, 4H), TOD control unit exactly changes the motor position to 2H and 4H by detecting the electric signals from position encoder that monitors motor position.

Pin	Function
1	Position A
2	Position B
3	Position C
4	Position D
5	Position ground
6	Control (4H -2H)
7	Control (2H - 4H)

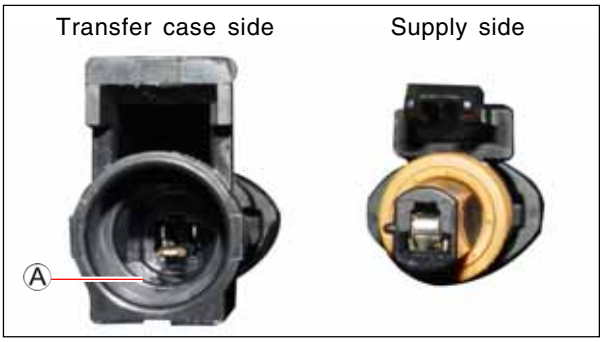


▶ Magnetic Clutch Power Supply Connector



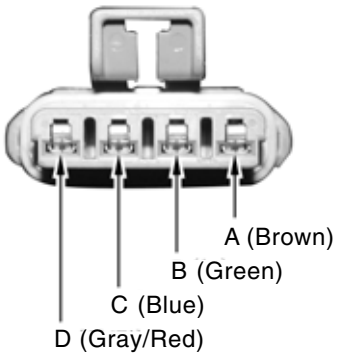
The transfer case integrated in KYRON doesn't have an internal speed sensor. Therefore, there are not extra terminals for speed sensor power supply and ground.

Pin	Function
A	Magnetic clutch coil power supply



Note (Old Version)

The rear speed sensor utilizes the hall effect. It generates 0V and 5V of square type digital wave according to the rotation of the wheel with teeth of transfer case rear output shaft. The speed signal from rear propeller shaft is entered into control unit. When the control unit determines that 4WD HIGH operation is available, electric current flows into the clutch coil. The coil magnetized by this electric current pull in the lockup hub to engage into output spline. Accordingly, the power is transferred to front wheels.



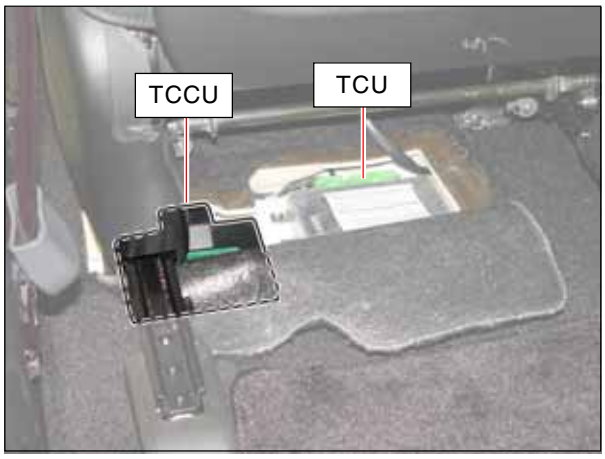
Pin	Function
A	Clutch coil
B	Sensor power (5V)
C	Sensor signal
D	Sensor ground

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AFFECTED VIN	

5. SYSTEM OPERATION

▶ 4WD Operation

TCCU is located under the driver's seat and permits the vehicle to shift from the two-wheel drive to the four-wheel drive (and back shift) according to driver's switch operation during driving.



1. 2H → 4H

a. Change the 4WD switch in instrument panel from 2H to 4H.

b. This shift is available during driving.

c. The "4WD HIGH" indicator in meter cluster comes on.



When the System is Defective

- **The "4WD CHECK" warning lamp comes on**

2. 4H → 2H

a. Change the 4WD switch in instrument panel from 4H to 2H.

b. This shift is available during driving.

c. The "4WD HIGH" indicator in meter cluster goes out.



Position Encoder

The position encoder is the code that TCCU can determine the shift motor position.

Position Code				Motor Position	Remark
1	2	3	4		
0	0	0	0	Left Stop	Input voltage 1: above 4.5V (HIGH) 0: below 0.5V (LOW)
1	0	1	0	2 H	
0	0	1	0	Zone 1	
0	1	1	0	Zone 2	
0	0	1	0	Zone 3	
0	0	1	1	4 H	

Operation

TCCU initialization and operation

1. TCCU sends relevant data to meter cluster via CAN to diagnose and check the indicators when the ignition switch is turned to ON. At this time, the 4WD indicators (4WD LOW and 4WD HIGH) come on for 0.6 seconds.
2. TCCU starts diagnosis by operating clutch coil and hub solenoid for 1.5 seconds.
3. The shift operation is controlled to move only toward selector switch position if the selector switch position is not met with shift motor position code when the ignition switch is turned to ON.

Drive Mode Change

The shift operation is only allowed when some conditions are satisfied. These shift conditions should be satisfied for 2 seconds before starting motor. The motor has three seconds of delay at its initial operation to do trouble diagnosis. Once the motor starts, the shift conditions are no longer checked.

Shift conditions are as follows:

1. Normal battery voltage and shift motor for all gears
2. 2H and 4H shifts has nothing to do with the vehicle speed, the “N” position in the automatic transmission or the clutch signal.

Motor Controls

1. TCCU operates the shift motor until it reads the required position code. If it detects the faulty code, the system is operated with the compensation mode.
2. Once the shift operation is started, it is completed regardless of the ignition power. If there are not operating signals from the position sensor, the shifting failure occurs due to timeout. This failure appears when the shifting time between 2H and 4H is delayed over 5 seconds compared to normal shift. Once the shifting time exceeds the specified time, TCCU cannot properly supply the voltage to shift motor and is operated in compensation mode.
3. Even though the system recognizes a fault before motor starts, it is considered as a fault.
4. Motor stops operation when it reaches target range.

Synchronization

Synchronization occurs during shifting from 2WD (2H) to 4WD (4H). The synchronizer clutch and the hub solenoid are controlled during the synchronization as follows:

1. The clutch coil operates when the selector changes from 2H to 4H.
2. The shift motor moves in 4H mode.
3. The locking hub solenoid starts its operation 4 seconds after shifted to 4H.
4. The clutch coil stops its operation 5 seconds after the hub solenoid is activated.

Compensation

The motor stops when the encoder related to troubles are detected during shift operation. It moves toward LOW-HIGH direction for 5 seconds so that the motor is not left in unidentified position.

6. TROUBLE DIAGNOSIS TEST

▶ Shift Motor Test

1. Check short and open circuit before and during shifting.
2. When the system detects a fault in the shift motor for over 1 second, the “4WD CHECK” warning lamp comes on and a trouble code is stored into memory.
3. The trouble code being detected in shift motor during its operation is defined as timeout.
4. The trouble code for the shift motor can be erased by using scanner.

▶ Transmission System Timeout Test

1. The shift timeout occurs when the position sensor of shift motor does not try to operate, which happens 1.5 seconds after completion of 2H-4H shift.
2. When the timeout occurs, TCCU cuts off the voltage to shift motor and operates the compensation mode.

▶ Position Encoder Test

1. When the system detects a fault in shift motor for over 1 second, the “4WD CHECK” warning lamp comes on and the trouble code is stored into the memory.
2. The position encoder fault can be divided into a general encoder fault and short to ground of position encoder circuit.
   a. General encoder fault: Invalid position code input
   b. Short to ground of position encoder circuit: Ground for encoder circuit

▶ Clutch Coil Test

1. Check the clutch coil for open and short circuit.
2. When the system detects a fault in shift motor for over 0.8 seconds, the “4WD CHECK” warning lamp comes on and the trouble code is stored into the memory.

▶ Compensation

1. The motor stops when the encoder related troubles are detected during shift operation. It moves toward LOW-HIGH direction for 5 seconds so that the motor is not left in unrecognized position.

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EFFECTIVE DATE	
AFFECTED VIN	

7. SELF-DIAGNOSIS TEST

1. TCCU detects the transfer case systems malfunctions and indicates malfunctioning part(s) through flickering of the “4WD CHECK” indicator.

   Connect Scan-I to the diagnostic connector located under the steering wheel.



2. The transfer case system is malfunctioning when:
   a. The “4WD CHECK” indicator remains on after 0.6 second after turning the ignition switch ON.
   b. The “4WD CHECK” indicator continuously comes on during driving.

3. Connect Scan-I to the diagnostic connector and read the defective code with the ignition switch “ON” (refer to Diagnosis Table).
4. After repairing, erase the defective code stored in TCCU.



NOTICE

- **Before replacing the malfunction parts with defective code, check the wires and connectors for looseness and open circuit.**

8. DIAGNOSTIC TROUBLE CODE

Code	Description	Action
P1806	Defective CAN commuication	- Check communication line. - Replace TCCU if necessary.
P1821	Open or short to magnetic clutch (EMC) circuit	- When power is not supplied to magnetic clutch coil properly - When the circuit is open or short to ground for 0.8 seconds (Warning lamp comes on) - The magnetic clutch operates correctly if the correct signal is supplied for 0.8 seconds even though it is open. (Warning lamp goes off and it is stored as history fault in memory) - Voltage at TCCU pin No. 11: 11~15 V - EMC resistance: 2.5 Ù - Check the relevant connectors for contact. - Replace TCCU if necessary.
P1822	Defective locking hub solenoid	- When the locking hub solenoid operates, there is no malfunction in magnetic clutch and TCCU to the hub solenoid output is open or short to ground for 0.8 seconds - Warning lamp comes on. - Check the relevant harnesses for contact. - Replace locking hub solenoid if necessary.
P1841	Open to ground in shift motor circuit	- When TCCU detects motor's malfunction for 1 second (Action: IGN OFF → ON) - Check the relevant harnesses for contact. - Replace TCCU if necessary.
P1842	Short to ground in shift motor output circuit	- When TCCU detects motor's malfunction for 1 second (Action: IGN OFF → ON) - Check the relevant harnesses for contact. - Replace TCCU if necessary.
P1843	Defective position sensor in motor	- When no operation is detected in position sensor - When no operation is detected for 1.5 seconds while 2H-4H operation - Check the relevant harnesses for contact. - Replace TCCU if necessary.
P1850	Defective position encoder	- When TCCU detects a fault in position encoder for 1 second while during 4WD shifting (Position encoder: Detects the angle when shift motor rotates) - IGN OFF → ON: The current state is cancelled and it is stored as history malfunction in memory. - The warning lamp comes on. - Check the relevant harnesses. - Check the relevant connectors for contact. - Check the shift motor.

Code	Description	Action
P1851	Shoft to ground for position encoder 1	- No 4WD shift possible if it occurs before shifting into 4WD mode. - Short to ground for position encoder 1 in shift motor - Check the relevant harnesses for short. TCCU pin No. 18 - Check the relevant connectors for contact. - Check the shift motor.
P1852	Shoft to ground for position encoder 2	- No 4WD shift possible if it occurs before shifting into 4WD mode. - Short to ground for position encoder 2 in shift motor - Check the relevant harnesses for short. TCCU pin No. 5 - Check the relevant connectors for contact. - Check the shift motor.
P1853	Shoft to ground for position encoder 3	- No 4WD shift possible if it occurs before shifting into 4WD mode. - Short to ground for position encoder 3 in shift motor - Check the relevant harnesses for short. TCCU pin No. 19 - Check the relevant connectors for contact. - Check the shift motor.
P1854	Shoft to ground for position encoder 4	- No 4WD shift possible if it occurs before shifting into 4WD mode. - Short to ground for position encoder 4 in shift motor - Check the relevant harnesses for short. TCCU pin No. 17 - Check the relevant connectors for contact. - Check the shift motor.

9. REMOVAL AND INSTALLATION OF TCCU

1. Slide the drive's seat as far as it goes and fold up the carpet.



2. Unscrew two bolts (10 mm) on the TCCU.

Installation Notice

Tightening torque	10 Nm



3. Disconnect the TCCU connector and remove the TCCU.

NOTICE

- **Be careful not to apply any impact to TCCU body.**







IWE LOCKING HUB SYSTEM

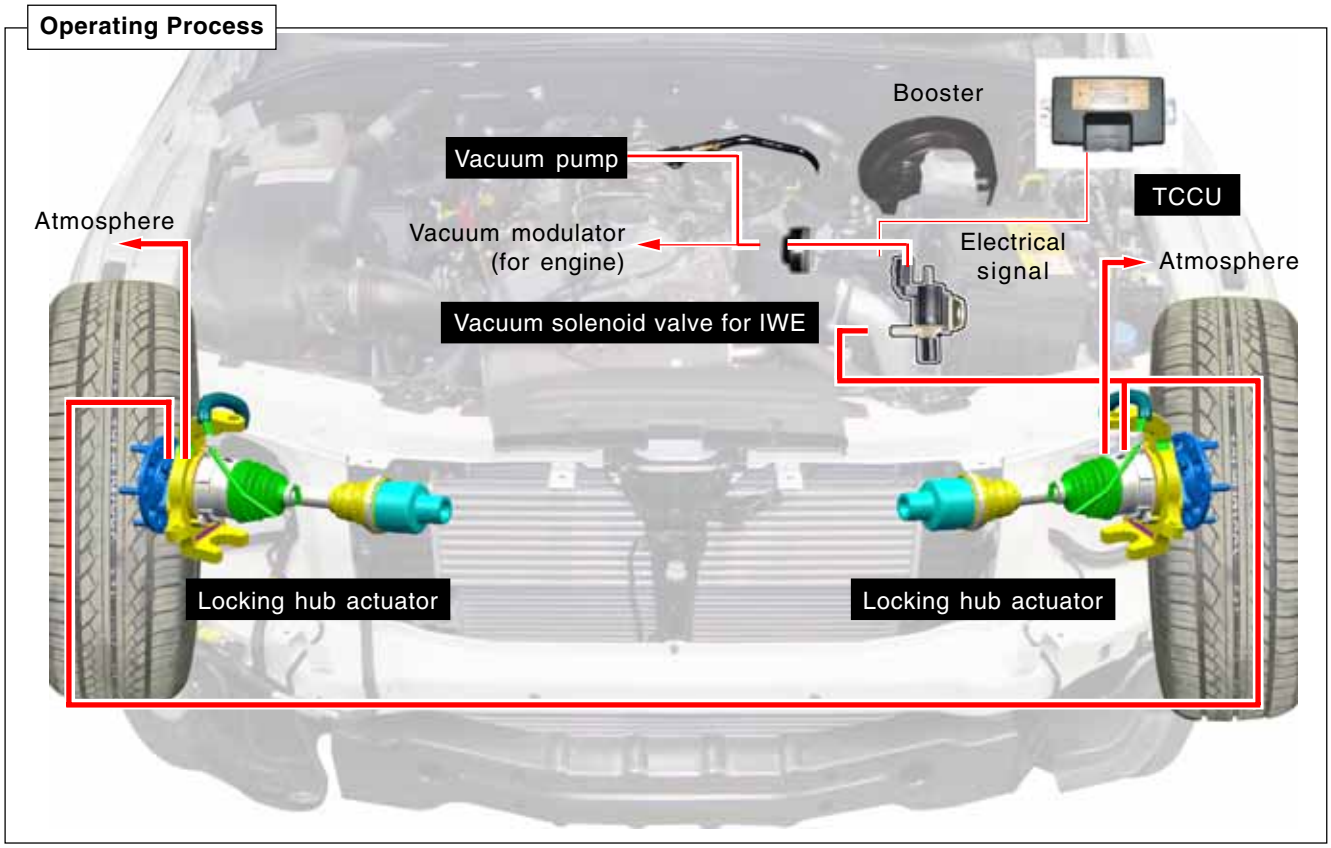
1. LOCKING HUB SYSTEM

The transfer case and the TCCU differ from previous models only in the speed sensor related parts. However, the operaing process of the vacuum locking hub operation system works oppositely from previous models and its components also have changed.

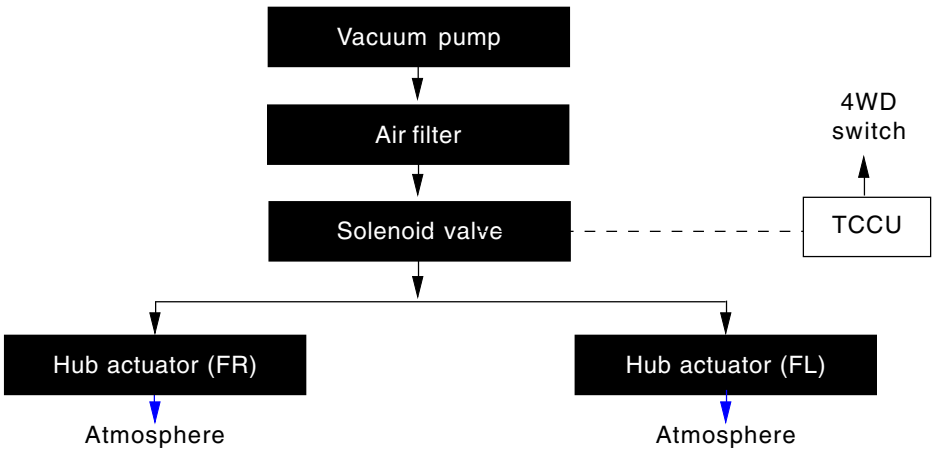
The vacuum locking hub that is applied to Kyron uses the IWE (Integrated Wheel End) system, and in this system, the vacuum is generated only within the hub actuator.

It is structured to transmit power to the front section after the actuator hub is engaged following the release of vacuum from the drive shaft end gear and the hub end gear.

Operating Process



Vacuum generation process in front hub actuator:



2. VACUUM SYSTEM RELATED TO 4WD



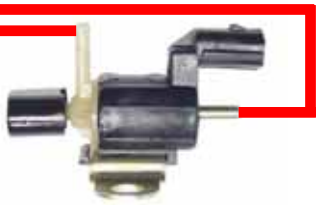
Vacuum operation during 2WD mode

During 2WD mode, the vacuum pressure from vacuum pump is continuously transmitted to the locking hub system. This vacuum pressure pulls in the locking hub actuator so that it will not be engaged with the front end hub gear.

In 4WD mode, the TCCU blocks the transferring of vacuum pressure from vacuum pump to locking hub by supplying the power to solenoid valve.



Air filter



Hub actuator (RH)

Hub actuator (LH)



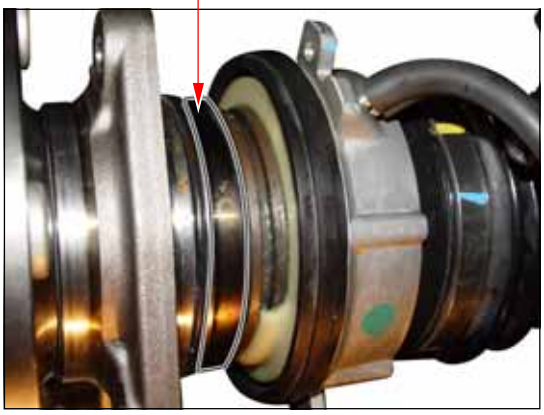
Atmosphere (in 4WD mode)

2WD (applying vacuum pressure to hub actuator)

The vacuum pressure pulls in the locking hub actuator so that it will not be engaged with the front end hub gear.

4WD (releasing vacuum pressure from hub actuator)

The vacuum pressure is released from the hub actuator. At this time, the front hub end gear is engaged.



3. COMPONENTS OF IWE (INTEGRATED WHEEL END)

Front Hub Assembly

The front hub assembly is connected to the tire and it drives the wheel by receiving the rotation force from the drive shaft during 4WD mode. When the hub actuator is moved to the gear (vacuum pressure released), the 4WD mode is engaged. When the hub actuator is out of the gear (vacuum pressure applied), the 4WD mode is concelled.



NOTICE

- **Rubber O-ring: Replace it with a new one when removing/installing the front hub.**

Front Drive Shaft

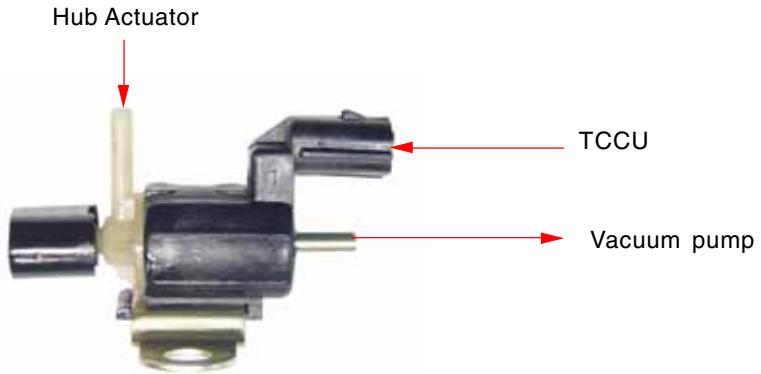
The front drive shaft is the part that receives the power when the transfer case operates in 4WD mode. During the 2WD mode, the hub actuator is positioned at the drive shaft end, and during the 4WD mode, the hub actuator is interlocked to the drive shaft end gear and the front hub end gear.



Solenoid Valve

The vacuum solenoid valve is installed at bottom of the battery tray and serves the function that allows to connect and block the vacuum pressure from vacuum pump to hub actuator.

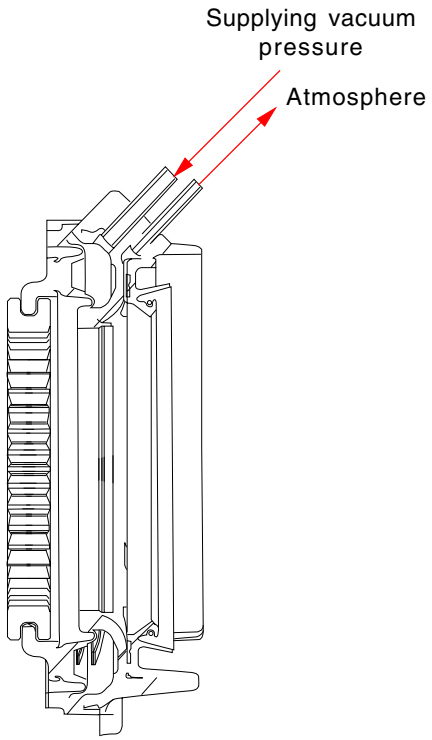
During the 2WD mode, a vacuum line is established between vacuum pump and hub actuator. During the 4WD mode, the TCCU applies 12V to the vacuum solenoid to block the vacuum pressure.



Locking Hub Actuator

This device transfers or blocks the output from drive shaft to the front wheel end according to the vacuum pressure. Unlike the conventional systems, the vacuum pressure to the front wheel end operates only within the actuator.

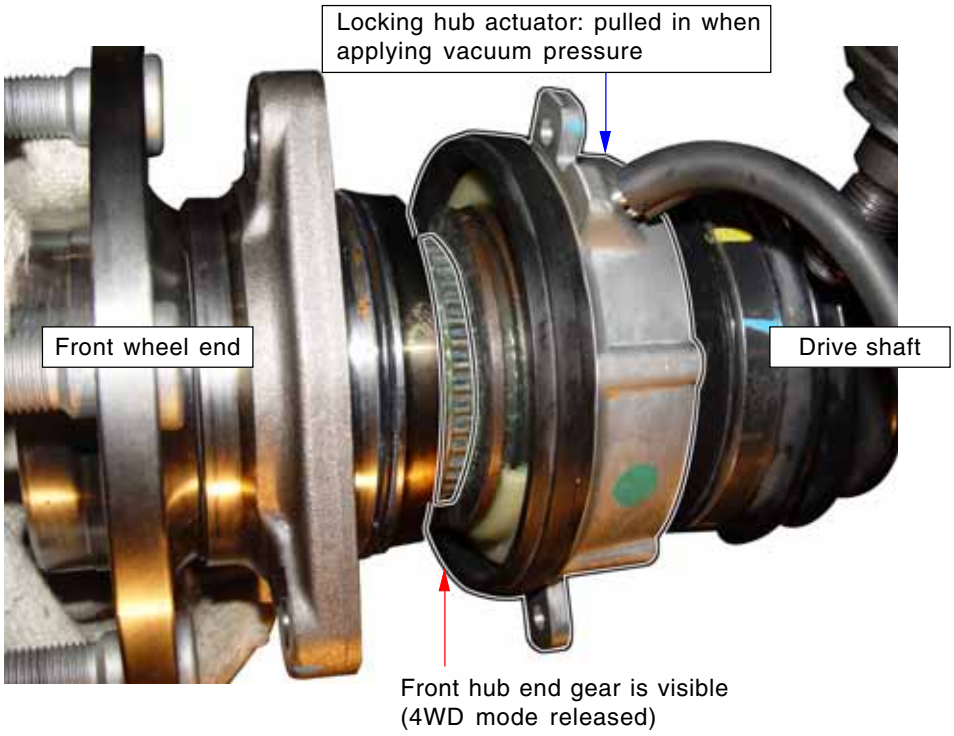




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EFFECTIVE DATE	
AFFECTED VIN	

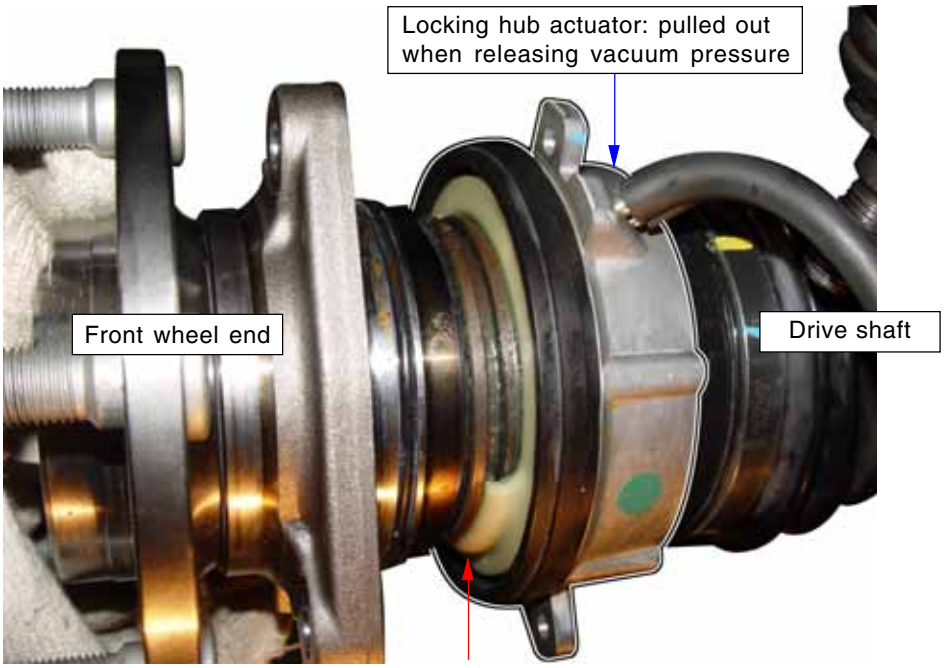
2WD:

The locking hub actuator is out of the front wheel hub end gear when applying the vacuum pressure.

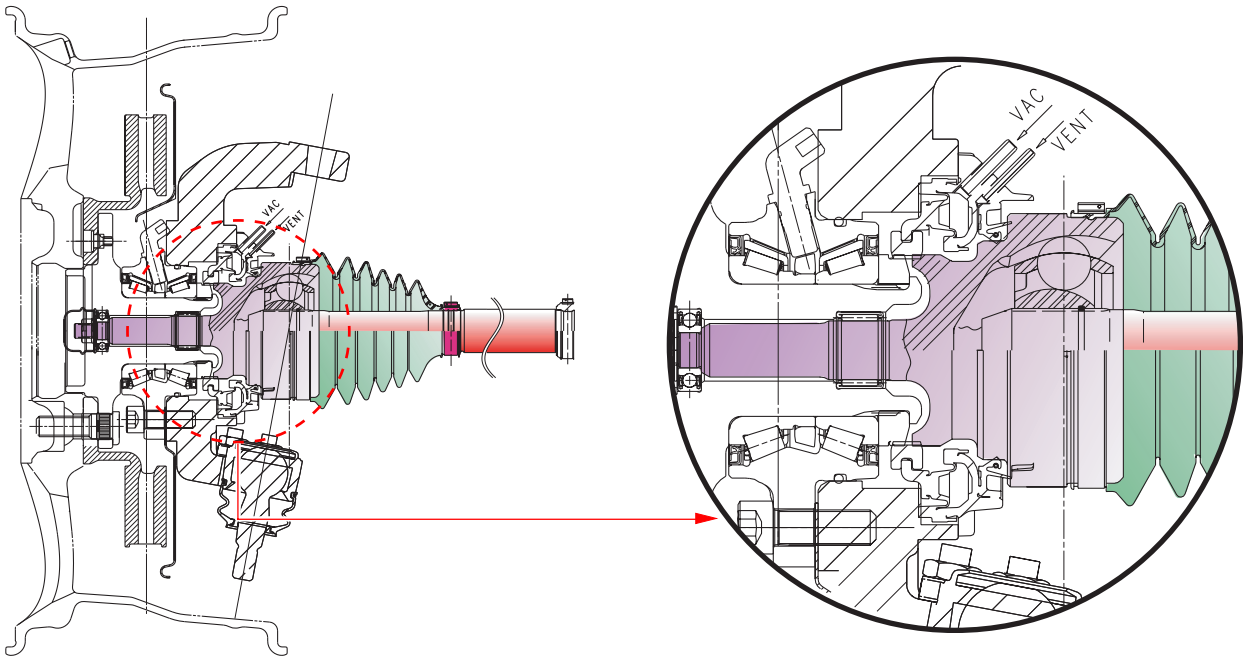


4WD:

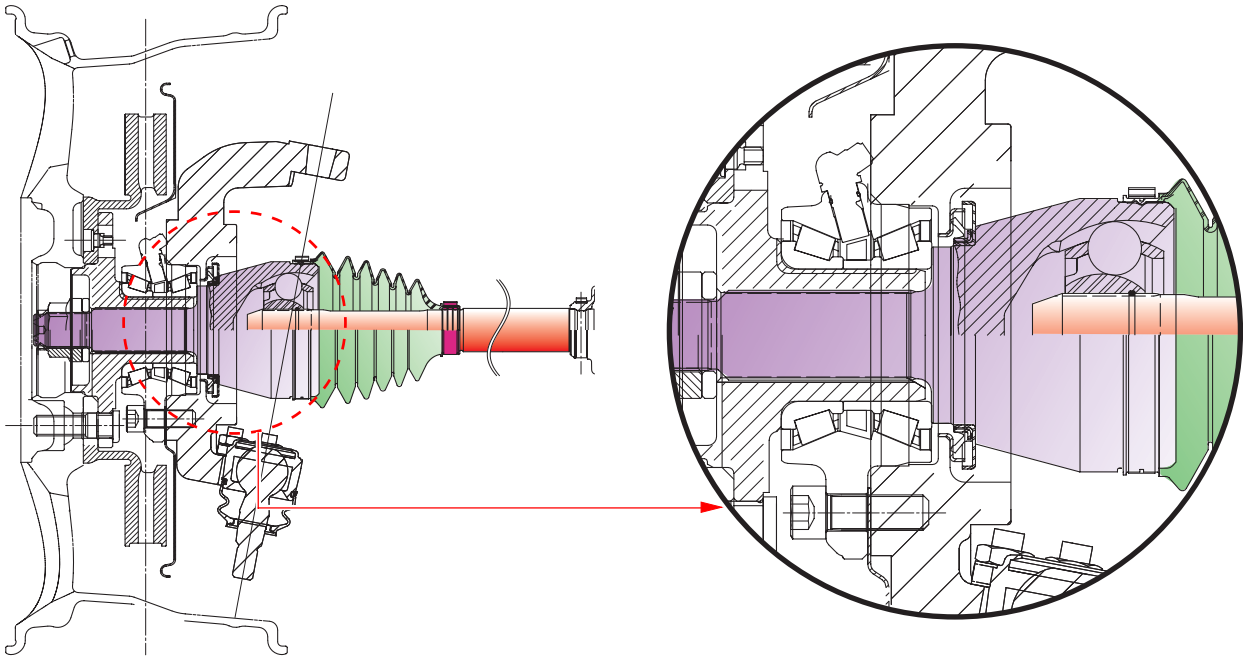
The locking hub actuator is engaged with the front wheel hub end gear when releasing the vacuum pressure.



Front Wheel End in Vehicle with 4WD



Front Wheel End in Vehicle without 4WD



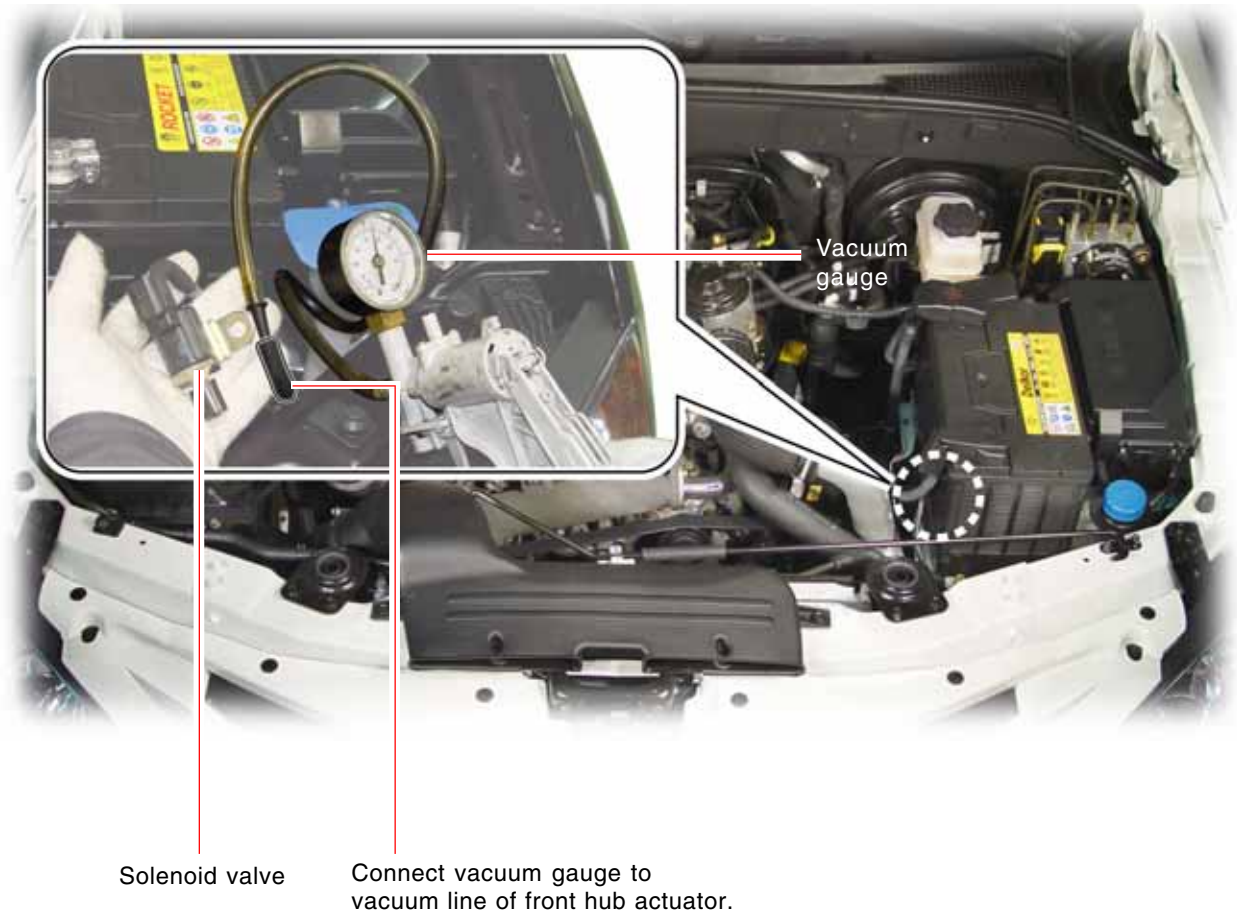
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AFFECTED VIN	

4. VACUUM LOCKING HUB CHECK

Compared to conventional locking hub systems, when the vehicle is in 2WD mode, the vacuum pressure from vacuum pump is continuously applied to the locking hub actuator. If any vacuum line is leaking, it may be engaged with the front drive shaft and the front locking hub and also it may cause leakage in the vacuum system supplied to the brake booster. Make sure that the vacuum lines are not leaking.

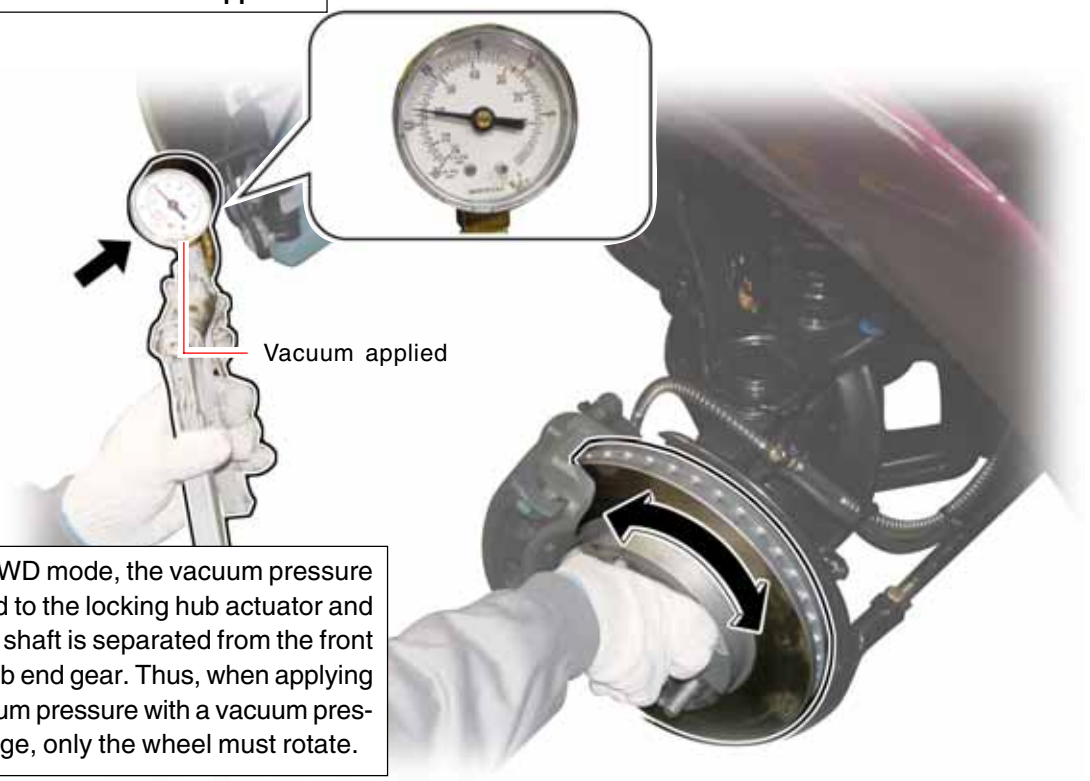
How to check the vacuum locking hub system:

1. Disconnect hub actuator vacuum line from vacuum solenoid valve.
2. Connect vacuum gauge to vacuum line of hub actuator.



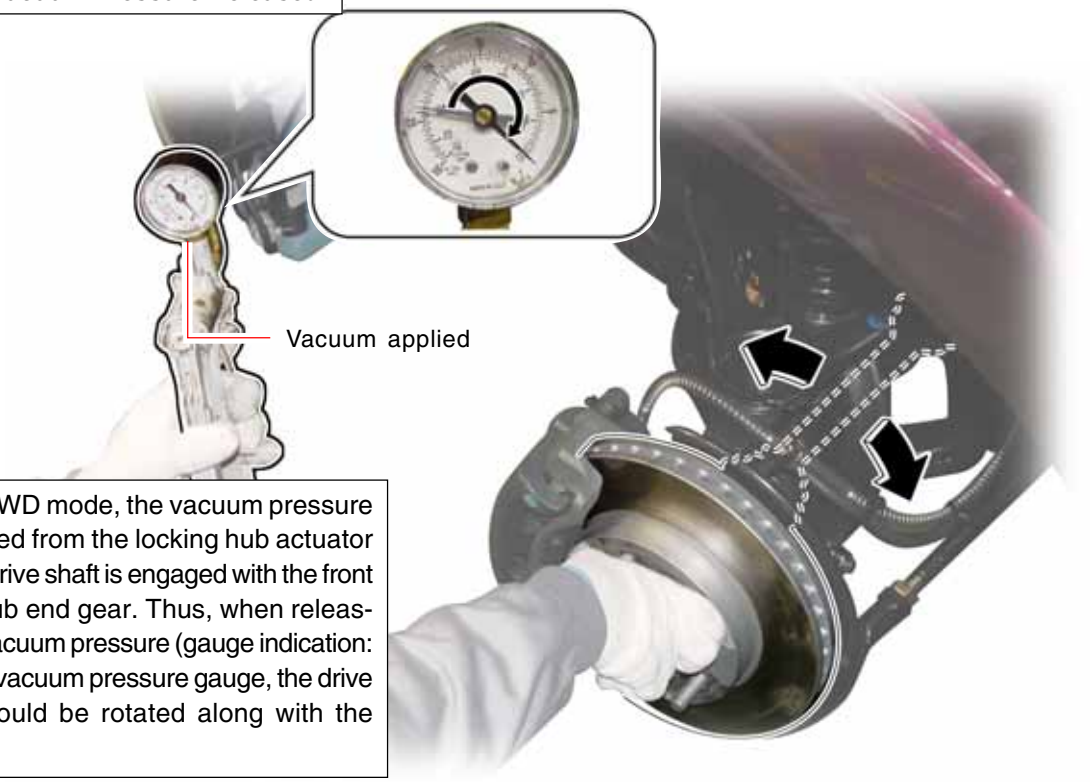
3. Check vacuum pressure with vacuum pressure gauge.

2WD: Vacuum Pressure Applied



During 2WD mode, the vacuum pressure is applied to the locking hub actuator and the drive shaft is separated from the front wheel hub end gear. Thus, when applying the vacuum pressure with a vacuum pressure gauge, only the wheel must rotate.

4WD: Vacuum Pressure Released



During 4WD mode, the vacuum pressure is released from the locking hub actuator and the drive shaft is engaged with the front wheel hub end gear. Thus, when releasing the vacuum pressure (gauge indication: 0) with a vacuum pressure gauge, the drive shaft should be rotated along with the wheel.

Hub Actuator Check



Disconnect the vacuum hose from the hub actuator and install the vacuum pressure gauge to the hub actuator. Apply vacuum pressure to make sure the hub actuator maintains vacuum pressure.

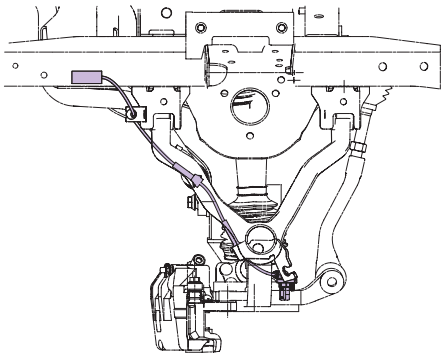
Normal	Leakage
	
If the vacuum pressure is maintained, the actuator hub component condition is OK.	If the vacuum pressure is not maintained, replace the actuator with a new one.

5. REMOVAL AND INSTALLATION OF IWE (INTEGRATED WHEEL END)

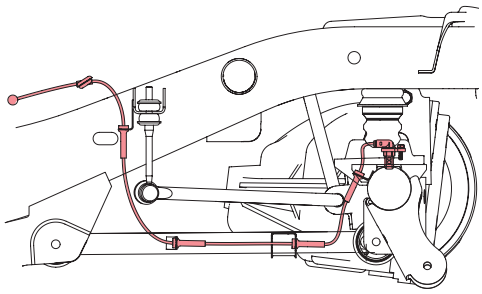
▶ Wheel Speed Sensor

※ **Preceding Work:** Disconnect the negative battery cable and remove the tires.

Note: Wheel Speed Sensor Location



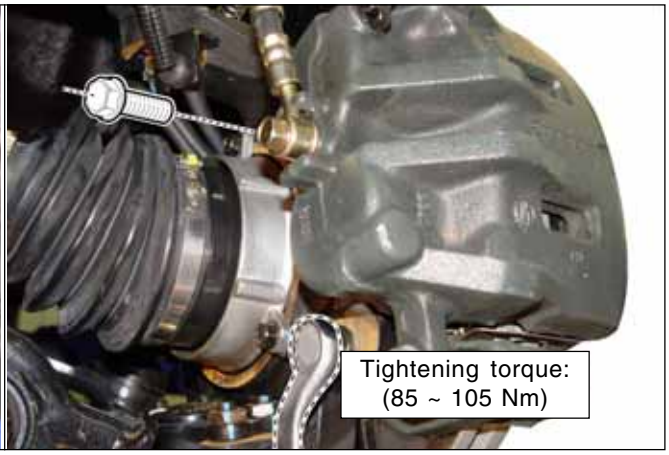
Front side (2WD)



Rear side (5-link type)

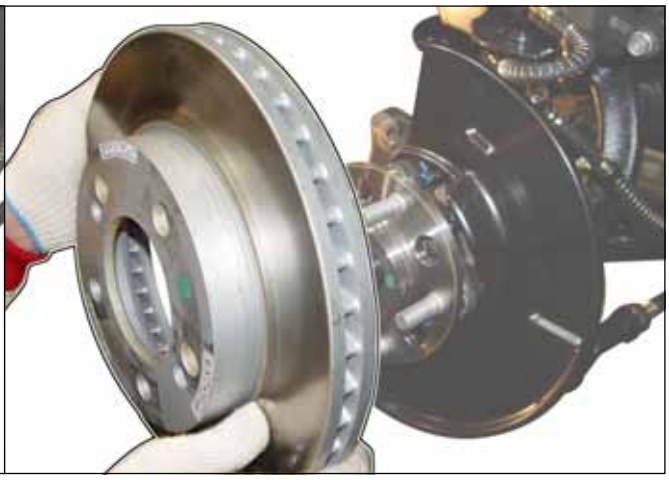
1. Unscrew the two bolts (19 mm) and set the removed brake caliper on the frame.





2. Unscrew the two screws and remove the brake disc.





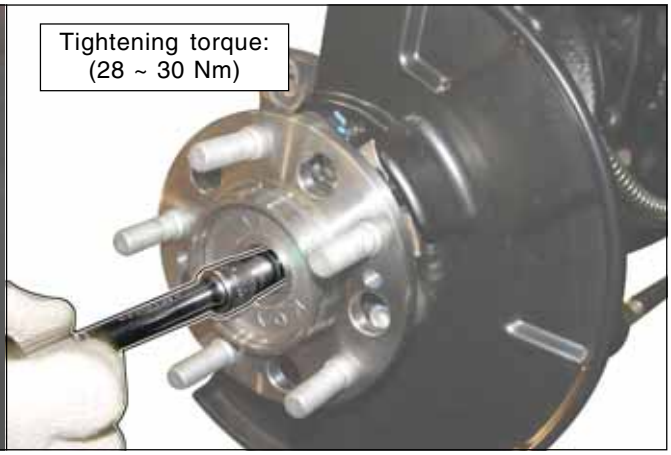
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EFFECTIVE DATE	
AFFECTED VIN	

3. Remove the hub cap and unscrew the lock nut.

NOTICE

- **Replace the hub cap with a new one when installing.**





4. Unscrew the three wheel end hub mounting bolts (hexagon, 10 mm).

Installation Notice

Tightening torque	100 ~ 130 Nm

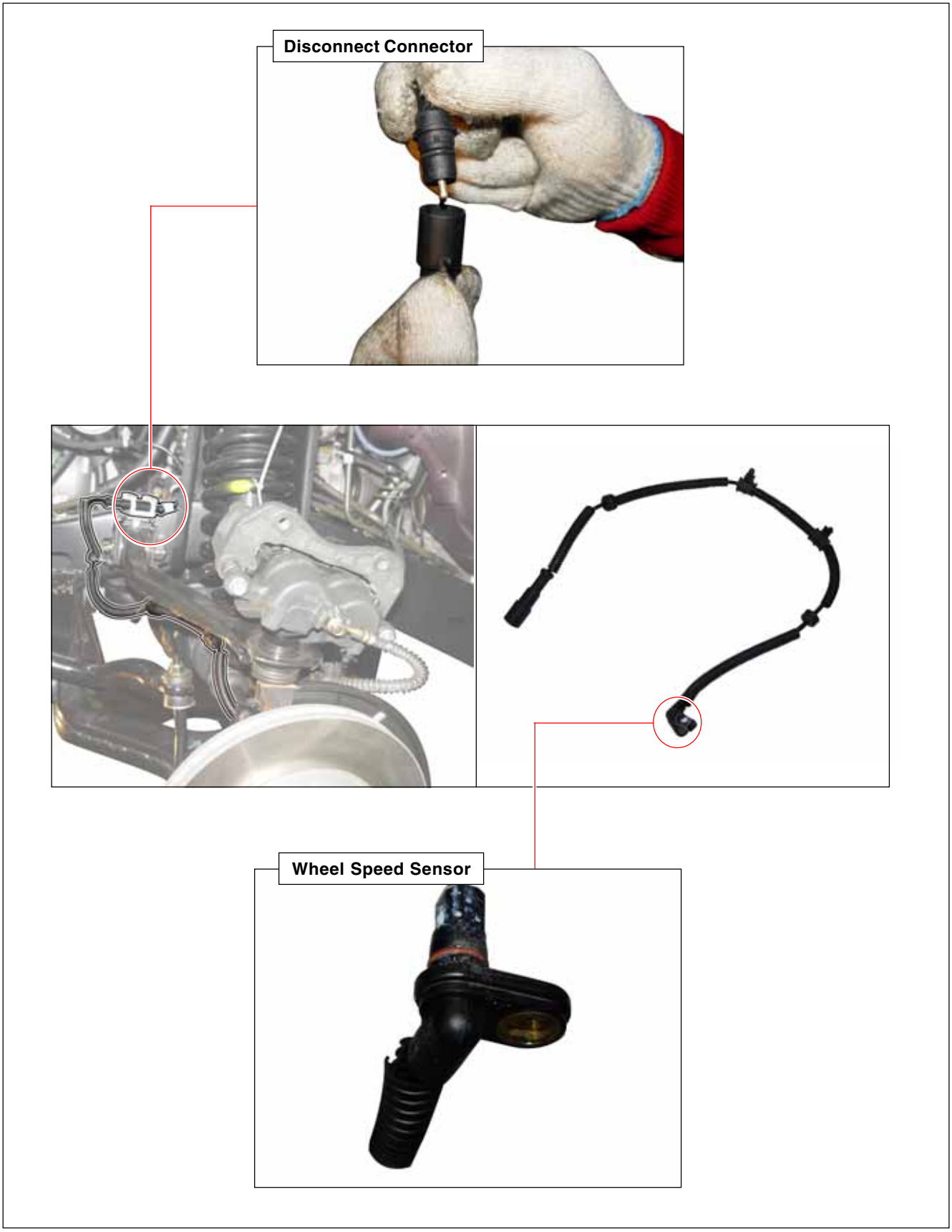


5. Slightly pull the wheel end hub until the wheel speed sensor is visible. Unscrew the mounting bolt (5 mm) and remove the wheel speed sensor.





6. Disconnect the wheel speed sensor connector and the cable.



Locking Hub Actuator Assembly

※ **Preceding Work:** 1. Remove the tire and the brake disc.
2. Remove the wheel speed sensor.

1. Unscrew the two bolts (10 mm) and remove the brake dust cover.



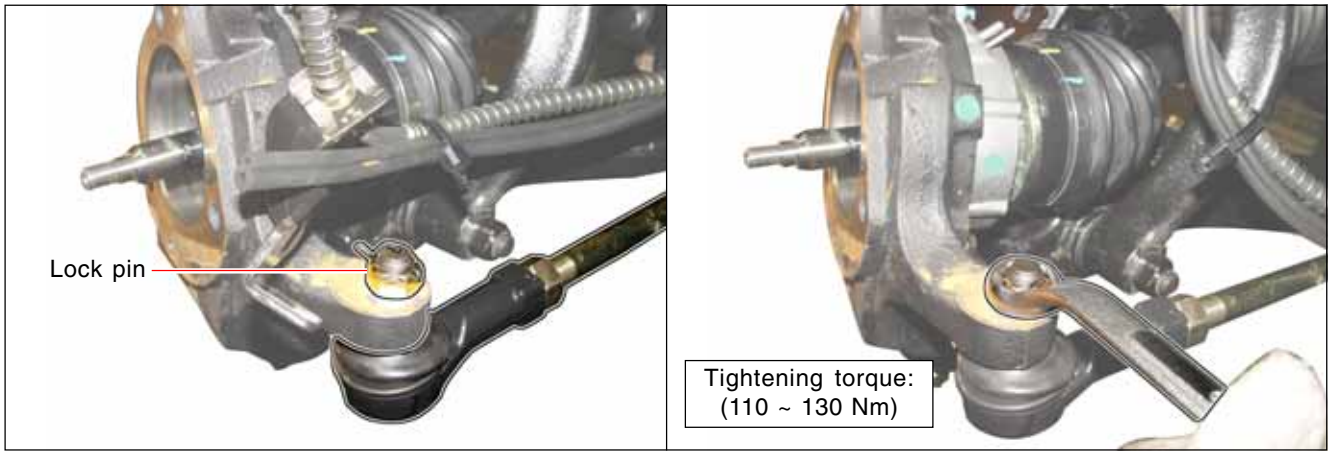
Installation Notice

Tightening torque	4 ~ 8 Nm

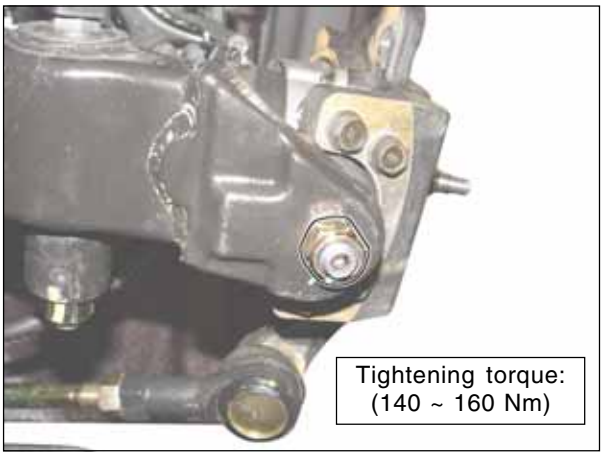
2. Pull out the upper arm lock pin and unscrew the mounting nut (19 mm).
At this time, do not fully remove the nut.



3. Pull out the steering gear linkage lock pin from the knuckle. Unscrew the mounting nut (19 mm) and remove the tie rod end.



4. Unscrew the lower arm mounting nut (22 mm).



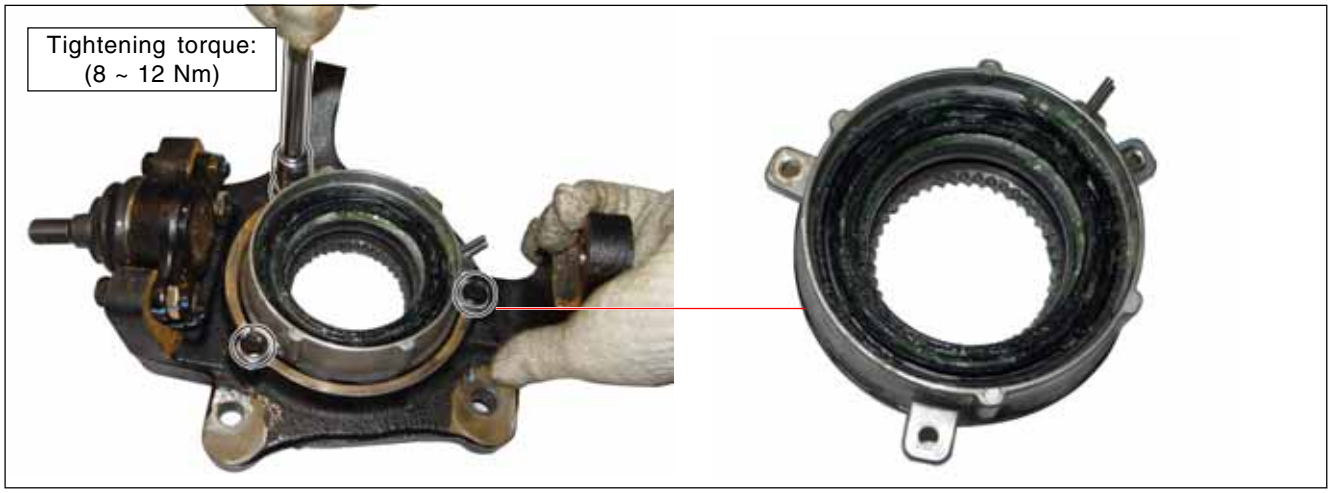
5. Remove the knuckle between upper arm and lower arm with special tool.



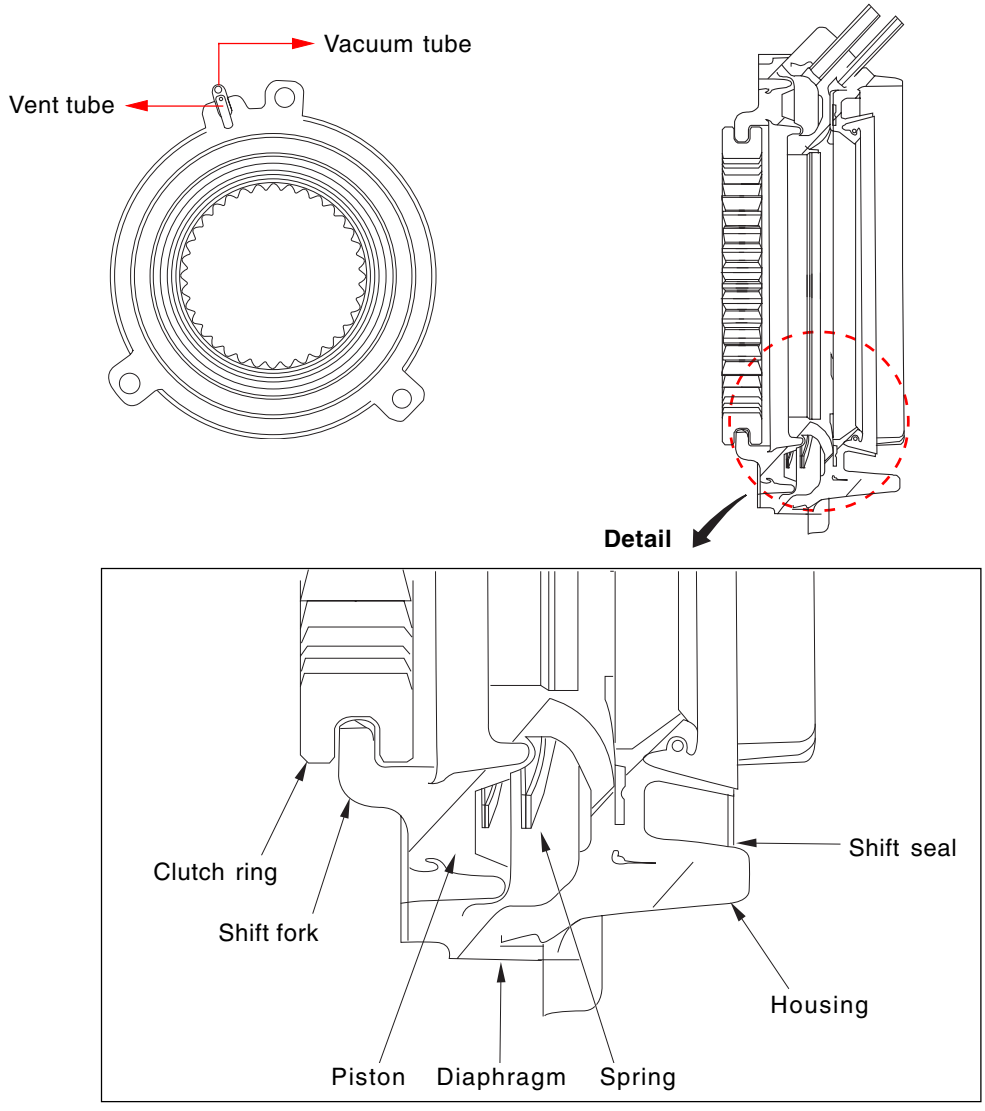


Hub Actuator

1. Unscrew the three bolts (10 mm) on the disassembled locking hub actuator assembly and remove the hub actuator.



Structure of Hub Actuator



▶ Inspection

1. Check the internal seal ring of hub actuator for damage.



2. Replace the O-ring of the locking hub end with a new one.



Installation Notice

* Completely clean the parts and apply the grease them before installing in the correct order.
Be careful not to damage the internal seal ring of the hub actuator.



CLUTCH

3010

TABLE OF CONTENTS

GENERAL 2

1. Function and overview 2
2. Specifications 6
3. Trouble diagnosis 7
4. Maintenance 8

CLUTCH ASSEMBLY 10

1. Removal and installation 10

GENERAL

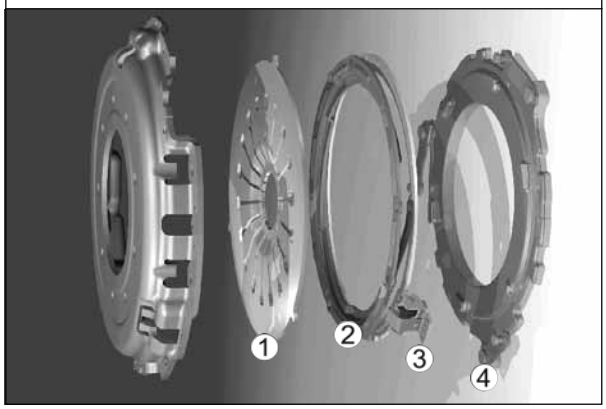
1. FUNCTION AND OVERVIEW

▶ SAT (Self Adjusting Technology) Clutch System

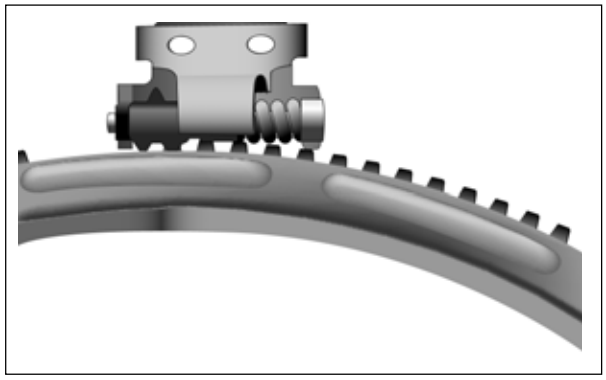
1. Function

SAT is new clutch system which adjusts the clutch free play according to the wear of clutch disc.

Internal Components of Clutch Cover



2. Operation Description



- Diaphragm spring rotates the adjusting equipment as clutch disc is wearing and so, pressure plate is pushed to clutch disc side at the amount of wear.
- Disc wear (Free play) → Diaphragm spring (1) → Adjusting equipment (2, 3) → Pressure plate (4)

▶ Overview

1. Driving Elements

The driving elements consist of two flat surfaces machined to a smooth finish.

One of these is the rear face of the engine flywheel and the other is the clutch pressure plate. The clutch pressure plate is fitted into a clutch steel cover.

2. Driven Elements

The driven element is the clutch disc with a splined hub which is free to slide lengthwise along the splines of the input shaft.

The driving and driven elements are held in contact by spring pressure. This pressure is exerted by a diaphragm spring in the clutch cover pressure plate assembly.

3. Operating Elements

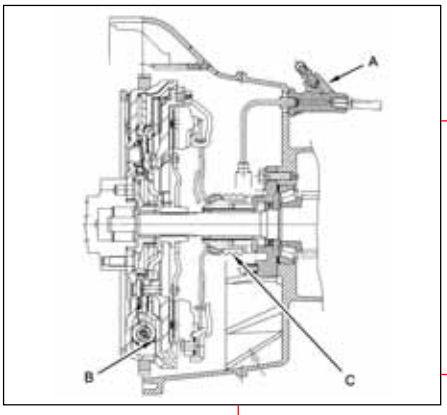
The clutch release system consists of the clutch pedal and clutch release cylinder.

This system directly releases the clutch by using hydraulic pressure while the conventional clutch system releases the clutch by using release lever and release fork. This system provides higher efficiency than conventional clutch system, and its durability is superior.

- Clutch master cylinder (mounted on clutch pedal)
- Concentric slave cylinder (mounted inside of transmission)

▶ Functions

Components of Clutch Assembly



A. Adapter/Pipe Assembly



B. Clutch Assembly



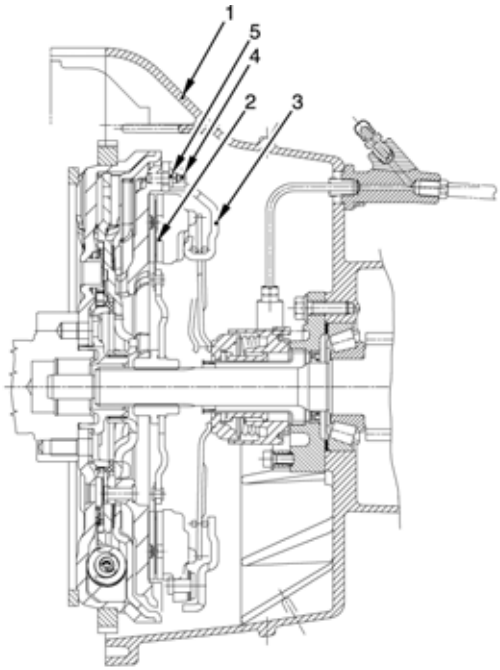


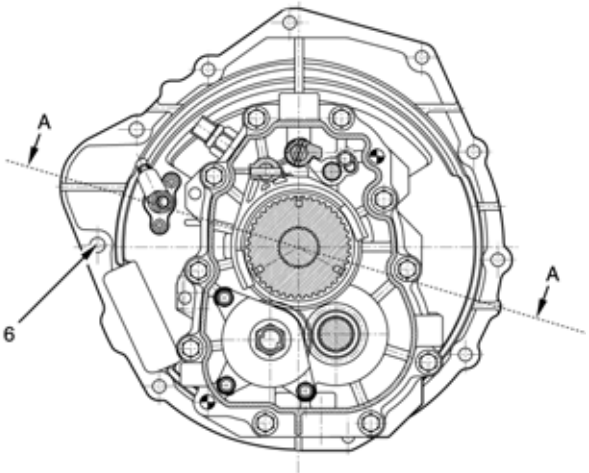
C. Concentric Slave Cylinder





Cross Sectional View of Clutch Assembly





1. Transmission housing
2. Clutch disc assembly
3. Clutch disc cover assembly
4. Bolt
5. Washer
6. Bolt

Clutch Master Cylinder and Reservoir

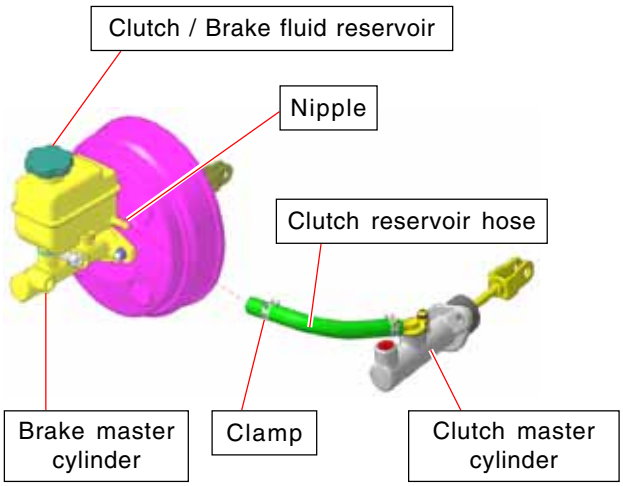
The clutch master cylinder generates the hydraulic pressure by moving the piston within the cylinder. It consists of oil tank, cylinder, piston, piston cup spring and push rod, and the clutch fluid is supplied from the brake fluid reservoir tank.

Operation:

When depressing the clutch pedal, the push rod pushes the piston and the piston cup, which sends the oil in the oil reservoir tank to the concentric slave cylinder through the hose and pipe. During this operation, an hydraulic pressure is produced within the master cylinder and transmitted to the concentric slave cylinder which then pushes the diaphragm to separate the pressure plate from the clutch disc.

When releasing the clutch pedal, it returns to its original position through the elasticity of diaphragm, and the clutch operation stops. The piston in cylinder returns to its original position.

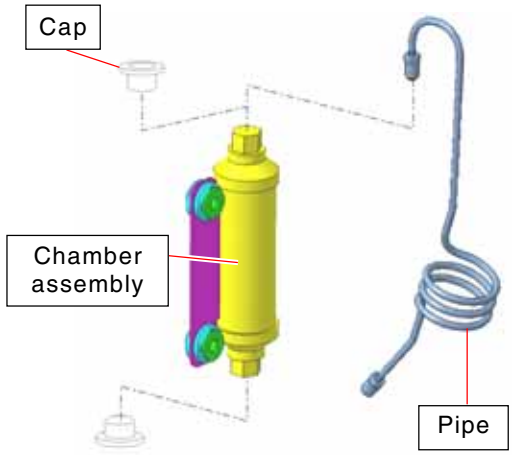




Clutch Release Chamber

The clutch release chamber keeps the hydraulic pressure in the clutch hose and pipe stable and also helps the hydraulic pressure to transfer quickly and generates the remaining pressure in the hose and pipe when the clutch is operated.

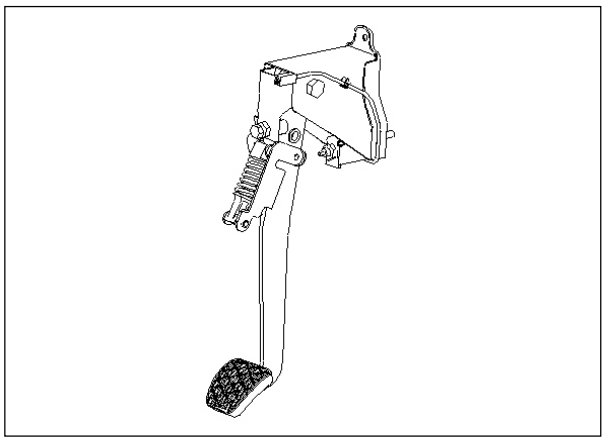




CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

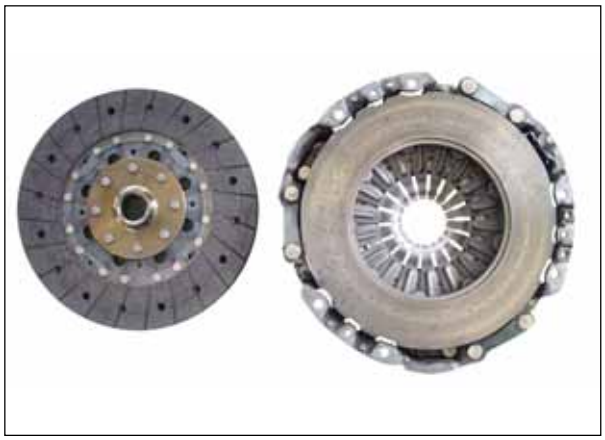
Clutch Pedal

1. Pendant type clutch pedal (leverage effect is applied to reduce the effort to the feet).
2. The clutch pedal has some free play that prohibits its operation prior to generating the resistance by depressing the pedal and touching the release bearing pressure plate. This free play is to prevent the clutch disc from burning out that is resulted from the overheating caused by the clutch slipping while driving. If this free play is too wide, engine power disconnection is difficult and the gear damage with abnormal noise will occur.



Clutch Assembly

Clutch assembly is composed of clutch cover (diaphragm spring, pressure plate) and clutch disc.



Clutch Disc

The clutch disc is installed between the engine flywheel and the pressure plate. The spline part is installed in the center of the disc and transmits the engine's electric power to the transmission. The transmission input shaft can be inserted into the spline part. The clutch disc has friction materials on its edges, where the engine power can be interrupted, and the cushion spring is installed to prevent friction materials (facing) from unevenly wearing out.

Clutch Cover

When depressing the clutch pedal, the concentric slave cylinder pushes the pressure plate diaphragm and separates the pressure plate. The advantages of using the diaphragm spring: the pressure varies only a little even when the clutch disc facing is considerably worn out, its structure is simple, and the pedal effort is small.

2. SPECIFICATIONS

▶ Specifications

Description		Specification
Operating type		Hydraulic
Clutch pedal	Type	Suspended
	Maximum pedal stroke	140 mm
	Pedal free play	5 ~ 15 mm
Clutch disc	Type	Single dry diaphragm
	Dimension of facing	240 × 155 × 4.0 mm
	Facing size/quantity	263 cm^2 / 2
	Thickness of disc	Free: 9.4 ~ 10 mm When loaded: 9.0 ± 0.3 mm
Clutch cover assembly setting force		Min. 720 kg
Clutch master cylinder	Stroke	30 mm
	Inner diameter	ϕ 17.46 mm
Concentric slave cylinder	Stroke	7.0 mm
	Sectional area	706 mm^2
Clutch fluid		DOT3 or DOT4

▶ Tightening Torque

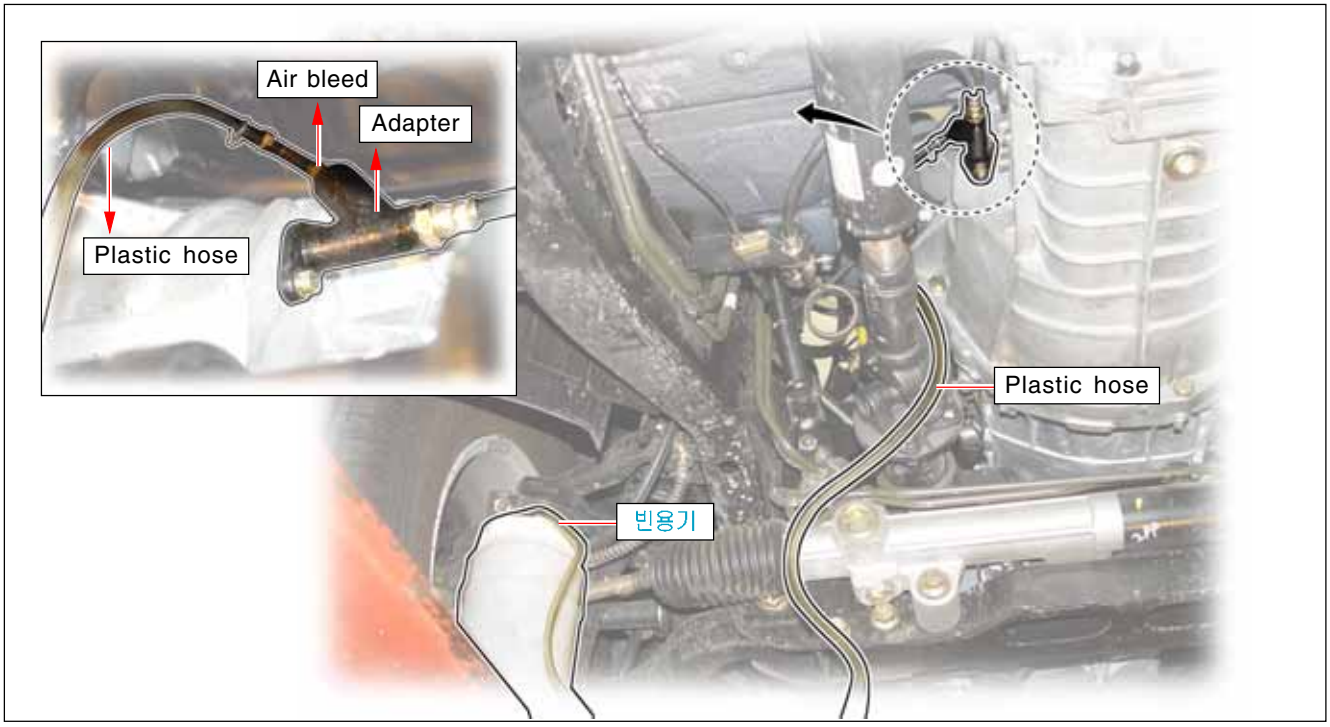
Description	Tightening Torque
Clutch housing bolt (8 locations)	49 ~ 59 Nm
Clutch cover (pressure plate assembly) bolt	21 ~ 27 Nm
Concentric slave cylinder bolt (3 locations)	10 ~ 16 Nm
Concentric slave cylinder flare nut	20 ~ 25 Nm
Adapter flare nut	20 ~ 25 Nm
Clutch oil pipe flange nut	15 ~ 18 Nm
Master cylinder bolt	8 ~ 18 Nm
Fulcrum (clutch pedal bushing) bolt/nut	16 ~ 32 Nm
Clutch pedal bracket mounting bolt	8 ~ 18 Nm
Stopper bolt	16 ~ 22 Nm

3. TROUBLE DIAGNOSIS

Check		Possible Cause	Action
Clutch slips		Excessive wear of facing	Replace
• Too low vehicle speed		Hard or oily facing	Adjust or replace
• Insufficient power on hills		Damaged diaphragm or flywheel	Replace
		Damaged or burnt diaphragm spring	Replace
		Insufficient clutch pedal free play	Adjust
		Faulty operation of clutch pedal	Repair or replace
		Worn or damaged clutch disc	Replace
Poor disengagement		Vibration or excessive run-out of disc	Replace
		Rust or wear of clutch disc spline	Repair or replace
		Oily facing	Adjust or replace
		Burnt diaphragm spring	Replace
		Excessive clutch pedal free play	Adjust
Hard to shift or does not shift		Excessive clutch pedal free play	Adjust pedal freeplay
		Faulty clutch release cylinder	Repair release cylinder
		Worn disc, excessive run-out, damaged lining	Repair or replace
		Dirty or damaged splines on input shaft or clutch disc	Repair as necessary
		Damaged clutch pressure plate	Replace
Clutch chatters when starting		Oily facing	Repair or replace
		Hard or faulty facing	Replace
		Burnt cushion spring	Replace
		Faulty pressure plate	Replace
		Bent clutch diaphragm spring	Replace
		Hard or bent flywheel surface	Adjust or replace
		Engine mounts loose or burnt lever	Tighten or replace
Difficult pedal operation		Poor bleeding in hydraulic system	Bleed or replace
		Poor lubrication on pedal shaft	Lubricate or replace
		Poor lubrication on clutch pedal	Repair
Clutch noisy	Not using the clutch	Insufficient clutch pedal free play	Adjust
		Excessive wear of clutch disc facing	Replace
	After disengagement	Worn or damaged concentric slave cylinder	Replace
	When disengaging	Faulty installation of clutch assembly or bearing	Repair
	Clutch pedal is partially depressed and vehicle speed is reduced	Damaged pilot bushing	Replace

4. MAINTENANCE

▶ Air Bleeding



NOTICE

- **Keep the fluid level over MAX in reservoir during bleeding operation.**
- **Do not let the fluid contact a painted surface.**



1. Remove the air bleed bolt cap from the adapter. Connect a plastic hose to the bleed bolt.
2. Put the other side of the hose into a empty container.
3. Slowly depress the clutch pedal several times.
4. With clutch pedal fully depressed, undo the air bleed bolt and bleed the air and fluid from the fluid line.
5. Repeat step 3 through 4 until no more air bubbles are in the escaping fluid.

NOTE

- **This work has to be done by two service persons.**
- **After bleeding, check the clutch system for operation and noise.**
- **Use only the Ssangyong genuine clutch fluid, and check the clutch fluid level in reservoir after service.**

Clutch fluid	DOT 3, 4

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EFFECTIVE DATE	
AFFECTED VIN	

▶ Clutch Replacement

To prevent early wear and slip in clutch disc, always use the designated tools and special tools for maintenance.

Service Instruction

1. Replacement of clutch disc → Replace the clutch cover assembly together.
2. Reinstallation of clutch disc and cover → Apply the jig set (SST) on the clutch cover set before removing the clutch disc and cover.

   (Example: engine removal and reinstallation, flywheel related job, checking the clutch assy)

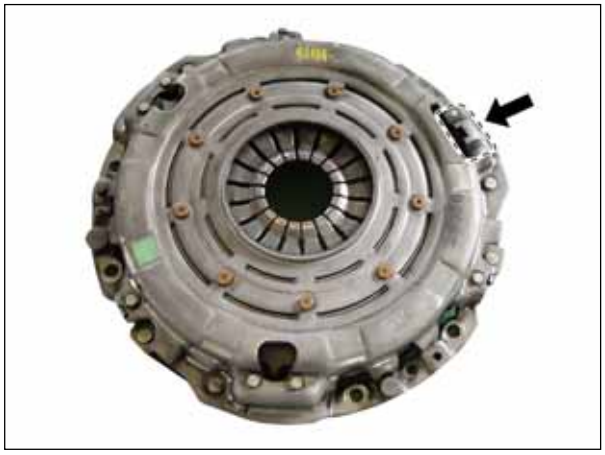
NOTICE

- **When reinstall the clutch assembly without the special zig, disc can be slipped and worn easily. Also, for the SAT clutch, the clearance between the clutch disc and pressure plate may be changed.**

How to Use Special Tool

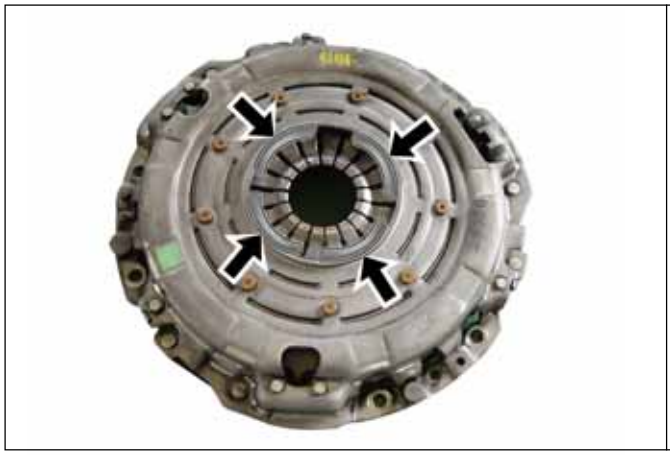
How to identify SAT clutch specification

Identify the SAT clutch with compensation device (arrow) on clutch cover.



Installation of Special Zig

Remove the transmission and place the zig set (4 pieces) between the clutch cover and diaphram spring around (refer to the picture).



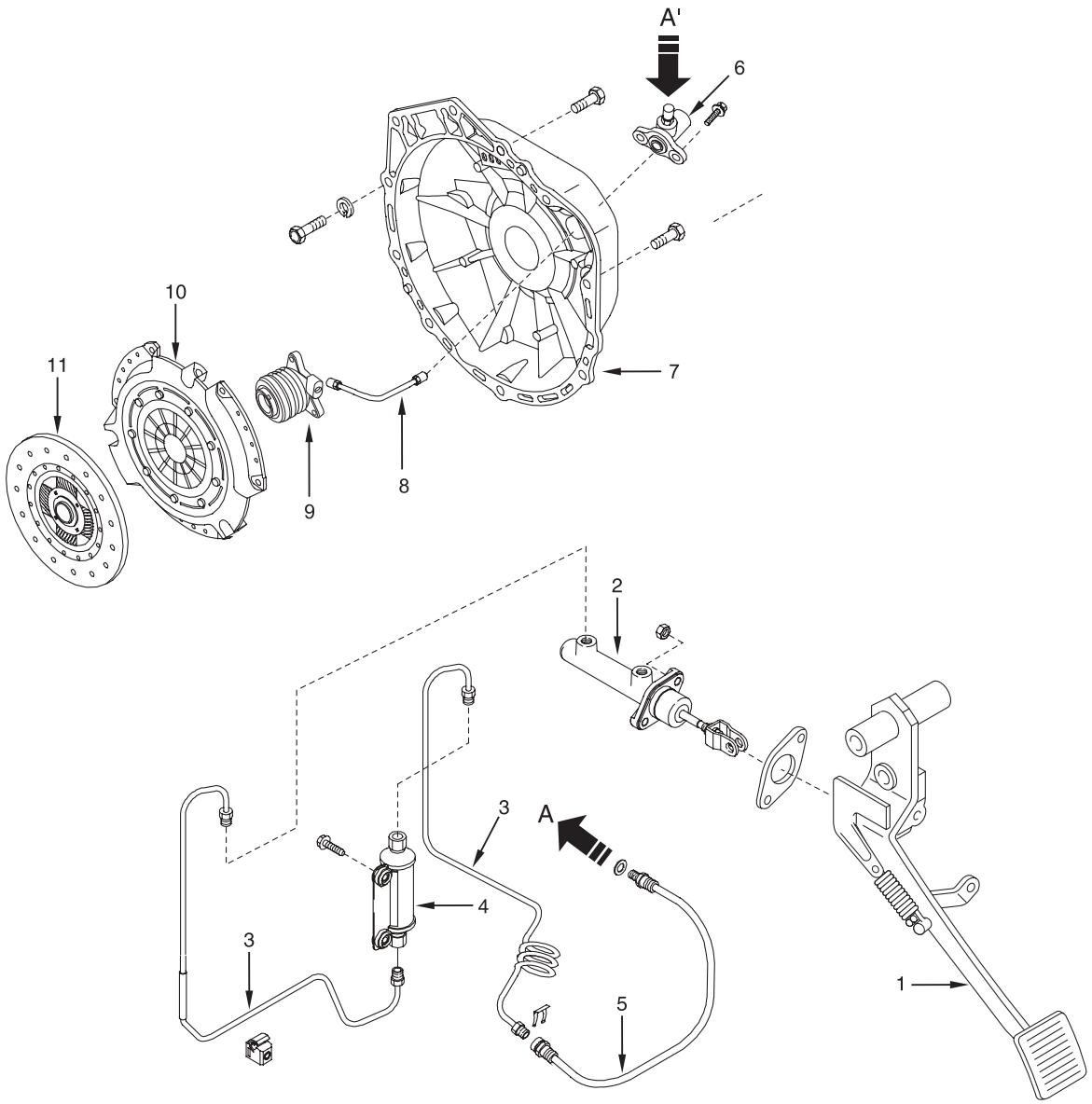


*** P/No: D9930 - 0010C**

CLUTCH ASSEMBLY

1. REMOVAL AND INSTALLATION

Components



1. Clutch pedal
2. Clutch master cylinder
3. Clutch hydraulic pipe
4. Clutch fluid chamber
5. Clutch hydraulic hose
6. Adapter
7. Clutch housing
8. Concentric slave pipe
9. Concentric slave cylinder
10. Clutch cover
11. Clutch disc

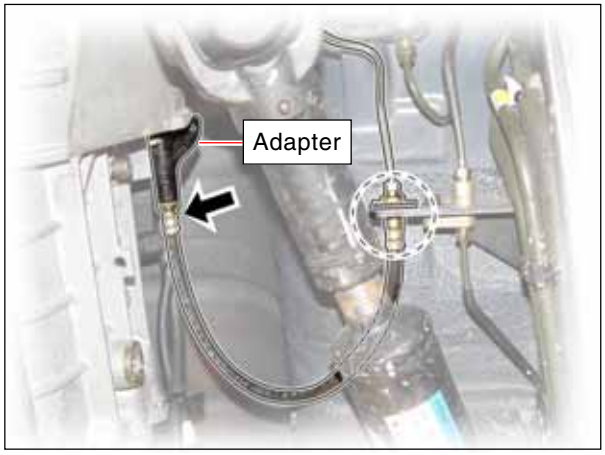
A-A′: Connection

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EFFECTIVE DATE	
AFFECTED VIN	

▶ Removal and Installation of Components

Clutch Assembly

1. Disconnect the clutch fluid hose from the adapter.
   Use the locking pliers to prevent the fluid leakage.



2. Remove the transmission assembly (Refer to “M/T” section).



3. Insert the centering pin (special tool) into center spline. Loosen the clutch cover bolts 1/2 turns in cross sequence until the spring tension is released.



NOTICE

- **Do not remove the bolts at a time, or clutch cover may be damaged or deformed.**

Installation Notice

Tightening torque	24 ± 3 Nm

NOTICE

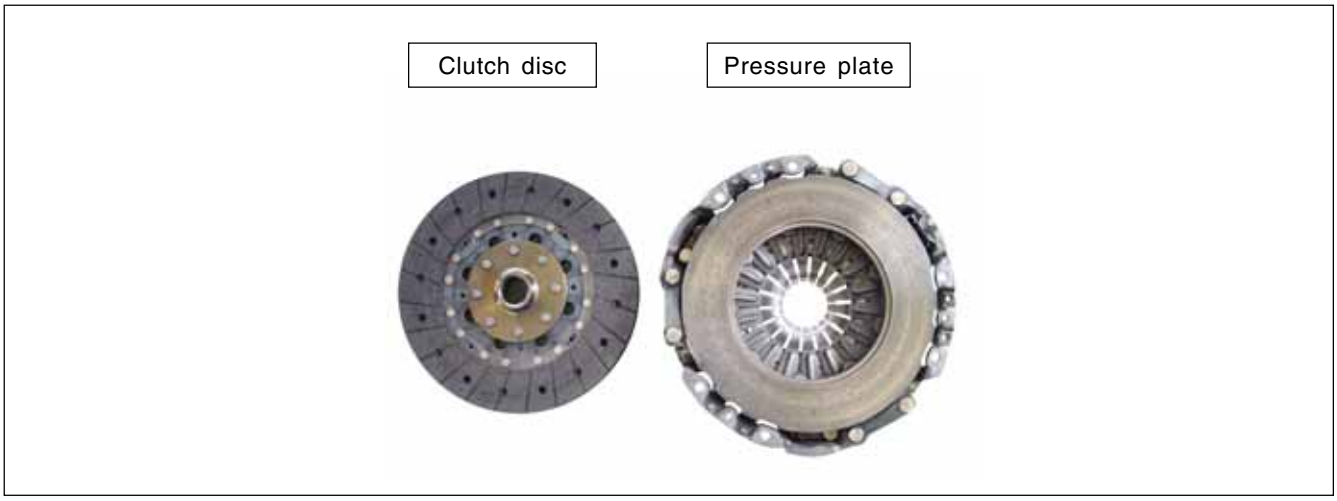
- **Loosen the mounting bolt while the special tool is installed.**

4. Unscrew the bolts and remove the clutch cover, pressure plate and clutch disc.

NOTICE

- **Be careful not to drop the pressure plate and clutch disc.**

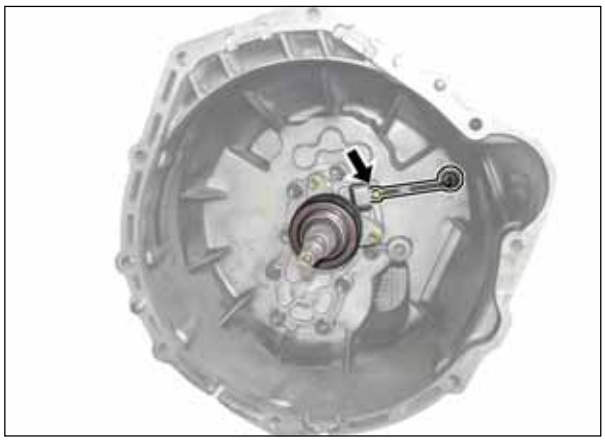




CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Concentric Slave and Adapter

1. Unscrew the oil pipe nut in the clutch housing and remove the oil pipe.



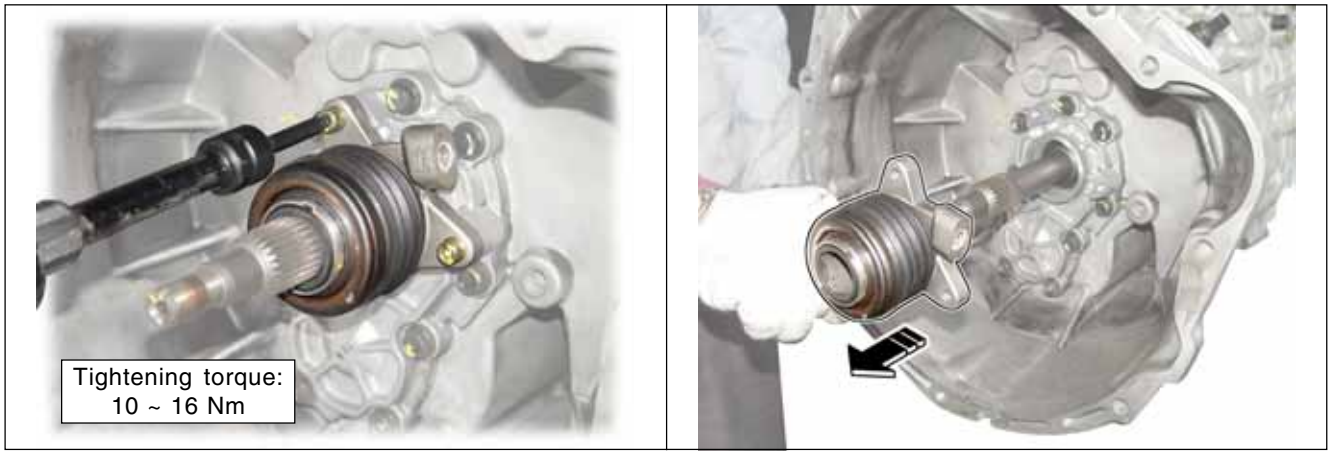
Installation Notice

Tightening torque	20 ~ 25 Nm

2. Unscrew the oil pipe adapter mounting bolt from the clutch housing and remove the adapter and oil pipe.



3. Unscrew three bolts and remove the concentric slave cylinder assembly on the input shaft of cylinder.



4. Install in the reverse order of removal.

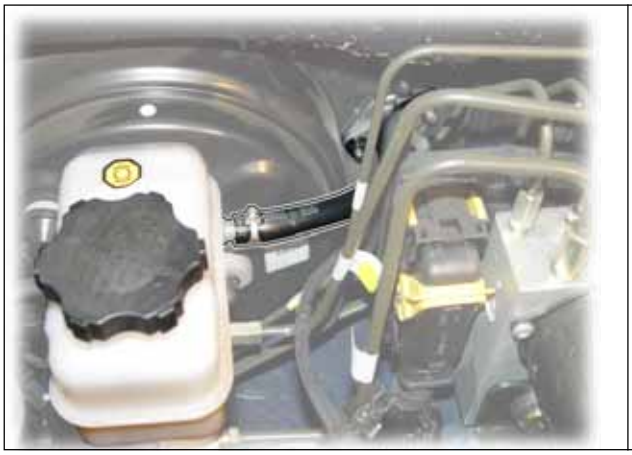
NOTICE

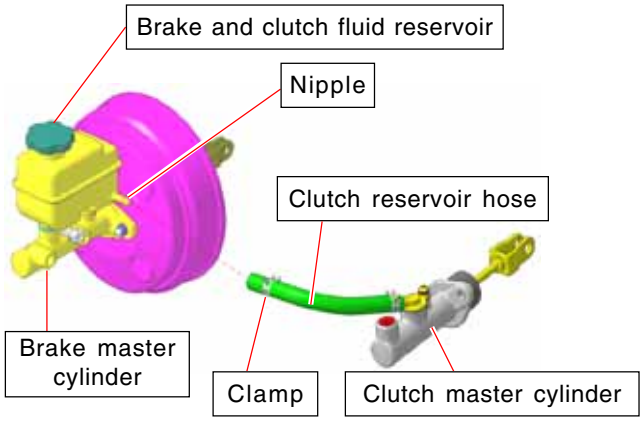
- **Before installation, clean all the components.**
- **Do not re-use the used clutch fluid and brake fluid.**
- **Replace parts if necessary.**

* Keep the specified tightening torque.

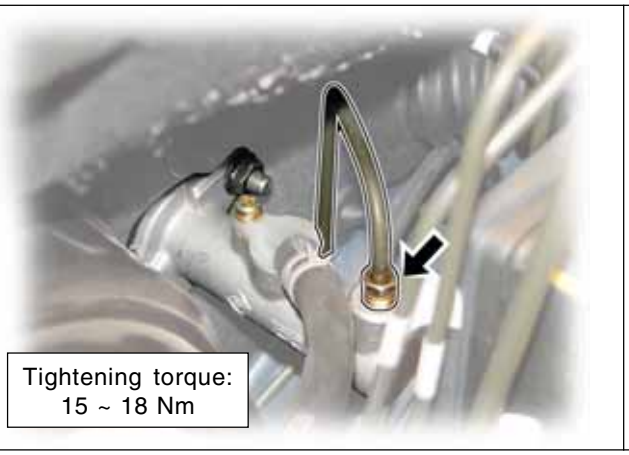
Clutch Master Cylinder

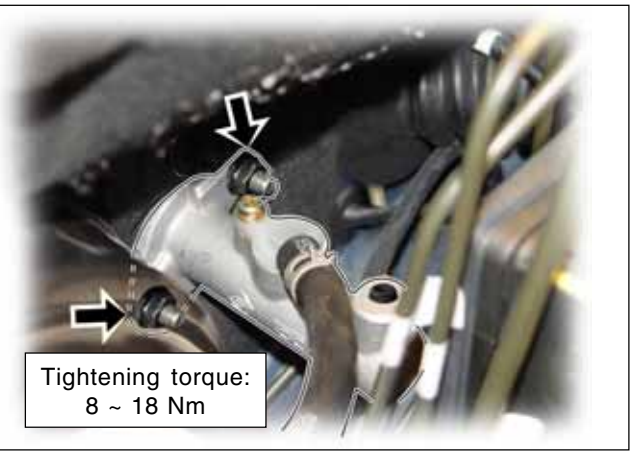
1. Drain the clutch fluid.
2. Disconnect the clutch fluid feed hose from the brake reservoir.





3. Disconnect the clutch fluid feed pipe (to chamber) and unscrew two clutch master cylinder mounting nuts (10 mm).





4. Disconnect the clutch master cylinder push rod from the clutch pedal and remove the clutch master cylinder (refer to “Removal of Clutch Pedal” section).
5. Install in the reverse order of removal and check “air bleeding and clutch pedal operation” after installation.
6. Fill brake and clutch fluid rese rvoir.



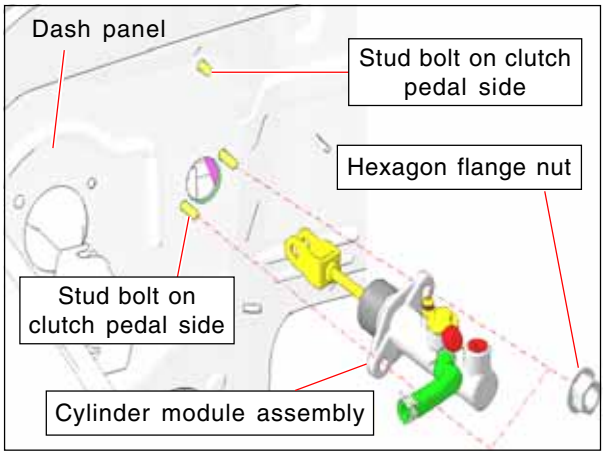
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Clutch Pedal

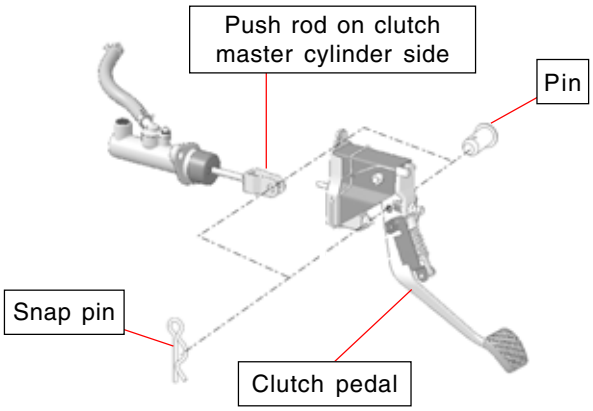
1. Unscrew the clutch master cylinder mounting bolts.

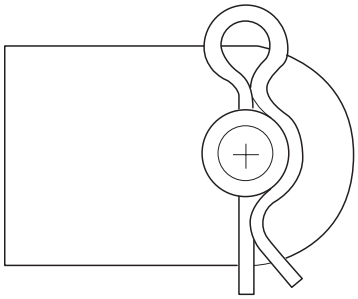
Installation Notice

Tightening torque	8 ~ 18 Nm



2. Remove the snap pin from master cylinder push rod side.





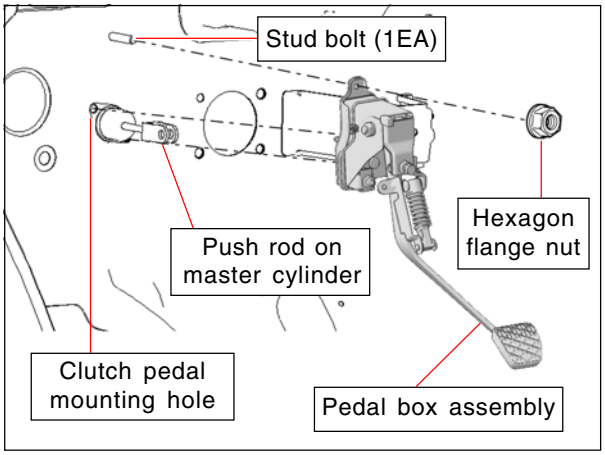
NOTICE

- **Securely install the snap pin as shown in figure.**

3. Unscrew the mounting nut (12 mm) and remove the pedal box assembly.

Installation Notice

Tightening torque	8 ~ 18 Nm



▶ Installation Notice

Install in the reverse order of removal. Adjust pedal stroke after installation.

NOTICE

- **Apply long-life grease (T/M DBL 6611.00) to the connections.**
- **Remove foreign materials.**
- **Keep the tightening torque.**
- **Replace the bushings with new ones.**

▶ Inspection and Adjustment

1. Pedal Stroke (A)

Maximum pedal stroke	140 mm

2. Pedal Height (B)

Height (from carpet)	181 ± 5 mm

NOTICE

- **To adjust the pedal height, loosen the lock nut (C) of the stopper bolt (D) and turn the stopper bolt until the stroke is correct. After adjustment, tighten the lock nut.**

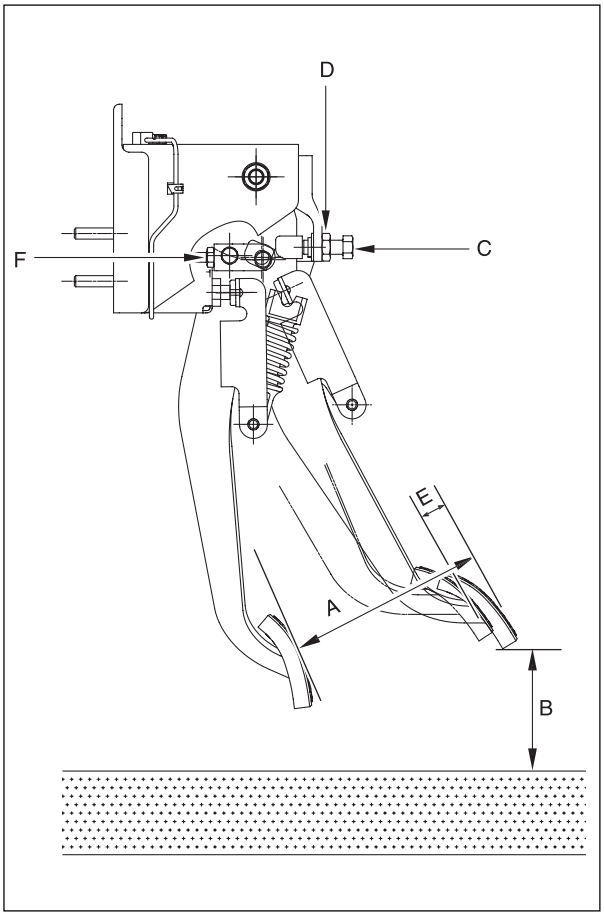
3. Pedal Free Play (E)

Free play	5 ~ 15 mm

NOTICE

- **To adjust the pedal free play, loosen the lock nut (F) of the master cylinder and turn the push rod until the free play is correct.**

4. Check the fulcrum bolt and the bushing for wear, the pedal for bending and the spring for damage.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Clutch Chamber

Removal/Installation

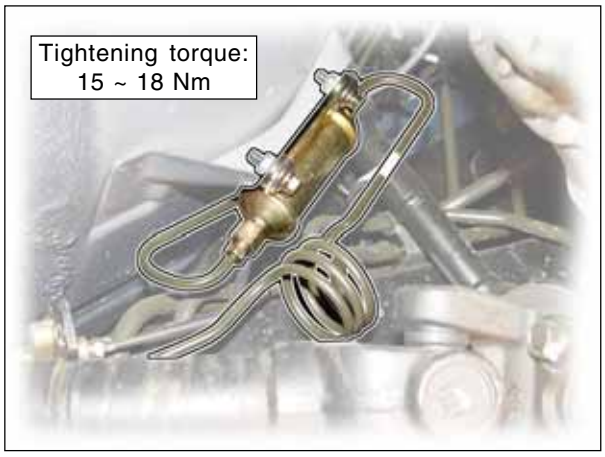
1. Drain the fluid.
2. Unscrew the bolt and remove the supply pipe from clutch master cylinder.

Installation Notice

Tightening torque	15 ~ 18 Nm



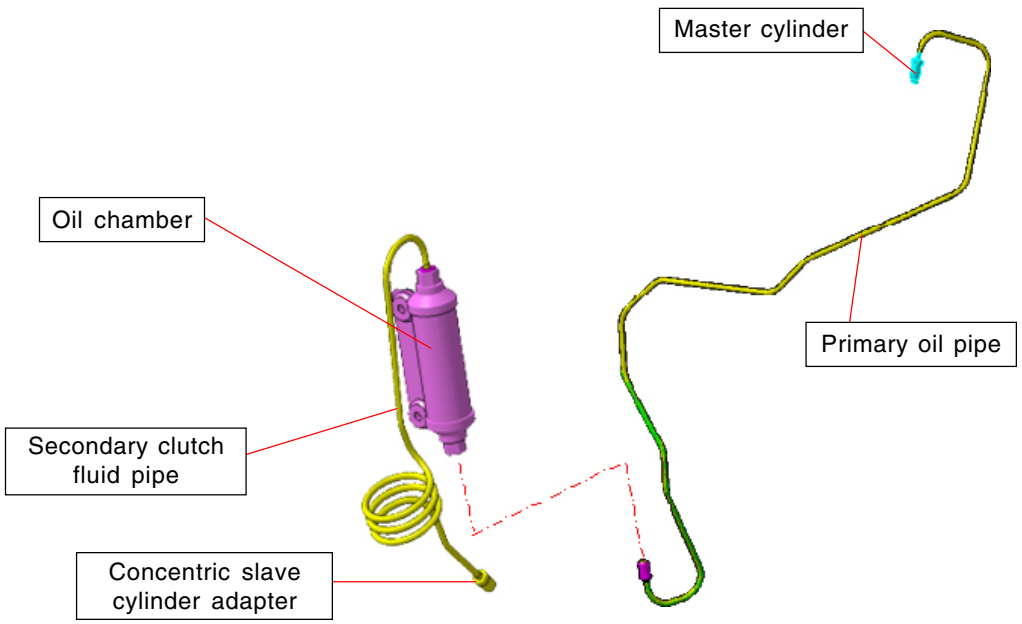
3. Unscrew the supply pipe bolt and remove primary oil pipe from clutch fluid chamber.
4. Unscrew the pipe bolt and remove the secondary clutch fluid pipe from concentric slave cylinder adapter.
5. Install the pipes. Be careful not to mix the pipes.



NOTE

- **Make sure to bleed the air from the system after installation.**
- **Check each pipe bolt for oil leaks.**
- **Clutch pipes are reusable. However, you must check the pipes for damages and cracks.**

Chamber and Pipe



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Inspection and Maintenance

1. Clutch Cover Assembly
   a. Check the diaphragm spring tip for wear and height unevenness.

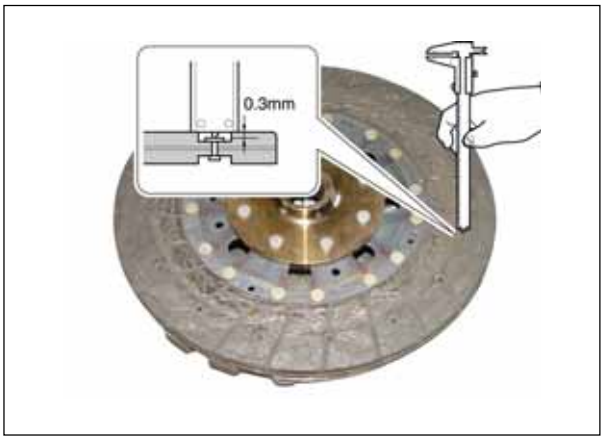
Unevenness limit	0.8 mm

   b. Check the pressure plate surface for wear, crack and discoloration.
   c. Check the strap plate rivet for looseness and replace the clutch cover if necessary.



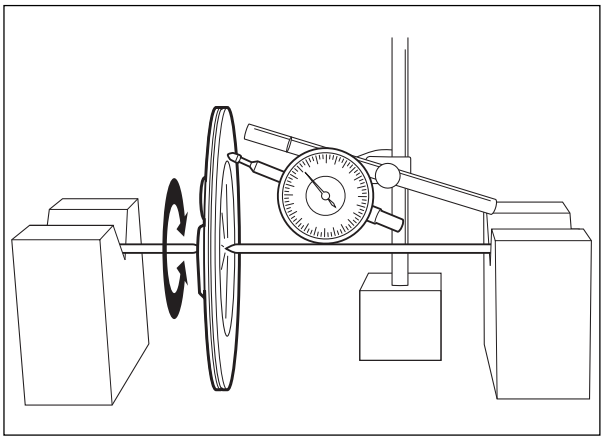
2. Clutch Disc
   a. Check the facing for rivet looseness, uneven contact, sticks, oil and grease.
   b. Measure the rivet head depth. If it is out of limit, replace the disc.

Wear limit	0.3 mm



3. Clutch Disc Run-Out
   a. Measure the clutch disc run-out and if it is out of limit, replace the disc.

Run-out limit	Within 0.7 mm



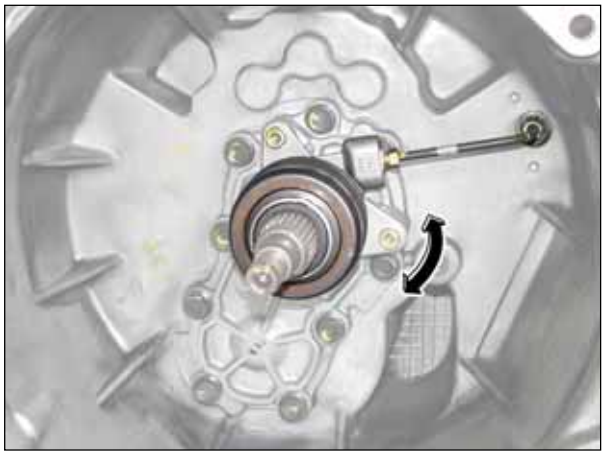
4. Pressure Plate
   a. Check the pressure plate spring for wear.



NOTICE

- **The excessively worn components should be replaced.**

5. Concentric Slave Cylinder
   a. Check any heat damage, abnormal noise, poor rotation and wear of the concentric slave cylinder bearing.



Concentric Slave Cylinder Assembly





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

AXLE

4120 / 4210

TABLE OF CONTENTS

GENERAL 3

FRONT AXLE 5

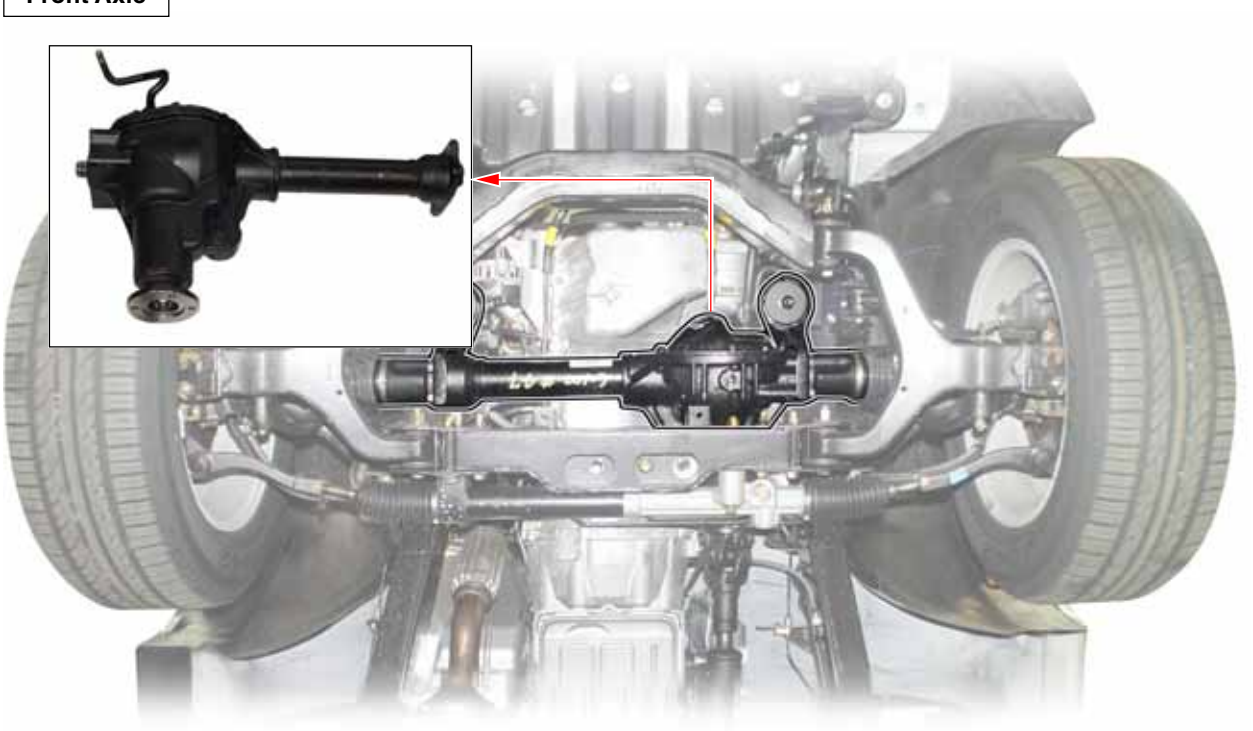
1. Location 5
2. Front axle assembly 6
3. Removal and installation 8

5-LINK TYPE REAR AXLE 15

1. Location 15
2. Removal and installation 20

GENERAL

Front Axle



Rear Axle



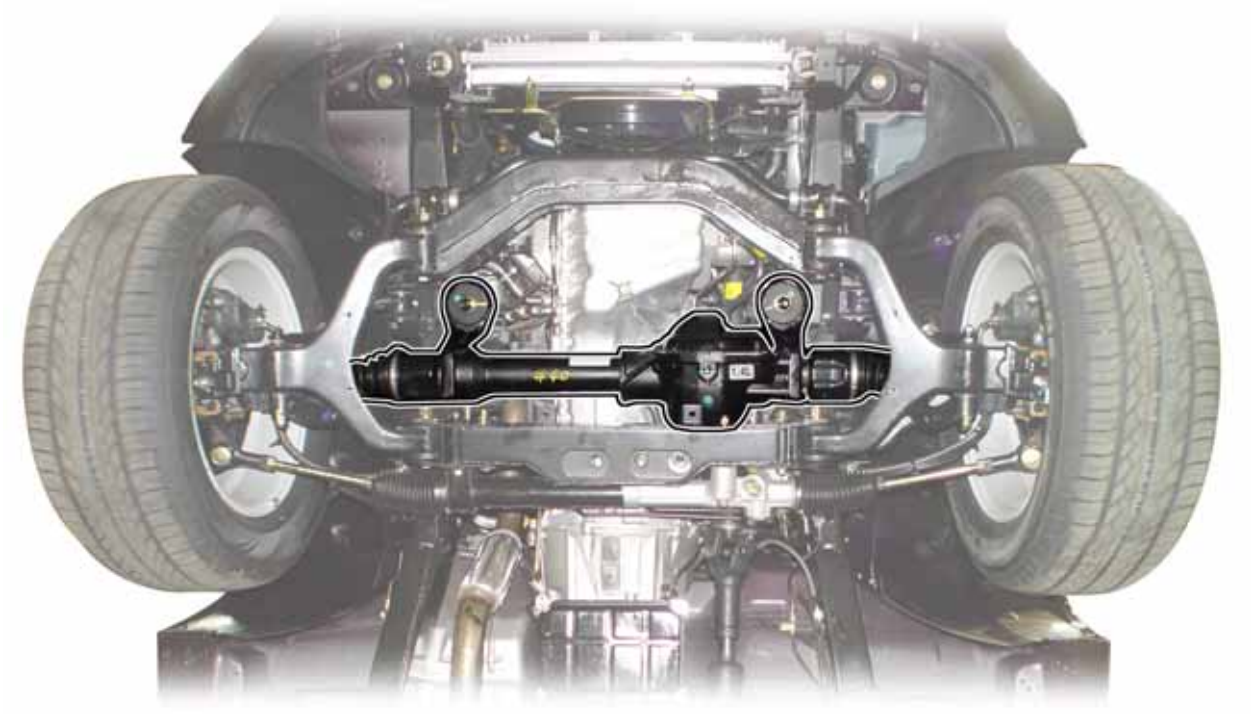
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

The specification below is for front and rear axles equipped in Actyon, including gear ratio and specific specifications. For details, refer to each section.

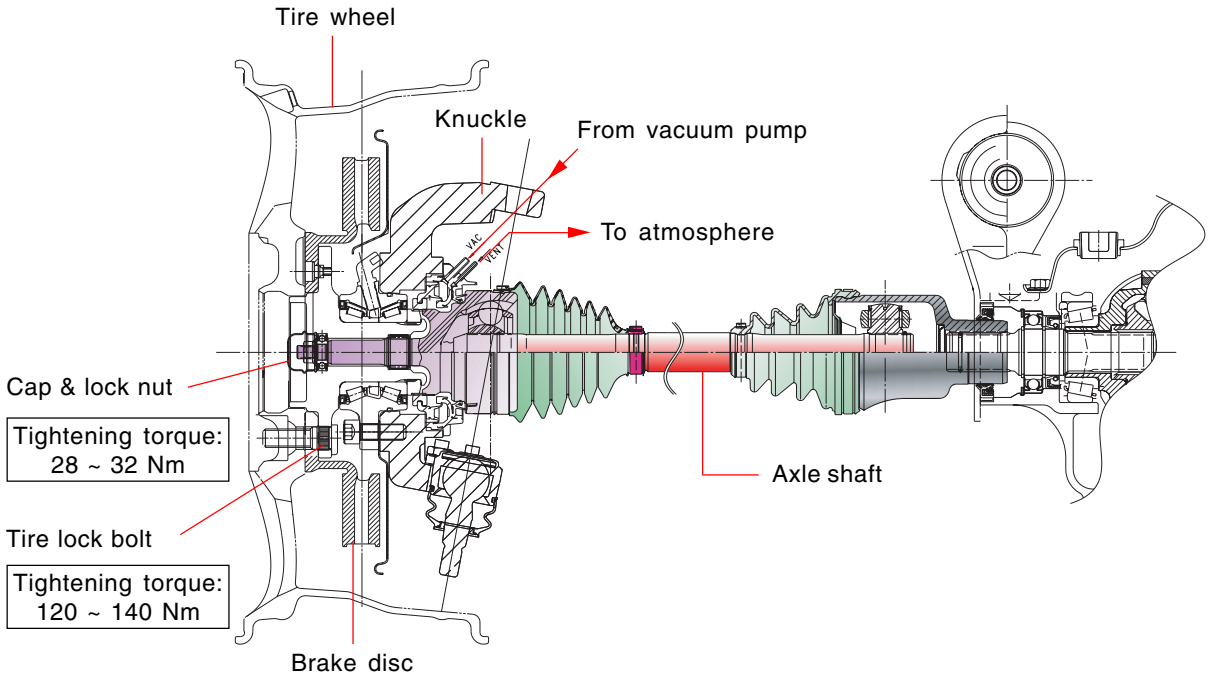
Location		Front axle		Rear axle	
Specification		M/T	A/T	M/T	A/T
Torque		-	-	-	-
Gear ratio		4.27R	4.55R	4.27R	4.55R
Gear	Type	Hypoid	→	←	←
	Size	ϕ 182.8 mm	←	ϕ 218.4 mm	←
	Offset	28.58 mm (DYMOS) 35 mm	←	38.1 mm	-
Housing		Steel	←	Steel casting (steel, aluminum cover)	←
Oil	Specification	SAE 80W/90 - GL5	←	SAE 80W/90 - GL5	←
	Capacity	1.4 L	1.4 L	1.9 L	←
Length		448.0 mm	←	469.0 mm	←
Width		681.9 mm	←	1717.7 mm	←
Weight		45 kg	←	90 kg	←

FRONT AXLE

1. LOCATION

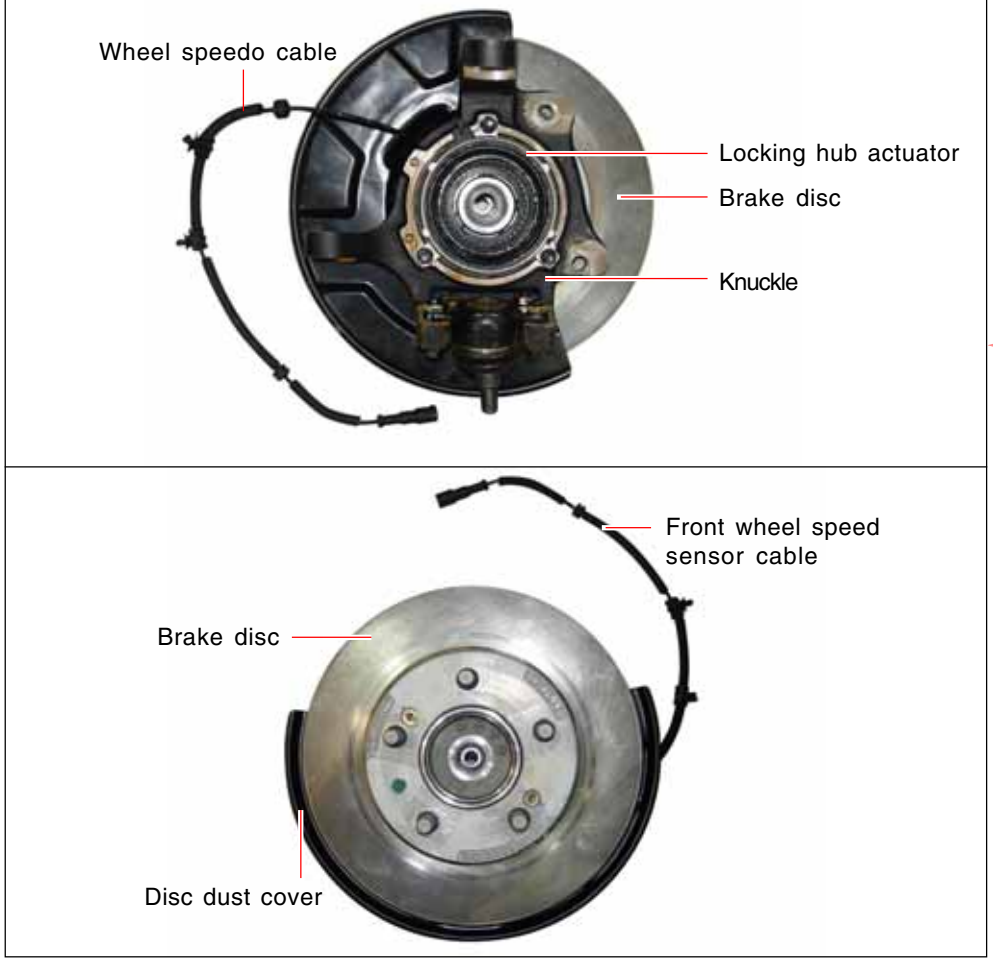


Sectional Diagram

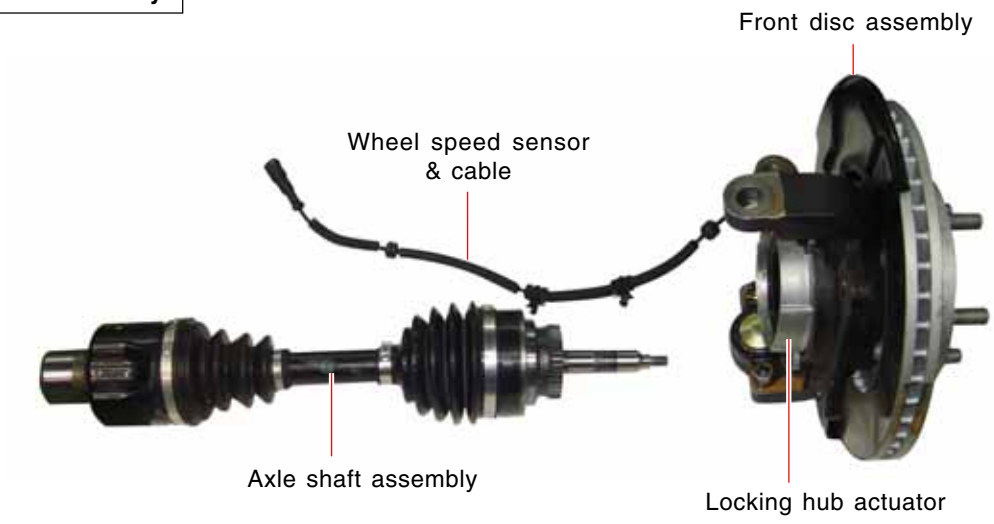


2. FRONT AXLE ASSEMBLY

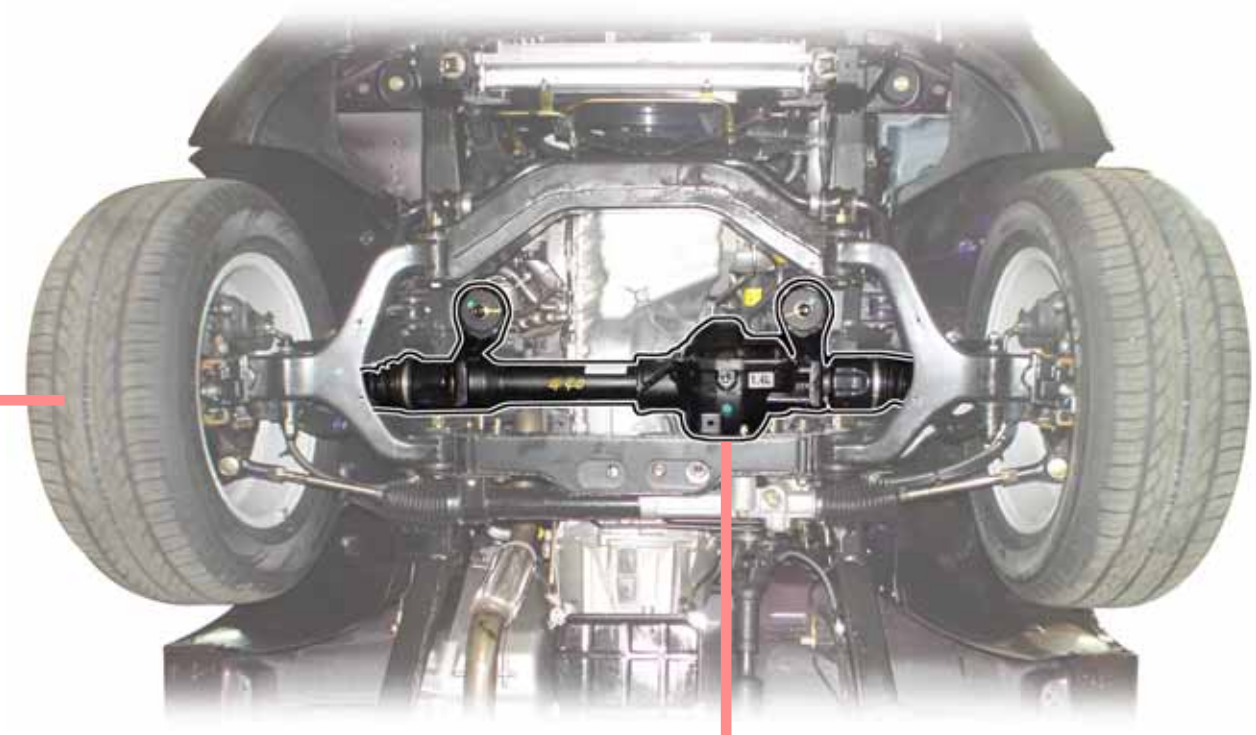
Front Disc & Wheel End Assembly



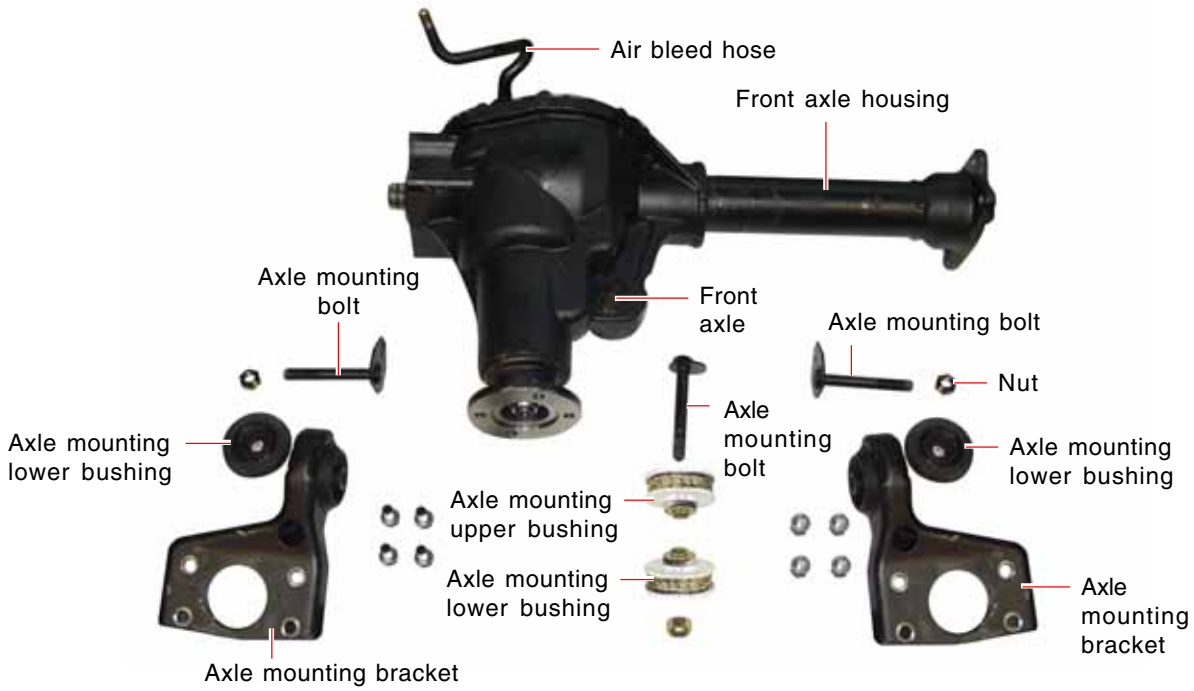
Axle Shaft Assembly



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



Front Axle Housing Assembly



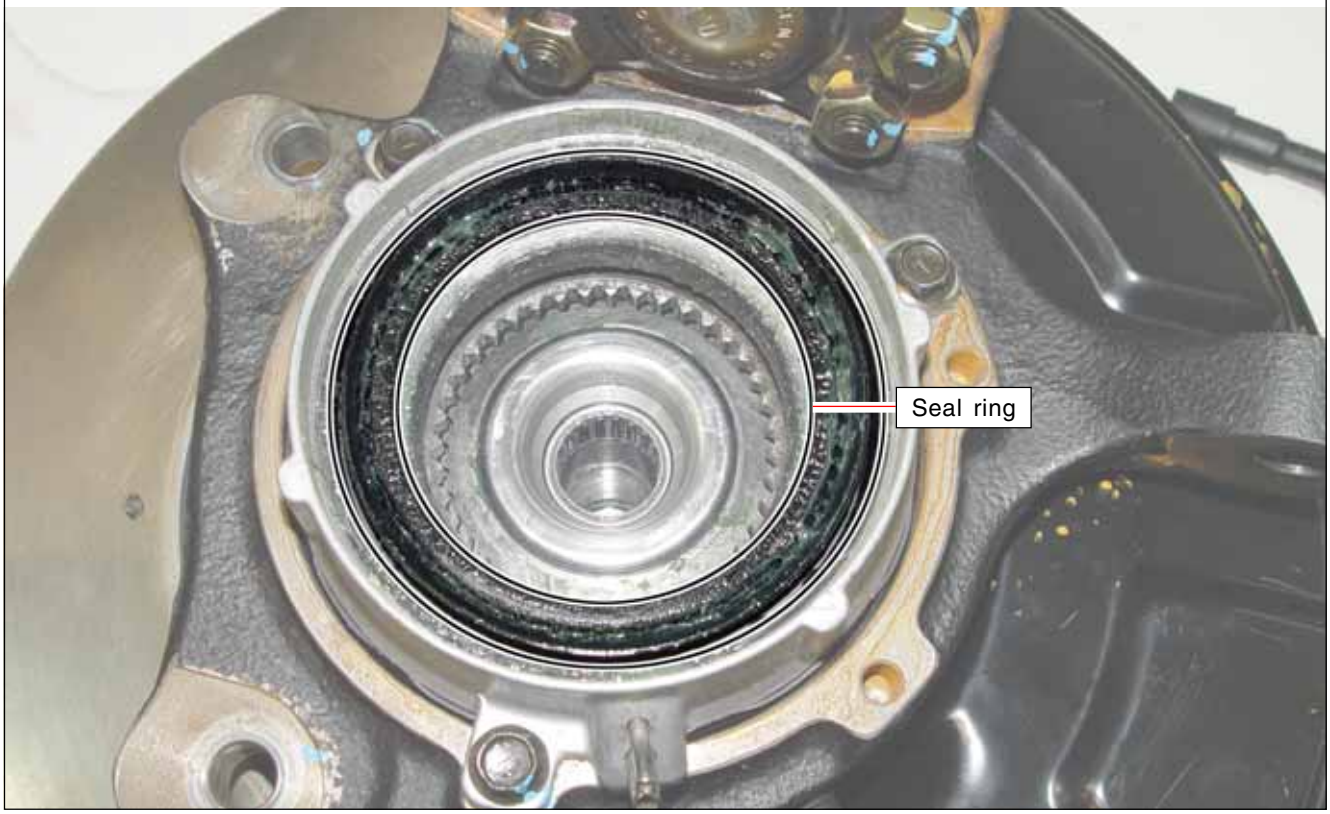
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. REMOVAL AND INSTALLATION

※ **Preceding work:** Perform the following steps before removing and installing the front axle assembly (axle housing/axle shaft).

Caution

1. Be careful not to damage the seal ring in the locking hub actuator when installing the front disc and the hub end assembly.



1. Removal of the front tire

Remove the front tire wheel caps. Unscrew five wheel nuts (21 mm) in diagonal direction by 2 to 3 steps and remove tires.

Installation Notice

Tightening torque	120 ~ 140 Nm

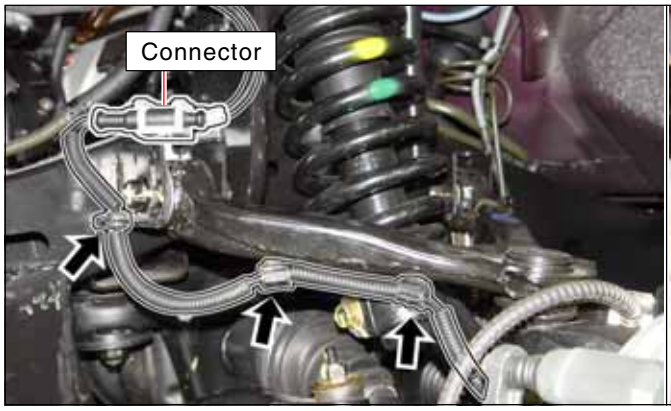


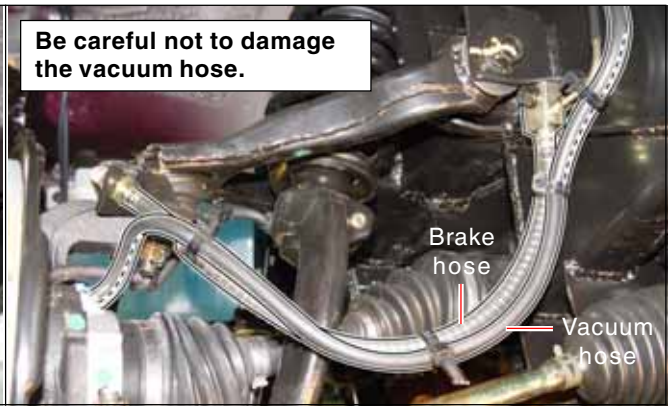


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. Wheel speed sensor connector and vacuum hose (At Both Sides)

Disconnect the wheel speed sensor cable and connector, and disconnect the vacuum hose from the locking hub actuator.





3. Brake disc caliper

Unscrew two mounting bolts (19 mm) and remove the brake disc caliper. Hang the removed caliper to the upper arm using the holder.

Installation Notice

Tightening torque	85 ~ 105 Nm

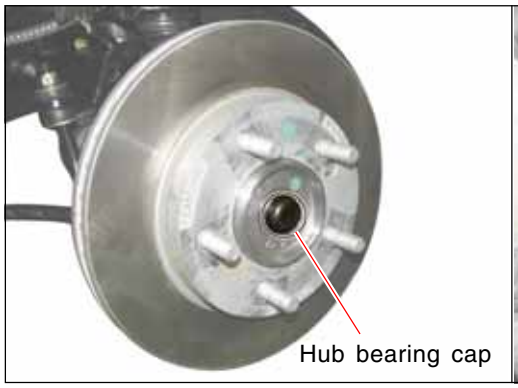




▶ Removal of Axle Shaft

Removal and Installation

1. Remove the hub bearing cap and unscrew the lock nut (14 mm) on the brake disc.

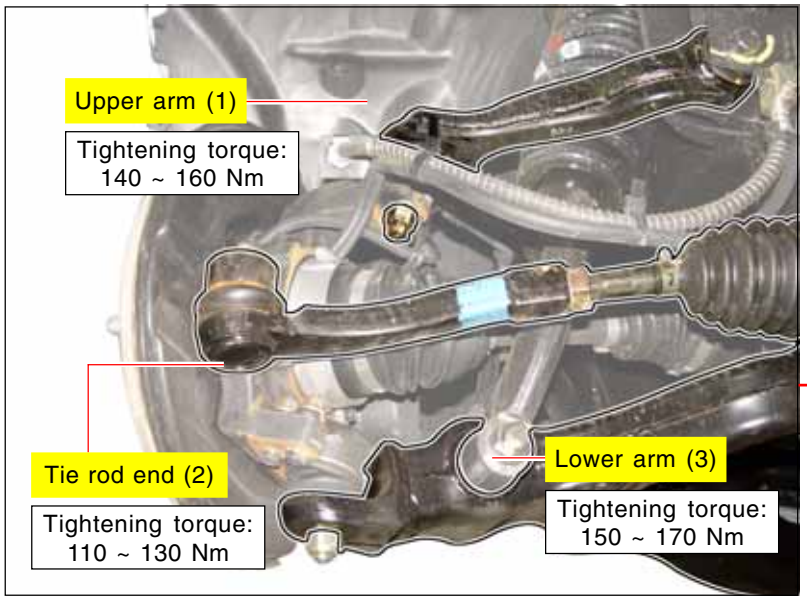




NOTICE

- **The hub bearing cap and the lock nut are not reusable. Always replace them with new ones after removal.**

2. Unscrew the upper arm lock nut, the tie rod end lock nut and the lower arm lock nut from knuckle, and then remove the front disc and the wheel end assembly.

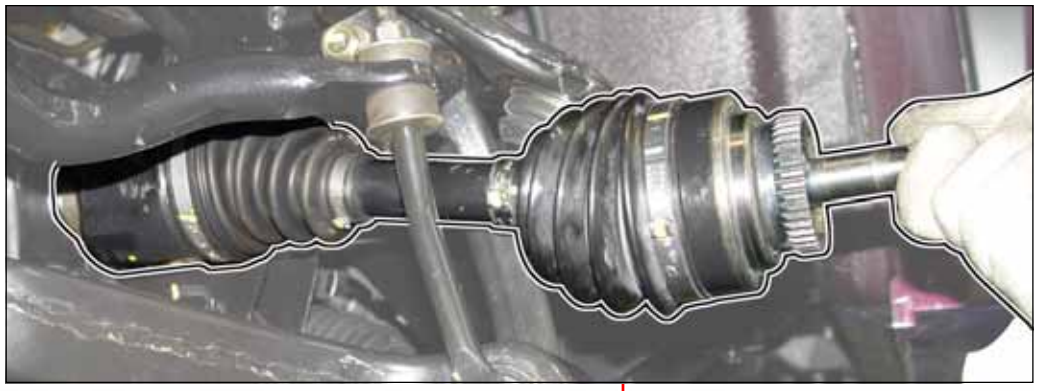


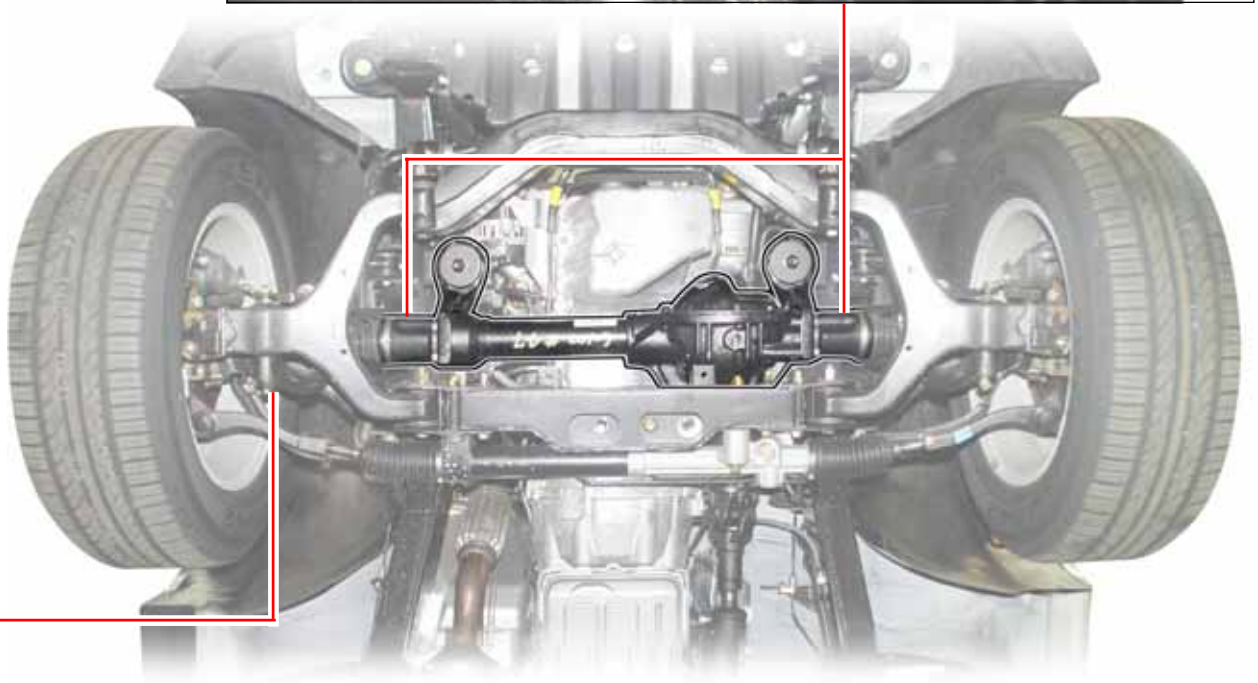
3. Loosen the upper arm (1) and the tie rod end (2) and remove the assembly by lifting it.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

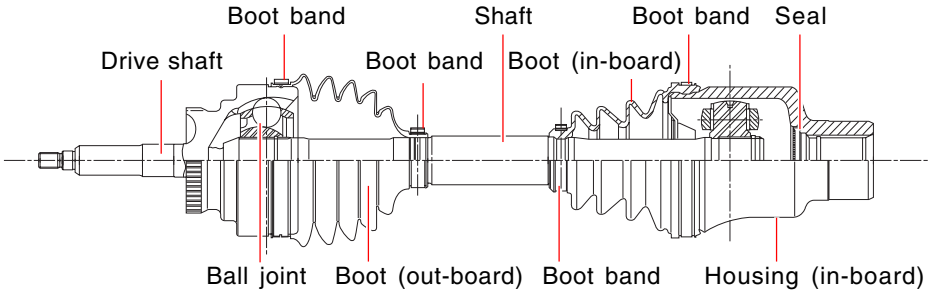
4. Remove the axle shaft from the axle housing using a special tool.





Components





▶ Removal of Axle Housing

1. Remove the axle shaft from the axle housing. Remove the propeller shaft and secure it to frame.



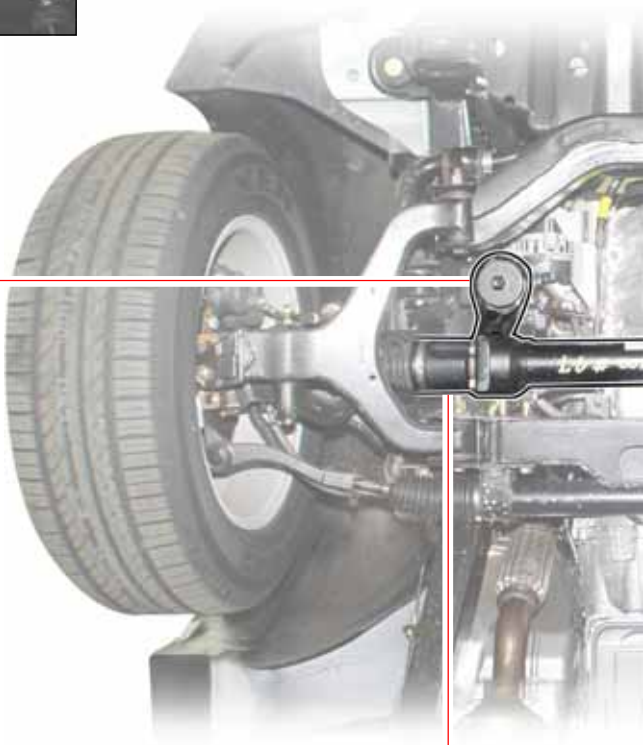
2. Removal of mounting bolt

Unscrew the mounting nut (22 mm) at right side of the axle housing and remove the axle mounting bolt.

Installation Notice

Tightening torque	95 ~ 142 Nm





3. Unscrew the four bolts (17 mm) on the axle housing and remove the axle mounting bracket.

Installation Notice

Tightening torque	80 ~ 100 Nm



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Unscrew one mounting nut (22 mm) at left side of the axle housing and four bolts on mounting bracket (17 mm) to remove the mounting bracket.

Tightening Torque

Mounting nut (22 mm)	95 ~ 142 Nm
Bracket bolt (17 mm)	80 ~ 100 Nm

NOTE

- **Remove the power steering hose mounting bracket before removing the left pin bolt. Otherwise, it cannot be removed due to interruption.**

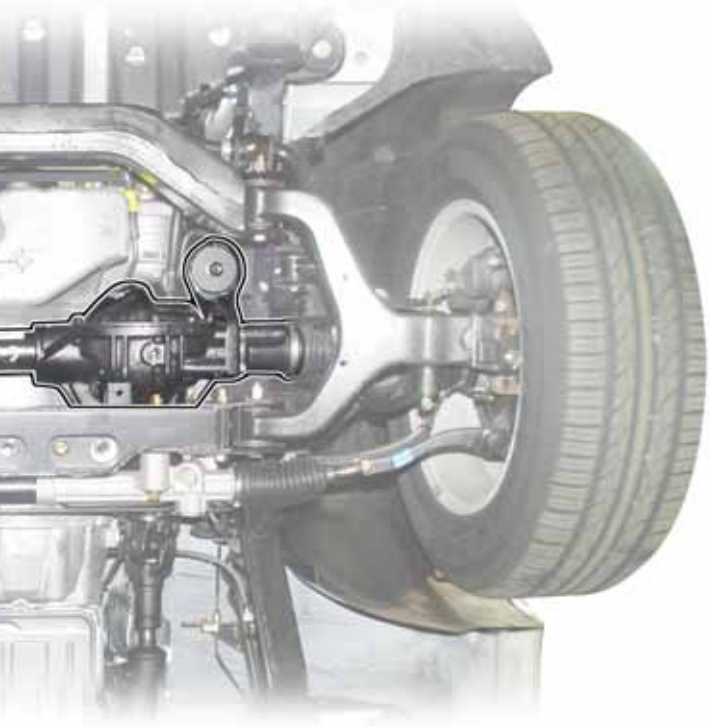


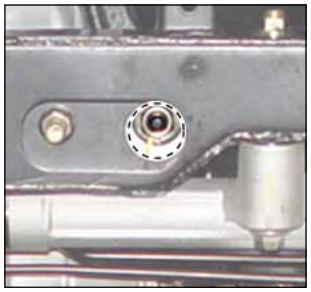
5. Place a safety jack under the axle housing and remove one axle mounting bolt (22 mm).

Installation Notice

Tightening torque	95 ~ 142 Nm

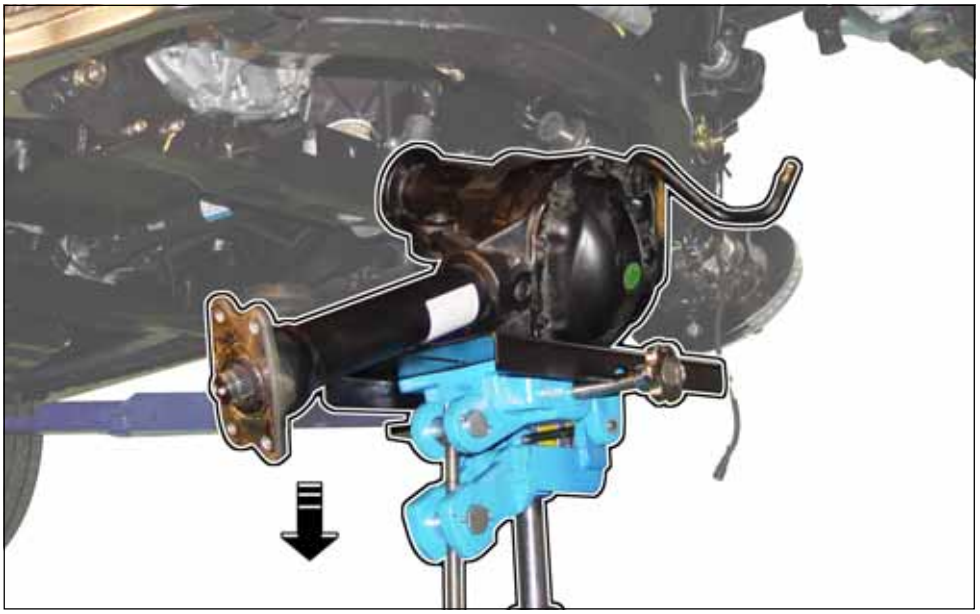








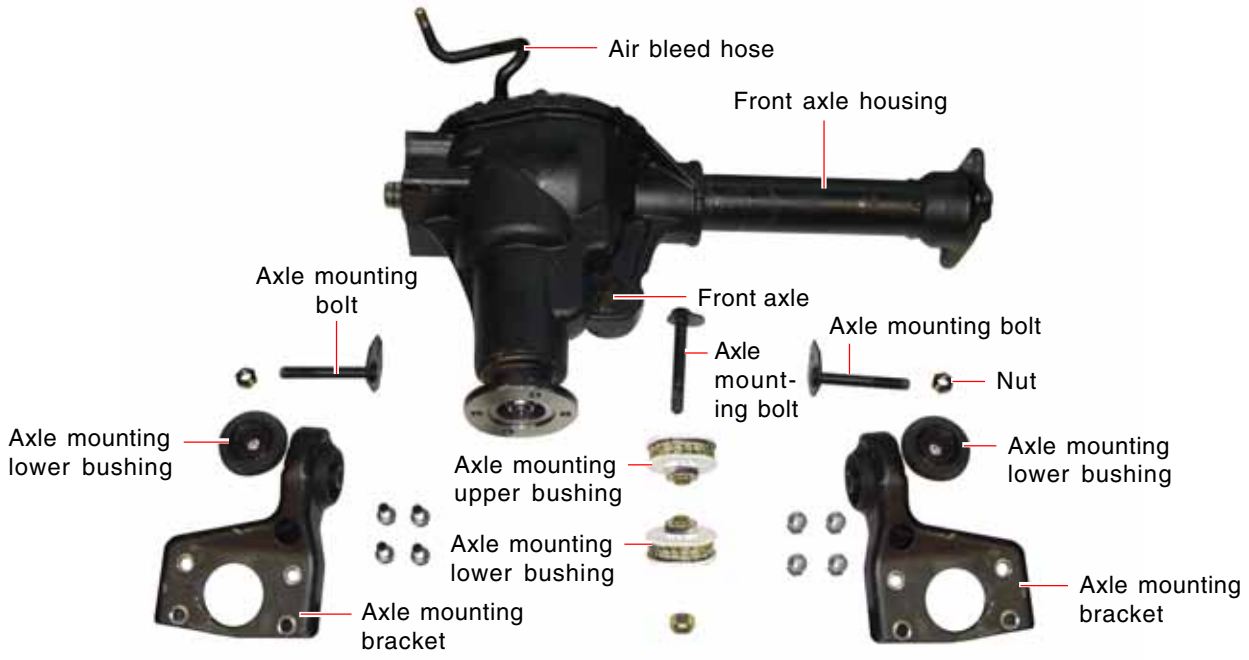
6. Remove the fixing clip on the air bleed hose above the axle housing and carefully lower the safety jack.



Axle Housing Assembly

NOTICE

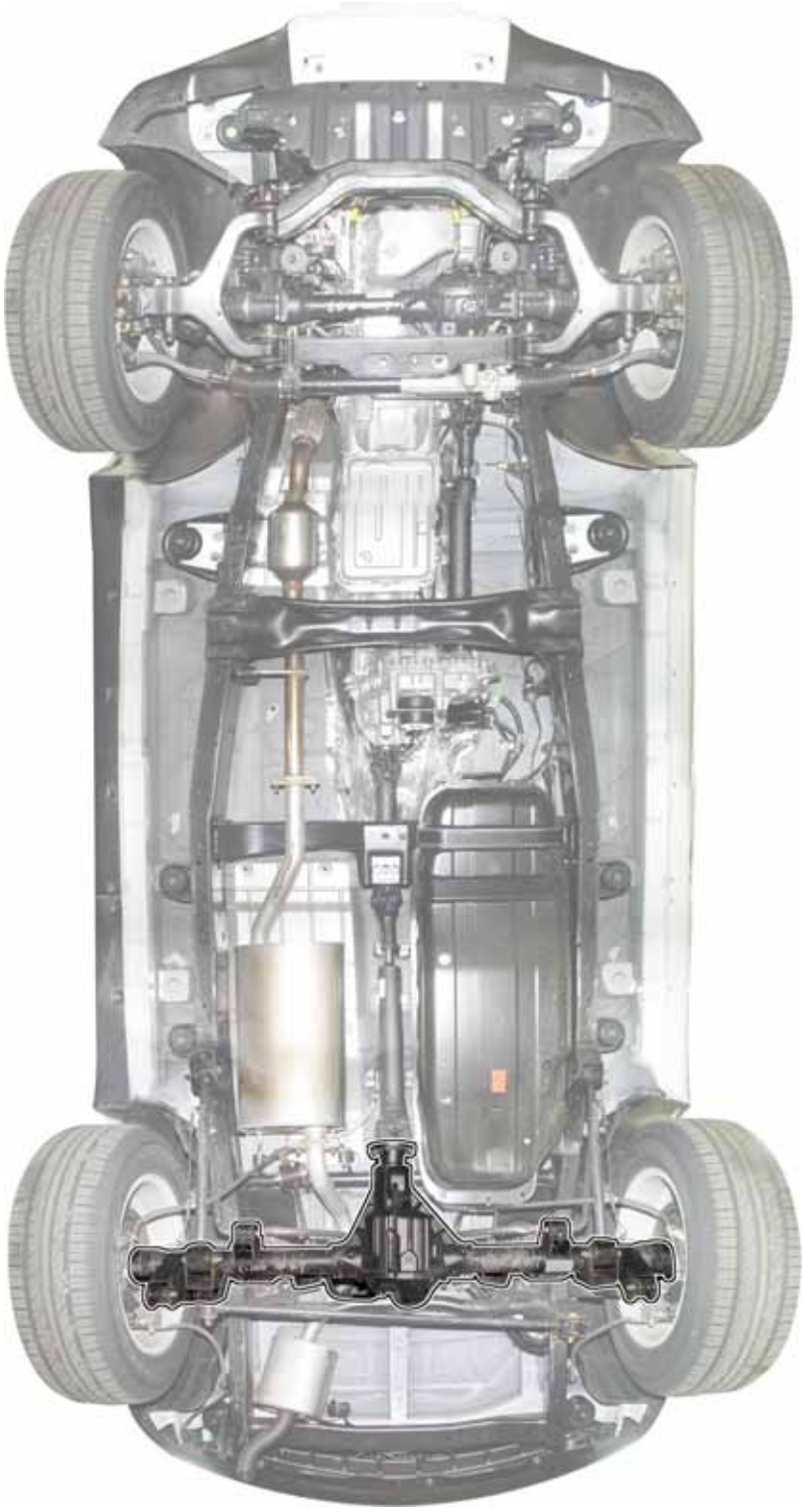
- **Be careful not to damage the left and right seals in axle housing when removing the axle mounting bracket or axle assembly.**



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

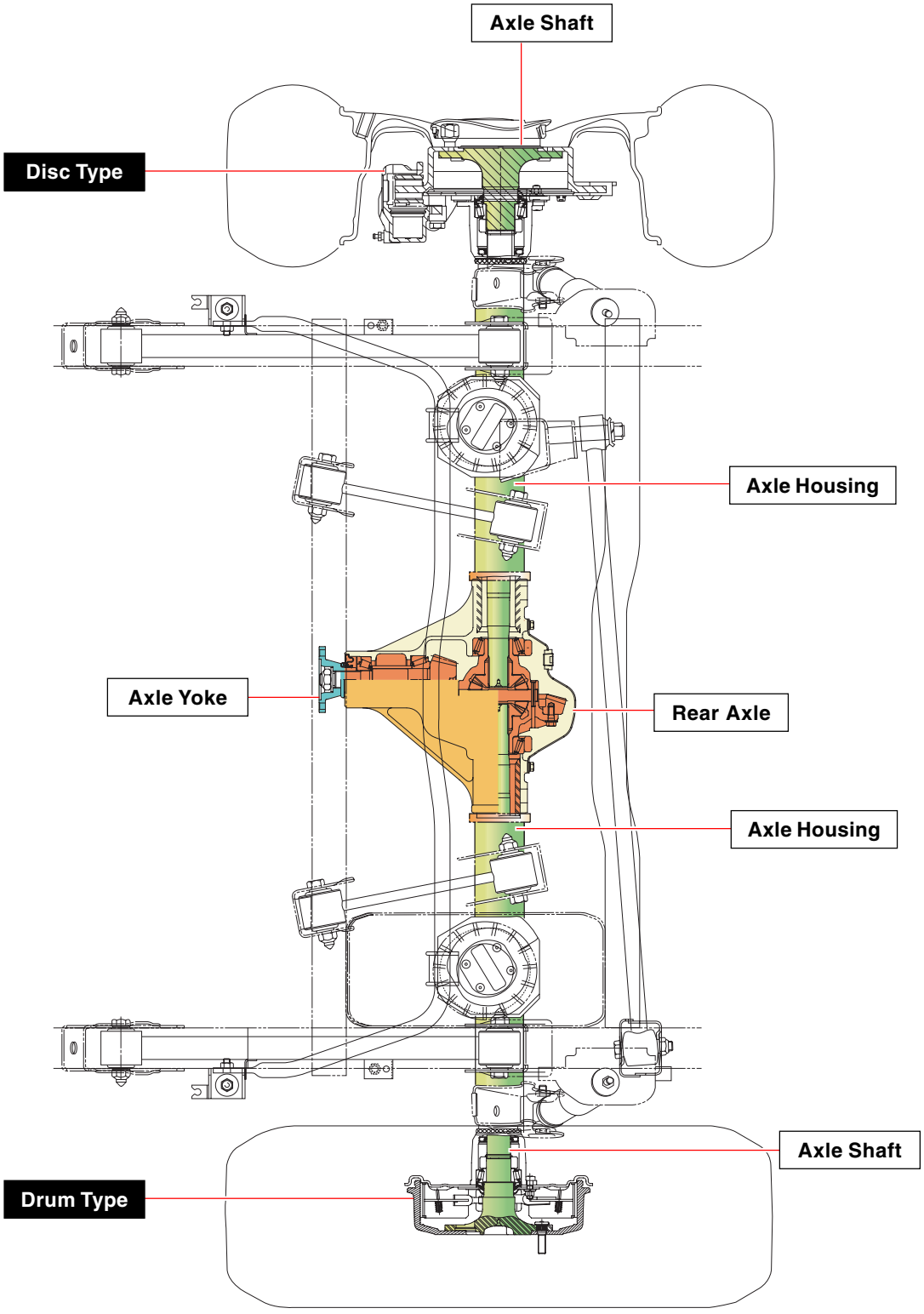
5-LINK TYPE REAR AXLE

1. LOCATION



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Components



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Specifications

Front View



Rear View



Specifications

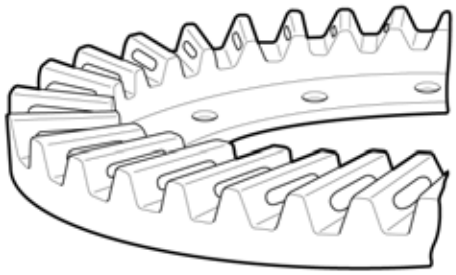
Description	Specification	
Axle shaft type	Semi-floating type	
Axle housing type	Build-up type	
Differential	Type	Conventional
	Gear type	Hypoid
Final gear ratio	DI engine + M/T	4.27
	DI engine + A/T	4.55
Oil	Capacity	1.9 L
	Specification	SAE 80W/90 GL-5

▶ Trouble Diagnosis

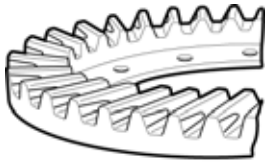
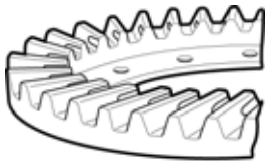
Symptom	Cause	Action
Noise (during driving straight ahead)	Lack of oil	Replenish
	Low oil viscosity	Replace
	Low oil quality	Replace
	Excessive backlash of ring gear	Replace
	Worn or damaged tooth of ring and pinion gear	Replace
	Worn or damaged drive pinion gear	Replace
	Worn bearing and side gear spline	Replace
	Distortion of axle housing	Replace
	Distortion of differential case	Replace
	Worn pinion shaft	Replace
	Incorrect drive pinion preload	Adjust
	Incorrect contact of ring gear and pinion	Reassembly
Oil leakage	Excessive oil	Adjust to proper level
	Improper sealing of carrier mating surface	Correct
	Cracked axle housing	Replace
	Worn or damaged oil seal	Replace
Noise (during turning)	Worn or damaged tooth of pinion or side gear	Replace
	Worn pinion shaft	Replace
	Excessive backlash of pinion gear and side gear	Replace
	Excessive end-play of axle shaft	Adjust
	Incorrect contact of side gear and differential case	Replace
	Cracked axle housing	Replace
	Distortion or poor installation of drive pinion oil seal	Replace
	Damaged or torn drive pinion oil seal	Replace
	Loosened bearing collar	Replace
	Worn or damaged universal joint	Replace
	Worn or damaged axle shaft bearing	Replace
Heated	Lack of oil	Replenish
	Insufficient backlash of gears	Adjust
	Excessive preload of bearing	Adjust

Inspection of Ring Gear Tooth Contact Pattern

1. Apply gear-marking compound (Prussian blue/red lead) on the ring gear teeth. Rotate the ring gear and check the tooth contact pattern.



2. Abnormal contact

Tooth Contact Pattern	Possible Cause	Remedy
1. Heel contact  A	Excessive backlash • Noise can be occured	Adjust backlash • Select proper shim to move the drive pinion toward the ring gear (toward toe)  B
2. Toe contact  A	Insufficient backlash • Tooth can be damaged or broken under heavy load	Adjust backlash • Select proper shim to move the drive pinion against the ring gear (toward heel)  B
3. Face contact  A	Excessive backlash • Drive pinion shaft is apart from the ring gear • Noise can be occured	Adjust backlash • Move the drive pinion toward the ring gear (toward the center of ring gear)  B
4. Flank contact  A	Insufficient backlash • Gear contacts on the low flank • Gear can be damaged or worn • Noise can be occured	Adjust backlash • Move the ring gear toward the drive pinion (toward the ring gear center line)  B

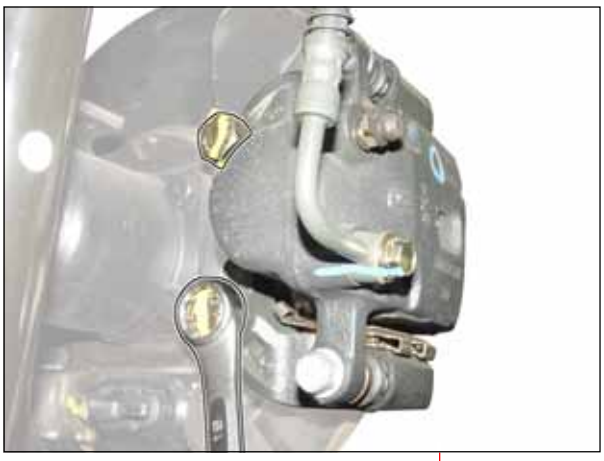
2. REMOVAL AND INSTALLATION

▶ Rear Axle Shaft (Disc Brake Type)

※ **Preceding Works:** Remove the tire.

1. Unscrew the two mounting bolts (19 mm) and remove the rear brake disc caliper. Secure the removed caliper on the vehicle frame.

Caliper mounting bolt	85 ~ 105 Nm





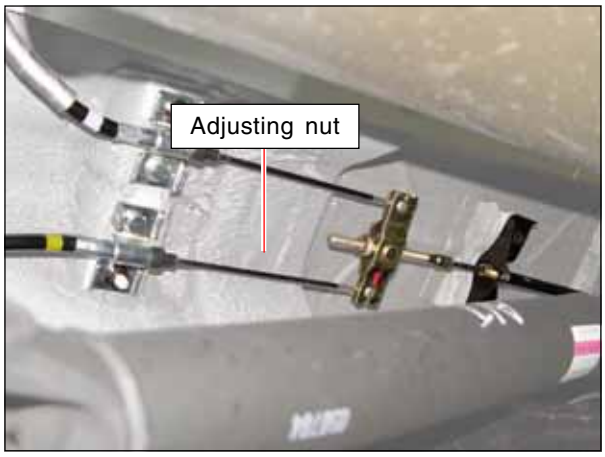
2. Unscrew the mounting bolt (10 mm) . Disconnect and secure the wheel speed sensor cable.

Installation Notice

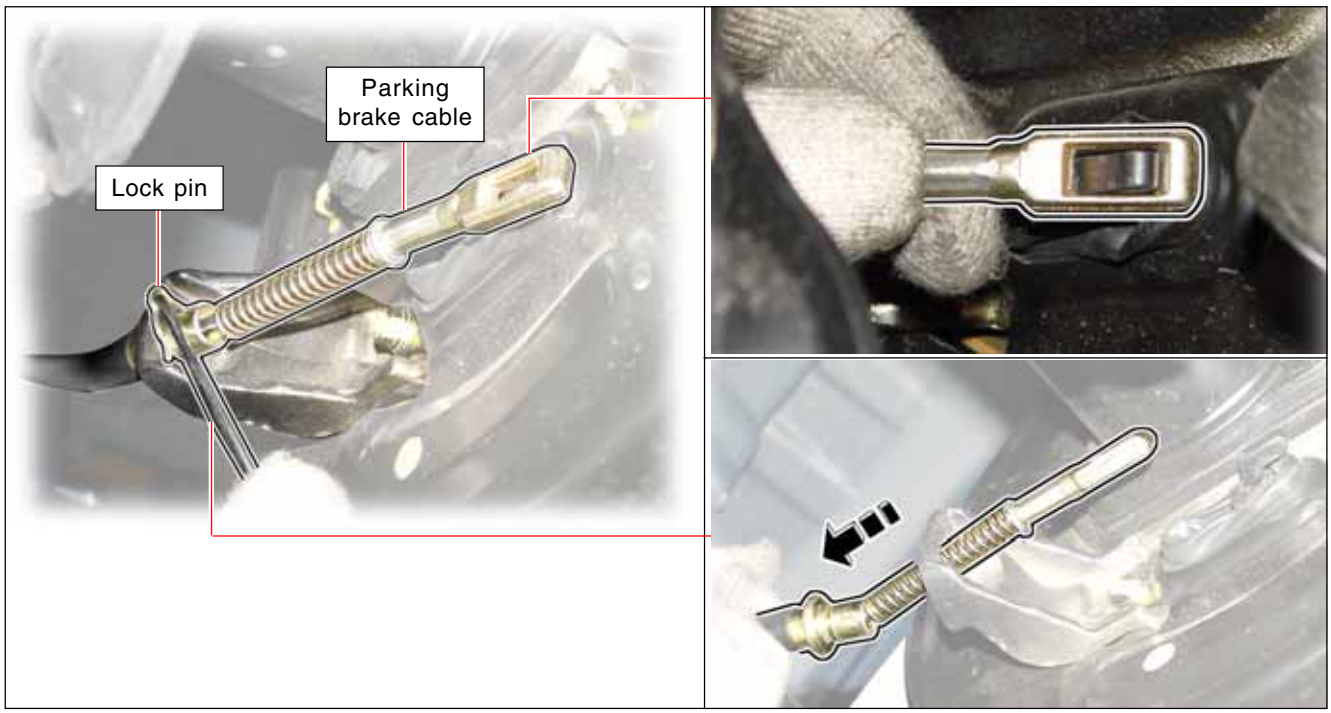
Tightening torque	6 ~ 8 Nm



3. Unscrew the adjusting nut of the parking brake cable equalizer to loosen the parking brake cable.



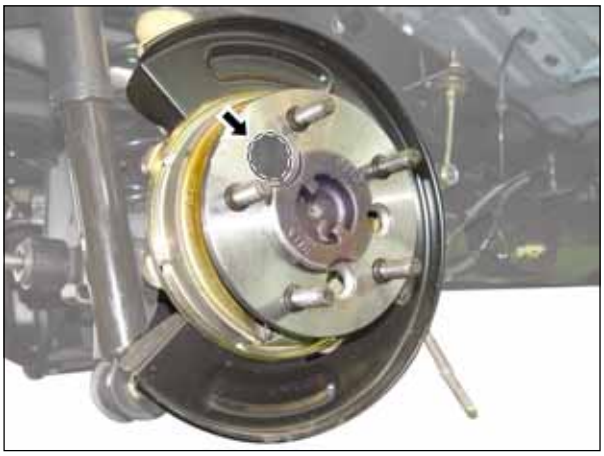
4. Remove the lock pin and disconnect the parking brake cable.



5. Remove the brake disc.



6. Remove the plastic plug from the axle shaft flange.



7. Unscrew the four flange lock bolts (17 mm) on the axle housing flange and remove the axle shaft.



Installation Notice

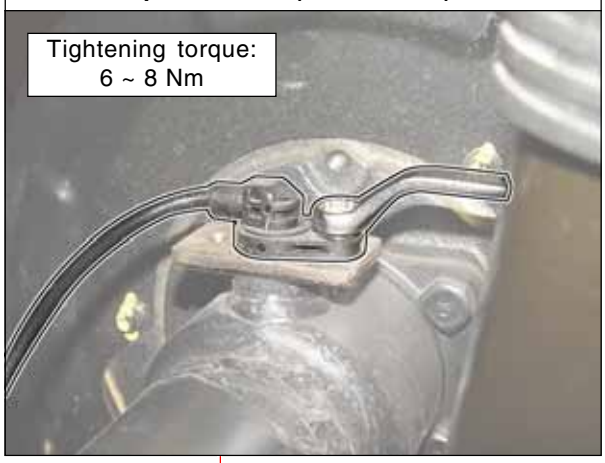
Tightening torque	50 ~ 64 Nm

▶ Rear Axle Housing

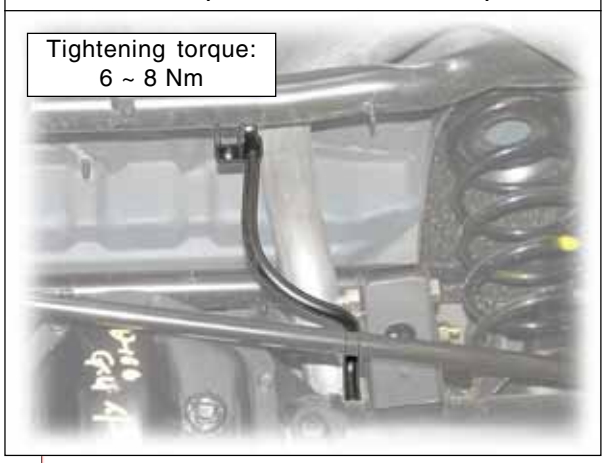
※ **Preceding Works:** Remove the tire.

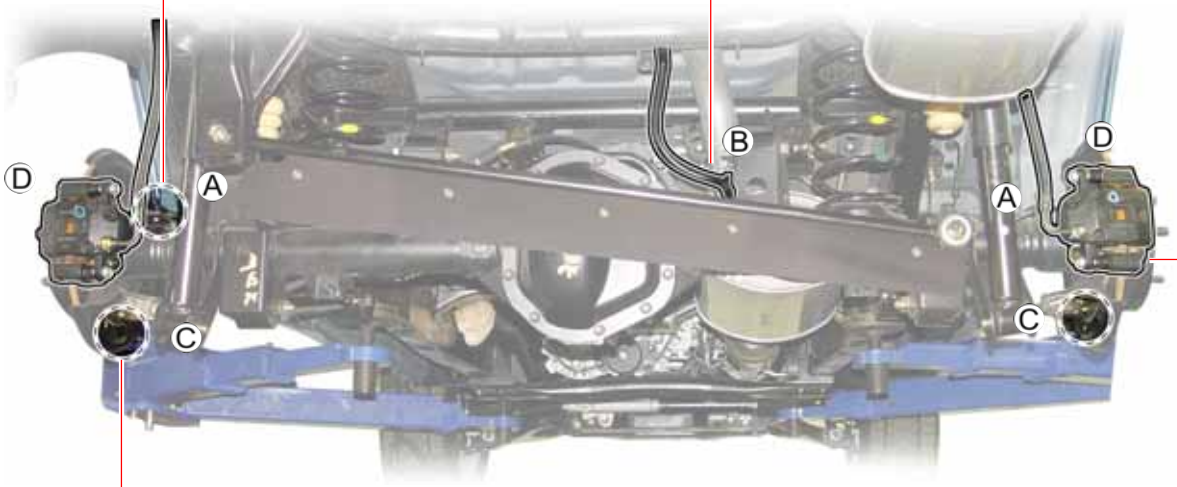
1. Remove the wheel speed sensor (A), the air breather lock nut (B), the parking brake cable (C) and the disc brake caliper (D) from the rear axle.

A. Wheel Speed Sensor (10 mm - 1EA) - LH/RH



B. Air Breather (Lock Bolt 10 mm - 1 EA)





C. Parking Brake Cable - LH/RH



D. Disc Brake Caliper - LH/RH



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EFFECTIVE DATE	
AFFECTED VIN	

2. Place a safety jack under the axle housing and unscrew the connections.

A. lateral rod mounting nut (22 mm)



Tightening torque	150 ~ 180 Nm

B. Lower arm bolt/nut (22 mm)

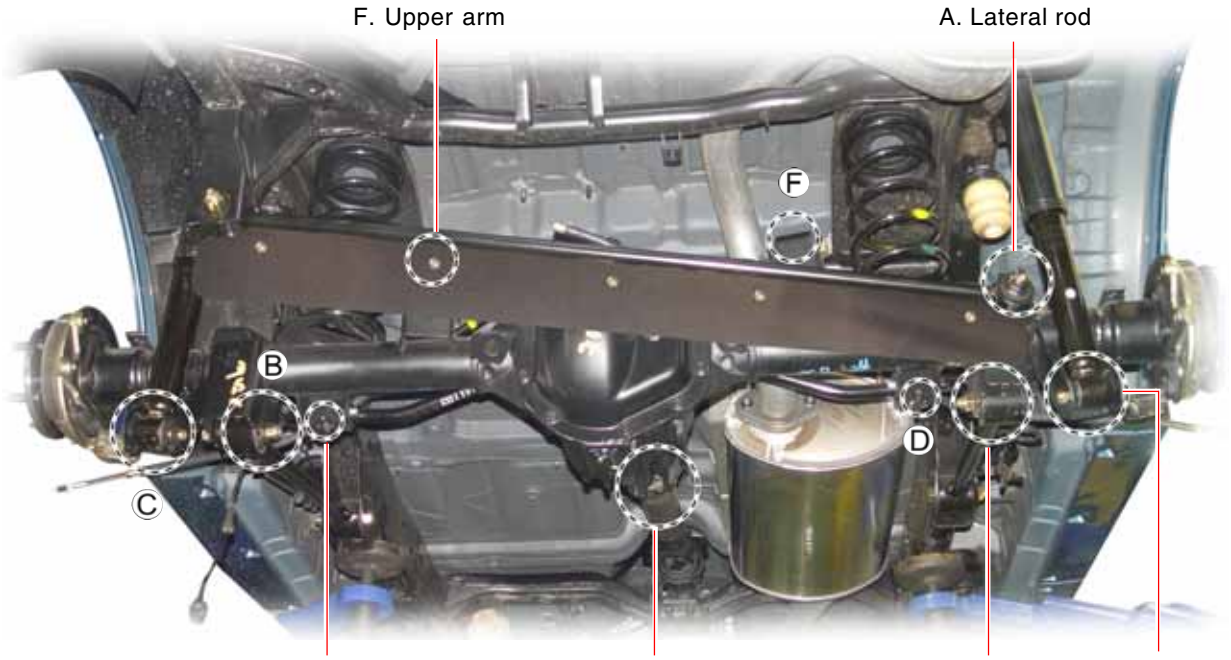


Tightening torque	150 ~ 180 Nm

C. Shock absorber bolt/nut (17 mm: nut, 10 mm: bolt)



Tightening torque	80 ~ 100 Nm



D. Mounting bracket bolts of stabilizer bar (14 mm - 2 EA: LH/RH)



Tightening torque	40 ~ 60 Nm

E. Remove the propeller shaft to the rear axle housing.



Tightening torque	70 ~ 80 Nm

F. Upper arm bolt/nut (22 mm)



Tightening torque	150 ~ 180 Nm

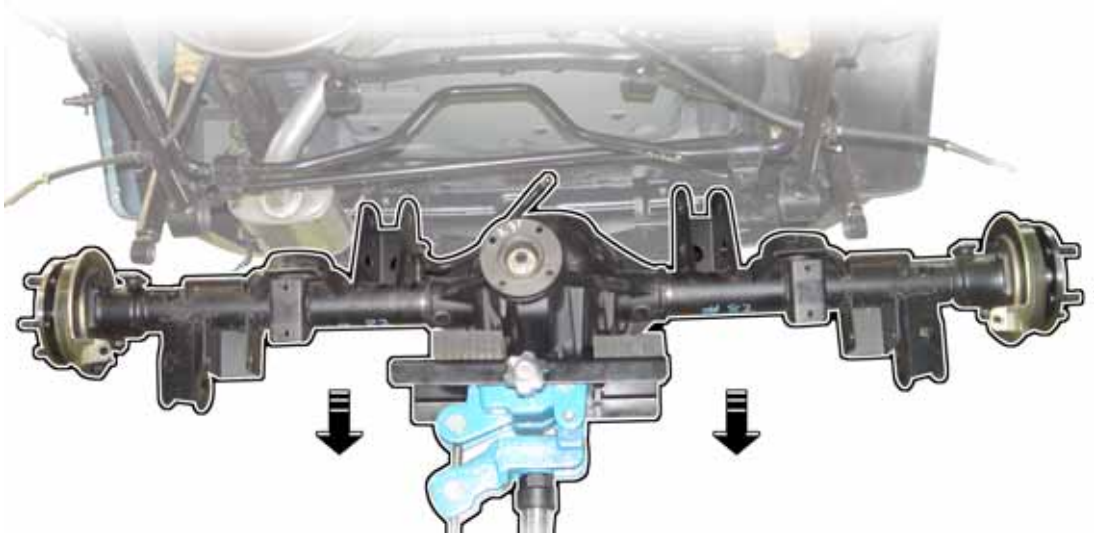
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EFFECTIVE DATE	
AFFECTED VIN	

3. Carefully lower the safety jack to remove the rear axle assembly from the vehicle frame.

Rear View



Front View



SUSPENSION

4410 / 4510

TABLE OF CONTENTS

FRONT SUSPENSION 2

1. System overview 2
2. System layout 6
3. Removal and installation 8
4. Coil spring & shock absorber assembly 10
5. Stabilizer bar 12
6. Lower arm 14

REAR SUSPENSION (5-LINK TYPE) 19

1. Overview 19
2. System layout 20
3. Trouble diagnosis 24
4. Removal and installation 25

FRONT SUSPENSION

1. SYSTEM OVERVIEW

Overview

The suspension is the device to connect the axle and vehicle frame. It absorbs the vibrations and impacts from road surface, which enhances the comforts, driving force, braking force and drivability.

1. Suspension type: Double Wishbone
2. Components

   Knuckle, upper arm assembly, lower arm assembly, coil spring, shock absorber assembly and stabilizer

Upper Arm Assembly



The upper arm is mounted to the frame and the knuckle and it relieves the load delivered from the tire to the knuckle. This enables to absorb the various impacts according to the load shapes and to ensure the drivability.

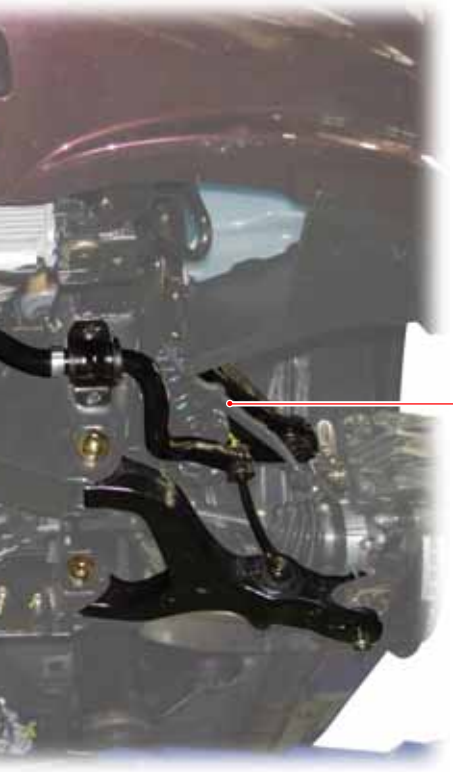


Lower Arm Assembly

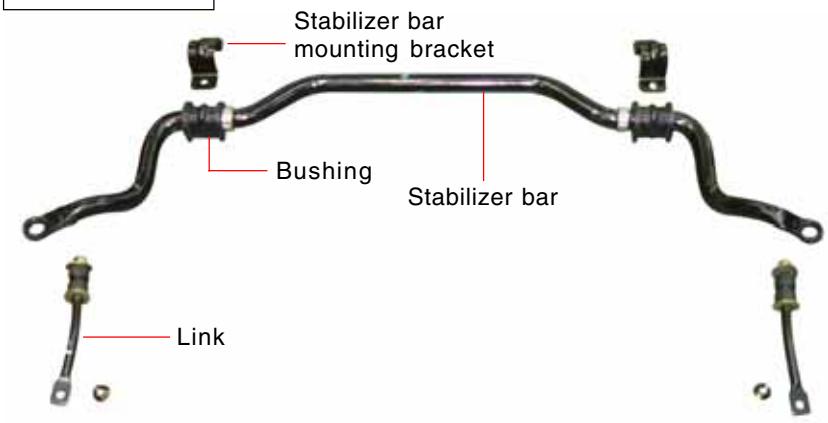


The lower arm is mounted to the knuckle, the shock absorber and the lower arm assembly. It relieves the load delivered from the tire to the knuckle. This enables to absorb the various impacts according to the load shapes and to ensure the drivability.

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EFFECTIVE DATE	
AFFECTED VIN	



Stabilizer Bar



A transverse mounted spring steel bar controls and minimizes body lean or tipping on corners. This is a round bar which connects the left wheel suspension assembly with the right side. The main function is to keep both wheels rolling at the same rate when meeting bumps, but it also affects handling.

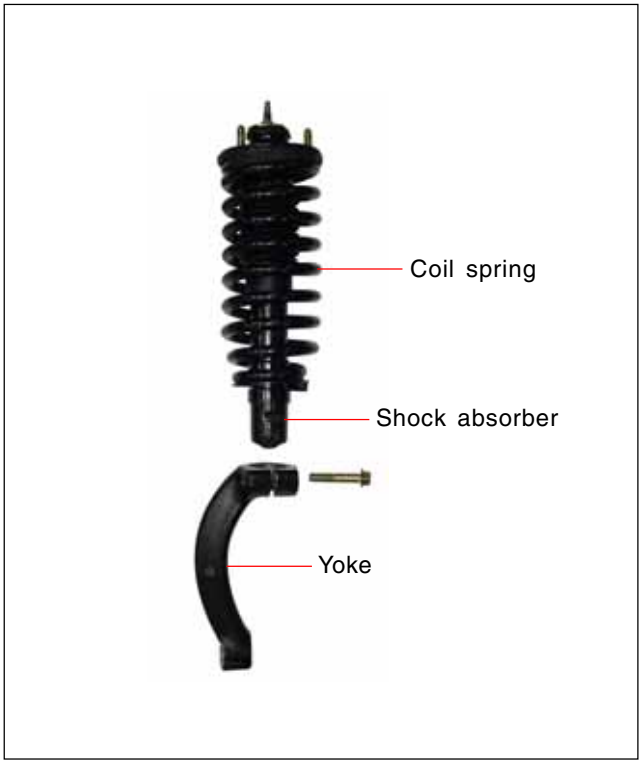
Coil Spring



A section of spring steed rod is wound in a spiral pattern or shape coil provides a cushion to absorb road imperfections and returns the vehicle to a predetermined right height. It is a major contributor to a vehicle's handling balance and ride quality. Higher spring rates and shorter overall lengths are commonly used to lower the vehicle's ride height for enhanced appearance and improved handling.

Shock Absorber Assembly

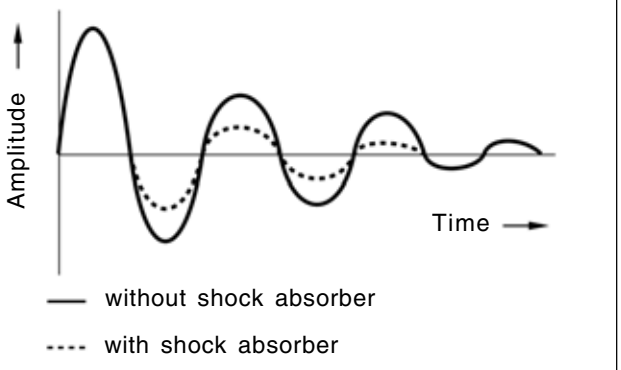
1. This vehicle uses the strut type shock absorber. This shock absorber is connected to the piston rod in the strut. This relieves the vertical vibrations of vehicle to provide ride comforts, prevents the spring break, enhances drivability, and extends the life span of steering components.

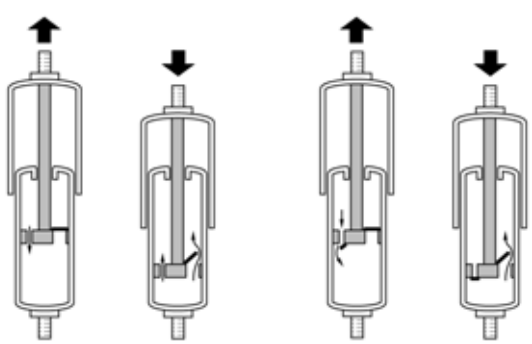


2. The shock absorber consists of a tube with piston and rod, and a cylinder tube. The piston has an orifice and valve and the cylinder is filled with oil.

   This double tube type shock absorber restrains the vibrations by using oil resistance. This provides better drivability even though the structure is complicated.

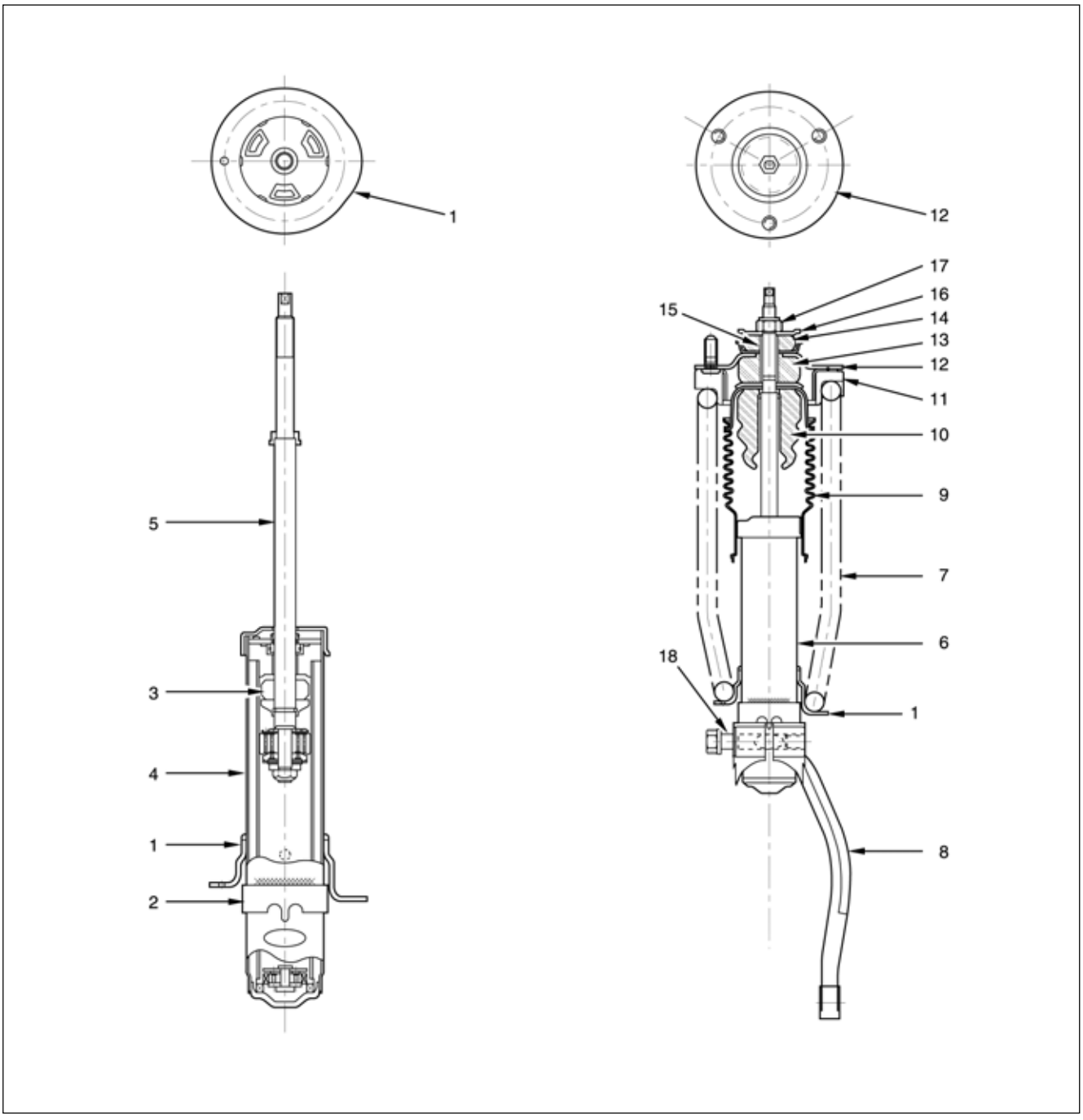
   This vehicle uses the gas shock absorber with cylindrical double tube.





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AFFECTED VIN	

▶ Sectional Drawing of Shock Absorber

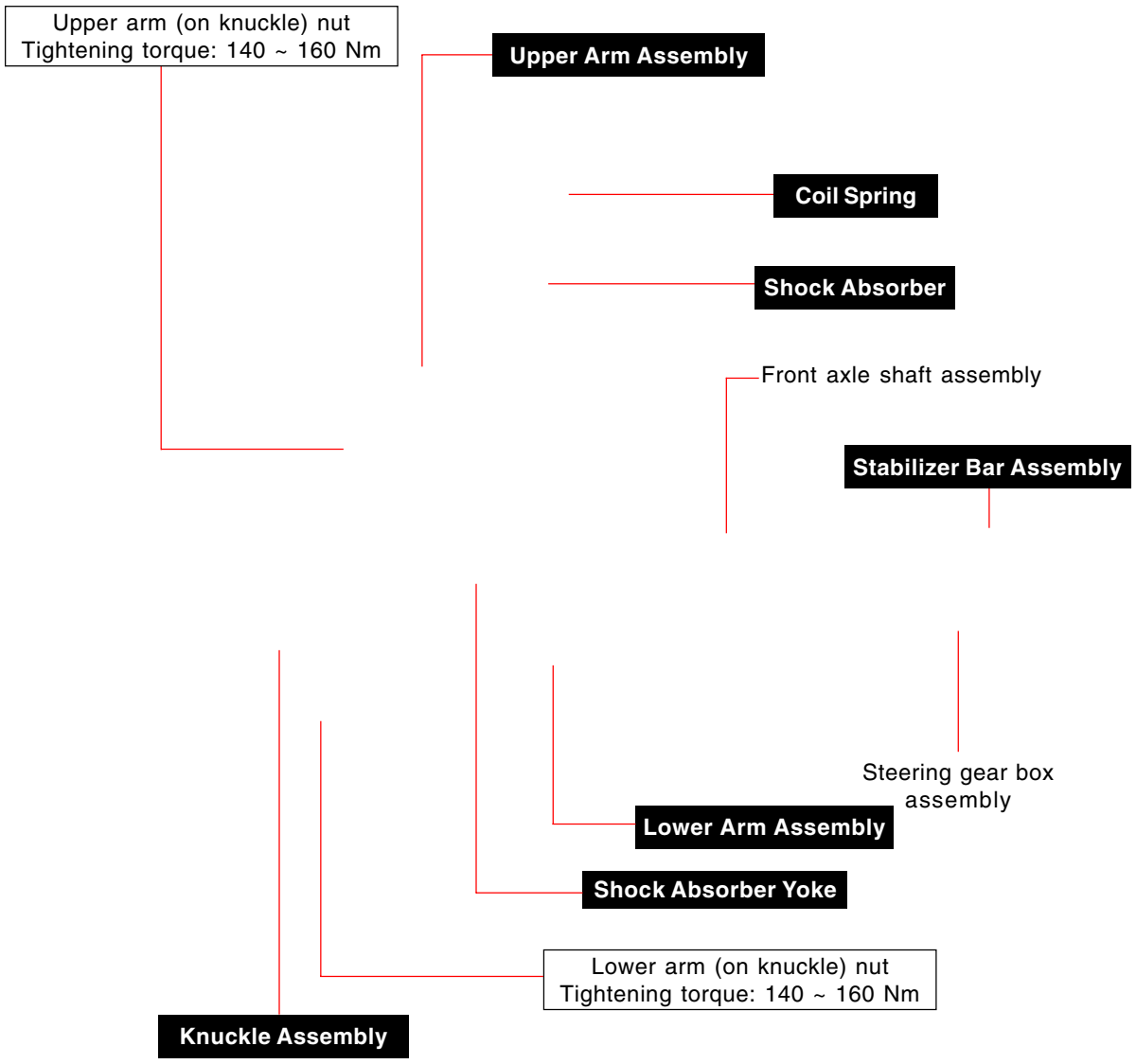


1. Lower spring seat
2. Yoke bracket
3. Rebound stopper
4. Cylinder
5. Piston
6. Shock absorber assembly
7. Spring
8. Yoke
9. Boot
10. Bumper stopper
11. Spring seat rubber
12. Upper spring seat
13. Rubber
14. Rubber
15. Spacer
16. Washer
17. Nut
18. Bolt

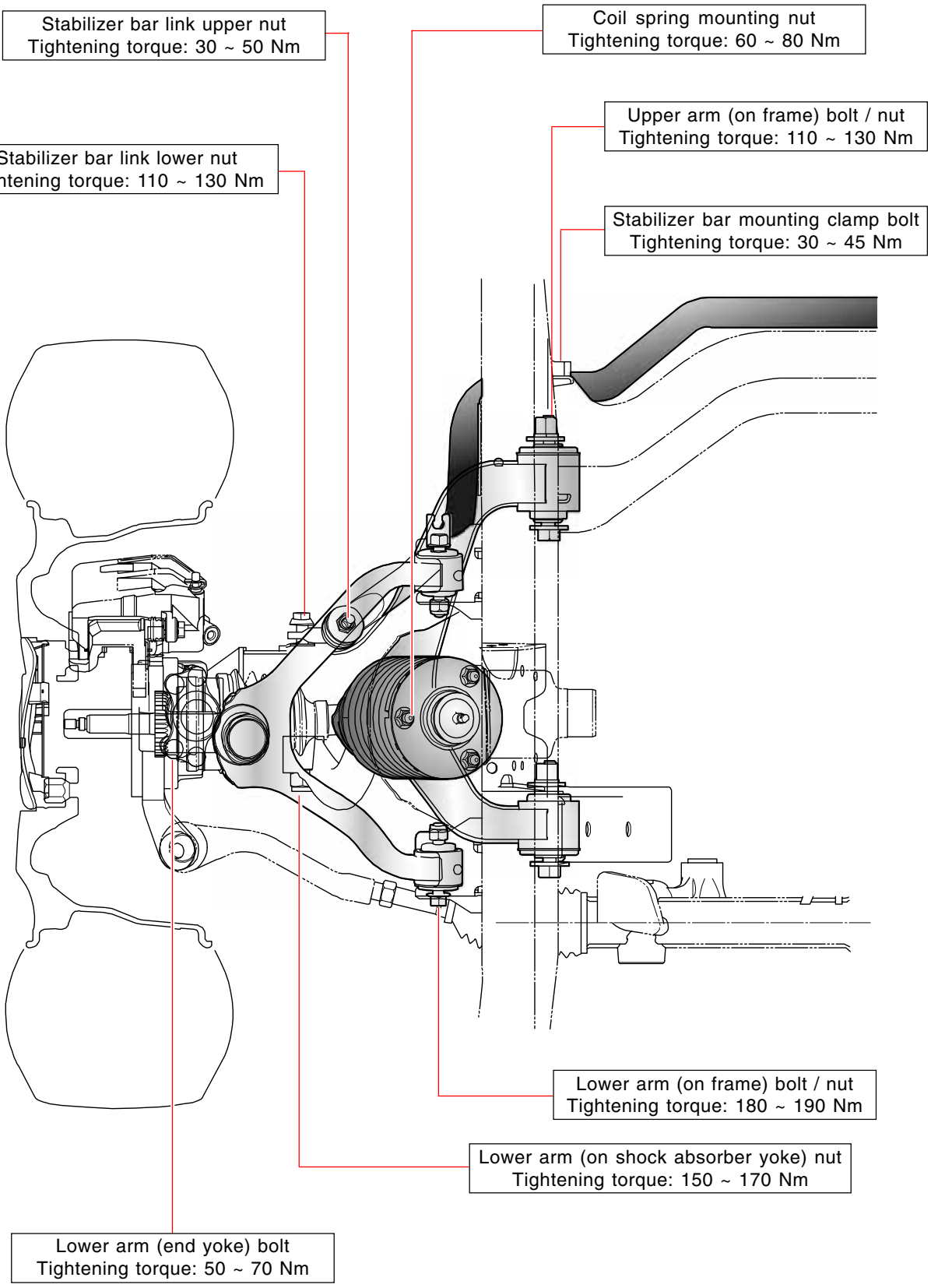
2. SYSTEM LAYOUT

Specifications

Description		Specification
Suspension type		Double wishbone
Spring type		Coil spring
Shock absorber type		Cylindrical double tube (gas type)
Stabilizer type		Torsion bar
Wheel alignment	Toe-in	2 ± 2 mm [0 ~ 4 mm]
	Camber	-0.19° ± 0.3° (the difference between both ends is should be below 0.5°)
	Caster	4.4° ± 0.5° (the difference between both ends is should be below 0.5°)
Height "H" (When tightening upper arm/ lower arm/shock absorber yoke nut)		86.5 ± 5 mm



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	


Stabilizer bar link upper nut
Tightening torque: 30 ~ 50 Nm
Coil spring mounting nut
Tightening torque: 60 ~ 80 Nm
Upper arm (on frame) bolt / nut
Tightening torque: 110 ~ 130 Nm
Stabilizer bar link lower nut
Tightening torque: 110 ~ 130 Nm
Stabilizer bar mounting clamp bolt
Tightening torque: 30 ~ 45 Nm
Lower arm (on frame) bolt / nut
Tightening torque: 180 ~ 190 Nm
Lower arm (on shock absorber yoke) nut
Tightening torque: 150 ~ 170 Nm
Lower arm (end yoke) bolt
Tightening torque: 50 ~ 70 Nm

3. REMOVAL AND INSTALLATION

▶ Upper Arm

: Remove the upper arm assembly according to the sequences shown below and keep the specified tightening torque when reinstalling it.

Preceding Works

1. Remove the tires.
   Remove the wheel cap and loosen the wheel nuts in several steps.

Installation Notice

Tightening torque	120 ~ 140 Nm



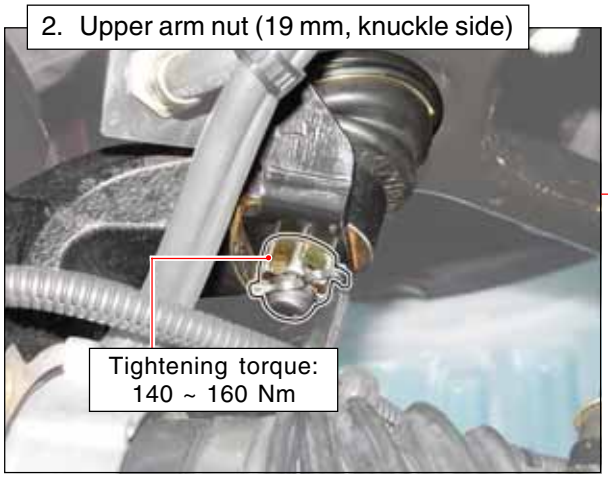
1. Wheel speed sensor cable



: Remove the wheel speed sensor cable and the connector from the upper arm.



2. Upper arm nut (19 mm, knuckle side)



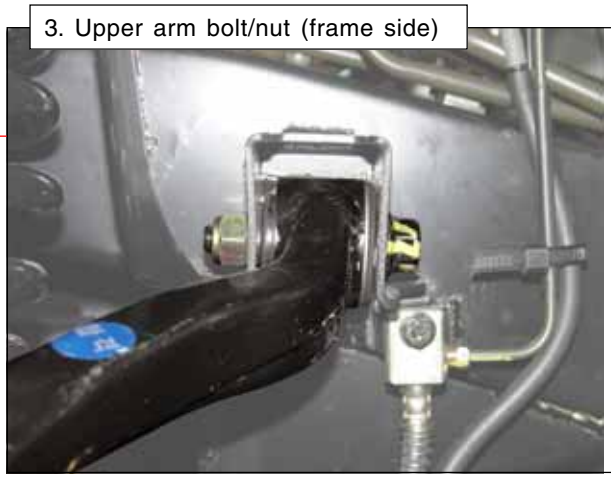
: Remove the cotter pin first and then remove the castle nut.

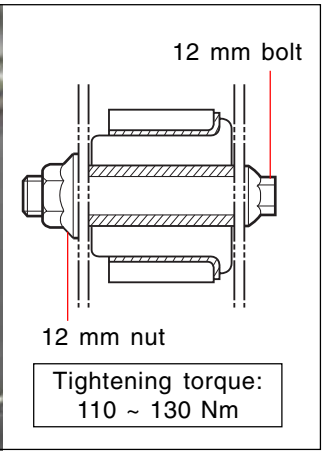
NOTICE

- **Replace the cotter pin with new one when installing.**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Upper arm bolt/nut (frame side)

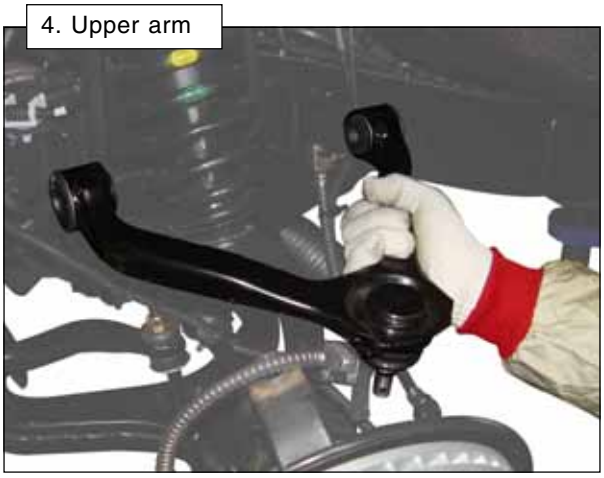




: Remove the upper arm mounting bolts and nuts (LH/RH) from the frame.

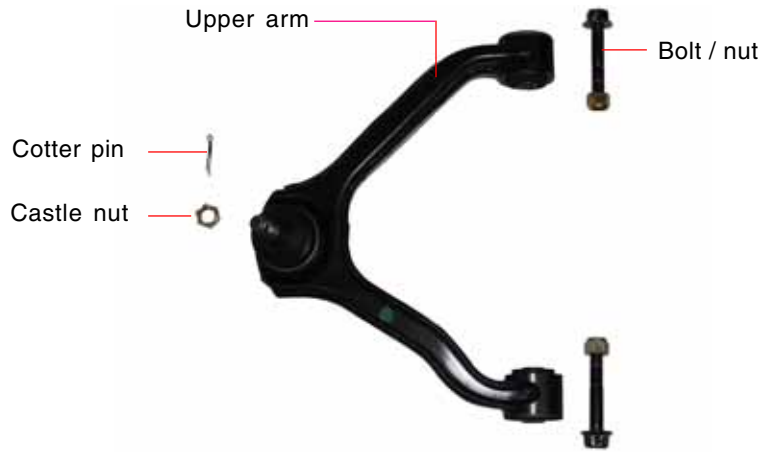


4. Upper arm



: Separate the upper arm from the frame first, and then separate it from the knuckle with a special tool.

Upper Arm Assembly

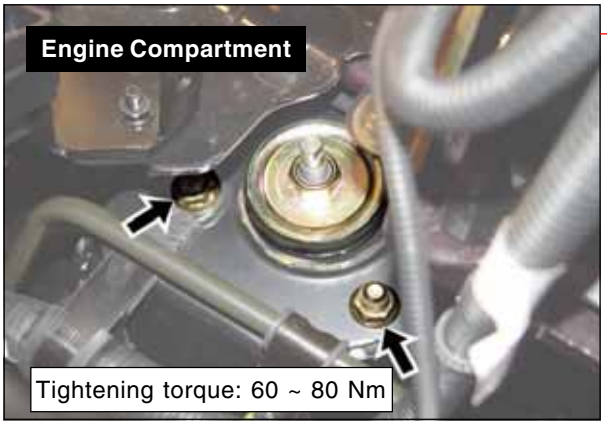


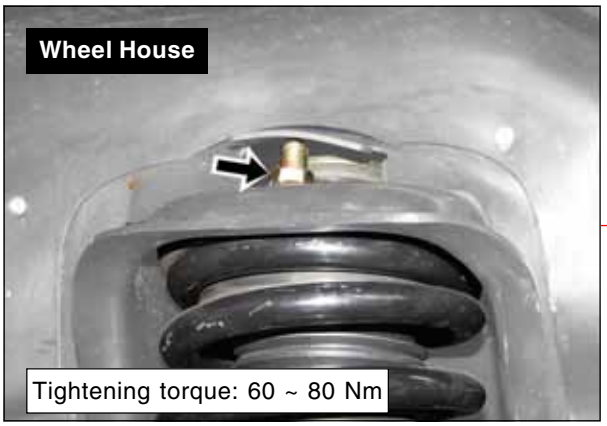
4. COIL SPRING & SHOCK ABSORBER ASSEMBLY

Preceding Work

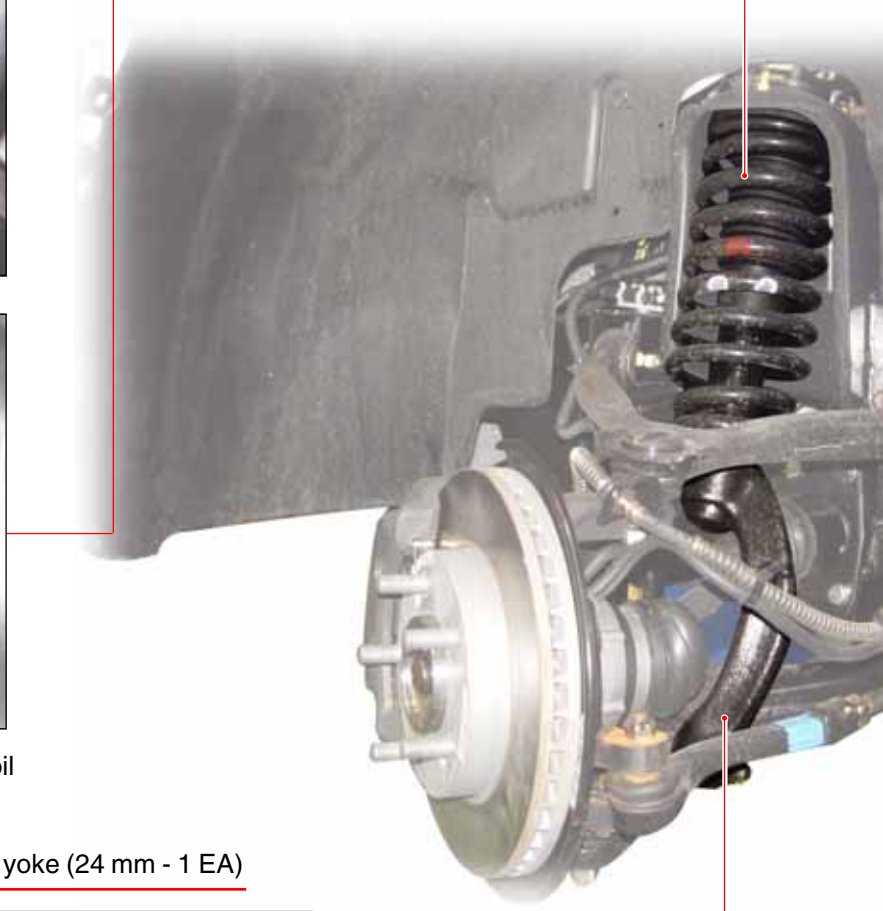
Remove the tire and the upper arm.

1. The upper mounting nuts of the coil spring/shock absorber assembly (14 mm - 3 EA)
   : At first, unscrew the two upper mounting nuts in engine compartment.



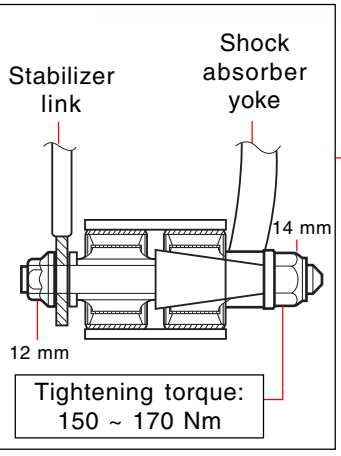


: Unscrew the upper mounting nut (14 mm) of the coil spring shock absorber in wheel house cover.



2. The lower nut of the coil spring/shock absorber yoke (24 mm - 1 EA)





: Unscrew the lower nut of coil spring/shock absorber yoke from the lower arm. Do not completely remove the nut.

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AFFECTED VIN	

3. Remove the coil spring/shock absorber.

   : Unscrew all the mounting nuts on the coil spring/shock absorber and separate the coil spring/shock absorber.





Coil Spring Assembly

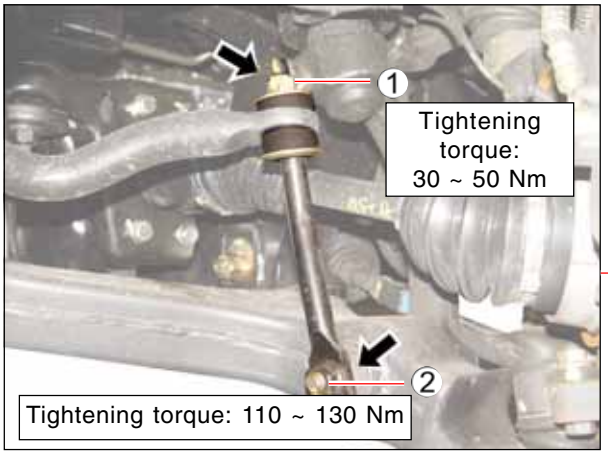


5. STABILIZER BAR

Preceding Work

Remove the tires.

1. Remove the stabilizer bar link.

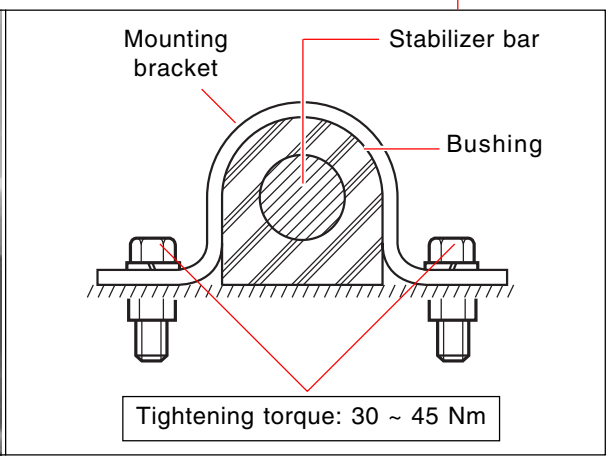




: Unscrew the lower mounting nut ② (12 mm) and upper mounting nut ① (10 mm) to remove the stabilizer bar link assembly.

2. Unscrew two bracket mounting bolts (14 mm) and remove the stabilizer bar assembly.

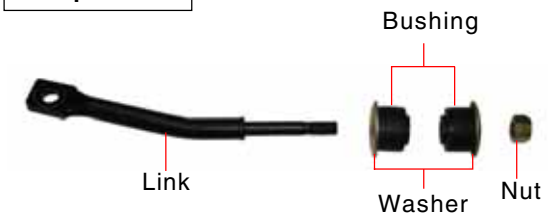


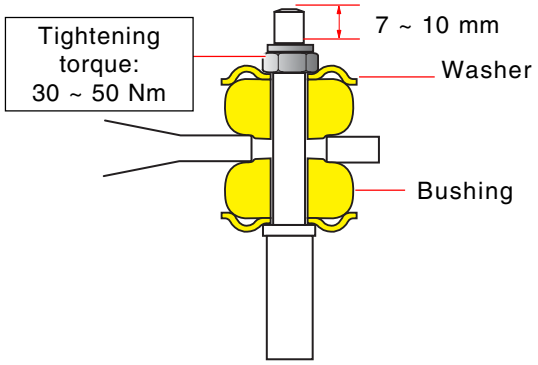


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EFFECTIVE DATE	
AFFECTED VIN	



Components

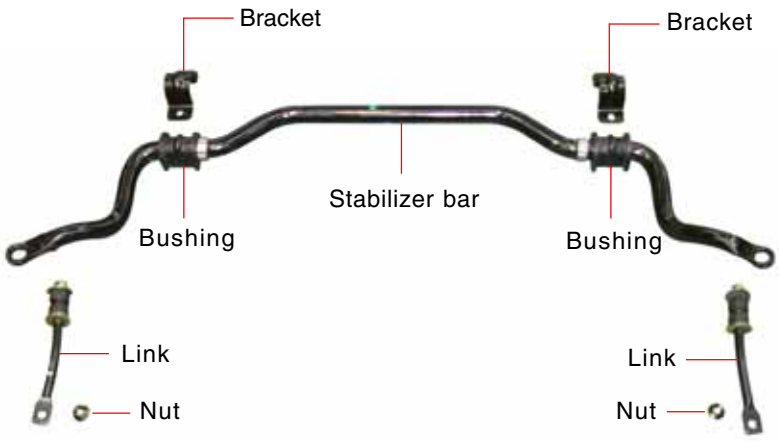




NOTICE

1. **Be cautious of the direction of the bushing and washer when installing.**
2. **Be cautious of the marks on the front stabilizer bar (LH/RH) when installing.**
   LH: yellow mark
   RH: white mark

Stabilizer Bar Assembly



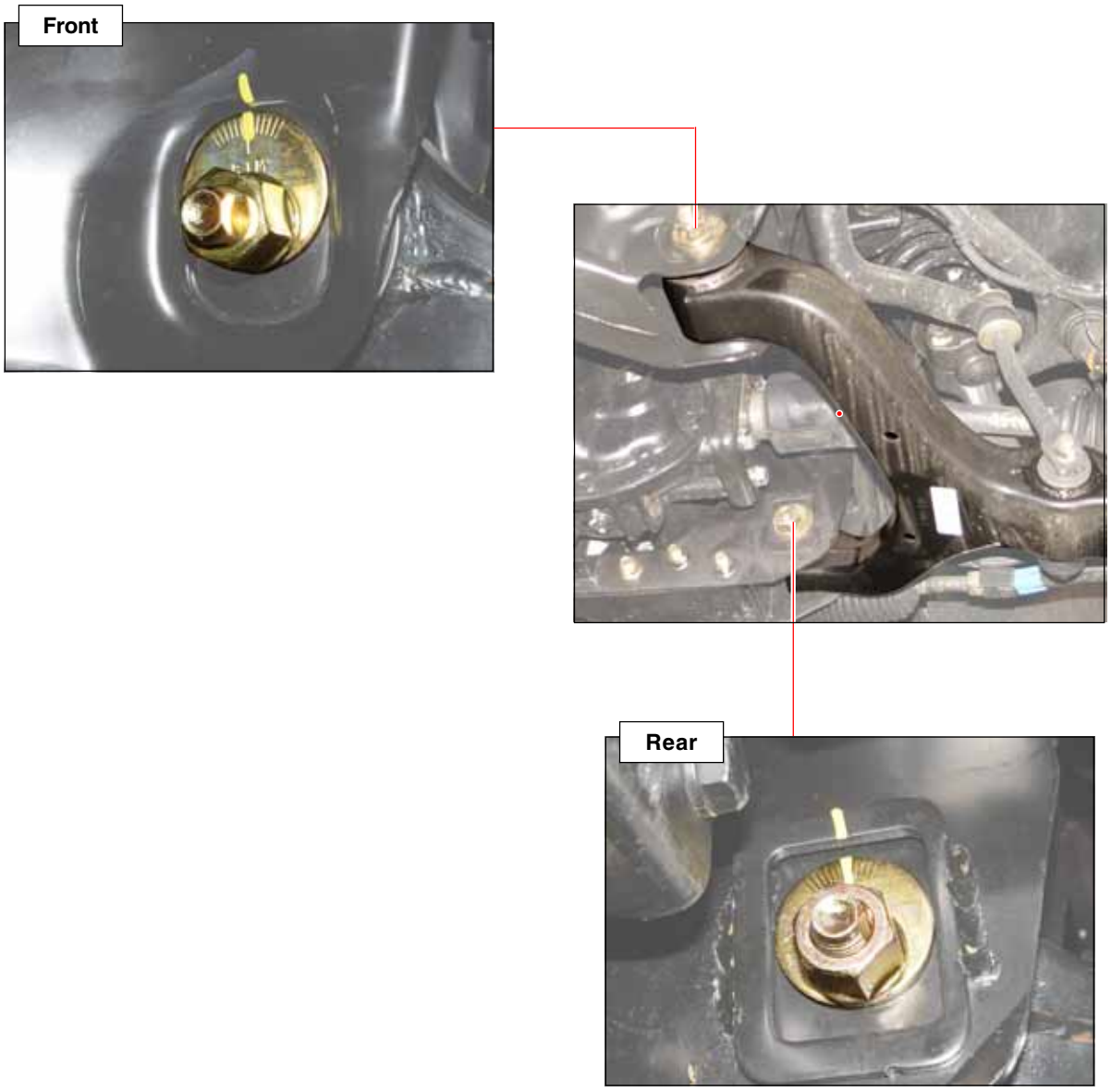
6. LOWER ARM

※ **Preceding Works:**

1. Remove the tires.
2. Make an alignment mark on the camber adjusting bolt of lower arm (frame side).

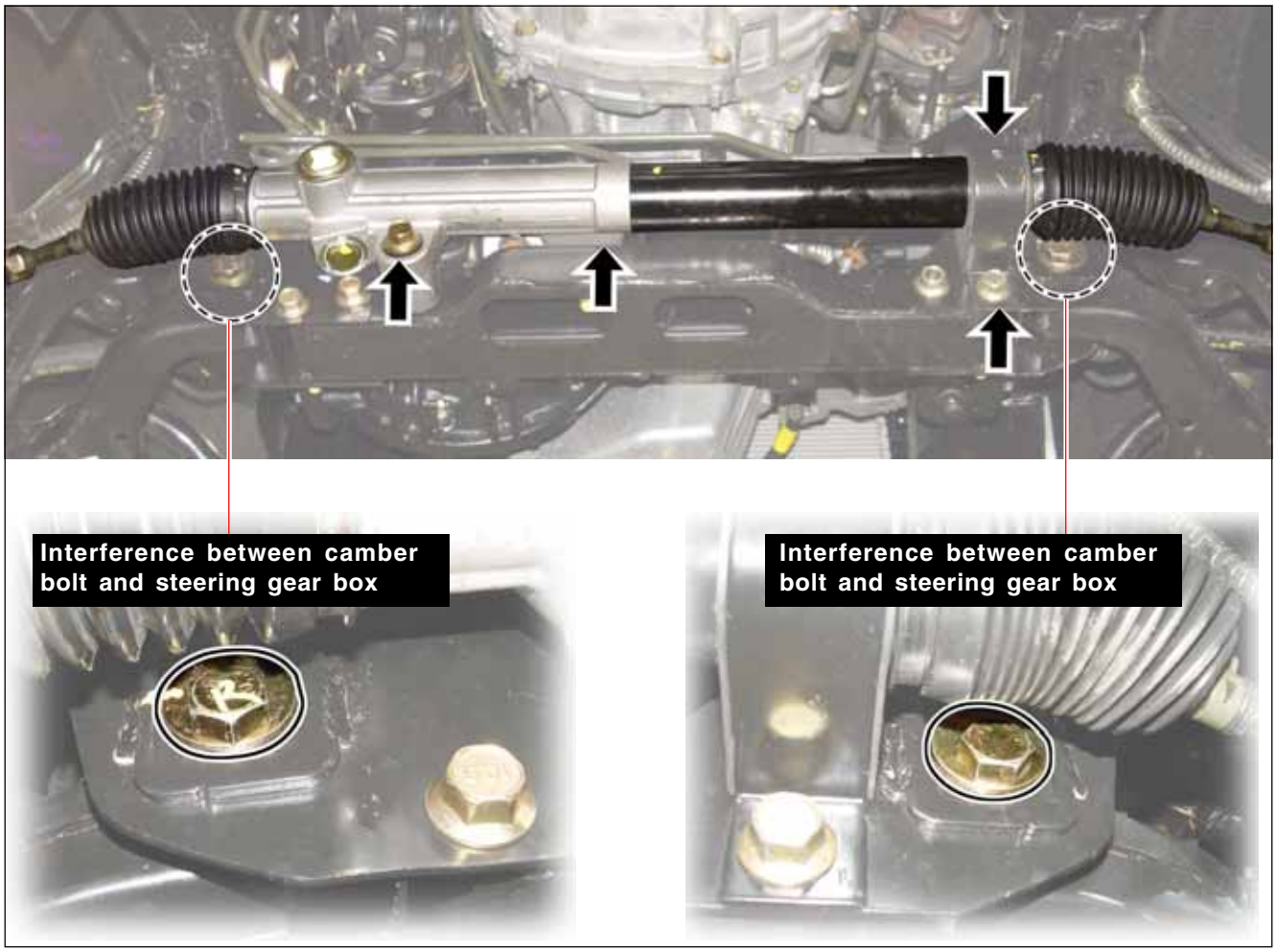
Wheel Alignment

Description	Specification
Toe-in	2 ± 2 mm [0 ~ 4]
Camber	-0.19° ± 0.3° (the difference between both ends is should be below 0.5°)
Caster	4.4° ± 0.5° (the difference between both ends is should be below 0.5°)



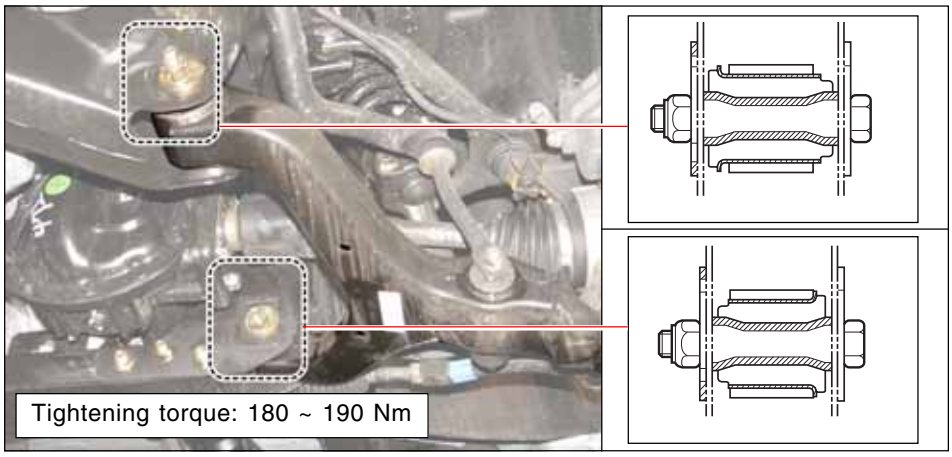
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3. Loosen the steering gear box by unscrewing the steering gear box mounting bolts (arrows) and remove the camber adjusting bolts.



Removal and Installation

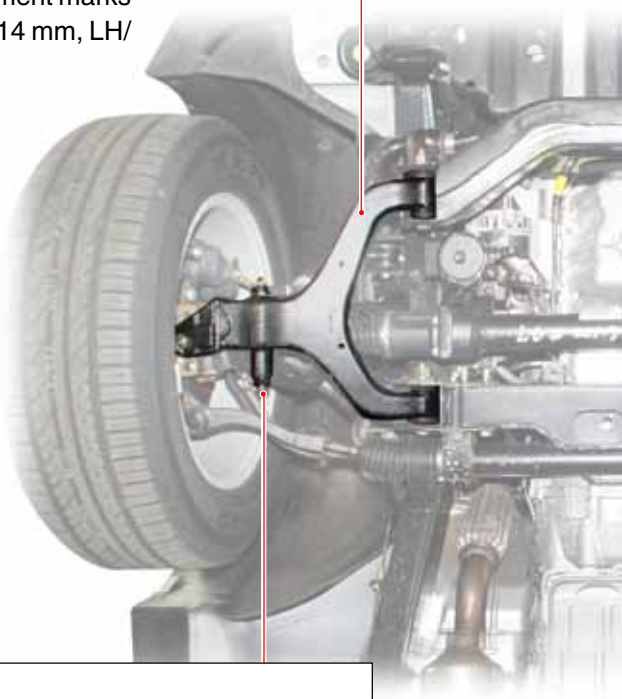
1. The lower arm mounting bolts/nuts on the frame (LH/RH)



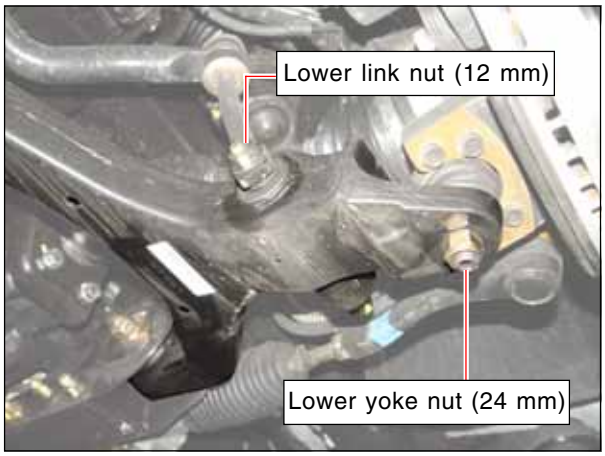
: Before removing nuts and bolts of lower arm assembly, make the alignment marks on the mounting nuts (14 mm, LH/RH) and the camber adjusting bolts (14 mm, LH/RH).

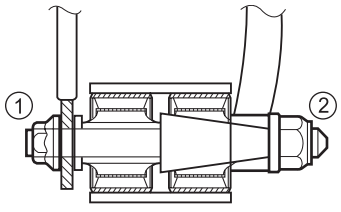
NOTE

- **Always perform the wheel alignment procedures after removing and reinstalling the lower arm assembly.**



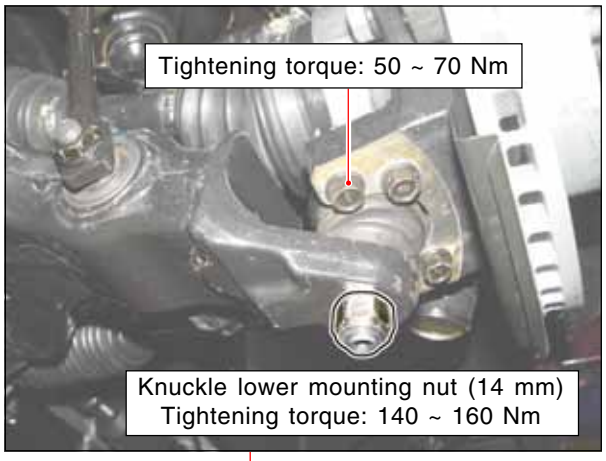
2. Unscrew the lower nut of stabilizer bar link and the lower nut of coil spring/shock absorber yoke.





Tightening torque
1. Lower link nut (110 ~ 130 Nm)
2. Lower shock absorber yoke nut (150 ~ 170 Nm)

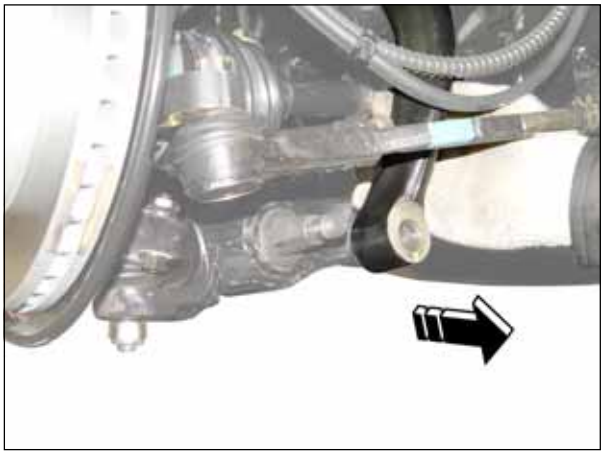
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EFFECTIVE DATE	
AFFECTED VIN	



3. Unscrew the lower mounting nut (14 mm) and remove the lower arm from knuckle end bolt with special tool.



4. Place a safety jack under the lower arm and unscrew the lower shock absorber yoke bolt. Remove the yoke while raising the lower arm with the safey jack.



5. Remove the lower arm assembly from the body.

Components



REAR SUSPENSION (5-LINK TYPE)

1. OVERVIEW

The rear suspension is to keep the ride comforts and drivability as the front suspension and this vehicle uses 5-link suspension system. It consists of coil springs on both sides, shock absorber, upper and lower arm, lateral rod and stabilizer bar.

1. Stabilizer Bar:

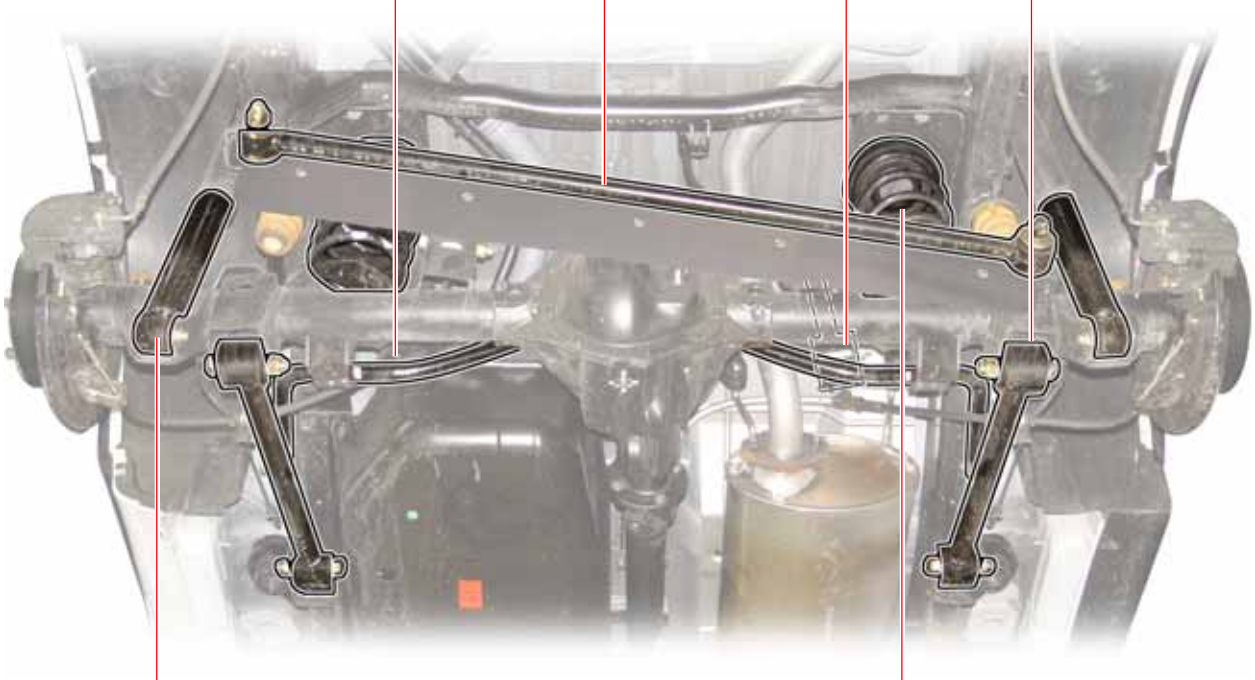
It maintains the balance of the vehicle when turning, and minimizes the vehicle's slope when the wheels are moving up and down separately to maintain the vehicle's stability.

2. Lateral Rod:

It compensates the transverse load to the vehicle.

3. Upper/Lower Arm:

It compensates the longitudinal load to the vehicle.



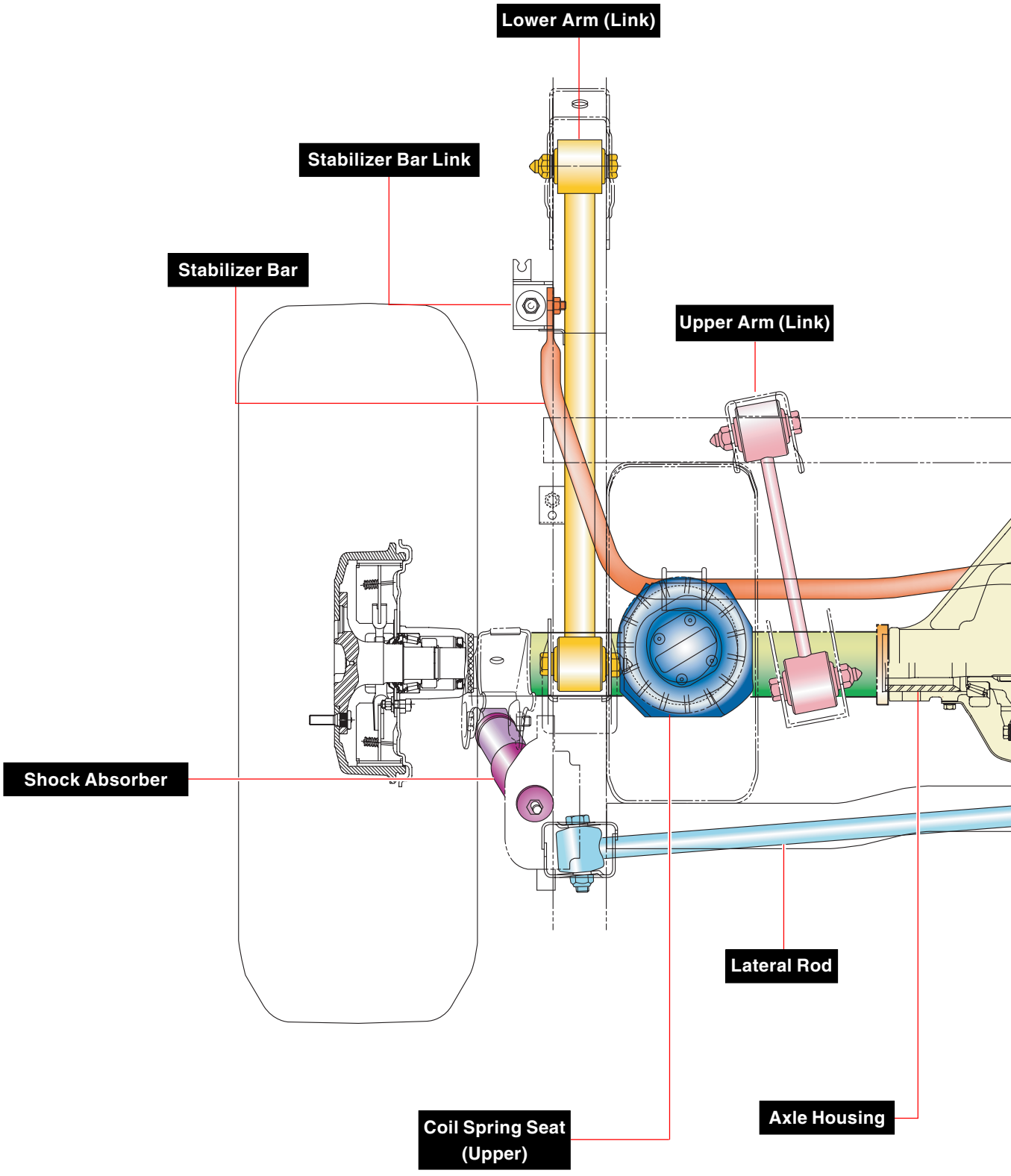
4. Shock Absorber:

It absorbs the vertical vibration of the vehicle body. It enhances the ride comforts and prevents the fatigue break of the spring.

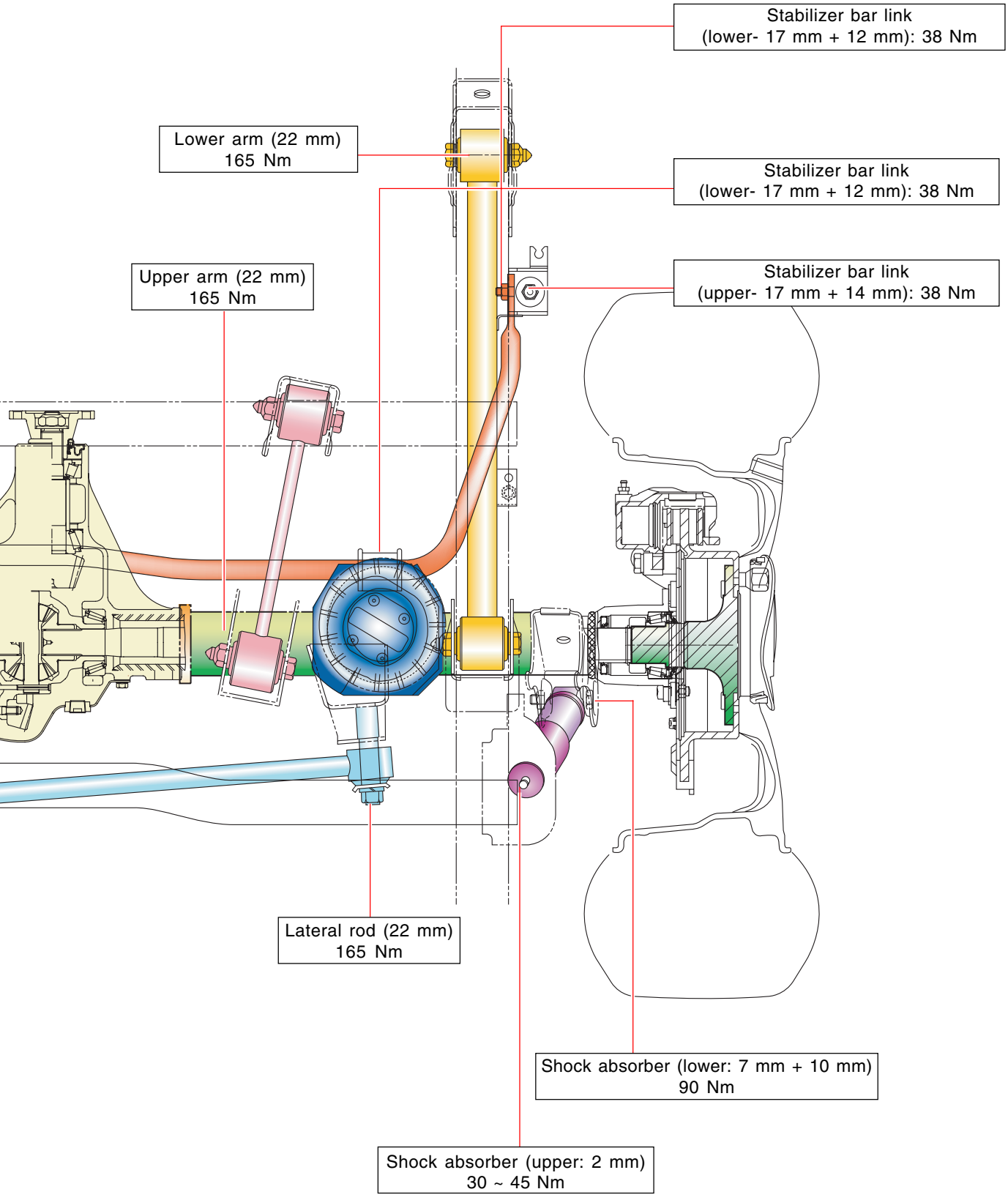
5. Coil Spring:

It is installed between the rear axle and body frame. It relieves the vibrations and impacts delivered from wheels to vehicle body.

2. SYSTEM LAYOUT



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	


Stabilizer bar link
(lower- 17 mm + 12 mm): 38 Nm
Lower arm (22 mm)
165 Nm
Stabilizer bar link
(lower- 17 mm + 12 mm): 38 Nm
Upper arm (22 mm)
165 Nm
Stabilizer bar link
(upper- 17 mm + 14 mm): 38 Nm
Lateral rod (22 mm)
165 Nm
Shock absorber (lower: 7 mm + 10 mm)
90 Nm
Shock absorber (upper: 2 mm)
30 ~ 45 Nm

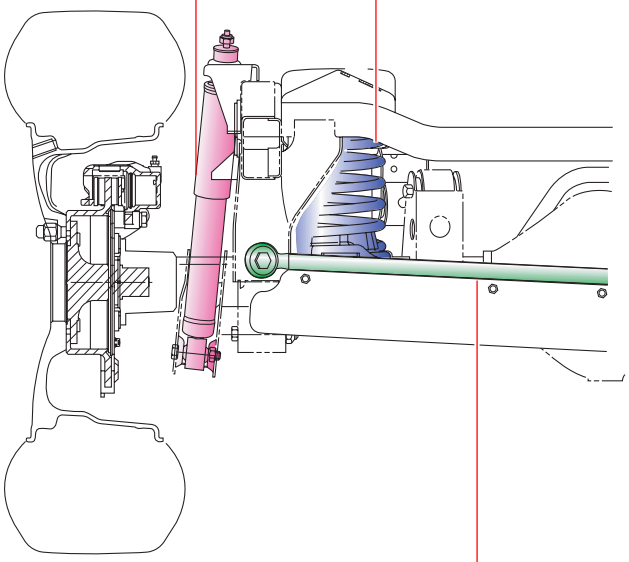
Location

Shock Absorber Assembly



Coil Spring Assembly





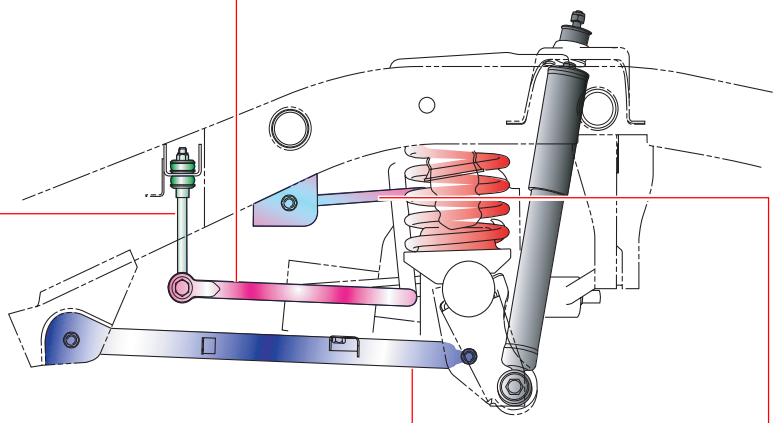
Lateral Rod Assembly



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Stabilizer Assembly





Stabilizer Bar Link



Upper/Lower Arm Assembly



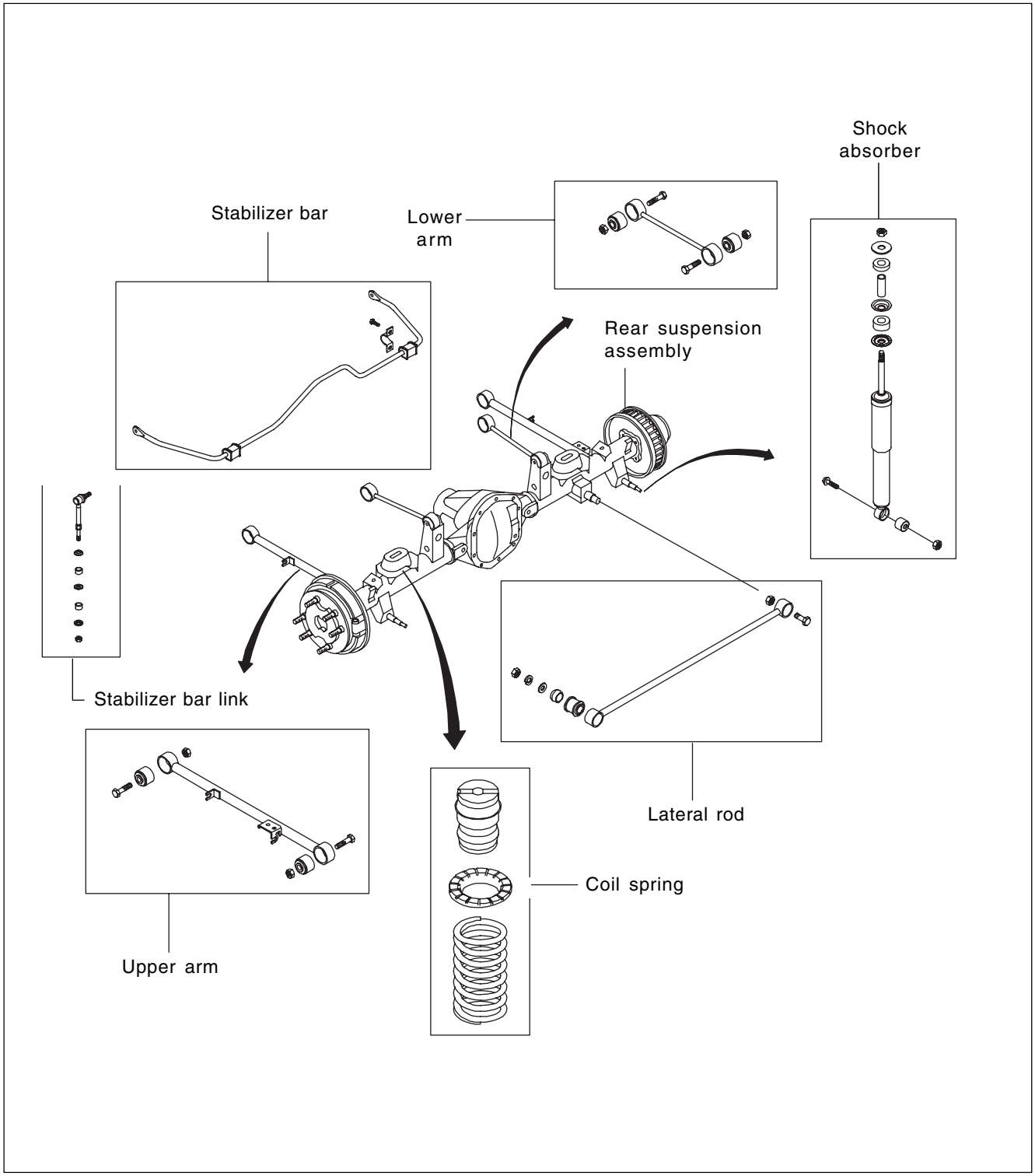
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EFFECTIVE DATE	
AFFECTED VIN	

3. TROUBLE DIAGNOSIS

Symptom	Cause	Action
Vehicle rolling	Broken stabilizer bar	Replace
	Faulty shock absorber	Replace
Abnormal noise	Loosened mountings	Re-tighten
	Damaged or worn wheel bearing	Replace
	Damaged shock absorber	Replace
	Damaged tire	Replace
Poor riding comfort	Over inflated tire	Adjust pressure
	Faulty shock absorber	Replace
	Loosened wheel nut	Tighten to specified torque
	Bent or broken coil spring	Replace
	Damaged tire	Replace
	Worn bushing	Replace
Vehicle pulls to right or left	Deformed arm assembly	Replace
	Worn bushing	Replace
	Bent or broken coil spring	Replace
Hard steering	Excessive resistance of lower arm ball joint	Replace
	Insufficient tire pressure	Replace
	Faulty power steering	Adjust
Steering instability	Worn or loosened lower arm bushing	Re-tighten or replace
Vehicle bottoming	Worn or broken coil spring	Replace

4. REMOVAL AND INSTALLATION

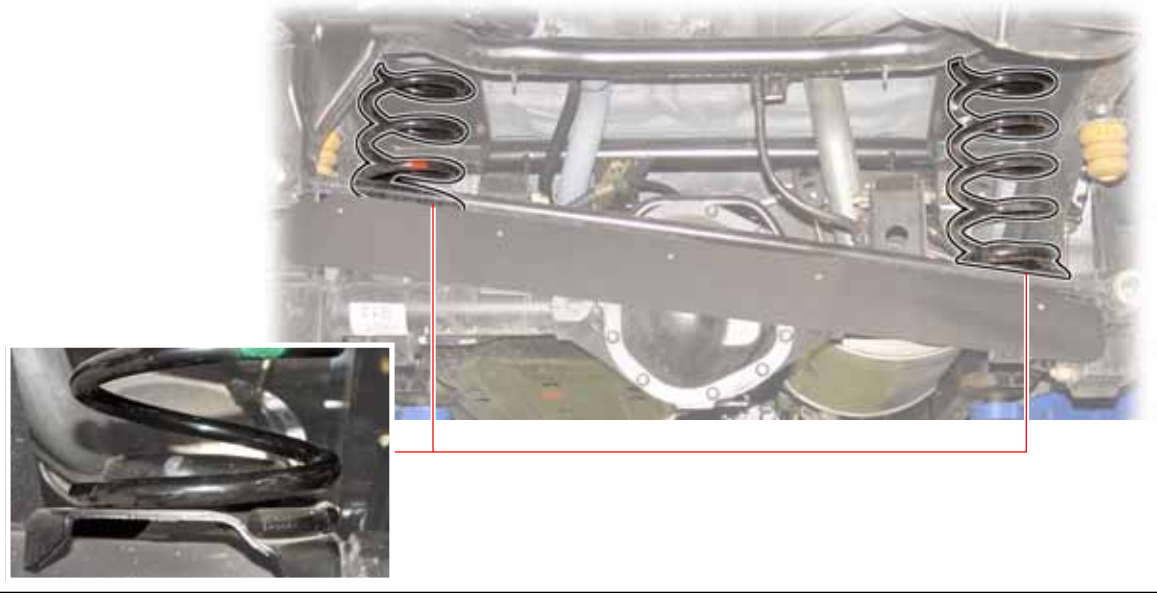
▶ System Layout



Removal of Components

Remove the rear suspension components in order.

1. Remove the coil spring using a special tool (Be careful of the installation direction).



2. Remove the lateral rod.

1) Unscrew the lateral rod mounting nut (22 mm) on axle.

Installation Notice

Tightening torque	150 ~200 Nm







2) Unscrew the lateral rod mounting bolt/nut (22 mm) on frame.

Installation Notice

Tightening torque	150 ~ 180 Nm

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Disconnect the link and the bracket from the stabilizer bar to remove the stabilizer bar.

1) Unscrew the stabilizer bar link mounting nuts (upper/lower) and remove the link.

Installation Notice

Tightening torque	38 Nm
Protrusion of upper bolt	7 ~ 12 mm



2) Remove the mounting cap bracket and bushing from the stabilizer bar (LH/RH).

Installation Notice

Tightening torque	30 ~ 45 Nm



4. Remove the shock absorber between the frame and the axle.



1) Remove the upper mounting nut (17 mm) and the shock absorber bolt (6 mm) as shown in the figure.

Installation Notice

Tightening torque	30 ~ 45 Nm
Protrusion of upper bolt	6 ~ 9 mm



2) Remove the lower bolt/nut (17 mm).

Installation Notice

Tightening torque	80 ~ 100 Nm



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. Remove the upper arm from frame and axle.



A. Unscrew upper arm mounting bolt/nut (22 mm) on axle.



Tightening torque	150 ~ 180 Nm

B. Unscrew upper arm mounting bolt/nut (22 mm) on frame.



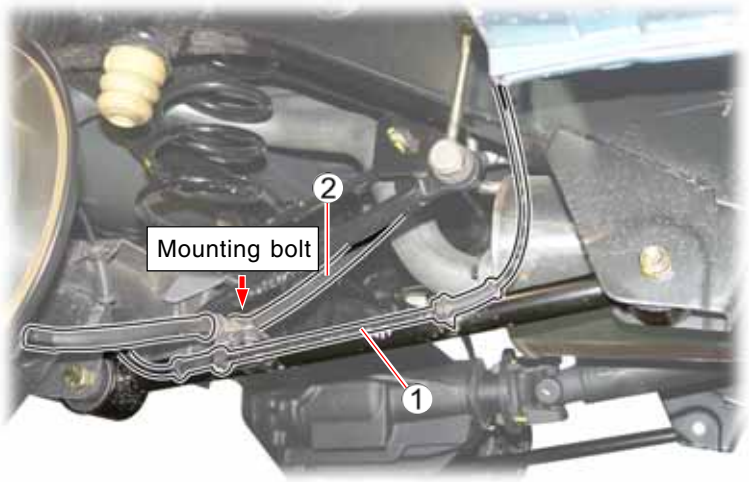
Tightening torque	150 ~ 180 Nm

NOTICE

- **The fuel tank should be removed before removing the rear left bolts (upper arm and lower arm).**

6. Remove the lower arm from the frame and the axle.

1) Remove the wheel speed sensor cable (1) and the parking cable (2) mounting bolt (12 mm) when removing the lower arm.



2) Unscrew lower arm mounting bolt/nut (22 mm) on frame.

Installation Notice

Tightening torque	150 ~ 180 Nm



3) Unscrew lower arm mounting bolt/nut (22 mm) on axle.

Installation Notice

Tightening torque	150 ~ 180 Nm



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

POWER STEERING SYSTEM

4610

TABLE OF CONTENTS

GENERAL INFORMATION 3

1. Overview 3
2. System layout 4
3. Inspection and Service 8
4. Removal and Installation 12

GENERAL INFORMATION

1. OVERVIEW

When a driver turns the steering wheel, the front wheels are steered and the vehicle moves to the desired direction. However, there is a certain limitation to increase the steering efficiency only with the mechanical methods. A steering system using hydraulic pressure has been introduced to decrease the driver's steering effort while using the normal gear ratio.

The power steering system consists of pump, oil reservoir, rack and gear box.

The power steering pump is a vane type and delivers hydraulic pressure to operate the power steering system. The pressure relief valve in the pump controls the discharging pressure.

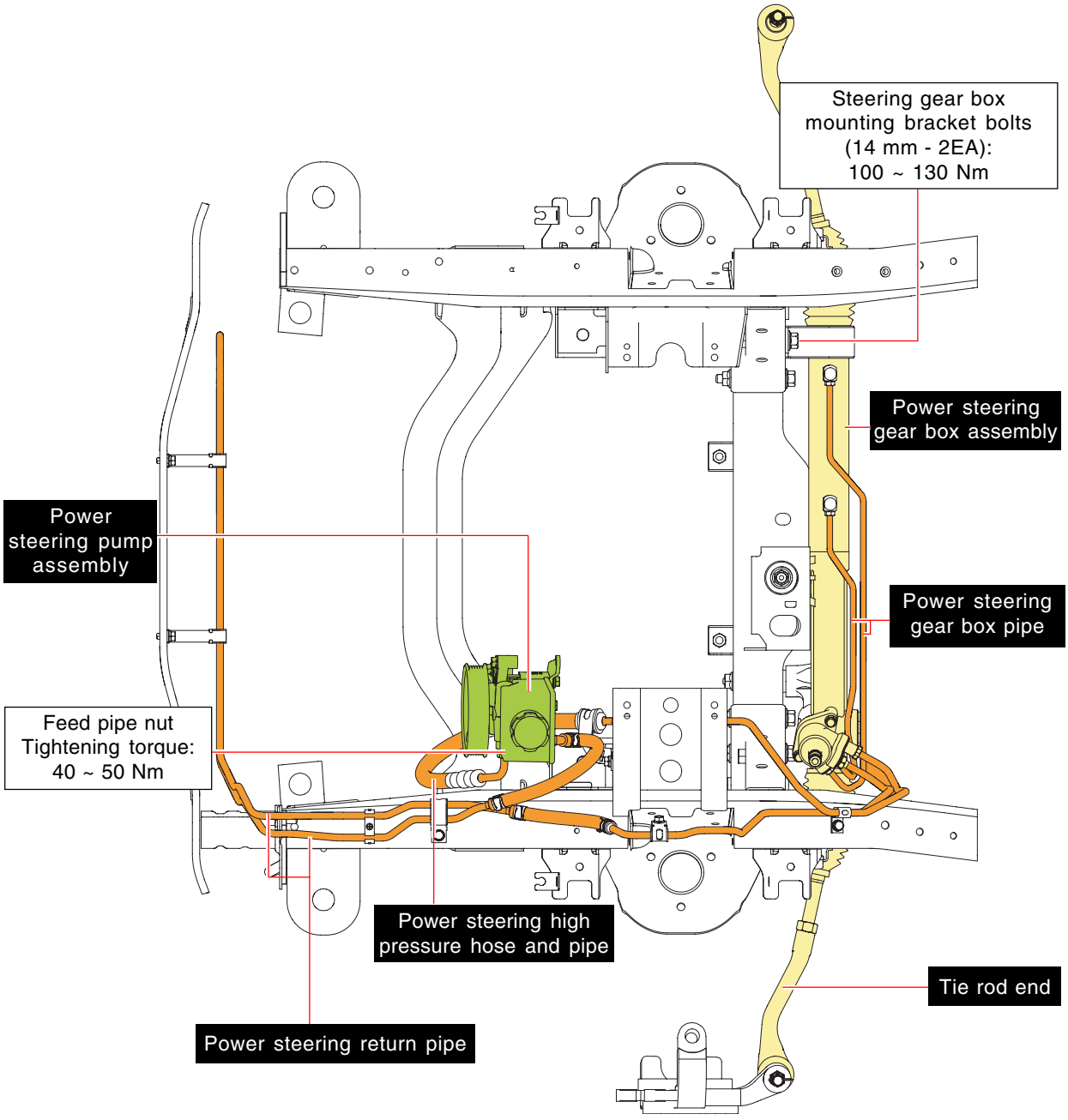
The rotary control valve in the rack and pinion gear directs the oil from the power steering pump to one side of the rack piston. The integrated rack piston converts the hydraulic pressure to linear movement. The operating force of the rack moves the wheels through the tie rod, the tie rod end and the steering knuckle. Even though the hydraulic pressure cannot be generated, a driver can steer the vehicle without power assist but it needs very high steering force.

In this case, the operating force of the steering wheel is conveyed to the pinion, and the movement of the pinion moves the rack through the pinion gear combined to the rack gear.

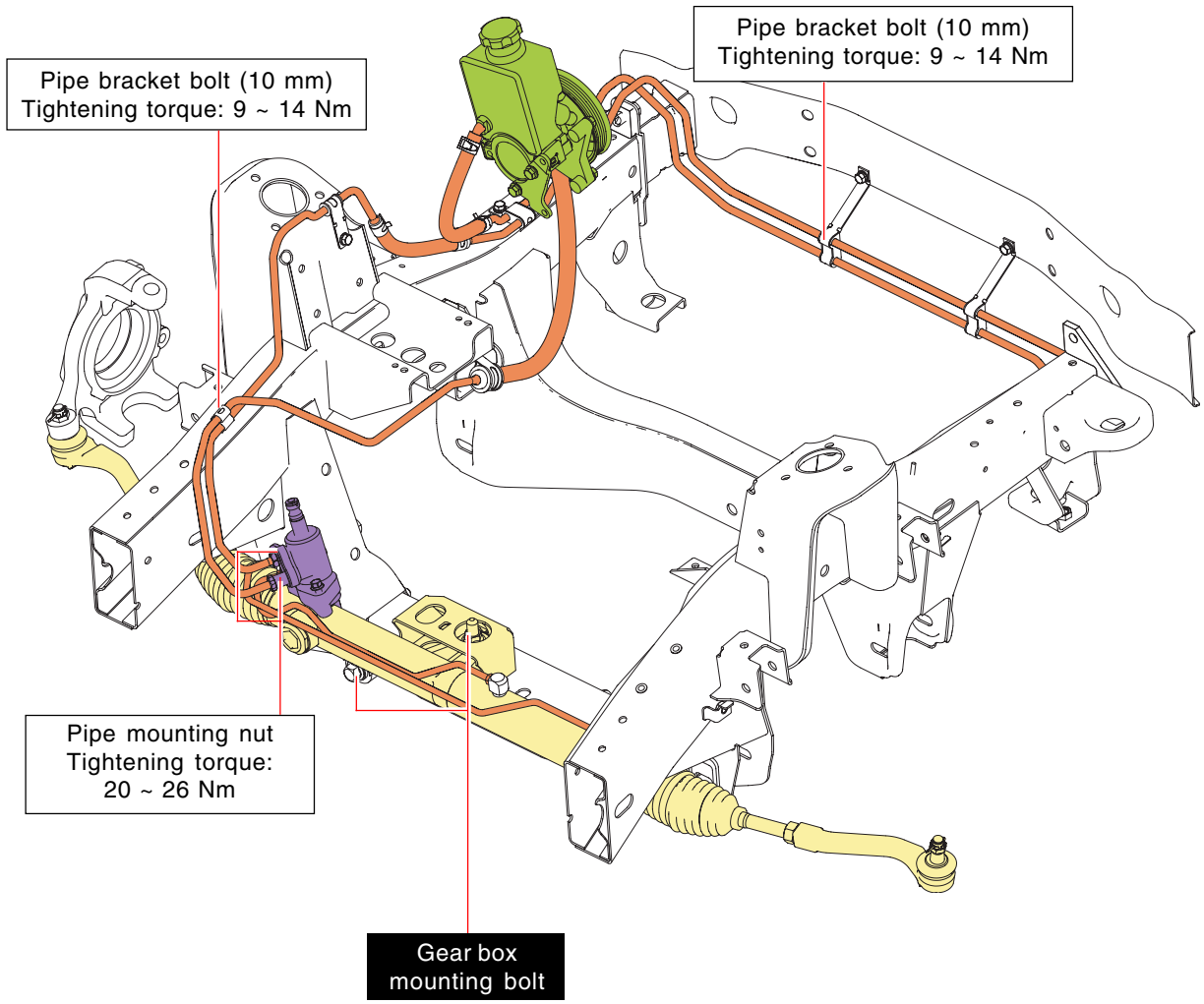
Specifications

Description			Specification
Steering wheel	Type		4-spoke type
	Outer diameter (mm)		390
Steering gear box	Type		Rack and pinion
	Gear ratio		∞
	Steering angle	Inner	36.2°
		Outer	32.4°
Oil pump	Type		Vane type
	Maximum pressure (kgf/cm^2)		88.2 ~ 95.3
	Displacement (cm^3/rev)		11.3
	Pulley size (mm)		124
Tilt column adjusting angle	Up		4°
	Down		8°
Minimum turning radius (m)			5.7
Oil	Specification		ATF Dexron II
	Capacity (ℓ)		1.1

2. SYSTEM LAYOUT

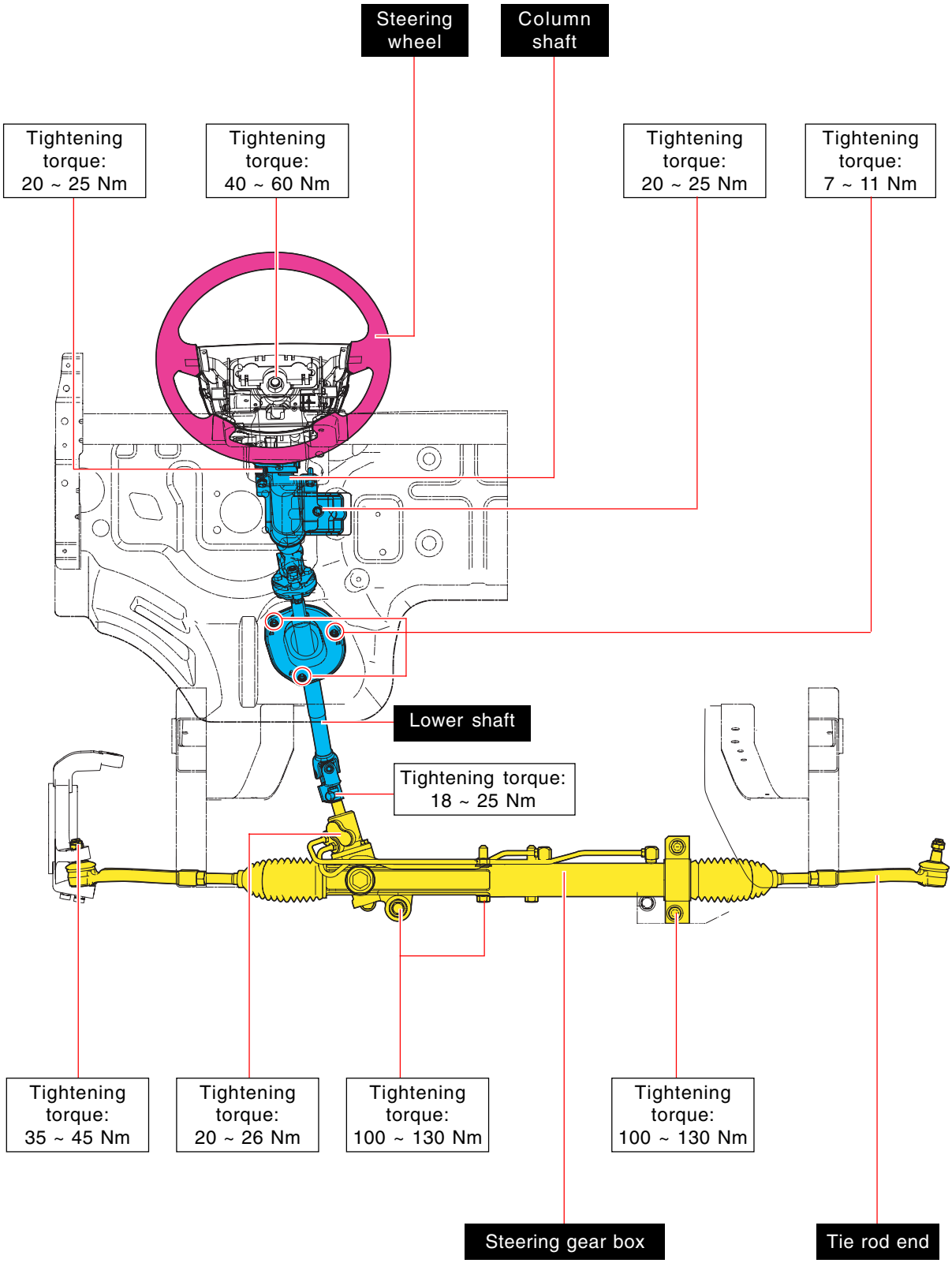


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AFFECTED VIN	

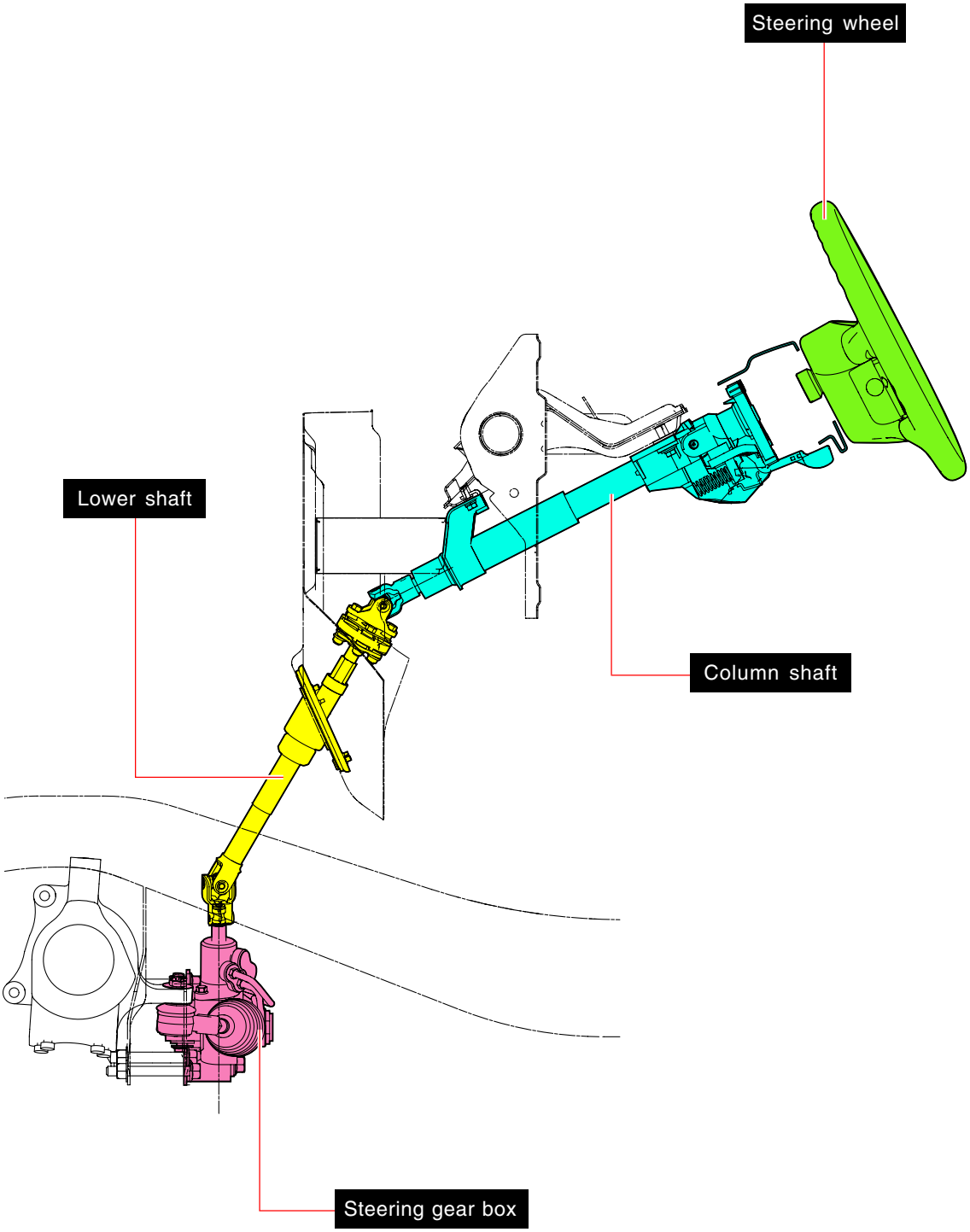


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EFFECTIVE DATE	
AFFECTED VIN	

▶ Components



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AFFECTED VIN	


Steering wheel
Lower shaft
Column shaft
Steering gear box

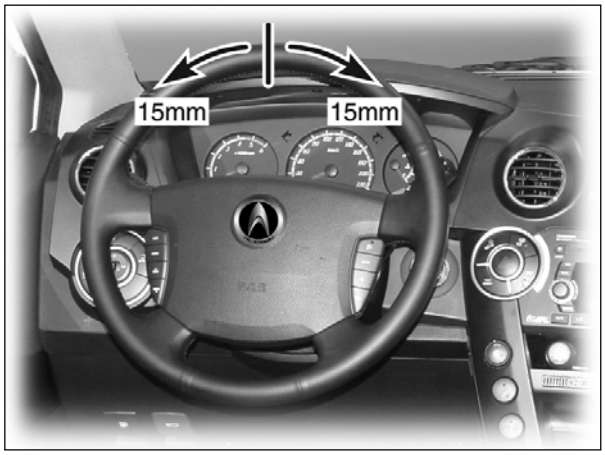
3. TROUBLE DIAGNOSIS

Symptom	Cause	Action
Hard steering	Lack of lubrication, Abnormal wear or binding of steering ball joint due to intrusion of foreign material	Lubricate or replace
	Damaged or faulty steering gear	Replace gear assembly
	Improper preload of steering pinion	Adjust
	Faulty steering shaft joint	Replace
	Steering fluid leaks	Repair or replace
	Lack of fluid or air-in system	Replenish or bleed
	Faulty steering oil pump	Replace
	Damaged or loosened pump drive belt	Adjust or replace
	Clogging oil line	Repair or replace
	Damaged wheel or tire	Repair or replace
	Faulty suspension system	Repair or replace
Steering pulls to one side	Damaged steering linkage	Replace
	Damaged wheel or tire	Repair or replace
	Faulty brake system	Repair or replace
	Faulty suspension system	Repair or replace
Excessive wheel play	Worn steering gear	Replace gear assembly
	Worn or damaged steering ball joint	Replace
	Loosened steering gearbox mounting bolts	Retighten
Poor return of steering wheel	Damaged or binding steering ball joint	Replace
	Improper preload of steering pinion	Replace gear assembly
	Damaged wheel or tire	Repair or replace
	Faulty suspension system	Repair or replace
Steering wheel shimmy	Damaged steering linkage	Replace
	Loosened steering gearbox mounting bolt	Retighten
	Damaged or binding steering ball joint	Replace
	Worn or damaged front wheel bearing	Replace
	Damaged wheel or tire	Repair or replace
	Faulty suspension system	Repair or replace
Abnormal noise from steering system	Loosened steering gearbox mounting bolt	Retighten
	Faulty steering gear	Replace gear assembly
	Steering column interference	Repair
	Loosened steering linkage	Retighten
	Damaged or loosened oil pump drive belt	Adjust or replace
	Loosened oil pump bracket	Retighten
	Loosened oil pump mounting bolt	Retighten
	Air-in system	Bleed
	Faulty oil pump	Replace

Power Steering Wheel Free Play Check

1. Start the engine and place the wheels at straight ahead direction.
2. Turn the steering wheel until the tires starts to move and measure the distance on the circumference (free play) of the steering wheel.

Specified value	30 mm



NOTICE

- **If the free play is out of the specified value, check the free play in steering column shaft connection and steering linkage. Replace or repair if necessary.**

Steering Effort Check

1. Park the vehicle on a paved and flat ground and place the front wheels at straight ahead direction.
2. Start the engine and let it run around 1,000 rpm.
3. Install the spring scale on the circumference of the steering wheel and measure the steering effort in both directions.

Steering effort	below 3.0 kg



NOTICE

- **The difference between both sides should be within 0.6 kg.**

Steering Angle Check

1. Place the front wheel on a turning radius measuring tool.
2. Turn the steering wheel to the its both ends and measure the maximum steering angle.

Specified value	Inner	36° 20′
	Outer	32° 40′



NOTICE

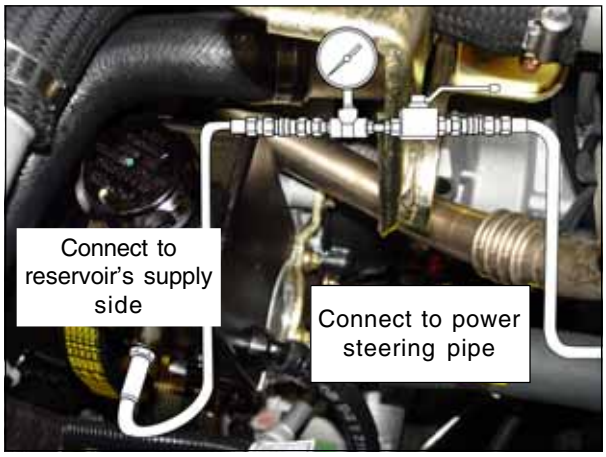
- **If the free play is out of the specified value, check and adjust the toe-in.**

Oil Pump Pressure and Oil Level Check

Oil Pump Pressure

Check the oil pump pressure to locate any defect in oil pump.

1. Unscrew the pressure line fitting in power steering pump.
2. Install the pressure gauge between the power steering pump and the power steering oil pressure line.
3. Place the shift lever to neutral position.
4. Apply the parking brake.
5. Fully open the valve in pressure gauge.
6. Start the engine and let it run at idle speed.
7. Turn the steering wheel several times so that the oil temperature reaches to normal operating level (oil temperature: 50 ~ 80°C).
8. Fully close the valve in pressure gauge and measure the oil pressure (pump relief valve pressure).



NOTICE

- **To prevent internal damage, do not close the gauge valve over 10 seconds.**

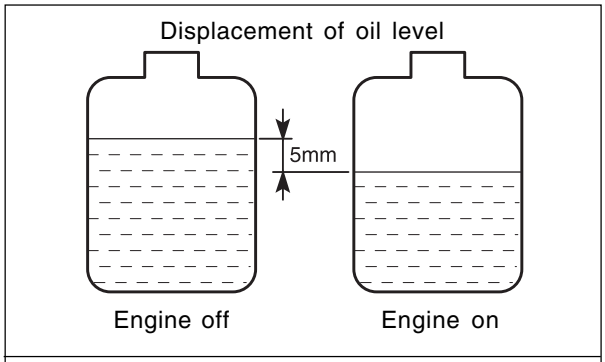
9. Measure the oil pressure with the gauge valve fully open (with no load).
10. If the pump pressure is in specified range, the pump is normal. If not, replace the power steering pump.

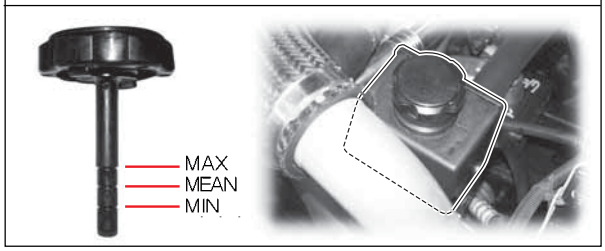
Pump relief valve pressure	89 ~ 97 kg/cm²
Pump pressure at no load	3 ~ 5 kg/cm²

Oil Level Check

The power steering oil level have to be checked by two conditions; one is checked at normal operating temperature, and the other one is checked when it is cooled.

If the difference between two measurements is below 5 mm and the level is between MAX and MIN level, it's normal. If it is over 5 mm, bleed air from the system.





Checking

1. Place the vehicle on a flat ground and start the engine and let it run at idle speed.
2. Turn the steering wheel several times so that the oil temperature reaches to normal operating level (oil temperature: 50 ~ 80°C).
3. Place the steering wheel at straight ahead direction.
4. Measure the oil level in the power steering oil reservoir.
5. Adjust the oil level between MAX and MIN.

Air Bleeding From Power Steering System



Air Bleeding

1. Lift up the vehicle with the steering wheel in straight ahead direction (No-load to tires).
2. Add the specified oil into reservoir up to the max level.
3. Turn the steering wheel to its both ends for 2 to 3 times.
4. Repeat step 3 until any bubble cannot be seen in the reservoir.
5. If any bubble is not found, add the specified oil into the reservoir to the specified level.

*** Checking ***

1. Start the engine and repeat step 2 and step 3 after bleeding.

NOTICE

- **Position the gear shift lever to "N (M/T)" or "P (A/T)", and apply the parking brake before starting the engine.**

2. This process should be performed to check if air still exists in the power steering system.

4. REMOVAL AND INSTALLATION

▶ Steering Column Shaft

※ **Preceding Work:** Disconnect the negative battery cable and place the tires to straight ahead direction.

Removal and Installation

1. Unscrew the screws at both sides of steering wheel and remove the horn pad (air bag module assembly). Disconnect the airbag module connector.

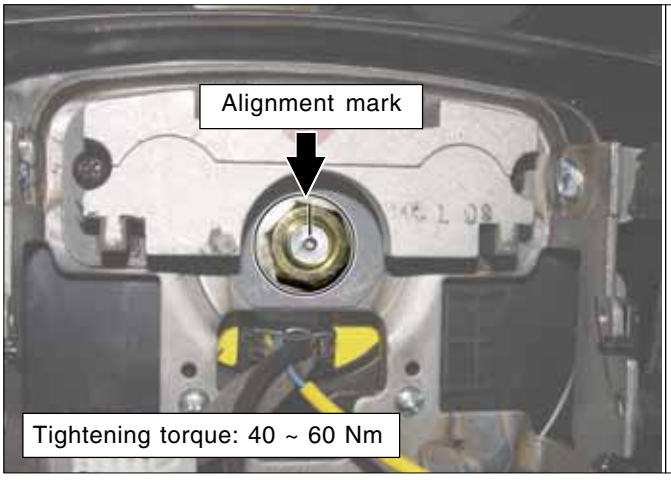




2. Unscrew the steering wheel lock nut and remove the wheel with special tool.

NOTICE

- **Make an alignment marks on the column shaft and steering wheel for correct installation.**
- **Disconnect the remote control connectors for each component (airbag and horn).**





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Remove the instrument panel side cover and unscrew the side lock bolt and screws to remove the instrument lower panel (refer to “Body” section).





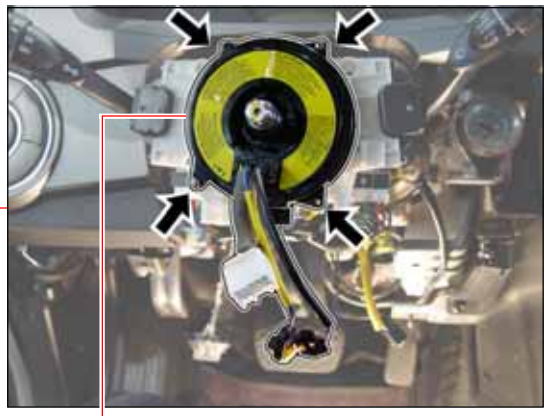
4. Remove the protective panel and lower undercover from the lower panel. Unscrew three column cover mounting bolts from the steering column shaft and remove the upper/lower column covers.





5. Disconnect the contact coil and connector from the column shaft and unscrew four contact coil mounting screws to remove the contact coil assembly.





Contact coil mounting screw



Connectors



Alignment marks

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. Disconnect the connector and unscrew the mounting screws to remove the combination switch.





Mounting screws



Connectors

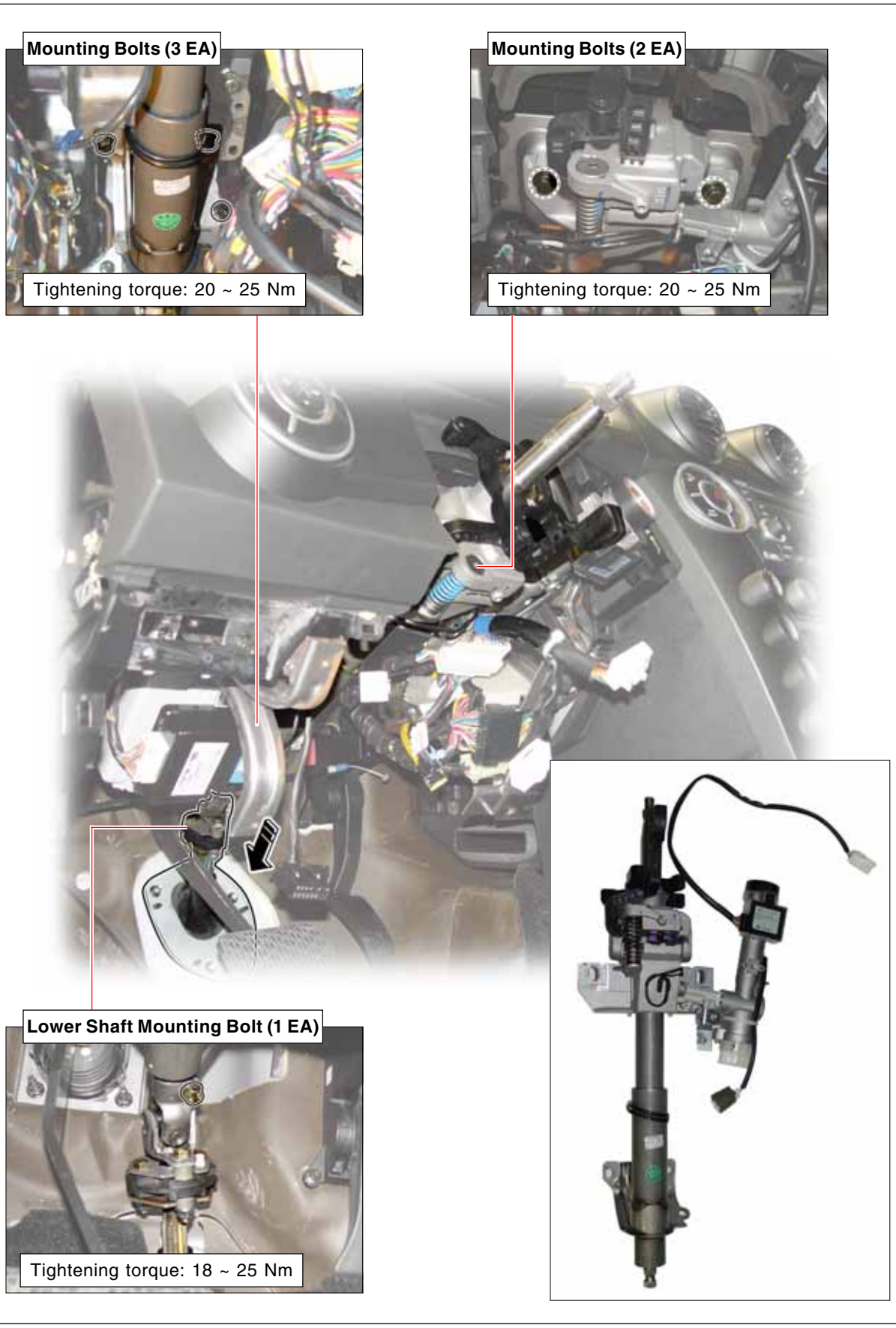
Combination Switch





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

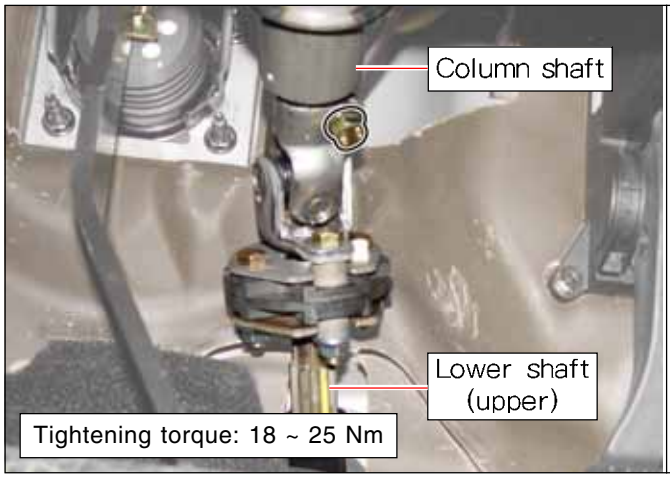
7. Unscrew the bolts and nuts and remove the steering column shaft assembly while pulling it down.

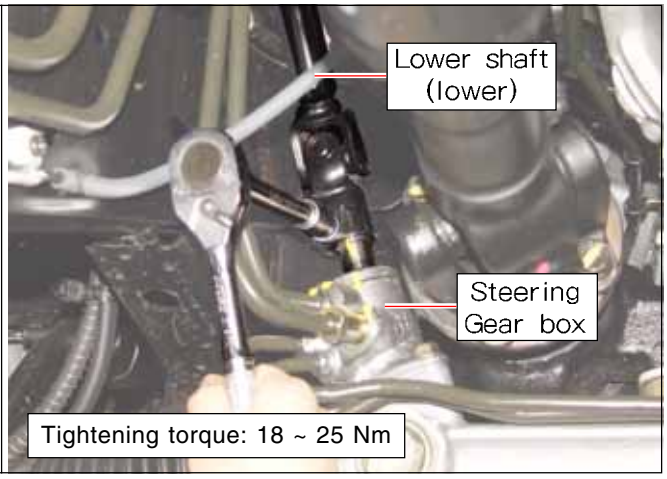


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Lower Shaft

1. Remove the upper and lower lock bolts of lower shaft inside of the vehicle.





2. Remove the lower shaft mounting nuts on the floor at driver's side.

Installation Notice

Tightening torque	7 ~ 11 Nm



3. Remove the lower shaft by pulling it up.

NOTICE

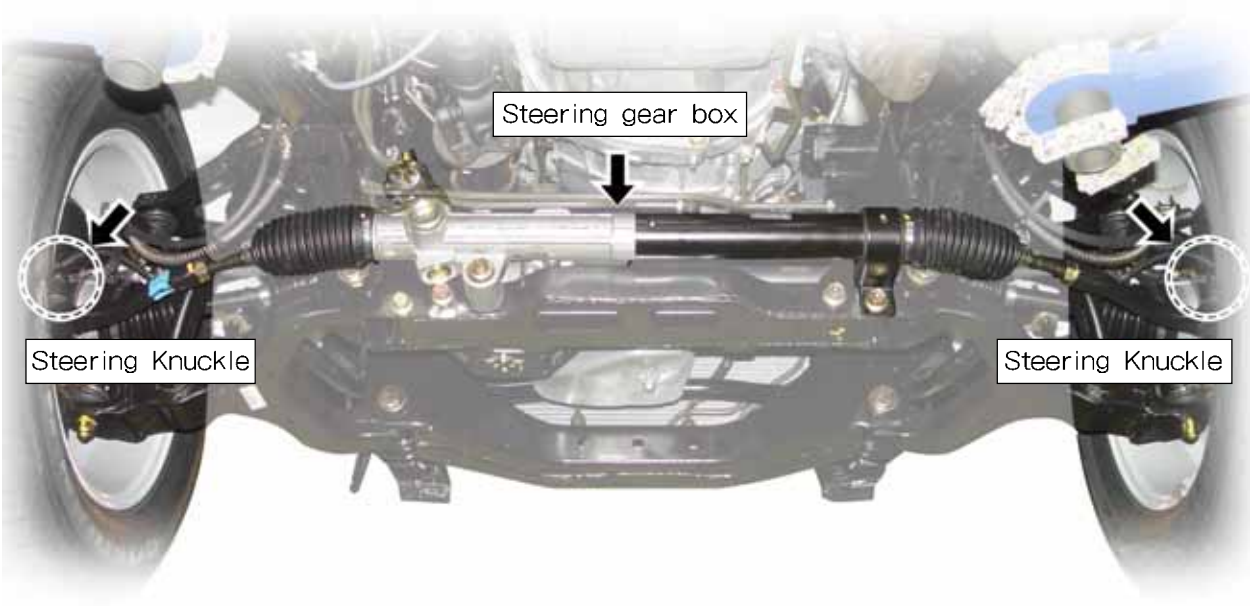
- **Install the lower shaft so that the lock bolt can be inserted into the point without spline.**
- **Be cautious of the alignment marks.**

Lower Shaft



▶ Steering Gear Box

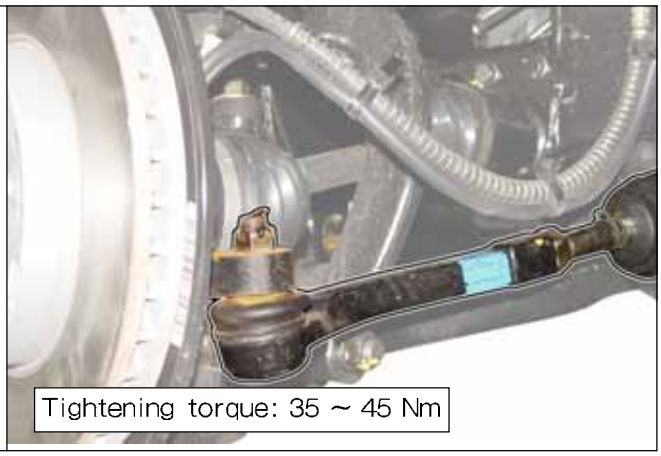
※ **Preceding Works:** 1. Disconnect the negative battery cable.
2. Remove the tire.



1. Remove the tie rod from steering knuckle. Remove the cotter pin and lock nut to remove the tie rod using a special tool.

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Ball Joint Puller





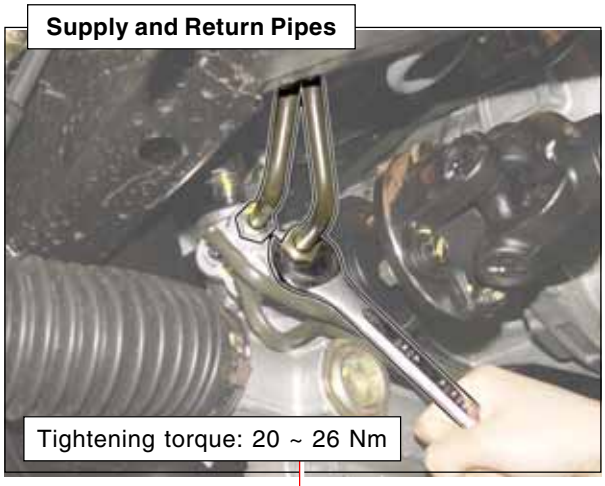
2. Unscrew the joint bolts of the lower shaft and remove the lower shaft and gear box.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

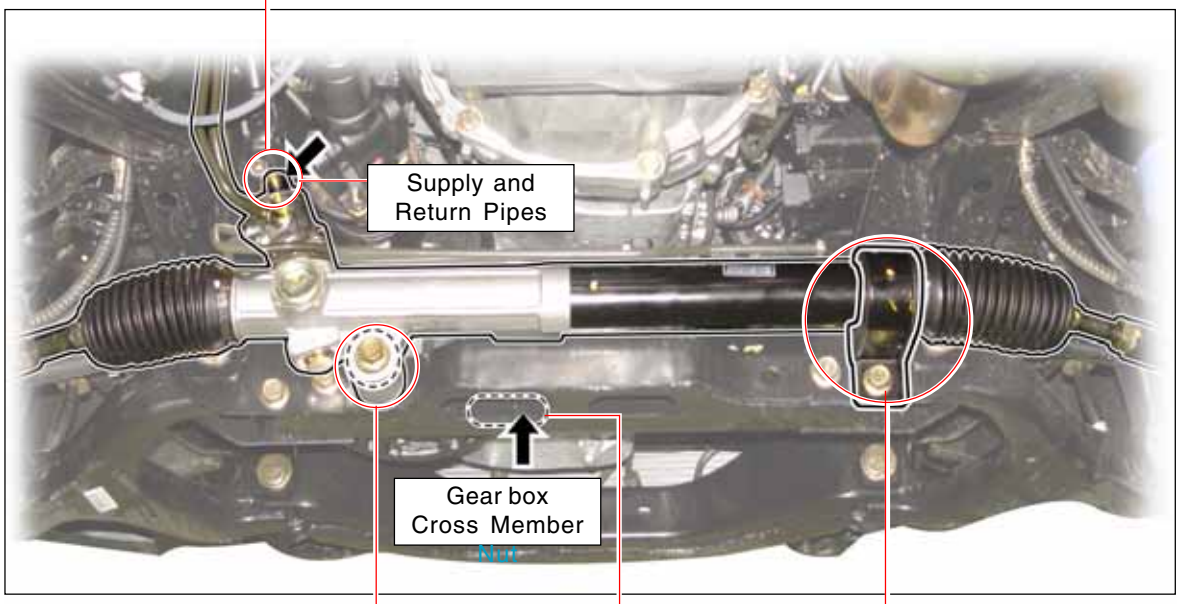
3. Disconnect the power steering pipes and remove the steering gearbox mounting bolts.

Supply and Return Pipes

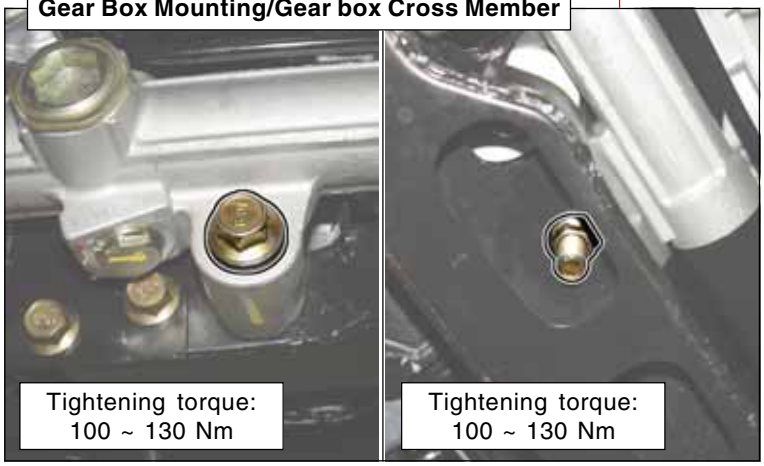


NOTICE

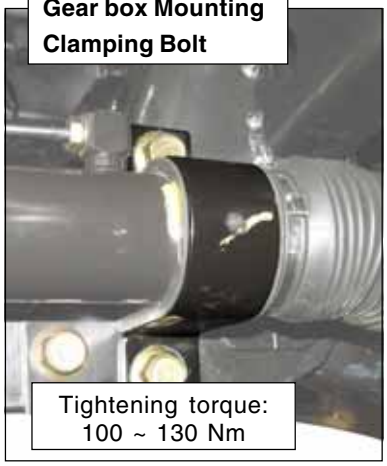
- **Plug the pipe openings with caps.**
- **Be careful not to spill the oil on the floor and vehicle body.**
- **Be careful of O-ring from being off the position.**



Gear Box Mounting/Gear box Cross Member



Gear box Mounting Clamping Bolt



NOTICE

- **Tighten the center bolt/nut first, and then tighten the left mounting bolt with the specified tightening torque.**

▶ Steering Gear Pump

1. Remove the drive belt.



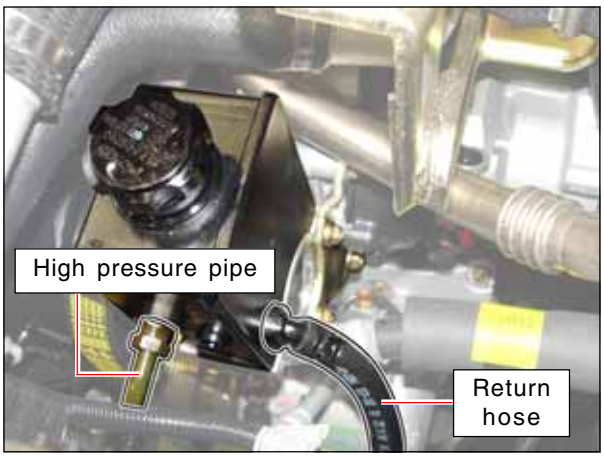
2. Disconnect the power steering return hose and remove the high pressure pipe nut.

Installation Notice

Tightening torque	40 ~ 50 Nm

NOTICE

- **Plug the openings so that power steering fluid doesn't leak out.**



3. Unscrew the bracket mounting nuts and remove the power steering gear pump assembly.

Installation Notice

Tightening torque	20 ~ 23 Nm



ABS/ESP SYSTEM

4890 / 4891

TABLE OF CONTENTS

GENERAL INFORMATION 2

1. General information 2
2. Specifications 5
3. Brake operation and noise 6

ESP (ELECTRONIC STABILITY PROGRAM) SYSTEM 7

1. General information 7
2. Components of ESP 8
3. Principle of ESP 13
4. BAS (brake assist system) 16
5. ARP (active roll-over protection) 17
6. HDC (hill descent control) 18
7. Components and locations 25
8. Input and output diagram 27
9. ESP system related precautions 28
10. Hydraulic circuit diagram 29
11. Hydraulic pressure for each ESP operating range 30
12. Hydraulic circuit of bas (brake assist system) 32
13. Components description 33
14. ESP system air bleeding 48
15. Sensor calibration and forced operation of actuator and sensor value 50
16. ABS/ESP trouble diagnosis 55

ABS SYSTEM 62

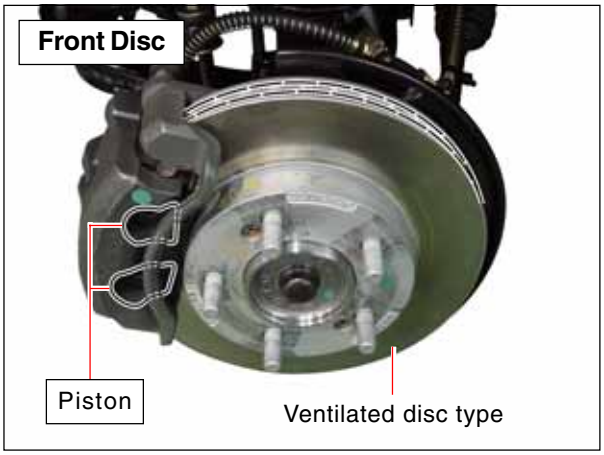
1. Input and output diagram 64
2. Hydraulic circuit of ABS 65
3. ABS circuit in each operation range 66
4. Components and location 67
5. Components description 68
6. Removal and installation 69

GENERAL INFORMATION

1. GENERAL INFORMATION

For the front brake system, the ventilated disc type is applied regardless of the ABS/ESP system installation. Two cylinders are installed in each caliper.

Description	Caliper diameter
Without ABS or ESP	43mm
With ABS or ESP	45mm



Front Ventilated Disc and Caliper (2 internal Cylinders)

For the rear brake system, it differ between ABS/ESP system equipped vehicle and non-ABS/ESP equipped vehicle. The drum type brake is installed on non-ABS equipped vehicle while the solid disc (thickness: approx. 10.4 mm) is installed on ABS/ESP equipped vehicle.

Description	Brake type
Without ABS	Drum brake
With ABS or ESP	Solid disc



Rear Disc and Caliper (1 Internal Cylinder)

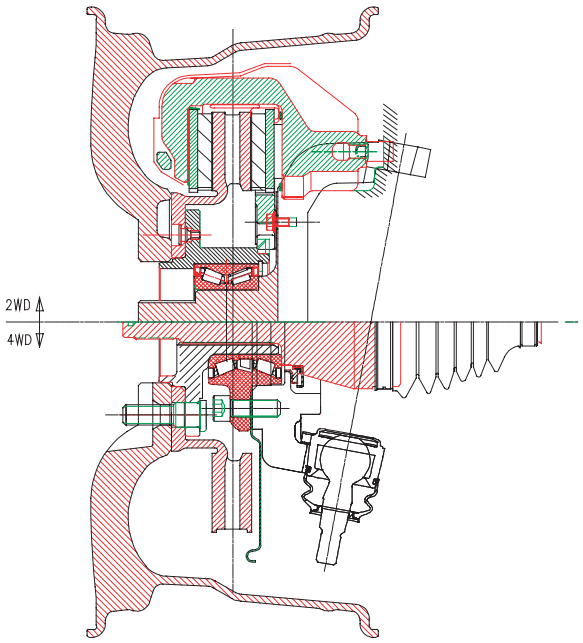
For the parking brake system, the hand operated type parking brake is installed regardless of the models.

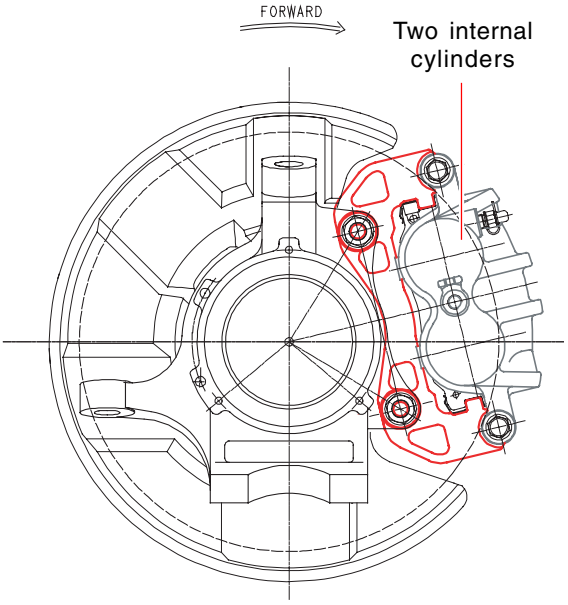


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EFFECTIVE DATE	
AFFECTED VIN	

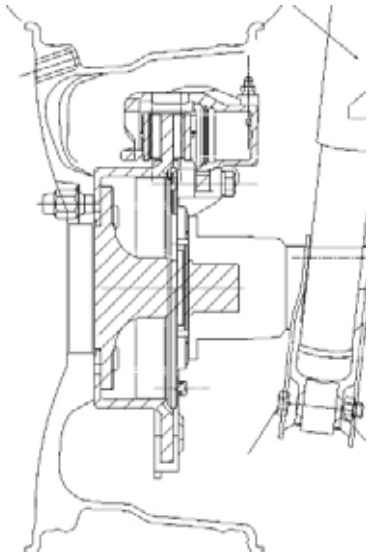
▶ Sectional Drawing

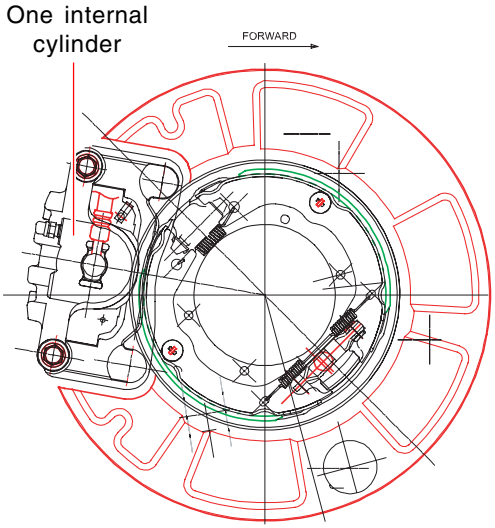
Front Disc Brake





Rear Disc Brake

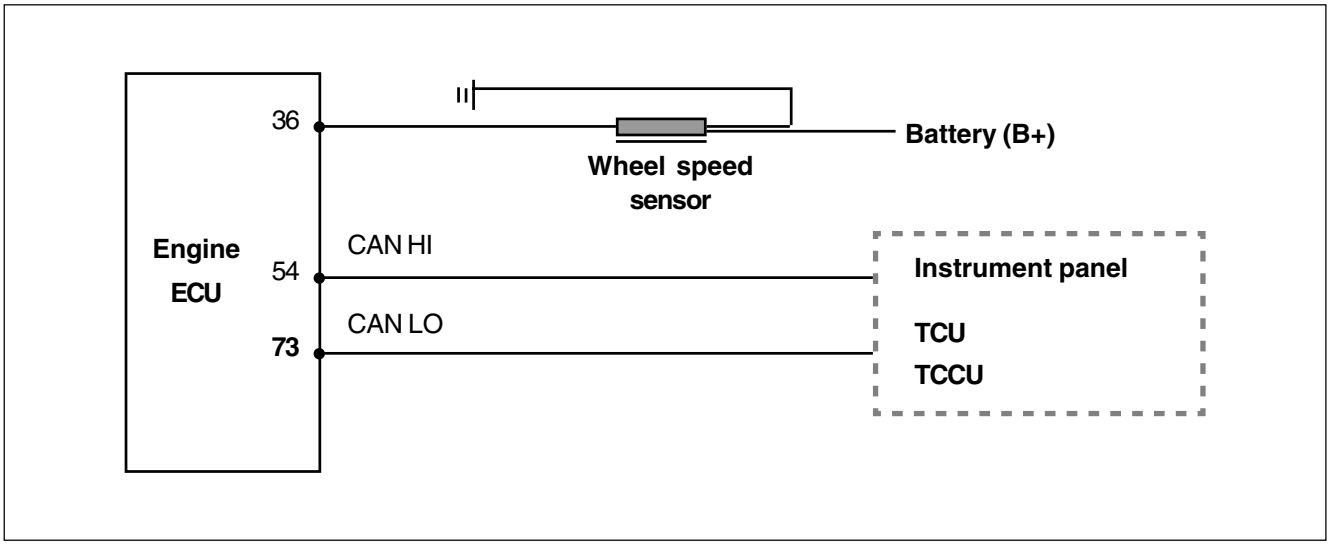




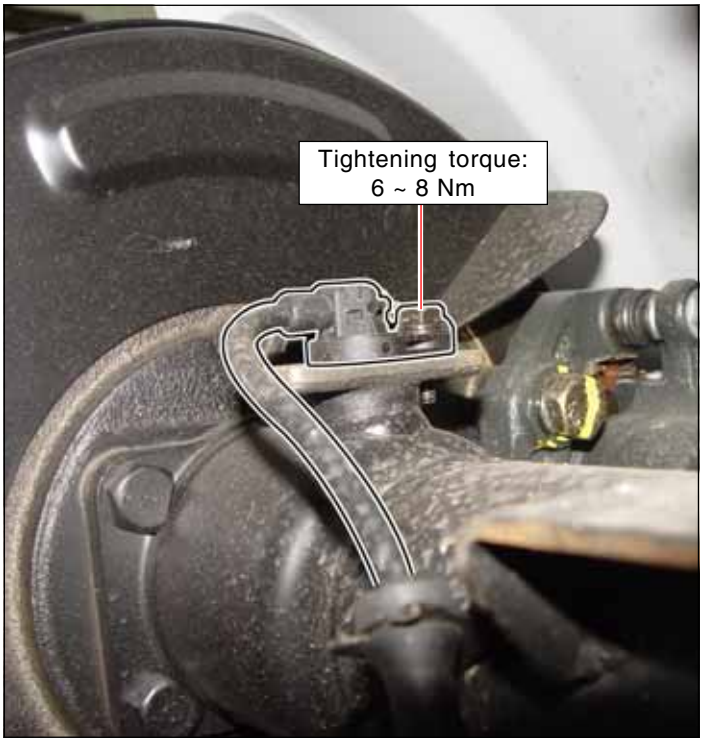
▶ Non-ABS Equipped Vehicle – With One Wheel Speed Sensor

The wheel speed sensor is installed on the rear right wheel regardless of the ABS/ESP installation.

This sensor is to signal the vehicle speed to the engine ECU, TCCU, transmission and instrument panel. There is no separate unit to process the wheel speed sensor signal. The wheel speed sensor is connected to the engine ECU (terminal 36), where its signal is processed, and is connected to other related systems through CAN communication.



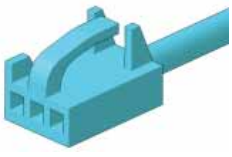
Location of the wheel speed sensor (rear right wheel)



Location of the Sensor Connector



Connector Appearance

In vehicle without ABS	In vehicle with ABS/ESP
	

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EFFECTIVE DATE	
AFFECTED VIN	

2. SPECIFICATIONS

Description	Item	NON-ABS	ABS/ESP
Brake pedal	Pedal ratio	4.0 : 1	
	Max. operating stroke	150 mm	
	Free play	1 ~ 4 mm	
Brake master cylinder	Type	Tandem type (with level sensor)	
	I.D. of cylinder	ϕ25.4 mm	
Brake booster	Type	Vacuum assisted type	
	Booster pressure ratio	9 : 1	
Front brake	Type	Ventilated disc type	
	I.D. of caliper cylinder	2 x ϕ43 mm	2 x ϕ45 mm
	Brake pad thickness	10.5 mm	
	Brake pad wear limit	2 mm	
	Disc plate thickness	26 mm	
	Disc plate wear limit	24 mm	
	I.D./O.D. of disc plate	ϕ294 / ϕ184 mm	
Rear brake	Type	Drum type	Solid disc type
	I.D. of drum	ϕ254 mm	-
	W x L x T	55 x 243 x 5	-
	I.D. of wheel cylinder	ϕ23.81 mm	-
	I.D. of caliper cylinder	-	ϕ42.9 mm
	Brake pad thickness	-	10 mm
	Brake pad wear limit	-	2 mm
	Disc plate thickness	-	10.4 mm
	Disc plate wear limit	-	8.5 mm
	I.D./O.D. of disc plate	-	ϕ299 / ϕ220 mm
Parking brake	Type	Mechanical type, rear wheels operated	
	Operation type	Hand Operated	
	I.D. of drum	ϕ254 mm	ϕ190 mm
Brake fluid	Capacity	0.7 ~ 0.8 ℓ	
	Specification	DOT4	

3. BRAKE OPERATION AND NOISE

This section describes the noise phenomena occured possibly in the brake system operation. Distinguish between the information given below and the actual problems and then, inspect the vehicle and take appropriate measures.

Noise Phenomena and Causes

Phenomenon 1. If depressing the brake pedal when the engine is cold, “screeching” sound always occurs and, after driving for a while, the sound disappears.

This usually occurs in the morning. When the temperature goes down, the dew condensation phenomenon sets moisture on the brake disc as the window frost forms. Due to this moisture, the iron within the brake disc and pad oxidizes, forming undetectable micro-rusts on the disc surface. When starting the engine under this condition, noise may sound due to the friction of micro-rusts. When operating the brake several times, the disc temperature goes up and the micro-rusts come off and the noise goes away. Depending on the driving conditions, noise gets louder when slightly depressing the brake pedal and oppositely, noise is smaller when deeply depressing the brake pedal. This is simply a physical phenomenon, called “morning effect” in professional terms, and does not imply any problems with the brake system.

Phenomenon 2. Slip or screech after the brake pad replacement.

This usually occurs when the bed-in is not made between the disc and the pad’s friction material. The bed-in is a state that the brake system normally works and gives no noise out, when, after about 300 km city driving, the contact area of the pad friction material is enlarged and the disk is in complete contact with the pad’s friction material. Therefore, for some time after the brake disk/pad replacement, the brake system poorly operates or noise (abnormal sound) occurs due to the partial contact.

Phenomenon 3. “Groaning” sound occurs in the automatic transmission vehicle when slightly taking the foot off the brake pedal to slowly start after waiting for the signal, or slightly depressing the brake pedal.

This is the noise “Creep groan” that occurs when, in both the automatic and manual transmission, slightly releasing the brake pedal in the neutral gear at downhill roads. It frequently occurs at the low braking power and low speed, through the following process. When operating the brake system at low speed and low pressure, adhesion and slip repeatedly take place between the brake disk and the friction material, and this makes the braking power inconstant, instantly increasing or decreasing, and gives out the brake noise. It is also a physical phenomenon and has no relation with the brake performance.

ESP (Electronic Stability Program) SYSTEM

1. GENERAL INFORMATION

The ESP system consists of basic ABS functions, the vehicle position control depending on the driving conditions and the road conditions, the HBA (Hydraulic Brake Assist System) that improves the braking power in an emergency, and the ARP (Active Rollover Protection) that obstructs the physical tendency to rollover during sharp turns and prevents the vehicle rollover by quickly and firmly controlling the engine output and the brake.

<u>The HDC (Hill Descent Control)</u> is newly introduced function that helps drivers maintain their speed automatically by switch operation when driving slowly on steep hills (over 10°).

ESP HECU



HDC Switch / Indicator



Functions applied on ESP system are as follows.

1. **ABS (Anti-Lock Brake System)**
2. **EBD (Electronic Brake-Force Distribution)**
3. **ABD (Automatic Braking Differential)**
4. **ASR (Acceleration Slip Regulation)**
5. **AYC (Active Yaw Control, Understeer Oversteer control)**
6. **HBA (Hydraulic Brake Assist System)**
7. **ARP (Active Rollover Protection)**
8. **HDC (Hill Descent Control)**

2. COMPONENTS OF ESP

ESP OFF Switch



ESP is deactivated by pressing the switch (ESP warning lamp comes on)

ESP is activated by pressing the switch again (ESP warning lamp goes off)

HDC Switch



HDC is activated by pressing the switch (Green HDC indicator comes on)

HDC is deactivated by pressing the switch again (Green HDC indicator goes off)



Steering Angle Sensor (Steering Wheel)



Detects the angle of the steering wheel and sends it to HECU.

Sensor cluster



Detects lateral acceleration, longitudinal acceleration and yaw rate.



HECU



Receives the signals from wheel speed sensor, steering wheel angle sensor, sensor cluster and pressure sensor and perform the vehicle stability control function.

Rear Wheel Speed Sensor (LH/RH)



Wheel Speed Sensor

For 4WD



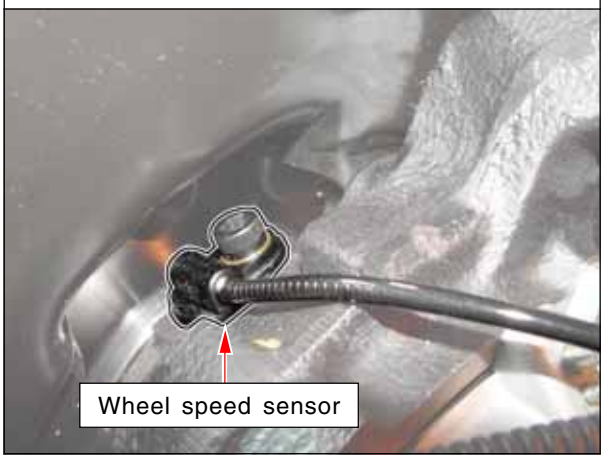
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EFFECTIVE DATE	
AFFECTED VIN	

Cautions When Removing the Front Wheel Speed Sensor

The locking hub system (Part time 4WD) utilizes IWE (Integrated Wheel End) system that locks the 4WD depending on the vacuum condition within the actuator.

Thus, the wheel speed sensor is installed on the front wheel end area. It is installed inside the backing plate to be protected from heat and foreign materials. Therefore, the front wheel end system (including disc) should be removed before removing the front wheel speed sensor.

Front Wheel Speed Sensor



Rear Wheel Speed Sensor



Wheel Speed Sensor





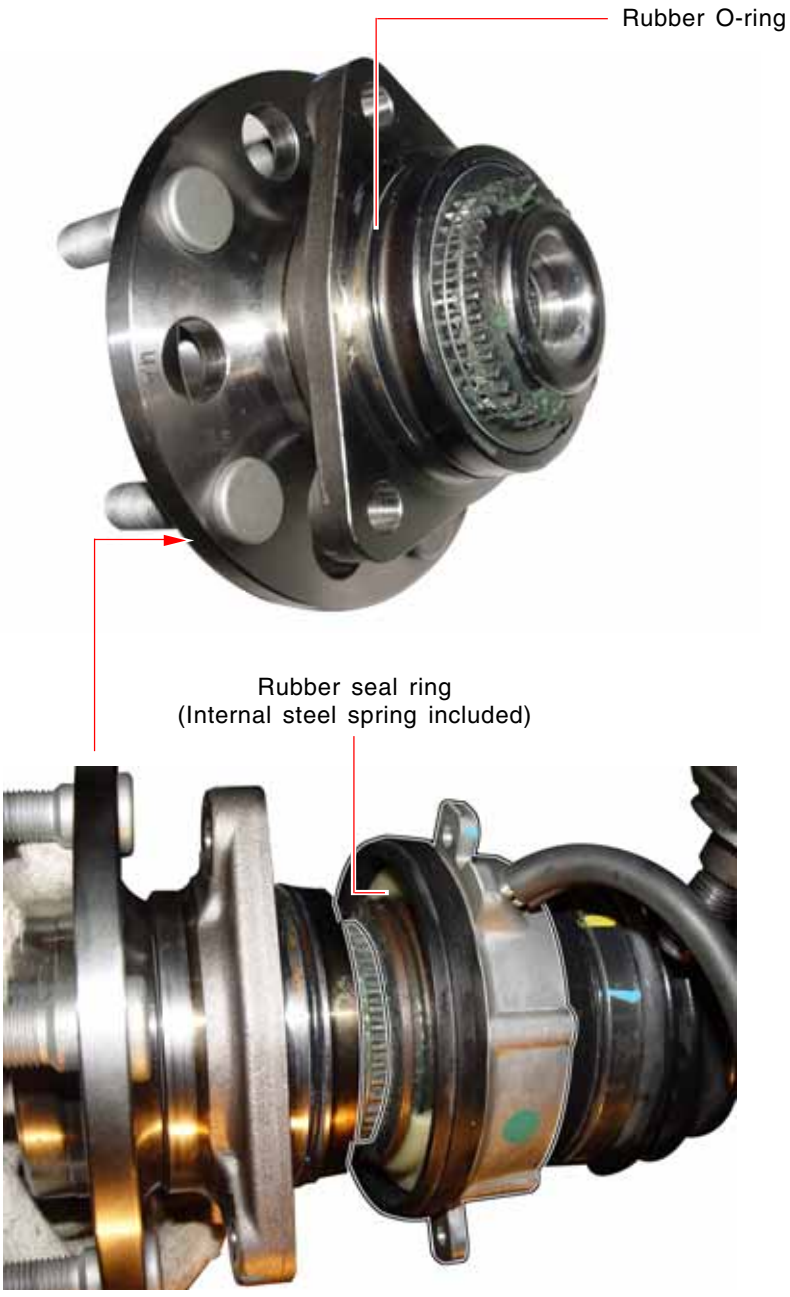
The wheel end should be removed before removing the wheel speed sensor.

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EFFECTIVE DATE	
AFFECTED VIN	

The rubber O-ring in IWE (Integrated Wheel End) should be replaced with new one when the front wheel end has been removed. The rubber O-ring prevents moisture and foreign materials from entering the IWE system.

The hub actuator of the IWE system should be installed with the same angle with the drive shaft so that the inner rubber seal ring cannot be stuck. Also, the round steel spring is installed on the rubber seal ring.

If the rubber seal ring or the round spring is damaged, the actuator assembly should be replaced.



※ **Please refer to the part time transfer case section for more specific information.**

When the ESP system is added to the ABS system, some devices will be added to the ABS system including the HECU (Hydraulic & Electronic Control Unit) and wheel speed sensor. The devices are as follows:

1. Two pressure sensors installed on the master cylinder
2. Sensor cluster (integrated yaw rate sensor and lateral sensor) and longitudinal sensor installed in IP.
3. SWAS (Steering Wheel Angle Sensor) installed in the steering column.

▶ Comparison with ABS System

Name	Specifications		Location
	ABS	ESP	
HECU (Hydraulic & Electronic Control Unit)	CPU: PEC 1 (32bit) Memory: 512 KB EEP ROM: 1KB	CPU: PEC 1 (32bit) Memory: 512 KB EEP ROM: 1KB	Side of brake booster
Wheel Speed Sensor	Active Type	Active Type	Mounted in each wheel (×4EA) Front airgap 2WD: 0.425 ~ 1.425 mm 4WD: 0.1 ~ 0.7 mm Rear airgap: 0.425 ~ 1.175mm
Steering Wheel Angle Sensor	N/A	Maximum angular velocity: 1500°/sec Working voltage: 9 ~ 16 V	In steering wheel
Sensor Cluster	N/A	Integrated yaw rate sensor, longitudinal and lateral sensors. Also, used for sensing G value for HDC (Hill Descent Control).	Under the center A/C panel of the instrument panel
Pressure Sensor	N/A	Analog Output	Under master cylinder

3. PRINCIPLE OF ESP

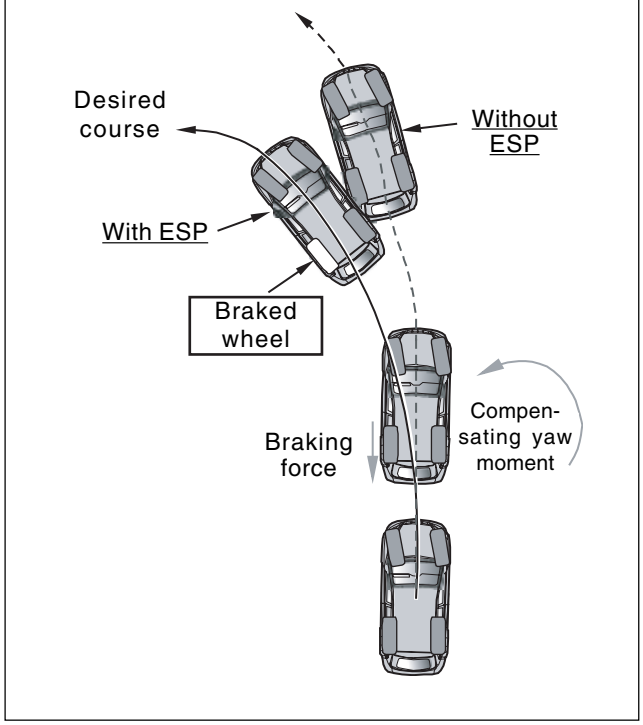
▶ Understeer & Oversteer Control

ESP (Electronic Stability Program) recognizes critical driving conditions, such as panic reactions in dangerous situations, and stabilizes the vehicle by wheel-individual braking and engine control intervention with no need for actuating the brake. This system is developed to help the driver avoid the danger of losing the control of the vehicle stability due to under-steering or over-steering during cornering.

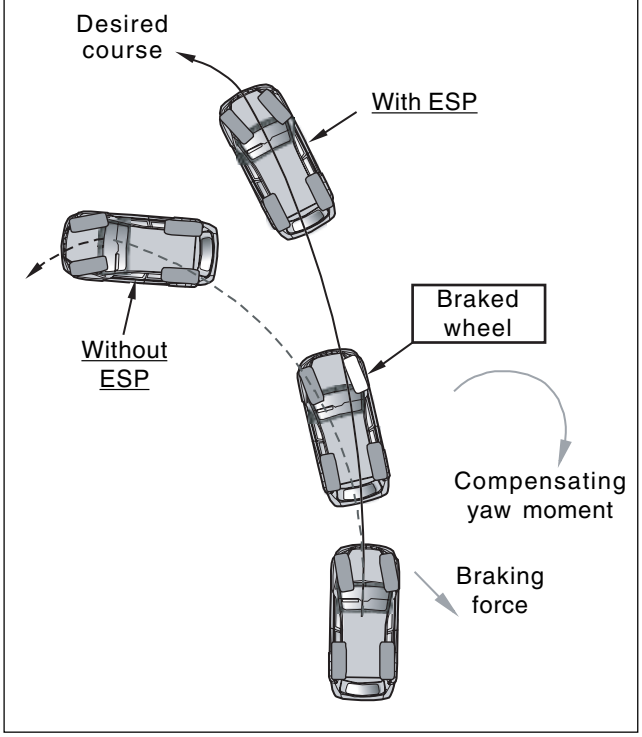
The yaw rate sensor, lateral sensor and longitudinal sensor in the sensor cluster and the steering angle sensor under the steering column detect the spin present at any wheels during over-steering, under-steering or cornering. The ESP ECU controls against over-steering or under-steering during cornering by controlling the vehicle stability using the input values from the sensors and applying the brakes independently to the corresponding wheels.

The system also controls during cornering by detecting the moment right before the spin and automatically limiting the engine output (coupled with the ASR system).

Under Steering



Over Steering



Understeering

Understeering is when the steering wheel is steered to a certain angle during driving and the front tires slip toward the reverse direction of the desired direction. Generally, vehicles are designed to have under steering. The vehicle can return back to inside of cornering line when the steering wheel is steered toward the inside even when the vehicle front is slipped outward. As the centrifugal force increases, the tires can easily lose the traction and the vehicle tends to slip outward when the curve angle gets bigger and the speed increases.

Oversteering

Oversteering is when the steering wheel is steered to a certain angle during driving and the rear tires slip outward losing traction.

When compared with under steering vehicles, the controlling of the vehicle is difficult during cornering and the vehicle can spin due to rear wheel moment when the rear tires lose traction and the vehicle speed increases.

ESP Controls During Under Steering

The ESP system recognizes the directional angle with the steering wheel angle sensor and senses the slipping route that occurs reversely against the vehicle cornering direction during understeering with the yaw rate sensor and the lateral sensor. Then the ESP system **applies the brake at the rear inner wheel** to compensate the yaw moment value. In this way, the vehicle does not lose its driving direction and the driver can steer the vehicle as driver intends.

ESP Controls During Oversteering

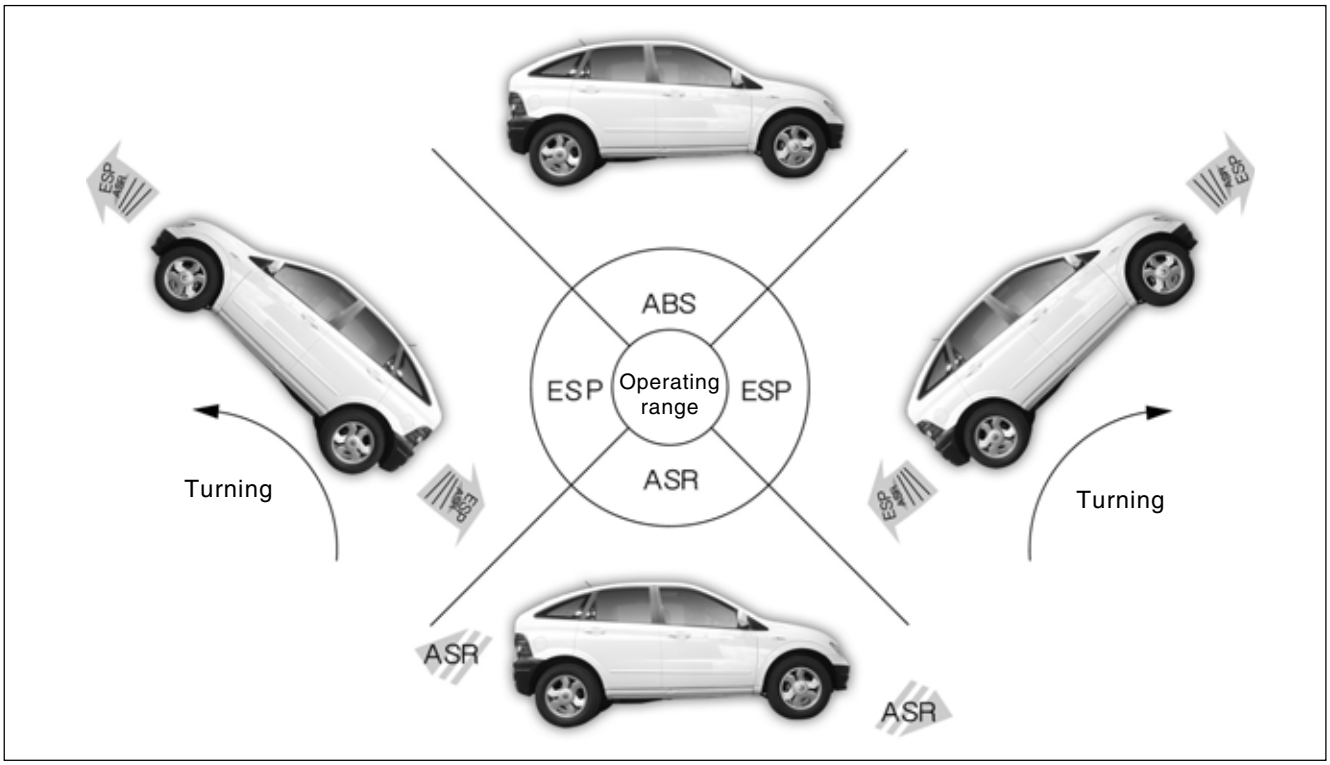
The ESP system recognizes the directional angle with the steering wheel angle sensor and senses the slipping route that occurs towards the vehicle cornering direction during oversteering with the yaw rate sensor and the lateral sensor. Then the ESP system **applies the brake at the front outer wheel** to compensate the yaw moment value. In this way, the vehicle does not lose its driving direction and the driver can steer the vehicle as he or she intends.

▶ ESP Control

As the single-track vehicle model used for the calculations is only valid for a vehicle moving forward, ESP intervention never takes place during backup. The ESP system includes the ABS/EBD and ASR systems allowing the system to be able to operate depending to the vehicle driving conditions. For example, when the brakes are applied during cornering at the speed of 100 km/h, the ABS system will operate at the same time the ASR or ABD systems operate to reduce the power from the slipping wheel. And when yaw rate sensor detects the rate exceeding 4 degree/seconds, the ESP system is activated to apply the brake force to the corresponding wheel to compensate the yaw moment with the vehicle stability control function.

When various systems operate simultaneously under a certain situation, there may be vehicle control problems due to internal malfunction of a system or simultaneous operations. In order to compensate to this problem, the ESP system sets the priority among systems. The system operates in the order of TCS (ASR or ABD), ESP and ABS. The order may be changed depending on the vehicle driving situations and driving conditions.

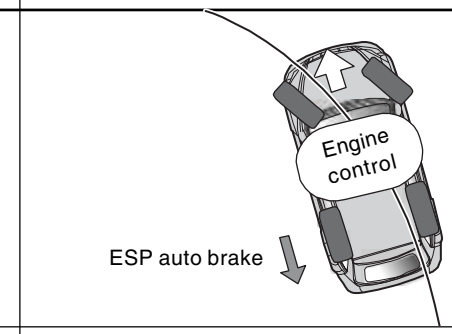
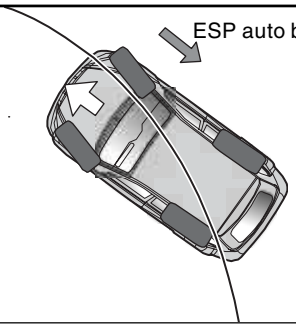
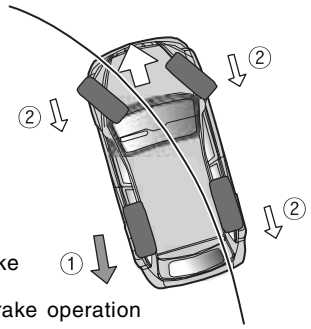
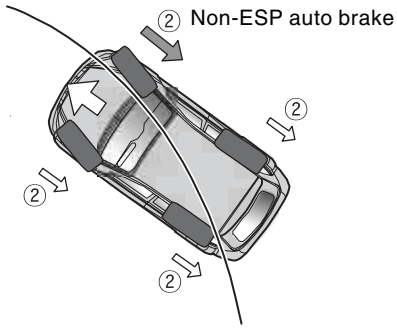
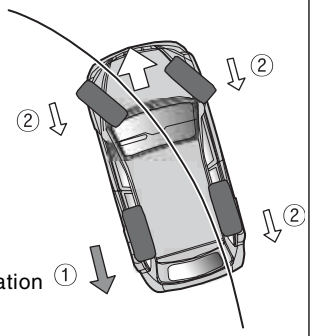
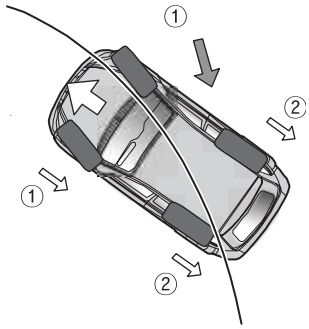
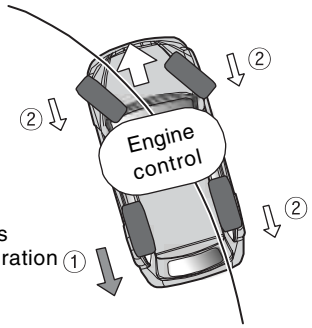
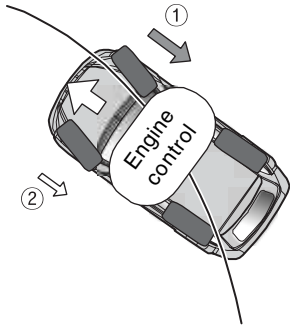
The following figure shows the operating range according to driving conditions.



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▶ Vehicle Control During Cornering

The figure below shows the vehicle controls by ESP system under various situations such as when the brake pedal is pressed (or not pressed) during cornering and when the ABS is operating or when just the conventional brake is operating during braking. It also includes the vehicle conditions when the TCS that is included in the ESP system is operating.

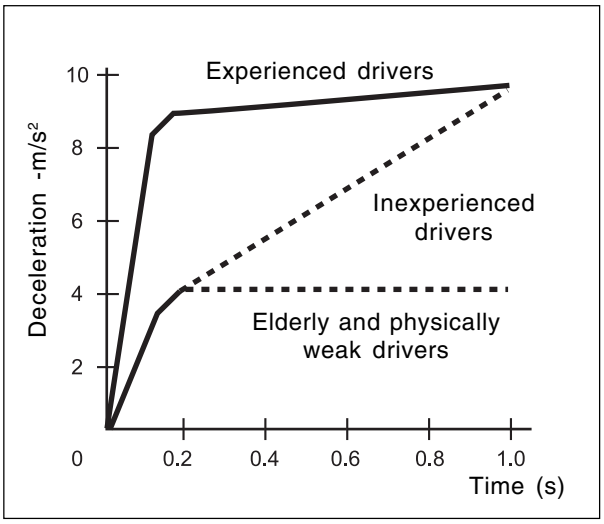
Operations	Understeering Control	Oversteering Control
Only ESP operating No braking by driver		
ESP + Conventional brake (ABS not operating)		
ESP + ABS brake		
ESP + TCS (Engine control)		

4. BAS (BRAKE ASSIST SYSTEM)

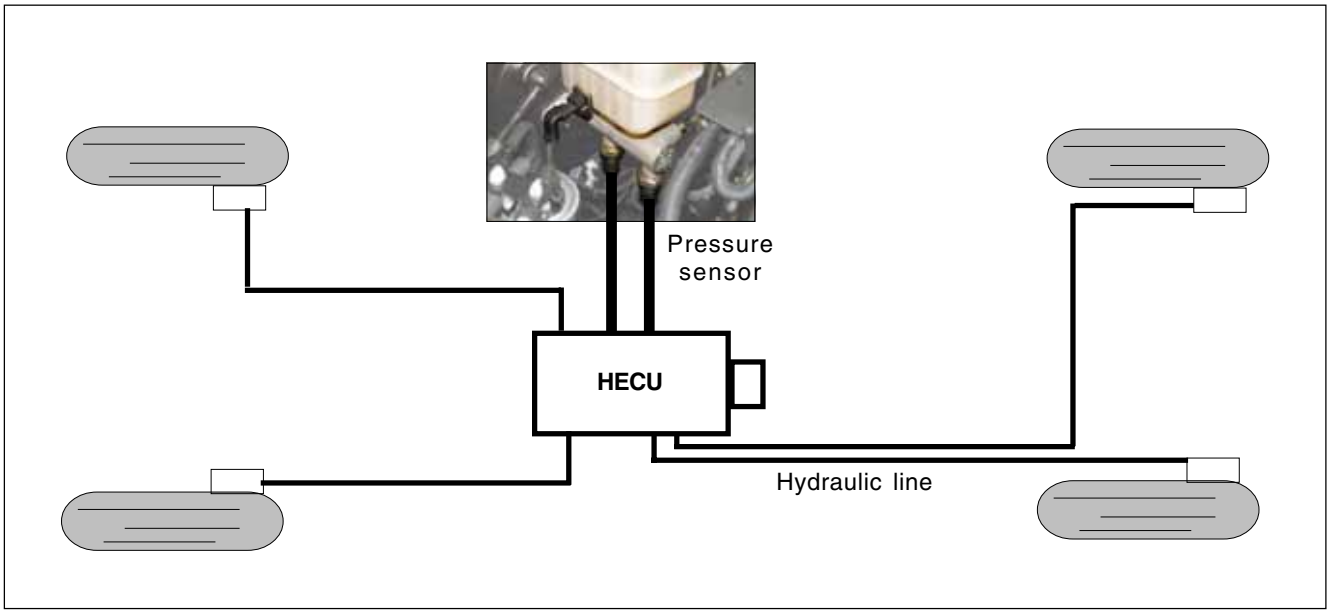
BAS (Brake Assist System) system helps in an emergency braking situation when the driver applies the brake fast, but not with sufficient pressure, which leads to dangerously long braking distance. ECU recognizes the attempt at full braking and transmits the signal calling for full brake pressure from the hydraulic booster.

An inexperienced, elderly or physically weak driver may suffer from the accident by not fully pressing the brake pedal when hard braking is required under emergency. The BAS System increases the braking force under urgent situations to enhance the inputted braking force from the driver.

Based on the fact that some drivers depress the brake pedal too soft even under when hard braking is necessary, the HECU system is a safety supplementary system that builds high braking force during initial braking according to pressure value of the brake pressure sensor and the pressure changes of the pressure sensor intervals. When the system is designed to apply high braking force when brake pedal is depressed softly by an elderly or physically weak driver, the vehicle will make abrupt stopping under normal braking situation due to high braking pressure at each wheels.



The brake pressure value and the changed value of the pressure sensor are the conditions in which the BAS system operates. There are 2 pressure sensors under the master cylinder. When the ESP ECU system determines that emergency braking is present, the pump operates, the brake fluid in the master cylinder is sent to the pump and the braking pressure is delivered to the wheels via the inlet valves. If the drive depresses the brake pedal slowly, the pressure change is not high. In this case, only the conventional brake system with booster is activated.



Operating conditions:

1. Pressure: over 20 bar
2. Pressure changes: over 1500 bar/sec
3. Vehicle speed: over 7 Km/h

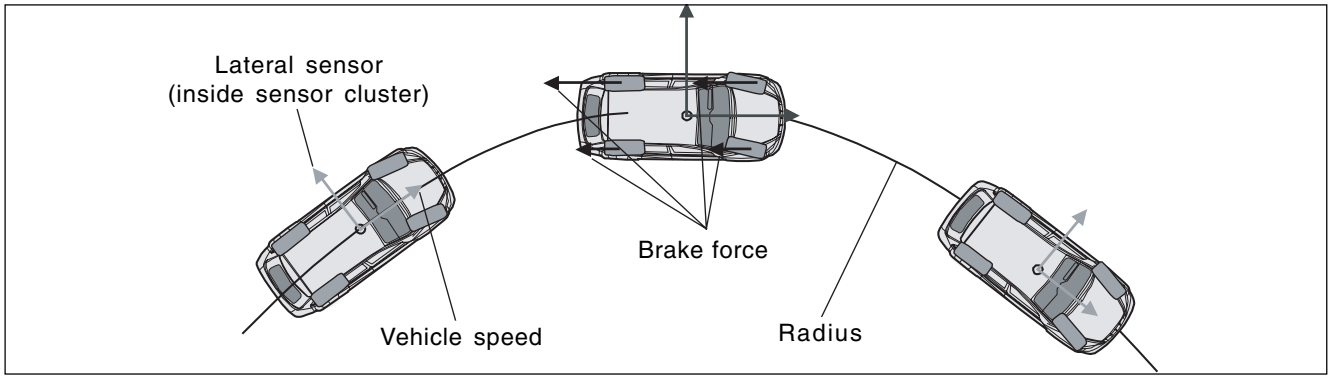
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5. ARP (ACTIVE ROLL-OVER PROTECTION)

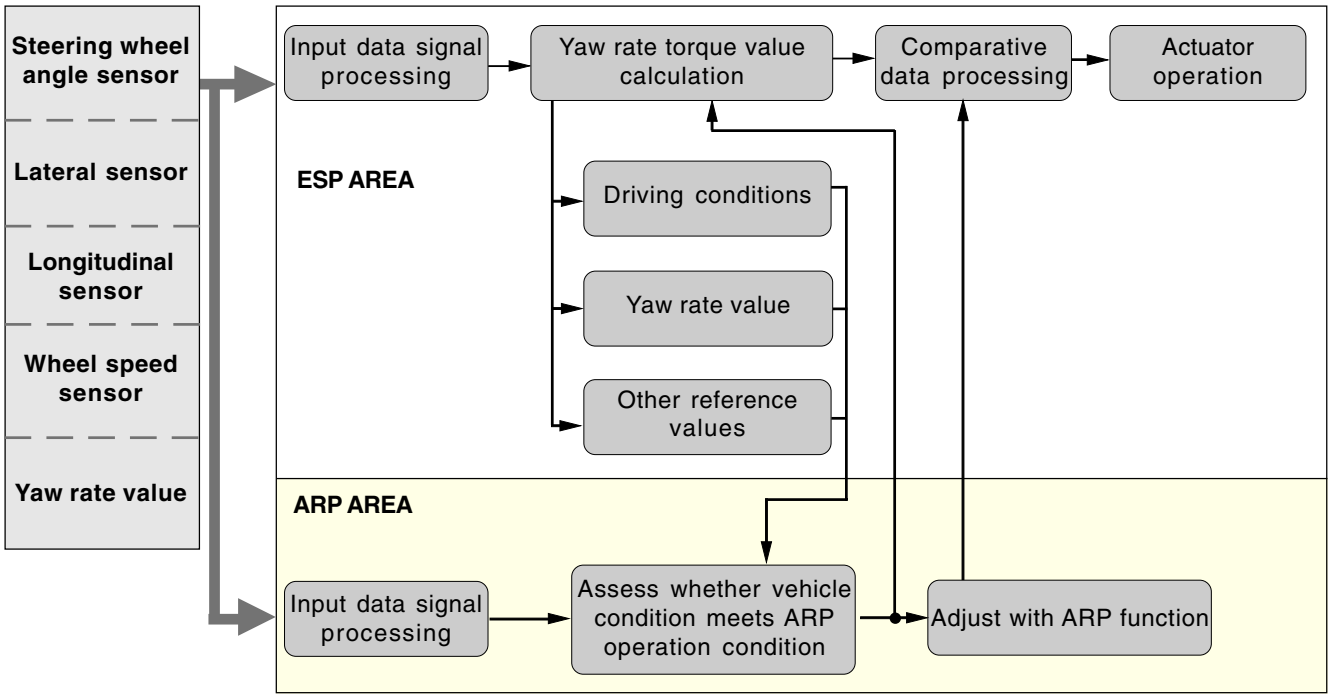
The ARP (Active Roll-over Protection) system is a safety assistant device that minimizes, by controlling brakes and the engine, the physical tendency of the vehicle rollover during sharp lane changes or U-turns. For the system, software is added to the existing ESP system and no additional device or switch is needed.

One must note that the ARP system, just as general assistant devices including the ABS, is only a safety assistant device using the ESP system and its function is useless when the situation overcomes the physical power.

Following picture shows how the ARP compensates the vehicle position by varying each wheel's braking power to overcome the physical tendency of the vehicle rollover during sharp turns.



The vehicle driving condition is controlled by the internally programmed logic according to the input signals from wheel speed sensor, steering angle sensor and lateral sensor.



NOTICE

- **During the ARP operation, vehicle safety (rollover prevention) takes the first priority and thus, stronger engine control is in effect. Consequently, the vehicle speed decreases rapidly, so the driver must take caution for the vehicle may drift away from the lane.**
- **The ARP function is activated when the vehicle is subject to turning over due to sharp cornering even when the ESP function is turned off (however, the ARP function is also deactivated when the ESP function is not operatable due to system malfunction).**

6. HDC (HILL DESCENT CONTROL)

▶ System Overview

The HDC system is an automatic descent control device that allows the vehicle to automatically decelerate to about 7 km/h by 0.1G, on steep roads (slope level exceeding 10%) through a separately installed switch operation. When the vehicle speed reaches below 7 km/h (refer to the information below), the HDC automatically terminates the operation.

When you see a steep downhill ahead, press the HDC switch and the green HDC indicator comes on. When the G sensor within the sensor cluster detects a slope level exceeding 10%, the ESP's HDC function operates. When this occurs, the green HDC indicator flashes along with a loud operation sound.

HDC Switch



HDC Indicator (Instrument Panel)



When you press the HDC switch, the green HDC indicator comes on, and when the HDC operates, the green HDC indictor flashes at 0.5 second of interval.

HDC

Red letters

HDC

Green letters

Sensor Cluster (G Sensor)



The G Sensor within the sensor cluster detects the steepness of driving roads. When the HDC switch is in operation, if the G sensor detects a downhill steepness exceeding 10%, it transmits the HDC operation signal to the ESP HECU.

NOTICE

- **The G sensor in sensor cluster measures the actual road steepness. However, it may recognize a sharp turn or rough road as a downhill road with a slope level exceeding 10%, and the HDC may operate.**

▶ HDC (Hill Descent Control) System Operating Conditions

1. **When HDC switch is turned ON** and

2. **Gearshift lever position (Forward/Reverse)** and

   Manual transmission: operates in the 1st gear or reverse gear position (does not operate in neutral position).

   Automatic transmission: operates in any position except for P (parking) or N (neutral) positions.

NOTICE

- **The vehicles with manual transmission do not have a separate device or switch that detects the 1st gear. It only detects the forward/reverse driving direction of the vehicle through backup lamp switch and neutral switch, and cannot solely detect the 1st gear position. The reason why, though the HDC also operates in 2nd gear position, that is because the engine may turn off during the HDC operation process. You may face a very dangerous situation if the engine turns off at a steep hill.**
- **The HDC is the device to improve the engine brake effect during downhill driving on a steep hill. For manual transmission equipped vehicle, HDC system should operated only in 1st gear.**

3. **When not depressing the accelerator pedal or brake pedal.** and

4. **The vehicle speed is above 7 km/h (in Automatic transmission/4H mode).** and

NOTE

- **The vehicle speed given in step (4) varies according to the vehicle driving mode, and the speed ranges by the vehicle driving mode and condition are as follows.**

1) Speed available in HDC mode (slope)

Forward driving **2H/4H mode: vehicle speed below 50 km/h (operation slope level: 10%, termination slope level: when it reaches 8%)**

Reverse driving **2H/4H mode: vehicle speed below 50 km/h (operation slope level: 8%, termination slope level: when it reaches 5%)**

2) HDC target speed in 2H/4H mode

(The HDC target speed is the speed that the HDC is not terminated even after the vehicle speed reaches 7 km/h, but is converted to the stand-by mode. When the vehicle speed increases again as a result of the increase of the road steepness, etc., the HDC goes into operation.)

Forward driving: 7 km/h

Reverse driving: 7 km/h (automatic transmission), 8.5 km/h (manual transmission)

5. Vehicle position control function in ESP and HBA function are not in operation: and

The HDC is the device to improve the engine brake effect during downhill driving on a steep hill. If the ESP function is in operation, HDC operation is overridden.

6. Slope level exceeds 10%.

When the slope level exceeds 10%, the HDC operates until the vehicle reaches the speed value given in step (4).

When the slope level is between 10% and 20% during the HDC operation

When depressing the accelerator pedal or brake pedal, HDC system is changed to stand-by mode. When releasing the pedal, HDC starts its operation again. Therefore, drivers can control the vehicle speed to a desired level by depressing and releasing the pedal.

When the slope level exceeds 20% during the HDC operation

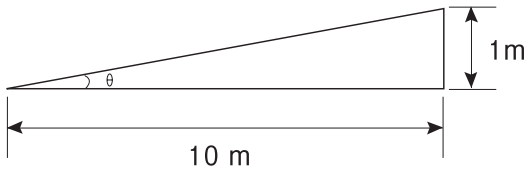
When depressing the accelerator pedal, HDC system is changed to stand-by mode. When depressing the brake pedal, HDC continues its operation and the braking power is increased.

In this case, HECU sounds an abnormal noise and brake pedal may be very rigid, but this is a normal condition due to HDC operation.

NOTE

- **The percentage of the slope level:**
  tan θ X 100 = slope level (%)

ex)



$$\tan\theta \times 100 = \frac{1}{100} \times 100 = 10\ (\%)$$

For example, 10% of slope level indicates that the heigh is 1 m when the transverse length is 10 m.

l 1G = 9.8 m/s²: Acceleration

▶ HDC (Hill Descent Control) System Non-Operation Conditions

1. **When HDC switch is turned OFF** or

2. **Gearshift lever has passed neutral (N) position.** or

> **NOTICE**
> - **Vehicle with manual transmission: Sensing at the neutral switch**
> - **Vehicle with automatic transmission: Sensing at the selector lever unit**

3. **When the vehicle speed is out of the specified values (under 7 km/h).** or

4. **When the ESP related functions, e.g. vehicle position control, BAS, ARP is activated during HDC operation.** or

   The HDC is the device to improve the engine brake effect during downhill driving on a steep hill. If the ESP function is in operation, HDC operation is overridden.

5. **When the internal temperature of HDC system goes over 450°C due to long downhill driving on a steep hill with HDC operated.** or

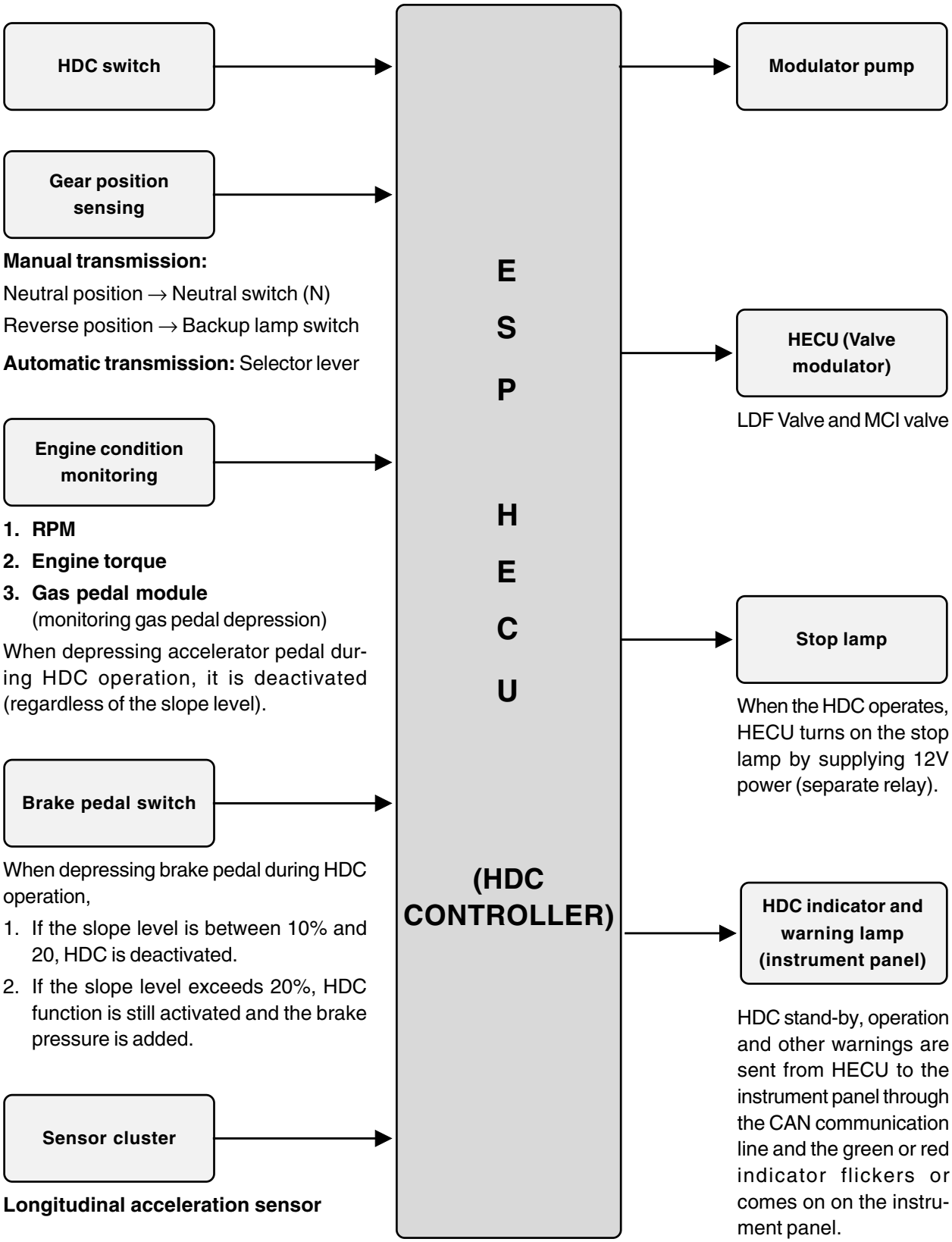
   There is no specific temperature sensor in the system, but a programmed logic inside the HECU predicts the temperature based on the operating times and conditions of HDC.

> **NOTICE**
> - **The red HDC warning lamp blinks when the internal temperature goes over 350°C. When it reaches 450°C, the HDC warning lamp stays on. The HDC can be operated in this range even where the HDC warning lamp blinks.**

6. **When the slope level is below 10%**

▶ Input/Output Signals for HDC Operation

The HDC controller operates its function in the HECU inside the ESP unit and receives the following signals to perform the hill descent control function.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Operation of HDC Indicator Controller

This table describes the coming-on and blinking mode of HDC indicator according to the HDC switch operation (ON/OFF) and operation conditions.

The HDC indicator on the instrument panel has two modes; green (function lamp) and red (warning lamp). The HDC switch is a push & self return type switch – when you press it once, it starts to operate and when you press it again, it stops the operation.

<table>
<tr><th colspan="4" rowspan="3">HDC Operation Mode</th><th>HDC Indicator</th><th>HDC Warning Lamp</th></tr>
<tr><th>Green</th><th>Red</th></tr>
<tr><th> 
</th><th> 
</th></tr>
<tr><td colspan="4">Initial ignition ON (From hence, this signifies operation mode after the engine starts. Even when HDC switch is ON, if the ignition is OFF, HDC operation stops automatically.)</td><td>OFF</td><td>ON
(goes off after 1.8 seconds)</td></tr>
<tr><td rowspan="2">Not available</td><td colspan="3">HDC switch OFF</td><td>OFF</td><td>OFF</td></tr>
<tr><td colspan="3">HDC system error</td><td>OFF</td><td>ON</td></tr>
<tr><td rowspan="2">Stand-by</td><td colspan="3">HDC switch ON</td><td>ON</td><td>OFF</td></tr>
<tr><td colspan="5">The HDC switch is turned ON, but HDC system is in stand-by mode because the operating requirements are not met.</td></tr>
<tr><td rowspan="2">In operation</td><td colspan="3">HDC system is operating.</td><td>Blinking (0.5 seconds of interval)</td><td>OFF</td></tr>
<tr><td colspan="5">The HDC switch is turned ON, and the operating requirements are met. HDC is operating with operating sound.</td></tr>
<tr><td rowspan="4">System overheat</td><td rowspan="2">High brake system temperature (over 350°C)</td><td>HDC stand-by mode</td><td>OFF</td><td>Blinking</td></tr>
<tr><td>HDC is operating</td><td colspan="2">Alternate blinking of green and red lamp (0.5 seconds of interval)</td></tr>
<tr><td colspan="2">Too high brake system temperature (over 450°C)</td><td>OFF</td><td>ON</td></tr>
<tr><td colspan="5">There is no specific temperature sensor in the system, but a programmed logic inside the HECU predicts the temperature based on the operating numbers and conditions of HDC (HDC cannot be operated).</td></tr>
</table>

NOTICE

Basically, the brake system's basic functions can work even when there are problems with the HDC system. As given in the table above, the HDC warning lamp comes on when:

- **Initial ignition ON**
- **HDC system error occurs**
- **Brake system overheat**

▶ Cautions When Using HDC System

Customers must first acquaint themselves with the HDC operation related information, e.g. operation conditions and non-operation conditions, because they may feel unfamiliar with its function and operation process. The noise during the HDC operation is very different from that during the ABS/ESP operation. This noise may be irritating and accompany some vibration, because, on steep hills, it attempts to control the physical properties of the vehicle weight with the braking power.

Below is the summary of precautions to remember in HDC operation.

NOTICE

- **The HDC system is intended for use only on off-roads with a slope level exceeding 10%. Thus, do not use it on public road.**
- **Too frequent use of HDC system may weaken the durability of the ESP HECU and related systems.**
- **Driver must turn the HDC switch to OFF position when driving on public and level roads. As mentioned previously, when a driver make sharp turns or drive on rough roads, the HDC may suddenly operate for these sudden shocks influencing the G sensor values. When such occurs, the driver may panic because the vehicle speed drops sharply and the driver will experience difficulty in controlling the vehicle.**
- **During the HDC operation, a loud noise and the vehicle vibration may occur from the HECU and the brake system, but this is a normal condition during the HDC operation.**

7. COMPONENTS AND LOCATIONS

There are no major changes in the ESP system of ACTYON comparing to the conventional ESP system. However, the HDC switch and the HDC indicator has been added to the system as the HDC system has been applied.



Master cylinder pressure sensor



Active Wheel Speed Sensor





Valve body



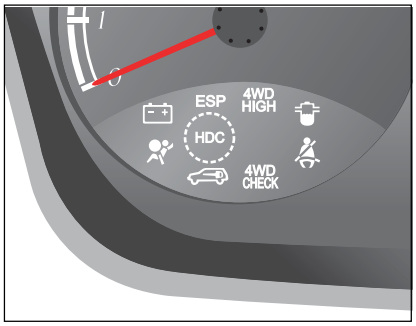
Motor pump

▶ Comparison with ABS System

No	Name	ESP Component	ABS Components	Remark
1	HECU	0	0	ESP system contains ESP OFF switch and HDC switch.
2	Pressure sensor	0	N/A	
3	Wheel speed sensor	0	0	
4	Sensor cluster	0	N/A	
5	Steering wheel angle sensor	0	N/A	



ESP OFF Switch



HDC Indicator



ABS / ESP Indicator





Steering Wheel Angle Sensor



HDC Switch

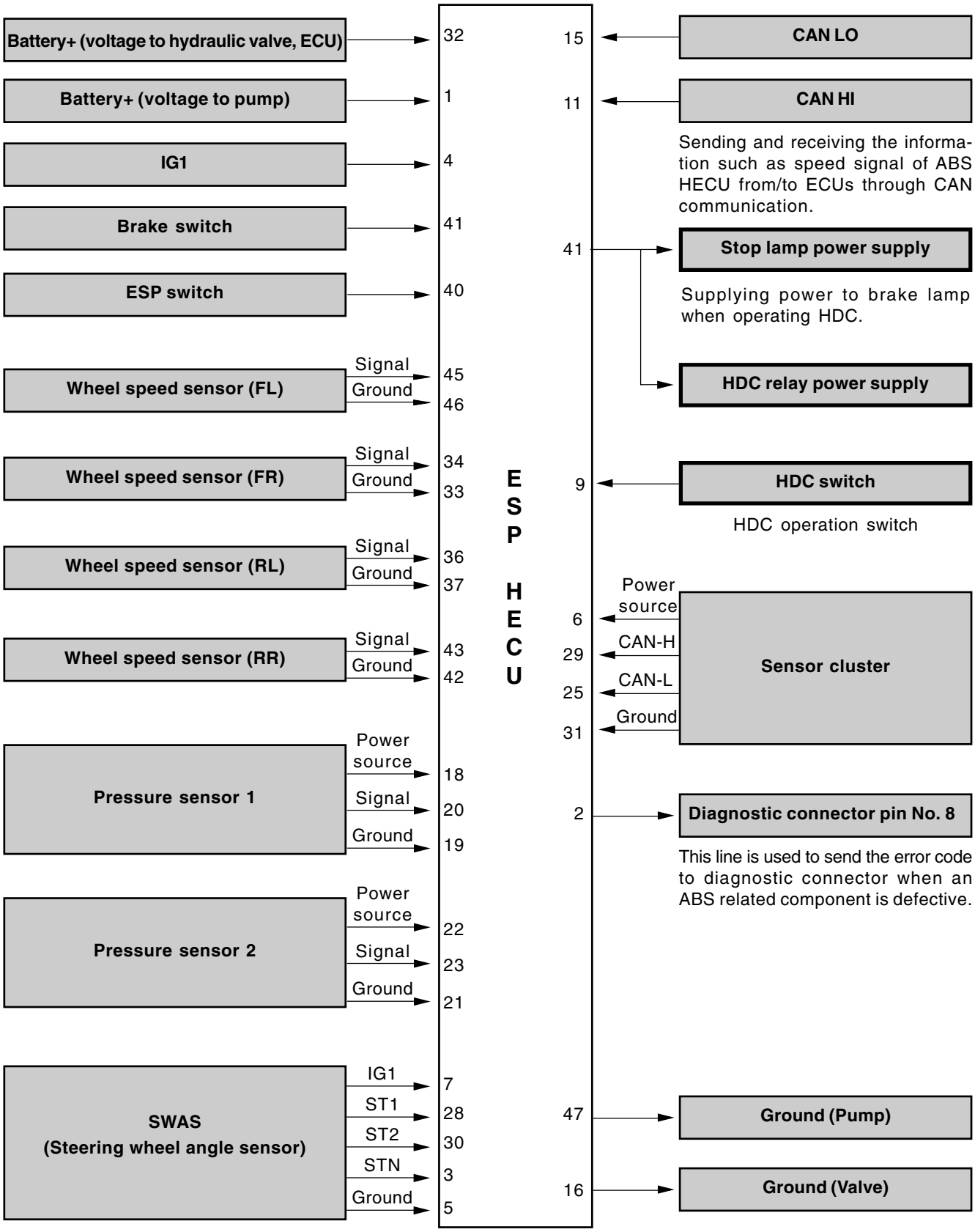


Sensor Cluster (Yaw Rate + Lateral Sensor + Longitudinal Sensor)

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EFFECTIVE DATE	
AFFECTED VIN	

8. INPUT AND OUTPUT DIAGRAM

Input/Output of ESP System



9. ESP SYSTEM RELATED PRECAUTIONS

1. **The HDC system is intended for use only on off-roads with a slope level exceeding 10%. Thus, do not use it on public road.**

2. **Too frequent use of HDC system may weaken the durability of the ESP HECU and related systems.**

3. **Driver must turn the HDC switch to OFF position when driving on public and level roads.** As mentioned previously, when a driver make sharp turns or drive on rough roads, the HDC may suddenly operate for these sudden shocks influencing the G sensor values. When such occurs, the driver may panic because the vehicle speed drops sharply and the driver will experience difficulty in controlling the vehicle.

4. **During the HDC operation, a loud noise and the vehicle vibration may occur from the HECU and the brake system, but this is a normal condition during the HDC operation.**

5. **The warning lamp flashes and warning beep sounds when the ESP is operating**

   When the ESP operates during vehicle movement, the ESP warning lamp on the instrument panel flashes and beep comes on every 0.1 seconds. The ESP system is only a supplementary device for comfortable driving. When the vehicle exceeds its physical limits, it cannot be controlled. Do not rely on the system. Keep on the safe driving.

6. **Feeling when ESP is working**

   When the ESP system activates, the feeling can be different depending on vehicle driving conditions.

   For example, you will feel differently when the ESP system is activated during the ABS is operating with the brakes applied and when the brakes are not applied on a curve.

   If the ESP system operates when the brake is applied, the brake pressure will be increased on the corresponding wheel which already has braking pressure for the ESP controls.

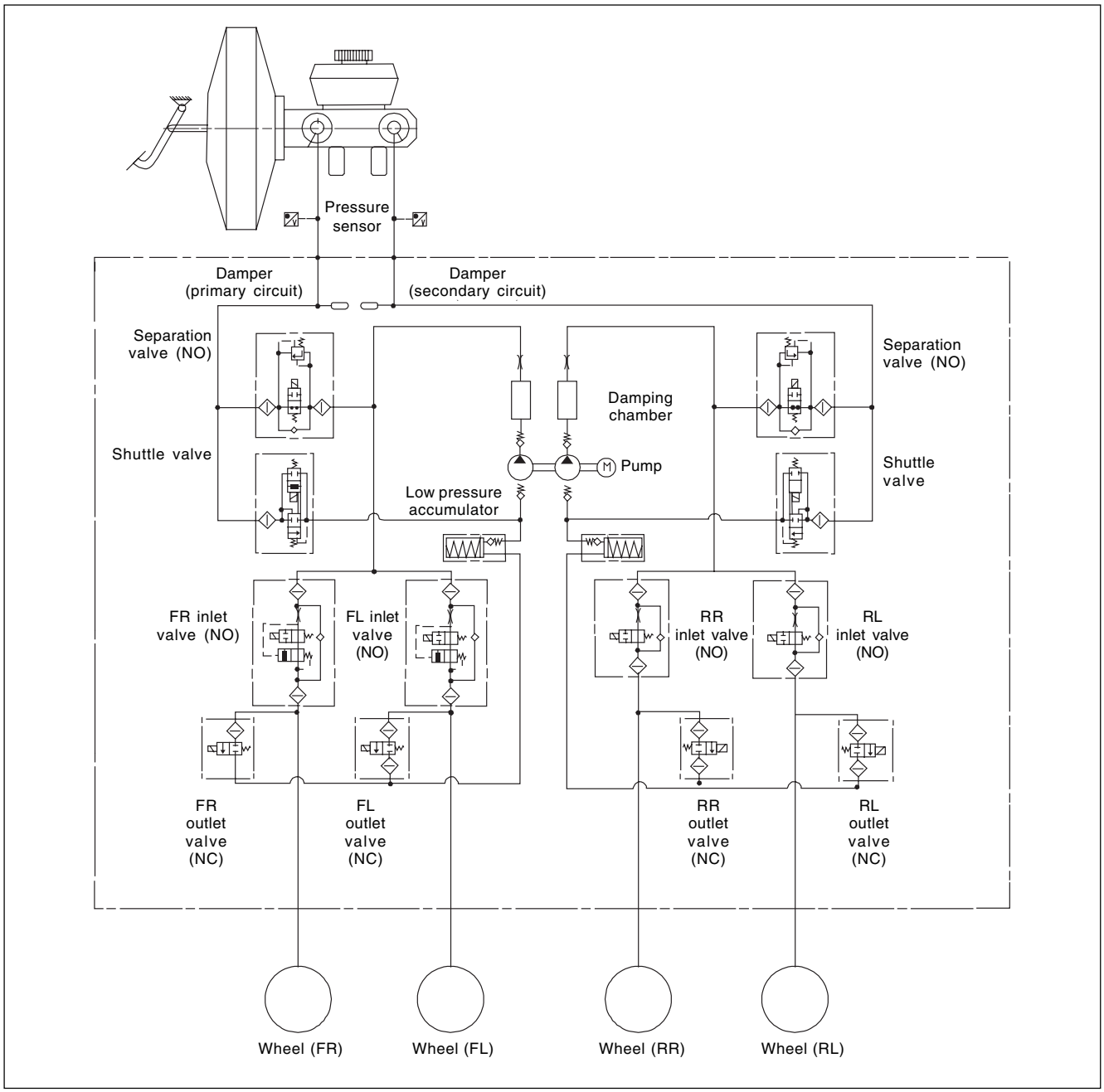
7. **Noise and vibration that driver feels when ESP system is operating**

   The ESP system may transfer noise and vibration to the driver due to the pressure changes caused by the motor and valve operations in a very short period of time. And, keep in mind that the output and vehicle speed could be decreased without rpm increase due to the ASR function that controls the engine power.

8. **ARP Operation**

   During the ARP operation, vehicle safety (rollover prevention) takes the first priority and thus, stronger engine control is in effect. Consequently, the vehicle speed decreases rapidly, so the driver must take caution for the vehicle may drift away from the lane.

10. HYDRAULIC CIRCUIT DIAGRAM

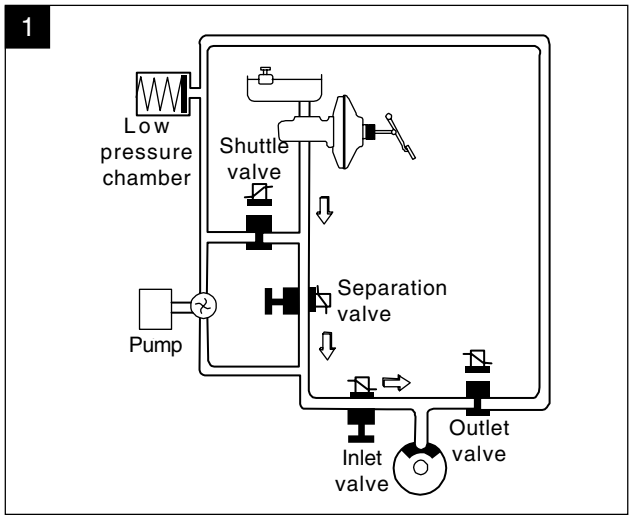


If the vehicle is equipped with ABS, the braking force at each wheel will be controlled with 3-channel 4-sensor method. Also, if the vehicle is equipped with ESP, 4 wheels will be controlled independently with 4-channel method. (When controlling ABS system only, it will be operated with 3-channel method.) When compared to the vehicle equipped with ABS only, the internal hydraulic circuit has a normally-open separation valve and a shuttle valve in primary circuit and in secondary circuit. When the vehicle brakes are not applied during engine running or when applying the non-ABS operating brakes, the normally-open separation valve and the inlet valve are open, whereas the normally-closed shuttle valve and the outlet valve are closed. When the ESP system is operating, the normally-open separation valve will be closed by the solenoid valve operation and the hydraulic circuit will be established by the shuttle valve. Then, the inlet and outlet valves will be closed or open depending on the braking pressure increase, decrease or unchanged conditions.

For details, refer to **"Hydraulic Pressure for each ESP Operating Range"**.

11. HYDRAULIC PRESSURE FOR EACH ESP OPERATING RANGE

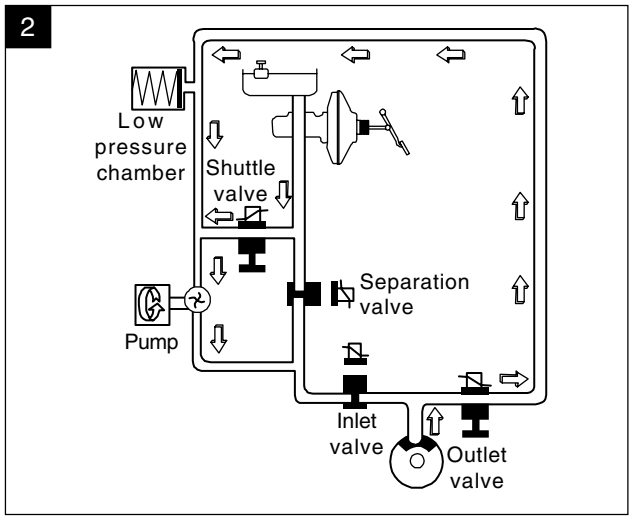
ESP Hydraulic unit in idling and normal braking position



In this position, the separation valve and the inlet valve are open (normal open), the electrically operated shuttle valve and the outlet valve are closed.

When the brake is applied under these conditions, the brake fluid will be sent to each wheel via the separation valve and inlet valve.

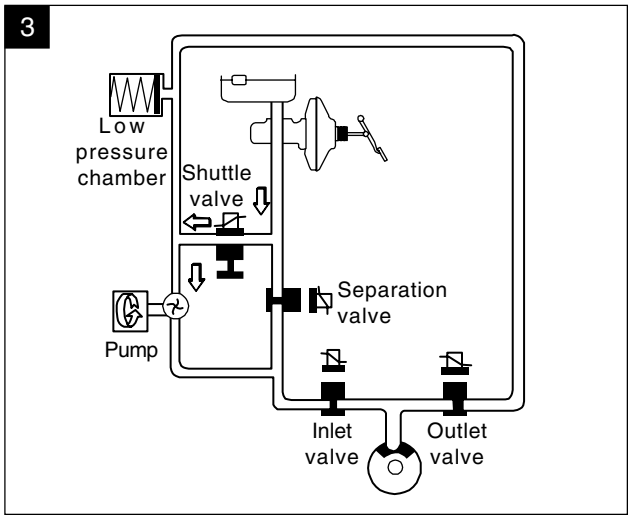
ESP Hydraulic unit (decreased pressure)



The pressure decreases just before the wheel speed drops and the wheels are locked. The inlet valve closes and the outlet valve opens as in the ABS HECU and the oil is gathered at the low pressure chamber while no additional oil is being supplied. Then the pump operates to allow fast oil drainage.

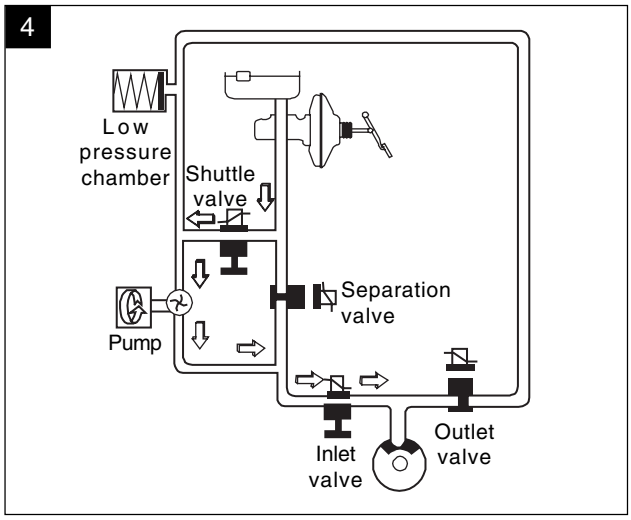
The shuttle valve and the separation valve do not operate while decompression.

ESP unit circuit (when the pressure is maintained)



The Inlet valve and outlet valve will be closed to maintain the pressure in the hydraulic circuit applied at the wheels. By closing the valves, the hydraulic pressure at the wheels will not be lost or supplied any more. During ESP operation, the separation valve closes and only the shuttle valve at the pump opens.

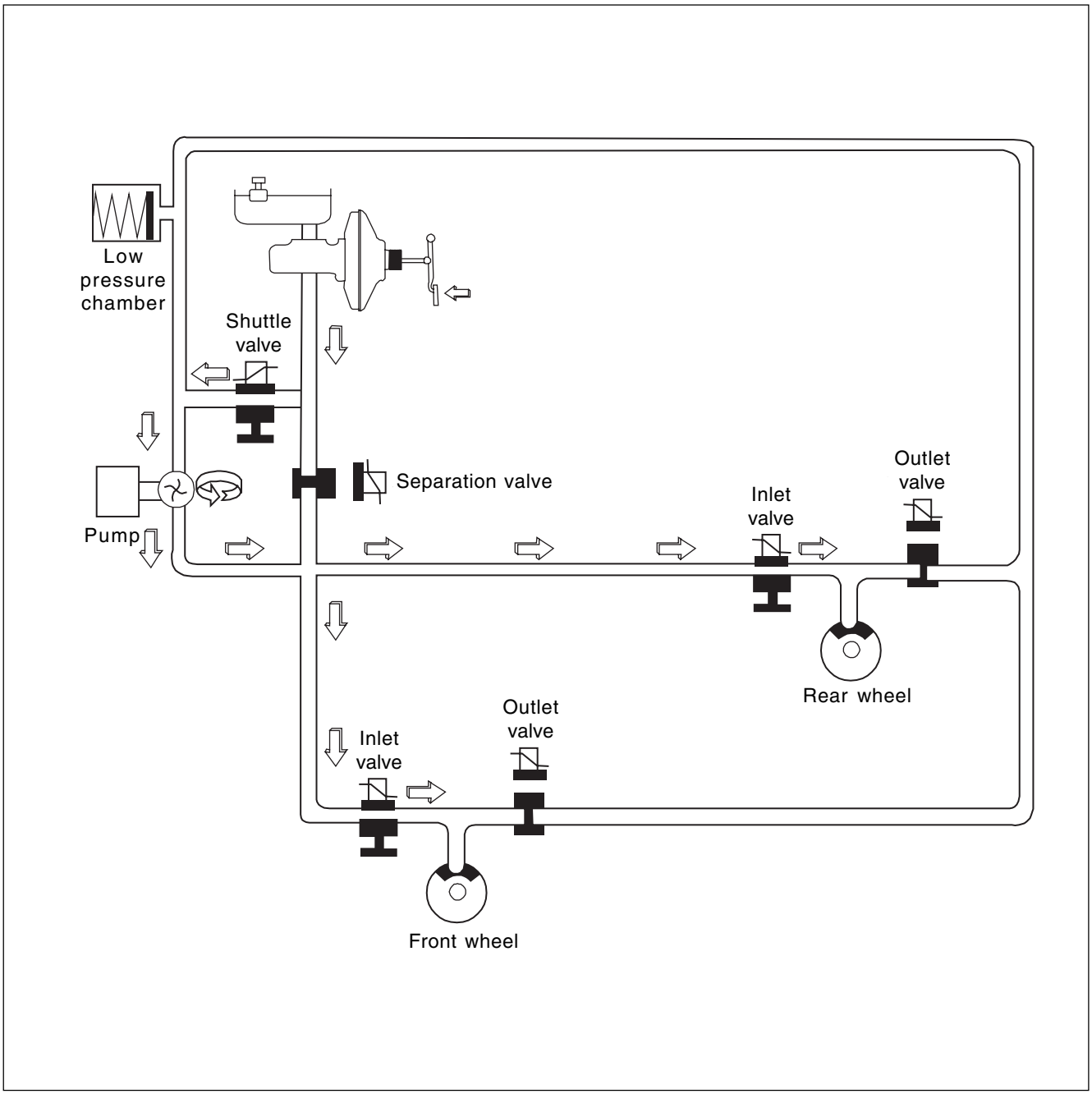
ESP unit circuit (when the pressure is increased)



The shuttle valve and inlet valve will be open and the separation valve and outlet valve will be closed. Then, the pump is operated.

When ESP operates while the ABS is operating, the pressure will be increased continuously until just before the corresponding wheel gets locked.

12. HYDRAULIC CIRCUIT OF BAS (BRAKE ASSIST SYSTEM)



The above figure shows one front and one rear wheel and the same hydraulic circuit forms as in the ESP operation.

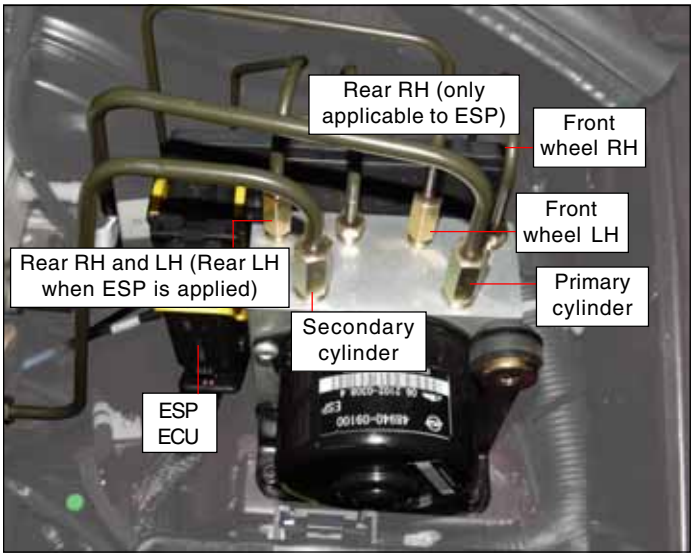
When HECU recognizes that it is an emergency and it is required for hard braking, depending on the pressure value of the brake pressure sensor and pressure changes caused by the pressure sensor timing, it operates the pump immediately to apply the brake pressure at the wheels. Then, the pressure in the pump increases until just before the corresponding wheel gets locked. The motor still keeps rotating and the outlet valve and the separation valve will stay closed.

When the wheel starts to lock, the BAS function cancels and switches to ABS operation.

13. COMPONENTS DESCRIPTION

▶ HECU (Hydraulic & Electronic Control Unit)

1. HECU installed in a vehicle

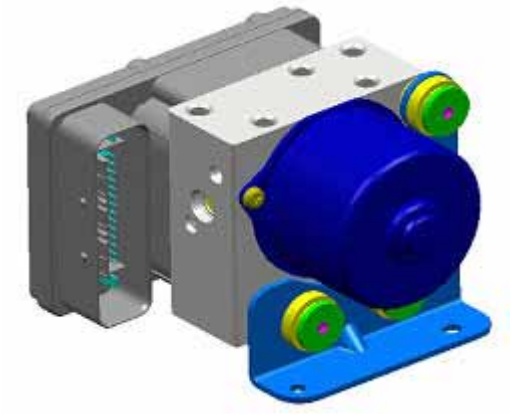


HECU consists of motor pump, solenoid valve and ECU including solenoid valve.

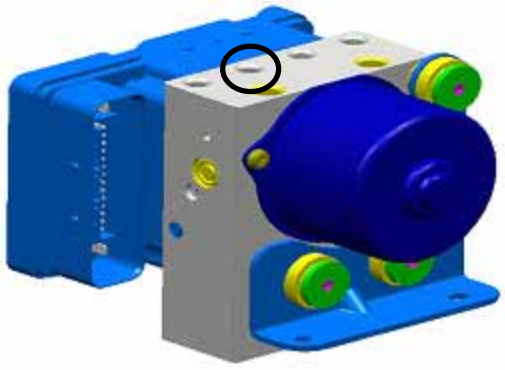
ECU connector has 47 pins and the number of valves in valve body is 12 (with ESP) or 6 (only with ABS).

2. Comparison of ESP HECU and ABS/EBD HECU

ABS HECU



ESP HECU



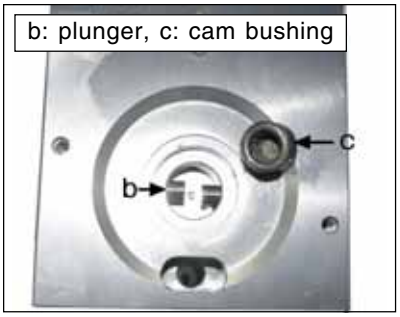
3. Other components



HECU internal valve



Pump Motor



Valve Body

Removal and Installation

1. Disconnect the negative battery terminal.
2. Disconnect the ESP unit connector.



3. Disconnect the primary and secondary pipes between HECU and master cylinder.

Tightening torque

Master cylinder to HECU	13 ~ 20 Nm



4. Disconnect the front and rear wheel brake pipes.

Tightening torque

HECU to each hydraulic line	13 ~ 20 Nm



NOTICE

- **Be careful not to damage the HECU pipes and nut threads when reinstalling.**

5. Unscrew two mounting nuts and remove the HECU.

Tightening torque

HECU mounting nut	4 ~ 8 Nm



NOTICE

- **Do not disassemble the removed HECU. Remove any foreign material on the openings of hydraulic pipe and seal it with tape.**

6. Install in the reverse order of removal.
7. Replenish with brake fluid and bleed air after installation. Refer to "Bleeding Using SCAN-100" section.

NOTICE

- **No coding is required when installing new HECU to the vehicle since it has automatic coding function. When installing HECU to another vehicle for test or any other reason, it is automatically coded with the vehicle's data.**

8. Perform the variant coding.

9. Perform the sensor cluster calibration using "SCAN-100".
   For the calibration procedure, refer to "Sensor calibration".

NOTICE

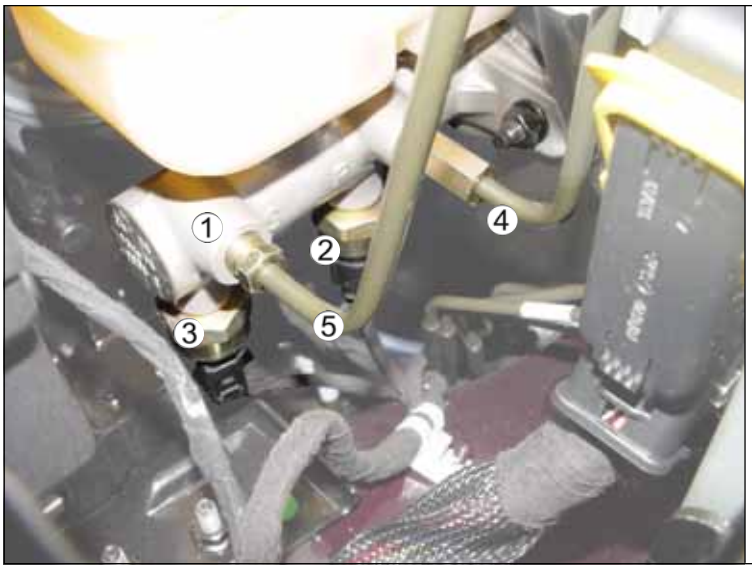
- **Perform the variant coding and sensor cluster calibration if HECU or sensor cluster is replaced.**

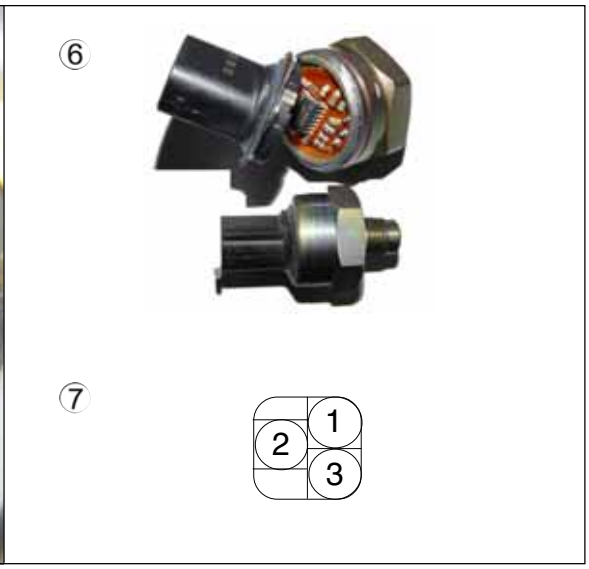
Removal and Installation of Wheel Speed Sensor

Refer to "Wheel Speed Sensor in ABS system".

▶ Pressure Sensor

Location



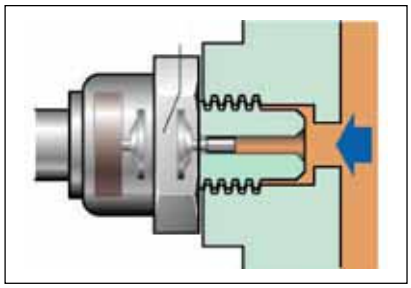


1. Master cylinder
2. Primary pressure sensor
3. Second pressure sensor
4. Hydraulic pipe in primary circuit
5. Hydraulic pipe in secondary circuit
6. Inside of pressure sensor
7. Connector

Specifications

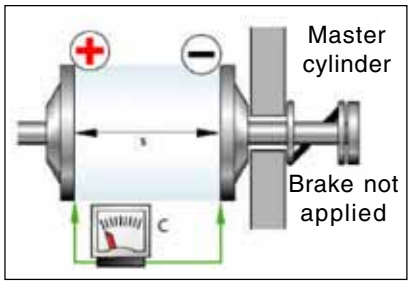
Supplying voltage	4.75 ~ 5.25 V
Output voltage	0.25 ~ 4.75 V (This is linearly changed from 0.5 V (brake not applied) to 4.75 V (brake applied))
Operating pressure range	0 ~ 170 bar

Description



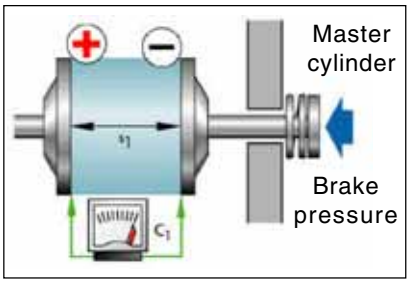
Two sensors installed in the lower side of the master cylinder consist of two ceramic discs, one disc is stationary and the other is moved according to the brake pressure.

The pressure value of the brake and the change value of the pressure sensor are operating conditions for BAS operation.



The distance (S) between the two ceramic discs with different polarity changes as the pressure changes of the brake. Due to this change the capacitance changes and it is measured in the voltage value.

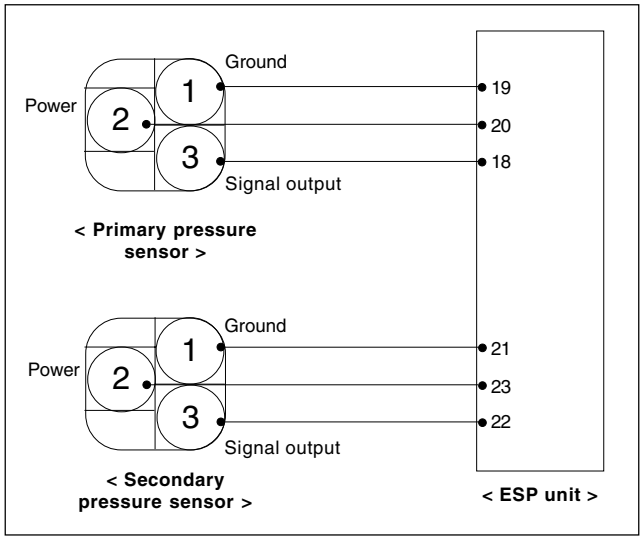
The voltage value is approx. 0.5 V when the brake is not operated.



When brake pressure is applied from the master cylinder, the ceramic disk moves towards the fixed ceramic disk and the electric charge volume changes accordingly.

The voltage value is linearly changed from 0.5 V (brake not applied) to 4.75 V (brake applied).

Pressure Sensor Circuit



The ESP unit supplies around 5V power to two pressure sensors installed on the ESP system when the ignition switch is ON.

Each sensor's pin no. 1 is its ground and pin no. 3 outputs the sensor output voltage to the ESP unit. When the brake is not in operation, this voltage is about 0.5V and, during the brake operation it increases linearly to about 0.5 ~ 4.75V.

BAS operating conditions:

1. Pressure: 20 bar

2. Pressure changes: over 1500 bar/sec

3. Vehicle speed: over 7 km/h

Removal and Installation

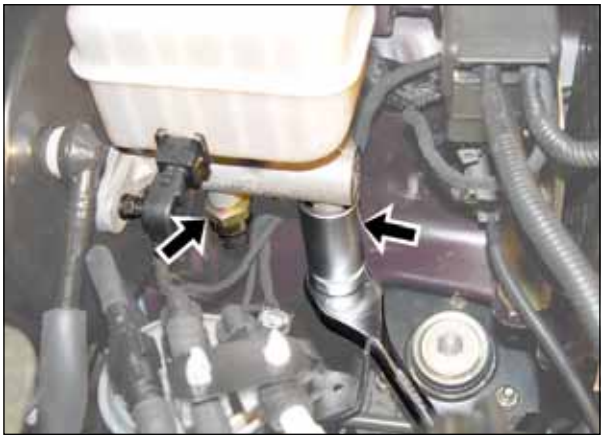
1. Disconnect the battery negative terminal.
2. Remove the connector of the pressure sensor.



3. Remove the fuel filter bracket to remove the pressure sensor. Remove the fuel filter bracket.



4. Place an empty container under the pressure sensors to collect the oil.
5. Remove the primary and secondary pressure sensors.



When installing

Tightening torque	33 ~ 37 Nm

6. Install in the reverse order of removal.
7. Bleed the brake system after installation.

▶ Sensor Cluster

Location



Installed sensor cluster



1. Center fascia panel
2. Sensor cluster

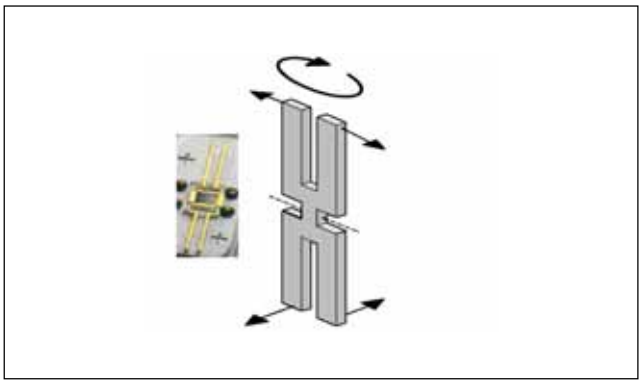
Specification (Sensor cluster: Yaw rate sensor + Lateral acceleration sensor + Longitudinal acceleration sensor)

Supplying voltage	Approx. 5V (4.75 ~ 5.25V)
Output voltage during stopping	Approx. 2.5V (Ignition switch “ON”)
Yaw rate sensor operating range	-75°/S ~ +75°/S
Lateral acceleration sensor operating range	-1.7 ~ +1.7g (16.7m/s^2)
Longitudinal acceleration sensor operating range	-1.7 ~ +1.7g (16.7m/s^2)

Sensor Cluster Operation and Principles

The lateral sensor, longitudinal sensor and the yaw rate sensor are integrated into the sensor cluster. There is an additional electronic circuit to send and receive the internal data to/from the CAN communication.

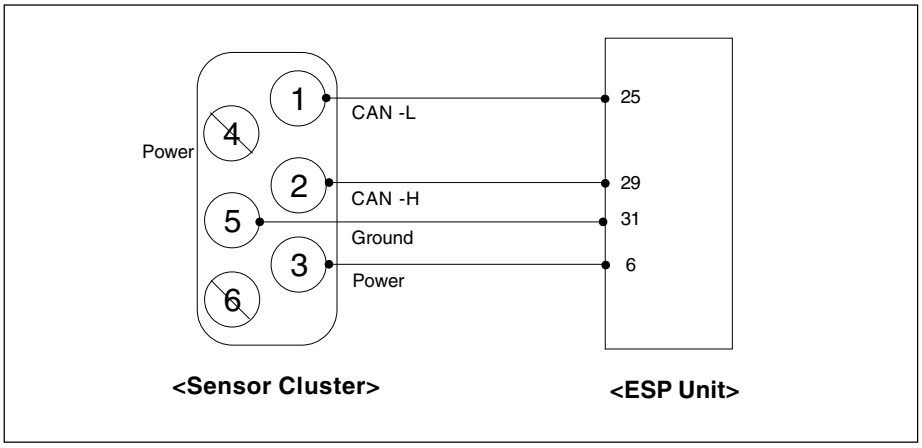
During the vehicle cornering, the microscopic tuning forks installed in the yaw rate sensor detects the yaw rate (acceleration around the vertical axis of the vehicle) and transmits it through the CAN communication line to the ESP unit, using the electronic signal. Especially, the longitudinal acceleration sensor detects the slope level of the driving road and provides important information for the HDC operation.



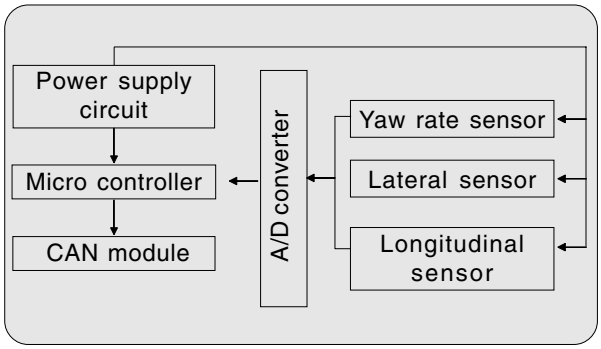
The Microscopic tuning forks in the yaw rate sensor measures the acceleration on the vertical axis of the vehicle. When the angular acceleration occurs on the vertical axis of the vehicle (Z axis) and this acceleration occurs more than 4° (4 degree) per second, vibration occurs at the top and bottom as shown in the figure. This vibration is transmitted through the CAN communication line by the form of voltage value. In other words, it detects the yawing of the vehicle.

The ESP control operates when a divergence occurs between the vehicle yawing and the steering angle (i.e. the ESP operates when the driver's intended position differs from the vehicle position). Therefore, the occurrence of vehicle yawing does not imply the ESP operation.

Pressure Sensor Circuit



The ESP sensor cluster can be considered as one module. The measured value by lateral/longitudinal and yaw rate sensors is transmitted to ESP unit via two CAN lines. The supplied voltage from ESP unit is approx. 5 V with ignition key "ON" and the output range through CAN line is approx. 0.2 ~ 4.8 V. When a sensor is faulty, the sensor cluster produces an output signal of 0 V (fail safe function in the yaw rate sensor).



< Internal electric circuit of sensor cluster >

Removal and Installation of Sensor Cluster

※ **Preceding Work:** Disconnect the negative battery cable.

1. Separate the center fascia panel and disconnect the connector to remove the center fascia panel.

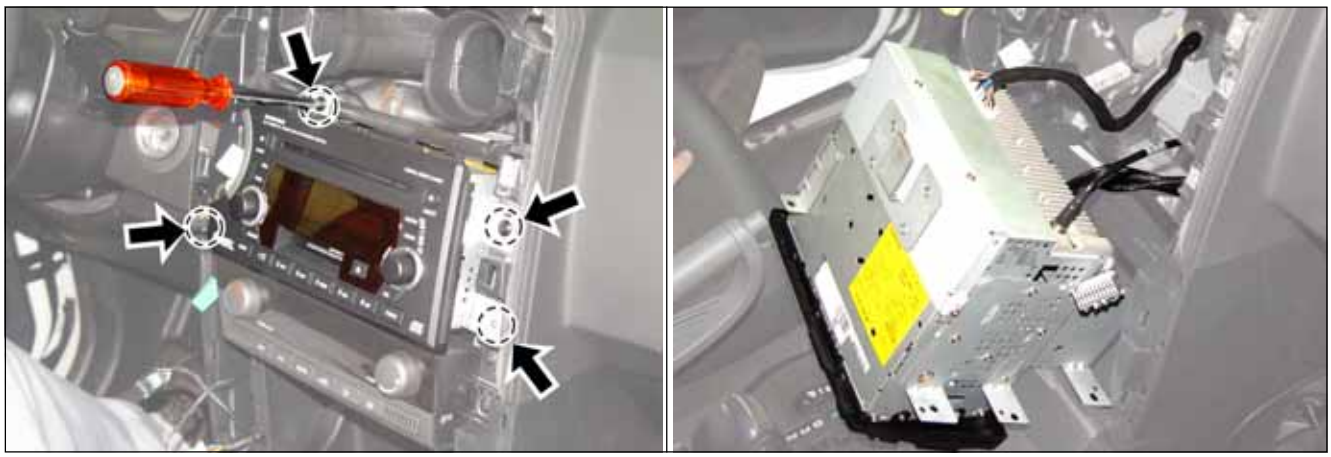


2. Unscrew two A/C controller mounting screws and remove the A/C controller.



3. Remove the mounting screw and disconnect the connectors to remove the AV head unit assembly.

NOTE
- **AV head unit may have different connectors according to the specifications.**



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Unscrew the cluster mounting bolts at both sides and disconnect the connector.



When installing

Tightening torque	10 Nm

5. Install in the reverse order of removal.



NOTICE

- **The installing direction and location are very important when installing the sensor cluster. Make sure that there are not any foreign material and interference with floor carpet on the mounting surface.**
- **Sensors are integrated into the sensor cluster. Therefore, be careful not to impact on them when removing and installing.**

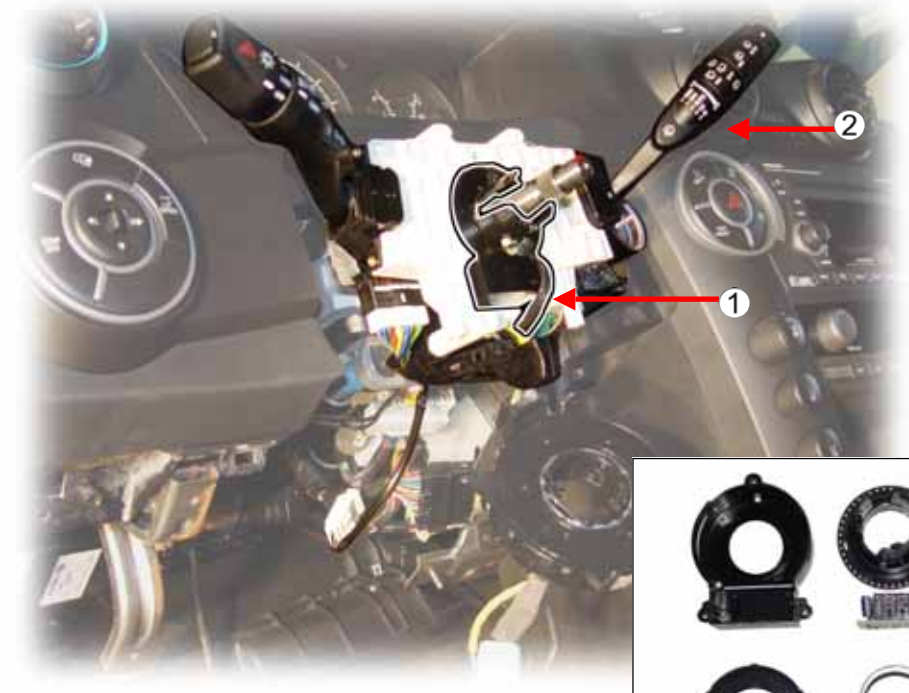
6. Make sure to perform the sensor cluster calibration after replacing the sensor cluster.

   For the calibration, refer to "Sensor Calibration (Initialization)".

▶ SWAS: Steering Wheel Angle Sensor

Location of Steering Wheel Angle Sensor

SWAS is installed at the bottom of air bag clock spring in steering wheel and sends the steering angle signal to ESP HECU.





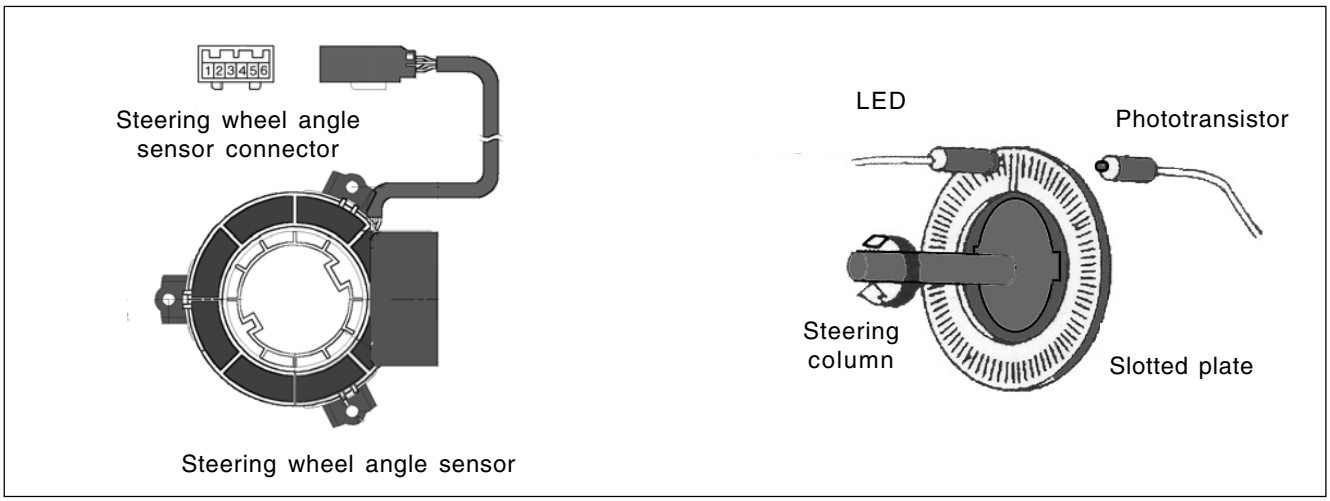
1. SWAS (Steering Wheel Angle Sensor)
2. Multifunction switch assembly

NOTICE

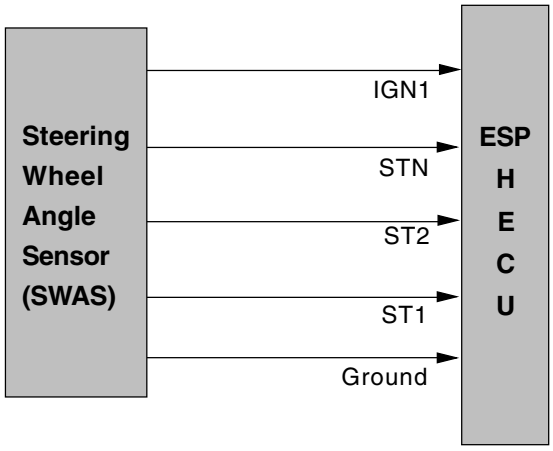
- **For removal and installation, refer to "Removal and Installation of Multifunction Switch" section.**

Specifications

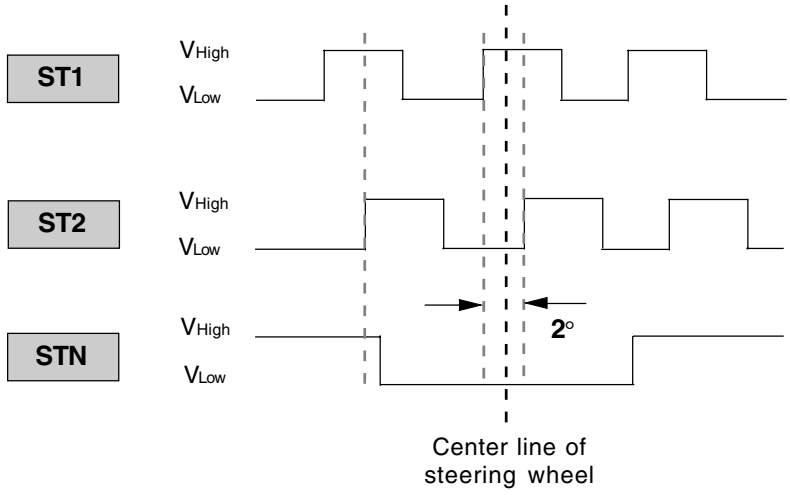
Working voltage	9 ~ 16 V
Max. output current	10 mA
Detected max. angular velocity	1500°/S
Working temperature	- 30 ~ 75°C
Supplying voltage	9 ~ 16 V (battery voltage)
Output voltage (HI)	Approx. 3.50 V (3.0 ~ 4.1 V)
Output voltage (LO)	Approx. 1.50 V (1.3 ~ 2.0 V)



The steering wheel angle sensor is integrated with the phototransistor and the LED and there is a slotted plate between them. When the inner slotted plate rotates with the steering column shaft when the steering wheel is turned, the voltage occurs through the holes. The detected voltage will be transmitted to the HECU as a pulse from the 3 terminals. Then, the two voltage pulses are used to get the average value for detecting the steering wheel position and its angle speed. And the other pulse is used for checking the alignment of the steering wheel.



Supplying voltage	9 ~ 16 V
Number of pulse per revolution	45 Pulses /1 rev
Duty	Approx. 50 %
High - V	3.0 ~ 4.1 V
Low - V	1.3 ~ 2.0 V
ST1 and ST2	Detects steering wheel angle and angular velocity as an average value
STN	Detects the center value of steering wheel



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

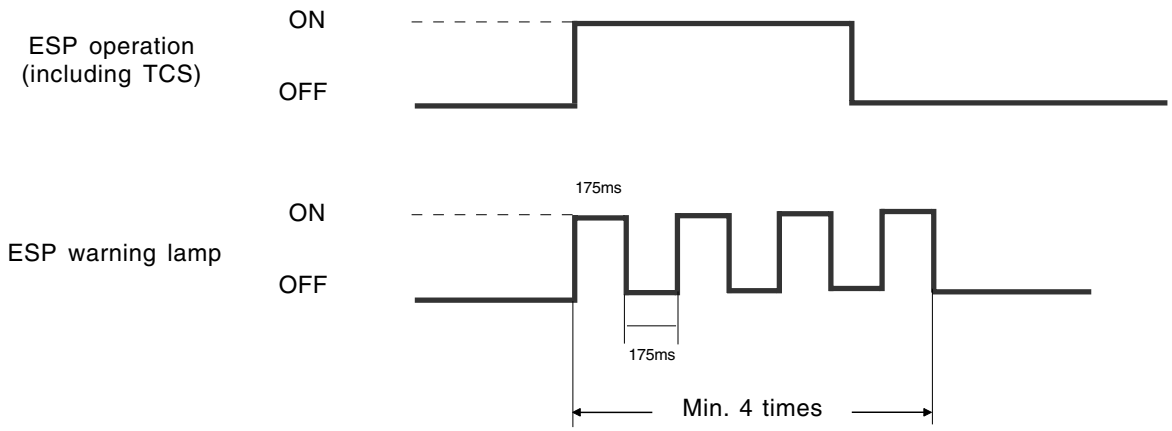
▶ ESP OFF Switch

Location



ESP Warning Lamp Blinking in Control

ESP warning lamp blinks and a beep sounds when ESP control is activated. The ESP warning lamp goes off when ESP function is deactivated. Even when the ESP is operated for a very short period of time, the ESP warning lamp blinks minimum of 4 times every 175 milliseconds. ESP function is a supplementary device to adjust the vehicle position when it is unstable. Therefore, when ESP warning lamp blinks and a beep sounds, lower the speed and pay attention to the safe driving.



ESP System Cancellation Using the ESP OFF Switch

When the ESP OFF switch is pushed (for over approximately 150 ms), the ESP system will be cancelled and the vehicle will be driven regardless of the output values from the corresponding sensors. Then, the ESP warning lamp on the instrument panel comes on. (However, the ARP function still operates.)

The detailed operation procedures are as follows:

1. The ESP warning lamp comes on when the ESP OFF switch is pushed for over 150 ms.
2. The switch returns to normal position when the OFF switch is released.
3. The ESP system will be cancelled after approximately 150 ms.

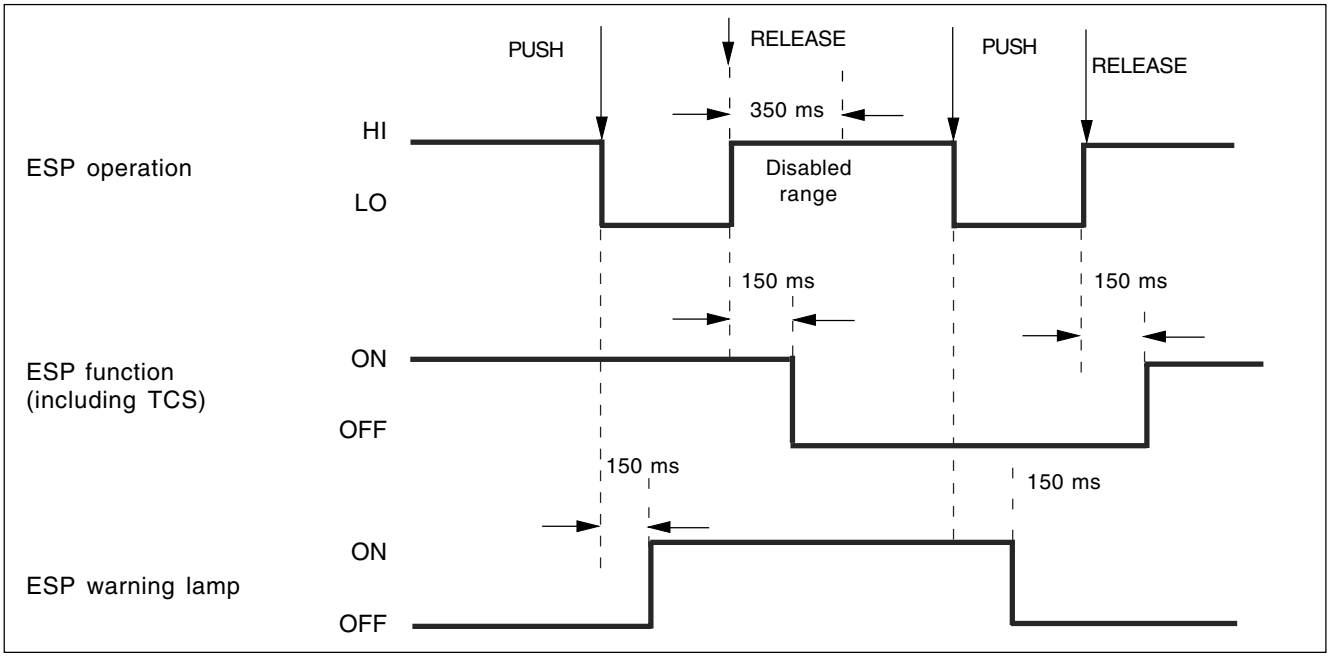
Based on the above procedures, we can see that the ESP system will be cancelled after a certain period (approx. 150 ms) from releasing period of the switch to the original position. The ESP system does not get cancelled immediately when the ESP warning lamp is turned on by pressing the ESP OFF switch. When you turn the ESP system off by pressing the ESP switch for over 150 ms, the TCS system (including ABD function) is turned off. **And the ABS system is still operated.**

Resuming the ESP System by Using the ESP OFF Switch

The ESP system will be resumed and the ESP warning lamp at the instrument panel goes off when the ESP switch is pushed (for over approximately 150 ms) while the ESP system is not operating and the ESP warning lamp is on.

The detailed operation procedures are as follows.

1. The ESP warning lamp goes off when the ESP OFF switch is pushed for over 150 ms.
2. The switch returns to normal position when the OFF switch is released.
3. The ESP system will be resumed after approx. 150 ms.

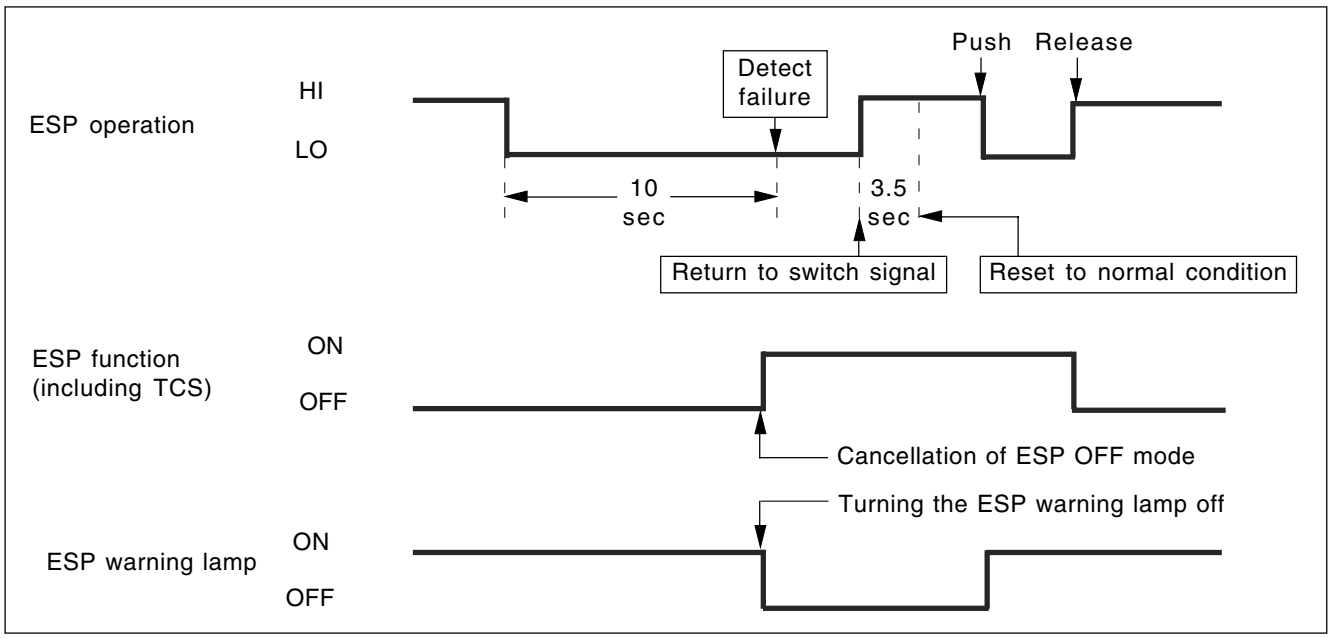


NOTICE

- **If turning the ignition switch off while the ESP system is activated or deactivating the ESP system, the ESP system will be resumed when ignition switch is turned on again.**
- **When the vehicle is controlled by ESP system during driving, the ESP OFF switch does not operate.**
- **The ESP OFF switch operates when it is pushed for over 150 ms. When it is pushed for less than 150 ms, the ESP OFF mode and the ESP warning lamp will not be changed.**
- **When the ESP OFF switch is pushed within 350 ms of being turned off, the ESP warning lamp and ESP system will not be turned on.**
- **The ARP function still operates after turning off the ESP system.**

ESP OFF Switch Monitoring

When the ESP unit recognizes that the ESP OFF switch is pushed for over 10 seconds, the ESP unit determines it as a ESP OFF switch malfunction. When the ESP OFF switch is pushed, the ESP system is resumed after 10 seconds. However, the ESP warning lamp comes on when the ESP OFF switch is pushed (for over 150 ms) and then goes out when the ESP system is resumed. When the ESP OFF switch returns to normal position, the ESP unit resets the ESP OFF switch for approx. 3.5 seconds.



ESP Warning Lamp Operation Depending on System Conditions

The table shows ESP warning lamp operations when the ESP system is defective or ESP (including TCS function) is working.

	Warning Lamp		Controls			
	ABS W/L	ESP W/L	ABS	ASR	ABD	Vehicle yaw control
Initial start (for 1.8 sec)	ON	ON	NO	NO	NO	NO
Normal mode	OFF	BLINKS WHEN ESP OPERATION	OK	OK	OK	OK
ESP fault	OFF	ON	OK	NO	NO	NO
ABS fault	ON	ON	NO	NO	NO	NO
System fault	ON	ON	NO	NO	NO	NO
Low battery voltage	ON	ON	NO	NO	NO	NO
High battery voltage	ON	ON	NO	NO	NO	NO
High brake pad temp.	OFF	ON	OK	NO	NO	NO
ESP-OFF mode	OFF	ON	OK	NO	NO	OK [1)]
Entering diag. mode	ON	ON	NO	NO	NO	NO

NOTICE

- **When the driver depresses the brake pedal during the ESP OFF mode, the yaw control is performed to compensate the vehicle stability (posture) during ESP operation.**

14. ESP SYSTEM AIR BLEEDING

The vehicle equipped only with ABS can use the conventional air bleeding procedure, however, the vehicle equipped with ESP should use the oil supply device using a compressor inorder to bleed the air.

▶ Air Bleeding Should be Done When

1. After removal and installation of the brake master cylinder.
2. After removal and installation of the ABS HECU.
3. After removal and installation of the brake oil pipes and hoses.
4. After replacing the brake fluid.

▶ Air Bleeding Procedures

1. Apply the parking brake and start the engine when the shift lever is at "P" position.
2. Connect the oil supply device (air bleeding device) with air compressor to brake fluid reservoir. The oil supply device should be filled with sufficient oil.
3. Loosen the air bleed screw in caliper and place an empty container under the screw.
4. Bleed the air in each wheel by using diagnostic device's air bleeding menu. At this time, the modulator motor runs for 180 seconds.
5. Simultaneously, run the oil supply device to supply oil and depress the brake pedal repeatedly.

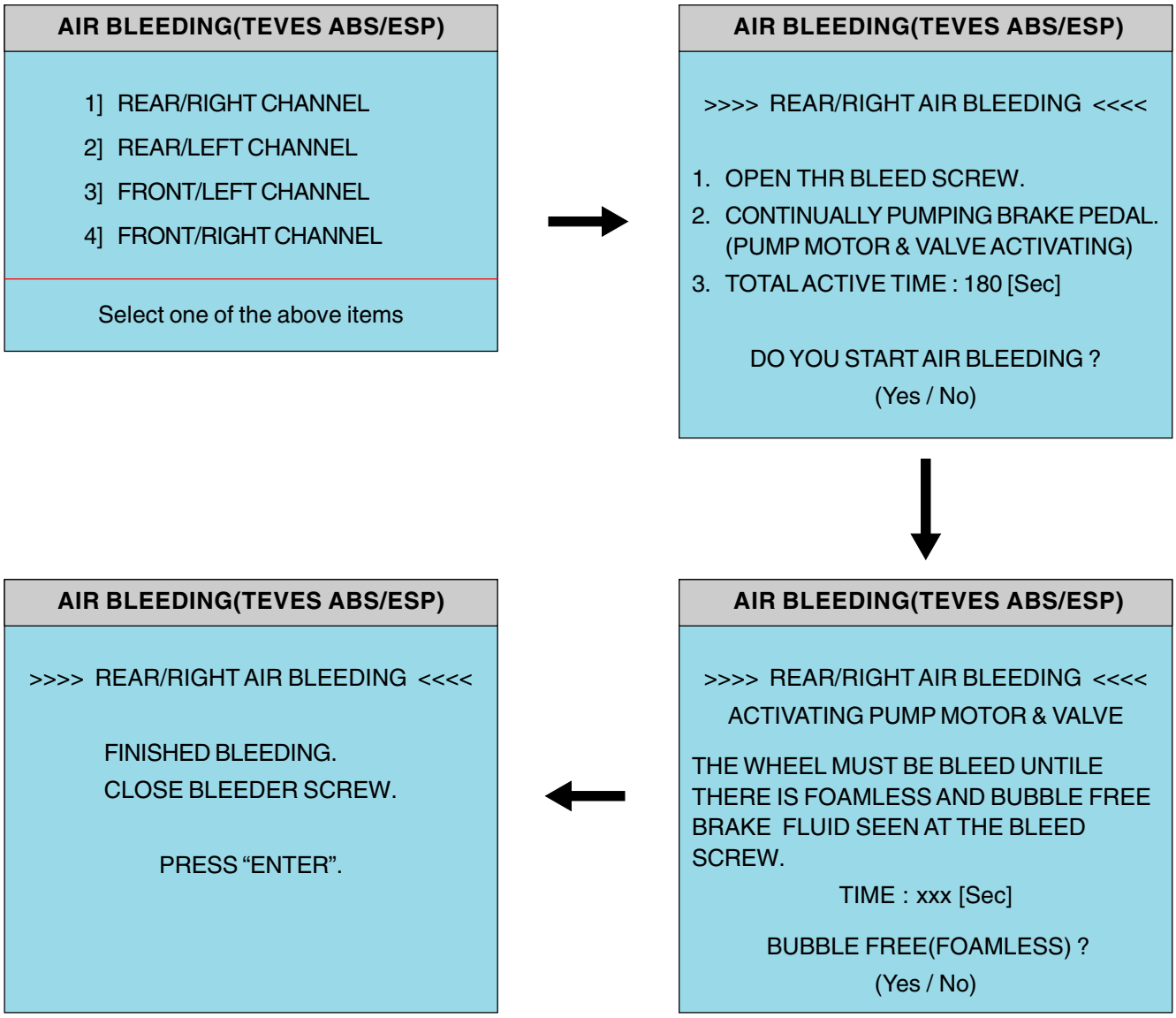
   This procedure needs at least 3 persons for doing below jobs:

   a. Collect the bleeding oil from the air bleed screw into the container.
   b. Depress the brake pedal repeatedly.
   c. Check the conditions of oil supply device.

   The air bleeding procedure should be started from the rear right wheel.

6. Repeat the step 4 through 5 until clear brake fluid comes out of air bleed screw.
7. Perform the same procedures at each wheel.

▶ Air Bleeding by Using Scan-100



15. SENSOR CALIBRATION AND FORCED OPERATION OF ACTUATOR AND SENSOR VALUE

▶ Sensor Calibration (Initialzation)

SENSOR INITIALIZE (ABS/ESP)
ACTUATOR TEST 1. LONGITUDINAL SENSOR (Only ABS & ESP) 2. LATERAL SENSOR (Only ESP) 3. PRESSURE SENSOR (Only ESP) 4. ABOVE 1,2,3 ALL SENSOR (Only ABS & ESP) 5. STEERING WHEEL ANGLE SENSOR (Only ESP)
Select one of the above items

→

SENSOR INITIALIZE
LONGITUDINAL ACCEL SENSOR (4WD only) DO YOU START INITIALIZE ? (Yes/No) CONDITION : - ENGINE IS NOT RUNNING. - VEHICLE STATUS IS FLAT. - DO NOT PUT THE BRAKE PEDAL. PROCEDURE : MUST BE FOLLOW THE ABOVE CONDITION. IF YOU START "INITIALZE SENSOR" ADAPT TO AUTOMATIC. Initialize both the primary and secondary pressure sensors when initializing a pressure sensor.

■ Steering wheel angle sensor

The steering wheel angle sensor automatically searches for a center position when the vehicle is driving straight forward with 20 km/h of driving speed (no additional diagnostic menu).

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EFFECTIVE DATE	
AFFECTED VIN	

▶ Actuator

ACTUATOR TEST

↓

ACTUATOR TEST

1. FRONT/LEFT INLET VALVE
2. FRONT/LEFT OUTLET VALVE
3. FRONT/RIGHT INLET VALVE
4. FRONT/RIGHT OUTLET VALVE
5. REAR(ESP: REAR/LEFT) INLET VALVE
6. REAR(ESP: REAR/LEFT) OUTLET VALVE
7. REAR/RIGHT(Only ESP) INLET VALVE
8. REAR/RIGHT(Only ESP) OUTLET VALVE
9. 1st TCS VALVE(Only ESP)
10. 2nd TCS VALVE(Only ESP)
11. 1st ESV VALVE(Only ESP)
12. 2nd ESV VALVE(Only ESP)
13. PUMP MOTOR

Select one of the above items

↓

FRONT/LEFT INLET VALVE

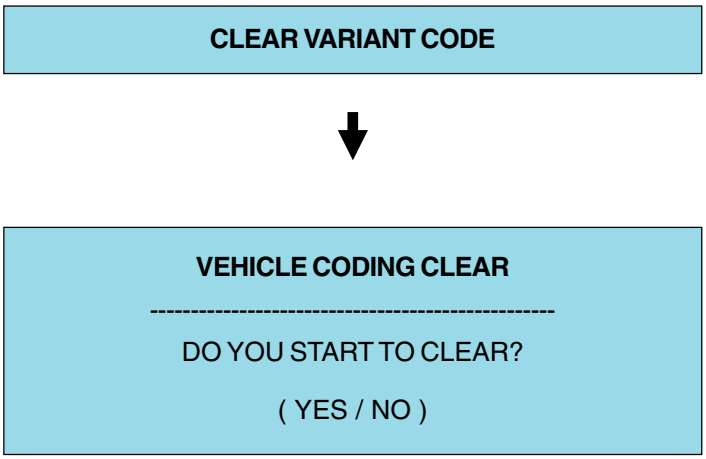
ON(ACTIVE): “YES” KEY
OFF(STOP): “NO” KEY

OTHER ITEM : “ △, ▽ ”

ACTIVE TIME : Max. 10 Sec

CONDITION : IG. ON or IDLE

▶ Clearing Code



▶ ABS/ESP Sensor Value

No	Content	Unit	ESP	ABS
1	Wheel Speed FR	0.1 km/h	O	O
2	Wheel Speed FL	0.1 km/h	O	O
3	Wheel Speed RR	0.1 km/h	O	O
4	Wheel Speed RL	0.1 km/h	O	O
5	Battery Voltage	0.1 V	O	O
6	Longitudinal Acceleration Sensor	0.01 g-: Straight ahead	O	O
7	Lateral Aceleration Sensor	0.01 g +: Left Turn	O	X (Fixed Value: 0)
8	Yaw Rate Sensor	0.5 deg/s +: Left Turn	O	X (Fixed Value: 0)
9	Steering Wheel Angle sensor	5 deg +: Left Turn	O	X (Fixed Value: 0)
10	Pressure Sensor (Primary)	1 bar	O	X (Fixed Value: 0)
11	Pressure Sensor (Secondary)	1 bar	O	X (Fixed Value: 0)
12	EBD Control	Operation / Non-operation	O	O
13	BTCS Control	Operation / Non-operation	O	X (Fixed Value: 0)
14	Engine TCS Control	Operation / Non-operation	O	X (Fixed Value: 0)
15	ESP Control	Operation / Non-operation	O	X (Fixed Value: 0)
16	ESP/TCS OFF Switch	ON / OFF	O	X (Fixed Value: 0)
17	ABS Control	Operation / Non-operation	O	O
18	Stop Lamp Switch	ON / OFF	O	O

(O: Applied, X: N/A)

▶ ABS / ESP Forced Operation

No	Name	Operation
1	FL Inlet Valve	Operation / Non-operation
2	FL Outlet Valve	Operation / Non-operation
3	FR Inlet Valve	Operation / Non-operation
4	FR Outlet Valve	Operation / Non-operation
5	Rear (or RL) Inlet Valve (*1)	Operation / Non-operation
6	Rear (or RL) Outlet Valve (*1)	Operation / Non-operation
7	RR Inlet Valve (*2)	Operation / Non-operation
8	RR Outlet Valve (*2)	Operation / Non-operation
9	TCS Valve Primary (*3)	Operation / Non-operation
10	TCS Valve Secondary (*3)	Operation / Non-operation
11	ESV Valve Primary (*3)	Operation / Non-operation
12	ESV Valve Secondary (*3)	Operation / Non-operation
13	-	-
14	-	-
15	Motor Pump	Operation / Non-operation

16. ABS/ESP TROUBLE DIAGNOSIS

o: Applied x: N/A

Function	Defective Components	Trouble Code	Descriptions	System	
Sensor Monitoring	**Front LH Wheel speed sensor**	C1011 C1012	Wheel speed sensor front left-electrical Wheel speed sensor front left-other	**ABS**	**ESP**
	1. C1011 **Cause** - Defective front LH wheel speed sensor - Short or poor contact wire to sensor **Action** - Check the connection of the wheel speed sensor connector - Check the connection of HECU connector - Check the harness connection **2. C1012** **Cause** - Defective front LH wheel speed sensor - No signals from wheel speed sensor and tooth wheel - Too large air gap between wheel speed sensor and tooth wheel - Different number of teeth in tooth wheel **Action** - Check the wheel speed sensor connector - Check the connection of HECU connector - Check air gap between wheel speed sensor and tooth wheel and tooth wheel mounting (Specified air gap: 0.475 ~1.425 mm (2WD), 0.1 ~ 0.7 mm (4WD)) - Check the number of teeth (48) in tooth wheel			**O**	**O**
	Front RH Wheel speed sensor	C1021 C1022	Wheel speed sensor front right-electrical Wheel speed sensor front right-other	**ABS**	**ESP**
	1.C1021 **Cause** - Defective front RH wheel speed sensor - Short or poor contact wire to sensor **Action** - Check the connection of the wheel speed sensor connector - Check the connection of HECU connector - Check the harness connection **2.C1022** **Cause** - Defective front RH wheel speed sensor - No signals from wheel speed sensor and tooth wheel - Too large air gap between wheel speed sensor and tooth wheel - Different number of teeth in tooth wheel **Action** - Check the wheel speed sensor connector and HECU connector - Check air gap between wheel speed sensor and tooth wheel and tooth wheel mounting (Specified air gap: 0.475 ~ 1.425 mm (2WD), 0.1 ~ 0.7 mm (4WD)) - Check the number of teeth (48) in tooth wheel			**O**	**O**

<table>
<tr><th>Function</th><th>Defective Components</th><th>Trouble Code</th><th>Descriptions</th><th colspan="2">System</th></tr>
<tr><td rowspan="4">Sensor Monitoring</td><td>Rear RH
Wheel speed sensor</td><td>C1031
C1032</td><td>Wheel speed sensor rear left-electrical
Wheel speed sensor rear left-other</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3">1. C1031
<u>Cause</u>
- Defective rear RH wheel speed sensor
- Short or poor contact wire to sensor
<u>Action</u>
- Check the connection of the wheel speed sensor connector
- Check the connection of the HECU connector
- Check the harness connection
2. C1032
<u>Cause</u>
- Defective rear RH wheel speed sensor
- No signals from wheel speed sensor and tooth wheel
- Too large air gap between wheel speed sensor and tooth wheel
- Different number of teeth in tooth wheel
<u>Action</u>
- Check the wheel speed sensor connector
- Check the connection of the HECU connector
- Check air gap between wheel speed sensor and tooth wheel and tooth wheel mounting (Specified air gap: 0.425 ~ 1.175 mm)
- Check the number of teeth (48) in tooth wheel</td><td>O</td><td>O</td></tr>
<tr><td>Rear LH
Wheel speed sensor</td><td>C1041
C1042</td><td>Wheel speed sensor rear left-electrical
Wheel speed sensor rear left-other</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3">1. C1041
<u>Cause</u>
- Defective rear LH wheel speed sensor
- Short or poor contact wire to sensor
<u>Action</u>
- Check the connection of the wheel speed sensor connector
- Check the connection of the HECU connector
- Check the harness connection
2. C1042
<u>Cause</u>
- Defective rear LH wheel speed sensor
- No signals from wheel speed sensor and tooth wheel
- Too large air gap between wheel speed sensor and tooth wheel
- Different number of teeth in tooth wheel
<u>Action</u>
- Check the wheel speed sensor connector and HECU connector
- Check air gap between wheel speed sensor and tooth wheel and tooth wheel mounting (Specified air gap: 0.425 ~ 1.175 mm)
- Check the number of teeth (48) in tooth wheel</td><td>O</td><td>O</td></tr>
</table>

<table>
<tr><th>Function</th><th>Defective Components</th><th>Trouble Code</th><th>Descriptions</th><th colspan="2">System</th></tr>
<tr><td rowspan="8">Sensor Monitoring</td><td>Pressure sensor</td><td>C1051</td><td>Defective input sensor</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3"><u>Cause</u>
- Abnormal signals from pressure sensor
- Defective pressure sensor or harness
<u>Action</u>
- Check the connection of the pressure sensor connector</td><td>X</td><td>O</td></tr>
<tr><td>Steering wheel angle sensor</td><td>C1061</td><td>Defective steering wheel angle sensor</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3"><u>Cause</u>
- Internally defective steering wheel angle sensor
- Abnormal signals from steering wheel angle sensor
- Ground to signal and power supply line or short to power supply line
- Abnormal signal voltage from steering wheel angle sensor
- Poor installation of steering wheel angle sensor and abnormal signal
<u>Action</u>
- Check the supplying voltage: (Specified voltage: 9 ~ 16 V)
- Check the output voltage: Check voltage between ESP unit terminals with ignition ON
• ST1 voltage check: between ESP unit terminal No. 5 and ground (Specified voltage: 1.3 ~ 4.1V)
• ST2 voltage check: between ESP unit terminal No. 2 and ground (Specified voltage: 1.3 ~ 4.1V)
• STN voltage check: between ESP unit terminal No.12 and ground (Specified voltage: 1.3 ~ 4.1V)</td><td>X</td><td>O</td></tr>
<tr><td>Longitudinal acceleration sensor</td><td>C1071
C1072</td><td>Longitudinal acceleration sensor-electrical
Longitudinal acceleration sensor-other</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3">1. C1071
2. C1072
<u>Cause</u>
- Internally defective steering wheel angle sensor
- Abnormal signal from steering wheel angle sensor
- Ground to signal and power supply line or short to power supply line
- Abnormal signal voltage from steering wheel angle sensor
- Poor installation of steering wheel angle sensor and abnormal signal
<u>Action</u>
- Check the supplying voltage: (Specified voltage: 9 ~ 16 V)
- Check the output voltage: Check voltage between ESP unit terminals with ignition ON</td><td>X</td><td>O</td></tr>
</table>

<table>
<tr><th>Function</th><th>Defective Components</th><th>Trouble Code</th><th>Descriptions</th><th colspan="2">System</th></tr>
<tr><td rowspan="2">Sensor Monitoring</td><td>Sensor cluster</td><td>C1073
C1074</td><td>Sensor cluster -electrical
Sensor cluster-other</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3">1. C1073
<u>Cause</u>
- Operating voltage exceeds specified range (Hi: 18.0 ± 1.0 V / Lo: 6.5 ± 0.5 V)
- Poor contact or installation of harness
<u>Action</u>
- Check the connection of the sensor cluster connector
- Replace the sensor cluster
2. C1074
<u>Cause</u>
- Internally defective HECU
- Abnormal internal A/D converter voltage: Over 5.0 ± 3 %
- Abnormal supplying voltage (4.580 ~ 4.960 V) to sensor cluster
→ Short circuit between supplying voltage output of sensor cluster and ground
- Poor ground of sensor cluster (0.0 ~ 0.5 V)
→ Short to ground on sensor cluster
- Abnormal signals from lateral acceleration sensor
- Abnormal signals from yawing sensor
- Poor installation of sensor
- Defective sensor cluster
- Defective or short circuit of CAN communication line
<u>Action</u>
- Replace the sensor</td><td>X</td><td>O</td></tr>
<tr><td rowspan="2">Battery Voltage Monitoring</td><td>Battery</td><td>C1101
C1102</td><td>Battery under voltage
Battery over voltage</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3">1. C1101
<u>Cause</u>
- Low voltage out of specified range (9.7 ± 0.3 V)
<u>Action</u>
- Check the supplying voltage
2. C1102
<u>Cause</u>
- Over voltage out of specified range (18.0 ± 1.0 V)
<u>Action</u>
- Check the supplying voltage</td><td>O</td><td>O</td></tr>
<tr><td rowspan="2">Brake Monitoring</td><td>Brake disc</td><td>C1111</td><td>Disk temperature is high</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3"><u>Cause</u>
- Overheated brake disc due to braking force: over 500°C
- Overheated brake disc due to excessive operation of HDC
<u>Action</u>
- Stop driving for a period of time after turning off the ESP</td><td>X</td><td>O</td></tr>
</table>

Function	Defective Components	Trouble Code	Descriptions	System	
Brake Monitoring	**Brake lamp switch ESP OFF switch**	C1201 C1202	Defective brake lamp switch Defective ESP OFF switch	**ABS**	**ESP**
	1. C1201 (5201) **Cause** - Mechanical defective in brake switch - Defective brake switch harness **Action** - Check the harness and connector **2. C1202 (5202)** **Cause** - Mechanical defective in ESP OFF switch - Defective ESP OFF switch harness (short to ground) **Action** - Check the connection of the harness and connector for ESP OFF switch			**X**	**O**
Valve Monitoring	**Valve, valve relay**	C1301	Defective valve, valve relay in HECU	**ABS**	**ESP**
	Cause - Abnormal supplying voltage to valve solenoid - Internally defective HECU **Action** - Replace the HECU - Check the battery voltage - Check the HECU connector			**O**	**O**
Pump Monitoring	**Pump motor**	C1311	Defective pump motor	**ABS**	**ESP**
	Cause - Too low (below 6.0 V) or no supplying voltage to pump motor - Over 0.93 V of voltage from pump motor voltage - Poor contact in pump motor connector - Poor ground **Action** - Check the supplying voltage - Check the connection of the HECU connector - Replace the HECU			**O**	**O**
HECU and Sensor Monitoring	**HECU**	C1401	HECU-internal	**ABS**	**ESP**
	Cause - Internally defective HECU - Defective A/D converter, internal voltage regulator, and controller - Defective sensor and short to supplying voltage line - Abnormal temperature sensor signal **Action** - Replace the HECU			**O**	**O**

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AFFECTED VIN	

Function	Defective Components	Trouble Code	Descriptions	System	
CAN Communication Monitoring	**Sensor initialization**	C1501	Abnormal sensor initialization	**ABS**	**ESP**
	Cause - Abnormal signals from sensors - Abnormal sensor data **Action** - Check the sensors - Initialize the sensors			**X**	**O**
	Vehicle coding	C1170	Vehicle coding error or misinstallation of HECU	**ABS**	**ESP**
	Cause - Discrepancy between HECU coding and vehicle coding - Misinstallation of HECU - Defective CAN communication **Action** - Check the HECU coding and vehicle coding - Check engine ECU coding - Perform vehicle coding - Replace the exact HECU			**O**	**O**
	CAN communication	C1601	CAN communication error	**ABS**	**ESP**
	Cause - Short or open to CAN communication line - Poor connection of CAN communication line **Action** - Check the CAN communication line			**O**	**O**
	CAN communication	C1602	Communication error between CAN communication line and engine ECU	**ABS**	**ESP**
	1. C1602 **Cause** - Short circuit to CAN communication line - Overload to CAN communication **Action** - Check the engine ECU - Check the CAN communication line - Check the connection of the engine ECU connector			**X**	**O**

<table>
<tr><th>Function</th><th>Defective Components</th><th>Trouble Code</th><th>Descriptions</th><th colspan="2">System</th></tr>
<tr><td rowspan="4">CAN Communication Monitoring</td><td>CAN communication</td><td>C1603
C1604
C1605</td><td>Communication error between TCU and CAN
Communication error between TCCU and CAN
Communication error between cluster (Meter) and CAN</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3">1. C1603
<u>Cause</u>
- Short to CAN communication line
- Overload to CAN communication
<u>Action</u>
- Check the A/T TCU
- Check the CAN communication line
- Check the connection of the TCU connector

2. C1604
<u>Cause</u>
- Short to CAN communication line
- Overload to CAN communication
<u>Action</u>
- Check the TCCU
- Check the CAN communication line
- Check the connection of the TCCU connector

3. C1605
<u>Cause</u>
- Short to CAN communication line (communication with the cluster (meter))
<u>Action</u>
- Check the CAN communication line
- Check the connection of the cluster (meter) and connector
- Replace the cluster (meter)</td><td>X</td><td>O</td></tr>
<tr><td>CAN communication</td><td>C1612</td><td>Signal from engine ECU is abnormal</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3"><u>Cause</u>
- Data error from engine ECU
<u>Action</u>
- Check engine ECU
- Check the CAN communication line
- Check the connection of the engine ECU connector</td><td>O</td><td>O</td></tr>
</table>

ABS SYSTEM

The following figure shows the basic system components of the ABS. This system consists of HECU (valve body and ECU integrated type), front wheel speed sensor and rear wheel speed sensor.

Front Wheel Speed Sensor (for 4WD)



Rear Wheel Speed Sensor



HECU (Valve Body and ECU Integrated Type)



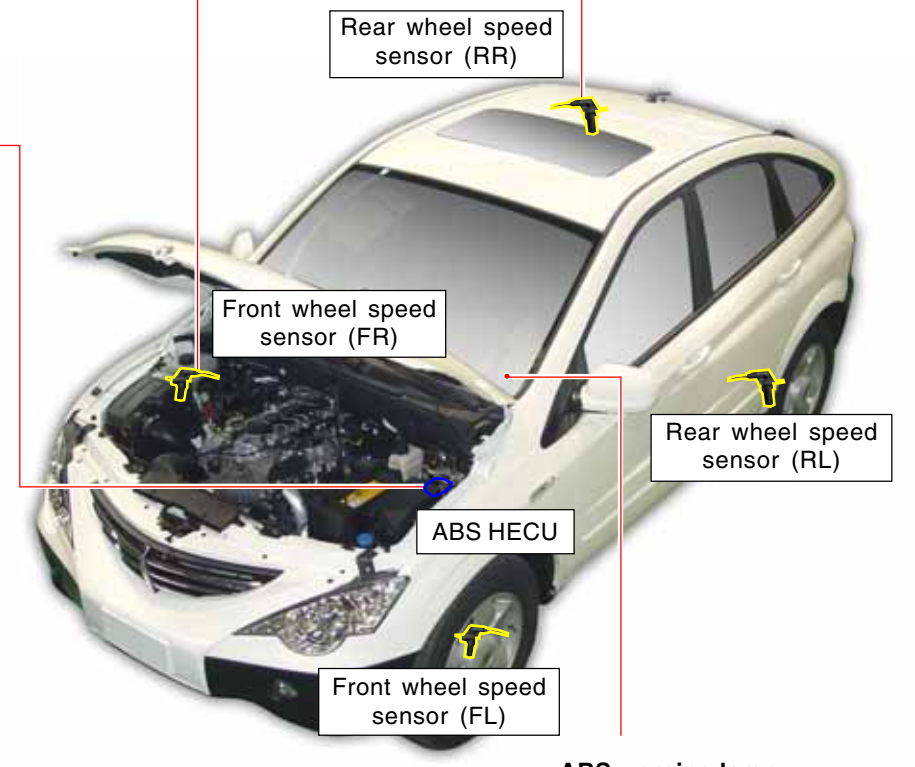
Valve body



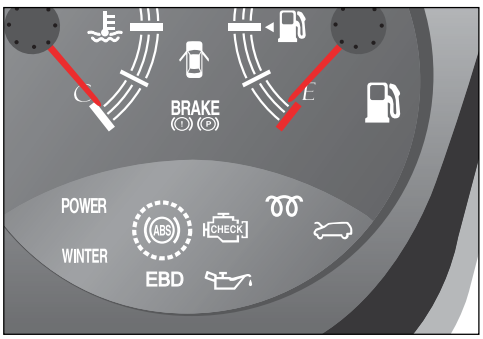
B: Plunger C: Cam bushing

Motor pump





ABS warning lamp



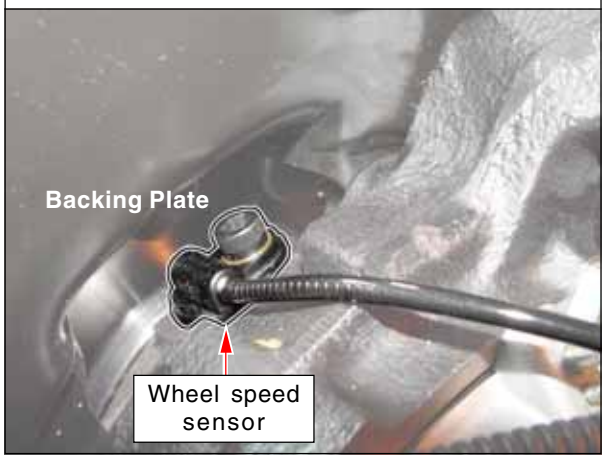
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AFFECTED VIN	

Cautions When Removing the Front Wheel Speed Sensor

The locking hub system of the ACTYON part time 4WD utilizes IWE (Integrated Wheel End) system that locks the 4WD depending on the vacuum condition within the actuator.

Thus, the wheel speed sensor is installed on the front wheel end area. It is installed inside the backing plate to be protected from heat and foreign materials. Therefore, the front wheel end system (including disc) should be removed before removing the front wheel speed sensor.

Front Wheel Speed Sensor



Rear Wheel Speed Sensor



Wheel Speed Sensor

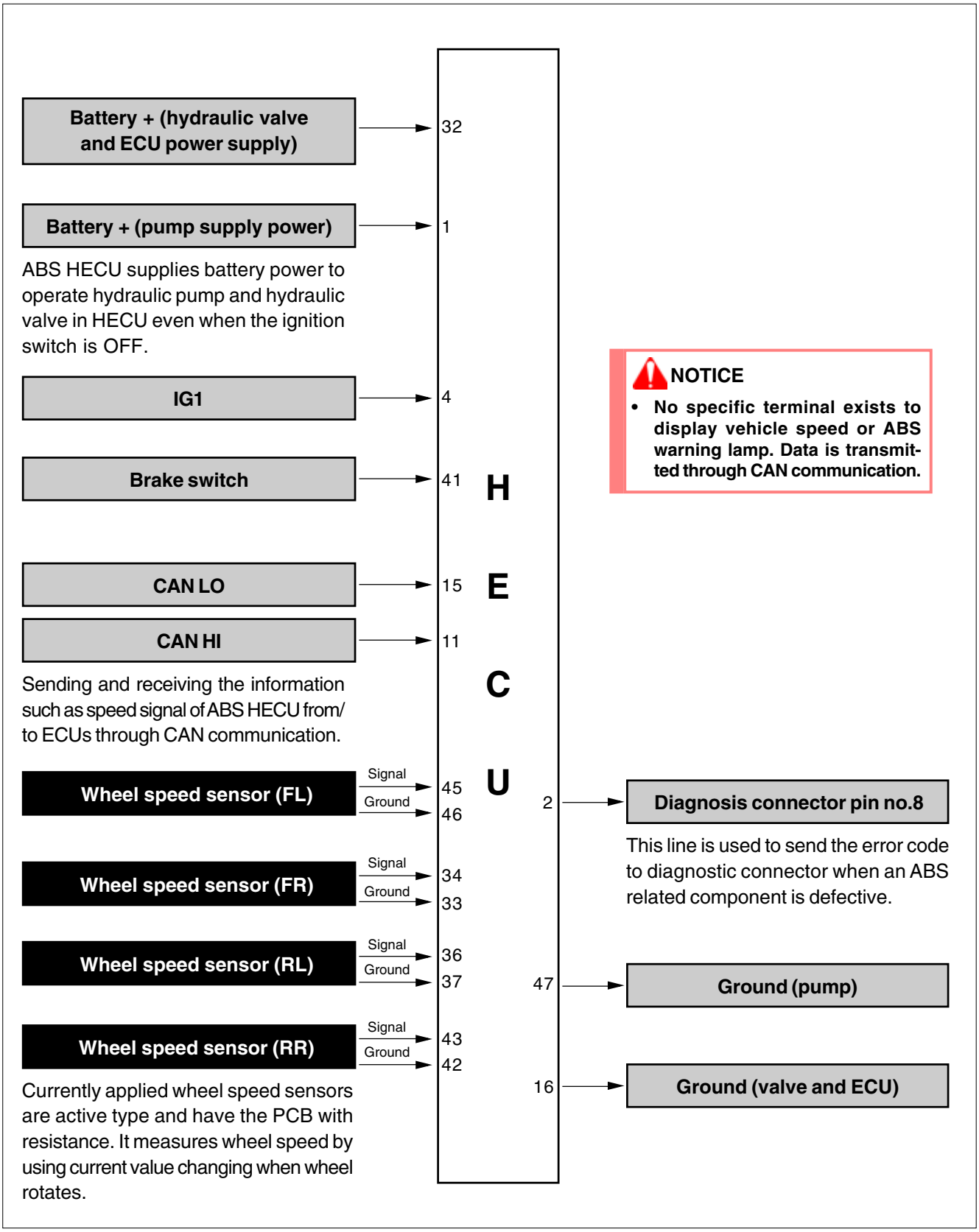




The wheel end should be remove before removing the wheel speed sensor.

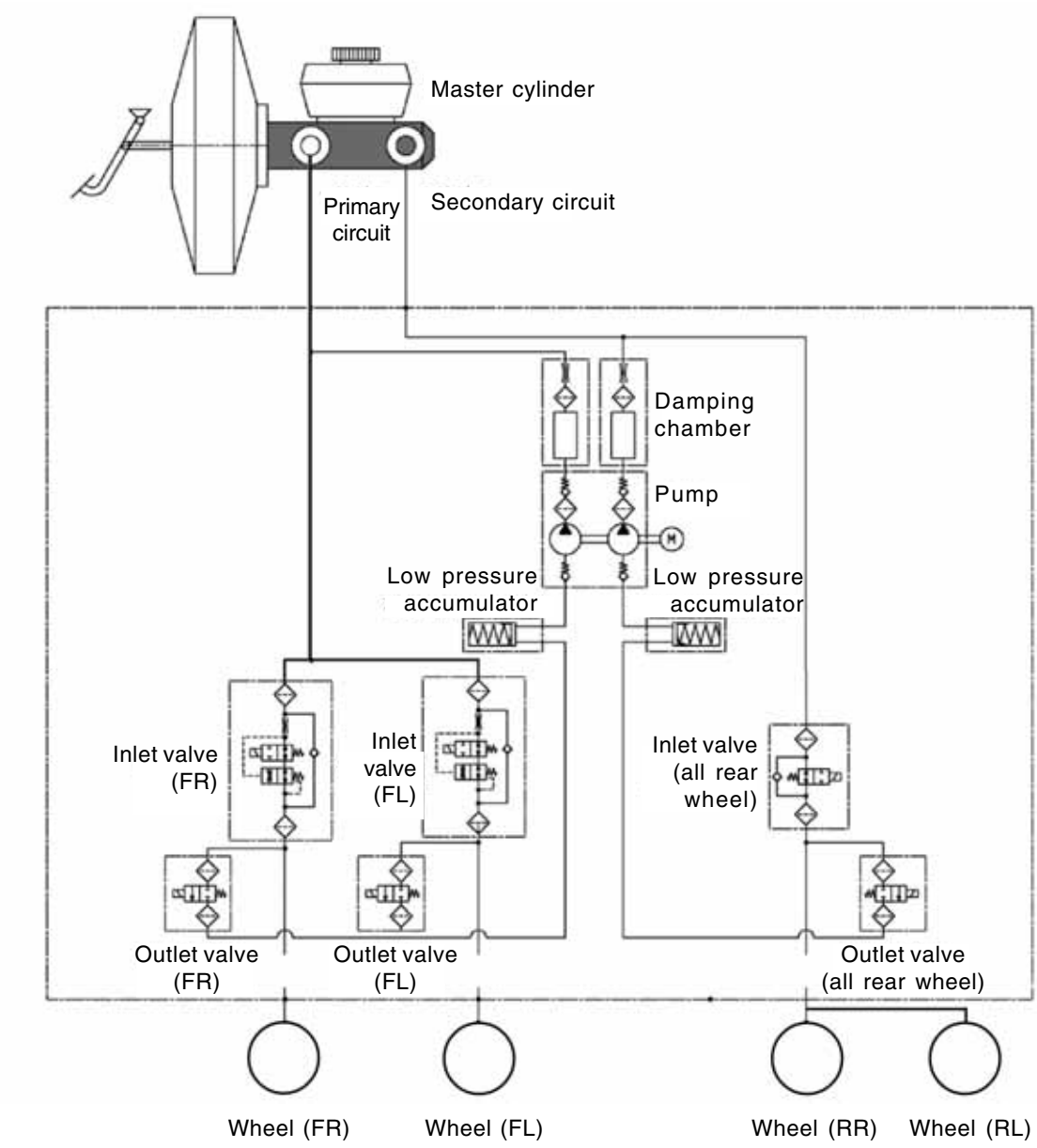
1. INPUT AND OUTPUT DIAGRAM

Input/Output of ABS



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EFFECTIVE DATE	
AFFECTED VIN	

2. HYDRAULIC CIRCUIT OF ABS

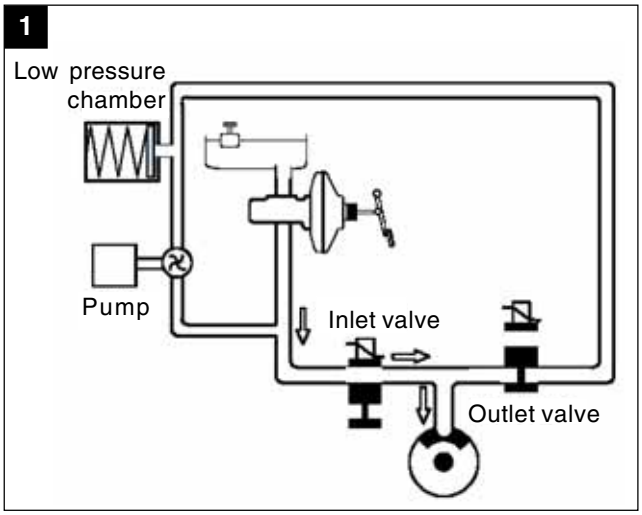


The vehicle equipped only with the ABS controls the wheel's braking force using 3-channel 4-sensor method.

The front wheels that are the primary circuit of the brake system is composed of two wheel speed sensors and two channel valves system with two inlet valves and two outlet valves. The rear wheels that are the secondary circuit of the brake system is composed of two wheel speed sensors, one inlet valve and one outlet valve. This system is similar to the one from the previous model.

3. ABS CIRCUIT IN EACH OPERATION RANGE

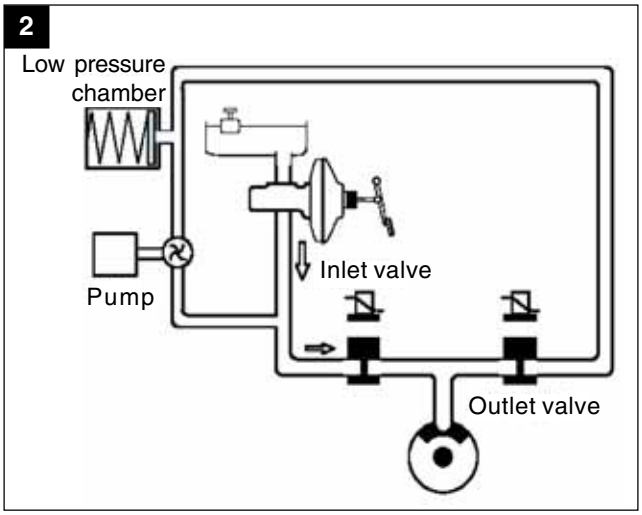
1



Hydraulic Pressure Circuit when ABS is Not Operating

The hydraulic pressure in the master cylinder increases through the vacuum booster and it is delivered to the wheel via the normal open inlet valve. At this moment, the normally-closed outlet valve is closed. The speed of the wheel that hydraulic pressure is delivered reduces gradually.

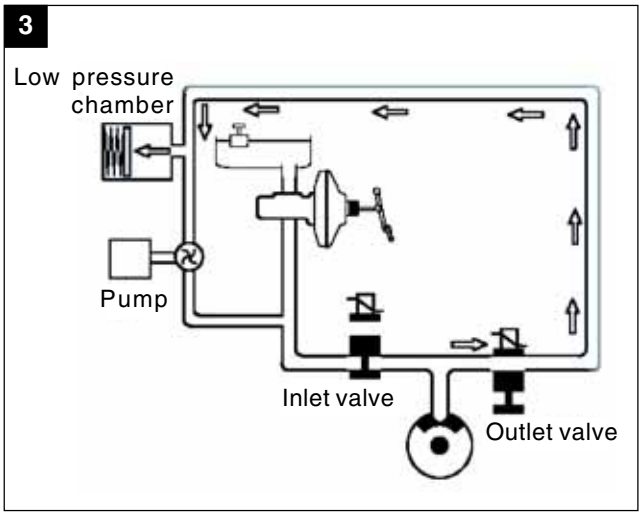
2



Hydraulic Pressure Locked in Circuit when ABS is Operating

As hydraulic pressure on each wheel increases, the wheel tends to lock. In order to prevent the wheel from locking, the hydraulic valve modulator operates the inlet valve control solenoid to close the inlet valve and stop the hydraulic pressure increases. At this moment, the outlet valve is closed. This procedure helps the wheel to maintain a stable hydraulic pressure.

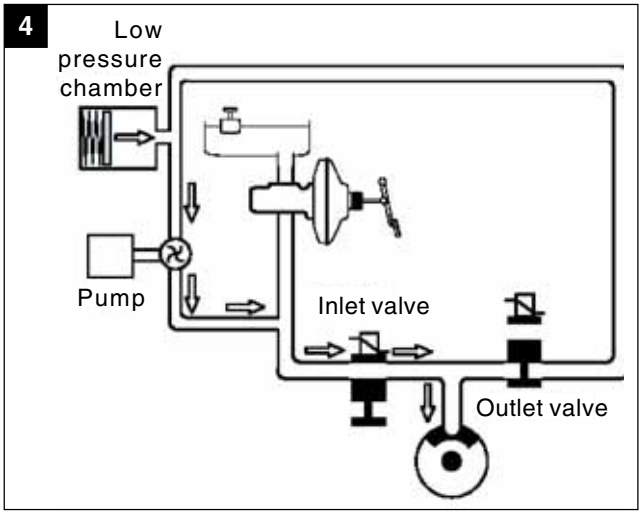
3



Pressure Decreases in the Circuit when ABS is Operating

Even when the hydraulic pressure on each circuit is stable, the wheel can be locked as the wheel speed decreases. This is when the ABS ECU detects the wheel speed and the vehicle speed and gives the optimized braking without locking the wheels. In order to prevent from hydraulic pressure increases, the inlet valve is closed and the outlet valve is opened. Also, the oil is sent to the low pressure chamber and the wheel speed increases again. The ABS ECU operates the pump to circulate the oil in the low pressure chamber to the master cylinder. This may make the driver to feel the brake pedal vibration and some noise.

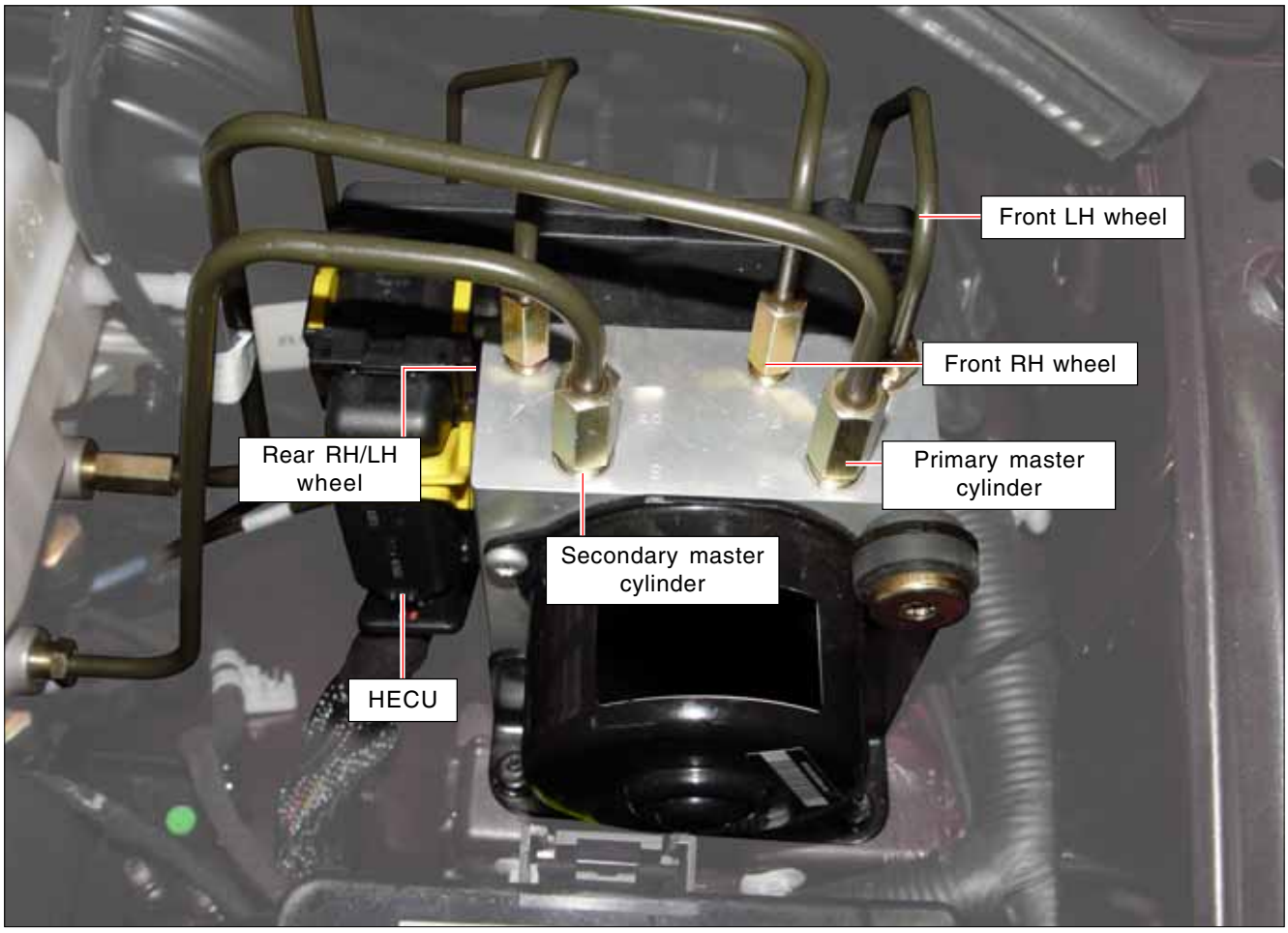
4



Pressure Increases in the Circuit when ABS is Operating

As the wheel speed increases, the inlet valve opens and the wheel's pressure increases due to the master cylinder pressure. The oil in the low pressure chamber circulates to the wheel by the pump (no pressure increase in wheel). Therefore, when depressing the brake pedal, the pressure generated in the master cylinder is transferred to the disc and then the outlet valve decreases this pressure intermittently. This operation continues repetitively until there are no signs that the ABS ECU is locking the wheels. When the ABS hydraulic pressure control takes place, there may be some vibration and noises at the brake pedal.

4. COMPONENTS AND LOCATION



Wheel Speed Sensor - Front (for 4WD)



Wheel Speed Sensor - Rear



5. COMPONENTS DESCRIPTION

▶ HECU (Hydraulic & Electronic Control Unit)



This section is provided only for the understanding of HECU. Note that this component cannot be disassembled for repair and maintenance. HECU consists of motor pump, valve body and ECU including solenoid valve.

ECU connector has 47 pins and the number of valves in valve body is 6 when equipped with only ABS and 12 when equipped with ESP system.

1. Motor pump



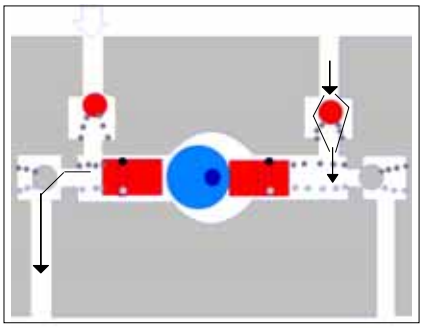
The motor is operated when ABS is activated. The cam-shaped output shaft of the motor (a) enables the brake system to receive and supply the brake fluid during the motor operation.

2. Valve body



The cam bushing (c) is installed between plungers (b) and it draws and discharges the brake fluid according to the rotation of motor output shaft.

<Pumping>



When the cam pushes the left plunger during motor operation, the system pressure is generated in the left cylinder. At this time, the right plunger is expanded by spring force and the expanded volume of the right cylinder draws the brake fluid.

3. ECU (Including Solenoid Valves)

HECU controls the hydraulic valves by supplying or cutting off the voltage to solenoid valves depending on the wheel speed and other information from wheel speed sensors. The ABS ECU has 6 solenoid valves. It has three channels; 2 channels for front wheels and 1 channel for rear wheels. Each channel has one inlet and one outlet valve, therefore, there are six solenoid valves.

Main functions are

a. Overall control of ABS functions
b. Monitoring of ABS electric components
c. Diagnosis function support

<ECU lower cover>



The electrical components are weak to moisture. To protect ECU, Gore Tex-based plate is used at ECU lower cover. The vent hall (arrow) allows air to ventilate but does not allow moisture to penetrate.

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EFFECTIVE DATE	
AFFECTED VIN	

6. REMOVAL AND INSTALLATION

▶ HECU Assembly

1. Disconnect the negative battery cable.

2. Disconnect the ABS hydraulic unit connector.



3. Disconnect the primary and secondary master cylinder pipes between HECU and master cylinder.

Tightening torque

Master cylinder - HECU	20 ~ 24 Nm



4. Disconnect the front and rear wheel brake pipes.

Tightening torque

HECU - Each hydraulic line	15 ~ 19 Nm

NOTICE

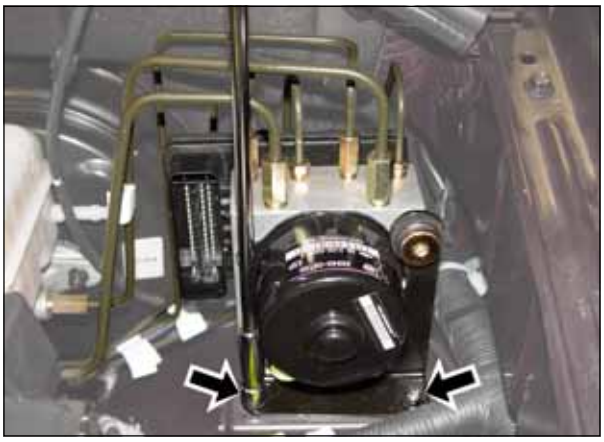
- **If the thread of the hydraulic pipe and the thread of the HECU do not get fitted correctly when installing, the components may be damaged and the oil may be leaked.**



5. Unscrew two mounting nuts and carefully remove HECU.

Tightening torque

HECU mounting nut	4 ~ 8 Nm



NOTICE

- **Do not attempt to disassemble the HECU assembly.**
- **Clean and Wrap the opening of pipes and HECU to prevent contamination.**

6. Install in the reverse order of removal.
7. After reinstallation, add some oil and perform the brake air bleeding. Refer to the "Bleeding air using SCAN-100" section.

NOTICE

- **When you install a new HECU to the vehicle, coding is executed automatically. Thus, no additional coding is necessary. When installing HECU to another vehicle for test or any other reason, it is automatically coded with the vehicle's data.**

8. Perform the variant coding.

9. Perform the sensor cluster calibration using "SCAN-100".
   For the calibration procedure, refer to "Sensor calibration".

NOTICE

- **Perform the variant coding and sensor cluster calibration if HECU or sensor cluster is replaced.**

▶ AWSS: Active Wheel Speed Sensor

The wheel speed sensor used in traditional ABS is made of permanent magnet and transmits the output voltage that changes as the wheel rotor rotates to the HECU system. New wheel speed sensor **detects the wheel speed through the current value** that depends on the resistance that changes according to the magnetic field by using four resisters and supplying the 12 V power supply to the sensor.

<Front wheel speed sensor>



<Rear wheel speed sensor>

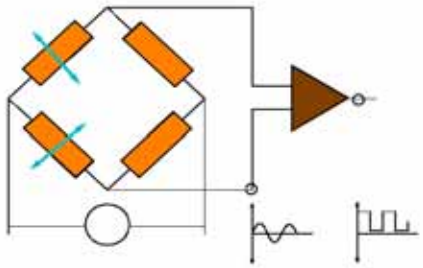


<Active wheel speed sensor>



For WHD

<Wheatstone bridge type>



This sensor contains:

1. Four resisters **2. Supply voltage from HECU (12 V)** **3. Internal printed circuit board**

The system uses the wheatstone bridge that detects and compares the changes in each resistance value. Before passing through the comparison measuring device, the sine wave current is obtained. But, after passing through it, a square wave, that is recognized by ECU, will be generated. The data from the rear right and left wheel speed sensors is used to get the mean value for the actual vehicle speed.

Specification

Air gap between sensor and rotor wheel	Front:	2WD: 0.475 ~ 1.425 mm (Tightening torque: 6 ~ 8 Nm) 4WD: 0.1 ~ 0.7 mm (Tightening torque: 15 ~ 20 Nm)
	Rear:	0.037 ~1.175 mm
Wheel speed sensor current (vehicle speed: at approx. 2.75 Km/h)		I_{HIGH} : Approx. 14 mA I_{LOW} : Approx. 7 mA
Wheel speed sensor voltage (one rotation per second at -40 ~ +60)		7.5 ~ 20 V

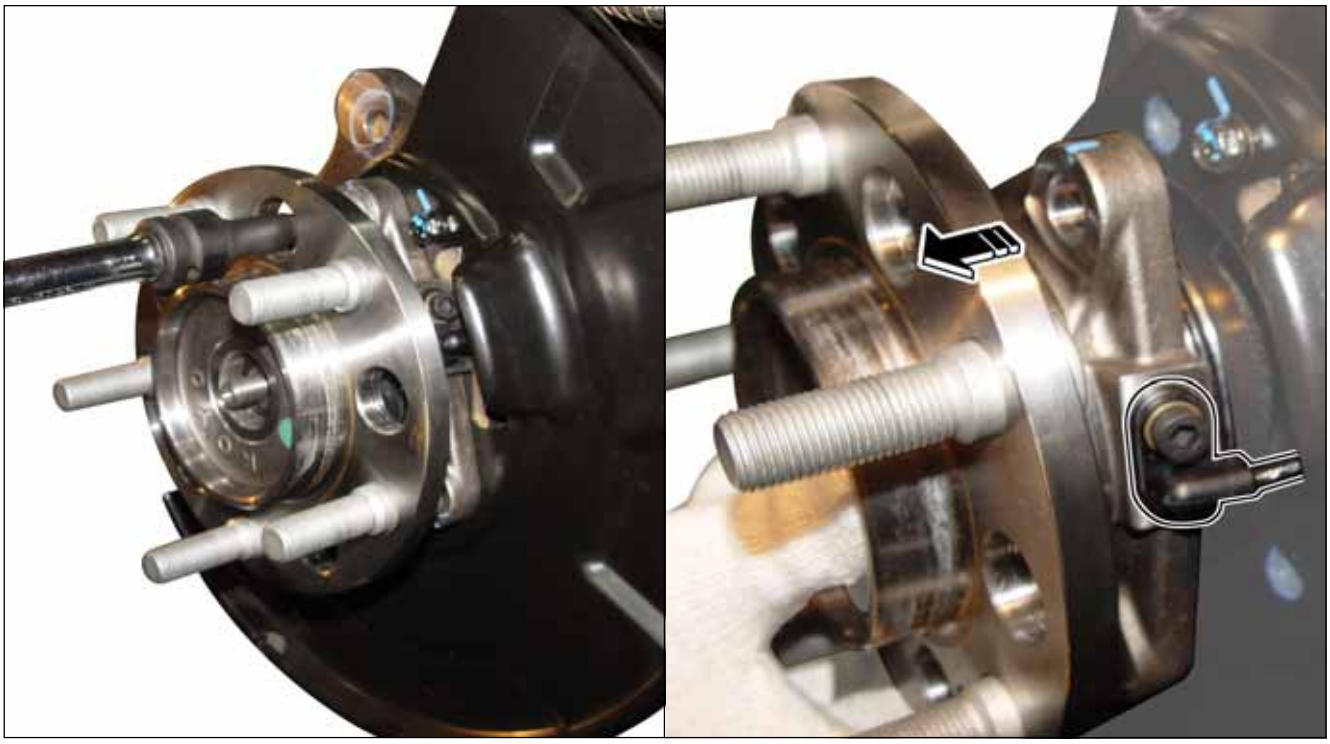
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AFFECTED VIN	

Removal and Installation of Front Wheel Speed Sensor

1. Disconnect the cable from the front upper arm and the front wheel speed sensor connector.



2. Remove the front brake disc. Loosen the hub end bolts (do not remove) and disconnect the wheel speed sensor.



3. Remove one self-locking hexagon bolt.



When Installing

Keep the specified tightening torque and air gap.

Tightening torque

Front wheel speed sensor	2WD	6 ~ 8 Nm
	4WD	15 ~ 20 Nm
Air gap	2WD	0.475 ~ 1.425 mm
	4WD	0.1 ~ 0.7 mm

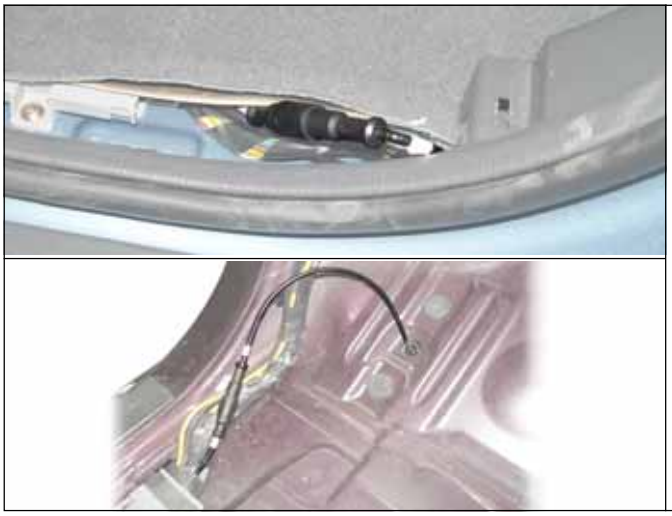


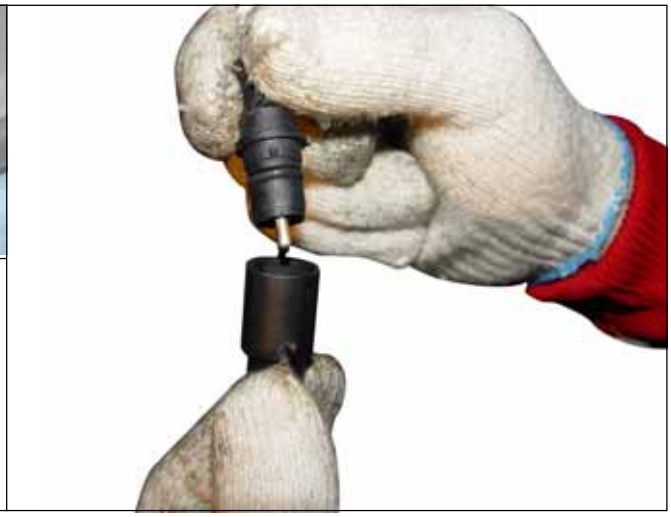
NOTICE

- **Tighten the bolts with the specified tightening torque. Otherwise, the air gap between the wheel speed sensor and wheel rotor may be out of specified value, and this may cause an incorrect input value to HECU.**

Removal and Installation of Rear Wheel Speed Sensor

1. Disconnect the wheel speed sensor connector from under the rear seat. Set aside the wheel speed sensor cable to the wheel house side.





2. Remove one mounting bolt (10 mm) from the knuckle. Remove rear wheel speed sensor.





When Installing

Keep the specified tightening torque and air gap.

Tightening torque

Wheel speed sensor	6 ~ 8 Nm
Air gap (mm)	0.425 ~ 1.175

NOTICE

- **Tighten the bolts with the specified tightening torque. Otherwise, the air gap between the wheel speed sensor and wheel rotor may be out of specified value, and this may cause an incorrect input value to HECU.**



AIR BAG SYSTEM

8810

TABLE OF CONTENTS

AIR BAG SYSTEM 3

1. Overview (Including curtain air bags) 3
2. Locations and related components 4
3. Air bag system operation process 6
4. Air bag module and other components 8
5. Electrical wiring diagram 16
6. Air bag system deploy (Firing loop) 17
7. Air bag deployment signal output (Crash out) 18
8. Air bag warning lamp operational conditions 19
9. Servicing the air bag system 20
10. Diagnosis 29

AIR BAG SYSTEM

1. OVERVIEW (INCLUDING CURTAIN AIR BAGS)

Front air bag inflation



Curtain air bag inflation



The air bag systems for this vehicle are not much different from the previous air bag system installed in other vehicles. The curtain air bags are installed at the bottom of the roof trim instead of the side air bag and they enhance the passenger's safety. The driver's and passenger's curtain air bags individually deploy.

When the front air bags deploy, the seat belt pretensioners retract the seat belts too.

Collision sensors, a kind of impact G (acceleration) sensor, detect the front and longitudinal collisions and determine whether or not to deploy air bags. The roles of each collision sensor are as below:

Front G sensors (inside the air bag unit)

1. Send signals to the front air bags and the driver's and front passenger's seat belt pretensioners.
2. By the signal from this sensor, front air bags (driver's and passenger's air bags) deploy and the seat belt pretensioners of the driver's and passenger's seat belts retract seat belts.

Curtain air bag G sensors

1. These are located inside the left and right B-pillar panel bottoms. When a collision occurs, the air bag at the side of collision deploys accordingly. Please pay attention to that, in the case of the curtain air bag, only the air bag at the side of collision deploys, not both.

Once an air bag deploys, its repair parts vary according to the deployment situation and damage to the vehicle from collision. Needed repairs also slightly vary between the front air bags and the curtain air bags. The following are the differences:

Replacement parts when the front air bags deploy: the air bag units and their connection wires (connectors included), the seat belt pretensioners and their connection wires (connectors included), the entire front air bags, and the instrument panel (IP).

Replacement parts when a curtain air bag deploys: the new curtain air bag for the deployed side, the air bag unit and its connection wires (connectors included), the collision G sensor assembly for the curtain air bag, and the trims and roof headlining for the broken parts.

2. LOCATIONS AND RELATED COMPONENTS

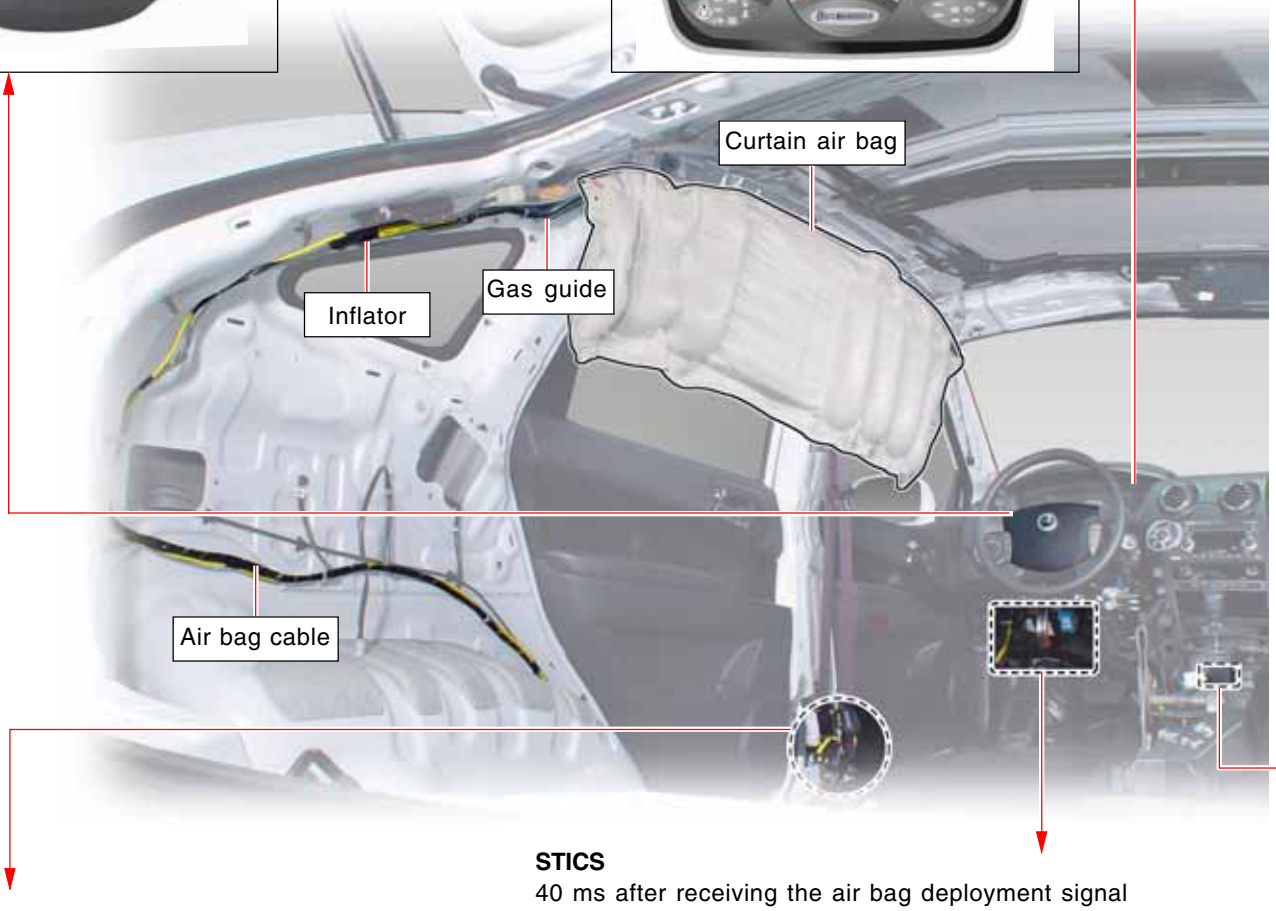
▶ LH

DAB: Driver Air Bag



Air Bag Warning Lamp (Cluster)

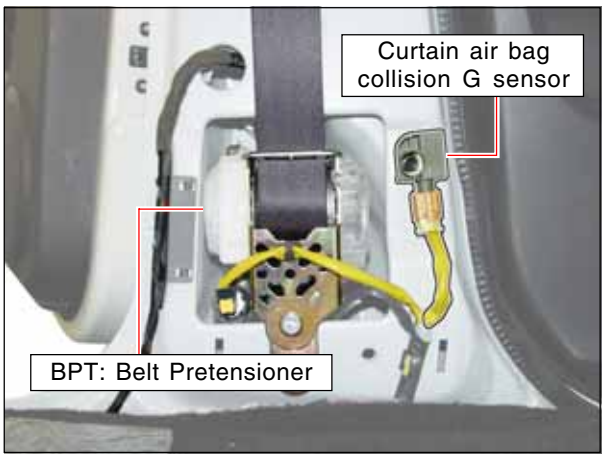


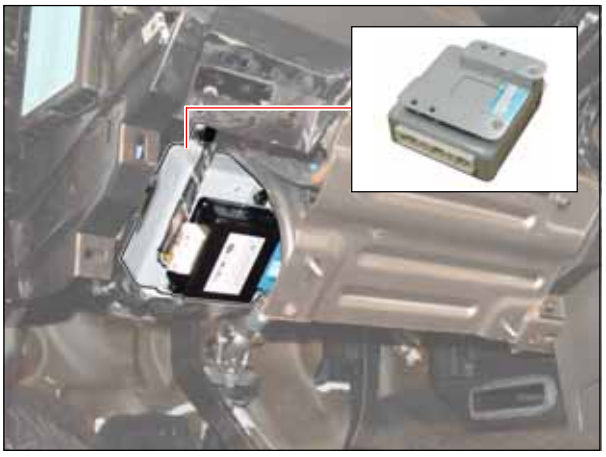


STICS

40 ms after receiving the air bag deployment signal at the vehicle speed 3 km/h or higher, it sends out the door UNLOCK signal for 5 seconds.

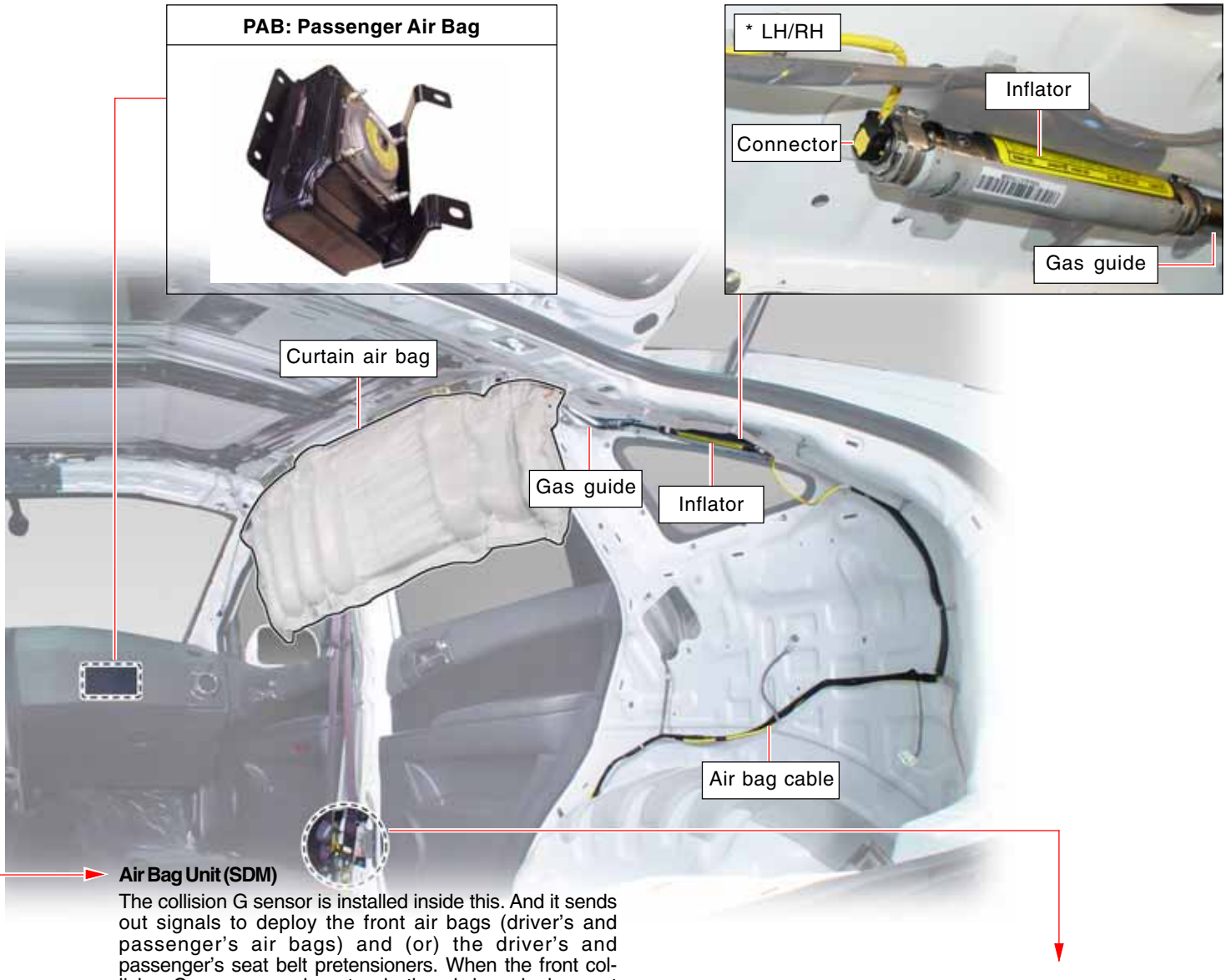
Driver side





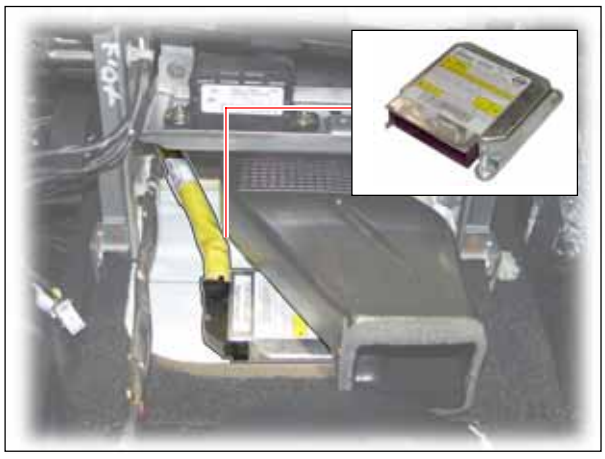
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AFFECTED VIN	

▶ RH

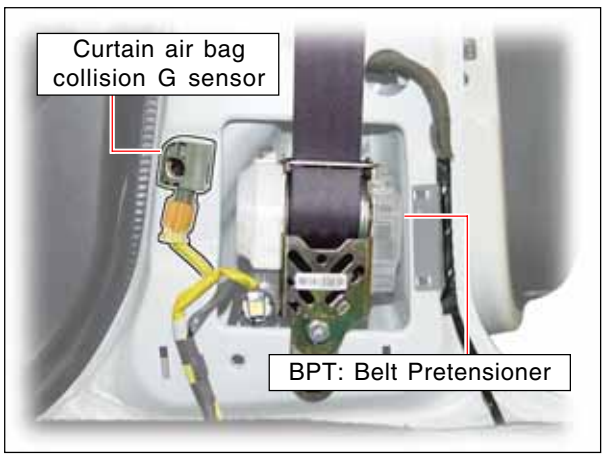


Air Bag Unit (SDM)

The collision G sensor is installed inside this. And it sends out signals to deploy the front air bags (driver's and passenger's air bags) and (or) the driver's and passenger's seat belt pretensioners. When the front collision G sensor sends out only the air bag deployment signal, the signal deploys the two front air bags and activates their seat belt pretensioners.



Passenger side

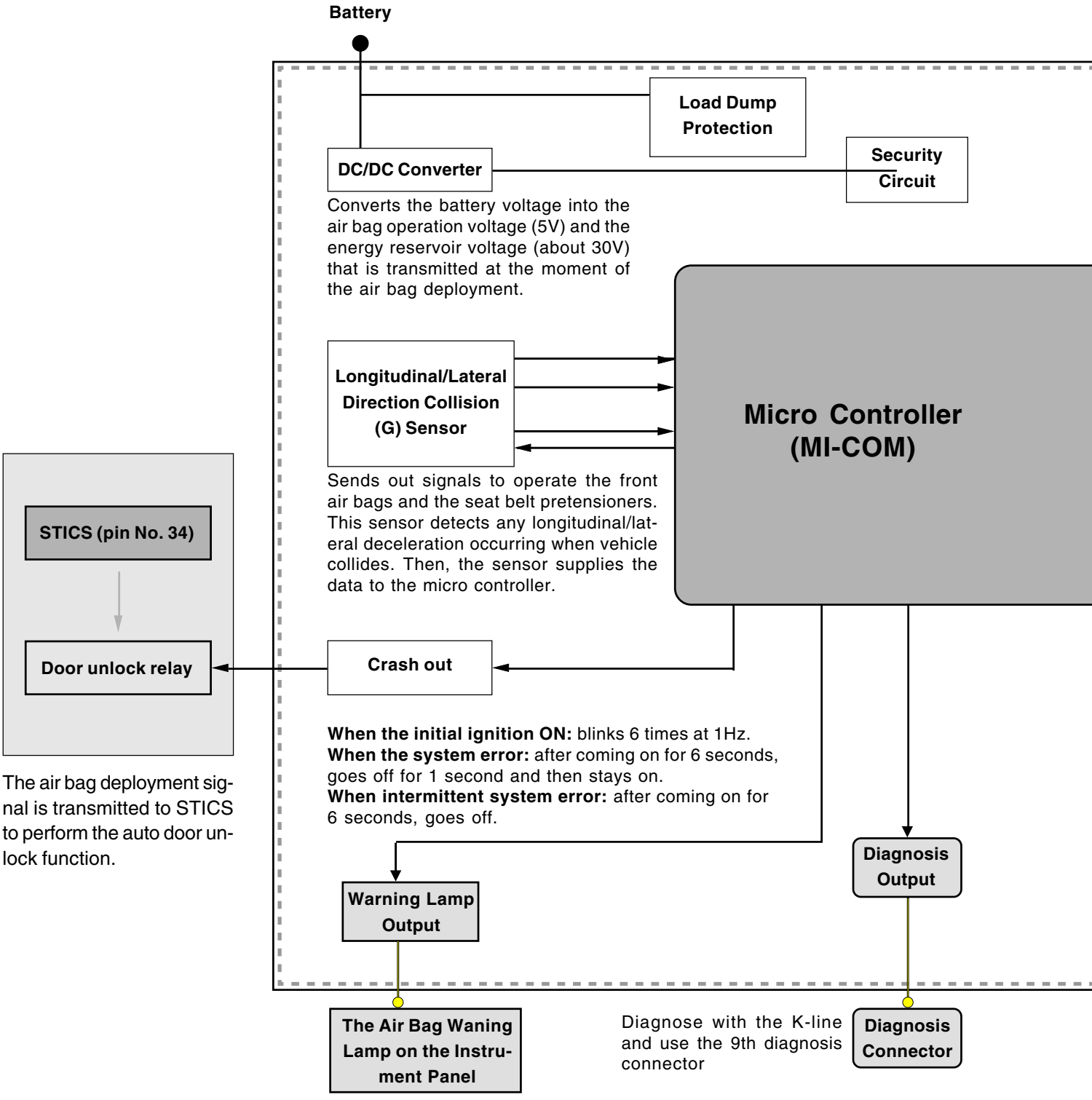


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3. AIR BAG SYSTEM OPERATION PROCESS

The overall air bag operation process and its functions and roles are broadly explained in this block diagram. This diagram summarizes and highlights the functions adopted by Ssangyoung Motors.

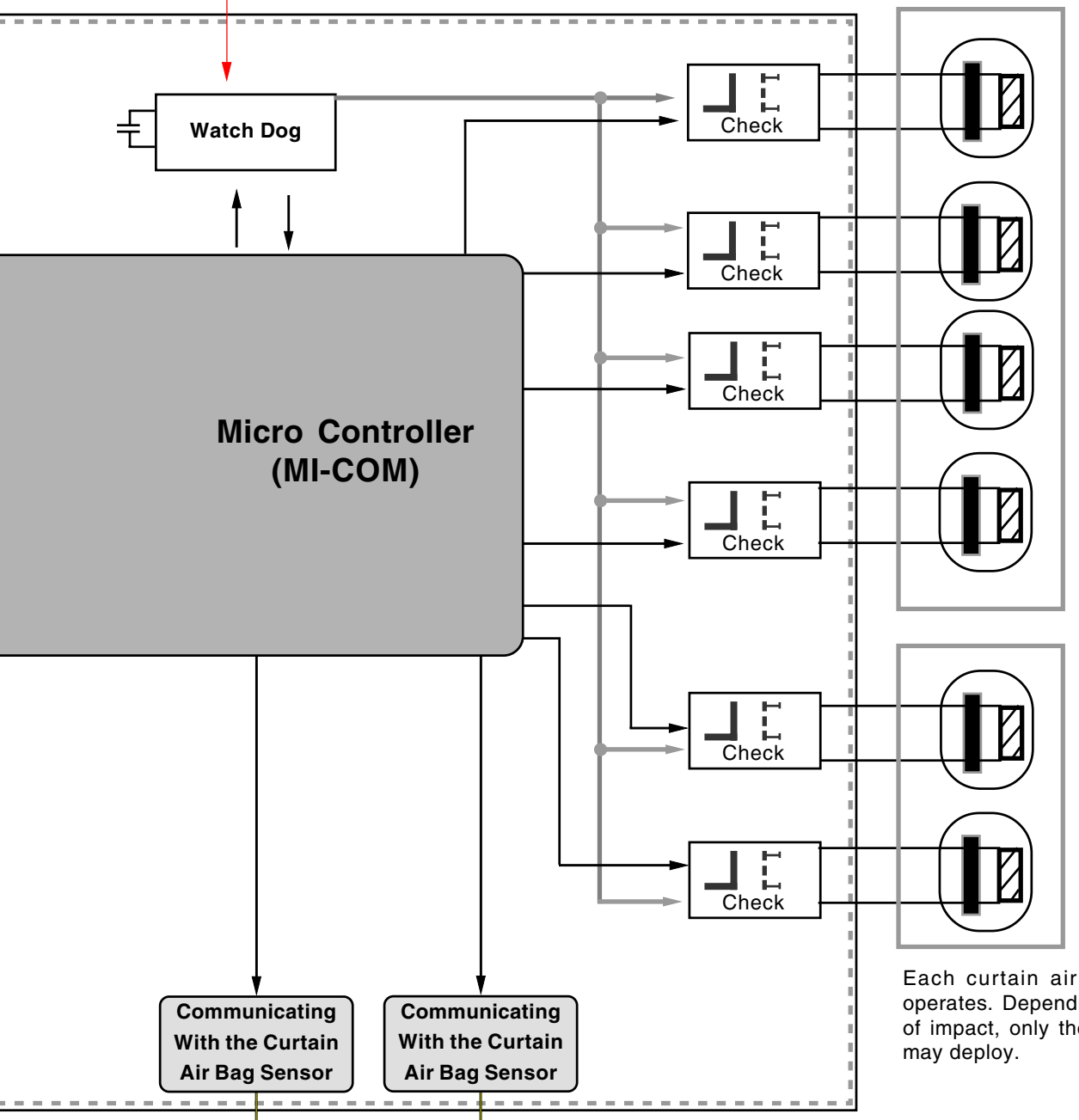
Air Bag System Block Diagram (Functions and Roles Included)



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EFFECTIVE DATE	
AFFECTED VIN	

The watch dog monitors the micro controller, the air bags, and the seat belt pretensioners in the air bag unit. When any error occurs, it turns on the air bag warning lamp.

When the front air bags deploy, the driver's air bag and the front passenger's air bag deploy simultaneously and their seat belt pretensioners also simultaneously retract their seat belts.
The air bag unit monitors conditions of the air bags and the seat belt pretensioners. When any error occurs, it stores the failure diagnostic code or turns on the air bag warning lamp on the instrument panel.



Each curtain air bag independently operates. Depending upon the severity of impact, only the left or right air bag may deploy.

The Collision G Sensor for the Curtain Air Bag (LH)

The Collision G Sensor for the Curtain Air Bag (RH)

The collision G sensors for the curtain air bags are installed at the bottom of left and right B-pillars. Each measures deceleration rate at time of collision and supplies information about the collision to the air bag unit. Each sensor measures the G value from its side and transmits the value to its air bag unit.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. AIR BAG MODULE AND RELATED COMPONENTS

This section describes the air bag module installed in ACTYON. The module consists of the inflator, the cushion, and the mounting cover.

▶ DAB: Driver Air Bag

The driver's air bag is installed inside the steering wheel. If the acceleration sensor (inside the air bag unit) is activated by the deceleration from vehicle collision, the detonation is fired by the electrical signal of the air bag unit. Then, the detonation sets off explosives and nitrogen gas is generated.

At this point, the air bag very quickly deploys and the gas is emitted from the relieving hole to absorb impact upon the driver.

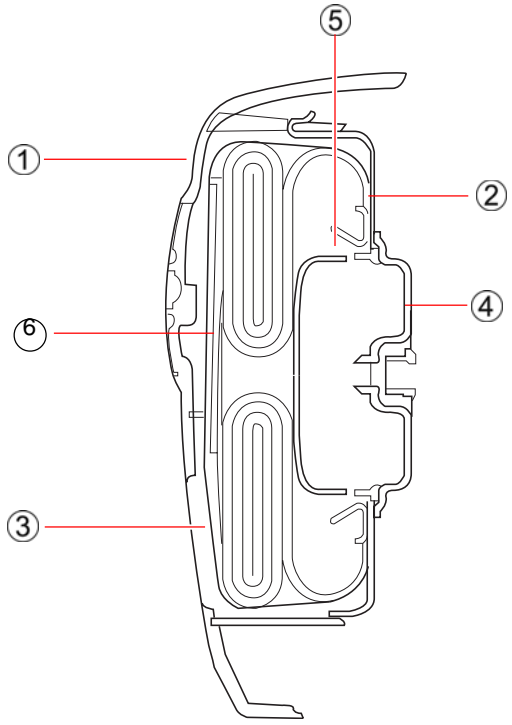


Front View



Rear View

Components



1. Air bag cover
2. Air bag housing
3. Air bag cushion (approx. 50 liters)
4. Inflator* (approx. 190 Kpa)
5. Retainer ring
6. Horn switch

Inflator*
The inflator is composed of the detonator, explosives, and the gas generator. It inflates air bag when vehicle collides.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ PAB: Passenger Air Bag

The passenger's air bag is installed inside the instrument panel above the glove box. Its operation process is the same as the driver's one. The driver's air bag, the passenger's air bag, and the seat belt pretensioners on both seats are made to operate together.

When the collision G sensor inside the air bag unit sends a collision signal, the air bag unit instantaneously applies a high current to the driver's and passenger's air bags and the seat belt pretensioners on both seats, fires the detonator in the inflator, and inflates the air bag cushions (curtain air bags independently operate in case of the side collisions).

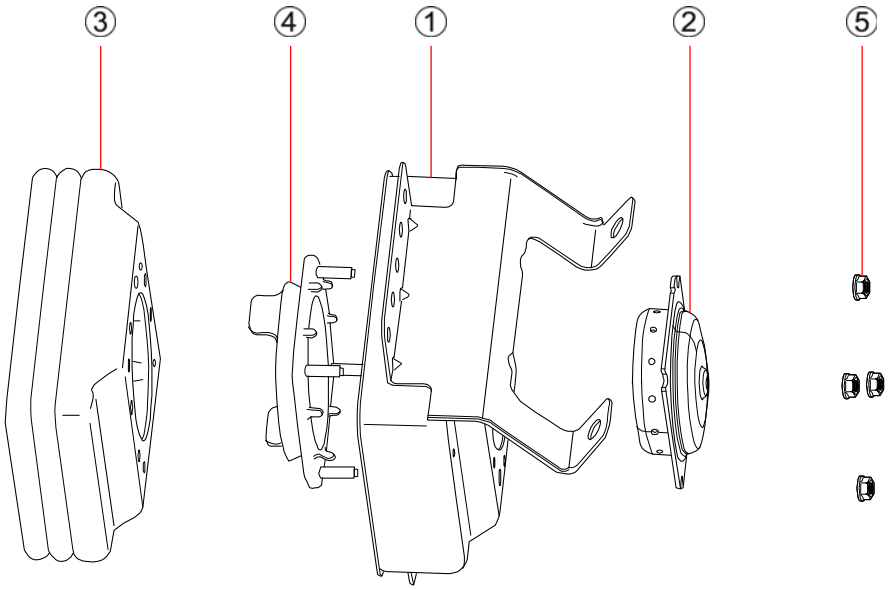


Rear View



Front View

Components



1. Passenger's air bag module housing
2. Inflator
3. Air bag cushion
4. Retainer
5. Nut

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

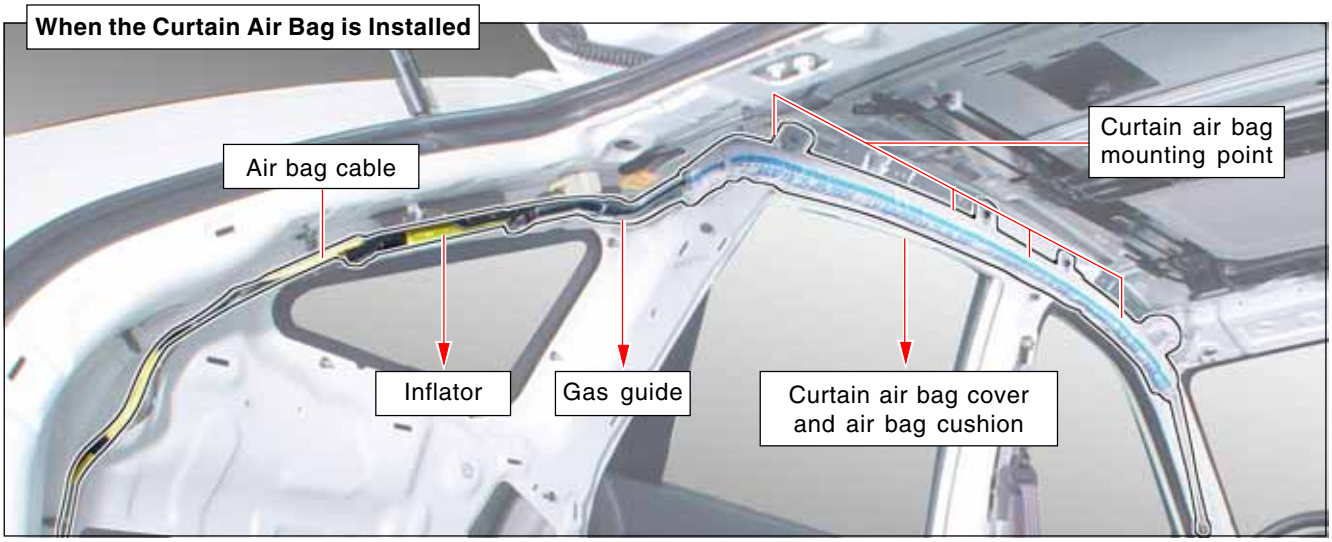
▶ CAB (Curtain Air Bag)

The curtain air bags are installed on both sides of the roof side rails (inside the headlinings). Each curtain air bag is also composed of the air bag cushion and the inflator that has the detonator, explosives, and the gas generator.

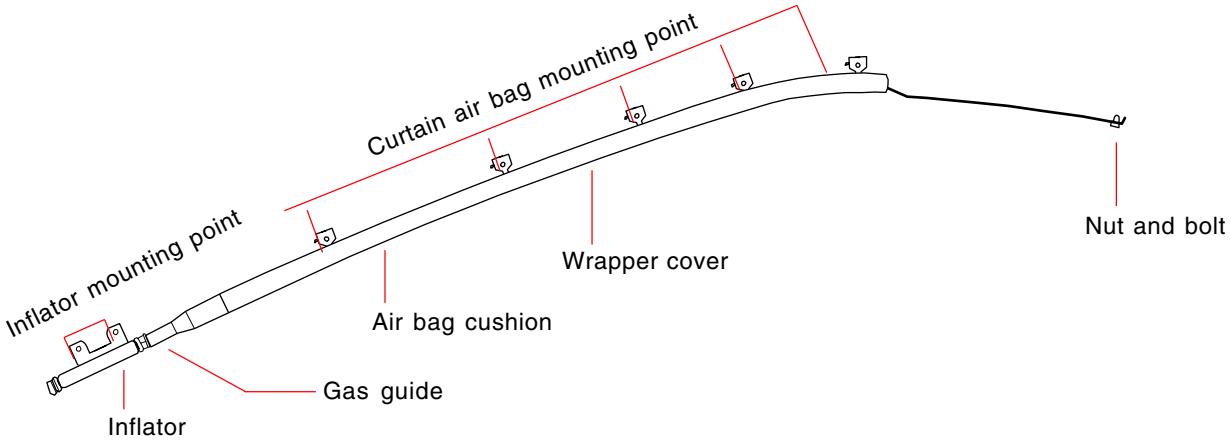
The deployment process logic of the curtain air bag is slightly different from the one of the front air bag (including pretensioner), but it is the same as the conventional side air bag.

A collision situation is detected by the curtain air bag collision G sensor installed at the lower side of the B-pillar. The signal is transmitted to the air bag unit. The air bag unit instantly inflates the necessary air bag necessary by sending a high current.

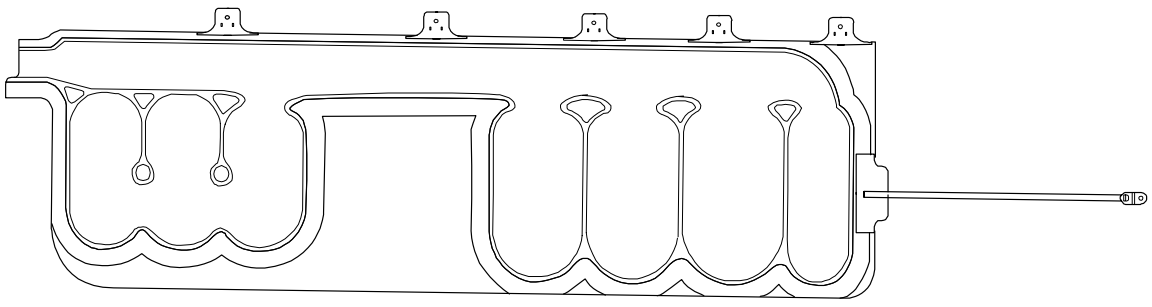
When the Curtain Air Bag is Installed



Terms of the Curtain Air Bag

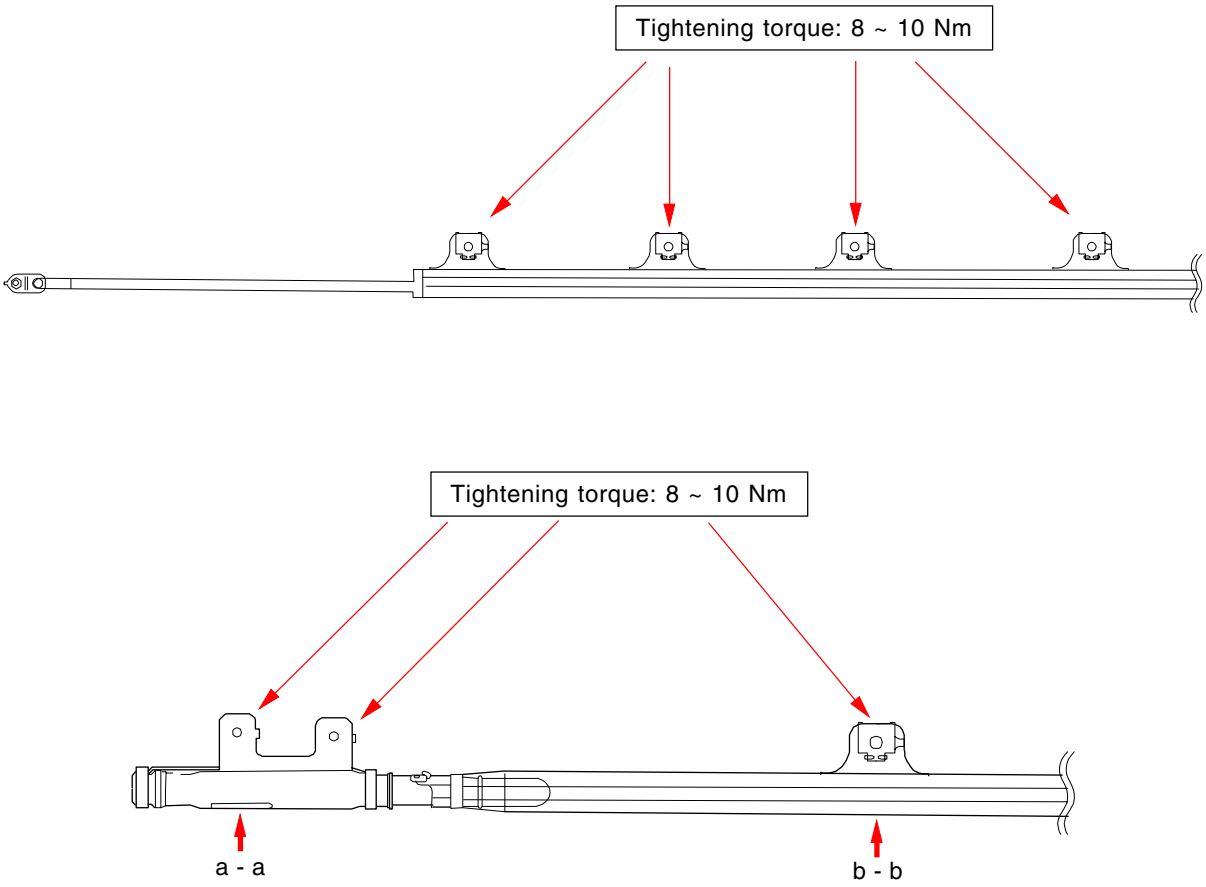


When the Curtain Air Bag Deploys

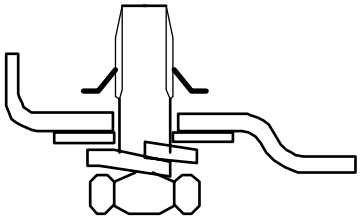


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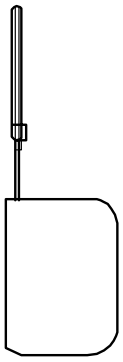
Components



Sectimal view a-a



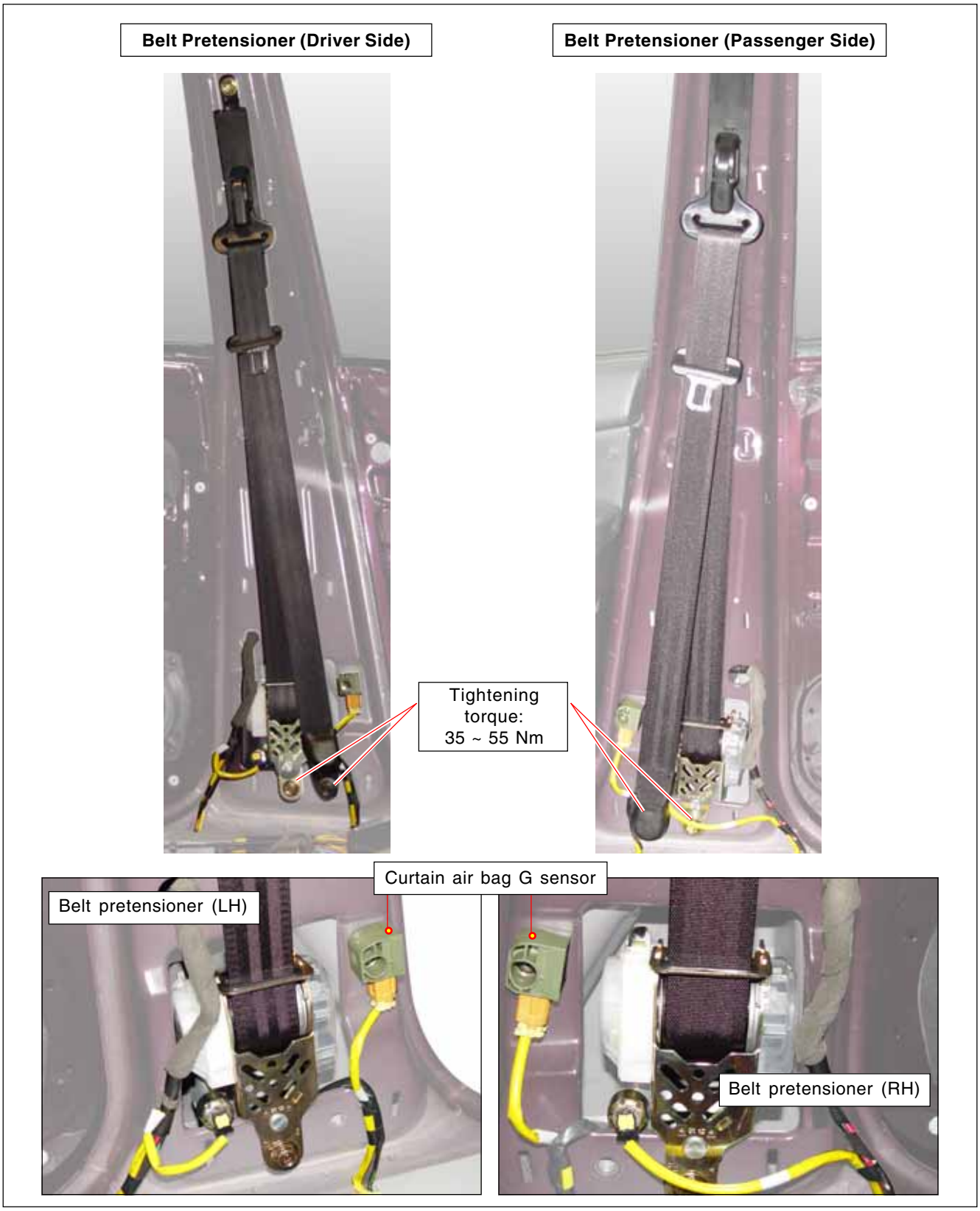
Sectimal view b-b



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AFFECTED VIN	

▶ Driver and Passenger BPT (Belt Pre-Tensioner)

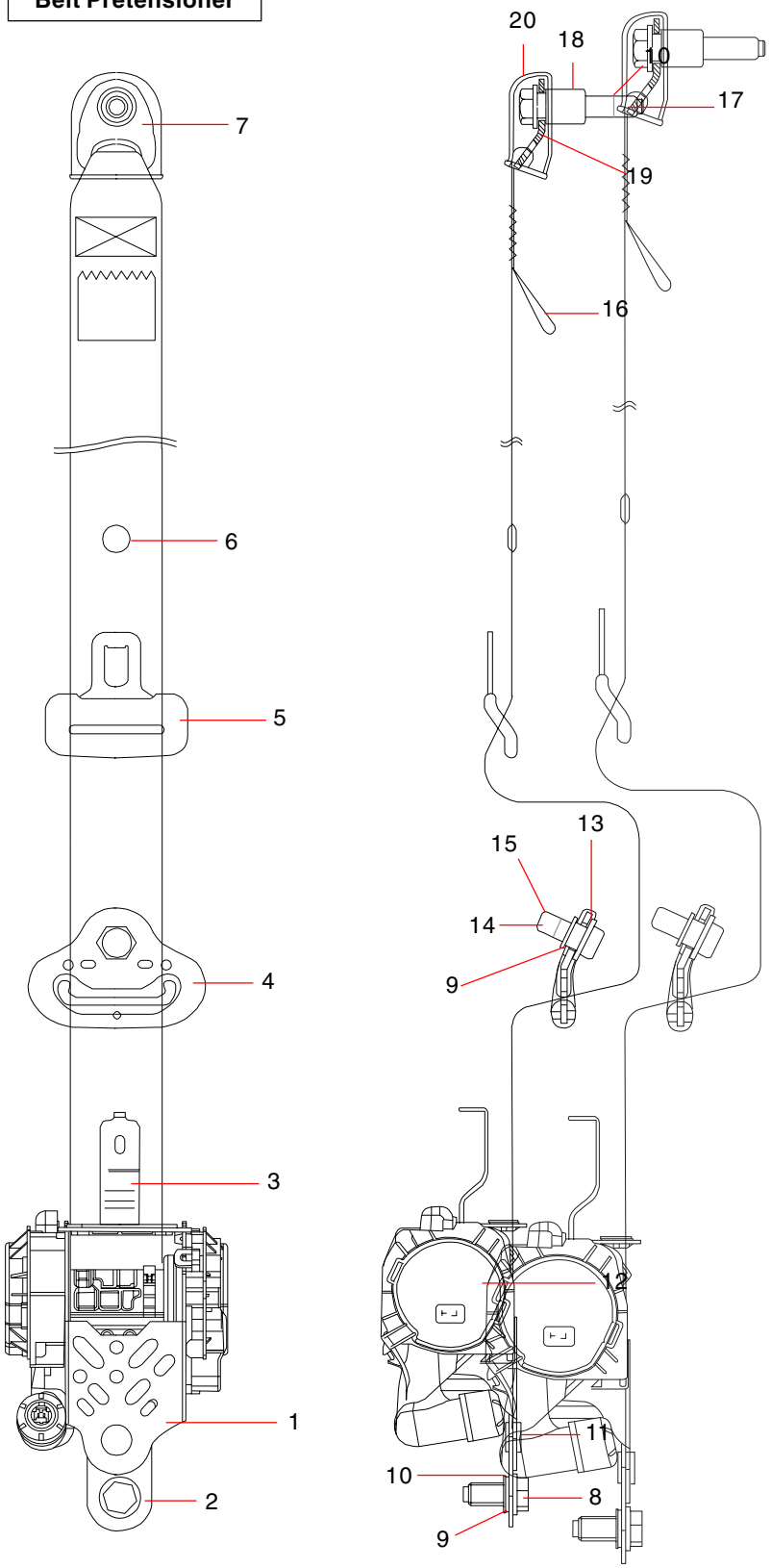
The belt pretensioner is installed at the lower side of the B-pillar and operates simutaneously when the front air bags deploy. When a collision occurs or when brakes are applied, a seat belt with a pretensioner detects the stopping action and tightens the belt before the wearer is propelled forward. This holds the occupant more securely in the seat.



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EFFECTIVE DATE	
AFFECTED VIN	

Components

Belt Pretensioner



1. Pretensioner reel assembly
2. Reel bracket
3. Ring upper stay
4. D-ring
5. Bending tongue
6. Tongue stopper
7. Mini anchor
8. D-bolt
9. Washer
10. Fiber washer
11. Rivet
12. ID label
13. Plastic washer
14. Steel washer
15. D-bolt
16. Label
17. D-bolt
18. Spacer
19. Bush
20. Mini anchor cover

▶ Air Bag Unit

Air bag unit is installed under the AV head unit in center fascia panel.





The sensor that detects collision is integrated into the air bag unit.





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Curtain Air Bag Sensor

The curtain air bag sensor is installed inside each B-pillar of the driver's and passenger's seats (that is, around the pretensioner reel). The body panel has guiding holes to ensure its correct installation. But incorrect tightening torque may break the sensor or make it insecure. As a result, the sensor may have inaccurate judgment and have the air bag deployed inaccurately.

Driver's Side

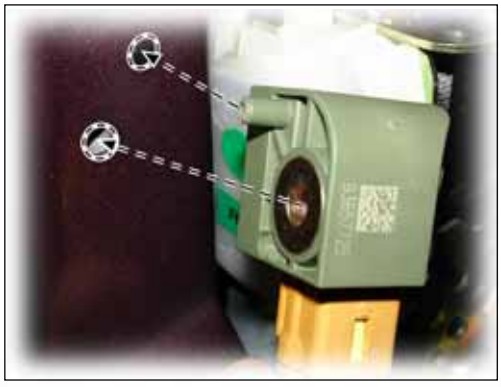




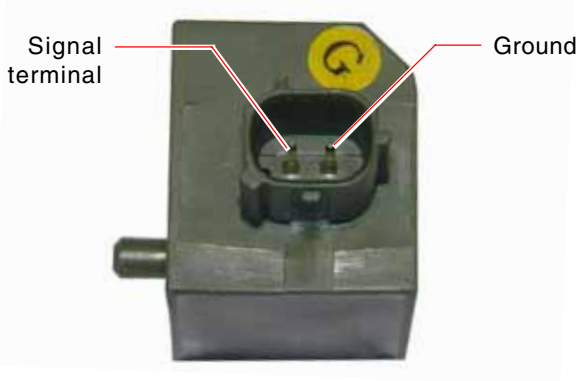
Tightening torque:
9 Nm ± 1 Nm

Passenger's Side







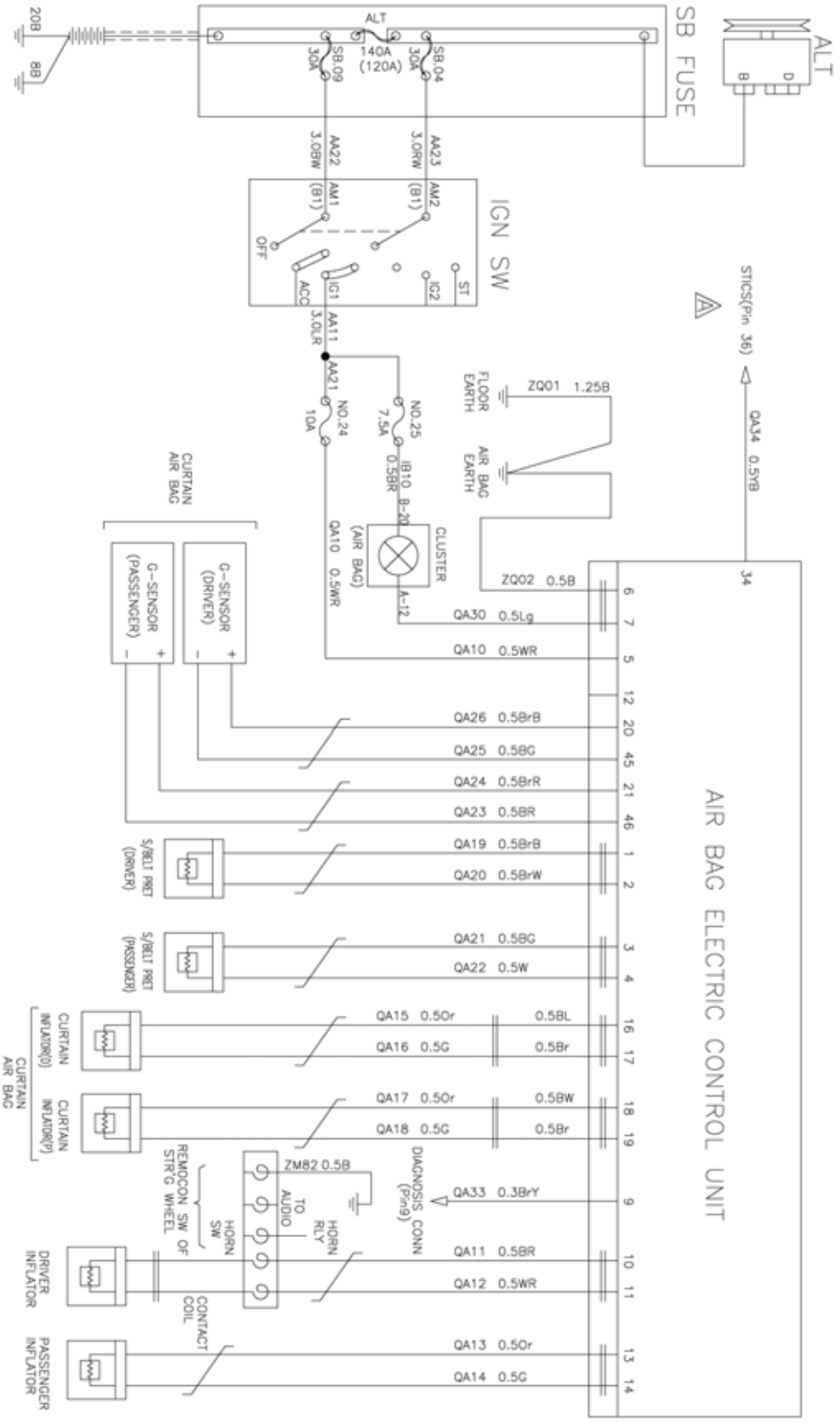


Connector



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EFFECTIVE DATE	
AFFECTED VIN	

5. ELECTRICAL WIRING DIAGRAM



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. AIR BAG SYSTEM DEPLOYMENT (FIRING LOOP)

According to the collision deceleration rate that each collision G sensor reads, the air bag unit sends out about 2~4 or higher Amp current. This current generates some heat, which fires the detonator in the inflator.

This table shows the basic inner resistance of the air bag related module and the basic instant current necessary for firing.

Air bag module	Driver/passenger air bag (DAB / PAB)	Belt pretensioner (BPT)	Curtain air bag (CAB)
Resistance (at -30 ~ 85°C)	2 ± 0.3 Ω	2.15 ± 0.35 Ω	2 ± 0.3 Ω
Firing current	1.2 Amp	0.8 Amp	1.0 Amp

NOTICE

- **Please do not connect a tester to any air bag connector or single item to measure the supplied power or resistance. The detonator may explode due to a sudden extra power supplied by the tester.**
- **Before removing or installing any air bag related components, disconnect the negative battery cable.**

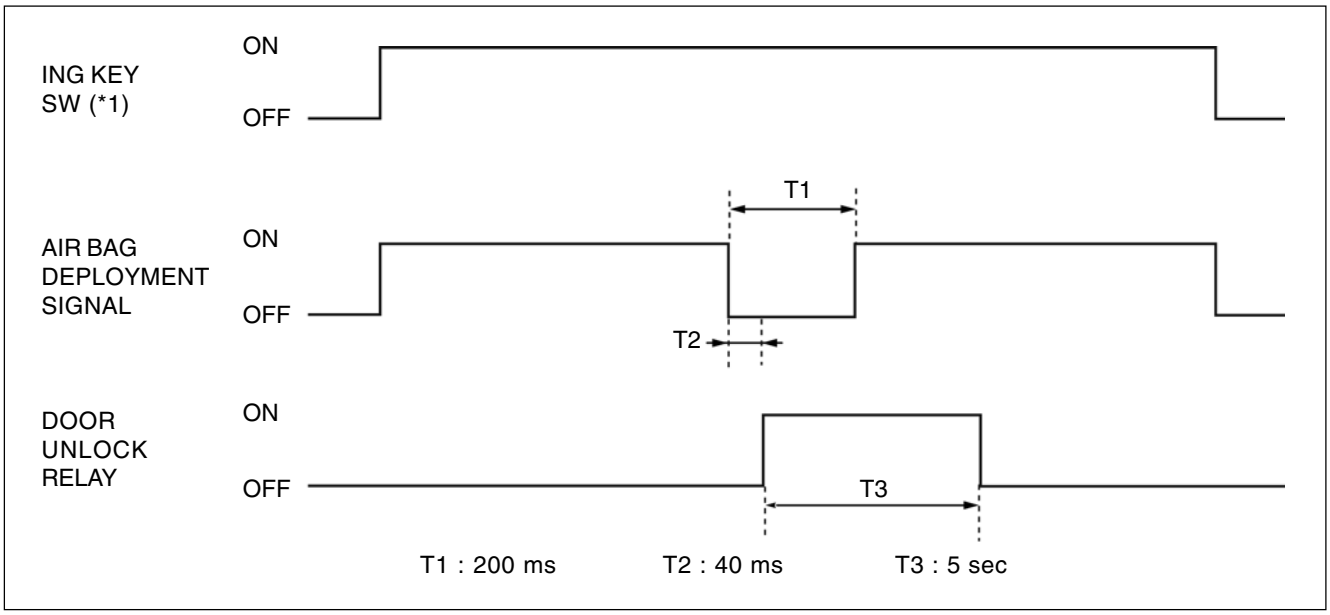
7. AIR BAG DEPLOYMENT SIGNAL OUTPUT (CRASH OUT)

When the air bag deploys, the signal is sent to STICS to perform the basic security operation which is the automatic door unlock function that release the automatic door lock mode.



Automatic Door Unlock (Crash unlock: unlock when colliding)

1. When the ignition key is the ON position, the air bag signal is not accepted for the first 7 seconds.
2. When the ignition key is the ON position and the vehicle speed is 3 km/h or higher, 40 ms after receiving the air bag deployment signal, the STICS sends out the door UNLOCK signal for 5 seconds.
3. Even though the ignition switch is turned off in the middle of the unlock signal being sent out, the unlock signal continues for the remaining time.
4. This function cancels when the ignition key is withdrawn.



NOTICE

Reminder for door lock/unlock control

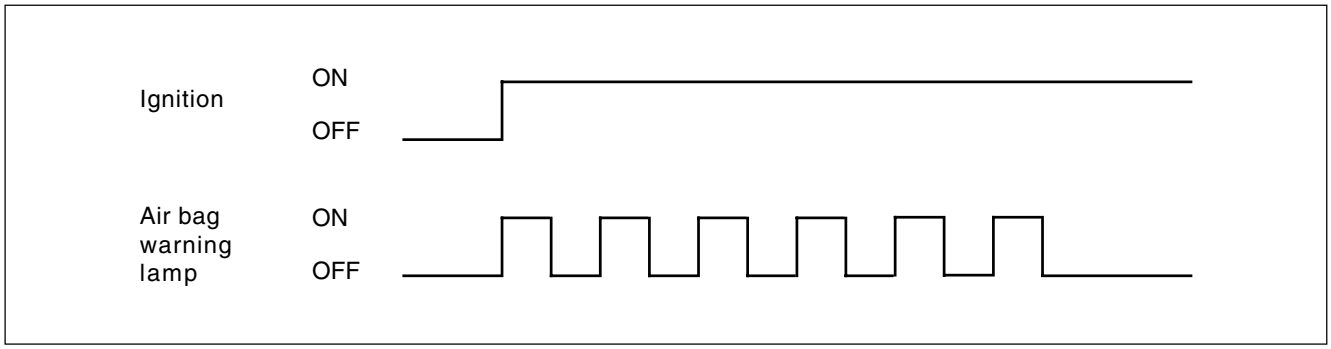
- **The unlock function by the air bag signal takes priority over any other lock/unlock operations.**
- **While or after the automatic unlock is made by the air bag system, any lock or unlock request by other functions is ignored unless the ignition key switch is turned off.**
- **When another lock or unlock output is requested while the door is being either locked or unlock, the new request will be ignored. But, if an unlock request is made by the air bag signal or the remote control key, the request will be accepted.**
- **When the lock and unlock functions are simultaneously requested, the lock function will be performed and the unlock function will be ignored.**

8. AIR BAG WARNING LAMP OPERATIONAL CONDITIONS

The air bag warning lamp on the instrument panel has a few operational conditions. The following are the conditions:

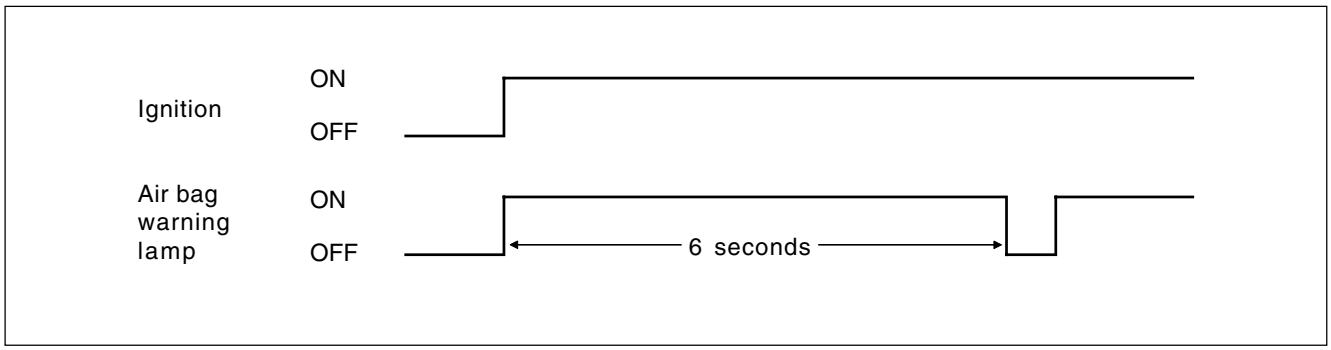
▶ When Turning the Ignition Switch to ON Position

The air bag unit performs a turn-on test when the ignition is turned on. The air bag unit flashes the air bag warning lamp six times at 1Hz interval. After flashing it six times, the air bag warning lamp will turn off if no malfunction have been detected.



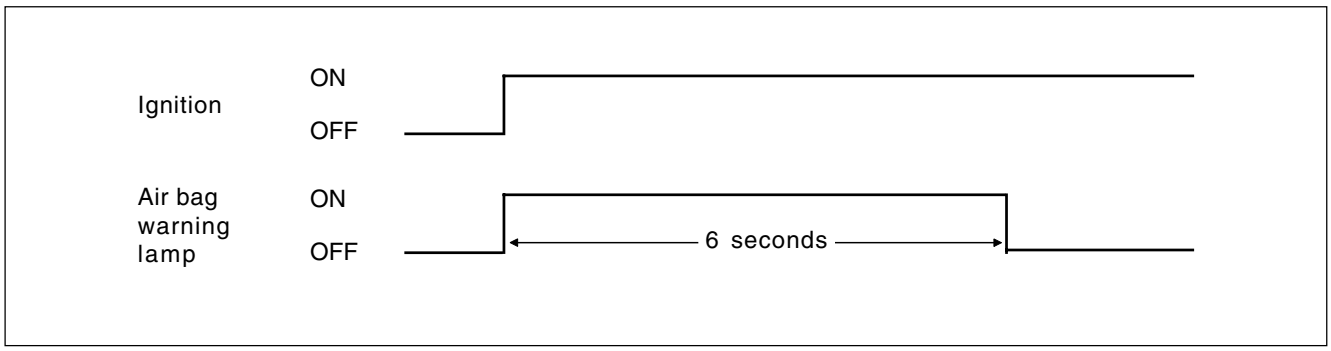
▶ When the Air Bag Unit Detects Any Malfunctions in Unit

When it is recorded as a system failure in the air bag unit, the air bag warning lamp on the instrument panel comes on for about 6 seconds and goes off for 1 second. Then the waning lamp stays on.



▶ When the Air Bag Unit Receives Any Malfunction Signals from the Other Systems

When, due to an error from outside the system, the intermittent failure signal is received 5 times or less, the air bag warning lamp comes on for about 6 seconds and then, goes off.



9. SERVICING THE AIR BAG SYSTEM

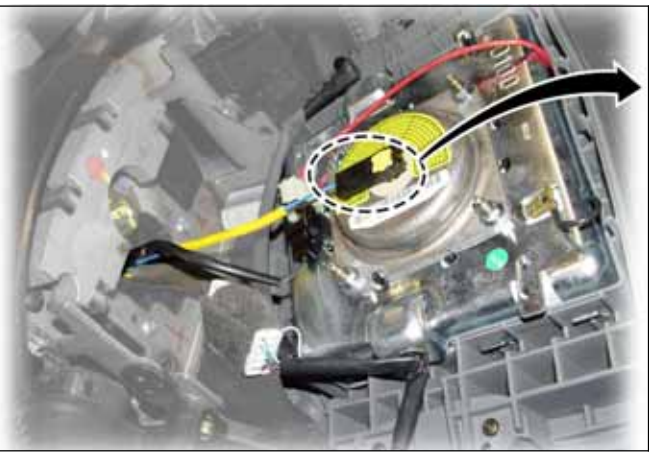
▶ DAB: Driver Air Bag

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the air bag module assembly from steering wheel. (For details, refer to “Switch” section.)



2. Disconnect all connectors from the removed air bag module and remove the air bag assembly.





Release the hook before disconnecting the connector.

Components

Front View



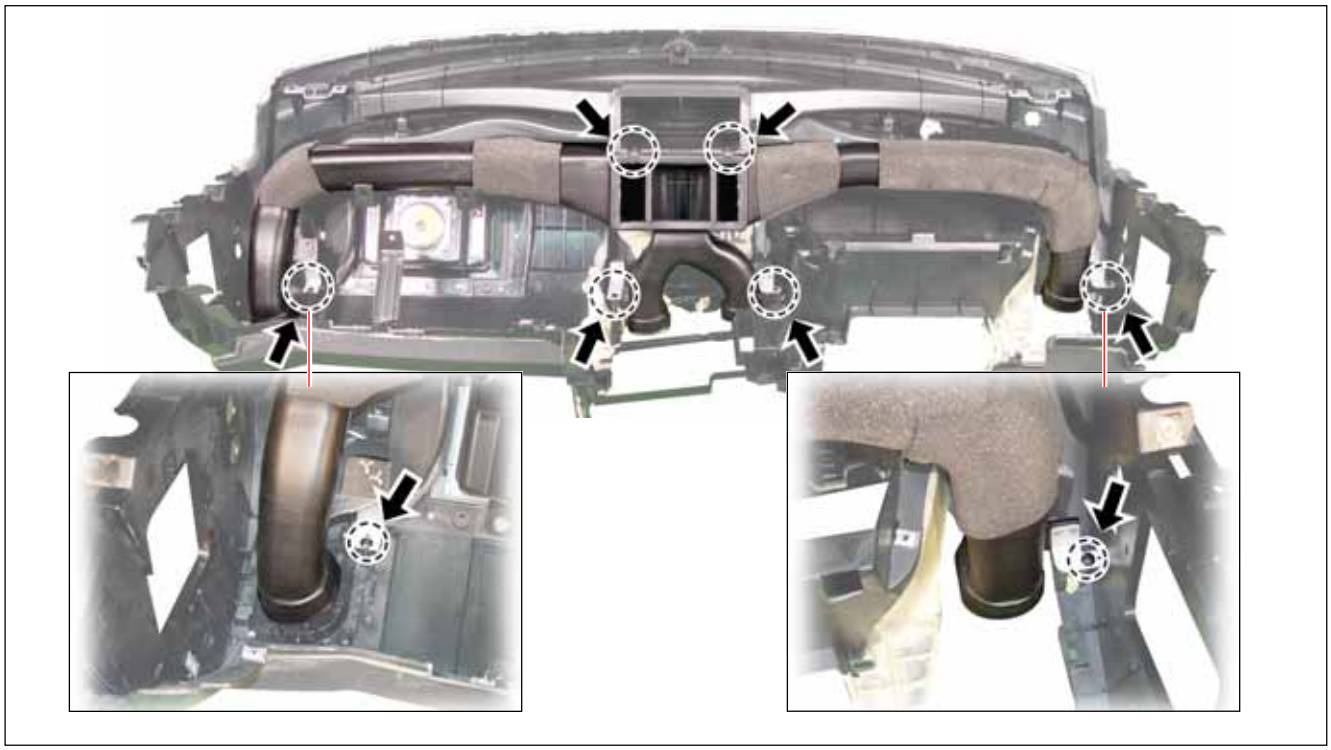
Rear View



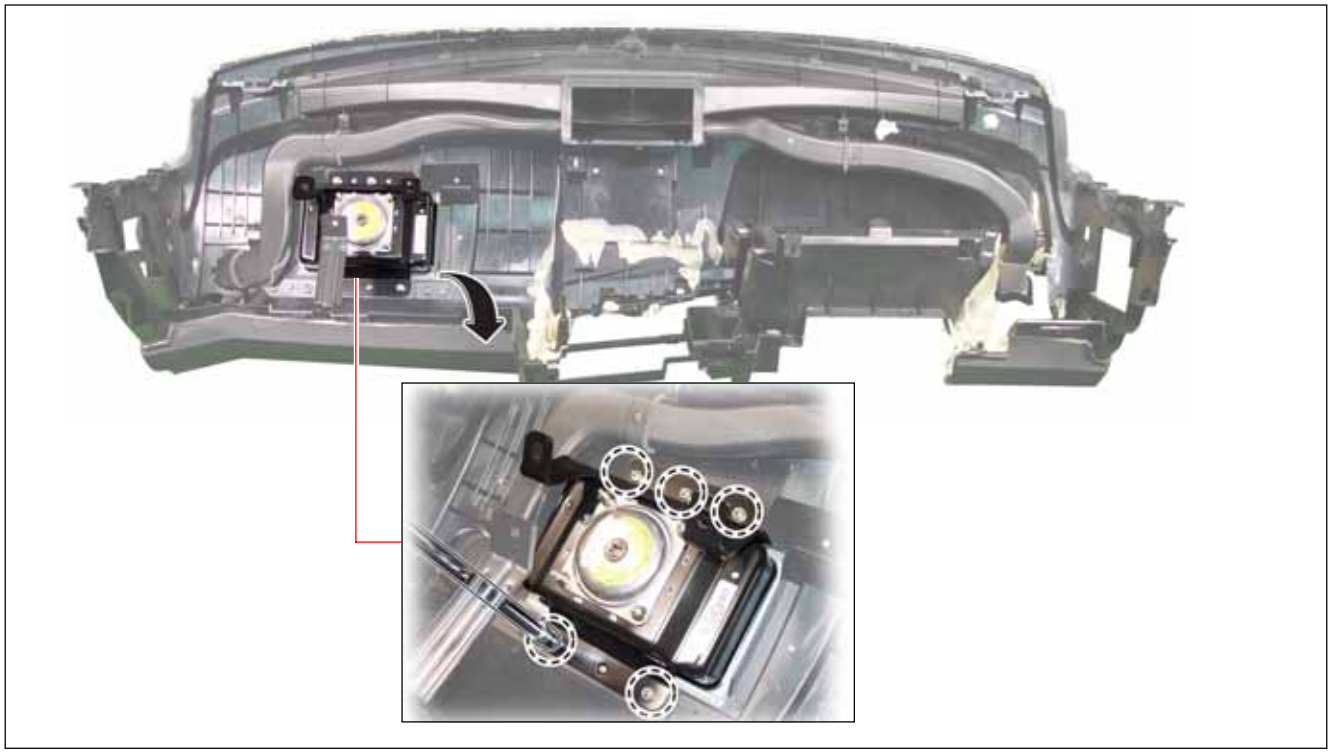
PAB: Passenger Air Bag

※ **Preceding Work:** Disconnect the battery nagative cable and remove the instrument panel assembly. (For details, refer to “Body” section.)

1. Remove the lower air duct from the removed instrument panel assembly (refer to “A/C” section).



2. Unscrew five nuts (10 mm) on the passenger’s air bag module.



3. Remove the air bag module assembly from the instrument panel.

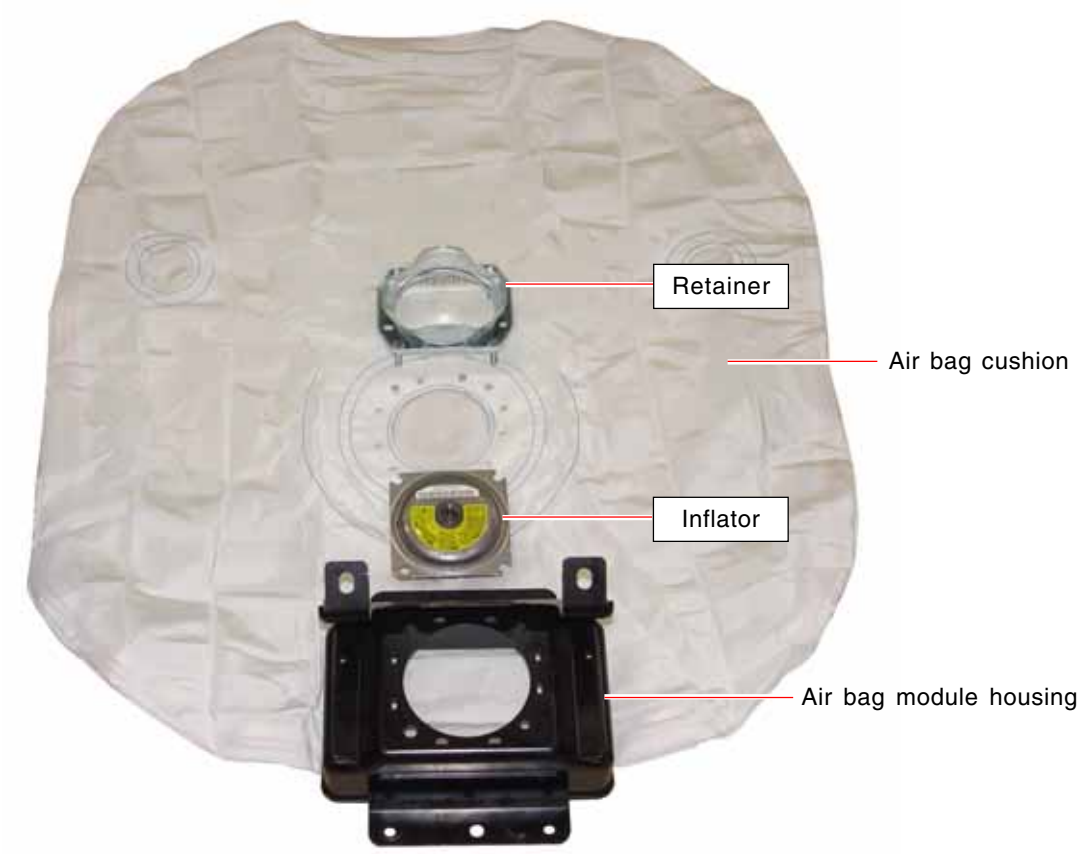




WARNING

- **The air bag module cannot be removed. Below picture is only for reference.**

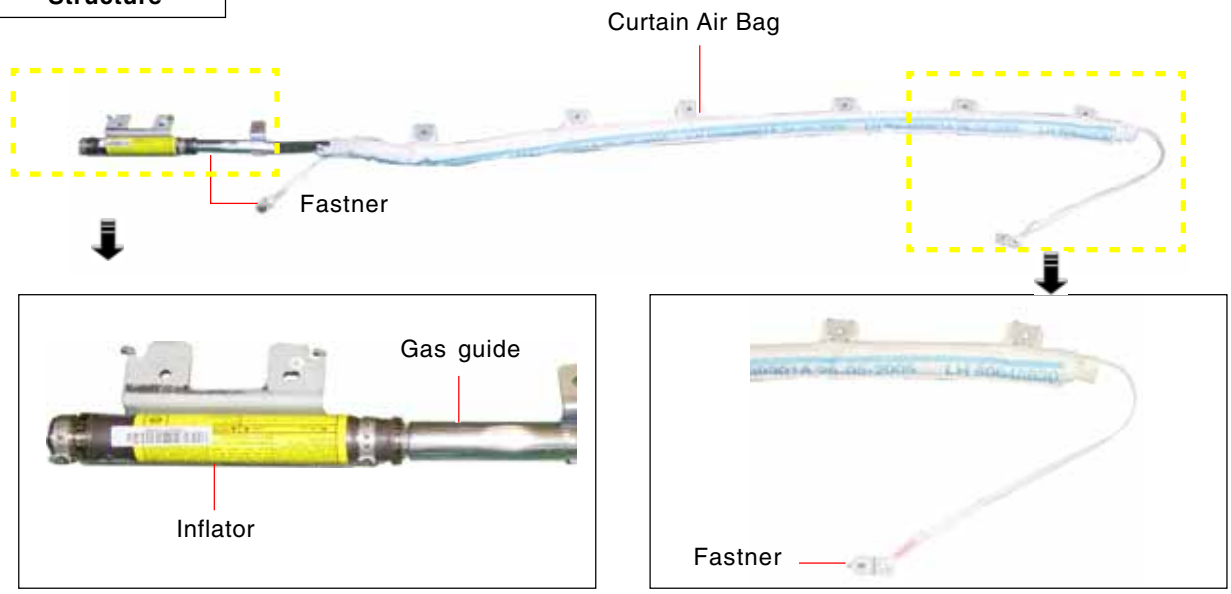
Components



CAB: Curtain Air Bag

※ **Preceding Work:** 1. Disconnect the negative (-) battery cable.
2. Remove the headlining assembly (refer to “Body” section).

Structure

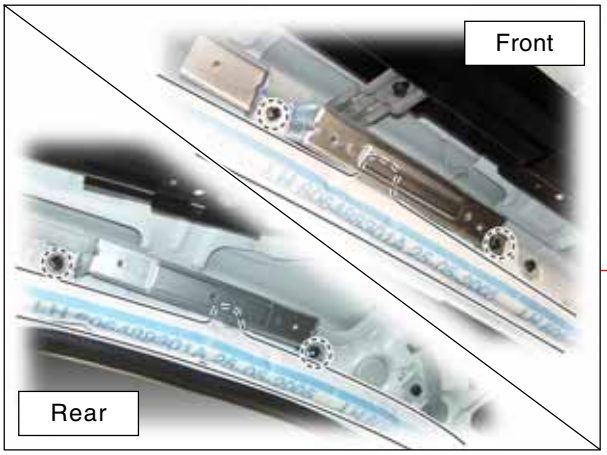


1. Disconnect the connector of the curtain air bag while releasing the hook.



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AFFECTED VIN	

2. Remove the assist grip (handle) from the roof trim.



3. Remove the mounting bolt from the front curtain air bag.

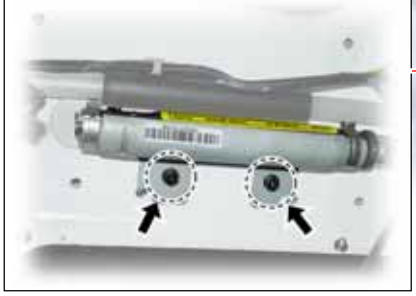


4. Unscrew the mounting bolt and remove the curtain air bag assembly.

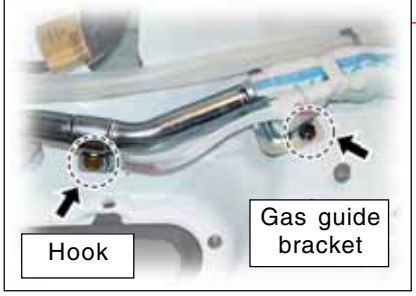
Curtain Air Bag

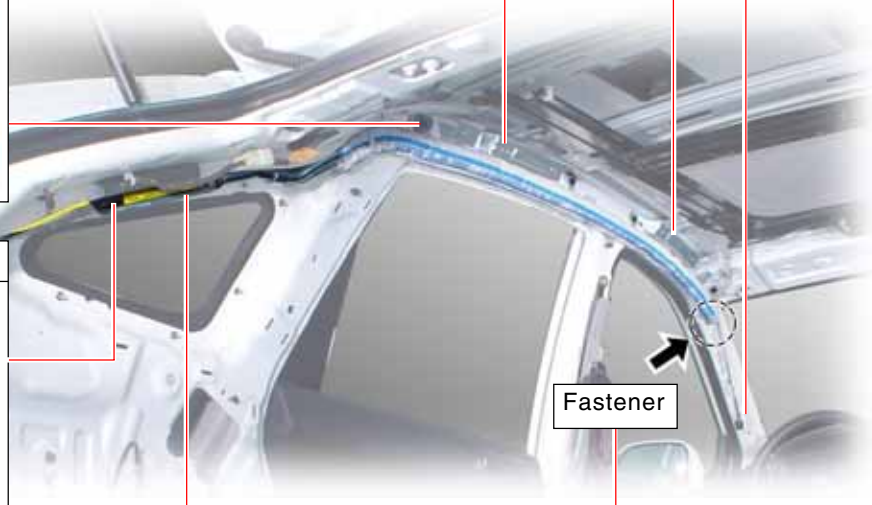


Rear (Inflator Bracket)

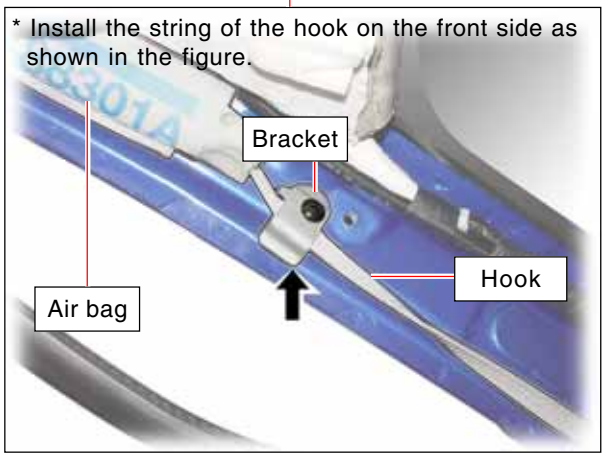


Gas Guide and Hook





* Install the string of the hook on the front side as shown in the figure.



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▶ Contact Coil

※ **Preceding Work:** Disconnect the negative battery cable and remove the steering wheel.

1. Disconnect the connector of the contact coil.



2. Unscrew four screws and remove the contact coil.
   Place the contact coil at the center position when installing.





Align the arrows when installing.

Components



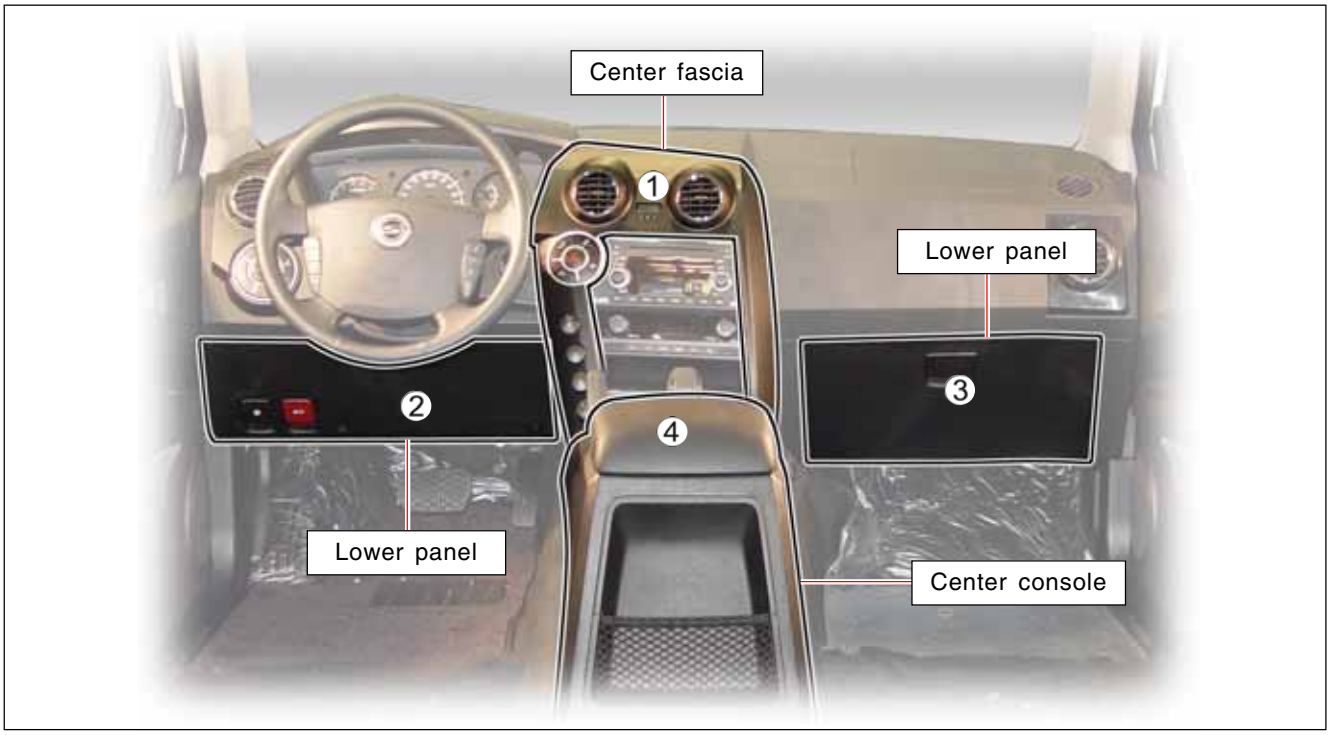
NOTICE

- **If the contact coil is not properly aligned, the steering wheel may not be able to rotate completely during turning. Restricted turning ability may cause the vehicle to crash and prevent the air bags from deploying during a crash.**
- **Turn the contact coil clockwise until it stops and turn it counterclockwise approx. 2.9 ± 0.2 turns to align the "▶ ◀" marks.**

▶ Air Bag Unit (SDM)

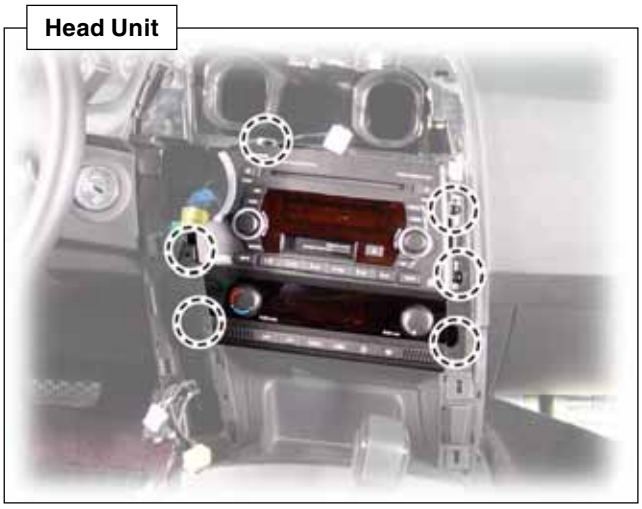
※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the center fascia, lower panels and center console in turns (refer to “Body” section).

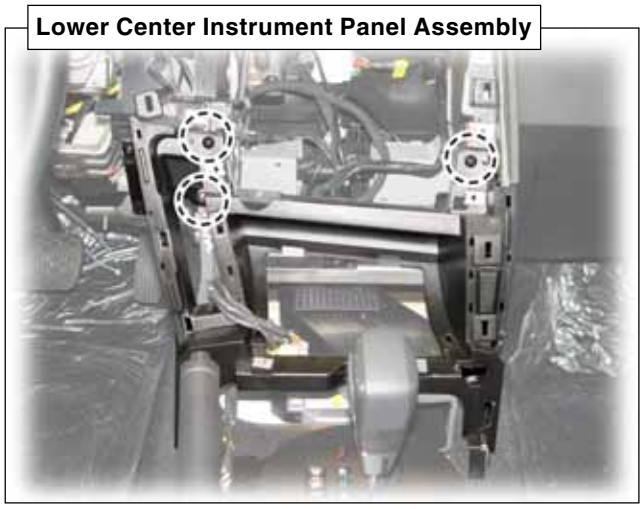


2. Remove the head unit (audio and A/C controller) and the lower center instrument panel (refer to "Body" section).

Head Unit



Lower Center Instrument Panel Assembly

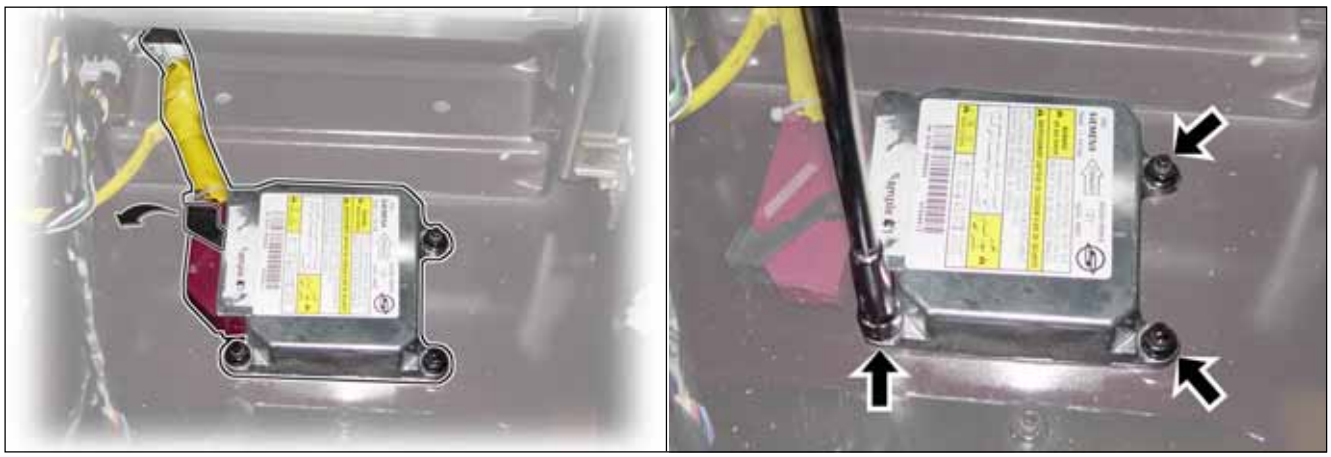


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3. Unscrew two screws and remove the air duct.



4. Disconnect the connector and remove three mounting nuts to remove the air bag unit.



Components





NOTICE

- **When an air bag deploys (curtain air bags and seat belt pretensioners included), the air bag unit must be replaced. Please do not attempt to delete the failure code with scan - I because some data about the deployment situation are stored in the unit.**
- **The air bag related components, especially the air bag unit, must be stored in a sealed case to prevent any damage.**
- **Please do not connect a tester to any air bag connector or single item to measure the supplied power or resistance. The detonator may explode due to a sudden extra power supplied by the tester.**
- **Before removing or installing any air bag related components, disconnect the negative battery cable.**

▶ Curtain Air Bag G Sensor

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the B-pillar panel at both sides. Disconnect the connector and remove one mounting bolt (10 mm) to remove the G sensor.

Installation Notice

Tightening torque	9 Nm ± 1 Nm

NOTICE

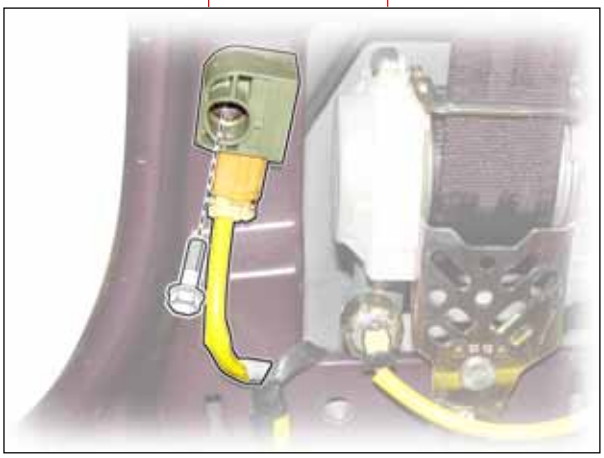
- **The body panel has guiding holes to ensure its correction installation. But incorrect tightening torque may break the sensor or make it insecure. As a result, the sensor may have inaccurate judgment and have the air bag deployed inaccurately.**
- **Because the gap between the installation bolt and the sensor is small, grind the bolt-locking socket to around 1.5 mm before mounting the curtain air bag sensor fixation bolt.**

Driver's Side



Passenger's Side





Components





10. DIAGNOSIS

Trouble Code	Defections	Action
1101	High battery voltage	• Check alternator output voltage. • Check battery condition (if its voltage is over 21.4 V for 16 seconds). • Check air bag unit terminals for damage.
1102	Low battery voltage	• Check alternator output voltage. • Check battery condition (if its voltage is below 7.2 V for 16 seconds, the warning lamp comes on. It resumes when the voltage is normal level for 9.6 seconds) • Check air bag unit terminals for damage.
1103	Low communication voltage for curtain air bag sensor	• Check curtain air bag sensor connector. • Check curtain air bag sensor wiring. • Check air bag unit terminals for damage. • Check if curtain air bag sensor is short to battery voltage or ground. • Check if curtain air bag sensor is defective. • Check battery condition (if its voltage is below 10.6 V for 16 seconds, the warning lamp comes on. It resumes when the voltage is normal level for 9.6 seconds).
1346	Driver's air bag circuit resistance is too high	• Check driver air bag connector. • Check driver air bag wiring (including clock spring). • Check air bag unit terminals for damage. • Resistance of squib: over 6.1 Ω
1347	Driver's air bag circuit resistance is too low	• Check driver air bag connector. • Check driver air bag connector (including clock spring). • Check air bag unit terminals for damage. • Resistance of squib: below 1.1 Ω
1348	Driver's air bag circuit is short to ground	• Check driver air bag connector. • Check driver air bag wiring (including clock spring). • Check air bag unit terminals for damage. • Resistance of Firing Loop: below 2 kΩ
1349	Drivers air bag circuit is short to battery voltage	• Check driver air bag connector. • Check driver air bag wiring (including clock spring). • Check the air bag unit terminals for damage. • Resistance of Firing Loop: below 2 kΩ
1352	Passengers air bag circuit resistance is too high	• Check passenger air bag connector. • Check passenger air bag wiring. • Check the air bag unit terminals for damage. • Resistance of squib: below 4.0 Ω
1353	Passengers air bag circuit resistance is too low	• Check passenger air bag connector. • Check passenger air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 0.8 Ω
1354	Passengers air bag circuit is short to ground	• Check passenger air bag connector. • Check passenger air bag wiring. • Check the air bag unit terminals for damage. • Resistance of Firing Loop: below 2 kΩ

Trouble Code	Defections	Action
1355	Passenger's air bag circuit is short to battery voltage	• Check passenger air bag connector. • Check passenger air bag wiring. • Check air bag unit terminals for damage. • Resistance of Firing Looop: below 2 kΩ
1361	Driver's pretensioner circuit resistance is too high	• Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.2 Ω
1362	Driver's pretensioner circuit resistance is too low	• Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 0.8 Ω
1363	Driver's pretensioner circuit is short to ground	• Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of Firing Looop: below 2 kΩ
1364	Driver's pretensioner circuit is short to battery voltage	• Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of Firing Looop: below 2 kΩ
1367	Passenger's pretensioner circuit resistance is too high	• Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.2 Ω
1368	Passenger's pretensioner circuit resistance is too low	• Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 0.8 Ω
1369	Passenger's pretensioner circuit is short to ground	• Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of Firing Looop: below 2 kΩ
1370	Passenger's pretensioner circuit is short to battery voltage	• Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of Firing Looop: below 2 kΩ
1378	Driver's curtain air bag circuit resistance is too high	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check the air bag unit terminals for damage. • Resistance of squib: over 4.3 Ω
1379	Driver's curtain air bag circuit resistance is too low	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check the air bag unit terminals for damage. • Resistance of squib: below 0.6 Ω

Trouble Code	Defections	Action
1380	Driver's curtain air bag is short to ground	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1381	Driver's curtain air bag is short to battery voltage	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1382	Passenger's curtain air bag circuit resistance is too high	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.3 Ω
1383	Passenger's curtain air bag circuit resistance is too low	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 0.6 Ω
1384	Passenger's curtain air bag is short to ground	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1385	Passenger's curtain air bag is short to battery voltage	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1395	Air bag connector problem	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage.
1400	Driver's curtain air bag sensor problem	• Check driver curtain air bag sensor connector. • Check driver curtain air bag sensor wiring. • Check air bag unit terminals for damage.
1401	Driver's curtain air bag sensor circuit is short to ground	• Check driver curtain air bag sensor connector. • Check driver curtain air bag sensor wiring. • Check the air bag unit terminals for damage. • Resistance: below 250 Ω
1402	Driver's curtain air bag sensor circuit is short to battery voltage	• Check driver curtain air bag sensor connector. • Check driver curtain air bag sensor wiring. • Check air bag unit terminals for damage. • Resistance: below 25 Ω
1409	Communication error in driver's curtain air bag sensor	• Check driver curtain air bag sensor connector. • Check driver curtain air bag sensor wiring. • Check air bag unit terminals for damage. • If the voltage drops below 10.6 V during normal system operation, the trouble code is generated. This trouble code is linked with B1 400, B1 401, B1 402 and B1 414.

Trouble Code	Defections	Action
1414	Wrong driver's curtain air bag sensor	• Check driver curtain air bag sensor connector. • Check driver curtain air bag sensor wiring. • Check air bag unit terminals for damage.
1403	Defective passenger's curtain air bag sensor	• Check passenger curtain air bag sensor connector. • Check passenger curtain air bag sensor wiring. • Check air bag unit terminals for damage.
1404	Passenger's curtain air bag sensor circuit is short to ground	• Check passenger curtain air bag sensor connector. • Check passenger curtain air bag sensor wiring. • Check air bag unit terminals for damage. • Resistance: below 250 Ω
1405	Passenger's curtain air bag sensor circuit is short to battery voltage	• Check passenger curtain air bag sensor connector. • Check passenger curtain air bag sensor wiring. • Check air bag unit terminals for damage. • Resistance: below 25 Ω
1410	Communication error in passenger's curtain air bag sensor	• Check passenger curtain air bag sensor connector. • Check passenger curtain air bag sensor wiring. • Check the air bag unit terminals for damage. • If the voltage drops below 10.6 V during normal system operation, the trouble code is generated. This trouble code is linked with B1 403, B1 404, B1 405 and B1 415.
1415	Wrong driver's curtain air bag sensor	• Check passenger curtain air bag sensor connector. • Check passenger curtain air bag sensor wiring. • Check air bag unit terminals for damage.
1620	SDM internal fault	• Replace SDM.
1650	Frontal impact record	• Replace SDM.
1651	Driver's curtain air bag impact record	• Replace SDM.
1652	Passenger's curtain air bag impact record	• Replace SDM.
1657	Belt pretensioner operation record	• Replace SDM.
2500	Warning lamp error	• Check wiring to warning lamp. • Check warning lamp bulb. • Check SDM unit terminal for damage.

AIR CONDITIONING SYSTEM

6810 / 6910 / 6810

TABLE OF CONTENTS

AIR CONDITIONING SYSTEM 2

1. System layout and components 2
2. Ventilation system 4
3. Air conditioner controller (Unit) 9
4. Self diagnosis (Only for FATC air conditioner) .. 16
5. System diagram 22
6. Sensors and actuators 23
7. AQS (Air quality system) 25
8. Air conditioner module sensors and actuators 29
9. Removal and installation for other related parts 39

FFH (FUEL FIRED HEATER) SYSTEM 56

1. Overview 56
2. FFH layout 57
3. Specifications 59
4. FFH operating process 60
5. Components and functions 65
6. Removal and installation 69
7. Trouble diagnosis 76

PTC (POSITIVE TEMPERATURE COEFFICIENT) SYSTEM 80

1. Overview 80
2. Components 81
3. PTC operating process 82
4. Removal and installation 84

AIR CONDITIONING SYSTEM

1. SYSTEM LAYOUT AND COMPONENTS

Type	Air Conditioner Controller
FATC	
Manual air conditioner	

Sun Sensor - Instrument Panel Upper Left



It changes sun load coming through front windshield into current to input to FATC controller.



AQS Switch

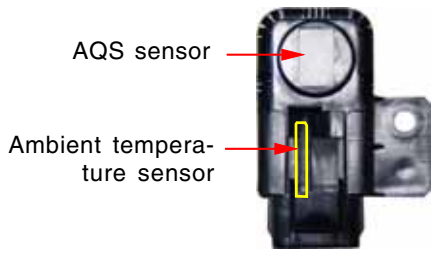


A function that turns on/off the air source selection and air quality system.

Compressor



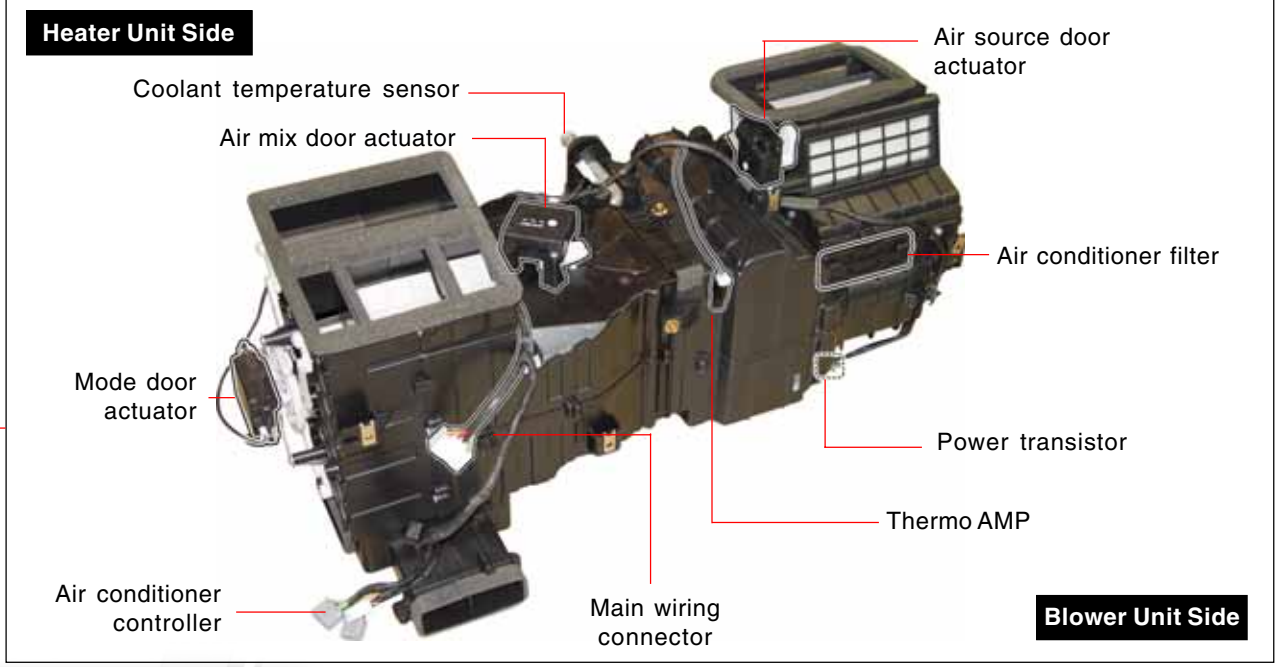
AQS Sensor and Ambient Temperature Sensor



This sensor is installed at the front bottom of engine compartment. This changes the air source mode by detecting the air pollution and the ambient temperature.

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AFFECTED VIN	

Air Conditioner Module Assembly - Inside of Instrument Panel





Condenser



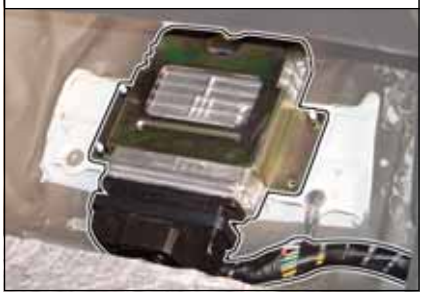
Installed in front of vehicle and condenses vapor refrigerant into low temperature and high pressure liquid refrigerant.

Receiver Drier (LH)



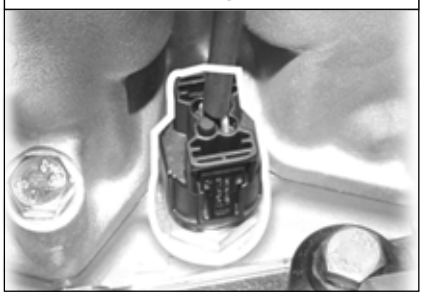
* Absorbs moisture in the refrigerant and reserves refrigerant to supply smoothly.

Engine ECU (Passenger Footstep)



* Detects A/C switch position, coolant temperature, engine condition and driving condition to control the air conditioner.

Coolant Temperature Sensor (On Engine)

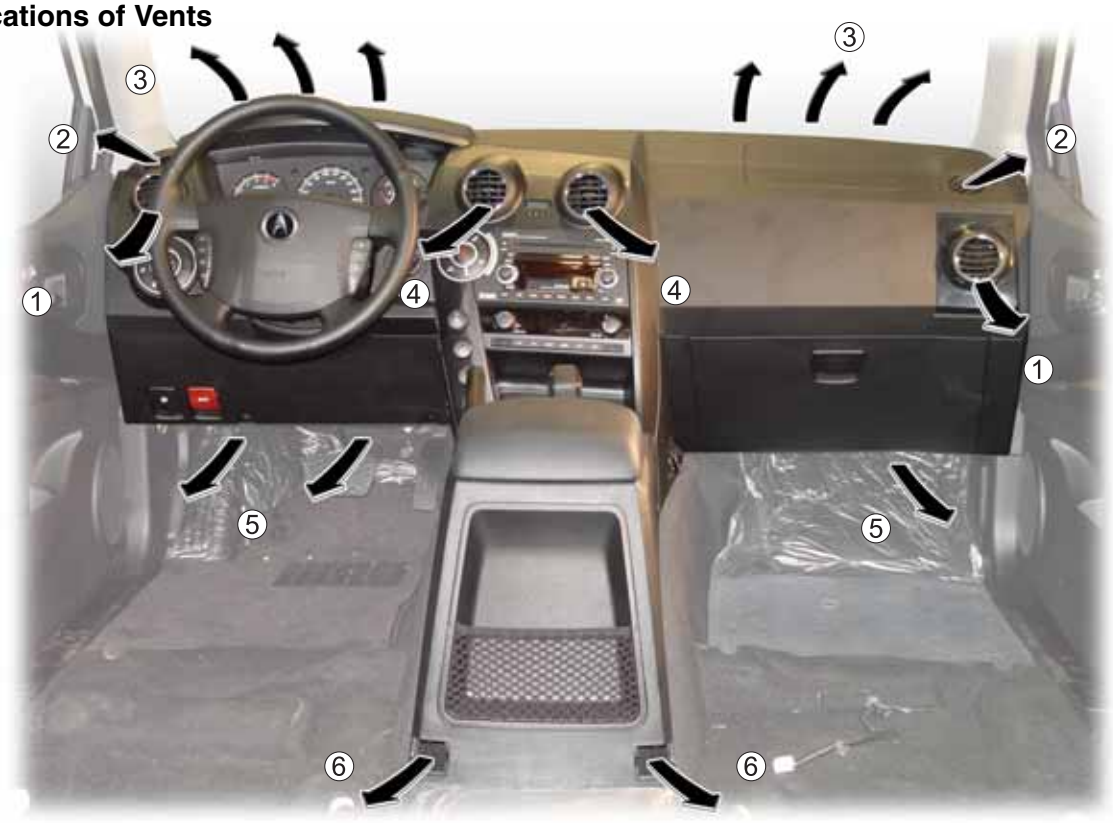


* A sensor that detects coolant temperature and transmits it to engine ECU.

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2. VENTILATION SYSTEM

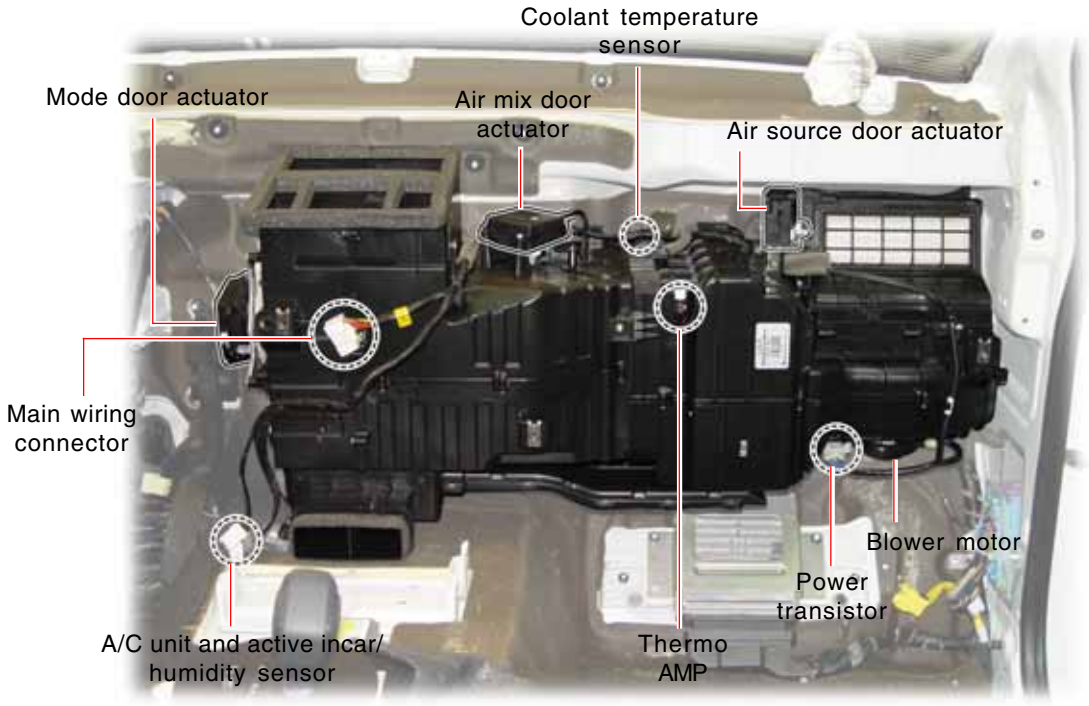
▶ Locations of Vents



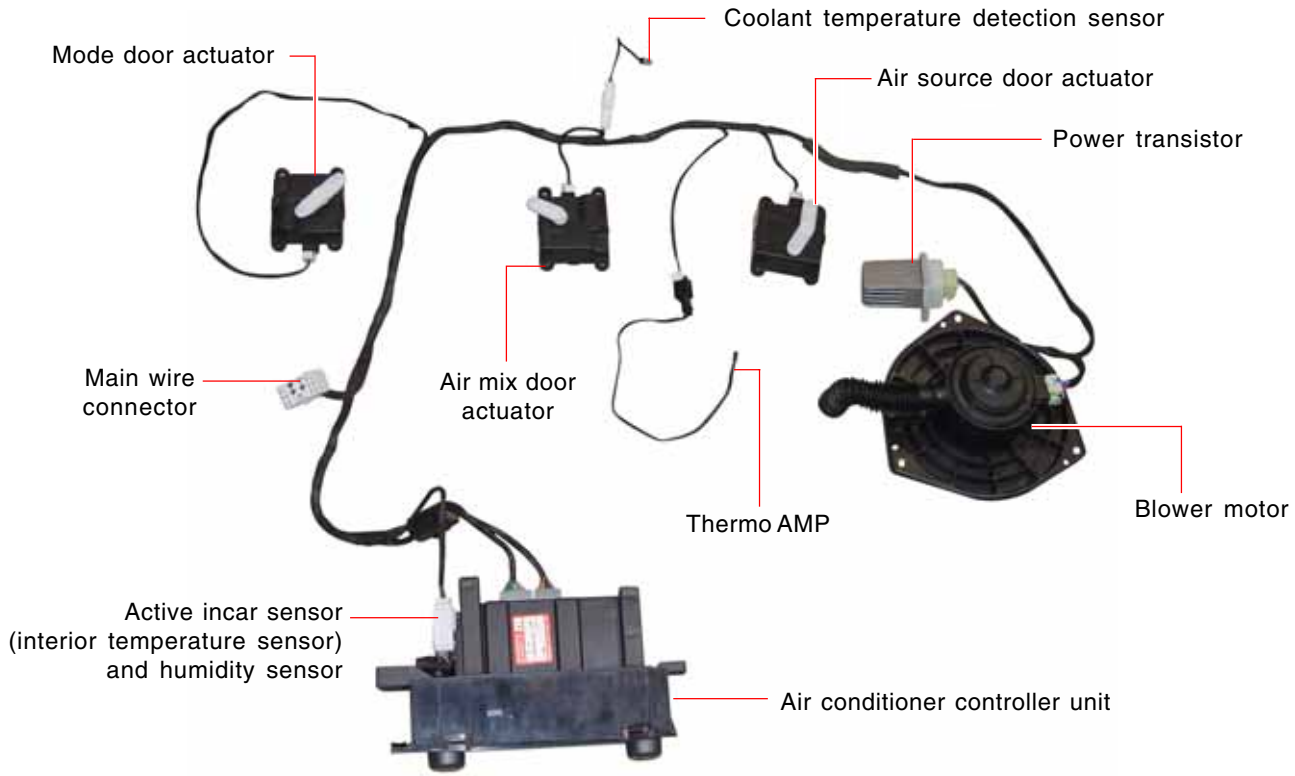
▶ Air Duct



▶ Air Duct Layout



Front Air Conditioner Module Wiring Layout



▶ Air Conditioner Module And Sensors

Locations

Coolant Temperature Sensor



Air Source Door Actuator

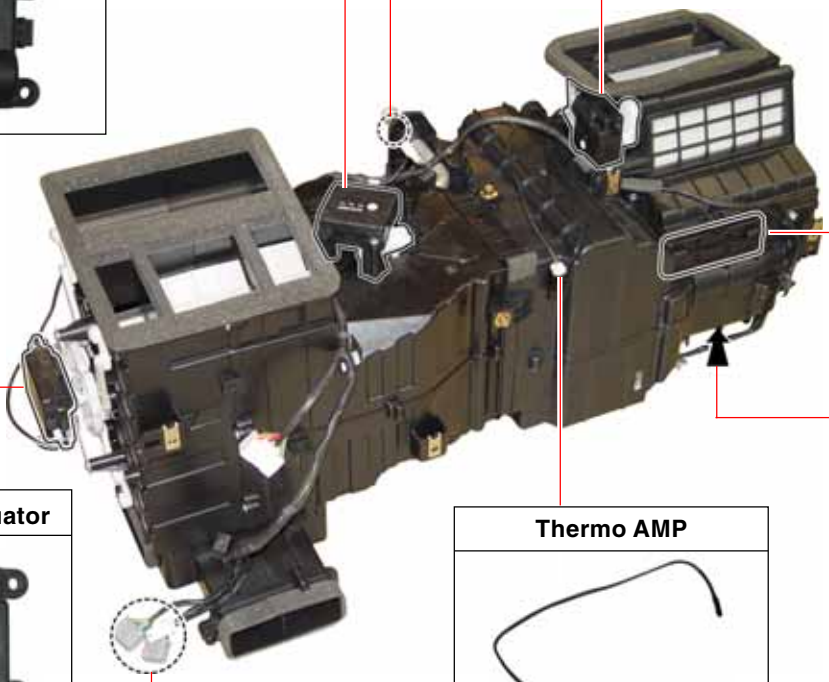


Air Conditioner Filter



Air mix door actuator

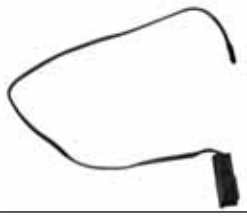




Mode Door Actuator



Thermo AMP



A/C Controller Unit

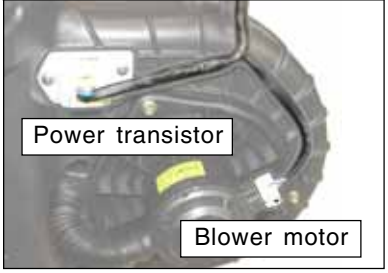


Active incar and humidity sensor

Active Incar Sensor (Humidity Sensor)

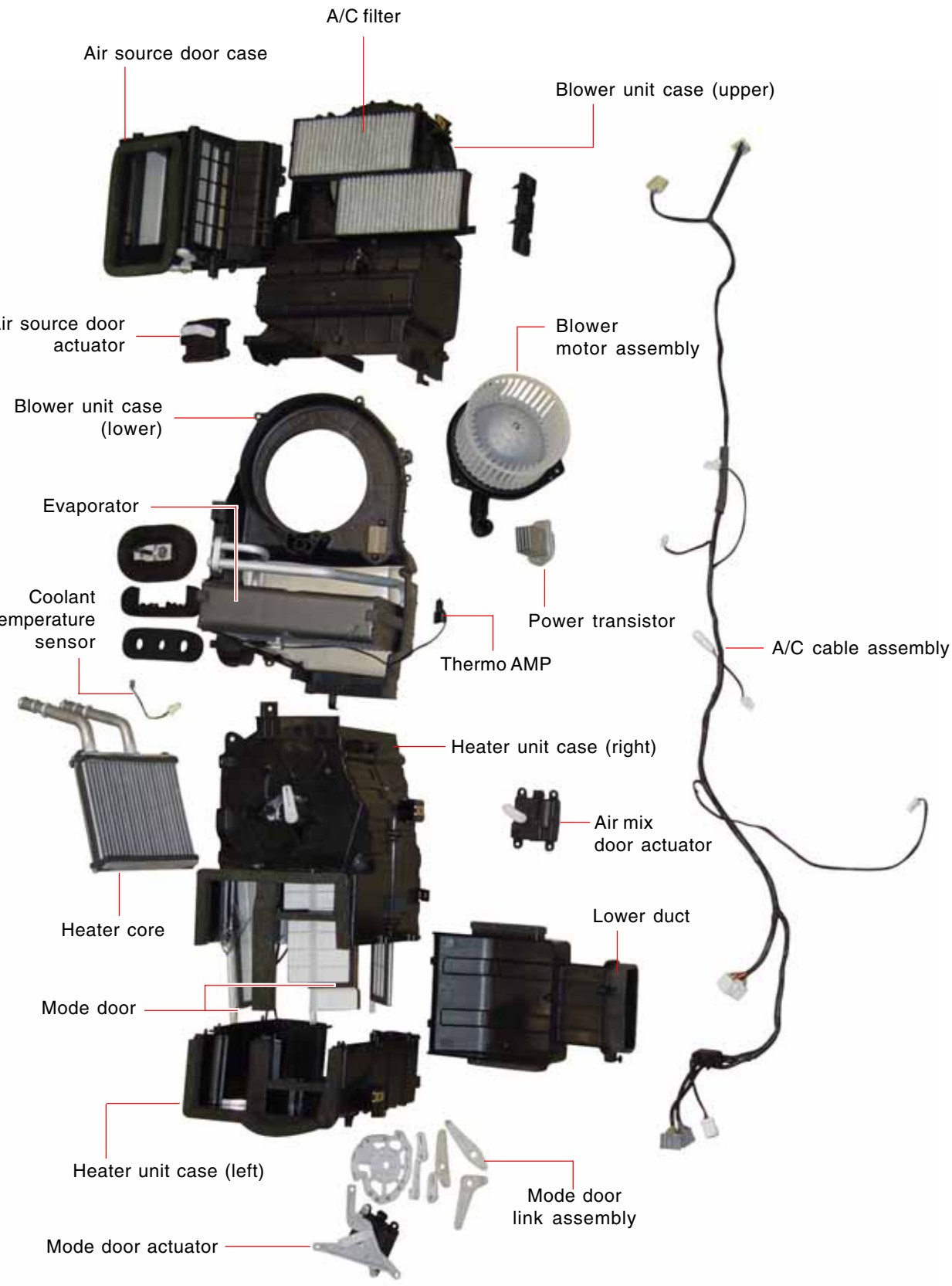


Power Transistor/Blower Motor



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AFFECTED VIN	

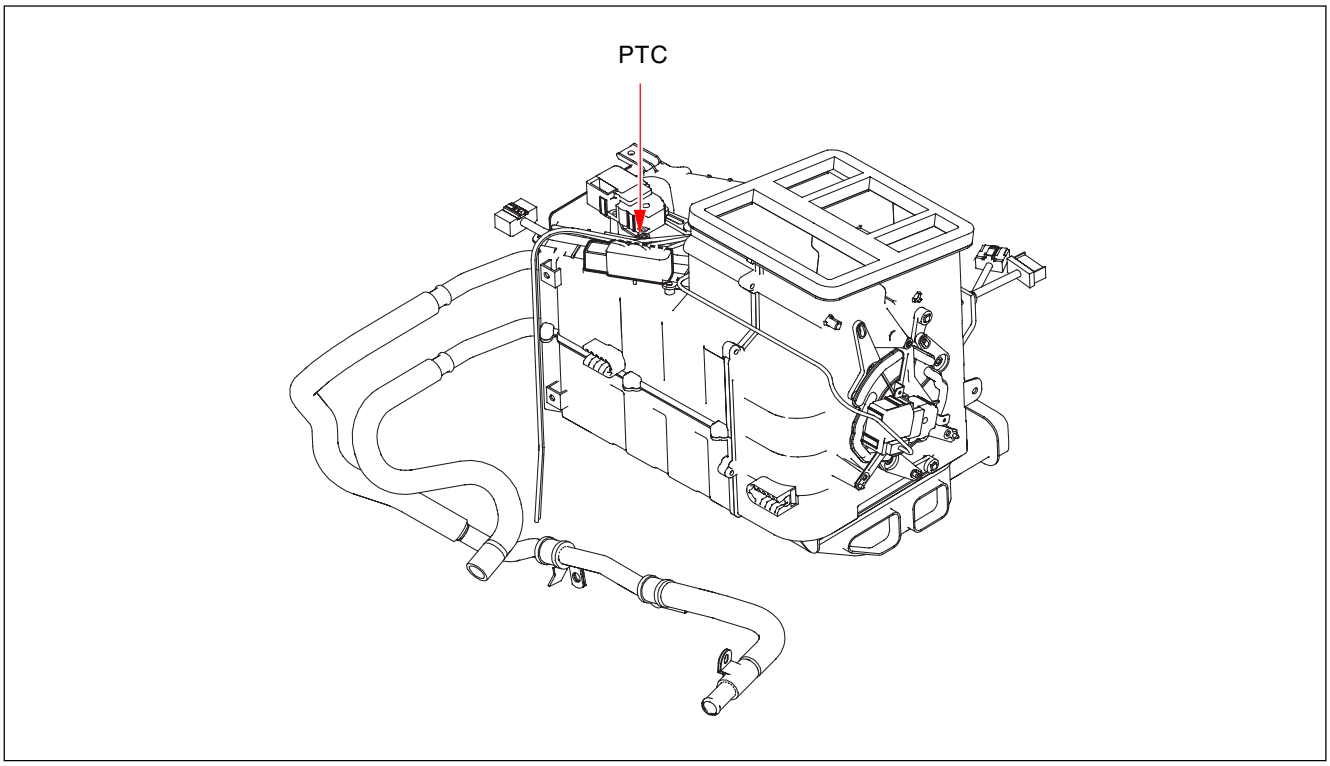
Components



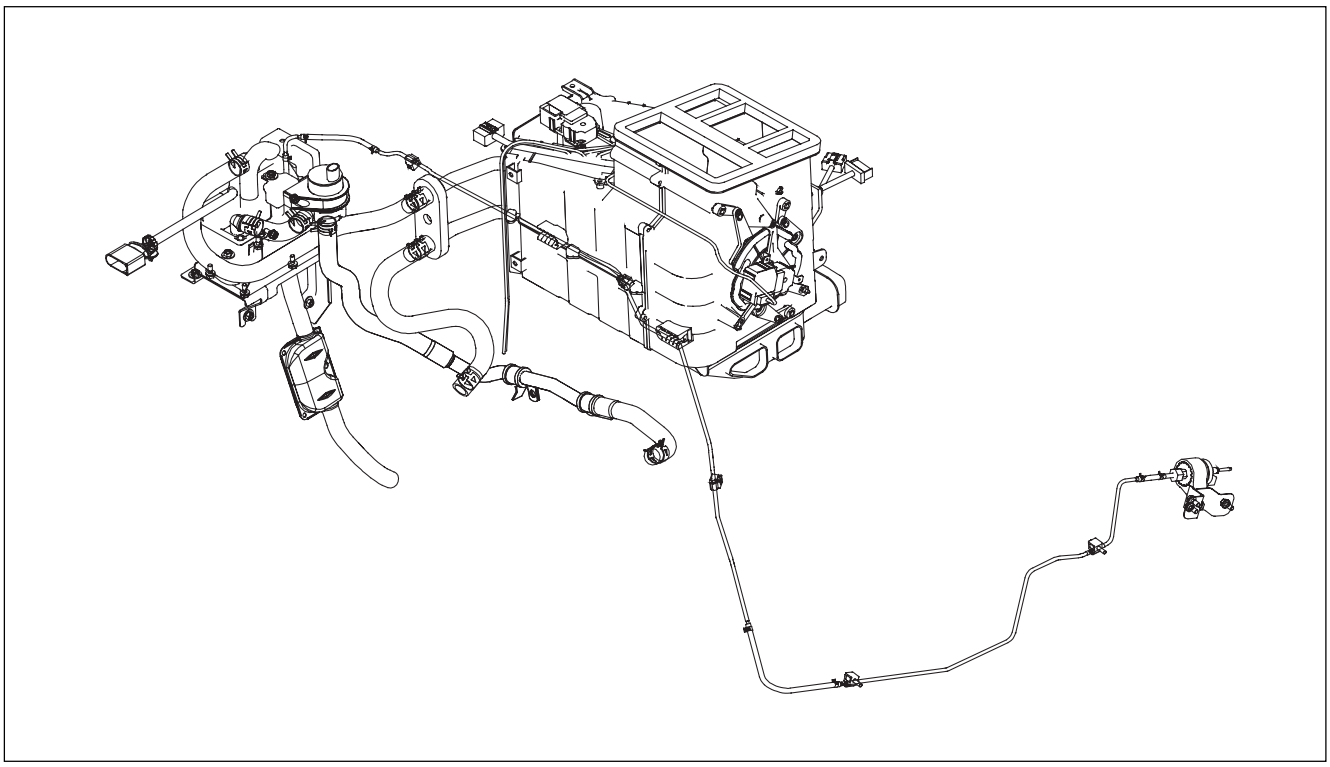
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AFFECTED VIN	

▶ PTC Heater and FFH Heater Layout

PTC Heater Assembly Layout

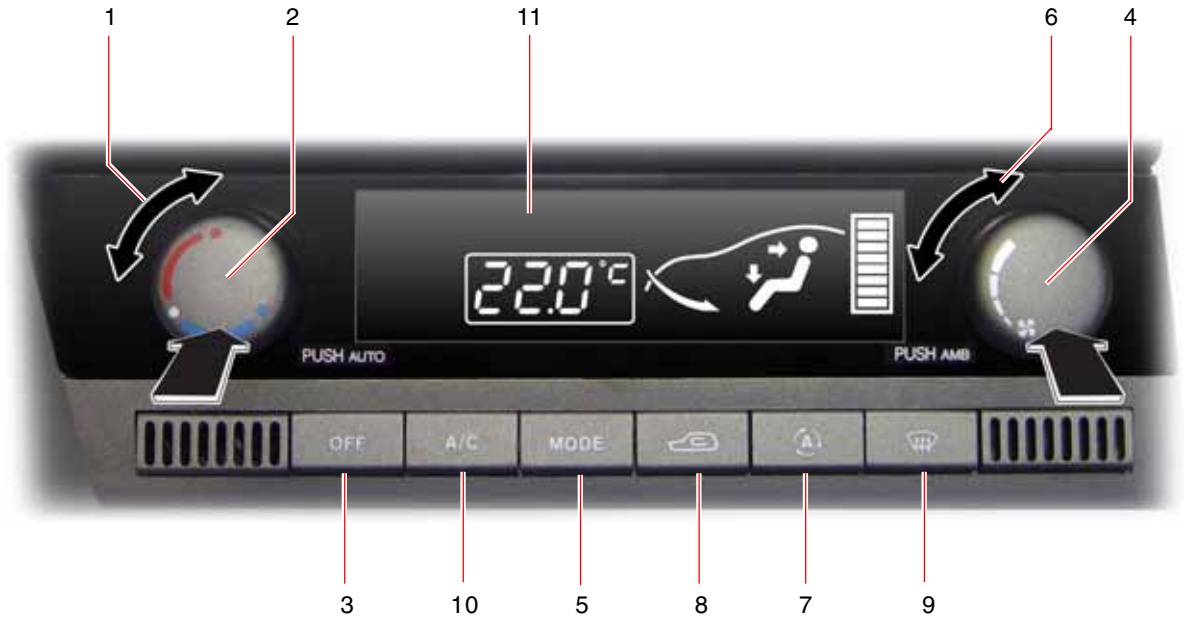


FFH Heater Assembly Layout



3. AIR CONDITIONER CONTROLLER (UNIT)

▶ Functions of Full Automatic Air Conditioner Controller



1. Temp SW	➡	Temperature control: Air mix actuator mixes hot air with cool air to maintain the set temperature.
2. Auto SW	➡	Auto control
3. OFF SW	➡	System OFF (Air source indicator stays ON)
4. Amb SW	➡	Displays ambient temperature ® Return to previous display after 5 seconds
5. Mode SW	➡	Changed to Manual mode from Auto Mode
6. Blower SW	➡	Fan speed control in 8 levels (33 levels in Auto mode)
7. AQS SW	➡	Manual selection of Rec Mode (in Auto mode)
8. Fre SW	➡	Manual selection of Fre Mode (in Auto mode)
9. Defroster SW	➡	Manual selection of Def Mode (in Auto mode)
10. A/C SW	➡	A/C ON (to Manual mode)
11. VFD(Display)	➡	Displays A/C status

* Rec Mode: Recirculation Mode
* Fre Mode: Fresh Mode
* Def Mode: Defroster Mode

▶ Functions of Full Automatic Air Conditioner Controller (II)

Temperature Control Switch and AUTO Button





When pressing the air conditioner AUTO mode and temperature control dial switch, the system operates in AUTO mode and can set the desired temperature (18 ~ 32°C) by rotating the switch. To get the desired temperature, the air conditioner controls compressor, door mode, air source door, air mix door and blower motor automatically.

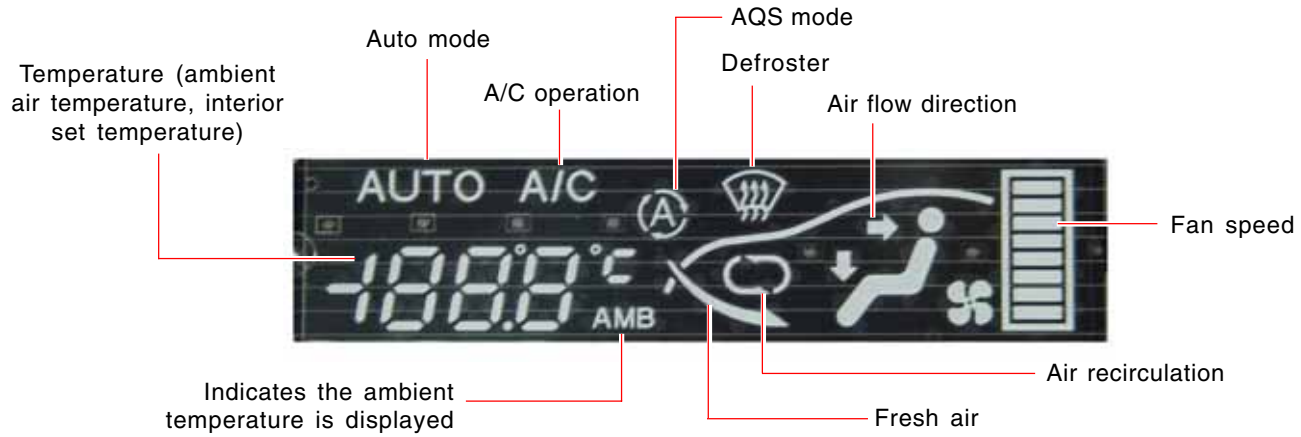
Active Incar/Humidity Sensor (AIH Sensor)

- The AIH sensor is installed on the air conditioner controller unit. It is a sensor that detects interior temperature and humidity.



Display Window (VFD)

Each switch mode appears as a symbol on the fluorescent display and malfunction of each sensor in air conditioner control system is also displayed.



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Fan Speed Control Switch and AMP Switch

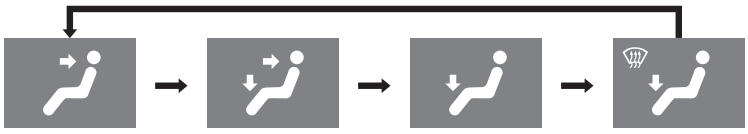


- When controlling the fan speed by rotating this switch in AUTO mode, the mode is changed from AUTO to manual and the fan speed can be changed in 8 levels.
- When pressing this switch, the outside temperature measured by ambient temperature sensor comes on for 5 seconds and then returns back to preset temperature.



Mode Switch

- By depressing this switch, the airflow mode is changed.



The air flows towards face. (Vent mode)	The air flows towards face and floor. (Bi-level mode)	The air flows towards floor. (Foot mode)	The air flows towards front windshield and floor. (Defrost and foot mode)

A/C Switch:

When pressing this switch, the air conditioner operates in manual mode and A/C ON indicator comes on.



A/C [OFF] Switch

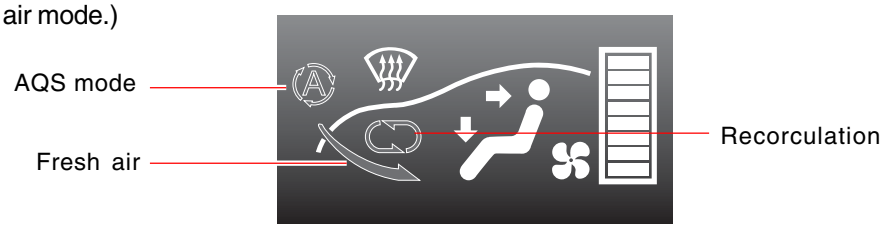
Air Source Selection Switch

When pressing this switch, the air recirculates in the vehicle and indicator comes on. When pressing it again, the indicator goes off and the fresh air comes in.

(However, under defroster mode or defroster/foot mode, it stays in the fresh air mode.)

AQS Switch

Air Quality System (AQS) changes the air source selection to recirculation mode when polluted air is detected through AQS sensor. The air source selection returns back to fresh air intake mode after a specified period or the polluted air disappears (refer to AQS and ambient temperature sensor).

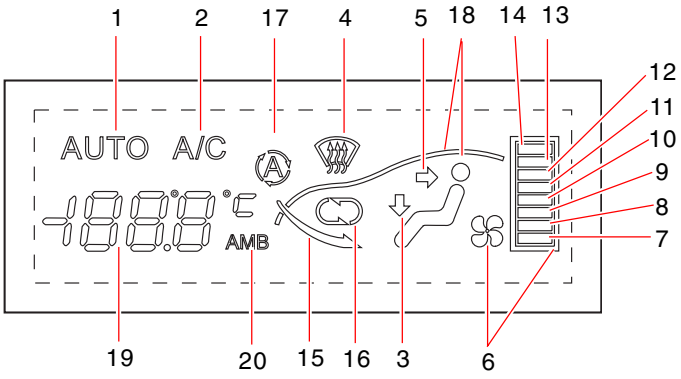


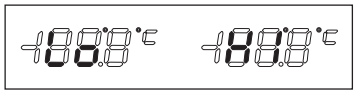
Defroster Switch

When pressing this switch, the airflow direction will be changed to windshield and door glasses, the air conditioner operates automatically and outside air comes in. At this moment, the defroster indicator, air conditioner indicator and fresh air mode indicator come on. When pressing the switch again, the air conditioner returns back to pevious operation.

When pressing the AUTO switch, the defroster mode appears on the VFD until the coolant temperature reaches at a certain level.

▶ Full Automatic Air Conditioner Controller Operation Table





If the temperature switch (dial) is set under 18.0 ˚C, the display shows "Lo" and if it is set over 32.0 ˚C, the display shows "Hi".

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
REC	-	-	-	-	-	○	-	-	-	-	-	-	-	-	×	○	-	○	○	×
FRE	-	-	-	-	-	○	-	-	-	-	-	-	-	-	○	×	-	○	○	×
FR/DEF	×	○	×	○	×	○	-	-	-	-	-	-	-	-	○	×	-	○	○	×
FAN speed 0	×	-	-	-	-	○	×	×	×	×	×	×	×	×	-	-	-	○	○	×
FAN speed 1	×	-	-	-	-	○	○	×	×	×	×	×	×	×	-	-	-	○	○	×
FAN speed 2	×	-	-	-	-	○	○	○	×	×	×	×	×	×	-	-	-	○	○	×
FAN speed 3	×	-	-	-	-	○	○	○	○	×	×	×	×	×	-	-	-	○	○	×
FAN speed 4	×	-	-	-	-	○	○	○	○	○	×	×	×	×	-	-	-	○	○	×
FAN speed 5	×	-	-	-	-	○	○	○	○	○	○	×	×	×	-	-	-	○	○	×
FAN speed 6	×	-	-	-	-	○	○	○	○	○	○	○	×	×	-	-	-	○	○	×
FAN speed 7	×	-	-	-	-	○	○	○	○	○	○	○	○	×	-	-	-	○	○	×
FAN speed 8	×	-	-	-	-	○	○	○	○	○	○	○	○	○	-	-	-	○	○	×
MODE VENT	×	-	×	×	○	○	-	-	-	-	-	-	-	-	-	-	-	○	○	×
MODE B/L	×	-	○	×	○	○	-	-	-	-	-	-	-	-	-	-	-	○	○	×
MODE FOOT	×	-	○	×	×	○	-	-	-	-	-	-	-	-	-	-	-	○	○	×
MODE D/F	×	-	○	○	×	○	-	-	-	-	-	-	-	-	-	-	-	○	○	×
AUTO (AUTO A/C)	○	-	-	-	-	○	-	-	-	-	-	-	-	-	-	-	-	○	○	×
A/C	×	○	-	-	-	○	○	×	×	×	×	×	×	×	-	-	-	-	-	×
AQS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	○	-	-	×
AMB	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○	○
OFF (IGN ON)	×	×	×	×	×	×	×	×	×	×	×	×	×	×	-	-	×	○	×	×
OFF (IGN OFF)	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
TEMPDIAL	-	-	-	-	-	○	-	-	-	-	-	-	-	-	-	-	-	○	○	-

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AFFECTED VIN	

▶ Full Automatic Air Conditioner Operations

This section describes the main operations of full automatic air conditioner.

Blower Motor Control

In AUTO mode, the blower motor automatically controls the fan in 33 levels according to the sensing conditions (e. g., ambient temperature and room temperature). In MANUAL mode, the blower motor controls the fan in 8 levels by the fan switch operation.

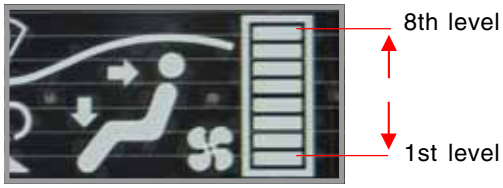
Fan control in AUTO mode (33 levels)

The blower fan is controlled in 33 levels according to the input data from sensors. The higher the lever is, the higher the output voltage increases (control voltage in 33rd stage: battery voltage).

Level	Control voltage	Level	Control voltage	Level	Control voltage	Level	Control voltage
OFF	0 V	9	6 V	18	8.25 V	27	10.5 V
1	4 V	10	6.25 V	19	8.5 V	28	10.75 V
2	4.25 V	11	6.5 V	20	8.75 V	29	11 V
3	4.5 V	12	6.75 V	21	9 V	30	11.25 V
4	4.75 V	13	7 V	22	9.25 V	31	11.5 V
5	5 V	14	7.25 V	23	9.5 V	32	11.75 V
6	5.25 V	15	7.5 V	24	9.75 V	33	VACC
7	5.5 V	16	7.75 V	25	10 V		
8	5.75 V	17	8 V	26	10.25 V		

Fan control in MANUAL mode (8 levels)

In Manual mode, the fan speed can be controlled in 8 levels using the dial.



Level	1	2	3	4	5	6	7	8
Control voltage	4 ~ 4.75 V	5 ~ 5.75 V	6 ~ 6.75 V	7 ~ 7.75 V	8 ~ 8.75 V	9 ~ 9.75 V	10 ~ 10.75 V	11 ~ Battery voltage

Heating Start Control

In winter, when the engine coolant temperature is low or the hot wind has not been sufficiently generated, the airflow from the vent is not hot and so, not helpful to heating. The heating control is to restrain this airflow from releasing. Thus, before the coolant temperature reaches 55°C, the blower motor is set to the first stage in Auto mode and the blower operating voltage increases by 0.075V/sec, following the increase of duct temperature.

The air flow direction is in DEF mode (below 20°C), D/F mode (20°C~55°C) and AUTO mode (55°C).

When the coolant temperature sensor is defective, the heating control function is cancelled after 500 seconds.

Cooling Start Airflow Control

When the intake temperature sensor indicates over 35°C, the voltage value increases by 1 V/sec with delay from 3 seconds after the compressor starts its operation.

In the initial operation stage, the hot air is discharged to the windshield (DEF mode) for a specific period of time (approx. 5 seconds). This prevents the hot air from suddenly discharging to the front passengers.

Amount of Sunload Compensation Control

The air flow is directed to “VENT” according to the amount of sunload. In “VENT” and “B/L” modes, the blower voltage increases within 2.5 V.

DEF Mode Compensation Control

In “DEF” mode, the voltage increases 2 V compared to that in “AUTO” mode. The voltage after compensation should not exceed 7 V.

Maximum Cooling/Heating Control

	17.5°C (Min.)	32.5°C (Max.)
Mode	Foot	VENT
Rec/Fresh Air	Ambient air	Inside air
Air mix	100%	0%
Air conditioner	OFF	ON
Blower motor	Hi	Hi

Ambient Air Temperature Display

When the AMB button is pressed, the ambient temperature is displayed for 5 seconds. When the vehicle stops while driving, the ambient temperature before stop is displayed.

Recirculation/Fresh Air Control

A. AUTO control: Fresh air, 20% of fresh air, Recirculated air

B. MANUAL control: Fresh air, Recirculated air

C. COMP OFF control: Fresh air (AUTO mode)

D. PTC linked control: When PTC is activated, the recirculation door is fixed at 30% of fresh air position. When PTC is deactivated, it returns to previous mode.

E. AQS control: In initial stage, the recirculation mode is activated for 35 seconds. After then AQS sensor converts the mode between recirculation and fresh air.

High Intake Air Temperature Delay Control

When the intake temperature sensor indicates over 35°C, the voltage value increases by 1 V/sec with delay from 3 seconds after the compressor starts its operation.

COMP Control

- Ambient air temperature control: COMP OFF when the ambient temperature is below 0°C, COMP ON when it is over 2°C.
- Intake air temperature control: COMP OFF when the thermo AMP temperature is below 2°C, COMP ON when it is over 4°C.

▶ Manual Air Conditioner Controller

Manual air conditioner controller controls the fan speed, air distribution direction, air source selection and temperature control with motor actuators according to soft button and dial switch operations.

Fan Speed Control Switch

The fan speed can be adjusted in 4 levels by rotating the switch. The operation stops when it is set tc “0”.

Bi-level Mode

The air flows towards front face and floor.

Temperature Control Switch

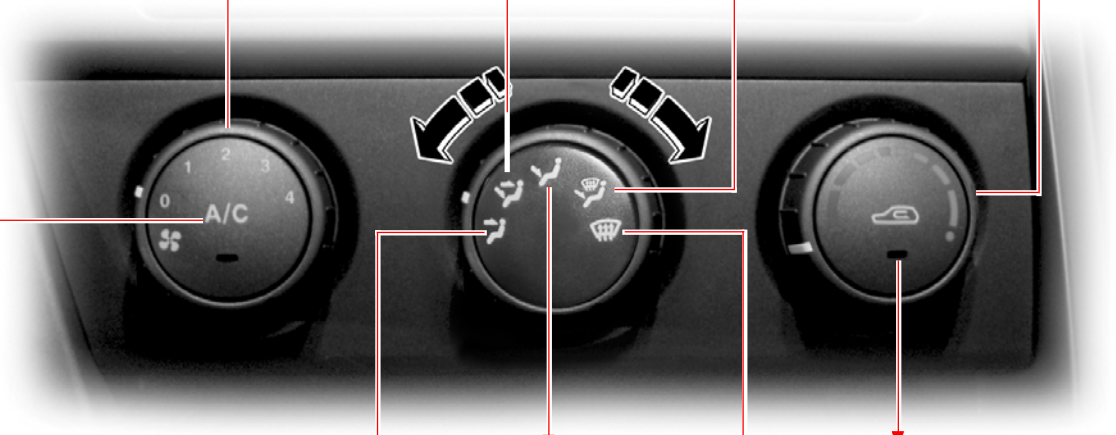
The temperature can be adjusted by rotating the switch.

Clockwise direction (red): Higher temperature

Counterclockwise direction (blue): Lower temperature

Defroster & Foot Mode

The air flows towards windshield and floor.



A/C Switch

When pressing the switch with the engine running, the A/C compressor operates and the indicator comes on.

Foot Mode

The air flows towards floor.

Air Source Selection Switch

When pressing this switch, the air recirculates in the vehicle and indicator comes on. When pressing it again, the indicator goes off and the fresh air comes in.

When it is raining or humid, set this switch to air fresh mode and select the vent mode to remove the moisture on the windshield.

Vent Mode

The air flows towards face.

Defroster

When pressing this switch, the airflow direction will be changed to windshield and door glasses, the air conditioner operates automatically and outside air comes in.

4. SELF DIAGNOSIS (ONLY FOR FATC A/C CONTROLLER)

▶ Overview

The FATC controller has self diagnosis function that can diagnose the system by itself. Before checking each component, be sure to check the fault code by using self diagnosis function.

The diagnosis procedure in this vehicle has 6 steps by the temperature control switch (step 2~5) and the fan speed control switch (step 6).

1. Step 1: Check the vacuum fluorescent display (VFD) segments.
2. Step 2: Check the air mix door and sensors for defect.

Code	Malfunction	Remark	Code	Malfunction	Remark
0	VDF segments are OK		5	Defective sun sensor	
1	Defective ambient temperature sensor		6	Check air mix door	
2	Defective interior temperature sensor		7	Humidity sensor	
3	Defective water temperature sensor		8	Defective AQS sensor	
4	Defective intake sensor		9	-	

3. Step 3: Check the position and conditions of recirculation air door and mode door.

Code	Malfunction	Remark	Code	Malfunction	Remark
1	VENT		6	DEF	
2	B/L		7	FRE	
3	-		8	20% FRE	
4	FOOT		9	REC	
5	D/F		0	All door OK	

4. Step 4: Check the position of actuator door, the fan speed and the compressor operation.

   When pressing the defroster switch after entering step 4,
   the mode is changed to 41 - 42 - 43 -44 - 45 - 46 - 41 in turns.

Displayed Number	41	42	43	44	45	46
Mode door	VENT	B/L	B/L	FOOT	D/F	DEF
Interior/Ambient door	REC	REC	20%FRE	FRE	FRE	FRE
Air mix door	F/COOL	F/COOL	F/HOT	F/HOT	F/HOT	F/HOT
Blower	4.5 V	10.5 V	8.5 V	8.5 V	8.5 V	MAX
Compressor	ON	ON	OFF	OFF	ON	ON

5. Step 5: When pressing the defroster switch, the display shows the currently monitored temperature in turns as below:

51	→	Ambient temperature	→	Interior temperature	→	Intake air temperature
		Ambient temperature sensor		Active incar sensor		Intake temperature sensor

6. Step 6: In this step, the temperature can be compensated within the range of -3°C to +3°C in the control process according to the temperature to air conditioner controller. The step 6 initiates when slightly rotating the fan speed switch (other than TEMP switch) in step 5.

▶ Self Diagnosis

1. Starting Self Diagnosis

Turn the ignition switch to OFF position and press OFF switch for more than 5 seconds within 10 seconds after turning the ignition switch to ON position.

2) Check LED segments on the vacuum fluorescent display (VFD).



1) Press OFF switch for more than 5 seconds.

2. Set in Trouble Diagnosis Step 2

In this step, check the air mix door and sensors for defect.

Once the system starts diagnosis step 2, the digit “2” is displayed, implying step 2, on the display window and the trouble diagnosis for sensors is executed. If no failure exists, “20” is displayed. If any failure exists, the appropriate trouble code is displayed as below.

1) Slightly turn the TEMP dial to the right to set in the trouble diagnosis step 2





2) Indication of Step 2. Starting self diagnosis

Wait for 10 ~ 20 seconds



3) Sensor failure code blinking

When two sensors are defective

NOTICE

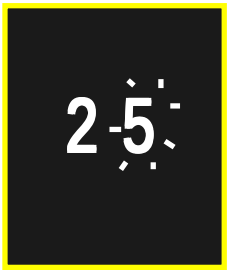
- **The symbol "-" in front of step number "2" means a short circuit of the blinking sensor.**



Short-circuit in the ambient air temperature sensor



First sensor failure code blinks twice



Second sensor failure code blinks twice

Trouble Code

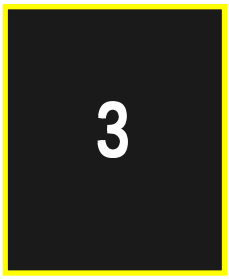
Code	Malfunction	Remark	Code	Malfunction	Remark
0	VDF segments are OK		5	Defective sun sensor	
1	Defective ambient temperature sensor		6	Check Air mix door	
2	Defective interior temperature sensor		7	Defective humidity sensor	
3	Defective water temperature sensor		8	Defective AQS sensor	
4	Defective intake sensor		9	-	

3. Set in Trouble Diagnosis Step 3

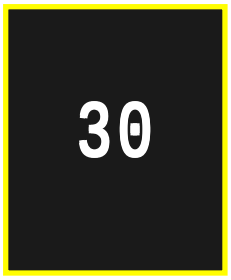
In this step, check the position and conditions of recirculation air door and mode door.
Slightly turn the TEMP switch until “3” is displayed on the display window.
If no failure exists, "30" is displayed. If any failure exists, the appropriate trouble code is displayed.

1) Slightly turn the TEMP dial to the right to set in the trouble diagnosis step 3





2) Indication of Step 3. Starting self diagnosis



3) Sensor failure code blinking (30: no failure)

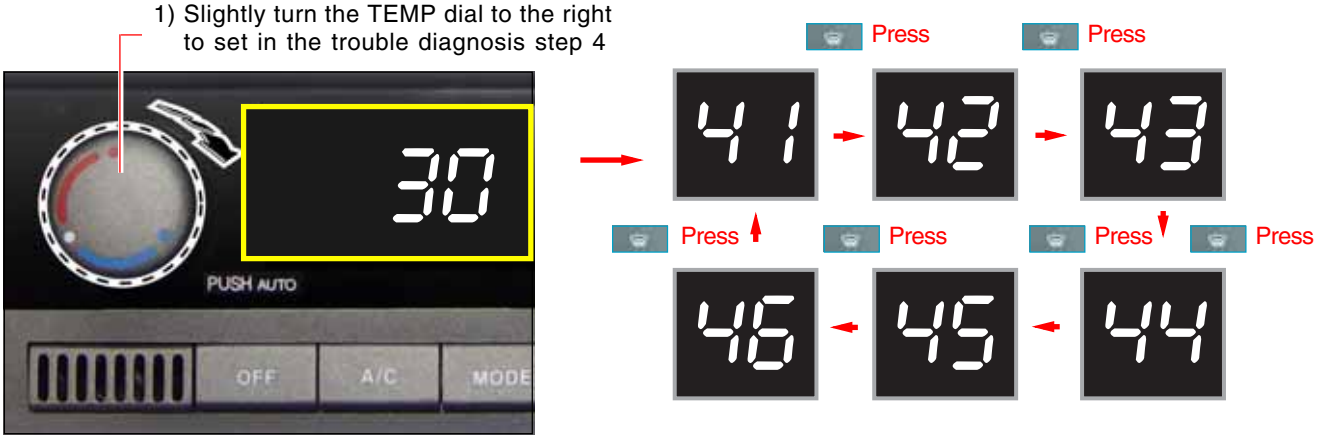
Trouble Code

Code	Malfunction	Remark	Code	Malfunction	Remark
1	Defective VENT		6	DEF	
2	Defective B/L		7	FRE	
3	-		8	20% FRE	
4	FOOT		9	REC	
5	D/F		0	All door OK	

4. Set in Trouble Diagnosis Step 4

In this step, check the position of actuator door, check the fan speed, and check the compressor operation.

Slightly turn the TEMP switch in step 3 until “41” is displayed on the display window. When pressing DEF switch ,mode changes as shown below in turns to check each function.



The following is the function check in step 4 of the diagnosis. Check the function according to the following table. The voltage for the blower in the table is the output voltage for the motor operation. The higher the voltage is, the faster the speed of the blower motor gets.

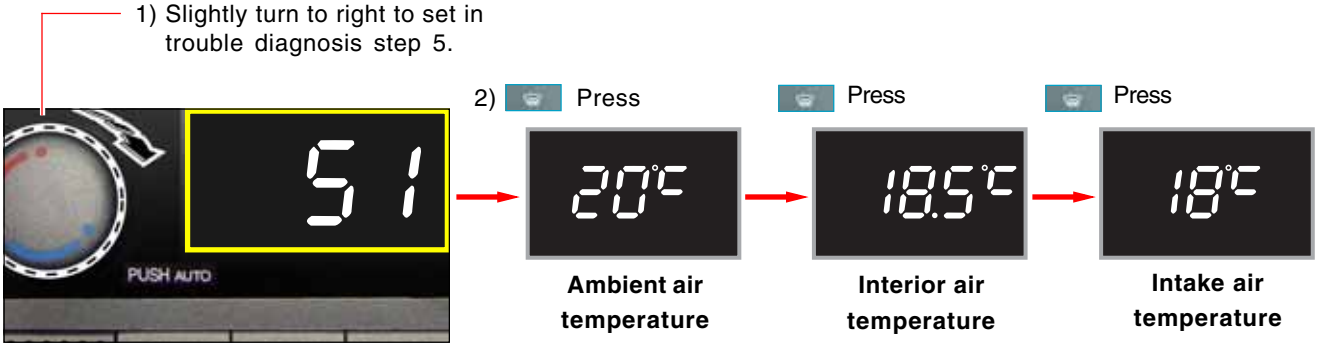
Function Check

Displayed Number	41	42	43	44	45	46
Mode door	VENT	B/L	B/L	FOOT	D/F	DEF
Interior/Ambient door	REC	REC	20%FRE	FRE	FRE	FRE
Air mix door	F/COOL	F/COOL	F/HOT	F/HOT	F/HOT	F/HOT
Blower	4.5 V	10.5 V	8.5 V	8.5 V	8.5 V	MAX
Compressor	ON	ON	OFF	OFF	ON	ON

5. Set in Trouble Diagnosis Step 5

In this step, check the conditions of temperature related sensors.

Slightly turn the TEMP switch in step 4 until “51” is displayed on the display window. When pressing DEF switch , displayed temperature changes as shown below in turns.

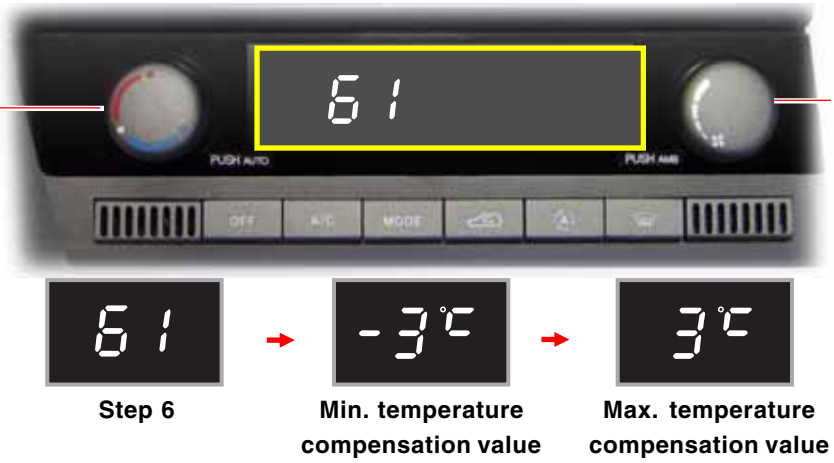


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. Set in Trouble Diagnosis Step 6

In this step, the temperature can be compensated within the range of -3°C to 3°C in the control process according to the temperature to air conditioner controller. The step 6 initiates when slightly rotating the fan speed switch (other than TEMP switch) in step 5.

2) Compensates the temperature by turning TEMP dial.



1) Starts the trouble diagnosis step 6 by turning fan speed dial.

Step 6

Min. temperature compensation value

Max. temperature compensation value

7. Canceling the Trouble Diagnosis

Turn the AUTO switch ON or turn the ignition key OFF.

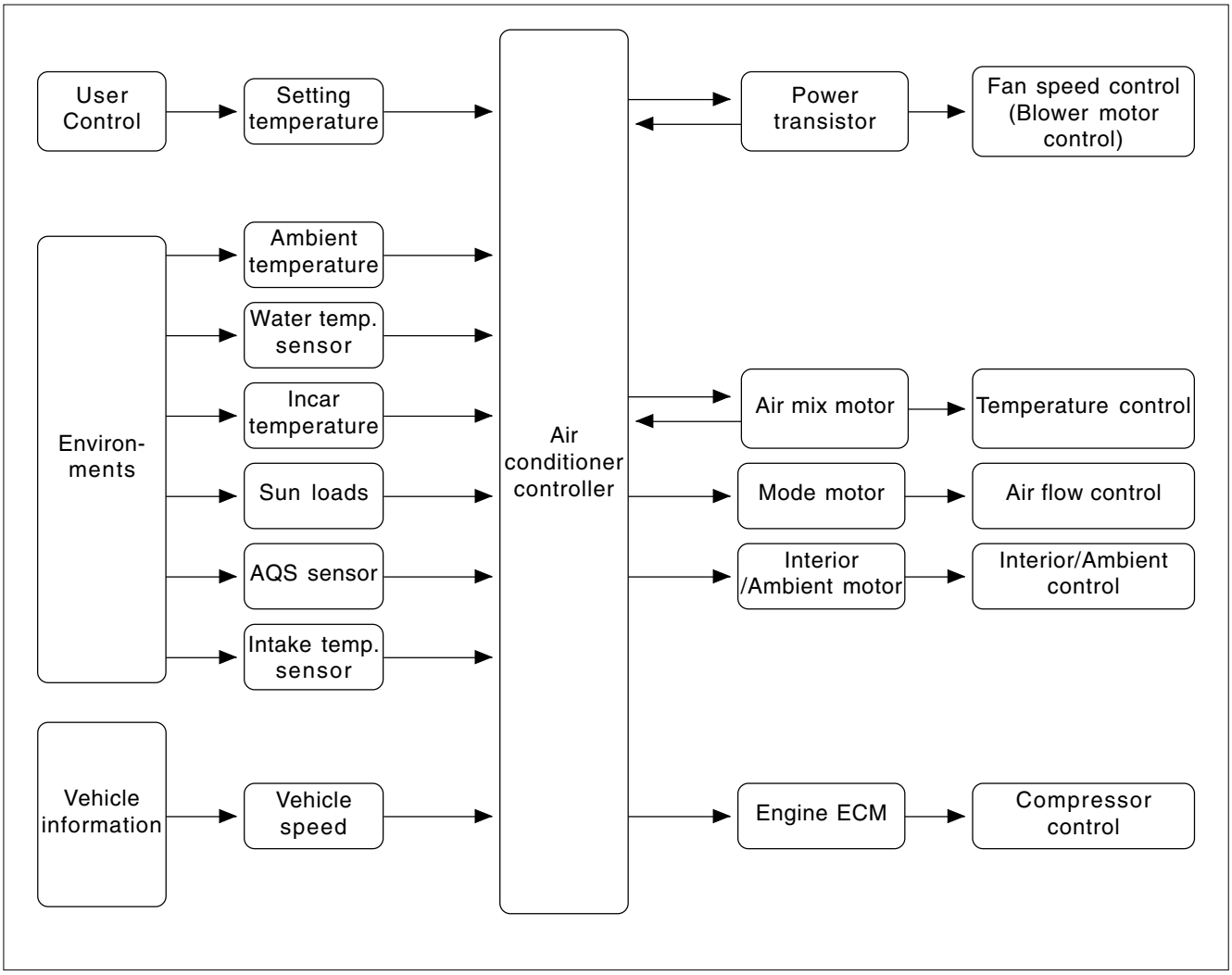
8. Symptoms when the A/C system is malfunctioning (initial self diagnosis)

- The display does not show the system malfunction even when a sensor is defective. Therefore, check the system in the diagnosis mode.



5. SYSTEM DIAGRAM

This figure shows the input and output system between FACT A/C components and A/C controller.



▶ Air Conditioner Compressor Control by Engine ECU

In case of conventional vehicle models, the system turns ON/OFF the compressor switch according to refrigerant pressure, ambient temperature and condenser temperature to protect air conditioner circuits. However, for the vehicle equipped with DI engine, the engine ECU turns off air conditioner compressor as below in addition to above conditions.

1. Coolant temperature: below -20°C
2. Coolant temperature: over 115°C
3. For approx. 4 seconds after starting the engine
4. When engine speed is below 650 rpm
5. When engine speed is over 4,500 rpm
6. During abrupt acceleration for the vehicle equipped with manual transmission

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. SENSORS AND ACTUATORS

▶ Sun Sensor

It is installed on the upper left end of instrument panel. It is using characteristics that the amount of current changes according to amount of light on the photosensitive surface. Photo diode, which converts the changes in light intensity into electrical changes, detects the amount of light coming through windshield and changes it into current and then sends the signal to FATC controller.



Inspection

1. Remove the sun sensor and measure the current between terminals under sunlight.
2. Measure the current again under shade. It is in normal conditions if the measured value is less than the measured value under sunlight.
3. Turn the ignition switch to “ON” position.
4. Measure the voltage to the sun sensor from FATC connector. (approx. 2.5 V under sunlight and 4.8 V under shade.)
5. If the voltage value cannot be measured, check the circuit for open. If the measured value is within the specified range, replace the FATC controller.

▶ Active Incar/Humidity Sensor: AIH Sensor

The AIH sensor is installed at the driver side instrument panel undercover. It is a sensor that detects interior temperature and humidity.

Location







Functions

Incar temperature sensor

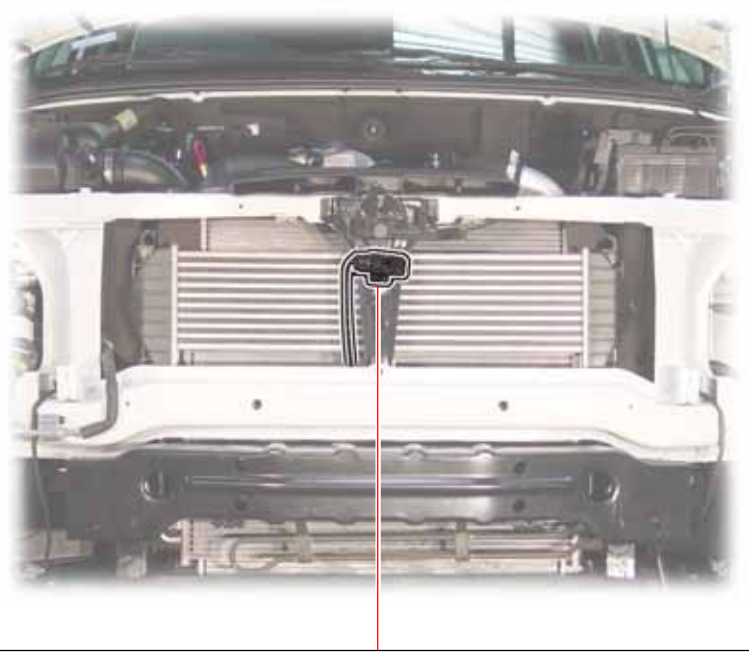
This sensor is a negative temperature coefficient (NTC) thermistor and detects the interior temperature with air coming from sensor hole and then sends the voltage value according to the changed resistance to FATC controller.

Humidity sensor

This sensor detects the interior humidity with humidity cell and then sends the voltage value according to the changed humidity to FATC controller.

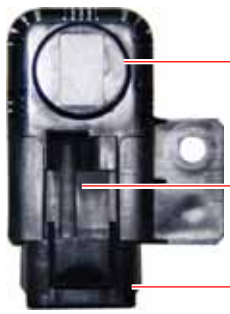
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EFFECTIVE DATE	
AFFECTED VIN	

7. AQS (AIR QUALITY SYSTEM)



AQS sensor and ambient temperature sensor





▶ AQS Operation

1. AQS (Air Quality System) changes the air source selection to recirculation mode when polluted air is detected through AQS sensor. The air source selection returns back to fresh air intake mode after a specified period or the polluted air disappears.

2. When pressing the AQS switch, the AQS indicator on display window comes on, and the air source selection is automatically changed to recirculation mode (REC). At this moment, the self diagnosis and preheating mode of AQS is performed for 35 seconds.



NOTICE

- **When pressing DEF switch during in this process, the AQS indicator goes out and the air source selection is changed to fresh air mode from recirculation mode.**
- **When pressing the AQS switch again, the self diagnosis and preheating mode of AQS operates only for the remaining time.**

3. After the self diagnosis and preheating mode of AQS is completed, the AQS system operates according to the air pollution.

   If the air pollution is not serious, the AQS system changes the air source selection to fresh air mode.

4. Although turning off the air conditioner while the AQS is in operation, the AQS stays ON (indicator on). However, if the air conditioner is turned on by turning the ignition switch ON from OFF, the AQS stops its operation and the indicator goes out and the display window shows the initial screen.



NOTE

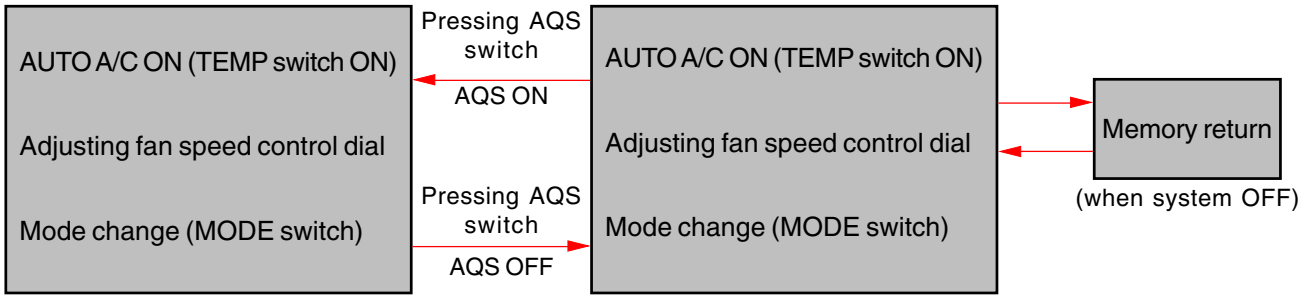
- **If the AQS switch is pressed in, the AQS function works regardless of air conditioner controller operation.**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. The modes available AQS function:
   1) AUTO mode
   2) Fan speed control dial operation mode
   3) A/C switch operation. At this mode, the AQS system operates according to the AQS switch operation.

NOTICE

- **If the ignition switch is turned off with AQS ON, the AQS is turned on when turning the ignition switch on again.**



6. The AQS is turned off,
   1) When pressing the defroster switch

      When pressing the DEF switch with AQS in operation, AQS operation is cancelled. When pressing it again, the system operates in the previous mode (AQS ON).

   2) When pressing the recirculation mode switch

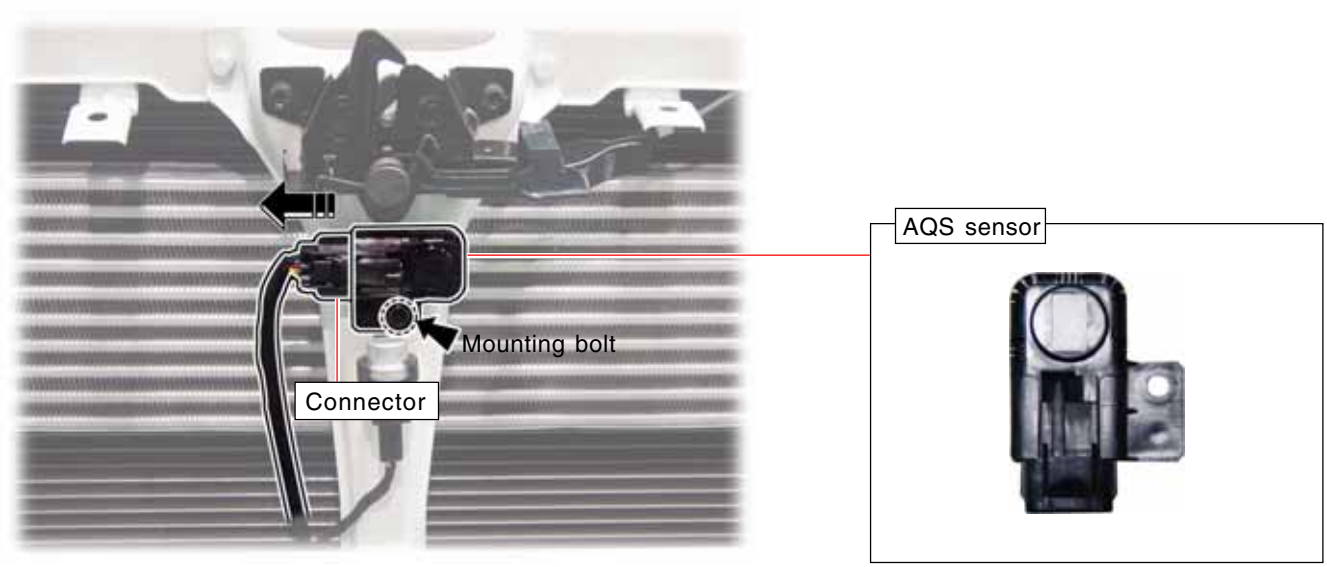
      When pressing the air source selection switch with AQS in operation, AQS operation is cancelled. When pressing it again, the system operates in the previous mode.

▶ Removal and Installation

1. Disconnect the negative battery cable and remove headlamps.



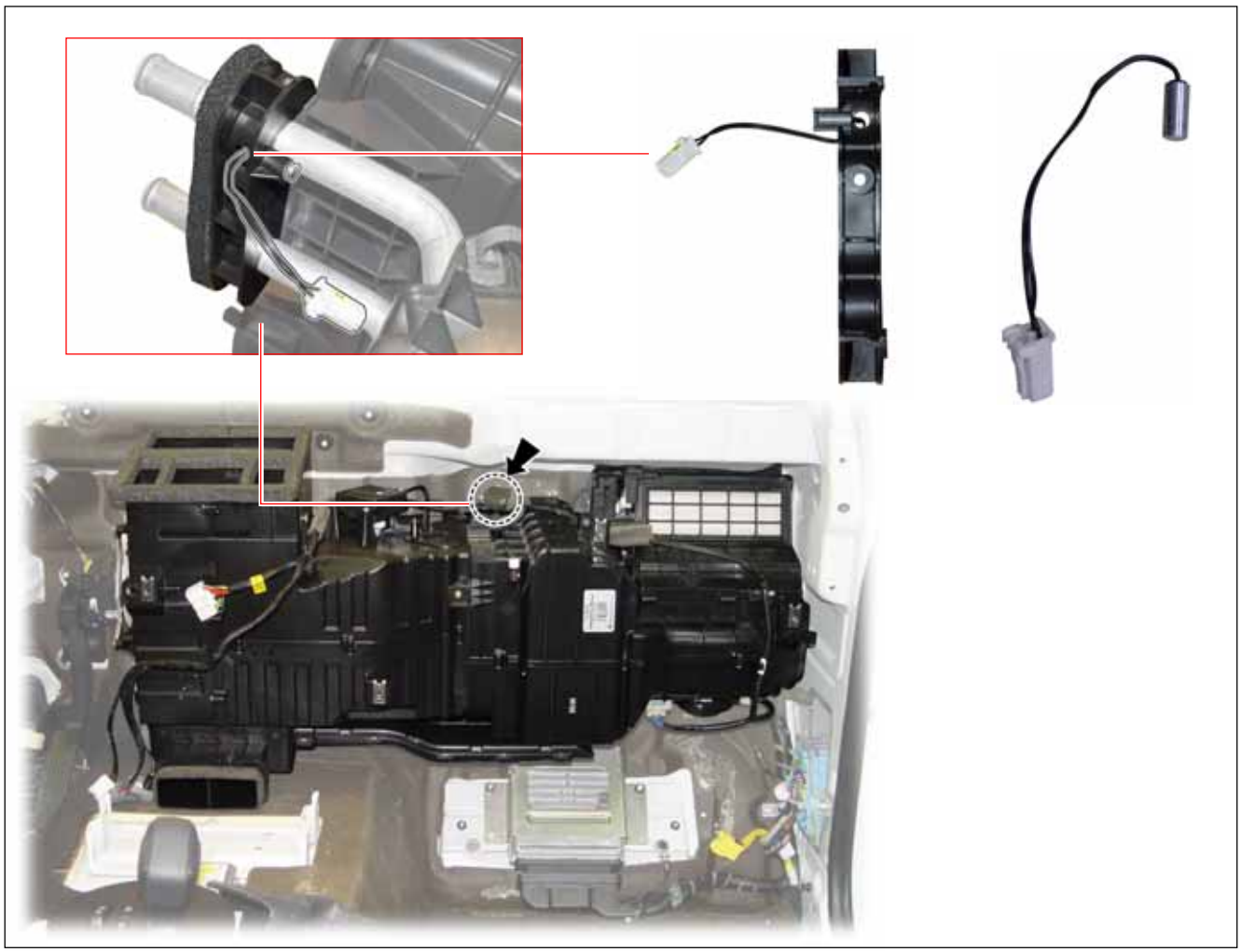
2. Disconnect the AQS sensor connector, unscrew the mounting bolt and remove the AQS sensor assembly (Install in the reverse order of removal).



8. AIR CONDITIONER MODULE SENSORS AND ACTUATORS

▶ Water Temperature Sensor

The water temperature sensor is installed on top of the heater unit. It monitors the temperature in the duct and converts the temperature to the voltage value according to the changed resistance value (NTC value). Then, it transmits the voltage value to the FATC controller.



Inspection

If the water temperature sensor defect code (DTC 3) is set, check as below.

1. Remove the water temperature sensor and measure the resistance between terminals on the sensor connector. (standard value: approx. 2.2 kΩ at 25°C)

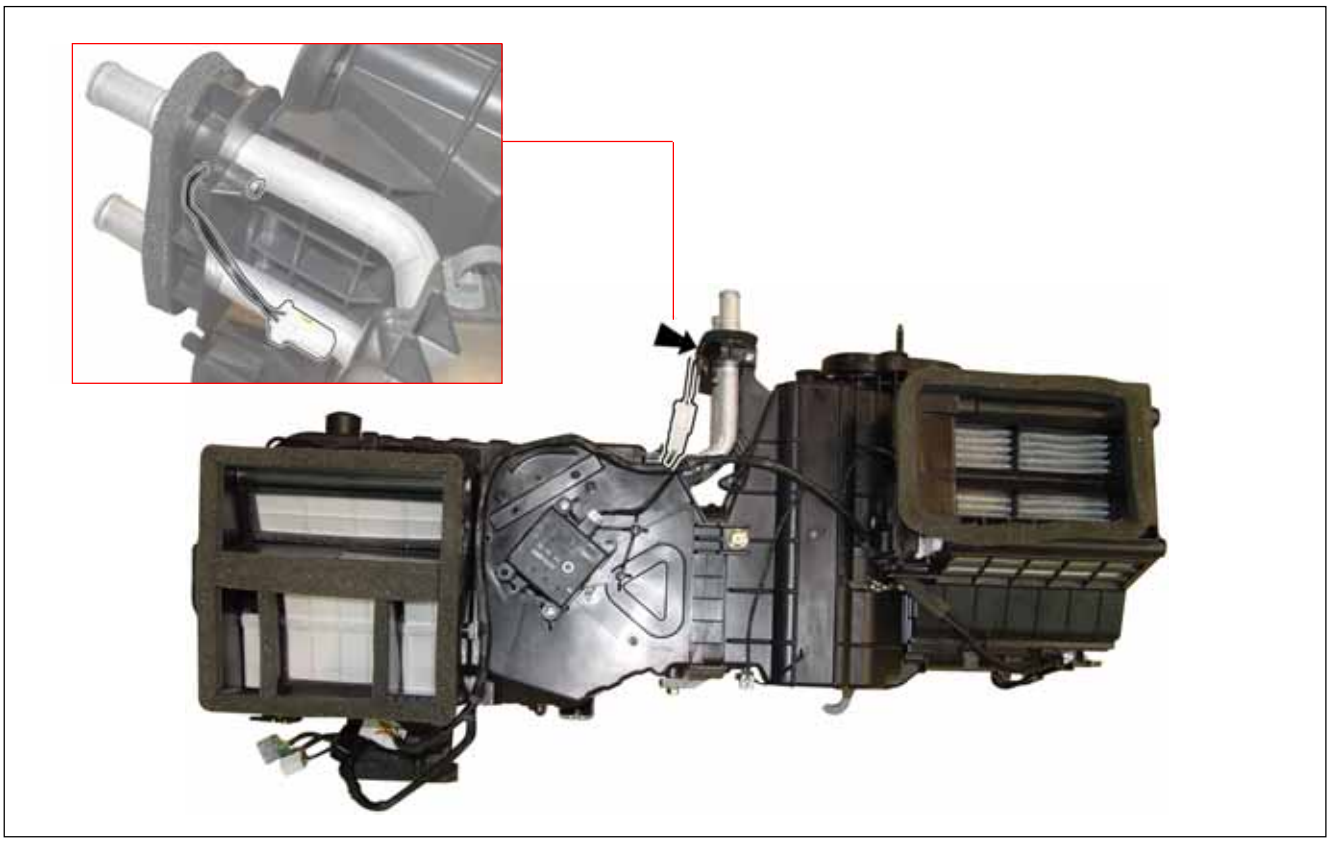
   In addition, if the resistance is extremely high or low, replace the sensor.
2. If the measured value is out of the specified range, replace the water temperature sensor. If the measured value is within the specified range, check as below.
3. Turn the ignition switch to ON position and measure the voltage to water temperature sensor from the FATC controller connector. (standard value: approx. 2 V at 25°C)
4. If the voltage value cannot be measured, check the circuit for open. If the measured value is within the specified range, replace the FATC controller.

Removal and Installation

※ **Preceding Work:** Disconnect the negative battery cable and remove the instrument panel assembly.

The water temperature sensor should be removed after removing the air conditioner module assembly.

1. Disconnect the connector from the removed A/C module assembly and then remove the bracket screw on heater pipe.



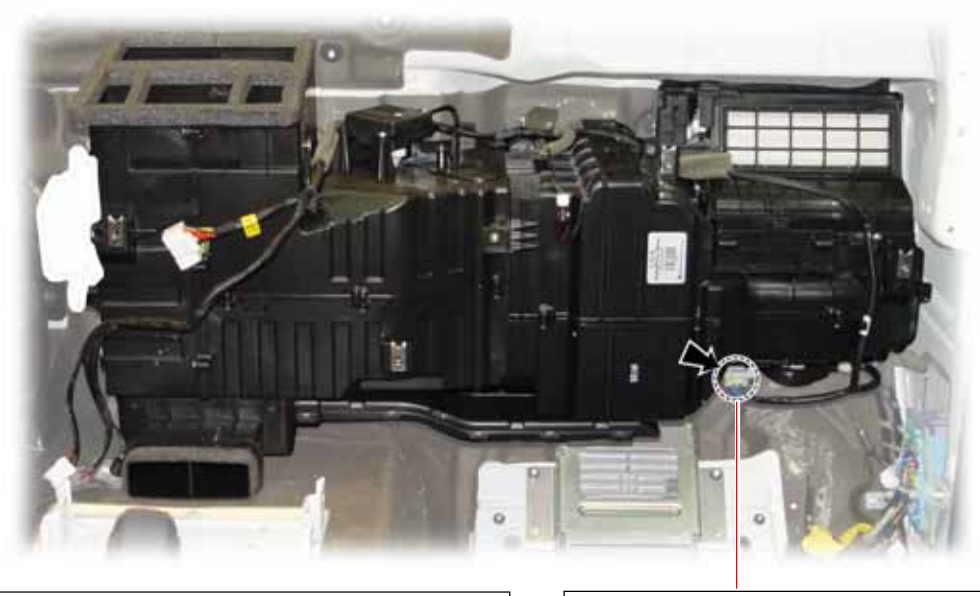
2. Remove the heater pipe bracket from the heater pipe and separate the water temperature sensor from bracket.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Power Transistor

The power transistor controls the fan speed. It controls the blower motor operating speed by changing the current value to the base of power transistor when receiving the fan control signal from FATC.





Air conditioner power transistor



Inspection

If the power transistor defect code (DTC 6) appears, check as below.

1. Turn the ignition switch to ON position.
2. Measure the voltage between blower motor terminals while changing the fan speed from stage 1 to stage 8.
3. The specified voltage value in each stage:

Stage	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7	Stage 8
Voltage (V)	4 ~ 4.75 V	5 ~ 5.75 V	6 ~ 6.75 V	7 ~ 7.75 V	8 ~ 8.75 V	9 ~ 9.75 V	10 ~ 10.75 V	11~Battery voltage

4. If the voltage is out of specified value, check the circuit for open. If the circuit is in normal condition, replace the power transistor.

Removal and Installation

※ **Preceding Work:** Disconnect the negative battery cable.

The power transistor should be removed after removing the lower instrument panel in front of passenger seat. (For removal and installation of the lower instrument panel, refer to the "Body" section.)

1. Remove the lower instrument panel in front of passenger seat and disconnect the power transistor connector.

Glove box and lower panel



Power transistor connector



2. Unscrew two mounting screws and remove the power transistor.

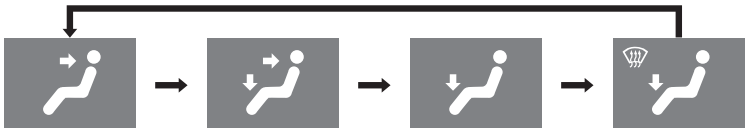




▶ Mode Door Actuator

The mode door actuator is an actuator that closes, opens and adjusts the mode door for VENT, FOOT and DEF mode to change the air flow directions by FATC controller. Under the FATC controller AUTO mode, it stays on DEF mode until the engine coolant temperature reaches at normal operating level and the mode is changed as below when the MODE switch is pressed.





The air flows towards face. (Vent mode)

The air flows towards face and foot. (Bi-level mode)

The air flows towards foot. (Foot mode)

The air flows towards front windshield and foot. (Defroster and foot mode)



Location of mode door actuator



Mode door actuator

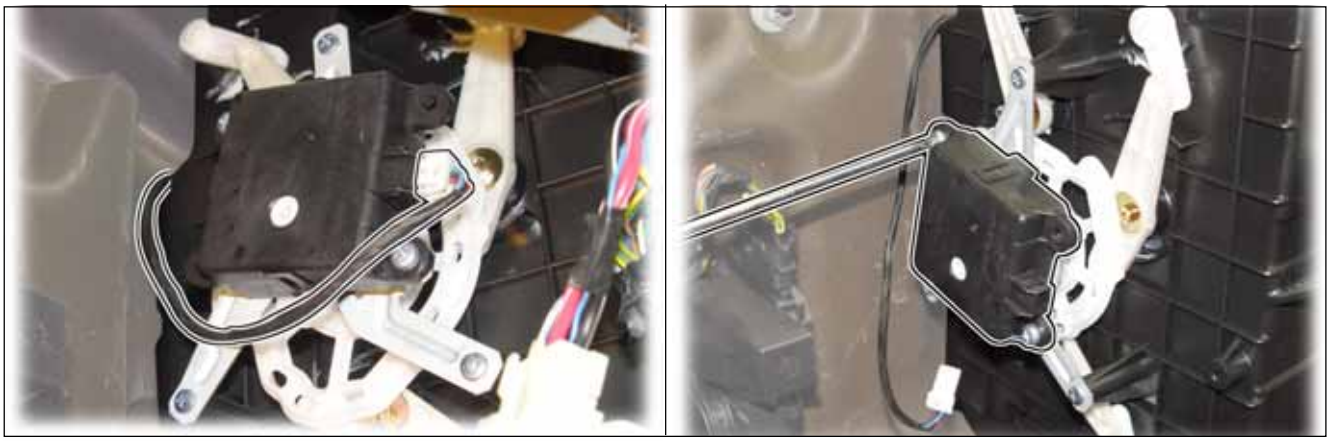


Removal and Installation

※ **Preceding Work:** Disconnect the negative battery cable.

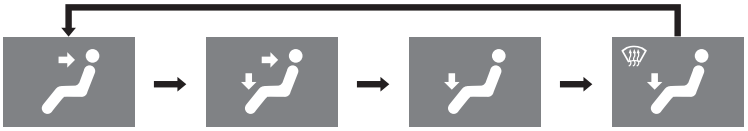
First remove the driver side lower instrument panel in order to remove and install mode door actuator. For removal and installation of the panel, refer to "BODY" section.

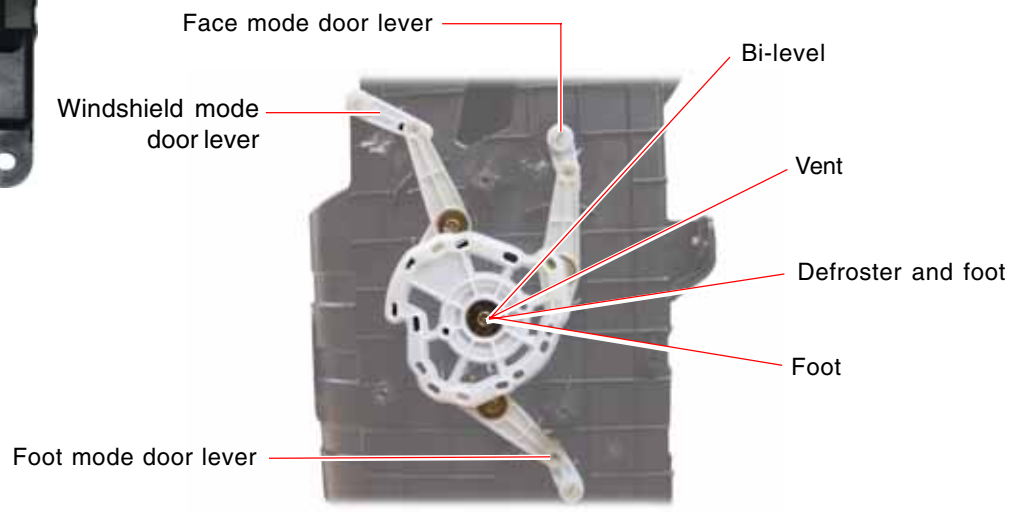
1. Remove the lower instrument panel in front of driver seat. Disconnect the mode door actuator connector and remove two mounting screws.



2. Separate the mode door actuator and remove the mode door link assembly.





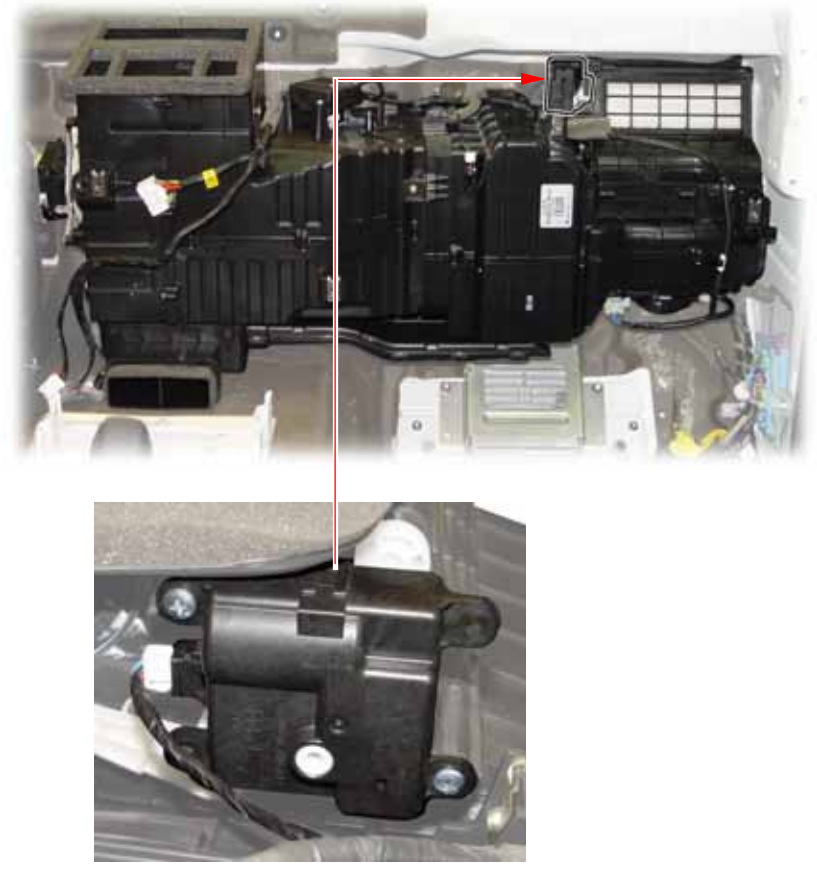


NOTE

- **Make sure that the mode door link is mounted on the air conditioner module assembly correctly. When installing, if the location of the mode door link is not correct, it may not operate properly.**

▶ IN/EX - Air Door Actuator

The air source door actuator sets the intake door mode by operating air source door motor according to the control signal from FATC.



Air source door actuator location

Air source door actuator





Removal and Installation

※ **Preceding Work:** Disconnect the negative battery cable and then remove the instrument panel assembly.

Remove the driver's instrument lower panel and then disconnect the connector of the air source door actuator. Unscrew two mounting screws and remove the in/ex air door actuator.



▶ Air Mix Door Actuator

The air mix door actuator controls the discharging air temperature properly by closing/opening the damper according to the control signals from FATC.



Air mix door actuator location

Air mix door actuator component





Removal and Installation

※ **Preceding Work:** Disconnect the battery negative cable and remove the instrument panel assembly.

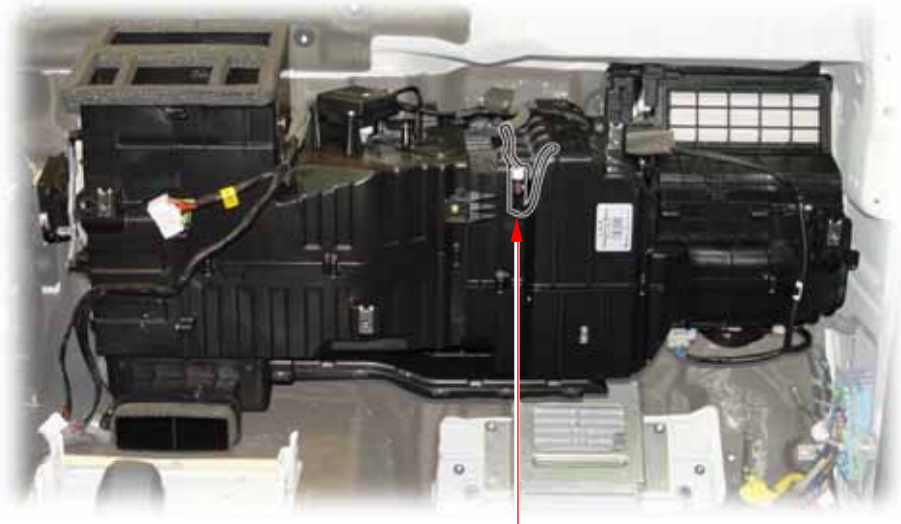
With the instrument panel assembly removed as shown in the above figure, disconnect the air mix door actuator connector and unscrew two mounting screws to remove the air mix door actuator.

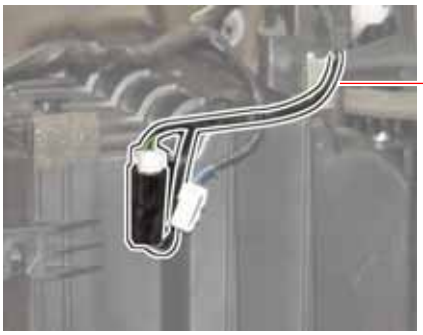


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EFFECTIVE DATE	
AFFECTED VIN	

▶ Thermo AMP (Intake Sensor)

The Intake sensor outputs the compressor ON or OFF signal to ECU to prevent evaporator from freezing. The sensing part of the intake sensor is the evaporator fin contact type.





Intake Sensor location



Intake Sensor

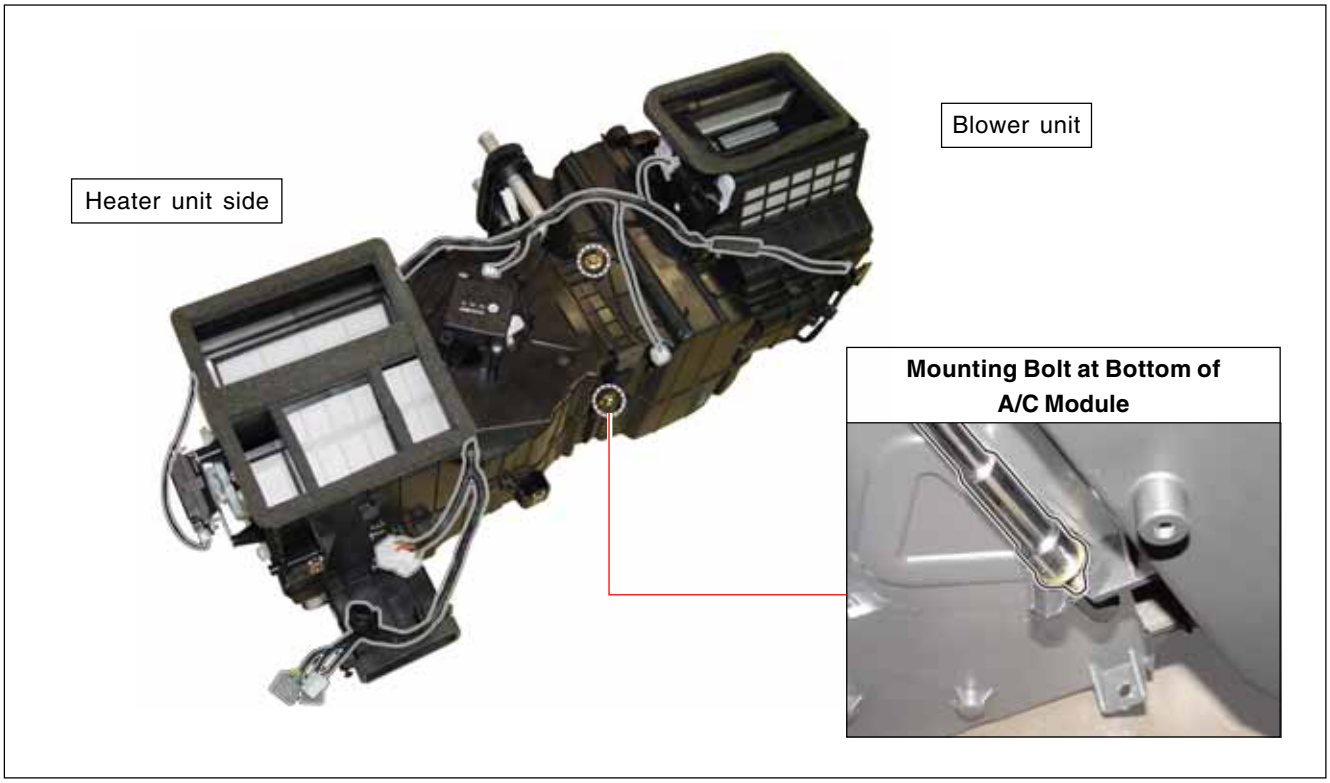
If the air conditioner does not turn on, check as below.

1. Remove the Intake sensor and measure the voltage between terminal No. 1 and 2 on the connector.
2. Check whether the output voltages are normal (ON: approx. 12 V, off: 0 V).
3. If the voltage value is out of the specified value, replace the Intake sensor. If the circuit is in normal condition, check as below.
4. Turn the ignition switch to ON position and turn on the air conditioner by pressing the A/C button. And measure the voltage between terminal A12 and A11 on the FATC controller connector (standard: approx. 12 V).
5. If the voltage value cannot be measured, check the circuit for open. If the measured value is not within the specified range, replace the intake sensor.

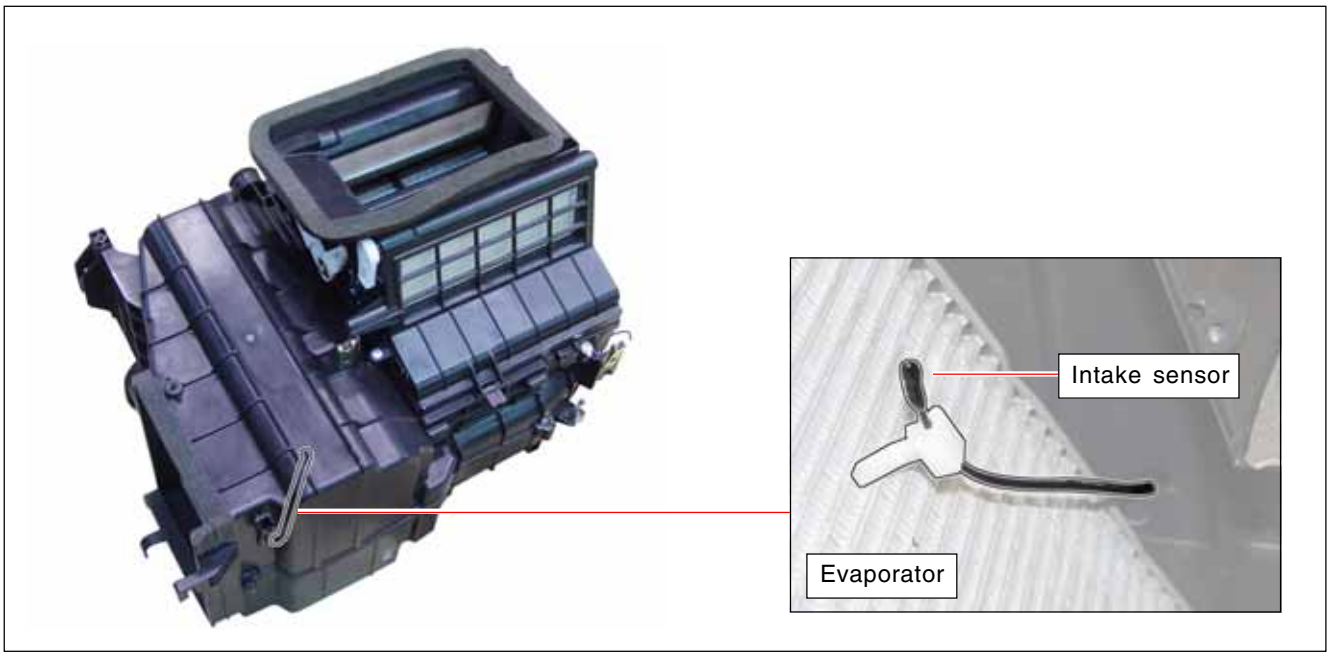
Removal and Installation

※ **Preceding Work:** Disconnect the negative battery cable and remove the instrument panel assembly.

1. Remove the blower unit, three mounting bolts (10 mm) on the heater unit and the sensor wire of the air conditioner to remove the blower unit and the heater unit.



2. Separate the upper case and lower case of blower unit and remove the Intake sensor from the evaporator.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

9. REMOVAL AND INSTALLATION FOR OTHER RELATED PARTS

▶ Air Conditioner Module Assembly

※ **Preceding Work:** Disconnect the negative battery cable and remove the instrument panel assembly.

1. **Collect the air conditioner refrigerant before removing the air conditioner module (dispose the wasted refrigerant to designated place).**
2. **Drain radiator coolant.**

1. Disconnect the heater hose (A) from the engine compartment and remove the A/C high/low pressure pipe mounting nuts (B).

A. Inner/outer heater hose and clamp



B. A/C joint pipe mounting nut



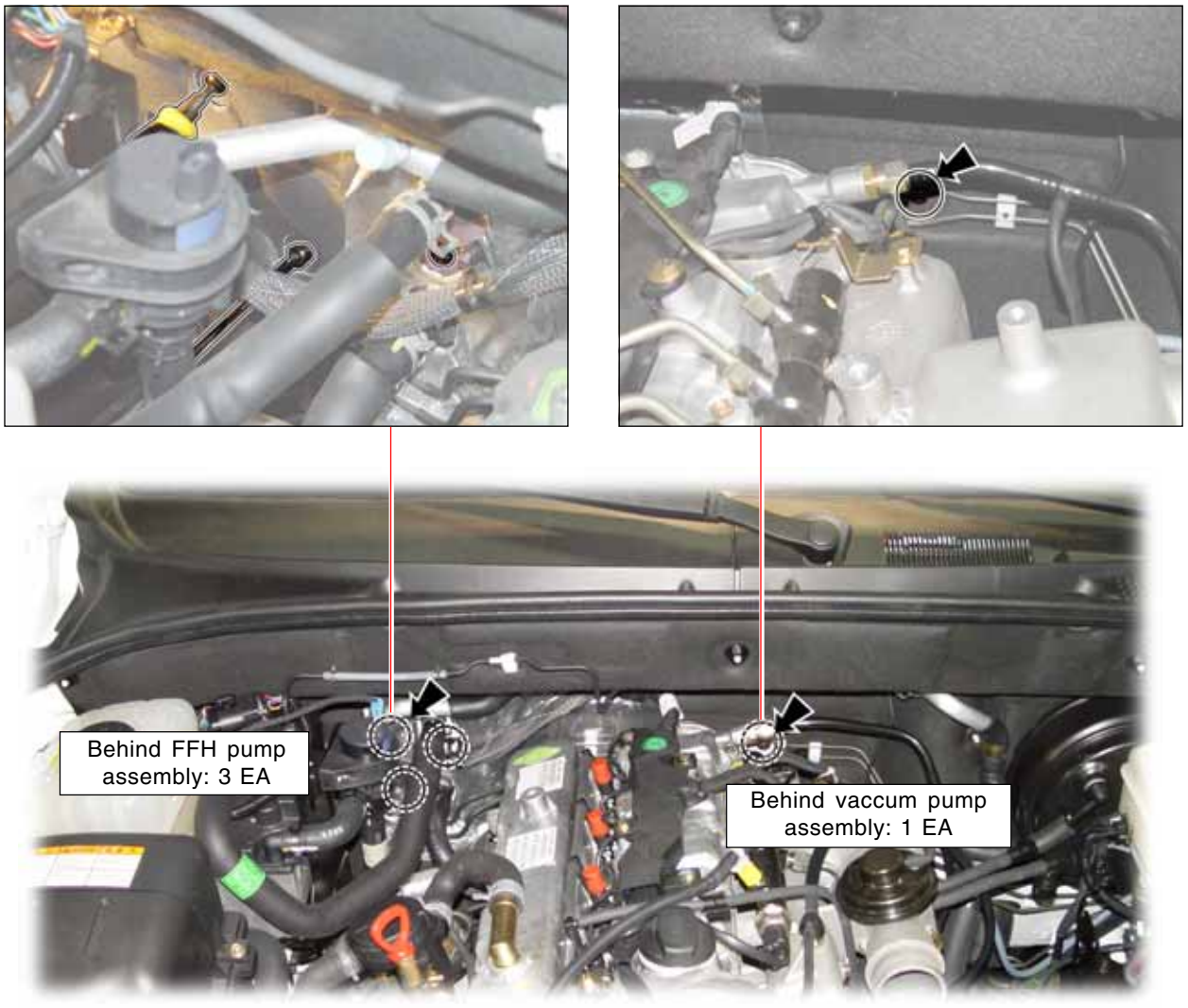
* Remove the mounting nut and loosen the coolant reservoir.





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. Unscrew four mounting screws on A/C module assembly (in engine compartment).

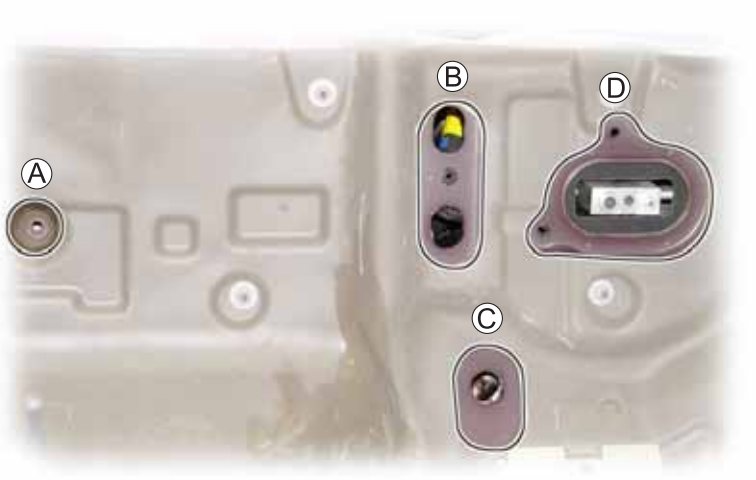


3. Carefully remove the A/C module assembly.

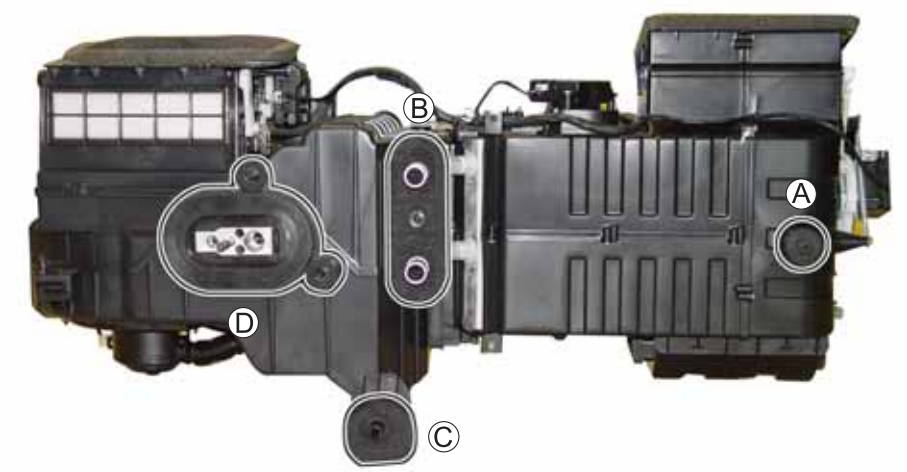


A/C Module Mounting Location

Mounting locations inside of vehicle



Mounting locations on backide of A/C module



Front View

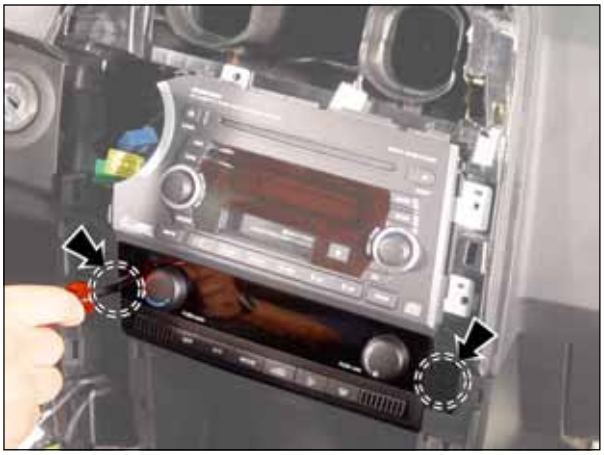


▶ A/C Controller Switch And Active Incar/Humidity Sensor

※ **Preceding Work:** Disconnect the negative battery cable and remove the center fascia panel assembly.

Air Controller Switch Assembly

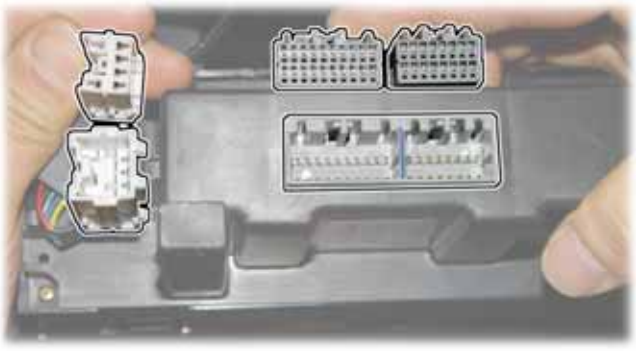
1. With the center fascia panel removed, unscrew two mounting screws from the A/C controller switch assembly.



2. Disconnect the connectors from the A/C controller switch assembly.



Connection Status

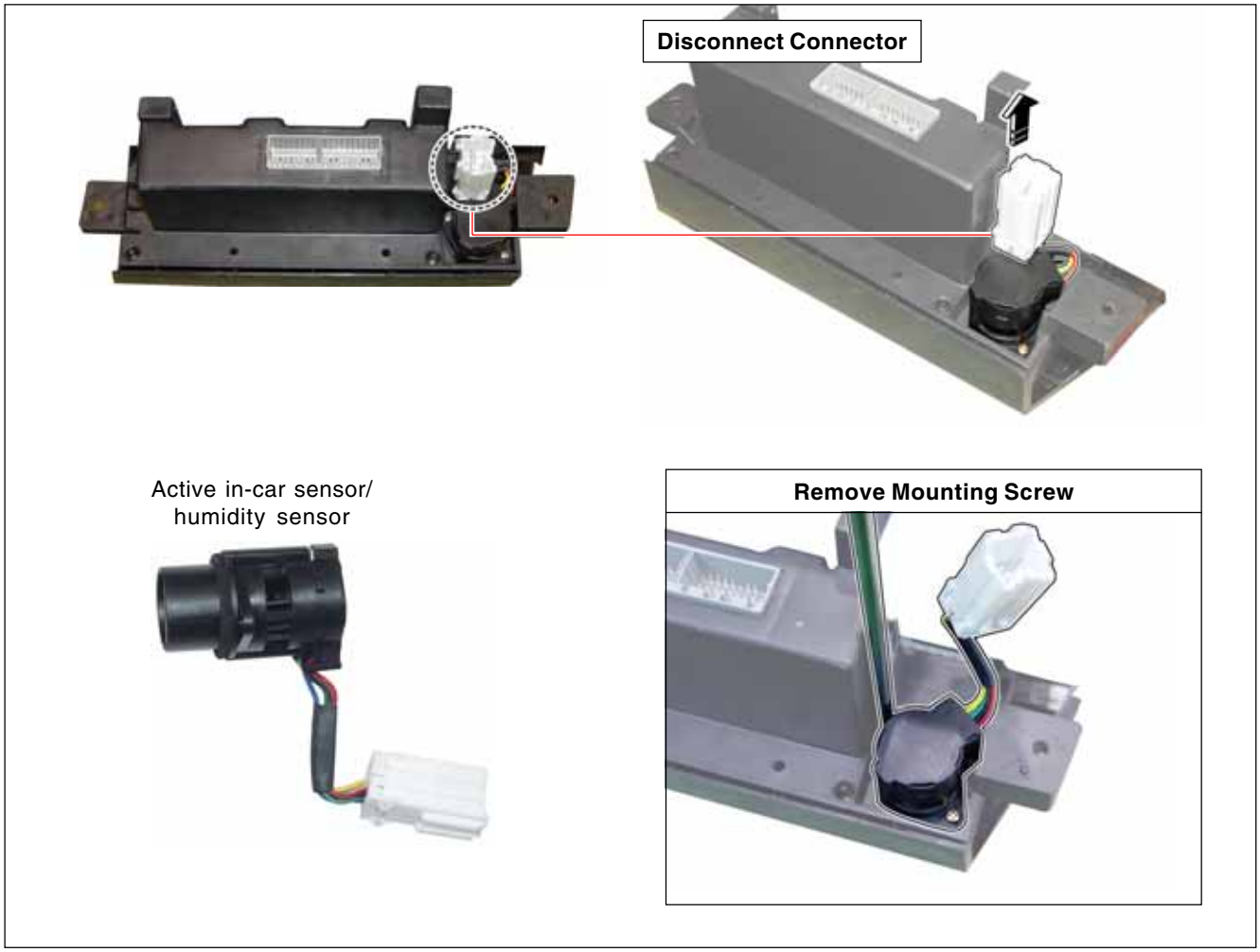


3. Remove the A/C controller switch assembly.



Active In-Car/humidity Sensor

Disconnect the sensor connector, unscrew two mounting screws, and remove the sensor from the air conditioner controller switch assembly.



▶ Air Duct Assembly

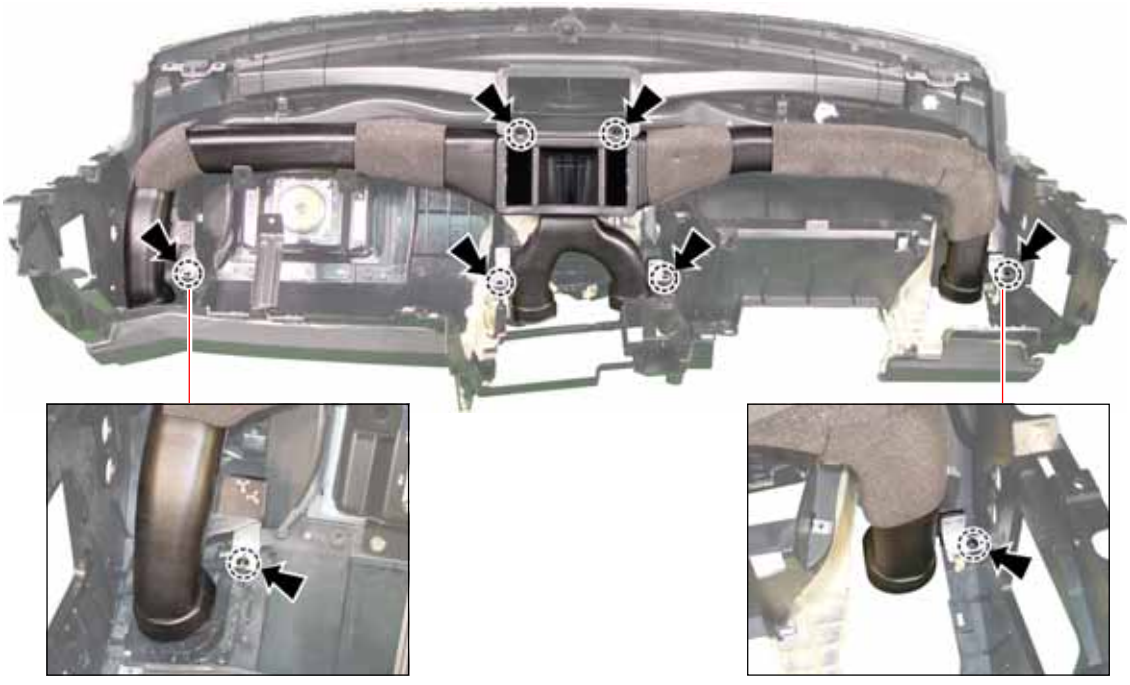
Air Duct (On Instrument Panel)

※ **Preceding Work:** 1. Disconnect the negative battery cable.
2. Remove the instrument panel assembly.

Installation

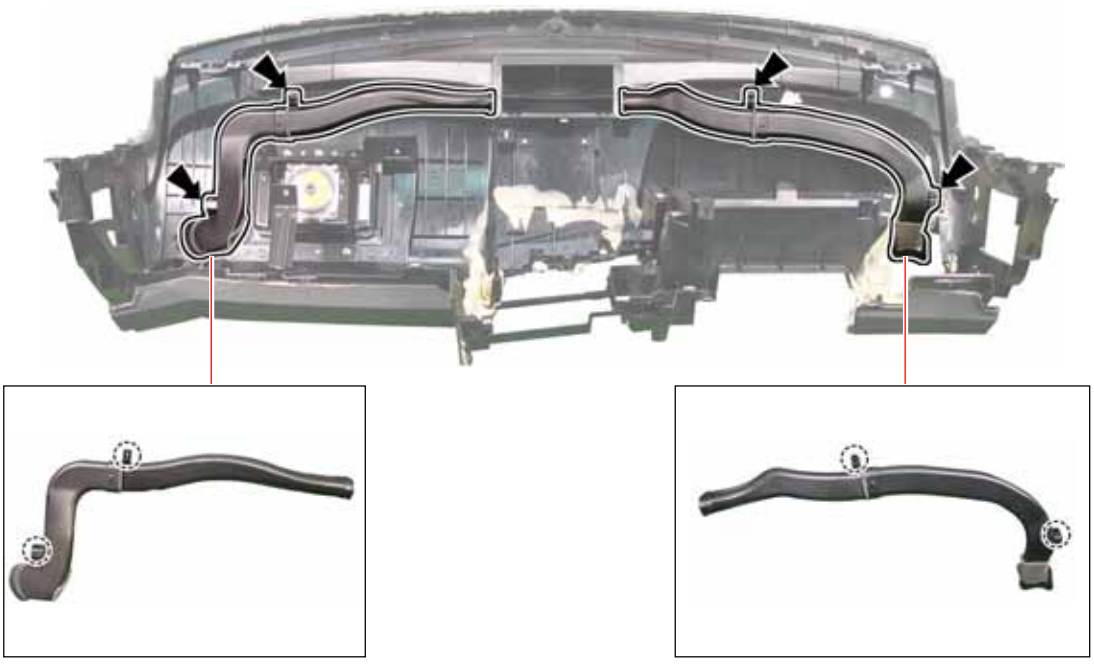


1. Unscrew six mounting screws (one at each side and four in center area) and remove the front air duct.

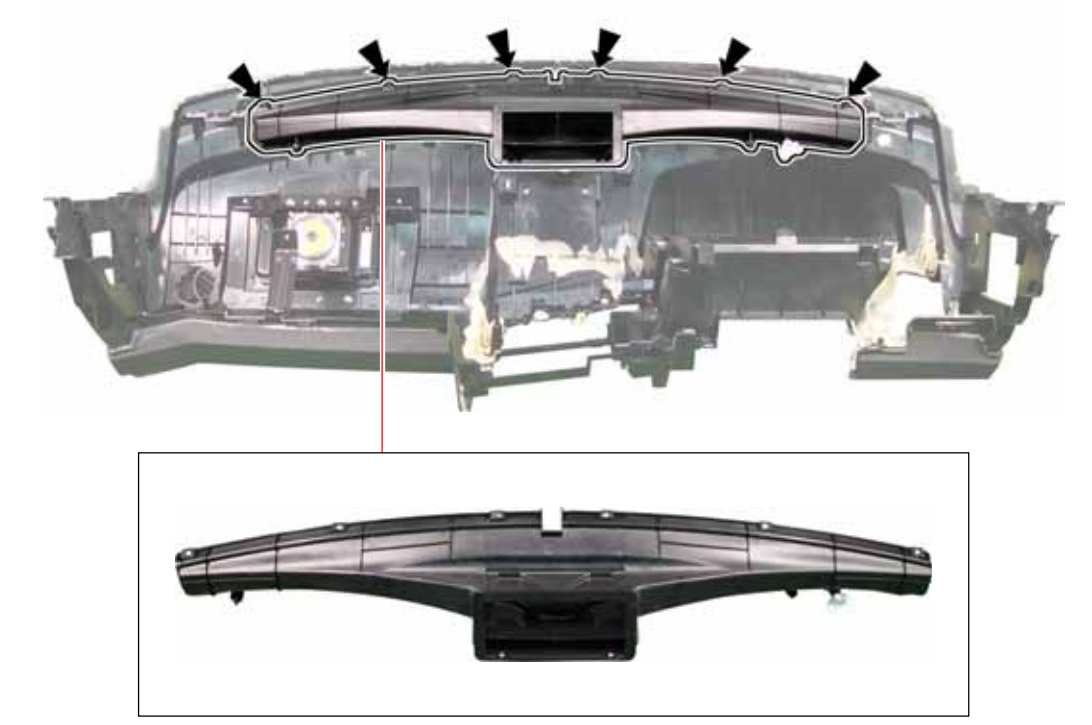


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EFFECTIVE DATE	
AFFECTED VIN	

2. Unscrew two mounting screws (one at each side) and remove the left and right air ducts.



3. Unscrew two mounting screws (one at each side) and remove the upper air duct.



▶ Floor Air Duct

※ **Preceding Work:** 1. Disconnect the negative battery cable and remove the center fascia panel and center lower panel.
2. Remove the center console assembly.

Floor Air Duct

Unscrew two mounting screws from the center of the air duct (A/C module side) and two mounting screws from the lower side of the air duct and remove the floor air duct assembly.

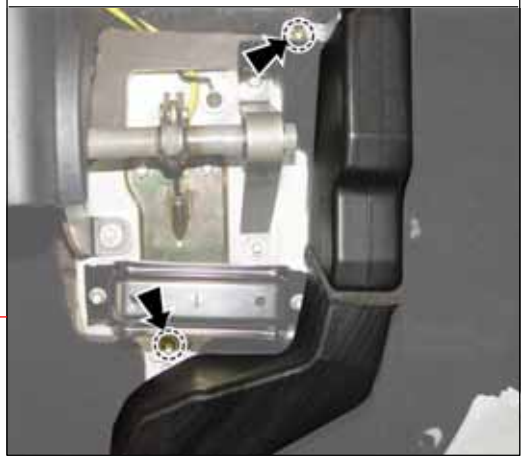
Vehicle with Foot Parking Brake

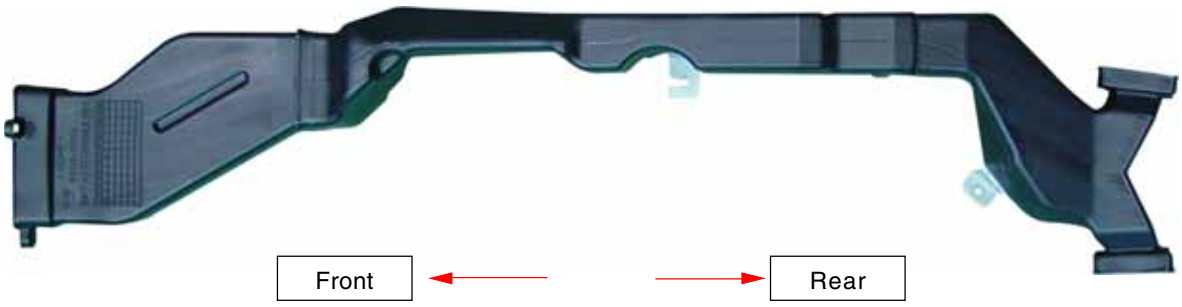


Mounting Screws (Center)



Mounting Screws (Lower)



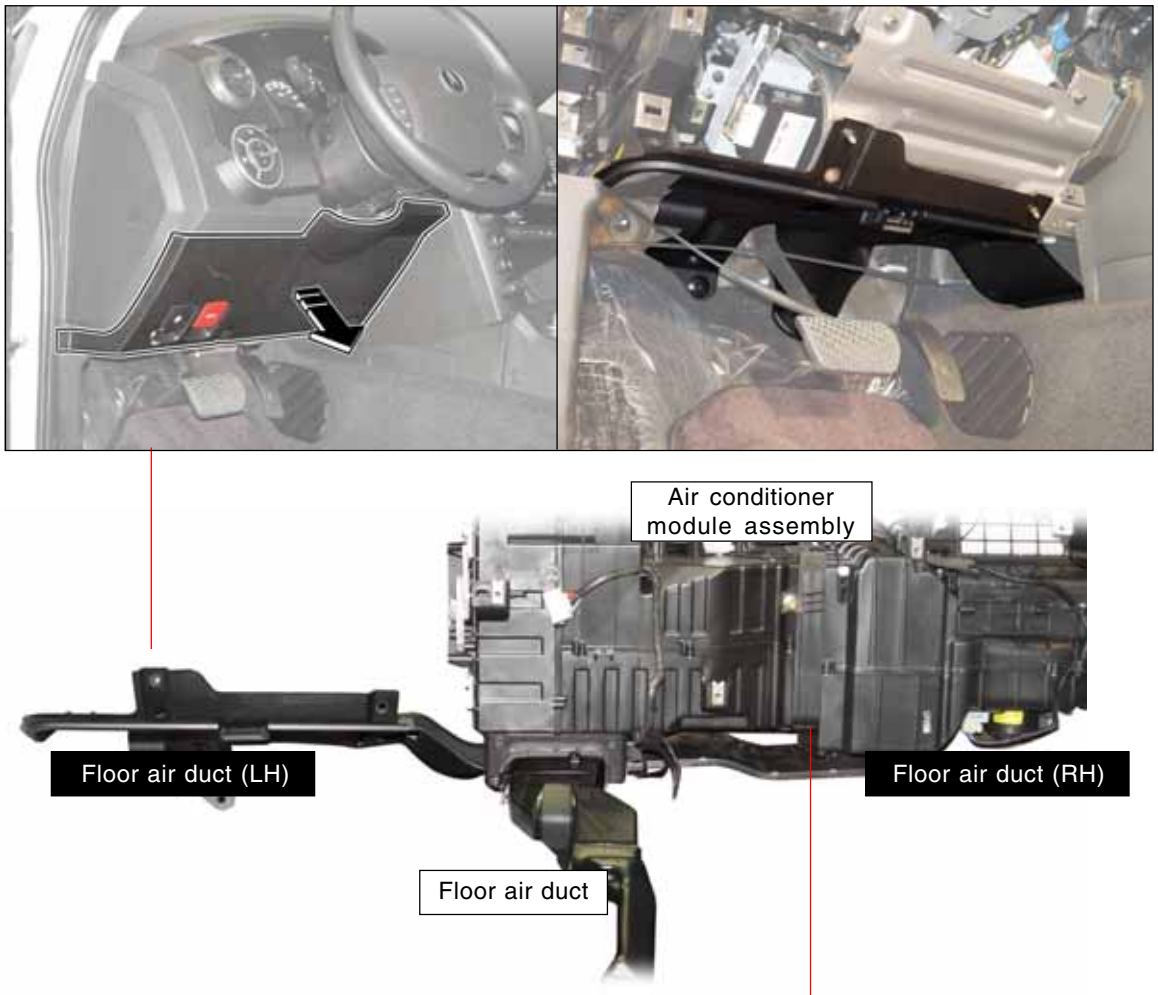


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EFFECTIVE DATE	
AFFECTED VIN	

▶ Front Floor Air Duct

- The front lower air duct supplies air flow towards the lower side of driver and passenger seats and its removal/ installation procedure are slightly different.

1. Driver side lower air duct is installed behind the lower instrument panel. Remove it according to the procedures for removal of lower panel (refer to “Body” section).



2. Passenger side floor air duct is located under the air conditioner module.



▶ Vent Grille Assembly

NOTICE

- **Be careful not to damage other components when removing and installing vent grilles.**
- **The vent grille can be removed by pushing its mounting position without removing the instrument panel or related penals.**

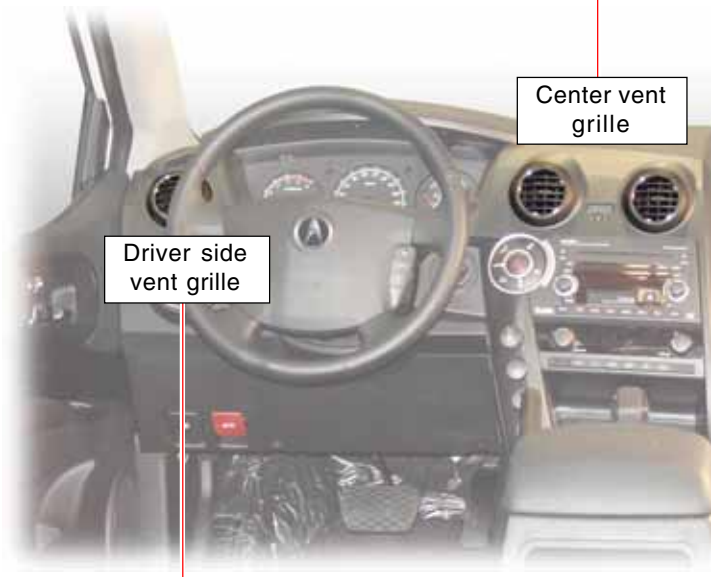
Center Vent Grille

The center vent grilles are installed in the center fascia panel and the appearance is different from side vent grilles.

Removal and Installation

Remove the center vent grille by prying off on both sides using a flat screwdriver.



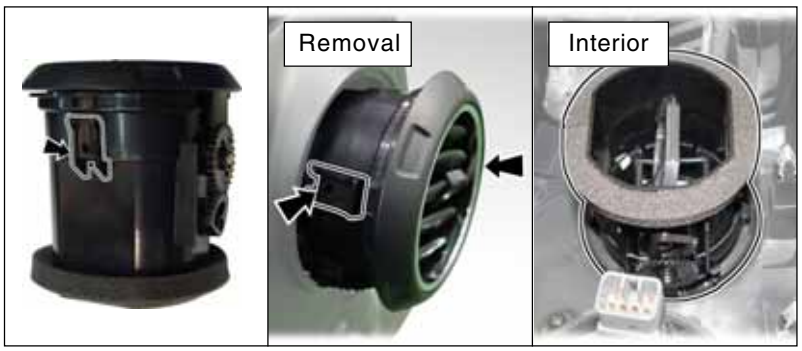


Side Vent Grille (Driver Side)

The driver side vent grille is installed in the outside rearview mirror switch bezel assembly.

Removal and Installation

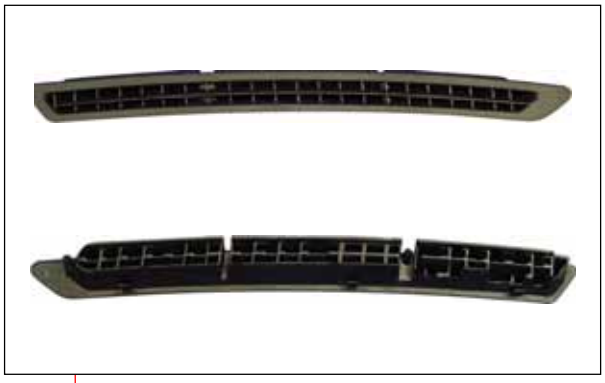
Remove the driver side vent grille by prying off the left and the right sides using a flat screwdriver.



* The vent grilles for LH/RH are the same

Front Vent Grille (LH/RH)

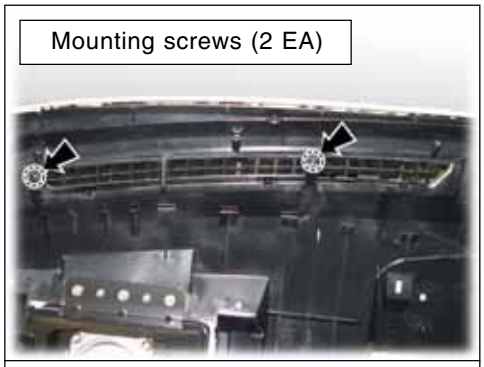
For service on the front vent grille, remove the instrument panel and air duct first.





Removal and Installation

Remove the air duct from the instrument panel. Unscrew two mounting screws while pushing the fixing hook on the vent grille and remove the vent grille through the front opening of the instrument panel.





Side Vent Grille (Passenger Side)

The passenger's side vent grille is installed in the instrument panel and it is the same as the driver's.

Removal and Installation

1. Separate the vent grilles at both sides using a flat screwdriver.
2. Remove the vent grille from the instrument panel.



▶ Condenser Assembly

※ **Preceding Work:** 1. Collect the A/C refrigerant and remove the front bumper assembly.
2. Drain the coolant
(Store the collected A/C refrigerant and coolant into the designated container.)

Removal and Installation

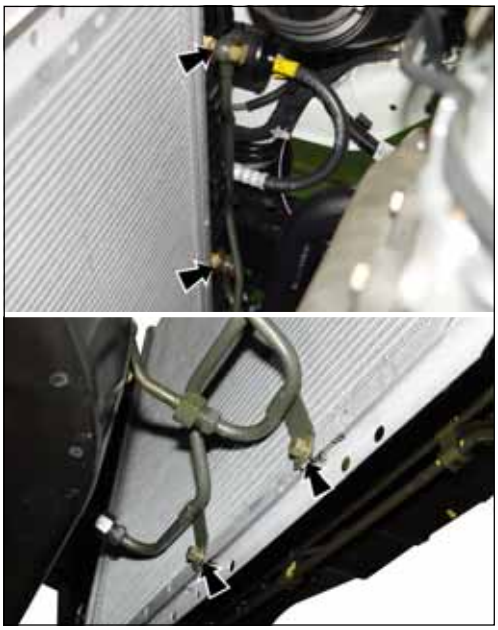
1. Remove the air cleaner duct. (Unscrew two mounting screws, release the cleaner hose clamp and remove the duct.)

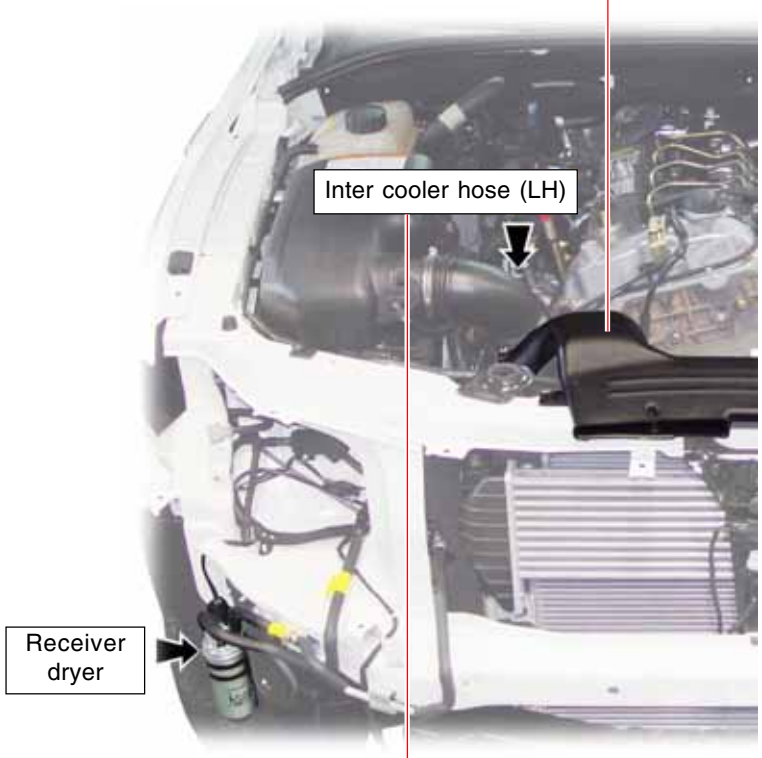


2. Remove the pipes from the radiator oil cooler for automatic transmission.

Installation Notice

Tightening torque	25 ~ 35 Nm





3. Remove the right and left hoses from the inter cooler.

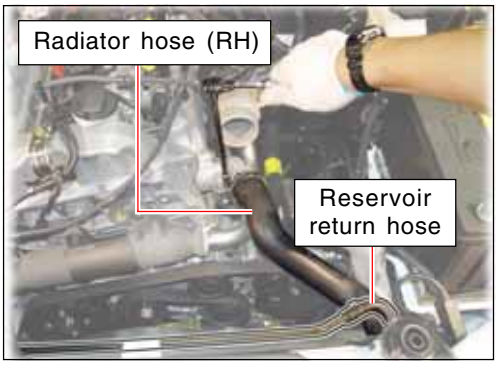
Inter Cooler: LH

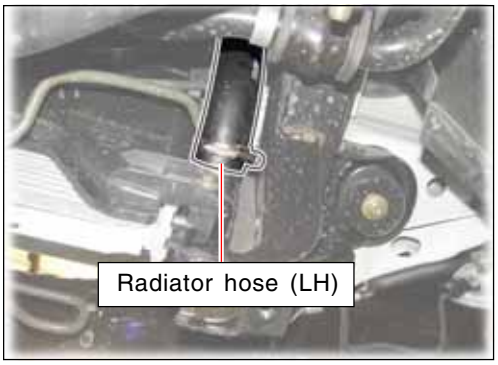


Inter Cooler: RH

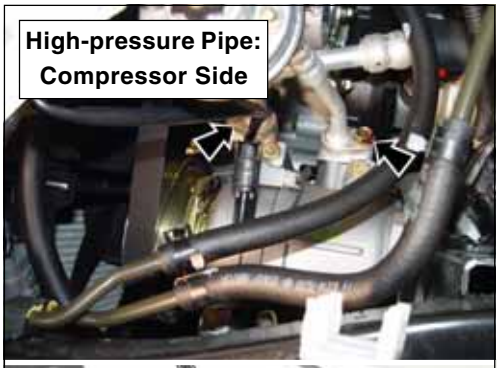


4. Remove the inlet/outlet hoses and reservoir return hose from the radiator.





5. Remove the air conditioner hose and pipe at condenser side.







*** Plug the pipe openings with a seal caps after disconnecting the high/ low pressure pipes.**

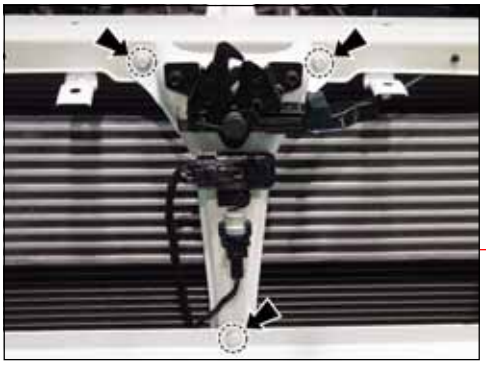
6. Disconnect the PWM unit connector from the electric fan unit.



7. Disconnect the ambient temperature switch connector and the AQS sensor connector and remove the ambient temperature switch.



8. Unscrew three hood latch mounting bolts from the front end panel and three mounting bolts from the front support panel to remove the hood latch and the support panel.

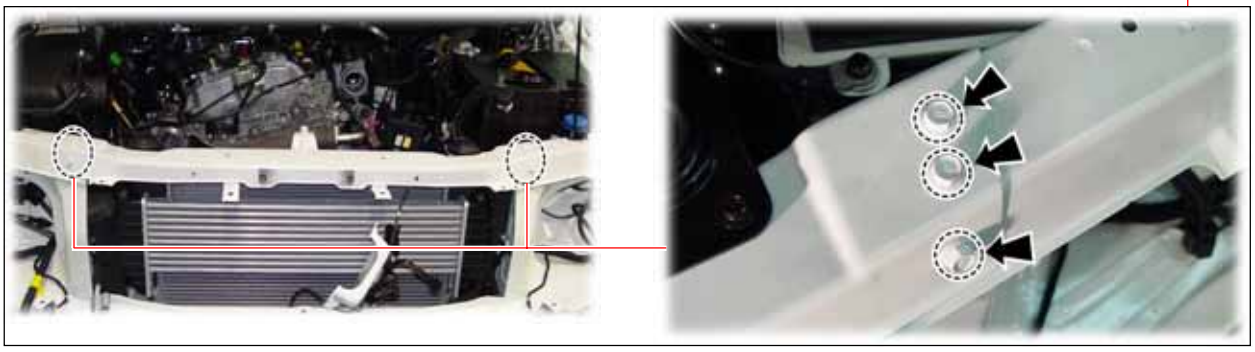




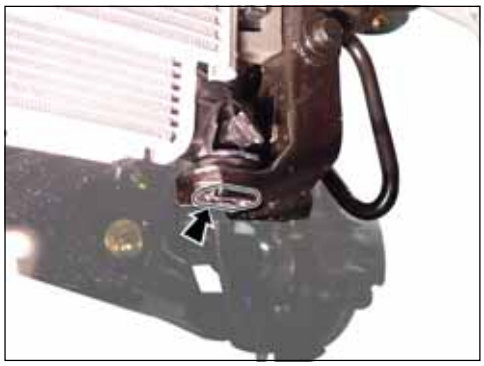
9. Unscrew two mounting bolts and remove the mounting bracket.



10. Unscrew three mounting bolts (10 mm) at both sides and remove the front end panel.



11. Remove the mounting clips and remove the radiator assembly.





12. Remove the upper and lower mounting bolts (10 mm) and remove the inter cooler from the radiator.







13. Unscrew five mounting bolts (10 mm) and remove the air conditioner condenser assembly.





▶ Receiver Dryer Assembly

※ **Preceding Work:** 1. Disconnect the negative battery cable.
2. Collect the air conditioner refrigerant.

Receiver dryer



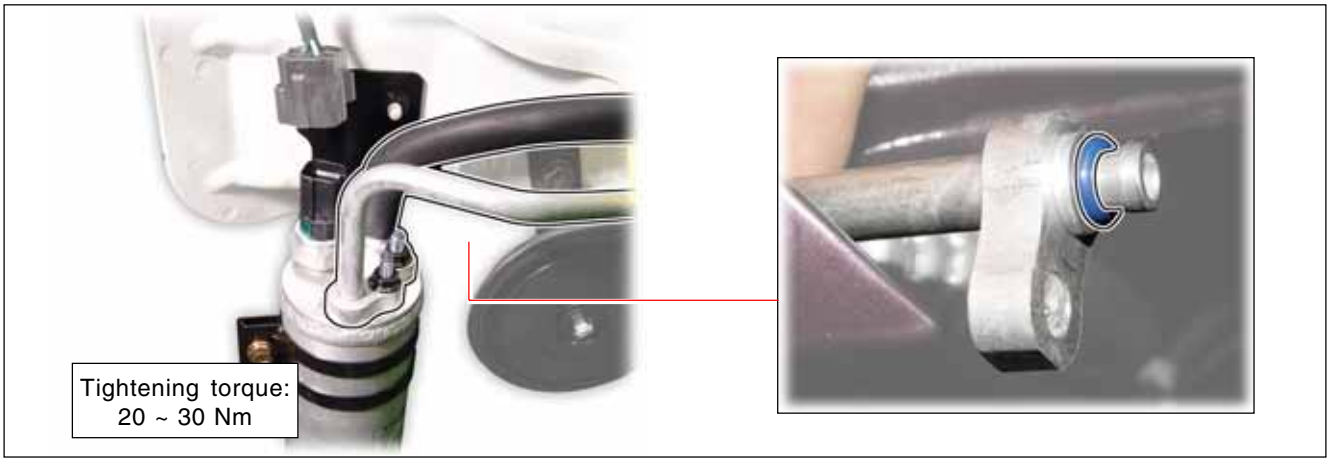


Inspection Procedure

1. Disconnect the connector from the receiver dryer.



2. Unscrew two mounting nuts on the receiver dryer and remove the high/low pressure pipes.

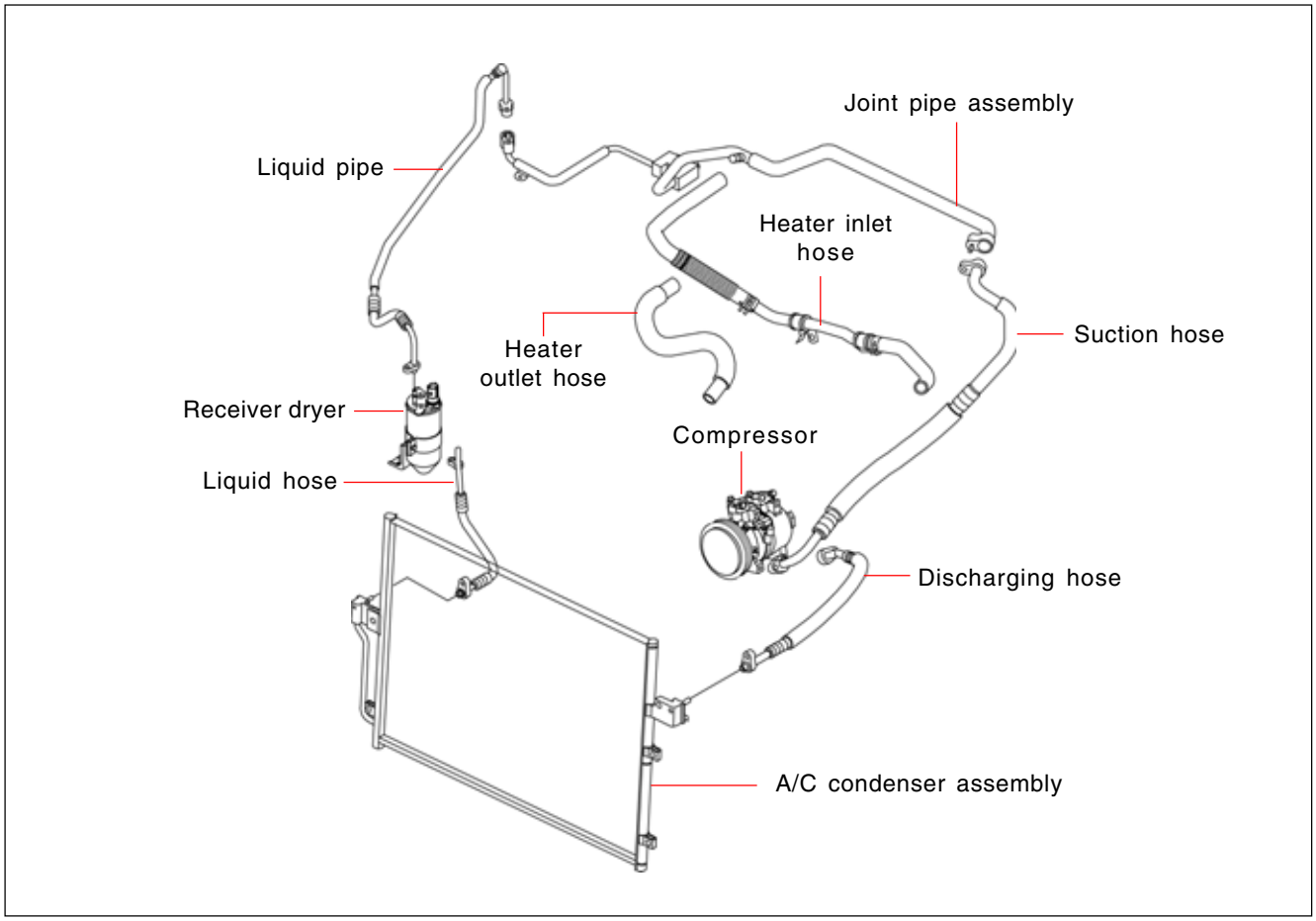


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Unscrew two bracket mounting bolts and remove the receiver dryer.



▶ Piping Layout of Air Conditioner and Heater



FFH (FUEL FIRED HEATER) SYSTEM

1. OVERVIEW

This system is to increase the coolant temperature quickly by firing diesel fuel in the burner that is installed in engine cooling system (optional). The DI engine equipped vehicle has the Positive Temperature Coefficient (PTC) system as a basic equipment. FFH is operated by the coolant temperature and ambient temperature while PTC is operated by the coolant temperature and intake air temperature.

FFH system consists of independent fuel lines and fuel pump, coolant circuit and coolant circulation pump, electrical glow plug and exhaust system. It also provides the diagnostic function. FFH system cannot be operated or stopped by driver's intention. The FFH system operates up to more 2 minutes to burn the residual fuel inside the system when stopping the engine during its operation. Therefore, a certain period of FFH operation after stopping the engine is not a malfunction.

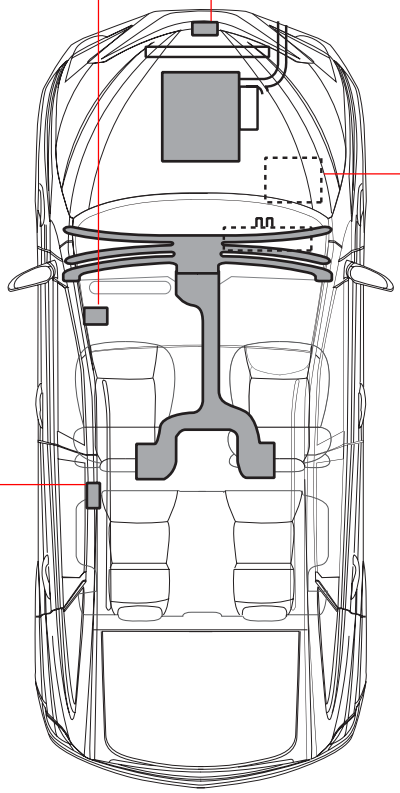
Components



Diagnostic connector

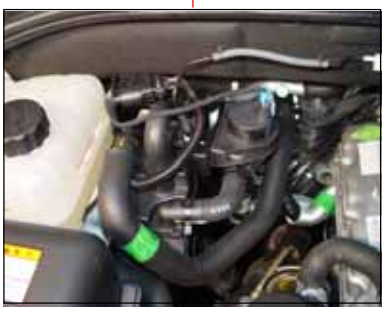


Ambient temperature switch





FFH Fuel pump



FFH

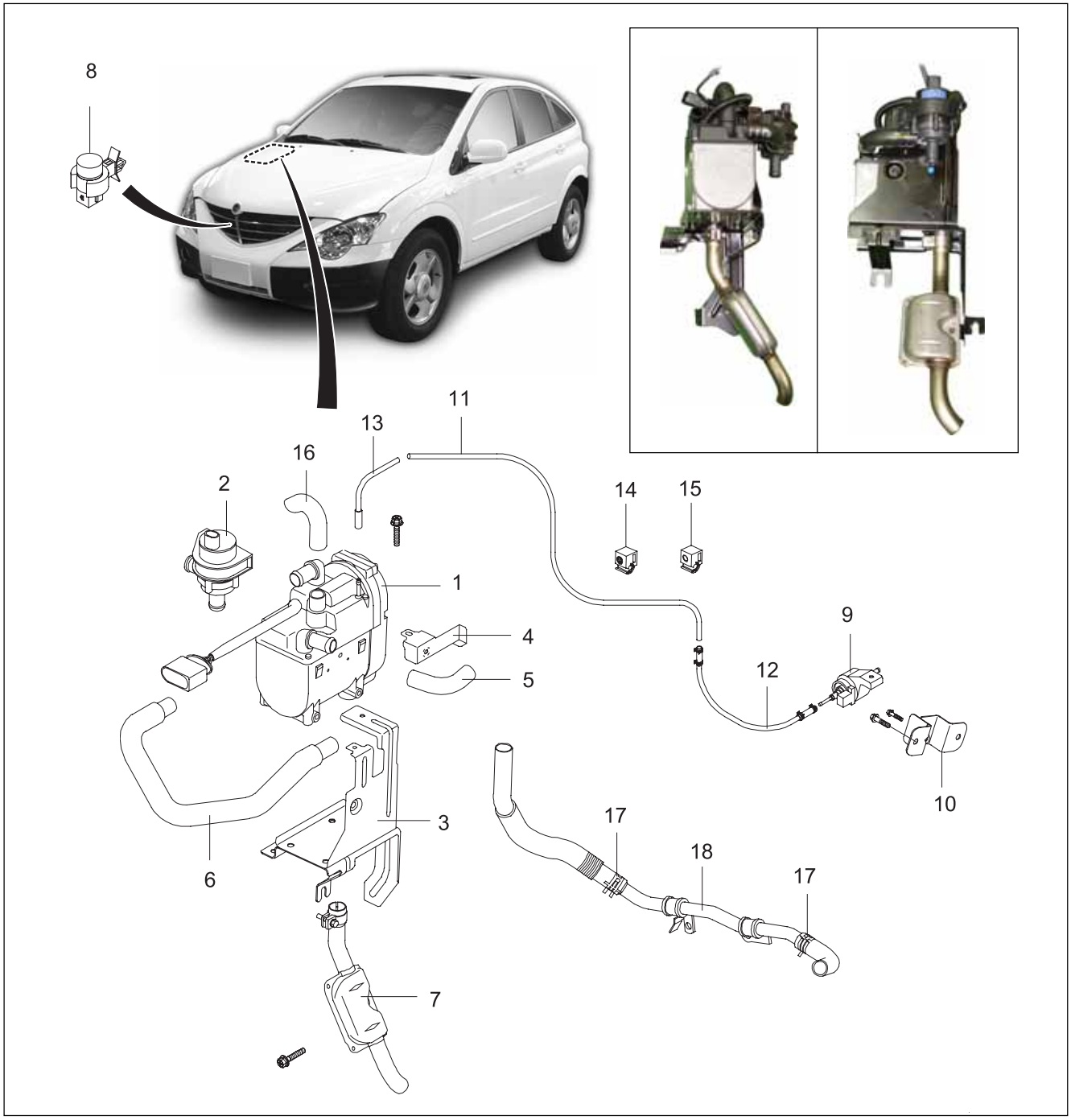




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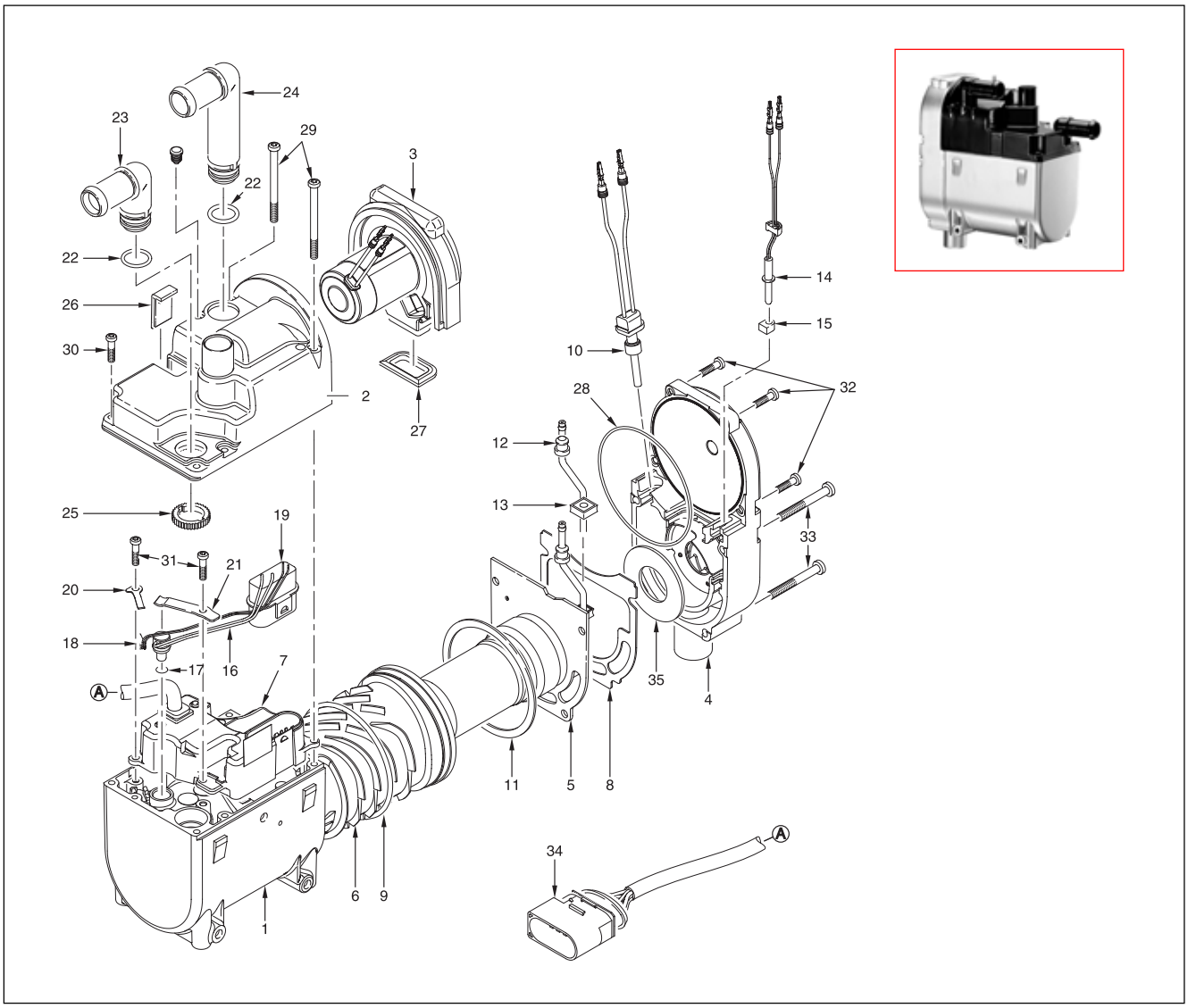
2. FFH LAYOUT

▶ Components



1. FFH assembly
2. Water pump and bracket assembly
3. FFH bracket assembly
4. FFH water pump bracket
5. FFH NO.3 inlet hose
6. FFH NO.2 inlet hose
7. FFH exhaust pipe & silencer
8. Ambient temperature switch
9. FFH fuel pump
10. Fuel pump bracket
11. Fuel pipe NO.1
12. Fuel pipe NO.2
13. Fuel pipe NO.3
14. Tube clip mounting
15. Tube clip mounting
16. Intake hose
17. Clamp
18. FFH NO.1 inlet hose

▶ Exploded View



1. Jacket
2. Jacket cover
3. Combustion air fan
4. Combustion chamber
5. Combustion chamber with flame tube
6. Heat exchanger
7. Controller
8. Seal (between combustion chamber and combustion air fan)
9. O-ring
10. Glow plug with cable
11. Seal (between combustion chamber and heat exchanger)
12. Upper bush for fuel pipe
13. Lower bush for fuel pipe
14. Flame sensor
15. Bush for flame sensor (graphite)
16. Control and overheating sensor with cable
17. O-ring
18. Surface sensor with cable
19. Controller connector
    - 14-pin connector (waterproof)
20. Pressure spring for surface sensor
21. Pressure spring for control and overheating sensor
22. O-ring
23. Coolant hose (inlet)
24. Coolant hose (outlet)
25. Tooth ring (2x)
26. Cable harness cover
27. Rubber seal
28. O-ring
29. Mounting bolt (M4 x 55 TORX / 2x)
30. Mounting bolt (M4 x 16 TORX / 2x)
31. Mounting bolt (M4 x 12 TORX / 2x)
32. Mounting bolt (M4 x 16 TORX / 4x)
33. Mounting bolt (M4 x 44 TORX / 4x)
34. Controller cable harness
35. Insulation washer

3. SPECIFICATIONS

Heater		D 5 S - H	
Heating medium		Coolant	
Control of the heat flow		Large (full load)	Small
Heat flow		5,000 W	2,300 W
Fuel consumption per hour		Approx. 0.63 Liter	Approx. 0.28 Liter
Mean electric power consumption	In operation	35 W	11 W
	At start	100 W	
	While driving	12 W	
Rated voltage		12 V	
* Lower voltage limit: An undervoltage protection device in the controller switches the heaters off at approx. 10 volt.		10 V	
* Upper voltage limit: An overvoltage protection device in the controller switches the heaters off at approx. 15 volt.		15 V	
Tolerable operating pressure		Up to 2.5 bar overpressure	
Minimum water flow through the heater		300 L/H	
Fuel		In the main fuel tank (fuel)	
Tolerable ambient temperature	Operation	- 40°C ~ 80°C	
	Storage	-40°C ~ 125°C	
Weight (without coolant and water pump & bracket)		approx. 2.3 kg	

4. FFH OPERATING PROCESS

▶ Operating Condition

FFH is operated according to the ambient temperature and coolant tempreature.

Initial Operating Conditions of FFH

Initial Operating Conditions of FFH: Ambient temperature: below 5°C

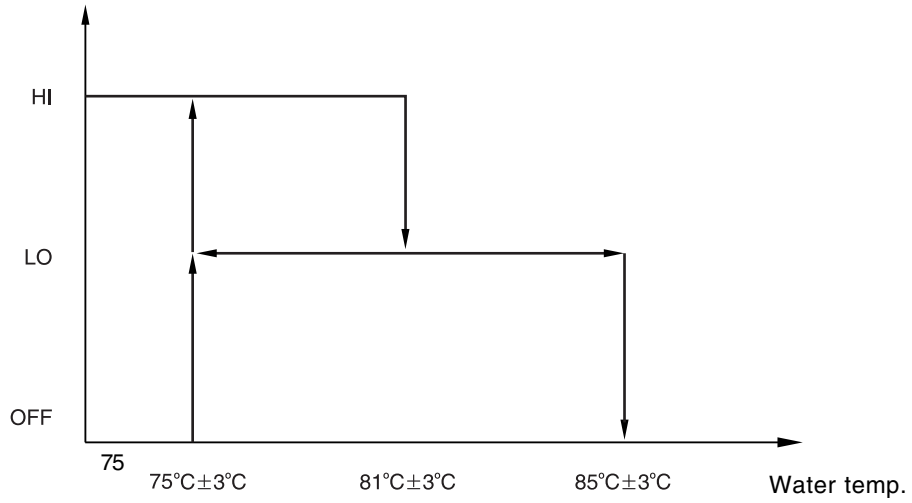
Coolant temperature: below 75°C

Repeated Operating Conditions of FFH: Coolant temperature: below 75°C

When the difference between the ambient temperature at initial operation and current ambient temperature is over 3°C (to reduce the hysteresis with the temperature difference when operating FFH), FFH is operated again.

For example, if the initial operating temperature was 4°C, the ambient temperature for the repeat operation should be below 1°C and the coolant temperature should be below 75°C.

FFH Operations According To the Changes of Coolant Temperature



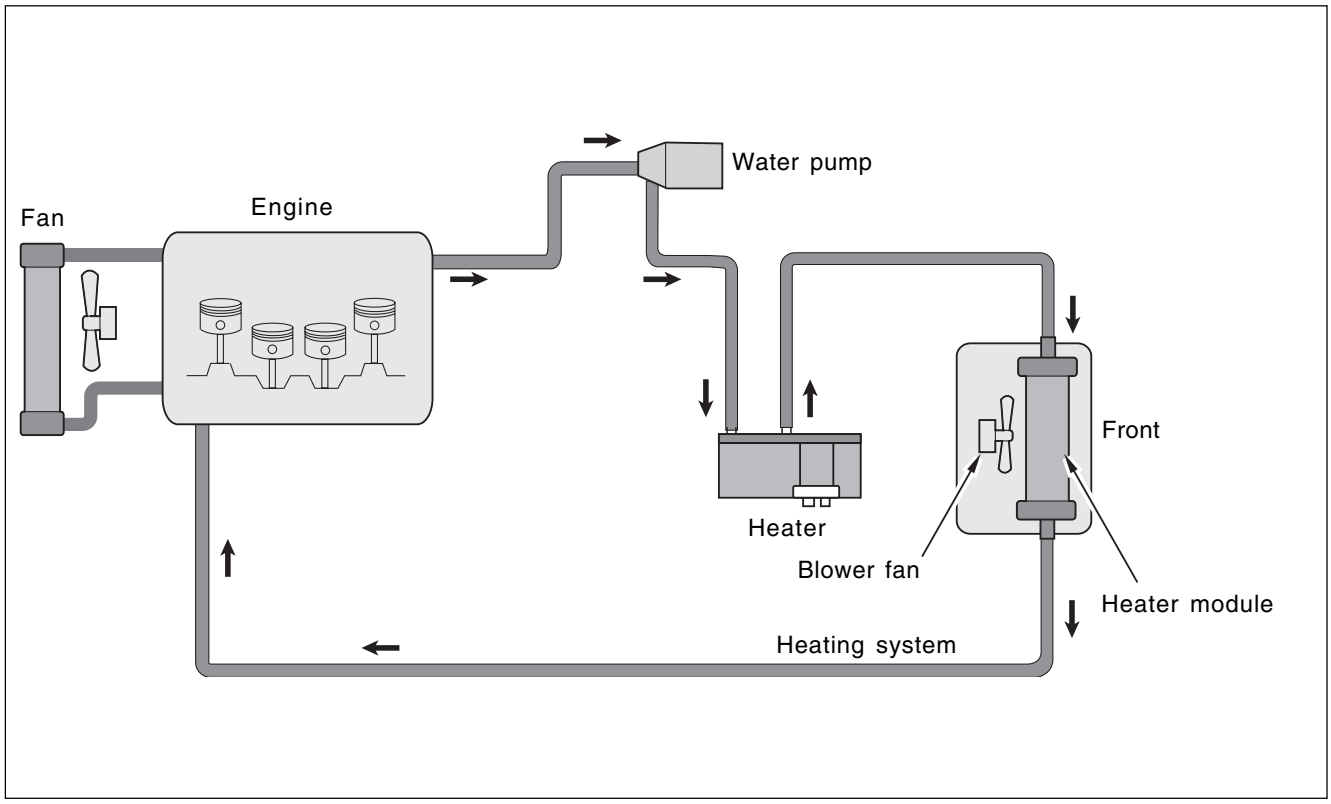
Above graph shows the FFH control process while the FFH is operating.

The control element is coolant temperature as shown in the graph.

The FFH is operated in HI mode (high output: approx. 5,000 W) until the coolant temperature reaches 80°C and starts to operate in LO mode (low output: approx. 2,300 W) from 81°C.

When the coolant temperature reaches approx. 85°C, FFH stops its operation until the ambient temperature condition is met and the coolant temperature drops to 75°C.

▶ Coolant Circulating Route



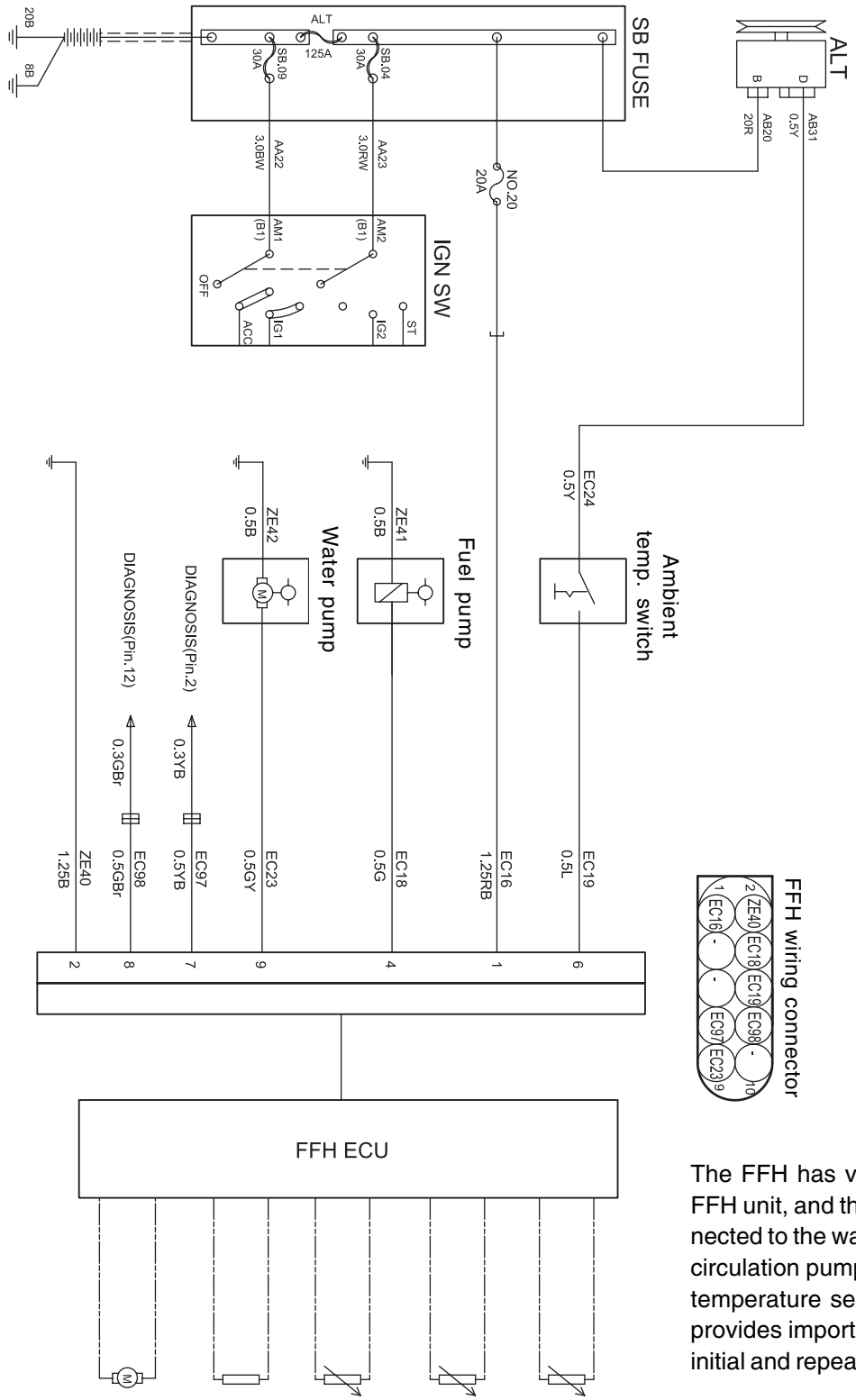
▶ Connecting the Coolant Circuit

The heater is connected to the coolant circuit in the coolant feed pipe from the vehicle engine to the heat exchanger.

NOTICE

- **Parts conveying coolant must be routed and fastened in such a way that they pose no temperature risk to person or material sensitive to temperature from radiation and direct contact.**
- **Before working on the coolant circuit, disconnect the negative battery cable and wait until all components have cooled down completely.**
- **When installing the heater and the water pump, note the direction of flow of the coolant circuit.**
- **Fill the coolant hoses with coolant before connecting the coolant circuit.**
- **When routing the coolant pipes, observe a sufficient clearance to hot vehicle parts.**
- **Protect all coolant hoses/coolant pipes from chafing and from extreme temperature.**
- **Secure all hose connections with hose clamps.**

▶ Circuit Diagram



The FFH has various sensors in FFH unit, and the FFH unit is connected to the water pump, the fuel circulation pump and the ambient temperature sensor (switch) that provides important signals for the initial and repeat operations.

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EFFECTIVE DATE	
AFFECTED VIN	

▶ Controller and Safety Mode

Heater Operations and Safety Mode

1. If the heater fails to ignite within 90 seconds after fuel pumping starts, the start procedure is repeated. If the heater still fails to ignite after a further 90 seconds of the fuel pumping, the heater is switched off in fault mode. The controller is locked after a certain number of failed starts.
2. If the flame does out by itself during operation, the heater is activated again. If the fuel pump fails to ignite within 90 seconds after fuel pumping has started again, the heater is switched off.
3. If the heater is overheated (due to the lack of water, poorly vented cooling circuit), the overheating sensor triggers, the fuel supply is interrupted and the heater is switched off.
4. The heater is switched off if the lower or upper voltage limit is reached.
5. The fuel pump does not start when the glow plug is defective or electrical lead to the dosing pump is interrupted.
6. The fan motor speed is monitored continuously. If the fan motor does not start up or it is locked, the heater is switched off in fault mode after 120 seconds.
7. It is possible to diagnose the system by connecting the diagnostic device to controller. For details, refer to the “Diagnosis Procedures” section.

[EMERGENCY SHUTDOWN]

If an emergency shutdown -EMERGENCY OFF- is necessary during operation, proceed as follows:

- **Pull the fuse (20A) out.**
- **Disconnect the heater from the battery power supply.**

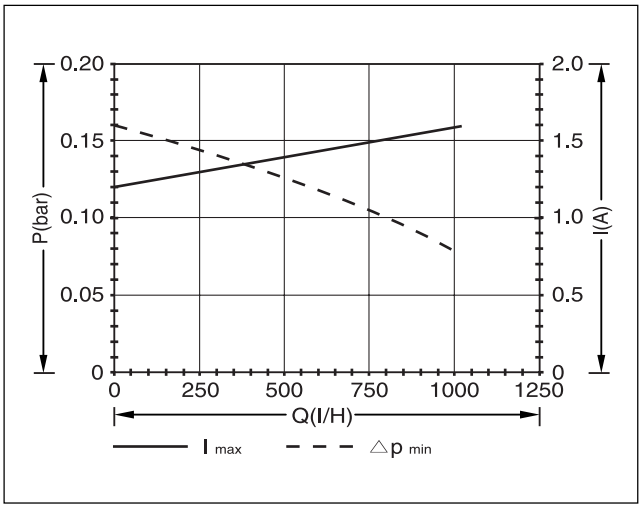
▶ Specification - Water Pump

Rated voltage	12 V
Operating voltage	9 V ~ 15 V
Power consumption	16 W
Pumping capacity (0.1 bar)	800 l/h
Operating temperature	- 40°C ~ 135°C
Weight	0.28 kg

▶ Characteristic Curve of Water Pump (12 V)

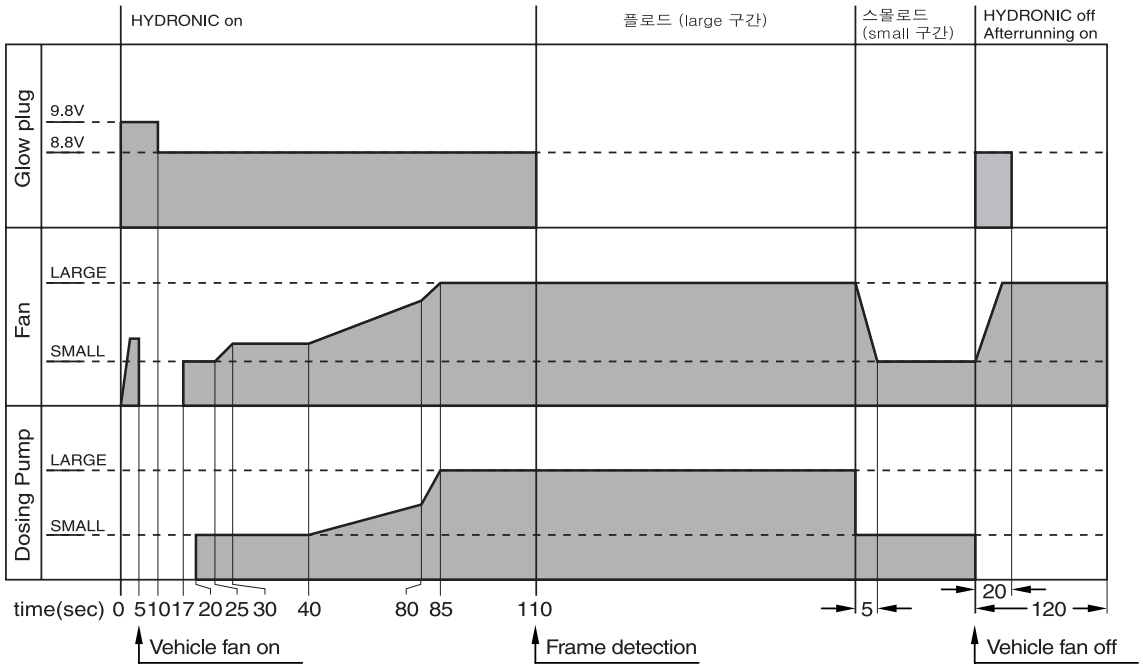
NOTICE

If the vehicle is delivered when the ambient temperature is 5 ˚C, the noise may be heard or the white smoke may be produced in winter since the fuel line is not filled with fuel. Also, the DTC for the safety time may be stored when diagnosing with SCAN-I. However, if it operates correctly when re-operating, the system is considered to be normal and the DTC should be erased using SCAN-I.

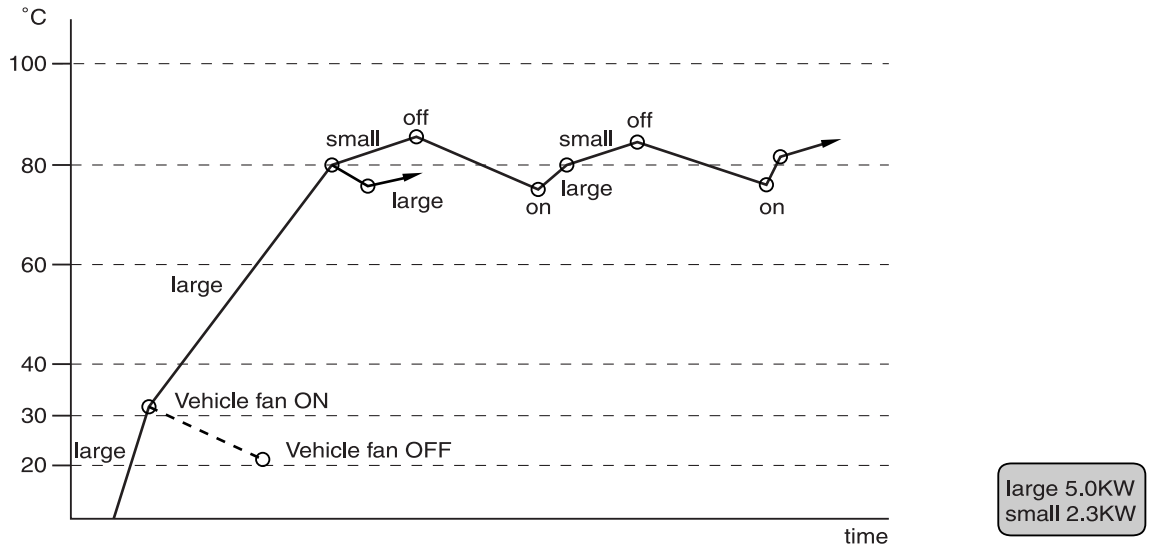


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EFFECTIVE DATE	
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▶ Function Diagram



▶ Switching Diagram According to Temperature Changes



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EFFECTIVE DATE	
AFFECTED VIN	

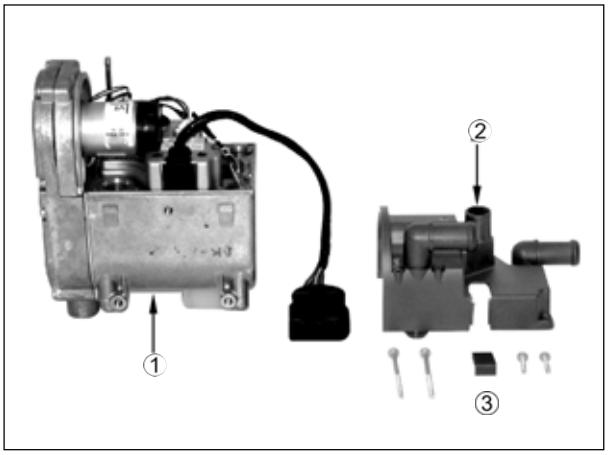
5. COMPONENTS AND FUNCTIONS

NOTICE

- **There is no need to disassemble the FFH unit for repair. This section is to show the internal components of the FFH unit.**

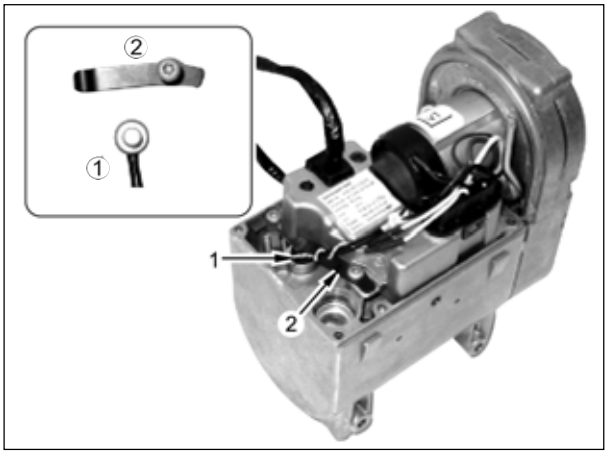
Jacket cover

1. The O-rings are installed between jacket cover and two coolant hoses.
2. The coolant hoses should be connected to the right side.
   1) Jacket
   2) Jacket cover
   3) Cable harness cover



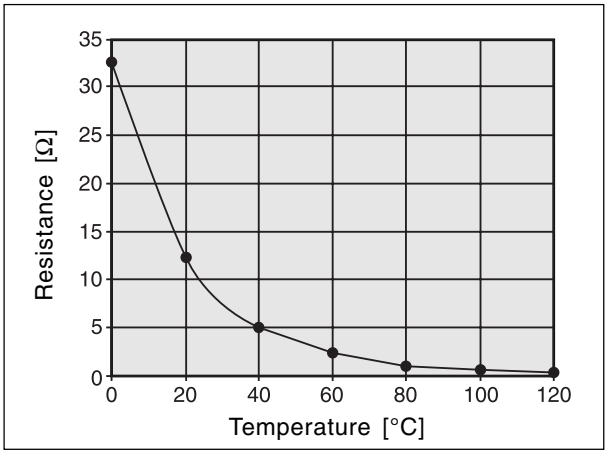
Controller and overheating sensor

1. The controller and overheating sensor make up one component with the cable.
   1) Controller and overheating sensor
   2) Mounting spring



Check controller and overheating sensor

Check the controller and overheating sensor with a digital multimeter. If the resistance according to the changes of the overheating sensor temperature is out of specified values, the flame sensor is defective.

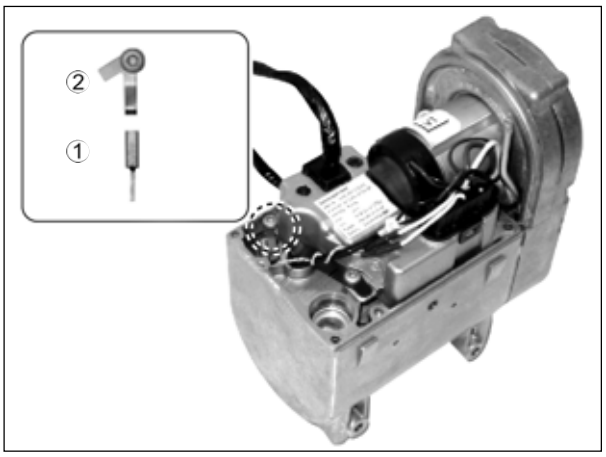


Specified value (Check the resistance changes according to the temperature since there is tolerance range)

Temperature [°C]	0	10	20	30	40	50	60	70	80	90	100	110	120
Resistance [W]	32.54	19.87	12.48	8.06	5.33	3.60	2.48	1.75	1.25	0.91	0.67	0.50	0.38

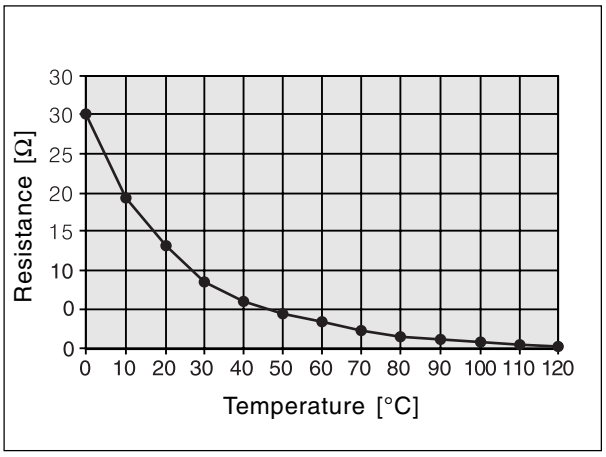
▶ Surface Sensor

1. The surface sensor and cable harness make up one component.
   1) Surface sensor
   2) Mounting spring



▶ Check Surface Sensor

Check the surface sensor with a digital multimeter. If the resistance of the surface sensor is out of specified values, the flame sensor is defective.



Specified value (Check the resistance changes according to the temperature since there is tolerance range)

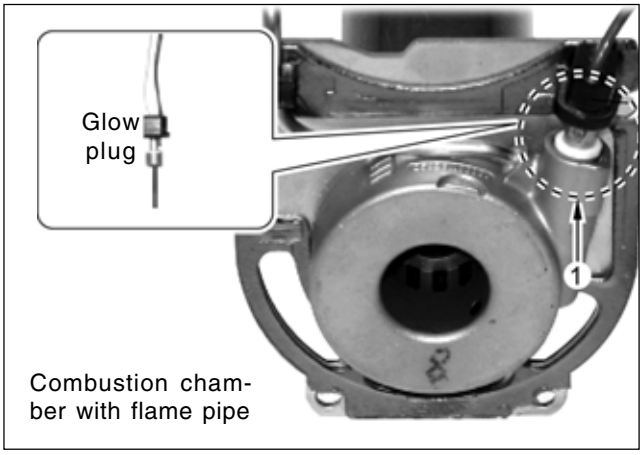
Temperature [°C]	0	10	20	30	40	50	60	70	80	90	100	110	120
Resistance [W]	30.00	19.53	13.03	8.90	6.20	4.41	3.19	2.34	1.75	1.32	1.02	0.77	0.62

▶ Controller

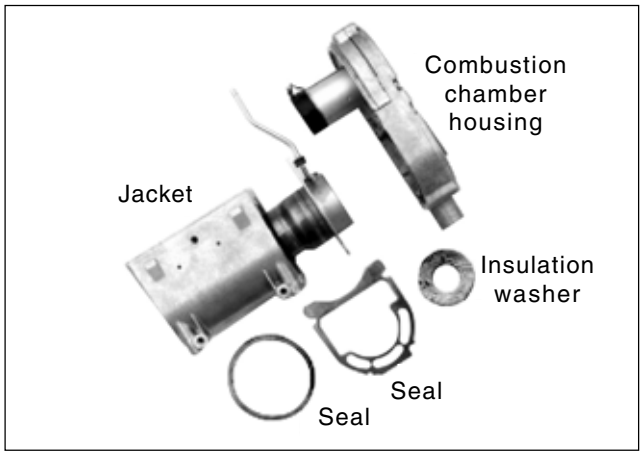
The surface heater and cable harness make up one component.

1) Controller
2) Jacket
3) Combustion chamber housing
4) Mounting screw

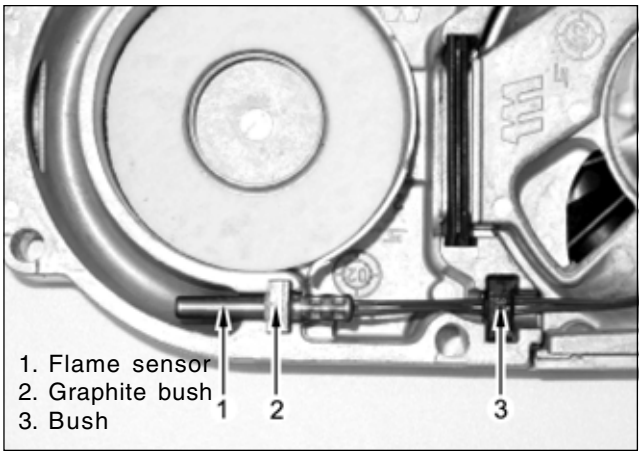
Glow Plug



Combustion Chamber Housing

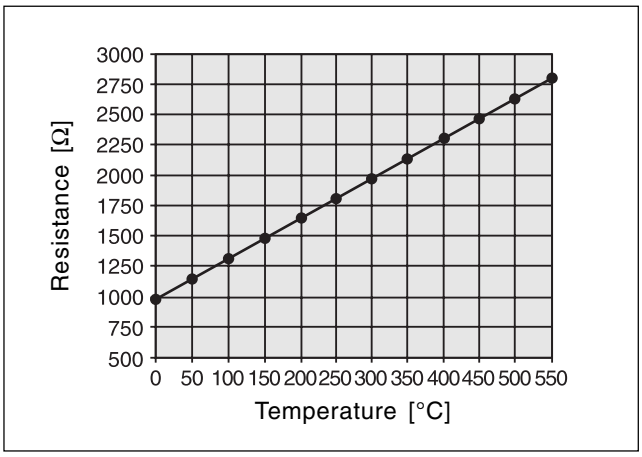


Flame Sensor



▶ Check Flame Sensor

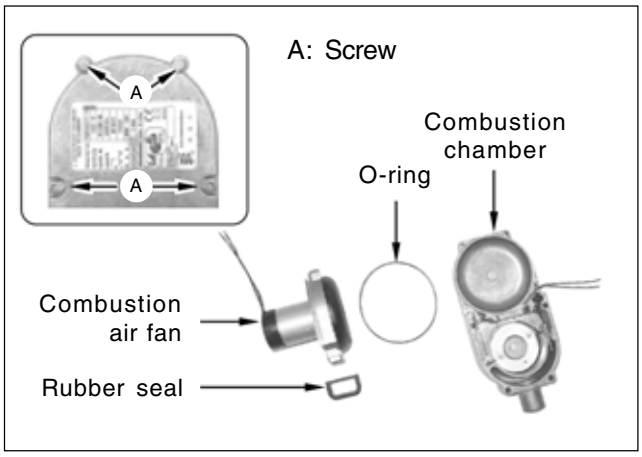
Check the flame sensor with a digital multimeter. If the resistance of flame sensor is out of specified values, the flame sensor is defective.

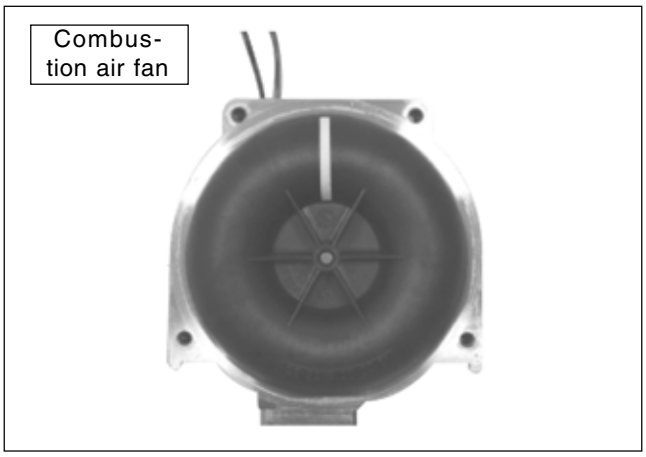


Specified value (Check the resistance changes according to the temperature since there is tolerance range)

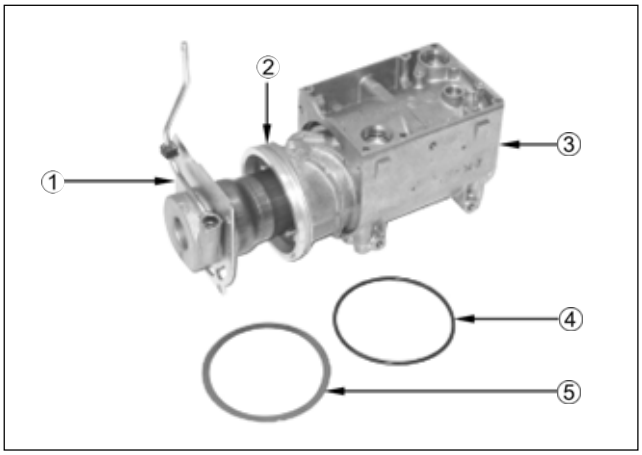
Temperature [°C]	-50	0	10	20	30	50	80	90	100	130	150	200	250	300	350	400
Resistance [W]	803	1000	1022	1062	1097	1194	1309	1347	1385	1498	1573	1758	1941	2120	2297	2470

Combustion Air Fan



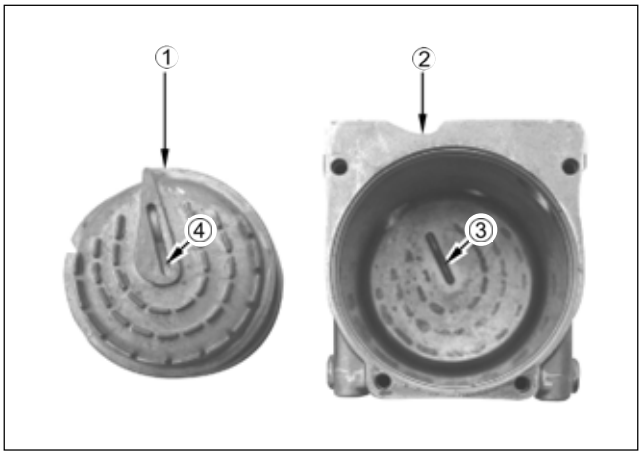


Combustion Chamber



1) Combustion chamber
2) Heat exchanger
3) Jacket
4) O-ring
5) Seal - combustion chamber / heat exchanger

Heat Exchanger



1) Heat exchanger
2) Jacket
3) Stopper
4) Groove (bottom of heat exchanger)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

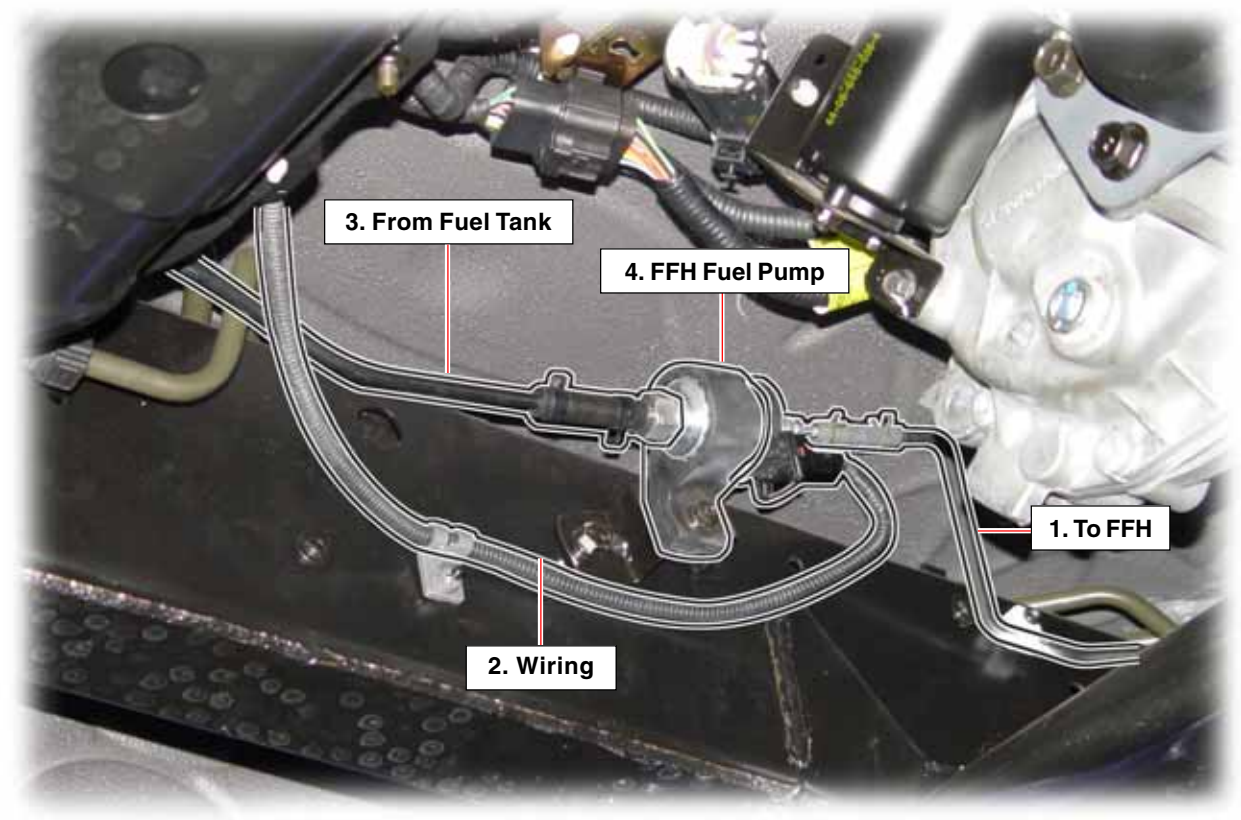
6. REMOVAL AND INSTALLATION

※ **Preceding Work:** Disconnect the negative battery cable.

NOTICE

- **The FFH is an auxiliary device that automatically operates or stops according to the coolant temperature and the ambient air temperature.**
- **In initial operating stage, the fuel pump generates the operating sound and the FFH heater produces white smoke. These are normal states to fill the fuel into the FFH fuel line.**
- **After replacing the FFH related components, fill up the system with fuel.**

▶ Fuel Pump

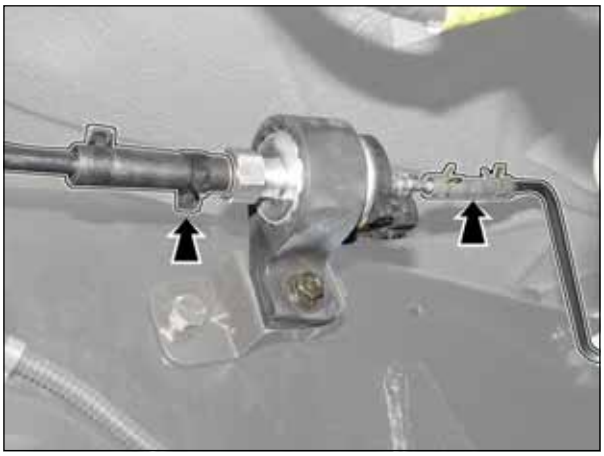




1. Disconnect the fuel pump connector with the vehicle lifted.



2. Disconnect the fuel hose from fuel pump.



3. Unscrew the bracket mounting bolt (10 mm) and remove the fuel pump assembly.



NOTICE

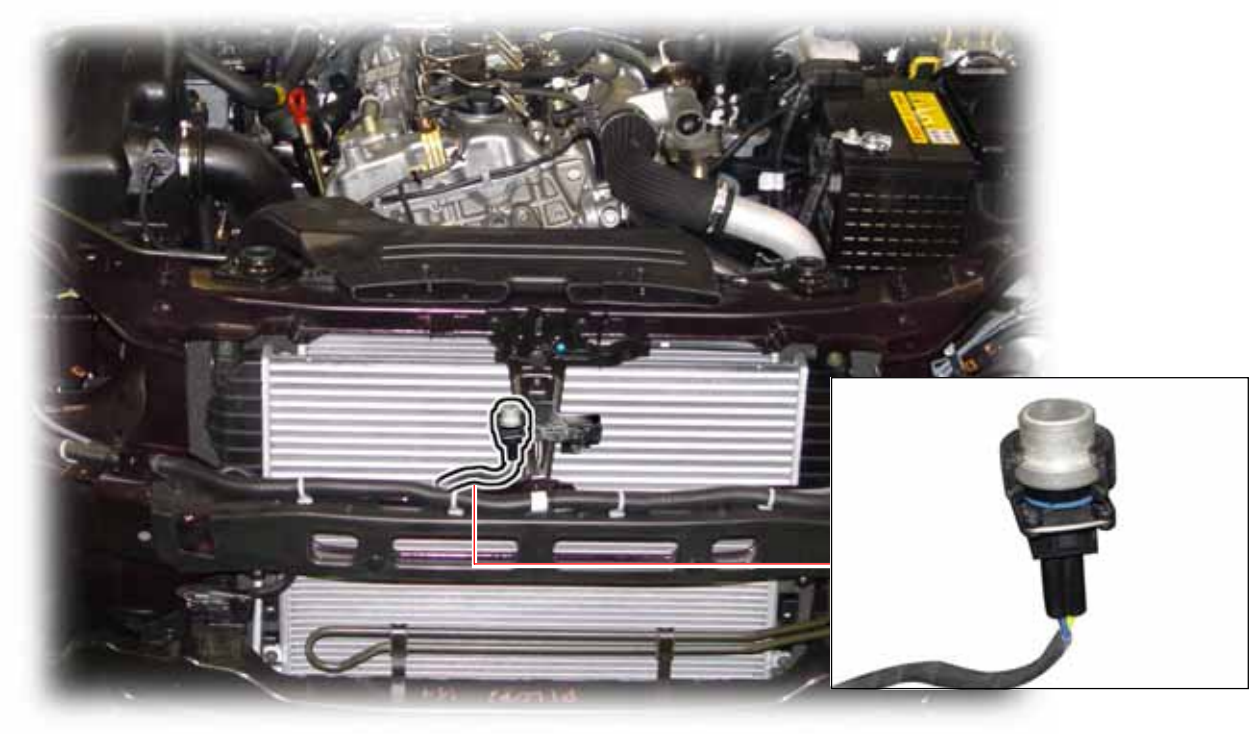
- **Plug the hose opening with a seal cap to prevent oil leakage**



CHANGED BY	
EFFECTIVE DATE	
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Ambient Temperature Switch

※ **Preceding Work:** Disconnect the negative battery cable and remove the right headlamp.



* The ambient temperature switch should be removed or installed after removing the headlamp.

1. Remove the ambient temperature switch from holder. Disconnect the connector while pushing the connector pin.

FFH Assembly

※ **Preceding Work:** Open the engine hood and disconnect the negative battery cable.



FFH Assembly





FFH Coolant Circulation Pump Assembly

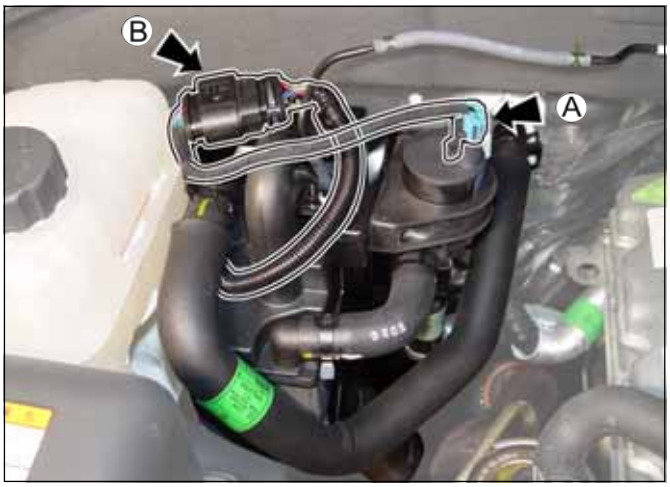






CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

1. Disconnect the FFH coolant circulation pump (A) connector and FFH connector (B).



2. Remove the hose and pipe from the fuel pump.

NOTICE

- **Plug the hose openings with seal caps to prevent oil leakage. Also, be careful not to damage them.**



3. Unscrew the hose clamps on the FFH coolant circulation pump and remove the inlet and outlet hoses.





4. Unscrew five bracket nuts (10 mm) and remove the FFH coolant circulation pump assembly.
   1)Unscrew three mounting nuts at bottom of coolant reservoir.



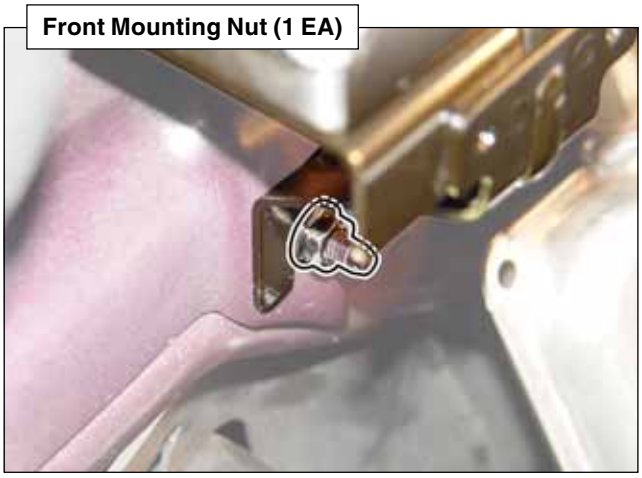
FFH Assembly



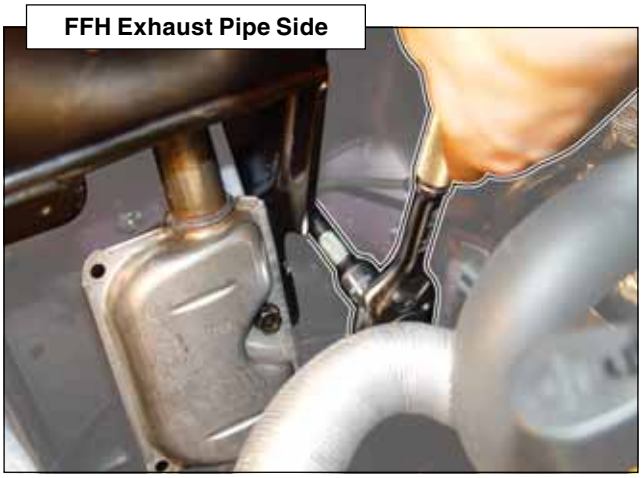


2)Unscrew the mounting nuts from the FFH coolant circulation pump.

Front Mounting Nut (1 EA)



FFH Exhaust Pipe Side



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. Fuel feeding operation should be performed after replacing FFH assembly or fuel lines.

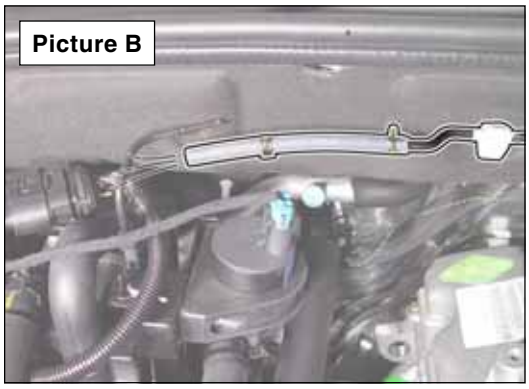
Fuel Feeding Operation

NOTICE

- **If the fuel supply operation is not performed, FFH system could make white smoke with abnormal noise.**

1. Disconnect the ambient temperature switch connector as shown in picture (A).
2. Check if the fuel comes out after engine started as the FFH fuel supply hose is disconnected. (Picture B)

Picture B





3. If the fuel is sprayed out, connect the fuel pipe to FFH assembly and keep the engine running for 1 minute.
4. Connect the ambient temperature switch connector.

Picture A



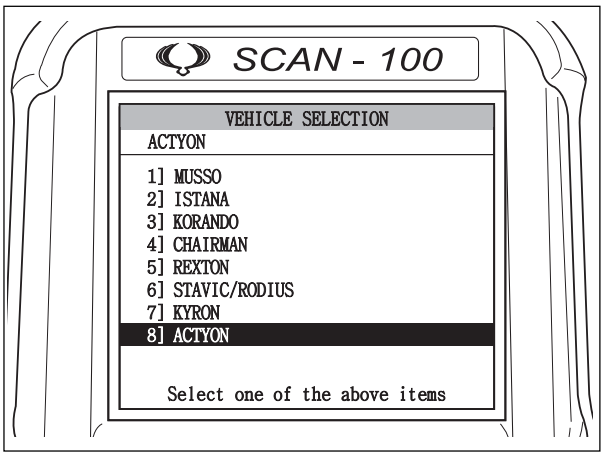
7. TROUBLE DIAGNOSIS

FFH Heater Trouble Diagnosis Precedure

Connect Scan-100 to the diagnostic connector located at the lower instrument panel on the driver's side.



1. Select [ACTYON] in [VEHICLE SELECTION].



2. Select "FFH (FUEL FIRED HEATER)" in [CONTROL UNIT SELECTION].
3. Select the trouble code out of check items.

Trouble Code	Trouble Description	Remedies
0	No faults	-
10	Shutdown for overvoltage	Measure battery voltage (must be < 15.9V). Check alternator and overvoltage.
11	Shutdown for undervoltage	Measure battery voltage (must be > 10.2V). Check alternator, wiring and undervoltage.
12	Overheating (abnormal reference value)	Temperature at surface sensor > 125°C: check cooling system. Check temperature sensor and overheating sensor, replace if necessary.
14	Overheating (difference evaluation-1)	Difference in temperature values between surface sensor and overheating sensor is too large. (Prerequisite for this trouble code display is that the heater is in operation and the measured temperature at the overheating sensor has reached min. 80°C): check cooling system. Check temperature sensor and overheating sensor, replace if necessary
15	Overheating (abnormal heater operation)	Heater does not operate (the controller is locked). Delete trouble code to release controller lock: check cooling system. Check temperature sensor and overheating sensor, replace if necessary
16	Overheating (difference evaluation-2)	If the surface sensor has a far higher temperature value than the overheating sensor, then the system generates a fault code.
17	Overheating (defective hardware)	Temperature at overheating sensor > 130°C: check cooling system. Check temperature sensor and overheating sensor, replace if necessary.
20	Open glow plug circuit	Check plug cable for damage, replace if necessary.
21	Overload or short circuit of glow plug	Check plug cable for damage, replace if necessary.
22	Short circuit of glow plug	Check plug cable for damage, replace if necessary
23	-	-
24	-	-
25	Short circuit of communication line	Check the diagnosis communication line.
30	Abnormal speed of combustion fan motor	Defective fan wheel or combustion fan motor (frozen, contaminated, stiff, damaged cable). Remove the foreign materials, defective combustion fan, broken fan when measuring the fan motor speed.
31	Defective combustion fan motor	Check cable harness for damage.
32	Overload or short circuit of combustion fan motor	Defective fan wheel or combustion fan motor (contaminated, stiff) Check cable harness for damage, replace if necessary.
34	Abnormal output of combustion fan motor	Check the ground and short of combustion fan motor circuit or ground to motor unit. Replace if necessary.
38	-	-
39	-	-
41	Abnormal water pump operation	Check connector.
42	Overload, short to ground	Check connector.
43	Abnormal output of water pump	-

Trouble Code	Trouble Description	Remedies
47	Overload or short circuit of fuel pump	Check cable harness for damage, replace if necessary.
48	Abnormal fuel pump operation	Check cable harness for damage, replace if necessary. Check plug-in connection, replace if necessary.
49	Short circuit of fuel pump (B+)	Check cable harness for open to battery voltage, replace if necessary.
50	Improper operation	The controller is locked due to excessive starting problem.
51	Delayed heating time	During start (no flame formed yet), the flame sensor reports temperature value too high for too long, check exhaust gas, combustion value and flame sensor.
52	Time exceeded for cold blowing	Check exhaust gas and combustion gas system. Check fuel quantity and fuel supply. Clean or replace filter in fuel pump.
53	Flame aborted from “large” stage	Fault (no more starting attempt allowed). Check exhaust gas and combustion air system. Check fuel quantity and fuel supply. Check flame sensor - see trouble code 64 and 65.
54	Flame aborted from “small” stage	Fault (no more starting attempt allowed). Check exhaust gas and combustion air system. Check fuel quantity and fuel supply. Check flame sensor - see trouble code 64 and 65.
60	Abnormal overheating sensor operation	Check cable harness for damage, check plug-in connection, replace if necessary. Check sensor resistance value, replace if necessary.
61	Short circuit or ground of overheating sensor	Check cable harness, replace if necessary. Check sensor resistance value, replace if necessary.
64	Abnormal flame sensor operation	Check cable harness for damage, check plug-in connection, replace if necessary. Check sensor resistance value, replace if necessary.
65	Short circuit of flame sensor	Check cable harness, replace if necessary. Check sensor resistance value, replace if necessary.
71	Defective surface sensor	Check cable harness for damage, check plug-in connection, replace if necessary. Check sensor resistance value, replace if necessary.
72	Short circuit of surface sensor	Check cable harness, replace if necessary. Check sensor resistance value, replace if necessary.
74	Defective overheating prevention device and its operation	-
87	-	-
88	-	-
89	-	-
90	Watchdog reset	Replace controller.
91	Abnormal reset function	If too many resets occurs, replace controller.
92	ROM error	Replace controller.
93	RAM error	Replace controller.
94	Defective transistor	Replace controller.

Trouble Code	Trouble Description	Remedies
95	Software error	Check cable harness for open to battery voltage. Replace controller if necessary.
96	Abnormal process operation	Replace controller.
97	Wrong processor cycle	Replace controller.
98	Defective main relay	Replace controller.
99	EEPROM error	Replace controller.

▶ Trouble Diagnosis

Causes		Remedies
Low coolant level	• Leakage in radiator • Leakage in coolant auxiliary tank • Leakage in heater core	• Change radiator. • Change coolant auxiliary tank. • Change heater.
	• Leakage in joint junction of coolant hose • Defective coolant hose	• Reconnect hose or replace clamp. • Change hose.
	• Leakage in water pump gasket • Leakage in water pump inner sealing	• Change gasket. • Change water pump.
	• Leakage in water inlet cap • Leakage in thermostat housing	• Change water inlet cap gasket. • Change thermostat sealing.
	• Insufficient tightening torque of cylinder head bolt • Damaged cylinder head gasket	• Tighten bolt to specified torque. • Change cylinder head gasket.
Abnormally high coolant temperature	• The coolant leakage (Check the coolant level) • Insufficient anti-freezer • Bent coolant hose	• Add coolant • Check density of coolant (Anti-freezer). • Rectify bent of hose, replace if necessary.
	• Defective thermostat • Defective water pump • Defective radiator • Defective coolant auxiliary tank or tank cap	• Change thermostat. • Change water pump. • Change radiator. • Change coolant auxiliary tank or tank cap.
	• Crack in cylinder head or in cylinder block • Clogged coolant flow in cylinder head or block	• Change cylinder head or cylinder block. • Clean coolant flow line.
	• Clogged water flow in radiator core	• Clean radiator core.
	• Defective cooling fan	• Change cooling fan or repair the relevant wiring.
	• Defective temperature sensor and wiring	• Change sensor or check relevant wiring.
Abnormally low coolant temperature	• Thermostat stuck while being open	• Change thermostat.
	• Defective cooling fan	• Change cooling fan or repair the relevant wiring.
	• Defective temperature sensor and wiring	• Change sensor or check relevant wiring.

ELECTRIC SYSTEM

8610 / 8410

TABLE OF CONTENTS

ELECTRIC SYSTEM LAYOUT 2

1. Locations of interior units and sensors 2
2. Switches, units and sensors in engine compartment 4
3. Interior switches 6
4. Electric components and layout 8
5. Diagnostic connector 10

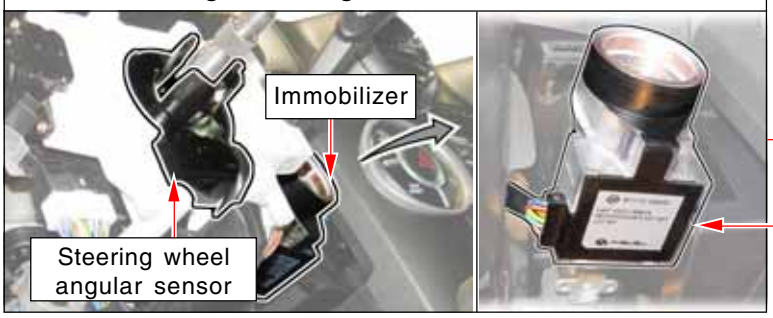
FUSES AND RELAYS 11

1. Fuse and relay box in engine compartment 11
2. Interior fuses and relays 16

ELECTRIC SYSTEM LAYOUT

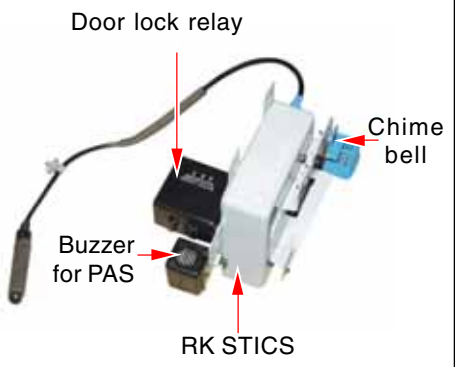
1. LOCATIONS OF INTERIOR UNITS AND SENSORS

Steering Wheel Angular Sensor / Immobilizer



Under Instrument Panel



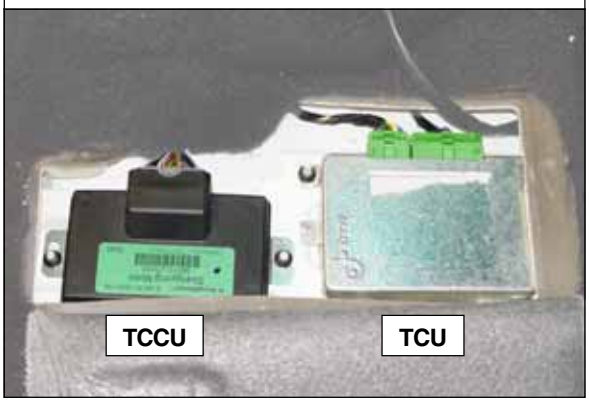




Interior Temperature and Humidity Sensor



TCCU and TCU

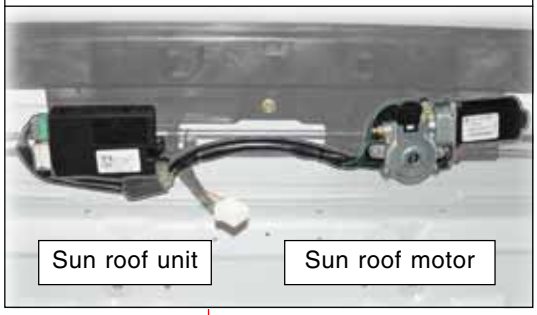


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EFFECTIVE DATE	
AFFECTED VIN	

Rain Sensing Unit (Including Auto Lignt) and ECM



Sun Roof Unit and Motor



Sensor Cluster





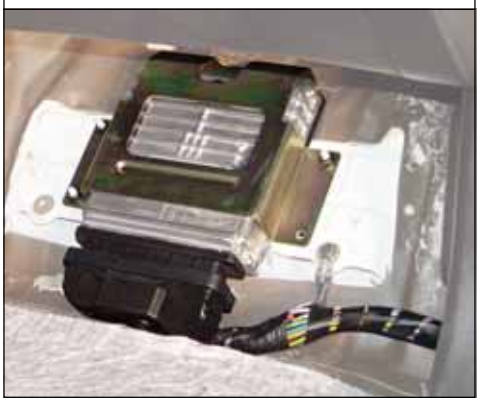
Air Bag ECU



PAS Unit



Engine ECU



Curtain Air Bag Sensor



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EFFECTIVE DATE	
AFFECTED VIN	

2. SWITCHES, UNITS AND SENSORS IN ENGINE COMPARTMENT

FFH (Fuel Fired Heater)

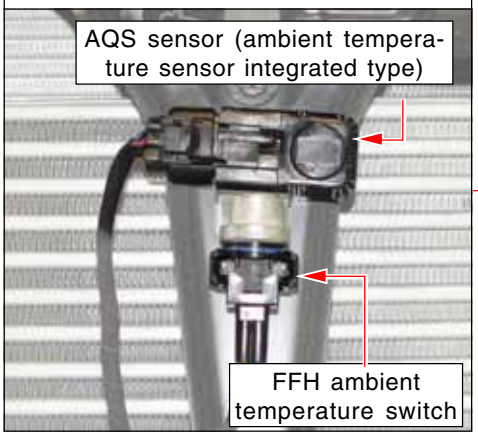




Receiver Drier and Horn

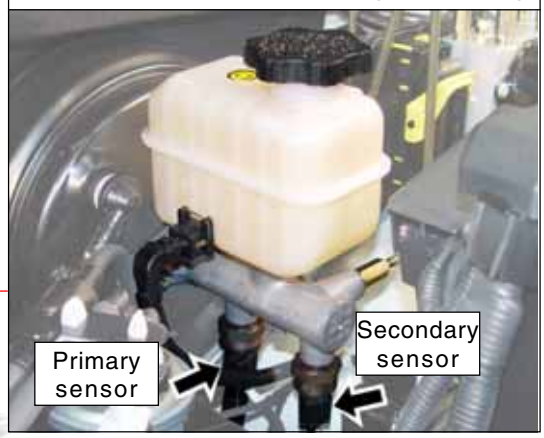


AQS Sensor and FFH Ambient Temperature Sensor



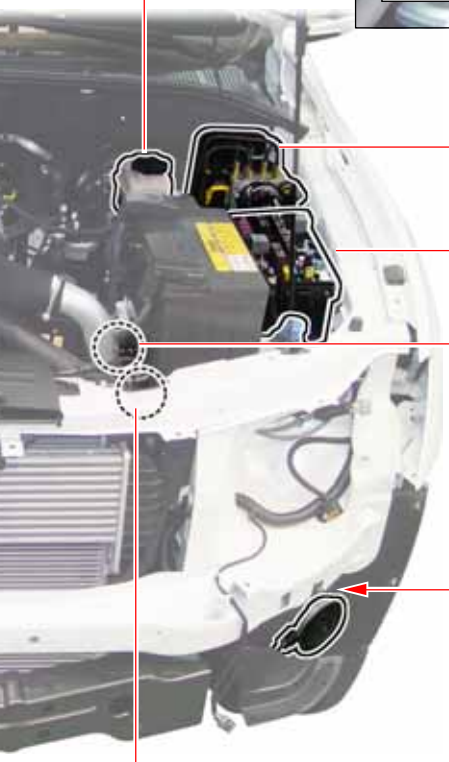
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ESP Pressure Sensor / Primary, Secondary



ESP (ABS) HECU





Fuse and Relay Box



IWE Vacuum Solenoid Valve (4WD)



(on battery tray)

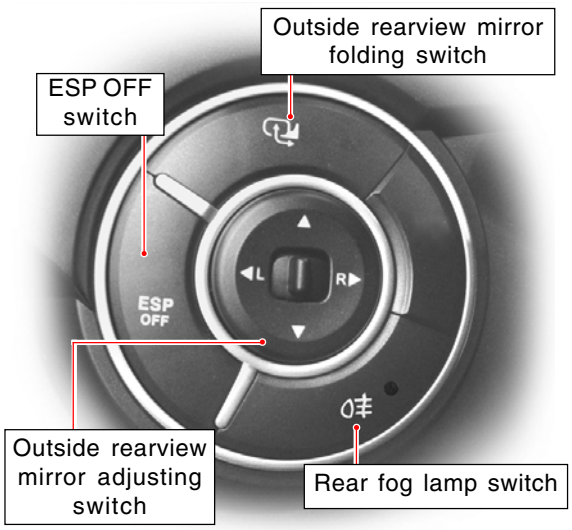
Theft Deterrent Horn (Under the Battery)



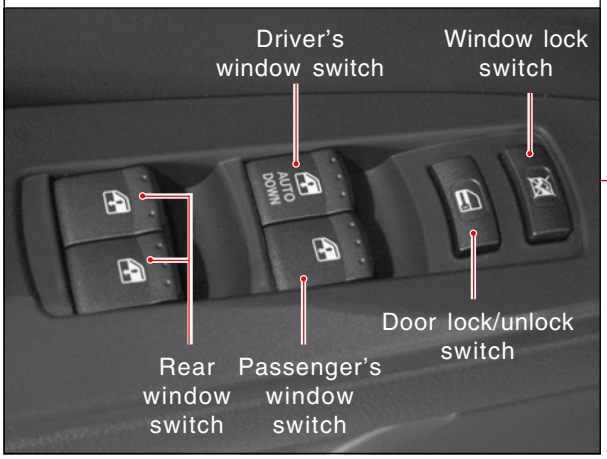
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EFFECTIVE DATE	
AFFECTED VIN	

3. INTERIOR SWITCHES

Bezel Assembly on Outside Rearview Mirror Adjusting Switch



Driver's Power Window Main Switch





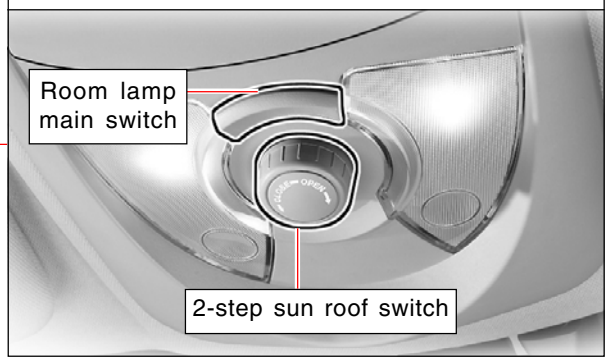
Remote Control Switch on the Steering Wheel



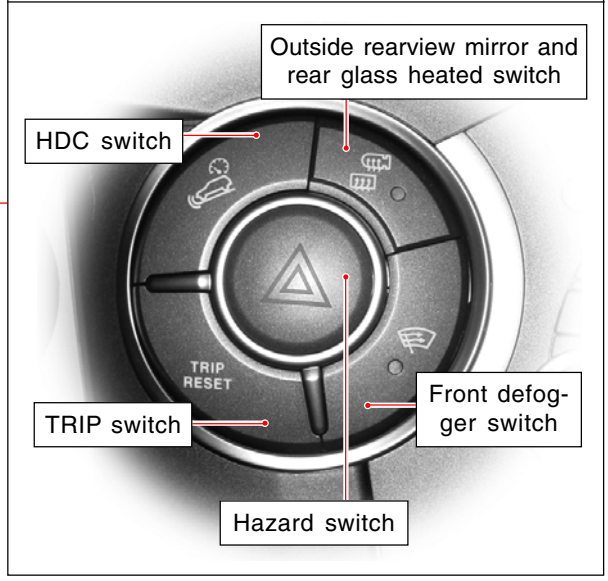
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EFFECTIVE DATE	
AFFECTED VIN	



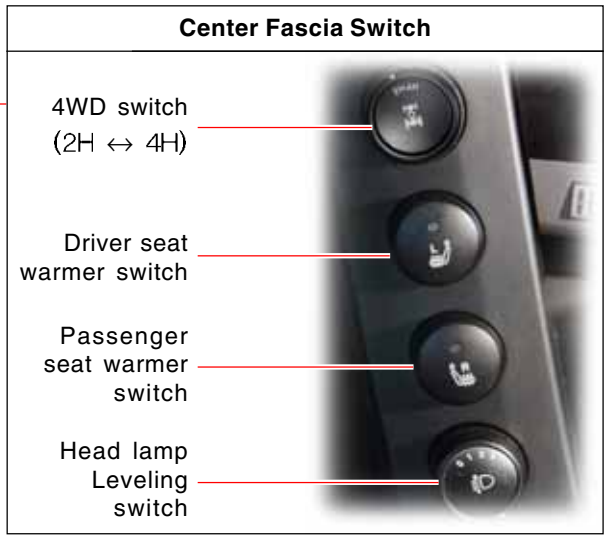
Sun Roof Switch



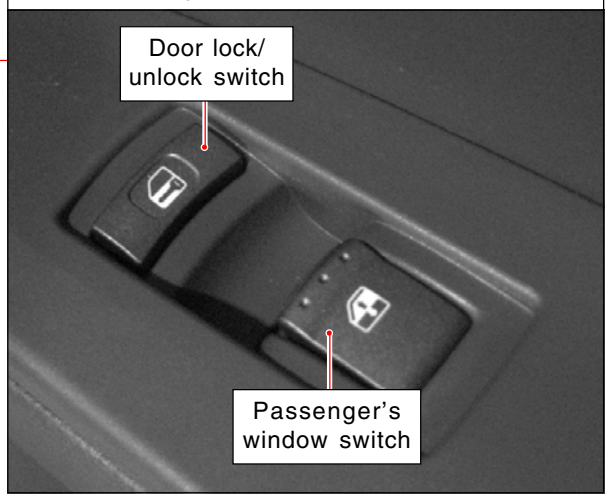
Bezel Assembly on Hazard Switch



Center Fascia Switch



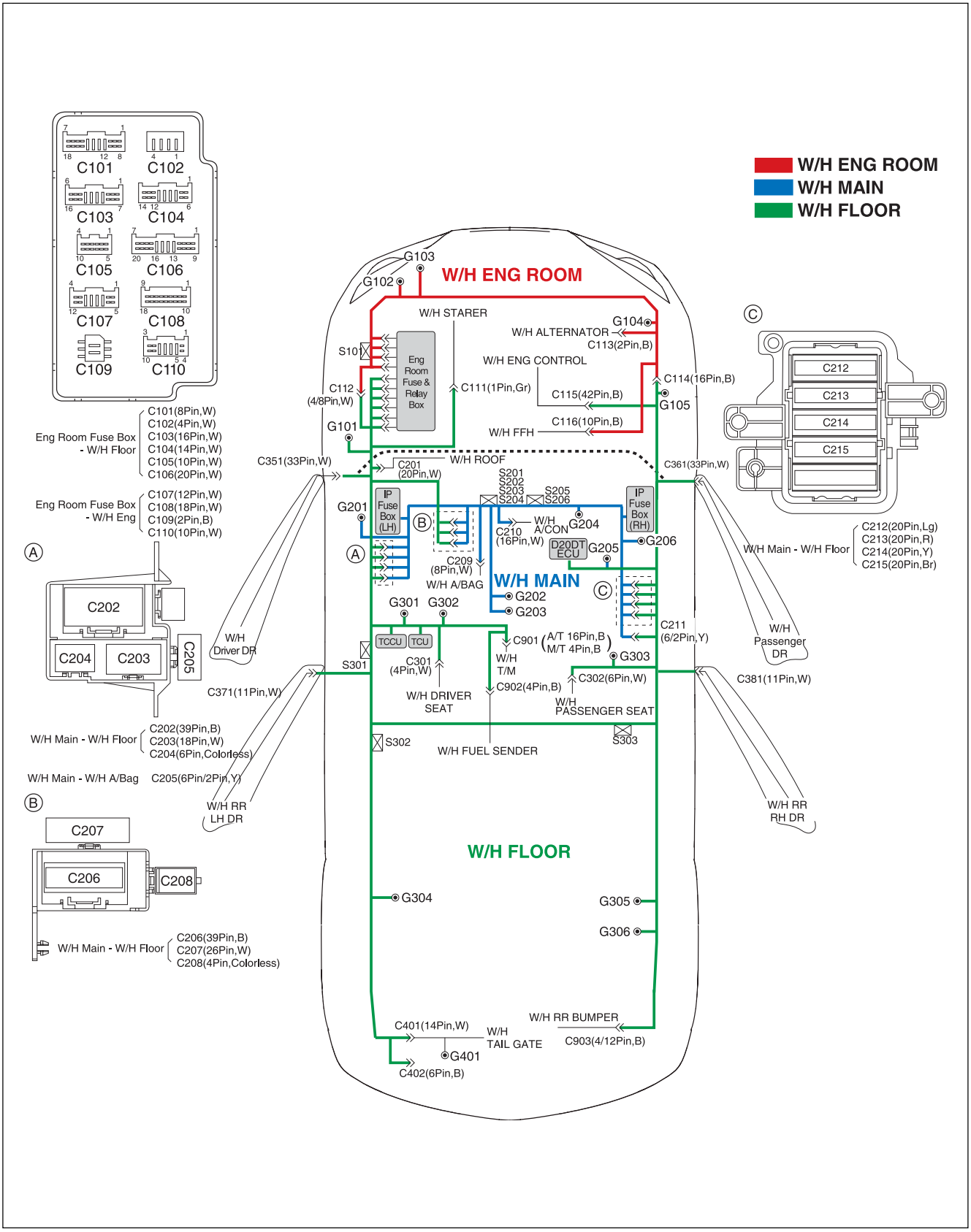
Passenger's Power Window Switch



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

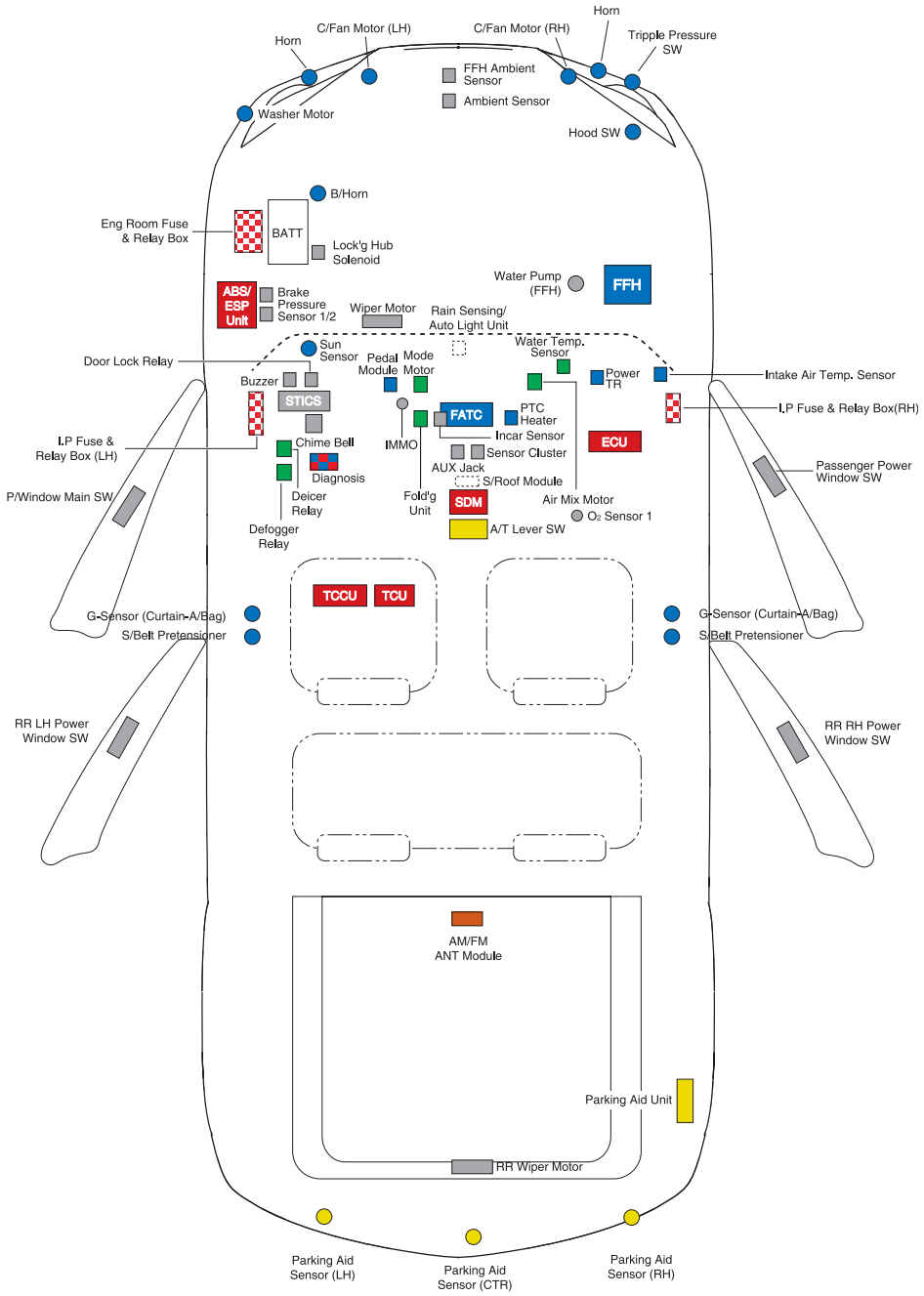
4. ELECTRIC COMPONENTS AND LAYOUT

▶ Wiring Harness Arrangement



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Components Locator



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. DIAGNOSTIC CONNECTOR

▶ Pin Arrangement of Diagnostic Connector

It is installed under the instrument panel and consists of 16 pins.

The REKES key coding should be performed with Scan-100.





▶ Functions of Terminal

Pin no. 1	FFH diagnosis
Pin no. 2	FFH forced driving
Pin no. 3	STICS
Pin no. 4	Ground
Pin no. 5	Signal ground
Pin no. 6	CAN - HIGH
Pin no. 7	Engine ECU
Pin no. 8	ABS / ESP
Pin no. 9	Air bag
Pin no. 10	-
Pin no. 11	TCU
Pin no. 12	-
Pin no. 13	TCCU
Pin no. 14	CAN - LOW
Pin no. 15	REKES coding
Pin no. 16	Battery +

FUSES AND RELAYS

There are three fuse and relay boxes in this vehicle (one at each side of instrument panel and one in engine compartment). The designation and capacity of relays and fuses is shown on the fuse and relay box cover.

1. FUSE AND RELAY BOX IN ENGINE COMPARTMENT



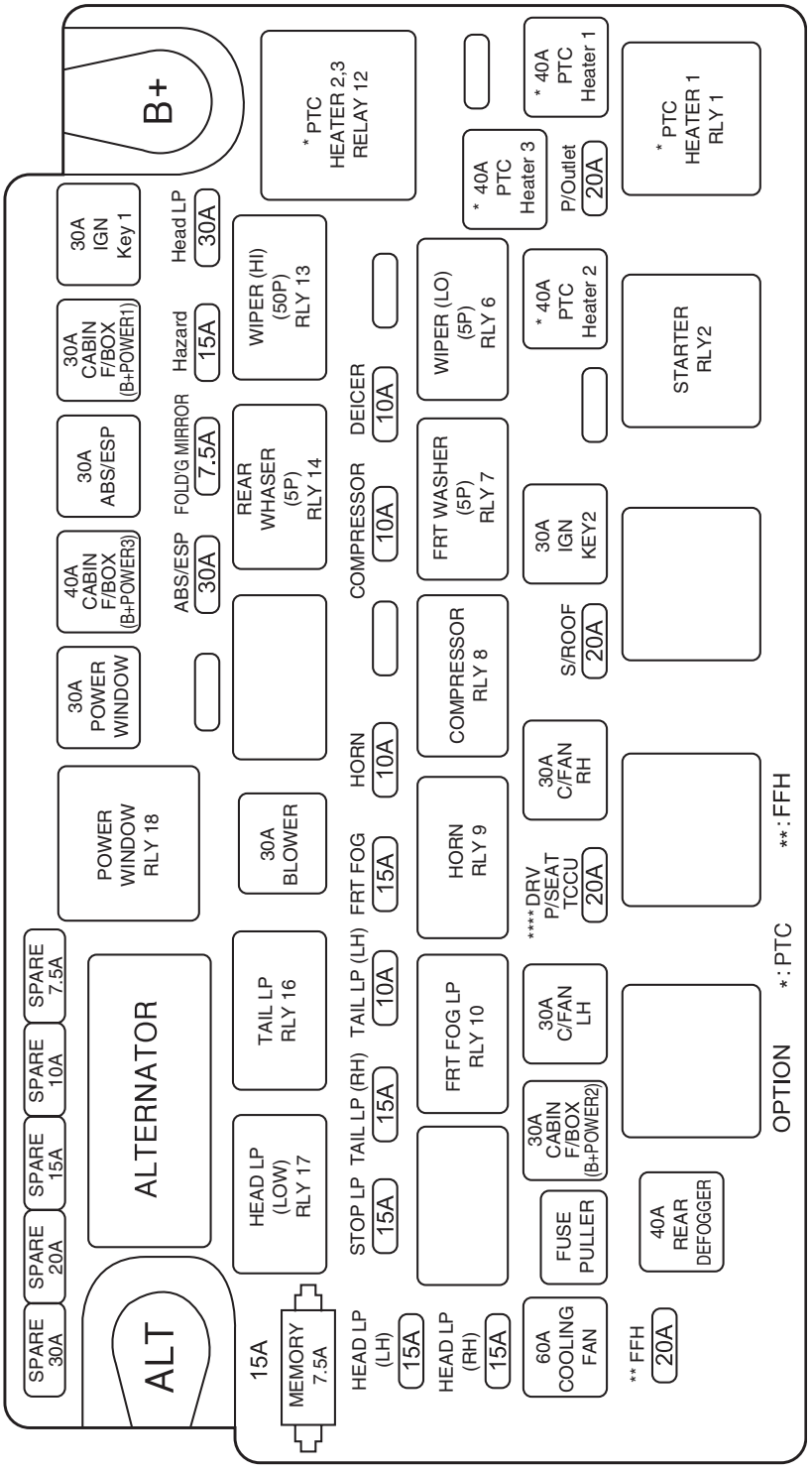
Fuses and Relays



Connector Arrangement



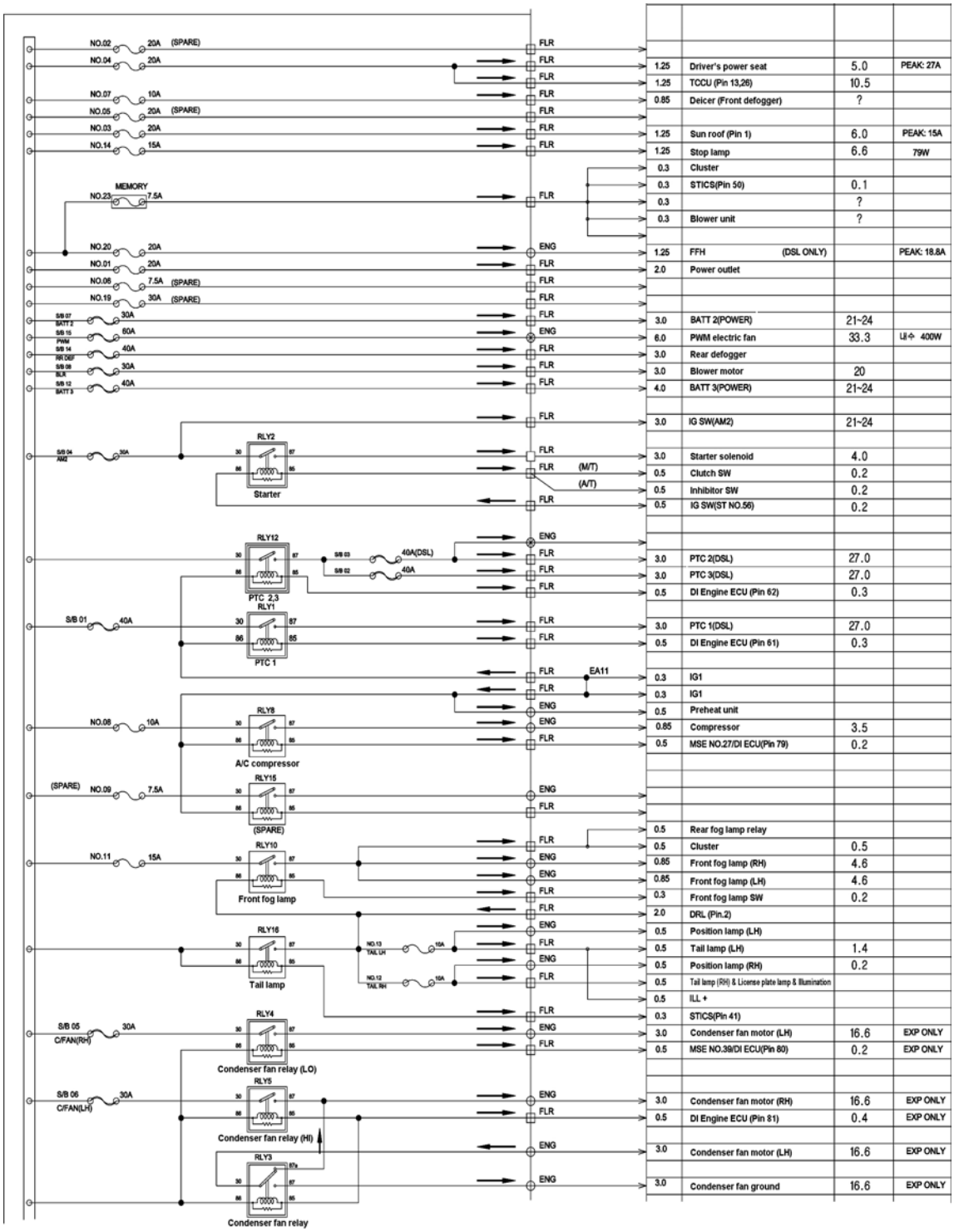
▶ Fuses and Relays in Engine Compartment



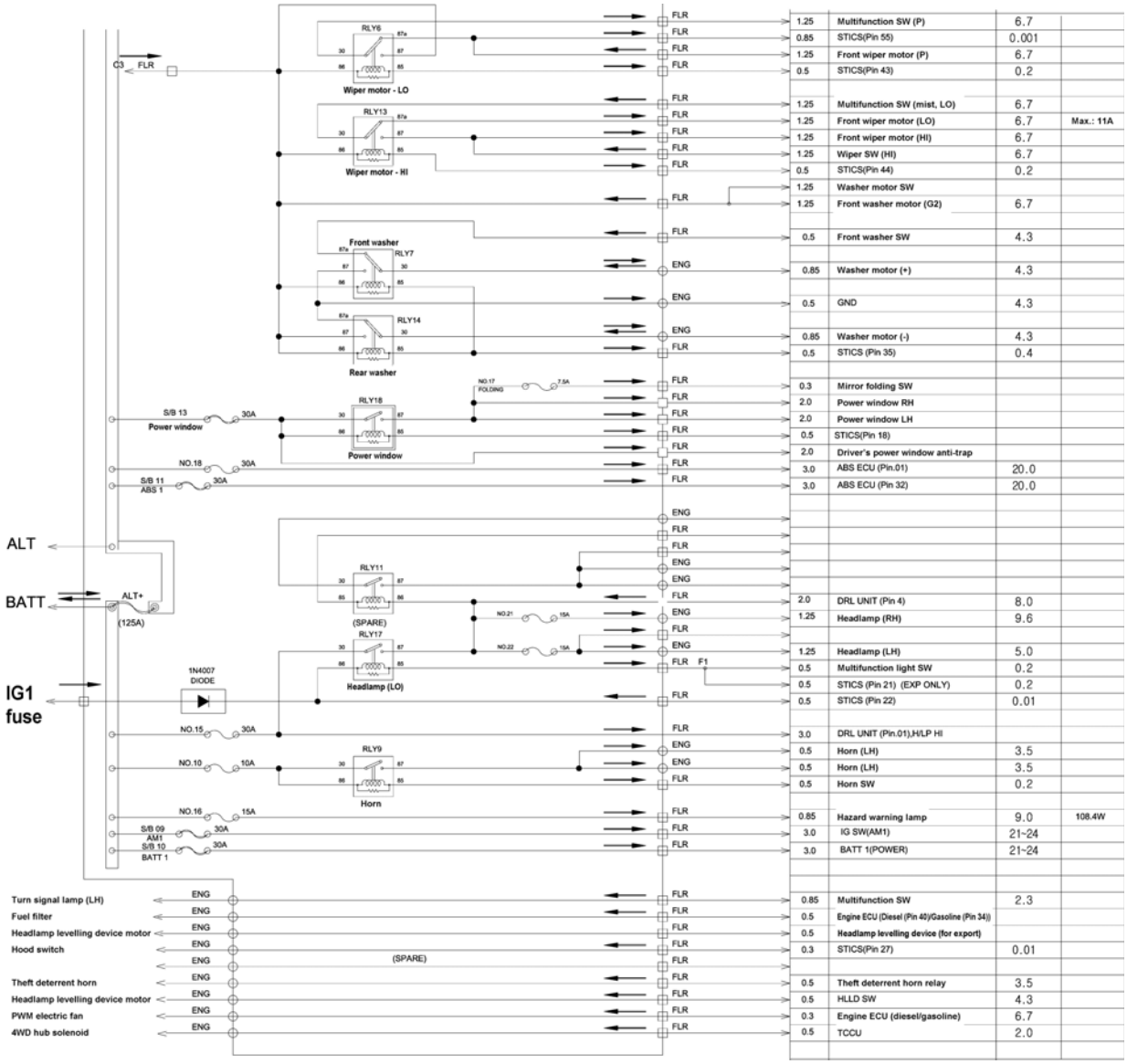
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EFFECTIVE DATE	
AFFECTED VIN	

▶ Power Distribution

For details, refer to the electric circuit diagram.



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EFFECTIVE DATE	
AFFECTED VIN	



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Removal and Installation

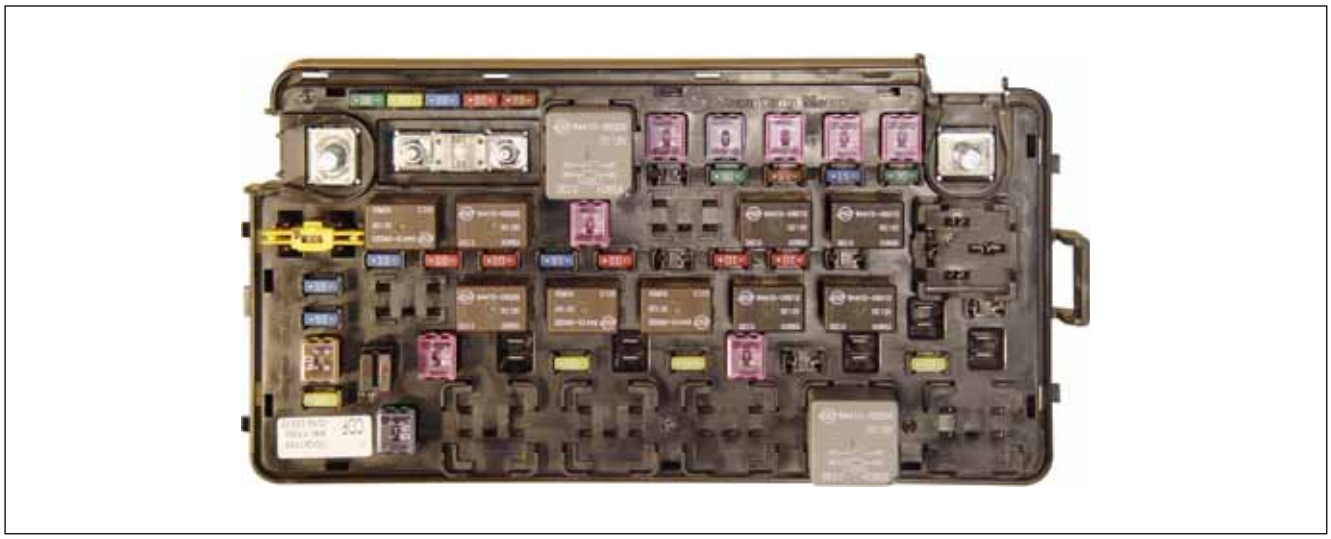
1. Disconnect the negative battery cable, open the fuse and relay box cover in engine compartment, and unscrew the mounting nuts.



2. Lift the fuse and relay box assembly and disconnect connectors behind the assembly.



3. Remove the fuse and relay box assembly.



2. INTERIOR FUSES AND RELAYS



Fuse and Relay Box (LH)





Fuse and Relay Box (RH)

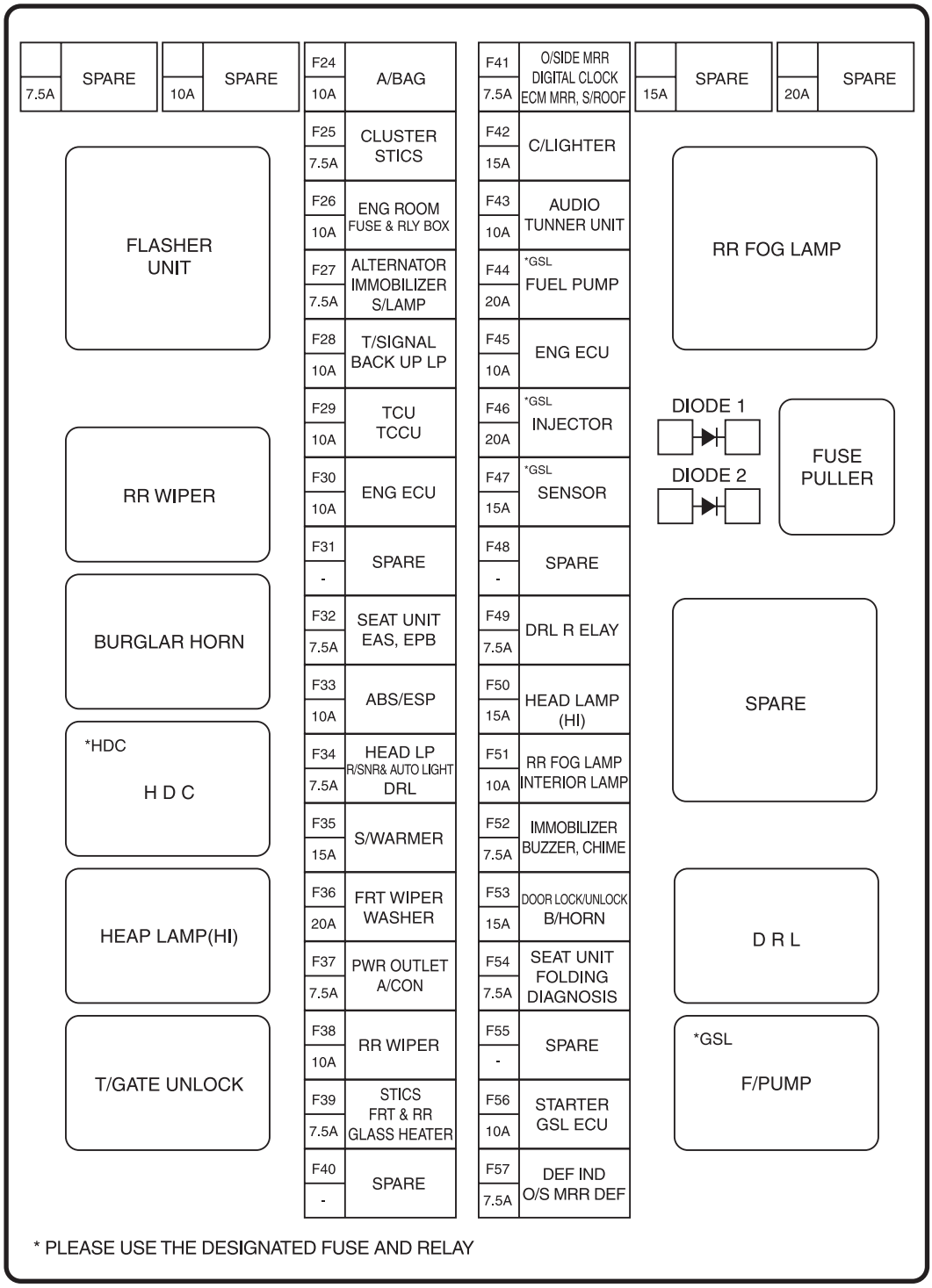




CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

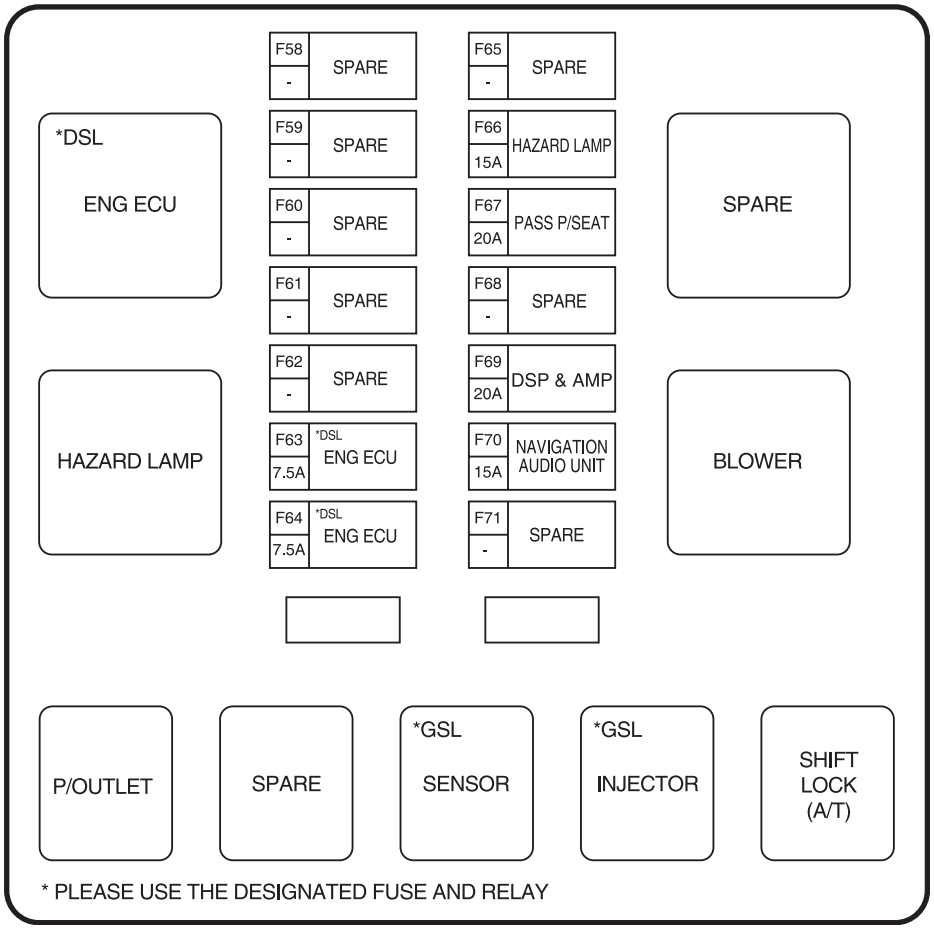
▶ Designation and Capacity

Driver Side



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Passenger Side



*** Engine ECU main relay**

This supplies the power to the engine ECU, turbocharger, EGR valve vacuum modulator, HP pump IMV and HFM.

*** No. 63 fuse (7.5A)**

This is marked as the engine ECU fuse. However, this receives the power from the main relay and supplies it to the turbocharger EGR vacuum modulator and HFM.

*** No. 64 fuse (7.5A)**

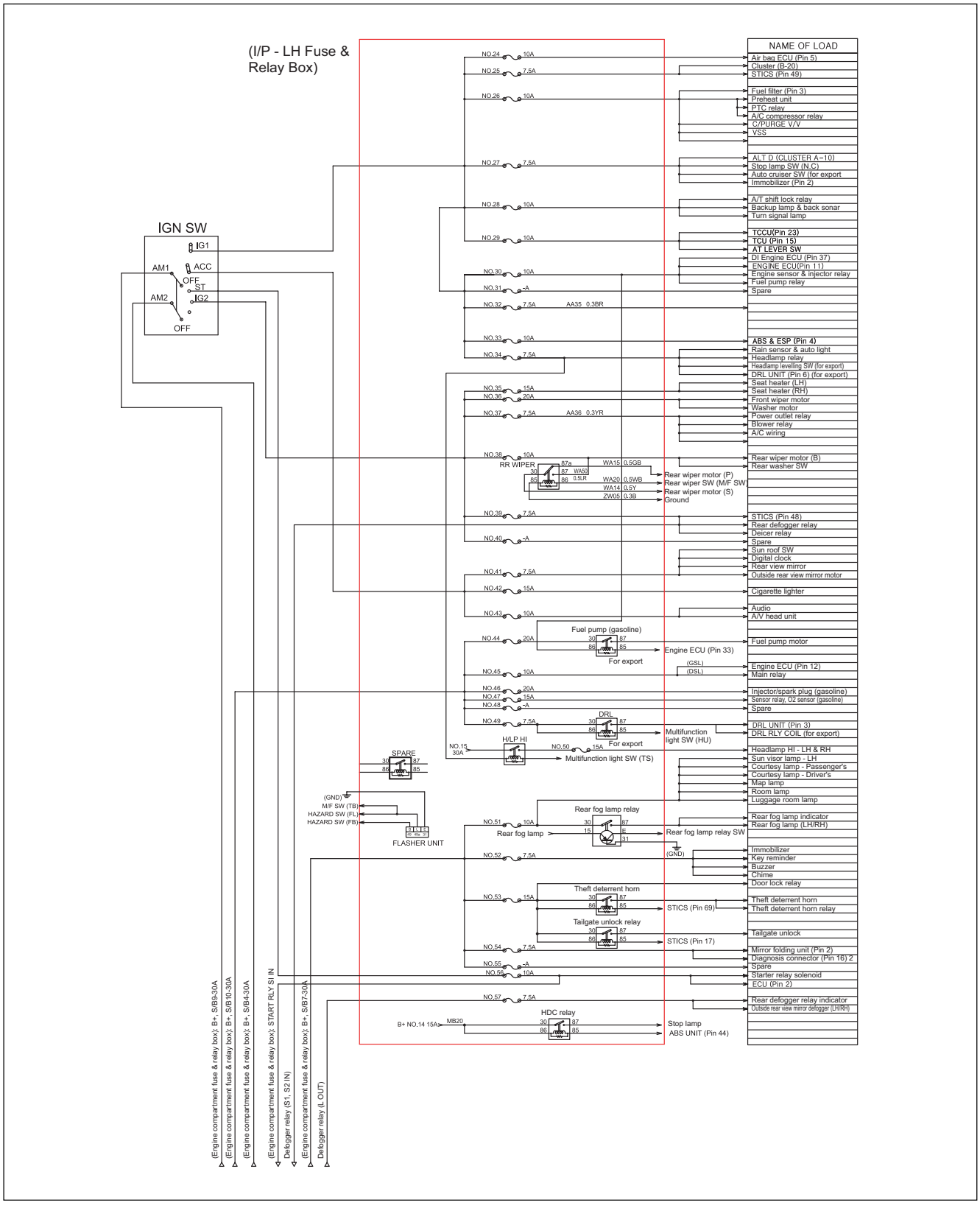
This supplies the power to the HP pump IMV. If this is blown out, IMV opens fully, so too many fuel is delivered.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Power Distribution of Interior Fuse

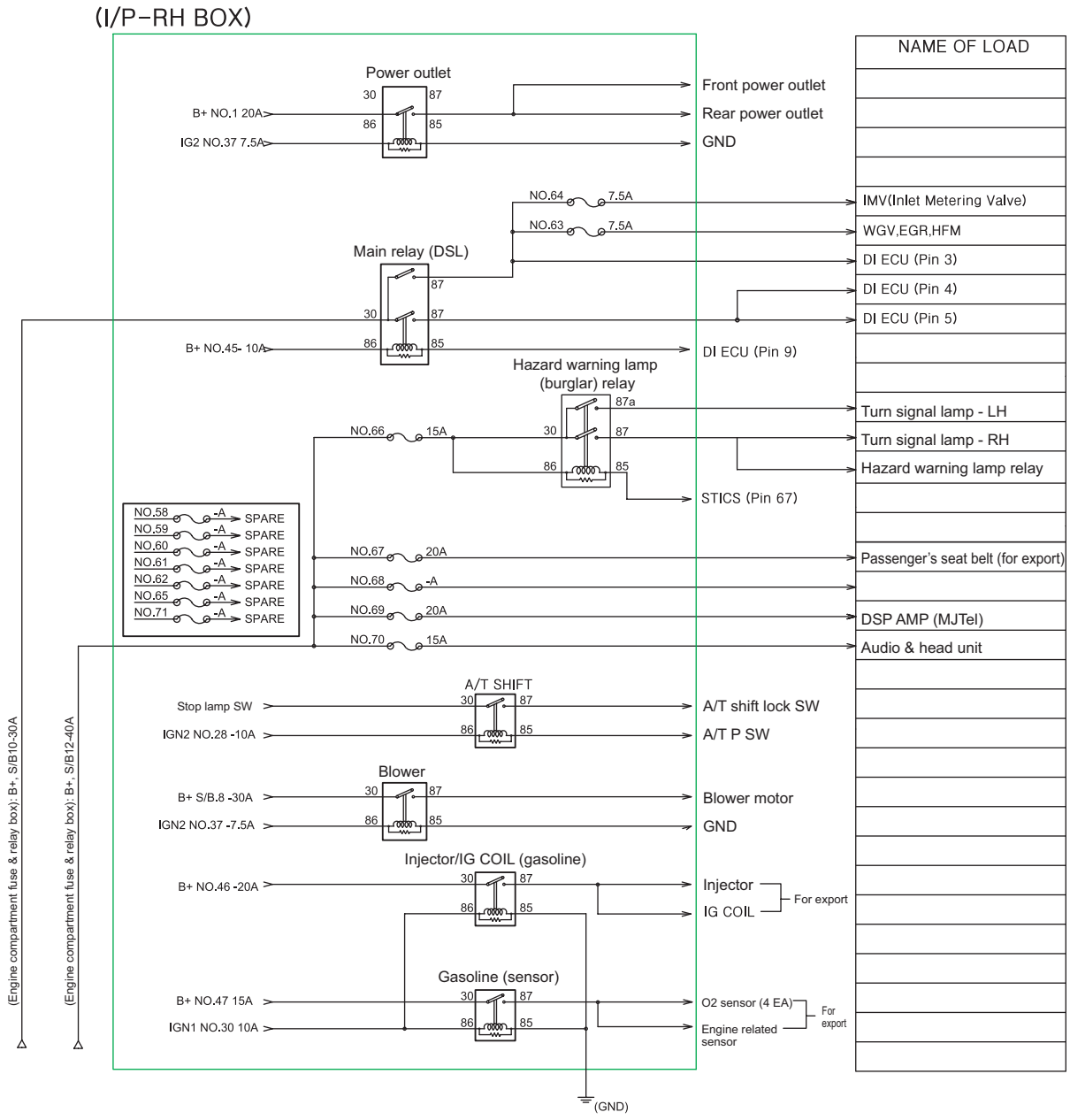
For details, refer to the electric circuit diagram.

IP - Interior Fuse (Driver Side)



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EFFECTIVE DATE	
AFFECTED VIN	

IP - Interior Fuse (Passenger Side)



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Check for Battery Discharge and Dark Current

Dark current means the small leakage of the current. The electric energy of the battery gets lost as the battery is left for an extended period of time even though the system is not operated (no current used). This means that the battery is discharged even while the vehicle is parked.

It is similar to the household voltameter which keeps running even though no electric home appliances are used. This is also because of the dark current and it is recommended to keep the plug off the outlet when the home appliances are not used.

Dark current always exists in the vehicle since there are a lot of electric parts in the vehicle system and units, sensors and wirings are interconnected. The battery is discharged by supplying the voltage to the connected wirings or it is self-discharged. Especially, there are some systems that use or need power even when the ignition key is off the key cylinder, such as ECUs, clock, audio system, etc.

For battery discharge, verify the cause according to the following procedure.

1. Vehicle stoppage time (parking time) and vehicle condition

It checks the battery's performance according to the self-discharge and aging.

Check for the engagement, corrosion and cleaness of the battery terminals. Also, check for water intrusion and short circuit in the vehicle and check if the engine compartment is washed.

2. Operating condition of interior lamps and other lamps

If there is malfunction in the lamp switch of the glove box, the lamp may light on even when the glove box is closed. The power may still be supplied to the lamp even though it doesn't light on due to the malfunction of other switches.

3. Fuse box (engine compartment and other interior fuse and relay box)

Visually check for the discoloration, deformation and foreign material of fuse and relay. Also check if some fuses or relays are hotter than others.

4. Check for power cable and wiring in engine compartment

Visually check for connection, deformation or discoloration of ground wire and high voltage wires (wires for battery, alternator, etc.) in the engine compartment.

NOTE

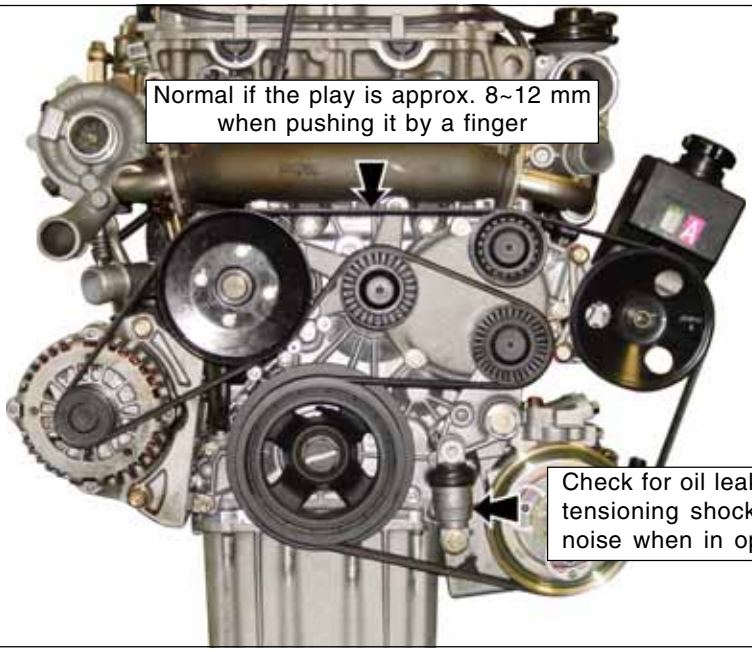
The reason for checking the deformation and discoloration is that the resistance may be higher than the specified value due to the malfunction, poor engagement or foreign material of the system. The higher the resistance is, the more heat is generated. The amount of heat is proportional to the square root of current value, resistance value and time.

5. Check for charging status of alternator if no failure is found in 1~4 steps

If the charging status of the alternator is poor, the battery's peformance becomes poor even when the battery and the vehicle system are normal. Also, the charging status becomes poor if the belt tension of the alternator is low.

Check for the belt tension and the charging voltage of the alternator according to the following procedures.

Belt Tension



The charging voltage of the alternator is approx. 13.5 ~ 14.5 V while the A/C and headlamp are in operation with the engine speed of 2000 ~ 2500 rpm and it is normally approx. 1 ~ 2 V higher than the battery voltage. If the voltage of the battery terminal is measured right after measuring the charging voltage of the alternator, the battery voltage may be measured higher than the normal voltage due to the residual voltage in the alternator. To measure the correct voltage of the battery, measure it in 0.5 ~ 1 hour after removing the key.

6. Check for dark current if no failure is found in 1~5 steps

Measurement of discharged voltage (Refer to the attached figures)

1) Prepare the multimeter, 10 mm spanner and wire for multimeter (approx. 20 cm).
2) Put the multimeter (10 A range) in place.
3) Disconnect the negative battery cable and connect the series wire to the negative battery terminal.
4) Connect the other end of wire to the block probe of the multimeter.
5) Engage negative battery cable to the negative battery terminal.
6) Turn the key to the “ON” position to supply power to units.
7) Turn the key to the “OFF” position and check if the part from B+ is OFF (interior lamp, glove box lamp, etc.).
8) **Lock all doors and press the door lock button on the remote controller with the hood switch connector disconnected or pressed.**
9) **A “beep” sound is heard and the anti-theft alarm is activated.**
10) Remove the negative battery cable (the multimeter is switched to series connection).
11) **Measure the current (A) in approx. 90 seconds.**
12) It is normal if the measured value is less than 0.04 A (approx. 40 mA).
13) If the measured value is not within the specified value, check for fluctuation while disconnecting each fuse in interior fuse box and engine compartment's fuse box.
14) If there is fluctuation, check the wire of that part (unit, relay) and connector. Replace it if necessary.

Details



Wire for series connection

Connect the multimeter in series as shown in the figure.



Supply power to the units by turning the key “ON” or starting the engine, turn the key “OFF”, remove the terminal and measure the current (A).

STICS

8710

TABLE OF CONTENTS

RKSTICS (REKES+STICS) / STICS 3

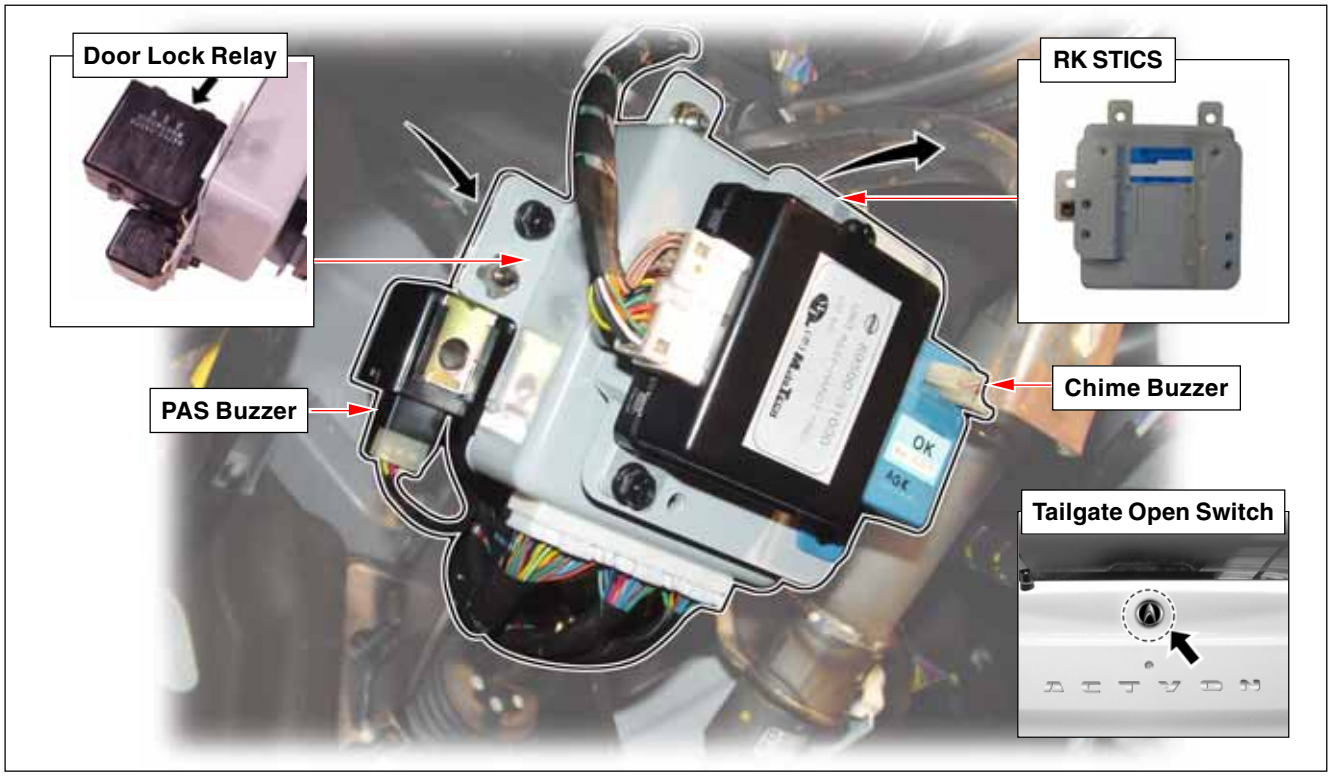
1. Overview 3
2. Major changes 3
3. Circuit diagram 4
4. Specifications 6
5. Functions and specifications 10
6. Diagnosis trouble code and help tips 55

RKSTICS (REKES+STICS) / STICS

1. OVERVIEW

The following function has been a dded to the RK STICS (REKES + STICS (Super Time & Integrated Control System):

The tailgate open switch is installed on the tailgate. It activates the tailgate relay when operating the tailgate open switch.



2. MAJOR CHANGES

▶ Auto Washer Coupled Wiper

When pressing the auto washer switch, the washer fluid is sprayed on the windshield and the wiper sweeps off 4 times, and then the washer fluid is sprayed and the wiper sweeps off 3 times again.

▶ Auto Light Sensor and Rain Sensor

The auto light sensor integrated rain sensor communicates with STICS.

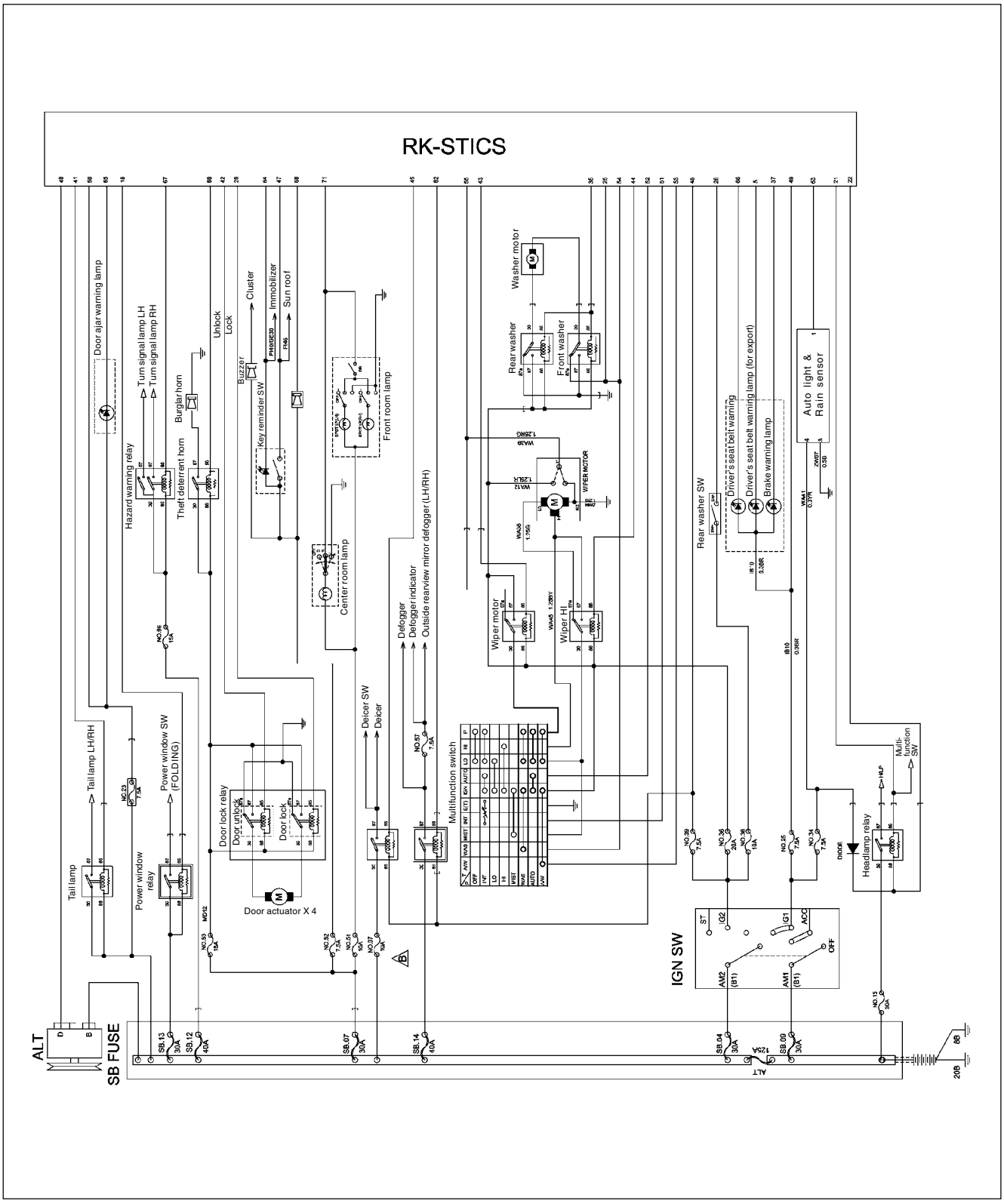
▶ Tailgate Open Relay Control

RK STICS → Tailgate unlock switch (Installed on the tailgate)
RK STICS → Tailgate unlock relay

3. CIRCUIT DIAGRAM

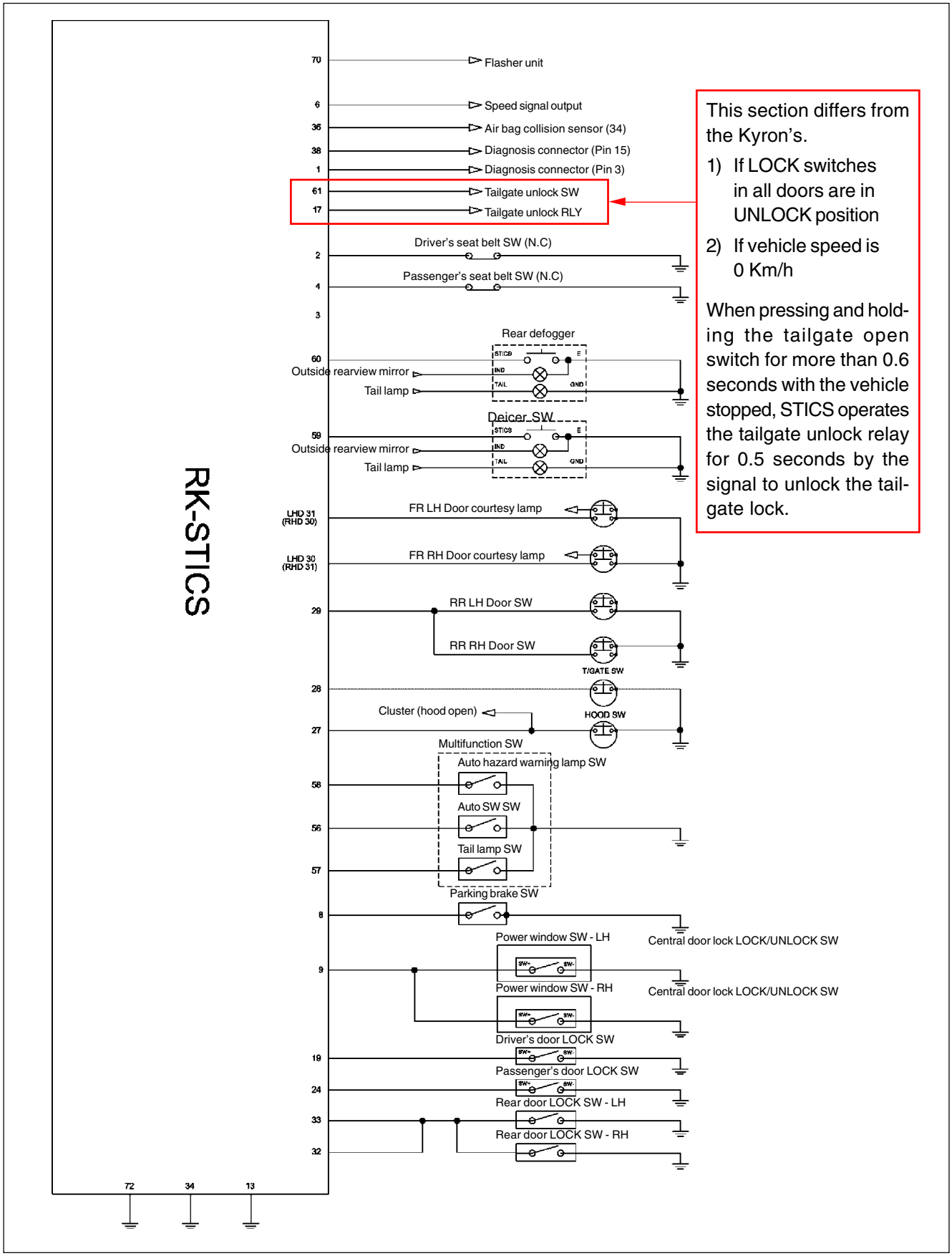
The circuit diagram below shows the input and output of STICS.

▶ STICS Input Singnals and Others



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AFFECTED VIN	

▶ STICS Output Signals and Others



This section differs from the Kyron's.

1) If LOCK switches in all doors are in UNLOCK position
2) If vehicle speed is 0 Km/h

When pressing and holding the tailgate open switch for more than 0.6 seconds with the vehicle stopped, STICS operates the tailgate unlock relay for 0.5 seconds by the signal to unlock the tailgate lock.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. SPECIFICATIONS

▶ Electrical Performance

Electrical Performance

Item	Requirement	Remark
Rated voltage	DC 12.0 V	
Operating voltage	DC 9.0 V ~ 16.0 V	Should operate normally within this range. (9.5 V ~ 16.0 V only for auto hazard lamp function)
Operating temperature	-30°C ~ +80°C	Should operate normally within this range.
Reserved temperature	-40°C ~ +85°C	
Max. operating humidity	95%	
Resistible voltage	24 V	
Insulating resistance	No heat and fire due to the current leaks.	Confined with PCB, waterproof and coating that requires the insulation.
Dark current	below 7.0 mA	When initiating the sleep mode after removing ignition key and locking the doors
Voltage drop	below 1.5 V	Pin no. 72 and 2, 4, 7, 8, 9, 10, 11, 12, 19, 24, 27, 28, 29, 30, 31, 32, 33, 36, 56, 57, 58, 59, 60, 61, 70, 71
	below 1.8 V	Pin no. 72 and 5, 6, 16, 17, 18, 20, 21, 23, 35, 37, 39, 41, 42, 43, 44, 45, 62, 64, 65, 66, 67, 68, 69

Characteristics of Radio Wave

1. Transmitting frequency: 447.800 ± 0.0125 MHz
2. Channel width: below 12.5 KHz
3. Frequency bandwidth: below 8.5 KHz
4. Modulation method: FSK (Frequency Shift Keying)
5 Receiving distance: Approx. 10 ~ 15 m (In case there are not obstacles around the system)

Rated Load

NO.	Description	Rated Load
1	Chime bell / Buzzer	DC 12 V 350 mA (Inductive load)
2	Front Room lamp	DC 12 V 16 W (Lamp load)
3	Rear Room lamp	DC 12 V 8 W (Lamp load)
4	Key hole illumination	DC 12 V 1.2 W (Lamp load)
5	Seat belt warning lamp	DC 12 V 1.2 W (Lamp load)
6	Parking brake warning lamp	DC 12 V 1.2 W (Lamp load)
7	Door ajar warning lamp	DC 12 V 1.2 W (Lamp load)
8	Door lock relay	DC 12 V 200 mA (Inductive load)
9	Door unlock relay	DC 12 V 200 mA (Inductive load)
10	Horn relay	DC 12 V 200 mA (Inductive load)
11	Tail lamp relay	DC 12 V 200 mA (Inductive load)
12	Hazard warning relay	DC 12 V 200 mA (Inductive load)
13	Power window relay	DC 12 V 200 mA (Inductive load)
14	Rear defogger relay	DC 12 V 200 mA (Inductive load)
15	Wiper LOW relay	DC 12 V 250 mA (Inductive load)
16	Wiper HIGH relay	DC 12 V 250 mA (Inductive load)
17	Front washer motor	DC 12 V 1.5 A
18	Rear washer motor relay	DC 12 V 500 mA (Inductive load)
19	Headlamp relay	DC 12 V 750 mA (Inductive load)
20	Front defogger relay	DC 12 V 200 mA (Inductive load)
21	Tailgate open relay	DC 12 V 200 mA (Inductive load)

Input Signals

NO.	Input Signal Name	Logic Status
1	IGN1	ON = BAT (IGN “ON” or “START”)
2	IGN2	ON = BAT (IGN “ON”)
3	ALT_D	ON = BAT equivalent (engine running)
4	Key reminder (door ajar warning switch)	IGN = BAT (Key in)
5	Driver’s door switch	OPEN = GND, CLOSE = OPEN
6	Passenger’s door switch	OPEN = GND, CLOSE = OPEN
7	Rear door switch	– OPEN (one of rear seat) = GND – CLOSE (all rear seats) = OPEN
8	Tailgate switch	OPEN = GND, CLOSE = OPEN
9	Hood switch	OPEN = GND, CLOSE = OPEN
10	Driver’s door lock/unlock switch	LOCK = OPEN, UNLOCK = GND
11	Passenger’s door lock/unlock switch	LOCK = OPEN, UNLOCK = GND
12	Rear door lock/unlock switch	– UNLOCK (one of rear seat) = GND – LOCK (all rear seats) = OPEN
13	Tailgate lock/unlock switch	LOCK = OPEN, UNLOCK = GND
14	Rear defogger switch	ON = GND, OFF = OPEN
15	Seat belt switch	Unfastened = GND, Fastened = OPEN
16	Hazard warning flasher selection switch	ON = GND, OFF = OPEN
17	Parking brake switch	ON = GND, OFF = OPEN
18	Air bag collision sensor	ON = 200 ms output (LOW), OFF = OPEN
19	Wiper motor (parking) switch	STOP = BAT VOLTAGE, ROTATING = GND
20	Washer switch	ON = BAT, OFF = OPEN
21	Intermittent auto switch	ON = BAT, OFF = OPEN
22	Auto washer switch	ON = BAT, OFF = OPEN
23	Intermittent resistance	0W ~ 51 KW (for intermittent wiper)
24	Speed sensor	ON = GND (PWM), OFF = OPEN
25	IDR (Coding)	ON = BAT, OFF = OPEN
26	Front defogger switch	ON = GND, OFF = OPEN
27	Auto hazard switch	ON = GND, OFF = OPEN
28	Central door lock switch	ON = GND, OFF = OPEN
29	Rear washer switch	ON = BAT, OFF = OPEN
30	Multifunction auto light switch	ON = GND, OFF = OPEN
31	Indicator lamp switch	ON = BAT/GND, OFF = OPEN (Approx. 5.1 V ~ 9.2 V)
32	Seat adjustment and switch memory unit	ON = GND (PWM), OFF = OPEN
33	Rain sensor	ON = GND (DATA), OFF = BAT
34	Diagnosis (SCAN-I)	ON = GND (DATA), OFF = BAT (KWP2000)
35	Immobilizer	ON = GND (DATA), OFF = BAT (KWP2000)
36	Tailgate open switch	ON = GND, OFF = OPEN

Chattering of Input Signals

1. Vehicle speed input:

   The vehicle speed is the average value of 4 pulses among 6 pulse inputs regardless of the input for 1.0 second after IGI 1 ON. The time indicated in each function does not include the vehicle speed calculating time.

2. 20 ms target input:

   Wiper motor A/S (parking) terminal

3. 100 ms target input switch

   All switches except wiper motor A/S (parking) terminal

Time Tolerance

1. If not indicated, time tolerance will be ± 10%.

   However, if less than 500 ms, time tolerance will be ± 100 ms.

2. The time indicated in each function does not include chattering processing time from switch input changing point.

5. FUNCTIONS AND SPECIFICATIONS

Wiper and Washer Operations

Front wiper operation

MIST

When pulling up the lever, the wiper operates once and the wiper lever returns to the "OFF" position.

OFF

Stop the operation.

AUTO

Operates automatically according to the vehicle speed or the amount of rain.

LO

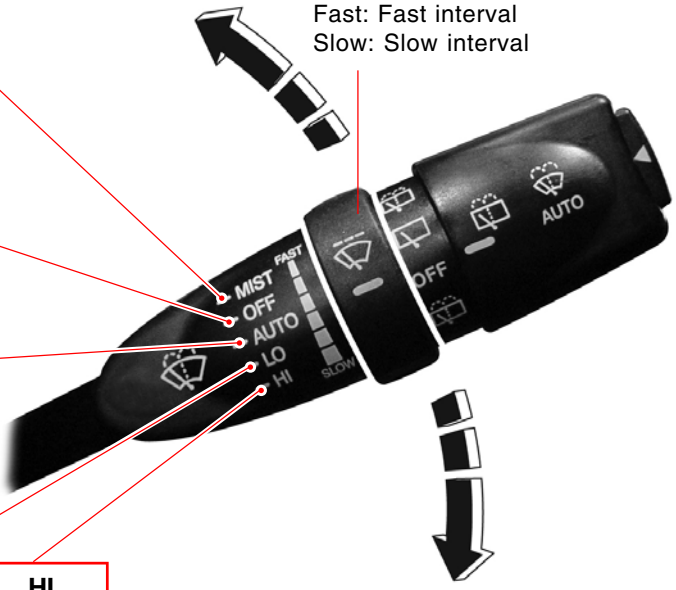
Continuous wipe, slow operation.

HI

Continuous wipe, fast operation

Front Automatic Wiping Speed Control Switch

The interval of wiper swings can be adjusted by twisting the control knob upward or downward when the windshield wiper switch is in the AUTO position.
Fast: Fast interval
Slow: Slow interval



Front Auto Washer and Wiper Switch

When pressing the auto washer switch with the wiper switch "OFF", the washer fluid is sprayed on the windshield and the wiper sweeps off 4 times, after then the washer fluid is sprayed and the wiper sweeps off 3 times again.

Rear Washer and Wiper

The rear washer and the wiper operate only while holding the switch. When releasing the switch, it returns to the rear wiper operate position.

Rear Wiper Operation



Wiper and Washer Coupled Operation

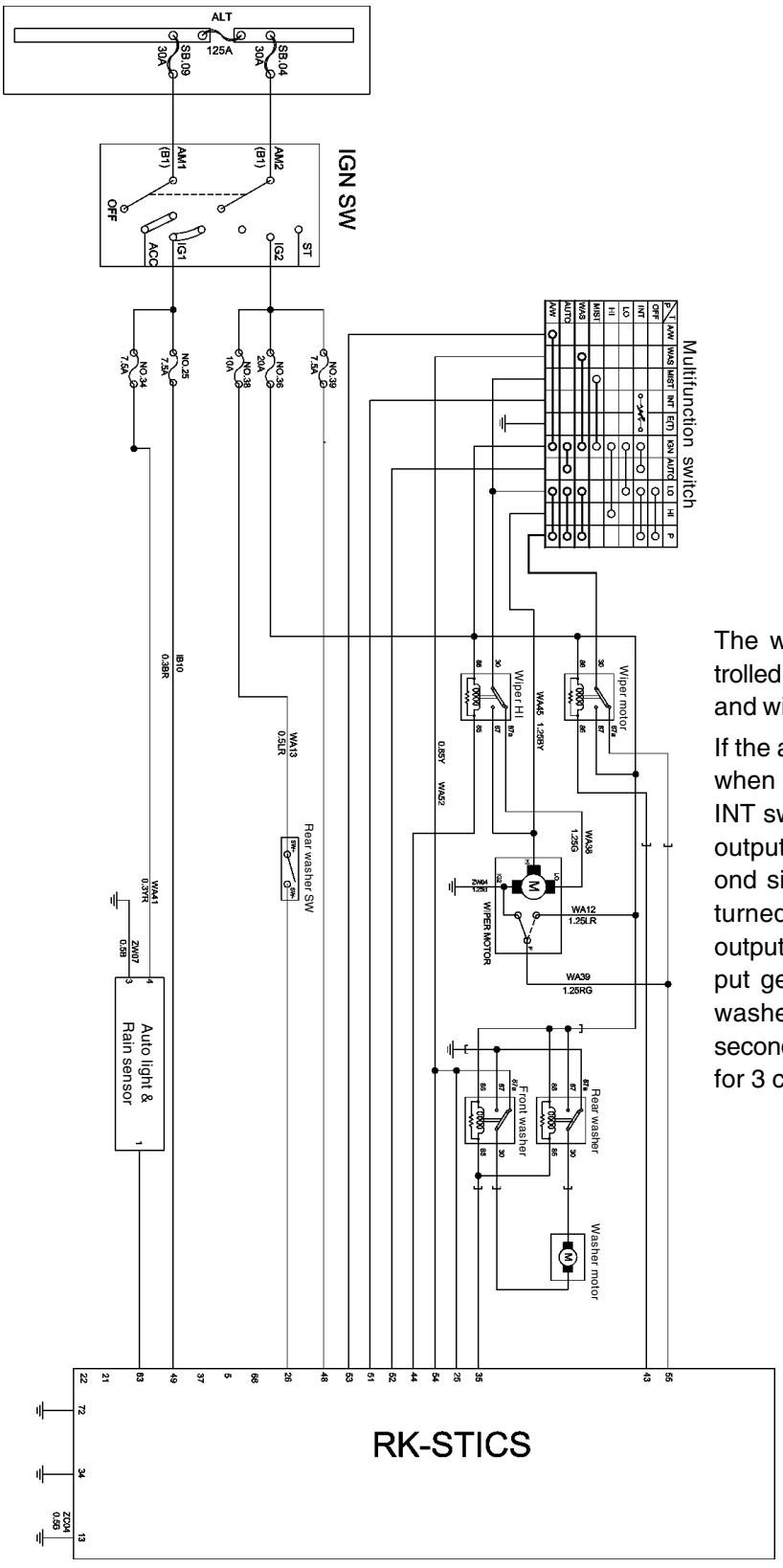
Pull the lever briefly (below 0.6 seconds): One wiping cycle
Pull and hold the lever for more than 0.6 seconds: Three wiping cycles with washer spray

Rear Wiper Stops

Rear Washer and Wiper

The rear washer and the wiper operate only while holding the switch. When releasing the switch, it returns to "OFF" position.

Circuit Diagram of Wiper



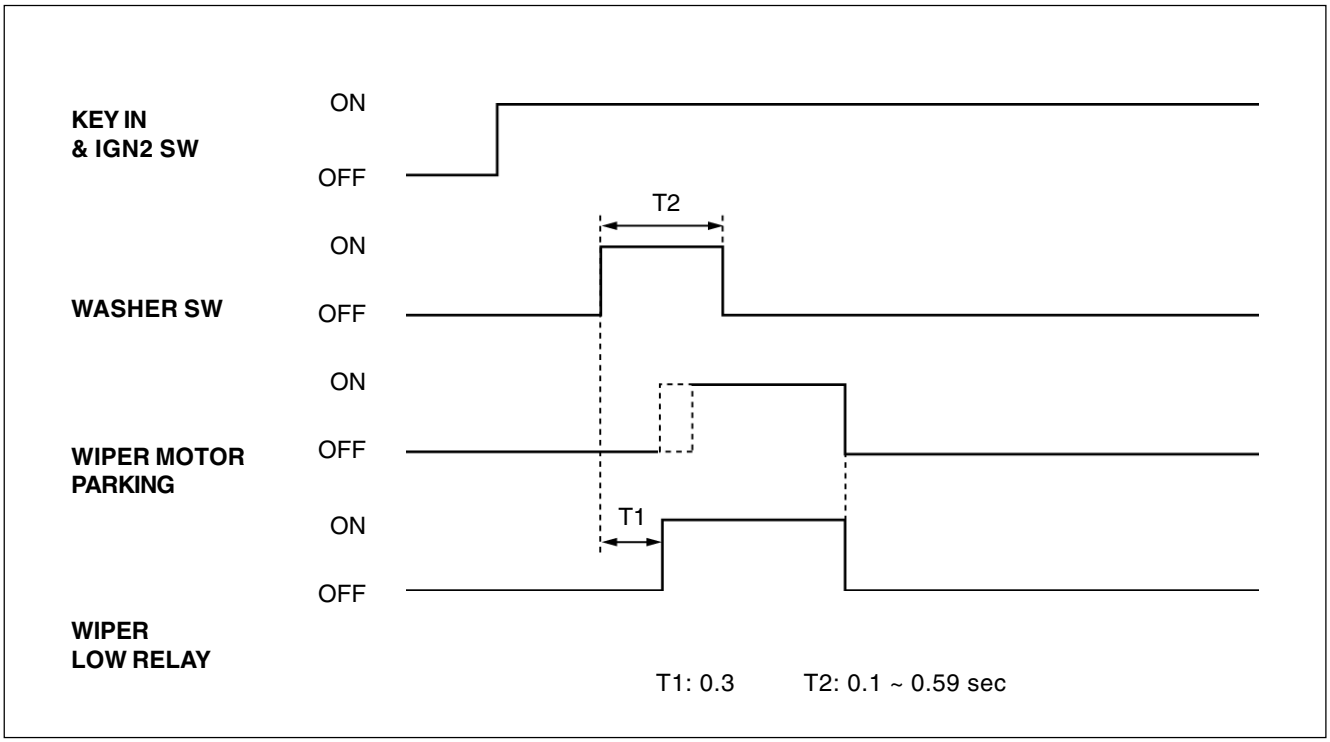
The wiper and washer system controlled by STICS has automatic washer and wiper operation system (AFW).

If the auto washer switch is turned on when the ignition key is ON and the INT switch is OFF, the washer motor output gets ON for approx. one second since the auto washer switch is turned on. When the washer motor output is detected, the wiper relay output gets ON for 4 cycles. Then, the washer motor output gets ON for 1 second, the wiper relay output gets ON for 3 cycles and gets OFF.

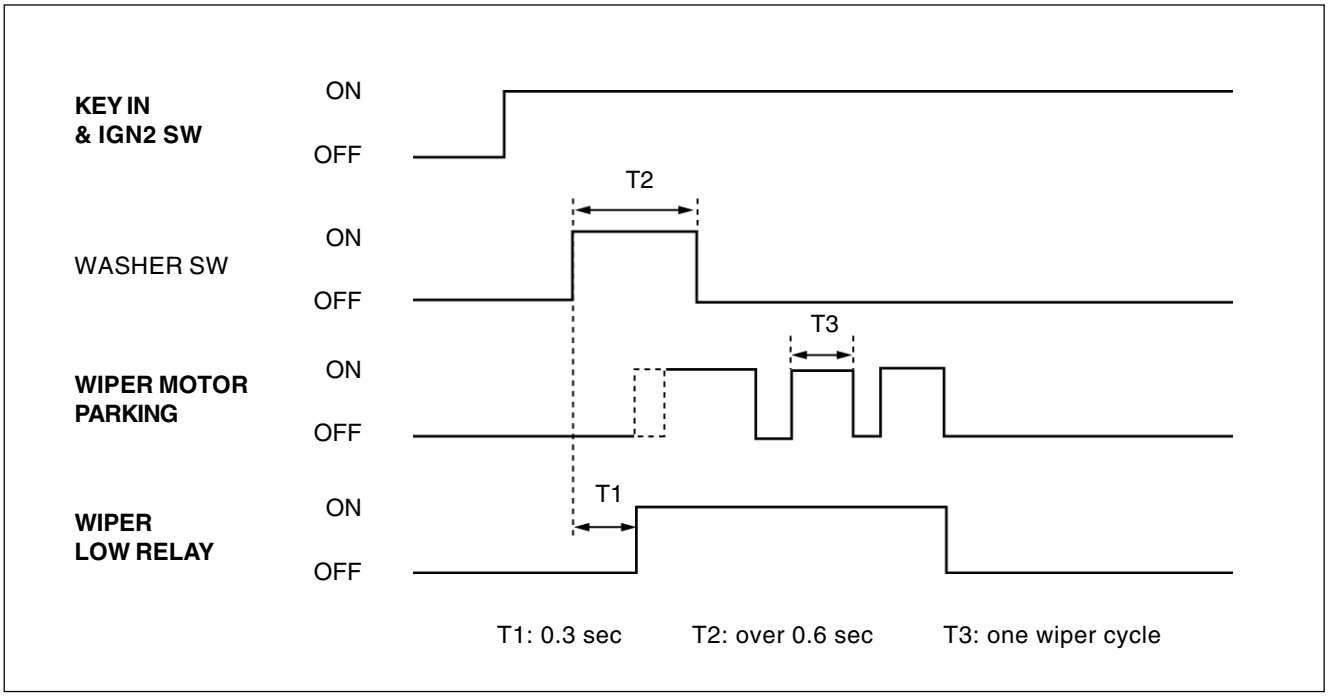
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Wiper MIST and Front Washer Coupled Wiper

1. The wiper relay is turned on at 0.3 seconds after from the time when the washer switch is turned on for 0.1 to 0.59 seconds (T2) with the ignition switch “ON”, . If the wiper parking terminal gets off, the wiper relay is turned off.

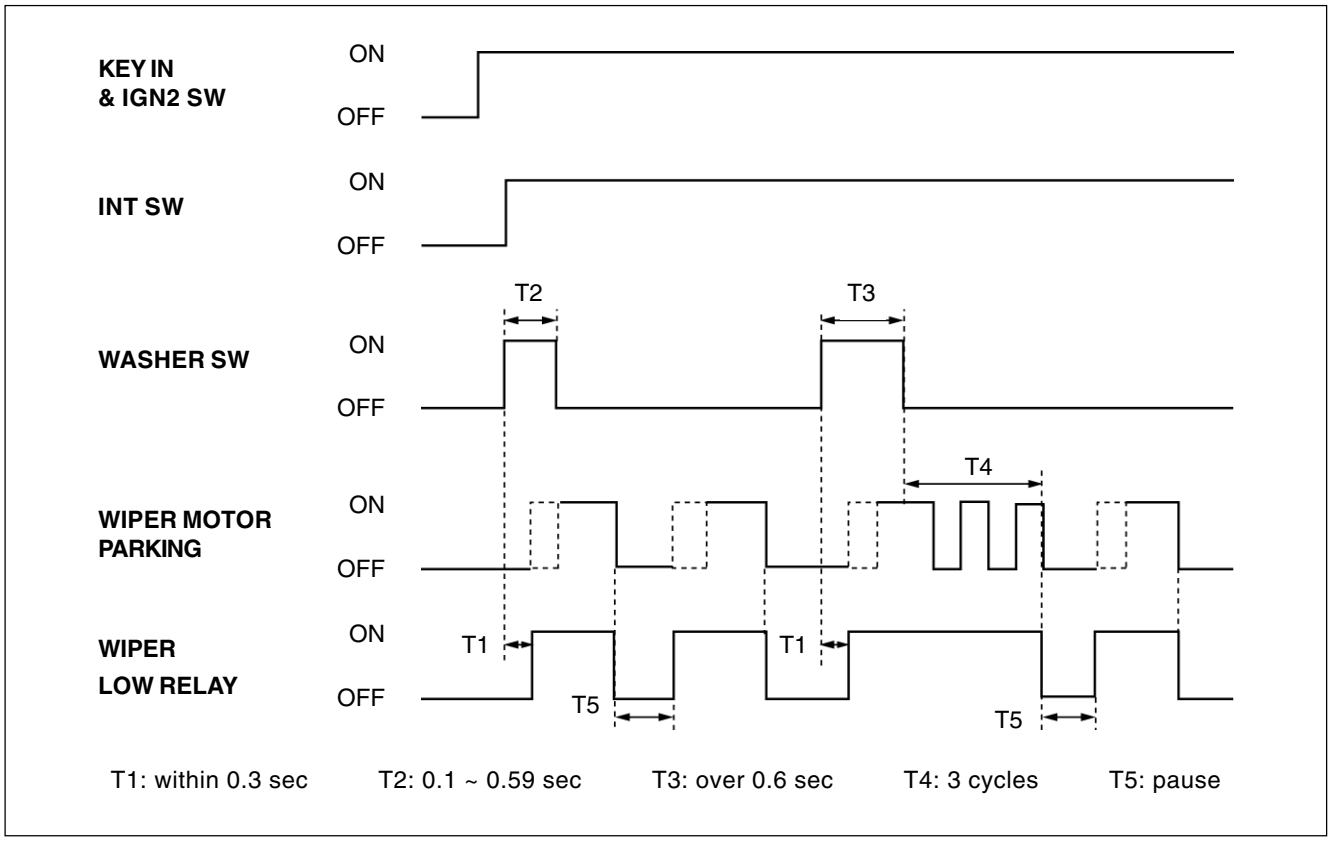


2. The wiper relay is turned on at 0.3 seconds (T1) after from the time when the washer switch is turned on for more than 0.6 seconds (T2) with the ignition switch “ON”. The wiper relay gets on 3 times immediately after turning off the washer switch.



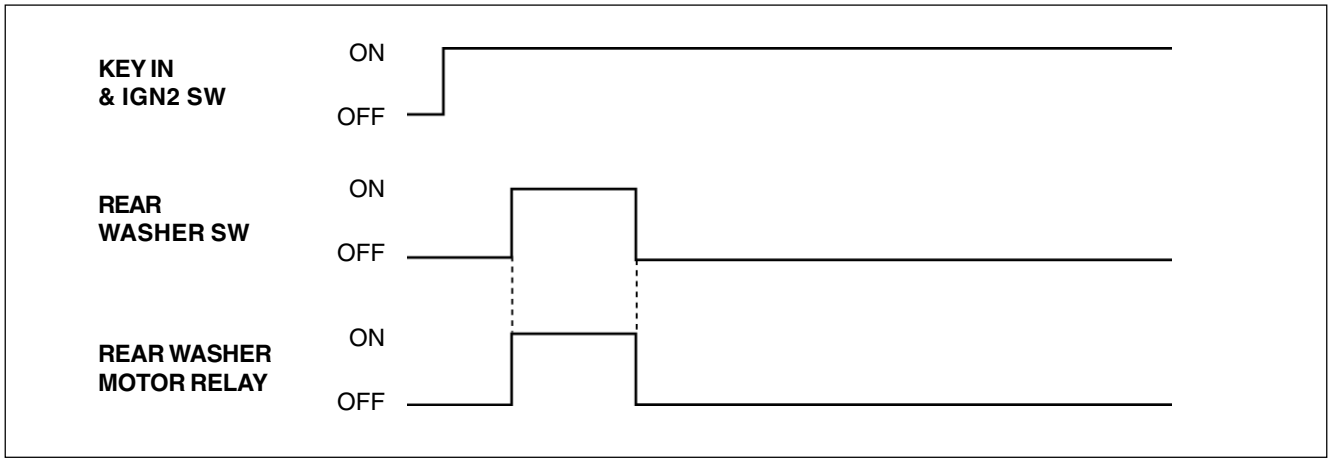
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3. When the washer switch is turned on for more than 0.6 seconds during the wiper operation by INT switch, the operation in step (2) is performed. When it is turned on for a certain period of time (0.1 to 0.59 seconds), the operation in step (1) is performed.



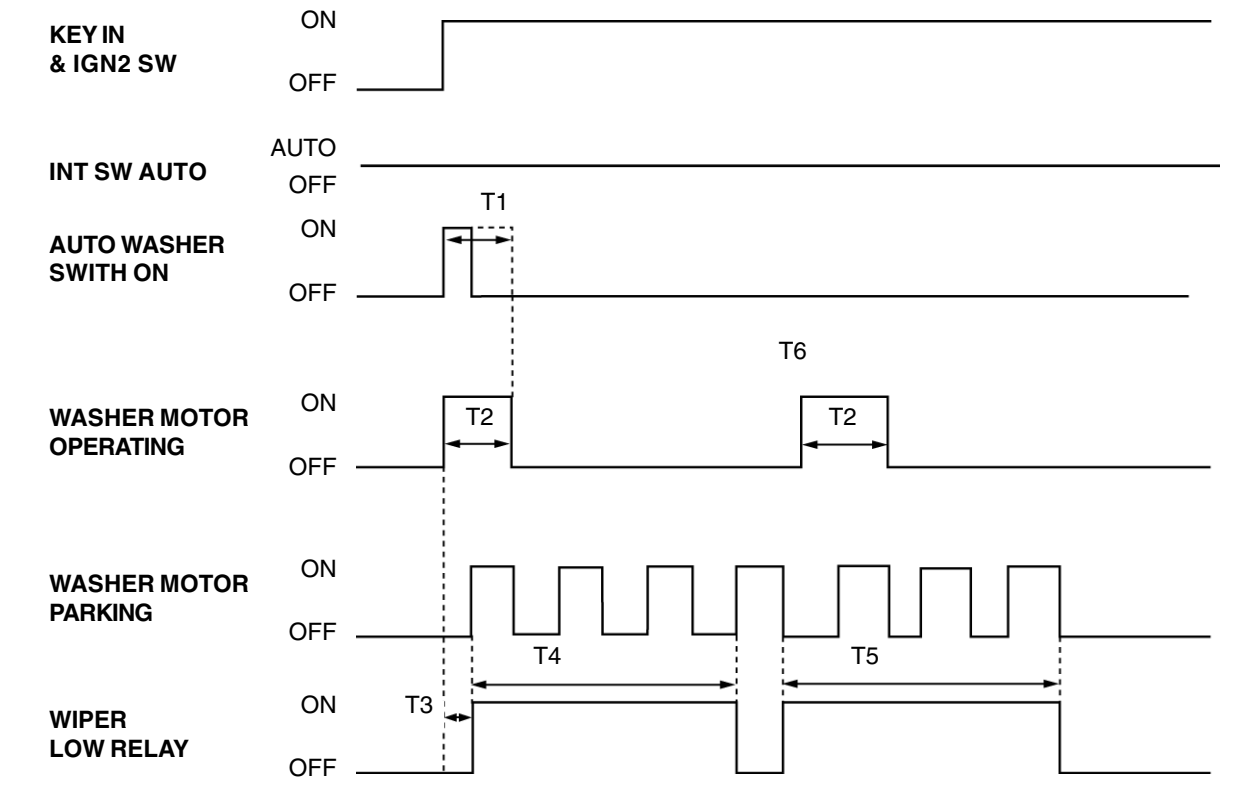
Rear Washer Motor Control

1. When the rear washer switch is turned on with the ignition switch “ON”, the rear washer motor relay output gets ON from the time when the rear washer switch is turned on. It gets OFF when the rear washer switch is turned off.
2. This control is not available while the front washer switch or the auto washer and wiper (AFW: Advanced Fast Washer) is in operation.



Auto Washer and Wiper Switch (AFW)

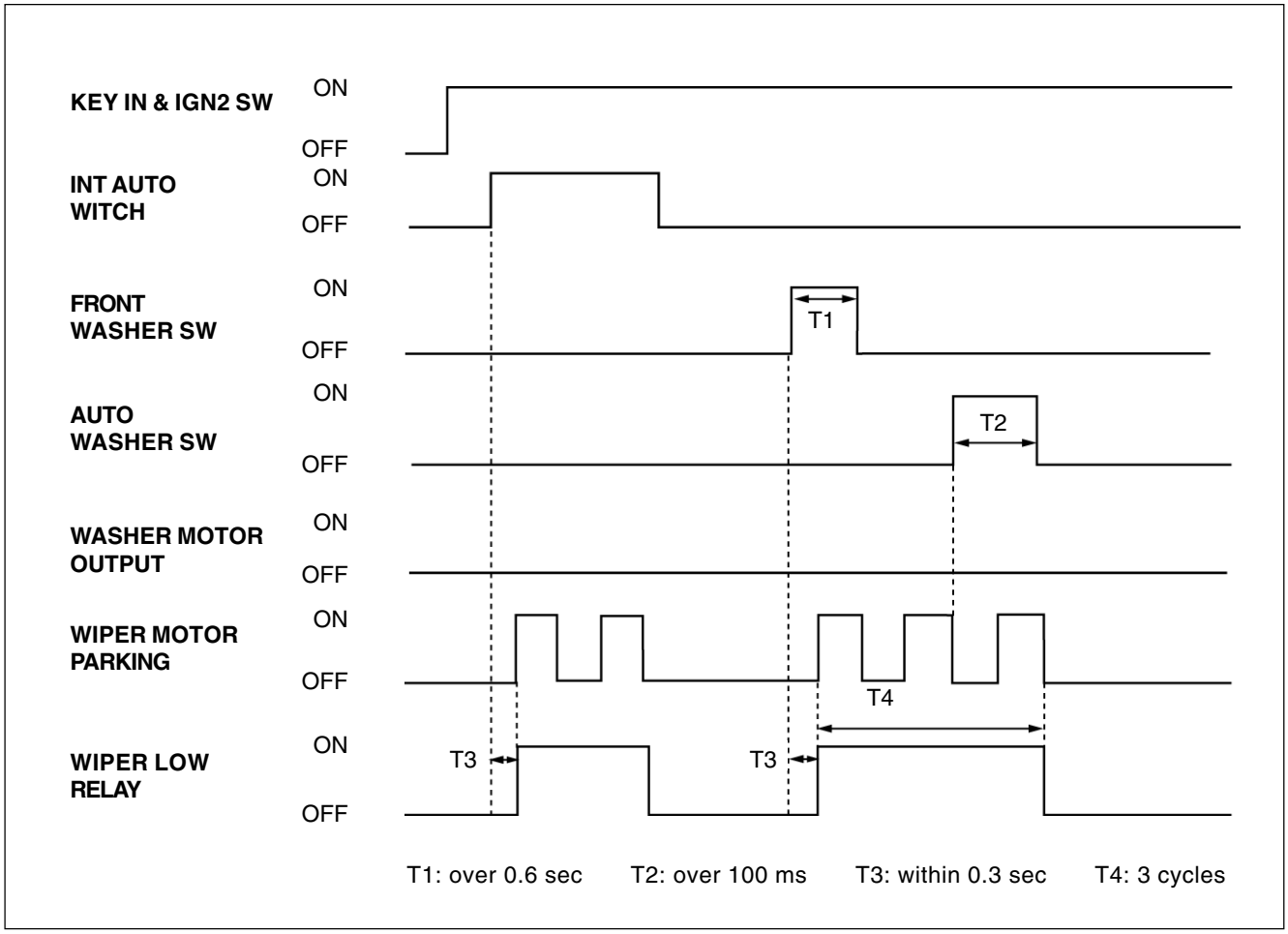
1. When the auto washer switch is turned on with the ignition switch “ON” and the INT switch “OFF”, the washer motor output gets ON for 1 second. If the system recognizes the output signal, the wiper relay output gets ON during 4 cycles and the washer motor output gets ON for 1 second. Then, the wiper relay output gets OFF after 3 cycles.



T1: over 100 ms T2: 1.0 ± 0.1 sec T3: within 0.3 sec T4: 4 cycles T5: 3 cycles T6: 0.5 ± 0.1 sec

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EFFECTIVE DATE	
AFFECTED VIN	

2. The auto washer switch output is overridden during the washer coupled wiper operation.
3. The auto washer switch input is overridden during the auto washer coupled wiper operation.
4. The auto washer switch input is overridden during the rain sensor coupled wiper or vehicle speed sensitive INT wiper operation.
5. When the auto INT switch input is received during the auto washer operation, the auto washer operation stops and the auto INT operation is activated.



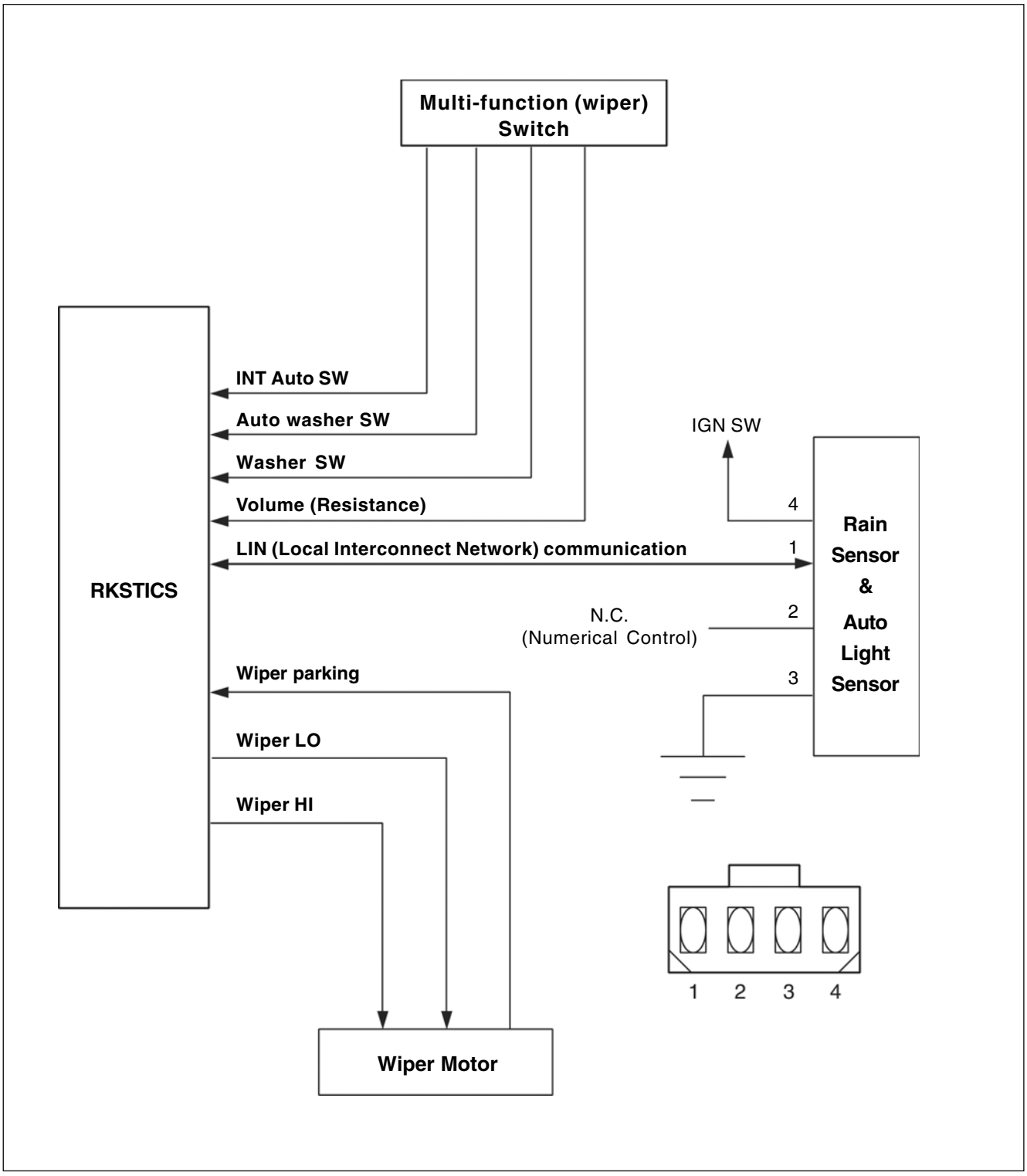
Priorities in Washer Operations

1. The rear washer switch input is overridden during the front washer operation.
2. The rear washer switch input is overridden during the auto washer and wiper (AFW) operation.
3. The front washer switch input is overridden during the rear washer operation.
4. The auto washer switch input is overridden during the rear washer operation.
5. The front washer switch input is overridden during the auto washer and wiper (AFW) operation.
6. The auto washer switch input is overridden during the front washer operation.

Rain Sensor Coupled Wiper and Auto Light Control

If equipped with RKSTICS rain sensor, it has following operation system.

System layout

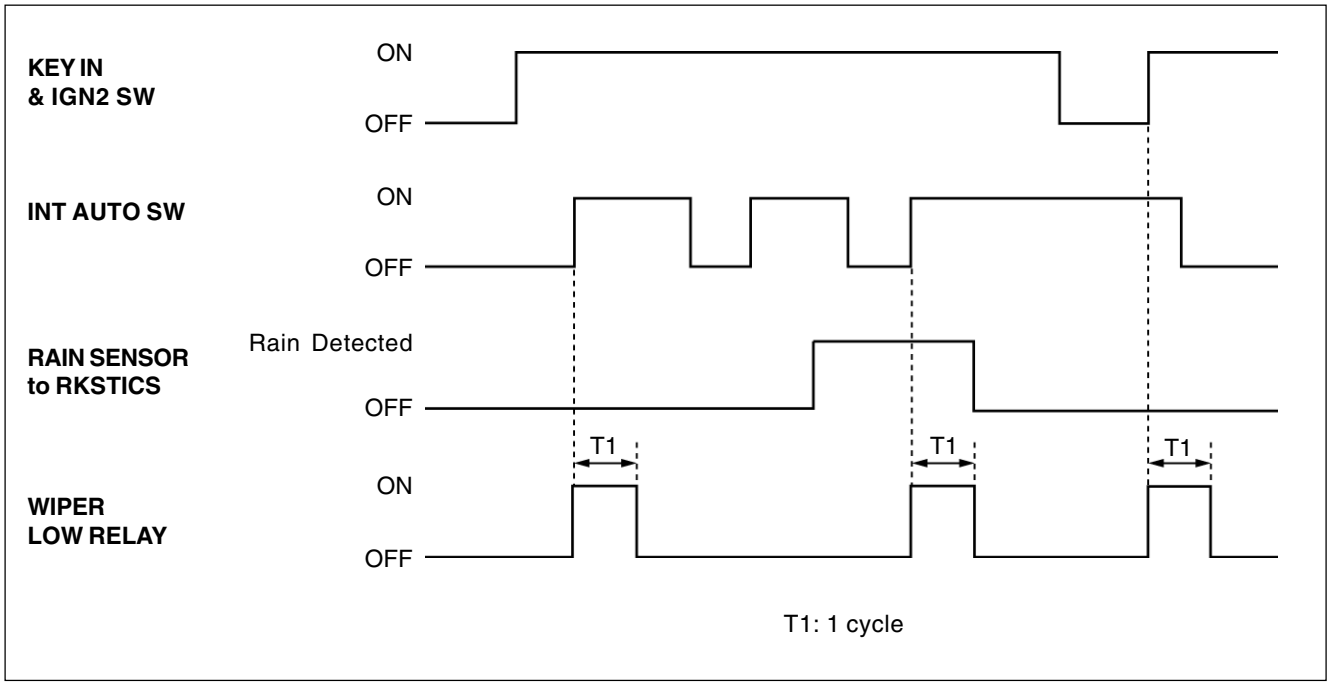


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INT Switch Auto Position Reminder (Power-Up Reminder Wiper)

1. When turning off and on the auto INT switch, the system drives the wiper motor through LOW relay regardless of communication with rain sensor.
2. The wiper relay (LOW) is turned on and the wiper motor runs one cycle when changing the wiper switch to “AUTO” position from any other positions (while the ignition key is in the “ON” position).

   When the wiper switch is turned to the “ON” position again from other positions, the system drives the wiper motor through LOW relay one cycle only when the rain sensor detects the “Rain Detected” signal.

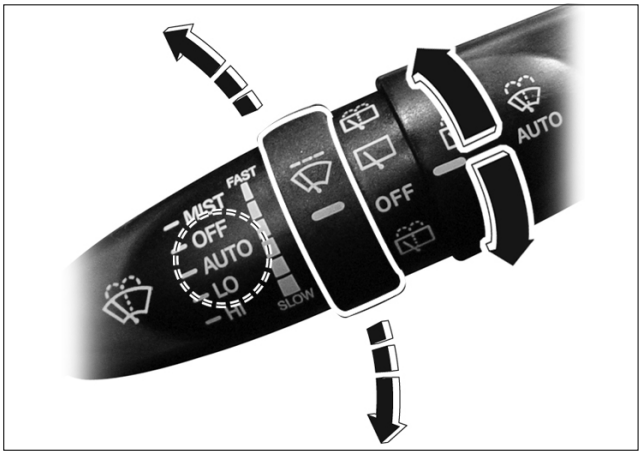


Rain sensing unit (auto light integrated type)



A sensor that emits infrared rays through LED and then detects the amount of rain drops by receiving reflected rays against sensing section (rain sensor mounting section on the windshield) with photodiode (auto light sensor integrated type)

Multifunction wiper switch: AUTO and sensitivity control

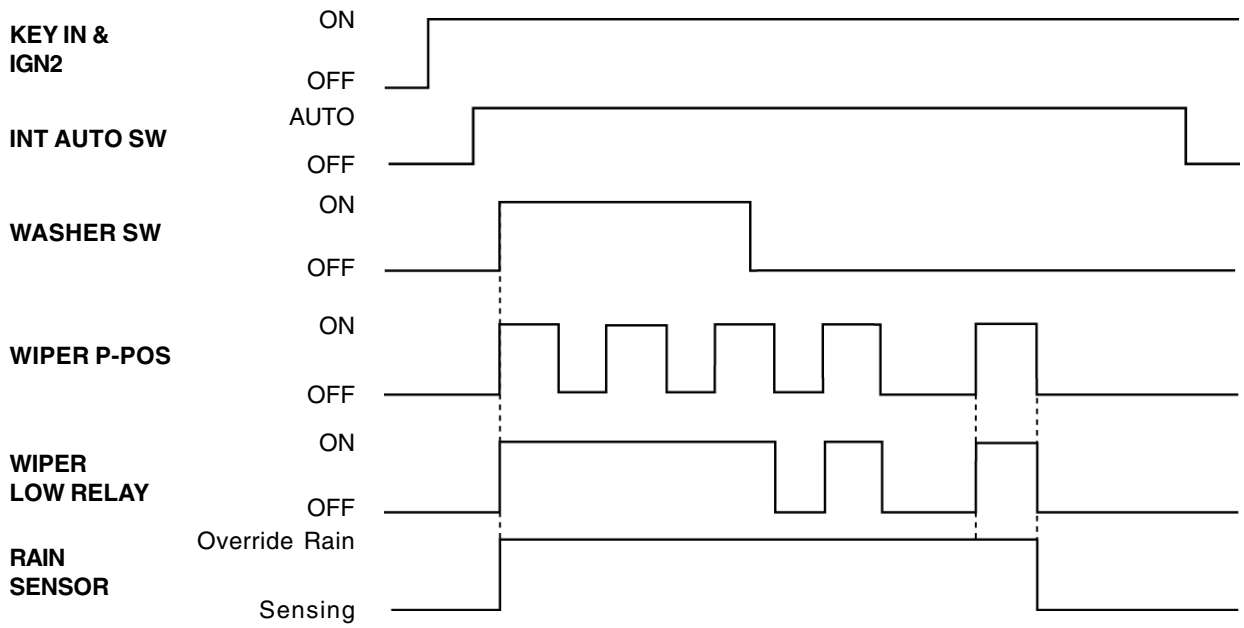


AUTO: Wiper operates automatically by rain sensor

FAST ↔ SLOW: Auto delay/Auto speed control. A position that can control sensitivity against rains in the windshield and transmits wiping demand signal accordingly

Washer Coupled Wiper in Rain Sensing Mode

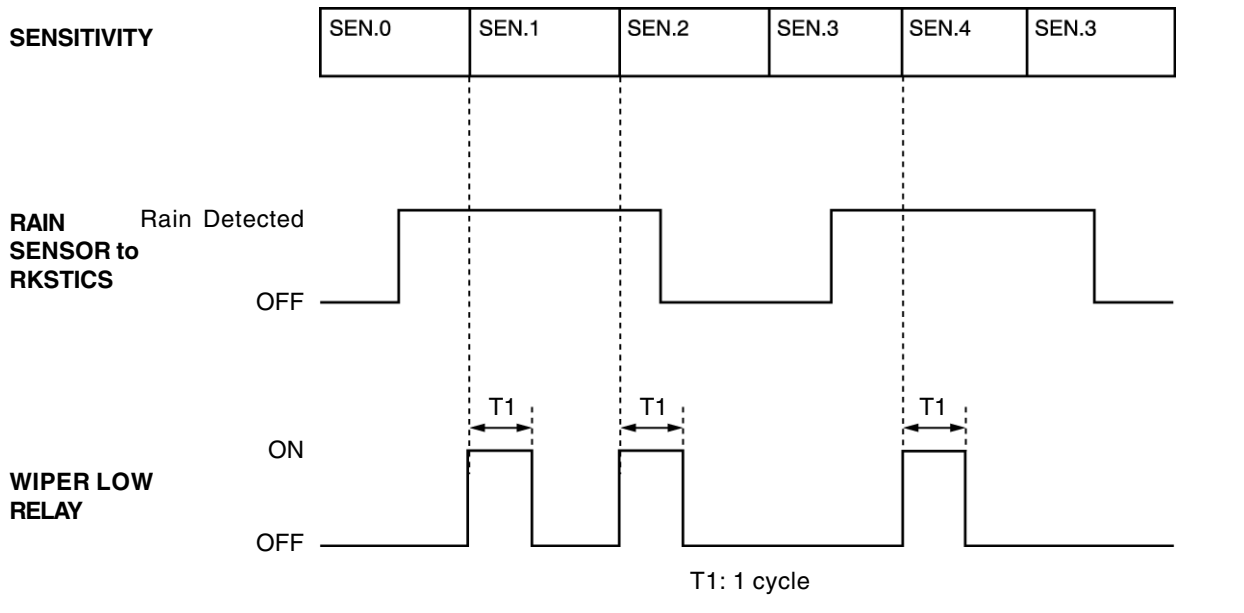
1. The washer coupled wiper is operated when receiving the washer switch input with the ignition switch “ON” and the auto INT switch “ON” in the rain sensing mode. At this moment, the communication with the rain sensor is overridden. However, the washer switch input is overridden during the continuous operation.
2. The operation data is sent to the rain sensor even during the washer coupled wiper’s operation.



Rain Sensing Sensitivity Control

1. The wiper LOW relay is turned on and the wiper motor runs one cycle when the volume sensitivity is increased (while the ignition key is in the “ON” position, the wiper switch is in the “ON” position, and the wiper motor is in “Parked” position). However, the wiper motor can be operated only when the rain sensor detects the “Rain Detected” signal.

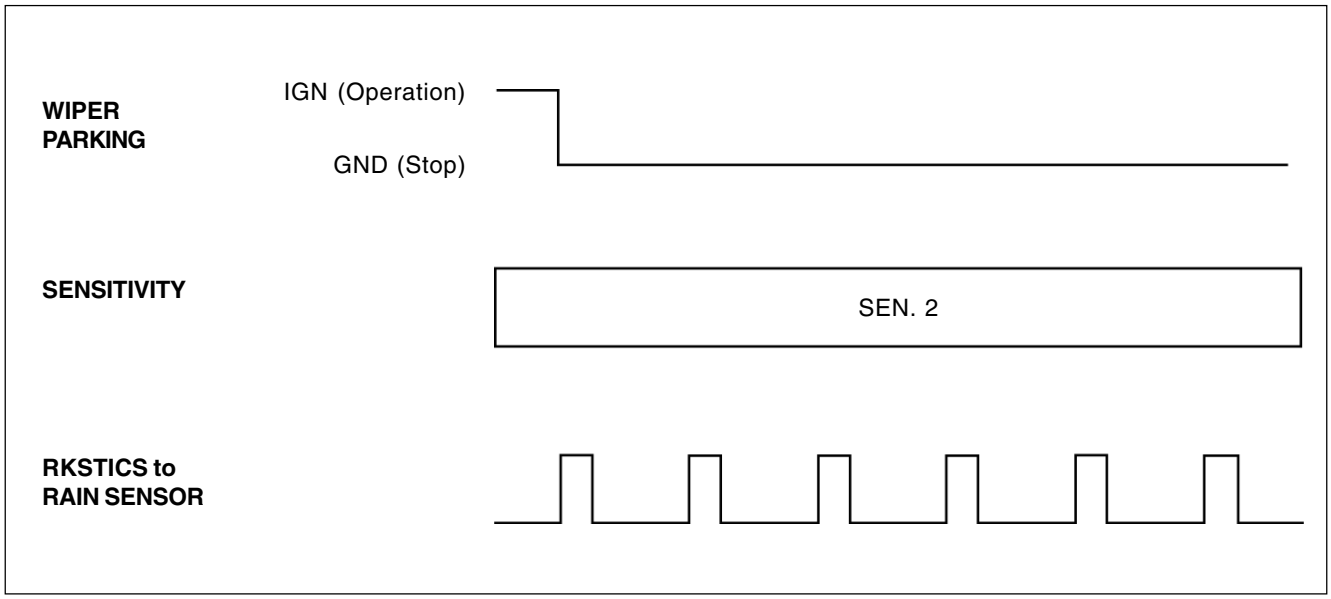
   * If the volume sensitivity is changed more than 2 stages within 2 seconds, the wiper motor runs only one cycle.



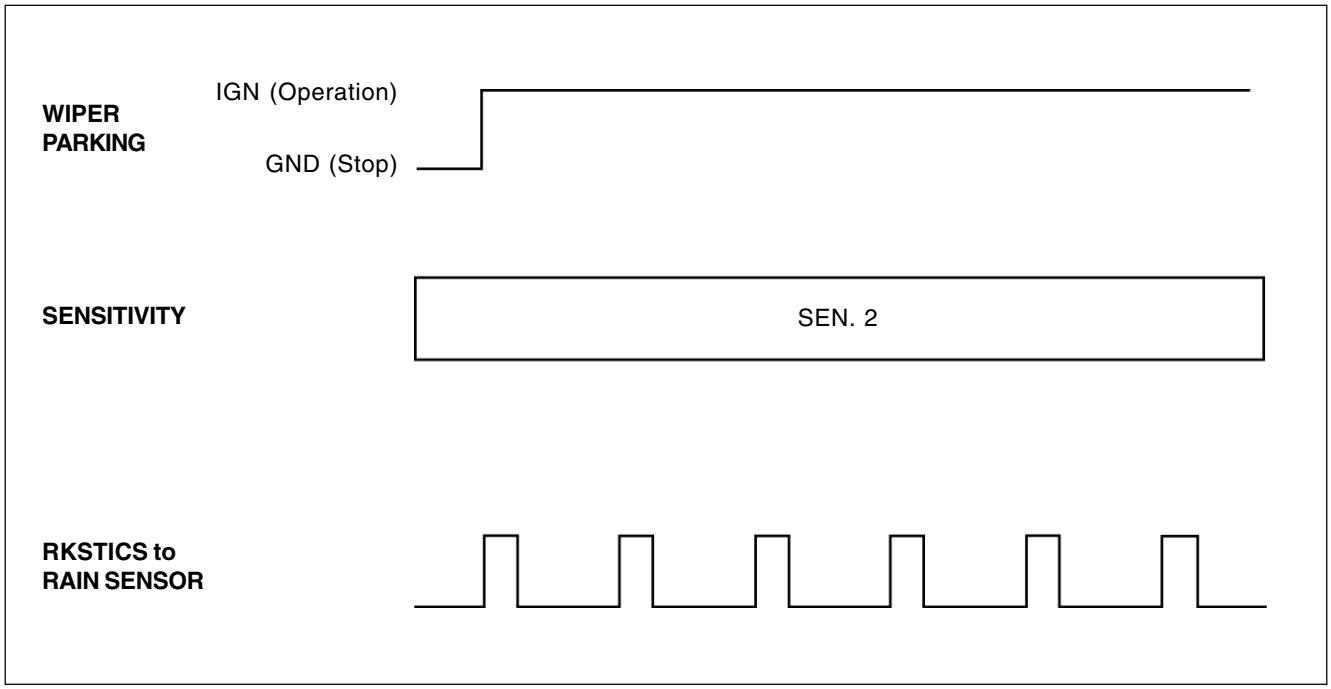
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AFFECTED VIN	

When the Wiper Parking Signal is abnormal

1. The wiper system continuously outputs the wiper parking signal when the wiper parking terminal is grounded (while the ignition key is in “ON” position and the wiper switch is in “ON” position).
   * The wiper motor runs only when the rain sensor requires the wiper operation.

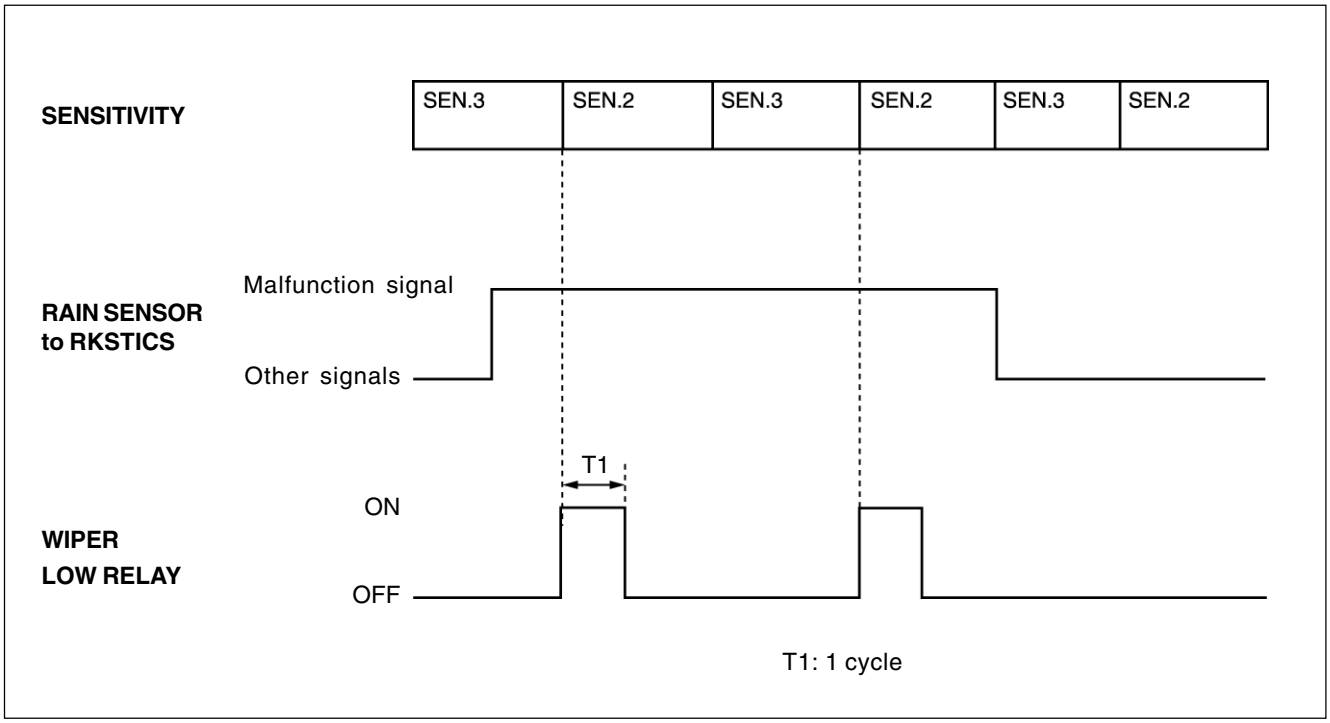


2. When the parking terminal is fixed to IGN, the wiper system outputs the wiper operating signal for 2 seconds, then continuously outputs the wiper parking signal.
   * The wiper motor runs only when the rain sensor requires the wiper operation.

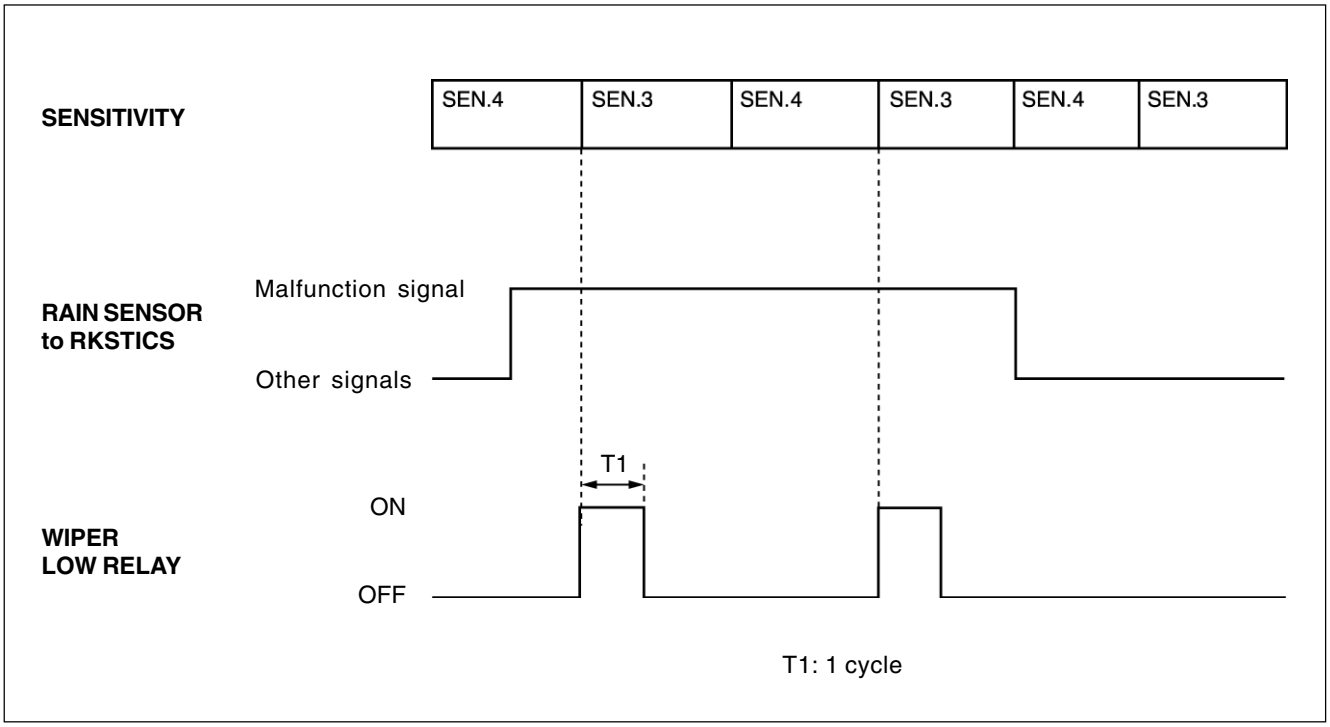


Defective Rain Sensor

1. The wiper relay (LOW) is turned on and the wiper motor runs one cycle when the volume sensitivity is changed to 2 from 3 during receiving the malfunction signal from the rain sensor (while the ignition key is in “ON” position and the wiper switch is in “ON” position).



2. The wiper relay (LOW) is turned on and the wiper motor runs one cycle when the volume sensitivity is changed to 3 from 4 during receiving the malfunction signal from the rain sensor (while the ignition key is in “ON” position and the wiper switch is in “ON” position).



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Shooting

Symptom 1. The wiper does not operate one cycle when turning the multifunction wiper switch to the "AUTO" from the "OFF" position or starting the engine while the wiper switch is in the "AUTO" position.

1. When starting the engine with the multifunction wiper switch in the "AUTO" position, the wiper operates one cycle to remind a driver that the wiper switch is in the "AUTO" position.
2. When the wiper switch is turned to "AUTO" from "OFF", the wiper operates one cycle. It always operates one cycle for the initial operation, however, the wiper does not operate afterwards to prevent the wiper blade wear if not raining when turning the wiper switch to "AUTO" from "OFF". However, the wiper operates **up to 5 minutes** after rain stops. If this function does not occur, check No. 8 pin. If the pin is normal, check the wiper relay related terminals in the ICM box.

Symptom 2. It rains but the system does not work in the "AUTO" position.

1. Check whether the multifunction wiper switch is in the "AUTO" position.
2. Check the power to the sensor. Check the conditions of the pin 3 (Ground) and the pin 4 (IGN).
3. Check the wiper relay for defective.

Symptom 3. The wiper operates 3 or 4 times at high speed abruptly.

Check whether the variable resistance knob on the multifunction wiper switch is set in "FAST". The "FAST" is the highest stage of the sensitivity and very sensitive to small amount of rain drops. Therefore, change the knob to the low sensitivity.

Symptom 4. The wiper operates continuously even on the dry glass.

1. Check the wiper blade for wear. If the wiper blade cannot wipe the glass uniformly and clearly, this problem could be occurred. In this case, replace the wiper blade with a new one.
2. Check whether the variable resistance knob on the multifunction wiper switch is set in "FAST". The "FAST" is the highest stage of the ensitivity and very sensitive to small amount of rain drops. Therefore, change the knob to the low sensitivity.

Symptom 5. The wiper does not operate at high speed even in heavy rain.

Check if the wiper operates at high speed when grounding pin 1 and pin 2.

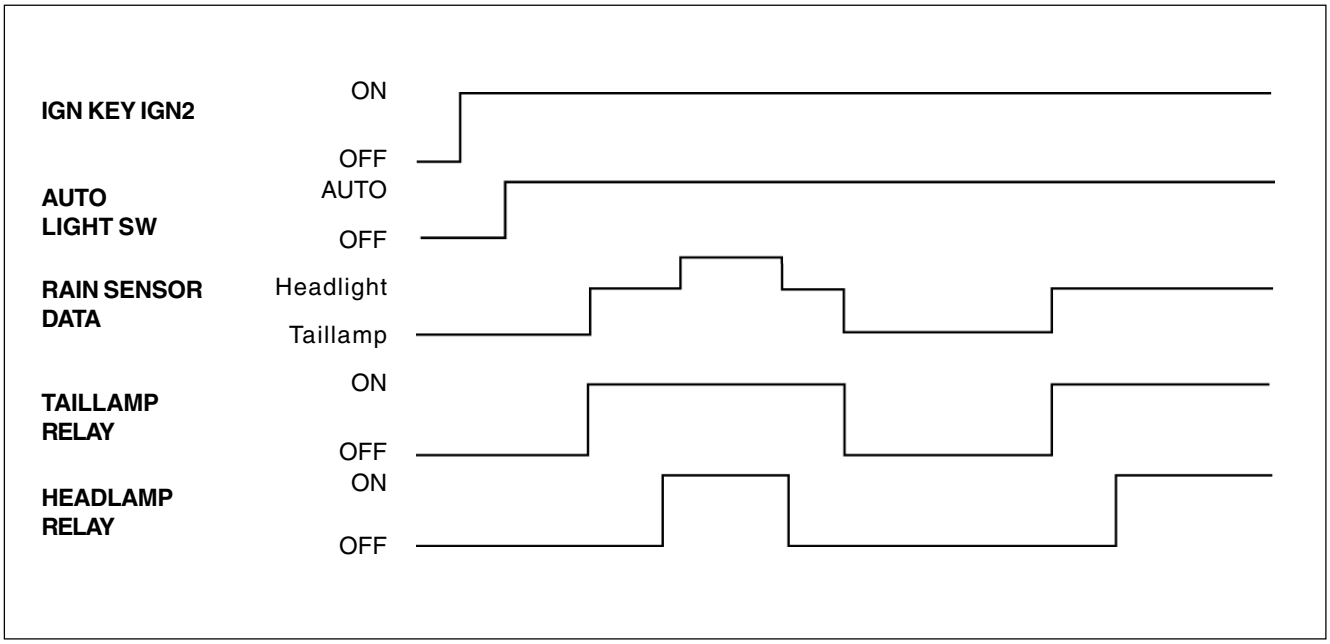
Symptom 6. The wiper responses are too fast or slow.

Check whether the variable resistance knob on the wiper switch is set in "FAST" or "SLOW".

Notify that the customer can select the sensitivity by selecting the variable resistance value. And, select a proper stage.

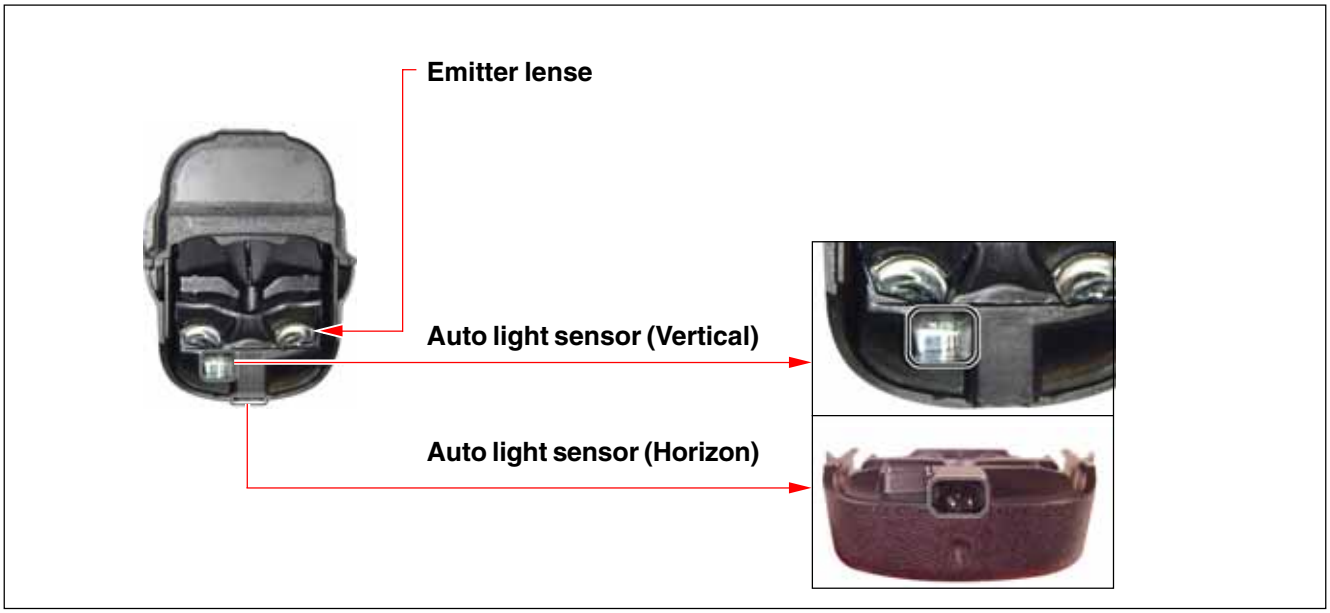
Auto Light Control

1. The tail lamps and headlamps can be controlled by the communication with the rain sensor only when the auto light switch is in “AUTO” position with the ignition switch “ON”.



2. Rain detected headlamp: If it rains heavy which requires the highest INT speed, the headlamps are turned on automatically.

3. Night detected wiping: When the auto light control turns on the headlamps and the rain sensor detects the rain, the wiper sensitivity is automatically increased by one level. (i.e. the AUTO wiper switch is at the 3rd level, but the wiper operates at the 4th level.)



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EFFECTIVE DATE	
AFFECTED VIN	

Speed Sensitive INT (Intermittent) Wiper

For RKSTICS without the rain sensor, perform the following operation:

1. Controls the wiper intermittent operation by the values from the vehicle speed and the volume.
   1) Calculates and converts the Intermittent interval automatically by using the INT VOLUME when the ignition switch is in the “ON” position and the INT switch is in the “ON” position.
   2) The wipers are operated in vehicle speed sensitive mode when turning the INT switch to the “ON” position with the engine running or starting the engine with the INT switch positioned to “ON”.
   3) Intermittent interval (at 0 km/h): 3 ± 0.5 ~ 19 ± 2 seconds

2. Vehicle speed calculation

   [Input the vehicle speed]

   It is calculated by the numbers of input pulses for one second.

$$1\ [\text{PULSE/SEC}] = \frac{60\ [\text{km/h}]\ \text{X}\ 60\ [\text{sec}]}{637\ \text{X}\ 4\ \text{PULSE}} \fallingdotseq 1.41\ [\text{km/h}]$$

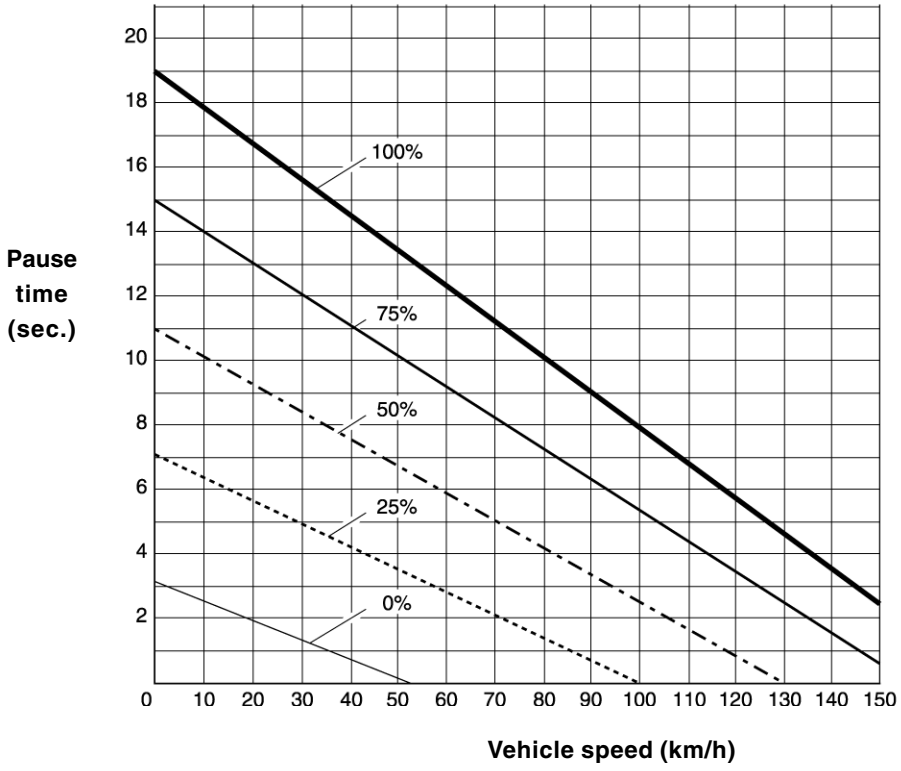
3. VOLUME calculation

   The pause time of the vehicle speed sensitive INT wiper is calculated by the INT volume (input voltage). Each level has the hysteresis.

4. Pause time calculation
   1) Pause time: the duration that wipers are stopped at parking position
   2) Elapsed time: the duration after the wiper motor started to operate from parking position
   3) The pause time is calculated by the vehicle speed and the VOLUME.
      - If the pause time is below 1.0 second, the wipers operate without pause.
      - If the pause time is over 1.5 seconds, the wipers operate intermittently.

Pause time of vehicle speed sensitive INT wiper

Vehicle Speed / Resistance	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
100%	19.00	17.90	16.80	15.70	14.60	13.50	12.40	11.30	10.20	9.10	8.00	6.90	5.80	4.70	3.60	2.50
75%	15.00	14.03	13.06	12.09	11.13	10.16	9.19	8.22	7.26	6.29	5.32	4.35	3.39	2.42	1.45	0.45
50%	11.0	10.16	9.33	8.49	7.66	6.82	5.99	5.15	4.32	3.48	2.65	1.81	0.98	0.14	0.00	0.00
25%	7.00	6.29	5.59	4.89	4.19	3.48	2.78	2.08	1.38	0.67	0.02	0.00	0.00	0.00	0.00	0.00
0%	3.0	2.43	1.86	1.29	0.72	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

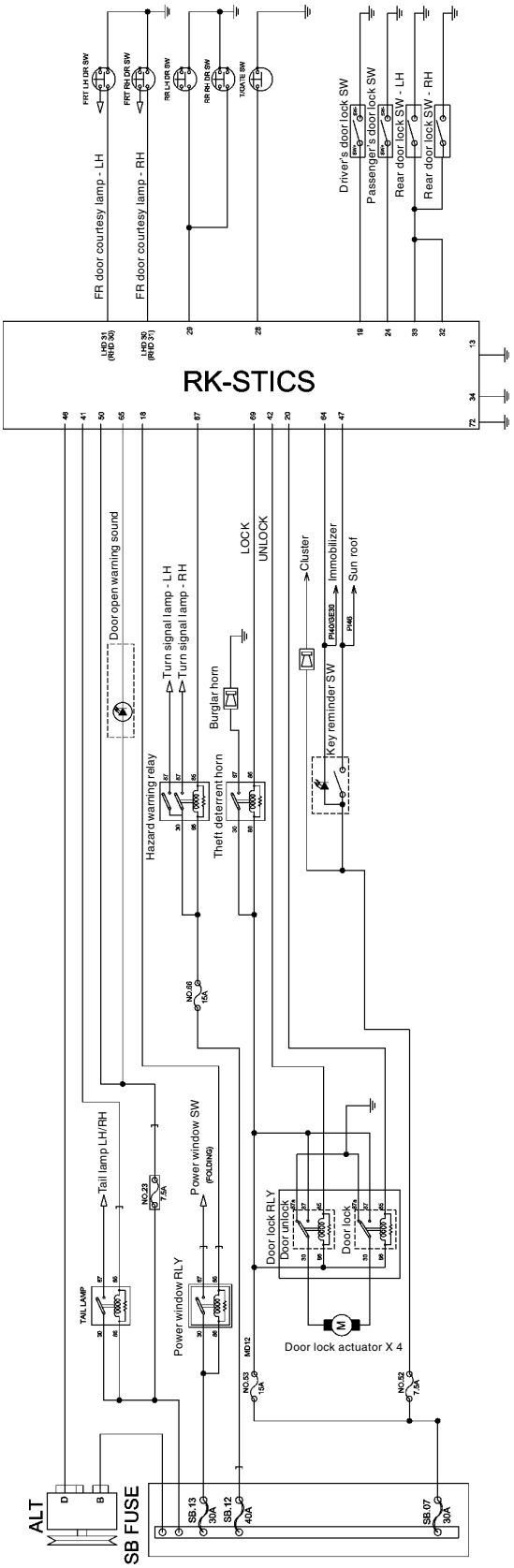


CAUTION

- **Speed sensitive INT (intermittent) wiper**
  1) **The wiper relay continues to output for remaining "ON" time even when the INT switch is turned off.**
  2) **IGN 2 switch "ON", INT switch "OFF": Resume the intermittent time when turning "ON"**
  3) **IGN 2 switch "OFF", INT switch "ON": Resume the intermittent time when turning "ON"**
- **Controls when the wiper motor parking is defective**
  1) **The wiper relay continues to output when the parking terminal is fixed at the ground or IGN while the wiper relay is "ON" (INT switch = ON or Washer switch = ON) (The output stops immediately after turning off the switch) (The output stops immediately after turning OFF the switch.)**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Wiring Circuit of STICS (Related to Ignition Key Reminder)



STICS control related to the ignition key reminder is a convenience function to prevent the driver from leaving the vehicle with the tail lamps ON or without removing the key.

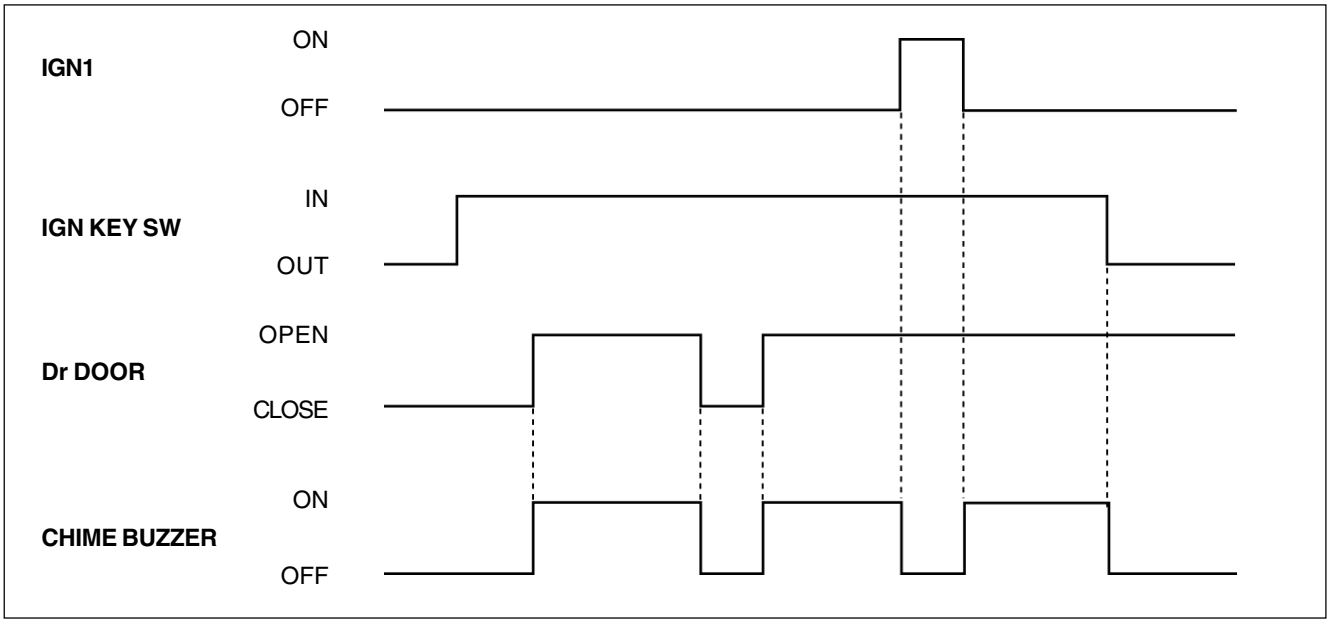
As shown in the figure, STICS monitors the signal of key reminder and controls the vehicle according to the door switch and tail lamp conditions. For details, refer to following information.

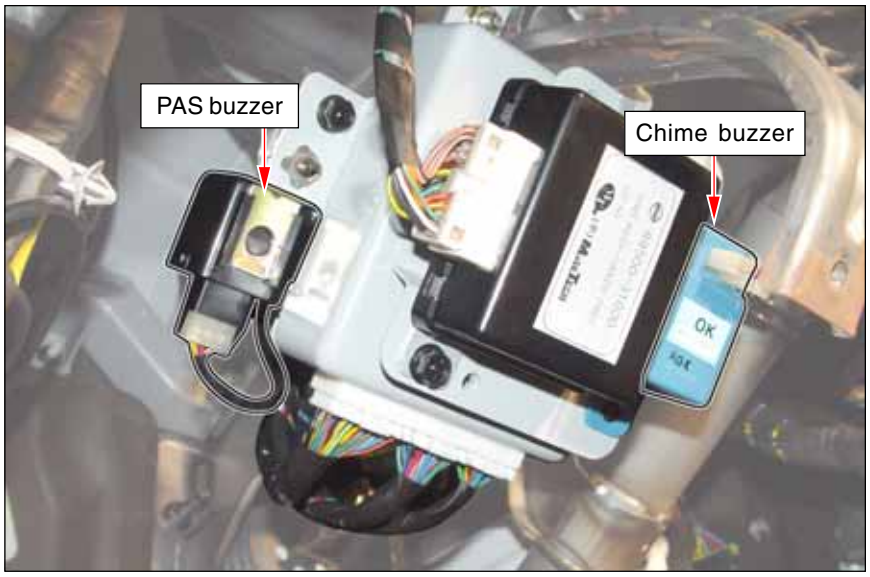
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Ignition Key Reminder Warning

(The ignition key reminder warning has priority over the "TAILLAMP ON WARNING".)

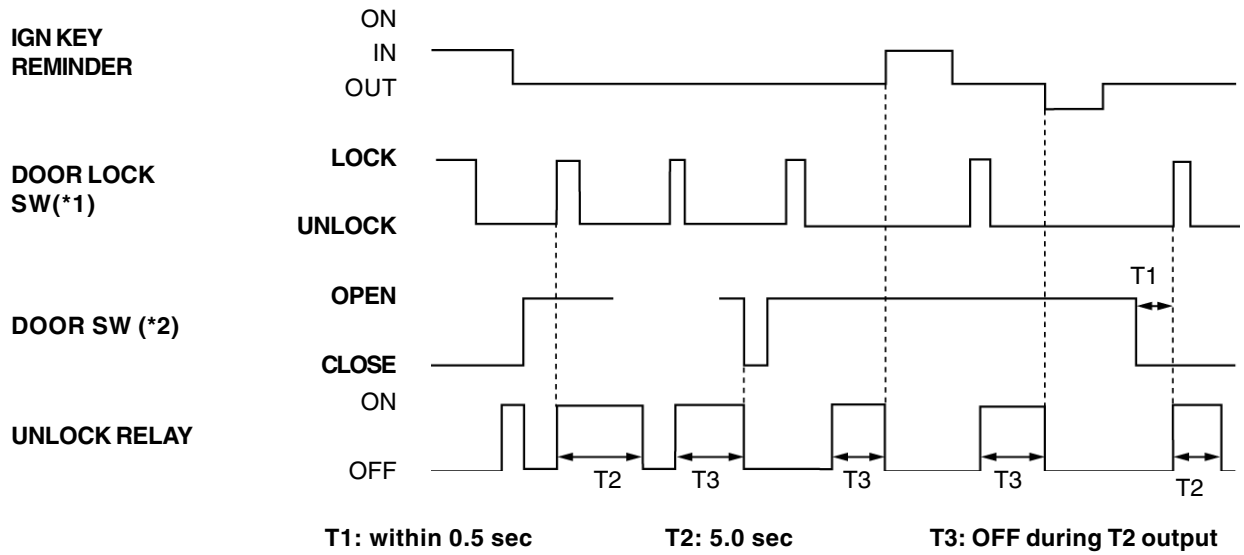
1. The chime buzzer sounds continuously when opening the driver's door while the ignition key is in ignition switch.
2. When removing the ignition key or closing the driver's door during chime buzzer operation, the buzzer stops.
3. This function is not available when the ignition switch is in "ON" position.





Ignition Key Reminder

1. The system outputs "UNLOCK" signal for 5 seconds after the driver's door is opened and the door lock switch is changed to "LOCK" (while the ignition key is in ignition switch).
2. The system outputs "UNLOCK" signal for 5 seconds (T2) when the door lock switch is changed to "LOCK" from "UNLOCK" and the driver's door is closed within 0.5 seconds (while the ignition key is in the ignition switch).
3. If the "UNLOCK" conditions are met, the system outputs "UNLOCK" signal unconditionally. However, if the ignition key is removed after the door lock switch is changed from "UNLOCK" to "LOCK", the system does not output "UNLOCK" signal.



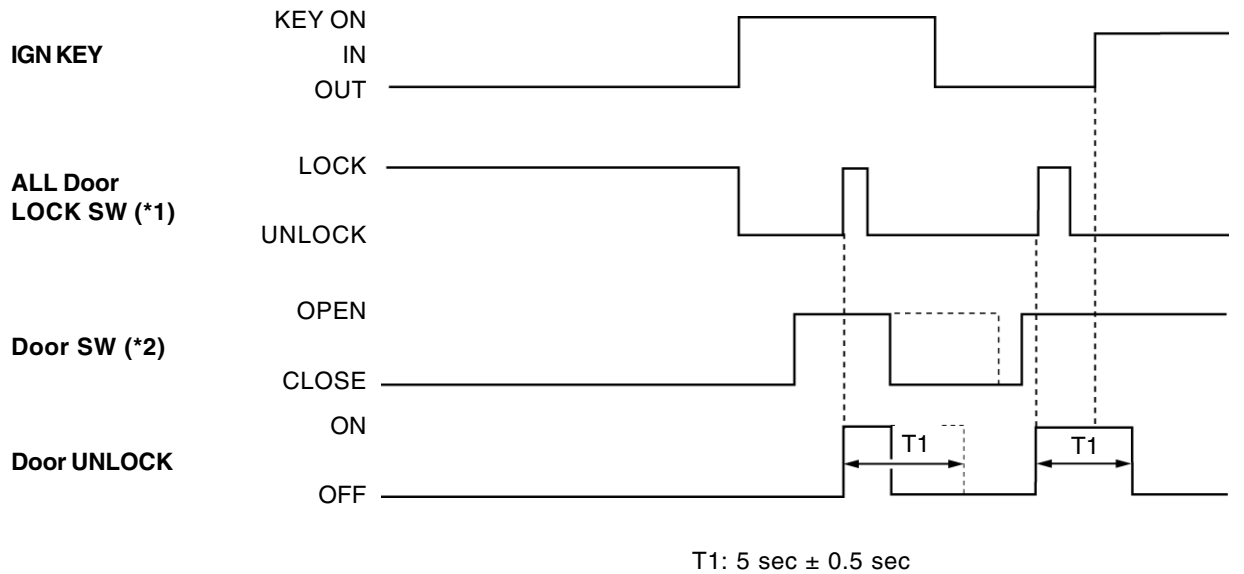
T1: within 0.5 sec **T2: 5.0 sec** **T3: OFF during T2 output**

(*1): Door LOCK switches in both front seats

(*2): Door switches in both front seats

All Door Lock Prevention Function when a Door is Open

1. All doors, except the tailgate and hood, output "UNLOCK" signal for 5 seconds when the "LOCK" signal is inputted (while the ignition key is removed and one of any doors is open).
2. When the door is closed during the UNLOCK output, the UNLOCK output stops immediately.
3. When the ignition key is inserted during the output, the output continues for approx. 5 seconds.
4. If the ignition switch is in the "ON" position or the ignition switch is removed, the above steps are performed. If the key is in the key cylinder, the ignition key reminder function is activated.
5. This function does not work if the vehicle speed is over 10 km/h.

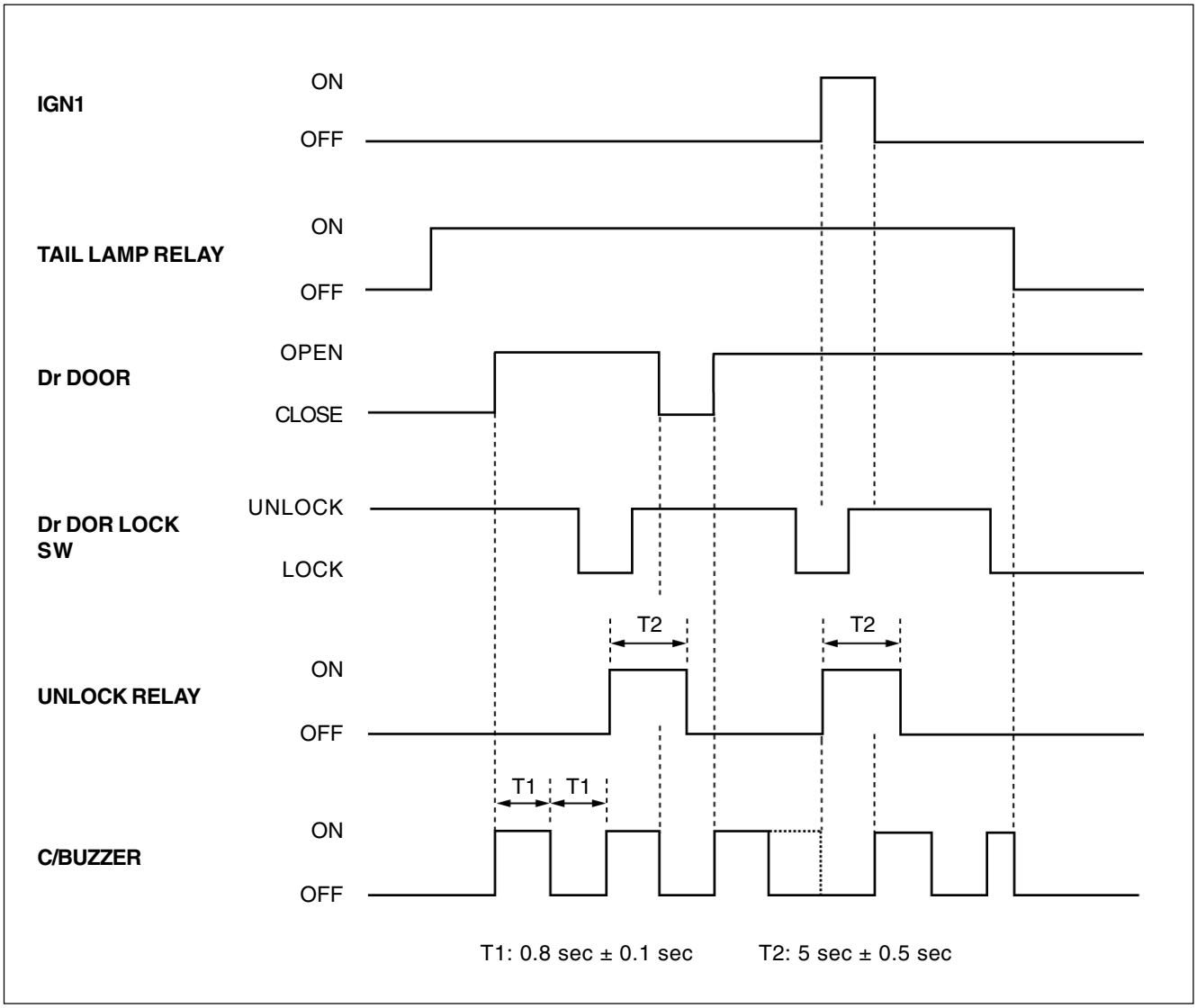


T1: 5 sec ± 0.5 sec

(*1) LOCK switches in all doors including tailgate (*2) Door switches in all doors excluding tailgate

Tail Lamp Left On Warning

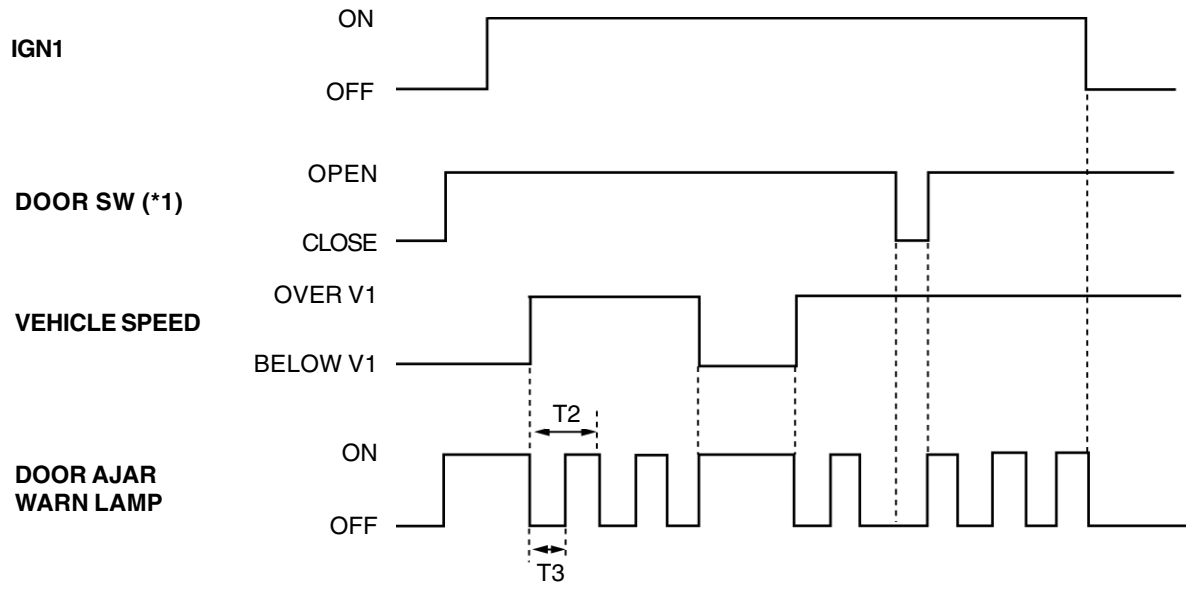
1. The chime buzzer sounds with the interval of 0.8 second when opening the driver's door while the tail lamp is turned on and the ignition key is removed.
2. The chime/buzzer output stops when turning off the tail lamp and closing the driver's door.
3. The system outputs "UNLOCK" signal for 5 seconds when the driver's and passenger's door lock switch is locked (while the tail lamp is turned on and the driver's door is open).
4. This function is not available when the ignition key is in the "ON" position.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

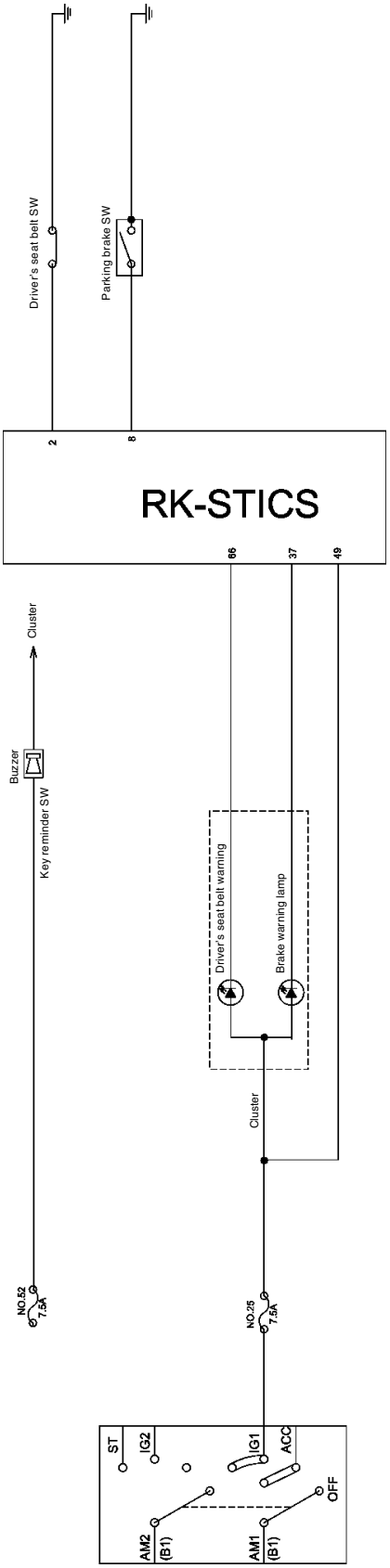
Door Ajar Warning

1. The warning light in instrument panel comes on when opening any of doors including tailgate while the vehicle speed is below 10 km/h.
2. The warning light goes off when closing the door under step 1.
3. The warning light blinks when the vehicle speed is over 10 km/h while the warning light is turned on.
4. The warning light blinks when a door is open while the vehicle speed is over 10 km/h.
5. The warning light goes off when closing the door under step 3.
6. The warning light comes on when the vehicle speed goes below 10 km/h under step 3.



(*1) DOOR OPEN: Open any doors including tailgate
CLOSE: Close the opened door

Wiring Circuit of STICS (Related to Seat Belt/Parking Brake Warning)



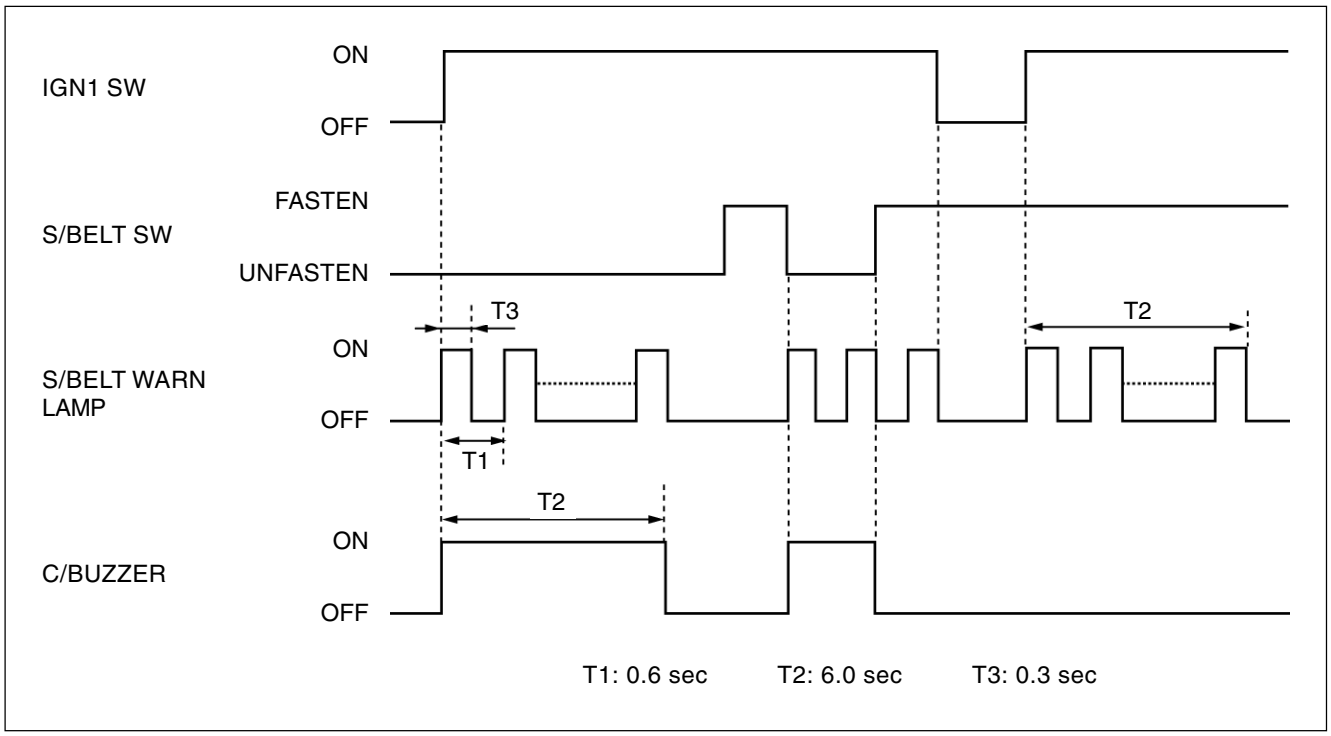
STICS monitors the seat belt fastening status and the parking brake engagement status and warns the driver with the warning light on the instrument panel or chime buzzer.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Seat Belt Warning

1. The seat belt warning light comes on and the chime buzzer sounds for 6 seconds when turning the ignition key to "ON" from "OFF".

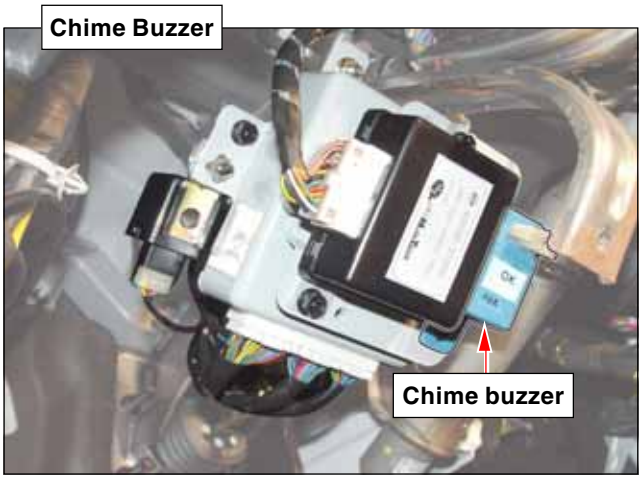
   If the seat belt is fastened before turning the ignition key to the the "ON" position, the warning light in the instrument panel blinks, however, the chime buzzer does not sound.
2. The seat belt warning light goes off and the chime buzzer stops when turning the ignition switch to the "OFF" position.
3. The chime buzzer stops and the seat belt warning light stays on for the specified period of time when fastening the seat belt during the warning operation.
4. The seat belt warning light comes on and the chime buzzer sounds for 6 seconds again when unfastening the seat belt during fastening operation while the ignition key is "ON" position.



Seat Belt Warning Light



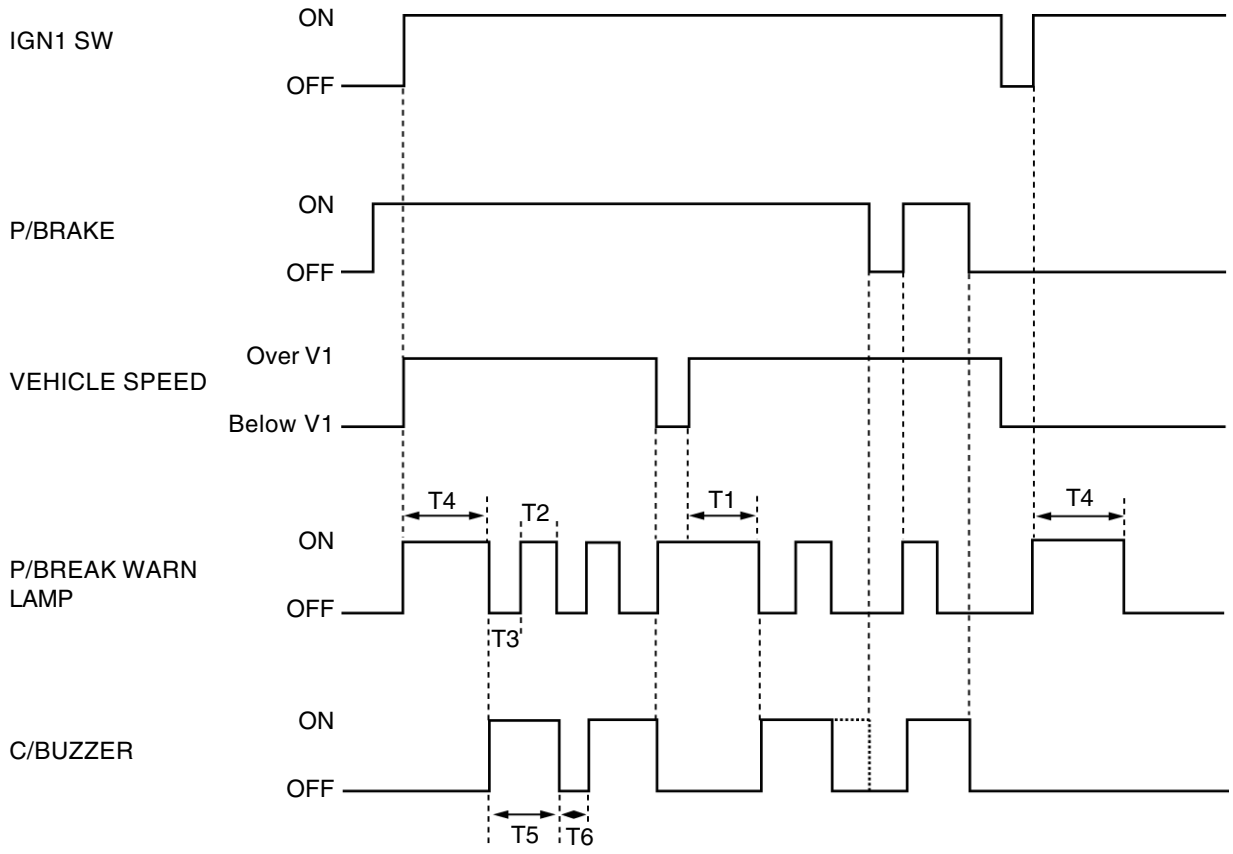
Chime Buzzer



The seat belt warning light comes on and the chime buzzer sounds for 6 seconds when turning the ignition key to "ON" from "OFF". After fastening the seat belt, the chime buzzer stops.

Parking Brake Warning

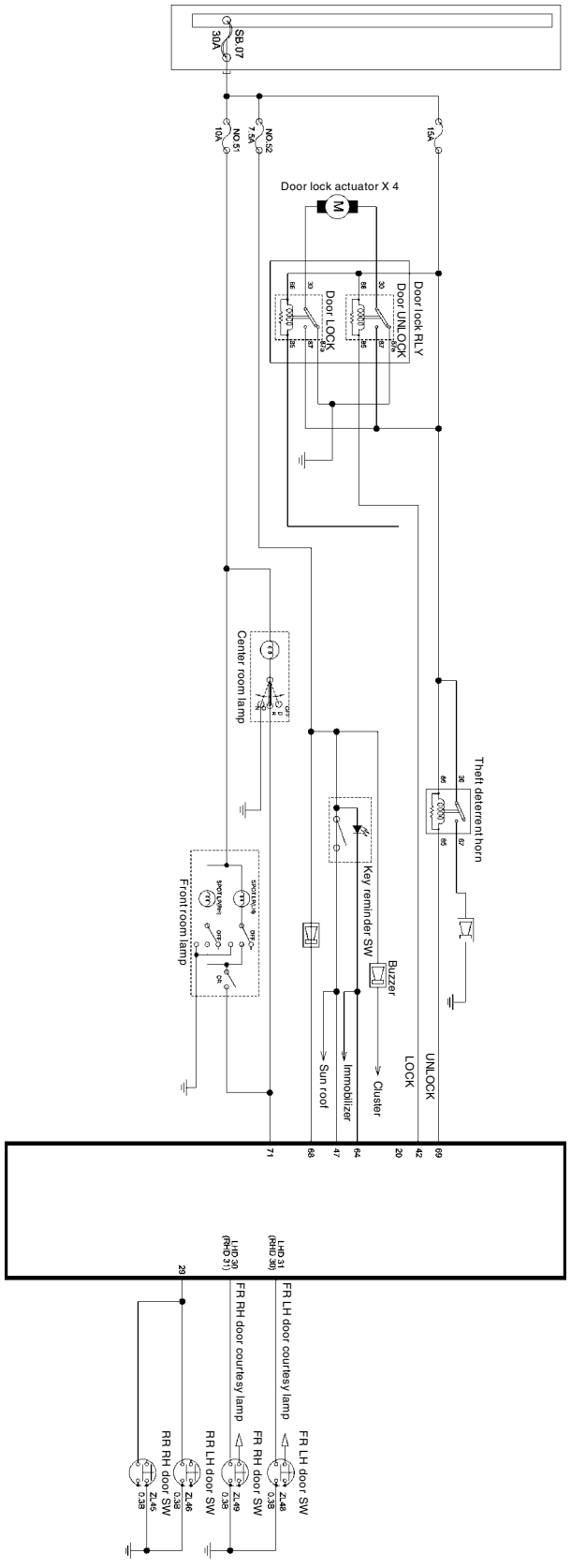
1. The parking brake warning light comes on for approx. 4 seconds when turning the ignition key from the “OFF” to the “ON” position regardless of the vehicle speed and the parking brake switch position. After this 4 seconds, the warning lamp comes on, goes off or blinks according to the vehicle speed and the parking brake switch position.
2. The warning light comes on when the parking brake switch is turned on while the vehicle speed is below 10 km/h.
3. The warning light goes off when turning off the parking brake switch under step 2.
4. The warning light blinks and the chime buzzer in the ICM box sounds for 2.85 seconds and stops for 1.5 seconds when the vehicle speed is over 10 km/h for more than 2 seconds while the parking brake switch is turned on.
5. The warning light goes off and the chime buzzer stops when turning off the parking brake switch under step 4.
6. The warning light comes on and the chime buzzer stops when the vehicle speed goes down below 10 km/h under step 4.
7. This function is not available when the ignition key is turned to the “OFF” position.



T1: 2.0 sec ± 0.5 sec T2: 0.6 sec T3: 0.3 sec T4: 4.0 sec V1: 10 Km/h T5: 2.5 sec ± 0.1 sec T6: 1.5s ± 0.1 sec

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Wiring Circuit of STICS (Related to Front/Center Room Lamp Control)



The room lamp control of STICS is related to the door's opening and closing status and UNLOCK signal of the remote controller.

The operating time control and dimming functions of room lamp have been introduced for user convenience. The ignition key reminder warning signal in the circuit is related to the dimming function.

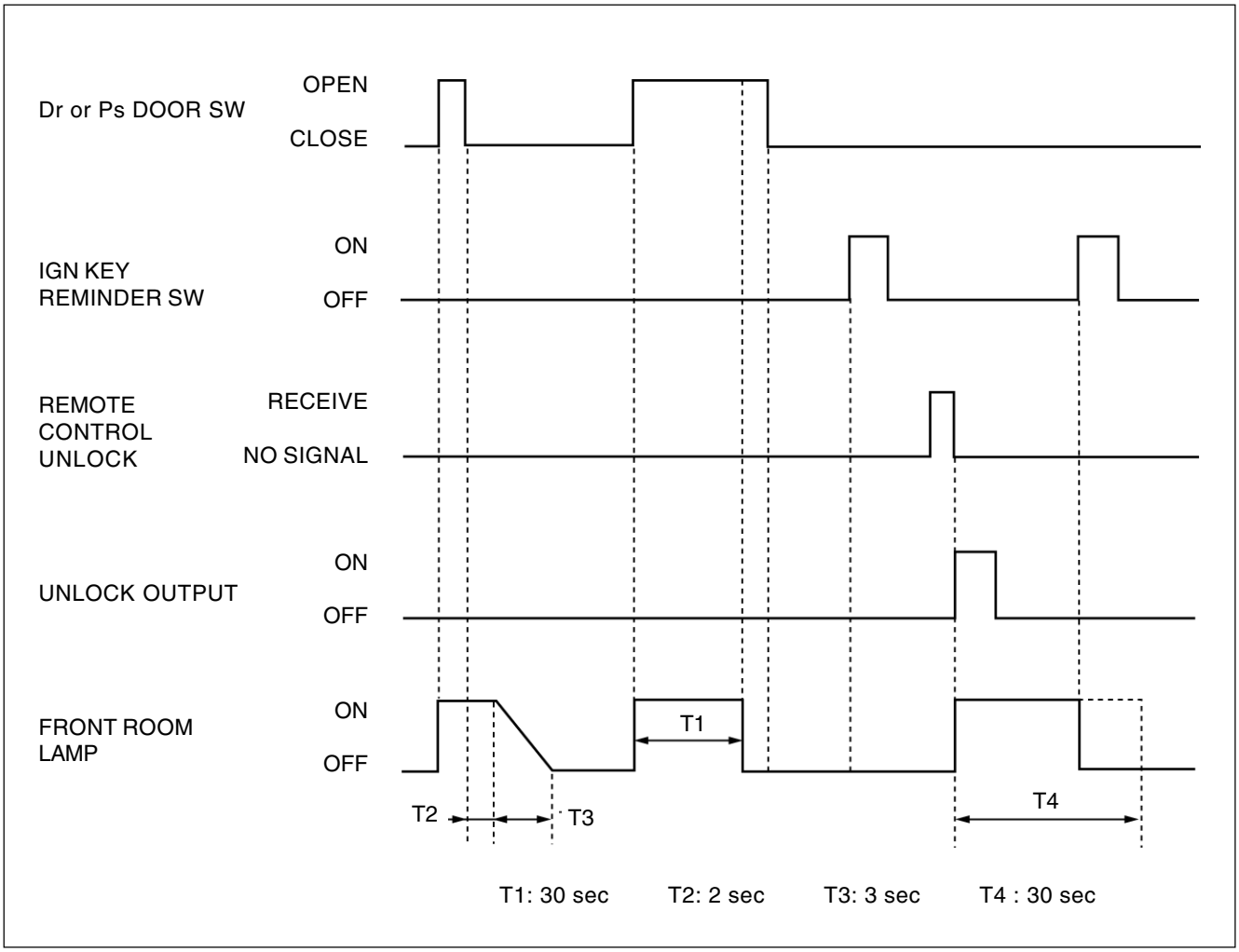
Refer to the detailed information in this manual for the control logic.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Front/Center Room Lamp Control

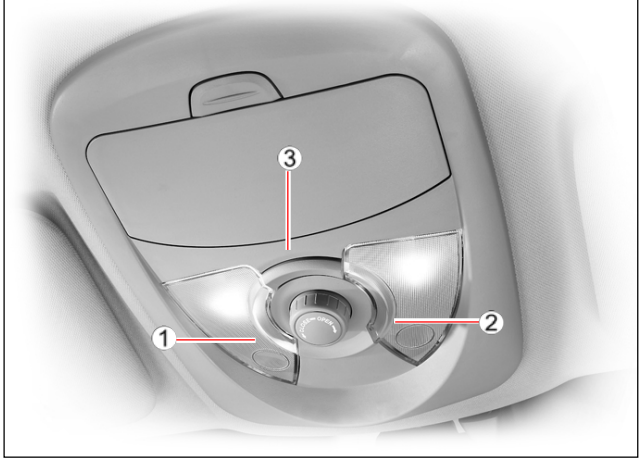
The overhead console lamp (front room lamp) and the center room lamp come on when opening the door while the center room lamp switch is at the coupled operating position and the key reminder switch is “OFF”.

1. When the door (Driver’s/Passenger’s/Rear) is opened, the front and center room lamps come on and automatically go off after 30 seconds.
2. The room lamp stays on for 2 seconds and then dims through 3 seconds when closing the opened doors.
3. The dimming operation must have greater than 32 steps per one second.
4. The room lamp output should stop immediately after turning on the ignition key during the dimming operation.
5. The front room lamp and the center room lamp come on for 30 seconds when receiving the unlock signal from the remote control key while the doors are closed.
6. The front room lamp and the center room lamp output period is extended by 30 seconds when receiving the unlock signal from the remote control key again during output. (The lamp stays on when unlocked by the remote control key.)
7. When a door is opened during its extended period, the lamp stays on. If closed, operates as in step 2.
8. The room lamp output stops immediately after receiving the lock signal from door lock switches while all doors are closed or entering into the anti-theft mode by pushing LOCK button on the remote control key.
9. The luggage room lamp does not have a door coupled operating function. It shoulde be turned on and off by hand.



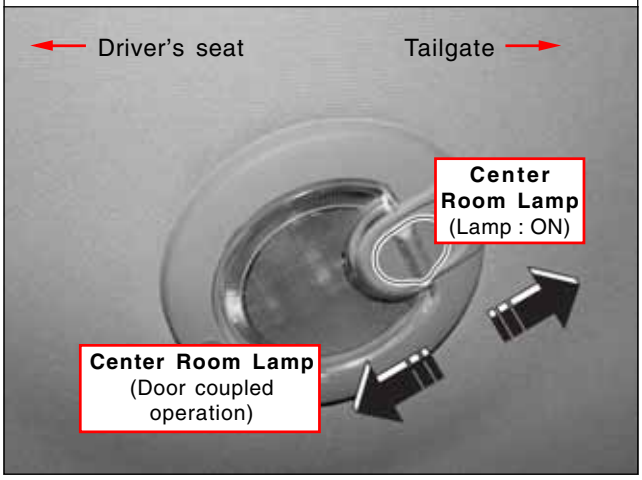
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Front Room Lamp: 12V / 8W - 2EA



Front room lamp (driver's or passenger's) is turned on and off when pressing the switch (1 or 2). However, it comes on when a door is opened and goes off when the door is closed. The front and center room lamps come on when pressing the room lamp main switch (3).

Center Room Lamp: 12V / 8W - 1EA



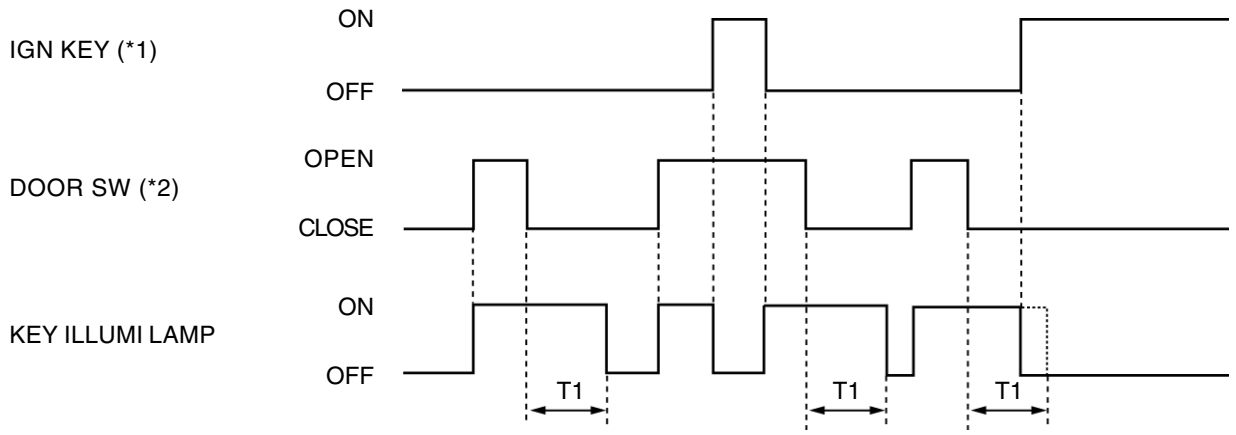
Center Room Lamp

If the switch is at the door coupled position, the center room lamp comes on when a door is opened. The lamp always comes on while the switch is at the other position.



Ignition Key Hole Illumination

1. The ignition key hole illumination comes on when opening the driver's door or passenger's door while the ignition switch is OFF.
2. The ignition key hole illumination stays on for 10 seconds when closing the door after step 1.
3. The output stops when the ignition key is turned to "ON" position.
4. The output stops when receiving the lock signal from the remote control key (under anti-theft mode).



T1 : 10 sec

(*1) ON : IGN KEY = ON
OFF : IGN KEY = OFF

(*2) OPEN : Driver's or Passenger's door = OPEN
CLOSE : Driver's and Passenger's = CLOSE

Key cylinder with key hole illumination

For diesel and gasoline engine equipped vehicle



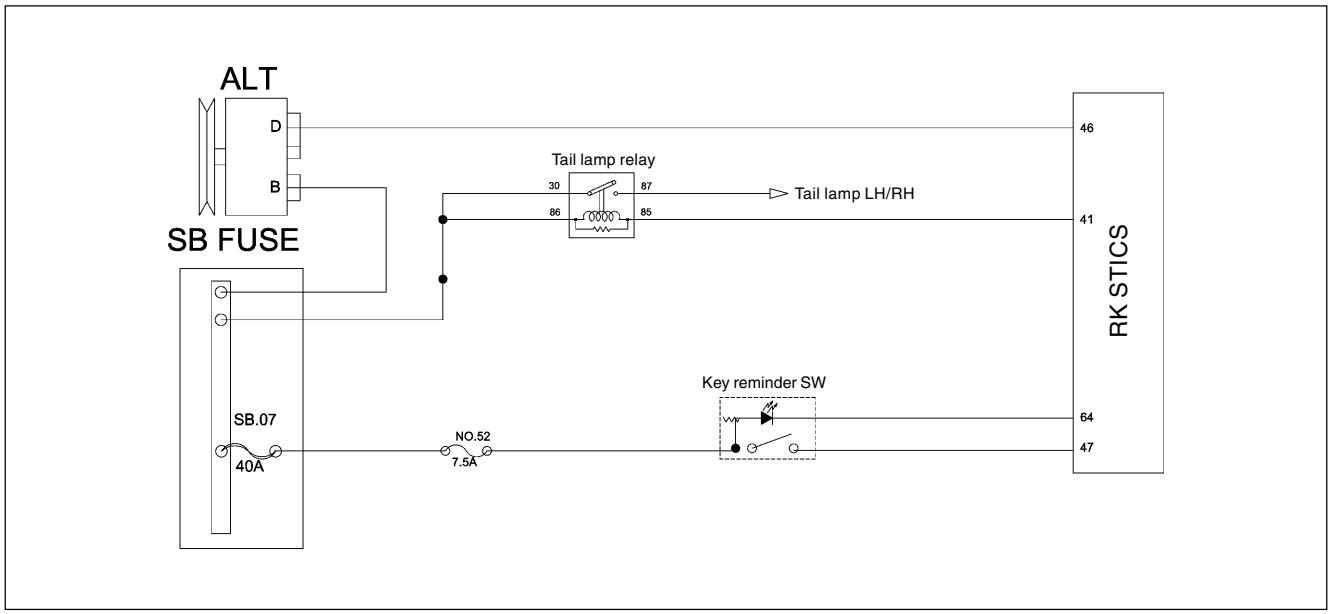
Without immobilizer
→ With key hole illumination

For gasoline engine equipped vehicle



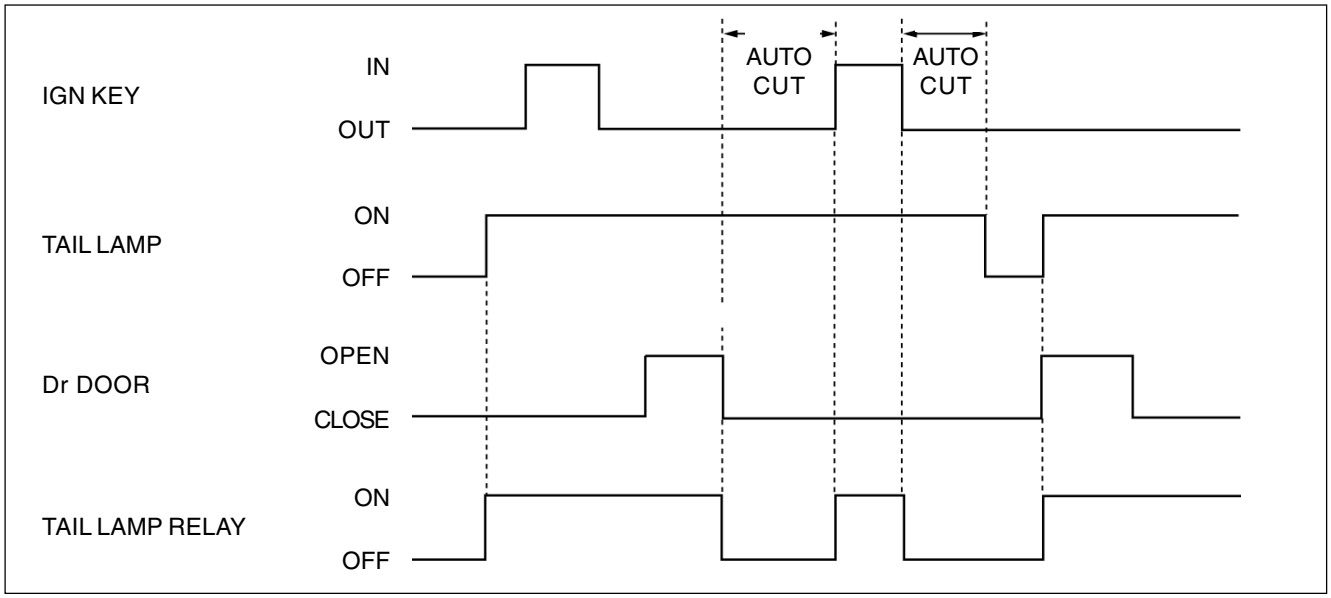
With immobilizer
→ Without key hole illumination

Wiring Circuit of STICS (Related to Tail Lamp Auto Cut (Battery Saver))

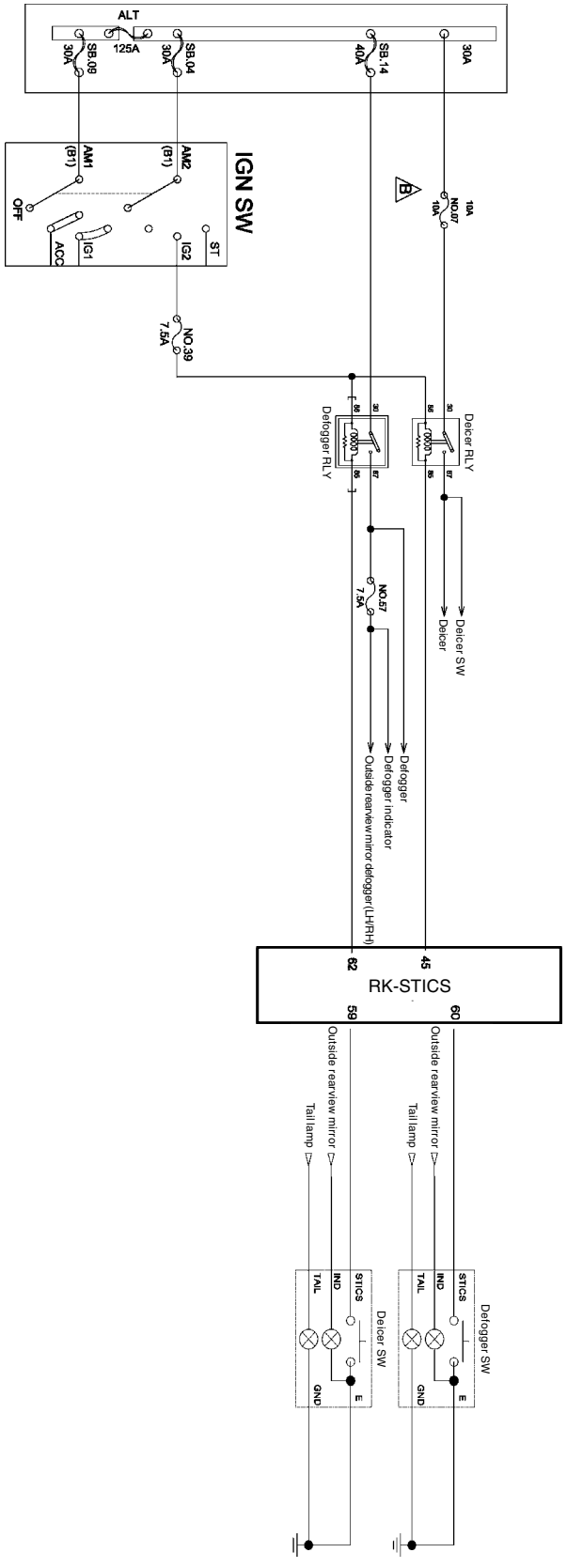


Tail Lamp Auto Cut (Battery Saver)

1. The tail lamp is turned on or off according to the operations of the tail lamp switch.
2. The tail lamp relay is turned off (auto cut) when opening and closing the driver's door after removing the ignition key without turning off the tail lamp.
3. The tail lamp relay is turned on when inserting the ignition key into the ignition switch.
4. The tail lamp relay is turned off (auto cut) when opening and closing the driver's door while the ignition key is removed and the tail lamp is turned on.



Circuit Diagram of STICS (Related to Front/Rear Defogger Timer)

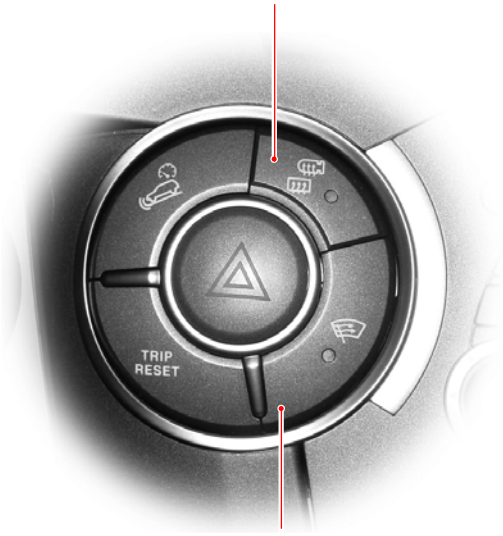


The defogger system defrosts or demists the window glass with the heated wire integrated in glass.

When operating the defogger switch, STICS controls the operating time only in IGN2 position.

Tailgate window and outside rearview mirror heated glass switch

The tailgate window and outside rearview mirror heated glass is turned on for 12 minutes when pressing this switch.



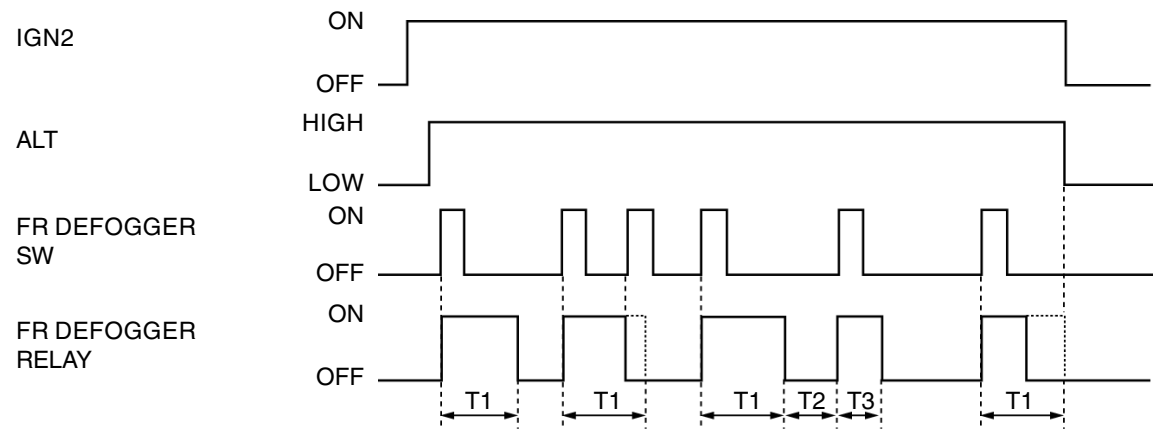
Windshield heated glass switch

The windshield heated glass is turned on for 12 minutes when pressing this switch.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Front Defogger Timer

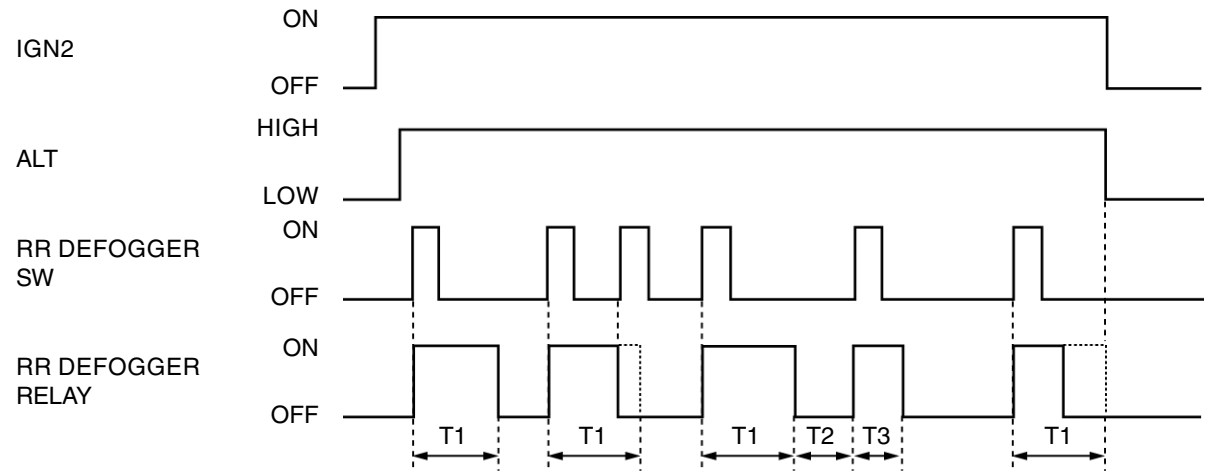
1. The front defogger output is “ON” when turning “ON” the front defogger switch while the ignition switch is “ON” (with engine running).
2. The output stops when turning on the defogger switch again during its operation.
3. The output is “ON” only for 6 minutes when turning “ON” the front defogger switch within 10 minutes after completion of output for 12 minutes. This can be done only once.
4. The output is “OFF” when the ignition switch is “OFF”.



ALT LOW = 9V ± 1V T1: 12 minutes T2: within 10 minutes T3: 6 minutes ON: IGN2 & ALT = ON
OFF: IGN2 OR ALT = OFF

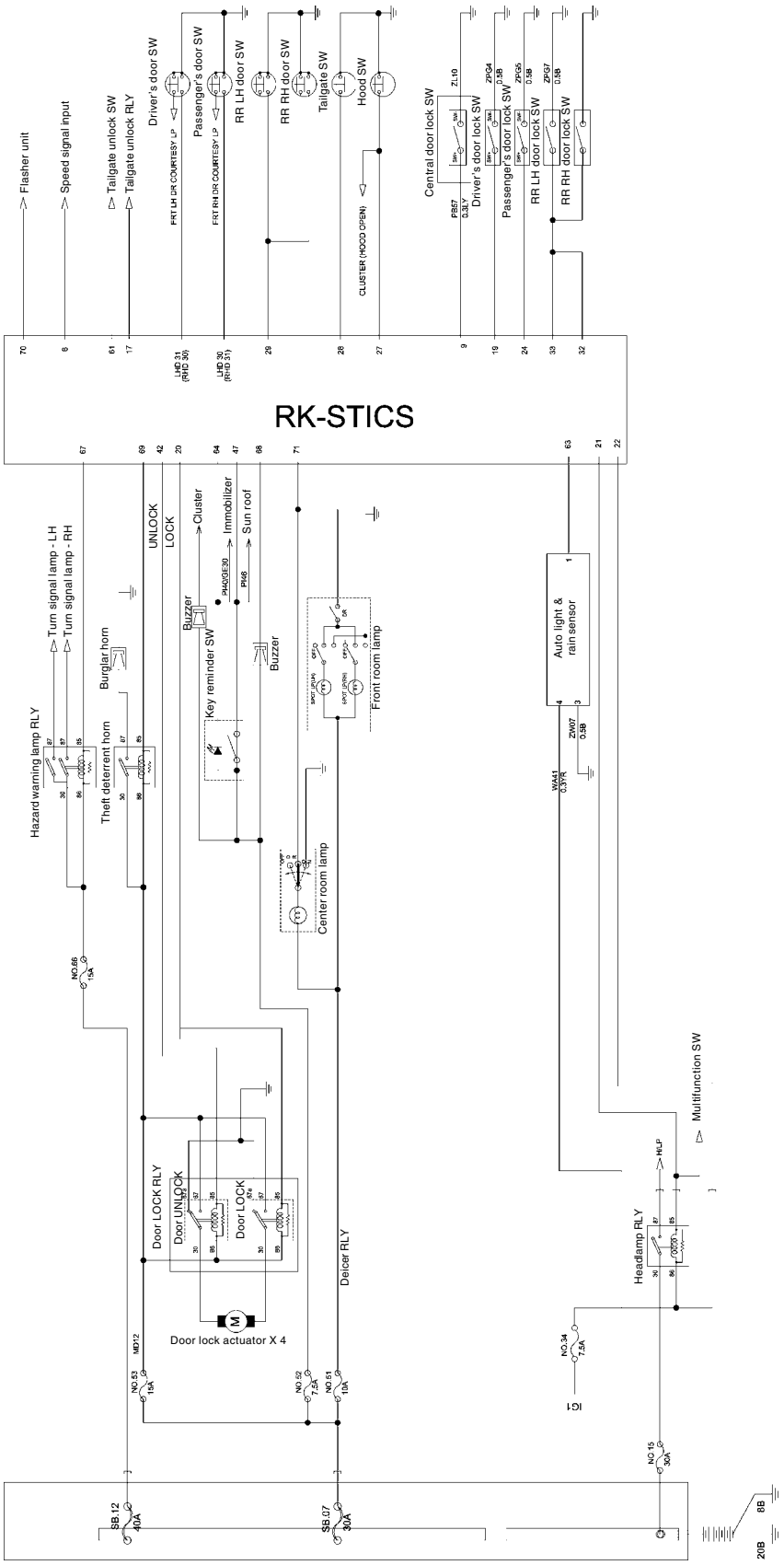
Rear Defogger Timer

1. The rear defogger output is “ON” when turning “ON” the rear defogger switch while the IGN 2 switch is “ON” (with engine running).
2. The output is “OFF” when turning “ON” the rear defogger switch again during output.
3. The output is “ON” only for 6 minutes when turning “ON” the rear defogger switch within 10 minutes after completion of output for 12 minutes. This can be done only once.
4. The output is “OFF” when the IGN 2 switch is “OFF”.



ALT LOW = 9V ± 1V T1: 12 minutes T2: within 10 minutes T3: 6 minutes ON: IGN 2 & ALT = ON
OFF: IGN 2 or ALT = OFF

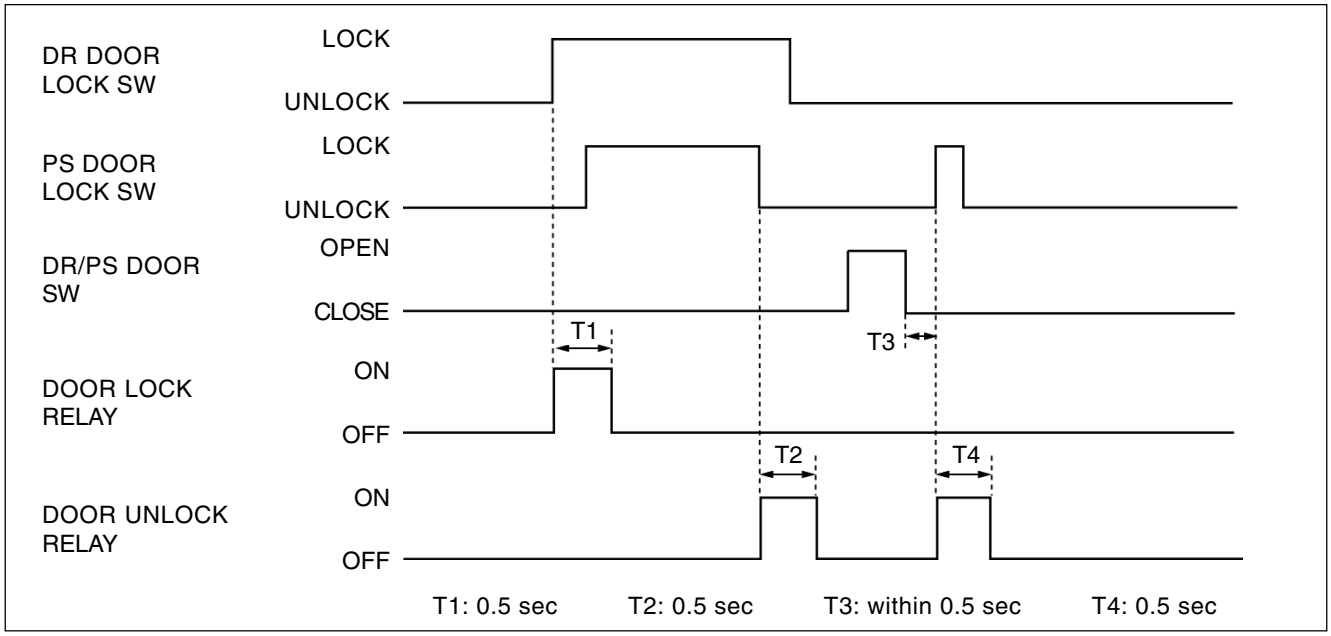
Circuit Diagram of STICS (Related to Remote Controller and Door Lock/Unlock



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

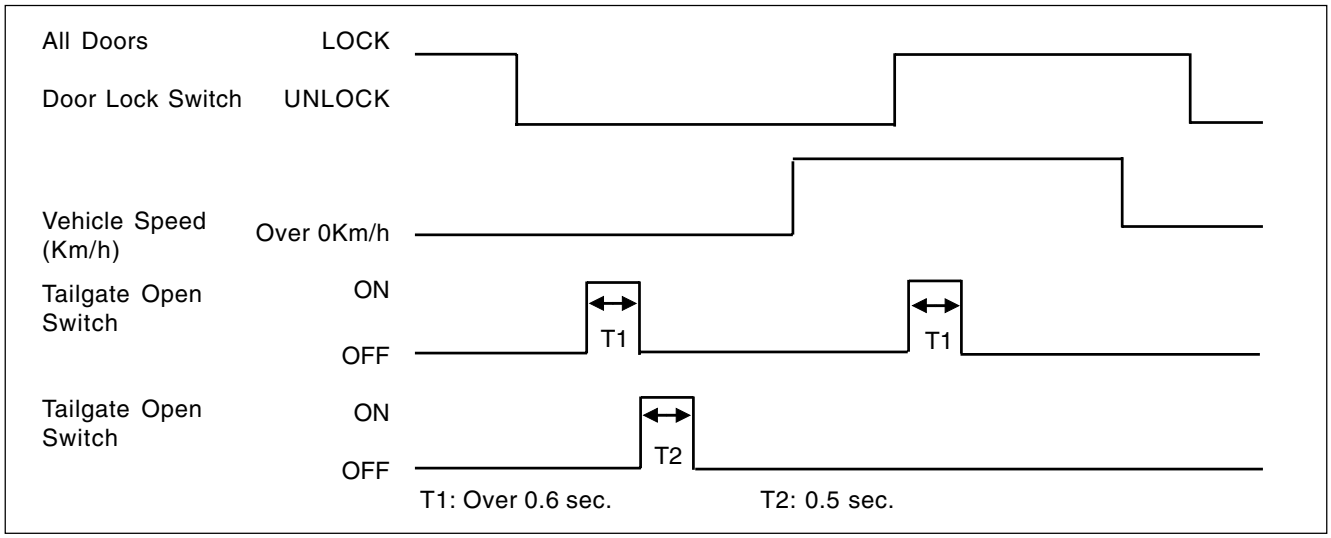
Door Lock/Unlock Control by Door Lock Switch

1. The door lock system outputs “LOCK” signal for 0.5 seconds when positioning the driver's or passenger’s door lock switch to the lock position.
2. The door lock system outputs “UNLOCK” signal for 0.5 seconds when positioning the driver's or passenger's door lock switch to the unlock position.
3. “LOCK” or “UNLOCK” by the door lock switch is ignored when outputting the “LOCK” or “UNLOCK” signal by other functions.
4. All door lock signals are “UNLOCK” for 0.5 seconds just for once when receiving the “LOCK” signal within 0.5 seconds after closing the driver’s or passenger's door while the ignition key is removed.



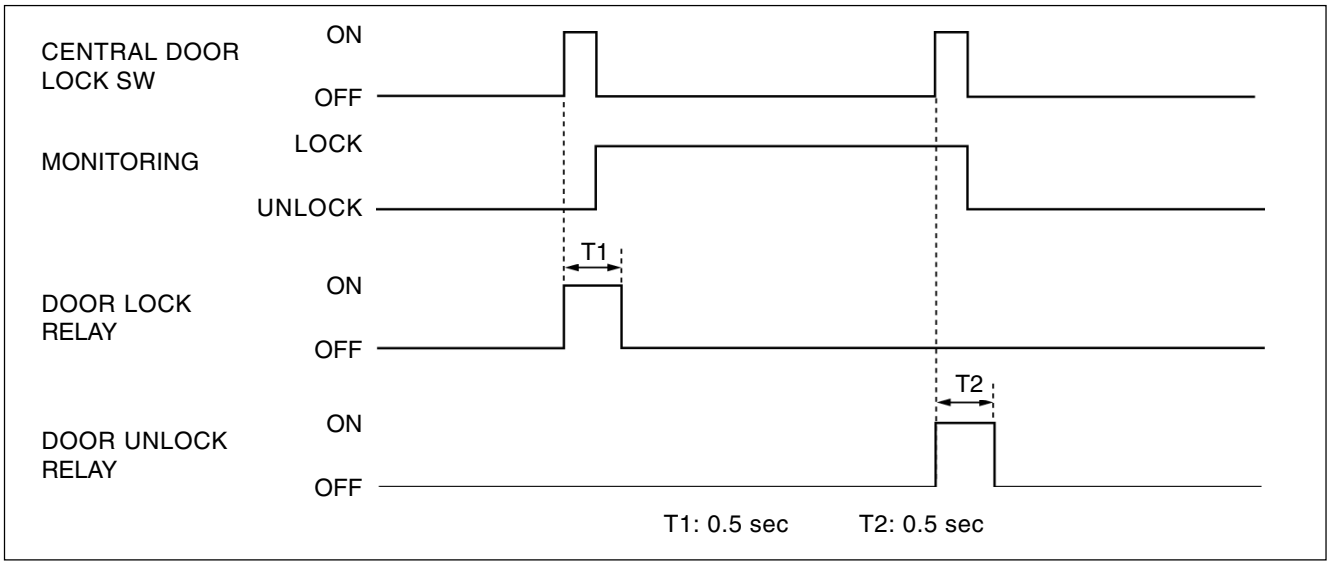
Tailgate Open Control

1. When pressing and holding the tailgate open switch for more than 0.6 seconds while LOCK switches in all doors are in UNLOCK position and the vehicle speed is 0 Km/h, STICS operates the tailgate relay for 0.5 seconds to unlock the tailgate.
2. If any LOCK switch is switched to LOCK position or vehicle speed exceeds 3 Km/h while operating the tailgate open relay, the output of the tailgate relay gets OFF.



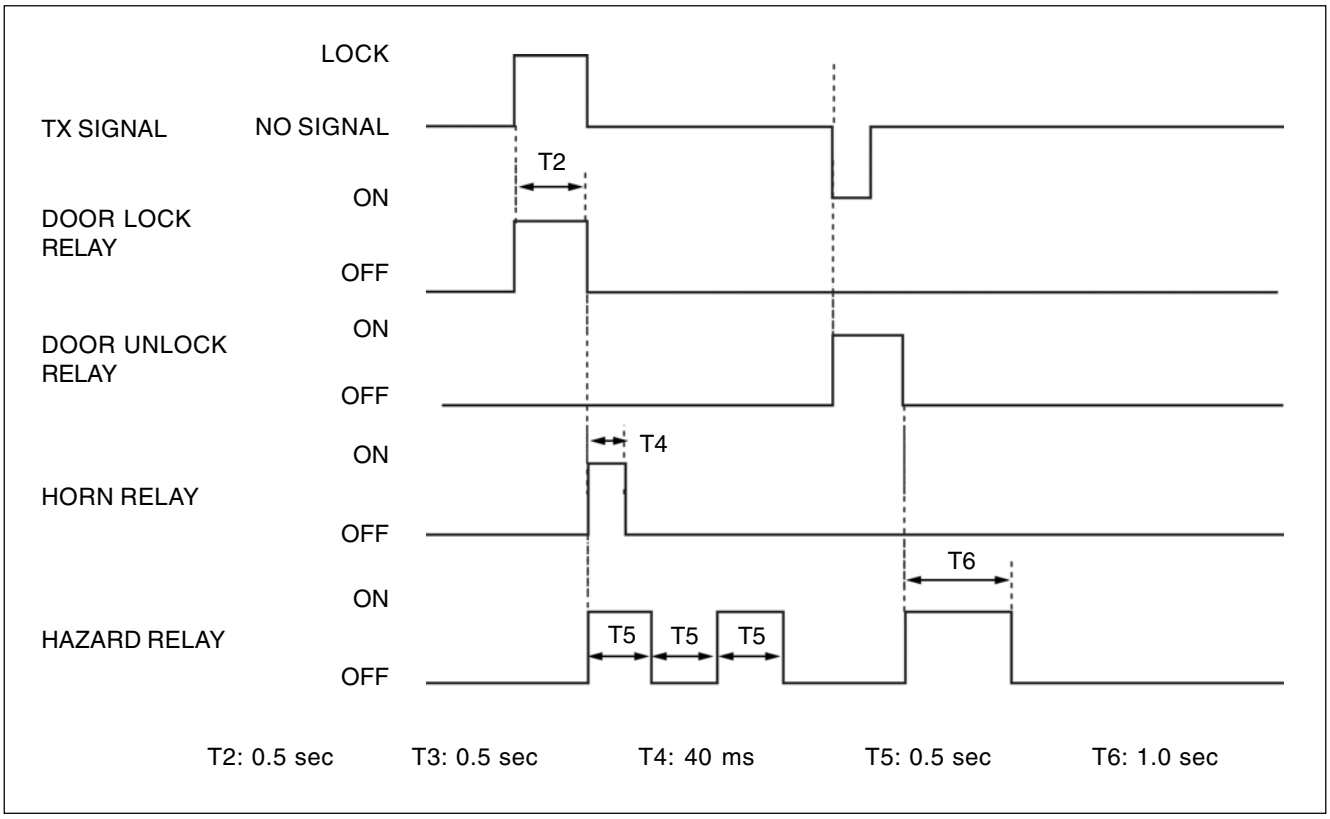
Door Lock/Unlock by Central Door Lock Switch

1. The door lock system outputs “LOCK/UNLOCK” signal for 0.5 seconds when operating the central door lock switch. (However, if the door lock switch (front doors) is at LOCK position, the system outputs UNLOCK signal, and vice versa.)
2. The “LOCK” or “UNLOCK” inputs from the central door lock switch in anti-theft mode are ignored.



Door LOCK/UNLOCK by Remote Control Key

1. The door lock relay output is “ON” for 0.5 seconds when receiving the remote control lock signal.
2. The door unlock relay output is “ON” for 0.5 seconds when receiving the remote control unlock signal.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

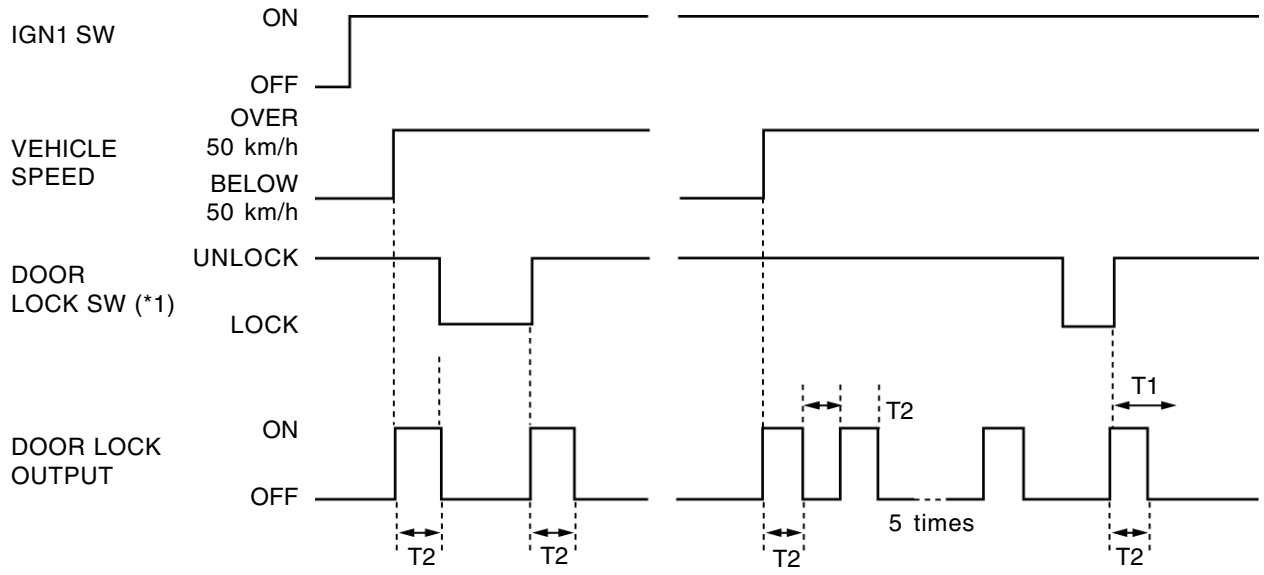
Auto Door Lock

1. The door lock system outputs “LOCK” when the vehicle speed maintains over 50 km/h.

   However, it doesn't output “LOCK” when all doors are locked or failed.
2. If any of doors is unlocked after outputting “LOCK” in step 1, outputs “LOCK” up to 5 times (except step 1) at the interval of one second.
3. If any of doors is unlocked after 5 times of "LOCK" outputs, the door is regarded as “FAIL”.
4. If the door that was regarded as fail changes (UNLOCK to LOCK) to unlock, only one “LOCK” output will be done.
5. If any door is regarded as FAIL, the auto door lock function does not work (if it is occurred when the vehicle speed is over 50 km/h, the auto door lock output does not occur even if the vehicle speed falls below 50 km/h and accelerates again to over 50 km/h.). Nonetheless, the central door lock function works properly.
6. When the system receives “UNLOCK” signal from a door switch, it outputs “LOCK” signals 5 times. If additional “LOCK” signal from another door switch is detected during the period, the system outputs five “LOCK” signals 5 times for the door.
7. The door lock system outputs “UNLOCK” automatically if the “LOCK” output conditions are established by this function or the key is cycled (IGN1=OFF) (even when there is no “LOCK” output while the vehicle speed maintains over 50 km/h under lock condition).

   (If the LOCK condition is established with the ignition switch ON, the system outputs UNLOCK signal unconditionally when turning the ignition switch to OFF position.)

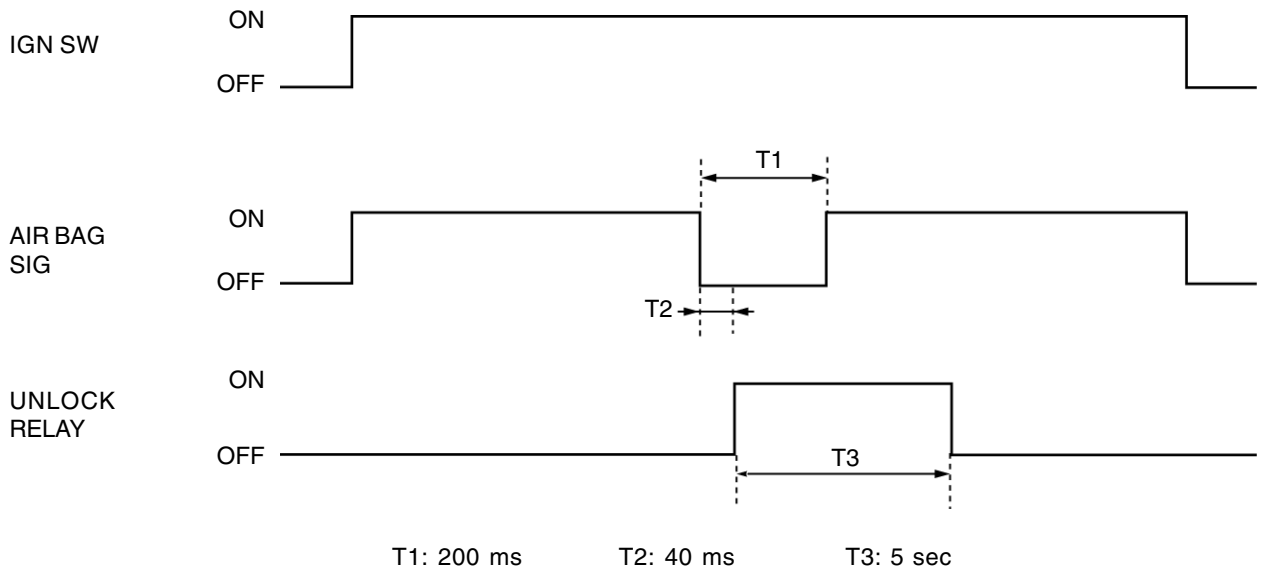
   However, when the ignition key is turned to “OFF” position, the lock output conditions will be cancelled.
8. The “FAIL” condition of the door will be erased when the ignition key is turned to “OFF” position.



T2: 0.5 sec
(*1) LOCK: All door lock switches (including tailgate) = LOCK
UNLOCK: Any of all door lock switches = UNLOCK

Auto Door Unlock (Crash Unlock)

1. The air bag collision signal input cannot be accepted within 7 seconds after turning the ignition key to “ON” position.
2. After this period, the door lock system outputs “UNLOCK” for all doors for 5 seconds from 0.4 seconds after receiving the air bag collision signal.
3. Even though the key is turned to “OFF” position during the output of “UNLOCK”, the output continues on for remaining period.
4. The function is erased when turning “off” the IGN switch.



CAUTION

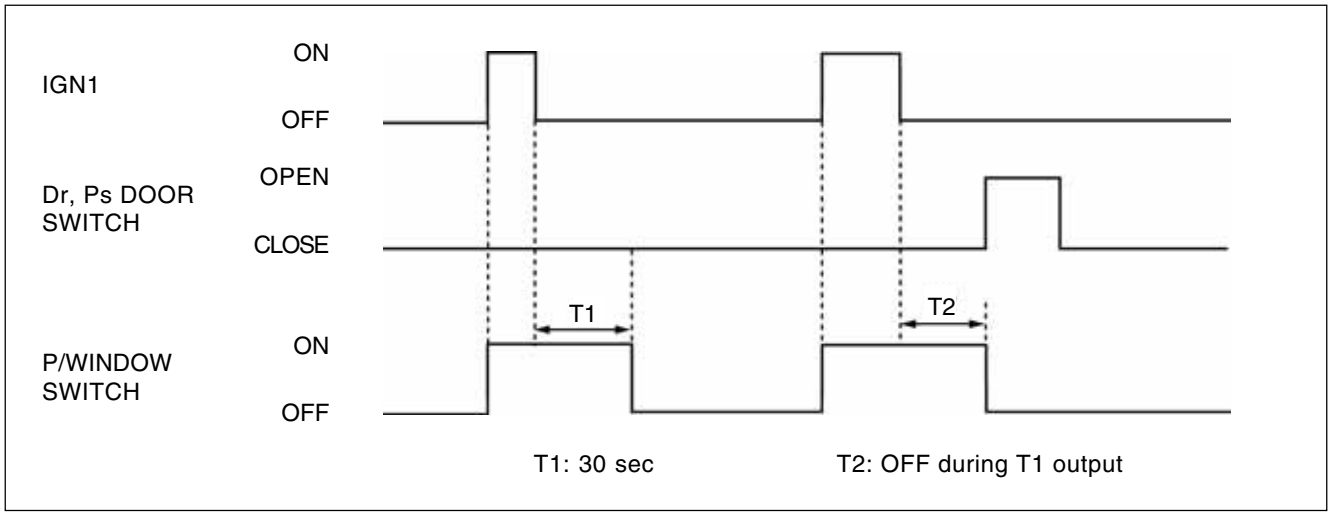
- **The “Unlock” control by air bag signal prevails over any “LOCK” or “UNLOCK” control by other functions.**
- **The “LOCK/UNLOCK” request by other functions will be ignored after/during the output of “UNLOCK” by the air bag.**

  However, the door lock is controlled by other functions when the ignition switch is “OFF”.
- **“LOCK” (or “UNLOCK”) output is ignored if “LOCK” (or “UNLOCK”) output is required while performing the output of “LOCK” (or “UNLOCK”).**
- **If the door lock system outputs “LOCK” and “UNLOCK” simultaneously, only the “LOCK” output can be activated.**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Time Lag Power Window Control

1. The power window relay output is “ON” when turning on the ignition switch.
2. The power window relay output is “ON” for 30 seconds when turning off the ignition switch.
   The power window relay output is “OFF” when opening the driver’s door or the passenger’s door.
3. The power window relay is turned “OFF” when receiving the remote control key lock signal (armed mode) during its extended operation period of 30 seconds.



Definition of Terms

1. DOOR OPEN and DOOR CLOSE
   DOOR OPEN: Any of all door switches (including hood and tailgate) is in "OPEN" position.
   DOOR CLOSE: All door switches (including hood and tailgate) are in "CLOSE" position.

CAUTION

The door lock/unlock operation does not affect the engine hood.

2. DOOR LOCK: Indicates that all door lock switches (including tailgate) are in LOCK positions.
   DOOR UNLOCK: Indicates that any of all door lock switches (including tailgate) is in UNLOCK position.

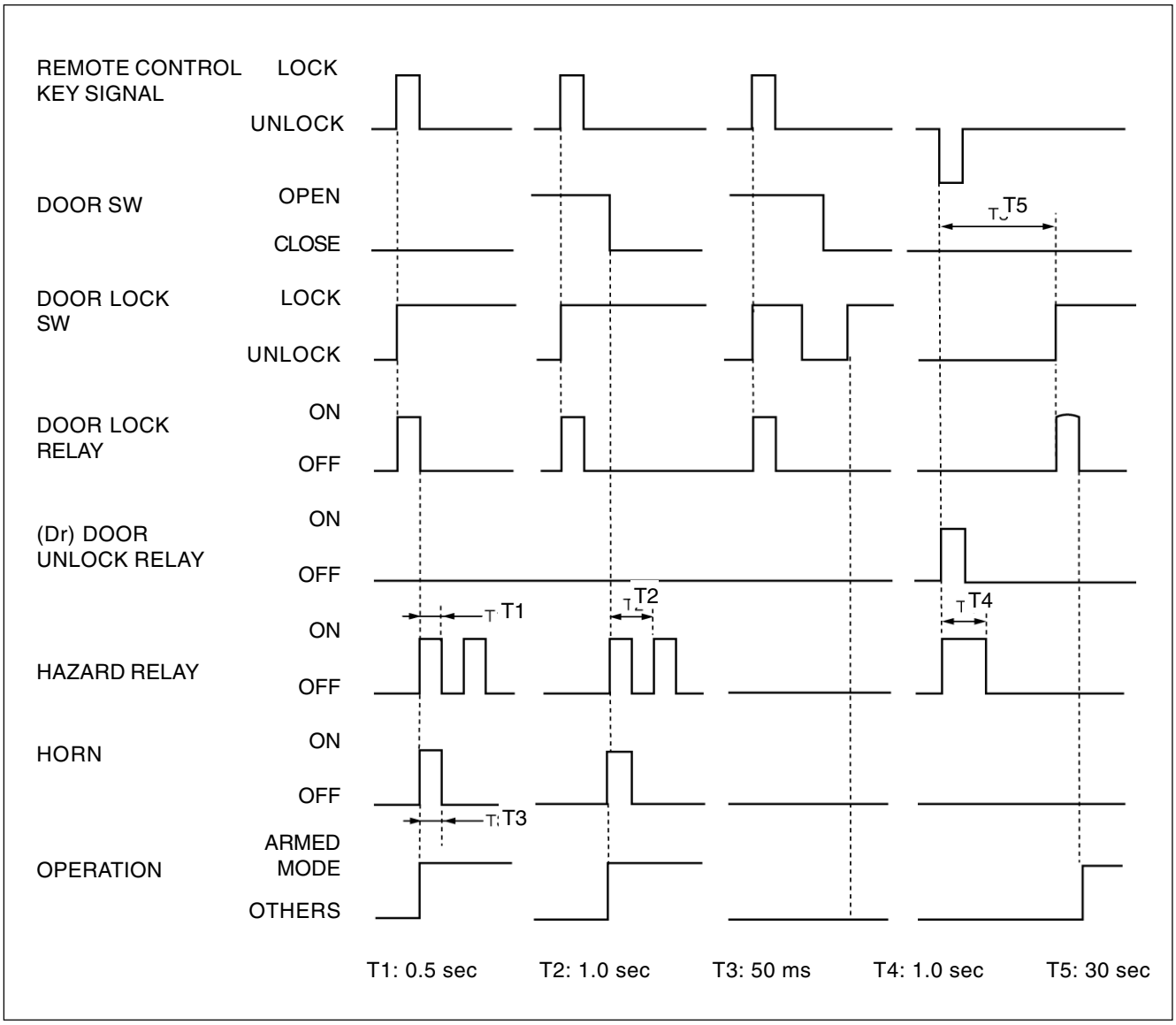


Engine hood open warning lamp
The warning lamp comes on when the engine hood is open.

Description of Burglar Alarm Function

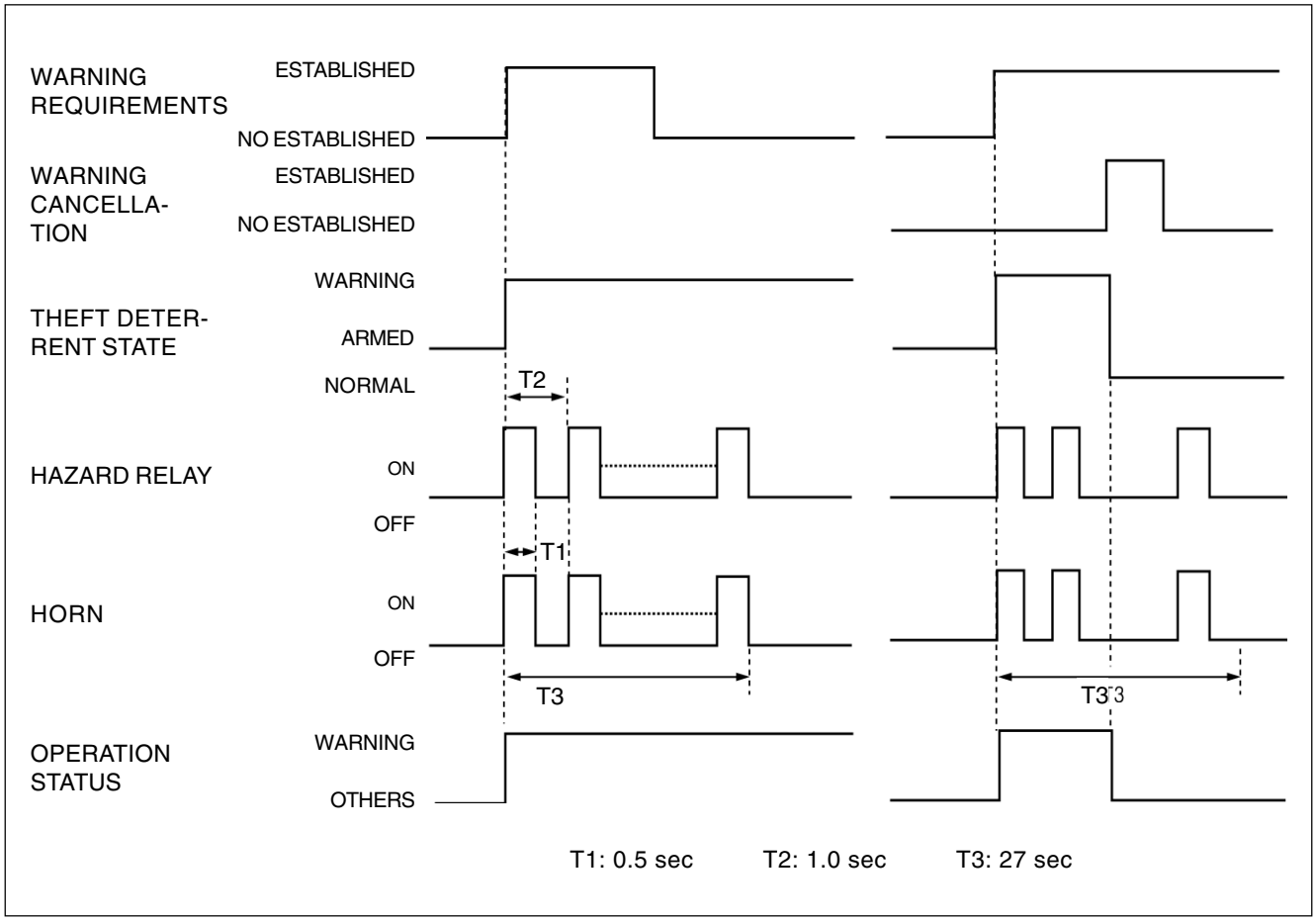
1. Armed mode activation requirements
   1) The “LOCK” output is “ON” when receiving the “LOCK” signal from transmitter while the ignition key is removed and all doors are closed. The armed mode is activated when the door lock switch is locked (theft deterrent horn output: once, hazard relay output: twice).
   2) The theft deterrent horn and hazard relay outputs are “ON” when receiving the “LOCK” signal from the remote control key again in armed mode (theft deterrent horn output: once, hazard relay output: twice).
   3) When receiving “LOCK” signal from the remote control key while any of doors is not closed, only the “LOCK” output can be done and then activates the armed ready mode (without theft deterrent horn and hazard warning flasher). At this moment, if the ignition key is in the ignition switch, the door unlock switch is turned “ON” or the door lock switch is unlocked, it cancels the armed mode and activates the normal mode.
   4) When the door is not opened or the ignition key is not inserted into ignition switch for 30 seconds after receiving “UNLOCK” signal, it outputs “LOCK” and then activates armed mode (RELOCK operation). Also, at this moment, the system outputs hazard warning flasher twice.
   5) The armed mode will not be activated except above conditions.

   Ex) The armed mode will not be activated when the door is locked by the ignition key.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. Armed mode cancellation requirements
   1) Unlocking by remote control key or engine starting.
3. Warning operation requirements
   1) When opening the door in armed mode
   2) When unlocking the door lock switch in armed mode by other than the remote control key
   3) When closing and then opening the door after completion of warning (27 seconds)
4. Warning operation
   1) The theft deterrent horn and hazard warning flasher output is “ON” for 27 seconds with the interval of 1 second.
5. Warning cancellation requirements
   1) Cancels warning by using any signal from the remote control key (LOCK, UNLOCK, PANIC) during warning operation.
   2) Cancels warning after 27 seconds (remaining period) while the ignition key is turned to “ON” position.
   3) If the ignition switch is turned to ON position when the warning is activated in armed mode, the warning is canceled immediately and the warning buzzer stops after 27 seconds (remaining time).
6. Operation when warning is cancelled
   1) The theft deterrent horn and hazard warning flasher outputs are “OFF”.



8. Operations when removing and installing the battery

Removed \ Installed	Normal	Armed	Warning	Remark
Normal	○			
Armed Ready	○			
Armed		○		
Warning			○	
Warning Completion	○	○	○	
RELOCK Ready	○			

If the system is in armed mode while installing a battery, the horn sounds and the emergency warning lamp blinks (Same operations with warning in armed mode).

RELOCK Operation

It the door is not opened or the ignition key is not inserted into the key cylinder within 30 seconds after unlocking the door with remote control key, the system outputs “LOCK” signal and activates the armed mode.

Specifications of Remote Control Key

When any of switches on remote control key is pressed, the integrated CPU in remote control key sends the coded control message to the CPU in receiver to control the vehicle.

Switch Functions on Remote Control Key

Function		Switch Operation
Function	Door lock	Briefly press the switch briefly
	Door unlock	Press and hold the door switch
	PANIC	Briefly press the panic button



Door button

1. Door lock (press briefly)
   1) The door is locked and it goes into the armed mode when pressing this button for 0.1 ~ 0.5 seconds.
2. Door unlock (press and hold)
   1) The door is unlocked and it gets out of the armed mode when pressing this button for 0.5 ~ 1.0 seconds.
   2) The front room lamp comes on for 30 seconds when receiving door unlock signal by the remote control key while the front room lamp coupled switch is pressed. It is turned off when receiving the LOCK signal from the remote control key.

Receiver

1. Operating requirements
   IGN Key = OUT (removed)
2. Code registration requirement
   Codes can be registered only through SCAN-100.
3. Transmitter Code Registration
   1) Up to five transmitter codes can be registered.
   2) The received code cannot be output during the registration.
   3) Both single REKES and dual REKES must be encoded through the SCAN-100.



▶ Coding Procedure for REKES Key

When the REKES key (transmitter) is lost or coded for the first time, use the SCAN-100.

1. Connect a SCAN-100 and select DUAL REKES in Actyon model.

CONTROL UNIT SELECTION	
ACTYON ECU	
01] ECU	08] FFH
02] TCU	09] DUAL REKES
03] ABS/ESP	
04] AIR-BAG	
05] TCCU(Part Time)	
06] IMMOBILIZER	
07] RK-STICS	
Select one of the aboce items	

2. Press ENTER in the following screen.

FUNCTION SELECTION
ACTYON REKES
01] REKES REMOCO ID CODING
Select one of the aboce items

3. Press YES in the following screen to code the REKES key.

The existing code is deleted.

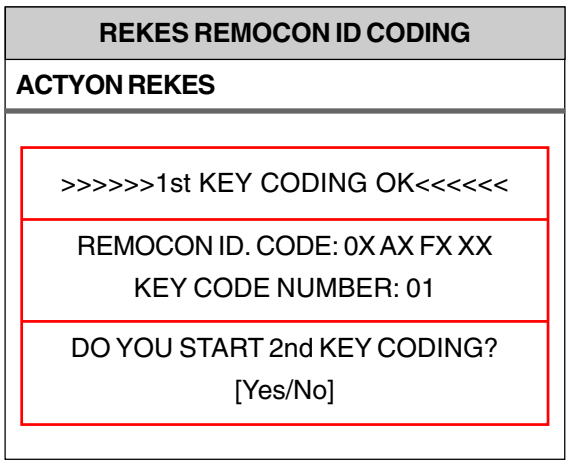
REKES REMOCON ID CODING
ACTYON REKES
DO YOU START REKES CODING?
[Yes/No]

4. Press any button on the remote control key for 0.5~1.5 seconds. A "beep" sound is heard.

REKES REMOCON ID CODING
ACTYON DUAL REKES
PROCESSING THE CODING
Press the remocon button (About 0.5-1.5 second)

To next page

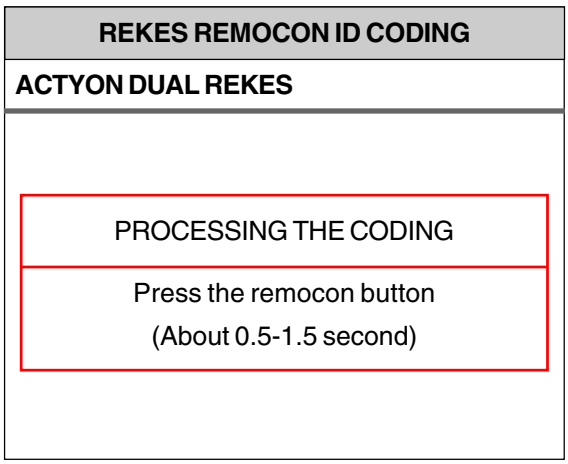
5. When the first key coding is completed, the following screen is displayed. Press YES to perform the second REKES key coding.



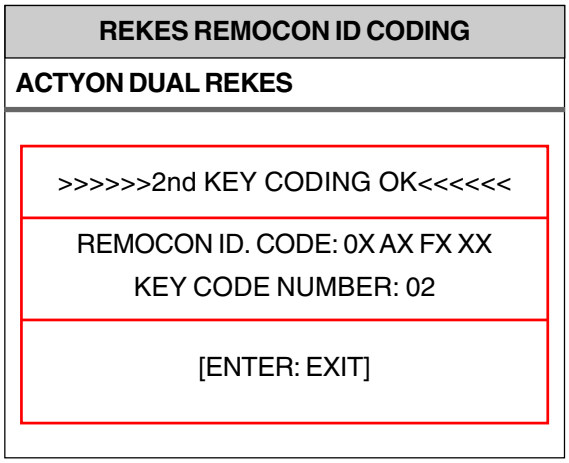
NOTE

The second REKES coding applies only to the condition if there is secondary REKES.

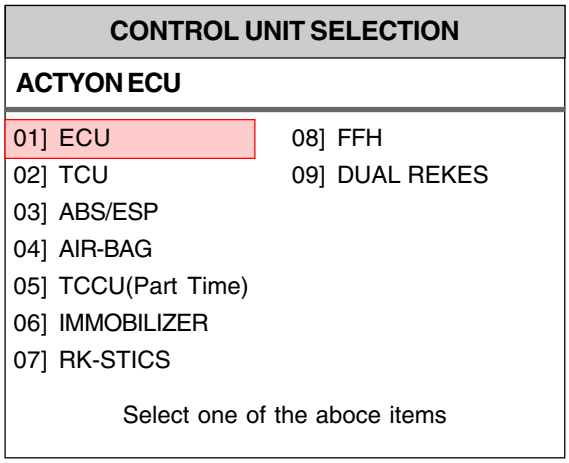
6. Press any button on the secondary remote control key for 0.5~1.5 seconds. A "beep" sound is heard.



7. When the second key coding is completed, the following screen is displayed. Press ENTER to finish the REKES key coding.



8. When the coding is completed, it returns to the following screen.



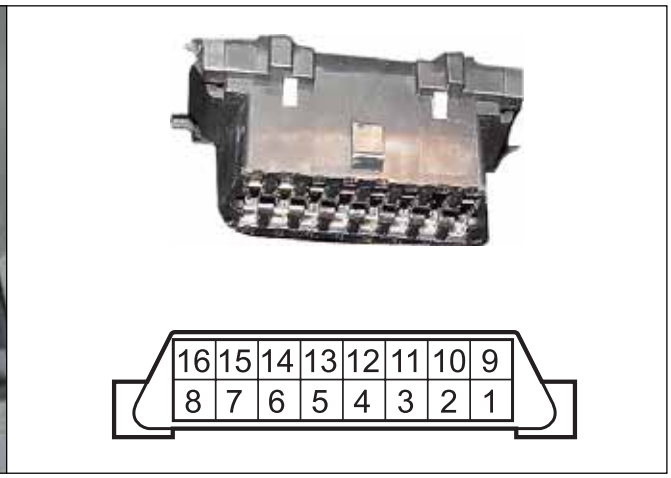
9. Exit SCAN-100 screen and disconnect it from the diagnostic connector to check the function of the remote control key. If it does not function, perform the above procedures again.

▶ Pin Arrangement of Diagnostic Connector

It is installed under the instrument panel and consists of 16 pins.

The REKES key coding should be performed with Scan-I.



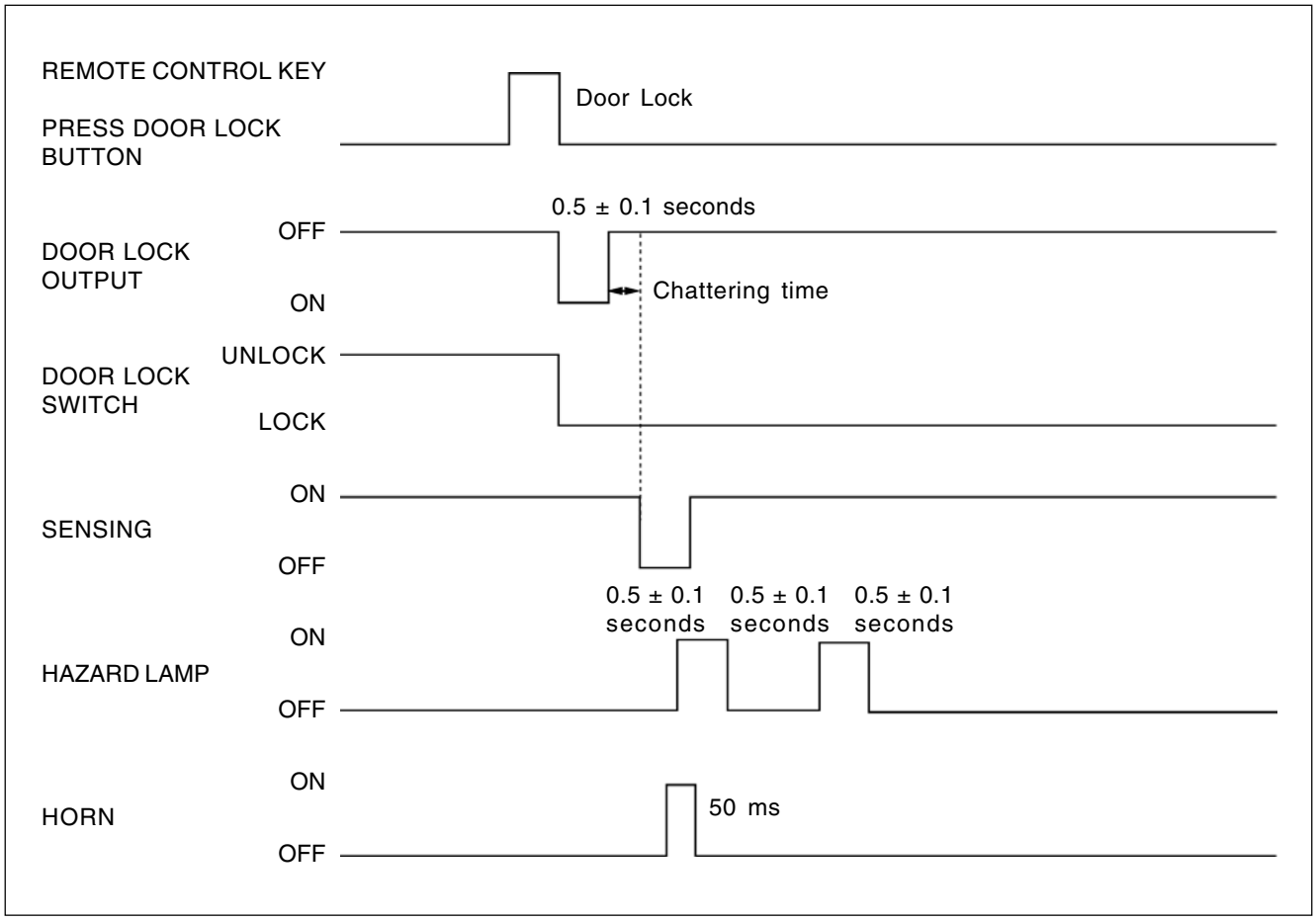


▶ Functions of Terminal

Pin no. 1	FFH diagnosis
Pin no. 2	FFH forced driving
Pin no. 3	STICS
Pin no. 4	Ground
Pin no. 5	Signal ground
Pin no. 6	CAN - HIGH
Pin no. 7	Engine ECU
Pin no. 8	ABS / ESP
Pin no. 9	Air bag
Pin no. 10	-
Pin no. 11	TCU
Pin no. 12	-
Pin no. 13	TCCU
Pin no. 14	CAN - LOW
Pin no. 15	REKES coding
Pin no. 16	Battery +

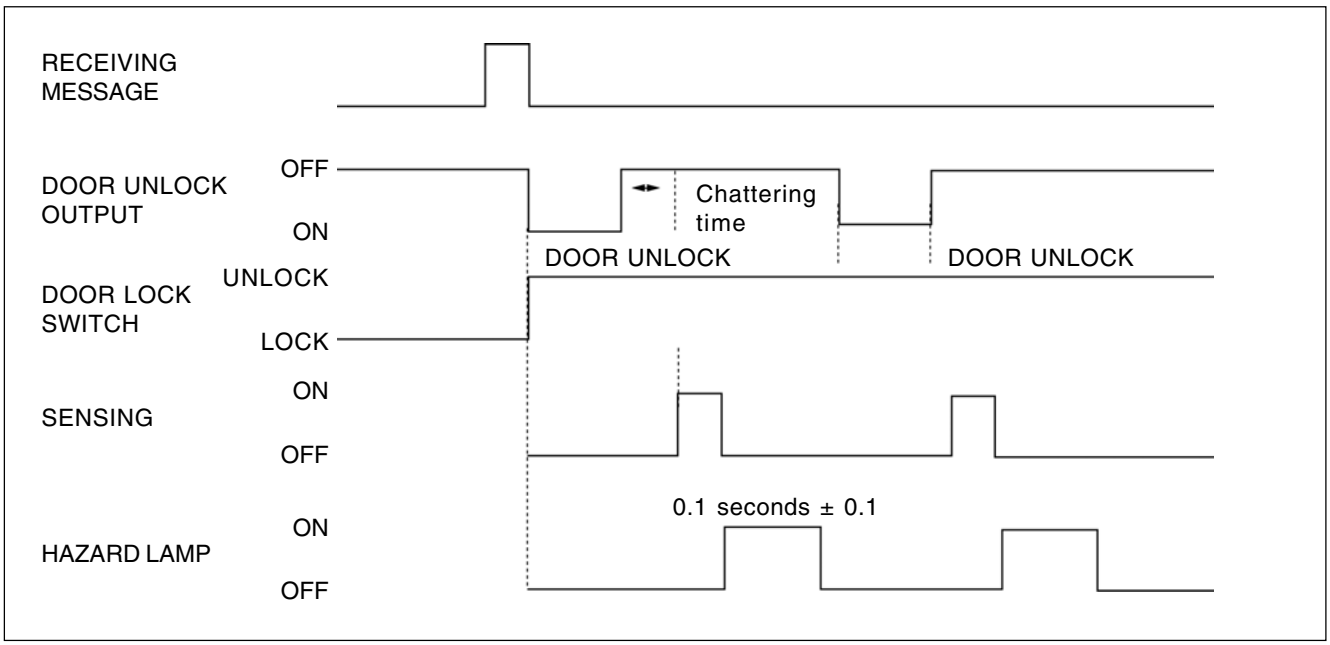
Remote Door Lock

1. All doors are locked when briefly pressing the door LOCK switch on remote control key (less than 0.5 seconds).
2. The system outputs LOCK signal immediately after receiving the door lock message from the remote control key. The system activates the theft deterrent mode when all doors are locked while they are fully closed (the hazard warning lamps blink twice.).



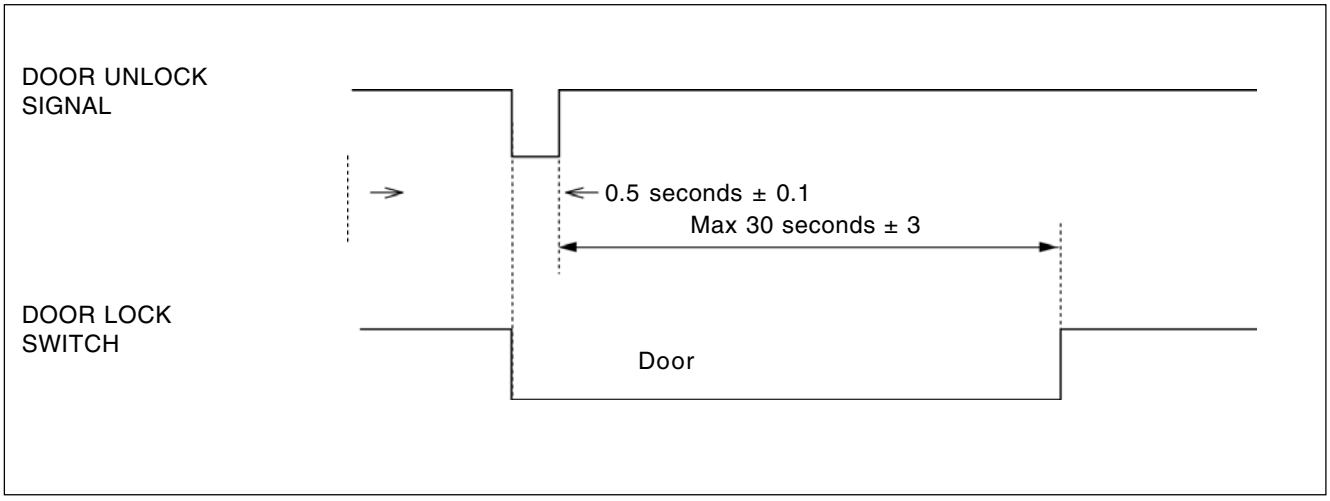
Door Unlock

1. The door unlock operates when pressing the door switch on the remote control key for longer than 0.5 seconds.
2. The door unlock relay is “ON” for 0.5 seconds when receiving the door unlock message from the remote control key.
3. The hazard warning lamps blink once only when all the doors unlocked.



Auto Door Lock in 30 Seconds after Pressing Door Unlock Button

1. If no door is opened for 30 seconds after inputting remote door unlock, the doors are automatically locked and the armed mode of anti-theft system is activated again.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. DIAGNOSIS TROUBLE CODE AND HELP TIPS

Fault Code	Malfunction	Descriptions
01	Dr Door Lock Knob	Driver's door lock knob is not operated when locking/unlocking doors.
02	Ps Door Lock Knob	Passenger's door lock knob is not operated when locking/unlocking doors.
03	Rr Door Lock Knob	Rear door lock knob is not operated when locking/unlocking doors.
04	T/Gate Lock Knob	Tailgate lock knob is not operated when locking/unlocking doors.
05	Door Lock Output	All door lock knob are not moved to lock position even when the door lock relay is activated.
06	Door Unlock Output	All door lock knob are not moved to unlock position even when the door unlock relay is activated.
07	C/DR Lock Output	Doors are locked by central door lock switch while the engine is running.
08	DR Lock Output	Doors are locked by driver's door lock switch while the engine is running.
09	PS Lock Output	Doors are locked by passenger's door lock switch while the engine is running.
10	Auto Door Lock Output	Door lock knob is not moved to lock position when the system outputs auto door lock signal while the ignition switch is in ON position and the vehicle speed is over 50 km/h.
11	Auto Door Unlock Output	Door lock knob is not moved to unlock position after receiving the output from collision sensor.
12	Wiper Output	The WIPER P-POS signal is not detected when the wiper relay is activated.
13	SPEED SIGNAL	The vehicle speed over 3 km/h is detected at the speed signal area while the ignition switch is in ON position and the alternator signal is "D" LOW.
14	INT WIPER Volume	The circuit is open (over 4.5 V) when changing the INT volume in the speed sensitive INT wiper (saved as history error).
15	SPEED SENSOR	The vehicle speed over 200 km/h is detected (saved as history error).
16	A/BAG COLLISION SENSOR INPUT	A signal is sent to the collision sensor input area while the ignition switch is in OFF position (saved as history error unconditionally).
17	A/BAG COLLISION SENSOR OUTPUT	The RKSTICS outputs UNLOCK signal after receiving collision sensor input while the ignition switch is in ON position (saved as history error).
18	A/BAG COLLISION MONITOR	The STICS outputs the Door Unlock signal due to the collision sensor and the feedback value is in proper range (saved as history error).
19	Door Ajar Warning IND	The door warning indicator blinks when the vehicle speed is over 10 km/h (saved as history error).
20	PARKING BRAKE IND	The parking brake indicator blinks when the vehicle speed is over 10 km/h (saved as history error).
21	Auto Washer Out	The auto washer output is not sent to the front washer (saved as history error).
22	WASHER RELAY	The front washer switch receives the input signal for more than 10 seconds (saved as history error).

Fault Code	Malfunction	Descriptions
23	REMOCON VOLTAGE CHECK	The voltage from remote control key is saved as history error.
24	SBR S/BELT SW (Only EU)	When the seat belt switch circuit is OPEN (HIGH) in KEY OUT & ARMED MODE, the system recognizes it as FAIL and saves it as History error (Normal Close (GND)).
25	SBR SENSOR (Only EU)	When the sensor value is recognized in KEY OUT & ARMED MODE, the system saves it as History error.
26	SBR CONNECTION (Only EU)	When the seat belt switch circuit maintains OPEN (HIGH) in KEY OUT & ARMED MODE while the vehicle speed is over 50 km/h, the system saves it as History error.

Removal and Installation

※ **Preceding Works:**

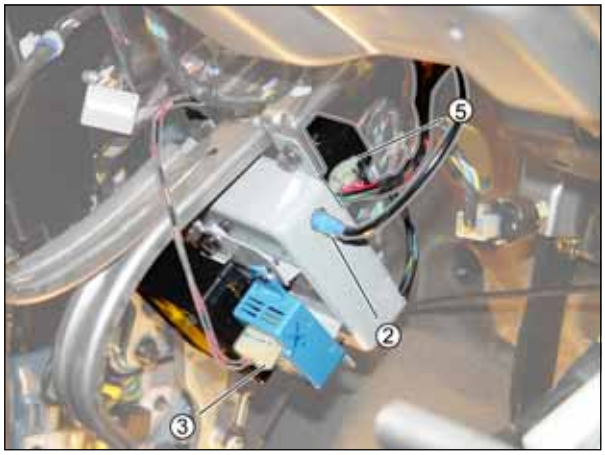
1. Disconnect the negative battery cable.
2. Remove the lower panel in front of driver's seat. (For details, refer to BODY section.)



1. Disconnect the connectors from STICS unit and chime buzzer and remove the RKSTICS antenna.

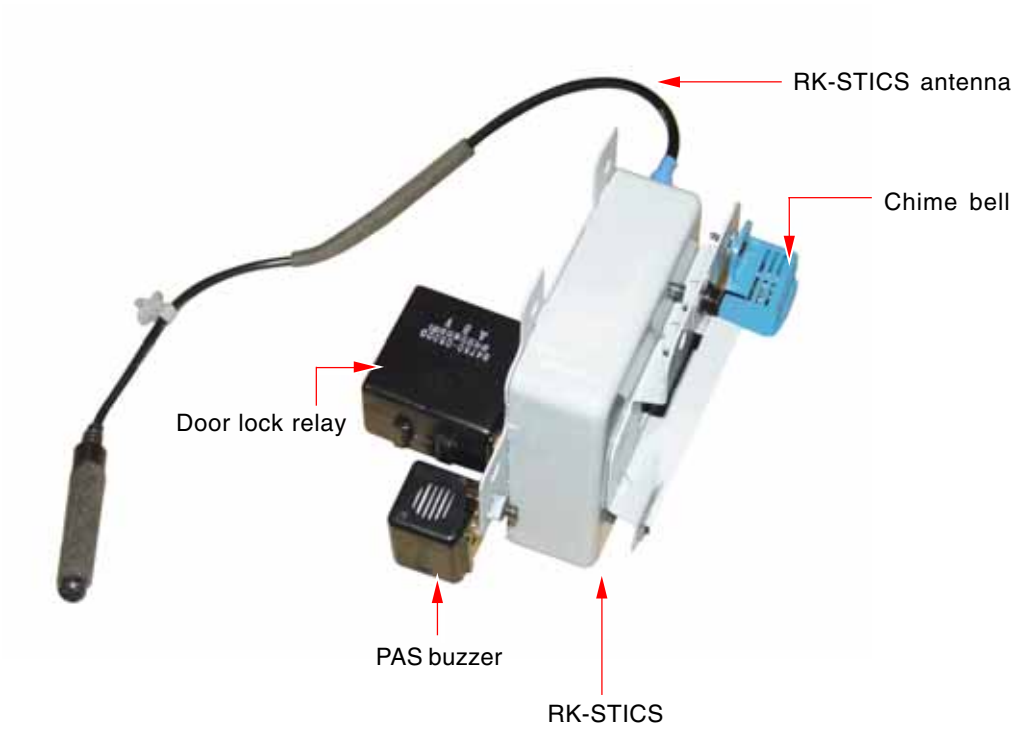


1. STICS connector
2. STICS antenna
3. Chime buzzer connector



4. PAS buzzer connector
5. Door lock/unlock relay connector

2. Unscrew two mounting bolts (10 mm) and remove the STICS unit.



3. Separate the STICS unit.

STICS Unit



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

IMMOBILIZER SYSTEM

7010

TABLE OF CONTENTS

IMMOBILIZER SYSTEM 2

1. Overview 2
2. Basic functions of immobilizer key (REKES function) 3
3. Other functions in system 4
4. Circuit diagram 6
5. Rekes operation logic 7
6. Immobilizer coding and removal of immobilizer unit 9
7. Actyon immobilizer coding procedure 10

IMMOBILIZER SYSTEM

1. OVERVIEW

What is the immobilizer system?

The immobilizer system prevents the vehicle theft by allowing only the authorized key to start the engine. The transponder inside the key communicates with the immobilizer installed in the key box, and the system permits the engine to start after confirming the encrypted coding from the engine ECU. Refer to the information that follows for specific functions and their descriptions.





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. BASIC FUNCTIONS OF IMMOBILIZER KEY (REKES FUNCTION)

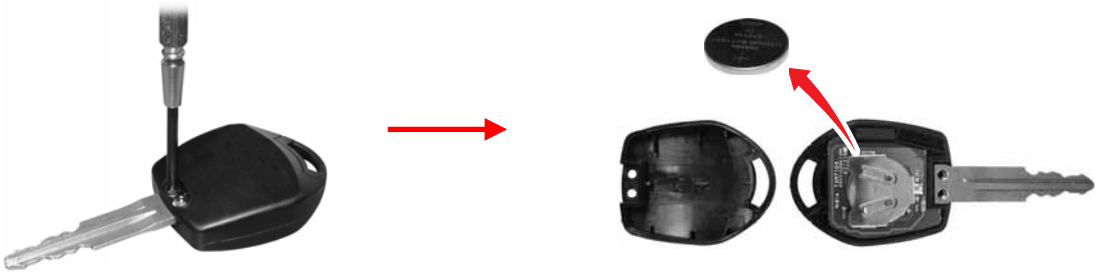
The information below is the function that applies to the REKES key and immobilizer key.

1. Door and tailgate lock (briefly press)
   All doors and tailgate are locked and the vehicle the theft deterrent mode is activated.
2. Door and tailgate unlock (press and hold)
   All doors and tailgate are unlocked and the theft deterrent mode is deactivated. The front room lamp and the center room lamp come on for 30 seconds. The lamps go off immediately when the LOCK signal is sent from the remote control key (room lamp coupled function).



Battery Replacement

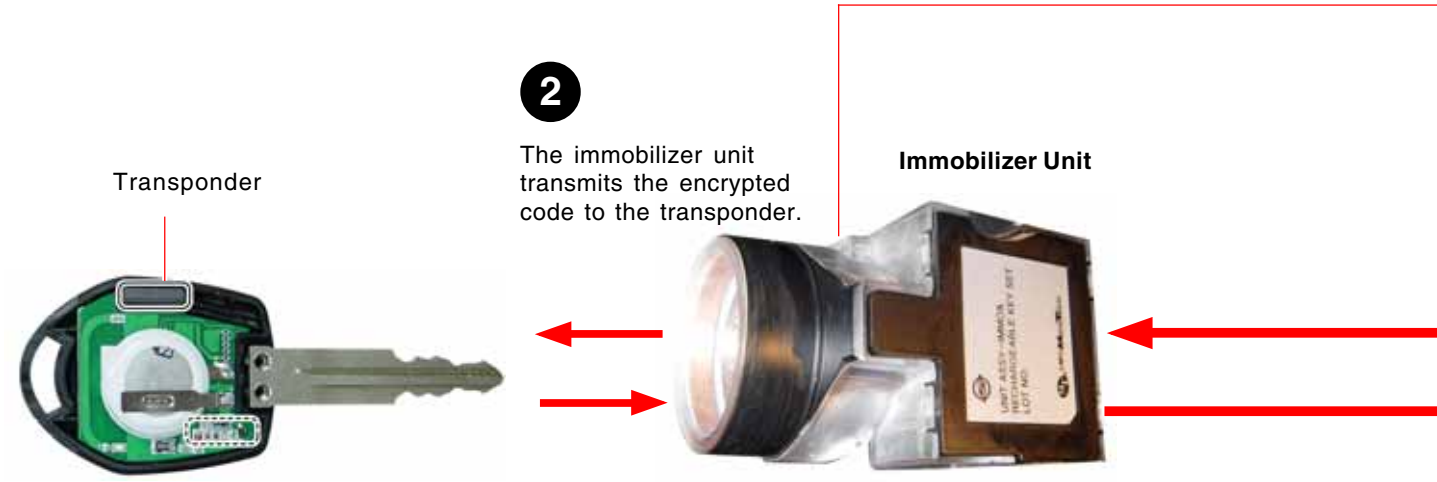
Specification	CR 2032
Quantity	one



3. OTHER FUNCTIONS IN SYSTEM

▶ Immobilizer Function

The immobilizer system prevents the vehicle theft by allowing only the authorized key to start the engine. The transponder inside the key communicates with the immobilizer installed in the key box, and the system permits the engine to start after confirming the encrypted coding from the engine ECU.



NOTICE

In the following cases, a driver may be unable to start the vehicle with the immobilizer.

- **When two or more immobilizer keys come into contact with (each) other(s).**
- **When the key is close to any device sending or receiving electromagnetic fields or waves.**
- **When the key is close to any electronic or electric devices such as lightening equipment, security keys or security cards.**
- **When the key is close to a magnetic or metal object or a battery.**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Immobilizer and Warning Lamp



This indicator comes on when the ignition key is communicating with the engine control unit (during engine starting) and goes out after starting the engine.

Lamp ON: in communication

Blinking twice for one second:
immobilizer system failure

Blinking once for two seconds:
immobilizer unit is not coded

NOTICE

The immobilizer indicator does not come on if the communication time between immobilizer key and ECU is too short.

1 When turning the ignition key to ON position, the ECU transmits the challenge message to the immobilizer unit. (to verify whether the key is valid)

Engine Control Unit (ECU)

6 Only when the two signals are identical, it recognizes the key as the authorized one and transmits the positive message to the ECU.

7 The ECU enable the engine to be started.

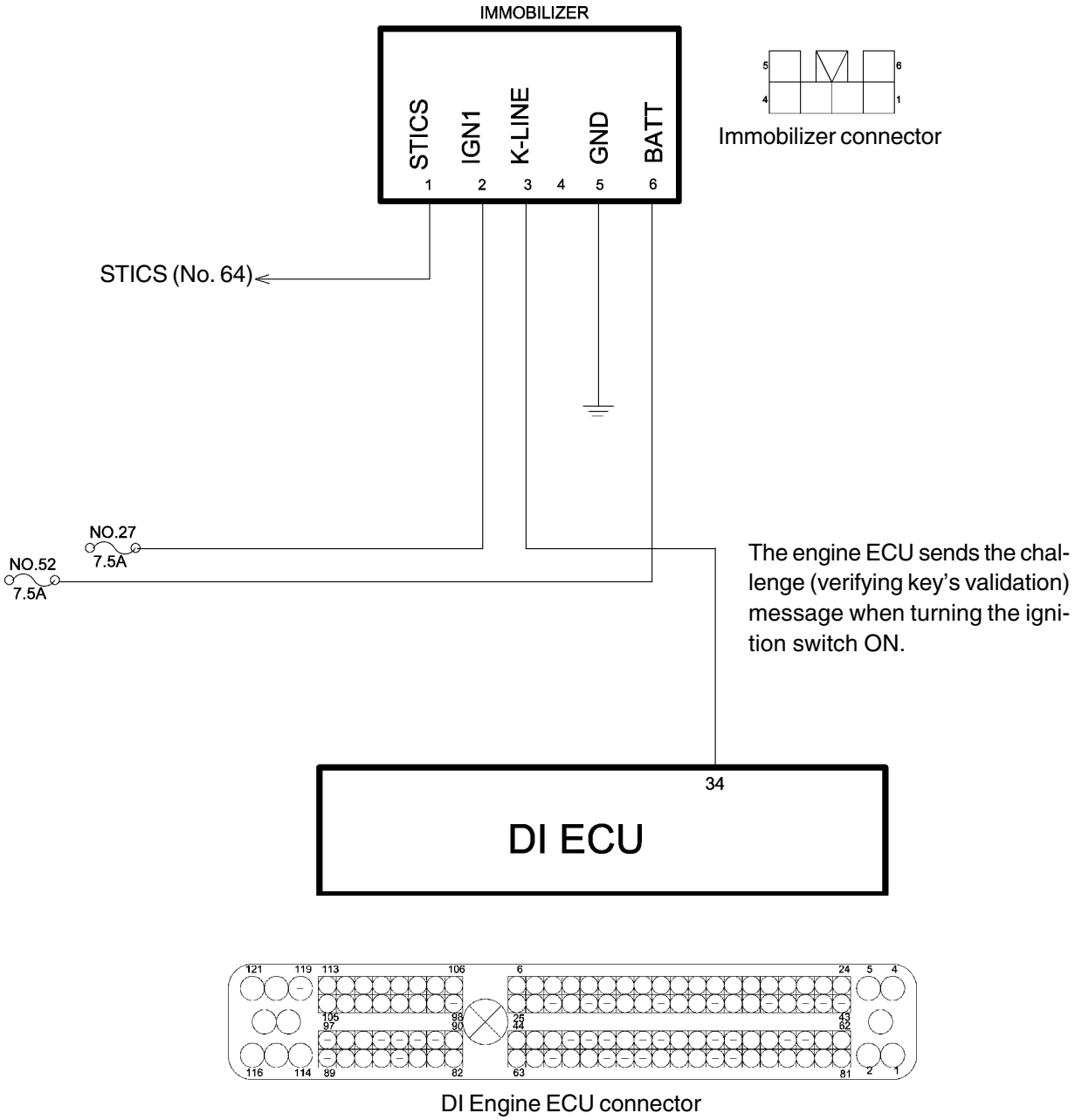
NOTICE

- **Do not drop or shock to the transponder in the key as it may be damaged.**
- **With a damaged transponder, the engine cannot be started.**
- **When you erase the code or register an extra key, let the owner attend on the site.**

NOTICE

- **In any case, the immobilizer system can not be removed from the vehicle. If you attempt to remove it and damage the system, starting will be impossible, so never attempt to remove, damage or modify it.**
- **The remote engine starter cannot be installed on the vehicle equipped with the immobilizer system.**

4. CIRCUIT DIAGRAM

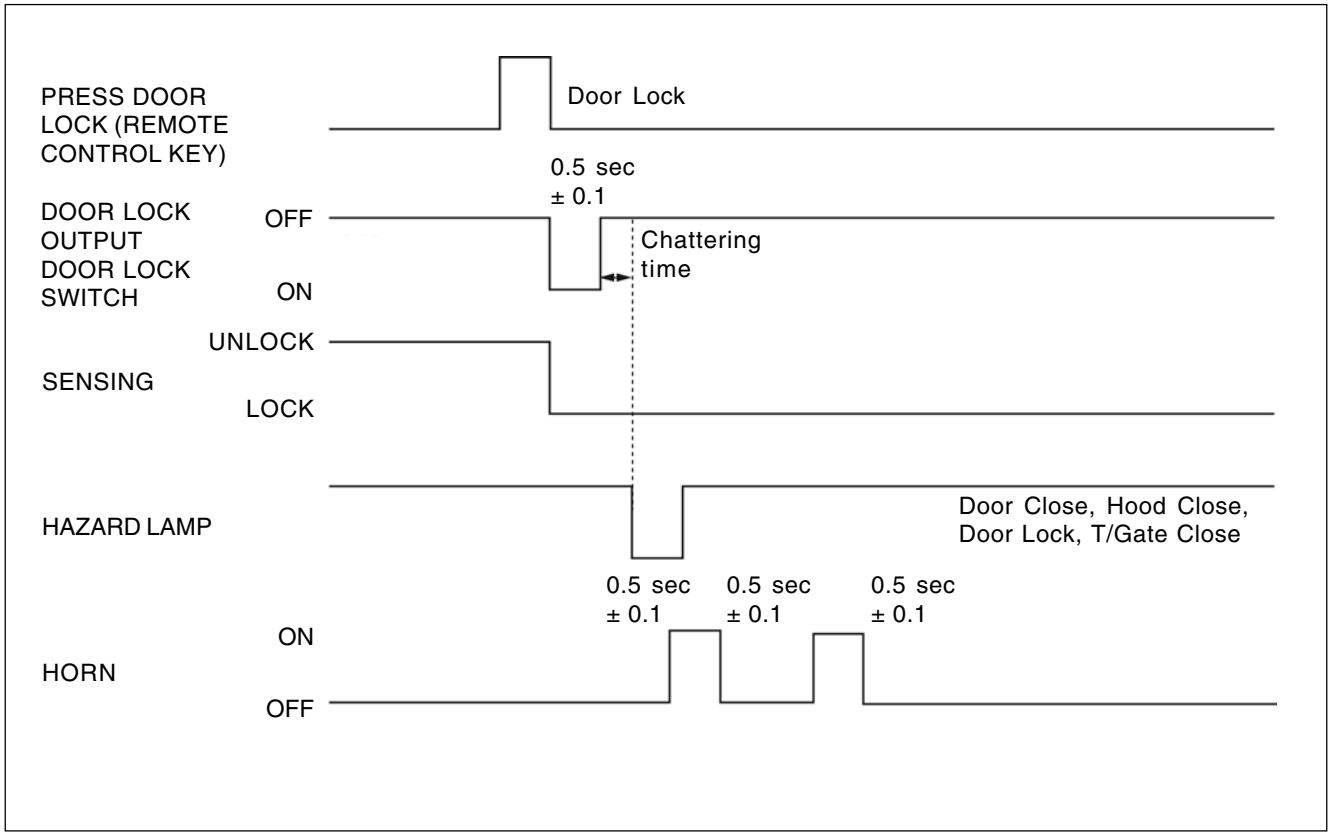


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. REKES OPERATION LOGIC

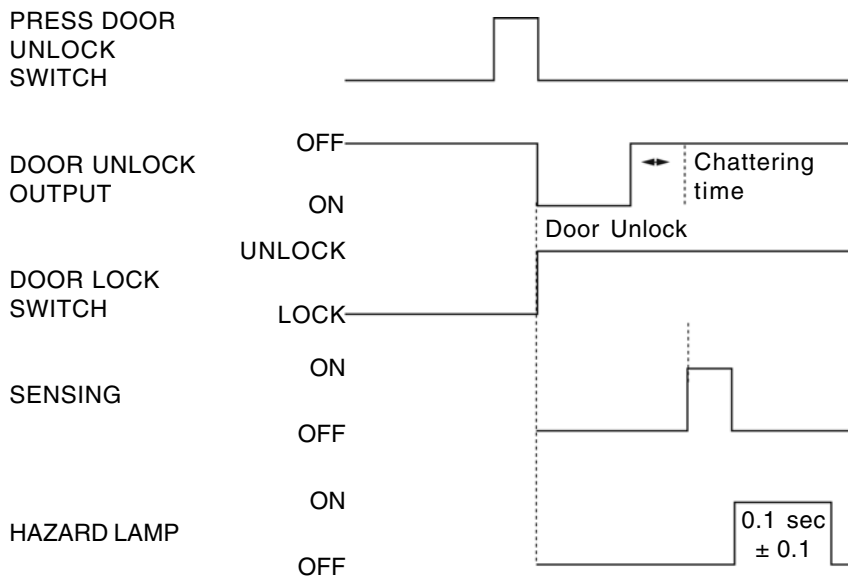
▶ Remote Door Lock

1. When briefly pressing the door lock switch on the remote control key for less than 0.5 seconds, all doors are locked.
2. The system outputs the “LOCK” signal immediately after receiving the door lock message from the remote control key. If the vehicle is locked while all doors including tailgate and engine hood are closed, the theft deterrent mode is activated (hazard warning lamps are blinking twice).



▶ Door Unlock

1. When pressing and holding the door unlock switch on the remote control key for more than 0.5 seconds, all doors are unlocked.
2. When receiving the DOOR UNLOCK message from the remote control key, the door unlock relay is turned on for 0.5 seconds.
3. The hazard warning lamps blink once only when the doors are successfully unlocked.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. IMMOBILIZER CODING AND REMOVAL OF IMMOBILIZER UNIT

When Replacing the ECU

After replacing the ECU with new one, perform the variant coding. Then, insert the ignition key and perform the immobilizer coding.

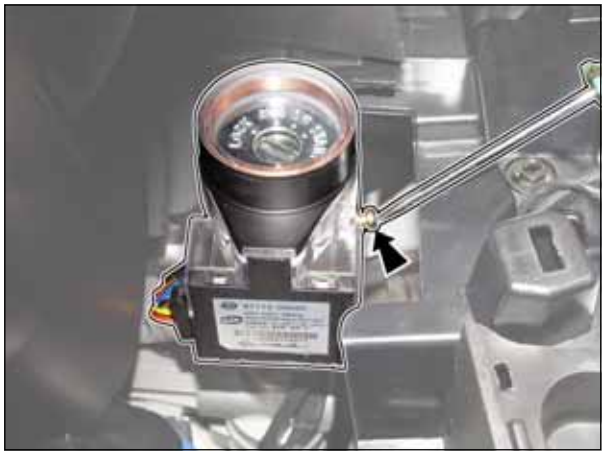
When Replacing the Immobilizer Unit or Key Head Part

When inserting an ignition key after replacing the immobilizer unit, the ECU transmits the challenge message and waits for the response message. The immobilizer unit indicator blinks with 0.5 Hz of interval to inform that the immobilizer unit is not programmed (i.e. newly replaced). In this case, the immobilizer coding should be performed.

Removal and Installation of Immobilizer Unit

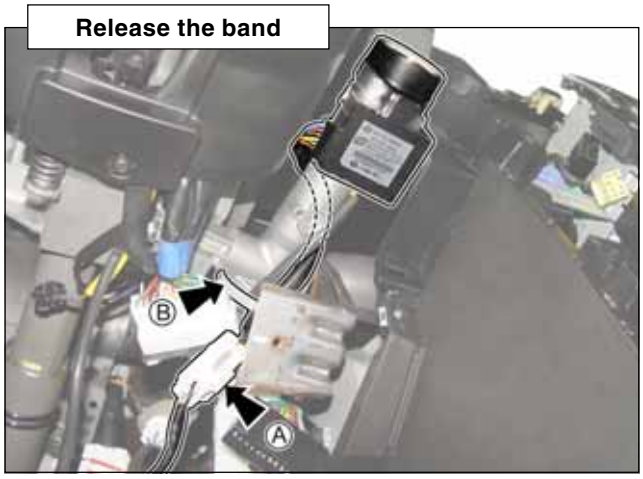
※ **Preceding Works:** 1. Remove the battery negative cable.
2. Remove the lower instrument panel (driver side) and center fescia panel.

1. Unscrew one mounting screw from the immobilizer unit.

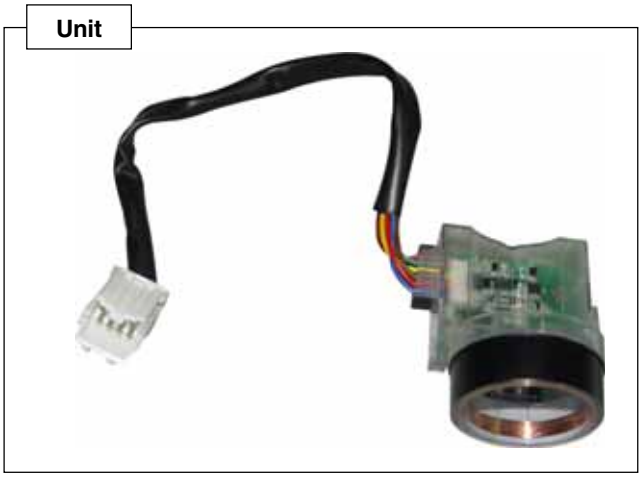


2. Release the band (B) and remove the unit connector (A).

Release the band



Unit



7. ACTYON IMMOBILIZER CODING PROCEDURE

Immobilizer Coding (SCAN - 100 to ECU)

1. Check the VIN (Vehicle Identification Number) to be coded.
2. Connect the SCAN - 100 to the diagnostic connector of the vehicle.

MAIN MENU

Diagnostics

01] DIAGNOSTICS
02] SNAPSHOT REPLAY
03] TOOL FUNCTION
04] SPECIAL MODE
05] COMBINATION
06] ECU REPROGRAM
07] DAP COMMUNICATION
08] GENERIC FUNCTION

Select one of the aboce items

Select "1" →

CONTROL UNIT SELECTION

ACTYON ECU

01] MUSSO
02] ISTANA
03] KORANDO
04] CHAIRMAN
05] REXTON
06] STAVIC/RODIUS
07] KYRON
08] ACTYON

Select one of the aboce items

↓ **Select "8"**

CONTROL UNIT SELECTION

ACTYON ECU

01] ECU
02] TCU
03] ABS/ESP
04] AIR-BAG
05] TCCU (PartTime)
06] IMMOBILIZER
07] RK-STICS
08] FFH
09] DUAL REKES

Select one of the aboce items

← **Select "6"**

IMMOBILIZER SELECTION

ACTYON IMMOBILIZER

01] IMMOBILIZER CODING
02] CONFIRM IMMOBILIZER STATUS

↓ **Select "1"**

TEST PASSWORD

ACTYON IMMOBILIZER

ENTER TEATER PASSWORD

XXXXX

Input the password "11434" →

IMMOBILIZER CODING (CONFIRM VIN)

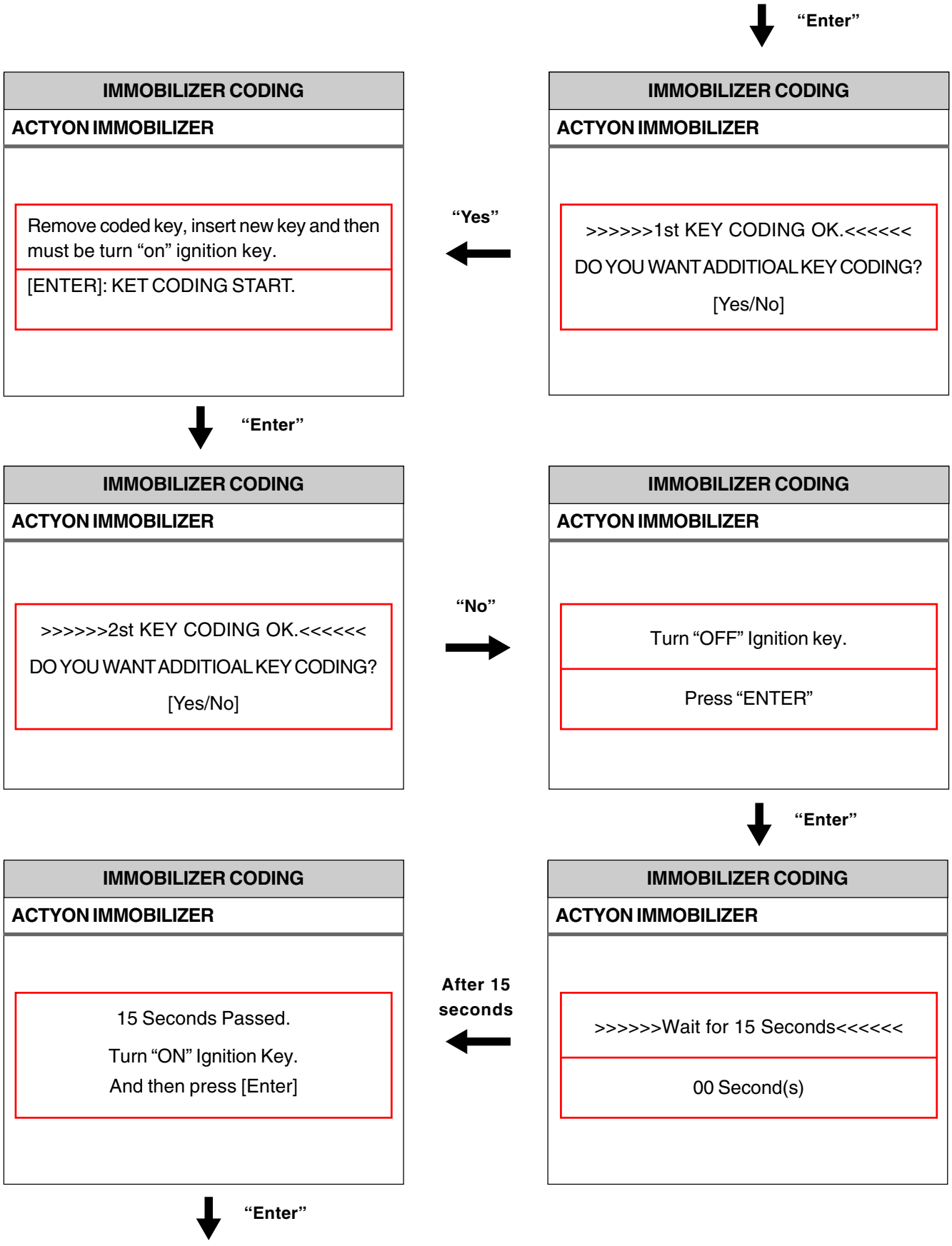
ACTYON IMMOBILIZER

VIN:XXXXXXXXXXXXX

Is it correct?

[Yes/No]

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	


"Enter"
IMMOBILIZER CODING
ACTYON IMMOBILIZER
>>>>>>1st KEY CODING OK.<<<<<<
DO YOU WANT ADDITIOAL KEY CODING?
[Yes/No]
"Yes"
IMMOBILIZER CODING
ACTYON IMMOBILIZER
Remove coded key, insert new key and then must be turn "on" ignition key.
[ENTER]: KET CODING START.
"Enter"
IMMOBILIZER CODING
ACTYON IMMOBILIZER
>>>>>>2st KEY CODING OK.<<<<<<
DO YOU WANT ADDITIOAL KEY CODING?
[Yes/No]
"No"
IMMOBILIZER CODING
ACTYON IMMOBILIZER
Turn "OFF" Ignition key.
Press "ENTER"
"Enter"
IMMOBILIZER CODING
ACTYON IMMOBILIZER
>>>>>>Wait for 15 Seconds<<<<<<
00 Second(s)
After 15 seconds
IMMOBILIZER CODING
ACTYON IMMOBILIZER
15 Seconds Passed.
Turn "ON" Ignition Key.
And then press [Enter]
"Enter"

IMMOBILIZER SELECTION
ACTYON IMMOBILIZER
01] IMMOBILIZER CODING
02] CONFIRM IMMOBILIZER STATUS

Select “2”

READ TRANSPONDER KEY DATA	
ACTYON IMMOBILIZER	
Security ID (0-3)	: XX XX XX XX
1st Key (0-1)	: 4C 21
2nd Key (0-1)	: 7E D9
3rd Key (0-1)	: 00 00
4th Key (0-1)	: 00 00
5th Key (0-1)	: 00 00
Standard keys	: 02
Coding Date	: 2006-MM-DD
Tool Signature	: 00 02 00

CLUSTER

8010

TABLE OF CONTENTS

INSTRUMENT CLUSTER 2

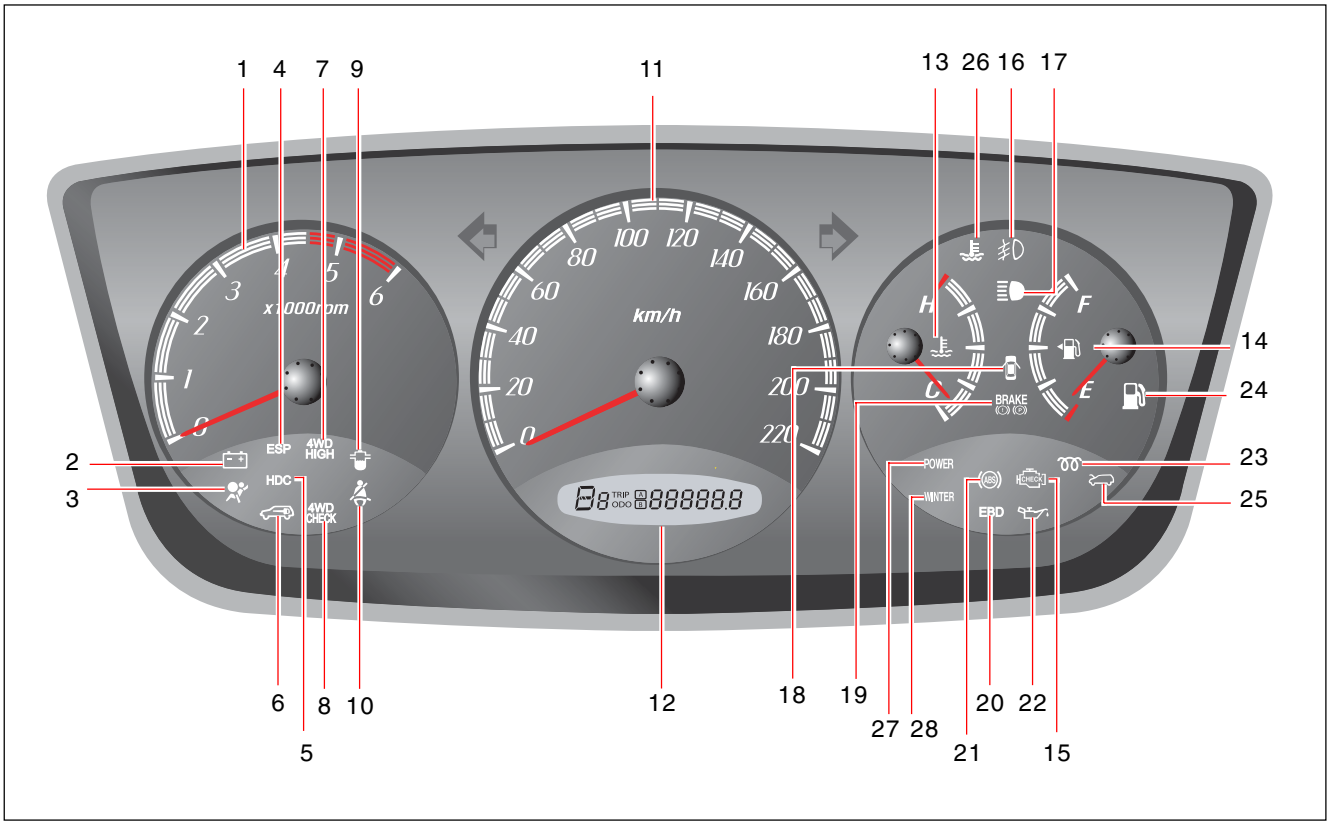
1. Descriptions of indicator display 2
2. Warning & indicator panel 10
3. Removal and installation of meter cluster 17

INSTRUMENT CLUSTER

The instrument cluster sends and receives the signals to and from the relevant control units through CAN communication.

The HDC warning light and the engine hood open warning light are newly introduced.

1. DESCRIPTIONS OF INDICATOR DISPLAY



1. RPM gauge
2. Battery charge warning light
3. Air bag warning light
4. ESP warning light
5. HDC warning light
6. Immobilizer indicator
7. 4WD HIGH indicator
8. 4WD CHECK warning light
9. Water separator warning light
10. Seat belt reminder
11. Speedometer
12. ODOmeter/Trip odometer
13. Coolant temperature gauge
14. Fuel level gauge
15. Engine CHECK warning light
16. Fog lamp indicator
17. High beam indicator
18. Door open warning light
19. Brake warning light
20. EBD warning light
21. ABS warning light
22. Engine oil pressure warning light
23. Glow indicator
24. Low fuel level warning light
25. Engine hood open warning light
26. Over temperature warning light
27. Power mode indicator
28. Winter mode indicator

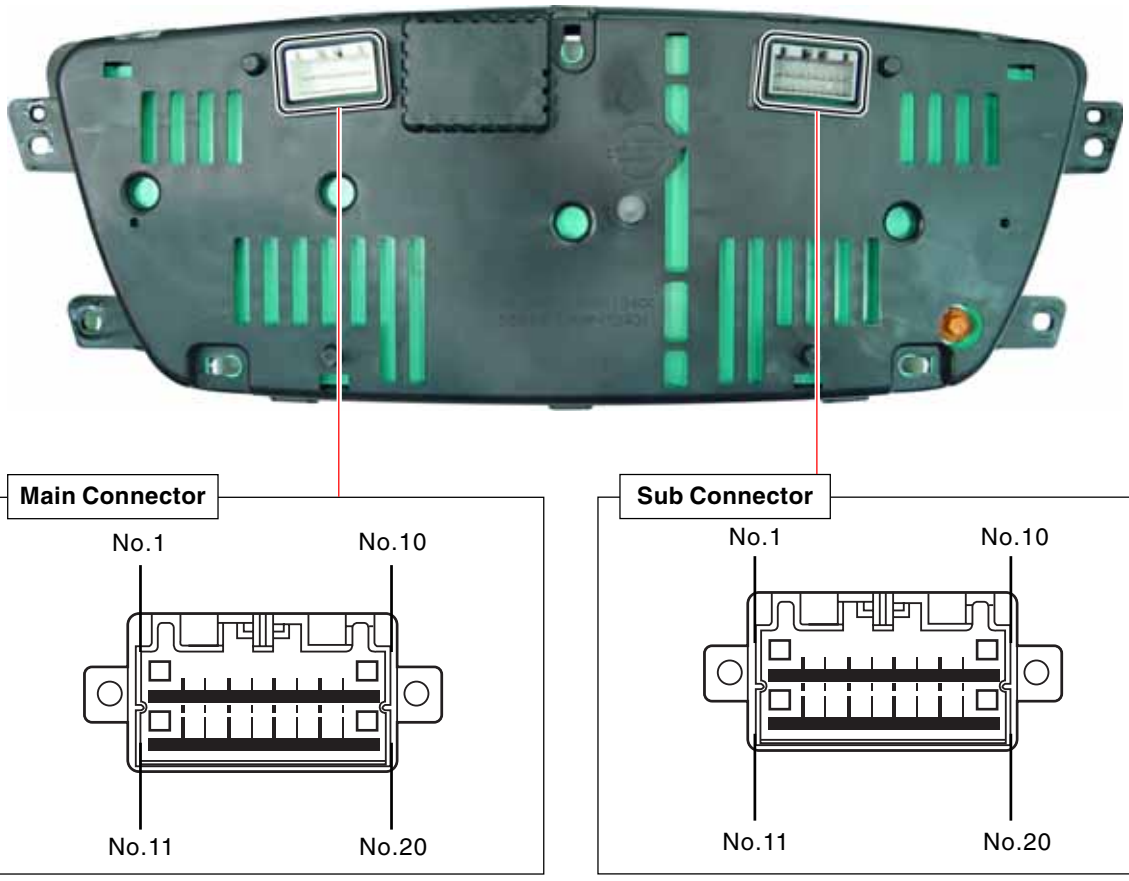
CHANGED BY	
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AFFECTED VIN	

▶ Configuration

Front View



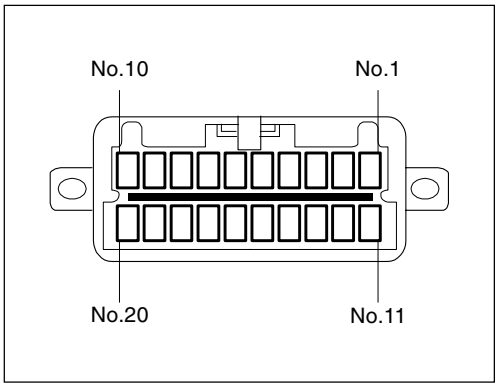
Rear View



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

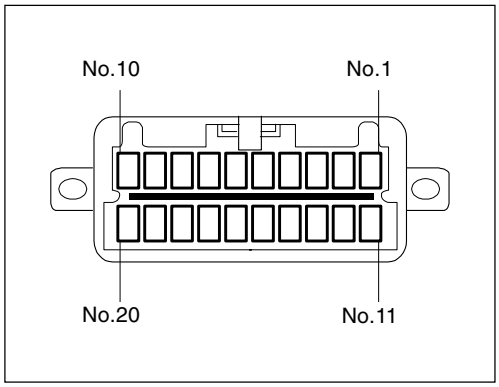
Connector Pin Arrangement

These connectors are viewed from the cluster body. The arrangement of the pin in the main connector is the same as the one of the sub connector.



Main Connector - 20 pins

1. A/T N (Neutral) output
2. Hood open
3. Seat belt (passenger)
4. -
5. -
6. Front fog lamp
7. Hazard warning flasher
8. -
9. Charge
10. IGN (alternator)
11. A/T P (Parking) output
12. Air bag
13. Seat blet (driver)
14. High beam (-)
15. RH indicator lamp (+)
16. High beam (+)
17. LH indicator lamp (+)
18. Oil pressure
19. Parking brake signal input (STICS)
20. -



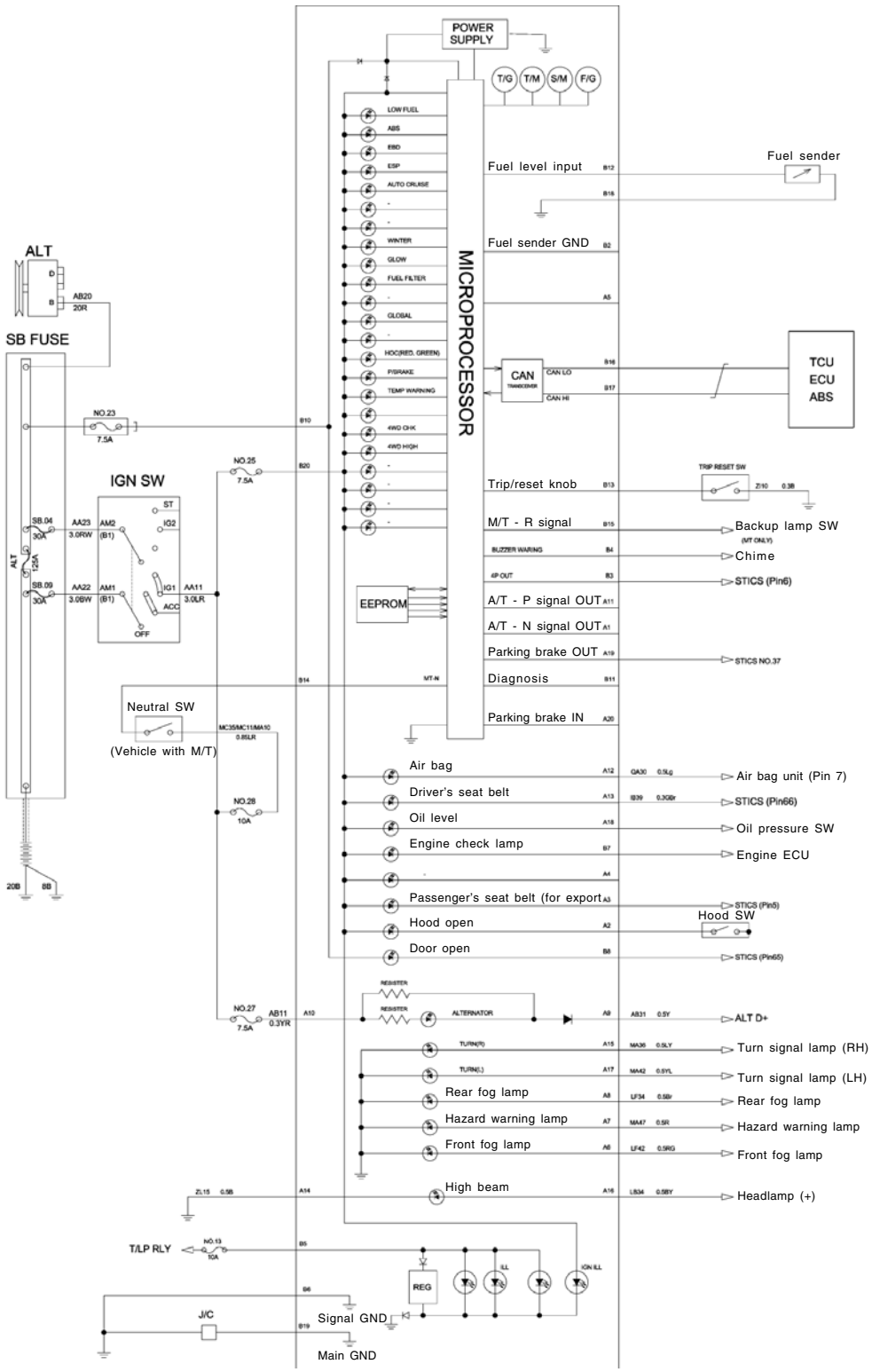
Sub Connector - 20 pins

1. -
2. -
3. 4P output
4. Buzzer output
5. Light (+)
6. PGND (signal -)
7. Engine check
8. Door open
9. -
10. Battery
11. Troubleshooting
12. Fuel input signal
13. TRIP / RESET switch
14. M/T N (Neutral) input
15. M/T R (Reverse) input
16. CAN Low
17. CAN High
18. AGND (Fuel -)
19. MYCOM ground
20. IGN

* 15. The manual transmission “R” (reverse) input wiring is connected, but not used by any system.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

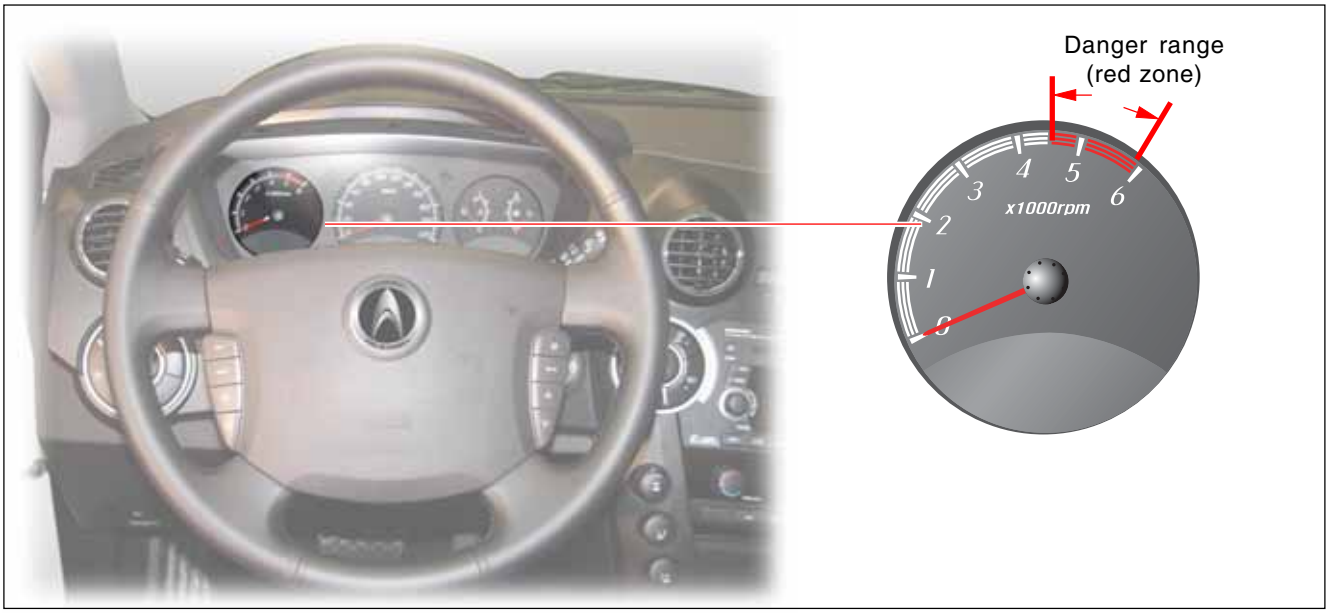
Circuit Diagram



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Warning Lights and Indicators

Engine Tachometer



The tachometer indicates engine speed in revolutions per minute. Multiply 1,000 to the current number, then it will be the current number of engine revolutions.

Under the normal engine operating temperature, the proper idling speed is 700 ~ 800 rpm. The red zone (danger rpm range) starts from 4,500 rpm.

1. Connect the tachometer for tune-up test and start the engine.
2. Eliminate the hysteresis by tapping the tachometer.
3. Compare the values on the tester and tachometer and replace the tachometer if the tolerance is excessive.

Description	Specification (VIN=13 ± 0.1V, Temperature: 25°C)						
Engine speed (rpm)	750	1000	2000	3000	4000	5000	6000
Tolerance (rpm)	-	+100	+100	+100	+100	+100	-
	-	-100	-100	-100	-100	-100	

NOTE

- **For vehicle equipped with gasoline engine, the indicator shows up to 7,000 rpm and 8,000 rpm. The tolerance at 7,000 rpm is ±100.**

Checking

If the tachometer pointer vibrates, stands at a certain range or sounds abnormal noise, there could be defectives in tachometer. If there is a difference between actual engine speed (rpm) and reading from tachometer, connect a scanner and then compare the value on tachometer with the reading from scanner.

Speedometer Gauge



The speedometer indicates the vehicle speed by calculating the signals from the rear left and rear right wheel speed sensors through ABS or ESP unit. In this model, the wheel speed sensor is installed at the rear right tire area even though the ABS/ESP is not equipped. Its signal is used as a standard vehicle speed that is transmitted to instrument panel, TCU, TCCU, and engine ECU via CAN communication.

If the speedometer gauge vibrates, stops at a certain range or makes an abnormal noise, there could be defectives in speedometer. However, these symptoms also could be occured when the tire has uneven wear, different tire inflation pressures or different tire specifications.

Perform the speedometer test regarding the tolerance as described. However, it is not similar simple work in field due to lack of measuring conditions such as test equipment and preciseness.

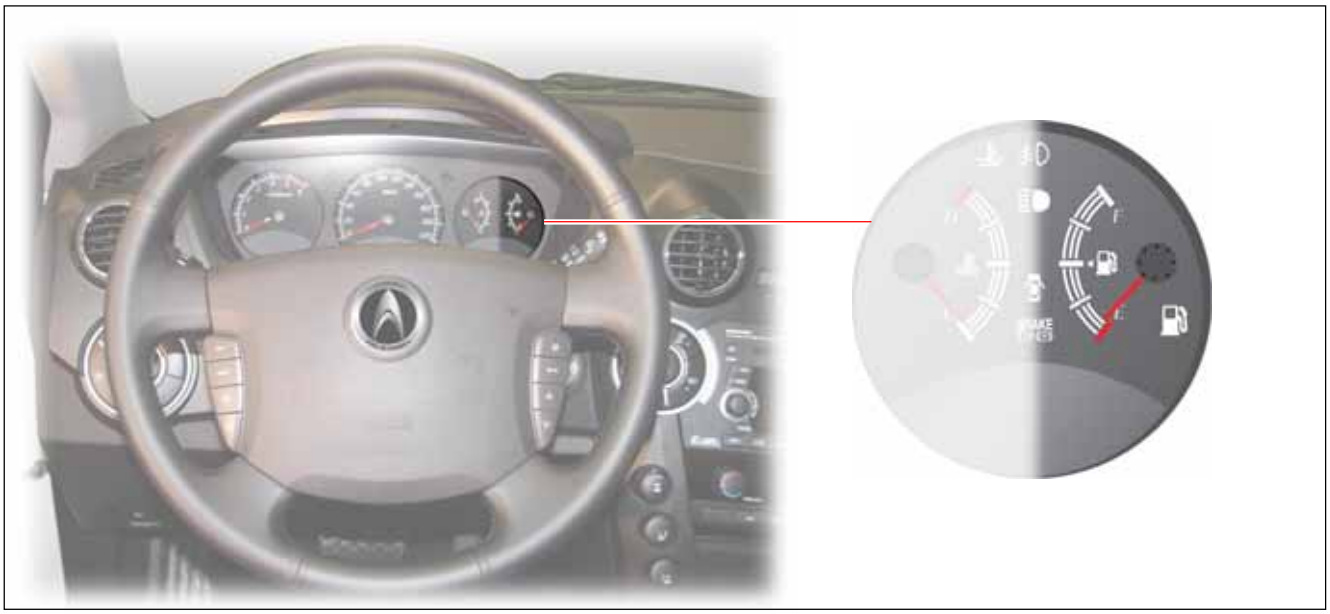
1. Check the allowable tolerance of the speedometer and operations of the trip odometer by using a tester.
2. Check if the speedometer gauge is shaking and the abnormal noise sounds.
3. Eliminate the hysteresis by tapping the speedometer.

Description	(VIN = 13 ± 0.1V, Temperature: 25°C)								
Standard speed (Km/h)	20	40	(60)	80	100	120	140	(160)	(180)
Tolerance (Km/h)	+4	+4	+7	+9	+10.5	+12.5	+14.5	+16	+18
	0	0	+2.5	+3.5	+4	+6	+7.5	+8.5	+10

NOTICE

- **The allowable tolerance increases when the tires are worn or the tire pressure is out of specified range.**

Fuel Level Gauge



The fuel level gauge displays the resistance value of the float on the fuel sender in the fuel tank through a pointer. Note that this vehicle doesn't have a service hole for checking the fuel sender connector in the fuel tank.

The fuel sender and its connector can be checked and replaced only when the fuel tank is removed. The power supply and resistance value should be measured at the connector in front of the fuel sender (refer to wiring diagram).

When the power supply and output resistance are normal, the float operation by fuel level may be defective; if so, replace the fuel sender.

Tolerance and resistance value by indicating angle

	Tolerance and resistance value by indicating angle (VIN = 13.5 ± 0.1 V, temperature: 25°C)						
Scale	Full	Full (Gauge)	(3/4)	1/2	(1/4)	Empty (Gauge)	Empty
Indicating angle (°)	-	105	78.75	52.5	26.25	0	-
Tolerance (°)	-	+4, 0	-	±5	-	0, -4	-
Resistance (Ω)	38	43	67	99.5	150	276.3	283

This table shows the tolerance and resistance value changes by fuel level in normal conditions. Therefore, the differences that can be occurred by the road conditions and fuel fluctuations are ignored.

Coolant Temperature Gauge



Using a needle, it displays the coolant temperature obtained from the engine coolant temperature sensor. The PTC resistance value of the coolant temperature sensor is transmitted to the engine ECU and then to the cluster as CAN signal. The angle of guage that can be varied by coolant temperature is as shown below.

		Tolerance and resistance value by indicating angle		
Indicating angle (°)	0	52.5	102	105
Tolerance	+0°C -4°C	+0°C -4°C	-	+4°C +0°C
Coolant temperature	Less than 40°C	70 ~ 110°C	120°C	Over 125°C

Measurement of coolant temperature sensor resistance

Measure the resistance between the terminal and the ground with an ohmmeter and replace if the resistance is out of specified range.

Resistance value by coolant temperature:
20°C - 2449Ω ± 5%
50°C - 826Ω ± 5%
80°C - 321Ω ± 5%
100°C - 12Ω ± 5%

When the resistance value by coolant temperature is within the specified range, check thermostat, water pump, radiator related coolant circuit for normal operation. Also, check the wiring harnesses and connectors for proper connection (engine ECU, No. 101 and 102).

2. WARNING & INDICATOR PANEL

ESP Warning Light

This warning light comes on when pressing the "**ESP OFF" switch** or the ESP system is defective. If the ESP function operates while driving, this warning light flickers and the alarm sounds.

HDC Warning Light

Green light on: HDC is ready for use (by pressing the HDC switch).
Green light blinking: HDC is being applied.
Red light on: the HDC system is overheated or malfunctioning.
When HDC is applied, the green HDC indicator blinks.
When the red HDC indicator is on, the HDC system is overheated or malfunctioning.

When the red HDC indicator is on, the HDC function does not work.

Immobilizer Indicator

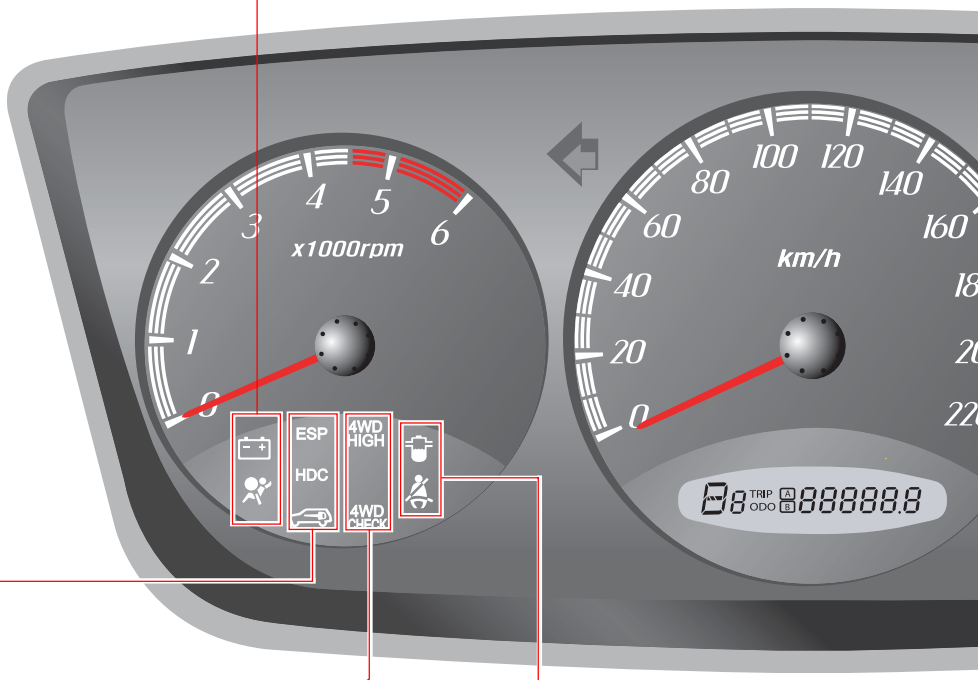
This indicator comes on when the ignition key is communicating with the engine control unit (during engine starting) for approx. 0.5 seconds.

Battery Charge Warning Light

This warning light comes on when the ignition switch is turned on and go off when the engine is started. If this light doesn't go off after engine starting or comes on while driving, it means there is a malfunction in the system.

Air Bag Warning Light

When the ignition is switched on, this warning light illuminates and then should go out, to confirm that the air bag is operational. If it does not come on, or if it does not go out, or if it flashes or illuminates continuously while driving, it means that there is malfunction in the system.



Water Separator Warning Light

When the water level inside water separator in fuel filter exceeds a certain level, this warning light comes on and buzzer sounds. Also, the driving force of the vehicle decreases. If these conditions occur, immediately drain the water from fuel filter and water separator.

Seat Belt Reminder

The seat belt warning light comes on and the seat belt warning chime sound for 6 seconds when the ignition switch is turned to "ON" position unless the driver's seat belt is securely fastened. This reminding operation stops when the driver fastens the seat belt even during its operation period.

4WD Indicator

4WD HIGH indicator
When shifting the driving mode from "4L" to "4H", this indicator blinks until the shifting operation is completed. After completion of the mode change to 4H, the indicator comes on.

4WD CHECK Warning Light
If "4WD CHECK" warning light stays on continuously, it may indicate that there is something wrong in the transfer case system.

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EFFECTIVE DATE	
AFFECTED VIN	

Over Temp. Warning Light

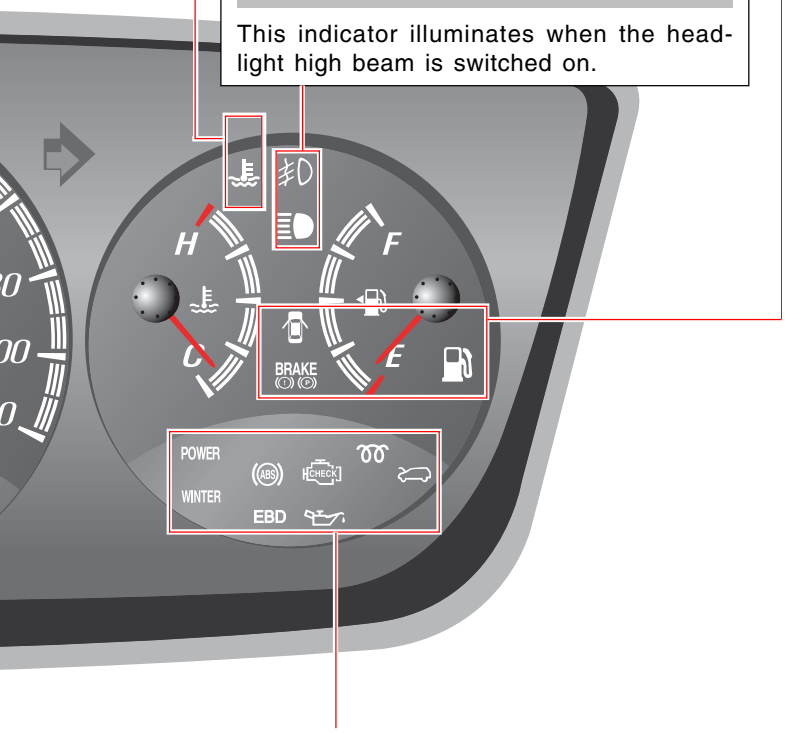
When the engine coolant temperate is abnormally hot (over 120°C), the engine overheat warning light blinks and a warning buzzer sounds. (check the coolant system)

Fog Lamp Indicator

When the tail or head lights are on, the fog lights come on if the fog light switch is turned to the “ON” position. Then, the fog light indicator comes on the instrument panel.

High Beam Indicator

This indicator illuminates when the headlight high beam is switched on.



Door Open Warning Light

This light comes on when a door or tailgate is either opened or not closed completely.

Brake Warning Light

This warning light comes on and warning buzzer sounds when the parking brake is applied and/or the brake fluid level is lower than specified level.

Low Fuel Level Warning Light

This warning light indicates that the fuel will soon be exhausted. The time it takes to turn on, however, varies according to the vehicle operating conditions or gradient of the road.

ABS Warning Light

This warning light comes on when the ignition switch is turned to ON and should go out if the system is normal. The vehicle equipped with ABS performs self-diagnosis on the system when the engine is started and drives off. During the diagnosis, brake pedal vibration and noise may be apparent when the driving motors discharges the hydraulic pressure from the internal hydraulic device. This means the ABS is properly functioning.

Engine Check Warning Light

If the light stays on or comes on while driving, some of engine control components including sensors and devices are defective.
When this warning light comes on, the vehicle operates in safety mode to maintain minimum driving conditions and to prevent the system from being damaged. In this mode, the engine driving force may be decreased or the engine may stall.

Glow Indicator

This indicator comes on when the ignition switch is turned on and stays on for a short time or may go off right away. When the glow plugs are sufficiently heated for cold starting, the light will go out. In the vehicle equipped with direct injection type engine, this indicator may come on very shortly or may not come on.

Engine Hood Open Warning Light

When the engine hood is open, this light comes on to inform the driver.

EBD Warning Light

This warning light comes on when the ignition switch is turned to ON and should go out if the system is normal. If the EBD system is abnormal, EBD warning light comes on.

Winter Mode Indicator

The indicator comes on when the Winter mode (W) switch near the gear selector lever is pressed.
Use this mode to drive off smoothly under icy and slippery road.

Engine Oil Pressure Warning Light

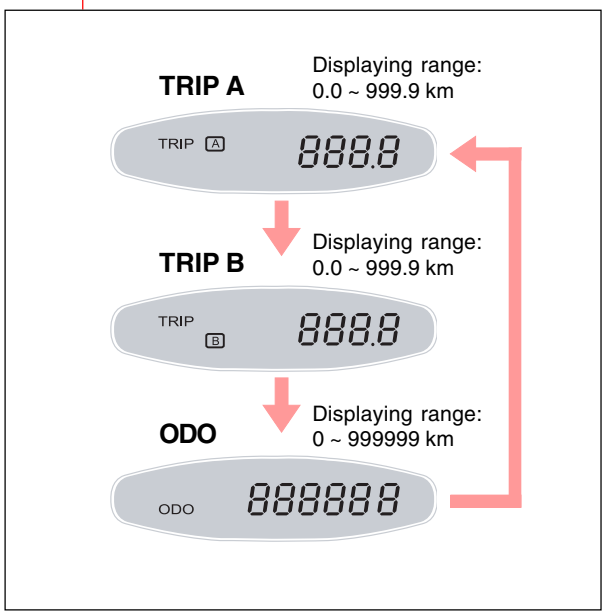
This warning light comes on when the ignition is switched on and should go out when the engine is started. If the light comes on while driving, it indicates that the oil pressure is dangerously low.

Power Mode Indicator

This indicator comes on when pressing the “P” of the mode switch next to the shift lever and the switch is used for rapid acceleration or uphill driving. When this switch is used, the driving force increases while shifting is delayed.

▶ TRIP ODOmeter (TRIP A, TRIP B) and ODOmeter





Odometer/Trip Odometer

When pressing the TRIP/RESET switch on the center panel, the odometer/trip odometer is converted and the meter resets to 0.0 km in Trip A and Trip B.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Operation of HDC Indicator Controller

This table describes the coming-on and blinking mode of HDC indicator according to the HDC switch operation (ON/OFF).

The HDC indicator on the instrument panel has two modes; green (function lamp) and red (warning lamp). The HDC switch is a push & self return type switch – when you press it once, it starts to operate and when you press it again, it stops the operation.

<table>
<tr><th colspan="3" rowspan="3">HDC Operation Mode</th><th>HDC indicator</th><th>HDC warning lamp</th></tr>
<tr><th>Green</th><th>Red</th></tr>
<tr><th>HDC</th><th>HDC</th></tr>
<tr><td colspan="3">Initial ignition ON (From hence, this signifies operation mode after the engine starts. Even when HDC switch is ON, if the ignition is OFF, HDC operation stops automatically.)</td><td>OFF</td><td>ON</td></tr>
<tr><td rowspan="2">Not available</td><td colspan="2">HDC switch OFF</td><td>OFF</td><td>OFF</td></tr>
<tr><td colspan="2">HDC system error</td><td>OFF</td><td>ON</td></tr>
<tr><td rowspan="2">Stand-by</td><td colspan="2">HDC switch ON</td><td>ON</td><td>OFF</td></tr>
<tr><td colspan="4">The HDC switch is turned ON, but HDC system is in stand-by mode because the operating requirements are not met.</td></tr>
<tr><td rowspan="2">In operation</td><td colspan="2">HDC system is operating.</td><td>Blinking (0.5 seconds of interval)</td><td>OFF</td></tr>
<tr><td colspan="4">The HDC switch is turned ON, and the operating requirements are met. HDC is operating with operating sound.</td></tr>
<tr><td rowspan="4">System overheat</td><td rowspan="2">High brake system temperature (over 350°C)</td><td>HDC stand-by mode</td><td>OFF</td><td>Blinking</td></tr>
<tr><td>HDC is operating</td><td colspan="2">Alternate blinking of green and red lamp (0.5 seconds of interval)</td></tr>
<tr><td colspan="2">Too high brake system temperature (over 450°C)</td><td>OFF</td><td>ON</td></tr>
<tr><td colspan="4">There is no specific temperature sensor in the system, but a programmed logic inside the HECU predicts the temperature based on the operating numbers and conditions of HDC (HDC cannot be operated).</td></tr>
</table>

NOTICE

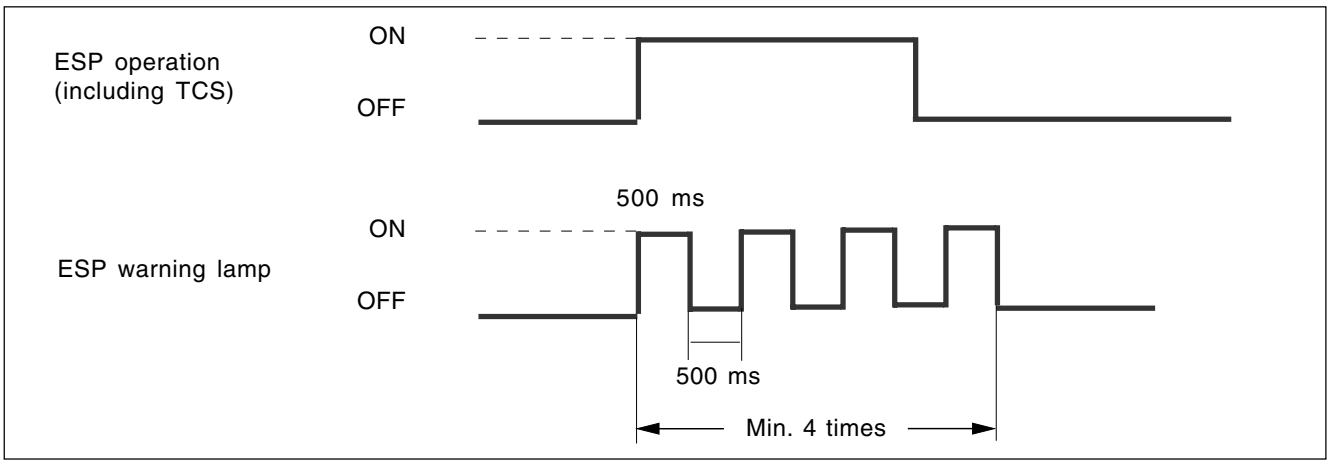
Basically, the brake system's basic functions can work even when there are problems with the HDC system. As given in the table above, the HDC warning lamp comes on when:

- **Initial ignition ON**
- **HDC system error occurs**
- **Brake system overheat**

▶ ESP Warning Lamp

ESP Warning Lamp Blinking in Control

ESP warning lamp blinks when ESP control is activated. If the activation reaches a certain limitation, a beep sounds to warn the driver. The ESP warning lamp goes off when ESP function is deactivated. Even when the ESP is operated for a very short period of time, the ESP warning lamp blinks minimum of 4 times every 500 milliseconds.



1. When receiving CAN data

LAMP: (200h, 1.5) ESP - INFO - BL: when receiving data, 500 ms on/off

BUZZER: (200h, 1.4) ESP - INFO - BUZZ: when receiving data, 100 ms on/off

ESP System Cancellation Using the ESP OFF Switch

When the ESP switch is pressed (for over approximately 150 ms), the ESP system will be cancelled and **the vehicle will be driven regardless of the output values from the corresponding sensors. Then, the ESP warning lamp on the instrument panel comes on.**

The detailed operation procedures are as follows:

1. The ESP warning lamp comes on when the ESP OFF switch is pressed for over 150 ms.
2. **The switch returns to normal position** when the OFF switch is released.
3. The ESP system will be cancelled after approximately 150 ms.

Based on the above procedures, we can see that the ESP system will be cancelled after a certain period (approx. 150 ms) from releasing the switch to the original position. The ESP system does not get canceled immediately when the ESP warning lamp is turned on by pressing the ESP OFF switch.

When you turn the ESP system off by pressing the ESP switch for over 150 ms, the TCS system is turned off. **And the basic ABS system will operate.**

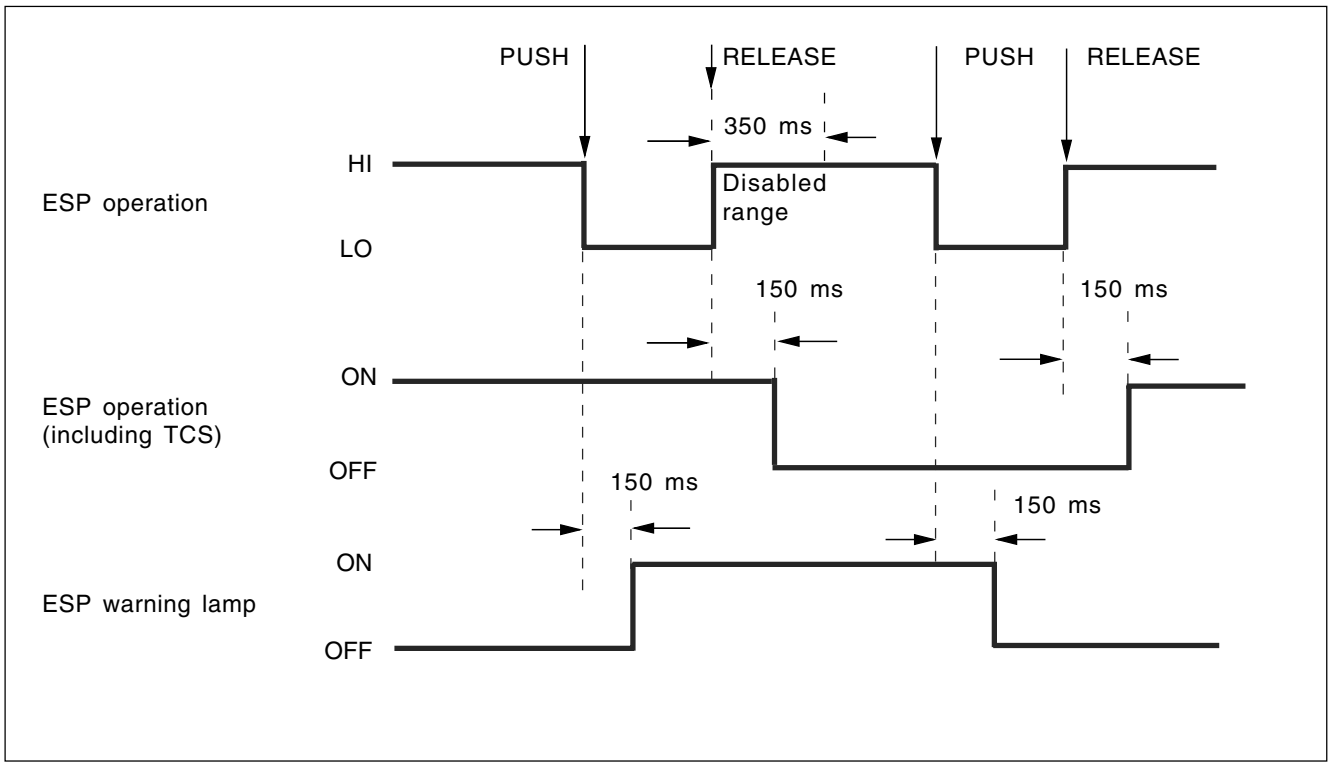
Resuming the ESP System by Using the ESP OFF Switch

The ESP system will be resumed and the ESP warning lamp at the instrument panel goes off when the ESP switch at the center switch panel is pushed (for over approximately 150 ms) while the ESP system is not operating.

The detailed operation procedures are as follows.

1. The ESP warning lamp comes on when the ESP OFF switch is pushed for over 150 ms.
2. **The switch returns to normal position** when the OFF switch is released.
3. The ESP system will be resumed after approx. 150 ms.

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EFFECTIVE DATE	
AFFECTED VIN	

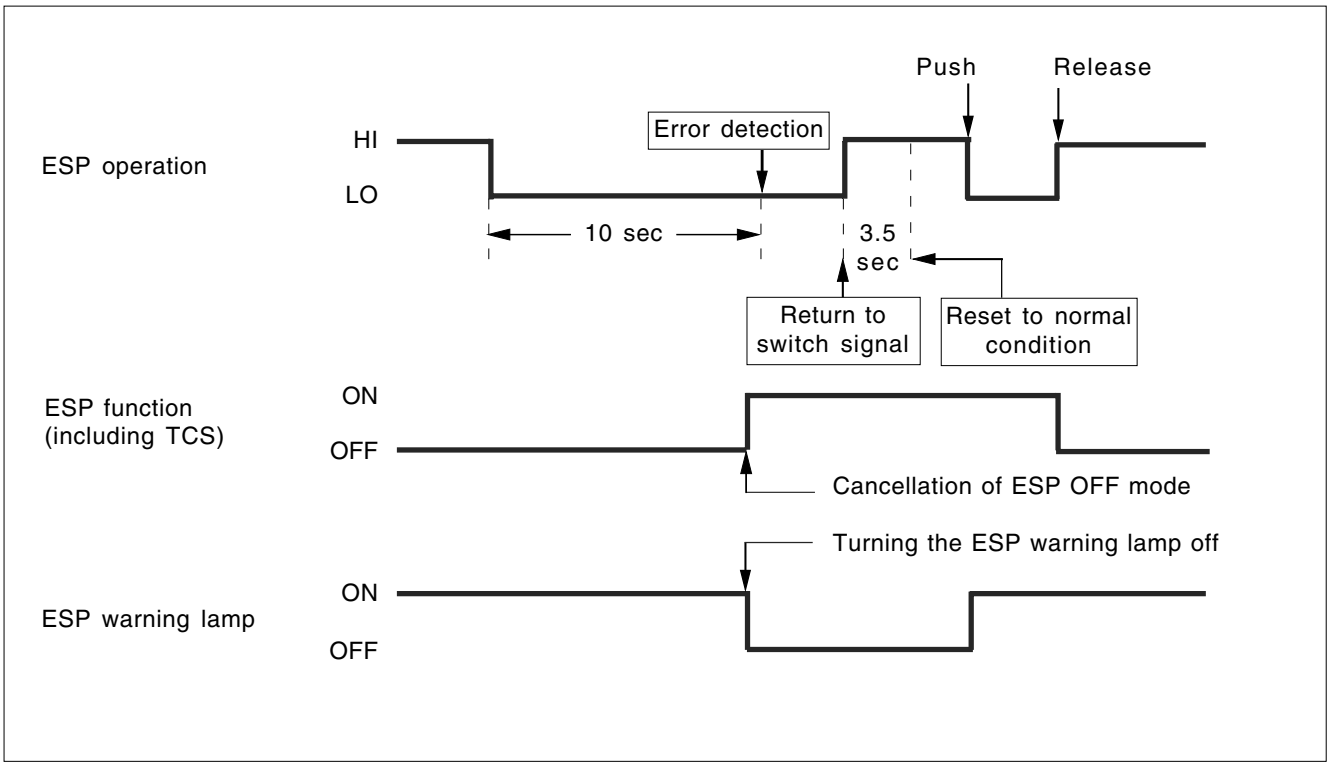


NOTICE

- **When turning the ignition switch off while the ESP system is activated, the ESP system will be resumed when ignition switch is turned on again.**
- **When the vehicle is controlled by ESP system during driving, the ESP OFF switch does not operate.**
- **The ESP OFF switch operates when it is pushed for over 150 ms. When it is pushed for less than 150 ms, the ESP OFF mode and the ESP warning lamp will not be changed.**
- **When the ESP OFF switch is pushed within 350 ms of being turned off, the ESP warning lamp and ESP system will not be turned on.**

ESP OFF Switch Monitoring

When the ESP unit recognizes that the ESP OFF switch is pushed for over 10 seconds, the ESP unit determines it as a ESP OFF switch malfunction. When the ESP OFF switch is pushed, the ESP system is resumed after 10 seconds. However, the ESP warning lamp comes on when the ESP OFF switch is pushed (for over 150 ms) and then goes out when the ESP system is resumed. When the ESP OFF switch returns to normal position, the ESP unit resets the ESP OFF switch for approx. 3.5 seconds.



ESP Warning Lamp Operation Depending on System Conditions

The table shows ESP warning lamp operations when the ESP system is defective or ESP (including TCS function) is working.

	Warning Lamp		Controls			
	ABS W/L	ESP W/L	ABS	ASR	ABD	Vehicle yaw control
Initial start (for 1.8 sec)	ON	ON	NO	NO	NO	NO
Normal mode	OFF	BLINKS WHEN ESP OPERATION	OK	OK	OK	OK
ESP fault	OFF	ON	OK	NO	NO	NO
ABS fault	ON	ON	NO	NO	NO	NO
System fault	ON	ON	NO	NO	NO	NO
Low batt. voltage	ON	ON	NO	NO	NO	NO
High battery voltage	ON	ON	NO	NO	NO	NO
High brake pad temp.	OFF	ON	OK	NO	NO	NO
ESP-OFF mode	OFF	ON	OK	NO	NO	OK Note 1)
Entering diag. mode	ON	ON	NO	NO	NO	NO

NOTICE

- **When the driver presses the brake pedal during the ESP OFF mode, the yaw control is performed to compensate the vehicle stability (posture) during ESP operation.**

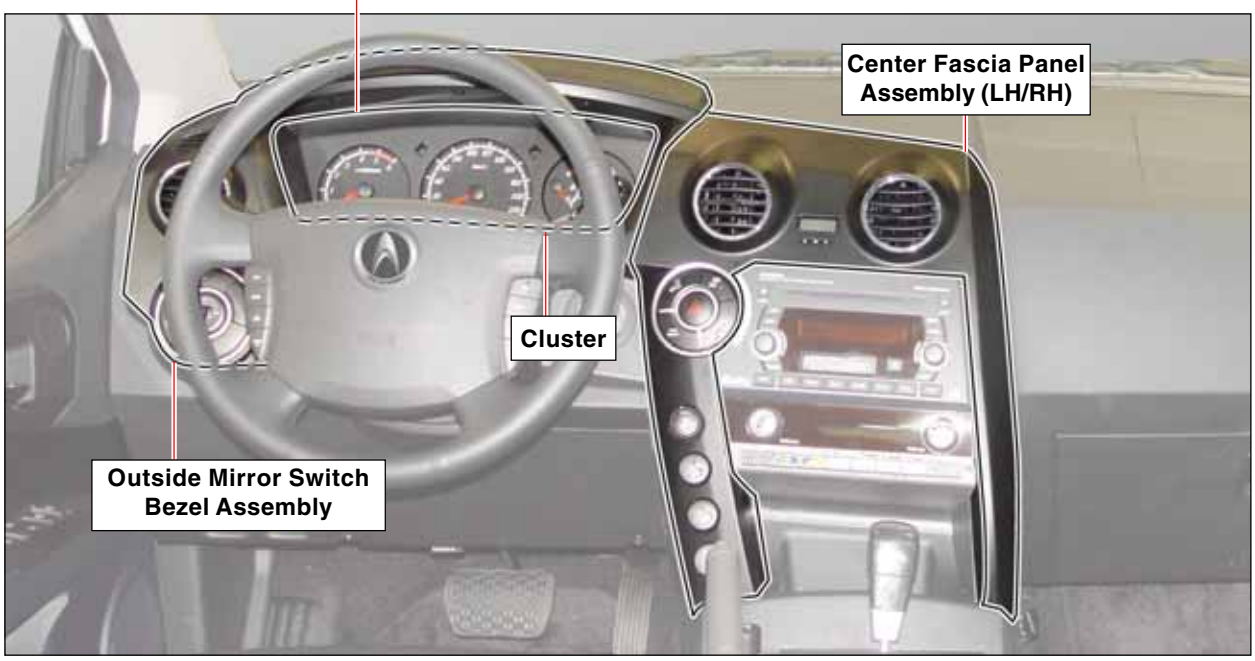
3. REMOVAL AND INSTALLATION OF METER CLUSTER

※ **Preceding Works:** Disconnect the negative battery cable.

▶ Location

Cluster





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EFFECTIVE DATE	
AFFECTED VIN	

Removal and Installation

1. Carefully pull off the lower part of the center fescia panel (Refer to “Body” section).



2. Remove four instrument panel mounting screws.



3. Disconnect the outside mirror switch bezel connector and remove the meter cluster panel assembly.





NOTICE

- **Be careful not to damage the another components during removal procedures.**

4. Unscrew four cluster mounting screws.



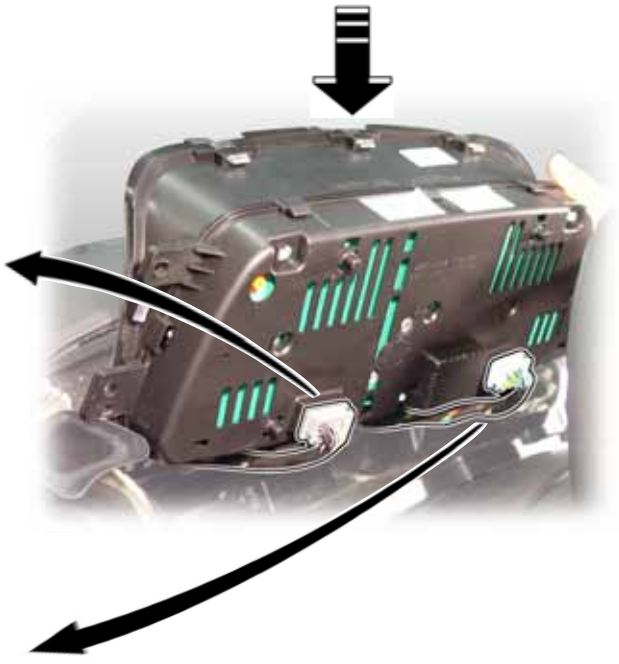
5. Disconnect the connectors from the back of meter cluster and remove the cluster from the instrument panel.



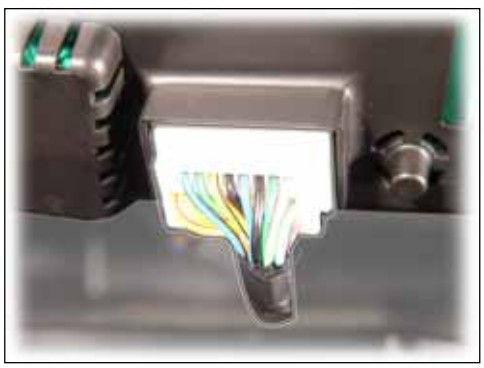


Sub Connector





Main Connector



SWITCHES

8510 / 7770 / 8610 / 7632 / 7610

TABLE OF CONTENTS

GENERAL INFORMATION 2

CENTER FASCIA & BEZEL SWITCH ASSEMBLY 4

1. Location 4
2. Switch arrangement 5
3. Functions 6
4. Switches in hazard & bezel switch assembly . 8

CENTER FASCIA SWITCH BEZEL ASSEMBLY 19

1. Details for center fescia switches 19
2. Removal and installation of hazard & bezel switch assembly 23

OUTSIDE REARVIEW MIRROR SWITCH BEZEL ASSEMBLY 29

1. Location 29
2. Switch arrangement 30
3. Switches in outside rearview mirror switch bezel assembly 31
4. Removal and installation of outside rearview mirror switch bezel assembly 39

OVERHEAD CONSOLE SWITCH 45

1. Location 45
2. Components 46
3. Switches in overhead console switch assembly 47
4. Removal and installation of center consol switches 54

SWITCH ASSEMBLY ON DRIVER'S DOOR ARMREST 56

1. Locations and functions 56
2. Switch arrangement and appearance 57
3. Power window operations 58
4. Circuit diagram of power window 65
5. Central door lock/unlock switch 67
6. Circuit diagram 71
7. Removal and installation of power window switch 72

AUDIO REMOTE CONTROL SWITCH ON STEERING WHEEL 79

1. Locations and functions 79
2. Components 80
3. Cirsuit diagram of audio switch on steering wheel 81
4. Removal and installation 82

MULTIFUNCTION SWITCH 84

1. Overview 84
2. Functions and operations 85
3. Operating range 88
4. Connector pin arrangement 89
5. Removal and installation 90

TAILGATE OPEN SWITCH 93

CIGARETTE LIGHTER 96

POWER OUTLET 98

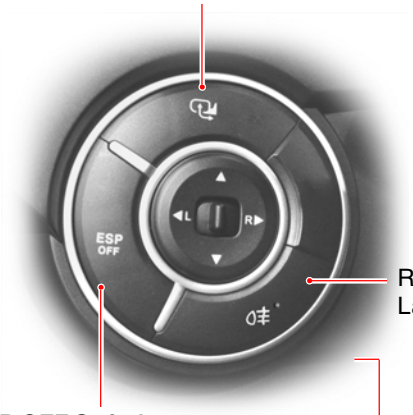
DIGITAL CLOCK 101

HORN (INCLUDING THEFT DETERRENT HORN) 103

1. Location 103
2. Circuit diagram of horn 104
3. STICS control for theft deterrent mode 105
4. Removal and installation 110

GENERAL INFORMATION

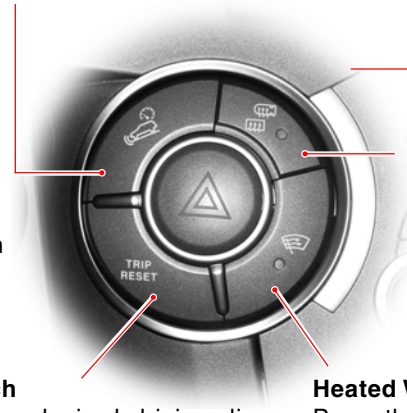
Outside Rearview Mirror Folding Switch
To fold the outside rearview mirrors, press the switch. To unfold the mirrors, press it again.



Rear Fog Lamp Switch

ESP OFF Switch
If you press the ESP OFF switch, the ESP function stops and the indicator lamp in instrument panel comes on. Press this switch again to resume the ESP function. At this time, the indicator lamp goes out.

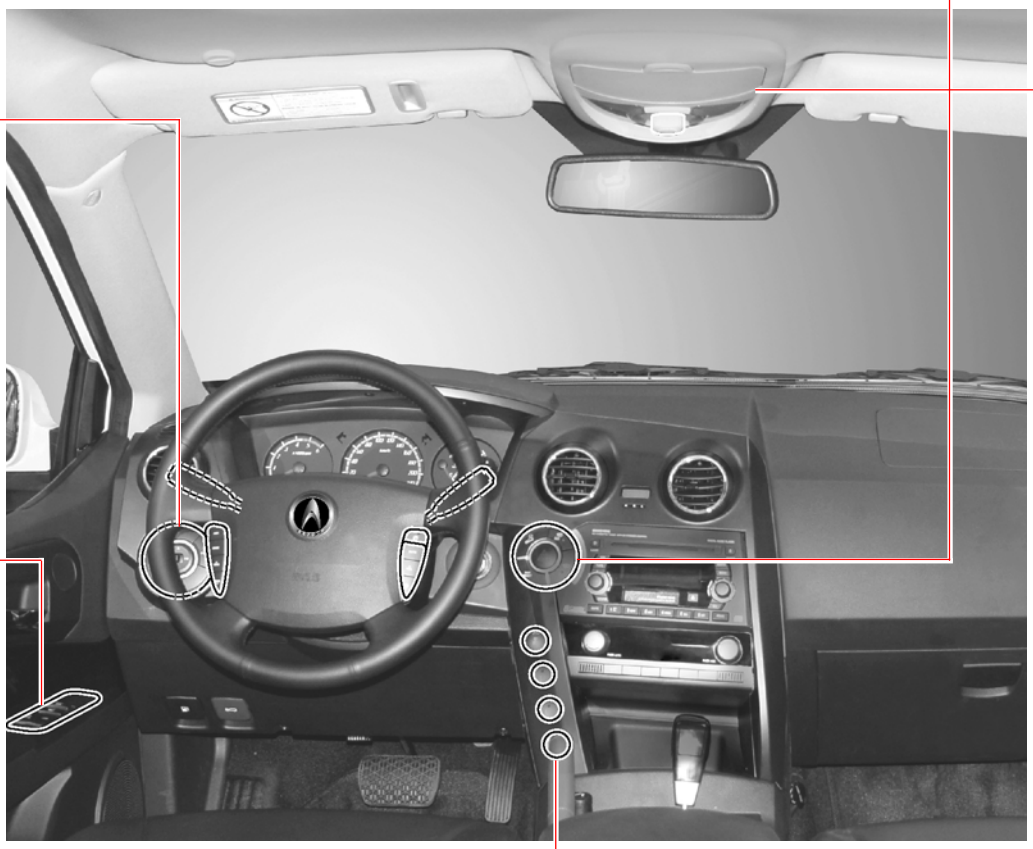
HDC Switch
When this button is pressed once, HDC is ready for use. The green HDC indicator comes on the instrument panel. When the button is pressed again, HDC is deactivated and the indicator goes off. (Refer to ABS/ESP section.)



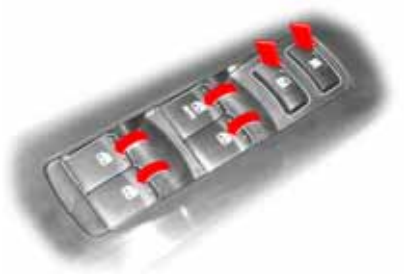
Heated Tailgate Glass and Outside **Rearview Mirror Glass Switch**
Press this switch to turn on the tailgate and outside rearview mirror defogger. It will operate for about 12 minutes.

TRIP Switch
To choose a desired driving distance display mode, press the switch: Changing sequence: ODO - TRIP A - TRIP B - ODO

Heated Windshield Glass Switch
Press this switch to turn on the heated windshield glass. It will operate for about 12 minutes.



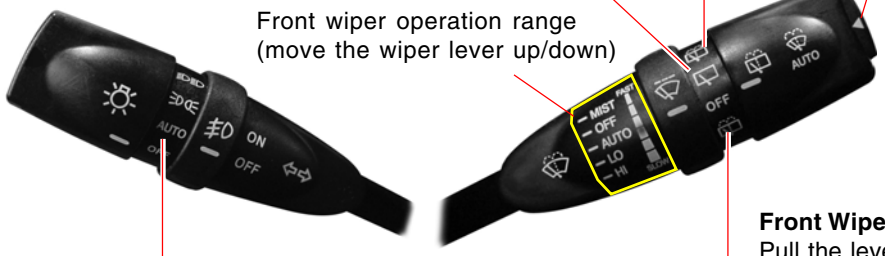
Driver's Power Window Switch



Driver can controls all door windows (Open/Close/Lock/Unlock) and doors (Lock/Unlock) with this switch unit.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Additional Functions of Multifunction Switch



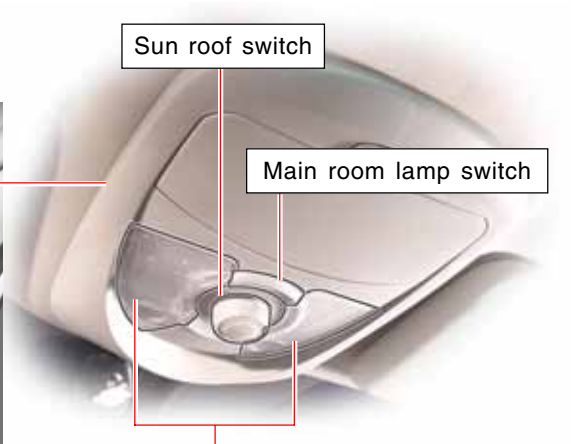
Auto Washer Switch
When the front wiper switch is off and this switch is pressed, washer fluid will be sprayed and the wiper will automatically operate 4 times. Then, the fluid will be sprayed again and the wiper will automatically operate 3 times.

Auto light position

Rear Wiper and Washer Coupled Operation

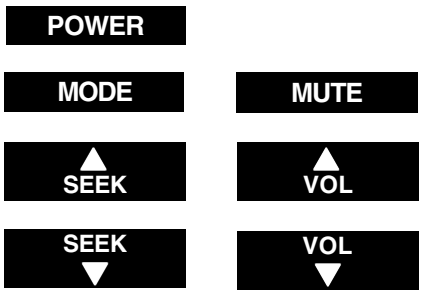
Front Wiper and Washer Coupled Operation
Pull the lever briefly (below 0.6 seconds):
One wiping cycle with washer spray.
Pull and hold the lever for more than 0.6 seconds:
Three wiping cycles with washer spray.







Audio Remote Control Switch





4WD Control Switch

Driver's Heated Seat Switch

Passenger's Heated Seat Switch

Head Lamp Leveling Switch

CENTER FASCIA & BEZEL SWITCH ASSEMBLY

1. LOCATION

The center fascia switch consists of hazard switch bezel assembly, 4WD control switch and heated seat switch.



Center Fascia Assembly



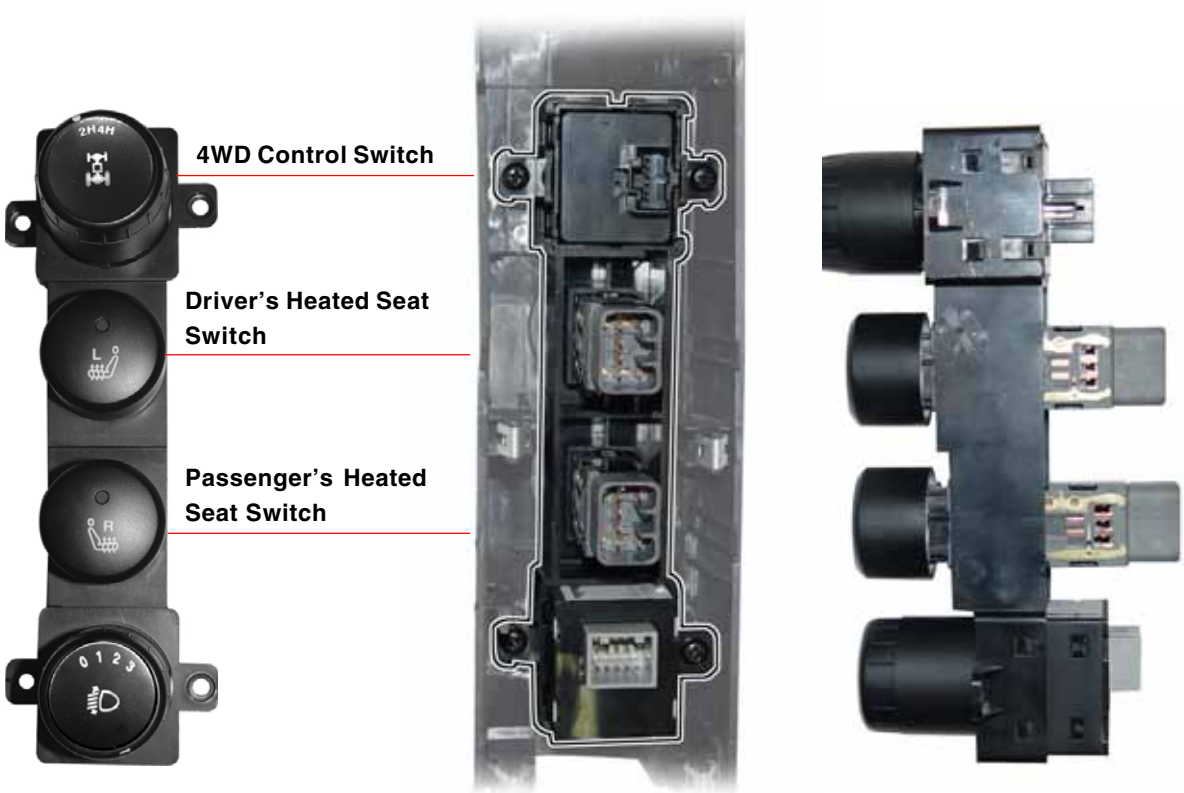
Hazard Switch Bezel Assembly



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. SWITCH ARRANGEMENT





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. FUNCTIONS

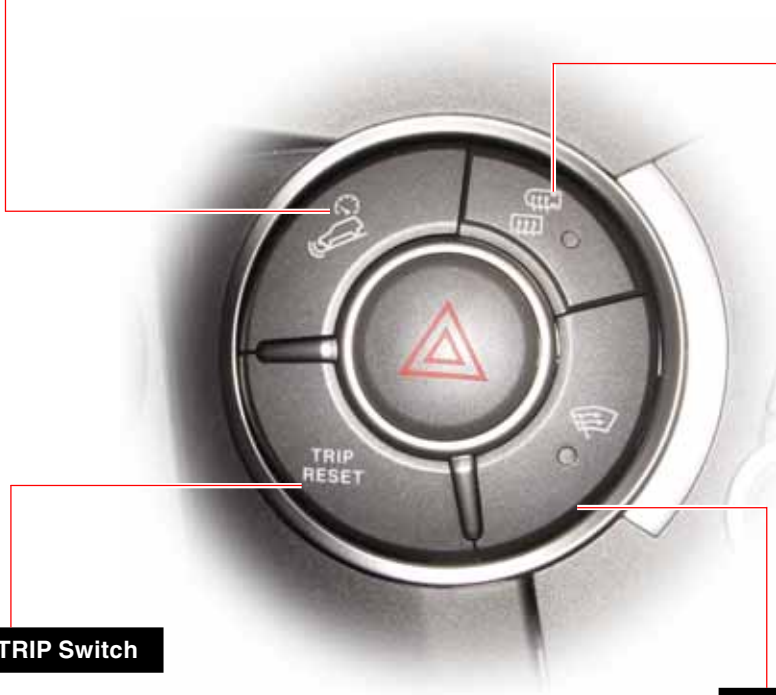
HDC Switch

When you press the HDC switch, the green HDC indicator comes on, and when the HDC operates, the green HDC indictor blinks with 0.5 second of interval.

The HDC system is an automatic descent control device that allows the vehicle to automatically decelerate to about 7 km/h by 0.1G, on steep roads (slope level exceeding 10%) through a separately installed switch operation. When the vehicle speed reaches below 7 km/h (refer to the information below), the HDC automatically terminates the operation.

NOTICE

- **The G sensor in sensor cluster measures the actual road steepness. However, it may recognize a sharp turn or rough road as a downhill road with a slope level exceeding 10%, and the HDC may operate.**



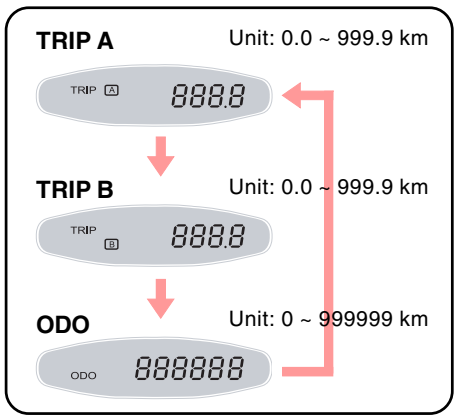
Heated Tailgate Glass & Outside Rearview Mirror Glass Switch

1. Press this switch to turn on the heated tailgate and outside rearview mirror glass. It will operate for about 12 minutes.
2. Press the switch again to stop the operation.
3. This switch is designed to defrost and defog on tailgate glass and outside rearview mirrors.
4. The heated glass will operate for about 6 minutes when the switch is pressed again within 10 minutes after completion of its first operation cycle.
5. The indicators in the switch come on when in use.

TRIP Switch

To choose a desired driving distance display mode, press the switch: Changing sequence: ODO - TRIP A - TRIP B - ODO

TRIP A/B display will be initialized to 0 km when the distance of an individual trip exceeds 999.9 km. If you press and hold the reset button for more than one second in TRIP A or TRIP B mode, the trip ODO meter resets to zero.

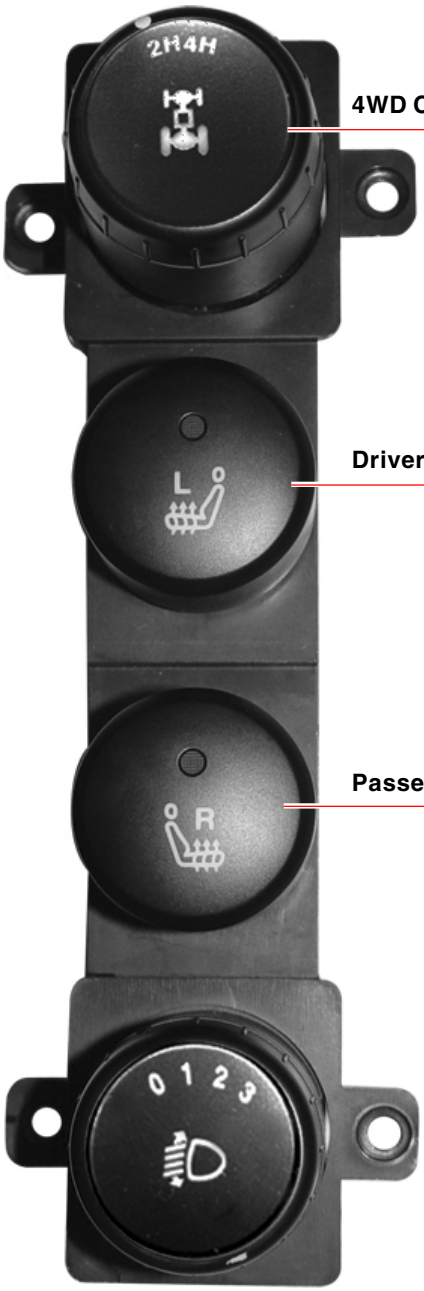


Heated Windshield Glass Switch

This switch is designed to defrost and defog on windshield.

1. Press this switch to turn on the heated windshield glass. It will operate for about 12 minutes.
2. Press the switch again to stop the operation.
3. The operation is resumed for 6 minutes if pressing the switch again within 10 minutes after the 12-minute operation is completed.
4. The indicators in the switch come on when in use.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



4WD Control Switch

Driver's Heated Seat Switch

Passenger's Heated Seat Switch

Choose a proper mode according to the road conditions.

4WD HIGH

This light comes on when switched to HIGH 4WD

4WD CHECK

This warning light comes on when the 4WD system is defective.

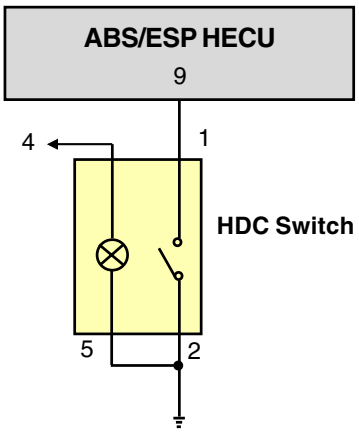
4. SWITCHES IN HAZARD & BEZEL SWITCH ASSEMBLY

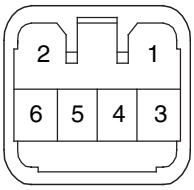
▶ HDC Switch

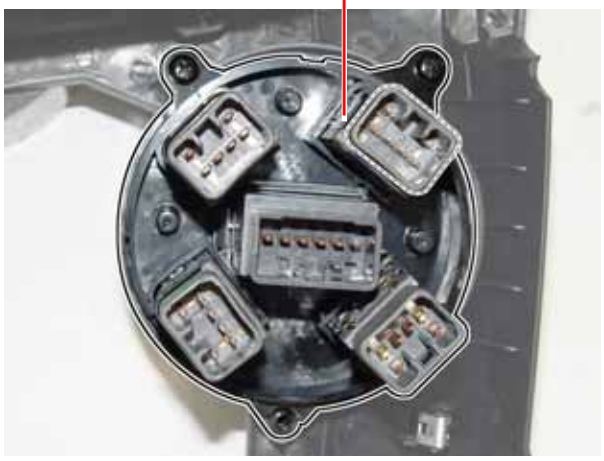
Overview

HDC switch is a Push & Self Return type switch and connected to ABS/ESP HECU terminal. This switch has an illumination lamp connected to the tail lamp circuit.









	ON	OFF
1(B)	○	
2(GND)	○	
3(IND)		
4(ILL+)	○	
5(ILL-)	○	

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Operation of HDC Indicator Controller

This table describes the coming-on and blinking mode of HDC indicator according to the HDC switch operation (ON/OFF).

The HDC indicator on the instrument panel has two modes; green (function lamp) and red (warning lamp). The HDC switch is a push & self return type switch – when you press it once, it starts to operate and when you press it again, it stops the operation.

<table>
<tr><th colspan="4" rowspan="3">HDC Operation Mode</th><th>HDC Indicator</th><th>HDC Warning Lamp</th></tr>
<tr><th>Green</th><th>Red</th></tr>
<tr><th>HDC</th><th>HDC</th></tr>
<tr><td colspan="4">Initial ignition ON (From hence, this signifies operation mode after the engine starts. Even when HDC switch is ON, if the ignition is OFF, HDC operation stops automatically.)</td><td>OFF</td><td>ON
(goes off after 1.8 seconds)</td></tr>
<tr><td rowspan="2">Not available</td><td colspan="3">HDC switch OFF</td><td>OFF</td><td>OFF</td></tr>
<tr><td colspan="3">HDC system error</td><td>OFF</td><td>ON</td></tr>
<tr><td rowspan="2">Stand-by</td><td colspan="3">HDC switch ON</td><td>ON</td><td>OFF</td></tr>
<tr><td colspan="5">The HDC switch is turned ON, but HDC system is in stand-by mode because the operating requirements are not met.</td></tr>
<tr><td rowspan="2">In operation</td><td colspan="3">HDC system is operating.</td><td>Blinking (0.5 second of interval)</td><td>OFF</td></tr>
<tr><td colspan="5">The HDC switch is turned ON, and the operating requirements are met. HDC is operating with operating sound.</td></tr>
<tr><td rowspan="4">System overheat</td><td rowspan="2">High brake system temperature (over 350°C)</td><td>HDC stand-by mode</td><td>OFF</td><td>Blinking</td></tr>
<tr><td>HDC is operating</td><td colspan="2">Alternate blinking of green and red lamp (0.5 second of interval)</td></tr>
<tr><td colspan="2">Too high brake system temperature (over 450°C)</td><td>OFF</td><td>ON</td></tr>
<tr><td colspan="5">There is no specific temperature sensor in the system, but a programmed logic inside the HECU predicts the temperature based on the operating numbers and conditions of HDC (HDC cannot be operated).</td></tr>
</table>

NOTICE

- **Basically, the brake system's basic functions can work even when there are problems with the HDC system. As given in the table above, the HDC warning lamp comes on when:**
  1) **Initial ignition ON**
  2) **HDC system error occurs**
  3) **Brake system overheat**

HDC (Hill Descent Control) System Operating Conditions

1. **When HDC switch is turned ON** and

2. **Gearshift lever position (Forward/Reverse)** and

   Manual transmission: operates in the 1st gear or reverse gear position (does not operate in neutral position).

   Automatic transmission: operates in any position except P (parking) or N (neutral) positions.

NOTICE

- **The vehicles with manual transmission do not have a separate device or switch that detects the 1st gear. It only detects the forward/reverse driving direction of the vehicle through backup lamp switch and neutral switch, and cannot solely detect the 1st gear position. The reason for noting the 1st gear above, though the HDC also operates in 2nd gear position, is because the engine may turn off during the HDC operation process. You may face a very dangerous situation if the engine turns off at a steep hill.**
- **The HDC is the device to improve the engine brake effect during downhill driving on a steep hill. For manual transmission equipped vehicle, HDC system should operated only in 1st gear.**

3. **When not depressing the accelerator pedal or brake pedal.** and

4. **The vehicle speed is above 7 km/h (in Automatic transmission/4H mode).** and

NOTE

- **The vehicle speed given in step (3) varies according to the vehicle driving mode, and the speed ranges by the vehicle driving mode and condition are as follows.**

1) Speed available in HDC mode (slope)

Forward driving **2H/4H mode: vehicle speed below 50 km/h (operation slope level: 10%, termination slope level: when it reaches 8%)**

Reverse driving **2H/4H mode: vehicle speed below 50 km/h (operation slope level: 8%, termination slope level: when it reaches 5%)**

2) HDC target speed in 2H/4H mode

(The HDC target speed is the speed that the HDC is not terminated even after the vehicle speed reaches 7 km/h, but is converted to the stand-by mode. When the vehicle speed increases again as a result of the increase of the road steepness, etc., the HDC goes into operation.)

Forward driving: 7 km/h

Reverse driving: 7 km/h (automatic transmission), 8.5 km/h (manual transmission)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. Vehicle position control function in ESP and HBA function are not in operation: and

The HDC is the device to improve the engine brake effect during downhill driving on a steep hill. If the ESP function is in operation, HDC operation is overridden.

6. Slope level exceeds 10%.

When the slope level exceeds 10%, the HDC operates until the vehicle reaches the speed value given in step (4).

When the slope level is between 10% and 20% during the HDC operation

When depressing the accelerator pedal or brake pedal, HDC system is changed to stand-by mode. When depressing the accelerator pedal again, HDC starts its operation again. Therefore, drivers can control the vehicle speed to a desired level by operating the accelerator pedal.

When the slope level exceeds 20% during the HDC operation

When depressing the accelerator pedal, HDC system is changed to stand-by mode. When depressing the brake pedal, HDC continues its operation and the braking power is increased.

In this case, HECU sounds an abnormal noise and brake pedal may be very rigid, but this is a normal condition due to HDC operation.

HDC (Hill Descent Control) System Non-Operation Conditions

1. **When HDC switch is turned OFF** or

2. **Gearshift lever has passed neutral (N) position.** or

NOTICE

- **Vehicle with the manual transmission: Sensing at the neutral switch**
- **Vehicle with the automatic transmission: Sensing at inhibit switch**

3. **When the vehicle speed is out of the specified values.** or

4. **When the ESP related functions, e.g. vehicle position control, HBA, ARP is activated during HDC operation.** or

   The HDC is the device to improve the engine brake effect during downhill driving on a steep hill. If the ESP function is in operation, HDC operation is overridden.

5. **When the internal temperature of HDC system goes over 350°C due to long downhill driving on a steep hill with HDC operated.** or

   There is no specific temperature sensor in the system, but a programmed logic inside the HECU predicts the temperature based on the operating numbers and conditions of HDC.

NOTICE

- **The red HDC warning lamp blinks when the internal temperature goes over 350°C. When it reaches 450°C, the HDC warning lamp comes on. The HDC can be operated in the range even where the HDC warning lamp blinks.**

6. **When the slope level is below 10%**

   When the slope level exceeds 10%, the HDC operates until the vehicle reaches the speed condition given in step (4).

When the slope level is between 10% and 20% during the HDC operation

When depressing the accelerator pedal or brake pedal, HDC system is changed to stand-by mode. When depressing the accelerator pedal again, HDC starts its operation again. Therefore, drivers can control the vehicle speed to a desired level by operating the accelerator pedal.

When the slope level exceeds 20% during the HDC operation

When depressing the accelerator pedal, HDC system is changed to stand-by mode. When depressing the brake pedal, HDC continues its operation and the braking power is increased.

In this case, HECU makes an abnormal noise and brake pedal may be very rigid, but this is a normal condition due to HDC operation.

▶ Heated Tailgate Glass/Outside Rearview Mirror (Defogger) Switch

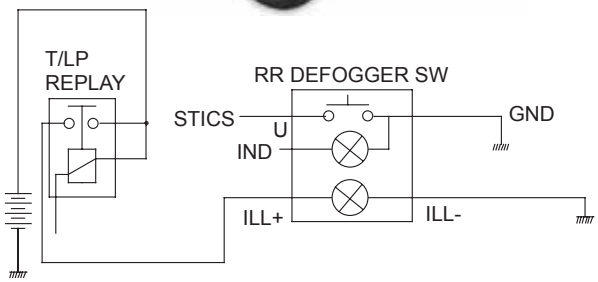
Overview

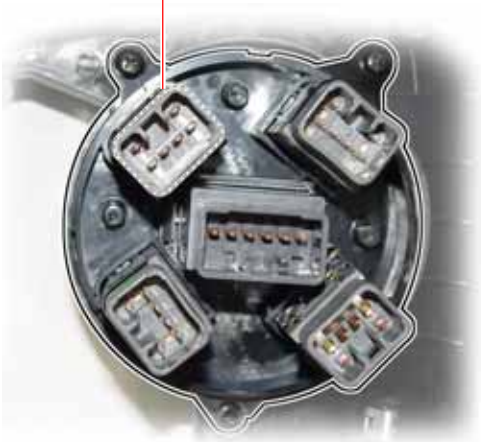
Heated tailgate glass/Outside rearview mirror switch is a Push & Self Return type switch.

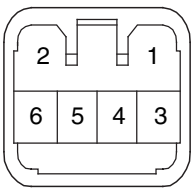
1. The outside rearview mirror & tailgate glass defogger operates for approx. 12 minutes when pressing this switch while the ignition switch is turned on.
2. It stops when pressing the switch again during its operation.
3. If pressing this switch again within 10 minutes after completion of first operation, it will operate for about 6 minutes.
4. It stops when the ignition switch is turned to “OFF”.



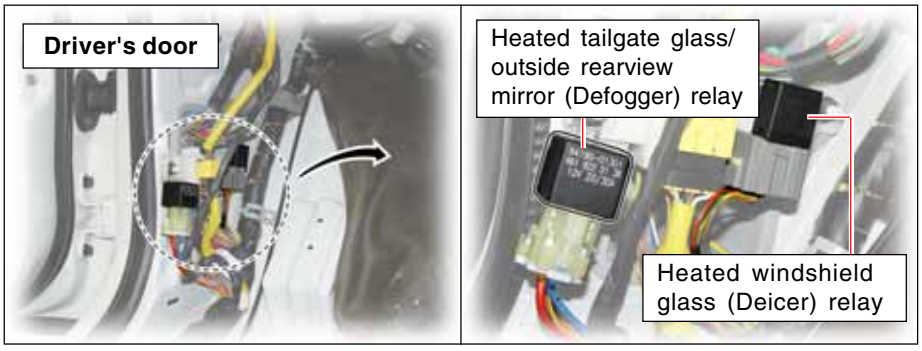




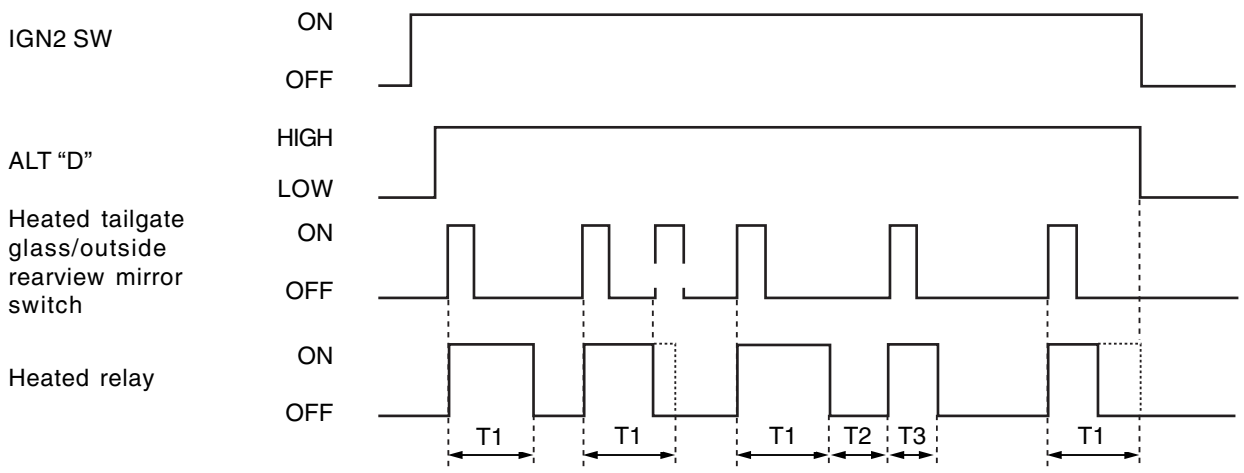




	ON	OFF
1(U)	○	
2(GND)	○	●
3(IND)	○	
4(ILL+)	○	●
5(ILL-)	○	



Timing Chart



ALT “L” = 9 V ± 1 V (Key ON) & ALT = ON

T1: 12 min. T2: within 10 min T3: 6 min ON: IGN2

OFF: IGN2 (Key ON) or ALT = OFF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Heated Windshield Glass (Deicer) Switch

Overview

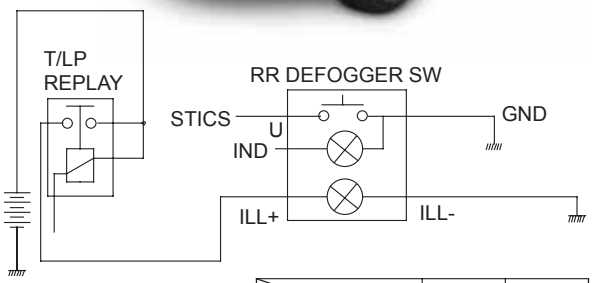
Heated windshield glass switch is a Push & Self Return type switch.

1. The windshield deicer operates for approx. 12 minutes when pressing this switch while the ignition switch is turned on.
2. It stops when pressing the switch again during its operation.
3. If pressing this switch again within 10 minutes after completion of first operation, it will operate for about 6 minutes.
4. It stops when the ignition switch is turned to “OFF”.

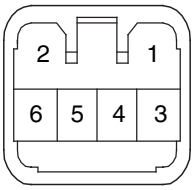


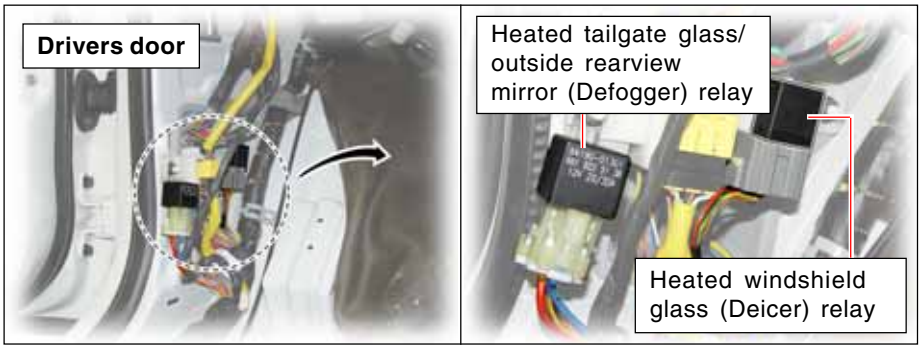




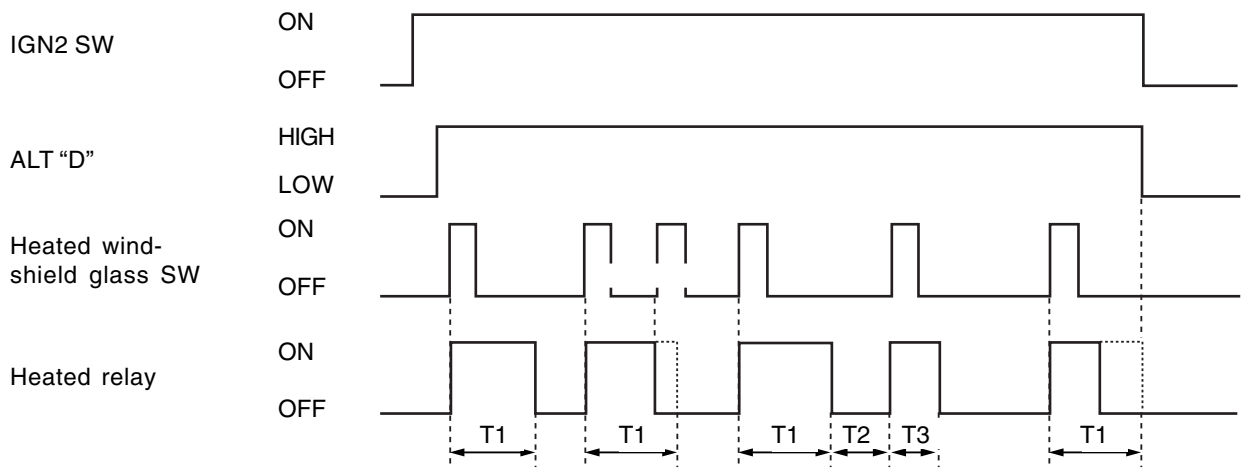


	ON	OFF
1(U)	○	
2(GND)	○	⊗
3(IND)	○	
4(ILL+)	○	⊗
5(ILL-)	○	





Timing Chart



ALT "L" = 9 V ± 1 V (Key ON) & ALT = ON

T1: 12 min. T2: within 10 min. T3: 6 min. ON: IGN2

OFF: IGN2 (Key ON) or ALT = OFF

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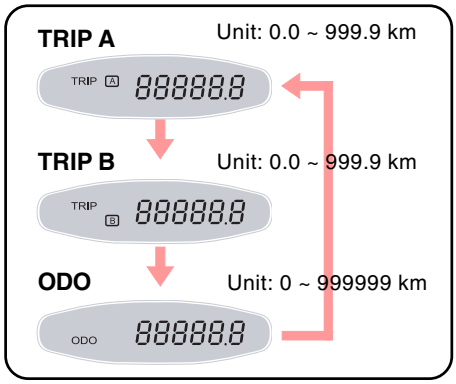
▶ TRIP Switch

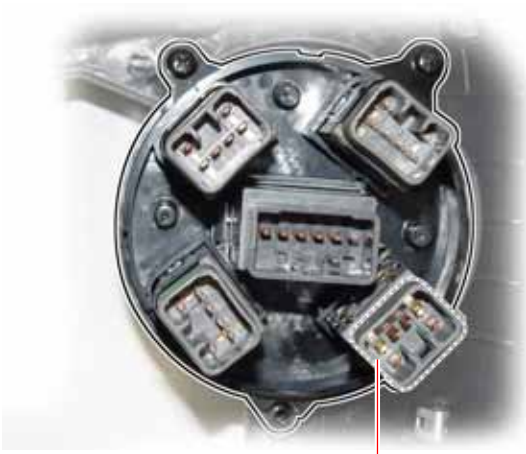
Overview

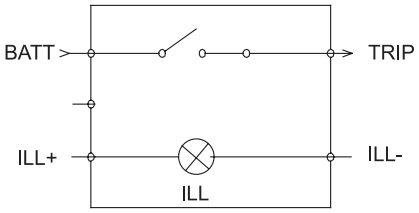
Trip switch is a Push & Self Return type switch.

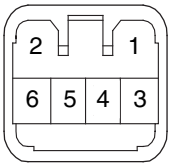
To choose a desired driving distance display mode, press the switch: Changing sequence: ODO - TRIP A - TRIP B - ODO

TRIP A/B display will be initialized to 0 km when the distance of an individual trip exceeds 999.9 km. If you press and hold the reset button for more than one second in TRIP A or TRIP B mode, the trip ODO meter resets to zero.











	ON	OFF
1(B)	○	
2(GND)	○	
3(IND)		
4(ILL+)	○	⊗
5(ILL-)	○	

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AFFECTED VIN	

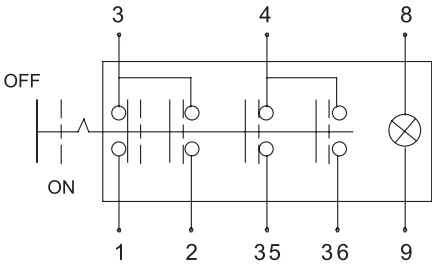
▶ Hazard Switch

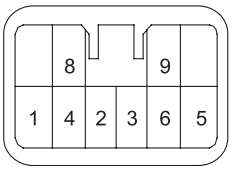
Overview

Hazard switch is connected to the turn signal lamp circuit.









P \ T	ON	OFF
1(IG)		○
2(B)	○	
3(FB)	○	○
4(FL)	○	
5(TL)	○	
6(TR)	○	
8(ILL-)	○	⊗
9(ILL+)	○	

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AFFECTED VIN	

CENTER FASCIA SWITCH BEZEL ASSEMBLY

1. DETAILS FOR CENTER FESCIA SWITCHES

▶ HDC Switch

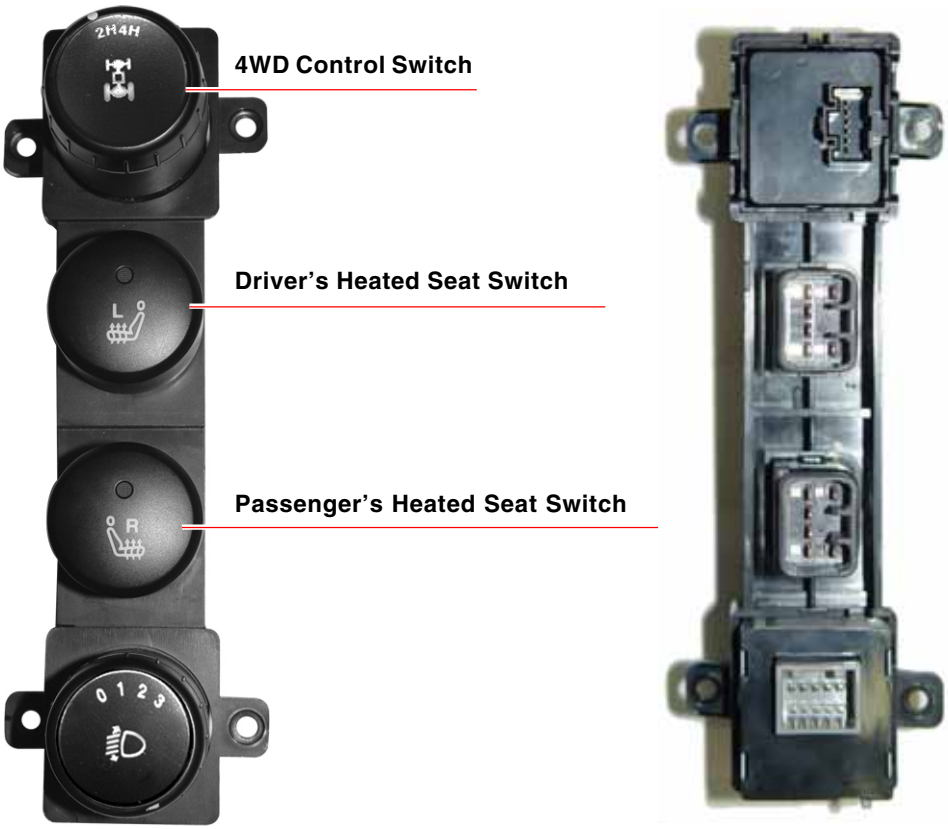
Overview

The following switches are integrated as an assembly in the center fascia as shown in the figures:

- 4WD Control Switch
- Driver's Heated Seat Switch
- Passenger's Heated Seat Switch

The figures below show the removal of switch assembly mounted as an assembly.





▶ 4WD Control Switch

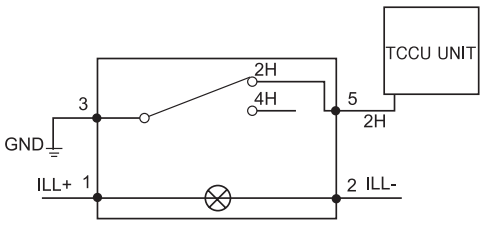
Overview

The 4WD control switch is the rotary switch which has no 4L mode and the switch operation is recognized by TCCU. The switch has the illumination lamp connected to the tail lamp circuit.

For newly introduced 4WD, refer to "Chassis" section.

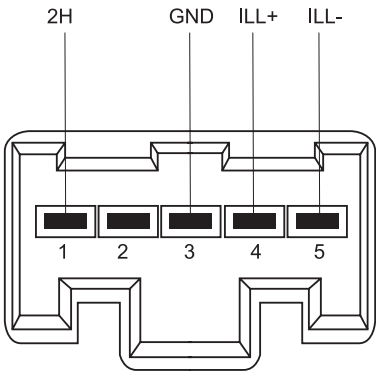


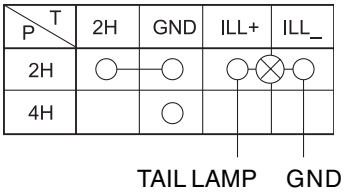












CAUTIONS

- There could be mechanical noises and shocks during mode changes. However, these are normal conditions due to mode changing operations.
- Use only the 2H mode on a normal paved surface. Do not drive your vehicle in the “4H” or “4L” position on paved road surfaces. Doing so will result in damages to the drive train.
- Driving in a 4 wheel mode on a normal paved surface will cause unwanted noises, premature wear of tires, or increased fuel consumption.
- If the “4WD CHECK” warning light stays on, have the 4WD system checked.
- When cornering a curved road in 4WD LOW or 4WD HIGH drive mode, there could be some mechanical shocks and resistances in vehicle’s drive train. These are normal conditions due to internal resistance in drive train when the 4WD LOW is properly working. To avoid damages to the drive train, do not drive your vehicle with excessively high speed in sharply curved road.

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EFFECTIVE DATE	
AFFECTED VIN	

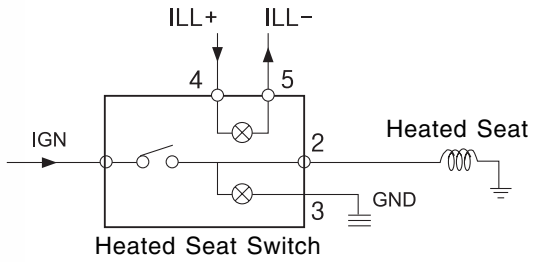
▶ Heated Seat Switch

Overview

Heated seat switch is Push lock type switch. When the heated eat switch is operated, the seat cushion and seatback gets warm. If the temperature of seat surface gets 40 ± 5°C, the thermistor cuts or connects the power to heated wire to maintain the temperature to the specified level. The is no control switch and unit to control the temperature of the seat surface temperature.

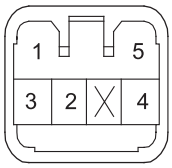












	ON	OFF
1(IGN)	○	
2(S/H RLY)	○	⊗
3(GND)	○	
4(ILL+)	○	⊗
5(ILL-)	○	

NOTE

- **The temperature of seat surface should be increased over 20°C within 3 minutes after turning on the switch while a person (height: 175 ± 5 cm, weight: 75 ± 5 kg) occupies the seat.**

CAUTIONS

- **Do not place anything sharp on the seat.**
- **When cleaning the seats, do not use organic solvents such as benzene or thinner.**
- **Do not use this function when the engine is not running. The battery could be discharged.**

▶ HLLD (Headlamp Leveling Device)



Overview

Headlamps are designed to get a front visibility when driving a vehicle at night.

The beam of the light can be aligned by using a screw installed on the unit.

If the beam of the light is too high, it makes an approaching driver be dazzled (same as when using high beam). On the contrary, if it is too low, a driver cannot get a good visibility. Therefore, the headlamps should be aligned properly.

There is an electric control device, so called "Headlamp Leveling Device", to align the beam of the light as needed while driving.

Principle

Operating Principle

A rod in actuator is linked to the headlamp to move the headlamp up or down when operating the leveling switch. The sensor integrated in actuator senses the rod positions.

Using when

This system compensates for a heavy load in the trunk or fully occupied vehicle which pushes the front of the vehicle up and causes the headlamps to project upward. The leveling system levels out the projection of the light.

Control

Leveling Control Switch

The leveling control switch is located on the instrument panel. It can adjust the level of beam aiming by 4 stages (0 to 3).

Ex) Level 0: "Driver" or "Driver + Front passenger"

Level 3: "Fully occupied + Heavy luggage in trunk"

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2. REMOVAL AND INSTALLATION OF HAZARD & BEZEL SWITCH ASSEMBLY

※ **Preceding Works:** Disconnect the negative battery cable.

▶ Location

Hazard switch bezel assembly



Center fascia switch assembly



▶ Removal and Installation

1. Remove the center fescia panel assembly.

NOTE
- **When removing, pull off its lower part first.**



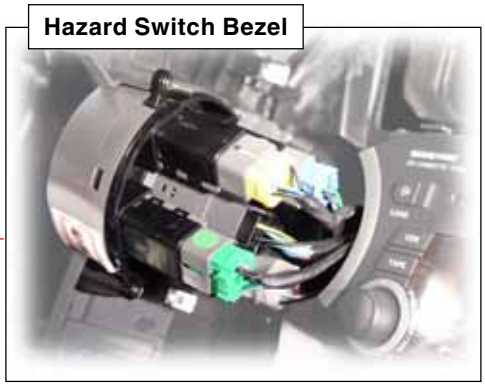
2. Disconnect the switch connectors and remove the center fascia panel assembly.



Digital Clock



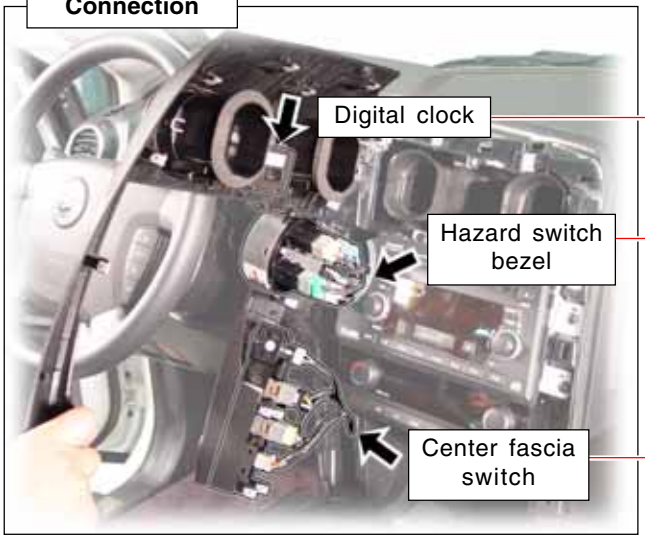
Hazard Switch Bezel



Center Fascia Switch



Connection



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AFFECTED VIN	

3. Remove the hazard switch bezel assembly and center fascia switch assembly from the removed center fascia panel.

Front View



Rear View



Remove Three Mounting Screws



Remove Four Mounting Screws



4. Remove each switch from the hazard switch bezel assembly.

Front View | Side View | Rear View



A. Remove the round cover and switches.



B. Remove the hazard switch mounting bracket and remove the hazard switch.



5. Remove each switch from the miscellaneous switch assembly.



Center Fascia Panel

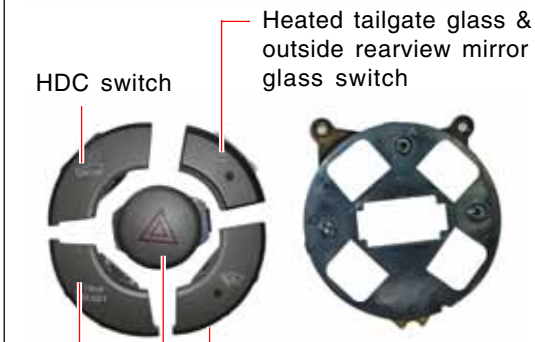
The digital clock receives the power constantly through the fuse No. 23 (7.5 A) from the battery and its lighting device is connected to the tail lamp circuit for illumination. When the ignition key is turned from OFF position, the power is supplied through the fuse No. 43 (10 A).

Digital clock











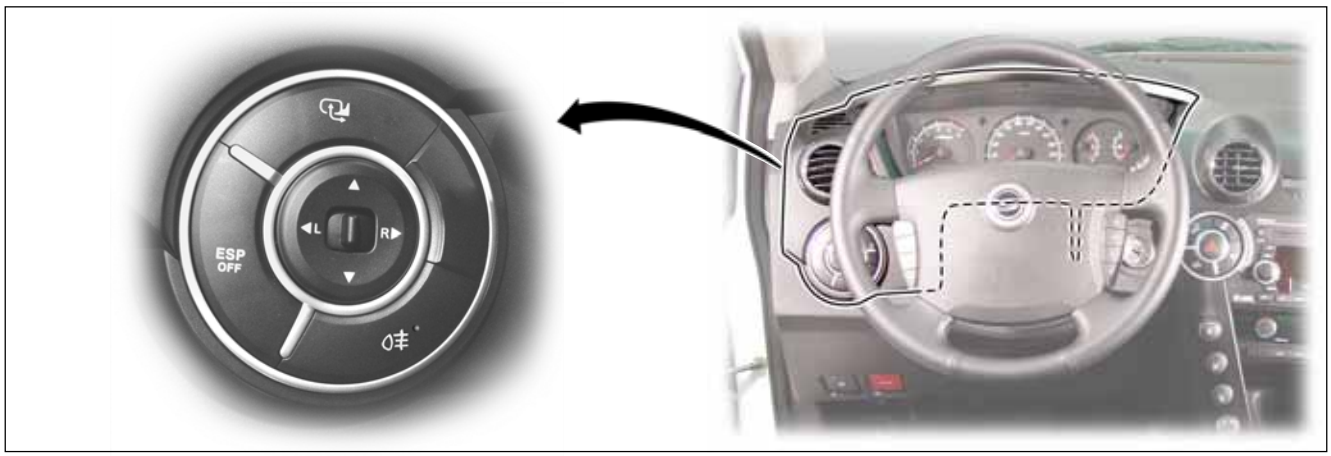


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AFFECTED VIN	

OUTSIDE REARVIEW MIRROR SWITCH BEZEL ASSEMBLY

1. LOCATION

Outside rearview mirror switch bezel assembly consists of outside rearview mirror folding switch, ESP OFF switch and rear fog lamp switch (regional option).



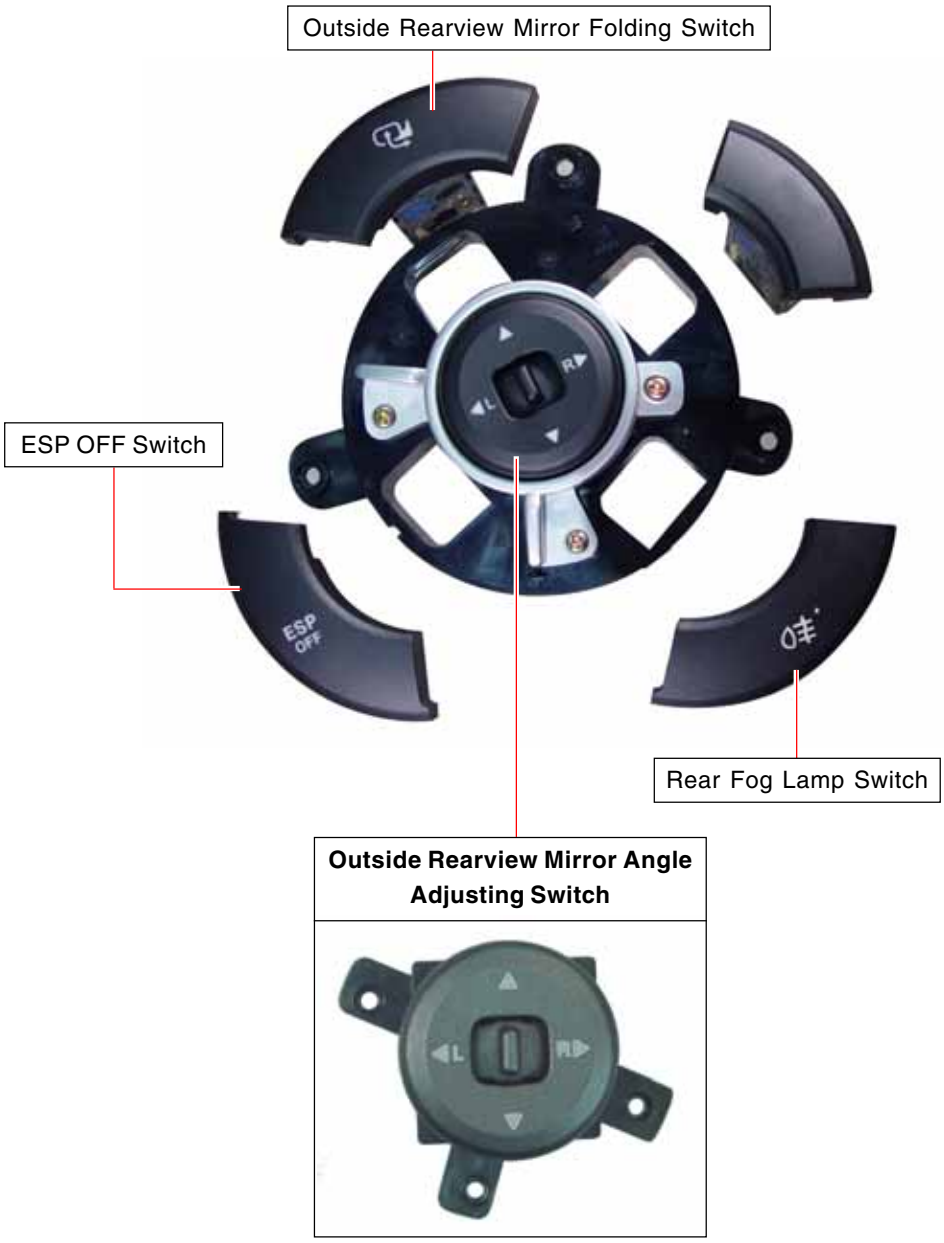
Front View of Outside Rearview Mirror Bezel Panel



Rear View of Outside Rearview Mirror Bezel Panel



2. SWITCH ARRANGEMENT







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3. SWITCHES IN OUTSIDE REARVIEW MIRROR SWITCH BEZEL ASSEMBLY

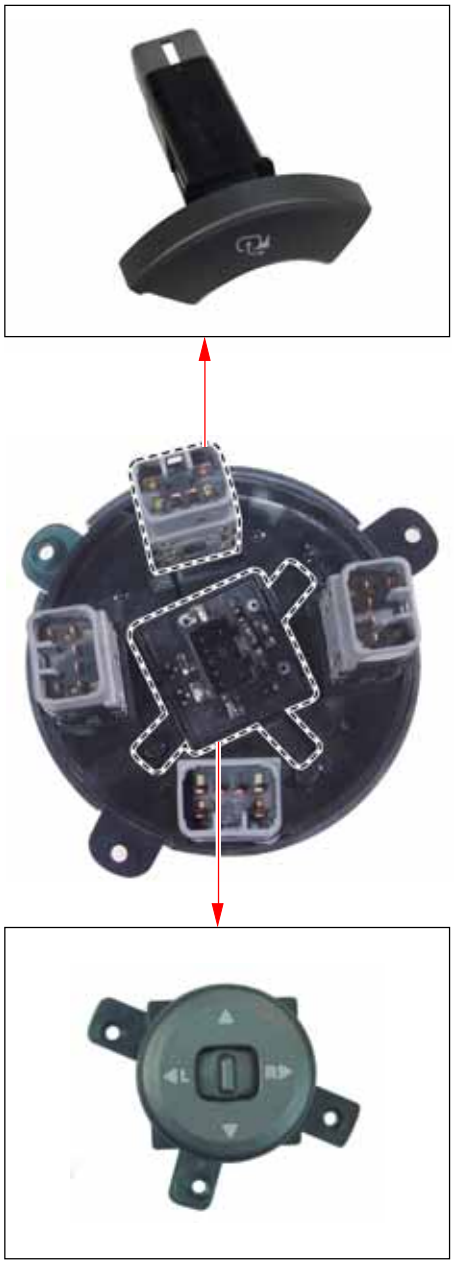
▶ Outside Rearview Mirror Folding and Adjusting Switch

Overview

The outside rearview mirror folding switch is a self-return type switch and equipped with the separate folding unit as a see-saw and self-return type switch.

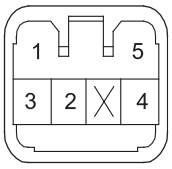
The power supply relay is connected to STICS and can fold and unfold outside rearview mirrors for 30 seconds after the engine is off. The folding unit for controlling the folding/unfolding operations is installed on the left side of instrument panel center frame.

Do not fold or unfold outside rearview mirrors manually. It may cause a malfunction of the mirror folding system.

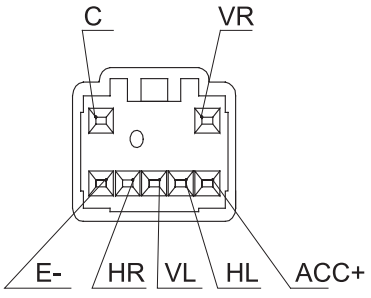


Outside Rearview Mirror Folding Switch

To fold the outside rearview mirrors, press the switch. To unfold the mirrors, press it again.



	ON	OFF
1(B)	○	
2(GND)	○	
3(IND)		
4(ILL+)	○	⊗
5(ILL-)	○	

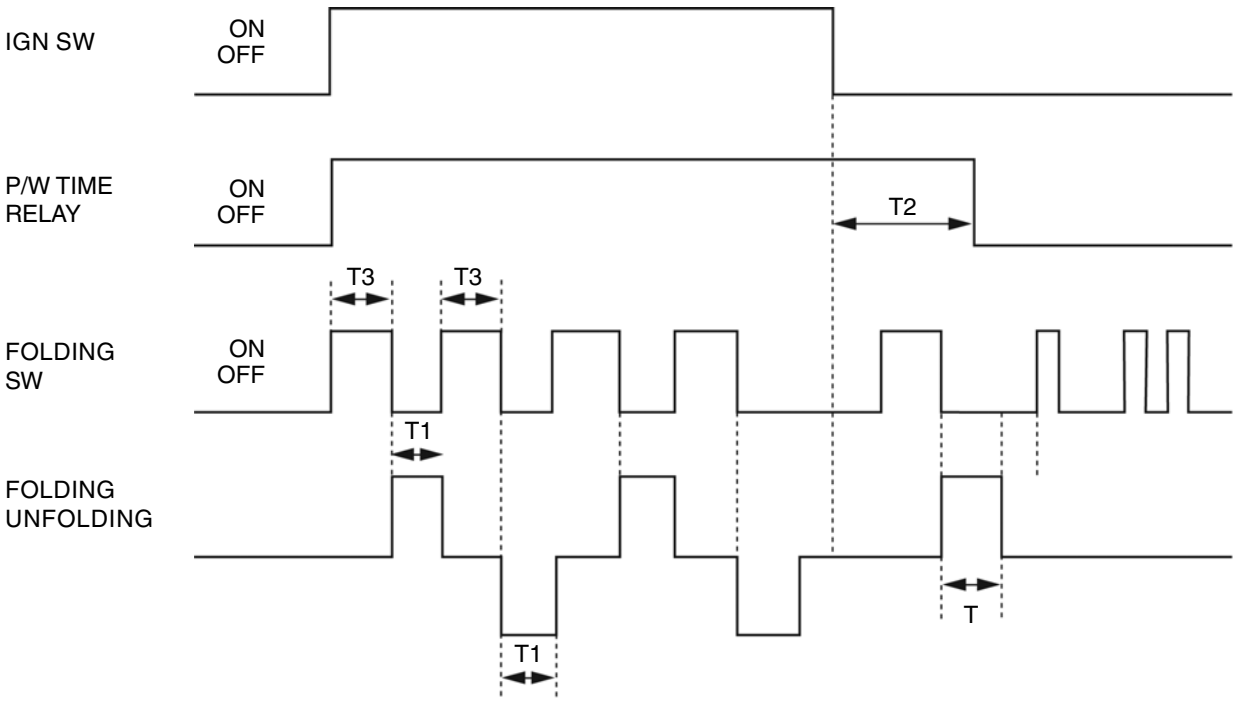


CLASS	DIR	VL	HL	VR	HR	C	ACC-	B
LEFT HAND	UP	○	○			○	○	○
	DOWN	○	○				○	○
	OFF	○	○			○		○
	LEFT	○		○		○	○	○
	RIGHT	○		○		○	○	○
RIGHT HAND	UP			○	○	○		○
	DOWN			○	○		○	○
	OFF			○	○	○		○
	LEFT			○		○	○	○
	RIGHT			○		○	○	○

The outside rearview mirrors can be folded and unfolded within 30 ± 6 seconds even after turning off the ignition switch. To prevent the outside rearview mirrors from stopping during its operation, the mirror operating time is extended 13 seconds when pressing the switch again.

Refer to the following timing chart for operation procedures.

Timing Chart



T: T < T1, T1: 13 ± 3 sec, T2: 30 ± 6 sec, T3: 1 Sec ± 0.1 sec

OPERATION TIMING CHART

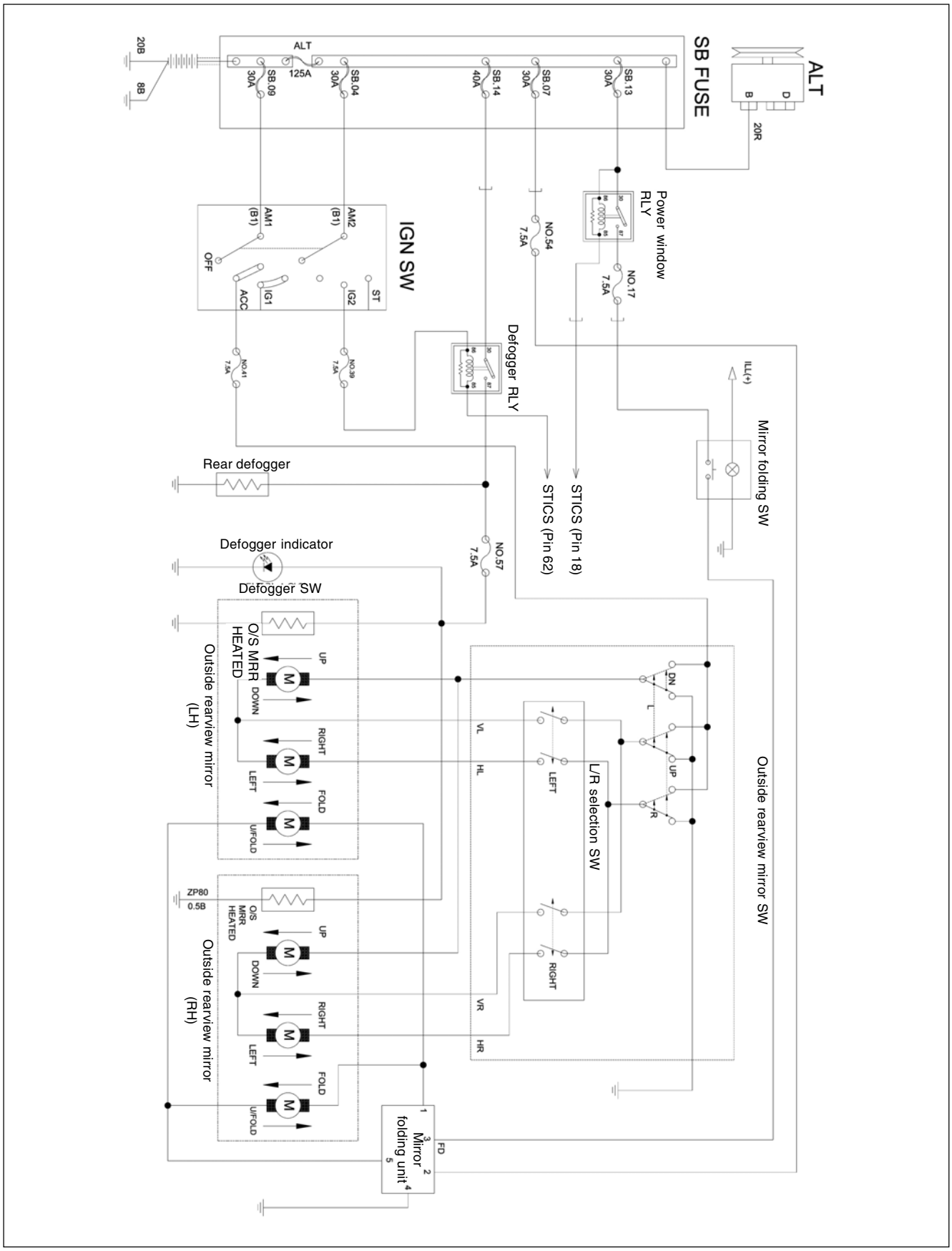
Outside Rearview Mirror Folding Unit





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Electrical Wiring Diagrams



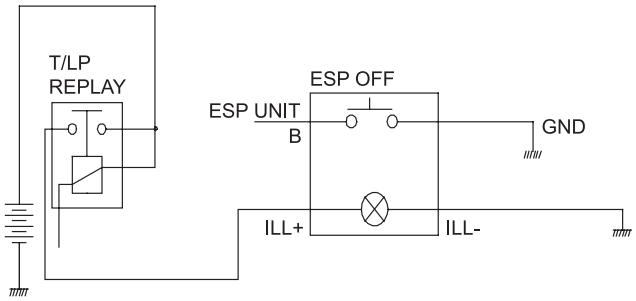
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EFFECTIVE DATE	
AFFECTED VIN	

▶ ESP OFF switch

Overview

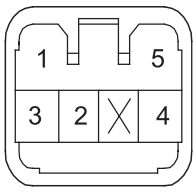
ESP OFF switch is a self return type switch used to enable or disable the ESP function.







	ON	OFF
1(B)	○	
2(GND)	○	
3(IND)		
4(ILL+)	○	⊗
5(ILL-)	○	



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ESP System Cancellation Using the ESP OFF Switch

When the ESP switch at the center switch panel is pushed (for over approximately 150 ms), the ESP system will be cancelled and the vehicle will be driven regardless of the output values from the corresponding sensors. Then, the ESP warning lamp on the instrument panel comes on.

The detailed operation procedures are as follows:

1. The ESP warning lamp comes on when the ESP OFF switch is pushed for over 150 ms.
2. The switch returns to normal position when the OFF switch is released.
3. The ESP system will be cancelled after approximately 150 ms.

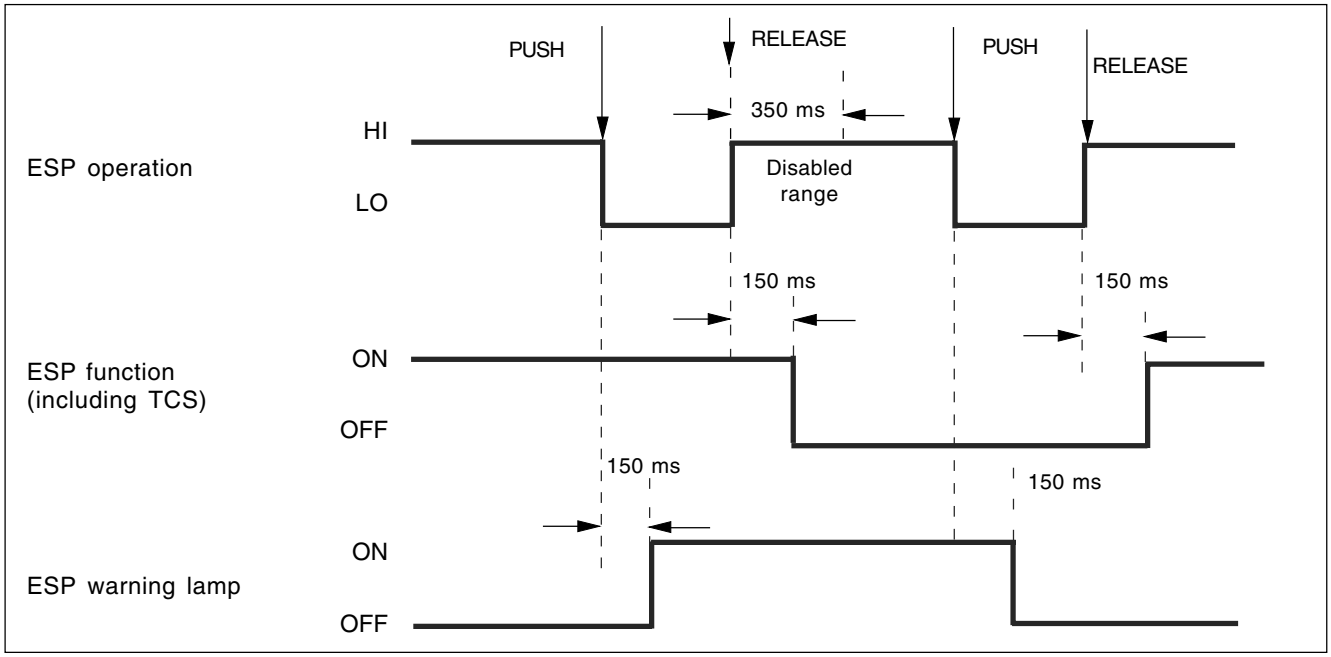
Based on the above procedures, we can see that the ESP system will be cancelled after a certain period (approx. 150 ms) from releasing the switch to the original position. The ESP system does not get canceled immediately when the ESP warning lamp is turned on by pressing the ESP OFF switch. When you turn the ESP system off by pressing the ESP switch for over 150 ms, the TCS system (including ABD function) is turned off. **And the ABS system is still operated.**

Resuming the ESP System by Using the ESP OFF Switch

The ESP system will be resumed and the ESP warning lamp at the instrument panel goes off when the ESP switch is pushed (for over approximately 150 ms) while the ESP system is not operating.

The detailed operation procedures are as follows.

1. The ESP warning lamp goes off when the ESP OFF switch is pushed for over 150 ms.
2. The switch returns to normal position when the OFF switch is released.
3. The ESP system will be resumed after approx. 150 ms.

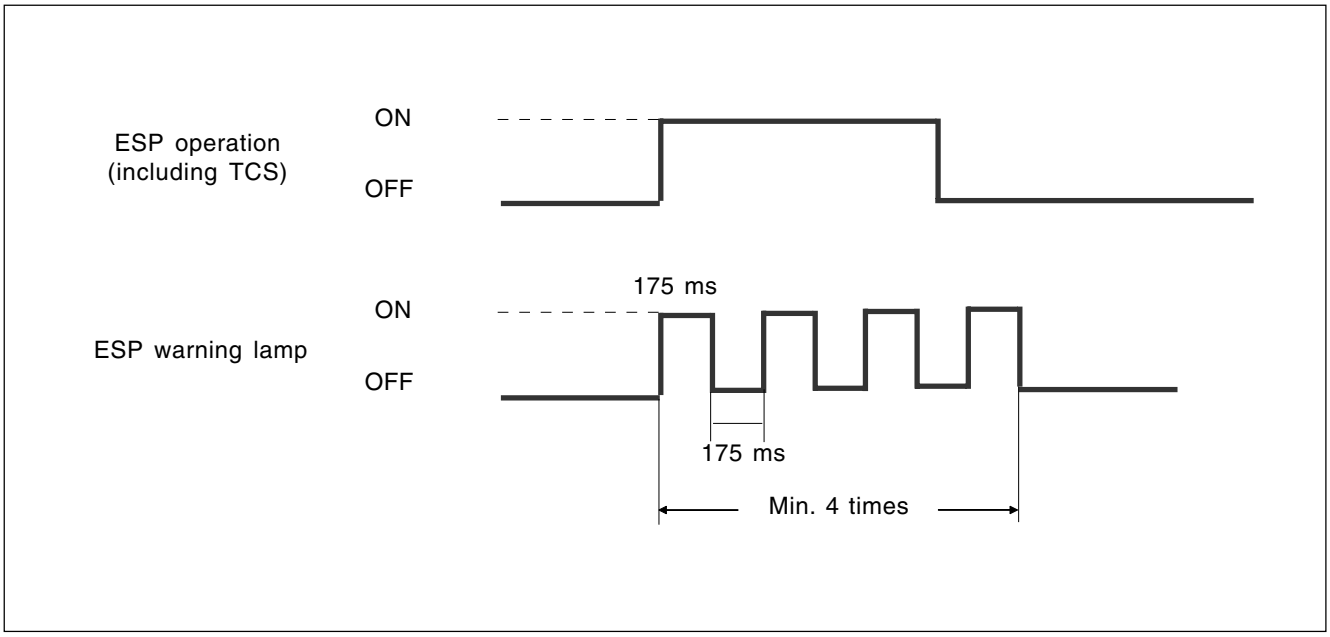


NOTICE

- **When turning the ignition switch off while the ESP system is activated, the ESP system will be resumed when ignition switch is turned on again.**
- **When the vehicle is controlled by ESP system during driving, the ESP OFF switch does not operate.**
- **The ESP OFF switch operates when it is pushed for over 150 ms. When it is pushed for less than 150 ms, the ESP OFF mode and the ESP warning lamp will not be changed.**
- **When the ESP OFF switch is pushed within 350 ms of being turned off, the ESP warning lamp and ESP system will not be turned on.**

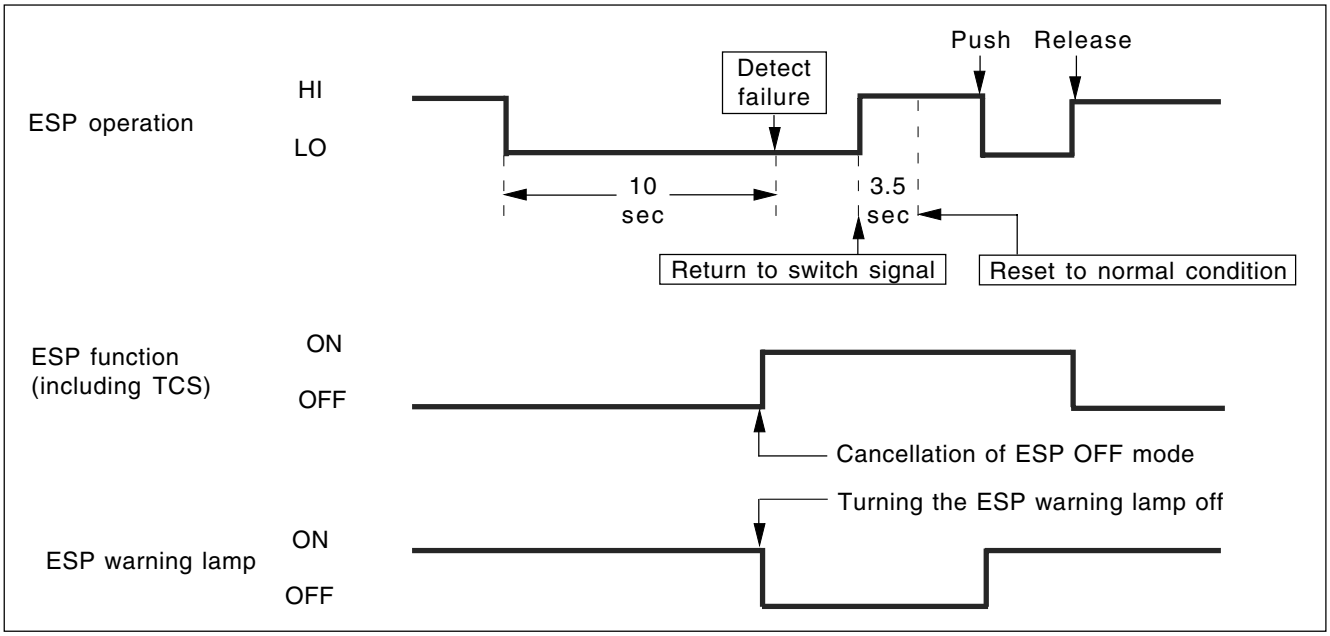
ESP Warning Lamp Blinking in Control

ESP warning lamp blinks when ESP control is activated. If the activation reaches a certain limitation, a beep sounds to warn the driver. The ESP warning lamp goes off when ESP function is deactivated. Even when the ESP is operated for a very short period of time, the ESP warning lamp blinks minimum of 4 times every 175 milliseconds.



ESP OFF Switch Monitoring

When the ESP unit recognizes that the ESP OFF switch is pushed for over 10 seconds, the ESP unit determines it as a ESP OFF switch malfunction. When the ESP OFF switch is pushed, the ESP system is resumed after 10 seconds. However, the ESP warning lamp comes on when the ESP OFF switch is pushed (for over 150 ms) and then goes out when the ESP system is resumed. When the ESP OFF switch returns to normal position, the ESP unit resets the ESP OFF switch for approx. 3.5 seconds.



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ESP Warning Lamp Operation Depending on System Conditions

The table shows ESP warning lamp operations when the ESP system is defective or ESP (including TCS function) is working.

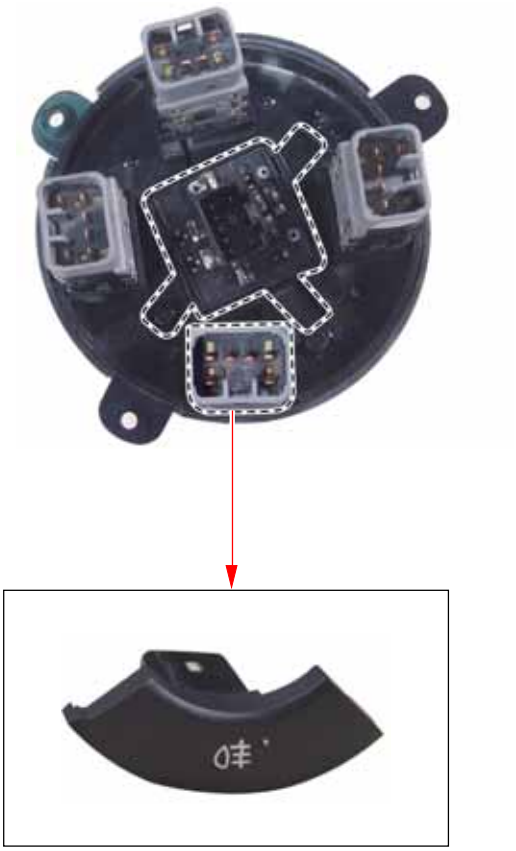
	Warning Lamp		Controls			
	ABS W/L	ESP W/L	ABS	ASR	ABD	Vehicle yaw control
Initial start (for 1.8 sec)	ON	ON	NO	NO	NO	NO
Normal mode	OFF	BLINKS WHEN ESP OPERATION	OK	OK	OK	OK
ESP fault	OFF	ON	OK	NO	NO	NO
ABS fault	ON	ON	NO	NO	NO	NO
System fault	ON	ON	NO	NO	NO	NO
Low batt. voltage	ON	ON	NO	NO	NO	NO
High battery voltage	ON	ON	NO	NO	NO	NO
High brake pad temp.	OFF	ON	OK	NO	NO	NO
ESP-OFF mode	OFF	ON	OK	NO	NO	OK
Entering diag. mode	ON	ON	NO	NO	NO	NO

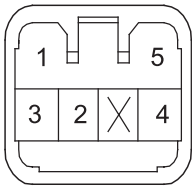
NOTICE

- **When the driver presses the brake pedal during the ESP OFF mode, the yaw control is performed to compensate the vehicle stability (posture) during ESP operation.**

▶ Rear Fog Lamp Switch

The rear fog lamp switch is a self return type switch. When the front fog lamp switch on the multifunction switch is ON and the light switch is placed in the tail lamp or headlamp operation position, the rear fog lamp is operated if pressing the rear fog lamp switch. When the rear fog lamp comes on, the LED on the switch lights on.





	ON	OFF
1(B)	○	
2(GND)	○	⊗
3(IND)	○	⊗
4(ILL+)	○	⊗
5(ILL-)	○	⊗

Rear Fog Lamp Operation Procedures

Multifunction switch in the front fog lamp position and headlamp or tail lamp ON



Pressing the rear fog lamp switch
LED on the switch ON



Rear fog lamp ON (including front fog lamp)



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4. REMOVAL AND INSTALLATION OF OUTSIDE REARVIEW MIRROR SWITCH BEZEL ASSEMBLY

※ **Preceding Works:** Disconnect the negative battery cable.

▶ Location



▶ Removal and Installation

Outside Rearview Mirror Switch Bezel Assembly

1. Remove the center fascia panel and unscrew four screws on the meter cluster fascia panel.



2. Disconnect the connector from the outside rearview mirror switch bezel assembly and remove the meter cluster fascia panel.

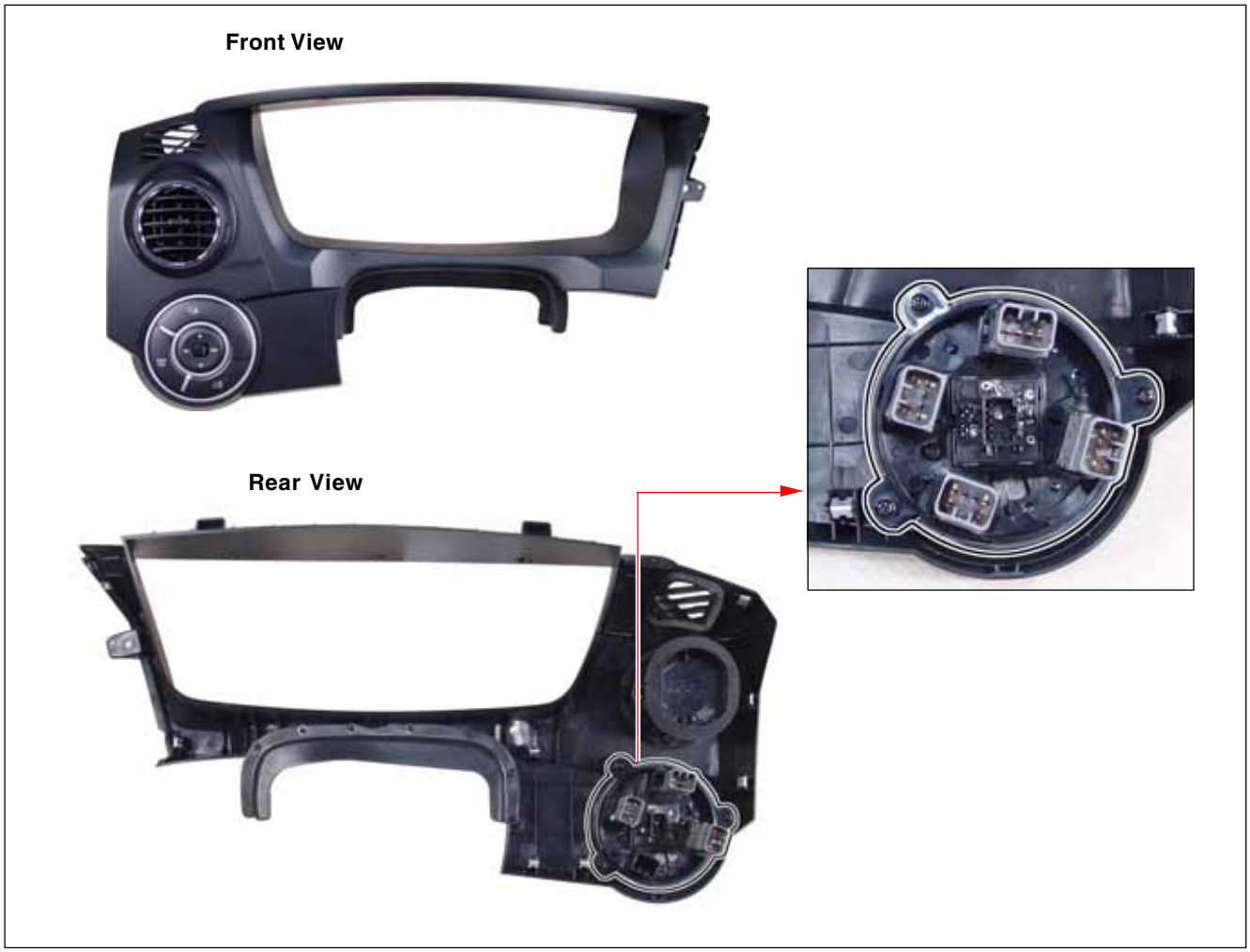




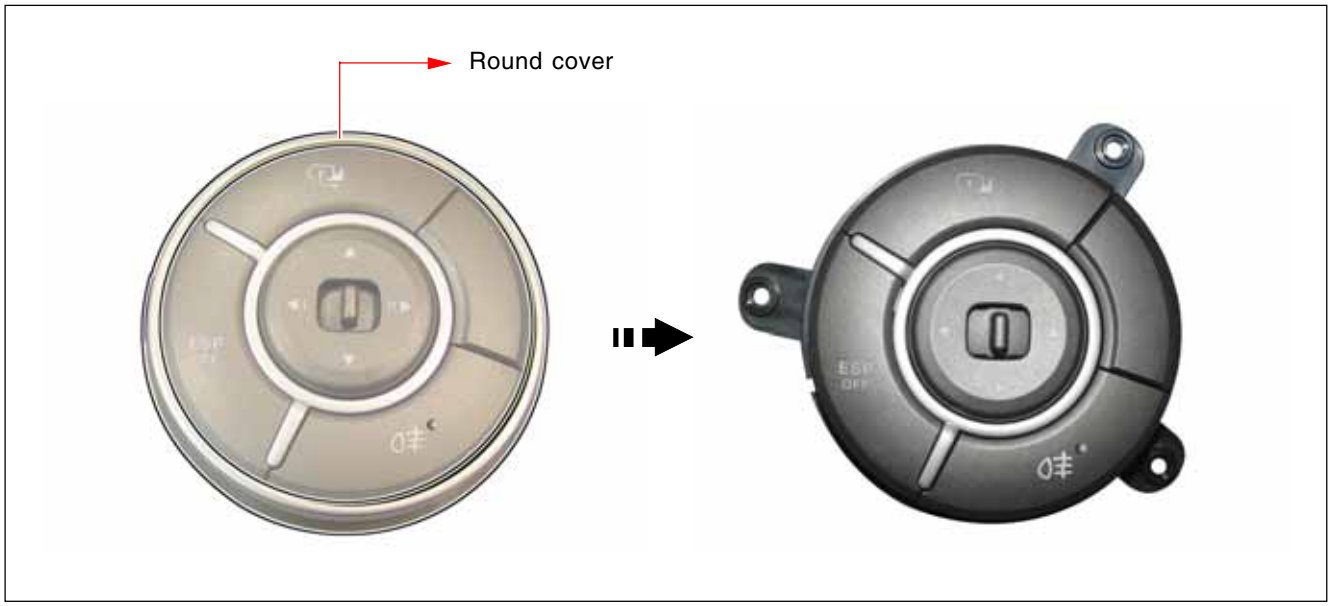
NOTE

- **To make the operation easier, move down the steering wheel.**

3. Remove the switch assembly from the removed meter cluster fascia panel.



4. Remove the round cover on the switch assembly.



5. Remove each switch from the outside rearview mirror switch bezel assembly.

Switch Assembly

Remove the switch bracket.





ESP OFF Switch



Outside Rearview Mirror Folding Switch



Dummy Switch



Rear Fog Lamp Switch



Outside Rearview Mirror Adjusting Switch





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AFFECTED VIN	

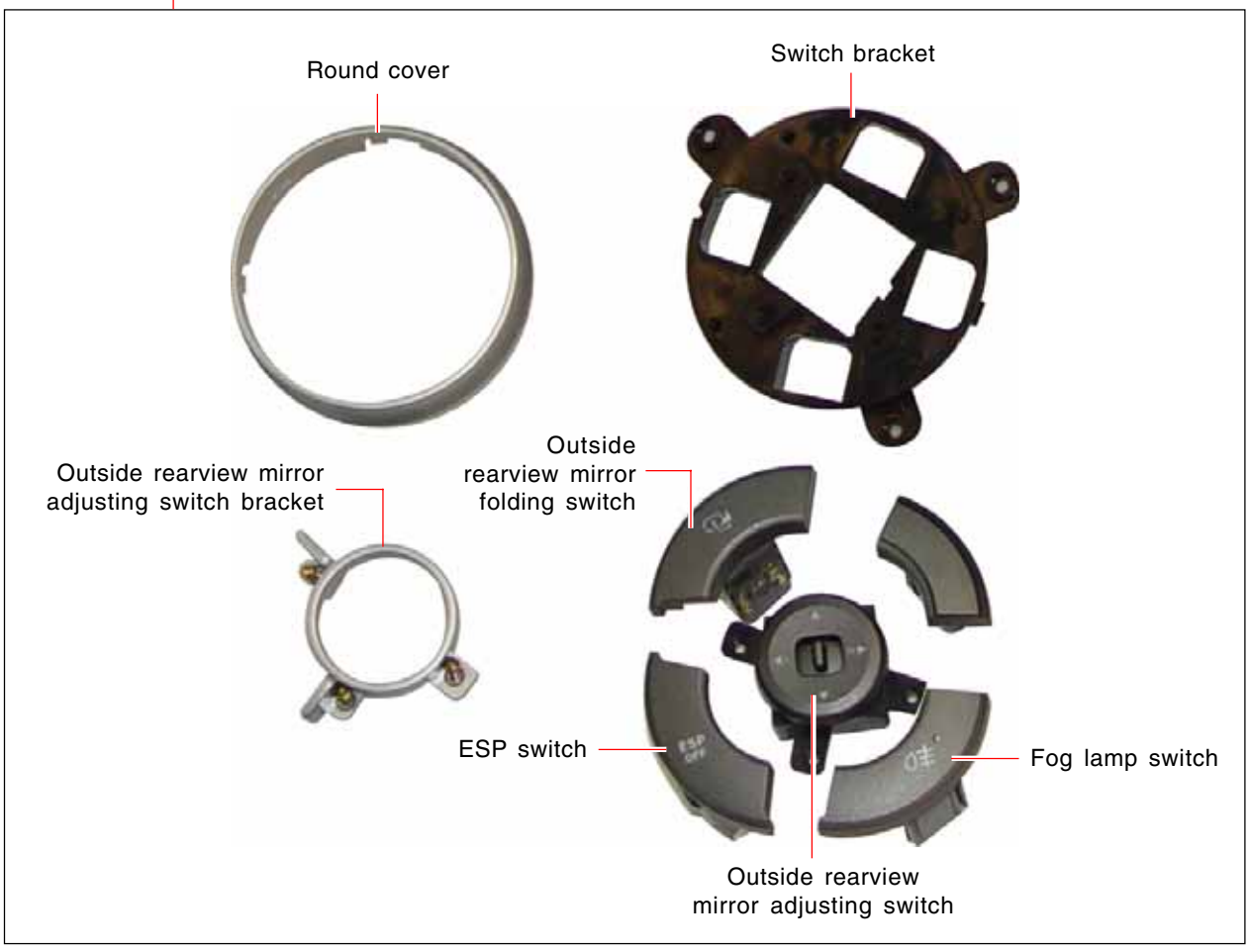
Meter Cluster Fascia Panel



IP fascia panel assembly



IP assembly



Outside Rearview Mirror Folding Unit

※ **Preceding Works:** Disconnect the negative battery cable.

1. Remove the lower instrument panel and inner bracket at the driver's side (refer to "Body" section).



2. Remove the connector and mounting bolt of the outside rearview mirror folding unit to remove the unit.



OVERHEAD CONSOLE SWITCH

1. LOCATION

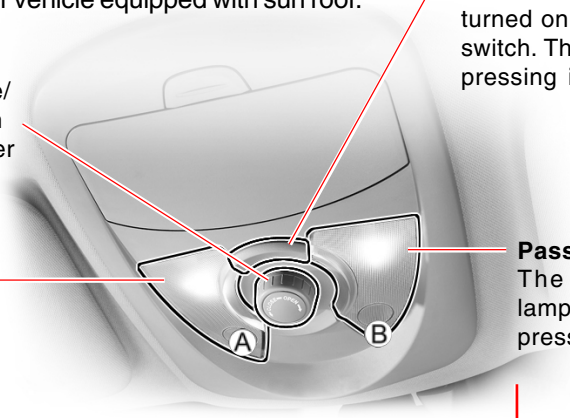
It is composed of three switches and installed in the roof head lining. The picture below shows the overhead console for vehicle equipped with sun roof.

Sunroof switch
Turn the switch clockwise/ counterclockwise to open or close the sun roof (refer to "Sun roof" section).

Main room lamp switch
Front/center room lamps are turned on when pressing in this switch. They are turned off when pressing in this switch again.

Driver's spot switch
The driver's room lamp comes on if you depress the spot switch (A).

Passenger's spot switch
The passenger's room lamp comes on if you depress the spot switch (B).

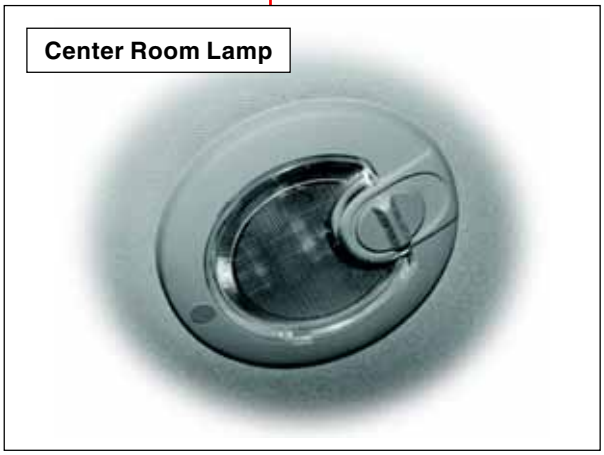




Luggage Room Lamp



Center Room Lamp



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2. COMPONENTS

▶ Overhead Console

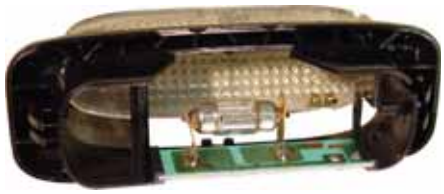


▶ Center Room Lamp and Luggage Room Lamp

Center Room Lamp



Luggage Room Lamp



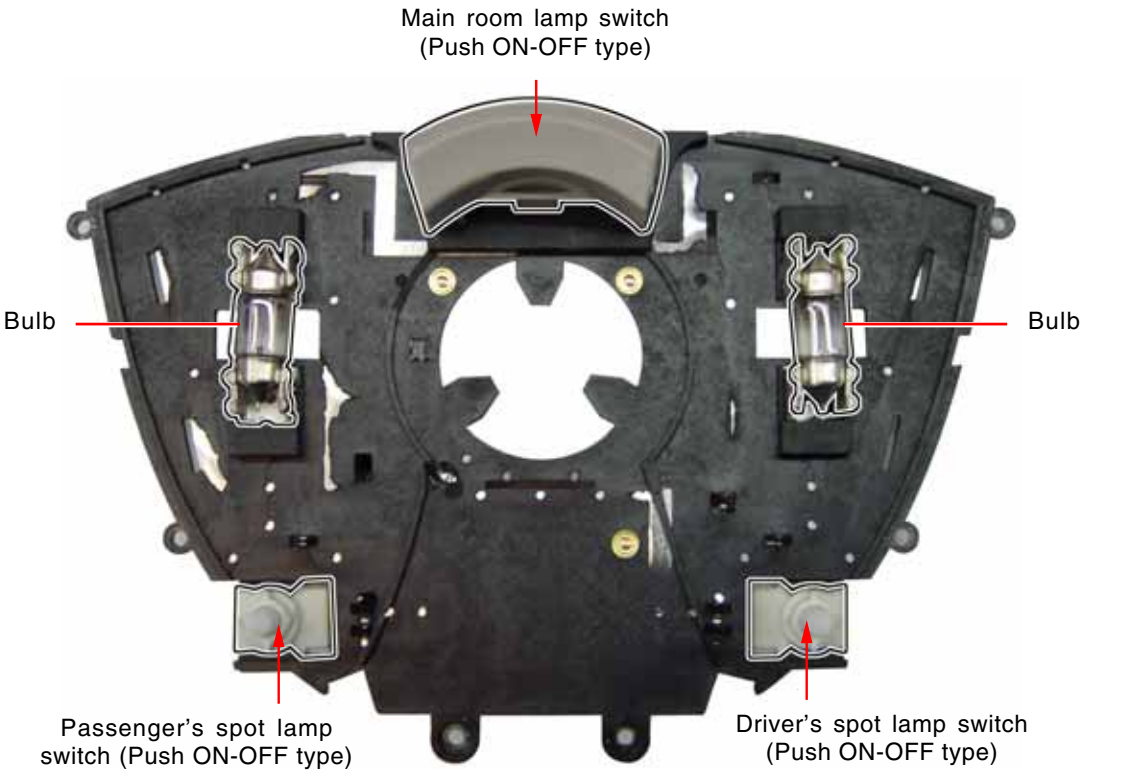
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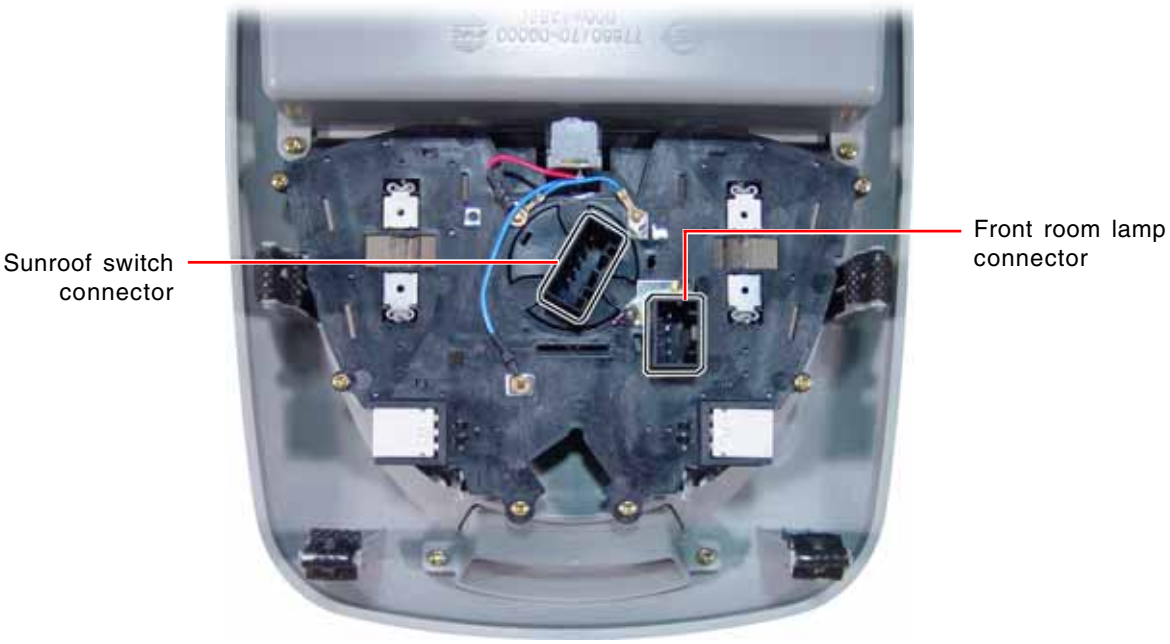
3. SWITCHES IN OVERHEAD CONSOLE SWITCH ASSEMBLY

Overview

Front room lamp switches in overhead console: Push ON/OFF type

Sunroof switch: Rotary, self return type

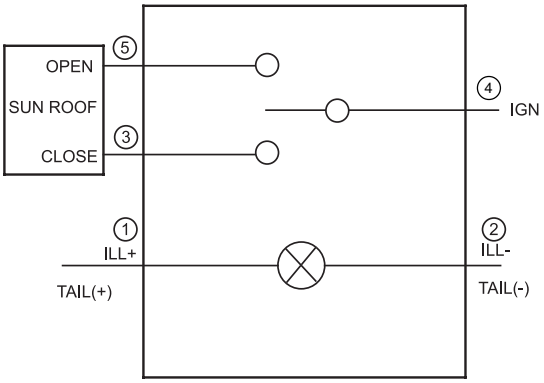


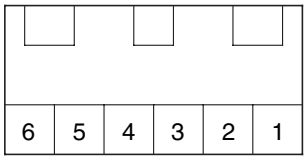


Sunroof Switch







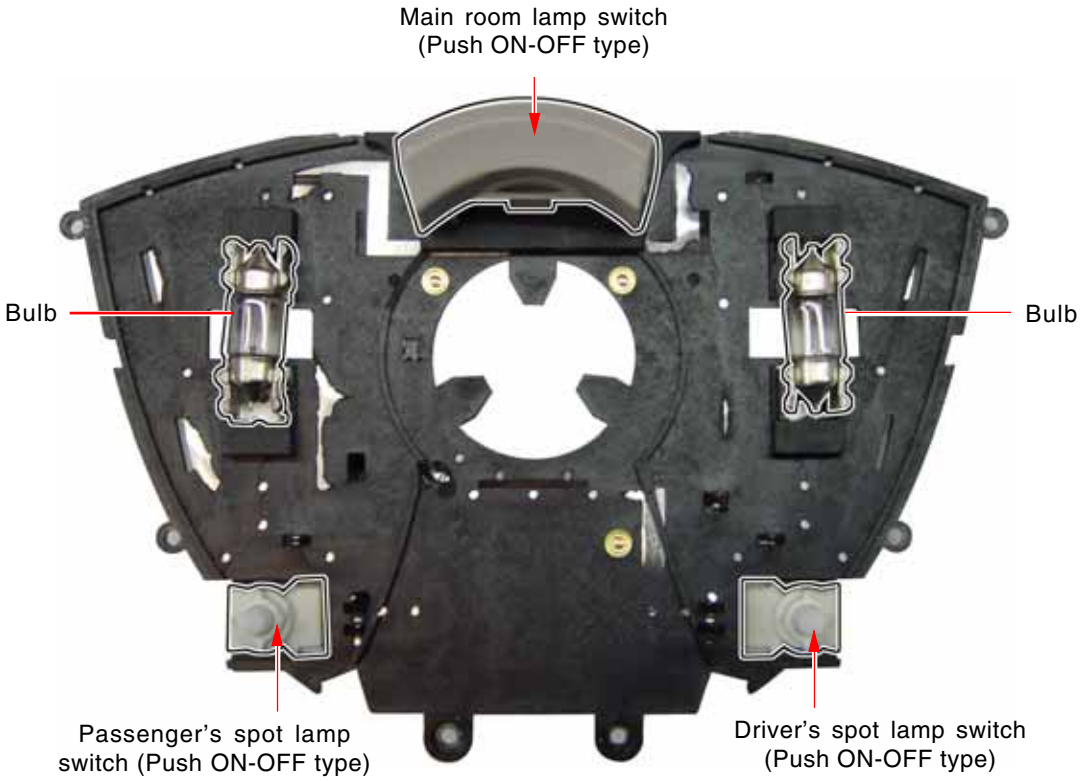


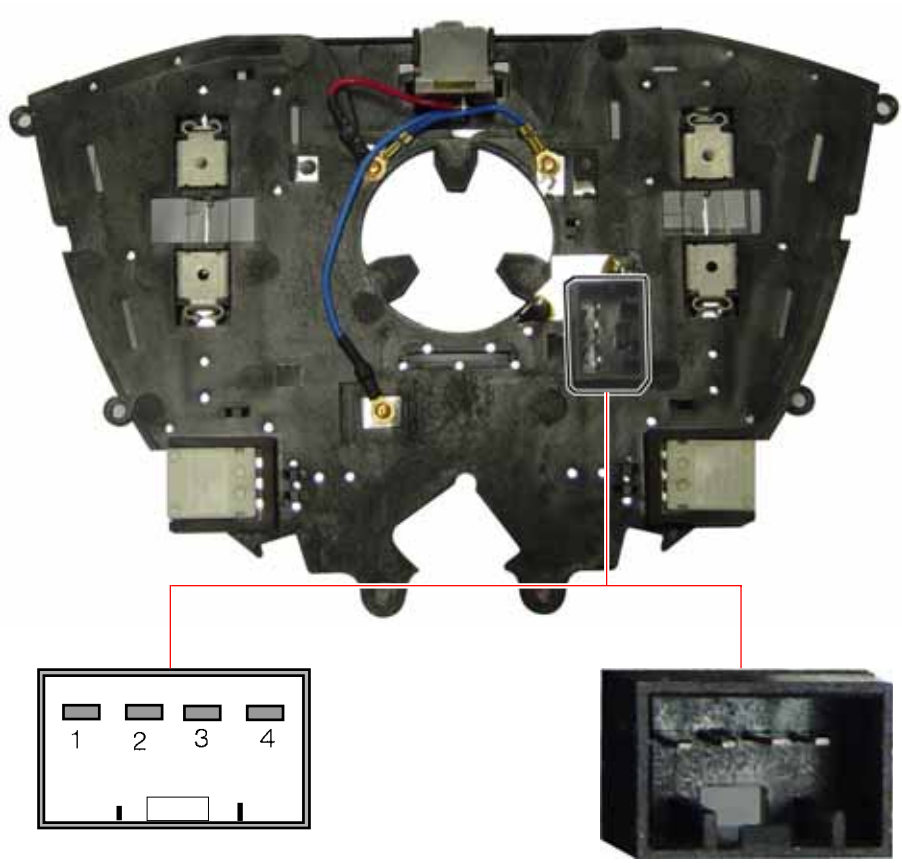




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Front Room Lamp

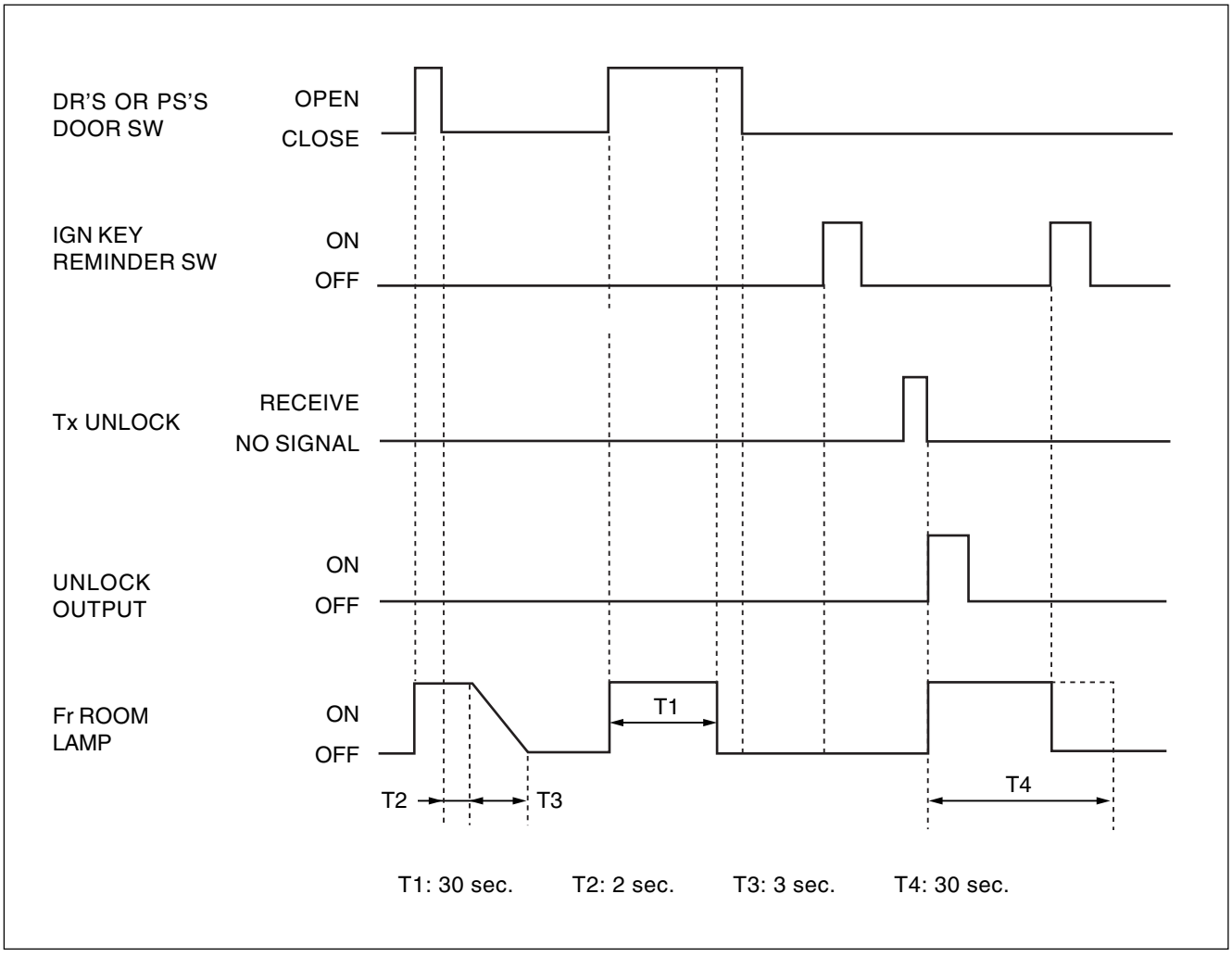




Room Lamp Control

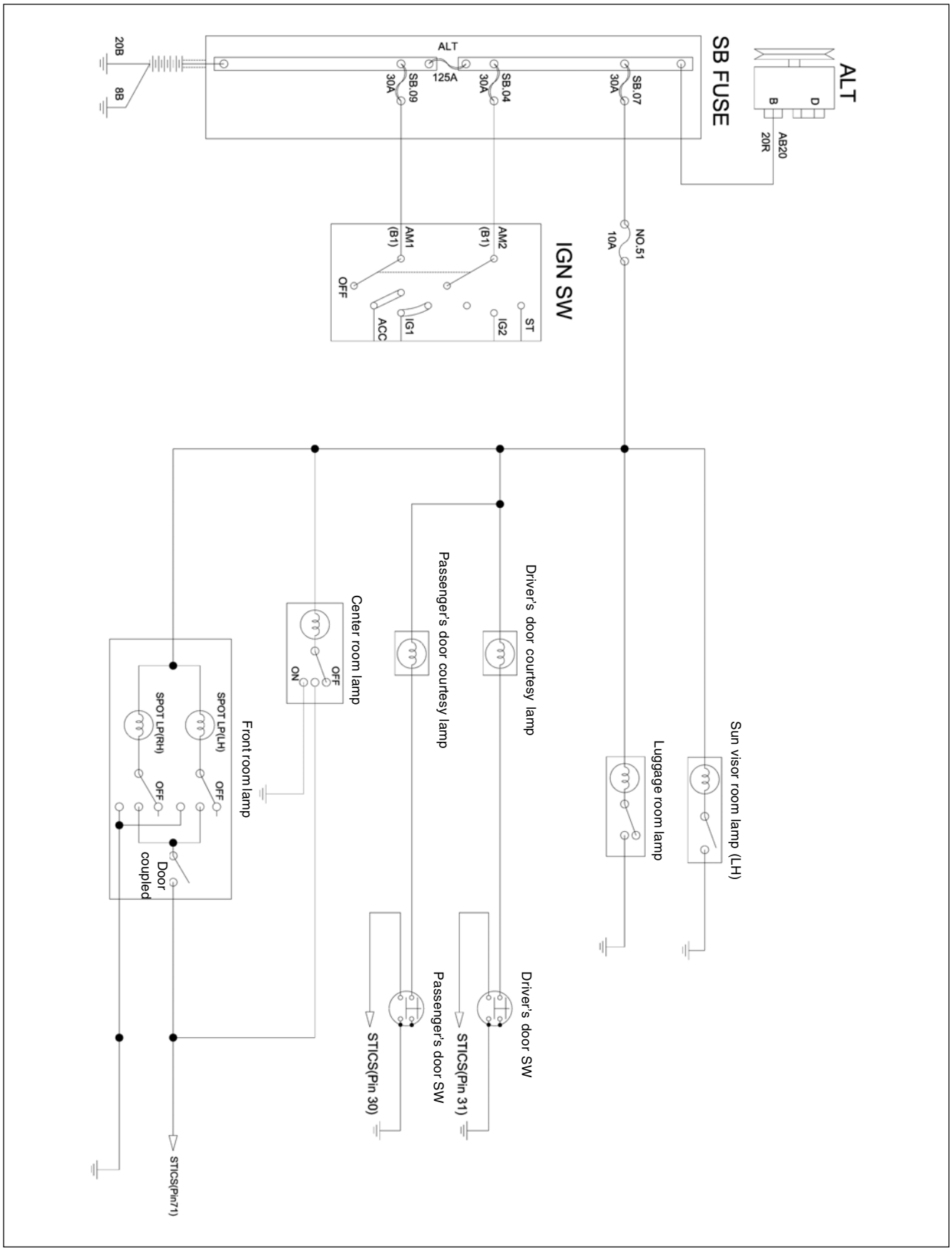
With the key reminder switch OFF, all the room lamps come on if a door (driver's/passenger's/rear) is open, which is controlled by STICS (except tailgate).

1. The front and rear room lamps come on when a door (driver's/passenger's/rear) is open and goes off automatically in 30 seconds.
2. The room lamp stays on for 2 seconds and then decays through 3 seconds when closing the door within 30 seconds.
3. The decaying operation must have greater than 32 steps per one second.
4. The room lamp output should stop immediately after turning on the ignition key during decaying operation.
5. The front room lamp comes on for 30 seconds when receiving the unlock signal from the remote control key while the door is closed.
6. The front/rear room lamp output period is extended by 30 seconds when receiving the unlock signal from the remote control key again during output.
7. When a door is opened during its extended period, the lamp stays on. If closed, operates as in step 2.
8. The room lamp output stops immediately after receiving the lock signal from driver's door, passenger's door and rear doors lock switch while the driver's door, passenger's door and rear doors are closed.



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AFFECTED VIN	

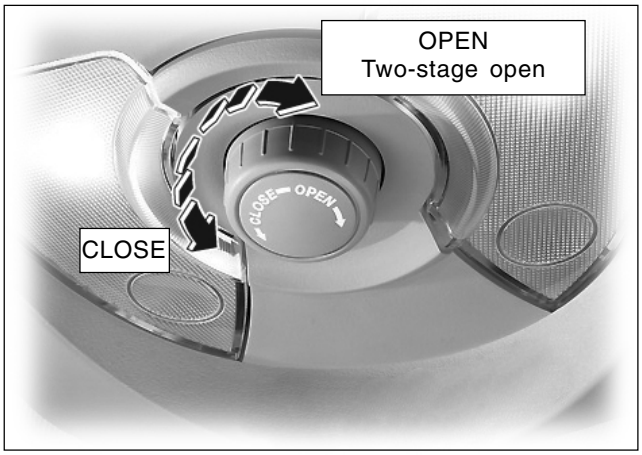
Electrical Wiring Diagram of Room Lamp



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SUNROOF OPERATION AND FUNCTIONS

When you drive this vehicle with the window or sunroof open at a certain position, you may feel some pressure upon your ears or hear some noises similar to those from a helicopter (Wind Buffeting Phenomenon). This phenomenon is caused by the air vibration produced by air entering through the windows and the sunroof. When this happens, adjust the position of windows or sunroof. Actyon has introduced the two stop positions to the sunroof system. When the sunroof is at the 1st stop position it minimizes the wind buffeting effect. To fully open the sunroof, turn the





▶ Sunroof Sliding Operation

1. Two-stage open

If you turn the sunroof switch clockwise (OPEN direction) for less than 0.5 seconds, the sunroof stops at the 1st stop position (330 mm) and if you turn the switch again, it stops at the fully open 2nd stop position (420 mm). If you want to stop the operation while the sunroof is sliding, turn the sunroof switch again.

2. Close

To fully close the sunroof, briefly turn the sunroof switch counterclockwise (CLOSE direction) with the sunroof open. To partially close the sunroof, turn and hold the sunroof switch until it reaches at the desired position.

▶ Sunroof Tilting Operation

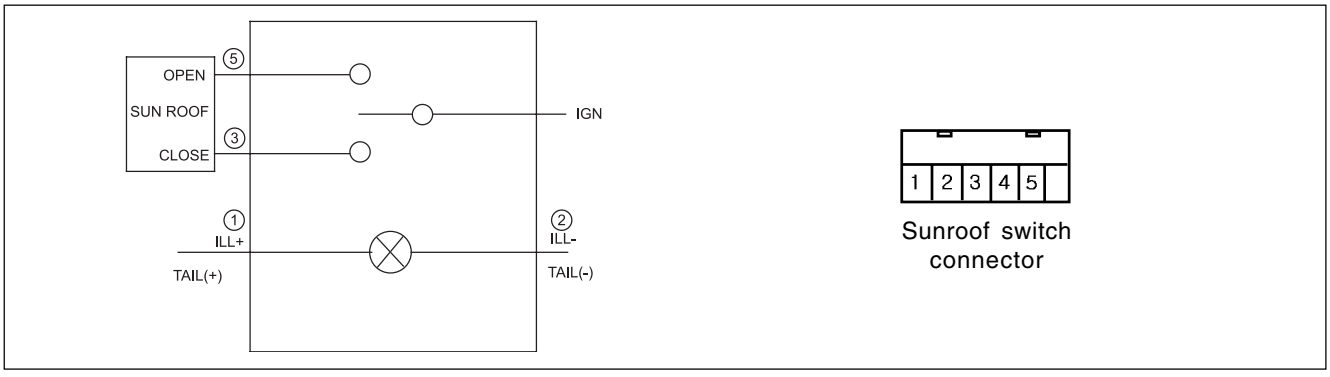
1. Tilt-up

To tilt-up the sunroof, turn the sunroof switch counterclockwise (CLOSE direction) with the sunroof fully closed.

2. Tilt-down

To tilt-down the sunroof, turn the sunroof switch clockwise (OPEN direction) with the sunroof tilted-up.

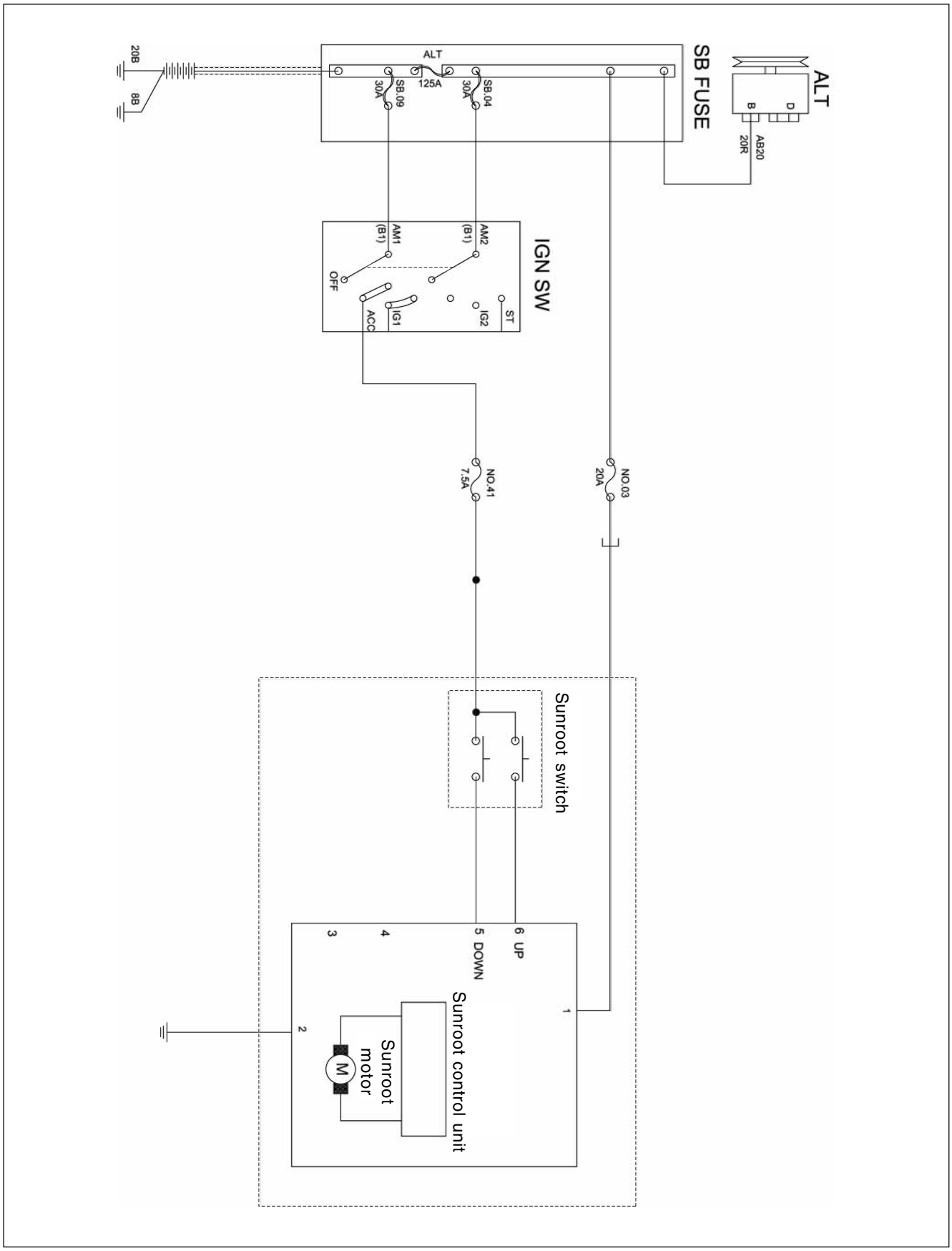
▶ Circuit Diagram of Sunroof Switch



The sunroof switch is a self return type switch and connected to the power supply terminal and sunroof circuit. For details, refer to “Sunroof” section.

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Sunroof Circuit Diagram



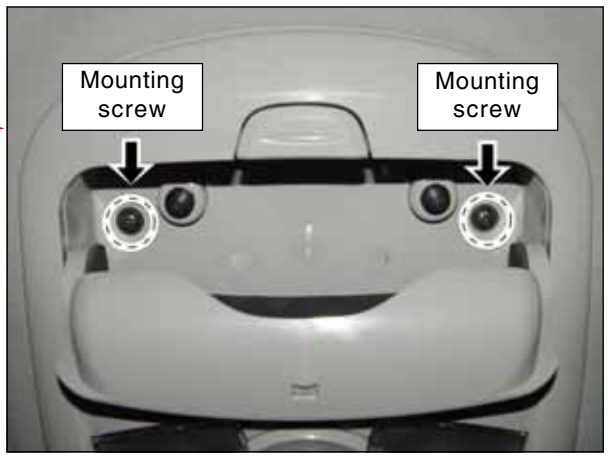
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4. REMOVAL AND INSTALLATION OF CENTER CONSOL SWITCHES

※ **Preceding Works:** Disconnect the negative battery cable.

NOTE
- **For details, refer to the "LAMP" section.**

1. Open the sunglasses box and unscrew the mounting screws (2 EA).





2. Remove the overhead console switch assembly and disconnect the connector.



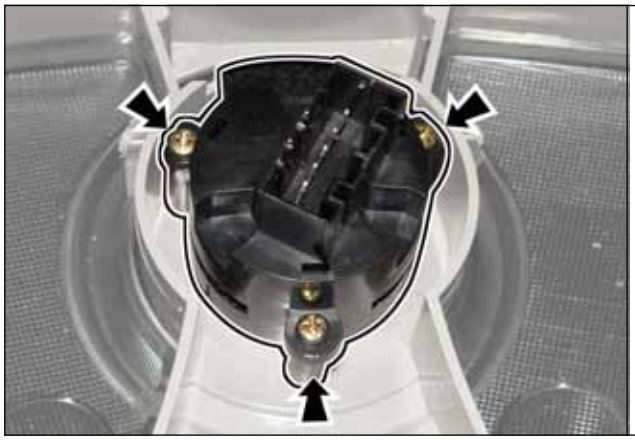


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3. Remove the front room lamp switch from the removed overhead console switch assembly.

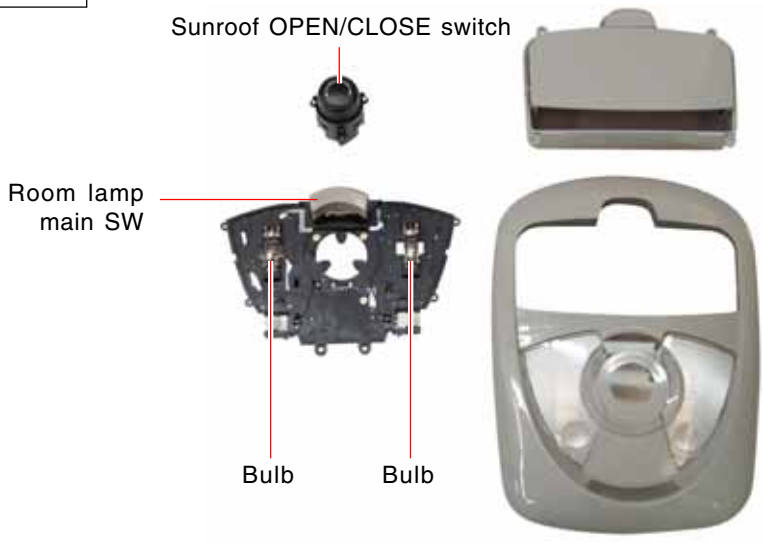


4. Unscrew three mounting screws and remove the sunroof switch.





Components



SWITCH ASSEMBLY ON DRIVER'S DOOR ARMREST

1. LOCATIONS AND FUNCTIONS

Driver can control all door windows (Open/Close/Lock/Unlock) and doors (Lock/Unlock) power this switch unit.

Driver's door window switch has Auto down/Auto up function. The window can be controlled within 30 seconds even after turning off the ignition switch. However, if any of front doors is opened or the Lock switch on the remote control key is pressed (theft deterrent mode is activated) during the delaying period, the delaying time is immediately canceled (power window relay is deactivated).

Driver's Door Window Switch

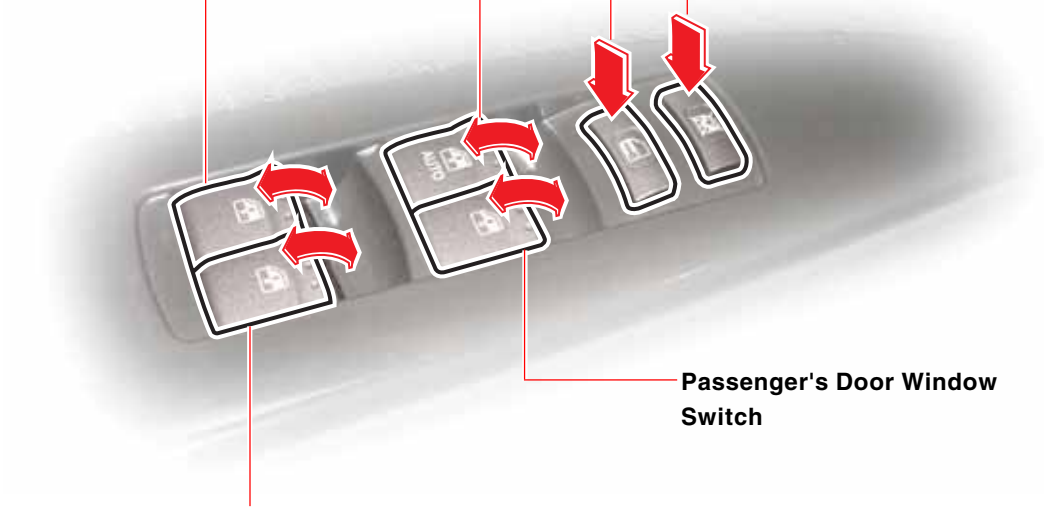
- When the front of the switch is lightly pressed, the window will be open while the switch is pressed.
- When pressed to its end, the window will open automatically until it is fully open. If you want to stop the window while automatic lowering, lightly press the switch again or pull up the switch.

Window Lock/Unlock Switch

When the door lock/unlock switch is pressed while all doors including the tailgate are locked, all doors will be unlocked. When the switch is pressed again, all doors will be locked.

Window Lock Switch

If the window lock switch is pressed down, passsenger's and rear windows cannot be operated by their switches.



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2. SWITCH ARRANGEMENT AND APPEARANCE

▶ Power Window Connector

	Rated Current	Maximum Current
Power window switch (motor operation)	10 A (operating voltage)	20 A (restricted current)
Door lock switch (actuator operation)	0.4 A (operating voltage)	0.7 A (actuator voltage)
Window lock switch (motor operation)	10 A (operating voltage)	20 A (restricted current)

Switch Assembly





Front View



Rear View



Side View





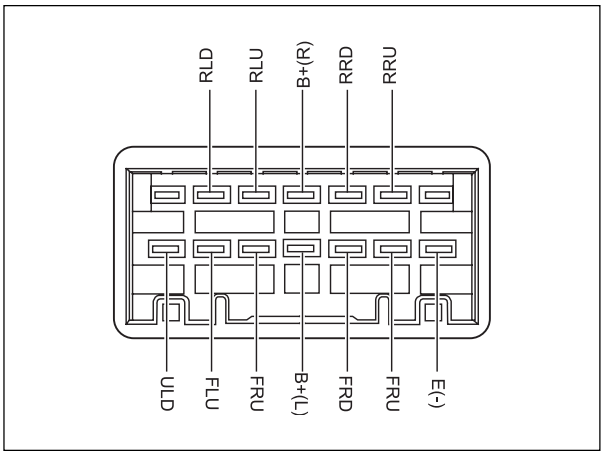
Connector

3. POWER WINDOW OPERATIONS

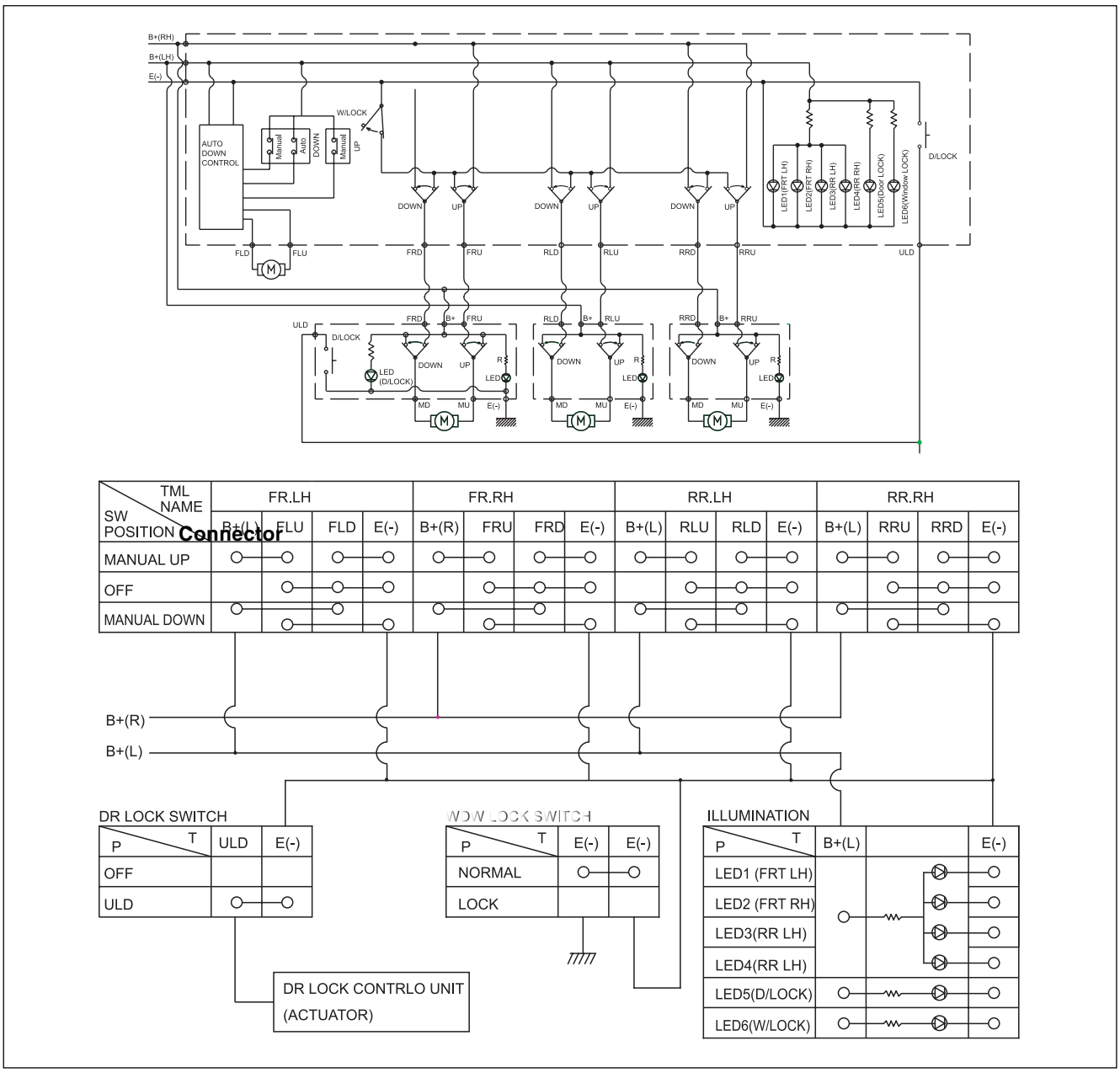
▶ Power Window Auto-down

When the front of the switch is lightly pressed, the window will be lowered while the switch is pressed. When pressed to its end, the window will open automatically until it is fully open. If you want to stop the window while automatic lowering, lightly press the switch again or pull up the switch.

Power window versions in this vehicle: Auto Down, Auto Down/Up



The circuit diagram shows the Auto Down version.



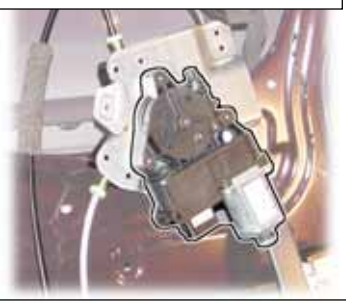
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▶ Power Window Auto Up

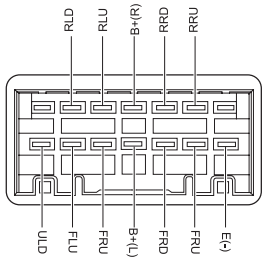
The Auto Up function only applies to the driver's window and is operated when pulling the switch up. The following circuit is for the vehicle equipped with the Auto Up function (optional).

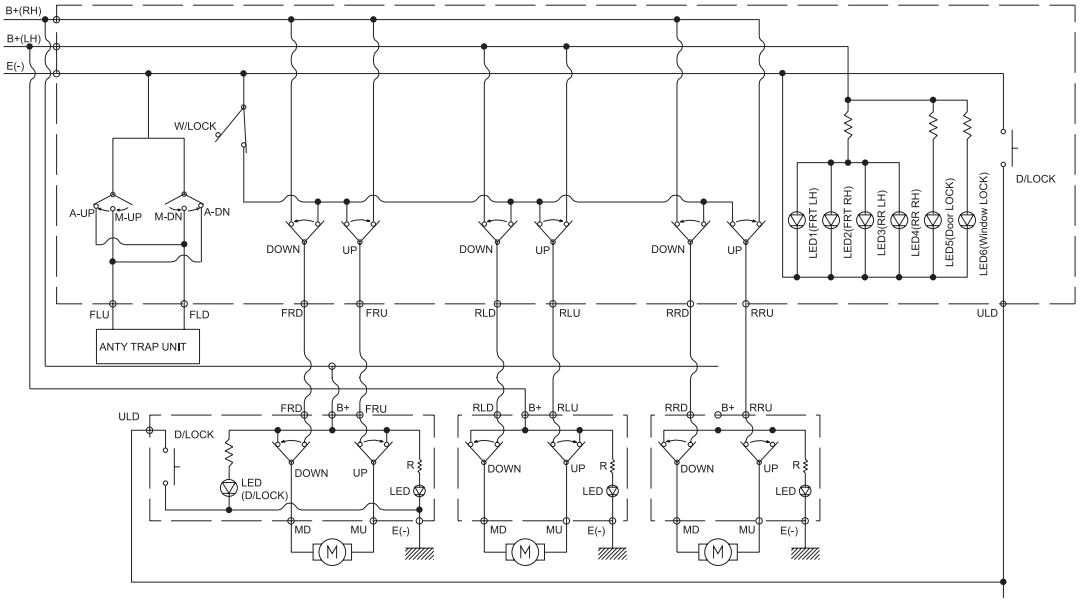
The power window motor with the Auto Up function includes the anti-trap function, so the power motor and the anti-trap control ECU is integrated together.

Driver's Power Window ECU Motor



Power Window ECU Motor Connectors





TML NAME / SW POSITION	FR.LH				FR.RH				RR.LH				RR.RH			
	B+(L)	FLU	FLD	E(-)	B+(R)	FRU	FRD	E(-)	B+(L)	RLU	RLD	E(-)	B+(L)	RRU	RRD	E(-)
MANUAL UP		○		○	○	○	○		○	○	○		○	○	○	
OFF										○	○	○		○	○	○
MANUAL DOWN			○	○	○		○	○	○		○	○	○		○	
AUTO UP			○	○												
AUTO DOWN		○		○												

B+(R)

B+(L)

DR LOCK SWITCH

P \ T	ULD	E(-)
OFF		
ULD	○	○

WDW LOCK SWITCH

P \ T	E(-)	E(-)
NORMAL	○	○
LOCK		

ILLUMINATION

P \ T	B+(L)		E(-)
LED1 (FRT LH)			○
LED2 (FRT RH)			○
LED3(RR LH)	○		○
LED4(RR LH)			○
LED5(D/LOCK)	○		○
LED6(W/LOCK)	○		○

DR LOCK CONTRLO UNIT (ACTUATOR)

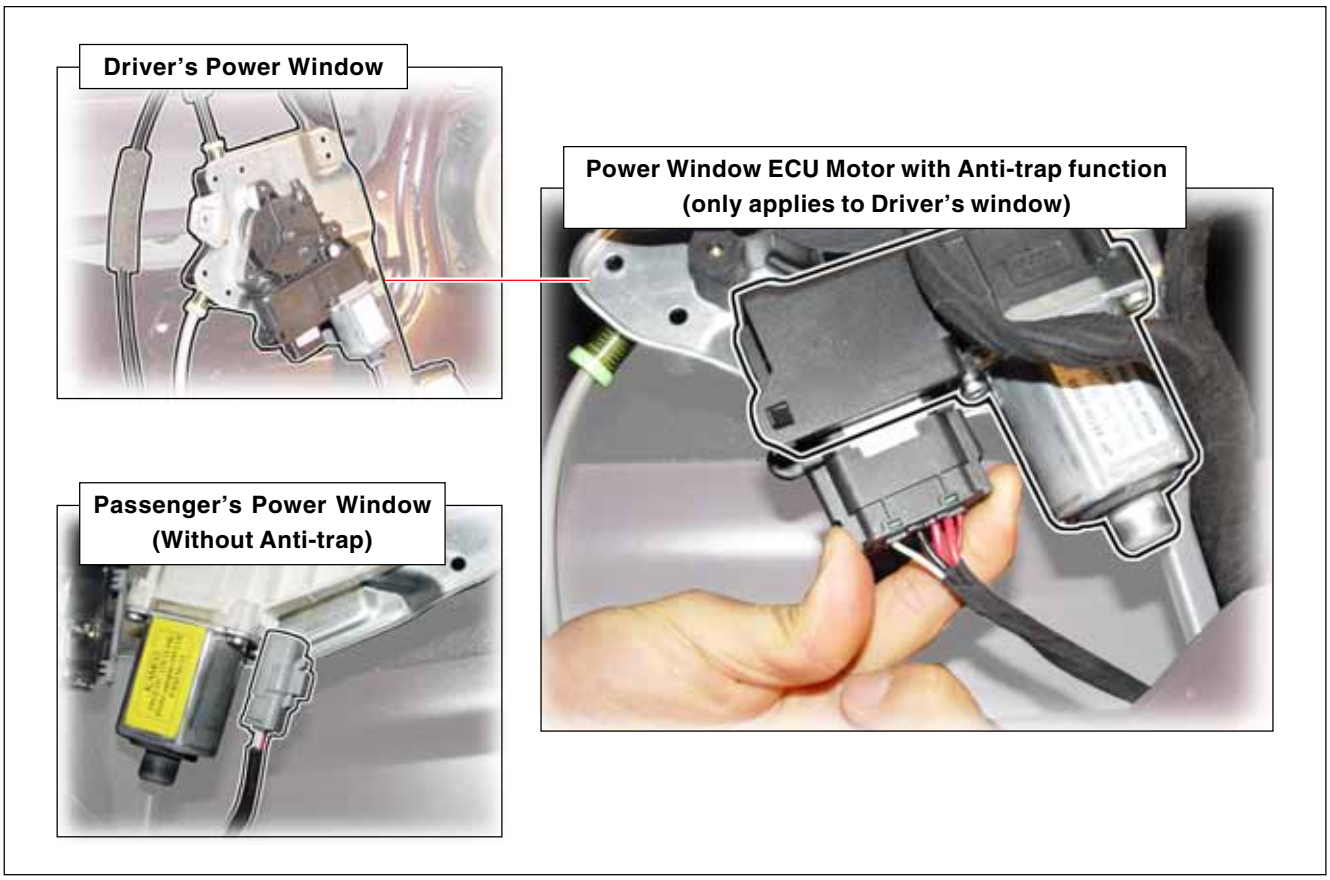
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▶ Power Window with Anti-trap Function

Anti-trap Function

- Condition for Auto-Up: Initialization completed, Ignition ON
- Anti-trap operation

  If there is resistance of 100 N while the window is operating with the auto up function, the window is lowered approx. 150~180 mm to prevent personal injury.
- There is undetectable area where the space between the top of the glass and the window frame is below 4 mm.



Stop Condition of Anti-trap Power Window While in Operation

The motor stops if any of below conditions is met while auto up/down or manual up/down is operated.

- When the voltage is out of operation range → both the automatic and manual operations are not active
- When the motor is overheated → both the automatic and manual operations are not active
- When anti-trap is operated → this is only operated during auto up
- When initialization is canceled → if an error is detected or erased → the automatic operation is not active
- When power relay OFF (when STICS shuts off the power to the power window relay)
- When a signal from other switch is input while the motor is running

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System Overview

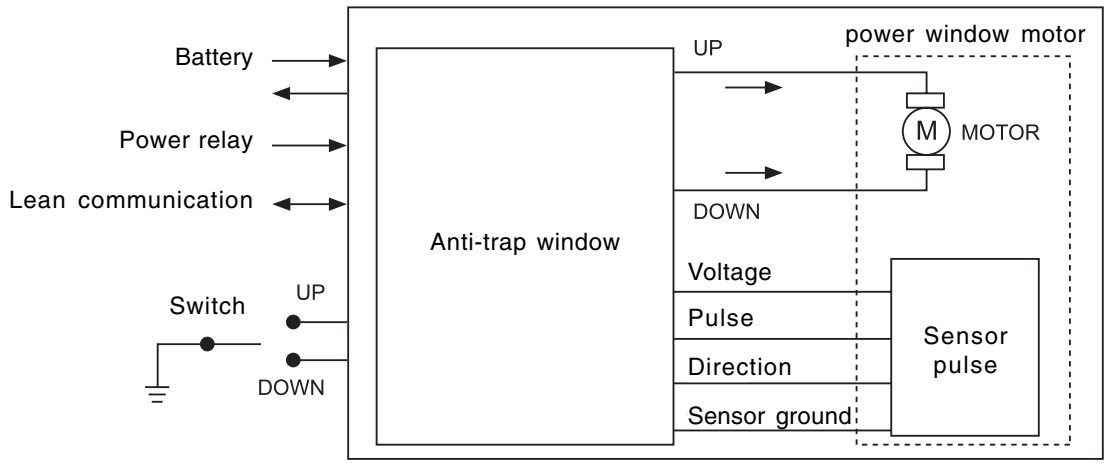
The driver's door is equipped with the auto down, auto up (optional) and anti-trap (if auto up equiped) function. Also, it is equipped with dual rail regulator.

Specifications

1. Electrical Specifications

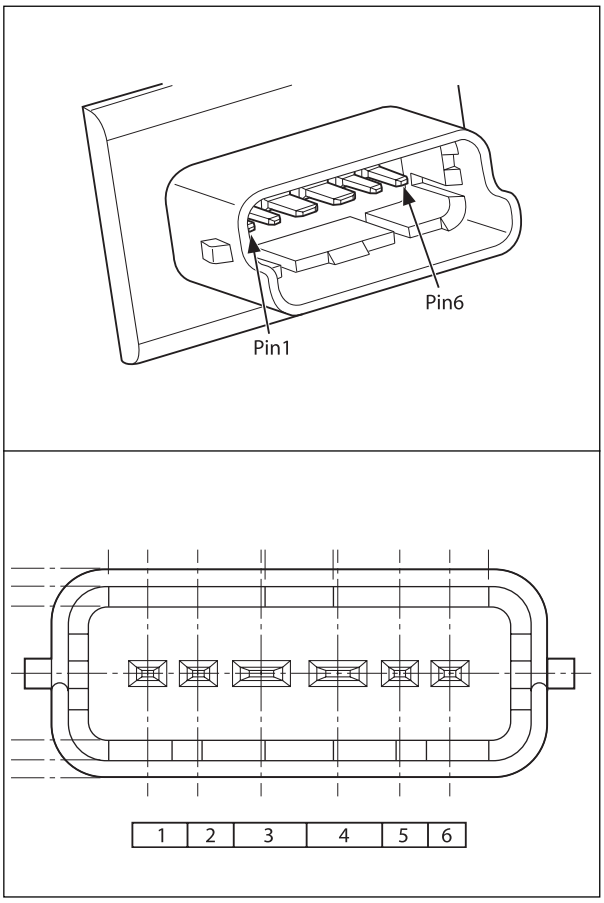
Item	Specified value	Remarks
Rated voltage	DC 12 V	Operated normally within this range
Operating voltage range	DC 9 V ~ DC 16 V	- Auto up function is inactive within 9 V ~ 10 V
Operating temperature range	-35°C ~ +75°C	- Data storage and manual operation is possible within 7 V ~ 9 V
Storage temperature range	-40°C ~ +85°C	- Stops motor if exceeding 16 V
Max. humidity	95% RH	
Power consumption	33 mA	No load included
Size and weight	-	Shown in the drawing
Current in slip mode	Max. 1 mA	

2. System Diagram



3. Power Window ECU Motor Connectors

Pin	Function	Operation	$I_{max.}$	I_{normal}
1	Up (close)	low	15 mA	10 mA
2	Power relay	high	15 mA	10 mA
3	Battery	-	25 A	10.6 A
4	GND	-	25 A	10.6 A
5	Lean comm.	-	15 mA	10 mA
6	Down (open)	low	15 mA	10 mA



System Function

1. Power Signals of B+ and Power Relay

The power window motor is integrated with ECU which is supplied with B+ power constantly to memorize the window position and operating speed. The motor runs only when the power is supplied to the switch by STICS. Also, it goes to slip mode to minimize the battery discharge.

2. Operating Voltage

- Auto up inactive voltage: when the voltage is within 9 V ~ 10 V, auto up is inactive due to voltage drop
- Limited operation: when the voltage is within 7 V ~ 9 V, data can be stored and the window can be operated manually.
- Motor stop: when the voltage is over 16 V, the motor is stopped

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3. Self-diagnosis

The ECU motor diagnoses of itself to stop the motor or reset the hardward if there is malfunction in the system or supply voltage.

- Service person may not know whether the ECU motor is in self-diagnosis or not.
- If there is an error in RAM checksum after wake-up

  → Hardware reset: auto Up deactivated (very unlikely in a real world) → Re-initialization
- If the voltage is low (less than 5V)

  → Hardware reset: motor stops (both auto/manual deactivated) → Reactivated when the voltage is returned to normal
- If the motor rotates more than 10 times to the upper direction after initialization (idling for more than 10 times than the memorized position)

  → Motor stops, initialization erased → No auto up → Reactivated after initialization
- If the motor rotates more than 400 times to the lower direction after initialization

  → Motor stops, initialization erased → No auto up → Reactivated after initialization
- Abnormal program running (very unlikely in a real world)

  → Hardware reset by monitoring program → motor stops (both auto/manual deactivated) → Replace motor

4. Motor Overheat Prevention Function

There is overheat prevention function to prevent motor from overheated (only if ECU operates normally).

- If the system is supplied with power ir resetted, the ECU motor initialize the temperature counter which counts the temperature increase as the motor runs.
- 1st limited value:

  The temperature is not measured directly. If the motor runs 8~9 times consectively, it runs again in 60 seconds after completing the current operation.

CAUTION

- **If the motor stops due to the 7~8 consecutive operation, it runs again in 3~4 minutes.**

- 2nd limited value (not plausible on-board)0

If the value reaches the 2nd limited value due to the consecutive operation, the motor stops immediately and runs again in certain period of time.

5. System Initialization

The top position of the wiper should be recognized again if the wiper motor or regulator is replaced or the initialization is erased due to the error detected.

- The auto up function is deactivated and the window position is not memorized unless the system is initialized.

6. System Re-initialization (For Recognizing the Window Operatiing Characteristics)

Raise/Lower the window for approx. 5 times after the initialization to recognize the vehicle's window operatiing characteristics (position, speed etc.). By doing this, the correct resistance (less than 100 N) is applied when anti-trap function is activated.

CAUTION

- **The power window ECU motor with the anti-trap function observes the actual lowest position of the power window motor at every 20 cycles to reflect the slight changes in positions of door weather strip, regulator system, motor, etc.**

7. Sleep Mode

The ECU goes into the sleep mode to save the battery voltage when the conditions are established.

- Condition: It goes into the sleep mode if the motor overheat prevention heat counter decreased to the initial value and the power relay is OFF for 10 seconds.
- It can go into the sleep mode after 10 minutes from the time when the motor stops by the motor overheat prevention program.

8. Wakeup Mode

It wakes up from the sleep mode when the hardward is reset (including connecting and disconnecting the connector or battery) or ignition switch is turned to ON position.

9. Soft Stop Down Mode

The ECU cuts off the power to the motor when the window is lowered to the 10 mm (approx. 7 revolutions) up from the lowest position to lower the window smoothly. From that position, the window is lowered by the inertia force.

To fully lower the window, operate the switch again after the soft stop down.

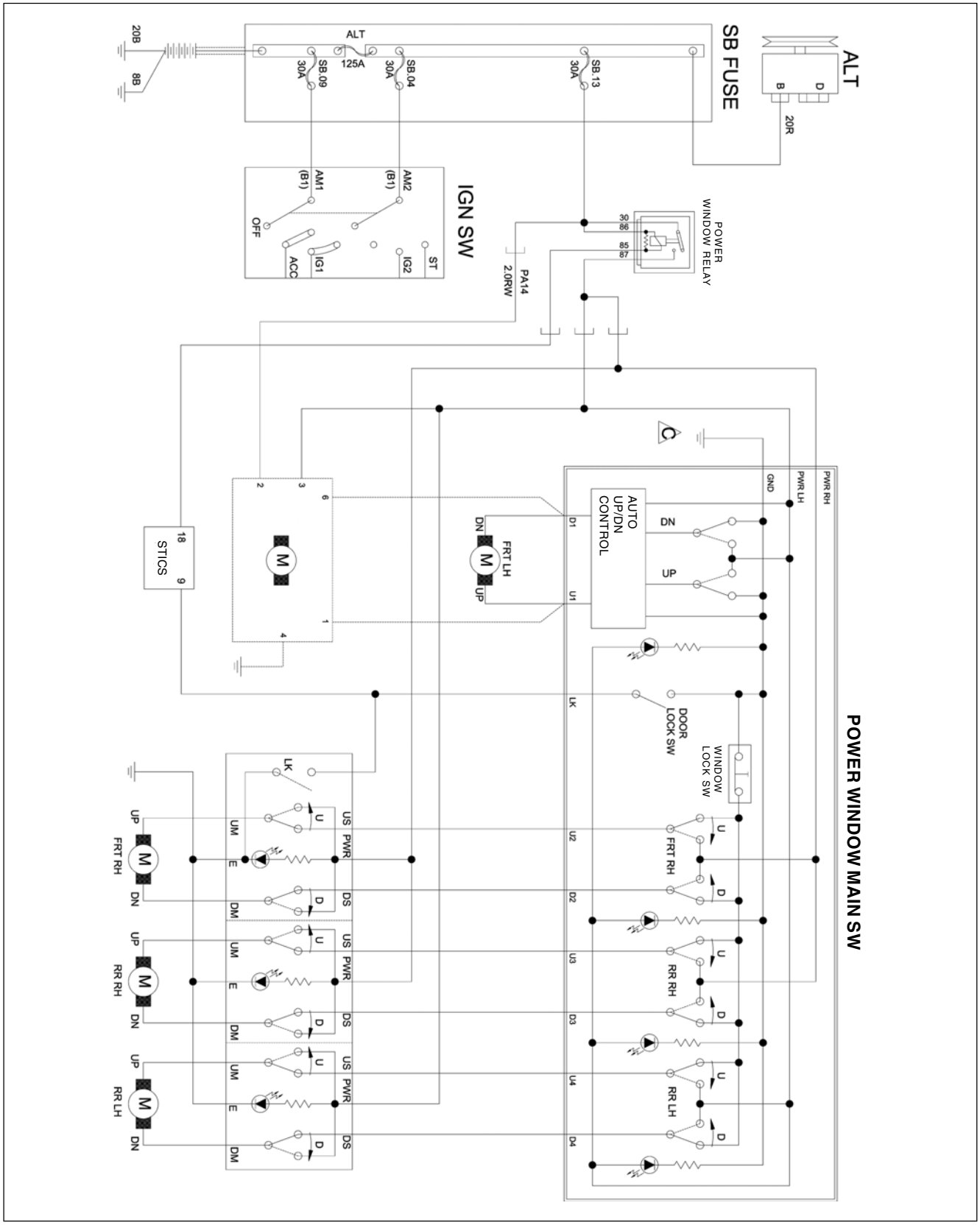
10. Other Characteristics and Cautions

- The initial values are erased when the error is detected by self-diagnosis.
- The ECU motor stores the window position, intial value, window running direction, operation characteristics in the memory. Normally, the stored values are not erased by initializing the hardware or disconnecting the battery cable. However, the stored value may be erased occasionally in the case when the ECU is down.
- If the stored values are erased unexpectdely, the system should be initialized again.
- The window operation stops when turning the power OFF while it is in operation. However, if the anti-trap function is in operation, it completes its operation.
- Stuck prevention filter for power window switch

  The signal from the switch is overridden if it is continuous for more than 20 seconds with no level change of the window due to the malfunction of the power window switch, short circuit or misoperation by the operator.
- The anti-trap function of the power window may not work properly due to wrong installation of glass run or regulator.

4. CIRCUIT DIAGRAM OF POWER WINDOW

It show the complete electric circuit of the power window. Refer to the electric circuit diagram manual for the color and the configuration of the connectors.



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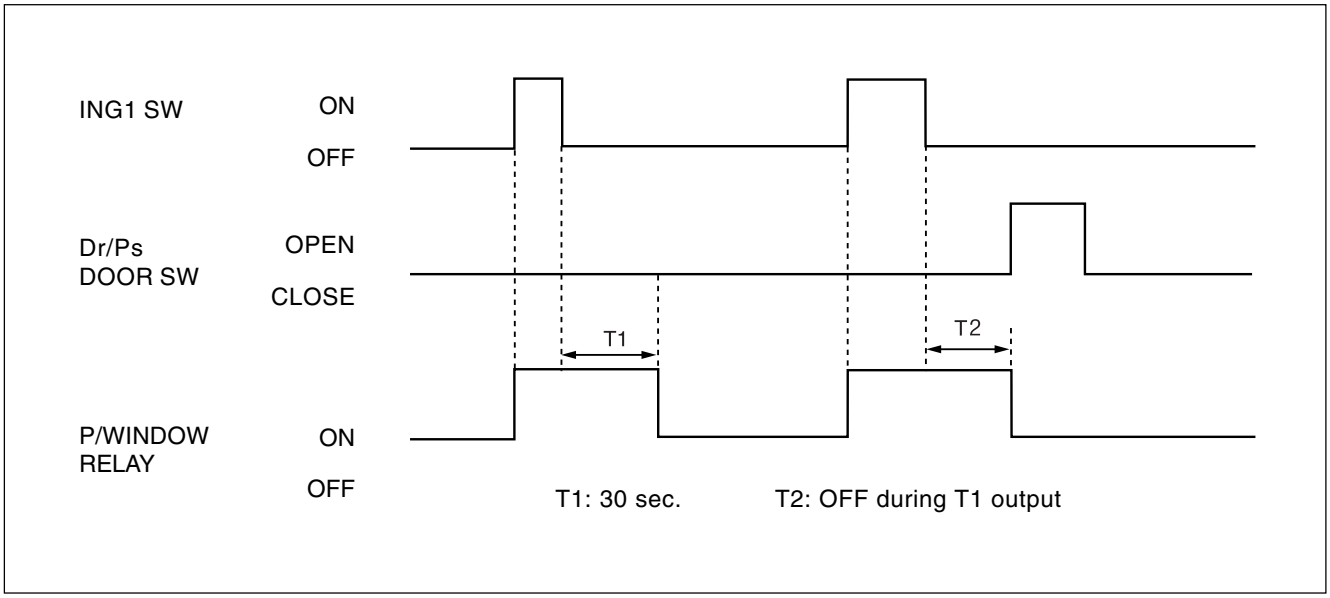
The power window electric circuit is connected to the power window main switch and STICS for the "Time lag power window control" function. For details, refer to the following context.

Time Lag Power Window Control

1. The power window relay output is “ON” when turning on the IGN 1 switch.
2. The power window relay output is “ON” for 30 seconds for T1 when turning off the IGN 1 switch.

   The power window relay output is “OFF” when opening the driver's door or the passenger's door.

   The power window relay is turned “OFF” when receiving the remote control key lock signal (armed mode) during its extended operation period of 30 seconds.



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5. CENTRAL DOOR LOCK/UNLOCK SWITCH

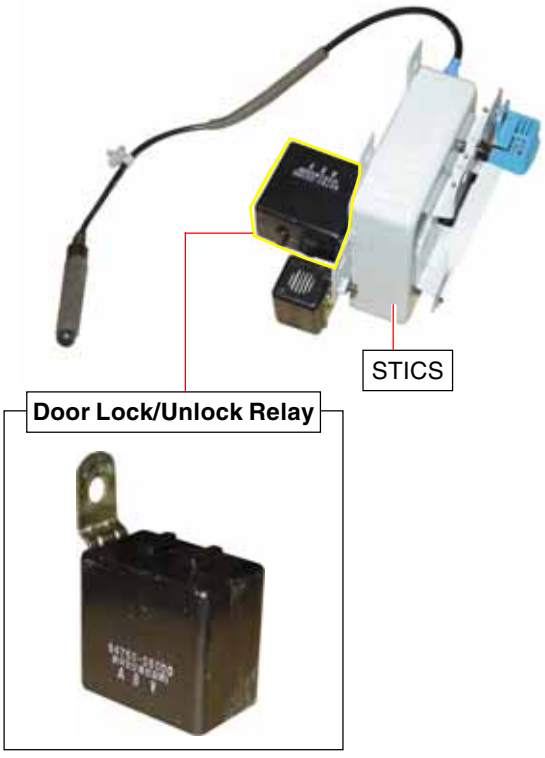
▶ Switch Arrangement and Functions

This vehicle has five door lock/unlock actuators including tailgate actuator. The doors can be opened separately. However, the door lock switch on driver's door armrest locks/unlocks all doors with STICS control. This is a same control type with Auto door lock function that locks the doors when the vehicle speed exceeds 50 km/h.



▶ Door Lock/Unlock Relay

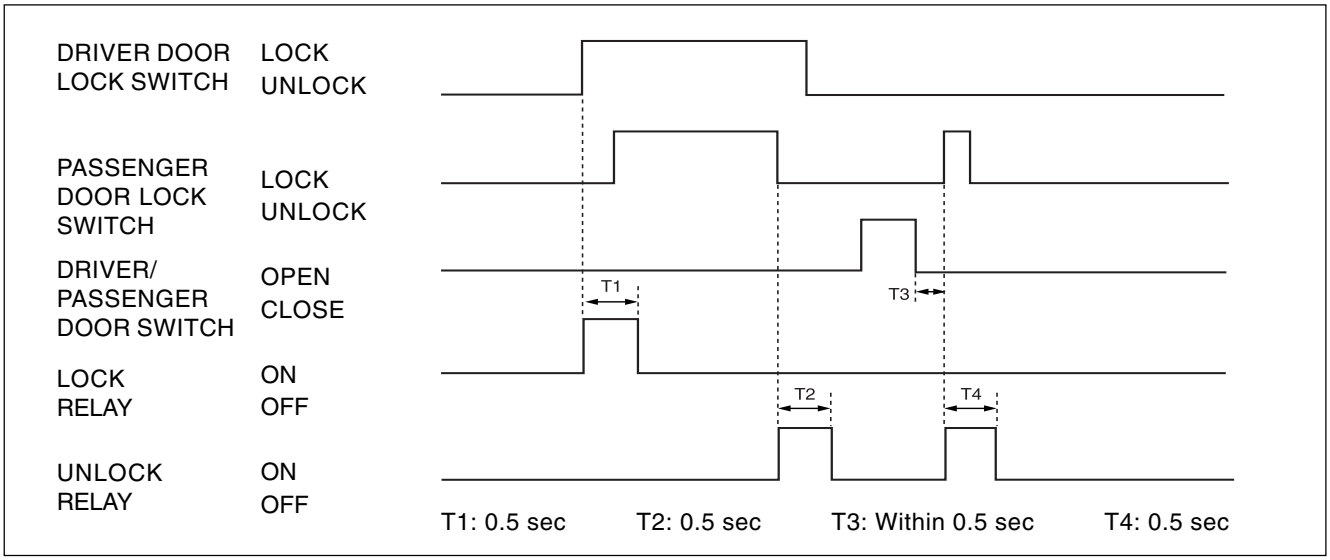




▶ Door LOCK/UNLOCK Control

Door Lock/Unlock by Door Lock Switch

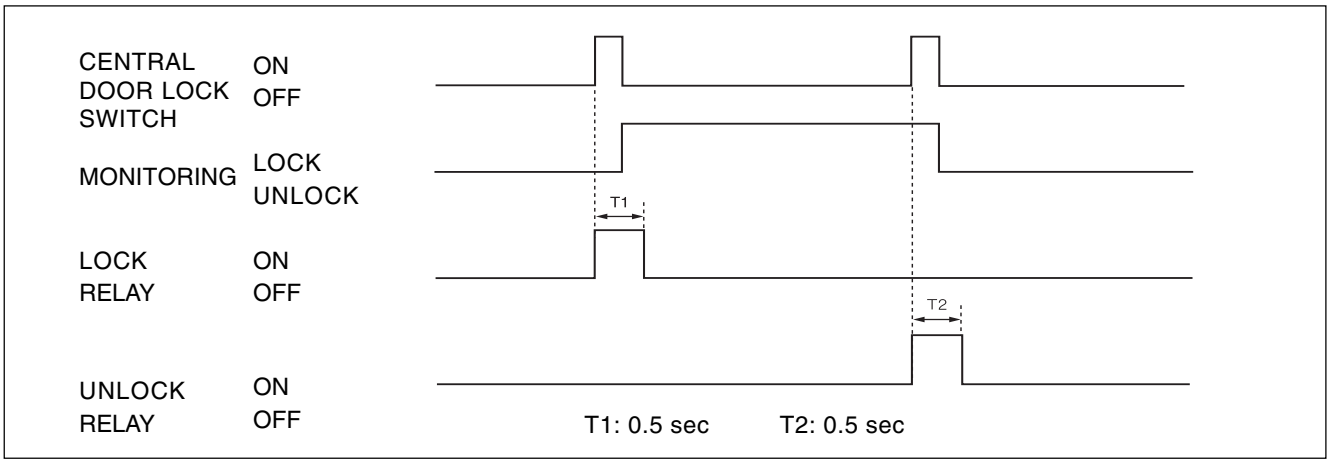
1. The door lock system outputs “LOCK” for 0.5 second when positioning the driver’s or passenger’s door lock switch to lock position.
2. The door lock system outputs “UNLOCK” for 0.5 second when positioning the driver’s or passenger’s door lock switch to unlock position.
3. “LOCK” or “UNLOCK” signal by the door lock switch is ignored when outputting the “LOCK” or “UNLOCK” by other functions.
4. All door lock signals are “UNLOCK” for 0.5 second just for once when receiving the “LOCK” signal within 0.5 second after closing the driver’s or passenger’s door. (with the ignition key removed)



Door Lock/Unlock by Central Door Lock Switch

1. The door lock system outputs “LOCK/UNLOCK” for 0.5 second when pressing “LOCK/UNLOCK” button on the central door lock switch.

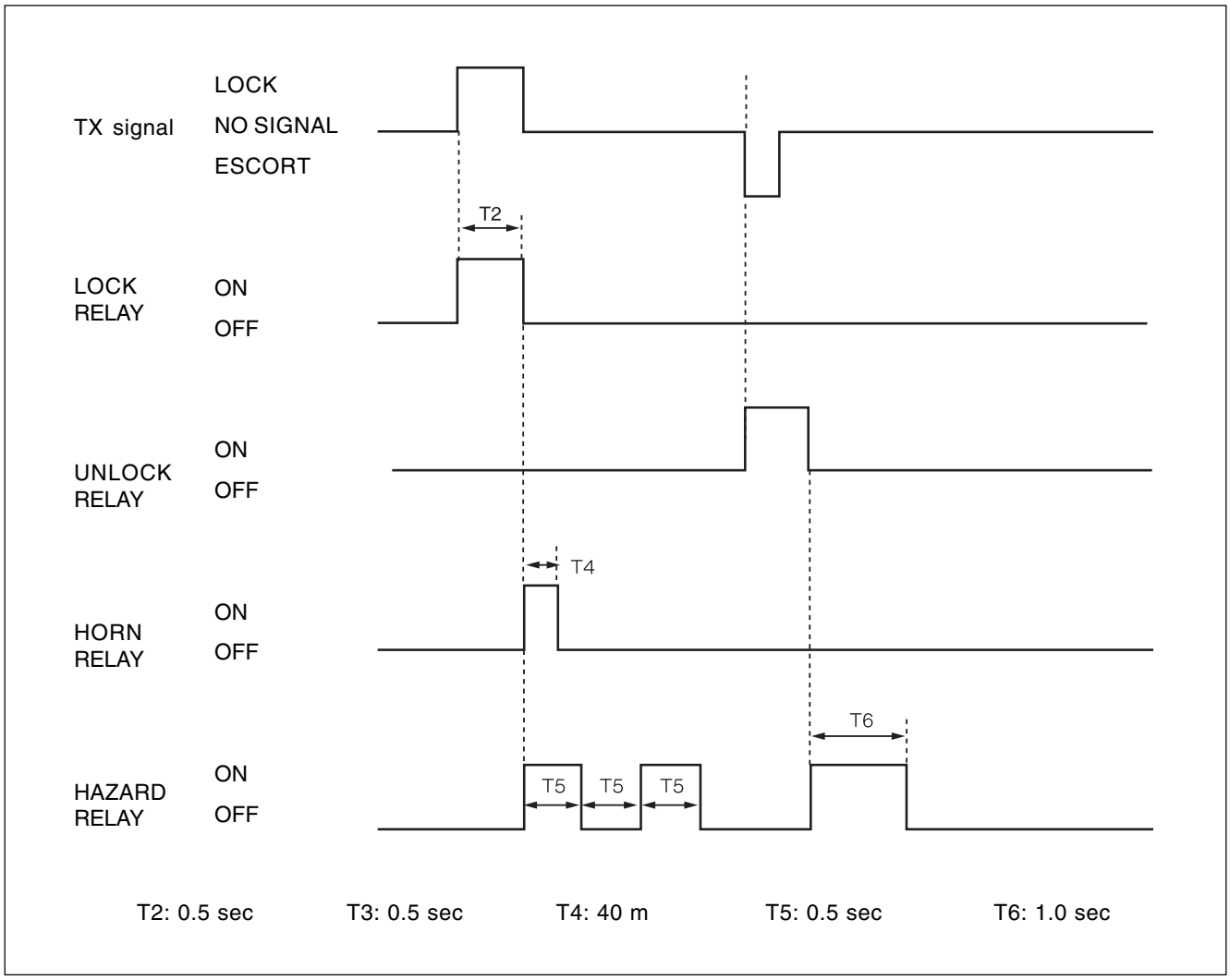
   (However, the door lock system outputs UNLOCK signal when the front doors are locked, and vice versa.)
2. The “LOCK” or “UNLOCK” inputs from the central door lock switch in armed mode are ignored.



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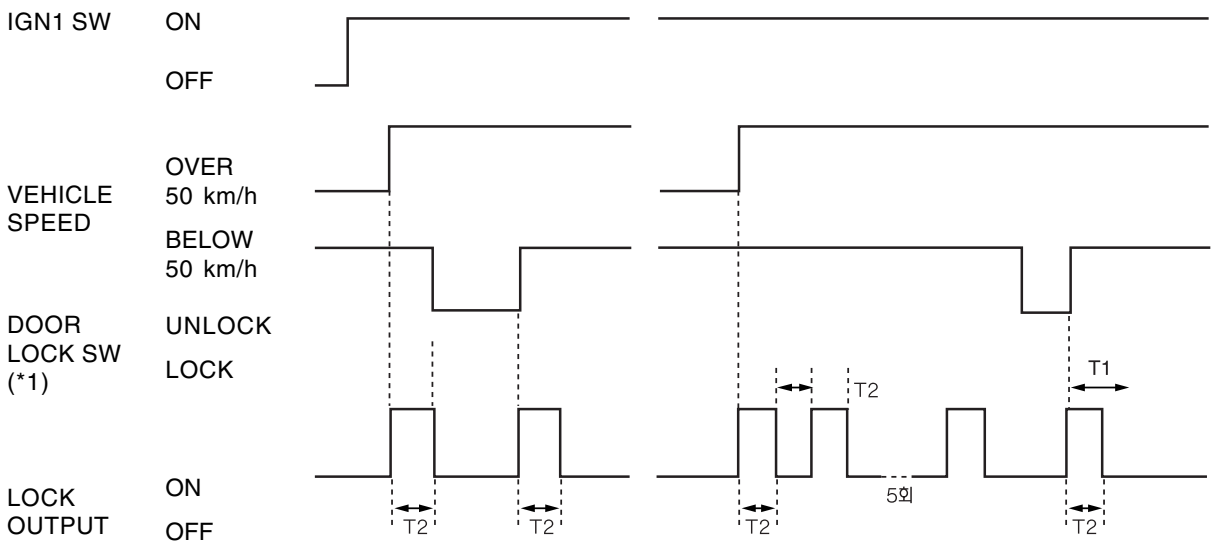
Door LOCK/UNLOCK by Remote Control Key

1. The door lock system outputs “LOCK” for 0.5 second when receiving “LOCK” signal from the remote control key.
2. The door lock system outputs “UNLOCK” signal for 0.5 second when receiving “UNLOCK” signal from the remote control key.



Auto Door Lock

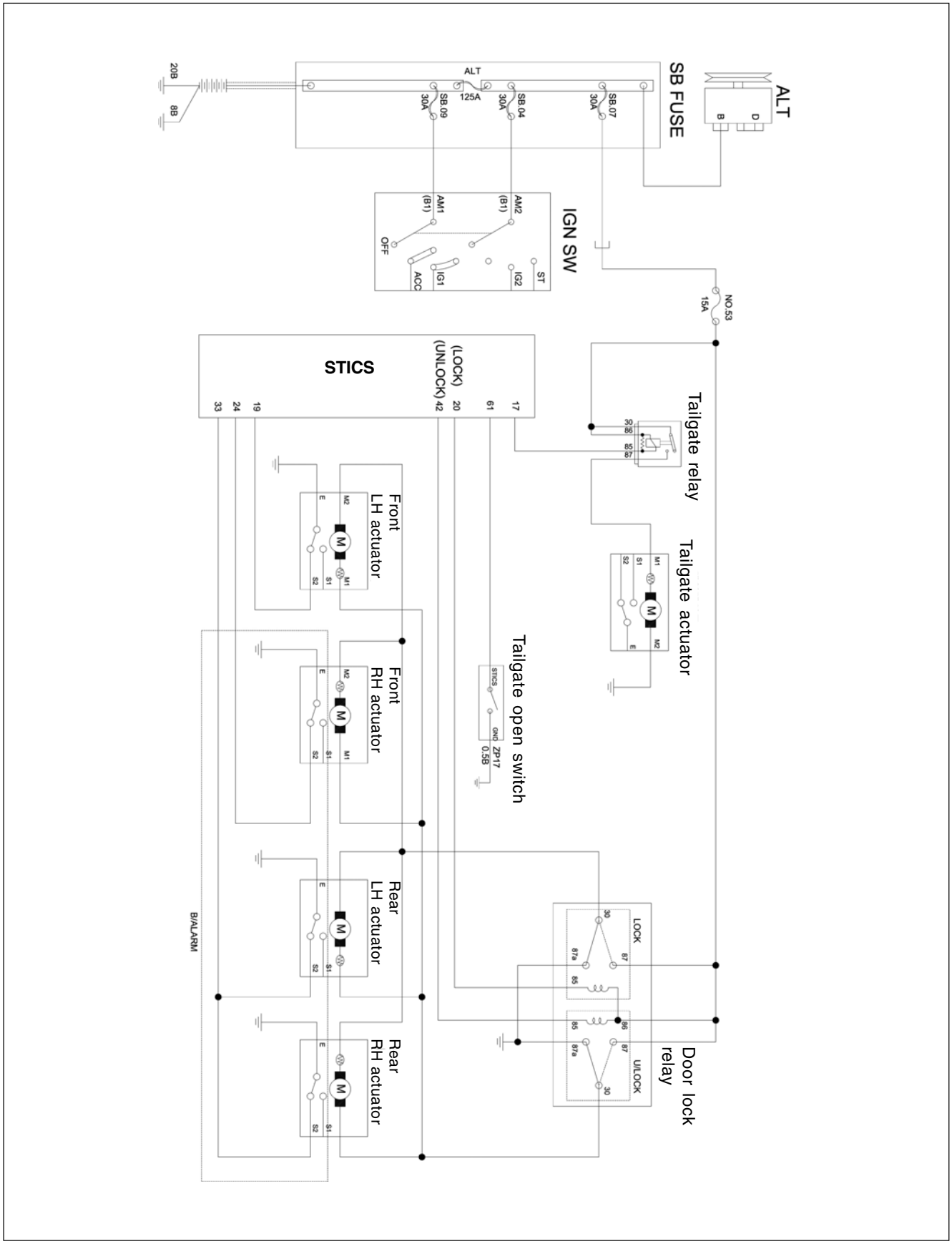
1. The STICS outputs “LOCK” when the vehicle speed stays over 50 km/h.
   However, it doesn't output “LOCK” when all doors are locked or failed.
2. If any of doors is unlocked after outputting “LOCK” in step 1, outputs “LOCK” up to 5 times (except step 1) with interval of one second.
3. If any of doors is unlocked after 5 times of “LOCK” outputs, the door (driver/passenger/rear/tailgate) is regarded as “FAIL”.
4. If the door that was regarded as fail changes (UNLOCK to LOCK) to unlock, only one “LOCK” output will be done.
5. If any door is regarded as FAIL, the auto door lock function does not work (if it is occurred when the vehicle speed is over 50 km/h, the auto door lock output does not occur even if the vehicle speed falls below 50 km/h and accelerates again to over 50 km/h). Nonetheless, the central door lock function works properly.
6. When the system receives “UNLOCK” signal from a door switch, it outputs five “LOCK” signals. If additional “LOCK” signal from another door switch is detected during the period, the system outputs five “LOCK” signals for the door.
7. The door lock system outputs “UNLOCK” automatically if the “LOCK” output conditions are established by this function or the key is cycled (IGN1 = ON → OFF) (even when there is no “Lock” output while the vehicle speed stays over 50 km/h under lock condition).
   However, when the ignition key is turned to “OFF” position, the lock output conditions will be canceled.
8. The “FAIL” condition of the door will be erased when the ignition key is turned to “OFF” position.



T2: 0.5 sec
1 LOCK: All door lock switches (including tailgate) = LOCK
UNLOCK: Any of door lock switches = UNLOCK

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EFFECTIVE DATE	
AFFECTED VIN	

6. CIRCUIT DIAGRAM



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AFFECTED VIN	

7. REMOVAL AND INSTALLATION OF POWER WINDOW SWITCH

Preceding Works: Disconnect the negative battery cable.

▶ Location

Driver's Door Power Windows Switch

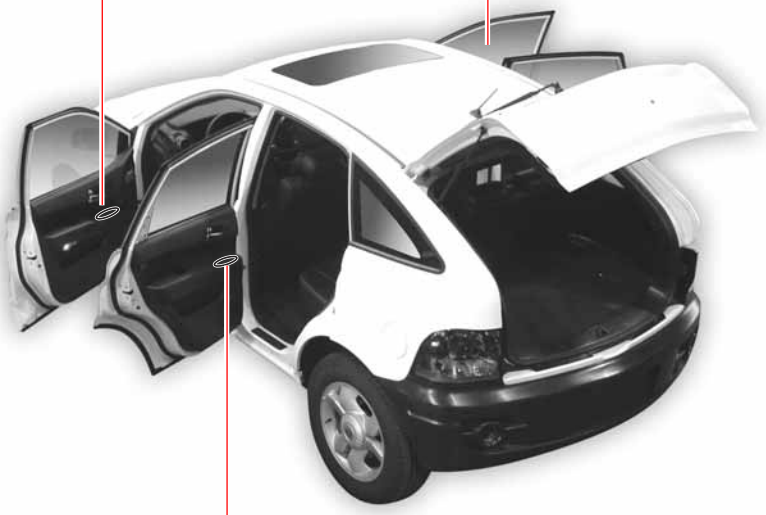




Passenger's Door Power Windows Switch







Rear Door Window Switch (LH/RH)





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Front Door (Driver's)

1. Remove the driver's door trim.



NOTE
- **Be careful not to damage the door trim.**
- **For more information, refer to the "Body" section.**

Location



Power Window Switch Assembly

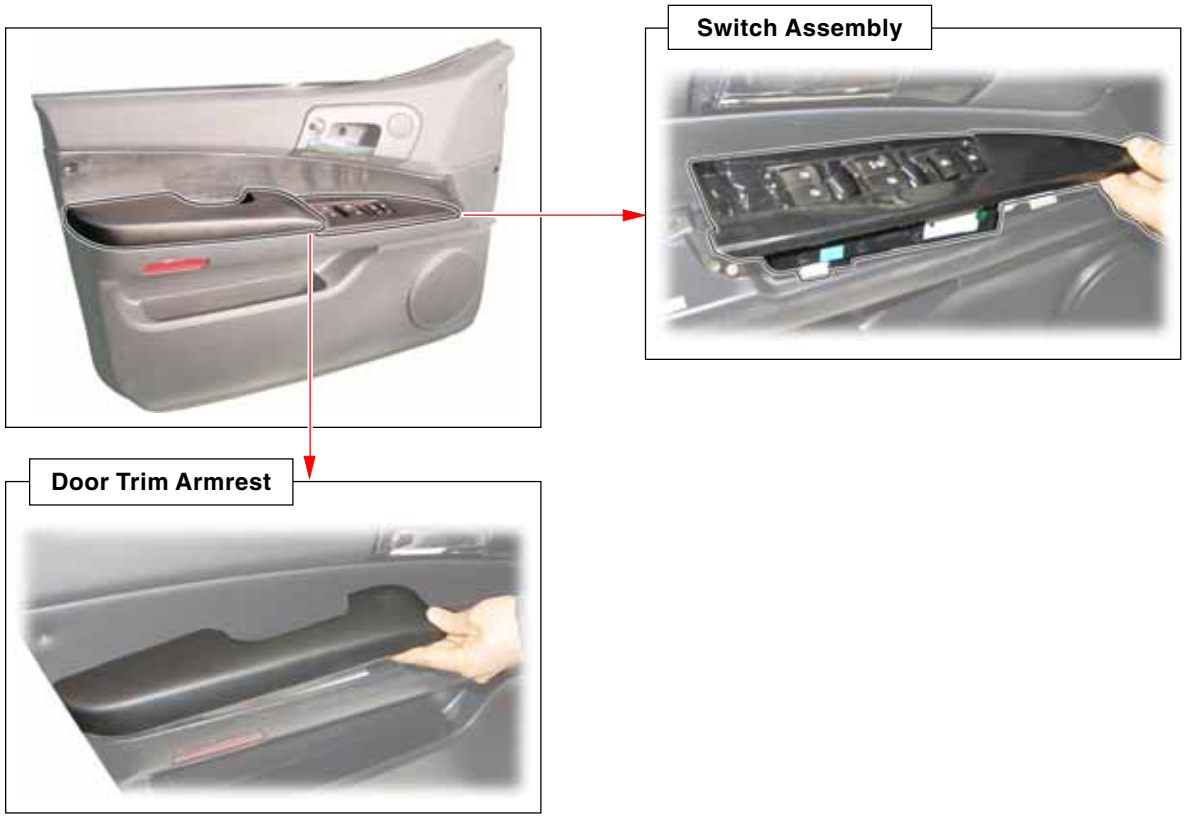




2. Unscrew ten mounting screws on the inner door handle of the door trim.



3. Remove the inner door handle and the memory seat switch assembly.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Remove the switch from the memory seat switch assembly.



Unscrew Four Mounting Screws and Remove the Switch.



Front View



Side View



Connector



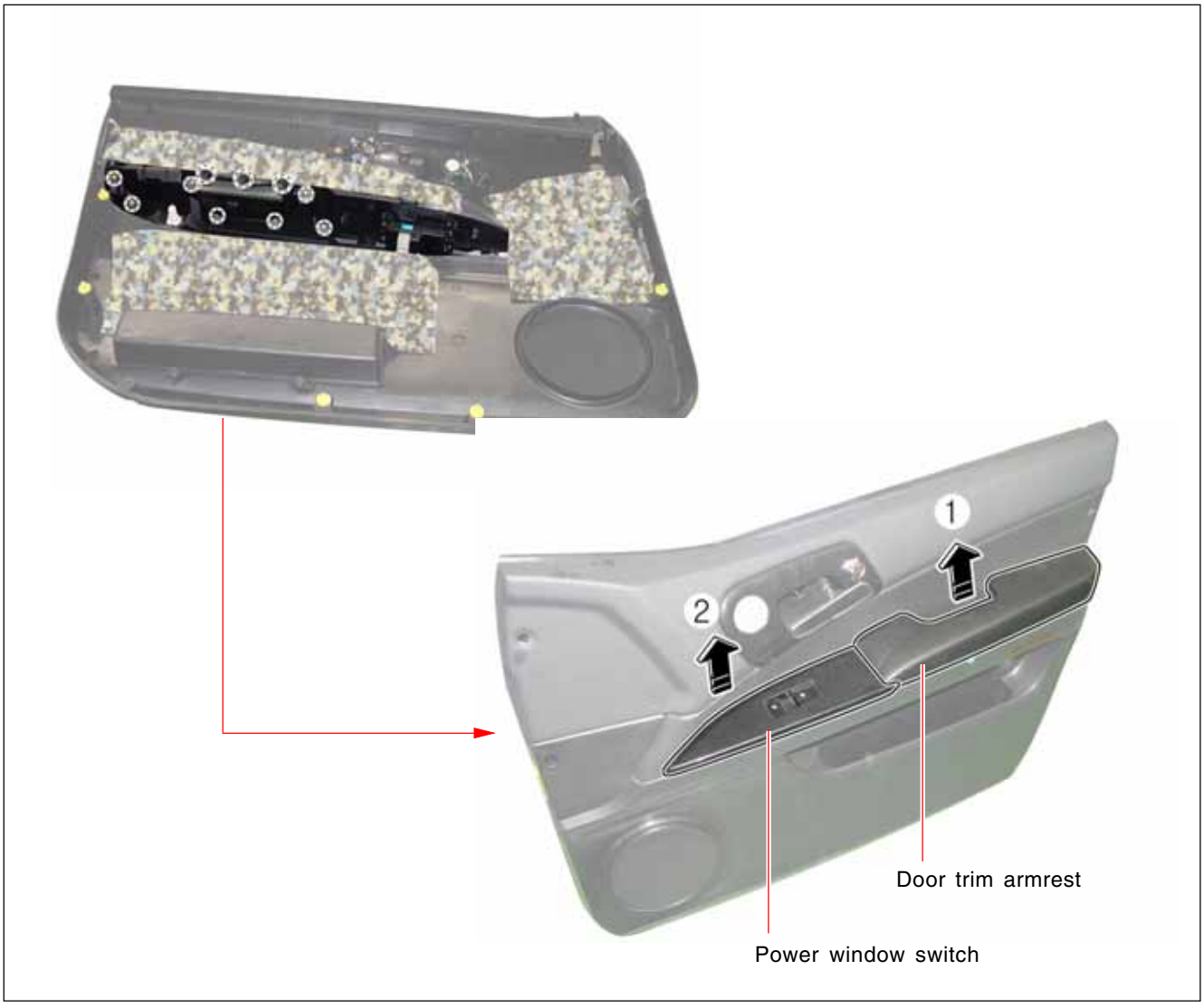
Front Door (Passenger's)

1. Remove the passenger's door trim.



NOTE
- **Be careful not to damage the door trim.**
- **For more information, refer to the "Body" section.**

2. Unscrew the mounting screws and remove the inner door handle and the memory seat switch assembly from the passenger's door trim.



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EFFECTIVE DATE	
AFFECTED VIN	

3. Remove the switch from the power window switch assembly.



Front View



Side View



Connector



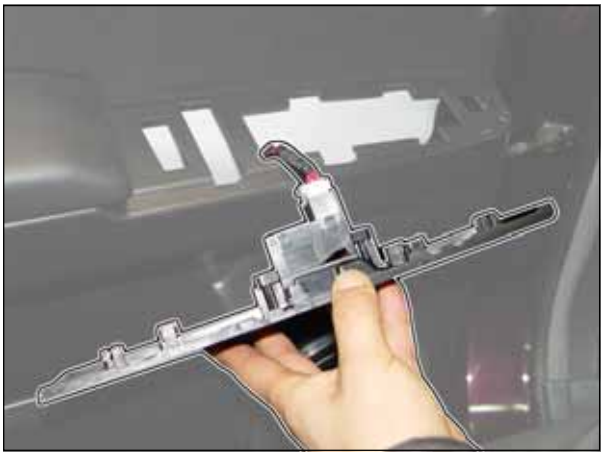
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Rear Door Power Window Switch

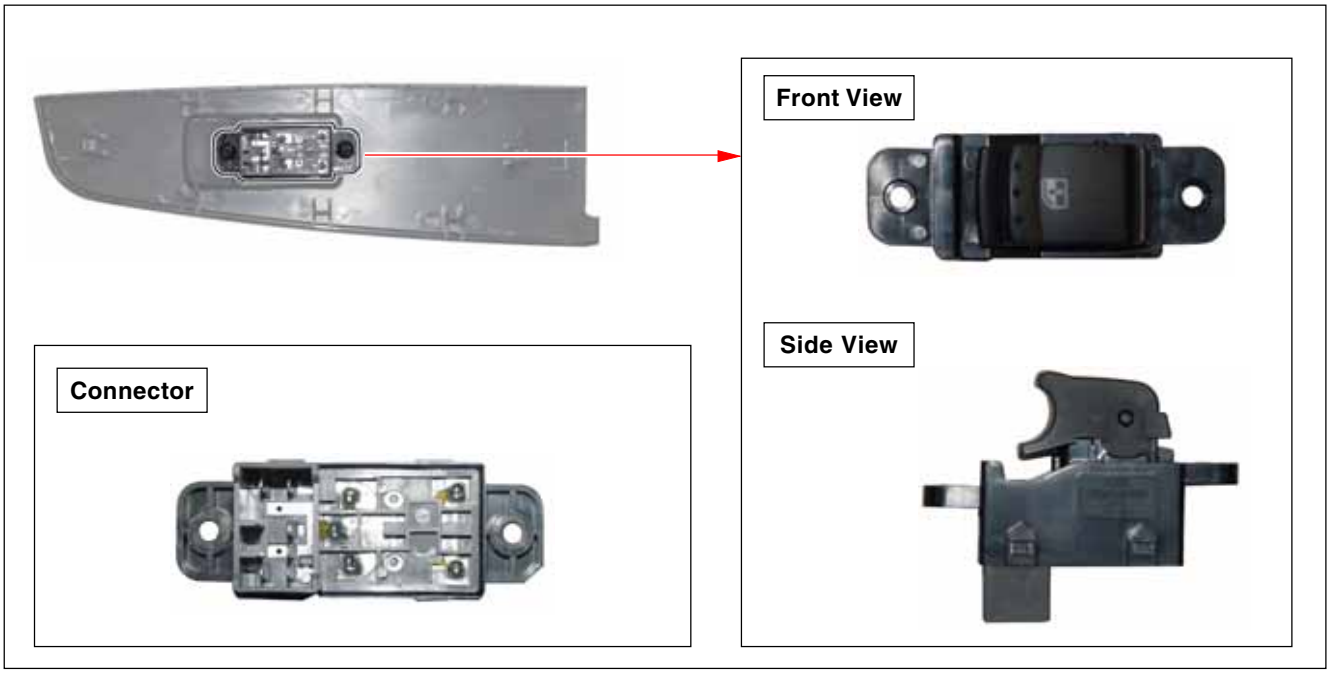
1. Separate the power window switch assembly with a special tool.



2. Disconnect the switch connector and remove the switch assembly.



3. Remove the switch.



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AUDIO REMOTE CONTROL SWITCH ON STEERING WHEEL

1. LOCATIONS AND FUNCTIONS

The audio switch on the steering wheel is composed of remote controller switches.



POWER

Turns on and off the audio system.

MODE

Changes the audio mode in order.

SEEK ▲ **SEEK ▼**

In radio mode

- Press briefly: Manual searching for a station.
- Press and hold: Automatic searching for a station.

In CD (DVD) player/Cassette tape mode

Plays previous/next track

MUTE

Stops audio output from audio system. To resume the audio output, press the button again.

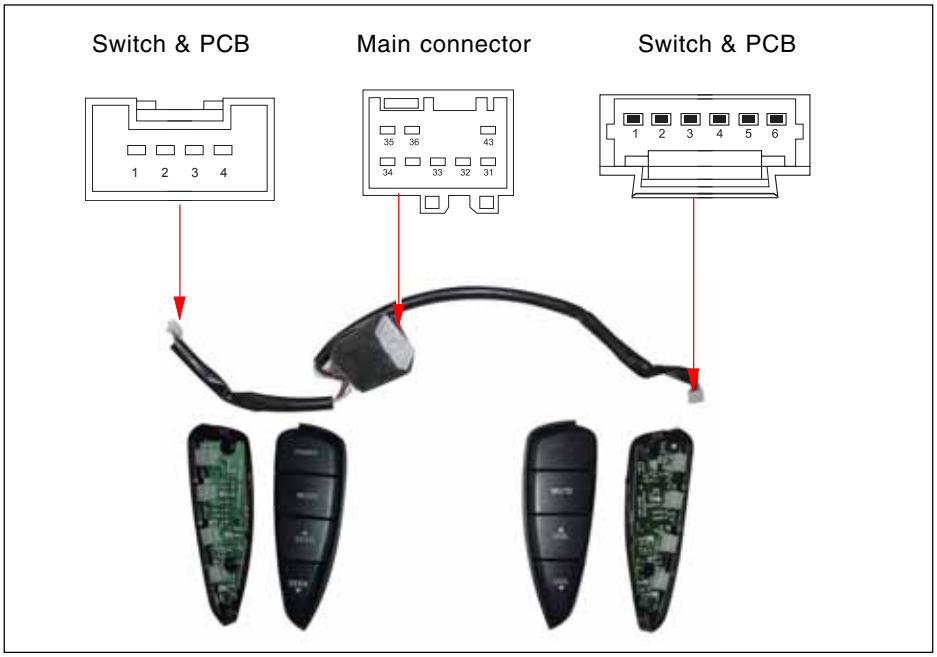
VOL ▲ Increase volume

VOL ▼ Decrease volume

2. COMPONENTS

The remote audio control switch is installed on the the steering wheel. Its rated voltage is 5 V and has three connectors.

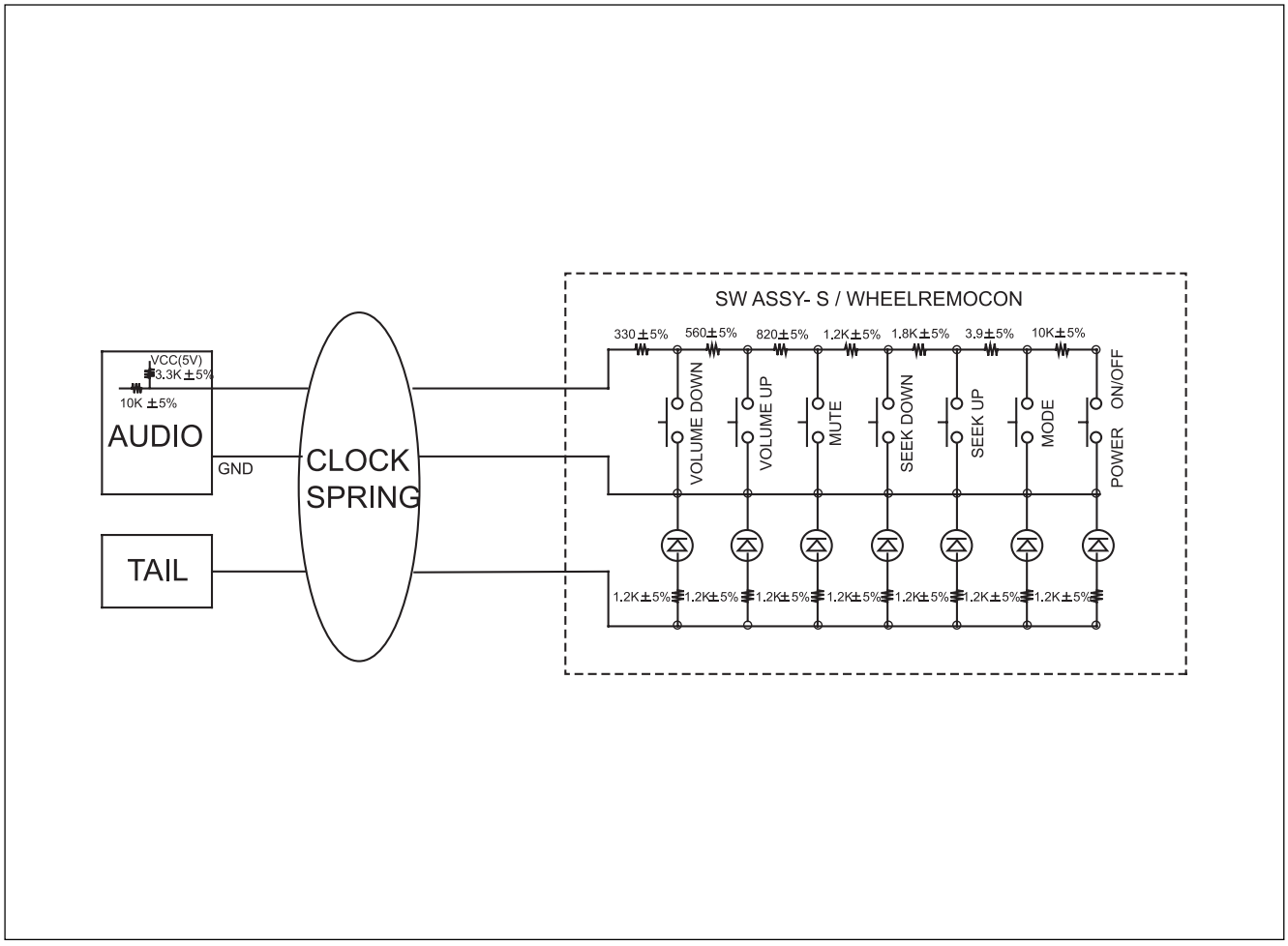




Main Connector	
Pin No.	Output voltage
31	Audio signal
32	Audio ground
33	Tail lamp power

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3. CIRSUIT DIAGRAM OF AUDIO SWITCH ON STEERING WHEEL

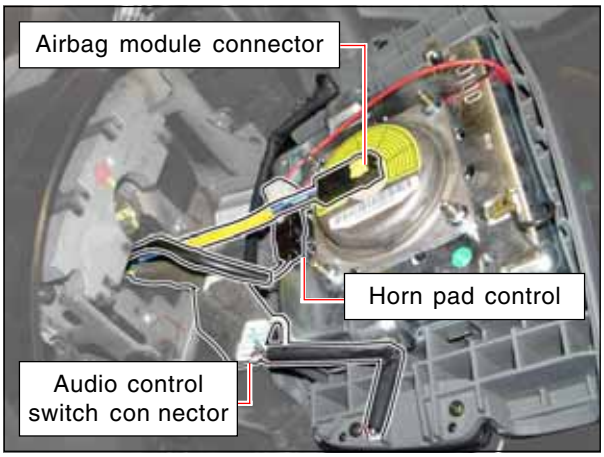


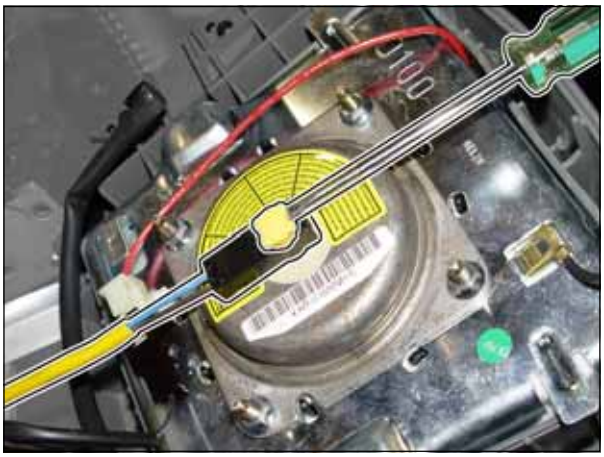
4. REMOVAL AND INSTALLATION

Preceding Works: Disconnect the negative battery cable.



1. Remove the airbag module assembly from the steering wheel.





Audio Control Switch (LH)



CHANGED BY	
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AFFECTED VIN	

2. Unscrew mounting screws at both sides of the removed airbag module and remove the audio remote control switch.







Audio Control Switch (RH)



MULTIFUNCTION SWITCH

1. OVERVIEW

The multifunction switch includes auto washer and wiper switch, fog light switch and auto hazard warning switch besides conventional functions. For the vehicle equipped with airbags, the airbag spring clock is installed on the multifunction switch, so be careful when removing and installing the switch or checking the wiring.

Mounted View



Auto Hazard Warning Switch

- Press briefly: Flashes 3 times
- Press and hold: Flashes 10 times

Front auto washer and wiper switch

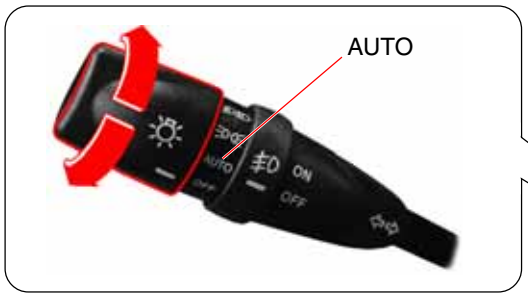
When the front wiper switch is off and this switch is pressed, washer fluid will be sprayed and the wiper will automatically operate 4 times. Then, the fluid will be sprayed again and the wiper will automatically operate 3 times.



<For detailed operation logics, refer to "STICS">

2. FUNCTIONS AND OPERATIONS

▶ AUTO Light Function

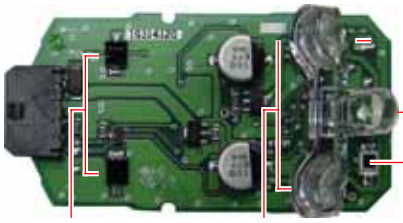




These senses the ambient illumination intensity to determine the timing for turning the headlamps and tail lamps on or off automatically when the light switch is set to “AUTO”.

AUTO Light & Rain Sensor

This senses the ambient illumination intensity to determine the timing for turning the headlamps and tail lamps on or off automatically when the light switch is set to “AUTO” (integrated with rhe rain sensor).



▶ Light Switch

Auto Hazard Warning Switch

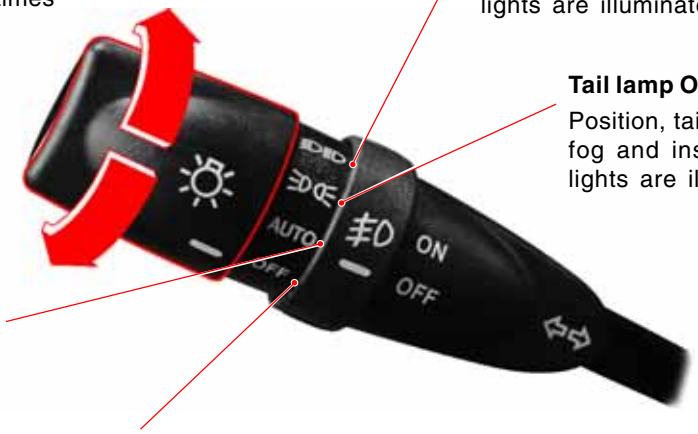
- ▶ Press briefly: Flashes 3 times
- ▶ Press and hold: Flashes 10 times

Headlamp ON

Headlight, position, tail, license plate, fog and instrument panel lights are illuminated.

Tail lamp ON

Position, tail, license plate, fog and instrument panel lights are illuminated.



Automatic light ON

Headlamps and tail lamps automatically turn on or off based upon the intensity of the sunlight analyzed by the automatic light sensor.

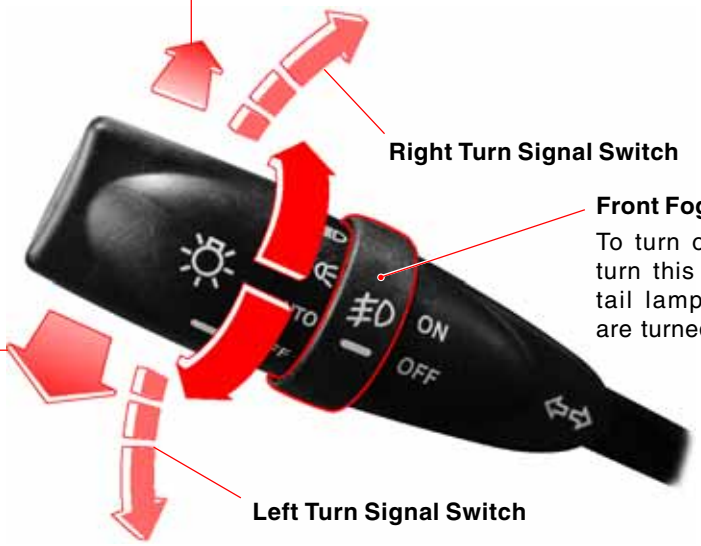
All lights are off.

Headlamp High Beam

To turn on the headlamp high beam, push the lever towards the instrument panel with the headlamp low beam on. The headlamp high beam indicator in instrument panel comes on when the headlamp high beam is turned on.

Passing

To flash the high beam, pull the lever towards the steering wheel and release it. The lever will return to the normal position when released. The high beam headlights stay on as long as you hold the lever.



▶ Front Wiper Switch

Front Automatic Wiping Speed Control Switch

Fast: Fast interval
Slow: Slow interval

MIST

When moving up the wiper lever, the wipers operate once. The lever will return to the “OFF” position when released.

OFF

Stop the operation.

AUTO

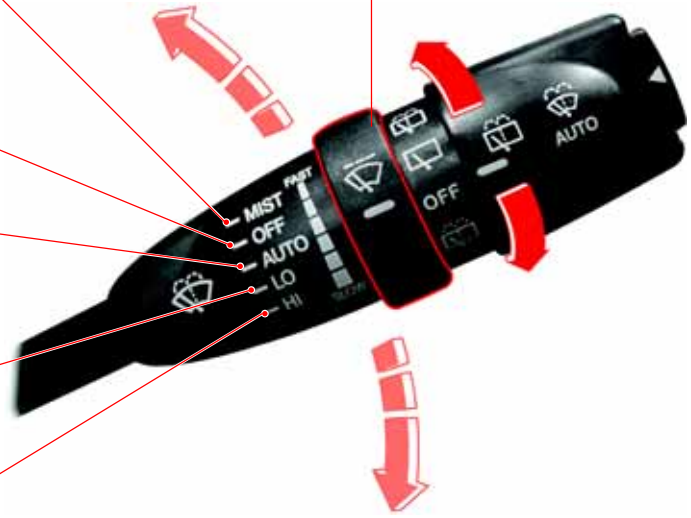
Operates automatically according to the vehicle speed or amount of rain.

LO

Continuous wipe, slow operation

HI

Continuous wipe, fast operation



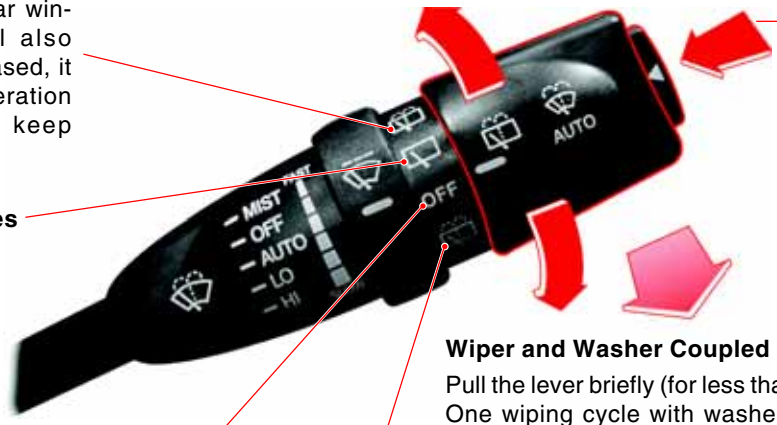
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Front Auto Washer Switch (AFW)

When the front wiper switch is off and this switch is pressed, washer fluid will be sprayed and the wiper will automatically operate 4 times. Then, the fluid will be sprayed again and the wiper will automatically operate 3 times.

Rear Washer and Wiper Switch

When the switch is fully turned, washer fluid will be sprayed onto the rear window glass and the wiper will also operate. When the switch is released, it will stop in the Rear Wiper Operation mode and only the wiper will keep operating.



Rear Wiper Operaes

Rear Wiper Stops

Wiper and Washer Coupled Operation

Pull the lever briefly (for less than 0.6 seconds):
One wiping cycle with washer spray
Pull and hold the lever for more than 0.6 seconds:
Three wiping cycles with washer spray

Rear Washer and Wiper Switch

When the switch is fully turned, washer fluid will be sprayed onto the rear window glass and the wiper will also operate. When the switch is released, it will return to the “OFF” position and turn off the wiper and washer.

When the wiper switch is in the “AUTO” position, this sensor detects the amount of rain, turns on the wiper, and controls the intermittent wiper intervals. For details, refer to "Rain Sensor" section.

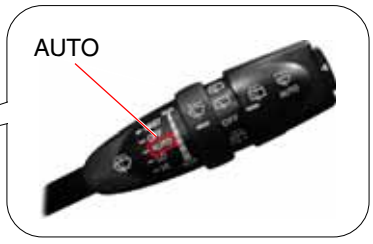
Rain & AUTO Light Sensor



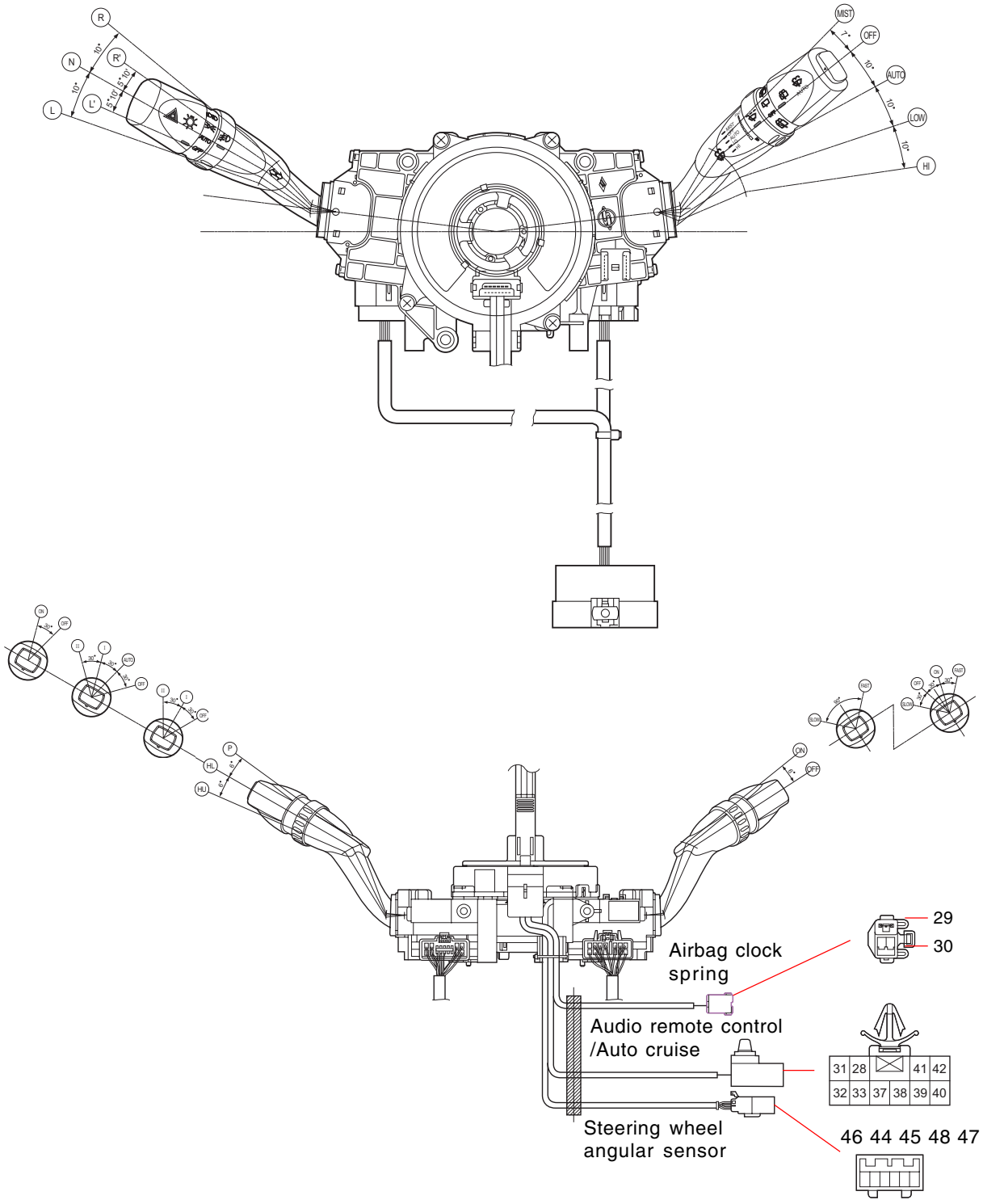
It controls the wiping speed by detecting the amount of rain drops.



Wiper Switch AUTO Position

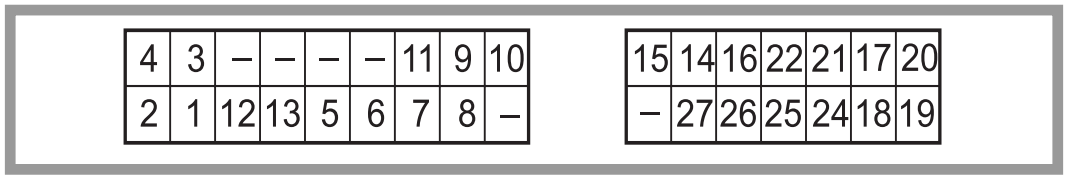


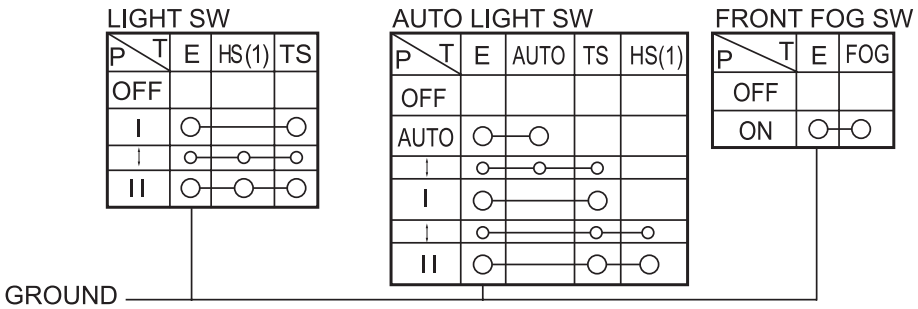
3. OPERATING RANGE

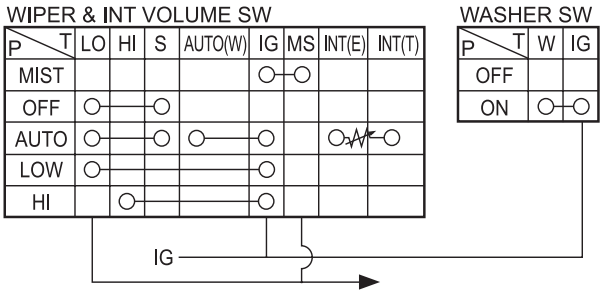


29	Air bag (-)
30	Air bag (+)
31 ~ 33	Audio remote control
43	Sound switch
37 ~ 42	Auto cruise
44 ~ 48	Steering wheel angular sensor

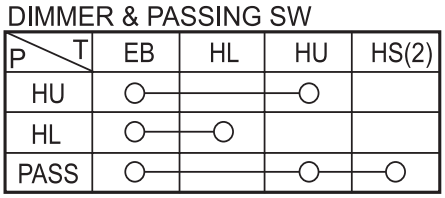
4. CONNECTOR PIN ARRANGEMENT

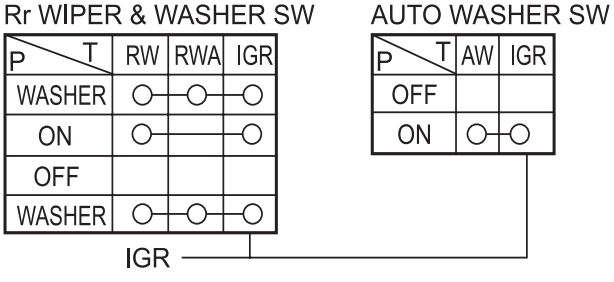






1	EB	Dimmer and passing ground
2	HL	Headlamp low beam
3	HU	Headlamp high beam
4	HS(2)	Passing
5	TS	Tail lamp switch
6	HS(1)	Headlamp switch
7	AUTO	AUTO light
8	E	Light/fog/hazard warning switch ground
9	TB	Flasher unit power
10	TL	Turn signal (LH) lamp switch
11	TR	Turn signal (RH) lamp switch
12	FOG	Front fog light switch
13	HA	Hazard switch
14	LO	Low wiper speed
15	HI	High wiper speed
16	S	Wiper stop
17	AUTO (W)	Intermittent wiper
18	INT (T)	Intermittent wiper
19	INT (E)	Intermittent wiper ground
20	W	Front washer switch
21	IG	IG
22	MS	Low wiper speed
23	-	
24	AW	AUTO washer switch
25	IGR	IGR
26	RW	Rear wiper
27	RWA	Rear wiper & washer





5. REMOVAL AND INSTALLATION

Preceding Work: Disconnect the negative battery cable.

1. Remove the air bag module and steering wheel



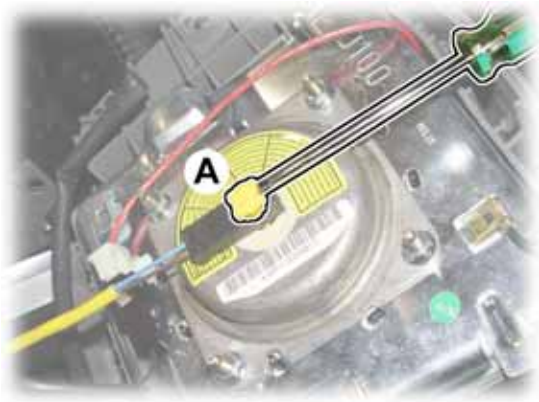
Air bag Module Assembly



NOTICE

- **Be careful not to drop or shock the air bag module during removal procedures.**

Lift up the hook when disconnecting the air bag contact coil connector (A).



Steering Wheel Assembly

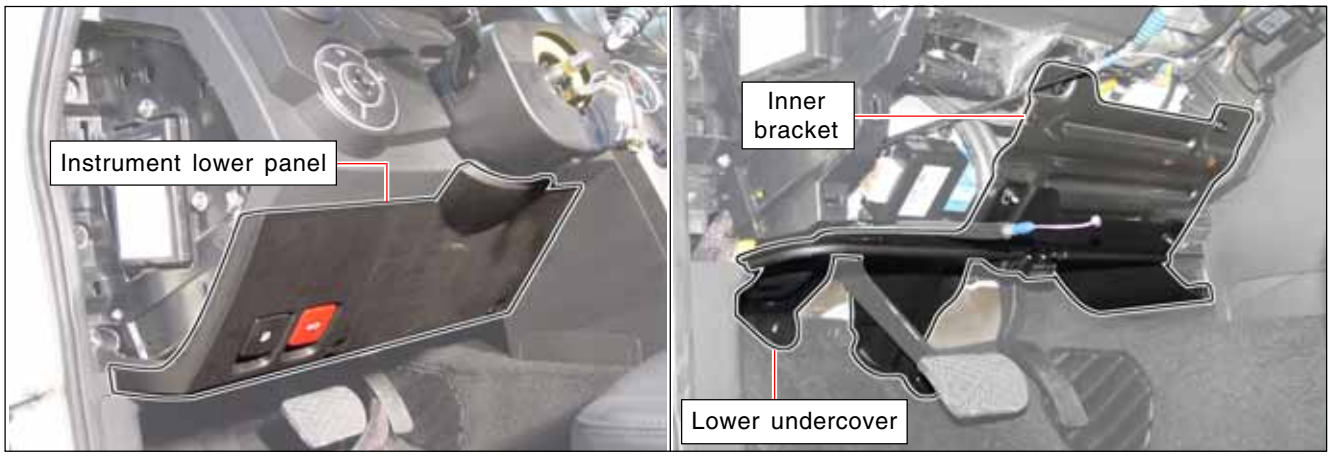


Put an installation mark on the steering wheel, column shaft and nut when removing the steering wheel. Place the steering wheel to the straight forward direction.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. Remove the driver side instrument lower panel, inner bracket and lower undercover. For details, refer to the “Body” section.



3. Unscrew three screws from the steering column cover and remove the upper and lower covers.



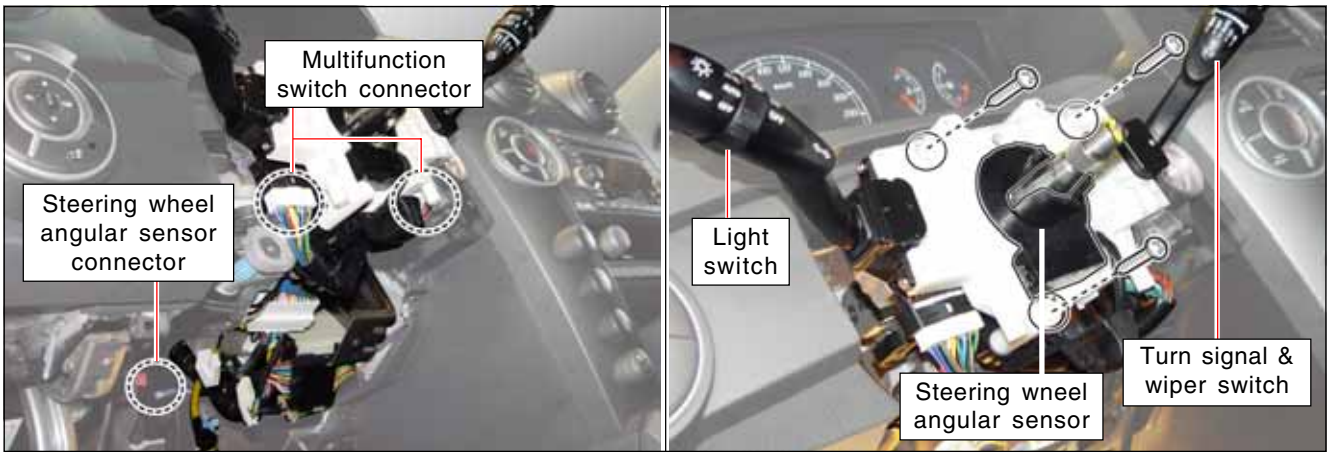
4. Unscrew four screws and remove the air bag contact coil assembly.



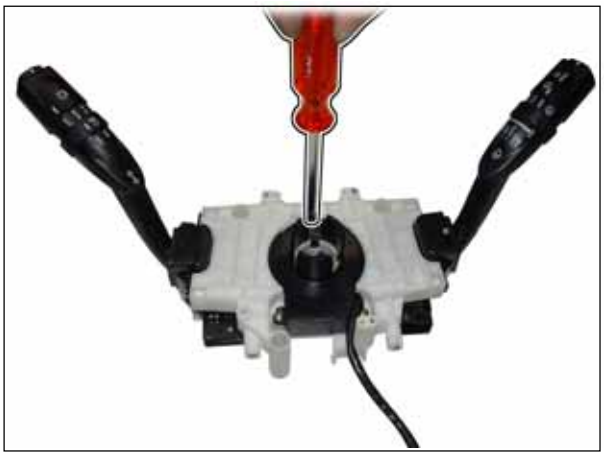


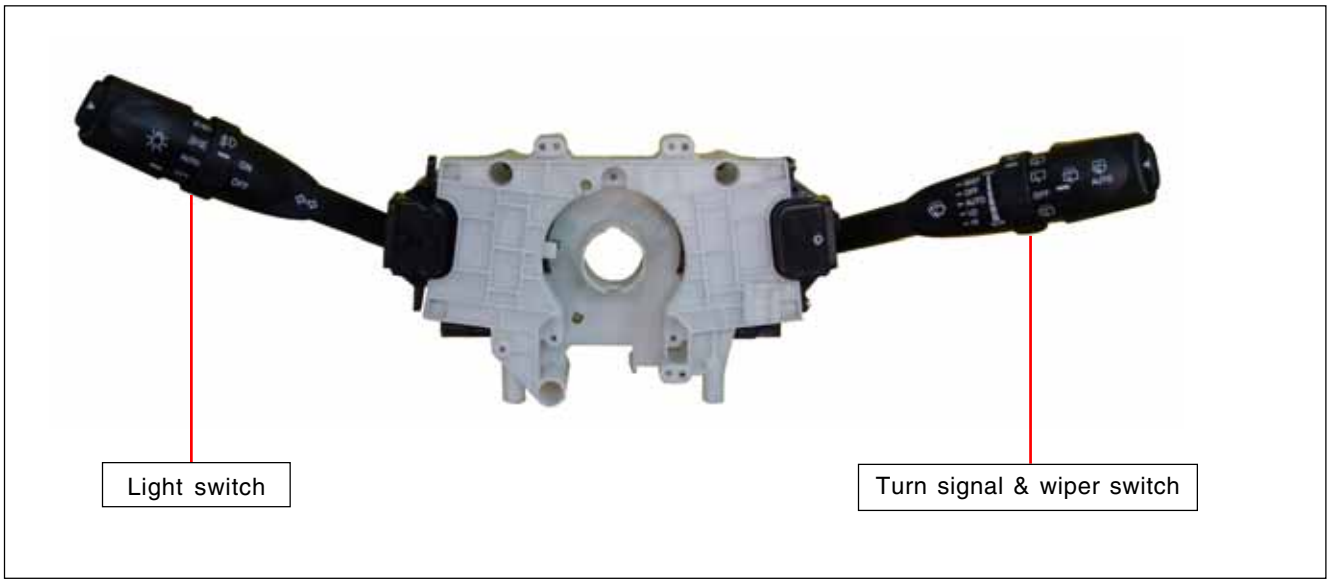
For installation, align the steering wheel to the installation mark and tighten the nut to the specified tightening torque.

5. Remove the mounting screws (3 EA) from the steering will steering wheel sensor and the multifunction switch (3 EA) at this moment, disconnect the connectors.



6. Remove the steering wheel angular sensor from the removed multifunction switch assembly.





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EFFECTIVE DATE	
AFFECTED VIN	

TAILGATE OPEN SWITCH





Front View





Connector

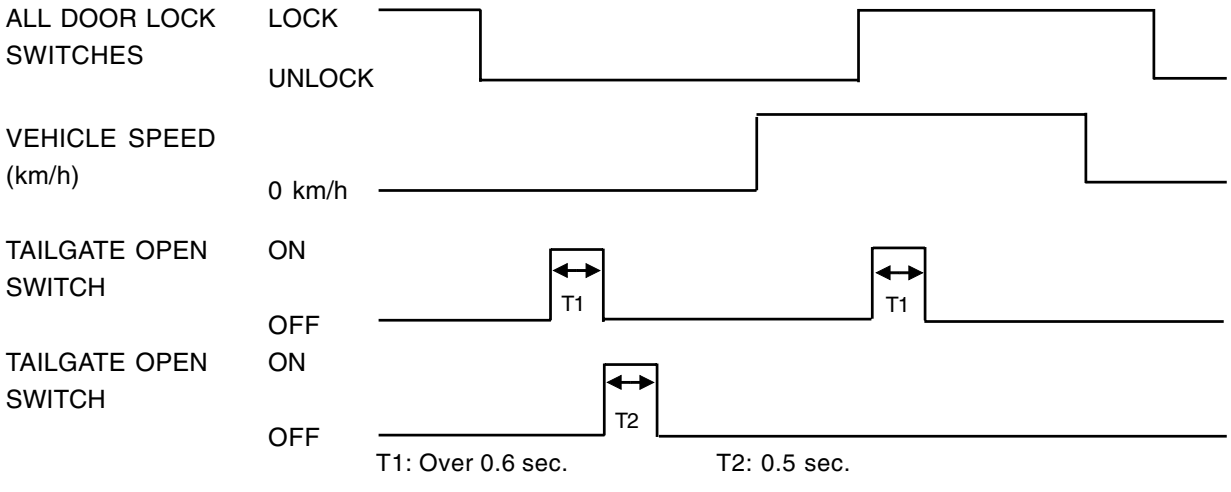
Rear View

Tailgate Open Control

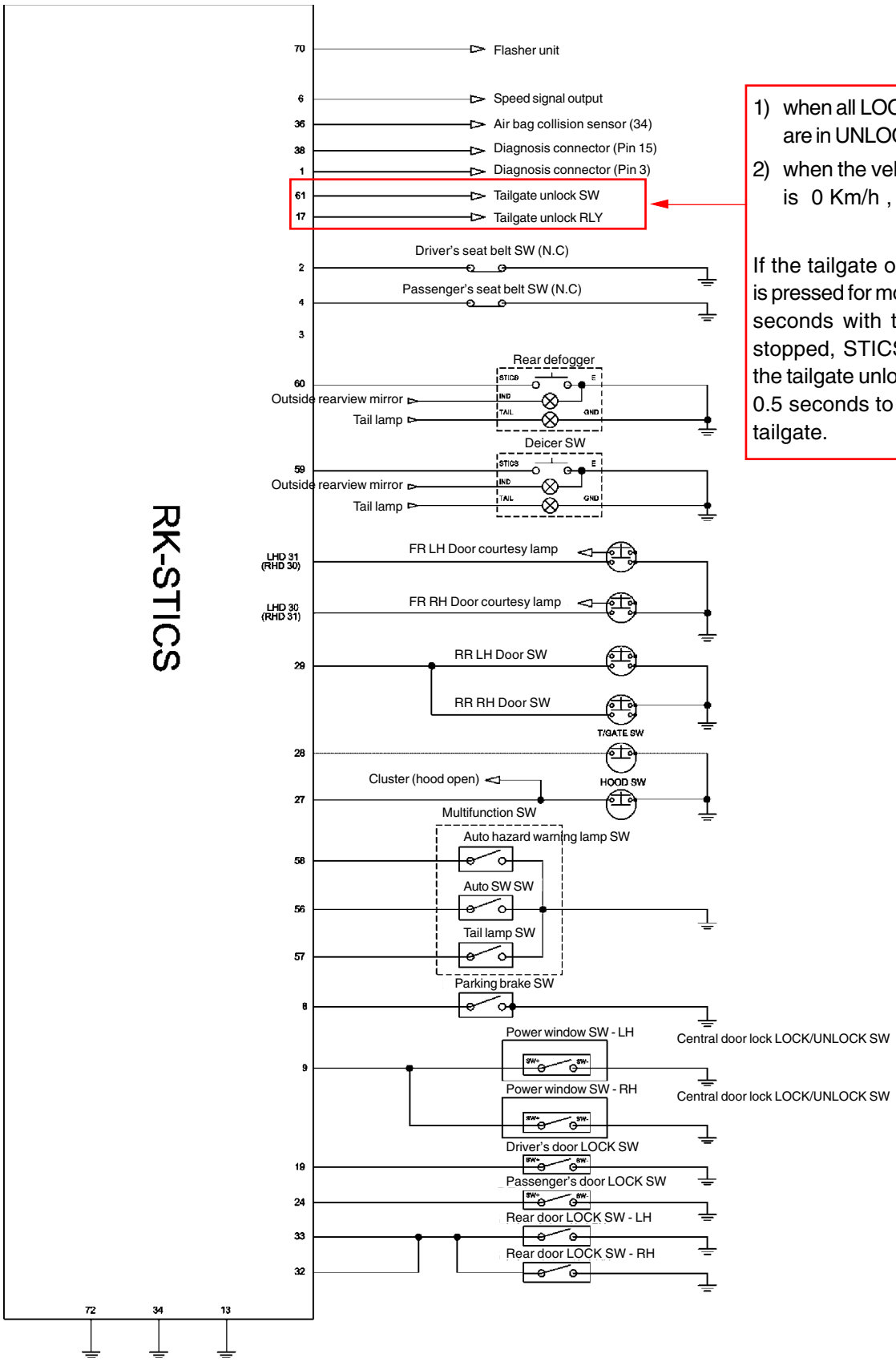
To unlock the tailgate, press the logo on the tailgate.

The operation procedures are as below:

1. When pressing the open switch on the tailgate for more than 0.6 seconds, the tailgate relay operates for 0.5 seconds to unlock the tailgate while all door lock switches are in UNLOCK position and the vehicle is stationary.
2. The tailgate relay output is turned off immediately after any LOCK switch is switched to LOCK position or the vehicle moves.



▶ Circuit Diagram of Tailgate Switch



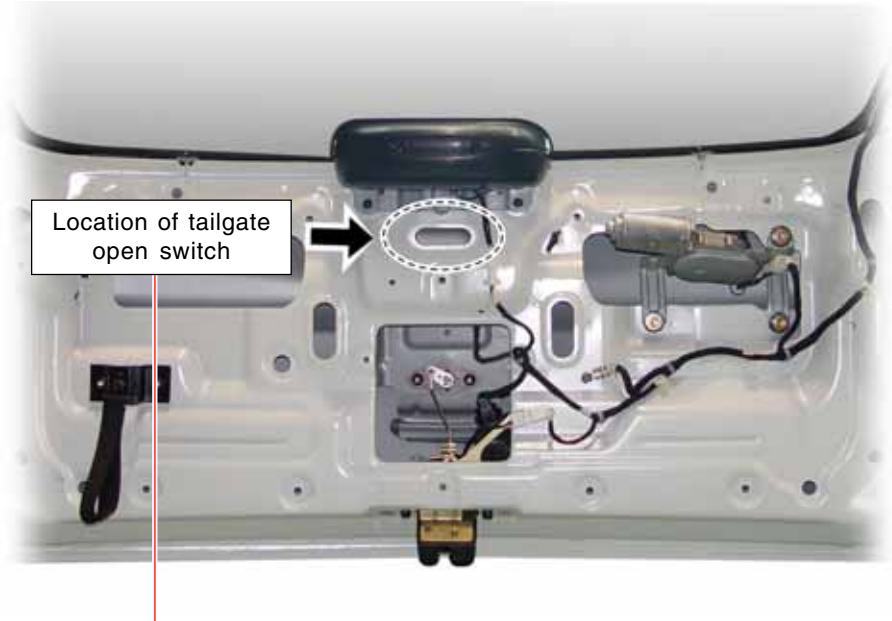
1) when all LOCK switches are in UNLOCK position,
2) when the vehicle speed is 0 Km/h ,

If the tailgate open switch is pressed for more than 0.6 seconds with the vehicle stopped, STICS operates the tailgate unlock relay for 0.5 seconds to unlock the tailgate.

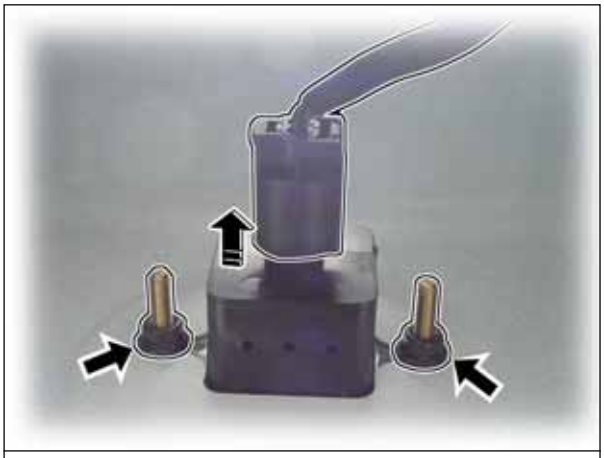
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Removal and Installation

※ **Preceding work:** Remove the tailgate trim assembly.



Installation



1. Disconnect the electric connector and unscrew two mounting nuts to remove the tailgate open switch.



CIGARETTE LIGHTER

※ **Preceding Work:**

1. Disconnect the negative battery cable.
2. Loosen the parking brake cable to raise the lever as high as possible.



1. Pull the parking brake and place the gear selector lever to "N" position to remove the center console box cover (1).



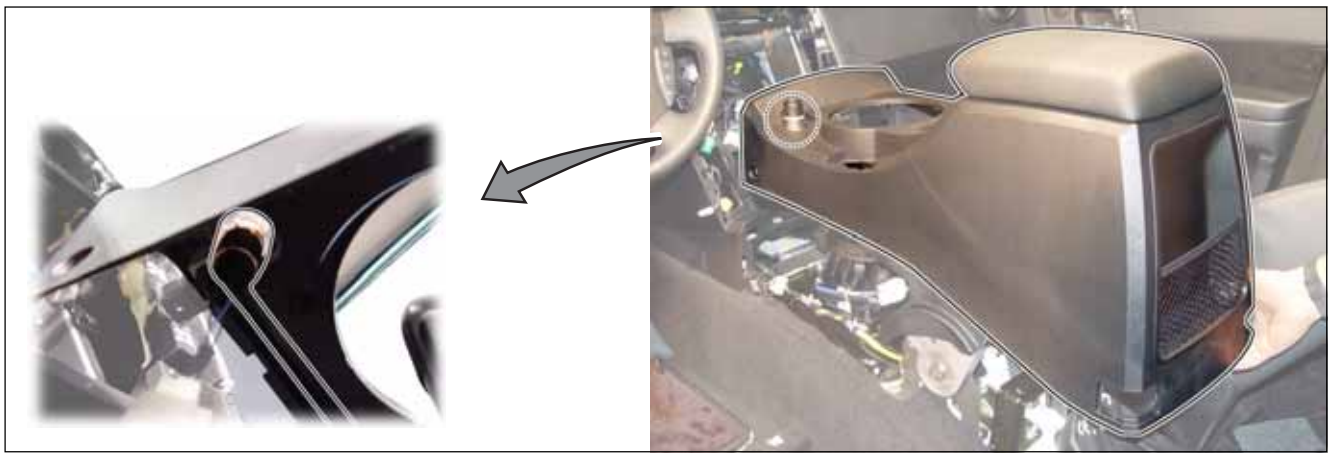


2. Remove the brackets around center console and unscrew two mounting screws.



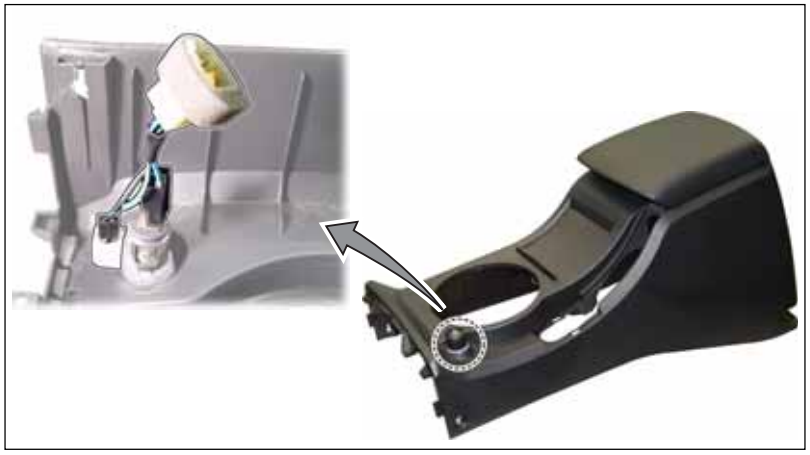
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Pull up the gear selector lever all the way and disconnect the electric connector from cigarette lighter. Then, remove the center console.





4. Remove the cigarette lighter assembly from the removed center console box.

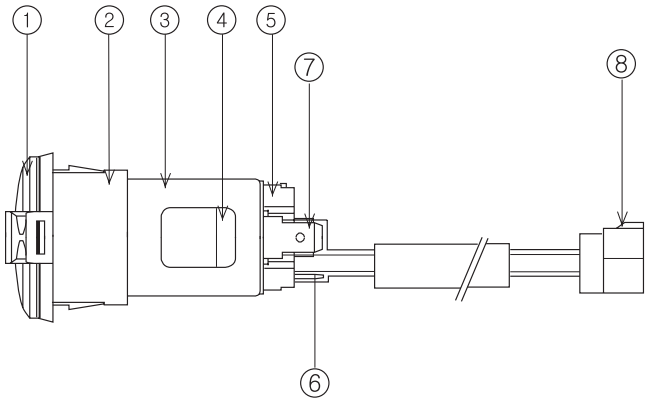


5. Adjust the tension of the parking brake cable.

Cigarette Lighter Assembly



POWER OUTLET



1. Cap
2. Cap cover
3. Socket
4. Installation holder
5. Insulator
6. (+) terminal
7. (-) terminal
8. Connector

Rated voltage: over DC 12 V, Max. operating current: 10 A, Resistance: over 5 MΩ



Front Power Outlet

1. Remove the power outlet bracket from the center console (passenger side).



2. Disconnect the power outlet connector.



3. Remove the power outlet from the bracket.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Rear Power Outlet

1. Remove the rear lower quarter panel (RH) and disconnect the power outlet connector.





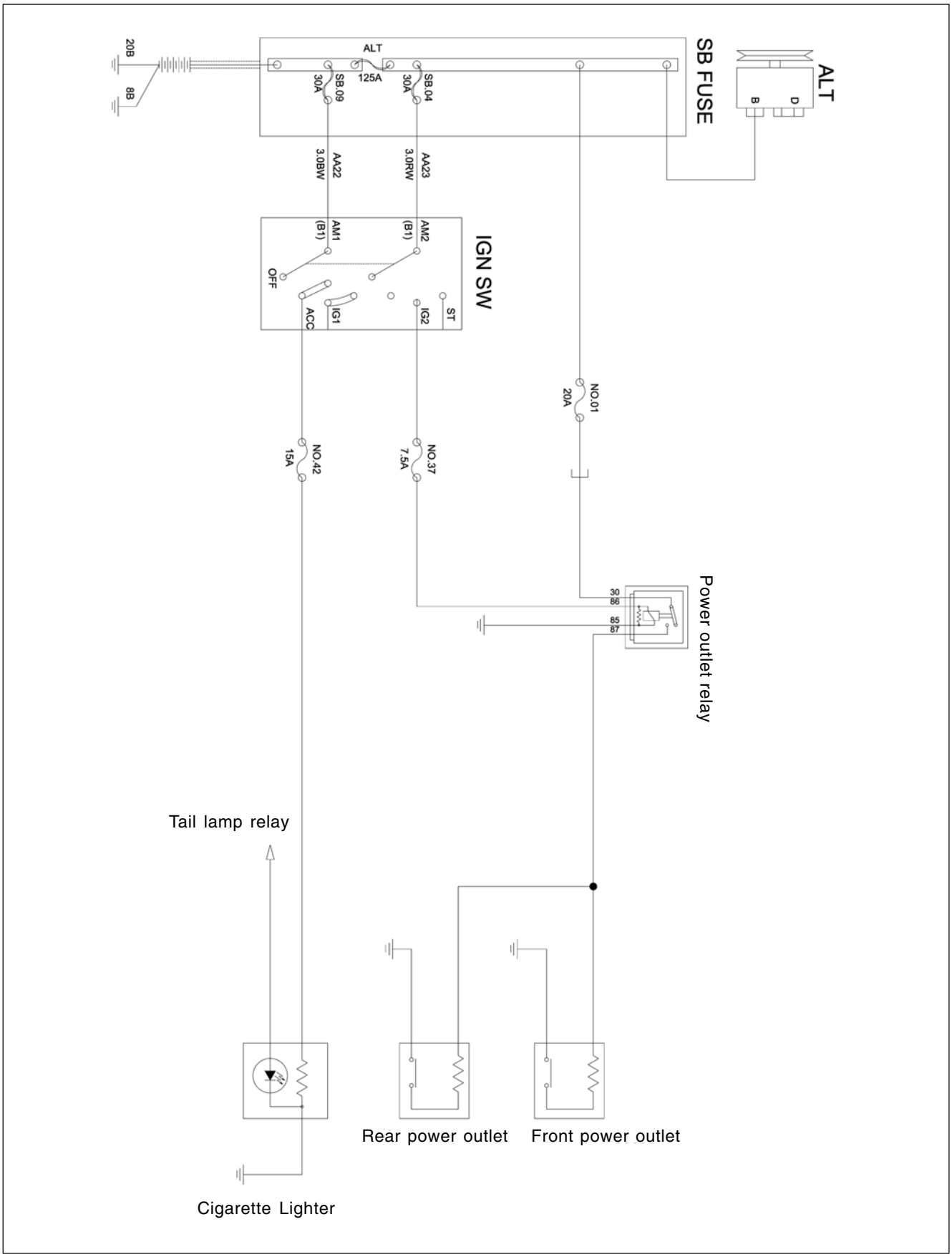
2. Unscrew eight screws and remove the power outlet mounting bracket.



3. Remove the power outlet from the removed bracket.



▶ Circuit Diagram of Cigarette Lighter and Power Outlet



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EFFECTIVE DATE	
AFFECTED VIN	

DIGITAL CLOCK

The digital clock receives the power constantly through the No. 23 fuse (7.5 A) from the battery and is connected to the tail lamp circuit and lighting devices for interior illumination. When the ignition switch is not in OFF position, it receives the power through the No. 43 fuse (10 A).



NO	CONNECTION
1	BAT(+)
2	IGN(+)
3	TNS(+)
4	GND(-)



Rated voltage: DC 12 V

Operating voltage: DC 8 V ~ DC 16 V

Time difference: ±2 sec/day (room temp.)

Current consumption:

Max. 150 mA with IGN ON

Max. 2.5 mA with IGN OFF

Display type: LCD

Brightness: 100% with Tail lamp OFF

40% with Tail lamp ON

Blinking cycle of Colon: Once per second

Digital Clock



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

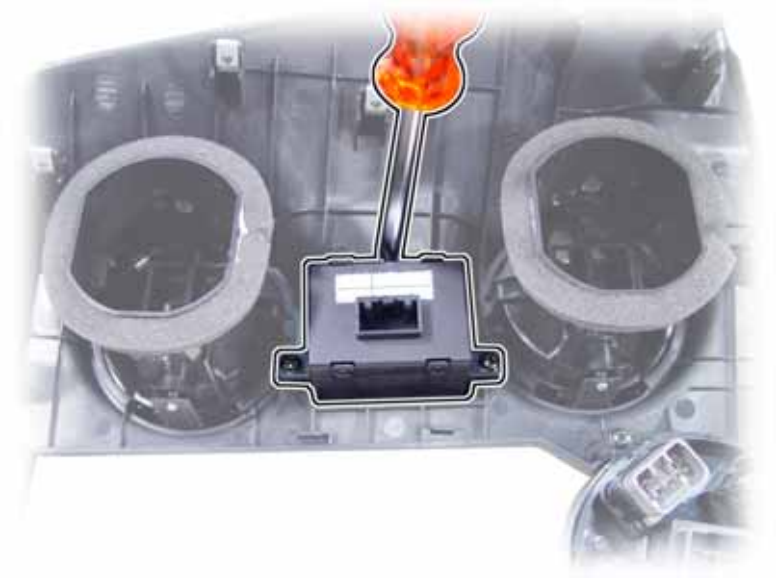
Removal and Installation of Digital Clock

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the center fascia panel (refer to “Body” section in this manual).



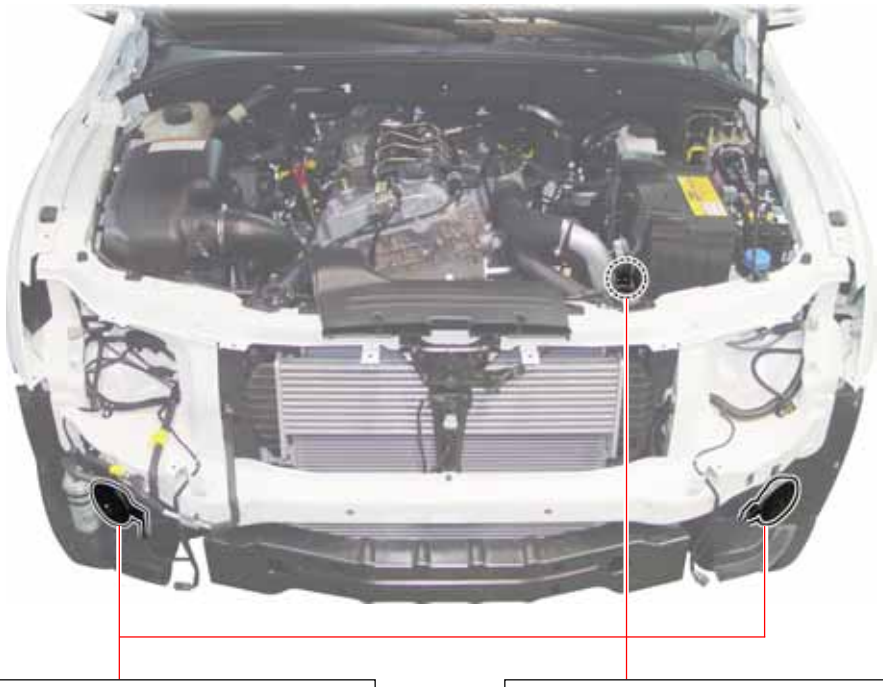
3. Unscrew three mounting screws and remove the digital clock from the center fascia panel.



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EFFECTIVE DATE	
AFFECTED VIN	

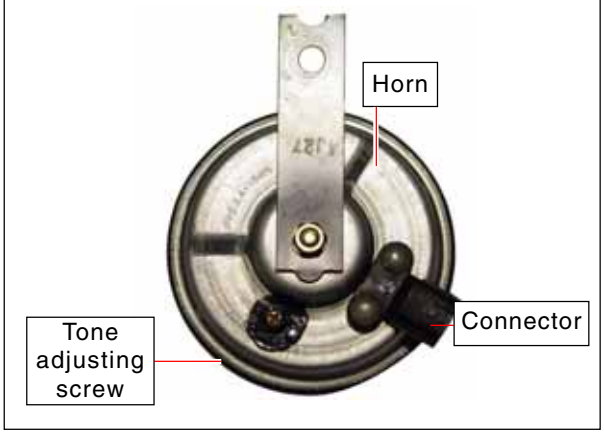
HORN (INCLUDING THEFT DETERRENT HORN)

1. LOCATION



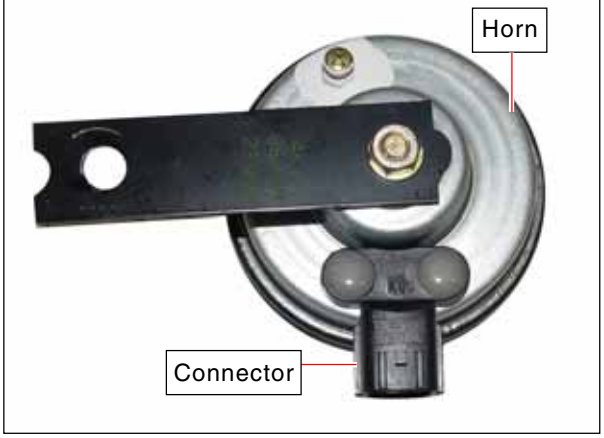
Horn Assembly





Theft Deterrent Horn





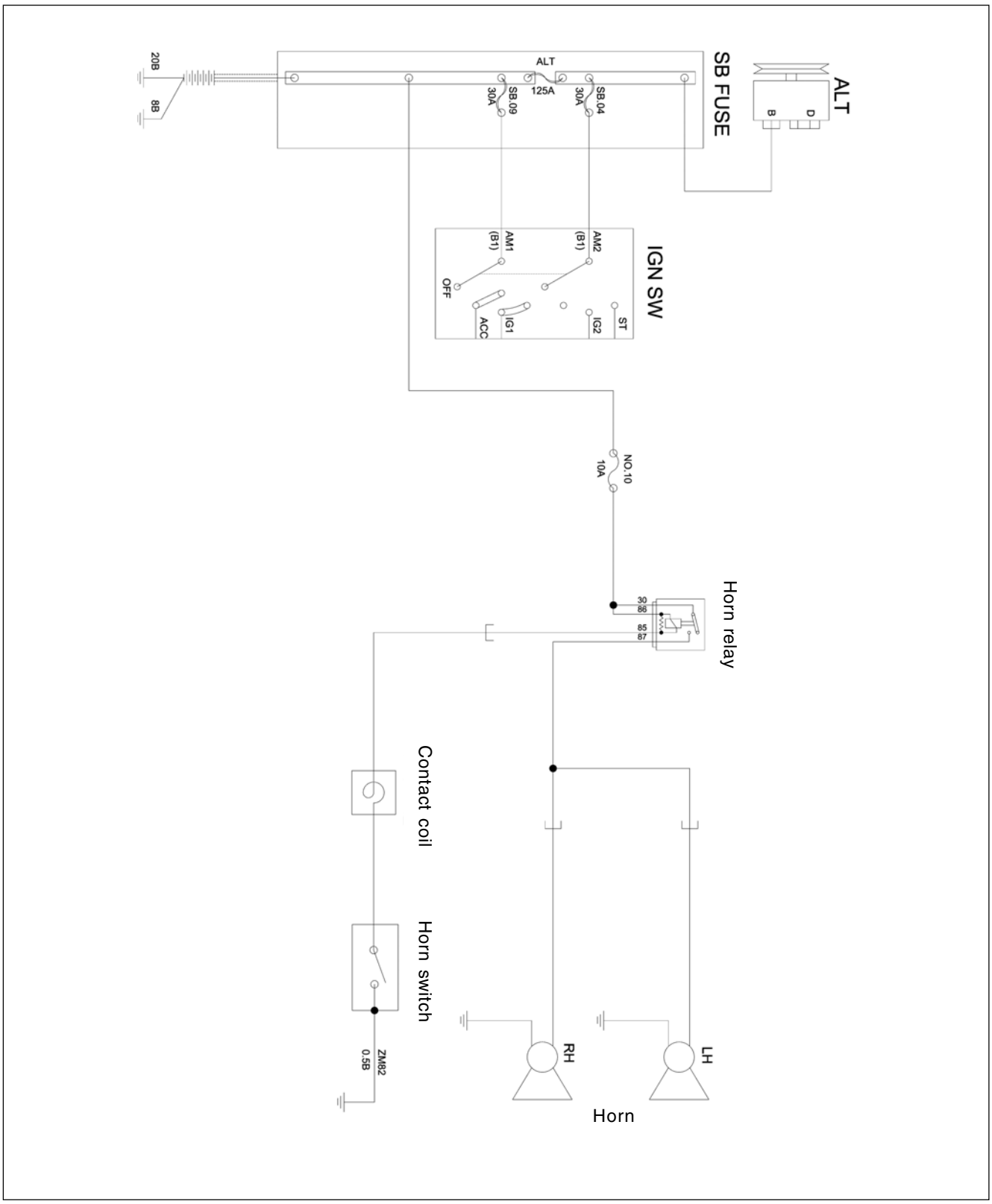
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. CIRCUIT DIAGRAM OF HORN

Location of horns: One at each side in engine compartment

Location of theft deterrent horn: Under the battery tray in engine compartment

The theft deterrent horn is controlled by STICS in armed mode regardless of horn relay operation.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. STICS CONTROL FOR THEFT DETERRENT MODE

▶ Functions in Theft Deterrent Mode

Definitions in theft deterrent mode

1. Door OPEN/CLOSE

Door OPEN: Any of door switches (engine hood, front doors, rear doors, tailgate) outputs “OPEN” signal.

Door CLOSE: All door switches (engine hood, front doors, rear doors, tailgate) output “CLOSE” signal.

2. Door LOCK/UNLOCK

Door LOCK: Any of door lock switches (front doors, rear doors, tailgate) outputs “LOCK” signal.

Door UNLOCK: All door lock switches (front doors, rear doors, tailgate) output “UNLOCK” signal.

NOTICE

- **The engine hood switch is not included in door lock/unlock switch.**

Description of Theft Deterrent Function

1. Armed mode activation requirements

a. The “LOCK” output is “ON” when receiving the “LOCK” signal from transmitter while the ignition key is removed and all doors are closed. The armed mode is activated when the door lock switch is locked (theft deterrent horn output: once, hazard relay output: twice).

b. The theft deterrent horn and hazard relay outputs are “ON” when receiving the “LOCK” signal from the remote control key again in armed mode (theft deterrent horn output: once, hazard relay output: twice).

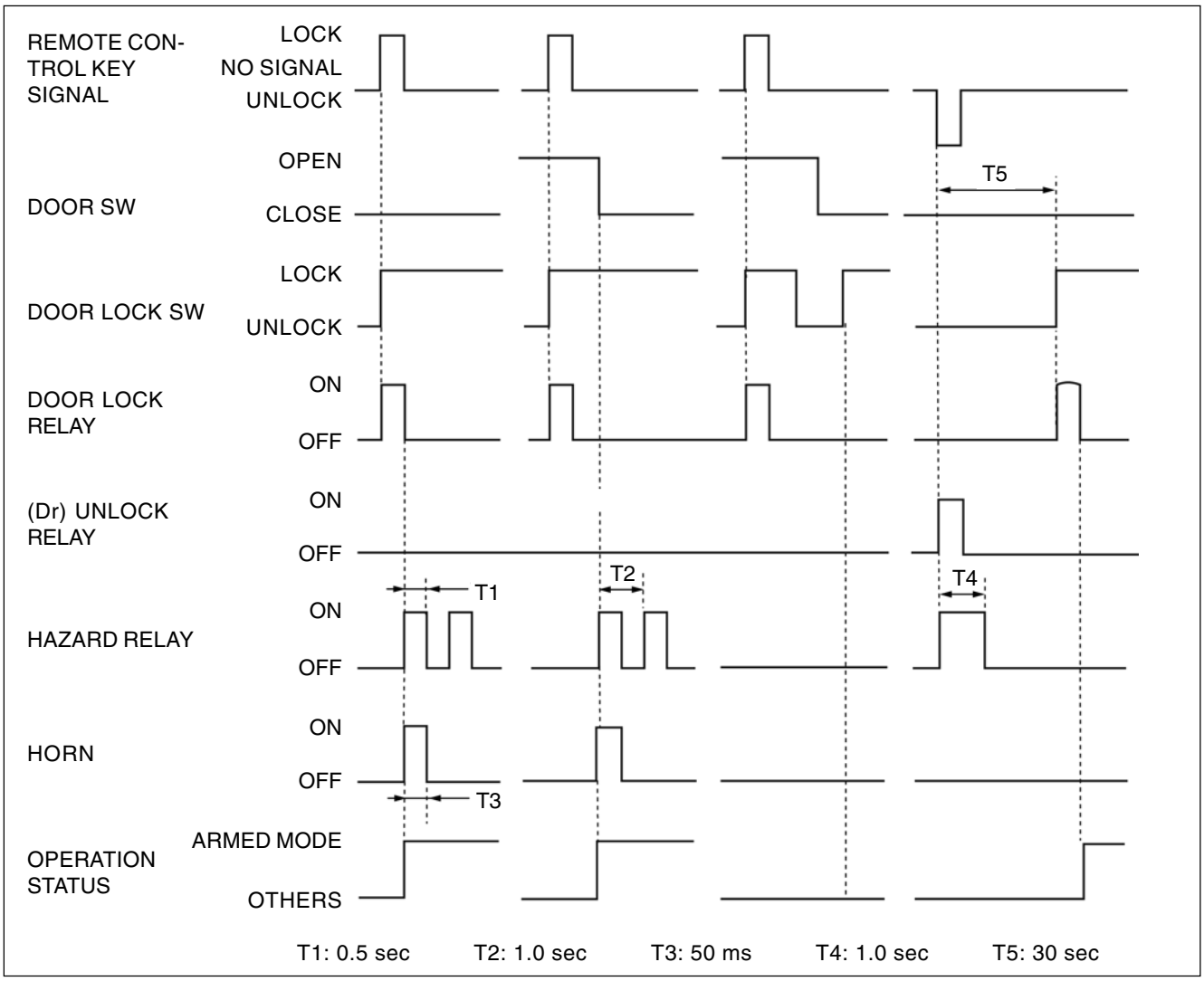
c. When receiving “LOCK” signal from the remote control key while any of doors is not closed, only the “LOCK” output can be done and then activates the armed ready mode (without theft deterrent horn and hazard warning flasher). At this moment, if the ignition key is in the ignition switch or the door lock switch is unlocked, cancels the armed mode and activates the normal mode.

However, in these cases, if closing the door, the theft deterrent horn outputs once and the hazard warning flasher outputs twice and then activates armed mode.

d. When the door is not opened or the ignition key is not inserted into ignition switch for 30 seconds after receiving “UNLOCK” signal, outputs “LOCK” and then activates armed mode (RELOCK operation). Also, at this moment, the system outputs the theft deterrent horn and hazard warning flasher.

e. The armed mode will not be activated except above conditions.

Ex) The armed mode will not be activated when the door is locked by the ignition key.



2. Armed mode cancellation requirements

a. Unlocking by remote control key or engine starting.

3. Warning operation requirements

a. When opening the door in armed mode

b. When unlocking the door lock switch not by the remote control in armed mode

c. When closing and then opening the door after completion of warning (27 seconds)

4. Warning operation

a. The theft deterrent horn and hazard warning flasher output is “ON” for 27 seconds with the interval of 1 second.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. Warning cancellation requirements

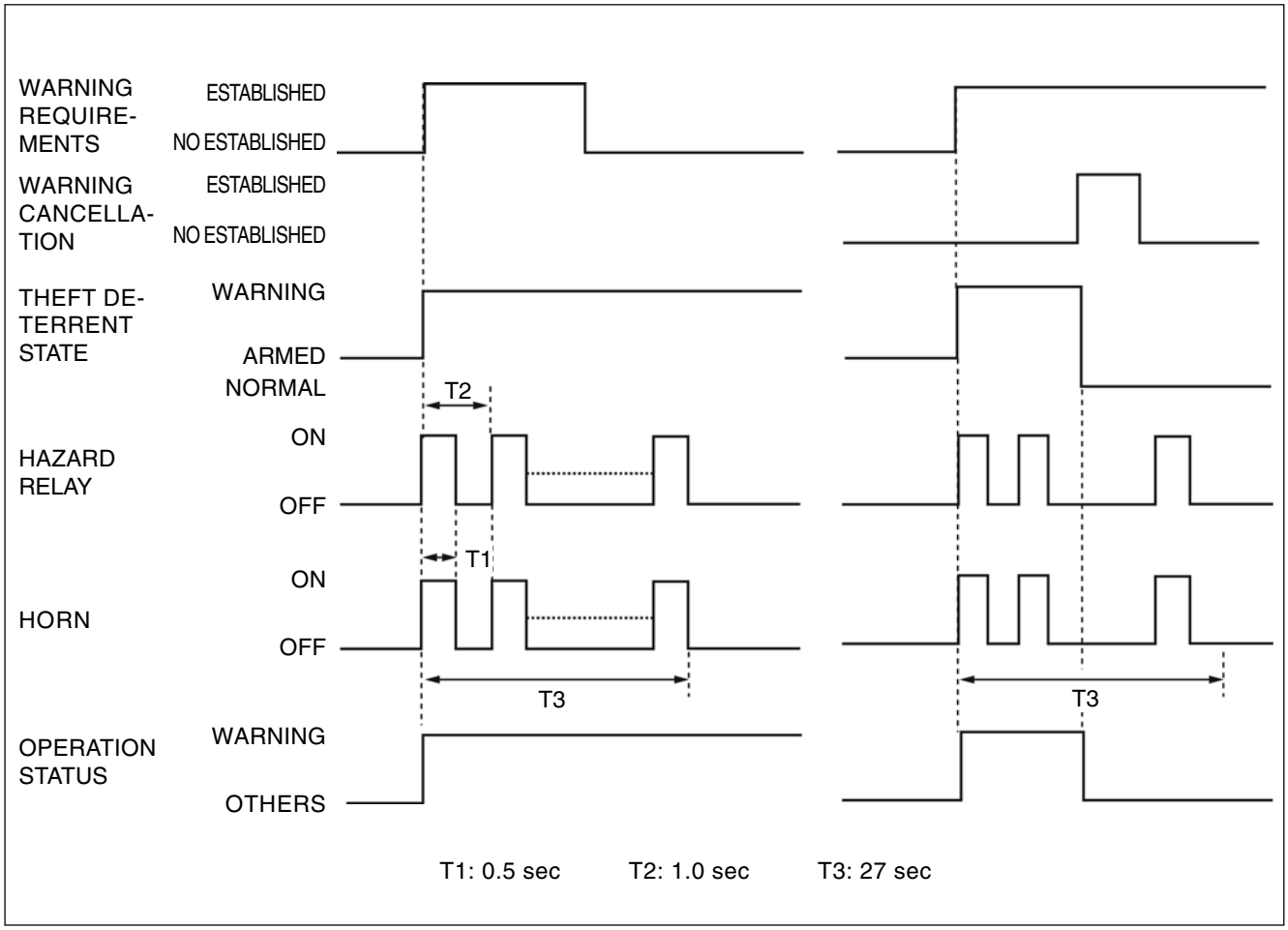
a. Cancels warning by using any signal from the remote control key (LOCK, UNLOCK, PANIC, ESCORT) during warning operation.

b. Cancels warning after 27 seconds (remaining period) while the ignition key is turned to "ON" position.

c. If the ignition switch is turned to ON position when the warning is activated in armed mode, the warning is canceled immediately and the warning buzzer stops after 27 seconds (remaining time).

6. Operation when warning is cancelled

a. The theft deterrent horn and hazard warning flasher outputs are “OFF”.REMOTE CONTROL KEY SIGNAL



7. Operations when removing and installing the battery

Removed \ Installed	Normal	Armed	Warning	Remark
Normal	○			
Armed Ready	○			
Armed		○		
Warning			○	
Warning Completion	○	○	○	
RELOCK Ready	○			

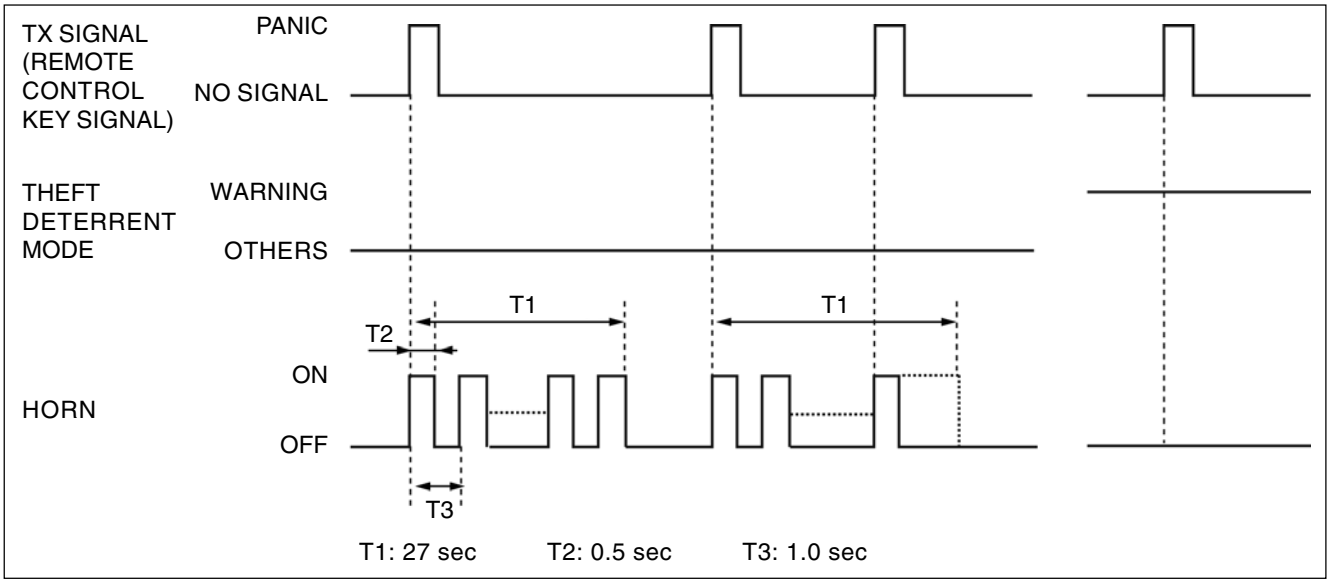
If the system is in armed mode while installing a battery, the horn sounds and the emergency warning lamp blinks (Same operations with warning in armed mode).

RELOCK operation

It the door is not opened or the ignition key is not inserted into the key cylinder within 30 seconds after unlocking the door with remote control key, the system outputs “LOCK” signal and activates the armed mode.

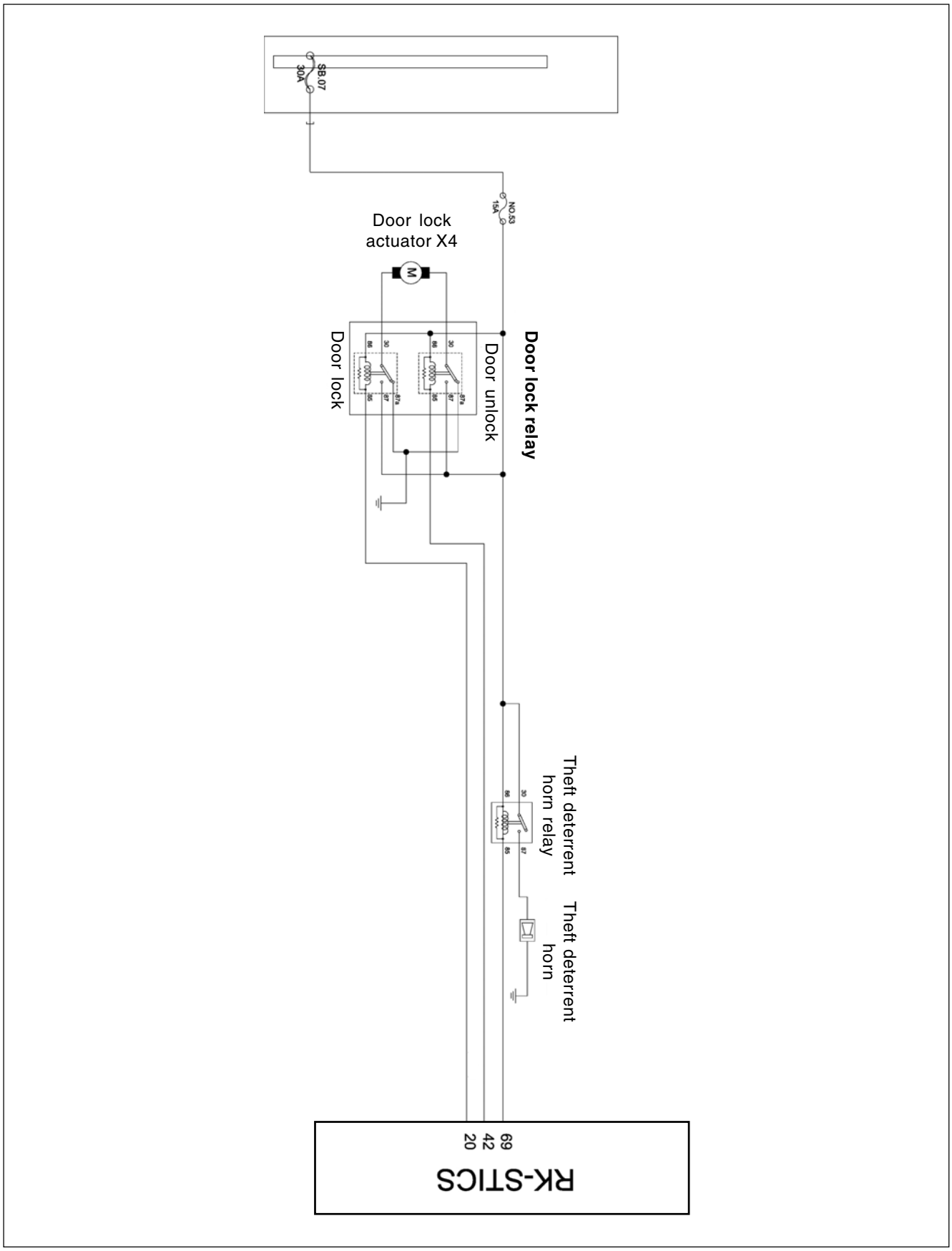
PANIC Warning

1. The PANIC warning output is “ON” (theft deterrent horn) for 27 seconds when receiving the PANIC signal from the remote control key (pressing PANIC button.
2. The PANIC warning output is “OFF” when receiving any signal from the remote control key during PANIC warning.
3. Followings are theft deterrent warnings:
   a. The theft deterrent warning is canceled when receiving PANIC signal from the remote control key during theft deterrent.
   b. The theft deterrent warning output is “ON” when the theft deterrent conditions are established during PANIC warning (PANIC output is “OFF”).
   c. The PANIC warning output is “ON” when receiving the PANIC signal from the remote control key in Armed Ready / Armed / Warning Completion / Relock Ready mode (maintaining the theft deterrent mode).
4. This function operates only in armed mode.



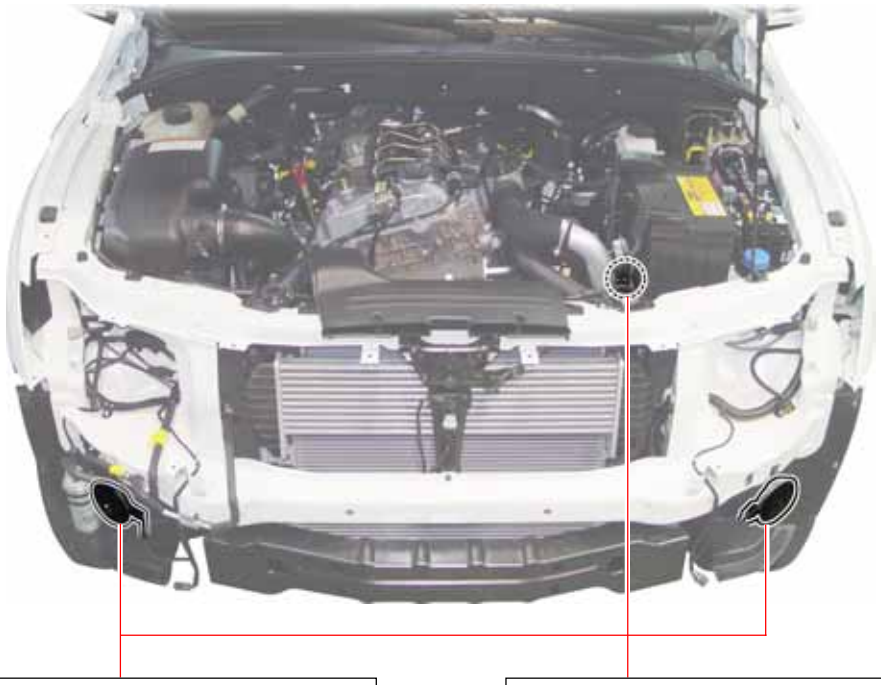
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AFFECTED VIN	

▶ Circuit Diagram of Theft Deterrent Horn

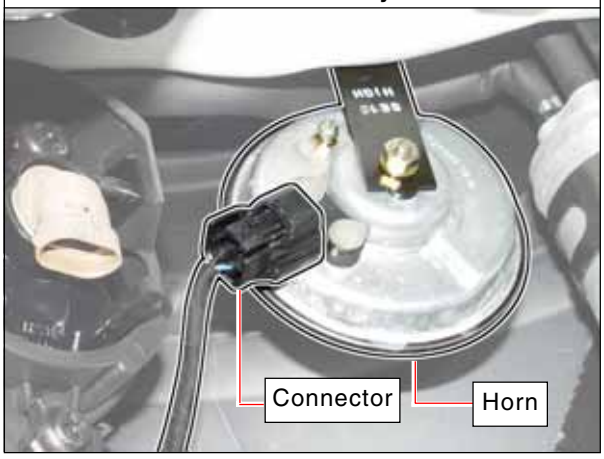


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AFFECTED VIN	

4. REMOVAL AND INSTALLATION

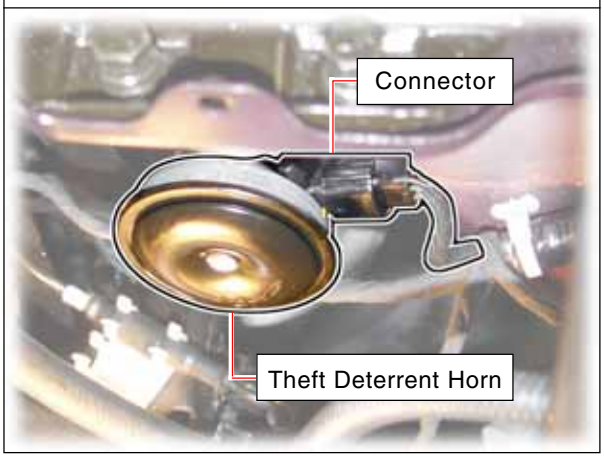


Horn Assembly



1. Disconnect the horn connector and unscrew one mounting bolt (10 mm) to remove the horn assembly.

Theft Deterrent Horn



1. Disconnect the theft deterrent horn connector and unscrew one mounting bolt (10 mm) to remove the theft deterrent horn assembly.

AUDIO SYSTEM

8930 / 8610 / 8910

TABLE OF CONTENTS

AUDIO SYSTEM 2

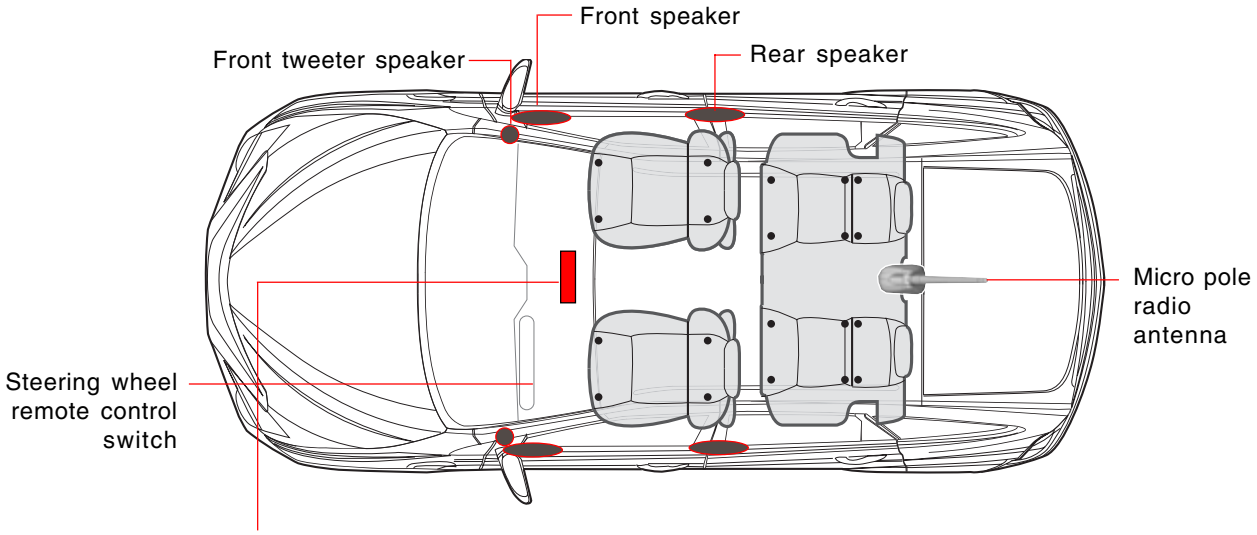
1. Audio system 2

MICRO (ACTIVE) POLE ANTENNA 7

AUDIO SYSTEM

1. AUDIO SYSTEM

Audio System - 6 Speakers

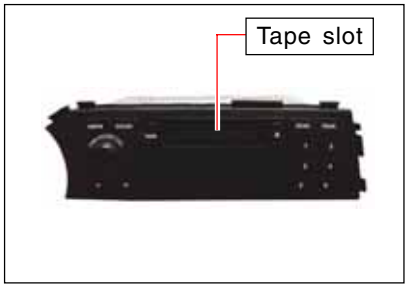


Audio Head Unit

1. CD + RADIO

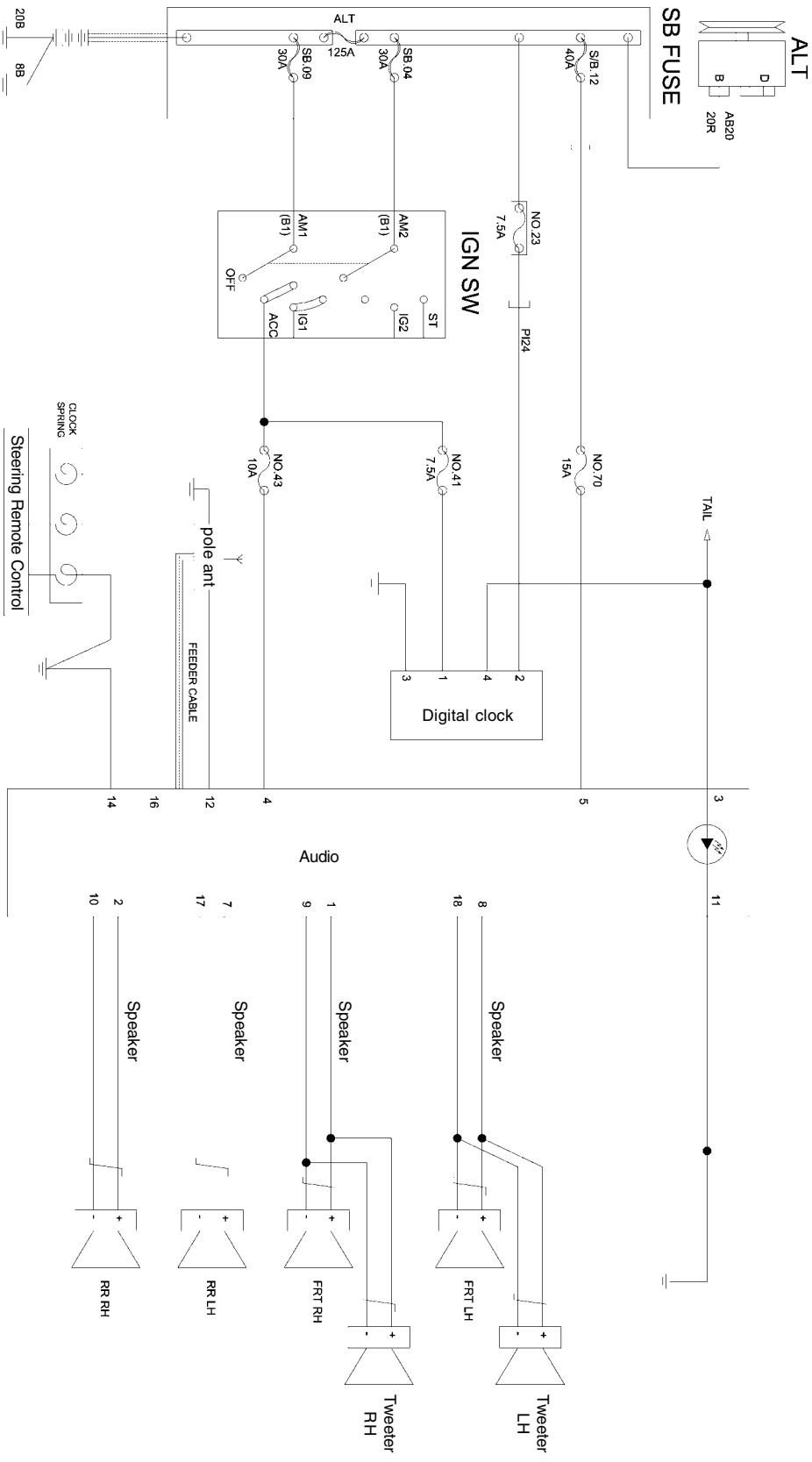


2. CD + TAPE



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Circuit Diagram of Audio System



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Removal and Installation of Audio Head Unit

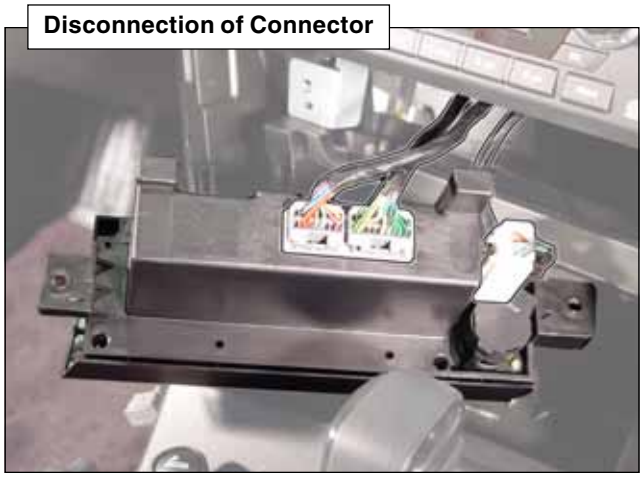
※ **Preceding Work:** 1. Disconnect the negative battery cable.
2. Remove the center fascia panel.

1. Remove two mounting screws and disconnect the connector to remove the A/C assembly.

Removal of Mounting Screw



Disconnection of Connector



2. Remove four mounting screws and disconnect the connector on the back of the audio assembly.

Removal of Mounting Screw



Disconnection of Connector



3. Remove the audio assembly.





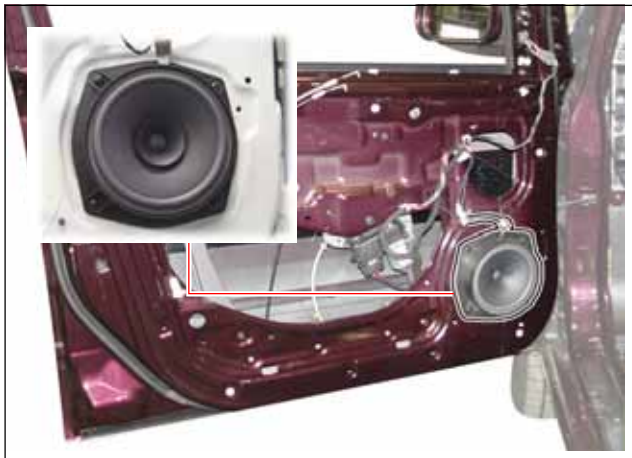
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Removal of Front Door Speaker and Rear Door Speaker

※ **Preceding work:** Disconnect the negative battery cable and remove the door trim (refer to “Body” section).

1. Disconnect the speaker connector.

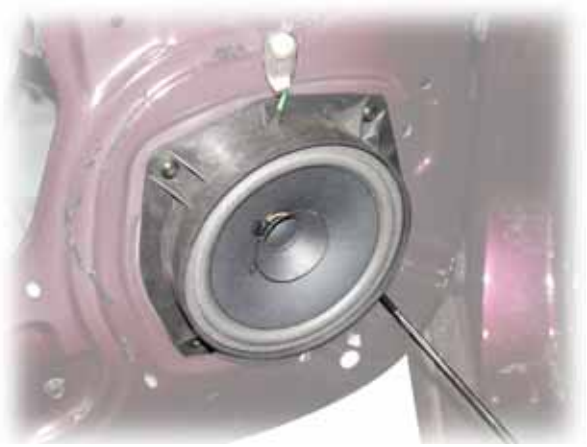
Front Door



Rear Door



2. Unscrew four mounting screws and disconnect the connector to remove the door speaker.





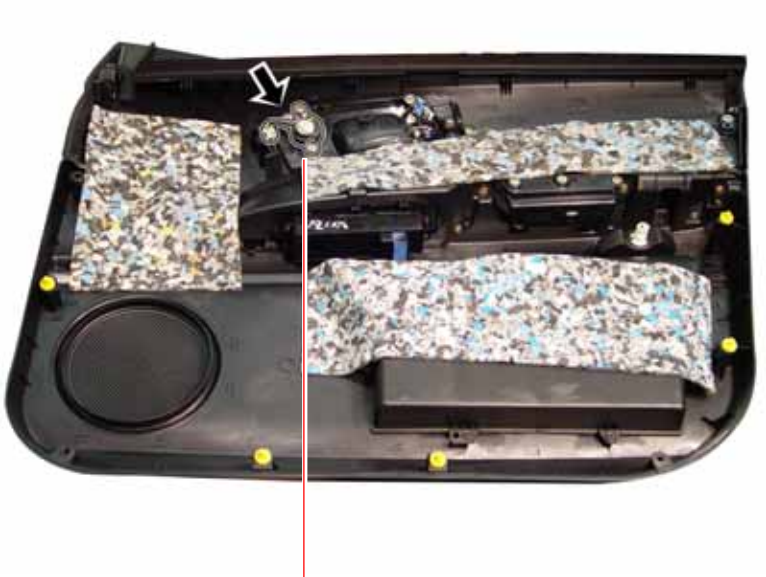
Front Door	40W/2Ω
Rear Door	40W/2Ω



Removal of Door Tweeter Speaker

※ **Preceding work:** Disconnect the negative battery cable and remove the door trim (refer to “Body” section).

1. Unscrew two speaker mounting screws from the removed the door trim to remove the speaker.





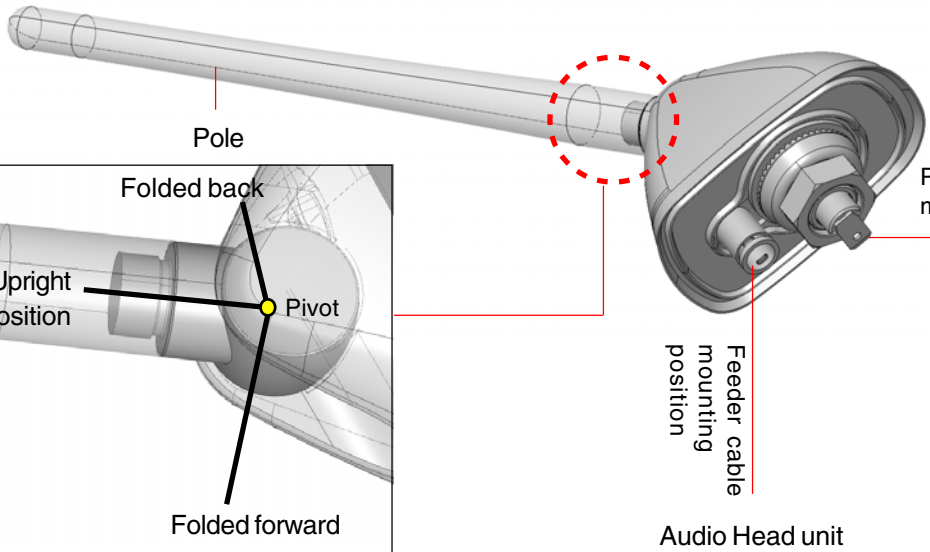


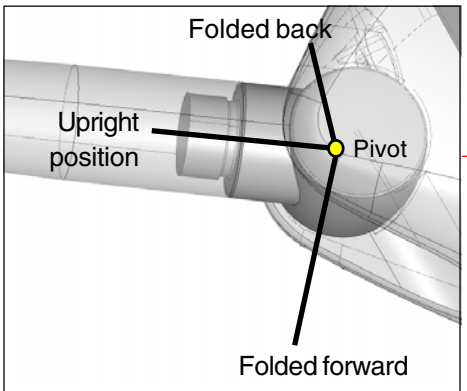
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MICRO (ACTIVE) POLE ANTENNA

This vehicle is equipped with pole antenna which maintains the optimum state when it is in upright position. It should be folded down when washing the vehicle.

Structure and Function





Audio Head unit



Antenna feeder cable is connected to the back of audio head unit.

Upright Position



To remove the antenna, rotate the pole counterclockwise.

The figure above shows the antenna in upright position for its optimum state.

The micro pole antenna is shorter than conventional antenna.



The printed circuit board above is integrated in the micro pole antenna as the radio antenna module to reduce noise and amplify signal. It is supplied with power from the No. 12 pin on audio head unit.

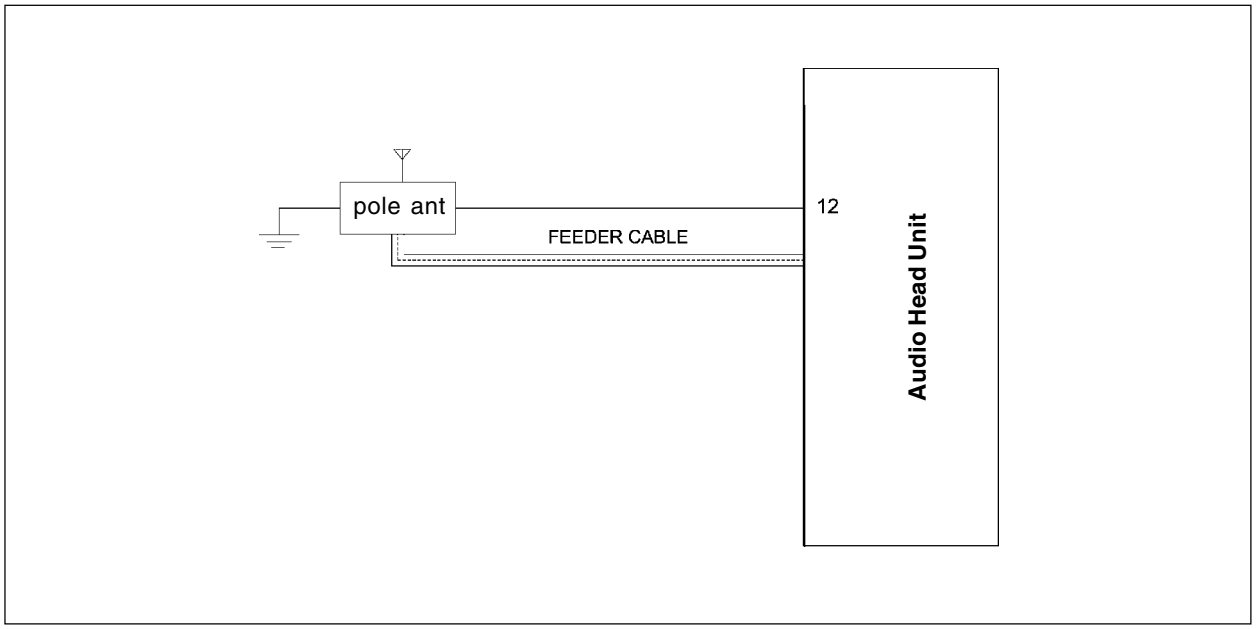


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EFFECTIVE DATE	
AFFECTED VIN	

Circuit Diagram

Micro Pole Antenna

The printed circuit board above is integrated in the micro pole antenna as the radio antenna module to reduce noise and amplify signal. It is supplied with power from the No. 12 pin on audio head unit.



CAUTIONS

1. Theft Deterrent

The micro pole antenna is compatible with other vehicles with same specification.

Remove the pole when leaving the vehicle to prevent it from being stolen.

2. No impact on the housing

The flexible pole stands against the impact. However, do not apply excessive force to the pole since the antenna housing is integrated with the circuit board.

3. No need to remove the antenna in car washing machine

The antenna moves to three positions by the external force. Therefore, there is no need to remove the antenna when washing the vehicle.

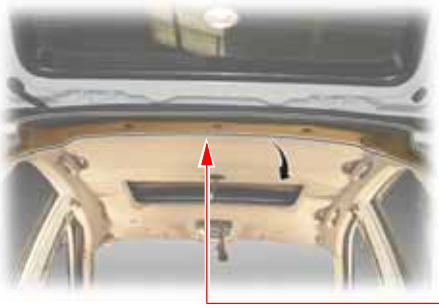
Removal of Micro Pole Antenna

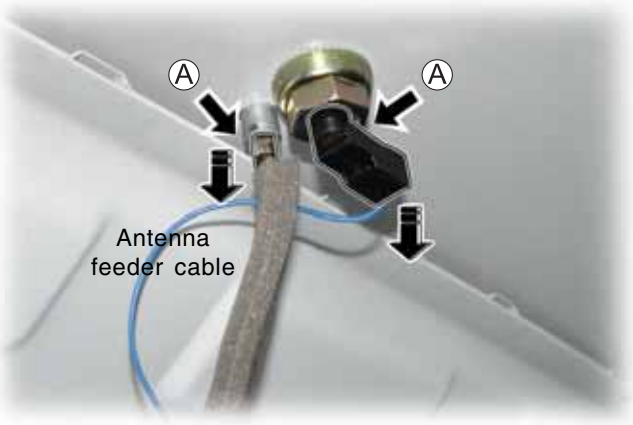
※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the D pillar (A) from the rear of the vehicle and the right storage box (B) of quarter pannel trim to remove the C pillar (C).
2. Remove three fasteners (D) from the back of the headlining (tailgate) to lower the headlining (at rear side).



2. Disconnect the radio antenna cable and module connector.



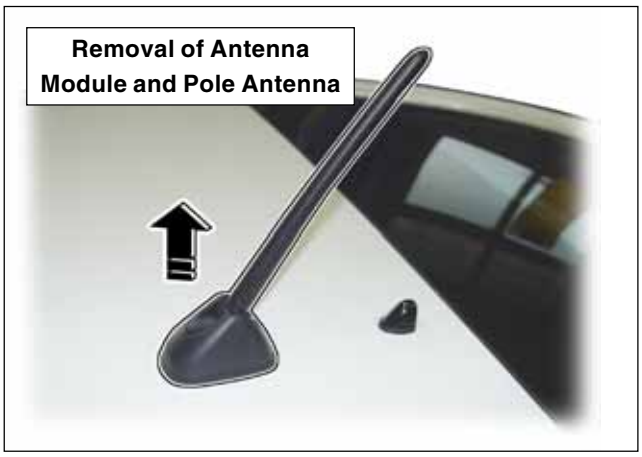


NOTICE

- **Pull the arrow position (A) down to disconnect the cable and connector. Otherwise, the cable or wiring could be damaged.**

3. Unscrew the antenna module mounting nut to remove the antenna module assembly.





NOTICE

- If the antenna mounting nut is not tightened to the specified torque (8 ~ 15 Nm), it could lead to the leakage due to the damaged nut or separated roof panel and antenna.

4. Check the antenna and rubber packing for their installation status and damage. Also, remove any foreign material on the surface of roof panel.







CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

WIPER & WASHER SYSTEM

7810

TABLE OF CONTENTS

WIPER AND WASHER SYSTEM 2

1. System layout and function 2
2. System layout of wiper and washer (With rain sensor) 4
3. Wiper & washer related function and specification 6
4. Wiper and washer system related circuit 10
5. Mechanical modification of front wiper mechanism 11
6. Removal and installation of wiper system 14

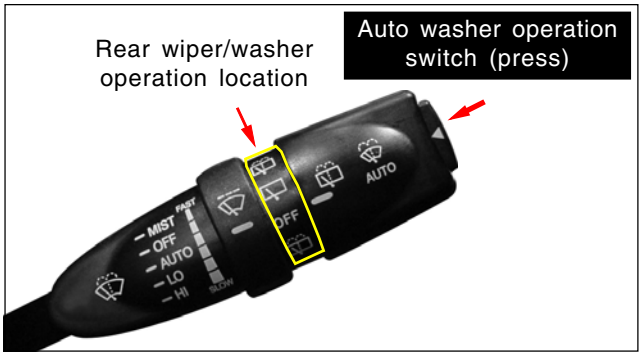
WIPER AND WASHER SYSTEM

1. SYSTEM LAYOUT AND FUNCTION

The wiper and washer system are controlled by STICS according to driver's wiper switch operation. And the detection of rain drops by rain sensor is transmitted to STICS as the signal for wiper system control.

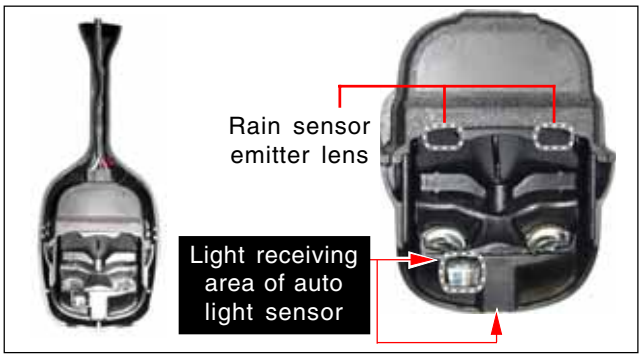
The characteristics of the wiper and washer system including basic functions of manual wiper are as follows.

1. Wiper function coupled auto washer



When the front wiper switch is off and this switch is pressed, washer fluid will be sprayed and the wiper will automatically operate 4 times. Then, the fluid will be sprayed again and the wiper will automatically operate 3 times.

2. Integrated auto light sensor in rain sensor unit



The rain sensor unit is installed on a proper location to detect the rain drops and the illumination intensity. To control the system, the sensed values of rain sensor and auto light sensor are sent to pin no. 63 in STICS unit.

3. Rear washer fluid supply system

There is no separate washer fluid reservoir for the rear washer system in this vehicle. The rear washer system uses the front washer fluid reservoir. Because of this, the washer hose is supposed to be long between front reservoir tank and rear washer nozzle. To avoid being damaged or interfered while in assembling the vehicle, the rear washer hose is fixed on headlining with silicone.

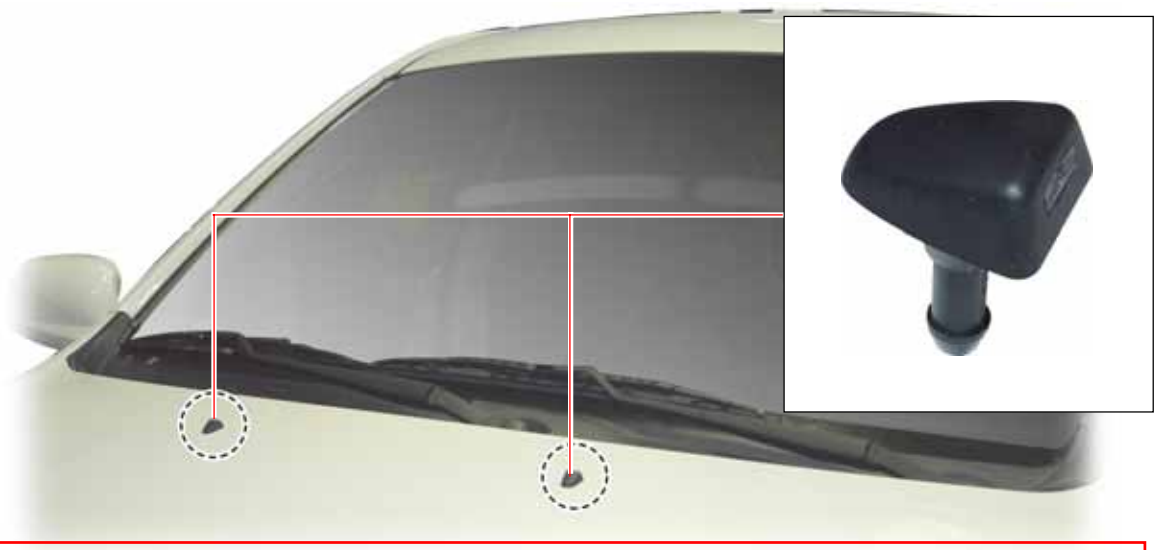


Rear washer hose and roof wiring harness are fixed at the headlining section with silicone.

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EFFECTIVE DATE	
AFFECTED VIN	

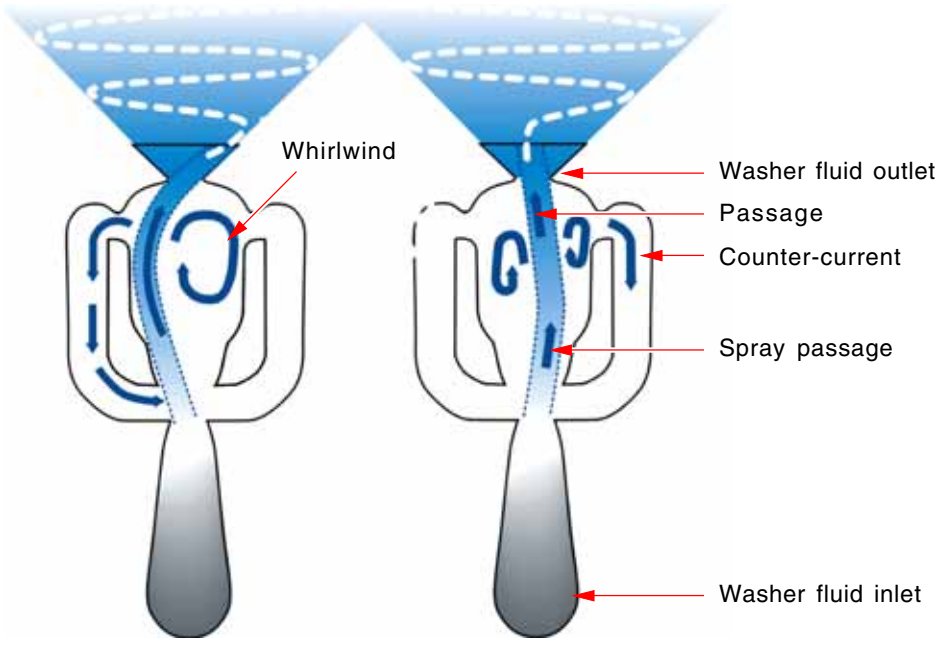
4. Fluidic washer nozzle

Fluidic Washer Nozzle is applied to the front washer spray system in this vehicle. The inside of nozzle is designed to utilize the fluidic movement.



* The water may be entered into the engine compartment if the curved area of the engine hood and the nozzle is not adhered closely. Therefore, install the washer nozzle on clean surface.

This is a shape of the inside of nozzle. It is designed to change the spraying direction continuously according to the spraying time (fan-shape). The figure below shows the changes of spraying direction according to the spraying time.



It is designed to be changed spraying direction using the whirlwind and backflow generated in nozzle.

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2. SYSTEM LAYOUT OF WIPER AND WASHER (WITH RAIN SENSOR)

Multifunction Wiper and Washer Switch



Auto washer switch

When the front wiper switch is off and this switch is pressed, washer fluid will be sprayed and the wiper will automatically operate 4 times. Then, the fluid will be sprayed again and the wiper will automatically operate 3 times.

Rain Sensor Unit



The rain sensor unit is integrated into the auto light sensor. It sends the amount of rain drops to STICS.

Front Nozzle Assembly

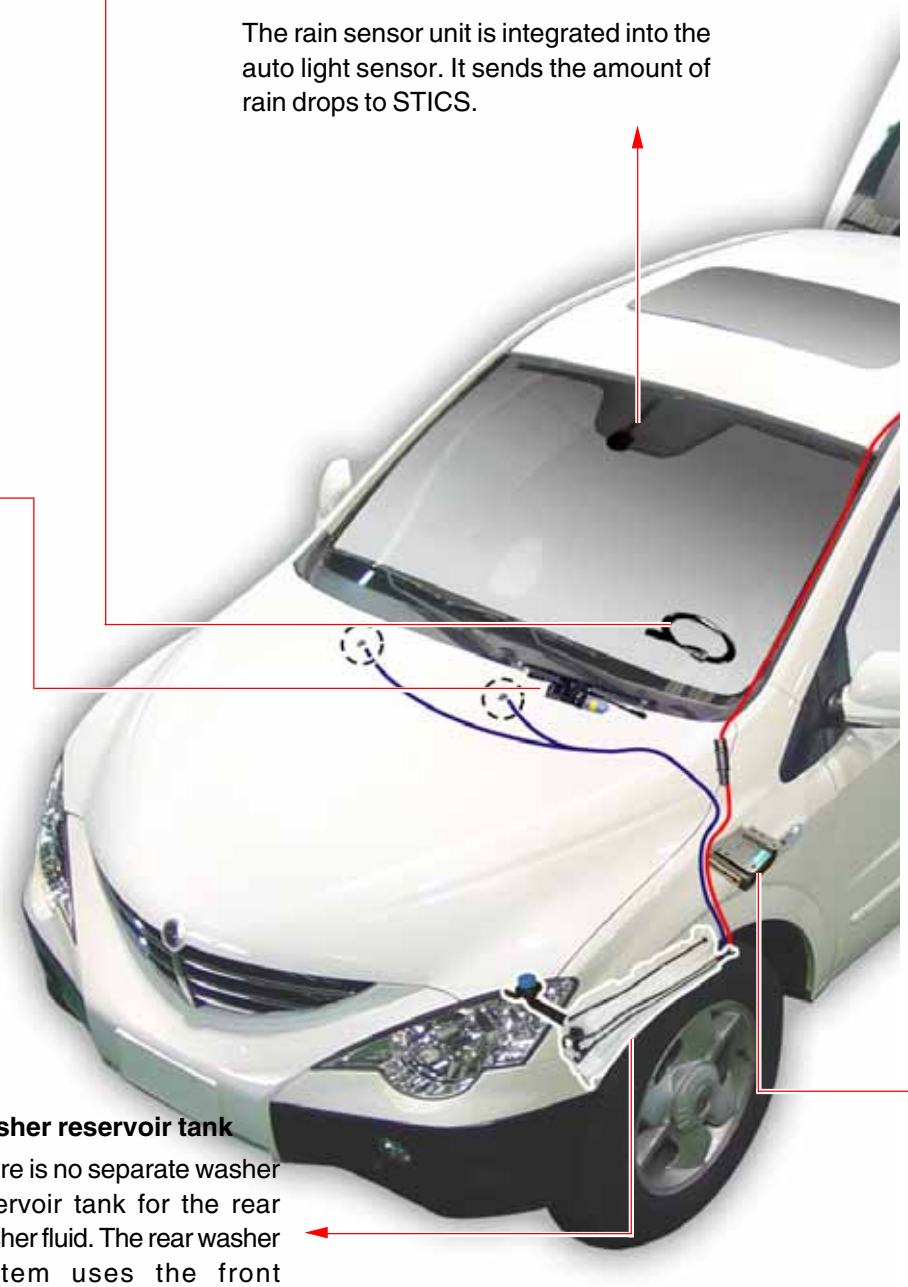


Front nozzle

The washer nozzles are installed at both sides of engine hood. The spraying pattern is specially designed to improve the spraying performance.

Washer Reservoir Tank Assembly





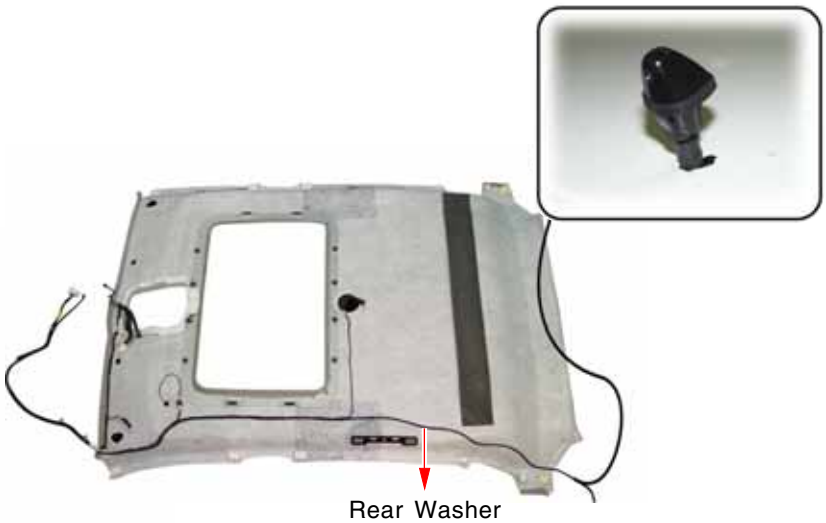
Washer reservoir tank

There is no separate washer reservoir tank for the rear washer fluid. The rear washer system uses the front washer fluid reservoir.

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AFFECTED VIN	



Rear Washer Hose Mounting

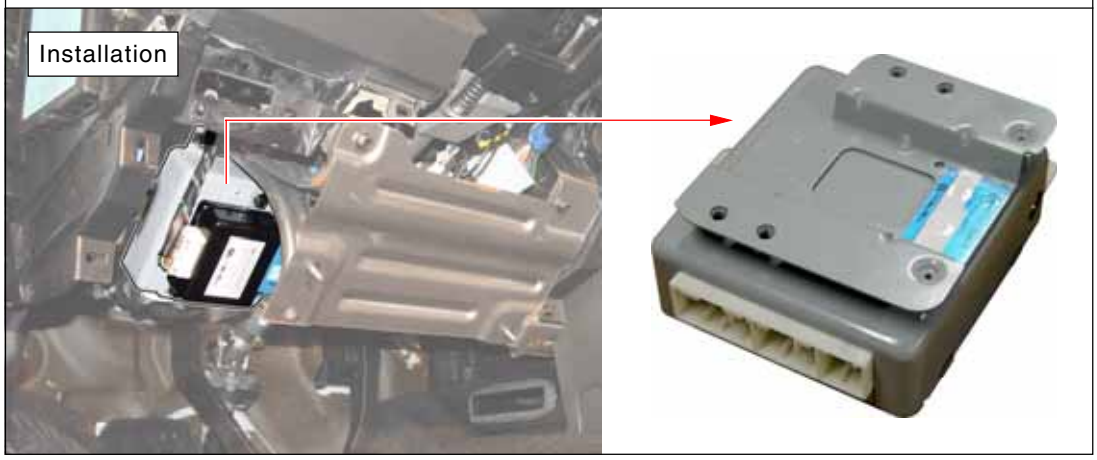


Rear washer hose mounting

There is no separate washer fluid reservoir for the rear washer system in this vehicle. The rear washer system uses the front washer fluid reservoir. Because of this, the washer hose is supposed to be long between front reservoir tank and rear washer nozzle. To avoid being damaged or interfered while in assembling the vehicle, the rear washer hose is fixed on headlining with silicone.

STICS receives the rain sensing data from the rain sensor and controls the wiper and washer systems.

STICS



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AFFECTED VIN	

3. WIPER & WASHER RELATED FUNCTION AND SPECIFICATION

▶ Wiper and Washer Fluid Switch Operation

MIST
When turning up the switch, the wiper operates once. When releasing the switch, the pointers return back to “OFF” position.

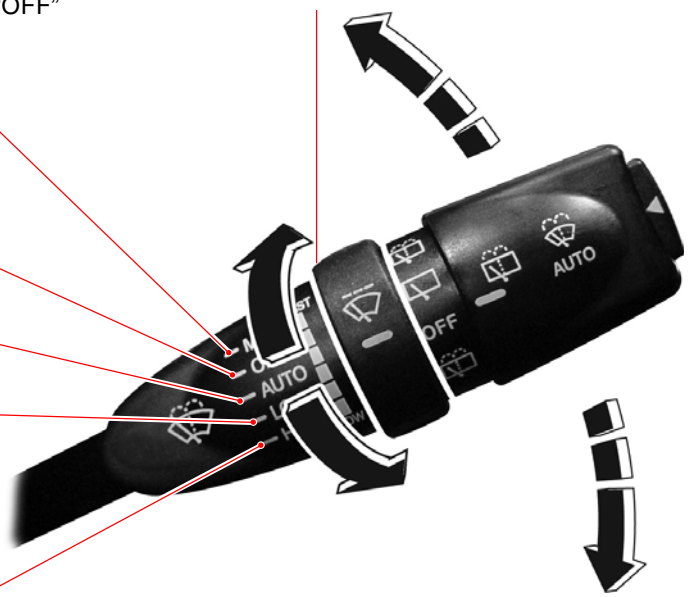
OFF
Wiping stops

AUTO
Wiper speed controls automatically according to the vehicle speed or amount of rain (rain sensing wiper).

LO
Wiping speed gets slower when placing the pointer at the “LO” positon.

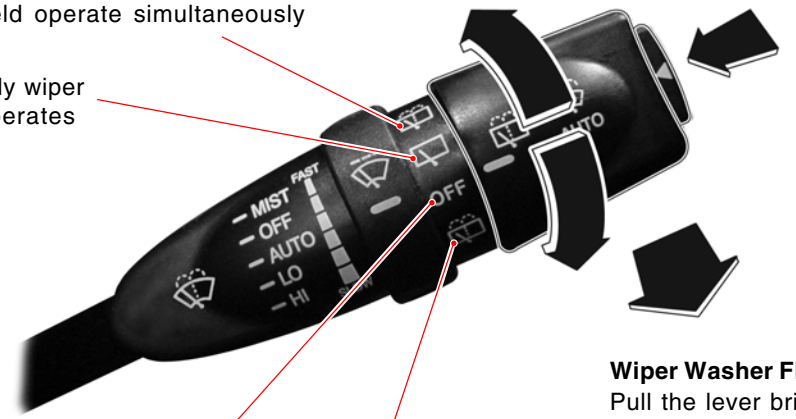
Wiping speed gets faster when placing the pointer at the “HI” positon.
HI

Wiper Speed Control Switch
When turning to FAST, wiping speed gets faster and when turing to SLOW, wiping speed gets slower.



Wiper and washer fluid for rear windshield operate simultaneously

Only wiper operates



Wiping stops

Washer fluid for rear windshield operates once.

Auto Washer Switch
If pressing the switch when the wiper switch turns to the “OFF” position, washer fluid is sprayed once and wiper operates 4 times.
After a while, washer fluid is sprayed one more and the wiper operates 3 times.

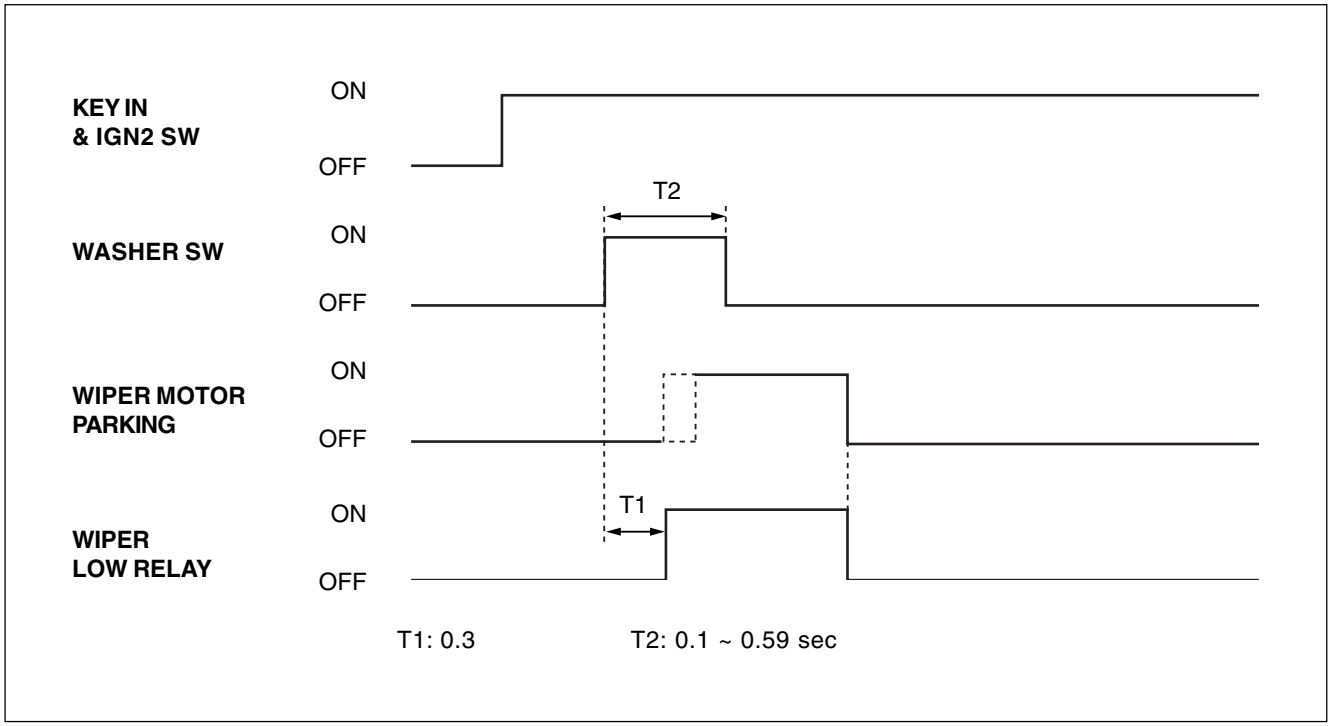
Wiper Washer Fluid Coupled Function
Pull the lever briefly (below 0.6 seconds)
: One wiping cycle with washer spray
Pull and hold the lever for more than 0.6 seconds
: Three wiping cycles with washer spray

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

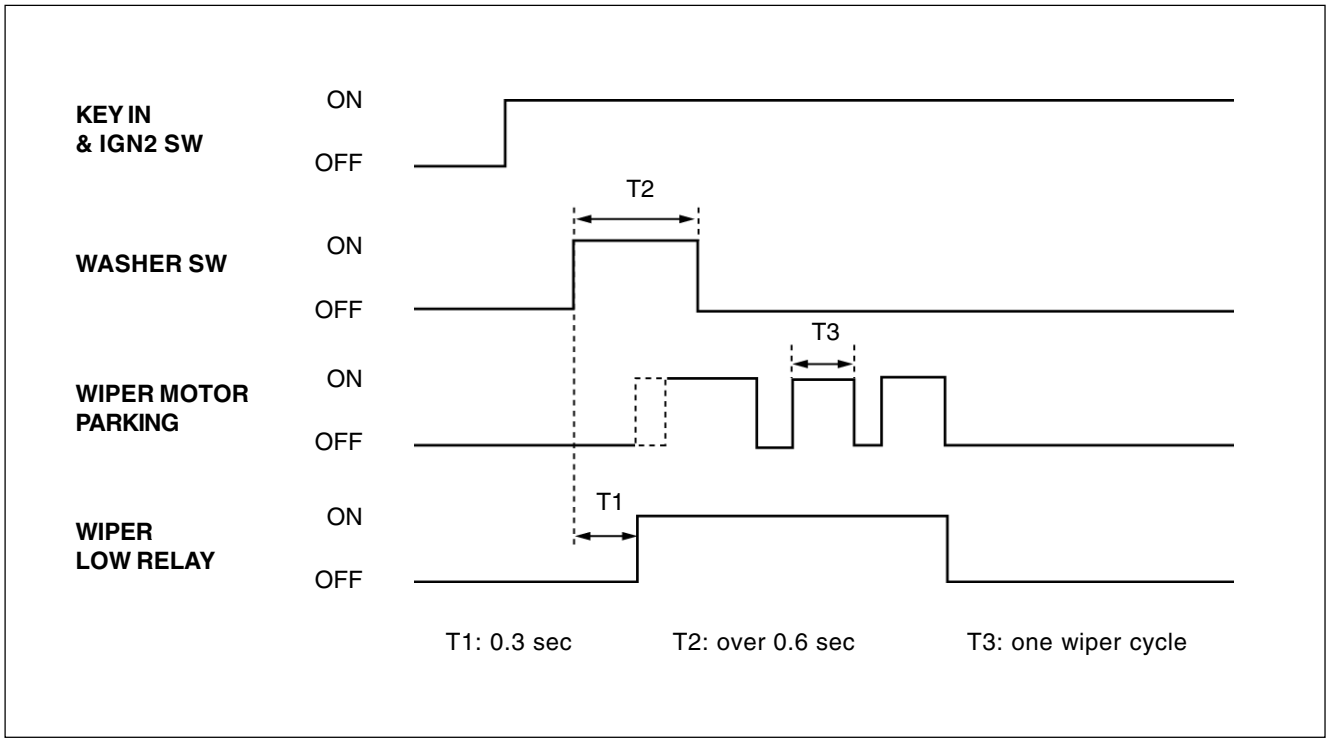
▶ STICS Control Logic Related to Wiper and Washer

Wiper MIST and Front Washer Coupled Wiper

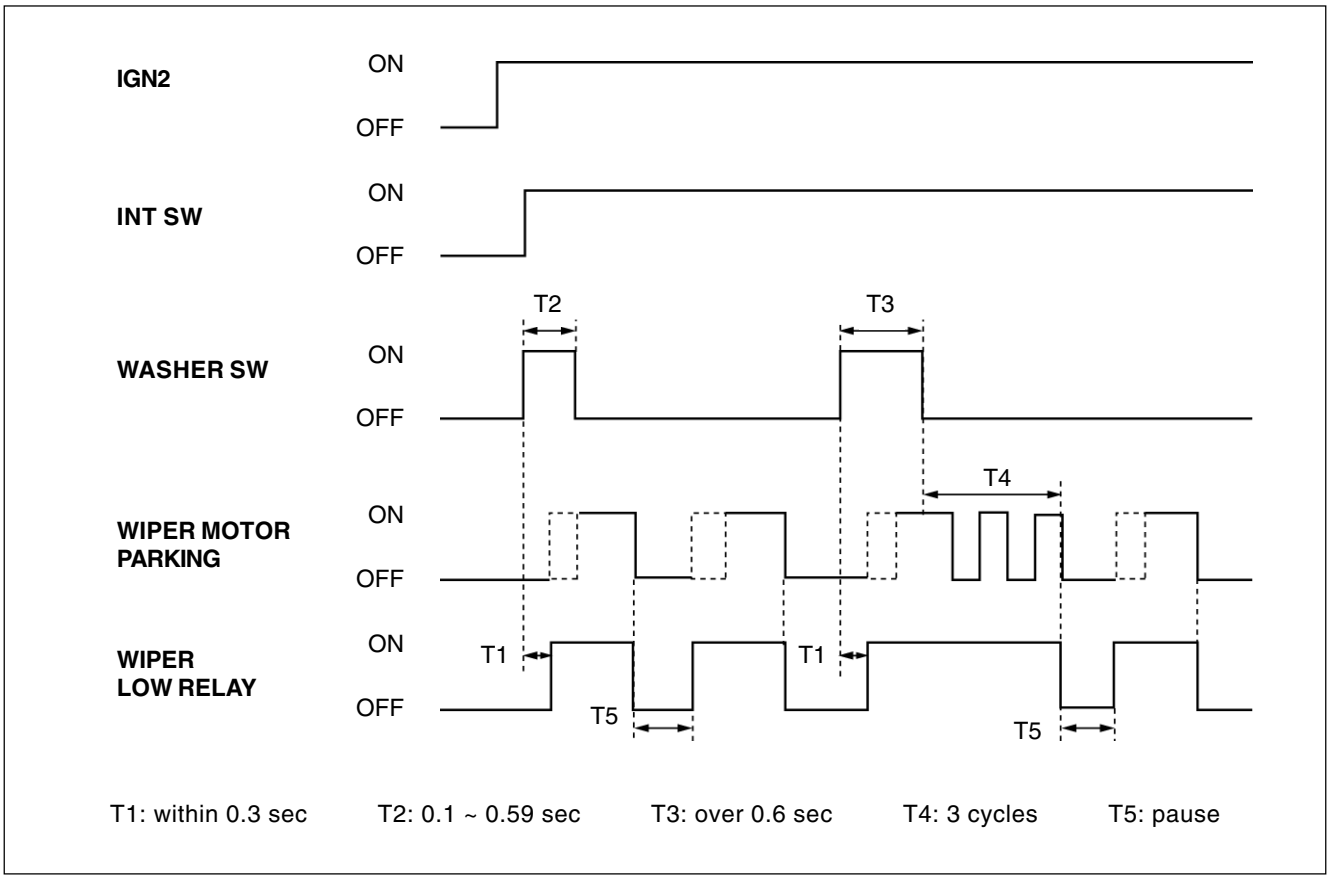
1. The wiper relay is turned on 0.3 seconds after turning “ON” the washer switch for 0.1 ~ 0.59 seconds with the ignition key “ON”, and it is turned off when the parking terminal is turned off.



2. The wiper relay is turned on 0.3 seconds after turning “ON” the washer switch over 0.6 seconds with the ignition key “ON”, and it is turned on three times immediately after turning off the washer switch.

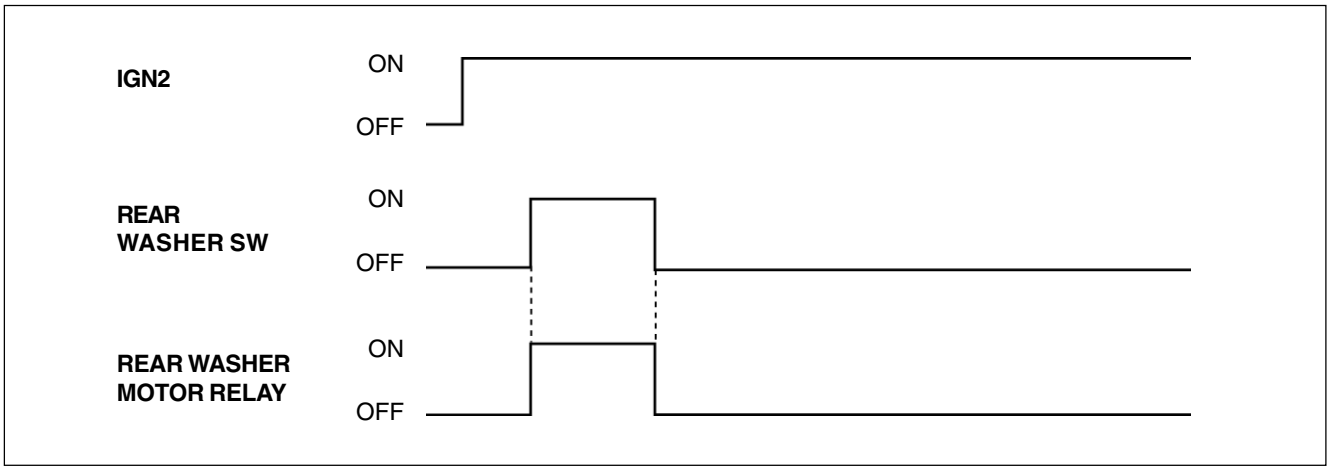


3. When the washer switch is ON for more than 0.6 seconds during the wiper operation by the INT switch, the operation in step (2) is performed. When it is ON for a certain period of time (0.1 to 0.59 seconds), the operation in step (1) is performed.



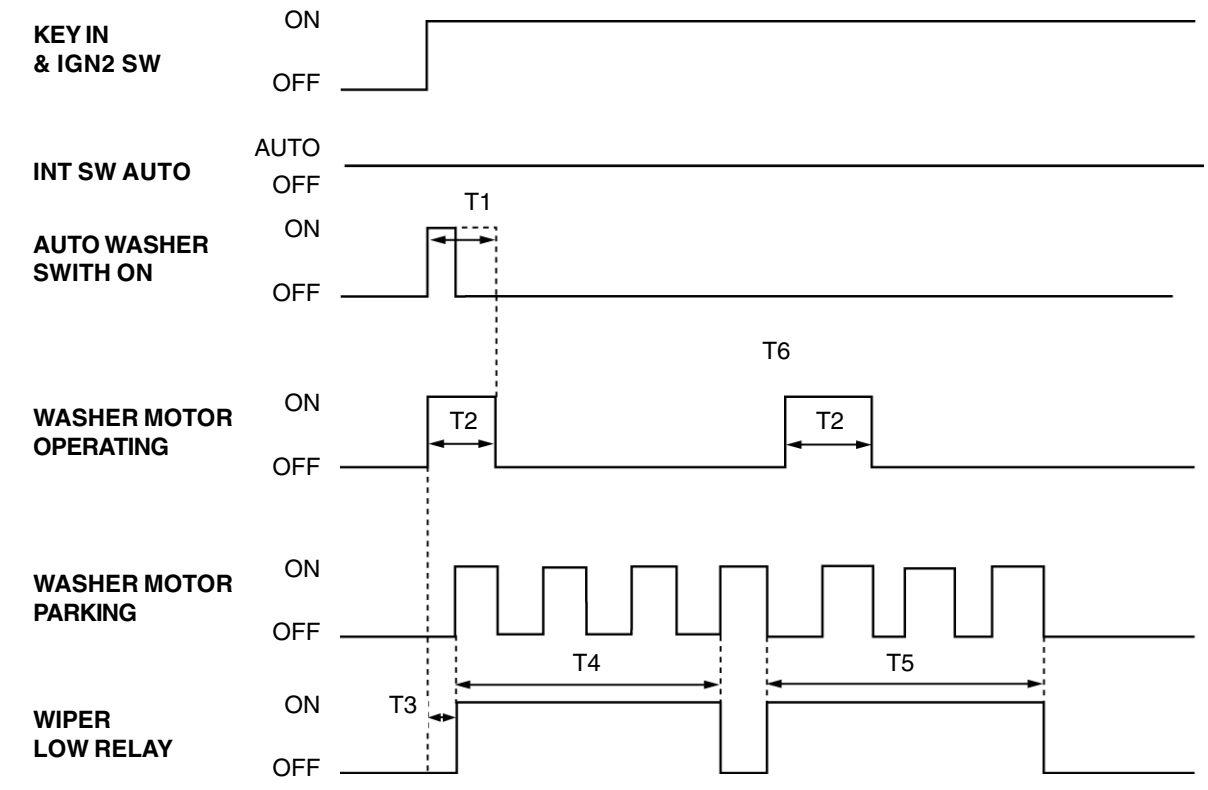
Rear Washer Motor Control

1. When the rear washer switch is turn on with the ignition switch “ON”, the rear washer motor relay output is activated from the time when the rear washer switch is turned on, and it is deactivated when the rear washer switch is turned off.
2. It cannot be activated while the front washer switch or the auto washer and wiper (AFW: Advanced Fast Washer) is in operation.



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EFFECTIVE DATE	
AFFECTED VIN	

3. The auto washer switch output is overridden during the washer coupled wiper operation.
4. The auto washer switch input is overridden during the auto washer coupled wiper operation.
5. The auto washer switch input is overridden during the rain sensor coupled wiper or vehicle speed sensitive INT wiper operation.
6. When the auto INT switch input is received during the auto washer operation, the auto washer operation stops and the auto INT operation is activated.

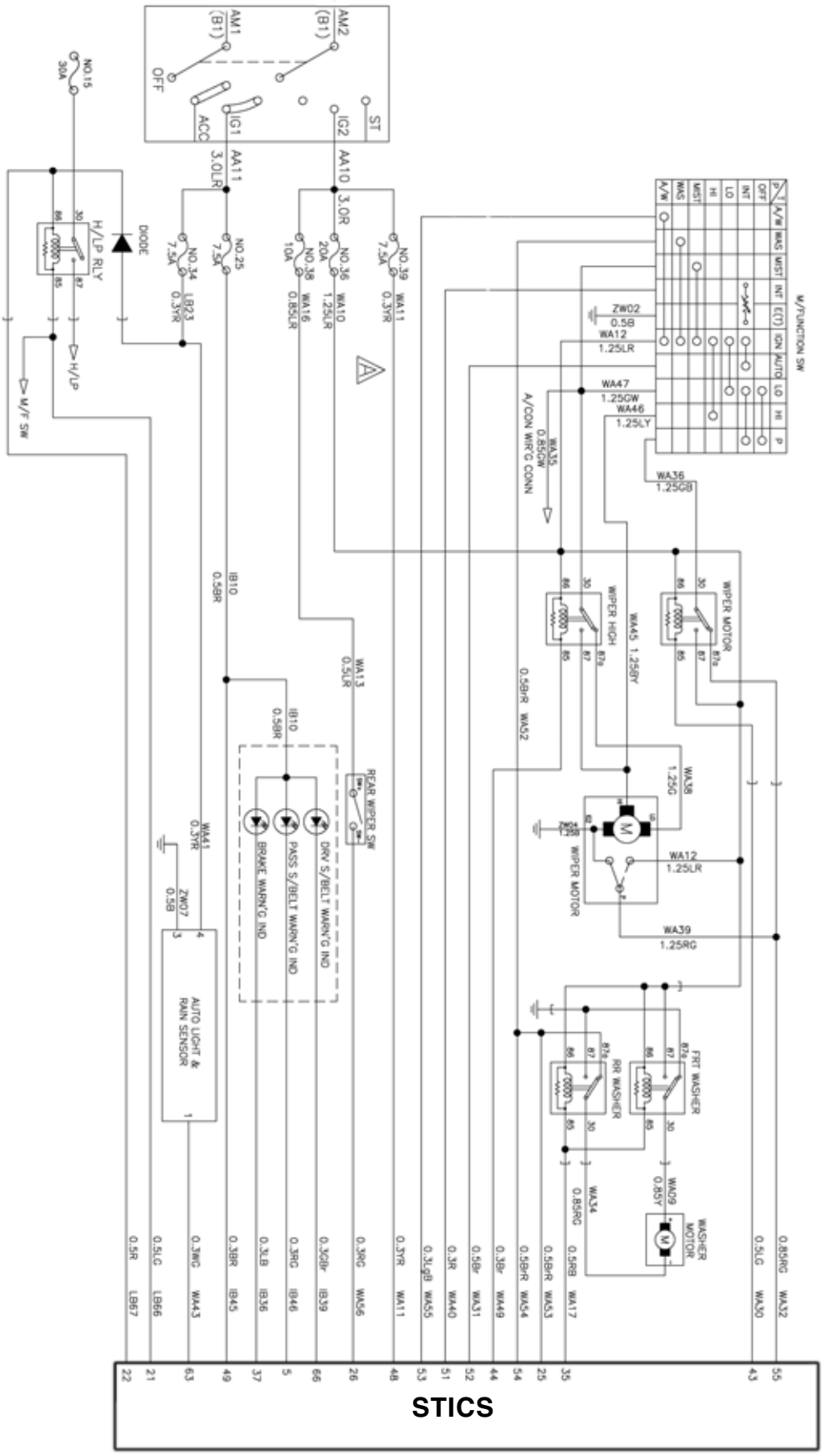


T1: over 100 ms T2: 1.0 ± 0.1 sec T3: within 0.3 sec T4: 4 cycles T5: 3 cycles T6: 0.5 ± 0.1 sec

***** Priorities in Washer Operations *****

1. The rear washer switch input is overridden during the front washer operation.
2. The rear washer switch input is overridden during the auto washer and wiper (AFW) operation.
3. The front washer switch input is overridden during the rear washer operation.
4. The auto washer switch input is overridden during the rear washer operation.
5. The front washer switch input is overridden during the auto washer and wiper (AFW) operation.
6. The auto washer switch input is overridden during the front washer operation.

4. WIPER AND WASHER SYSTEM RELATED CIRCUIT DIAGRAM



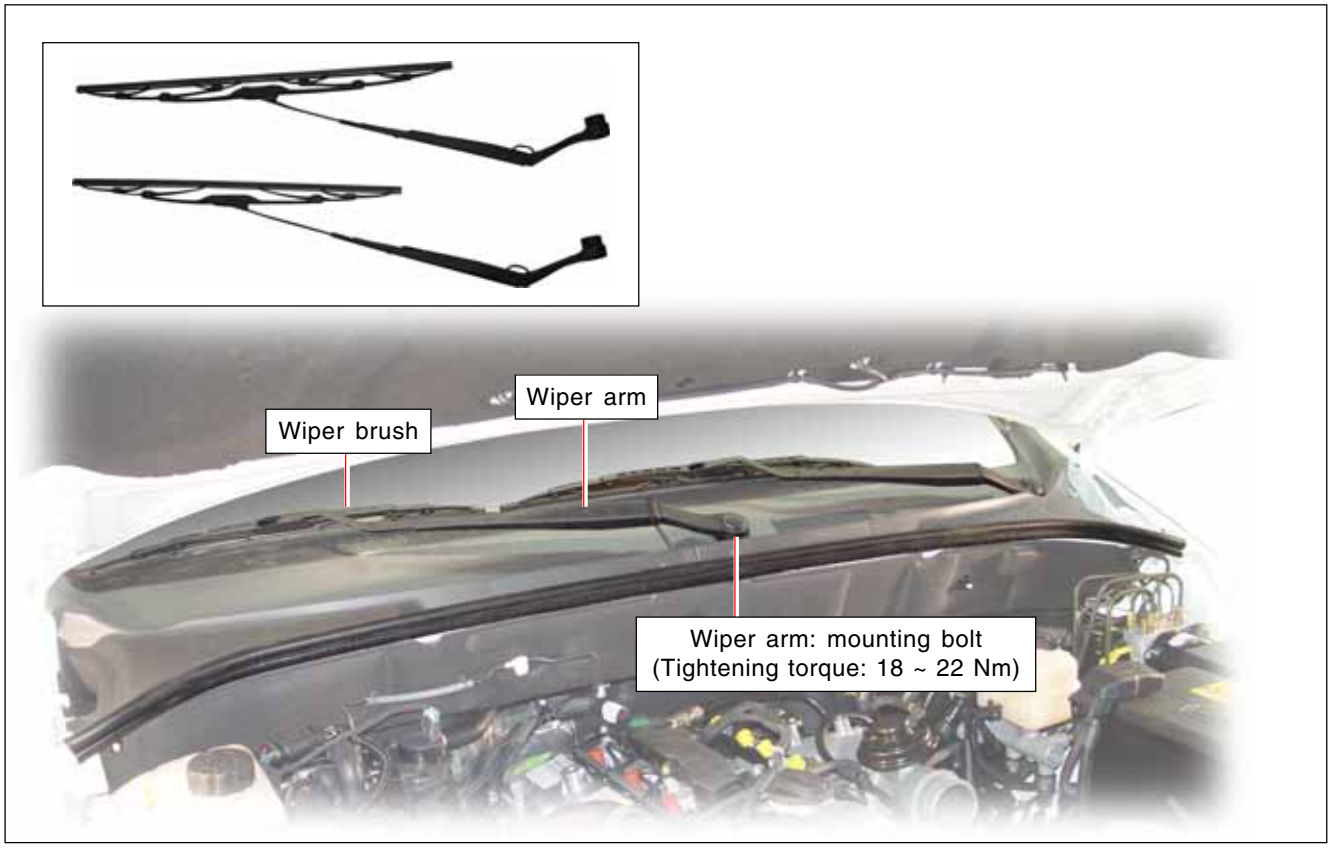
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AFFECTED VIN	

5. CORRECTION OF FRONT WIPER

The wiper arm blade should be replaced depending on its conditions. However, its expected life span may be shorten or it may not operate properly due to wrong installation or deformation of wiper arm.

Under such circumstances, measure the attack angle of the wiper blade against the windshield and adjust the angle of the wiper arm using the adjuster (refer to the following figure).

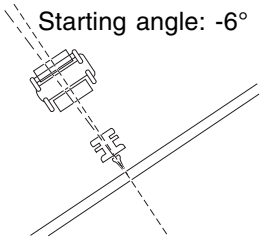
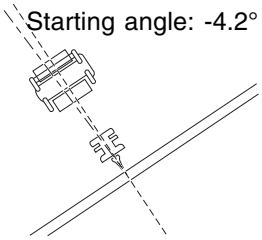
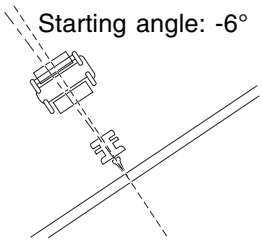
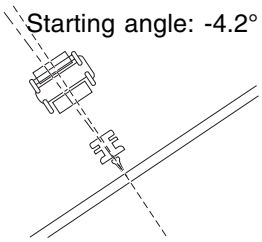
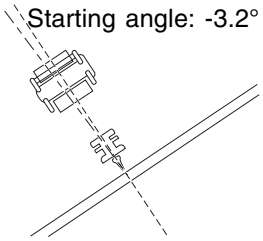
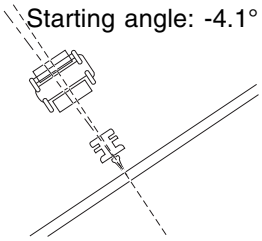
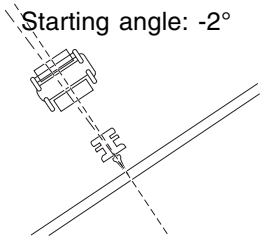
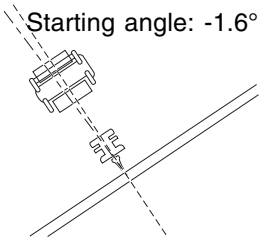
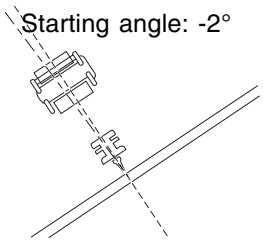
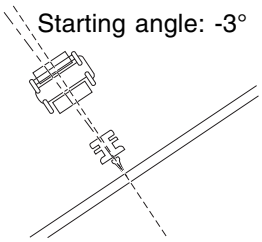
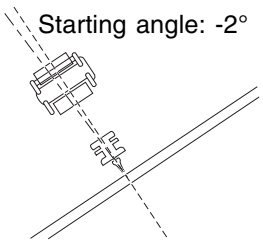
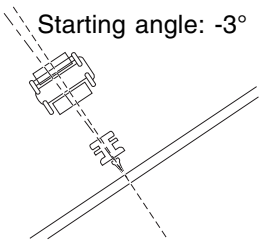
However, normally, the wiper arm does not need to be adjusted since most wiper arms are designed to fit to the windshield. The following information is the reference to check the wiping operation.



NOTICE

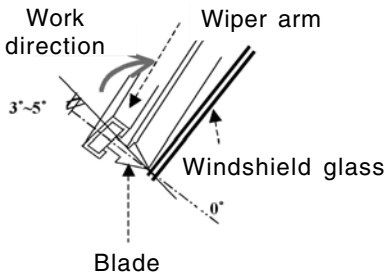
1. **Check the wiper blade for its wear or damage before measuring the attack angel. Also, keep in mind that the wiper may not operate properly if the windshield is coated even the wiper arm and its angle are in normal operating conditions.**
2. **The attack angel and return angle is the angle against the windshield line when viewed from the pivot center line.**

▶ Attack Angle of Wiper Blade Against the Windshield by Model

	Driver side	Angle adjustment	Passenger side	Angle adjustment
Actyon	Starting angle: -6° 	-6°	Starting angle: -4.2° 	-4°
Kyron	Starting angle: -6° 	-6°	Starting angle: -4.2° 	-4°
Rodius	Starting angle: -3.2° 	-4°	Starting angle: -4.1° 	-4°
Rexton	 Starting angle: -2° 	-2°	Starting angle: -1.6° 	-2°
Musso	 Starting angle: -2° 	-2°	Starting angle: -3° 	-3°
Korando	Starting angle: -2° 	-2°	Starting angle: -3° 	-3°
Chairman	Not available (If necessary, replace the wiper arm)			

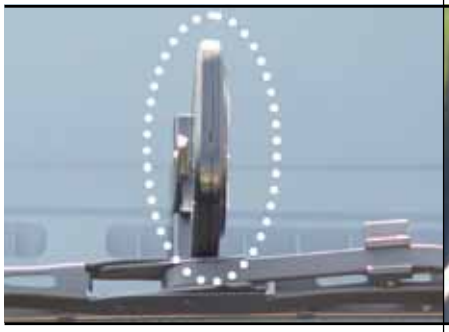
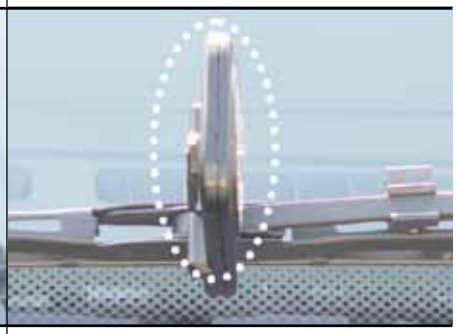
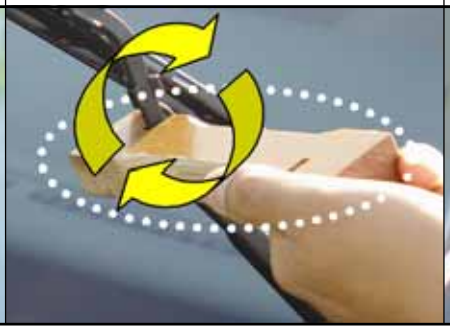
Measurement and adjustment of wiper arm angle

Tools

Protractor	Adjustor	Work position
		

- How to use protractor: Set to “0”. Rear the value of the opposite side of the pointer.
- Standard angle of wiper arm: Driver side (3.2°)/Passenger side (4.1°)

Work Procedure

1. Install the protractor on the windshield (end of the wiper arm).	2. Set the pointer to 0°	3. Install the protractor on the upper side of the wiper arm.
		
4. Check if the angle is within the specified value.	5. If the angle is out of the specified value, adjust the wiper arm using a jig.	6. Return the vehicle to the customer after adjustment.
		

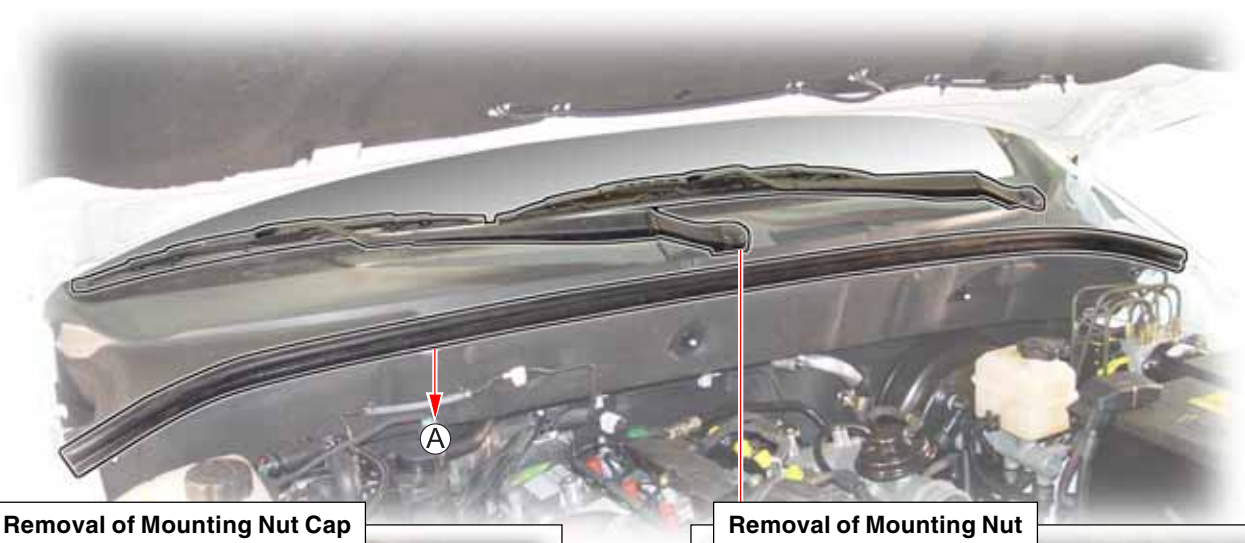
6. REMOVAL AND INSTALLATION OF WIPER

▶ Removal of Front Wiper Assembly

※ Preceding Work:

1. Disconnect the negative battery cable.
2. Perform the work with the engine hood open or removed.

1. Remove the cap and unscrew the mounting nut. Remove the cowl foxong molding (A).



Removal of Mounting Nut Cap

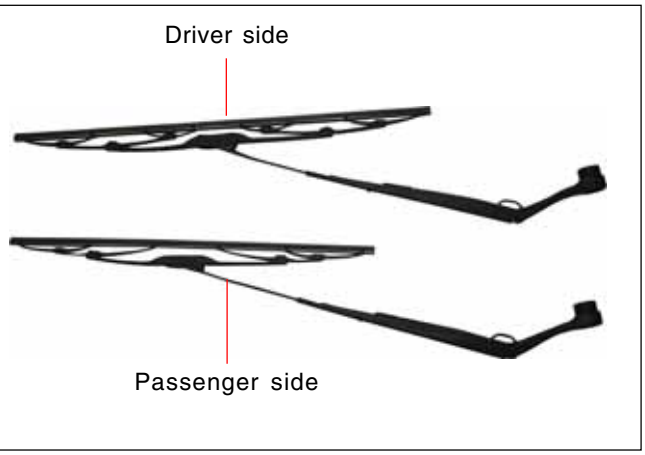


Removal of Mounting Nut



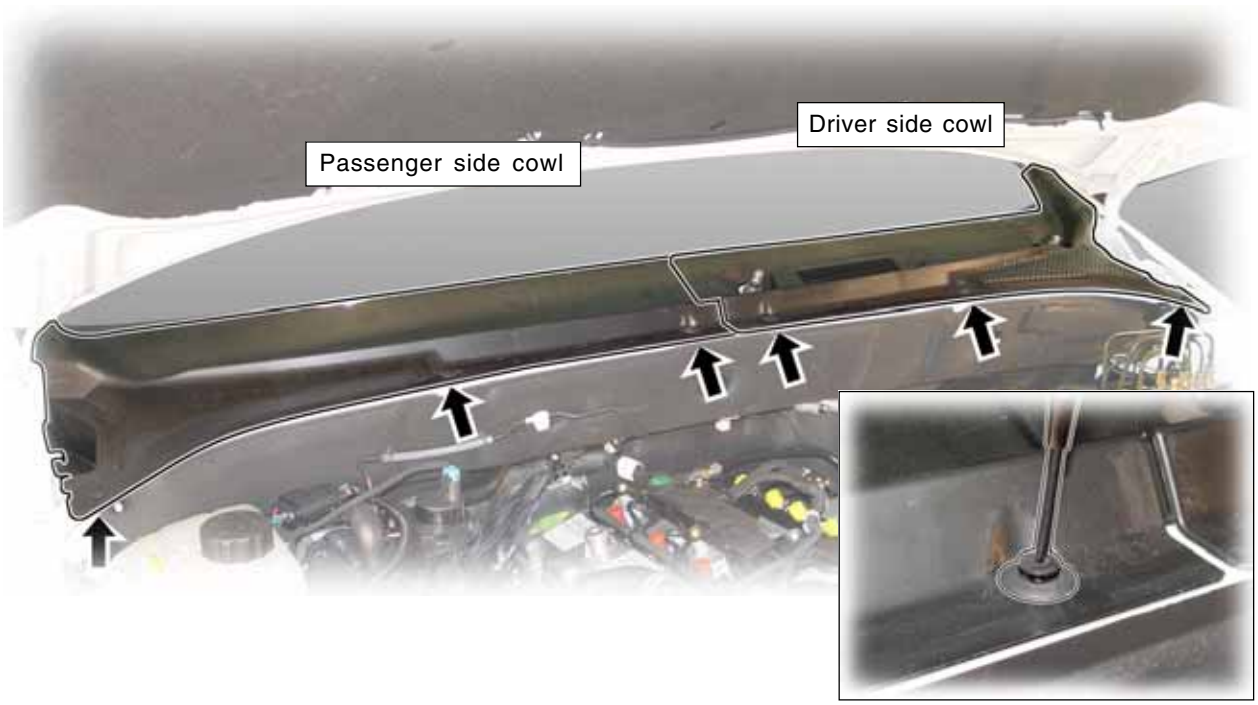
2. Remove the wiper blade assembly.



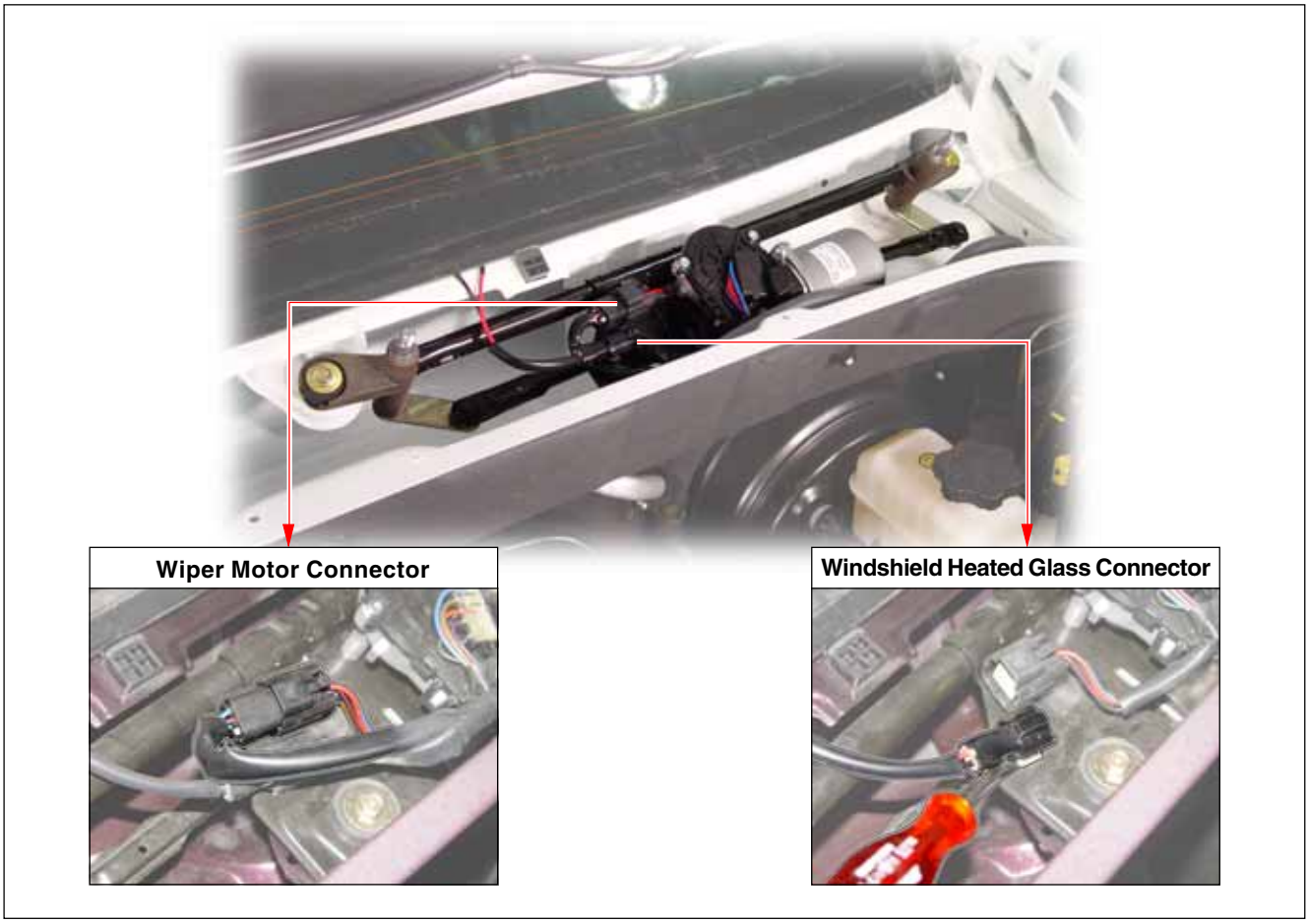


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3. Remove the clips and the fixing cowls (driver side cowl should be removed first).



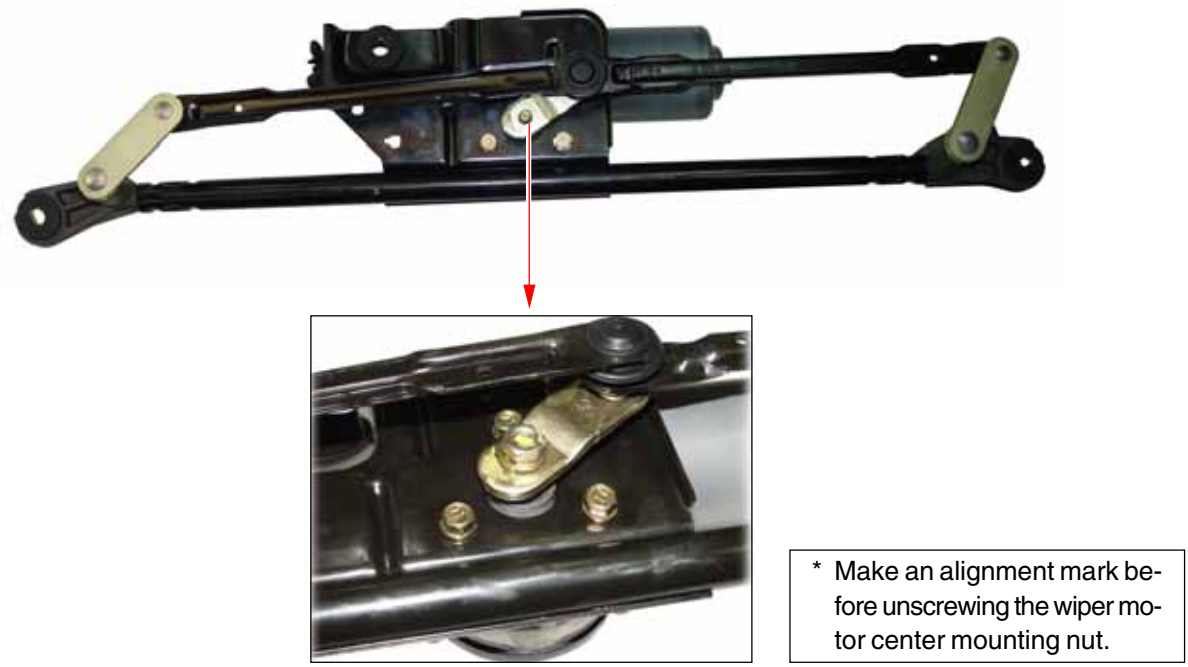
4. Disconnect the wiper motor connector (1) and front windshield heated wire connector (2) connected to the wiper link assembly.



5. Unscrew the mounting nuts (10 mm - 3EA) from the wiper link assembly.



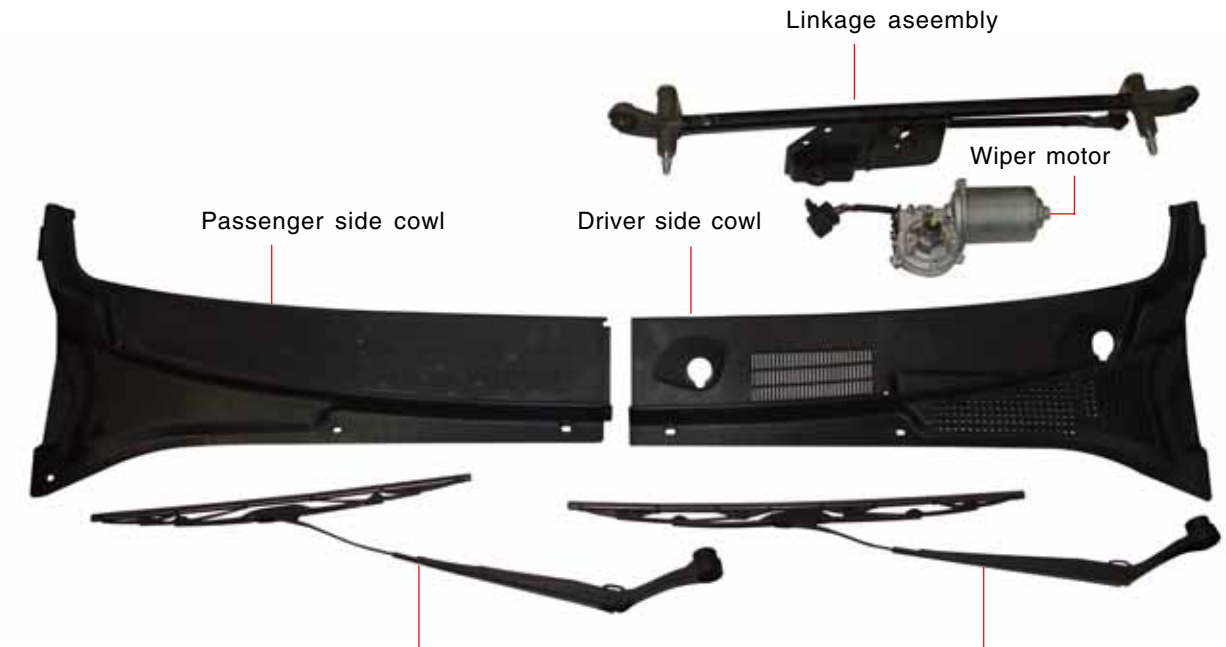
6. Unscrew the mounting nut (10 mm - 1EA) and bolts (8 mm - 3EA) from the removed wiper linkage assembly and then remove the wiper motor.



* Make an alignment mark before unscrewing the wiper motor center mounting nut.

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Layout of Front Wiper Assembly



Wiper Motor Assembly



Connector





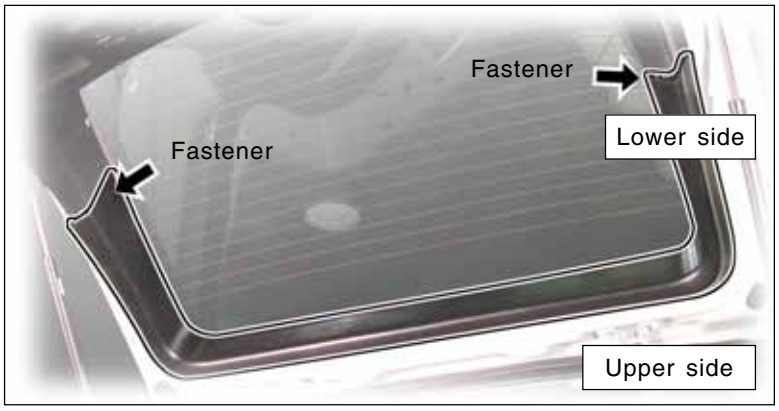


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▶ Removal of Rear Wiper Assembly

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the tailgate upper trim.





2. Remove the tailgate lower trim (fasteners at A, B, C and D).

Ⓐ Upper mounting screw on the tailgate lower trim



Ⓒ Lower mounting screw on the lower trim



Ⓓ Lower mounting screws on the tailgate.



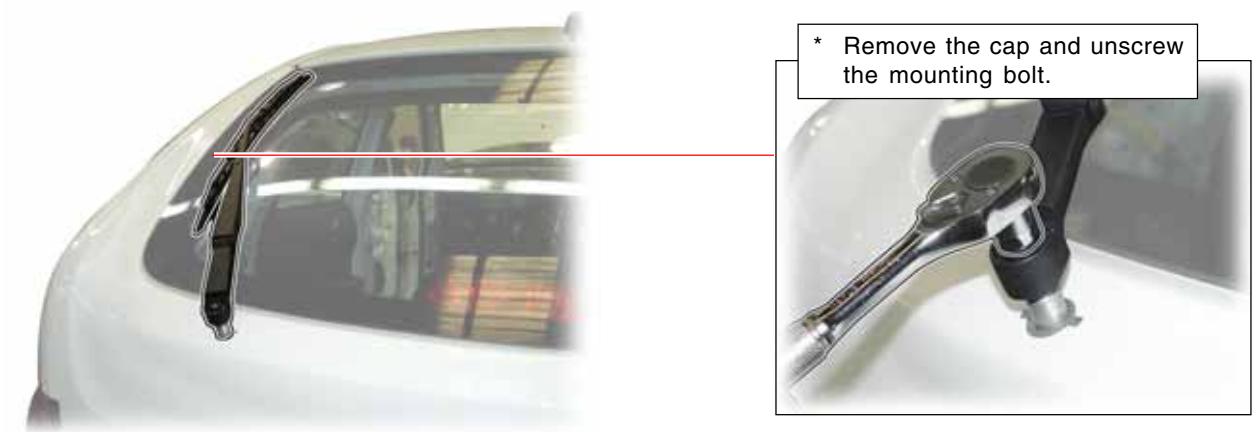
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3. Remove the tailgate trim and vinyl cover by pulling them from the lower side.

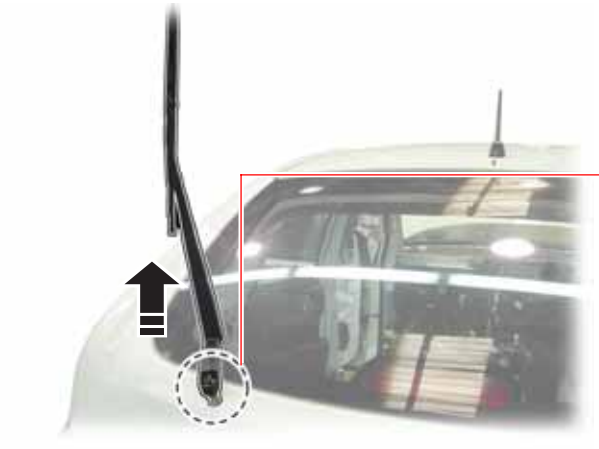


Locations of fasteners

4. Close the tailgate and then remove the wiper blade assembly.



5. Remove the wiper blade. Remove the wiper motor cap and unscrew the mounting nut.



Remove the Cap

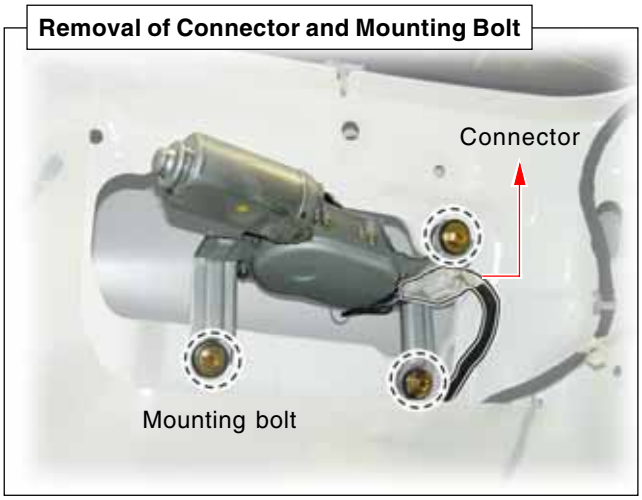


Remove the Nut



6. Disconnect the wiper motor connector and remove three mounting bolts with the tailgate open. Remove the rear wiper motor assembly.

Removal of Connector and Mounting Bolt

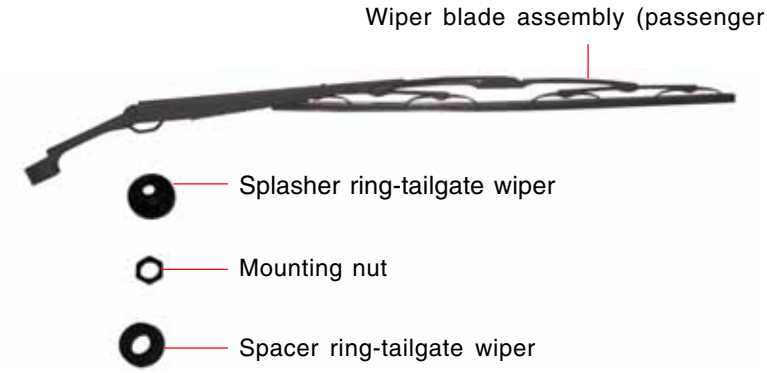


Removal of Motor



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Rear Wiper Assembly





Rear wiper motor and linkage assembly

Front



Rear



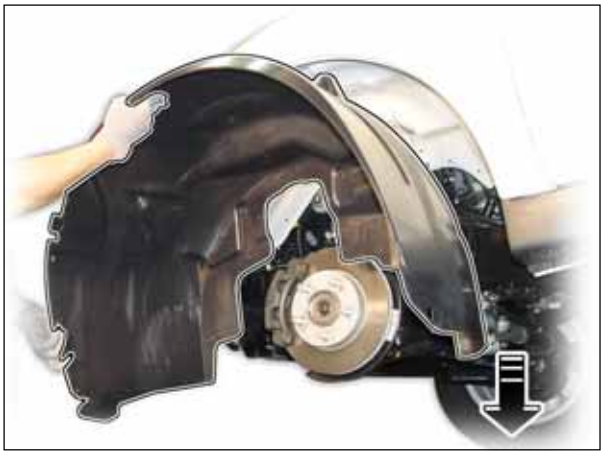
▶ Washer Fluid Reservoir and Nozzle Assembly

※ **Preceding Work:**

1. Disconnect the negative battery cable.
2. Remove the tire.

Reservoir

1. Remove the front wheel house cover.



2. Unscrew one mounting bolt and remove the filler hose.

Mounting Bolt (10 mm)



Removal



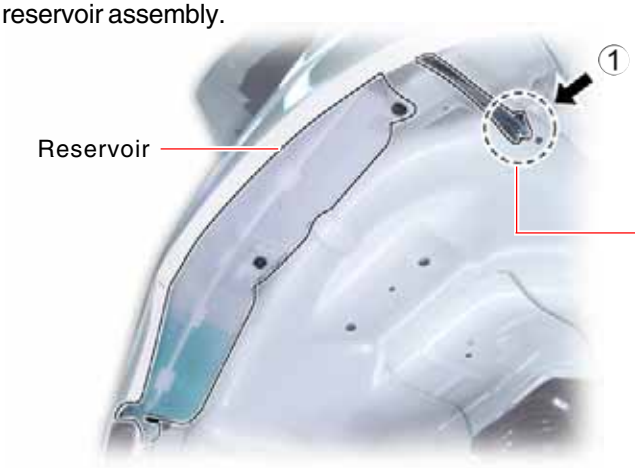
NOTICE

- **Drain the washer fluid to a proper container before removing the filler hose.**

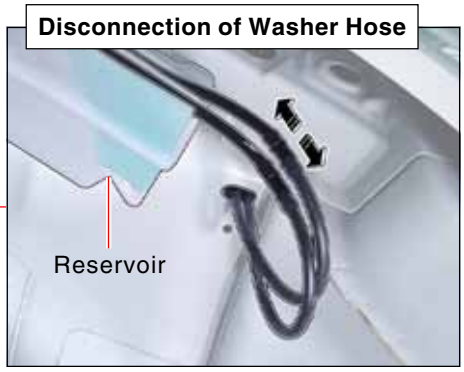
3. Unscrew three mounting bolts for the reservoir.



4. Slightly lower the reservoir and disconnect the washer hose ① and washer motor connector ②. Remove the reservoir assembly.



Disconnection of Washer Hose

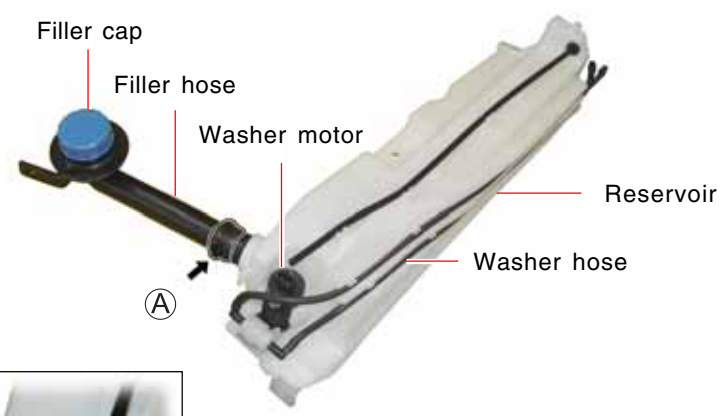


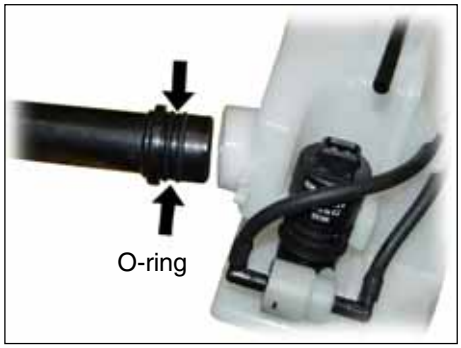


Disconnection of Washer Motor Connector



Reservoir Assembly





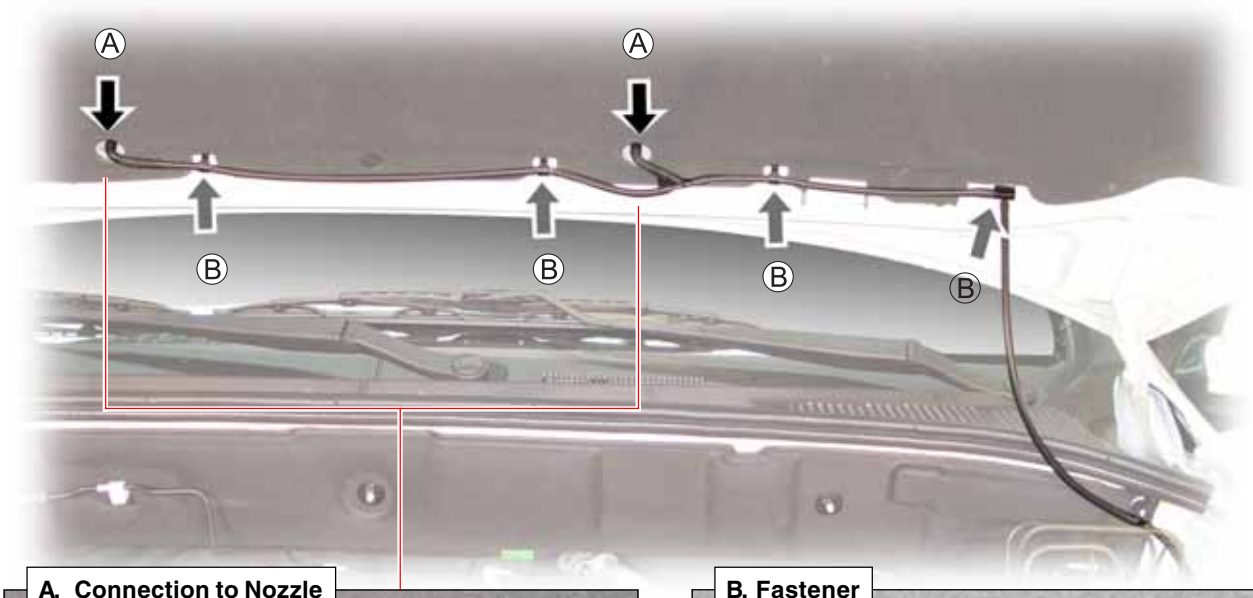
NOTICE

- **When installing the filler hose, be careful not to damage the O-ring.**

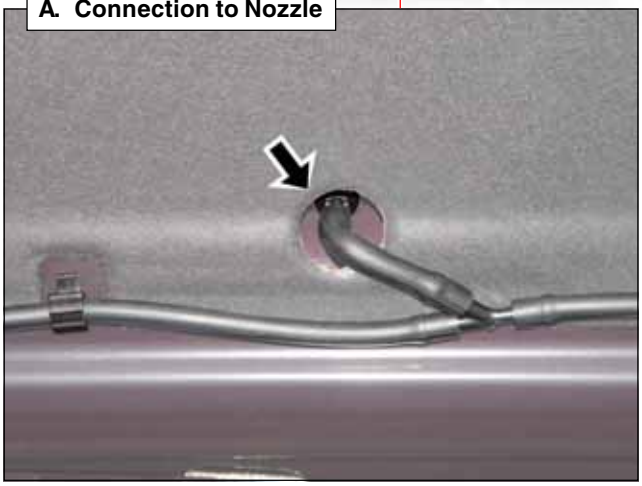
Washer Nozzle

Front Washer Nozzle

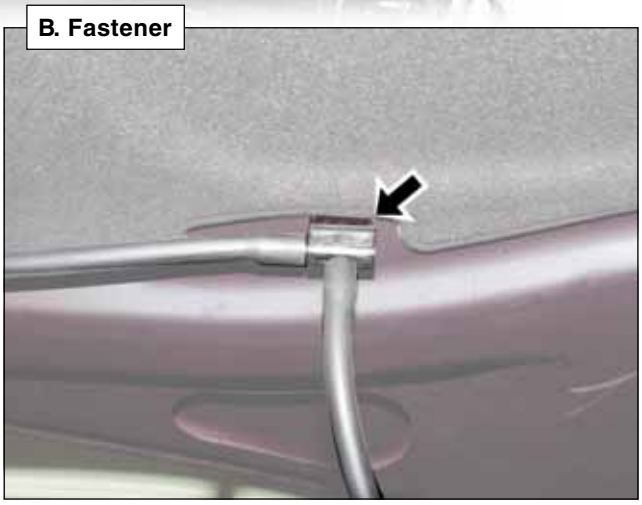
1. Open the engine hood and separate the washer hoses (A) from nozzles and remove the fasteners (B).



A. Connection to Nozzle



B. Fastener

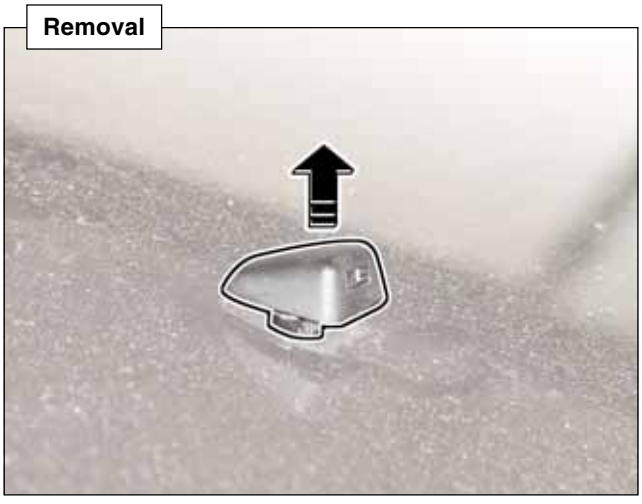


2. Remove the front washer nozzles from the engine hood by pressing both sides as shown in the figure.

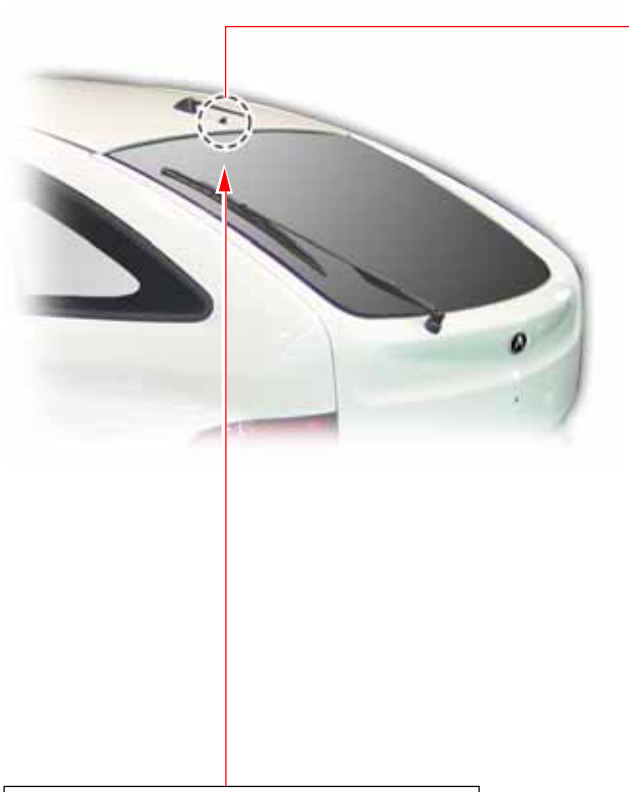
Disconnection



Removal



Rear Washer Nozzle



Rear Washer Nozzle



1. Pry off the rear washer nozzle from the tailgate with a flat blade screwdriver.



NOTICE

- **Be careful not to damage the body and the nozzle.**

2. Separate the nozzle from the hose.



NOTICE

- **The water may be entered into the engine compartment if the curved area of the engine hood and the nozzle is not adhered closely. Therefore, install the washer nozzle on clean surface.**

RAIN SENSOR UNIT (WITH AUTO LIGHT SENSOR)

8610

TABLE OF CONTENTS

RAIN SENSING SYSTEM (WITH AUTO LIGHT SENSOR) 2

1. System layout and overview 2
2. Rain sensor operation 4
3. Rain sensor related circuit 5
4. Functions and specifications of rain sensing wiper 6
5. Operation mode of rain sensing wiper system 11
6. Functions and checks of rain sensor 12
7. Diagnosis procedures 14
8. Trouble shooting 16

RAIN SENSING SYSTEM (WITH AUTO LIGHT SENSOR)

1. SYSTEM LAYOUT AND OVERVIEW

The rain sensing wiper unit in this vehicle doesn't control the wiper directly. The rain sensing unit detects the amount of rain drops and sends the operating signal to STICS, and STICS drives the wiper directly.

Rain Sensor Unit
(Auto Light Sensor Integrated Type)



A sensor that emits infrared rays through LED and then detects the amount of rain drops by receiving reflected rays against sensing section (rain sensor mounting section on the windshield) with photodiode. The auto light sensor is Integrated into the rain sensor (refer to the below picture).

Multifunction Wiper Switch:
AUTO and Sensitivity Control



AUTO: Wiper operates automatically by rain sensor
FAST <-------> SLOW: Auto delay/Auto speed control. A position that controls sensitivity against rains on the windshield and transmits wiping demand signal accordingly.



Emitter lens
The LED which is located at bottom emits the infrared rays and the lens guides the infrared rays to target point.

Auto light sensor (Vertical)

Auto light sensor (Horizon)



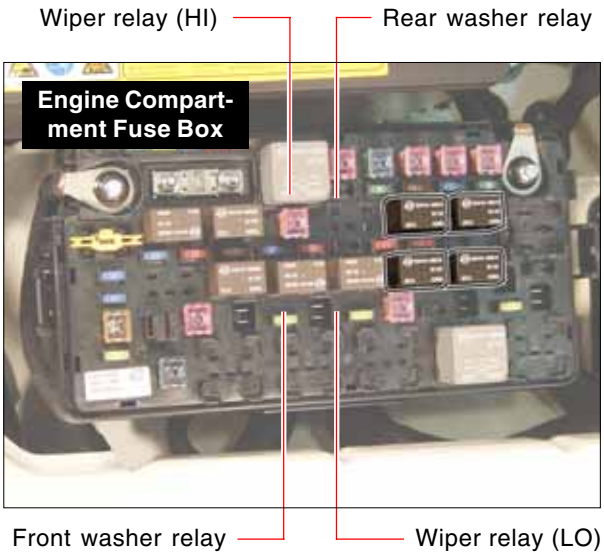
Enlarged auto light sensor section

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▶ STICS

The rain sensing unit detects the amount of rain drops and sends the operating signal to STICS, and STICS drives the wiper directly. At this moment, STICS determines the wiper operation mode (washer, MIST, AUTO), then sends the information to the rain sensor.





Auto Light Sensor and Rain Sensor Coupled Control

1. **Rain detected headlamp:** If it rains heavy which requires the intermediate INT speed, the headlamps are turned on automatically.
2. **Night detected wiping:** When the auto light control turns on the headlamps and the rain sensor detects the rain, the wiper sensitivity is automatically increased by one level. (For example, the AUTO wiper switch is at the 3rd level, but the wiper operates at the 4th level.)

2. RAIN SENSING OPERATION

The rain sensor is installed on the specific heat treated windshield that has minimum 13% of transmittance rate with specified intensity of radiation. It is installed on the glass with a adhesive of Sorepa. It communicates with STICS and makes the wipers to operate automatically under the rain sensing mode (multifunction switch wiper: AUTO mode). The emitting section of the rain sensor unit emits infrared rays against the windshield and then detects the amount of rain drops by receiving reflected rays with photodiode.

The difference compared with the conventional rain sensor is that the auto light sensor is Integrated into the rain sensor.

Followings are the components and functions of the rain sensor unit

▶ Rain Sensor Unit (Including Cover)



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3. RAIN SENSOR RELATED CIRCUIT

The rain sensor has one connector with 4 pins and each pin has following function as shown in the circuit diagram. However, in this vehicle, the terminal No. 1 and No. 2 are for communications between STICS and the rain sensor; the No. 1 terminal sends the detected value from the rain sensor to STICS then the STICS drives wiper motor.

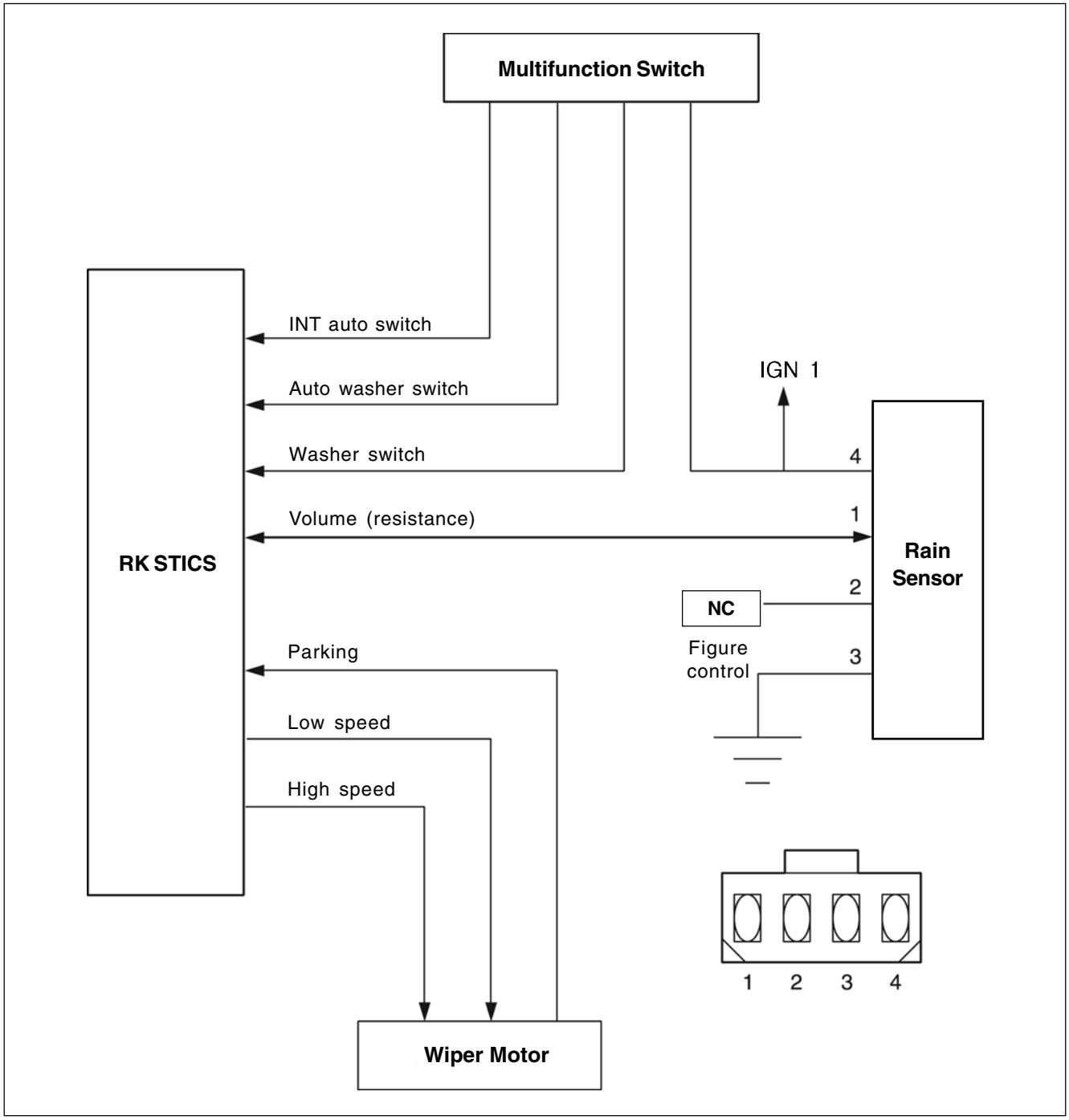
No. 2 terminal sends the wiper and washer operation information such as

washer operation mode,

wiper relay, or

multifunction wiper switch is in AUTO wiper position

to the rain sensor to recognize whether it is actual rain or it is in rain sensing wiper operation mode.

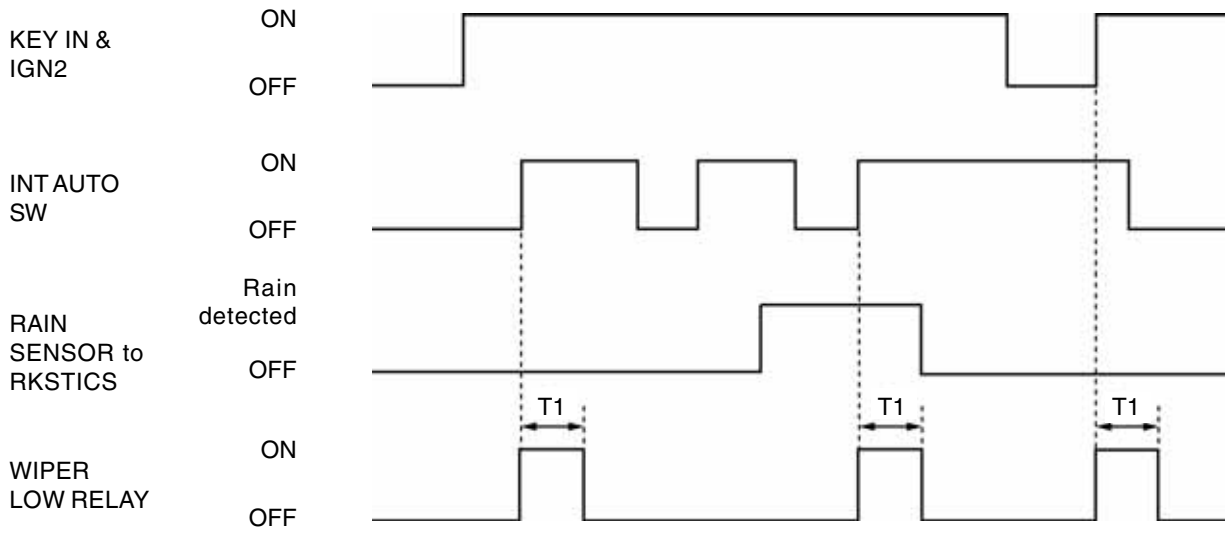


4. FUNCTIONS AND SPECIFICATIONS OF RAIN SENSING WIPER

Power-up Reminder Wiper

1. When turning off and on the INT auto switch, the system drives the wiper motor for one cycle through LOW relay regardless of communication with rain sensor.
2. The wiper relay (LOW) is turned on and the wiper motor runs one cycle when changing the INT auto switch to “ON” position from “OFF” position for the first tiime(while the ignition key is in “ON” position).

   When the wiper switch is turned to “ON” position again from “OFF” position, the system drives the wiper motor through LOW relay one cycle only when the rain sensor detects the “Rain Detected” signal.

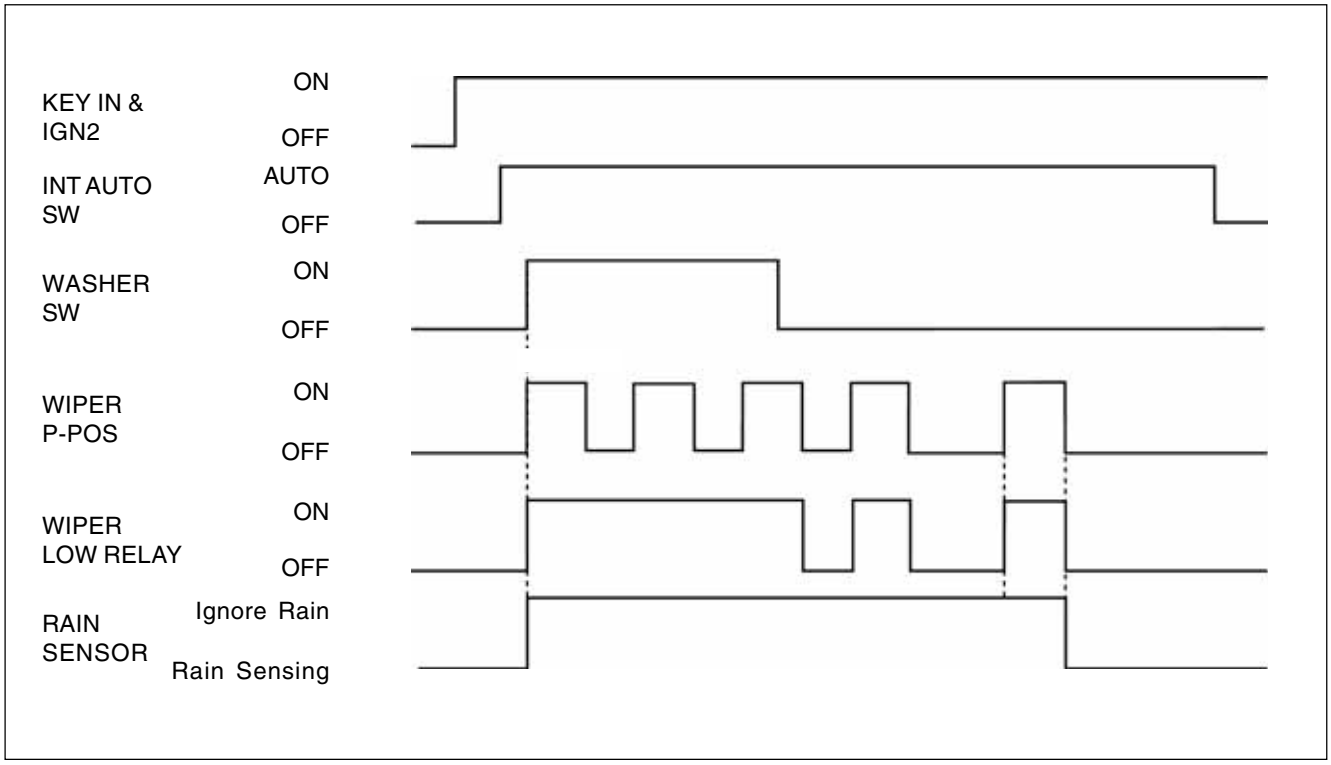


T1: 1 cycle

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Washer Coupled Wiper in the Rain Sensing Mode

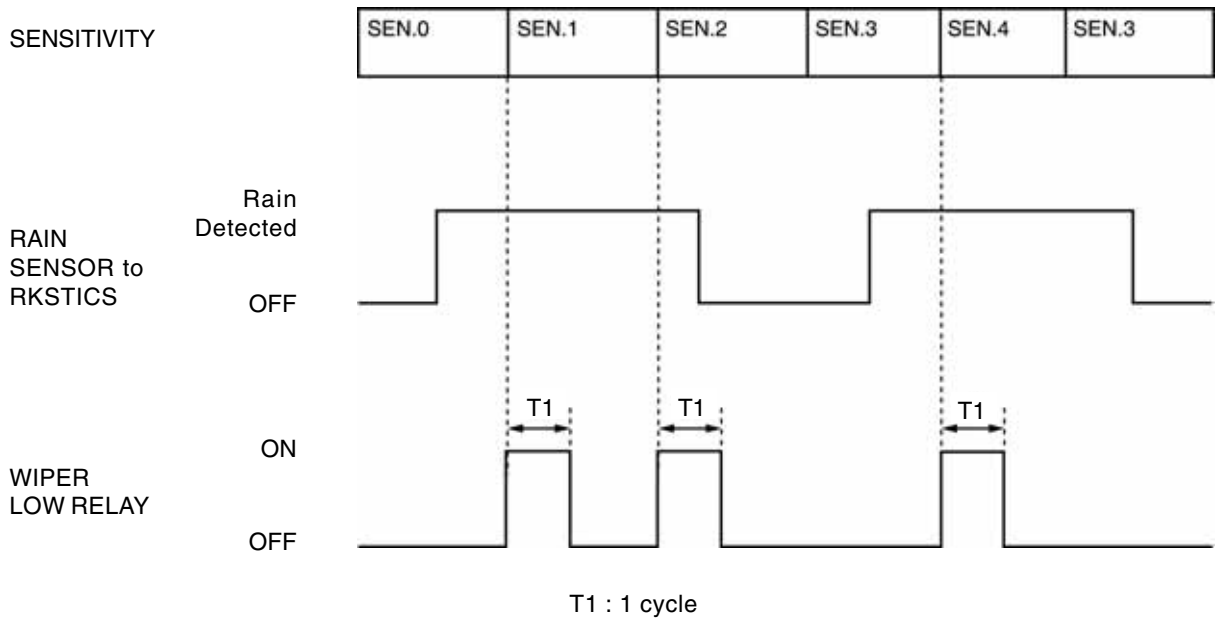
1. The washer coupled wiper is operated when receiving the washer switch input with the ignition switch “ON” and the auto INT switch “ON” in rain sensing mode. At this moment, the communication with the rain sensor is overridden. However, the washer switch input is overridden during continuous operation.
2. The operation data is sent to the rain sensor even during the washer coupled wiper operation.



Rain Sensing Sensitivity Control

1. The wiper relay (LOW) is turned on and the wiper motor runs one cycle when the volume sensitivity is increased (ex: from 0 to 1) (while the ignition key is in “ON” position, the wiper switch is in “AUTO” position, and the wiper motor is in “Parked” position). However, the wiper motor can be operated only when the rain sensor detects the “Rain Detected” signal.

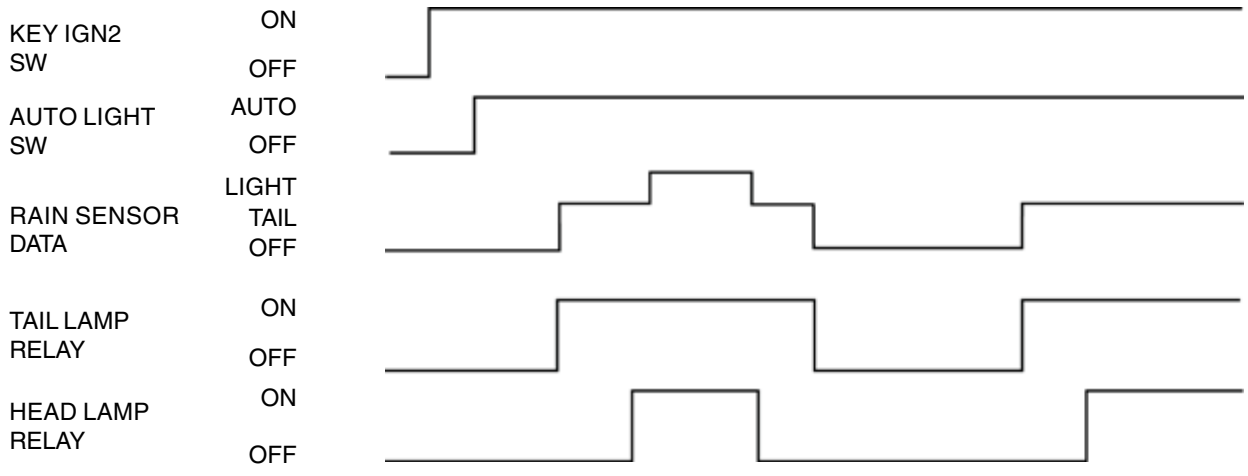
   * If the volume sensitivity is changed more than 1 stage within 2 seconds, the wiper motor runs only one cycle.



T1 : 1 cycle

Auto Light Control

1. Only when the auto light switch is in “AUTO” position, it controls the tail lamp and headlamp by communicating with the rain sensor (while the ignition key is in “ON” position).

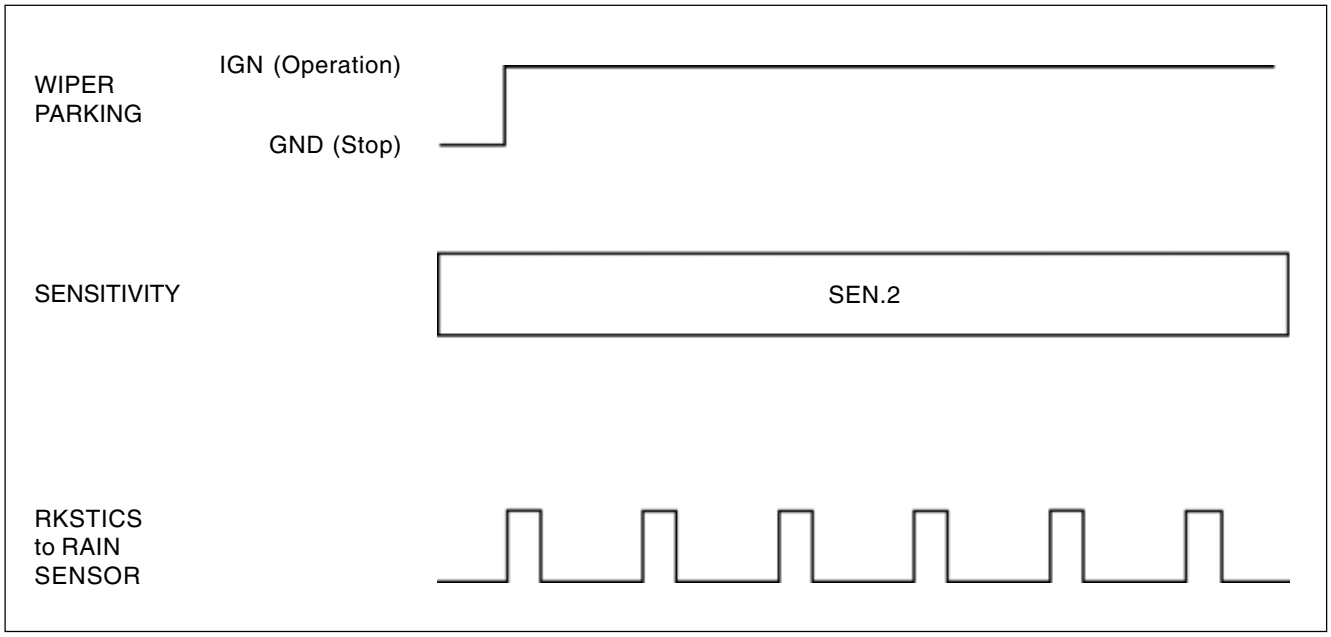


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Wiper Operation When the Wiper Parking Terminal Is Grounded

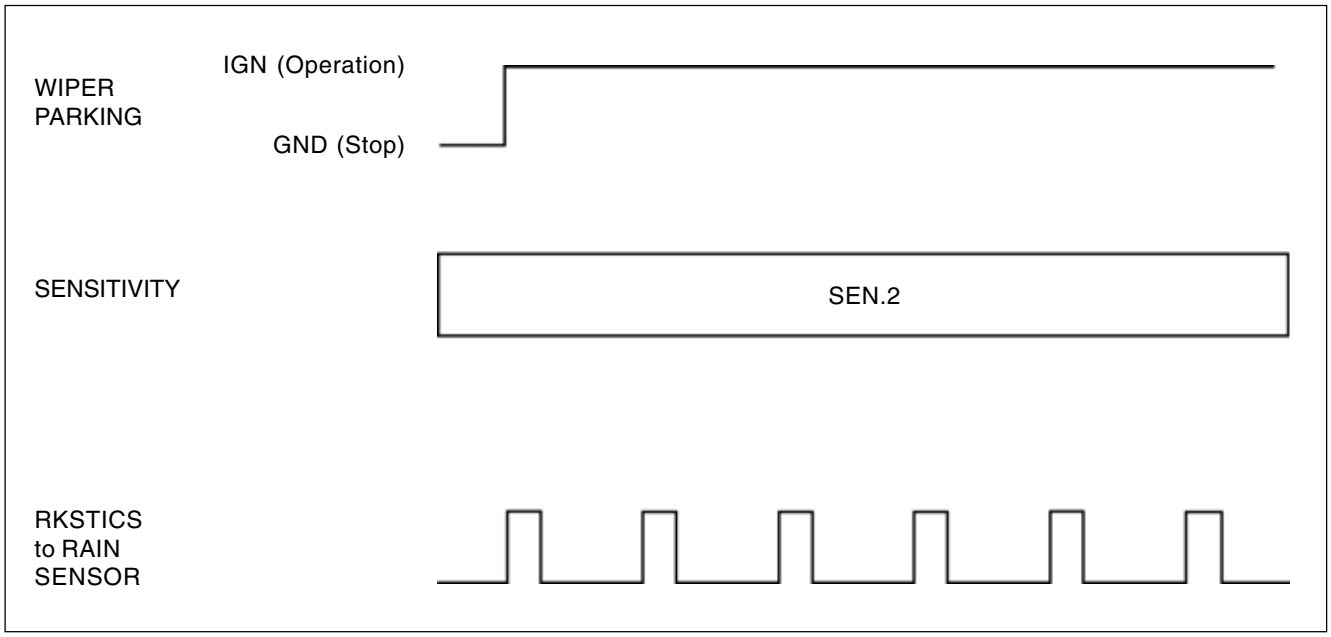
1. The wiper system continuously outputs the parking signal of current sensitivity when the parking terminal is grounded (while the ignition key is in “ON” position and the INT switch is in “ON” position).

   *** The wiper motor runs only when the rain sensor requires.**



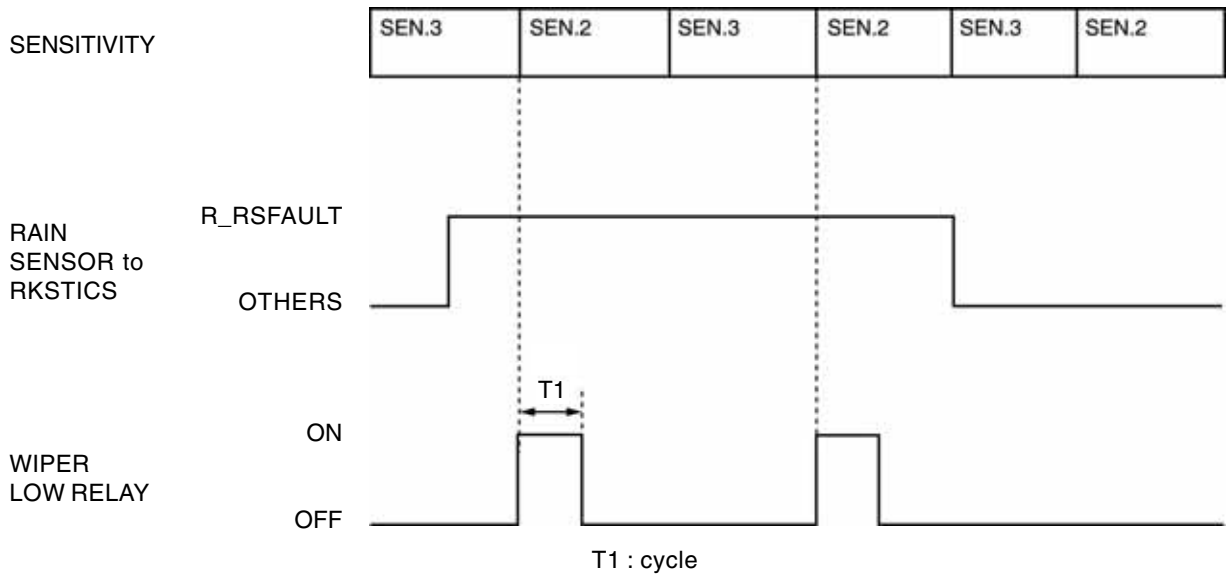
2. When the parking terminal is fixed to IGN, the wiper system outputs the operating signal of current sensitivity for 2 seconds, then continuously outputs the parking signal of current sensitivity (while the ignition key is in “ON” position and the INT switch is in “ON” position).

   *** The wiper motor runs only when the rain sensor requires.**

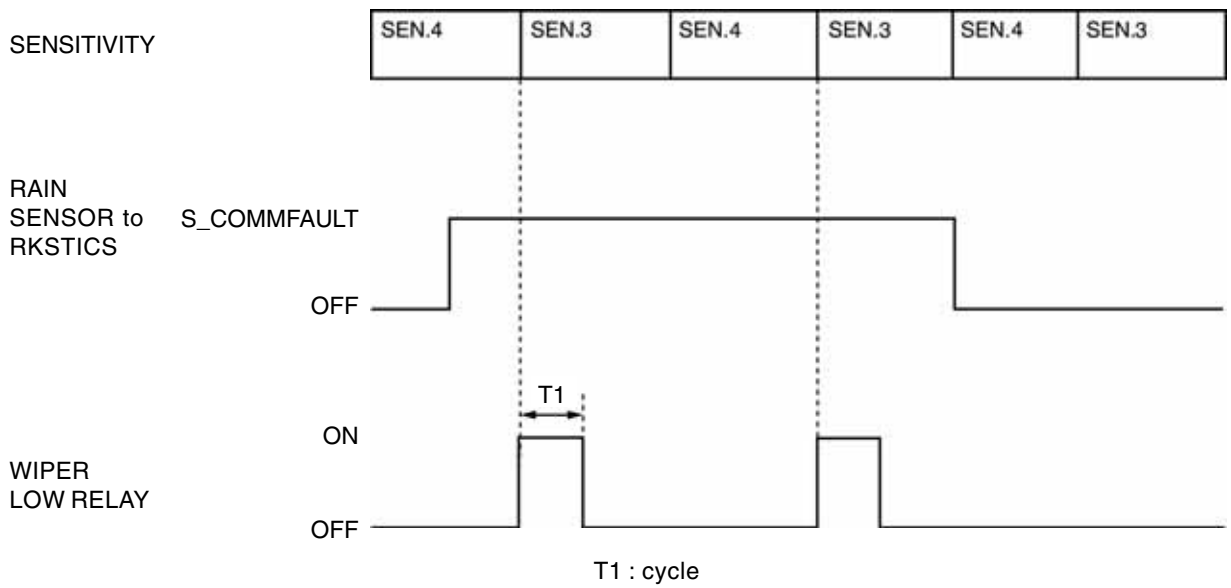


Defective Rain Sensor

1. The wiper relay (LOW) is turned on and the wiper motor runs one cycle when the wiper sensitivity is changed to 2 from 3 during receiving the malfunction signal from the rain sensor (while the ignition key is in “ON” position and the INT switch is in “ON” position).



2. The wiper relay (LO) is turned on and the wiper motor runs one cycle when the wiper sensitivity is changed to 3 from 4 during receiving the malfunction signal from the rain sensor (while the ignition key is in “ON” position and the INT switch is in “ON” position).



5. OPERATION MODE OF RAIN SENSING WIPER SYSTEM

Driver Switch Positions		Operation Mode
MIST (transmits the manual operation mode signal to sensor)		As long as the switch is in MIST position, the wiper motor operates in low speed. The wiper blade returns to parking position if the switch returns to the original position. The rain sensor ignores inputs during parking signal periods.
OFF (transmits the manual operation mode signal to sensor)		The wiper motor rotates in low speed until it returns to parking position. When the system is in manual mode, the sensitivity of sensor will be set to 2 (AUTO 2) internally. By doing so, immediate wiping with proper intervals is possible when a driver sets the system from OFF to AUTO.
AUTO 1 (low sensitivity)	SLOW ▲	Auto delay/auto speed control. Low sensitivity against rains on windshield. When the switch is in AUTO position, the sensor transmits the wiping request signal to STICS.
AUTO 2 (low/med sensitivity)		Auto delay/auto speed control. Low/medium sensitivity against rains on windshield.
AUTO 3 (medium sensitivity)		Auto delay/auto speed control. Medium sensitivity against rains on windshield.
AUTO 4 (med/hi sensitivity)		Auto delay/auto speed control. Medium/high sensitivity against rains on windshield.
AUTO 5 (high sensitivity)	▼ FAST	Auto delay/auto speed control. High sensitivity against rains on windshield.
LOW SPEED (transmits the manual operation mode signal to sensor)		The wiper motor rotates continuously in low speed of approx. 45 rev./minute (in the normal battery voltage). The rain sensor operations are same as in MIST.
HI SPEED (transmits the manual operation mode signal to sensor)		The wiper motor rotates continuously in high speed of approx. 70 rev./minute at (in the normal battery voltage). The rain sensor operations are same as in MIST.

1. **Rain detected headlamp:** If it rains heavy which requires the highest INT speed, the headlamps are turned on automatically.
2. **Night detected wiping:** When the auto light control turns on the headlamps and the rain sensor detects the rain, the wiper sensitivity is automatically increased by one level. (i.e. the AUTO wiper switch is at the 3rd level, but the wiper operates at the 4th level.)

6. FUNCTIONS AND CHECKS OF RAIN SENSOR

▶ Front Windshield Glass and Coupler Attachment

Check the outer windshield surface of sensing area for wear, damage and scratch. The sensor is able to compensate the wear up to a specific level. Check the coupler attached surface of windshield for porosity. If the porosity exists, the sensor cannot function properly.

NOTE
- **If the installed wiper brushes are out of specification (size and length), the rain sensing area cannot be fully wiped.**
- **In this case, the rain sensor's sensitivity could be decreased and the wipers are not properly operated.**

▶ Recognition of AUTO Mode

1. When the engine is started with the multifunction wiper switch in "AUTO" position, the wiper operates one cycle to remind a driver that the wiper switch is in "AUTO" position.
2. When the wiper switch is turned to "AUTO" from "OFF", the wiper operates one cycle.

   It always operates one cycle for the initial operation, however, the wiper does not operate afterwards to prevent the wiper blade wear if not raining when turning the wiper switch to "AUTO" from "OFF".

   However, the wiper operates up to 5 minutes after rain stops.
3. If this function does not occur, check No. 2 terminal on the rain sensor. If any defective cannot be found, check the wiper relay (LOW) for defective.

NOTE
- **As described, the STICS recognizes if the wiper switch is in "AUTO" position. If there is no problem, go to diagnosis mode in STICS and check the terminal that receives signal from wiper and communication lines between rain sensor unit and STICS.**

▶ Instant Wipe Function

When the variable resistance knob on the multifunction wiper switch is turned by each 1 stage from low sensitivity (S mark) to high sensitivity (F mark), the wiper operates one cycle.

NOTE
- **When the variable resistance knob is rotated by 4 stage from 0 stage without stoping, the wiper operates one cycle. The wiper operates one cycle when changing the wiping stage (0 → 1, 1 → 2, 2 → 3).**

▶ Washer Coupled Wiper Function

Check the washer coupled wiper operation by pressing the washer switch.

▶ Irregular Operations (Abrupt Operations)

1. Check the sensor for coming off.
2. Check the rain sensor cover's installation status.
3. Check that the customer is familiar to how to control the wiper sensitivity.

   Check that the customer can select the sensitivity by selecting the variable resistance value (stage 1 to stage 5), that is, the wiper sensitivity control value. And, also check whether the sensitivity is selected to the highest value of FAST (stage 5).
4. **Check the wiper blade for wear.**

   If the wiper blade cannot wipe the glass uniformly and clearly, the irregular operations could be occurred. And, the wiper blade should be replaced with new one with same specifications.

▶ Self Diagnosis

Poor Sensing

Position the wiper switch to "AUTO" position and rotate the variable resistance knob from "FAST" toward "SLOW" by one step. At this moment, check if the wiper operates one cycle.

The wiper operates when the windshield glass is excessively worn or scratched, the windshield glass is not cleared wiped due to using worn wiper blade or different wiper blade, or the rain sensor is not improperly installed.

Poor Sensor

Rotate the variable resistance knob toward "SLOW" by 1 more step. At this moment, check if the wiper operates one cycle.

If the wiper operates, this is caused when the sensor is defective or the sensor has the communication problem with STICS.

7. DIAGNOSIS PROCEDURES

1. Check the glass and coupler for proper installation.

↓

2. Check the AUTO recognition function.

↓

3. Check the instant wipe function.

↓

4. Check the washer coupled wiper function.

↓

5. Check the high speed.

↓

6. Find the causes for irregular operations (abrupt operations).

↓

7. Check the system with self-diagnosis function.

Trouble Shooting

Symptom 1. The wiper does not operate one cycle when turning the multifunction wiper switch to the "AUTO" from the "OFF" position or starting the engine while the wiper switch is in the "AUTO" position.

1. When starting the engine with the multifunction wiper switch in the "AUTO" position, the wiper operates one cycle to remind a driver that the wiper switch is in the "AUTO" position.
2. When the wiper switch is turned to "AUTO" from "OFF", the wiper operates one cycle. It always operates one cycle for the initial operation, however, the wiper does not operate afterwards to prevent the wiper blade wear if not raining when turning the wiper switch to "AUTO" from "OFF". However, the wiper operates **up to 5 minutes** after rain stops. If this function does not occur, check No. 8 pin. If the pin is normal, check the wiper relay related terminals.

Symptom 2. It rains but the system does not work in "AUTO" position.

1. Check whether the multifunction wiper switch is in the "AUTO" position.
2. Check the power to the sensor. Check the conditions of the pin 3 (Ground) and the pin 4 (IGN).
3. Check the wiper relay for defective.

Symptom 3. The wiper operates 3 or 4 times at high speed abruptly.

Check whether the variable resistance knob on the multifunction wiper switch is set in "FAST". The "FAST" is the highest stage of the sensitivity and very sensitive to small amount of rain drops. Therefore, change the knob to the low sensitivity.

Symptom 4. The wiper operates continuously even on the dry glass.

1. Check the wiper blade for wear. If the wiper blade cannot wipe the glass uniformly and clearly, this problem could be occurred. In this case, replace the wiper blade with a new one.
2. Check whether the variable resistance knob on the multifunction wiper switch is set in "FAST". The "FAST" is the highest stage of the ensitivity and very sensitive to small amount of rain drops. Therefore, change the knob to the low sensitivity.

Symptom 5. The wiper does not operate at high speed even in heavy rain.

Check if the wiper operates at high speed when grounding pin 1 and pin 2.

Symptom 6. The wiper responses are too fast or too slow.

Check whether the variable resistance knob on the wiper switch is set in "FAST" or "SLOW".

Notify that the customer can select the sensitivity by selecting the variable resistance value. And, select a proper stage.

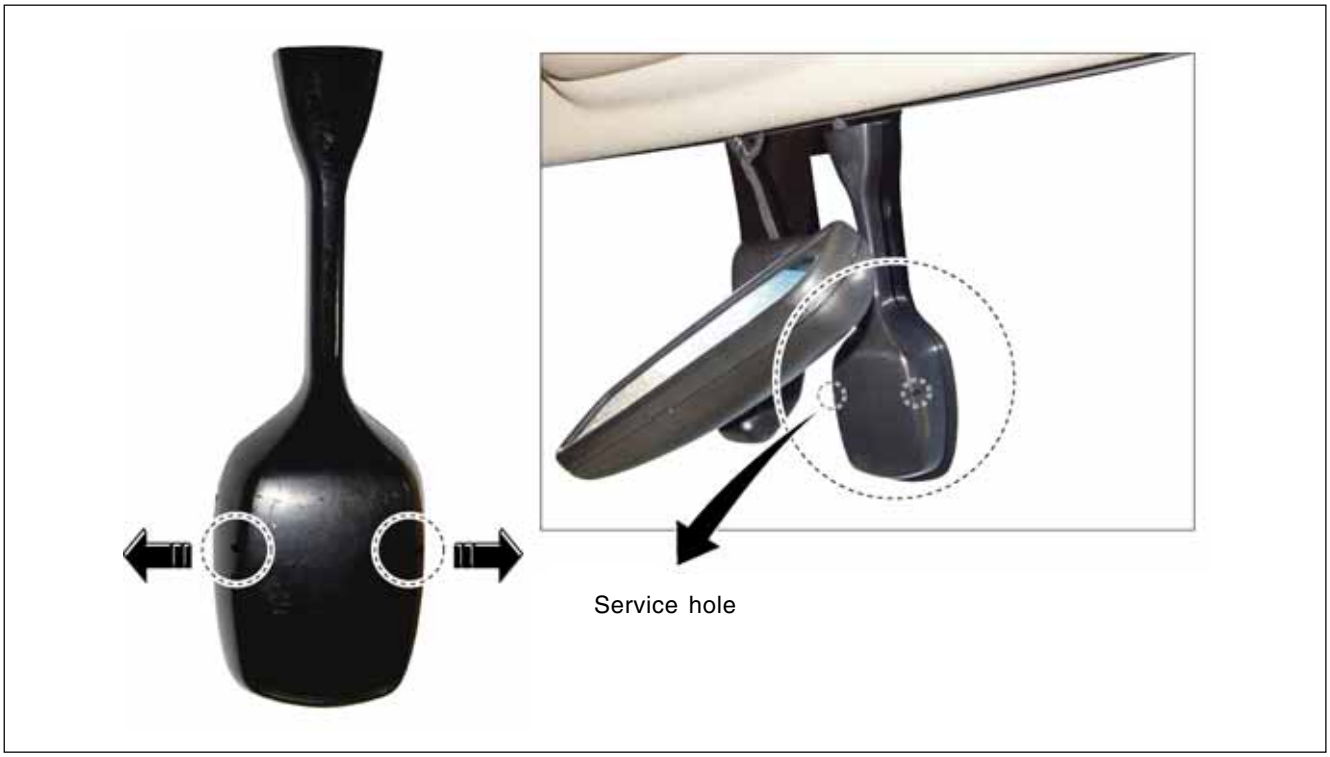
8. TROUBLE SHOOTING

Removal and Installation of Rain Sensor

1. Pry off the rain sensor cover by inserting a small screwdriver into service holes at both sides.

NOTICE

- **Otherwise, the cover or rain sensor components could be damaged.**



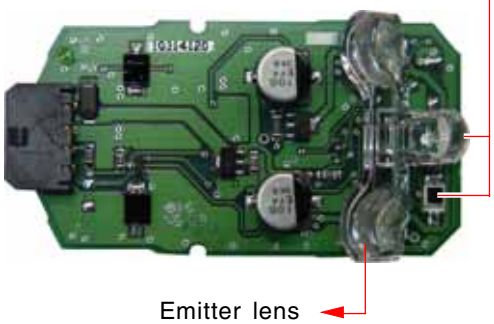
2. Disconnect the connector from the rain sensor unit located at the front windshield glass and then lift up the rain sensor unit to separate from the glass.



Components of the Rain Sensor Unit



PCB Assembly and Emitter Lens



Housing and Receiver Lens





PARKING AID SYSTEM

8790

TABLE OF CONTENTS

PARKING AID SYSTEM (PAS) 2

1. System configuration 2
2. Component specifications 4
3. Alarm interval 5
4. Troubleshooting of sensor 5
5. Cautions on parking aid system 6
6. Circuit diagram 7
7. Removal and installation of parking aid 8

PARKING AID SYSTEM (PAS)

1. SYSTEM CONFIGURATION

The parking aid device is integrated in the rear bumper and it uses three Piezoelectric elements to measure vertical and horizontal distance to obstacles.

When placing the gear selector lever to “R” position, the designated unit (PAS unit in the rear right quarter panel) activates the parking aid sensors to measure the distance to obstacles.

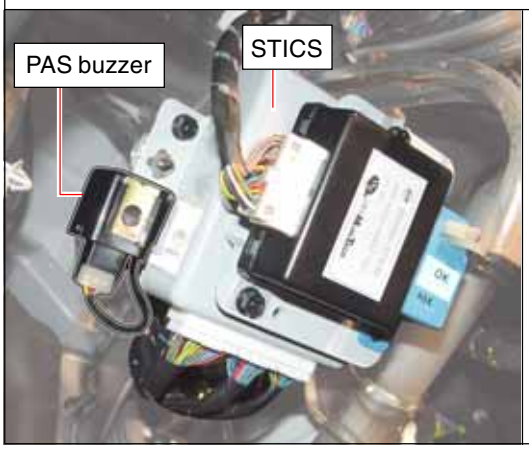
PAS Related Devices

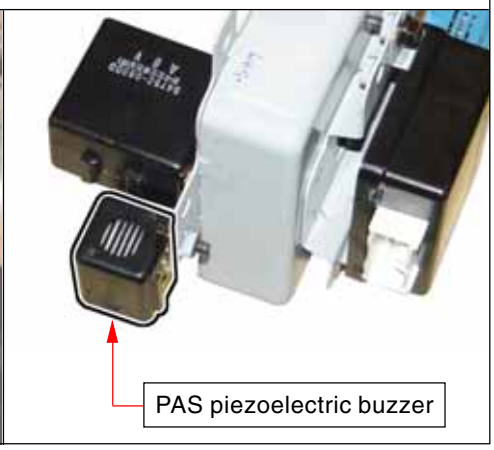
Gear Selector Lever (R Position)





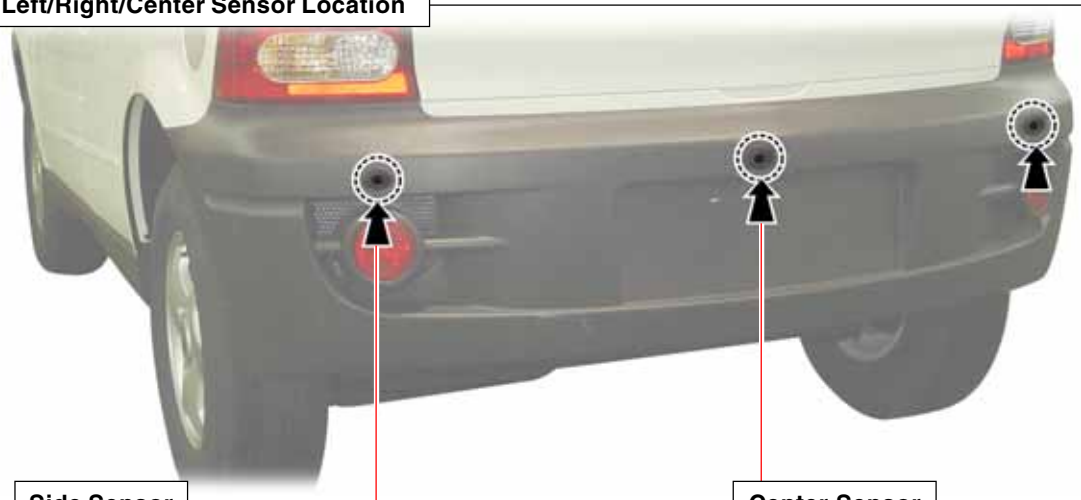
Location of PAS Buzzer Unit



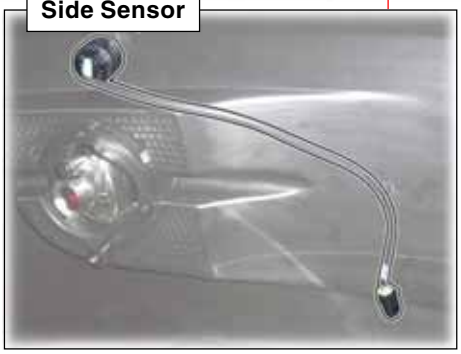


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AFFECTED VIN	

Left/Right/Center Sensor Location



Side Sensor



Center Sensor

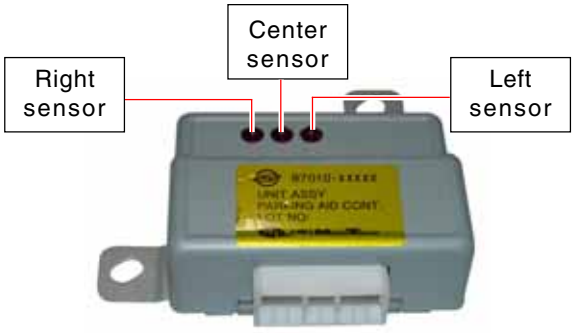




PAS Sensor



Parking Aid Unit



The PAS unit is installed in the rear right section of the rear quarter panel.

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AFFECTED VIN	

2. COMPONENT SPECIFICATIONS

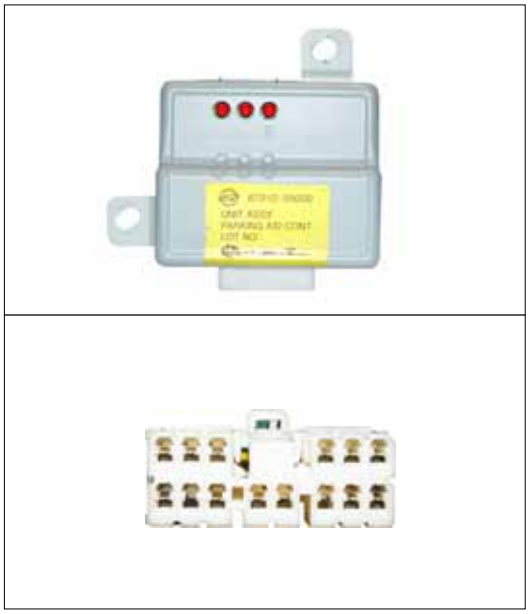
The parking aid system emits the supersonic wave signals from the sensors on the rear bumper with a specific interval and detects the reflected signals from obstacles while the gear selector lever is in “R” position. The alarm interval increases as the obstacle approaches. This supplementary system is to secure the safety distance for parking.

Descriptions		Value	Descriptions		Value
Rated voltage		DC 12 V	Operating temperature		-30°C ~ +80°C
Operating voltage		DC 9 V ~ 16 V	Storage temperature		-40°C ~ +85°C
Current consumption	Unit	Below 100 mA	Relative humidity		95% RH max
	Sensor	Below 20 mA (each)	Weight	Unit	160g ± 10g max
Sensor insulating resistance		Over 5 MW		Sensor	70g ± 10g max

▶ Parking Aid Unit

Detecting type: Super sonic wave

Detecting distance: 25 cm ~ 120 cm (distance between sensor and obstacle)



▶ Parking Aid Sensor

1. Type: Piezo ceramic element
2. Frequency: 40 KHz ± 2 KHz
3. Detecting range (13.5 V)
   - Horizontal: Min. 20° at 110 ± 5 cm Min. 100° at 50 ± 5 cm
   - Vertical: Min. 20° at 110 ± 5 cm Min. 60° at 50 ± 5 cm

NOTE

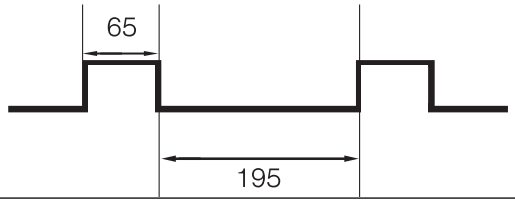
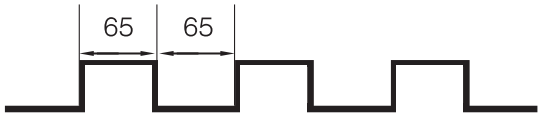
There is no upper mounting cover and spring in the PAS sensor installed in this vehicle.



3. ALARM INTERVAL

Alarm interval and display changes according to the distance as below:

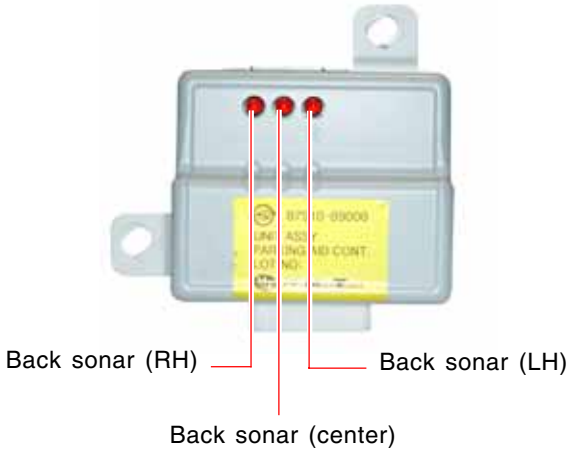
While reversing, if obstacles are within stage 1, the warning beep sounds with long intervals. If within stage 2, the warning beep sounds with short intervals and if within stage 3, the warning beep sounds continuously.

Stage	L, C, R Sensor	Interval (msec)	Remark
1	81 ~ 120 cm		"Beep ——— "
2	51 ~ 80 cm		"Beep -, Beep -, Beep -"
3	25 ~ 50 cm		"Beep ——— "

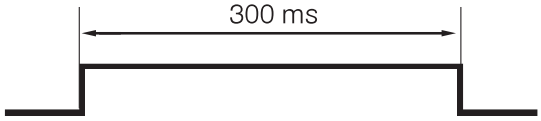
4. TROUBLESHOOTING OF SENSOR

When the power is applied (gear selector lever is in "R" position), the sensor will be diagnosed once. If found any failure due to open circuit to sensor or communication error, warning buzzer sounds for 3 seconds and the data on failed sensor transmits to the instrument panel to light up the corresponding LED. If normal, the warning buzzer sounds only for 65 ms.

1. Whenever the power is applied, the diagnosis mode is initiated.
2. Sensor failure conditions (conditions for warning beep due to failure)
   - Sensor failure conditions (conditions for warning beep
   - Open in sending circuit
   - Open in receiving circuit
   - Open in power circuit (+, -)



Warning Beeps

When failed (also when diagnosing the unit)		
When normal		

5. CAUTIONS ON PARKING AID SYSTEM

Cautions

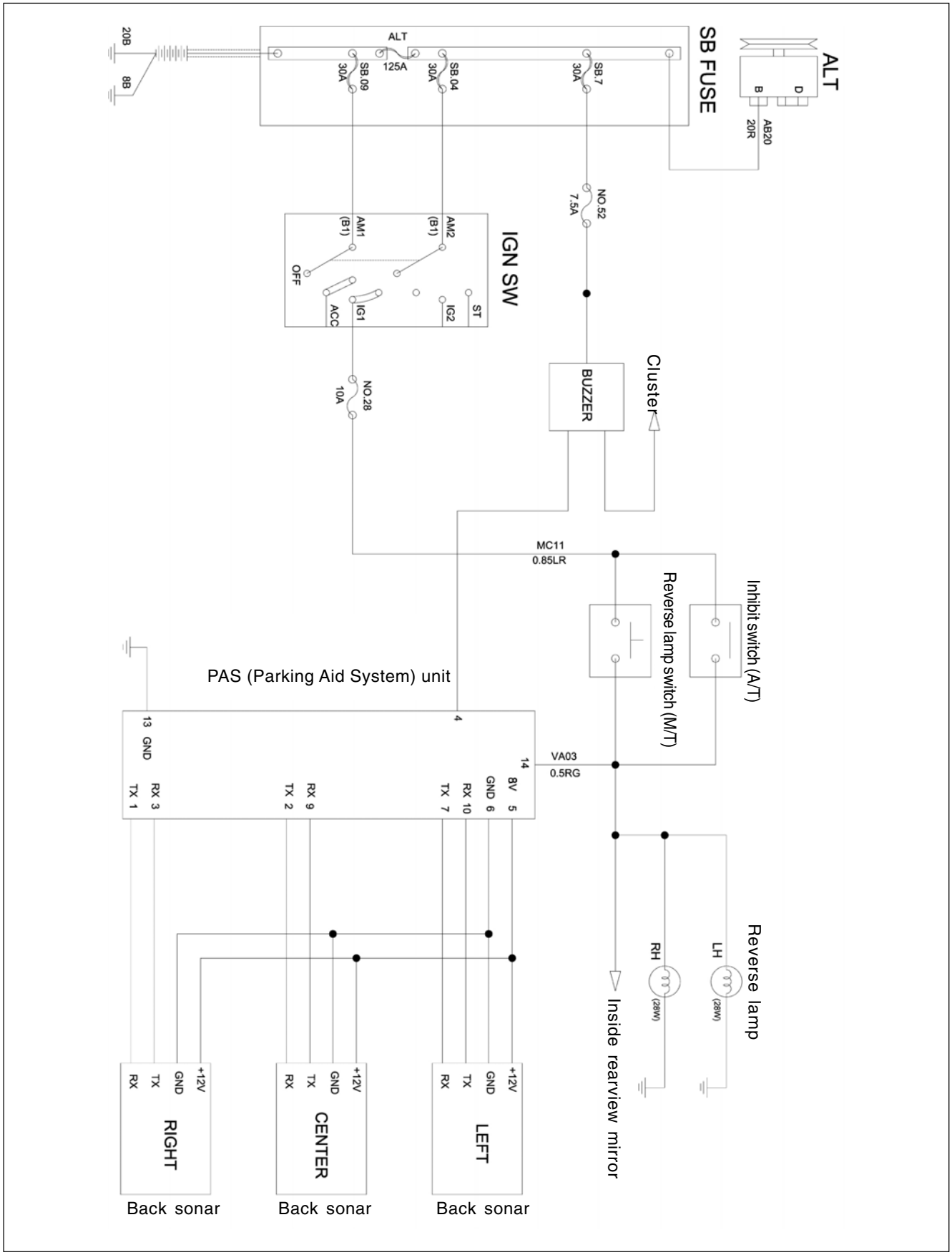
- **Note that the display does not show everything in the rear area. Always check nobody, especially animals and children, is behind the vehicle when parking or reversing.**
- **If you can not properly check the vehicle behind, get out of the vehicle and then visually check it.**

1. The parking aid system is just a supplemental device to help your parking operation.
2. Always keep the safety precautions.
3. Do not press or shock the sensors by hitting or high-pressure water gun while washing, or the sensors will be damaged.
4. If the system is in normal operating condition, a short beep sounds when the gear selector lever is moved into “R” position with the ignition key “ON”.
5. If the system is in abnormal operating condition, a beep sounds for 3 seconds when the gear selector lever is moved into “R” position with the ignition key “ON” or engine running. However, it is also occurred when the obstacle is within 50 cm from the rear bumper.

The parking aid system will not work or improperly work under following cases:

1. Certain obstacles that sensors can not detect
   - Wires, ropes, chains.
   - Cotton, sponge, clothes, snow that absorb ultrasonic waves.
   - Obstacles lower than the bumper (ex. drain ditch or mud puddle)
2. Not defective but improperly working
   - When the sensing portion is frozen (operates normally after thawed)
   - When the sensing portion is covered by rain, water drops, snow or mud (operates normally after cleaned)
   - When receiving other ultrasonic signals (metal sound or air braking noises from heavy commercial vehicles)
   - When a high-power radio is turned on
3. Narrowed sensing area
   - When the sensing portion is partially covered by snow or mud (operates normally after cleaned)
   - Surrounding temperature of sensor is too high (approx. over 80 °C) or too low (approx. below -30 °C)
4. Not defective but may occur improper working
   - When driving on the rough roads, gravel road, hill and grass
   - When the bumper height is changed due to the heavy load
   - When the sensing portion is frozen
   - When the sensing portion is covered by rain, water drops, snow or mud
   - When receiving other ultrasonic signals (metal sound or air braking noises from heavy commercial vehicles)
   - When a high-power radio is turned on
   - When some accessories are attached in detecting ranges

6. CIRCUIT DIAGRAM



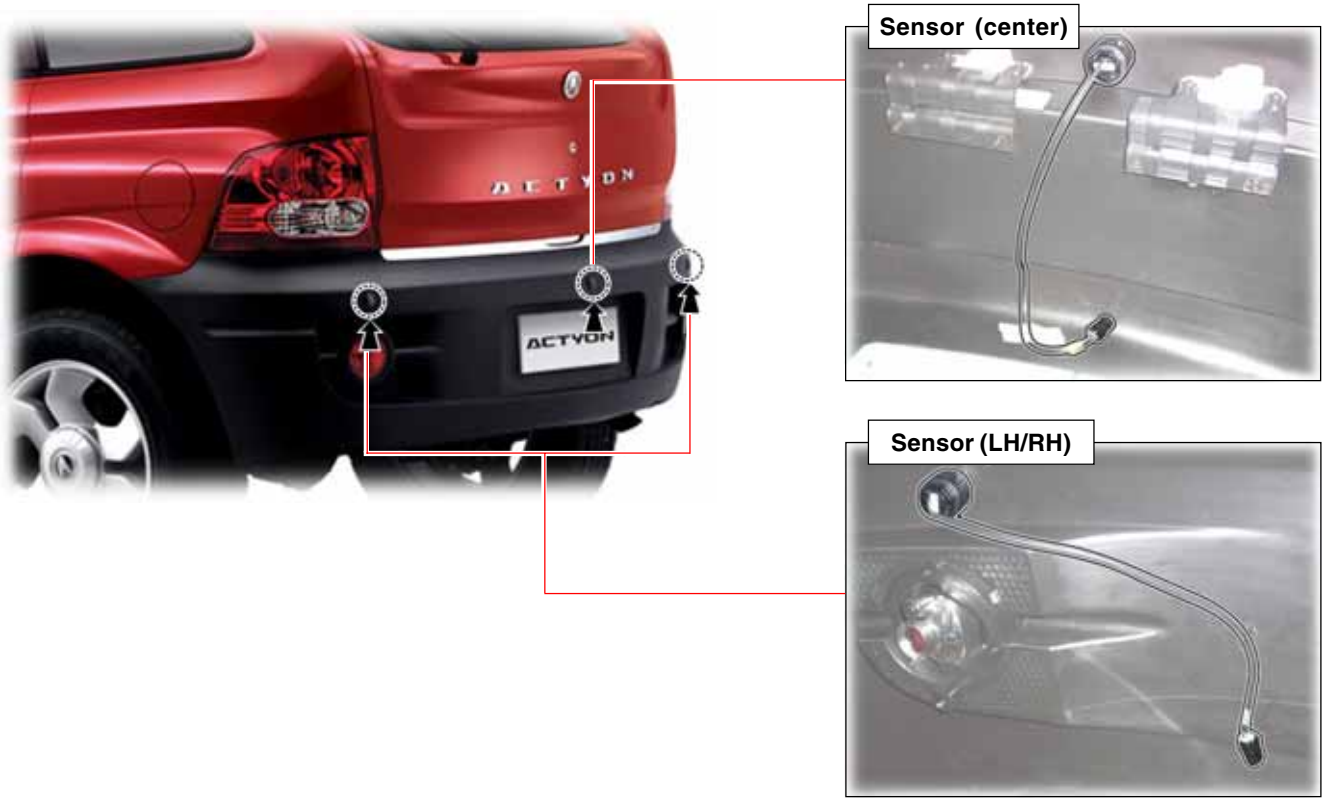
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EFFECTIVE DATE	
AFFECTED VIN	

7. REMOVAL AND INSTALLATION OF PARKING AID

The PAS unit is installed in the rear right quarter panel. Therefore, remove the rear right quarter trim before working on the PAS unit (refer to "Body" section).

▶ Parking Aid Sensor

※ **Preceding Work:** Remove the rear bumper.



1. Disconnect the connector and remove the sensor by rotating the cover.





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2. Remove the sensor from the bumper.



Components of PAS Sensor

Connector



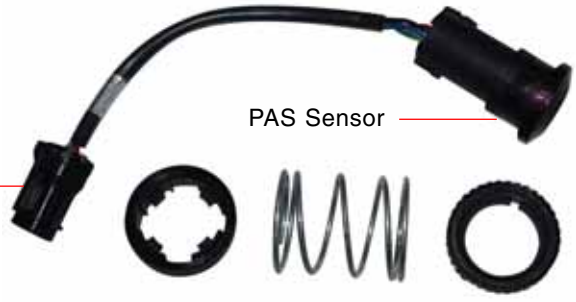


Reference

*** PAS sensor of Kyron model**

Connector





LAMP

8310 / 8320 / 8610

TABLE OF CONTENTS

LAMPS 2

1. Locations of exterior lamps and specifications 2

FRONT LAMPS 6

1. Compositions of front lamps 6
2. Aiming and adjustment of front lamp 8
3. Removal and installation of headlamps 10

REAR LAMP 15

1. Composition of rear combination lamp 15
2. Removal and installation of rear combination lamp 16

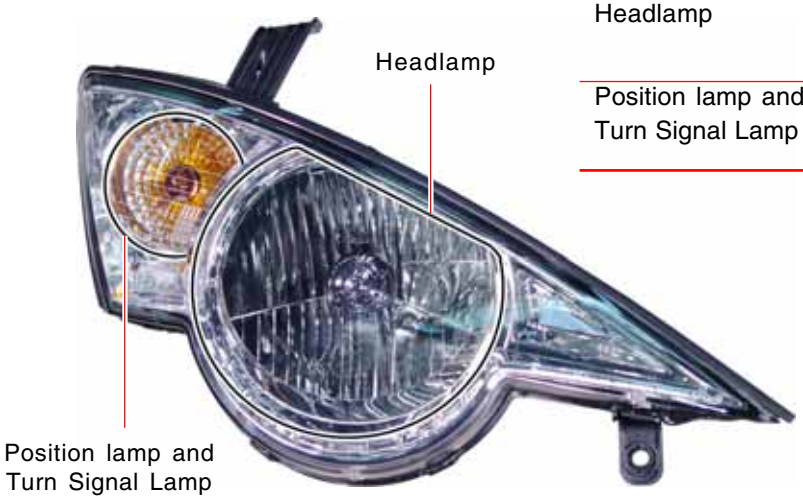
INTERIOR LAMPS 22

1. Composition of interior lamps 22
2. Removal and installation of interior lamps 24

LAMPS

1. LOCATIONS OF EXTERIOR LAMPS AND SPECIFICATIONS

Headlamp



Lamp	Specification
Headlamp	High Beam: 12 V / 60 W Low Beam: 12 V / 55 W
Position lamp and Turn Signal Lamp	EU: 12V/W5W/PY21W General: 12V/8W/28W

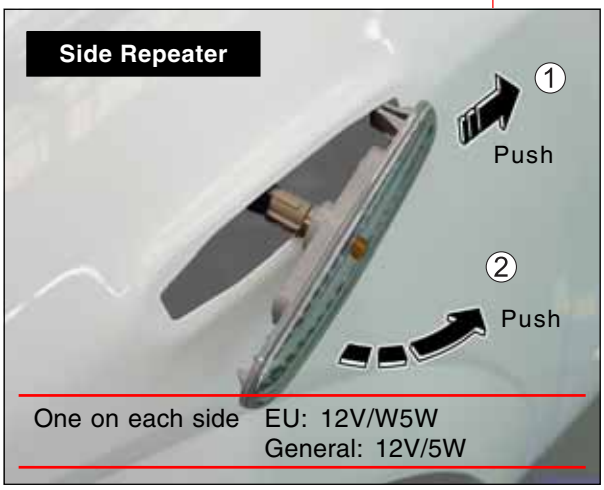


Front Fog Light



One on each side	EU: 12V/H27W General: 12V/27W

Side Repeater



One on each side	EU: 12V/W5W General: 12V/5W

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EFFECTIVE DATE	
AFFECTED VIN	

Rear Combination Lamp



Lamp	Specification
Stop lamp/Tail lamp	EU: 12V/P21W/5W General: 12V/27W/8W
Turn signal lamp	EU: 12V/PY21W General: 12V/27W
Back-up lamp	EU: 12V/16W × 1 General: 12V/16W × 2



Rear Fog Light



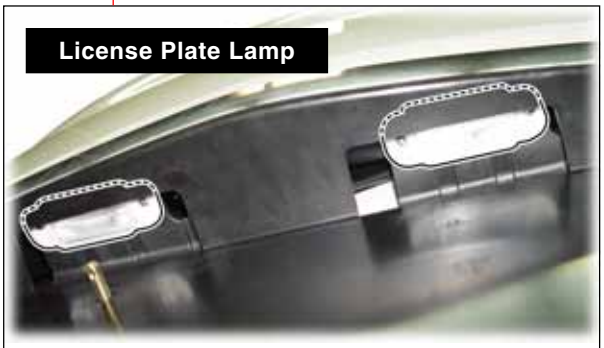
One on each side EU: 12V/P21W
General: 12V/21W

High Mounted Stop Lamp



One on center EU: 5 lamps, 12V/W5W
General: 5 lamps, 12V/5W

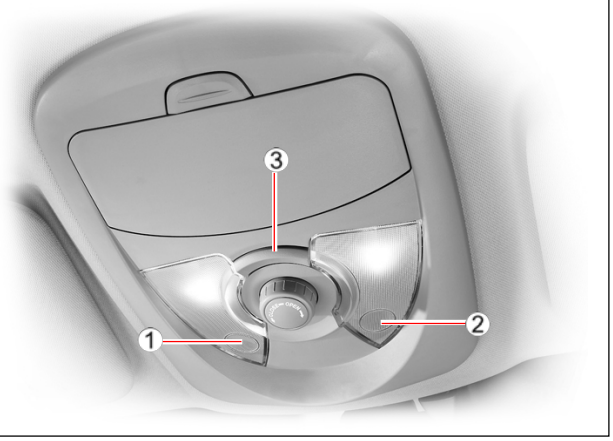
License Plate Lamp



One on each side EU: 12V/W5W
General: 12V/5W

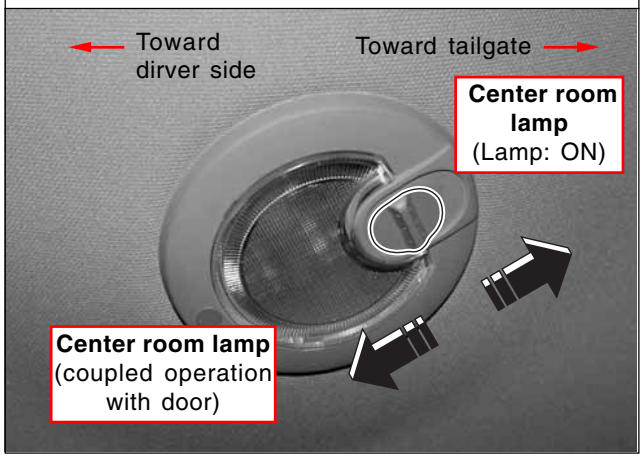
▶ INTERIOR LAMPS

Front Room Lamp: 12V/10W - (2 EA)



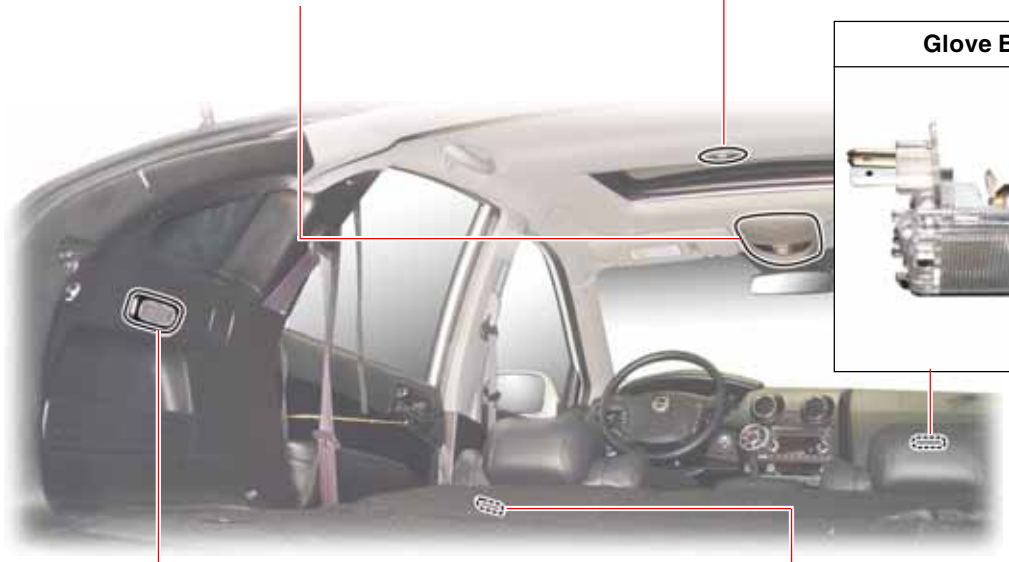
The driver's room lamp and the passenger's room lamp are separately turned on when pressing the switch (1, 2). However, the front lamps are turned on when opening a door and turned off when closing it. The front room lamps and center lamp are turned on when pressing the room lamp main switch (3).

Center Room Lamp: 12V/10W - (1 EA)

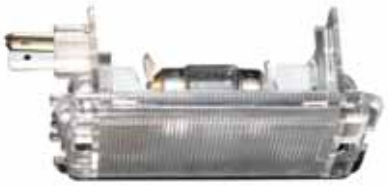


Center Room Lamp

When this switch is pushed towards the rear of the vehicle, the lamp comes on when opening a door and goes off in 30 seconds. If the switch is pushed to the opposite direction, the lamp stays on.



Glove Box: 12V/10W



Luggage Room Lamp: 12V/10W



Door Courtesy Lamp: 12V/5W (on front doors)

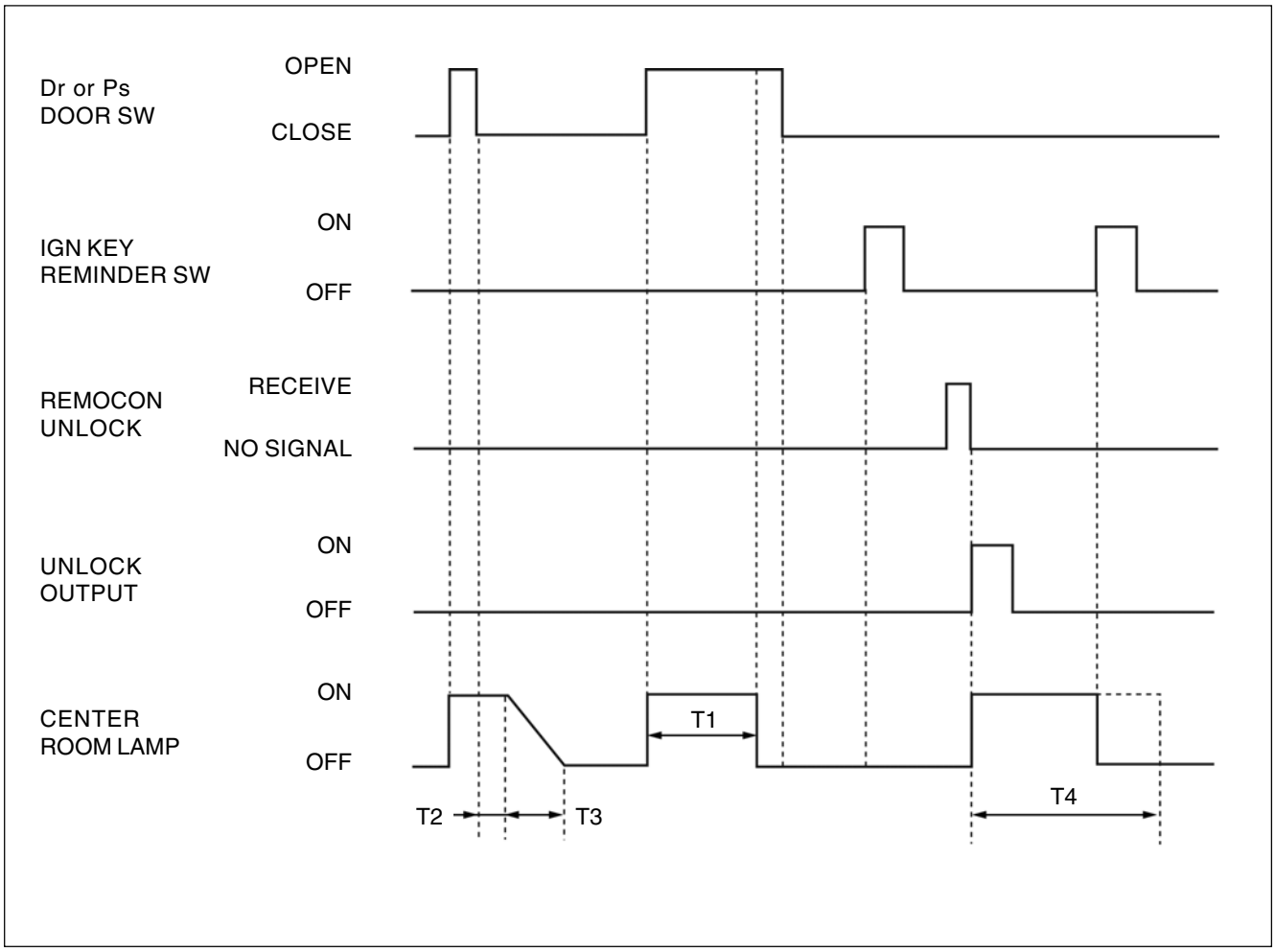


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EFFECTIVE DATE	
AFFECTED VIN	

Room Lamp Control

The overhead console lamp (front room lamp) and the center room lamp come on when opening a door while the center/luggage room lamp switch is at coupled operating position and the key reminder switch is OFF.

1. When a door (Driver's/Passenger's/Rear) is opened, the front and center room lamps come on and automatically go off after 30 seconds.
2. The room lamp stays on for 2 seconds and then decays through 3 seconds when closing the driver's door, passenger's door or rear doors within 30 seconds after opening a door.
3. The decaying operation must have greater than 32 steps per one second.
4. The room lamp output should stop immediately after turning on the ignition key during decaying operation.
5. The front room lamp and center room lamp come on for 30 seconds when receiving the unlock signal from the remote control key while the doors are closed.
6. The front room lamp and center room lamp output period is extended by 30 seconds when receiving the unlock signal from the remote control key again during output (The lamp stays on when unlocked by the remote control key).
7. When a door is opened during its extended period, the lamp stays on. If closed, operates as in step 2.
8. The room lamp output stops immediately and the theft deterrent system is activated after receiving the lock signal from driver's door, passenger's door and rear doors lock switch while the driver's door, passenger's door and rear doors are closed.
9. The luggage room lamp comes on when the switch is pressed.



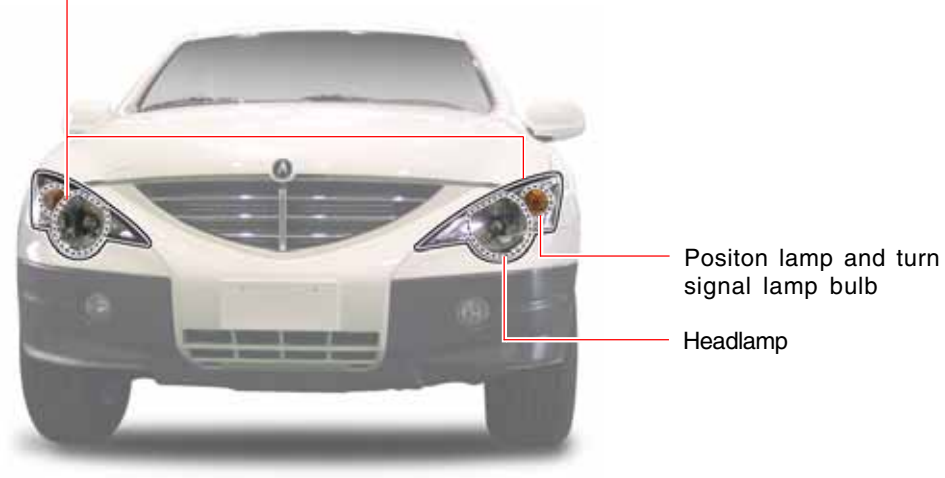
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FRONT LAMPS

1. COMPOSITIONS OF FRONT LAMPS

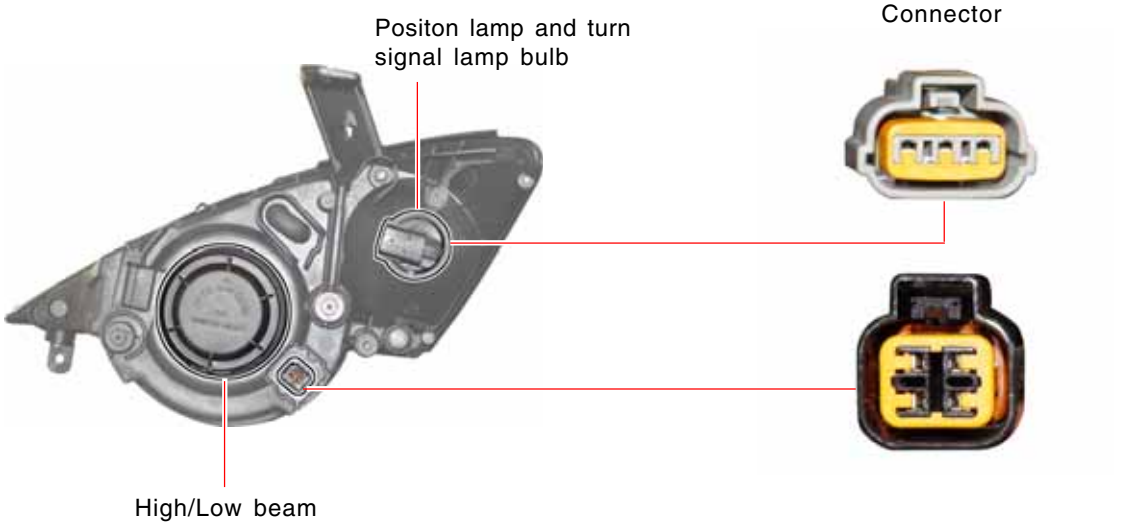
Headlamp





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EFFECTIVE DATE	
AFFECTED VIN	

Connection Connector When Installing

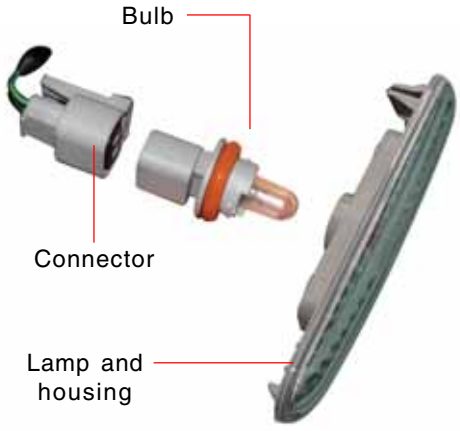




Fog Light (LH/RH: 1 EA)



Side Repeater (LH/RH: 1 EA)



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EFFECTIVE DATE	
AFFECTED VIN	

2. AIMING AND ADJUSTMENT OF FRONT LAMP

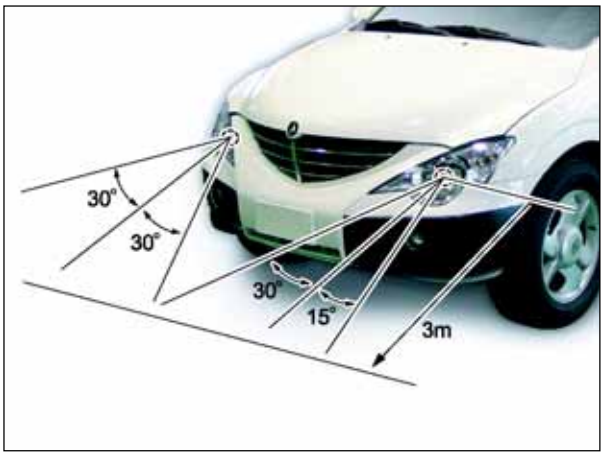
▶ Headlamp Aiming

Headlamp Aiming

Adjust the headlamp aiming while turning the aiming screws (up/down/left/right) in turn with a screwdriver.

- **Headlamp aiming requirements:**

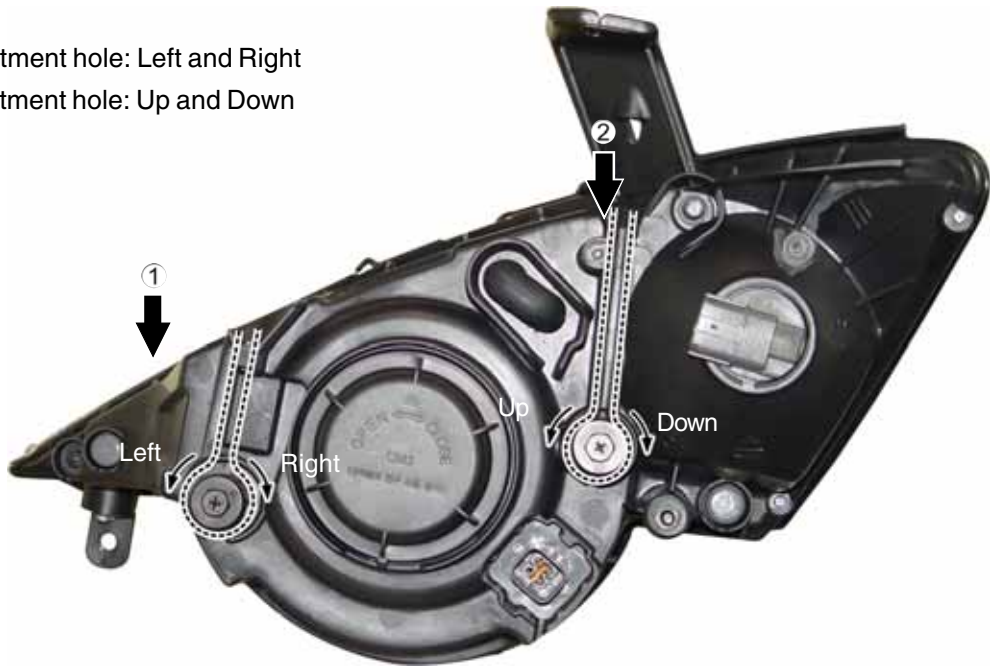
1. specified tire pressure
2. one passenger (driver, 70 kg),
3. spare tire and OVM tools loaded (unlade all other loads) and parking on a flat surface



Adjustment Direction

No. 1 adjustment hole: Left and Right

No. 2 adjustment hole: Up and Down



Vertical adjustment hole





Transverse adjustment hole

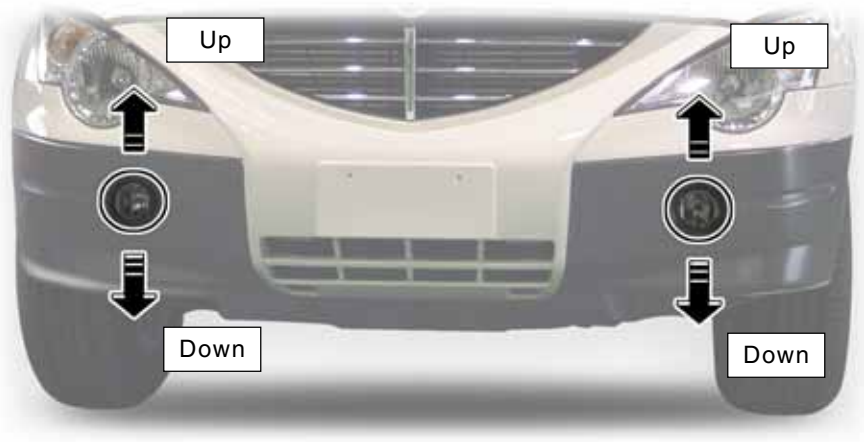


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Front Fog Light Aiming Adjustment

The front fog lights are installed in the front bumper. Front fog light aiming (up/down) can be adjusted by the control knob installed on the fog light.







Down

The lamp aiming moves down and the light faces downward when the knob is turned counterclockwise.

Up

The lamp aiming moves up and the light faces upward when the knob is turned clockwise.

3. REMOVAL AND INSTALLATION OF HEADLAMPS

▶ Headlamp

Headlamp Assembly

※ **Preceding Work:** Turn off the lamp switch.

1. Open the engine hood and unscrew two mounting screws on the headlamp lower cover to remove the lower cover.





NOTICE

- **Be careful not to damage the headlamp cover when removing it.**

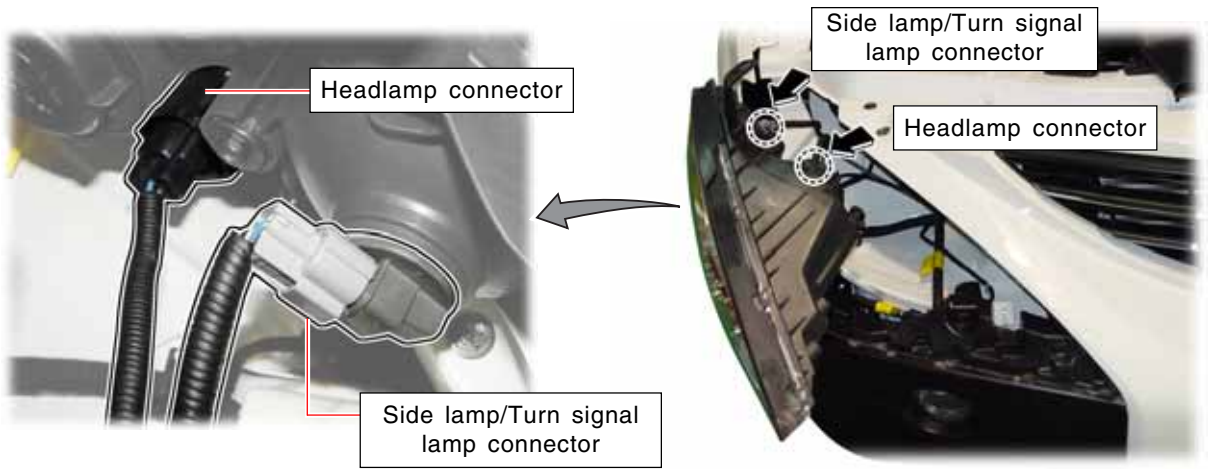


2. Unscrew the lower and upper mounting bolts (10 mm) from the headlamp.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Pull the headlamp assembly forward and disconnect two headlamp connectors to remove the headlamp.



Components



NOTICE

- **If the lamp cover rubber ring is damaged while installing, replace it with new one.**

Headlamp Bulb Replacement

1. Turn the lamp switch OFF and remove the headlmap dust cover to disconnect the connector from the headlamp bulb.



NOTE
- **To make the bulb replacement easier, remove the headlamp assembly.**



2. Unlock the bulb mounting clamp by pushing its upper side and remove the bulb from the headlamp.







NOTICE
- **Use only specified bulb for replacement.**
- **Do not touch the bulb with bare hands when it is hot. You may get burnt.**

3. To replace bulbs of side lamp and turn signal lamp, remove the headlamp assembly first.

NOTICE
- **Use only specified bulb for replacement.**
- **Do not touch the bulb with bare hands when it is hot. You may get burnt.**
- **Make sure that the bulb is securely tightened after installation.**



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Fog Light and Side Repeater

Fog Light

※ **Preceding Work:** Turn the lamp switch OFF.

A. Fog light Assembly

: Disconnect the fog light connector and unscrew three mounting screws to remove the fog light assembly.



B. Fog light Bulb Replacement

1. Disconnect the connector from the front fog light.



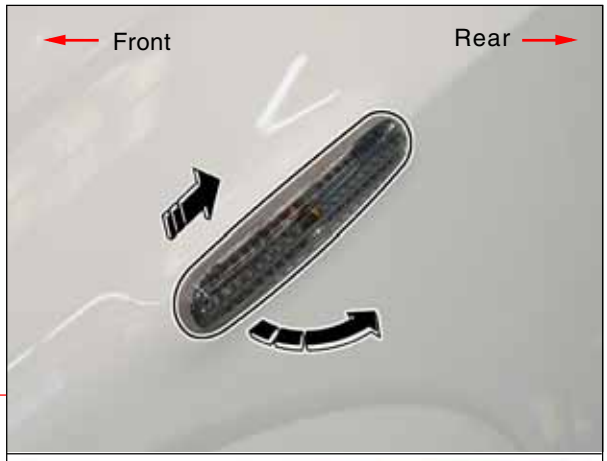
2. Rotate the fog light bulb to remove it.

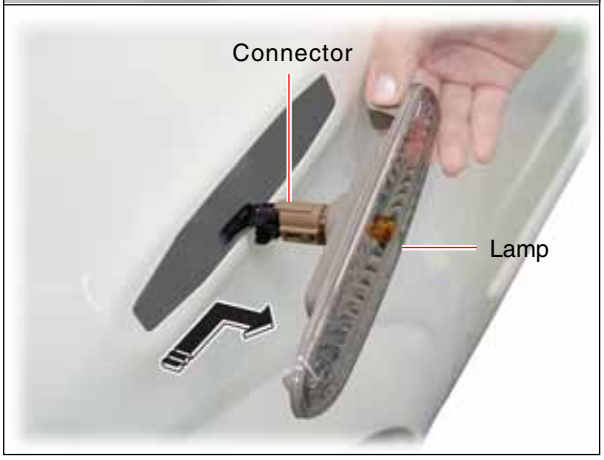


Side Repeater

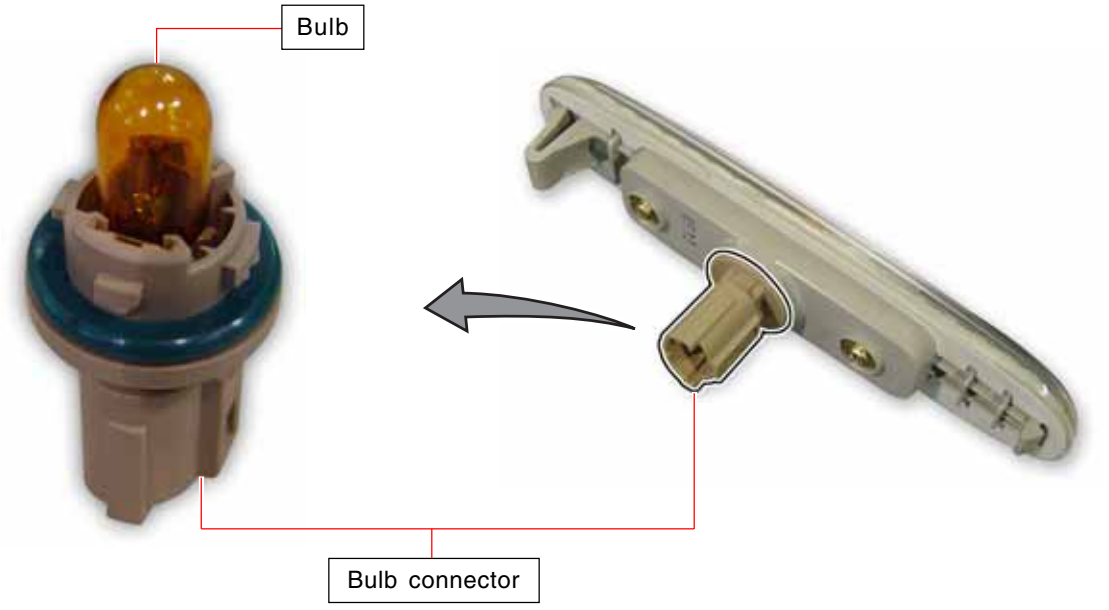
1. Release the side repeater by pushing it rearward and disconnect the side repeater connector.
2. Disconnect the connector and remove the lamp.







Components

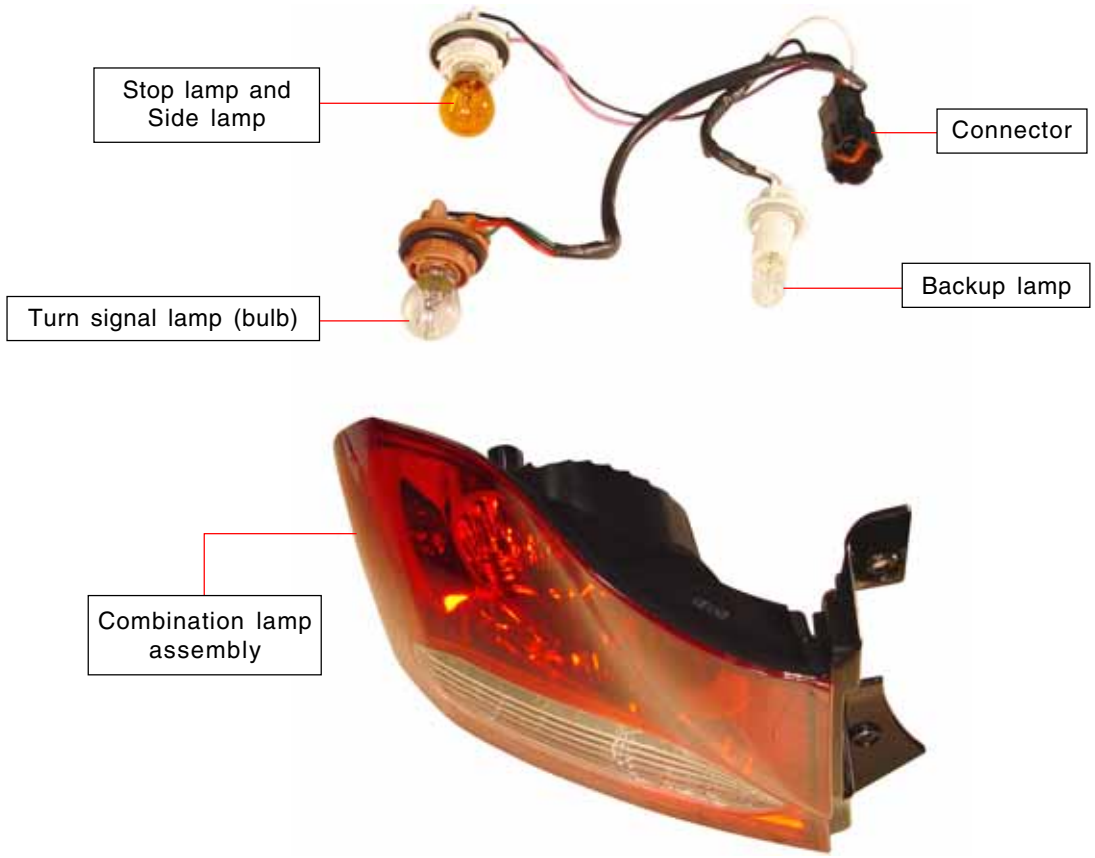


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EFFECTIVE DATE	
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REAR LAMP

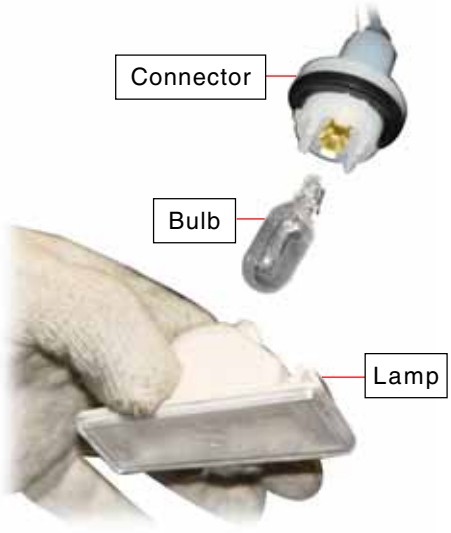
1. COMPOSITION OF REAR COMBINATION LAMP

Rear Combination Lamp





License Plate Lamp



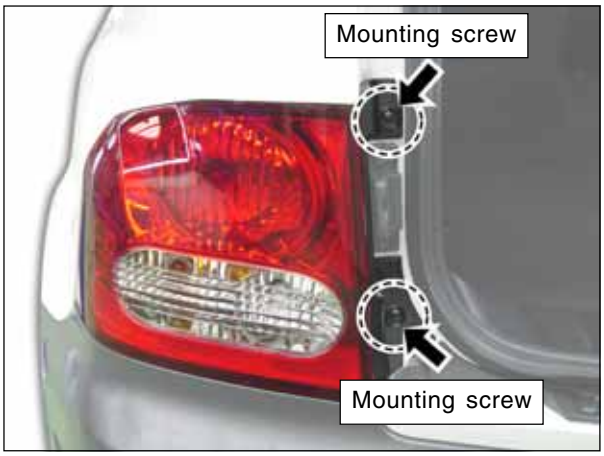
2. REMOVAL AND INSTALLATION OF REAR COMBINATION LAMP

Rear Combination Lamp Assembly

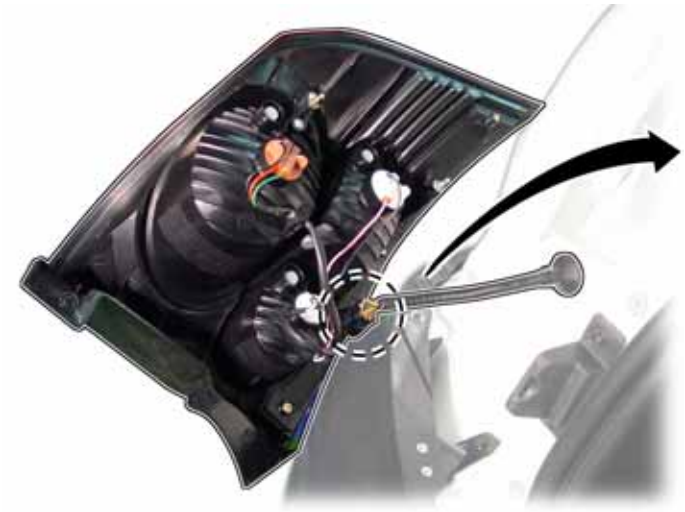
※ **Preceding Work:** Turn the lamp switch OFF.



1. Open the tailgate and unscrew two mounting screws to remove the rear combination lamp assembly.



2. Disconnect the connector and remove the rear combination lamp assembly.



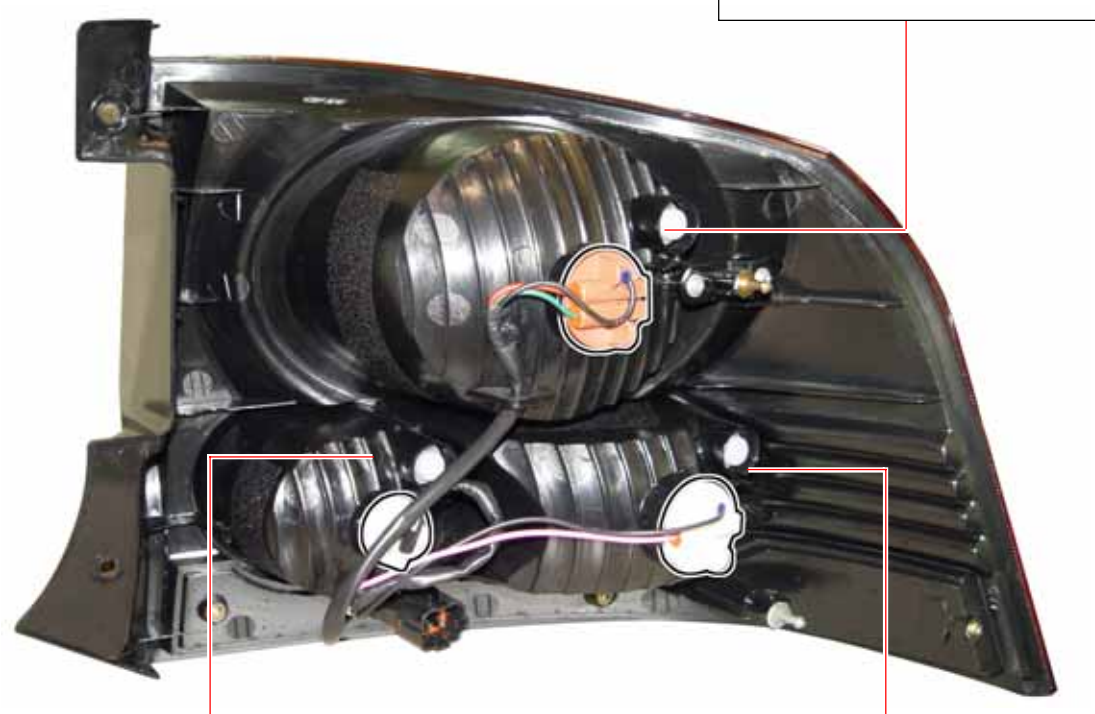


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Open the bulb holders/connectors by turning them counterclockwise and remove the bulbs.

Side Lamp/Stop Lamp Bulb





Backup Lamp Bulb



Turn Signal Lamp Bbulb



NOTICE

- **Use only specified bulb for replacement.**

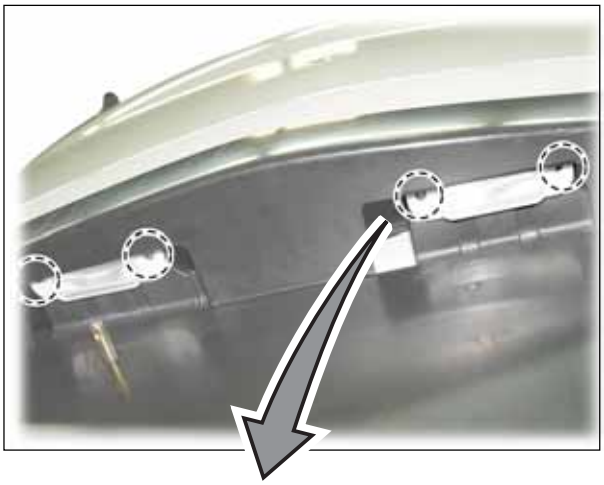
License Plate Lamp Assembly

• The replacement procedure for the license plate lamp and bulb is the same.

※ **Preceding work:** Turn the lamp switch OFF.

1. Unscrew two mounting screws from the license plate lamp on the rear bumper and remove the lamp.





2. Remove the bulb from the removed license plate lamp.

NOTICE

- **Use only specified bulb for replacement.**





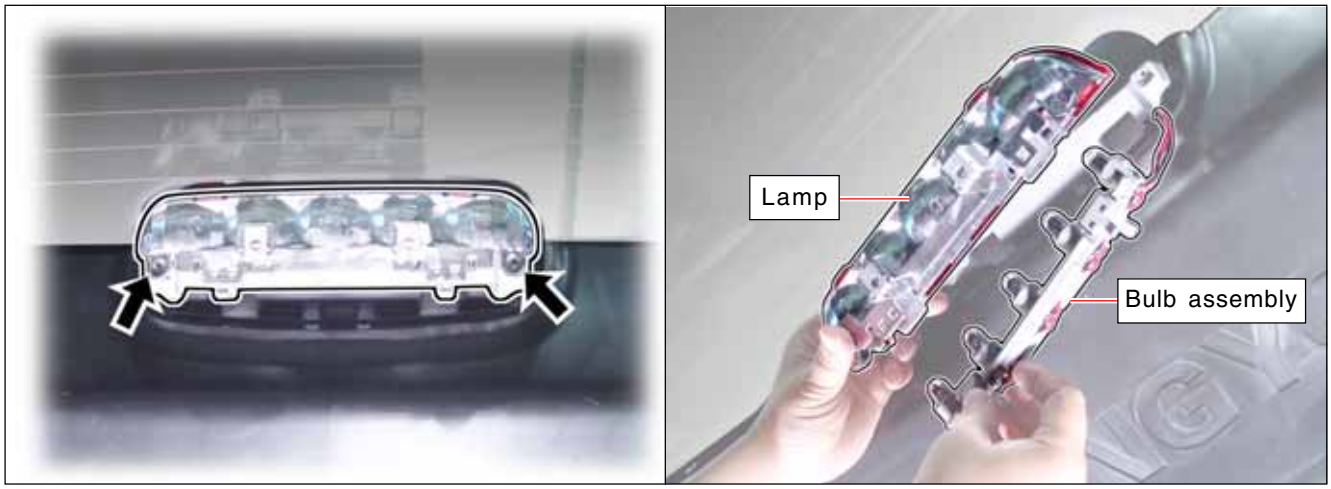
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EFFECTIVE DATE	
AFFECTED VIN	

High Mounted Stop Lamp

1. Open the tailgate and remove the cover from the high mounted stop lamp.



2. Remove the bulb assembly.



3. Remove the bulb from the bulb assembly.

Rear Fog Light

※ **Preceding work:** Turn the lamp switch OFF.



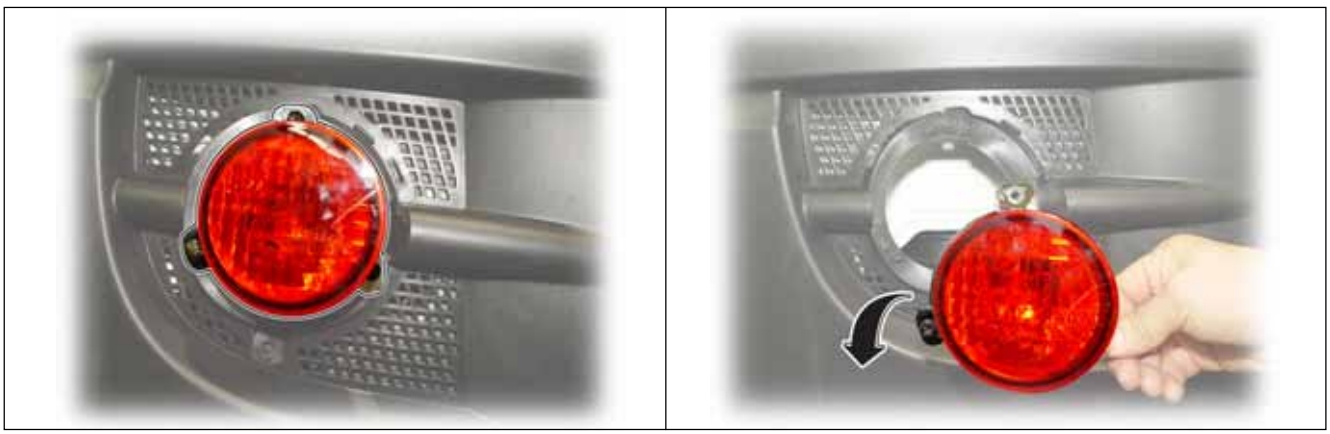
NOTICE

- **Use only specified bulb for replacement.**

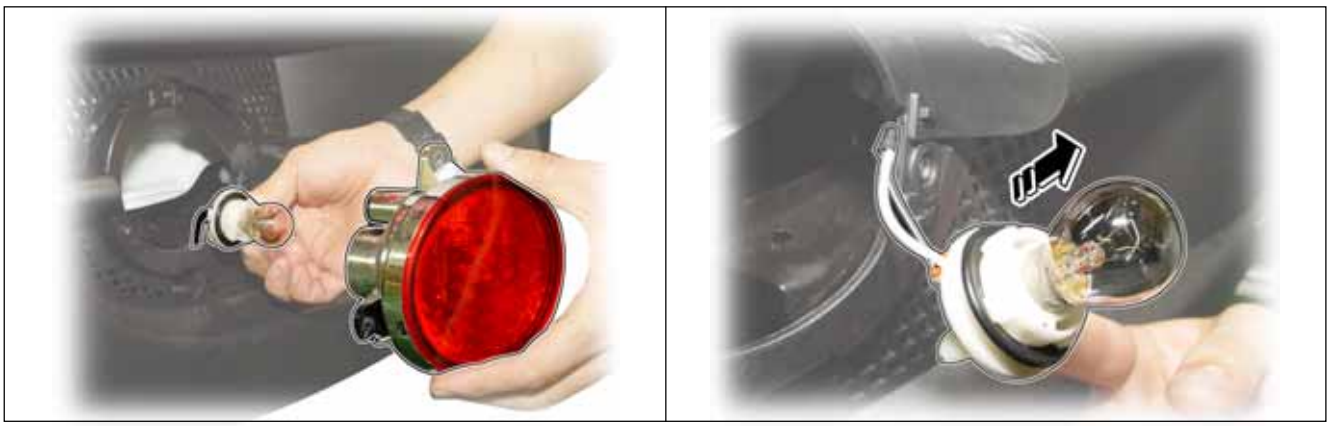
1. Open the tailgate and remove the rear fog light cover.



2. Unscrew the mounting screw and remove the rear fog light assembly.



3. Remove the bulb from the rear fog light.



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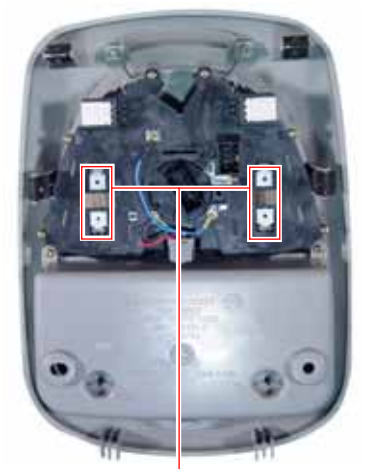
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EFFECTIVE DATE	
AFFECTED VIN	

INTERIOR LAMPS

1. COMPOSITION OF INTERIOR LAMPS

Front Room Lamp Assembly



Front room lamp bulb



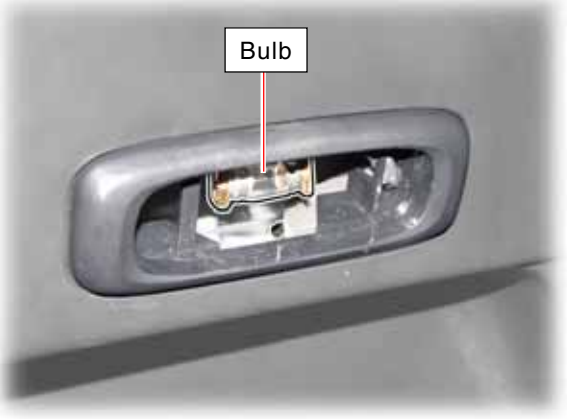
Front room lamp cover



Sunglasses box

Luggage Room Lamp Assembly







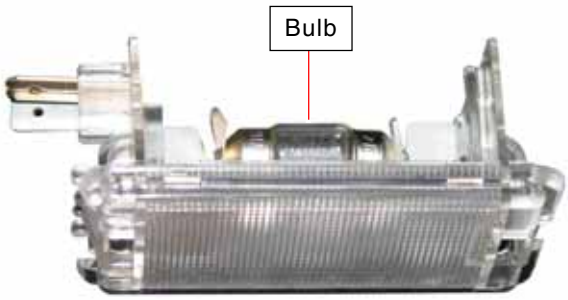
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Interior Room Lamp Assembly



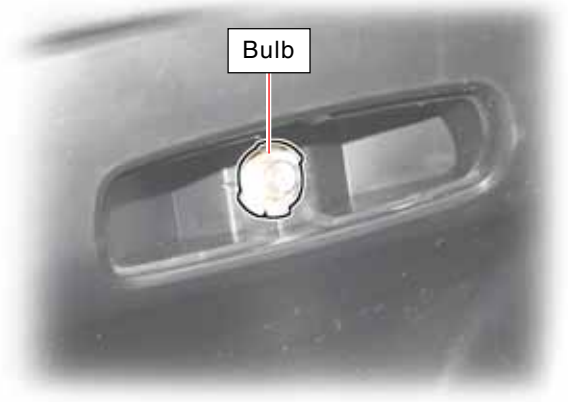


Glove Box Lamp



The glove box lamp comes on only when the tail lamp is on.

Door Courtesy Lamp Assembly



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EFFECTIVE DATE	
AFFECTED VIN	

2. REMOVAL AND INSTALLATION OF INTERIOR LAMPS

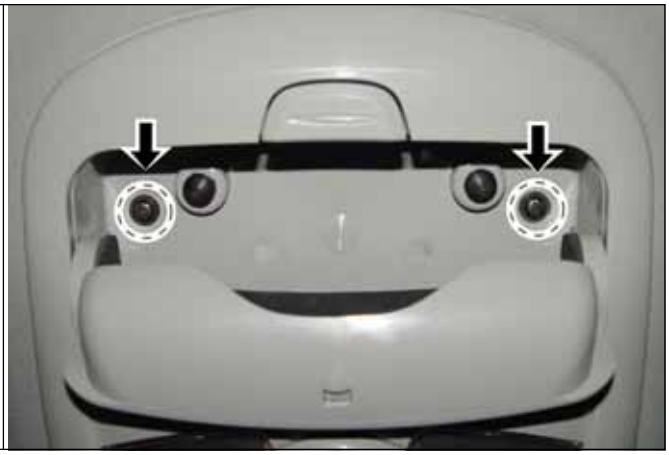
▶ Overhead Console

Removal and Installation of Overhead Console Assembly

※ **Preceding Work:** Turn the lamp switch OFF.

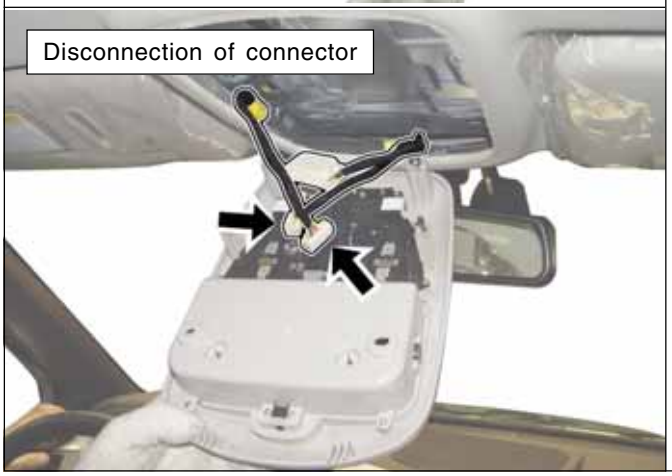
1. Open the sunglasses box and remove two overhead console assembly mounting screws.





2. Remove the overhead console assembly starting from the front side and disconnect the connector to remove the overhead console assembly.







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AFFECTED VIN	

Overhead Console Room Lamp Bulb Replacement

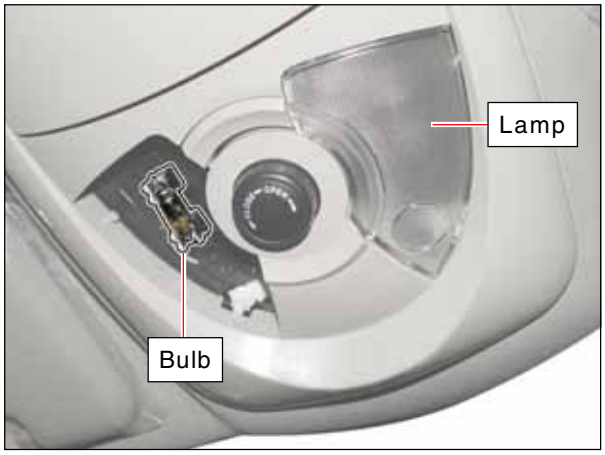
1. Turn the room lamp switch OFF.
2. Remove the lamp cover by prying it off from the rear side.



NOTICE

- **When replacing the bulb, pry off the cover by inserting a screwdriver into the groove not to damage other components.**

3. Carefully remove the bulb from the lamp and replace it with new one.

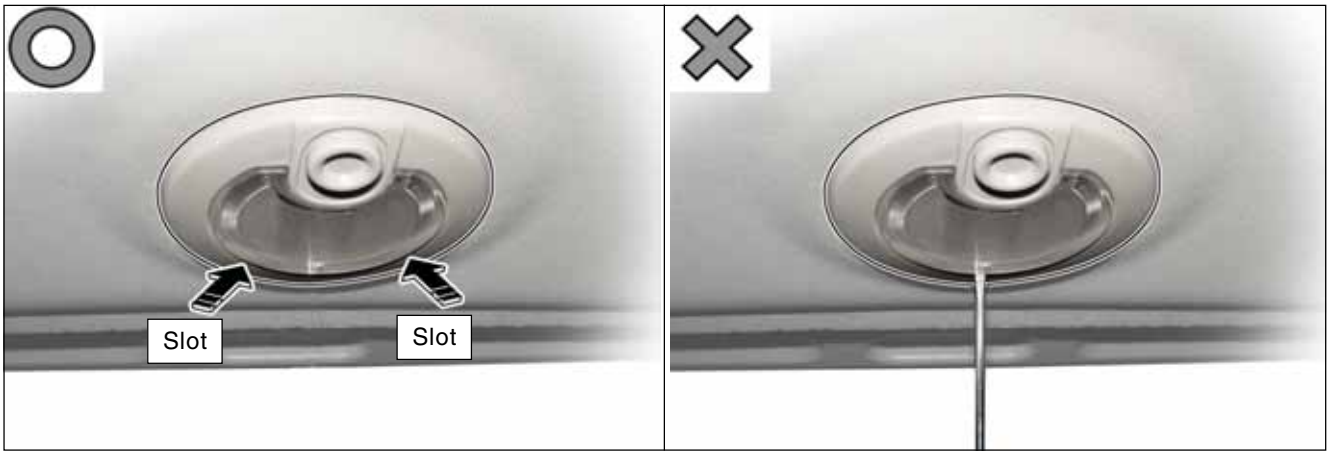


▶ Center Lamp Assembly

Removal and Installation of Center Lamp Assembly

※ **Preceding work:** Turn the lamp switch OFF.

1. Remove the lamp cover.



2. Unscrew the mounting screw on the lamp and remove the lamp assembly. Disconnect the connector to remove the lamp assembly.



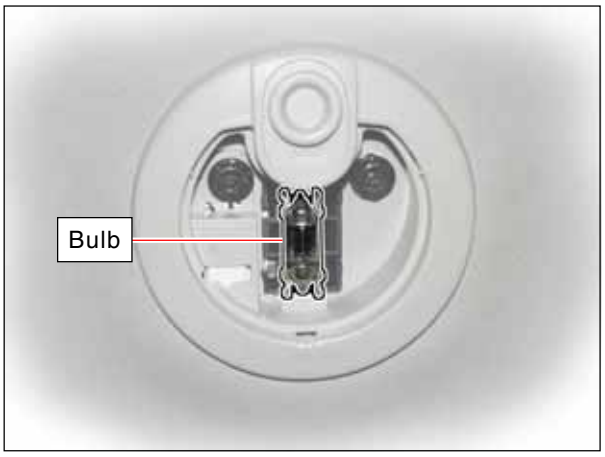
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AFFECTED VIN	

Replacement of Bulb

1. Turn the lamp switch OFF.
2. Remove the lamp cover and replace the bulb with new one.

NOTICE

- **Use only specified bulb for replacement.**



Configuration



▶ Luggage Room Lamp Assembly

Removal and Installation of Luggage Room Lamp

※ **Preceding work:** Turn the luggage room lamp switch OFF.

1. Open the tailgate and remove the luggage room lamp assembly by prying off the cover using a screwdriver.



2. Disconnect the connector from the removed lamp assembly.



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Replacement of Bulb

1. Turn the luggage room lamp switch OFF.
2. Rreplace the bulb with new one.



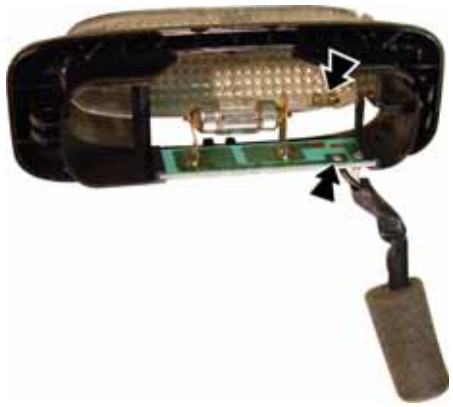
NOTICE

- **Use only specified bulb for replacement.**

※ Cautions for Lamp Installation

NOTE

- **Install the luggage room lamp cover by aligning the arrow positions correctly.**
  If not installed correctly, the lamp may not operate properly.



▶ Door Courtesy Lamp (Bulb) Assembly

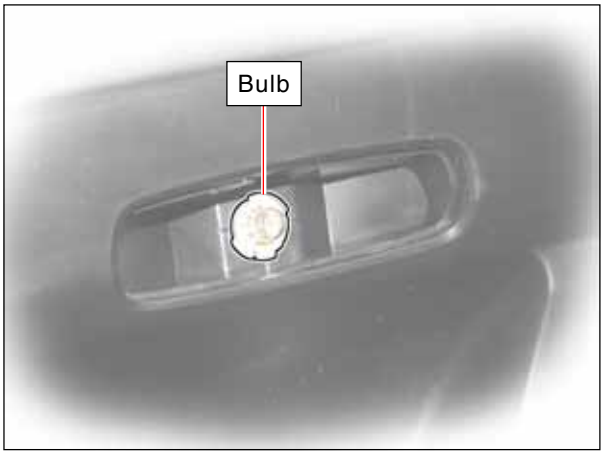
1. Remove the door courtesy lamp cover from the door panel.



NOTICE

- **Remove the cover using the groove not to damage other components.**

2. Remove the bulb from the door courtesy lamp.



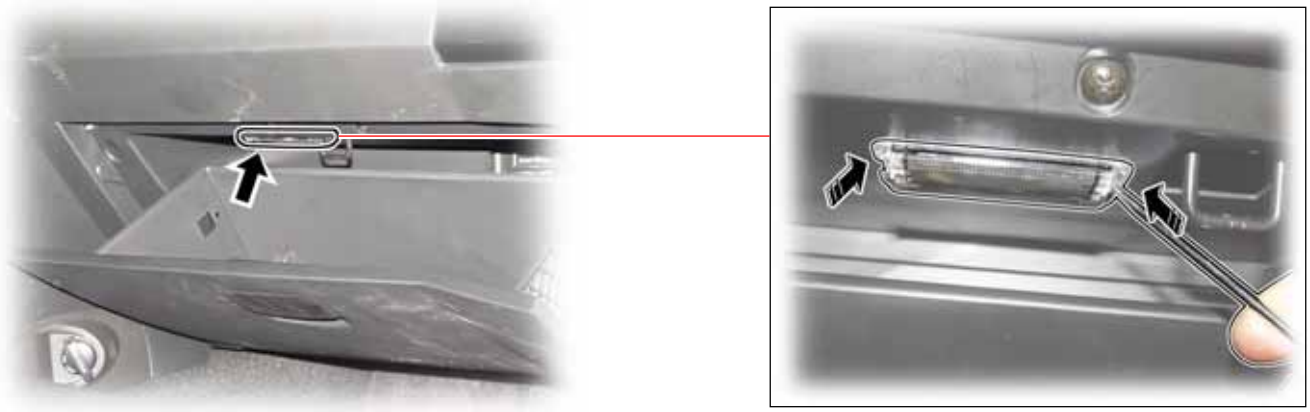
NOTICE

- **Use only specified bulb for replacement.**
- **The bulb should be installed to the groove correctly. If there is gap, apply adhesive to the groove. If it is installed loosely, it can be off the position and damage the door trim due to the vibration from slamming door or vehicle vibration.**

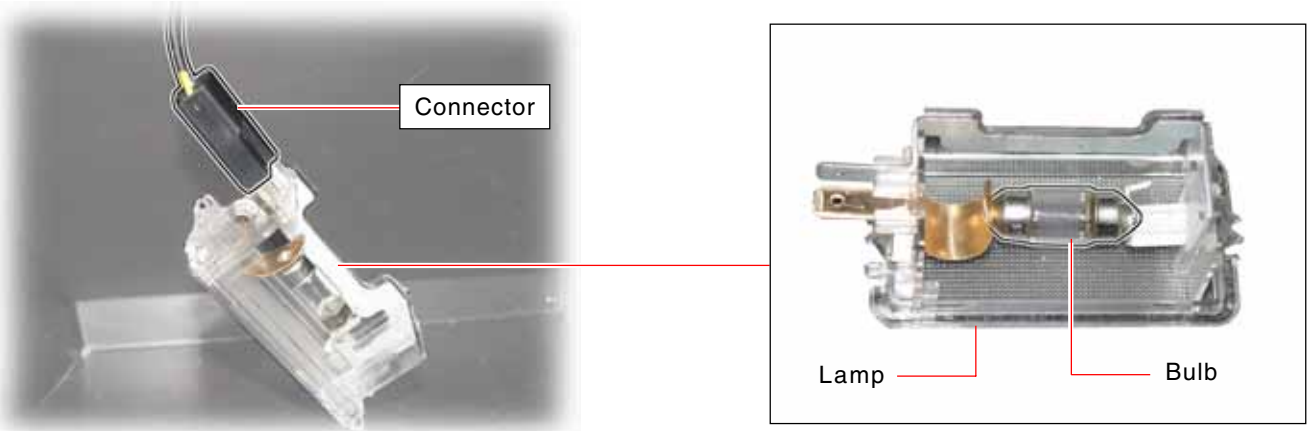
▶ Glove Box Lamp Assembly

※ **Preceding work:** Turn the light switch OFF.

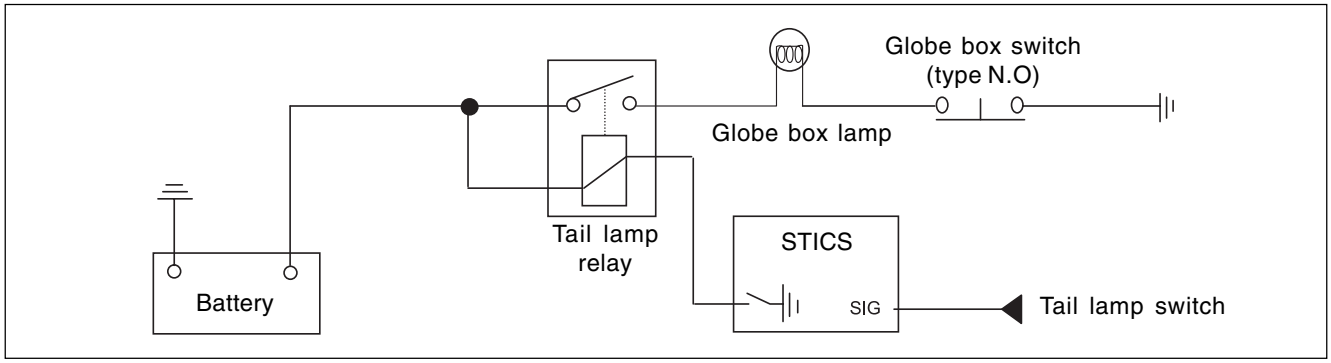
1. Open the glove box and remove the lamp by pushing both sides (arrows).



2. Disconnect the connector and remove the lamp assembly.



Glove Box Lamp Illumination Circuit



Description

1. The tail lamp switch signal is sent to STICS which then outputs the tail lamp relay ground so that the lamp comes on if the glove box is open.
2. The tail lamp comes on as above if the auto light tail lamp signal is sent to STICS while the auto light operates.
3. The tail lamp goes off when opening and closing the driver's door after removing the ignition key even though the operating conditions are met (battery saver function).

SUNROOF SYSTEM

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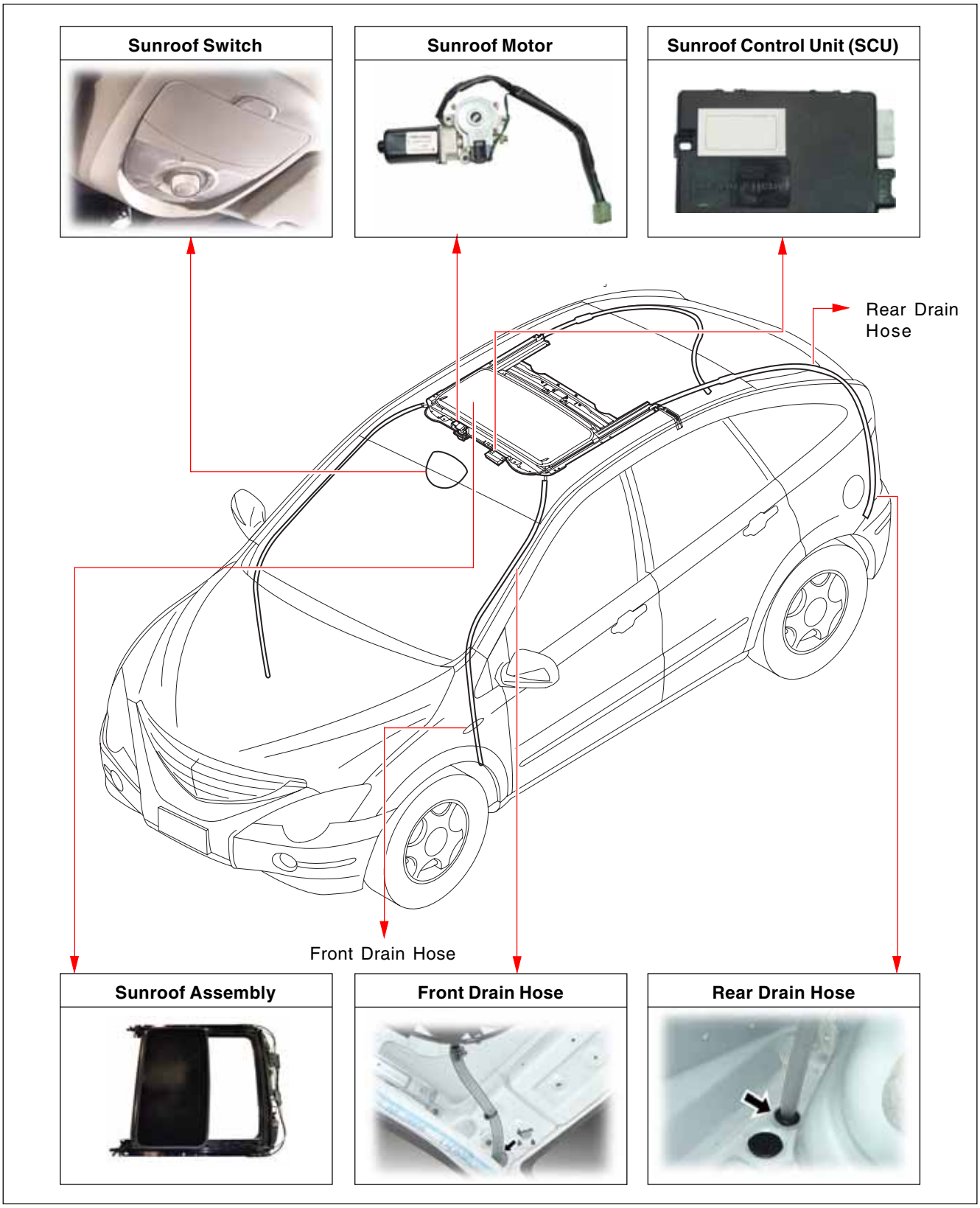
TABLE OF CONTENTS

SUNROOF ASSEMBLY 2

1. Components and locations 2
2. Operation and function 3
3. Trouble diagnosis 7
4. Removal and installation of sunroof assembly and components 8

SUNROOF ASSEMBLY

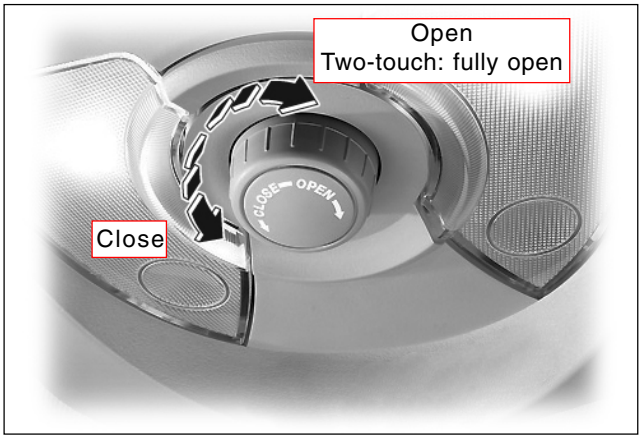
1. COMPONENTS AND LOCATIONS



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EFFECTIVE DATE	
AFFECTED VIN	

2. OPERATION AND FUNCTION

When driving the vehicle with the window or sunroof open at a certain position, you may feel some pressure upon your ears or hear some noises similar to those from a helicopter (wind buffeting effect). This happens because of an influx in air through the window or sunroof and its resonance effect. If this happens, adjust by opening the window or sunroof. Actyon introduced two-touch function to the sunroof. When the sunroof is at the 1st stop position, it minimizes the wind buffeting effect. To open the sunroof fully, move the switch to the second stop.





▶ Sunroof Sliding Operation

1. Two-touch Open

If you rotate the sunroof switch clockwise (OPEN direction) for less than 0.5 seconds, the sunroof slides back and opens until it reaches at the 1st stop position (330 mm). Then, if you continue to rotate the switch to its stop, the sunroof is fully opened (420 mm). To stop the operation while moving, operate the sunroof switch to any direction.

2. Close

To fully close the sunroof, briefly (for approx. 0.5 sec.) rotate the sunroof switch counterclockwise (CLOSE direction) with the sunroof open. To partially close the sunroof, rotate and hold the sunroof switch until it reaches at the desired position.

▶ Sunroof Tilting Operation

1. Tilt-up

To tilt-up the sunroof, rotate the sunroof switch counter-clockwise (CLOSE direction) with the sunroof fully closed.

2. Tilt-down

To tilt-down the sunroof, rotate the sunroof switch clock-wise (OPEN direction) with the sunroof tilted-up.

▶ Anti-trap Function

To prevent any body parts from being trapped by the sliding sunroof, an Anti-Trap function automatically opens the sunroof when an object is trapped. However, if the Anti-Trap function operates 3 times consecutively, the function switches to the manual operation and the sunroof goes back to the original position.

However, if the force against the sunroof is less than the specified value or the continuous resistance is detected, the Anti-Trap function doesn't operate. Therefore, make sure that there is no obstacle such as hand, head or part of body before operating the sunroof.



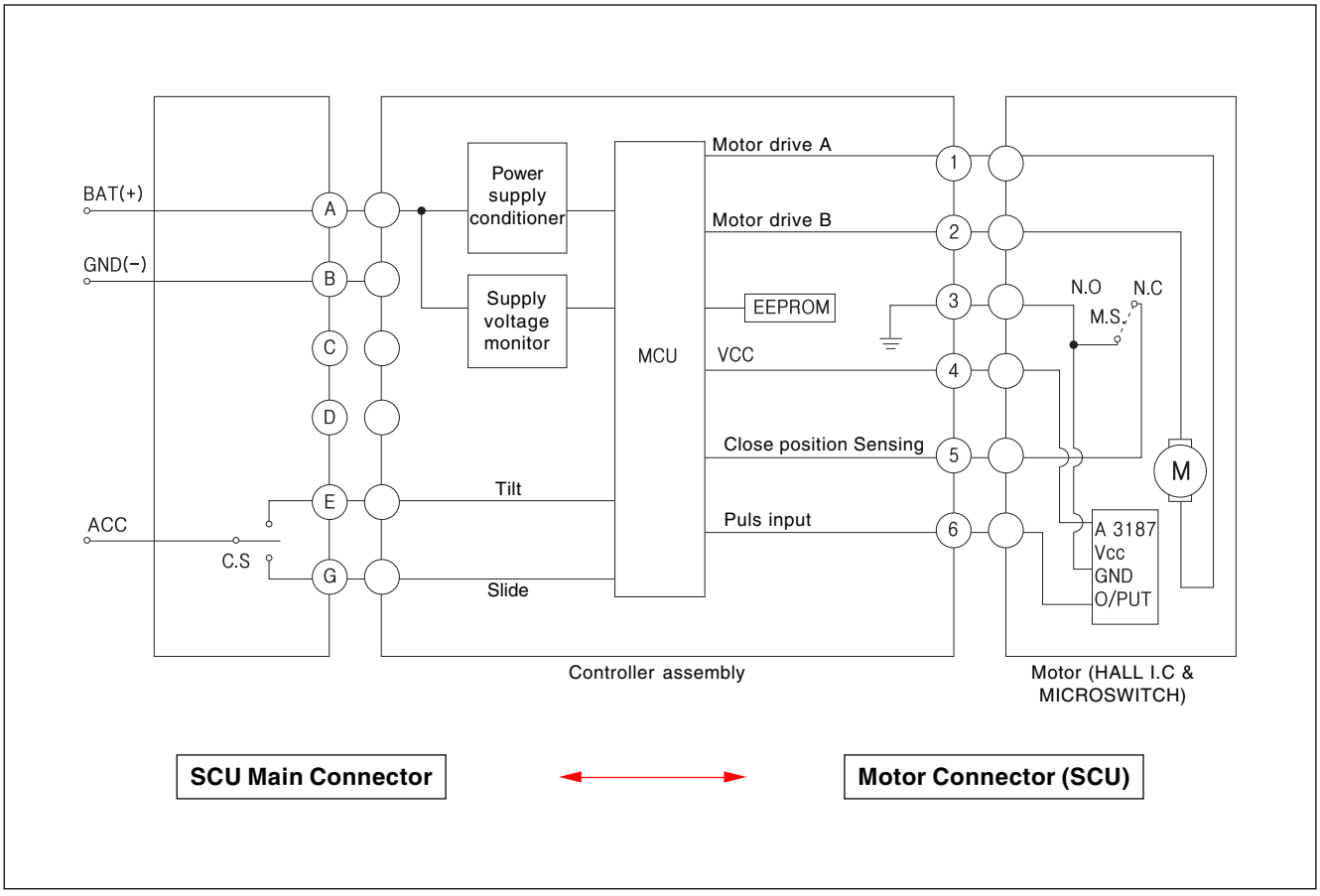
Anti-trap function is integrated in SCU.

▶ Hazard (Manual) Operation

The sunroof can be operated by rotating the screw in motor operating hole on the sunroof motor with a proper tool.

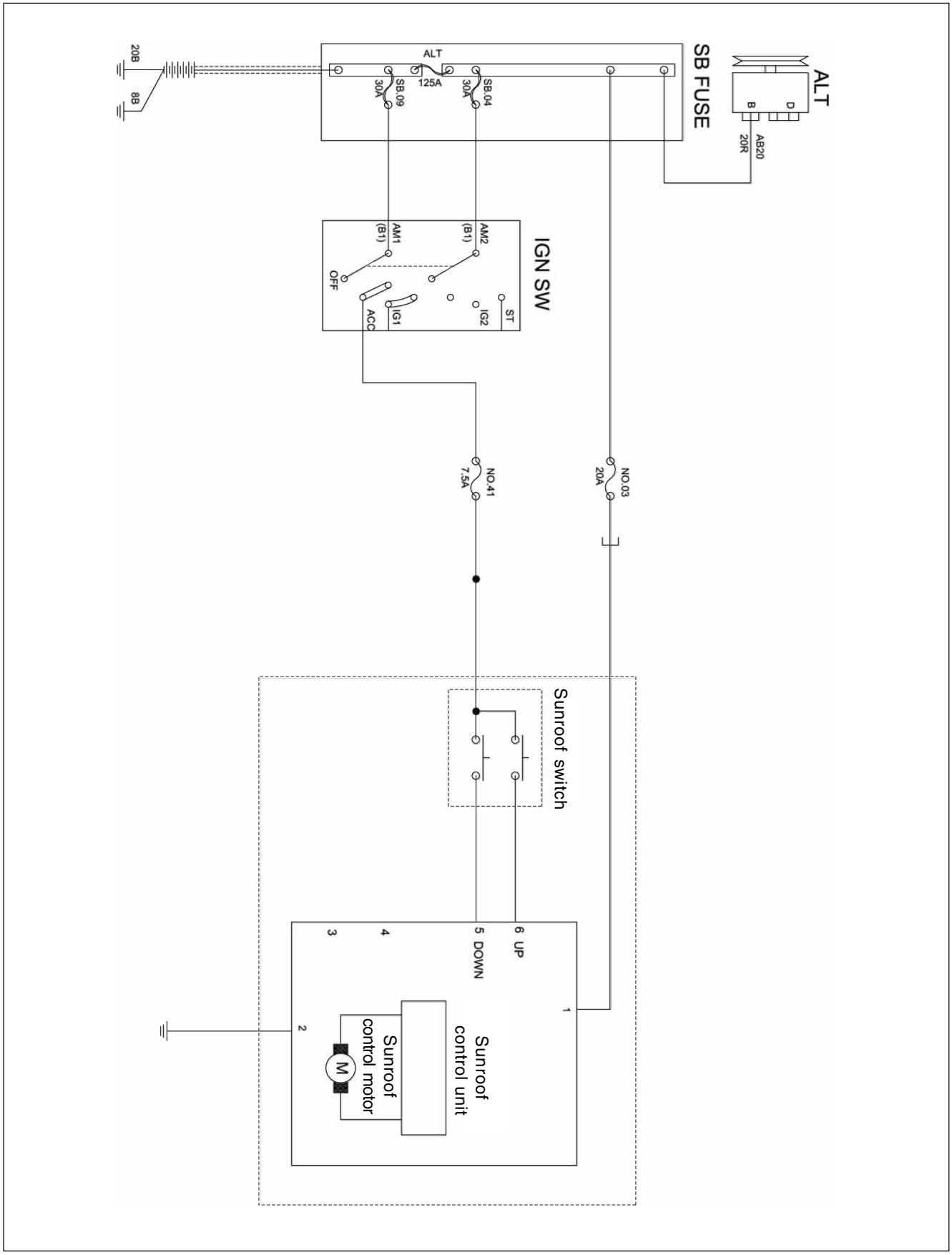


▶ Circuit Diagram of Sunrrof Motor and SCU



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AFFECTED VIN	

▶ Circuit Diagram of Sunroof



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EFFECTIVE DATE	
AFFECTED VIN	

▶ Resetting of Sunroof Control Unit

If the sunroof does not operate properly, check and reset the sunroof control unit.

1. To prevent any parts damage and personal injury, the sunroof setting is canceled
   1) When the battery voltage is not provided, the fuse is blown, or the abrupt voltage drop occurs due to deteriorated battery while operating the sunroof.
   2) When an undesired cancellation occurs due to mistake by a technical person during repairing the sunroof system.
   3) When parts damage, shorted circuit, or electric leakage occurs.
   4) When keeping the sunroof switch at "OPEN" position.

2. Symptoms when the sunroof setting is canceled
   1) The one-touch operation cannot be activated.
   2) The sunroof is tilted even after completion of closing operation when closing it.
   3) The sunroof opening and tilting level is significantly low.
   4) The sunroof does not operate properly when operating the sunroof switch.

3. [0] point reset of sunroof
   1) Close the sunroof with the sunroof switch and keep the position for approx. 10 seconds. If the [0] point setting is successfully completed, the sunroof should be properly opened from this position.
   2) Check if the sunroof is fully closed. Tilt the sunroof with the sunroof switch and keep it at the position for 10 seconds ([0] point setting).
   3) Close the sunroof with the sunroof switch.

4. Checking after reset
   1) If the sunroof does not operate properly, check the power supply system.

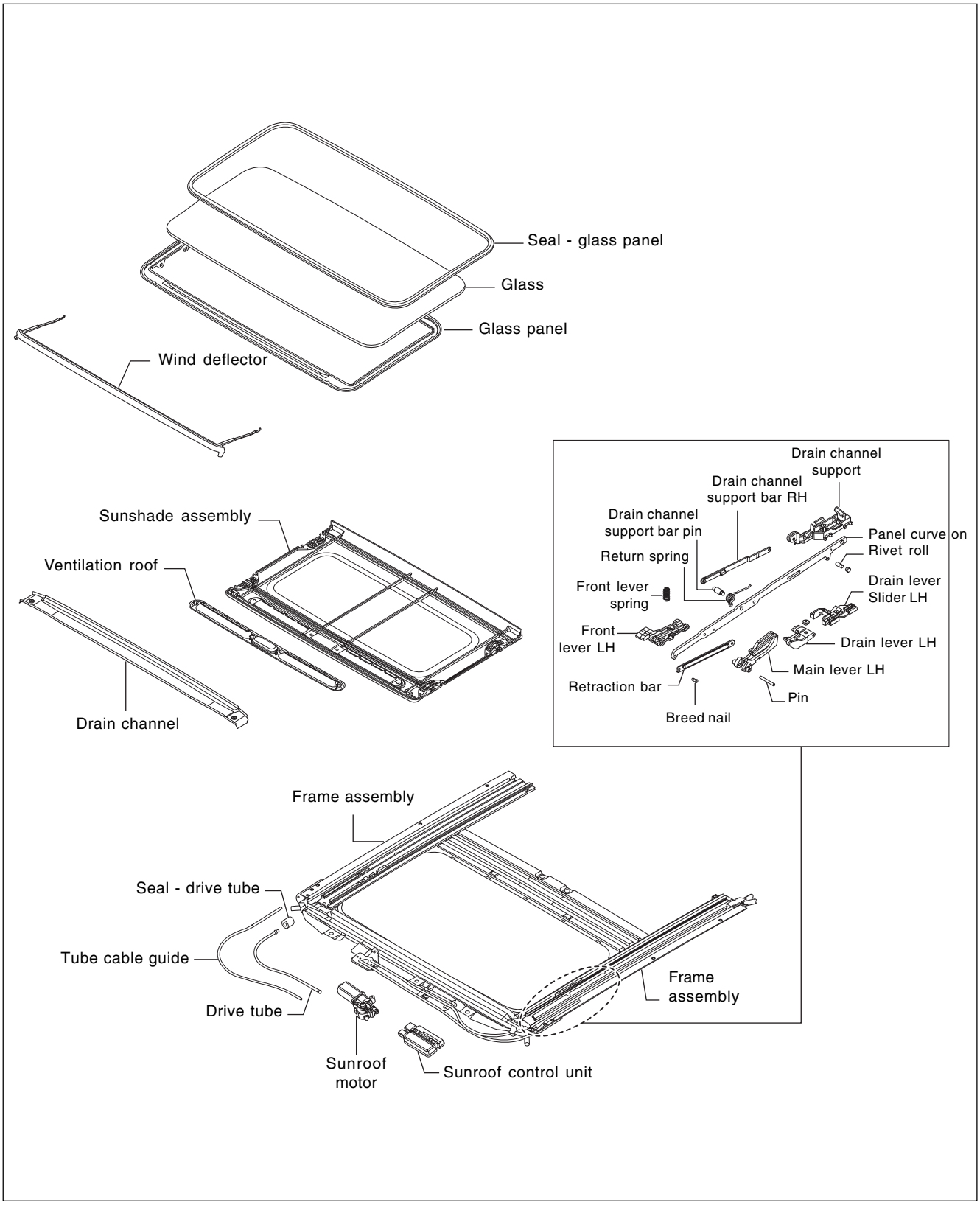
      If the sunroof does not operate when the power supply system is in normal conditions, check the sunroof motor and sunroof control unit and replace the defective component as necessary. Replace the sunroof control unit first and operate the sunroof. If the problem still exists, replace the sunroof motor.
   2) If the sunroof operates only when the switch is operated, check the ground circuit of switch and reset the sunroof system again.

3. TROUBLE DIAGNOSIS

Symptom	Cause	Action
Water leaks	Clogged or bent drain hose	Check and correct drain hose conditions.
	Improper gap and clearance between panel and glass	Readjust glass location.
Wind noise	Improper gap and clearance between panel and glass	Readjust glass location.
Improper operations	Defective wire, fuse or ground	Check and replace/repair.
	Defective relay, motor or unit	Replace the defecive component.
	Damaged side cover by dislocation of sun shade	Reinstall sun shade and side cover. (Replace the damaged parts.)
	Foreign material in rail	Remove foreign material.
Malfunction	Caught side cover by dislocation of sun shade	Reinstall sun shade and side cover. (Replace the damaged parts.)
	Improper operation of anti-trap function	Check interference of body and wind deflector. (Relieve the spring tension.)
	Defective motor	Replace it.
Operation noise	Caught side cover by dislocation of sun shade	Reinstall sun shade and side cover. (Replace the damaged parts.)
	Interference between drain hose and vehicle body	Attach a sponge on drain hose.
	Interference between vehicle body and roof panel	Apply sealant between vehicle body and roof panel.
	Improper gap and clearance between roof panel and glass	Readjust glass location.

4. REMOVAL AND INSTALLATION OF SUNROOF ASSEMBLY AND COMPONENTS

▶ Exploded View



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EFFECTIVE DATE	
AFFECTED VIN	

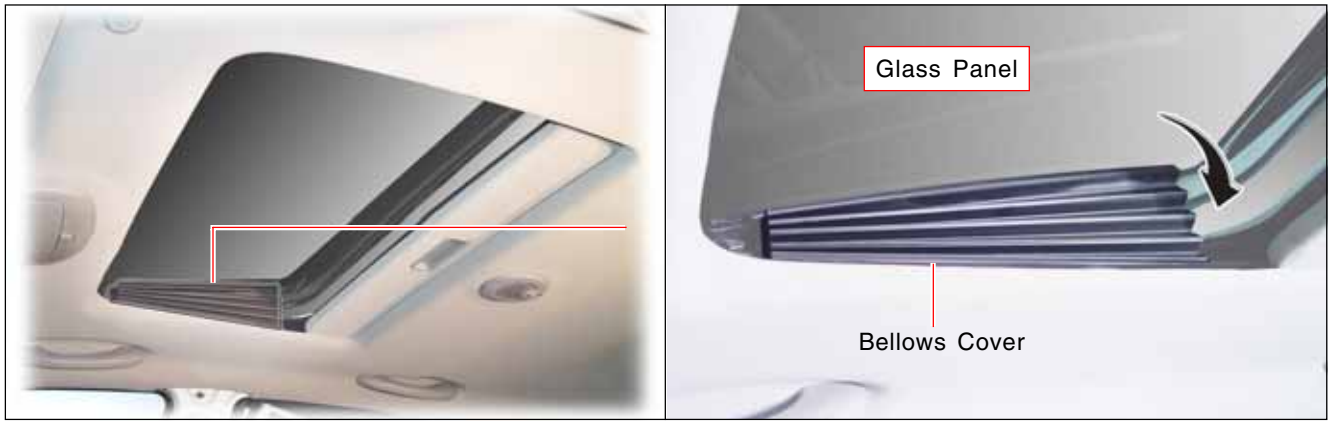
▶ Glass Panel Assembly

NOTICE

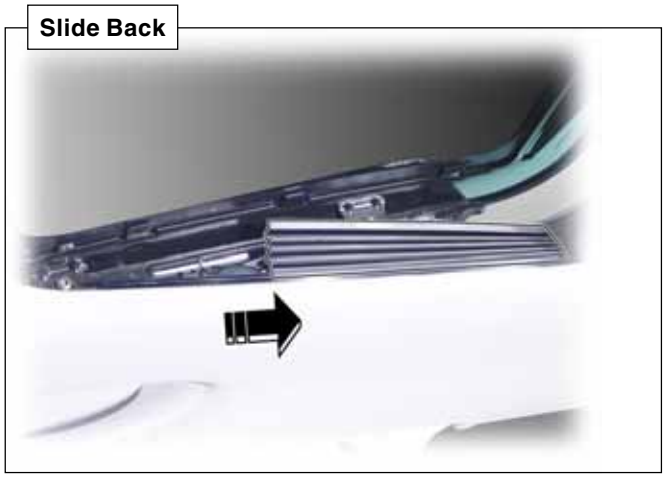
- **Work only when the sunroof is tilted-up.**

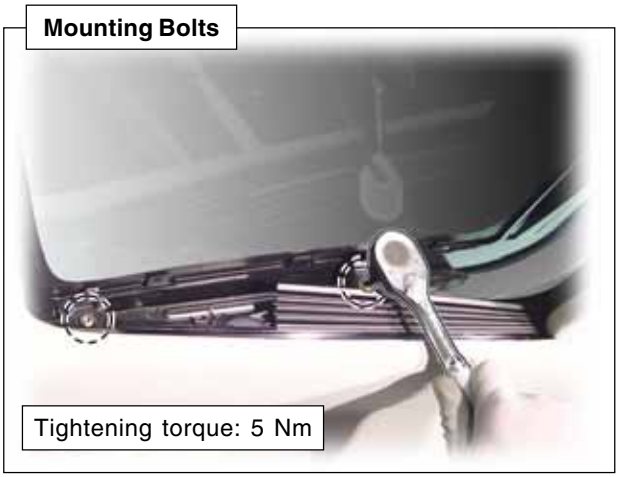
Removal of Glass Panel

1. Separate the upper side of the bellows cover from the glass panel while the sunroof is tilted up.



2. Slide the bellows cover backward (to the tailgate side) and remove two mounting bolts (TORX bolt) on the glass panel with a Torx wrench (25 T).





3. Remove the glass panel.



Installation of Glass Panel

1. Place the glass panel with the sunroof tilted-up and temporarily tighten two TORX bolts (T25) at both sides. At this moment, the logo on the glass panel should face the rear side of the vehicle.



2. Completely close the sunroof using the sunroof switch.

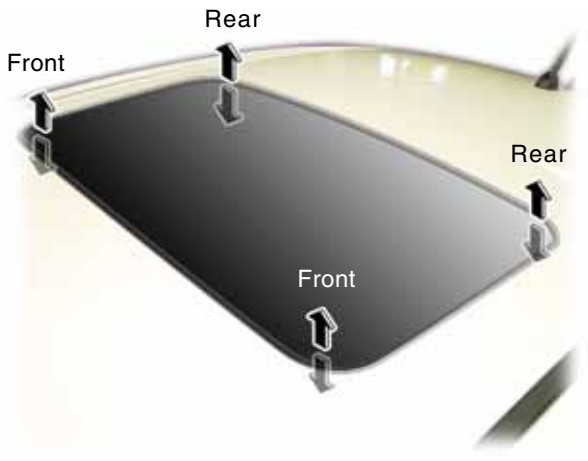


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Adjust the following items with the specified value and tighten the bolts.

1. Gap Between Front and Rear Glass Panel

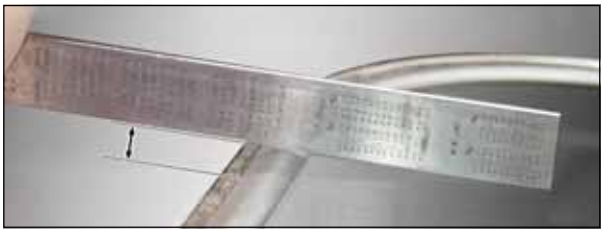
Gap: Distance from roof panel to glass



1) Front gap (-1 ~ 0 mm)

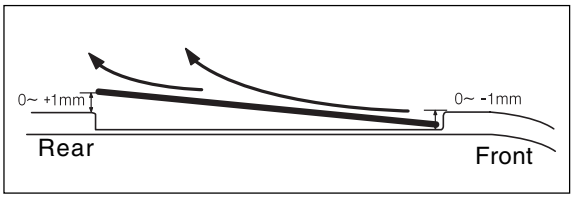


2) Rear gap (0 ~ 1 mm)



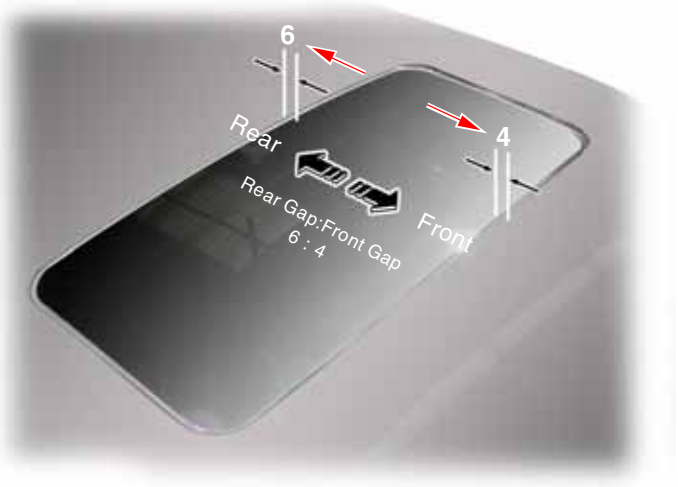
NOTE

- **To prevent the wind noise during high speed driving (over 100 km/h), the rear gap should be greater than front gap.**



2.Front/Rear Gap of Glass Panel

To avoid the abnormal noise due to interference between roof panel and rear section of sunroof glass panel while driving, the installation gap should be maintained the ratio of 4:6 (front:rear) when installation.



NOTE

- **Install the glass panel by pressing the glass panel to the front side while checking the gap. This work should be done by two operators.**

3. After Assembly

Measure the interference between roof and glass panel while moving the glass panel.

Gap between roof and glass panel should be approx. 5 mm. If this gap is too small, the glass panel may be scratched or the interferencing noise may sound.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Bellows Cover

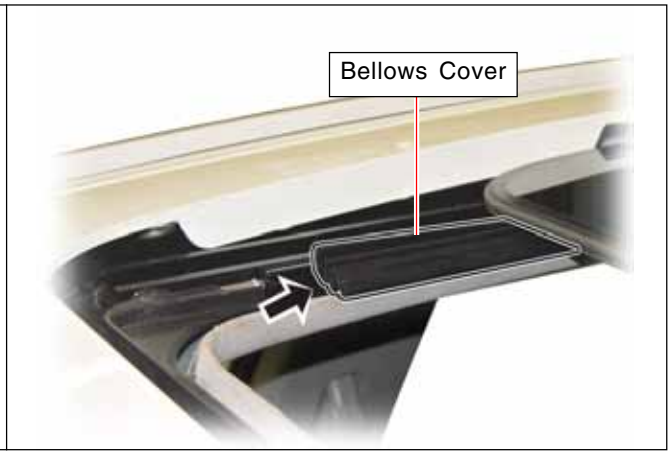
1. Open the sun shade panel and separate the upper side of the bellows cover from the glass panel.





2. Slide the sunroof halfway back using the sunroof switch.





3. Remove the bellows cover by pulling it forward. When installing it, inserting the bellows cover to the groove of the sunroof mechanism.





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

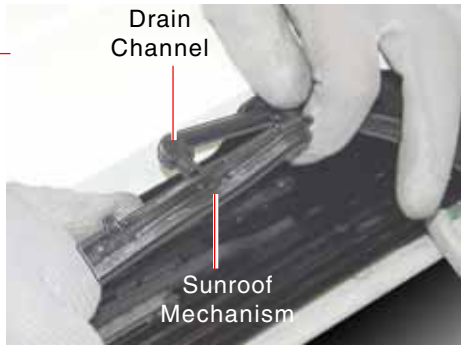
▶ Drain Channel

With Sunroof Sliding Open

※ **Preceding Work:** Remove the glass panel.

1. Separate the locks of drain channel from the sunroof mechanism mounting holes at both sides.





2. Lift one lock above the drain channel mounting hole and separate the lower lock of the drain channel.



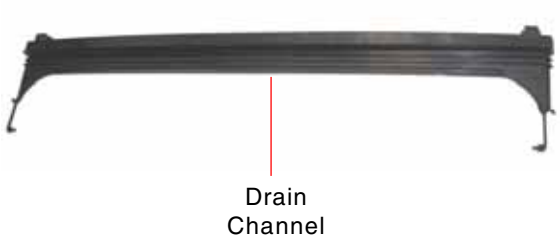


NOTICE

- **When removing the drain channel, do not apply excessive force on it. Otherwise, it may be damaged.**

3. Remove the drain channel.





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Sun Shade Panel

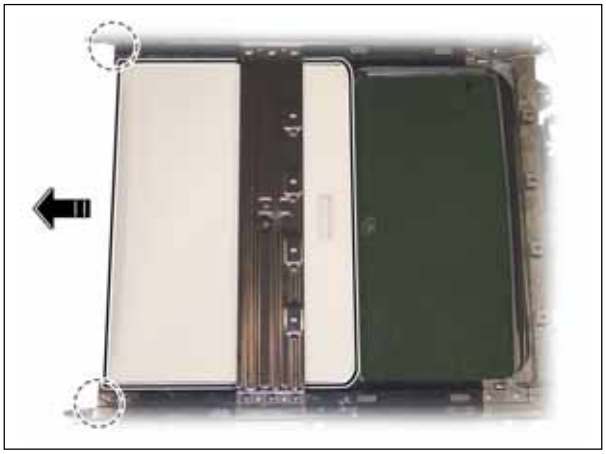
With Sunroof Fully Closed

※ **Preceding Work:** 1. Fully close the sunroof with sunroof switch.
2. Remove the headlining assembly.

1. Remove the mounting clip (small picture) with the headlining removed.



2. Remove the sun shade panel through the sunroof mechanism rail.



▶ Sunroof Control Unit (SCU) and Motor

With Sunroof Fully Closed

※ **Preceding Work:** 1. Fully close the sunroof with sunroof switch.
2. Remove the headlining.

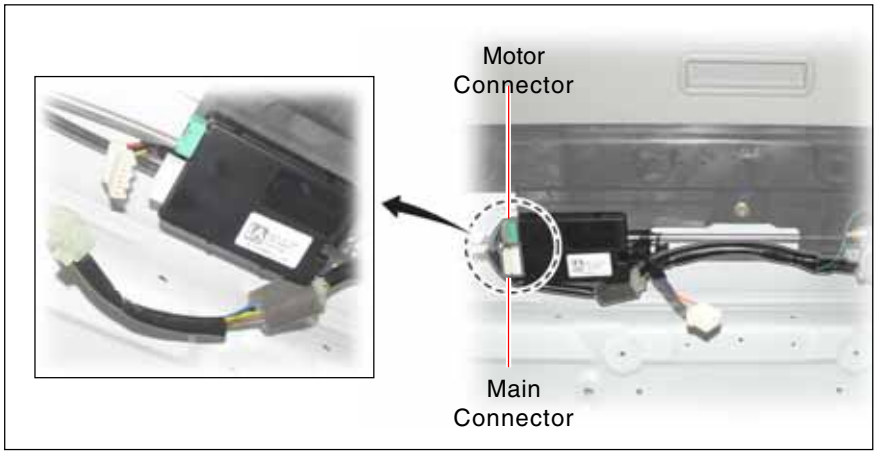
SCU Assembly



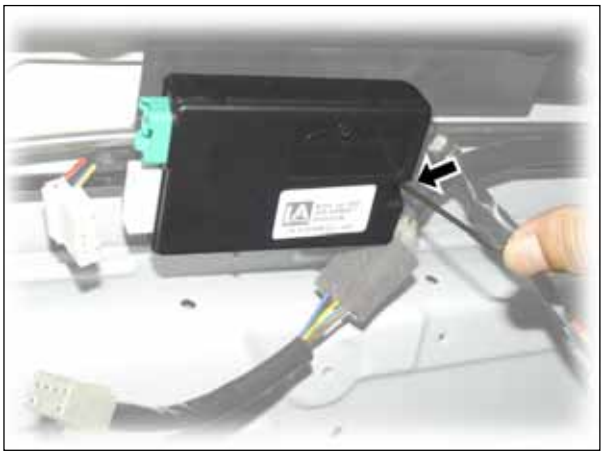
1. Remove four mounting bolts between SCU and motor and remove the protective panel.



2. Disconnect the connector from the sunroof control unit.

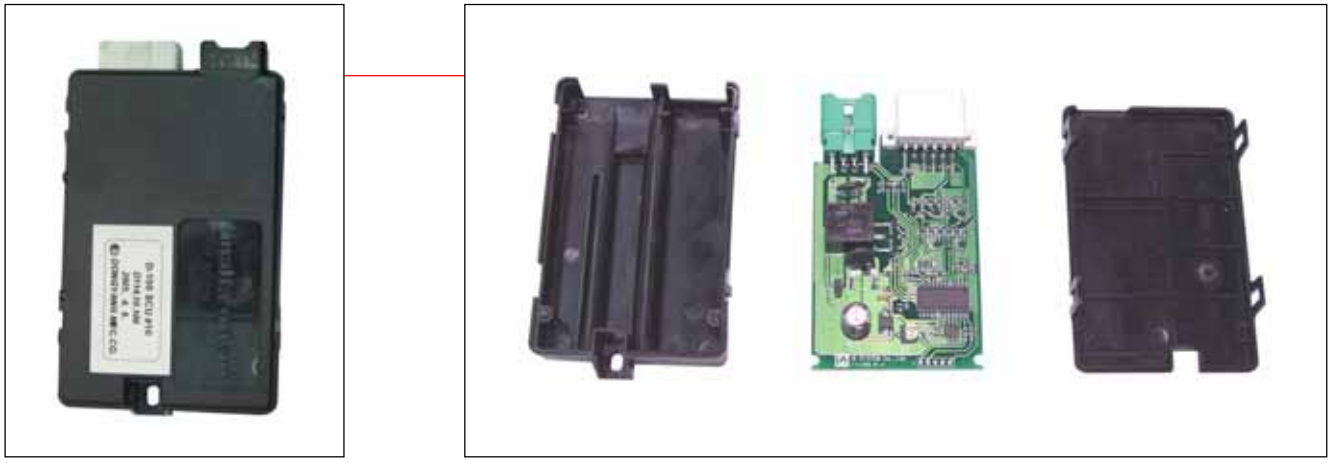


3. Remove the SCU mounting bolt (TORX bolt) using a Torx wrench.

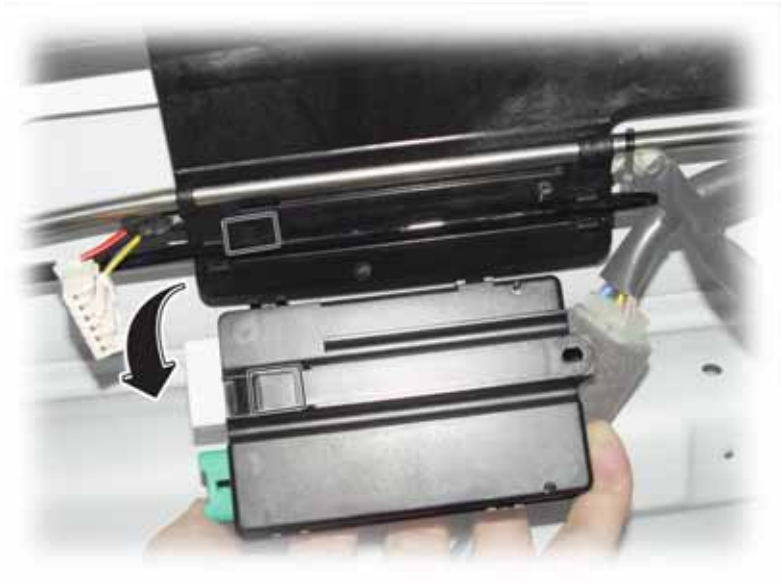


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Remove the SCU from the sunroof rail.



5. When installing, completely fit the sunroof rail into the slot of sunroof control unit and tighten the screw.



NOTICE

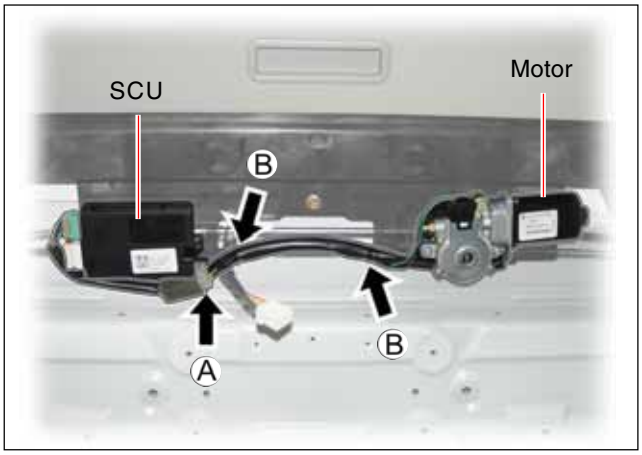
- **Completely fit the sunroof rail and wiring into the slot of sunroof control unit.**

Completely fit the tab.



Motor Assembly

1. Separate the connector (A) and the mounting clamp (B) from the SCU with the protective panel removed.



2. Unscrew the three mounting bolts (25T) with a Torx wrench and remove the motor assembly from the sunroof rail.

Removal of Mounting Bolt (T25)



Removal of Motor Assembly



NOTICE

- **To make the motor positioning easier, do not operate the motor (even for the testing) before installation.**



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Sunroof Drain Hose

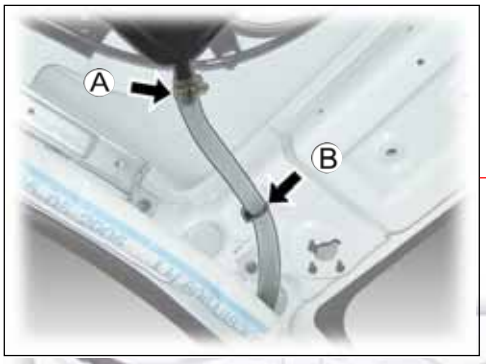
※ **Preceding Work:** 1. Remove the headlining.
2. Remove the rear quarter panels (LH/RH).

NOTICE

- **Be careful not to bend and damage the hose by sheet metal (vehicle body).**

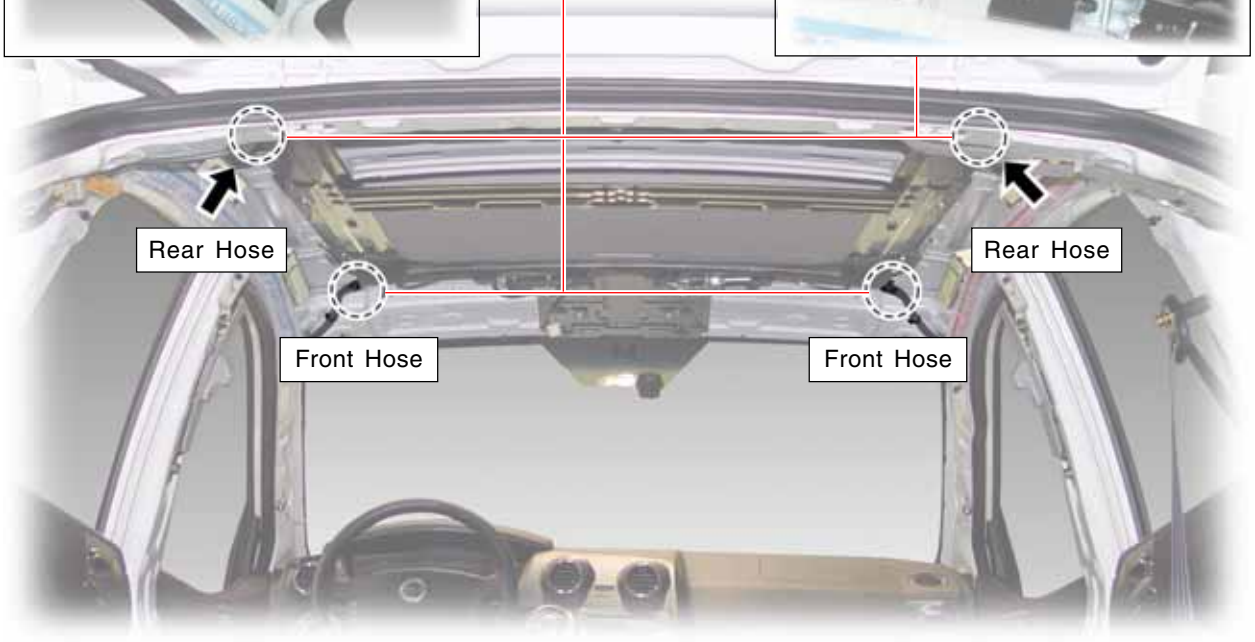


1. Separate the clamp (A) and mounting piece (B) from the front drain hose and remove the hose.

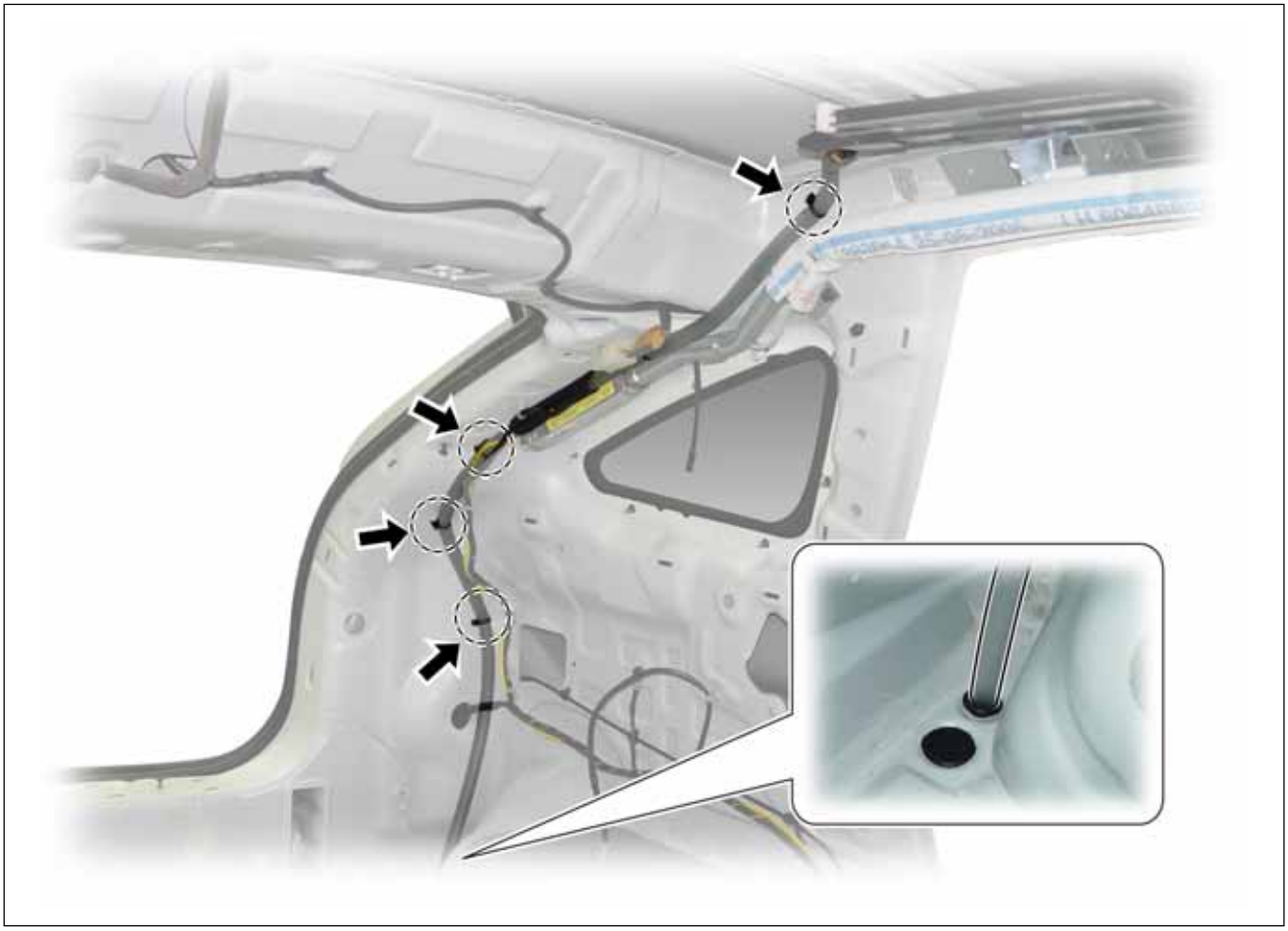


2. Remove the clamp from the rear drain hose.





3. The rear drain hose can be removed after removing the fasteners as shown in the figure.

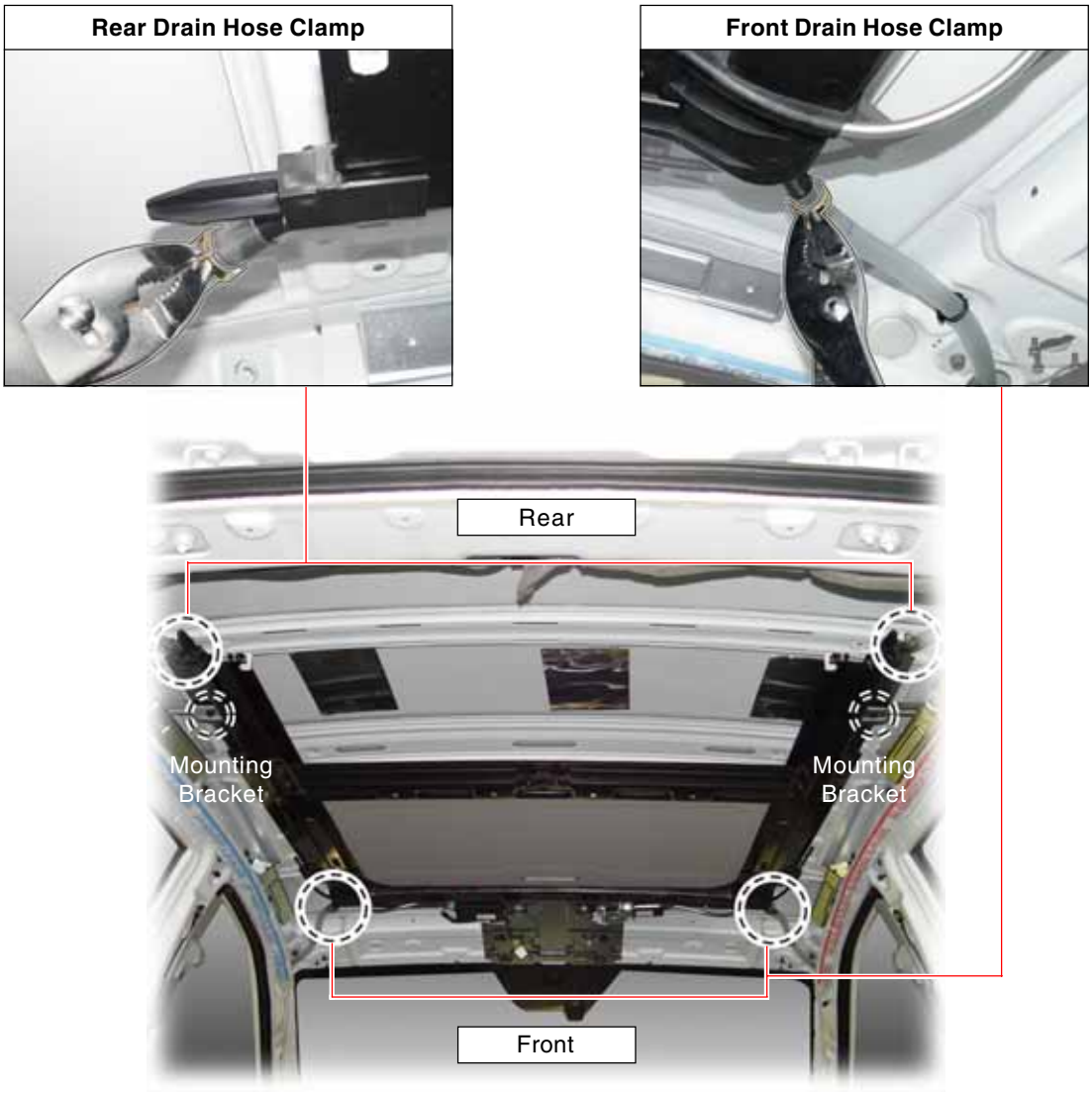


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

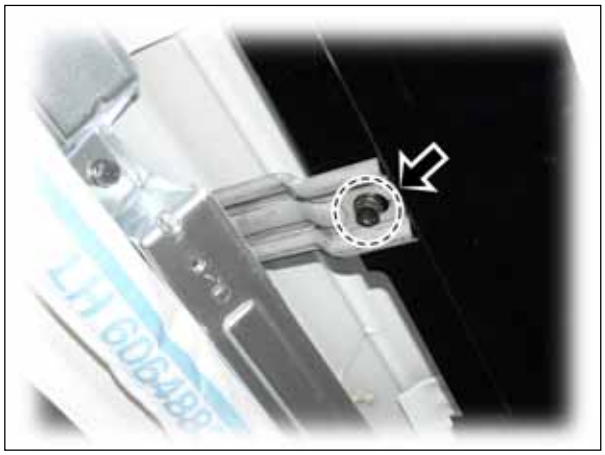
▶ Sunroof Assembly

※ **Preceding Work:** Removal of headlining

1. Separate the front and rear drain hoses with the sunroof closed.



2. Unscrew two bracket mounting bolts at both sides.

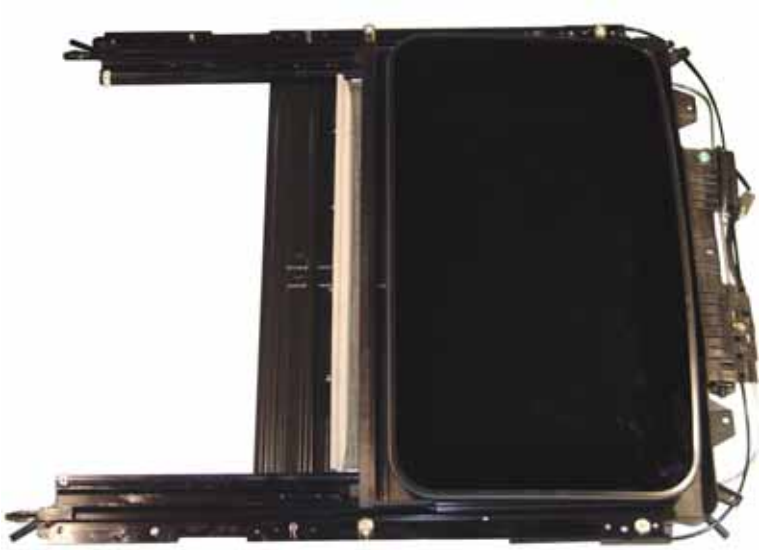


3. Unscrew seven mounting bolts and remove the sunroof assembly.



Sunroof Assembly





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SEAT & SEAT BELT

7410 / 7430

TABLE OF CONTENTS

SEAT ASSEMBLY 2

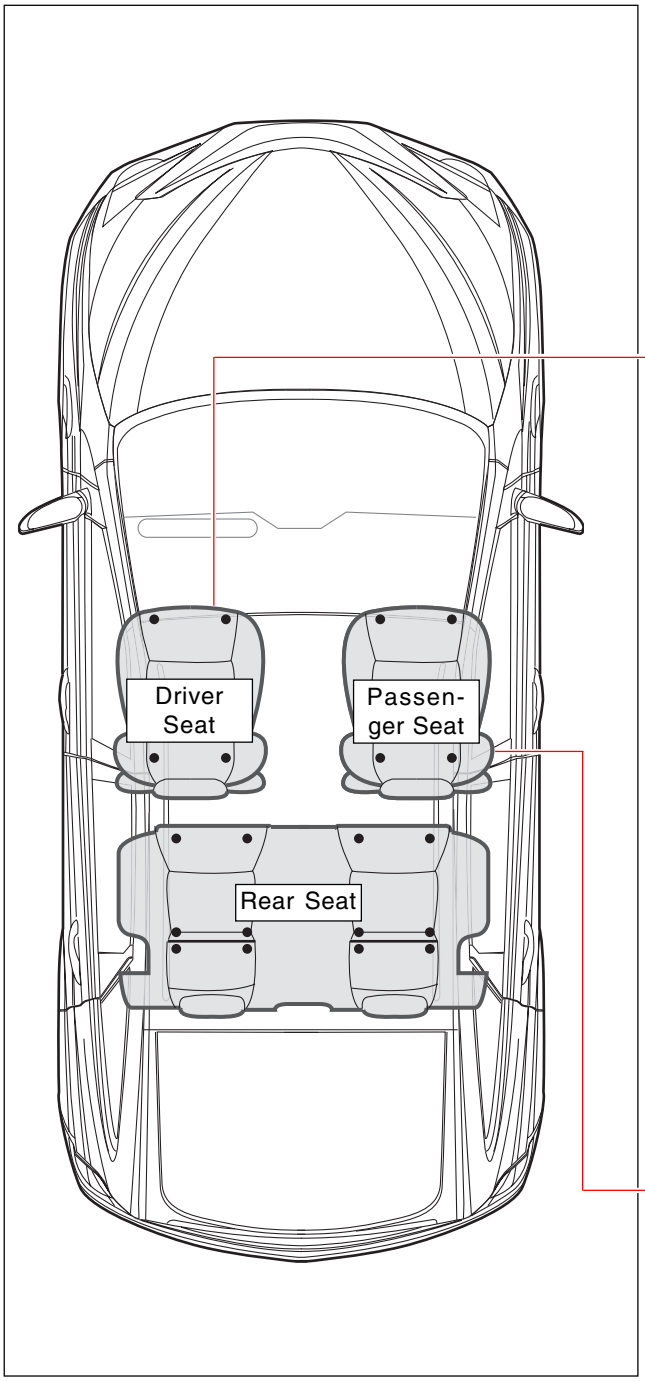
1. Seat mounting points 2
2. Composition and function of seat 4
3. Removal and installation of seat assembly 8

SEAT BELT 13

1. Seat belt configuration 13
2. Removal and installation of seat belt 14

SEAT ASSEMBLY

1. SEAT MOUNTING POINTS



Front Seat

1. Driver seat mounting point

Tightening torque	35 ~ 55 Nm



2. Passenger seat mounting point

Tightening torque	35 ~ 55 Nm



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Rear Seat

Seatback (Rear No.2)



Tightening torque: 35 ~ 55 Nm

Seatback (Rear No.1), Rear side



Tightening torque: 35 ~ 55 Nm



Rear Seat



Tightening torque: 35 ~ 55 Nm

Seatback (Rear No.1), Front side



Tightening torque: 35 ~ 55 Nm

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. COMPOSITION AND FUNCTION OF SEAT

▶ Front Seat

Driver Seat



Lumbar
Support Lever

Reclining Motor

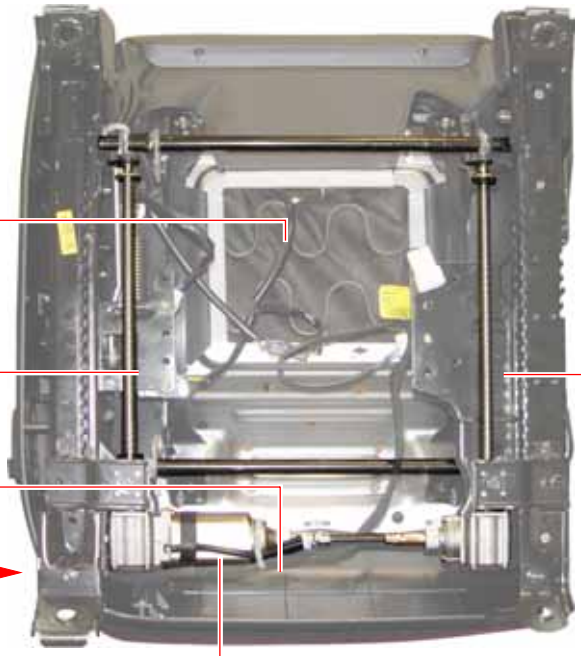


Seat cushion
(rear area) up/
down bar

Sliding rail

Sliding rail

Seat cushion
(front area) up/
down bar



Sliding motor

**Seat Cushion (Rear Area)
Up/Down Motor**

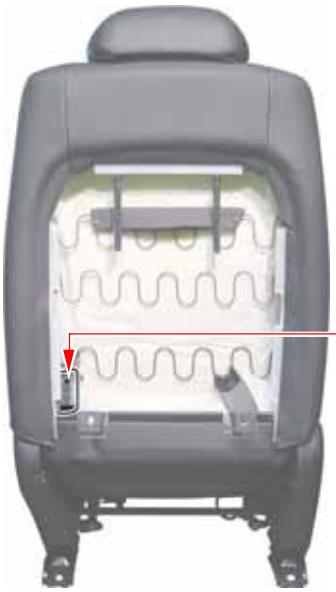


**Seat Cushion (Front Area)
Up/Down Motor**



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Passenger Seat

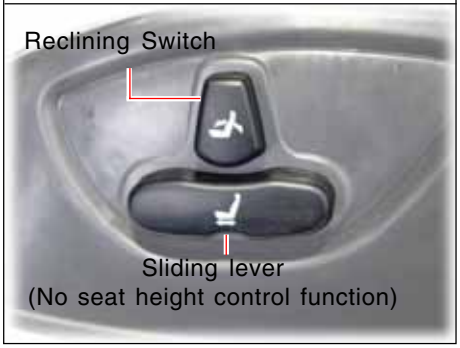


Reclining Motor





Power Seat Switch

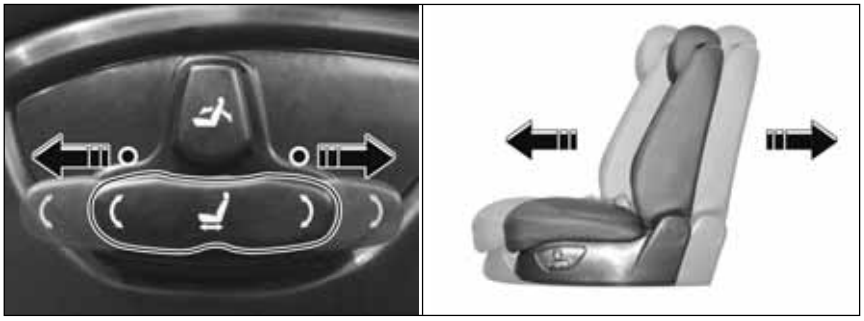


▶ Functions

Switches and Functions of Driver Seat

1. Seat Sliding Adjustment

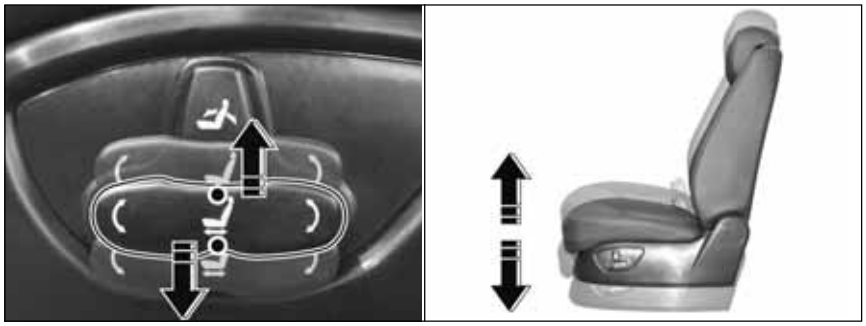
When sliding the switch forward or rearward, the seat slides forward or rearward by the sliding motor.



*** Driver and passenger seats**

2. Seat Cushion Height Adjustment

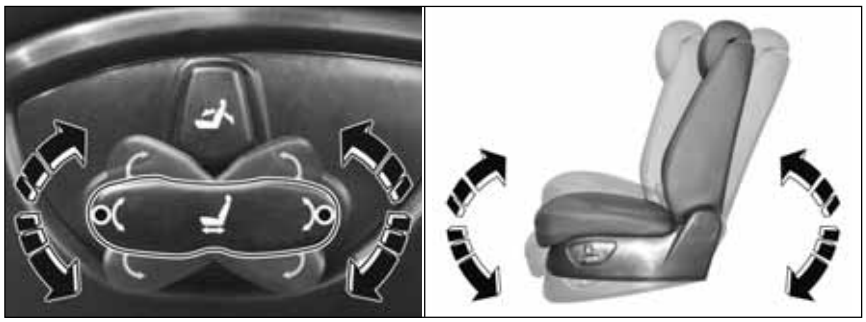
When moving the center of the switch up or down, the whole seat cushion moves up or down.



*** Only for driver seat**

3. Seat Cushion Angle Adjustment

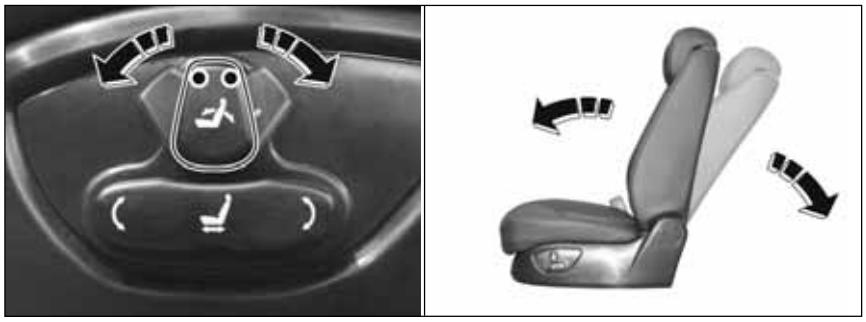
When moving **the front side of the seat cushion switch** up or down, the front side of the seat cushion moves up or down. When moving **the rear side of the switch** up or down, the rear side of the seat cushion moves up or down.



*** Only for driver seat**

4. Seatback Reclining Adjustment

When moving the upper side of the reclining switch forward or rearward, the seatback moves forward or rearward by the motor.



*** Driver and passenger seats**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Rear Seat



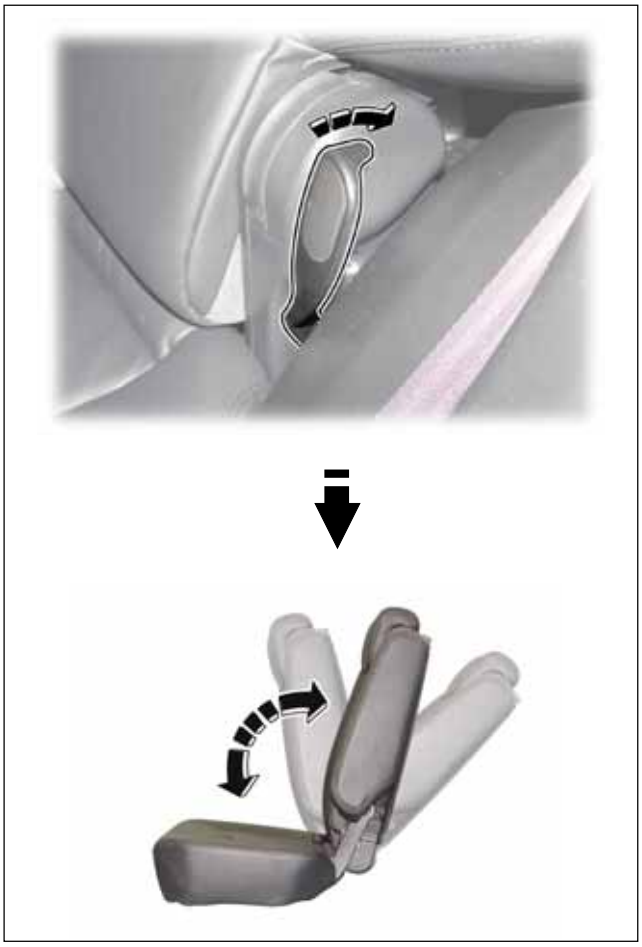
1. Headrest Height Adjustment



To raise the headrest, pull it up without pressing the release button. To lower the headrest, press the release button (1) on top of seatback and push the headrest down.

2. Seatback Reclining Adjustment

To change the seatback angle, push the lever rearward. Then, release the lever at the desired position. The seat is locked at the position



Full Flatting the Seat



3. REMOVAL AND INSTALLATION OF SEAT ASSEMBLY

▶ Front Seats (Driver and Passenger Seats)

- The driver seat and the passenger seat can be removed with the same manner.

NOTE

- **To remove the bolt cap, insert a flat blade screw driver into the slot and pry the bolt cap off.**

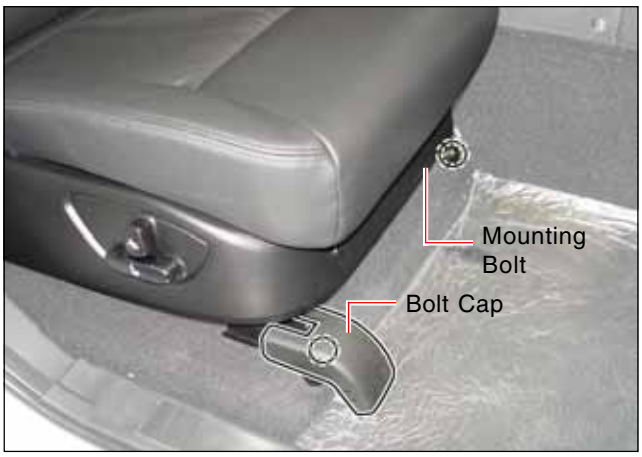




1. Move the seat rearward as far as possible. Remove the bolt cap and unscrew the mounting bolts at both sides.

Installation Notice

Tightening torque	35 ~ 55 Nm

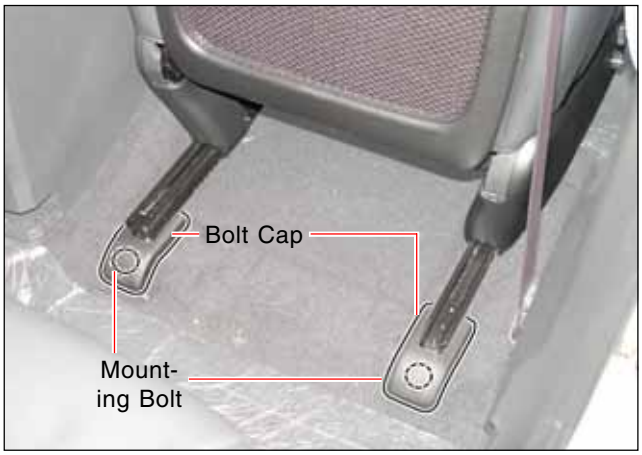


*** Passenger seat (Same in driver seat)**

2. Move the seat forward as far as possible. Remove the bolt cap and unscrew the mounting bolts at both sides.

Installation Notice

Tightening torque	35 ~ 55 Nm



*** Passenger seat (Same in driver seat)**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Lay down the seatback and disconnect the connector under the seat and then remove the seat assembly.

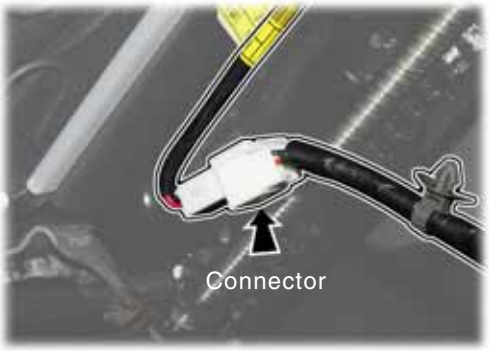
Driver Seat





Passenger Seat





Driver and Passenger Seats

*** When installing, make sure to follow the specified torque and fit it into the mounting hole.**

Passenger Seat



Driver Seat



▶ Rear Seat

1. Slide the front seats forward and remove the seat mounting bolt caps and two mounting nuts.

Tightening torque	35 ~ 55 Nm



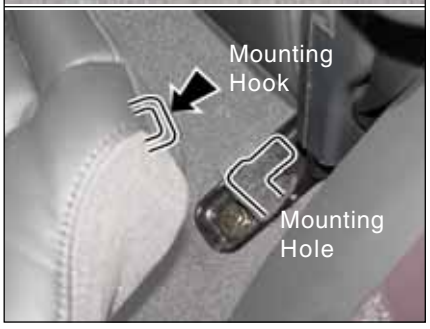




2. Unscrew the seat mounting bolts and remove the seat cushion while sliding it toward the seatback. At this moment, the seat cushion should be out of the mounting holes.

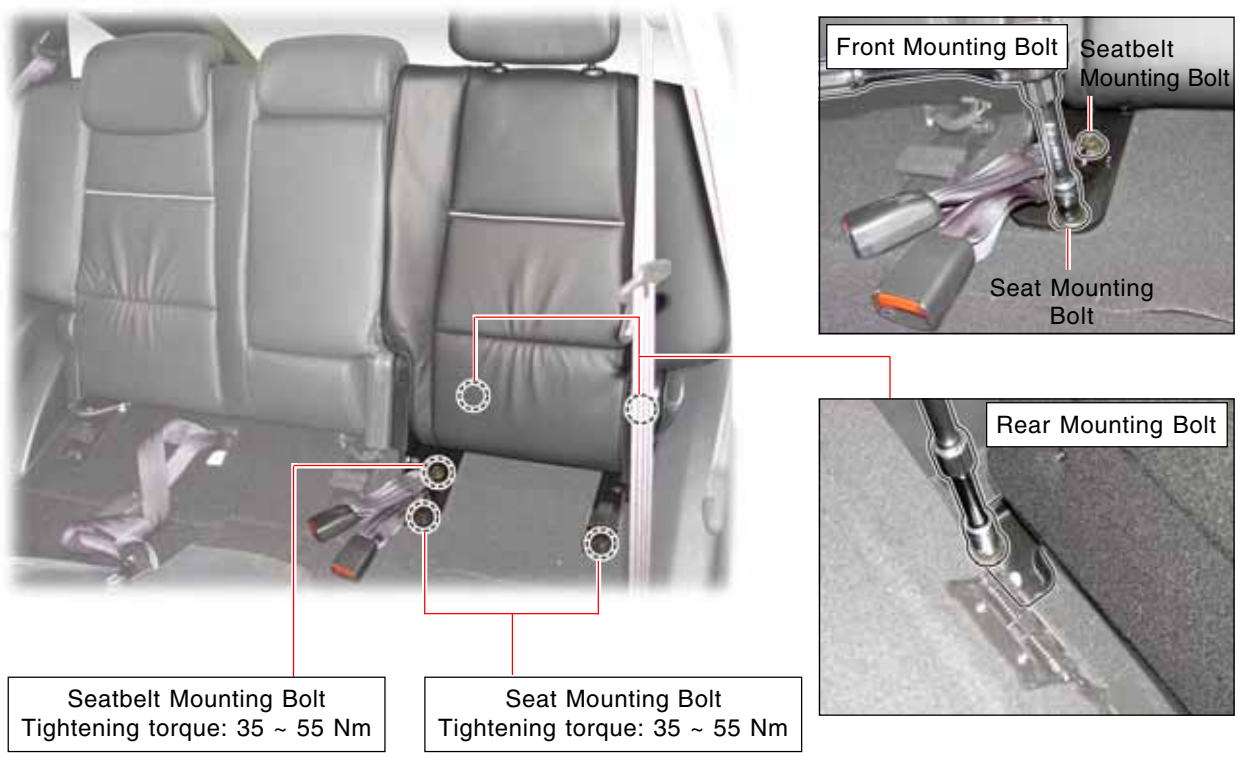




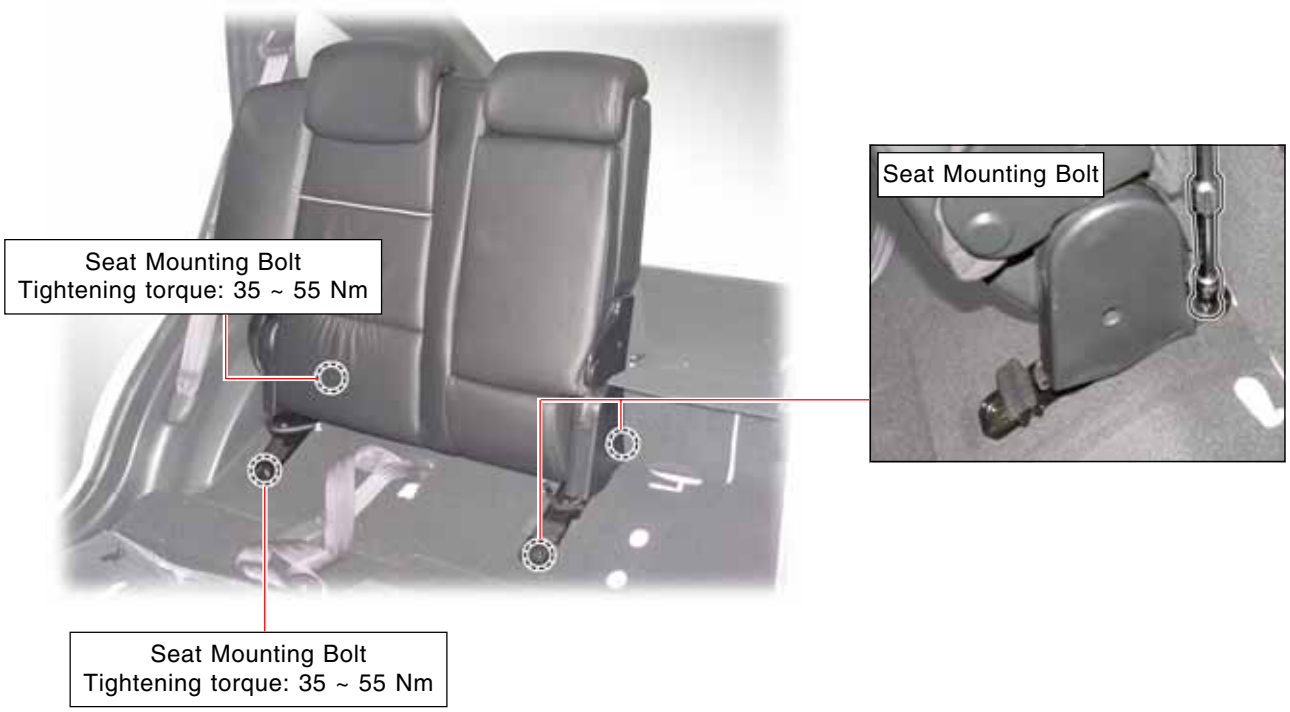


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EFFECTIVE DATE	
AFFECTED VIN	

3. Remove the seat mounting bolts of the rear left seatback and the seatbelt mounting bolt with the rear seat cushion removed. Then, remove the rear left seatback.



4. Remove the rear right seatback mounting bolts with the rear seat cushion removed and remove the seatback.



Composition of Rear Seat

*** Install the rear seat in the reverse order or removal. Also, make sure to fit the seat into the mounting holes and tighten the mounting bolts with the specified tightening torque.**



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

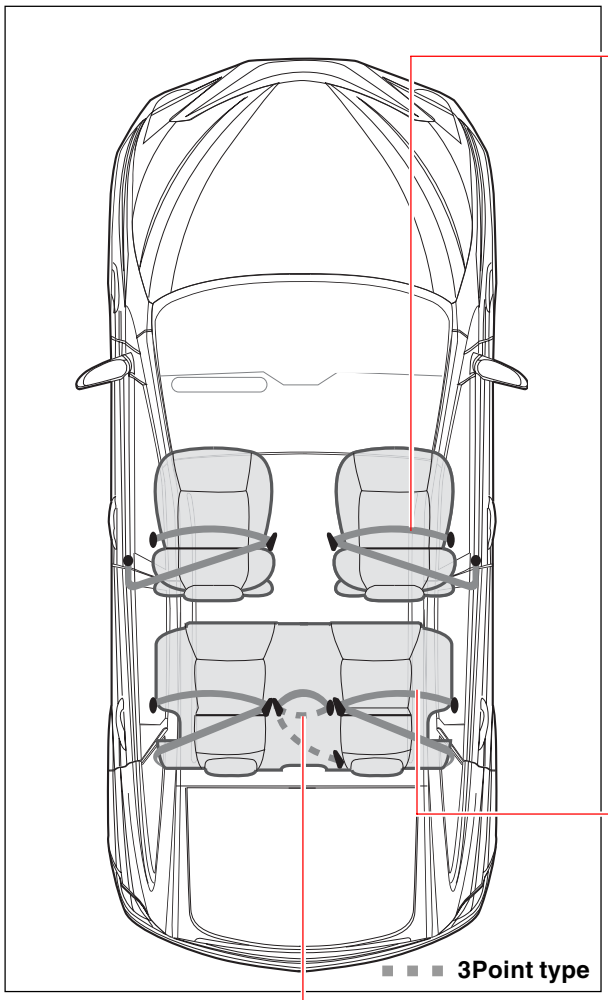
SEAT BELT

1. SEAT BELT CONFIGURATION

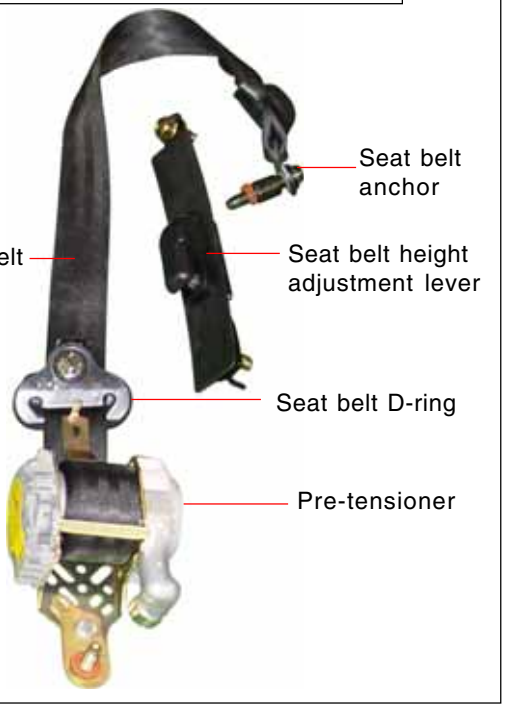
3-Point type seat belt: driver seat, passenger seat and rear seat

2-Point type seat belt: center seat of rear seat

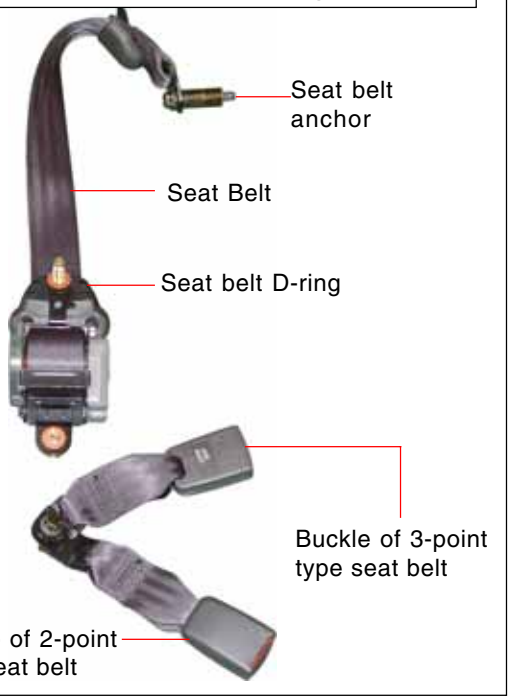
Pretensioner: Installed at front seats. The seat belt pretensioner rewinds the seat belt immediately to protect occupant's face and chest when a strong frontal collision occurs.



Seat Belt in Front Seats (3 point type)



Seat Belt in Rear Seat (3 Point Type) (LH/RH)



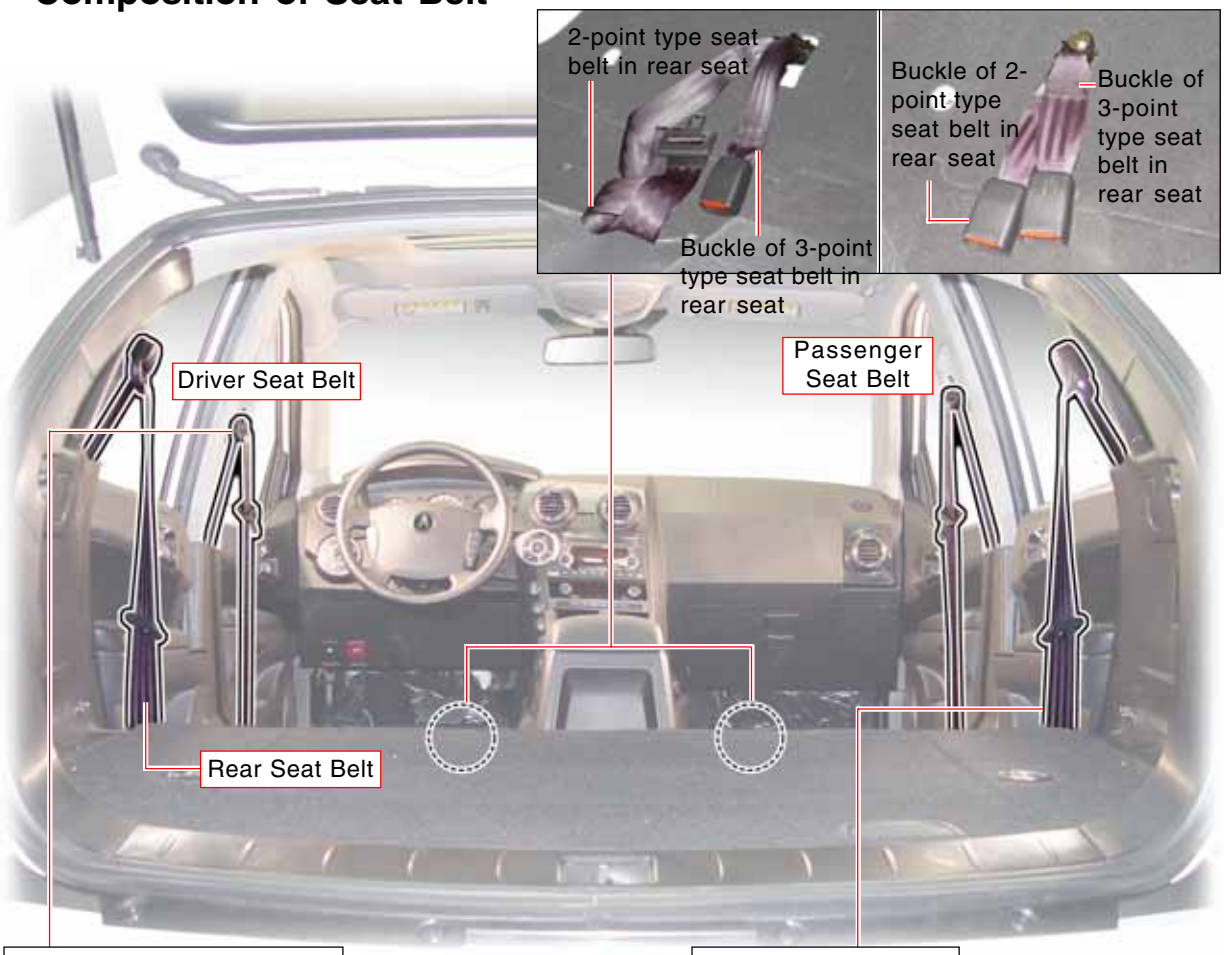
Seat Belt in Rear Seat (2 & 3Point Type) (Center)



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EFFECTIVE DATE	
AFFECTED VIN	

2. REMOVAL AND INSTALLATION OF SEAT BELT

▶ Composition of Seat Belt



Front Seat Belt (Driver/ Passenger): 3-point type



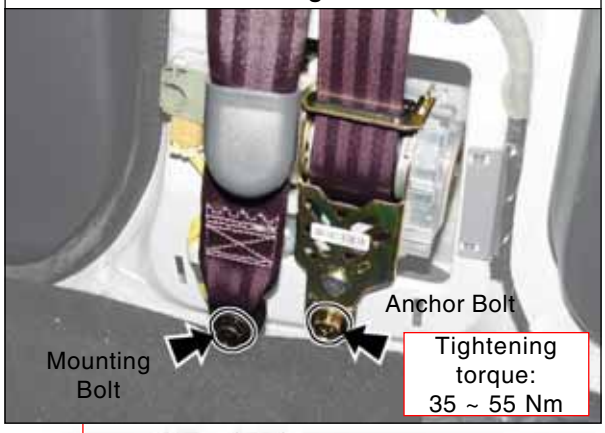
Rear Seat Belt : 3 point type



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EFFECTIVE DATE	
AFFECTED VIN	

Location of Seat Belt

Front Seat Belt Mounting Bolt and Anchor Bolt



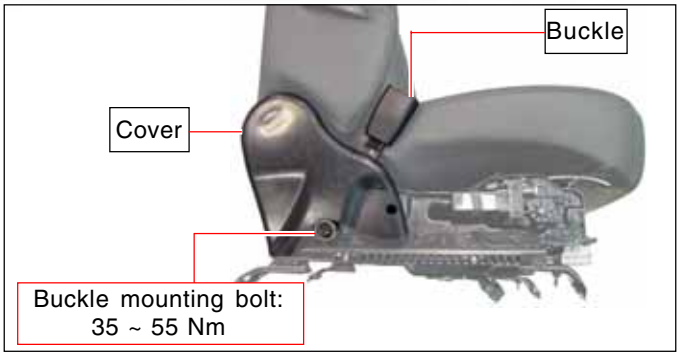
Seat Belt Height Adjustment Mounting Bolt (2 ea)





Fixed Type Buckle (Front Seats)

It is installed in the front seats and can be removed after removing the cover.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Front Seat Belt

※ **Preceding Work:** Removal of front seat



2. Open the bolt cover and unscrew the seat belt anchor bolt. Remove the B pillar (lower).



1. Remove the seat belt D-ring cover.
   1) Press both sides of button (1) and push the bottom of D-ring cover (arrow) to release the upper hook (2).



   2) Raise the arrow section and remove the D-ring cover.



NOTICE

- **In order not to damage the D-ring cover, be sure to observe the above procedures.**

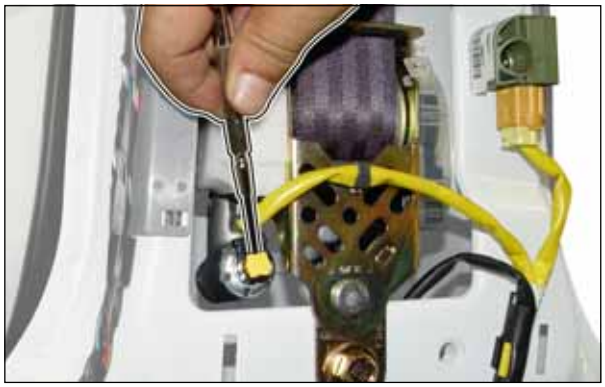
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



3. Unscrew the seat belt upper mounting bolt from the height adjuster and carefully lay down the seat belt.

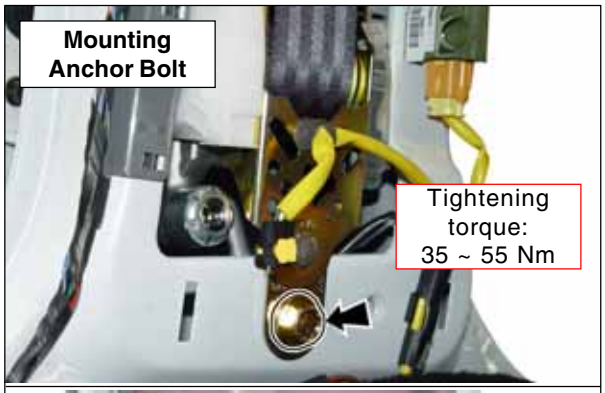


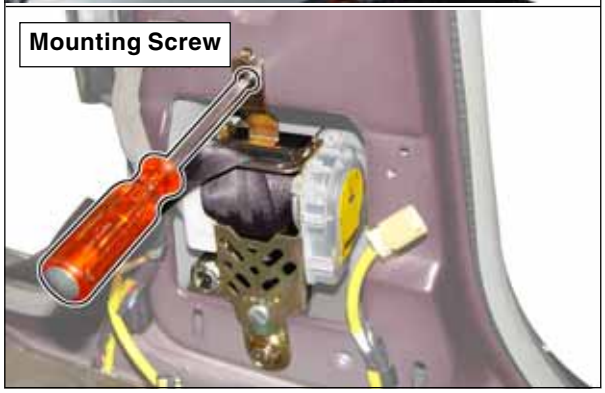
4. Remove the B pillar (lower) trim and disconnect the pretensioner connector.



5. Carefully lay down the seat belt and unscrew the mounting screws and bolts to remove the seat belt.







CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. Unscrew the mounting screws and remove the B pillar (upper).

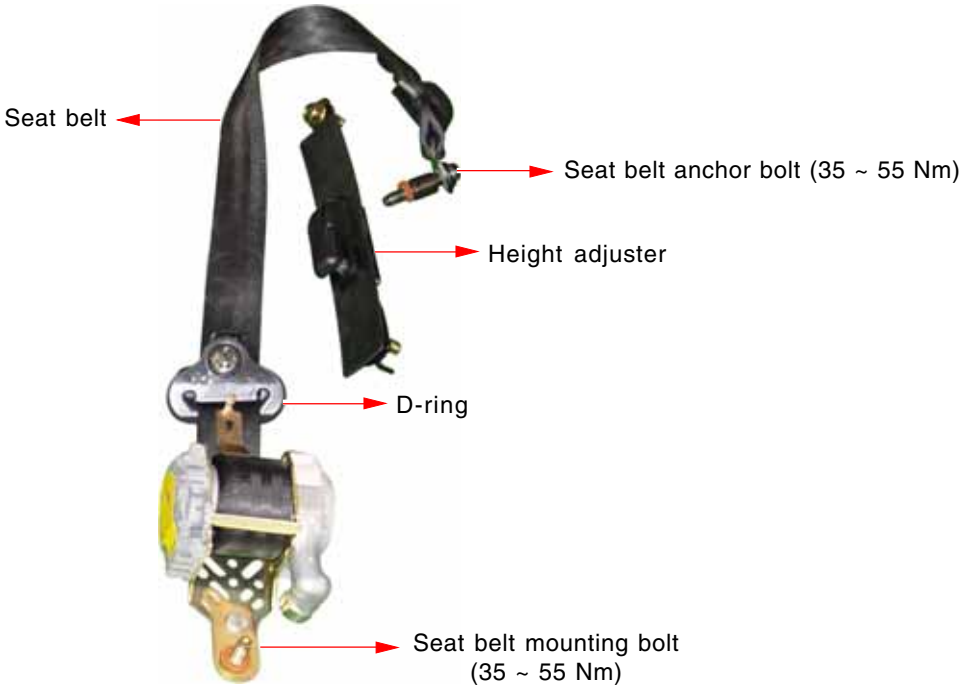


7. Unscrew the mounting bolts and remove the height adjuster.

Tightening torque	35 ~ 55 Nm



Composition of Front Seat Belt



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Rear Seat Belt

※ **Preceding Work:** Removal of rear seat



1. Open the bolt cover and unscrew the upper mounting bolt.



2. Remove the rear quarter panel and unscrew the guide pin screw and mounting bolts to remove the seat belt.





3. Unscrew the lower anchor bolt of the rear seat belt.



AUTO CRUISE SYSTEM

TABLE OF CONTENTS

AUTO CRUISE ASSEMBLY 2

1. Cruise control system 2
2. Curise control switch 2
3. Removal and installation of cruise control switch 2
4. Electrical wiring diagrams 3

AUTO CRUISE ASSEMBLY

1. CRUISE CONTROL SYSTEM

The purpose of the cruise control system is to automatically maintain a vehicle speed set by the driver. When the cruise control is activated, speed is maintained or increased by means of an electrically controlled cable attached to the accelerator assembly. If the vehicle must be slowed to maintain the speed that was set by the driver, the cruise control system allows the throttle return spring to close the throttle return spring to close the throttle.

Of driving conditions require sudden acceleration after the cruise control had been set, speed can be increased in the normal manner by manually pressing the accelerator. The cruise control is disengaged if the brakes (or clutch, with manual transaxle) are applied.

The minimum speed for setting the cruise control is 38.6 km/h (24 mph). When cruise control is operating, the cruise indicator lamp is on in the instrument cluster. The cruise control system is capable of monitoring internal software and hardware faults as well as external faults in the connectors and wire harness. If a fault is detected, creise control is stopped immediately, and the program logic and hardware logic independently prevent the cruise control from opening the throttle. The cruise control will function in temperatures ranging from -40°C (-40°F) to 80°C (185°F) maximum temperature could cause the regulation properties to be out of tolerance, but the safety shutdown will still be operational under maximum temperature conditions. If high temperature interferes with cruise control operation, the actuator electromagnetic clutch will open, and the throttle, unless the accelerator pedal is pressed.

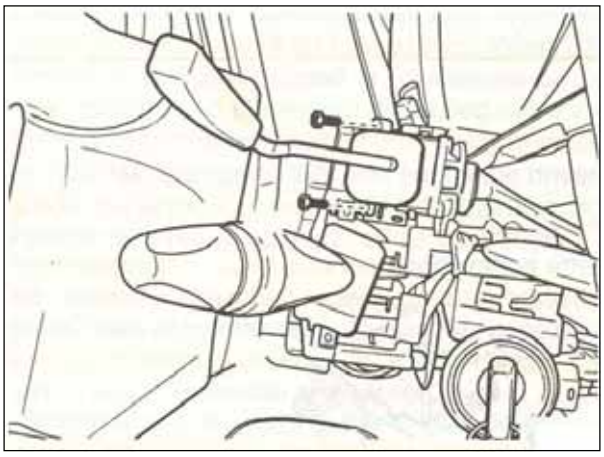
2. CURISE CONTROL SWITCH

The cruise control switch located under the steering wheel.

3. REMOVAL AND INSTALLATION OF CRUISE CONTROL SWITCH

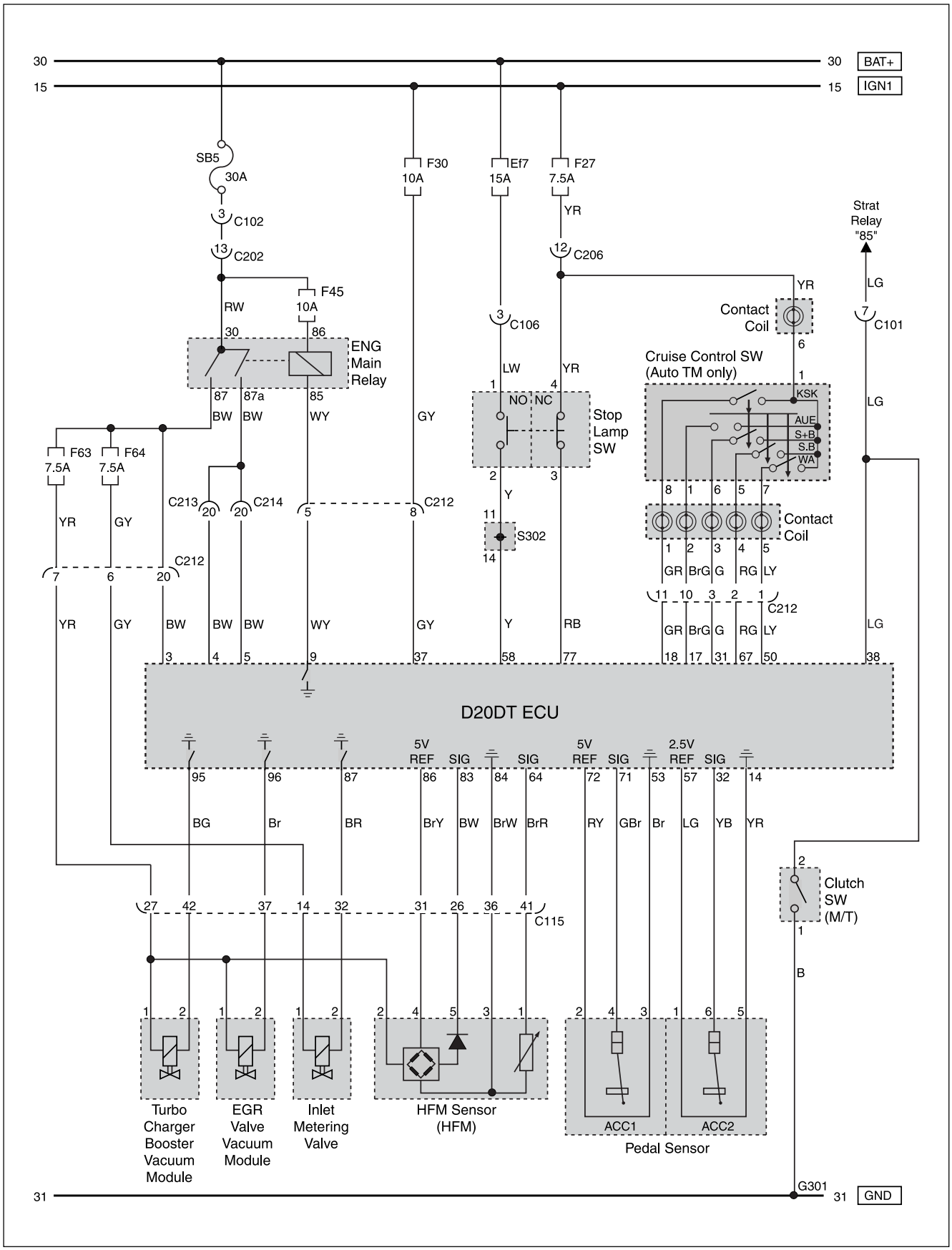
▶ Cruise Control Switch

1. Disconnect the negative battery cable.
2. Remove the steering wheel air bag and cruise switch cover.
3. Remove the crew with control switch.
4. Remove the control switch
5. Installation should follow the removal procedure in the reverse order.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. ELECTRICAL WIRING DIAGRAMS



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

BODY INTERIOR

7730 / 7610 / 7330 / 7630 / 7632 / 7850 / 7770

TABLE OF CONTENTS

INTERIOR TRIM 2

1. Locations 2

CENTER CONSOLE 4

1. Center console (automatic transmission) 4
2. Center console (manual transmission) 6

INSTRUMENT PANEL ASSEMBLY 8

1. Removal and installation of instrument panel assembly 8

SUN VISOR 20

1. Removal and installation of sun visor 20

PILLAR AND REAR QUARTER TRIM 21

1. Removal and installation of pillar and rear quarter trim 21

HEADLINING ASSEMBLY 27

1. Removal and installation of headlining assembly 27

OUTSIDE REARVIEW MIRROR 30

1. Removal and installation of outside rearview mirror 30

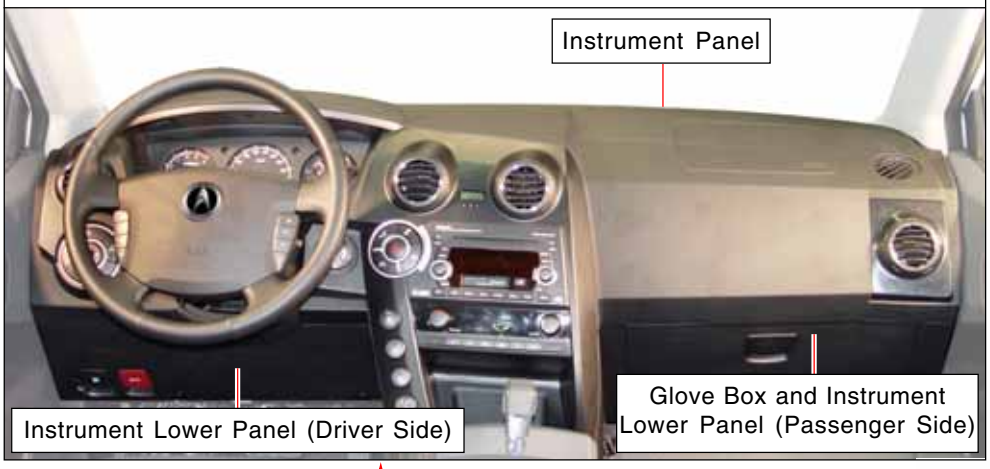
INSIDE REARVIEW MIRROR (ECM MIRROR) 32

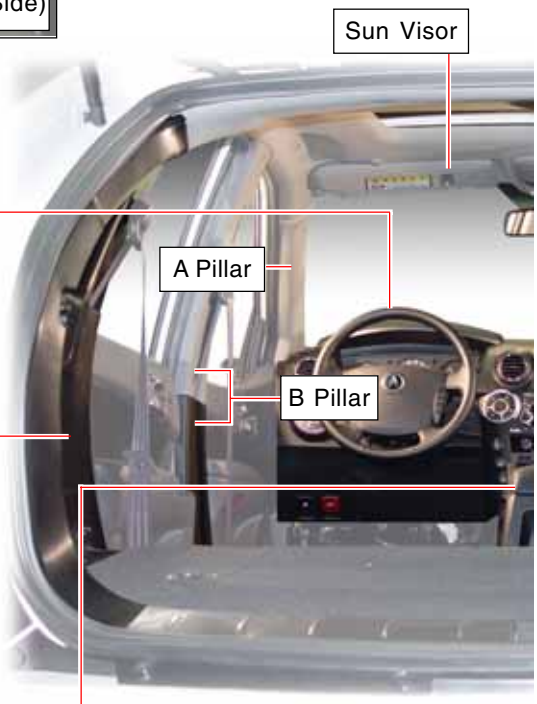
1. Removal and installation of inside rearview mirror 32

INTERIOR TRIM

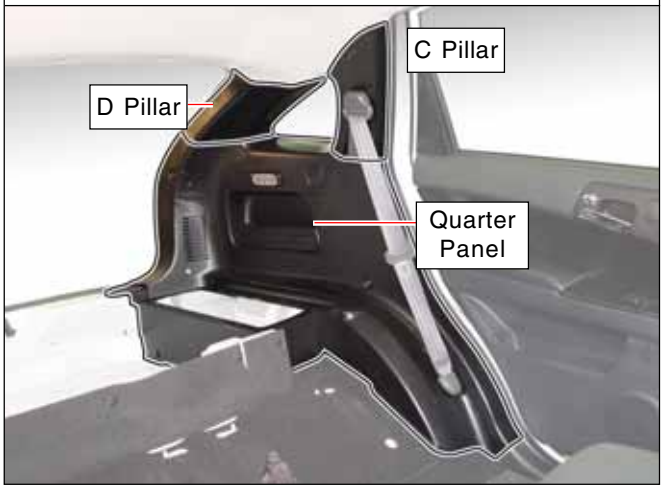
1. LOCATIONS

Instrument Panel Assembly





C Pillar/D Pillar and Rear Quarter Panel

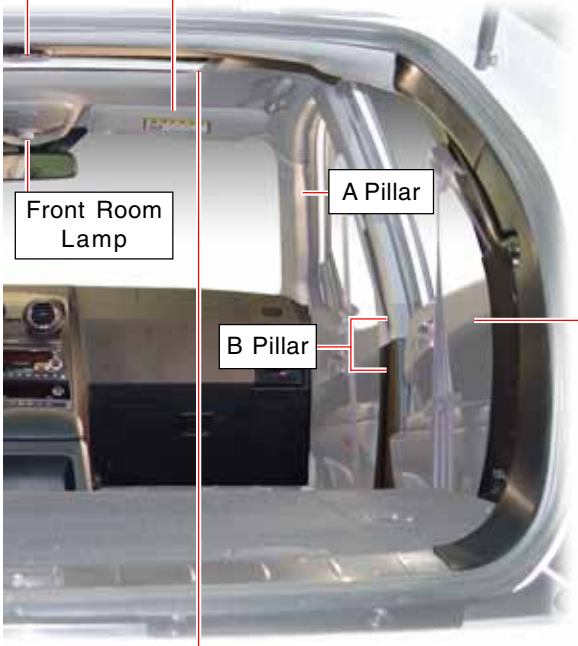


Center Console Assembly

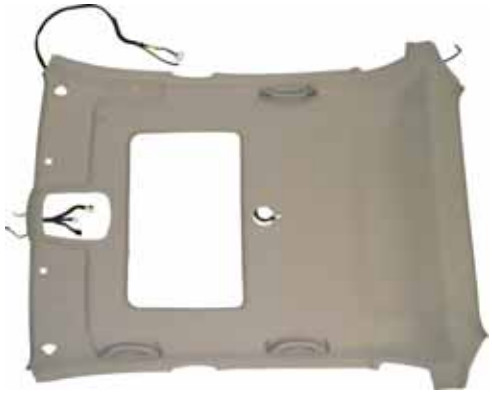


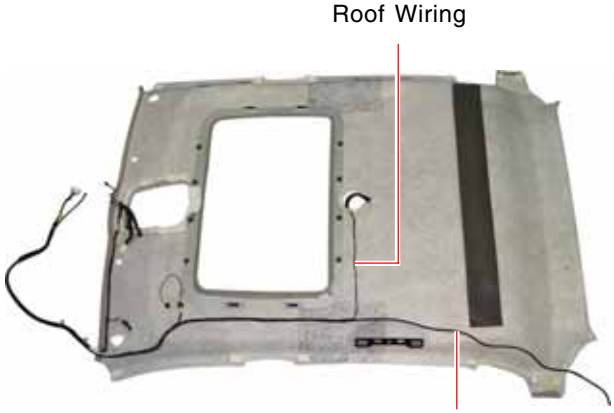
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EFFECTIVE DATE	
AFFECTED VIN	

Door Trim (Front Door)	Rear Door Trim
	



Headlining Assembly





CENTER CONSOLE

1. CENTER CONSOLE (AUTOMATIC TRANSMISSION)

Removal and Installation

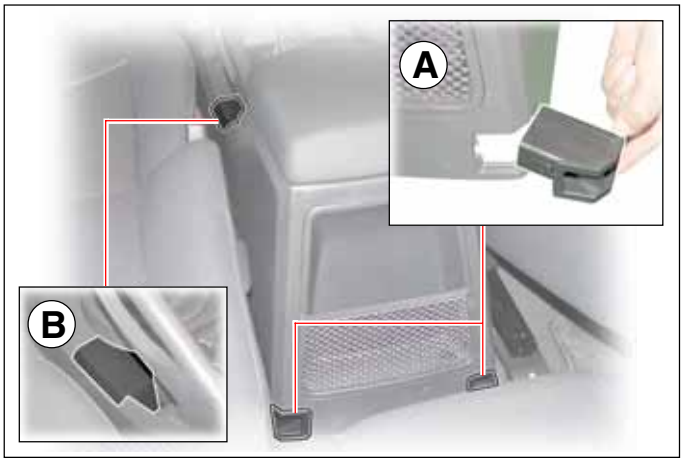
1. Place the gear selector lever to any position other than “P” and remove the lever cover.



NOTICE

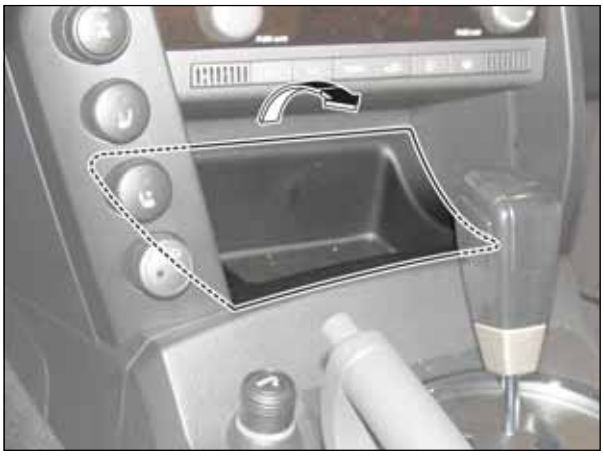
- **Make sure that the gear selector lever cover is fitted into the mounting groove when installing it.**

2. Remove the rear duct adapter (A) and the center console cover (B).

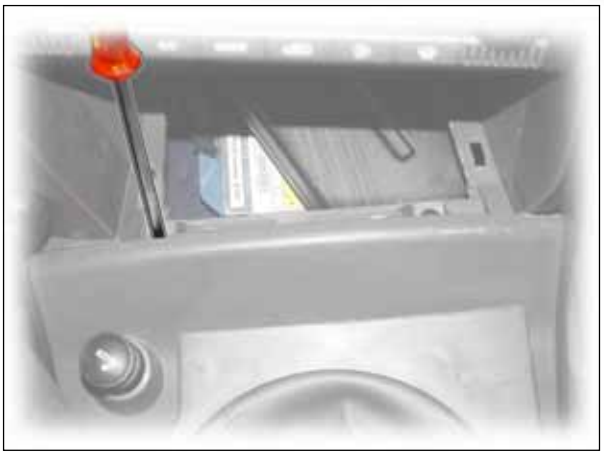




3. Remove the center fascia lower tray from the center console.



4. Unscrew two mounting screws from the center storage box.



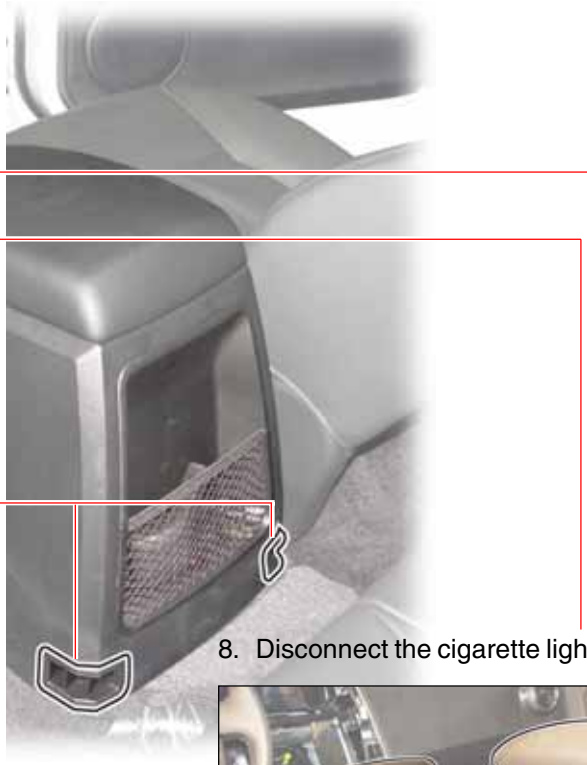
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EFFECTIVE DATE	
AFFECTED VIN	

5. Unscrew two mounting screws at both sides of the center console.

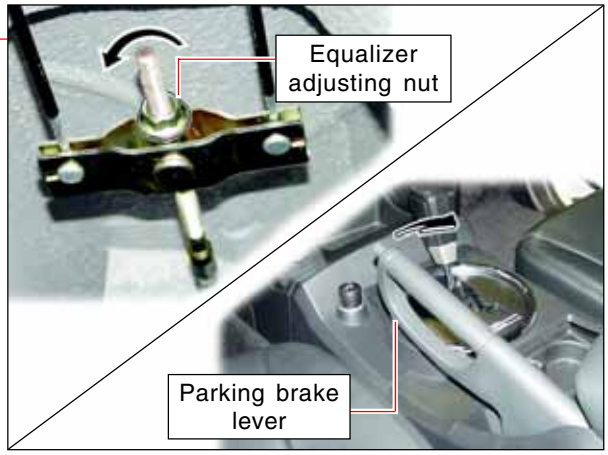


6. Remove the storage box cover and unscrew two mounting bolts in center console.





7. Make an installation mark on equalizer adjusting nut. Slacken the equalizer adjusting nut so that the parking brake lever can be raised all the way.



8. Disconnect the cigarette lighter connector and remove the center console.



9. Install the center console and adjust the parking brake equalizer adjusting nut to the original position.

2. CENTER CONSOLE (MANUAL TRANSMISSION)

Removal and Installation

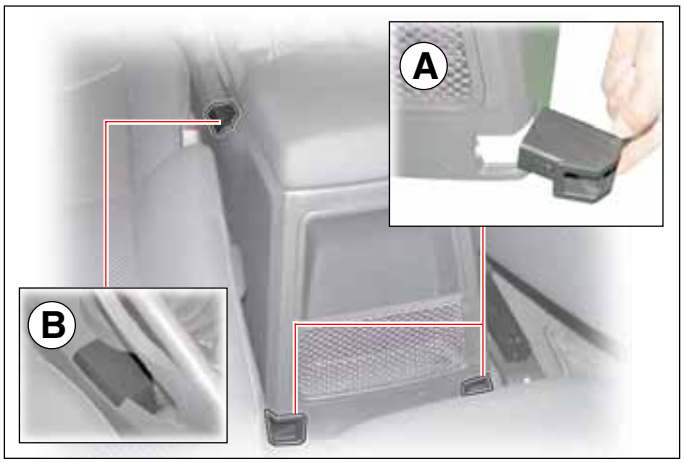
1. Remove the gear selector lever knob by turning it counterclockwise.



Center Console Assembly



2. Remove the rear duct adapter (A) and center console cover (B).





3. Remove the center fascia lower tray from the center console.



4. Unscrew two mounting screws from the center storage box.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. Unscrew two mounting screws at both sides of center console.



6. Remove the storage box cover and unscrew the mounting bolts in center console.



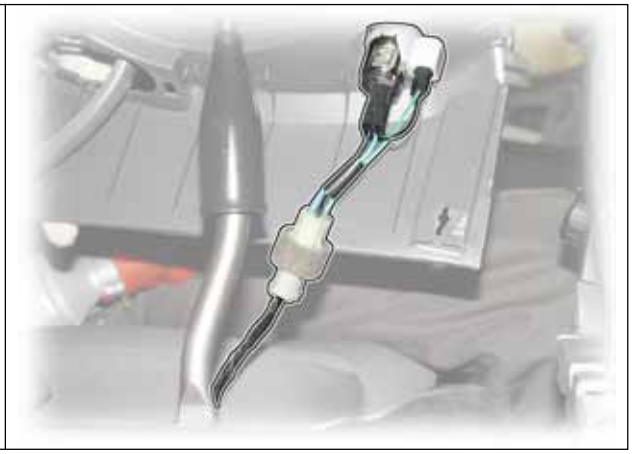
7. Make an installation mark on equalizer adjust nut. Slacken the equalizer adjusting nut so that the parking brake lever can be raised all the way.





8. Disconnect the cigarette lighter connector and remove the center console assembly.





9. Install the center console and adjust the parking brake equalizer adjusting nut to the original position.

INSTRUMENT PANEL ASSEMBLY

1. REMOVAL AND INSTALLATION OF INSTRUMENT PANEL ASSEMBLY

Preceding Work

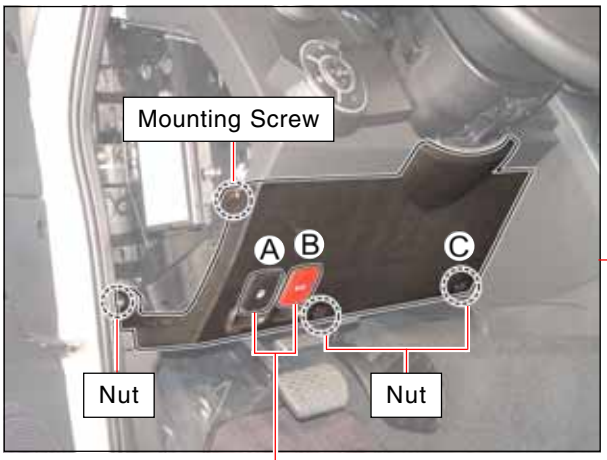
Disconnect the negative battery cable and perform the preceding work to the following procedure.

1. Insert a flat blade screwdriver into the groove (A) and pry off the instrument side cover.

NOTICE
- **Be careful not to damage the components around the instrument panel and clips.**

Driver Side	Passenger Side
	

2. Disconnect the cables for fuel lid opening lever (A) and engine hood release lever (B). Unscrew three mounting nuts and one mounting screw and remove the lower panel.





3. Unscrew the mounting bolts and nuts and remove the undercover and bracket.

NOTE
- **Remove each cable with the lower panel separated.**







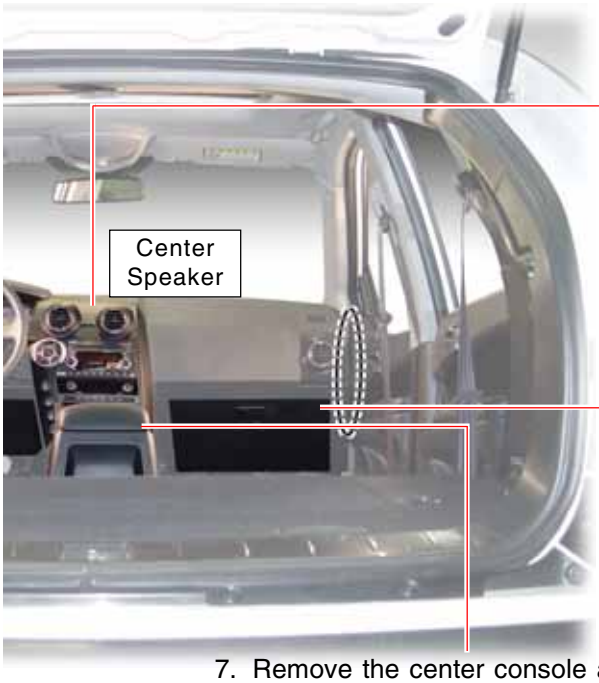
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Remove the center fascia panel by separating lower side first and pulling it upward.



5. Remove the panel assembly of outside rearview mirror switch bezel (Refer to “Switch” section.).





6. Remove the lower instrument panel (passenger side) and glove box (Refer to the reference 1 on next page).



7. Remove the center console assembly and the center fascia lower tray.

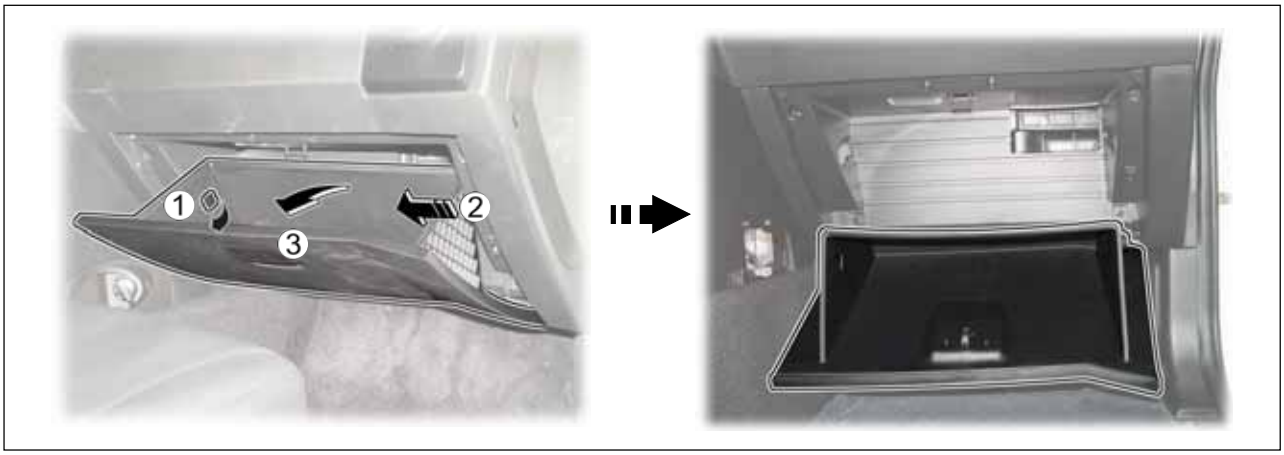


8. Remove the steering wheel assembly (Refer to the reference 2 on next page).

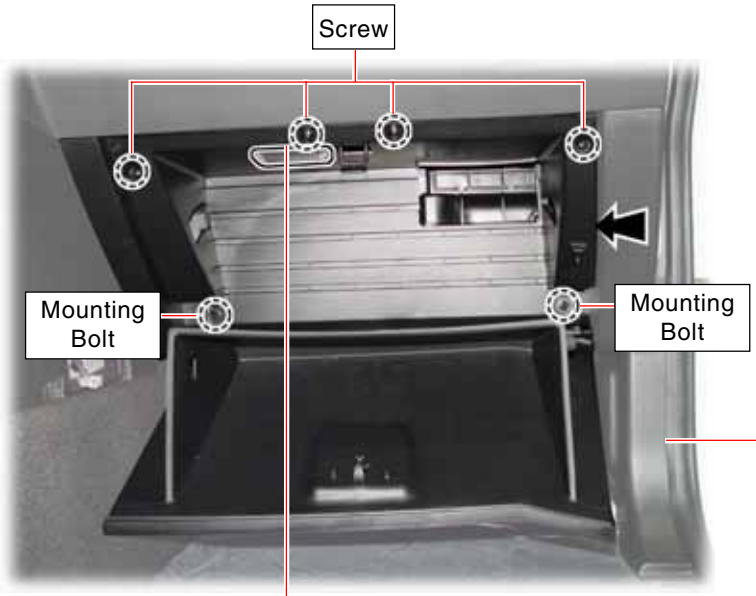


Reference 1: Removal and Installation of Glove Box

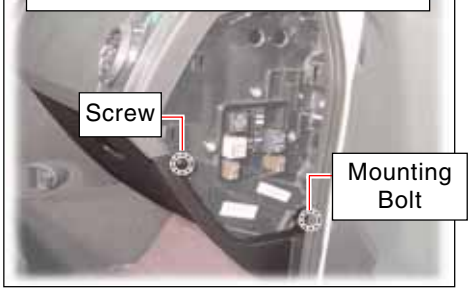
1. Open the glove box and disconnect the fixing hook ① and then lower the glove box ③ while pushing it to left side ②.



2. Remove five screws and three bolts from the glove box and disconnect the glove box lamp (A) and switch (B) connectors to remove the glove box assembly.



Removal of Mounting Bolt and Screw (Front/Side)



A. Glove Box Lamp Connector



NOTE

- **The glove box lamp comes on only when the tail lamp is on.**

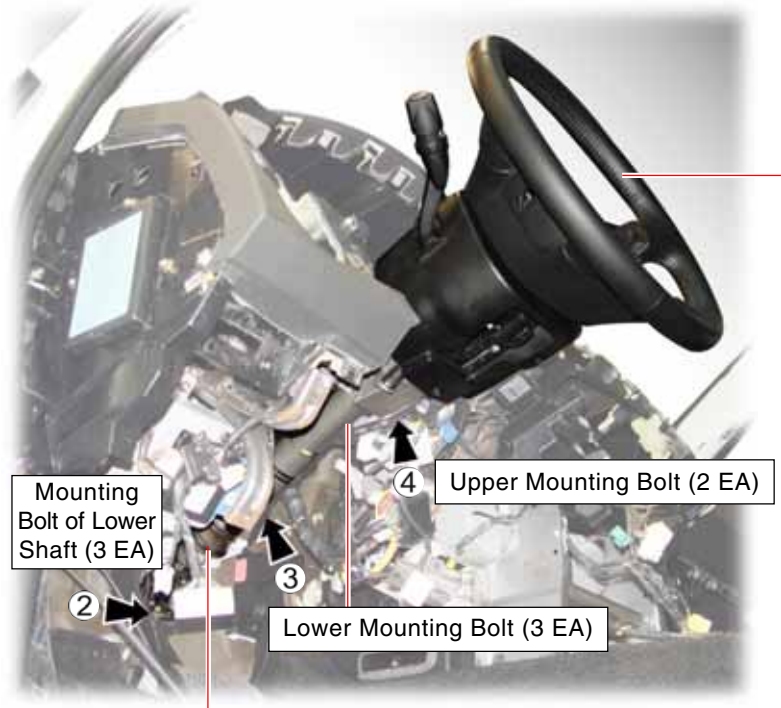
B. Glove Box Switch Connector

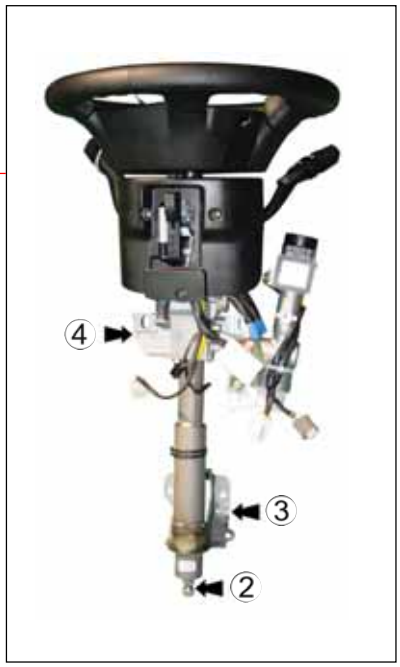


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AFFECTED VIN	

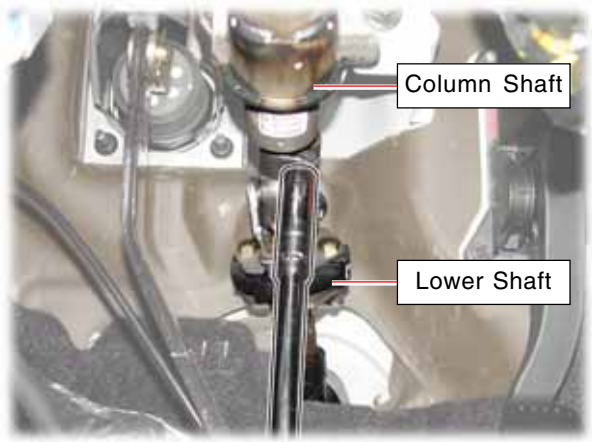
Reference 2: Removal and Installation of Steering Wheel Assembly

1. Disconnect the combination meter connector, key switch connector, steering angle sensor connector and airbag connector.





2. Unscrew the connecting bolt for lower shaft and steering column shaft (lower side).



3. Unscrew three lower mounting bolts from the steering column shaft.



4. Unscrew two upper mounting bolts from the steering column shaft.



5. Carefully remove the steering wheel assembly.

Removal and Installation of Instrument Panel Assembly

- When removing or installing, be careful not to damage the instrument panel.

Front View



Rear View



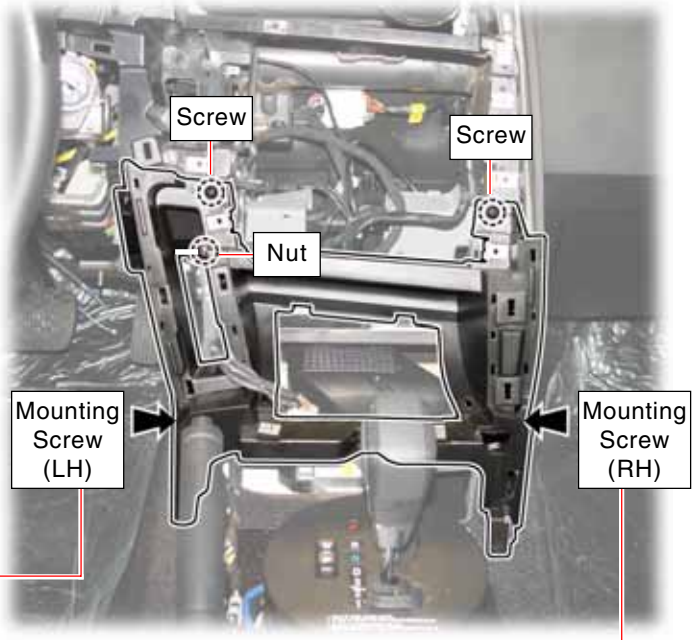
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

1. Remove the lower instrument main panel.

① Unscrew two front mounting screws and a nut from the lower instrument main panel.

Lower Main Panel





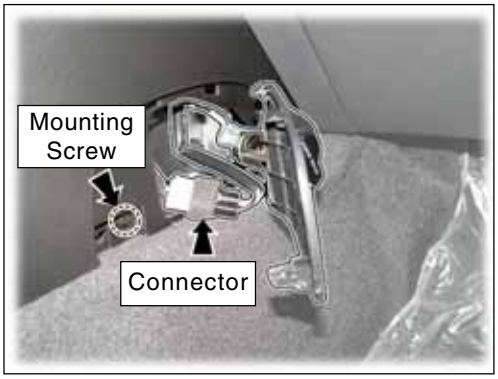
② Remove the mounting screw cover at left lower side and unscrew mounting screw.



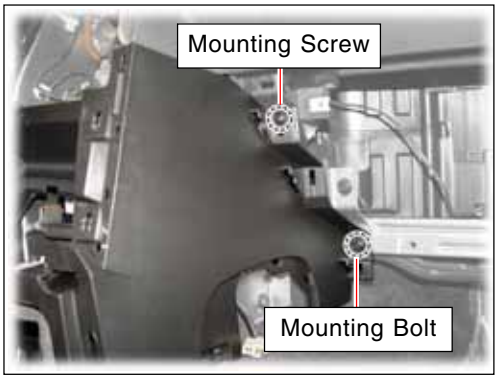
③ Unscrew two mounting screws at left upper side.



④ Remove the power outlet cover at right lower side. disconnect the power outlet connector and remove mounting screw.



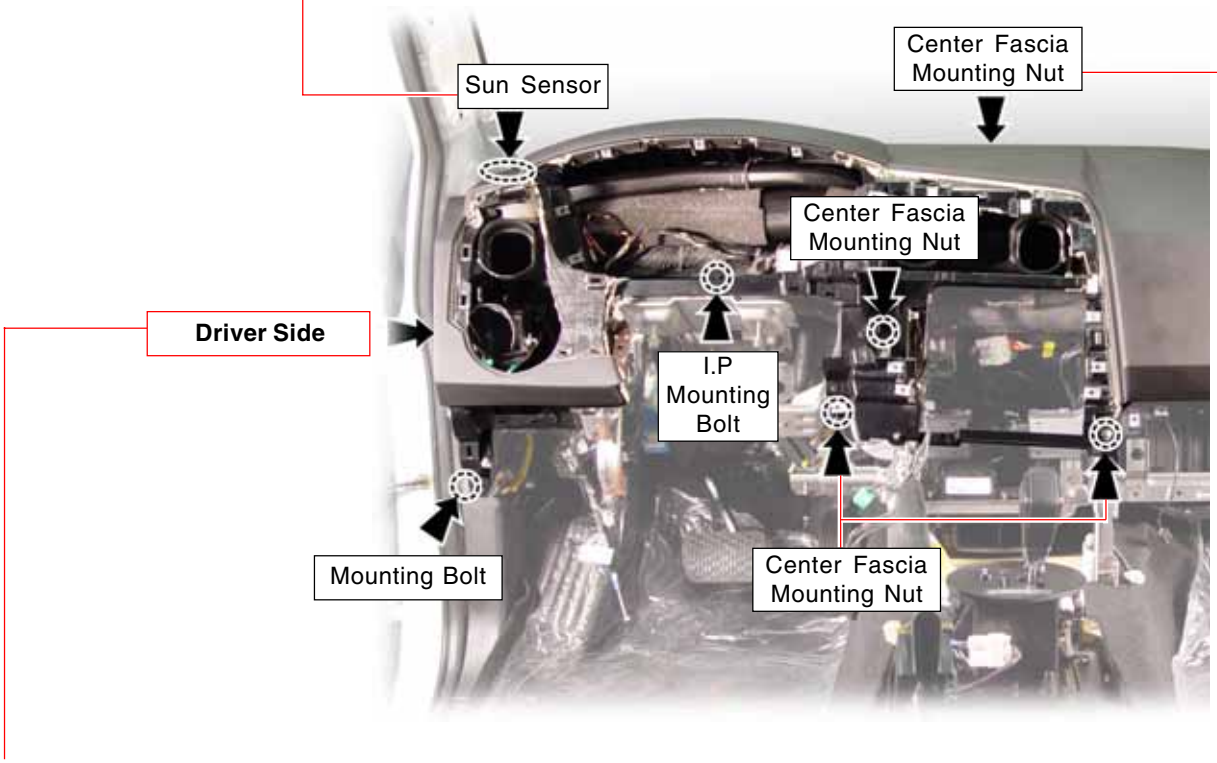
⑤ Unscrew a mounting screw and a bolt at right upper side with the glove box assembly removed.



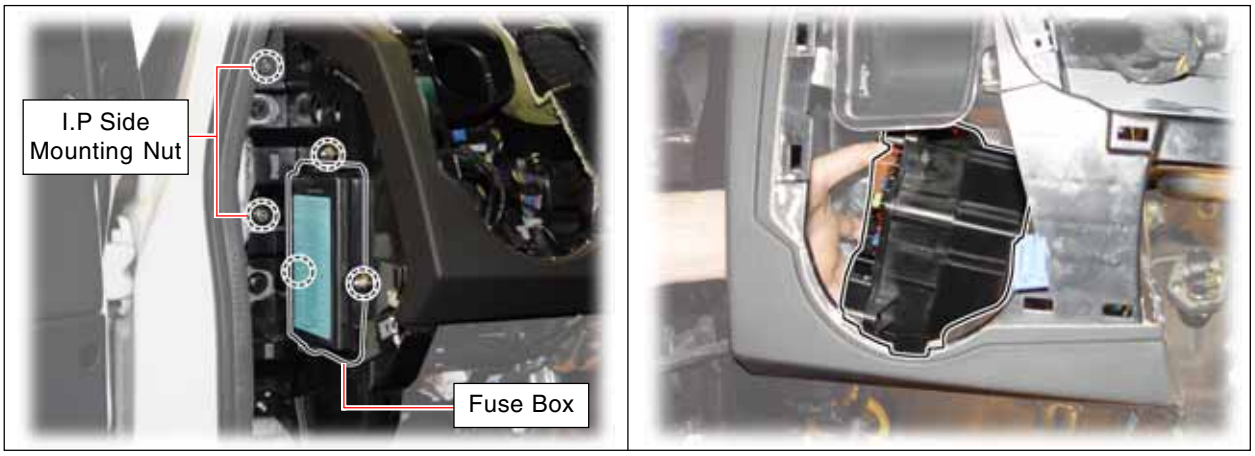
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EFFECTIVE DATE	
AFFECTED VIN	

2. Remove the sun sensor from the instrument panel (driver side).



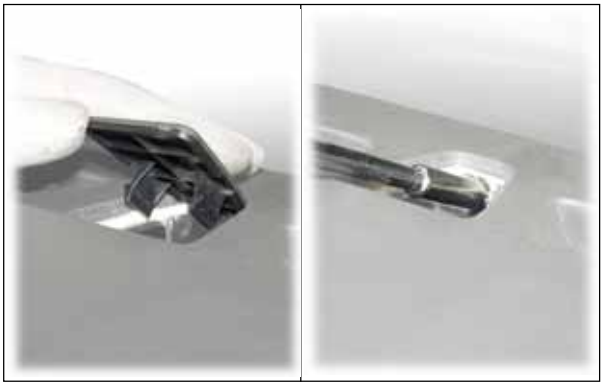


3. Unscrew the mounting nuts from the fuse/relay box and instrument panel (driver side).



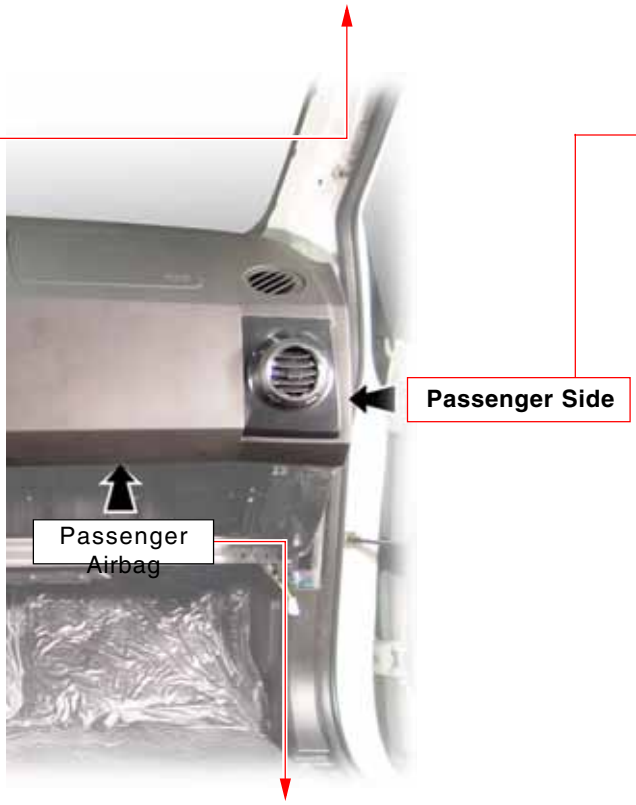
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EFFECTIVE DATE	
AFFECTED VIN	

4. Unscrew the center mounting nut on the instrument panel.

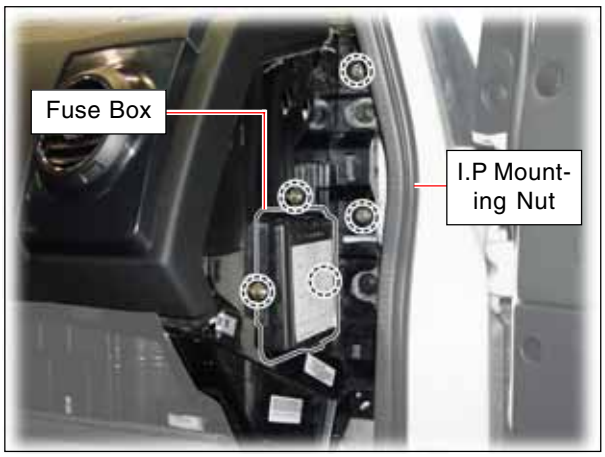


* Remove the center speaker.





5. Unscrew the mounting nuts from the fuse/relay box and instrument panel (passenger side).



6. Disconnect the passenger airbag connector and unscrew three mounting bolts.



Removal and Installation of Instrument Panel Frame Assembly

Disconnect the connectors and ground cable from the instrument panel frame.

1. Disconnect the brake switch connector.

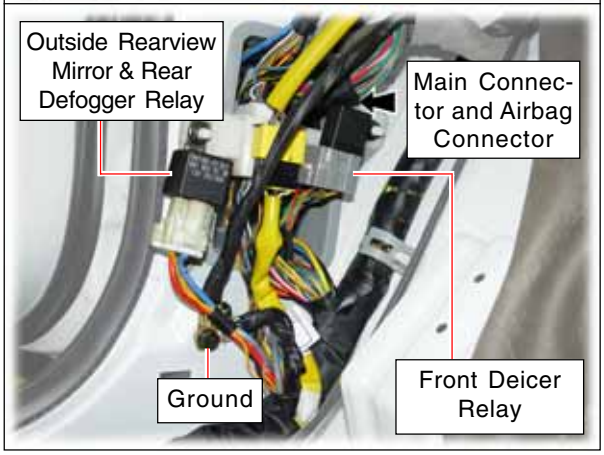


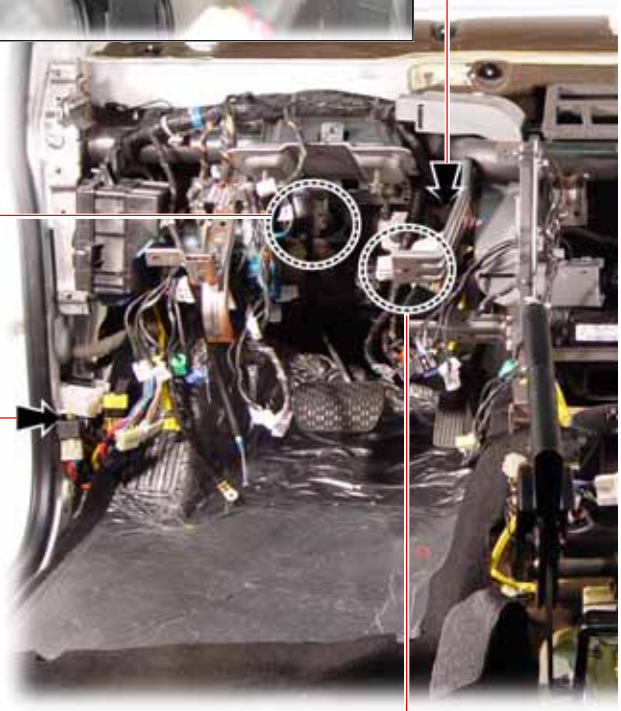
2. Disconnect the accelerator pedal sensor connector.



3. Remove the cover a left lower side of instrument panel and disconnect the main connector and the airbag connector.





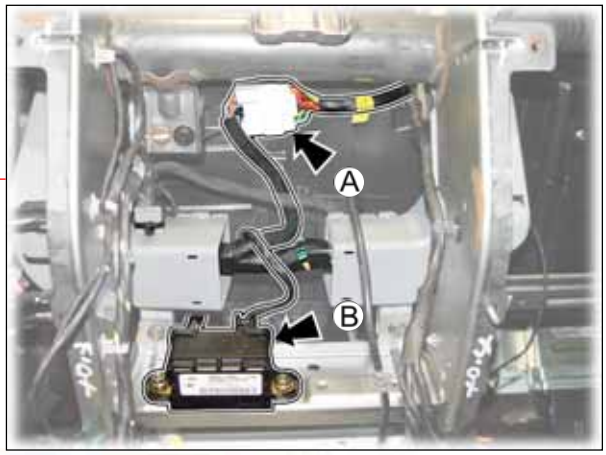


4. Disconnect the connector and remove the mounting bolt.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. Disconnect the A/C connector (A) and remove the sensor cluster (B).

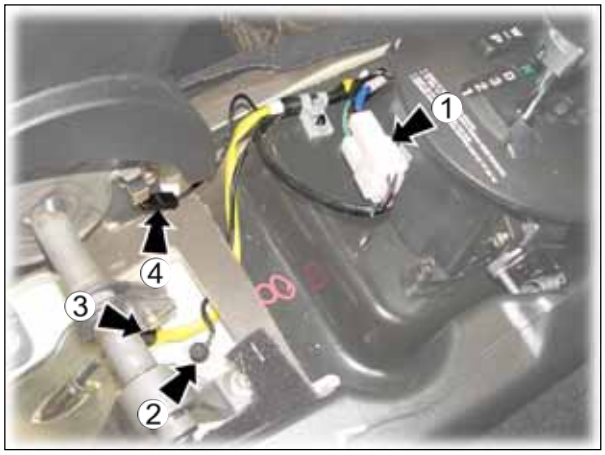


6. Disconnect the air bag unit connector.

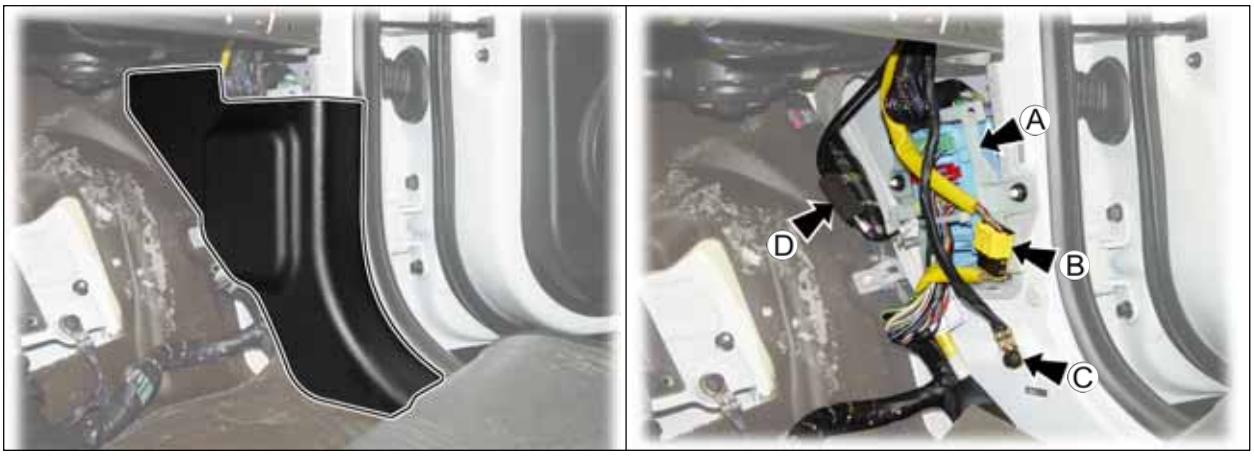




7. Disconnect the A/T connector (1), ground (2), air bag ground (3) and parking brake switch connector (4).

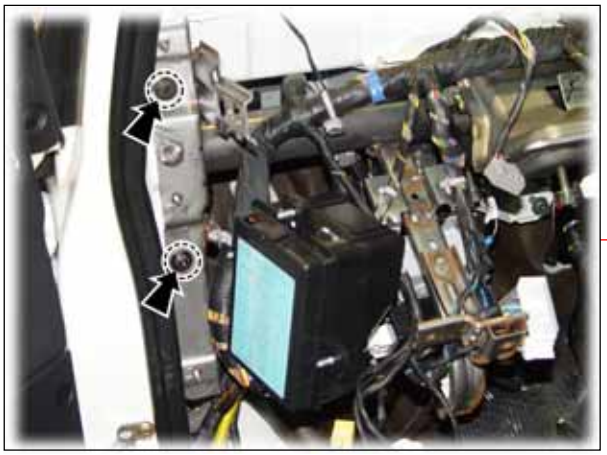


8. Disconnect the main connector (A), air bag connector (B), ground (C) and audio antenna connector.



Unscrew the mounting bolts/nuts and carefully remove the instrument panel frame while paying attention not to touch any cable and electric connector.

1. Unscrew two mounting bolts from the intrument panel frame at driver side.



2. Unscrew the mounting bolts from the steering column bracket.

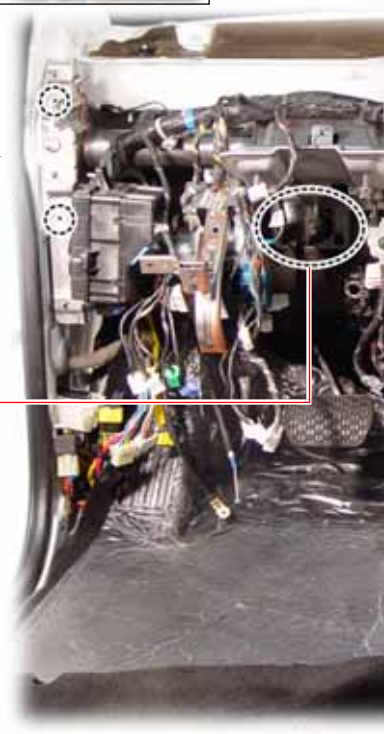


3. Unscrew two center mounting bolts from the instrument panel frame at left side.



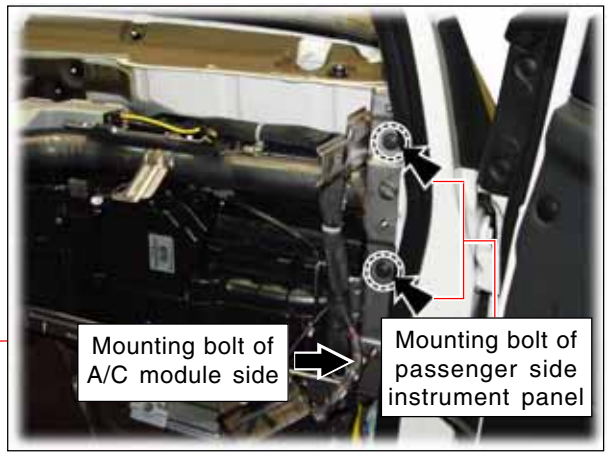
4. Unscrew one mounting bolt from the center side.

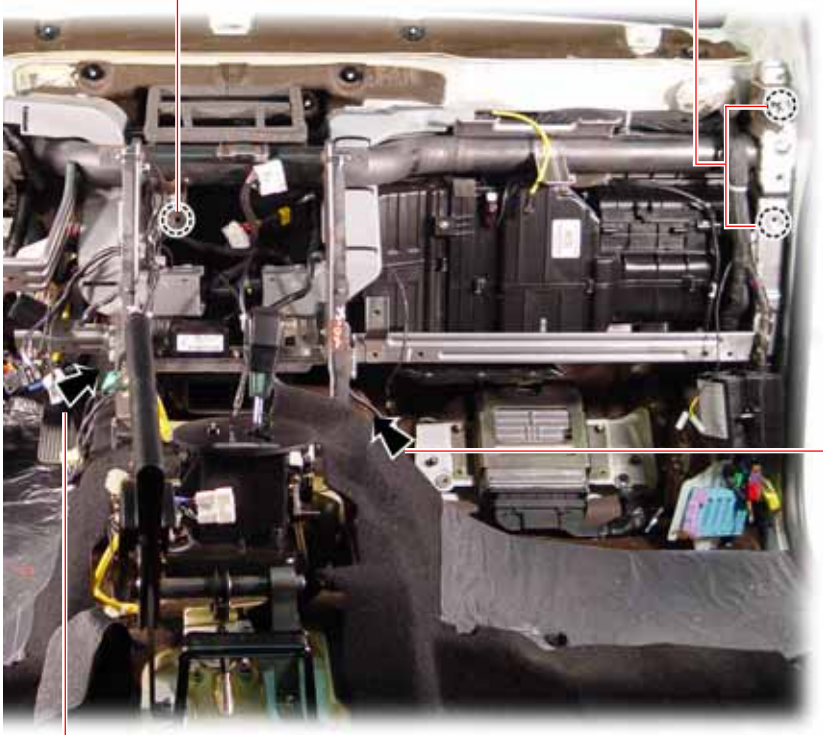




CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. Unscrew the mounting bolts from the instrument panel frame and air conditioner module at right side.

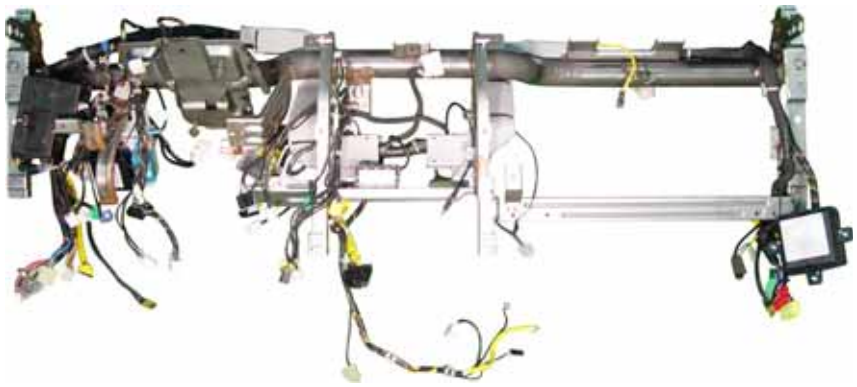




6. Unscrew three center mounting bolts from the instrument panel at right side.



Instrument Panel Frame Assembly



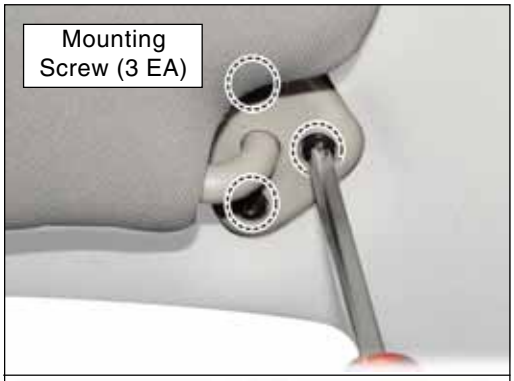
SUN VISOR

1. REMOVAL AND INSTALLATION OF SUN VISOR



1. Unscrew the mounting screws from the sun visor and disconnect the electric connector.







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EFFECTIVE DATE	
AFFECTED VIN	

PILLAR AND REAR QUARTER TRIM

1. REMOVAL AND INSTALLATION OF PILLAR AND REAR QUARTER TRIM

※ **Preceding Works:** 1. Disconnect the negative battery cable and remove the seats.
2. For seat belt, refer to “Seat and Seat Belt” section.

NOTICE

- **When installing and removing, be careful not to damage the pillar, trim and other components.**

A Pillar Trim

1. Unscrew the mounting screw and remove the A pillar trim.





B Pillar Trim

2. Remove the front and rear scuff trims and unscrew the lower mounting bolts of the seat belt to remove the lower B pillar.



3. Unscrew the upper mounting bolt and remove the seat belt. Then, unscrew the upper mounting screws to remove the B pillar.



Rear Quarter Trim and C & D Pillar Trims

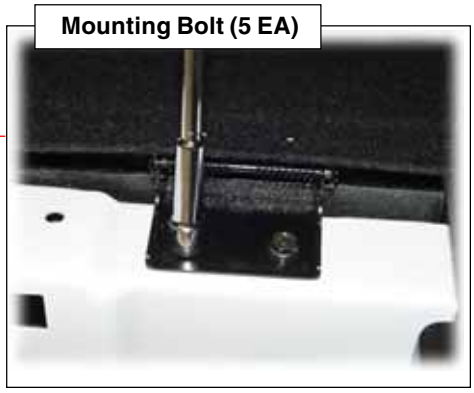
Remove the trims and covers before removing the rear quarter trim.

1. Remove the spare tire cover.



2. Unscrew five bolts and remove the rear seat cover.





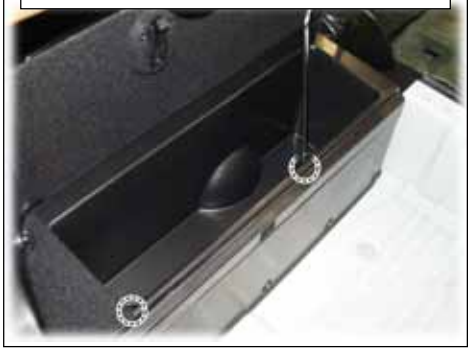


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Unscrew two mounting bolts and release the hook to remove storage bins at both sides in luggage compartment.



Mounting Bolt of Storage Bin (2 EA)



Luggage Net Hook

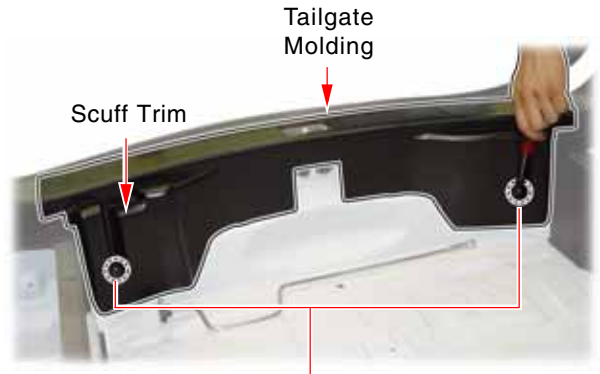


Removal of Storage Bin



4. Remove the tailgate scuff trim.

① Remove the tailgate molding and unscrew the mounting screws for scuff trim.



Mounting Screw



② Remove the tailgate scuff trim.



1. D Pillar Trim

1-1. Unscrew the mounting screws and remove the D pillar trim.





2. C Pillar Trim

2-1. Remove the rear quarter trim and seat belt. Then, remove the C pillar trim.





3. Rear Quarter Trim

3-1. Unscrew the lower mounting screw from the rear quarter trim.



3-2. Remove the luggage compartment lamp (rear left quarter trim).



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3-3. Unscrew the lower mounting bolt from rear seat belt on rear quarter trim.

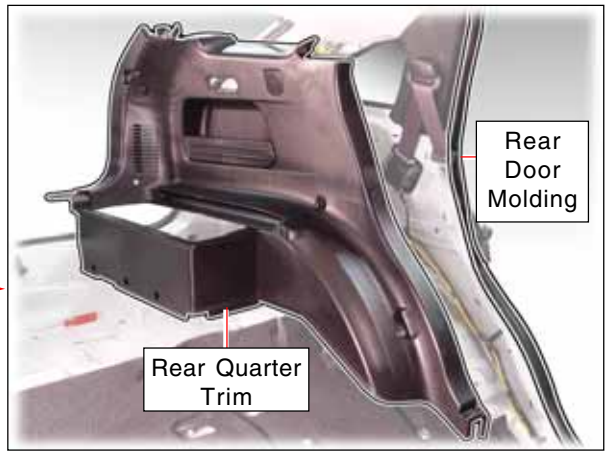


3-4. Remove the rear door scuff trim.

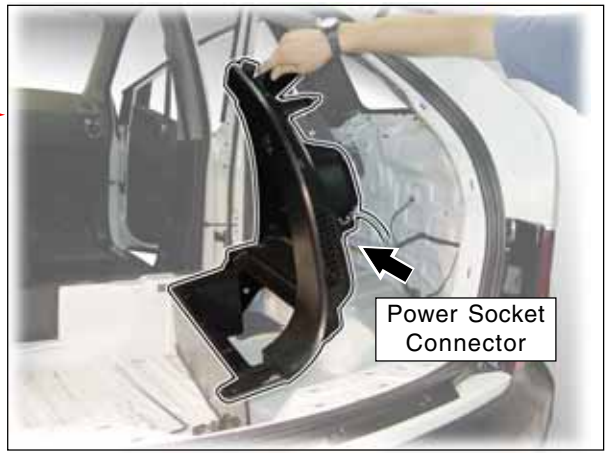




3-5. Remove the rear door molding and the rear quarter trim assembly.



3-6. The removal procedures for RH rear quarter trim is same with that of LH rear quarter trim. However, the power outlet connector should be disconnected before removing it.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Rear Quarter Trim and Fasteners

Rear Quarter Trim (LH)





* Fastener locations (10)

Rear Quarter Trim (RH)





* Fastener locations (10)

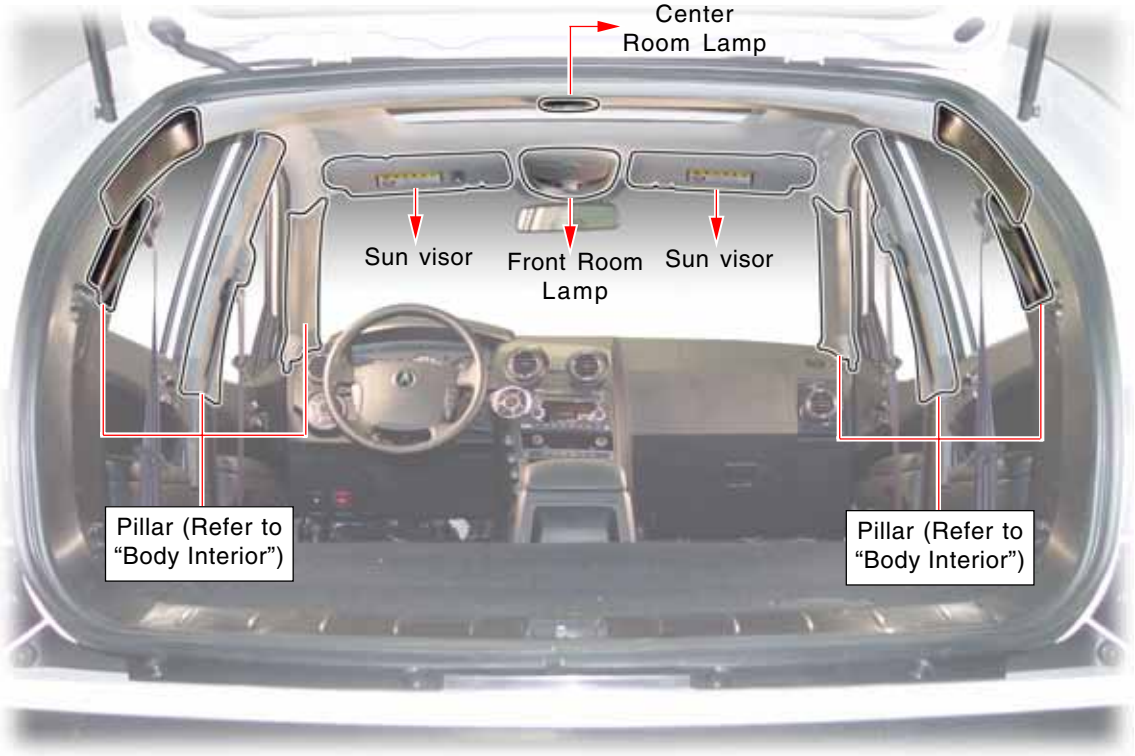
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

HEADLINING ASSEMBLY

1. REMOVAL AND INSTALLATION OF HEADLINING ASSEMBLY

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the components shown in the figure below.



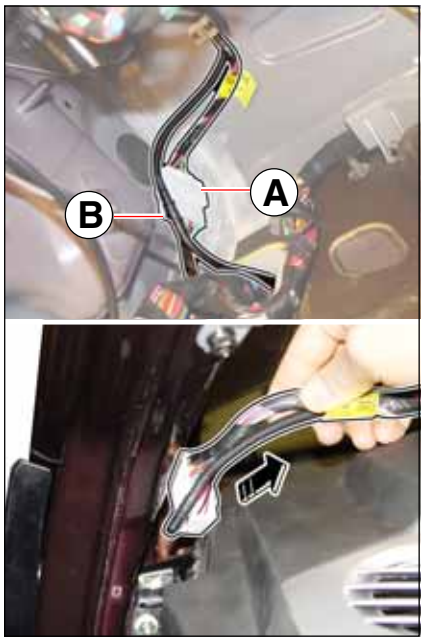
2. Disconnect the rear washer fluid hose from D pillar.



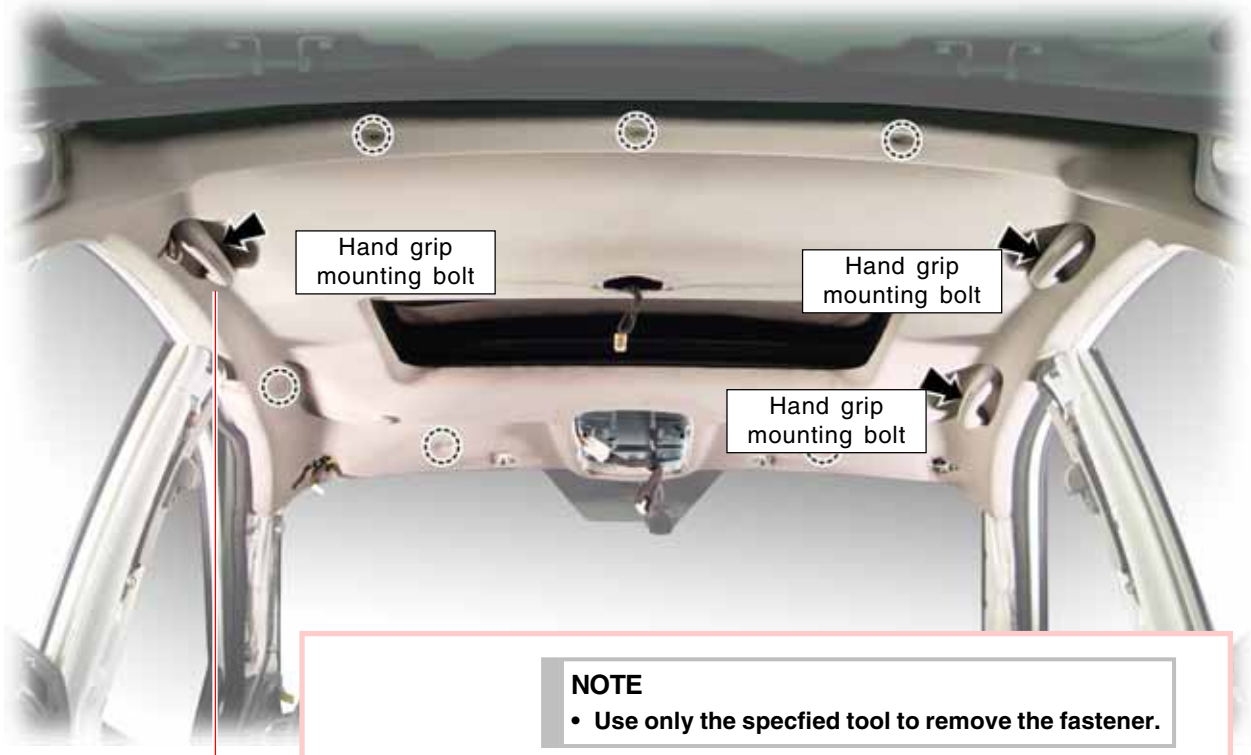
NOTICE

- **The washer fluid could be dropped from the hose when disconnecting the hose.**

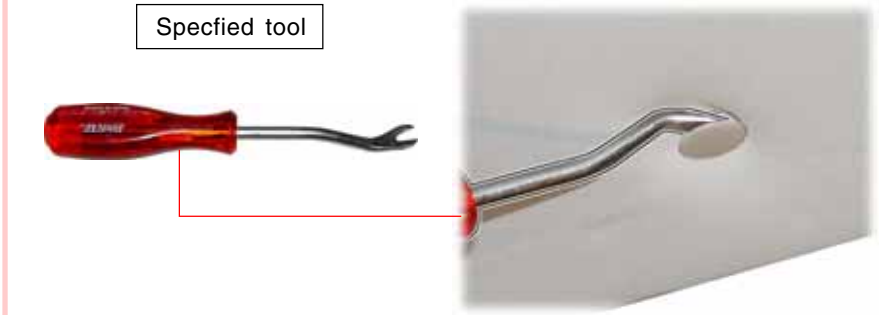
3. Remove the roof wiring connector (A) and rear washer fluid hose (B) through the opening in instrument panel.



4. Pull out the fasteners (rear - 3, front - 2, driver side - 1) and remove the headlining assembly.



NOTE
- **Use only the specfied tool to remove the fastener.**

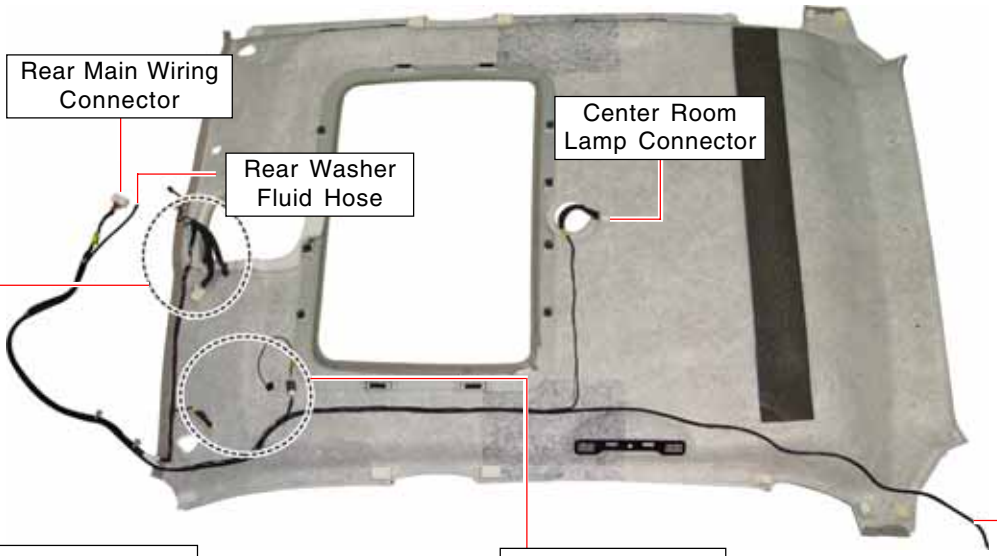


- Remove two mounting bolts at each hand grip.

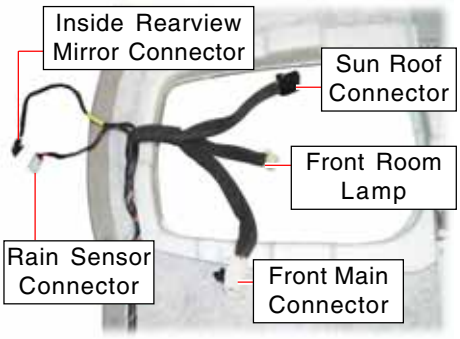


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

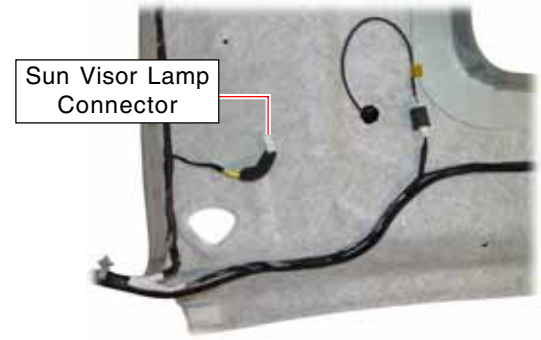
Headlining Assembly

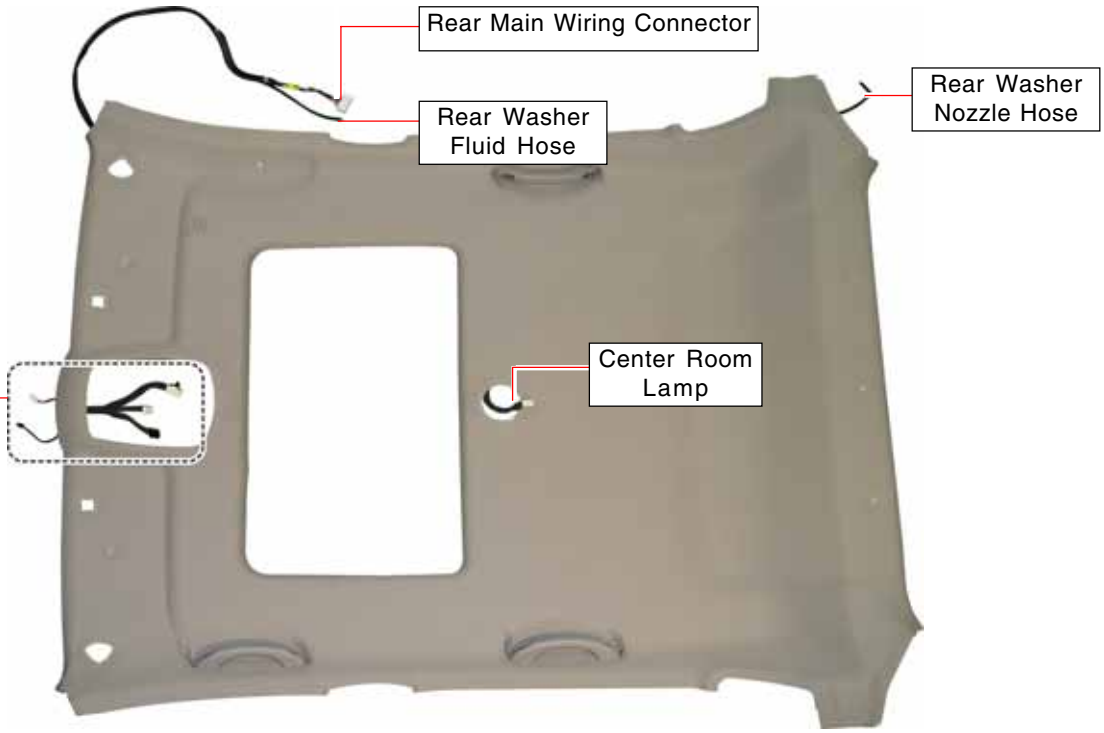


Front (Center)



Roof (Driver side)





OUTSIDE REARVIEW MIRROR

1. REMOVAL AND INSTALLATION OF OUTSIDE REARVIEW MIRROR



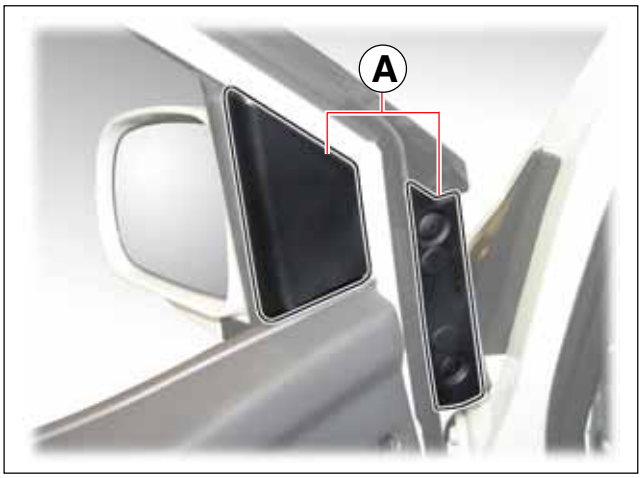
Mounting Points of Outside Rearview Mirror



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

1. Remove the inner covers (A) from the outside rear-view mirror.





2. Remove the door trim.

* Unscrew eight mounting screws with dotted circle and remove the door trim starting from lower side. (For details, refer to “Door” section.)

3. Disconnect the outside rearview mirror connector.



4. Unscrew five mounting bolts and remove the outside rearview mirror.

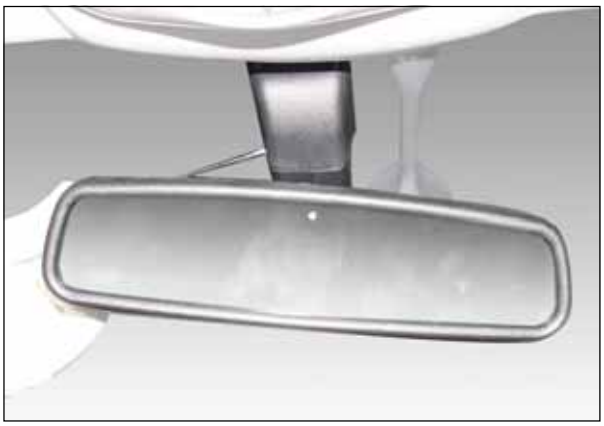


INSIDE REARVIEW MIRROR (ECM MIRROR)

1. REMOVAL AND INSTALLATION OF INSIDE REARVIEW MIRROR

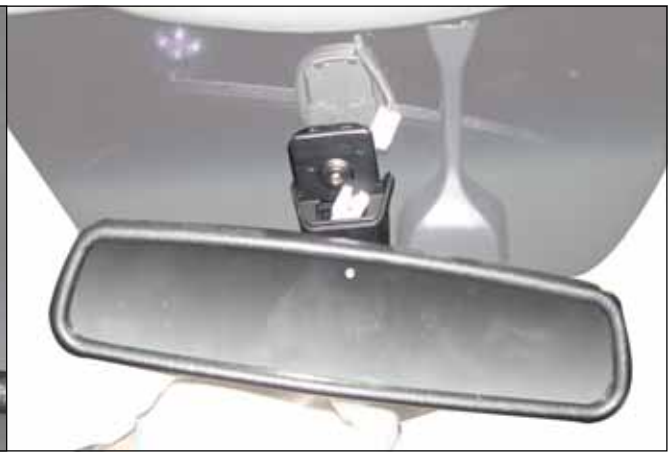
For safer night driving, an electro chromatic mirror (ECM) automatically quells the annoyance of headlight glare from following traffic. It has a light sensor to adjust the reflection rate of inside rearview mirror based on the light intensity around the vehicle.

1. Pry off the room mirror cover with a flat blade screwdriver.

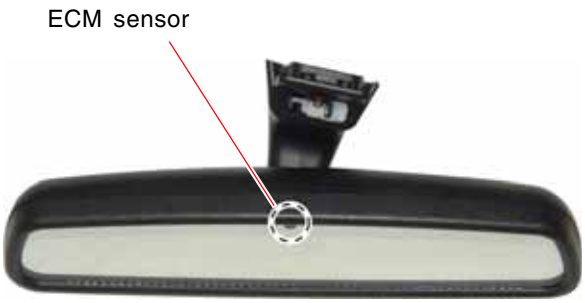


2. Disconnect the wiring connector and remove the inside rearview mirror.





Inside Rearview Mirror





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

BODY EXTERIOR

5110 / 7870 / 7880 / 6110 / 7930 / 5720 / 6210 / 6310 / 7840

TABLE OF CONTENTS

BODY EXTERIOR 2

1. Composition of Body Exterior 2

FRONT BUMPER ASSEMBLY 4

1. Construction 4
2. Removal and installation of front bumper assembly 5

REAR BUMPER ASSEMBLY 8

1. Construction 8
2. Removal and installation of rear bumper assembly 9

HOOD ASSEMBLY 13

1. Construction 13
2. Removal and installation of hood assembly and components 14
3. Hood adjustment 17

SIDE SILL MOLDING 18

1. Construction 18
2. Removal and installation 19

FENDER PANEL ASSEMBLY 20

1. Removal and installation of fender assembly 20

FRONT DOOR ASSEMBLY 23

1. Components of front door opening system 23
2. Removal and installation of front door assembly 24
3. Front window regulator 27

REAR DOOR ASSEMBLY 29

1. Components of rear door opening system 29
2. Removal and installation of rear door 30
3. Rear window regulator 34

TAILGATE ASSEMBLY 38

1. Construction 38
2. Removal and installation of tailgate assembly 40

REAR QUARTER GLASS 46

1. Removal and installation of quarter glass 46

BODY EXTERIOR

1. COMPOSITION OF BODY EXTERIOR

Hood Assembly



Sunroof Assembly



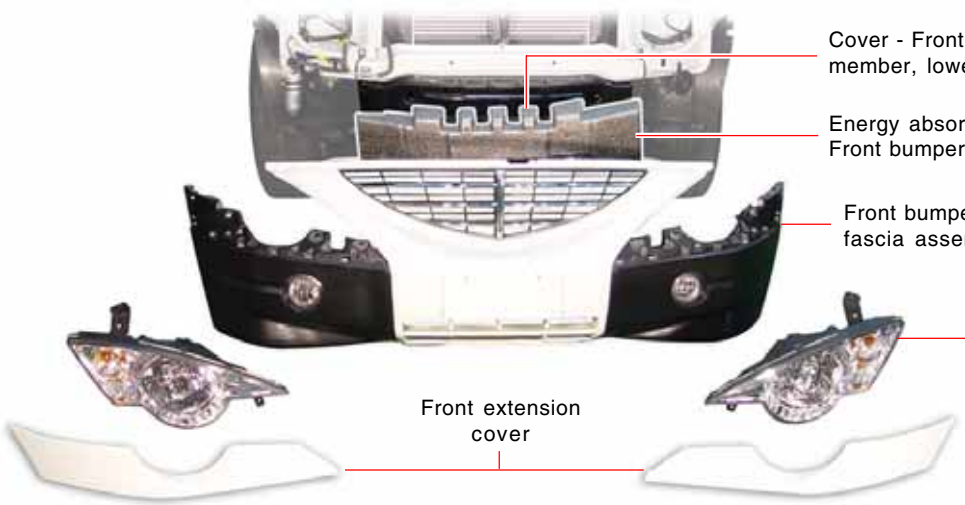


Front Fender Assembly

Front Door Assembly



Front Bumper Assembly



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Rear Door Assembly

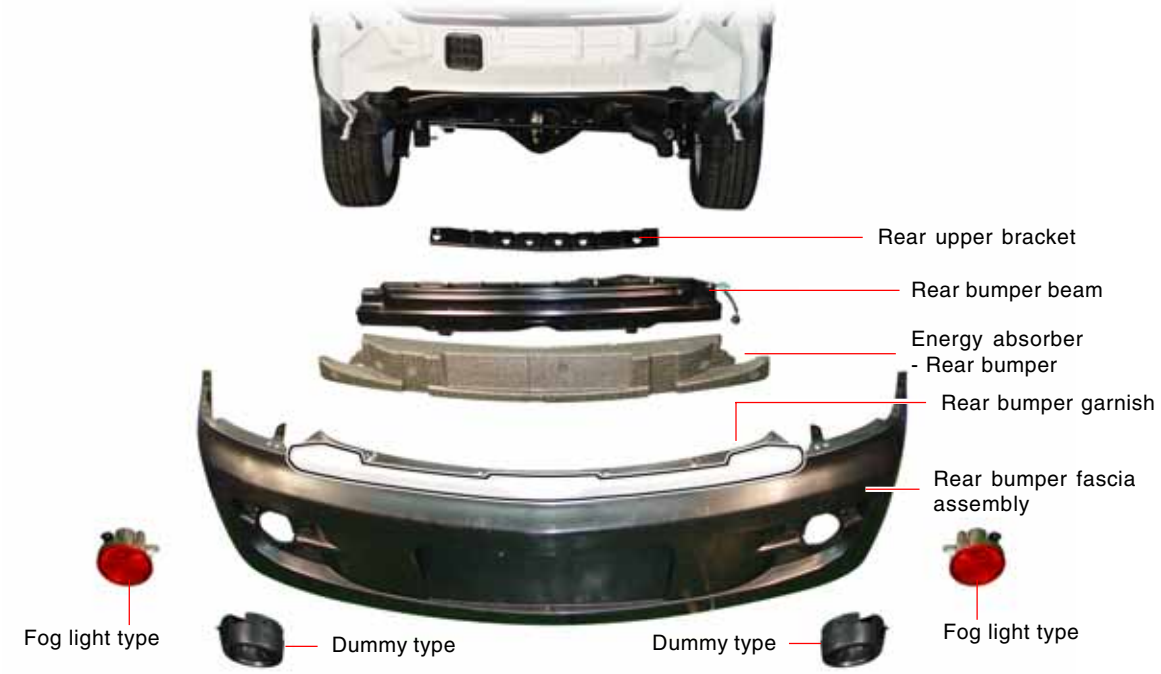


Tailgate Assembly





Rear Bumper Assembly



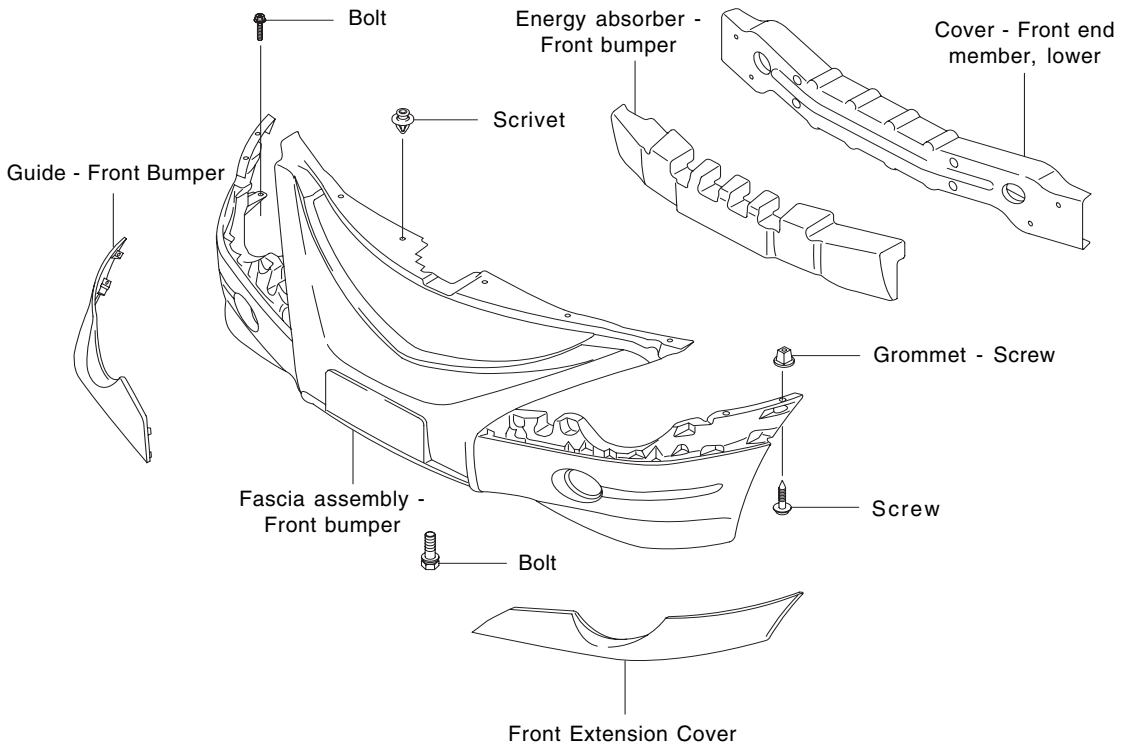
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AFFECTED VIN	

FRONT BUMPER ASSEMBLY

1. CONSTRUCTION



Front Bumper Assembly



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EFFECTIVE DATE	
AFFECTED VIN	

2. REMOVAL AND INSTALLATION OF FRONT BUMPER ASSEMBLY

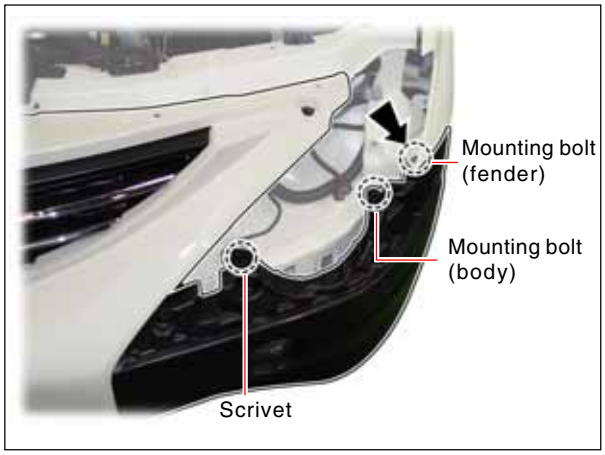
Removal and Installation

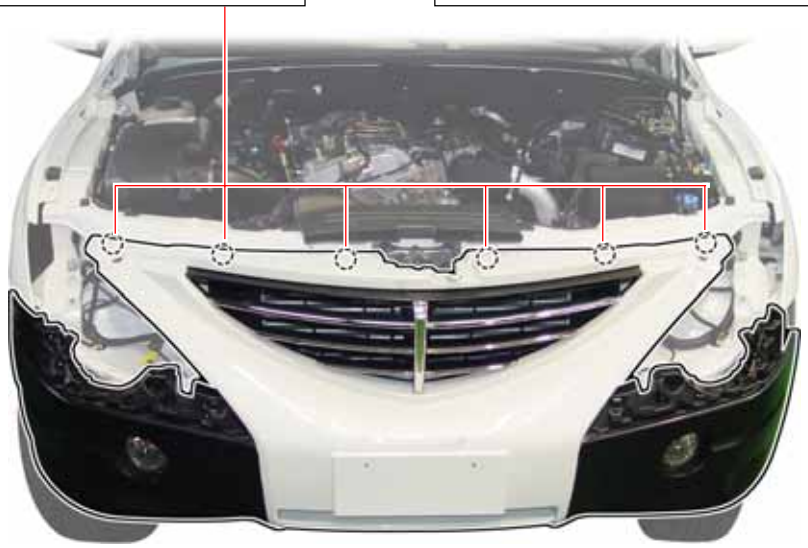
※ **Preceding Work:** Disconnect the negative battery cable and remove the headlamps.

1. Remove the scrivets ( ) from the upper cover.



2. Unscrew the mounting bolts with the headlamp removed.

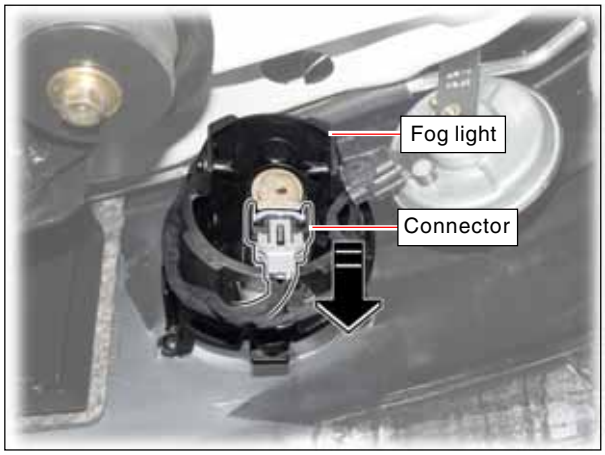




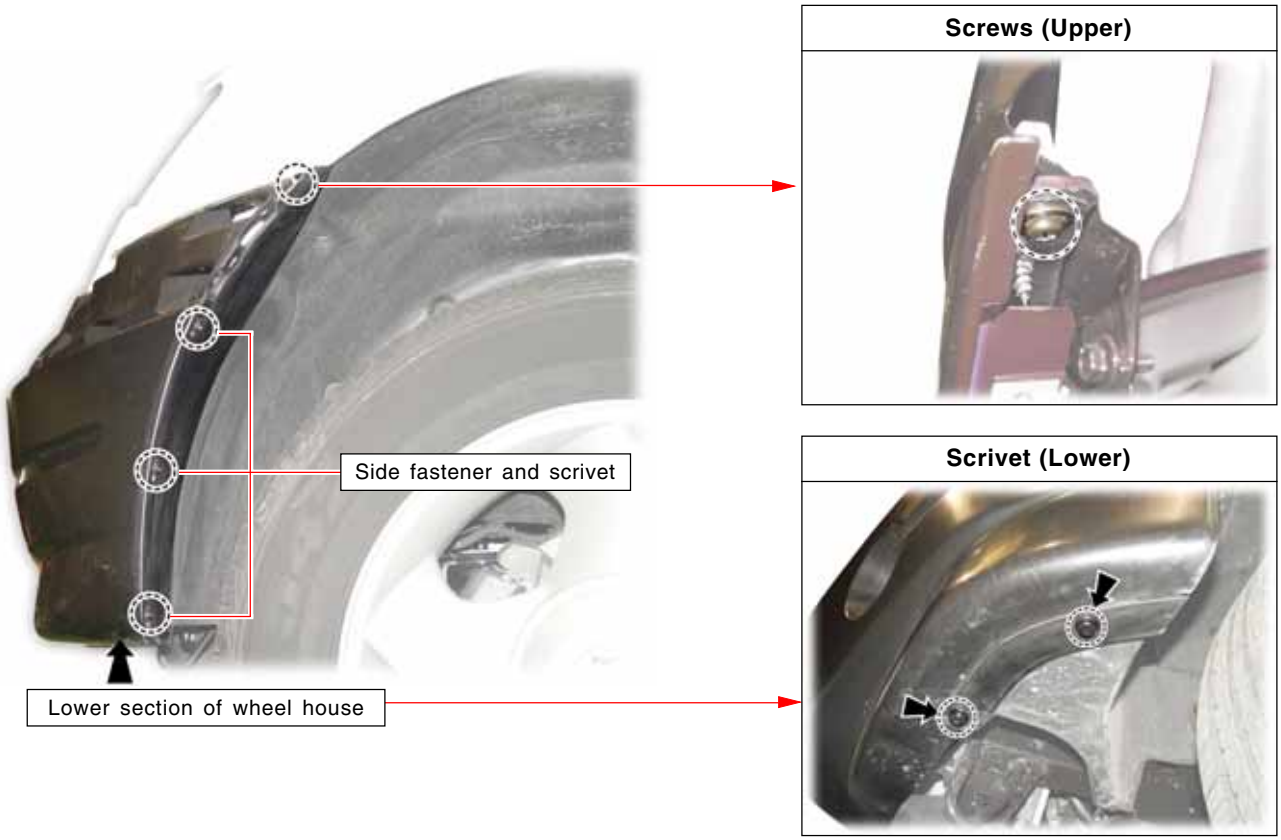
3. Unscrew the lower mounting bolts at both sides on the front bumper.



4. Disconnect the fog light connector.



5. Unscrew the mounting screws from the wheelhouse to remove the front bumper assembly.



6. Remove the front bumper assembly.

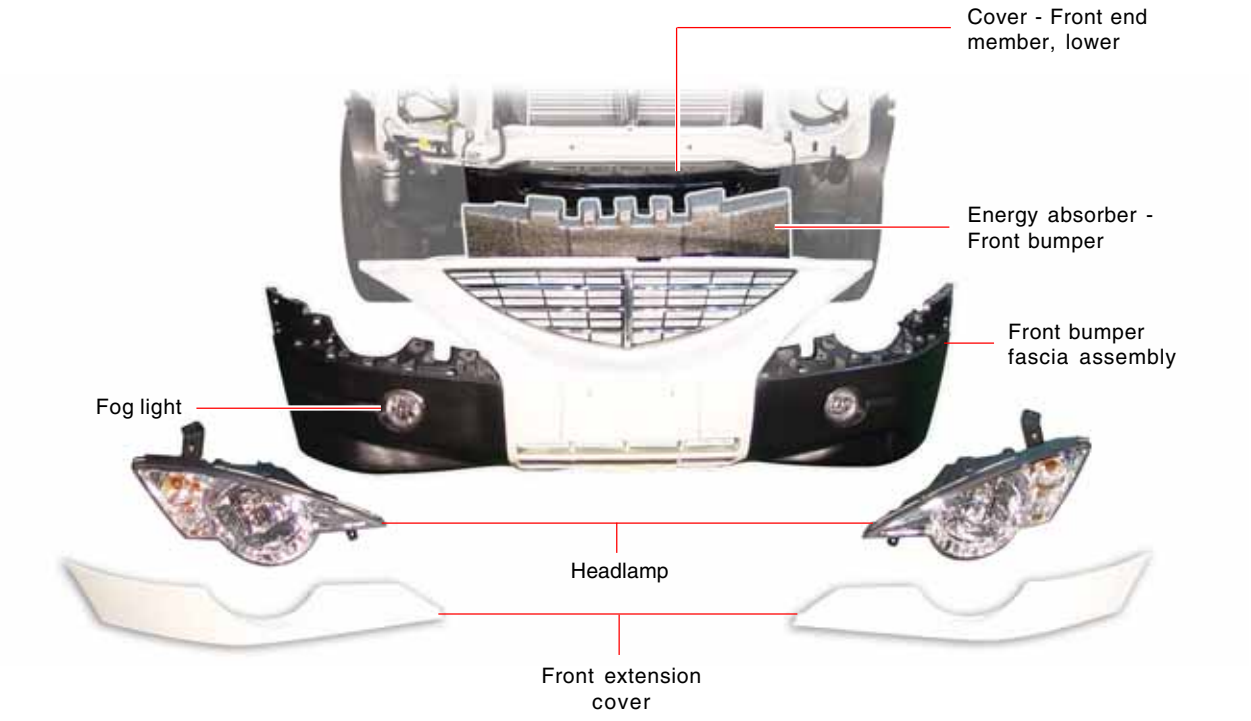


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

7. Remove the energy absorber from the front end member lower cover.



Composition of Front Bumper Assembly

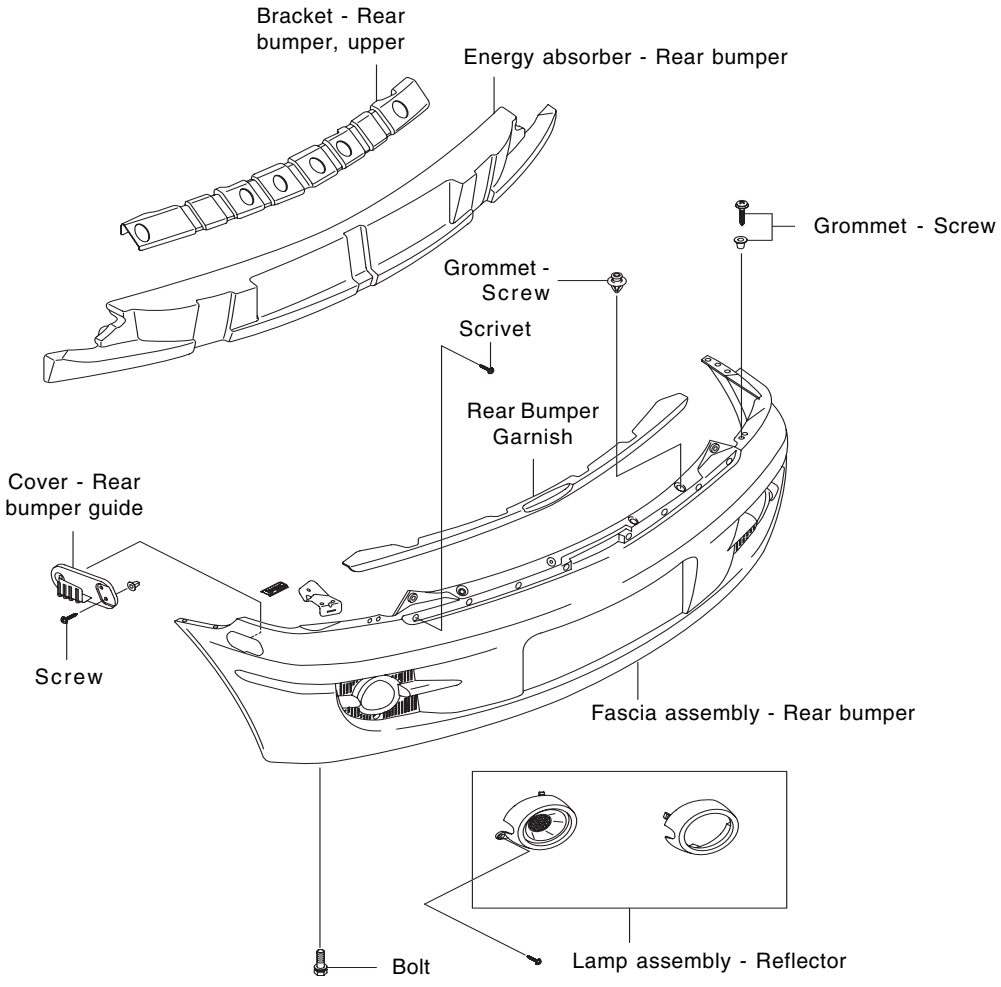


REAR BUMPER ASSEMBLY

1. CONSTRUCTION



Rear Bumper



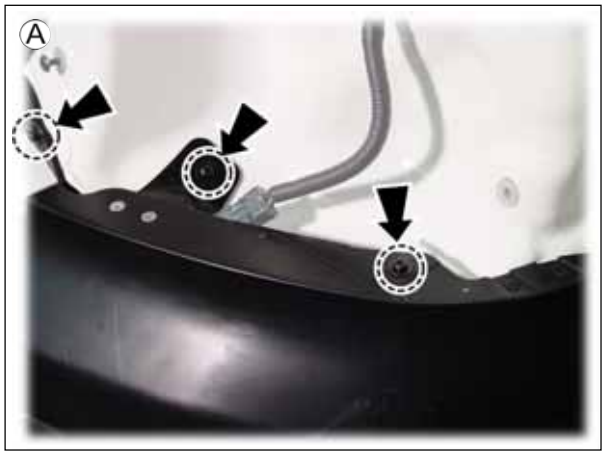
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AFFECTED VIN	

2. REMOVAL AND INSTALLATION OF REAR BUMPER ASSEMBLY

Removal and Installation

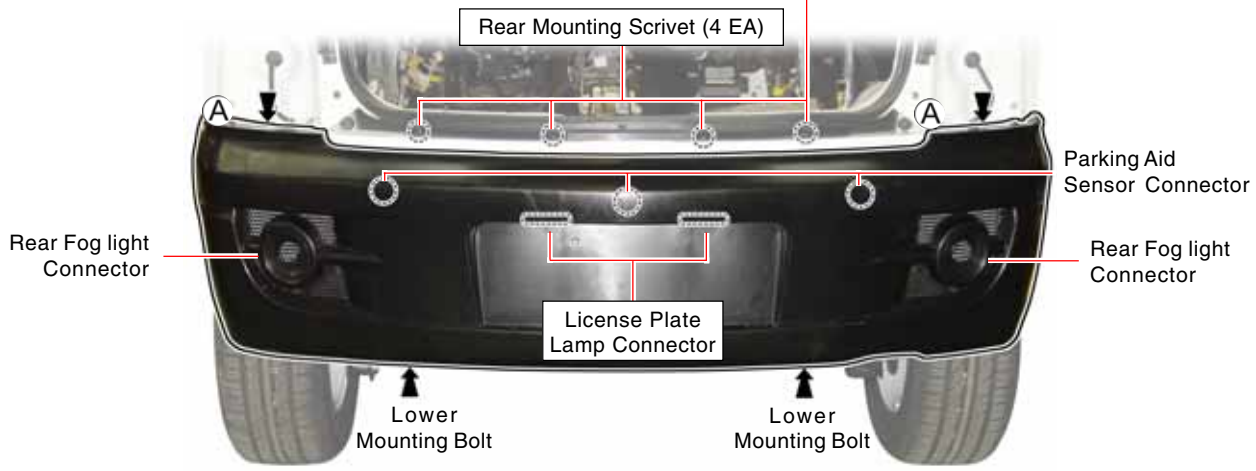
※ **Preceding Work:** Disconnect the negative battery cable and remove the combination lamp assembly at both sides.

1. Unscrew three mounting screws with the rear combination lamp assembly removed.



2. Unscrew two upper mounting bolts.





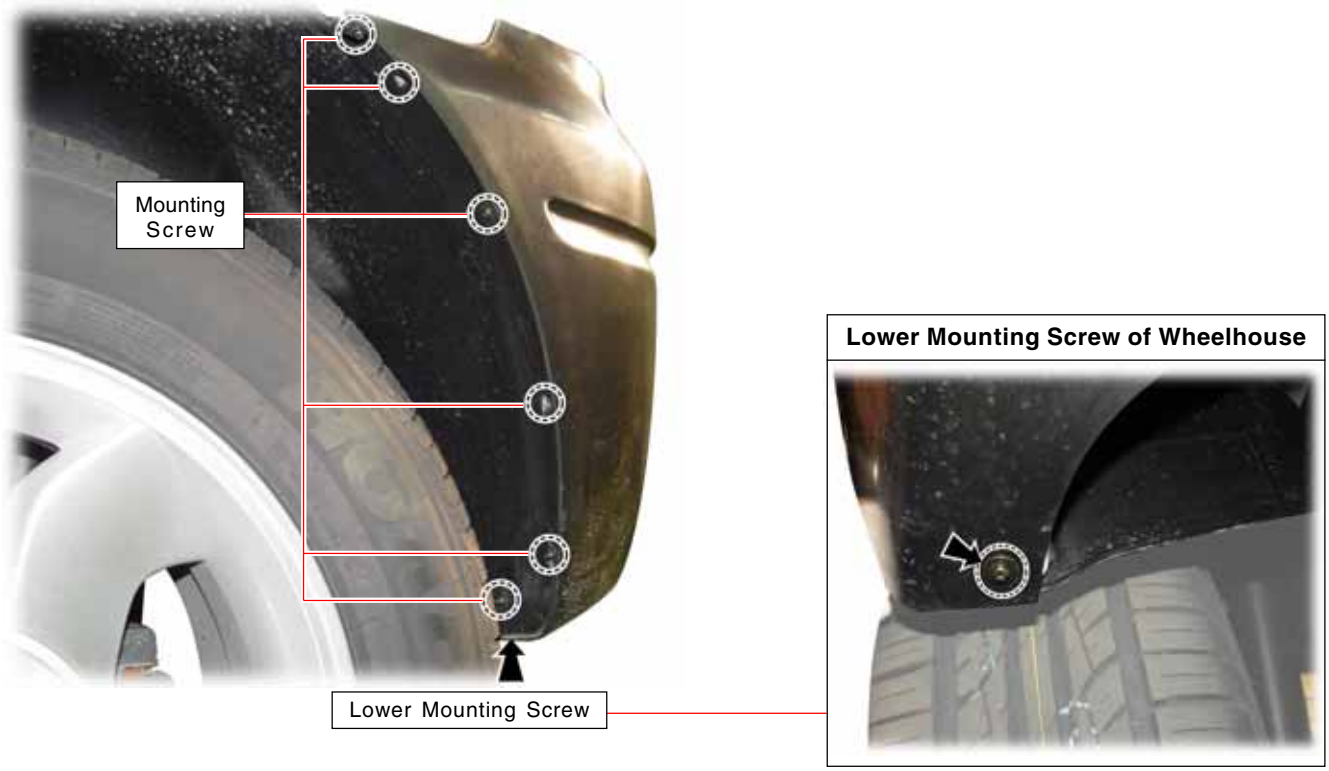
3. Remove two lower mounting bolts at both sides.



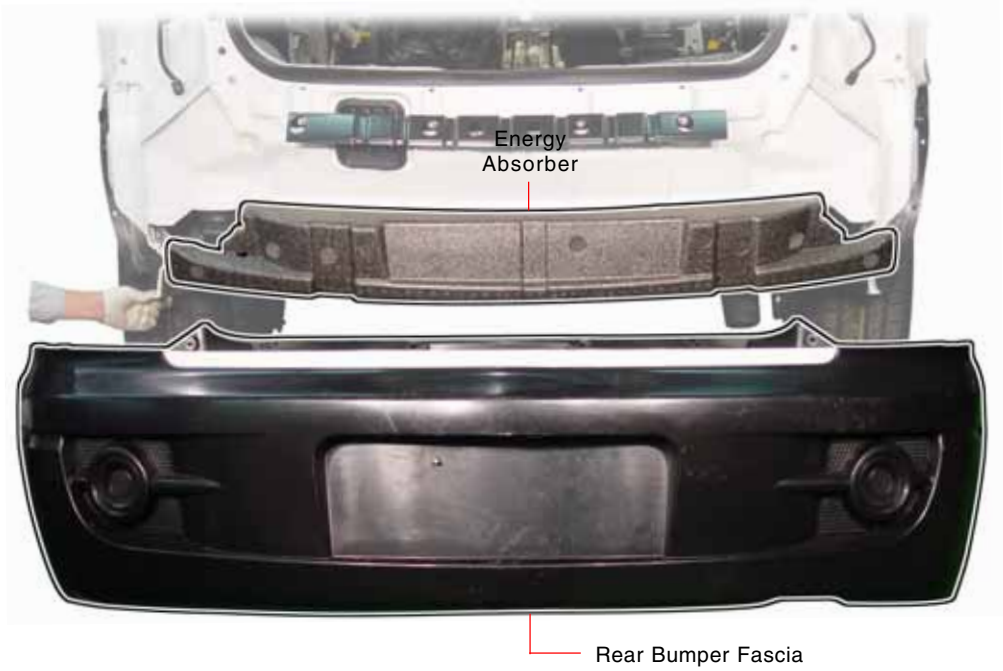
4. Disconnect the connectors for parking aid sensor, rear fog light and license plate lamp.



5. Unscrew seven mounting screws from the rear wheelhouse.



6. Remove the rear bumper fascia and the energy absorber.



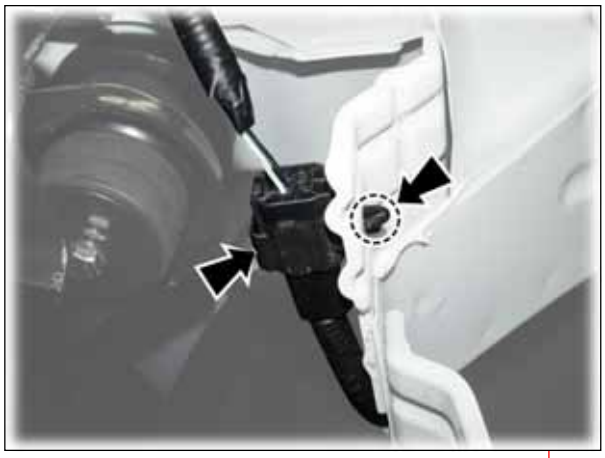
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

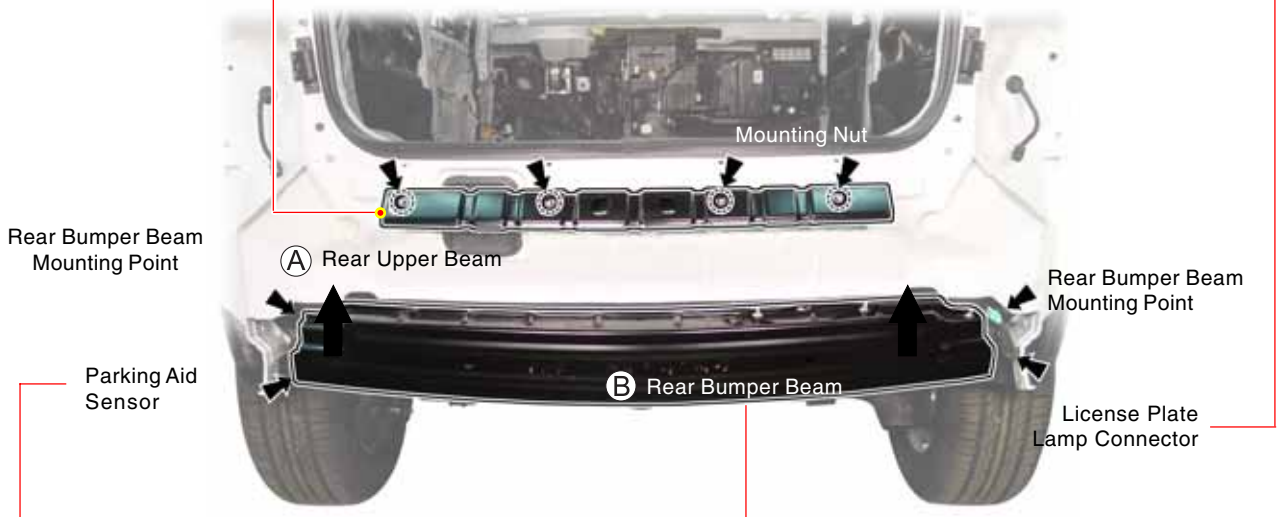
7. Remove the rear upper beam Ⓐ and Ⓑ according to the following procedure with the rear bumper fascia removed.

① Unscrew four mounting nuts and remove the rear upper beam assembly.

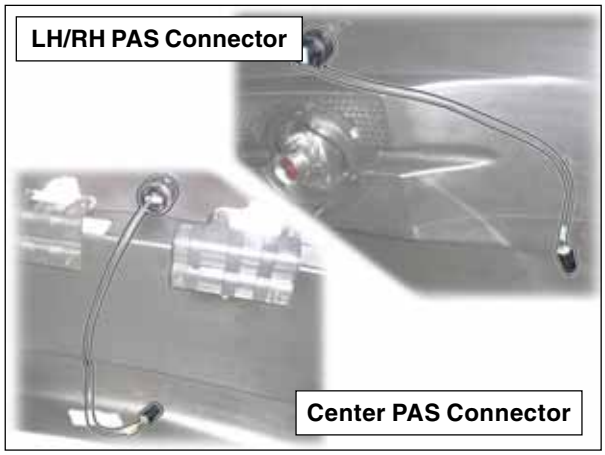


② Disconnect the license plate lamp connector.

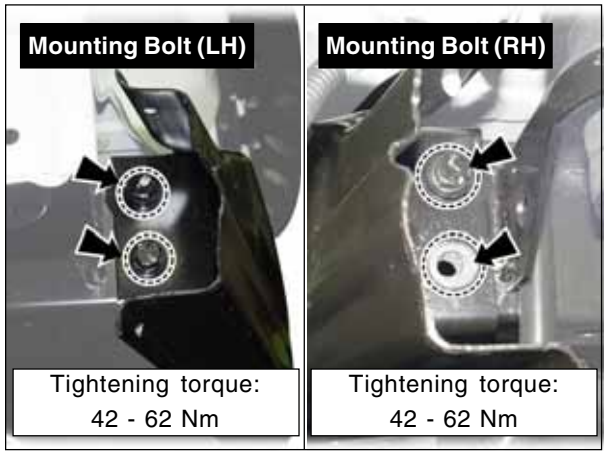




③ Disconnect the main wiring (parking aid sensor) connector at rear side and remove the connector fastener from body.



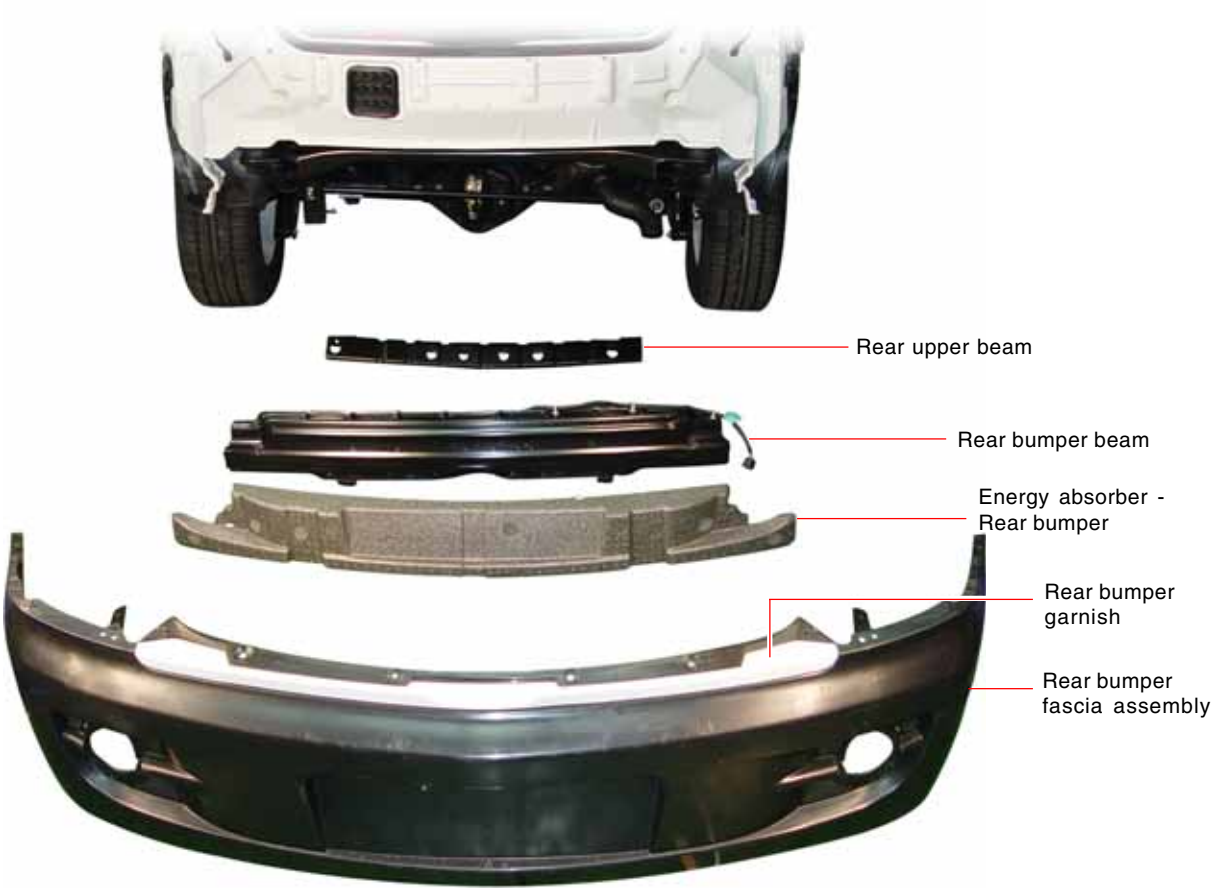
④ Unscrew two mounting bolts from the rear bumper beam at both sides. (Do not remove the upper bolt completely.)



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

8. Install the rear bumper beam assembly in the reverse order of removal.

Composition of Rear Bumper Assembly

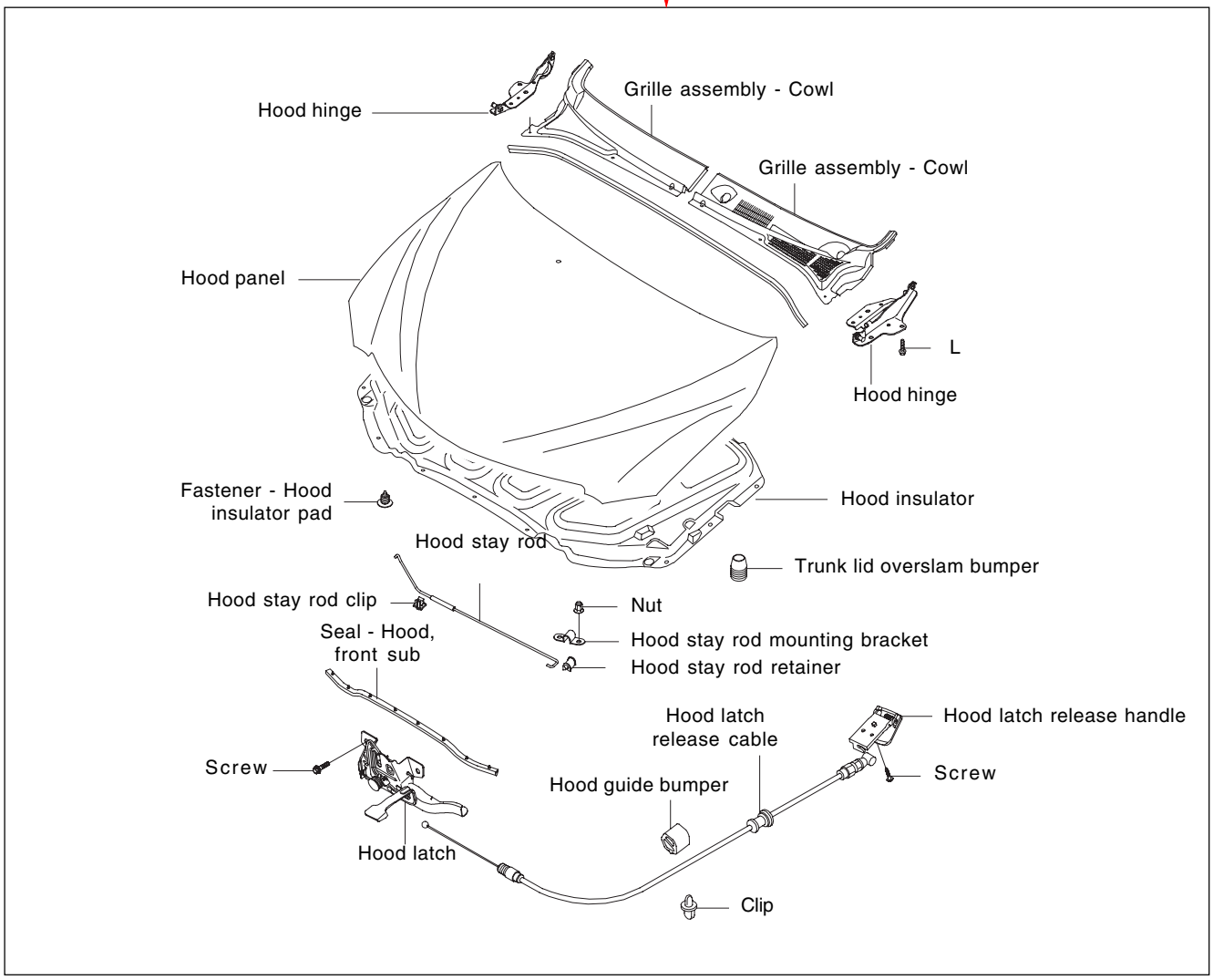


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AFFECTED VIN	

HOOD ASSEMBLY

1. CONSTRUCTION



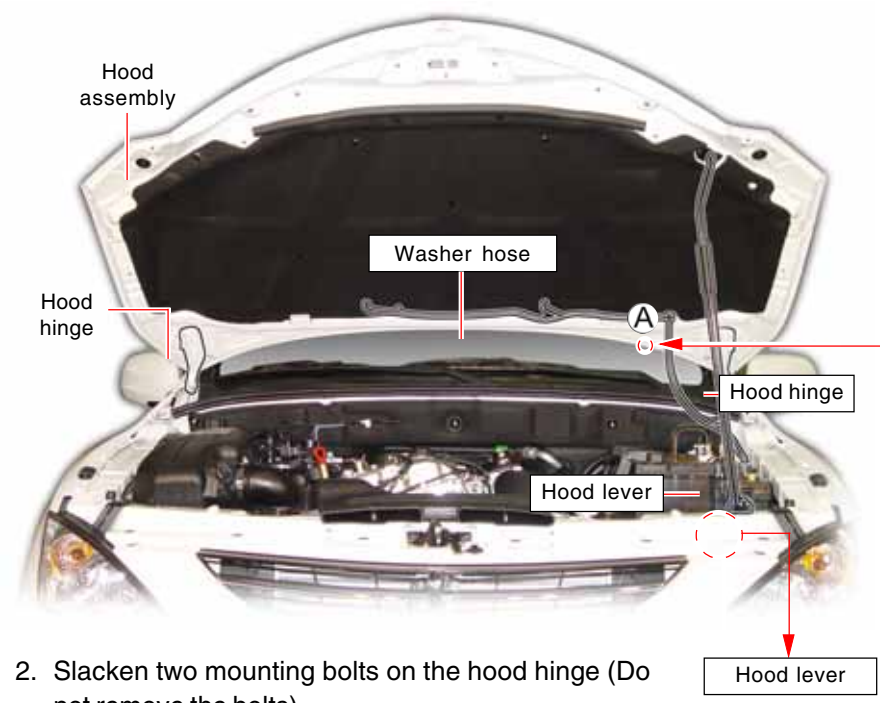


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EFFECTIVE DATE	
AFFECTED VIN	

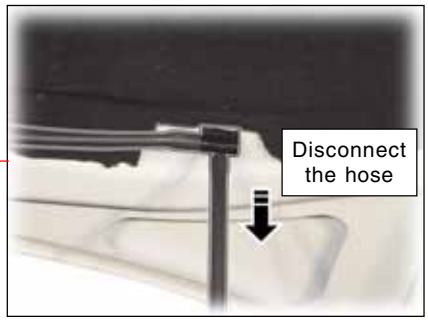
2. REMOVAL AND INSTALLATION OF HOOD ASSEMBLY AND COMPONENTS

※ **Preceding Work:** Cover the vehicle body and place the chocks under the tires.

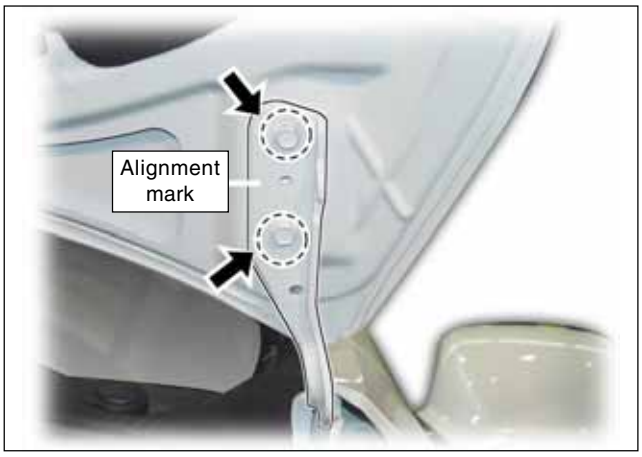
Hood



1. Disconnect the washer fluid nozzle hose (A) from the engine hood.



2. Slacken two mounting bolts on the hood hinge (Do not remove the bolts).



NOTE

- **Make an alignment mark on the hood and hinge for installation.**

3. Carefully remove the engine hood.

Pay particular attention to avoid vehicle damage and personal injury.

Unscrew two mounting bolts and remove the hood lever.

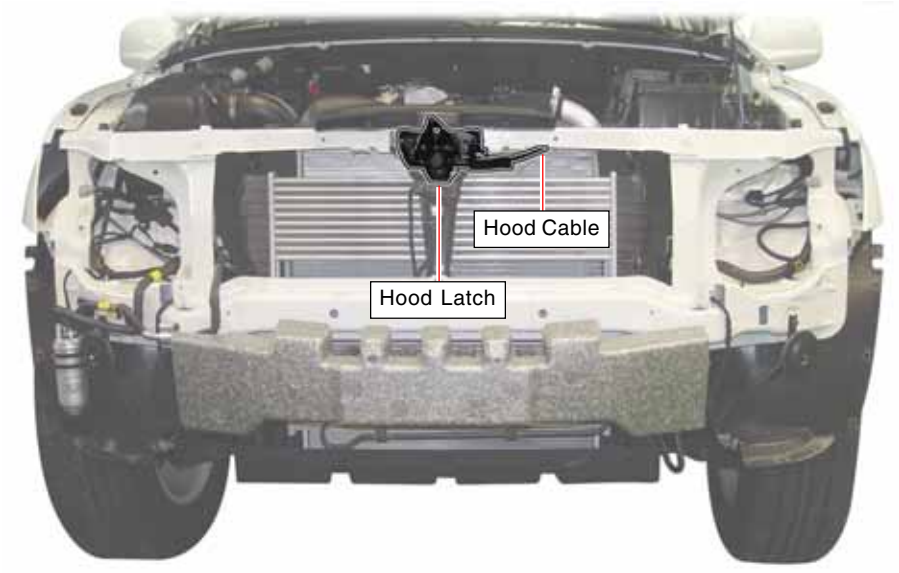




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EFFECTIVE DATE	
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Hood Latch and Cable

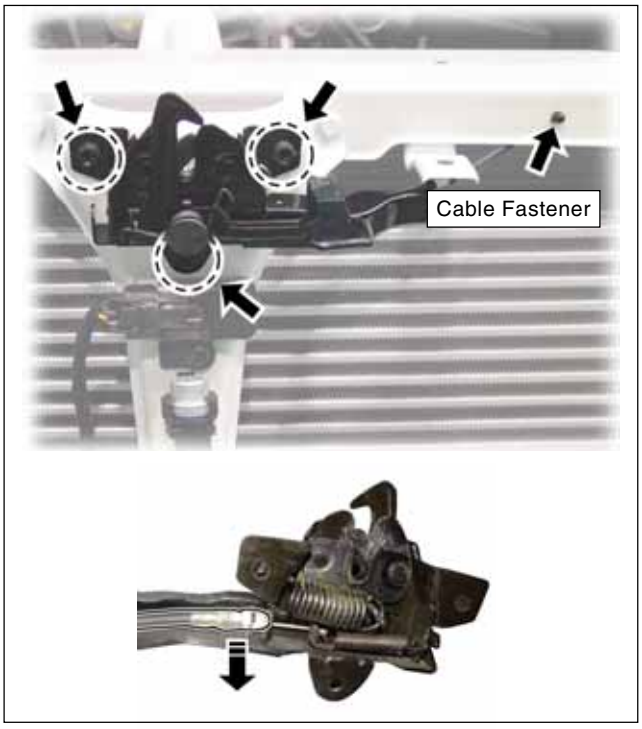
※ **Preceding Work:** Remove the front bumper assembly.



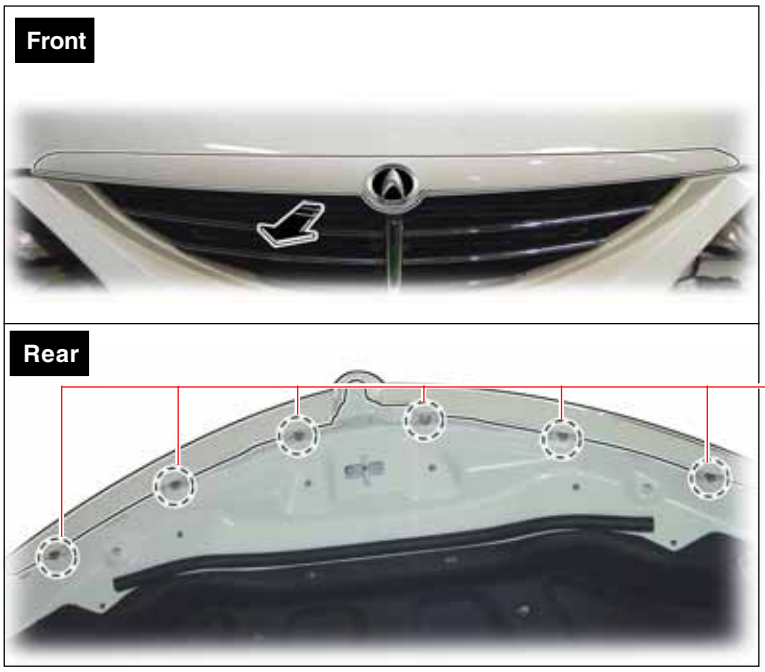
1. Remove the lower instrument panel at driver side and disconnect the hood release lever cable.
   (Refer to “Body” section.)



2. Unscrew three bolts (10 mm), disconnect the hood release cable, and remove the hood latch.



Hood Garnish (Front)



1. Lift the hood and unscrew six mounting bolts from hood garnish.



2. Remove the hood garnish while pulling it forward.

Hood Insulation Pad

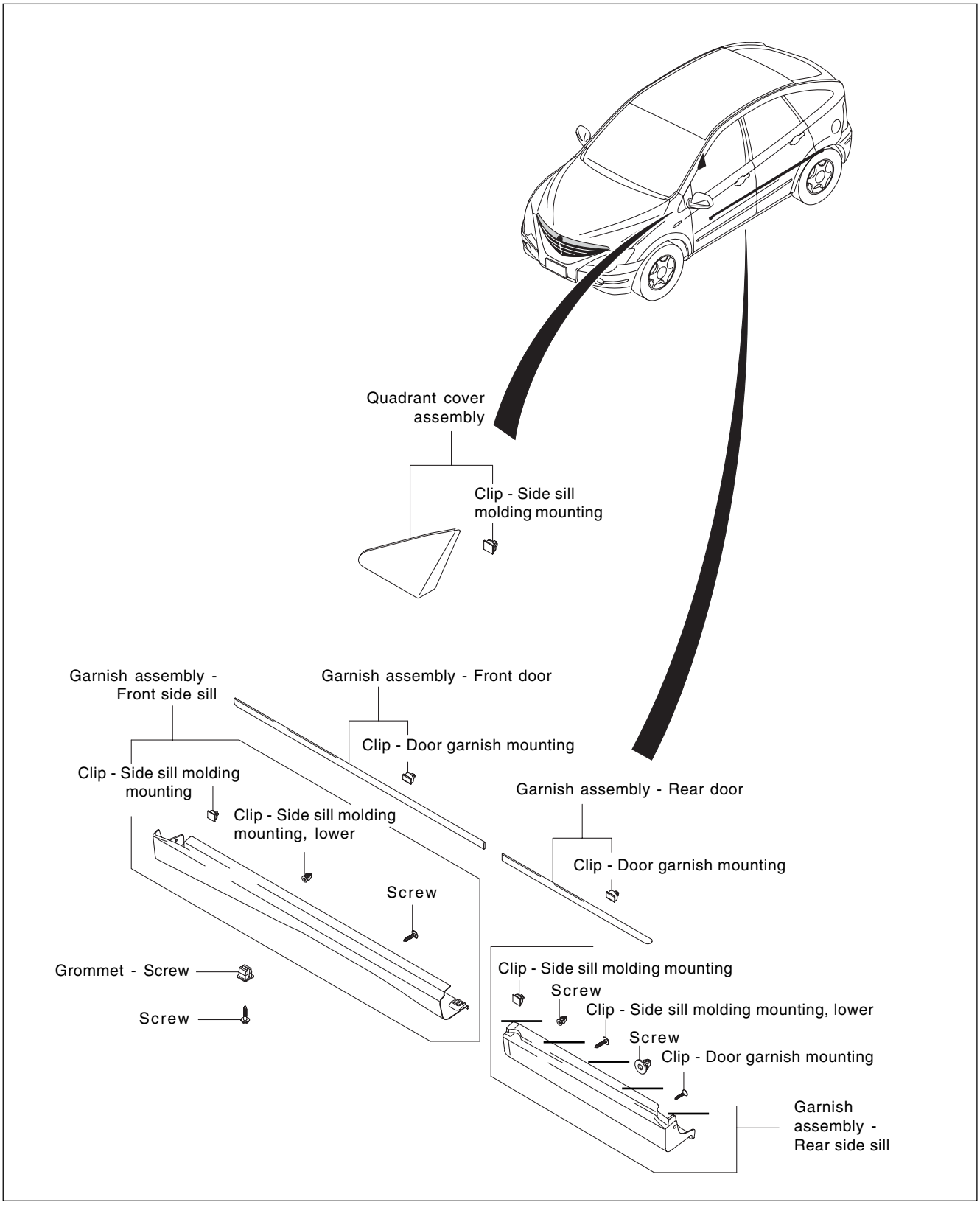
- Remove the fasteners and insulation pad. Once removed, the insulation pad should be replaced with new one.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SIDE SILL MOLDING

1. CONSTRUCTION



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

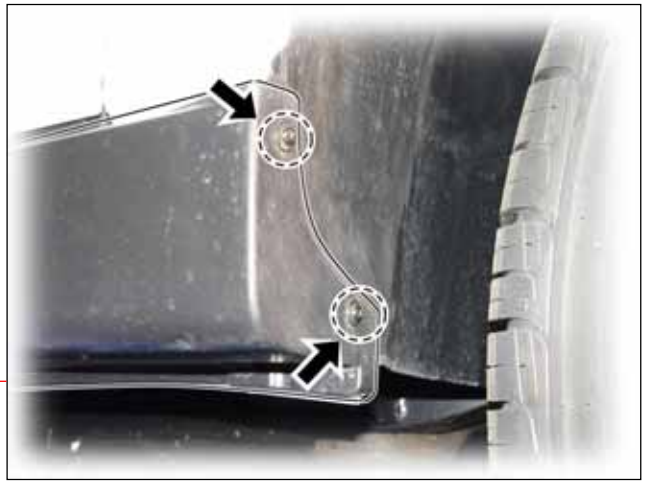
2. REMOVAL AND INSTALLATION

Side sill Molding

All side moldings can be removed/installed with a similar procedure.



1. Unscrew two mounting screws from the front/rear wheelhouse.



2. Unscrew the lower mounting screws from the side sill molding.

Front side sill molding	5 mounting screws
Rear side sill molding	3 mounting screws



3. Carefully remove the side molding seal.



FENDER PANEL ASSEMBLY

1. REMOVAL AND INSTALLATION OF FENDER ASSEMBLY

※ **Preceding Work:** Disconnect the negative battery cable and remove the headlamps, front bumper and cowl.

1. Remove the tires and wheelhouse cover.



2. Remove the quadrant cover.



CAUTION

Be careful not to damage the fasteners.



4. Disconnect the side repeater connector and remove the lamp assembly.



3. Remove the insulator sponge from the fender.

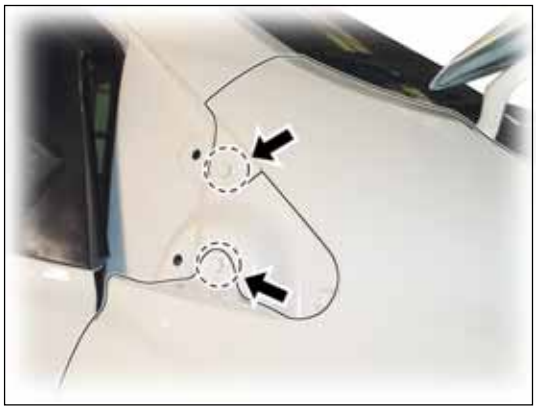


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EFFECTIVE DATE	
AFFECTED VIN	

5. Unscrew one mounting bolt in cowl.



6. Unscrew two quadrant cover bolts.

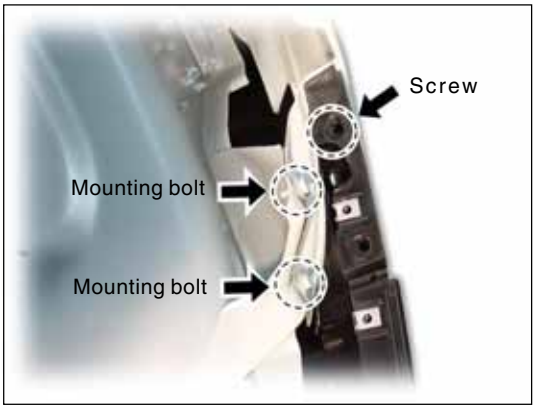




7. Unscrew the front mounting bolt from the headlamp.



8. Unscrew two bolts and one screw from the wheelhouse.





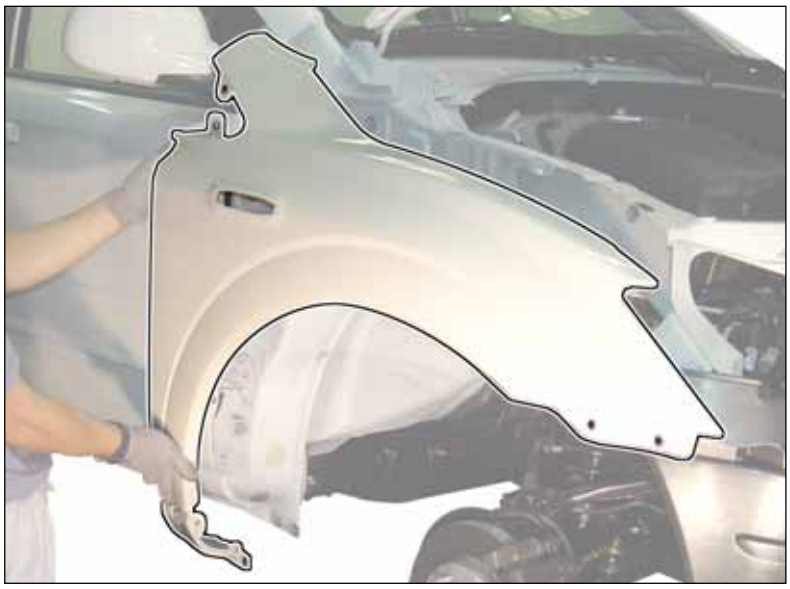
9. Unscrew the lower bolts from the fender.



10. Unscrew the upper bolts from the fender.



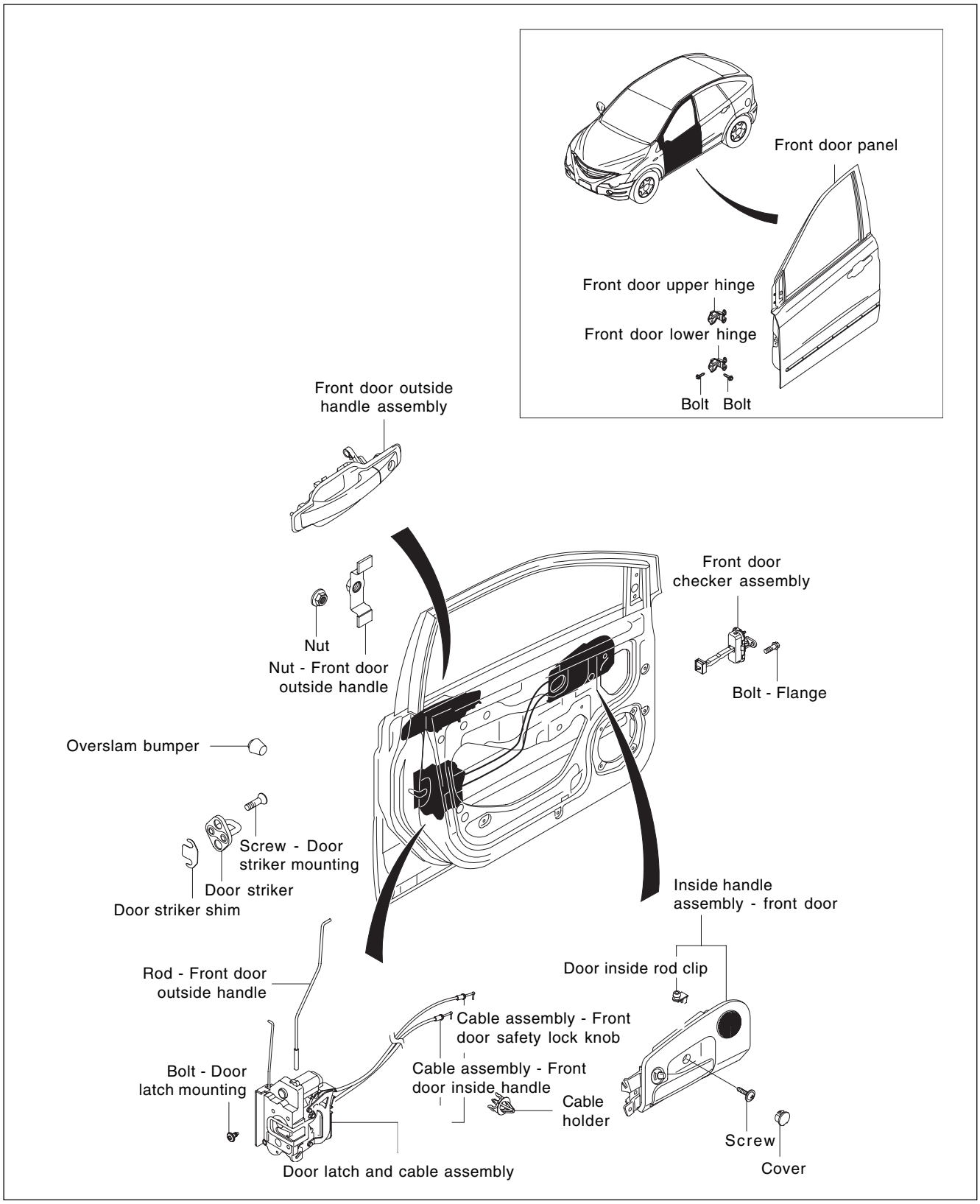
11. Remove the fender panel from the vehicle.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

FRONT DOOR ASSEMBLY

1. COMPONENTS OF FRONT DOOR OPENING SYSTEM



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. REMOVAL AND INSTALLATION OF FRONT DOOR ASSEMBLY

FRONT DOOR TRIM (Driver Side)

※ **Preceding Work:** Disconnect the negative battery cable.

- Removal of fastener cover





1. Unscrew seven mounting screws from the door trim and separate the fasteners starting from bottom of the door trim to remove it.



Location of Fasteners

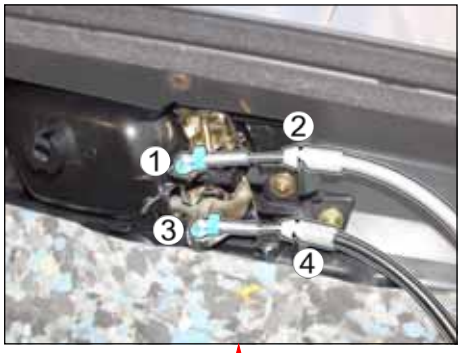


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EFFECTIVE DATE	
AFFECTED VIN	

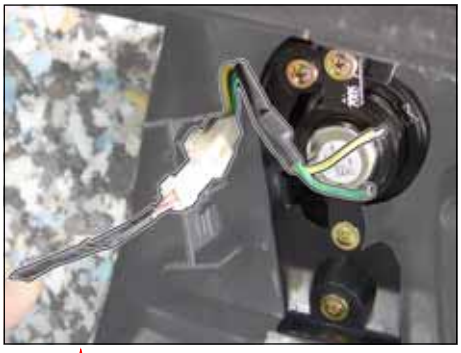
2. Remove the door handle cable (A), door courtesy lamp connector (B), door tweeter speaker connector (C) and power window switch connector (D) from the removed door trim.

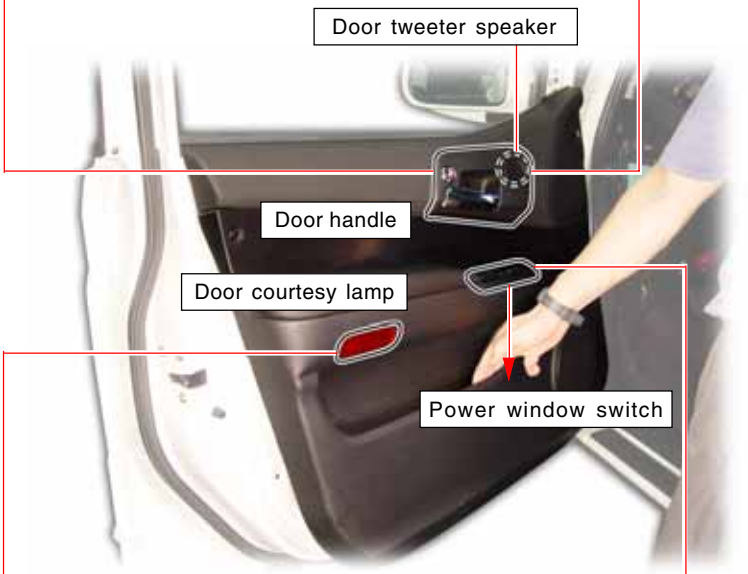
A. Door handle connector

: Remove the cables from 1 to 4 as in order shown in figure below.



C. Door tweeter speaker connector





B. Door courtesy lamp connector

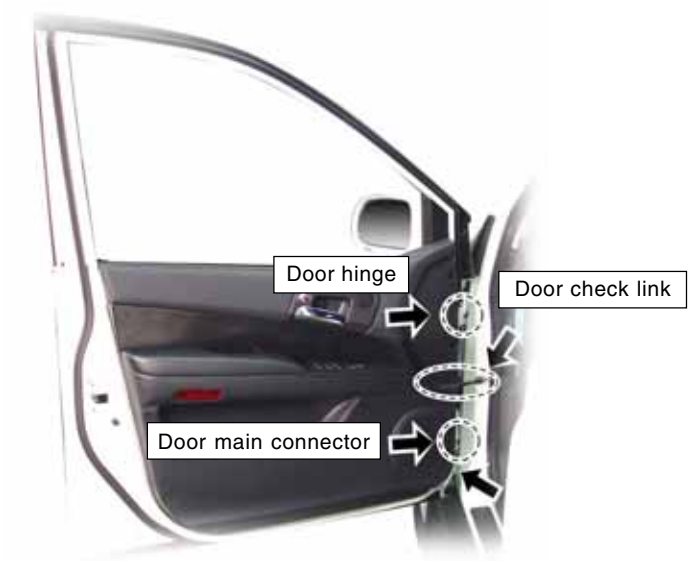


D. Power window switch connector

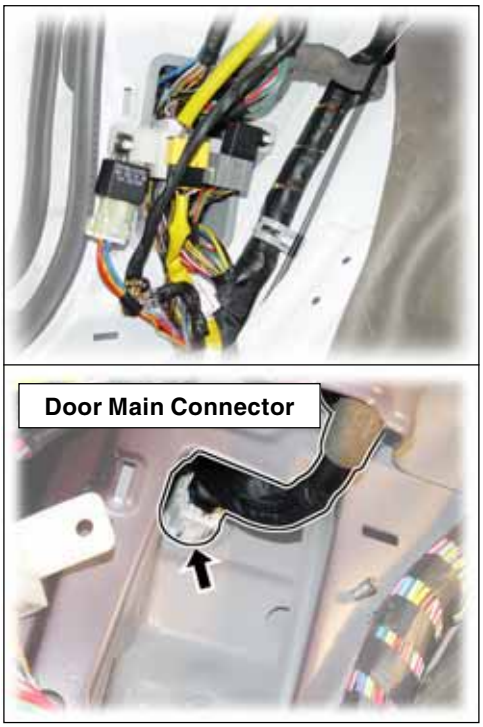


Front Door (Driver Side)

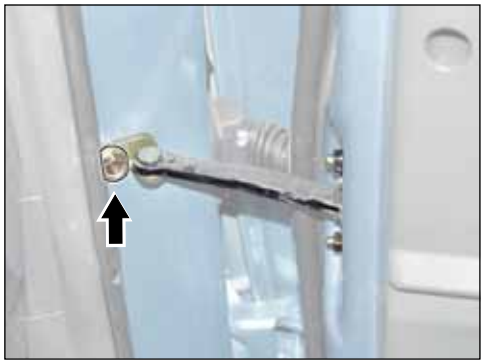
※ **Preceding Work:** Disconnect the negative battery cable.



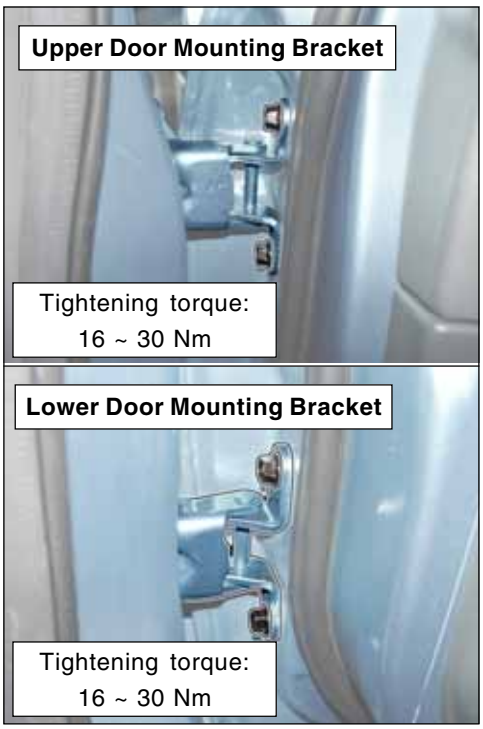
1. Remove the main wiring harness cover and disconnect the door main connector.



2. Unscrew the mounting bolt from the door check link (vehicle side).



3. Unscrew the upper and lower hinge bolts and remove the door assembly.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. FRONT WINDOW REGULATOR

▶ Dual Rail with Regulator

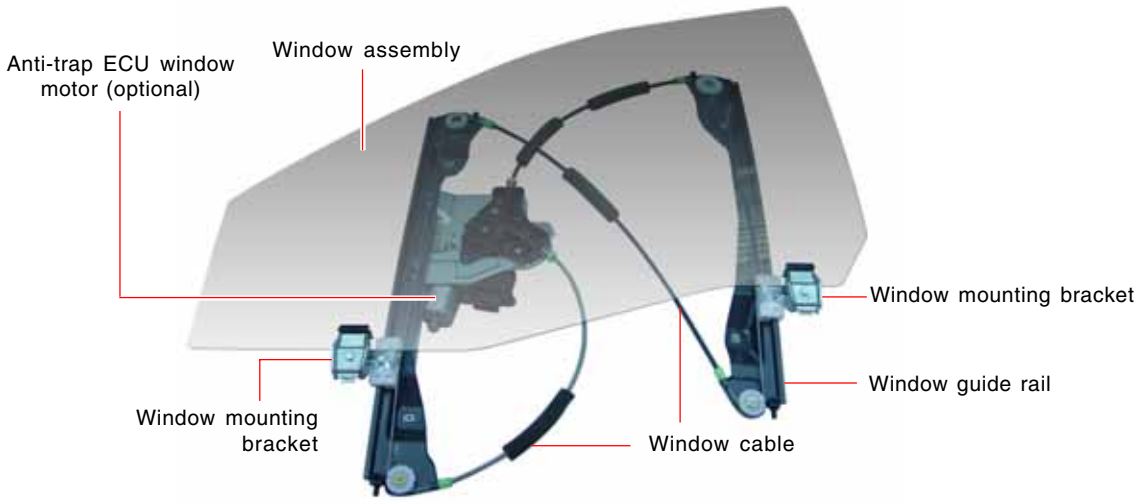
1. The dual rail with regulator is installed to this vehicle. Its advantages are as below:

Smooth operation

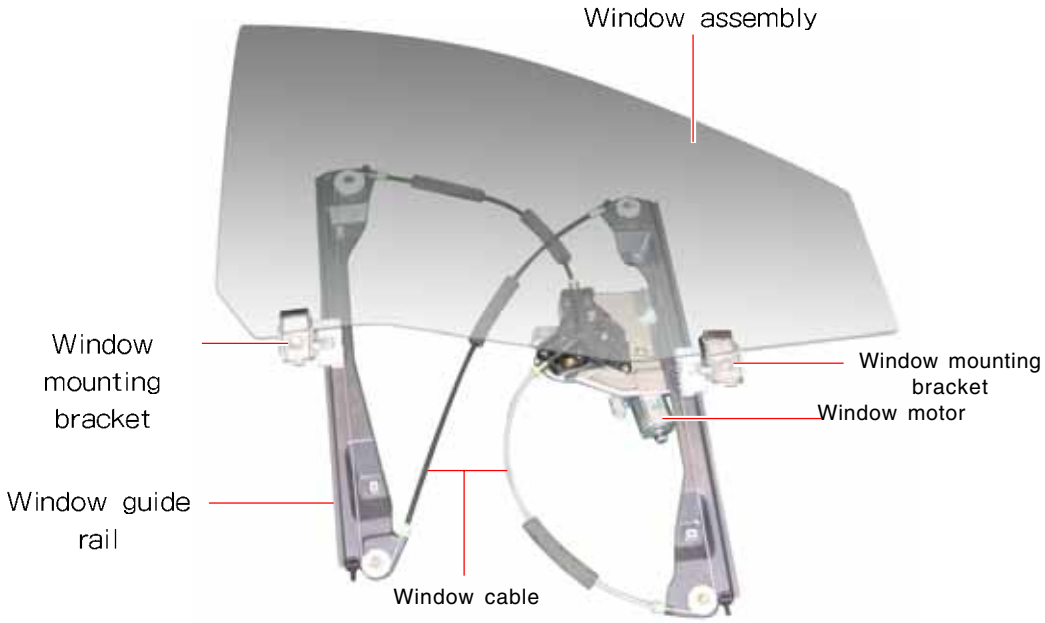
1) Safety operation
2) Preventing the glass pinch
3) Preventing the glass tilting
4) Reduced the length of glass run
5) Increased durability of lifting mechanism (including glass run)
6) No contamination due to grease (applied solid coating)

Components

Driver Side Window and Regulator



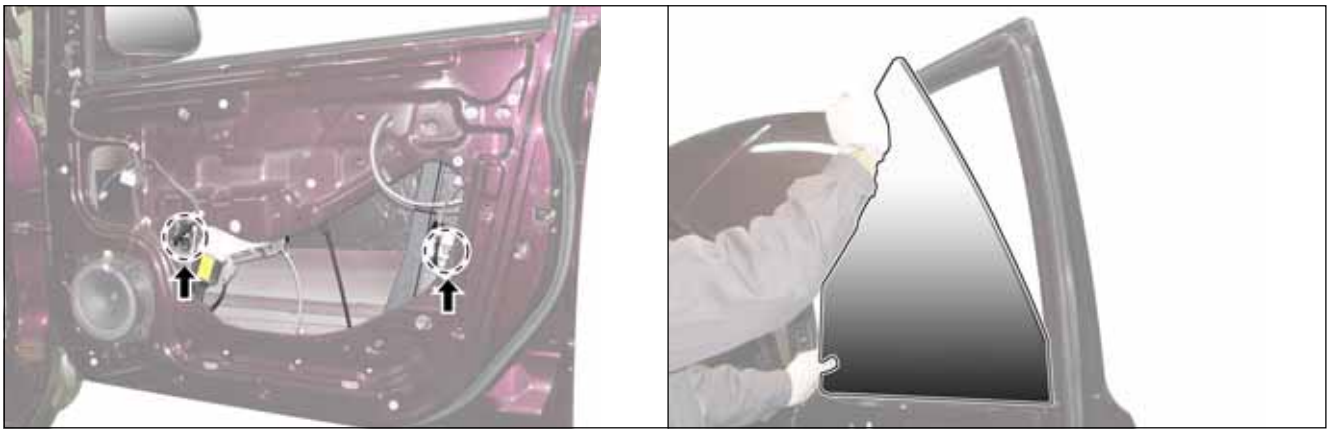
Passenger Side Window and Regulator



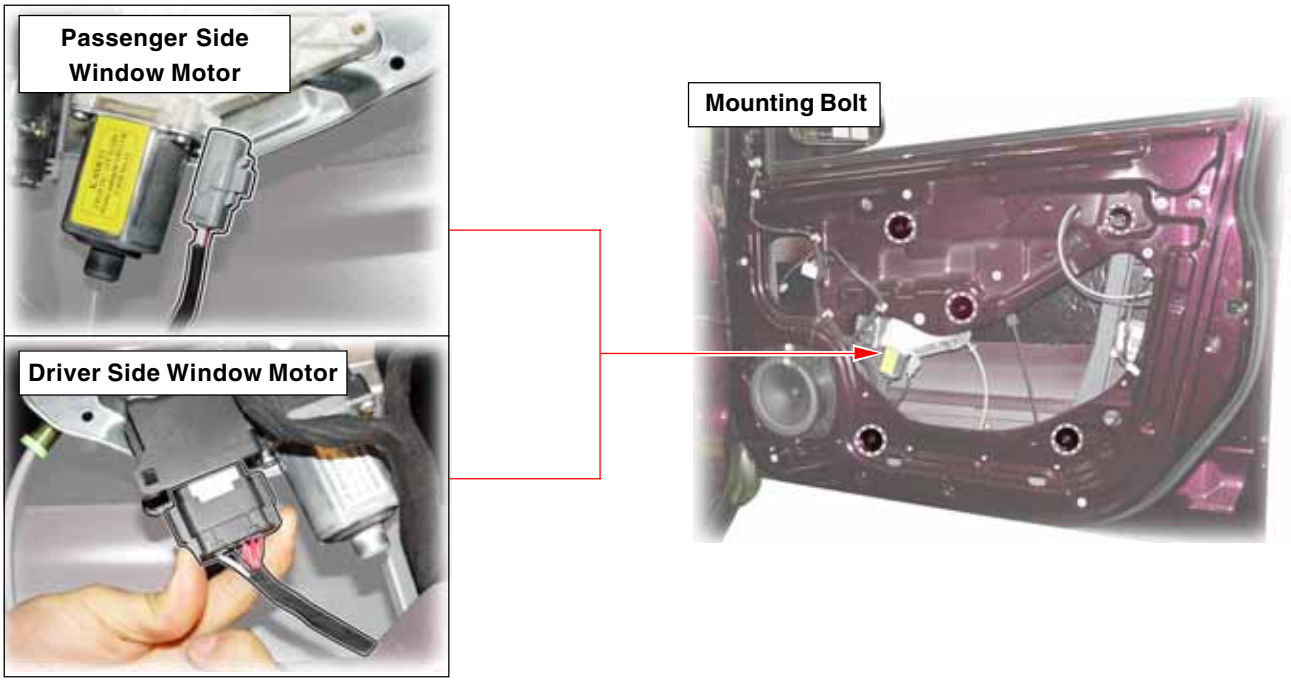
Removal and Installation of Window Regulator (Passenger Side)

※ **Preceding Work:** Disconnect the negative battery cable.

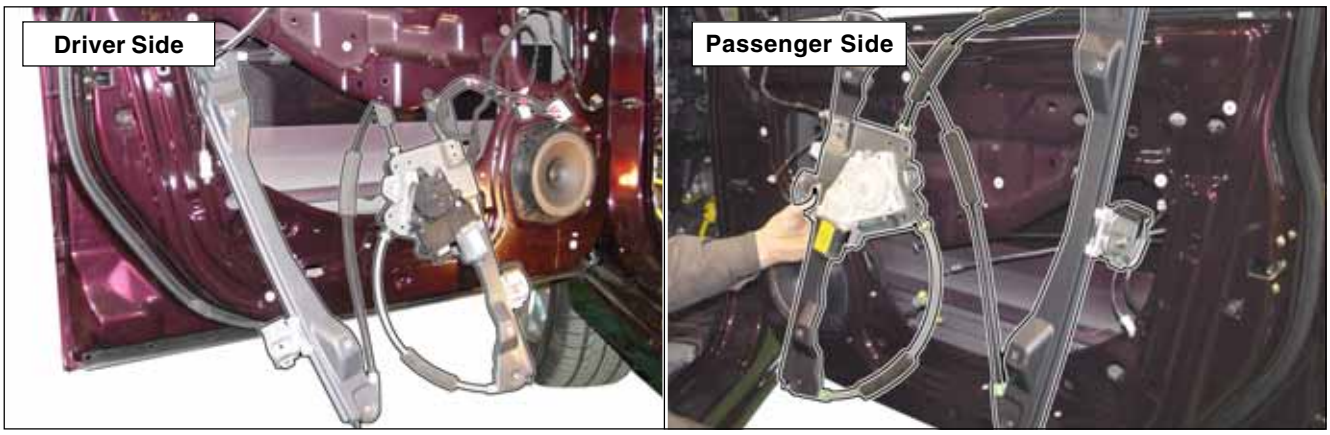
1. Lower the window until the window mounting bracket can be seen. Unscrew the nuts from the window mounting bracket and remove the window.



2. Disconnect the window motor connector and unscrew the mounting bolts from the window regulator.



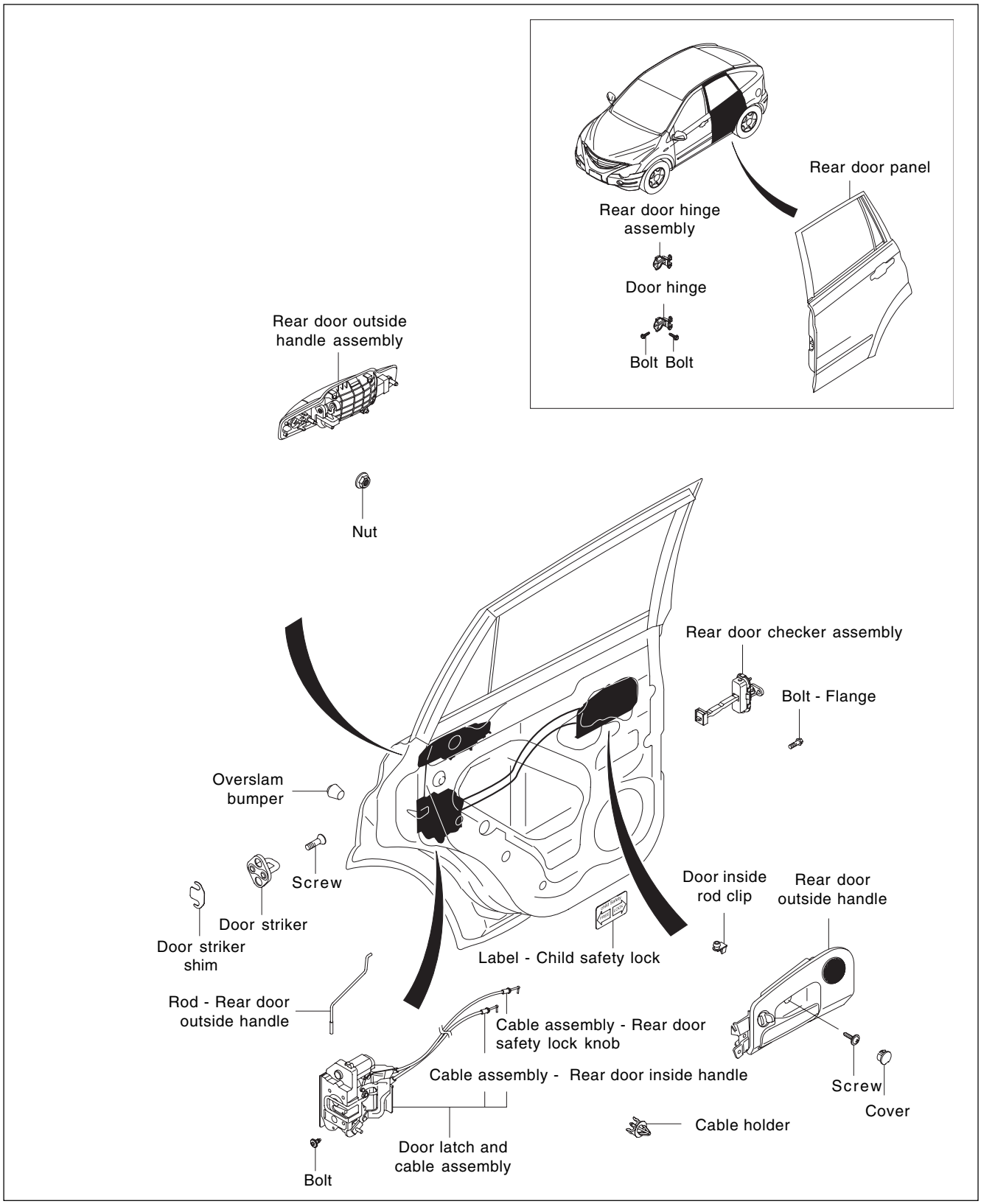
3. Remove the window regulator from the door.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

REAR DOOR ASSEMBLY

1. COMPONENTS OF REAR DOOR OPENING SYSTEM



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. REMOVAL AND INSTALLATION OF REAR DOOR

DOOR TRIM

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the inside panel from the rear door.



2. Unscrew six mounting screws from the door trim.



3. Separate the bottom of door trim and pull it up to remove it.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Location of Fasteners



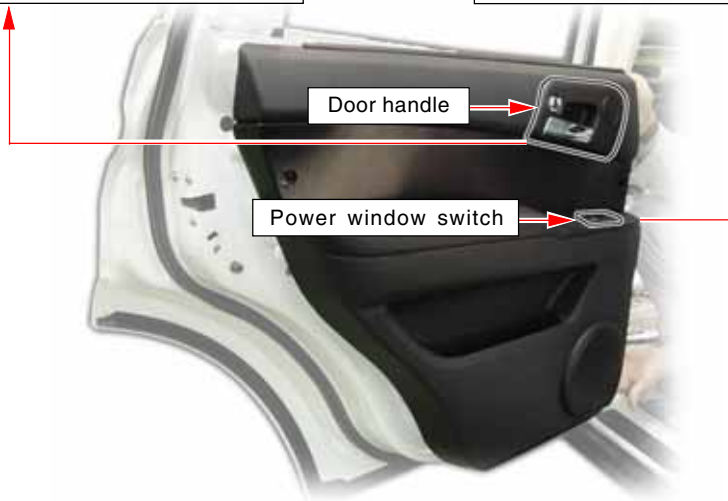
4. Remove the door handle cable (A) and the power window switch (B) to remove the door trim.

A. Door Handle Cable



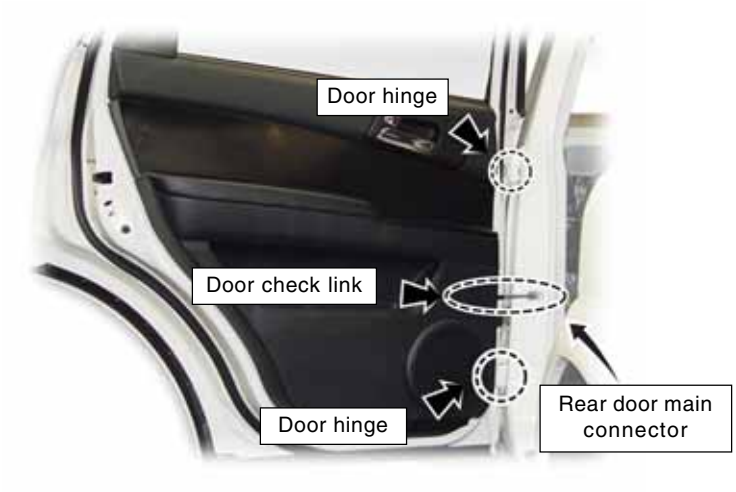
B. Power Window Switch Connector





Removal and Installation of Rear Door Assembly

※ **Preceding Work:** Discon nect the negative battery cable.



1. Remove the lower B pillar and the front seat belt and disconnect the rear door main connector.

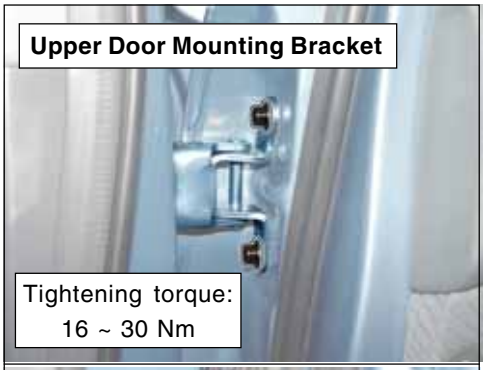


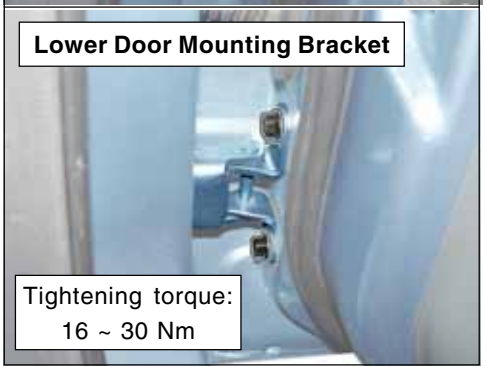


2. Unscrew the mounting bolts from the door check link (vehicle side).



3. Unscrew the upper and lower hinge bolts and remove the door assembly.

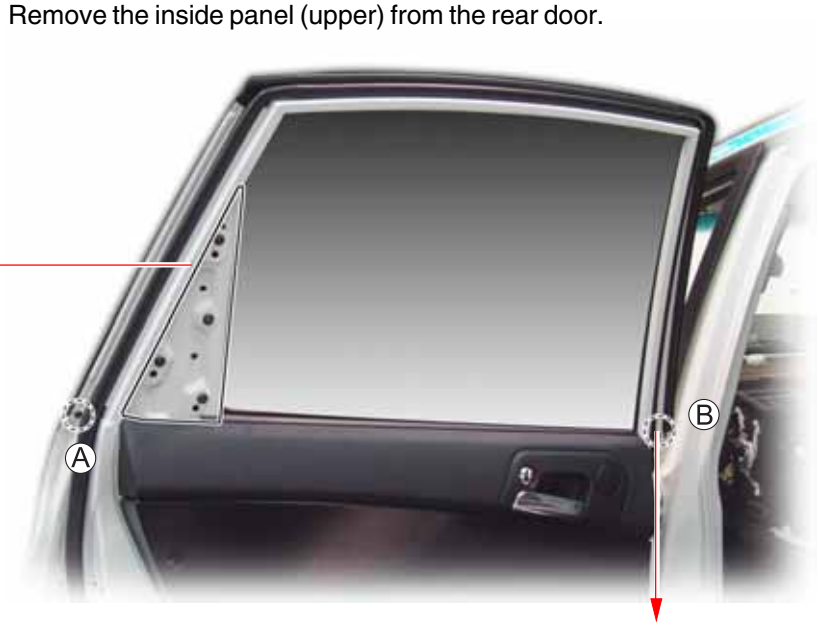




CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

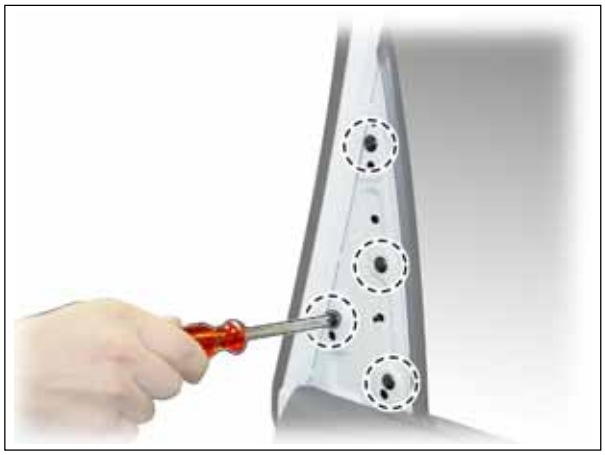
Rear Door Molding and Panel

※ **Preceding Work:** Remove the inside panel (upper) from the rear door.



1. Door Outer Panel

① Unscrew four mounting screws with the inside panel removed.

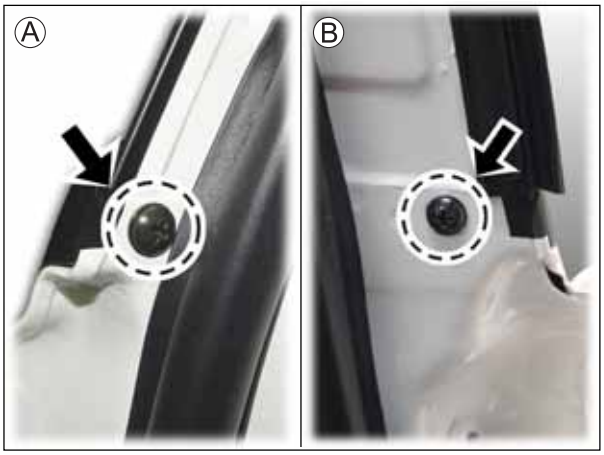


② Remove the outer panel from the door.



2. Door Outer Window Molding

① Unscrew two mounting screws from the inner window molding.



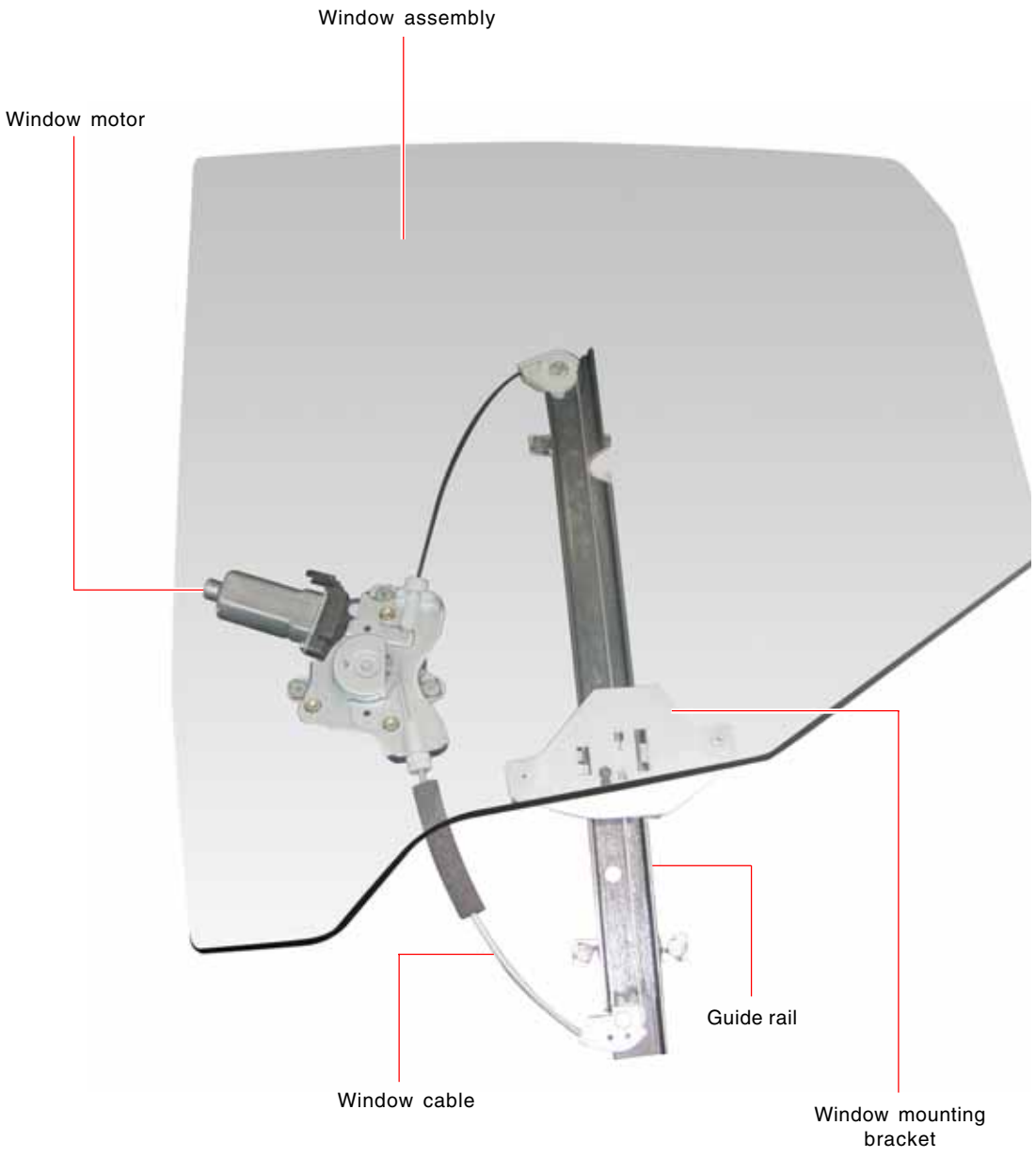
② Carefully remove the molding.



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AFFECTED VIN	

3. REAR WINDOW REGULATOR

Components



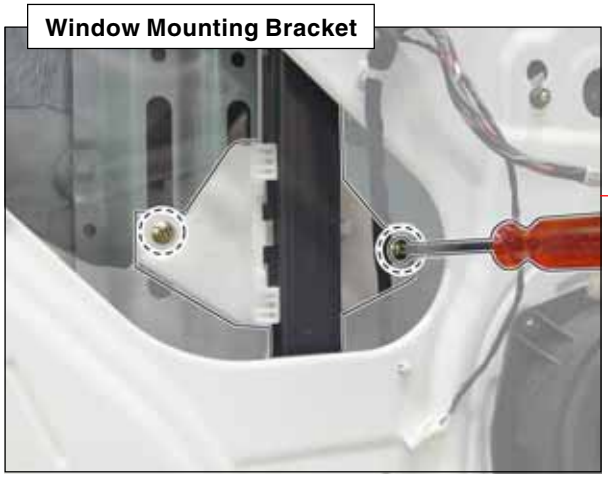
CHANGED BY	
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AFFECTED VIN	

Removal and Installation of Window Regulator

※ **Preceding Work:** 1. Disconnect the negative battery cable.
2. Remove the rear door trim assembly.

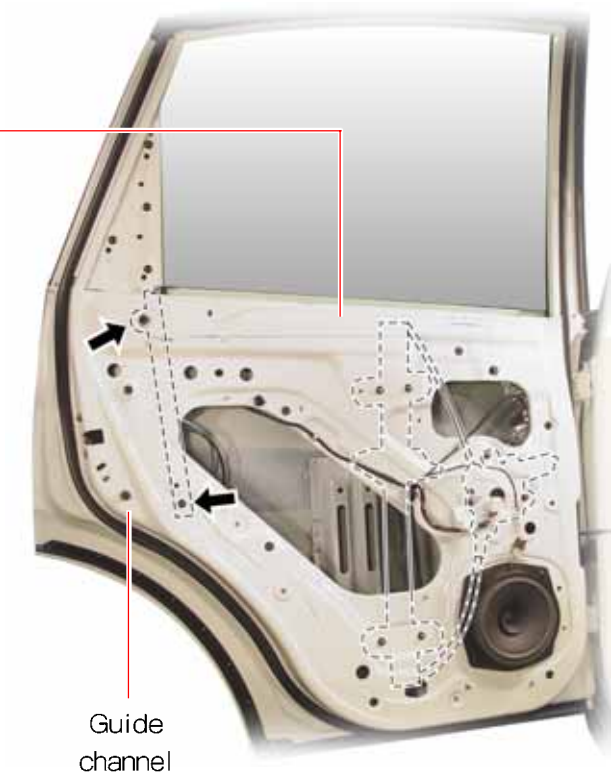
1. Lower the window until the window mounting bracket can be seen. Unscrew the nut on the window mounting bracket to remove the window glass.

Window Mounting Bracket



Removal of Window Glass

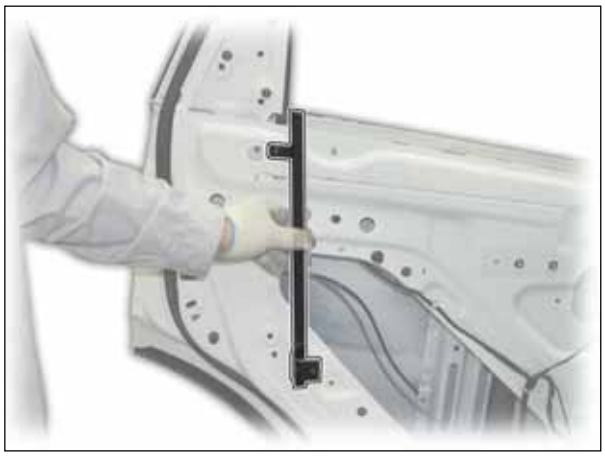




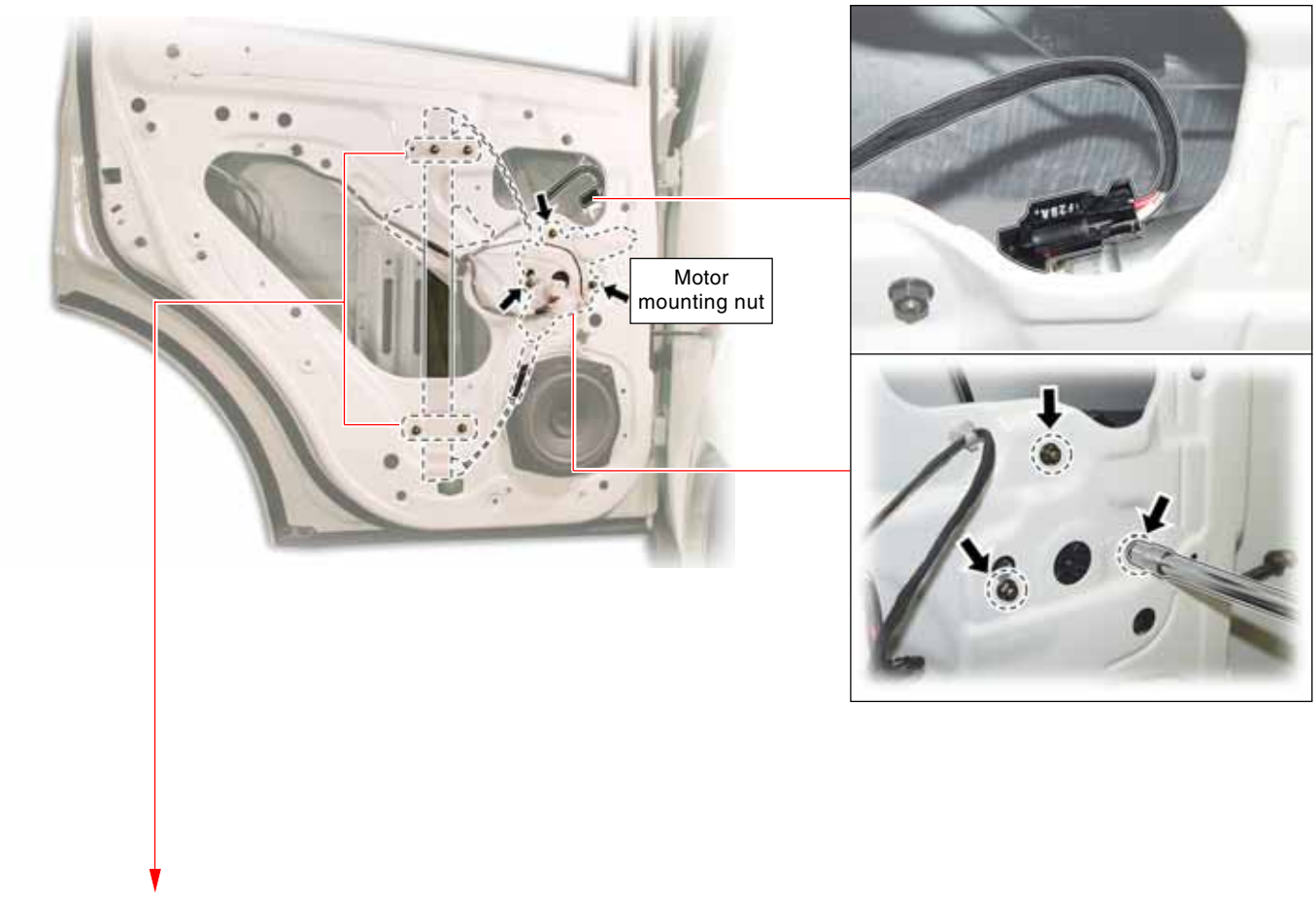
2. Lower the window and unscrew two mounting nuts from the guide channel.



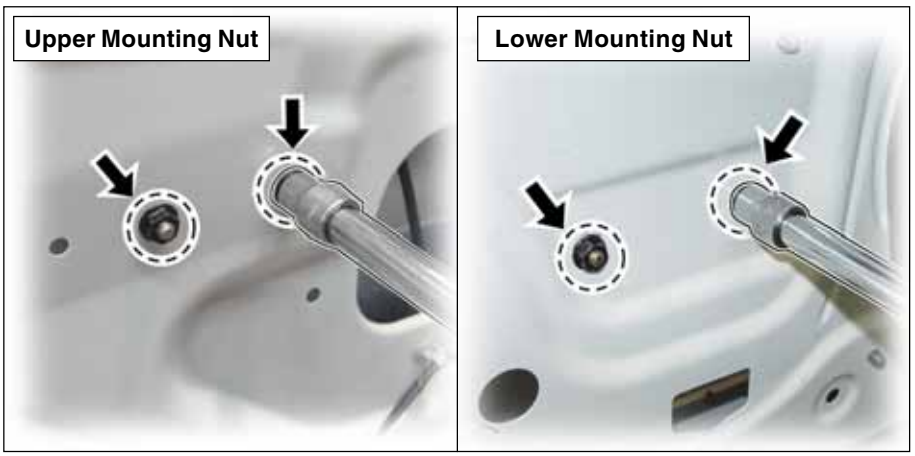
3. Remove the guide channel from the door.



4. Remove the window motor connector and three mounting nuts.



5. Unscrew the mounting nuts from the window regulator (upper: 2 EA, lower: 2 EA).



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. Remove the window regulator from the door.

Removal of Window Regulator

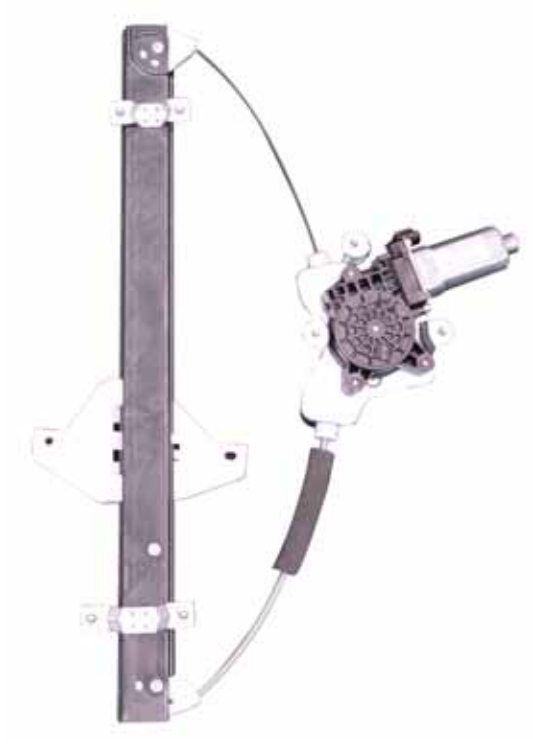


Installation Location of Window Regulator



Window Regulator Assembly



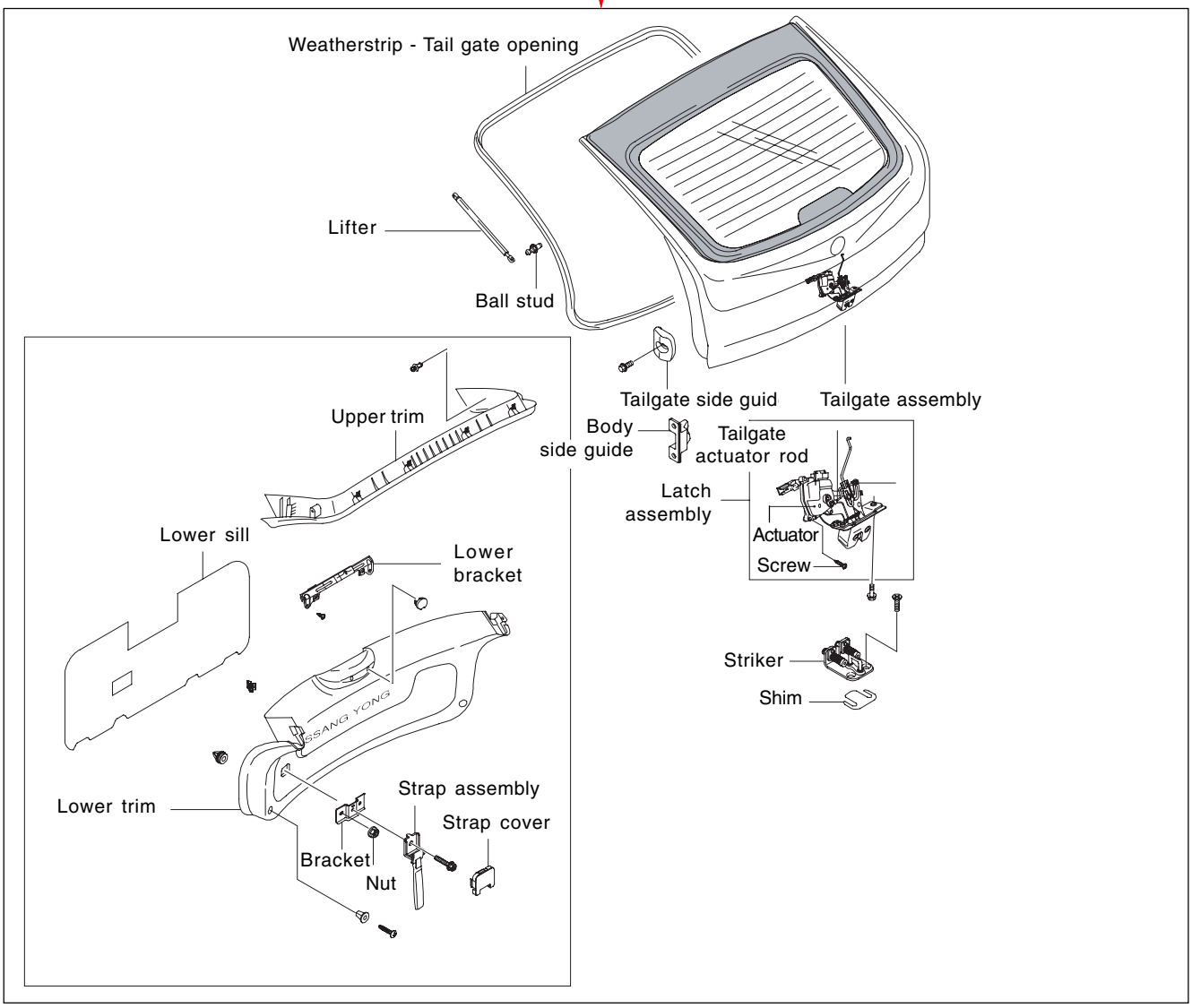


TAILGATE ASSEMBLY

1. CONSTRUCTION

Layout





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EFFECTIVE DATE	
AFFECTED VIN	

Operating Mechanism



Construction - Inside View

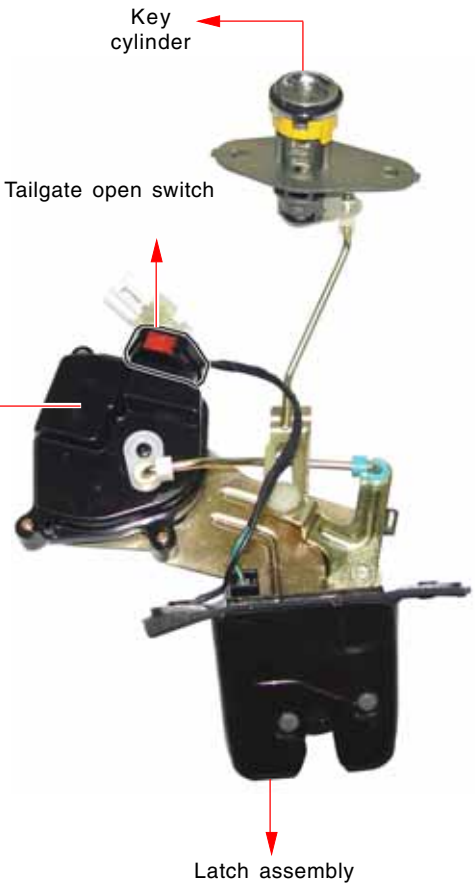
Tailgate Open Switch



Appearance | Switch



Construction - Outside View



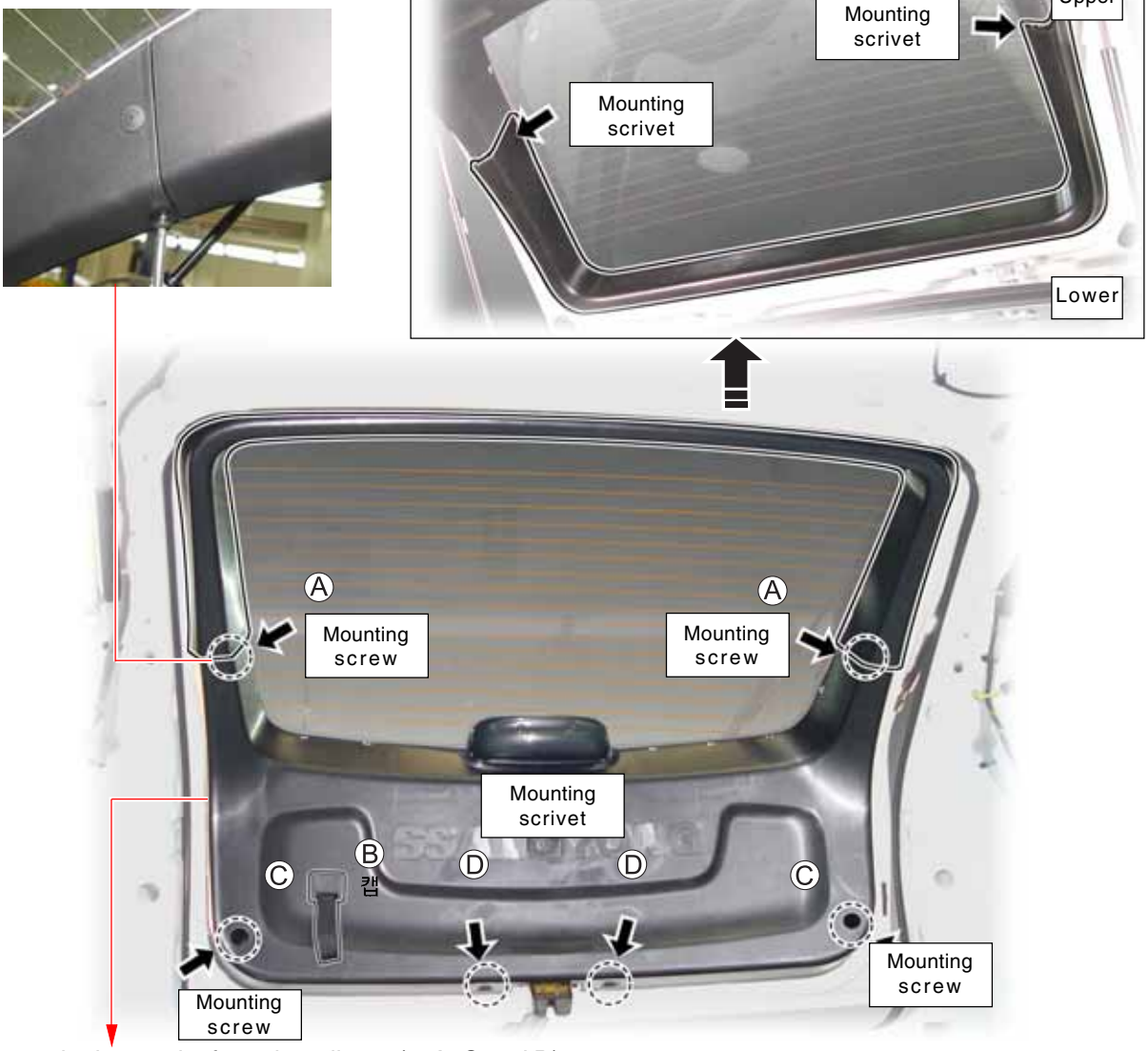
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. REMOVAL AND INSTALLATION OF TAILGATE ASSEMBLY

Tailgate Trim

※ **Preceding Work:** Disconnect the negative battery cable.

1. Unscrew the scrivets and the upper trim screws and remove the upper trim from the tailgate.



2. Remove the lower trim from the tailgate (at A, C and D).

Ⓐ Upper Mounting Screw of Lower Trim



Ⓒ Lower Mounting Screw of Lower Trim

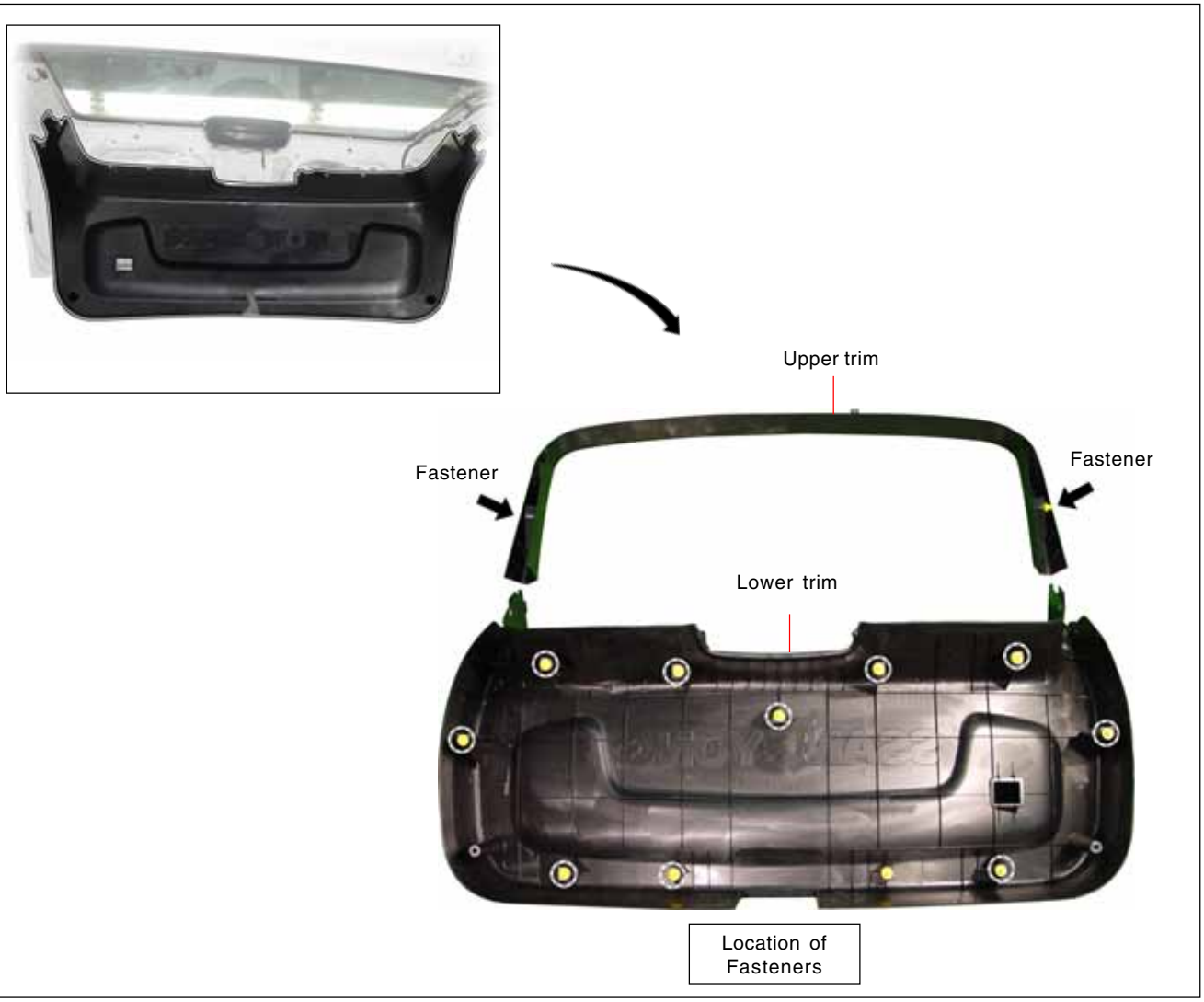


Ⓓ Lower mounting screws of tailgate.

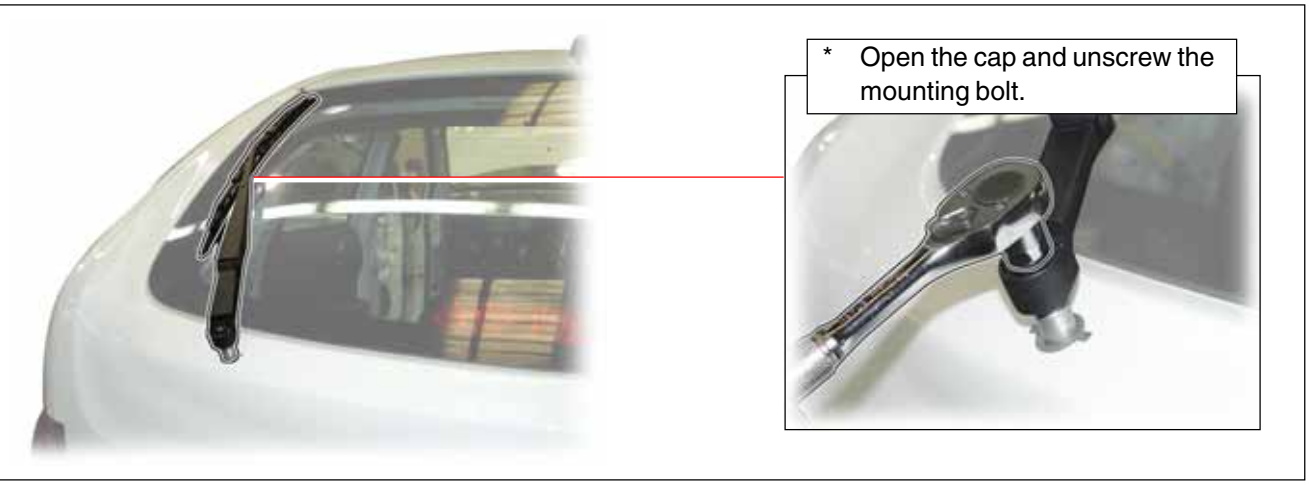


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Remove the tailgate trim while separating the fasteners starting from bottom. Then, remove the vinyl cover.



4. Close the tailgate and remove the wiper blade assembly.



Tailgate Assembly

※ **Preceding Work:** 1. Disconnect the negative battery cable.
2. Remove the tailgate trim assembly.

CAUTION
Pay particular attention to avoid vehicle damage and personal injury.

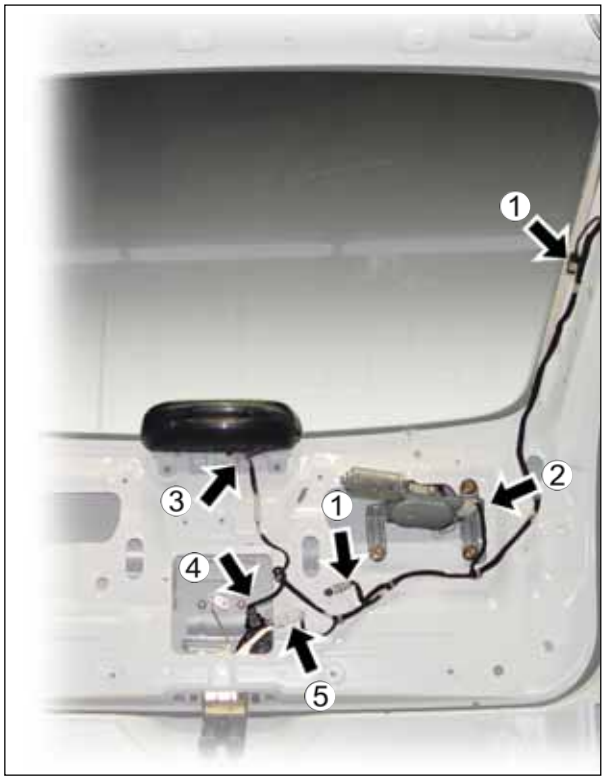
1. Remove the mounting clips at both sides and remove the gas lifter.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

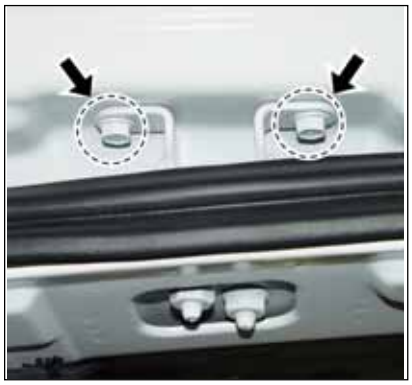


2. Disconnect the de-icer cable connector (1), wiper motor connector (2), high-mounted stop lamp connector (3), door actuator connector (4), door switch (5) and ground. Then, remove the harness assembly.



3. Unscrew two hinge bolts and remove the tailgate assembly.

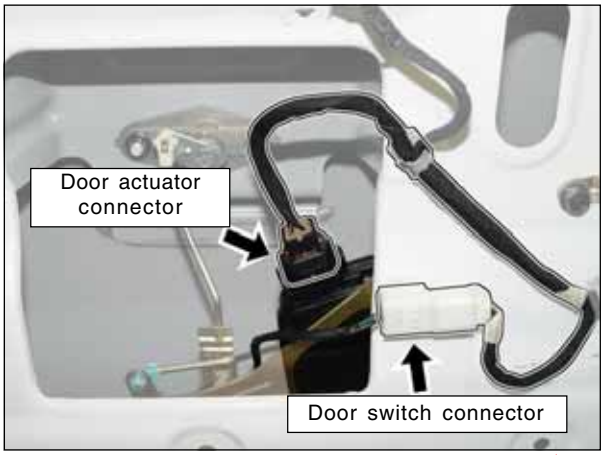
Tightening torque	15 ~ 26 Nm



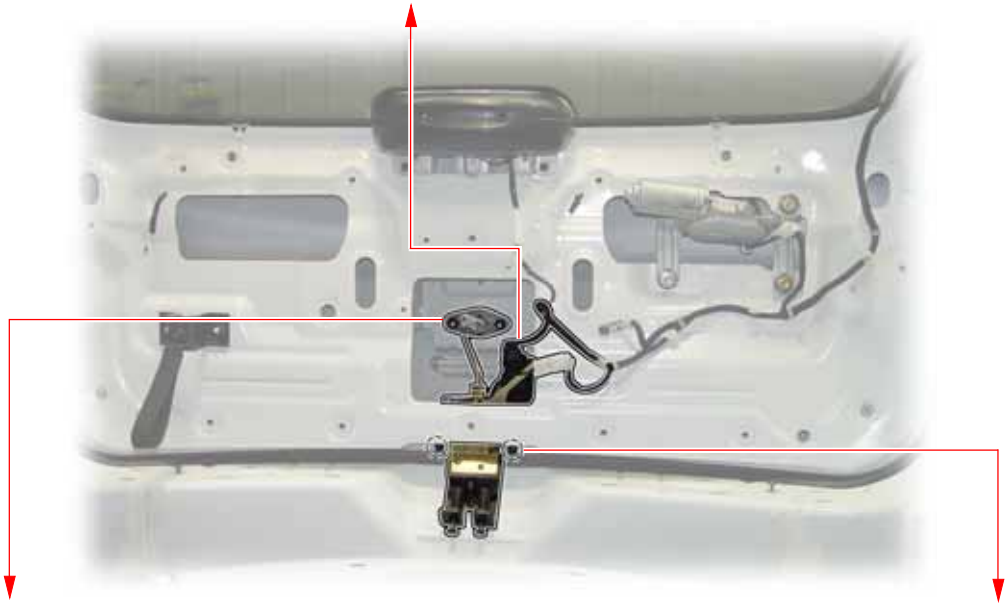
Tailgate Latch and Actuator

※ **Preceding Work:** 1. Disconnect the negative battery cable.
2. Remove the trim assembly.

1. Disconnect the door actuator connector and the door switch connector.







2. Separate the connecting rod from the key cylinder.

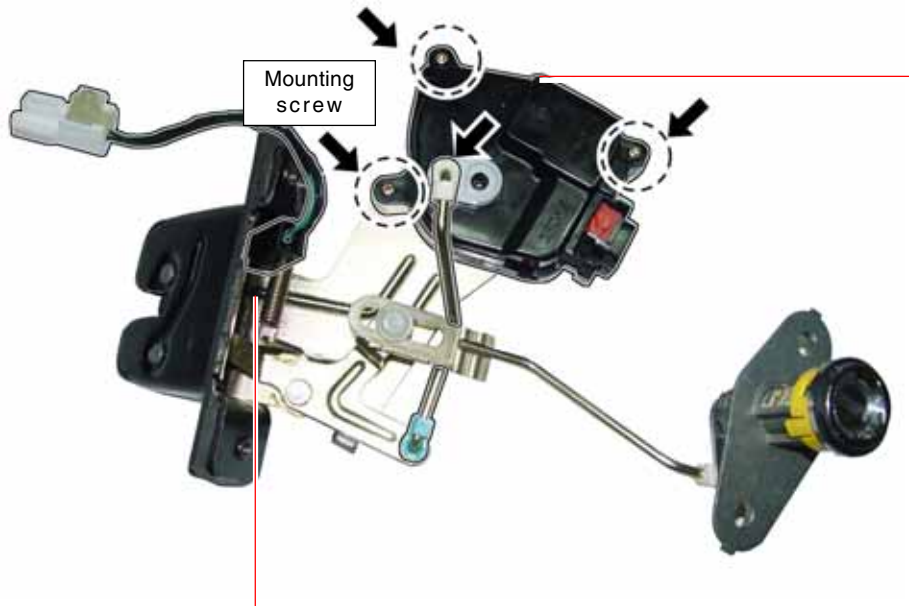


3. Unscrew three mounting bolts and remove the latch assembly.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Separate the connecting rod (A) and three mounting screws from the removed latch assembly to remove the door actuator.



Door switch



Door actuator





REAR QUARTER GLASS

1. REMOVAL AND INSTALLATION OF QUARTER GLASS

Removal

※ **Preceding work:** Remove the rear quarter trim.



1. Unscrew six mounting nuts from the rear quarter glass.



2. Remove the rear quarter glass while pushing it inside of the vehicle.





3. Remove the quarter glass and remove the butyl seal on the glass and frame using a knife or a special tool.





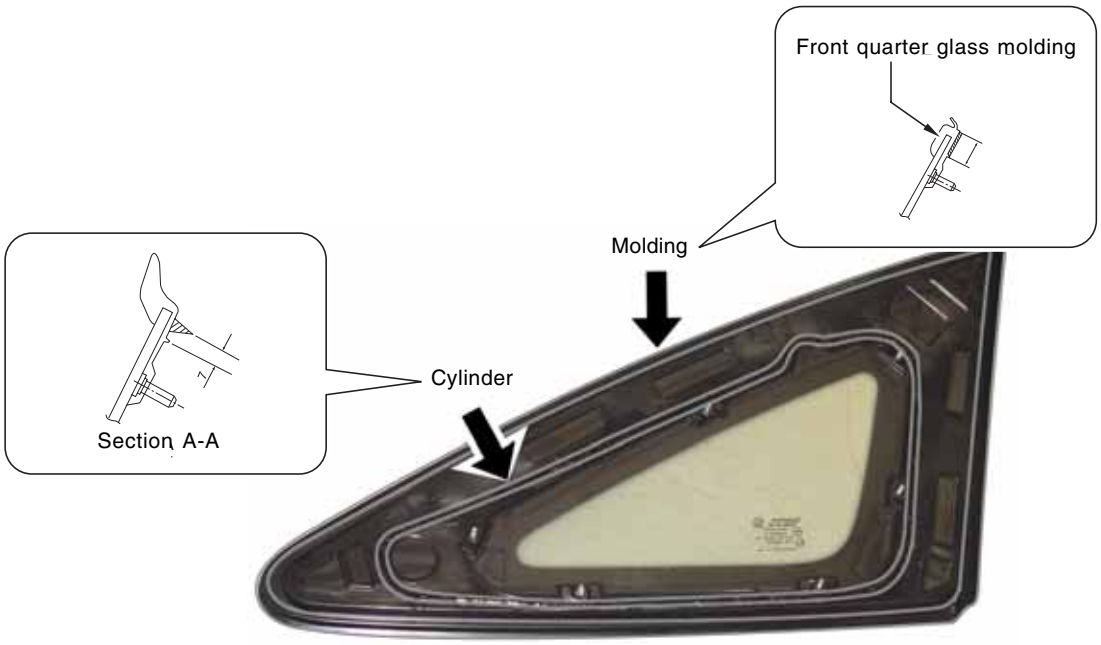
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EFFECTIVE DATE	
AFFECTED VIN	

Installation

1. Wipe out any foreign material on the body frame.



2. Apply the butyl seal to the new quarter glass at regular interval.



3. Install the rear quarter glass to the body frame and tighten the mounting bolts to the specified torque. (Tightening torque: 6.5 Nm)

Installation of Quarter Glass



Tighten the Nut



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

BODY REPAIR

5110

TABLE OF CONTENTS

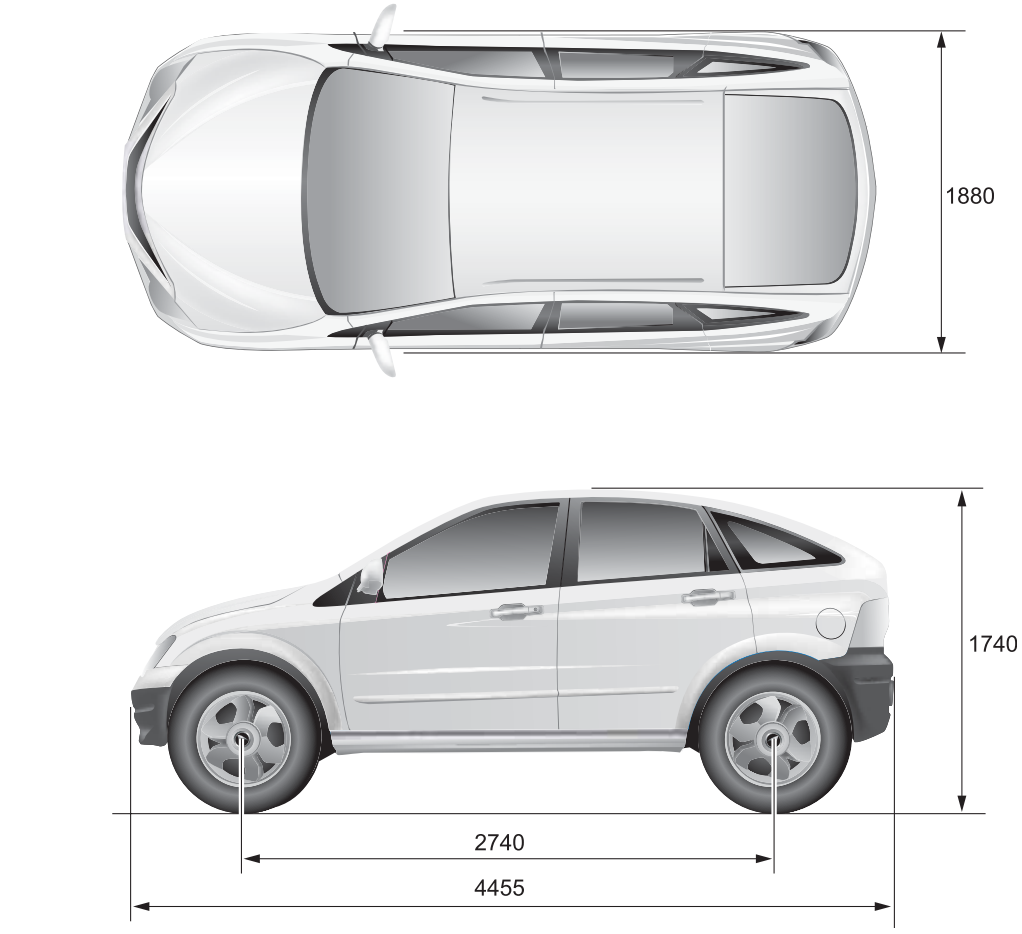
BODY REPAIR 2

1. Dimensions 2
2. Jack-up points (dotted circles) 3
3. Design changes for improving NVH performance 4
4. Body repair 12

BODY REPAIR

1. DIMENSIONS

Unit: mm



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. JACK-UP POINTS (DOTTED CIRCLES)

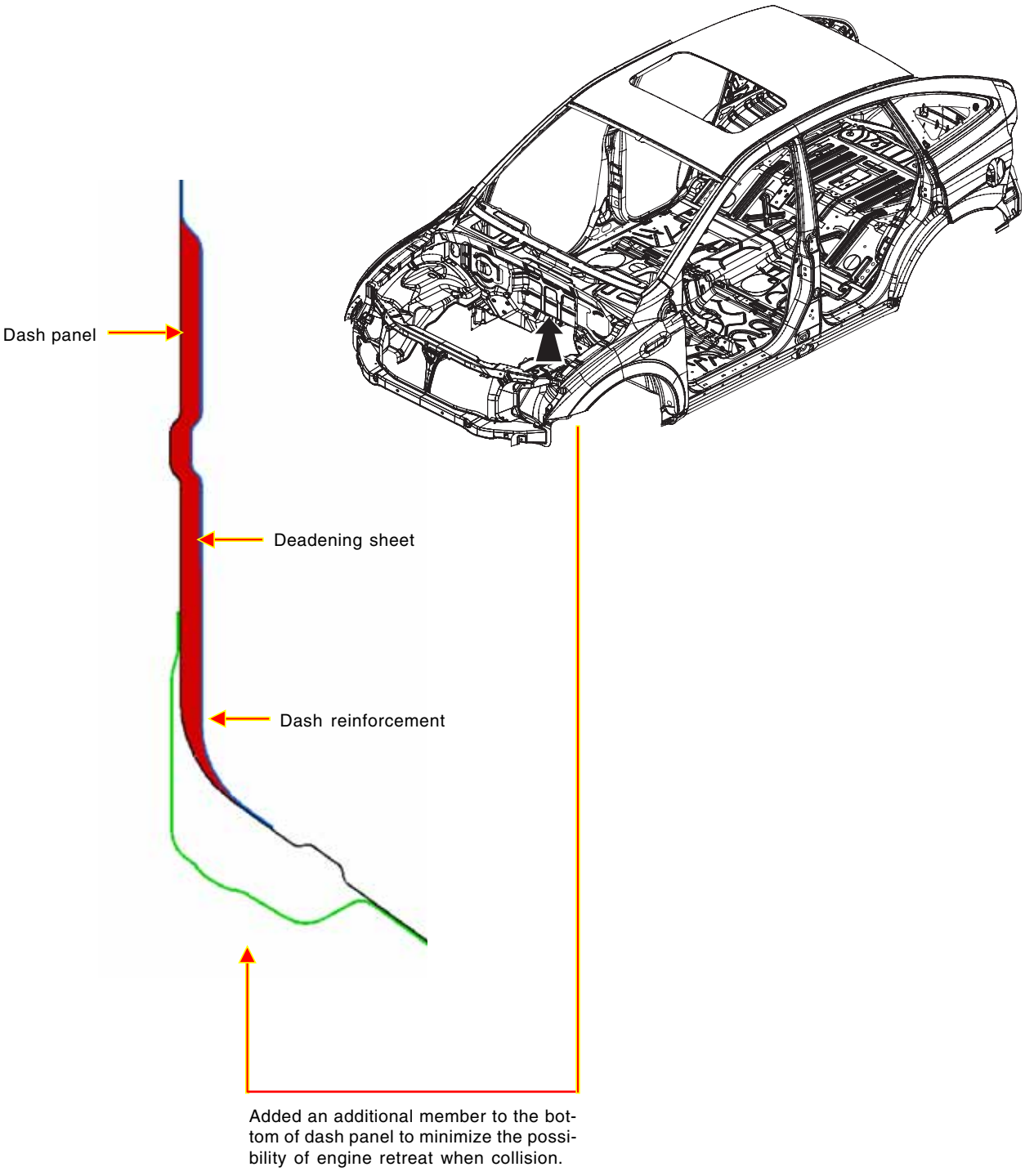


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EFFECTIVE DATE	
AFFECTED VIN	

3. DESIGN CHANGES FOR IMPROVING NVH PERFORMANCE

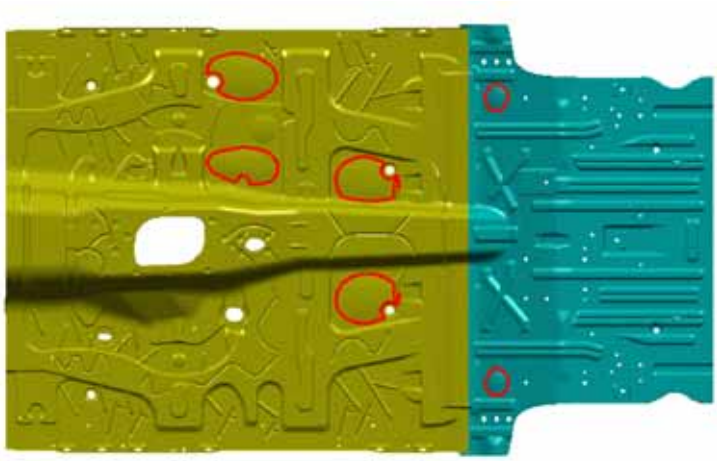
▶ Dual Type Dash Panel and Engine Tunnel with Foaming Pad

Blocks the noise from engine and transmission and improves the reinforcement of vehicle body.



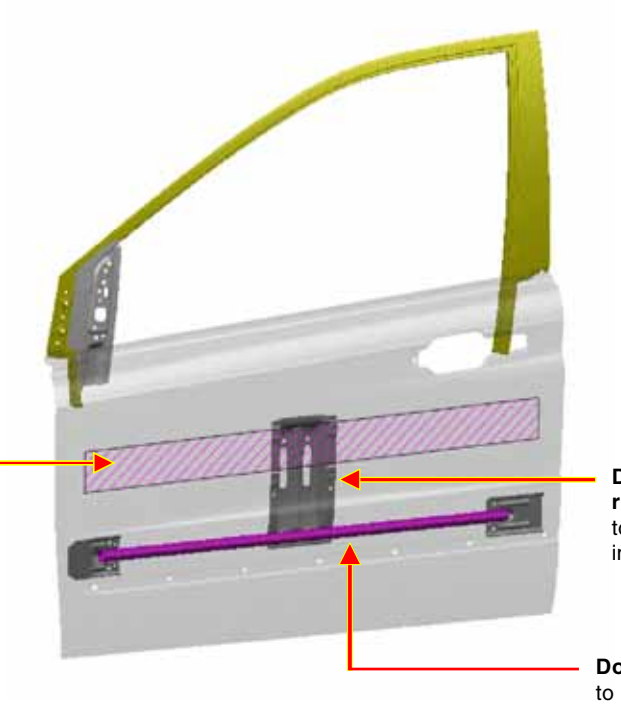
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AFFECTED VIN	

▶ Improved Reinforcement and NVH According to the Introducing of Front Floor and Rear Floor



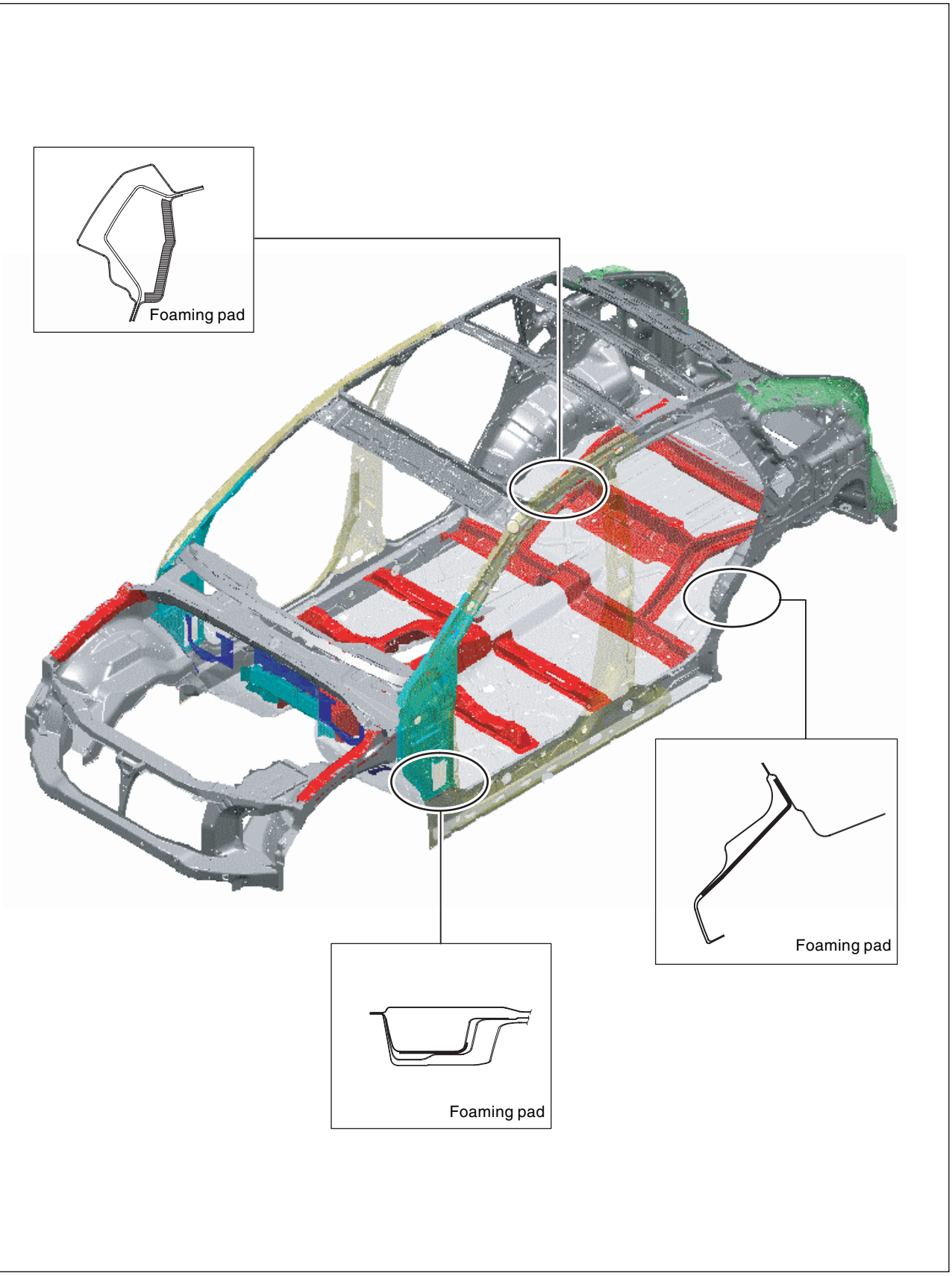
▶ Applied BPR (Body Panel Reinforcement) Sealer to the Door Outer Panel

BPR sealer is sprayed by robot and is designed to reinforce the body panel and reduce the noise.



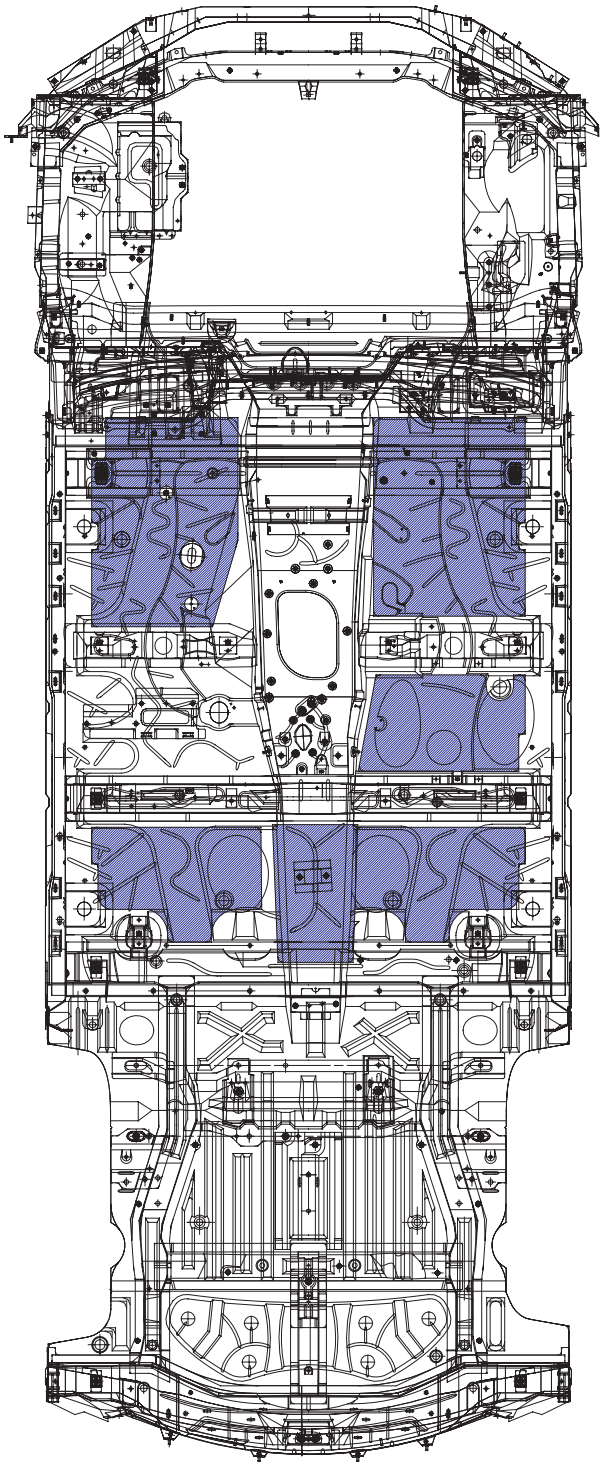
▶ Applied BPR (Body Panel Reinforcement) Sealer to the Body Panel

BPR sealer is sprayed by robot and is designed to reinforce the body panel and reduce the noise.



CHANGED BY	
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AFFECTED VIN	

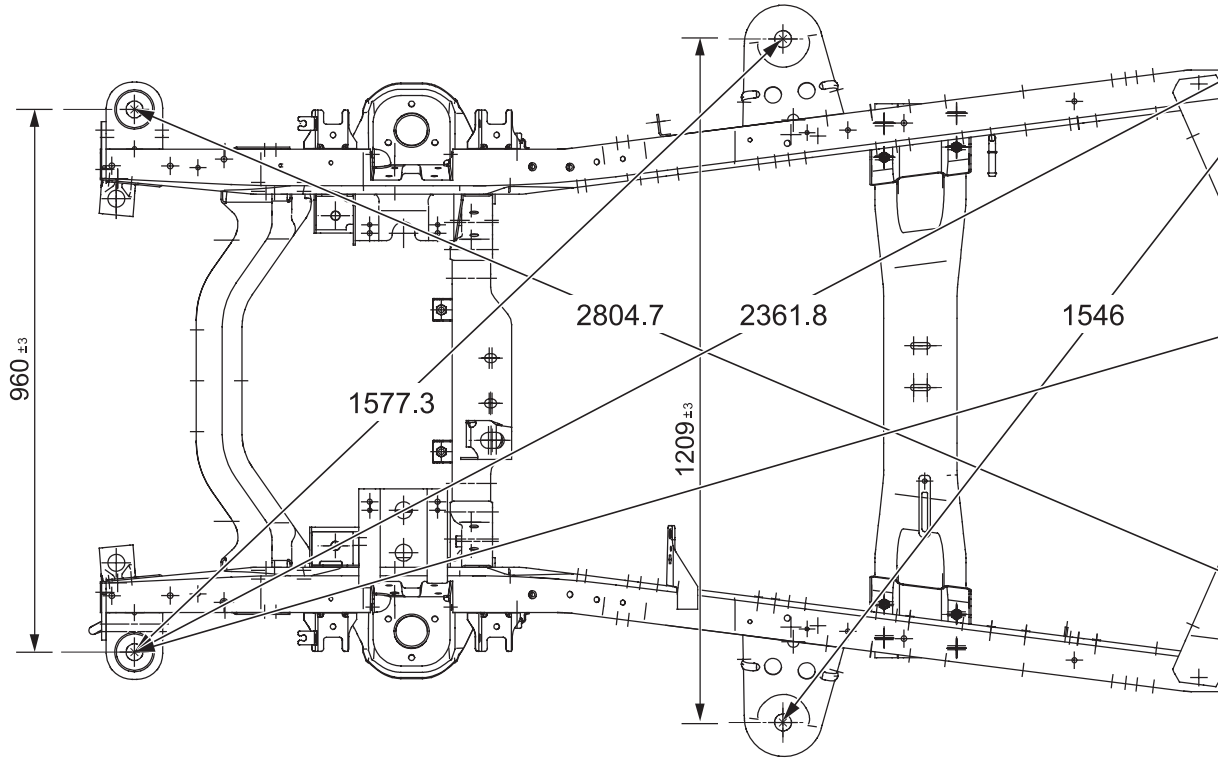
▶ Applied the Asphalt to the Body Panel (Improved Anti-Vibration)

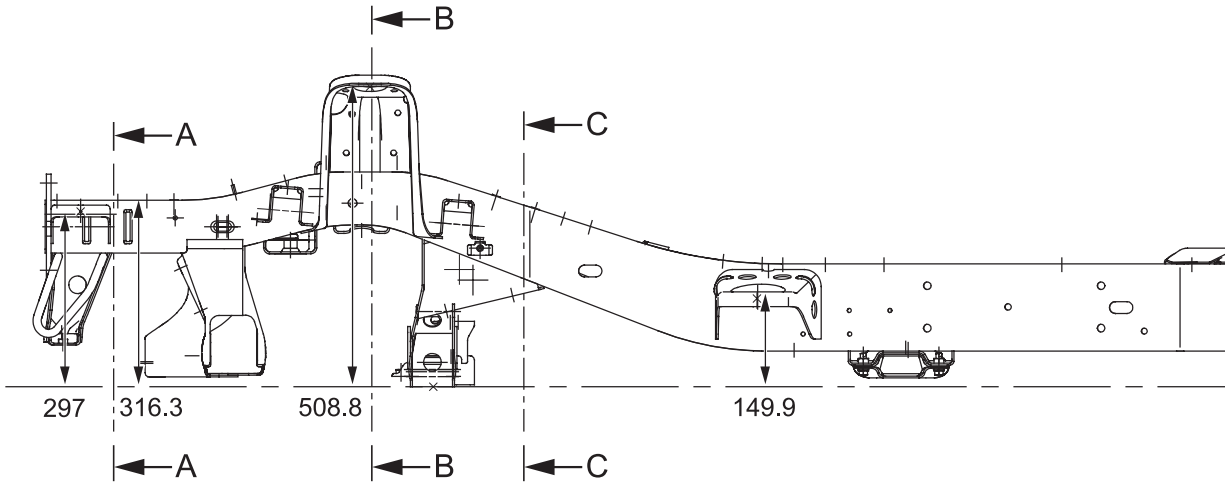


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EFFECTIVE DATE	
AFFECTED VIN	

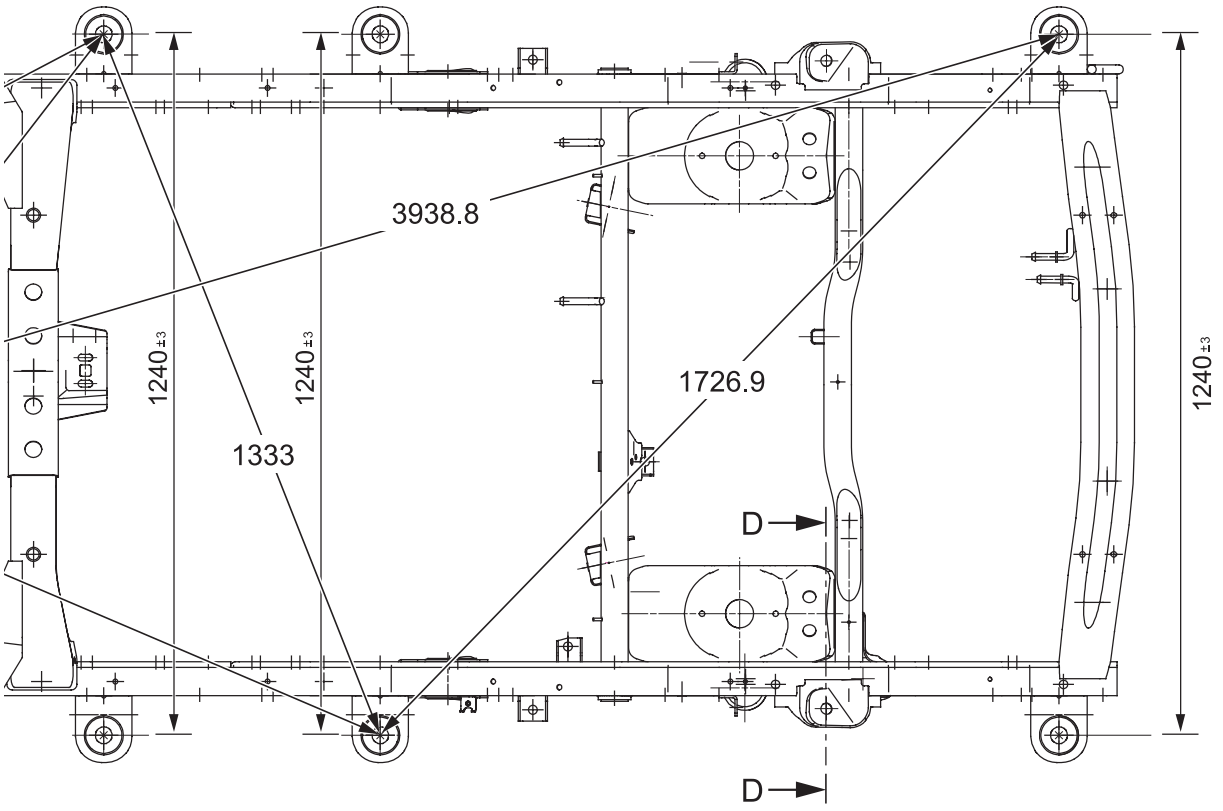
▶ Frame Dimensions

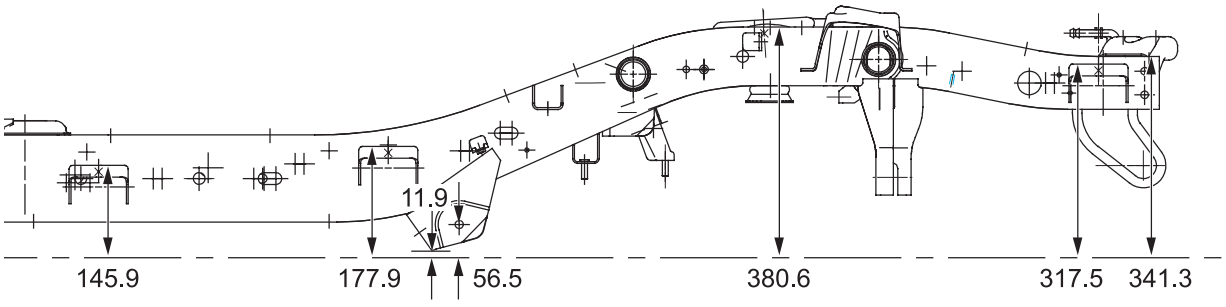
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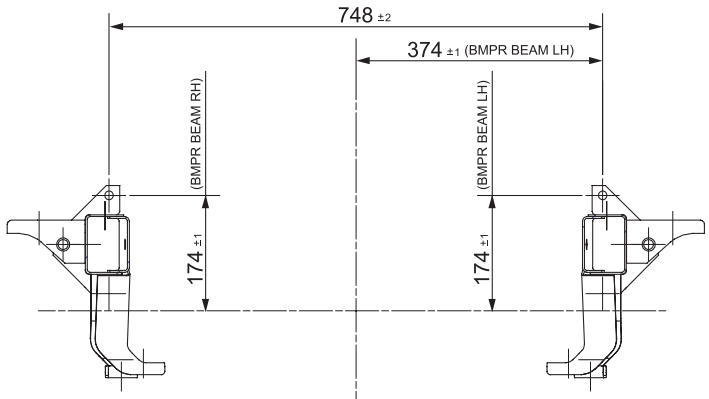




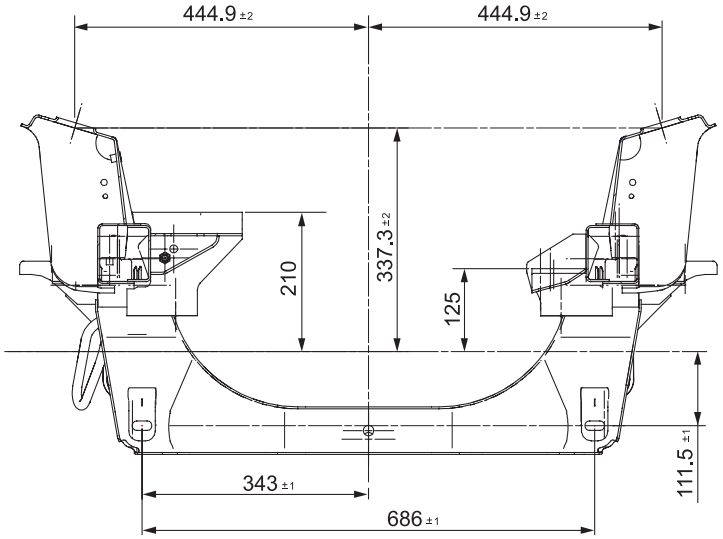
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Sectional Drawing

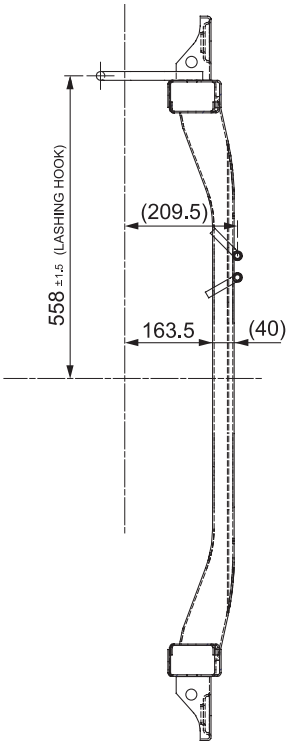
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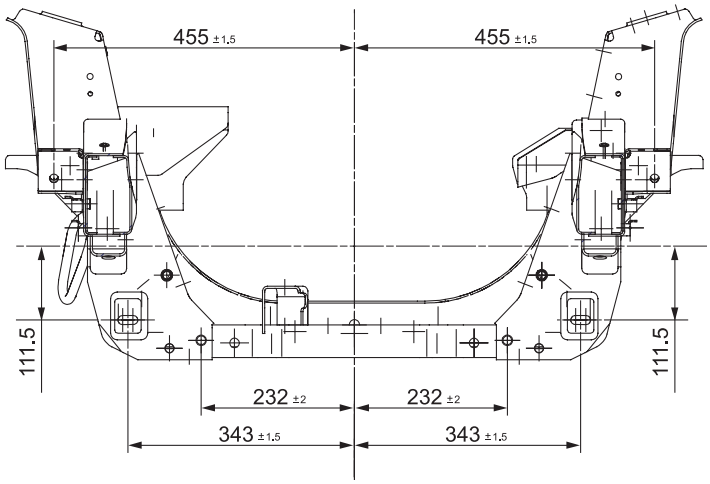
SECTION A



SECTION B



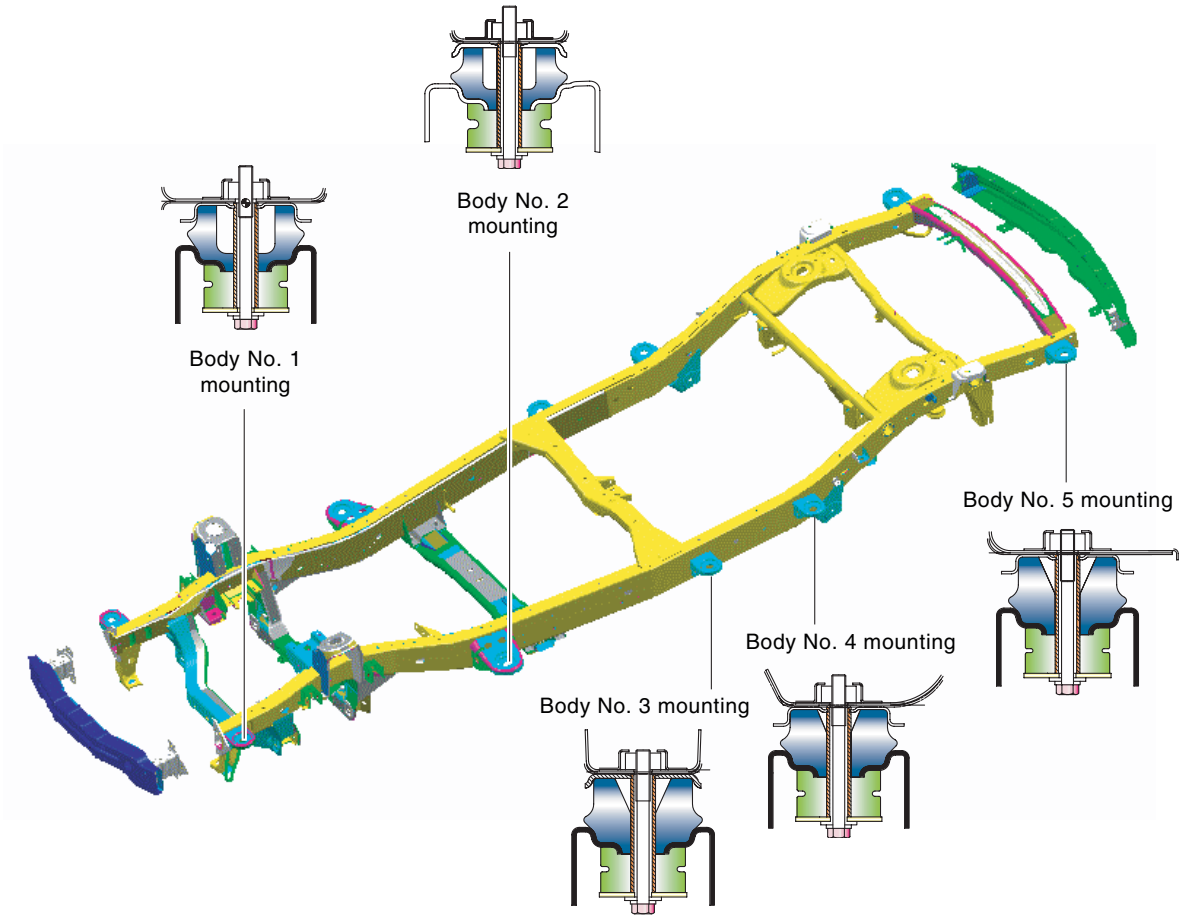
SECTION D



SECTION C

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Frame Body Mounting



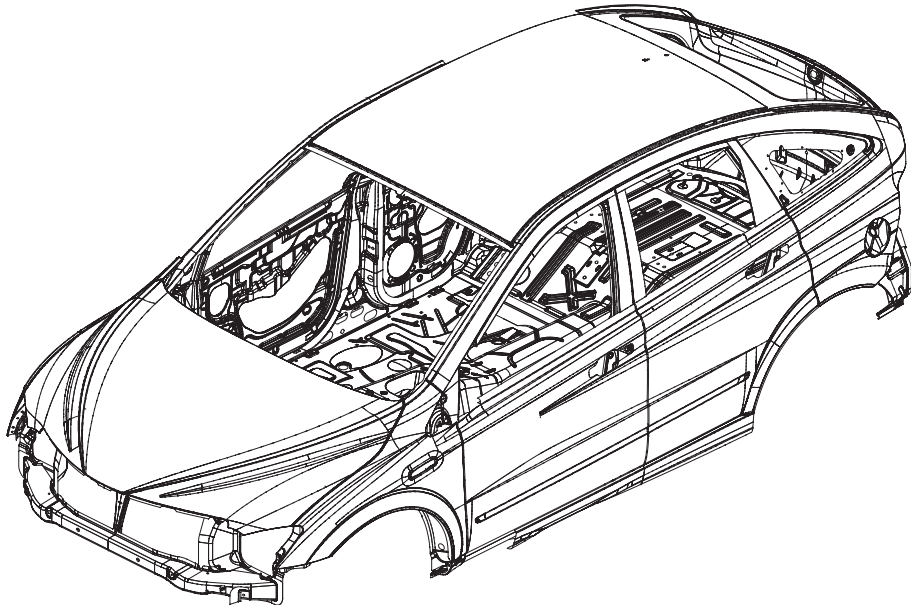
	Body No. 1 mounting	Body No. 2 mounting	Body No. 3 mounting	Body No. 4 mounting	Body No. 6 mounting
1.	Washer & tube assembly - body No. 1	Washer & tube assembly - body No. 2	Washer & tube assembly - body No. 3	Washer & tube assembly - body No. 4	Washer & tube assembly - body No. 5
2.	Insulator - body No. 1, upper	Insulator - body No. 2, upper	Insulator - body No. 3, upper	Insulator - body No. 4, upper	Insulator - body No. 5, upper
3.	Insulator - body, lower	Insulator - body, lower	Insulator - body, lower	Insulator - body, lower	Insulator - body, lower
4.	Washer - plain body mounting	Washer - plain body mounting	Washer - plain body mounting	Washer - plain body mounting	Washer - plain body mounting
5.	Bolt Tightening torque 55~65 Nm	Bolt Tightening torque 55~65 Nm	Bolt Tightening torque 55~65 Nm	Bolt Tightening torque 55~65 Nm	Bolt Tightening torque 55~65 Nm

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

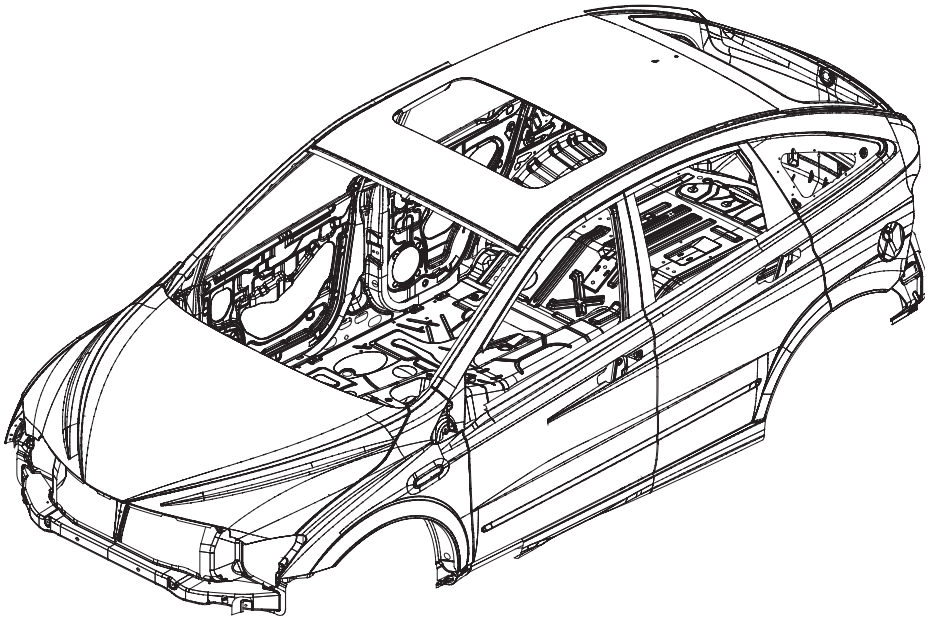
4. BODY REPAIR

▶ White Body

Without sunroof



With sunroof

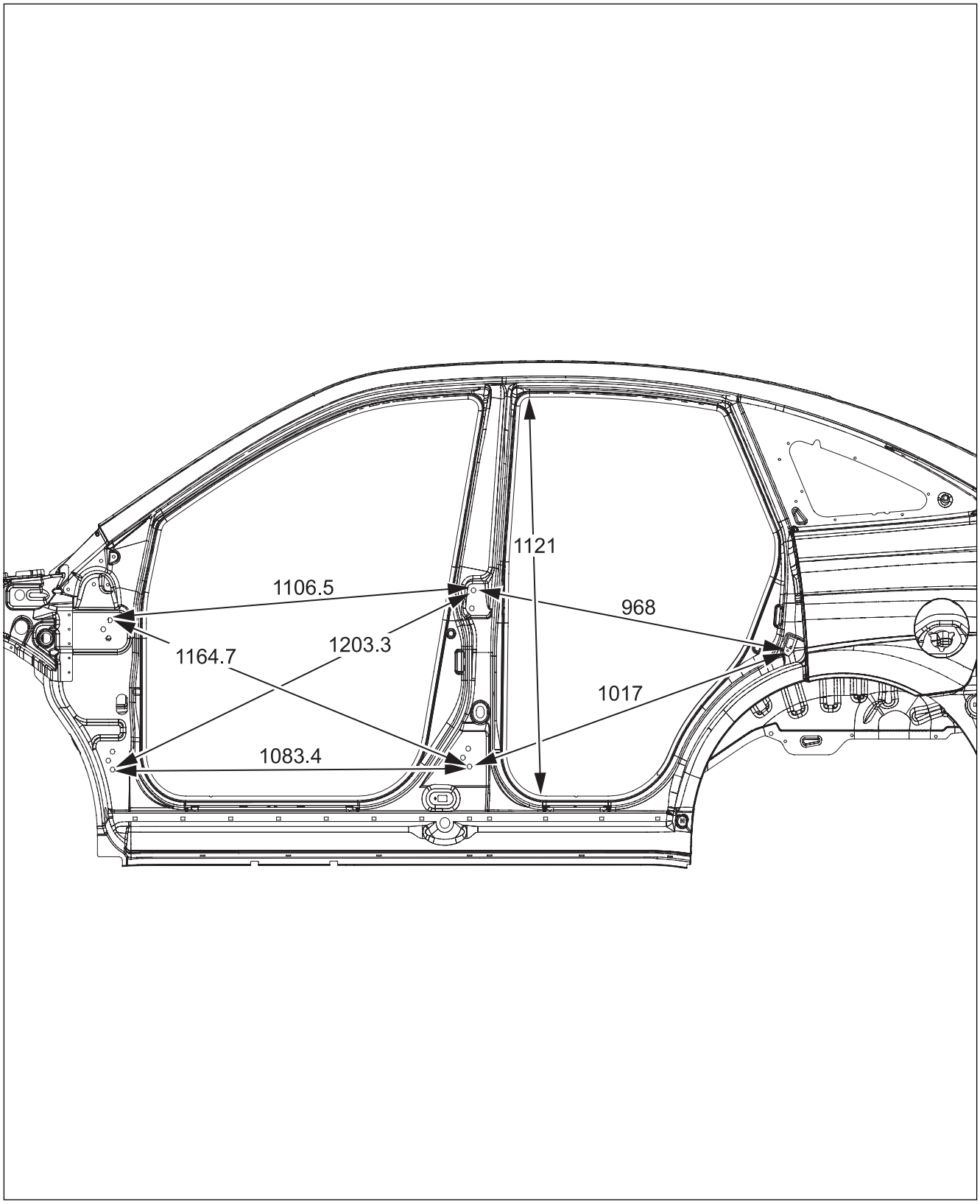


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EFFECTIVE DATE	
AFFECTED VIN	

▶ Body Dimensions

Side Structure Complete

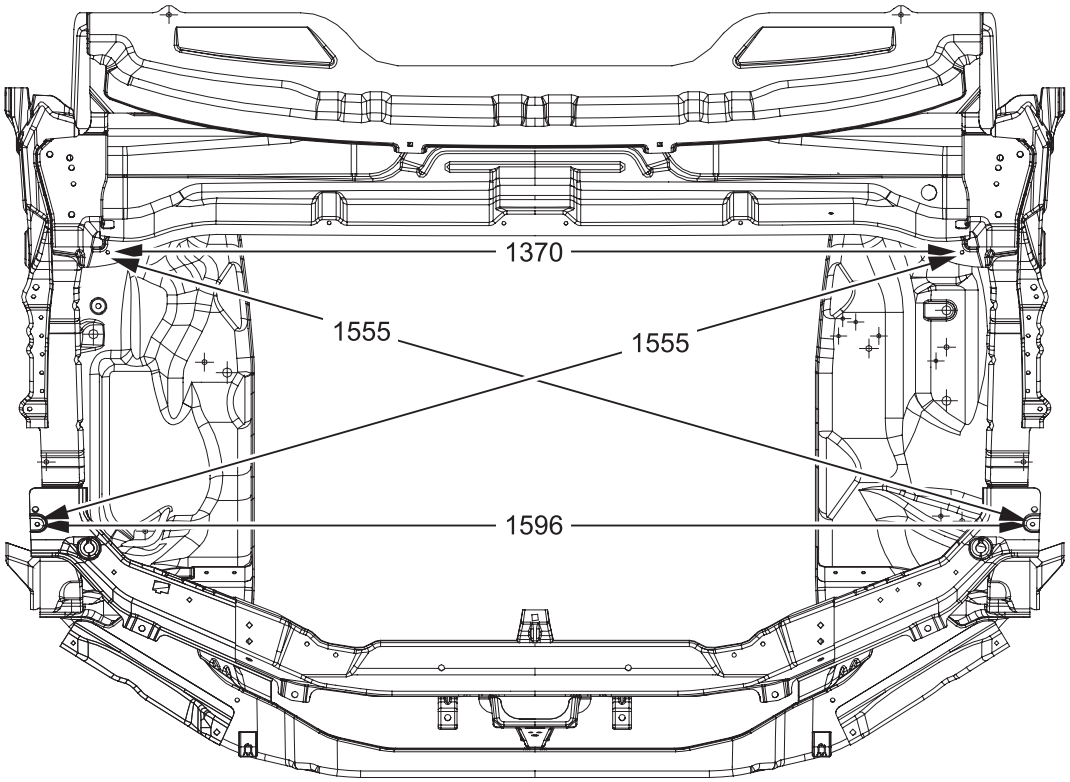
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AFFECTED VIN	

Engine Compartment

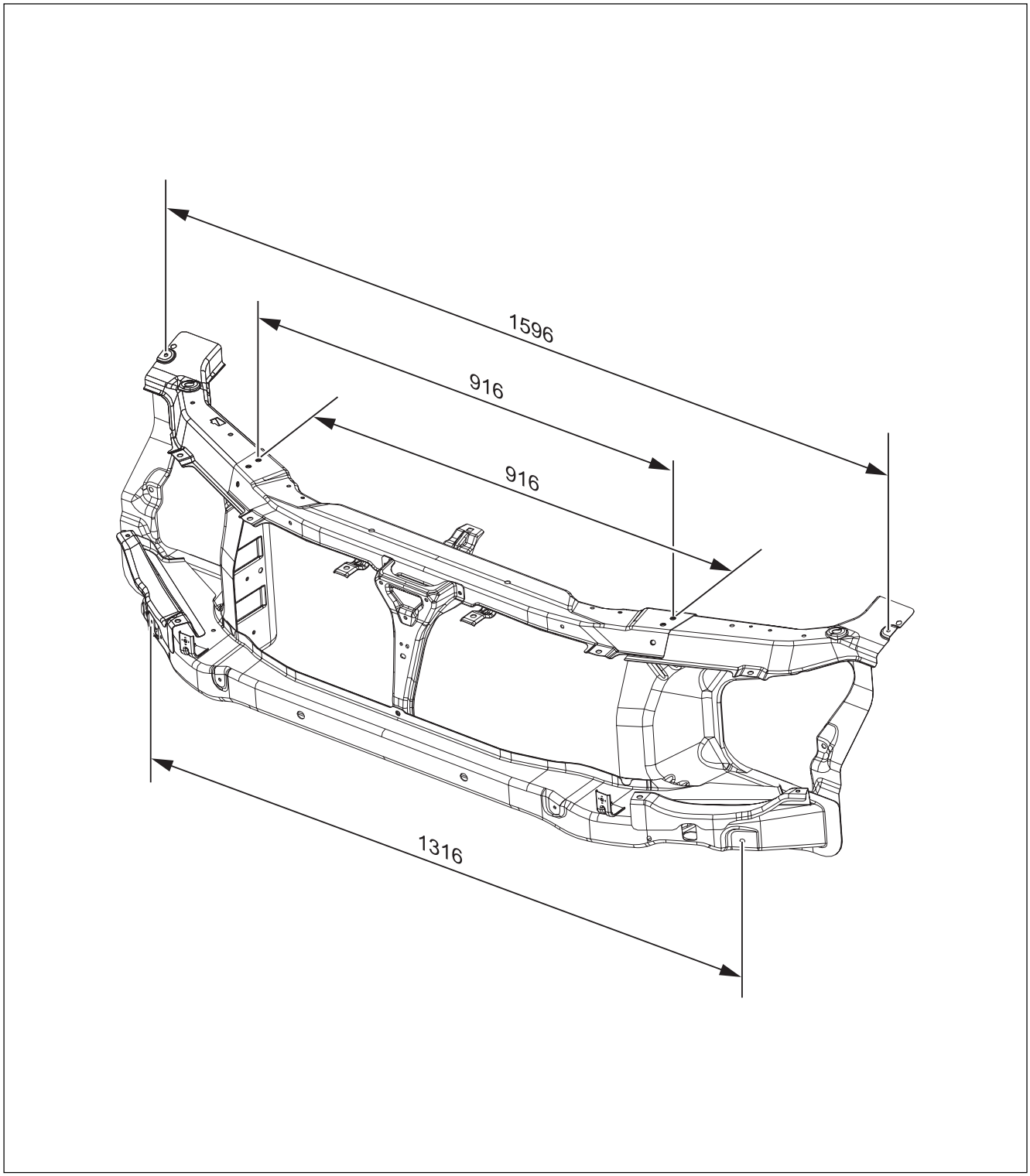
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CHANGED BY	
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AFFECTED VIN	

Front End

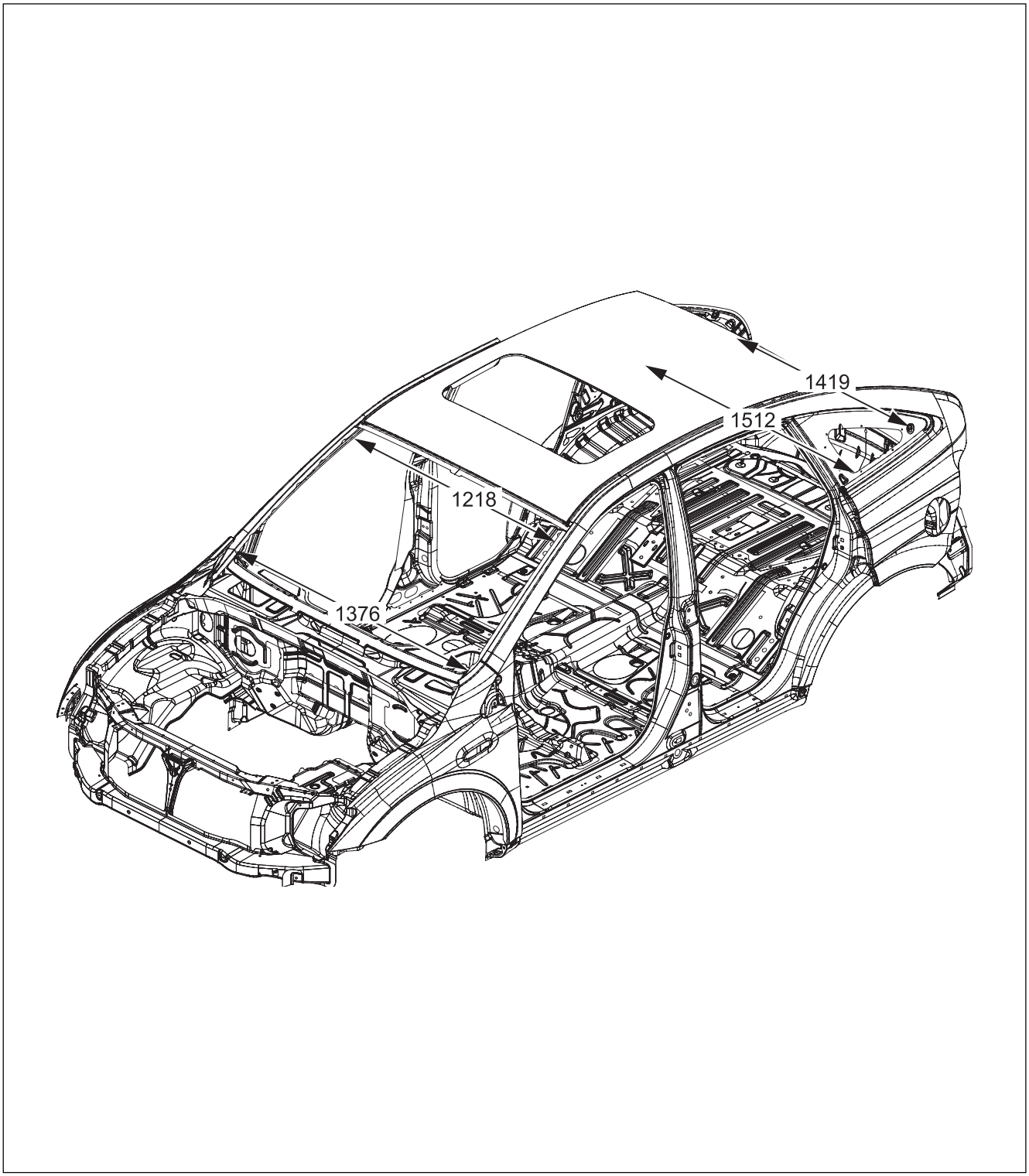
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EFFECTIVE DATE	
AFFECTED VIN	

Windshield Glass Mounting Panel

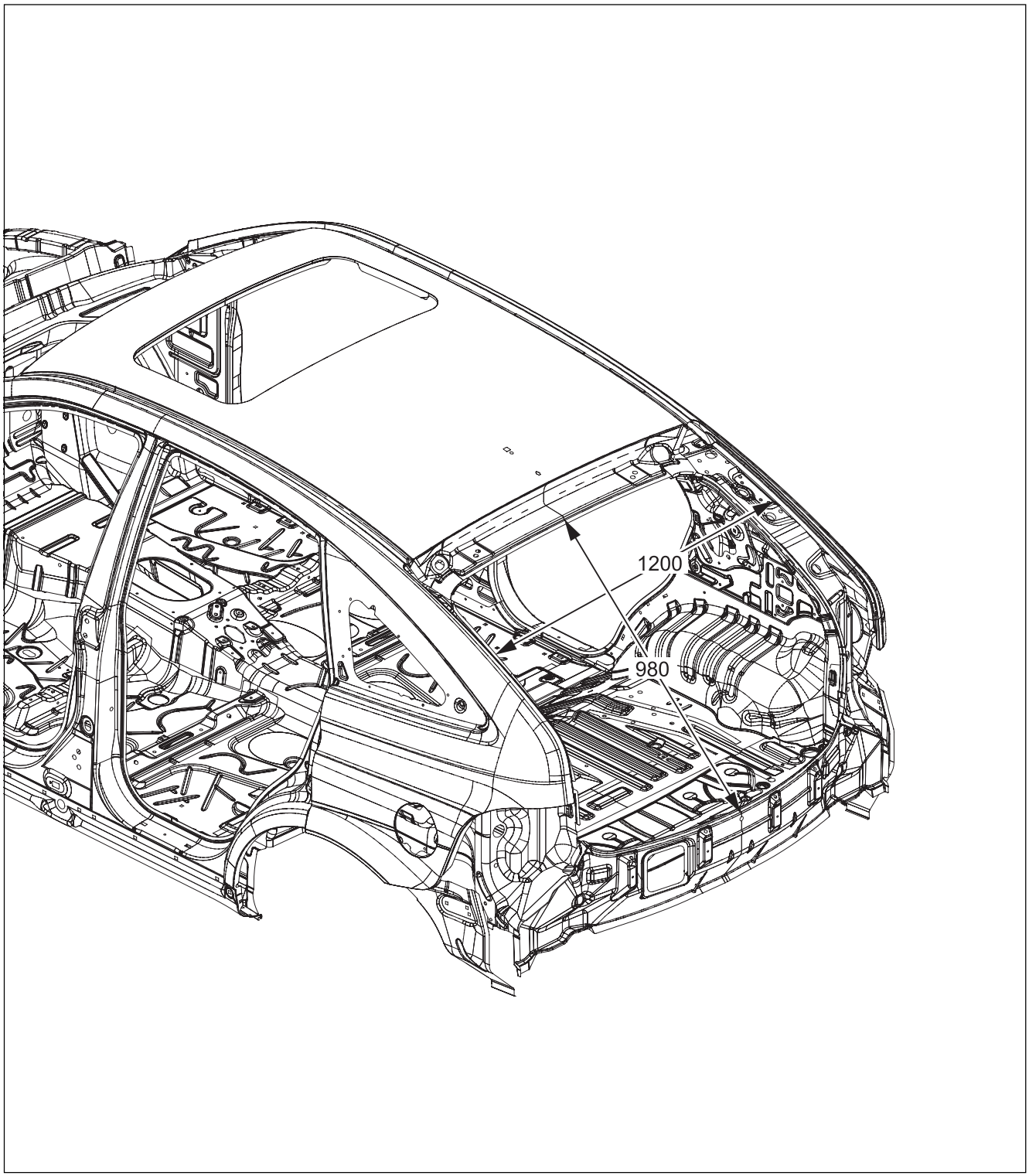
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AFFECTED VIN	

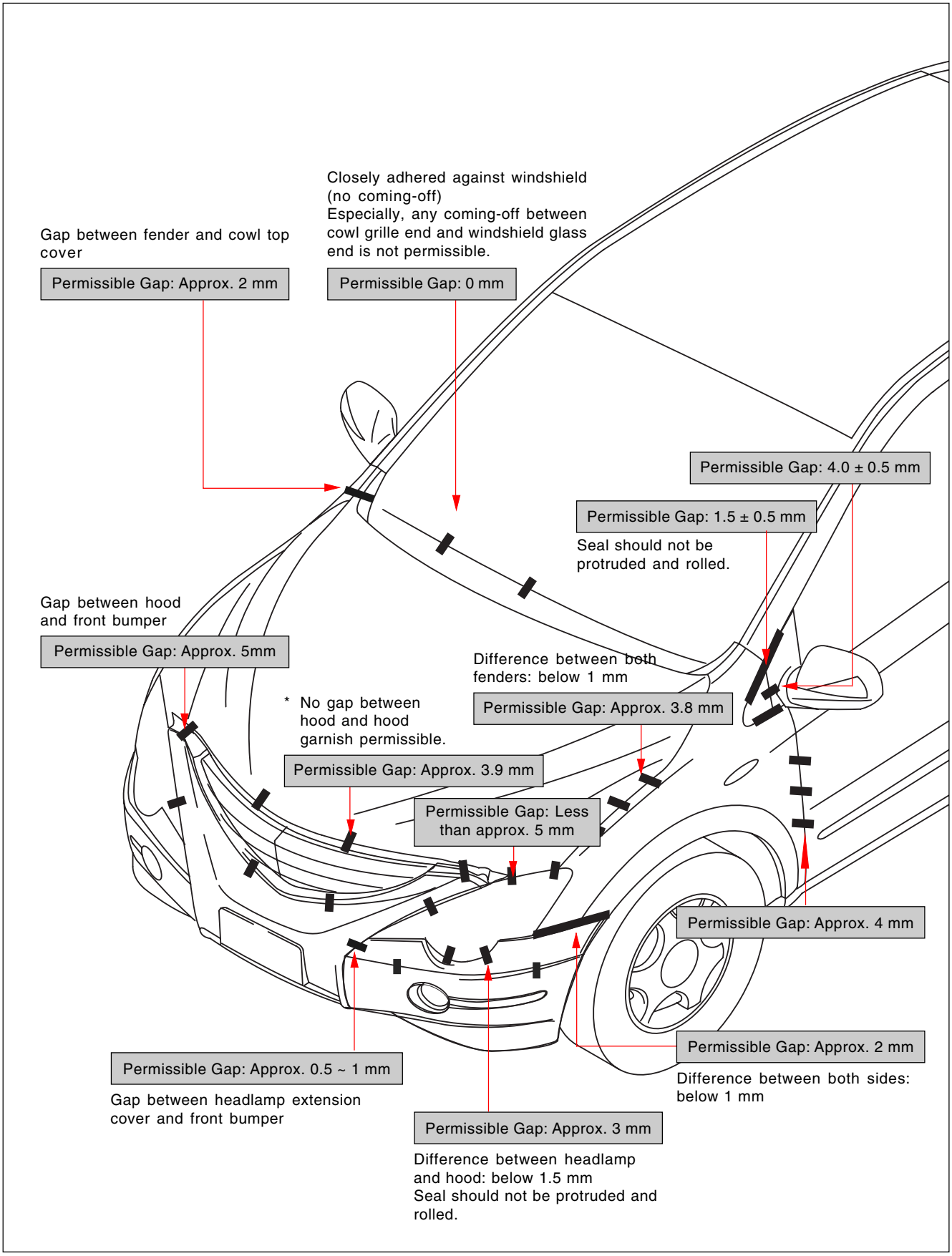
Tailgate

Unit: mm

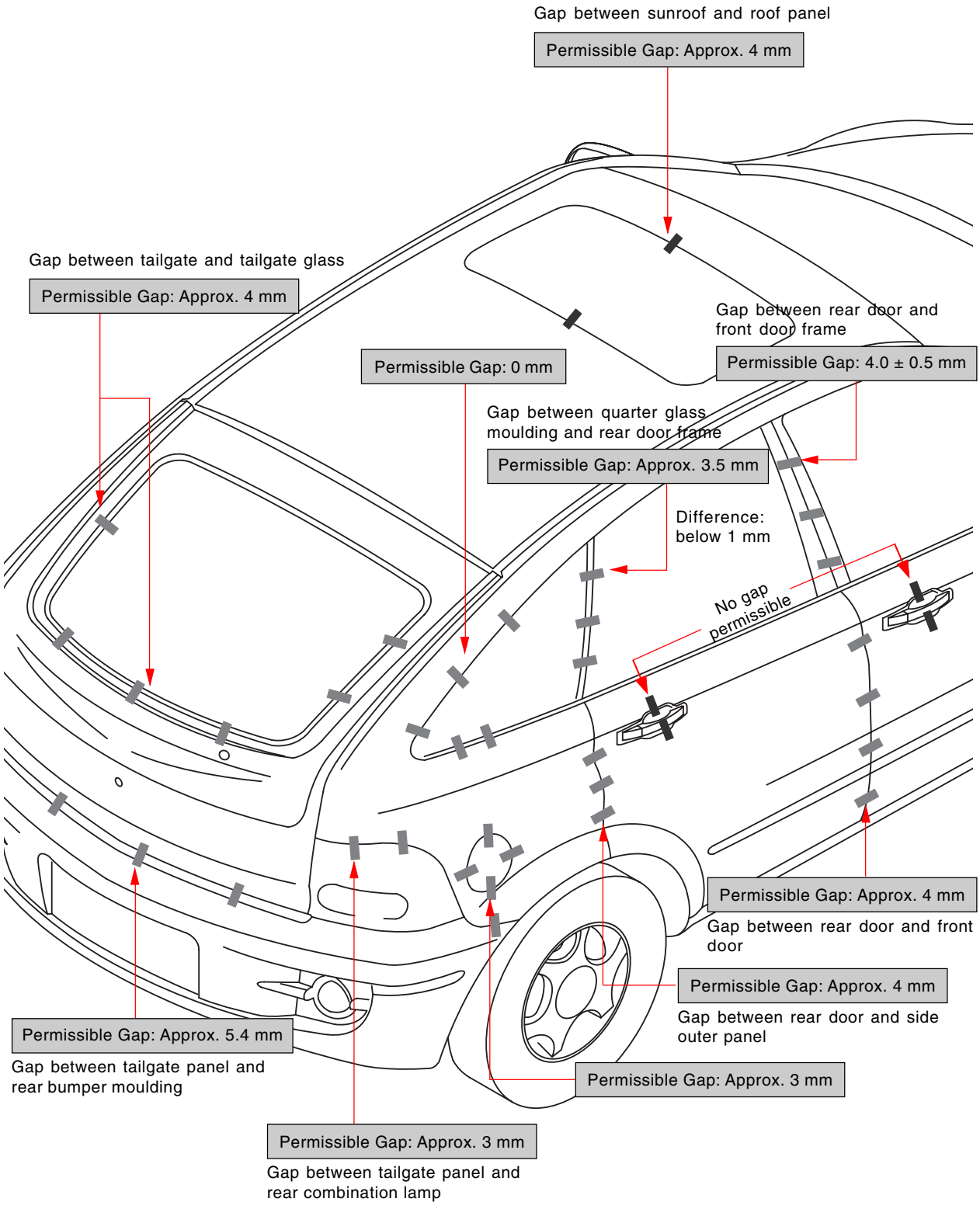


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AFFECTED VIN	

▶ Body Gaps

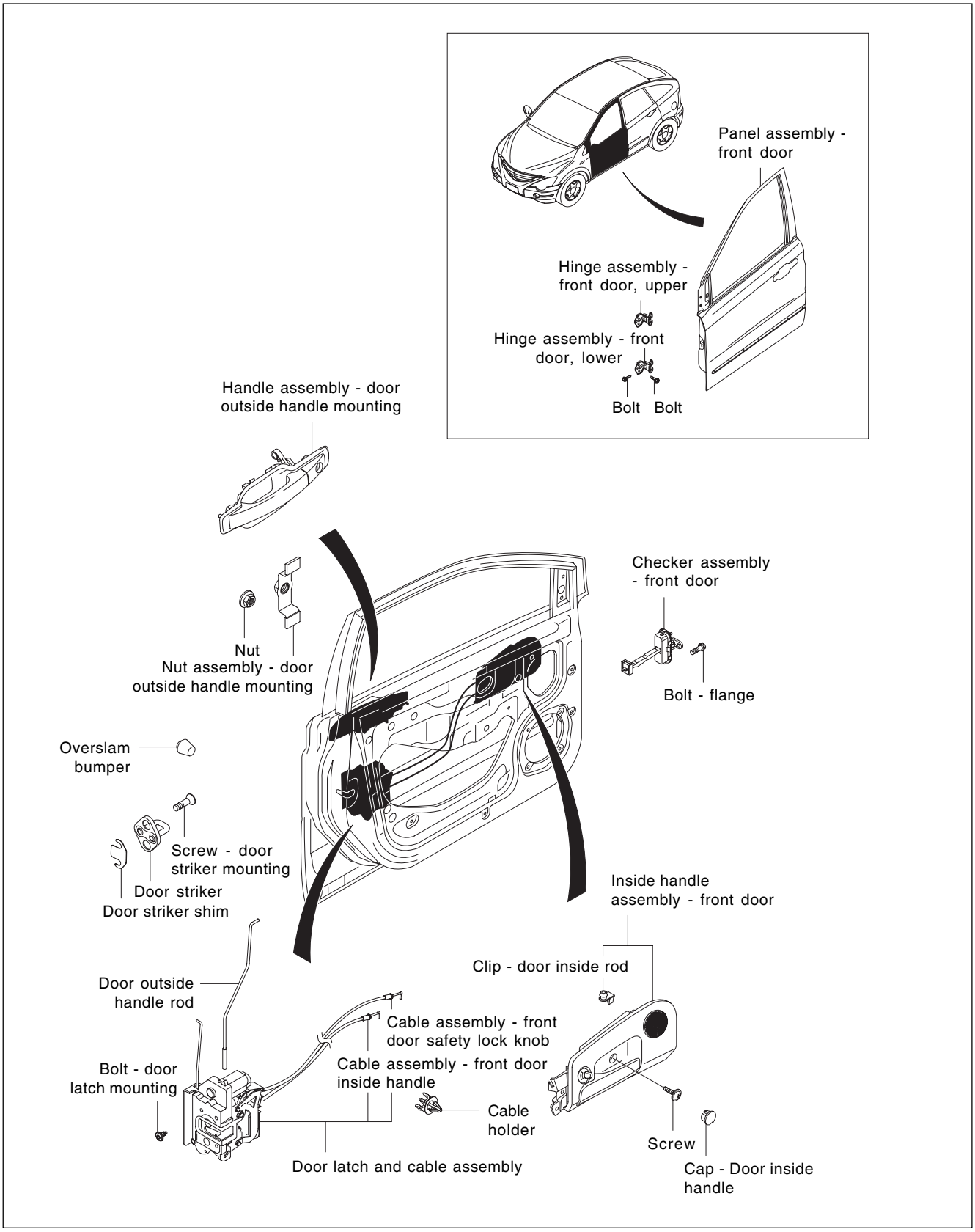


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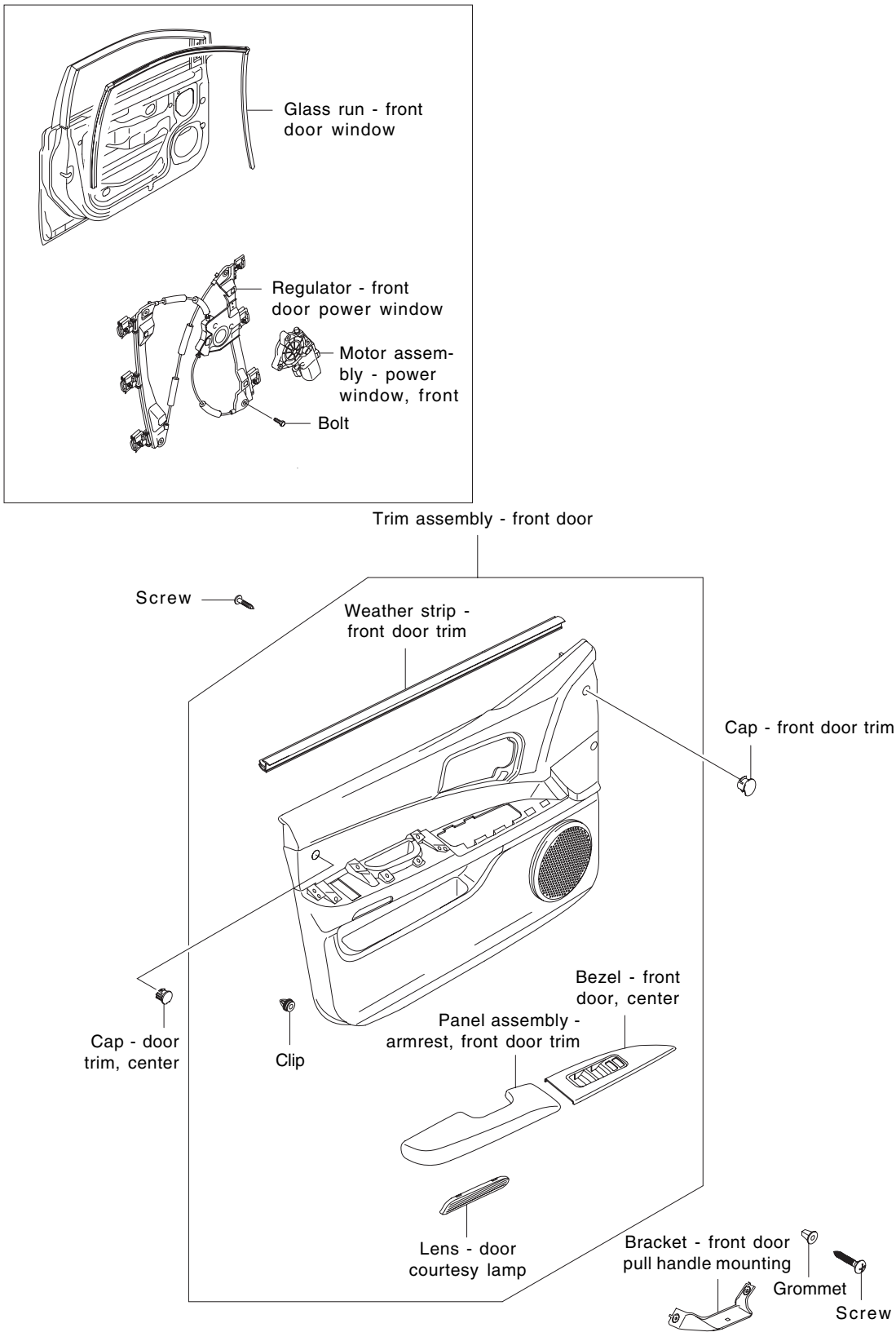

Gap between sunroof and roof panel
Permissible Gap: Approx. 4 mm
Gap between tailgate and tailgate glass
Permissible Gap: Approx. 4 mm
Gap between rear door and front door frame
Permissible Gap: 4.0 ± 0.5 mm
Permissible Gap: 0 mm
Gap between quarter glass moulding and rear door frame
Permissible Gap: Approx. 3.5 mm
Difference: below 1 mm
No gap permissible
Permissible Gap: Approx. 4 mm
Gap between rear door and front door
Permissible Gap: Approx. 4 mm
Gap between rear door and side outer panel
Permissible Gap: Approx. 5.4 mm
Gap between tailgate panel and rear bumper moulding
Permissible Gap: Approx. 3 mm
Permissible Gap: Approx. 3 mm
Gap between tailgate panel and rear combination lamp

▶ Door Components (Including Engine Hood)

Front Door

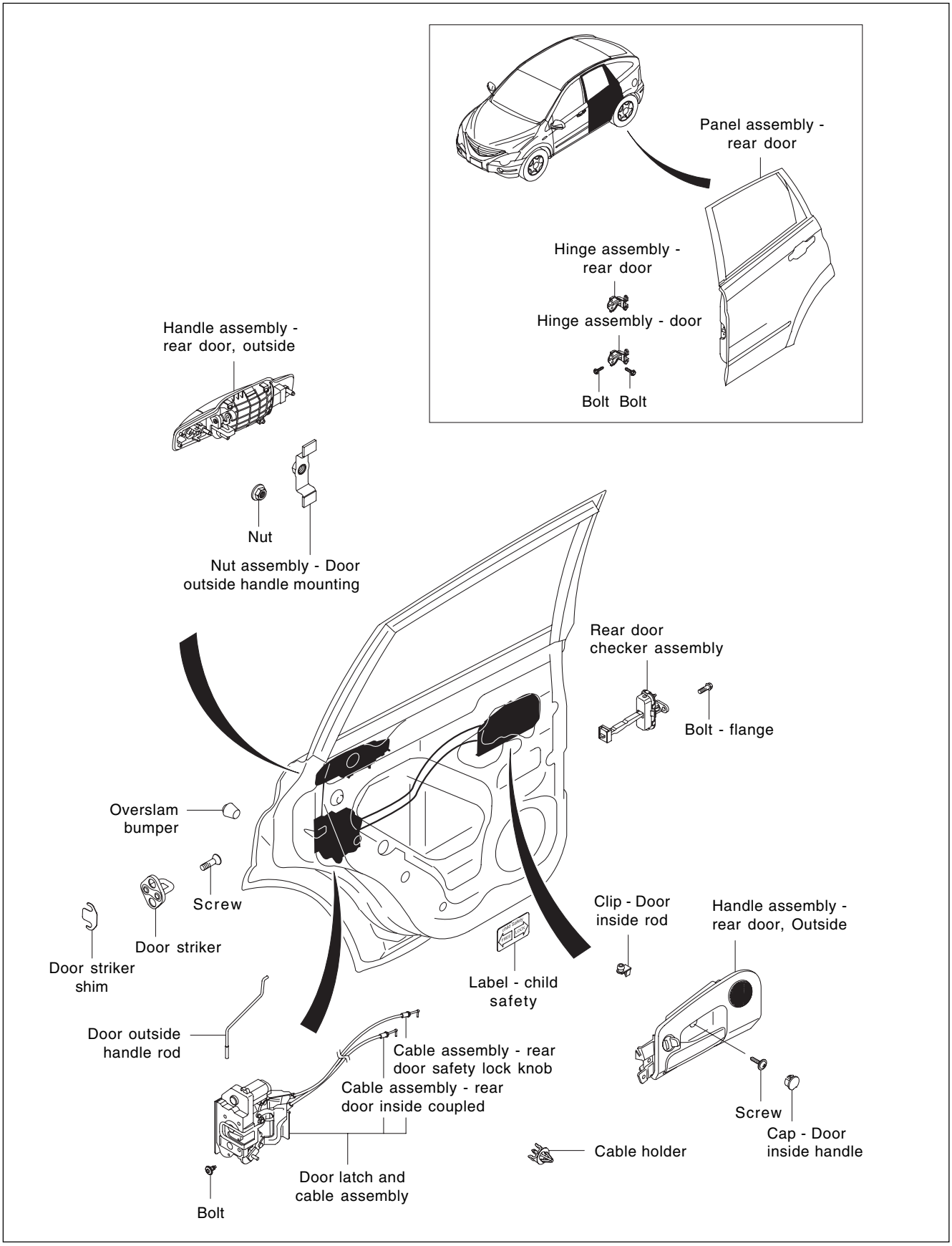


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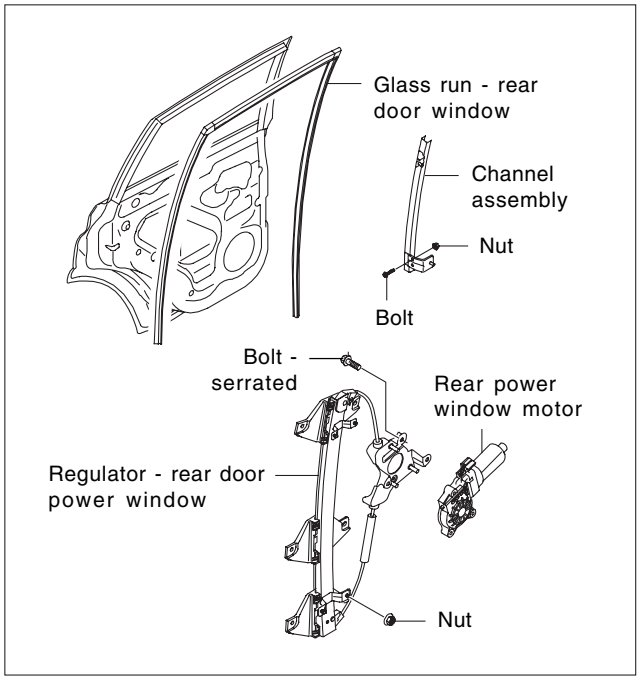


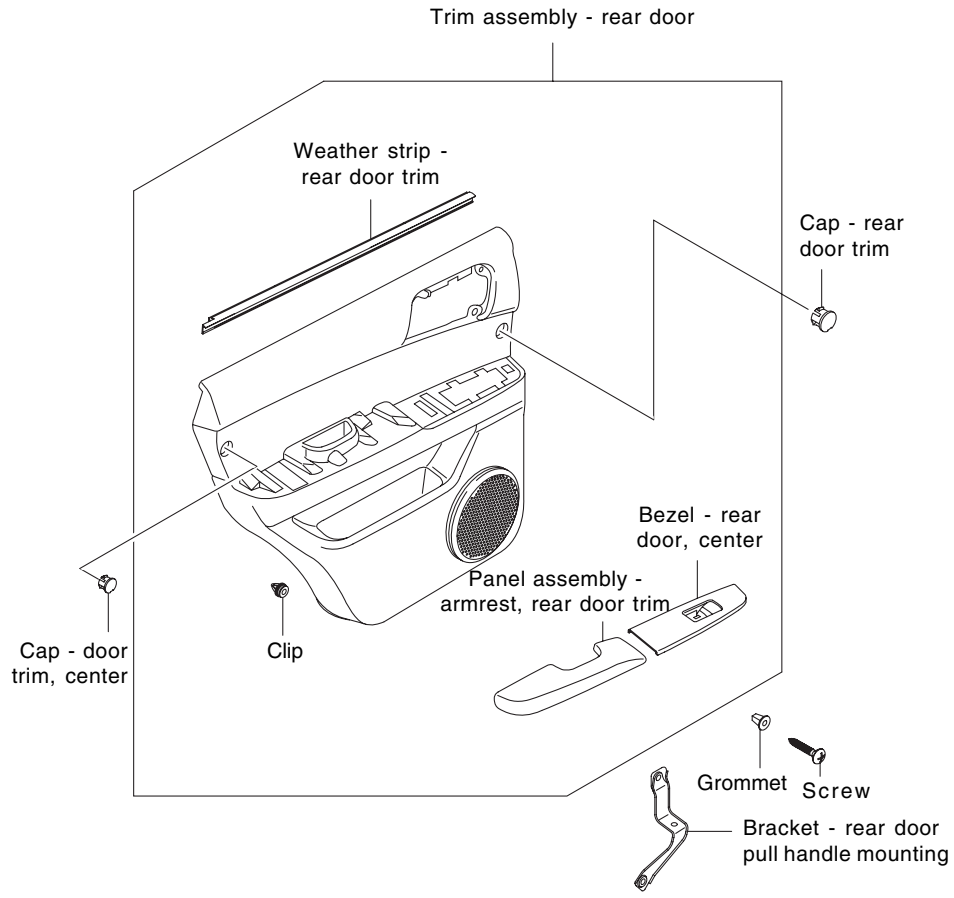
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AFFECTED VIN	

Rear Door



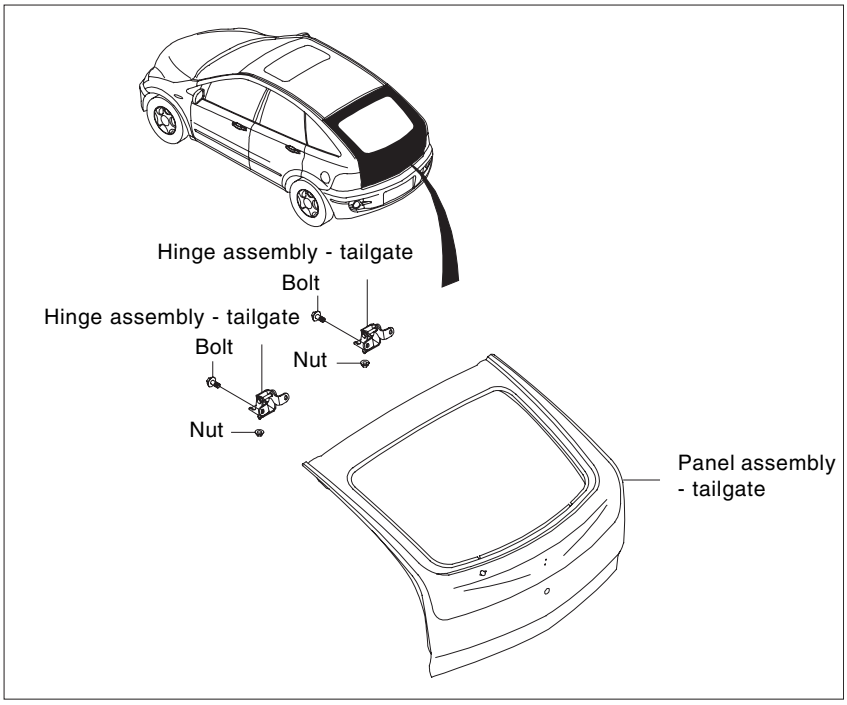
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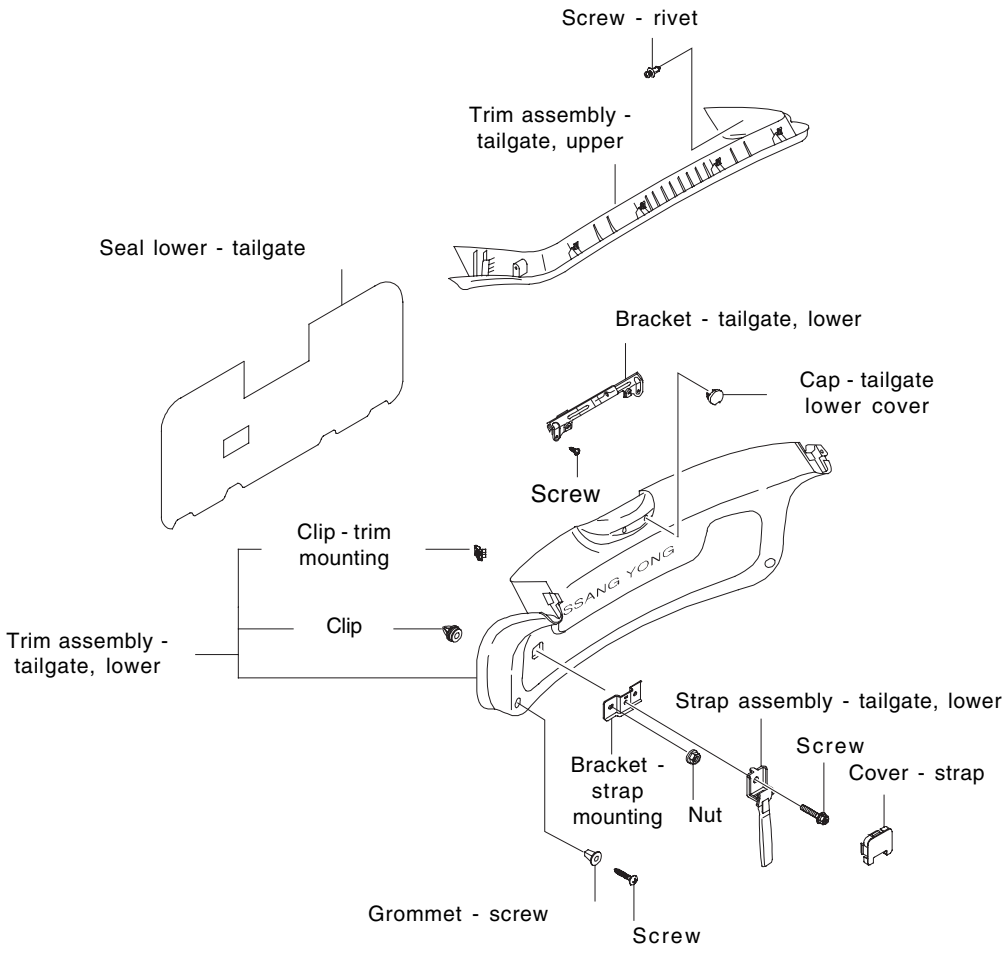




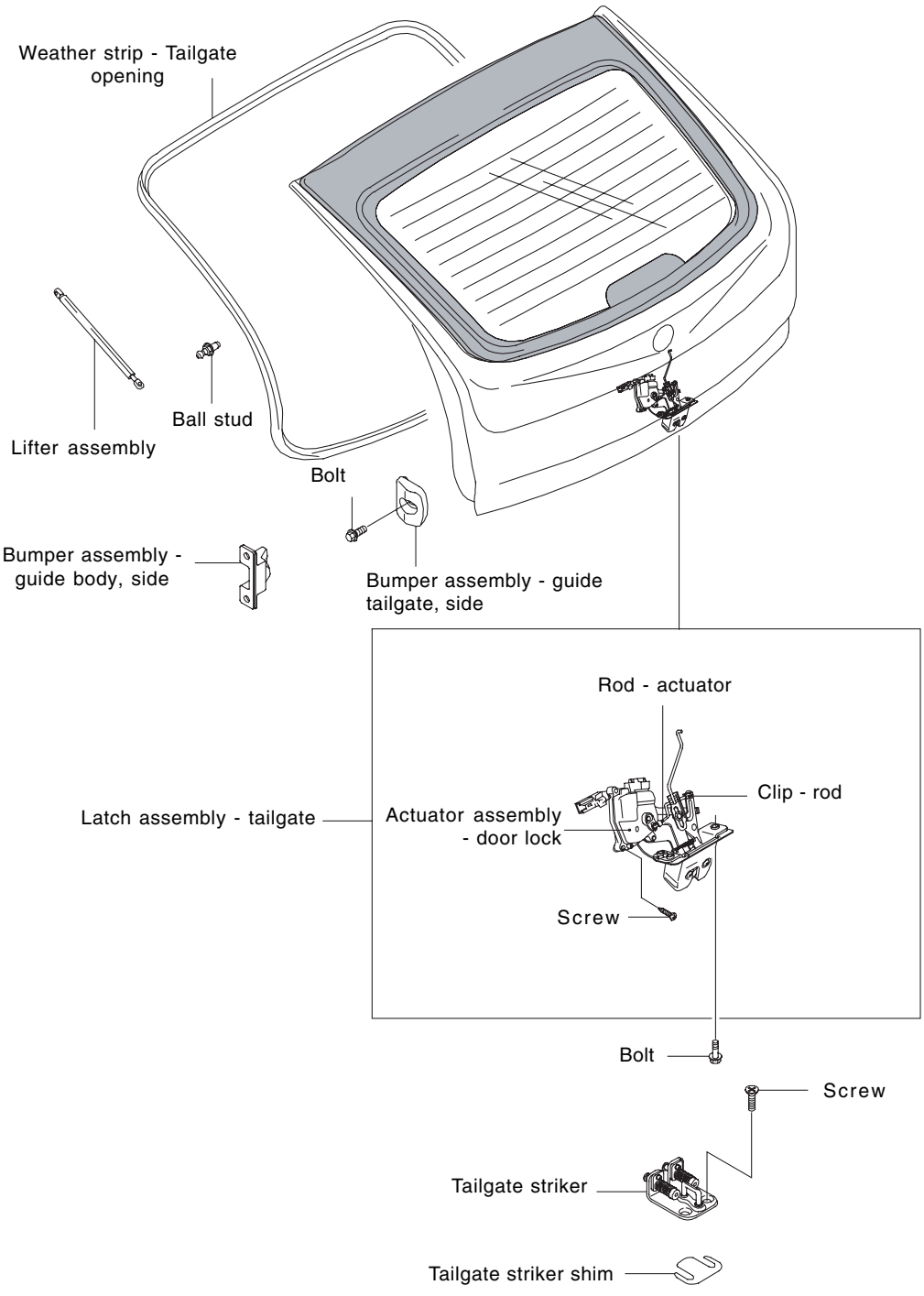
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AFFECTED VIN	

Tailgate



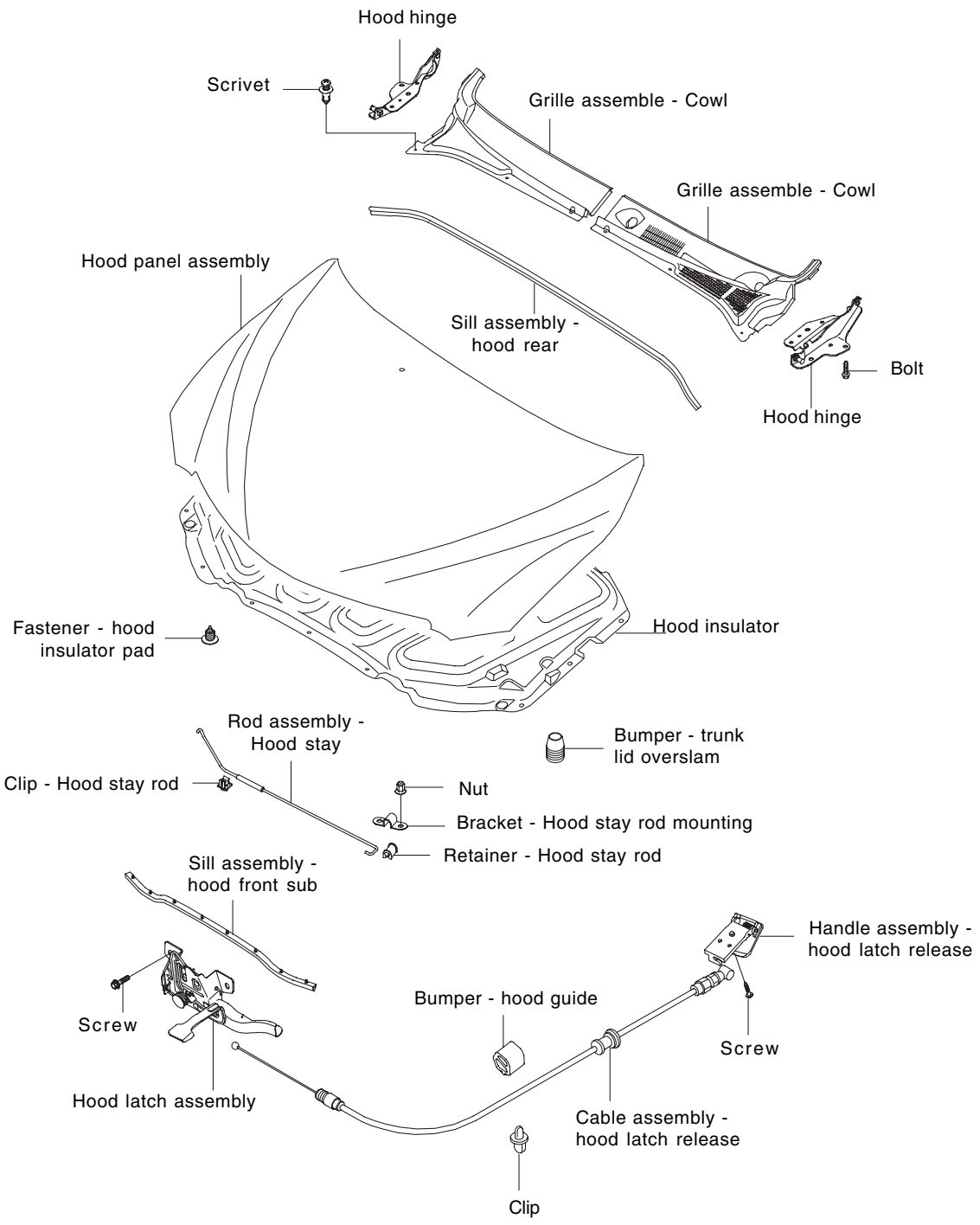


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AFFECTED VIN	

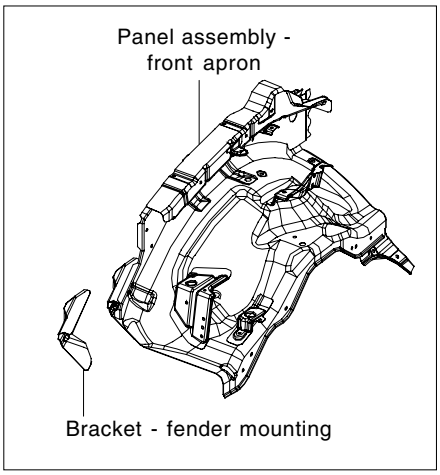
Engine Hood

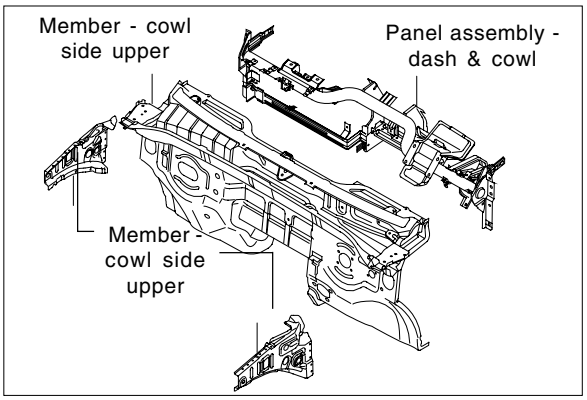


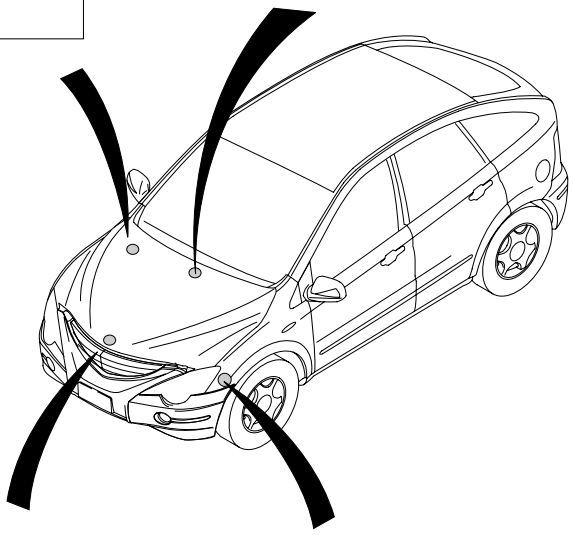
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EFFECTIVE DATE	
AFFECTED VIN	

▶ Body Panels

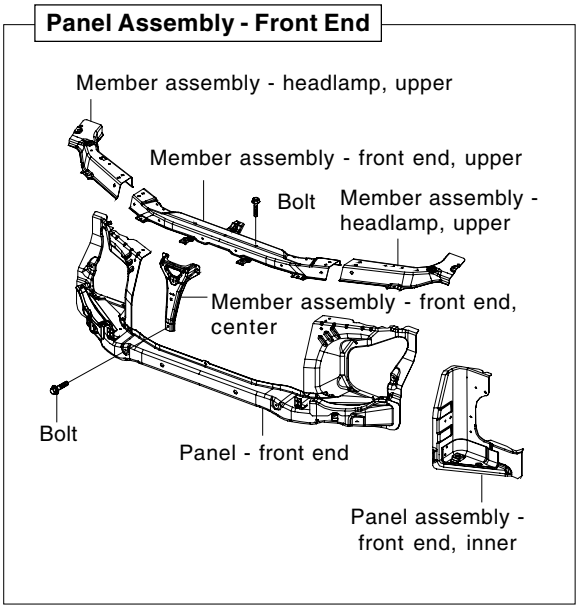
Firewall, Fender and Front End

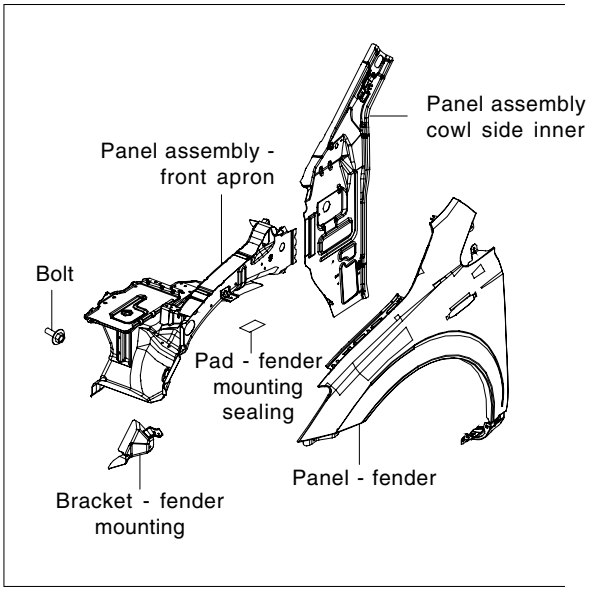






Panel Assembly - Front End

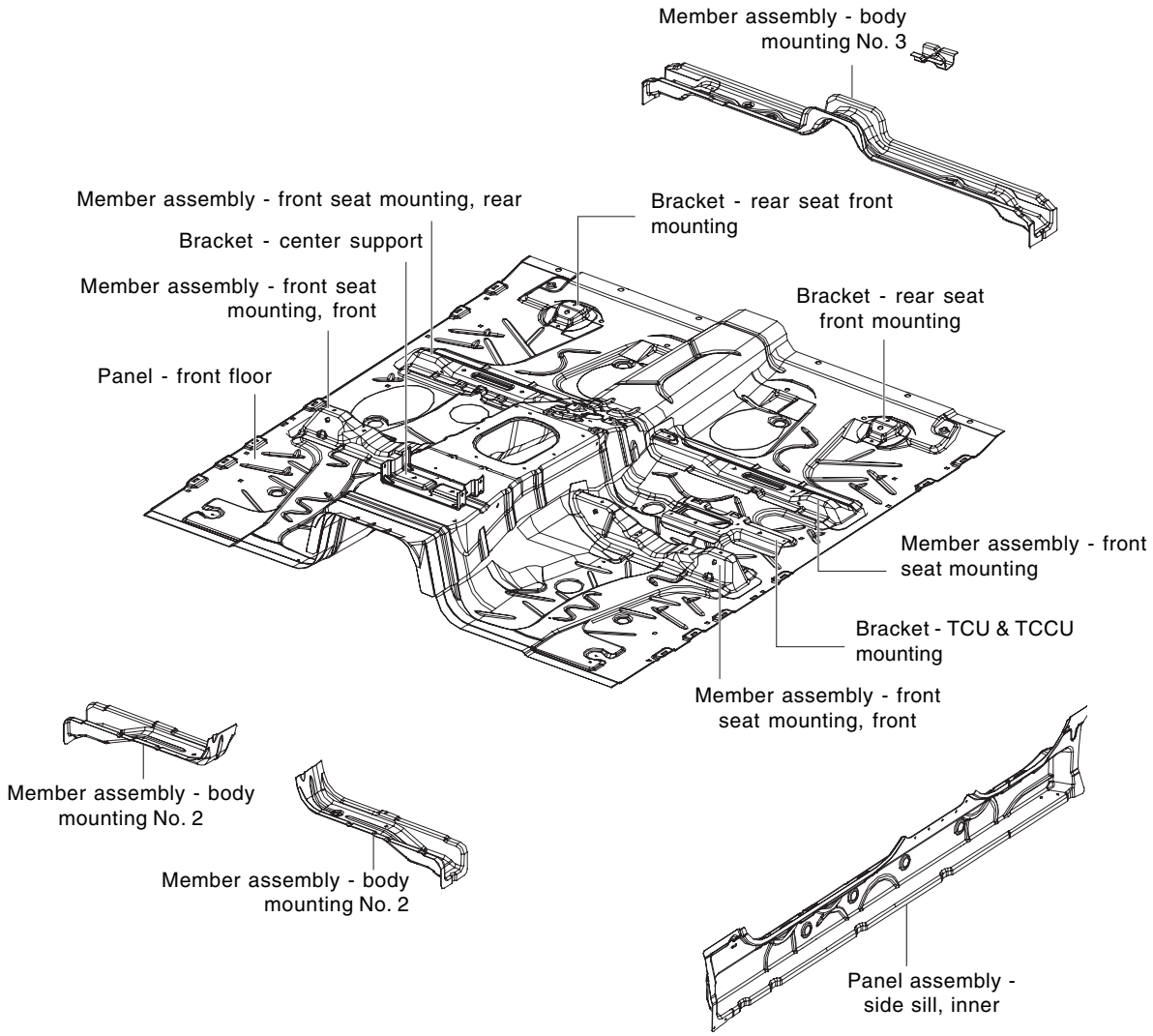




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EFFECTIVE DATE	
AFFECTED VIN	

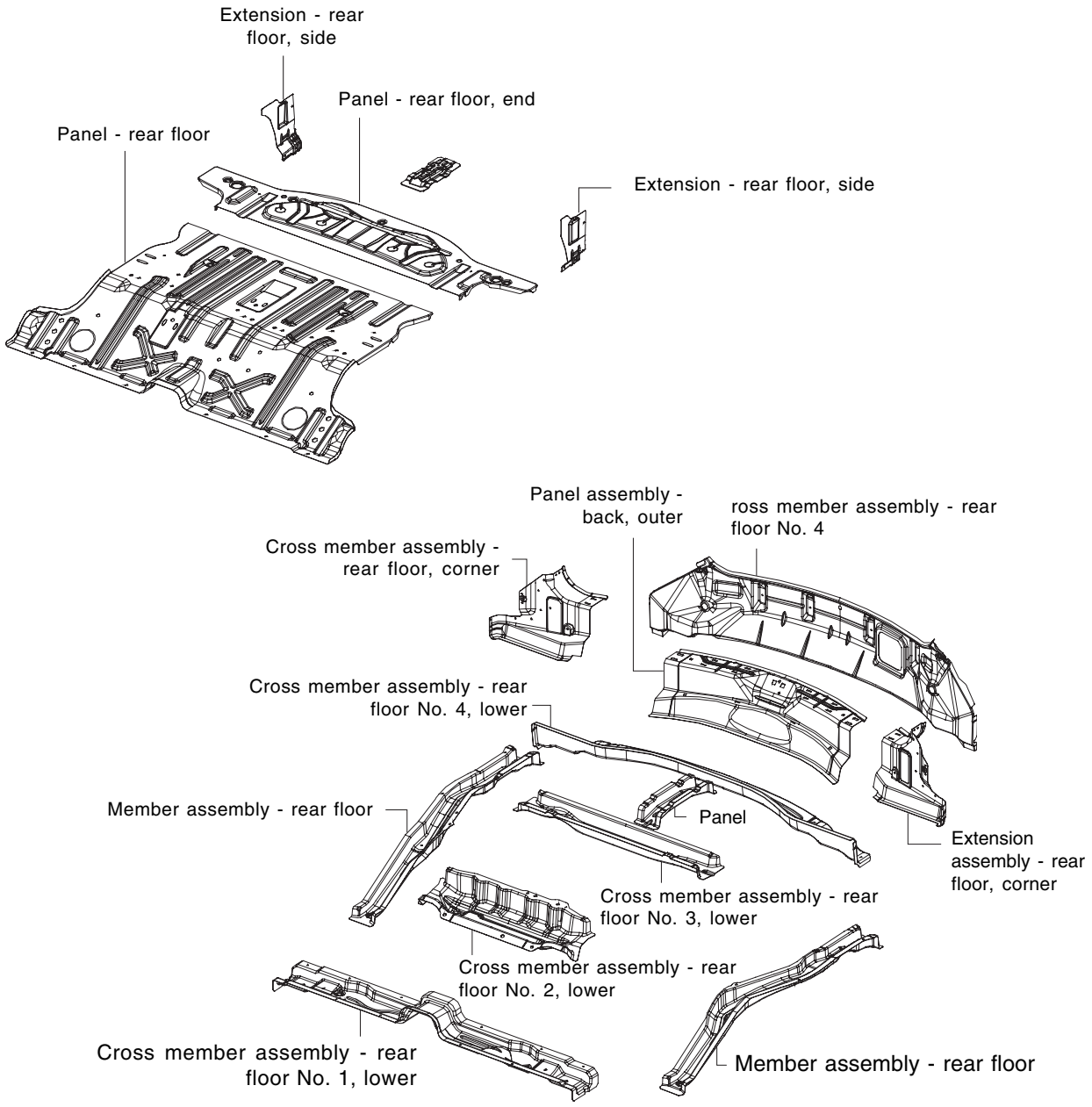
Floor Panels

Front Floor



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

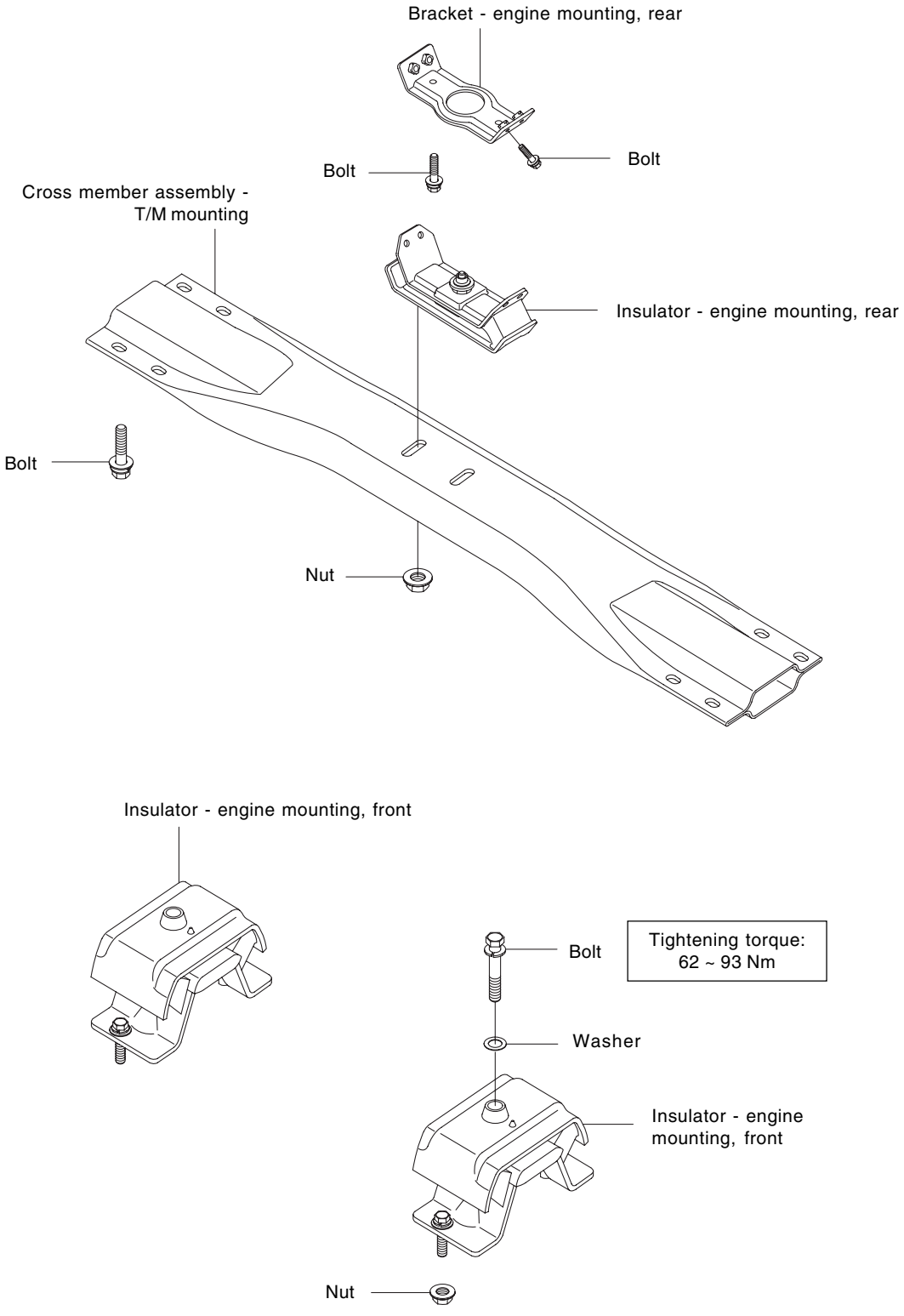
Rear Floor



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Engine Mounting Bracket

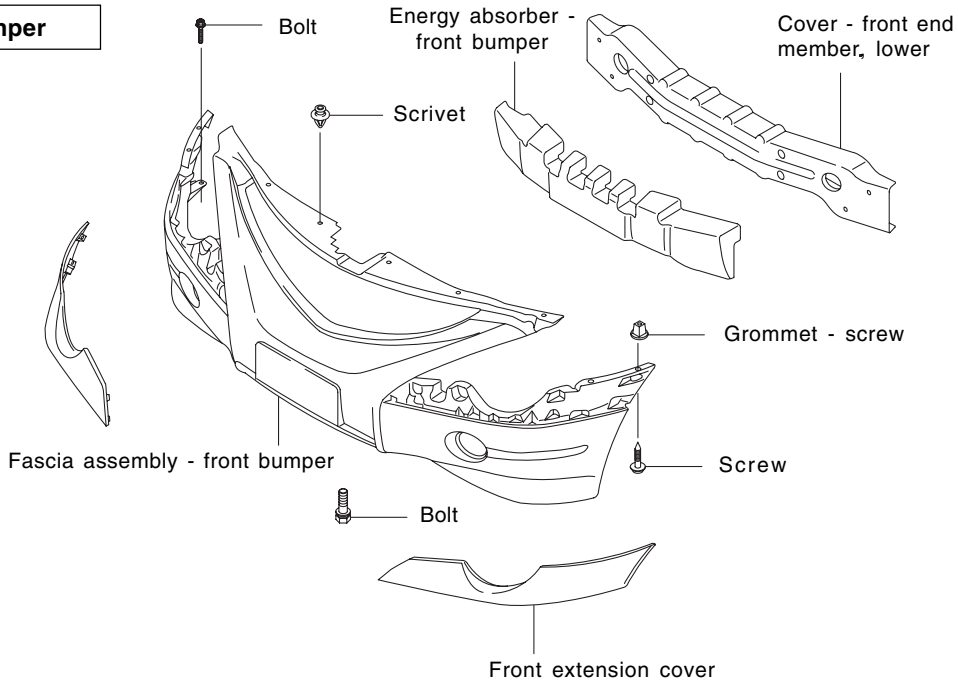
Transmission Side



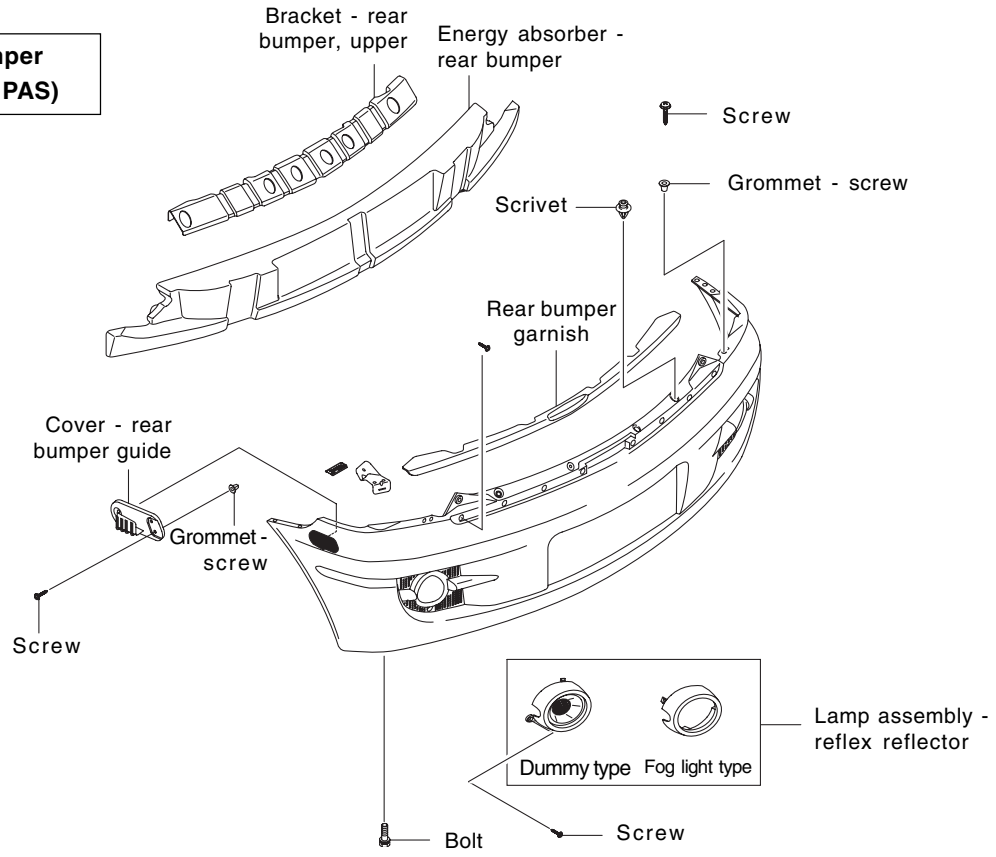
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EFFECTIVE DATE	
AFFECTED VIN	

Bumper

Front Bumper



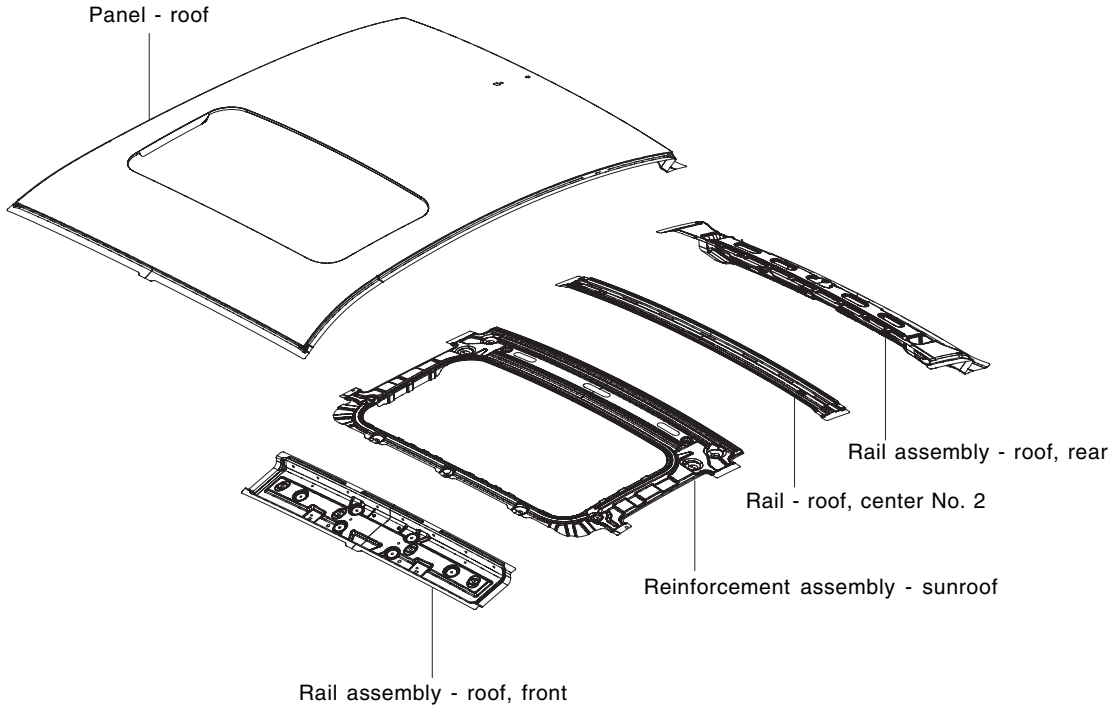
Rear Bumper (Excluding PAS)



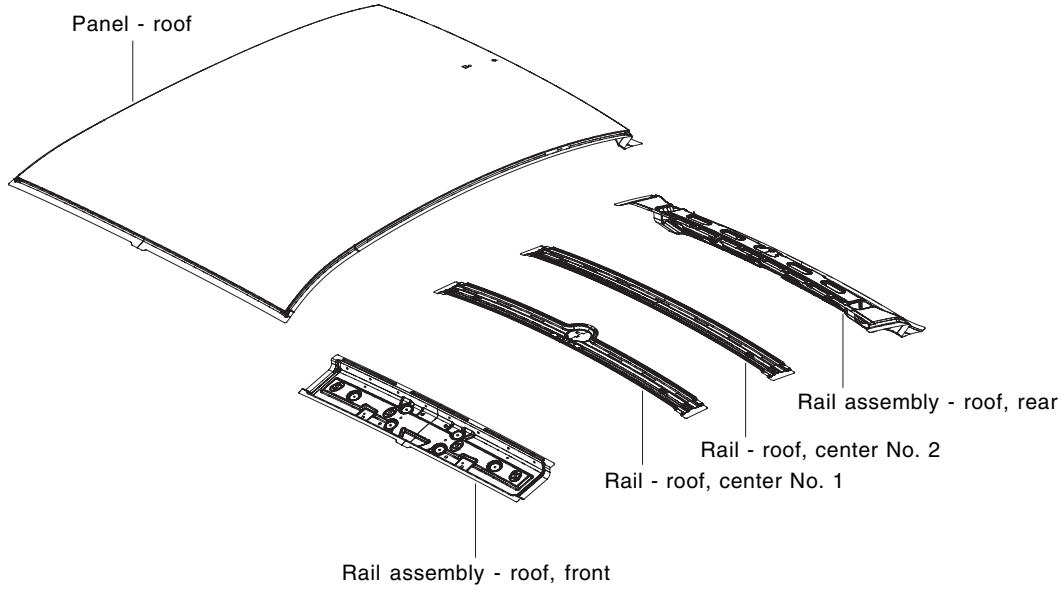
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AFFECTED VIN	

Roof Panel

Roof Panel with Sunroof

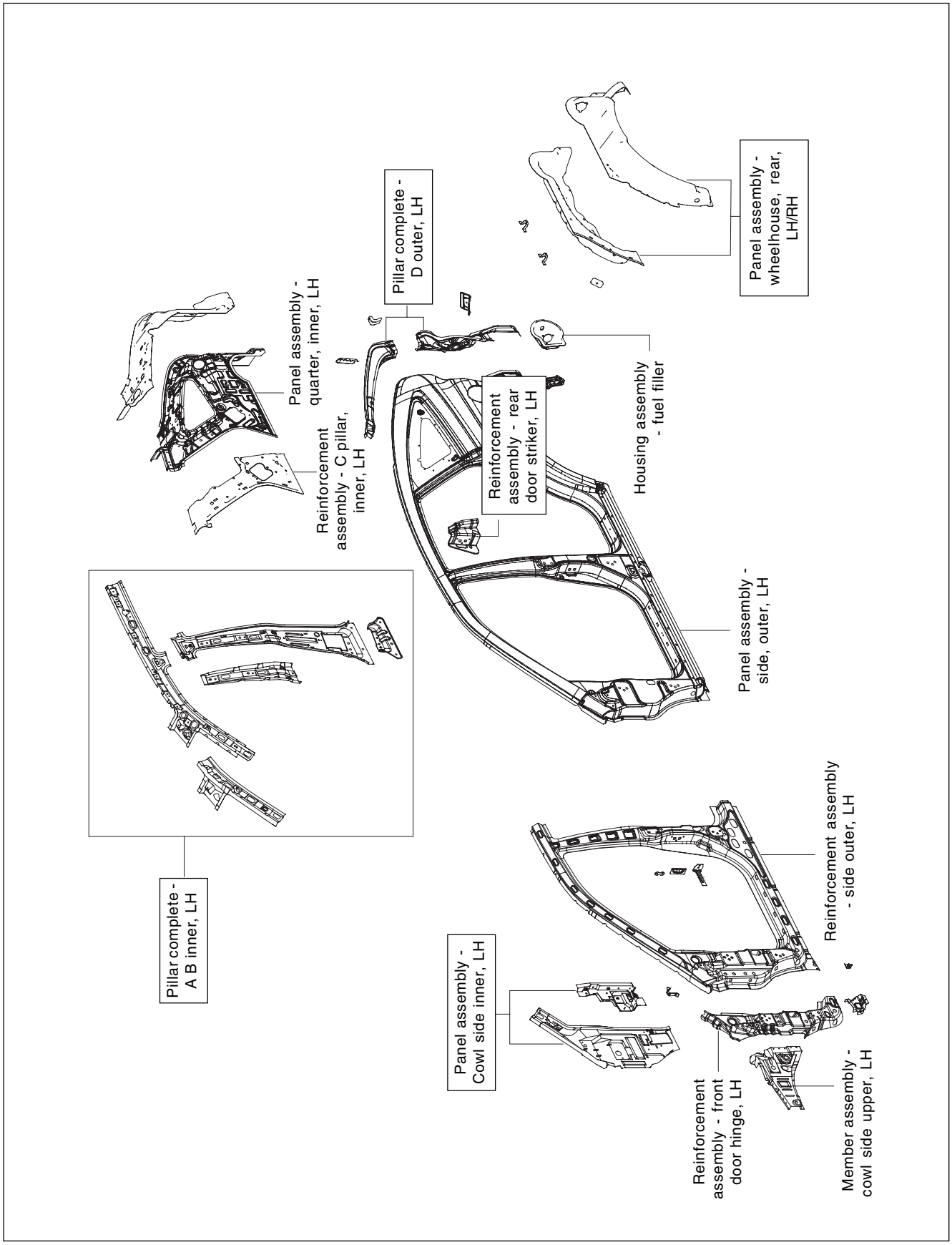


Roof Panel without Sunroof



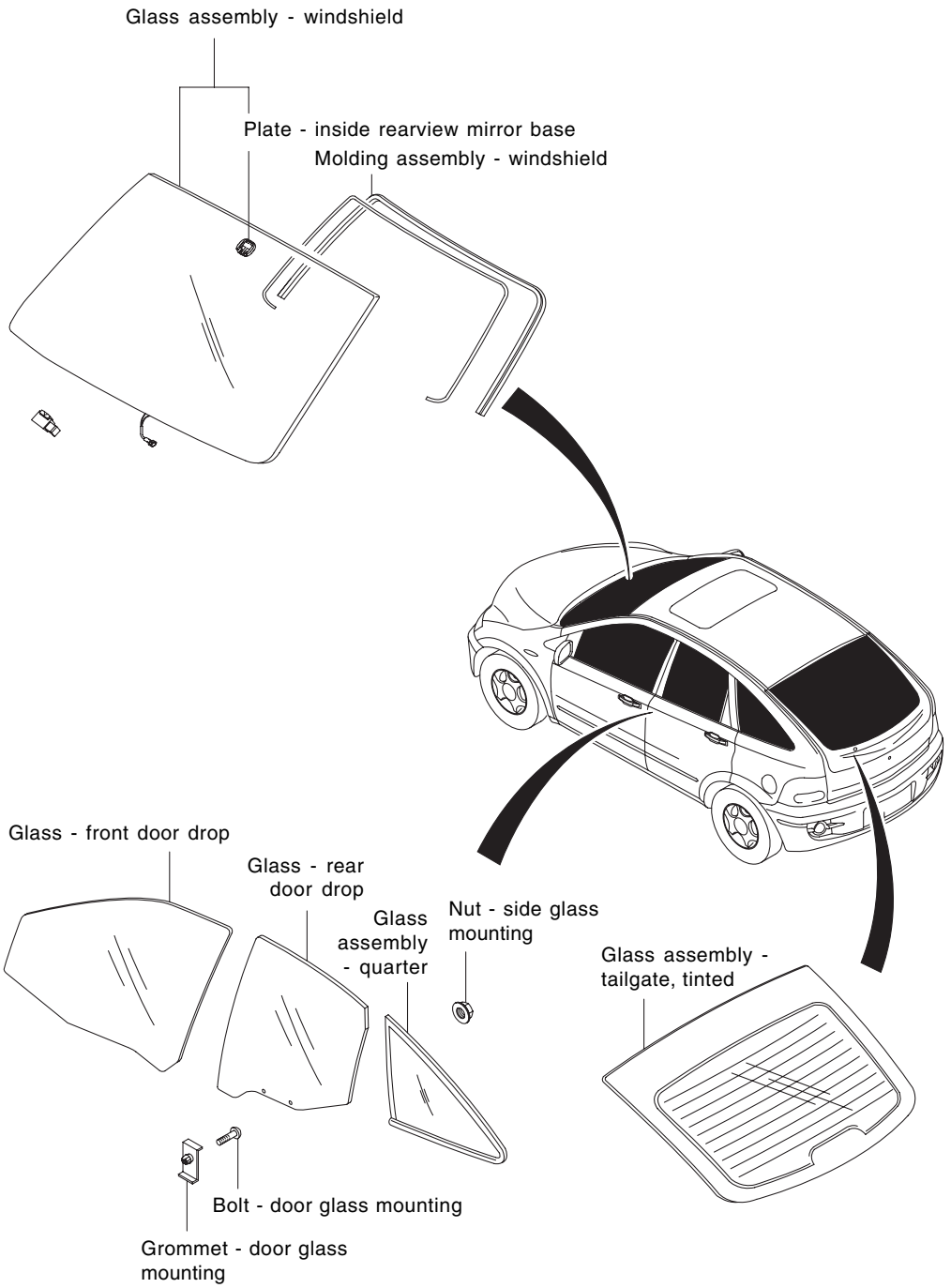
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Side Panel



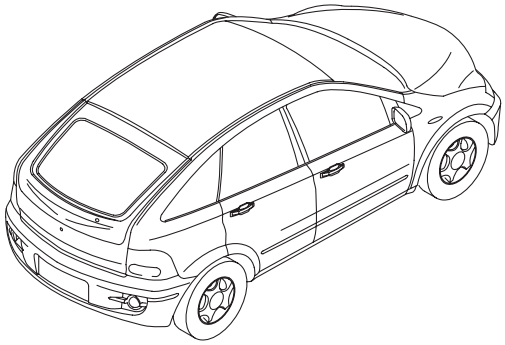
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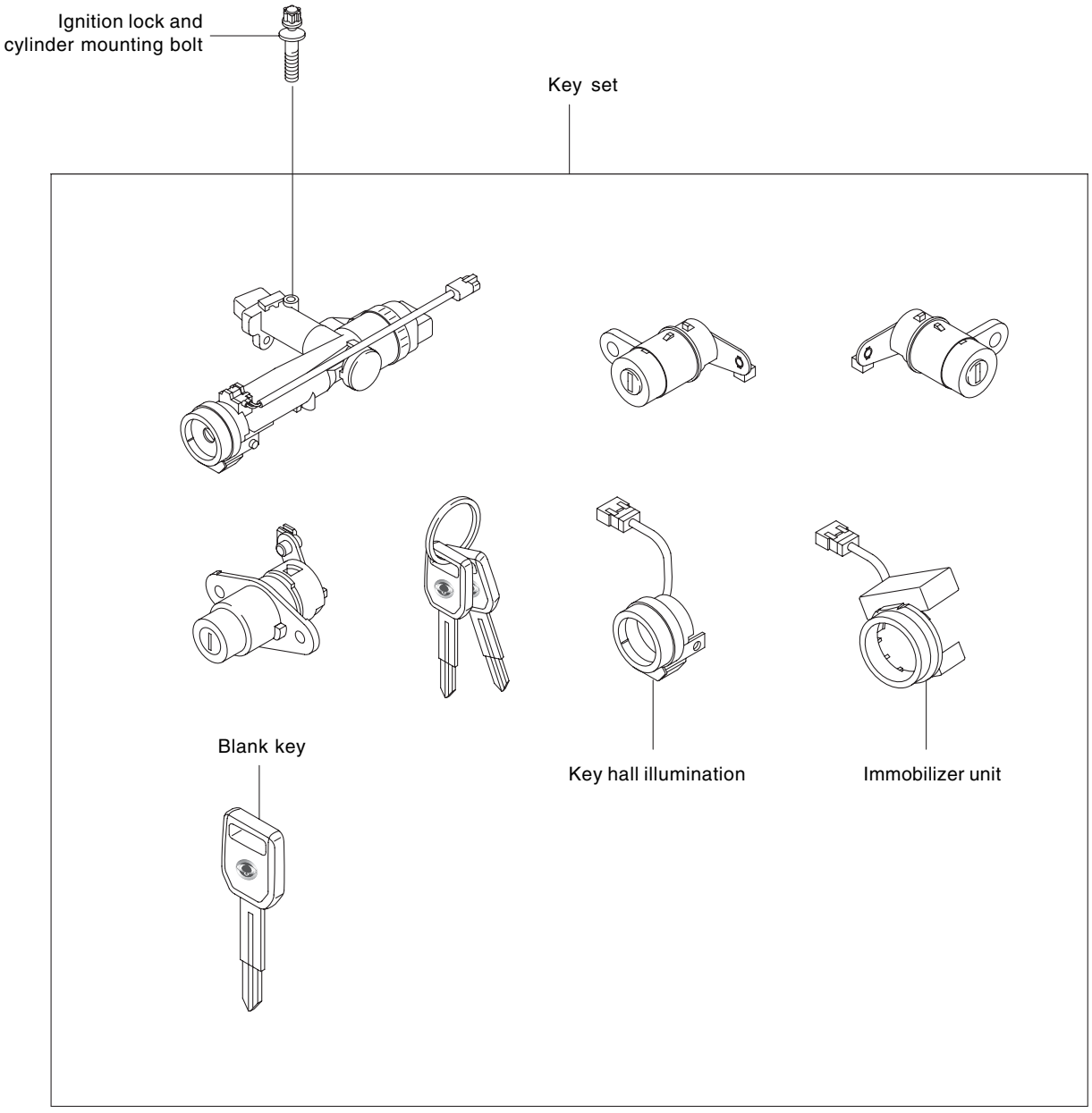
Glass



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EFFECTIVE DATE	
AFFECTED VIN	

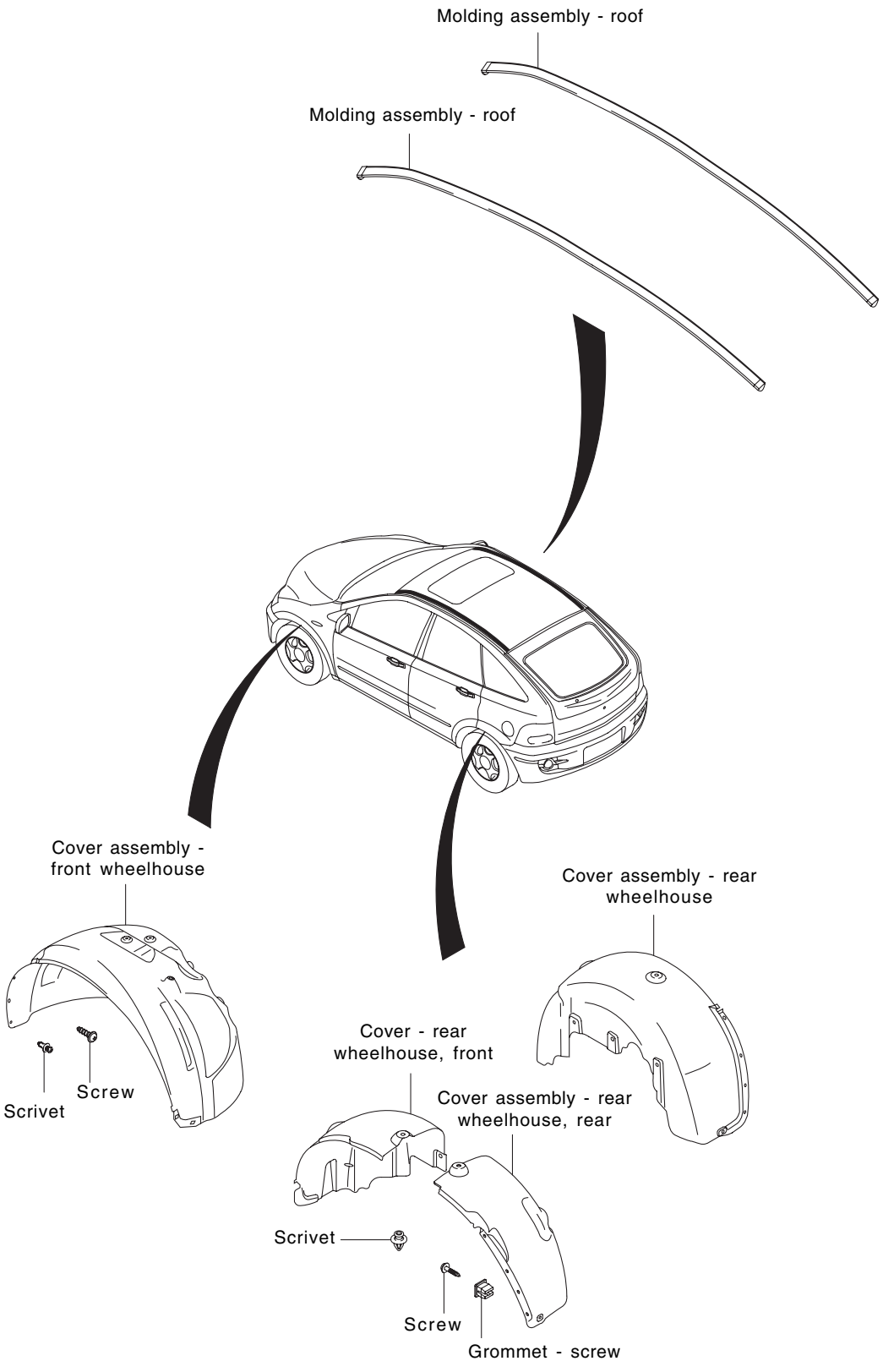
Key Set





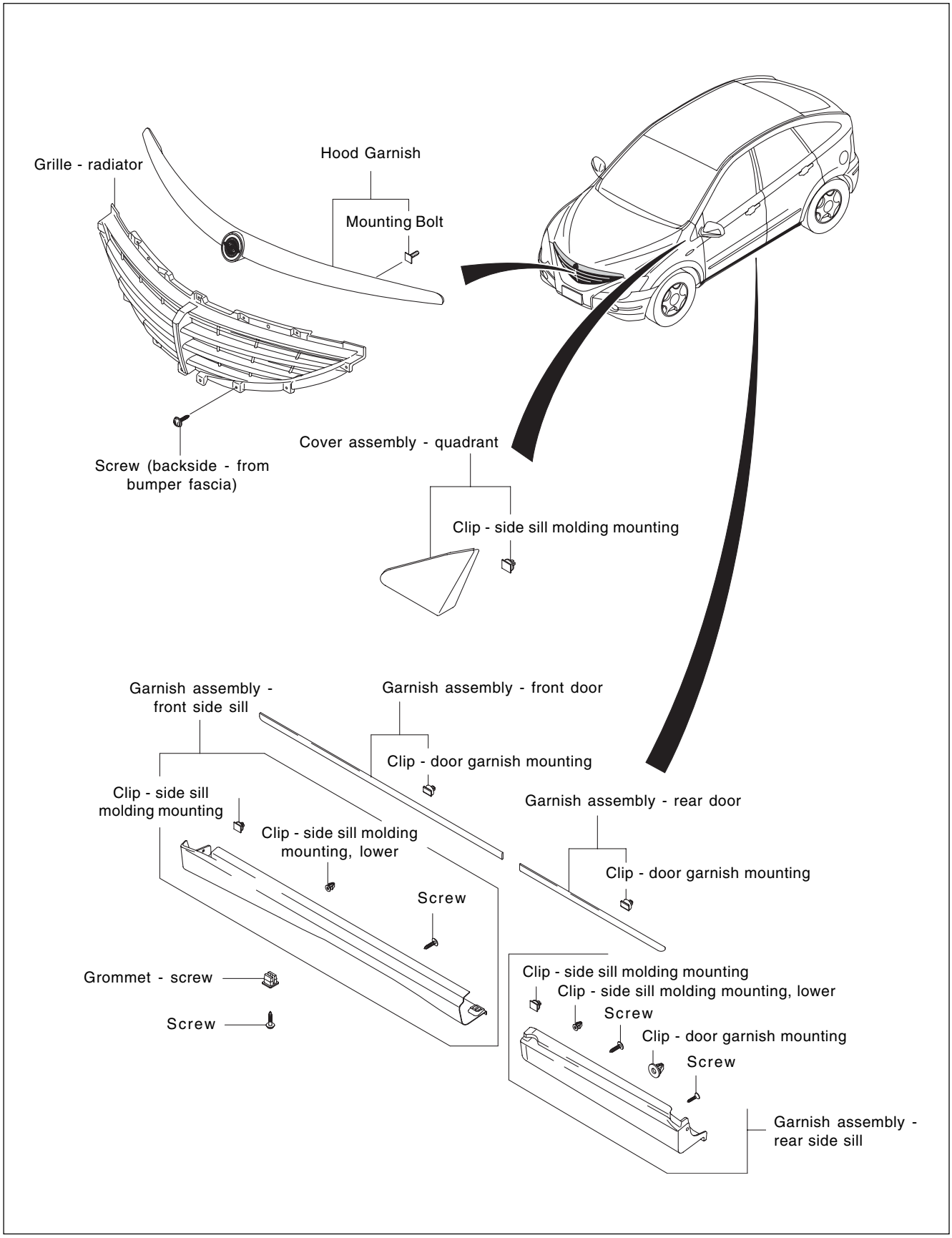
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EFFECTIVE DATE	
AFFECTED VIN	

Others (I)



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Others (II)



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Section 00

SYSTEM / VEHICLE GENERAL

SYSTEM

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TABLE OF CONTENTS

1. Major Changes in ACTYON SPORTS Electric System 2
2. Major Changes in ACTYON SPORTS Chassis system 3
3. DECK 4
4. BODY 5

1. MAJOR CHANGES IN ACTYON SPORTS ELECTRIC SYSTEM

7010 REKES KEY (Including Immobilizer & Rechargeable Key)

With REKES



Without REKES



REKES Key similar to REXTON II is used. The operational functions and logics are the same as REXTON II. To code REKES key, just press one of the buttons as you press on of the button with ACTYON.

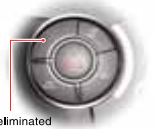
8510 SWITCH

Outside Rearview Mirror Bezel



ESP$_{OFF}$ eliminated

Hazard Switch Bezel



HDC eliminated

As only ABS & EBD are available, the functions for ESP, ARP and HDC and relevant switches do not exist.

8510 MULTIFUNCTION WIPER SWITCH

ACTYON SPORTS

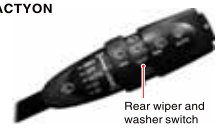


Rear wiper and washer switch eliminated



Due to the elimination of the rear wiper and washer system, the relevant functions on the multifunction wiper switch are eliminated.

ACTYON



Rear wiper and washer switch



Rear wiper and washer system is available.

8510 4WD PART-TIME TRANSFER CASE

4WD Part-time Transfer Case



4WD Switch

4L added



TCCU



4L function is applied by using P/T 4WD system for KYRON to improve the driveability of the loaded vehicle on rough roads. TCCU for T/C control is exchangeable with TCCU of ACTYON for repair with TCCU of ACTYON.

8410 FUSE AND RELAY

Engine Compartment Fuse Box



Interior Fuse Box (LH)



Interior Fuse Box (RH)



There's a little change in the fuse and relay used in the existing ACTYON due to the removal of ESP, Sun roof, AV system, and rear wiper and washer system.



8320 REAR COMBINATION LAMP



Stop/Tail lamp	12V-27/8W
Turn signal lamp	12V-27W
Back-up lamp	12V-21W

Changes in the design and shape of rear combination lamp

8010 CLUSTER (4WD LOW added)



4WD HIGH 4WD LOW

The 4L indicator on the instrument cluster is added by applying **4WD LOW** function on ACTYON 4WD system. (The indicator for ESP/HDC is eliminated.)

8790 PAS

Mounting Location of PAS Unit



PAS unit



PAS sensor



The PAS sensor is the same as that of ACTYON, while the unit is the same as the function, operation, and shape of REXTON II.

8910 AUDIO SYSTEM



Due to the elimination of the AV system, the relevant devices and glass antenna to receive TV signal are not available.

1491 ENGINE ECU / ENGINE ACOUSTIC COVER

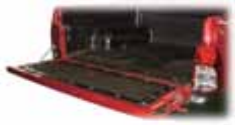


Engine Acoustic Cover (Used in ACTYON)



Engine ECU has no difference with that of ACTYON in terms of engine power curve, but it is not exchangeable with the engine ECU of ACTYON because there is change in the detailed control logic related to exhaust gas control. Acoustic cover and the mounting bracket are removed.

6410 TAILGATE



Because the tailgate switch of ACTYON is eliminated and door switch does not exist, the door ajar warning light on the instrument cluster does not come on even though the tailgate is opened. The open tailgate is not included in the operating condition of theft deterrent mode.

8710 STICS



STICS is used after modifying the circuit and logic of KYRON STICS. The operation of tailgate and key related modes (including theft deterrent mode) are modified. In addition, the rear wiper system is removed.

CHANGED BY	EFFECTIVE DATE	AFFECTED VIN

2. MAJOR CHANGES IN ACTYON SPORTS CHASSIS SYSTEM

4411 FRONT SUSPENSION & WHEEL ALIGNMENT

Shock absorber assembly



Wheel alignment (front)

Toe-in	2 ± 2 mm [0 ~ 4 mm]
Camber	-0.19° ± 0.3° (Side to side variation is below 0.5°)
Caster	4.4° ± 0.5° (Side to side variation is below 0.5°)

* The value of wheel alignment is the same as that of ACTYON

The same coil spring used in ACTYON is used, while the front shock absorber which strengthened the damping force is used. (not exchangeable with that of ACTYON)

* Classification of ACTYON SPORTS coil spring : For 4WD (marked in green) / for 2WD (marked in blue)

2210 FUEL SYSTEM (Fuel filler/Hose/Cable)





Due to the increase in overall length, the length and shape of fuel hose (fuel tank) is modified a little. The fuel filler door cable is split into two by installing adaptor.

4511 REAR SUSPENSION

Rear Shock Absorber and Coil Spring



Not exchangeable with that of ACTYON due to the increased damping force.

* ACTYON SPORTS coil spring is marked in orange.

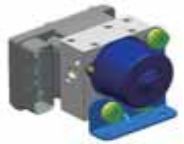
4170 TIRE INFLATION PRESSURE

Rim	Tire Size	Tire Inflation Pressure		
6.5Jx16	225/75**R16**	Front		32 psi
		Rear	Unladen CVW	32 psi
			Laden GVW	40 psi
7.5Jx18	225/60**R18**	Front		30 psi
		Rear	Unladen CVW	30 psi
			Laden GVW	36 psi

for reference: CVW: curb vehicle weight
GVW: gross vehicle weight

* According to the loading, the pressure should be controlled within the tire inflation pressure according to the range of unladen or laden

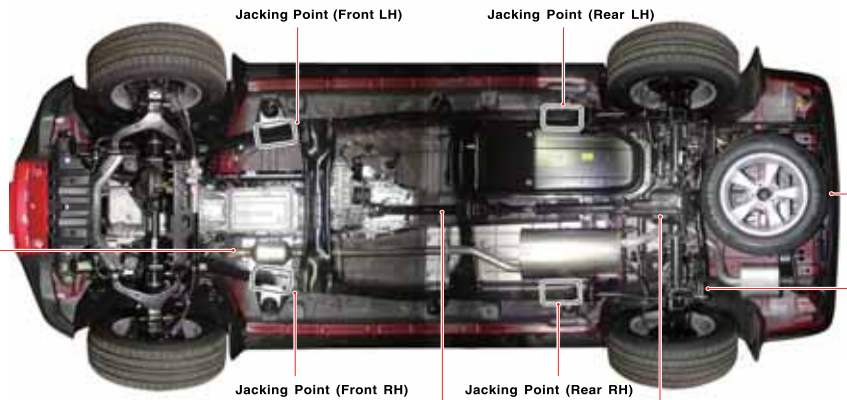
4892 ABS HECU



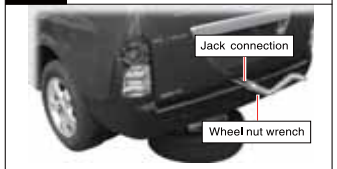
Wheel Speed Sensor



ESP is not available while only ABS/EBD system is used in ACTYON SPORTS. The ABS/EBD system and the wheel speed sensor for ACTYON SPORTS are the same as those of ACTYON.



4170 FULL SIZE SPARE TIRE

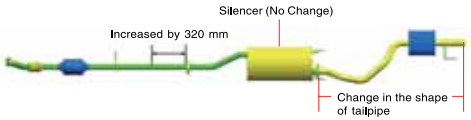


Pantograph Jack



The full size tire, same as the regular tire, is applied for driving the loaded vehicle, instead of applying the temporary spare tire. Pantograph jack is applied instead of hydraulic jack.

2411 EXHAUST SYSTEM



Compared to the overall length of ACTYON, the overall length is increased by 310 mm, thus increasing the length of DOC pipe by 320 mm. And the shape (curvature) of the tailpipe is also modified. There is no change in silencer, while the heat protector is moved back a little.

3310 REAR PROPELLER SHAFT



Front propeller shaft (for 4WD) is exchangeable with the existing one of ACTYON, and the length of the rear propeller shaft is increased by 320 mm due to the longer wheel base.

4210 REAR AXLE



The front axle is the same as that of ACTYON. As for the rear axle, the size of the ring gear in the axle is increased from 8.5 inch to 9 inch to improve the climbing performance and to raise torque. (Final reduction gear ratio of ACTYON SPORTS 4WD: 4.55:1)

4990 LCRV - Vehicle without ABS

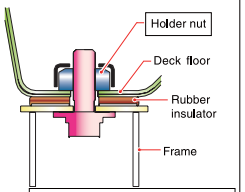


This is the system to control the braking pressure which is being transferred to rear brake system during loading or unloading. The greater the loads are, the greater the rear braking pressure is. It is necessary to use the bracket suitable for the relevant axle, because **LCRV** bracket can be varied according to the rear axle model.

3. DECK

5110 DECK MOUNTING NO. 2

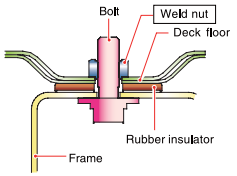




Tightening torque: 70 ~ 90 Nm

DECK MOUNTING NO.1

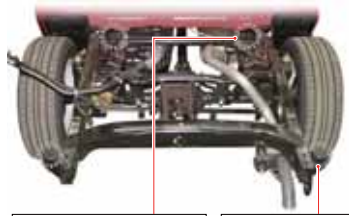


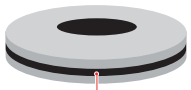


Tightening torque: 70 ~ 90 Nm



RUBBER INSULATOR (DECK MOUNTING)





Steel plate integrated

If the abnormal noise generating from the friction between deck and frame occurs, it is needed to replace with the insulator with integrated steel plate (1.2 mm).

Deck Mounting No.1



Deck Mounting No.2



NOTICE

Though it is mounted into the frame using the double-sided adhesive tape, it is not easy to remove due to the deck load. Install the new insulator after thoroughly cleaning the frame surface.

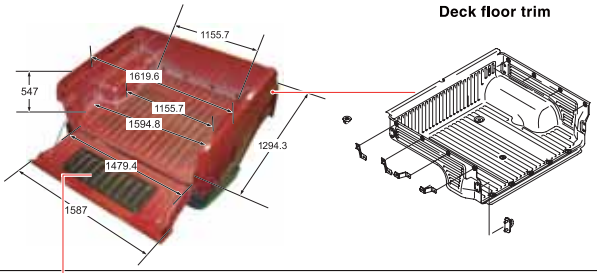
MOUNTING BOLT

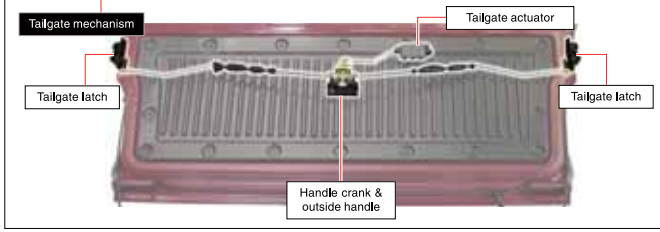


The larger mounting bolts (M10 → M12) in diameter than those of MUSSO SPORTS prevents the deck from being moved by the looseness of bolts. (no lock tight)

The floor area of the deck, the standard to classify the truck, is expanded from 1.74 m² in the MUSSO SPORTS to 2.1 m² in ACTYON SPORTS.

Deck floor trim





WHEN NUTS INSIDE THE DECK ARE LOOSENED OR REMOVED



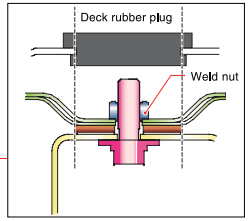
1. If weld nuts on the deck are loosened or removed, drill the deck floor with a hole cutter (ϕ 40 mm) and fasten the new nuts. (Refer to the mounting structure)



When the deck floor trim is removed, the locations of the nut location which is mounted on the deck is visible on the floor.



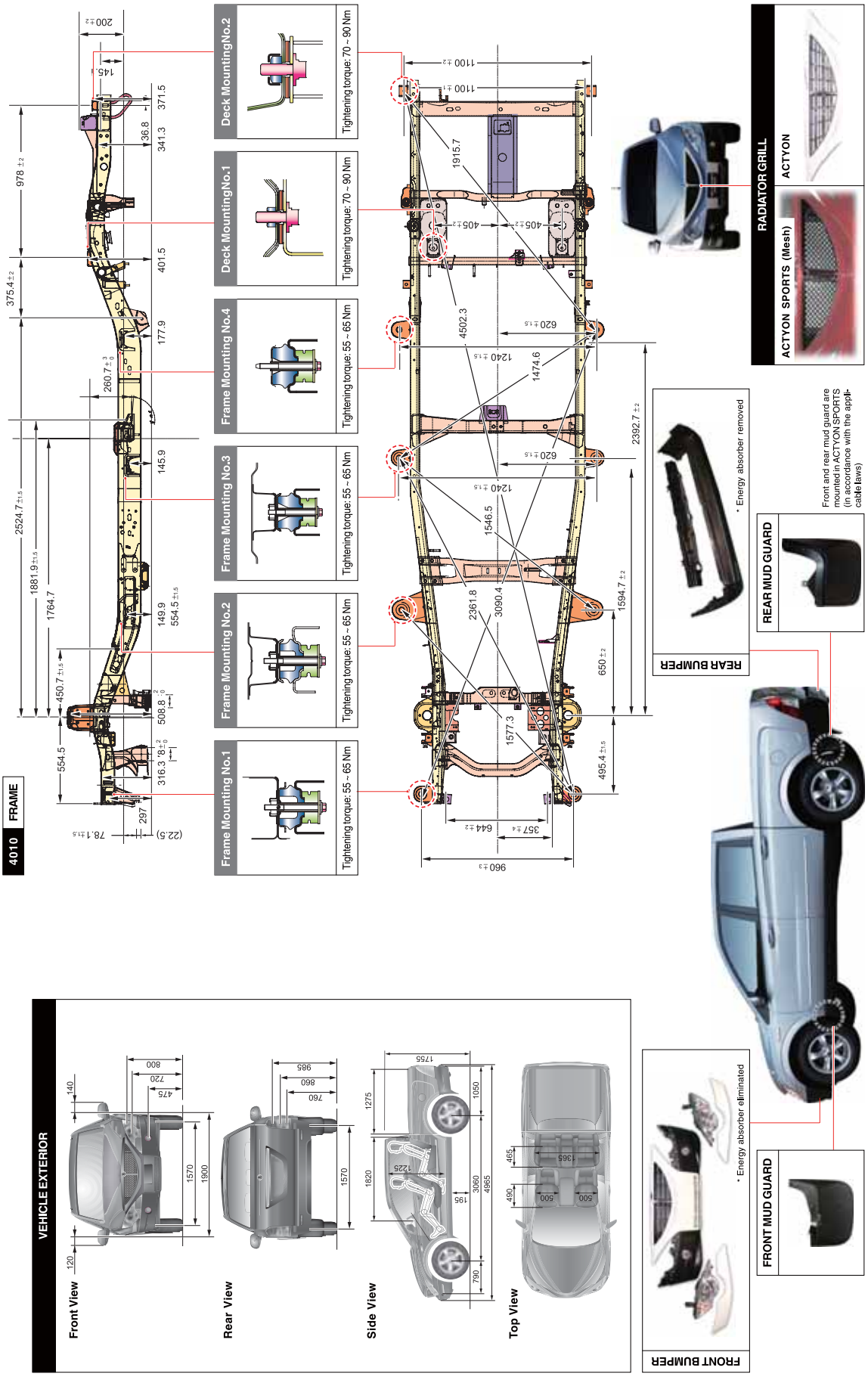
2. Insert the ϕ 40 mm of deck rubber plug after mounting the deck.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SYSTEM

4. BODY



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

VEHICLE GENERAL

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TABLE OF CONTENTS

DIMENSIONS 2

VEHICLE IDENTIFICATION 4

SPECIFICATIONS 5

JACK UP POINTS 12

ENGINE SPECIFICATIONS AND PERFORMANCE CURVE 13

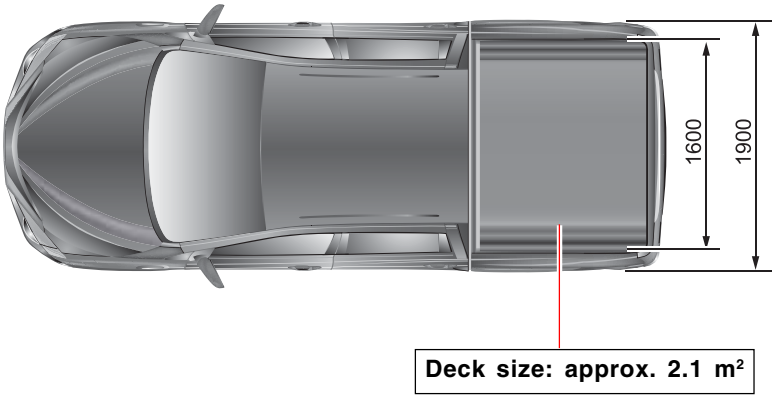
4A/T SHIFT PATTERN DIAGRAM 15

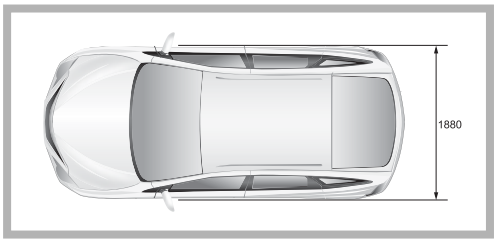
DIMENSIONS

▶ DIMENSIONS I (GENERAL)

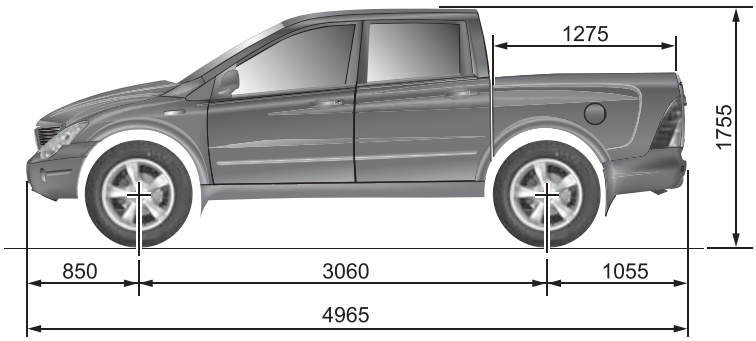
Unit: mm (▭ indicates ACTYON)

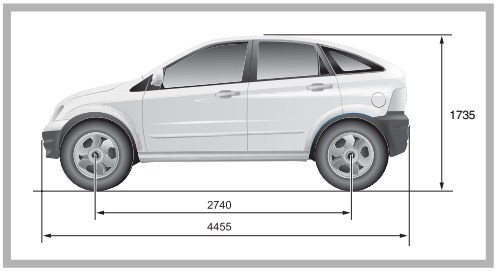
Top View



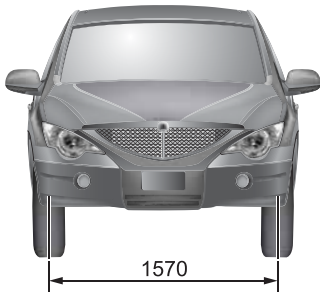


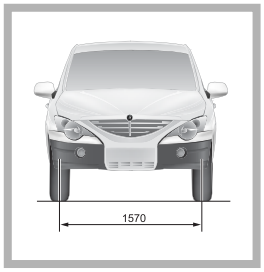
Side View



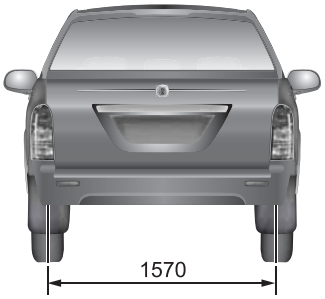


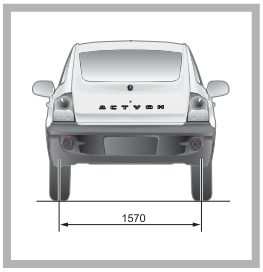
Front View





Rear View



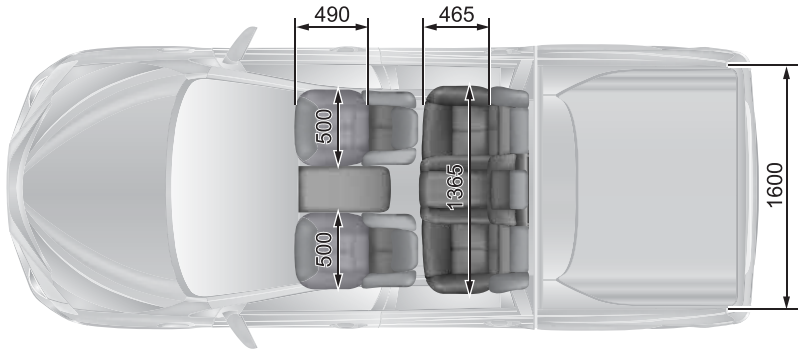


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

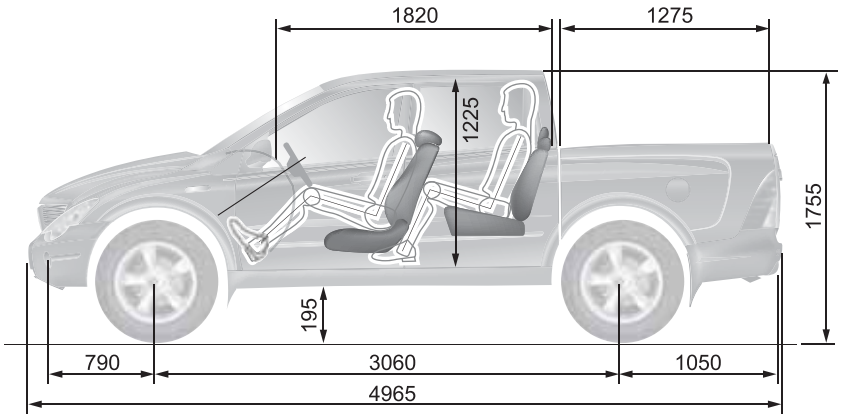
▶ DIMENSIONS II (GENERAL)

Unit: mm

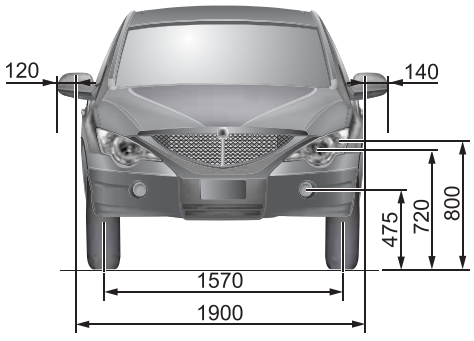
Top View



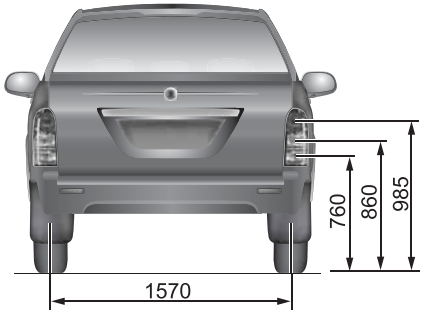
Side View



Front View



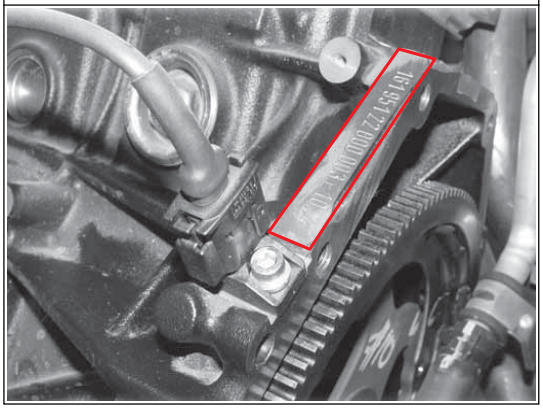
Rear View



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

VEHICLE IDENTIFICATION

Engine Number (G23D)

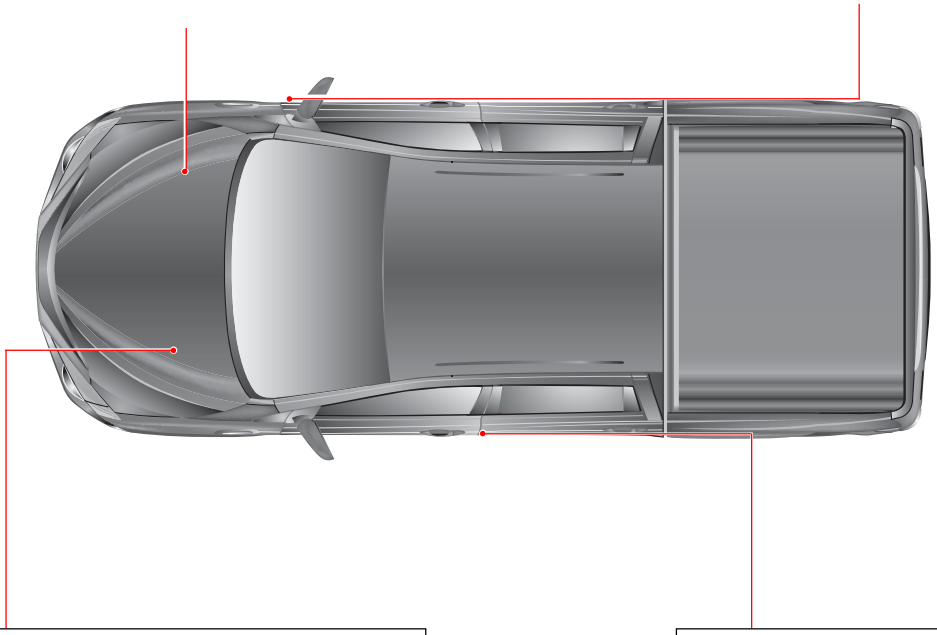


The engine number is stamped on the upper rear left-hand side of the cylinder block.

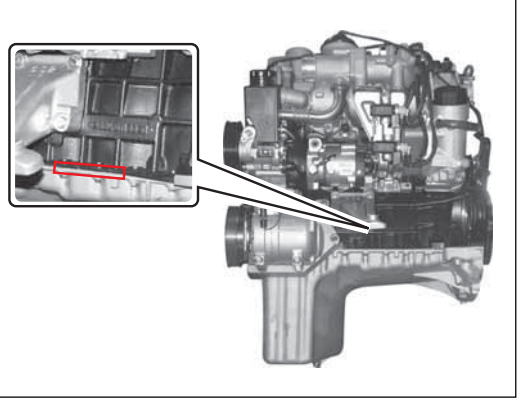
Chassis Number



The chassis number is stamped on the frame behind the front right tire.



Engine Number (D20DT)



The engine number is stamped on the lower area of cylinder block in the intake manifold side.

Certification Label



The certification label is located on the driver's door sill (B pillar).

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SPECIFICATIONS

▶ SPECIFICATIONS

* ( ) Optional, [ ] 2WD

Descriptions			ACTYON		ACTYON SPORTS
			D20DT	G23D	D20DT
General	Overall length (mm)		4,455	←	4,965
	Overall width (mm)		1,880	←	1,900
	Overall height (mm)		1,735	←	1,755
	Gross vehicle weight (kg)	A/T	2,520	←	2,740 [2,640]
		M/T	2,520	←	2,740 [2,640]
	Curb vehicle weight (kg)	A/T	1,974 [1,865]	←	1,986 [1,877]
		M/T	1,952 [1,843]	←	1,963 [1,854]
	Fuel		Diesel	Gasoline	Diesel
	Fuel tank capacity (ℓ)		75	←	←
	Min. turning radius (m)		5.6	←	6.18
Engine	Numbers of cylinders/ Compression ratio		4 / 17.5:1	4 / 10.4 : 1	4 / 17.5:1
	Total displacement (cc)		1,998	2,295	1,998
	Camshaft arrangement		DOHC	←	←
	Max. power		141 PS / 4,000 rpm	150 PS / 5,500 rpm	141 PS / 4,000 rpm
	Max. torque		310 Nm / 1,800 ~ 2,700 rpm	214 Nm / 3,500 ~ 4,600 rpm	310 Nm / 1,800 ~ 2,700 rpm
	Idle speed		780 ± 50 rpm	750 ± 50 rpm	780 ± 50 rpm
	Cooling system		Water- cooled / forced circulation	←	←
	Coolant capacity (ℓ)		10.5 ~ 11.0	←	←
	Lubrication type		Gear pump, forced circulation	←	←
	Max. oil capacity (ℓ) **(when shipping)**		8.2	7.9	8.2
	Turbocharger and cooling type		Turbocharger, air-cooled	–	←
Manual Transmission	Operating type		Semi- Remote control, floor change type	←	←
	Gear ratio	1st	4.315	←	←
		2nd	2.475	←	←
		3rd	1.536	←	←
		4th	1.000	←	←
		5th	0.807	←	←
		Reverse	3.919	←	←
Automatic Transmission	Model		Electronic, 4-speed	←	←
	Operating type		Floor change type	←	←
	Gear ratio	1st	2.741	←	←
		2nd	1.508	←	←
		3rd	1.000	←	←
		4th	0.708	←	←
		Reverse	2.429	←	←
Transfer Case	Model		2WD, Part-time	Part-time	←
	Type		Planetary gear type	←	←
	Gear ratio	High (4H)	1.000 : 1	←	←
		Low (4L)	2.483 : 1	←	–

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Descriptions			ACTYON		ACTYON SPORTS
			D20DT	G23D	D20DT
Clutch (M/T)	Operating type		Hydraulic type	←	←
	Disc type		Dry single diaphragm type	←	←
Power Steering	Type		Rack and pinion	←	←
	Steering angle	Inner	35.7°	←	←
		Outer	32.1°	←	←
Front Axle	Drive shaft type		Ball joint type	←	←
	Axle housing type		Build-up type	←	←
Rear Axle	Drive shaft type	Solid axle suspension	Semi-floating type	←	←
	Axle housing type		Build-up type	←	←
Brake	Master cylinder type		Tandem type	←	←
	Booster type		Vacuum assisted booster type	←	←
	Brake type	Front wheels	Disc type	←	←
		Rear wheels	Drum (disc) type	←	←
	Parking brake		Cable type (internal expansion)	←	←
Suspension	Front suspension		Wishbone + coil spring	←	←
	Rear suspension	Solid axle suspension	5-link + coil spring	←	←
Air Conditioner	Refrigerant (capacity)		R-134a (650 ± 30g)	←	←
Electrical	Battery type / Capacity (V-AH)		MF / 12 - 90	←	←
	Starter capacity (V-kW)		12 - 2.2	12 - 1.2	12 - 2.2
	Alternator capacity (V-A)		12 - 115	←	←

▶ MAINTENANCE INTERVAL (DIESEL ENGINE)

* Use only approved Ssangyong genuine parts.

Maintenance service and record retention are the owner's responsibility. You should retain evidence that proper maintenance has been performed on your vehicle in accordance with the scheduled maintenance service chart.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first								
	x1,000 km	15	30	45	60	75	90	105	120
	x1,000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96

ENGINE CONTROL SYSTEM

Drive belt			I	I	I	I	I	I	I	I
* Engine oil & filter (1)* (3)* (4)*		EU	Initial check: 5,000 km, and replenish if necessary, change every 15,000 km or 12 months							
		General	Initial change: 5,000 km, change every 10,000 km or 12 months							
Cooling system hose & connections			I	I	I	I	I	I	I	I
Engine coolant (3)* (4)*			Change every 60,000 km or 3 years. And, inspect and replenish if necessary.							
* Fuel filter	Direct Injection (Diesel Engine)	EU	I	R*	I	R*	I	R*	I	R*
		General	Replace every 25,000 km (Draining water from fuel filter: whenever replacing the engine oil)							
Additional Water Separator (if equipped)			Replace every 150,000 km or 5 years (Drain the water whenever replacing the engine oil)							
Fuel line & connections			I	I	I	I	I	I	I	I
Air cleaner (2)*		EU	Initial clean: 5,000 km, clean every 15,000 km, replace every 30,000 km (The service interval should be shortened under severe conditions)							
		General	Initial clean: 5,000 km, clean every 10,000 km, replace every 30,000 km (The service interval should be shortened under severe conditions)							
Injection timing (See NOTE1)			I	I	I	I	I	I	I	I

NOTE 1: Adjust as required;
- When excessive smoke is visible (black or white)
- Poor performance/economy

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R - Replace or change.

(1)* If vehicle is operated under severe condition:
- Frequent stop-and-go traffic, extended idling, short driving distance below 6 km, driving distance below 16 km when the outside temperature remains below freezing
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- High load driving such as trailer towing
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

Shorten the service interval. Inspect the engine oil at any time, occasionally, if necessary refill the engine oil.

(2)* If vehicle is operated under severe condition, driving in dusty condition or sandy condition, pollutant area or off-road driving, frequently inspect the air cleaner, if necessary, change the air cleaner.

(3)* More frequent maintenance is required if under dusty driving condition.

(4)* Refer to "Recommended fluids, coolant and lubricants".

* Water separator: When replace the engine oil, also drain the water from the fuel filter.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM		Kilometers (miles) or time in months, whichever comes first							
	x1,000 km	15	30	45	60	75	90	105	120
	x1,000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96

CHASSIS AND BODY

Exhaust pipes & mountings		I	I	I	I	I	I	I	I
Brake / Clutch fluid (3)*		Change every: 2 years (inspect frequently)							
Parking brake / Brake pads (Front & Rear) (4)*	EU	Periodic check: every 15,000 km, adjust or replace if necessary.							
	General	Periodic check: every 10,000 km, adjust or replace if necessary.							
Brake line & connections (including booster)		Inspect every 15,000 km or 1 years, adjust or replace if necessary.							
Manual transmission oil (5)*		I	I	I	R	I	I	I	R
Clutch & brake pedal free play		I	I	I	I	I	I	I	I
Front & Rear differential fluid (3)*		Inspect frequently, change every 30,000 km							
Transfer case fluid (3)*		Inspect every 15,000 km, change every 60,000 km (Frequnt check of oil leak)							
Automatic transmission fluid (6)*		Inspect every 30,000 km or 12 month (But change every 60,000 km under severe condition)							
Chassis & underbody bolts & nuts tight / Secure (7)*		Check frequntly and adjust or replace if necessary							
Tire condition & inflation pressure		Check frequntly and adjust or replace if necessary							
Wheel alignment (8)*		Inspect when abnormal condition is noted							
Steering wheel & linkage		I	I	I	I	I	I	I	I
Power steering fluid & lines (3)*		I	I	I	I	I	I	I	I
Drive shaft boots (9)*		I	I	I	I	I	I	I	I
Seat belts, buckles & anchors		I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch		Check frequntly and adjust or replace if necessary							
Wheel bearing grease		I	I	I	I	I	I	I	I
Propeller shaft grease - Front / Rear (10)*	EU	I	I	I	I	I	I	I	I
	General	Inspect every 10,000 km							
Air conditioner filter		Change every 10,000 km (The service interval should be shortened under severe conditions)							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R - Replace or change.

(3)* Refer to “Recommended fluids and lubricants”.

(4)* More frequent maintenance is required if the vehicle is operated under any of the following conditions:
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(5)* Inspect manual transmission fluid every 15,000 km (Inspect the leak of fluid at any time,occasionally), then change every 60,000 km

(6)* Change automatic transmission fluid and every 60,000 km if the vehicle is mainly driven under severe conditions: Towing a trailer or off-road driving (Inspect the leak of fluid at any time,occasionlly)

(7)* After completion of off-road operation, the underbody of the vehicle should be throughly inspected. Examine threaded fasteners for looseness.

(8)* If necessary, rotate and balance wheels.

(9)* After completion of off-road operation, the drive shaft boots should be inspected.

(10)* Inspect propeller shaft grease every 5,000 km or 3 months if the vehicle is mainly driven under severe condition.
- In off-road or dusty road, or
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain.

Severe Conditions in Air Conditioner Filter
- Pollutant area or off-road driving, extended air conditioner or heater operation

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ MAINTENANCE INTERVAL (GASOLINE ENGINE)

* Use only approved Ssangyong genuine parts.

Maintenance service and record retention are the owner's responsibility. You should retain evidence that proper maintenance has been performed on your vehicle in accordance with the scheduled maintenance service chart.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first								
	x1,000 km	15	30	45	60	75	90	105	120
	x1,000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96

ENGINE CONTROL SYSTEM

Drive belt	I	I	I	I	I	I	I	I
Engine oil & engine oil filter (1)* (3)* (Initial change: 10,000 km)	R**	R	R	R	R	R	R	R
Cooling system hose & connections	I	I	I	I	I	I	I	I
Engine coolant (3)*	Change every 60,000 km or 3 years. And, inspect replenish if necessary.							
Fuel filter (2)*	Replace every 100,000 km (if using poor quality of fuel, replace every 30,000 km)							
Fuel line & connections	I	I	I	I	I	I	I	I
Air cleaner (2)*	I	I	I	R	I	I	I	R
Ignition timing	I	I	I	I	I	I	I	I
Spark plugs (G23D)	-	R	-	R	-	R	-	R
Charcoal canister & vapor lines	-	-	I	-	-	I	-	-

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R - Replace or change.

** - In order to secure engine long life and effective break-in, first oil (factory filled) would be recommended to drain with in 10,000 km.

(1)* If vehicle is operated under severe condition: short distance driving, extensive idling or driving in dusty condition, shorten the service interval.

(2)* If vehicle is operated under severe condition, pollutant area or off-road driving, driving in dusty condition or sandy condition, frequently inspect the air cleaner, if necessary, change the air cleaner.

(3)* Refer to "Recommended fluids and lubricants".

CHASSIS AND BODY

Exhaust pipes & mountings			I	I	I	I	I	I	I	I
Brake / Clutch fluid (3)*			Change every: 2 years (inspect frequently)							
Parking brake / Brake pads (Front & Rear) (4)*		EU	Periodic check: every 15,000 km, adjust or replace as necessary.							
		General	Periodic check: every 10,000 km, adjust or replace as necessary.							
Brake line & connections (including booster)			Inspect every 15,000 km or 1 years, adjust or replace if necessary							
Manual transmission oil (5)*			I	I	I	R	I	I	I	R
Clutch & brake pedal free play			I	I	I	I	I	I	I	I
Front & Rear differential fluid (3)*	Front	EU	Periodic check: every 15,000 km, adjust or replace if necessary.							
		General	Periodic check: every 10,000 km, adjust or replace if necessary.							
	Rear	EU	Periodic check: every 15,000 km, adjust or replace if necessary.							
		General	Periodic check: every 10,000 km, adjust or replace if necessary.							
Transfer case fluid (3)*			Inspect every 15,000 km, change every 60,000 km (Frequent check of oil leak)							
Automatic transmission fluid (6)*			Inspect every 30,000 km or 12 month (But change every 60,000 km under severe condition)							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R - Replace or change.

(3)* Refer to "Recommended fluids and lubricants".

(4)* More frequent maintenance is required if the vehicle is operated under any of the following conditions:

- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(5)* Inspect manual transmission fluid every 15,000 km (Inspect the leak of fluid at any time,occasionally), then change every 60,000 km

(6)* Change automatic transmission fluid and every 60,000 km if the vehicle is mainly driven under severe conditions. (Inspect the leak of fluid at any time, occasionlly)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM		Kilometers (miles) or time in months, whichever comes first							
	x1,000 km	15	30	45	60	75	90	105	120
	x1,000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96

CHASSIS AND BODY

Chassis & underbody bolts & nuts tight / Secure (6)*		Check frequntly and adjust or replace if necessary							
Tire condition & inflation pressure		Check frequntly and adjust or replace if necessary							
Wheel alignment (7)*		Inspect when abnormal condition is noted							
Steering wheel & linkage		I	I	I	I	I	I	I	I
Power steering fluid & lines (3)*		I	I	I	I	I	I	I	I
Drive shaft boots		I	I	I	I	I	I	I	I
Seat belts, buckles & anchors		I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch		Check frequntly and adjust or replace if necessary							
Wheel bearing grease		I	I	I	I	I	I	I	I
Propeller shaft grease - Front / Rear (8)*	EU	I	I	I	I	I	I	I	I
	General	Inspect every 10,000 km							
Air conditioner filter		Change every 10,000 km (The service interval should be shortened under severe conditions)							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R - Replace or change.

(3)* Refer to “Recommended fluids and lubricants”.

(6)* After completion of off-road operation, the underbody of the vehicle should be throughly inspected. Examine threaded fasteners for looseness.

(7)* If necessary, rotate and balance wheels.

(8)* Inspect propeller shaft grease every 5,000 km or 3 months if the vehicle is mainly driven under severe condition.

- In off-road or dusty road, or
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain.

Severe Conditions in Air Conditioner Filter

- Pollutant area or off-road driving, extended air conditioner or heater operation

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ RECOMMENDED FLUIDS AND LUBRICANTS

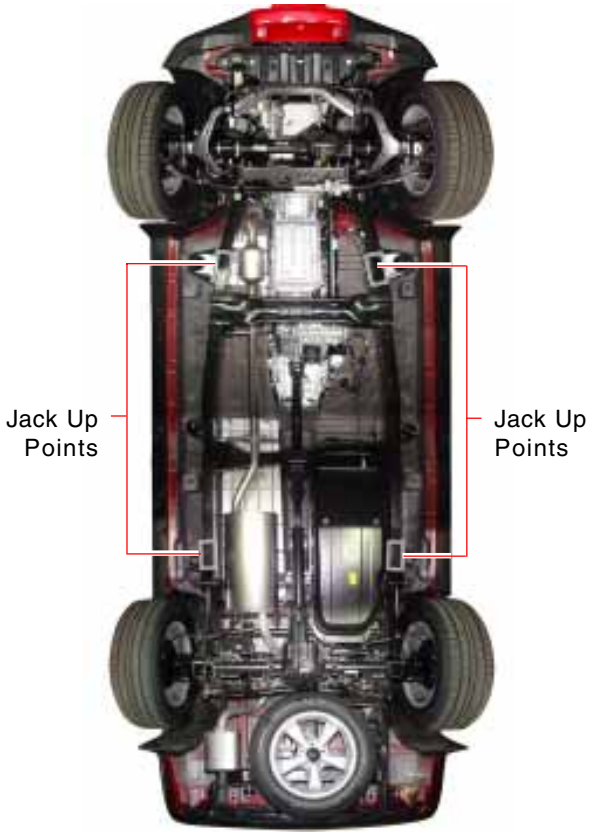
Descriptions					Capacity	Specifications
Engine Oil				D20DT	≒ 7.5 ℓ	Quality class: Ssangyong genuine engine oil (Approved by MB Sheet 229.1 or 229.3) Viscosity: MB sheet No. 224.1
				G23D	≒ 7.5 ℓ	
Engine Coolant				D20DT	10.5 ~ 11.0 ℓ	Ssangyong genuine coolant (Anti-freeze:SYC-310, Anti-freeze:water = 50:50)
				G23D		
Automatic Transmission Fluid					≒ 9.5 ℓ	Ssangyong genuine oil (CASTROL TQ 95)
Manual Transmission Fluid				4WD	≒ 3.6 ℓ	Ssangyong genuine oil (ATF DEXRON II)
				2WD	≒ 3.4 ℓ	
Transfer Case Fluid					≒ 1.4 ℓ	Ssangyong genuine oil (ATF DEXRON III)
Axle Oil	Front	Automatic Transmission			≒ 1.4 ℓ	Ssangyong genuine oil (SAE 80W/90, API GL-5)
		Manual Transmission			≒ 1.4 ℓ	
	Rear	Solid Axle Suspension	ACTYON	2WD ALL, 4WD M/T	≒ 1.9 ℓ	Ssangyong genuine oil (SAE 80W/90, API GL-5)
				4WD A/T	≒ 2.0 ℓ	
			ACTYON SPORTS	2WD A/T	≒ 1.9 ℓ	
				4WD ALL, 2WD M/T	≒ 2.0 ℓ	
Brake / Clutch Fluid					As required	Ssangyong genuine oil (DOT4)
Power Steering Fluid					≒ 1.0 ℓ	Ssangyong genuine oil (ATF DEXRON II or III)

NOTICE

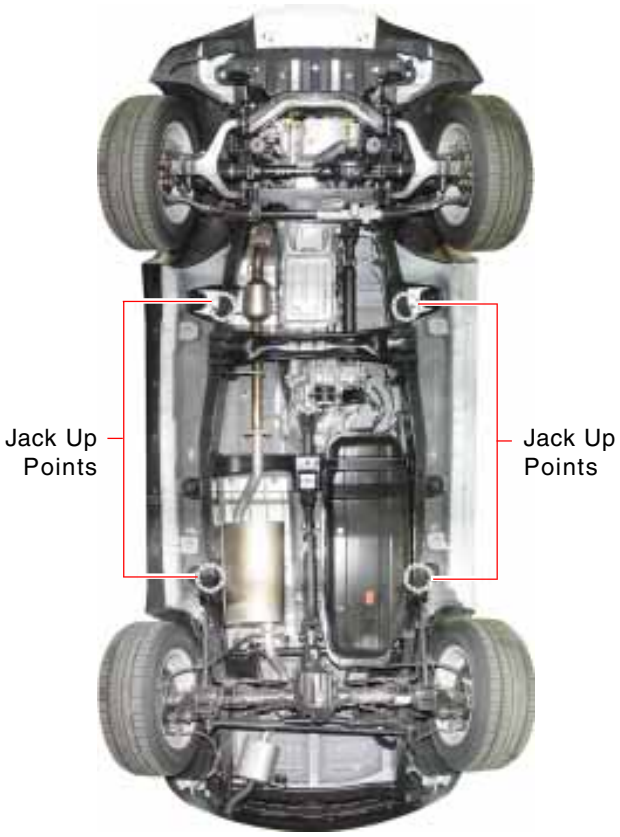
- **Use only Ssangyong recommended fluids and lubricants.**
- **Do not mix any different types or brands of oils or fluids. This may cause damages.**
- **Keep the specified levels when adding or replacing the fluids.**

JACK UP POINTS

ACTYON SPORTS Jack Up Points



ACTYON Jack Up Points



▶ 4-POST LIFT

As illustrated, raise up the vehicle using the 4-post lift securely and place the vehicle chocks in front of and behind the wheels.

NOTICE

- **Be sure to use attachment during lifting to prevent the lift from contacting with body floor.**
- **While lifting the vehicle, widen the lift floor as far as possible to stabilize between vehicle front and rear. When fixing the lift floor, be careful not to contact with brake tube and fuel line.**
- **With vehicle raised up, you should visually check from outside of vehicle that the mounting positions of jacks are set correctly and there are no problems before servicing the vehicle.**

▶ SAFETY JACK AND SAFETY STAND

When lifting up the vehicle with safety jack and stand, you should be more careful during works.

NOTICE

- **Never be under the vehicle if supported with only jack. If you have to be under the vehicle, be sure to use vehicle chocks.**
- **Use the vehicle chocks in front of and behind the wheels.**



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ENGINE SPECIFICATIONS AND PERFORMANCE CURVE

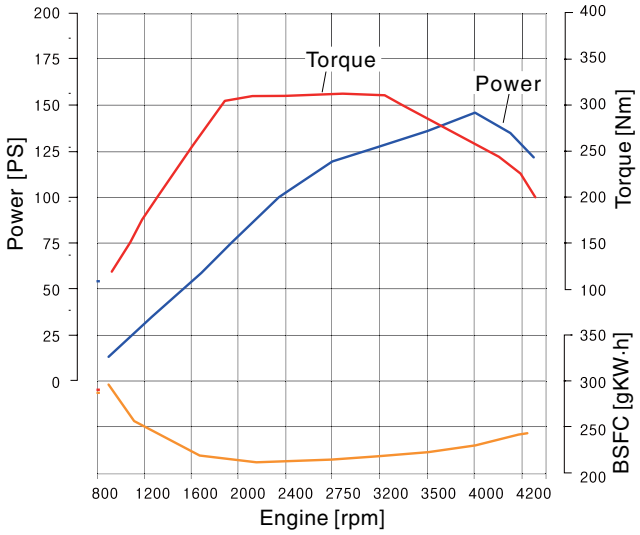
▶ SPECIFICATIONS (SAME AS ACTYON)

Descriptions				ACTYON	ACTYON SPORTS	ACTYON
				D20DT	D20DT	G23D
Engine	Type / Number of cylinders			D20DT / 4-cylinder	←	G23D / 4-cylinder
Cylinder	Inner diameter		(mm)	86.2	←	90.9
	Travel		(mm)	85.6	←	88.4
Displacement			(cc)	1,998	←	2,295
Compression ratio				17.5:1	←	10.4:1
Max. Power	A/T		(ps/rpm)	145/4,000	←	150/5,500
	M/T		(ps/rpm)	145/4,000	←	–
Max. Torque	A/T		(kg.m/rpm)	31.6 / 1,800 ~ 3,250	←	22.4/3,600 ~ 4,600
	M/T		(kg.m/rpm)	31.6 / 1,800 ~ 3,250	←	–
Idle speed			(rpm)	750 ± 50	←	←
Valve	Intake	Open	(BTDC)	9°	←	13.15°
		Close	(ABDC)	26°	←	13.57°
	Exhaust	Open	(BBDC)	38°	←	16.58°
		Close	(ATDC)	16°	←	17.05°
Camshaft	Type			DOHC	←	←
Fuel system	Fuel type			Low sulfur diesel	←	Unleaded gasoline
	Fuel pump type			Vane pump in HP pump (Low pressure: Vane, High pressure: radial plunger pump)	←	–
	Fuel supply pressure			HP pump inlet port: max 400 mbar HP pump outlet port (with IMV fully open): over 1,050 bar	←	–
	Water separation in fuel filter			every 10,000 km	←	–
	Fuel tank capacity		(ℓ)	75	←	←
Lubricator	Oil specification			Quality class: Ssangyong genuine engine oil (Approved by MB Sheet 229.1 or 229.3) Viscosity: MB sheet No. 224.1	←	← ← ← ←
	Lubrication type			Gear pump, forced circulation	←	←
	Oil filter type			Full flow type, filter element type	←	←
	Oil capacity		(ℓ)	≒ 7.5	←	←
Cooling system	Cooling system			Water- cooled	←	←
	Cooling fan type			Belt operate type	←	←
	Thermostat	Opening temp. (°C)		85	←	←
	Fully open: 100°C	Type		WAX pellet type	←	←
	Coolant capacity		(ℓ)	≒ 10.5 ~ ≒ 11.0	←	←

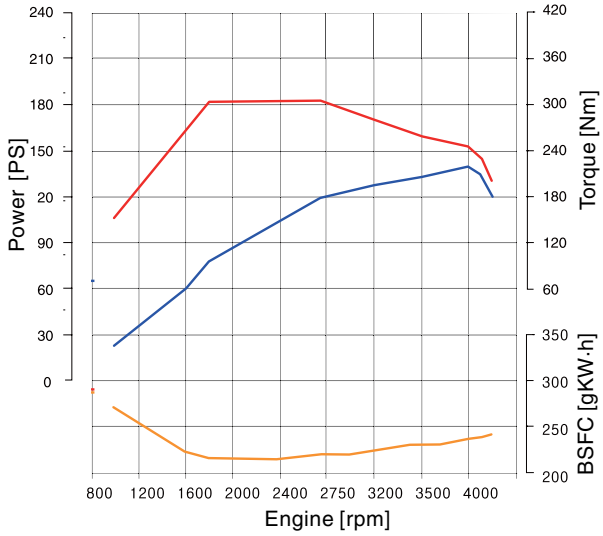
▶ D20DT ENGINE PERFORMANCE CURVE - (SAME AS ACTYON)

Output and Torque

General

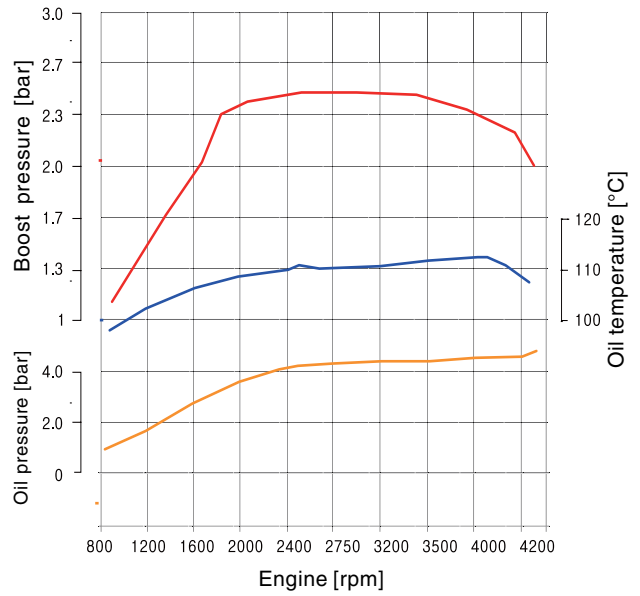


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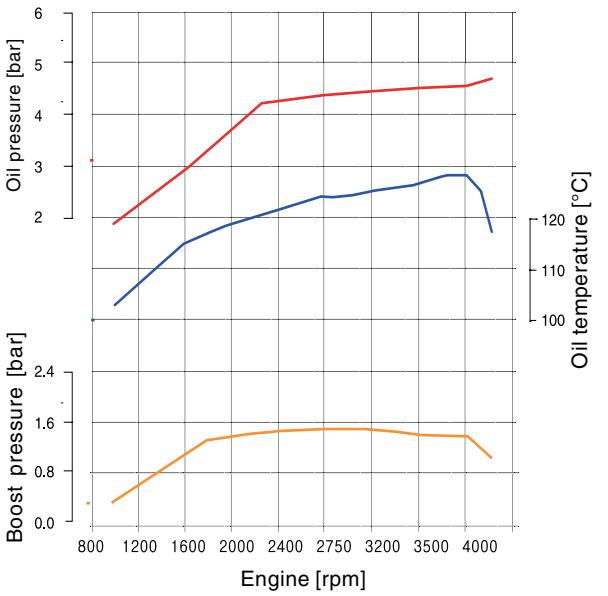


Oil Temperature/Pressure and Boost Pressure

General



EU4



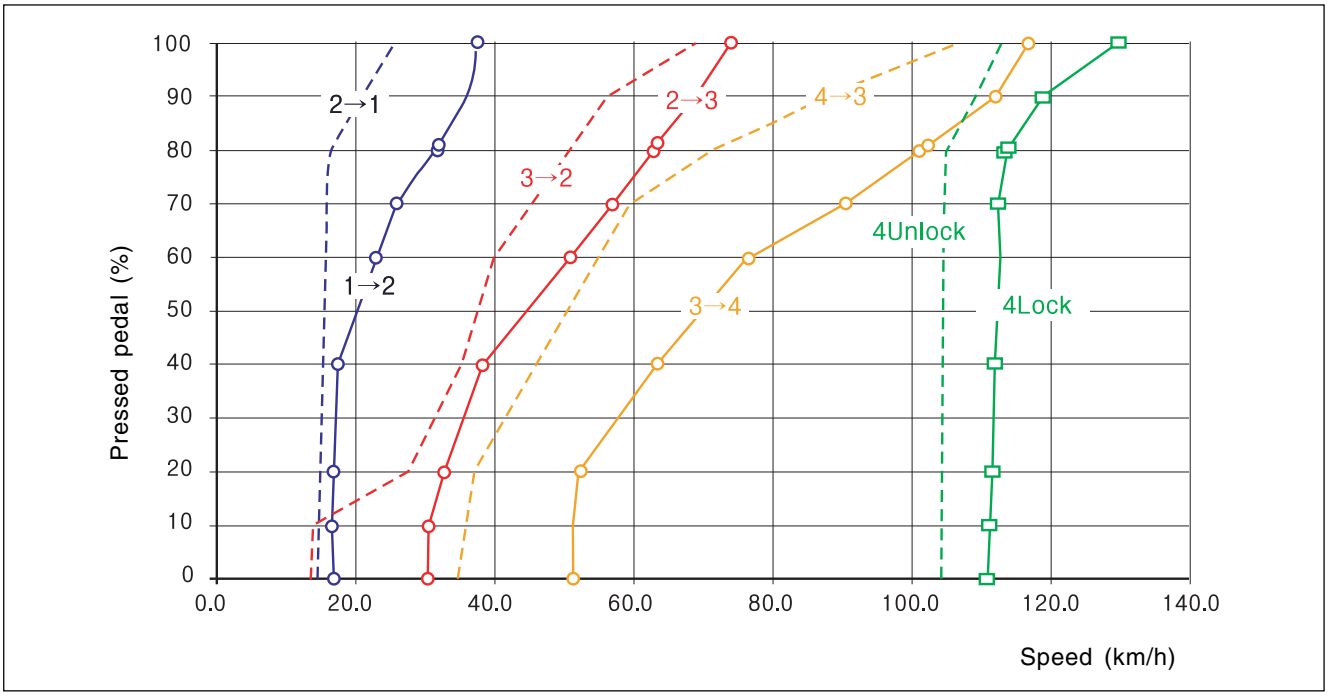
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EFFECTIVE DATE	
AFFECTED VIN	

4A/T SHIFT PATTERN DIAGRAM

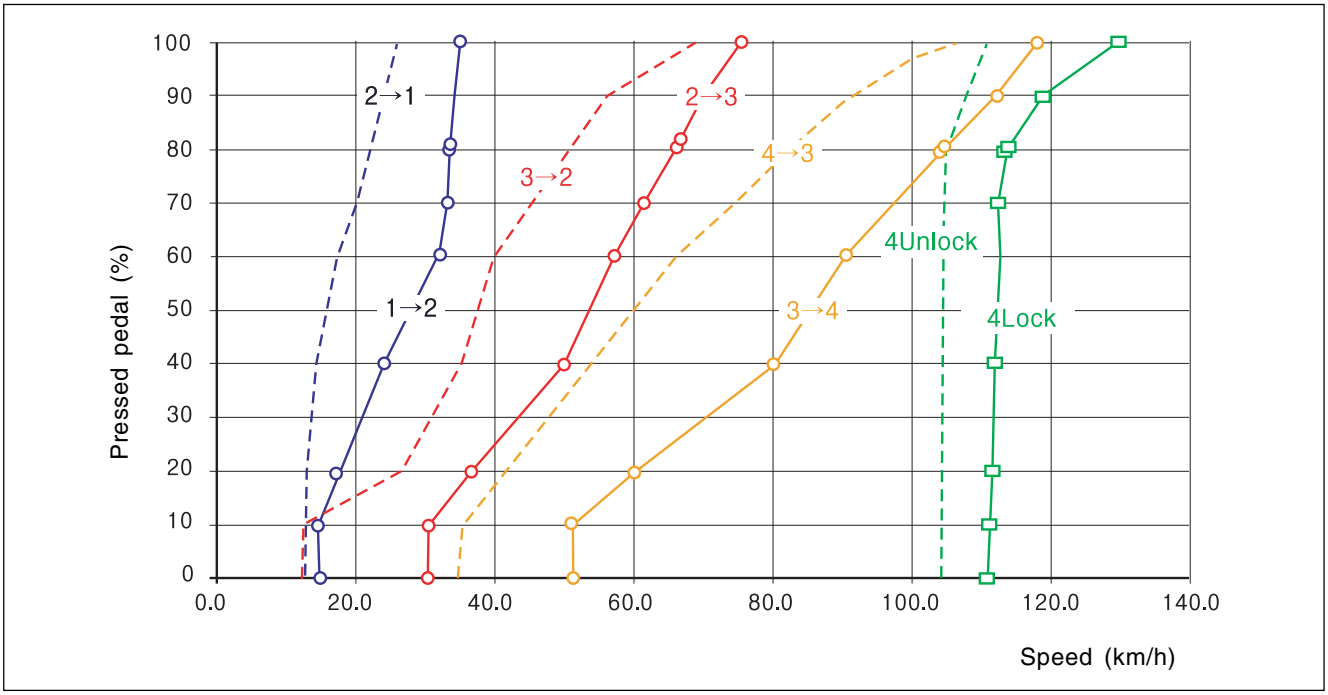
ACTYON SPORTS

▶ NORMAL MODE

* Winter mode has the same shift pattern as the normal mode except for starting off the vehicle using the 2nd gear.



▶ POWER MODE

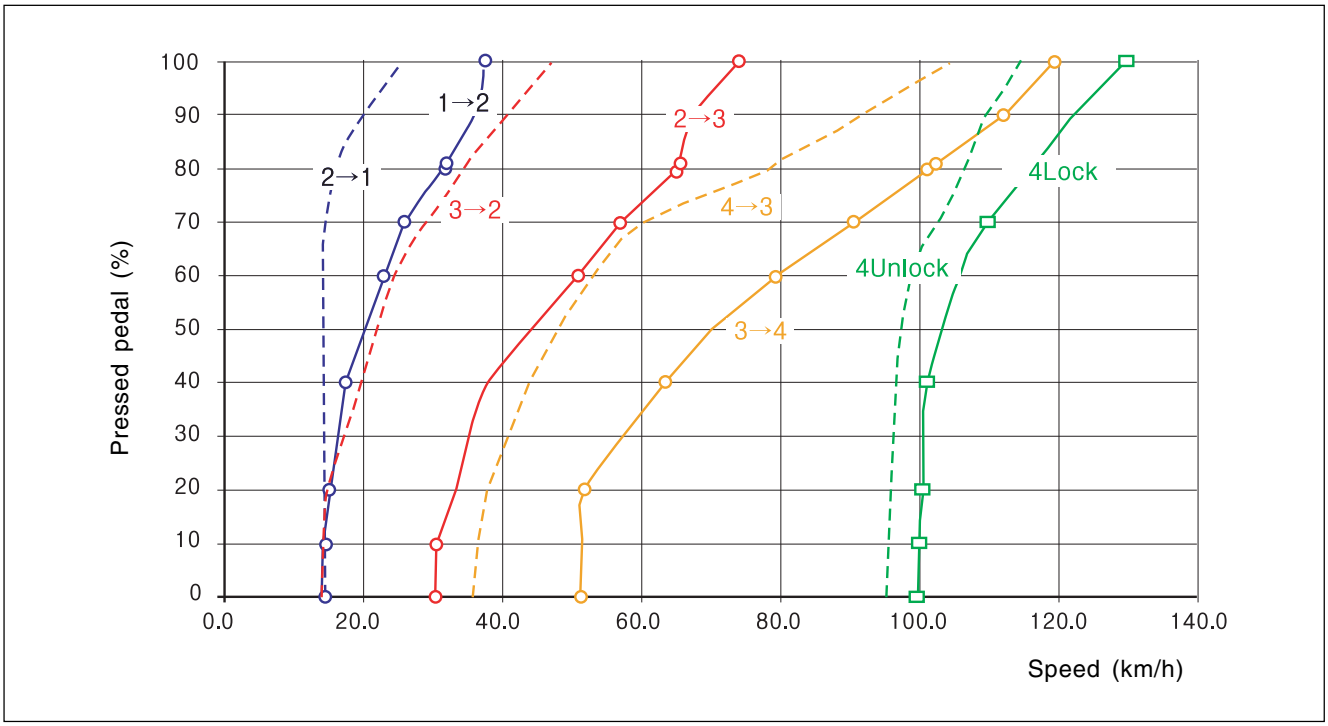


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

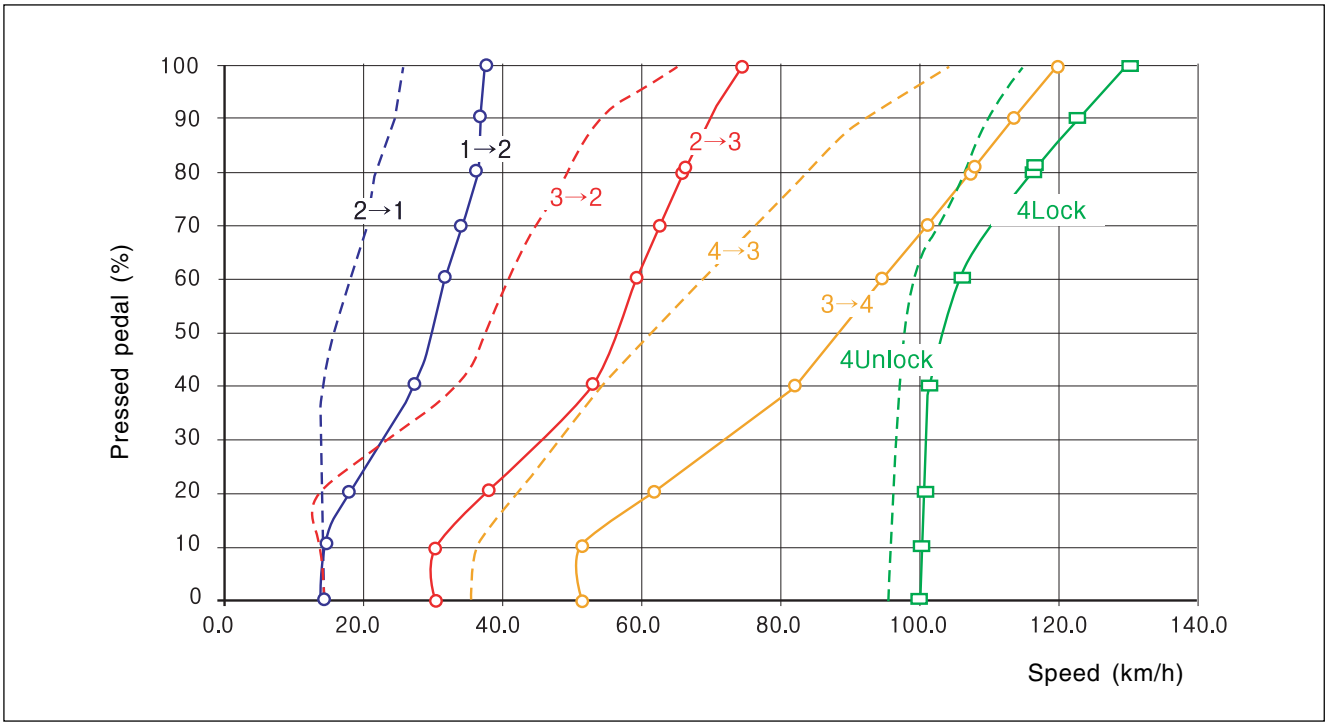
ACTYON

▶ NORMAL MODE

* Winter mode has the same shift pattern as the normal mode except for starting off the vehicle using the 2nd gear.



▶ POWER MODE



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Section 01

D20DT (EU4) ENGINE

- GENERAL INFORMATION
- ENGINE
- FUEL SYSTEM
- INTAKE SYSTEM
- EXHAUST SYSTEM
- PCV OIL SEPARATOR
- COOLING SYSTEM
- ENGINE ECU

GENERAL INFORMATION

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TABLE OF CONTENTS

1. Dimensions 2
2. Vehicle identification 3
3. Specifications 4
4. Tightening torque of standard bolts 6

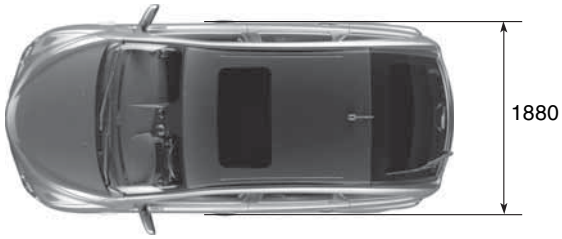
GENERAL INFORMATION

1. DIMENSIONS

▶ ACTYON

Unit: mm

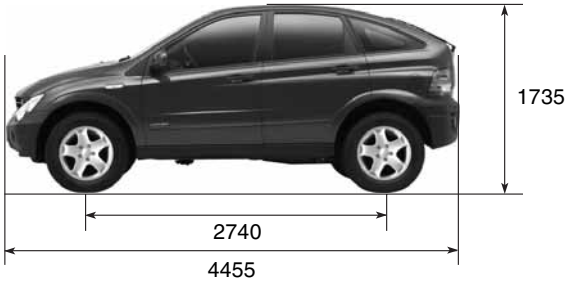
Top View



Front View



Side View



Rear View



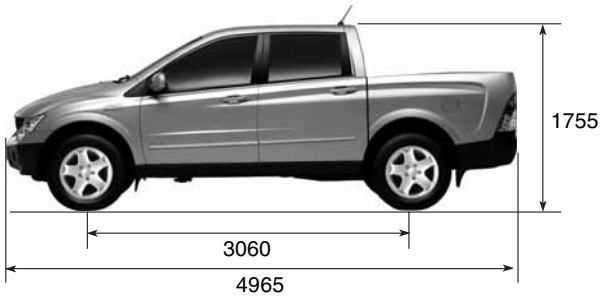
▶ ACTYON SPORTS

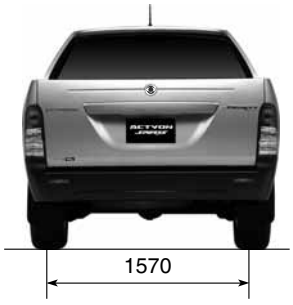
Top View



Front View







CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. VEHICLE IDENTIFICATION

▶ ACTYON/ACTYON SPORTS

Engine Number (G23D)

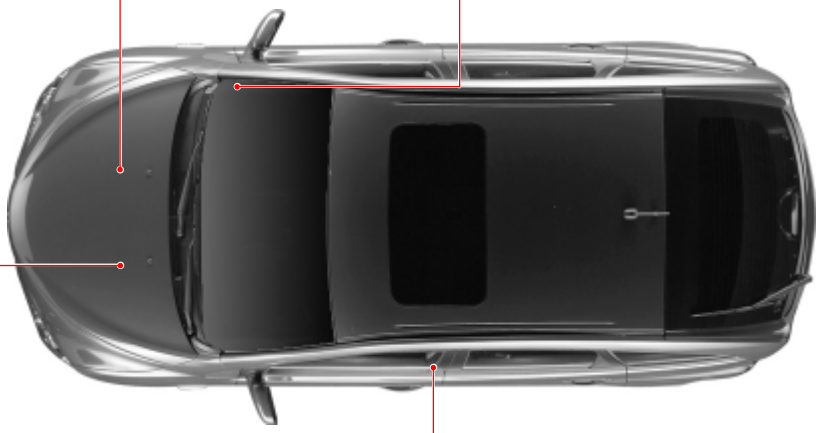


Gasoline Engine: The engine number is stamped on the upper rear left-hand side of the cylinder block.

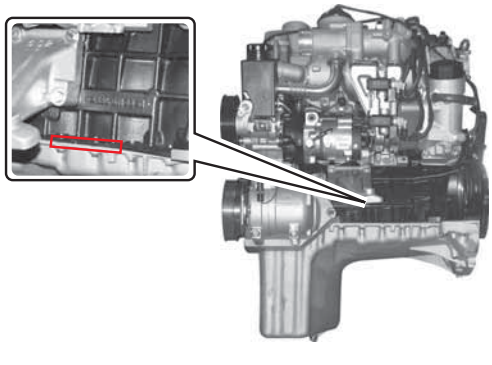
Chassis Number



The chassis number is stamped on the frame behind the front right tire.



Engine Number



Diesel Engine: The engine number is stamped on the lower area of cylinder block behind the Intake manifold.

Certification Label



The certification label is located on the driver's door sill.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. SPECIFICATIONS

▶ ACTYON/ACTYON SPORTS

Descriptions			ACTYON		ACTYON SPORTS
			D20DT	G23D	D20DT
General	Overall length		4,455 mm	←	4,965 mm
	Overall width		1,880 mm	←	1,900 mm
	Overall height		1,735 mm	←	1,755 mm
	Gross vehicle weight	A/T	2,520 kg	←	2,740 [2,640] kg
		M/T	2,520 kg	←	2,740 [2,640] kg
	Curb vehicle weight	A/T	1,974 [1,865] kg	←	1,986 [1,877] kg
		M/T	1,952 [1,843] kg	←	1,963 [1,854] kg
	Fuel		Diesel	Gasoline	Diesel
	Fuel tank capacity		75 ℓ	←	←
	Min. turning radius		5.6 m	←	6.18 m
Engine	Numbers of cylinders/ Compression ratio		4 / 17.5:1	4 / 10.4 : 1	4 / 17.5:1
	Total displacement		1,998 cc	2,295 cc	1,998cc
	Camshaft arrangement		DOHC	←	←
	Max. power	A/T	141 PS / 4,000 rpm	150 PS / 5,500 rpm	141 PS / 4,000 rpm
		M/T	141 PS / 4,000 rpm		141 PS / 4,000 rpm
	Max. torque	A/T	310 Nm / 1,800 ~ 2,700 rpm	214 Nm / 3,500 ~ 4,600 rpm	310 Nm / 1,800 ~ 2,700 rpm
		M/T	310 Nm / 1,800 ~ 2,700 rpm		310 Nm / 1,800 ~ 2,700 rpm
	Idle speed		780 ± 50 rpm	750 ± 50 rpm	780 ± 50 rpm
	Cooling system		Water- cooled / forced circulation	←	←
	Coolant capacity		11.5 ℓ	10.0 ~ 10.5 ℓ	11.5 ℓ
	Lubrication type		Gear pump, forced circulation	←	←
	Max. oil capacity (when shipping)		8.2 ℓ	7.9 ℓ	8.2 ℓ
	Turbocharger and cooling type		Turbocharger, air-cooled	–	←
Manual Trans-mission	Operating type		Semi- Remote control, floor change type	←	←
	Gear ratio	1st	4.315	←	←
		2nd	2.475	←	←
		3rd	1.536	←	←
		4th	1.000	←	←
		5th	0.807	←	←
		Reverse	3.919	←	←

* ( ) Option, [ ] 2WD

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

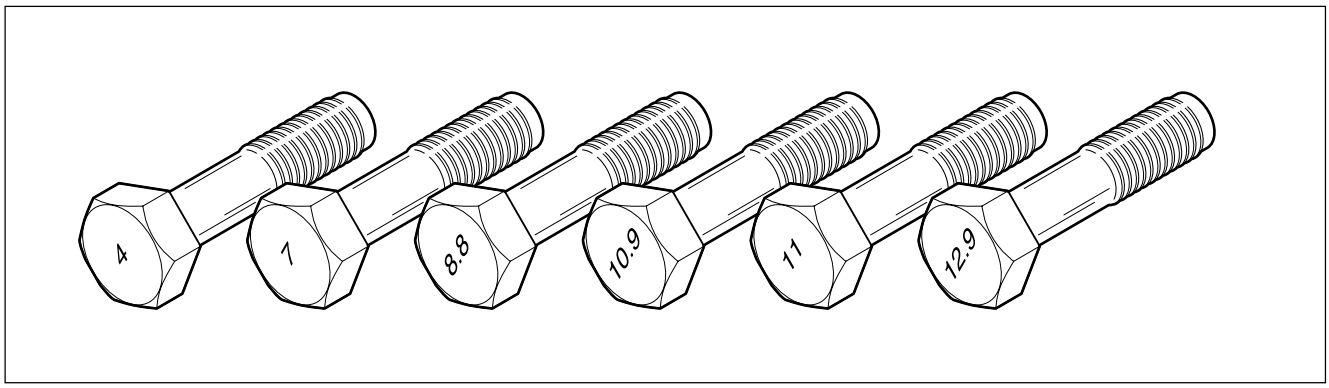
Descriptions			ACTYON		ACTYON SPORTS
			D20DT	G23D	D20DT
Automatic Transmission	Model		Electronic, 4-speed	←	←
	Operating type		Floor change type	←	←
	Gear ratio	1st	2.741	←	←
		2nd	1.508	←	←
		3rd	1.000	←	←
		4th	0.708	←	←
		Reverse	2.429	←	←
Transfer Case	Model		2WD, Part-time	Part-time	←
	Type		Planetary gear type	←	←
	Gear ratio	High (4H)	1.000 : 1	←	←
		Low (4L)	2.483 : 1	←	–
Clutch (M/T)	Operating type		Hydraulic type	←	←
	Disc type		Dry single diaphragm type	←	←
Power Steering	Type		Rack and pinion	←	←
	Steering angle	Inner	35.7°	←	←
		Outer	32.1°	←	←
Front Axle	Drive shaft type		Ball joint type	←	←
	Axle housing type		Build-up type	←	←
Rear Axle	Drive shaft type	Solid axle suspension	Semi-floating type	←	←
	Axle housing type		Build-up type	←	←
Brake	Master cylinder type		Tandem type	←	←
	Booster type		Vacuum assisted booster type	←	←
	Brake type	Front wheels	Disc type	←	←
		Rear wheels	Drum (disc)	←	←
	Parking brake		Cable type (internal expansion)	←	←
Suspension	Front suspension		Wishbone + coil spring	←	←
	Rear suspension	Solid axle suspension	5-link + coil spring	Build-up axle + coil spring	←
Air Conditioner	Refrigerant (capacity)		R-134a (650 ± 30g)	←	←
Electrical	Battery type / Capacity (V-AH)		MF / 12 - 90	←	←
	Starter capacity (V-kW)		12 - 2.2	12 - 1.2	12 - 2.2
	Alternator capacity (V-A)		12 - 115	←	←

* ( ) Option, [ ] 2WD

4. TIGHTENING TORQUE OF STANDARD BOLTS

▶Tightening Torque By Bolt Specification

Bolt Diameter	Pitch	Tightening Torque (kg·cm)					
		Standard Tightening Torque			Max. Allowable Tightening Torque		
		4T	7T	9T	4T	7T	9T
M3	0.5	5	9	13	7	12	17
M4	0.7	12	20	30	16	27	40
M5	0.8	24	40	57	32	53	77
M6	1.0	41	68	99	55	91	130
M8	1.25	88	160	230	130	210	310
M10	1.25	190	330	470	260	430	620
	1.5	190	310	450	250	420	600
M12	1.25	350	580	840	460	770	1,100
	1.75	330	550	790	440	730	1,000
M14	1.5	550	910	1,300	730	1,200	1,900
M16	1.5	830	1,100	2,000	1,100	1,900	2,700
M18	1.5	1,200	2,000	2,900	1,600	2,700	3,800
M20	1.5	1,700	2,800	4,000	2,200	3,700	5,300
M22	1.5	2,300	3,800	5,400	3,000	5,000	7,200
M24	1.5	2,900	4,900	7,000	3,900	6,500	9,400
	2.0	2,800	4,700	6,800	3,800	6,300	9,100



1. Metric bolt strength is embossed on the head of each bolt. The strength of bolt can be classified as 4T, 7T, 8.8T, 10.9T, 11T and 12.9T in general.
2. Observe standard tightening torque during bolt tightening works and can adjust torque to be proper within 15 % if necessary. Try not to over max. allowable tightening torque if not required to do so.
3. Determine extra proper tightening torque if tightens with washer or packing.
4. If tightens bolts on the below materials, be sure to determine the proper torque.
   - Aluminum alloy: Tighten to 80 % of above torque table.
   - Plastics: Tighten to 20 % of above torque table.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ENGINE

1114

TABLE OF CONTENTS

STRUCTURE AND FUNCTION DESCRIPTIONS .. 2

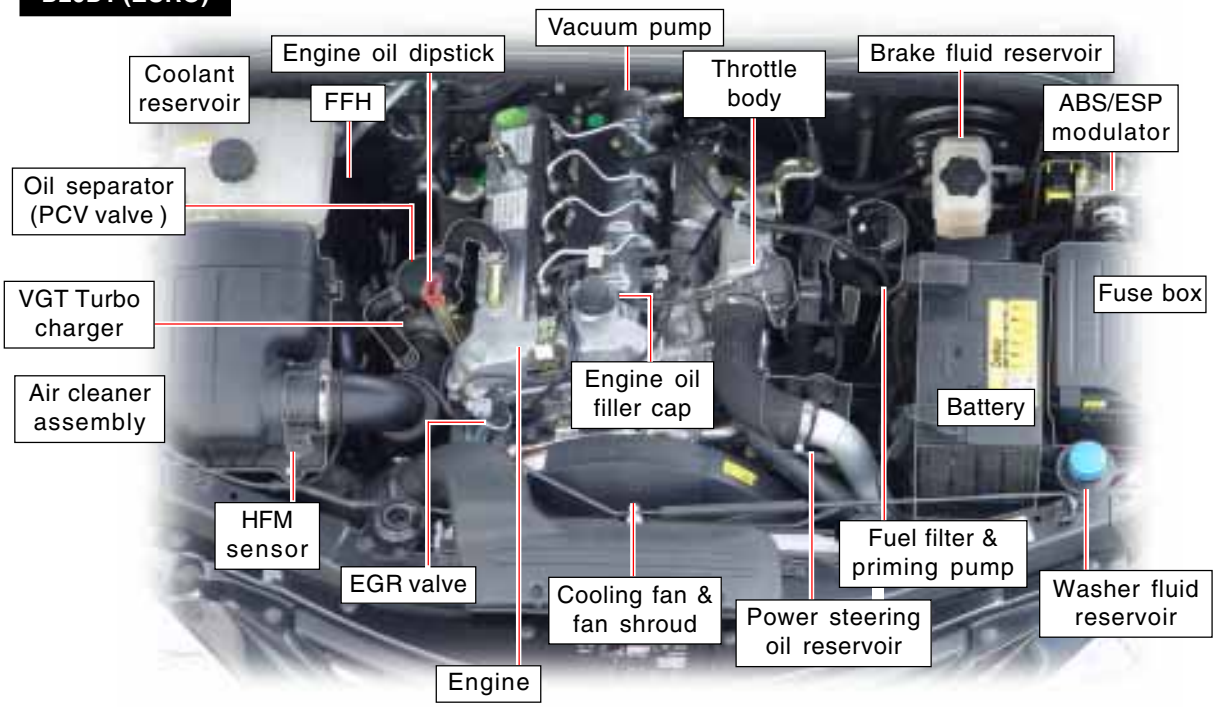
1. Major components in engine and engine compartment 2
2. Specifications and performance curve 5
3. Tightening torque 7
4. Major changes in D20DT (EURO IV) engine (compared to D20DT) 11
5. Removal and installation of D20DT (EURO IV) engine assembly 15

STRUCTURE AND FUNCTION DESCRIPTIONS

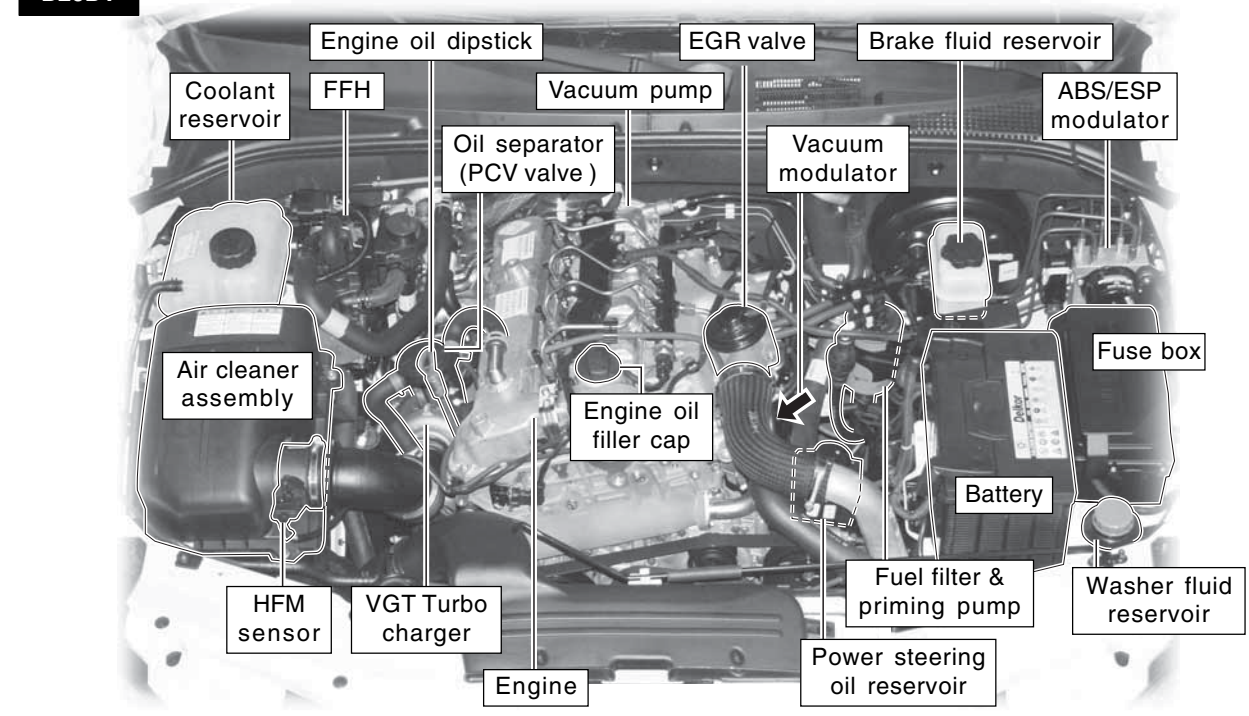
1. MAJOR COMPONENTS IN ENGINE AND ENGINE COMPARTMENT

The electronically controlled advanced D20DT engine that has high pressure fuel system has been introduced to this vehicle. It satisfies the strict emission regulation and provides improved output and maximum torque.

D20DT (EURO)



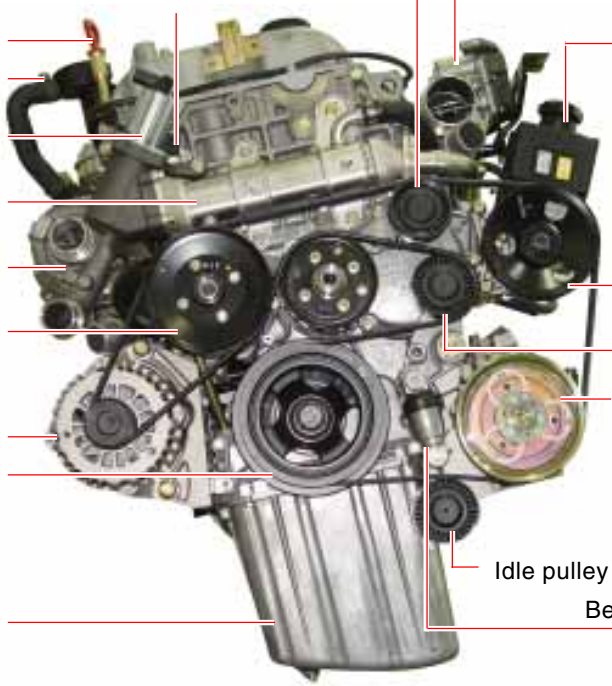
D20DT



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AFFECTED VIN	

▶ Engine Assembly Structure

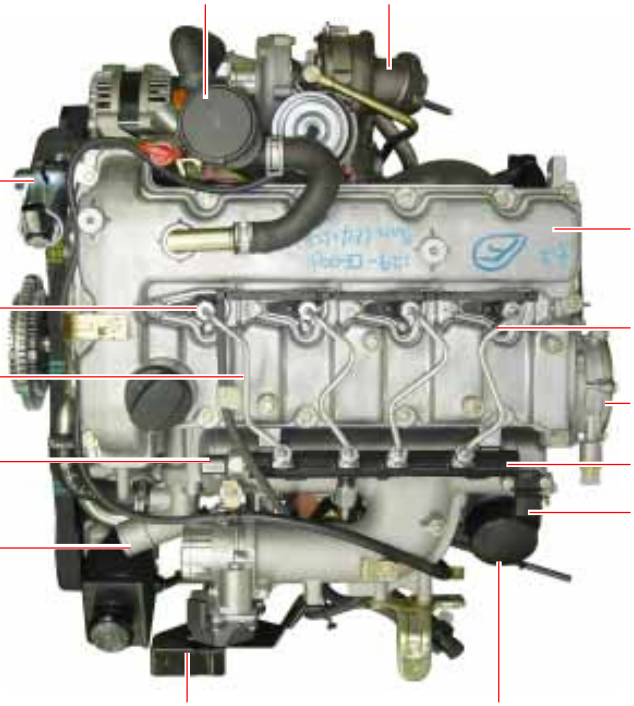
Front View



Touch idler equipped (for A/T)

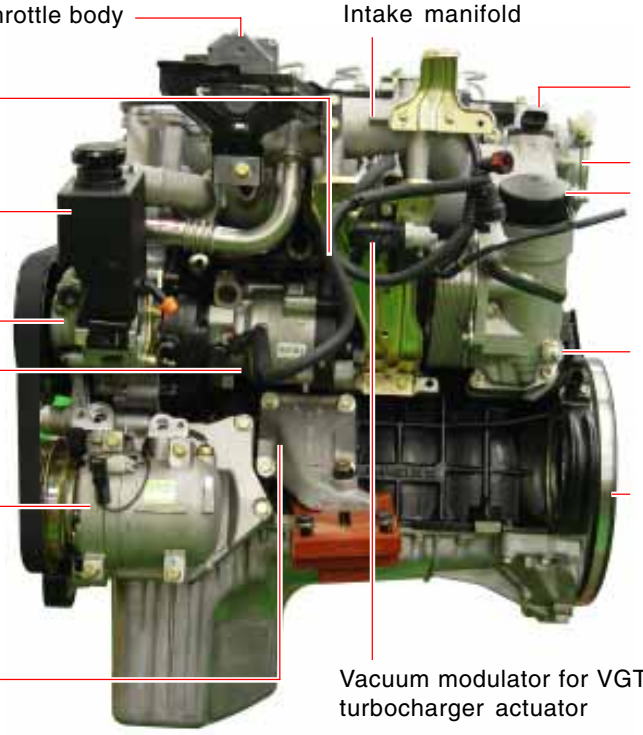


Top View

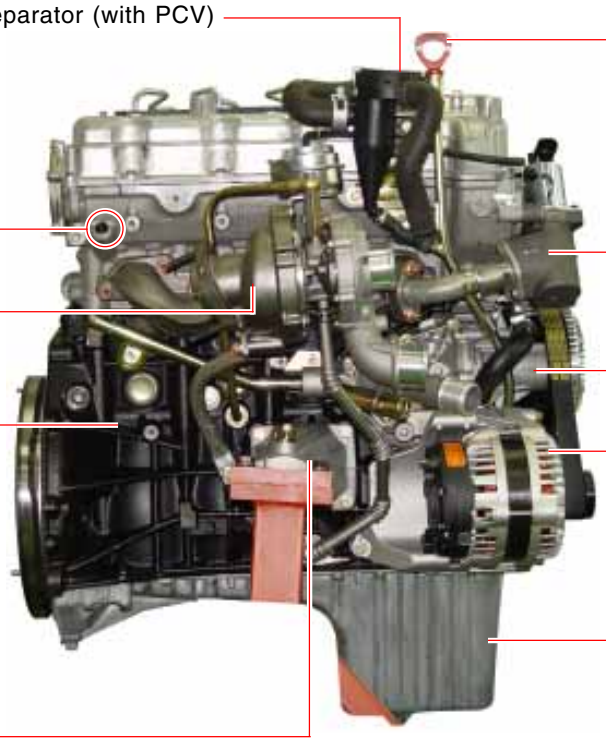


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EFFECTIVE DATE	
AFFECTED VIN	

Right Side View



Left Side View



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AFFECTED VIN	

2. SPECIFICATIONS AND PERFORMANCE CURVE

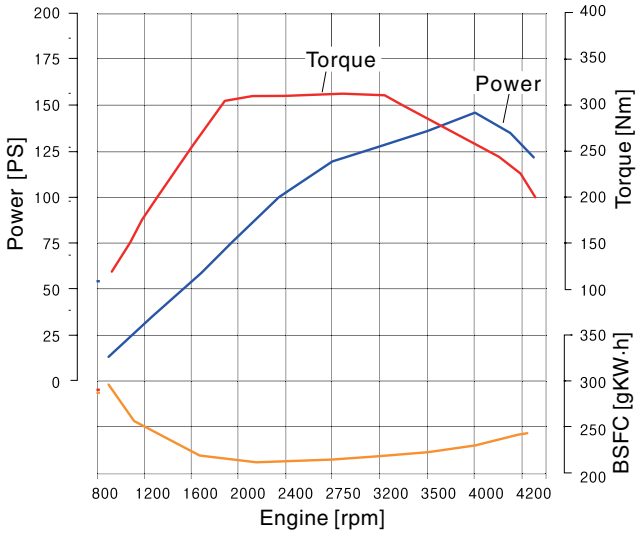
▶ Specifications

Description			D20DT (EURO 4)	D20DT
Engine	Type/Number of cylinders		D20DT/4-cylinder	←
Cylinder	Inner diameter		86.2 mm	←
	Stroke		85.6 mm	←
Displacement			1998 cc	←
Compression ratio			17.5:1	←
Maximum output			141 ps / 4,000 rpm	←
Maximum torque			310 Nm / 1,800 ~ 2,750 rpm	←
Idle speed	For Manual Transmission		780 ± 50 rpm	←
	For Automatic Transmission		780 ± 50 rpm	←
Valve	Intake	Opens (BTDC)	9°	←
		Closes (ABDC)	26°	←
	Exhaust	Opens (BBDC)	38°	←
		Closes (ATDC)	16°	←
Camshaft	Type		DOHC	←
Fuel system	Fuel type		Low sulfur diesel	←
	Fuel pump type		Vane pump in HP pump	←
	Fuel supply pressure		HP pump inlet port: max. 400 mbar HP pump outlet port (with IMV fully open): over 1,050 bar	←
	Water separation in fuel filter		at every 10,000 km	←
	Fuel tank capacity		75 ℓ	←
Lubrication system	Oil specification		Quality class: Ssangyong genuine engine oil (Approved by MB Sheet 229.1 or 229.3) Viscosity: MB sheet No. 224.1	←
	Lubrication type		Forced delivery	←
	Oil filter type		Full flow, filter element type	←
	Oil capacity		≒ 7.5 ℓ	←
Cooling system	Cooling type		Water cooling type	←
	Cooling fan operation type		Belt operated type	←
	Thermostat (Fully Open: 100°C)	Opening temperature	85 °C	←
		Type	WAX pellet type	←
	Coolant capacity		≒ 11.5 ℓ	←

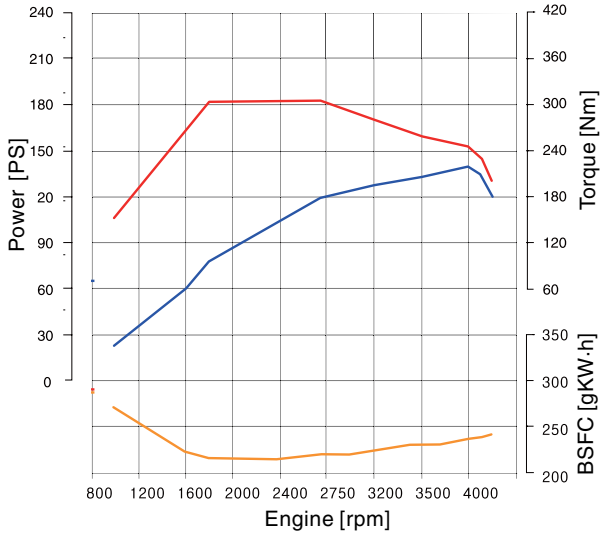
▶ Engine Performance Curve

Output and Torque

General

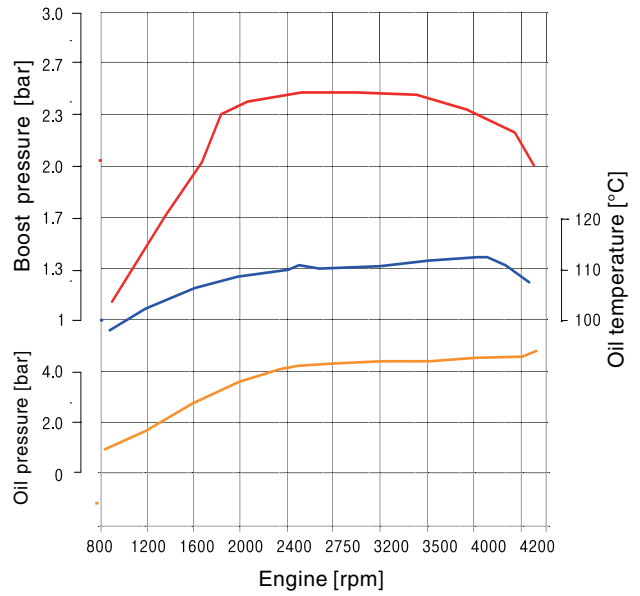


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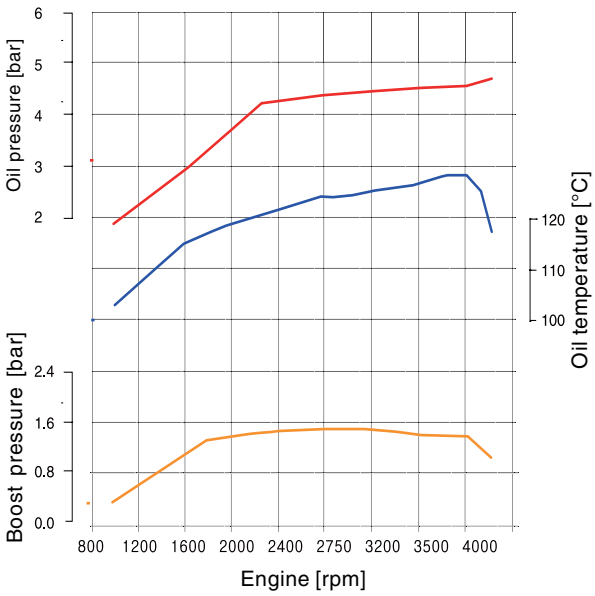


Oil Temperature/Pressure and Boost Pressure

General



EU4



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. TIGHTENING TORQUE

Name	Bolt Size	Quantity	Tightening Torque (Nm)	
			D20DT (EURO 4)	D20DT
Main bearing cap	M11 x 67	10	55 ± 5 120° ± 10°	55 ± 5 120° ± 10°
Connecting rod cap	M9 x 51	8	40 ± 5 90° ± 10°	40 ± 5 90° ± 10°
Rear cover	M6 x 20	6	10 ± 1	10 ± 1
Oil pump	M8 x 35SOC	3	25 ± 2.5	25 ± 2.5
T.G.C.C	M6 x 40	6	10 ± 1	10 ± 1
	M6 x 60	3	10 ± 1	10 ± 1
	M6 x 70	2	10 ± 1	10 ± 1
Flywheel	M10 x 22	8	45 ± 5 90° ± 10°	45 ± 5 90° ± 10°
Crankshaft hub	M20 x 85	1	200 180° ± 10°	200 180° ± 10°
Oil pan	M6 x 20	20	10 ± 1	10 ± 1
	M6 x 35	3	10 ± 1	10 ± 1
	M6 x 85	3	10 ± 1	10 ± 1
	M8 x 40	4	25 ± 2.5	25 ± 2.5
High pressure pump mounting bolt	M8 x 55	3	25 ± 2.5	25 ± 2.5
High pressure pump main nut (intershaft)	M14 x 1.5	1	65 ± 5	65 ± 5
Cylinder head	M8 x 25	2	25 ± 2.5	25 ± 2.5
	M8 x 50	2		
	M10 x 158	1	85 ± 5	85 ± 5
	M10 x 177	9	270° + 10°	270° + 10°
Camshaft sprocket (Intake)	M11 x 40	1	25 ± 2.5 90° ± 10°	25 ± 2.5 90° ± 10°
Camshaft sprocket (Exhaust)				
Chain tensioner	M24	1	65 ± 5	65 ± 5
Auto tensioner	M12 x 90 (UP)	1	82 ± 6	82 ± 6
	M8 x 45 (LOWER)	1	32 ± 3	32 ± 3
Water pump assembly	M6 x 50	7	10 ± 1	10 ± 1
Water pump pulley	M6 x 10	4	10 ± 1	10 ± 1
Hot water inlet pipe assembly	M6 x 12	2	10 ± 1	10 ± 1
Alternator bracket	M8 x 80	1	25 ± 2.5	25 ± 2.5
	M8 x 34	2	25 ± 2.5	25 ± 2.5
	M8 x 30	2	25 ± 2.5	25 ± 2.5
Alternator	M10 x 90	1	46 ± 4.6	46 ± 4.6
	M10 x 116	1	46 ± 4.6	46 ± 4.6

Name	Bolt Size	Quantity	Tightening Torque (Nm)	
			D20DT (EURO 4)	D20DT
Air conditioner compressor bracket assembly	M8 x 25	1	25 ± 2.5	25 ± 2.5
	M8 x 60	3	25 ± 2.5	25 ± 2.5
Air conditioner compressor sub bracket assembly	M6 x 16	1	10 ± 1.0	10 ± 1.0
	M8 x 20	1	25 ± 2.5	25 ± 2.5
Intake manifold	M8 x 50	5	25 ± 2.5	25 ± 2.5
	M8 x 133	5	25 ± 2.5	25 ± 2.5
Acoustic cover bracket	M6 x 16	2	25 ± 2.5	25 ± 2.5
	M8 x 105	1	25 ± 2.5	25 ± 2.5
Knock sensor	M8 x 28	1	20 ± 2.6	20 ± 2.6
Camshaft position sensor	M8 x 14	1	12 ± 1.7	12 ± 1.7
Booster pressure sensor	M6 x 20	2	10 ± 1.0	10 ± 1.0
Exhaust manifold stud bolt	M8 x 46	8	15 ± 1.5	15 ± 1.5
	M8 x 35	2	15 ± 1.5	15 ± 1.5
Exhauster manifold nut	M8	8	40 ± 4.0	40 ± 4.0
Turbo charger assembly	M8	3	25 ± 2.5	25 ± 2.5
Turbocharger hollow bolt	M10 x 1.0	1	18 ± 1.8	18 ± 1.8
Turbocharger oil feed pipe	M16 (Cylinder block side)	1	25 ± 2.5	25 ± 2.5
Turbocharger support bar (nut)	M8	1	23 ± 2.3	23 ± 2.3
Turbocharger support bar (bolt)	M8 x 20	1	25 ± 2.5	25 ± 2.5
Turbocharger return pipe	M6 x 16 (T/C side)	2	10 ± 1.0	10 ± 1.0
	M6 x 16 (Cylinder block side)	2	10 ± 1.0	10 ± 1.0
EGR valve assembly	M6 x 25	4	10 ± 1.0	10 ± 1.0
EGR-LH pipe nut	M8	2	35 ± 3.5	35 ± 3.5
EGR-RH pipe nut	M6 x 16	2	10 ± 1.0	10 ± 1.0
EGR center bolt	M6 x 16	4	10 ± 1.0	10 ± 1.0
EGR center pipe	M8 x 25	2	25 ± 2.5	25 ± 2.5
	M8 x 30	2	25 ± 2.5	25 ± 2.5
Glow plug	M5	5	15 ± 3.0	15 ± 3.0
Vacuum pump	M6 x 20	3	10 ± 1.0	10 ± 1.0
	M6 x 25	5	10 ± 1.0	10 ± 1.0
Cooling fan bracket assembly	M6 x 55	1	10 ± 1.0	10 ± 1.0
	M6 x 85	3	10 ± 1.0	10 ± 1.0
Cylinder head cover	M6 x 35	18	10 ± 1.0	10 ± 1.0
Vacuum modulator	M6 x 16	4	10 ± 1.0	10 ± 1.0

Name	Bolt Size	Quantity	Tightening Torque (Nm)	
			D20DT (EURO 4)	D20DT
Oil dipstick tube	M6 x 16	1	10 ± 1.0	10 ± 1.0
	M8 x 35	1	25 ± 2.5	25 ± 2.5
Oil filter assembly	M8 x 55	2	25 ± 2.5	25 ± 2.5
	M8 x 125	1	25 ± 2.5	25 ± 2.5
Fuel rail assembly	M8 x 35	2	25 ± 2.5	25 ± 2.5
Injector	M6 x 60	4	10 ± 1.0 180° + 20°	10 ± 1.0 180° + 20°
Fuel pipe clip (H-C)	M14	2	40 ± 4.0	40 ± 4.0
Fuel pipe clip (C-I)	M14	8	40 ± 4.0	40 ± 4.0
Crankshaft position sensor	M6 x 14	1	0.8 ± 0.4	0.8 ± 0.4
	GAP	-	0.7 ± 1.5 mm	0.7 ± 1.5 mm
Power steering pump	M8 x 100	2	25 ± 2.5	25 ± 2.5
Head screw plug	-	1	25 ± 2.5	25 ± 2.5
Cam shaft cap bolt	M8 x 60	20	25 ± 2.5	25 ± 2.5
Piston topping	-	-	0.765 ~ 1.055 mm	0.765 ~ 1.055 mm
Connecting rod end play	-	-	0.500 ~ 1.500 mm	0.500 ~ 1.500 mm
Cam shaft end play	-	-	0.100 ~ 0.350 mm	0.100 ~ 0.350 mm
Crank shaft end play	-	-	0.100 ~ 0.254 mm	0.100 ~ 0.254 mm

▶ Engine Head Bolt Tightening Torque

Head bolt wrench and tightening torque according to the cylinder head bolt changes of the DI engine (D20DT)



Cylinder head bolt wrench



I.D. of head bolt head: 14.5 mm

O.D. of head bolt wrench: 13.3 mm

W9912 003 0B

Tightening Torque

A. Removal order

: Remove the bolts in the order as shown in the figure.

B. Installation order (Based on the number in the picture)

: 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1 → 14 → 13 → 12 → 11 (Reverse order of removal)

Size	Tightening torque	Bolt No. (Quantity)
M8 x 25	25 ± 2.5 Nm	11, 12 (2)
M8 x 50	25 ± 2.5 Nm	13, 14 (2)
M10 x 158	85 ± 5 Nm	4 (1)
M10 x 127	270° ± 10°	1 ~ 10 (9)



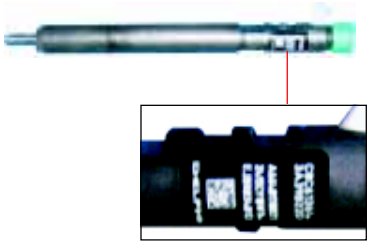
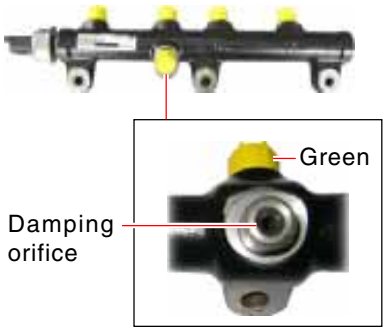
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AFFECTED VIN	

4. MAJOR CHANGES IN D20DT (EURO IV) ENGINE (COMPARED TO D20DT)

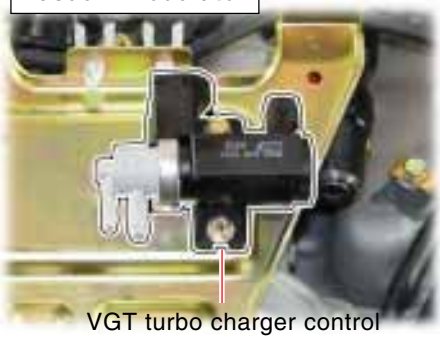
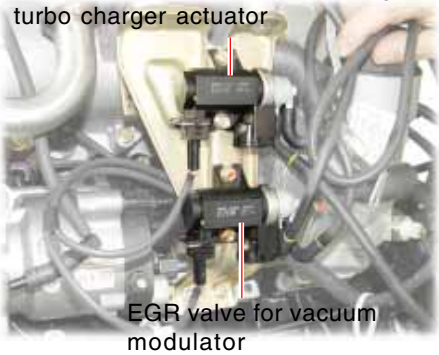
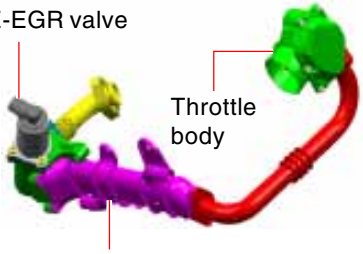
▶ Engine Assembly

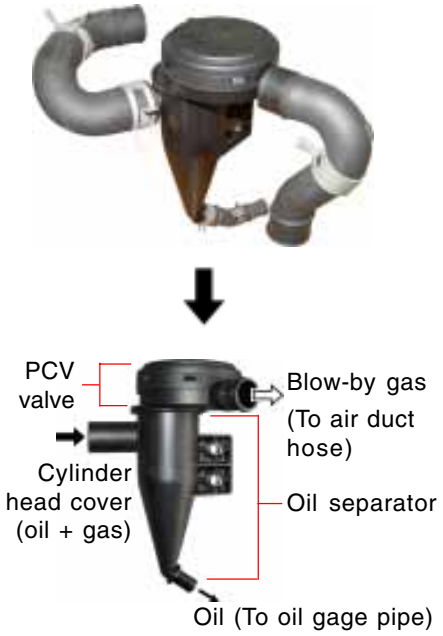
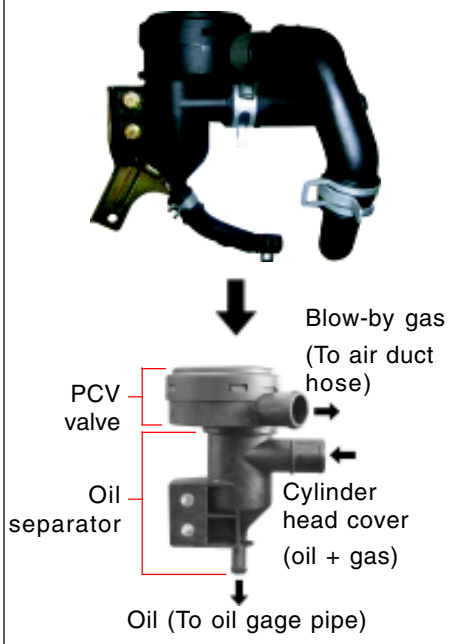
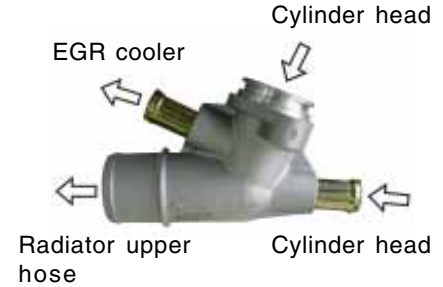
D20DT (EURO 4) Engine	D20DT Engine
Front Side View Touch idler equipped (for A/T)  	
Top Side View 	
Right Side View 	
Left Side View 	

▶ Major Changes and Summary

D20DT (EURO 4) Engine	D20DT Engine	Remarks
Injector  C3I Label	 C2I Label	* **Injector label** - D20DT: Green (Cap) (16 digits: C2I value) - D20DT (EURO 4): Red (Cap) (20 digits: C3I value)
Fuel pipe 		* **Diameter increased** - D20DT: ID (2.4 mm), OD (6.0 mm) - D27DT (EURO 4): ID (3 mm), OD (6.35 mm)
Fuel high pressure pipe 		: Diameter expanded due to the increased capacity.
Common rail 		* D20DT (EURO4): Added damping orifice. (Orifice is added to fuel inlet/ outlet ports in order to dampen the pulsation in fuel flow caused by multi-injections.)
Electric controlled E-EGR valve 	**EGR valve** 	* E-EGR valve: ECU controls the EGR valve directly without any media. It provide more precise EGR control by transmitting the electric signal of EGR valve operating position.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

D20DT (EURO 4) Engine	D20DT Engine	Remarks
HFM 6.0 	**HFM 5.0** 	* **Version up** - D27DT: HFM5-CI (Analog signal) - D27DTP: HFM6-ID (Digital signal added)
Vacuum modulator  VGT turbo charger control	Vacuum modulator for controlling turbo charger actuator  EGR valve for vacuum modulator	* D20DT (EURO4) engine uses electric ally controlled E-EGR valve. Thus, the vacuum modulator for controlling EGR valve has been deleted.
Throttle body 	**N/A**	* Throttle body is for future regulation requiring emission reductions. Currently, it is used to prevent the engine from turning off with fluttering noise at the moment the air to intake manifold is blocked by closed flap when the engine is switched off.
EGR cooler EGR Gas  Coolant	**EGR center pipe**  EGR Gas	* To enhance EGR function, coolant EGR cooler is adopted to reduce the temperature of exhaust gas into the intake manifold.
E-EGR system layout E-EGR valve Throttle body  EGR cooler	**EGR system layout**  EGR center pipe EGR valve	* **Reason of changes** - To satisfy the emission regulation, E-EGR valve and EGR cooler are adopted. And the layout also has a great difference from D27DT.

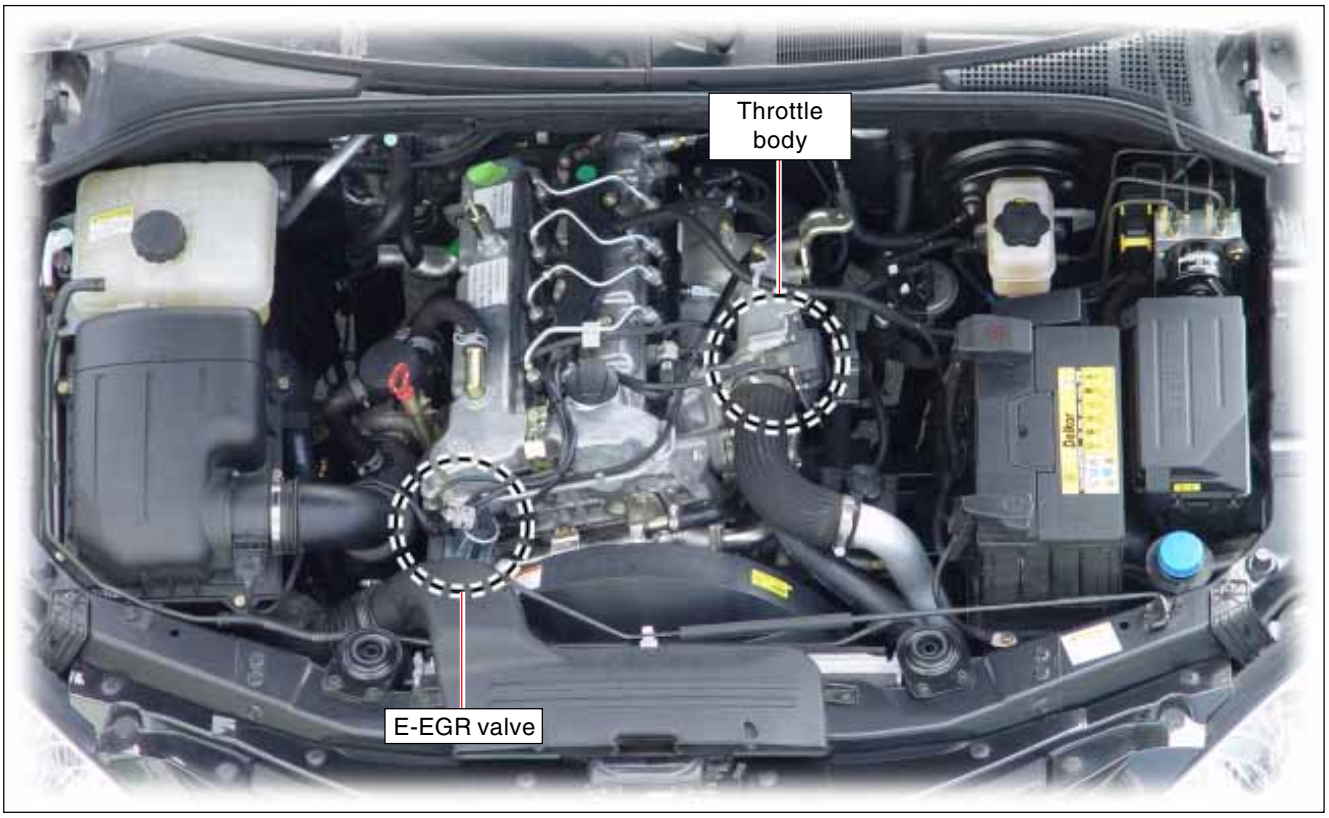
D20DT (EURO 4) Engine	D20DT Engine	Remarks
PCV oil separator  	 	* **Increase of Oil separator capacity (approx. 10%)** - D20DT (EURO 4): 160ℓ/min - D20DT: 120ℓ/min
Intake manifold 		* The appearance of intake manifold is changed to the round type due to the throttle body. Also, the mounting location of booster pressure sensor is changed.
Water pump  		* **For D20DT (EURO4) engine:** Additional connecting port for EGR cooler hose
Coolant outlet port  		* **For D20DT (EURO4) engine:** engine: Additional port for coolant of EGR cooler

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. REMOVAL AND INSTALLATION OF D20DT (EURO IV) ENGINE ASSEMBLY

NOTICE

1. **Disconnect the negative battery cable before removing the engine.**
2. **Drain the engine oil and the coolant.**
3. **Be careful not to spill the fuel on the vehicle body while removing the fuel pipes.**



The removal and installation of the engine assembly are described based on the major parts and mounting locations.

The followings are fully applicable when repairing and working with the damaged vehicle. When removing and installing the engine, refer to the previously distributed manual.

▶ Removal and Installation of Engine Assembly

Preceding Work

1. Disconnect the negative battery cable and remove the skid plate under the engine compartment.



Installation Notice

Tightening torque	12 ± 1.2 Nm

2. Drain the engine coolant.



NOTICE

- **Use only the designated container to collect the coolant. Store it in a safe place and observe the regulation when disposing.**
- **Use only Ssangyong genuine engine coolant when refilling.**

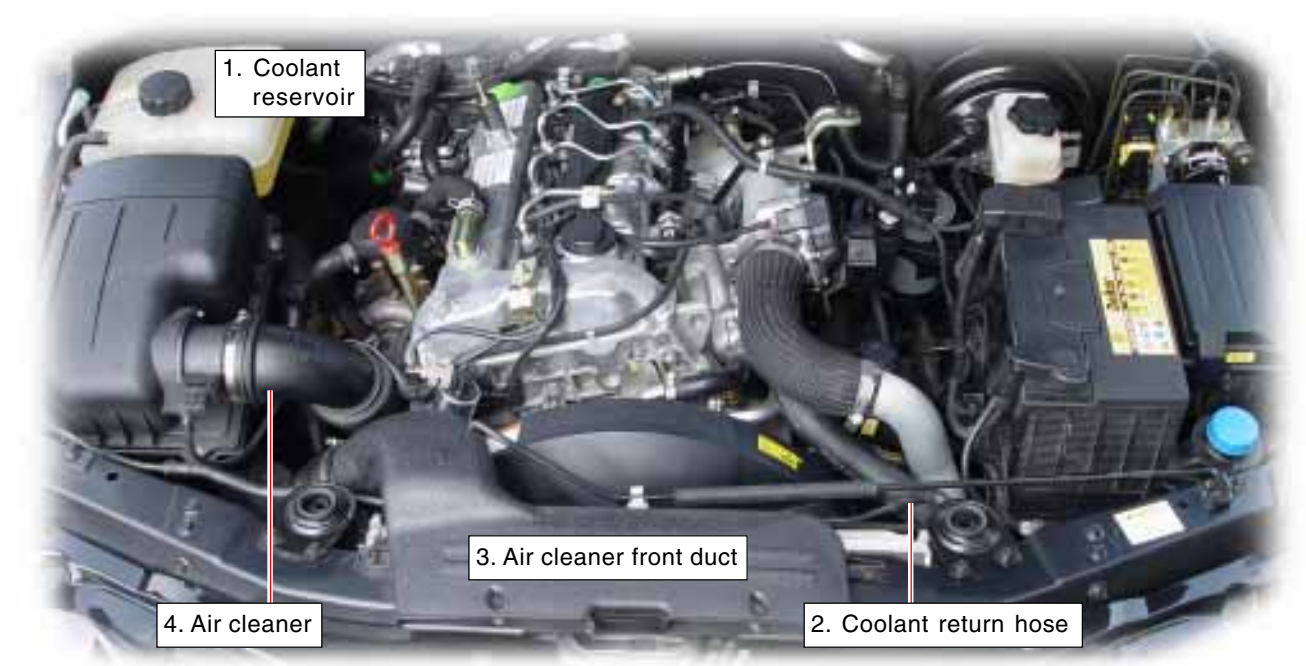
3. Remove the transmission and transfer case assembly.

   Be careful not to spill the oil from the oil lines when disconnecting them in the vehicle with automatic transmission.

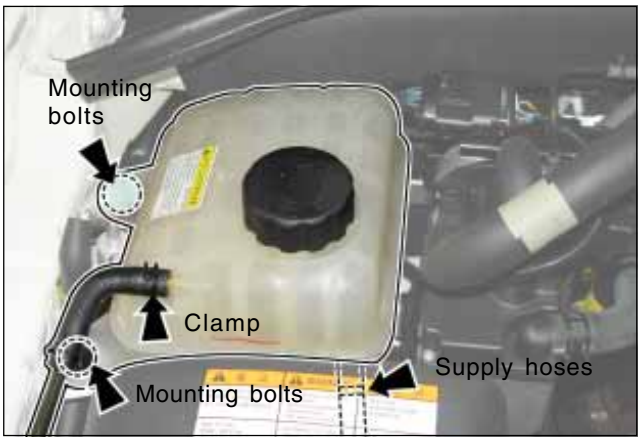


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

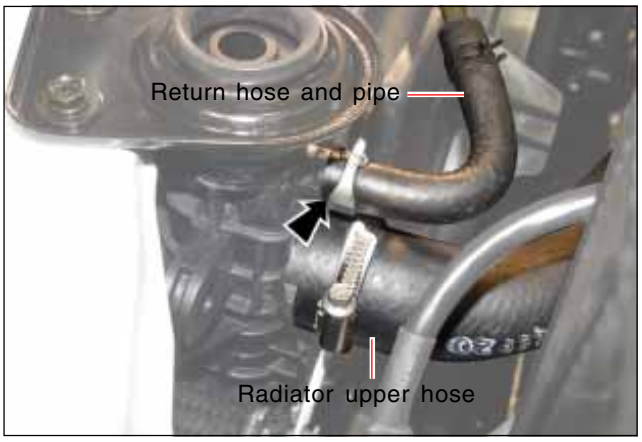
Removal and Installation of Engine



1. Unscrew the mounting bolts (10 mm), disconnect the return/supply hoses, and remove the coolant reservoir.



2. Release the clamps on the reservoir and radiator and remove the return hose and pipe.



3. Unscrew the mounting bolts (10 mm), release the hose clamps, and remove the air cleaner front duct.



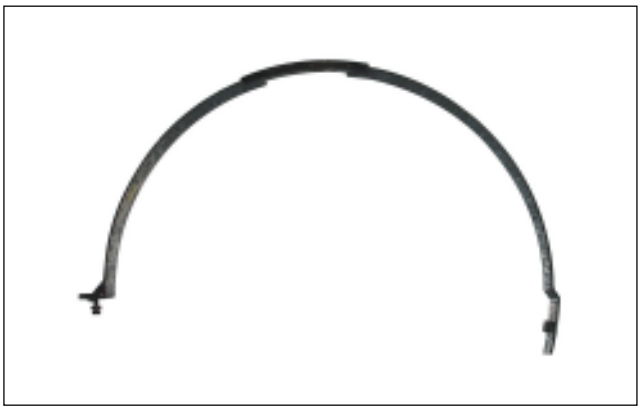
4. Remove the air cleaner intake hose and HFM sensor.



5. Remove the left intercooler hose and the lower hose of the radiator. Remove the right intercooler hose and the upper hose of the radiator.



6. Unscrew the fan shroud mounting bolts in the engine compartment and remove the band.





7. Unscrew the four fan shroud mounting bolts to remove the fan shroud from the engine compartment.



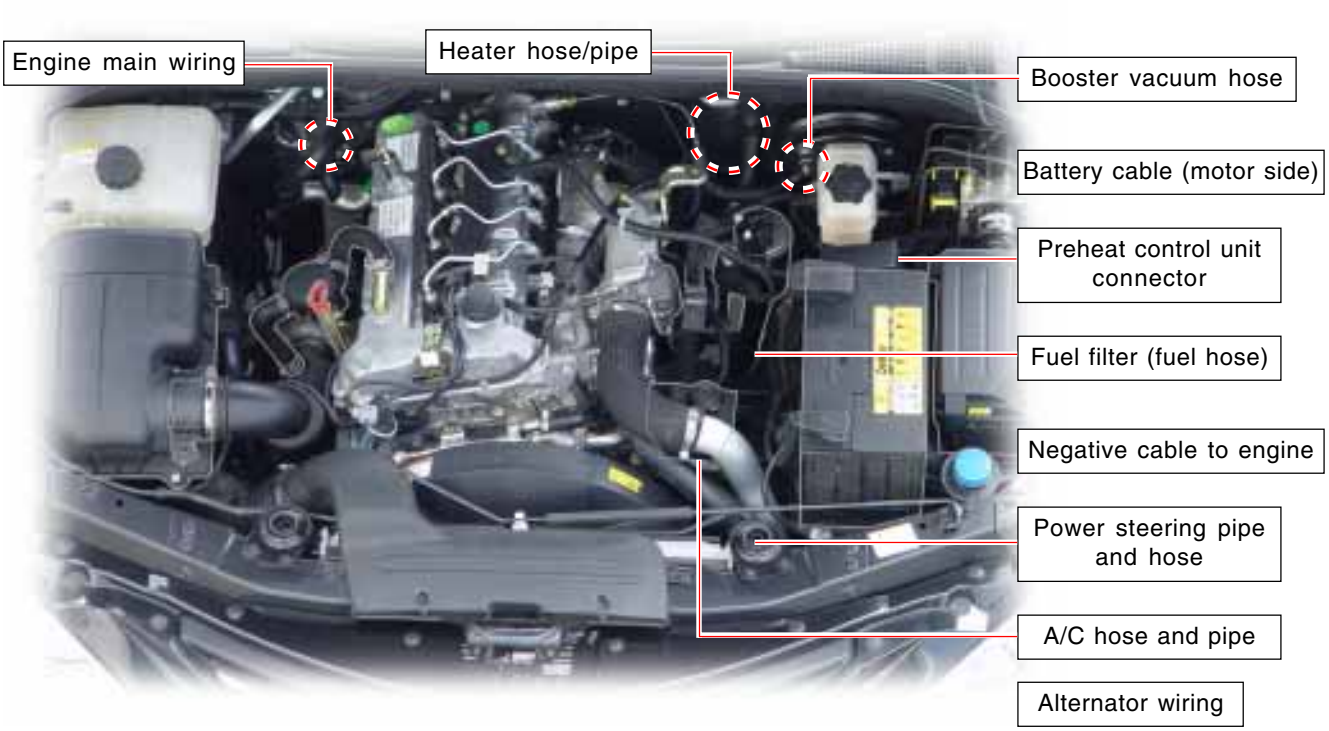


8. Remove the cooling fan from the engine by removing the hexagon bolt.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

9. Remove/Disconnect the accessories as below (no specific sequence).



9-1. Disconnect the engine main wiring.



9-2. Disconnect the booster vacuum hose.



9-3. Disconnect the heater hose and pipe.



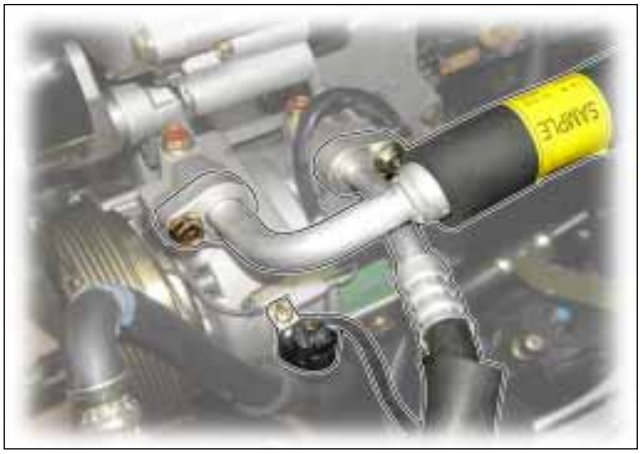
9-4. Disconnect the fuel hose of the fuel filter.



9-5. Disconnect the connector of the preheat control unit.



9-6. Disconnect the A/C compressor connector and inlet/outlet connecting pipes.



9-7. Disconnect the supply pipe, return pipe and hose connected to the power steering pump reservoir.



9-8. Disconnect the negative cable (engine side).



9-9. Disconnect the battery cable and battery.



9-10. Disconnect the alternator wiring and the ground cable.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

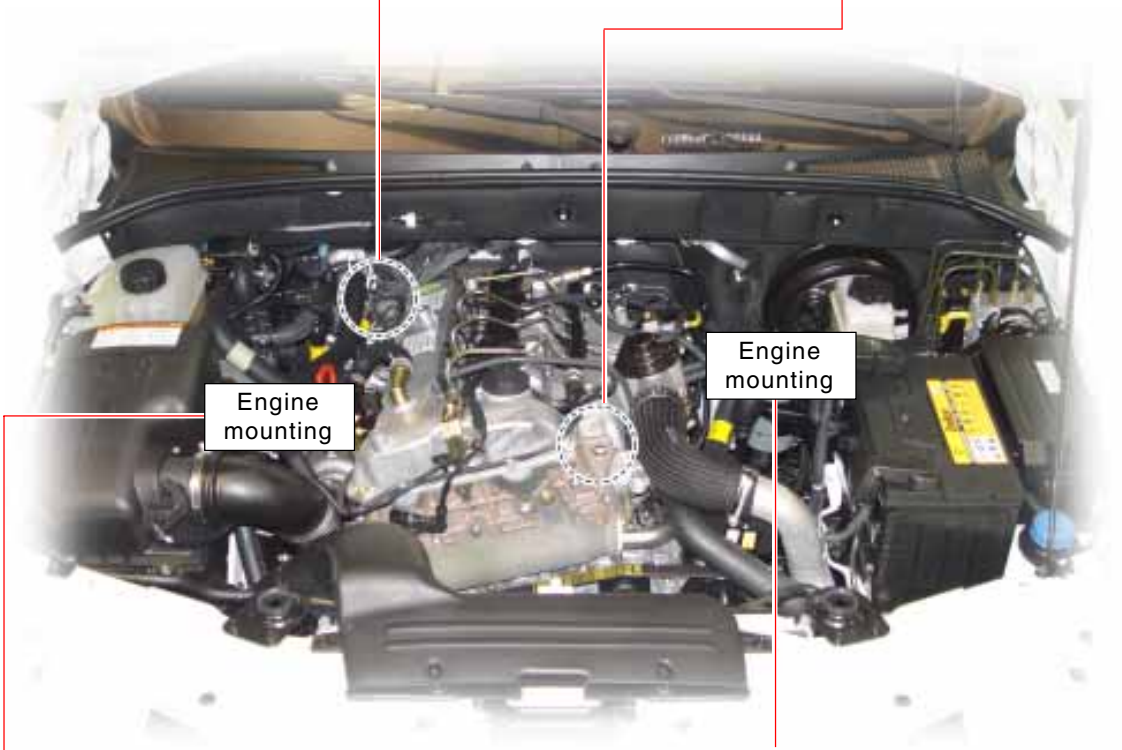
10. Remove two engine mounting bolts (LH/RH) and remove the engine assembly using the engine jack.

Rear bracket for engine removal

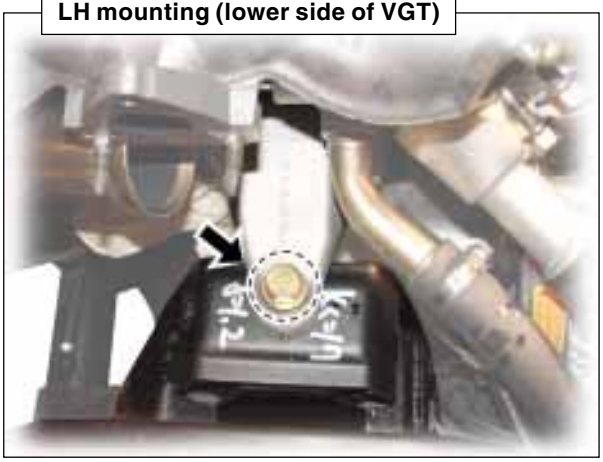


Front bracket for engine removal

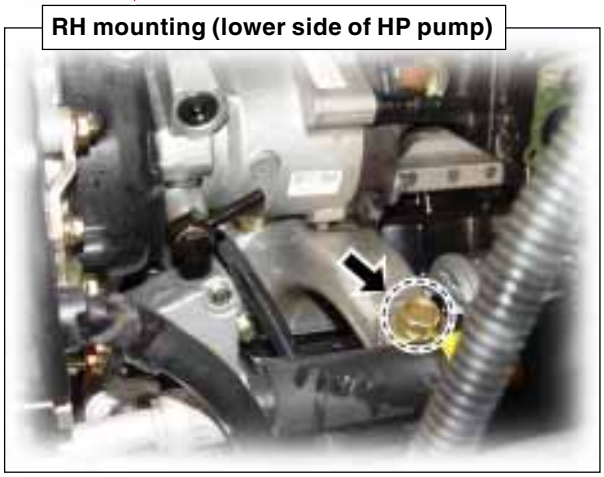




LH mounting (lower side of VGT)



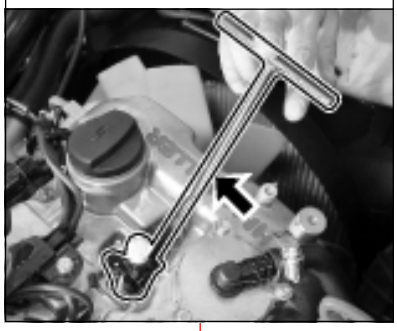
RH mounting (lower side of HP pump)



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EFFECTIVE DATE	
AFFECTED VIN	

▶ Location of Engine and Major Special Service Tools

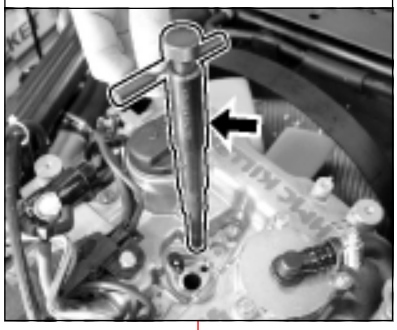
Injector Puller



Glow Plug Socket

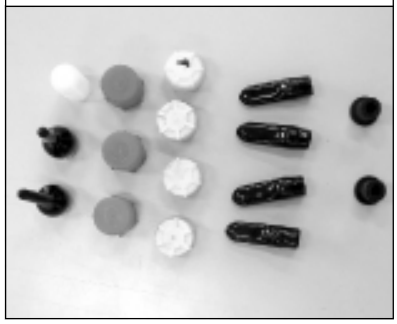


Injector copper washer Puller





Sealing Caps (Fuel line)



Removal/Installation Device for HP Pump



Removal/Installation Socket for High Pressure Pipe



Head Bolt Wrench



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

FUEL SYSTEM

1881

TABLE OF CONTENTS

FUEL SYSTEM 2

1. Major changes in fuel system of engine 2
2. Components of fuel system 3

INJECTOR 5

1. Structure and overview 5
2. Injector coding (C2I/C3I) 6

COMMON RAIL & FUEL SUPPLY PIPE 8

1. Components and overview 8
2. Removal and installation of common rail and fuel supply pipe 9

FUEL SYSTEM

1. MAJOR CHANGES IN FUEL SYSTEM OF ENGINE

There are some changes in the parts related to the fuel system due to the newly adopted D20DT (EURO 4) engine. The major changes are as follows. Refer to the next pages for further details.

Injector

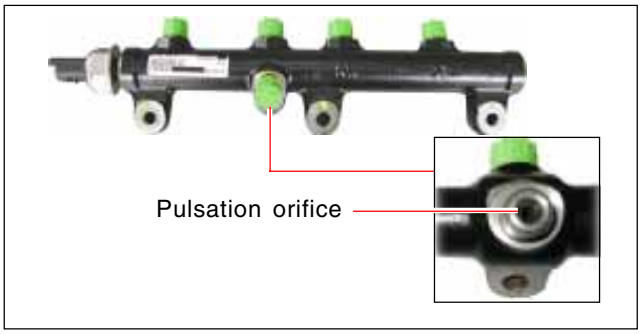
- Two nozzle holes are added (currently 7) to the tip of the injector to increase the amount of fuel injection and to improve injection efficiency according to the increased engine power.
- The existing C2I coding (16 digits) is changed to C3I coding (20 digits) to monitor fuel injection and follow the target value.
- For the D20DT engine, the injector MDP (minimum current for the solenoid in the injector to lift the nozzle) is leaned only when the engine is running. However, for the D20DT (EURO 4) engine, it is learned when the vehicle is in motion and the engine is at idle speed.



Common Rail

- The orifice is added to the connection to the fuel pipe of the HP pump to prevent the fuel pulsation by the fuel supply and fuel cut according to the increase of injected fuel volume.

  (It is also installed on the connection of the high pressure fuel supply line of the HP pump.)



Fuel Rail - Chrome Color

- The I.D and O.D of the fuel rail between HP pump and common rail are increased according to the increased amount of fuel injection.

  Also, the engine ECU, HFM sensor and EGR system are changed to control the fuel injection volume and engine more precisely.

* Fuel pipe (Common rail → Injector)

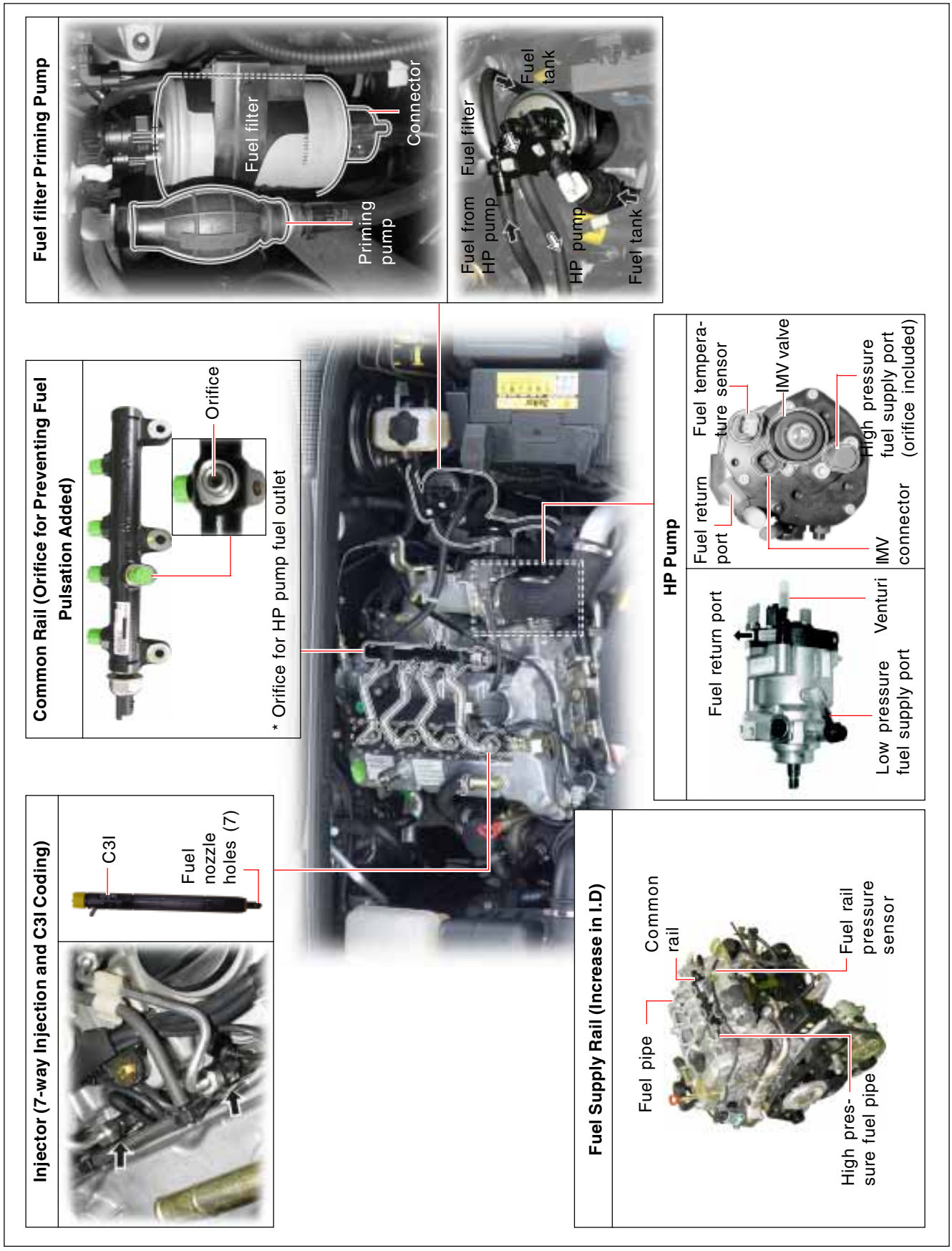


* Fuel high pressure pipe (HP pump → Common rail)



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EFFECTIVE DATE	
AFFECTED VIN	

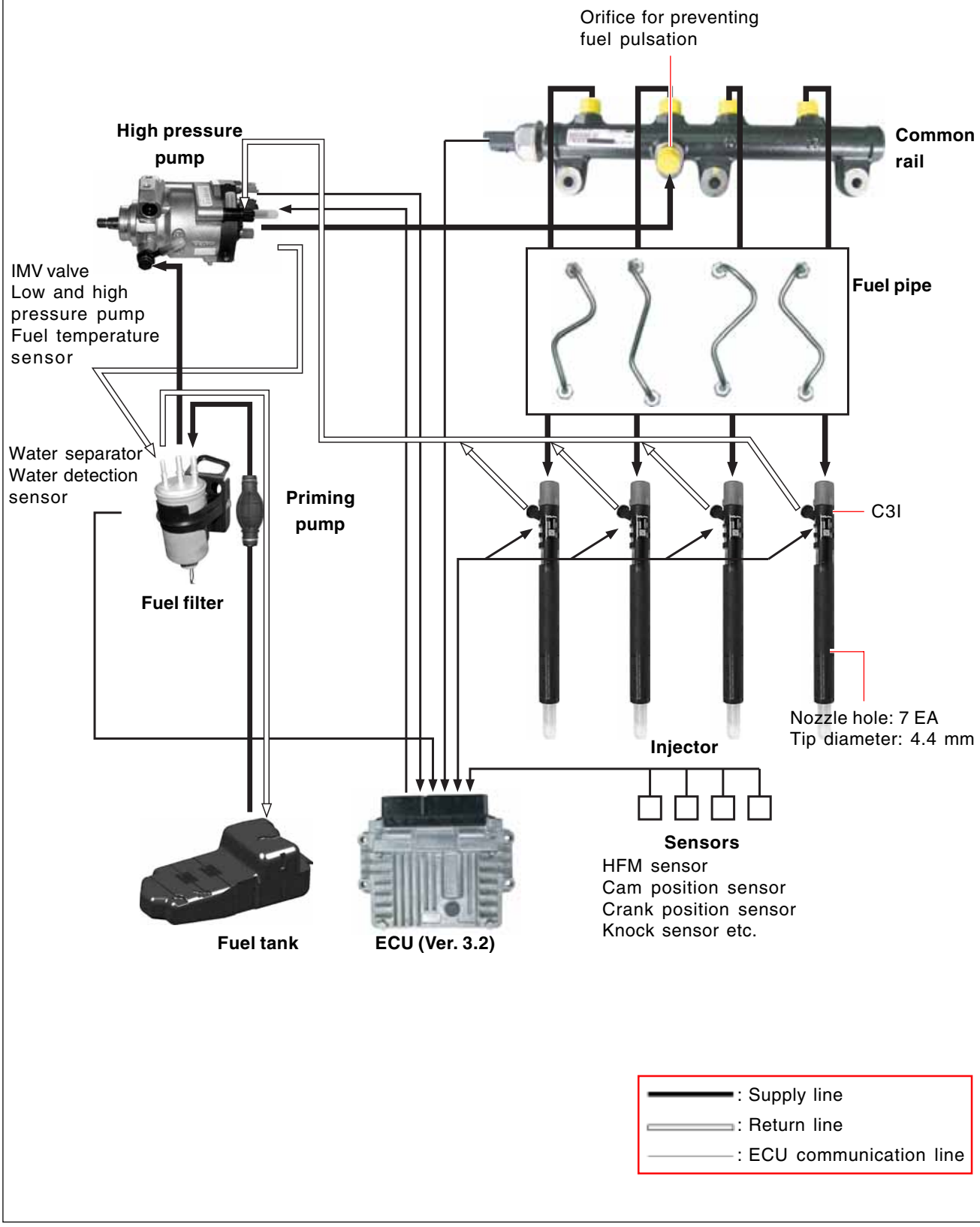
2. COMPONENTS OF FUEL SYSTEM



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EFFECTIVE DATE	
AFFECTED VIN	

▶ Fuel Flow of D20DT (EURO 4) Engine

Fuel Supply System



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EFFECTIVE DATE	
AFFECTED VIN	

INJECTOR

1. STRUCTURE AND OVERVIEW

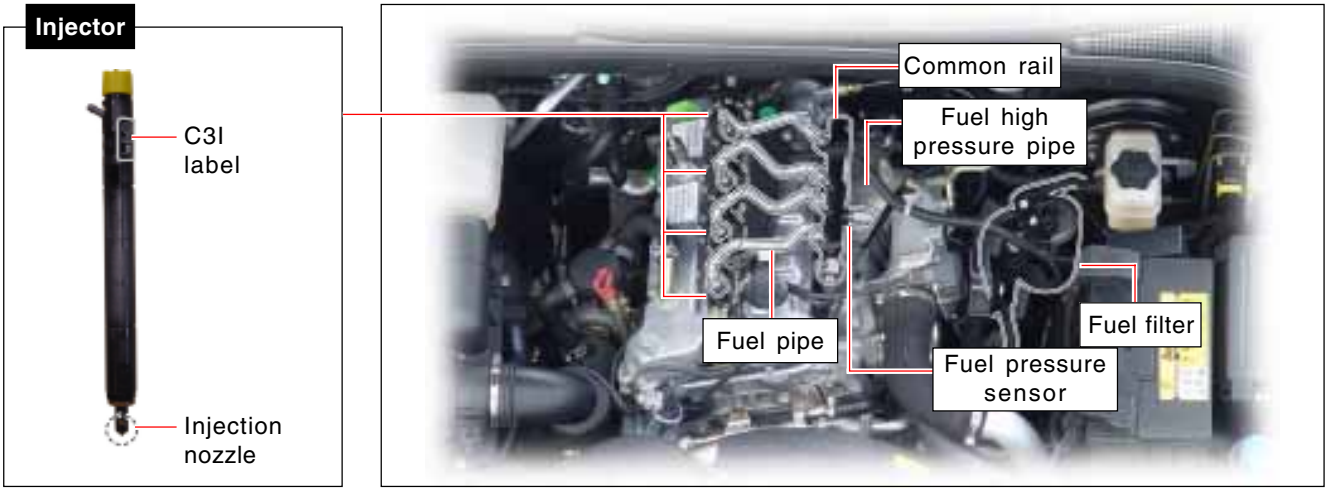
The injector for the D20DT (EURO 4) engine is different from the injector for the D20DT engine. Also, the injectors for each engine are not compatible with each other.

The amount of fuel injection is increased according to the increased engine power and the number of nozzle holes on tip are increased (from 5 to 7).

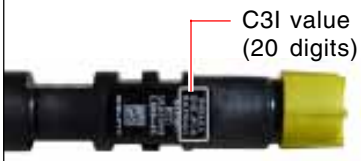
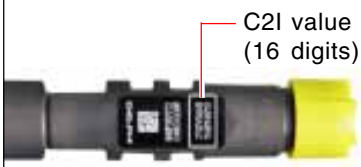
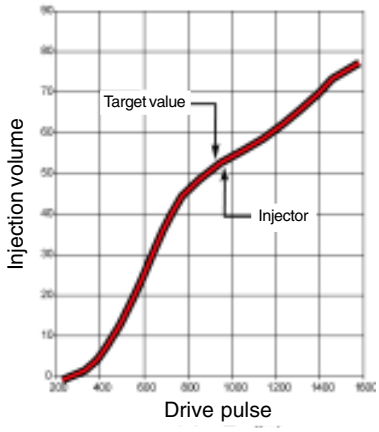
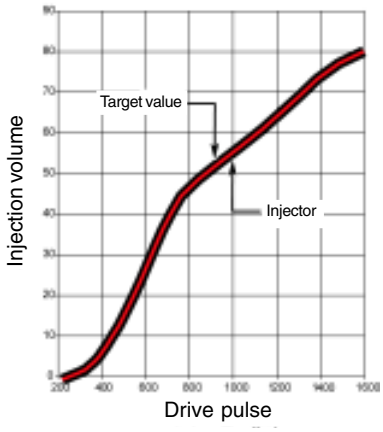
Also, the C2I label is replaced to C3I label for the better control of the fuel injection volume.

With C3I coding, the MDP learning is performed when the vehicle is in motion and the engine is at idle speed.

Major changes in injector are as follows:



▶ Injector Label

Comparison Between C3I and C2I	Fuel Injection and Closeness to Target Value (Controllability) of C2I and C3I	
Injector C3I Label for D20DT (EURO 4) Engine  **Injector C2I Label for D20DT Engine**  	**C3I**  The closeness to the target value is superb so that the volume is precisely controlled (decrease in irregular injection in each injector).	**C2I**  The amount of injected fuel is close to the target value which is better than the case of C2I coding overridden.

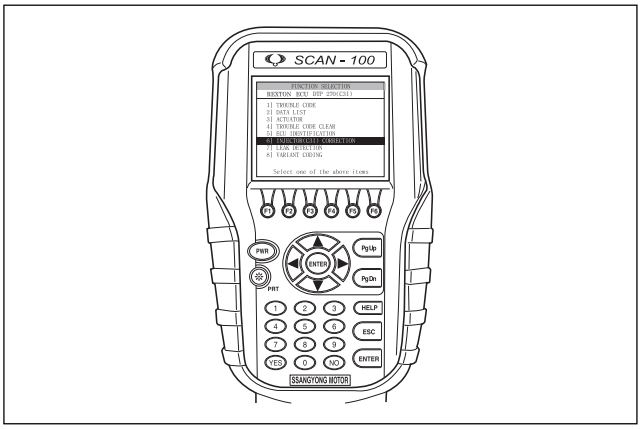
2. INJECTOR CODING (C2I/C3I)

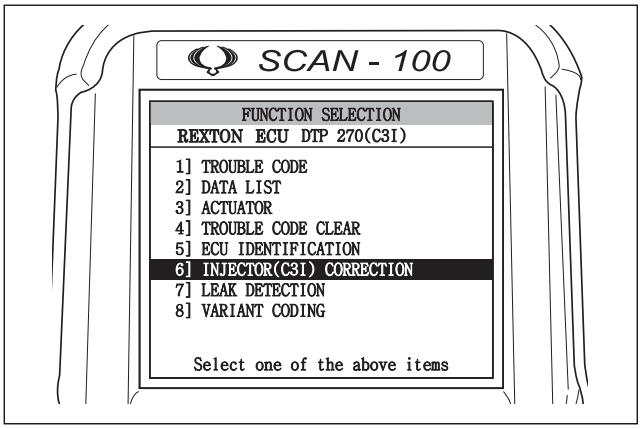
Preceding Work: Perform the "Entering Diagnosis Procedures"

1. Select "6] INJECTOR (C2I) CORRECTIONS" and press ENTER in "FUNCTION SELECTION" screen.

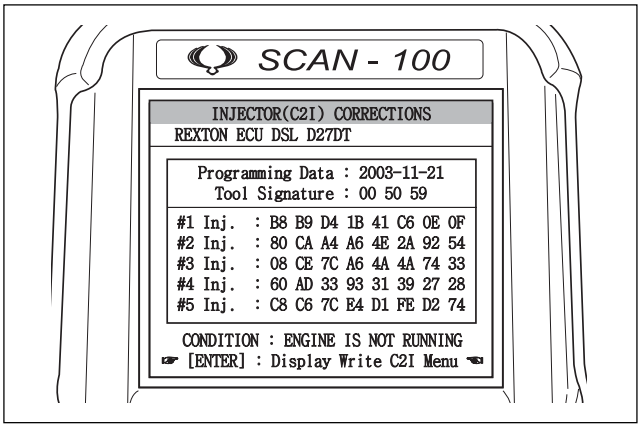
NOTICE

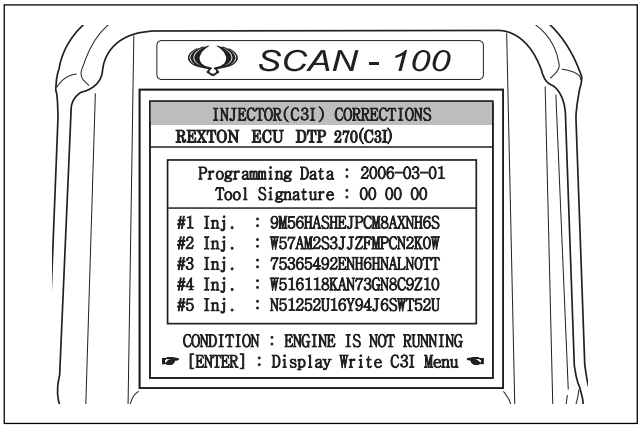
- **If the injector/ECU has been replaced or the injector system defective is suspected, go to C2I Coding item and check the injector and coded injector C2I value.**





2. The "INJECTOR (C2I) CORRECTIONS" screen that shows current C2I or C3I coding values of #1 to #5 injector is displayed. Press ENTER and enter the coding value.

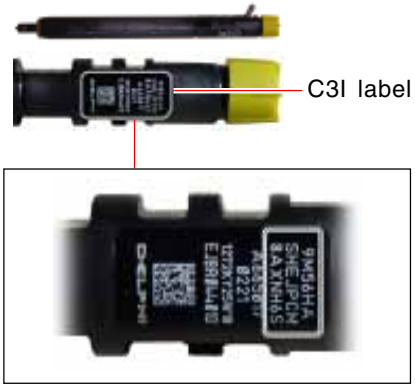




3. If you replaced the ECU, enter the C2I or C3I value of the relevant injector.

NOTE

- **The C2I or C31 value of replacing injector is recorded in the label.**
- **C2I coding number: 16 characters (ex, C0 2D 835....)**
- **C3I coding number: 20 characters (ex, 8D87E03R....)**

D20DTP (EURO 4) Engine	D20DT Engine
	

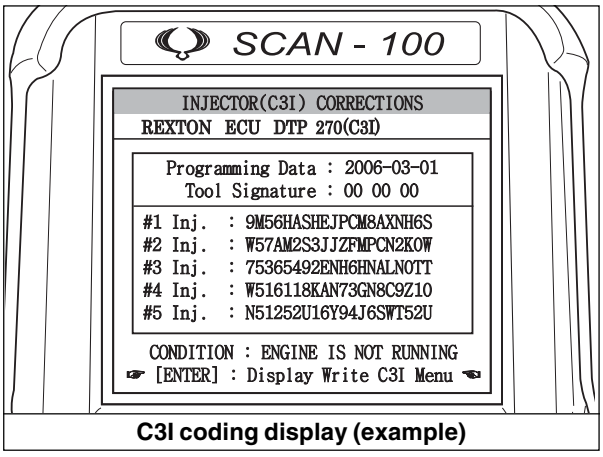
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3-1. If you want to enter a new code press [ENTER].

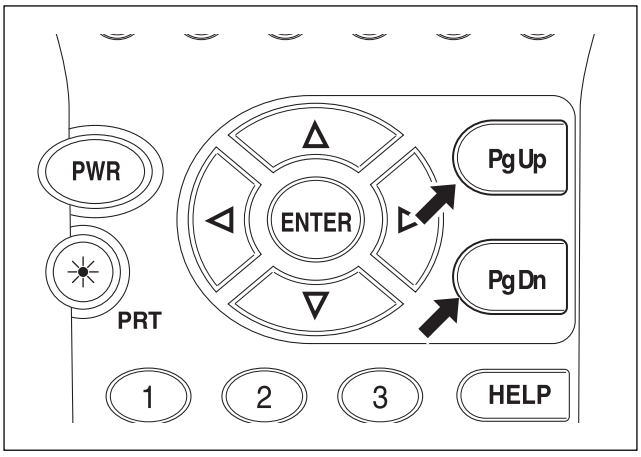
For the C3I coding, select the number with numeric key pads and select the alphabet with PgUp and PgDn keys.

NOTE

- **When selecting an alphabet, A through Z and then 0 to 9 come in order.**



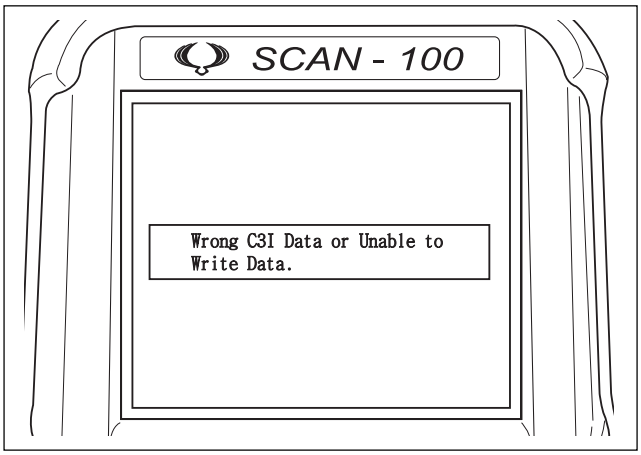
C3I coding display (example)



3-2. If you enter the invalid C2I or C3I value of the relevant injector, the message as shown in figure appears with alarm sound.

NOTE

- **If you want to go back to previous screen, press ESC key. You can see the previous C2I value.**



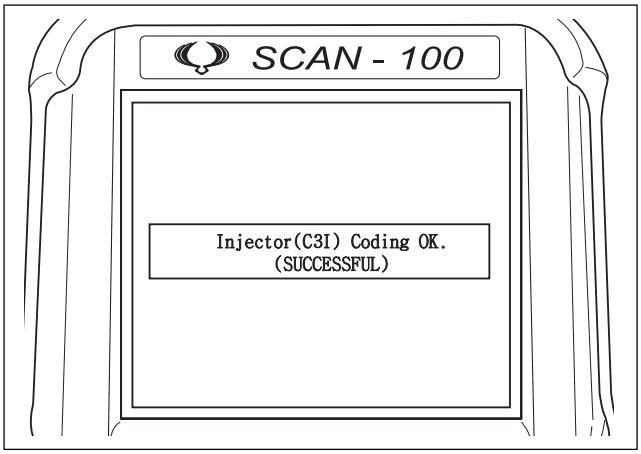
3-3. If you enter the valid C2I or C3I value of the relevant injector, the message as shown in figure appears with alarm sound.

NOTE

- **If you want to go back to previous screen, press ESC. The new C2I or C3I value is displayed.**

NOTICE

- **For C2I or C3I coding, select the engine. Then, the corresponding injector coding screen appears.**



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

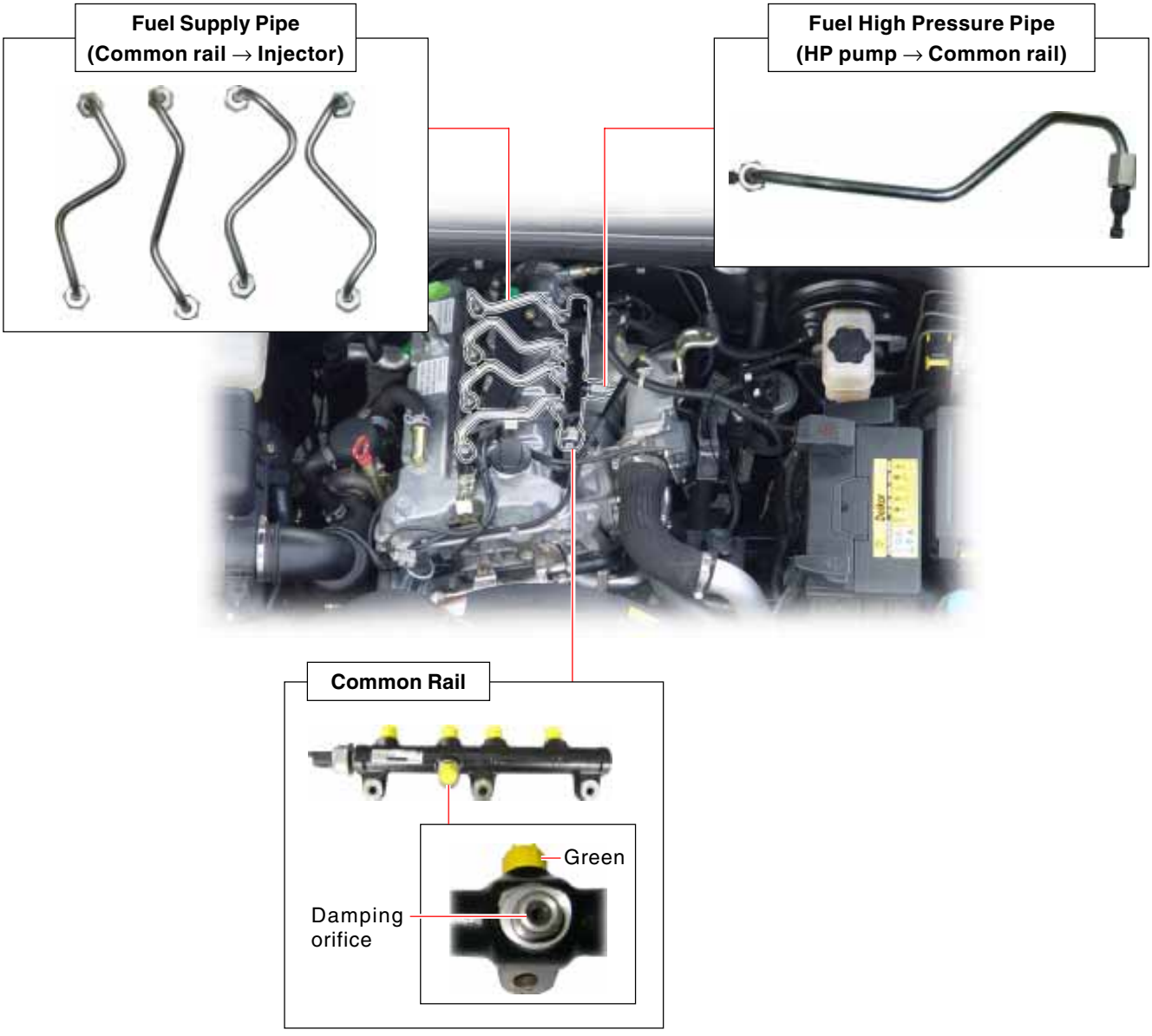
COMMON RAIL & FUEL SUPPLY PIPE

1. COMPONENTS AND OVERVIEW

The diameter of fuel supply pipe between HP pump and the common rail and the diameter of fuel pipe between the common rail and the injector have been increased to provide the increased volume of fuel injection for the higher output of D20DT (EURO 4) engine.

Also, the orifice has been added to prevent the fuel pulsation in the common rail and the HP pump fuel supply line.

To control the amount of injected fuel to each cylinder precisely and evenly, it is important to prevent the fuel pulsation occurred during the fuel supply and fuel cut.

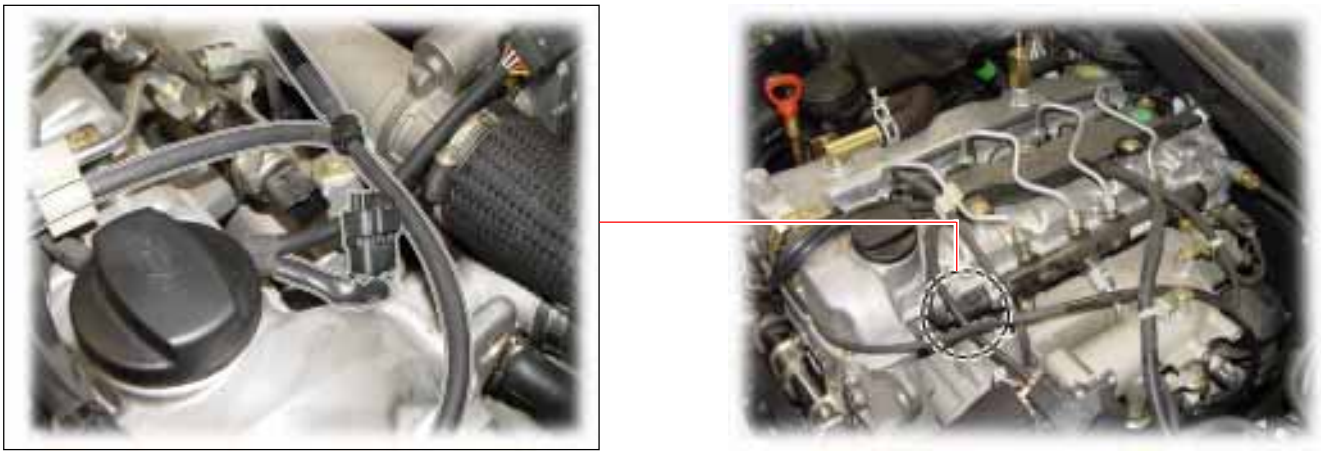


CHANGED BY	
EFFECTIVE DATE	
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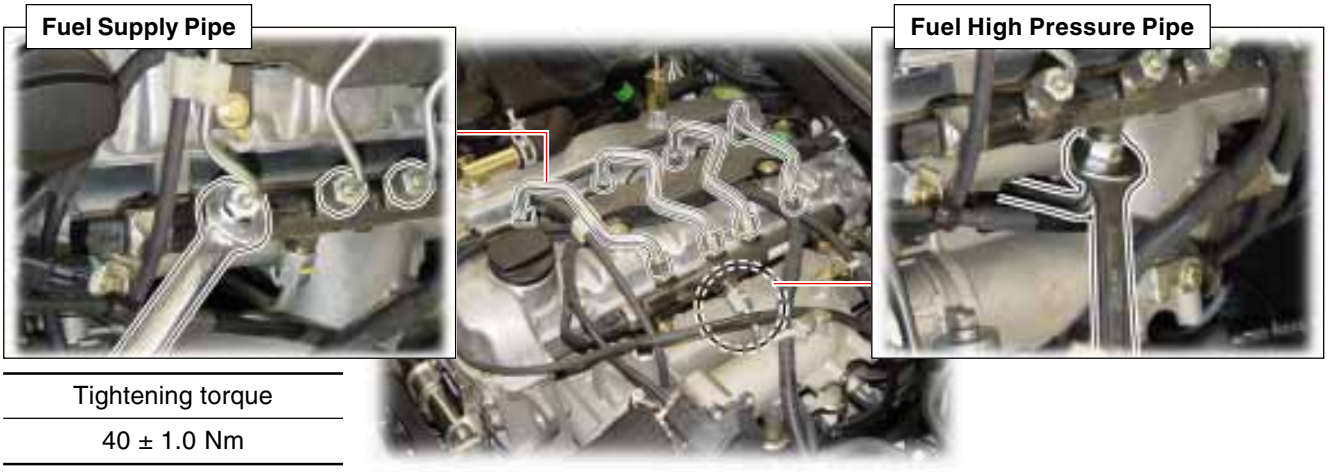
2. REMOVAL AND INSTALLATION OF COMMON RAIL AND FUEL SUPPLY PIPE

※ **Preceding Work:** Remove the engine cover.

1. Disconnect the fuel pressure sensor connector and remove the clamps.



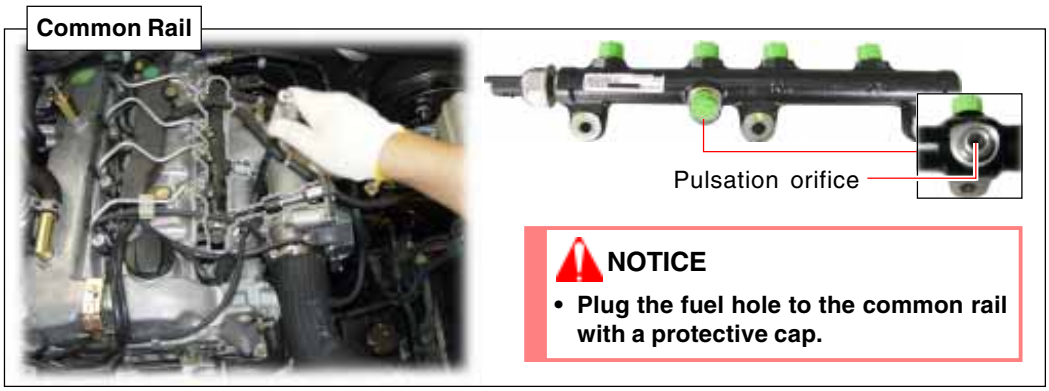
2. Unscrew the mounting bolts of the fuel high pressure pipe and common rail to remove the fuel supply pipe, fuel high pressure pipe and common rail from the engine.



Tightening torque
40 ± 1.0 Nm

NOTICE

- **When installing, replace the fuel supply pipes with new ones.**
- **Plug the fuel hole to the common rail with a protective cap.**



NOTICE

- **Plug the fuel hole to the common rail with a protective cap.**

MEMO

EXHAUST SYSTEM

1725 / 1790 / 1792 / 2433

TABLE OF CONTENTS

EXHAUST SYSTEM 2

1. Components 2

E-EGR VALVE (Electric-Exhaust Gas Recirculation Valve) 3

1. Overview of E-EGR Valve 3
2. Operating range of E-EGR valve 5
3. Structure of E-EGR valve 6
4. Removal and installation of E-EGR valve assembly 7

EGR COOLER 10

1. Overview of EGR cooler 10
2. Removal and installation of ERG cooler 10

VACUUM MODULATOR FOR CONTROLLING VGT TURBOCHARGER ACTUATOR 11

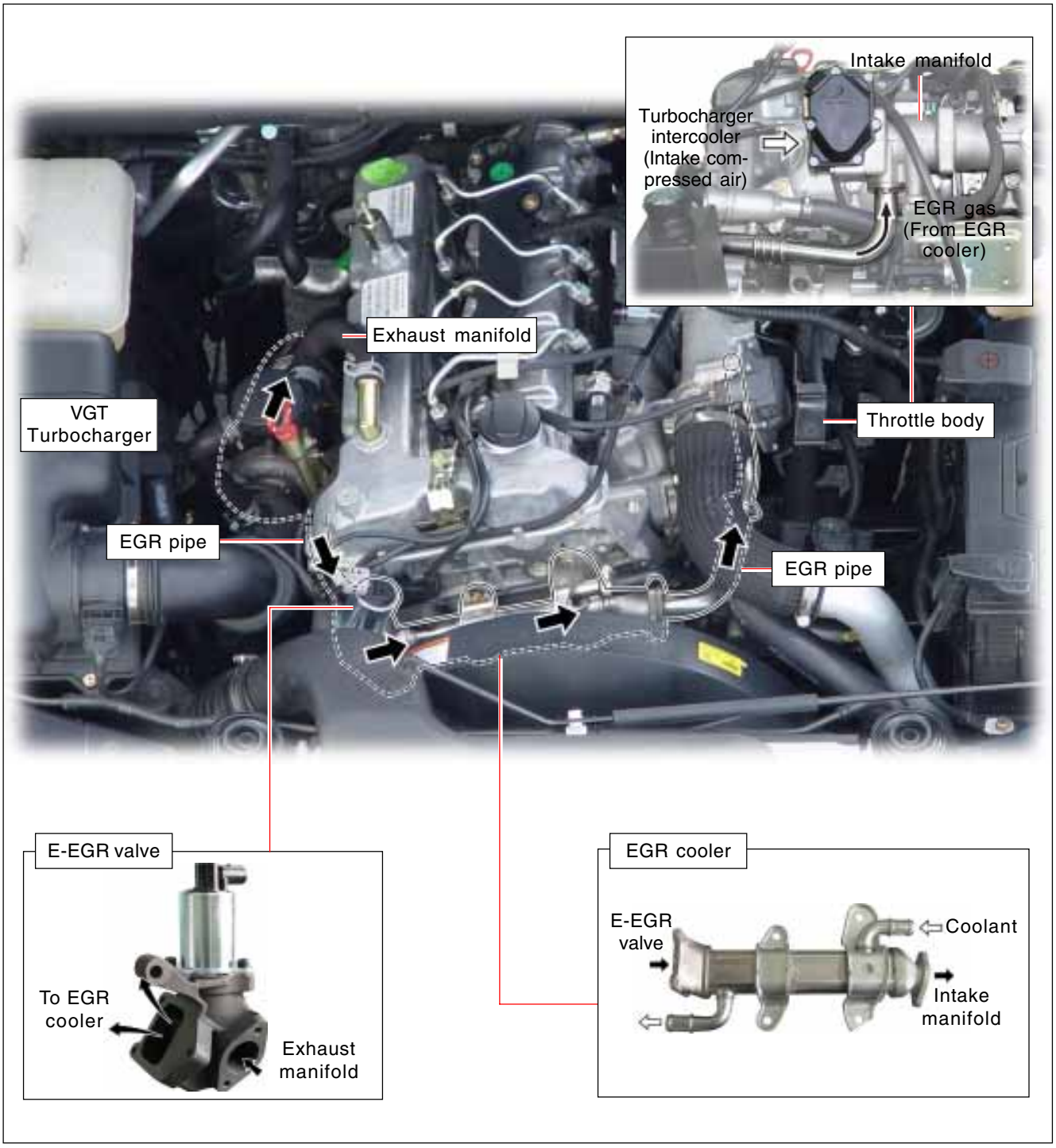
1. Overview and system layout 11
2. Removal and installation of vacuum modulator 12

EXHAUST SYSTEM

1. COMPONENTS

The components of the exhaust system for the D20DT (EURO4) engine have been changed as follows:

1. **E-EGR valve**: Controlling the EGR valve electrically and sends the valve location signal to ECU (vacuum modulator control has been deleted)
2. **EGR cooler**: Decreasing EGR gas (NOx) efficiently by cooling the EGR gas and let it flow to the intake pipe



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

E-EGR VALVE (Electric-Exhaust Gas Recirculation Valve)

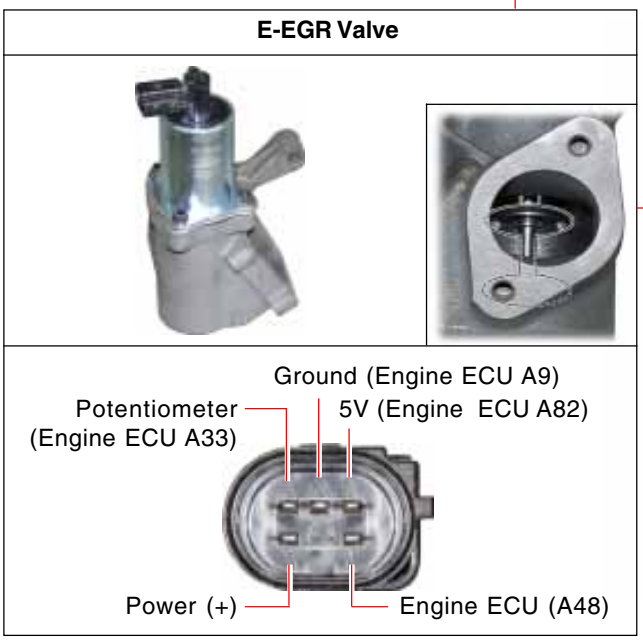
1. OVERVIEW OF E-EGR VALVE

The EGR valve for the D20DT (EURO4) engine is the E-EGR (Electric-Exhaust Gas Recirculation) valve that is directly controlled by the ECU with electric signal, while the EGR valve for the D20DT engine is controlled by the vacuum modulator.

The E-EGR valve is directly controlled by the ECU through the duty control and the valve location signal is sent to ECU as feedback.

This signal is also used as feedback signal for ECU to control the EGR rate. Also it is used to check whether the E-EGR valve is properly controlled by ECU.







The E-EGR valve is controlled electrically, not by vacuum, and duty controlled. Its functions and performance have been changed as follows compared to the EGR valve controlled by vacuum modulator.

1. Improved response and accuracy by engine ECU control

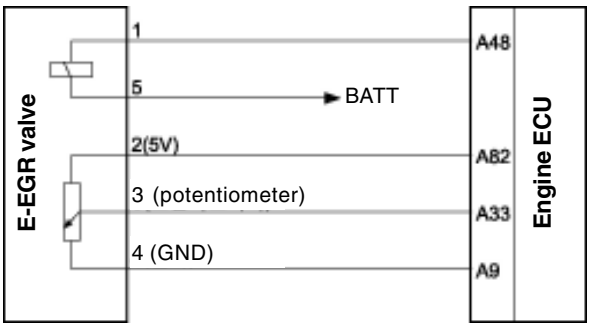
For the D20DT engine, the vacuum modulator between engine ECU and EGR valve controls the opening level of EGR valve. However, for the D20DT (EURO4) engine, the engine ECU operates the solenoid in EGR valve only by electric signals.

The response of the EGR valve has been improved as the engine ECU controls the valve directly. Also, the valve is controlled more precisely by the electric signals.

2. Feedback function of E-EGR valve

By mean of electric signals, the engine ECU can directly control the E-EGR valve and take feedback of the valve location. In addition to, EGR control feedback signal from the HFM sensor improves the control of E-EGR valve.





The solenoid resistance of E-EGR valve is approx. 8W ± 0.5W at No. 1 and 5 terminals and the overall resistance at No. 2 and 4 terminals is approx. 4 kW ± 40%.

The resistance (at No. 3 and 2 terminals) changes as the EGR's opening level changes by the electric signals in ECU.

This signal is sent to ECU as feedback signals indicating opening level of EGR valve.

Basically, the feedback signal for the EGR valve's opening level indicates the air intake volume of the HFM sensor. (If the exhaust gas is entered into the intake pipe as the EGR valve opens, the amount of fresh air entered via the HFM sensor decreases. The engine ECU receives the amount of air passing the HFM sensor according to the opening level of the EGR valve.)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Prevention of EGR valve's chattering and improved durability

Two valve seats of the EGR valve decrease the chattering phenomenon of the valve occurred by the pressure of exhaust gas when the valve is being opened or closed. As to this, the durability of the valve stem has been improved.

4. Cleaning function of EGR valve

The solenoid valve is operated when the engine is being turned off and is at mid-high speed to remove the foreign materials (eg, carbon) accumulated on the valve seat and housing.

5. Learning function of EGR valve location for carbon accumulation

The E-EGR valve monitors the closed and open location of valve before turning off the engine. This value is analyzed to compensate the changes in valve position occurred by the accumulated carbon.

2. OPERATING RANGE OF E-EGR VALVE

The operating range and control range of the E-EGR valve are controlled by control logic (MAP). Followings show only major operating range.

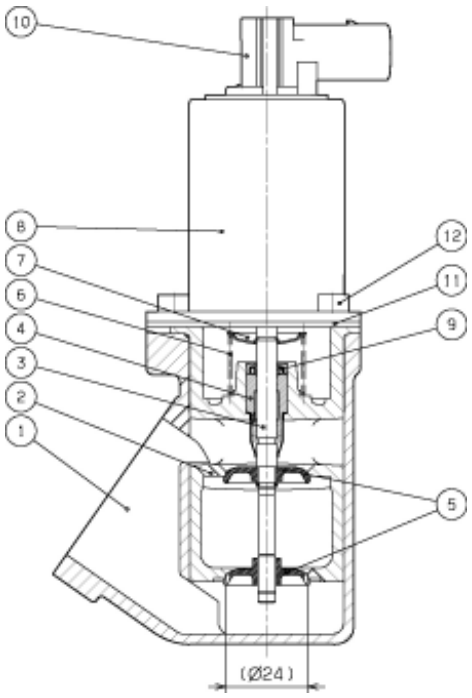
1. **Intake air temperature : approx. -10°C ~ 50°C**
2. **Atmospheric pressure: Over approx. 0.92 bar**
3. **Engine coolant temperature: 0°C ~ 100°C**
4. **EGR valve shut-off when acceleration (engine rpm > 2600)**
5. **EGR valve shut-off when engine is idling for over 1 minute**
6. **EGR valve shut-off when vehicle speed is over 100 km/h**
7. **EGR valve shut-off when engine torque is over 380 Nm**
8. **EGR valve is normal when there is no DTC related to EGR valve.**

3. STRUCTURE OF E-EGR VALVE

Internal Structure

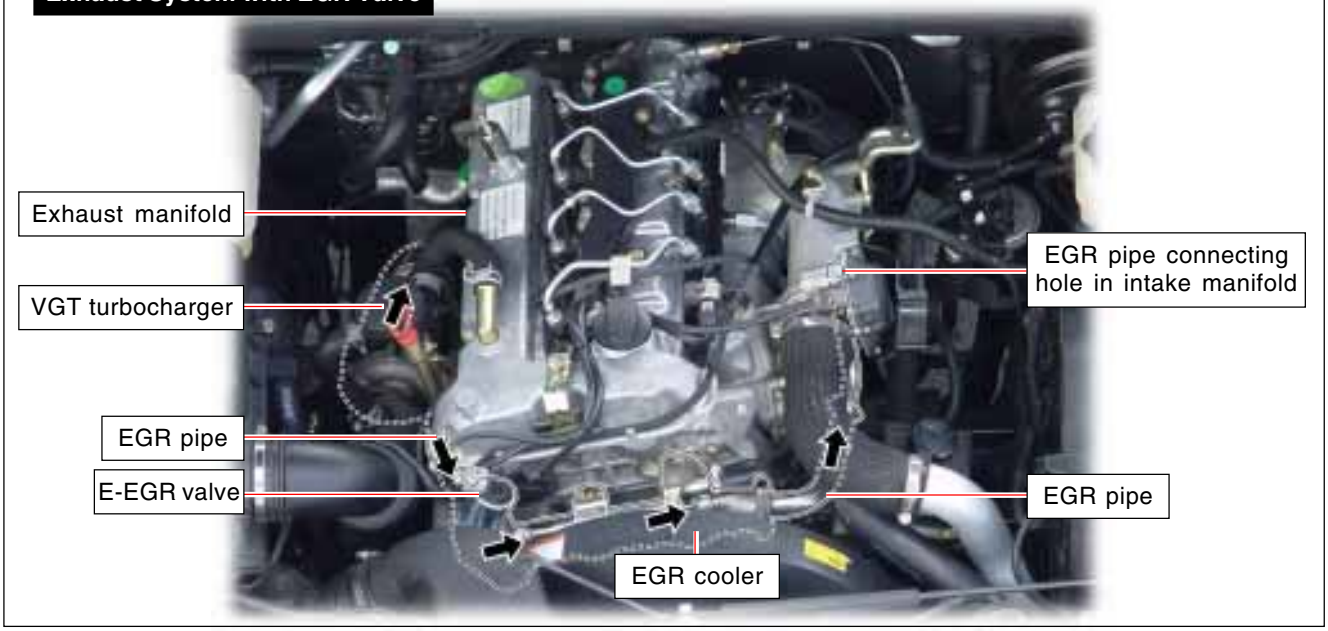






1. Valve body
2. Socket
3. Stem
4. Stem guide assembly
5. Valve disc (2) - Diameter ϕ 24 mm
6. Spring
7. Spring disc
8. Solenoid housing assembly
9. Sealing assembly
10. Potentiometer and connector
11. Gasket
12. Bolt

Exhaust System with EGR Valve



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

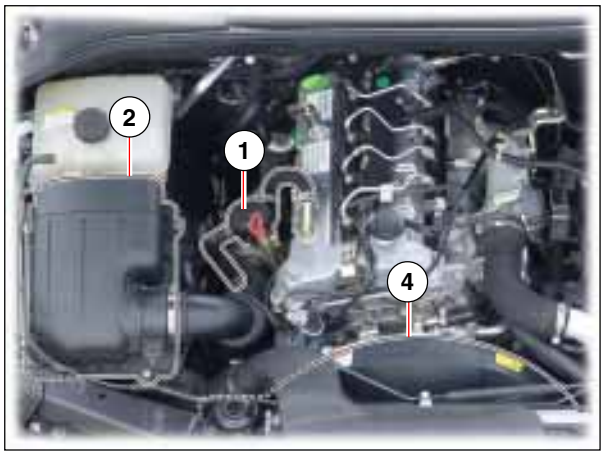
4. REMOVAL AND INSTALLATION OF E-EGR VALVE ASSEMBLY

NOTICE

- **When removing the E-EGR valve, the EGR cooler pipe should be removed too.**
- **The solenoid and the valve housing can be separated. However, E-EGR valve assembly should be removed as a unit for setting the valve seat.**

▶ Removal and Installation

※ **Preceding Works:**
1. Remove the PCV oil separator
2. Intake inlet duct.
3. Drain the coolant.
4. Remove the fan shroud and cooling fan.



1. Open the drain cock under the radiator and drain the coolant completely.

NOTICE

- **The coolant should be stored in the designated container. Be careful not to spill the coolant at any place.**

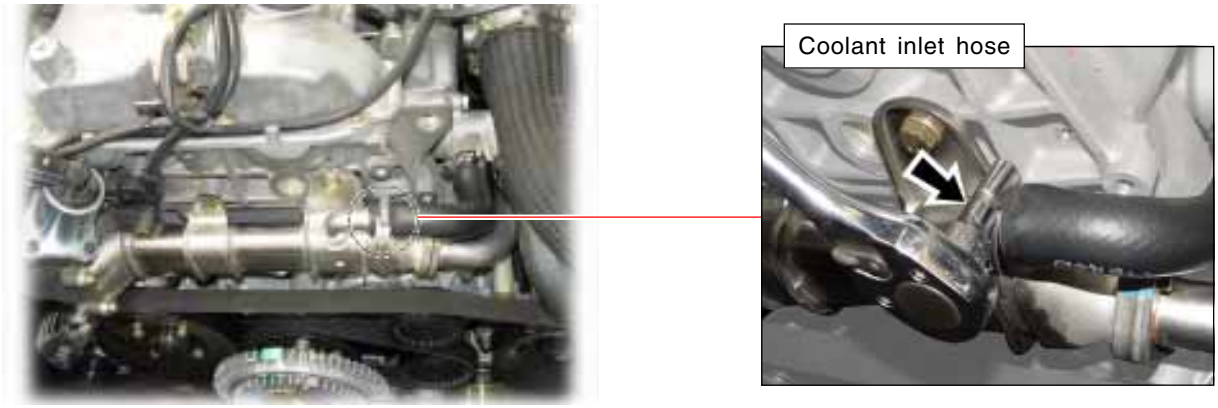


2. Disconnect the front air duct and remove the fan shroud (including fan shroud band) and cooling fan.

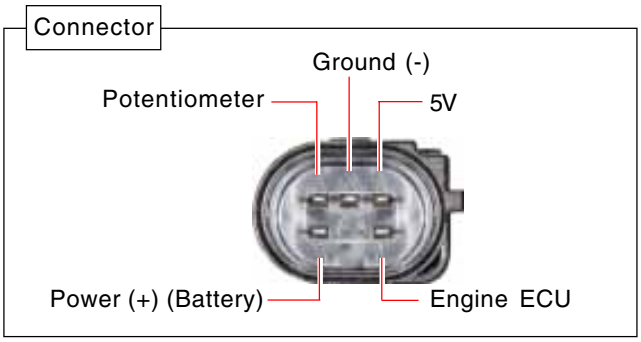




3. Disconnect the coolant inlet hose of EGR cooler pipe.

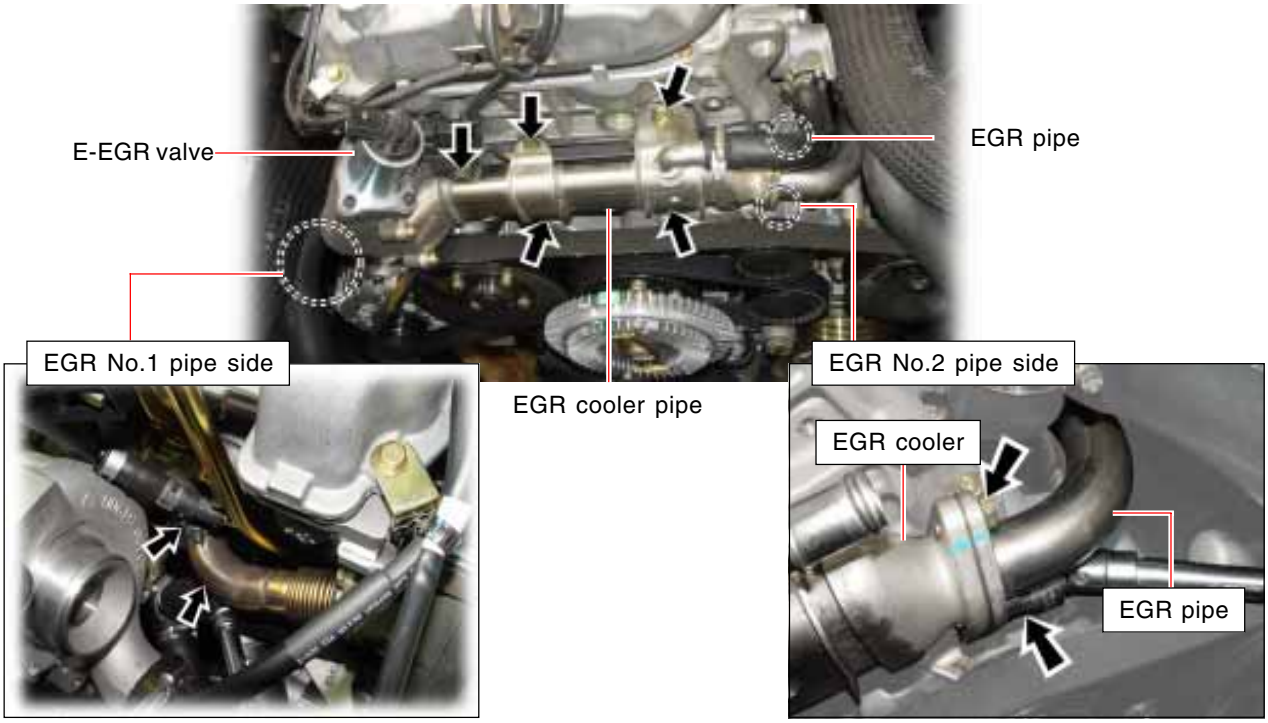


4. Disconnect the E-EGR valve connector.



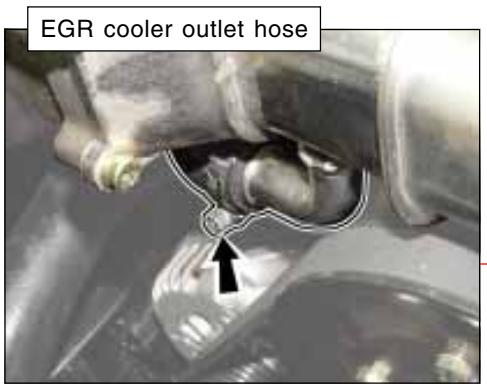


5. Unscrew the mounting bolts on E-EGR valve and EGR cooler.



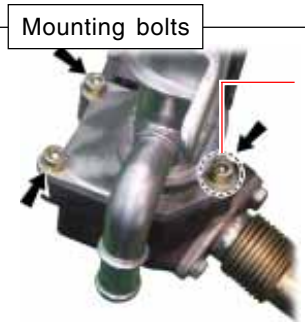
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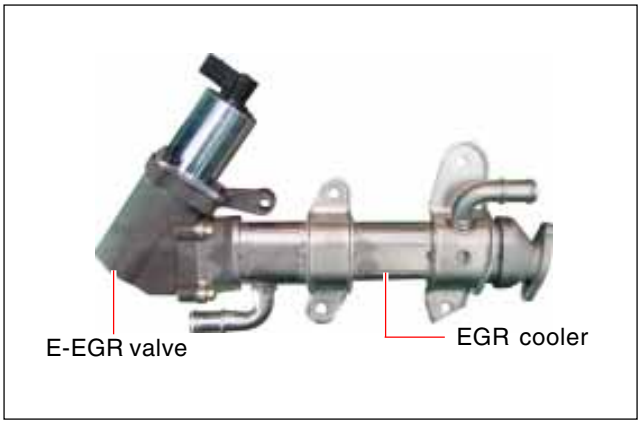
6. Release the hose clamp and remove the E-EGR valve and EGR cooler.





7. Remove the E-EGR valve and EGR cooler from the removed E-EGR valve assembly.

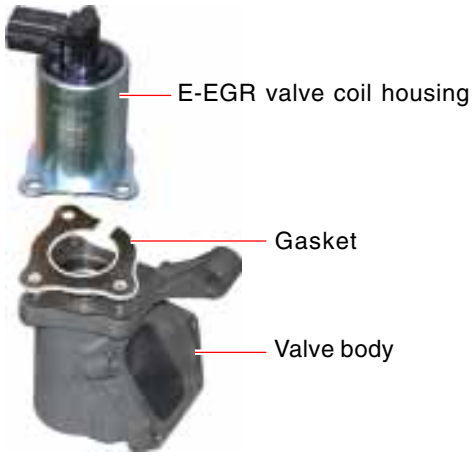




8. Separate the valve body and the E-EGR valve coil housing from the E-EGR valve assembly.



Structure of E-EGR Valve



These should be replaced as a unit.

EGR COOLER

1. OVERVIEW OF EGR COOLER

For D20DT (EURO4) engine, the EGR gas gets into intake manifold passing through the EGR cooler.

The EGR system is to reduce the nitrogen oxide (NOx). With the E-EGR valve, the EGR rate can be precisely controlled as the opening level of valve is precisely controlled and the feedback signal is sent to ECU.

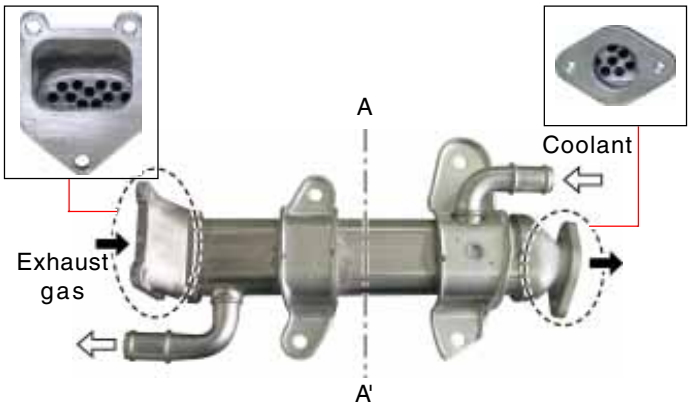
However, for more efficient EGR system (reducing NOx), the temperature of recirculated gas should be decreased. The EGR cooler decreases this temperature.

The EGR cooler is an additional cooling circuit on the center pipe. Also, the capacity of water pump has been increased for improving coolant flow.

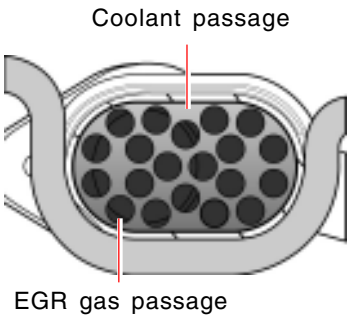
Location



EGR Cooler



Sectional View of EGR Cooler: A - A'



2. REMOVAL AND INSTALLATION OF ERG COOLER

* Refer to “E-EGR valve”

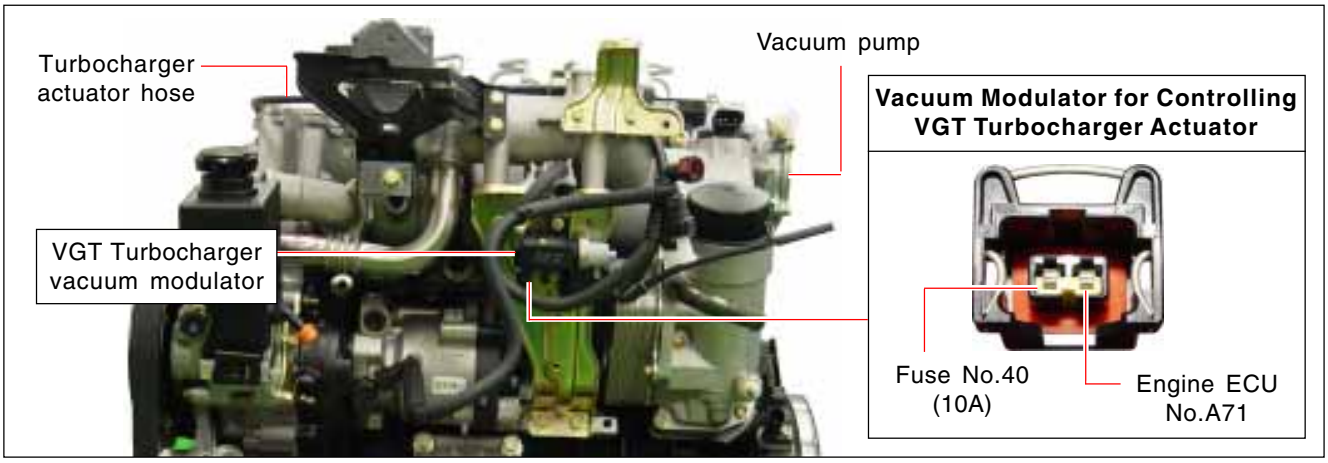
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VACUUM MODULATOR FOR CONTROLLING VGT TURBOCHARGER ACTUATOR

1. OVERVIEW AND SYSTEM LAYOUT

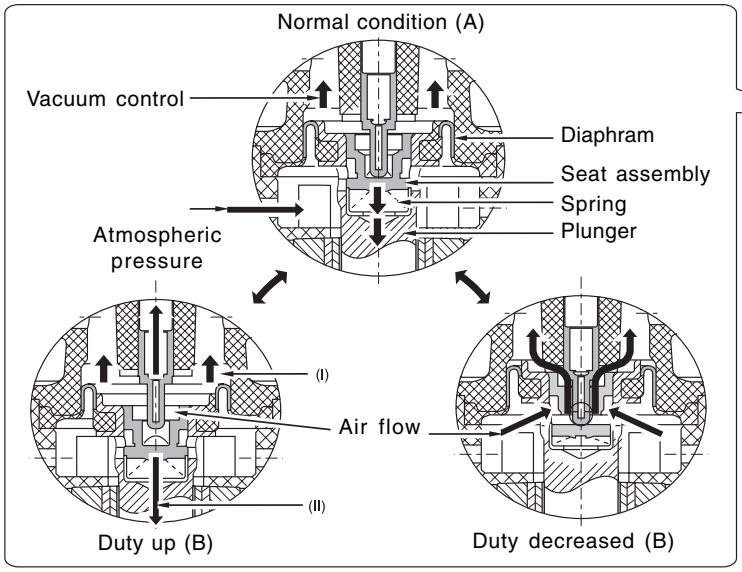
For the D20DT (EURO4) engine, the vacuum modulator for controlling EGR valve has been deleted and only the vacuum modulator for controlling VGT turbocharger actuator is used.

▶ System Layout

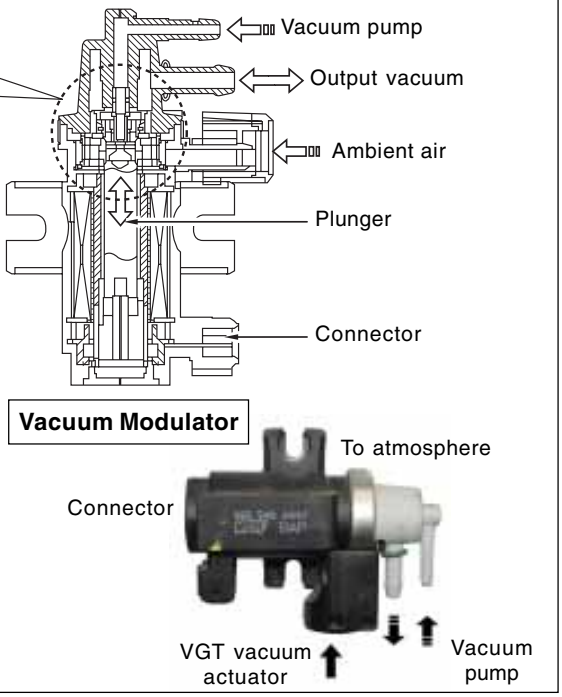


▶ Operating Principle of Vacuum Modulator

According to the signals from ECU, the solenoid valve regulates the vacuum pressure by vertical movement of plunger to operate the VGT turbocharger actuator. The plunger is moved by the vacuum pressure (-900 ± 20 mbar) from the vacuum pump (PWM control type).

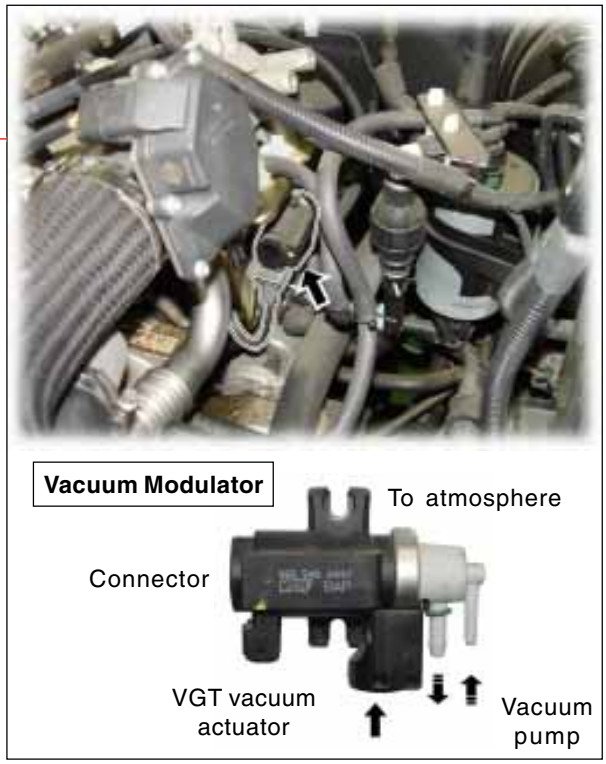


* The vacuum pressure is adjusted according to the pressure of nipple cover chamber (I) and the magnetic force (II) of plunger.

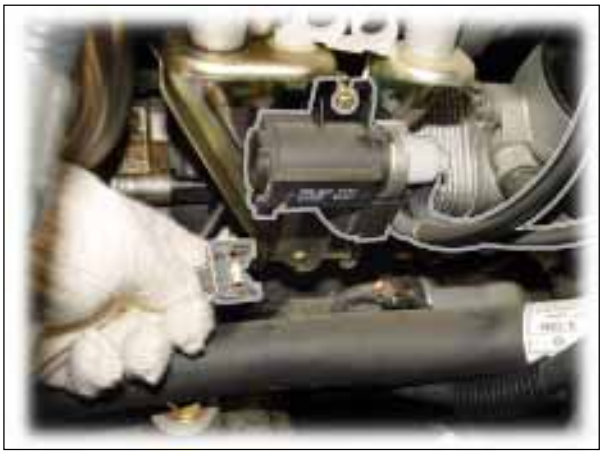


2. REMOVAL AND INSTALLATION OF VACUUM MODULATOR

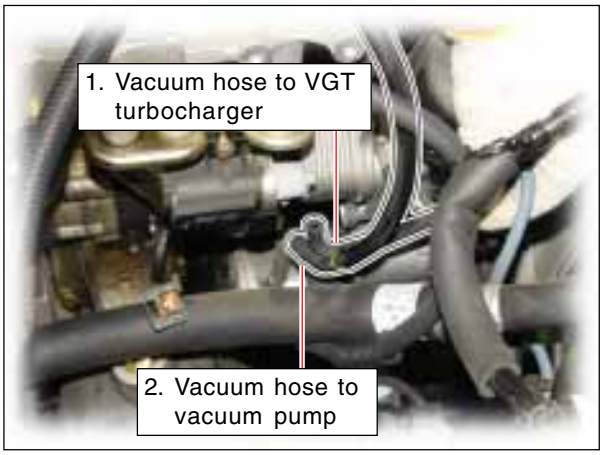




1. Disconnect the vacuum modulator connector.

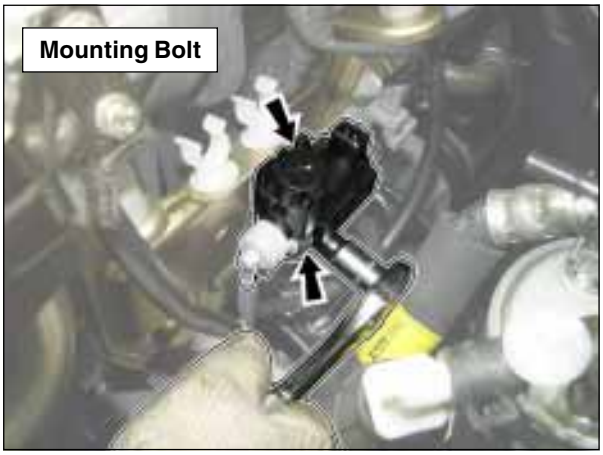


2. Disconnect the vacuum hoses (1, 2) from vacuum modulator.



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3. Unscrew the mounting bolt and remove the vacuum modulator (Tightening torque: 10 ± 1.0 Nm).





4. Install in the reverse order of removal.

MEMO

EXHAUST SYSTEM

1725 / 1790 / 1792 / 2433

TABLE OF CONTENTS

EXHAUST SYSTEM 2

1. Components 2

E-EGR VALVE (Electric-Exhaust Gas Recirculation Valve) 3

1. Overview of E-EGR Valve 3
2. Operating range of E-EGR valve 5
3. Structure of E-EGR valve 6
4. Removal and installation of E-EGR valve assembly 7

EGR COOLER 10

1. Overview of EGR cooler 10
2. Removal and installation of ERG cooler 10

VACUUM MODULATOR FOR CONTROLLING VGT TURBOCHARGER ACTUATOR 11

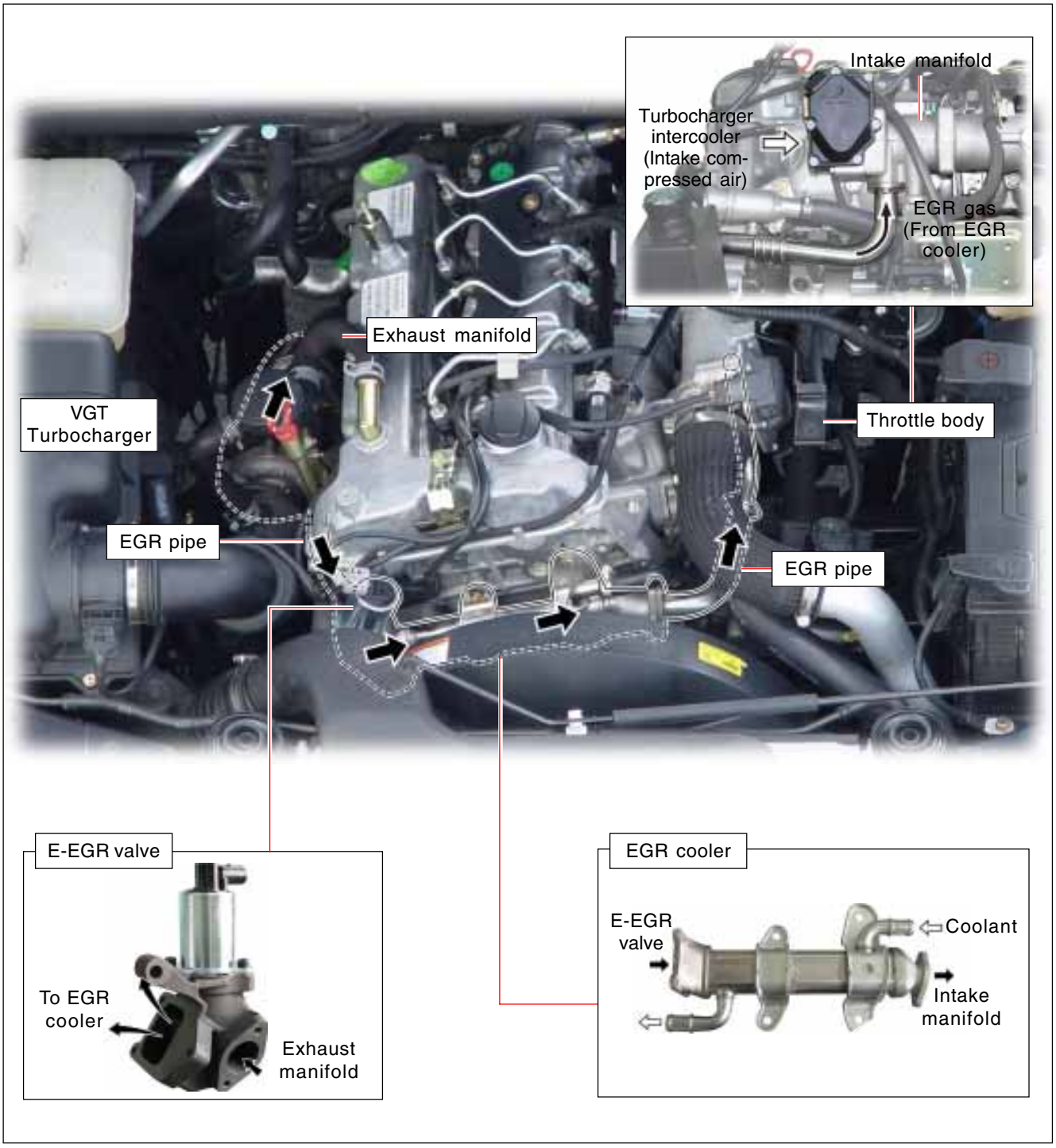
1. Overview and system layout 11
2. Removal and installation of vacuum modulator 12

EXHAUST SYSTEM

1. COMPONENTS

The components of the exhaust system for the D20DT (EURO4) engine have been changed as follows:

1. **E-EGR valve**: Controlling the EGR valve electrically and sends the valve location signal to ECU (vacuum modulator control has been deleted)
2. **EGR cooler**: Decreasing EGR gas (NOx) efficiently by cooling the EGR gas and let it flow to the intake pipe



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AFFECTED VIN	

E-EGR VALVE (Electric-Exhaust Gas Recirculation Valve)

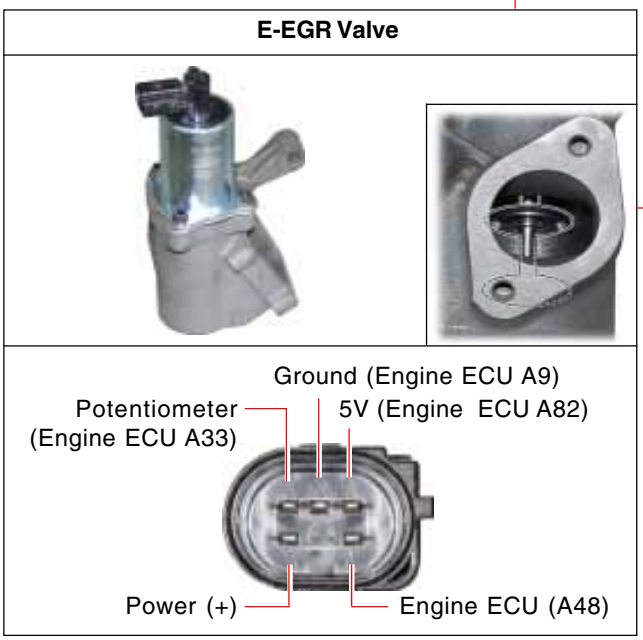
1. OVERVIEW OF E-EGR VALVE

The EGR valve for the D20DT (EURO4) engine is the E-EGR (Electric-Exhaust Gas Recirculation) valve that is directly controlled by the ECU with electric signal, while the EGR valve for the D20DT engine is controlled by the vacuum modulator.

The E-EGR valve is directly controlled by the ECU through the duty control and the valve location signal is sent to ECU as feedback.

This signal is also used as feedback signal for ECU to control the EGR rate. Also it is used to check whether the E-EGR valve is properly controlled by ECU.







The E-EGR valve is controlled electrically, not by vacuum, and duty controlled. Its functions and performance have been changed as follows compared to the EGR valve controlled by vacuum modulator.

1. Improved response and accuracy by engine ECU control

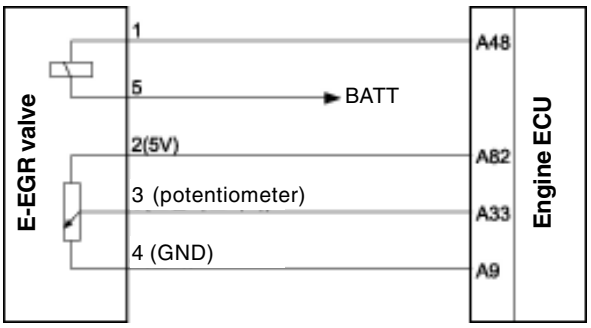
For the D20DT engine, the vacuum modulator between engine ECU and EGR valve controls the opening level of EGR valve. However, for the D20DT (EURO4) engine, the engine ECU operates the solenoid in EGR valve only by electric signals.

The response of the EGR valve has been improved as the engine ECU controls the valve directly. Also, the valve is controlled more precisely by the electric signals.

2. Feedback function of E-EGR valve

By mean of electric signals, the engine ECU can directly control the E-EGR valve and take feedback of the valve location. In addition to, EGR control feedback signal from the HFM sensor improves the control of E-EGR valve.





The solenoid resistance of E-EGR valve is approx. 8W ± 0.5W at No. 1 and 5 terminals and the overall resistance at No. 2 and 4 terminals is approx. 4 kW ± 40%.

The resistance (at No. 3 and 2 terminals) changes as the EGR's opening level changes by the electric signals in ECU.

This signal is sent to ECU as feedback signals indicating opening level of EGR valve.

Basically, the feedback signal for the EGR valve's opening level indicates the air intake volume of the HFM sensor. (If the exhaust gas is entered into the intake pipe as the EGR valve opens, the amount of fresh air entered via the HFM sensor decreases. The engine ECU receives the amount of air passing the HFM sensor according to the opening level of the EGR valve.)

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EFFECTIVE DATE	
AFFECTED VIN	

3. Prevention of EGR valve's chattering and improved durability

Two valve seats of the EGR valve decrease the chattering phenomenon of the valve occurred by the pressure of exhaust gas when the valve is being opened or closed. As to this, the durability of the valve stem has been improved.

4. Cleaning function of EGR valve

The solenoid valve is operated when the engine is being turned off and is at mid-high speed to remove the foreign materials (eg, carbon) accumulated on the valve seat and housing.

5. Learning function of EGR valve location for carbon accumulation

The E-EGR valve monitors the closed and open location of valve before turning off the engine. This value is analyzed to compensate the changes in valve position occurred by the accumulated carbon.

2. OPERATING RANGE OF E-EGR VALVE

The operating range and control range of the E-EGR valve are controlled by control logic (MAP). Followings show only major operating range.

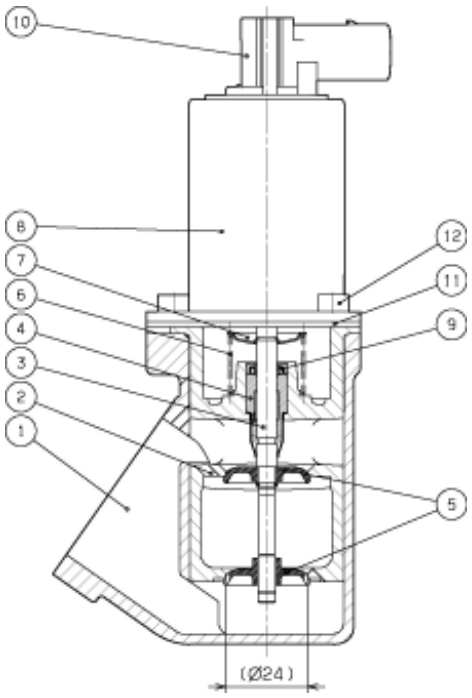
1. **Intake air temperature : approx. -10°C ~ 50°C**
2. **Atmospheric pressure: Over approx. 0.92 bar**
3. **Engine coolant temperature: 0°C ~ 100°C**
4. **EGR valve shut-off when acceleration (engine rpm > 2600)**
5. **EGR valve shut-off when engine is idling for over 1 minute**
6. **EGR valve shut-off when vehicle speed is over 100 km/h**
7. **EGR valve shut-off when engine torque is over 380 Nm**
8. **EGR valve is normal when there is no DTC related to EGR valve.**

3. STRUCTURE OF E-EGR VALVE

Internal Structure

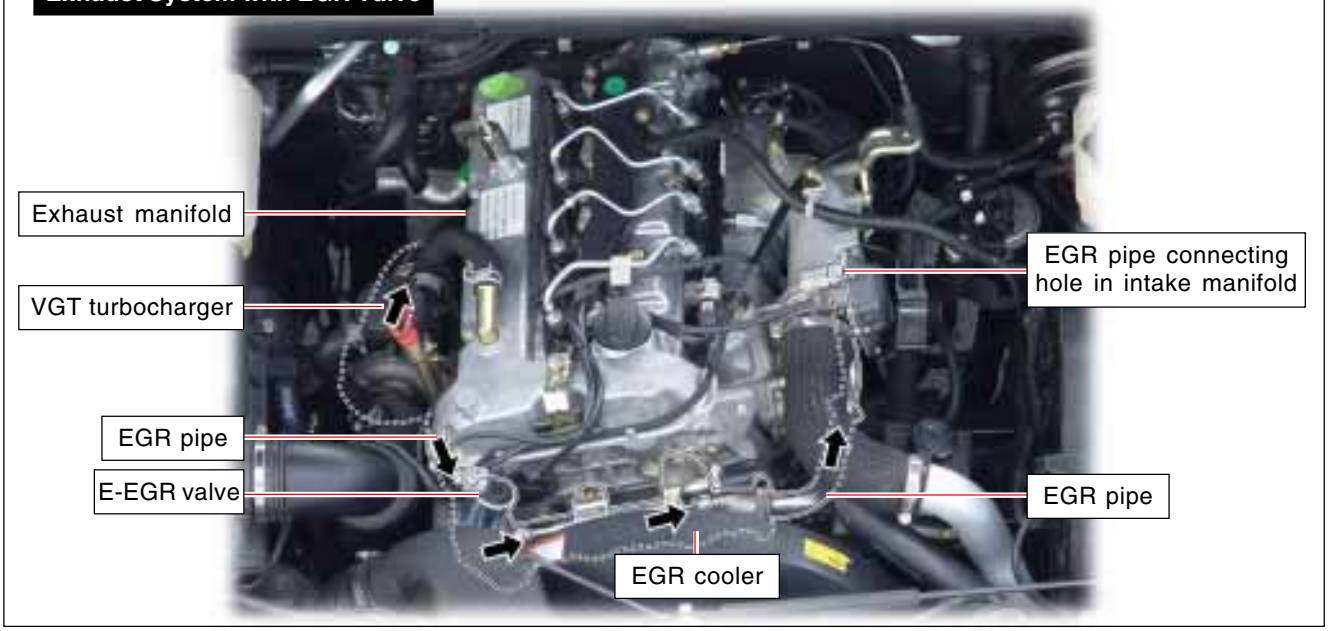






1. Valve body
2. Socket
3. Stem
4. Stem guide assembly
5. Valve disc (2) - Diameter ϕ 24 mm
6. Spring
7. Spring disc
8. Solenoid housing assembly
9. Sealing assembly
10. Potentiometer and connector
11. Gasket
12. Bolt

Exhaust System with EGR Valve



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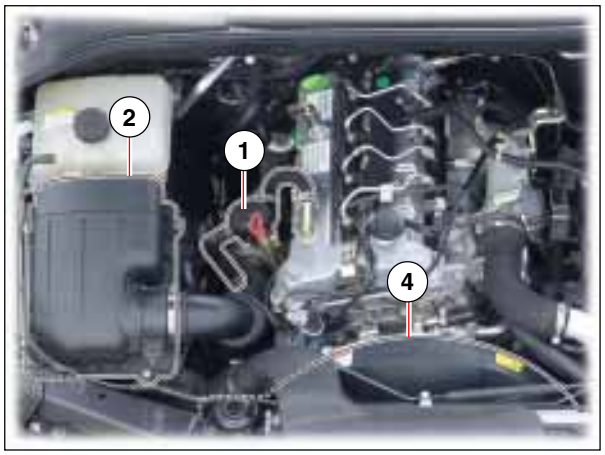
4. REMOVAL AND INSTALLATION OF E-EGR VALVE ASSEMBLY

NOTICE

- **When removing the E-EGR valve, the EGR cooler pipe should be removed too.**
- **The solenoid and the valve housing can be separated. However, E-EGR valve assembly should be removed as a unit for setting the valve seat.**

▶ Removal and Installation

※ **Preceding Works:**
1. Remove the PCV oil separator
2. Intake inlet duct.
3. Drain the coolant.
4. Remove the fan shroud and cooling fan.



1. Open the drain cock under the radiator and drain the coolant completely.

NOTICE

- **The coolant should be stored in the designated container. Be careful not to spill the coolant at any place.**

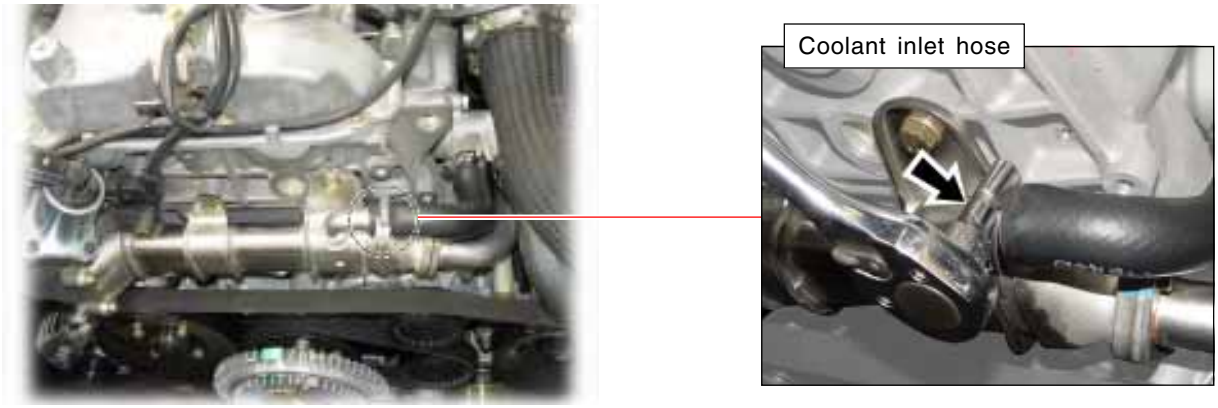


2. Disconnect the front air duct and remove the fan shroud (including fan shroud band) and cooling fan.

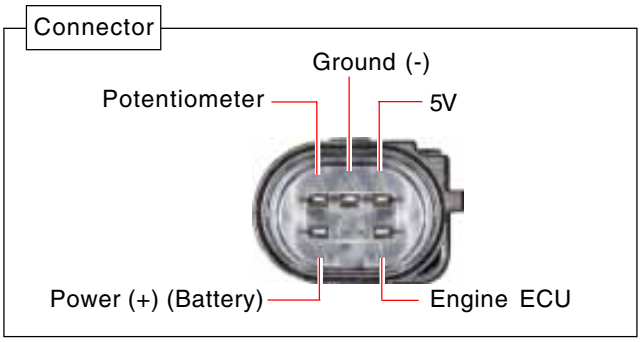




3. Disconnect the coolant inlet hose of EGR cooler pipe.

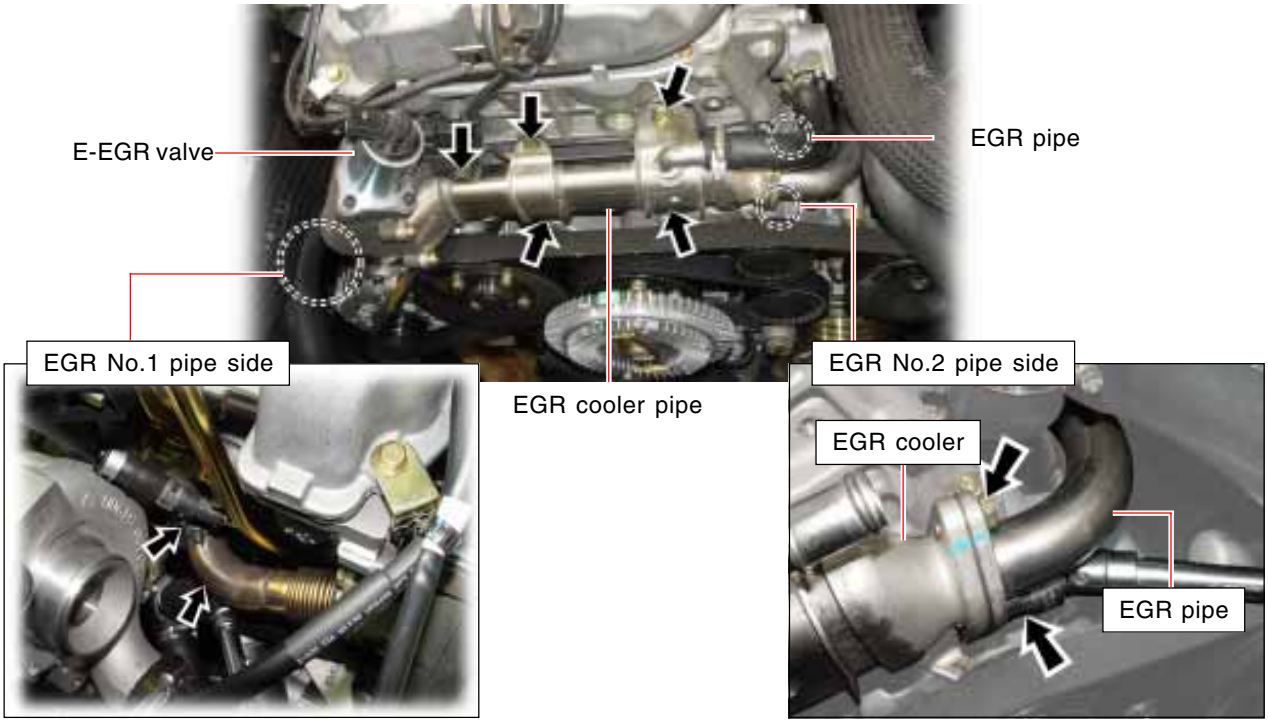


4. Disconnect the E-EGR valve connector.



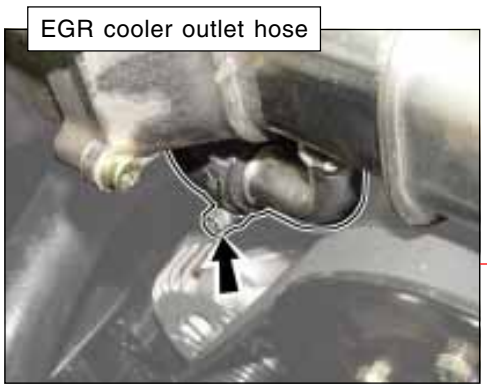


5. Unscrew the mounting bolts on E-EGR valve and EGR cooler.



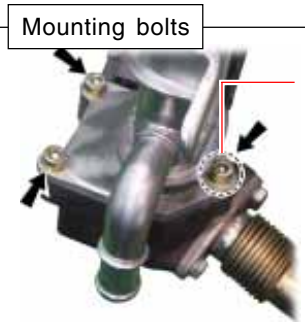
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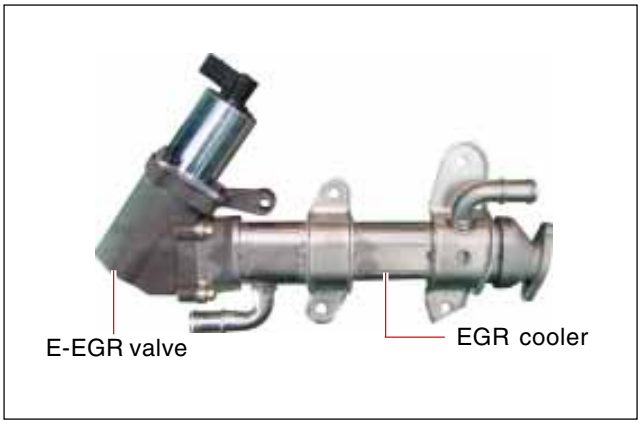
6. Release the hose clamp and remove the E-EGR valve and EGR cooler.





7. Remove the E-EGR valve and EGR cooler from the removed E-EGR valve assembly.

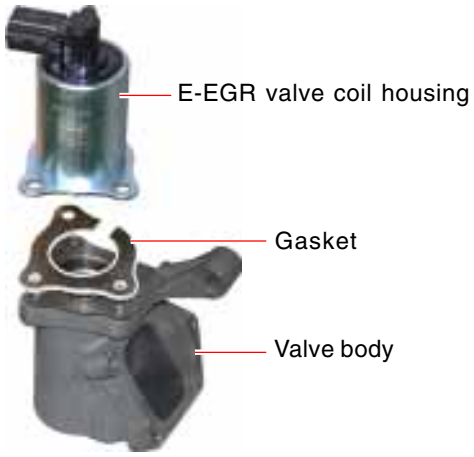




8. Separate the valve body and the E-EGR valve coil housing from the E-EGR valve assembly.



Structure of E-EGR Valve



These should be replaced as a unit.

EGR COOLER

1. OVERVIEW OF EGR COOLER

For D20DT (EURO4) engine, the EGR gas gets into intake manifold passing through the EGR cooler.

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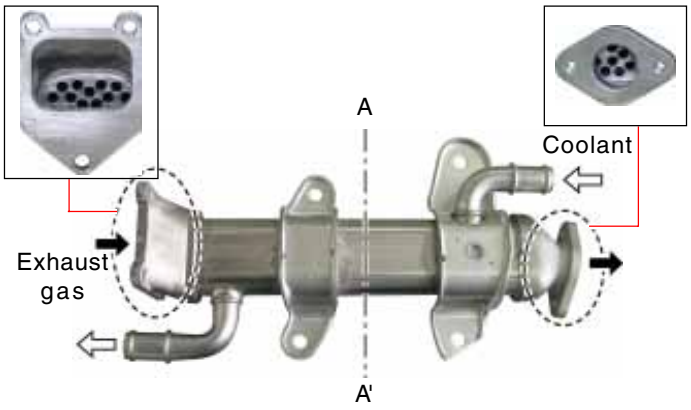
However, for more efficient EGR system (reducing NOx), the temperature of recirculated gas should be decreased. The EGR cooler decreases this temperature.

The EGR cooler is an additional cooling circuit on the center pipe. Also, the capacity of water pump has been increased for improving coolant flow.

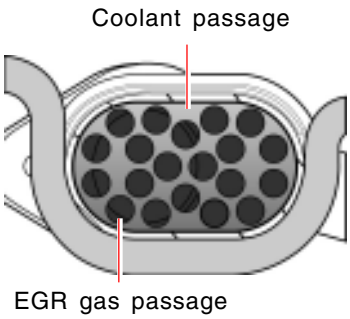
Location



EGR Cooler



Sectional View of EGR Cooler: A - A'



2. REMOVAL AND INSTALLATION OF ERG COOLER

* Refer to “E-EGR valve”

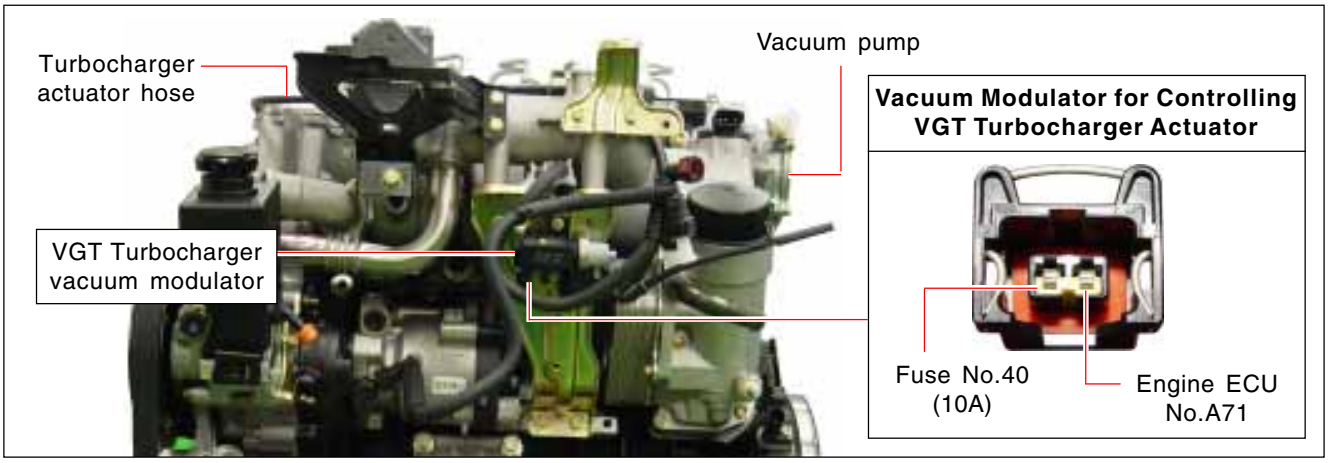
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VACUUM MODULATOR FOR CONTROLLING VGT TURBOCHARGER ACTUATOR

1. OVERVIEW AND SYSTEM LAYOUT

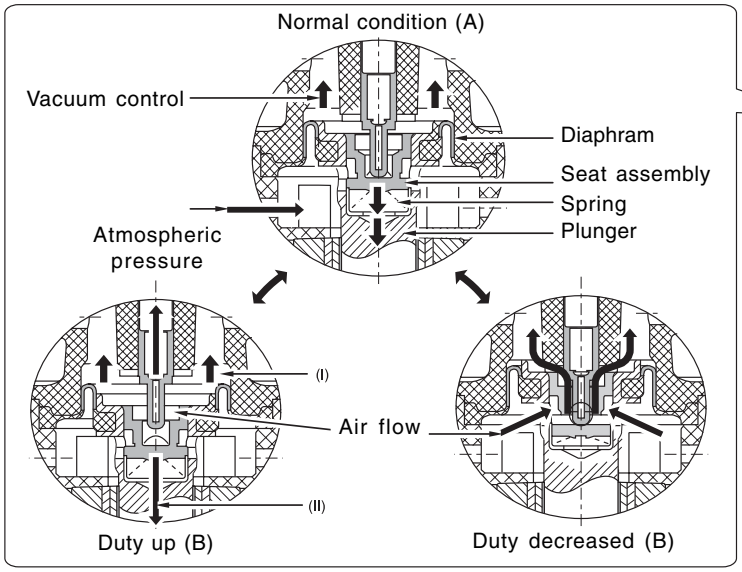
For the D20DT (EURO4) engine, the vacuum modulator for controlling EGR valve has been deleted and only the vacuum modulator for controlling VGT turbocharger actuator is used.

▶ System Layout

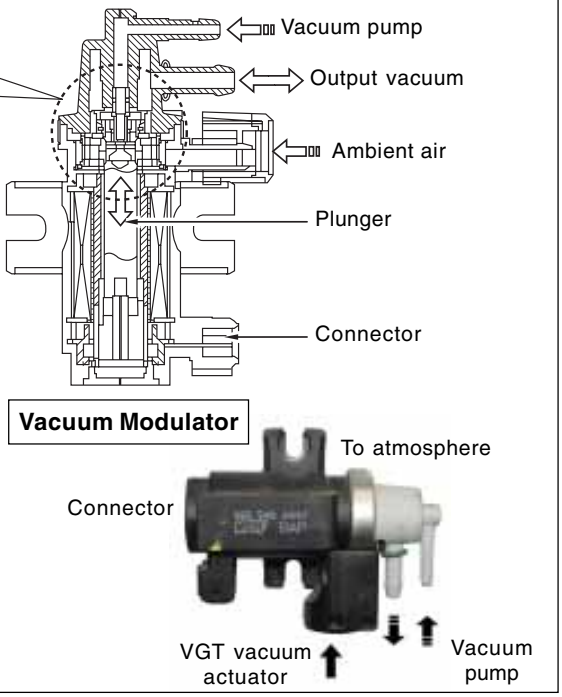


▶ Operating Principle of Vacuum Modulator

According to the signals from ECU, the solenoid valve regulates the vacuum pressure by vertical movement of plunger to operate the VGT turbocharger actuator. The plunger is moved by the vacuum pressure (-900 ± 20 mbar) from the vacuum pump (PWM control type).

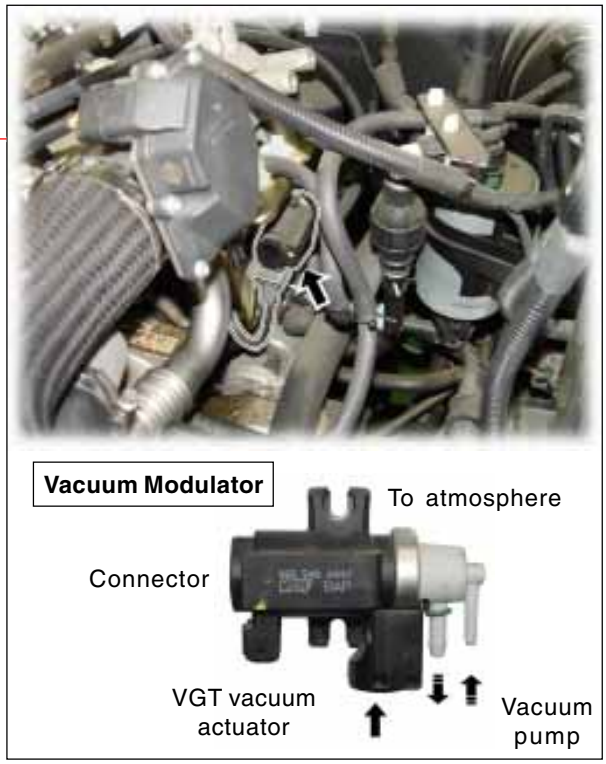


* The vacuum pressure is adjusted according to the pressure of nipple cover chamber (I) and the magnetic force (II) of plunger.

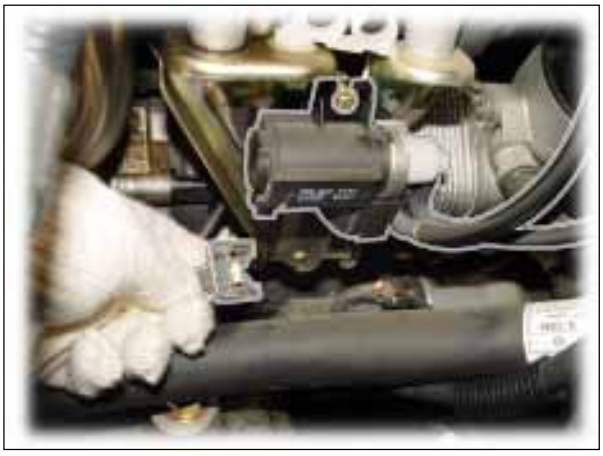


2. REMOVAL AND INSTALLATION OF VACUUM MODULATOR

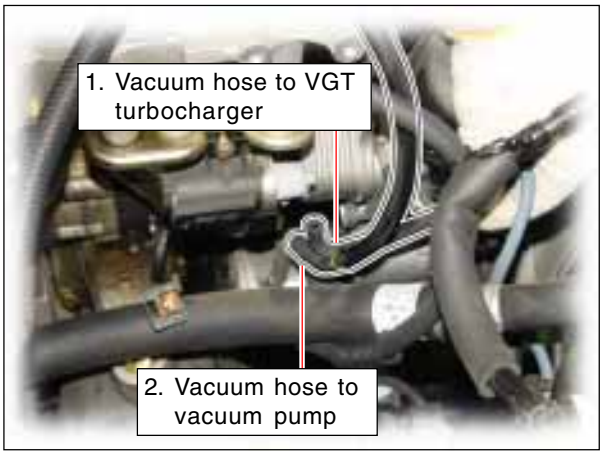




1. Disconnect the vacuum modulator connector.

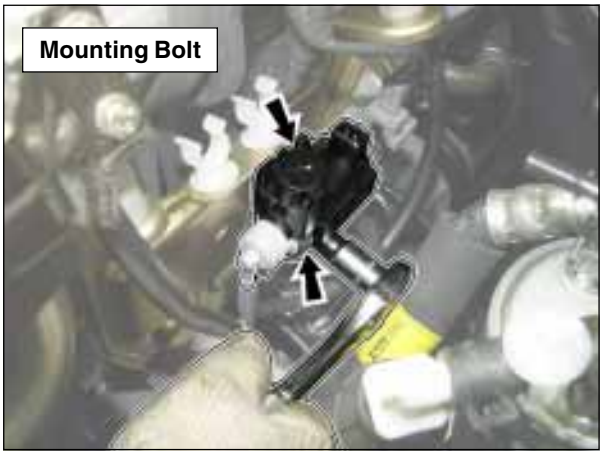


2. Disconnect the vacuum hoses (1, 2) from vacuum modulator.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Unscrew the mounting bolt and remove the vacuum modulator (Tightening torque: 10 ± 1.0 Nm).





4. Install in the reverse order of removal.

MEMO

PCV OIL SEPARATOR

1222

TABLE OF CONTENTS

PCV OIL SEPARATOR 2

1. Overview 2
2. Removal and Installation of Oil Separator 4

PCV OIL SEPARATOR

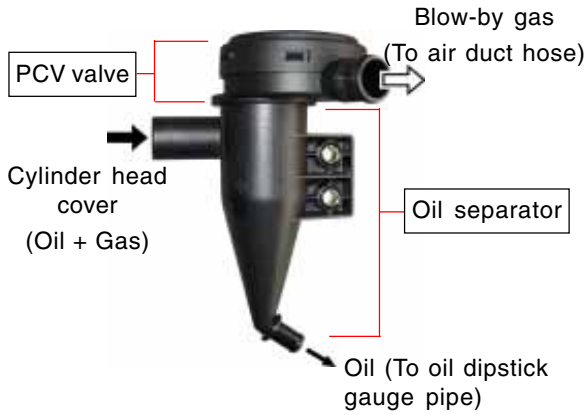
* PCV: Positive Crankcase Ventilation

1. OVERVIEW

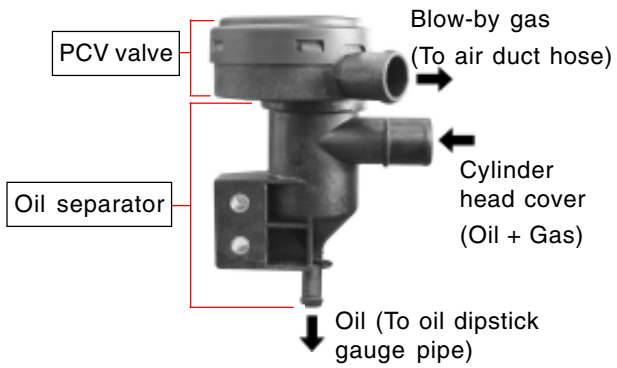
For the D20DT (EURO4) engine, the PCV oil separator's capacity has been increased by 10% compared to the conventional PCV oil separator for D20DT engine to separate the oil and the gas more efficiently.

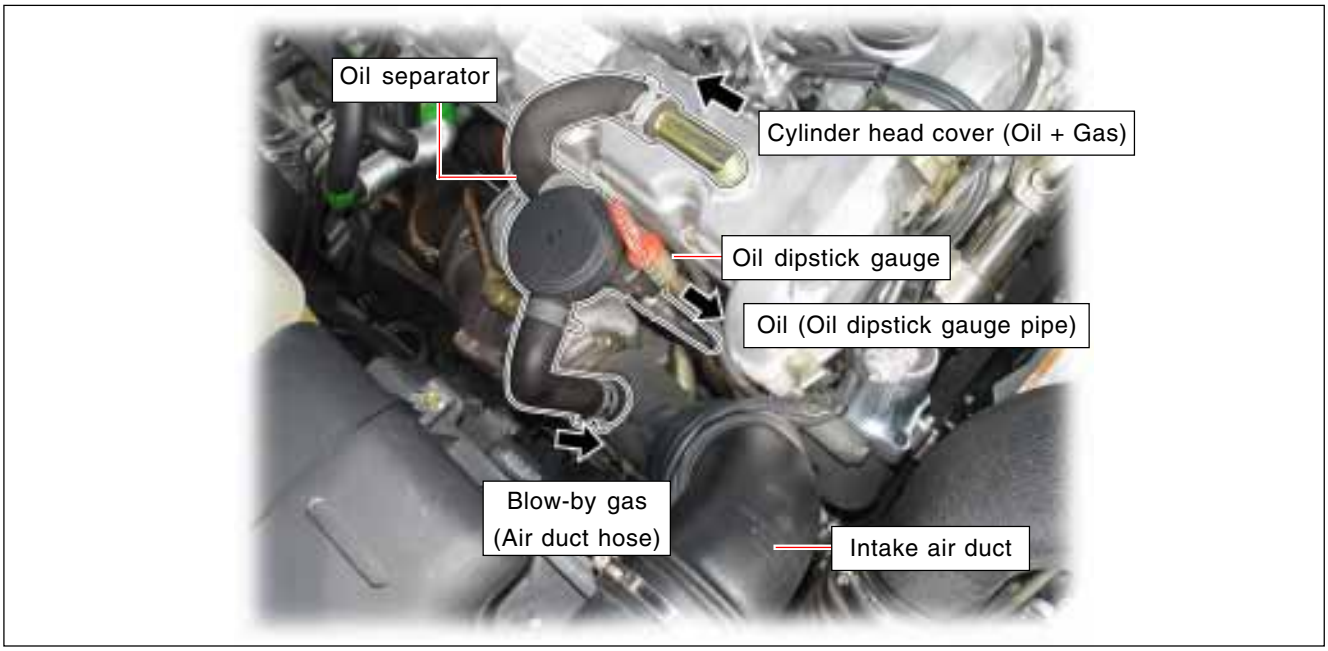
▶ Oil Separators

PCV Oil Separator (High Capacity Type)



PCV Oil Separator





The first separation will happen when blowby gas passes through baffle plates in cylinder head cover. Then oil and gas will be separated due to cyclone effect after entering the oil separator inlet port. Separated oil returns to oil pan via oil drain port and the gas will be burnt again after entering the combustion chamber through air duct hose via PCV valve that opens/closes due to pressure differences between the intake side and crankcase.

NOTICE

Performance of PCV Separator and Oil/Carbon Accumulation in Intake Manifold

It is not possible to separate the blowby gas (oil and unburned gas) completely from the crankcase. This problem is related to the engine control and the PCV oil separator is designed to recirculate approx. 70% of blowby gas.

When servicing the intake system, you can find that oil and carbon is accumulated in the intake pipe. It is normal for the vehicle that is normally used in city. Because of the engine control problem, the 100% of blowby gas cannot be recirculated and EGR and PCV oil separator's operating ranges are overlapped in normal driving mode. These are the cause of oil and carbon accumulated in the intake pipe.

When the EGR system is operated, the particulate material in the exhaust gas is drawn into the intake pipe and the oil not filtered in the PCV oil separator is also drawn into the intake pipe.

However, unless the particulate material or oil are accumulated excessively in the pipe, they do not affect the intake/exhaust valve or related components.

On the contrary, if they are removed using carbon cleaner or chemicals, the engine system may not function properly.

If too much oil or particulate material is accumulated, check the followings:

1. Engine oil level
2. EGR valve (exhaust gas leak and operating condition)
3. Turbocharger (oil/gas leak and operating condition)
4. PCV oil separator (installation condition and leak)
5. PCV oil separator (some functions)

2. REMOVAL AND INSTALLATION OF OIL SEPARATOR

※ **Preceding Work:** Remove the engine acoustic cover.

1. Disconnect the hoses from the PCV oil separator.



NOTICE

- **Be careful not to spill engine oil when disconnecting the hose from the oil dipstick gauge pipe.**

2. Unscrew two mounting bolts and remove the PCV oil separator.





NOTICE

- **If the clamp on the connecting port is loosened, replace it with new one.**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

COOLING SYSTEM

2112 / 1520

TABLE OF CONTENTS

COOLING SYSTEM 2

Comparison in cooling system for each engine 2

WATER PUMP 3

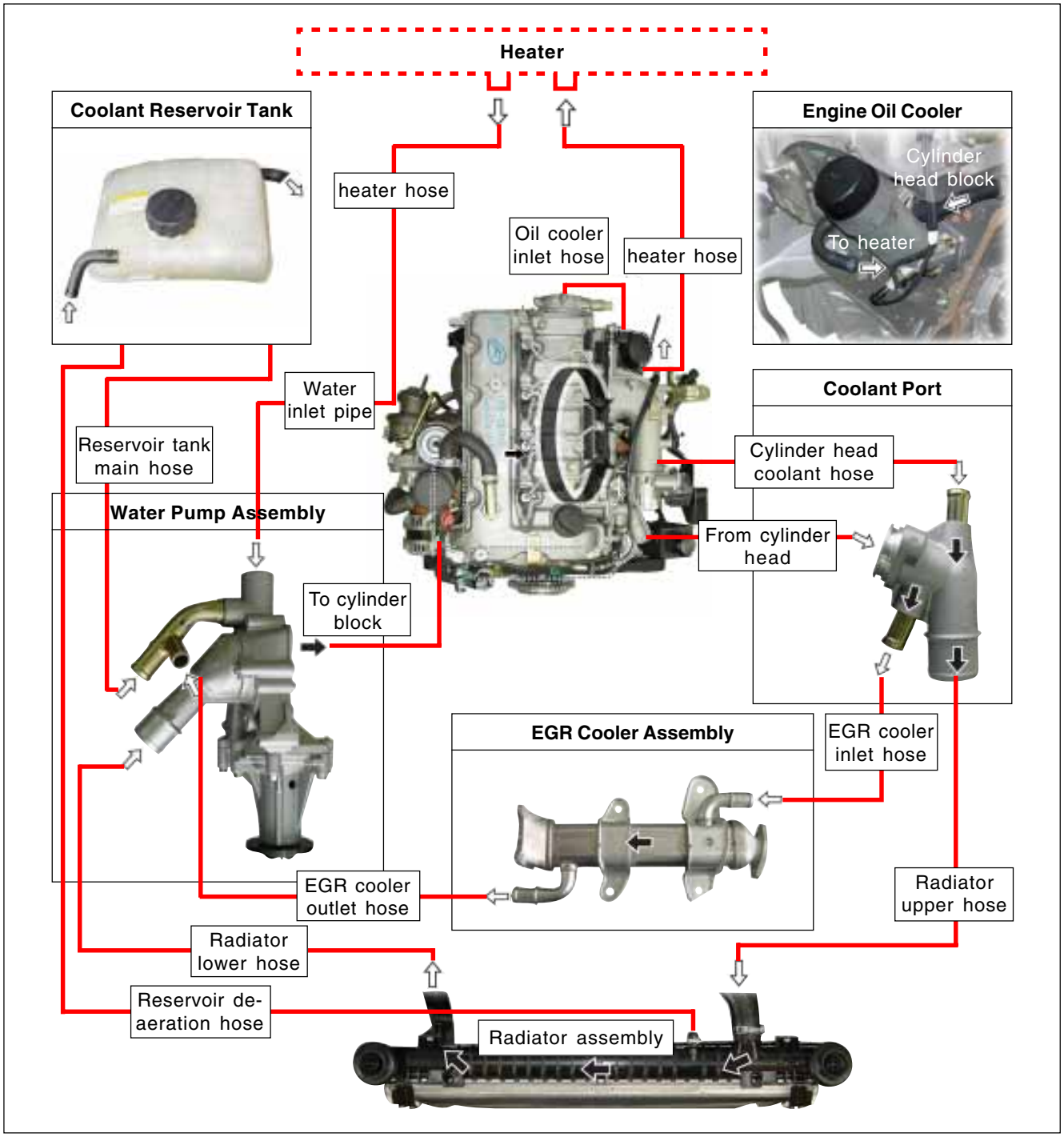
Overview 3

COOLING SYSTEM

COMPARISON IN COOLING SYSTEM FOR EACH ENGINE

For the D20DT (EURO4) engine, the cooling system is equipped with E-EGR cooler and the water pump which its capacity is improved according to the additional coolant line in the cylinder block.

▶ Cooling System for Engine



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

WATER PUMP

OVERVIEW

The belt-driven centrifugal water pump consists of an impeller, a drive shaft, and a belt pulley. The impeller is supported by a completely sealed bearing. The water pump is serviced as an assembly and, therefore, cannot be disassembled.

The capacity of water pump has been increased due to the EGR cooler, increased engine power and additional coolant port in the cylinder block.



For D20DT (EURO4) Engine

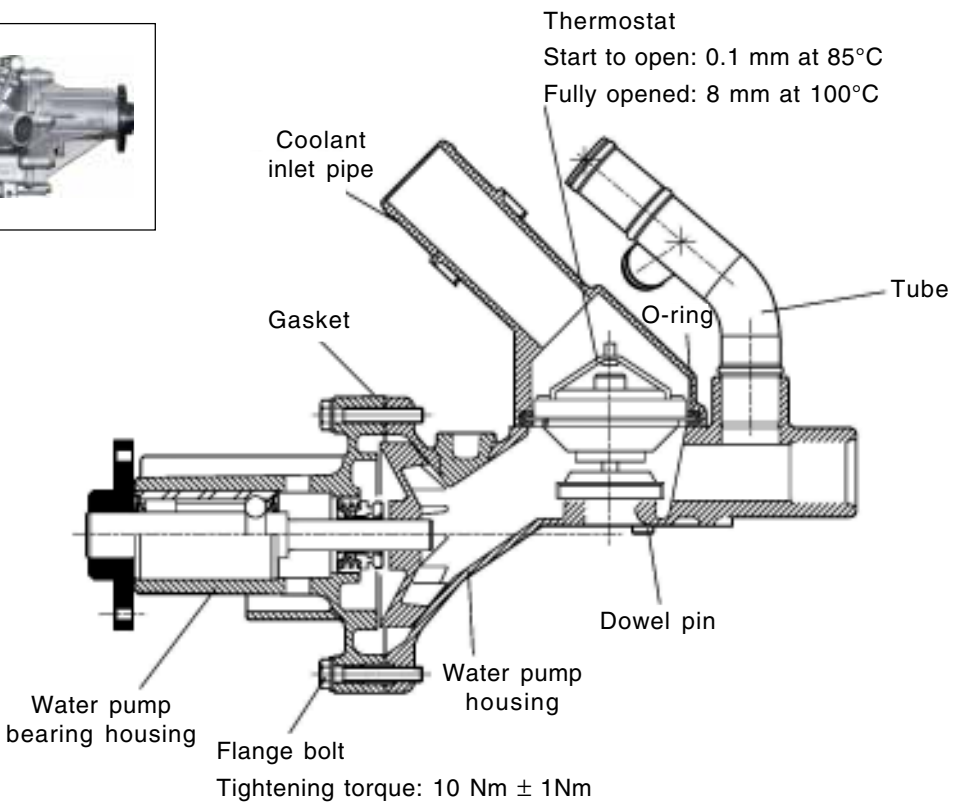


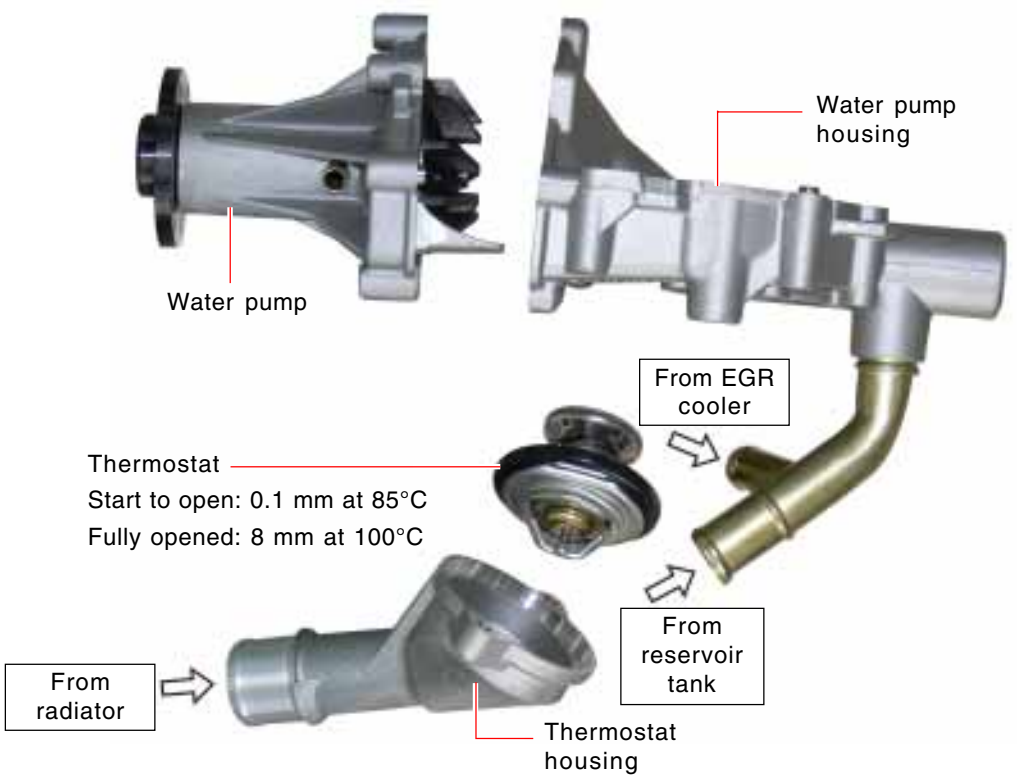
For D20DT Engine



▶ Structure of Water Pump for D20DT Engine







CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ENGINE ECU

1491

TABLE OF CONTENTS

ENGINE ECU 2

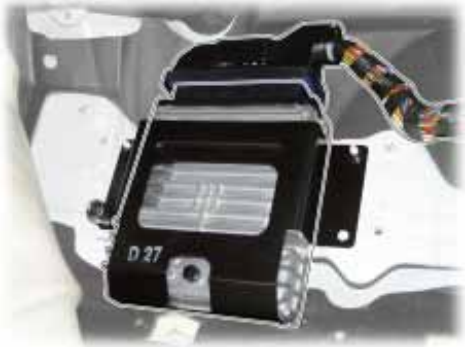
1. Overview of engine ECU 2
2. Terminal (pin) arrangement of ECU 3
3. Removal and installation of engine ECU 7

ENGINE ECU

1. OVERVIEW OF ENGINE ECU

The engine ECUs are various according to the engine model (D20DT engine, D20DT (EURO4) engine). For the D20DT (EURO4) engine, one connector is added to the engine ECU (2 connectors total) to control the additional sensor, actuator and exhaust gas control function.



D20DT (EURO4) Engine ECU - Ver. 3.2	D20DT Engine ECU - Ver. 3.1
Connector A Connector B 	
	

For the D20DT (EURO4) engine, the connector pin is added and DTC is changed as the following components are added. the functions of engine ECU pin for D20DT (EURO4) engine and D20DT engine are not same. For more details, refer to the respective section.

1. **E-EGR (Electric-Exhaust Gas Recirculation) Valve**

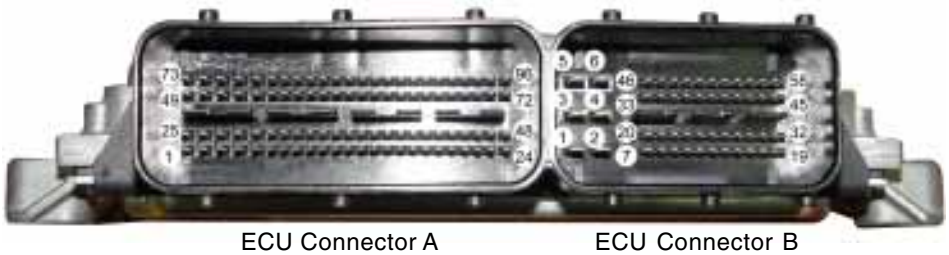
   It is electrically controlled by the ECU for precise control. Old version was controlled by the vacuum modulator.
2. **Throttle Body**

   It is electrically controlled by ECU as E-EGR valve.
3. **AQGS (Advanced Quick Glow System) Unit**

   The glow control relay (K-line communication with engine ECU) is deleted. The unit communicates via CAN communication with engine ECU. Also, the number of pins is increased as glow plug's performance has been improved (1000°C increase in approx. 2 seconds).

2. TERMINAL (PIN) ARRANGEMENT OF ECU

▶ Description of ECU Terminals for D20DT (EURO4) Engine



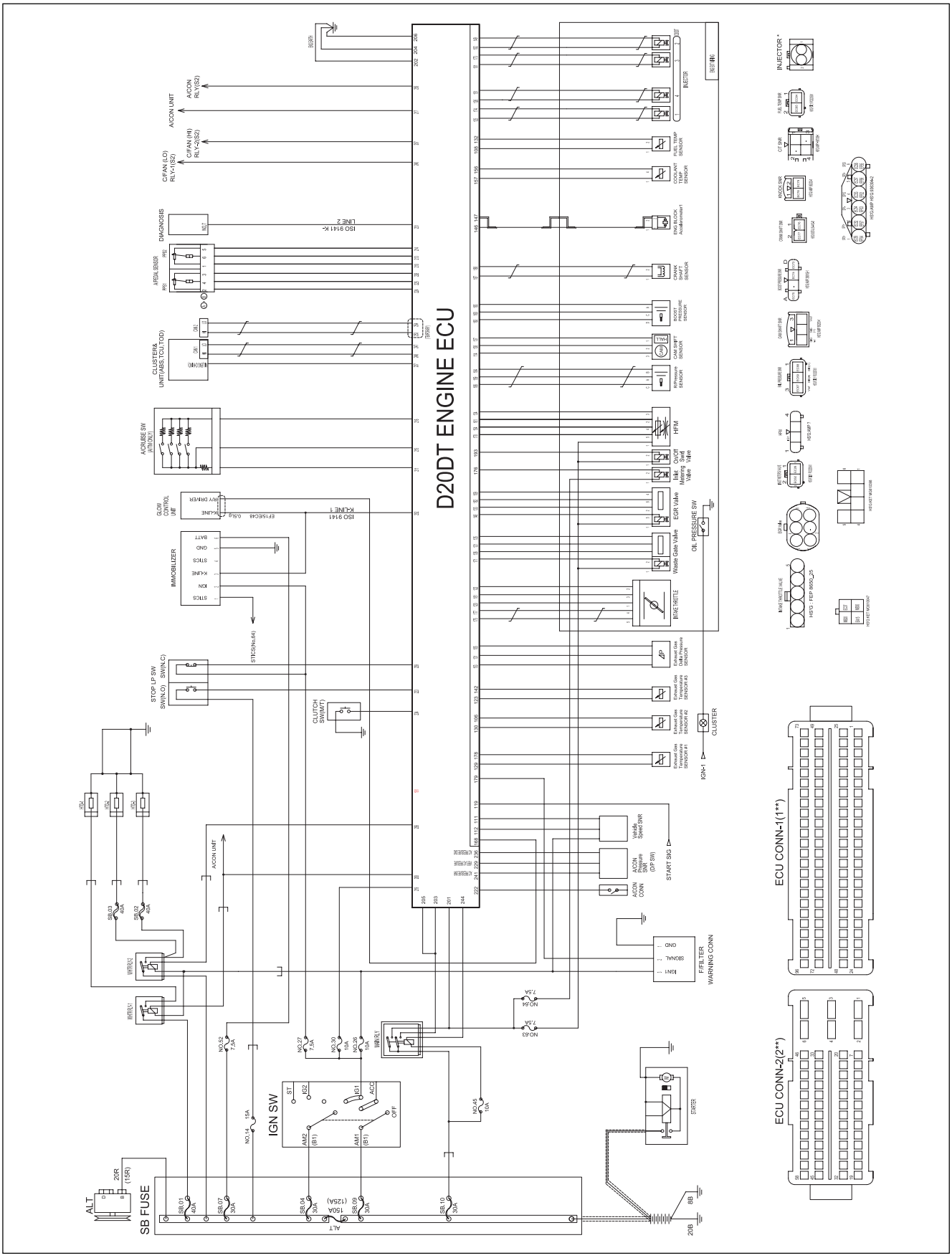
ECU Connector A (No.1 ~ 96) ECU Connector B (No.1 ~ 58)

Connector A			Connector B		
Pin No.	**Description**	**Remarks**	**Pin No.**	**Description**	**Remarks**
A1	Injector #2 (power supply)		B1	Main power (B+)	
A2	Injector #5 (power supply)		B3	Main power (B+)	
A3	-		B5	Main power (B+)	
A4	-		B2	Main ground	
A5	-		B4	Main ground	
A6	-		B6	Main ground	
A7	-		B7	-	
A8	Fuel temperature sensor signal		B8	PTC #1 relay control	
A9	E-EGR valve ground		B9	-	
A10	-		B10	#2 Accelerator pedal sensor reference voltage	
A11	-		B11	Auto cruise operation voltage	
A12	-		B12	-	
A13	-		B13	#2 Accelerator pedal sensor signal	
A14	Camshaft position sensor ground		B14	#2 Accelerator pedal sensor ground	
A15	-		B15	Auto cruise signal input	
A16	#2 Knock sensor signal		B16	Auto cruise ground	
A17	-		B17	Blower switch signal	
A18	-		B18	PWM Electric fan control	
A19	-		B19	Ignition key signal	
A20	Throttle body reference voltage		B20	-	
A21	-		B21	-	
A22	Throttle body flap position sensor signal		B22	Air conditioner operation signal	
A23	-		B23	Brake switch operation signal	
A24	-		B24	#1 Accelerator pedal sensor reference voltage	
A25	Injector #1 (power supply)		B25	#1 Accelerator pedal sensor signal	
A26	Injector #4 (power supply)		B26	#1 Accelerator pedal sensor ground	
A27	Injector #3 (power supply)		B27	-	

Connector A			Connector B		
Pin No.	Description	Remarks	Pin No.	Description	Remarks
A28	-		B28	-	
A29	-		B29	Air conditioner refrigerant pressure sensor reference voltage	
A30	-		B30	-	
A31	-		B31	Diagnosis connector	
A32	Fuel temperature sensor ground		B32	-	
A33	E-EGR valve reference voltage		B33	-	
A34	HFM temperature sensor signal (Analog)		B34	-	
A35	-		B35	-	
A36	-		B36	Air conditioner pressure switch ground	
A37	Camshaft position sensor reference voltage		B37	-	
A38	Camshaft position sensor signal		B38	-	
A39	-		B39	Brake pedal switch	
A40	-		B40	Condenser fan (Lo) relay	
A41	#2 Knock sensor ground		B41	Air conditioner refrigerant input sensor signal	
A42	-		B42	-	
A43	-		B43	-	
A44	-		B44	ECU main power relay	
A45	-		B45	-	
A46	#1 Knock sensor signal		B46	-	
A47	#1 Knock sensor ground		B47	CAN-LO	
A48	-		B48	CAN-HI	
A49	Injector #5 ground		B49	-	
A50	Injector #3 ground		B50	-	
A51	Injector #4 ground		B51	-	
A52	-		B52	Immobilizer (K-Line)	
A53	-		B53	-	
A54	HFM sensor temperature sensor (Digital)		B54	-	
A55	-		B55	Air conditioner compressor relay	
A56	Coolant temperature sensor ground		B56	PTC #2 relay control	
A57	Coolant temperature sensor signal		B57	Condenser fan HI relay	
A58	-		B58	-	
A59	Rail pressure sensor signal		-	-	
A60	Booster pressure sensor reference voltage		-	-	
A61	HFM sensor ground		-	-	
A62	-		-	-	

Connector A			Connector B		
Pin No.	Description	Remarks	Pin No.	Description	Remarks
A63	Booster pressure sensor signal		-	-	
A64	-		-	-	
A65	-		-	-	
A66	-		-	-	
A67	-		-	-	
A68	-		-	-	
A69	-		-	-	
A70	HFM sensor signal input		-	-	
A71	-		-	-	
A72	-		-	-	
A73	Injector #2 ground		-	-	
A74	Injector #1 ground		-	-	
A75	Throttle body drive (+)		-	-	
A76	IMV PWM control		-	-	
A77	-		-	-	
A78	-		-	-	
A79	Fuel filter water detection signal		-	-	
A80	-		-	-	
A81	Throttle body sensor ground		-	-	
A82	E-EGR valve sensor signal		-	-	
A83	Boost pressure sensor ground		-	-	
A84	Rail pressure sensor signal ground		-	-	
A85	-		-	-	
A86	Rail pressure sensor reference voltage		-	-	
A87	Crankshaft position sensor (-)		-	-	
A88	Crankshaft position sensor (+)		-	-	
A89	-		-	-	
A90	-		-	-	
A91	Switchable engine mounting control		-	-	
A92	-		-	-	
A93	-		-	-	
A94	-		-	-	
A95	-		-	-	
A96	-		-	-	

▶ D20DT (EURO4) ENGINE'S ECU CIRCUIT



ENGINE ECU
D20DT (EU IV) SM - 2006.08

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. REMOVAL AND INSTALLATION OF ENGINE ECU

▶ Removal and Installation

※ **Preceding Work:** Disconnect the battery negative cable.

1. Open the passenger's door and remove the carpet and door scarf panel. lift the front side of the floor mat and cover mounting nuts on the ECU unit and remove the ECU unit cover.



2. Remove the LH/RH connectors of the ECU unit.



NOTE
- **Push the fixing lever on the connector to the front to disconnect the connector.**



3. Unscrew four ECU unit mounting nuts and remove the ECU unit.





MEMO

Section 02

G23D (EU4) ENGINE

- GENERAL INFORMATION
- ENGINE ASSEMBLY
- ENGINE MECHANICAL
- ENGINE COOLING
- ENGINE ELECTRICAL
- INTAKE & EXHAUST

GENERAL INFORMATION

SECTION 0A

TABLE OF CONTENTS

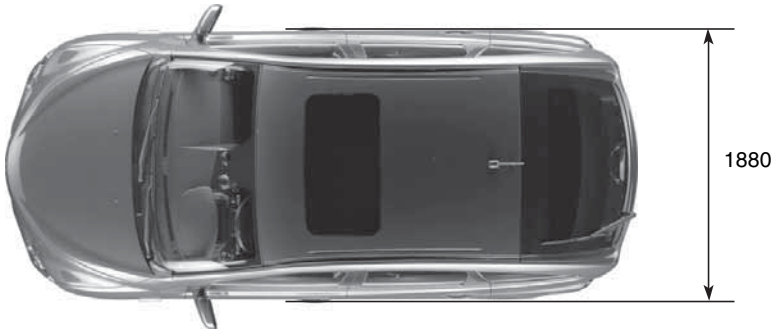
1. Dimensions 0A-2
2. Vehicle identification 0A-3
3. Specifications 0A-4
4. Locations in engine compartment 0A-6
5. Scheduled maintenance services 0A-9
6. Fuse & relay box 0A-11
7. Lifting points 0A-12
8. Tightening torque of standard bolts 0A-13

1. DIMENSIONS

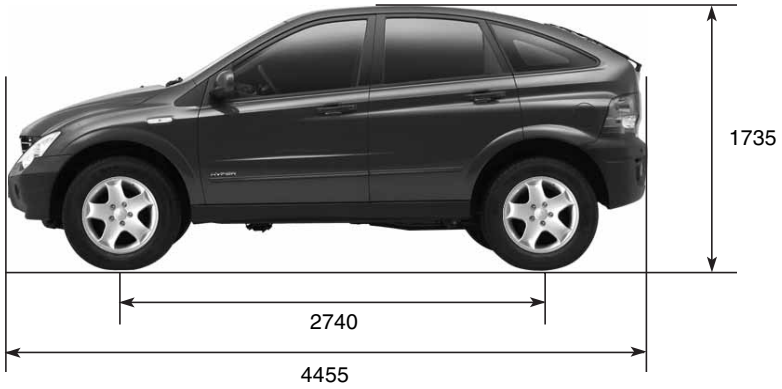
▶ ACTYON

Unit: mm

Top View



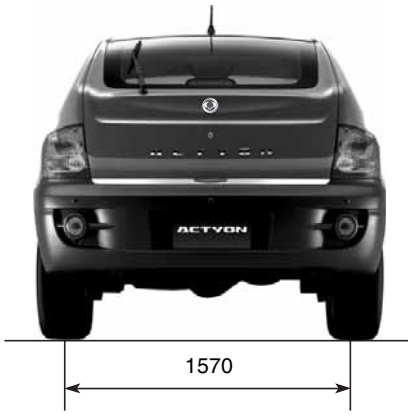
Side View



Front View



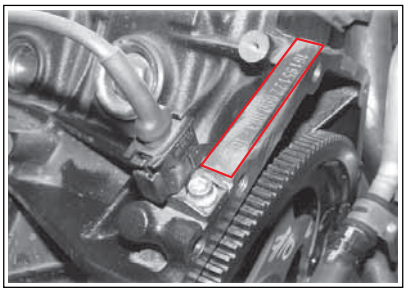
Rear View



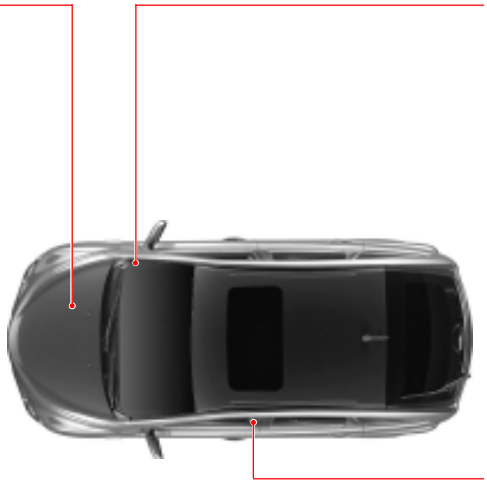
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. VEHICLE IDENTIFICATION

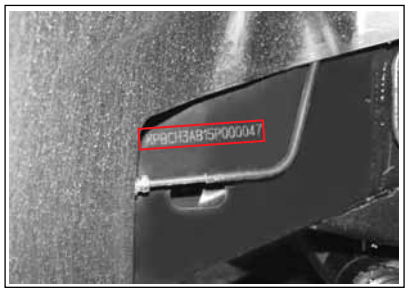
1. Engine Number



Gasoline Engine: The engine number is stamped on the upper rear left-hand side of the cylinder block.



2. Chassis Number



3. Certification Label



The certification label is located on the driver's door sill.

▶ Identification of Engine No. and Chassis No.

1. G23D Engine Number

162 990 1 0 012345

- 162 990 — ENGINE TYPE
- 97: 2.3 L
- 5: ACTYON
- 0: Common
  1: Left - Hand Drive
  2: Right - Hand Drive
- 0: Manual T/M
  1: Hydr - Auto Coupling
  2: Automatic T/M
- 012345 — Serial Number

2. Chassis Number

*** K P T G 0 B 1 9 S 1 P 000000**

- *. Symbol according to No.
- 1. Nation : K
- 2. Maker Identification : P
- 3. Vehicle Type
- 4. Line Models
- 5. Body Type
- 6. Trim Level
- 7. Restraint System
- 8. Engine Type
- 9. Check Digit
- 10. Model Year
- 11. Plant Code
- 12~17. Production Serial Number

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. SPECIFICATIONS

* ( ) Optional, [ ] 2WD

Descriptions			Actyon G23D	Remarks
General	Overall length		4,455 mm	
	Overall width		1,880 mm	
	Overall height		1,735 kg	
	Gross vehicle weight	A/T	2,520 kg	
		M/T	2,520 kg	
	Curb vehicle weight	A/T	1,974 kg [1,865 kg]	
		M/T	1,952 kg [1,843 kg]	
	Fuel		Gasoline	
	Fuel tank capacity		75 ℓ	
	Min. turning radius		5.6 m	
Engine	Numbers of cylinders/ Compression ratio		4 / 10.4 : 1	
	Total displacement		2,295 cc	
	Camshaft arrangement		DOHC	
	Max. power		150 PS / 5,500 rpm	
	Max. torque		214 Nm / 3,500 ~ 4,600 rpm	
	Idle speed		750 ± 50 rpm	
	Cooling system		Water- cooled / forced circulation	
	Coolant capacity		10.5 ~ 11.0 ℓ	
	Lubrication type		Gear pump, forced circulation	
	Max. oil capacity (when shipping)		7.9 ℓ	
	Turbocharger and cooling type		–	
Manual Transmission	Operating type		Semi- Remote control, floor change type	
	Gear ratio	1st	4.315	
		2nd	2.475	
		3rd	1.536	
		4th	1.000	
		5th	0.807	
		Reverse	3.919	
Automatic Transmission	Model		Electronic, 4-speed	
	Operating type		Floor change type	
	Gear ratio	1st	2.741	
		2nd	1.508	
		3rd	1.000	
		4th	0.708	
		Reverse	2.429	
Transfer Case	Model		Part-time	
	Type		Planetary gear type	
	Gear ratio	High (4H)	1.000 : 1	
		Low (4L)	2.483 : 1	
Clutch (M/T)	Operating type		Hydraulic type	
	Disc type		Dry single diaphragm type	

* ( ) Optional, [ ] 2WD

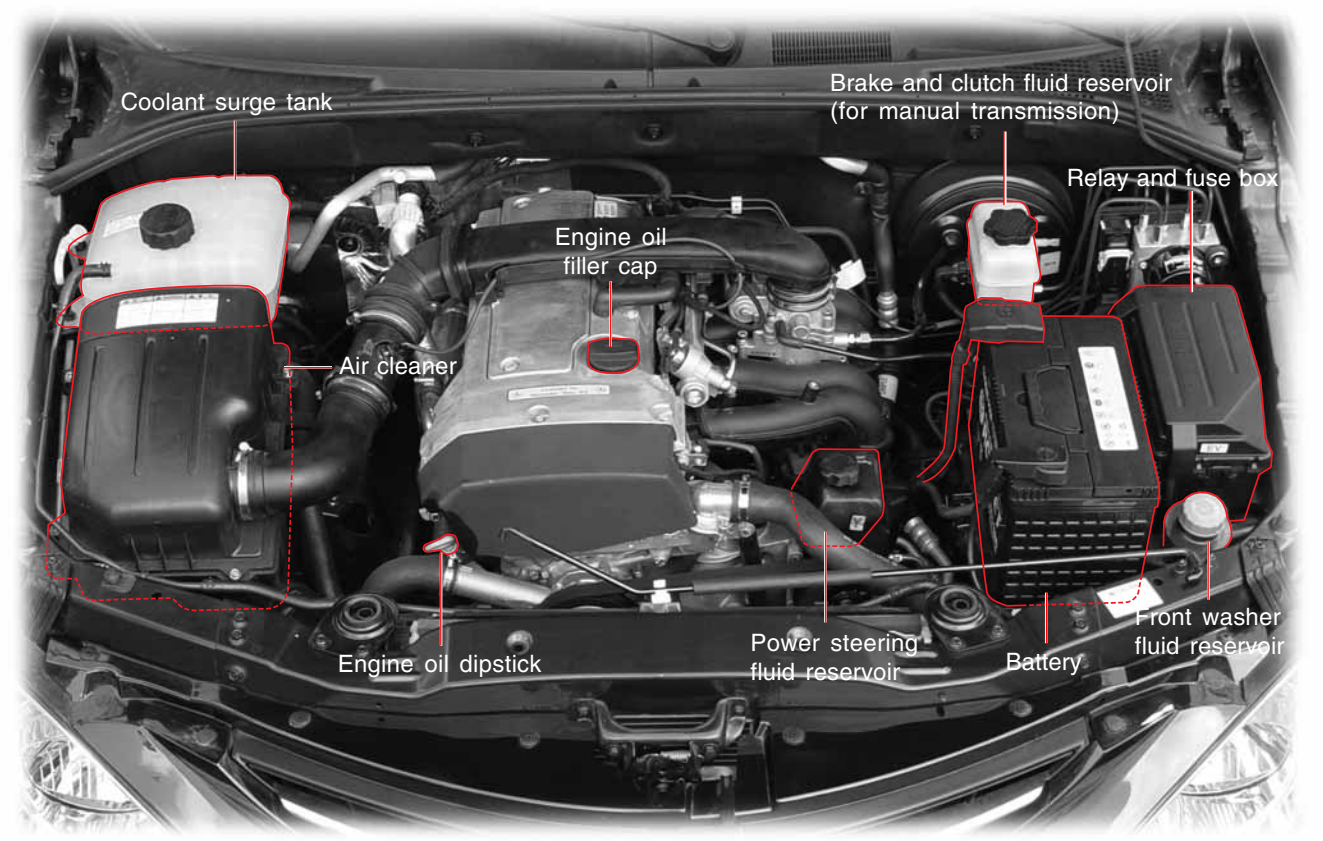
Descriptions			Actyon G23D	Remarks
Power Steering	Type		Rack and pinion	
	Steering angle	Inner	35.7°	
		Outer	32.1°	
Front Axle	Drive shaft type		Ball joint type	
	Axle housing type		Build-up type	
Rear Axle	Drive shaft type	Solid axle suspension	Semi-floating type	
	Axle housing type		Build-up type	
Brake	Master cylinder type		Tandem type	
	Booster type		Vacuum assisted booster type	
	Brake type	Front wheels	Disc type	
		Rear wheels	Drum (disc)	
	Parking brake		Cable type (internal expansion)	
Suspension	Front suspension		Wishbone + coil spring	
	Rear suspension	Solid axle suspension	Build-up axle + coil spring	
Air Conditioner	Refrigerant (capacity)		R-134a (650 ± 30g)	
Electrical	Battery type / Capacity (V-AH)		MF / 12 - 90	
	Starter capacity (V-kW)		12 - 1.2	
	Alternator capacity (V-A)		12 - 115	

Recommended Fluids and Lubricants

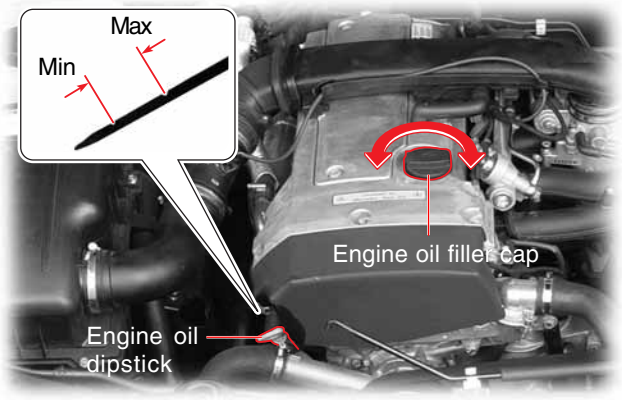
Descriptions					Capacity	Specifications
Engine Oil					≒ 7.5 ℓ	Quality class: Ssangyong genuine engine oil (Approved by MB Sheet 229.1 or 229.3) Viscosity: MB sheet No. 224.1
Engine Coolant					10.5 ~ 11.0 ℓ	Ssangyong genuine coolant (Anti-freeze:SYC-310, Anti-freeze:water = 50:50)
Automatic Transmission Fluid					≒ 9.5 ℓ	Ssangyong genuine oil (CASTROL TQ 95)
Manual Transmission Fluid				4WD	≒ 3.6 ℓ	Ssangyong genuine oil (ATF DEXRON II)
				2WD	≒ 3.4 ℓ	
Transfer Case Fluid					≒ 1.4 ℓ	Ssangyong genuine oil (ATF DEXRON III)
Axle Oil	Front	Automatic Transmission			≒ 1.4 ℓ	Ssangyong genuine oil (SAE 80W/90, API GL-5)
		Manual Transmission			≒ 1.4 ℓ	
	Rear	Solid Axle Suspension	ACTYON	2WD ALL, 4WD M/T	≒ 1.9 ℓ	Ssangyong genuine oil (SAE 80W/90, API GL-5)
				4WD A/T	≒ 2.0 ℓ	
			ACTYON SPORTS	2WD A/T	≒ 1.9 ℓ	
				4WD ALL, 2WD M/T	≒ 2.0 ℓ	
Brake / Clutch Fluid					As required	Ssangyong genuine oil (DOT4)
Power Steering Fluid					≒ 1.0 ℓ	Ssangyong genuine oil (ATF DEXRON II or III)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. LOCATIONS IN ENGINE COMPARTMENT



▶ Engine oil



Level Check

Park the vehicle on a level ground and apply the parking brake. Stop the engine and wait more than 5 minutes.

1. Pull out the dipstick and wipe it with a clean cloth. Re-insert it all the way.
2. Pull out it again and check the oil level.
3. The oil level should be between the maximum (Max) mark and minimum (Min) mark on the oil dipstick. Oil should be replenished before the level goes below the minimum mark.

Replenishment

1. If the level gets to the lower point, open the filler cap on top of the cylinder block and add the genuine oil without exceeding the level of the upper mark.
2. Recheck the oil level after 5 minutes.

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EFFECTIVE DATE	
AFFECTED VIN	

Function of Engine Oil

Engine oil's major function is to lubricate and cool the parts inside of the engine, which enables engine to work properly.

Consumption of Engine Oil

The consumption of engine oil is depending on the viscosity and quality of the oil, and the driving habit. More oil may be required under the following conditions;

- When the Vehicle is New

A new engine usually consumes more oil because its pistons, piston ring and cylinder walls are not yet adjusted with an optimal condition.

Oil Consumption : Max. 0.8 Liter per 1,000 km

Accordingly, it is necessary for the driver to check frequently the oil level and to replenish oil if needed. SYMC recommends that the oil level be checked every time you refuel the vehicle or you drive the long distance until the first 5,000 km.

- When driving at High Engine Speeds

As long as you keep the followings with sufficient care in your first running the vehicle, it will guarantee you to get excellent and comfortable performance for a long with your vehicle.

- Remember to check the engine oil level and shorten the cycle to refuel the engine oil under severe driving conditions.
- Avoid subjecting to engine to heavy loads by driving at full throttle, especially be careful when the outside temperature remains below freezing for the first 1,000 km.
- Do not use the trailing in the first 1,000 km driving

* What's Severe Driving Condition?

- Driving at the high engine speed or at high-speed
- Driving for consecutive two hours at high speed
- Driving the rough road, off-road, dirt-laden road, and muddy roads
- Driving in areas where salt or other corrosive materials are being used
- Repeated driving in short-distance
- Driving with the excessive idling
- High load driving such as trailing

Change Interval

- The engine oil filter element should be changed with the engine oil at the same time.
- Use only the Ssangyong genuine engine oil and filter.

Engine Oil

Service Interval
Initial change: 10,000 km, change every 15,000 km or 12 months (The service interval should be shortened under severe conditions)

Engine Oil Filter

Item	Service interval
Engine oil filter	Same interval as the engine oil

Specification and Capacity

Specification	Quality class: Ssangyong genuine engine oil (Approved by MB Sheet 229.1 or 229.3) Viscosity: MB sheet No. 224.1
Capacity	7.5 L

WARNING

- **Use only Ssangyong genuine engine oil and filters. Use of non-recommended products could cause damage to the engine.**

Warnings and Cautions When Checking

WARNING

- **Clean the dipstick with a clean cloth so that any foreign materials cannot get into the engine.**
- **Use only the Ssangyong genuine engine oil.**
- **The oil should not go above the upper mark on the dipstick.**
- **Operating with insufficient or too much amount of oil can damage the engine.**

NOTICE

- **Regularly check the engine oil level and add the Ssangyong genuine engine oil if necessary.**

SAE viscosity classes

The SAE classes (viscosity) should be selected in accordance with the average seasonal air temperature.

Applying the SAE classes exactly on the basis of the outside air temperatures would necessitate frequently changing the engine oil. The temperature limits for the SAE classes should therefore be regarded as reference temperatures and the actual air temperature may be higher or lower for a short period of time.

* How to check engine oil specification

Example:

0W, 5W, 10W, 15W, 20W, 25W **20, 30, 40, 50, 60**

Winter oil viscosity (W: Winter)

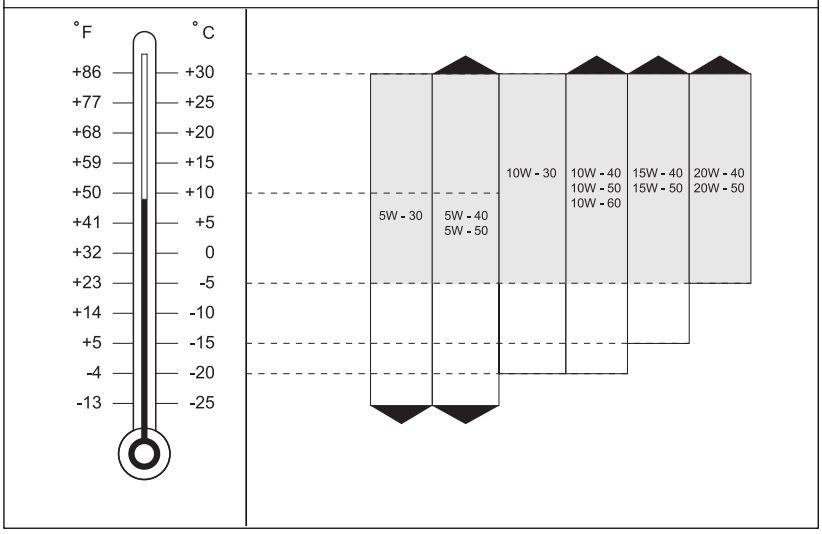
Summer oil viscosity

- The numerical, for example SAE 10W, relates to viscosity at particular temperature and the alphabet “W” indicates the oil’s suitability for colder temperature.

  For summer oil viscosity, higher numbers mean higher viscosities.

Engine

The viscosity should be selected according to outside temperature. Do not switch to a different viscosity in the event of brief temperature fluctuations.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. SCHEDULED MAINTENANCE SERVICES

Maintenance service and record retention are the owner's responsibility. You should retain evidence that proper maintenance has been performed on your vehicle in accordance with the scheduled maintenance service chart.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first							
x1,000 km	15	30	45	60	75	90	105	120
x1,000 miles	10	20	30	40	50	60	70	80
Months	12	24	36	48	60	72	84	96
ENGINE CONTROL SYSTEM								
Drive belt	I	I	I	I	I	I	I	I
Engine oil & engine oil filter (1)* (3)* (Initial change: 10,000 km)	R**	R	R	R	R	R	R	R
Cooling system hose & connections	I	I	I	I	I	I	I	I
Engine coolant (3)*	Change every 60,000 km or 3 years. And, inspect replenish if necessary.							
Fuel filter (2)*	Replace every 100,000 km (if using poor quality of fuel, replace every 30,000 km)							
Fuel line & connections	I	I	I	I	I	I	I	I
Air cleaner (2)*	I	I	I	R	I	I	I	R
Ignition timing	I	I	I	I	I	I	I	I
Spark plugs (G23D)	-	R	-	R	-	R	-	R
Charcoal canister & vapor lines	-	-	I	-	-	I	-	-

Chart Symbols:
I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.
R - Replace or change.
** - In order to secure engine long life and effective break-in, first oil (factory filled) would be recommended to drain with in 10,000 km.

(1)* If vehicle is operated under severe condition: short distance driving, extensive idling or driving in dusty condition, shorten the service interval.

(2)* If vehicle is operated under severe condition, pollutant area or off-road driving, driving in dusty condition or sandy condition, frequently inspect the air cleaner, if necessary, change the air cleaner.

(3)* Refer to "Recommended fluids and lubricants".

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM			Kilometers (miles) or time in months, whichever comes first							
x1,000 km			15	30	45	60	75	90	105	120
x1,000 miles			10	20	30	40	50	60	70	80
Months			12	24	36	48	60	72	84	96
CHASSIS AND BODY										
Exhaust pipes & mountings			I	I	I	I	I	I	I	I
Brake / Clutch fluid (3)*			Change every: 2 years (inspect frequently)							
Parking brake / Brake pads (Front & Rear) (4)*		EU	Periodic check: every 15,000 km, adjust or replace as necessary.							
		General	Periodic check: every 10,000 km, adjust or replace as necessary.							
Brake line & connections (including booster)			Inspect every 15,000 km or 1 years, adjust or replace if necessary							
Manual transmission oil (5)*			I	I	I	R	I	I	I	R
Clutch & brake pedal free play			I	I	I	I	I	I	I	I
Front & Rear differential fluid (3)*	Front	EU	Periodic check: every 15,000 km, adjust or replace if necessary.							
		General	Periodic check: every 10,000 km, adjust or replace if necessary.							
	Rear	EU	Periodic check: every 15,000 km, adjust or replace if necessary.							
		General	Periodic check: every 10,000 km, adjust or replace if necessary.							
Transfer case fluid (3)*			Inspect every 15,000 km, change every 60,000 km (Frequent check of oil leak)							
Automatic transmission fluid (6)*			Inspect every 30,000 km or 12 month (But change every 60,000 km under severe condition)							

Chart Symbols:
I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.
R - Replace or change.

(3)* Refer to "Recommended fluids and lubricants".

(4)* More frequent maintenance is required if the vehicle is operated under any of the following conditions:
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(5)* Inspect manual transmission fluid every 15,000 km (Inspect the leak of fluid at any time,occasionally), then change every 60,000 km

(6)* Change automatic transmission fluid and every 60,000 km if the vehicle is mainly driven under severe conditions. (Inspect the leak of fluid at any time, occasionlly)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE ITEM / MAINTENANCE INTERVAL		Kilometers (miles) or time in months, whichever comes first							
	x1,000 km	15	30	45	60	75	90	105	120
	x1,000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96

CHASSIS AND BODY

Chassis & underbody bolts & nuts tight / Secure (6)*		Check frequntly and adjust or replace if necessary							
Tire condition & inflation pressure		Check frequntly and adjust or replace if necessary							
Wheel alignment (7)*		Inspect when abnormal condition is noted							
Steering wheel & linkage		I	I	I	I	I	I	I	I
Power steering fluid & lines (3)*		I	I	I	I	I	I	I	I
Drive shaft boots		I	I	I	I	I	I	I	I
Seat belts, buckles & anchors		I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch		Check frequntly and adjust or replace if necessary							
Wheel bearing grease		I	I	I	I	I	I	I	I
Propeller shaft grease - Front / Rear (8)*	EU	I	I	I	I	I	I	I	I
	General	Inspect every 10,000 km							
Air conditioner filter		Change every 10,000 km (The service interval should be shortened under severe conditions)							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R - Replace or change.

(3)* Refer to “Recommended fluids and lubricants”.

(6)* After completion of off-road operation, the underbody of the vehicle should be throughly inspected. Examine threaded fasteners for looseness.

(7)* If necessary, rotate and balance wheels.

(8)* Inspect propeller shaft grease every 5,000 km or 3 months if the vehicle is mainly driven under severe condition.

- In off-road or dusty road, or
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain.

Severe Conditions in Air Conditioner Filter

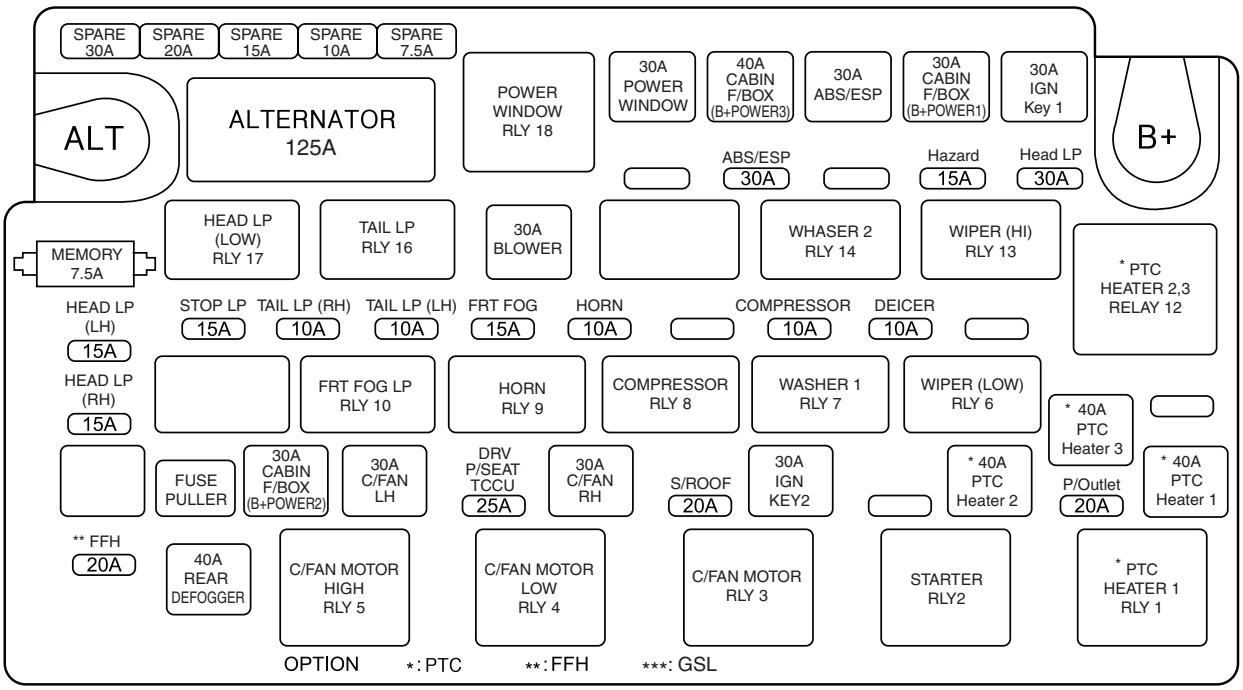
- Pollutant area or off-road driving, extended air conditioner or heater operation

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

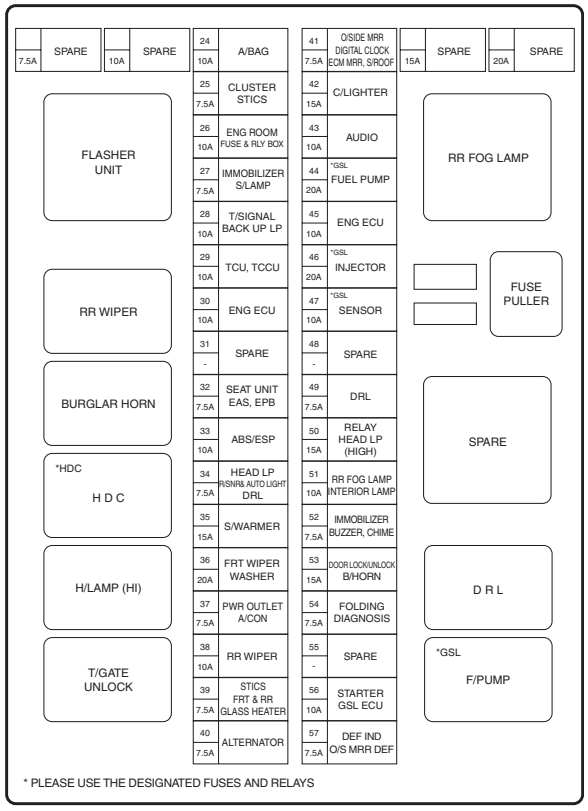
6. FUSE & RELAY BOX

▶ ACTYON

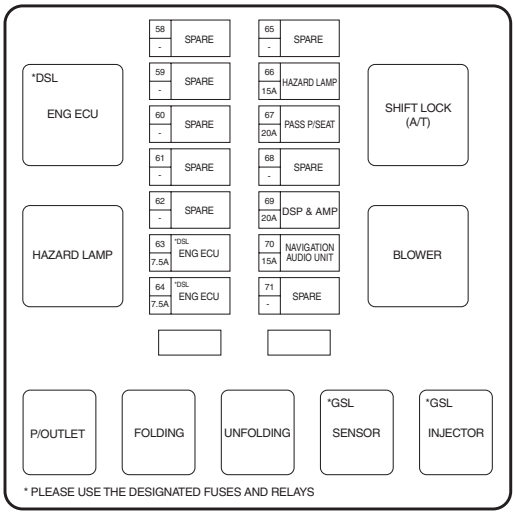
Engine Compartment



Driver's Side

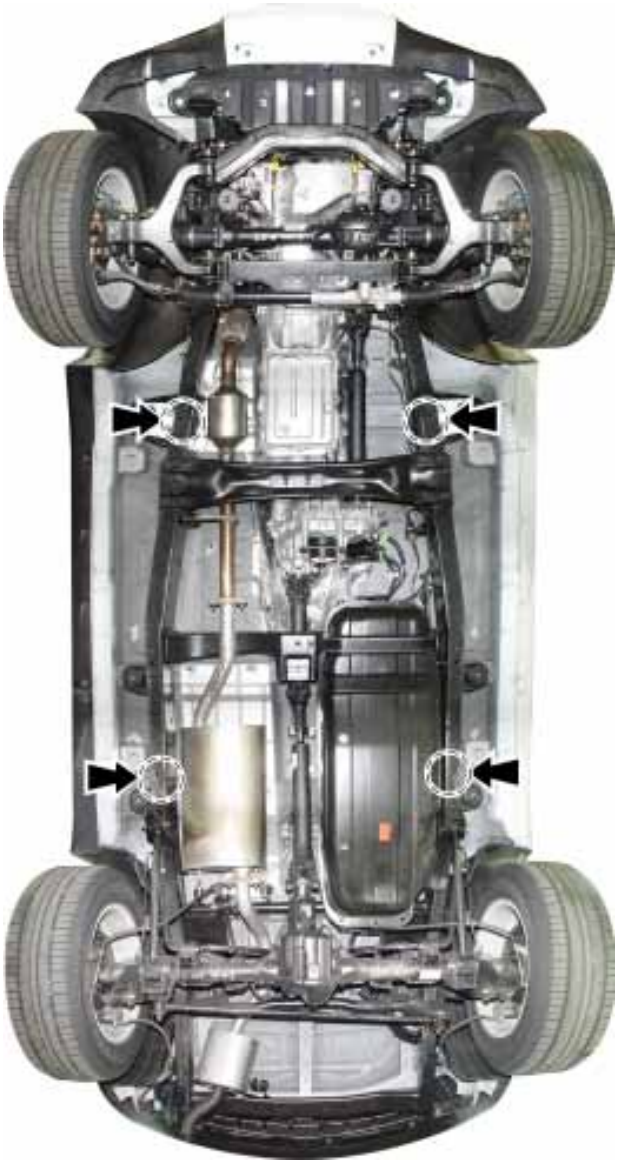


Passenger's Side



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

7. LIFTING POINTS



▶ 4-Post Lift

As illustrated, raise up the vehicle using the 4-post lift securely and place the vehicle chocks in front of and behind the wheels.

NOTICE

- **Be sure to use attachment during lifting to prevent the lift from contacting with body floor.**
- **While lifting the vehicle, widen the lift floor as far as possible to stabilize between vehicle front and rear. When fixing the lift floor, be careful not to contact with brake tube and fuel line.**
- **With vehicle raised up, you should visually check from outside of vehicle that the mounting positions of jacks are set correctly and there are no problems before servicing the vehicle.**

▶ Safety Jack and Safety Stand

When lifting up the vehicle with safety jack and stand, you should be more careful during works.

NOTICE

- **Never be under the vehicle if supported with only jack. If you have to be under the vehicle, be sure to use vehicle chocks.**
- **Use the vehicle chocks in front of and behind the wheels.**

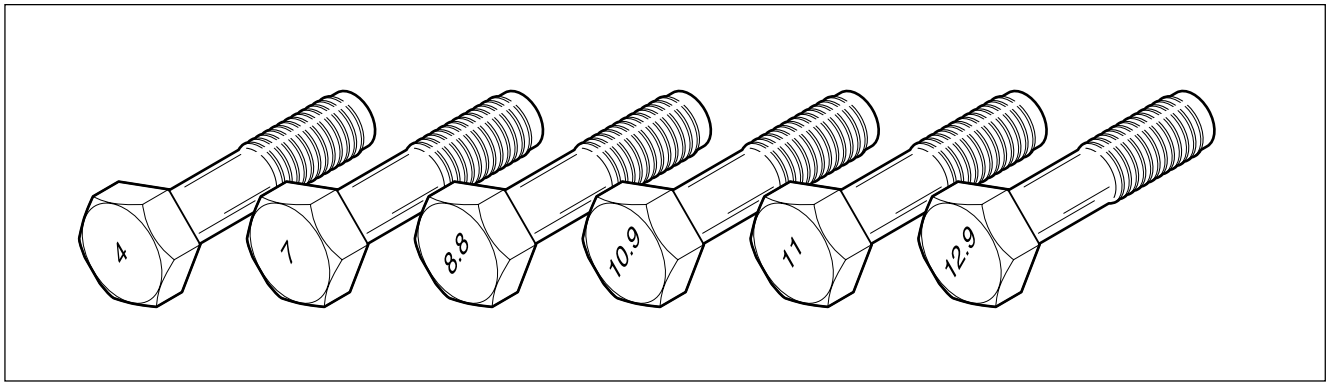


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

8. TIGHTENING TORQUE OF STANDARD BOLTS

▶Tightening Torque By Bolt Specification

Bolt Diameter	Pitch	Tightening Torque (kg·cm)					
		Standard Tightening Torque			Max. Allowable Tightening Torque		
		4T	7T	9T	4T	7T	9T
M3	0.5	5	9	13	7	12	17
M4	0.7	12	20	30	16	27	40
M5	0.8	24	40	57	32	53	77
M6	1.0	41	68	99	55	91	130
M8	1.25	88	160	230	130	210	310
M10	1.25	190	330	470	260	430	620
	1.5	190	310	450	250	420	600
M12	1.25	350	580	840	460	770	1,100
	1.75	330	550	790	440	730	1,000
M14	1.5	550	910	1,300	730	1,200	1,900
M16	1.5	830	1,100	2,000	1,100	1,900	2,700
M18	1.5	1,200	2,000	2,900	1,600	2,700	3,800
M20	1.5	1,700	2,800	4,000	2,200	3,700	5,300
M22	1.5	2,300	3,800	5,400	3,000	5,000	7,200
M24	1.5	2,900	4,900	7,000	3,900	6,500	9,400
	2.0	2,800	4,700	6,800	3,800	6,300	9,100



1. Metric bolt strength is embossed on the head of each bolt. The strength of bolt can be classified as 4T, 7T, 8.8T, 10.9T, 11T and 12.9T in general.
2. Observe standard tightening torque during bolt tightening works and can adjust torque to be proper within 15 % if necessary. Try not to over max. allowable tightening torque if not required to do so.
3. Determine extra proper tightening torque if tightens with washer or packing.
4. If tightens bolts on the below materials, be sure to determine the proper torque.
   - Aluminum alloy: Tighten to 80 % of above torque table.
   - Plastics: Tighten to 20 % of above torque table.

MEMO

ENGINE ASSEMBLY

SECTION 1A

TABLE OF CONTENTS

1. Description and operation 1A-2
2. G23D Engine assembly 1A-3
3. Diagnostic information and procedure 1A-6
4. General diagnosis 1A-9
5. Specifications 1A-14
6. Special tools and equipment 1A-16

1. DESCRIPTION AND OPERATION

▶ Cleanliness and Care

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousanths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of enigne oil should be applied to friction areas during assembly, to protect and lubricate the surfaces on initial operation. Proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be kept in order. They should be installed in the same locations, and with the same mating surfaces, as when they were removed.

Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

▶ On-engine Service

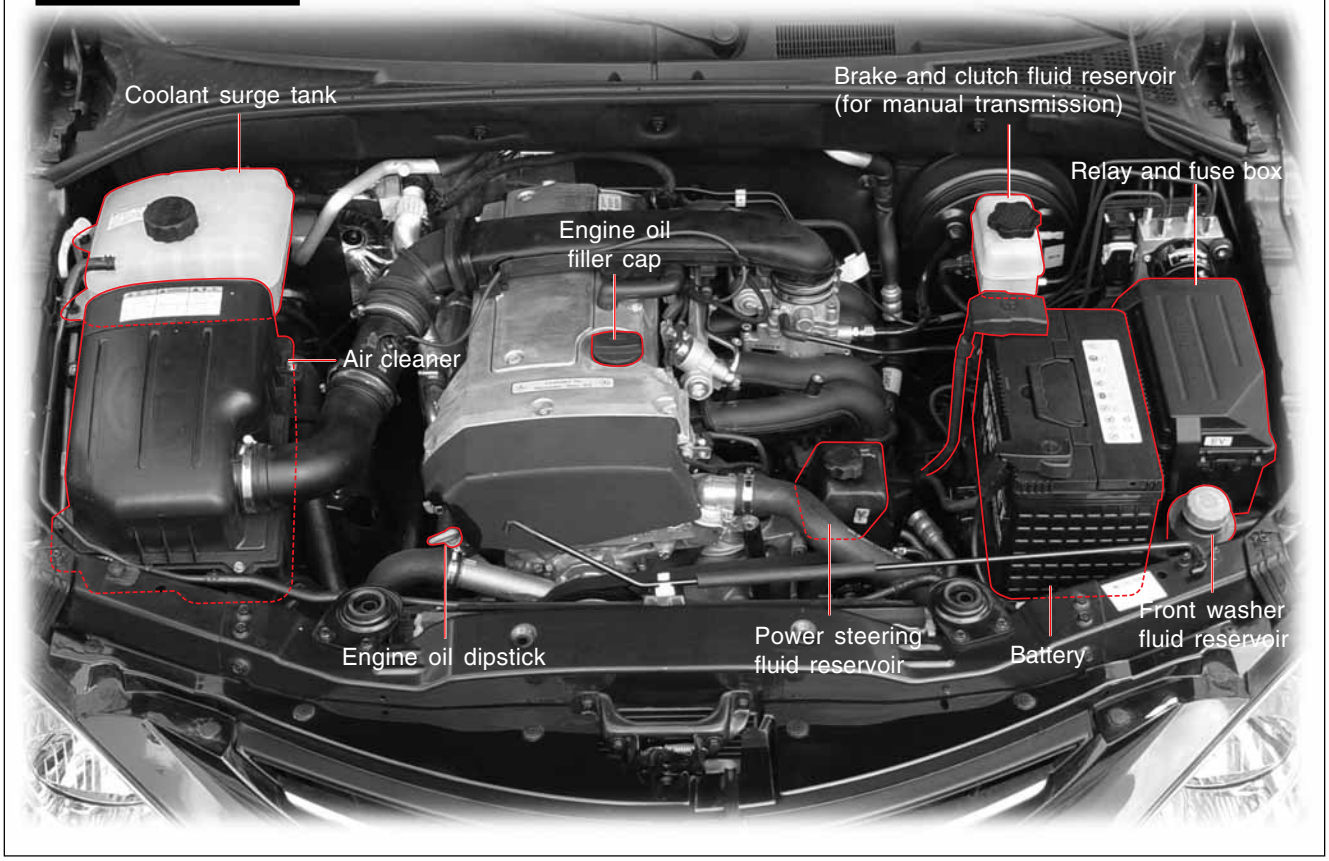
NOTICE

- **Disconnect the negative battery cable before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.**

NOTICE

- **Any time the air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.**

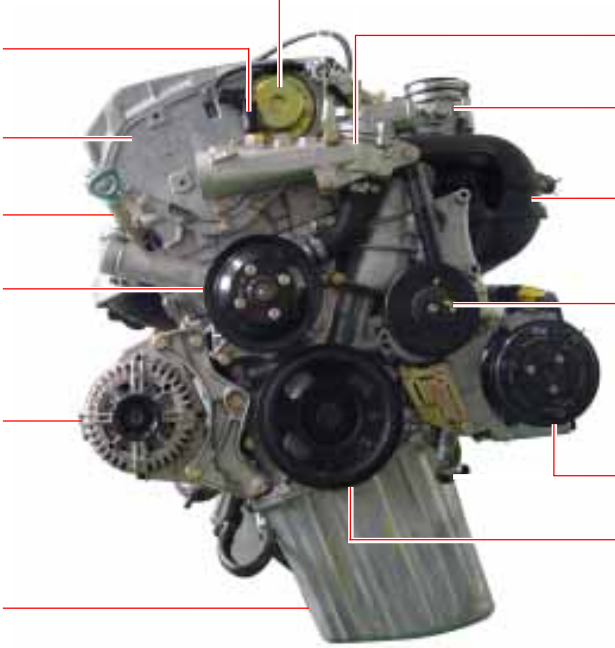
G23D Engine Room



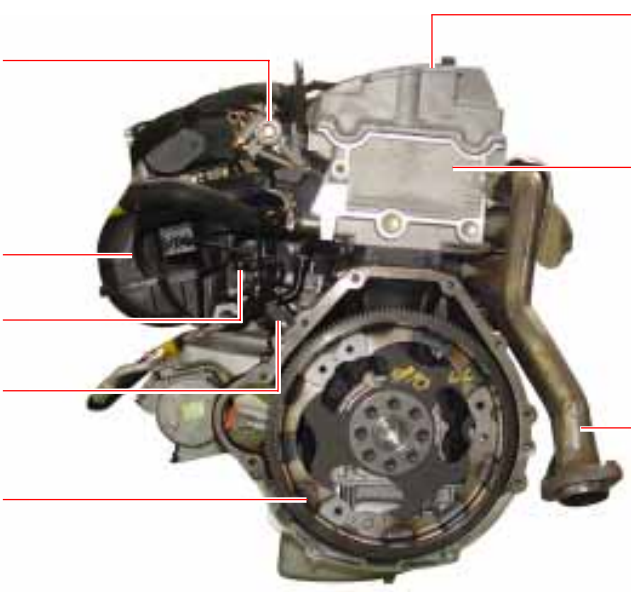
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EFFECTIVE DATE	
AFFECTED VIN	

2. G23D ENGINE ASSEMBLY

Front View

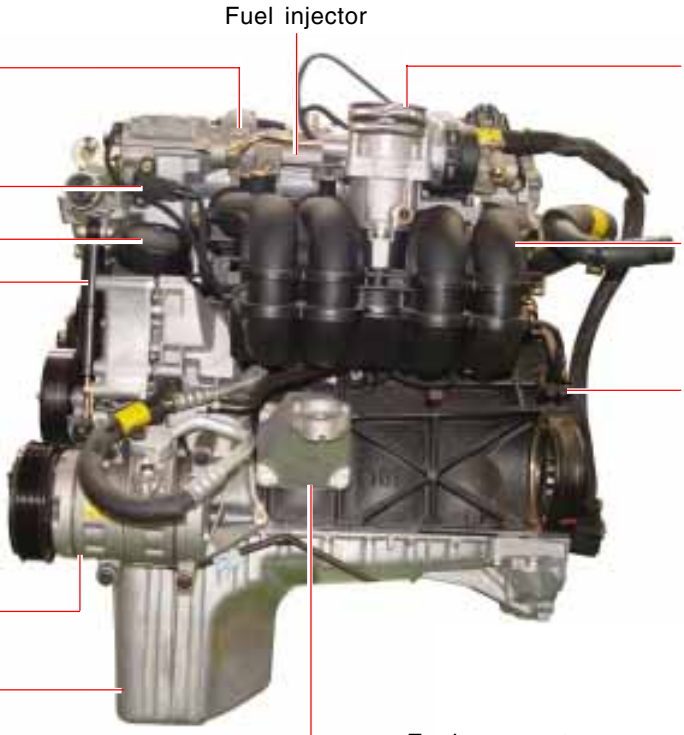


Rear View

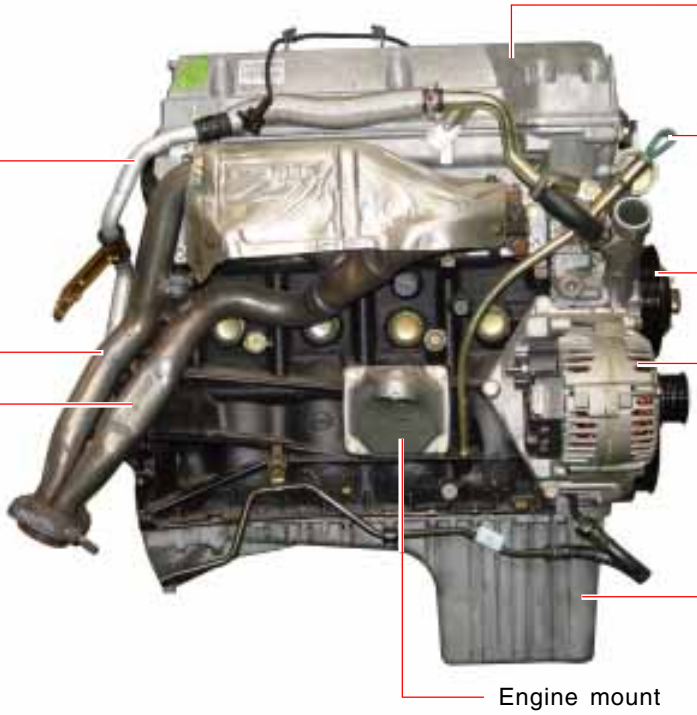


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EFFECTIVE DATE	
AFFECTED VIN	

LH Side View



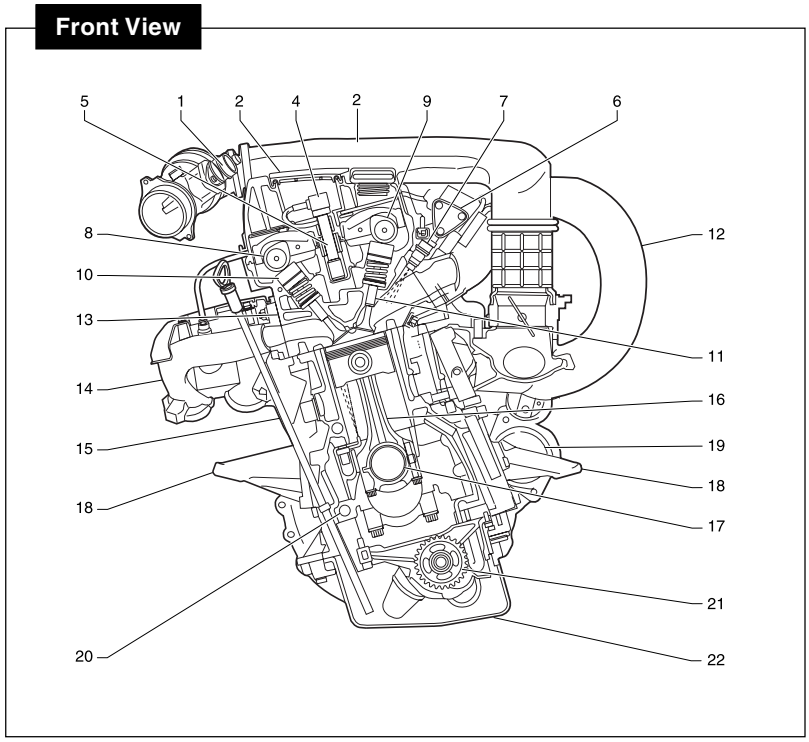
RH Side View



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

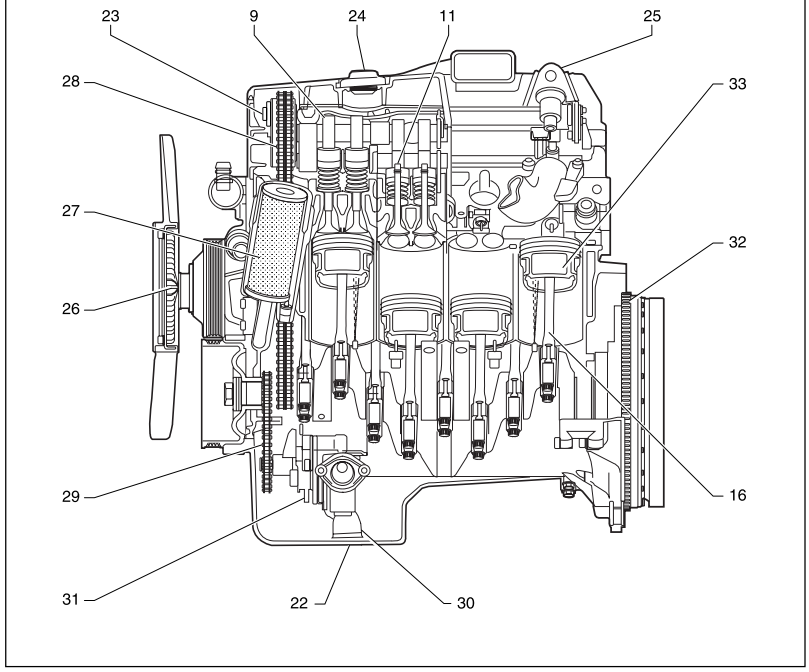
▶ G23D Engine Structure

Front View



1. HFM Sensor
2. Intake Air Duct
3. Cylinder Head Cover
4. Ignition Coil
5. Spark Plug Connector
6. Fuel Distributor
7. Injector
8. Exhaust Camshaft
9. Intake Camshaft
10. Valve Tappet
11. Intake Valve
12. Intake Manifold
13. Cylinder Head
14. Exhaust Manifold
15. Dipstick Guide Tube and Gauge
16. Connecting Rod
17. Crankshaft
18. Engine Mounting Bracket
19. Starter
20. Crankcase
21. Oil Pump Sprocket
22. Oil Pan

Side View



23. Camshaft Adjuster
24. Oil Filler Cap
25. Engine Hanger Bracket
26. Cooling Fan and Viscous Clutch
27. Oil Filter
28. Timing Chain
29. Oil Pump Drive Chain
30. Oil Strainer
31. Oil Pump
32. Ring Gear and Flywheel of Drive Plate
33. Piston

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. DIAGNOSTIC INFORMATION AND PROCEDURE

▶ Oil Leak Diagnosis

Most fluid oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedures may help you in locating and repairing most leaks.

Finding the Leak

1. Identify the fluid. Determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
2. Identify where the fluid is leaking from.
   2.1 After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper.
   2.2 Wait a few minutes.
   2.3 You should be able to find the approximate location of the leak by the drippings on the paper.
3. Visually check around the suspected component. Check around all the gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.
4. If the leak still cannot be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent.
   4.1 Clean the area well.
   4.2 Dry the area.
   4.3 Operate the vehicle for several miles at normal operating temperature and varying speeds.
   4.4 After operating the vehicle, visually check the suspected component.
   4.5 If you still cannot locate the leak, try using the powder or black light and dye method.

Powder Method

1. Clean the suspected area.
2. Apply an aerosol-type powder (such as foot powder) to the suspected area.
3. Operate the vehicle under normal operating conditoins.
4. Visually inspect the suspected component. You should be able to trace the leak path over the white powder surface to the source.

Black Light and Dye Method

A dye and light kit is available for finding leaks, Refer to the manufacturer's directions when using the kit.

1. Pour the specified amount of dye into the engine oil fill tube.
2. Operate the vehicle normal operating conditions as directed in the kit.
3. Direct the light toward the suspected area. The dyed fluid will appear as a yellow path leading to the source.

Repairing the Leak

Once the origin of the leak has been pinpointed and traced back to its source, the cause of the leak must be determined in order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check for the following conditions and correct them as they may cause a leak.

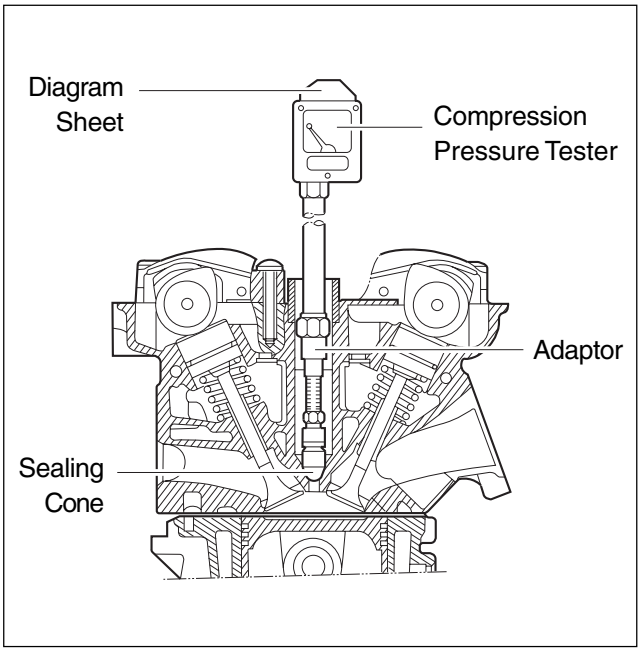
Gaskets

- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The fasteners are tightened improperly or the threads are dirty or damaged.
- The flanges or the sealing surface is warped.
- There are scratches, burrs or other damage to the sealing surface.
- The gasket is damaged or worn.
- There is cracking or porosity of the component.
- An improper seal was used (where applicable).

Seals

- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The seal bore is damaged (scratched, burred or nicked).
- The seal is damaged or worn.
- Improper installation is evident.
- There are cracks in the components.
- The shaft surface is scratched, nicked or damaged.
- A loose or worn bearing is causing excess seal wear.

▶ Compression Pressure Test



Standard Service Data

Application	G23D Engine
Compression Ratio	10.4 : 1
Normal Engine Temperature	←
Normal Compression Pressure	Min. 11 bar, Max. 15 bar
Permissible Pressure Difference Between Individual Cylinders	←

Tools Required

A9912 0012B (001 589 76 21 00) Compression Pressure Tester

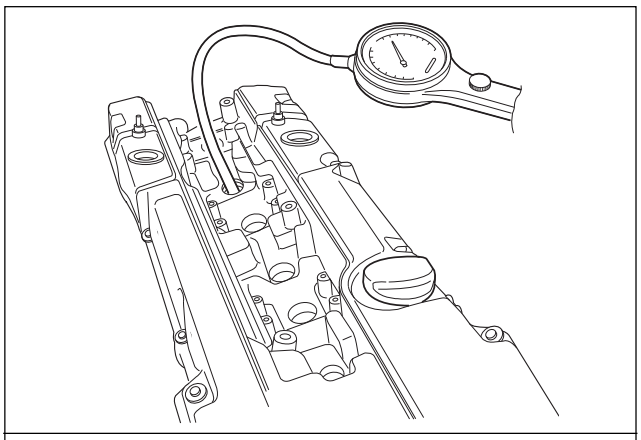
Measuring Procedure

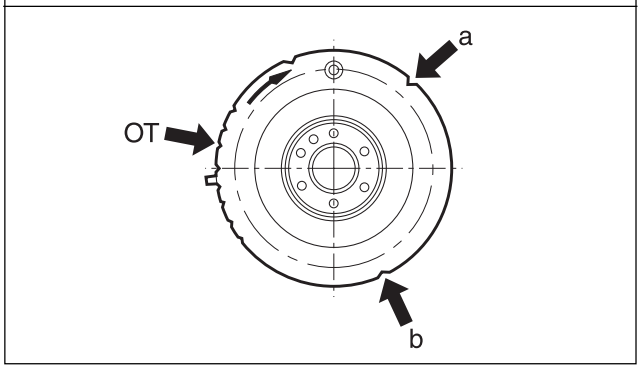
1. Warm the engine up to normal operating temperature.
2. Remove the spark plugs using the spark plug wrench.
3. Place the diagram sheet to compression pressure tester A9912 0012B (001 589 76 21 00).
4. Connect the adaptor to compression pressure tester A9912 0012B (001 589 76 21 00) and install it into the spark plug hole.
5. Crank the engine approx. eight revolutions by using the start motor.
6. Compare the measurements of compression pressure tester A9912 0012B (001 589 76 21 00) with the specifications.
7. Measure the compression pressure of the other cylinders in the same way.
8. If measured value is not within the specifications, perform the cylinder pressure leakage test.

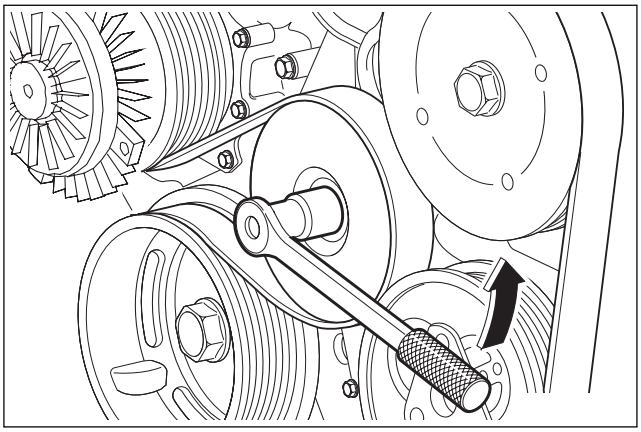
NOTICE

- **Discharge the combustion residues in the cylinders before testing the compression pressure.**
- **Apply the parking brake before cranking the engine.**

▶ Cylinder Pressure LeakageTest







Permissible Pressure Leakage

At Whole Engine	Max. 25 %
At Valve and Cylinder Head Gasket	Max. 10 %
At Piston and Piston Ring	Max. 20 %

Cylinder Number

OT (TDC)	UT (BDC 180 °)
1, 4	2, 3

Universal Tool

Cylinder Pressure Leakage Tester	Bosch, EFAW210A Sun, CLT 228

Leakage Test

1. Warm the engine up to normal operating temperature.
2. Disconnect the negative battery cable.
3. Remove the spark plugs.
4. Check the coolant level by opening the coolant reservoir cap and replenish if insufficient.
5. Open the engine oil filler cap.
6. Connect the tester to air pressure line and adjust the scale of tester.
7. Install the connecting hose to spark plug hole.
8. Position the piston of No.1 cylinder at TDC by rotating the crankshaft.
9. Connect the connecting hose to tester and measure the leakage volume after blowing up 5 bar of compressed air.

NOTICE

- **Measure the leakage volume in the completely opening condition of throttle valve by pulling the acceleration cable.**

10. Perform the pressure test according to the firing order.

NOTICE

- **Firing Order: 1 - 3 - 4 - 2**

11. Compare the leakage pressure with the specifications.

4. GENERAL DIAGNOSIS

Condition		Probable Cause	Correction
Hard starting (With normal cranking)	Malfunction of immobilizer system	• Faulty immoblilzer system	• Check (Antenna, Immobilizer transponder) • Replace (Antenna, Immobilizer transponder)
	Malfunction of ignition system	• Faulty fuse	• Replace the fuse.
		• Faulty spark plug.	• Clean, adjust the plug gap or replace.
		• Electric leakage at the high tension cable.	• Replace the cable.
		• Poor connection of the high tension cable or lead wires.	• Replace the cable or wires.
		• Faulty ignition coil.	• Replace the ignition coil.
	Malfunction of fuel system	• Empty of fuel in the fuel tank.	• Feed the fuel.
		• Dirty or clogged fuel filter.	• Replace the filter.
		• Clogged fuel pipe.	• Clean the fuel pipe.
		• Malfunction of the fuel pump.	• Replace the fuel pump.
		• Malfunction of the fuel injector.	• Replace the injector.
		• The foreign material in the fuel tank.	• Clean the fuel tank.
	Decline of compression pressure	• Poor tightening spark plug.	• Tighten to the specified torque. Compression
		• Cracked cylinder head gasket.	• Replace the gasket.
		• Inadequate the valve clearance.	• Adjust the clearance.
		• Leakage of the valve clearance.	• Repair the valve.
		• Interference of the valve stem.	• Replace the valve or the valve guide.
		• Low elasticity or damage of the valve spring.	• Replace the valve spring.
		• Abnormal interference of pistons and cylinders.	• Replace the piston ring.
		• Excessive wear of pistons, rings, or cylinders.	• Replace the ring or the piston and boring or replace the cylinder.
	Others	• Broken timing belt.	• Replace the belt.
		• Loosening, damage or leakage of the vacuum hose.	• Connect the hose correctly or replace it.
		• Leakage of intake system.	• Replace intake system.
Lack of engine power	Decline of compression pressure	• Refer to above in this page.	• Refer to above in this page.
	Malfunction of ignition system	• Faulty spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.

▶ General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Lack of engine power	Malfunction of fuel system	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
	Others	• Clogged exhaust system.	• Check and repair the system.
		• Clogged or contaminated air cleaner element.	• Clean or replace the air cleaner element.
		• Leak of the intake manifold gasket.	• Replace the gasket.
		• Dragging brakes.	• Repair or replace the brakes.
Rough engine idling	Decline of compression pressure	• Refer to "Page 1A-7".	• Refer to "Page 1A-7".
	Malfunction of fuel system	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
		• Malfunction of the fuel pressure regulator.	• Replace the regulator.
	Malfunction of ignition system	• Malfunction of the spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
		• Malfunction of the ignition coil.	• Replace the ignition coil.
	Others	• Clogged or contaminated air cleaner element.	• Clean or replace the air cleaner element.
		• Leak of the intake manifold gasket.	• Replace the gasket.
		• Poor connection or damage or leakage of the vacuum hose.	• Connect the hose correctly or replace it.
Engine hesitate (Upon pressing accelerating pedal, the engine makes delayed response This situation is remarkable when cruising or starting.)	Decline of compression pressure	• Refer to "Page 1A-7".	• Refer to "Page 1A-7".
	Malfunction of ignition system	• Poor spark plug or Poor adjustment of the plug gap.	• Replace the plug or adjust the gap.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
	Others	• Malfunction of the air cleaner system.	• Clean or replace the air cleaner system.
		• Leak of the intake manifold gasket.	• Replace the gasket.

▶ General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Engine surging (Engine power makes fluctuation in a fixed speed and speed changes without operating the accelerating pedal.)	Decline of compression pressure	• Refer to "Page 1A-7".	• Refer to "Page 1A-7".
	Malfunction of fuel system	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
		• Malfunction of the fuel pressure regulator.	• Replace the fuel pressure regulator.
	Malfunction of ignition system	• Malfunction of the spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
		• Poor ignition timing.	• Adjust the ignition timing.
	Others	• Leak of the intake manifold gasket.	• Clean or replace the gasket.
		• Leakage of the vacuum hose.	• Connect the hose correctly or replace it.
Excessive detonation (According to the opening range of Malfunction of metallic is made with abnormal explosion)	Overtheated engine	• Refer to "Overheat" in this page.	• Refer to "Overheat" in this page.
	Malfunction of fuel system	• Abnormal spark plug.	• Replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
	Malfunction of ignition system	• Clogged or contaminated fuel filter and fuel pipe.	• Clean or replace the fuel filter and the fuel pipe.
	Others	• Leak of the intake manifold gasket.	• Replace the gasket.
		• Excessive carbon deposit due to abnormal combustion.	• Remove the carbon.
Overheat	Malfunction of cooling system	• Lack of coolant.	• Refill coolant.
		• Malfunction of the thermostat.	• Replace the thermostat.
		• Malfunction of the cooling fan.	• Check or replace the cooling fan.
		• Poor water pump performance.	• Replace the pump.
		• Clogged or leaky radiator.	• Clean, repair or replace the radiator.
	Malfunction of lubrication system	• Poor engine oil.	• Replace engine oil with the specified one.
		• Blocking oil filter or strainer.	• Clean or repair the oil filter or the strainer.
		• Lack of engine oil.	• Refill oil.
		• Poor oil pump performance.	• Replace or repair the pump.
	Other	• Leakage of oil	• Repair.
		• Damaged cylinder head gasket.	• Replace the gasket.

▶ General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Poor fuel consumption	Decline of compression pressure	• Refer to "Page 1A-7".	• Refer to "Page 1A-7".
	Malfunction of fuel system	• Leakage of the fuel tank or the fuel pipe.	• Repair or replace the fuel tank or the fuel pipe
	Malfunction of ignition system	• Abnormal spark plug (Excessive carbon deposit, inadequate gap, burnt electrode).	• Replace the plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable normally or replace it.
	Malfunction of cooling system	• Malfunction of the thermostat.	• Repair the thermostat.
	Others	• Improperly installed valve.	• Repair or replace the valve.
		• Low pressure of tires.	• Adjust the pressure of tires.
Excessive consumption of engine oil	Leakage of engine oil	• Loosened oil drain plug.	• Tighten the plug.
		• Loosened oil pan bolt.	• Tighten the bolt. Engine Oil
		• Loosened oil filter.	• Tighten the filter.
		• Loosened oil pressure switch.	• Tighten the switch.
		• Leakage of camshaft front oil seal.	• Replace the seal.
		• Leakage of crankshaft front oil seal.	• Replace the seal.
		• Leakage at the cylinder head cover gasket.	• Replace the gasket.
		• Damage of the cylinder head gasket.	• Replace the gasket.
	Oil mixing in combustion chamber	• Stuck piston ring.	• Remove carbon and replace the ring.
		• Worn piston or cylinder.	• Replace the piston or the cylinder.
		• Worn piston ring or ring groove.	• Replace the piston or ring.
		• Inadequate position of the piston ring cutting part.	• Adjust the position.
		• Abrasion or damage of the valve system.	• Replace the valve system.
Low oil pressure	Malfunction of lubrication system	• Inadequate oil viscosity.	• Replace with the specified one.
		• Loosening of the oil pressure switch.	• Tighten the switch.
		• Lack of engine oil.	• Refill oil.
		• Blocking oil strainer.	• Clean the strainer.
		• Lowered function of the oil pump.	• Replace the pump.
		• Abrasion or damage of the oil pump relief valve.	• Replace the valve.

▶ General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Engine noise	Valve noise	• Inadequate valve clearance	• Adjust the valve clearance.
		• Abrasion of valve stem or guide.	• Replace the valve stem or the guide.
		• Weak valve spring.	• Replace the spring.
	Piston, ring, cylinder noise	• Abrasion of the piston, the ring or the cylinder.	• Boring the cylinder or replace the piston, the ring or the cylinder.
	Connecting rod noise	• Abrasion of the connecting rod bearing.	• Replace the bearing.
		• Loosened the connecting rod nut.	• Tighten to the specified torque
	Crankshaft noise	• Abrasion of the crankshaft bearing.	• Replace the bearing.
		• Abrasion of the crankshaft journal.	• Grind or replace the crankshaft journal.
		• Loosened bearing cap bolt.	• Tighten to the specified torque.
		• Excessive clearance of the crankshaft thrust bearing.	• Adjust or replace.

5. SPECIFICATIONS

▶ Engine Specifications

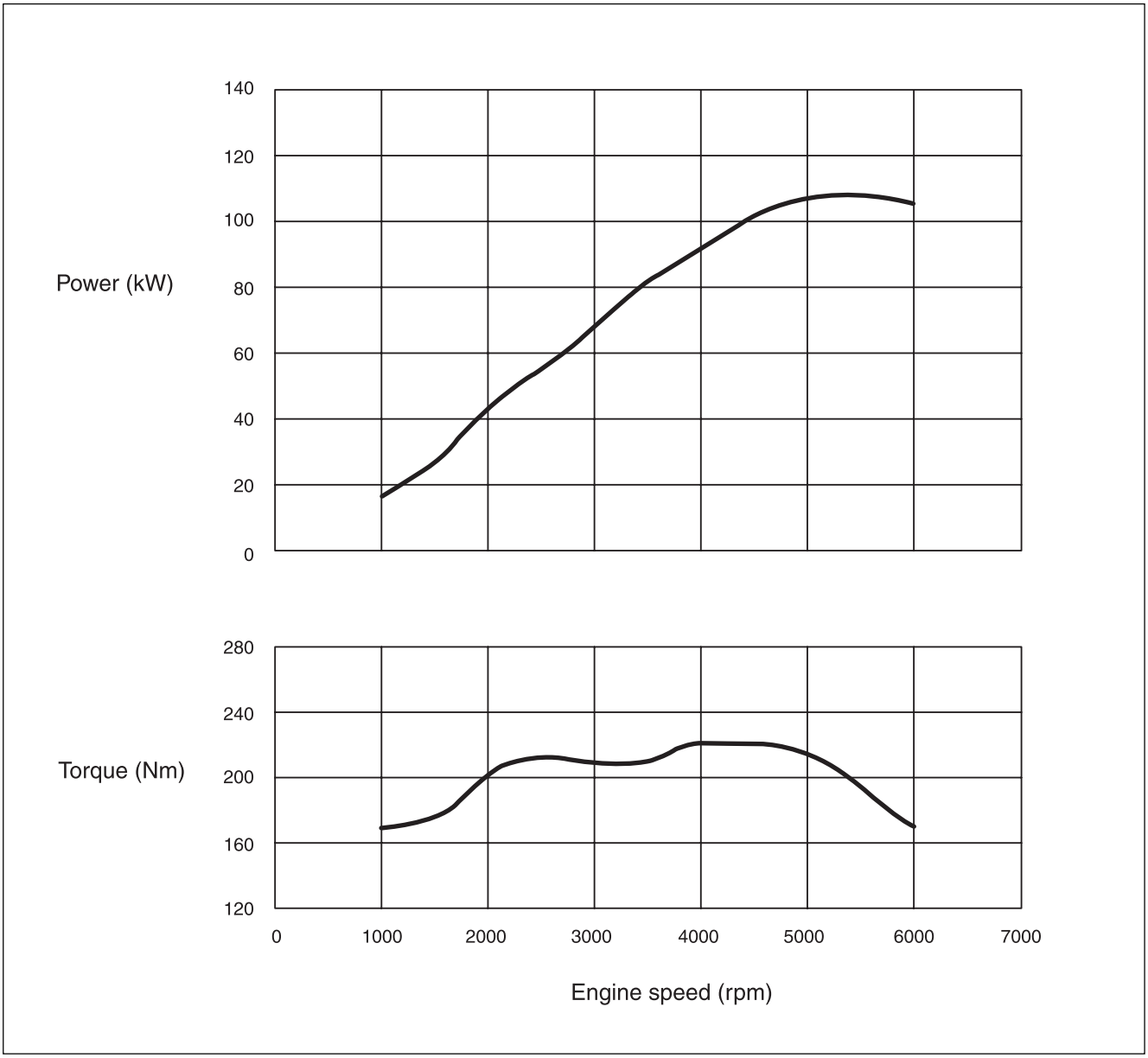
Application			G23D Engine	Remarks
Engine Model			M161.970	
Displacement			2295 cc	
Cylinder (Bore x Stroke)			90.9 x 88.4 mm	
Fuel Injection / Ignition System			MSE 3.53D	
Compression Ratio			10.4 : 1	
Number of Cylinders			4	
Camshaft Valve Arrangement			DOHC	
Camshaft Drive Type			Chain-Driven	
Max. Output			149 ps / 5500 rpm	
Max. Torque			22.4 kg•m / 4000 rpm	
Firing Order			1 - 3 - 4 - 2	
Ignition Type			Distributor less double ignition	
Ignition Timing			BTDC 6° ± 2°	
Valve Timing	Intake	Open/Close	ATDC 13.15° / ABDC 13.57°	
	Exhaust	Open/Close	BBDC 16.58° / BTDC 17.05°	
Valve Clearance Adjustment			←	
Idle Speed			750 ± 50 rpm	
Fuel Injection Pressure			3.2 - 4.2 kg/cm²	
Oil Capacity			7.5 ℓ	
Lubrication Type			Forced by gear pump	
Oil Filter Type			Full flow with paper filter	
Fuel			Unleaded gasoline	

MSE : Engine Control Module

3.53D : 4 Cylinder Version

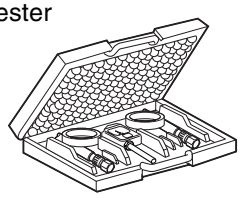
▶ Performance Curve

G23D Engine



6. SPECIAL TOOLS AND EQUIPMENT

▶ Special Tools Table

Name and Part Number
A99120012B (001 589 76 21 00) Compression Pressure Tester 

ENGINE MECHANICAL

SECTION 1B

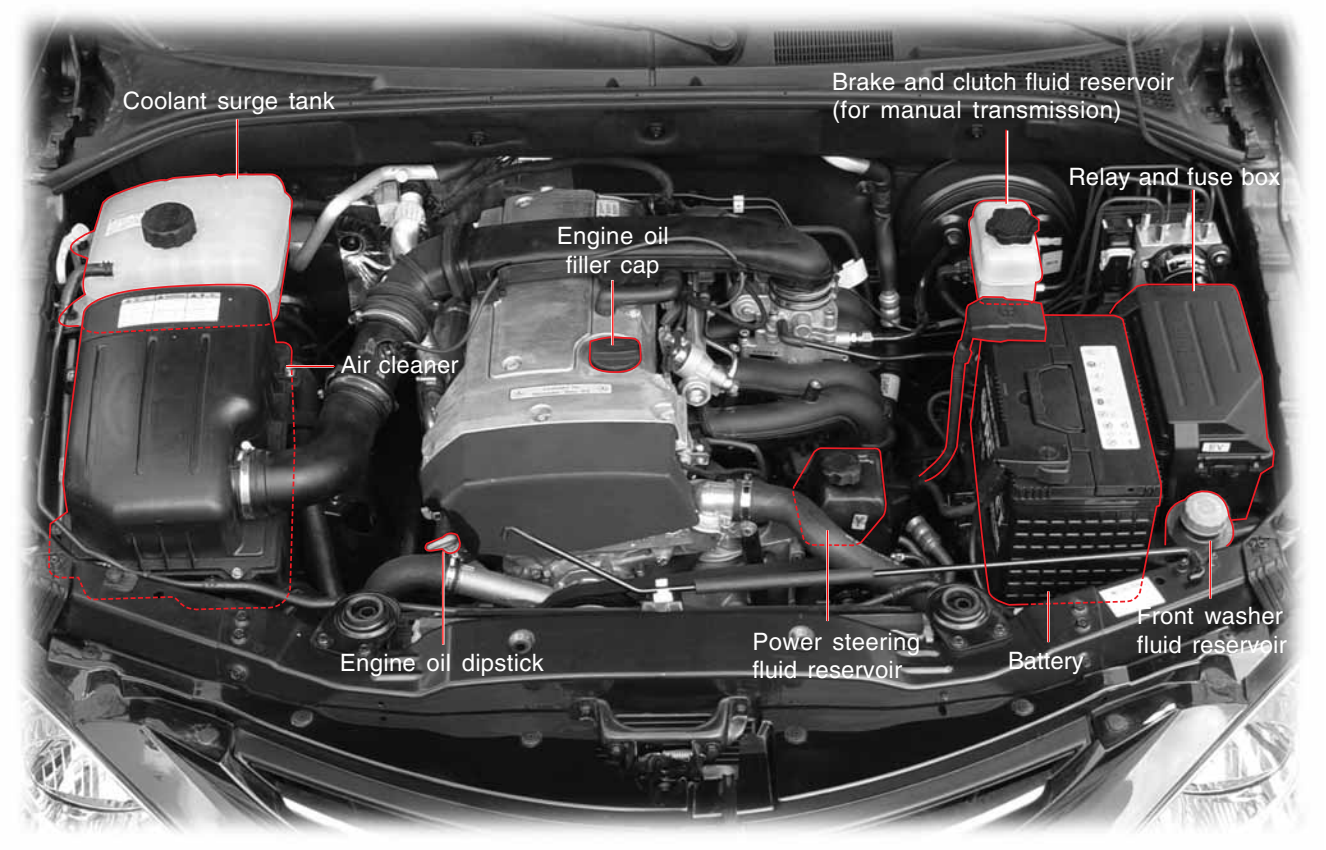
TABLE OF CONTENTS

1. Maintenance and repair 1B-2
2. Crankcase ventilation system 1B-10
3. Removal and installation in groups 1B-12
4. Unit repair 1B-79
5. Specifications 1B-85
6. Special tools and equipment 1B-87

1. MAINTENANCE AND REPAIR

▶ ON-Vehicle Service

Engine Room



Removal & Installation Procedue



1. Disconnect the negative terminal of battery.
2. Remove the hood.

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3. Remove the under cover.

Installation Notice

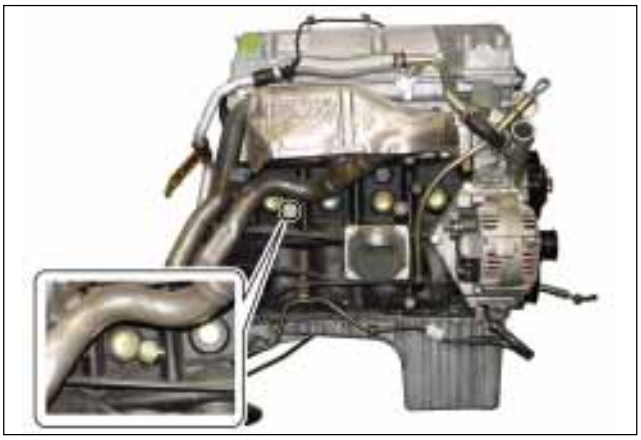
Tightening Torque	28 - 47 N•m (21 - 35 lb-ft)



4. Loosen the radiator drain cock and drain the coolant.

NOTICE

- **Open the coolant reservoir cap.**



5. Loosen the cylinder block drain plug and then drain the coolant completely.

Installation Notice

Tightening Torque	5 N•m (26 lb-ft)

NOTICE

- **Replace the seal before installation of the drain plug.**



6. Disconnect the coupling of HFM sensor and remove the air cleaner cross pipe.





7. Remove the air cleaner cover. Remove the mounting bolts and air cleaner housing and element assembly.



8. Remove the radiator and PWM electric fans. For more information, refer to "Engine Cooling" section.



8-1. Drain the A/C refrigerant using the refrigerant collector before removing the radiator and PWM electric fan assembly.

8-2. Disconnect the upper and the lower hoses of the radiator.

NOTICE

- **Be careful not to spill the coolant when disconnecting the radiator hose.**



8-3. Disconnect the oil cooler pipe of the automatic transmission.

NOTICE

- **Be careful for the oil leakage and collect it using designated collector.**
- **Be careful not to spill the oil on other parts.**

9. Disconnect the parts connected to the engine from the engine compartment.

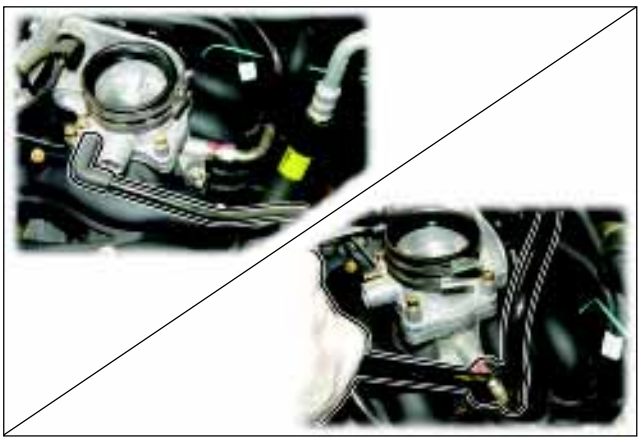
9-1. Disconnect the terminals and the ground terminal from the generator.



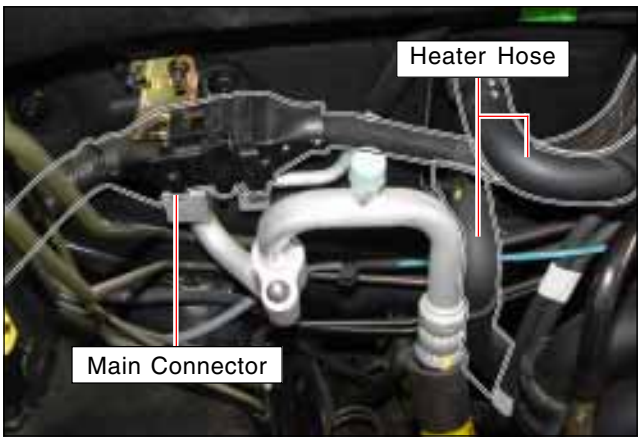
9-2. Disconnect the ground terminal to the intake manifold.



9-3. Disconnect the vacuum hose and the purge control hose to the intake manifold.



9-4. Disconnect the inlet and outlet heater hoses and main connector.



9-5. Remove the fuel feed and return line.

NOTICE

- **Before removing the fuel lines, release the pressure in the fuel system.**





Tightening Torque	21 - 25 N•m (15 - 18 lb-ft)

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9-6. Remove the V-belt and the power steering pump assembly from the engine.

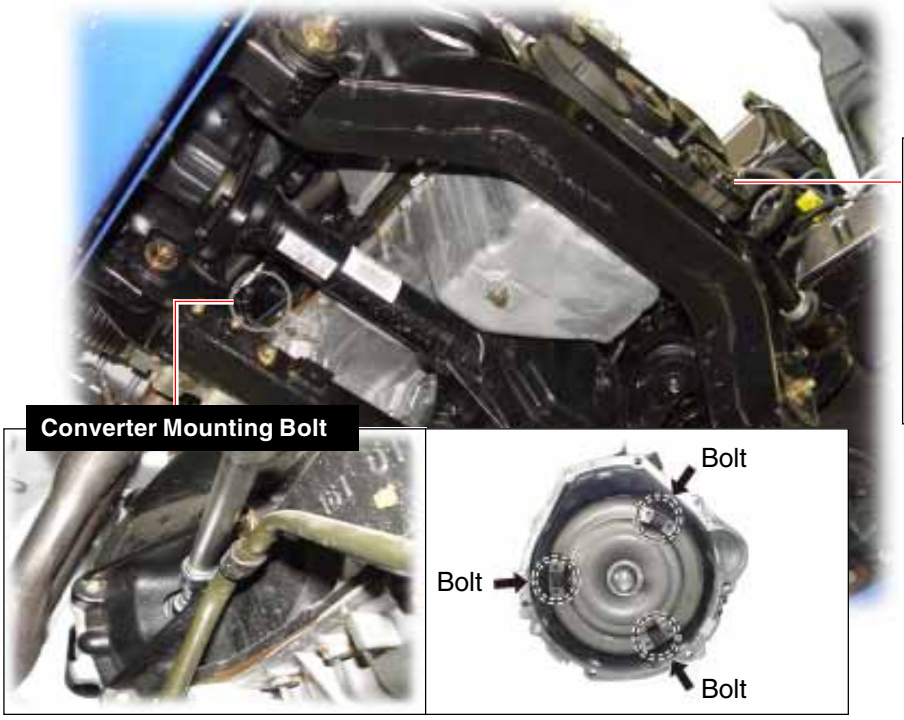




9-7. Discharge the refrigerant from A/C system, and disconnect the discharge pipe and suction pipe from the compressor.



10. By rotating the crankshaft from the front of engine, remove the 6 torque converter mounting bolts from the engine ring gear plate.





Tightening Torque: 42 N•m (31 lb-ft)

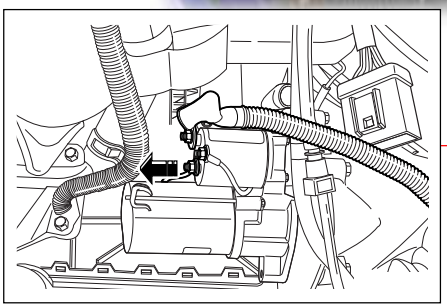


11. Remove the automatic transmission oil cooler line retaining bolts from the automatic transmission side and oil pan side.

    Remove the automatic transmission oil cooler line retaining bolts from engine side and oil pan side.

12. Remove the automatic transmission.





Disconnect the terminals from starter motor and remove the starter motor.

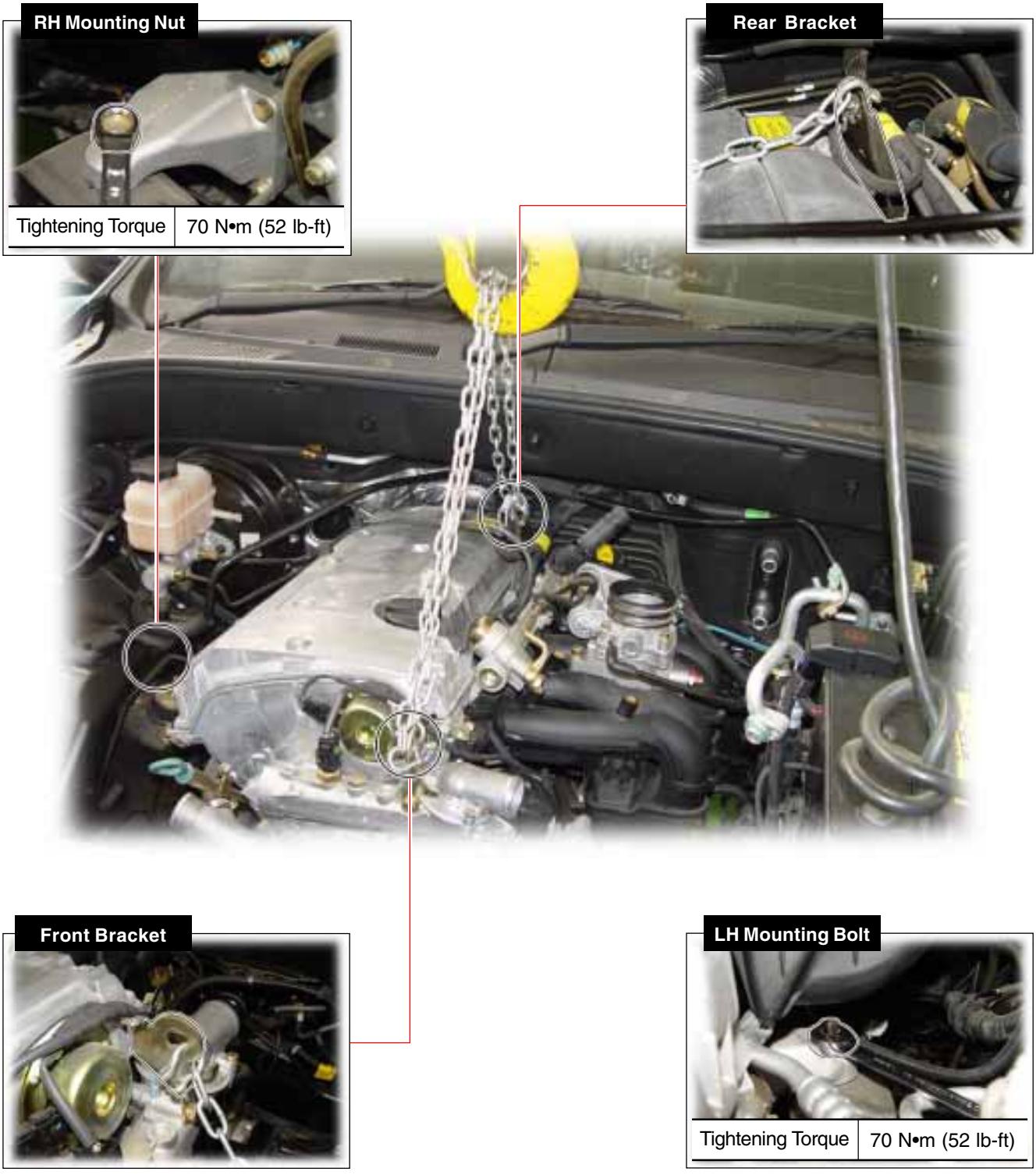


Remove the exhaust manifold and exhaust pipe.

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

13. Connect the chain to the engine bracket and unscrew the mounting bolts and nuts (LH/RH) from the engine mounting.



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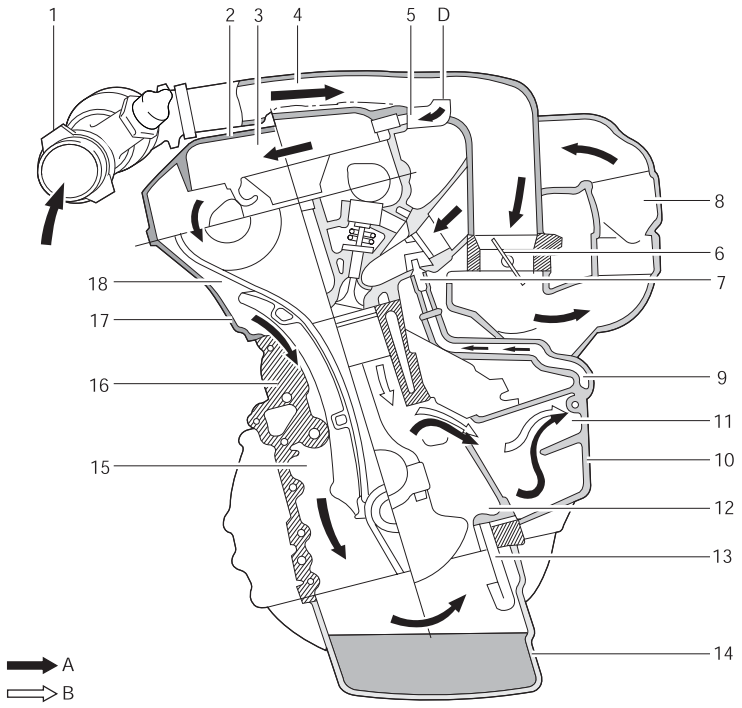
14. Carefully separate the engine assembly from the vehicle.



15. Installation should follow the removal procedure in the reverse order.

2. CRANKCASE VENTILATION SYSTEM

▶ Operation at Idling and Mid- Load



1. HFM Sensor
2. Cylinder Head Cover
3. Oil Spearation Chamber (Full-Load or Over Mid-Load)
4. Intake Air Duct (Cross Pipe)
5. Vent Line (Full-Load or Over Mid-Load)
6. Throttle Valve
7. Restrictor, Diameter 1.1mm (Mid-Load at Idling)
8. Intake Manifold
9. Vent Line (Mid-Load at Idling)
10. Air Conditioner Bracket
11. Oil Separation Chamber (Mid-Load at Idling)
12. Crank Chamber
13. Oil Return Pipe
14. Oil Pan
15. Timing Gear Case Cover
16. Crankcase
17. Chain Housing

A. Fresh Air
B. Blow-By Gas
D. Vent Connection

Operation at Idling and Mid- Load

- The throttle valve (6) is closed or very partially opened, and the vacuum pressure in intake manifold is high.

  The blow-by gas and the fresh air that is additionally supplied through the vent connection (D) in the crank-case in partial load gets supplied to the combustion chamber from the crank chamber (12) through the oil separation chamber (11), air-conditioner bracket (10), vent line (9), and restrictor (7) mounted to the cylinder head.

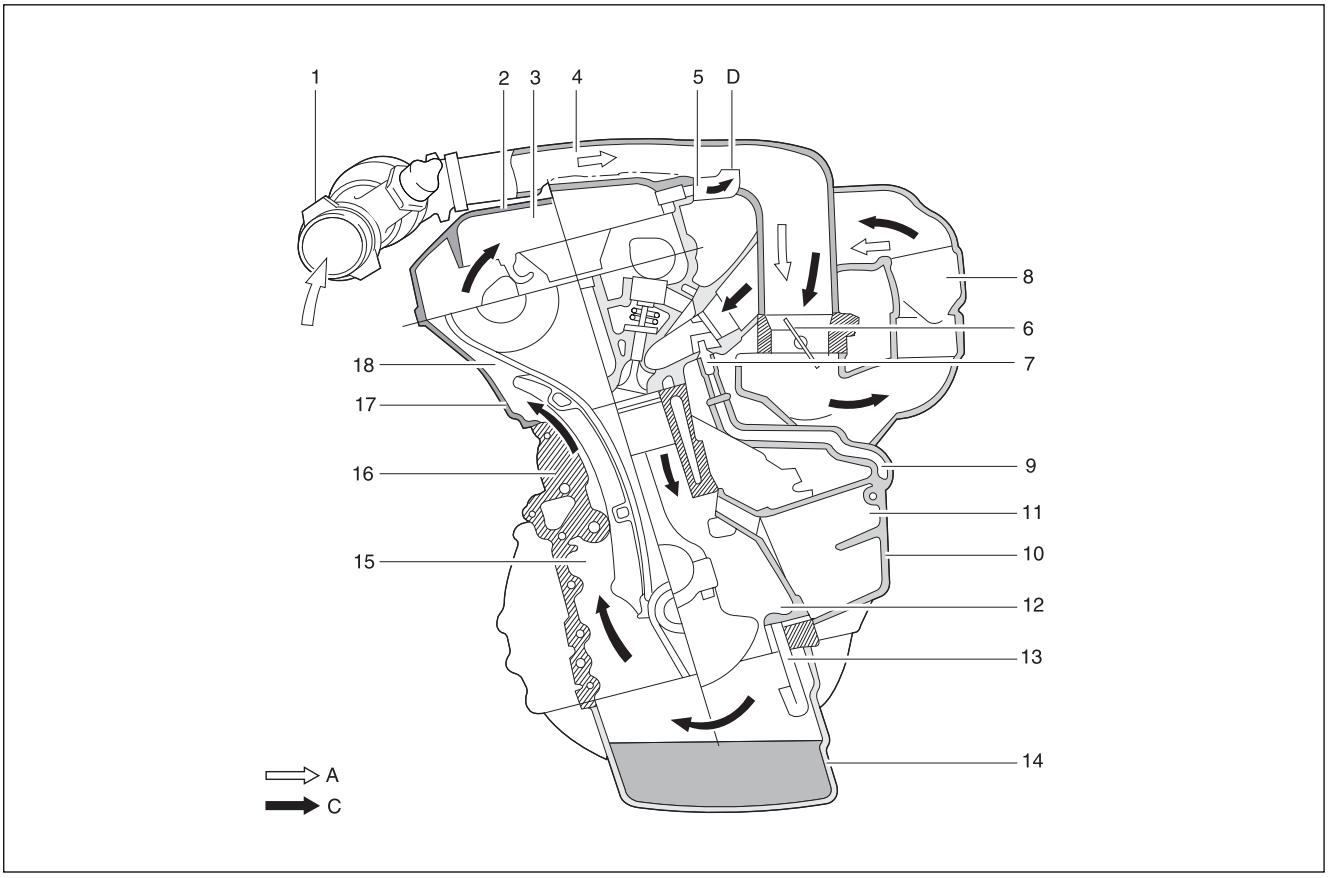
  The circulated engine oil returns to the oil pan through the oil return pipe (13) at the bottom of oil separation chamber (11).

  The fresh air gets supplied to the crank chamber (12) through the HFM sensor (1), intake air duct (4), vent line (5), oil separation chamber (3), chain housing (17), and the timing gear case cover (15).

  The additional supply of the fresh air is needed to prevent from forming the residues of the engine oil.

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EFFECTIVE DATE	
AFFECTED VIN	

▶ Operation When Full- Load at Partial Load



1. HFM Sensor
2. Cylinder Head Cover
3. Oil Spearation Chamber (Full-Load or Over Mid-Load)
4. Intake Air Duct (Cross Pipe)
5. Vent Line (Full-Load or Over Mid-Load)
6. Throttle Valve
7. Restrictor, Diameter 1.1mm (Mid-Load at Idling)
8. Intake Manifold
9. Vent Line (Mid-Load at Idling)
10. Air Conditioner Bracket
11. Oil Separation Chamber (Mid-Load at Idling)
12. Crank Chamber
13. Oil Return Pipe
14. Oil Pan
15. Timing Gear Case Cover
16. Crankcase
17. Chain Housing

A. Fresh Air
C. Blow-By Gas
D. Vent Connection

Operation When Full- Load at Partial Load

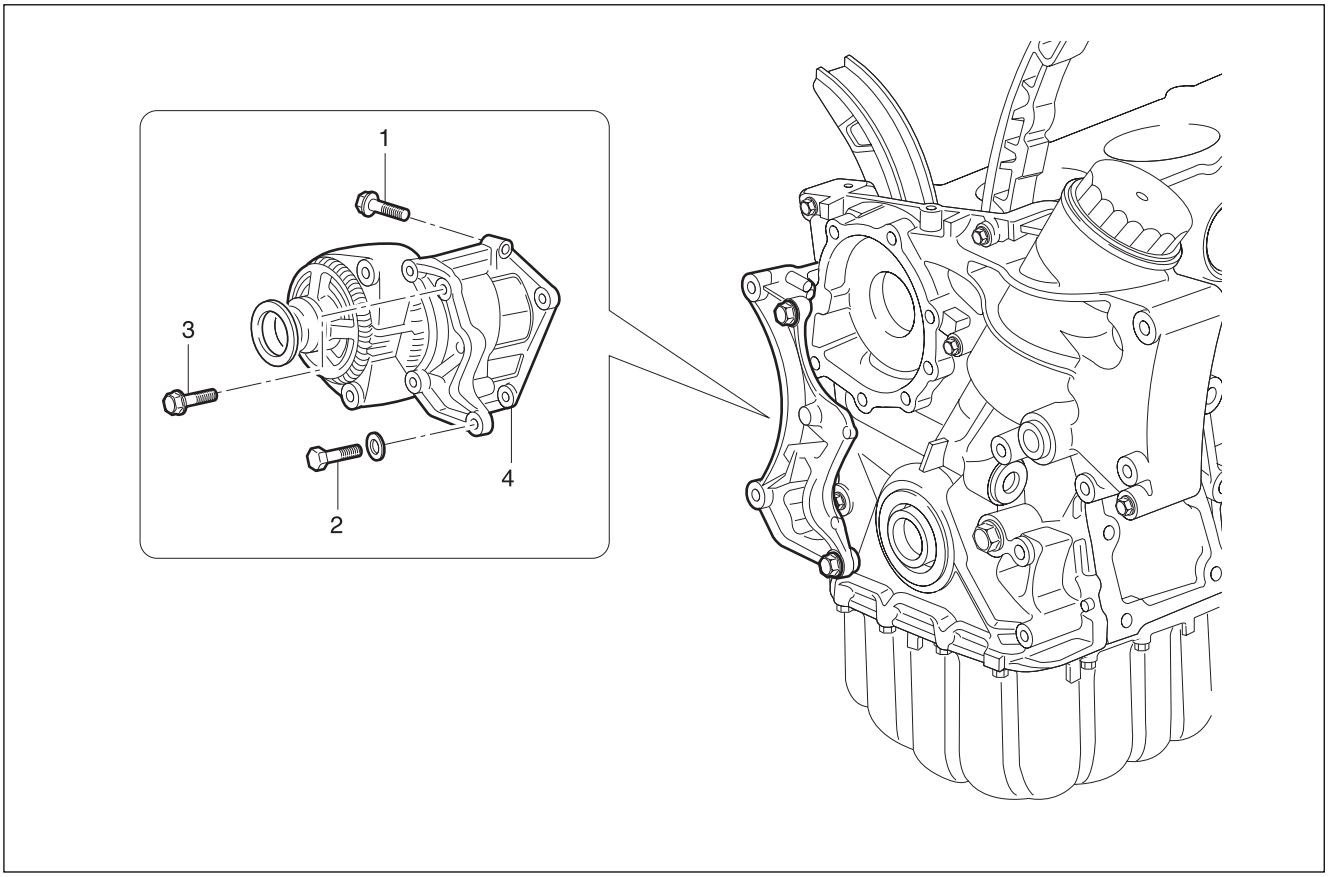
- The throttle valve (6) is partially opened or fully opened.

  The air flows very rapidly through the vent line (5) s connection (D) and the intake air duct when full load at partial load.

  Consequently, most of the low-by gases are supplied to the combustion chamber through the timing gear case cover (15), chain housing (17), oil separation chamber (3), vent line (5), throttle valve (6), and intake manifold (8).

3. REMOVAL AND INSTALLATION IN GROUPS

▶ Alternator



1. Bolt (M8 X 40, 3 pieces)
   ..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
2. Bolt (M8 X 70, 2 pieces)
   ..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
3. Bolt (M8 X 85, 1 piece)
   ..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
4. Alternator Bracket

Removal & Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the drive belt.
3. Remove the alternator.
4. Unscrew the alternator carrier bolts and remove the carrier.

NOTICE

- **Apply 3 Nm of torque when mounting the bolt (1) ; apply 25 Nm of torque when mounting the bolts (2), and (3) ; and then tighten the bolt (1) with 25 Nm of torque.**

5. Installation should follow the removal procedure in the reverse order.

Installation Notice

Tightening Torque	70 N•m (52 lb-ft)

▶ Engine Mount

Removal & Installation Procedure

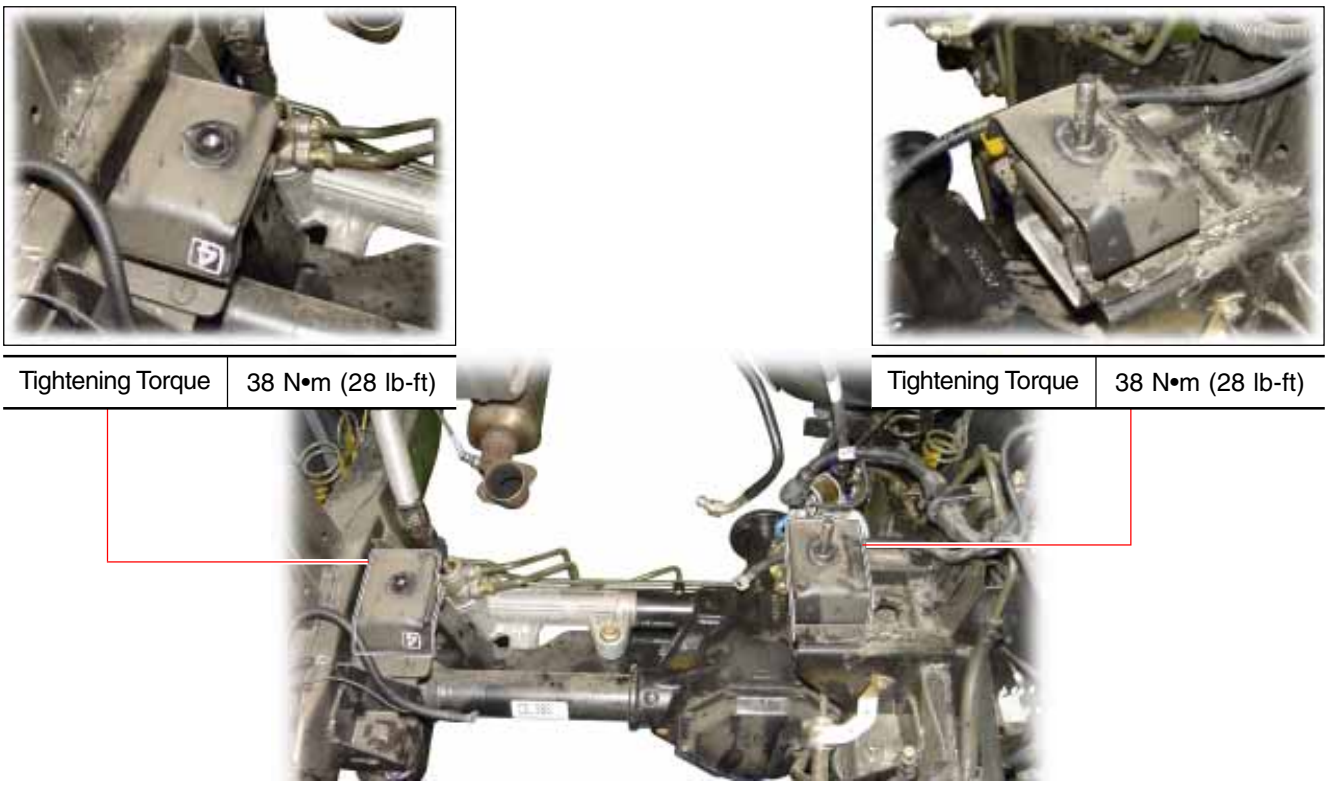
1. Unscrew the upper engine mount nut or bolt and remove the engine.



Tightening Torque	70 N•m (52 lb-ft)

Tightening Torque	70 N•m (52 lb-ft)

2. Unscrew the lower nuts.



Tightening Torque	38 N•m (28 lb-ft)

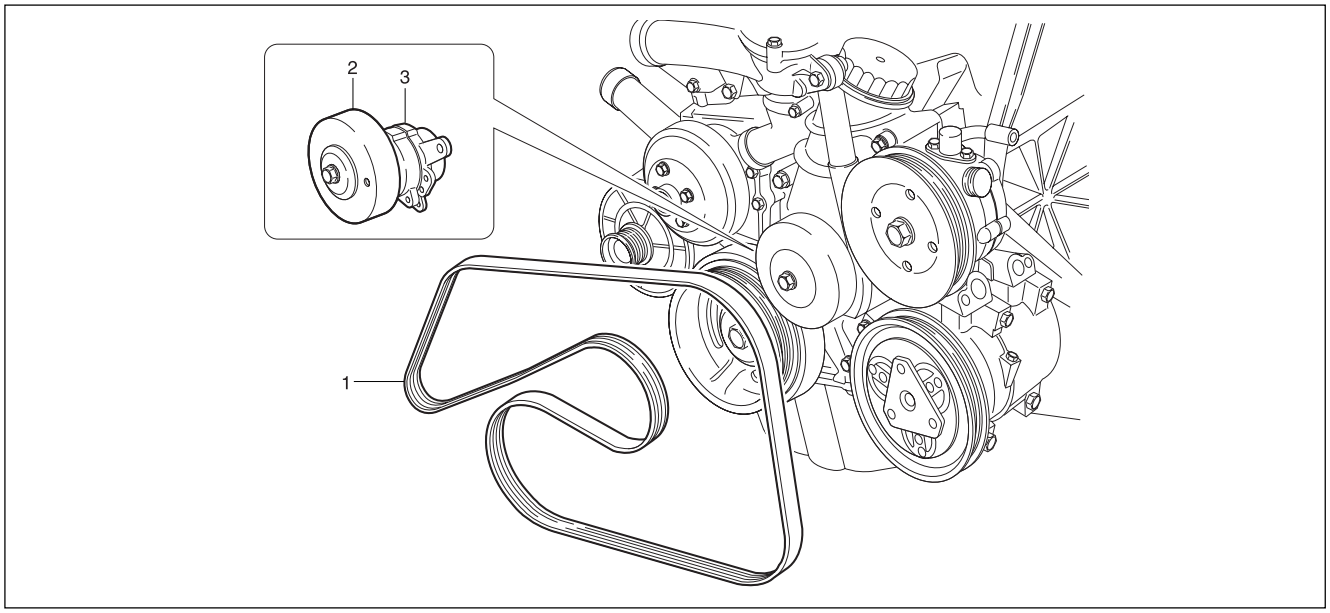
Tightening Torque	38 N•m (28 lb-ft)

3. Remove the hydraulic engine mounting insulator.
4. Installation should follow the removal procedure in the reverse order.

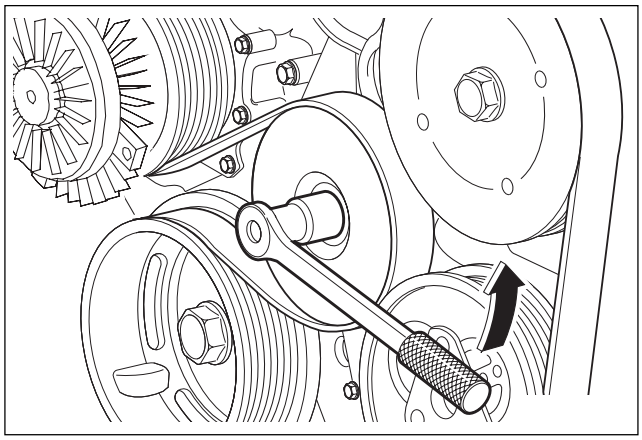
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▶Poly V - Belt

※ **Preceding Work:** Removal of cooling fan



1. Poly V-Belt (2,155 mm)
2. Belt Tensioning Pulley
3. Belt Tensioner



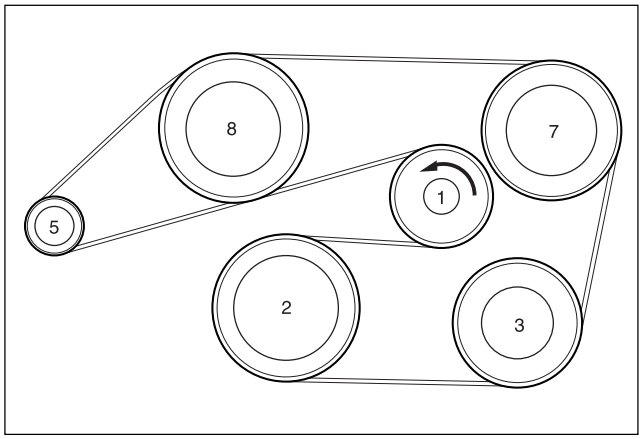
Removal & Installation Procedure

1. Release the belt tension by turning the stud on the cap with 12 sided wrench or spanner counterclock-wise.
2. Remove the poly v-belt.

NOTICE

- **Check the belt for damage and tensioning pulley bearing point for wear and replace them if necessary.**

3. Install the belt after prying the tensioning pulley.



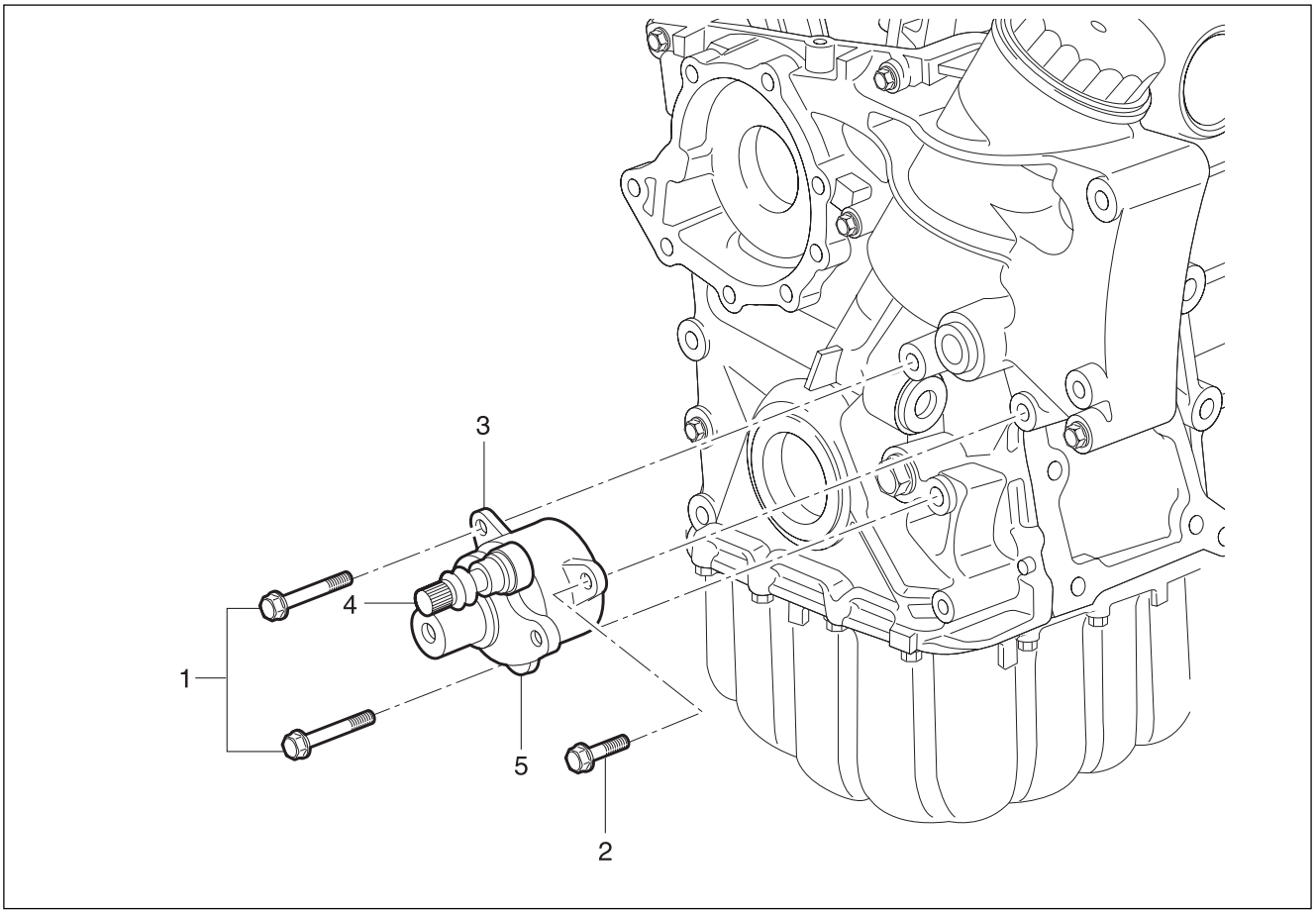
Poly V - Belt Arrangement

1. Belt Tensioning Pulley
2. Crankshaft Belt Pulley
3. A/C Compressor Pulley
5. Generator Pulley
7. Power Steering Pump Pulley
8. Water Pump Pulley

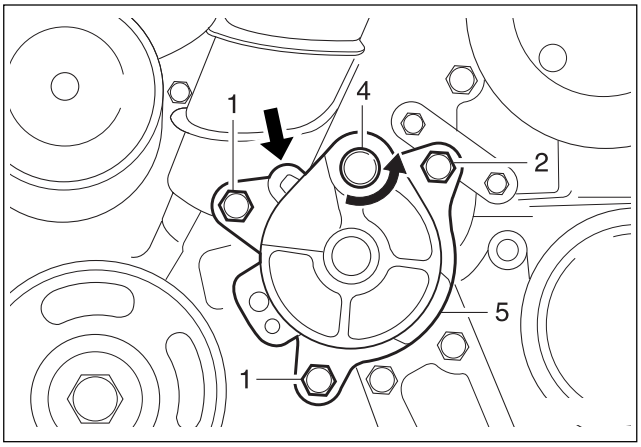
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Tensioning Device

※ **Preceding Work:** Removal of tensioning device shock absorber



1. Bolt (M8 x 75, 2 pieces) + Washer ..... 22.5 - 27.5 N•m (16.6 - 0.3 lb-ft)
2. Bolt (M8 x 25, 1 pieces) + Washer ..... 22.5 - 27.5 N•m (16.6 - 0.3 lb-ft)
3. Tensioning Device
4. Stud bolt
5. Tensioning Arm



Removal & Installation Procedure

1. Turn the stud bolt to counterclockwise.
2. Insert the pin into the hole in tensioning arm.
3. Unscrew the bolts (1, 2) and remove the tensioning device.

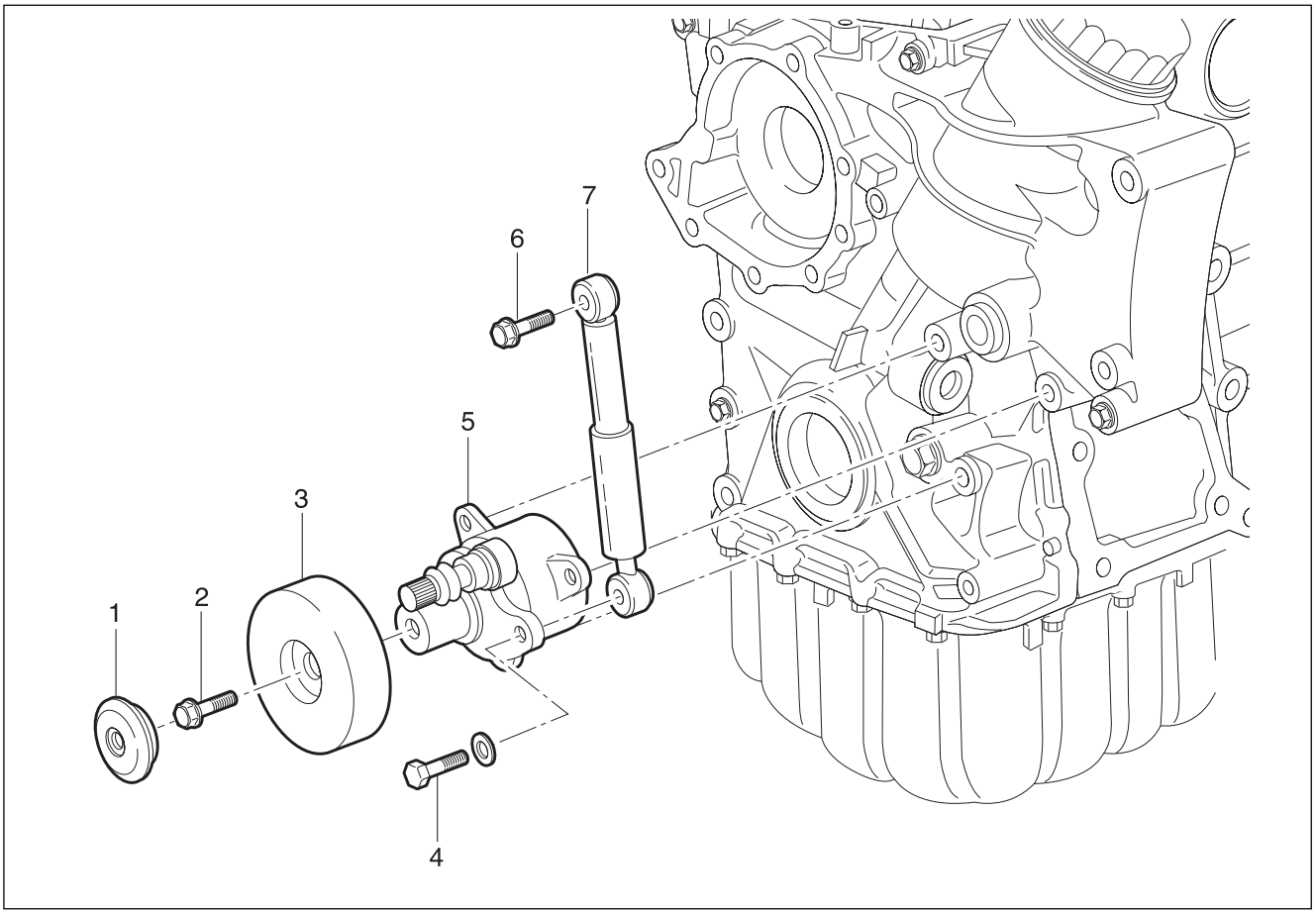
Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

4. Installation should follow the removal procedure in the reverse order.

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AFFECTED VIN	

▶ Tensioning Device Shock Absorber



1. End Cover
2. Bolt ..... 40.5 - 9.5 N•m (29.9 - 6.5 lb-ft)
3. Tensioning Pulley
4. Bolt (M8 X 25) + Washer
   ..... 22.5 - 7.5 N•m (16.6 - 0.3 lb-ft)
5. Tensioning Device
6. Bolt (M8 X 35) + Washer
   ..... 22.5 - 7.5 N•m (16.6 - 0.3 lb-ft)
7. Shock Absorber

Removal & Installation Procedure

1. Remove the end cover (1).
2. Remove the bolt (2) and remove the tensioning pulley (3).

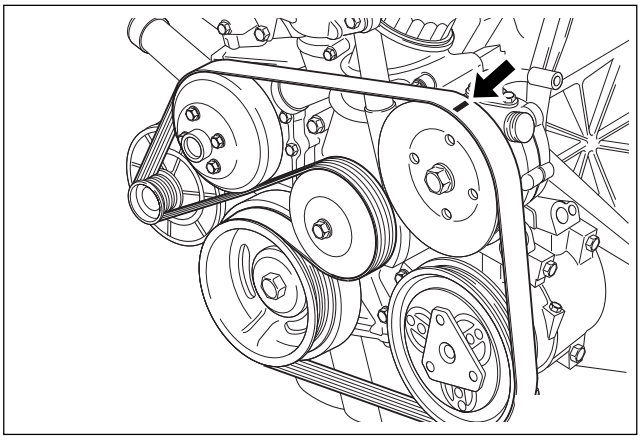
Installation Notice

Tightening Torque	40.5 - 49.5 N•m (29.9 - 36.5 lb-ft)

3. Unscrew the bolts (4,6) and remove the shock absorber (7).

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

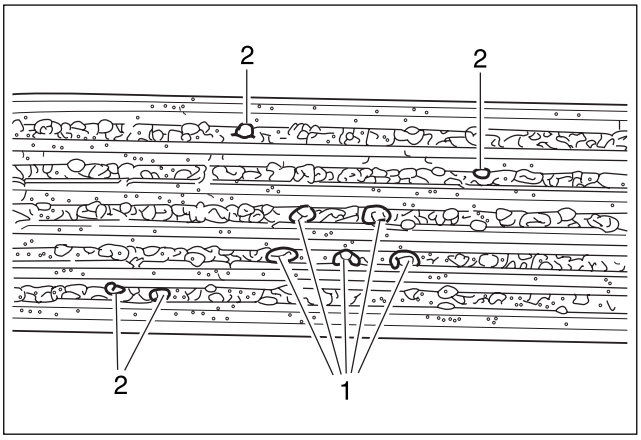


▶ Poly V - Belt Inspection

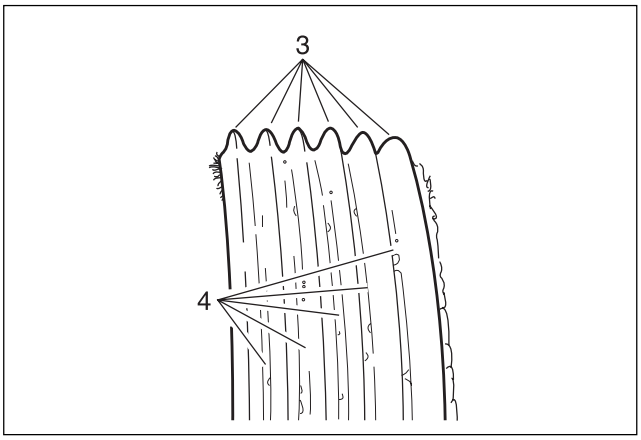
- Make marks on the belt with chalk.
- Rotate the engine and check the belt for damage.

NOTICE

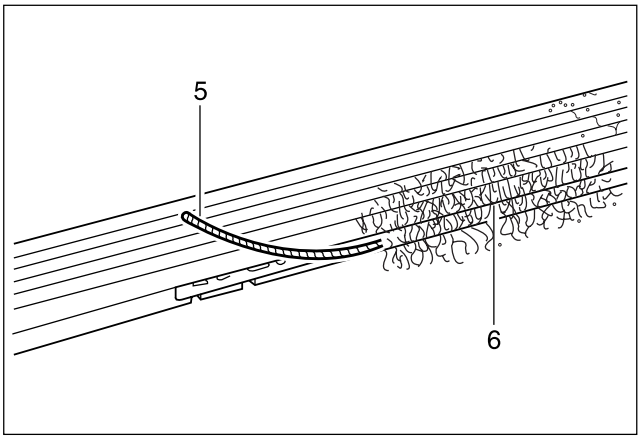
- **If one of the following types of damages is found, replace the belt.**



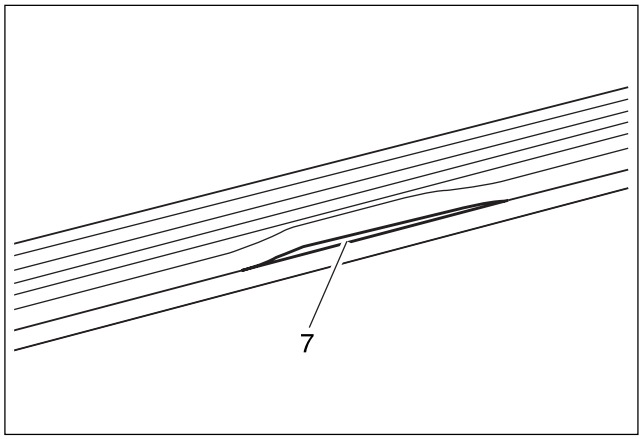
1. Rubber lumps in the base of rib.
2. Dirt or grit ingrained.



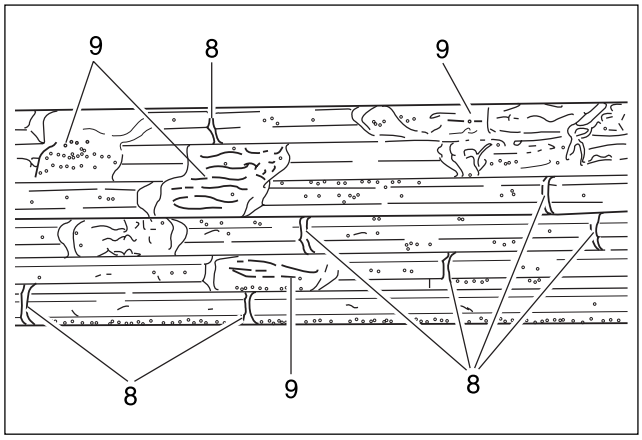
3. Pointed rib.
4. Belt cord visible in the base of rib.



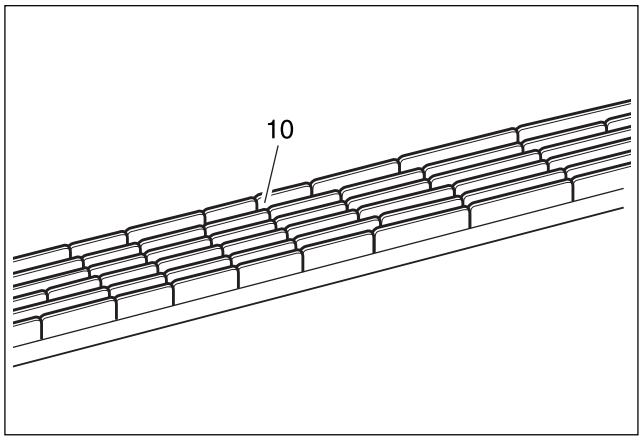
5. Cord torn out at the side.
6. Outer cords frayed.



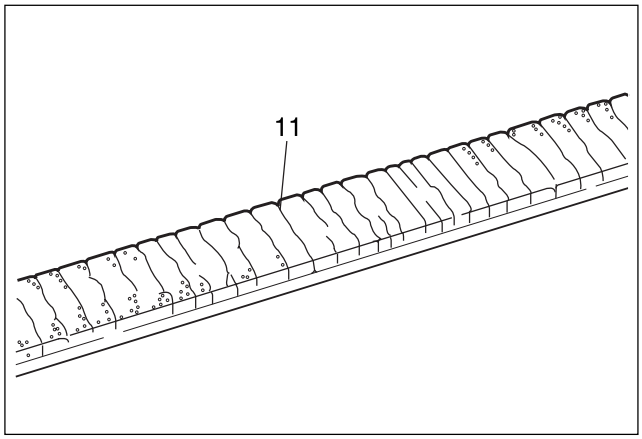
7. Rib detached from the base of belt.



8. Splits across the rib.
9. Sections of rib torn out.

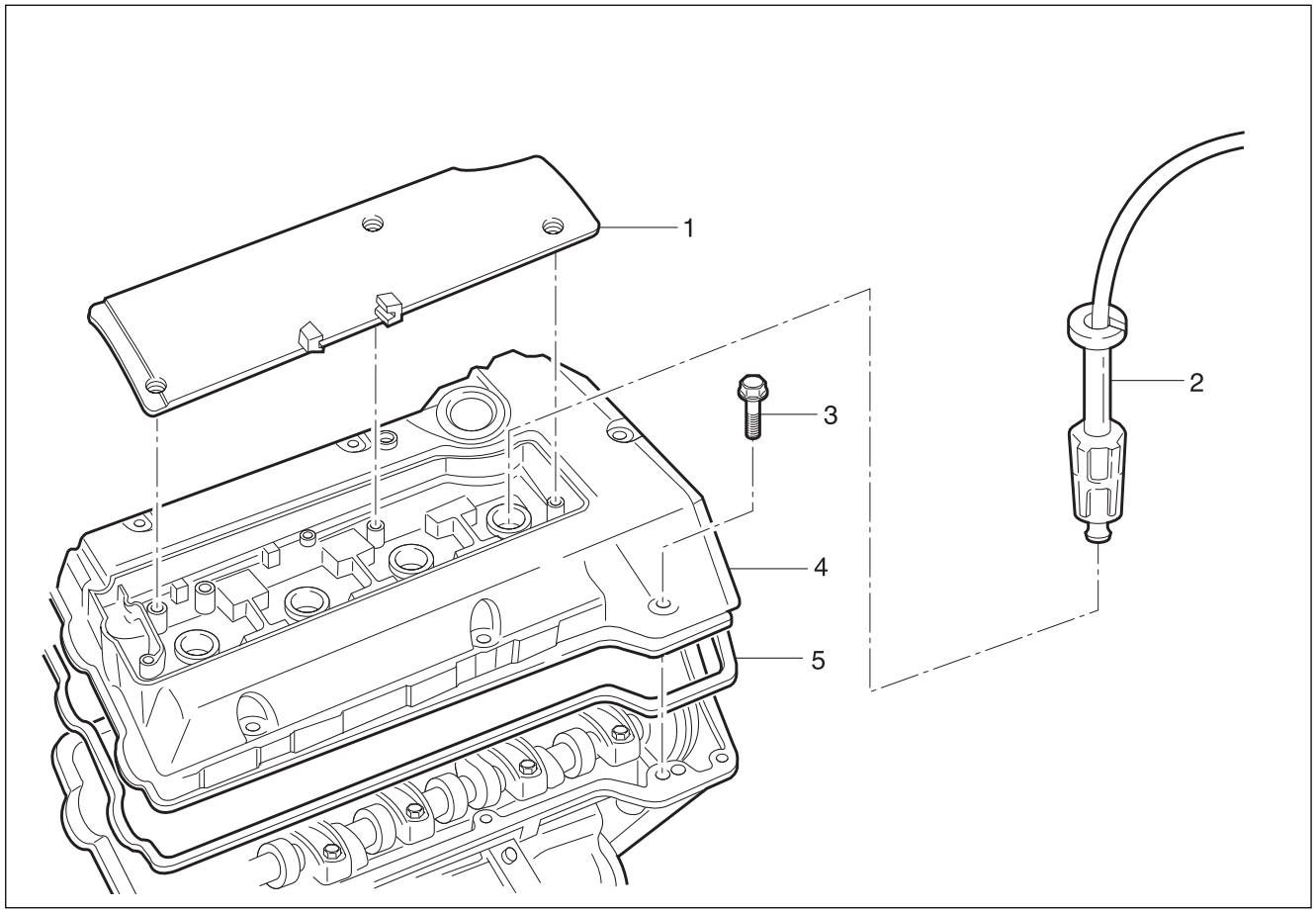


10. Splits across several ribs.

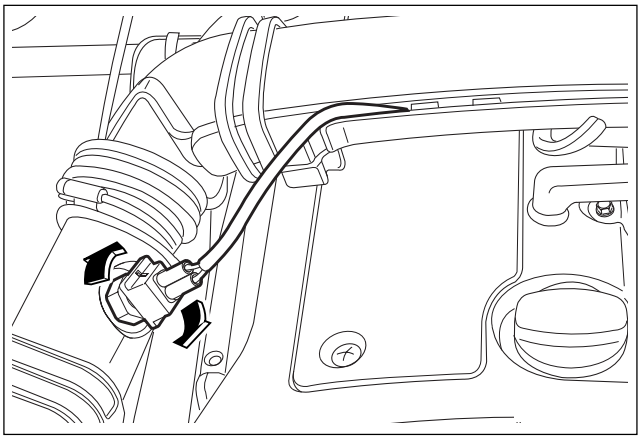


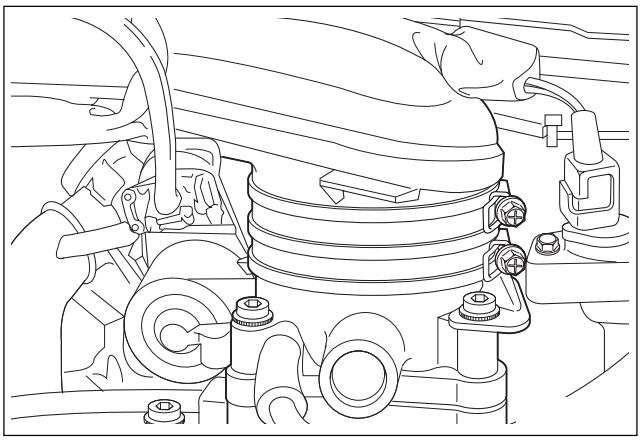
11. Splits across the back of the belt.

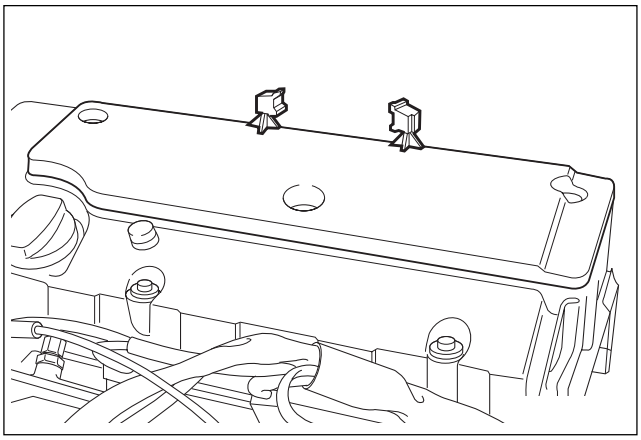
▶ Cylinder Head Cover

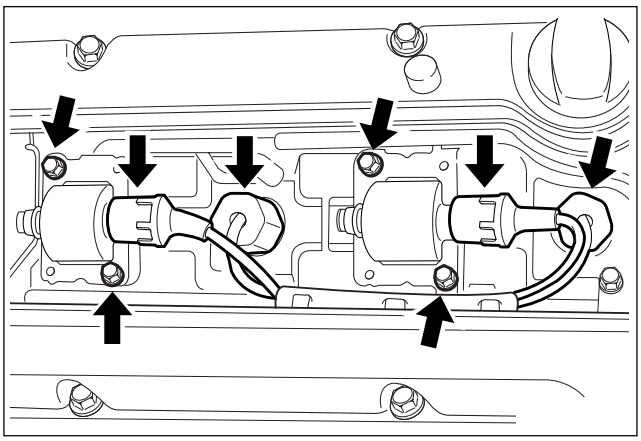


1. Spark Plug Cover
2. Spark Plug Connector
3. Bolt (M6 X 45 : 4 pieces, M6 X 60 : 6 pieces)
   ..... 9 - 11 N•m (80 - 97 lb-in)
4. Cylinder Head Cover
5. Gasket ..... Replace









Removal & Installation Procedure

1. Remove the intake air duct.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)

2. Remove the spark plug cover.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)

NOTICE

- **Release 3 screws from the spark plug cover and remove the cover for G23D Engine coil.**

3. Remove the spark plug connector and ignition cable.
4. Unscrew the bolts (3) and remove the head cover and the gasket.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)

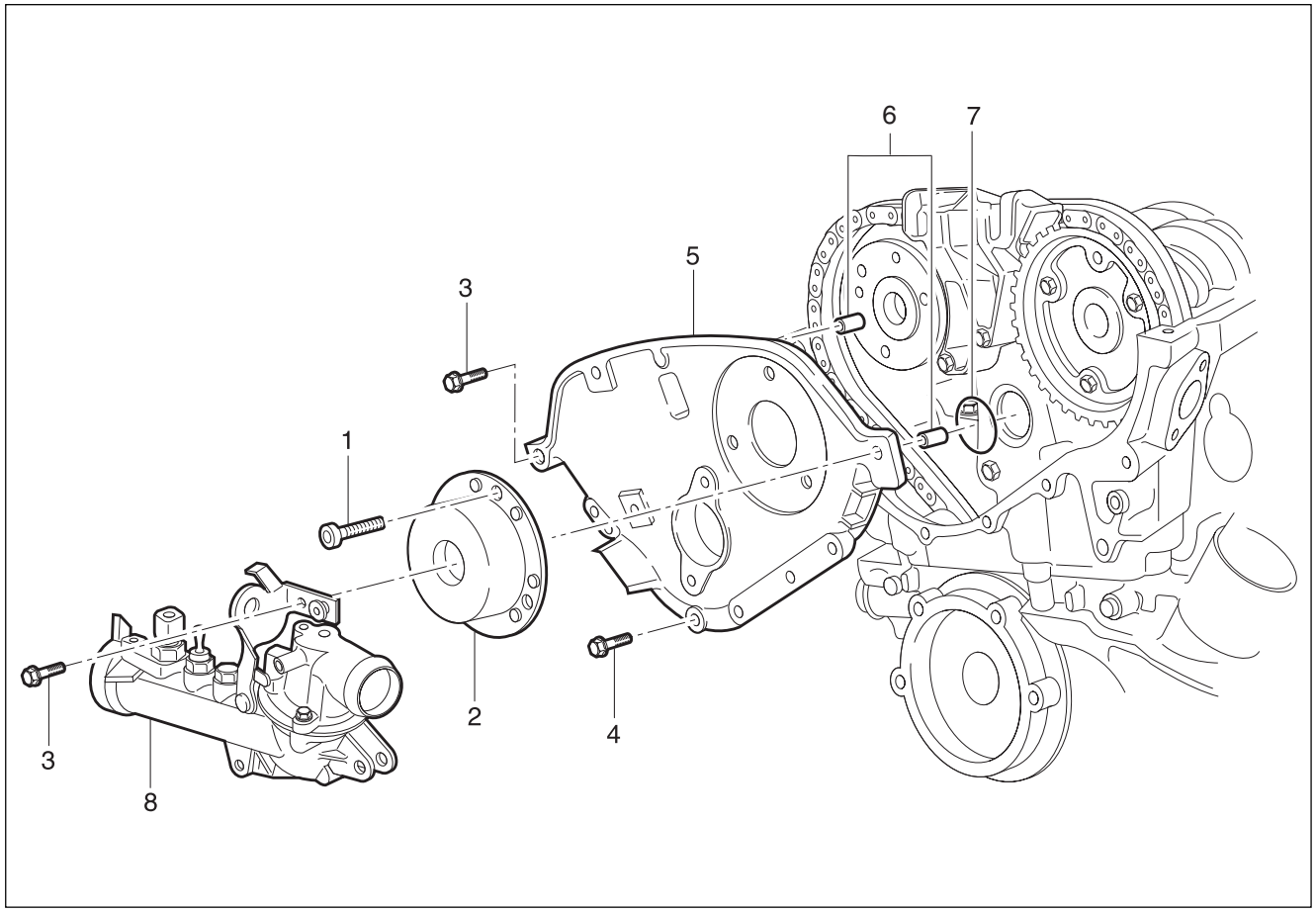
NOTICE

- **Replace the gasket with a new one if necessary.**

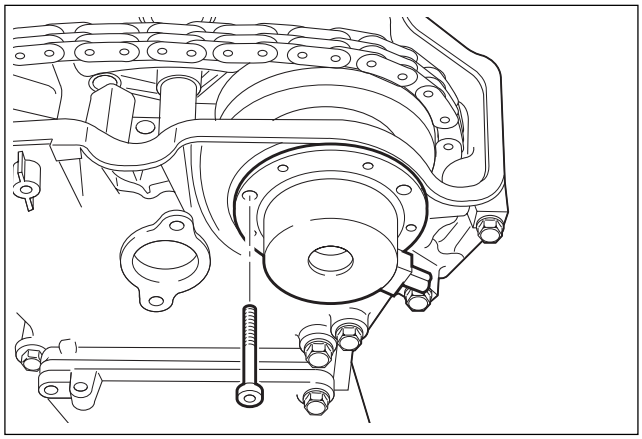
5. Installation should follow the removal procedure in the reverse order.
6. Check for oil leaks by operating the engine.

▶ Cylinder Head Front Cover

※ **Preceding Work:** Removal of cylinder head cover
Removal of thermostat housing assembly
Removal of engine hanger bracket



1. Bolt (M6 X 16, 3 pieces)
   ..... 9 - 11 N•m (80 - 97 lb-in)
2. Camshaft Adjuster
3. Bolt (M8 X 35, 2 pieces)
   ..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
4. Bolt (M6 X 22, 6 pieces)
   ..... 9 - 11 N•m (80 - 97 lb-in)
5. Front Cover (E20 : G23D.943)
6. Sleeve
7. O-Ring .....Replace
8. Thermostat Housing.

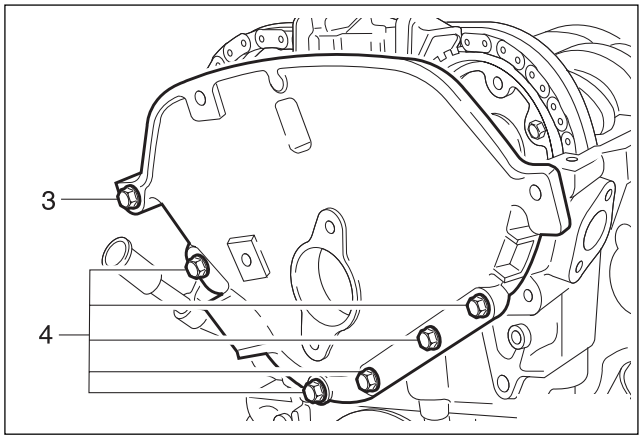


Removal & Installation Procedure

1. Disconnect the camshaft adjuster connector and remove the camshaft adjuster.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)



2. Remove the cylinder head front cover.

Installation Notice

Tightening Torque (3)	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
Tightening Torque (3)	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

Apply the sealant at the mating surface of the cylinder head and the front cover.

3. Remove the O-Ring.

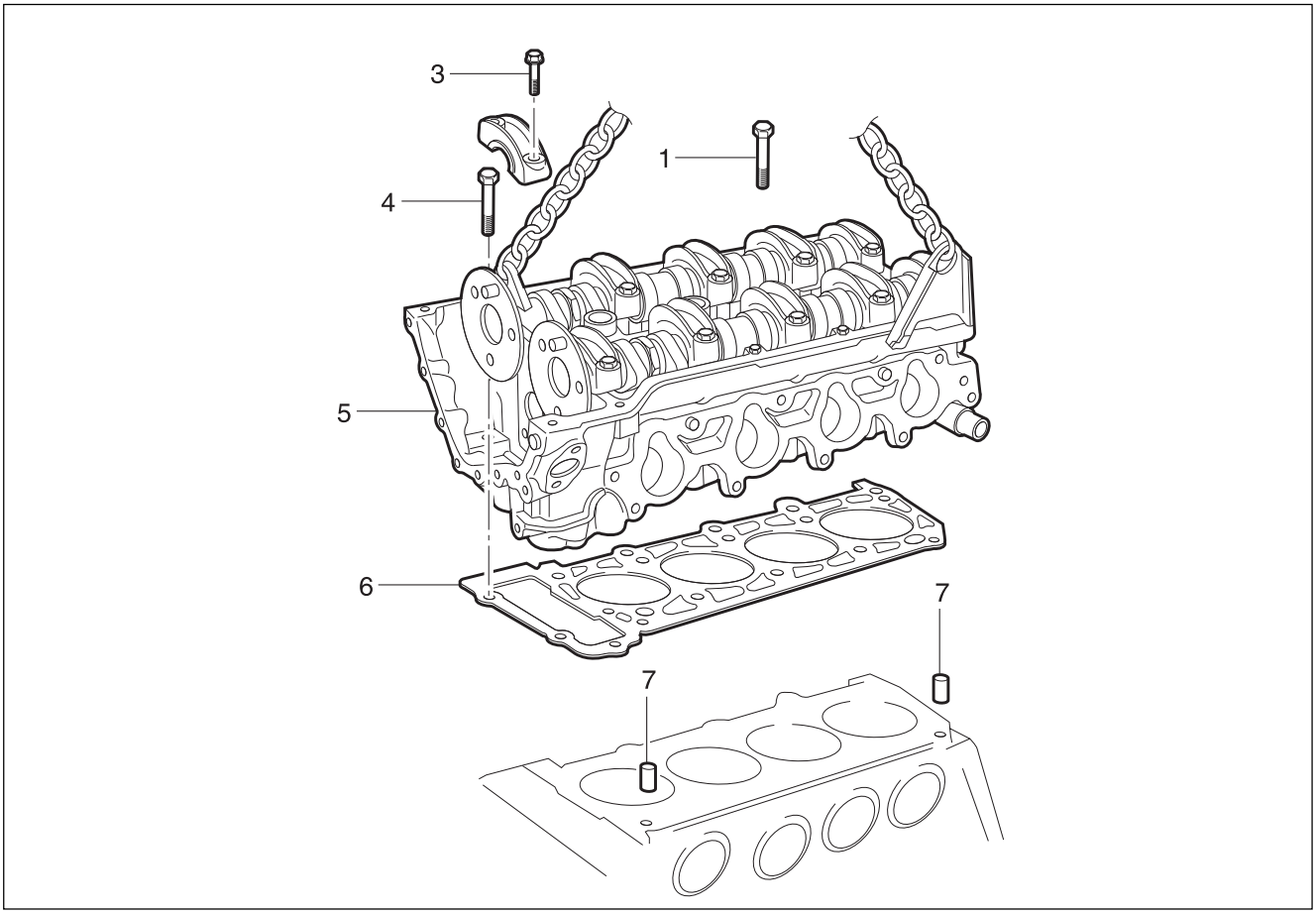
NOTICE

- **Replace the O-ring with new one and apply the sealant.**

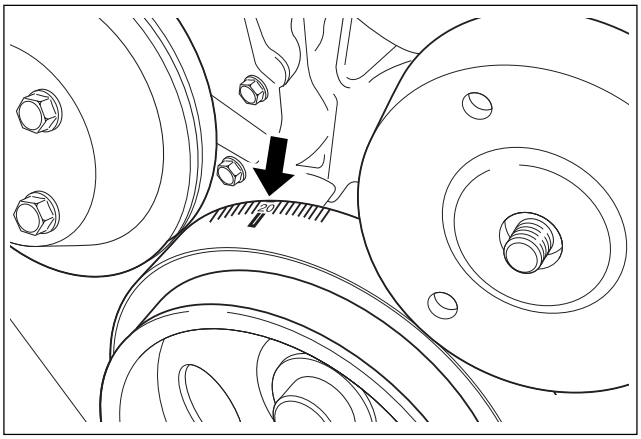
4. Installation should follow the removal procedure in the reverse order.

▶ Cylinder Head

※ **Preceding Work:** Removal of cylinder head cover
Removal of cylinder head front cover
Removal of intake manifold
Removal of cylinder head lower line (intake manifold side)



1. Cylinder Head Bolt (M12 X 100, 10 pieces)
   ..... 1ststep 55 N•m (41 lb-ft)
   ..... 2nd step 90 °rotation added
   ..... 3rd step 90 °rotation added
3. Bolt (M8 X 35, 4 pieces)
   ..... 22.5 - 27.5 N•m (16.6 - 0.3 lb-ft)
4. Camshaft Bearing cap
5. Cylinder Head
6. Gasket ..... Replace
7. Dowel Sleeve ..... Note



Tools Required

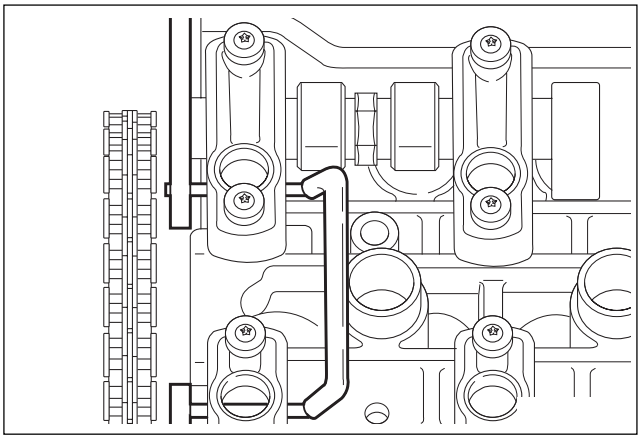
A9912 0080B (617 589 00 10 00) Allen Wrench Socket

A9913 0080B (116 589 20 33 00) Sliding Hammer

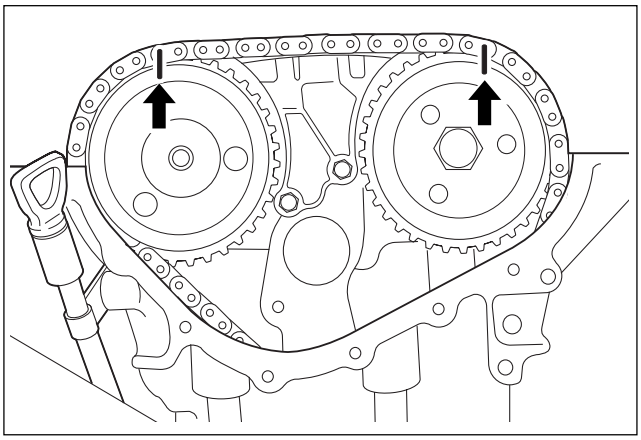
A9913 0061B (116 589 01 34 00) Threaded Pin

Removal & Installation Procedure

1. Rotate the crankshaft so that the piston of number 1 cylinder is at ATDC 20.



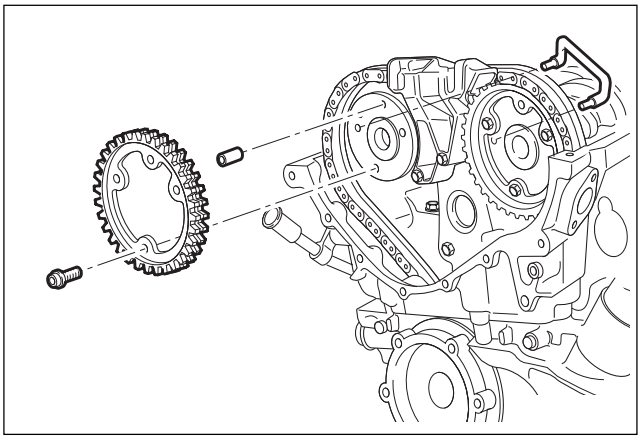
2. Put the holding pin A9913 0052B (111 589 03 15 00) into the cam-shaft bearing cap.



3. Put the alignment marks (arrows) on the timing chain and camshaft sprocket.
4. Remove the chain tensioner.

Installation Notice

Tightening Torque	72 - 88 N•m (53 - 65 lb-ft)



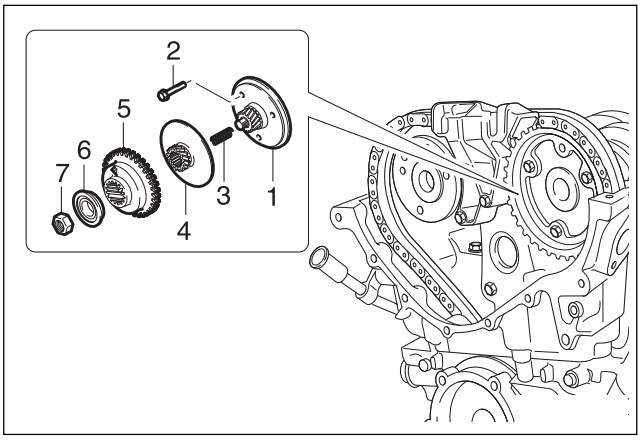
5. Remove the exhaust camshaft sprocket.

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

NOTICE

- **The flange bolt is designed to be used only once, so always replace with new one.**



6. Remove the camshaft adjuster.

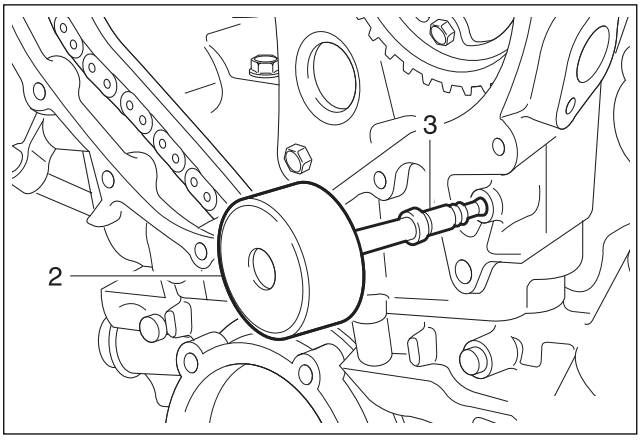
Installation Notice (Flange Bolt)

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

NOTICE

- **The flange bolt is designed to be used only once, so always replace with new one.**

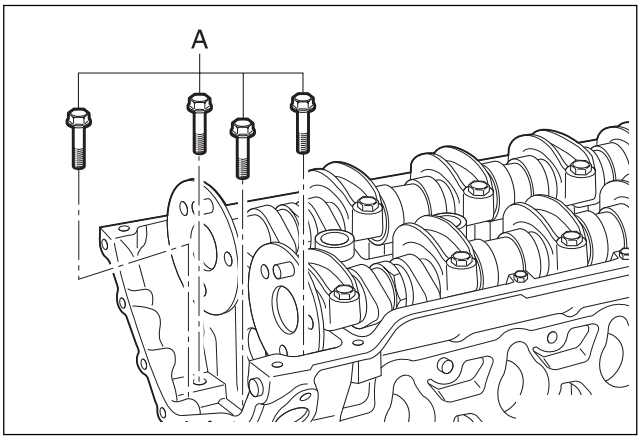
1. Flange Shaft
2. Flange Bolt
3. Compression Spring
4. Adjust Piston
5. Camshaft Sprocket
6. Seal Cover
7. Nut



7. Remove the guide rail pin using the sliding hammer A9913 0080B (116 589 20 33 00) (02) and the threaded pin A9913 0061B (116 589 01 34 00) (03).

NOTICE

- **Apply the sealant on guide rail pin when installation.**

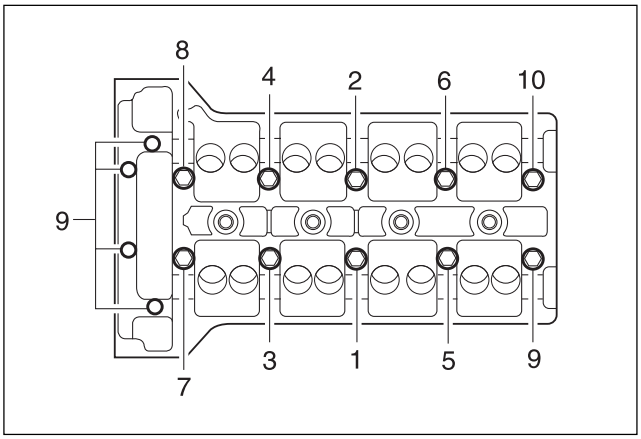


8. Unscrew the bolts (A).

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

Bolt (A) : (M8 X 35, 4 pieces)



9. Remove the cylinder head bolts in the reverse order of the numerics (No.10 → No.1) using allen wrench socket A9912 0080B (617 589 00 10 00).

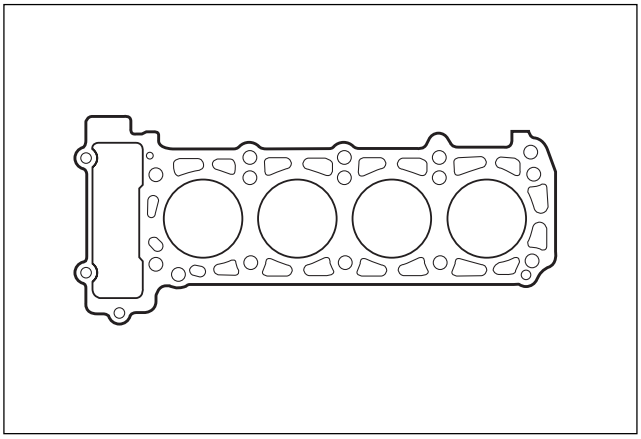
Installation Notice

Tighten the bolts as numerical order with specified torque (No.1 → No.10).

Tightening Torque	1st step: 55 N•m(41 lb-ft)
	2nd step: +90°
	3rd step: +90°

NOTICE

- **Operate during engine cooling.**

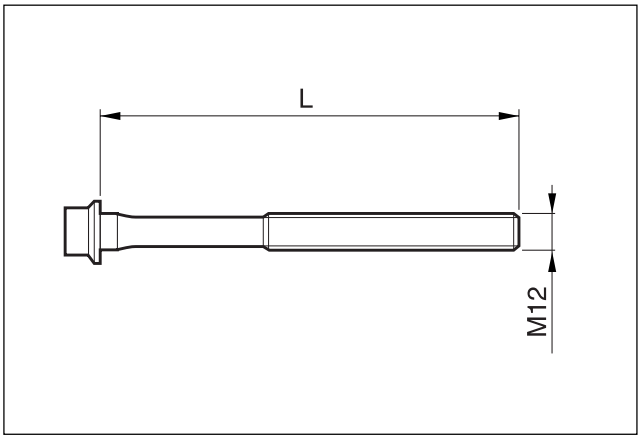


10. Remove the No. 1 bearing cap of the exhaust camshaft.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

11. Carefully remove the cylinder head.
12. Check the cylinder head mating surface and clean the crankcase head bolt mounting hole.
13. Replace the cylinder head gasket with new one.



14. Check the length of the cylinder head bolt.

Installation Notice

Length (L)	When New 100 mm
	Max. Length 105 mm

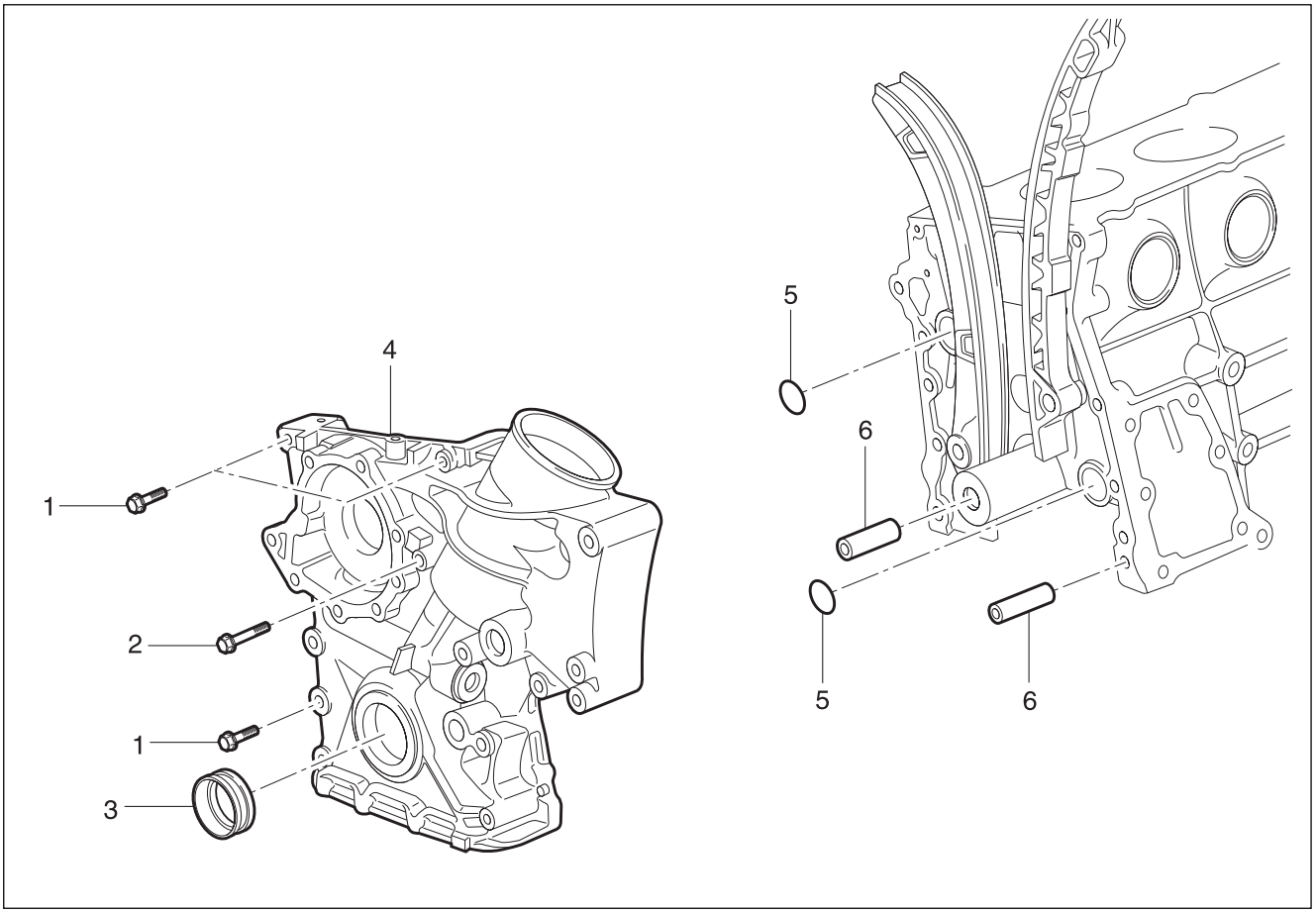
NOTICE

- **Replace the bolt if the measured length exceed the max. length.**

15. Installation should follow the removal procedure in the reverse order.

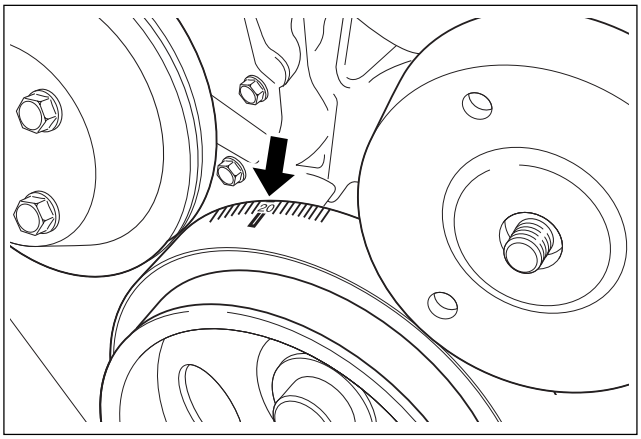
▶ Timing Gear Case Cover

※ **Preceding Work:** Removal of viscous clutch
Removal of cylinder head front cover
Removal of tensioning device
Removal of water pump
Removal of oil filter element
Removal of oil pan
Removal of generator bracket



1. Bolt (M8 X 60, 3 pieces)
..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
2. Bolt (M8 X 75, 1 piece)
..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
3. Seal
4. Timing Gear Case Cover
5. O-Ring
6. Sleeve.

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EFFECTIVE DATE	
AFFECTED VIN	



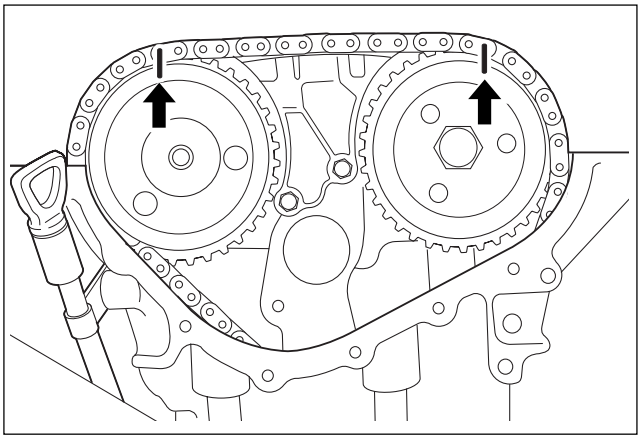
Tools Required

A9913 0080B (116 589 20 33 00) Sliding Hammer

A9913 0061B (116 589 01 34 00) Threaded Pin

Removal & Installation Procedure

1. Remove the power steering belt pulley and A/C compressor bracket.
2. Remove the oil line from power steering pump.
3. Rotate the crankshaft so that the piston of number, cylinder is at ATDC 20 °.



4. Put the alignment marks (arrows) on the timing chain and camshaft sprocket.
5. Remove the chain tensioner.

Installation Notice

Tightening Torque	72 - 88 N•m (53 - 65 lb-ft)

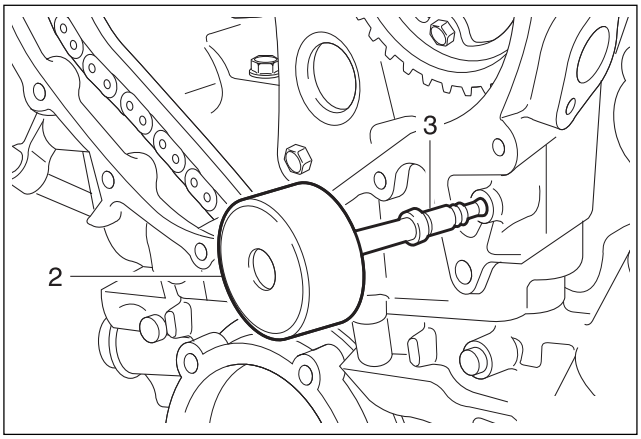
6. Remove the intake and exhaust camshaft sprocket (remove the camshaft adjuster assembly in E23 engine).

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

NOTICE

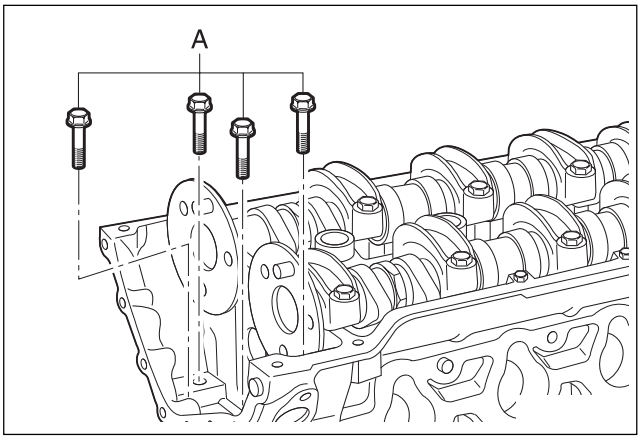
- **The flange bolt is designed to be used only once, so always replace with new one.**



7. Remove the guide rail pin using the sliding hammer A9913 0080B (116 589 20 33 00) (02) and the threaded pin A9913 0061B (116 589 01 34 00) (03).

NOTICE

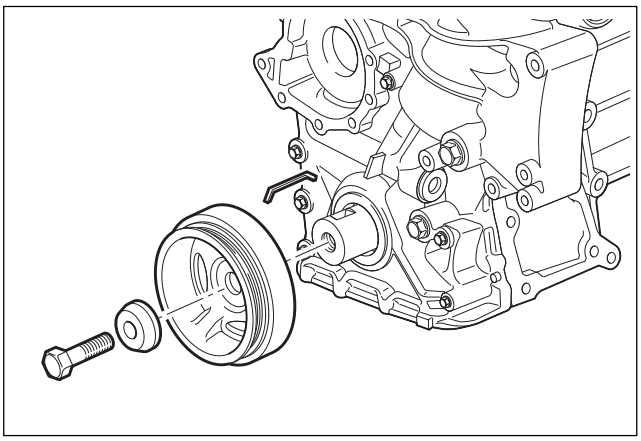
- **Apply the sealant on guide rail pin when installation.**



8. Unscrew the bolts (A).

Installation Notice

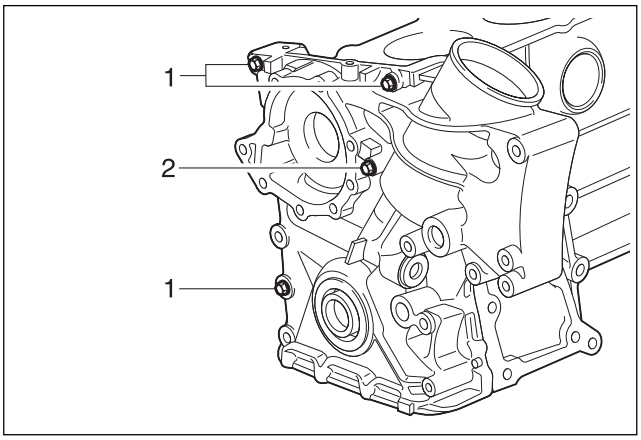
Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)



9. Remove the belt pulley and vibration damper.

Installation Notice (Center Bolt)

Tightening Torque	1st step: 200 + 20 N•m (148 + 15 lb-ft)
	2nd step: 90° ± 10°



10. Unscrew the bolts (1, 2) on timing gear case cover and remove the timing gear case cover.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

NOTICE

- **Be careful not to damage the cylinder head gas-ket.**

11. Remove the radial shaft seal.

NOTICE

- **Installation note replace the seal with new one.**

12. Clean the timing gear case cover and crankcase sealing surface.
13. Replace the O-ring with new one and apply the sealant on the sealing surface.

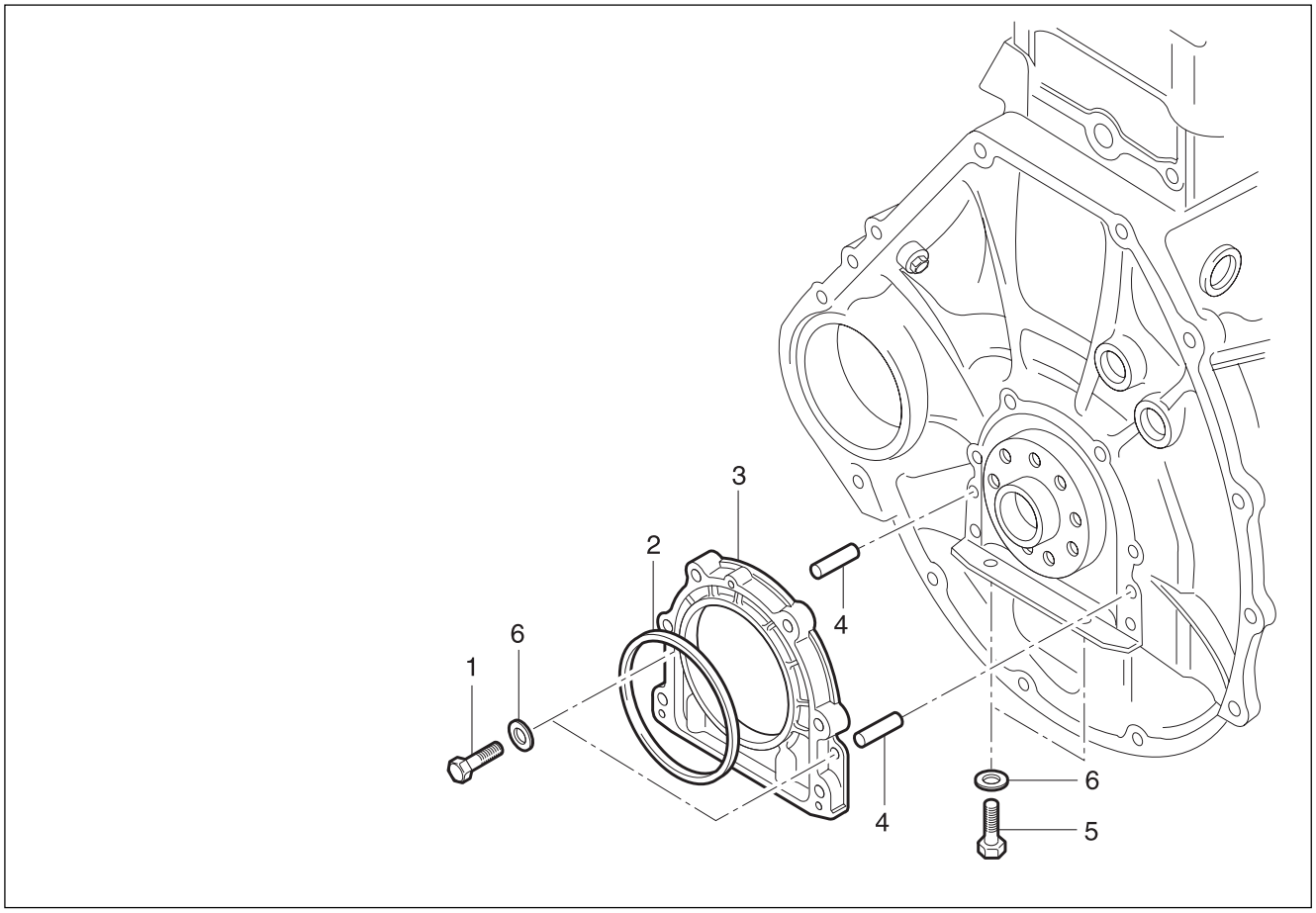
NOTICE

- **Be careful not to stain the oil chamber of chain tensioner with the sealant.**

14. Installation should follow the removal precedure in the reverse order.
15. Warm up the engine and check for oil leaks.

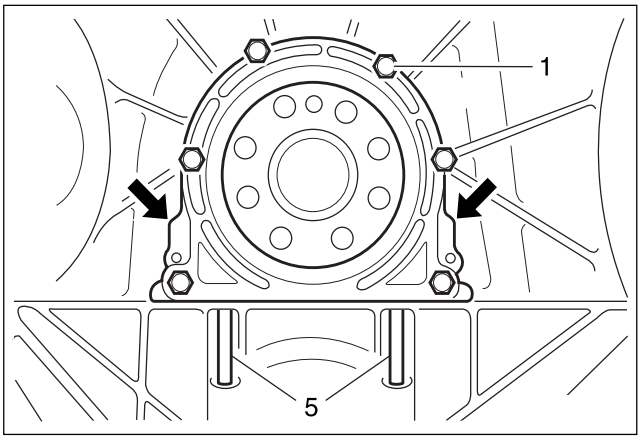
▶ Crankshaft Sealing Rear Cover

※ **Preceding Work:** Removal of the automatic transmission drive plate or flywheel



1. Bolt (M6 x 20, 6 pieces)
   ..... 9 - 11 N•m (80 - 97 lb-in)
2. Radial Shaft Seal
3. Rear Cover
4. Sleeve
5. Bolt (M6 x 85, 2 pieces)
   ..... 9 - 11 N•m (80 - 97 lb-in)
6. Washer

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EFFECTIVE DATE	
AFFECTED VIN	



Tools Required

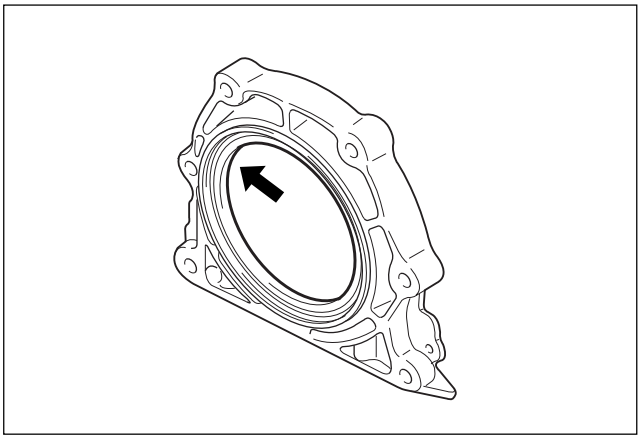
W9911 0020B (601 589 03 43 00) Crankshaft Rear Seal Installer

Removal & Installation Procedure

1. Unscrew the bolts (1) and (5) and remove the closing cover by pulling the rear cover lug (arrows).

NOTICE

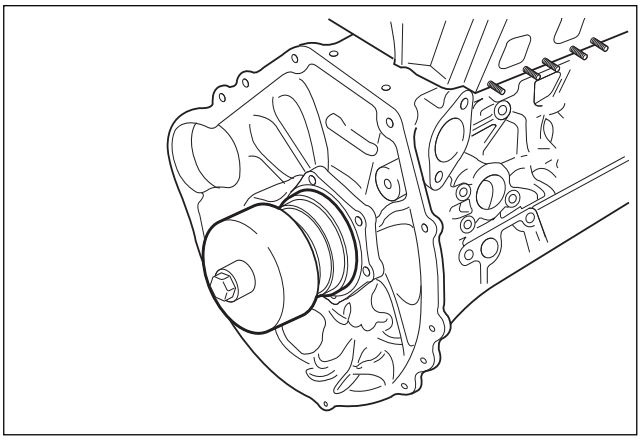
- **Be careful not to damage the oil pan gasket.**



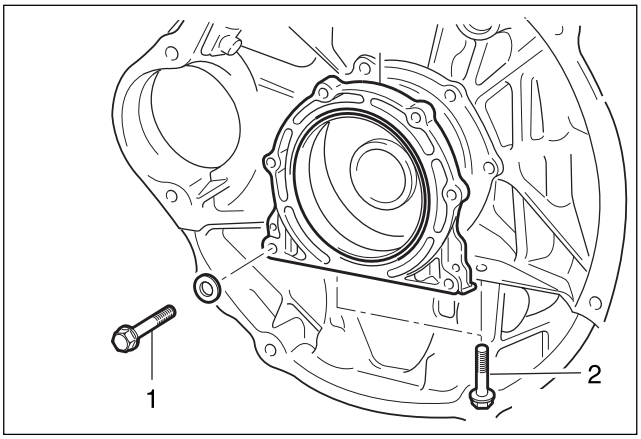
2. Clean the sealing surface of the crankcase and the rear sealing cover.
3. Check the radial shaft seal and replace it if necessary.
4. Apply the Loctite 573 to the rear cover sealing surface.
5. Apply the engine oil to the dust lip of the radial shaft seal.

NOTICE

- **Do not use the grease.**



6. Install the crankshaft rear radial seal and the crankshaft sealing rear cover, using crankshaft rear seal installer W9911 0020B (601 589 03 43 00).



7. Install the crankshaft sealing rear cover mounting bolts and remove the crankshaft rear seal installer W9911 0020B (601 589 03 43 00).

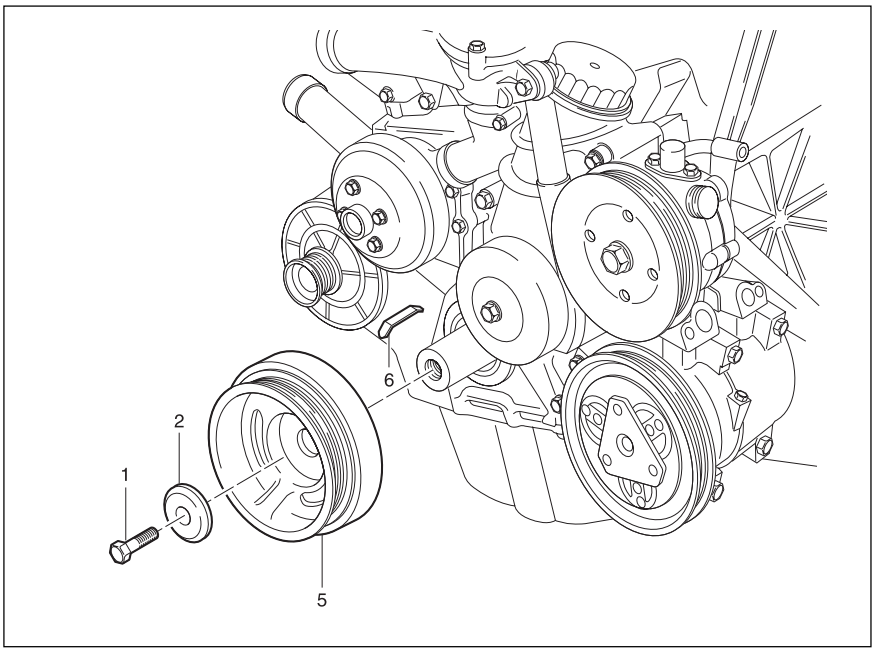
Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)

8. Installation should follow the removal procedure in the reverse order.

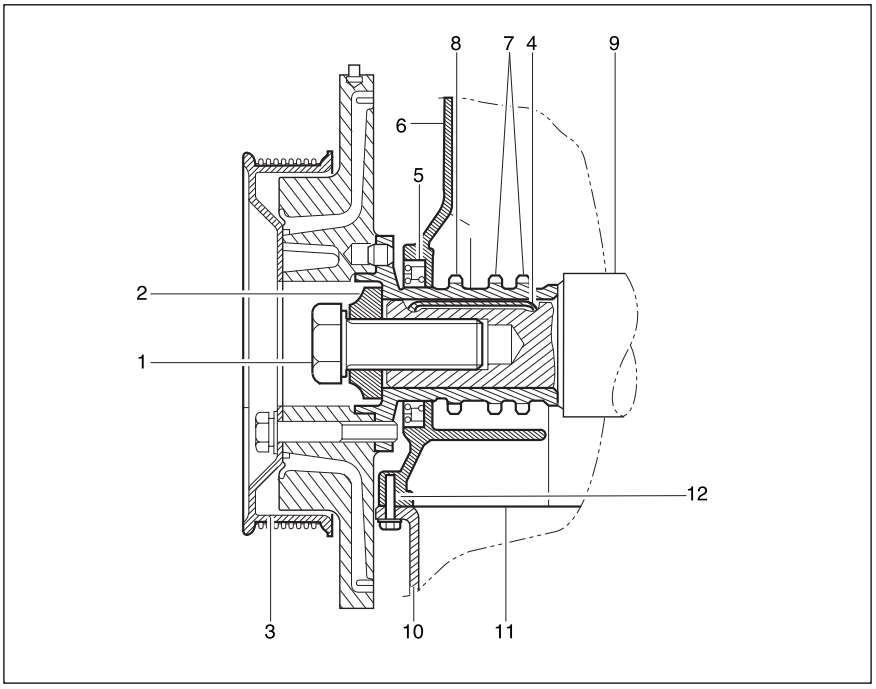
▶ Belt Pulley and Vibration Damper

※ **Preceding Work:** Removal of cooling fan and viscous clutch
Removal of fan shroud
Removal of drive belt



1. Vibration Damper Center
   1st step 200+20 N•m
   (148 + 15 lb-ft)
   2nd step 90 °+ 10 °rotation
   added
2. Vibration Damper Disk
5. Vibration Damper Assembly
6. Key

▶ Components

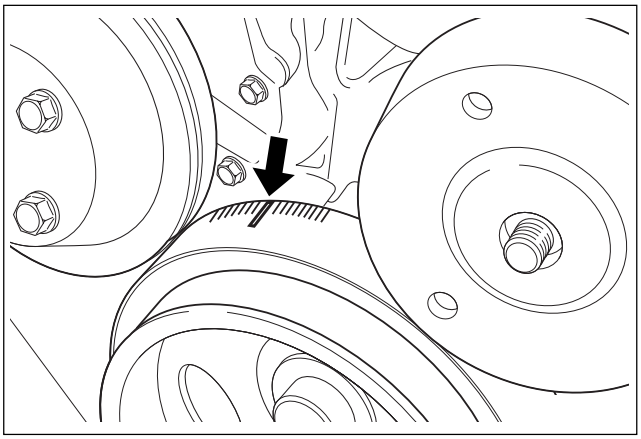


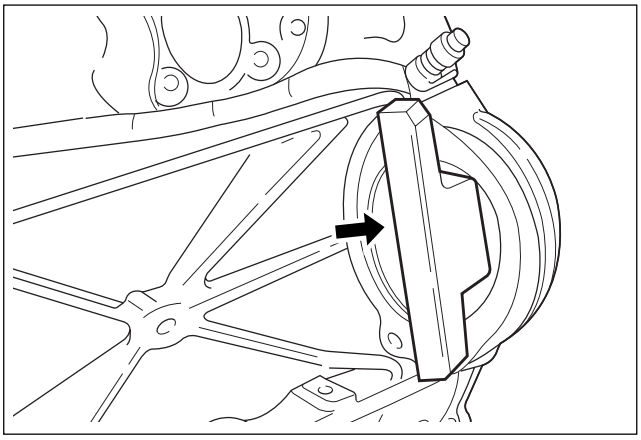
1. Center Bolt (M18 x 50)
2. Center Bolt Washer
3. Vibration Damper and Pulley Assembly
4. Key
5. Crankshaft Front Seal
6. Timing Gear Case Cover
7. Crankshaft Sprocket (Camshaft Driven)
8. Crankshaft Sprocket (Oil Pump Driven)
9. Crankshaft
10. Oil Pan
11. Oil Pan Gasket
12. Oil Pan Mounting Bolt (M6 x 22)

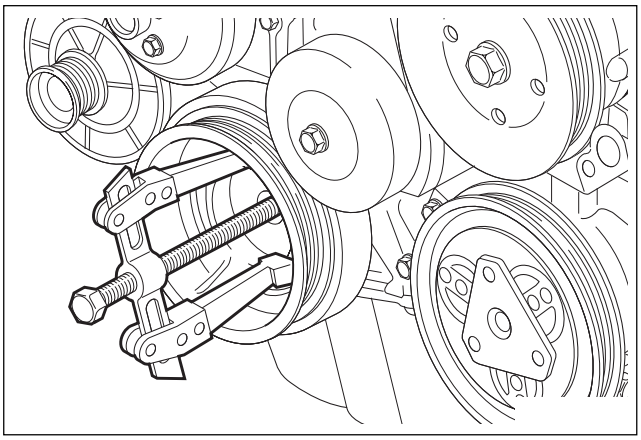
Service Data Standard

Permissble Deviation of The Vibration Damper	Radial Runout	0.6 mm
	Axial Ruout	0.6 mm

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	







Tools Required

A9910 0150B (602 589 00 40 00) Engine Lock

Removal & Installation Procedure

1. Adjust the piston of number 1 cylinder to the TDC.
2. Remove the start motor and install the engine lock A9910 0150B (602 589 00 40 00) to the flywheel ring gear.
3. Remove the vibration damper center bolt.

Installation Notice

Tightening Torque	1st step: 200 + 20 N•m (148 + 15 lb-ft)
	2nd step: 90° ± 10°

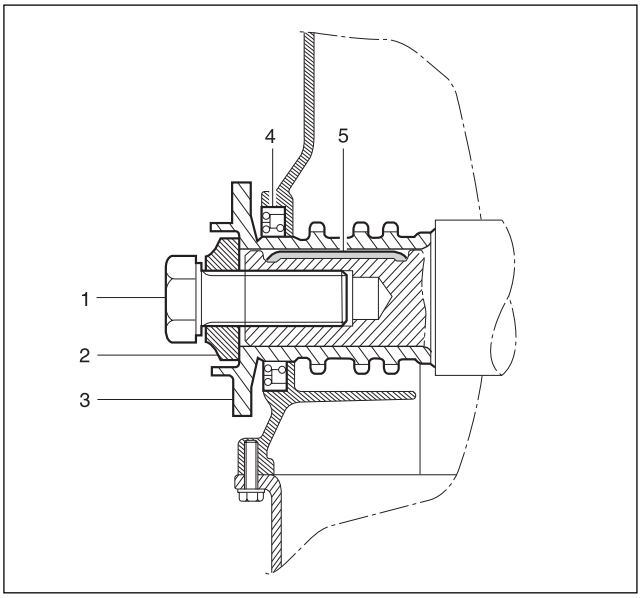
4. Remove the vibration damper assembly using the puller.
5. Installation should follow the removal procedure in the reverse order.

NOTICE

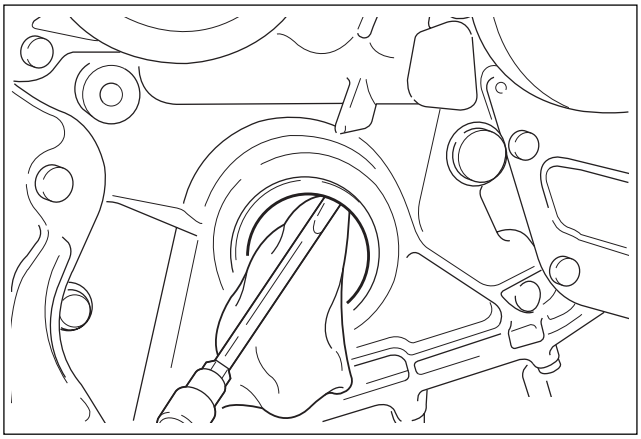
- **If possible, don't separate the vibration damper and the pulley.**

▶ Crankshaft Front Radial Seal

※ **Preceding Work:** Removal of belt pulley and vibration damper



1. Center Bolt (M18 x 50)
   ..... 1st step 200 + 20 45 N•m (148 +15 lb-ft)
   ..... 2nd step 90 ° + 10 °
2. Center Bolt Washer
3. Crankshaft Front Seal Installer
4. Crankshaft Front Seal
5. Key



Tools Required

A9911 0060B (601 589 03 14 00) Crankshaft Front Seal Installer

Replacement Procedure

1. Remove the radial seal with a screw driver.

NOTICE

- **Use a clean cloth not to damage the radial seal mounting hole and the crankshaft.**

2. Coat the radial sealing lip with engine oil.
3. Using the crankshaft front seal installer A9911 0060B (601 589 03 14 00), assemble the radial seal.
4. Align the sleeve groove and the woodruff key and tighten the center bolt until the center bolt and the damper disk stop in the movement.

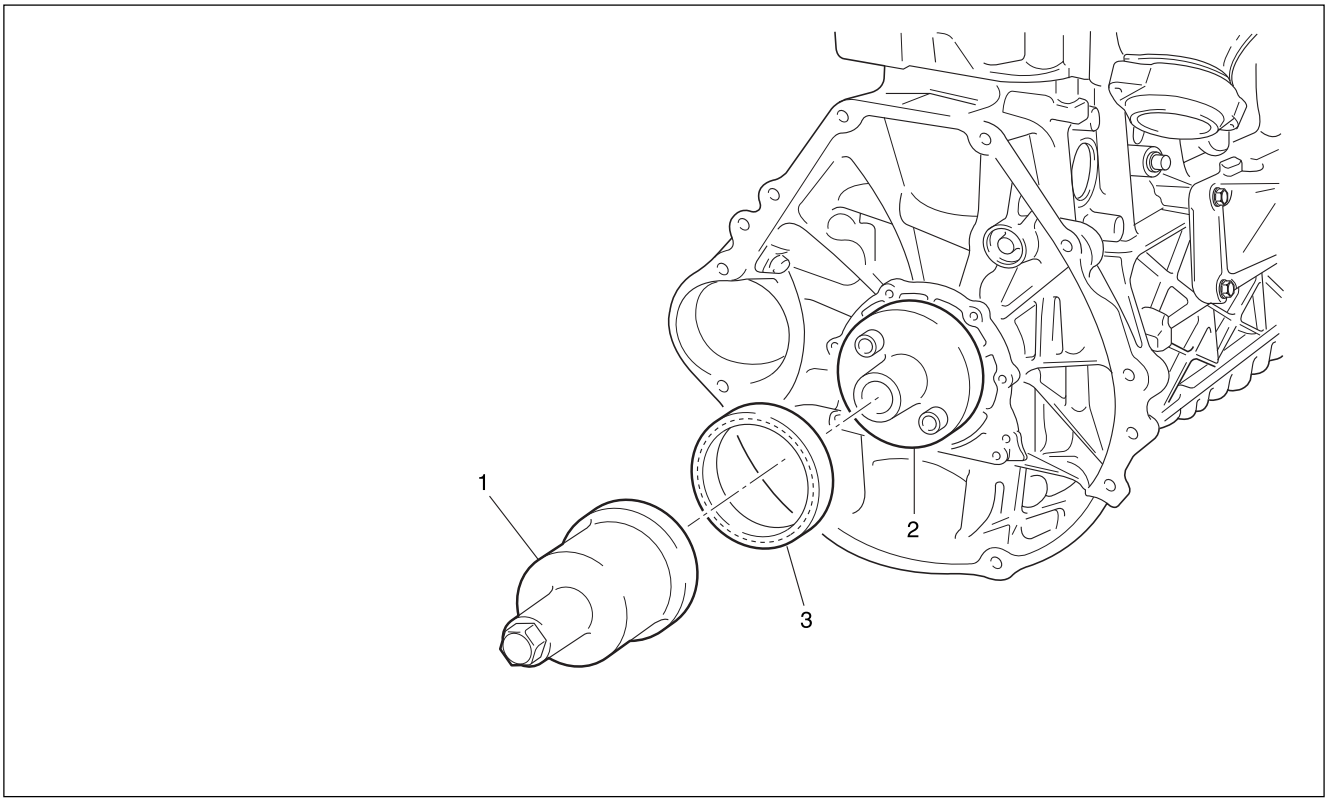
Installation Notice

Tightening Torque	1st step: 200 + 20 N•m (148 + 15 lb-ft)
	2nd step: 90° ± 10°

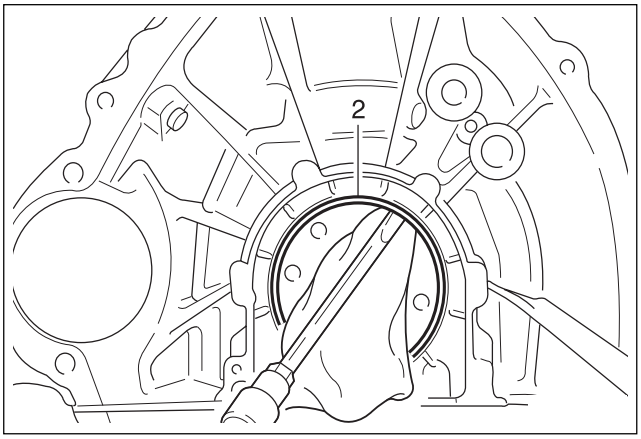
5. Remove the crankshaft front seal installer A9911 0060B (601 589 03 14 00), and install the belt pulley and the vibration damper.
6. Check for leaks while operating the engine.

▶ Crankshaft Rear Radial Seal

※ **Preceding Work:** Removal of flywheel or drive plate



1. Special Tool
2. Special Tool
3. Crankshaft Rear Seal



Tools Required

W9911 0020B (601 589 03 43 00) Crankshaft Rear Seal Installer

Replacement Procedure

1. Remove the radial seal with a screw driver.

NOTICE

- **Use a clean cloth not to damage the radial seal mounting hole and the crankshaft.**

2. Install the special tool (2) to the crankshaft.
3. Apply the engine oil on the special tool (2).

NOTICE

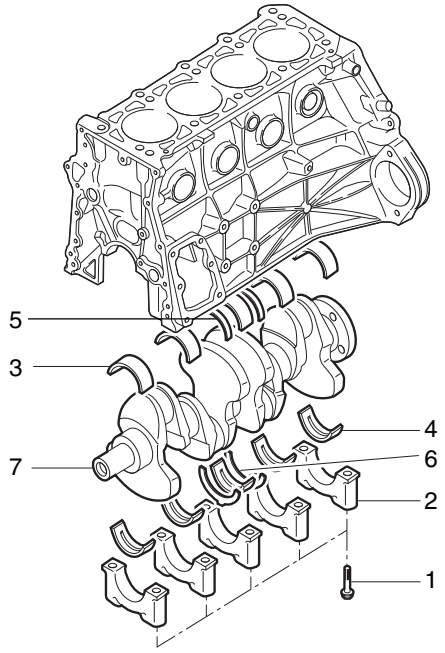
- **Do not use the grease.**

4. Install the radial seal on the inner parts assembler.
5. Press in the special tool (1) until the radial seal is stopped.
6. Check for leaks while operating the engine..

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Crankshaft

※ **Preceding Work:** Removal of engine
Removal of cylinder head
Removal of timing gear case cover
Removal of crankcase sealing rear cover
Removal of oil pan
Removal of baffle plate
Removal of oil pump



1. Bearing Cap Bolt (M8 X 55 - 10 pieces)
   ..... 1ststep 55 N•m (41 lb-ft)
   ..... 2nd step 90 °rotation added
2. Bearing Cap
3. Upper Main Bearing
4. Lower Main Bearing
5. Upper Thrust Bearing
6. Lower Thrust Bearing
7. Crankshaft.

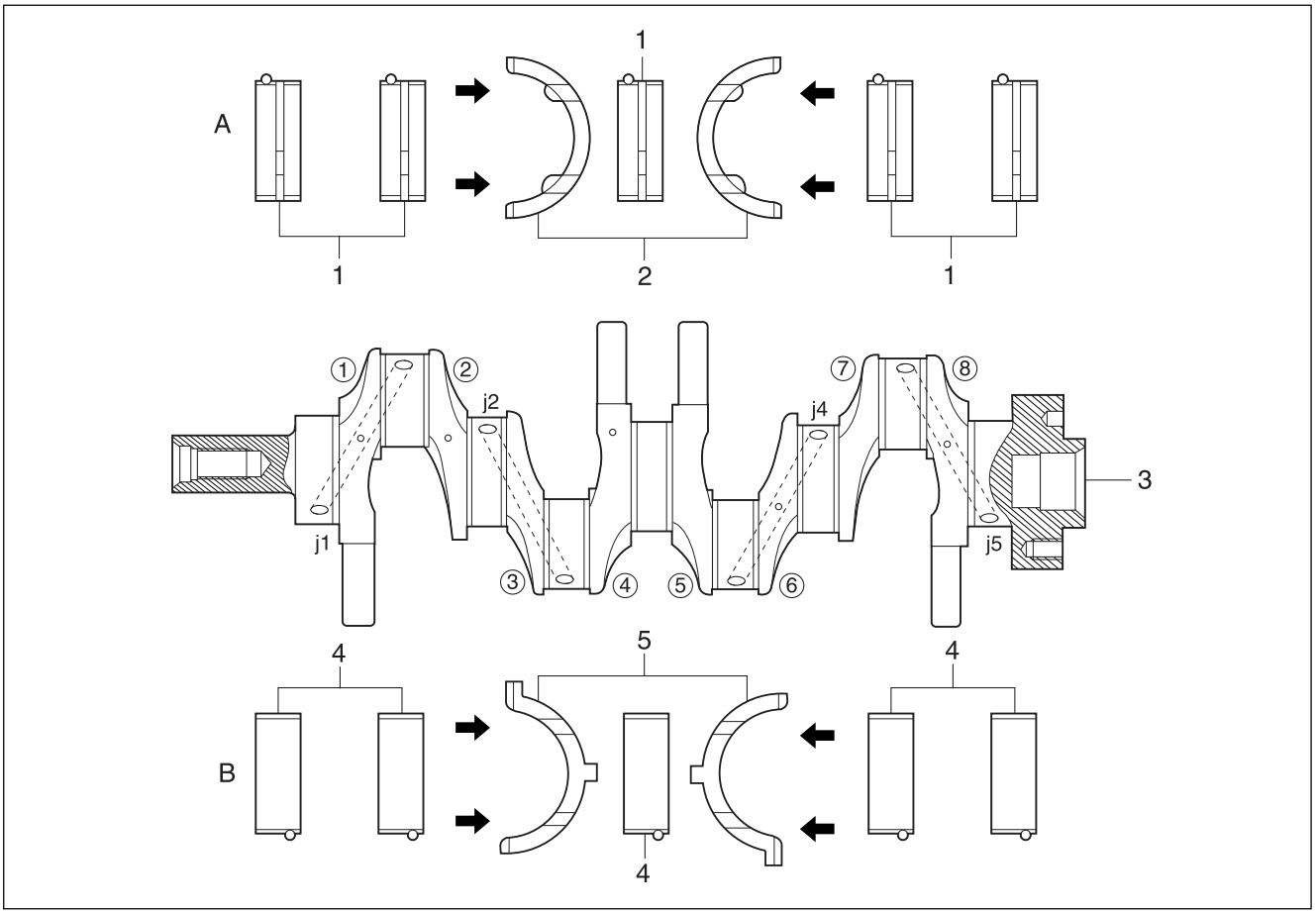
Service Data Standard (Crankshaft Main Bearing Gap)

Item	Measuring Position	Gap (mm)
Main Bearing Journal (NO.1,5,7)	Radial	Static condition : 0.015 - 0.039 Dynamic condition : 0.031 - 0.051 (Consider the expansion 0.011 - 0.016)
	Axial	0.010 - 0254

(Connecting Rod Bearing Gap)

Item	Item	Gap (mm)
Connection Rod Bearing	Radial	0.020 - 0.065

▶ Arrangement of the Thrust Bearing and the Main Bearing



1. Upper Main Bearing
2. Upper Thrust Bearing
3. Crankshaft
4. Lower Main Bearing
5. Lower Thrust Bearing

A. Crankcase Side
B. Bearing Cap Side (Oil Pan Side)

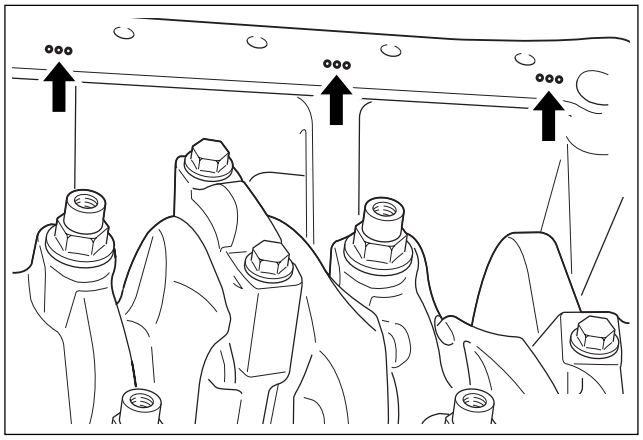
(1) - (8) Weight Balance/Color Marking Point

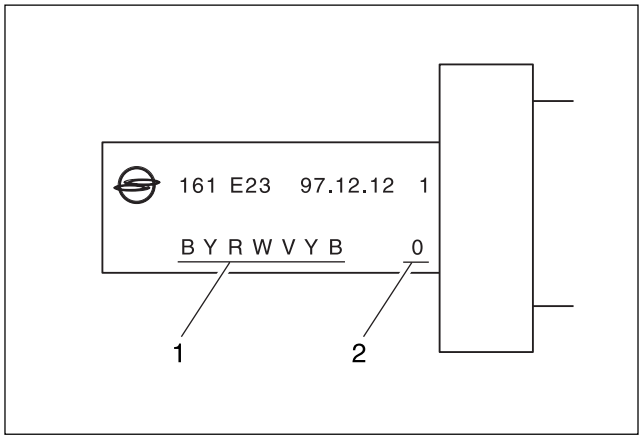
j1 - j5 Journal Main Bearing #1 - #5

- Color Dot Marking

The color dot marking are put on the (1), (2), (4), (6), (8), and it indicates the diameter of crankshaft journal by color as below.

Color Dot Marking	Crankshaft Journal Diameter (mm)
Blue	57.960 - 57.965
Yellow	57.955 - 57.960
Red	57.950 - 57.955
White	57.945 - 57.950
Violet	57.940 - 57.945





Selection of Crankshaft Main Bearing

1. Crankcase Side

   There are seven punching marks on the mating surface to oil pan. This mark is correspondent to the bearing distinguished by color. Select the relevant bearing according to the punching mark when repaired.

Purching Mark	Bearing Color Selected
B	Blue
Y	Yellow
R	Red

2. Crankshaft Bearing Cap Side

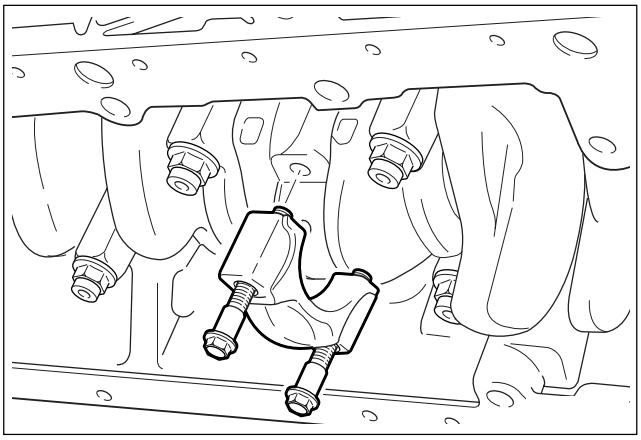
   Select the crankshaft main bearing according to the marking letter on the crank shaft main journal when repaired.

Marking Letter	Bearing Color Selected
B	Blue
Y	Yellow
R	Red
W	White
V	Violet

Service Data

Crankshaft Standard and Repair Size	Crankshaft Bearing Journal Diameter	Crankshaft Bearing Diameter	Crankshaft Journal Width at fit bearing	Connecting Rod Bearing Journal Diameter	Connecting Rod Bearing Journal Width
Standard size	57.940 - 57.965	58	24.50 - 24.533	47.935 - 47.965	27.958 - 28.042
1st repair size	57.705 - 57.715	-	-	47.700 - 47.715	-
2nd repair size	57.450 - 57.465			47.450 - 47.465	
3rd repair size	57.205 - 57.215			47.200 - 4.215	
4th repair size	56.955 - 56.965			46.950 - 46.965	

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



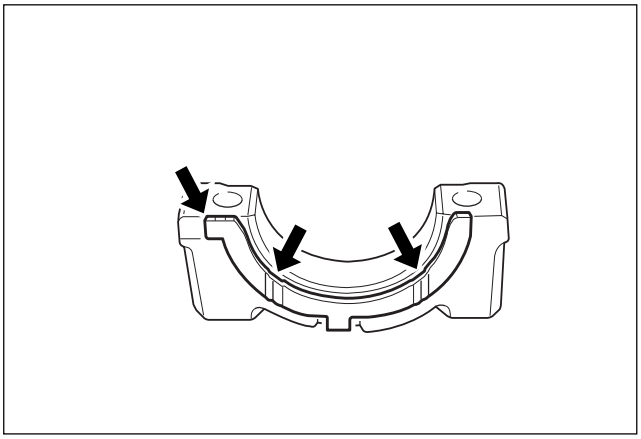
Removal & Installation Procedure

1. Unscrew the connecting rod bearing cap bolt and remove the bearing cap.

Installation Notice

Tightening Torque	40 N•m (30 lb-ft) + 90°

- Make sure that the upper and lower bearing shells do not change each other.
- Coat the bearing shell with engine oil.
- Install the bearing cap according to the consecutive number.



2. Unscrew the crankshaft bearing cap bolts and separate the upper and lower bearing shells and thrust washers.

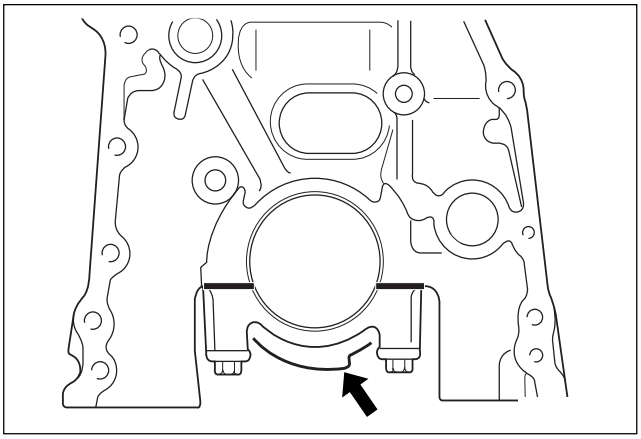
Installation Notice

Tightening Torque	55 N•m (41 lb-ft)+ 90°

- Remove the bearing cap from front (pulley side) to rear.
- Make sure that the upper and lower bearing shells do not change each other and coat with engine oil.
- The oil grooves (arrows) in the thrust washers must face outward and insert the thrust bearing into the bearing cap.
- There are five kinds of thrust washers by thick-ness. Select the proper washer when repaired.

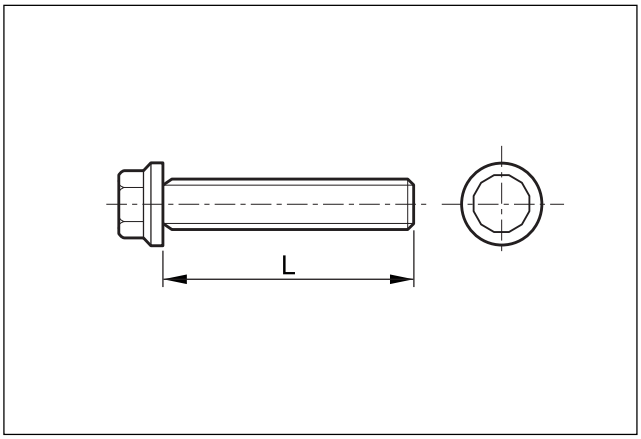
Part No. : 601 030 00 62 2.15 mm
Part No. : 601 030 01 62 2.20 mm
Part No. : 601 030 02 62 2.25 mm
Part No. : 601 030 03 62 2.30 mm
Part No. : 601 030 04 62 2.40 mm

3. Remove the crankshaft.
4. Installation should follow the removal procedure in the reverse order.
5. After completion of the installation, check for the rotating condition of the crankshaft.



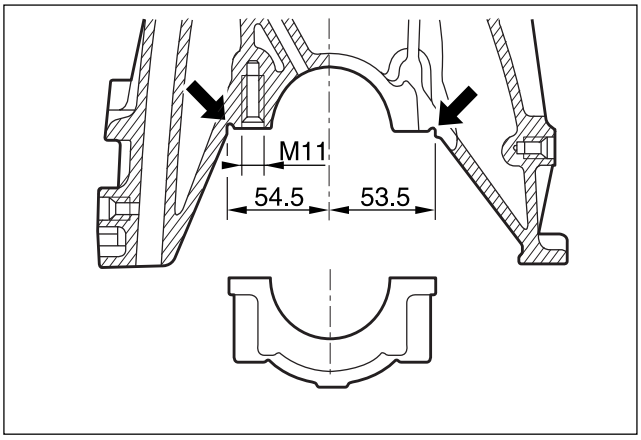
NOTICE

- **Make sure the crankshaft bearing cap properly seated in place in the crankcase side. When perfectly installed, the projected part (arrow) locates in the left side (intake manifold side).**
- **Assemble so that the projected part of the cap and crankcase face the same direction.**

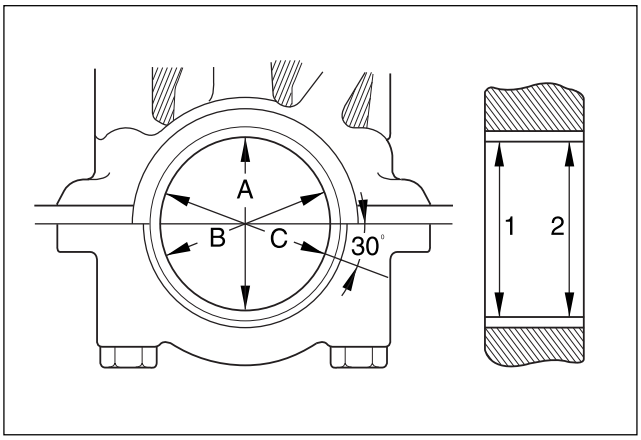


Inspection

1. If the length 'L' of the crankshaft bearing cap bolt exceeds 63.8 mm, replace it.



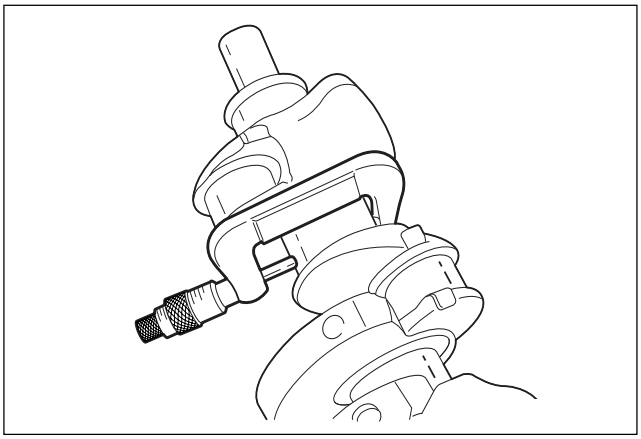
2. Make sure the crankshaft bearing cap is properly seated on the cylinder block (arrows).



3. Measure and record the inner diameter of the crankshaft bearing.

NOTICE

- **Measure at 2 points (1, 2).**
- **Measure 'A', 'B' and 'C' as shown. If average value of 'B' and 'C' is less than value 'A', then the average value of 'B' and 'C' is actual average value. If average value of 'B' and 'C' is more than value 'A' is actual average value.**



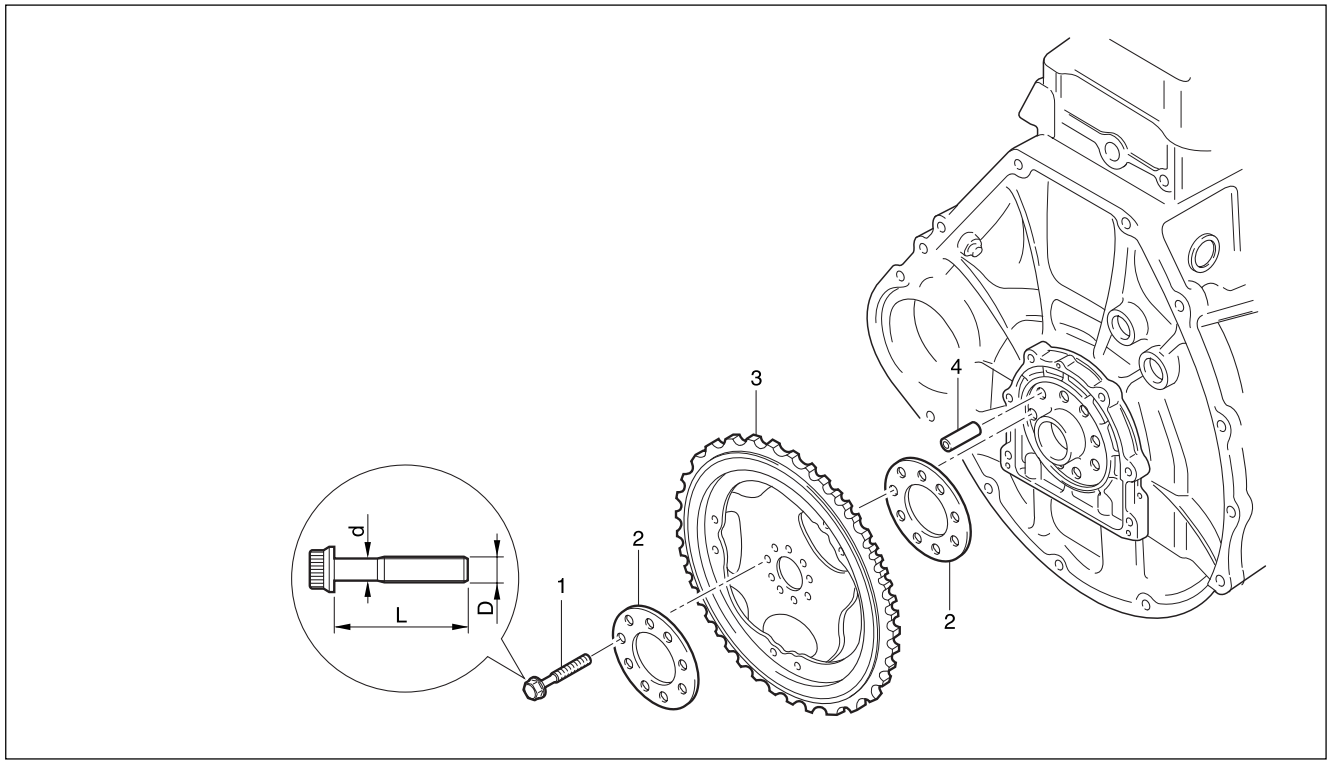
4. Measure and record the diameter of the crankshaft bearing journal.

NOTICE

- **Record the mean value when measured at 3 points (A,B,C).**
- **Measure the inner diameter of bearing and the diameter of journal and if it is out of the standard data, replace the bearing shell.**

▶ Flywheel / Driven Plate

※ **Preceding Work:** Removal of manual or automatic transmission



1. Flywheel Mounting Bolt (M10 x 22, 8 pieces)
   ..... 1st step 45 + 5 N•m (33 + 3.7 lb-ft)
   2nd step 90 ° + 10 °
2. Plate
3. Driven Plate (A/T)
4. Dowel Pin

Service Data Standard (Stretch Bolt)

Normal Size	D	-	M x 15
Stretch Side Diameter	d	When New	8.5 - 0.2 mm
		Min. Diameter	8.0 mm
Bolt Length	L	When New	21.8 - 22.2 mm
Tightening Torque	1st step 45 + 5 N•m (33 + 37 lb-ft), 2nd step 90° + 10°		

Removal & Installation Procedure

1. Unscrew the flywheel mounting bolt.

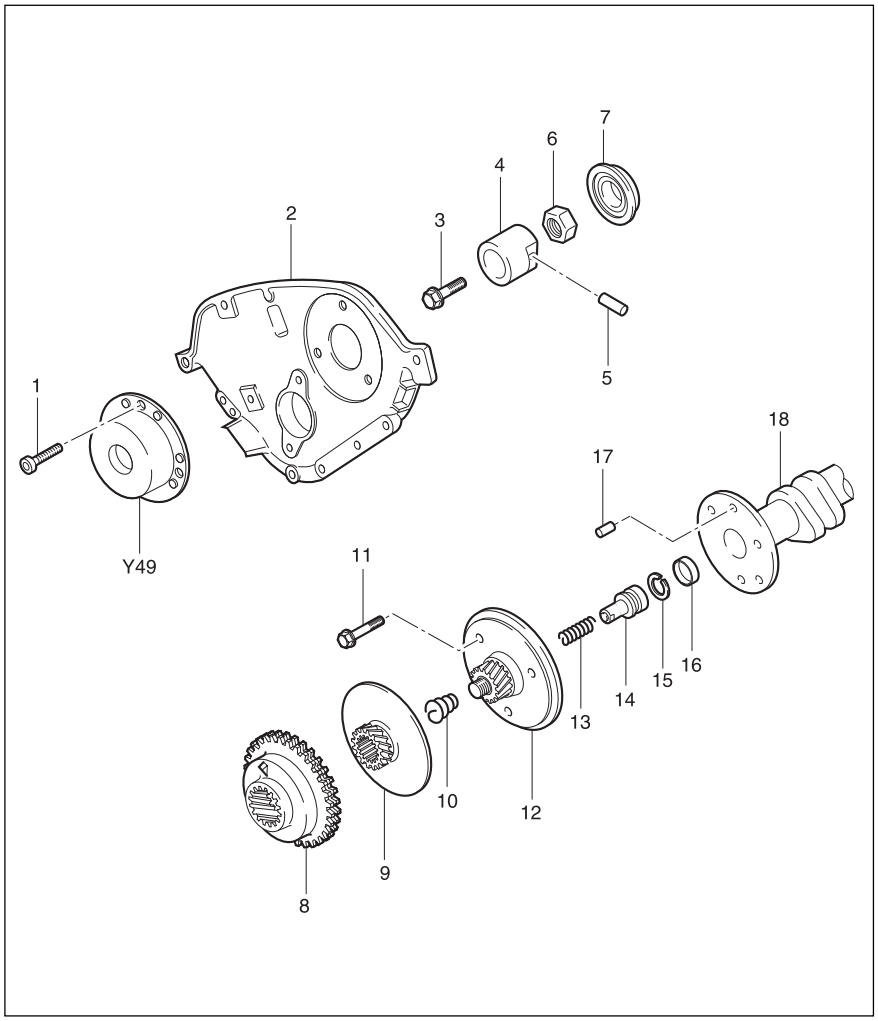
Installation Notice

Tightening Torque	1st step: 45 + 5 N•m (33 + 3.7 lb-ft)
	2nd step: 90° ± 10°

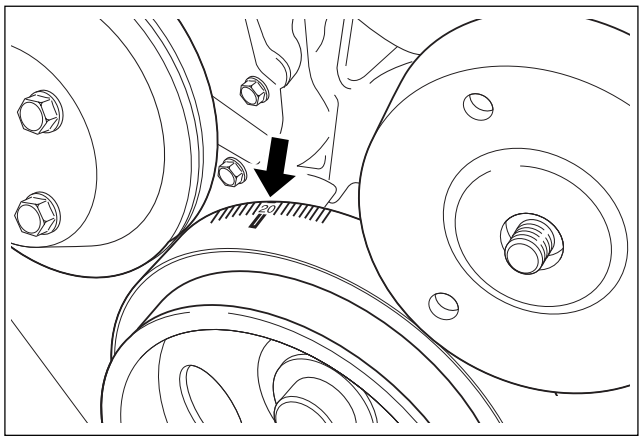
- Replace the bolt when the stretch side diameter (d) of the flywheel mounting bolt is less than 8.0mm.
- For the flywheel mounting bolt tightening, keep the socket wrench and Tommy-bar to be 90 °and tighten as specified.

2. Remove the flywheel for manual transmission vehicles, or the driven plate (3), and plate (2) for Auto transmission vehicle.
3. Installation should follow the removal procedure in the reverse order.

▶ Camshaft Adjuster



1. Bolt (M6 X 16, 3 pieces)
   9 - 11 N•m (80 - 97 lb-in)
2. Cylinder Head Front Cover
3. Bolt
   35 N•m (26 lb-ft)
4. Armature
5. RollPin
6. Nut (M20 X 1.5)
   60 - 70 N•m (44 - 52 lb-ft)
7. Seal Cover
8. Camshaft Sprocket
9. Adjust Piston
10. Conical Spring
11. Flange Bolt (M7 X 13, 3 pieces)
    1stStep 18 - 22 N•m
    (13 - 16 lb-ft)
    2nd Step 60 ° ± 5 °Rotation
    Added
12. Flange Shaft
13. Compression Spring
14. Control Piston
15. Circlip
16. Oil Gallery
17. Straight Pin
18. Intake Camshaft
    Y49 Magnetic Actuator
    (2 - Pin Connector)



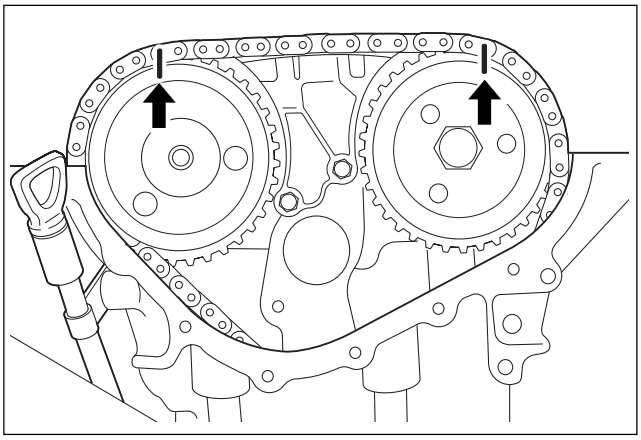
Removal & Installation Procedure

1. Turn the crankshaft and position the no.1 cylinder piston at ATDC 20 °.

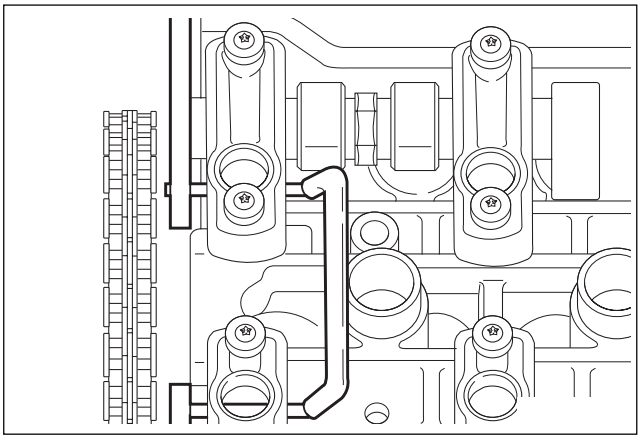
NOTICE

- **Turn the crankshaft in the direction of engine rotation.**

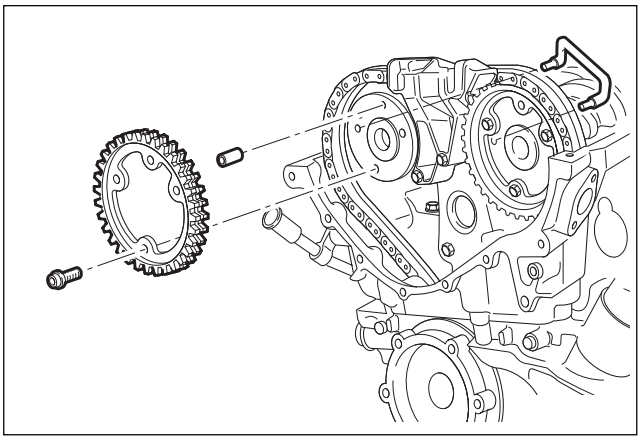
2. Remove the cylinder head front cover.



3. Put the alignment marks (arrows) on the camshaft sprocket and the timing chain.



4. Insert the holding pin A9913 0052B (111 589 03 15 00) into the no.1 and no.6 bearing cap hole on camshaft to secure intake and exhaust camshaft.
5. Remove the chain tensioner.



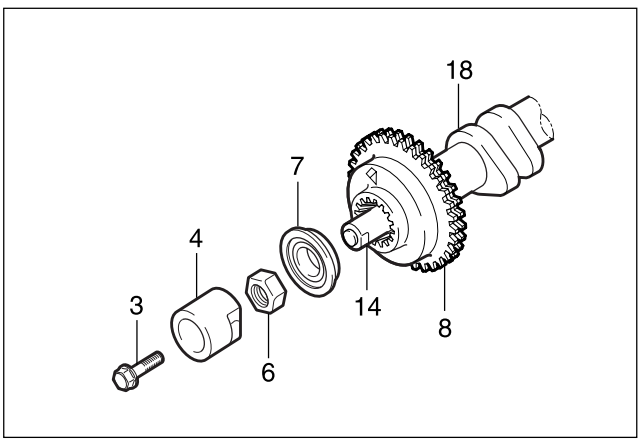
6. Unscrew the exhaust sprocket bolt and remove the exhaust camshaft sprocket.

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

NOTICE

- **The flange bolt is designed to be used only once, so always replace with new one.**



7. Unscrew the bolt (3) from the armature (4) and re ove the roll pin, and remove the armature.

Installation Notice

Tightening Torque	35 N•m (26 lb-ft)

8. Unscrew the nut (6) and remove the seal cover (7).

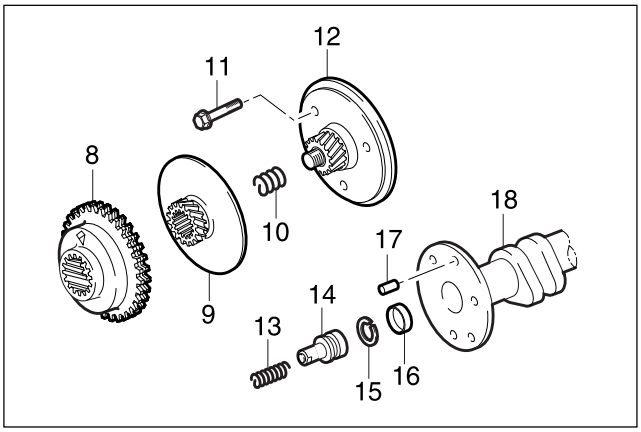
Installation Notice

Tightening Torque	60 - 70 N•m (44 - 52 lb-ft)

NOTICE

- **Put the locking slot of nut toward armarture.**

9. Take off the timing chain from intake camshaft sprocket.



10. Remove the adjuster piston (9) and conical spring (10) from intake camshaft sprocket.
11. Unscrew the bolt (11) and remove the flange shaft.

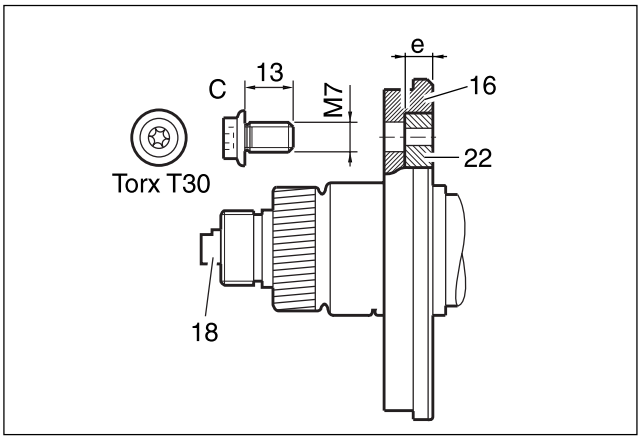
Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

NOTICE

- **The flange bolt is designed to be used only once, so always replace with new one.**

12. Installation should follow the removal procedure in the reverse order.
13. Check and adjust the camshaft timing.



Camshaft Sprocket Bolt

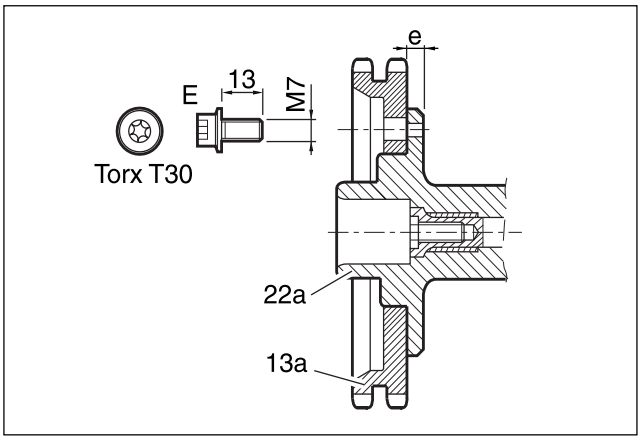
Intake Flange Shaft Bolt

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

NOTICE

- **The sprocket bolts are designed to be used only once, so always replace with new one.**

C. M7 x 13 Collar Bolt Torx-T30
e. 6.8 mm
16. Flange Shaft
18. Control Piston
22. Intake Camshaft



Exhaust Camshaft Sprocket Bolt

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

NOTICE

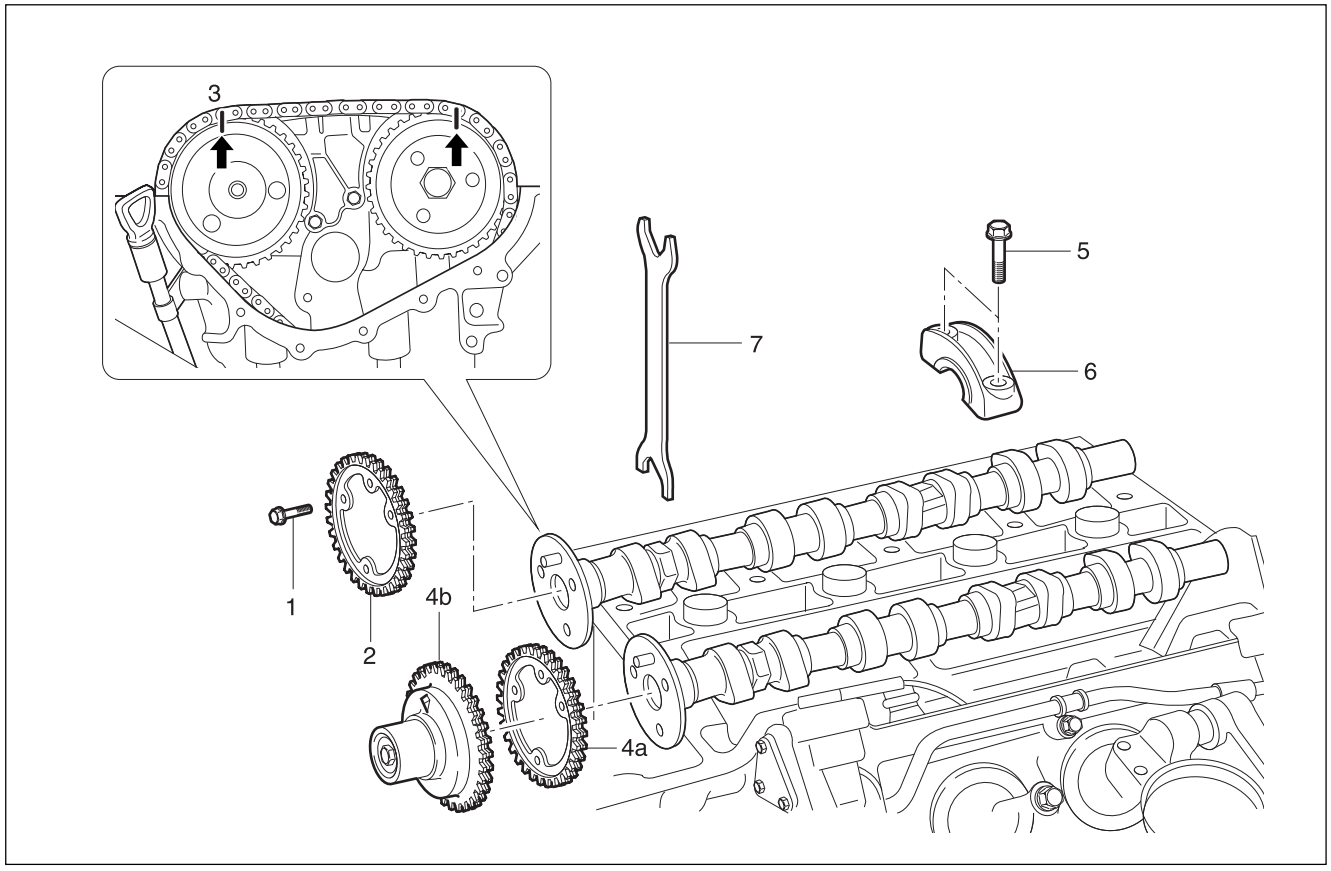
- **The sprocket bolts are designed to be used only once, so always replace with new one.**

E. M7 x 13 Collar Bolt Torx-T30
e. 6.8 mm
13a. Camshaft Sprocket
22a. Exhaust Camshaft

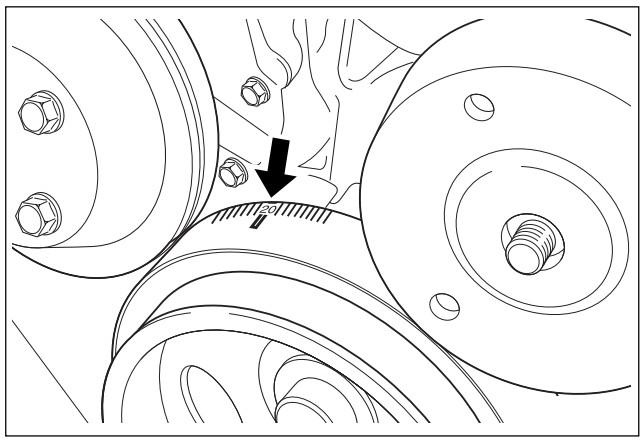
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AFFECTED VIN	

▶ Camshaft

※ **Preceding Work:** Removal of cylinder head cover
Removal of camshaft adjust actuator and cylinder head front cover



1. Bolt (M7 X 13, 3 pieces)
   ..... 1st Step 18 - 22 NSm (13 - 16 lb-ft)
   ..... 2nd Step 60 ° ± 5 ° Rotation Added
2. Exhaust Camshaft Sprocket
3. Timing Chain
   4a. Intake Camshaft Spocket (E20)
   4b. Camshaft Adjuster and Camshaft Sprocket (E23)
5. Bearing Cap Bolt (20 pieces)
   ..... 22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
6. Camshaft Bearing Cap
7. Wrench



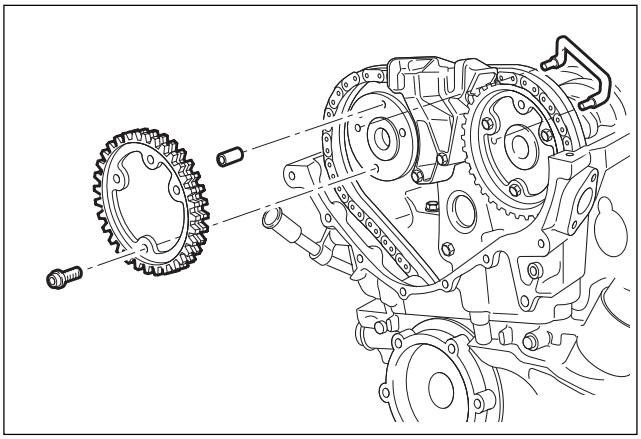
Removal & Installation Procedure

1. Turn the crankshaft and position the no.1 cylinder piston at ATDC 20 °.
2. Put the alignment marks (arrows) on the camshaft sprocket and the timing chain.
3. Remove the chain tensioner.

Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)

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AFFECTED VIN	



4. Remove the exhaust camshaft sprocket.

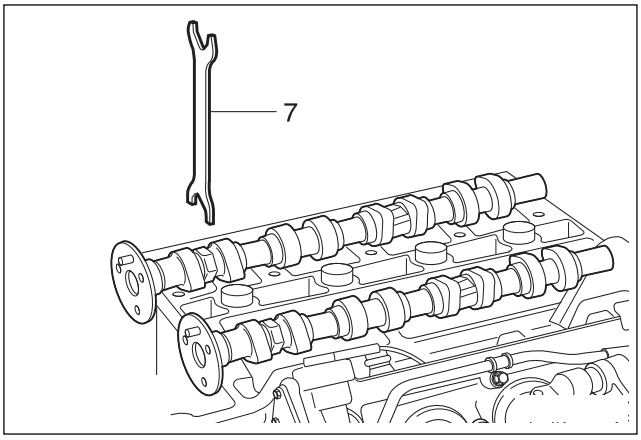
Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

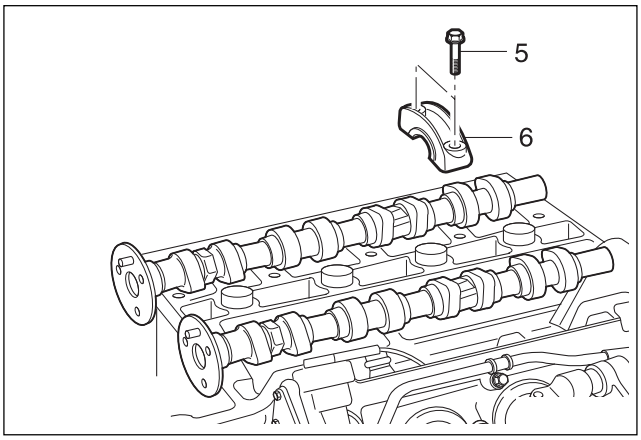
NOTICE

- **The sprocket bolt is designed to be used only once, so always replace with new one.**

5. Take off the timing chain from intake camshaft sprocket, and secure it not to fall down into the timing gear case.



6. Using the wrench (7), turn the camshaft until there is no resistence in camshaft bearing area.



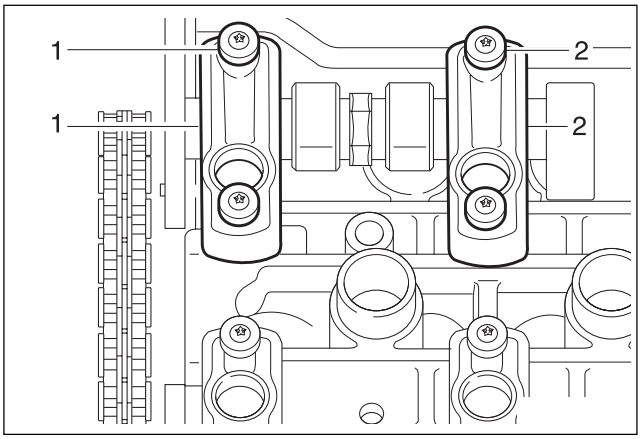
7. Remove the bearing cap, and remove the intake and the exhaust camshaft.

Installation Notice

Tightening Torque	60 - 70 N•m (44 - 52 lb-ft)

NOTICE

- **Check the numbers on the bearing cap not to be mixed up.**



8. Apply the engine oil on the valve tappet and camshaft bearing.
9. Installation should follow the removal procedure in the reverse order.

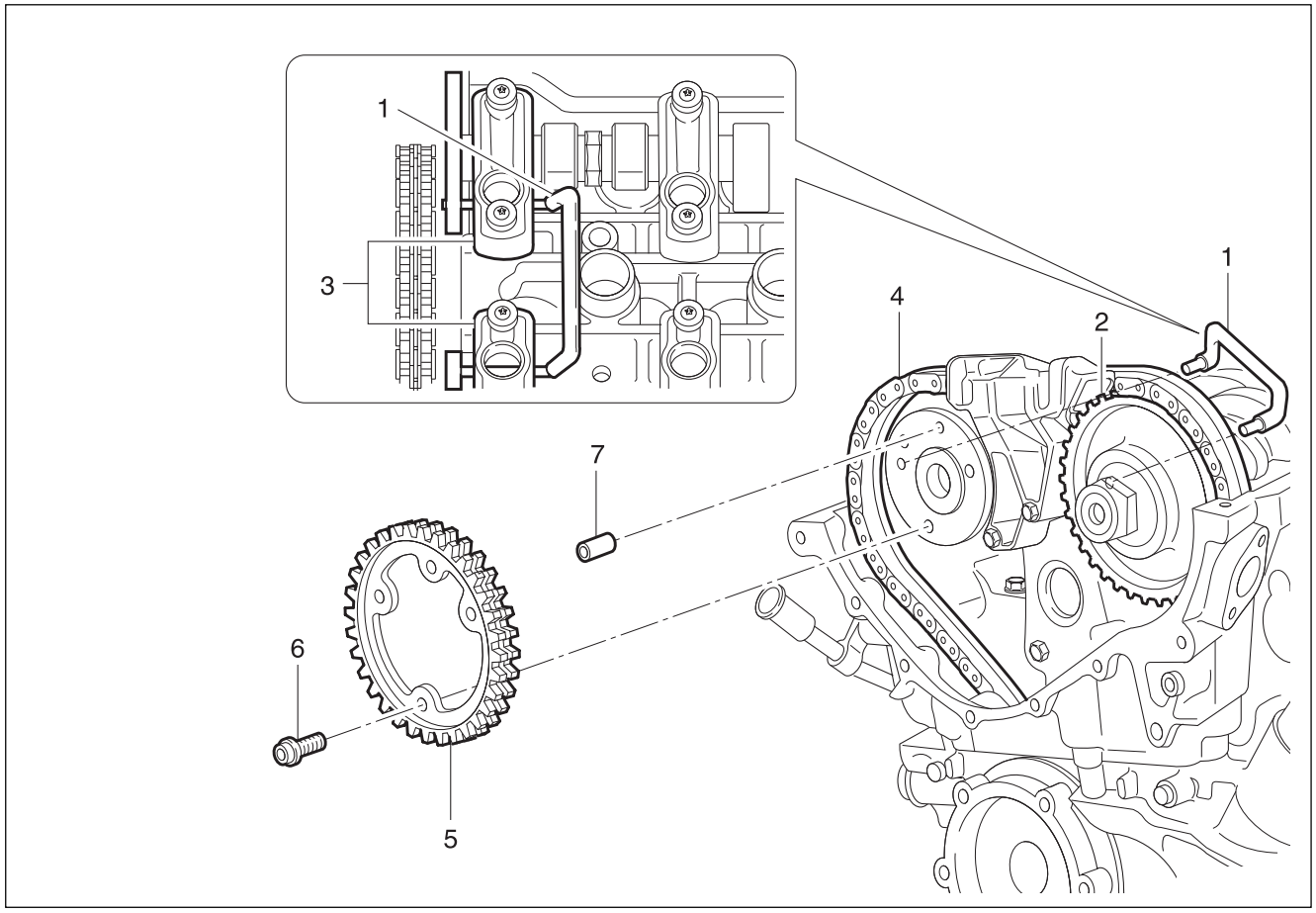
NOTICE

- **Base circle of cam should cantact with the valve tappet.**
- **Install the camshaft bearing caps according to the numbers on the cylinder head cast and bearing cap.**

10. Check the camshaft timing position.

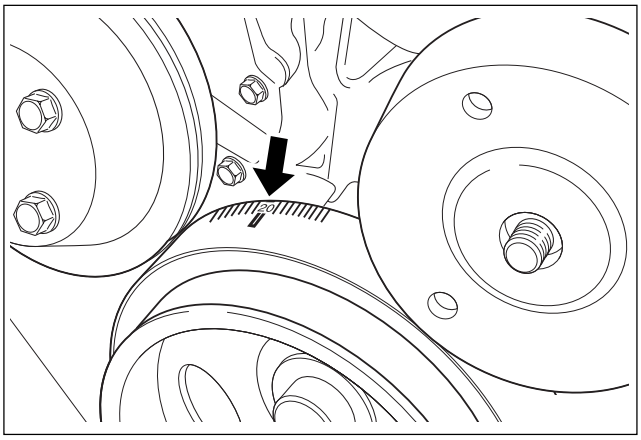
▶ Camshaft Timing Position

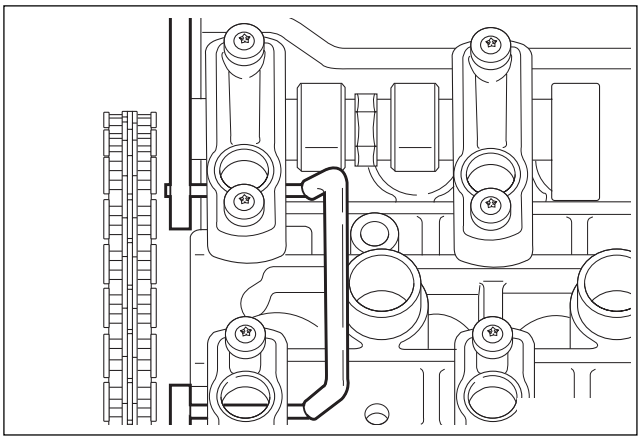
※ **Preceding Work:** Removal of cylinder head cover
Removal of cylinder head front cover



1. Holding Pin A9913 0052B (111 589 03 15 00)
2. Intake Camshaft Sprocket
3. Camshaft Bearing Cap
4. Timing Chain
5. Exhaust Camshaft Sprocket
6. Bolt (M7 X 13, 3 pieces)
   ..... 1st step 18 - 22 NSm (13 - 16 lb-ft)
   .....2nd step 60 ° ± 5 °rotation added
7. StratePin

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Tools Required

A9913 0052B (111 589 03 15 00) Holding Pin

Inspection Procedure

1. Position the NO.1 cylinder piston to ATDC 20 °by turning the crankshaft.

NOTICE

- **When the ATDC 20 °mark on vibration damper is aligned with timing gear case cover, the intake and ex-haust cam of cylinder will make the slope to the center and will face up. In this way, the insert hole in NO.1 and NO.4 camshaft bearing cap will match in line with the flange hole for camshaft sprocket.**

2. Check the timing as below procedure;
   - Check if the holding pin A9913 0052B (111 589 03 15 00) can be inserted into the NO.1 and NO.4 bearing cap hole.
   - At this condition, check if the ATDC 20 °mark on vibration damper aligns with the marker on the timing gear case.

Adjustment Procedure

1. Position the NO.1 cylinder to ATDC 20 °.
2. Remove the chain tensioner.
3. Remove the exhaust camshaft sprocket.
4. Adjust the timing position with inserting the holding pin A9913 0052B (111 589 03 15 00) into the NO.1 and NO.4 camshaft bearing cap hole and flange hole while rotating the camshaft by using wrench.
5. Install the chain to the intake camshaft sprocket.
6. Install the chain to the exhaust camshaft sprocket and tighten the bolt.

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 90° ± 5°

The sprocket bolt is designed to be used only once, so replace with new one.

7. Install the chain tensioner.

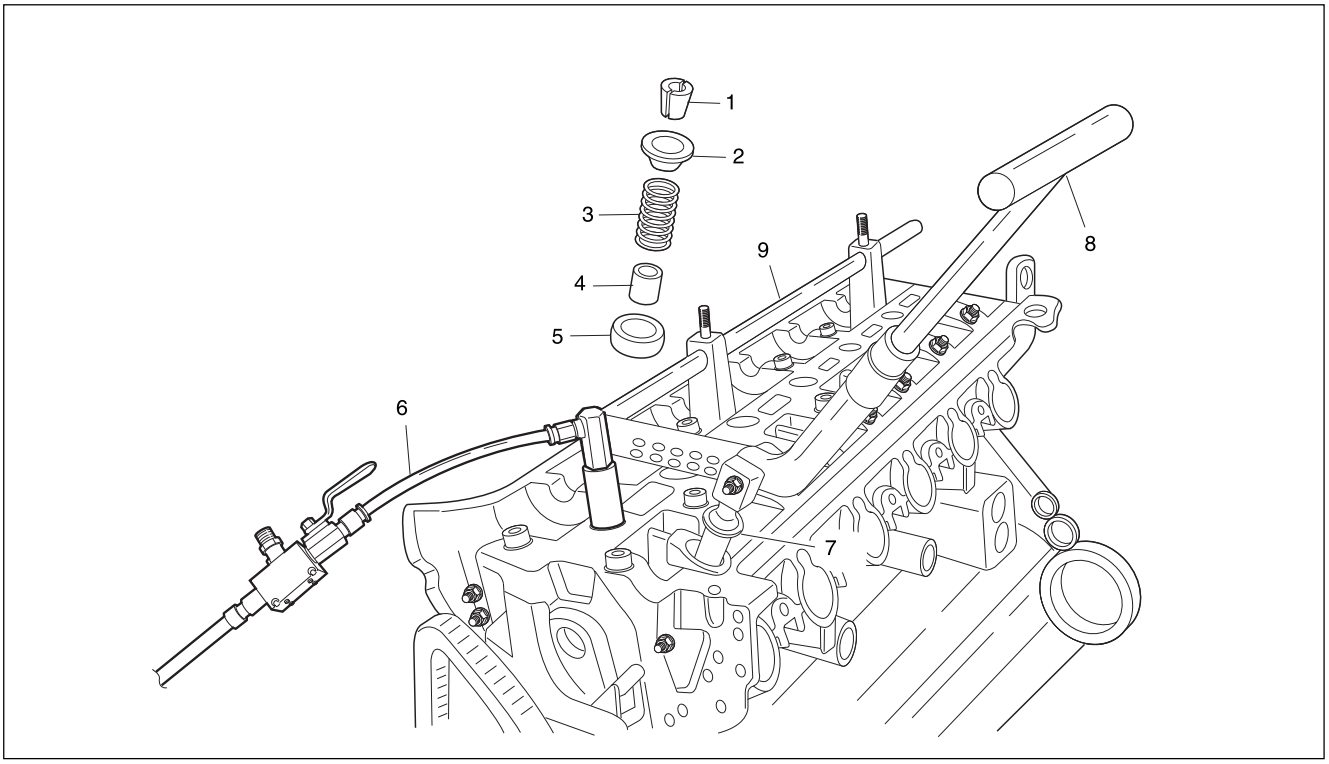
Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)

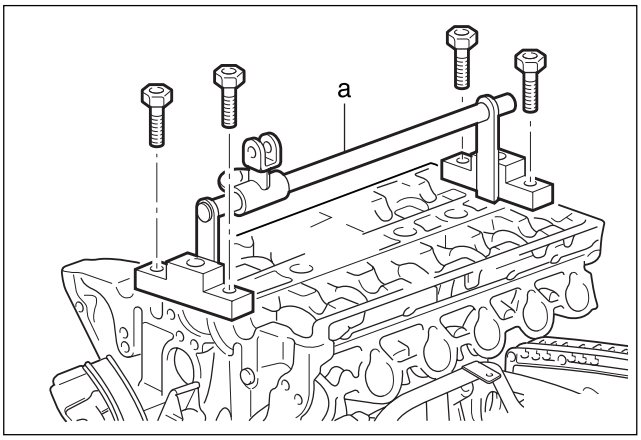
8. Check the camshaft timing.

▶ Valve Spring

※ **Preceding Work:** Removal of camshaft
Removal of spark plug



1. Valve Cotter
2. Valve Spring Retainer
3. Valve Spring
4. Valve Stem Seal
5. Lower Retainer
6. Connecting Hose A9912 0012B (DW110 - 090)
7. Thrust Piece A9917 0121B (111 589 25 63 00)
8. Lever Pusher A9917 0111B (111 589 18 61 00)
9. Supporting Bar A9917 0101B (111 589 01 59 00)



Tools Required

A9917 0101B (111 589 01 59 00) Supporting Bar
A9917 0111B (111 589 18 61 00) Lever Pusher
A9917 0121B (111 589 25 63 00) Thrust Piece
A9910 0150B (602 589 00 40 00) Engine Lock
A9912 0012B (DW110 - 090) Connecting Hose

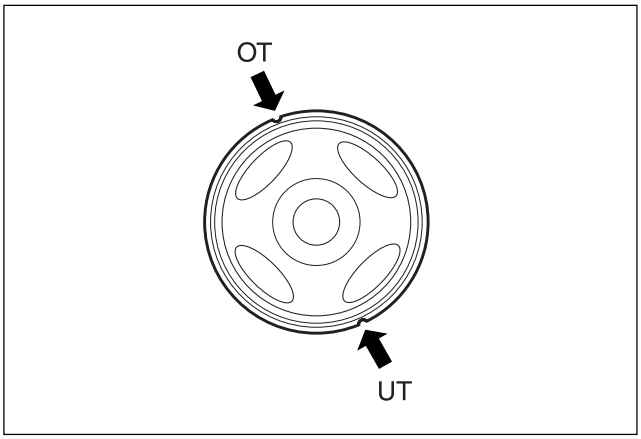
Removal & Installation Procedure

1. Place the supporting bar A9917 0101B (111 589 01 59 00) (a) at the camshaft bearing cap and tighten them with the bearing cap bolt.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

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EFFECTIVE DATE	
AFFECTED VIN	

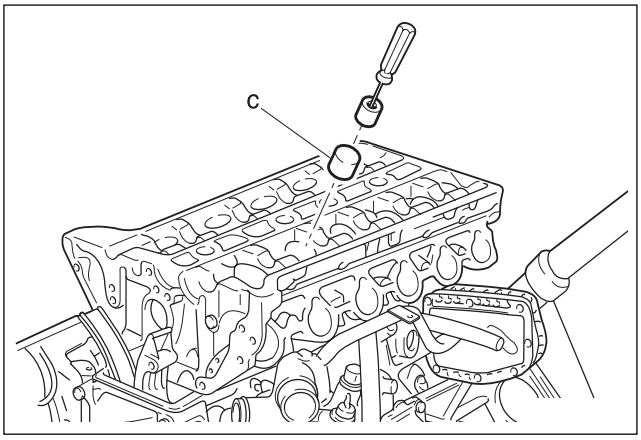


2. Turn the crankshaft to position the each cylinder piston at TDC.

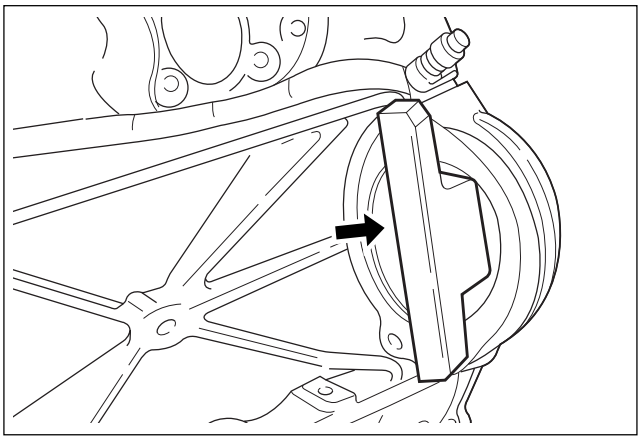
Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 90° ± 5°

NOTICE

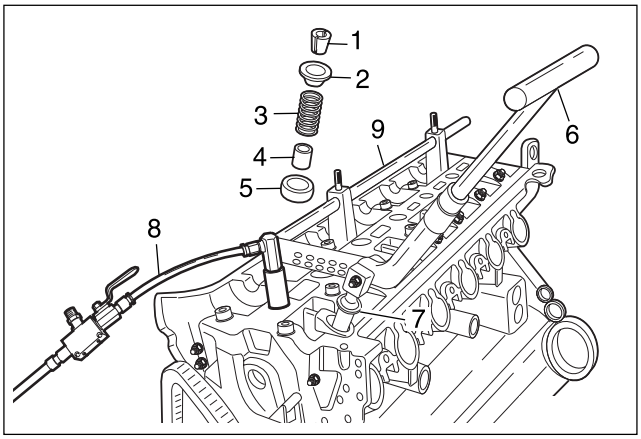
- **Remove the valve spring only at TDC.**
- **Always rotate the crankshaft by holding the chain to prevent from timing chain damage and tangling, and for smooth rotation.**



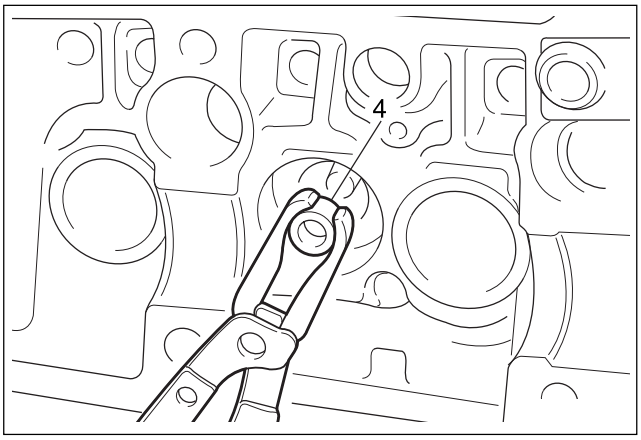
3. Remove the valve tappet using the valve tappet remover.
4. Install the connecting hose A9912 0012B (DW110 - 090) (c) to the spark plug hole.



5. Install the engine lock A9910 0150B (602 589 00 40 00) to the ring gear to prevent the crankshaft from rotating.
6. Blow up with compressed air.



7. Install the supporting bar A9917 0101B (111 589 01 59 00) (d) and the lever pusher A9917 0111B (111 589 18 61 00) (a).
8. Mount the thrust piece A9917 0121B (111 589 25 63 00) (b) vertically to the valve spring retainer (2).
9. Press the valve spring (3) by using the lever pusher A9917 0111B (111 589 18 61 00) (a).
10. Remove the valve cotter (1) using the pincette.
11. Remove the upper retainer (2) and the valve spring (3).



12. Remove the valve stem seal (4) and replace if necessary.

NOTICE

- **Check the valve stem seal for damage and replace if necessary.**

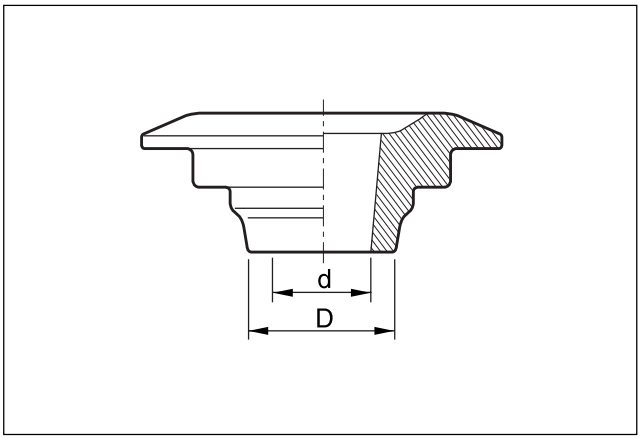
13. Remove the lower retainer (5).

NOTICE

- **Check the retainer for damages and replace with a new one if necessary.**

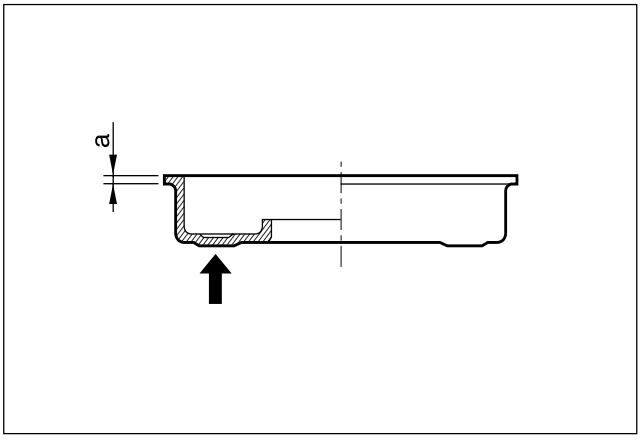
14. Installation should follow the removal procedure in the reverse order.

Test (Upper and Lower Valve Tappet and Valve Cotter)



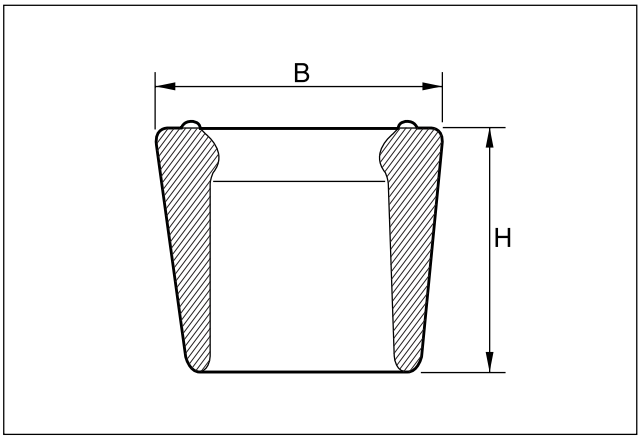
- Upper Valve Spring Retainer

Size (mm)	(d)	8.5
	(D)	12.3



- Lower Valve Spring Retainer

Size (mm)	(a)	0.8 - 1.0

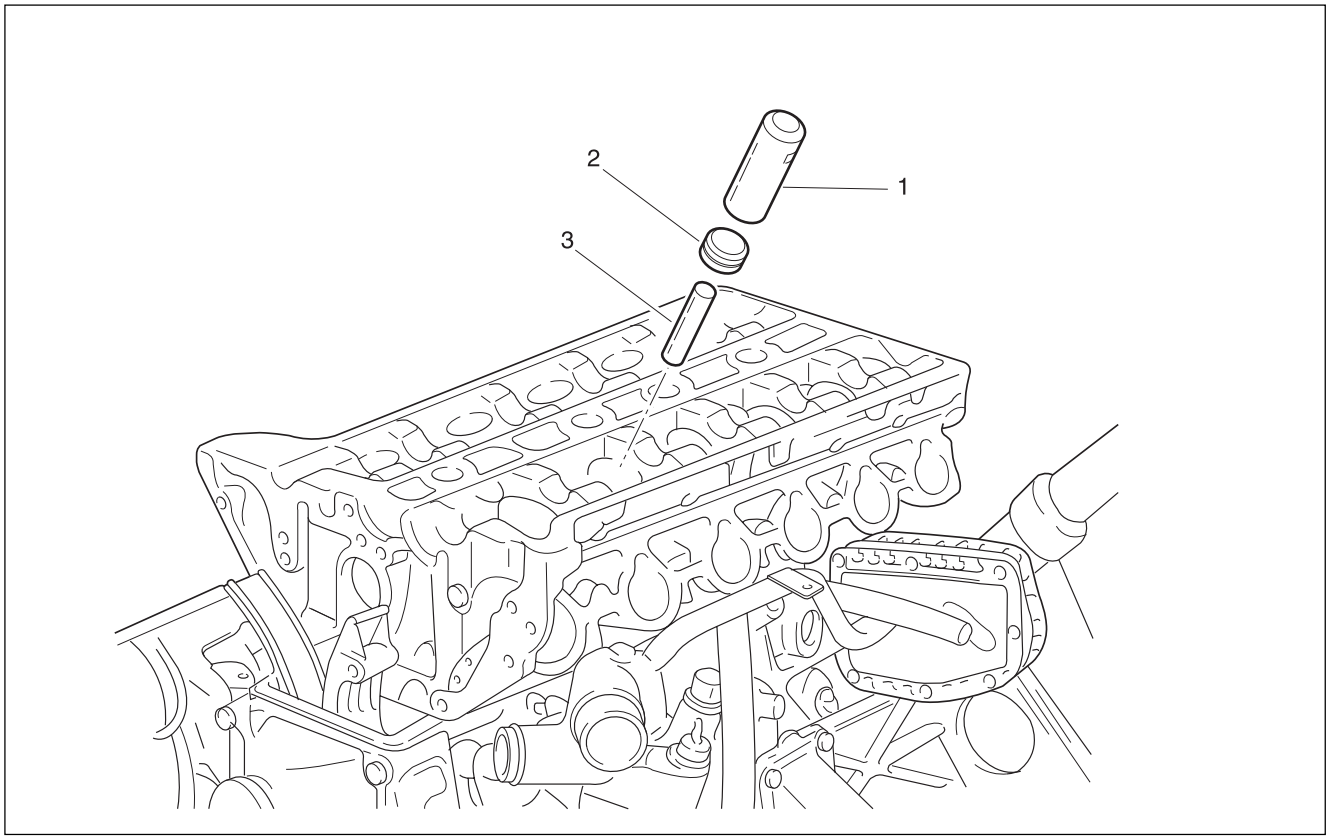


- Valve Cotter

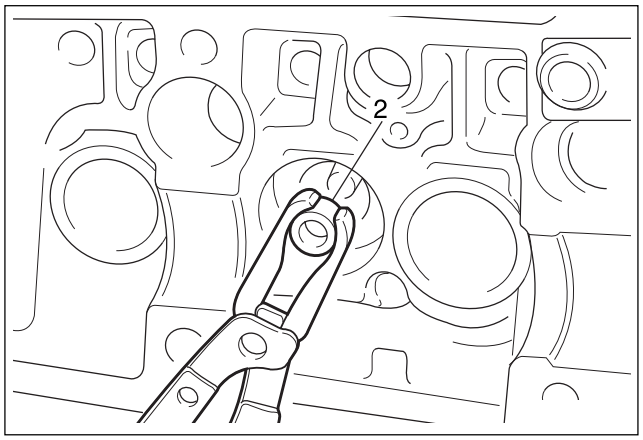
Size (mm)	(B)	9.0
	(H)	9.2 - 9.8

▶ Valve Stem Seal

※ **Preceding Work:** Removal of valve spring



1. Drift 119 589 00 43 00
2. Valve Stem Seal
3. Protective Sleeve



Tools Required

A9917 0171B (119 589 00 43 00) Drift

Replacement Procedure

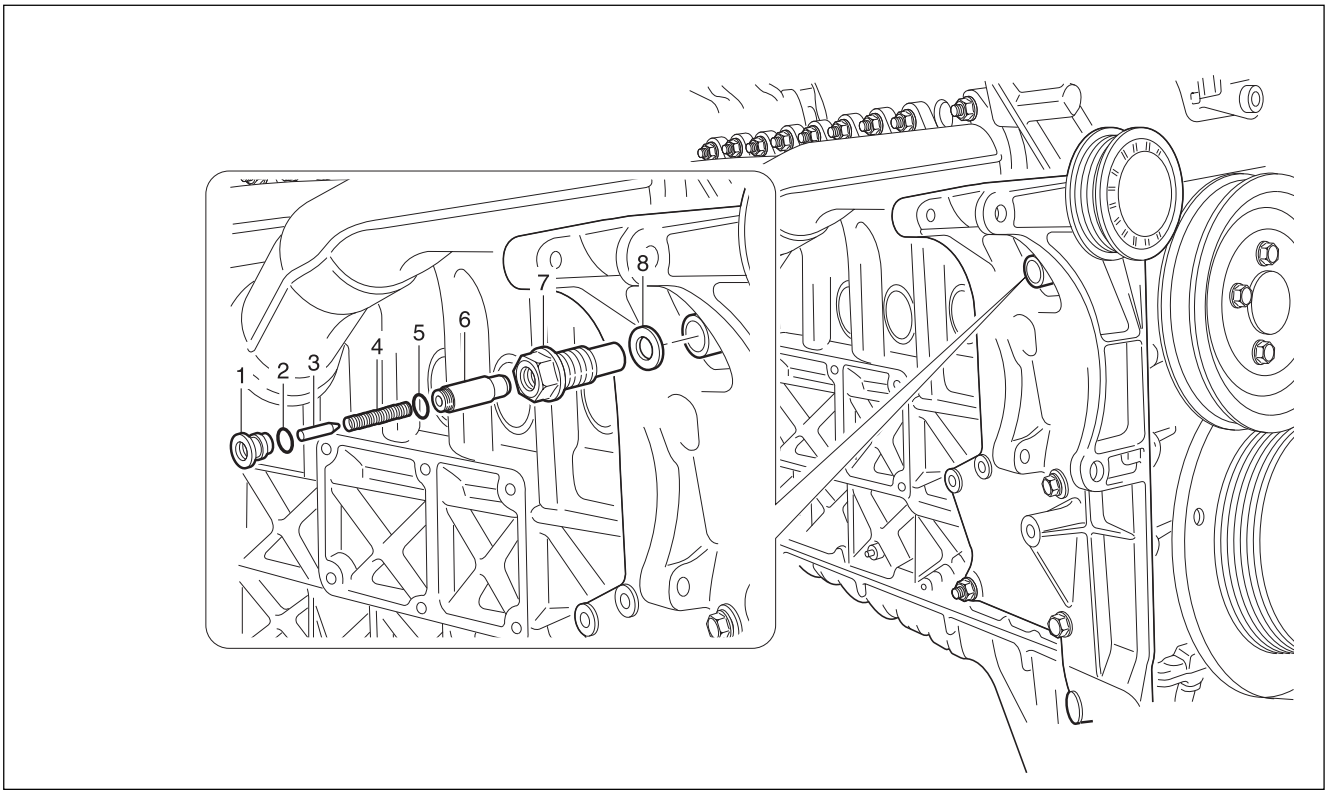
1. Remove the valve stem seal (2) using the pliers.

NOTICE

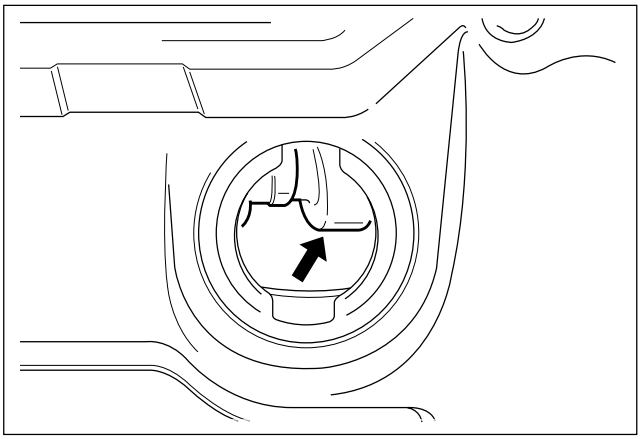
- **Check the valve stem seal for damage and replace if necessary.**

2. Coat the valve stem seal with oil and assemble it with the protective sleeve.
3. Insert the valve stem seal by pressing it with the drift A9917 0171B (119 589 00 43 00).

▶ Chain Tensioner



1. Screw Plug ..... 40 N•m (30 lb-ft)
2. Seal
3. Filler Pin
4. Compression Spring
5. Snap Ring
6. Thrust Pin
7. Chain Tensioner Housing
   ..... 72 - 88 N•m (53 - 65 lb-ft)
8. Seal



Removal Procedure

1. Position the number 1 cylinder to ATDC 20 °.

NOTICE

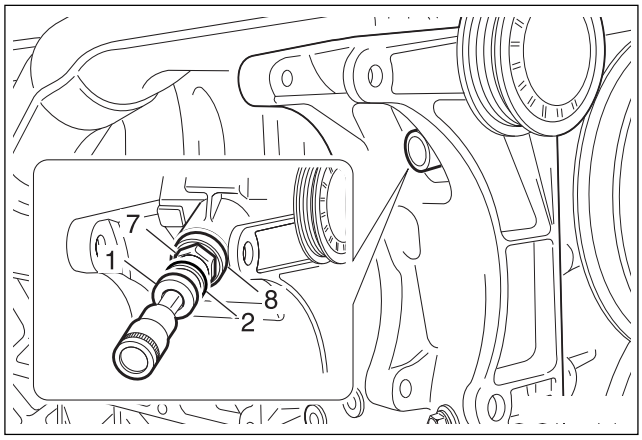
- **Remove the oil filler cap at adjustment position, and check whether the intake camshaft cam's lobe (arrow) stays in the upper side.**

2. Cover the generator with a clean cloth.
3. Release the tension by unscrewing the screw plug once.

NOTICE

- **In case that the tension is reduced by unscrewing the screw plug, reinstall after completely removing the chain tensioner. If the chain tensioner is tightened again without completely reducing its tension, then the snap ring doesn't return to the original position and the tension gets exceeded.**

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EFFECTIVE DATE	
AFFECTED VIN	

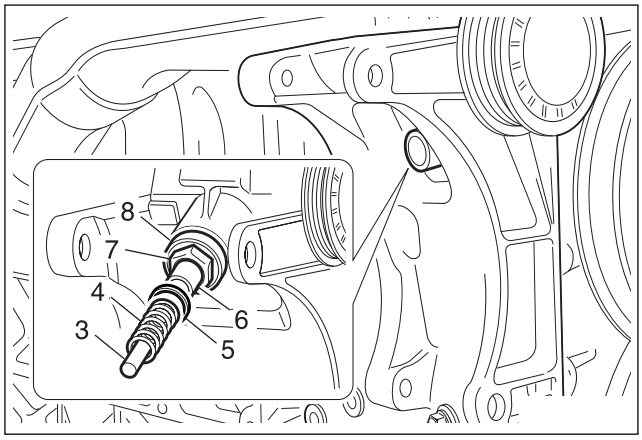


4. Carefully unscrew the screw plug (1), and remove the seal (2).

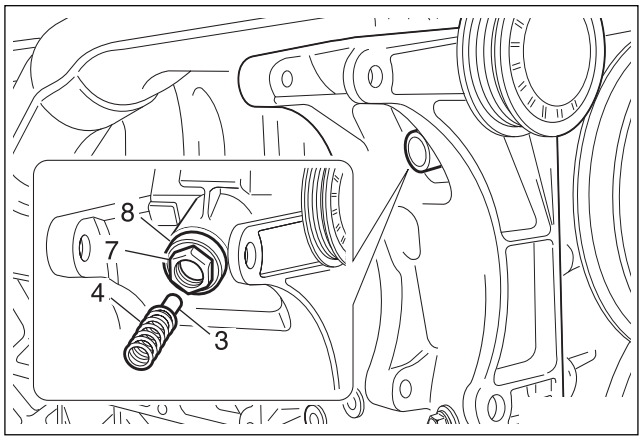
NOTICE

- **For the removal of screw plug, be careful that it can be jumped out due to the force of compression spring.**
- **Remove the screw plug only when the seal and compression spring are damaged.**

5. Carefully remove the filler pin (3), compression spring (4), snap ring (5), and the thrust pin (6).



6. Remove the chain tensioner housing (7) and the seal (8).



Installation Procedure

1. Connect the thrust pin (6) and the snap ring (5) to the chain tensioner housing (7).

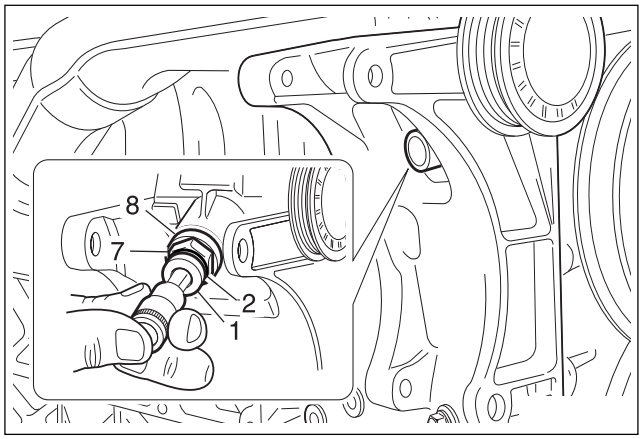
NOTICE

- **When connecting the thrust pin, push in the thrust pin far enough so that it doesn't protrude at the chain tensioner housing.**

2. Install the chain tensioner housing (7), thrust pin (6), snap ring (5), and the seal (8).

Installation Notice

Tightening Torque	72 - 88 N•m (53 - 65 lb-ft)



3. Insert the compression spring (4) with the filler pin (3) into chain tensioner housing.

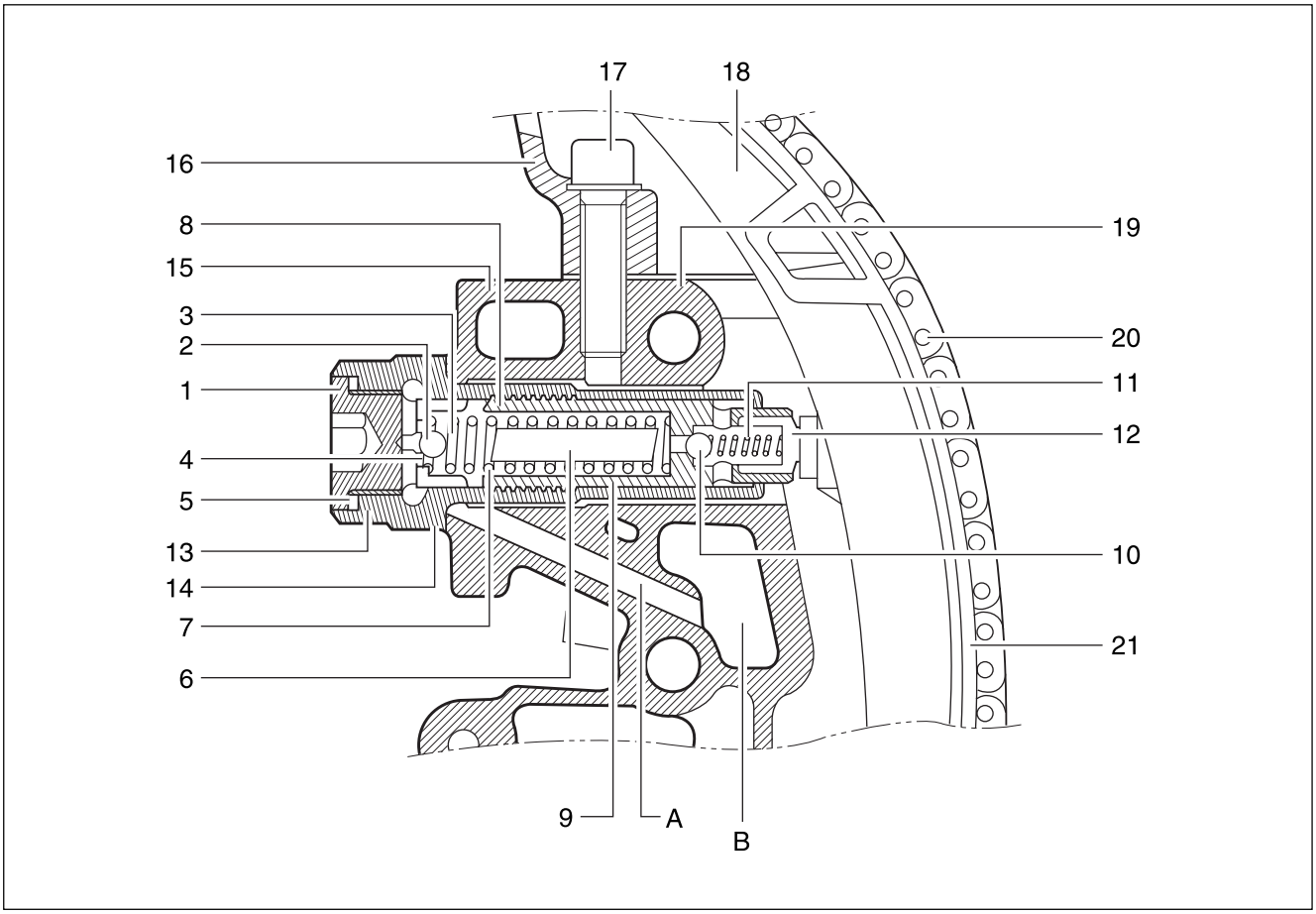
4. Lightly apply the grease to the seal (2) and install the screw plug (1).

Installation Notice

Tightening Torque	40 N•m (30 lb-ft)

5. Check for leaks by operating the engine.

▶ Sectional View

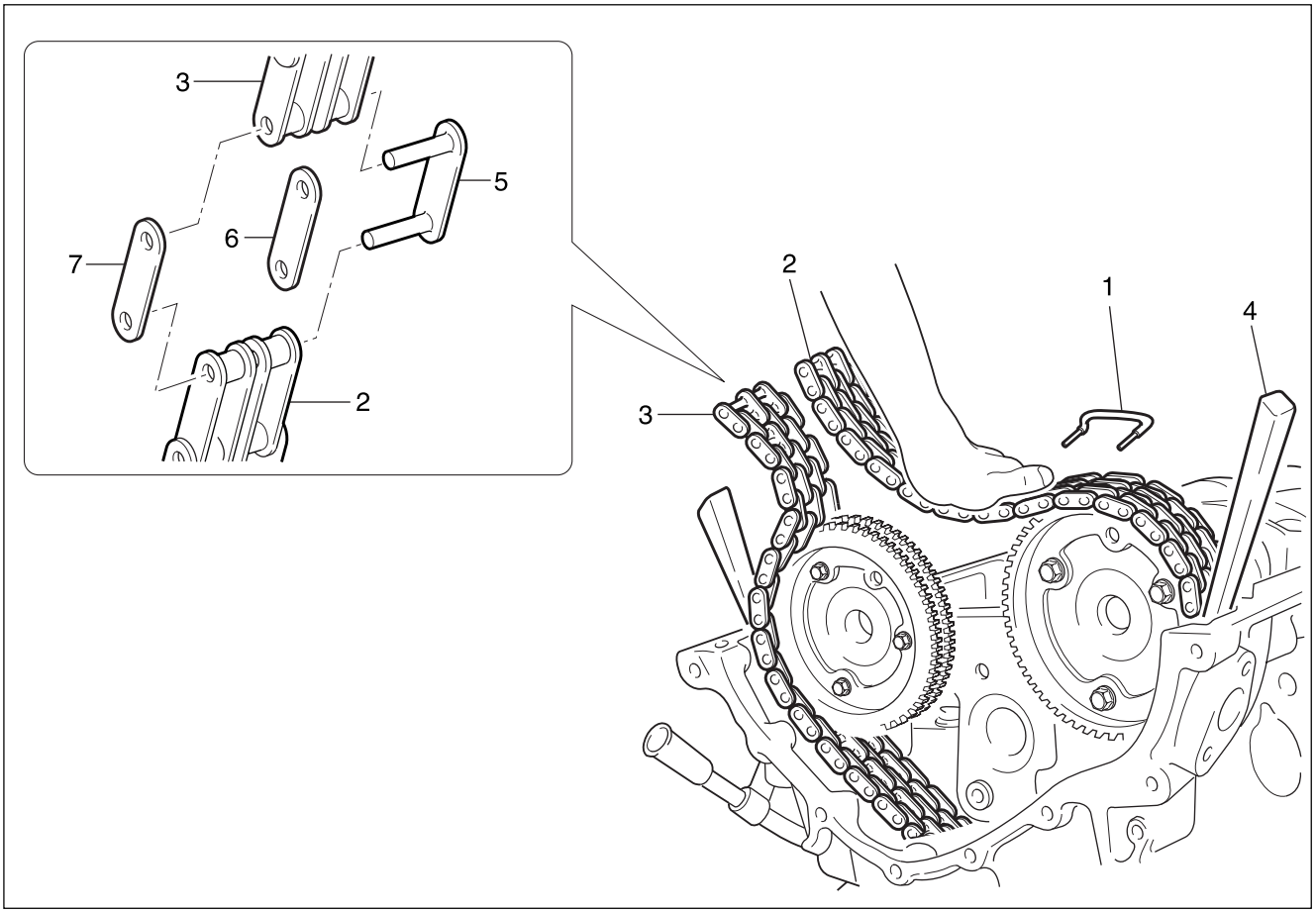


1. Screw Plug
2. Ball (Nonreturn Valve)
3. Compression Spring
4. Ball Guide
5. Seal (Aluminum)
6. Filler Pin
7. Compression Spring
8. Snap Ring
9. Thrust Pin
10. Ball (Nonreturn Valve)
11. Compression Spring
12. Thrust Piece
13. Chain Tensioner Housing
14. Seal
15. Timing Gear Case Cover
16. Cylinder Head
17. Bolt / Washer
18. Tensioning Rail
19. Cylinder Head Gasket
20. Timing Chain
21. Tensioning Rail Base (Sliding Surface)

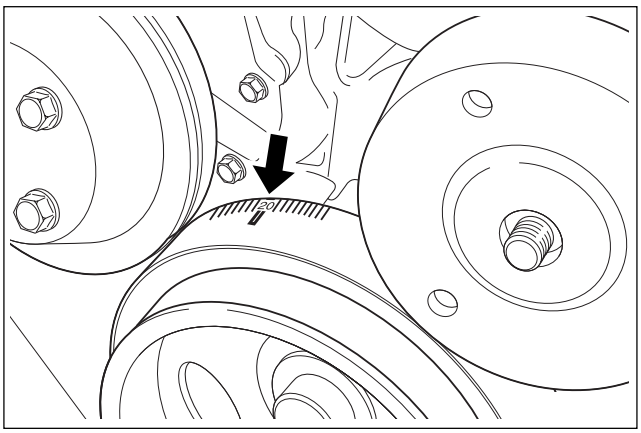
A. Oil Supply Hole
B. Chain Tensioner Oil Storage Hole

▶ Timing Chain

※ **Preceding Work:** Removal of cylinder head cover
Removal of spark plug



1. Pin
2. New Timing Chain
3. Timing Chain (Used)
4. Wedge
5. Link
6. Center Plate
7. Outer Plate



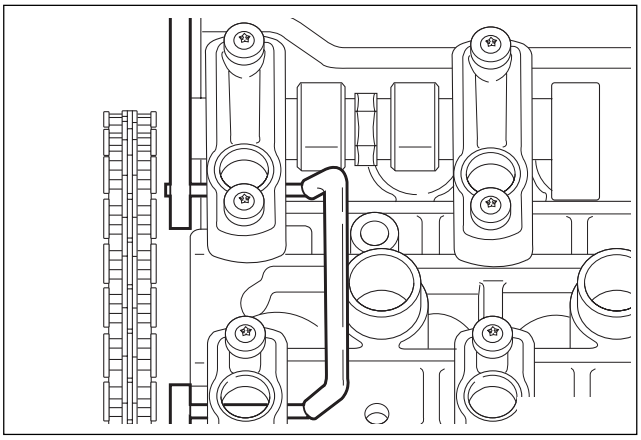
Tools Required

A9913 0010B (000 589 58 43 00) Chain Assembly

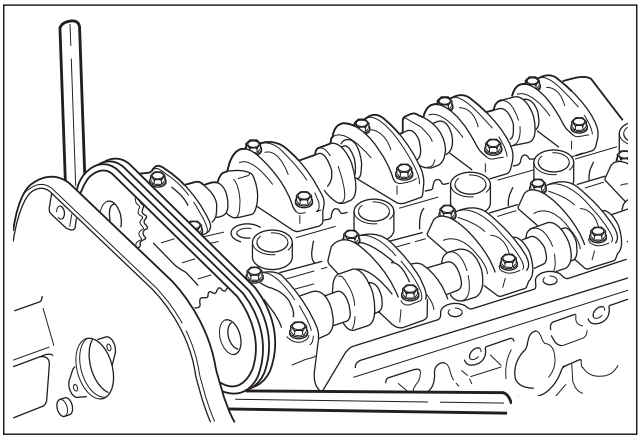
A9913 0052B (111 589 03 15 00) Holding Pin

Replacement Procedure

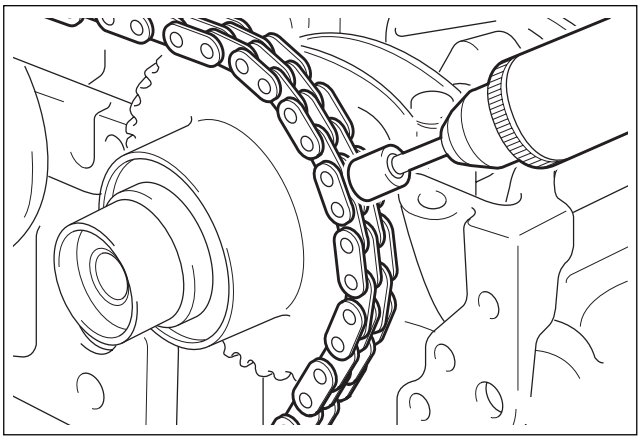
1. Position the NO.1 cylinder to ATDC 20 °.



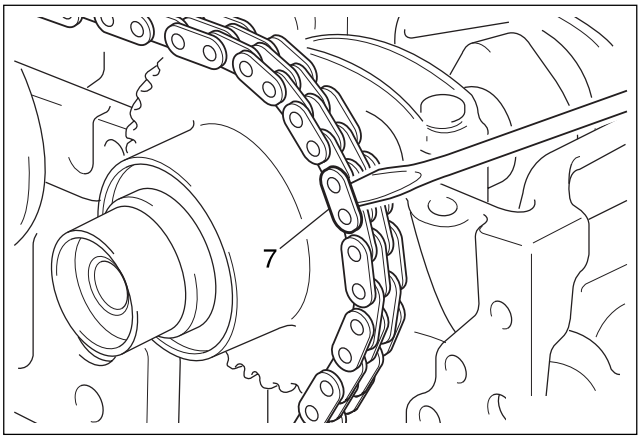
2. Insert the holding pin A9913 0052B (111 589 03 15 00) to the intake and exhaust camshaft flange not to rotate camshaft.
3. Remove the chain tensioner.



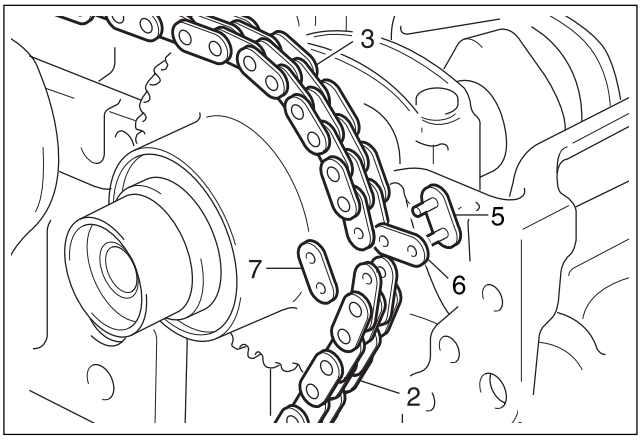
4. Mount the wedges to both sides of the camshaft sprocket as shown in the figure.

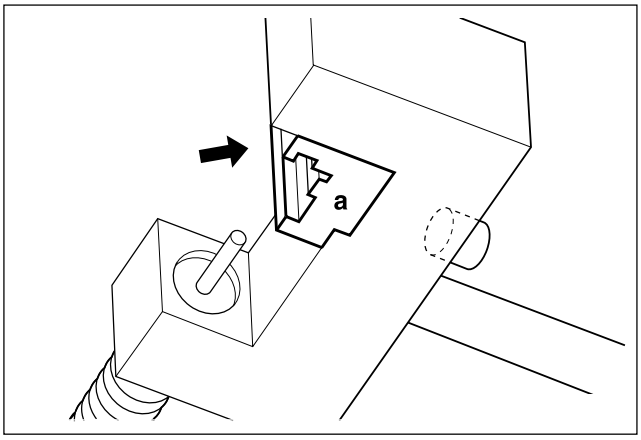


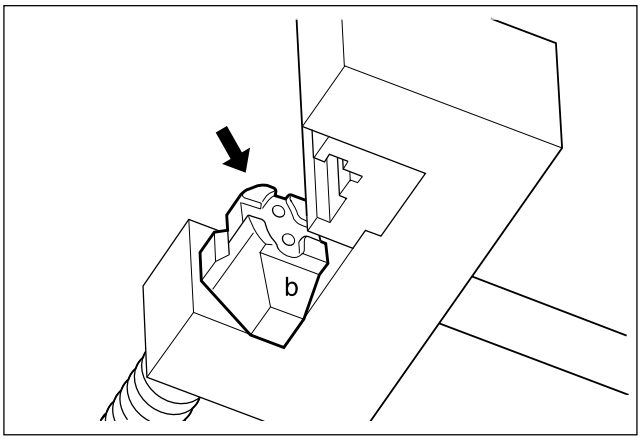
5. Cover the chain housing with a clean cloth, and grind off the timing chain pin from the intake camshaft sprocket with the grinder.

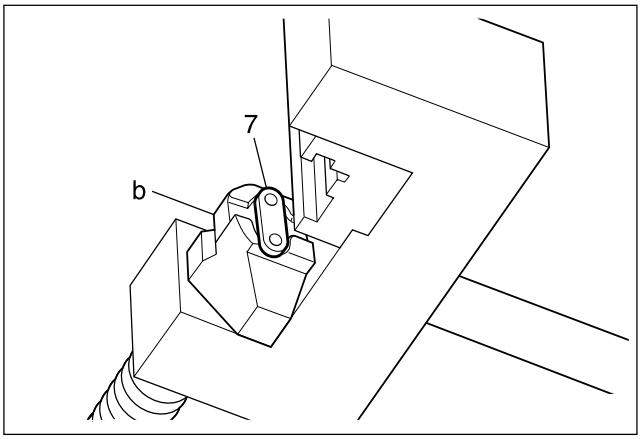


6. Remove the outer plate (7) with the screw driver and remove the link (5).









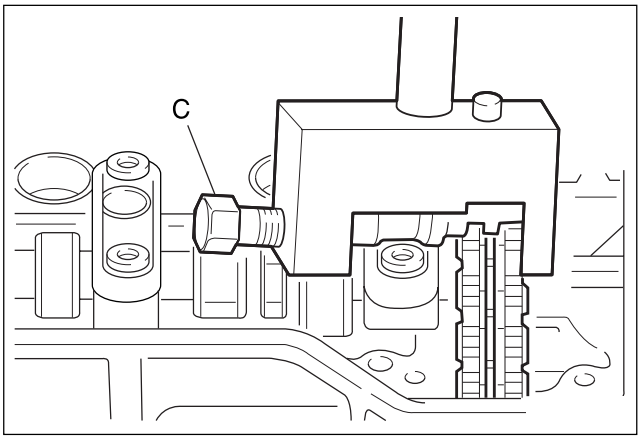
7. Connect the new timing chain (2) to the used timing chain (3) with the link (5), center plate (6, thickness 1.6 mm), and the outer plate (7).
8. Rotate the crankshaft in the direction if engine revolution by pressing the new timing chain against the exhaust camshaft sprocket to prevent it to be tangled.

NOTICE

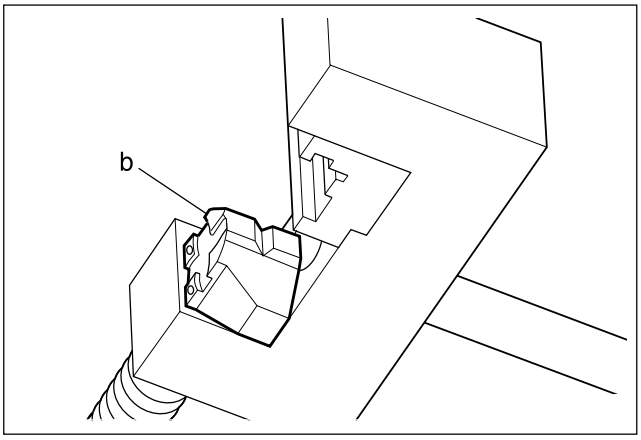
- **Be sure to remove the wedge before cranking the engine.**

9. Take out the used timing chain out from the chain housing.
10. Connect both separators of the new timing chain with the link (5) and the center plate (6).
11. Install the jaw (a) and the thrust piece (b) to the assembly tool as shown in the figures.

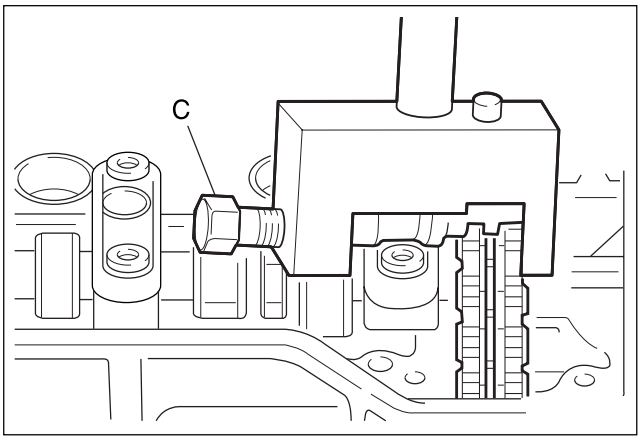
12. Place the outer plate (7, thickness 1.2 mm) inside the thrust piece (b).



13. Install the chain assembly A9913 0010B (000 589 58 43 00)above the link and tighten the spindle (c) until a block is felt.
14. Place the chain assembly A9913 0010B (000 589 58 43 00).



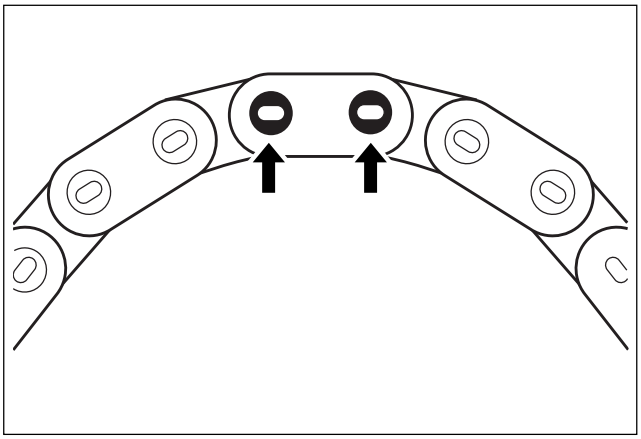
15. Replace the thrust piece (b) as shown in the figure.



16. Install the chain assembly A9913 0010B (000 589 58 43 00) to the link pin and tighten the spindle (c).

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)



17. Rivet the link pin.
    Check the condition and it again if necessary.
18. Install the chain tensioner.

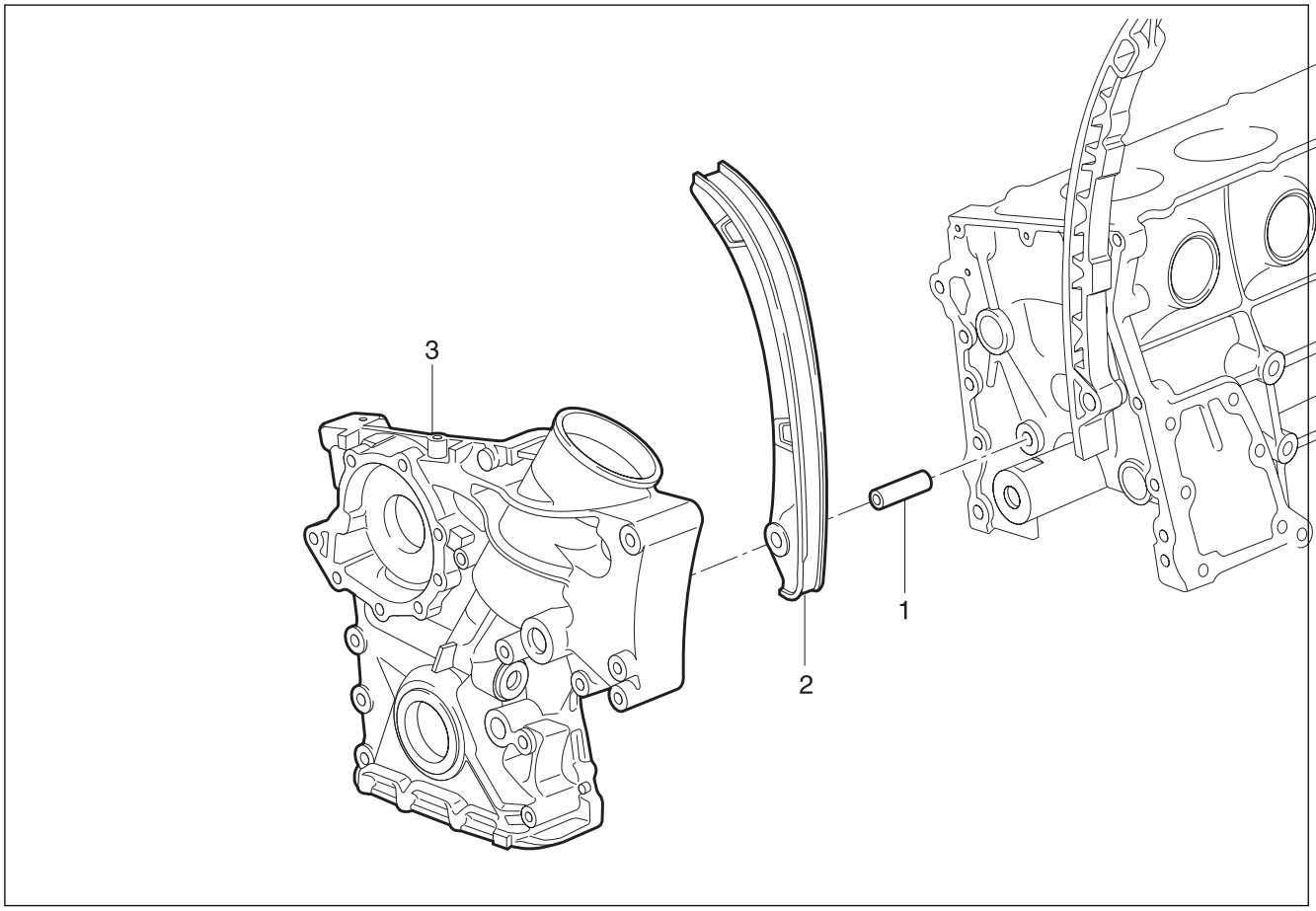
Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)

19. Check the camshaft timing position.

▶ Tensioning Rail

※ **Preceding Work:** Removal of cylinder head



1. Sliding Rail Pin
2. Sliding Rail
3. Timing Gear Case Cover

Removal & Installation Procedure

1. Remove the timing gear case cover (3).

NOTICE
- **Be careful not to damage the gasket.**

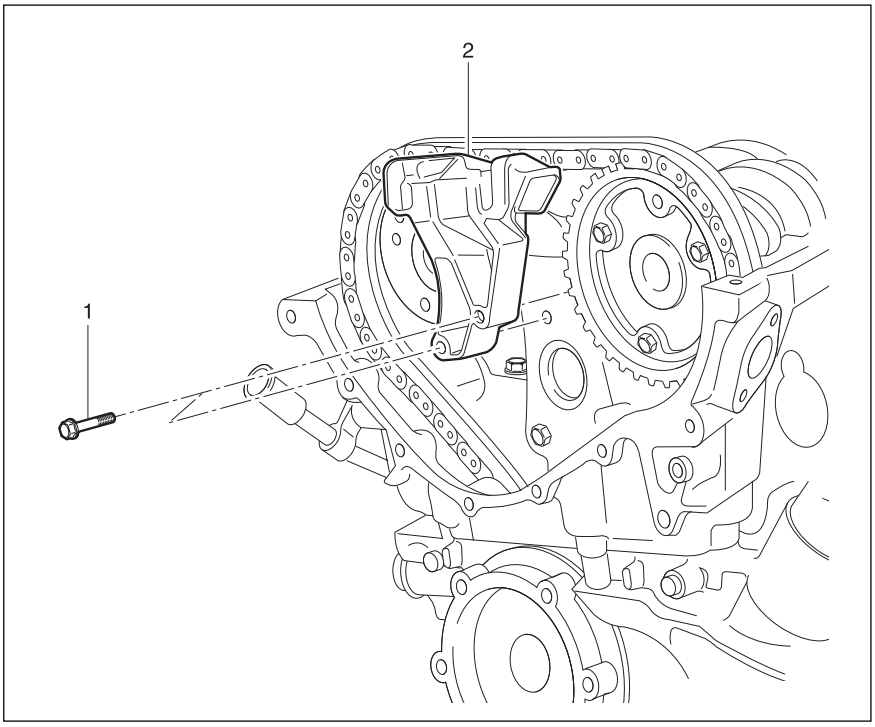
2. Remove the sliding rail (1) from the sliding rail pin (2).

NOTICE
- **Replace the plastic guide (2) if it is damaged.**
- **For installation, exactly align the plastic guide (2) with the sliding rail (1).**

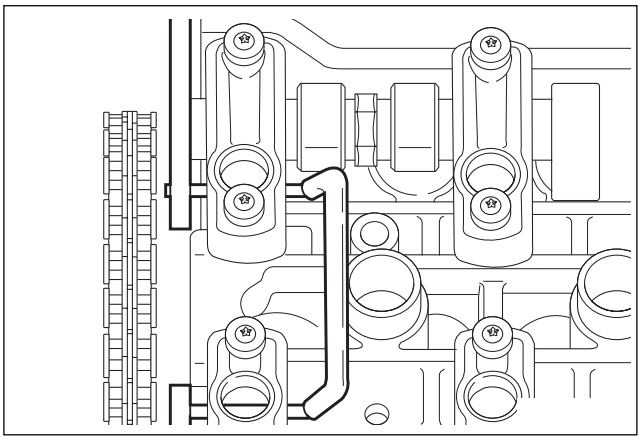
3. Installation should follow the removal procedure in the reverse order.

▶ Cylinder Head Guide Rail

※ **Preceding Work:** Removal of cylinder head front cover



1. Bolt (M6 X 45, 2 pieces)
   9 - 11 N•m (80 - 97 lb-in)
2. Guide Rail



Tools Required

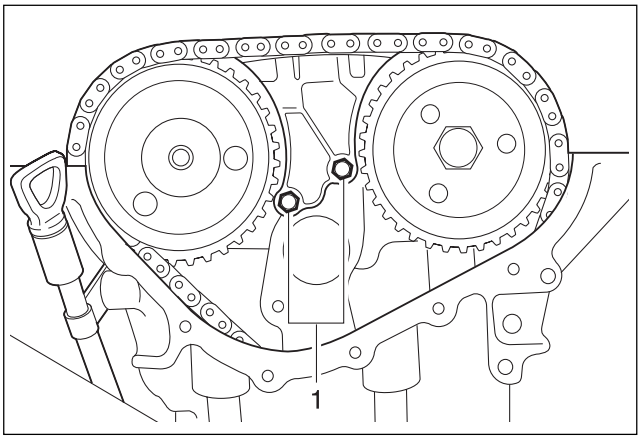
A9913 0052B (111 589 03 15 00) Holding Pin

Removal & Installation Procedure

1. Position the number 1 cylinder to ATDC 20 ° guide rail.
2. Install the holding pin A9913 0052B (111 589 03 15 00) into the no.1 and no.6 bearing cap hole.
3. Remove the chain tensioner.

Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)



4. Unscrew the bolt (1) and remove the guide rail.

Installation Notice

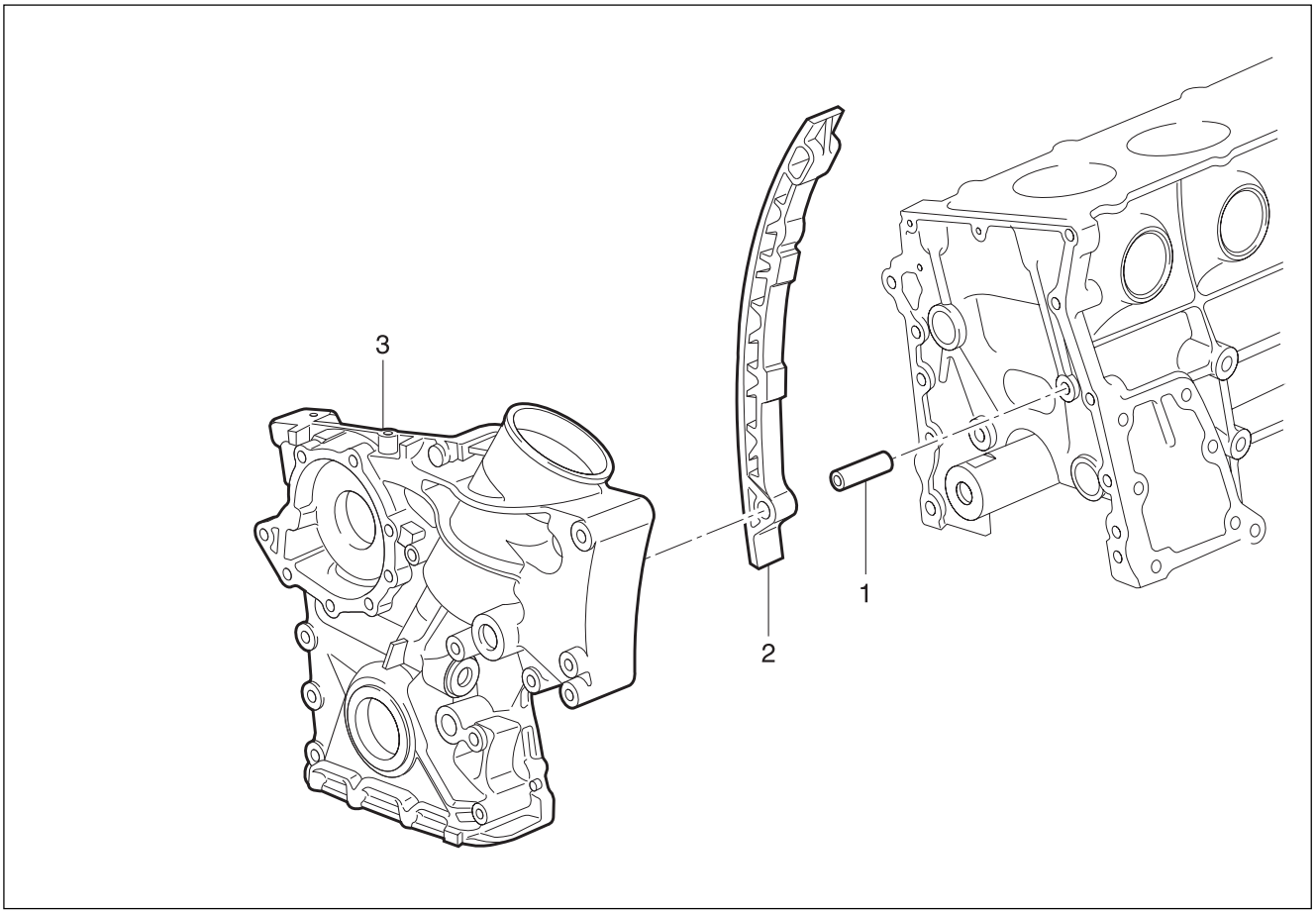
Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)

5. Installation should follow the removal procedure in the reverse order.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Crankcase Guide Rail

※ **Preceding Work:** Removal of timing gear case cover



1. Guide Rail Pin
2. Guide Rail
3. Timing Gear Case Cover

Removal & Installation Procedure

1. Remove the timing gear case cover (3).

NOTICE

- **Be careful not to damage the gasket when removing / installing the timing gear case cover.**

2. Remove the guide rail (2) from the guide rail pin (1).

NOTICE

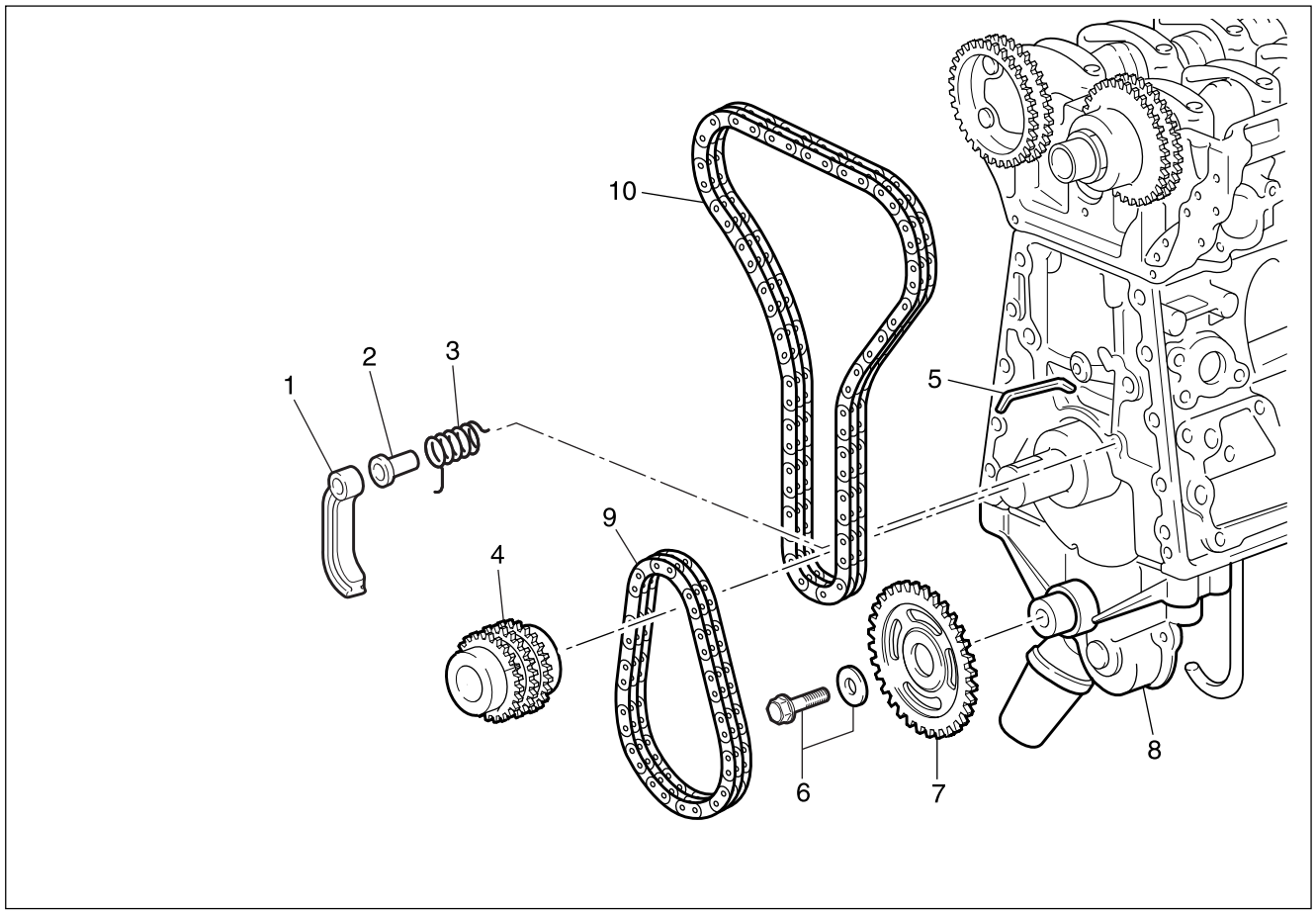
- **Replace the plastic guide (2) if damaged.**
- **Connect the plastic guide (2) and the guide rail (1) by aligning them accurately when installing.**

3. Installation should follow the removal procedure in the reverse order.

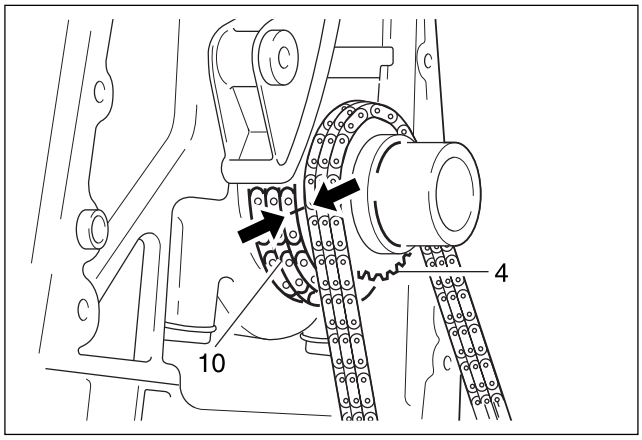
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Crankshaft Sprocket

※ **Preceding Work:** Removal of oil pan
Removal of tensioning rail
Removal of crank case guide rail



1. Oil Pump Chain Tensioner
2. Oil Pump Chain Bushing
3. Oil Pump Chain Spring
4. Crankshaft Sprocket
5. Key
6. Bolt (M8 x 20, 1 piece) / Washer
..... 29 - 35 N•m (21 - 26 lb-ft)
7. Oil Pump Sprocket
8. Oil Pump
9. Oil Pump Roller Chain
10. Timing Chain



Tools Required

W9911 0050B (615 589 01 33 00) Crankshaft Sprocket Puller

Removal & Installation Procedure

1. Put the assembly mark at the crankshaft sprocket (4) and the timing chain (10) with the paint (arrow).

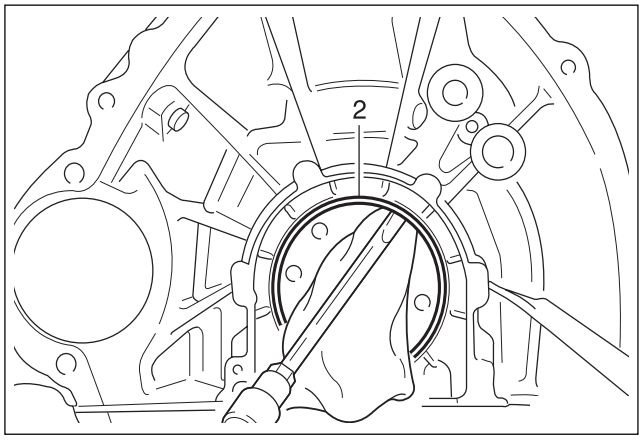
NOTICE

- **Align the assembly marks on crankshaft sprocket and timing chain. Also, align the assembly marks on camshaft sprocket and timing chain when installing.**

2. Unscrew the bolt (6) and remove the oil pump sprocket (7) from the oil pump.

Installation Notice

Tightening Torque	29 - 35 N•m (21 - 26 lb-ft)



3. Remove the oil pump roller chain (9).
4. Remove the oil pump chain tensioner (1), oil pump chain bushing (3), and the oil pump chain spring (2).
5. Remove the crankshaft sprocket (4) using crankshaft sprocketpuller W9911 0050B (615 589 01 33 00).

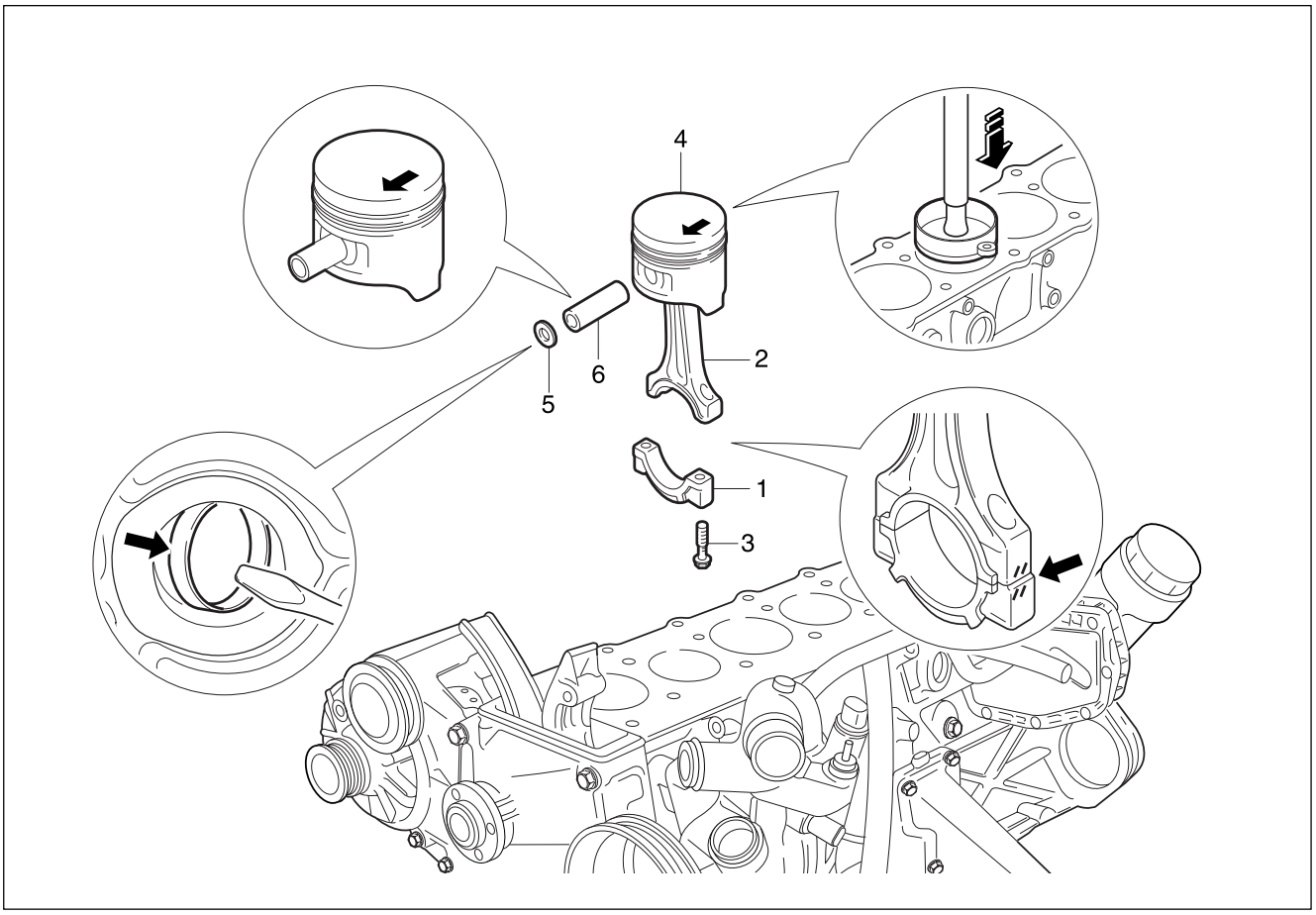
NOTICE

- **Make sure not to lose the crankshaft pulley key (5) when removing.**
- **Install the crankshaft sprocket (4) after warming it up.**

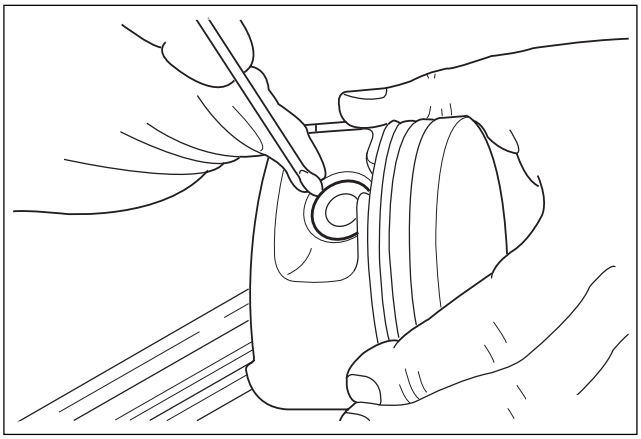
6. Installation should follow the removal procedure in the reverse order.

▶ Piston

※ **Preceding Work:** Removal of engine
Removal of cylinder head
Removal of oil pan
Removal of oil pump
Removal of baffle plate



1. Connecting Rod Bearing Cap
2. Connecting Rod
3. Connecting Rod Bolt (M9 x 52, 8 pieces)
   ..... 1st step 40 N•m (30 lb-ft)
   ..... 2nd step 90 °
4. Piston
5. Snap Ring
6. Piston Pin



Removal Procedure

1. Unscrew the connecting rod bolt (3) and remove the cap.
2. Remove the connecting rod and the piston upward.

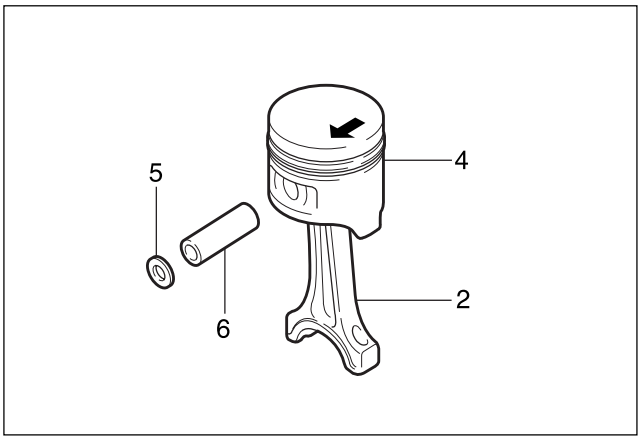
NOTICE

- **Make sure that the bearing cap and shell are not changed each other.**

3. Removethe snapring (5)and pulloutthepiston pin (6).

NOTICE

- **Remove the snap ring using a clean cloth as shown in the right picture so that the piston, piston ring, and the snap ring don't get damaged.**



Installation Procedure

1. Check the piston ring gap and apply the engine oil to the piston pin and the connecting rod bushing.
2. Connect the piston and the connecting rod by pressing in the piston pin (6) and install the snap ring to the groove.
3. Clean the cylinder bore, connecting rod bearing journal, connecting rod bearing shell and the piston and coat them with engine oil.
4. Install the piston ring.
5. Install the piston so that the arrow on the piston head faces to the forward of the vehicle.
6. After aligning the connecting rod and the bearing cap mark (// or a number), tighten the bolts.

Installation Notice

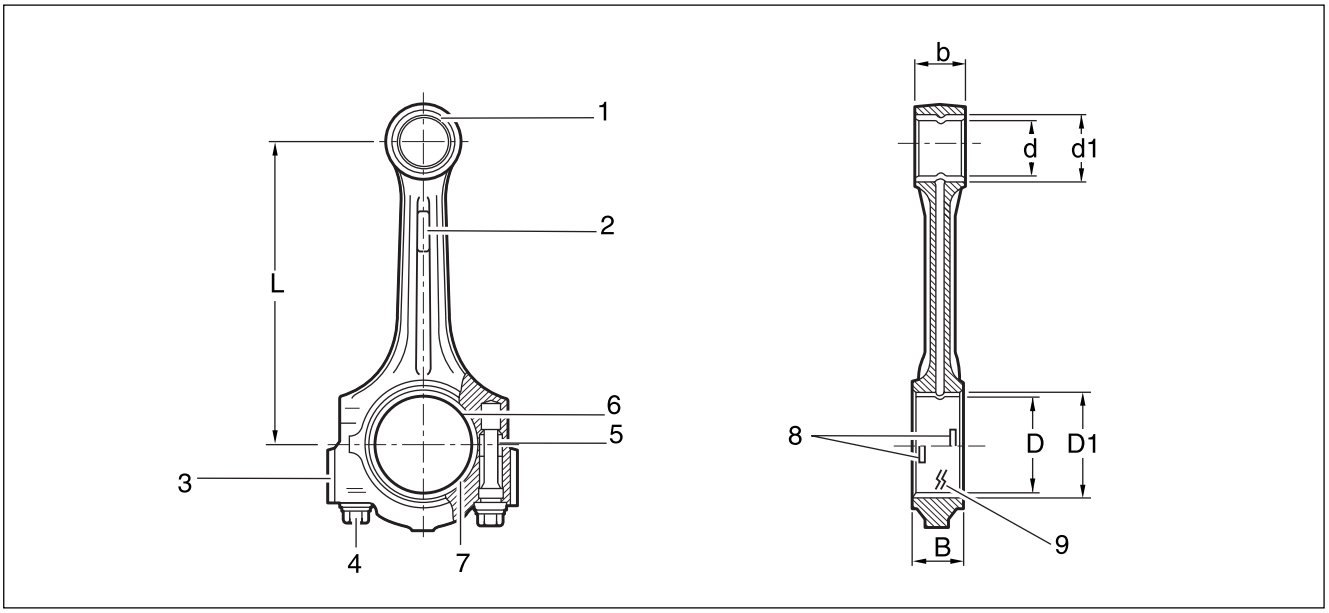
Tightening Torque	1st step: 40 N•m (30 lb-ft)
	2nd step: 90°

Apply the engine oil to the bearing cap upper and lower bearing shells.

7. Check if the crankshaft rotates without any trouble by rotating it.

▶ Connecting Rod

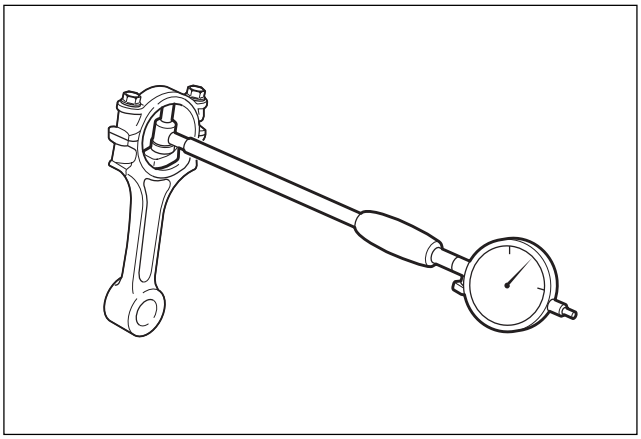
※ **Preceding Work:** Removal of piston



1. Connecting Rod Bushing
2. Oil Gallery
3. Balance Weight
4. Connecting Rod Bearing Cap Bolt
   (M9 x 52, 8 pieces)
   ..... 1ststep 40 N•m (30 lb-ft)
   ..... 2nd step 90 °
5. Fit Sleeve
6. Upper Connecting Rod Bearing
7. Lower Connecting Rod Bearing
8. Bearing Shell Lug
9. Marking [Indication (///) or Numbers]

Service Data Standard

Distance (L) from The Connecting Rod Bearing to Bushing Bore Center	149 ±0.05 mm
Width of The Connecting Rod (B) at Bearing Bore	21.940 - 22.000 mm
Width of The Connecting Rod (b) at Bushing Bore	21.940 - 22.000 mm
Basic Bore at The Bearing Shell (D1)	51.600 - 51.614 mm
Basic Bore at The Bushing (d1)	24.500 - 24.521 mm
Bushing Inner Diameter (d)	22.007 - 22.013 mm
Clearance Between The Piston Pin and The Bushing	0.007 - 0.018 mm
Peak-to-valley Height of Connecting Rod Bushing on Inside	0.005 mm
Permissible Wwist of Connecting Rod Bearing Bore to Connecting Rod Bushing Bore	0.1/100 mm
Permissible Deviation of Axial Paralleism of Connecting Rod Bearing Bore to Connecting Rod Bushing Bore	0.045/100 mm
Permissible Deviation of Axial Paralleism of Connecting Rod Bearing Bore from Concentricity	0.01 mm
Permissible Difference of Each Connecting Rod in Weight	0.4 g

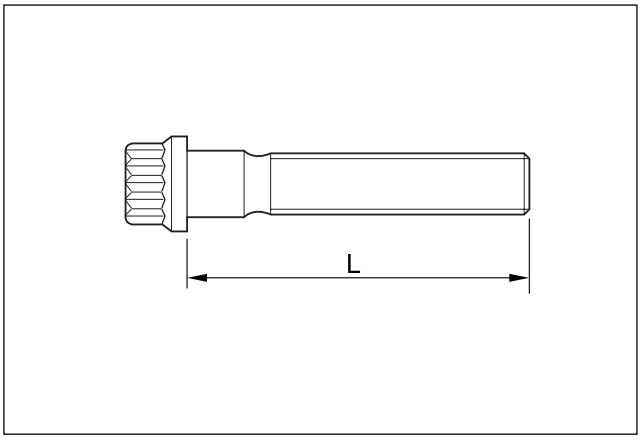


Inspection

1. Measure the basic bore of the connecting rod bearing.

NOTICE

- **If the basic bore exceeds the value of 51.614 mm, replace the bearing or check the connecting rod.**

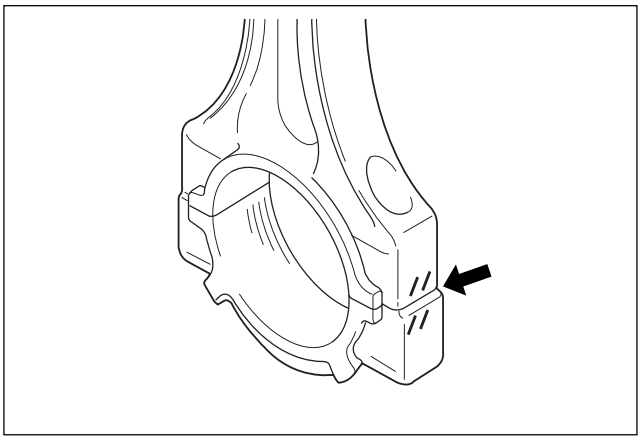


2. Check connecting rod bolts.

Length When New (L)	51.7 - 52 mm
Max. Length (L)	52.9 mm
Tightening Torque	1st step : 40 N•m (30 lb-ft)
	2nd step : 90°

NOTICE

- **If the length exceeds max. length, replace it.**



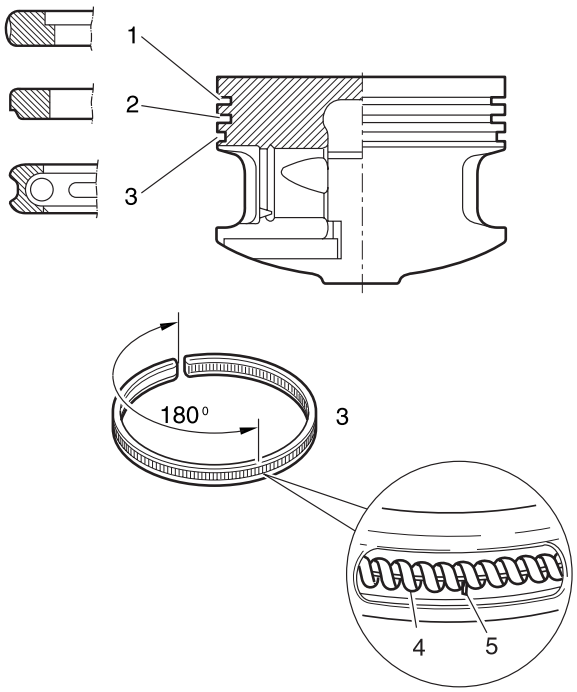
3. Check the assembly mark (indication//or number: arrow) of the connecting rods and the bearing cap when installing.

NOTICE

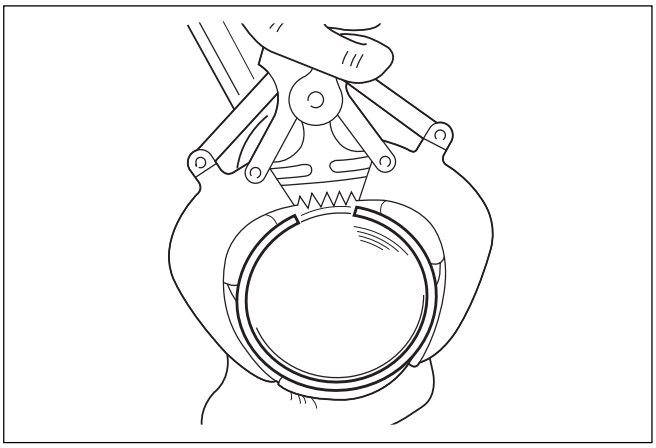
- **Make sure it doesn't exceed over 4g with other connecting rods when replacing the connecting rods.**
- **Check if the connecting rod and the bearing cap are accurately seated on the groove when replacing the bearing.**

▶ Piston Ring

※ **Preceding Work:** Removal of piston



1. Piston Compression Ring (Top Ring)
2. Piston Compression Ring (2nd Ring)
3. Piston Oil Ring
4. Spring
5. Spacer
6. SideRail



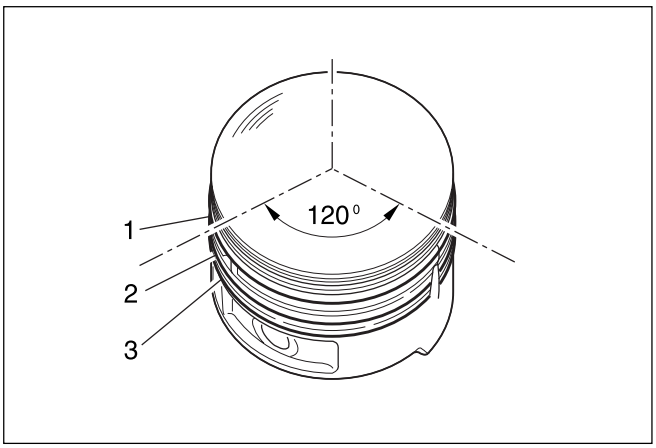
Replacement Procedure

1. Measure the piston ring's gap.

End Gap of the Piston Ring	Groove 1 0.20 - 0.40 mm
	Groove 2 0.20 - 0.40 mm
	Groove 3 0.20 - 0.45 mm
Gap Between the Piston and the Piston Ring	Groove 1 0.028 - 0.060 mm
	Groove 2 0.010 - 0.045 mm
	Groove 3 0.010 - 0.045 mm

NOTICE

- **If out of specification, replace the piston ring.**



2. Remove the piston ring with a pliers.
3. For installation, position the piston ring to be the 'TOP' mark on the piston ring upward and arrange the piston ring ends to be 120 ° part.
4. Adjust the hook spring joint in the oil ring 180 ° way from the ring end.

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AFFECTED VIN	

▶ Oil Pan





Oil pan assembly





Removal & Installation Procedure

1. Remove the drain plug and drain the oil completely.



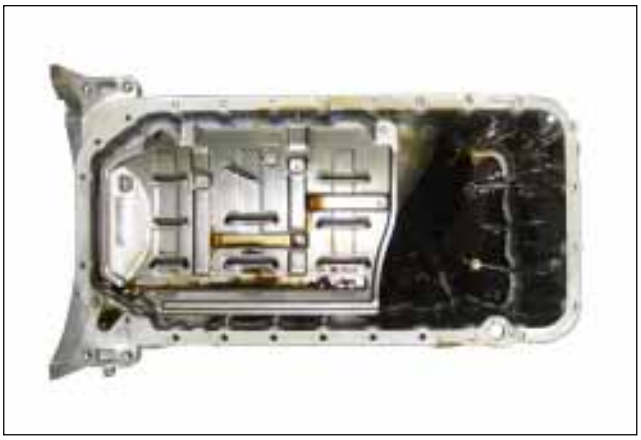
2. Unscrew the bolts and remove the oil pan and gasket.

NOTICE

- **Arrange the bolts according to each size.**

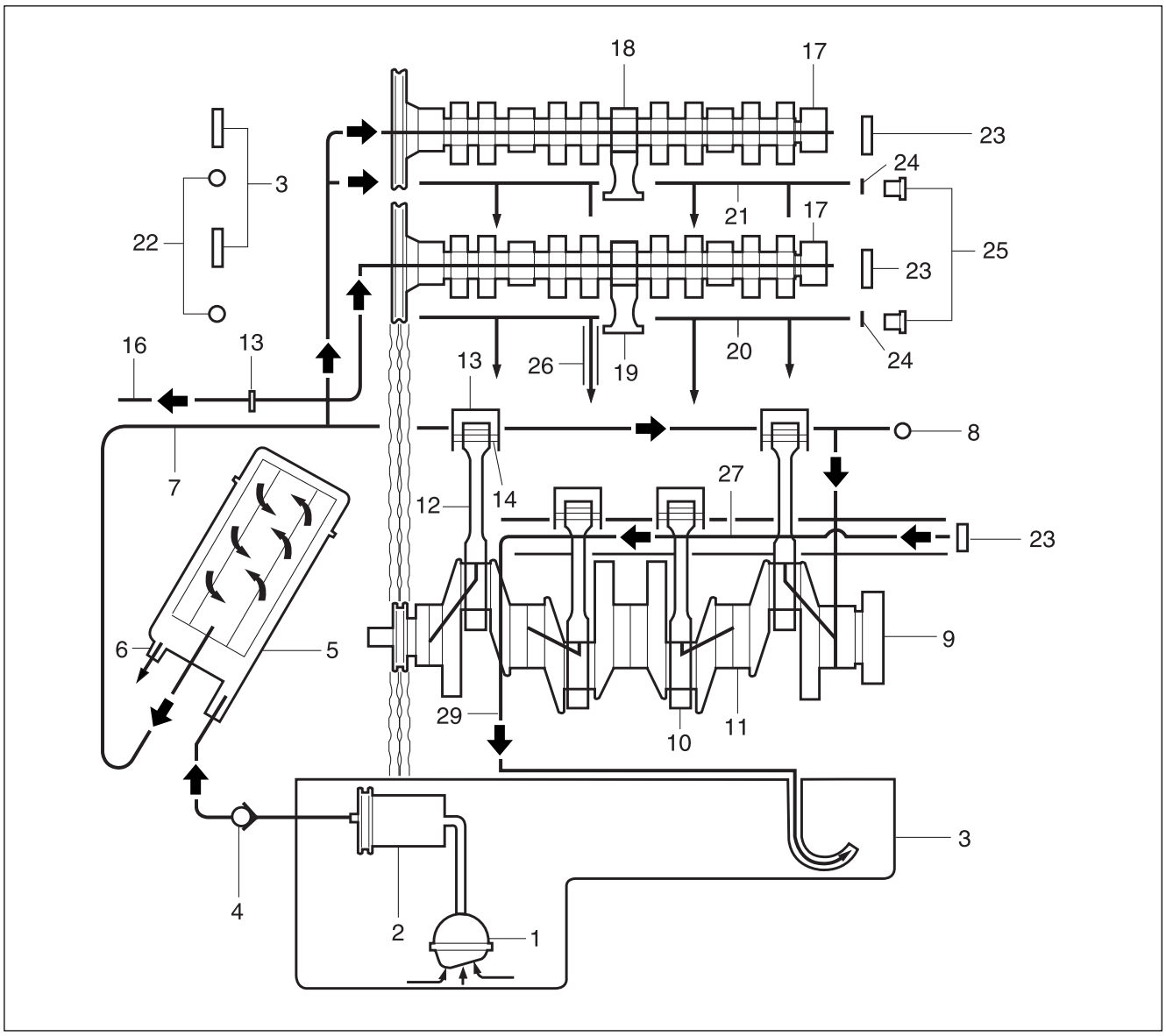


3. Clean the inside of oil pan and sealing surface, then apply the sealant.
4. Replace the gasket with new one.
5. Install the oil pan with gasket, and tighten each bolt in specified torque.



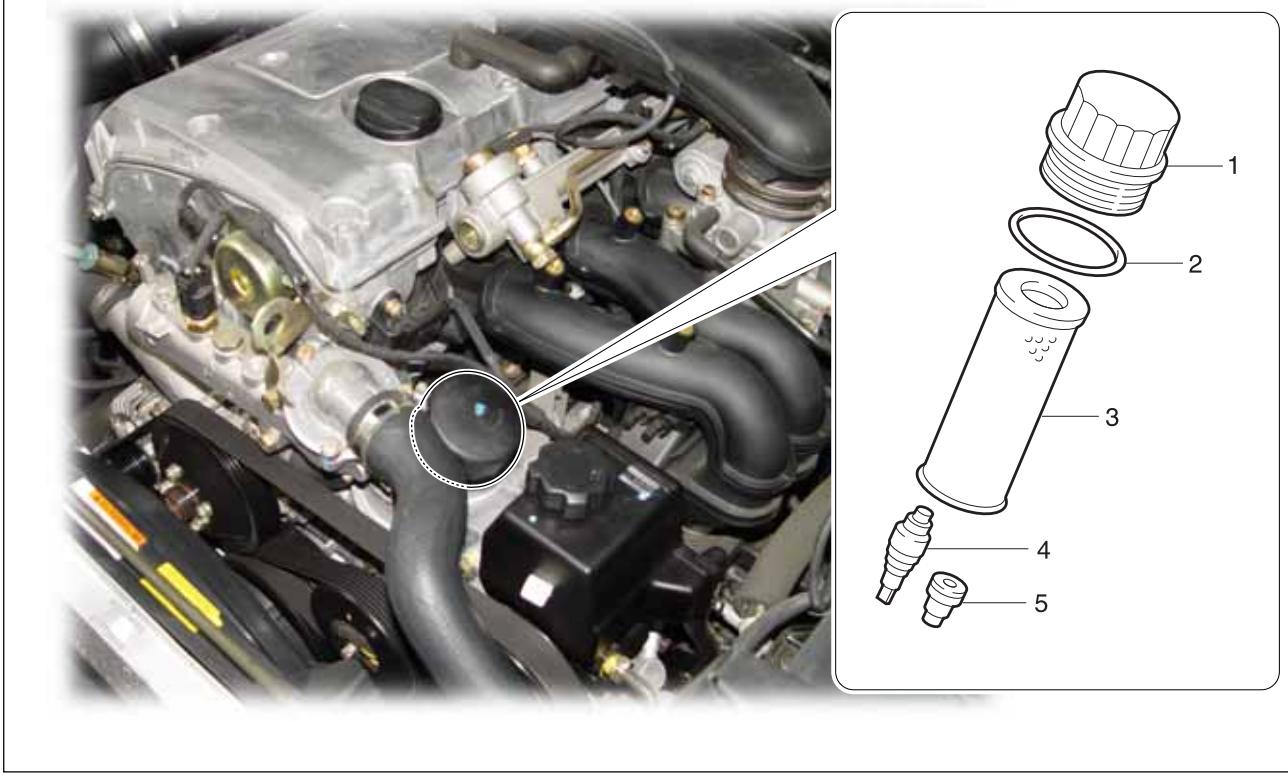
6. Check for oil leaks while running the engine.

▶ Oil Circulation



1. Oil Strainer
2. Oil Pump
3. Oil Pan
4. Oil Non-Return Valve
5. Oil Filter
6. Oil Filter Bypass Valve
7. Main Oil Gallery
8. Closing Ball (ϕ 15 mm)
9. Crankshaft
10. Connecting Rod Bearing
11. Crankshaft Bearing
12. Connecting Rod
13. Piston
14. Oil Spray (Piston Crown Area)
15. Non-Return Valve (Crankcase)
16. Oil Supply (To Chain Tensioner)
17. Camshaft
18. Cam Bearing
19. Valve
20. Oil Gallery (Supply Oil to Intake Tappet)
21. Oil Gallery (Supply Oil to Exhaust Tappet)
22. Ball (ϕ 8 mm)
23. Camshaft Plug
24. Seal
25. Screw Plug
26. Oil Return Gallery (Cylinder Head and Crankcase)
27. Oil Return Gallery (Crankcase)
28. End Cover (ϕ 20 mm)
29. Oil Return Pipe

▶ Engine Oil and Oil Filter Element



1. Oil Filter Cover 25 N•m (18 lb-ft)
2. O-Ring Replace
3. Oil Filter Element
4. Oil Drain Plug
5. Oil Filter Bypass Valve

Tools Required

A9910 0050A (103 589 02 09 00) Oil Filter Remover

Replacement Procedure

1. Install the oil filter remover A9910 0050A (103 589 02 09 00) on the oil filter cover.

NOTICE

- **Make the screw cover removable by tightening the bolt at the side of the oil filter remover 103 589 02 09 00.**

2. Install the wrench to the upper bolt in the oil filter remover A9910 0050A (103 589 02 09 00) and remove the oil cover by turning it.
3. Remove the oil filter element.

NOTICE

- **Work with a cloth under the vehicle when removing the oil filter element to not drain the oil.**



4. Remove the drain plug and drain the engine oil.

NOTICE

- **Leave the oil filler cap open to ease the engine oil discharge.**

5. Tighten the engine oil drain plug after cleaning it.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

Replace the seal washer with new one.

6. Replace the O-ring in the oil filter cover with new one.

NOTICE

- **Apply the engine oil to the O-ring.**

7. Insert new oil filter element into the oil filter housing.
8. Temporarily tighten the oil filter cover. Install the Oil filter remover A9910 0050A (103 589 02 09 00), and then completely tighten it.

Installation Notice

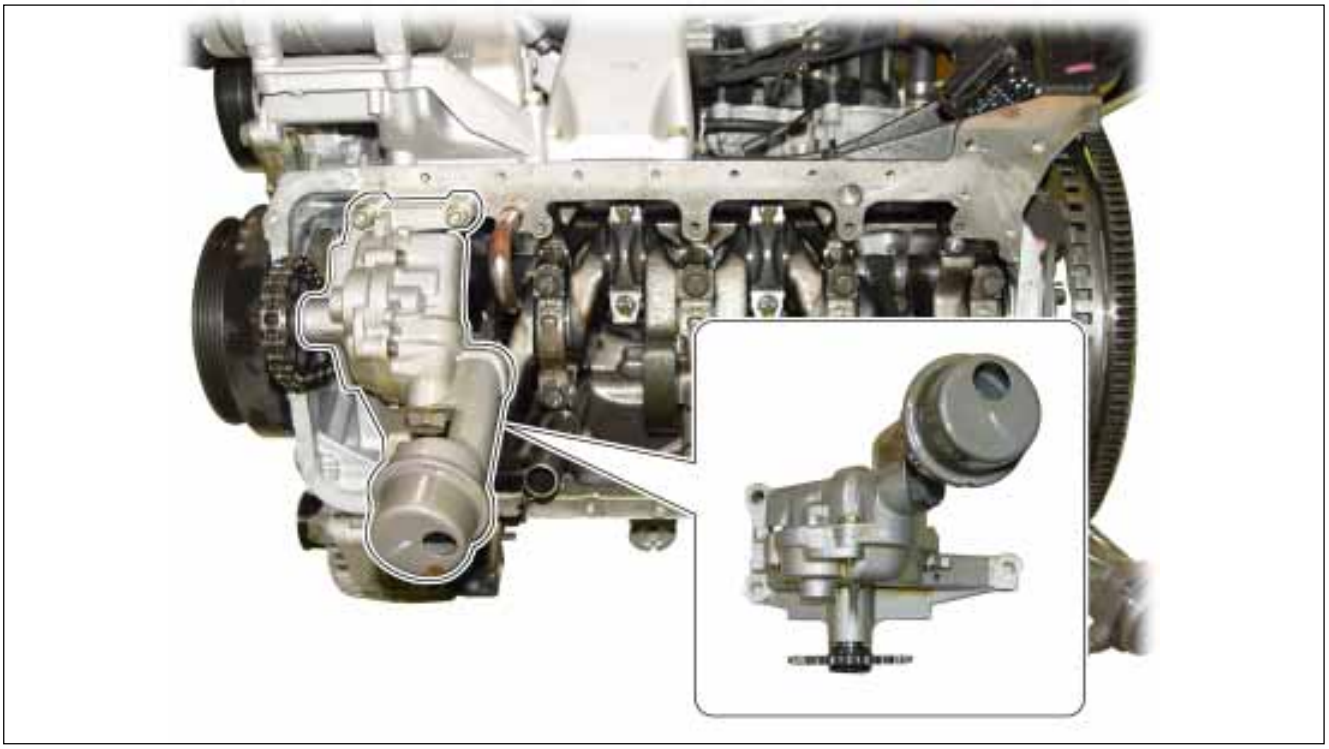
Tightening Torque	25 N•m (18 lb-ft)

9. Fill up engine oil through the engine oil filler opening (3).
10. Check for oil leaks at normal engine temperature after starting the engine.
11. Stop the engine and wait 5 minutes.

    Check the oil level and fill up as specified if necessary.

▶ Oil Pump

※ **Preceding Work:** Removal of oil pan





Removal & Installation Procedure

1. Unscrew the three bolt (1) and remove the oil pump.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)



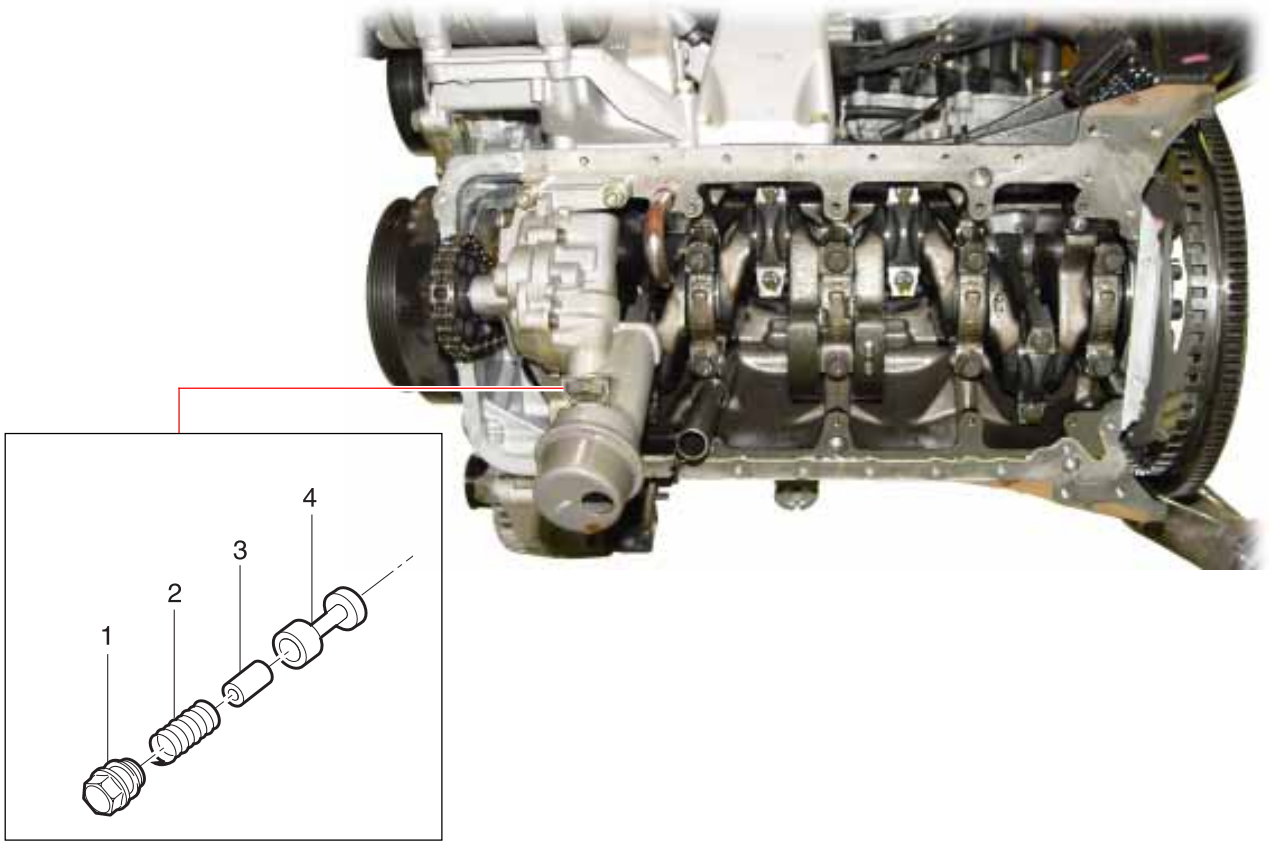
2. Remove the oil pump from the cylinder block.



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AFFECTED VIN	

▶ Oil Pressure Relief Valve

※ **Preceding Work:** Removal of oil pan



1. Screw Plug ..... 50 N•m (37 lb-ft)
2. Compression Spring
3. Guide Pin
4. Piston

Removal & Installation Procedure

1. Remove the screw plug (1).

Installation Notice

Tightening Torque	50 N•m (37 lb-ft)

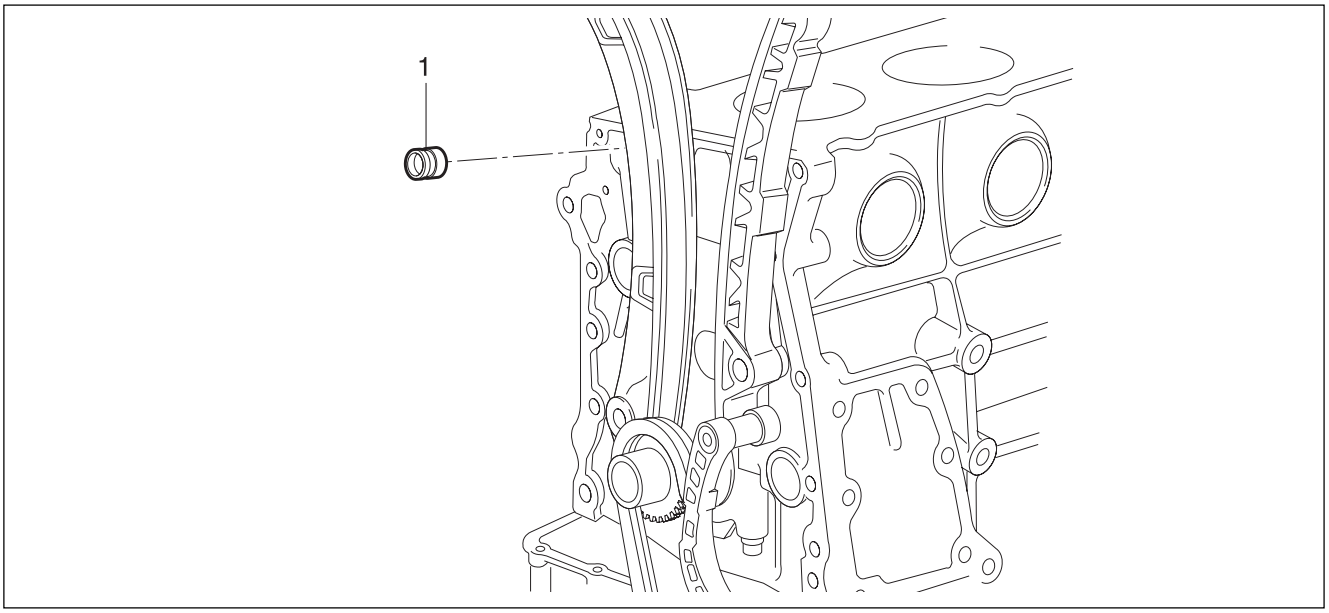
2. Remove the spring (2), guide pin (3) and the piston (4).
3. Installation should follow the removal procedure in the reverse order.

NOTICE

- **Don't use the seal for the screw plug.**

▶ Oil Non-Return Valve

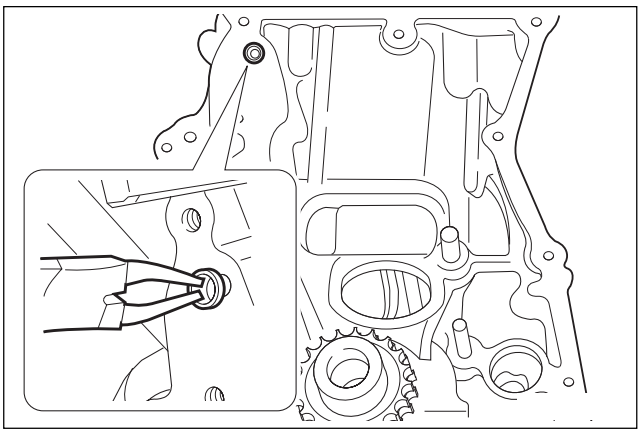
※ **Preceding Work:** Removal of timing gear case cover



1. Oil Non-return Valve

Functions

The non-return valve prevents the oil in the chain tensioner from drying up. In other words, it stops oil-returning in order to prevent the oil in the chain tensioner from getting dry. As a result, the chain tensioner can be activated with oil in itself.

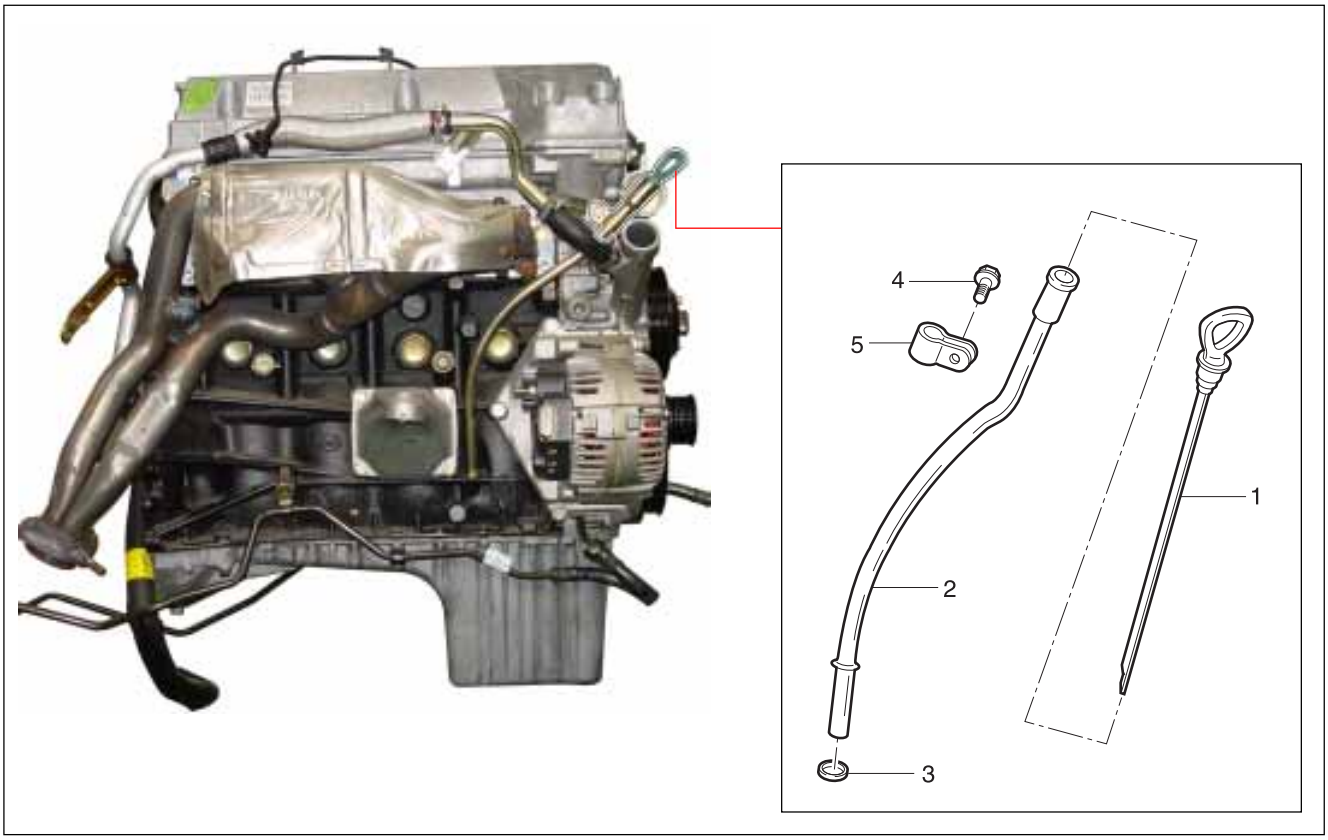


Replacement Procedure

1. Remove the non-return valve using a pliers.
2. Insert new non-return valve with hand.

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EFFECTIVE DATE	
AFFECTED VIN	

▶ Oil Dipstick Guide Tube



1. Oil Dipstick Level Gauge
2. Oil Dipstick Guide Tube
3. O-Ring
4. Bolt (M6 X 16, 1 piece)
   ..... 9 - 11 N•m (80 - 97 lb-in)
5. Clamp

Removal & Installation Procedure

1. Pull out the oil dipstick level gauge (1).
2. Unscrew the bolt (4) and remove the oil dipstick guide tube (2).

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)

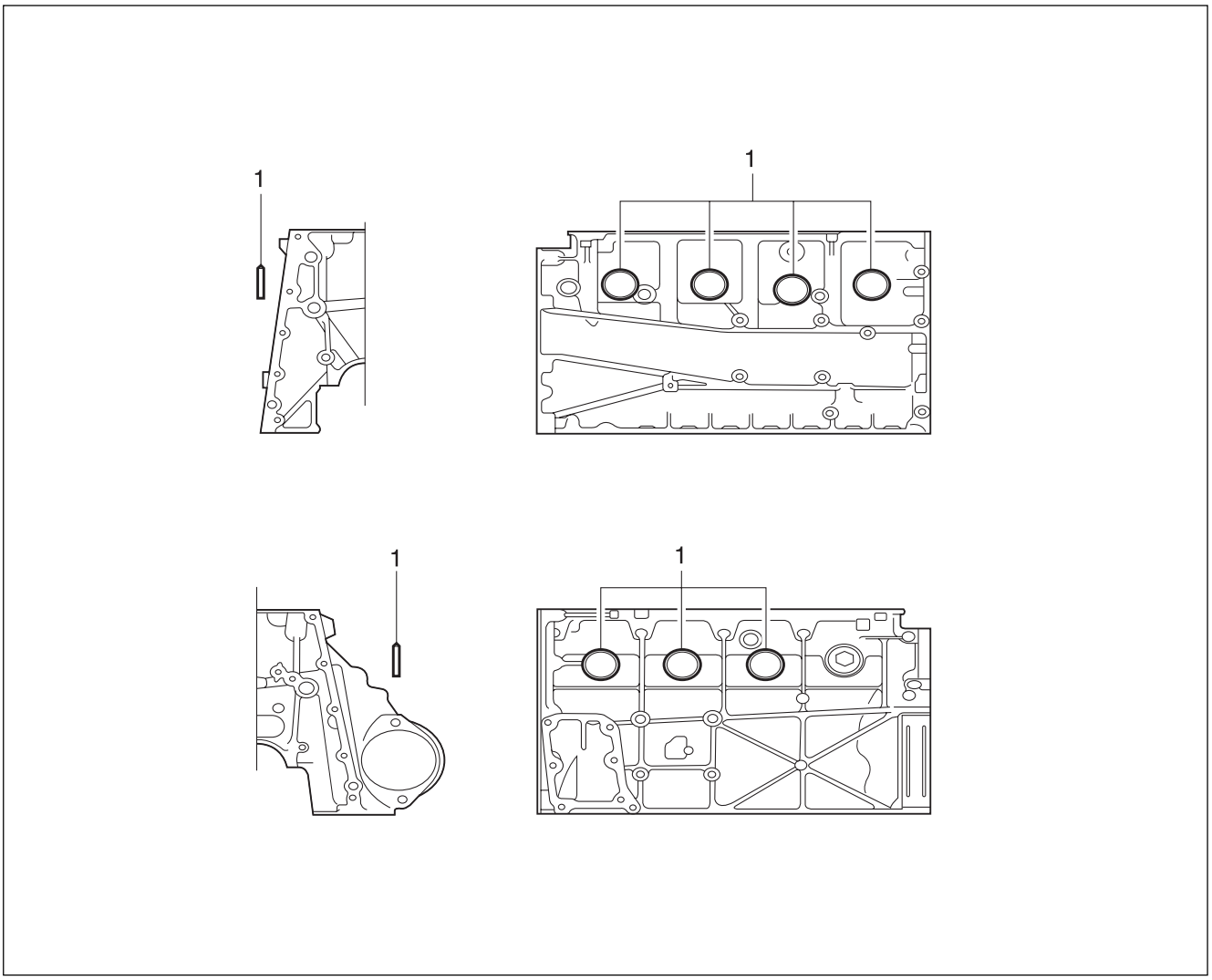
It is very hard to remove the oil dipstick guide tube without special tool. If it is not necessary, do not remove the guide tube.

3. Installation should follow the removal procedure in the reverse order.
4. Check for leaks by starting the engine.

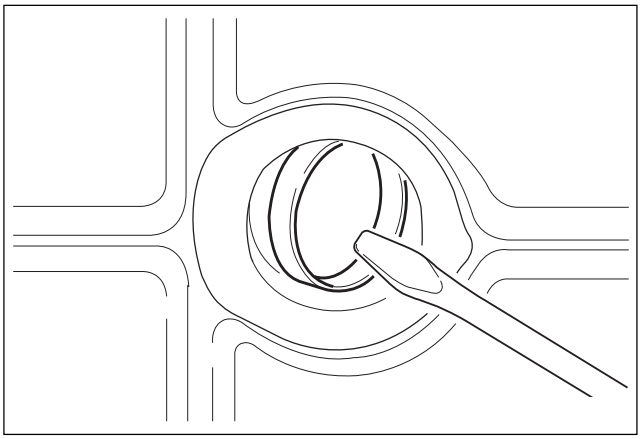
4. UNIT REPAIR

▶ Core Plugs in Crankcase

※ **Preceding Work:** Draining of the coolant



1. Core Plug ..... Replace

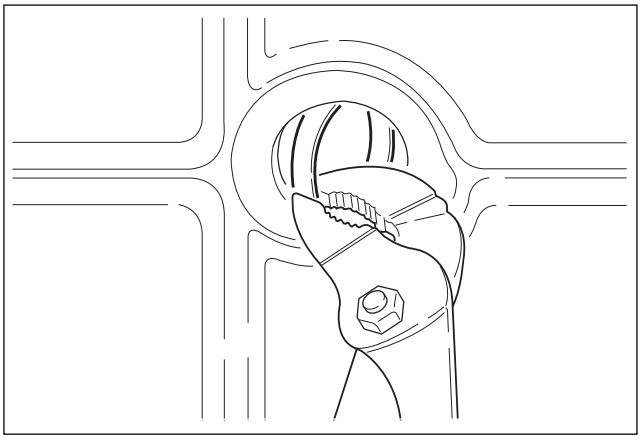


Tools Required

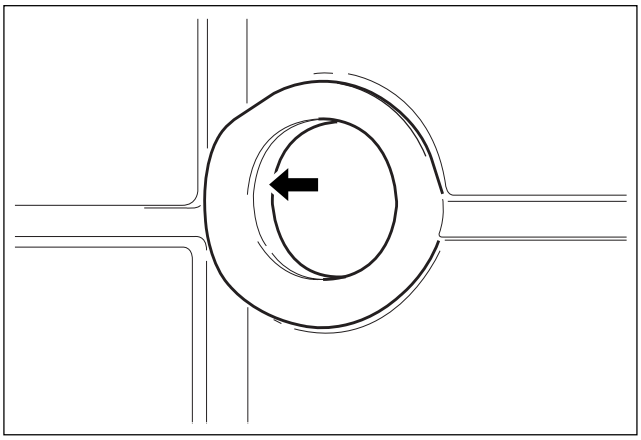
W9911 0010B (102 589 00 15 00) Drift

Replacement Procedure

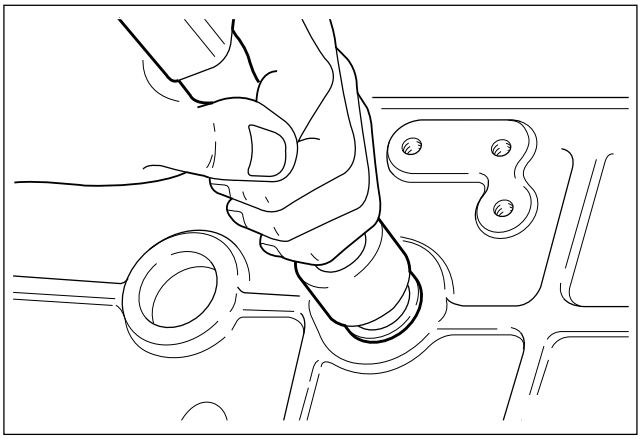
1. Remove the intake and exhaust manifolds.
2. Pull back the core plug until the end of one side comes out using the screw driver.



3. Pull out the plug carefully using a pliers.



4. Clean the sealing surface and apply Loctite 241.



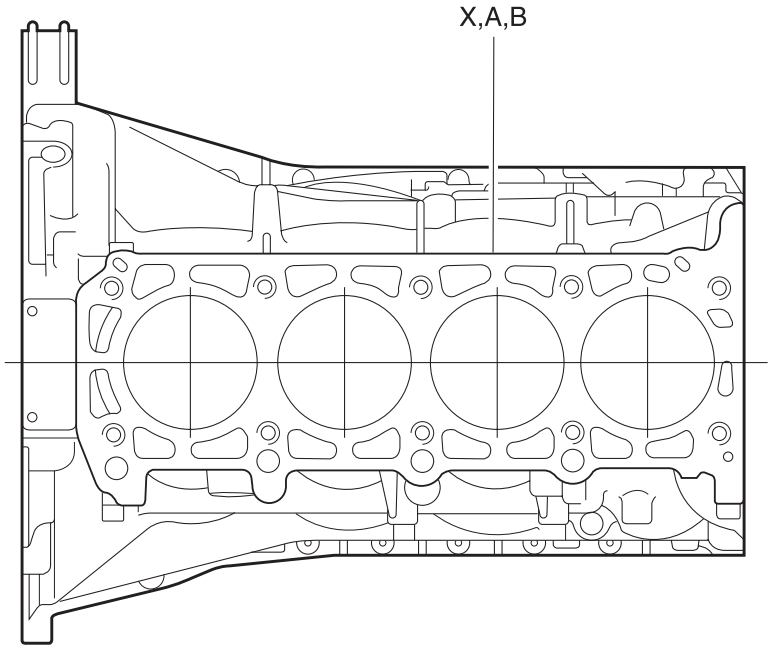
5. Press in new plug using a drift.

NOTICE

- **Wait for about 45 minutes before filling the coolant so that the Loctite 241 hardens.**

6. Warm up the engine and check the coolant for leaks.

▶ Cylinder Bore



Group Code Letter and Cylinder Bore Size

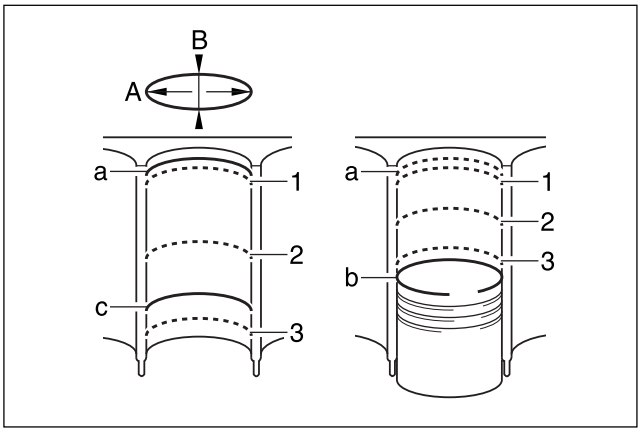
Engine	Group Code Letter of Cylinder	Piston Type to be Used	Cylinder Bore Size (mm)
G23D	A	A or X	ϕ90.906 - ϕ90.912
	X	A, X or B	ϕ90.906 - ϕ90.912
	B	X or B	ϕ90.912 - ϕ90.918
	X + 5	X + 5	ϕ90.950 - ϕ90.968
	X + 10	X + 10	ϕ91.000 - ϕ91.018

Group Code Letter Cylinder	Group Code Letter [1]	Cylinder Bore Size (mm)
Standard Size ϕ 90.9	A	ϕ89.900 - ϕ89.906
	X	ϕ89.906 - ϕ89.912
	B	ϕ89.912 - ϕ89.918
1st Repair Size (Standard Size + 0.25)	A	ϕ90.150 - ϕ90.156
	X	ϕ89.156 - ϕ90.162
	B	ϕ90.162 - ϕ90.168
2nd Repair Size (Standard Size + 0.5)	A	ϕ90.400 - ϕ90.406
	X	ϕ90.406 - ϕ90.412
	B	ϕ90.412 - ϕ90.418

1) The group code letters are carved on the surface of the piston crown and in the mating surface of the crankcase.

Service Data Standard

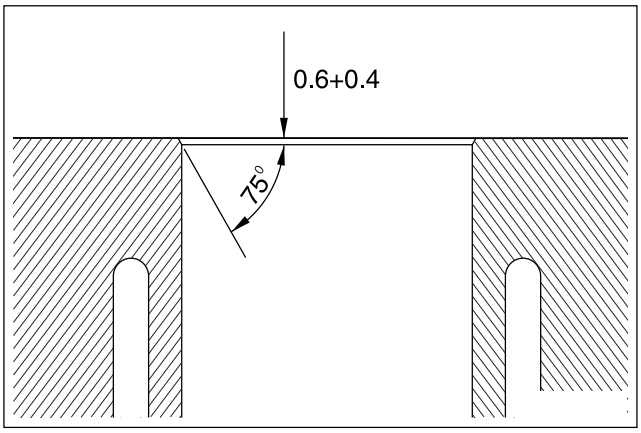
Wear Limit in Longitudinal and Transverse Direction		0.1 mm
Permissible Deviation of Cylinder Out-of-round	When new	0.007 mm
	Wear limit	0.05 mm
Permissible Deviation of Rectangular Cylinder Height (Except Chamfered Area)		0.05 mm
Basic Peak-to-valley Height After Final Honing and Brushing		0.003 - 0.006 mm
Chamfer Angle		75 °
Honing Angle		50 ° ± 10 °



Measurement of Cylinder Bore

1. Clean the cylinder wall.
2. Using a internal diameter gauge, measure the bore size in axial and transverse direction at three points (1,2,3).

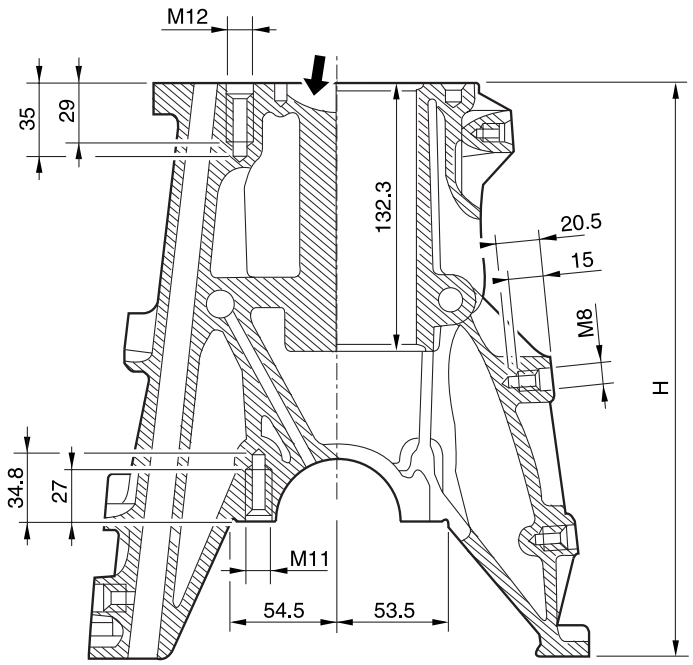
1, 2, 3 Measuring Points
A. Axial Direction
B. Transverse Direction
a. Location of the No.1 Piston Ring at TDC
b. Location of the Piston BDC
c. Location of the Oil Ring at BDC



Chamfer Angle

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AFFECTED VIN	

▶ Crankcase Mating Surface

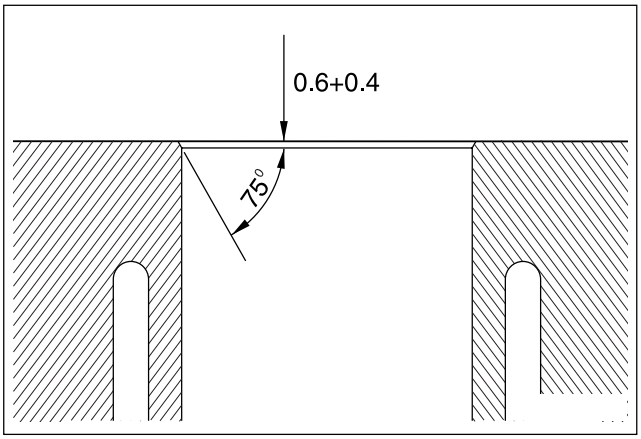


Service Data Standard

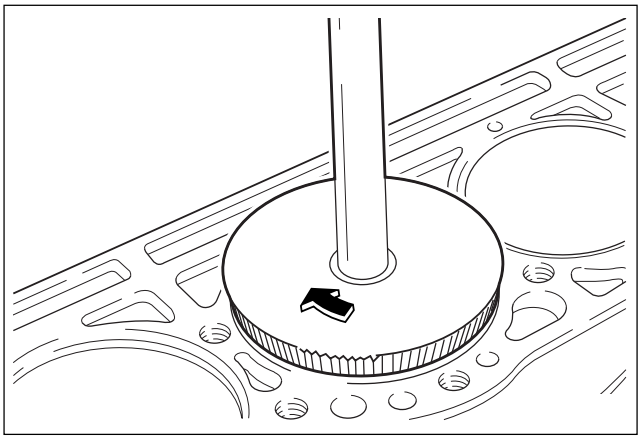
Height of The Crankcase 'H' (When new)		289.35 - 289.45 mm
Minimum Height After Milling		289.05 mm
Flatness	Crankcase Upper Mating Surface	0.03 mm
	Crankcase Lower Mating Surface	0.04 mm
Permissible Deviation of Parallelismof The Upper to Lower Mating Surface	Axial Direction	0.1 mm
	Transverse Direction	0.05 mm
Peak-to-valley Height	Crankcase Upper Mating Surface	0.012 - 0.009 mm
	Crankcase Lower Mating Surface	0.025 - 0.020 mm

Chamfering Procedure

1. Chamfer angle : 75 °



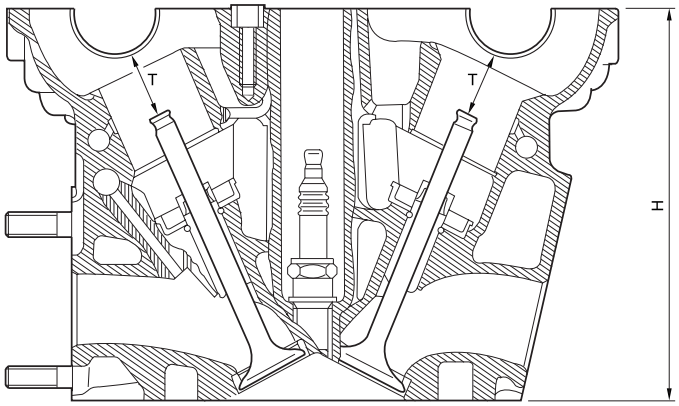
2. Polish the lower chamfered area evenly with a grinder after finishing the chamfering with a suitable tool (e.g., hand milling cutter).



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EFFECTIVE DATE	
AFFECTED VIN	

▶ Cylinder Head Mating Surface

※ **Preceding Work:** Removal of valves



Service Data Standard

Overall Height of Cylinder Head			135.9 - 136.0 mm
Minimum Height After Machining			135.5 mm
Flatness	Axial Direction		0.08 mm
	Transverse Direction		0.0 mm
Distance 'T' (Between Camshaft Bearing and Valve Stem)	Standard Size	Intake	24.21 - 24.75 mm
		Exhaust	22.21 - 22.75 mm
	Repair Size	Intake	23.96 - 24.51 mm
		Exhaust	21.96 - 22.51 mm

NOTICE

- **Do not exceed 0.4 mm for the milling of the mating surface of crankcase and cylinder head.**

Measurement of Mating Surfac

1. Measure the height (H) of the cylinder head (refer to Service data standard).
2. Check the mating surface of the cylinder head.
3. Mill the sharp edge of the combustion chamber.
4. Re-measure the height (H) of the cylinder head.
5. Seal the intake and exhaust valves.
6. Measure the dimension (T) between the camshaft bearing and the valve system *(refer to Service data standard).*
7. Mill the cylinder head valve seat *(refer to Service data standard).*

Universal Tool

Surface Grinding Machine	Sceledum, Type RTY Roaro Schio / Italy

5. SPECIFICATIONS

▶ Fastener Tightening Specifications

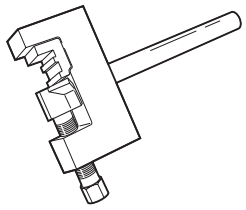
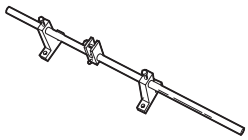
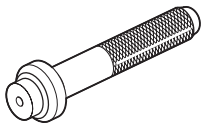
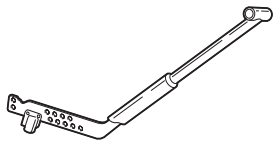
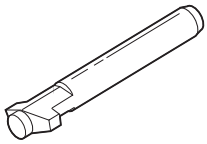
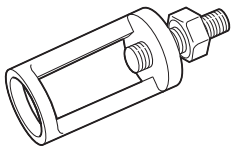
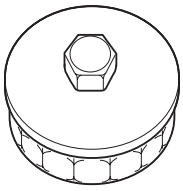
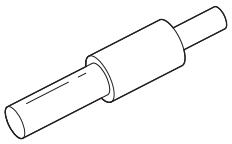
Application		N•m	Lb-Ft	Lb-In
Fuel Feed and Return Line		21 ~ 25	15 ~ 18	-
Exhaust Manifold and Pipe		30	22	-
Engine Mounting Nuts		70	52	-
Generator Carrier Bolts		25	18	-
Tensioning Pulley Bolt		40.5 ~ 49.5	29.9 ~ 36.5	-
Steering Pump Bolts		22.5 ~ 27.5	16.6 ~ 20.3	-
A/C Braket Bolts		22.5 ~ 27.5	16.6 ~ 20.3	-
Intake Air Duct Mounting Nuts		9 ~ 11	-	80 ~ 97
Spark Plug Cover Bolts		9 ~ 11	-	80 ~ 97
Cylinder Head Cover Bolts		9 ~ 11	-	80 ~ 97
Magnetic Assembly Bolt		9 ~ 11	-	80 ~ 97
Cylinder Head Front Cover Bolts	M8	22.5 ~ 27.5	16.6 ~ 20.3	-
	M6	9 ~ 11	-	80 ~ 97
Cylinder Head Bolts		55 +90° +90°	41 +90° +90°	- - 80 ~ 97
Timing Gear Case Cover Bolts		22.5 - 27.5	16.6 ~ 20.3	-
Crankshaft Sealing Rear Cover Mounting Bolts		9 ~ 11	-	-
Vibration Damper Center Bolts		200 + 20 +90° + 10°	148 + 15 +90° + 10°	- -
Flywheel Mounting Bolt		40 +90°	30 +90°	- -
Amarture Bolt in Flywheel		45 + 5	33 + 3.7	-
Camshaft Adjuster Flange Bolts		+90° + 10° 35	+90° + 10° 26	- -
Intake Flange Shaft Bolts		18 ~ 22 60° ± 5°	13 ~ 16 60° ± 5°	- -
Exhaust Camshaft Sprocket Bolts		18 ~ 22 60° ± 5°	13 ~ 16 60° ± 5°	- -
Intake Flange Shaft Bolts		18 ~ 22	13 ~ 16	-
Exhaust Camshaft Sprocket Bolts		60° ± 5°	60° ± 5°	-
Camshaft Bearing Cap Bolts		22.5 ~ 27.5	16.6 ~ 20.3	-
Chain Tensioner Screw Plug		40	30	-
Chain Tension Assembly		72 ~ 88	53 ~ 65	-
Oil Pump Sprocket Bolt		29 ~ 35	21 ~ 26	-
Tensioning Device Bolts		26 ~ 32	19 ~ 24	-
Water Pump Pulley		22.5 ~ 27.5	16.6 ~ 20.3	-
Upper Intake Manifold Bolt		22.5 ~ 27.5	16.6 ~ 20.3	-
Lower Intake Mainfold Bolt		22.5 ~ 27.5	16.6 ~ 20.3	-
Flange Bolt to Exhaust Mainfold		30	22	-

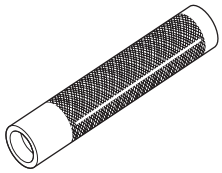
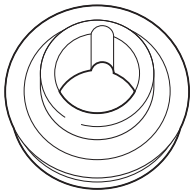
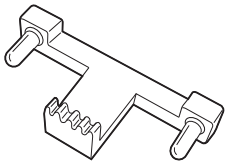
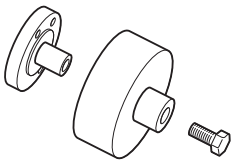
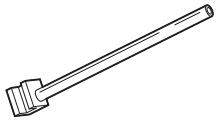
▶ Fastener Tightening Specifications (Cont'd)

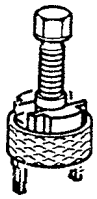
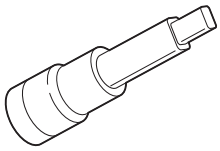
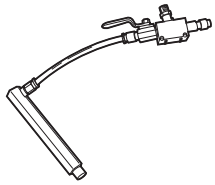
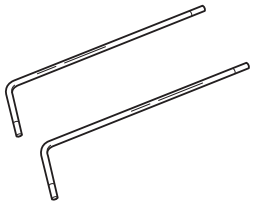
Application	N•m	Lb-Ft	Lb-In
Exhaust Mainfold Nut to Stud Bolt	26 ~ 34	19 ~ 25	-
Oil Drain Plug	25	18	-
Oil Filter Cover	25	18	-
Oil Filter Bolt	22.5 ~ 27.5	16.6 ~ 20.3	-
Oil Pump Drive Sprocket Bolt	29 ~ 35	21 ~ 26	-
Oil Pump Mounting Bolt	22.5 ~ 27.5	16.6 ~ 20.3	-
Oil Strainer Bracket Bolt	9 ~ 11	-	80 ~ 97
Oil Pressure Relief Valve Screw Plug	50	37	-
Oil Dipstick Guide Tube Bolt	9 ~ 11	-	80 ~ 97
Oil Gallery Screw Plug	15	11	-
Shock Absorber Bolts	22.5 ~ 27.5	16.6 ~ 20.3	-
Crankshaft Bearing Cap Bolts	55/+90°	41/+90°	-
Torque Converter Mounting Bracket Bolts	42	31	-

6. SPECIAL TOOLS AND EQUIPMENT

▶ Special Tools Table

Name and Part Number	Name and Part Number
A9913 0010B (000 589 58 43 00) Chain Assembly 	A9917 0101B (111 589 01 59 00) Supporting Bar 
W9911 0010B (102 589 00 15 00) Drift 	A9917 0111B (111 589 18 61 00) Lever Pusher 
A9911 0050B (102 589 12 15 00) Drift 	A9917 0121B (111 589 25 63 00) Thrust Piece 
A9910 0050A (103 589 02 09 00) Oil Filter Remover 	A9913 0061B (116 589 01 34 00) Threaded Pin 

Name and Part Number
A9917 0171B (119 589 00 43 00) Drift 
A9911 0060B (601 589 03 14 00) Crankshaft Front Seal Installer 
A9910 0150B (602 589 00 40 00) Engine Lock 
W9911 0020B (601 589 03 43 00) Crankshaft Rear Seal Installer 
A9910 0150A (603 589 00 40 00) Fan Clutch Holder 

Name and Part Number
W9911 0050B (615 589 01 33 00) Crankshaft Sprocket Puller 
A9912 0080B (617 589 00 10 00) Allen Wrench Socket 
A9911 0012B (DW110-090) Connecting Hose 
A9917 0012B (DW110-120) Holding Pin 

ENGINE COOLING

SECTION 1D

TABLE OF CONTENTS

1. Description and operation 2
2. DTC for PWM electric fan 5
3. Diagnostic information and procedure 6
4. Component locator 8
5. Repair instructions on-vehicle service 9
6. Specification 20
7. Special tools and equipment 22

NOTICE

- **Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.**

1. DESCRIPTION AND OPERATION

▶ General Description

The cooling system maintains the engine temperature at an efficient level during all engine operating conditions. When the engine is cold, the cooling system cools the engine slowly or not at all. This slow cooling of the engine allows the engine to warm up quickly.

The cooling system includes a radiator and recovery subsystem, cooling fans, a thermostat and housing, a water pump, and a water pump drive belt. The timing belt drives the water pump.

All components must function properly for the cooling system to operation. The water pump draws the coolant from the radiator. The coolant then circulates through water jackets in the engine block, the intake manifold, and the cylinder head. When the coolant reaches the operating temperature of the thermostat, the thermostat opens. The coolant then goes back to the radiator where it cools.

This system directs some coolant through the hoses to the heat core. This provides for heating and defrosting. The coolant reservoir is connected to the radiator to recover the coolant displaced by expansion from the high temperatures. The coolant reservoir maintains the correct coolant level.

The cooling system for this vehicle has no radiator cap or filler neck. The coolant is added to the cooling system through the coolant reservoir.

▶ Radiator

This vehicle has a lightweight tube-and-fin aluminum radiator. Plastic tanks are mounted on the upper and the lower sides of the radiator core.

On vehicles equipped with automatic transaxles, the transaxle fluid cooler lines run through the radiator tank. A radiator drain plug is on this radiator.

To drain the cooling system, open the drain plug.

▶ Coolant Reservoir

The coolant reservoir is a transparent plastic reservoir, similar to the windshield washer reservoir.

The coolant reservoir is connected to the radiator by a hose and to the engine cooling system by another hose. As the vehicle is driven, the engine coolant heats and expands. The portion of the engine coolant displaced by this expansion flows from the radiator and the engine into the coolant reservoir. The air trapped in the radiator and the engine is degassed into the coolant reservoir.

When the engine stops, the engine coolant cools and contracts. The displaced engine coolant is then drawn back into the radiator and the engine. This keeps the radiator filled with the coolant to the desired level at all times and increases the cooling efficiency.

Maintain the coolant level between the MIN and MAX marks on the coolant reservoir when the system is cold.

▶ Water Pump

The belt-driven centrifugal water pump consists of an impeller, a drive shaft, and a belt pulley.

The impeller is supported by a completely sealed bearing.

The water pump is serviced as an assembly and, therefore, cannot be disassembled.

▶ Thermostat

A wax pellet-type thermostat controls the flow of the engine coolant through the engine cooling system. The thermostat is mounted in the thermostat housing to the front of the cylinder head.

The thermostat stops the flow of the engine coolant from the engine to the radiator to provide faster warm-up, and to regulate the coolant temperature. The thermostat remains closed while the engine coolant is cold, preventing circulation of the engine coolant through the radiator. At this point, the engine coolant is allowed to circulate only throughout the heater core to warm it quickly and evenly.

As the engine warms, the thermostat opens. This allows the engine coolant to flow through the radiator where the heat is dissipated. This opening and closing of the thermostat permits enough engine coolant to enter the radiator to keep the engine within proper engine temperature operating limits.

The wax pellet in the thermostat is hermetically sealed in a metal case. The wax element of the thermostat expands when it is heated and contracts when it is cooled.

As the vehicle is driven and the engine warms, the engine coolant temperature increases. When the engine coolant reaches a specified temperature, the wax pellet element in the thermostat expands and exerts pressure against the metal case, forcing the valve open. This allows the engine coolant to flow through the engine cooling system and cool the engine.

As the wax pellet cools, the contraction allows a spring to close the valve.

The thermostat begins to open at 82 °C (180 °F) and is fully open at 95 °C (203 °F). The thermostat closes at 80 °C (176 °F).

▶ Electric Cooling Fan

NOTICE

- **Keep hands, tools, and clothing away from the engine cooling fans to help prevent personal injury. This fan is electric and can turn on even when the engine is not running.**

NOTICE

- **If a fan blade is bent or damaged in any way, no attempt should be made to repair or reuse the damaged part. A bent or damaged fan assembly should always be replaced with a new one to prevent possible injury.**

The cooling fans are mounted behind the radiator in the engine compartment. The electric cooling fans increase the flow of air across the radiator fins and across the condenser on air conditioned (A/C)-equipped vehicles.

This helps to speed cooling when the vehicle is at idle or moving at low speeds.

All models have two fans. The main fan is 320 mm (12.6 inches) in diameter with seven blades to aid the airflow through the radiator and the condenser. An electric motor attached to the radiator support drives the fan. The auxiliary fan is 320 mm (12.6 inches) in diameter.

A/C Off or Non-AC Model

- The cooling fans are actuated by the engine control module (ECM) using a low-speed cooling fan relay, a high-speed cooling fan relay and a cooling fan motor relay.
- The ECM will turn the cooling fans on at low speed when the coolant temperature reaches 95 °C (203 °F) and at high speed when the coolant temperature reaches 105 °C (221 °F).
- The ECM will change the cooling fans from high peed to low speed at 100 °C (212 °F) and will turn the cooling fans off at 90 °C (194 °F).

A/C On

- The ECM will turn the cooling fans on at low speed when the A/C system is on. The ECM will change to high speed when the high side A/C pressure reaches 1860 kPa (269.8 psi).
- The cooling fans will return to low speed when the high side A/C pressure reaches 1378 kPa (199.8 psi).

▶ Engine Coolant Temperature Sensor

The Engine Coolant Temperature (ECT) sensor uses a temperature to control the signal voltage to the Engine Control Module (ECM).

▶ Coolant Temperature Gauge

The coolant temperature gauge controls the instrument panel temperature indicator. The coolant temperature gauge is located with ECT sensor.

▶ PWM Electric Fan



Advantages and Disadvantages of the PWM Electric Fan

Advantages:

- Enhanced A/C performance: at low speed, at idling, driving in city
- Reduction of vibration/noise: fan activated by PWM only when necessary
- Reduction of engine consuming power (V/Fan driving force) by 4 Hp
- Cost saving

Disadvantage:

- Poor engine cooling perfomance at low and high rpm

▶ PWM (Pulse Width Modulation) Unit



It controls the time of the output voltage to control the fan motor speed independently.

Internal functions:

- Motor power shutting-off function when overcurrent is applied
- Adverse voltage prevention function
- Detection function for the motor lock
- Temperature detecting function: The electric fan operates at FULL speed to cool down the PWM unit when the interior temperature of PWM unit is over 120~150°C.
- Communication function when failing: The fail signal is transmitted to the ECU when the PWM unit is malfunctioning.
- Soft start function: The motor speed is gradually increased when the motor is initially operated.

▶ Shutting-off Condition of the A/C Compressor

Coolant temperature:

- When coolant temperature is below 20°C or over 115°C, engine speed is below 650 rpm or over 4500 rpm for 4 seconds after engine starting, abrupt acceleration and A/C refrigerant pressure sensor detecting the followings
- A/C compressor is turned off when the refrigerant pressure is below 2.0 kg/cm^2 and then is turned on when the refrigerant pressure is over 2.4 kg/cm^2.
- A/C compressor is turned off when the refrigerant pressure is over 30 kg/cm^2 and then is turned on when the refrigerant pressure is below 21.4 kg/cm^2.

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AFFECTED VIN	

2. DTC FOR PWM ELECTRIC FAN

Related item	DTC	Trouble	Help	Engine CHECK warning lamp
Cooling fan system (PWM electric fan)	P0480	PWM electric fan - Short circuit to power supply	Condition - The cooling fan's output wiring has a short circuit to power supply. Actions 1.Inspect the circuit and the terminal of No. 39 ECU pin. 2.Inspect the power supply. 3.Inspect the cooling fan. 4.Check the ECU.	
		PWM electric fan - Open/ Short circuit to ground	Condition - The cooling fan's output wiring has a short circuit to power supply. Actions 1.Inspect the circuit and the terminal of No. 39 ECU pin. 2.Inspect the power supply. 3.Inspect the cooling fan. 4.Check the ECU.	
	P0483	PWM electric fan - Motor overloaded	Condition - The cooling fan's output wiring has a short circuit to power supply. Actions 1.Inspect the circuit and the terminal of No. 39 ECU pin. 2.Inspect the power supply. 3.Inspect the cooling fan. 4.Check the ECU.	
	P0484	PWM electric fan - Motor stalled	Condition - The cooling fan's output wiring has a short circuit to power supply. Actions 1.Inspect the circuit and the terminal of No. 39 ECU pin. 2.Inspect the power supply. 3.Inspect the cooling fan. 4.Check the ECU.	
	P0485	PWM electric fan - Short circuit	Condition - The cooling fan's output wiring has a short circuit to power supply. Actions 1.Inspect the circuit and the terminal of No. 39 ECU pin. 2.Inspect the power supply. 3.Inspect the cooling fan. 4.Check the ECU.	

3. DIAGNOSTIC INFORMATION AND PROCEDURE

▶ Cooling System Diagnosis

Engine Overheats

Checks	Action
Check for a loss of the coolant	Add the coolant.
Check for a weak coolant solution.	Confirm that the coolant solution is a 50/50 mixture of ethylene glycol and water.
Check the front of the radiator for any dirt, any leaves, or any insects.	Clean the front of the radiator.
Check for leakage from the hoses, the water pump, the	Replace any damaged components.
heater, the thermostat housing, the radiator, the core	
plugs, or the head gasket.	
Check for a faulty thermostat.	Replace a damaged thermostat.
Check for retarded ignition timing.	Perform an ECM code diagnosis. Confirm the integrity of the timing chain.
Check for an improperly operating electric cooling fan.	Replace the electric cooling fan.
Check for radiator hoses that are plugged or rotted.	Replace any damaged radiator hoses.
Check for a faulty water pump.	Replace a faulty water pump.
Check for a faulty coolant reservoir cap.	Replace a faulty coolant reservoir cap.
Check for a cylinder head or an engine block that is cracked or plugged.	Repair the damaged cylinder head or the damage engine block.

Loss of Coolant

Checks	Action
Check for a leak in the radiator.	Replace a damaged radiator.
Check for a leak in the following locations: • Coolant reservoir. • Hose.	Replace the following parts, as needed. • Coolant reservoir. • Hose.
Check for loose or damaged radiator hoses, heater hoses, and connections.	Reseat the hoses. Replace the hoses or the clamps.
Check for leaks in the water pump seal.	Replace the water pump seal.
Check for leaks in the water pump gasket.	Replace the water pump gasket.
Check for an improper cylinder head torque.	Tighten the cylinder head bolts to specifications. Replace the cylinder head gasket, if needed.
Check for leaks in the following locations: • Intake manifold. • Cylinder head gasket. • Cylinder block plug. • Heater core. • Radiator drain plug.	Repair or replace any components, as needed, to correct the leak.

Engine Fails to Reach Normal Operating Temperature or Cool Air from the Heater

Checks	Action
Check to determine if the thermostat is stuck open or is the wrong type of thermostat.	Install a new thermostat of the correct type and heat range.
Check the coolant level to determine if it is below the LOW mark on the coolant reservoir.	Add sufficient coolant to raise the fluid to the specified mark on the coolant reservoir.

▶ System Leakage Test



Tools Required

A9921 0012A (124 589 15 21 00) Leakage Tester

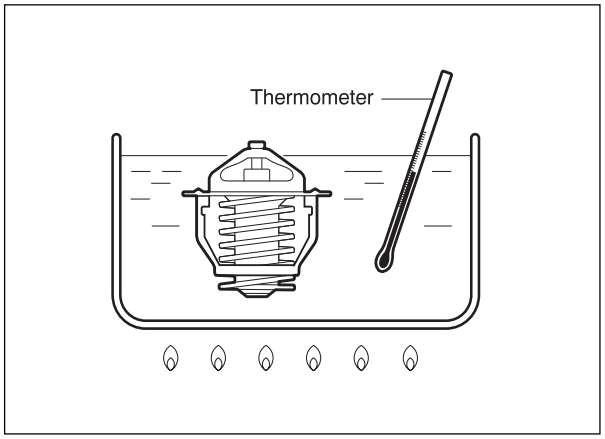
Test Procedure

1. Loosen the cap a little and release pressure and remove the cap.

> **NOTICE**
> - **For the risk of scalding, cap must not be opened unless the coolant temperature is below 90 °C (194 °F).**

2. Fill coolant up to upper edge (arrow) of reservoir.
3. Connect the leakage tester A9921 0012A (124 589 15 21 00) to the reservoir filler cap and apply 1.4 bar of pressure.
4. If the pressure on the tester drops, check leakage at the all coolant hoses and pipes and each connections. Replace or retighten if necessary.

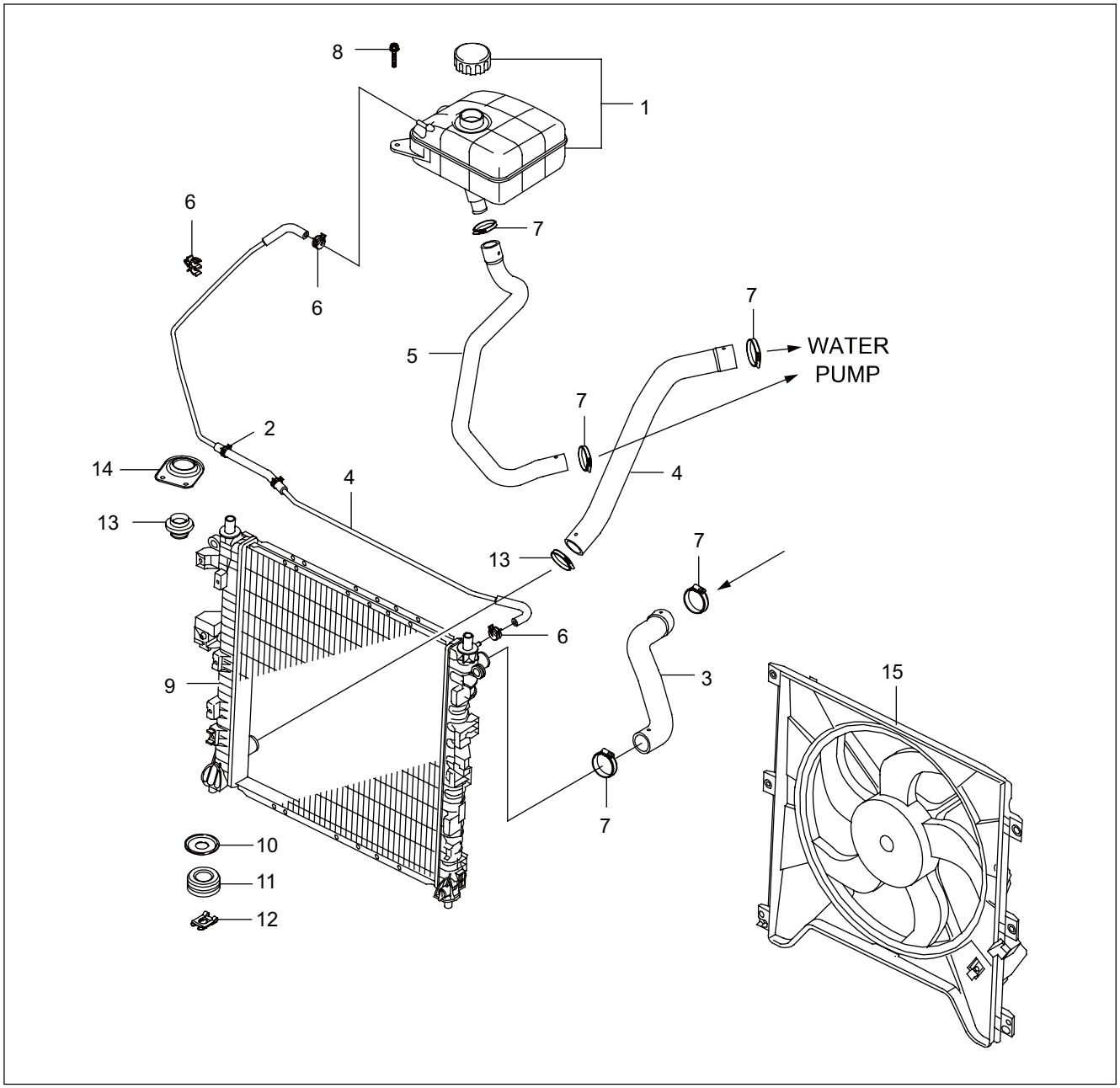
▶ Thermostat Test



Test Procedure

1. Remove the thermostat from the vehicle. Refer to “Thermostat” in this section.
2. Make sure the valve spring is tight when the thermostat is closed. If the spring is not tight, replace the thermostat.
3. Suspend the thermostat and a thermometer in a pan of 50/50 mixture of ethylene glycol and water. Do not let the thermostat or the thermometer rest on the bottom of the pan. The uneven concentration of heat on the bottom could result in inaccurate temperature measurements.
4. Heat the pan on a burner.
5. Use the thermometer to measure the temperature of the heated solution.
6. The thermostat should begin to open at 82°C (180°F) and it should be fully be fully open at 95°C (203°F). If it does not open at these temperatures, replace the thermostat.

4. COMPONENT LOCATOR



1. Reserver Tank
2. Deaeration Tube
3. Inlet Hose
4. Outlet Hose
5. 3 way Hose
6. Clamp
7. Clamp
8. Bolt (M6, 2 piece)
9. Radiator
10. Lower Radiator Insulator
11. Plate
12. Clip
13. Upper Radiator Insulator
14. Bracket
15. PWM Electric Fan

5. REPAIR INSTRUCTIONS ON-VEHICLE SERVICE

▶ Coolant Drain and Fill Up

Draining & Filling up Procedure

1. Loosen the cap a little and release pressure and remove the cap.

> **NOTICE**
> - **For the risk of scalding, the cap must not be opened unless the coolant temperature is below 90 °C (194 °F).**



2. Loosen the radiator lower drain cock and drain the coolant.

> **NOTICE**
> - **Collect coolant by using a proper container.**



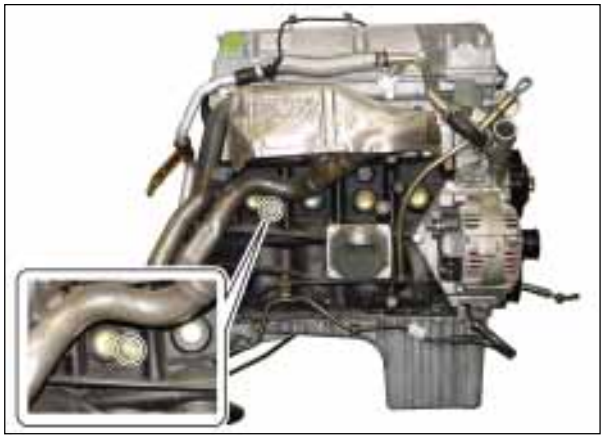
3. Drain the coolant from the crankcase by inserting a hose (dia. 14 mm) onto the drain bolt on the side of crankcase (exhaust manifold) and by loosening the plug.

> **NOTICE**
> - **Just loosen the drain plug to drain the coolant and do not remove the plug completely.**
> - **Collect coolant by using proper container.**

4. After complete draining of the coolant, remove the hose connector to drain plug and reinstall the drain plug.

Installation Notice

Tightening torque	30 Nm (22 lb-ft)



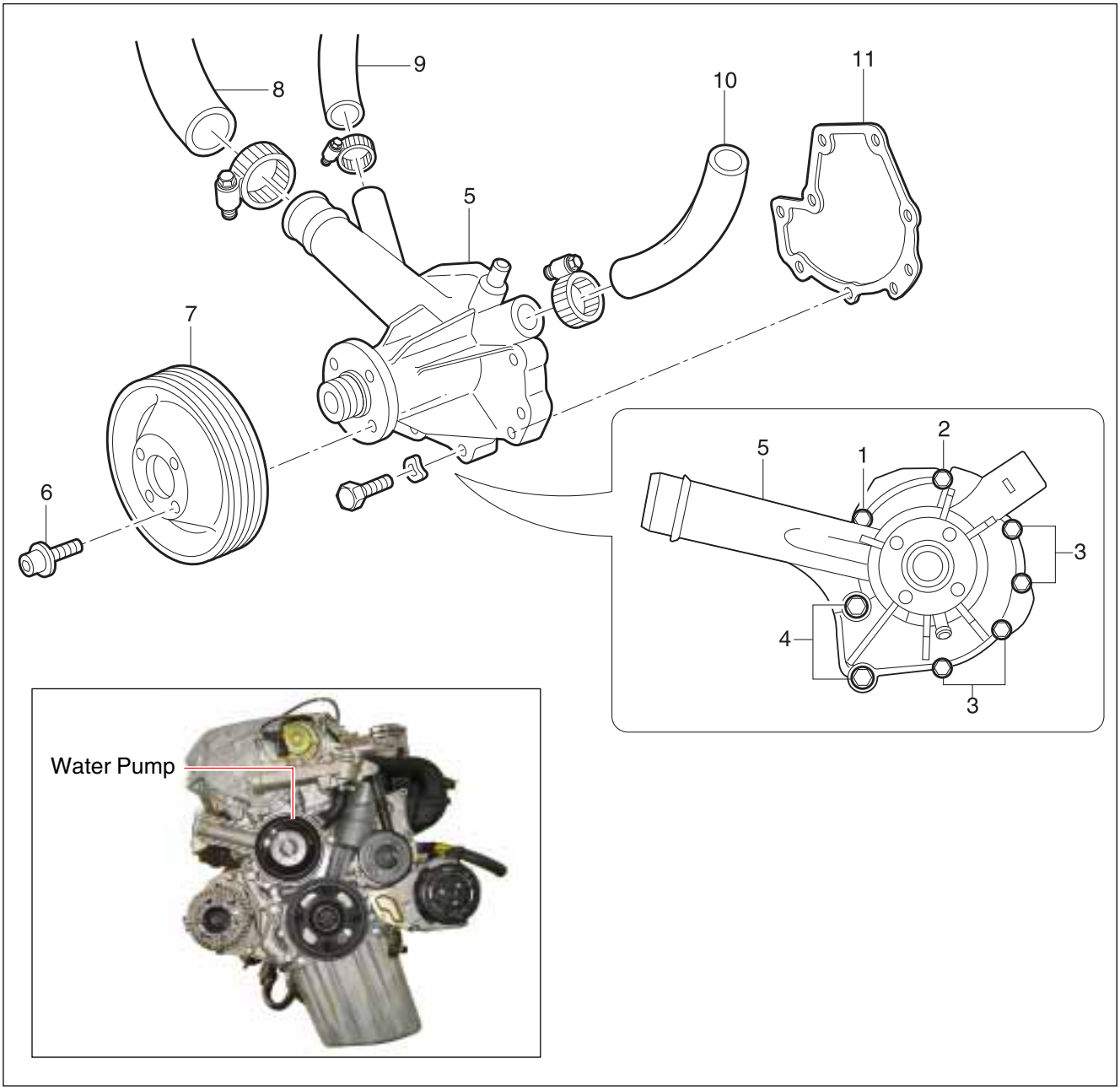
5. Tighten the radiator lower drain cock.
6. Remove the de-aeration hose clamp in the coolant pump and remove the de-aeration hose.
7. Fill up the coolant through the coolant reservoir tank.

> **NOTICE**
> - **Match the anti-freeze and the water ratio to 50 : 50.**
> - **Supplement the coolant until the coolant overflows to the de-aeration hose.**

8. Insert the de-aeration hose and completely tighten the clamp.
9. Check the coolant level in the coolant reservoir tank.
10. Warm up (until thermostat is opened) the engine and recheck the coolant level in the reservoir tank and fill up the coolant if necessary.

▶ Water Pump

※ **Preceding Works:** Removal of viscous clutch



1. Bolt (M6 X 45, 1 pieces) ..... 9 - 11 Nm (80 - 97 lb-in)
2. Bolt (M6 X 95, 1 pieces) ..... 9 - 11 Nm (80 - 97 lb-in)
3. Bolt (M6 X 25, 4 pieces) ..... 9 - 11 Nm (80 - 97 lb-in)
4. Bolt (M6 X 85, 2 pieces) ..... 22.5 - 27.5 Nm (16.6 - 20.3 lb-ft)
5. Water Pump Housing
6. Bolt (M6 X 16, 4 pieces) ..... 9 - 11 Nm (80 - 97 lb-in)
7. Water Pump Pulley
8. Coolant Inlet Hose
9. Heater Hose
10. Coolant Bypass Hose
11. Gasket

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AFFECTED VIN	

Tools Required

A9910 0150A (603 589 00 40 00) Fan Clutch Holder

Removal & Installation Procedure

1. Drain the coolant.
2. Disconnect the coolant hoses (8, 9, 10).
3. Tak off the drive belt.
4. Unscrew the four bolts (6) from water pump pulley and remove the pulley (7).

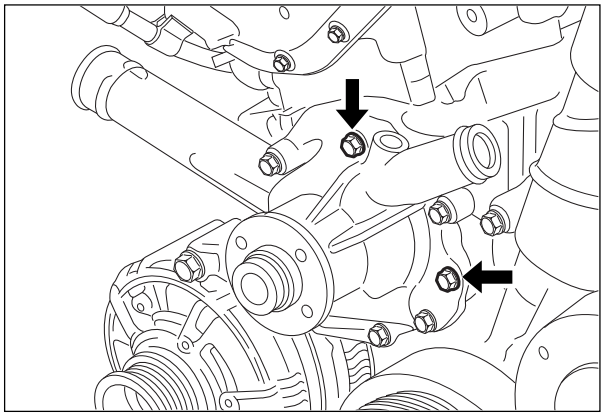


Installation Notice

Tightening torque	9 - 11 Nm (80 - 97 lb-in)

Hold the pulley with fan clutch holder A9910 0150A (603 589 00 40 00) while removing the pulley.

5. Unscrew the bolts (1, 2, 3, 4) from water pump housing (5) and remove the water pump.



Installation Notice

Tightening torque	(1, 2, 3)	9 - 11 Nm (80 - 97 lb-in)
	(4)	22.5 - 27.5 Nm (16.6 - 20.3 lb-ft)

6. Clean the sealing surface.
7. Replace the gasket with new one.

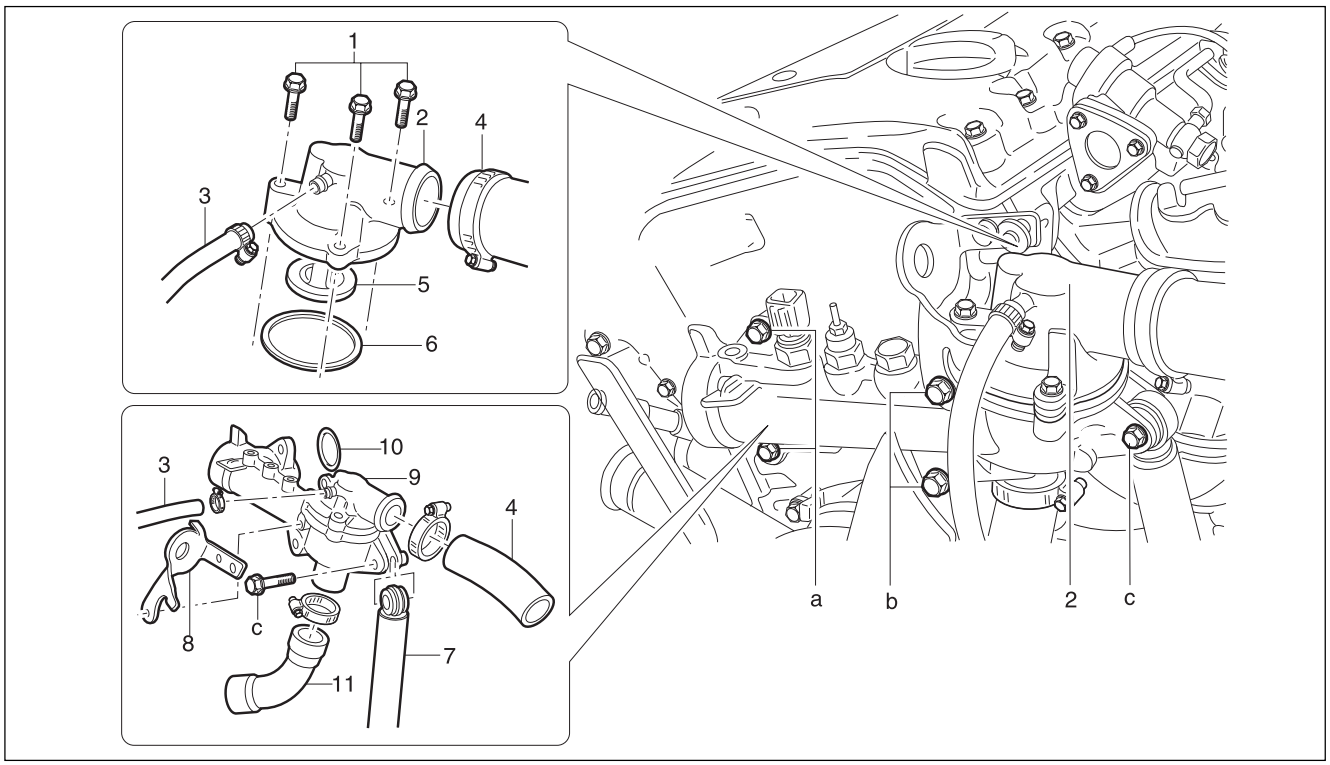
NOTICE

- **Apply the sealant when the sealing surface of water pump housing and coolant mounting area is clean.**

8. Installation should follow the removal procedure in the reverse order.
9. Check for leaks by starting the engine.

▶ Thermostat and Thermostat Housing Assembly

※ **Preceding Works:** Removal of viscous clutch



1. Bolt (M6 X 25, 3 pieces)
   ..... 9 - 11 Nm (80-97 lb-in)
2. Thermostat Cover
3. De-aeration Hose
4. Coolant Outlet Hose
5. Thermostat
6. O-ring
7. Tensioning Device Shock Absorber
   ..... 22.5 - 27.5 Nm (16.6-20.3 lb-in)
8. Engine Hanger Bracket
9. Thermostat Housing Assembly
10. O-ring
11. Coolant Bypass Hose

a. Bolt (M6 X 95, 2 pieces)
   ..... 9 -11 Nm (80 - 97 lb-in)
b. Bolt (M8 X 75, 2 pieces)
   .....22.5 - 27.5 Nm (16.6 - 20.3 lb-ft)
c. Bolt (M8 X 35, 1 piece)
   .....22.5 - 27.5 Nm (16.6 - 20.3 lb-ft)

Removal & Installation Procedure

1. Drain the coolant.
2. Remove the de-aeration hose (3), coolant outlet hose (4) and coolant bypass hose (11).
3. Disconnect the engine coolant temperature sensor connector and coolant temperature gauge connector.
4. Unscrew the three bolts (1) and remove the thermostat cover assembly from thermostat housing.

   Do not separate the thermostat cover and thermostat.
5. Replace the O-ring if necessary.
6. Unscrew the bolt (c) and pry off the tensioning device shock absorber (7).
7. Unscrew the bolts (a, b) and remove the engine hanger bracket and thermostat housing.
8. Replace the O-ring with new one.
9. Installation should follow the removal procedure in the reverse order.
10. Check for leaks in cooling system.

▶ PWM (Pulse Width Modulation) Electric Fan

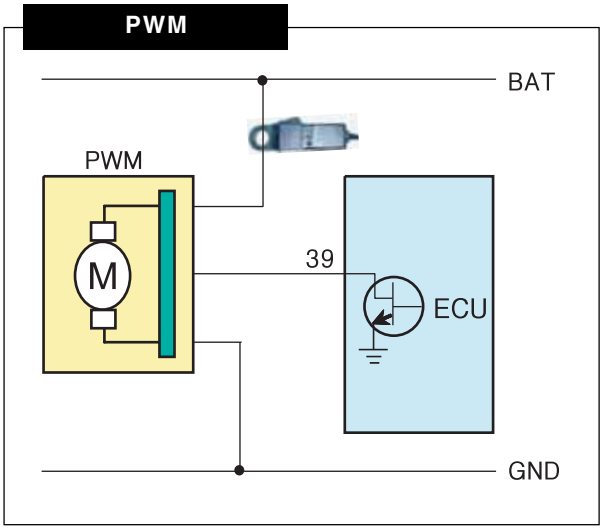
Function

The PWM (Pulse Width Modulation) high capacity electric fan is installed instead of electric condenser fan to enhance the durability and controllability and reduce noise.

Mounting Location





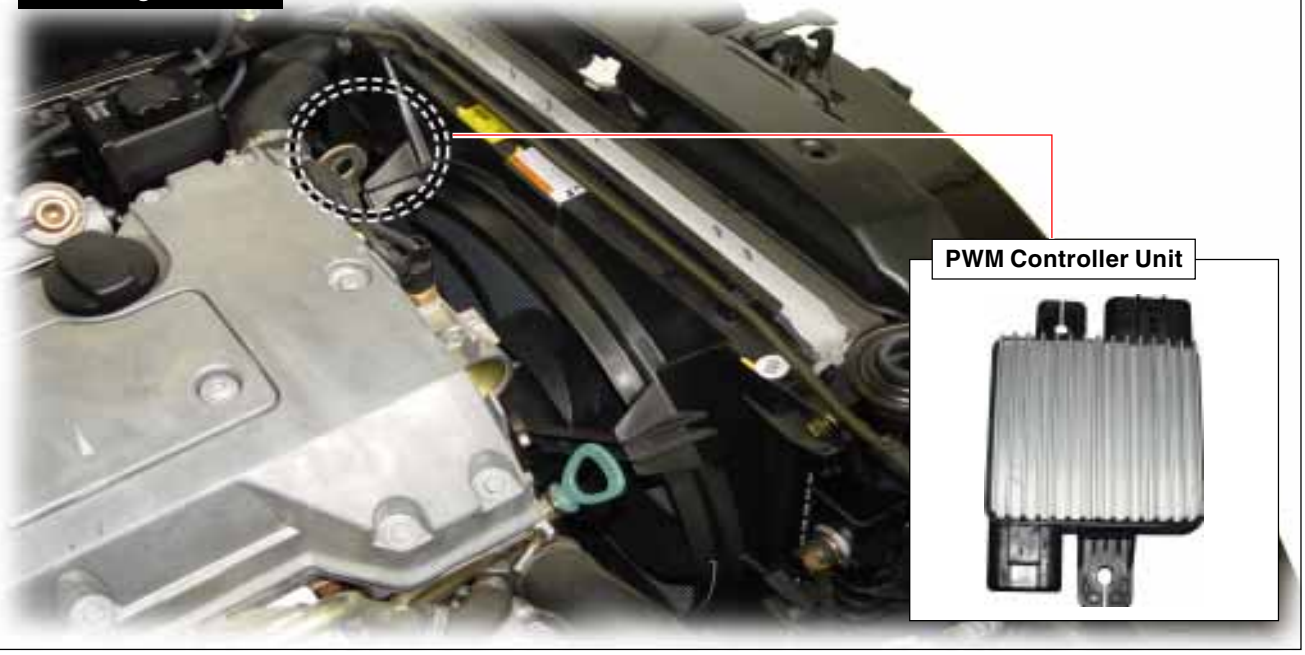


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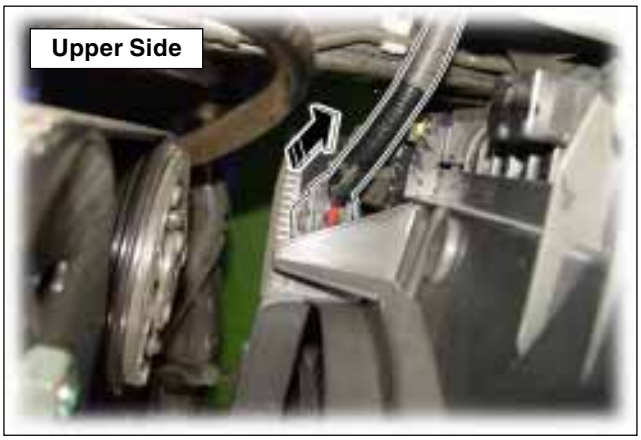
PWM Controller Unit

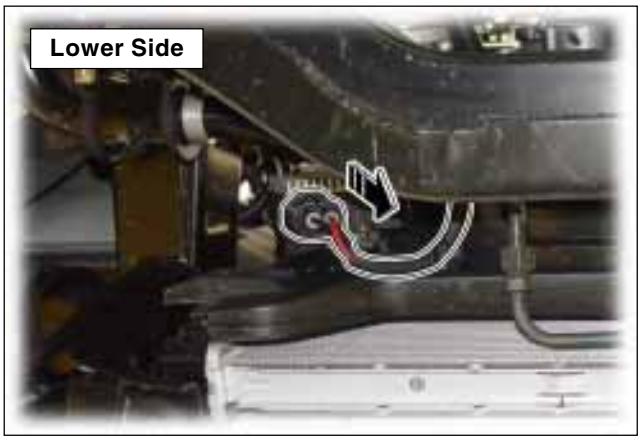
※ **Preceding Works:** Disconnect the negative battery cable to prevent the abrupt operation of PWM electric fan.

Mounting Location



1. Disconnect the PWM controller unit's connector.





2. Remove two mounting bolts and remove the PWM controller unit.

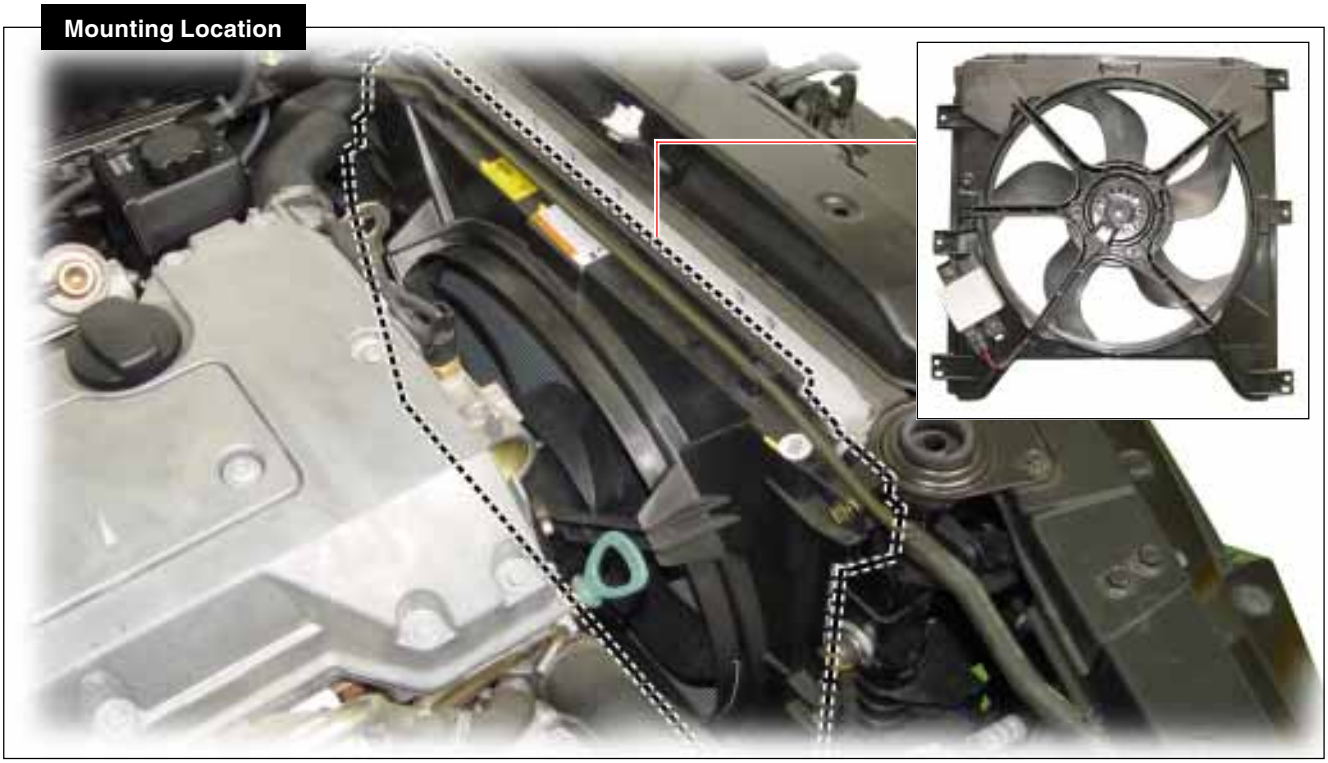


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PWM Electric Fan and Shroud Assembly

※ **Preceding Works:** Disconnect the negative battery cable or remove the key switch.

Mounting Location



1. Unscrew four mounting bolts to remove the front center undershield assembly.



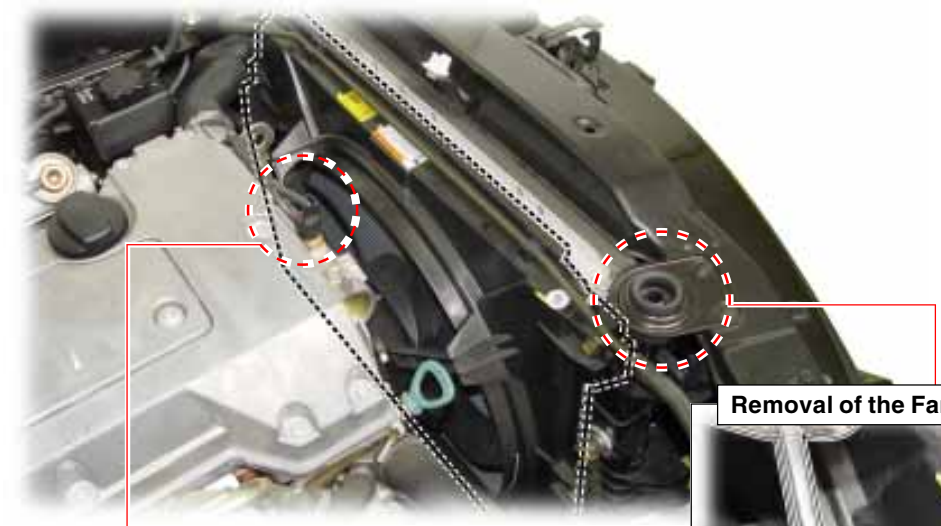
2. Disconnect the upper coolant hose of the radiator.



NOTICE

- **When disconnecting the coolant upper hose, be careful not to spill the coolant.**

3. Disconnect the upper connector of the PWM unit and unscrew the fan shroud mounting bolt.



Removal of the Fan Shroud Mounting Bolt





Disconnection of the PWM Unit Connector



4. Remove the PWM electric fan and the fan shroud from the vehicle with care.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Radiator Assembly

Removal & installation procedure

1. Drain the A/C refrigerant using the refrigerant collector.



2. Drain coolant from the radiator.
3. Remove the each coolant hoses.



4. Remove the upper and lower automatic transmission oil cooling pipes from radiator.

Installation Notice

Tightening torque	25 - 35 Nm (18 - 26 lb-ft)



5. Remove the mounting bolt from the automatic transmission oil cooler pipe and then disconnect the cooler pipe.

Installation Notice

Tightening torque	3 - 7 Nm (27 - 62 lb-ft)

6. Disconnect the right and left mounting clips of the radiator.



7. Disconnect the upper coolant hose, the return hose and the lower coolant hose from the radiator.

Upper Hose and Return Hose



* Be careful of the coolant leaks.

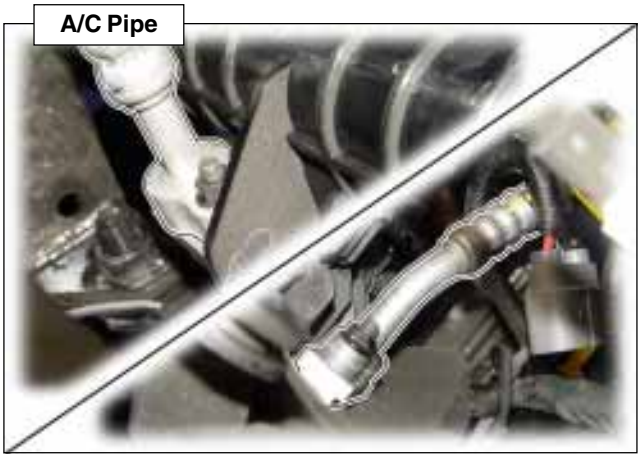
Lower Hose



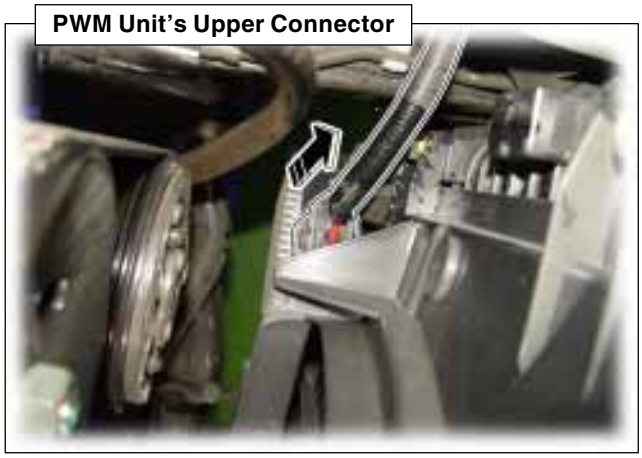
* Be careful of the coolant leaks.

8. Disconnect the A/C pipe from the radiator and disconnect the upper connector of the PWM unit.

A/C Pipe



PWM Unit's Upper Connector



9. Remove the upper mounting bracket of the radiator.





10. Unscrew the right and left mounting bolts of the radiator.





11. Remove the radiator assembly from the vehicle. (The front upper mounting can be removed before for easier removal.)





12. Remove the A/C cooler from the radiator assembly.



A/C Cooler



Radiator Assembly



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. SPECIFICATION

▶ General Specifications

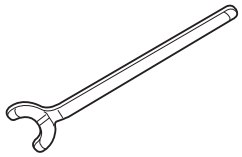
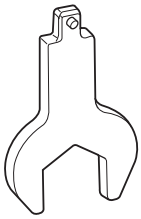
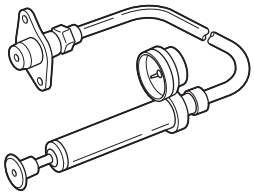
Application		Unit	Gasoline Engine
Cooling System	Type	-	Water Cooling Forced Circulation
Coolant	Capacity	L	11.3
Thermostat	Type	-	Wax Pellet Type
	Initial Opening Temp.	°C (°F)	82 (180)
	Fully Opening Temp.	°C (°F)	95 (203)
	Fully Closing Temp.	°C (°F)	80 (176)
	Stroke	mm	7
Cooling Fan	Type	-	PWM
	Blades	-	5
	Diameter	mm	320
	Low Speed ON Temp.	°C (°F)	95 (203)
	Low Speed OFF Temp.	°C (°F)	90 (194)
	High Speed ON Temp.	°C (°F)	105 (221)
	High Speed OFF Temp.	°C (°F)	100 (212)
	High Speed ON Temp. (By A/C Pressure)	kPa (psi)	269.8 (1860)
Coolaant Reservoir	Pressure Valve Opening Pressure	kPa (psi)	118 - 147 (17.1 - 21.3)
	Vacuum Valve Opening Pressure	kPa (psi)	9.8 (1.4)
Water Pump	Type	-	Turbo Centrifugal
	Impeller Diameter	mm	65
	Impeller Blades	-	8
Radiator	Type	-	Cross-flow
	Core Width	mm	701
	Core Height	mm	372
	Core Thickness	mm	18
Coolant Temperature Gauge	Minimum Radiation Capability	Kcal/h	45,000
	Resistance (at 50 °C (122°F))	Ω	185.2
	Resistance (at 80 °C (176°F))	Ω	47.4
	Resistance (at 105 °C (221°F))	Ω	28.2
Engine Coolant Temperature Sensor	Resistance (at 20 °C (68°F))	K Ω	3.33 - 37.8
	Resistance (at 80 °C (176°F))	K Ω	0.32 - 0.35
Anti-Freeze Agent	Type	-	ALUTEC-P78
	Mixture of Water and Good Quality Ethylene Glycol-Base Anti-Freeze	-	50 : 50

▶ Fastener Tightening Specifications

Application		Nm	Lb-Ft	Lb-In
Automatic Transmission Oil Cooler Pipe		20	15	-
Automatic Transmission Oil Cooler Pipe Mounting Bolt		3 - 7	-	27 - 62
Coolant Drain Plug		30	22	-
Cooling Fan Bolt		9 - 11	-	80 - 97
Cooling Fan Shroud Bolt		3 - 7	-	27 - 62
Oil Cooler Pipe Line Bolt		9 - 11	-	80 - 97
Radiator Mounting Bracket Bolt		3 - 7	-	27 - 62
Tensioning Device Shock Absorber Bolt		22.5 - 27.5	16.6 - 20.3	-
Thermostat Cover Bolt		9 - 11	-	80 - 97
Thermostat Housing Bolt	M6	9 - 11	-	80 - 97
	M8	22.5 - 27.5	16.6 - 20.3	-
Viscous Clutch Mounting Bolt		40.5 - 49.5	29.8 - 36.5	-
Water Pump Housing Bolt	M6	9 - 11	-	80 - 97
	M8	22.5 - 27.5	16.6 - 20.3	-
Water Pump Pulley Bolt		9 - 11	-	80 - 97

7. SPECIAL TOOLS AND EQUIPMENT

▶ Special Tools Table

Name and Part Number	Name and Part Number
A9910 0060A (111 589 00 40 00) Holder 	A9910 0070A (111 589 02 01 00) Open End Wrench 
A9921 0012A (124 589 15 21 00) Leakage Tester 	A9910 0150A (603 589 00 40 00) Fan Clutch Holder 

ENGINE ELECTRICAL

SECTION 1E

TABLE OF CONTENTS

1. Description and operation 1E-2
2. Diagnostic information and procedure 1E-5
3. Repair instructions 1E-7

1. DESCRIPTION AND OPERATION

▶ Battey

The sealed battery is standard on all cars. There are no vent plugs in the cover. The battery is completely sealed, except for two small vent holes in the sides.

These vent holes allow the small amount of gas produced in the battery to escape. The battery has the

following advantages over conventional batteries:

- No water addition for the life of the battery.
- Overcharge protection. If too much voltage is applied to the battery, it will not accept as much current as a conventional battery. In a conventional battery, the excess voltage will still try to charge the battery, leading to gassing, which causes liquid loss.
- Not as liable to self-discharge as a conventional battery. This is particularly important when a battery is left standing for long periods of time.
- More power available in a lighter, smaller case.

The battery has three major functions in the electrical system. First, the battery provides a source of energy for cranking the engine. Second, the battery acts as a voltage stabilizer for the electrical system. Finally, the battery can, for a limited time, provide energy when the electrical demand exceeds the output of the generator.

▶ Ratings

A battery has two ratings: (1) a reserve capacity rating designated at 27 °C (80 °F), which is the time a fully charged battery will provide 25 amperes of current flow at or above 10.5 volts; (2) a cold cranking amp rating determined under testing at -18 °C (0 °F), which indicates the cranking load capacity.

Reserve Capacity

The reserve capacity (RC) is the maximum length of time it is possible to travel at night with the minimum electrical load and no generator output. Expressed in minutes, the RC rating is the time required for a fully charged battery, at a temperature of 27 °C (80 °F) and being discharged at a current of 25 amperes, to reach a terminal voltage of 10.5 volts.

Cold Cranking Amperage

The cold cranking amperage test is expressed at a battery temperature of -18 °C (0 °F). The current rating is the minimum amperage, which must be maintained by the battery for 30 seconds at the specified temperature, while meeting a minimum voltage requirement of 7.2 volts. This rating is a measure of cold cranking capacity.

The battery is not designed to last indefinitely. However, with proper care, the battery will provide many years of service. If the battery tests well, but fails to perform satisfactorily in service for no apparent reason, the following factors may point to the cause of the trouble:

- Vehicle accessories are left on overnight.
- Slow average driving speeds are used for short periods.
- The vehicle's electrical load is more than the generator output, particularly with the addition of aftermarket equipment.
- Defects in the charging system, such as electrical shorts, a slipping generator belt, a faulty generator, or a faulty voltage regulator.
- Battery abuse, including failure to keep the battery cable terminals clean and tight or a loose battery hold-down clamp.
- Mechanical problems in the electrical system, such as shorted or pinched wires.

▶ Charging Time Required

The time required to charge a battery will vary depending upon the following factors:

- **Size of Battery** — A Completely discharged large heavy-duty battery required more than twice the recharging time as a completely discharged small passenger car battery.
- **Temperature** — A longer time will be needed to charge any battery at -18 °C (0 °F) than at 27 °C (80 °F). When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first. The battery will accept a higher current rate as the battery warms.
- **Charger Capacity** — A charger which can supply only 5 amperes will require a much longer charging period than a charger that can supply 30 amperes or more.
- **State-of-Charge** — A completely discharged battery requires more than twice as much charge as a one-half charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

▶ Charging a Completely Discharged Battery (Off the Vehicle)

Unless this procedure is properly followed, a perfectly good battery may be needlessly replaced. The following procedure should be used to recharge a completely discharged battery:

1. Measure the voltage at the battery terminals with an accurate voltmeter. If the reading is below 10 volts, the charge current will be very low, and it could take some time before the battery accepts the current in excess of a few milliamperes. Refer to "Charging Time Required" in this section, which focuses on the factors affecting both the charging time required. Such low current may not be detectable on ammeters available in the field.
2. Set the battery charger on the high setting.

IMPORTANT

- **Some chargers feature polarity protection circuitry, which prevents charger unless the charger leads are correctly connected to the battery terminals. A completely discharged battery may not have enough voltage to activate this circuitry, even though the leads are connected properly, making it appear that the battery will not accept charging current. Therefore, follow the specific charger manufacturer's instruction for by passing or overriding the circuitry so that the charger will turn on and charge a low-voltage battery.**

3. Continue to charge the battery until the charge current is measurable. Battery chargers vary in the amount of voltage and current provided. The time required for the battery to accept a measurable charger current at various voltages may be as follows:

Voltage	Hours
16.0 or more	Up to 4 hours
14.0 - 15.9	Up to 8 hours
13.9 or less	Up to 16 hours

- If the charge current is not measurable at the end of the above charging times, the battery should be replaced.
- If the charge current is measurable during the charging time, the battery is good, and charging should be completed in the normal manner.

IMPORTANT

- **It is important to remember that a completely discharged battery must be recharged for a sufficient number of ampere hours (AH) to restore the battery to a usable state.**

- If the charge current is still not measurable after using the charging time calculated by the above method, the battery should be replaced.

▶ Jump Starting Procedure

1. Position the vehicle with the charged battery so that the jumper cables will reach from the charged battery to the battery that requires charging.
2. Turn off the ignition, all the lights, and all the electrical loads in both vehicles.
3. Leave the hazard flasher on if jump starting where there may be other traffic and any other lights needed for the work area.
4. Apply the parking brake firmly in both vehicles.

IMPORTANT

- **In order to avoid damaging the vehicle make sure the cables are not on or near pulleys, fans, or other parts that will move when the engine starts.**

5. Shift an automatic transmission to PARK.

NOTICE

- **In order to avoid injury, do not use cables that have loose or missing insulation.**

6. Clamp one end of the first jumper cable to the positive terminal on the booster battery. Make sure it does not touch any other metal parts.
7. Clamp the other end of the same cable to the positive terminal on the discharged battery. Never connect the other end to the negative terminal of the discharged battery.

NOTICE

- **Do not attach the cable directly to the neg-ative terminal of the discharged battery. Doing so could cause sparks and possible battery explosion.**

8. Clamp one end of the second cable to the negative terminal of the booster battery.
9. Make the final connection to a solid engine ground, such as the engine lift bracket at least 450 millimeters (18 inches) from the discharged battery.
10. Start the engine of the vehicle with the good battery. Run the engine at a moderate speed for several minutes.
11. Then start the engine of the vehicle with the discharged battery.
12. Remove the jumper cables by reversing the above sequence exactly, removing the negative cable from the vehicle with the discharged battery first. While removing each clamp, take care that it does not touch any other metal while the other end remains attached.

▶ Alternator

Alternators are equipped with internal regulators. Unlike three-wire generators, the alternator may be used with only two connections: battery positive and an “D+” terminal to the charge indicator lamp.

As with other charging systems, the charge indicator lamp lights when the ignition switch is turned to RUN, and goes out when the engine is running. If the charge idicator is on with the engine running, a charging system defect is indicated. This indicator light will glow at full brilliance for several kinds of defects as well as when the system voltage is too high or too low.

The regulator voltage setting varies with temperature and limits the system voltage by controlling rotor field current. Achieve correct average field current for proper system voltage control by varying the on-off time. At high speeds, the on-time may be 10 percent and the off-time 90 percent. At low speeds, with high electrical loads, the on-time may be 90 percent and the off-time 10 percent.

▶ Charging System

Generators use a new type of regulator that incorporates a diode trio. A Delta stator, a rectifier bridge, and a rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and fan are used. There is no test hole.

▶ Starter

Wound field starter motors have pole pieces, arranged around the armature, which are energized by wound field coils.

Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing, protecting them from exposure to dirt, icy conditions, and splashes. In the basic circuit, solenoid windings are energized when the switch is closed. The resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear. The solenoid main contacts close. Cranking then takes place.

When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage.

To prevent excessive overrun, the switch should be released immediately after the engine starts.

▶ Starting System

The engine electrical system includes the battery, the ignition, the starter, the generator, and all the related wiring.

Diagnostic tables will aid in troubleshooting system faults. When a fault is traced to a particular component, refer to that component section of the service manual.

The starting system circuit consists of the battery, the starter motor, the ignition switch, and all the related electrical wiring. All of these components are connected electrically.

2. DIAGNOSTIC INFORMATION AND PROCEDURE

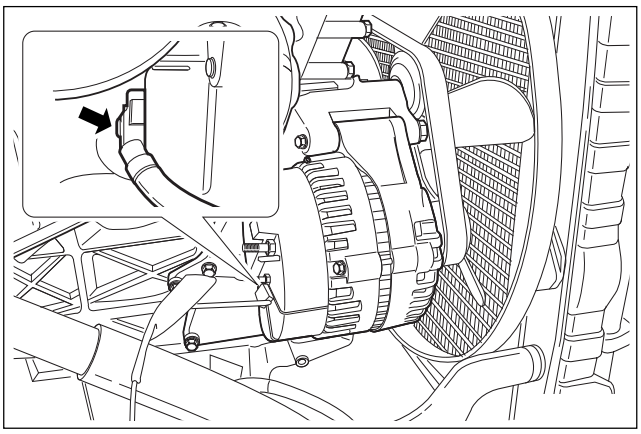
▶ Ignition System

Condition	Probable Cause	Correction
No Crank	• Low battery voltage.	• Charging the battery or Replace the battery.
	• Battery cable is loose, corroded, or damaged.	• Repair or Replace the battery cable.
	• Faulty starter motor or starter motor circuit is open.	• Repair or Replace the starter motor/starter motor circuit.
	• Faulty ignition switch.	• Replace the ignition switch.
	• Ground short.	• Repair the ground short.
Crank OK, But Too Slow	• Low battery voltage.	• Charging the battery or Replace the battery.
	• Battery. • Battery cables are loose, corroded, or damaged.	• Repair or Replace the battery cable.
	• Faulty starter motor.	• Repair or Replace the starter motor.
Starter Motor Does Not Stop	• Faulty starter motor.	• Repair or Replace the starter motor.
	• Faulty ignition switch.	• Replace the ignition switch.
Starter Motor Running, But Not Cranking	• Broken the clutch pinion gear or faulty starter motor.	• Replace the starter motor.
	• Broken the flywheel ring gear.	• Replace the flywheel.
	• Connected circuit is open.	• Repair the open circuit.
Battery Discharge	• Loosen the generator drive belt.	• Adjust the belt tension or Replace the belt.
	• The circuit is open or a short.	• Repair the open or a short circuit.
	• Battery run down.	• Replace the battery.
	• Open ground circuit.	• Repair the open ground circuit.
Charging Indicator Lamp Does Not Work When the Ignition Switch ON (Engine Does Not Work)	• Charging indicator lamp is blown or fuse is blown.	• Repair or Replace the charging indicator lamp/fuse.
	• Faulty ignition switch.	• Replace the ignition switch.
	• Generator ground circuit is open or a short.	• Repair the circuit.
Charging Indicator Lamp Does Not Put Out Lights After Starting the Engine	• Battery cable is corroded or damaged.	• Repair or Replace the battery cable.
	• Loosen the generator drive belt.	• Adjust the belt tension or Replace the belt.
	• Faulty wiring harness.	• Repair the wiring harness.
Battery Over Charging	• Generator Voltage Regulator Faulty	• Replace Generator
	• Voltage detecfing wiring faulty	• Repair Wiring

▶ Ignition System (Cont'd)

Condition	Probable Cause	Correction
Hard Engine Starting	• Ignition coil faulty	• Replace ignition coil
	• Distributor (including optical sensor) faulty	• Replace distribator (or sensor)
	• Spark plug malfuntion	• Replace spark plug or adjust clearance
	• Ignition timing faulty (spark plug light is normal)	• Resetting valve timing
Unstable Engine Idling	• Spark plug malfunction	• Replace spark plug or adjust clearance
	• Ignition coil faulty	• Replace ignition coil
	• Ignition timing faulty	• Resetting valve timing
Enging Acceralation Malfunction	• Ignition timing faulty	• Resetting valve timing

3. REPAIR INSTRUCTIONS



▶ ON-Vehicle Service

Generator

※ **Preceding Works:** Removal of the polly V-belt

Removal & Installation Procedure

1. Disconnect the negative battery terminal.
2. Unscrew the nut and disconnect the terminal (1).

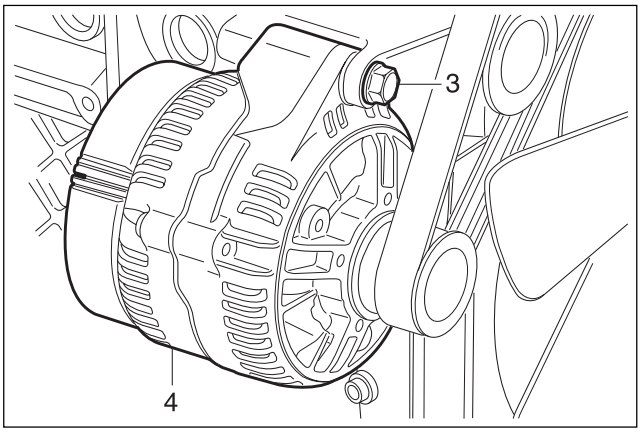
Installation Notice

Tightening Torque	14 - 18 N•m (10 - 13 lb-ft)

3. Unscrew the nut and disconnect the terminal (2).

Installation Notice

Tightening Torque	4 - 5 N•m (35 - 44 lb-in)

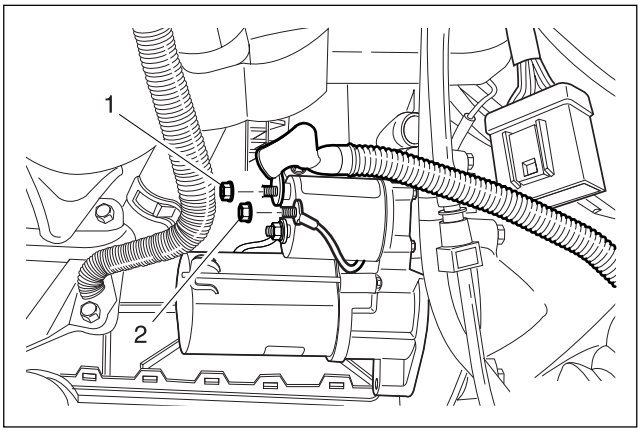


4. Unscrew the combination bolt (3).

Installation Notice

Tightening Torque	42 - 50 N•m (31 - 37 lb-ft)

5. Remove the generator.
6. Installation should follow the removal procedure in the reverse order.



Starter

Removal & Installation Procedure

1. Disconnect the negative battery terminal.
2. Unscrew the nut and disconnect the battery cable(1).

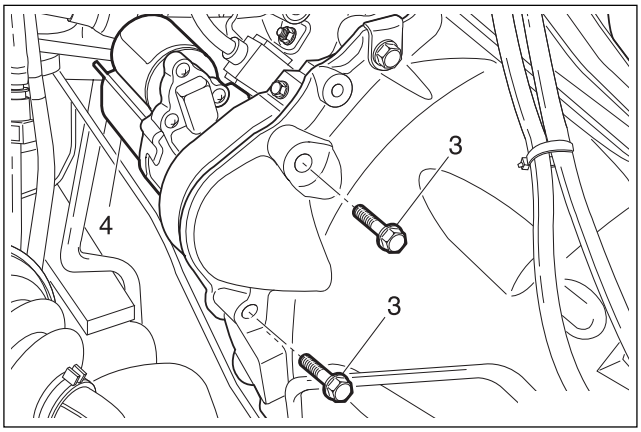
Installation Notice

Tightening Torque	12 - 15 N•m (9 - 11 lb-ft)

3. Unscrew the nut and disconnect the engine electric wire (2).

Installation Notice

Tightening Torque	6 - 7 N•m (53 - 62 lb-ft)



4. Unscrew the mounting bolts (3) of starter.

Installation Notice

Tightening Torque	35 - 48 N•m (26 - 35 lb-ft)

5. Remove the starter.
6. Installation should follow the removal procedure in the reverse order.



Battery

Removal & Installation Procedure

NOTICE

- **Disconnect the negative battery cable first.**
- **Insert the clamp bolt (8) into the battery tray hole (11) from inside when installing.**

1. Disconnect the negative battery cable and then disconnect the positive battery cable.

Installation Notice

Tightening Torque	12 - 18 N•m (9 - 13 lb-ft)

2. Remove the nut from the battery clamp bolt that fasten the battery holddown bracket.

Installation Notice

Tightening Torque	15 N•m (11 lb-ft)

3. Remove the battery.
4. Installation should follow the removal procedure in the reverse order.



Spark Plug and Ignition Coil

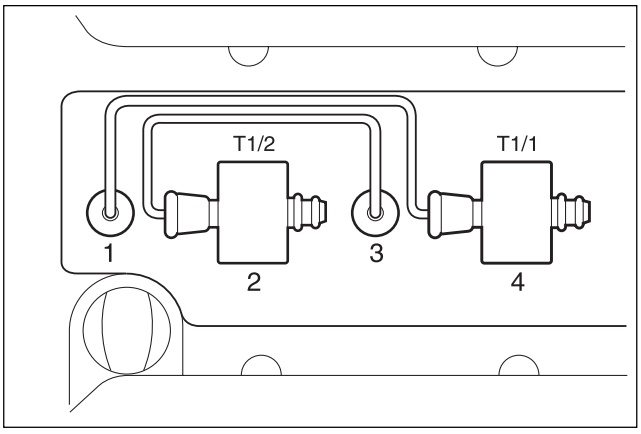
※ **Preceding Works:** Removal of intake air duct

Replacement Procedure

1. Disconnect the negative battery cable.
2. Remove the ignition cable cover bolts and remove the ignition cable cover.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)



3. Separate the ignition cable from the ignition coil and the spark plug.
4. Remove the two bolts (M6 X 25) from each ignition coil and remove the ignition coil.

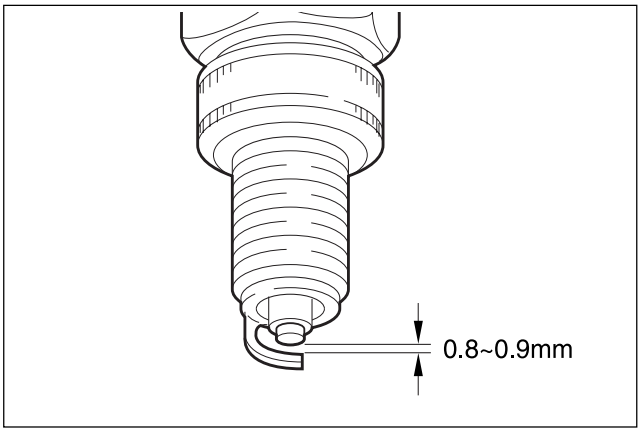
Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)

- Make sure that the ignition cables are correctly routed.
- Exactly install the ignition cable guide pin into the vehicle to be grounded.
- The ignition cables are located on the cylinder head cover. Each ignition coil provides the high voltage to two spark plugs simultaneously.

  T 1/1 : Cylinder 1 and 4

  T 1/2 : Cylinder 2 and 3



5. Remove the spark plug using the spark plug wrench.

Installation Notice

Tightening Torque	25 - 30 N•m (15 - 22 lb-ft)
Clearance	0.8 + 0.1 mm

6. Installation should follow the removal procedure in the reverse order.

MEMO

INTAKE & EXHAUST

SECTION 1G

TABLE OF CONTENTS

1. Description and operation 1G-2
2. Repair instructions on-vehicle service 1G-5
3. Specifications 1G-12

1. DESCRIPTION AND OPERATION

▶ Exhaust System

Notice: When you are inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to avoid possible overheating of the floor panel and possible damage to the passenger compartment insulation and trim materials.

Check the complete exhaust system and the nearby body areas and trunk lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections, or other deterioration which could permit exhaust fumes to seep into the trunk may be an indication of a problem in one of these areas. Any defects should be corrected immediately.

▶ Muffler

Aside from the exhaust manifold connection, the exhaust system uses a flange and seal joint design rather than a slip joint coupling design with clamp and U-bolts. If hole, open seams, or any deterioration is discovered upon inspection of the front muffler and pipe assembly, the complete assembly should be replace, the complete assembly should be replaced. The same procedure is applicable to the rear muffler assembly.

Heat shields for the front and rear muffler assembly and catalytic converter protect the vehicle and the environment from the high temperatures that the exhaust system develops.

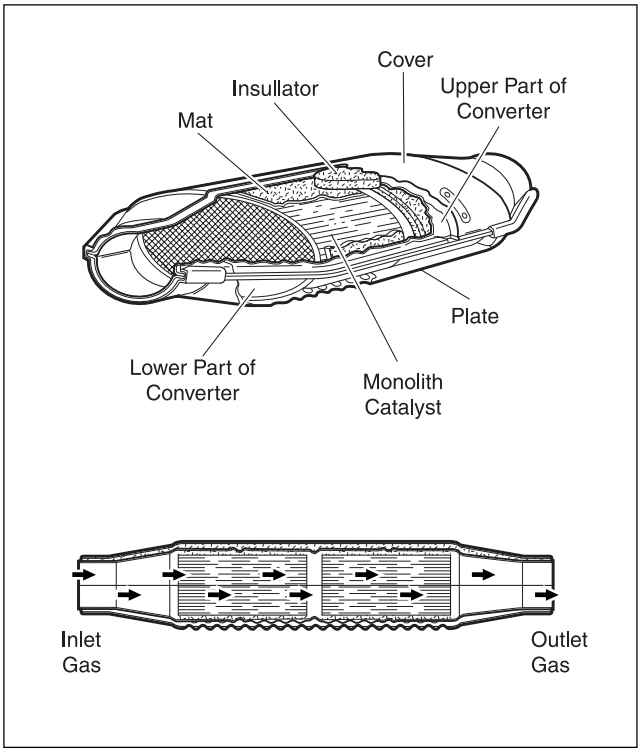
▶ Catalytic Converter (Gasoline Engine)

1. When jacking or lifting the vehicle from the body side rails, be certain that the lift pads do not contact the catalytic converter, as this could damage the catalytic converter.
2. Use of anything other than unleaded fuel will damage the catalyst in the catalytic converter.

The catalytic converter are emission-control devices added to the exhaust system to reduce pollutants from the exhaust pipes.

The oxidation catalyst is coated with a catalytic material containing platinum and palladium, which reduces levels of hydrocarbon (HC) and carbon monoxide (CO) from the exhaust gas. The three-way catalyst has coatings which contain platinum and rhodium, which additionally lower the levels of oxides of nitrogen (NOx).

Catalytic Converter Structure



The Catalytic converter of monolith type consists of 2 walled metal bodies which is made of Cordierite.

The principal element of converter consists of the materials like Alumina or oxidized Serume in order to apply to Ceramic Monolith.

Washer coat operates first, and catalytic metal elements (Pt, Pd, Rh) operates to washer coat next.

Monolith type is lighter than other types, easy to manufacture and quickly approaches to proper temperature.

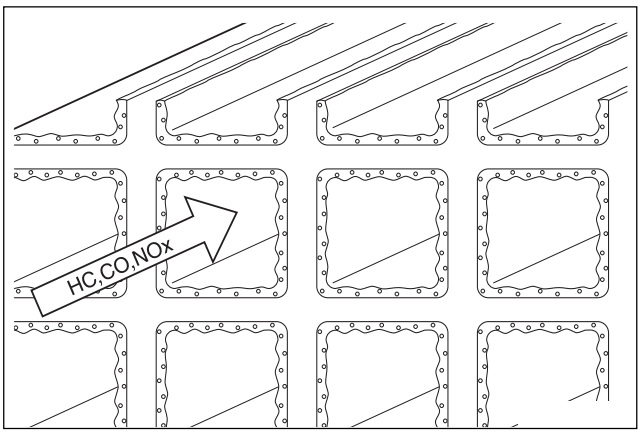
Washer coat is used to make a contact surface with exhaust gas bigger by adhering closely to small holes of inner layer.

If a lead compound or phosphorus adheres to the surface and the temperature rises, its surface is decreased.

The total area of general monolith converter is about 45,000~500,000ft^3. (10 times of a football field)

Generally Alumina (AL_2 O^3) is used as a raw material and its 7 phases of gamma, delta, theta have big areas and high stability for the temperature, and nowadays gamma Alumina is used usually.

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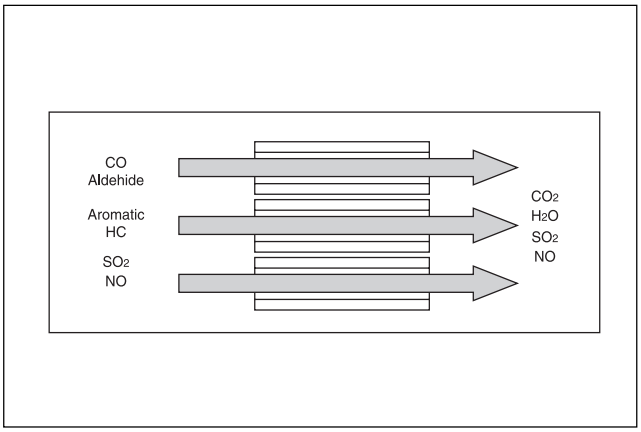
Catalytic Converter and Temperature

Catalytic converter has the normal function of purification at a range of the temperature.

Because it has a weak point of decreasing of the purification rate in the condition of continuous high temperature, it should keep the temperature range of 400 to 500°C for normal condition.

HC purification rate becomes better according to the increase of temperature in the normal range of temperature.

CO purification rate becomes the best near the temperature of 450°C, and NO_x does so near the temperature of 400 to 500°C.

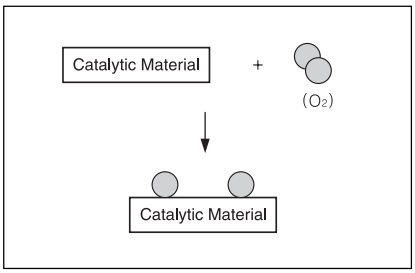


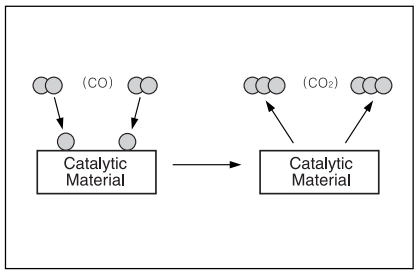
Purification of Catalytic Converter

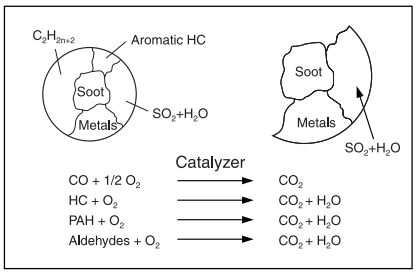
- Adhesion of soluble organic fraction (SOF) below 180°C
- Purification of soluble organic fraction (SOF) over 180°C

  Chemical reaction formula
  - $SOF(HC)+O_2 \rightarrow CO_2+H_2O$
  - $2CO+O_2 \rightarrow 2CO_2$
  - $2C_2H_6+7O_2 \rightarrow 4CO_2+6H_20$
- By catalytic action of two primary catalytic converter, oxidation occurs in order to decrease HC and CO.

- Oxygen adheres to catalytic material : below 180°C
- Catalytic material supplies each CO and HC with O_2 for their oxidation : above 180°C
- Catalytic material conversion process by DOC





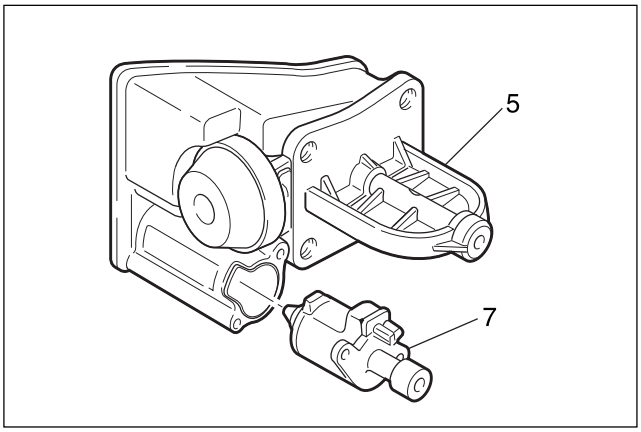


Method for Reduction of NOx

NOx is generated a great deal in case that combustion temperature and excess air factor are high. EGR valve can decrease NOx (30 to 35% decrease) by making temperature of combustion chamber fall by means of exhaust gas re-circulation.

- EGR valve is installed on the diesel engine of Musso, Korando, Istana and Rexton.

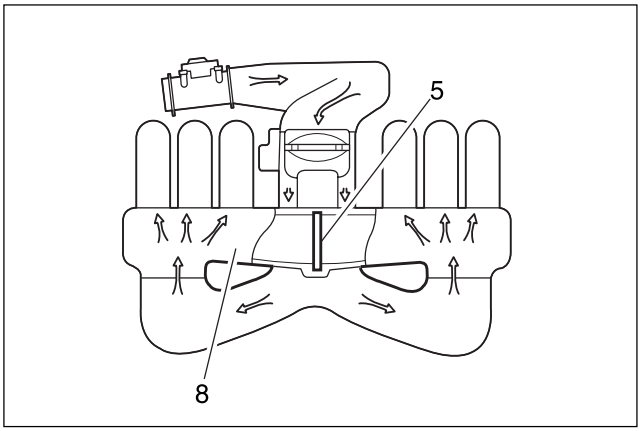
  And micro switch is installed together to control EGR valve.
- The setting method of micro switch is identical with the existing one.



▶ Resonance Flap

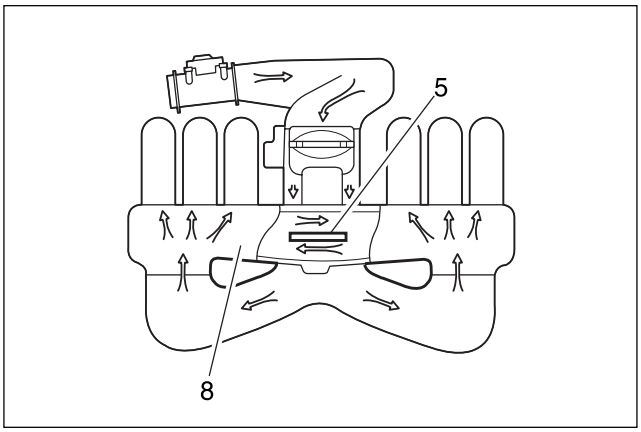
Function

A pneumatically actuated resonance flap (5) is located on the intake manifold, and will be opened and closed by load, which operates resonance flap according to engine and controlled by ECU and rpm.



Resonance flap closed (at idle/partial load : less than 3,800/rpm)

The switch valve (7) will be adjusted by ECU and resonance falp will be colosed. By increasing air flow passage through dividing intaking air flow toward both air collection housing (8). This leads to a signficant increase in the torque in the lower speed range.

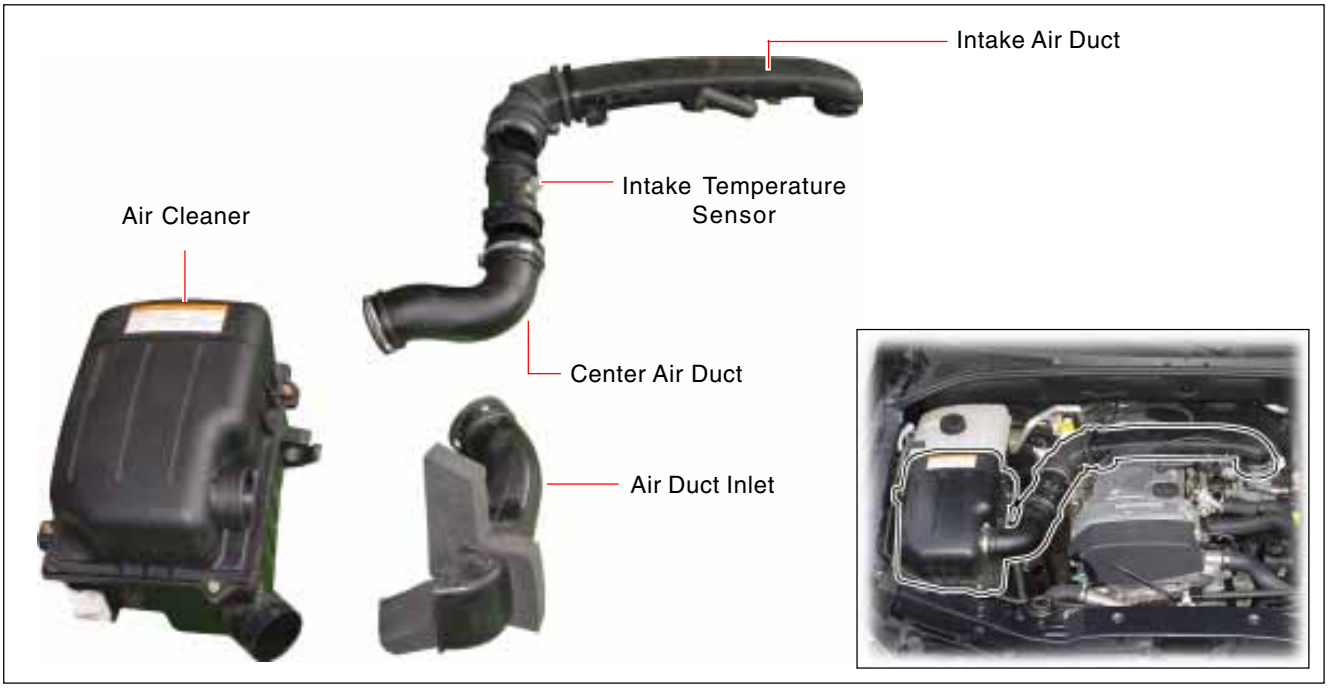


Resonance flap open (at full load : over 3, 800/rpm)

The switch valve (7) will not be adjusted by ECU and resonance falp (5) will be open. The collected air in the air collection housing (8) will not be divided and intaking air passage will be shorten.

2. REPAIR INSTRUCTIONS ON-VEHICLE SERVICE

▶ Air Cleaner and Intake Air Duct



Removal & Installation Procedue

1. Disconnect the intake temperature sensor connector.



2. Undo the clamp of the air cleaner (intake temperature side).



3. Unscrew two mounting bolts and separate the coolant reservoir tank.



4. Unscrew one air cleaner mounting nut and undo the inlet air duct clamp to remove the air cleaner assembly.





5. Undo the clamp of the air duct (intake manifold side) and disconnect the blow-by hose.

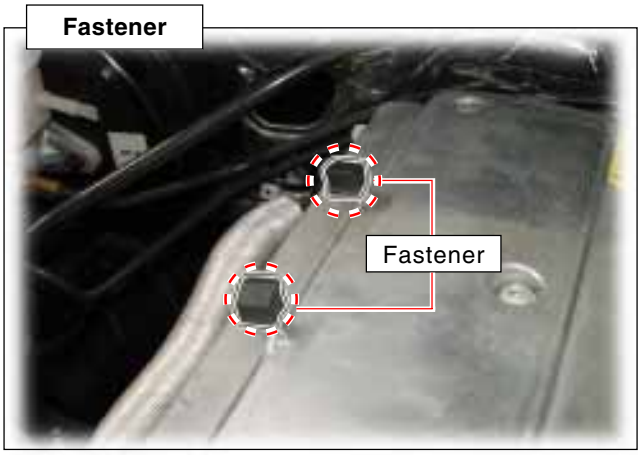


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6. Remove the air duct assembly from the fasteners.



Fastener



Air Duct Assembly

Front side

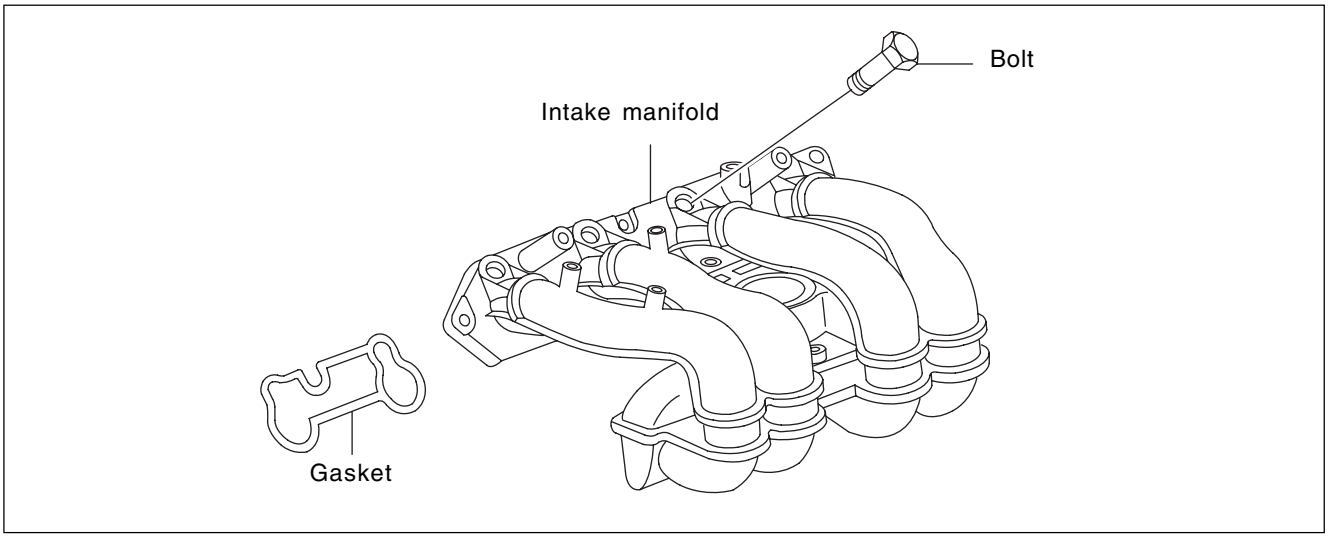


Rear side



▶ Intake Manifold

※ **Preceding Work:** Remove the fuel distributor and injection valve.



Removal & Installation Procedue

1. Remove the air duct and the injector (refer to the "Inlet Air duct" section).



2. Disconnect the vacuum hose of the throttle valve actuator mounted on the intake manifold and remove the throttle valve actuator from the intake manifold.



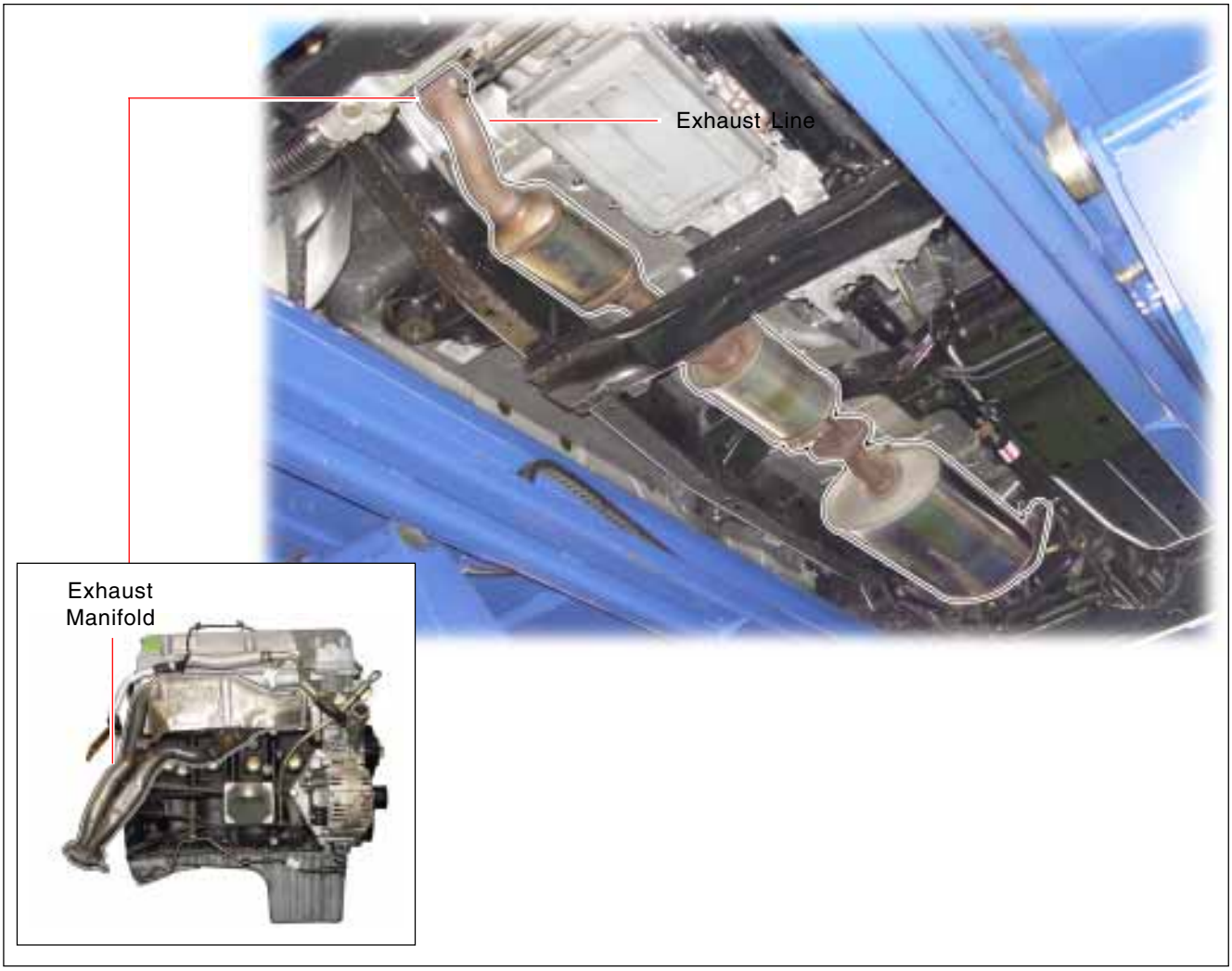
3. Disconnect the MAP sensor connector from inside of the intake manifold.



4. Unscrew the intake manifold mounting nut and bolt from the engine to remove the intake manifold.



▶ Exhaust Line & Exhaust Manifold



Removal & Installation Procedue

1. Remove the air duct from the engine compartment (refer to the "Air duct" section).



2. Disconnect the heater hose to the exhaust manifold.

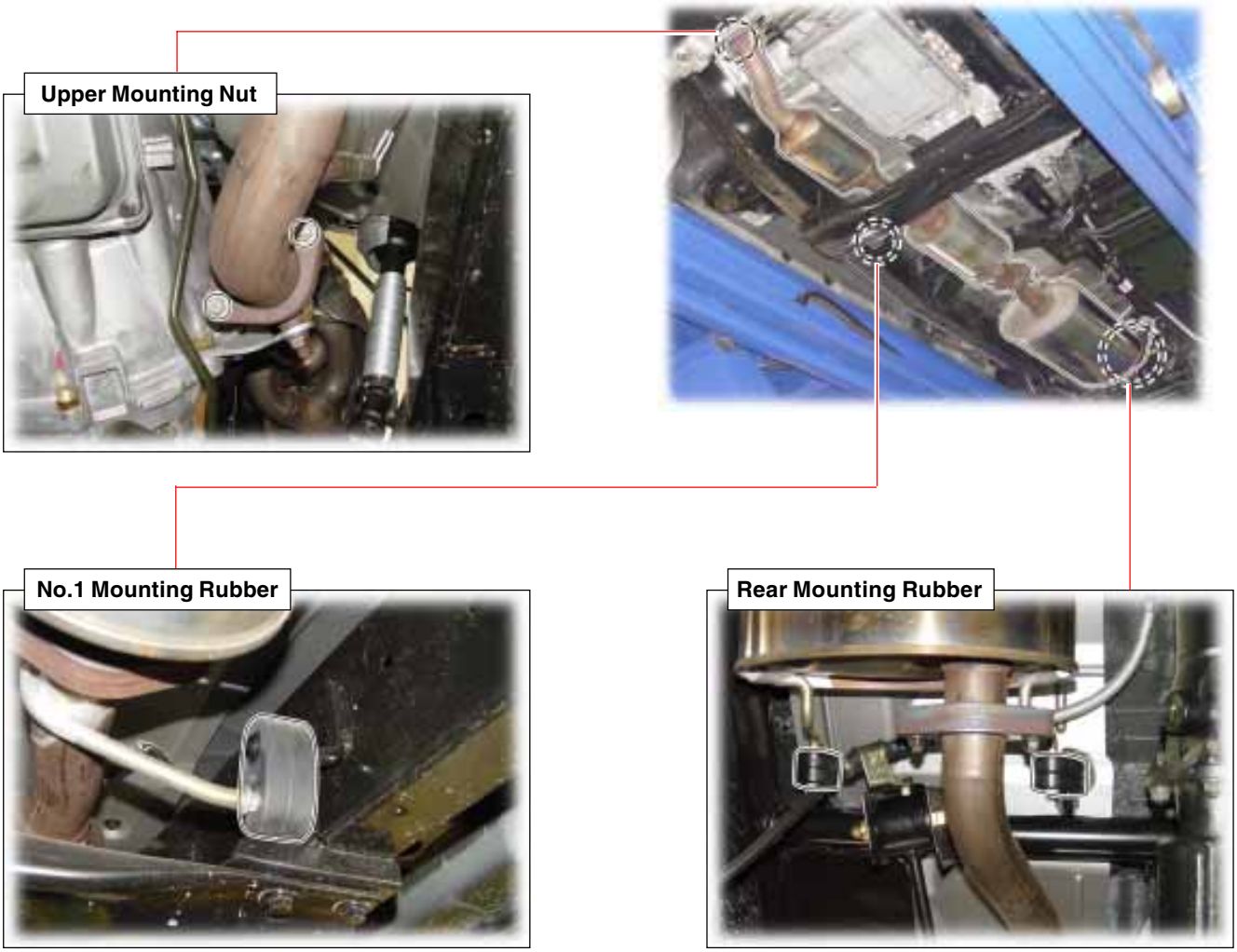


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EFFECTIVE DATE	
AFFECTED VIN	

3. Remove the two oxygen sensors from the exhaust pipe.



4. Remove the upper mounting nut and mounting rubber of the exhaust pipe to remove the exhaust pipe assembly.



3. SPECIFICATIONS

▶ Fastener Tightening Specifications

Application	N•m	Lb-Ft	Lb-In
DOC to Muffler Nut	28 - 47	21 - 35	-
Exhaust Manifold to Front Exhaust Pipe Nut	15 - 28	11 - 21	-
Front Exhaust Pipe to DOC Nut	28 - 47	21 - 35	-
Front Exhaust Pipe to Muffler Nut	28 - 47	21 - 35	-
Intake Air Duct Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-
Intake Manifold Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-
Muffler to Tail Exhaust Pipe Nut	28 - 47	21 - 35	-
Resonance Flap Mounting Bolt	9 - 11	-	80 - 97

Section 03

ELECTRICAL SYSTEM

- FUSES AND RELAYS
- INSTRUMENT CLUSTER
- IMMOBILIZER KEY (WITH REKES KEY)
- RKSTICS (REKES+STICS) / STICS
- MULTIFUNCTION SWITCH
- 4-WHEEL DRIVE SWITCH
- PARKING AID SYSTEM
- TAIL LAMP ASSEMBLY

ELECTRICAL SYSTEM

8410 / 8010 / 7010 / 8710 / 8510 / 8790 / 8320

TABLE OF CONTENTS

FUSES AND RELAYS 3

1. Engine compartment fuses and relays designations 3
2. Interior fuse and relay 4

INSTRUMENT CLUSTER 6

1. Instrument cluster 6

IMMOBILIZER KEY (WITH REKES KEY) . 7

RKSTICS (REKES+STICS) / STICS 8

1. Overview 8
2. Comparison to ACTYON (Major changes) 8
3. Rated load & input signal 9
4. Circuit diagram of wiper 11
5. Circuit diagram of door lock 12
6. Theft deterrent mode 13
7. Coding procedure for REKES key 16
8. Pin arrangement of diagnosis connector 18

MULTIFUNCTION SWITCH 19

1. Multifunction wiper switch 19
2. Multifunction switch connector and function 20

4-WHEEL DRIVE SWITCH..... 21

1. Switch overview 21

PARKING AID SYSTEM 22

1. Configuration 22
2. Alarm interval 24
3. Cautions on parking aid system 25
4. Circuit diagram 26
5. Removal and installation of parking aid 27

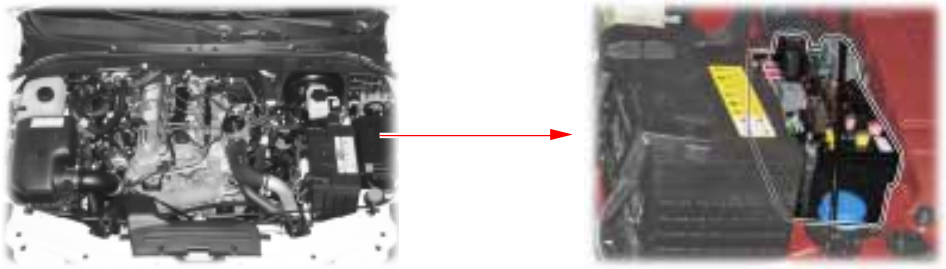
TAIL LAMP ASSEMBLY 31

1. Tail lamp configuration 31
2. Rear lamp related circuit 33
3. Removal and installation of rear combination lamp (Bulb replacement) 34

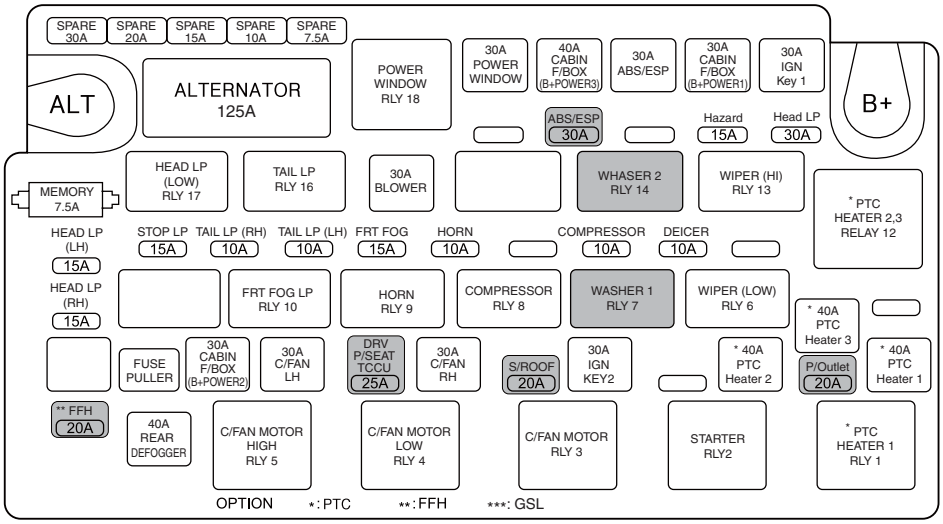
FUSES AND RELAYS

Fuses and relays of ACTYON SPORTS are similar to those of ACTYON. However, as tailgate switch, rear washer and wiper system, AV system, and ESP do not exist any longer, the relays for those devices do not also exit.

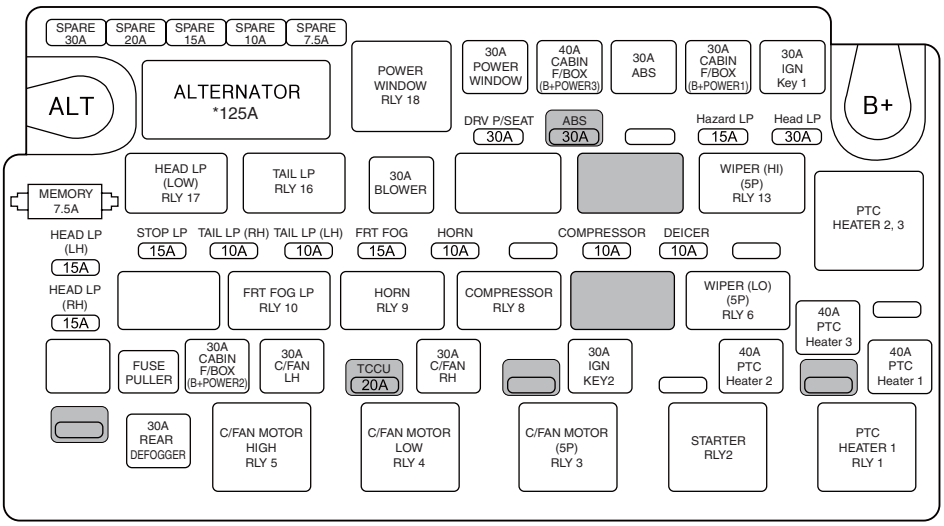
1. ENGINE COMPARTMENT FUSES AND RELAYS DESIGNATIONS



ACTYON



ACTYON SPORTS



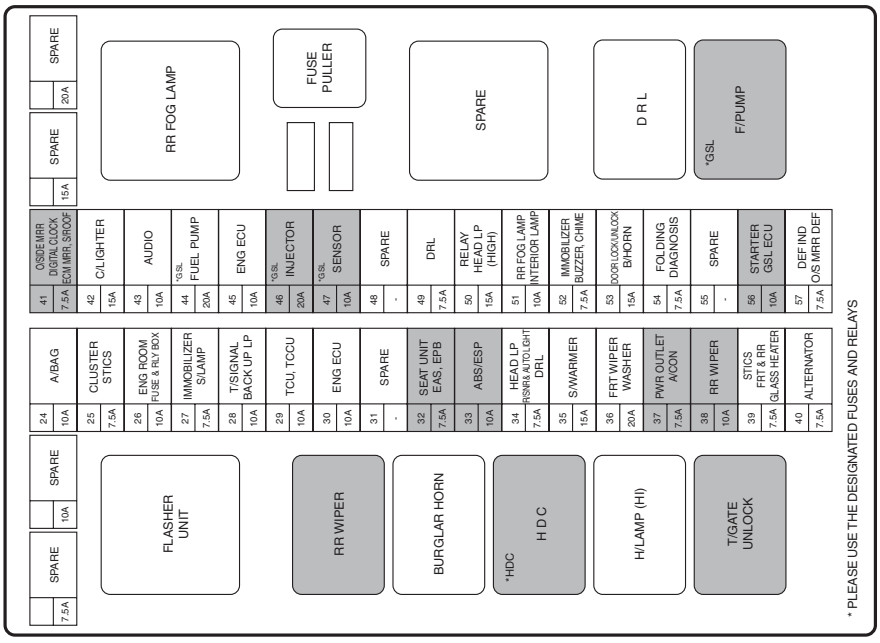
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2. INTERIOR FUSE AND RELAY

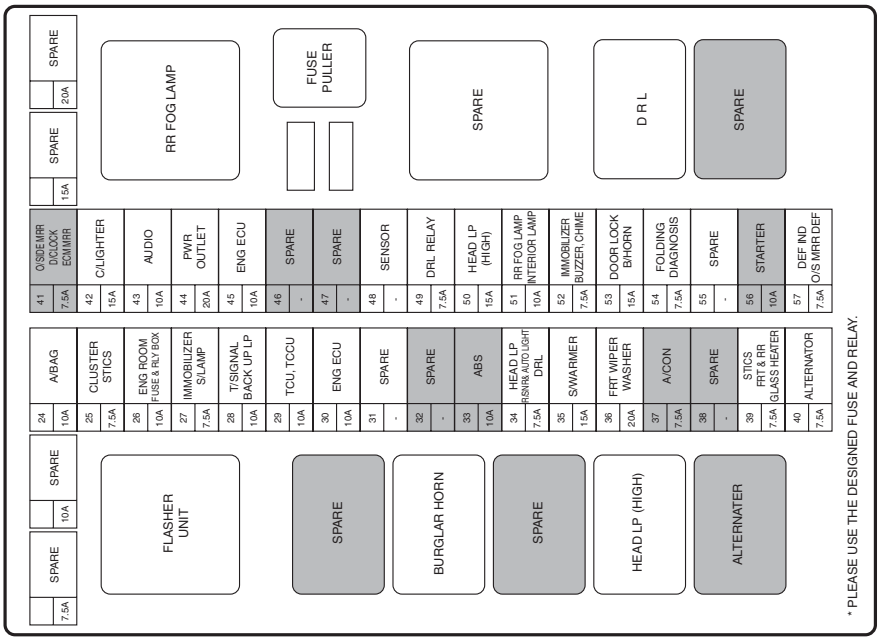
Fuse Box Label (Driver Side)



ACTYON



ACTYON SPORTS

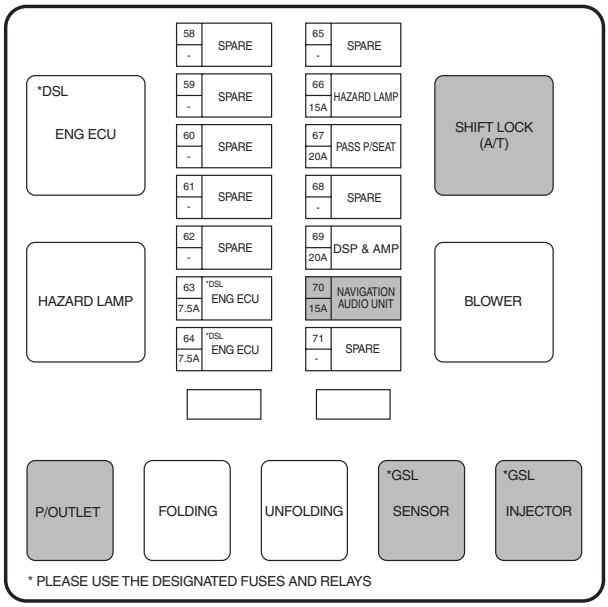


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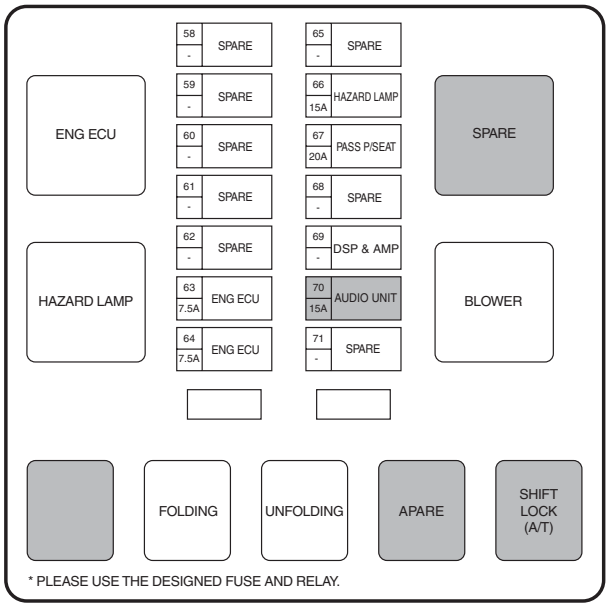
Fuse Box Label (Passenger's Side)



ACTYON



ACTYON SPORTS



*** Engine ECU Main Relays**

This supplies power to engine ECU, turbocharger and EGR valve vacuum modulator, HP pump IMV and HFM.

*** #63 Fuse (7.5A)**

This is designated as engine ECU fuse, but supplies power from the main relays to turbocharger, EGR vacuum modulator and HFM .

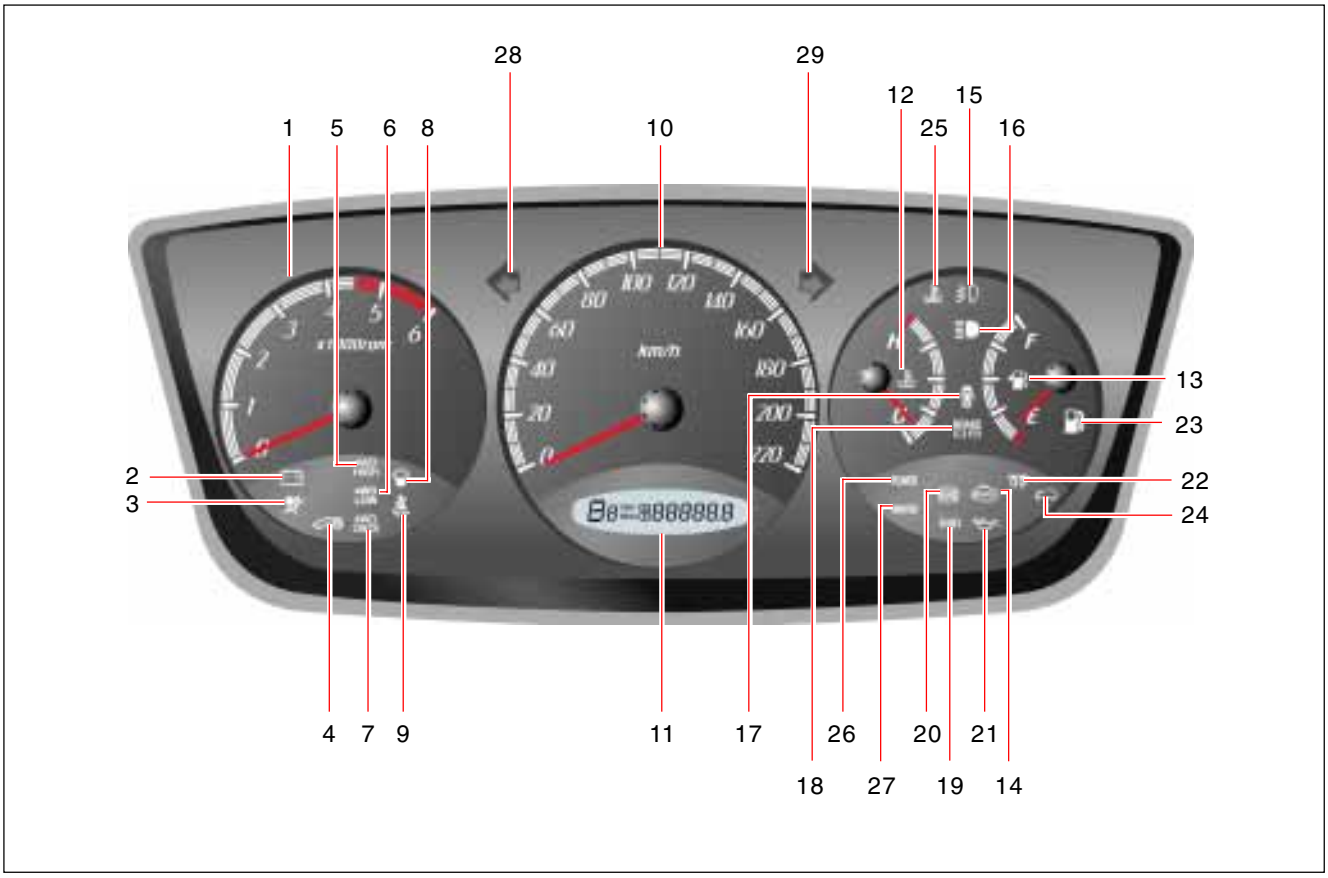
*** #64 Fuse (7.5 A)**

This supplies power to HP pump IMV. When the circuit is open, more fuel can be supplied because IMV is opened to the maximum.

INSTRUMENT CLUSTER

The instrument cluster of ACTYON SPORTS, which is very similar to ACTYON, newly adopts 4WD LOW due to the change in 4WD system. ESP and HDC do not exist, the indicators for those in the instrument cluster are also removed. The instrument cluster receives and sends the basic data from/to control units via CAN.

1. INSTRUMENT CLUSTER



1. Tachometer
2. Battery charge warning light
3. Air bag warning light
4. Immobilizer indicator
5. 4WD HIGH indicator
6. 4WD LOW indicator
7. 4WD CHECK warning light
8. Water separator warning light
9. Seat belt reminder (driver's seat)
10. Speedometer
11. ODOmeter/ Trip odometer
12. Engine coolant temperature gauge
13. Fuel gauge
14. Engine check warning light
15. Fog light indicator
16. High beam indicator
17. Door ajar warning light
18. Brake warning light
19. EBD warning light
20. ABS warning light
21. Engine oil pressure warning light
22. Glow indicator
23. Low fuel level warning light
24. Engine hood open warning light
25. Engine overheat warning light
26. Power mode indicator
27. Winter mode indicator
28. Left turn signal indicator
29. Right turn signal indicator

IMMOBILIZER KEY (with REKES key)

Door Unlock and Panic Function

Briefly press (below 0.5 sec): Door unlock and theft deterrent mode is deactivated

Press and hold (over 2 sec): Panic function

1. **Door unlock (Briefly press)**
   - If the unlock button on the remote control is pressed, the door will be opened and the theft deterrent mode will be activated. If the door coupled switch of front room lamp is pressed, the lamp will come on for 30 seconds. It will turn off immediately after the lock button of the remote control is pressed.
2. **Panic function: activated in the theft deterrent mode**
   - If you press and hold the door unlock and panic buttons, the buzzer will sound for 27 seconds.
   - The function is inactivated if any button of remote control is pressed.

LED flasher

Briefly press: blink once

Press and hold: blink twice



Door Lock Function

Briefly press (below 0.5 sec): Door lock and theft deterrent mode is activated

Door lock (Briefly press)

- If you press this button locks all doors and activates the theft deterrent mode.

Without REKES key

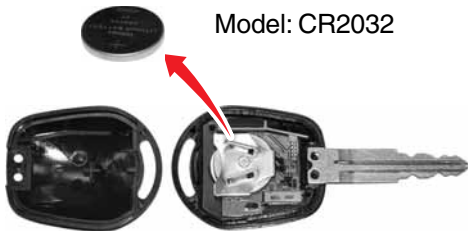


Battery Replacement

Model	CR 2032 (Rekes key type)
	V 625U (without Rekes)
Amount	One

With REKES





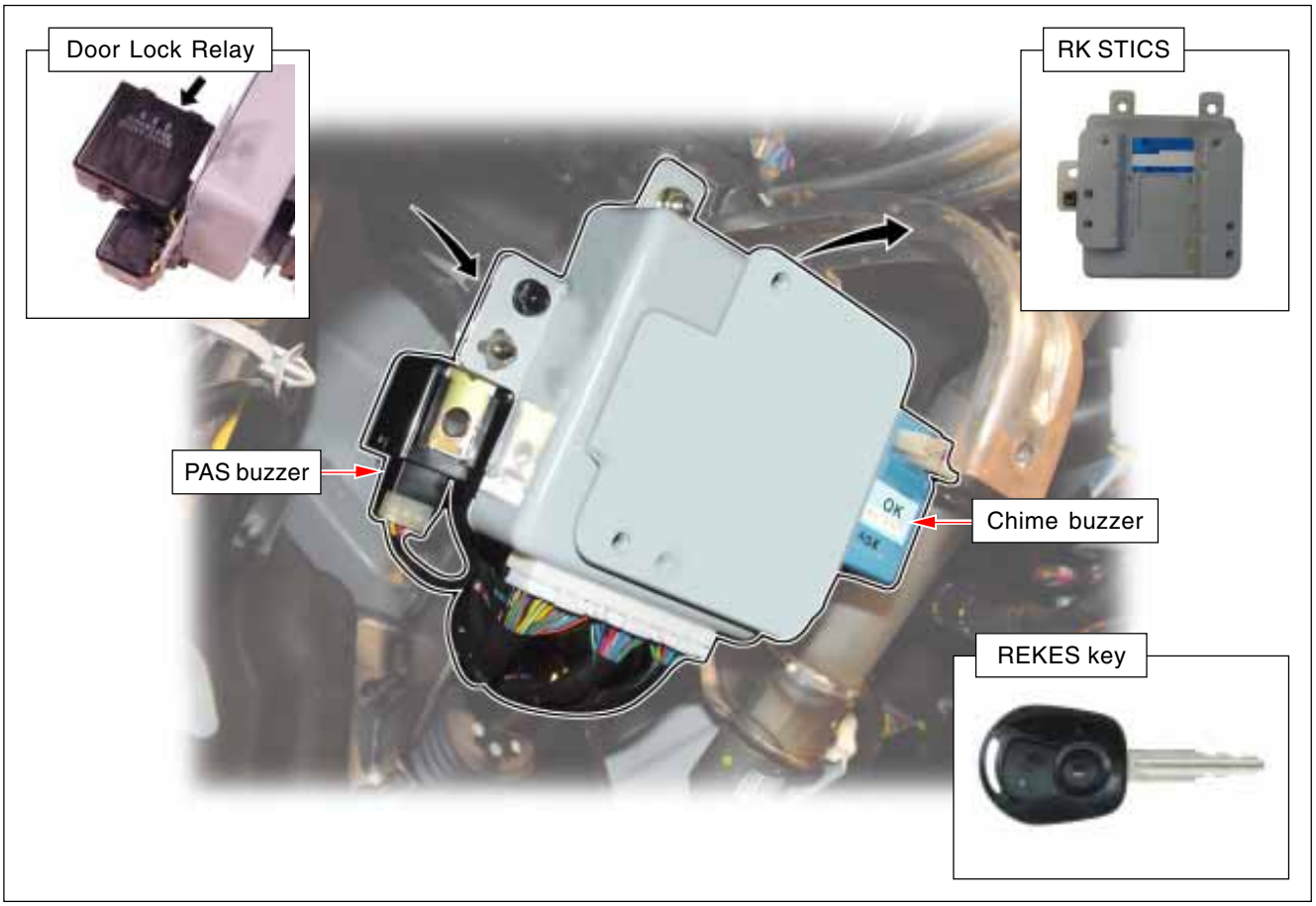
Without REKES key



RKSTICS (REKES+STICS) / STICS

1. OVERVIEW

STICS of ACTYON SPORTS, called as RKSTICS (REKES + STICS (Super Time & Integrated Control System)), is almost the same as that of ACTYON in terms of its function and role. Due to the removal of tailgate opening switch and rear wiper and washer system, the circuit layout is slightly changed, compared to ACTYON.



2. COMPARISON TO ACTYON (MAJOR CHANGES)

▶ **Rear wiper and washer system eliminated**

▶ **Tailgate open switch eliminated**

Since the tailgate opening switch is removed and the tailgate door switch is not adopted, the door ajar warning light in the instrument cluster does not come on even though the deck tailgate is opened.

▶ **Opening / Closing of the deck tailgate is not related to the operation condition of the theft deterrent mode.**

The deck tailgate can be controlled as lock/unlock status depending on the operation of central locking system by connecting the tailgate to the wiring line of the rear door. However, the opening/closing of the tailgate is not included in the operation condition of theft deterrent mode because the separate signal is not given to STICS.

Theft deterrent condition (according to door status): when engine hood, and front and rear doors are closed.

3. RATED LOAD & INPUT SIGNAL

Rated Load

NO.	Description	Rated Load
1	Chime bell / Buzzer	DC 12V 350 mA (Inductive load)
2	Front Room lamp	DC 12V 16W (Lamp load)
3	Rear Room lamp	DC 12V 8W (Lamp load)
4	Key hole illumination	DC 12V 1.2W (Lamp load)
5	Seat belt warning lamp	DC 12V 1.2W (Lamp load)
6	Parking brake warning lamp	DC 12V 1.2W (Lamp load)
7	Door ajar warning lamp	DC 12V 1.2W (Lamp load)
8	Door lock relay	DC 12V 200 mA (Inductive load)
9	Door unlock relay	DC 12V 200 mA (Inductive load)
10	Horn relay	DC 12V 200 mA (Inductive load)
11	Tail lamp relay	DC 12V 200 mA (Inductive load)
12	Hazard warning relay	DC 12V 200 mA (Inductive load)
13	Power window relay	DC 12V 200 mA (Inductive load)
14	Rear defogger relay	DC 12V 200 mA (Inductive load)
15	Wiper LOW relay	DC 12V 250 mA (Inductive load)
16	Wiper HIGH relay	DC 12V 250 mA (Inductive load)
17	Front washer motor	DC 12V 1.5A
18	Rear washer motor relay (Not used in ACTYON SPORTS)	DC 12V 500 mA (Inductive load)
19	Headlamp relay	DC 12V 750 mA (Inductive load)
20	Front defogger relay	DC 12V 200 mA (Inductive load)

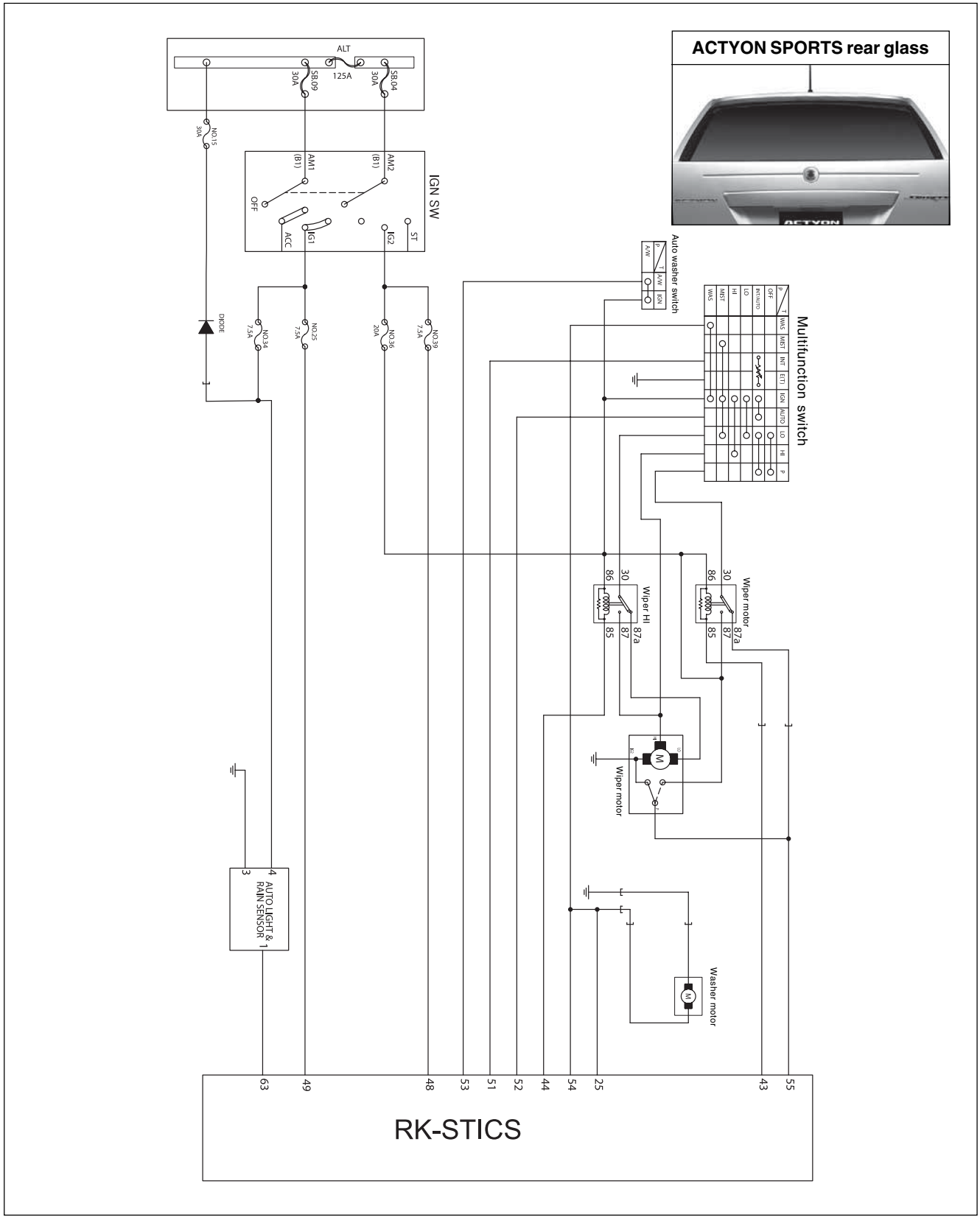
Input Signals

Dr: Driver's seat, Ps: Passenger's seat, Fr: Front seat, Rr: Rear seat

NO.	Input Signal Name	Logic Status
1	IGN1	ON = BAT (IGN ON or START)
2	IGN2	ON = BAT (IGN ON)
3	ALT_D	ON = BAT (engine running)
4	Key reminder (door ajar warning switch)	IGN = BAT (Key in)
5	Driver's door switch	OPEN = GND, CLOSE = OPEN
6	Passenger's door switch	OPEN = GND, CLOSE = OPEN
7	Rear door switch	- OPEN (one of rear seats) = GND - CLOSE (all rear seats) = OPEN
8	Tailgate switch (not used in ACTYON SPORTS)	OPEN = GND, CLOSE = OPEN
9	Hood switch	OPEN = GND, CLOSE = OPEN
10	Driver's door lock/unlock switch	LOCK = OPEN, UNLOCK = GND
11	Passenger's door lock/unlock switch	LOCK = OPEN, UNLOCK = GND
12	Rear door lock/unlock switch	- UNLOCK (one of rear seats) = GND - LOCK (all rear seats) = OPEN
13	Tailgate lock/unlock switch	LOCK = OPEN, UNLOCK = GND
14	Rear defogger switch	ON = GND, OFF = OPEN
15	Seat belt switch	Unfastened = GND, Fastened = OPEN
16	Hazard warning flasher selection switch	ON = GND, OFF = OPEN (For export only)
17	Parking brake switch	ON = GND, OFF = OPEN
18	Air bag collision sensor	ON = 200 ms output (LOW), OFF = OPEN
19	Wiper motor (parking) switch	STOP = BAT VOLTAGE, ROTATING = GND
20	Washer switch	ON = BAT, OFF = OPEN
21	Intermittent auto switch	ON = BAT, OFF = OPEN
22	Auto washer switch	ON = BAT, OFF = OPEN
23	Intermittent resistance	0W ~ 51 KW (for intermittent wiper)
24	Speed sensor	ON = GND (PWM), OFF = OPEN
25	IDR (coding)	ON = BAT, OFF = OPEN
26	Front defogger switch	ON = GND, OFF = OPEN
27	Auto hazard switch	ON = GND, OFF = OPEN
28	Central door lock switch	ON = GND, OFF = OPEN
29	Rear washer switch (not used in ACTYON SPORTS)	ON = GND, OFF = OPEN
30	Multifunction auto light switch	ON = GND, OFF = OPEN
31	Indicator lamp switch	ON = BAT/GND, OFF = OPEN (Approx. 5.1 V ~ 9.2 V)
32	Seat adjustment and switch memory unit	ON = GND (PWM), OFF = OPEN
33	Rain sensor	ON = GND (DATA), OFF = BAT
34	Diagnosis (SCAN-100)	ON = GND (DATA), OFF = BAT (KWP2000)
35	Rechargeable key and immobilizer	ON = GND (DATA), OFF = BAT (KWP2000)

4. CIRCUIT DIAGRAM OF WIPER

Rear wiper and washer system is not applied, the circuit related to rear wiper and washer is removed from the STICS circuit regarding wiper control.



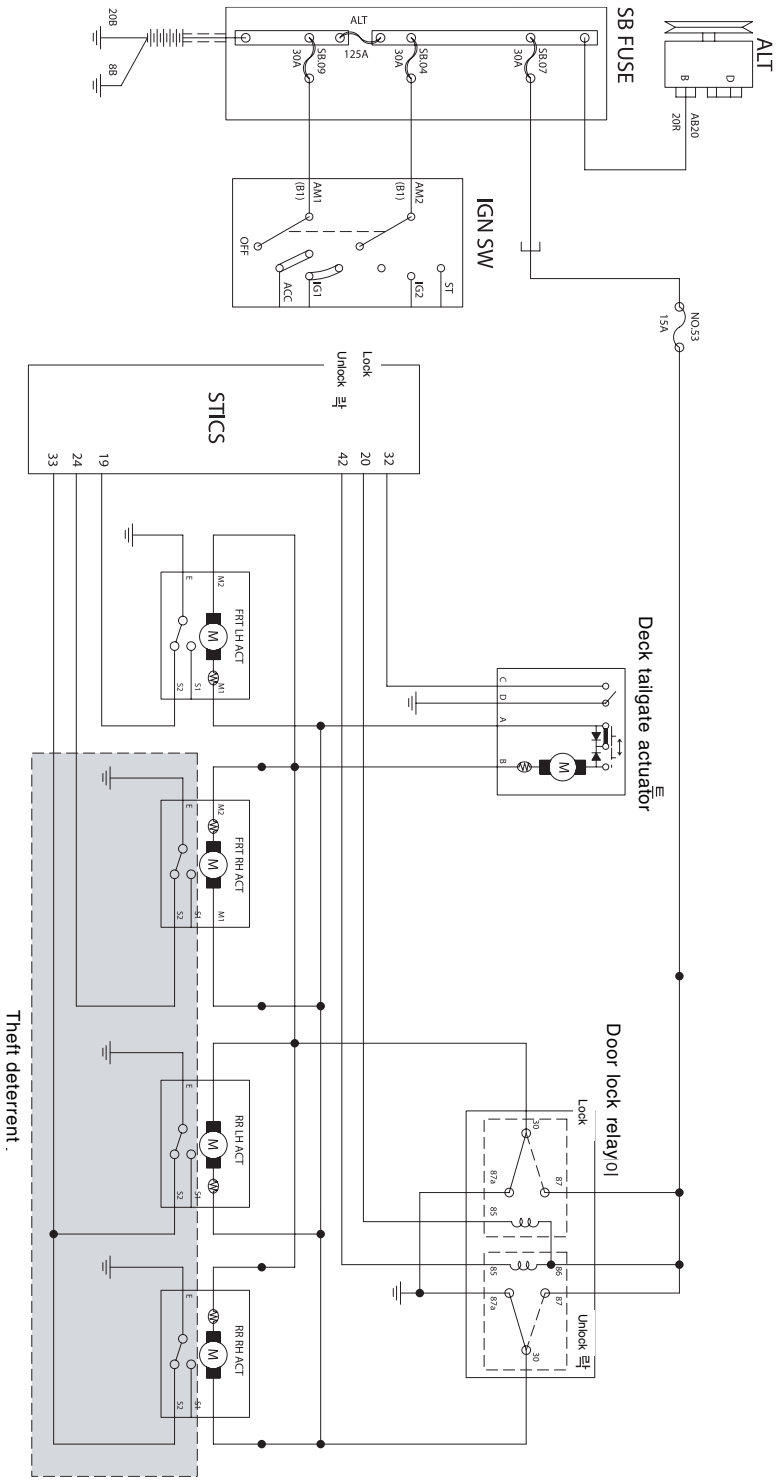
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5. CIRCUIT DIAGRAM OF DOOR LOCK

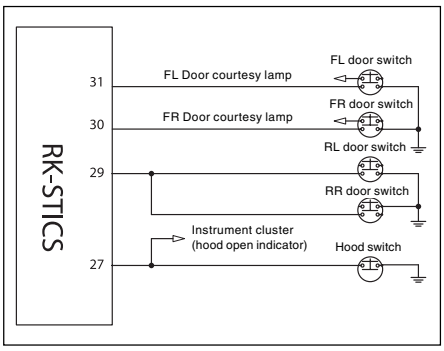
Since the deck tailgate is applied, the tailgate opening switch is removed and the tailgate door switch is not applied, the door ajar warning light in the instrument cluster does not come on even though the deck tailgate is opened.

ACTYON SPORTS Tailgate





*** STICS Circuit for Door Switch**



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AFFECTED VIN	

6. THEFT DETERRENT MODE

Followings are the definition on opening/closing of door and lock/unlock of the door lock switch in relation to the theft deterrent system.

1. **Door open (OPEN) and door close (CLOSE)**

   Door Open (OPEN): this means that one of engine hood, driver's door, passenger's door, or rear door switches is opened.

   Door Close (CLOSE): this means that engine hood, driver's door, passenger's door, rear doors and tailgate switches are all closed.

NOTICE

- **Engine hood is excluded in the door lock and door unlock control.**
- **Opening/Closing of the deck tailgate is not related to the operation condition of the theft deterrent mode, namely even though the deck tailgate is opened, the theft deterrent system will come into the theft deterrent mode as long as engine hood and the front and rear doors are closed.**

2. **Door lock (LOCK) and door unlock (UNLOCK)**

   Door Lock (LOCK): this means that driver's door, passenger's door, rear doors and tailgate lock switches are locked.

   Door Unlock (UNLOCK): this means that driver's door, passenger's door, rear doors and tailgate lock switches are unlocked.



Engine hood open warning light

When the engine hood is opened, this indicator comes on.

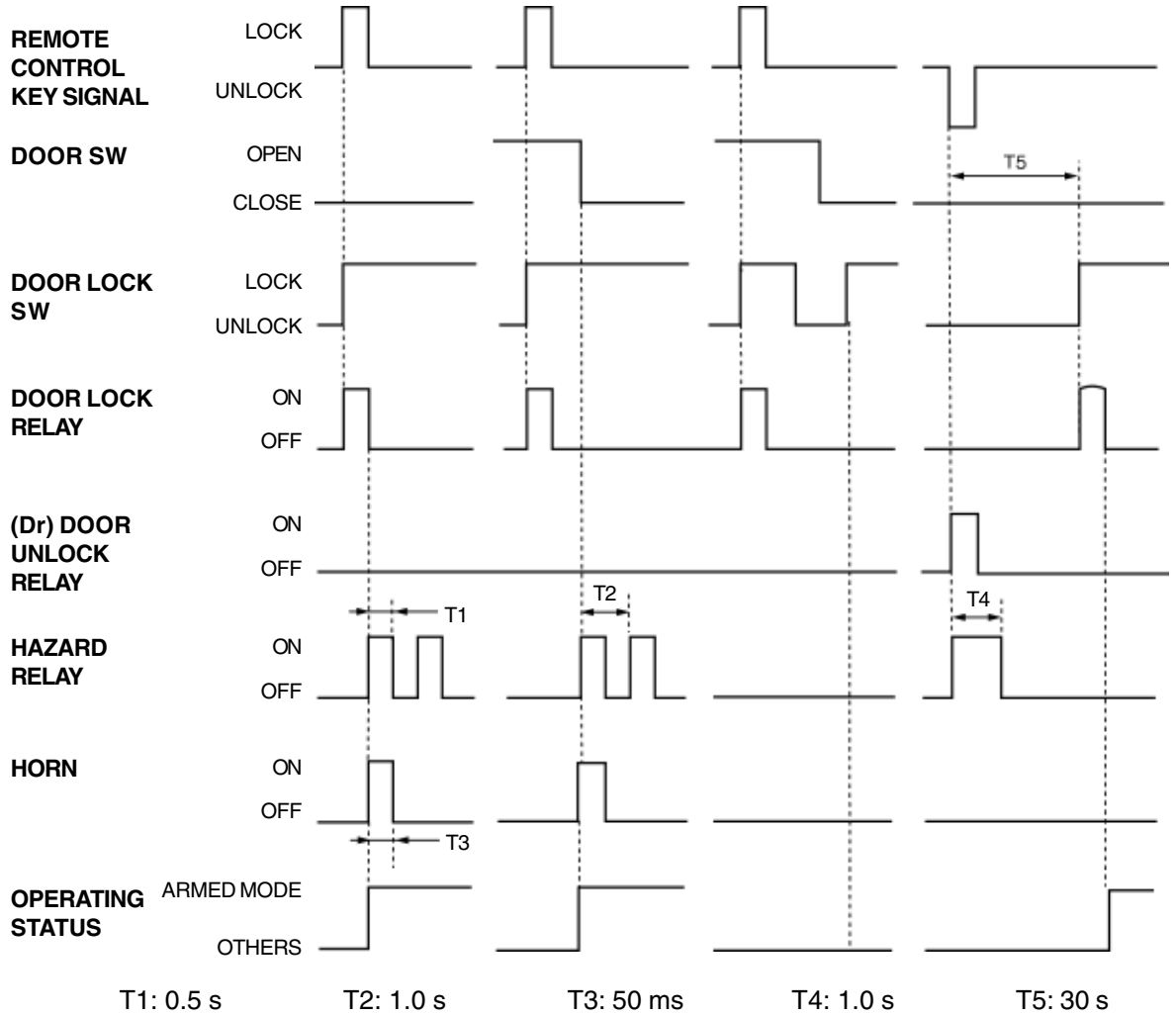
NOTICE

- **The door switch is not installed on the deck tailgate and accordingly, the door ajar warning light on the instrument cluster will not come on, even though the tailgate is opened.**

Description of Theft Deterrent Function

1. Armed mode activation requirements
   1) The “LOCK” output is “ON” when the “LOCK” signal is received from transmitter while the ignition key is removed and all doors are closed. The armed mode is activated when the door lock switch is locked (hazard warning flasher blink twice).
   2) The armed mode is still activated and the hazard warning flasher blink twice when the “LOCK” signal is received from the remote control key again in armed mode.
   3) When the “LOCK” signal is received from the remote control key while any of doors is not closed, only the “LOCK” output can be done and then activates the armed ready mode (without theft deterrent horn and hazard warning flasher). At this moment, if the ignition key is inserted or the door lock switch is unlocked, it cancels the armed mode and activates the normal mode.
   4) When the door is opened or the ignition key is not inserted into ignition switch within 30 seconds after receiving “UNLOCK” signal from the remote control key, it outputs “LOCK” and then activates armed mode (RELOCK operation). Also, at this moment, the system blinks hazard warning flasher twice.
   5) The armed mode will not be activated except above conditions.

      Ex) The armed mode will not be activated when the door is locked by the ignition key.

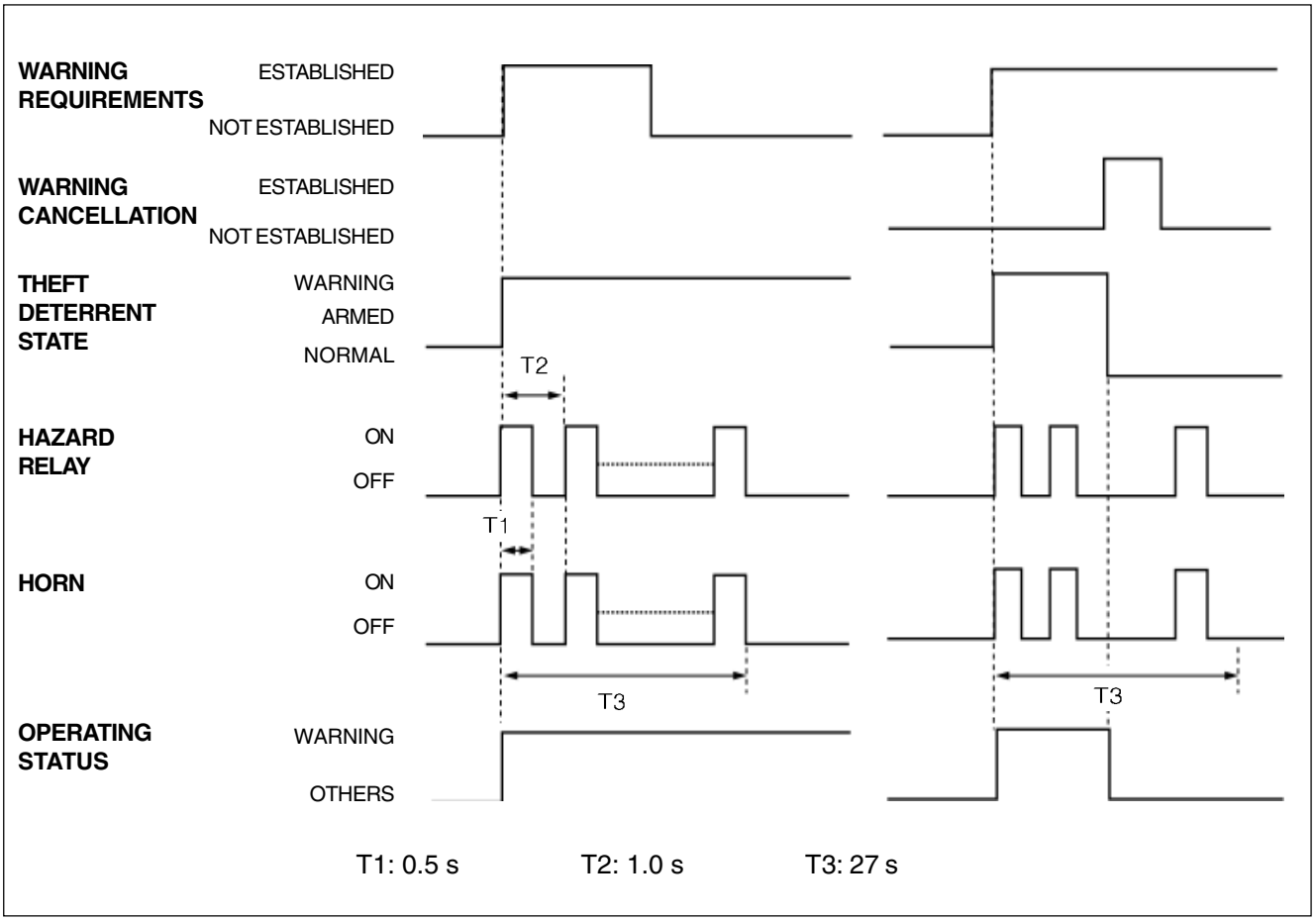


T1: 0.5 s T2: 1.0 s T3: 50 ms T4: 1.0 s T5: 30 s

* The deck tailgate is not included in the operation conditions of theft deterrent system, because there’s no door switch.

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AFFECTED VIN	

2. Armed mode cancellation requirements
   1) Receiving UNLOCK signal from the remote control key or starting the engine.
3. Warning operation requirements
   1) When opening the door in armed mode
   2) When unlocking the door lock switch in armed mode by other than the remote control key
   3) When closing and then opening the door after completion of warning (27 seconds)
4. Warning operation
   1) The theft deterrent horn and hazard warning flasher output is “ON” for 27 seconds at the interval of 1 second.
5. Warning cancellation requirements
   1) Cancels warning by using any signal from the remote control key (LOCK, UNLOCK, PANIC) during warning operation.
   2) Cancels warning after 27 seconds (remaining time) while the ignition key is turned to “ON” position.
   3) If the ignition switch is turned to ON position when the warning is activated in armed mode, the warning is cancelled immediately and the warning buzzer stops after 27 seconds (remaining time).
6. Operation when warning is cancelled
   1) The theft deterrent horn and hazard warning flasher outputs are “OFF”.

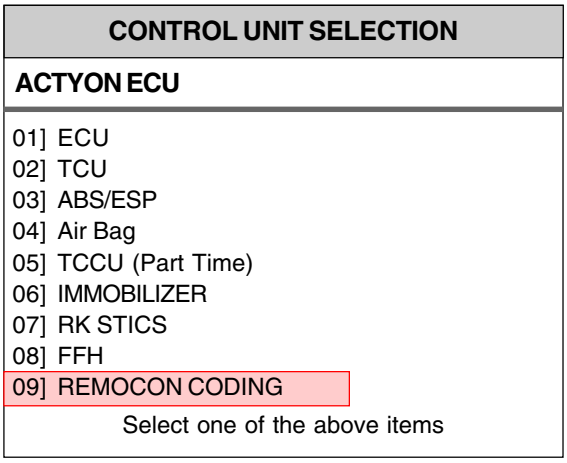


7. CODING PROCEDURE FOR REKES KEY

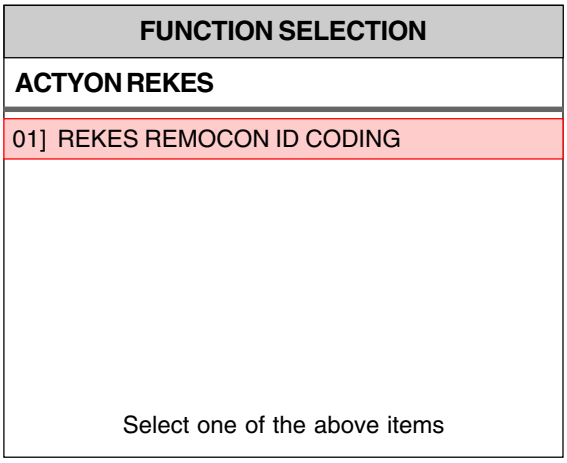
When you lost the REKES key (Transmitter) or you want to recode it, you should use a scanner.

REKES key of ACTYON SPORTS is the same as that of REXTON II, not ACTYON. To code the REKES key of REXTON II, the door unlock button should be pressed for more than two seconds (panic signal) when the scanner is being connected. However, pressing one of the buttons for about 2 seconds will send the coding signal in case of REKES key coding of ACTYON SPORTS (the same procedure as ACTYON).

1. Connect the scanner and select the desired ACTYON model to choose Remocon coding.

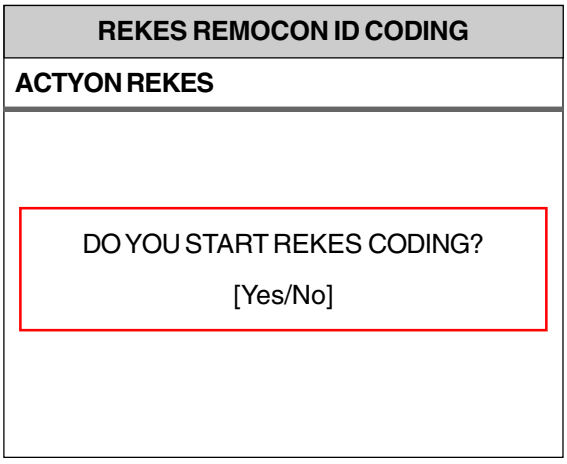


2. Press ENTER on the following screen.

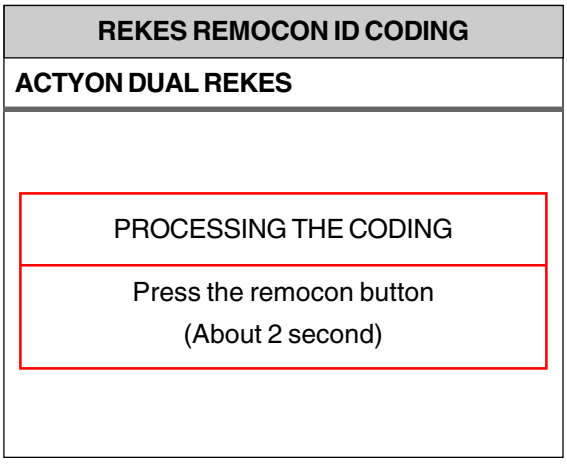


3. Press YES on the following screen to code the REKES key.

<u>The existing code is deleted.</u>



4. Press any button on the remote control key for 2 seconds. A “beep” sound is heard.



To next page

5. When the first key coding is completed, the following screen is displayed. Press YES to perform the second REKES key coding.

REKES REMOCON ID CODING
ACTYON REKES
>>>>>>1st KEY CODING OK<<<<<<
REMOCON ID. CODE: 0X AX FX XX KEY CODE NUMBER: 01
DO YOU START 2nd KEY CODING? [Yes/No]

NOTE

- **The second REKES coding is performed only if there is the second REKES.**

6. Press any button on the secondary remote control key for 2 seconds. A “beep” sound is heard.

REKES REMOCON ID CODING
ACTYON DUAL REKES
PROCESSING THE CODING
Press the remocon button (About 2 second)

7. When the second key coding is completed, the following screen is displayed. Press ENTER to finish the REKES key coding.

REKES REMOCON ID CODING
ACTYON DUAL REKES
>>>>>>2nd KEY CODING OK<<<<<<
REMOCON ID. CODE: 0X AX FX XX KEY CODE NUMBER: 02
[ENTER: EXIT]

8. When the coding is completed, it returns to the following screen.

CONTROL UNIT SELECTION
ACTYON ECU
01] ECU 02] TCU 03] ABS/ESP 04] Air Bag 05] TCCU (Part Time) 06] IMMOBILIZER 07] RK STICS 08] FFH 09] REMOCON CODING
Select one of the above items

9. Exit SCAN-100 screen and disconnect it from the diagnostic connector to check the function of the remote control key. If it does not work, perform the above procedures again.

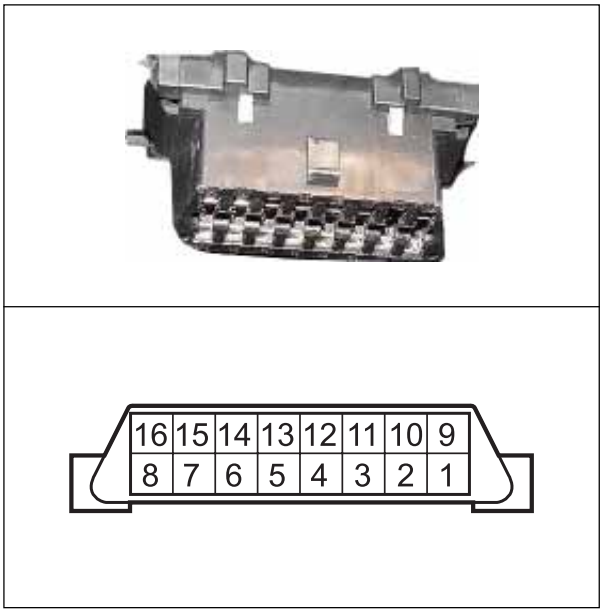
8. PIN ARRANGEMENT OF DIAGNOSIS CONNECTOR

Diagnosis connector is installed at the lower driver side instrument panel and it consists of 16 pins. REKES key coding should be done using SCAN-100. Compared to ACTYON, pin No. 1 and No. 2 are not used in ACTYON SPORTS because FFH system is not applied.



▶ Pin Functions

Pin no. 1	FFH diagnosis (not used in ACTYON SPORTS)
Pin no. 2	FFH forced driving (not used in ACTYON SPORTS)
Pin no. 3	STICS
Pin no. 4	Ground
Pin no. 5	Signal ground
Pin no. 6	CAN - HIGH
Pin no. 7	Engine ECU
Pin no. 8	ABS
Pin no. 9	Air bag
Pin no. 10	-
Pin no. 11	TCU
Pin no. 12	-
Pin no. 13	TCCU
Pin no. 14	CAN - LOW
Pin no. 15	REKES coding
Pin no. 16	Battery +



NOTICE

- **Connecting REKES coding pin (No. 15) of the diagnosis connector to the jump wire between ground terminals doesn't allow REKES coding. (it can be done only with SCAN-100).**

MULTIFUNCTION SWITCH

Since rear wiper and rear washer system is not applied, rear wiper control switch on the multifunction wiper switch is removed.

1. MULTIFUNCTION WIPER SWITCH

MIST

When moving up the wiper lever, the wipers operate once. The lever will return to the "OFF" position when released.

OFF

Stops the operation.

AUTO

Automatically operates according to the vehicle speed or amount of rain.

LO

Continuous wipe, slow operation

HI

Continuous wipe, fast operation

Front automatic wiping speed control switch

FAST: Fast interval

SLOW: Slow interval



DAYTIME RUNNING LIGHT (DRL): For Countries Mandating DRL

For vehicles equipped with the DRL, the tail lights automatically turn on when turning the starter key from ACC to ON.

The headlights turn on as the engine starts.

With the headlights automatically ON, turning the light switch from OFF to ON turns off the headlights but keeps the tail lights on. (Turning the light switch immediately deactivates the DRL function.)

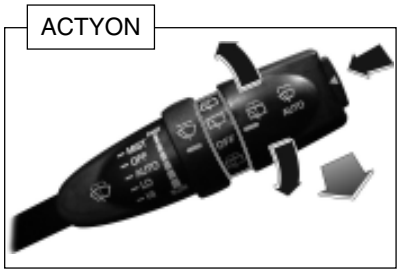
Front auto washer and wiper switch (AFW)

When the front wiper switch is off and this switch is pressed, washer fluid will be sprayed and the wiper will automatically operate 4 times. Then, the fluid will be sprayed again and the wiper will automatically operate 3 times.

Rear wiper and wiper control switch is removed. (Used in ACTYON)



ACTYON



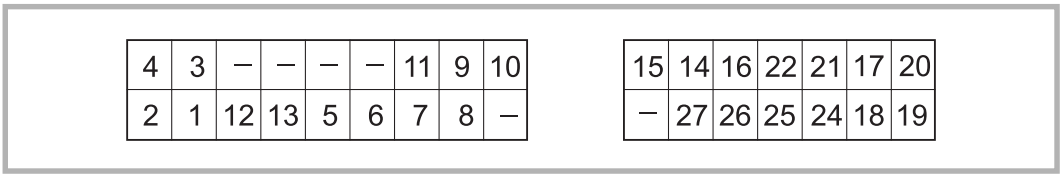
Wiper and washer fluid coupled operation

Pull the lever briefly for less than 0.6 seconds:
One wiping cycle with washer spray

Pull and hold the lever for more than 0.6 seconds:
Three wiping cycles with washer spray

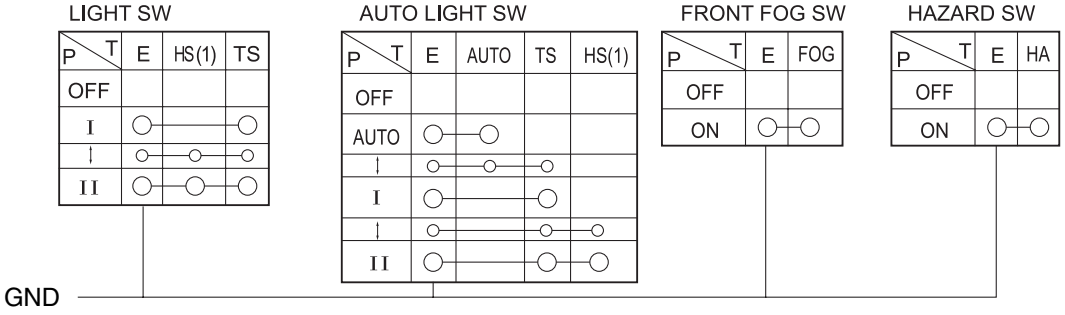
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EFFECTIVE DATE	
AFFECTED VIN	

2. MULTIFUNCTION SWITCH CONNECTOR AND FUNCTION

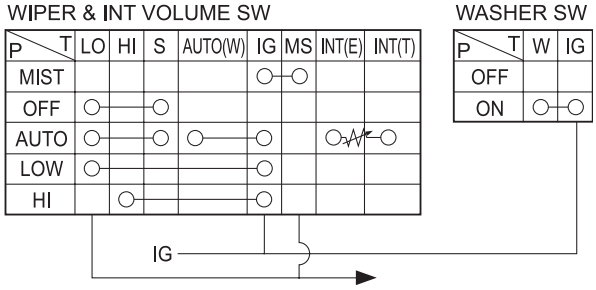


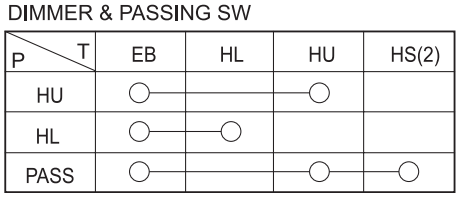
4	3	–	–	–	–	11	9	10
2	1	12	13	5	6	7	8	–

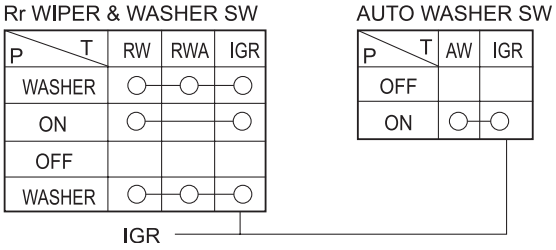
15	14	16	22	21	17	20
–	27	26	25	24	18	19



1	EB	Dimmer and passing ground
2	HL	Headlamp low beam
3	HU	Headlamp high beam
4	HS (2)	Passing
5	TS	Tail lamp switch
6	HS (1)	Headlamp switch
7	AUTO	AUTO light
8	E	Light/fog/hazard warning switch ground
9	TB	Flasher unit ground
10	TL	Turn signal (LH) lamp switch
11	TR	Turn signal (RH) lamp switch
12	FOG	Front fog light switch
13	HA	Hazard switch
14	LO	Low wiper speed
15	HI	High wiper speed
16	S	Wiper stop
17	AUTO (W)	Intermittent wiper
18	INT (T)	Intermittent wiper
19	INT (E)	Intermittent wiper ground
20	W	Front washer switch
21	IG	IG
22	MS	Low wiper speed
23	-	
24	AW	AUTO washer switch
25	IGR	IGR
26	RW	Rear wiper (Not used in ACTYON SPORTS)
27	RWA	Rear wiper & washer (Not used in ACTYON SPORTS)





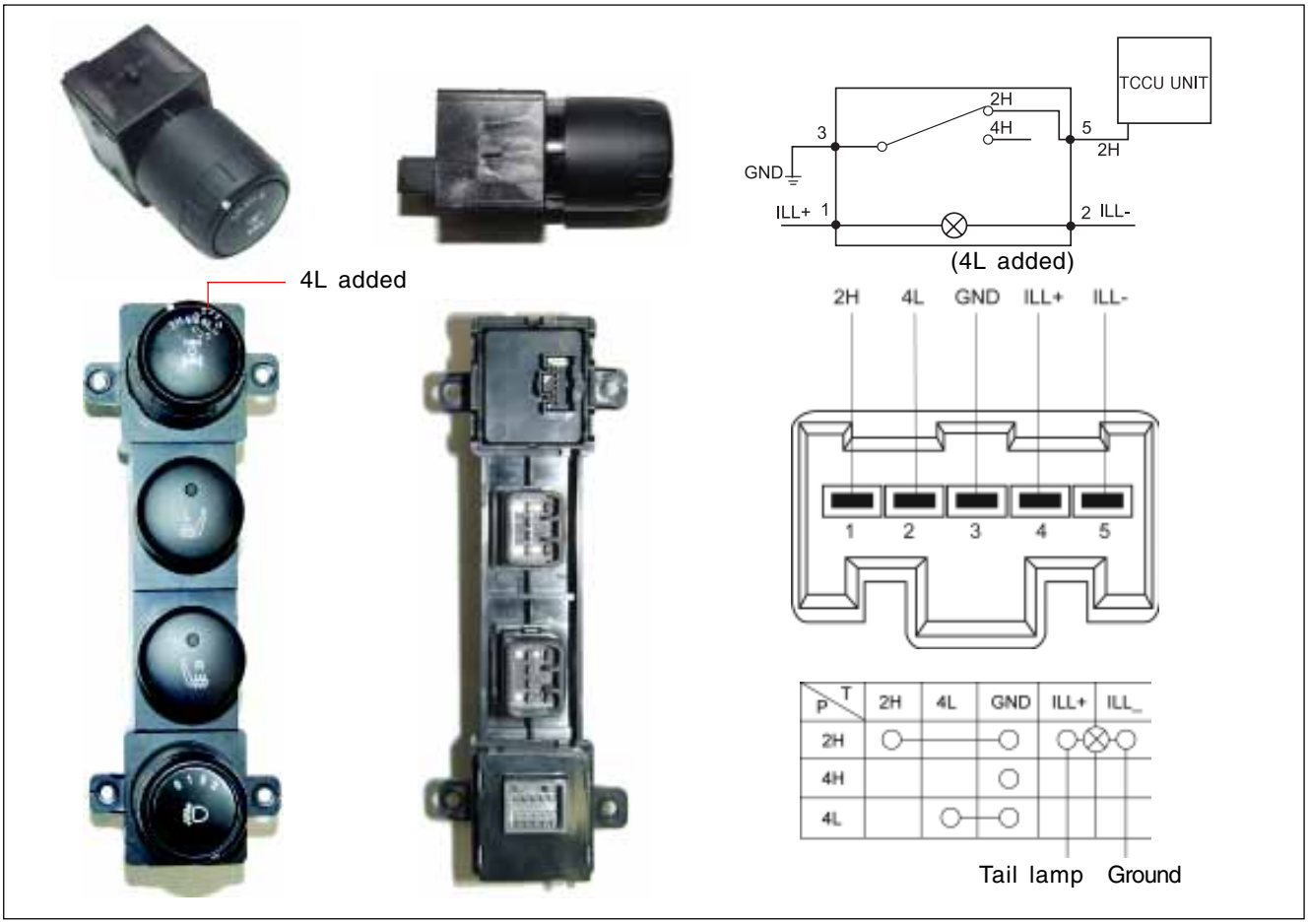


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EFFECTIVE DATE	
AFFECTED VIN	

4-WHEEL DRIVE SWITCH

1. SWITCH OVERVIEW

4L function is newly applied. 4WD system is operated by the rotary switch and its position is recognized in TCCU. The switch has the illumination connected to the tail lamp circuit. (TCCU is compatible with that of ACTYON)



CAUTIONS WHEN USING 4-WHEEL DRIVE MODE

- There could be mechanical noises and shocks during mode shifts. However, these are normal conditions due to the mode shifting operations.
- Use only the 2H mode on a normal paved surface. Do not drive your vehicle in the “4H” position on a normal paved surface. Doing so will result in damages to the drive train.
- Driving in a 4 wheel mode on a normal paved surface will cause unwanted noises, premature wear of tires, or increased fuel consumption.
- For safety reasons, depress the brake and decrease the vehicle speed when shifting to 4L or shifting from 4L to other wheel drive system.
- When “4WD CHECK” warning light comes on, or “4WD LOW” and “4WD HIGH” lights simultaneously come on or blink, or one of them blinks, have 4WD system checked because it may indicate that shifting in 4WD system is defective.
- When cornering a curved road in a 4-wheel drive mode, there could be some mechanical shocks and resistances in vehicle’s drive train. These are normal conditions due to internal resistance in the drive train when the 4-wheel drive mode is properly working. To avoid damages to the drive train, do not drive your vehicle with an excessively high speed on a sharply curved road.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

PARKING AID SYSTEM

1. CONFIGURATION

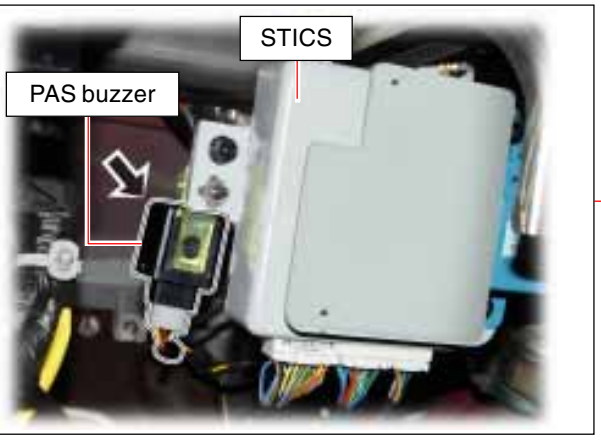
The parking aid device is integrated in the rear bumper and it uses three Piezoelectric elements to measure vertical and horizontal distance to obstacles.

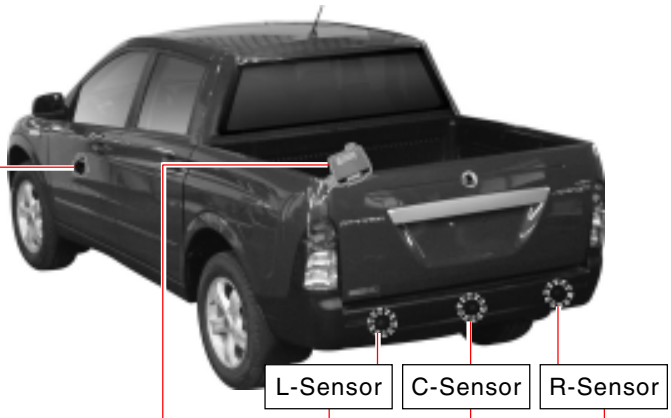
When the shift lever is placed to “R” position, the designated unit (same as REXTON II PAS unit) activates the parking aid sensors to measure the distance to obstacles.

The PAS unit of ACTYON displays the malfunctions using the LED when there are any defects in sending/receiving signal or the open circuit to sensor. On the other hand, the PAS unit of ACTYON SPORTS informs the malfunction of the relevant sensor using a buzzer. (Same as REXTON II)

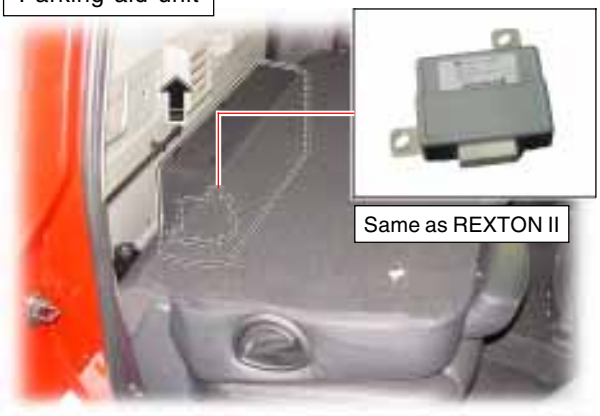
Shift Lever (R Position)







Parking aid unit



Location: on the end floor of the rear seat.
(work with it after removing the storage box)

Same as ACTYON



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ COMPONENT SPECIFICATIONS

The parking aid system emits the supersonic wave signals from the sensors on the rear bumper at a specific interval and detects the reflected signals from obstacles while the shift lever is in "R" position. The alarm interval increases as the obstacle approaches. This supplementary system is useful to measure the distance when parking.

Descriptions		Value	Descriptions		Value
Rated voltage		DC 12 V	Operating temperature		-30°C ~ +80°C
Operating voltage		DC 9 V ~ 16 V	Preserving temperature		-40°C ~ +85°C
Max allowed current	Unit	Below 100 mA	Relative humidity		95% RH max
	Sensor	Below 20 mA (each)	Weight	Unit	160g ± 10g max
Sensor insulating resistance		Over 5MΩ		Sensor	70g ± 10g max

Parking Aid Unit

Detecting type: Supersonic wave

Detecting distance: 25 ~ 120 cm (distance between sensor and obstacle)





Parking Aid Sensor

- Detecting type: Supersonic wave
  (Piezo ceramic element)

  The sensors detect the distance to obstacles by measuring the time when the supersonic wave emitted from the sensor is reflected by obstacles and returned to the sensor.
- Frequency (supersonic wave): 40 KHz ± 1 KHz
- Detecting distance: 25 cm ~ 120 cm
  (distance between sensor and obstacle)
- Tolerance: ± 5 cm

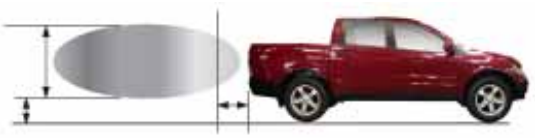


2. ALARM INTERVAL

▶ Alarm Interval

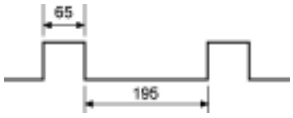
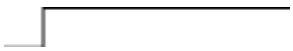
While reversing, if obstacles are within stage 1, the warning beep sounds with long intervals. If within stage 2, the warning beep sounds with short intervals and if within stage 3, the warning beep sounds continuously.

Sensing Distance



Within 20 cm from the ground
(Intrinsically, supersonic wave sensors may not detect obstacles within 20 cm from the ground)

Within 25 cm from the bumper
(Intrinsically, supersonic wave sensors may not detect obstacles within 25 cm from the bumper)

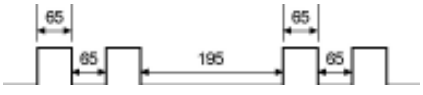
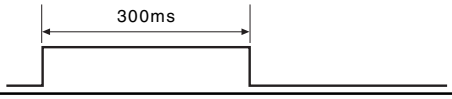
Stage	L, R Sensor	C Sensor	Interval (msec)	Remark
1	90 ~ 120 cm	90 ~ 120 cm		“beep----, beep----”
2	60 ~ 90 cm			“beep-, beep-, beep-”
3	25 ~ 60 cm			“beep----”
Tolerance	± 5 cm		±10%	

▶ Troubleshooting of Sensor

When the power is supplied (shift lever is in “R” position), the sensor will be diagnosed once. If there found more than one failure due to open circuit to sensor or communication error, warning buzzer sounds for 3 seconds and the data on failed sensor transmits to the instrument cluster to light up the corresponding LED. If it is normal, the warning buzzer sounds once for 65 ms.



※ When the sensor failed in self-diagnostics

Fault mode	Interval (msec)	Remark
When L (Left) sensor failed		“beep----beep”
When C (Center) sensor failed		“beepbeep---- beepbeep”
When R (Right) sensor failed		“beepbeepbeep---- beepbeepbeep”
When more than one sensor failed		“beepbeepbeepbeep”

3. CAUTIONS ON PARKING AID SYSTEM

Cautions

- Note that the display does not show everything in the rear area. Always check nobody, especially animals and children, is behind the vehicle when parking or reversing.
- If you can not properly check the vehicle behind, get out of the vehicle and then visually check it.

1. The parking aid system is just a supplemental device to help your parking.
2. Always keep the safety precautions.
3. Do not press or shock the sensors by hitting or high-pressure water gun while washing, or the sensors can be damaged.
4. If the system is in normal operating condition, a short beep sounds when the shift lever is moved to “R” position with the ignition key “ON”.

The parking aid system will not work or improperly work under following cases:

1. Obstacles that sensors can not detect

- Wires, ropes, chains.
- Cotton, sponge, clothes, snow that absorb ultrasonic waves.
- Obstacles lower than the bumper (ex. drain ditch or mud puddle)

2. Not defective but poorly working

- When the sensing portion is frozen (operates normally after thawing)
- When the sensing portion is covered by rain, water drops, snow or mud (operates normally after cleaning)
- When receiving other ultrasonic signals (metal sound or air braking noises from heavy commercial vehicles)
- When a high-power radio is turned on

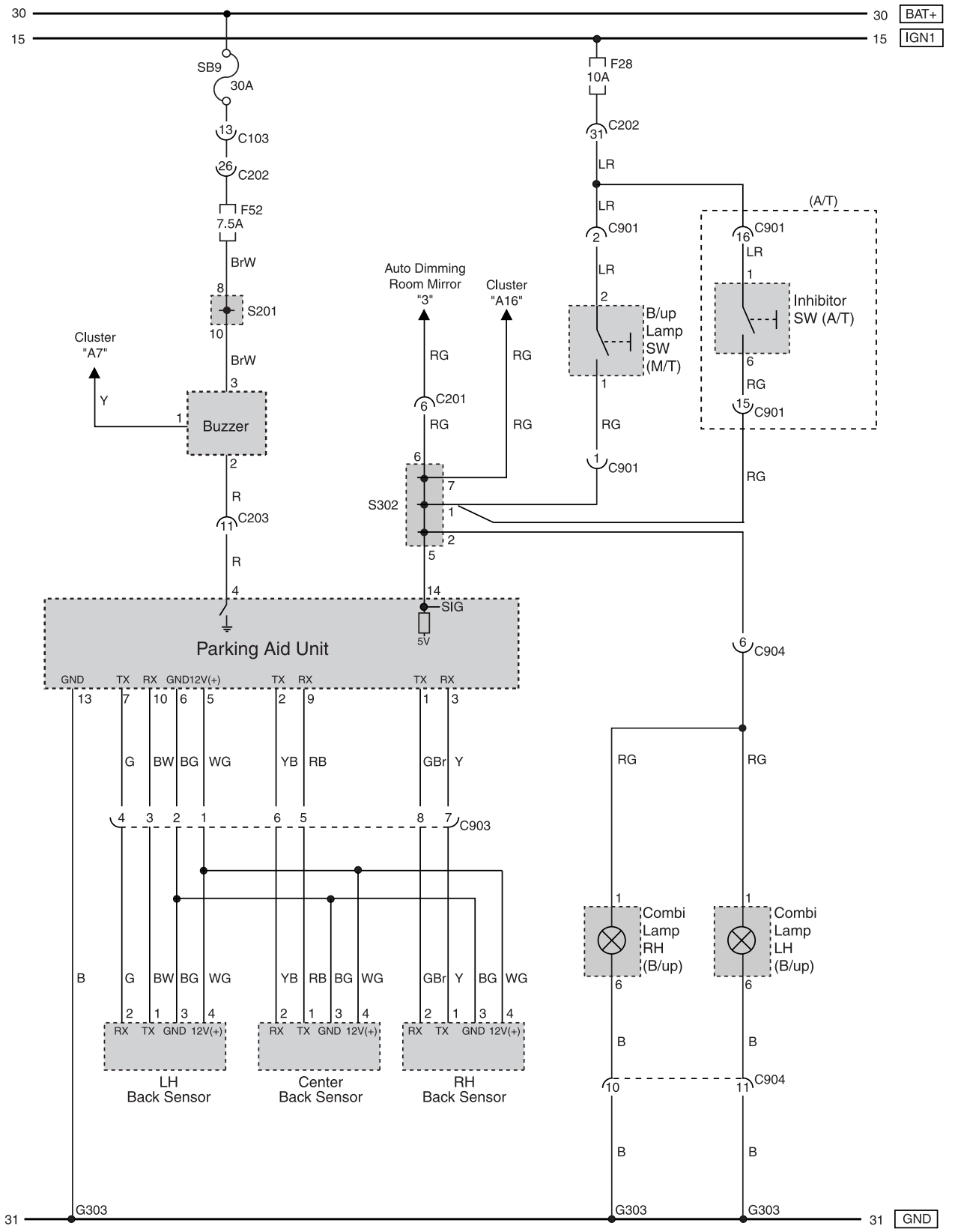
3. Narrowed sensing area

- When the sensing portion is partially covered by snow or mud (operates normally after cleaning)
- Surrounding temperature of sensor is too high (over approx. 80°C) or too low (below approx. -30°C)

4. Not defective but improperly working

- When driving on rough roads, gravel road, hill and grass
- When the bumper height is changed due to heavy load
- When the sensing portion is heavily frozen
- When the sensing portion is heavily covered by rain, water drops, snow or mud
- When receiving other ultrasonic signals (metal sound or air braking noises from heavy commercial vehicles)
- When a high-power radio is turned on
- When some accessories are attached in detecting ranges

4. CIRCUIT DIAGRAM



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AFFECTED VIN	

5. REMOVAL AND INSTALLATION OF PARKING AID

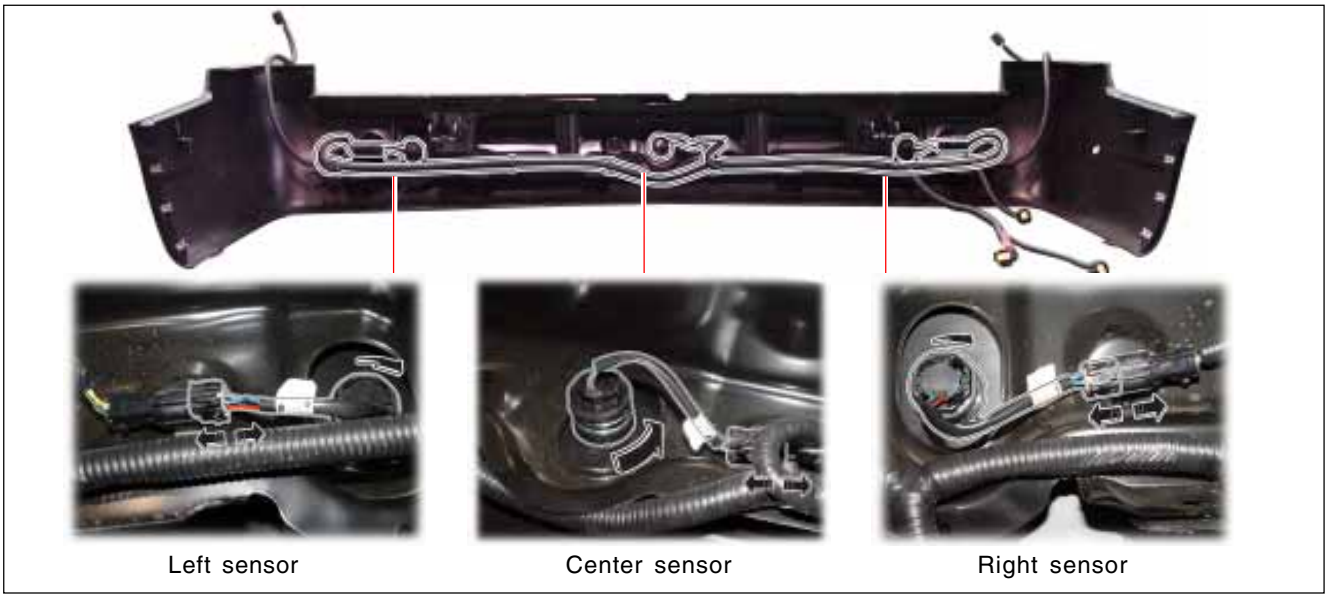
Parking Aid Sensor

※ **Preceding Work:** remove (-) terminal of the battery or the ignition key.





1. Disconnect the sensor connector and remove the cover by rotating the cover.



Left sensor Center sensor Right sensor

2. Remove the PAS sensor by pushing toward outside from the inside of the bumper.



PAS Sensor Installation



When installing the sensor on the bumper, be sure to completely fit into their grooves.



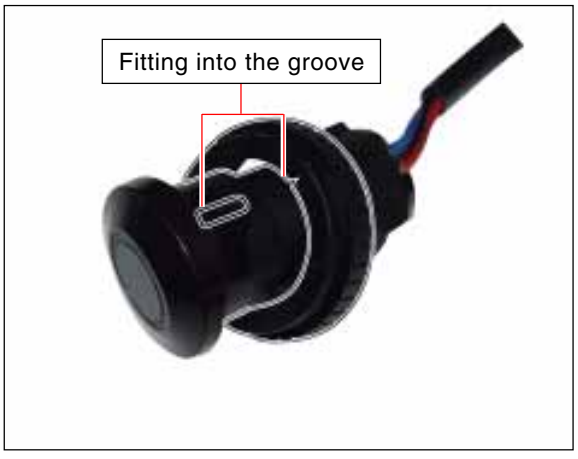
When it is pulled out



When it is shrunk



1. Fit the lower cover of the sensor into the groove for the sensor.



2. Fit the upper cover of the sensor into the groove for the sensor.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

PAS UNIT

※ Preceding Work:

1. Disconnect the (-) terminal of battery.
2. Fold down the seatback in the rear seat, and take out the storage box.

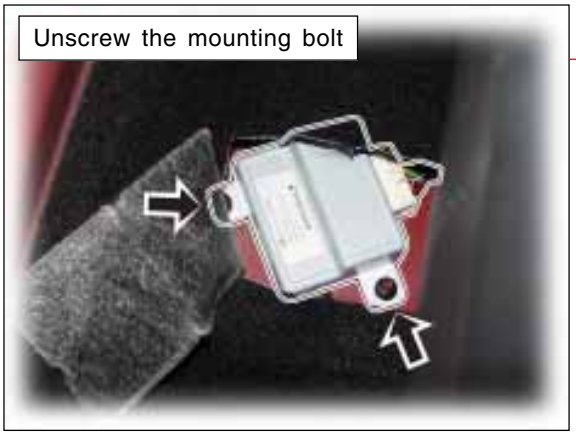


1. Remove the floor mat which is installed PAS unit from the behind of the folded rear seat.
2. Disconnect the connector of PAS unit and unscrew the mounting bolts (10 mm - two), and remove the PAS unit.

Removal of storage box (PAS unit is installed under the storage box.)



Unscrew the mounting bolt



Disconnect the connector





Piezo Buzzer for PAS

※ Preceding Work:

1. Disconnect the (-) terminal of battery.
2. Remove the lower instrument panel assembly (Driver's side).



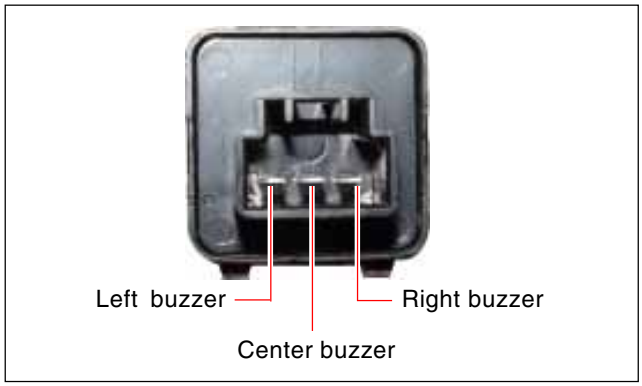
1. Disconnect the Piezo buzzer connector and its mounting bolt.





2. Remove the buzzer assembly.





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

TAIL LAMP ASSEMBLY

1. TAIL LAMP CONFIGURATION

Tail lamp consists of a rear combination lamp (stop lamp, tail lamp, turn signal lamp, back-up lamp) and license plate lamp, etc.



License Plate Lamp



Left/right: one (12V/5W)

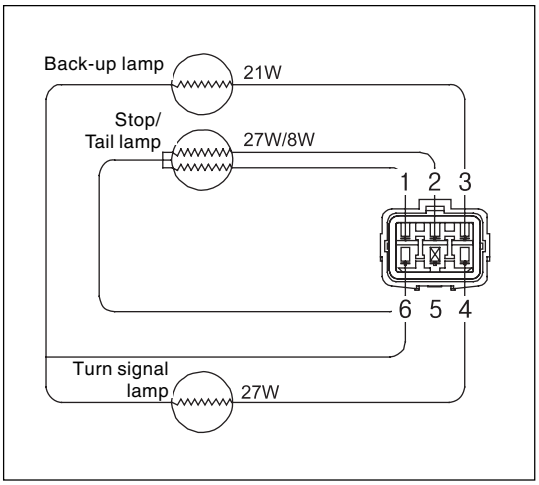
Rear Combination Lamp



Stop/Tail lamp
12V-27/8W

Turn signal lamp
12V-27W

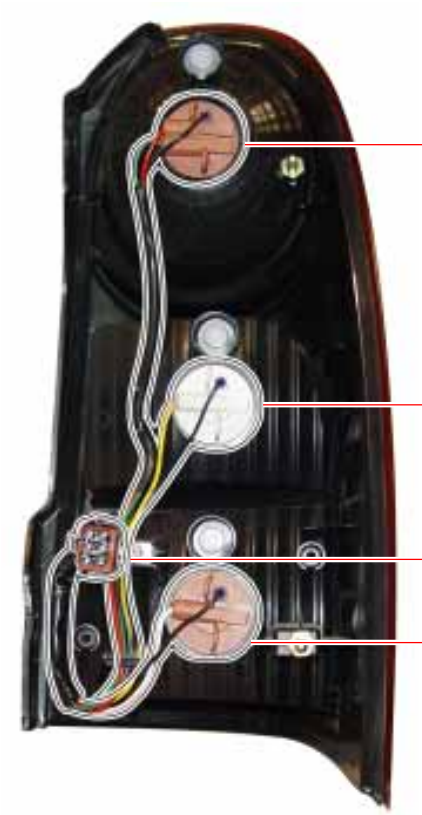
Back-up lamp
12V-21W



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Shape and Specification of Rear Combination Lamp Bulb





Stop Lamp / Tail Lamp Bulb



12V - 27/8W

Turn Signal Bulb



12V - 27W

Main Connector



Back-up Lamp Bulb

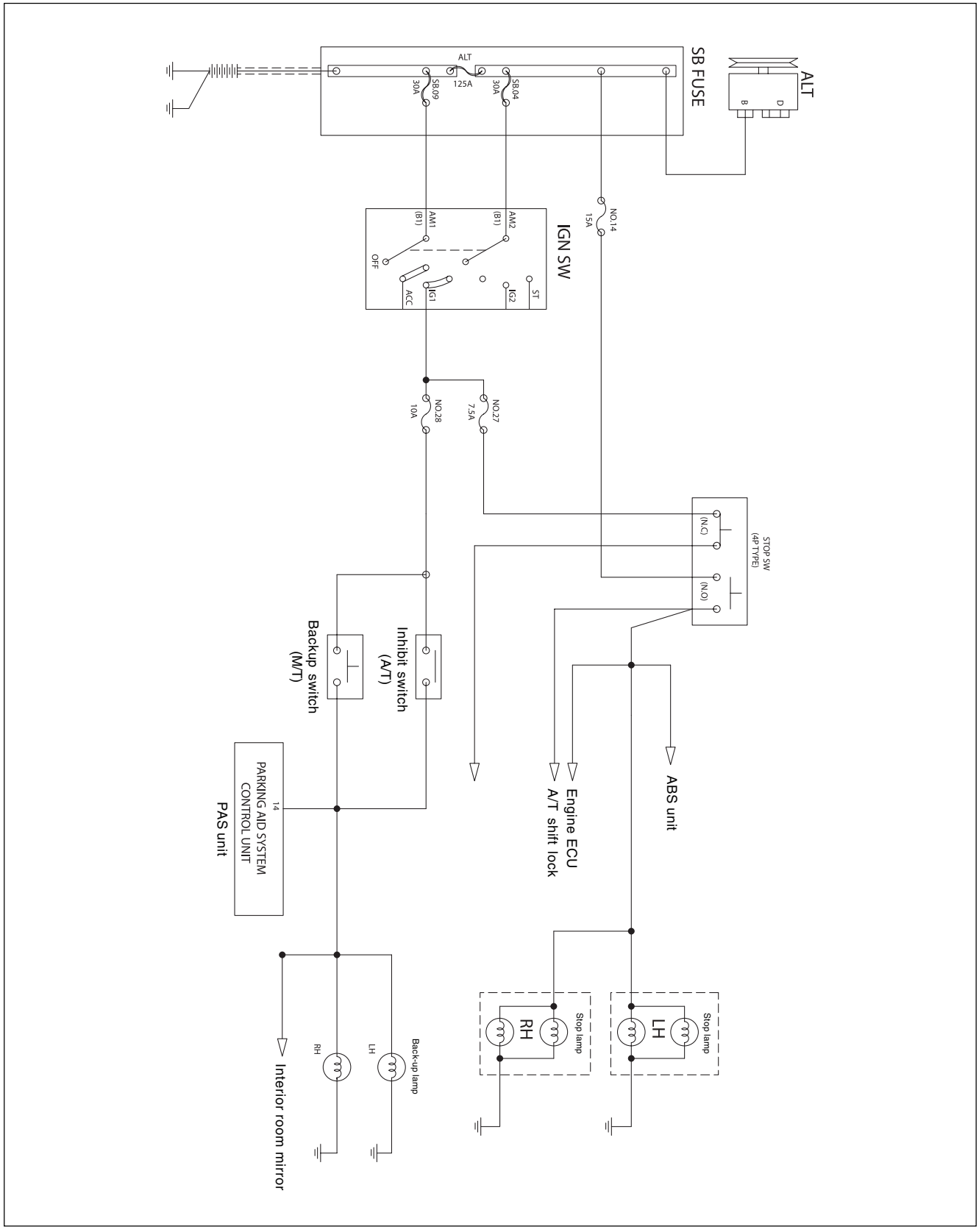


12V - 21W

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. REAR LAMP RELATED CIRCUIT

▶ Tail Lamp Circuit Diagram



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. REMOVAL AND INSTALLATION OF REAR COMBINATION LAMP (BULB REPLACEMENT)

Rear Combination Lamp Assembly

※ **Preceding Work:** Disconnect the (-) terminal of battery or turn off the ignition switch.

1. Open the tailgate and unscrew two mounting screws to remove the rear combination lamp assembly.

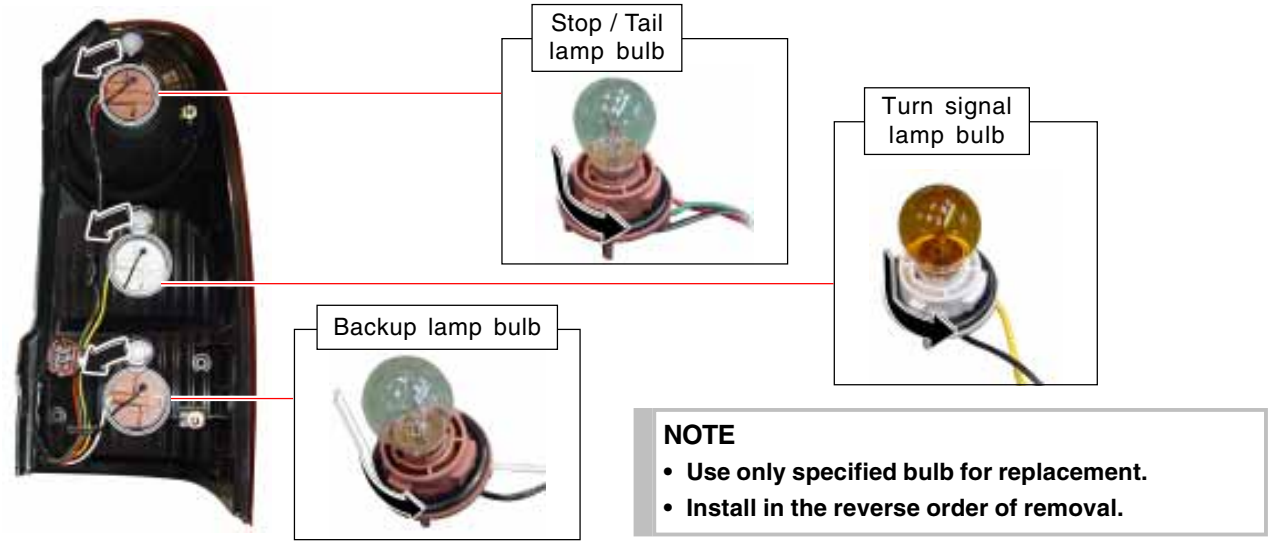




2. Disconnect the connector and remove the rear combination lamp assembly.



3. Open the bulb holders/connectors by turning them counterclockwise and remove the bulbs.



NOTE
- **Use only specified bulb for replacement.**
- **Install in the reverse order of removal.**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Section 04

CHASSIS

- TCCU (Transfer Case Control Unit)
- LCRV (Load Conscious Reducing Valve)

CHASSIS

3410 / 4990

TABLE OF CONTENTS

TCCU (TRANSFER CASE CONTROL UNIT) 2

1. Major changes in TCCU 2
2. Transfer case block diagram .....
3. Circuit diagram of transfer case 4
4. TCCU pin numbers and description .....
5. Self-diagnosis test .....
6. Diagnostic trouble code .....

LCRV (LOAD CONSCIOUS REDUCING VALVE) 9

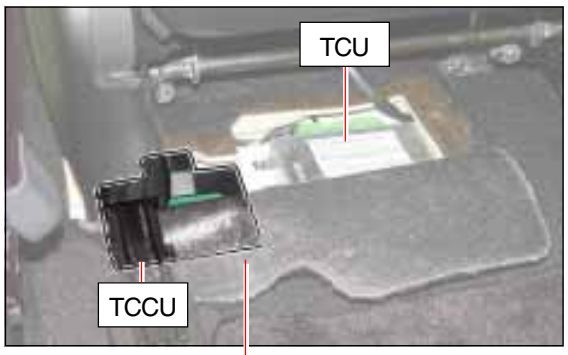
1. LCRV overview .....
2. LCRV operation .....
3. Performance curve of LCRV 10
4. Structure of LCRV (Load Conscious Reducing Valve) 11
5. Diagnosis of LCRV 12
6. Setting of LCRV 14
7. Removal and installation of LCRV 15

TCCU (Transfer Case Control Unit)

1. MAJOR CHANGES IN TCCU

TCCU is located under the driver's seat and allows the vehicle to shift from two-wheel drive to four-wheel drive.

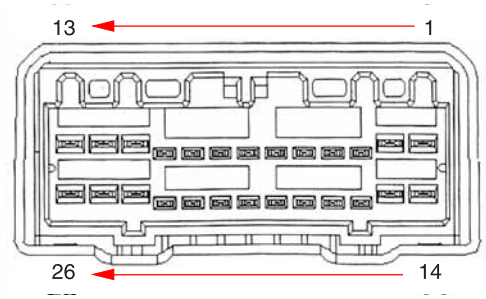
Location



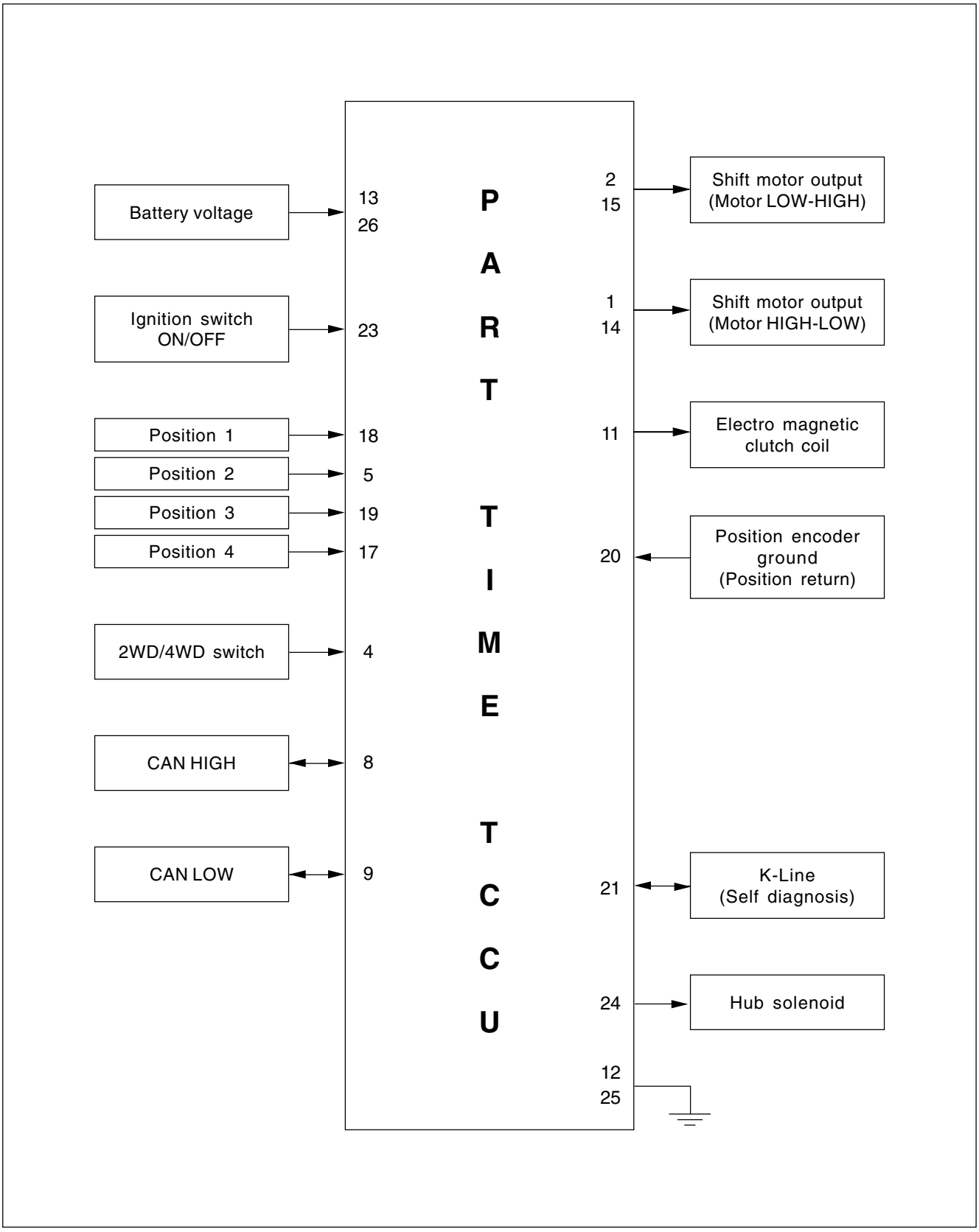




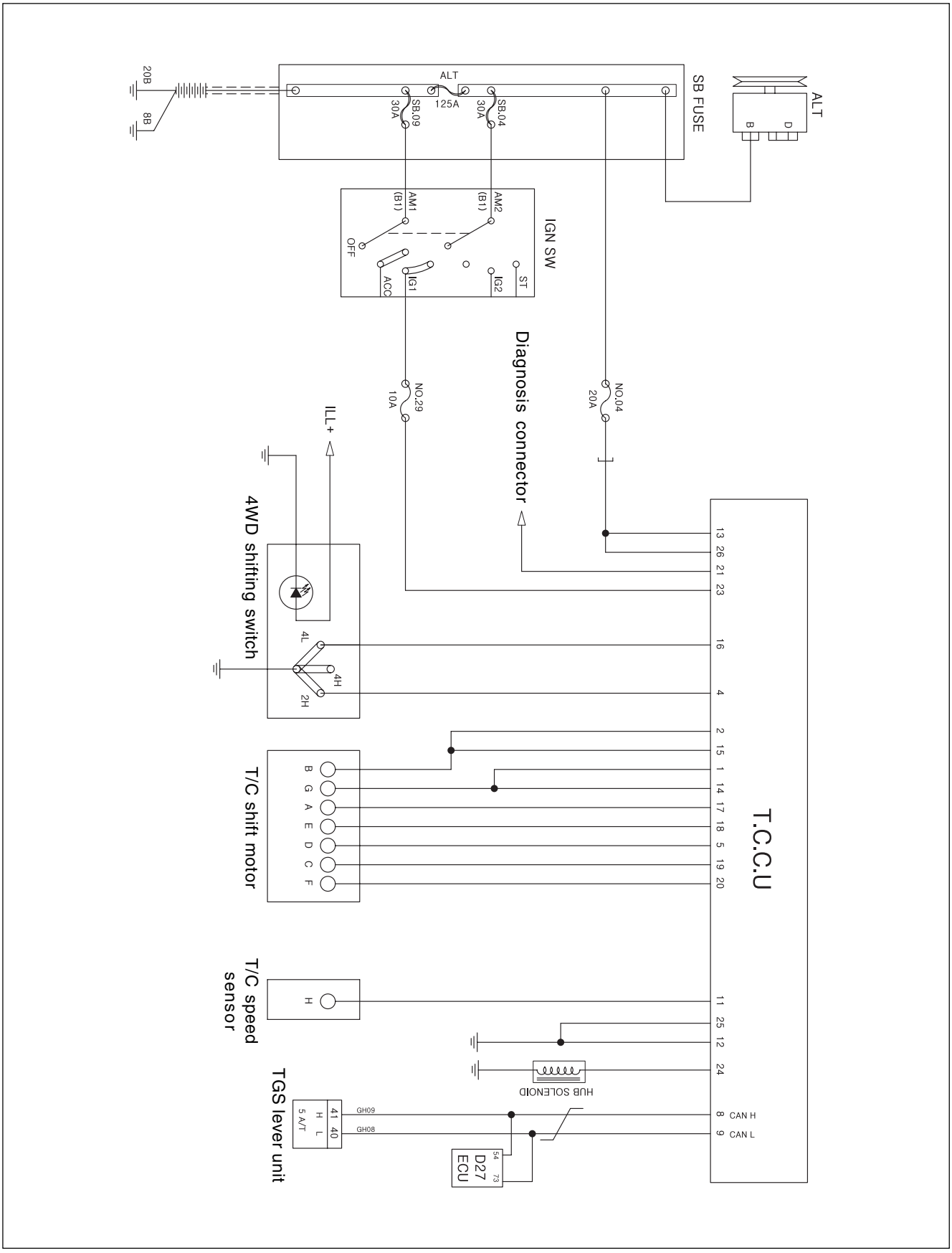
Connector and pin number



2. TRANSFER CASE BLOCK DIAGRAM

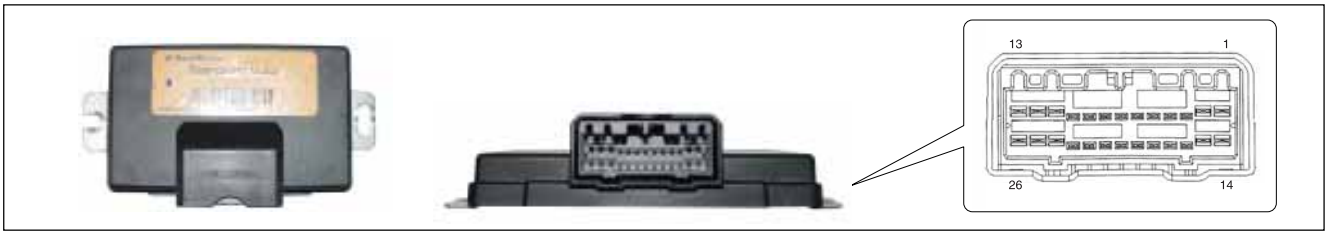


3. CIRCUIT DIAGRAM OF TRANSFER CASE



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. TCCU PIN NUMBERS AND DESCRIPTION



T/C: Transfer Case

Pin No.	Function	Input/Output	Description
1	Motor HI - LO	Output	This is a terminal that outputs the input signal to the T/C motor during operating the 4WD shifting switch. When switching the 2WD mode to 4WD mode, the battery power is supplied to “Motor Hi-Lo” and the opposite side is earthed.
2	Motor LO - HI	Output	
3	-	-	-
4	2/4WD shifting switch	Input	Switch position shifting (2H-4H) recognition
5	Position 2	Input	Detecting shift motor position 2
6	-	-	-
7	-	-	-
8	CAN H	Both	These lines are sharing the information among the related units through the CAN communication. The differences from the conventional part time T/C models are that the speed sensing type tone wheel in T/C has been eliminated and the speed signal comes from the ABS/ESP HECU or the instrument cluster.
9	CAN L		
10	-	-	-
11	EMC (Electro magnetic clutch)	Output	Supplying the voltage to magnetic clutch for all shifting operations • When supplying power: Battery voltage • When no power supplied: Ground power
12	Ground	Input	Providing the ground to TCCU
13	Battery	Input	Battery voltage supplying terminal for operating the system
14	Motor High-Low	Output	Same as No.1 & 2 pin
15	Motor Low-High	Output	
16	High-Low switch	Input	Recognizing the switch shifting between 4H and 4L(But ACTYON does not have the 4L function)
17	Position 4	Input	Detecting shift motor position 4
18	Position 1	Input	Detecting shift motor position 1
19	Position 3		Detecting shift motor position 3
20	Position return	Input	Providing the ground related to shift motor sensor plate.
21	K-Line	Both	Connecting to diagnosis connector
22	-	-	-
23	Ignition power	Input	Power supplying terminal when ignition switch is ON
24	Solenoid power supply	Output	Locking hub system applied to ACTYON makes difference in relating to the conventional part time system and the vacuum supply in operating process. For ACTYON, when 2H is using under normal conditions, vacuum is actuating in locking hub and located on the end of drive shaft. Once it shifts into 4WD, TCCU supplies power to solenoid to block the vacuum and the inside of locking hub is exposed to outside air. (Refer to Locking Hub) But, there’s no difference how TCCU supplies power to solenoid.
25	Ground	-	-
26	Battery	-	-

5. SELF-DIAGNOSIS TEST

1. If TCCU detects any malfunction in the transfer case system, it indicates the malfunctioning part(s) by turning the “4WD CHECK” indicator on.

   Connect SCAN-100 to the diagnosis connector located under the steering wheel.



2. The transfer case system is malfunctioning when:
   a. The “4WD CHECK” indicator remains on after 0.6 second after turning the ignition switch ON.
   b. The “4WD CHECK” indicator continuously comes on during driving.

3. After connecting SCAN-100 to the diagnosis connector and read the defective code with the ignition switch “ON” (refer to Diagnosis Table).
4. After repairing, erase the defective code stored in TCCU.



NOTICE

- **Before replacing the malfunctioning parts with defective code, check the wires and connectors for looseness and open circuit.**

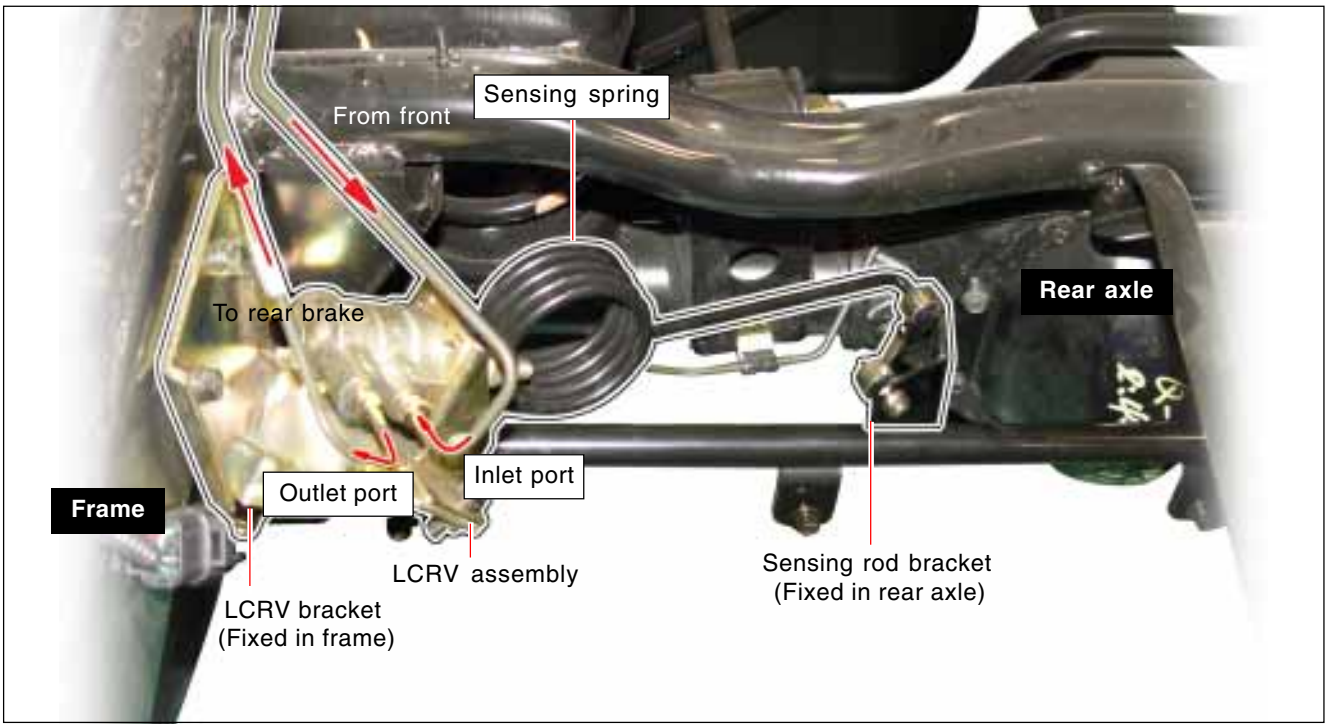
6. DIAGNOSTIC TROUBLE CODE

Code	Defectives	Descriptions
P1805	Defective 4WD shifting switch	- When the 4WD shifting switch is defective - Check TCCU pin No. 4 and 16. - Shifting 4WD mode • 2H (Pin No.4: Ground) • 4H (No contact: Open) • 4L (Pin No.16: Ground)
P1806	Defective CAN communication	- Check communication line. - Replace TCCU if necessary.
P1815	Abnormal CAN Neutral signal	- Set when not receiving automatic transmission Neutral signal more than 1 second through CAN. - Check CAN line. - Check TCU.
P1821	Open or short to ground in electro magnetic clutch (EMC) circuit	- Voltage at TCCU pin No.11: 11 ~ 15 V - EMC resistance: 2.5 Ω - Check the relevant connectors for contact. - Replace TCCU if necessary.
P1822	Open or short to ground in hub control circuit	- Open or short to ground in hub circuit over 0.2 seconds - Replace TCCU if necessary.
P1841	Open circuit in shift motor	- When TCCU detects the motor failure for 1 second - Check the relevant harnesses for contact. - Replace TCCU if necessary.
P1842	Short to ground in shift motor output circuit	- When TCCU detects the motor failure for 1 second - Check the relevant harnesses for contact. - Replace TCCU if necessary.
P1843	Defective position sensor in motor	- Set after 1.5 seconds while 2H-4H operation - Set after 3 seconds while 4H-4L operation - Check the relevant harnesses for contact. - Replace TCCU if necessary.
P1844	Fixed in 4L	- Set when not shifting from 4L to 4H even though shifting conditions are satisfied and there are no errors - Replace TCCU if necessary.
P1850	Defective position encoder	- Set when the position encoder is defective, which recognizes the position of shift motor. - Check the relevant harnesses. - Check the relevant connectors for contact. - Check the shift motor.
P1851	Short to ground for position encoder 1	- Short to ground for position encoder 1 in shift motor - Check the relevant harnesses for short. • TCCU pin No.18 - Check the relevant connectors for contact. - Check the shift motor.

Code	Defectives	Descriptions
P1852	Short to ground for position encoder 2	- Short to ground for position encoder 2 in shift motor - Check the relevant harnesses for contact. • TCCU pin No. 5 - Check the relevant connectors for contact. - Check the shift motor.
P1853	Short to ground for position encoder 3	- Short to ground for position encoder 3 in shift motor - Check the relevant harnesses for short. • TCCU pin No.19 - Check the relevant connectors for contact. - Check the shift motor.
P1854	Short to ground for position encoder 4	- Short to ground for position encoder 4 in shift motor - Check the relevant harnesses for contact. • TCCU pin No. 17 - Check the relevant connectors for contact. - Check the shift motor.

LCRV (Load Conscious Reducing Valve)

ACTYON SPORTS does not adopt ABS/EBD system. Instead, it applies LCRV to control the braking pressure which is transferred to rear brake system.



1. LCRV OVERVIEW

The front braking pressure is usually higher than the rear braking pressure. The reasons are that the vehicle front is heavier than the rear due to the engine and other components and the center of gravity is leaning forward due to inertia effect during braking. As a result, the front braking pressure is generally set at higher level than the rear braking pressure.

As you may know from the vehicle structure and exterior, ACTYON SPORTS is designed to have different braking pressure according to the load condition in the rear. LCRV (Load Conscious Reducing Valve) is the system to control the braking pressure that is transferred to the rear brake system depending on the load condition.

(However, the vehicle with ABS/EBD system is equipped with the electronic braking system that controls the braking pressure to the front and rear wheels and prevents the wheels from locking.)

LCRV assembly has two brake hydraulic ports: the inlet port from the front master cylinder (located on the bottom of the assembly) and the outlet port (located on the top of the assembly) which is connected to the brake pipe on both rear sides after the braking pressure is decreased or increased through LCRV.

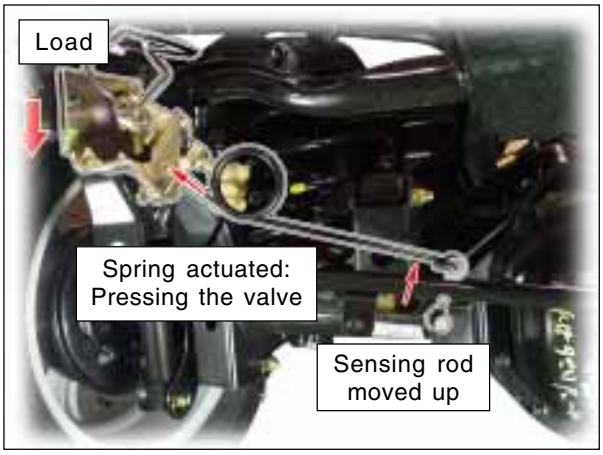
The braking pressure from LCRV inlet port and outlet port can be controlled by the operations of sensing rod and spring which are moving according to the distance between frame and rear axle, which is varied depending on the load conditions (including number of rear seat passengers, and the loads in the deck which can accommodate up to 400 kg).

NOTICE

- **The major function of LCRV is to control the height between frame and rear axle. As a result, do not modify the suspension system including rear coil spring and shock absorber which can make an influence on the height. Such modification can decrease the difference of the preset braking pressure, which may cause any dangerous situation.**

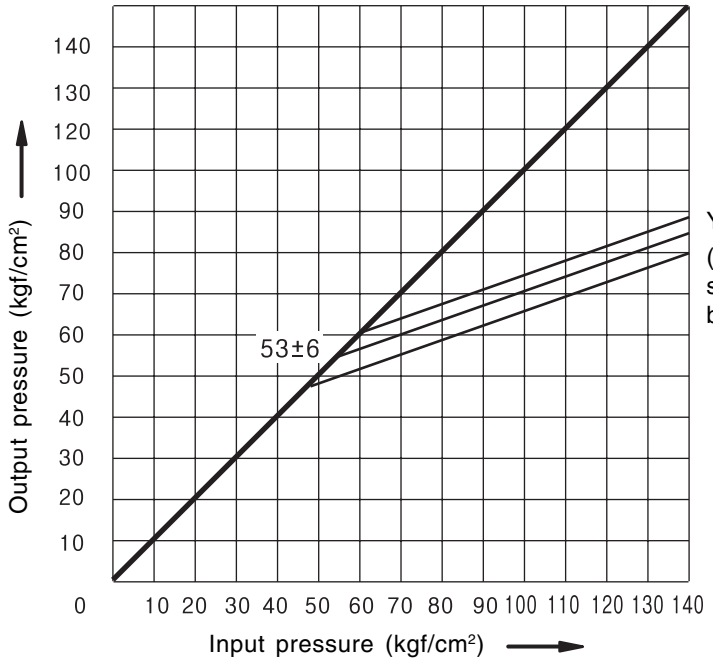
2. LCRV OPERATION

LCRV is the mechanical system to control the flow path of valve by installing brackets on frame and rear axle by using the change in distance between frame and rear axle housing and utilizing the displacement of sensing rod and spring which are connected between frame and rear axle, according to the load condition. In other words, the more loads on the deck, the closer distance between the frame with the deck and axle housing (which is connected to the shaft of tire on the ground). At this moment, the sensing rod moves up and the spring connected to the sensing rod presses the valve. Under such condition, the greater braking pressure is given to the rear braking system, compared to the unload condition.



3. PERFORMANCE CURVE OF LCRV

The curve below shows the value of output pressure when the LCRV input pressure (from the brake master cylinder to the rear braking system) is output through LCRV.



Y-gap: 35 mm

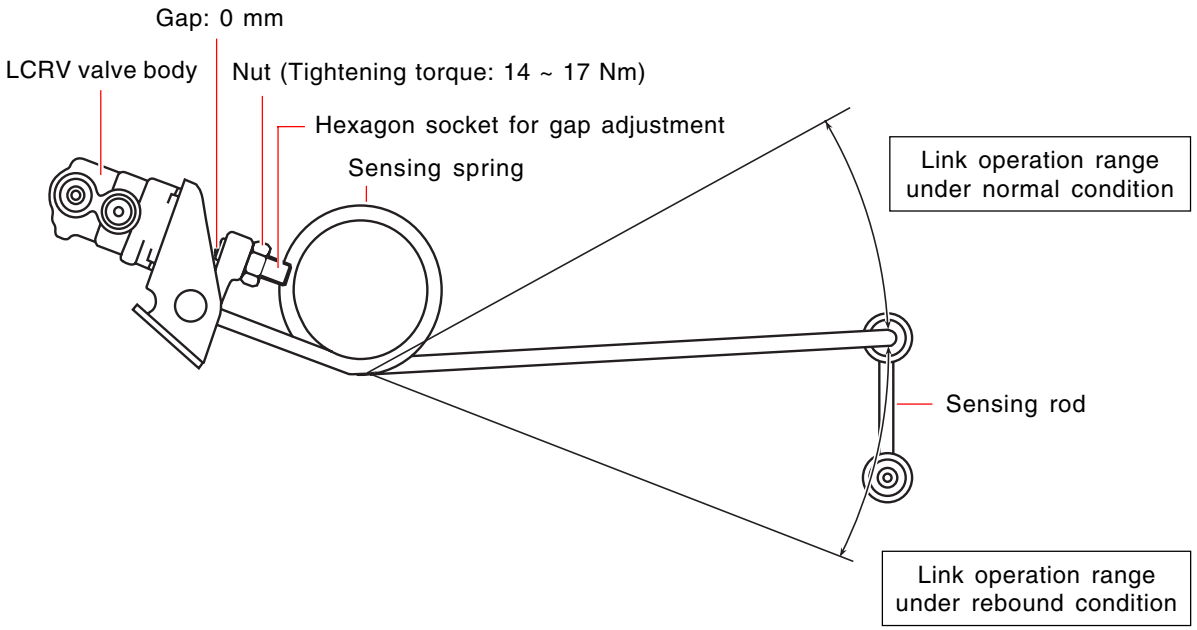
(Y-gap: the distance between sensing rod mounting bracket No. 1 and No. 2.)

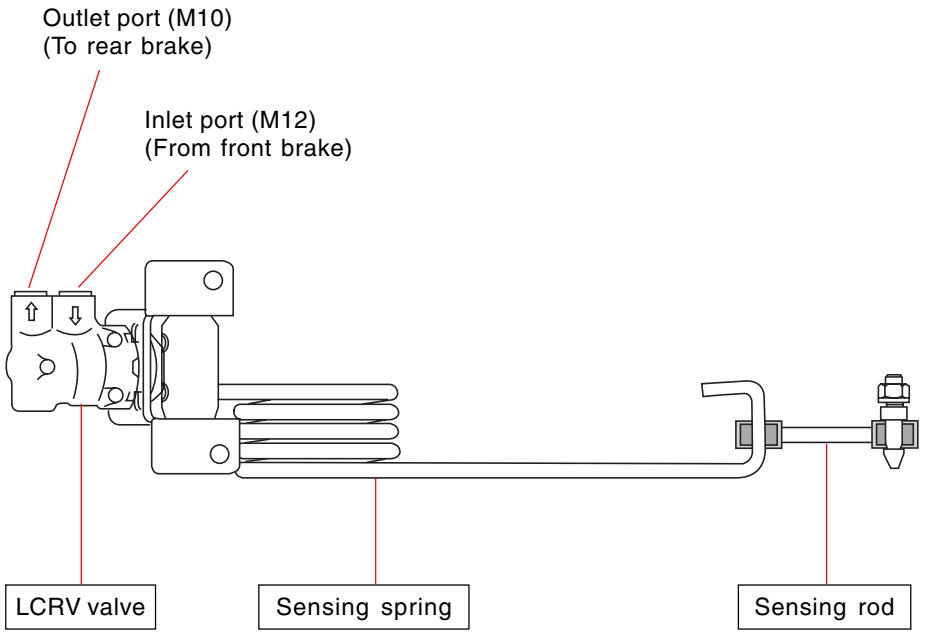
In the earlier stage, the LCRV input pressure and the output pressure through LCRV that are providing to the rear brake system are almost same (approx. 40~50 Kgf/cm2). When the position of sensing rod is changed according to the deck loads, accordingly you can see the deviation between the input and output pressures.

If Y-gap is getting bigger in LCRV operating range, the output pressure also become bigger.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. STRUCTURE OF LCRV (LOAD CONSCIOUS REDUCING VALVE)





5. DIAGNOSIS OF LCRV

Diagnosis pertaining to LCRV will be conducted when the rear brake system is defective (for example, the pre-lock of the rear wheel due to the abnormal braking pressure).

When the rear wheels are pre-locked earlier than the front wheels, there will be the same effect as applying the parking brake while driving. This makes the rear wheels lose their directional control and be rotated recklessly, causing a fatal accident.

The electronic brake system like ABS/EBD plays the role to prevent such phenomena. Accordingly, the vehicle without ABS/EBD system or the multi-purpose vehicle need the system to effectively control the rear braking pressure according to the load changes.

When the rear brake system of the vehicle with LCRV is defective, it is necessary to check the system based on the followings.

If you feel that the rear brake is locked first or that the vehicle posture is unstable while braking, please check the followings.

1. **Checking Brake System**

   Check the brake fluid level, brake pad and lining wear, and brake hose and pipe.

2. **Measuring Height between Rear Wheel Housing and Tire (under unladen vehicle)**

   Measure the height between rear wheel housing and tire while the rear seat and deck are empty.



Specified value: 515 mm ± 10 mm

3. **If there is variation in height, it is necessary to check the rear suspension including rear shock absorber and rear coil spring**

   If the rear suspension including rear shock absorber is modified or the non-genuine parts are used, the height may be changed because the stiffness and damping force of the spring are different.



NOTICE

- **Do not use any non-genuine shock absorber, and do not modify the rear suspension, including coil spring. It may give rise to the problem in braking pressure. Note that usage of non-genuine parts or modifications shall make the warranty invalid.**

4. **Checking LCRV-related components for mounting and wear: sensing rod, spring, valve assembly and bracket**

   Check the valve gap after lifting up the unladen vehicle using the 4-post lift when checking LCRV-related components.

NOTICE

- **If using the 2-post lift which supports frames, it is difficult to check the LCRV-related components because the unlifted tires are pressed against ground and the distance between rear axle (with lower LCRV bracket) and frame is longer (rebound).**

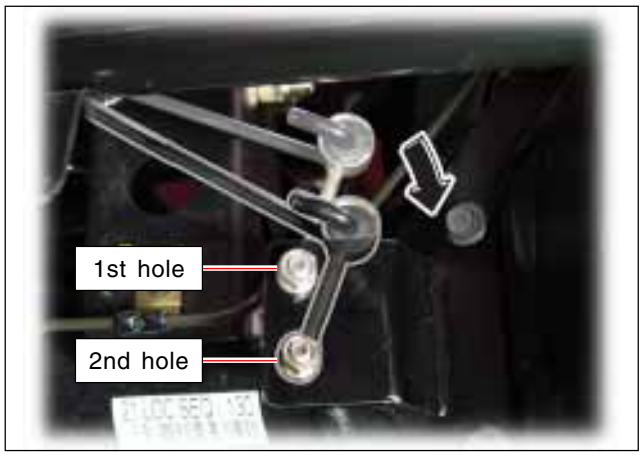
5. **If there's no any defect when checking the above four items, exactly perform the following valve setting procedure.**

6. SETTING OF LCRV

1. Lift up the unladen vehicle using the 4-post lift.
2. Remove the upper mounting nut of sensing rod from the first hole of rear axle bracket, and tighten the rod in the second hole by hand.



Remove the rod from the first hole by unscrewing the mounting nut.

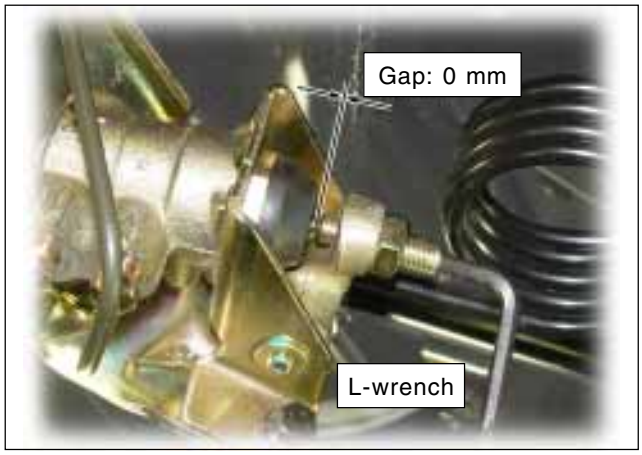


Tighten the sensing rod in the second hole by hand.

3. Unscrew the mounting nut on the end of LCRV valve and set the gap of the hexagon socket for gap adjustment to “0 (zero)” using a L-wrench.

NOTICE

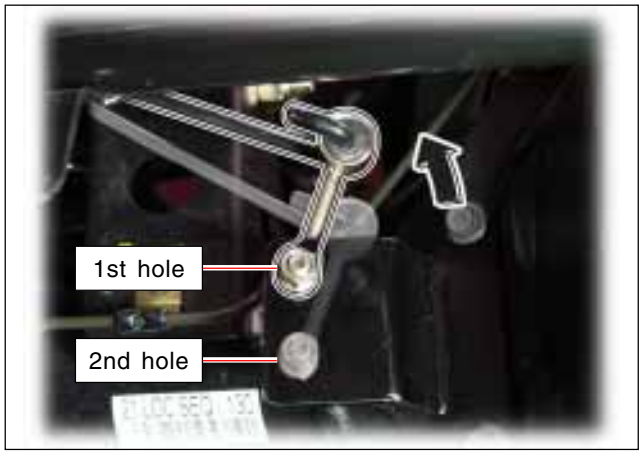
- **Setting the gap to 0 (zero) means that the socket should be adjusted so that it slightly contacts the valve, and the position of the valve should not be changed by pressing the valve by the adjusting socket.**



4. Once the setting is completed, tighten the mounting bolt of the hexagon socket for gap adjustment. Then install the sensing rod in the first hole of the rear axle bracket, not the second hole.



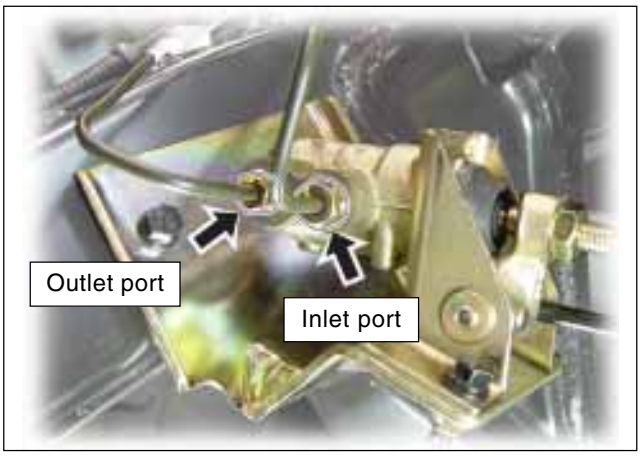
Tighten the mounting nut of the hexagon socket for gap adjustment. (Tightening torque: 14 ~ 17 Nm)



Tighten the mounting nut after moving and installing the sensing rod in the first hole. (Tightening torque: 11 ~ 14 Nm)

7. REMOVAL AND INSTALLATION OF LCRV

1. Lift up the unladen vehicle using the 4-post lift and completely drain brake oil.
2. Remove the pipes to connect LCRV inlet and outlet ports, and remove the mounting nut in the sensing rod to disassemble the sensing rod from the rear axle bracket.



Tightening torque: Inlet port (M12: 20 ~ 24 Nm)
Outlet port (M10: 15 ~ 19 Nm)



Tightening torque: 11 ~ 14 Nm

3. Remove the valve assembly and spring by unscrewing the mounting bolt of LCRV assembly from the bracket.
4. Remove LCRV assembly as well as spring and sensing rod.



5. Install in the reverse order of removal.
6. Fill brake oil after reinstalling, and air-bleed the brake system.

MEMO

Section 05

BODY

- BODY REPAIR
- REAR SEAT
- SEAT BELT
- REAR TRIM/QUARTER TRIM/PILLAR
- TAILGATE
- REAR BUMPER
- DECK ASSEMBLY
- C PILLAR GARNISH

BODY

5110 / 7510 / 7430 / 7730 / 6410 / 7880 / 5110 / 7930

TABLE OF CONTENTS

BODY REPAIR 2

1. Dimensions 2
2. Jack up points (Dotted portions) 3
3. Design changes for improving NVH performance .. 4
4. Frame 7
5. Body dimensions 11
6. Major gaps 14

REAR SEAT 16

1. Seat components & mounting points 16
2. Removal and installation of rear seat 17

SEAT BELT 19

1. Seat belt configuration 19
2. Seat belt mounting 21

REAR TRIM/QUARTER TRIM/PILLAR ... 22

1. Rear trim and quarter trim/pillar configuration 22
2. Removal and installation 23

TAILGATE 25

1. Tailgate configuration 25
2. Removal and installation of tailgate assembly 26
3. Tailgate mechanism configuration 30
4. Tailgate arrangement 31

REAR BUMPER 32

1. Rear bumper configuration 32
2. Removal and installation of rear bumper assembly 33

DECK ASSEMBLY 35

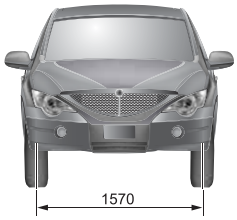
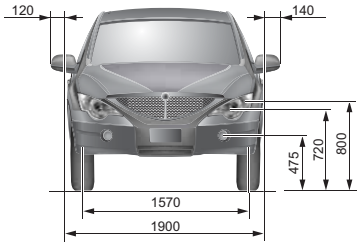
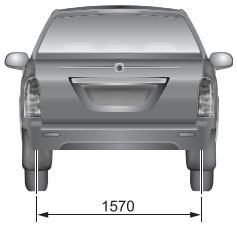
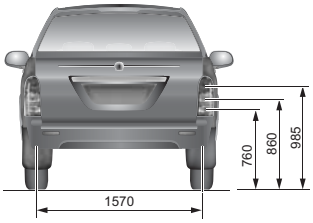
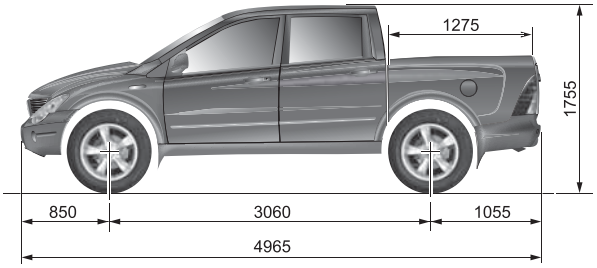
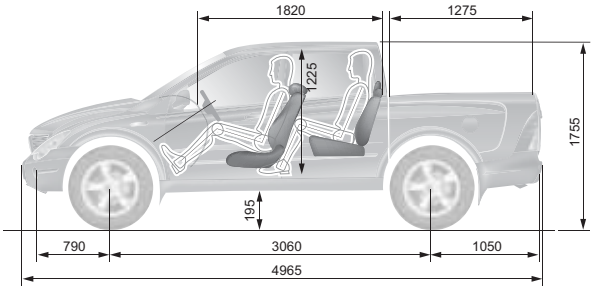
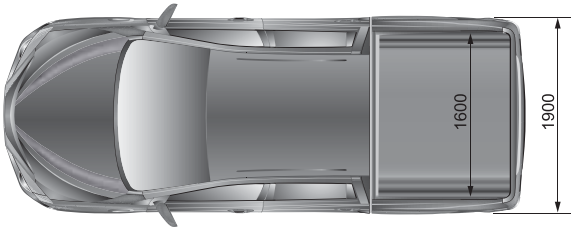
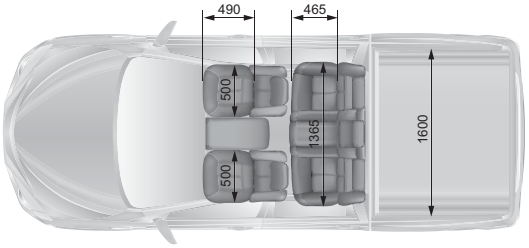
1. Deck assembly configuration 35
2. Removal and installation of deck assembly 36
3. Inspection and maintenance of rubber insulator and deck 39

C PILLAR GARNISH 40

BODY REPAIR

1. DIMENSIONS

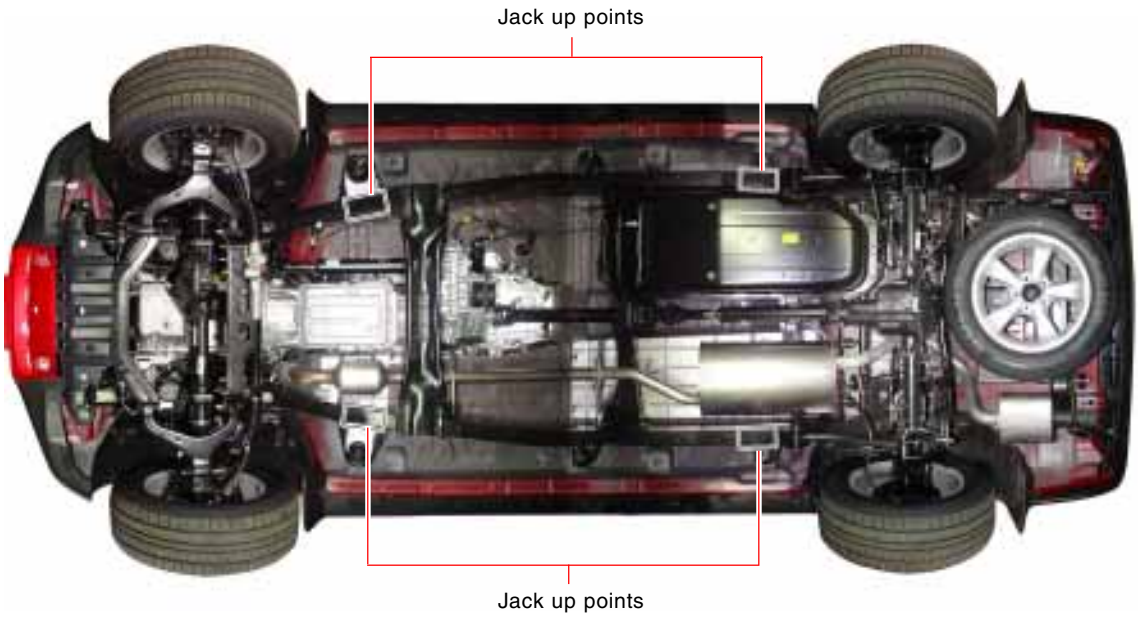
Unit: mm

General Dimension	Detailed Dimension
	
	
	
	

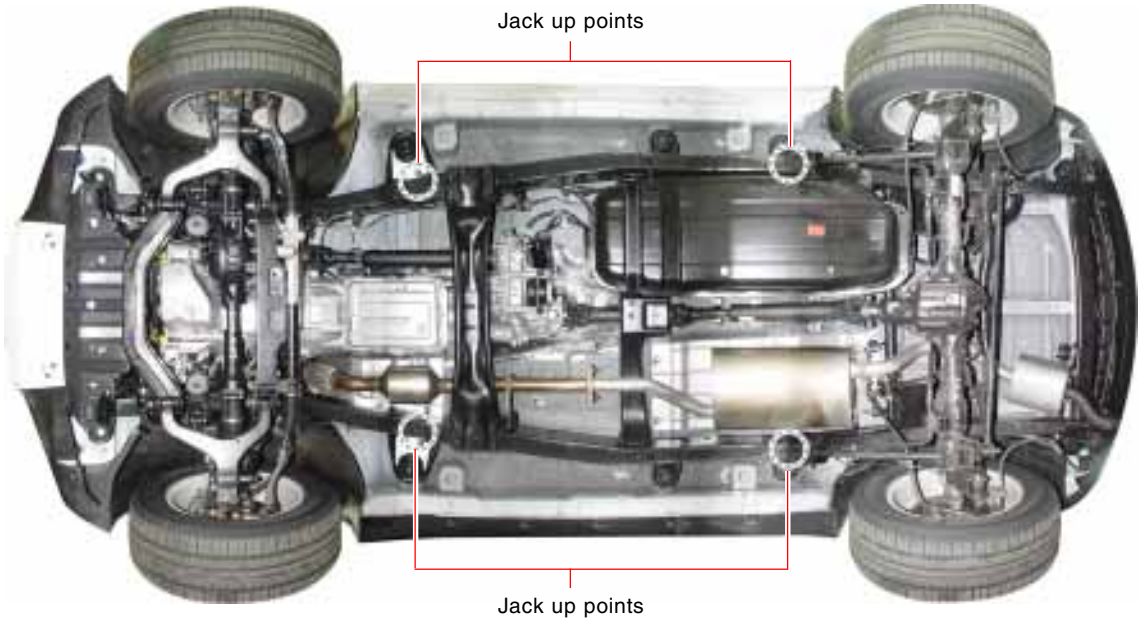
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EFFECTIVE DATE	
AFFECTED VIN	

2. JACK UP POINTS (DOTTED PORTIONS)

ACTYON SPORTS



ACTYON

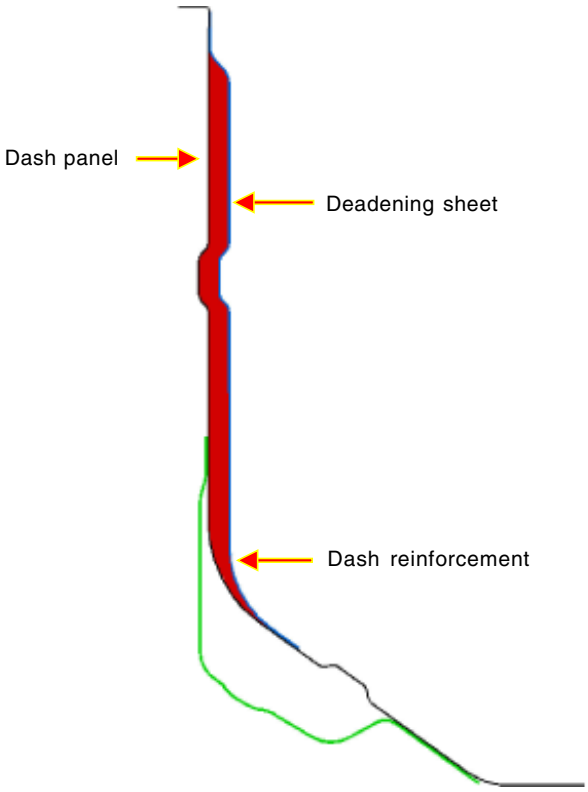


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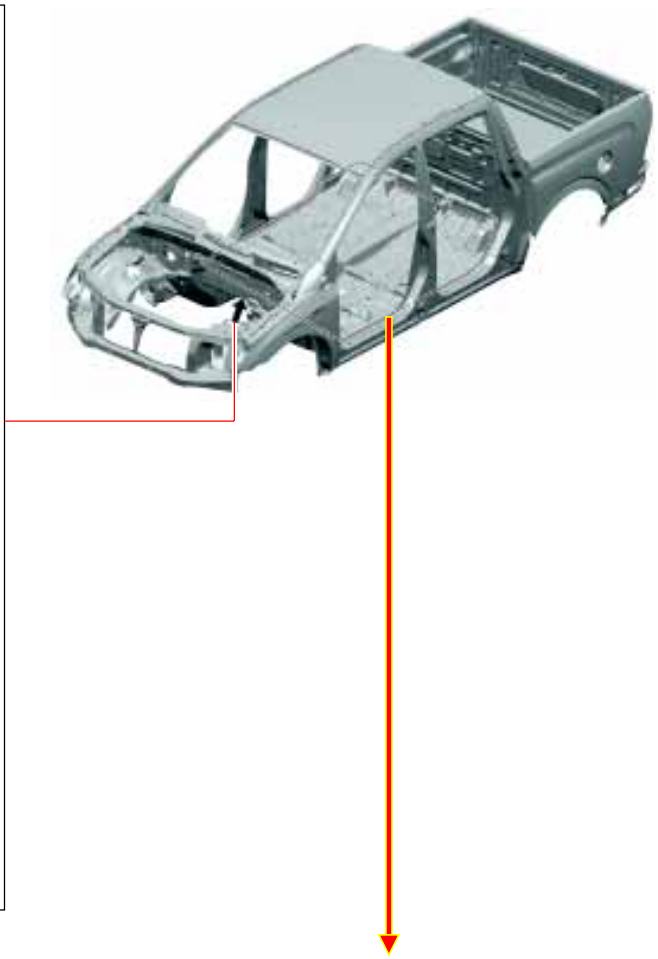
3. DESIGN CHANGES FOR IMPROVING NVH PERFORMANCE

▶ Dual Type Dash Panel and Engine Tunnel with Foaming Pad

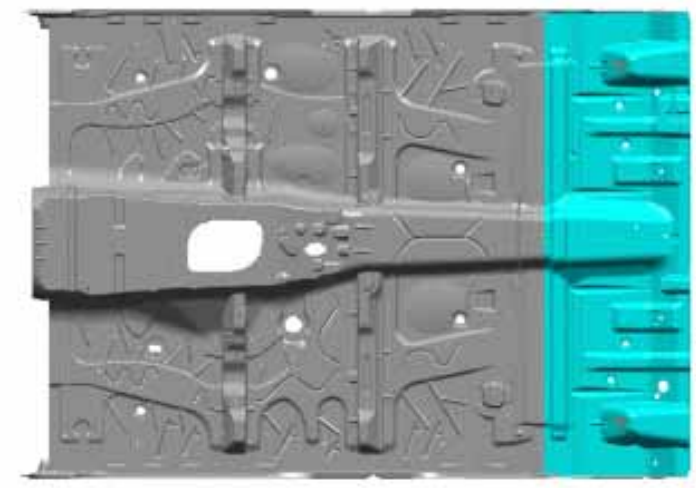
Blocks the noise from engine and transmission and improves the reinforcement of vehicle body.



Added an additional member to the bottom of dash panel to minimize the possibility of engine retreat when collision.



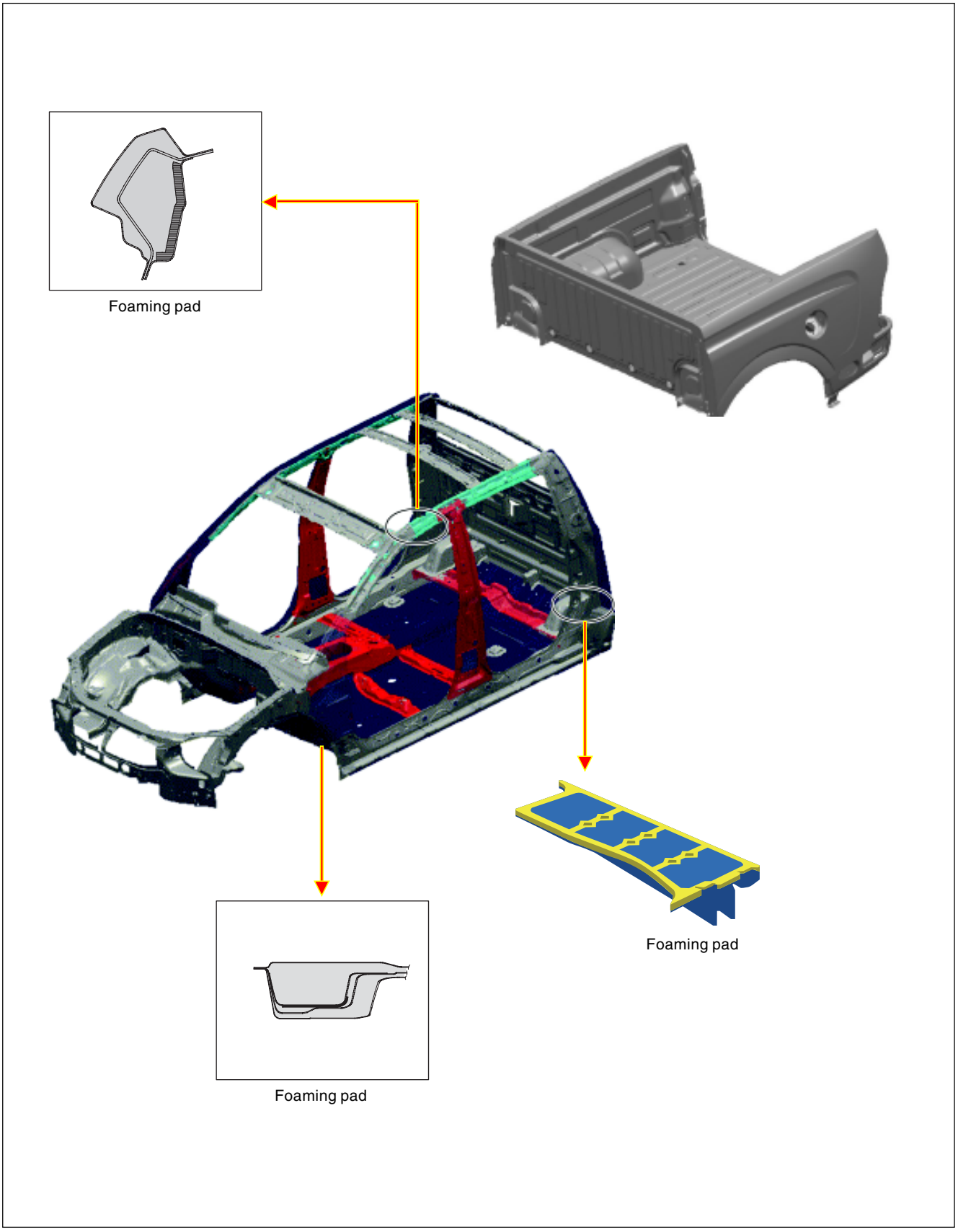
▶ Improved Reinforcement and NVH According to the Introducing of Front Floor and Rear Floor



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EFFECTIVE DATE	
AFFECTED VIN	

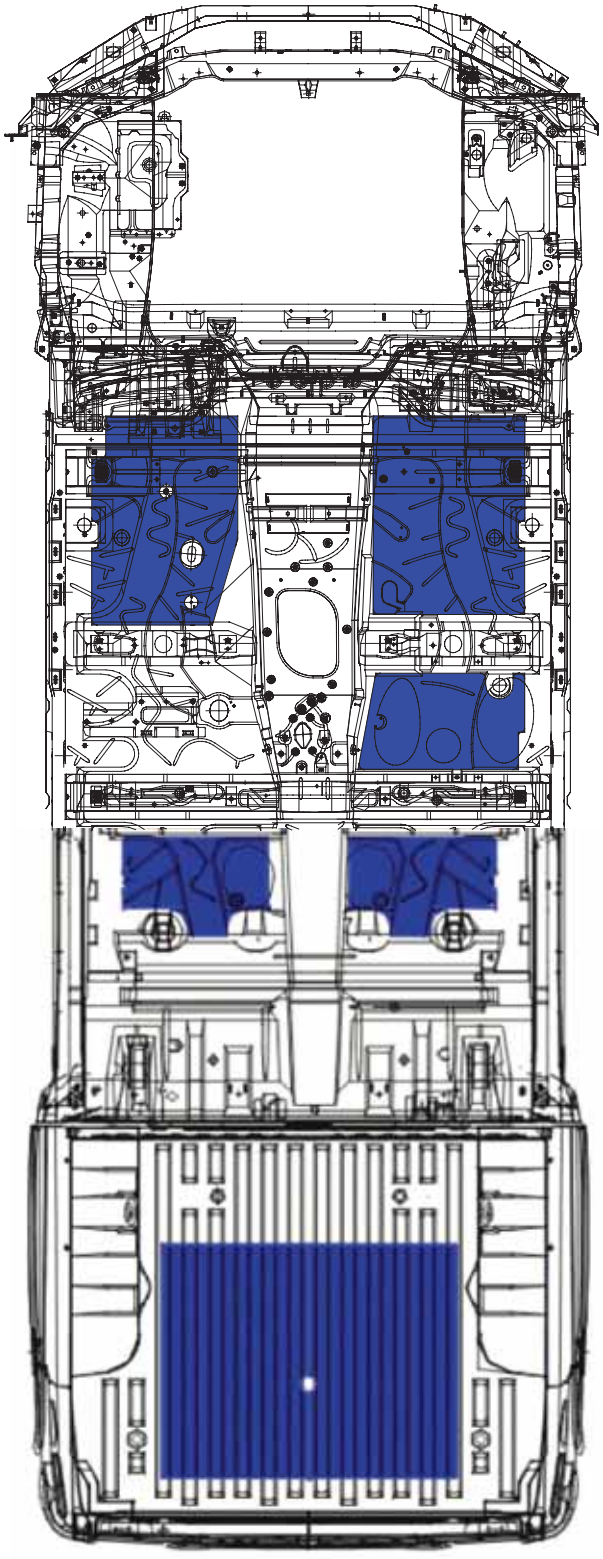
▶ Applied BPR (Body Panel Reinforcement) Sealer to the Door Outer Panel

BPR sealer is sprayed by robot and is designed to reinforce the body panel and reduce the noise.

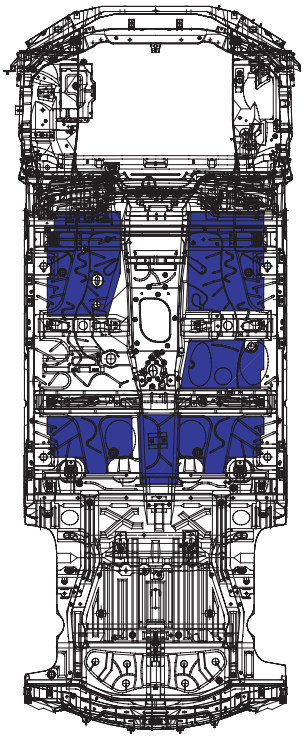


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▶ Applying the Asphalt Sheet to the Body Panel (Improved Anti-Vibration)



ACTYON

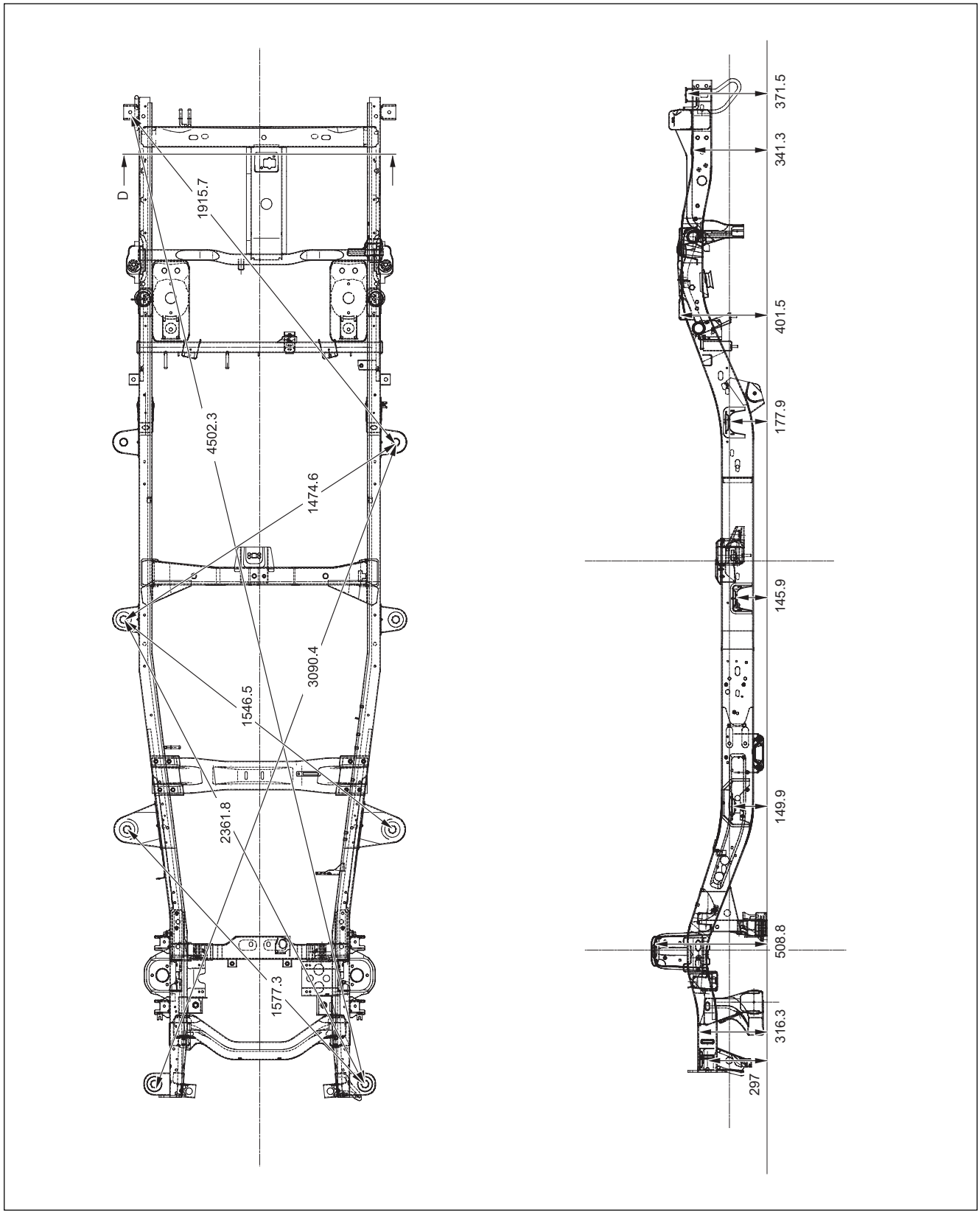


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4. FRAME

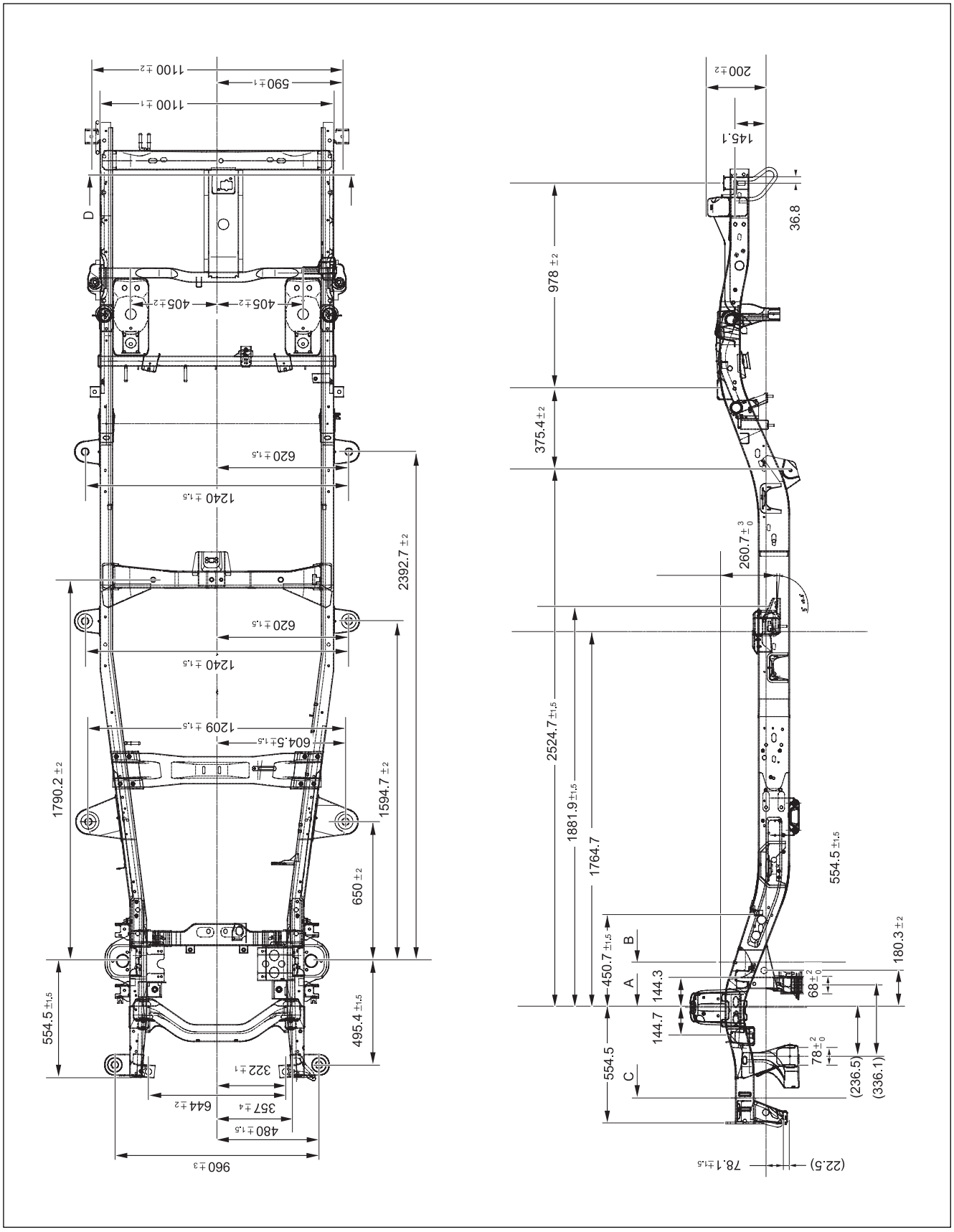
▶ Frame Dimensions

Unit: mm



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EFFECTIVE DATE	
AFFECTED VIN	

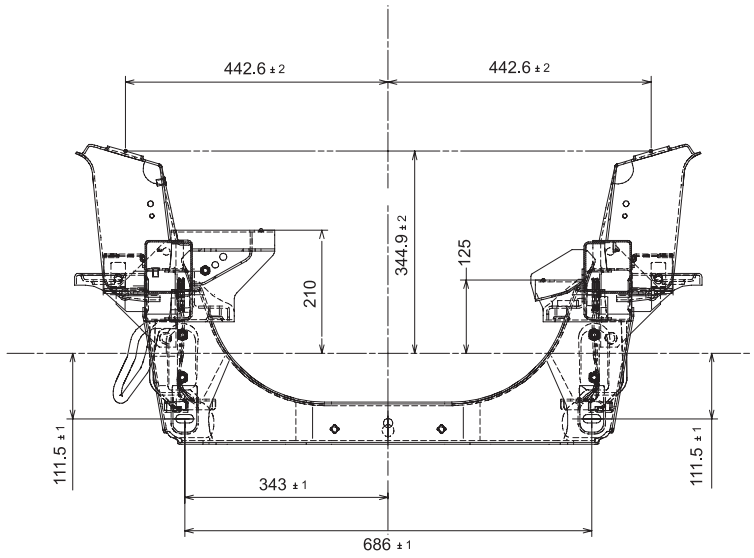
Unit: mm



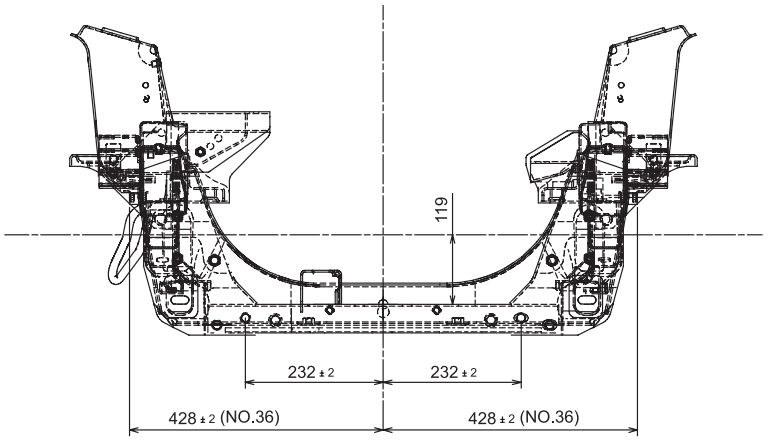
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AFFECTED VIN	

Sectional Drawing

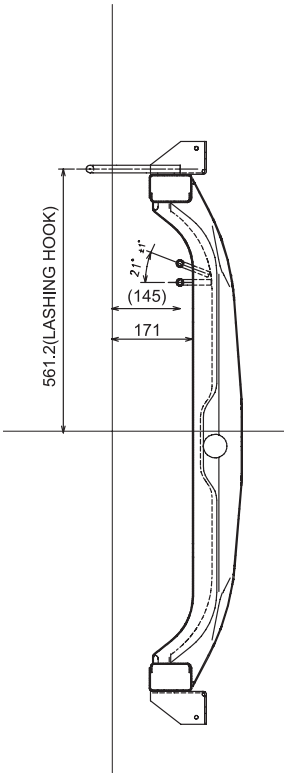
Unit: mm



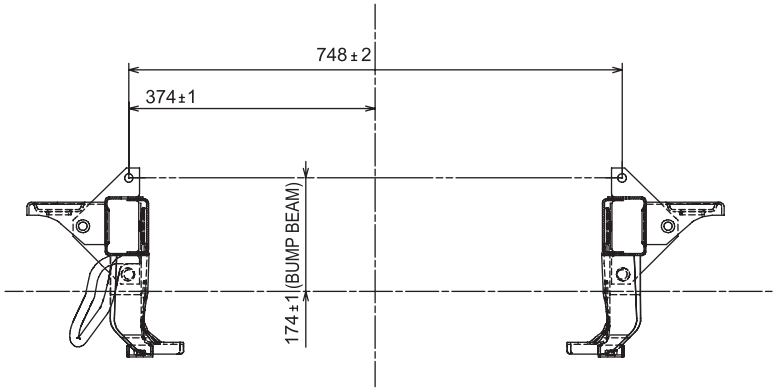
SECTION A



SECTION B



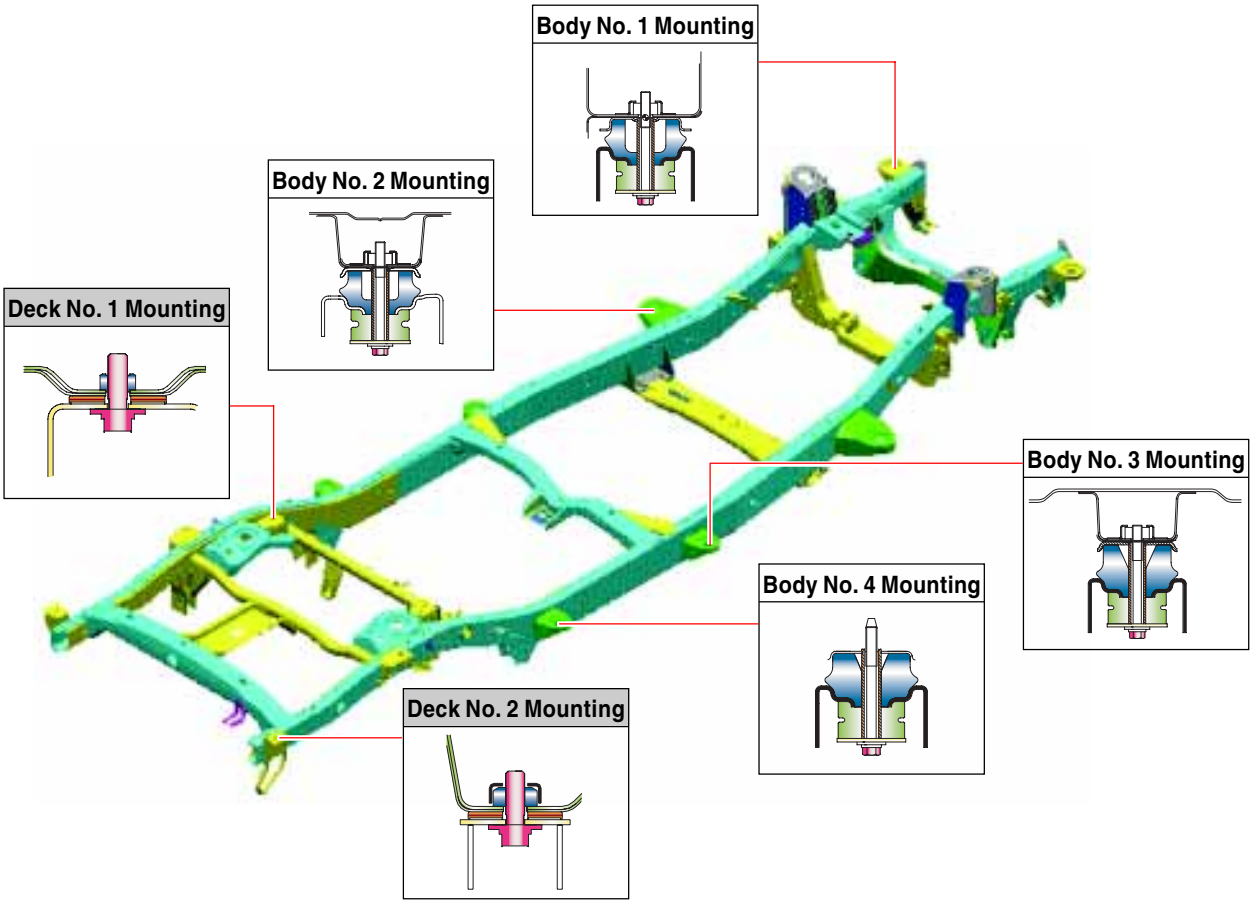
SECTION D



SECTION C

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Frame Body Mounting



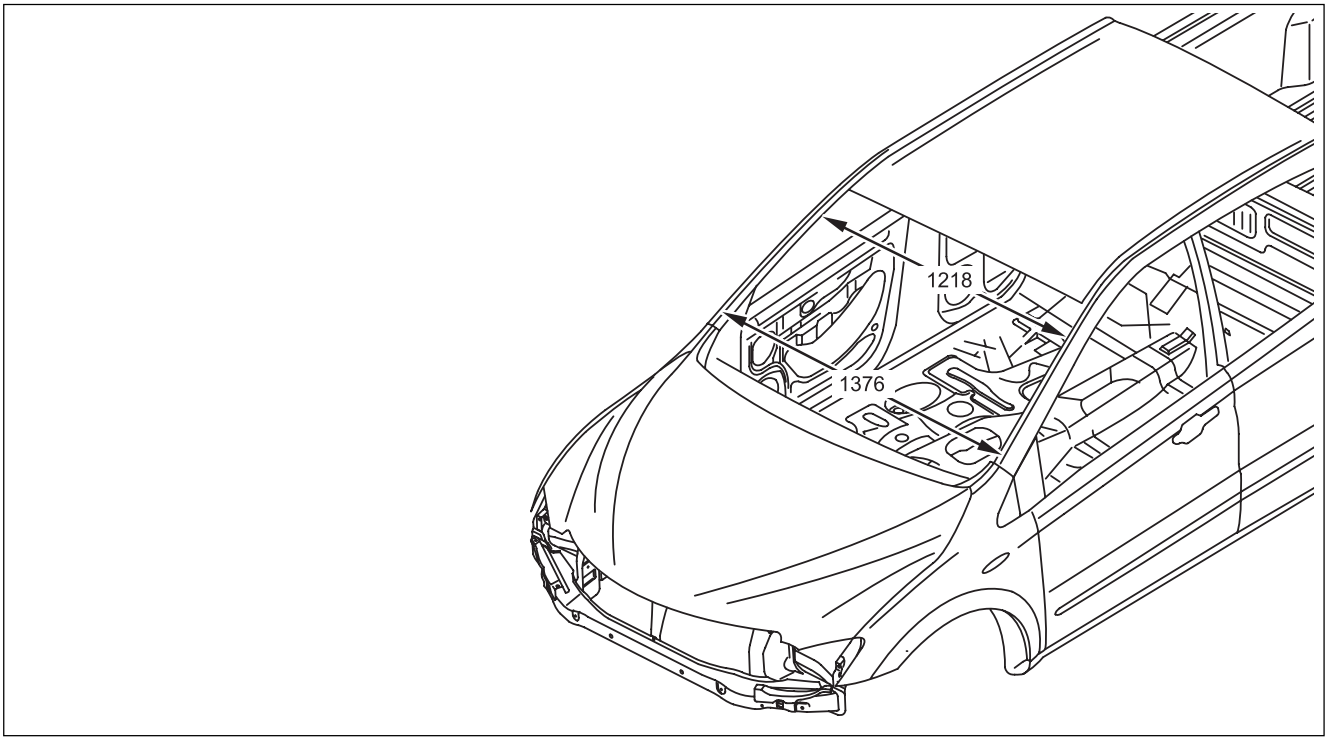
	Body No. 1 mounting	Body No. 2 mounting	Body No. 3 mounting	Body No. 4 mounting	Deck mounting (No.1/2)
1.	Washer & tube assembly - body No. 1	Washer & tube assembly - body No. 2	Washer & tube assembly - body No. 3	Washer & tube assembly - body No. 4	Rubber insulator
2.	Insulator - body No. 1, upper	Insulator - body No.2, upper	Insulator - body No.3, upper	Insulator - body No. 4, upper	Bolt
3.	Insulator - body, lower	Insulator - body, lower	Insulator - body, lower	Insulator - body, lower	
4.	Washer - plain body mounting	Washer - plain body mounting	Washer - plain body mounting	Washer - plain body mounting	
5.	Bolt	Bolt	Bolt	Bolt	
	Tightening torque 55~65 Nm	Tightening torque 55~65 Nm	Tightening torque 55~65 Nm	Tightening torque 55~65 Nm	Tightening torque 70~90 Nm

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. BODY DIMENSIONS

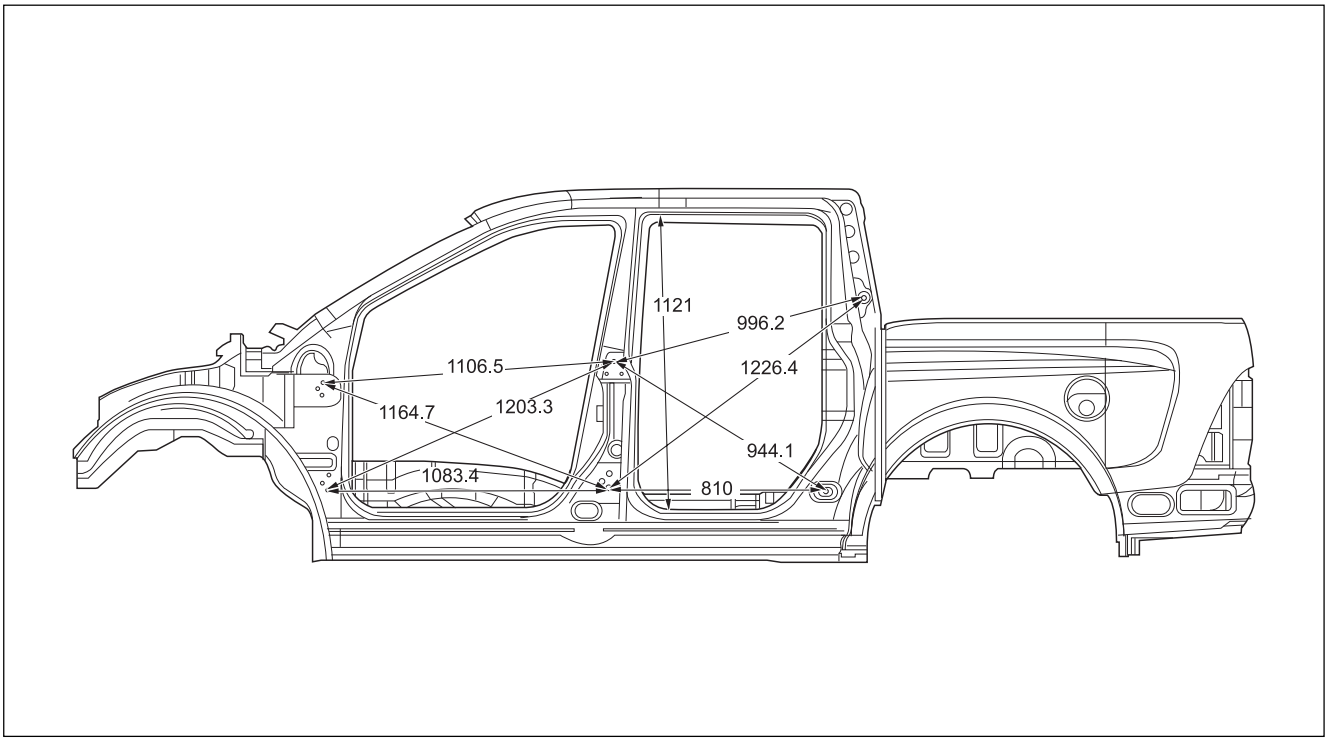
Windshield Glass Mounting Section

Unit: mm



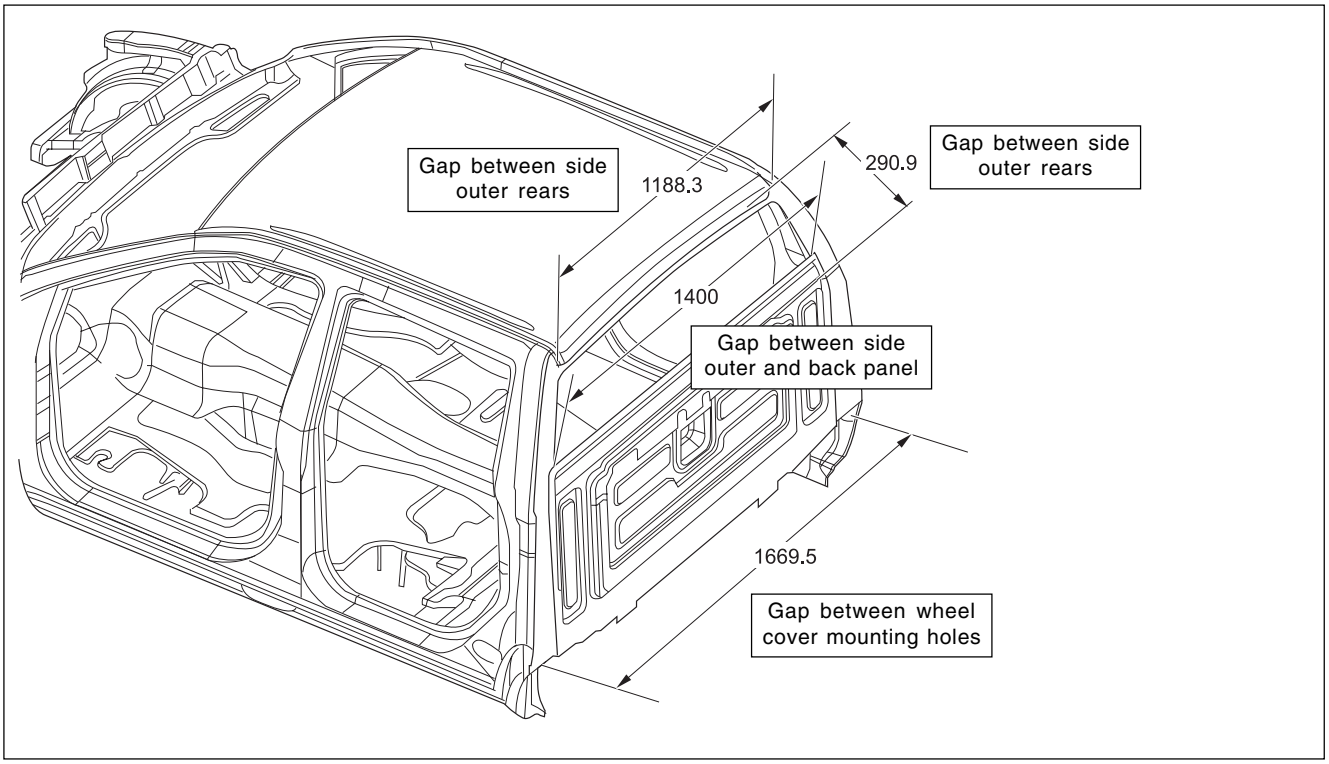
Side Structure Complete

Unit: mm



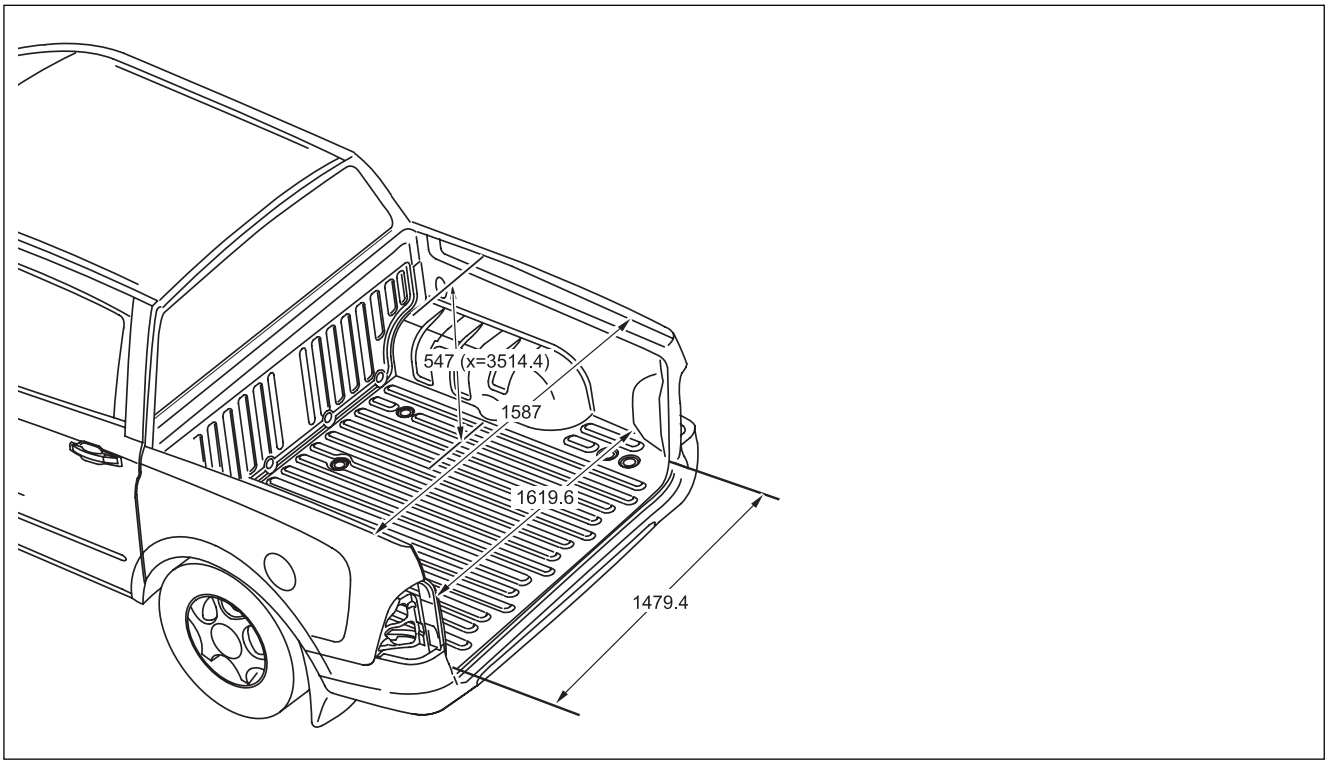
Rear Glass

Unit: mm



Tailgate

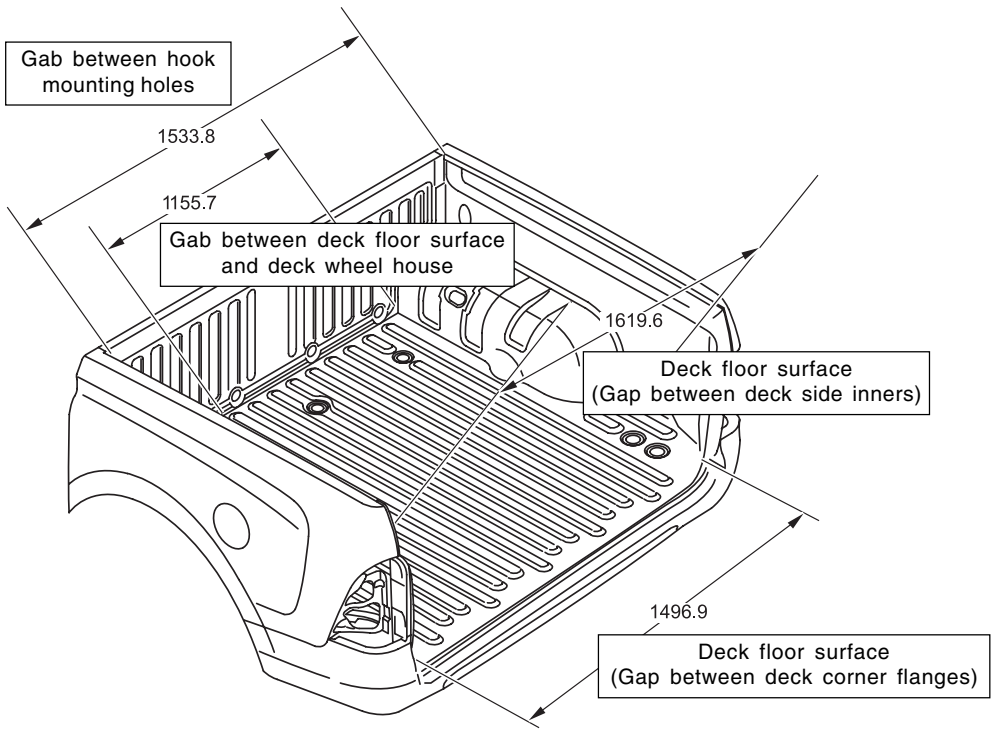
Unit: mm

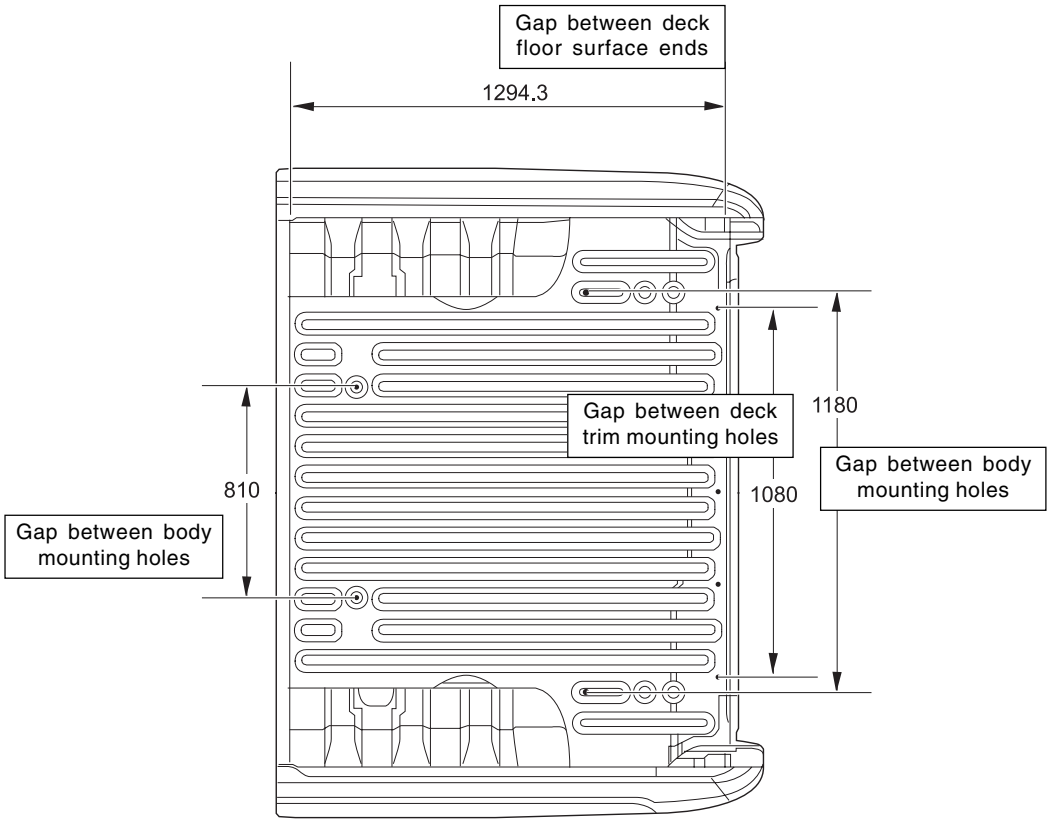


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Deck

Unit: mm





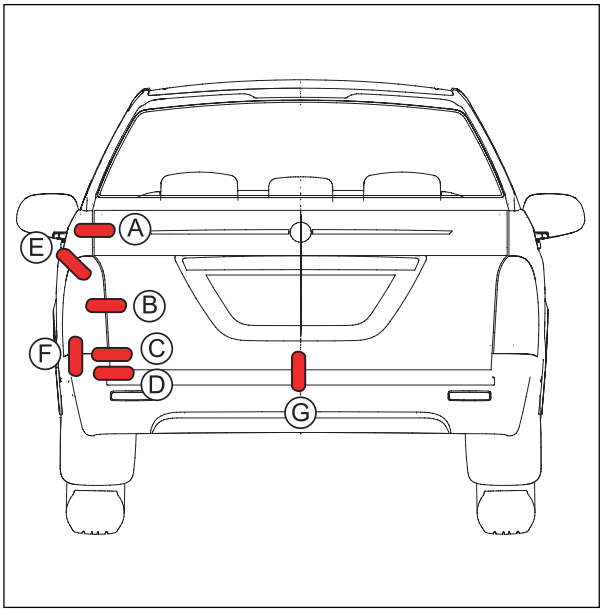
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. MAJOR GAPS

Tailgate

Unit: mm

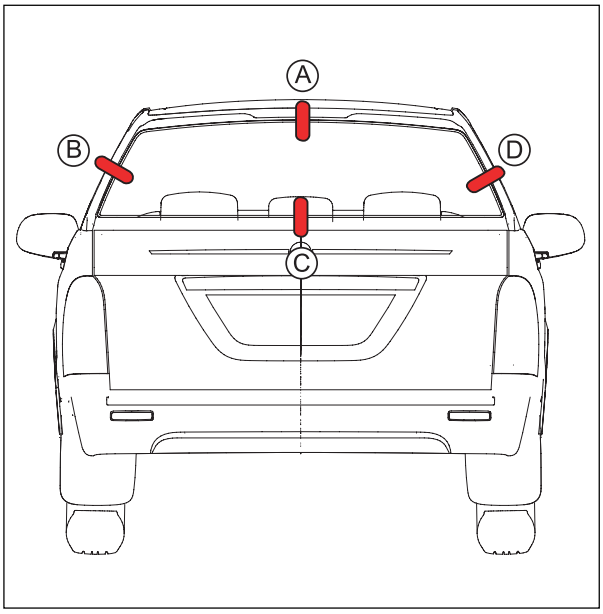
Position	Gap	Flush
A	5 ± 0.5	0 ± 0.5
B	6 ± 0.5	0.8 ± 0.5
C	7.5 ± 0.5	0.8 ± 0.5
D	8.5 ± 0.5	0.8 ± 0.5
E	1 ± 0.5	0 ± 0.5
F	1 ± 0.5	0 ± 0.5
G	35 ± 0.5	-



Rear Glass

Unit: mm

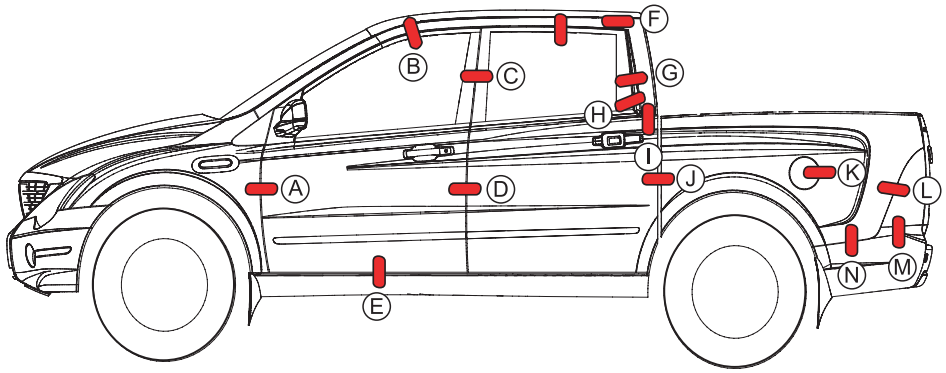
Position	Gap	Flush	
A	2.3 ± 1.0	-3.0	Based on glass
B	2.3 ± 1.0	-3.0	
C	2.3 ± 1.0	-3.0	
D	2.3 ± 1.0	-3.0	



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AFFECTED VIN	

Side

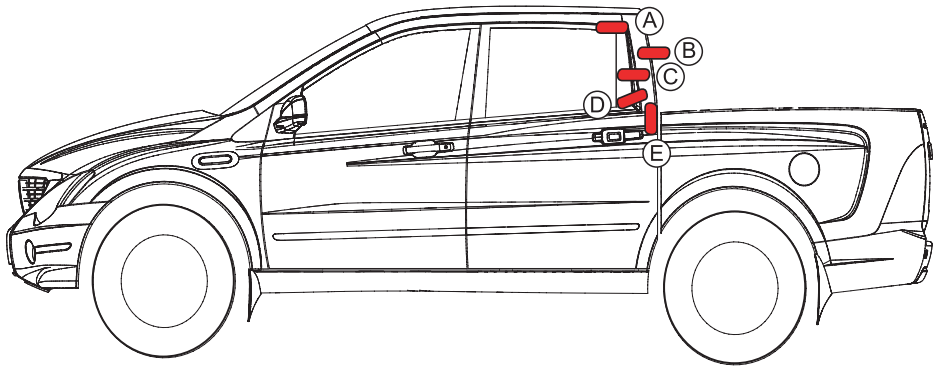
Unit: mm



Position	Gap	Flush	Position	Gap	Flush
A	4 + 1	0 (0 / -1)	A	5 ± 0.5	-
B	5.5 + 1	-	B	7.5 ± 1.5	-
C	4 ± 0.5	0 (0 / -1)	C	15.5 (+1 / -3)	0.7 ± 1.0
D	4 + 1	0 (0 / -1)	D	2.6 ± 0.5	-0.7 ± 0.5
E	6.5 ± 1.0	-	E	1 ± 0.5	0 ± 0.5
F	1 ± 0.5	0.75 ± 0.5	F	1 ± 0.5	0 ± 0.5
G	4.5 ± 0.5	9 (0 / -1)	G	2 ± 0.5	0.8 ± 0.5

Rear Upper Garnish

Unit: mm

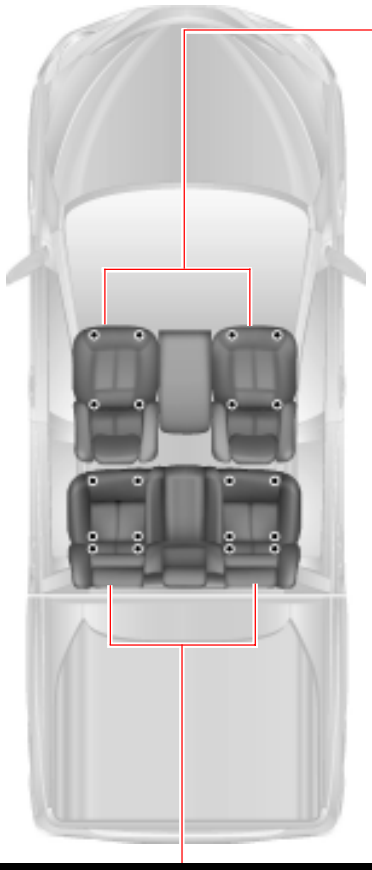


Position	Gap	Flush	Position	Gap	Flush
A	1 ± 0.5	0.75 ± 0.5	D	5 ± 0.5	0 (0 / -1)
B	16 ± 0.5	1 ± 0.5	E	7.5 ± 1.0	-
C	4.5 ± 0.5	9 (0 / -1)			

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

REAR SEAT

1. SEAT COMPONENTS & MOUNTING POINTS



Driver's Seat and Passenger's Seat

The seats are the same as those of ACTYON in terms of their structure and operation. But the seat shape is slightly different.

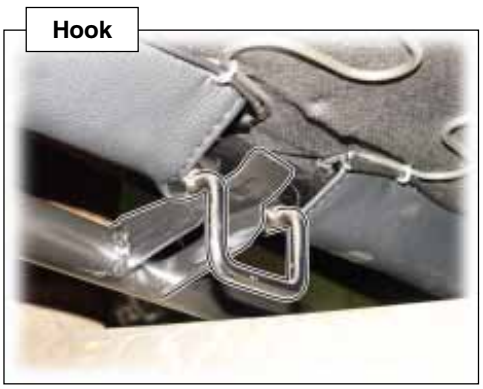


Tightening torque	35 ~ 55 Nm

Rear Seat (Bench, Separation Type)



Rear seats are designed to separate seatbacks from seat cushions. Firstly, remove or mount the seat cushions and then seatbacks.

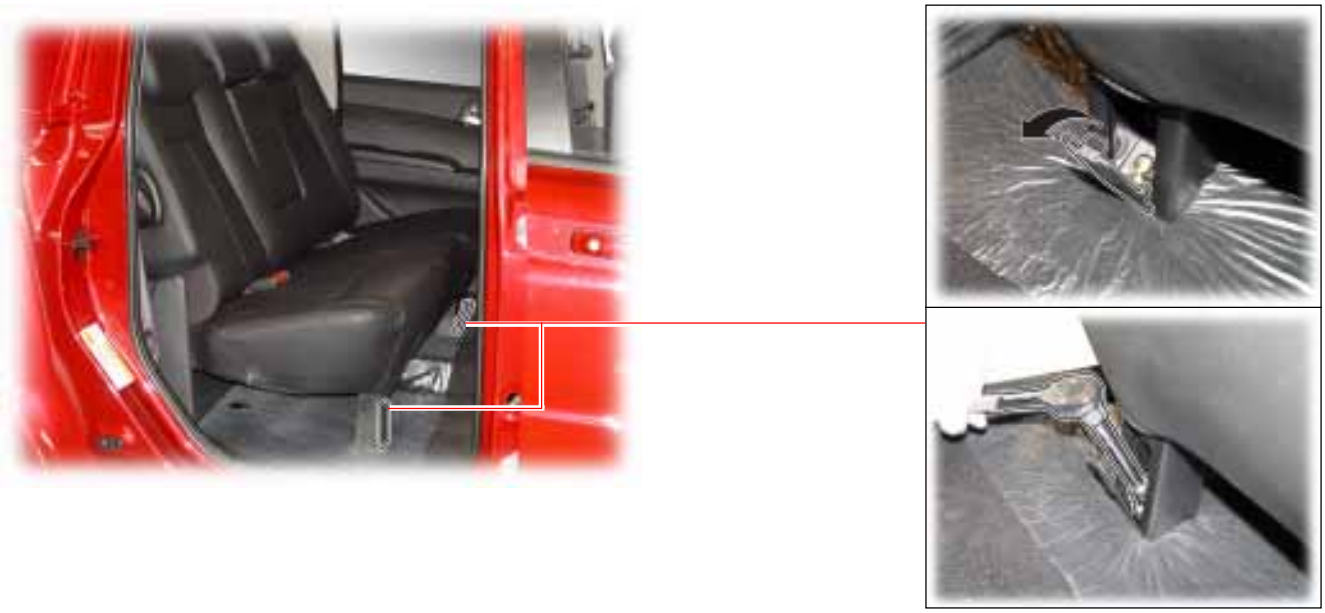


Seat cushion tightening torque	35 ~ 55 Nm
Seatback tightening torque	35 ~ 55 Nm

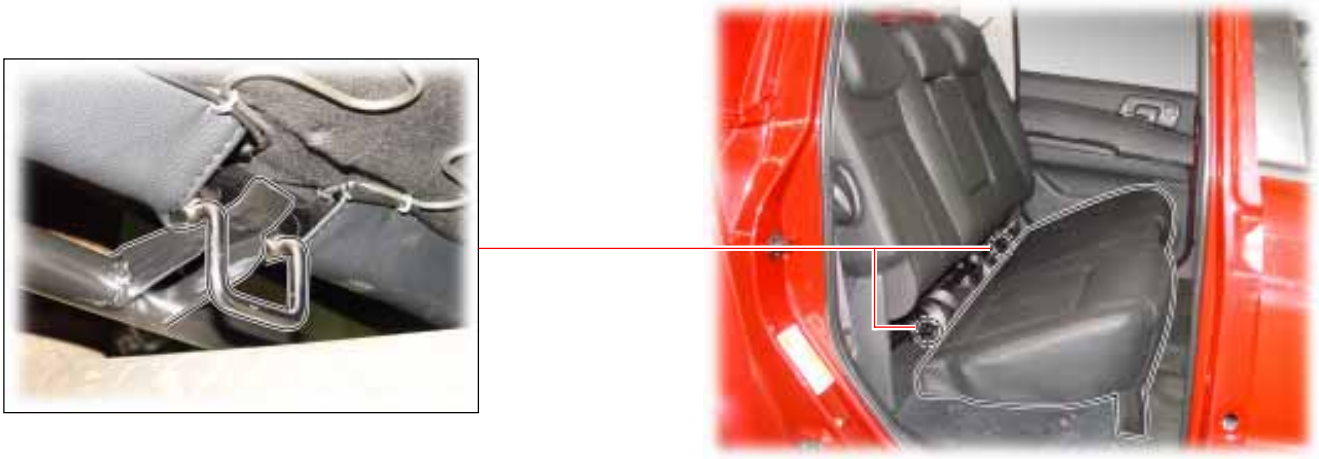
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. REMOVAL AND INSTALLATION OF REAR SEAT

1. Open the cushion seat mounting bolt cap of the rear seats, and unscrew the mounting bolts.



2. Remove the seat cushion from the hooks under seatback, and remove the seat cushion.



3. Unscrew the L/R mounting bolts (2) of the seatback.



4. Fold down the seatback by pulling the release lever of seatback, and remove the seatback.





Rear Seat



Cushion Seat Holding Hook



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SEAT BELT

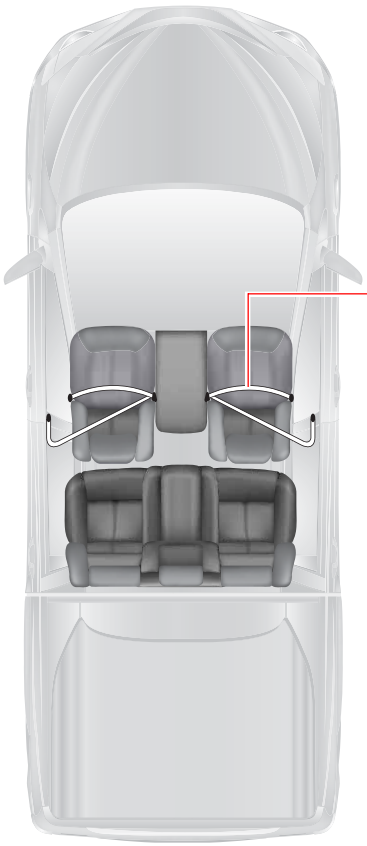
1. SEAT BELT CONFIGURATION

3-Point type seat belt: driver seat, passenger seat and rear seat

2-Point type seat belt: center seat of rear seat

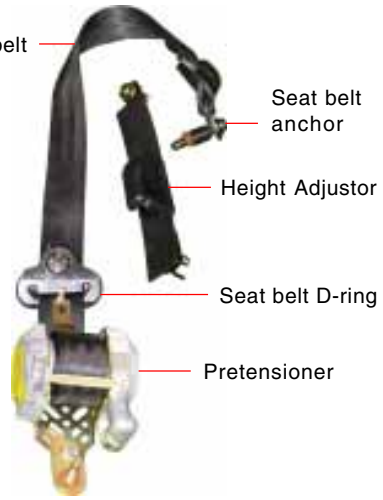
Pretensioner: Installed at front seats. The seat belt pretensioner rewinds the seat belt immediately to protect occupant's face and chest when a strong frontal collision occurs.

▶ Front Seat Belt (Three-Point Seat Belt)



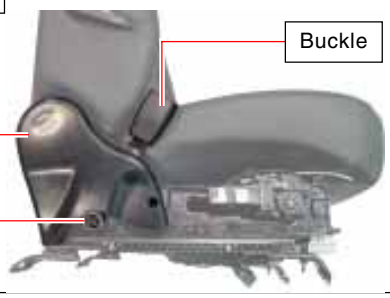
Three-Point Seat Belt of Front Seat (Driver's Seat and Passenger's Seat)





Front Seat (Fixed Type Buckle)

It is installed in the front seats and can be removed after removing the cover.

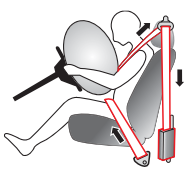


Seat Belt Pretensioner

When a severe frontal impact occurs, seat belt pretensioners rewind the seat belts immediately to restrain the occupants to their seats. It helps the effective operation of the seat belts and airbags.

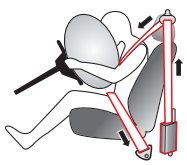
The supplementary load limiter is integrated in the pretensioner.

Pretensioner



The seat belt pretensioners remove slack from the driver and passenger front seat belts during a frontal impact.

Load limiter



Immediately after a collision, they loose the belts to prevent from injuring the body from the belt's pressure.

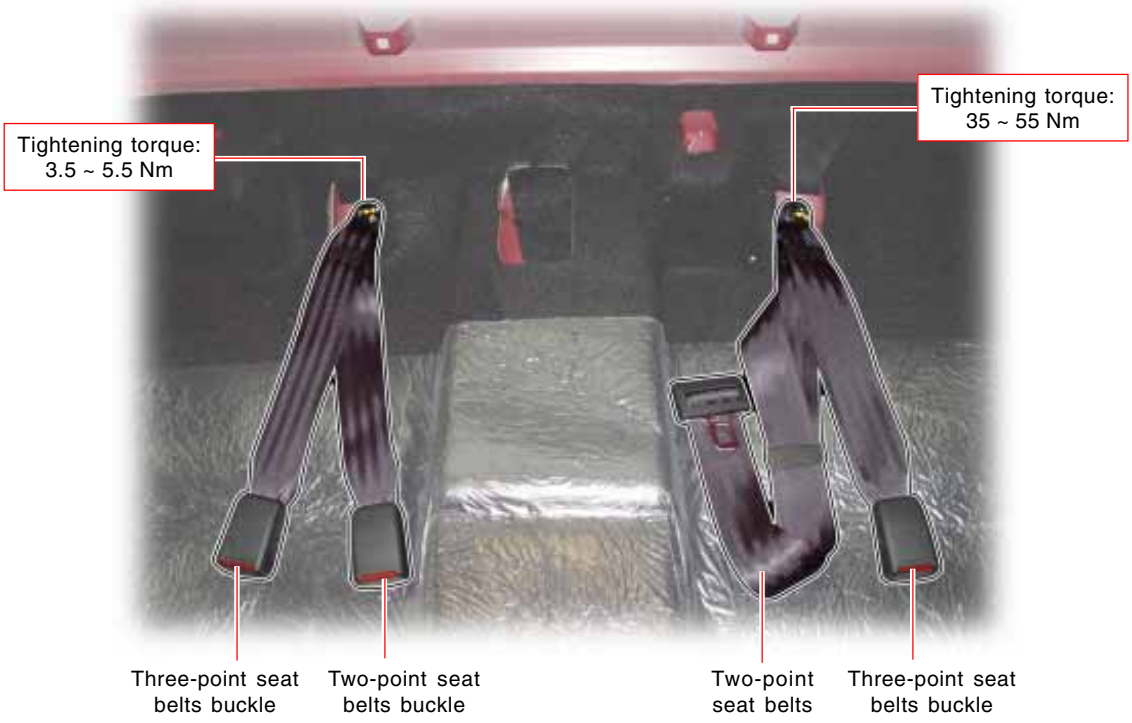
▶ Rear Seat Belt



Three-Point Seat Belts (Left/right)



Two-Point Seat Belt and Buckle



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. SEAT BELT MOUNTING

▶ Mounting Positions of Seat Belts and Tightening Torque

Front Seat Belt D Ring Cover

The way to remove D-ring cover is the same as that of ACTYON.

1. Press both sides of button (1) and push the bottom of D-ring cover (arrow) to release the upper hook (2).



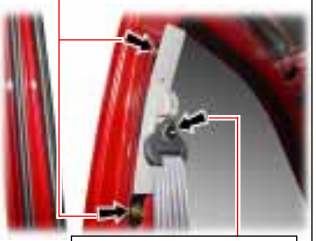
2. Raise the arrow section and remove the D-ring cover.





Rear upper bolt:
35 ~ 55 Nm

Seat belt adjuster mounting bolt: 35 ~ 55 Nm



Seat belt upper bolt:
35 ~ 55 Nm



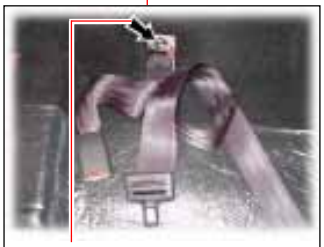
Rear seat belt anchor bolt:
35 ~ 55 Nm



Rear seat belt mounting bolt: 35 ~ 55 Nm

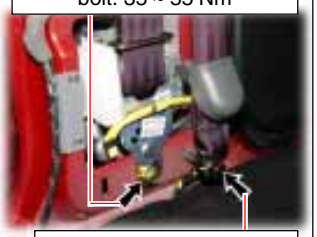


Buckle mounting bolt:
35 ~ 55 Nm



Rear seat center belt mounting bolt: 35 ~ 55 Nm

Front seat belt mounting bolt: 35 ~ 55 Nm



Front seat belt anchor bolt: 35 ~ 55 Nm

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

REAR TRIM/QUARTER TRIM/PILLAR

1. REAR TRIM AND QUARTER TRIM/PILLAR CONFIGURATION

Rear trim consists of quarter trim/pillar, OVM tool and storage box, and it is also equipped with the hole clip holding the OVM tools.

Components



* Remove the OVM tools and the storage box when removing or mounting the rear trim.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. REMOVAL AND INSTALLATION

※ **Preceding Works:** Remove the rear seat assembly as well as the rear storage box and OVM tools.

1. Remove the rear upper trim.





* The rear upper trim is secured with pins. It is necessary to check the exact pin point during removal and installation.

2. Remove each trims and pillars in the following order.



A. Remove L/R door scuff trim.



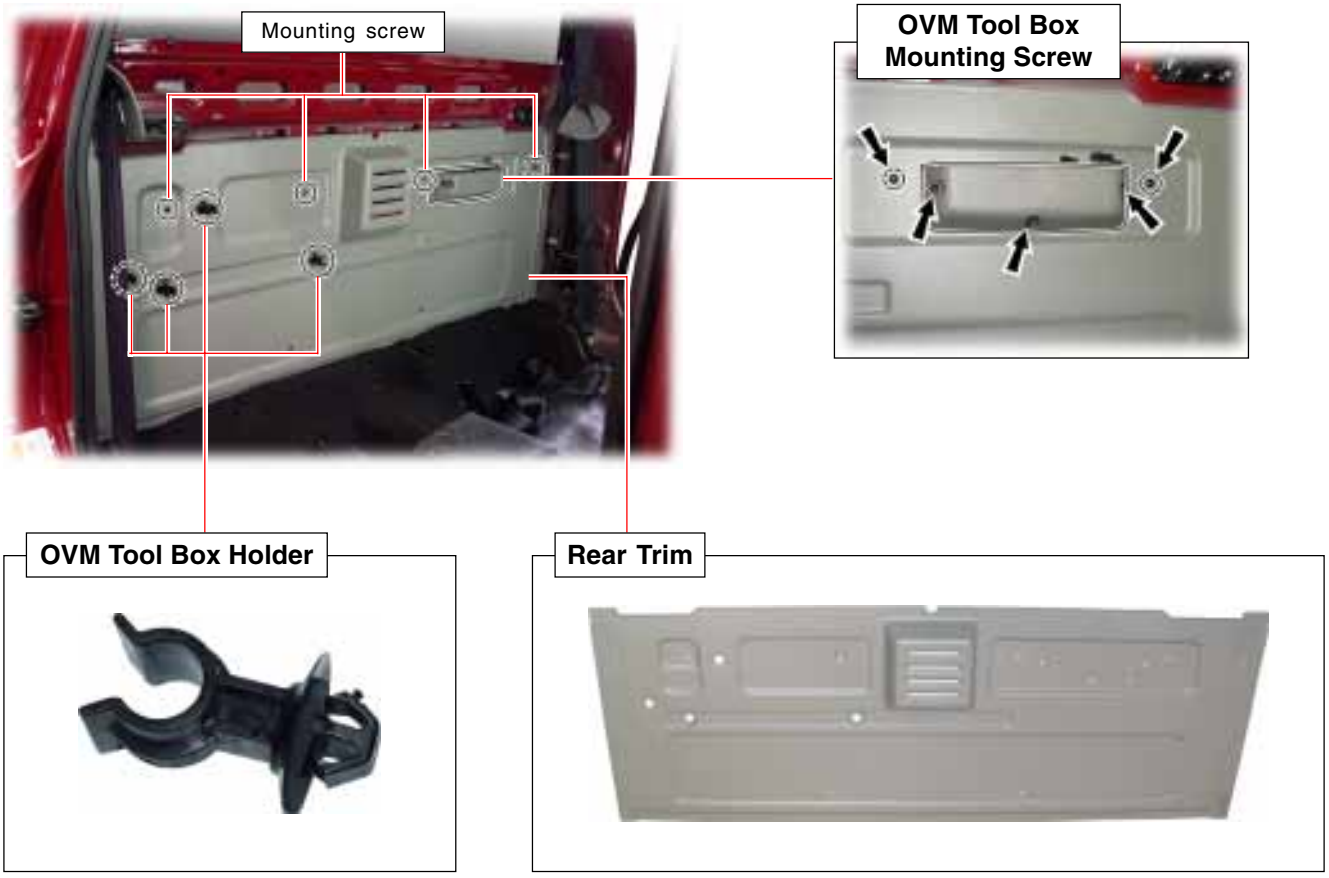
C. Unscrew the mounting screws on the rear C pillar, and remove the C pillar.



B. Unscrew the rear seatbelt anchor bolt on the door molding and rear quarter trim, and remove the rear quarter trim.



3. Undo the mounting screws and remove the OVM tool holder before removing the rear trim.



4. Install in the reverse order of removal.



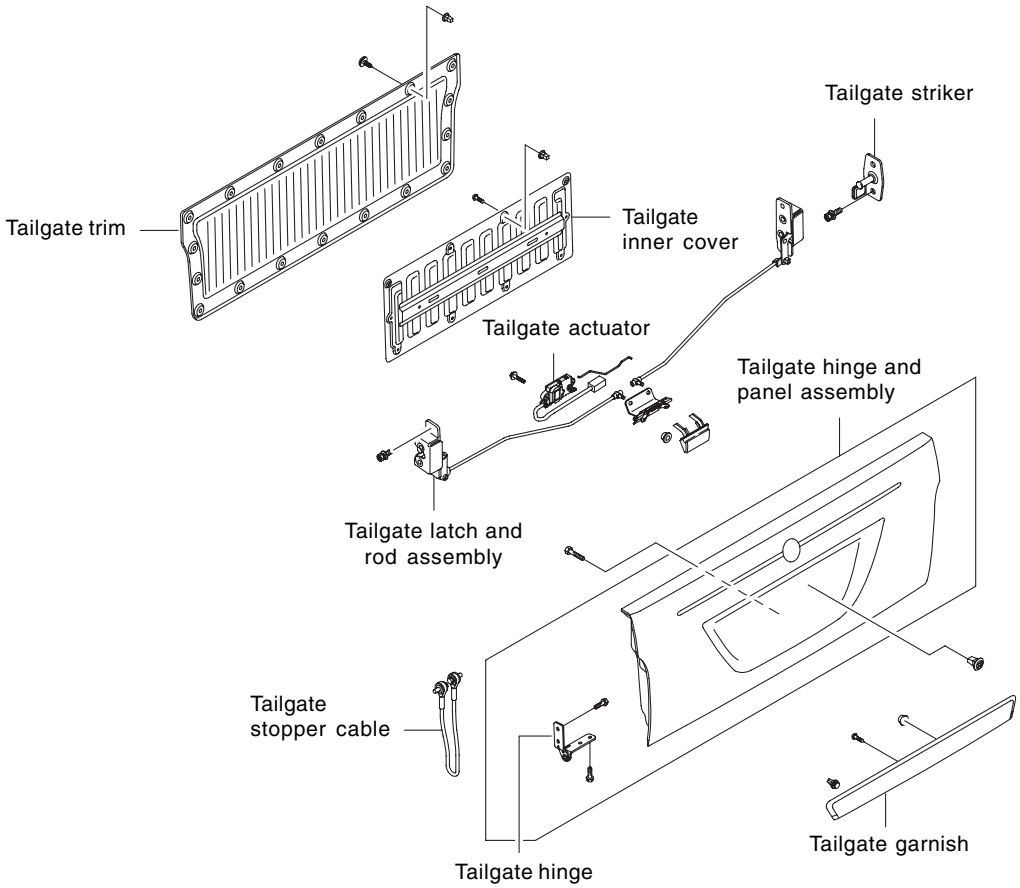
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

TAILGATE

1. TAILGATE CONFIGURATION



Tailgate Assembly Configuration



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EFFECTIVE DATE	
AFFECTED VIN	

2. REMOVAL AND INSTALLATION OF TAILGATE ASSEMBLY

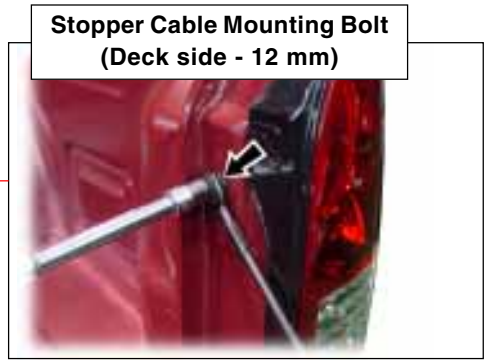
Tailgate Assembly

1. Pull out the license plate lamp and tailgate actuator connector from the lower tailgate.



2. Open the tailgate, and unscrew the stopper cable mounting bolt (A) and tailgate hinge (B) mounting bolt.







3. Carefully remove the tailgate. (two persons are needed)



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Tailgate Mechanism Assembly

※ **Preceding Work:** Park the vehicle on a firm and level ground, and place the vehicle chocks in front of and behind the wheels.

1. Open the tailgate, and remove the tailgate trim.





2. Unscrew the mounting screw from the tailgate inner cover, and remove the inner cover.





3. Remove L/R tailgate latches and link from the tailgate.



* Unscrew the mounting bolts (2) to remove the tailgate latch.





Pull up the latch link while widening the hook locked part of the latch link.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

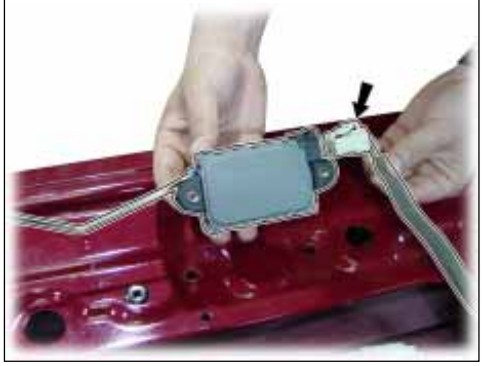
4. Remove the tailgate actuator from the tailgate.



A. Remove the actuator link from the tailgate outside handle crank, and unscrew the actuator mounting bolts (2).



B. Remove the actuator from the tailgate, and disconnect the connector.



5. Unscrew the mounting nut on the tailgate outside handle crank, and remove the crank and outside handle.



Removal of Handle Crank



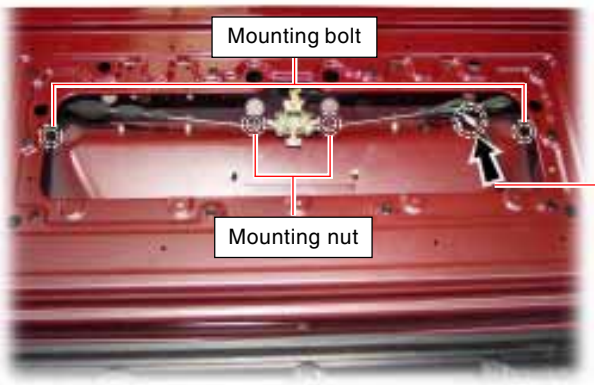
Removal of Outside Handle



Tailgate Rear Garnish

※ **Preceding Work:** Remove the inner cover and trim of the tailgate.

1. Disconnect the license plate lamp connector, and unscrew L/R mounting bolts and central mounting nut on the rear garnish.



License Plate Lamp Connector



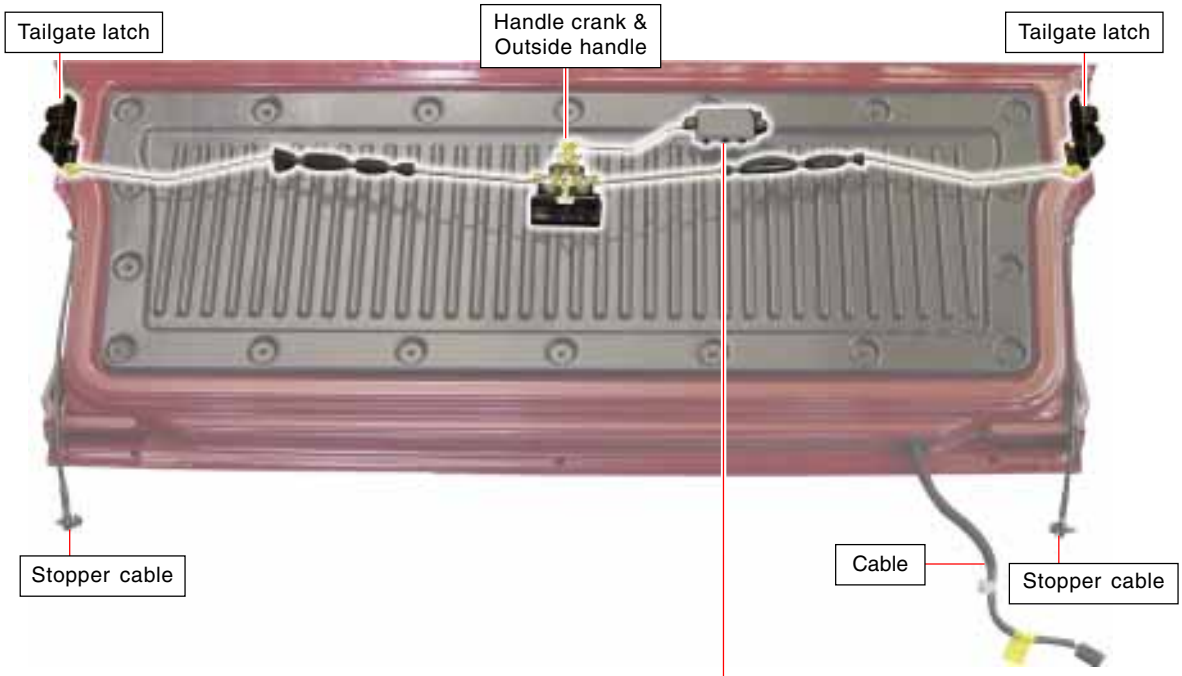
2. Remove the rear garnish from the outside of tailgate.



Rear Garnish

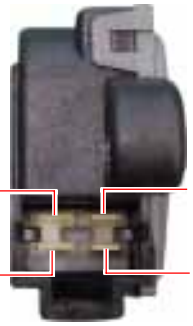


3. TAILGATE MECHANISM CONFIGURATION



Tailgate Actuator



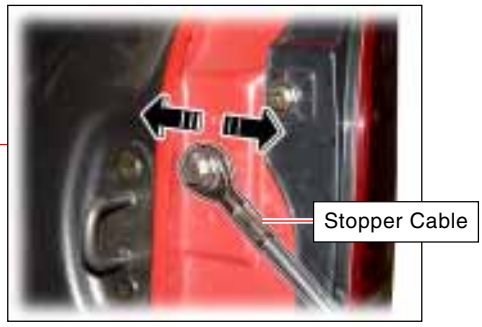


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. TAILGATE ARRANGEMENT

L/R Arrangement of Open Tailgate





* Disconnect the right stopper cable (deck side) to adjust the height of the tailgate horizontal surface.

NOTICE

- **If the heights of horizontal surface is uneven when the tailgate is opened, it needs to adjust the height.**

Tailgate Height Adjustment





* Move the L/R hinges of the tailgate to left/right/up/down to adjust the height and gap of the tailgate.

Tailgate Protrusion Adjustment





* Unscrew the mounting bolt on the tailgate latch hook to adjust the protrusion.

REAR BUMPER

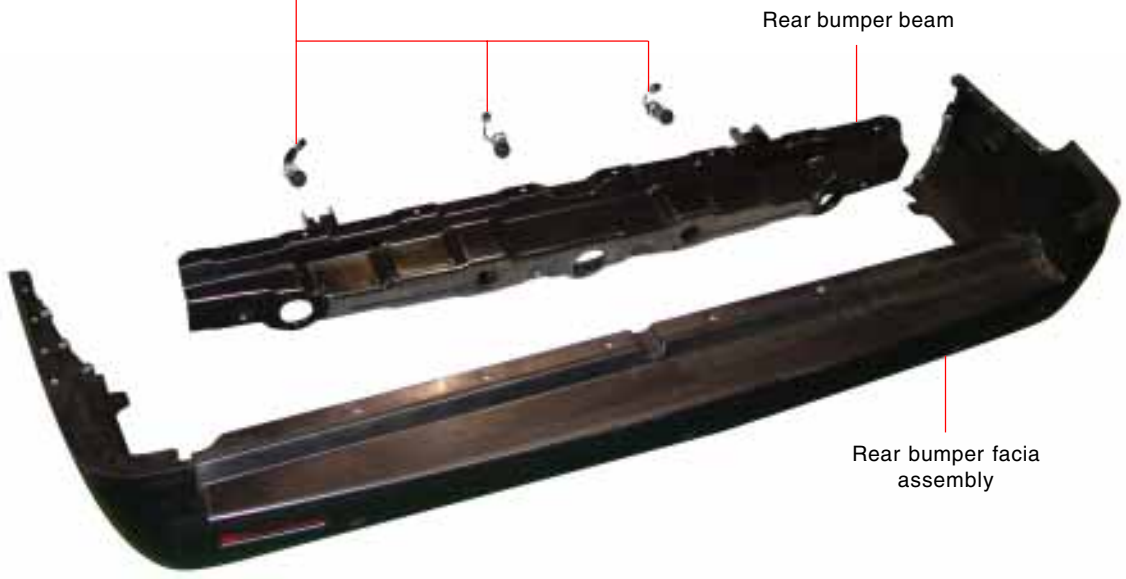
1. REAR BUMPER CONFIGURATION



Rear Bumper Assembly Configuration

PAS Sensor





* Energy absorber removed

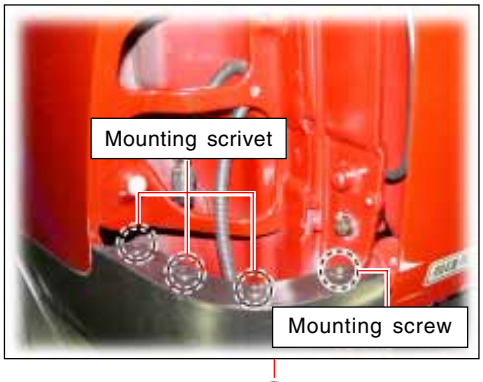
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. REMOVAL AND INSTALLATION OF REAR BUMPER ASSEMBLY

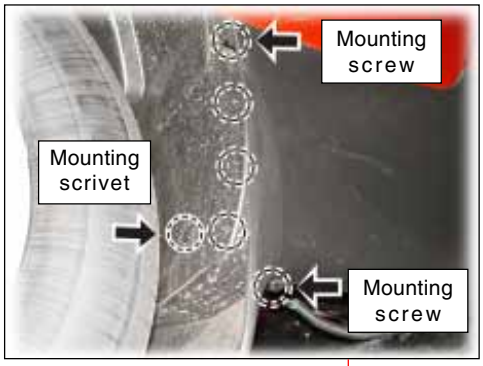
Removal and Installation

※ **Preceding Work:** Disconnect (-) terminal of battery, and remove L/R combination lamp assemblies.

1. Unscrew the mounting screw (1) and the scrivet ( ) after removing the rear combination lamp assembly.



2. Unscrew the mounting screws (4) and the scrivet (1) to the wheel housing and the mounting screw (1) to the lower bumper (wheel housing).

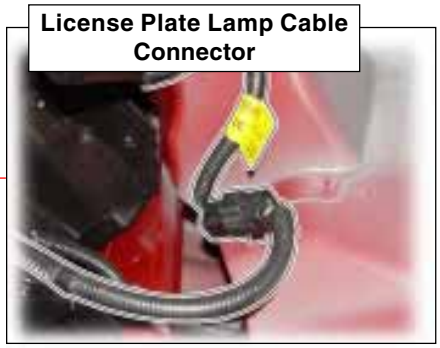




3. Disconnect the main connector for PAS sensor and the cable connector for license plate lamp, which are connected to the rear bumper from the bottom of the rear bumper.







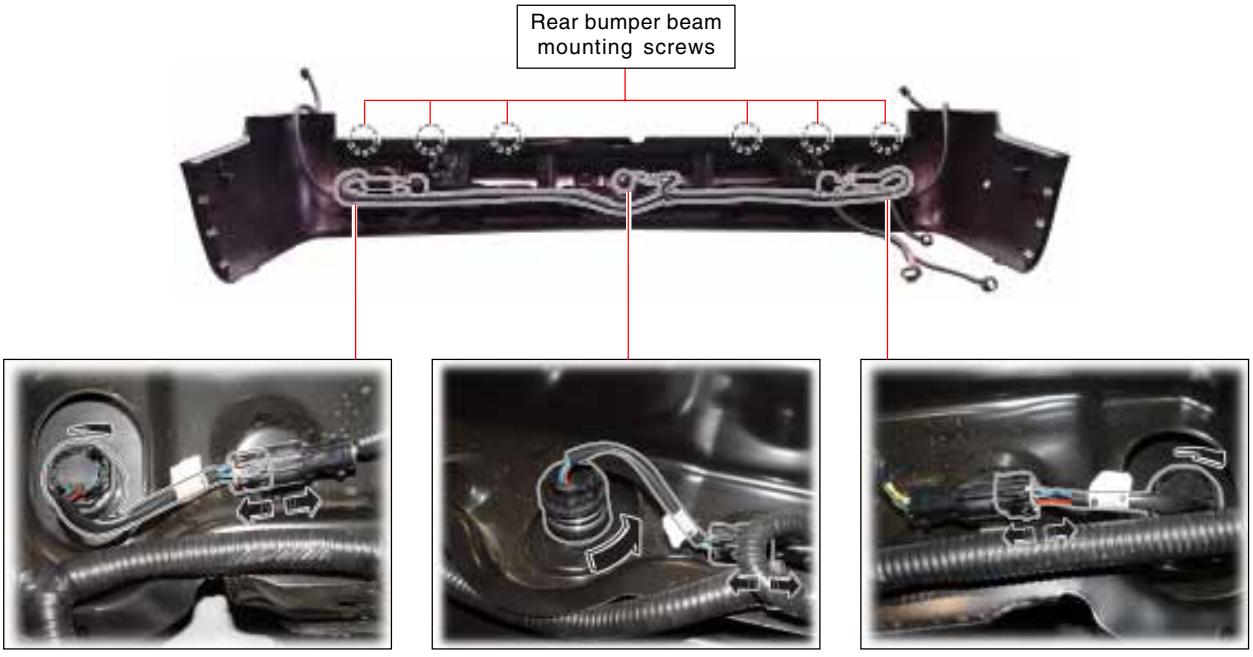
4. Unscrew the L/R mounting bolts (2) for rear bumper assembly from the bottom of rear bumper.



5. Remove the rear bumper assembly from the vehicle.



6. Pull out the rear bumper beam and PAS sensor from the removed rear bumper assembly.

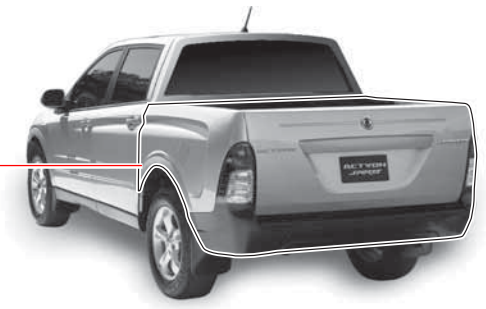


7. Install in the reverse order of removal.

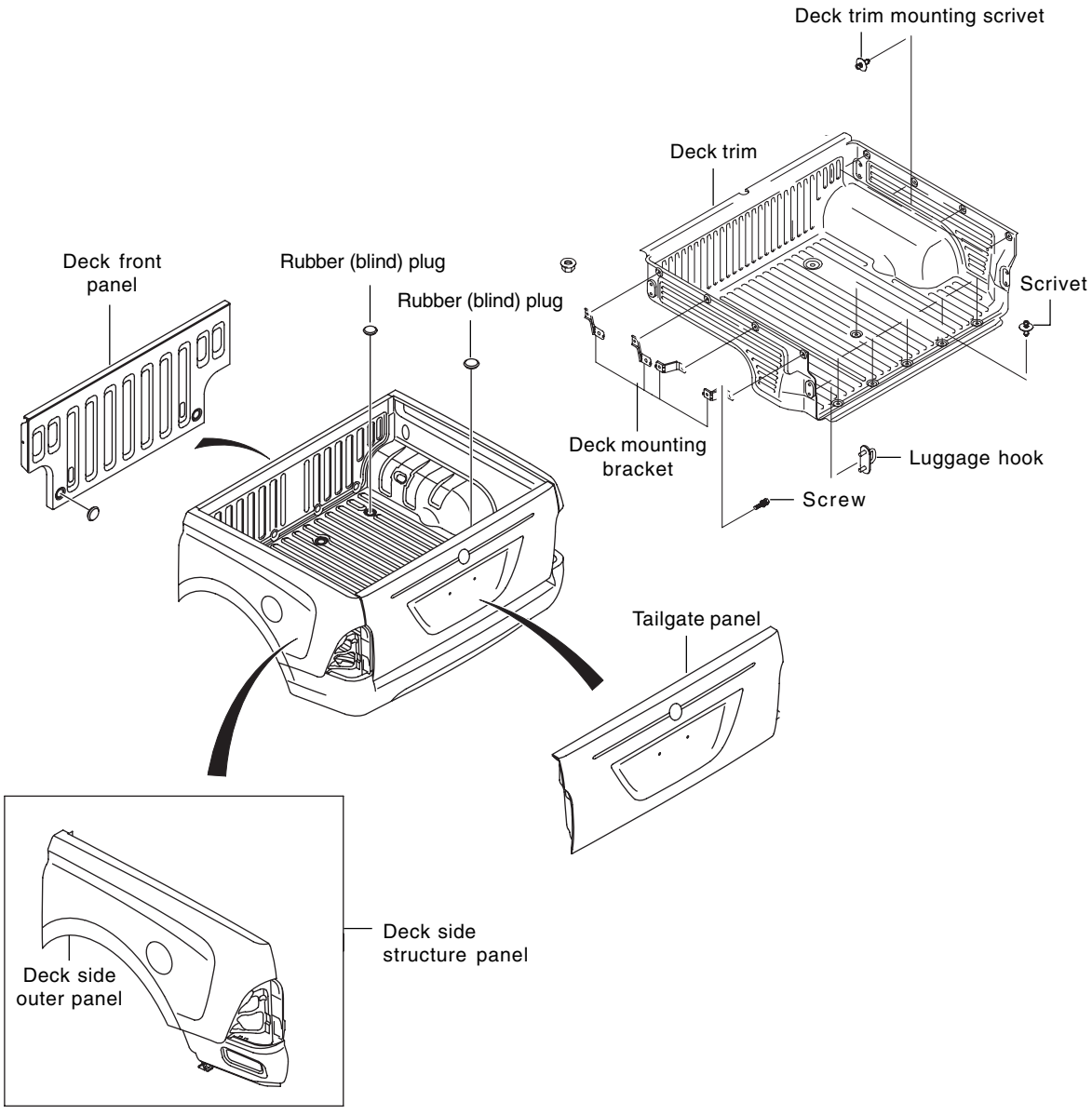
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DECK ASSEMBLY

1. DECK ASSEMBLY CONFIGURATION



Deck Assembly Configuration



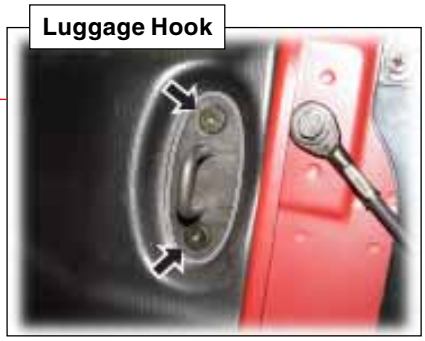
* Deck assembly and rear bumper can be removed or mounted at the same time. However, this section just illustrates the removal and installation procedures of deck assembly with the rear bumper removed.

2. REMOVAL AND INSTALLATION OF DECK ASSEMBLY

Removal and Installation

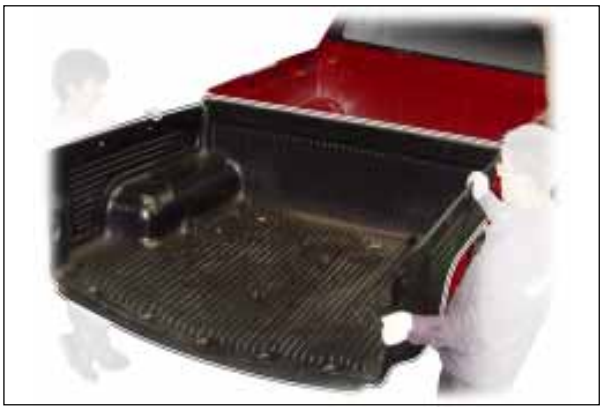
1. Remove the luggage hooks (4) and the scrivets (4 at the top left/ right; 6 at the floor), which are securing the deck trim.







2. Remove the deck trim from the deck. (Two persons are needed.)



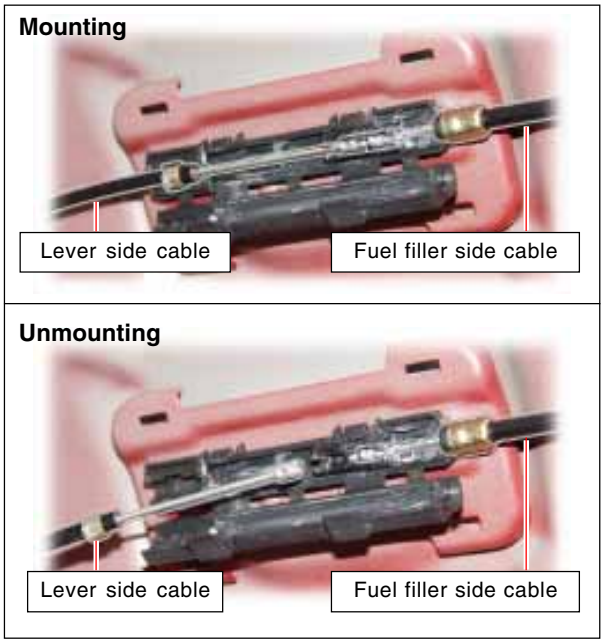
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Deck Assembly

1. Raise up the vehicle using the lift, and remove the wheel housing cover.



2. Disconnect the cable from the cable adapter of the fuel filler lid located on the wheel housing side.



3. Unscrew the mounting bolts on the fuel filling hose.



4. Remove the mounting screw for fuel hose adaptor from the bottom of vehicle.



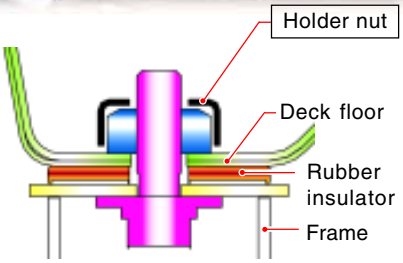
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. Unscrew the deck mounting bolts (4) from the bottom of vehicle.



Rear Side Mounting Bolt (Deck Mounting No.2)

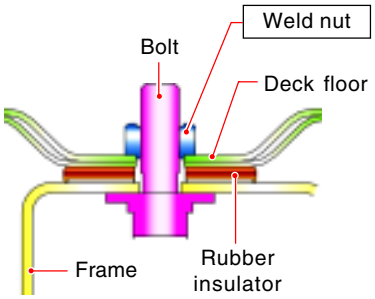




Tightening torque: 70 ~ 90 Nm

Front Side Mounting Bolt (Deck Mounting No.1)





Tightening torque: 70 ~ 90 Nm

6. Remove the deck assembly from the vehicle.

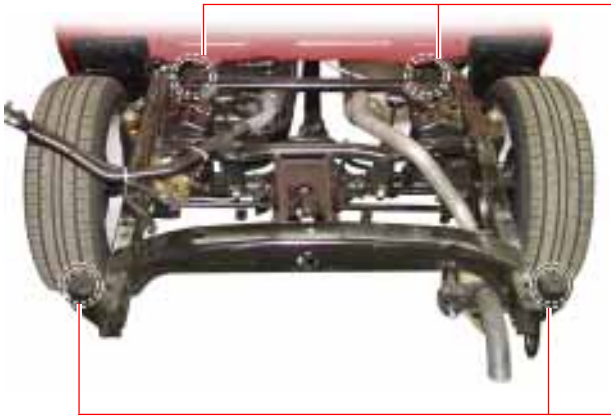




CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. INSPECTION AND MAINTENANCE OF RUBBER INSULATOR AND DECK

Rubber Insulator

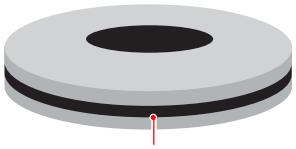


Deck No. 1 Mounting Rubber Insulator



Deck No. 2 Mounting Rubber Insulator





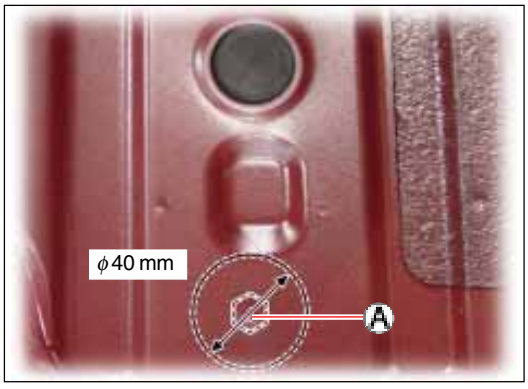
Integrated steel plate

If it is defective or produces any noise, replace it with a insulator that consists of approx. 1.2 mm steel plate. The insulator can prevent the noise generating from the friction between deck and frame.

How to Prevent Deck Nuts from Loosening

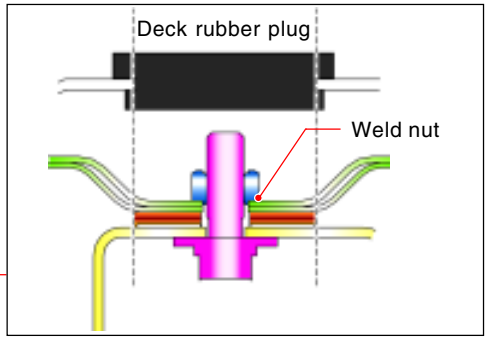
1. If the welded nuts inside the deck are loosened or coming off, drill the deck floor (ϕ 40 mm) using the hole cutter to insert new nuts. (Refer to Deck Mounting)

   If the deck floor trim is removed, the positions of nut (A) to be mounted on the deck are visible on the floor.



2. Insert the ϕ 40 mm of deck rubber plug after deck mounting.



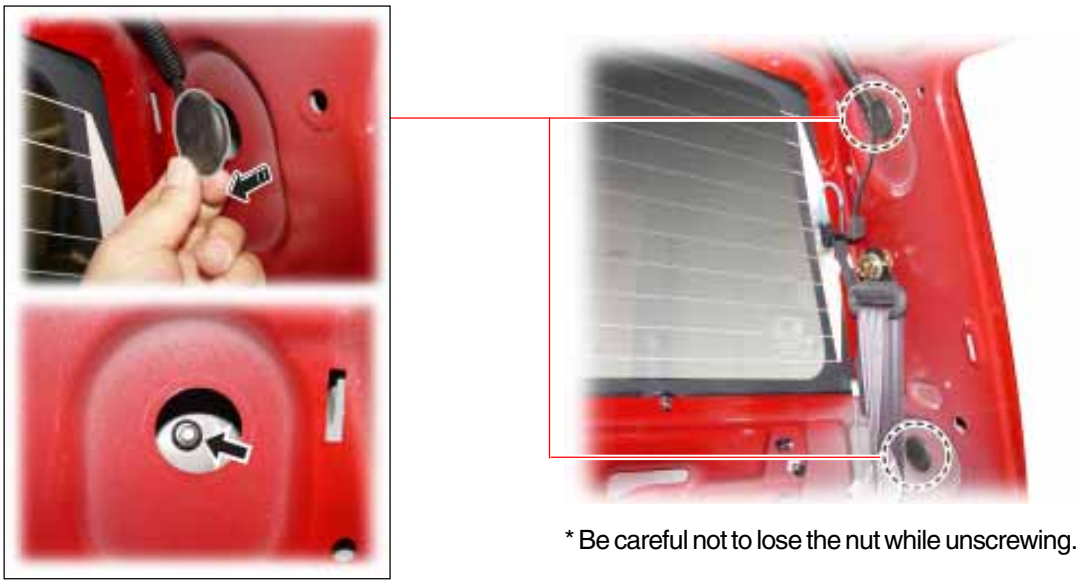


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

C PILLAR GARNISH

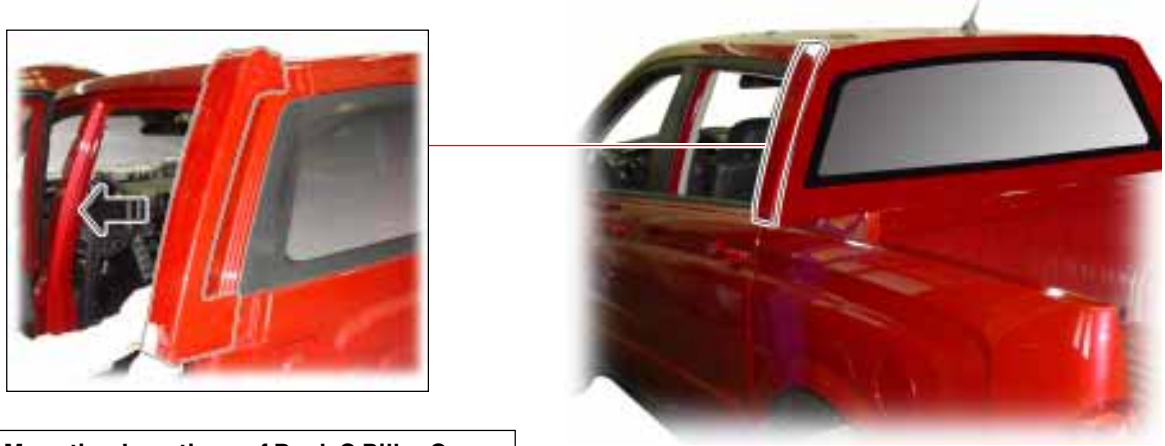
※ **Preceding Work:** Remove the rear trim assembly.

1. Remove the hole cover for C pillar cover mounting nut with the rear trim assembly removed, and unscrew the mounting nut.

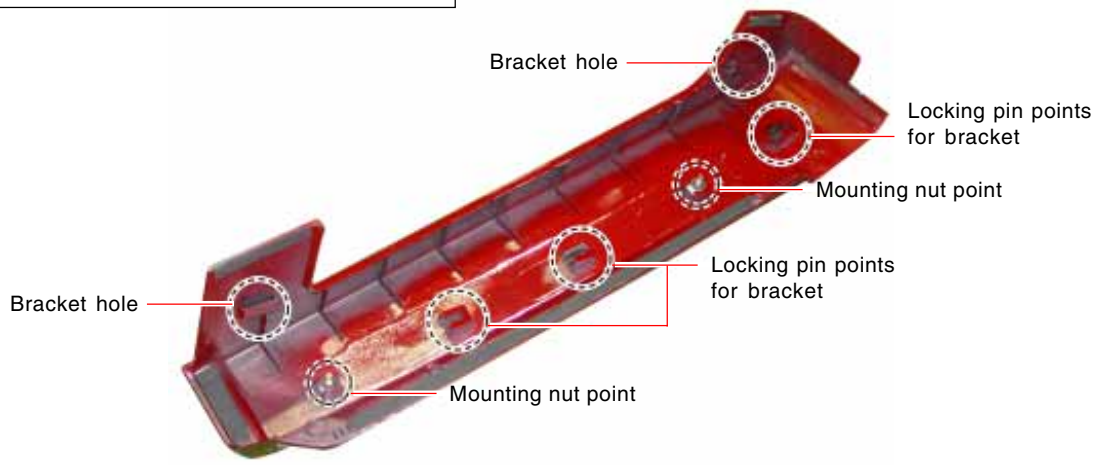


* Be careful not to lose the nut while unscrewing.

2. Remove the C pillar garnish from the vehicle. Please be careful not to lose or damage the locking pins.



Mounting Locations of Deck C Pillar Cover



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Section 06

DIAGNOSIS

- ECU
- TCU
- BRAKE
- AIR-BAG
- T/C
- RK-STICS
- FFH
- RAIN SENSOR
- FATC
- TGS LEVER
- P/TRUNK
- CCCS

ECU

TABLE OF CONTENTS

DIESEL 3
GASOLINE 65
CDPF 115

DIESEL

INDEX OF DTC 4
TROUBLE DIAGNOSIS TABLE 7

INDEX OF DTC

New DTC

P0100 Air Mass Flow (HFM) Malfunction 7
P0102 Low HFM Sensor Signal (Circuit Open) 7
P0103 High HFM Sensor Signal (Circuit Short) 8
P0105 Supply Voltage Fault to Booster Pressure Sensor 8
P0106 High Booster Pressure Sensor Signal 9
P0107 Booster Pressure Sensor Open/GND Short 9
P0108 Booster Pressure Sensor Short 10
P0109 Low Booster Pressure Sensor Signal 10
P0110 Intake Air Temperature Circuit Malfunction - Source Power Problem 11
P0112 Intake Air Temperature Circuit Malfunction - Open 12
P0113 Intake Air Temperature Circuit Malfunction - Short 13
P0115 Supply Voltage Fault to Coolant Temperature Sensor 13
P0117 Coolant Temperature Sensor Malfunction - Open 13
P0118 Coolant Temperature Sensor Malfunction - Short 14
P0120 Accelerator Pedal Sensor #1 Malfunction - supply Voltage Fault 14
P0122 Accelerator Pedal Sensor #1 Malfunction - Open 14
P0123 Accelerator Pedal Sensor #1 Malfunction - Short 14
P0147 Impossible to Learn Idle MDP 15
P0148 Impossible to Learn Drive MDP 15
P0171 Insufficient MDP of Injector #1 15
P0172 Insufficient MDP of Injector #2 15
P0173 Insufficient MDP of Injector #3 15
P0174 Insufficient MDP of Injector #4 15
P0175 Insufficient MDP of Injector #5 15
P0180 Fuel Temperature Sensor - Malfunction 15
P0182 Fuel Temperature Sensor - Short to Ground . 16
P0183 Fuel Temperature Sensor - Short to B+ 16
P0190 Supply Voltage Fault to Fuel Rail Pressure Sensor 17
P0191 Fuel Rail Pressure Sensor Signal Fault 17
P0192 Fuel Rail Pressure Sensor Malfunction - Open 17
P0193 Fuel Rail Pressure Sensor Malfunction - Short 18
P0201 Injector #1 Circuit Open 18
P0202 Injector #2 Circuit Open 18
P0203 Injector #3 Circuit Open 18
P0204 Injector #4 Circuit Open 18
P0205 Injector #5 Circuit Open 18
P0215 Main Relay Fault - Stuck 19
P0219 Too Small Clearance of Crank Angle Sensor 19
P0220 Accelerator Pedal Sensor #2 Malfunction - Supply Voltage Fault 19
P0222 Accelerator Pedal Sensor #2 Malfunction - Open 19
P0223 Accelerator Pedal Sensor #2 Malfunction - Short 19
P0243 VGT Turbocharger Actuator Circuit Short 20
P0245 Turbo Charger Actuator Circuit Fault - Short .. 20
P0246 Turbo Charger Actuator Circuit Fault - Short to B+ 20
P0251 IMV Driver Circuit Malfunction - Short 20
P0253 IMV Driver Circuit Malfunction - Short to Ground 20
P0255 IMV Driver Circuit Malfunction - Open 20
P0263 Injector #1 Balancing Fault 21
P0266 Injector #2 Balancing Fault 21
P0269 Injector #3 Balancing Fault 21
P0272 Injector #4 Balancing Fault 21
P0275 Injector #5 Balancing Fault 21
P0325 Accelerometer #1 (Knock Sensor) Malfunction 21
P0325 Accelerometer #1 (Knock Sensor) Malfunction 22
P0335 No Crank Signals 22
P0336 Too Large Clearance of Crank Angle Sensor 22
P0341 Cam Position Sensor Malfunction (Poor Synchronization) 22
P0344 Cam Position Sensor Malfunction 22
P0372 Crank Angle Sensor Malfunction 23
P0400 EGR Control Valve Fault 23
P0401 EGR Control Valve Fault (Low) 23
P0402 EGR valve stuck in open position 23
P0405 High EGR open position deviation 24
P0406 High EGR close position deviation 24
P0407 Low EGR Position Signal 24
P0408 High EGR Position Signal 25
P0480 PWM Electric Fan Malfunction (Open circuit) (Only for D27DTP (POWER UP) model) 25
P0481 PWM Electric Fan Malfunction(Short to B+) (Only for D27DTP (POWER UP) model) 25
P0482 PWM Electric Fan Malfunction (Short to GND) (Only for D27DTP (POWER UP) model) 25
P0483 Fan PWM motor out have short to GND 25
P0484 Fan PWM Stall motor 25
P0485 Fan PWM motor have over load 25
P0487 Faulty Maximum Throttle Closing Value 25
P0488 Faulty Maximum Throttle Opening Value 26
P0530 Air Conditioner Refrigerant Sensor Supply Power Fault 26
P0532 Air Conditioner Refrigerant Pressure Signal Circuit Short 26
P0533 Excessive Air Conditioner Refrigerant Pressure 27
P0560 Battery Voltage Malfunction 27
P0562 Low Battery Voltage 27
P0563 High Battery Voltage 28
P0571 Brake Pedal Switch Fault 28
P0602 Faulty Vehicle Speed Sensor Coding 28
P0606 ECU Watchdog Fault 28
P0608 Faulty ABS/ESP Coding 29
P0611 No Data for C3I 29
P0612 Internal Error in C3I Data 29

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

P0613 Faulty TCU Coding 29
P0614 TCCU Coding Failt 29
P0618 Multi Calibration Not Performed 29
P0619 Multi Calibration Performing Error 29
P062D Injector Bank #1 Malfunction - Low Voltage ... 29 (former P1611)
P062E Injector Bank #2 Malfunction - Low Voltage ... 29 (former P1618)
P062F Multi Calibration Memory Error 30
P0630 Variant Coding is not done 30
P0631 Variant Coding writing error 30
P0633 Immobilizer Fault (refer to immobilizer section) 30
P0641 ECU Supply Voltage 1 Fault (5 V) 30
P0642 ECU Supply Voltage 1 Fault - Low (5 V) 30
P0643 ECU Supply Voltage 1 Fault - High (5 V) 30
P0649 Diag Lamp Drive Open Circuit 30
P0650 Diag Lamp Drive Short to BATT 30
P0651 ECU Supply Voltage 2 Fault (5 V) 31
P0652 ECU Supply Voltage 2 Fault - Low (5 V) 31
P0653 ECU Supply Voltage 2 Fault - High (5 V) 31
P066A Internal Malfunction in #1 Glow Plug Controller 31
P066B Internal Short in #1 Glow Plug Controller 31
P066C Internal Malfunction in #2 Glow Plug Controller 31
P066D Internal Short in #2 Glow Plug Controller 31
P066E Internal Malfunction in #3 Glow Plug Controller 31
P066F Internal Short in #3 Glow Plug Controller 31
P0670 Defective Power Supply of Glow Plug Controller 31
P0671 #3 Glow Plug Fault - Open 32
P0672 #4 Glow Plug Fault - Open 32
P0673 #5 Glow Plug Fault - Open 32
P0674 #1 Glow Plug Fault - Open 32
P0675 #2 Glow Plug Fault - Open 32
P067A Internal Malfunction in #4 Glow Plug Controller 32
P067B Internal Short in #4 Glow Plug Controller 32
P067C Internal Malfunction in #5 Glow Plug Controller 32
P067D Internal Short in #5 Glow Plug Controller 32
P0683 Defective CAN Communiction of Glow Plug Controller 32
P0685 Main Relay Malfunction 33
P0697 ECU Supply Voltage Fault (2.5 V) 33
P0698 ECU Supply Voltage Fault - Low (2.5 V) 33
P0699 ECU Supply Voltage Fault - High (2.5 V) 33
P0700 TCU Signal Fault 33
P0704 Clutch Switch Malfunction 33
P0805 Neutral Signal Input Malfunction (Only for D27DT M/T model) 33
P1102 HFM Sensor - High Characteristic Value (Only for D27DT model) 34
P1103 HFM Sensor - Low Characteristic Value (Only for D27DT model) 34
P1105 Barometric Sensor Circuit Short 34
P1106 Booster Pressure Sensor Malfunction 34
P1107 Barometric Sensor Circuit Short/GND Short .. 34
P1108 Barometric Sensor Circuit Short 34
P1109 Booster Pressure Sensor Initial Check Fault 35
P110A AMF OBD High Sigral 35
P110B AMF OBD Low Sigral 35
P1115 Coolant Temperature Sensor Malfunction 35
P1120 Accelerator Pedal Sensor #1 Malfunction 36
P1121 Accelerator Pedal Sensor #2 Malfunction 36
P1122 Accelerator Pedal Sensor Malfunction (Limp Home Mode) 36
P1123 Accelerator Pedal Sensor Malfunction (Torque Mode) 36
P1124 Accelerator Pedal Sensor Malfunction - Stuck 36
P1148 Accelerometer (Knock Sensor) Learning Fault 36
P1149 Too High Water Level in Fuel Filter 36
P1170 Torque Trim Fault - High 36
P1171 #1 Injector MDP Malfunction 36
P1172 #2 Injector MDP Malfunction 36
P1173 #3 Injector MDP Malfunction 37
P1174 #4 Injector MDP Malfunction 37
P1175 #5 Injector MDP Malfunction 37
P1190 Fuel Rail Pressure Sensor Initial Signal Fault 37
P1191 Pressure Build Up - Too Slow 37
P1192 Fuel Rail Pressure Sensor Initial Signal Fault - Low 38
P1193 Fuel Rail Pressure Sensor Initial Signal Fault - High 38
P1201 Injector #1 Circuit Short 38
P1202 Injector #2 Circuit Short 38
P1203 Injector #3 Circuit Short 39
P1204 Injector #4 Circuit Short 39
P1205 Injector #5 Circuit Short 39
P1234 VGT Operation Fault (High) 39
P1235 VGT Operation Fault 39
P1252 Too High IMV Pressure 39
P1253 Minimum Rail Pressure Control Malfunction (IMV Fault) 40
P1254 Maximum Rail Pressure Control Malfunction (IMV Fault) 40
P1256 Too Small Transfer Pressure Fuel in Rail Pressure System 41
P1257 Too Large Transfer Pressure Fuel in Rail Pressure System 41
P1258 Too Small High Pressure Fuel in Rail Pressure System 42
P1259 Too Large High Pressure Fuel in Rail Pressure System 42
P1260 Too High IMV Driving Current 43
P1286 Low Resistance for Injector #1 Wiring Harness 43
P1287 High Resistance for Injector #1 Wiring Harness 43
P1288 Low Resistance for Injector #2 Wiring Harness 44
P1289 High Resistance for Injector #2 Wiring Harness 44
P1290 Low Resistance for Injector #3 Wiring Harness 44

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

P1291 High Resistance for Injector #3 Wiring Harness ... 45
P1292 Low Resistance for Injector #4 Wiring Harness ... 45
P1293 High Resistance for Injector #4 Wiring Harness ... 45
P1294 Low Resistance for Injector #5 Wiring Harness ... 46
P1295 High Resistance for Injector #5 Wiring Harness ... 46
P1405 EGR Solenoid Valve Malfunction - Short to Ground ... 46
P1406 EGR Solenoid Valve Malfunction - Short to +Batt ... 46
P1407 Faulty EGR close position ... 47
P1409 EGR Valve Circuit Short ... 47
P1480 Condenser Fan #1 Circuit Malfunction - Open .. 47
P1481 Condenser Fan #1 Circuit Malfunction - Short .. 47
P1482 Condenser Fan #1 Circuit Malfunction - Short to Ground ... 47
P1500 Vehicle Speed Fault ... 48
P1501 Faulty Variant Coding (Vehicle Speed) ... 48
P1503 Faulty Vehicle Speed Sensor Input ... 48
P1526 Condenser Fan #2 Circuit Malfunction - Open 48
P1527 Condenser Fan #2 Circuit Malfunction - Short 48
P1528 Condenser Fan #2 Circuit Malfunction - Short to Ground ... 49
P1530 #1 Heater Operating Circuit - Open ... 49
P1531 #1 Heater Operating Circuit - Short ... 49
P1532 #1 Heater operating circuit - Short to Ground 49
P1534 #2 Heater Operating Circuit - Open ... 49
P1535 #2 Heater operating circuit - Short ... 50
P1536 #2 Heater operating circuit - Short to Ground 50
P1540 Air Conditioner Operating Circuit Fault - Open 50
P1541 Air Conditioner Operating Circuit Fault - Short 50
P1542 Air Conditioner Operating Circuit Fault - Short to Ground ... 50
P1564 Auto Cruise Switch Fault (power) ... 50
P1565 Auto Cruise Switch Malfunction (Acceleration) 50
P1566 Auto Cruise Switch Malfunction (OFF) ... 50
P1567 Auto Cruise Switch Malfunction (Return) ... 50
P1568 Auto Cruise Switch Fault (when accelerating) 50
P1568 Auto Cruise Switch Malfunction (Deceleration) 50
P1569 Auto Cruise Switch Fault (when decelerating) 50
P1569 Auto Cruise Switch Malfunction (Safety) ... 50
P1570 Auto Cruise Switch Fault (Signal) ... 51
P1571 Brake Lamp Signal Fault ... 51
P1572 Brake Lamp Signal Fault ... 51
P1573 Auto Cruise Switch Fault (Short) ... 52
P1578 Auto Cruise Switch Fault (Circuit Short) ... 52
P1600 ECU Shut Down Fault ... 52
P1601 ECU Fault ... 52
P1602 ECU Fault ... 52
P1603 ECU Fault ... 52
P1604 ECU Fault ... 52
P1605 ECU Fault ... 53
P1606 ECU Fault ... 53
P1607 ECU Injector Cut Fault ... 53
P1608 ECU Fault ... 53
P1614 ECU C2I/MDP Fault ... 53
P1615 ECU Fault ... 53
P1616 ECU Fault ... 53
P1620 ECU Fault ... 53
P1621 ECU Fault ... 53
P1622 ECU Fault ... 53
P162E Injector Bank #1 Malfunction - High Voltage .. 54 (former P1619)
P162D Injector Bank #2 Malfunction - High Voltage .. 54 (former P1612)
P1630 Wrong response from Immobilizer (refer to immobilizer section) ... 54
P1631 Immobilizer Fault (refer to immobilizer section)55
P1632 Immobilizer Fault (refer to immobilizer section)55
P1633 Immobilizer Fault (refer to immobilizer section)55
P1634 Immobilizer Fault (refer to immobilizer section)55
P1635 No response from Immobilizer (refer to immobilizer section) ... 55
P1636 Immobilizer Fault (refer to immobilizer section) . 56
P1650 AMF OBD Short to GND ... 56
P1657 Engine Mount Control Malfunction (Open) ... 56
P1658 Engine Mount Control Malfunction (Short to B+) 56
P1659 Engine Mount Control Malfunction (Short to GND) ... 56
P1671 #3 Glow Plug Fault - Short ... 56
P1672 #4 Glow Plug Fault - Short ... 56
P1673 #5 Glow Plug Fault - Short ... 56
P1674 #1 Glow Plug Fault - Short ... 57
P1675 #2 Glow Plug Fault - Short ... 57
P1676 Glow Plug Communication Fault ... 57
P1677 Glow Plug Controller Fault ... 57
P1678 Glow Plug Malfunction - Open ... 57
P1679 Glow Plug Malfunction - Short ... 58
P1680 Glow Plug Malfunction - Short to Ground ... 58
P1683 Defective CAN Communiction of Glow Plug Controller ... 58
P2100 Throttle Drive Circuit Short ... 58
P2101 Throttle Drive Ground Short ... 58
P2102 Throttle Drive Short ... 58
P2103 Throttle Drive Battery Short ... 59
P2104 Throttle Drive Overheat ... 59
P213B Abnormal Throttle Control ... 59
P213C Low Throttle Signal ... 60
P213D High Throttle Signal ... 60
P2671 #3 Glow Plug Short (Battery) ... 61
P2672 #4 Glow Plug Short (Battery) ... 61
P2673 #5 Glow Plug Short (Battery) ... 62
P2674 #1 Glow Plug Short (Battery) ... 62
P2675 #2 Glow Plug Short (Battery) ... 63
P3040 ECU Internal Malfunction ... 63
P3041 ECU Internal Malfunction ... 63

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

TROUBLE DIAGNOSIS TABLE

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P0100	Air Mass Flow (HFM) Malfunction	- The external power supply is faulty. • Check the external power supply. • Check the sensor wiring harness (open, short, poor contact). - Actual air mass flow vs. Output voltages. • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.					
P0102	Low HFM Sensor Signal (Circuit Open)	- HFM sensing values are lower than minimum sensing values. - Check the resistance in HFM sensor. - Check the ECU wiring harness (open and poor contact). • Check the ECU pin #82 and #84 for open circuit. - Actual air mass flow vs. Output voltages. • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P0103	High HFM Sensor Signal (Circuit Short)	- HFM sensing values are higher than maximum sensing values. - Check the resistance in HFM sensor. - Check the ECU wiring harness (open and poor contact). • Check the ECU pin #82 and #84 for open circuit. - Actual air mass flow vs. Output voltages. • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.					
P0105	Supply Voltage Fault to Booster Pressure Sensor	- Out of range of supply voltages about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #100 and #108 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0106	High Booster Pressure Sensor Signal	- Out of signal range about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					
P0107	Booster Pressure Sensor Open/GND Short	- Out of signal range about boost pressure sensor at Engine running condition (Lower than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0108	Booster Pressure Sensor Short	- Out of signal range about boost pressure sensor at Engine running condition (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545~2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					
P0109	Low Booster Pressure Sensor Signal	- Out of signal range about boost pressure sensor at Ignition key-On and Engine Stop (Lower than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0110	Intake Air Temperature Circuit Malfunction - Source Power Problem	- The intake air temperature sensing value is lower than minimum value or higher than maximum value, or the external power to HFM sensor is faulty. - Check the supply voltage to sensor. • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. • Check the source power circuit for short to ground. - Check the sensor resistance. • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. • Check the ECU pin #64 and #84 for open and short. - Replace the ECU if required.					

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0112	Intake Air Temperature Circuit Malfunction - Open	- The intake air temperature sensing value is lower than maximum value of 150°C: Open - Check the supply voltage to sensor. • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. • Check the source power circuit for short to ground. - Check the sensor resistance. • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. • Check the ECU pin #64 and #84 for open. - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0113	Intake Air Temperature Circuit Malfunction - Short	- The intake air temperature sensing value is lower than maximum value of 150°C: Open - Check the supply voltage to sensor. • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. • Check the source power circuit for short to ground. - Check the sensor resistance. • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. • Check the ECU pin #64 and #84 for open. - Replace the ECU if required.					
P0115	Supply Voltage Fault to Coolant Temperature Sensor	- Check if the supply voltage of approx. 12 V is applied.					
P0117	Coolant Temperature Sensor Malfunction - Open	- Malfunction in recognition of coolant temperature • Less than minimum values (Circuit Open) • External power supply malfunction - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual air temp. vs. Resistance • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (open and poor contact). • ECU pin #101 and #102 - Visually check the sensor and replace if required. - Replace the ECU if required.					

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0118	Coolant Temperature Sensor Malfunction - Short	- Malfunction in recognition of coolant temperature • More than maximum values (Circuit Short) • External power supply malfunction - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual air temp. vs. Resistance • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (short and poor contact). • ECU pin #101 and #102 - Visually check the sensor and replace if required. - Replace the ECU if required.					
P0120	Accelerator Pedal Sensor #1 Malfunction - Supply Voltage Fault	- The supply voltage is faulty. - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #72, #53 for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O				
P0122	Accelerator Pedal Sensor #1 Malfunction - Open	- Out of range about potentiometer 1 of pedal sensor: lower than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #71, #53 for open and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O				
P0123	Accelerator Pedal Sensor #1 Malfunction - Short	- Out of range about potentiometer 1 of pedal sensor: higher than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #71, #53 for short and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O				

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P0147	Impossible to Learn Idle MDP	- Causes (Idle range MDP learning) • The MDP is not learned again until driving over 50,000 km after the MDP is learned. - Conditions for MDP learning (Idle) • Leaning twice for each cylinder (attempt every 5 sec.) • Initial MDP learning: coolant temperature > 60°C • Fuel temperature: 0 ~ 80°C • Vehicle speed: Idle. • The tachometer's needle vibrates while learning idle MDP. • Replace ECU after learning.					
P0148	Impossible to Learn Drive MDP	- Causes • It occurs twice for each cylilnder if MDP is not learned again until driving over 50,000 km after the MDP is learned. - Actions • Check knock sensor and wiring. • Check injector specification. • Check C3I/C2I.					
P0171	Insufficient MDP of Injector #1	- MDP learning value is decreased due to aged injector #1.					
P0172	Insufficient MDP of Injector #2	- MDP learning value is decreased due to aged injector #2.					
P0173	Insufficient MDP of Injector #3	- MDP learning value is decreased due to aged injector #3.					
P0174	Insufficient MDP of Injector #4	- MDP learning value is decreased due to aged injector #4.					
P0175	Insufficient MDP of Injector #5	- MDP learning value is decreased due to aged injector #5.					
P0180	Fuel Temperature Sensor - Malfunction	- The power source circuit is faulty for fuel temperature sensor. (Fuel temperature sensor is mounted in high pressure pump) - Actual fuel temp. vs. Resistance • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. • ECU pin: #109, #110 - Check the ECU wiring and replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0182	Fuel Temperature Sensor - Short to Ground	- The sensing values are higher than specified values for fuel temperature sensor. (More than maximum sensing values 140°C - Circuit Short) - Actual fuel temp. vs. Resistance • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. • ECU pin: #109, #110 - Check the ECU wiring and replace the ECU if required.					
P0183	Fuel Temperature Sensor - Short to B+	- The sensing values are lower than specified values for fuel temperature sensor. (Less than maximum sensing values - 40°C - Circuit Open) - Actual fuel temp. vs. Resistance • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. • ECU pin: #109, #110 - Check the ECU wiring and replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P0190	Supply Voltage Fault to Fuel Rail Pressure Sensor	- The supply voltage to fuel rail pressure sensor is faulty. - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055± 0.125V • Output voltage at atmospheric pressure: 0.5±0.04V - Check the sensor and ECU wiring harness. • Check the ECU pin #6, #26 for open and short. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				
P0191	Fuel Rail Pressure Sensor Signal Fault	- The rail pressure drop is too high. - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #6, #26 for open and short. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				
P0192	Fuel Rail Pressure Sensor Malfunction - Open	- The fuel rail pressure sensing values are lower than specified values. • Minimum sensing values: - 112 bar (Open) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for open and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0193	Fuel Rail Pressure Sensor Malfunction - Short	- The fuel rail pressure sensing values are higher than specified values. • Maximum sensing values: 1,600 bar (Short) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055± 0.125V • Output voltage at atmospheric pressure: 0.5±0.04V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for short and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				
P0201	Injector #1 Circuit Open	- Injector #1 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #117, #114). - Replace the ECU if required.					
P0202	Injector #2 Circuit Open	- Injector #2 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #118, #121). - Replace the ECU if required.					
P0203	Injector #3 Circuit Open	- Injector #3 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #117, #116). - Replace the ECU if required.					
P0204	Injector #4 Circuit Open	- Injector #4 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #117, #115). - Replace the ECU if required.					
P0205	Injector #5 Circuit Open	- Injector #5 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #118, #120). - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P0215	Main Relay Fault - Stuck	- The main relay is stuck ; Shut down. - Resistance of main relay: 92 Ω ± 9 Ω (at 20°C) - Check the main relay wiring harness. - Check the ECU wiring harness. • Check the ECU pin #3, 4, 5 for open and short. - If the forced operation is not available, replace the ECU. - Check the fuse for main relay					
P0219	Too Small Clearance of Crank Angle Sensor	- Crank angle signal faults or clearance too close. - Check the sensor wiring harness for ECU pin #90 and #82 (open, short, poor contact). - Check the resistance of crank angle sensor: 1090 Ω ± 15 %. - Measure the air gap: 0.3 ~ 1.3 mm • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. • Drive plate (A/T), DMF (M/T) - Replace the ECU if required.					
P0220	Accelerator Pedal Sensor #2 Malfunction - Supply Voltage Fault	- The supply voltage is faulty. - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #57, #14 for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O				
P0222	Accelerator Pedal Sensor #2 Malfunction - Open	- Out of range about potentiometer 2 of pedal sensor: lower than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #32, #14 for open and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O				
P0223	Accelerator Pedal Sensor #2 Malfunction - Short	- Out of range about potentiometer 2 of pedal sensor: higher than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #32, #14 for short and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O				

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0243	VGT Turbocharger Actuator Circuit Short	- Causes • There is electric problem in the vacuum modulator drive module of turbocharger. - Check pin for the followings (Vacuum Modulator): • Power (Main Relay) • GND (ECU Pin #A71) - Actions • Check the unit's resistance (15.4 +/ - 0.7 Ω) and wiring. • Check the input voltage (12V). • Visually check the unit and replace if necessary.					
P0245	Turbo Charger Actuator Circuit Fault - Short	- The waste gate driver circuit is short to ground or open - Check the actuator wiring harness. - Check the solenoid valve. - Check the ECU wiring harness. • Check the ECU pin #95 for open and short. - Replace the ECU if required.	O				
P0246	Turbo Charger Actuator Circuit Fault - Short to B+	- The turbo charger actuator power source circuit is short. - Check the actuator wiring harness. - Check the solenoid valve. - Check the ECU wiring harness for short and poor contact. - Replace the ECU if required.	O				
P0251	IMV Driver Circuit Malfunction - Short	- IMV driver circuit malfunction: Short - Check the IMV wiring harness. • Check the ECU pin #87 for short. - Check the ECU wiring harness. - Check the IMV resistance. • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.			O		
P0253	IMV Driver Circuit Malfunction - Short to Ground	- IMV driver circuit malfunction: Short to ground - Check the IMV wiring harness. • Check the ECU pin #87 for short to ground. - Check the ECU wiring harness. - Check the IMV resistance. • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.			O		
P0255	IMV Driver Circuit Malfunction - Open	- IMV driver circuit malfunction: Open - Check the IMV wiring harness. • Check the ECU pin #87 for open. - Check the ECU wiring harness. - Check the IMV resistance. • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.			O		

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P0263	Injector #1 Balancing Fault	- Injector #1 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).					
P0266	Injector #2 Balancing Fault	- Injector #2 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).					
P0269	Injector #3 Balancing Fault	- Injector #3 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).					
P0272	Injector #4 Balancing Fault	- Injector #4 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).					
P0275	Injector #5 Balancing Fault	- Injector #5 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).					
P0325	Accelerometer #1 (Knock Sensor) Malfunction	- The signal / noise ratio is too low about accelerometer # 1. - Check the accelerometer wiring harness and tightening torque. • Tightening torque: 20 ± 5 Nm - Check the ECU wiring harness for open and short. • ECU pin #45 and #46 - If the trouble still exists even after replacing the accelerometer, replace the ECU.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0325	Accelerometer #1 (Knock Sensor) Malfunction	- The signal / noise ratio is too low about accelerometer # 1. - Check the accelerometer wiring harness and tightening torque. • Tightening torque: 20 ± 5 Nm - Check the ECU wiring harness for open and short. • ECU pin #45 and #46 - If the trouble still exists even after replacing the accelerometer, replace the ECU.					
P0335	No Crank Signals	- Refer to P0372.					
P0336	Too Large Clearance of Crank Angle Sensor	- Air gap of crank angle sensor is abnormal. - Check the sensor wiring harness for ECU pin #90 and #82 (open, short, poor contact). - Check the resistance of crank angle sensor: 1090 Ω ± 15 %. - Measure the air gap: 0.3 ~ 1.3 mm • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. • Drive plate (A/T), DMF (M/T) - Replace the ECU if required.					
P0341	Cam Position Sensor Malfunction (Poor Synchronization)	- Not synchronized with Crank angle signal. - Check the source voltage of cam position sensor (specified value: 4.5 ~ 12 V). - Check the sensor wiring harness for ECU pin #103 and #104 (open, short, poor contact). - Check the cam position sensor. - Measure the air gap: 0.2 ~ 1.8 mm - Replace the ECU if required.					
P0344	Cam Position Sensor Malfunction	- No cam recognition signal (missing events). - Check the source voltage of cam position sensor (ECU pin #111) (specified value: 4.5 ~ 12 V). - Check the sensor wiring harness for ECU pin #103 and #104 (open, short, poor contact). - Check the cam position sensor. - Measure the air gap: 0.2 ~ 1.8 mm - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0372	Crank Angle Sensor Malfunction	- Even though cam position recognition is normal, no crank angle signal recognition (missing tooth). - Check the sensor wiring harness for ECU pin #90 and #82 (open, short, poor contact). - Check the resistance of crank angle sensor: 1090 Ω ± 15 %. - Measure the air gap: 0.3 ~ 1.3 mm • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. • Drive plate (A/T), DMF (M/T) - Replace the ECU if required.					
P0400	EGR Control Valve Fault	- When the EGR emission is more than specified value. • The EGR controller circuit is open or short to ground. • The EGR controller is short to battery. - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check if the EGR valve is stuck. - Check the resistance of EGR valve: 15.4 Ω. - Check the ECU wiring harness. • Check the ECU pin #96 for open and short.					
P0401	EGR Control Valve Fault (Low)	- When the EGR emission is more than specified value. • The EGR controller circuit is open or short to ground. • The EGR controller is short to battery. - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check if the EGR valve is stuck. - Check the resistance of EGR valve: 15.4 Ω. - Check the ECU wiring harness. • Check the ECU pin #96 for open and short.					
P0402	EGR Valve Stuck in Open Position	- Causes • The EEGR valve is stuck with it open. - Check pin (refer to the page 1407) - Actions • Check EEGR valve and sensor wiring. • Visually check the unit and replace if necessary. • Replace the ECU if required. • Refer to DTCs (P0407 and P0408).					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P0405	High EGR Open Position Deviation	- Causes • The difference between E-EGR position demand (MAP) value and E-EGR position feedback signal value is over 15% (the sensor output indicates E-EGR is open over 15% in the close status). - Actions • Measure the resistance of E-EGR valve sensor. • Check the sensor and actuator wiring harness. • Check the unit.					
P0406	High EGR Close Position Deviation	- Causes • The difference between E-EGR position demand (MAP) value and E-EGR position feedback signal value is over 15% (the sensor output indicates EEGR is closed over 15% in the open status). - Actions • Measure the resistance of E-EGR valve sensor. • Check the sensor and actuator wiring harness. • Check the unit.					
P0407	Low EGR Position Signal	- Diagnosis of E-EGR signal for the followings: • Sensor signal is high or low. • Total resistance value: 4Ω +/-40% • Sensor output range: 1.2 ~ 4.0 V • Total sensor resistance: 4 kΩ ± 40% • Total motor resistance: 8.0Ω ± 0.5Ω - Check pin for the followings: • Check sensor reference voltage (5V) - ECU Pin #A33 • Sensor signal - ECU Pin #A82 • Sensor GND - ECU Pin #A09 - Actions • Measure the resistance of E-EGR valve sensor. • Check the sensor and actuator wiring harness. • Check the unit.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0408	High EGR Position Signal	- Diagnosis of E-EGR signal for the followings: • Sensor signal is high or low. • Total resistance value: 4Ω +/-40% • Sensor output range: 1.2 ~ 4.0 V • Total sensor resistance: 4 kΩ ± 40% • Total motor resistance: 8.0Ω ± 0.5Ω - Check pin for the followings: • Check sensor reference voltage (5V) - ECU Pin #A33 • Sensor signal - ECU Pin #A82 • Sensor GND - ECU Pin #A09 - Actions • Measure the resistance of E-EGR valve sensor. • Check the sensor and actuator wiring harness. • Check the unit.					
P0480	PWM Electric Fan Malfunction (Open circuit) (Only for D27DTP (POWER UP) model)	- The communication line between PWM electric fan and ECU is open. - The PWM electric fan's own malfunction cannot be identified.					
P0481	PWM Electric Fan Malfunction(Short to B+) (Only for D27DTP (POWER UP) model)	- The communication line between PWM electric fan and ECU has a short to battery. - The PWM electric fan's own malfunction cannot be identified.					
P0482	PWM Electric Fan Malfunction (Short to GND) (Only for D27DTP (POWER UP) model)	- The communication line between PWM electric fan and ECU has a short to ground. - The PWM electric fan's own malfunction cannot be identified.					
P0483	Fan PWM motor out have short to GND	- Motor out have short to GND					
P0484	Fan PWM Stall motor	- Stall motor					
P0485	Fan PWM motor have over load	- Motor have over load					
P0487	Faulty Maximum Throttle Closing Value	- Causes • The throttle is not fully closed when learning the full open value after stopping the engine. - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0488	Faulty Maximum Throttle Opening Value	- Causes • The throttle is not fully open when learning the full open value after initial ignition on. - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.					
P0530	Air Conditioner Refrigerant Sensor Supply Power Fault	- Causes • There is electric problem in the air conditioner's pressure sensor. - Check the sensor's specifications and ECU pin. • Power: 5V ..... ECU Pin #B29 • Sensor signal ..... ECU Pin #B41 • Sensor GND ..... ECU Pin #B36 • Actual range: 2.0 kgf/cm^2 (0.75V) ~ 32 kgf/cm^2 (4.5V) • Resistance: 51KΩ (signal terminal and ground) • Output signal 0.5V ..... 0.0 kgf/cm^2 4.5V ..... 32.0 kgf/cm^2 - Actions • Check the sensor's resistance and wiring. • Visually check the unit and replace if necessary.					
P0532	Air Conditioner Refrigerant Pressure Signal Circuit Short	- Causes • There is electric problem in the air conditioner's pressure sensor. - Check the sensor's specifications and ECU pin. • Power: 5V ..... ECU Pin #B29 • Sensor signal ..... ECU Pin #B41 • Sensor GND ..... ECU Pin #B36 • Actual range: 2.0 kgf/cm^2 (0.75V) ~ 32 kgf/cm^2 (4.5V) • Resistance: 51KΩ (signal terminal and ground) • Output signal 0.5V ..... 0.0 kgf/cm^2 4.5V ..... 32.0 kgf/cm^2 - Actions • Check the sensor's resistance and wiring. • Visually check the unit and replace if necessary.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0533	Excessive Air Conditioner Refrigerant Pressure	- Causes • There is electric problem in the air conditioner's pressure sensor. - Check the sensor's specifications and ECU pin. • Power: 5V ..... ECU Pin #B29 • Sensor signal ..... ECU Pin #B41 • Sensor GND ..... ECU Pin #B36 • Actual range: 2.0 kgf/cm^2 (0.75V) ~ 32 kgf/cm^2 (4.5V) • Resistance: 51KΩ (signal terminal and ground) • Output signal 0.5V ..... 0.0 kgf/cm^2 4.5V ..... 32.0 kgf/cm^2 - Actions • Check the sensor's resistance and wiring. • Visually check the unit and replace if necessary.					
P0560	Battery Voltage Malfunction	- Malfunction in recognition of system source voltage (A/D converter faults). • Less than minimum 8 Volts in 2000 rpm below • Less than 10 Volts in 2000 rpm above. - Check the battery wiring harness for ECU pin #3, #4 and #5 (open, short, poor contact). - Check the battery main relay and fuse. - Check the body ground. - Measure the resistance between body ground and ECU ground. • Repair the ECU ground if the resistance is high. - Replace the ECU if required.	O				
P0562	Low Battery Voltage	- Malfunction in recognition of system source voltage (Lower than threshold). • Less than minimum 8 Volts in 2000 rpm below • Less than 10 Volts in 2000 rpm above. - Check the battery wiring harness for ECU pin #3, #4 and #5 (open, short, poor contact). - Check the battery main relay and fuse. - Check the body ground. - Measure the resistance between body ground and ECU ground. • Repair the ECU ground if the resistance is high. - Replace the ECU if required.	O				

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P0563	High Battery Voltage	- Malfunction in recognition of system source voltage (Higher than threshold). • More than minimum 16 Volts in 2000 rpm below - Check the battery wiring harness for ECU pin #3, #4 and #5 (open, short, poor contact). - Check the alternator. - Check the body ground. - Measure the resistance between body ground and ECU ground. • Repair the ECU ground if the resistance is high. - Replace the ECU if required.	O				
P0571	Brake Pedal Switch Fault	- The brake pedal switch or light switch is faulty. • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake and light switch wiring harness. - Check the supply voltage to brake and light switch (12 V). - Check the brake and light switch for contact. - Check the ECU wiring harness for ECU pin #77 and #58 (short, poor contact). - Replace the ECU if required.					
P0602	Faulty Vehicle Speed Sensor Coding	- The vehicle signal is inputted via CAN communication without ESP or TCCU. - The CAN communication between units is malfunctioning.					
P0606	ECU Watchdog Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0608	Faulty ABS/ESP Coding	- The ABS/ESP variant coding is faulty. - The CAN communication is malfunctioning.					
P0611	No Data for C3I	- C3I • There is no C3I data in ECU or the checksum is faulty.					
P0612	Internal Error in C3I Data	- C3I • The error is occurred while sending C3I data in ECU to RAM.					
P0613	Faulty TCU Coding	- The TCU variant coding is faulty. - The CAN communication between units is malfunctioning.					
P0614	TCCU Coding Failt	- Occurred if TCCU variant coding is faulty. - Occurred when there is CAN communication error between units.					
P0618	Multi calibration not performed	- Perform multi calibration again.					
P0619	Multi calibration performing error	- Perform multi calibration again.					
P062D (former P1611)	Injector Bank #1 Malfunction - Low Voltage	- Malfunction of injector (#1, #4, #3) circuit (Low): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #1: Open and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. • ECU pin #44 and #63 - Replace the ECU if required.					
P062E (former P1618)	Injector Bank #2 Malfunction - Low Voltage	- Malfunction of injector (#2, #5) circuit (Low): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #2: Open and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. • ECU pin #44 and #63 - Replace the ECU if required.					

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P062F	Multi calibration memory error	- Perform multi calibration again.					
P0630	Variant Coding is not done	- Variant coding is not done					
P0631	Variant Coding writing error	- Variant coding writing error					
P0633	Immobilizer Fault (refer to immobilizer section)	- Key memory is not available (permissible - 5). - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.					
P0641	ECU Supply Voltage 1 Fault (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelera-tor pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.					
P0642	ECU Supply Voltage 1 Fault - Low (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelera-tor pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.					
P0643	ECU Supply Voltage 1 Fault - High (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelera-tor pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.					
P0649	Diag Lamp Drive Open Circuit	Open circuit					
P0650	Diag Lamp Drive Short to BATT	Short to batt					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0651	ECU Supply Voltage 2 Fault (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.			O		O
P0652	ECU Supply Voltage 2 Fault - Low (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.			O		O
P0653	ECU Supply Voltage 2 Fault - High (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.			O		O
P066A	Internal malfunction in #1 glow plug controller	- Cylinder #1 (Glow Plug #1) - Details: refer to P2673.					
P066B	Internal short in #1 glow plug controller	- Cylinder #1 (Glow Plug #1) - Details: refer to P2673.					
P066C	Internal malfunction in #2 glow plug controller	- Cylinder #2 (Glow Plug #2) - Details: refer to P2673.					
P066D	Internal short in #2 glow plug controller	- Cylinder #2 (Glow Plug #2) - Details: refer to P2673.					
P066E	Internal malfunction in #3 glow plug controller	- Cylinder #3 (Glow Plug #3) - Details: refer to P2673.					
P066F	Internal short in #3 glow plug controller	- Cylinder #3 (Glow Plug #3) - Details: refer to P2673.					
P0670	Defective power supply of glow plug controller	- Details: refer to P2673.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P0671	#3 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P0672	#4 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P0673	#5 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P0674	#1 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P0675	#2 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P067A	Internal malfunction in #4 glow plug controller	- Cylinder #4 (Glow Plug #4) - Details: refer to P2673.					
P067B	Internal short in #4 glow plug controller	- Cylinder #4 (Glow Plug #4) - Details: refer to P2673.					
P067C	Internal malfunction in #5 glow plug controller	- Cylinder #5 (Glow Plug #5) - Details: refer to P2673.					
P067D	Internal short in #5 glow plug controller	- Cylinder #5 (Glow Plug #5) - Details: refer to P2673.					
P0683	Defective CAN communiction of glow plug controller	- GCU's CAN signal is intermittently defective.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0685	Main Relay Malfunction	- The the main relay is unexpectedly high/low state (ECU is supplied after 3 seconds). - Relay resistance: 92 ± 9 Ω (at 20°C) - Check the relay wiring harness (open, short and poor contact). • Check for open and short: ECU pin #9. - If the forced operation is not available, replace the ECU.					
P0697	ECU Supply Voltage Fault (2.5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 2.5 V - Check the supply voltage to each sensor • Supply voltage (2.55 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required.					
P0698	ECU Supply Voltage Fault - Low (2.5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 2.5 V - Check the supply voltage to each sensor • Supply voltage (2.5 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required.					
P0699	ECU Supply Voltage Fault - High (2.5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 2.5 V - Check the supply voltage to each sensor • Supply voltage (2.55 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required.					
P0700	TCU Signal Fault	- The communication between ECU and TCU is faulty. - Check the communication line between ECU and TCU. - Check the ECU pin #54, 73 for open and short. - Replace the ECU if required.					
P0704	Clutch switch malfunction	- The clutch switch is faulty (Manual Transmission Only). - Check the switch wiring harness. • Check the ECU pin #38 for open, short and poor contact. - Check the switch supply voltage and operations. - Replace the ECU if required.					
P0805	Neutral Signal Input Malfunction (Only for D27DT M/T model)	- The neutral signal of M/T is sent to CAN cluster which is then sent to ECU via CAN communication. - The ECU cannot detect whether signal is missing due to the malfunction in neutral signal and wiring or due to the line malfunction. - Check the wiring related to neutral switch.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P1102	HFM Sensor - High Characteristic Value (Only for D27DT model)	- The characteristic value of HFM sensor is over the specified value (not wiring malfunction).					
P1103	HFM Sensor - Low Characteristic Value (Only for D27DT model)	- The characteristic value of HFM sensor is below the specified value (not wiring malfunction).					
P1105	Barometric Sensor Circuit Short	- Out of range about barometric sensor (over voltage). - Actual barometric pressure vs. Output voltages. • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU.					
P1106	Booster Pressure Sensor Malfunction	- Out of range of supply voltages about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					
P1107	Barometric Sensor Circuit Short/GND Short	- Out of range about barometric sensor (short to ground). - Actual barometric pressure vs. Output voltages. • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU.					
P1108	Barometric Sensor Circuit Short	- Out of range about barometric sensor (short to B+). - Actual barometric pressure vs. Output voltages. • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1109	Booster Pressure Sensor Initial Check Fault	- Implausible signal values or range about boost pressure sensor at Engine running condition (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					
P110A	AMF OBD High Sigral	- High sigral					
P110B	AMF OBD Low Sigral	- Low sigral					
P1115	Coolant Temperature Sensor Malfunction	- Implausible values of coolant temperature (If the temperature is below the limits values after warm up). - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual air temp. vs. Resistance • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (open, short and poor contact). • ECU pin #101 and #102 - Visually check the sensor and replace if required. - Check the thermostat, water pump radiator related coolant route (thermostat stuck). - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P1120	Accelerator Pedal Sensor #1 Malfunction	- The potentiometer 1 is not plausible with potentiometer 2. - Check the supply voltage to sensor. - Check the wiring harness. • Check the ECU pin #72, 53 and #32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.	O				
P1121	Accelerator Pedal Sensor #2 Malfunction	- The potentiometer 1 is not plausible with potentiometer 2. - Check the supply voltage to sensor. - Check the wiring harness. • Check the ECU pin #72, 53 and #32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.	O				
P1122	Accelerator Pedal Sensor Malfunction (Limp Home Mode)	- When triggering limp home mode. - Check the supply voltage to sensor. - Check the wiring harness. • Check the ECU pin #72, 71, 53 and #57, 32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.					
P1123	Accelerator Pedal Sensor Malfunction (Torque Mode)	- When triggering reduced torque mode. - Check the supply voltage to sensor. - Check the wiring harness. • Check the ECU pin #72, 71, 53 and #57, 32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required	O				
P1124	Accelerator Pedal Sensor Malfunction - Stuck	- The accelerator pedal sensor is stuck. - Check the brake switch wiring harness and operations. - Check the accelerator pedal operations. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.					O
P1148	Accelerometer (Knock Sensor) Learning Fault	- Check if the MDP is successful. - Check the accelerometer (knock sensor) sensor and wiring harness. - Replace the ECU if required.		O			
P1149	Too High Water Level in Fuel Filter	- Drain the water from fuel filter.					
P1170	Torque Trim Fault - High	- Refer to P0372.					
P1171	#1 Injector MDP Malfunction	- The #1 injector MDP is faulty. - Replace the injector and perform C2I coding again.					
P1172	#2 Injector MDP Malfunction	- The #2 injector MDP is faulty. - Replace the injector and perform C2I coding again.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1173	#3 Injector MDP Malfunction	- The #3 injector MDP is faulty. - Replace the injector and perform C2I coding again.					
P1174	#4 Injector MDP Malfunction	- The #4 injector MDP is faulty. - Replace the injector and perform C2I coding again.					
P1175	#5 Injector MDP Malfunction	- The #5 injector MDP is faulty. - Replace the injector and perform C2I coding again.					
P1190	Fuel Rail Pressure Sensor Initial Signal Fault	- The rail pressure sensor initial values are higher or lower than specified values with the ignition “ON”. • Maximum sensing values: 90 bar (Short) • Minimum sensing values: - 90 bar (Open) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for open and short. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				
P1191	Pressure Build Up - Too Slow	- The pressure build up during cranking is too slow. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1192	Fuel Rail Pressure Sensor Initial Signal Fault - Low	- The rail pressure sensor initial values are lower than specified values with the ignition “ON”. • Minimum sensing values: - 90 bar (Open) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for open and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				
P1193	Fuel Rail Pressure Sensor Initial Signal Fault - High	- The rail pressure sensor initial values are higher than specified values with the ignition “ON”. • Maximum sensing values: 90 bar (Short) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for short and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				
P1201	Injector #1 Circuit Short	- Injector #1 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #117, #114). - Replace the ECU if required.					
P1202	Injector #2 Circuit Short	- Injector #2 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #118, #121). - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1203	Injector #3 Circuit Short	- Injector #3 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #117, #116). - Replace the ECU if required.					
P1204	Injector #4 Circuit Short	- Injector #4 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #117, #115). - Replace the ECU if required.					
P1205	Injector #5 Circuit Short	- Injector #5 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #118, #120). - Replace the ECU if required.					
P1234	VGT Operation Fault (High)	- The boost pressure control is faulty. - Check the air intake system. - Check the supply voltage to sensor. - Check the wiring harness and the ECU wiring harness. - Replace the ECU if required.	O				
P1235	VGT Operation Fault	- The boost pressure control is faulty. - Check the air intake system. - Check the supply voltage to sensor. - Check the wiring harness and the ECU wiring harness. - Replace the ECU if required.	O				
P1252	Too High IMV Pressure	- The rail pressure is excessively high. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1253	Minimum Rail Pressure Control Malfunction (IMV Fault)	- Rail pressure faults: Too low - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the high pressure fuel lines, fuel rails and high pressure pipes for leaks. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					
P1254	Maximum Rail Pressure Control Malfunction (IMV Fault)	- Rail pressure faults: Too high - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the high pressure fuel lines, fuel rails and high pressure pipes for leaks. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1256	Too Small Transfer Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					
P1257	Too Large Transfer Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1258	Too Small High Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					
P1259	Too Large High Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1260	Too high IMV Driving Current	- Abnormal rail pressure, IMV CURRENT TRIM TOO HIGH, DRIFT - Check the IMV wiring harnesses. - Check the ECU wiring harnesses. • Check ECU's pin A76 for open and short. - Check the Rail pressure sensor. • Supply voltage: 5 ± 0.1V • Output voltage at 1600 bar: 4.055 ± 0.125V • Output voltage at atmospheric pressure: 0.5 ± 0.04V - Check low-pressure fuel system. • Check fuel in fuel reservoir and air penetration. • Check fuel filter's specification. - Check high-pressure fuel system. • Check fuel rail and high-pressure pipe for leaks. - Check IMV's resistance (5.44 Ω). • If the resistance is out of specification, replace the high-pressure pump and IMV.					
P1286	Low Resistance for Injector #1 wiring harness	- Out of range about wiring harness resistance for Injector #1. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #1 wiring harness and electric isolation. - Check the injector #1 wiring harness for open circuit. • If the pin in injector #1 is defective, replace injector #1 and perform C2I coding, then check again. • If the pin in injector #1 is not defective, check the ECU wiring harness. - Replace the ECU if required.					
P1287	High Resistance for Injector #1 wiring harness	- Out of range about wiring harness resistance for Injector #1. • High: More than 0.573 Ω (injector circuit short) - Check the injector #1 wiring harness and electric isolation. - Check the injector #1 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #1 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1288	Low Resistance for Injector #2 wiring harness	- Out of range about wiring harness resistance for Injector #2. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #2 wiring harness and electric isolation. - Check the injector #2 wiring harness for open circuit. • If the pin in injector #2 is defective, replace injector #2 and perform C2I coding, then check again. • If the pin in injector #2 is not defective, check the ECU wiring harness. - Replace the ECU if required.					
P1289	High Resistance for Injector #2 wiring harness	- Out of range about wiring harness resistance for Injector #2. • High: More than 0.573 Ω (injector circuit short) - Check the injector #2 wiring harness and electric isolation. - Check the injector #2 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #2 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.					
P1290	Low Resistance for Injector #3 wiring harness	- Out of range about wiring harness resistance for Injector #3. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #3 wiring harness and electric isolation. - Check the injector #3 wiring harness for open circuit. • If the pin in injector #3 is defective, replace injector #3 and perform C2I coding, then check again. • If the pin in injector #3 is not defective, check the ECU wiring harness. - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1291	High Resistance for Injector #3 wiring harness	- Out of range about wiring harness resistance for Injector #3. • High: More than 0.573 Ω (injector circuit short) - Check the injector #3 wiring harness and electric isolation. - Check the injector #3 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #3 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.					
P1292	Low Resistance for Injector #4 wiring harness	- Out of range about wiring harness resistance for Injector #4. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #4 wiring harness and electric isolation. - Check the injector #4 wiring harness for open circuit. • If the pin in injector #4 is defective, replace injector #4 and perform C2I coding, then check again. • If the pin in injector #4 is not defective, check the ECU wiring harness. - Replace the ECU if required.					
P1293	High Resistance for Injector #4 wiring harness	- Out of range about wiring harness resistance for Injector #4. • High: More than 0.573 Ω (injector circuit short) - Check the injector #4 wiring harness and electric isolation. - Check the injector #4 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #4 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.					

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1294	Low Resistance for Injector #5 wiring harness	- Out of range about wiring harness resistance for Injector #5. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #5 wiring harness and electric isolation. - Check the injector #5 wiring harness for open circuit. • If the pin in injector #5 is defective, replace injector #5 and perform C2I coding, then check again. • If the pin in injector #5 is not defective, check the ECU wiring harness. - Replace the ECU if required.					
P1295	High Resistance for Injector #5 wiring harness	- Out of range about wiring harness resistance for Injector #5. • High: More than 0.573 Ω (injector circuit short) - Check the injector #5 wiring harness and electric isolation. - Check the injector #5 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #5 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.					
P1405	EGR Solenoid Valve Malfunction - Short to ground	- Out of range about EGR gas: High. • EGR controller circuit: Open or short to ground - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check the EGR solenoid valve. - Check the EGR valve for stick. - Check the resistance of EGR actuator: 15.4 Ω. - Check the ECU wiring harness for open and short. • ECU pin #96					
P1406	EGR Solenoid Valve Malfunction - Short to +Batt	- Out of range about EGR gas: Low. • EGR controller circuit: Short to battery - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check the EGR solenoid valve. - Check the EGR valve for stick. - Check the resistance of EGR actuator: 15.4 Ω - Check the ECU wiring harness for open and short. • ECU pin #96					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1407	Faulty EGR Close Position	- Causes • The EGR position is not closed when EGR is not operated within 50 seconds with the engine idling. - Check pin for the followings: • EEGR #1: Valve power (Main relay) • EEGR #2: Sensor (Reference voltage) ..... ECU #A33 • EEGR #4: Sensor (Ground) ..... ECU #A09 • EEGR #5: Valve drive (PWM) ..... ECU #A48 • EEGR #6: Sensor (Signal) ..... ECU #A82 - Actions • Check EEGR valve and sensor wiring. • Visually check the unit and replace if necessary. • Refer to DTCs (P0407 and P0408).					
P1409	EGR Valve Circuit Short	- Check pin for the followings: • The EEGR valve wiring is open. • EEGR Pin #1: Power(Main Relay) • EEGR Pin #5: ECU Pin #A48 - Actions • Check EEGR valve wiring. • Visually check the unit and replace if necessary. • Refer to DTCs (P0407 and P0408).					
P1480	Condenser Fan #1 Circuit Malfunction - Open	- Condenser fan #1: Open - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #80 - If the forced operation is not available after replacing the relay, replace the ECU.					
P1481	Condenser Fan #1 Circuit Malfunction - Short	- Condenser fan #1: Short - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #80 - If the forced operation is not available after replacing the relay, replace the ECU.					
P1482	Condenser Fan #1 Circuit Malfunction - Short to Ground	- Condenser fan #1: Short to ground. - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #80 - If the forced operation is not available after replacing the relay, replace the ECU.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P1500	Vehicle Speed Fault	- The vehicle speed signal through CAN communication is faulty. - Check the CAN communication line for open and short. - Check the ABS/ESP and TCU communication lines. - Check the ECU wiring harness. - Replace the ECU if required.					
P1501	Faulty Variant Coding (Vehicle Speed)	- If the vehicle sensor coding is set to YES (for vehicle with ABS), the vehicle speed input is faulty when the vehicle speed is below 15 km/h with the engine running at 1,600 rpm. - If the vehicle sensor coding is set to NO (for vehicle with CAN and ABS/ESP), the corresponding DTC is not shown. - Check the vehicle speed sensor coding.					
P1503	Faulty Vehicle Speed Sensor Input	- If the vehicle sensor coding is set to YES (for vehicle with ABS), the amount of pulses of the speed pulse ring for vehicle speed detection is more than the specified value. - Specified pulse: 52 pulses/rev. - Check the vehicle speed sensor coding.					
P1526	Condenser Fan #2 Circuit Malfunction - Open	- Condenser fan #2: Open - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #81 - If the forced operation is not available after replacing the relay, replace the ECU.					
P1527	Condenser Fan #2 Circuit Malfunction - Short	- Condenser fan #2: Short - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #81 - If the forced operation is not available after replacing the relay, replace the ECU.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P1528	Condenser Fan #2 Circuit Malfunction - Short to Ground	- Condenser fan #2: Short to ground - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #81 - If the forced operation is not available after replacing the relay, replace the ECU.					
P1530	#1 Heater Operating Circuit - Open	- #1 heater circuit malfunction: Open. - Check the wiring harness for open. • ECU pin #61 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.					
P1531	#1 Heater Operating Circuit - Short	- #1 heater circuit malfunction: Short. - Check the wiring harness for short. • ECU pin #61 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.					
P1532	#1 Heater operating circuit - Short to Ground	- #1 heater circuit malfunction: Short to ground. - Check the wiring harness for short. • ECU pin #61 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.					
P1534	#2 Heater Operating Circuit - Open	- #2 heater circuit malfunction: Open. - Check the wiring harness for open. • ECU pin #62 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.					

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1535	#2 Heater Operating Circuit - Short	- #2 heater circuit malfunction: Short. - Check the wiring harness for short. • ECU pin #62 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.					
P1536	#2 Heater Operating Circuit - Short to Ground	- #2 heater circuit malfunction: Short to ground. - Check the wiring harness for short. • ECU pin #62 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.					
P1540	Air Conditioner Operating Circuit Fault - Open	- Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required.					
P1541	Air Conditioner Operating Circuit Fault - Short	- Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required.					
P1542	Air Conditioner Operating Circuit Fault - Short to Ground	- Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required.					
P1564	Auto Cruise Switch Fault (power)	- Applied to vehicle with auto cruise, occurred due to coding error for vehicle without auto cruise - Auto cruise switch SPEC • Reference voltage: 5V (ECU Pin #B11) • Switch signal: ECU Pin #B15 • Switch GND: ECU Pin #B16 • Switch signal voltage level * Resistance when accelerating: 220Ω ± 1% * Resistance when decelerating: 560Ω ± 1% * Resumed resistance: 1200Ω ± 1% * Resistance with switch OFF: 75Ω ± 1%					
P1565	Auto Cruise Switch Malfunction (Acceleration)	- The auto cruise accelerator switch or related wiring is malfunctioning.					
P1566	Auto Cruise Switch Malfunction (OFF)	- The auto cruise OFF switch or related wiring is malfunctioning.					
P1567	Auto Cruise Switch Malfunction (Return)	- The auto cruise switch or related wiring is malfunctioning.					
P1568	Auto Cruise Switch Fault (when accelerating)	- Auto cruise switch fault (accelerating)					
P1568	Auto Cruise Switch Malfunction (Deceleration)	- The auto cruise decelerator switch or related wiring is malfunctioning.					
P1569	Auto Cruise Switch Fault (when decelerating)	- Auto cruise switch fault (decelerating)					
P1569	Auto Cruise Switch Malfunction (Safety)	- The auto cruise safety switch or related wiring is malfunctioning.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P1570	Auto Cruise Switch Fault (Signal)	- Applied to vehicle with auto cruise, occurred due to coding error for vehicle without auto cruise - Auto cruise switch SPEC • Reference voltage: 5V (ECU Pin #B11) • Switch signal: ECU Pin #B15 • Switch GND: ECU Pin #B16 • Switch signal voltage level * Resistance when accelerating: 220Ω ± 1% * Resistance when decelerating: 560Ω ± 1% * Resumed resistance: 1200Ω ± 1% * Resistance with switch OFF: 75Ω ± 1%					
P1571	Brake Lamp Signal Fault	- The brake pedal switch is faulty. • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake pedal switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake pedal switch wiring harness. - Check the supply voltage to brake pedal switch (12 V). - Check the brake pedal switch for contact. - Check the ECU wiring harness for ECU pin #77 (open, short, poor contact). - Replace the ECU if required.					
P1572	Brake Lamp Signal Fault	- The brake pedal switch or light switch is faulty. • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake pedal switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake pedal and light switch wiring harness. - Check the supply voltage to brake pedal and light switch (12 V). - Check the brake pedal and light switch for contact. - Check the ECU wiring harness for ECU pin #58 (open, short, poor contact). - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P1573	Auto Cruise Switch Fault (short)	- Applied to vehicle with auto cruise, occurred due to coding error for vehicle without auto cruise - Auto cruise switch SPEC • Reference voltage: 5V (ECU Pin #B11) • Switch signal: ECU Pin #B15 • Switch GND: ECU Pin #B16 • Switch signal voltage level * Resistance when accelerating: 220Ω ± 1% * Resistance when decelerating: 560Ω ± 1% * Resumed resistance: 1200Ω ± 1% * Resistance with switch OFF: 75Ω ± 1%					
P1578	Auto Cruise Switch Fault (Circuit Short)	- Applied to vehicle with auto cruise, occurred due to coding error for vehicle without auto cruise - Auto cruise switch SPEC • Reference voltage: 5V (ECU Pin #B11) • Switch signal: ECU Pin #B15 • Switch GND: ECU Pin #B16 • Switch signal voltage level * Resistance when accelerating: 220Ω ± 1% * Resistance when decelerating: 560Ω ± 1% * Resumed resistance: 1200Ω ± 1% * Resistance with switch OFF: 75Ω ± 1%					
P1600	ECU Shut Down Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					
P1601	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					
P1602	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					
P1603	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					
P1604	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P1605	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					
P1606	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O
P1607	ECU Injector Cut Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					
P1608	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					
P1614	ECU C2I/MDP Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O
P1615	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O
P1616	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O
P1620	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O
P1621	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O
P1622	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P162D (former P1612)	Injector Bank #1 Malfunction - High Voltage	- Malfunction of injector (#1, #4, #3) circuit (High): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #1: Short and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. • ECU pin #44 and #63 - Replace the ECU if required.					
P162E (former P1619)	Injector Bank #2 Malfunction - High Voltage	- Malfunction of injector (#2, #5) circuit (High): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #2: Short and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. • ECU pin #44 and #63 - Replace the ECU if required.					
P1630	Wrong response from Immobilizer (refer to immobilizer section)	- The invalid key is inserted or no communication between transponder and immobilizer (no response from transponder). - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1631	Immobilizer Fault (refer to immobilizer section)	- The immobilizer is not operating. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.					
P1632	Immobilizer Fault (refer to immobilizer section)	- No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.					
P1633	Immobilizer Fault (refer to immobilizer section)	- No key coding. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.					
P1634	Immobilizer Fault (refer to immobilizer section)	- No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna. - Replace the ECU if required.					
P1635	No response from Immobilizer (refer to immobilizer section)	- No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna. - Replace the ECU if required.					

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P1636	Immobilizer Fault (refer to immobilizer section)	- Severe trouble is not defined. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.					
P1650	AMF OBD Short to GND	- Short to GND					
P1657	Engine Mount Control Malfunction (Open)	- The wiring for engine mount level control is malfunctioning. - Standard level: - Operating condition:					
P1658	Engine Mount Control Malfunction (Short to B+)	- The wiring for engine mount level control is short to battery. - ECU pin No. 23, relay control - Engine speed : Over 1,200 rpm (30 km/h for vehicle speed)					
P1659	Engine Mount Control Malfunction (Short to GND)	- The wiring for engine mount level control is short to ground. - ECU pin No. 23, relay control - Engine speed : Over 1,200 rpm (30 km/h for vehicle speed)					
P1671	#3 Glow Plug Fault - Short	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P1672	#4 Glow Plug Fault - Short	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P1673	#5 Glow Plug Fault - Short	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1Ω - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1674	#1 Glow Plug Fault - Short	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P1675	#2 Glow Plug Fault - Short	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P1676	Glow Plug Communication Fault	- The communication between ECU and glow plug is faulty. - Check the communication line between ECU and glow plug. - Check the glow plug wiring harness. - Check the resistance of glow plug: below 1 Ω. - Check the glow plug relay. - Check the ECU wiring harness. • Check the ECU pin #113 for short to ground. - Replace the ECU if required.					
P1677	Glow Plug Controller Fault	- The communication between ECU and glow plug is faulty. - Check the communication line between ECU and glow plug. - Check the glow plug wiring harness. - Check the resistance of glow plug: below 1Ω. - Check the glow plug relay. - Check the ECU wiring harness. • Check the ECU pin #113 for short to ground. - Replace the ECU if required.					
P1678	Glow Plug Malfunction - Open	- Glow plug circuit malfunction: Open. - Check the glow plug wiring harness for open. • ECU pin #113 - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required.					

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode
P1679	Glow Plug Malfunction - Short	- Glow plug circuit malfunction: Short. - Check the glow plug wiring harness for open. • ECU pin #113 - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required.					
P1680	Glow Plug Malfunction - Short to Ground	- Glow plug circuit malfunction: Short to ground. - Check the glow plug wiring harness for open. • ECU pin #113 - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required.					
P1683	Defective CAN communiction of glow plug controller	- No GCU CAN signal - Details: refer to P2673.					
P2100	Throttle Drive Circuit Short	- Perform the diagnosis when the ignition is turned on. - Defective intake throttle drive circuit (ECU pin #A75, A77) - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.					
P2101	Throttle Drive Ground Short	- Perform the diagnosis when the ignition is turned on. - Defective intake throttle drive circuit (ECU pin #A75, A77) - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.					
P2102	Throttle Drive Short	- Perform the diagnosis when the ignition is turned on. - Defective intake throttle drive circuit (ECU pin #A75, A77) - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P2103	Throttle Drive Battery Short	- Perform the diagnosis when the ignition is turned on. - Defective intake throttle drive circuit (ECU pin #A75, A77) - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.					
P2104	Throttle Drive Overheat	- Perform the diagnosis when the ignition is turned on. - Defective intake throttle drive circuit (ECU pin #A75, A77) - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.					
P213B	Abnormal Throttle Control	- Causes • The difference between throttle position demand (MAP) and throttle position feedback signal is out of +5% or -13%. - Defective throttle control (P213B) - Defective throttle signal (P213C, P213D) - Defective throttle drive (P2103, P2101, P2102, P2104, P2100) - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P213C	Low Throttle Signal	- Causes • The throttle valve position sensor signal is stuck low. - Check pin for the followings: • Throttle valve #1: sensor (Power) ..... ECU #A20 • Throttle valve #2: sensor (Signal) ..... ECU #A22 • Throttle valve #3: sensor (GND) ..... ECU #A81 • Throttle valve #4: valve (Positive) ..... ECU #A75 • Throttle valve #5: valve (Positive) ..... ECU #A77 - Sensor & Motor SPEC • Motor * Power: 12V * Max. current : 6.8A (Normal: 3.6 ~ 0.2) * Motor resistance: 4.3Ω • Sensor * Power: 5V - Actions • Check the throttle valve and sensor wiring harnesses. (The signal output of throttle valve is below than 0.24 V.) • Visually check the unit and replace if necessary.					
P213D	High Throttle Signal	- Causes • The throttle valve position sensor signal is stuck high. - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P2671	#3 Glow Plug Short (Battery)	- NGK glow module (AQGS: Advanced Quick Glowing System) - It is detected by AQGS which then sends the message to ECU through CAN. - The electrical problem is occurred in AQGS. - Diagnosis criteria in AQGS • Plug short: voltage > 6V, current = 0A • Plug short (GND): voltage = 0V • Plug short (battery): voltage = Battery voltage • FET defective, FET short (GND): voltage = 0V, current = 0A • Abnormal input voltage: 6V < input voltage < 16V • Abnormal communication: Communication error for over 1 sec., abnormal data - Actions • Check glow plug for defect (measure the resistance of unit). • Check the connector and wiring harnesses. • Visually check the unit. • Replace the unit if necessary. • Check the CAN line. • Check the IG1 voltage. • Check the battery voltage.					
P2672	#4 Glow Plug Short (Battery)	- NGK glow module (AQGS: Advanced Quick Glowing System) - It is detected by AQGS which then sends the message to ECU through CAN. - The electrical problem is occurred in AQGS. - Diagnosis criteria in AQGS • Plug short: voltage > 6V, current = 0A • Plug short (GND): voltage = 0V • Plug short (battery): voltage = Battery voltage • FET defective, FET short (GND): voltage = 0V, current = 0A • Abnormal input voltage: 6V < input voltage < 16V • Abnormal communication: Communication error for over 1 sec., abnormal data - Actions • Check glow plug for defect (measure the resistance of unit). • Check the connector and wiring harnesses. • Visually check the unit. • Replace the unit if necessary. • Check the CAN line. • Check the IG1 voltage. • Check the battery voltage.					

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P2673	#5 Glow Plug Short (Battery)	- NGK glow module (AQGS: Advanced Quick Glowing System) - It is detected by AQGS which then sends the message to ECU through CAN. - The electrical problem is occurred in AQGS. - Diagnosis criteria in AQGS • Plug short: voltage > 6V, current = 0A • Plug short (GND): voltage = 0V • Plug short (battery): voltage = Battery voltage • FET defective, FET short (GND): voltage = 0V, current = 0A • Abnormal input voltage: 6V < input voltage < 16V • Abnormal communication: Communication error for over 1 sec., abnormal data - Actions • Check glow plug for defect (measure the resistance of unit). • Check the connector and wiring harnesses. • Visually check the unit. • Replace the unit if necessary. • Check the CAN line. • Check the IG1 voltage. • Check the battery voltage.					
P2674	#1 Glow Plug Short (Battery)	- NGK glow module (AQGS: Advanced Quick Glowing System) - It is detected by AQGS which then sends the message to ECU through CAN. - The electrical problem is occurred in AQGS. - Diagnosis criteria in AQGS • Plug short: voltage > 6V, current = 0A • Plug short (GND): voltage = 0V • Plug short (battery): voltage = Battery voltage • FET defective, FET short (GND): voltage = 0V, current = 0A • Abnormal input voltage: 6V < input voltage < 16V • Abnormal communication: Communication error for over 1 sec., abnormal data - Actions • Check glow plug for defect (measure the resistance of unit). • Check the connector and wiring harnesses. • Visually check the unit. • Replace the unit if necessary. • Check the CAN line. • Check the IG1 voltage. • Check the battery voltage.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P2675	#2 Glow Plug Short (Battery)	- NGK glow module (AQGS: Advanced Quick Glowing System) - It is detected by AQGS which then sends the message to ECU through CAN. - The electrical problem is occurred in AQGS. - Diagnosis criteria in AQGS • Plug short: voltage > 6V, current = 0A • Plug short (GND): voltage = 0V • Plug short (battery): voltage = Battery voltage • FET defective, FET short (GND): voltage = 0V, current = 0A • Abnormal input voltage: 6V < input voltage < 16V • Abnormal communication: Communication error for over 1 sec., abnormal data - Actions • Check glow plug for defect (measure the resistance of unit). • Check the connector and wiring harnesses. • Visually check the unit. • Replace the unit if necessary. • Check the CAN line. • Check the IG1 voltage. • Check the battery voltage.					
P3040	ECU Internal Malfunction	- The internal sector of ECU is malfunctioning.					
P3041	ECU Internal Malfunction	- The internal sector of ECU is malfunctioning.					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

GASOLINE

INDEX OF DTC 66
TROUBLE DIAGNOSIS TABLE 69

INDEX OF DTC

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

P0010 Cam Actuator - Short circuit to B+ 69
P0010 Cam Actuator - Short or Open circuit to Ground 69
P0011 Cam Actuator - Fixed to Advance Position 69
P0012 Cam Actuator - Fixed to Retard Position 69
P0101 Faulty HFM Sensor Signal 69
P0102 Low HFM Sensor Signal 70
P0103 High HFM Sensor Signal 70
P0105 Defective Intake Manifold Pressure Sensor Signal 70
P0111 Faulty Intake Air Temperature Sensor Signal . 71
P0112 Intake Air Temperature Sensor Malfunction - Open circuit 71
P0113 Intake Air Temperature Sensor Malfunction - Short circuit 71
P0116 Faulty Coolant Temperature Sensor Signal .. 71
P0117 Coolant Temperature Sensor Malfunction - Open circuit 72
P0118 Coolant Temperature Sensor Malfunction - Short circuit 72
P0120 No.1 Throttle Position Sensor - Low Voltage .. 72
P0120 No.1 Throttle Position Sensor - High Voltage .. 73
P0120 No.2 Throttle Position Sensor - Low Voltage .. 73
P0120 No.2 Throttle Position Sensor - High Voltage .. 73
P0120 Throttle Actuator - Insuffcient Supply Power ... 74
P0120 TPS Valve Inconsistent with HFM Sensor Value 74
P0120 Both Throttle Position Sensors Malfunction .. 74
P0120 Inconsistent Signals of No.1 and No.2 Throttle Position Sensors 75
P0120 Throttle Actuator Control Malfunction 75
P0120 Intake Air Flow Sensor and Throttle Sensor Malfunction 75
P0120 Accelerator Pedal Sensor Malfunction - Supply Voltage Fault 76
P0120 Accelerator Pedal Sensor #1 Malfunction - Low Voltage 76
P0120 Accelerator Pedal Sensor #1 Malfunction - High Voltage 76
P0120 Accelerator Pedal Sensor #2 Malfunction - Low Voltage 76
P0120 Accelerator Pedal Sensor #2 Malfunction - High Voltage 76
P0120 Accelerator Pedal Sensor #1 & #2 - Defective Signal 76
P0120 Accelerator Pedal Sensor #1 & #2 Malfunction 76
P0121 Throttle Position Sensor Actuator's Learning Control Malfunction 77
P0121 Faulty Throttle Body Return Spring 77
P0125 Low Coolant Temperature While Controlling Air/Fuel Ratio 77
P0128 Thermostat Fully Open 77
P0131 No.1 Oxygen Sensor - Below the Minimum Permissible Voltage 78
P0132 No.1 Oxygen Sensor - Overvoltage 78
P0133 No.1 Oxygen Sensor - Poor Performance 78
P0134 No.1 Oxygen Sensor - Malfunction 79
P0134 No.1 Oxygen Sensor - Lean Indication (When Decelerating) 79
P0135 No.1 Oxygen Sensor - Faulty Heating Current, Heater Circuit is Open or Short circuit or Short circuit to Ground 79
P0135 No.1 Oxygen Sensor Heater - Short circuit to B+ 80
P0135 No.1 Oxygen Sensor Heater - Open or Short circuit to Ground 80
P0137 No.2 Oxygen Sensor - Below the Minimum Permissible Voltage 80
P0138 No.2 Oxygen Sensor - Overvoltage 81
P0140 No.2 Oxygen Sensor - Lean Indication (When Decelerating) 81
P0141 No.2 Oxygen Sensor Heater - Short circuit to B+ 81
P0141 No.2 Oxygen Sensor Heater - Open or Short circuit to Ground 82
P0141 No.2 Oxygen Sensor - Poor Heating 82
P0151 No.3 Oxygen Sensor - Below the Minimum Permissible Voltage 82
P0152 No.3 Oxygen Sensor - Overvoltage 83
P0153 No.3 Oxygen Sensor - Poor Performance 83
P0154 No.3 Oxygen Sensor - Malfunction 83
P0154 No.3 Oxygen Sensor - Lean Indication (When Decelerating) 84
P0155 No.3 Oxygen Sensor - Faulty Heating Current .. 84
P0155 No.3 Oxygen Sensor Heater - Short circuit to B+ 84
P0155 No.3 Oxygen Sensor Heater - Open or Short circuit to Ground 84
P0157 No.4 Oxygen Sensor - Below the Minimum Permissible Voltage 85
P0158 No.4 Oxygen Sensor - Overvoltage 85
P0160 No.4 Oxygen Sensor - Lean Indication (When Decelerating) 85
P0161 No.4 Oxygen Sensor - Poor Heating 86
P0161 No.4 Oxygen Sensor Heater - Short circuit to B+ 86
P0161 No.4 Oxygen Sensor Heater - Open or Short circuit to Ground 86
P0171 Short-term Learning Control of Air/Fuel Ratio: Fuel Rich 86
P0171 Air/Fuel Ratio Control Malfunction - Fuel Rich .. 87
P0171 Learning Control Malfunction - Rich at Idling .. 87
P0171 Learning Control Malfunction - Rich under Low Load 87

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

P0171 Learning Control Malfunction - Rich under High Load ... 87
P0172 Air/Fuel Ratio Control Malfunction - Fuel Lean ... 87
P0172 Learning Control Malfunction - Lean at Idling ... 87
P0172 Learning Control Malfunction - Lean under Low Load ... 87
P0172 Learning Control Malfunction - Lean under High Load ... 87
P0172 Learning Control Malfunction - Rich under Low Load ... 87
P0172 Short-term Learning Control of Air/Fuel Ratio: Fuel Lean ... 88
P0174 Air/Fuel Ratio Control Malfunction - Fuel Rich .. 88
P0174 Fuel Rich at Idling ... 88
P0174 Fuel Rich under Low Load ... 88
P0174 Fuel Rich under High Load ... 88
P0174 Short-term Learning Control of Air/Fuel Ratio: Fuel Rich ... 88
P0175 Air/Fuel Ratio Control Malfunction - Fuel Lean ... 89
P0175 Fuel Lean at Idling ... 89
P0175 Fuel Lean under Low Load ... 89
P0175 Fuel Lean under High Load ... 89
P0175 Short-term Learning Control of Air/Fuel Ratio: Fuel Lean ... 89
P0221 Deceleration Over Limit (CPU2) ... 89
P0221 Acceleration Over Limit (CPU2) ... 89
P0221 Control Lever Double Action (CPU2) ... 90
P0221 Control Lever Safety Terminal Malfunction (CPU2) ... 90
P0221 Pedal Position Change Fault (CPU2) ... 90
P0221 Throttle Position Change Fault (CPU2) ... 90
P0221 Defective Constant Speed Driving Control Data (CPU2) ... 90
P0221 Faulty Pedal Position Detected (CPU2) ... 90
P0221 Faulty Throttle Position Detected (CPU2) ... 90
P0221 Faulty CAN Communication Detected (CPU2) ... 90
P0221 Faulty Configuration Detected (CPU2) ... 90
P0221 Faulty A/D Converter Detected (CPU2) ... 90
P0221 CPU #1 and #2 - Pedal Position Signal Fault ... 90
P0221 CPU #1 and #2 - TP Valve Position Signal Fault ... 91
P0221 CPU #1 and #2 - MSR Signal Fault ... 91
P0221 CPU #1 and #2 - Idle Control ... 91
P0221 AD Converter Overflow Detected (CPU2) ... 91
P0221 ROM Malfunction (CPU2) ... 91
P0221 RAM Malfunction (CPU2) ... 91
P0221 CPU Recognition Malfunction (CPU2) ... 91
P0231 Fuel Pump Relay - Open circuit to Ground ... 91
P0232 Fuel Pump Relay - Short circuit to B+ ... 91
P0261 No.1 Injector - Short or Open circuit to Ground ... 92
P0262 No.1 Injector - Short circuit to B+ ... 92
P0264 No.2 Injector - Short or Open circuit to Ground ... 92
P0265 No.2 Injector - Short circuit to B+ ... 92
P0267 No.3 Injector - Short or Open circuit to Ground ... 93
P0268 No.3 Injector - Short circuit to B+ ... 93
P0270 No.4 Injector - Short or Open circuit to Ground ... 93
P0271 No.4 Injector - Short circuit to B+ ... 93
P0273 No.5 Injector - Short or Open circuit to Ground ... 94
P0274 No.5 Injector - Short circuit to B+ ... 94
P0276 No.6 Injector - Short or Open circuit to Ground ... 94
P0277 No.6 Injector - Short circuit to B+ ... 94
P0300 Cylinder - Poor Ignition ... 95
P0301 No.1 Cylinder - Poor Ignition ... 95
P0302 No.2 Cylinder - Poor Ignition ... 95
P0303 No.3 Cylinder - Poor Ignition ... 96
P0304 No.4 Cylinder - Poor Ignition ... 96
P0305 No.5 Cylinder - Poor Ignition ... 96
P0306 No.6 Cylinder - Poor Ignition ... 97
P0325 #1 Knock Sensor Malfunction (1, 2, 3 CYL) ... 97
P0330 #2 Knock Sensor Malfunction (4, 5, 6 CYL) ... 97
P0335 Faulty Crank Position Sensor Signal - No Engine RPM ... 98
P0335 Faulty Crank Position Sensor Signal - Faulty Recognition of Gap ... 98
P0335 Crank Position Sensor Adaptation Malfunction - Poor Initialization ... 98
P0336 Crank Position Sensor - Excessive Engine RPM ... 98
P0340 #1 Cylinder Synchronization Malfunction ... 99
P0341 #1 Cylinder Recognition Malfunction ... 99
P0351 #1 Ignition Coil - Faulty Output Voltage ... 99
P0352 #2 Ignition Coil - Faulty Output Voltage ... 100
P0353 #3 Ignition Coil - Faulty Output Voltage ... 100
P0411 Defective Secondary Air Pump - Insufficient Air Volume ... 100
P0413 Secondary Air Pump - Open circuit to Ground . 101
P0414 Secondary Air Pump - Short circuit to B+ ... 101
P0420 Faulty Catalyst 1 Purification Rate (1, 2, 3 Cylinder lines) ... 101
P0430 Faulty Catalyst 2 Purification Rate (4, 5, 6 Cylinder lines) ... 101
P0442 Fuel Tank: Oil Leakage ... 101
P0443 Purge Control Solenoid Valve Malfunction - Faulty closing ... 102
P0444 Purge Control Solenoid Valve Malfunction - Short or Open circuit to Ground ... 102
P0445 Purge Control Solenoid Valve Malfunction - Short circuit to B+ ... 102
P0447 Canister Shut-off Valve Malfunction - Short or Open circuit to Ground ... 103

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

P0448 Canister Shut-off Valve: Short circuit to B+ ... 103
P0450 Fuel Tank Pressure Sensor Malfunction 103
P0452 Low Fuel Tank Pressure Sensor Signal 104
P0453 High Fuel Tank Pressure Sensor Signal 104
P0455 Fuel Tank: Large Oil Leakage 104
P0460 Faulty Fuel Pump Fuel Level Sensor Indication 105
P0462 Faulty Fuel Pump Fuel Level Transmission 105
P0480 PWM electric fan - Short circuit to power supply 106
P0480 PWM electric fan - Open/Short circuit to ground 106
P0481 Condenser Fan (Low) Relay - Short circuit to B+ 106
P0481 Condenser Fan (Low) Relay - Open circuit to Ground 106
P0483 PWM electric fan - Motor overloaded 106
P0484 PWM electric fan - Motor stalled 106
P0485 PWM electric fan - Short circuit 106
P0500 CAN signal Fault:Auto Cruise Malfunction ... 107
P0500 Auto Cruise Acceleration Function Fault 107
P0500 Auto Cruise Deceleration Function Fault 107
P0501 Defective Vehicle Speed Sensor Signal 107
P0501 Defective Vehicle Speed Sensor Signal 107
P0562 Low Battery Voltage 107
P0564 Defective Auto Cruise Control Lever 107
P0600 CAN Communication Malfunction: ASR 107
P0600 CAN Communication Malfunction: ABS 107
P0600 Defective Immobilizer System 107
P0600 CAN Communication Malfunction: TCU 108
P0600 CAN Communication Malfunction: TOD (Not used) 108
P0600 CAN Communication Malfunction: Shift Lever 108
P0600 CAN Communication Malfunction: ABS Speed Sensor (FR) 108
P0600 CAN Communication Malfunction: ABS Speed Sensor (RR) 108
P0600 CAN Communication Malfunction: Faulty Initialization 109
P0600 CAN Communication Malfunction: MSR Transmission Signal 109
P0600 CAN Communication Malfunction: ASR Transmission Signal 109
P0601 Throttle Position Sensor - Faulty Learning Signal 109
P0601 Auto Cruise Shutdown Memory Malfunction 109
P0601 ECU Malfunction (Call Monitor) 109
P0601 Servo Motor's Voltage Output Stopped 110
P0601 Servo Motor - Short or Open circuit 110
P0601 ECU Malfunction (CPU not compatible) 110
P0601 ECU Malfunction (Faulty CPU Communication) 110
P0601 ECU Malfunction (Faulty CPU (2) Environment) 110
P0601 ECU Malfunction (CPU (2) Malfunction) 110
P0601 ECU Malfunction (Faulty CPU run-time) 110
P0601 Communication Malfunction (CPU2) 110
P0602 ECU Not Coded 110
P0602 Incorrect Transmission Coding 110
P0603 Incorrect VIN ECU Coding 110
P0604 ECU Fault (RAM) 110
P0605 ECU Fault (EPROM) 111
P0605 ECU Fault (Faulty NVRAM Checksum) 111
P0605 ECU Fault (Faulty Coding ID Checksum) 111
P0605 ECU Fault (Faulty Coding Checksum) 111
P0605 ECU Fault (Faulty Programming Checksum) .. 111
P0650 Engine CHECK Warning Lamp - Short circuit to B+ 111
P0650 Engine CHECK Warning Lamp - Open or Short circuit to Ground 111
P0661 Variable Air Intake Valve - Open or Short circuit to Ground 111
P0662 Variable Air Intake Valve - Short circuit to B+ 112
P0702 TCU Fault 112
P0702 Transmission Malfunction: Solenoid Valve Voltage 112
P0703 CAN Communication Fault: Stop Lamp Switch 112
P0705 Transmission Malfunction: Shift Lever 112
P0715 Transmission Malfunction: Vehicle Speed Sensor 112
P0720 Transmission Malfunction: Faulty Speed to Output 112
P0730 Transmission Malfunction: Hydraulic System 112
P0730 Transmission Malfunction: Faulty Gear Recognition 112
P0734 A/T Control Malfunction 112
P0740 Transmission Malfunction: TCC Head Control 112
P0743 Transmission Malfunction: Lockup Converter Clutch 112
P0748 Transmission Malfunction: Modulator Pressure 112
P0753 Transmission Malfunction: Solenoid Valve 1-2/4-5 112
P0758 Transmission Malfunction: Solenoid Valve 2-3 112
P0763 Transmission Malfunction: Solenoid Valve 3-4 112
P0778 Transmission Malfunction: Transmission Pressure 112
P0836 Transmission Malfunction: Transfer Case .. 112
P1570 Immobilizer Not Coded 113
P1590 Safety Fuel Shut-off Time Expired 113
P1609 Starter Signal Recognition Malfunction 113

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

TROUBLE DIAGNOSIS TABLE

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Variable Valve Timing System	P0010	Cam Actuator - Short circuit to B+	• **Condition** - Variable valve timing system circuit: short circuit to battery • **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 73. 3. Check the cam actuator's power circuit for short and open. 4. Check the magnet and hardware. 5. Check the ECU.	O
		Cam Actuator - Short or Open circuit to Ground	• **Condition** - Variable valve timing system circuit: short or open circuit to ground • **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 73. 3. Check the cam actuator's power circuit for short and open. 4. Check the magnet and hardware. 5. Check the ECU.	O
	P0011	Cam Actuator - Fixed to Advance Position	• **Condition** - The noise occurred by valve timing (advance/retard) in each range is over than the specified value. • **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 73. 3. Check the cam actuator's power circuit for short and open. 4. Check the magnet and hardware. 5. Check the ECU.	O
	P0012	Cam Actuator - Fixed to Retard Position	• **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 73. 3. Check the cam actuator's power circuit for short and open. 4. Check the magnet and hardware. 5. Check the ECU.	O
HFM Sensor	P0101	Faulty HFM Sensor Signal	• **Condition** - Improper air volume is detected. • **Specification** - 20 kg/h - 0.47 V 0 kg/h - 0.99 V 10 kg/h - 1.2226 ~ 1.2398 V 15 kg/h - 1.3552 ~ 1.3778 V 30 kg/h - 1.6783 ~ 1.7146 V 60 kg/h - 2.1619 ~ 2.2057 V 120 kg/h - 2.7215 ~ 2.7762 V 250 kg/h - 3.4388 ~ 3.5037 V 370 kg/h - 3.8796 ~ 3.9511 V 480 kg/h - 4.1945 ~ 4.2683 V 640 kg/h - 4.5667 ~ 4.6469 V • **Actions** 1. Measure the actual air volume using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 92 and 116. 3. Inspect HFM sensor. 4. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
HFM Sensor	P0102	Low HFM Sensor Signal	• **Condition** - The signal is below the minimum engine load (0.02). - Related circuit: open circuit • **Specification** - 20 kg/h - 0.47 V 0 kg/h - 0.99 V 10 kg/h - 1.2226 ~ 1.2398 V 15 kg/h - 1.3552 ~ 1.3778 V 30 kg/h - 1.6783 ~ 1.7146 V 60 kg/h - 2.1619 ~ 2.2057 V 120 kg/h - 2.7215 ~ 2.7762 V 250 kg/h - 3.4388 ~ 3.5037 V 370 kg/h - 3.8796 ~ 3.9511 V 480 kg/h - 4.1945 ~ 4.2683 V 640 kg/h - 4.5667 ~ 4.6469 V • **Actions** 1. Measure the actual air volume using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 92 and 116. 3. Inspect HFM sensor. 4. Check the ECU.	O
	P0103	High HFM Sensor Signal	• **Condition** - The signal is over the maximum engine load (0.02). - Related circuit: short circuit • **Specification** - 20 kg/h - 0.47 V 0 kg/h - 0.99 V 10 kg/h - 1.2226 ~ 1.2398 V 15 kg/h - 1.3552 ~ 1.3778 V 30 kg/h - 1.6783 ~ 1.7146 V 60 kg/h - 2.1619 ~ 2.2057 V 120 kg/h - 2.7215 ~ 2.7762 V 250 kg/h - 3.4388 ~ 3.5037 V 370 kg/h - 3.8796 ~ 3.9511 V 480 kg/h - 4.1945 ~ 4.2683 V 640 kg/h - 4.5667 ~ 4.6469 V • **Actions** 1. Measure the actual air volume using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 92 and 116. 3. Inspect HFM sensor.	O
MAP Sensor (G23 only)	P0105	Defective Intake Manifold Pressure Sensor Signal		

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Intake Air Temperature Sensor	P0111	Faulty Intake Air Temperature Sensor Signal	• **Condition** - The temperature change of over 20 °C is occurred more than 5 times. • **Specification** 20°C - 2420 Ω - 2.65 V 30°C - 1662 Ω - 2.18 V 50°C - 853 Ω - 1.40 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits of ECU pin No. 80 and 116. 3. Inspect intake air temperature sensor (ATS-HFM6.0 integrated). 4. Check the ECU.	O
	P0112	Intake Air Temperature Sensor Malfunction - Open circuit	• **Condition** - The sensor value is less than minimum specified value (0.1 V). - Related circuit: open circuit • **Specification** 20°C - 2420 Ω - 2.65 V 30°C - 1662 Ω - 2.18 V 50°C - 853 Ω - 1.40 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits of ECU pin No. 80 and 116. 3. Inspect intake air temperature sensor (ATS-HFM6.0 integrated). 4. Check the ECU.	O
	P0113	Intake Air Temperature Sensor Malfunction - Short circuit	• **Condition** - The sensor value is over the maximum specified value (4.9 V). - Related circuit: short circuit • **Specification** 20°C - 2420 Ω - 2.65 V 30°C - 1662 Ω - 2.18 V 50°C - 853 Ω - 1.40 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits of ECU pin No. 80 and 116. 3. Inspect intake air temperature sensor (ATS-HFM6.0 integrated). 4. Check the ECU.	O
Coolant Temperature Sensor	P0116	Faulty Coolant Temperature Sensor Signal	• **Condition** - The coolant temperature is below 50 °C after engine warmed up. • **Specification** 20°C - 2.50 kΩ - 3.57 V 80°C - 0.32 kΩ - 1.22 V 100°C - 0.18 kΩ - 0.78 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits of ECU pin No. 78 and 79. 3. Check the coolant temperature sensor. 4. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Coolant Temperature Sensor	P0117	Coolant Temperature Sensor Malfunction - Open circuit	• **Condition** - The sensor value is less than minimum specified value (0.11 V). - Related circuit: open circuit • **Specification** 20°C - 2.50 kΩ - 3.57 V 80°C - 0.32 kΩ - 1.22 V 100°C - 0.18 kΩ - 0.78 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits of ECU pin No. 78 and 79. 3. Check the coolant temperature sensor. 4. Check the ECU.	O
	P0118	Coolant Temperature Sensor Malfunction - Short circuit	• **Condition** - The sensor value is over the maximum specified value (4.96 V). - Related circuit: short circuit • **Specification** 20°C - 2.50 kΩ - 3.57 V 80°C - 0.32 kΩ - 1.22 V 100°C - 0.18 kΩ - 0.78 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits of ECU pin No. 78 and 79. 3. Check the coolant temperature sensor. 4. Check the ECU.	O
Throttle Body Control	P0120	No.1 Throttle Position Sensor - Low Voltage	• **Condition** - No.1 throttle position sensor circuit: short or open circuit to ground. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Throttle Body Control	P0120	No.1 Throttle Position Sensor - High Voltage	• **Condition** - No.1 throttle position sensor's main power is grounded. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O
		No.2 Throttle Position Sensor - Low Voltage	• **Condition** - No.2 throttle position sensor circuit: short or open circuit to ground. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O
		No.2 Throttle Position Sensor - High Voltage	• **Condition** - No.2 throttle position sensor's main power is grounded. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Throttle Body Control	P0120	Throttle Actuator - Insuffcient Supply Power	• **Condition** - Actuator circuit: short circuit • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O
		TPS Valve Inconsistent with HFM Sensor Value	• **Condition** - The potentiometer is defective. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O
		Both Throttle Position Sensors Malfunction	• **Condition** - The potentiometer is defective. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Throttle Body Control	P0120	Inconsistent Signals of No.1 and No.2 Throttle Position Sensors	• **Condition** - The difference in amount of 1/2 is occurred in potentiometer. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O
		Throttle Actuator Control Malfunction	• **Condition** - The wiring or actuator is defective. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O
		Intake Air Flow Sensor and Throttle Sensor Malfunction	• **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Accelerator Pedal Sensor	P0120	Accelerator Pedal Sensor Malfunction - Supply Voltage Fault	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	O
		Accelerator Pedal Sensor #1 Malfunction - Low Voltage	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	O
		Accelerator Pedal Sensor #1 Malfunction - High Voltage	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	O
		Accelerator Pedal Sensor #2 Malfunction - Low Voltage	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	O
		Accelerator Pedal Sensor #2 Malfunction - High Voltage	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	O
		Accelerator Pedal Sensor #1 & #2 - Defective Signal	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	O
		Accelerator Pedal Sensor #1 & #2 Malfunction	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Throttle Body Control	P0121	Throttle Position Sensor Actuator's Learning Control Malfunction	• **Condition** - The actuator is not properly adjusted and the conditions are not satisfied. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O
		Faulty Throttle Body Return Spring	• **Condition** - The return spring of actuator is defective. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O
Coolant Temperature Sensor	P0125	Low coolant temperature while controlling air/fuel ratio	• **Condition** - The coolant temperature is below the specified temperature for controlling air/fuel ratio after engine warmed up. • **Specification** 20°C - 2.50 kΩ - 3.57 V 80°C - 0.32 kΩ - 1.22 V 100°C - 0.18 kΩ - 0.78 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits for ECU pin No. 78 and 79. 3. Check the coolant temperature sensor. 4. Check the ECU.	O
Thermostat	P0128	Thermostat Fully Open	• **Condition** 1. The actual coolant temperature is lower than the coolant temperature calculated by ECU due to the slow preheat. • **Actions** 1. Check the thermostat.	O

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.1 Oxygen Sensor (Installed Before Catalytic Converter)	P0131	No.1 Oxygen Sensor - Below the Minimum Permissible Voltage	• **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds (refer to P0133) • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 9. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O
	P0132	No.1 Oxygen Sensor - Overvoltage	• **Condition** - No.1 oxygen sensor is defective. Output voltage > 1.05 V The sensing voltage is not in the specified range. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) - Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 16 and 17. 3. Inspect the oxygen sensor. 4. Check the ECU.	O
	P0133	No.1 Oxygen Sensor - Poor Performance	• **Condition** - No.1 oxygen sensor is defective. The response to the sensor signal is delayed. Closed loop interval of air/fuel ratio control > 1500 ms • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) - Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 16 and 17. 3. Inspect the oxygen sensor. 4. Check the ECU.	O

NOTE

- **The No.1 oxygen sensor is located before the catalytic converter (for exhaust manifold 1/2/3) and no.2 oxygen sensor is located after the catalytic converter.**
- **The No.3 oxygen sensor is located before the catalytic converter (for exhaust manifold 4/5/6) and no.4 oxygen sensor is located after the catalytic converter.**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.1 Oxygen Sensor (Installed Before Catalytic Converter)	P0134	No.1 Oxygen Sensor - Malfunction	**• Condition** - No.1 oxygen sensor is defective. The sensor does not operate. **• Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) - Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ **• Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 16 and 17. 3. Inspect the oxygen sensor. 4. Check the ECU.	O
		No.1 Oxygen Sensor - Lean Indication (When Decelerating)	**• Condition** - No.1 oxygen sensor is defective. There is no "LEAN" signal after shutting off the fuel. **• Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) - Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ **• Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 16 and 17. 3. Inspect the oxygen sensor. 4. Check the ECU.	O
	P0135	No.1 Oxygen Sensor - Faulty Heating Current, Heater Circuit is Open or Short circuit or Short circuit to Ground	**• Condition** - No.1 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). **• Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds **• Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 9. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.1 Oxygen Sensor (Installed Before Catalytic Converter)	P0135	No.1 Oxygen Sensor Heater - Short circuit to B+	• **Condition** - No.1 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 9. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O
		No.1 Oxygen Sensor Heater - Open or Short circuit to Ground	• **Condition** - No.1 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 9. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O
No.2 Oxygen Sensor (Installed After Catalytic Converter)	P0137	No.2 Oxygen Sensor - Below the Minimum Permissible Voltage	• **Condition** - No.2 oxygen sensor is defective. The sensor does not operate. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance:≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 19 and 20. 3. Inspect the oxygen sensor. 4. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.2 Oxygen Sensor (Installed After Catalytic Converter)	P0138	No.2 Oxygen Sensor - Overvoltage	• **Condition** - No.2 oxygen sensor is defective. The output value is not within the specified range. The sensing voltage is not in the specified range. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 19 and 20. 3. Inspect the oxygen sensor. 4. Check the ECU.	O
	P0140	No.2 Oxygen Sensor - Lean Indication (When Decelerating)	• **Condition** - No.2 oxygen sensor is defective. There is no "LEAN" signal after shutting off the fuel. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 19 and 20. 3. Inspect the oxygen sensor. 4. Check the ECU.	O
	P0141	No.2 Oxygen Sensor Heater - Short circuit to B+	• **Condition** - No.2 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 7. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.2 Oxygen Sensor (Installed After Catalytic Converter)	P0141	No.2 Oxygen Sensor Heater - Open or Short circuit to Ground	• **Condition** - No.2 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 7. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O
		No.2 Oxygen Sensor - Poor Heating	• **Condition** - No.2 oxygen sensor is defective. The response to the sensor signal is delayed. • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 7. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O
No.3 Oxygen Sensor (Installed Before Catalytic Converter)	P0151	No.3 Oxygen Sensor - Below the Minimum Permissible Voltage	• **Specification** - Specified voltage: Below 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 22 and 23. 3. Inspect the oxygen sensor. 4. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.3 Oxygen Sensor (Installed Before Catalytic Converter)	P0152	No.3 Oxygen Sensor - Overvoltage	• **Condition** - No.3 oxygen sensor is defective. The output value is not within the specified range. The sensing voltage is not in the specified range. • **Specification** - Specified voltage: Below 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 22 and 23. 3. Inspect the oxygen sensor. 4. Check the ECU.	O
	P0153	No.3 Oxygen Sensor - Poor Performance	• **Condition** - No.3 oxygen sensor is defective. The response to the sensor signal is delayed. • **Specification** - Specified voltage: Below 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 22 and 23. 3. Inspect the oxygen sensor. 4. Check the ECU.	O
	P0154	No.3 Oxygen Sensor - Malfunction	• **Condition** - No.3 oxygen sensor is defective. The sensor does not operate. • **Specification** - Specified voltage: Below 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 22 and 23. 3. Inspect the oxygen sensor. 4. Check the ECU.	O

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.3 Oxygen Sensor (Installed Before Catalytic Converter)	P0154	No.3 Oxygen Sensor - Lean Indication (When Decelerating)	• **Condition** - No.3 oxygen sensor is defective. There is no "LEAN" signal after shutting off the fuel. • **Specification** - Specified voltage: Below 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 22 and 23. 3. Inspect the oxygen sensor. 4. Check the ECU.	O
	P0155	No.3 Oxygen Sensor - Faulty Heating Current	• **Condition** - No.3 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 6. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O
		No.3 Oxygen Sensor Heater - Short circuit to B+	• **Condition** - No.3 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 6. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O
		No.3 Oxygen Sensor Heater - Open or Short circuit to Ground	• **Condition** - No.3 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 6. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.4 Oxygen Sensor (Installed After Catalytic Converter)	P0157	No.4 Oxygen Sensor - Below the Minimum Permissible Voltage	• **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 MΩ (850°C) Between sensor circuit and housing - Operating temperature: 850 °C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 25 and 26. 3. Inspect the oxygen sensor. 4. Check the ECU.	O
	P0158	No.4 Oxygen Sensor - Overvoltage	• **Condition** - No.4 oxygen sensor is defective. The output value is not within the specified range. The sensing voltage is not in the specified range. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 MΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip -Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 25 and 26. 3. Inspect the oxygen sensor. 4. Check the ECU.	O
	P0160	No.4 Oxygen Sensor - Lean Indication (When Decelerating)	• **Condition** - No.4 oxygen sensor is defective. There is no "LEAN" signal after shutting off the fuel. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 MΩ (850°C) Between sensor circuit and housing - Operating temperature: 850 °C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 25 and 26. 3. Inspect the oxygen sensor. 4. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.4 Oxygen Sensor (Installed After Catalytic Converter)	P0161	No.4 Oxygen Sensor - Poor Heating	• **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 3. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O
		No.4 Oxygen Sensor Heater - Short circuit to B+	• **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 3. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O
		No.4 Oxygen Sensor Heater - Open or Short circuit to Ground	• **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 3. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O
No.1 Oxygen Sensor (Installed Before Catalytic Converter)	P0171	Short-term Learning Control of Air/Fuel Ratio: Fuel Rich	• **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) - Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 16 and 17. 3. Inspect the oxygen sensor. 4. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

O : Turning on when the condition is occurred twice consecutively

● : Turning on when the condition is occurred once

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel Correction	P0171	Air/Fuel Ratio Control Malfunction - Fuel Rich	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	●
		Learning Control Malfunction - Rich at Idling	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	●
		Learning Control Malfunction - Rich under Low Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	●
		Learning Control Malfunction - Rich under High Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	●
	P0172	Air/Fuel Ratio Control Malfunction - Fuel Lean	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	●
		Learning Control Malfunction - Lean at Idling	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	●
		Learning Control Malfunction - Lean under Low Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	●
		Learning Control Malfunction - Lean under High Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	●

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.2 Oxygen Sensor (Installed After Catalytic Converter)	P0172	Short-term Learning Control of Air/Fuel Ratio: Fuel Lean	• **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 19 and 20. 3. Inspect the oxygen sensor. 4. Check the ECU.	O
Fuel Correction	P0174	Air/Fuel Ratio Control Malfunction - Fuel Rich	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	O
		Fuel Rich at Idling	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	O
		Fuel Rich under Low Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	O
		Fuel Rich under High Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	O
No.3 Oxygen Sensor (Installed Before Catalytic Converter)	P0174	Short-term Learning Control of Air/Fuel Ratio: Fuel Rich	• **Specification** - Specified voltage: Below 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850 °C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 22 and 23. 3. Inspect the oxygen sensor. 4. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel Correction	P0175	Air/Fuel Ratio Control Malfunction - Fuel Lean	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	O
		Fuel Lean at Idling	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	O
		Fuel Lean under Low Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	O
		Fuel Lean under High Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	O
No.4 Oxygen Sensor (Installed After Catalytic Converter)	P0175	Short-term Learning Control of Air/Fuel Ratio: Fuel Lean	• **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance : ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 MΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 25 and 26. 3. Inspect the oxygen sensor. 4. Check the ECU.	O
Throttle Body Safety Function	P0221	Deceleration Over Limit (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		Acceleration Over Limit (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Throttle Body Safety Function	P0221	Control Lever Double Action (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		Control Lever Safety Terminal Malfunction (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		Pedal Position Change Fault (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		Throttle Position Change Fault (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		Defective Constant Speed Driving Control Data (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		Faulty Pedal Position Detected (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		Faulty Throttle Position Detected (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		Faulty CAN Communication Detected (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		Faulty Configuration Detected (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		Faulty A/D Converter Detected (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		CPU #1 and #2 - Pedal Position Signal Fault	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Throttle Body Safety Function	P0221	CPU #1 and #2 - TP Valve Position Signal Fault	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		CPU #1 and #2 - MSR Signal Fault	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		CPU #1 and #2 - Idle Control	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		AD Converter Overflow Detected (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		ROM Malfunction (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		RAM Malfunction (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
		CPU Recognition Malfunction (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	O
Fuel Pump Relay	P0231	Fuel Pump Relay - Open circuit to Ground	• **Condition** - Fuel pump circuit: short or open circuit to ground • **Specification** - The voltage drop of pin No. 33 and ground: Below 1 V (current = 150 mA) • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 33. 2. Inspect the fuel pump relay. 3. Check the ECU.	O
	P0232	Fuel Pump Relay - Short circuit to B+	• **Condition** - Fuel pump: short circuit to battery • **Specification** - The voltage drop of pin No. 33 and ground: Below 1 V (current = 150 mA) • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 33. 2. Inspect the fuel pump relay. 3. Check the ECU.	O

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel Injection System	P0261	No.1 Injector - Short or Open circuit to Ground	• **Condition** - No.1 injector is defective. No.1 injector circuit: short circuit to ground • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 63. 2. Inspect the injector. 3. Check the ECU.	O
	P0262	No.1 Injector - Short circuit to B+	• **Condition** - No.1 injector is defective. No.1 injector circuit: short circuit to battery • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Check the No.1 injector's power supply and terminal. 2. Inspect the injector. 3. Check the ECU.	O
	P0264	No.2 Injector - Short or Open circuit to Ground	• **Condition** - No.2 injector is defective. No.2 injector circuit: short circuit to ground • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 61. 2. Inspect the injector. 3. Check the ECU.	O
	P0265	No.2 Injector - Short circuit to B+	• **Condition** - No.2 injector is defective. No.2 injector circuit: short circuit to battery • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Check the No.2 injector's power supply and terminal. 2. Inspect the injector. 3. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel Injection System	P0267	No.3 Injector - Short or Open circuit to Ground	• **Condition** - No.3 injector is defective. No.3 injector circuit: short circuit to ground • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 66. 2. Inspect the injector. 3. Check the ECU.	O
	P0268	No.3 Injector - Short circuit to B+	• **Condition** - No.3 injector is defective. No.3 injector circuit: short circuit to battery • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Check the No.3 injector's power supply and terminal. 2. Inspect the injector. 3. Check the ECU.	O
	P0270	No.4 Injector - Short or Open circuit to Ground	• **Condition** - No.4 injector is defective. No.4 injector circuit: short circuit to ground • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 62. 2. Inspect the injector. 3. Check the ECU.	O
	P0271	No.4 Injector - Short circuit to B+	• **Condition** - No.4 injector is defective. No.4 injector circuit: short circuit to battery • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Check the No.4 injector's power supply and terminal. 2. Inspect the injector. 3. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel Injection System	P0273	No.5 Injector - Short or Open circuit to Ground	• **Condition** - No.5 injector is defective. No.5 injector circuit: short circuit to ground • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 65. 2. Inspect the injector. 3. Check the ECU.	O
	P0274	No.5 Injector - Short circuit to B+	• **Condition** - No.5 injector is defective. No.5 injector circuit: short circuit to battery • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Check the No.5 injector's power supply and terminal. 2. Inspect the injector. 3. Check the ECU.	O
	P0276	No.6 Injector - Short or Open circuit to Ground	• **Condition** - No.6 injector is defective. No.6 injector has a short circuit to ground. • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 64. 2. Inspect the injector. 3. Check the ECU.	O
	P0277	No.6 Injector - Short circuit to B+	• **Condition** - No.6 injector is defective. No.6 injector circuit: short circuit to battery • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Check the No.6 injector's power supply and terminal. 2. Inspect the injector. 3. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Poor Ignition (Misfire)	P0300	Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in more than one cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9.Check the ECU.	●
	P0301	No.1 Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in No.1 cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9. Check the ECU.	●
	P0302	No.2 Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in No.2 cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9. Check the ECU.	●

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Poor Ignition (Misfire)	P0303	No.3 Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in No.3 cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9. Check the ECU.	●
	P0304	No.4 Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in No.4 cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9. Check the ECU.	●
	P0305	No.5 Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in No.5 cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9. Check the ECU.	●

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Poor Ignition (Misfire)	P0306	No.6 Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in No.6 cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9. Check the ECU.	●
Knock Sensor	P0325	#1 Knock Sensor Malfunction (1, 2, 3 CYL)	• **Condition** - No.1 knock sensor is defective. The value is not within the specified range when the engine temperature is over 75°C, the engine speed is over 3000 rpm and other units are properly operated (for cylinder No. 1, 2 and 3). • **Specification** - Sensitivity: approx. 26 ± 8 mV/g Resistance > 10 MΩ • **Actions** 1. Inspect the circuits and terminals of the ECU pin No. 117 and 118. 2. Inspect the No.1 knock sensor. 3. Check the ECU.	O
	P0330	#2 Knock Sensor Malfunction (4, 5, 6 CYL)	• **Condition** - No.2 knock sensor is defective. The value is not within the specified range when the engine temperature is over 75°C, the engine speed is over 3000 rpm and other units are properly operated (for cylinder No. 4, 5 and 6). • **Specification** - Sensitivity: approx. 26 ± 8 mV/g Resistance > 10 MΩ • **Actions** 1. Inspect the circuits and terminals of the ECU pin No. 114 and 115. 2. Inspect the No.2 knock sensor. 3. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Crank Position Sensor	P0335	Faulty Crank Position Sensor Signal - No Engine RPM	• **Condition** - The crank angle signals cannot be detected even the cam position is properly detected. • **Specification** - Sensor's internal resistance : 700 ~ 1050 Ω • **Actions** 1. Measure the crankshaft rpm using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 100 and 99. 3. Inspect the crank angle sensor. 4. Inspect air gap between sensor and drive plate. 5. Check the drive plate's teeth. 6. Check the ECU.	O
		Faulty Crank Position Sensor Signal - Faulty Recognition of Gap	• **Condition** - The cam and crank angle signal is improperly recognized or not recognized. • **Specification** - Sensor internal resistance: 700 ~ 1050 Ω • **Actions** 1. Measure the crankshaft rpm using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 100 and 99. 3. Inspect the crank angle sensor. 4. Inspect air gap between sensor and drive plate. 5. Check the drive plate's teeth. 6. Check the ECU.	O
		Crank Position Sensor Adaptation Malfunction - Poor Initialization	• **Condition** - The crank angle sensor is faulty initialized. • **Specification** - Sensor internal resistance: 700 ~ 1050 Ω • **Actions** 1. Measure the crankshaft rpm using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 100 and 99. 3. Inspect the crank angle sensor. 4. Inspect air gap between sensor and drive plate. 5. Check the drive plate's teeth. 6. Check the ECU.	O
	P0336	Crank Position Sensor - Excessive Engine RPM	• **Condition** - The engine rpm is over the proper amount or improper. • **Specification** - Sensor internal resistance: 700 ~ 1050 Ω • **Actions** 1. Measure the crankshaft rpm using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 100 and 99. 3. Inspect the crank angle sensor. 4. Inspect air gap between sensor and drive plate. 5. Check the drive plate's teeth. 6. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Cam Position Sensor	P0340	#1 Cylinder Synchronization Malfunction	• **Condition** - The cam position sensor is defective. The No.1 cylinder is poorly synchronized. • **Specification** - Sensor supply voltage: 4.5 V - 24 V • **Actions** 1. Measure the set voltage of cam position sensor. 2. Inspect the circuits and terminals of ECU pin No. 106 and 104. 3. Inspect the cam position sensor. 4. Check the cam sensor and sprocket for damage. 5. Check the ECU.	O
	P0341	#1 Cylinder Recognition Malfunction	• **Condition** - There is no cam recognition signal. • **Specification** - Sensor supply voltage: 4.5 V - 24 V • **Actions** 1. Measure the set voltage of cam position sensor. 2. Inspect the circuits and terminals of ECU pin No. 106 and 104. 3. Inspect the cam position sensor. 4. Check the cam sensor and sprocket for damage. 5. Check the ECU.	O
Ignition Coil	P0351	#1 Ignition Coil - Faulty Output Voltage	• **Condition** - The ignition unit is defective (for No. 2 and 5 cylinders). Ignition circuit: short circuit to primary and secondary current • **Specification** - Primary resistance: 0.36 Ω Secondary resistance: 5.9 kΩ - Secondary voltage: 38 KV - Ignition output Primary current: 7.0 A Primary voltage: 380 V • **Actions** 1. Inspect the circuits and terminals of the ECU pin No. 70, 71 and 72. 2. Inspect the power supply of ignition coil. 3. Inspect the ignition coil and high-voltage cable. 4. Inspect the spark plug for moisture, crack, wear, improper cap and excessive burnt electrode residue. 5. Check the ECU.	O

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Ignition Coil	P0352	#2 Ignition Coil - Faulty Output Voltage	• **Condition** - The ignition unit is defective (for No. 3 and 4 cylinders). Ignition circuit: short circuit to primary and secondary current • **Specification** - Primary resistance: 0.36 Ω Secondary resistance: 5.9 kΩ - Secondary voltage: 38 KV - Ignition output Primary current: 7.0 A Primary voltage: 380 V • **Actions** 1. Inspect the circuits and terminals of the ECU pin No. 70, 71 and 72. 2. Inspect the power supply of ignition coil. 3. Inspect the ignition coil and high-voltage cable. 4. Inspect the spark plug for moisture, crack, wear, improper cap and excessive burnt electrode residue. 5. Check the ECU.	O
	P0353	#3 Ignition Coil - Faulty Output Voltage	• **Condition** - The ignition unit is defective (for No. 1 and 6 cylinders). Ignition circuit: short circuit to primary and secondary current • **Specification** - Primary resistance: 0.36 Ω Secondary resistance: 5.9 kΩ - Secondary voltage: 38 KV - Ignition output Primary current: 7.0 A Primary voltage: 380 V • **Actions** 1. Inspect the circuits and terminals of the ECU pin No. 70, 71 and 72. 2. Inspect the power supply of ignition coil. 3. Inspect the ignition coil and high-voltage cable. 4. Inspect the spark plug for moisture, crack, wear, improper cap and excessive burnt electrode residue. 5. Check the ECU.	O
Secondary Air Supply System	P0411	Defective Secondary Air Pump - Insufficient Air Volume	• **Condition** - The secondary air injection pump relay and air pump valve/ hose are defective. • **Specification** - The voltage drop of pin No. 76 and ground: Below 1 V (current = 1000 mA) • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 76. 2. Inspect the secondary air pump relay. 3. Inspect the arrange ment of secondary air pump's valve and hose. 4. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Secondary Air Supply System	P0413	Secondary Air Pump - Open circuit to Ground	• **Condition** - Secondary air injection pump relay circuit: short or open circuit to ground • **Specification** - The voltage drop of pin No. 76 and ground: Below 1 V (current = 1000 mA) • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 76. 2. Inspect the secondary air pump relay. 3. Check the ECU.	O
	P0414	Secondary Air Pump - Short circuit to B+	• **Condition** - Secondary air injection pump relay circuit: short circuit to battery • **Specification** - The voltage drop of pin No. 76 and ground: Below 1 V (current = 1000 mA) • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 76. 2. Inspect the secondary air pump relay. 3. Check the ECU.	O
Catalytic Monitoring Device	P0420	Faulty Catalyst 1 Purification Rate (1, 2, 3 Cylinder lines)	• **Condition** - The calculated purification rate for bank 1 is below the specified range. (Bank 1 - Cylinder 1/2/3) • **Actions** 1. Inspect the exhaust gas for leaks. 2. Inspect the oxygen sensor and its signal. 3. Inspect the actual effciency of exhaust gas through the exhaust gas test. 4. Inspect the catalyst. 5. Check the ECU.	O
	P0430	Faulty Catalyst 2 Purification Rate (4, 5, 6 Cylinder lines)	• **Condition** - The calculated purification rate for bank 2 is below the specified range. (Bank 2 - Cylinder 4/5/6) • **Actions** 1. Inspect the exhaust gas for leaks. 2. Inspect the oxygen sensor and its signal. 3. Inspect the actual effciency of exhaust gas through the exhaust gas test. 4. Inspect the catalyst. 5. Check the ECU.	O
Evaporated Gas Control System	P0442	Fuel Tank: Oil Leakage	• **Condition** - Minute leak of evaporated gas is occurred (below 1 mm). • **Actions** 1. Inspect the fuel tank and connecting route for the followings: - Fuel tank cap for crack or damage - Vacuum hose for crack, puncture and clogging - Fuel tank for crack, puncture and damage - Canister for crack, puncture and damage - Fuel tank pressure sensor - Canister shut-off valve 2. Check the ECU.	O

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Purge Control Solenoid Valve	P0443	Purge Control Solenoid Valve Malfunction - Faulty closing	• **Condition** - The purge control circuit is defective. The purge control is not available. • **Specification** - Duty ratio: 0 ~ 100 % Below 20 % - 7.5 Hz 20 ~ 30 % - 15 Hz 30 ~ 75 % - 30 Hz - Internal resistance ≥ 26 Ω • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 34. 2. Inspect the power of the solenoid valve. 3. Inspect the purge control solenoid valve. 4. Check the ECU.	O
	P0444	Purge Control Solenoid Valve Malfunction - Short or Open circuit to Ground	• **Condition** - Power supply circuit: short or open circuit to ground • **Specification** - Duty ratio: 0 ~ 100 % below 20 % - 7.5 Hz 20 ~ 30 % - 15 Hz 30 ~ 75 % - 30 Hz - Internal resistance ≥ 26 Ω • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 34. 2. Inspect the power of the solenoid valve. 3. Inspect the purge control solenoid valve. 4. Check the ECU.	O
	P0445	Purge Control Solenoid Valve Malfunction - Short circuit to B+	• **Condition** - Power supply circuit: short circuit to battery • **Specification** - Duty ratio: 0 ~ 100 % below 20 % - 7.5 Hz 20 ~ 30 % - 15 Hz 30 ~ 75 % - 30 Hz - Internal resistance ≥ 26 Ω • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 34. 2. Inspect the power of the solenoid valve. 3. Inspect the purge control solenoid valve. 4. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Canister Shut-off Valve	P0447	Canister Shut-off Valve Malfunction - Short or Open circuit to Ground	• **Condition** - Fuel system shut-off valve circuit: short or open circuit to ground • **Specification** - Duty ratio: 0 ~ 100 % below 20 % → 7.5 Hz 20 ~ 30 % → 15 Hz 30 ~ 75 % → 30 Hz - Internal resistance ≥ 26 Ω • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 36. 2. Inspect the power of the solenoid valve. 3. Inspect the purge control solenoid valve. 4. Check the ECU.	O
	P0448	Canister Shut-off Valve: Short circuit to B+	• **Condition** - Fuel system shut-off valve circuit: short circuit to battery • **Specification** - Duty ratio: 0 ~ 100 % below 20 % → 7.5 Hz 20 ~ 30 % → 15 Hz 30 ~ 75 % → 30 Hz - Internal resistance ≥ 26 Ω • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 36. 2. Inspect the power of the solenoid valve. 3. Inspect the purge control solenoid valve. 4. Check the ECU.	O
Fuel tank pressure sensor	P0450	Fuel Tank Pressure Sensor Malfunction	• **Condition** - Improper fuel tank pressure is detected. • **Specification** 37.5 mbar → 4.51 V 30.0 mbar → 3.90 V 20.0 mbar → 3.10 V 10.0 mbar → 2.30 V 0 mbar → 1.50 V 10.0 mbar → 0.60 V 12.5 mbar → 0.49 V • **Actions** 1. Measure the actual fuel tank pressure using SCAN-100. 2. Inspect the circuits of ECU pin No. 18 and 41 and check pin No. 42. 3. Check the fuel tank pressure sensor. 4. Check the ECU.	O

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel tank pressure sensor	P0452	Low Fuel Tank Pressure Sensor Signal	• **Condition** - The fuel tank pressure signal is below the minimum fuel tank pressure (0.1V). - Related circuit: open circuit • **Specification** 37.5 mbar → 4.51 V 30.0 mbar → 3.90 V 20.0 mbar → 3.10 V 10.0 mbar → 2.30 V 0 mbar → 1.50 V 10.0 mbar → 0.60 V 12.5 mbar → 0.49 V • **Actions** 1. Measure the actual fuel tank pressure using SCAN-100. 2. Inspect the circuits of ECU pin No. 18 and 41 and check pin No. 42. 3. Check the fuel tank pressure sensor. 4. Check the ECU.	O
	P0453	High Fuel Tank Pressure Sensor Signal	• **Condition** - The fuel tank pressure signal is over the maximum fuel tank pressure (4.9 V). - Related circuit: open circuit • **Specification** 37.5 mbar → 4.51 V 30.0 mbar → 3.90 V 20.0 mbar → 3.10 V 10.0 mbar → 2.30 V 0 mbar → 1.50 V 10.0 mbar → 0.60 V 12.5 mbar → 0.49 V • **Actions** 1. Measure the actual fuel tank pressuring using SCAN-100. 2. Inspect the circuits of ECU pin No. 18 and 41 and check pin No. 42. 3. Check the fuel tank pressure sensor. 4. Check the ECU.	O
Evaporated Gas Control System	P0455	Fuel Tank: Large Oil Leakage	• **Condition** - The evaporated gas in the fuel tank is leaked. Diagnosis for large leaks • **Actions** 1. Inspect the fuel tank and connecting route for the followings: - Fuel tank cap for crack or damage - Vacuum hose for crack, puncture and clogging - Fuel tank for crack, puncture and damage - Canister for crack, puncture and damage - Fuel tank pressure sensor - Canister shut-off valve 2. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel Level Detection Sensor	P0460	Faulty Fuel Pump Fuel Level Sensor Indication	• **Condition** - The fuel level or the changed amount of fuel after driving for certain distance is improper. • **Specification** 67.29 liters - 38.0 Ω 62.48 liters - 48.2 Ω 58.28 liters - 56.8 Ω 52.23 liters - 67.0 Ω 45.34 liters - 83.3 Ω 37.41 liters - 99.5 Ω 30.10 liters - 122.5 Ω 21.36 liters - 150.0 Ω 6.45 liters - 268.2 Ω • **Actions** 1. Measure the actual fuel level using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 102 and 75. 3. Check the external resistance (200 Ω). 4. Inspect the fuel sender unit. 5. Check the ECU.	O
	P0462	Faulty Fuel Pump Fuel Level Transmission	• **Condition** - The FF (hexadecimal) is inputted to ECU from cluster. • **Specification** 67.29 liters - 38.0 Ω 62.48 liters - 48.2 Ω 58.28 liters - 56.8 Ω 52.23 liters - 67.0 Ω 45.34 liters - 83.3 Ω 37.41 liters - 99.5 Ω 30.10 liters - 122.5 Ω 21.36 liters - 150.0 Ω 6.45 liters - 268.2 Ω • **Actions** 1. Measure the actual fuel level using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 102 and 75. 3. Check the external resistance (200 Ω). 4. Inspect the fuel sender unit. 5. Check the ECU.	O
Cooling fan system (PWM electric fan)	P0480	PWM electric fan - Short circuit to power supply	• **Condition** - The cooling fan's output wiring has a short circuit to power supply. • **Actions** 1. Inspect the circuit and the terminal of No. 39 ECU pin. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Cooling fan system (PWM electric fan)	P0480	PWM electric fan - Open/Short circuit to ground	• **Condition** - The cooling fan's output wiring has a short circuit to power supply. • **Actions** 1. Inspect the circuit and the terminal of No. 39 ECU pin. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	
Condenser Fan Unit	P0481	Condenser Fan (Low) Relay - Short circuit to B+	• **Condition** - Power supply wiring: short circuit • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 35. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	
		Condenser Fan (Low) Relay - Open circuit to Ground	• **Condition** - Short or open circuit to ground • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 35. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	
Cooling fan system (PWM electric fan)	P0483	PWM electric fan - Motor overloaded	• **Condition** - The cooling fan's output wiring has a short circuit to power supply. • **Actions** 1. Inspect the circuit and the terminal of No. 39 ECU pin. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	
	P0484	PWM electric fan - Motor stalled	• **Condition** - The cooling fan's output wiring has a short circuit to power supply. • **Actions** 1. Inspect the circuit and the terminal of No. 39 ECU pin. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	
	P0485	PWM electric fan - Short circuit	• **Condition** - The cooling fan's output wiring has a short circuit to power supply. • **Actions** 1. Inspect the circuit and the terminal of No. 39 ECU pin. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Auto Cruise Control	P0500	CAN signal Fault: Auto Cruise Malfunction	• **Condition** - The auto cruise is defective.	O
		Auto Cruise Acceleration Function Fault	• **Condition** - The acceleration signal is faulty.	O
		Auto Cruise Deceleration Function Fault	• **Condition** - The deceleration signal is faulty.	O
	P0501	Defective Vehicle Speed Sensor Signal	• **Condition** - The vehicle speed signal is faulty.	O
		Defective Vehicle Speed Sensor Signal	• **Condition** - The vehicle speed signal is faulty.	O
Battery Voltage	P0562	Low Battery Voltage	• **Condition** - The voltage of ECU is faulty. * Less than minimum 8 Volts in 2000 rpm below * Less than 10 Volts in 2000 rpm above • **Specification** Over 8 V • **Actions** 1. Measure the actual battery voltage using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 12, 11, 10 and 5. 3. Check the power supply relay. 4. Check the battery and the ECU.	O
Auto Cruise Control	P0564	Defective Auto Cruise Control Lever	• **Condition** - The auto cruise lever is defective.	O
CAN Communication	P0600	CAN Communication Malfunction: ASR	• **Condition** - The CAN communication with ASR is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O
		CAN Communication Malfunction: ABS	• **Condition** - The CAN communication with ABS is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O
		Defective Immobilizer System	• **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
CAN Communication	P0600	CAN Communication Malfunction: TCU	• **Condition** - The CAN communication with TCU is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O
		CAN Communication Malfunction: TOD (Not used)	• **Condition** - The CAN communication with TOD is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O
		CAN Communication Malfunction: Shift Lever	• **Condition** - The CAN communication with TGS lever is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O
		CAN Communication Malfunction: ABS Speed Sensor (FR)	• **Condition** - The ABS front speed sensor's signal is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O
		CAN Communication Malfunction: ABS Speed Sensor (RR)	• **Condition** - The ABS rear speed sensor's signal is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
CAN Communication	P0600	CAN Communication Malfunction: Faulty Initialization	• **Condition** - The communication network data is not initialized. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O
		CAN Communication Malfunction: MSR Transmission Signal	• **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O
		CAN Communication Malfunction: ASR Transmission Signal	• **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O
Throttle Body Control	P0601	Throttle Position Sensor - Faulty Learning Signal	– **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O
ECU	P0601	Auto Cruise Shutdown Memory Malfunction	• **Condition** - The ECU's internal circuit is defective. • **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Malfunction (Call Monitor)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
ECU	P0601	Servo Motor's Voltage Output Stopped	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		Servo Motor - Short or Open circuit	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Malfunction (CPU not compatible)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Malfunction (Faulty CPU Communication)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Malfunction (Faulty CPU (2) Environment)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Malfunction (CPU (2) Malfunction)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Malfunction (Faulty CPU run-time)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		Communication Malfunction (CPU2)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
	P0602	ECU Not Coded	• **Condition** - The ECU coding is incorrect. • **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
Incorrect Coding	P0602	Incorrect Transmission Coding	• **Condition** - TCU (Variant) coding is faulty. • **Actions** 1. Check the current coding using SCAN-100. 2. Check ECU and TCU. 3. Check the CAN line.	O
Incorrect Coding	P0603	Incorrect VIN ECU Coding	• **Actions** 1. Check the current coding using SCAN-100. 2. Check ECU and TCU. 3. Check the CAN line.	O
ECU	P0604	ECU Fault (RAM)	• **Condition** - The memory function of ECU RAM is defective. • **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
ECU	P0605	ECU Fault (EPROM)	• **Condition** - The memory function of ECU is defective. • **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Fault (Faulty NVRAM Checksum)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Fault (Faulty Coding ID Checksum)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Fault (Faulty Coding Checksum)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Fault (Faulty Programming Checksum)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
Engine CHECK Warning Lamp	P0650	Engine CHECK Warning Lamp - Short circuit to B+	• **Condition** - Lamp circuit: short circuit to battery • **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 29.	O
		Engine CHECK Warning Lamp - Open or Short circuit to Ground	• **Condition** - Lamp circuit: short or open circuit to ground • **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 29.	O
Variable Air Intake System	P0661	Variable Air Intake Valve - Open or Short circuit to Ground	• **Condition** - Variable air intake valve circuit: short or open circuit to ground • **Specification** - ON/OFF flip range: approx. 3500 rpm - Operating current: 0.4 - 0.6 A - Solenoid internal resistance: 25 ± 5 Ω (20°C) • **Actions** 1. Check the actual operation condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 97. 3. Check the resonance flap's power supply. 4. Check the resonance flap solenoid and unit for damage. 5. Check the ECU.	O

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Variable Air Intake System	P0662	Variable Air Intake Valve - Short circuit to B+	• **Condition** - Variable air intake valve circuit: short circuit to battery • **Specification** - ON/OFF flip range: approx. 3500 rpm - Operating current: 0.4 - 0.6 A - Solenoid internal resistance: 25 ± 5 Ω (20°C) • **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 97. 3. Check the resonance flap's power supply. 4. Check the resonance flap solenoid and unit for damage. 5. Check the ECU.	O
TCU	P0702	TCU Fault	• **Actions** - Check DTC codes for TCU.	O
		Transmission Malfunction: Solenoid Valve Voltage	• **Actions** - Check DTC codes for TCU.	O
Auto Cruise Control	P0703	CAN Communication Fault: Stop Lamp Switch	• **Condition** - The brake switch is defective.	O
TCU	P0705	Transmission Malfunction: Shift Lever	• **Actions** - Check DTC codes for TCU.	O
	P0715	Transmission Malfunction: Vehicle Speed Sensor	• **Actions** - Check DTC codes for TCU.	O
	P0720	Transmission Malfunction: Faulty Speed to Output	• **Actions** - Check DTC codes for TCU.	O
	P0730	Transmission Malfunction: Hydraulic System	• **Actions** - Check DTC codes for TCU.	O
		Transmission Malfunction: Faulty Gear Recognition	• **Actions** - Check DTC codes for TCU.	O
	P0734	A/T Control Malfunction	• **Actions** - Check DTC codes for TCU.	O
	P0740	Transmission Malfunction: TCC Head Control	• **Actions** - Check DTC codes for TCU.	O
	P0743	Transmission Malfunction: Lockup Converter Clutch	• **Actions** - Check DTC codes for TCU.	O
	P0748	Transmission Malfunction: Modulator Pressure	• **Actions** - Check DTC codes for TCU.	O
	P0753	Transmission Malfunction: Solenoid Valve 1-2/4-5	• **Actions** - Check DTC codes for TCU.	O
	P0758	Transmission Malfunction: Solenoid Valve 2-3	• **Actions** - Check DTC codes for TCU.	O
	P0763	Transmission Malfunction: Solenoid Valve 3-4	• **Actions** - Check DTC codes for TCU.	O
	P0778	Transmission Malfunction: Transmission Pressure	• **Actions** - Check DTC codes for TCU.	O
	P0836	Transmission Malfunction: Transfer Case	• **Actions** - Check DTC codes for TCU.	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

New DTC

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Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Incorrect Coding	P1570	Immobilizer Not Coded	• **Actions** 1. Check the current coding using SCAN-100. 2. Check ECU and TCU. 3. Check the CAN line.	O
Throttle Body Control	P1590	Safety Fuel Shut-off Time Expired	• **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O
Starter Signal	P1609	Starter Signal Recognition Malfunction	• **Condition** - The starter signal is improperly recognized. • **Specification** - Over 9.6 V (for 1 seconds) • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 2. 2. Check the ECU.	O

MEMO

CDPF

TROUBLE DIAGNOSIS TABLE FOR CDPF 116

TROUBLE DIAGNOSIS TABLE FOR CDPF

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode	Engine CHECK Warning Lamp
P0425	Temperature Sensor #1 - Open/Short	- There is an electric problem in sensor. - The electric circuit has an open circuit. - The electric circuit has a short circuit to ground. - The electric circuit has a short circuit to battery. - The recycling mode cannot be activated. ※ Recycling mode: Recycling CDPF by combusting soot accumulated in CDPF						O
P0427	Temperature Sensor #1 - Low Input Value	- An error is generated which is related to input voltage of sensor (5V). - The temperature is below -16°C (min. temperature) or, - The sensor signal has a short circuit to ground.						
P0428	Temperature Sensor #1 - High Input Value	- The sensor signal has a short circuit to battery. - The temperature is over 846°C (max. temperature). - Check the wiring for open/short circuit.						
P0426	Temperature Sensor #1 - Noise in Input	- Noise is generated due to the poor contact of connector. - The temperature change of sensor is over 30°C. (It is to check whether there is noise in signal.)						
P0429	Temperature Sensor #1 - Poor Response	- The difference between the calcu-lated input temperature value and the value from sensor is over 30°C. - The change value of the air tempera-ture is below 3°C when not in recycling mode.						
P0435	Temperature Sensor #2 - Open/Short	- There is an electric problem in sensor. - The electric circuit has an open circuit. - The electric circuit has a short circuit to ground. - The electric circuit has a short circuit to battery. - The recycling mode cannot be activated.						O
P0437	Temperature Sensor #2 - Low Input Value	- The input voltage of sensor (5V) is abnormal. - The temperature is below -16°C (min. temperature) or, - The sensor signal has a short circuit to ground.						

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode	Engine CHECK Warning Lamp
P0438	Temperature Sensor #2 - High Input Value	- The input voltage of sensor (5V) is abnormal. - The temperature is over 846°C (max. temperature) or, - The sensor signal has a short circuit to battery. - If the temperature is at the max. limit, check wiring for short circuit.						
P0436	Temperature Sensor #2 - Noise in Input	- Noise is generated due to the poor contact of connector. - The temperature change of sensor is over 30°C. (It is to check whether there is noise in signal.)						
P0430	Temperature Sensor #2 - Poor Response	- Check the output difference between front and rear side of DOC. - Check condition for error: * Normal driving condition (non-recycling mode) * No error related to input/output * 255 seconds after initial engine starting - The difference betwee the actual output value and the calculated value is over 50°C. - Check the temperature sensor and replace if necessary.						
P0470	Differential Pressure Sensor - Max./ Min. Output	- Specification for output value of pressure sensor : 0.5 ~4.5V - The output value of sensor is over 4.5 V or below 0.5 V. - Check the pressure sensor wiring for open or short circuit.						O
P0471	Differential Pressure Sensor - Abnormal Differential Pressure	- The actual (measured) pressure difference (actual pressure) is different from the calculated pressure difference (pressure difference between front and rear side of CDPF). (Possible cause : malfunctioning pressure sensor, leakage in pressure tube, parts removed)						O
P0475	CDPF - Pressure Leakage	- There is pressure leakage at front or rear side of CDPF. - The pressure is dropped below -15 Kpa for over 10 seconds due to soot.						O
P0432	CDPF - Excessive Soot Accumulated	- The pressure is over 23 Kpa for over 960 seconds due to the resistance by soot. - If P0432 is generated without error in pressure sensor, the torque is reduced. - Remove CDPF and clean it by blowing it from the opposite side of discharged side. Then, install it again and check it for soot.	O					O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immedi-ately Engine Stop	Limp Home Mode	Engine CHECK Warning Lamp
P1430	CDPF - Soot Accumulated Over the Limit	- The recycling mode cannot be activated. - The pressure is over 23 Kpa for over 960 seconds due to the resistance by soot. - When the engine CHECK warning lamp flashes, drive the vehicle at over 50 km/h for 20 minutes so that the soot in CDPF is combusted.						Flashing
P0431	DOC Tempera-ture Measured Value - Too Low	- The measured DOC temperature is below the limit for recycling (below 0.5 times). - Cause: Old/worn DOC - The recycling mode cannot be activated.						O
P1432	Torque Reduc-tion Mode	- Operating condition : When the amount of soot is over the specified range (P1430 error stored) and the recycling mode cannot be operated (related error occurred), the torque reduction mode is activated so that the driver let the system in-spected as soon as possible. - In operation: torque reduction, engine CHECK warning lamp ON	O					O
P1407	Throttle Valve Vacuum Modulator - Open/Short	- The vacuum modulator of throttle valve has an electrical problem. - The electric circuit has an open circuit. - The electric circuit has a short circuit to ground. - The electric circuit has a short circuit to battery.						O
P0488	Throttle Valve - Seized	- The vacuum modulator of throttle valve has an open circuit. - The throttle valve is seized (mechanically). - Check condition for seizing: * No error in HFM and EGR * Engine running						O
P242F	Change Interval for CDPF Filter - Warning	- The vehicle is driven for approx. 500,000 km (CDPF change interval).						O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

TCU

TABLE OF CONTENTS

DIAGNOSTIC TROUBLE CODES FOR ION (BTRA) AUTO TRANSMISSION ... 3
DIAGNOSIS TROUBLE CODE OF DC5AT 13

DIAGNOSTIC TROUBLE CODES FOR ION (BTRA) AUTO TRANSMISSION

DTC Code	Defective	Cause and Action
P0707	Low gear position sensor input	Cause: - Gear position sensor signal of the inhibitor switch is lower than the normal value (defective gear position sensor) - Specified value of gear position sensor signal: 0.87 V Symptom: - Cannot shift to 1st, 3rd and 4th gear. - Torque converter clucth stops from its operation. Action: - Check gear position sensor for short to ground. - Check inhibitor switch and TCU connector for proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P0708	High gear position sensor input	Cause: - Gear position sensor signal of the inhibitor switch is higher than the normal value (defective inhibitor switch) - Specified value of inhibitor switch: 4.12 V Symptom: - Cannot shift to 1st, 3rd and 4th gear position. - Torque converter clucth stops from its operation. Action: - Check gear position sensor for short to B+. - Check inhibitor switch and TCU connector for proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P0741	Torque converter clutch cannot be engaged	Cause: - Torque conver clutch cannot be engaged even when solenoid valve (S7) is operated. - The rpm of engine and output shaft is not consistent with the selected shift's gear ratio. • Allowable slip rpm of torque converter:100 rpm Symptom: - Torque converter clutch cannot be locked Action: - Check solenoid valve (S7) wiring for short to ground or open circuit. - Replace solenoicd valve (S7) if necessary. - Check T/M connector TCU connector for their proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.

DTC Code	Defective	Cause and Action
P0742	Torque converter clutch engaged	Cause: - Torque conver clutch is engaged when solenoid valve (S7) is not operated. - The rpm of engine and output shaft is not consistent with the characteristic under the condition with torque converter not engaged. • Allowable slip rpm of torque converter < 50 rpm Symptom: - Torque converter clutch is locked. Action: - Check solenoid valve (S7) wiring for short to B+. - Replace solenoicd valve (S7) if necessary. - Check T/M connector TCU connector for their proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P0710	Defective T/M oil temperature sensor	Cause: - Oil temperature of T/M exceeds the specified value. • Oil temperature sensor voltage > 4.88 V • Oil temperature sensor voltage < 0.21 V Symptom: - Oil temperature is fixed to 120°C - Shifting impression is poor. Action: - Check T/M oil temperature sensor for short or open circuit. - Check T/M connector and TCU connector for proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds.
P0790	Defective W/N/P mode switch	Cause: - The W/N/P mode switch's connection is intermittently disconnected (the input of the mode switch changes rapidly). Symptom: - The switch is fixed to normal mode. Action: - Check W/N/P mode switch input circuit for short or open circuit. - Check W/N/P mode switch wiring. - Replace W/N/P mode switch if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC Code	Defective	Cause and Action
P1703	Abnormal engine rpm (CAN)	Cause: - The engine rpm signal (CAN) is out of specified value or there is no engine rpm signal. • Engine rpm < 0 rpm • Engine rpm > 7000 rpm Symptom: - The engine rpm corresponding to the max. engine torque is applyed to the shifting condition. Action: - Check ECU and TCU connectors for poor contact. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds.
P1704	Abnormal output shaft rpm (CAN)	Cause: - The output shaft signal (CAN) is out of specified value or there is no output shaft signal. • Output shaft rpm < 0 rpm • Output shaft rpm > 9000 rpm - The actual vehicle speed is 0 while other signals indicate that vehicle is moving. Symptom: - Cannot shift down by limiting the engine rpm to prevent the engine from overrunning. Action: - Check ECU and TCU connectors for poor contact. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds and the rpm is over 0.
P1708	Low TCU supply voltage	Cause: - The TCU supply voltage is low or there is no measured voltage value. Symptom: - Cannot shift to 1st gear position. - Cannot shift to other gear positions due to the low supply voltage. - No. 6 solenoid valve (S6) stops from its operation. Action: - Check TCU terminal for poor contact, bending or deformation. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P1709	High TCU supply voltage	Cause: - The TCU supply voltage is high. • TCU supply voltage > 16.5 V Symptom: - All solenoid valves stop from their operation when high battery voltage is detected. - Enters into the emergency mode. Action: - Check TCU terminal for short to B+ or short to ground. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.

DTC Code	Defective	Cause and Action
P1713	Defective accelerator pedal signal (CAN)	Cause: - The accelerator pedal signal (CAN) is out of the specified value. • Accelerator pedal signal < 0 % • Accelerator pedal signal > 100 % Symptom: - Cannot shift to 4th gear position. - Torque converter clucth stops from its operation. - The interior default value is applied for shift determination (if the accelerator pedal signal is defective, ECU selects the default value and sends it and error message to TCU via CAN line). - The accelerator pedal signal is not used for P, R, N B2. Action: - Check ECU and TCU connectors for poor contact and their terminals for bend or deformation. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P1714	Defective vehicle coding	Cause: - The vehicle coding stored in EEPROM is defective (self-test when IGN ON). Symptom: - Determines the vehicle coding value via CAN communication or selects 0 for the coding value. - Shifting impression is poor. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1715	Abnormal VPS offset	Cause: - VPS (Variable pressure solenoid valve) is used for controlling clutch and band pressure while shifting. - The VPS offset stored in EEPROM is incorrect (self-test when IGN ON). • VPS offset > 120 mA Symptom: - Shifting impression is poor. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1717	Defective RAM	Cause: - RAM operates abnormally. (self-test when IGN ON) Symptom: - No output signal. - Enters into the emergency mode. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1718	Defective ROM	Cause: - The program memory is defective (self-test when IGN ON). - The calculated checksum value is not consistent with the stored checksum value. Symptom: - No output signal. - Enters into the emergency mode. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

DTC Code	Defective	Cause and Action
P1719	Abnormal CAN communication	Cause: - Cannot use information necessary for TCU via CAN communication. Symptom: - The default value is used for all CAN signals. - Enters into the emergency mode. Action: - Check ECU and TCU connectors wiring for poor contact. - Check ECU and TCU connectors' terminals for bend or deformation. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P1720	Defective EEPROM	Cause: - EEPROM memory is defective. - The calculated checksum value is not consistent with the stored checksum value or the error occurs in EEPROM communication. (self-test when IGN ON) Symptom: - Determines the vehicle coding value via CAN communication or selects 0 for the coding value. - Shifting impression is poor. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1722	Incorrect vehicle model	Cause: - Cannot detect the vehicle coding through EEPROM or CAN communication. Symptom: - Selects 0 for the coding value. - Enters into the emergency mode. Action: - Check TCU connector and terminals for poor contact. - DTC disappears after turning ignition from OFF to ON.
P1733	No. 1 solenoid valve open	Cause: - The No. 1 solenoid valve operates with the No. 2 solenoid valve to control the oil flow for the 1-2 shift valve. - The No.1 solenoid valve internal circuit or solenoid valve wiring is open. - The solenoid valve connection is short to B+. Symptom: - The No. 1 solenoid valve is OFF. - Enters into the emergency mode. Action: - Check No. 1 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.1 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

DTC Code	Defective	Cause and Action
P1734	No. 2 solenoid valve open	Cause: - The No. 2 solenoid valve operates with the No. 1 solenoid valve to control the oil flow for the 2-3 shift valve. - The No. 2 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 2 solenoid valve is OFF. - Enters into the emergency mode. Action: - Check No. 2 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.2 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1735	No. 3 solenoid valve open	Cause: - The No. 3 solenoid valve operates with the No. 4 solenoid valve to shift smoothly and control the shifting order. - The No. 3 solenoid valve turns the clutch regulator valve ON and OFF. - The No. 3 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 3 solenoid valve is OFF. - Shifting impression is poor. Action: - Check No. 3 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.3 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC Code	Defective	Cause and Action
P1736	No. 4 solenoid valve open	Cause: - The No. 4 solenoid valve operates with the No. 3 solenoid valve to shift smoothly and control the shifting order. - The No. 4 solenoid valve turns the clutch regulator valve ON and OFF. - The No. 4 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 4 solenoid valve is OFF or ON. - Shifting impression is poor. Action: - Check No. 4 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.4 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1737	No. 5 solenoid valve open	Cause: - The No. 5 solenoid valve is a variable solenoid valve to change the pressure for shifting. - The No. 5 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 4 solenoid valve is always OFF. - Shifting impression is poor. Action: - Check No. 5 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 3.6 ~ 5.5Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.5 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1738	No. 6 solenoid valve open	Cause: - The No. 6 solenoid valve is used to set the hydraulic line pressure to HIGH/LOW level. - The No. 6 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The hydraulic line pressure is high. (No. 6 solenoid valve stops its operation) - Cannot to shift to 1st gear position. Action: - Check No. 6 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 6 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

DTC Code	Defective	Cause and Action
P1739	No. 7 solenoid valve open	Cause: - The No. 7 solenoid valve controls the operation of the torque converter clutch. - The No. 7 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 7 solenoid valve stops its operation (OFF). - The torque converter clutch cannot be locked. Action: - Check No. 7 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 7 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1741	No. 1 solenoid valve short	Cause: - The No. 1 solenoid valve operates with the No. 2 solenoid valve to control the oil flow for the 1-2 shift valve. - The No. 1 solenoid valve circuit is short to ground. Symptom: - The No. 1 solenoid valve is OFF. - Enters into the emergency mode. Action: - Check No. 1 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.1 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1742	No. 2 solenoid valve short	Cause: - The No. 2 solenoid valve operates with the No. 1 solenoid valve to control the oil flow for the 2-3 shift valve. - The No. 2 solenoid valve circuit is short to ground. Symptom: - The No. 2 solenoid valve is OFF. - Enters into the emergency mode. Action: - Check No. 2 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 2 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC Code	Defective	Cause and Action
P1743	No. 3 solenoid valve short	Cause: - The No. 3 solenoid valve operates with the No. 4 solenoid valve to shift smoothly and control the shifting order. - The No. 3 solenoid valve turns the clutch regulator valve ON and OFF. - The No. 3 solenoid valve circuit is short to ground. Symptom: - The No. 3 solenoid valve is OFF. - Shifting impression is poor. Action: - Check No. 3 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 3 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1744	No. 4 solenoid valve short	Cause: - The No. 4 solenoid valve operates with the No. 3 solenoid valve to shift smoothly and control the shifting order. - The No. 4 solenoid valve turns the clutch regulator valve ON and OFF. - The No. 4 solenoid valve circuit is short to ground. Symptom: - The No. 4 solenoid valve is OFF. - Shifting impression is poor. Action: - Check No. 4 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 4 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1745	No. 5 solenoid valve short	Cause: - The No. 5 solenoid valve is a variable solenoid valve to change the pressure for shifting. - The No. 5 solenoid valve circuit is short to ground. Symptom: - The No. 4 solenoid valve is always OFF. - Shifting impression is poor. Action: - Check No. 5 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 3.6 ~ 5.5Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.5 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

DTC Code	Defective	Cause and Action
P1746	No. 6 solenoid valve short	Cause: - The No. 6 solenoid valve is used to set the hydraulic line pressure to HIGH/LOW level. - The No. 6 solenoid valve circuit is short to ground. Symptom: - The hydraulic line pressure is high. (No. 6 solenoid valve stops its operation) - Cannot to shift to 1st gear position. Action: - Check No. 6 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value : 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 6 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1747	No. 7 solenoid valve short	Cause: - The No. 7 solenoid valve controls the operation of the torque converter clutch. - The No. 7 solenoid valve circuit is short to ground. Symptom: - The No. 7 solenoid valve stops its operation (OFF). - The torque converter clutch cannot be locked. Action: - Check No. 7 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 7 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DIAGNOSIS TROUBLE CODE OF DC5AT

Trouble Code	Defectives	Action
P2000	Faulty TCU internal watchdog test	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2001	Faulty TCU internal watchdog function	• Self-diagnosis. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2002	Faulty TCU external watchdog test	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2003	Faulty TCU external watchdog function	• Self-diagnosis. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2004	Faulty TCU Clock	• Self-diagnosis. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2005	Faulty TCU RAM	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2006	Faulty TCU RAM CAN-Controller 1	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2007	Faulty TCU RAM CAN-Controller 2	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2008	Faulty TCU ROM	• Self-diagnosis with IGN ON. • When the TCU internal checksum is different from scanner checksum. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P200A	Faulty TCU EEPROM	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P200B	Faulty TCU CPU (internal)	• Self-diagnosis. • Check harness contact.
P200C	Faulty TCU program control	• Self-diagnosis. • Check harness contact.
P2010	No TCU variant coding	• Self-diagnosis with IGN ON. • When the TCU coding is not exist. • Check again after TCU coding.

Trouble Code	Defectives	Action
P2011	Faulty TCU variant coding	• Self-diagnosis with IGN ON. • When the TCU coding is faulty. • Check again after TCU coding.
P2012	Faulty TCU checksum	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2013	Faulty TCU (internally)	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2100	Defective 1-2, 4-5 shift solenoid valve	• When 1-2 or 4-5 shift solenoid valve is defective. • Measure the resistance of 1-2 or 4-5 shift solenoid valve (turn the IGN OFF, then and disconnect TCU connector). - TCU connector terminals: B12 (14), B3 (38) - Specified value: 3.8 ± 0.2 Ω • Triggered emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2101	1-2, 4-5 shift solenoid valve - short	• When 1-2 or 4-5 shift solenoid valve is defective. • Measure the resistance of 1-2 or 4-5 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B12 (14), B3 (38) - Specified value: 3.8 ± 0.2 Ω • Triggered emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2102	Defective 2-3 shift solenoid valve	• When 2-3 shift solenoid valve is defective. • Measure the resistance of 2-3 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B12 (14), B3 (38) - Specified value: 3.8 ± 0.2 Ω • Triggered emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2103	2-3 shift solenoid valve - short	• When 2-3 shift solenoid valve is defective. • Measure the resistance of 2-3 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B12 (14), B3 (38) - Specified value: 3.8 ± 0.2 Ω • Triggered mechanical emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.

Trouble Code	Defectives	Action
P2104	Defective 3-4 shift solenoid valve	• When 3-4 shift solenoid valve is defective. • Measure the resistance of 3-4 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B11 (15), B3 (38) - Specified value: 3.8 ± 0.2 Ω • Triggered mechanical emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2105	3-4 shift solenoid valve - short	• When 3-4 shift solenoid valve is defective. • Measure the resistance of 3-4 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B11 (15), B3 (38) - Specified value: 3.8 ± 0.2 Ω • Triggered mechanical emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2106	Defective lockup clutch solenoid valve	• Measure the resistance of lockup clutch solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B9 (17), B3 (38) - Specified value: 2.5 ± 0.2 Ω • Triggered emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2107	Defective modulator pressure solenoid valve	• Measure the resistance of modulator pressure solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B5 (36), B3 (38) - Specified value: 5.0 ± 0.2 Ω • Triggered emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2108	Defective shift pressure solenoid valve	• Measure the resistance of shift pressure solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B4 (37), B3 (38) - Specified value: 5.0 ± 0.2 Ω • Triggered emergency mode when the defective is detected. - Electrical error: Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.

Trouble Code	Defectives	Action
P2200	Faulty speed sensor N2 signal	• When the speed sensor N2 detects 0 rpm of front sun gear speed. • Check the related harness for open, short and contact. - TCU connector terminal B14: rectangular wave signal B8: signal ground B13: 6V
P2203	Faulty speed sensor N3 signal	• When the speed sensor N3 detects 0 rpm of planetary gear carrier speed. • Check the related harness for open, short and contact. - TCU connector terminal B6: rectangular wave signal B8: signal ground B13: 6V
P220A	Abnormal speed sensor output signal (N2, N3)	• When the rpm difference between speed sensor N2 and N3 is over 150 rpm. • Check the related harness for open, short and contact.
P2220	T/M Oil temperature sensor - short	• Turn the IGN OFF, then disconnect TCU connector. • Selector lever position: R or D • T/M Measure the resistance of oil temperature sensor. • TCU connector terminals B7, B8 • Check the related harness for open, short and contact.
P2221	Abnormal T/M oil temperature sensor signal	• Turn the IGN OFF, then disconnect TCU connector. • Selector lever position: R or D • Measure the resistance of T/M oil temperature sensor. • TCU connector terminals: B7, B8 • Check the related harness for open, short and contact.
P2222	Abnormal T/M oil temperature sensor signal	• Turn the IGN OFF, then disconnect TCU connector. • Selector lever position : R or D • Measure the resistance of T/M oil temperature sensor. • TCU connector terminals: B7, B8 • Check the related harness for open, short and contact.
P2300	Faulty CAN communication	• Turn the IGN OFF, then disconnect TCU connector. • Check the communication line for open, short and contact. • Measure the resistance of CAN line: B1, B2 • Specified value : approx. 120 W
P2301	Faulty CAN communication	• Turn the IGN OFF, then disconnect TCU connector. • Check the communication line for open, short and contact. • Measure the resistance of CAN line: B1, B2 • Specified value : approx. 120 W
P2310	CAN: Faulty brake system communication	• Check CAN communication line H and L. • Check ABS/ESP unit. • Check the related harness for open, short and contact.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Defectives	Action
P2311	CAN: Faulty ECU communication	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2312	CAN: Faulty ECU communication	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2313	CAN: Faulty selector lever control communication	• Check CAN communication line H and L. • Check selector lever. • Check the related harness for open, short and contact.
P2315	CAN: Faulty instrument panel communication	• Check CAN communication line H and L. • Check instrument cluster. • Check the related harness for open, short and contact.
P2317	CAN: Faulty communication between TCCU/TOD and CAN (For 4WD only)	• Check CAN communication line H and L. • Check TCCU/TOD unit. • Check the related harness for open, short and contact.
P2330	CAN: Faulty brake system signal	• Check CAN communication line H and L. • Check ABS/ESP unit. • Check the related harness for open, short and contact.
P2331	CAN: Faulty ECU message	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2332	CAN: Faulty ECU message	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2333	CAN: Faulty selector lever signal	• Check CAN communication line H and L. • Check selector lever. Check selector lever. • Check the related harness for open, short and contact.
P2335	CAN: Faulty instrument cluster signal	• Check CAN communication line H and L. • Check instrument cluster. • Check the related harness for open, short and contact.
P2337	CAN: Faulty TCCU/TOD (For 4WD only)	• Check CAN communication line H and L. • Check TCCU/TOD unit. • Check the related harness for open, short and contact.
P2400	CAN: Faulty rear RH wheel speed sensor signal	• Check CAN communication line H and L. • Check ABS/ESP unit. - Check wheel speed sensor connector. - Check the air gap between tooth wheel and wheel speed sensor. (Air gap: 0.309 ~ 0.958 mm) - Check the numbers of tooth wheel: 48 • Check the related harness for open, short and contact.

Trouble Code	Defectives	Action
P2401	CAN: Faulty rear LH wheel speed sensor signal	• Check CAN communication line H and L. • Check ABS/ESP unit. - Check wheel speed sensor connector. - Check the air gap between tooth wheel and wheel speed sensor. (Air gap: 0.309 ~ 0.958 mm) - Check the numbers of tooth wheel: 48 • Check the related harness for open, short and contact.
P2402	CAN: Faulty front RH wheel speed sensor signal	• Check CAN communication line H and L. • Check ABS/ESP unit. - Check wheel speed sensor connector. - Check the air gap between tooth wheel and wheel speed sensor. (Air gap: 0.335 ~ 0.945 mm) - Check the numbers of tooth wheel: 48
P2403	CAN: Faulty front LH wheel speed sensor signal	• Check CAN communication line H and L. • Check ABS/ESP unit. - Check wheel speed sensor connector. - Check the air gap between tooth wheel and wheel speed sensor. (Air gap: 0.335 ~ 0.945 mm) - Check the numbers of tooth wheel: 48
P2404	CAN: No brake signal	• Check CAN communication line H and L. • Check ABS/ESP unit. • Check the related harness for open, short and contact.
P2405	CAN: No accelerator pedal signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2406	CAN: No engine torque signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2407	CAN: No ESP signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2408	CAN: No minimum engine torque signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2409	CAN: No maximum engine torque signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P240A	CAN: No engine rpm signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.

Trouble Code	Defectives	Action
P240B	CAN: No engine coolant temperature signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P240C	CAN: No selector lever position signal	• Check CAN communication line H and L. • Check selector lever. • Check the related harness for open, short and contact.
P240D	CAN: No transfer case position signal (For 4WD only)	• Check CAN communication line H and L. • Check TCCU/TOD unit. • Check the related harness for open, short and contact.
P2500	Invalid transmission gear ratio	• Cycle the IGN switch from OFF to ON. Check A/T system again after a certain period of driving. • If the trouble still exists, replace A/T assembly. • To protect transmission, any shift is not available.
P2501	Excessive engine rpm	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2503	Faulty recognition of currently selected gear	• Check selector lever. • Check the related harness for open, short and contact.
P220B	Excessive N2, N3 rpm	• Check speed sensor N2 and N3.
P2510	Torque converter lockup clutch stuck	• Check the hydraulic lines for leaks (valve No.22 in valve body). • Check the resistance of lockup clutch solenoid valve (Turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals B9 (17), B3 (18) - Specified value : 2.5 ± 0.2 W • Triggered emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2511	Faulty torque converter lockup heat control	• Check the hydraulic lines for leaks.
P2520	Faulty recognition of torque reduction	• Check ECU.
P2502	Poor gear mesh, transmission slip	• Check the hydraulic lines for leaks. • Check oil filter.
P2600	Too low TCU supply voltage	• Check TCU supply voltage.
P2601	Too high TCU supply voltage	• Check TCU supply voltage.
P2602	Abnormal solenoid valve supply voltage	• Check solenoid supply voltage.
P2603	Abnormal speed sensor supply voltage	• Check speed sensor supply voltage. - TCU connector terminals B13 (13) : 6V

MEMO

BRAKE

TABLE OF CONTENTS

SELF-DIAGNOSIS LIST (ABS, ABD, ASR 5.3) 3
ABS/ESP TROUBLE DIAGNOSIS 13

SELF-DIAGNOSIS LIST (ABS, ABD, ASR 5.3)

Fault code	Defects	Application			Service hint
		ABS	ABD	ASR	
01	No defects	0	0	0	-
02	ECU	0	0	0	Internal fault of ECU. Replace the ECU.
03	Front/left speed sensor (defective wiring)	0	0	0	1. Check resistance between wiring harness and wheel speed sensor : 1.280KW - 1.920KW. 2. Check for wire ground and B+ OPEN. 3. If there is no defect on above, replace sensor.
04	Front/right speed sensor (defective wiring)	0	0	0	1. Check resistance between wiring harness and wheel speed sensor : 1.280KW - 1.920KW. 2. Check for wire ground and B+ OPEN. 3. If there is no defect on above, replace sensor.
05	Rear/left speed sensor (defective wiring)	0	0	0	1. Check resistance between wiring harness and wheel speed sensor : 1.280KW - 1.920KW. 2. Check for wire ground and B+ OPEN. 3. If there is no defect on above, replace sensor.
06	Rear/right speed sensor (defective wiring)	0	0	0	1. Check resistance between wiring harness and wheel speed sensor : 1.280KW - 1.920KW. 2. Check for wire ground and B+ OPEN. 3. If there is no defect on above, replace sensor.
07	Front/left speed sensor (defective wiring)	0	0	0	1. Check that connector pin arrangement on the relevant wire is correct. 2. Check for wire ground and B+ open. 3. Check air gap between wheel rotor and wheel speed sensor : 0.377 - 1.229 mm. 4. Check proper contact of wheel speed sensor connector and ECU connector. 5. Check sensor output voltage while shaking wiring harness by turning wheel 1/2 to 1 revolution per second (Voltage should be over 70mV when checked by multimeter and over 120mV/P-P when checked by oscilloscope). 6. If there is no defect on above, replace sensor.
08	Front/right speed sensor (abnormal signal)	0	0	0	1. Check that connector pin arrangement on the relevant wire is correct. 2. Check for wire ground and B+ open. 3. Check air gap between wheel rotor and wheel speed sensor : 0.377 - 1.229 mm. 4. Check proper contact of wheel speed sensor connector and ECU connector. 5. Check sensor output voltage while shaking wiring harness by turning wheel 1/2 to 1 revolution per second (Voltage should be over 70mV when checked by multimeter and over 120mV/P-P when checked by oscilloscope). 6. If there is no defect on above, replace sensor.
09	Rear/left speed sensor (abnormal signal)	0	0	0	1. Check that connector pin arrangement on the relevant wire is correct. 2. Check for wire ground and B+ open. 3. Check air gap between wheel rotor and wheel speed sensor : 0.369 - 1.213 mm. 4. Check proper contact of wheel speed sensor connector and ECU connector. 5. Check sensor output voltage while shaking wiring harness by turning wheel 1/2 to 1 revolution per second (Voltage should be over 70mV when checked by multimeter and over 120mV/P-P when checked by oscilloscope). 6. If there is no defect on above, replace sensor.

Fault code	Defects	Application			Service hint
		ABS	ABD	ASR	
10	Rear/right speed sensor (abnormal signal)	0	0	0	1. Check that connector pin arrangement on the relevant wire is correct. 2. Check for wire ground and B+ open. 3. Check air gap between wheel rotor and wheel speed sensor : 0.369 - 1.213mm 4. Check proper contact of wheel speed sensor connector and ECU connector. 5. Check sensor output voltage while shaking wiring harness by turning wheel 1/2 to 1 revolution per second (Voltage should be over 70mV when checked by multimeter and over 120mV/P-P when checked by oscilloscope). 6. If there is no defect on above, replace sensor.
11	Wheel rotor teeth	0	0	0	1. This code will appear if a wheel rotor teeth of four wheels is defective. 2. Check the teeth number of wheel rotor and condition.
13	Front/left inlet valve	0	0	0	1. If this code appear together with the items related with valve relay failure, check the items related with valve failure first and repair defective causes. 2. Check each valve using a over-riding function of tester on sole noid valve diagnosis function. 3. Replace hydraulic modulator.
14	Front/left outlet valve	0	0	0	↑
15	Front/right inlet valve	0	0	0	↑
16	Front/right outlet valve	0	0	0	↑
17	Rear/left inlet valve	-	0	0	↑
18	Rear/left outlet valve	-	0	0	↑
19	Rear/right inlet valve	-	0	0	↑
20	Rear/right outlet valve	-	0	0	↑
17	Rear axle inlet valve	0	-	-	↑
18	Rear axle outlet valve	0	-	-	↑
21	Switching valve	-	0	0	1. If this code appear together with the items related with valve relay failure, check the items related with valve failure first and repair defective causes. 2. Check each valve using a over-riding function of tester on sole noid valve diagnosis function. 3. Check contact of ECU and hydraulic modulator connectors and terminals. 4. Check terminals for open or short (When connector is removed). 5. Replace hydraulic modulator if there is no defect on above.

Reference

- Internal resistance of each solenoid valve on fault code 13-20; Inlet valve : 8.5-10W, outlet valve : 4.0-5.5W
- Internal resistance of each valve on fault code 21 and 22; ASV (prime) valve, USV (pilot) valve: 8.5-10.0W

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Fault code	Defects	Application			Service hint
		ABS	ABD	ASR	
22	Shut-off valve	-	0	0	1. If this code appear together with the items related with valve relay failure, check the items related with valve failure first and repair defective causes. 2. Check each valve using a over-riding function of tester on solenoid valve diagnosis function. 3. Check contact of ECU and hydraulic modulator connectors and terminals. 4. Check terminals for open or short (When connector is removed). 5. Replace hydraulic modulator if there is no defect on above.
24	Motor relay/ return pump	0	0	0	1. Check using a over-riding function of tester on pump motor diagnosis function 2. Check resistance between pump motor ground terminal and battery negative terminal : less than 15mW. 3. Check body ground point. 4. Check relay coil internal resistance:40-80W. 5. Replace hydraulic modulator if there is no defect on above.
27	Stop lamp switch	0	0	0	1. Check using stop lamp switch diagnosis function from sensor value output function of tester. 2. Check contact of stop lamp switch terminals on ECU connector. 3. Check other wires for open and short (more than 80% of ECU supply voltage). 4. Check stop lamp switch function and replace if defective (when switch knob (plunger) is pressed by 3mm, resistance between each switch end will be infinite and if not pressed, it will be less than 200mW). 5. Voltage on No.11 when brake pedal is depressed : 11-14V Voltage on No.4 when brake pedal is released : 11-14V
28	Battery voltage low	0	0	0	1. Check battery voltage. 2. Check resistance between relevant voltage terminal of connector and each battery terminal (positive & negative). 3. Check that normal voltage is applied on each pin on connector when ignition switch is turned 'ON' or 'OFF'. 4. Check 10A and 60A fuses for ABS. 5. Replace hydraulic modulator if there is no defect on above.
30	CAN signal (TCU)	-	-	0	1. Check related CAN line for open, short. 2. Check poor contact of related CAN connector. 3. ECU is defective, replace ECU .
31	EMS (Engine)	-	-	0	1. Check related CAN line for open, short. 2. Check poor contact of related CAN connector. 3. ECU is defective, replace ECU . 4. Check EMS using special tool of self-diagnosing.
33	CAN communication	-	-	0	1. Check related CAN line for open, short. 2. Check poor contact of related CAN connector. 3. ECU is defective, replace ECU .
34	Brake over heating	0	0	0	

ABS/ESP TROUBLE DIAGNOSIS

o: Applied x: N/A

<table>
<tr><th>Function</th><th>Defective Components</th><th>Trouble Code</th><th>Descriptions</th><th colspan="2">System</th></tr>
<tr><td rowspan="4">Sensor Monitoring</td><td>Front LH
Wheel speed sensor</td><td>C1011 (5011)
C1012 (5012)</td><td>Wheel speed sensor front left-electrical
Wheel speed sensor front left-other</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3">1. C1011 (5011)
<u>Cause</u>
- Defective front LH wheel speed sensor
- Short or poor contact wire to sensor
<u>Action</u>
- Check the wheel speed sensor connector
- Check HECU connector
- Check the harness connection
2. C1012 (5012)
<u>Cause</u>
- Defective front LH wheel speed sensor
- No signals from wheel speed sensor and tooth wheel
- Too large air gap between wheel speed sensor and tooth wheel
- Different number of teeth in tooth wheel
<u>Action</u>
- Check the wheel speed sensor connector
- Check HECU connector
- Check air gap and tooth wheel mounting (Specified air gap: 0.335 ~ 0.945 mm)
- Check the number of teeth (48) in tooth wheel</td><td>O</td><td>O</td></tr>
<tr><td>Front RH
Wheel speed sensor</td><td>C1021 (5021)
C1022 (5022)</td><td>Wheel speed sensor front right-electrical
Wheel speed sensor front right-other</td><td></td><td></td></tr>
<tr><td colspan="3">1.C1021 (5021)
<u>Cause</u>
- Defective front RH wheel speed sensor
- Short or poor contact wire to sensor
<u>Action</u>
- Check the wheel speed sensor connector
- Check HECU connector
- Check the harness connection
2.C1022 (5022)
<u>Cause</u>
- Defective front RH wheel speed sensor
- No signals from wheel speed sensor and tooth wheel
- Too large air gap between wheel speed sensor and tooth wheel
- Different number of teeth in tooth wheel
<u>Action</u>
- Check the wheel speed sensor connector and HECU connector
- Check air gap and tooth wheel mounting (Specified air gap: 0.335 ~ 0.945 mm)
- Check the number of teeth (48) in tooth wheel</td><td>O</td><td>O</td></tr>
</table>

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

<table>
<tr><th>Function</th><th>Defective Components</th><th>Trouble Code</th><th>Descriptions</th><th colspan="2">System</th></tr>
<tr><td rowspan="6">Sensor Monitoring</td><td>Rear RH
Wheel speed sensor</td><td>C1031 (5031)
C1032 (5032)</td><td>Wheel speed sensor rear left-electrical
Wheel speed sensor rear left-other</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3">1. C1031 (5031)
<u>Cause</u>
- Defective rear RH wheel speed sensor
- Short or poor contact wire to sensor
<u>Action</u>
- Check the wheel speed sensor connector
- Check the HECU connector
- Check the harness connection
2. C1032 (5032)
<u>Cause</u>
- Defective rear RH wheel speed sensor
- No signals from wheel speed sensor and tooth wheel
- Too large air gap between wheel speed sensor and tooth wheel
- Different number of teeth in tooth wheel
<u>Action</u>
- Check the wheel speed sensor connector
- Check the HECU connector
- Check air gap and tooth wheel mounting (Specified air gap: 0.309 ~ 0.958 mm)
- Check the number of teeth (48) in tooth wheel</td><td>O</td><td>O</td></tr>
<tr><td>Rear LH
Wheel speed sensor</td><td>C1041 (5041)
C1042 (5042)</td><td>Wheel speed sensor rear left-electrical
Wheel speed sensor rear left-other</td><td></td><td></td></tr>
<tr><td colspan="3">1. C1041 (5041)
<u>Cause</u>
- Defective rear LH wheel speed sensor
- Short or poor contact wire to sensor
<u>Action</u>
- Check the wheel speed sensor connector
- Check the HECU connector
- Check the harness connection
2. C1042 (5042)
<u>Cause</u>
- Defective rear LH wheel speed sensor
- No signals from wheel speed sensor and tooth wheel
- Too large air gap between wheel speed sensor and tooth wheel
- Different number of teeth in tooth wheel
<u>Action</u>
- Check the wheel speed sensor connector and HECU connector
- Check air gap and tooth wheel mounting (Specified air gap: 0.309 ~ 0.958 mm)
- Check the number of teeth (48) in tooth wheel</td><td>O</td><td>O</td></tr>
</table>

Function	Defective Components	Trouble Code	Descriptions	System	
Sensor Monitoring	**Pressure sensor**	C1051 (5051)	Defective input sensor	**ABS**	**ESP**
	Cause - Abnormal signals from pressure sensor - Defective pressure sensor or harness **Action** - Check the pressure sensor connector			**X**	**O**
	Steering wheel angle sensor	C1061 (5061)	Defective steering wheel angle sensor		
	Cause - Internally defective steering wheel angle sensor - Abnormal signals from steering wheel angle sensor - Short circuit between supplying voltage output and ground - Abnormal signal voltage from steering wheel angle sensor - Poor installation of steering wheel angle sensor and abnormal signal **Action** - Check the supplying voltage: (Specified voltage: 9 ~ 16 V) - Check the output voltage: Check voltage between ESP unit terminals with ignition ON • ST1 voltage check: between ESP unit terminal No. 5 and ground (Specified voltage: 1.3 ~ 4.1V) • ST2 voltage check: between ESP unit terminal No. 2 and ground (Specified voltage: 1.3 ~ 4.1V) • STN voltage check: between ESP unit terminal No.12 and ground (Specified voltage: 1.3 ~ 4.1V)			**X**	**O**
	Sensor cluster	C1073 (5073) C1074 (5074)	Sensor cluster -electrical Sensor cluster-internal		
	1. C1073 (5073) **Cause** - Operating voltage exceeds specified range (Hi: 18.0 ± 1.0 V / Lo: 6.5 ± 0.5 V) - Poor contact or installation of harness **Action** - Check the sensor cluster connector - Replace the sensor cluster **2. C1074 (5074)** **Cause** - Internally defective HECU - Abnormal A/D converter voltage: 5.0 ± 3 % - Abnormal supplying voltage (4.580 ~ 4.960 V) to sensor cluster → Short circuit between supplying voltage output of sensor cluster and ground - Poor ground of sensor cluster (0.0 ~ 0.5 V) → Short to ground on sensor cluster - Abnormal signals from lateral acceleration sensor - Abnormal signals from yawing sensor - Poor installation of sensor - Defective sensor cluster - Defective or short circuit of CAN communication line **Action** - Replace the sensor			**X**	**O**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Function	Defective Components	Trouble Code	Descriptions	System	
Battery Voltage Monitoring	**Battery**	C1101 (5101) C1102 (5102)	Battery under voltage Battery over voltage	**ABS**	**ESP**
	1. C1101 (5101) **Cause** - Low voltage out of specified range (9.7 ± 0.3 V) **Action** - Check the supplying voltage **2. C1102 (5102)** **Cause** - Over voltage out of specified range (18.0 ± 1.0 V) **Action** - Check the supplying voltage			**O**	**O**
Brake Monitoring	**Brake disc**	C1111 (5111)	Disk temperature is high		
	Cause - Overheated brake disk due to braking force: over 500°C **Action** - Stop driving for a period of time after turning off the ESP			**X**	**O**
	Brake lamp switch **ESP OFF switch**	C1201 (5201) C1202 (5202)	Defective brake lamp switch Defective ESP OFF switch		
	1. C1201 (5201) **Cause** - Mechanical defective in brake switch - Defective brake switch harness **Action** - Check the harness and connector **2. C1202 (5202)** **Cause** - Mechanical defective in ESP OFF switch - Defective ESP OFF switch harness (short to ground) **Action** - Check the harness and connector for ESP OFF switch			**X**	**O**
Valve Monitoring	**Valve, valve relay**	C1301 (5301)	Defective valve, valve relay in HECU		
	Cause - Abnormal supplying voltage to valve solenoid - Internally defective HECU **Action** - Replace the HECU - Check the battery voltage - Check the HECU connector			**O**	**O**

Function	Defective Components	Trouble Code	Descriptions	System	
Pump Monitoring	**Motor pump**	C1302 (5302)	Defective motor pump	**ABS**	**ESP**
	Cause - Too low (below 6.0 V) or no supplying voltage to pump motor - Over 0.93 V from pump motor voltage - Poor contact in pump motor connector - Poor ground **Action** - Check the supplying voltage - Check the HECU connector - Replace the HECU			**O**	**O**
HECU and Sensor Monitoring	**HECU**	C1401 (5401)	HECU hardware		
	Cause - Internally defective HECU - Defective A/D converter, internal voltage regulator, and controller - Defective sensor and short to supplying voltage line - Abnormal temperature sensor signal **Action** - Replace the HECU			**O**	**O**
	Sensor initialization	C1501 (5501)	Abnormal sensor initialization		
	Cause - Abnormal signals from sensors - Abnormal sensor data **Action** - Check the sensors - Initialize the sensors			**O**	**O**
	Vehicle coding	C1170 (5170)	Variant coding error, or misinstallation HECU		
	Cause - Discrepancy between HECU coding and vehicle coding - Defective CAN communication line - Misinstallation HECU **Action** - Check the HECU coding and vehicle coding - Perform vehicle coding - Replace the exact HECU - Check engine ECU variant coding			**(O)**	**O**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Function	Defective Components	Trouble Code	Descriptions	System	
	CAN communication	C1601 (5601)	CAN communication error	**ABS**	**ESP**
	Cause - Short or open to CAN communication line - Poor connection of CAN communication line **Action** - Check the CAN communication line - Check the HECU connector			**(O)**	**O**
	CAN communication	C1602 (5602) C1603 (5603) C1604 (5604) C1605 (5605)	Communication error between engine ECU and HECU Communication error between TCU and HECU Communication error between TCCU (4WD) and HECU Communication error between cluster (Meter) and HECU		
	1. C1602 (5602) **Cause** - Short to CAN communication line - Overload to CAN communication Action **Action** - Check the engine ECU - Check the CAN communication line - Check the engine ECU connector **2. C1603 (5603)** **Cause** - Short to CAN communication line - Overload to CAN communication Action **Action** - Check the TCU - Check the CAN communication line - Check the TCU connector **3. C1604 (5604)** **Cause** - Short to CAN communication line - Overload to CAN communication Action **Action** - Check the TCCU - Check the CAN communication line - Check the TCCU connector **4. C1605 (5605)** **Cause** - Short to CAN communication line - Overload to CAN communication Action **Action** - Check the cluster (meter) - Check the CAN communication line - Check the cluster (meter) connector			**X**	**O**

Function	Defective Components	Trouble Code	Descriptions	System	
CAN Communication Monitoring	**CAN signal error EMS**	C1612 (5612)	Signal from engine ECU is abnormal	**ABS**	**ESP**
	Cause - Engine ECU is defective - Signal from engine ECU error **Action** - Check engine ECU - Check ECU S/W version			**X**	**O**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

AIR-BAG

TABLE OF CONTENTS

DIAGNOSIS (SRE-6) 3
DIAGNOSTIC TROUBLE CODES (SRE-6) 4
DIAGNOSIS (SRE-NCS) 7

DIAGNOSIS (SRE-6)

Possible Cause		Action	
Ignition “ON” Check warning lamp on I/P	Does the warning lamp blink at seven times for 7 seconds and then turn off?	Yes	System OK
		No	Connect the scan tool to diagnostic connector (ALDL). Select the fault code display menu and clear code menu.
	Does the fault code display on the scan tool display?	Yes	Perform “Diagnostic System Check”.
		No	Check any fuse open. Replace fuse.
	Is there any open in fuse?	Yes	Disconnect wiring connector.
		No	Check any wiring short between fuse and wiring connector.
	Is there any short in fuse?	Yes	Repair wiring.
		No	Disconnect SDM wiring connector. Check wiring short between connector terminal and SDM connector terminal.
	Is there any short in wiring?	Yes	Replace airbag wiring.
		No	Check any open between ALDL connector No.4, No. 5 terminal and ground.
	Is there any open in wiring?	Yes	Repair wiring
		No	Ignition “ON” Measure voltage at the cigar lighter socket.
	Does the voltage indicate 11 ~ 14 V?	Yes	Check any open or short between ALDL connector terminal and wiring connector terminal.
		No	Repair the wiring of the cigar lighter socket.
	Is there any open or short in wiring?	Yes	Repair wiring
		No	Check any open or short between SDM connector terminal and wiring connector terminal.
	Is there any open or short in wiring?	Yes	Replace the airbag wiring.
		No	Replace the SDM.

DIAGNOSTIC TROUBLE CODES (SRE-6)

Code	Fault Contents	Check
01h	Driver airbag circuit, resistance too high	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
02h	Driver airbag circuit, resistance too low	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
03h	Driver airbag circuit, short to ground	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
04h	Driver airbag circuit, short to battery voltage	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
05h	Passenger airbag circuit, resistance too high	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
06h	Passenger airbag circuit, resistance too low	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
07h	Passenger airbag circuit, short to ground	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
08h	Passenger airbag circuit, short to battery voltage	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
09h	Driver pretensioner circuit, resistance too high	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.
0Ah	Driver pretensioner circuit, resistance too low	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.
0Bh	Driver pretensioner circuit, short to ground	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.
0Ch	Driver pretensioner circuit, short to battery voltage	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.

Code	Fault Contents	Check
0Dh	Passenger pretensioner circuit, resistance too high	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
0Eh	Passenger pretensioner circuit, resistance too low	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
0Fh	Passenger pretensioner circuit, short to ground	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
10h	Passenger pretensioner circuit, short to battery voltage	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
34h	Driver side airbag circuit, resistance too high	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
35h	Driver side airbag circuit, resistance too low	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
36h	Driver side airbag circuit, short to ground	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
37h	Driver side airbag circuit, short to battery voltage	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
38h	Passenger side airbag circuit, resistance too high	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
39h	Passenger side airbag circuit, resistance too low	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
3Ah	Passenger side airbag circuit, short to ground	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
3Bh	Passenger side airbag circuit, short to battery voltage	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
50h	Driver side airbag sensor, open/short to battery voltage	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.
51h	Passenger side airbag circuit, short to ground	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.

Code	Fault Contents	Check
52h	Communication malfunction of the driver side airbag	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.
53h	Internal fault of the driver side airbag sensor	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.
54h	Passenger side airbag sensor, open/short to battery voltage	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
55h	Passenger side airbag sensor, short to ground	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
56h	Communication malfunction of the passenger side airbag	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
57h	Internal fault of the passenger side airbag sensor	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
17h	Battery voltage too high	Check generator output voltage. Check the battery voltage. Check the bending of the airbag terminal.
18h	Battery voltage too low	Check generator output voltage. Check the battery voltage. Check the bending of the airbag terminal.
1Eh	SDM internal fault (Initialization fault)	Replace the SDM.
1Fh	SDM internal fault	Replace the SDM.

Notice

- ***Use only the scan tool to check the airbag module and the sensing and diagnostic module (SDM). Never measure the resistance of an airbag module with an ohmmeter. An ohmmeter's battery can deploy the airbag and cause injury.***
- ***Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.***
- ***Do not attempt to repair the supplemental inflatable restraints (SIR) wiring harness. An SIR repair can create a high-resistance connection which can keep the airbags from deploying when needed, resulting in injury.***

DIAGNOSIS (SRE-NCS)

Trouble Code	Defections	Action
1101	High battery voltage	• Check alternator output voltage. • Check battery condition (over 21.4 V for 16 seconds). • Check air bag unit terminals for damage.
1102	Low battery voltage	• Check alternator output voltage. • Check battery condition (below 7.2 V for 16 seconds, resumes when the voltage is normal level for 9.6 seconds) • Check air bag unit terminals for damage.
1103	Low communication voltage for curtain air bag sensor	• Check curtain air bag sensor connector. • Check curtain air bag sensor wiring. • Check air bag unit terminals for damage. • Check if curtain air bag sensor is short to battery voltage or ground. • Check if curtain air bag sensor is defective. • Check battery condition (below 10.6 V for 16 seconds, resumes when the voltage is normal level for 9.6 seconds).
1346	Driver's air bag circuit resistance is too high	• Check driver air bag connector. • Check driver air bag wiring (including clock spring). • Check air bag unit terminals for damage. • Resistance of squib: over 6.1 Ω
1347	Driver's air bag circuit resistance is too low	• Check driver air bag connector. • Check driver air bag connector (including clock spring). • Check air bag unit terminals for damage. • Resistance of squib: below 1.1 Ω
1348	Driver's air bag circuit is short to ground	• Check driver air bag connector. • Check driver air bag wiring (including clock spring). • Check air bag unit terminals for damage. • Resistance of Firing Loop: below 2 kΩ
1349	Drivers air bag circuit is short to battery voltage	• Check driver air bag connector. • Check driver air bag wiring (including clock spring). • Check the air bag unit terminals for damage. • Resistance of Firing Loop: below 2 kΩ
1352	Passengers air bag circuit resistance is too low	• Check passenger air bag connector. • Check passenger air bag wiring. • Check the air bag unit terminals for damage. • Resistance of squib: below 0.8 Ω
1353	Passengers air bag circuit resistance is too high	• Check passenger air bag connector. • Check passenger air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.0 Ω
1354	Passengers air bag circuit is short to ground	• Check passenger air bag connector. • Check passenger air bag wiring. • Check the air bag unit terminals for damage. • Resistance of Firing Loop: below 2 kΩ

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Defections	Action
1355	Passenger's air bag circuit is short to battery voltage	• Check passenger air bag connector. • Check passenger air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1361	Driver's pretensioner circuit resistance is too high	• Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.2 Ω
1362	Driver's pretensioner circuit resistance is too low	• Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 0.8 Ω
1363	Driver's pretensioner circuit is short to ground	• Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1364	Driver's pretensioner circuit is short to battery voltage	• Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1367	Passenger's pretensioner circuit resistance is too high	• Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.2 W
1368	Passenger's pretensioner circuit resistance is too low	• Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 0.8 Ω
1369	Passenger's pretensioner circuit is short to ground	• Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1370	Passenger's pretensioner circuit is short to battery voltage	• Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1378	Driver's curtain air bag circuit resistance is too high	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check the air bag unit terminals for damage. • Resistance of squib: over 4.3 Ω
1379	Driver's curtain air bag circuit resistance is too low	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check the air bag unit terminals for damage. • Resistance of squib: below 0.6 Ω

Trouble Code	Defections	Action
1380	Driver's curtain air bag is short to ground	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1381	Driver's curtain air bag is short to battery voltage	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1382	Passenger's curtain air bag circuit resistance is too high	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.3 Ω
1383	Passenger's curtain air bag circuit resistance is too low	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 0.6 Ω
1384	Passenger's curtain air bag is short to ground	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1385	Passenger's curtain air bag is short to battery voltage	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1395	Air bag connector problem	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage.
1400	Driver's curtain air bag sensor problem	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage.
1401	Driver's curtain air bag sensor circuit is short to ground	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check the air bag unit terminals for damage. • Resistance: below 250 Ω
1402	Driver's curtain air bag sensor circuit is short to battery voltage	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 25 Ω
1409	Communication error in driver's curtain air bag	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • If the voltage drops below 10.6 V during normal system operation, the trouble code is generated. This trouble code is linked with B1 400, B1 401, B1 402, B1 414.

Trouble Code	Defections	Action
1414	Wrong driver's curtain air bag sensor	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage.
1403	Passenger's curtain air bag sensor	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage.
1404	Passenger's curtain air bag sensor circuit is short to ground	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 250 Ω
1405	Passenger's curtain air bag sensor circuit is short to battery voltage	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 25 Ω
1410	Communication error in passenger's curtain air bag	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check the air bag unit terminals for damage. • If the voltage drops below 10.6 V during normal system operation, the trouble code is generated. This trouble code is linked with B1 403, B1 404, B1 405, B1 415.
1415	Wrong driver's curtain air bag sensor	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage.
1620	SDM internal fault	• Replace SDM.
1650	Frontal impact record	• Replace SDM.
1651	Driver's curtain air bag impact record	• Replace SDM.
1652	Passenger's curtain air bag impact record	• Replace SDM.
1657	Belt pretensioner operation record	• Replace SDM.
2500	Warning lamp error	• Check wiring to warning lamp. • Check warning lamp bulb. • Check SDM unit terminal.

T/C

TABLE OF CONTENTS

GENERAL DIAGNOSIS (TOD) 3
DIAGNOSTIC TROUBLE CODE (TOD) 4
DIAGNOSIS (AWD) 6

GENERAL DIAGNOSIS (TOD)

Symptoms	Check	Action
Electric shift problems	• Faulty or damaged TCCU, speed sensor, motor, clutch or internal wirings	• Overhaul and check, replace if necessary
	• Damaged or worn shift cam, hub, fork and rail shift	• Overhaul and check for wear and damage.
	• Binding shift fork, hub collar or gear	• Check sliding parts, replace if necessary.
Cannot drive front wheel when shifting to 4H, 4L	• Broken drive chain	• Check internal parts and replace drive chain.
Noise in 4WD operation	• Improper or low oil	• Drain and replace with specified oil.
	• Loosened bolts or mounted parts	• Retighten as specified.
	• Noisy T/C bearing	• Disassemble bearings and parts and check for wear or damage. Replace if necessary.
	• Gear abnormal noise	• Check for wear and damage including speedometer gear. Replace if necessary.
Noise in 4H or 4L	• Worn or damaged sprockets or drive chain	• Disassemble and check for wear and damage. Replace if necessary.
	• Incorrect tire pressure	• Adjust tire pressure.
Transfer case oil leakage	• Cracked transfer case	• Replace the case.
	• Leakage from other parts	• Clean case and parts and check for leakage.
	• Breather clogging	• Remove breather hose and clean. Replace if necessary.
	• Improper or too much oil	• Use specified oil and adjust oil level.
	• Loosened sealing bolts	• Retighten.
	• Improperly applied sealant	• Use specified sealant and retighten.
	• Worn or damaged oil seal	• Replace oil seal.

TCCU periodically monitors the input and output while the system is in operation. When a fault is detected, the trouble code is stored into TCCU memory.

If the ignition switch is turned to “OFF”, TCCU stops monitoring for input and output, however, when the ignition switch is turned to “OFF” before shifting completes, TCCU continues monitoring for input and output required for the shifting.

DIAGNOSTIC TROUBLE CODE (TOD)

Code	Description	Action
P1806	Detective CAN commuication	• Check communication line. • Replace TCCU if necessary.
P1805	Defective mode switch	• When the mode switch is defective • Check TCCU pin No.4 and 16. • Mode change - 2H (Pin No. 4: Ground) - 4H (No contact: Open) - 4L (Pin No.16: Ground)
P1821	Open or short to ground in magnetic clutch coil circuit	• Voltage at TCCU pin No.11: 11 ~ 15 V • EMC resistance: 2.5 Ω • Check the relevant connectors for contact. • Replace TCCU if necessary.
P1822	Open or short to ground in hub control circuit	• When the hub control circuit is open or short to ground over 0.2 second • Replace TCCU if necessary.
P1841	Open to ground in shift motor circuit	• When TCCU detects the motor failure for 1 second • Check the relevant harnesses for contact. • Replace TCCU if necessary.
P1842	Short to ground in shift motor output circuit	• When TCCU detects the motor failure for 1 second • Check the relevant harnesses for contact. • Replace TCCU if necessary.
P1843	Defective position sensor in motor	• 2H-4H: after 1.5 seconds • 4H-4L: after 3 seconds • Check the relevant harnesses for contact. • Replace TCCU if necessary.
P1844	Stuck in 4L mode	• When no shifting operation from 4L to 4H, even though the shift conditions are satisfied and no error. • Replace TCCU if necessary.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Code	Description	Action
P1850	Defective position encoder	• When the position encoder is defective • Check the relevant harnesses. • Check the relevant connectors for contact. • Check the shift motor.
P1851	Short to ground for position encoder 1	• Short to ground for position encoder 1 in shift motor • Check the relevant harnesses for short. - TCCU pin No.18 • Check the relevant connectors for contact. • Check the shift motor.
P1852	Short to ground for position encoder 2	• Short to ground for position encoder 2 in shift motor • Check the relevant harnesses for short. - TCCU pin No.5 • Check the relevant connectors for contact. • Check the shift motor.
P1853	Short to ground for position encoder 3	• Short to ground for position encoder 2 in shift motor • Check the relevant harnesses for short. - TCCU pin No.19 • Check the relevant connectors for contact. • Check the shift motor.
P1854	Short to ground for position encoder 4	• Short to ground for position encoder 4 in shift motor • Check the relevant harnesses for short. - TCCU pin No.17 • Check the relevant connectors for contact. • Check the shift motor.
P1815	Abnormal CAN neutral signal	• No neutral signal from automatic transmission over 1 second through CAN. • Check CAN communication line. • Check TCU.

DIAGNOSIS (AWD)

Symptoms		Cause	Action
Noise	Noise in all ranges	- Low oil level	- Check major components (bearing surface) for excessive wear
			- Replenish oil
		- Improper oil	- Drain oil and replenish the specified oil
		- Worn or broken chain	- Replace chain or sprocket
	Growling	- Broken bearing	- Replace transfer case housing
		- Low oil level	- Check major components (bearing surface) for excessive wear
			- Replenish oil
	Noise when cornering	- Worn pinion gear teeth	- Replace differential carrier assembly
	Low frequency noise and vibration	- Missing shaft support snap ring	- Visually check the relevant parts for wear and replace if necessary
	Howling	- Abnormal friction in drive system	- Disassemble drive system, check rotating parts for wear and replace the worn parts.
Clunking	Clunking (when starting and stopping)	- Excessive backlash in T/C (over 3°)	- Check backlash and replace if necessary
		- Improper mounting	- Excessive backlash in drive system
			- Check drive system
		- Excessive backlash in other parts	- Excessive backlash in drive system
			- Check drive system
Undrivable	Cannot deliver forward/reverse driving force	- Worn or broken chain	- Replace chain or sprocket
		- Broken sprocket	- Replace chain or sprocket
		- Broken differential carrier	- Replace differential carrier assembly
		- Broken shaft	- Replace shaft
Binding	Dragging in front wheels or rear wheels	- Differential carrier stuck	- Replace differential carrier
Leakage	Leakage at transmission connection	- Damaged oil seal in T/C	- Replace oil seal
		- Clogged breather	- Check breather for clogging
			- Replace connecting hose
	Leakage at front and rear shafts	- Foreign material in oil seal	- Remove any foreign material, check oil seal for damage and replace oil seal
		- Broken oil seal	- Replace oil seal
		- Clogged breather	- Check breather for clogging
			- Replace connecting hose
	Leakage at case or cover body	- Cracked case or cover	- Replace transfer case
		- Air bubbles inside	
	Leakage at drain plug	- Bubbles no mounting bolt	- Replace drain plug
		- Uneven or missing plug coating	
	Leakage at filler plug	- Bubbles no mounting bolt	- Replace filler plug
		- Uneven or missing plug coating	
	Leakage at body connection	- Improperly applied sealant	- Disassembe T/C, apply sealant and reassemble it
		- Loose bolt around the leaking area	- Tighten to the specified torque

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

RK-STICS

TABLE OF CONTENTS

DIAGNOSIS TROUBLE CODE AND HELP TIPS 3

DIAGNOSIS TROUBLE CODE AND HELP TIPS

Fault Code	Malfunction	Descriptions
01	Dr Door Lock Knob	Driver's door lock knob is not operated when locking/unlocking doors.
02	Ps Door Lock Knob	Passenger's door lock knob is not operated when locking/unlocking doors.
03	Rr Door Lock Knob	Rear door lock knob is not operated when locking/unlocking doors.
04	T/Gate Lock Knob	Tailgate lock knob is not operated when locking/unlocking doors.
05	Door Lock Output	All door lock knob are not moved to lock position even when the door lock relay is activated.
06	Door Unlock Output	All door lock knob are not moved to unlock position even when the door unlock relay is activated.
07	C/DR Lock Output	Doors are locked by central door lock switch while the engine is running.
08	DR Lock Output	Doors are locked by driver's door lock switch while the engine is running.
09	PS Lock Output	Doors are locked by passenger's door lock switch while the engine is running.
10	Auto Door Lock Output	Door lock knob is not moved to lock position when the system outputs auto door lock signal while the ignition switch is in ON position and the vehicle speed is over 50 km/h.
11	Auto Door Unlock Output	Door lock knob is not moved to unlock position after receiving the output from collision sensor.
12	Wiper Output	The WIPER P-POS signal is not detected when the wiper relay is activated.
13	SPEED SIGNAL	The vehicle speed over 3 km/h is detected at the speed signal area while the ignition switch is in ON position and the alternator signal is "D" LOW.
14	INT WIPER Volume	The circuit is open (over 4.5 V) when changing the INT volume in the speed sensitive INT wiper (saved as history error).
15	SPEED SENSOR	The vehicle speed over 200 km/h is detected (saved as history error).
16	A/BAG COLLISION SENSOR INPUT	A signal is sent to the collision sensor input area while the ignition switch is in OFF position (saved as history error unconditionally).
17	A/BAG COLLISION SENSOR OUTPUT	The RKSTICS outputs UNLOCK signal after receiving collision sensor input while the ignition switch is in ON position (saved as history error).
18	A/BAG COLLISION MONITOR	The STICS outputs the Door Unlock signal due to the collision sensor and the feedback value is in proper range (saved as history error).
19	Door Ajar Warning IND	The door warning indicator blinks when the vehicle speed is over 10 km/h (saved as history error).
20	PARKING BRAKE IND	The parking brake indicator blinks when the vehicle speed is over 10 km/h (saved as history error).
21	Auto Washer Out	The auto washer output is not sent to the front washer (saved as history error).
22	WASHER RELAY	The front washer switch receives the input signal for more than 10 seconds (saved as history error).

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Fault Code	Malfunction	Descriptions
23	REMOCON VOLTAGE CHECK	The voltage from remote control key is saved as history error.
24	SBR S/BELT SW (Only EU)	When the seat belt switch circuit is OPEN (HIGH) in KEY OUT & ARMED MODE, the system recognizes it as FAIL and saves it as History error (Normal Close (GND)).
25	SBR SENSOR (Only EU)	When the sensor value is recognized in KEY OUT & ARMED MODE, the system saves it as History error.
26	SBR CONNECTION (Only EU)	When the seat belt switch circuit maintains OPEN (HIGH) in KEY OUT & ARMED MODE while the vehicle speed is over 50 km/h, the system saves it as History error.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

FFH

TABLE OF CONTENTS

DIAGNOSIS 3

▶ TROUBLE DIAGNOSIS 5

DIAGNOSIS

Trouble Code	Trouble Description	Remedies
0	No faults	-
10	Shutdown for overvoltage	Measure battery voltage (must be < 15.9V). Check alternator and overvoltage.
11	Shutdown for undervoltage	Measure battery voltage (must be > 10.2V under load). Check alternator, wiring and undervoltage.
12	Overheating (abnormal reference value)	Temperature at overheating sensor > 125°C: check cooling system. Check temperature sensor and overheating sensor, replace if necessary.
14	Overheating (difference evaluation-1)	Difference in temperature values between surface sensor and control overheating sensor is too large. (Prerequisite for this trouble code display is that the heater is in operation and the water temperature at the overheating sensor has reached min. 80°C): check cooling system. Check temperature sensor and overheating sensor, replace if necessary
15	Overheating (abnormal heater operation)	Heater does not operate (The controller is locked.) Delete trouble code to release controller lock: check cooling system. Check temperature sensor and overheating sensor, replace if necessary
16	Overheating (difference evaluation-2)	If the surface sensor has a far higher temperature value than the control overheating sensor, then the system proceeds with a fault shutdown.
17	Overheating (defective hardware-2)	Temperature at control overheating sensor > 130°C: check cooling system. Check temperature sensor and overheating sensor, replace if necessary.
20	Open glow plug circuit	Check plug cable for damage, replace if necessary
21	Overload or short circuit of glow plug	Check plug cable for damage, replace if necessary
22	Short circuit of glow plug	Check plug cable for damage, replace if necessary
23	-	-
24	-	-
25	Short circuit of communication line	Check the communication line.
30	Abnormal speed of combustion fan motor	Defective fan wheel or combustion air fan motor (frozen, contaminated, stiff, damaged cable)
31	Defective combustion fan motor	Check cable harness for damage, replace if necessary.
32	Overload or short circuit of combustion fan motor	Defective fan wheel or combustion air fan motor (contaminated, stiff) Check cable harness for damage, replace if necessary.
34	Abnormal output of combustion fan motor	Check the ground and short of combustion air fan motor circuit, replace if necessary.
36	-	-
38	-	-
39	-	-
41	Abnormal water pump operation	Check connector.
42	Overload or short circuit of water pump	Check connector.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Trouble Description	Remedies
43	Abnormal output of water pump	-
47	Overload or short circuit of fuel pump	Check cable harness for damage, replace if necessary.
48	Abnormal fuel pump operation	Check cable harness for damage, replace if necessary. Check plug-in connection, replace if necessary.
49	Short circuit of fuel pump (B+)	Check cable harness for open to battery voltage, replace if necessary.
50	Improper operation	The controller is locked due to excessive starting problem.
51	Delayed heating time	During start (no flame formed yet), the flame sensor reports temperature value too high for too long, check exhaust gas, combustion air and flame sensor.
52	Time exceeded for cold blowing	Check exhaust gas and combustion air. Check fuel quantity and fuel supply. Clean or replace filter in fuel pump.
53	Flame aborted from “large” stage	Fault (no more starting attempt allowed). Check exhaust gas and combustion air system. Check fuel quantity and fuel supply. Check flame sensor - see trouble code 64 and 65.
54	Flame aborted from “small” stage	Fault (no more starting attempt allowed). Check exhaust gas and combustion air system. Check fuel quantity and fuel supply. Check flame sensor - see trouble code 64 and 65.
60	Abnormal overheating sensor operation	Check cable harness for damage, check plug-in connection, replace if necessary. Check sensor resistance value, replace if necessary.
61	Short circuit or ground of overheating sensor	Check cable harness, replace if necessary. Check sensor resistance value, replace if necessary.
64	Abnormal flame sensor operation	Check cable harness for damage, check plug-in connection, replace if necessary. Check sensor resistance value, replace if necessary.
65	Short circuit of flame sensor	Check cable harness, replace if necessary. Check sensor resistance value, replace if necessary.
71	Defective surface sensor	Check cable harness for damage, check plug-in connection, replace if necessary. Check sensor resistance value, replace if necessary.
72	Short circuit of surface sensor	Check cable harness, replace if necessary. Check sensor resistance value, replace if necessary.
74	Defective overheating prevention device	-
87	-	-
88	-	-
89	-	-
90	Watchdog reset	Replace controller.
91	Abnormal reset function	If too many resets occurs, replace controller
92	ROM error	Replace controller.
93	RAM error	Replace controller.
94	Defective transistor	Replace controller.

Trouble Code	Trouble Description	Remedies
95	Software error	Check cable harness for open to battery voltage, replace if necessary. Replace controller.
96	Abnormal process operation	Replace controller.
97	Wrong processor cycle	Replace controller.
98	Defective main relay	Replace controller.
99	EEPROM error	Replace controller.

▶ Trouble Diagnosis

Causes		Remedies
Low coolant level	• Leakage in radiator • Leakage in coolant auxiliary tank • Leakage in heater core	• Change radiator. • Change coolant auxiliary tank • Change heater core.
	• Leakage in joint junction of coolant hose • Leakage in defective coolant hose	• Check hose or replace clamp. • Change hose.
	• Leakage in water pump gasket • Leakage in water pump sealing	• Change gasket. • Change water pump.
	• Leakage in water inlet cap • Leakage in thermostat housing	• Change water inlet cap gasket. • Change thermostat sealing.
	• Insufficient tightening torque of cylinder head bolt • Damaged cylinder head gasket	• Tighten bolt to specified torque. • Change cylinder head gasket.
Abnormally high coolant temperature	• The coolant leakage (Check the coolant level) • Excessive anti-freezer • Poor coolant hose condition	• Add coolant • Check density of coolant (Anti-freezer). • Check bent of hose, replace if necessary.
	• Defective thermostat • Defective water pump • Defective radiator • Defective coolant auxiliary tank or tank cap	• Change thermostat • Change water pump. • Change radiator. • Change coolant auxiliary tank or tank cap.
	• Crack in cylinder head or in cylinder block • Clogged water flow in cylinder head or block	• Change cylinder head or cylinder block. • Clean coolant flow line.
	• Clogged water flow in radiator core	• Clean radiator core.
	• Defective cooling fan	• Change or check cooling fan.
	• Defective temp. sensor, wiring, and lamp cluster	• Change sensor or check relevant wiring.
Abnormally low coolant temperature	• Defective thermostat	• Change thermostat.
	• Defective cooling fan	• Change or check cooling fan.
	• Defective temp. sensor, wiring, and lamp cluster	• Change sensor or check relevant wiring.

MEMO

RAIN SENSOR

TABLE OF CONTENTS

TROUBLE SHOOTING 3

TROUBLE SHOOTING

Symptom 1.	**The wiper does not operate one cycle when turning the multifunction wiper switch to the "AUTO" from the "OFF" position or starting the engine while the wiper switch is in the "AUTO" position.**

1. When starting the engine with the multifunction wiper switch in the "AUTO" position, the wiper operates one cycle to remind a driver that the wiper switch is in the "AUTO" position.
2. When the wiper switch is turned to "AUTO" from "OFF", the wiper operates one cycle. It always operates one cycle for the initial operation, however, the wiper does not operate afterwards to prevent the wiper blade wear if not raining when turning the wiper switch to "AUTO" from "OFF". However, the wiper operates **up to 5 minutes** after rain stops. If this function does not occur, check No. 8 pin. If the pin is normal, check the wiper relay related terminals in the ICM box.

Symptom 2.	**It rains but the system does not work in the "AUTO" position.**

1. Check whether the multifunction wiper switch is in the "AUTO" position.
2. Check the power to the sensor. Check the conditions of the pin 3 (Ground) and the pin 4 (IGN).
3. Check the wiper relay for defective.

Symptom 3.	**The wiper operates 3 or 4 times at high speed abruptly.**

Check whether the variable resistance knob on the multifunction wiper switch is set in "FAST". The "FAST" is the highest stage of the sensitivity and very sensitive to small amount of rain drops. Therefore, change the knob to the low sensitivity.

Symptom 4.	**The wiper operates continuously even on the dry glass.**

1. Check the wiper blade for wear. If the wiper blade cannot wipe the glass uniformly and clearly, this problem could be occurred. In this case, replace the wiper blade with a new one.
2. Check whether the variable resistance knob on the multifunction wiper switch is set in "FAST". The "FAST" is the highest stage of the ensitivity and very sensitive to small amount of rain drops. Therefore, change the knob to the low sensitivity.

Symptom 5.	**The wiper does not operate at high speed even in heavy rain.**

Check if the wiper operates at high speed when grounding pin 1 and pin 2.

Symptom 6.	**The wiper responses are too fast or slow.**

Check whether the variable resistance knob on the wiper switch is set in "FAST" or "SLOW".

Notify that the customer can select the sensitivity by selecting the variable resistance value. And, select a proper stage.

MEMO

FATC

TABLE OF CONTENTS

SELF DIAGNOSIS (ONLY FOR FATC AIR CONDITIONER) 3

SELF DIAGNOSIS (ONLY FOR FATC AIR CONDITIONER)

▶ Self Diagnosis

1. Starting Self Diagnosis

Turn the ignition switch to ON position and press OFF switch for more than 5 seconds within 10 seconds.

2) Check LED segments on the vacuum fluorescent display (VFD).



1) Press OFF switch more than 5 seconds.

2. Set in Trouble Diagnosis Step 2

In this step, check the air mix door and sensors for defect.

Once the system starts diagnosis step 2, the digit “2” is displayed, implying step 2, on the display window and the trouble diagnosis for sensors is executed. If no failure exists, “20” is displayed. If any failure exists, the appropriate trouble code is displayed as below.

1) Slightly turn the TEMP dial to the right to set in the trouble diagnosis step 2





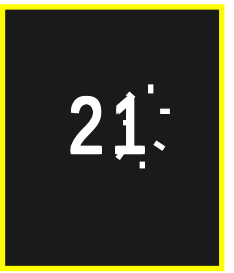
2) Indication of Step 2. Starting self diagnosis

10 ~ 20 seconds



3) Sensor failure code blinking

When two sensors are defective



First sensor failure code blinks twice



Second sensor failure code blinks twice

NOTICE

- **The symbol "-" in front of step number "2" means a short circuit of the blinking sensor.**



Short-circuit in the ambient air temperature sensor

Trouble Code

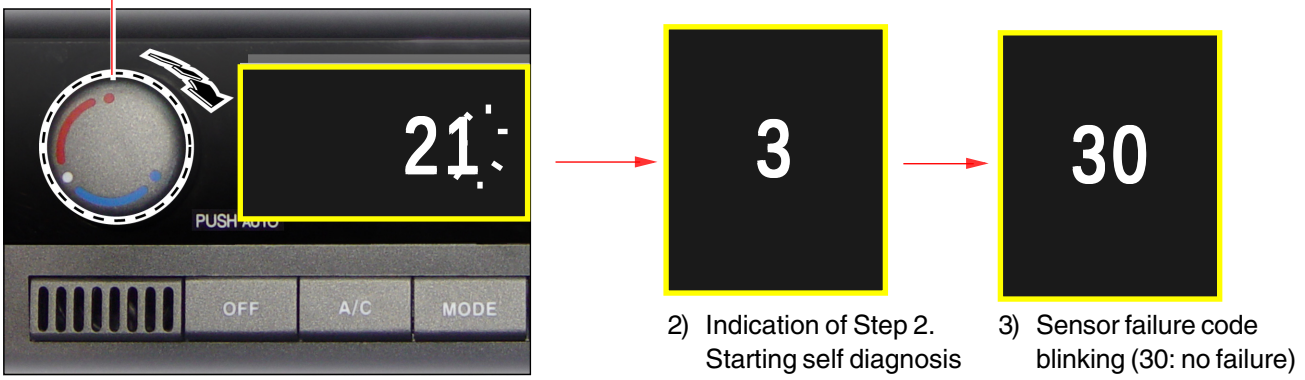
Code	Malfunction	Remark	Code	Malfunction	Remark
0	VDF segments are OK		5	Defective sun sensor	
1	Defective ambient temperature sensor		6	Check Air mix door	
2	Defective interior temperature sensor		7	Defective humidity sensor	
3	Defective duct temperature sensor		8	-	
4	Defective intake sensor		9	-	

3. Set in Trouble Diagnosis Step 3

In this step, check the position and conditions of recirculation air door and mode door.

Slightly turn the TEMP switch until “3” is displayed on the display window.

If no failure exists, "30" is displayed. If any failure exists, the appropriate trouble code is displayed.



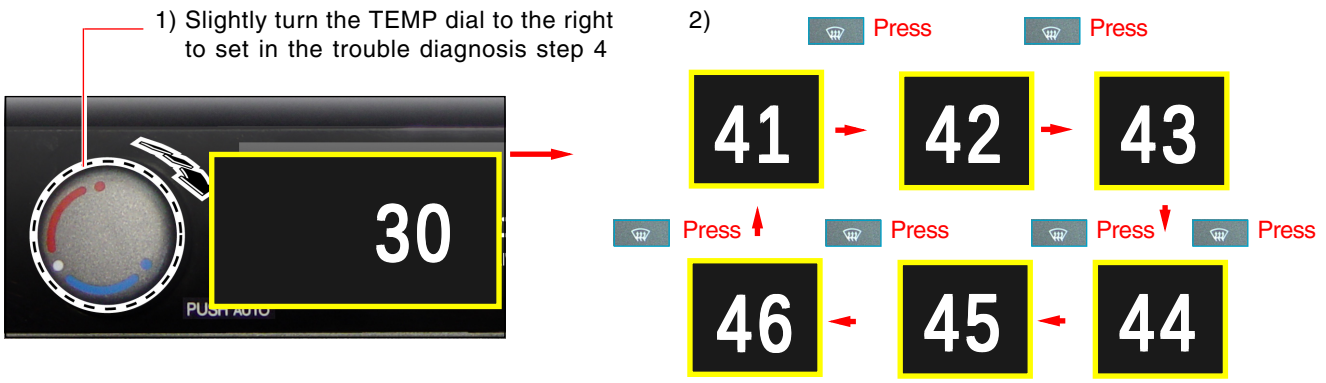
Trouble Code

Code	Malfunction	Remark	Code	Malfunction	Remark
1	Defective VENT		6	DEF	
2	Defective B/L		7	FRE	
3	-		8	20% FRE	
4	FOOT		9	REC	
5	D/F		0	All door OK	

4. Set in Trouble Diagnosis Step 4

In this step, check the position of actuator door, check the fan speed, and check the compressor operation.

Slightly turn the TEMP switch in step 3 until “41” is displayed on the display window. When pressing DEF switch ,mode changes as shown below in turns to check each function.



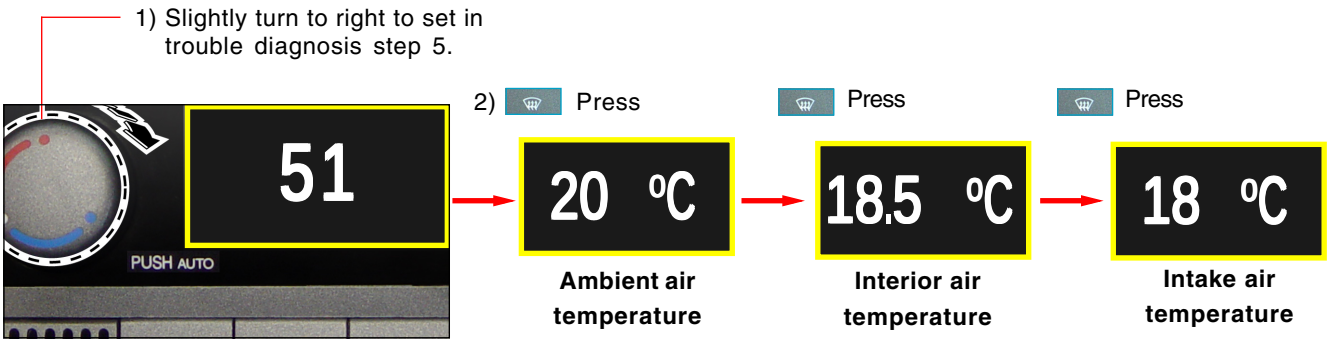
Function Check

Displayed Number	41	42	43	44	45	46
Mode door	VENT	B/L	B/L	FOOT	D/F	DEF
Interior/Ambient door	REC	REC	20%FRE	FRE	FRE	FRE
Air mix door	F/COOL	F/COOL	F/HOT	F/HOT	F/HOT	F/HOT
Blower	4.5 V	10.5 V	8.5 V	8.5 V	8.5 V	MAX
Compressor	ON	ON	OFF	OFF	ON	ON

5. Set in Trouble Diagnosis Step 5

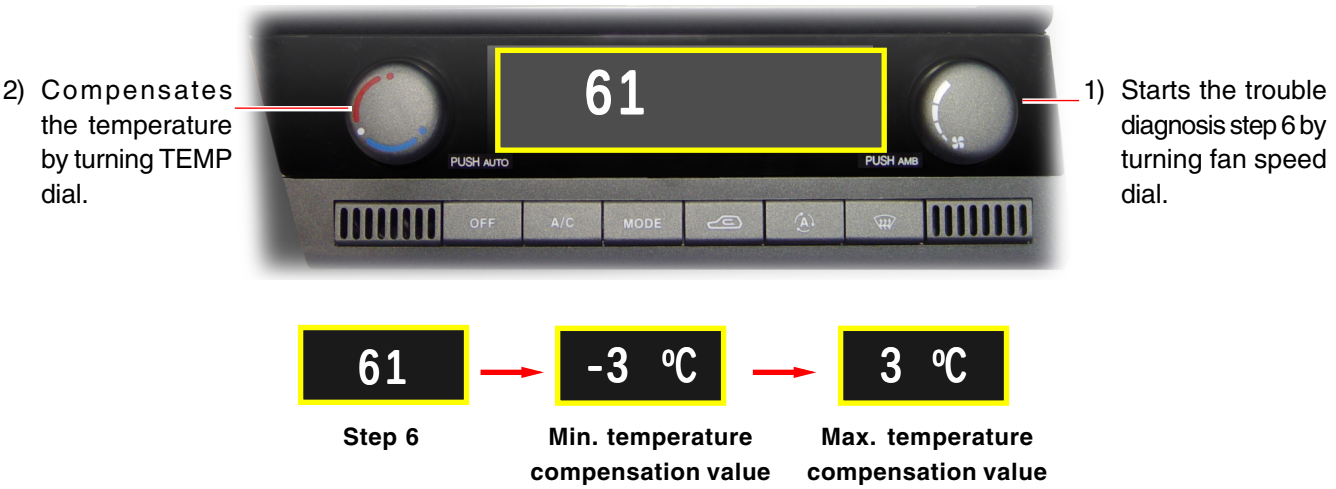
In this step, check the conditions of temperature related sensors.

Slightly turn the TEMP switch in step 4 until "51" is displayed on the display window. When pressing DEF switch , displayed temperature changes as shown below in turns.



6. Set in Trouble Diagnosis Step 6

In this step, the temperature can be compensated within the range of -3°C to 3°C in the control process according to the temperature to air conditioner controller. The step 6 initiates when slightly rotating the fan speed switch (other than TEMP switch) in step 5.



7. Canceling the Trouble Diagnosis

Turn the AUTO switch ON or turn the ignition key OFF.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

TGS LEVER

TABLE OF CONTENTS

DTC AND DIAGNOSIS 3

DTC AND DIAGNOSIS

▶ DTC for Selector Lever

DTC	Malfunction	Help tips
P1000-1	Defective program memory	Cause: The calculated checksum value is not consistent with the stored checksum value. Symptom: - Solenoid valve is inoperative. - Backup lamp is OFF. - CAN bus is OFF. - All shift lever position indicators are OFF. Action: Reset the unit by cyling the ignition switch (OFF → ON) several times.
P1000-2	Defective data memory	Cause: The malfunction is occurred during the RAM memory test with the ignition ON. Symptom: - Solenoid valve is inoperative. - Backup lamp: OFF - CAN bus: OFF - All shift lever position indicators: OFF Action: If the malfunction stays after turning the ignition switch from OFF to ON, replace the TGS lever.
P1000-3	Faulty MCU reset	Cause: The malfunction is occurred during the microprocessor test with the ignition ON. Symptom: - Solenoid valve is inoperative. - Backup lamp is OFF. - CAN bus is OFF. - All shift lever position indicators are OFF. Action: Reset the unit by cyling the ignition switch (OFF → ON) several times.
P1000-4	Faulty MCU data process	
P1000-5	Faulty MCU watchdog function	
P1000-6	Too long MCU data throughput time	
P1750-2	Low battery voltage	Cause: The battery voltage is low. (Specified value: less than 8.0 ± 0.3 V for 50 ms) Symptom: All shift lever position indicators are OFF. Action: - The operation is automatically resumed if the battery voltage is over 8.7 ± 0.3 V for 50 ms. - Check the shift lever connector and power line for contact.
P1817-1	Faulty backup lamp operating current	Cause: The operating current is over 14 ~ 36 A for 50 ms when the backup lamp is in ON condition. Symptom: - Backup lamp is OFF. - Current shift lever indicator is flashing. - Indicator “R” is flashing in “R” position. Action: Check the input and output wirings of backup lamp for open and short.
P1832-1	Faulty solenoid operating current	Cause: The solenoid valve operating current is over 3 ~ 5 A when the solenoid is operating. Symptom: - Solenoid valve is OFF. - Current shift lever indicator is flashing. Action: The operation is automatically resumed since the interior temperature is normally within the solenoid operating temperature range. If the problem stays, check the power to the shift lever.

DTC	Malfunction	Help tips
P1833-2	Open solenoid valve circuit	Cause: The solenoid valve circuit is open or short to battery for 50 ms when the solenoid valve is OFF. Symptom: - Solenoid valve is OFF. - Current shift lever indicator is flashing. Action: Check the power terminal to the shift lever.
P1856-1	Short shift lever position signal (to B+)	Cause: The shift lever position sensor or the power supply is malfunctioning. Symptom: - All shift lever position indicators are flashing.. - The incorrect lever position signal is transmitted through the CAN line. Action: - The operation is automatically resumed if the fault is not detected for 100 ms. - Check the power supply terminal to the shift lever.
P1856-2	Open or short shift lever position signal (to GND)	Cause: The shift lever position sensor is open or short to ground. Symptom: - All shift lever position indicators: flashing. - The incorrect lever position signal is transmitted through the CAN line. Action: - The operation is automatically resumed if the fault is not detected for 100 ms. - Check the power supply terminal to the shift lever.
P1856-3	Abnormal shift lever position signal	Cause: The shift lever position sensor signal is incorrect. Symptom: - All shift lever position indicators are flashing. - The incorrect lever position signal is transmitted through the CAN line. Action: - The operation is automatically resumed if the fault is not detected for 100 ms. - Check the power supply terminal to the shift lever.
P1856-4	Incorrect shift lever position sensor coding	Cause: The calibration value of shift lever position sensor is not stored or not consistent with the stored value. Symptom: - All shift lever position indicators are flashing. - The incorrect lever position signal is transmitted through the CAN line. Action: - Reset the unit by cyling the ignition switch (OFF → ON) several times. - Check the shift lever and replace it if necessary.
P1860-2	Faulty vehicle speed signal	Cause: The vehicle speed is detected as 300 km/h. Symptom: - The gear is shifted as for the vehicle speed is 0 km/h. - Current shift lever position indicator is flashing. Action: - The operation is automatically resumed if the fault is not detected. * For the shift lever, the vehicle speed data is needed to the solenoid valve operation for R/P lock and N lock function.
P1875-3	Faulty CAN bus OFF signal	Cause: The CAN bus OFF condition of the CAN controller is detected for 3 times in the unit. Symptom: - Cannot send the CAN message. - Current shift lever position indicator is flashing. Action: - Check the CAN communication line for open or short. - Check the shift lever and replace it if necessary. * CAN Bus OFF: The status that the CAN communication is totally interrupted if there is an error in the sent/received data through the CAN communication in the unit.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Malfunction	Help tips
P1876-1	Abnormal CAN communication (vehicle speed)	Cause: There is no vehicle speed signal via CAN communication for 500 ms. Symptom: - The gear is shifted as for the vehicle speed is 0 km/h. - Current shift lever position indicator is flashing. Action: Check the CAN communication line.
P1910-1	High battery voltage	Cause: The battery voltage is too high. (Specified value: Over 16.3 ± 0.3 V for 50 ms) Symptom: All shift lever position indicators: OFF Action: - The operation is automatically resumed if the battery voltage is over 16.3 ± 0.3 V for 50 ms. - Check the shift lever power supply line.
P1912-1	Open/Short shift lever tip switch signal (to B+)	Cause: The shift lever tip switch signal is open or short to B+. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in manual mode position. - If the shift lever is not in “M” position, the malfunction is overridden. Action: - The operation is automatically resumed if the fault is not detected for 50 ms. - Check the shift lever tip switch.
P1912-2	Short shift lever tip switch signal s(to GND)	Cause: The shift lever tip switch signal is open or short to ground. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in the manual mode position. - If the shift lever is not in “M”, the malfunction is overridden. Action: - The operation is automatically resumed if the fault is not detected for 50 ms. - Check the shift lever tip switch.
P1912-3	Abnormal shift lever tip switch signal	Cause: The shift lever tip switch signal is faulty. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in the manual mode position. - If the shift lever is not in “M” position, the malfunction is overridden. Action: - The operation is automatically resumed if the fault is not detected for 50 ms. - Check the shift lever tip switch.
P1912-4	Open/Short steering wheel tip switch signal (to B+)	Cause: The steering wheel tip switch signal is open or short to B+. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in the manual mode position. - If the shift lever is not in “M” position, the malfunction is overridden. Action: - The operation is automatically resumed if the fault is not detected for 50 ms. - Check the steering wheel's tip switch.
P1912-5	Open/Short steering wheel tip switch signal (to GND)	Cause: The steering wheel tip switch signal is open or short to ground. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in the manual mode position. - If the shift lever is not in “M” position, the malfunction is overridden. Action: - The operation is automatically resumed if the fault is not detected for 50 ms. - Check the steering wheel tip switch.

DTC	Malfunction	Help tips
P1912-6	Abnormal steering wheel tip switch signal	Cause: The steering wheel tip switch signal is faulty. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in the manual mode position. - If the shift lever is not in “M” position, the malfunction is overridden. Action: - The operation is automatically resumed if the fault is not detected for 50 ms. - Check the steering wheel tip switch.
P1912-7	Defective tip switch	Cause: The manual mode switch operates for 50 ms when the shift lever is P, R or N positions. Symptom: - Indicator “M” flashes if the shift lever is in D. - The mode is recognized as the manual mode even if the shift lever is in “D” position. Action: The operation is automatically resumed if the fault is not detected for 50 ms and the shift lever is in P, R or N positions.
P1927-8	Faulty TCU shift	Check the TCU if there is errors related to the A/T shift.
P1928-4	Defective TCU CAN communication	Cause: - The up/down shift command in not delivered to the TCU (faulty tip switch). - There is no CAN signal for 500 ms. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in the manual mode position. - If the shift lever is not in “M” position, the malfunction is overridden. Action: Check the CAN communication line.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

P/TRUNK

TABLE OF CONTENTS

DTC 3

DTC

Function	System component	DTC	Description
Power Trunk Monitoring	**Power striker**	**0**	**Faulty power striker**
	Causes - The related wiring is damaged. - The connector is poorly connected or damaged. - The micro switch is malfunctioning. - The power striker'motor is malfunctioning. **Actions** - Check the related wiring and connector for proper connection. - Replace the power striker.		
	Power latch	**1**	**Faulty power latch**
	Causes - The related wiring is damaged. - The connector is poorly connected or damaged. - The micro switch is malfunctioning. - The power latch motor is malfunctioning. **Actions** - Check the related wiring and connector for proper connection. - Replace the power latch.		
	DC-Gear motor	**2**	**Faulty DC-gear motor**
	Causes - The related wiring is damaged. - The connector is poorly connected or damaged. - The hall sensor is malfunctioning. - The DC-gear motor is malfunctioning. **Actions** - Check the related wiring and connector for proper connection. - Replace the DC-gear motor.		
	Power trunk lid	**3**	**Faulty power trunk lid**
	Causes - The related wiring is damaged. - The connector is poorly connected or damaged. - The PTL ECU is malfunctioning. **Actions** - Check the related wiring for proper connection. - Replace the PTL ECU.		

Function	System component	DTC	Description
Power Trunk Monitoring	**Battery**	**4**	**Low battery voltage**
	Causes - The related wiring is damaged. - The connector is poorly connected or damaged. - The battery is defective. **Actions** - Check the related wiring for proper connection. - Check the battery and replace it if necessary.		
	CAN communication	**5**	**Faulty CAN communication**
	Causes - The related wiring is damaged. - The connector is poorly connected or damaged. - The CAN communication is malfunctioning. - The PTL ECU is malfunctioning. **Actions** - Check the related wiring for proper connection. - Replace the PTL ECU.		
	Power trunk	**6**	**Faulty usage**
	Cause - If the DC-gear motor is operated 7 times within 2 minutes, it is considered as misusage and overheated DC-gear motor. **Action** - The system resumes its operation in 90 seconds.		
	PTL ECU	**7**	**Faulty temperature detection of unit**
	Causes - The related wiring is damaged. - The connector is poorly connected or damaged. - The internal temperature sensor in the PTL ECU is malfunctioning. - The PTL ECU is malfunctioning. **Actions** - Check the related wiring for proper connection. - Replace the PTL ECU.		
	PTL ECU	**8**	**Faulty temperature detection of unit**
	Causes - The related wiring is damaged. - The connector is poorly connected or damaged. - The power trunk lamp is malfunctioning. - The PTL ECU is malfunctioning. **Actions** - Check the related wiring for proper connection. - Replace the power trunk lamp. - Replace the PTL ECU.		

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

CCCS

TABLE OF CONTENTS

CCCS DIAGNOSIS 3

▶ STICS Input/Output Monitoring Data 5

DIAGNOSIS OF MAIN DICS 10

▶ Main DICS Input/Output Monitoring Data 11

DIAGNOSIS OF SUB DICS 17

▶ Sub DICS Input/Output Data 18

DIAGNOSIS OF MS-DOS 20

▶ MSDOS Input/Output Data 22

DIAGNOSIS OF ESIMS 25

▶ ESIMS Input/Output Data 26

CCCS DIAGNOSIS

Code	Malfunction	Help
0 X 01	Driver door lock knob does not lock	- Check the driver side door actuator - Check the sensor values • Driver side door open switch (STICS sensor value: No. 5) • Door lock switch (STICS sensor value: No. 21) • Driver door lock switch (STICS sensor value: No. 37) • Door lock switches other than the driver side door (STICS sensor value: No. 38) • Door lock (DICS-Main: No. 30) • Key lock (DICS-Main: No. 32) - Check the driver side door wires and connectors
0 X 02	Passenger door lock knob does not lock	- Check the passenger side door actuator - Check the sensor values • Passenger side door open switch (STICS sensor value: No. 6) • Door lock switch (STICS sensor value: No. 21) • Door lock switches other than the driver side door (STICS sensor value: No. 38) • Door lock (DICS-Sub: No. 3) • Key lock (DICS-Sub: No. 5) - Check the passenger side door wires and connectors
0 X 03	Rear door lock knob does not lock	- When one of the two rear seat door knobs is defective - Check the rear seat door actuator - Check the sensor values • Rear door knob switch (STICS sensor value: No. 7) • Rear right door open switch (STICS sensor value: No. 8) • Door lock switch (STICS sensor value: No. 21) • Rear door open switch (STICS sensor value: No. 23) • Door lock switches other than the driver side door (STICS sensor value: No. 38) • Door lock switch (DICS-Main sensor value: No. 32) • Key lock (DICS-Main sensor value: No. 32) • Door lock (DICS-Sub sensor value: No. 3) • Key lock (DICS-Sub sensor value: No. 5) - Check the rear door wires and connectors
0 X 04	Defective tail lamp auto off function (Battery save function)	- Check the tail lamp relay connector - Check the sensor values • Tail lamp switch (STICS sensor value: No. 3) • Tail lamp signal input status (STICS sensor value: No. 20) • Tail lamp relay (STICS sensor value: No. 47) - Check the tail lamp wires and connectors - The defective code of signals coming from ABS/ESP which senses the vehicle speed incorrectly due to the exterior noises - Current vehicle speed (STICS sensor value: No. 58)
0 X 05	Incorrect indication of the vehicle speed (Detects as over 300 km/h)	- Check the speed sensor connector - Check the other units (ABS) that use speed signal - Does not receive the vehicle speed signal from STICS when the ignition switch is turned off

Code	Malfunction	Help
0 X 06	Vehicle speed indicates over 0 km/h when the ignition switch is turned off	- Current vehicle speed (STICS sensor value: No. 58) - Check the speed sensor connector - Check the other units (ABS) that use speed signal
0 X 07	Tail lamp turns OFF without any signals when the tail lamp switch is turned on	- Check the tail lamp relay connector - Check the sensor values • Tail lamp switch (STICS sensor value: No. 3) • Tail lamp signal input status (STICS sensor value: No. 20) • Tail lamp relay (STICS sensor value: No. 47)
0 X 08	IGN 2 SW is detected as OFF when IGN 1 SW is ON	- Check the tail lamp wires and connectors - Check the sensor values • Key reminder switch (STICS sensor value: No. 13) • Ignition 1 switch (STICS sensor value: No. 17) • Ignition 2 switch (STICS sensor value: No. 18) • Ignition 1 switch (DICS-Main sensor value: No. 60) • Ignition 2 switch (DICS-Main sensor value: No. 59) • Key reminder (DICS-Main sensor value: No. 62)
0 X 09	Driver side door lock knob does not unlock	- Check the driver side door actuator - Check the sensor values • Door open switch (STICS sensor value: No. 5) • Door unlock switch (STICS sensor value: No. 22) • All door unlock switches (STICS sensor value: No. 39) • Key unlock (Main-DICS: No. 31) - Check the driver side door wires and connectors
0 X 0A	Passenger side door lock knob does not unlock	- Check the passenger side door actuator - Check the sensor values • Passenger side door open switch (STICS sensor value: No. 6) • Door unlock switch (STICS sensor value: No.22) • All door unlock switches (STICS sensor value: No. 39) • Key unlock (DICS-Main: No. 31) • Key unlock (Main-DICS: No. 04) - Check the driver side door wires and connectors
0 X 0B	Rear door lock knob does not unlock	- When one of the two rear seat door knobs is defective - Check the rear seat door actuator - Check the sensor values • Rear door knob switch (STICS sensor value: No. 7) • Rear right door open switch (STICS sensor value: No. 8) • Door unlock switch (STICS sensor value: No. 22) • Rear door open switch (STICS sensor value: No. 23) • All door unlock switches (STICS sensor value: No. 39) • Key unlock (DICS-Main sensor value: No. 31) • Key unlock (DICS-Sub sensor value: No. 4) - Check the rear seat door wires and connectors

▶ STICS Input/Output Monitoring Data

No.	Input/ Output	Sensor value item	Information				Help
1	Input	Reverse lever detection	Not detected	GND	Detected	12 V	1. Sensor signal detects when the reverse gear signal in A/T equipped vehicle 2. Ground level when not operating 3. Battery level when operating 4. This signal is used when outside rearview mirror in DICS Main/Sub is linked with 5°C. It is linked only when the outside rearview mirror selection switch in DICS Main is not in center position.
2	Input	Driver side seatbelt switch	Unfasten	GND	Fastened	12 V	1. Switch signal checks the driver side seatbelt has been fastened 2. Ground level when unfastened 3. Battery level when fastened
3	Input	Tail lamp switch	OFF	12 V	ON	GND	1. Switch that turns ON or OFF tail lamp switch 2. Battery level when tail lamp switch is OFF 3. Ground level when tail lamp switch is ON
4	Input	Trunk lid open switch	Close	GND	Open	12 V	1. When equipped with PTL, no input data is transmitted from trunk lid open switch to STICS 2. Battery level when open 3. Ground level when close
5	Input	Front left door open switch	Close	12 V	Open	GND	1. Ground level when door is open 2. Battery level when door is close
6	Input	Front right door open switch	Close	12 V	Open	GND	1. Ground level when door is open 2. Battery level when door is close
7	Input	Rear door knob switch	Open	GND	Close	12 V	1. Operating conditions • When the central door lock and unlock function is in operation • When the doors are locked by the driver's door lock knob • When receiving signal from DICS via CAN communication in auto door lock/unlock operation at vehicle speed of 50 km/h. 2. Ground level when rear door knob is open 3. Battery level when rear door knob is close
8	Input	Rear right door open switch	Close	12 V	Open	GND	1. Ground level when door is open 2. Battery level when door is close
9	Input	Parking brake switch	Not operating	12 V	Operating	GND	1. Switch detects the parking brake engagement 2. Ground level when parking brake is engaged 3. Battery level when not operating
10	Input	Auto windshield wiper switch	OFF	12 V	ON	GND	1. Auto windshields wiper switch. No inputs to STICS when the vehicle is equipped with the rain sensor 2. Ground level when ON 3. Battery level when OFF
11	Input	Hood open switch	Close	12 V	Open	GND	1. Hood open detection switch 2. Ground level when open 3. Battery level when close

No.	Input/ Output	Sensor value item	Information				Help
12	Input	Trunk unlock switch	Not operating	GND	Operating	12 V	1. Switch detects the trunk lid unlock from the glove compartment • With the power trunk: Communication between PTL and CAN • Without the power trunk: Controlled by STICS 2. OFF: GND 3. ON: 12 V
13	Input	Key reminder switch	Not detected	GND	Detected	12 V	1. Key reminder detection switch 2. Battery level when operating 3. Ground level when not operating
14	Input	KEY ACC switch	Not detected	GND	Detected	12 V	1. Key accessory detection switch 2. Battery level when operating 3. Ground level when not operating
15	Input	Alternator switch	Not detected	GND	Detected	12 V	1. Alternator charging detection switch 2. Battery level when operating 3. Ground level when not operating
16	Input	P/N switch	Not detected	GND	Detected	12 V	1. Parking (P) or neutral (N) position of A/T detection switch 2. Battery level when operating 3. Ground level when not operating
17	Input	IGN1 switch	Not detected	GND	Detected	12 V	1. Ignition 1 detection switch 2. Battery level when operating 3. Ground level when not operating
18	Input	IGN2 switch	Not detected	GND	Detected	12 V	1. Ignition 2 detection switch 2. Battery level when operating 3. Ground level when not operating
19	Input	Windshield Wiper position switch	Not detected	12 V	Detected	GND	1. Windshield wiper position switch detects the wiper position when the operation stops. With the rain sensor equipped vehicle, no inputs are transmitted to STICS 2. Ground level when in the original position (operating) 3. Battery level when not operating 4. Cannot detect when equipped with the rain sensor
20	Input	Tail lamp operation signal	No input	12 V	Input	GND	1. Tail lamp operation signal (monitoring) is the function that detects the auto light operation of the tail lamp 2. With signal input 3. Without signal input
21	Input	Central door lock switch	Not detected	12 V	Detected	GND	1. Locking door knob switch (Can be detected when the lock switch is in operation) 2. Battery level during door unlock 3. Ground level during door lock
22	Input	Central door unlock switch	Not detected	12 V	Detected	GND	1. Unlocking door knob switch (Can be detected when the unlock switch is in operation) 2. Battery level during door lock 3. Ground level during door unlock

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

No.	Input/ Output	Sensor value item	Information				Help
23	Input	Rear left door open switch	Close	12 V	Open	GND	1. Rear left door open switch 2. Ground level when door is open 3. Battery level when door is close
24	Input	Heating grid switch	Not detected	12 V	Detected	GND	1. Heating grid operation switch (Blink once when the switch is operated) 2. Battery level when not operating (OFF) 3. Ground level when operating (ON)
25	-	-	-	-	-	-	-
26	Input	Washer switch	OFF	GND	ON	12 V	1. Windshield washer operating switch When equipped with the rain sensor,no inputs are transmitted to STICS 2. Battery level when operating (ON) 3. Ground level when not operating (OFF)
27	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-
32		Armed mode operation	Operating	GND	Not operating	12 V	1. Informs on armed mode 2. Electrical signals cannot be found 3. Battery level when operating 4. Ground level when not operating
33	Output	Rear left P/WDW UP relay	Not operating	12 V	Operating	GND	1. Relay for raising the rear left power window (The value changes when it operates within DICS-Main) 2. Ground level when operating 3. Battery level when not operating
34	Output	Rear left P/WDW DN relay	Not operating	12 V	Operating	GND	1. Relay for lowering the rear left power window (The value changes when it operates within DICS-Main) 2. Ground level when operating 3. Battery level when not operating
35	Output	Rear right P/WDW UP relay	Not operating	12 V	Operating	GND	1. Relay for raising the rear right power window (The value changes when it operates within DICS-Main) 2. Ground level when operating 3. Battery level when not operating
36	Output	Rear right P/WDW DN relay	Not operating	12 V	Operating	GND	1. Relay for lowering the rear right power window (The value changes when it operates within DICS-Main) 2. Ground level when operating 3. Battery level when not operating
37	Output	Driver side door lock relay	Not operating	12 V	Operating	GND	1. Driver side door knob lock relay (Locks all doors) The value appears only when the relay is connected 2. Ground level when operating 3. Battery level when not operating

No.	Input/ Output	Sensor value item	Information				Help
38	Output	All door lock other than driver side	Not operating	12 V	Operating	GND	1. All door knob lock relays other than the driver side The value appears only when the relay is connected 2. Ground level when operating 3. Battery level during normal
39	Output	Driver side door unlock relay	Not operating	12 V	Operating	GND	1. All door knob unlock relays (Cannot operate with driver side lock knob) The value appears only when the relay is connected 2. Ground level when operating 3. Battery level when not operating
40	Output	Windshield wiper relay	Not operating	GND	Operating	12 V	1. Windshield wiper operation switch When equipped with the rain sensor, no inputs are transmitted to STICS 2. Battery level when operating 3. Ground level when not operating
41	Output	Siren operation	Not operating	12 V	Operating	GND	1. Siren operation signal 2. Ground level when operating 3. Battery level when not operating
42	Output	Parking brake headlamp	Not operating	12 V	Operating	GND	1. Parking brake headlamp 2. Ground level when operating 3. Battery level when not operating
43	Output	Buzzer operation	Not operating	12 V	Operating	GND	1. Buzzer operation 2. Ground level when operating 3. Battery level when not operating
44	Output	Door open headlamp	Not operating	12 V	Operating	GND	1. Door open and driving warning 2. Ground level when operating 3. Battery level when not operating
45	Output	Heating grid relay	Not operating	12 V	Operating	GND	1. Heating grid operation relay drive output 2. Ground level when operating 3. Battery level when not operating
46	Output	Hazard warning relay	Operating	GND	Not operating	12 V	1. Heating grid operation relay drive output (Operates when in armed mode) 2. Ground level when operating 3. Battery level when not operating
47	Output	Tail lamp relay	Not operating	12 V	Operating	GND	1. Tail lamp relay drive output (Blink once when operating the tail lamp switch) 2. Ground level when operating 3. Battery level when not operating
48	-	-	-	-	-	-	-
49	Output	Front left foot lamp	Not operating		Operating		1.Driver side foot lamp (Operating value delays as per dimming time) 2. Pulse signal between the battery and ground when operating. → Refer to operation signal STICS specifications

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

No.	Input/ Output	Sensor value item	Information				Help
50	Output	Front right foot lamp	Not operating		Operating		1. Passenger side foot lamp (Operating value delays as per dimming time) 2. Pulse signal between the battery and ground when operating. → Refer to operation signal STICS specifications
51	Output	Rear foot lamp	Not operating		Operating		1. Rear door foot lamp (Operating value delays as per dimming time) 2. Pulse signal between the battery and ground when operating. → Refer to operation signal STICS specifications
52	Output	Room lamp	Not operating		Operating		1. Room lamp (Operating value delays as per dimming time) 2. Pulse signal between the battery and ground when operating. → Refer to operation signal STICS specifications
53	Output	Rheostat lamp	Not operating		Operating		1. Brightness changes according to the rheostat volume when the tail lamp is turned on 2. Pulse signal between the battery and ground when operating. Pulse width may change by 20% ~ 100% (based on GND). → Refer to operation signal STICS specifications
54	Output	Fixed rate dimming control	Not operating		Operating		1. Fixed rate dimming light (Operating value changes periodically) 2. Pulse signal between the battery and ground when operating. Pulse width maintains 50% of the duty rate. → Refer to operation signal STICS specifications
55	-	-	-	-	-	-	-
56	-	-	-	-	-	-	-
57	-	-	-	-	-	-	-
58	Output	Current vehicle speed	A km/h				
59	Output	Dimming control	A%				Controls the dimming by 20 ~ 100%
60	Output	Windshield wiper operating resistance stages	A kohn				1. Windshield wiper volume value: 0 ~ 10 kΩ → Value between 0 ~ Vcc For the rain sensor equipped vehicle, no inputs are transmitted to STICS
61	Output	Intermittent time	A · 10 ms				1. The unit time of the windshield wiper intermittent intervals For the rain sensor equipped vehicle, no inputs are transmitted to STICS

DIAGNOSIS OF MAIN DICS

Code	Malfunction	Help
0 X 21	Power window limiter switch open	- The inputs have more than 30 edge hall pulses under the limiter switch off recognized as the upper position condition during the power window up or down outputs - Check the limiter switch - Check the sensor values • Power window anti-trap (DICS-Main: No. 50) • Power window limiter switch (DICS-Main: No. 56)
0 X 22	Defective power window motor hall sensor	- When the power window motor is under load, the auto-stop orders the power window to disengage auto-up function regardless ON or OFF inputs (no pulse signals) - No inputs of hall pulse exceeding 700 milliseconds during the power window motor down outputs under the limiter switch OFF (the upper position of the window) conditions or no inputs of pulse exceeding 100 milliseconds during the up outputs under the limit switch ON (the lowest position of the window) conditions. - Replace the power window motor
0 X 23	Inactive key door lock actuator	- Check the driver side door actuator - Check the sensor value • Key lock (DICS-Main: No. 32)
0 X 24	Inactive key door unlock actuator	- Check the driver side door actuator • Check the method of the actuator operation - Check the sensor value • Key unlock (DICS-Main: No. 31)
0 X 25	Memory switch input during no mirror UP or DN input	- When the outside rearview mirror has no UP or DOWN sensor values, DICS-Main recognizes and disables the vehicle memory function. However, when the memory input has detected, it means the sensor is open-circuited or has different mirror has been installed. - Check the outside rearview mirror UP or DOWN sensor wires - Measure sensor values and check the accordance position • Internal DOWN switch of the outside rearview mirror (DICS-Main: No. 21) • Internal UP switch of the outside rearview mirror (DICSMain:No. 22) • Internal DOWN motor of the outside rearview mirror (DICS-Main: No. 37) • Internal UP motor of the outside rearview mirror (DICSMain:No. 38) • Internal sensor of the outside rearview mirror (DICS-Main: No. 49) • Internal operation of the outside rearview mirror (DICSMain:No. 53)
0 X 26	Memory switch input during no mirror LT or RT input	- When the outside rearview mirror has no LEFT or RIGHT sensor values, DICS-Main recognizes and disables the vehicle memory function. However, when the memory input has detected, it means the sensor is open-circuited or has different mirror has been installed. - Check the outside rearview mirror LEFT or RIGHT sensor wires. - Measure the sensor values and check the relevant position • Internal RIGHT switch of the outside rearview mirror (DICS-Main: No. 19) • Internal LEFT switch of the outside rearview mirror (DICSMain: No. 20) • Internal RIGHT motor of the outside rearview mirror (DICSMain: No. 35) • nternal LEFT motor of the outside rearview mirror (DICSMain: No. 36) • Internal sensor of the outside rearview mirror (DICS-Main: No. 49) • Internal operation of the outside rearview mirror (DICSMain: No. 53)
0 X 27	Defective auto-stop	- The window does not lower to the certain range when autostop is detected during the driver side window auto-up operation. - Check the power window motor wires - Measure the sensor values and check the relevant position • Power window anti-trap (DICS-Main: No. 50) • Replace the power window motor

▶ Main DICS Input/Output Monitoring Data

No.	Input/ Output	Sensor value item	Information				Help
1	Input	Rear left P/WDW UP S/W	Not operating		Operating		1. Switch the input signal to raise the rear left window 2. Internal input 3. Input signal transmits to STICS through CAN
2	Input	Front right P/WDW DN S/W	Not operating		Operating		1. Switch the input signal to lower the passenger's window 2. Internal input 3. Input signal transmits to DICS-Sub through CAN
3	Input	Front right P/WDW AUTO DN S/W	Not detected		Detected		1. Switch the input signal to lower the passenger's window automatically 2. Internal input 3. Input signal transmits to DICS-Sub through CAN
4	Input	Front right P/WDW UP S/W	Not operating		Operating		1. Switch the input signal to raise the passenger's window 2. Internal input 3. Input signal transmits to DICS-Sub through CAN
5	Input	Front left P/WDW DN S/W	Not operating		Operating		1. Switch the input signal to lower the driver side window 2. Internal input 3. DICS-Main has direct drive circuit
6	Input	Front left P/WDW AUTO DN S/W	Not detected		Detected		1. Switch the input signal to lower the driver side window automatically 2. Internal input 3. MICOM drives based on the signal
7	Input	Front left P/WDW UP S/W	Not operating		Operating		1. Switch input signal to raise the driver side window 2. Internal input 3. DICS-Main has direct drive circuit
8	Input	Front left P/WDW AUTO UP S/W	Not operating		Operating		1. Switch input signal to raise the driver side window automatically (operates only when the engine is running) 2. Internal input 3. MICOM drives based on the signal 4. When the obstruction is found (detects as hall pulse signal), the auto-stop engages the window to be lowered by 150 mm from its position
9	Input	Detecting driver's P/WDW detention	Not detected		Detected		1. Input signal of the motor protection is engaged by cutting the motor output when detects the increasing in currency when the motor is stopped at the lowest position of the driver side's window 2. Internal input
10	Input	Detecting 3 km/h of vehicle speed	Not detected		Detected		1. Input signal coming from STICS 2. Outside rearview mirrors will not fold when the signal comes on while outside rearview mirror is folding.

No.	Input/ Output	Sensor value item	Information				Help
11	Input	The driver side window status (limit switch)	Closed		Open		1. A signal that informs when the driver side window is opened. 2. When the window is at upper position, it is OFF (close) and when it's not in upper position by lowering, it is ON (open). 3. VCC 5 V level when window is opened: Operating 4. Ground level when window is closed: Not operating
12	Input	Easy access switch	Not operating		Operating		1. The steering column and electrical seat moves automatically during riding ON or OFF when this signal is ON. 2. Internal input 3. Input signal transmits to ESIMS and MSDOS through CAN
13	Input	P/WDW lock switch	Not operating		Operating		1. Only the driver side window is operational when this signal is ON. 2. Internal input 3. Input signal transmits to STICS and DICS Sub through CAN
14	Input	Rear right P/WDW DN S/W	Not operating		Operating		1. Switch input signal to lower the rear right window 2. Internal input 3. Input signal transmits to STICS through CAN
15	Input	Rear right P/WDW UP S/W	Not operating		Operating		1. Switch input signal to raise the rear right window 2. Internal input 3. Input signal transmits to STICS through CAN
16	Input	Rear left P/WDW DN S/W	Not operating		Operating		1. Switch input signal to lower the rear left window 2. Internal input 3. Input signal transmits to STICS through CAN
17	Input	Passenger side outside rearview mirror selection switch	Not detected		Detected		1. Signal that operates the driver side mirror, passenger side mirror and inside rearview mirror has selected the passenger side outside rearview mirror 2. Internal input 3. The signal transmits to DICS SUB and ESIMS through CAN
18	Input	Driver side outside rearview mirror selection switch	Not detected		Detected		1. Signal that operates the driver side mirror, passenger side mirror and inside rearview mirror has selected the passenger side outside rearview mirror 2. Internal input 3. When both left and right mirror selection signals are OFF, the signal selects inside rearview mirror and then ESIMS controls the inside rearview mirror 4. The signal transmits to DICS SUB and ESIMS through CAN

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

No.	Input/ Output	Sensor value item	Information				Help
19	Input	Driver side outside rearview mirror right-turn switch	Not operating		Operating		1. Switch input to raise the mirror toward right 2. Internal input 3. This signal transmits to DICS SUB and ESIMS through CAN
20	Input	Driver side outside rearview mirror left-turn switch	Not operating		Operating		1. Switch input to move the mirror toward left 2. Internal input 3. This signal transmits to DICS SUB and ESIMS through CAN
21	Input	Driver side outside rearview mirror down switch	Not operating		Operating		1. Switch input to lower the mirror 2. Internal input 3. This signal transmits to DICS SUB through CAN
22	Input	Driver side outside rearview mirror up switch	Not operating		Operating		1. Switch input to raise the mirror upward 2. Internal input 3. This signal transmits to DICS SUB through CAN
23	Input	Driver side outside rearview mirror unfolding switch	Not operating		Operating		1. Switch input to unfold the mirror 2. Internal input 3. This signal transmits to DICS SUB through CAN
24	Input	Driver side outside rearview mirror folding switch	Not operating		Operating		1. Switch input to fold the mirror 2. Internal input 3. This signal transmits to DICS SUB through CAN
25	Input	Memory switch 3	Not detected		Detected		1. Signal that selects No. 3 memory position 2. When the memory switch is pressed for more than 2 seconds under P/N signal ON condition, MSDOS receives memorized position of the mirror through CAN and then moves the mirror to memorized position. 3. When the memory position switch is pressed after memory set switch input under the P/N signal ON condition, the current position value of the mirror (sensor value) transmits to MSDOS 4. Analog input when operating (about 3.8V) 5. VCC 5V when not operating
26	Input	Memory switch 2	Not detected		Detected		1. Signal that selects number 2 memory position 2. Analog input when operating (about 2.4V) 3. VCC 5V level when not operating
27	Input	Memory switch 1	Not detected		Detected		1. Signal that selects number 1 memory position 2. Analog input when operating (about 1.3V) 3. VCC 5 V level when not operating
28	Input	Memory stop switch	Not detected		Detected		1. Switch signal to stop the memory return 2. Ground level when operating 3. VCC 5 V level when not operating
29	Input	Memory SET switch	Not detected		Detected		1. Switch input to store the positions of the memory related mechanisms. When one of the memory switch among 3 is pressed after this signal, position value of the outside rearview mirrors will be transmitted to MSDOS through CAN 2. Analog input when operating (about 0V) 3. VCC 5 V level when not operating

No.	Input/ Output	Sensor value item	Information				Help
31	Input	Driver side door key unlock	Not operating		Operating		1. ON when the driver side door key fob is unlocked 2. Ground level when operating 3. VCC 5 V level when not operating
32	Input	Driver side door key lock	Not operating		Operating		1. ON when the driver side door key fob is locked 2. Ground level when operating 3. VCC 5 V level when not operating
33	Output	Driver side outside rearview mirror unfolding motor	Not operating		Operating		1. Unfolding operation of the driver side outside rearview mirror mottor 2. Battery level when operating 3. Ground level when not operating
34	Output	Driver side outside rearview mirror folding motor	Not operating		Operating		1. Folding operation of the driver side outside rearview mirror motor 2. Battery level when operating 3. Ground level when not operating
35	Output	Driver side outside rearview mirror right-turn motor	Not operating		Operating		Operates the driver side outside rearview mirror motor toward right
36	Output	Driver side outside rearview mirror left-turn motor	Not operating		Operating		Operates the driver side outside rearview mirror motor toward left
37	Output	Driver side outside rearview mirror down motor	Not operating		Operating		Operates the driver side outside rearview mirror motor down
38	Output	Driver side outside rearview mirror up motor	Not operating		Operating		Operates the driver side outside rearview mirror motor up
39	Output	Driver side P/WDW DN MTR	Not operating		Operating		1. Driver side power window motor down 2. Battery level when operating 3. Ground level when not operating
40	Output	Driver side P/WDW UP MTR	Not operating		Operating		1. Driver side power window motor up 2. Battery level when operating 3. Ground level when not operating
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	Output	Memory LED	Not operating		Operating		1. Indicates when the LED lamp blinks during the memory set or when the return operation is ON 2. 2 V level when operating 3. Ground level when not operating
44	Output	Output power (5V)	Not operating		Operating		1. 5 V of power supplies each of the power window switch, outside rearview mirror sensor and power window motor hall sensor 2. 5 V level when operating 3. Ground level when not operating
45	Output	Driver side outside rearview mirror operating power	Not operating		Operating		1. Supplying power for the mirror LED lamp 2. 5 V level when operating 3. Ground level when not operating
46	Output	Easy access LED	Not operating		Operating		1. LED lamp turns on when easy access switch is pressed and turns off when pressed again.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

No.	Input/ Output	Sensor value item	Information				Help
47	Output	Driver side P/WDW S/W LED					1. LED lamp for power window switch illumination
48	Output	Driver side P/WDW LOCK S/W LED					1. LED lamp turns on when the window lock button is pressed and turns off when pressed again.
49	Status	Yes or No of the driver side outside rearview mirror sensor					1. ON when the driver side outside rearview mirror has no sensor detected or sensor is open-circuited
50	Status	Anti-trap operation status					1. Anti-trap activates when the obstruction is found during auto-up operation of the driver side power window with ignition ON.
51	Status	Side rearview mirror time lag					1. Indicates the outside rearview mirror can be controlled for a certain period of time after ignition key has been removed.
52	Status	Power window time lag					1. Indicates the power window can be controlled for a certain period of time after ignition key has been removed.
53	Status	Possibility of the side rearview mirror operation					1. Indicates the mirror can be controlled when ignition key is in ACC or IGN 1 or when mirror is in time lag
54	Status	Possibility of the power window operation					1. Indicates the power windows can be controlled when ignition key is in IGN 1 or when power windows is in time lag
55	Status	Hall sensor malfunction					1. When the signal coming from a hall sensor in the power window is abnormal
56	Status	Limit switch malfunction					1. When the signal coming from a limit switch in the power window regulator is abnormal
57	Input (CAN)	Armed mode operation state					1. Receives the signal from STICS when the vehicle enters the armed mode by REKES by locking the door. REKES linked power window and outside rearview mirror operation is possible only under the armed status.
58	Input (CAN)	Key ACC power					1. Ignition key ACC status receives from STICS
59	Input (CAN))	IGN 2 power					1. Ignition key IGN 2 status receives from STICS
60	Input	IGN 1 power					1. Ignition key IGN 1 status receives from STICS or DICS receives directly
61	Input (CAN)	Alternator operation status					1. Status of the engine under starting receives from STICS
62	Input (CAN)	Key reminder switch					1. Receives from STICS and indicates when the ignition key is inserted
63	Input (CAN)	Input status of the P/N signals					1. Receives from STICS and indicates the P/N status of transmission
64	Input (CAN)	Input status of the reverse signal					1. Receives from STICS and indicates the reverse status of transmission
65	Input	Lateral sensor value of the driver side outside rearview mirror (HI)	Sensor value (increase or decrease by 1)				1. Vertical sensor upper value of the outside rearview mirror 2. Sensor value when turned right: Increase 3. Sensor value when turned left: Decrease

No.	Input/ Output	Sensor value item	Information	Help
66	Input	Lateral sensor value of the driver side outside rearview mirror (LOW)	Sensor value [value changes within 8 bit (1~255)]	1. Vertical sensor upper value of the outside rearview mirror 2. Sensor value when turned right: Increase 3. Sensor value when turned left: Decrease * HI value increases or decreases by 1 if exceeded 8 bit (1~255)
67	Input	Vertical sensor value of the driver side outside rearview mirror (HI)	Sensor value (increase or decrease by 1)	1. Lateral sensor upper value of the outside rearview mirror 2. Sensor value when moved up: Increase 3. Sensor value when moved down: Decrease
68	Input	Vertical sensor value of the driver side outside rearview mirror (LOW)	Sensor value [value changes within 8 bit (1~255)]	1. Lateral sensor upper value of the outside rearview mirror 2. Sensor value when moved up: Increase 3. Sensor value when moved down: Decrease * HI value increases or decreases by 1 when exceeds 8 bit (1~255)
69	Input	Software version		Indicates current software version

DIAGNOSIS OF SUB DICS

Code	Malfunction	Help
0 X 07	Operates when power window is locked	- When the power window is locked, the window can be operated from the passenger side. (Passenger switch input during the control by DICS-Main while power window is locking) - Defective CAN communication
0 X 08	Door lock key actuator does not operate	- Check the passenger side door actuator • Check the method of actuator operation status - Check the sensor value • Key lock (DICS-Sub: No. 5)
0 X 09	Door unlock key actuator does not operate	- Check the passenger side door actuator • Checking the method of actuator operation status - Check the sensor value • Key unlock (DICS-Sub: No. 4)
0 X 0A	No mirror UP or DN inputs correspondence to the memory switch inputs	- When the outside rearview mirror has no UP or DOWN sensor values, DICS-Main recognizes and disables the vehicle memory function. However, when the memory input has detected, it means the sensor is open-circuited or has different mirror has been installed. - Check the outside rearview mirror UP or DOWN sensor wires - Measure the sensor values and check the relevant position • Internal DOWN motor of the outside rearview mirror (DICS-Sub: No. 13) • Internal UP motor of the outside rearview mirror (DICSSub: No. 14) • Internal sensor of the outside rearview mirror (DICS-Sub: No. 44)
0 X 0B	No mirror LEFT or RIGHT inputs correspondence to the memory switch inputs	- When the outside rearview mirror has no LEFT or RIGHT sensor values, DICS-Main recognizes and disables the vehicle memory function. However, when the memory input has detected, it means the sensor is open-circuited or has different mirror has been installed. - Check the outside rearview mirror LEFT or RIGHT sensor wires - Measure the sensor values and check the relevant position • Internal RIGHT motor of the outside rearview mirror (DICSSub: No. 11) • Internal LEFT motor of the outside rearview mirror (DICSSub: No. 12) • Internal sensor of the outside rearview mirror (DICS-Sub: No. 17)

▶ Sub DICS Input / Output Data

No.	Input/ Output	Sensor value item	Information				Help
1	Input	Detecting passenger side P/WDW detention	Not operating		Operating		1. Input signal for the motor protection is transmitted. The motor output detects increasing current when the motor is stopped at the lowest position of the passenger side window. 2. Internal input
2	-	-	-	-	-	-	-
3	Input	Passenger side door lock knob	Not operating		Operating		1. Status of the door lock actuator monitors ring switch on(passenger side) door trim 2. Ground level when the lock is detected 3. VCC 5V level when the unlock is detected
4	Input	Passenger side door key unlock	Not operating		Operating		1. ON when the passenger side door key fob is unlocked 2. Ground level when operating (unlock) 3. VCC 5V level when not operating (lock)
5	Input	Passenger side door key lock	Not operating		Operating		1. ON when the passenger side door key fob is locked 2. Ground level when operating 3. VCC 5V level when not operating
6	Input	Front left P/WDW DN S/W	Not detected		Detected		1. Switch input signal to lower the passenger side window 2. DICS SUB drives directly with the circuit
7	Input	Front right P/WDW auto DN S/W	Not detected		Detected		1. Switch input signal to lower the passenger side window automatically 2. MICOM drives directly according to the above signal
8	Input	Front right P/WDW UP S/W	Not detected		Detected		1. Switch input signal to raise the passenger side window 2. DICS SUB drives directly with the circuit
9	Output	Passenger side outside rearview mirror unfolding MTR	Not detected		Detected		1. Motor operates the passenger side's outside rearview mirror to unfold
10	Output	Passenger side outside rearview mirror folding MTR	Close		Open		1. Motor operates the passenger side's outside rearview mirror to fold
11	Output	Passenger side outside rearview mirror left-turn MTR	Not operating		Operating		1. Motor operates the passenger side's outside rearview mirror towards right
12	Output	Passenger side outside rearview mirror right-turn MTR	Not operating		Operating		1. Motor operates the passenger side's outside rearview mirror towards left
13	Output	Passenger side outside rearview mirror down MTR	Not operating		Operating		1. Motor operates the passenger side's outside rearview mirror down
14	Output	Passenger side outside rearview mirror up MTR	Not operating		Operating		1. Motor operates the passenger side's outside rearview mirror up
15	Output	Passenger side P/WDW down MTR	Not operating		Operating		1. Passenger side's power window motor down 2. Battery level when operating 3. Ground level when not operating

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

No.	Input/ Output	Sensor value item	Information				Help
16	Output	Passenger side P/ WDW up MTR	Not operating		Operating		1. Passenger side's power window motor up 2. Battery level when operating 3. Ground level when not operating
17	State	Yes or No of the passenger side outside rearview mirror sensor	Yes		No		1. ON when the passenger side's outside rearview mirror has no sensor or sensor is open-circuited
18	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-
20	Output	Output power (5V) VDD	Not operating		Operating		1. 5 V is supplied to the power window switch and outside rearview mirror sensor 2. 5 V of level when operating 3. Ground level when not operating
21	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-
23	Output	Passenger side P/ WDW SW LED Lamp	Not operating		Operating		1. LED lamp for the power window switch illumination (Value changes when the window is locked)
24	-	-	-	-	-	-	-
25	Input	Lateral sensor value of the driver side outside rearview mirror (HI)	Sensor value (increase or decrease by 1)				1. Lateral sensor upper value of the outside rearview mirror Sensor value when moves up: Increase Sensor value when moves down: Decrease
26	Input	Lateral sensor value of the driver side outside rearview mirror (LOW)	Sensor value [value changes within 8 bit (1~255)]				1. Lateral sensor lowers value of the outside rearview mirror Sensor value when moves up: Increase Sensor value when moves down: Decrease
27	Input	Vertical sensor value of the driver side outside rearview mirror (HI)	Sensor value (increase or decrease by 1)				1. Vertical sensor raises value of the outside rearview mirror Sensor value when turns right: Increase Sensor value when turns left: Decrease
28	Input	Vertical sensor value of the driver side outside rearview mirror (LOW)	Sensor value [value changes within 8 bit (1~255)]				1. Vertical sensor raises value of the outside rearview mirror Sensor value when turns right: Increase Sensor value when turns left: Decrease
29	Input	Software version					Indicates the current software version

DIAGNOSIS OF MS-DOS

Code	Malfunction	Help
0 X 61	Defective driver side seat sliding	• MSDOS continuously monitors the sensor values when the driver operates the seat sliding switch or when the memory return is in action. When the seat sliding operation is engaged but the sensor value remains unchanged, the seat motor sensor may be malfunction. **NOTE** **• When it's operated continuously at the seat stall position, it can be recognized as an error and the motor may not respond. You should erase the stored errors then test the seat at the mid position.** • Measure the sensor values and check the relevant position Driver side seat slides-backward (MSDOS sensor value: No. 7) Driver side seat slides-forward (MSDOS sensor value: No. 8) Driver side seat backward slide motor (MSDOS sensor value: No. 15) Driver side seat forward slide motor (MSDOS sensor value: No. 16)
0 X 62	Defective driver side seat tilting	• MSDOS continuously monitors the sensor values when the driver operates the seat tilting or the memory return is in motion. When the seat tilting operation is engaged but the sensor value remains unchanged, the seat motor sensor may be malfunction. **NOTE** **• When it's operated continuously at the seat stall position, it can be recognized as an error and the motor may not respond. You should erase the stored errors then test the seat at the mid position.** • Measure the sensor values and check the relevant position Driver side seat tilt-down (MSDOS sensor value: No. 5) Driver side seat tilt-up (MSDOS sensor value: No. 6) Driver side seat tilt-down motor (MSDOS sensor value: No. 13) Driver side seat tilt-up motor (MSDOS sensor value: No. 14)
0 X 63	Defective driver side seat height adjustment	• MSDOS continuously monitors the sensor values when the driver operates the seat height adjustment or the memory return is in motion. When the seat height adjustment operation is engaged but the sensor value remains unchanged, the seat motor sensor may be malfunction. **NOTE** **• When it's operated continuously at the seat stall position, it can be recognized as an error and the motor may not respond. You should erase the stored errors then test the seat at the mid position.** • Measure the sensor values and check the relevant position Driver side seat height-lowers (MSDOS sensor value: No. 3) Driver side seat height-raises (MSDOS sensor value: No. 4) Driver side seat height-lowering motor (MSDOS sensor value: No. 11) Driver side seat height-raising motor (MSDOS sensor value: No. 12)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Code	Malfunction	Help
0 X 64	Defective driver side seatback angle adjustment	• MSDOS continuously monitors the sensor values when the driver operates the seat reclining or the memory return is in motion. When the seat recline operation is engaged but the sensor value remains unchanged, the seat motor sensor may be malfunction. **NOTE** **• When it's operated continuously at the seat stall position, it can be recognized as an error and the motor may not respond. You should erase the stored errors then test the seat at the mid position.** • Measure the sensor values and check the relevant position Driver side seatback angle-declination (MSDOS sensor value: No. 1) Driver side seatback angle-inclination (MSDOS sensor value: No. 2) Driver side seatback angle-declination motor (MSDOS sensor value: No. 10) Driver side seatback angle-inclination motor (MSDOS sensor value: No. 11)
0 X 65	No position data input from DICSMain	• When MSDOS sends memory setting order, all DICS_MAIN, DICS-SUB and ESIMS send the position data to MSDOS. If no position data has received from DICS_MAIN, then it will be recognized as an error. • Input data from a respective unit when resetting the memory switch • Check CAN communication between DICS_MAIN and MSDOS
0 X 66	No position data input from DICSSub	• When MSDOS sends memory setting order, all DICS_MAIN, DICS-SUB and ESIMS send the position data to MSDOS. If no position data has received from DICS_MAIN, then it will be recognized as an error. • Input data from a respective unit when resetting the memory switch • Check CAN communication between DICS_SUB and MSDOS
0 X 67	No position data input from ESIMS	• When MSDOS sends memory setting order, all DICS_MAIN, DICS-SUB and ESIMS send the position data to MSDOS. If no position data has received from DICS_MAIN, then it will be recognized as an error. • Input data from a respective unit when resetting the memory switch • Check CAN communication between ESIMS and MSDOS
0 X 68	No return data input from DICS-Main	• During the memory return, DICS_MAIN, DICS-SUB and ESIMS send the memory return operation signals continuously through CAN communication. MSDOS recognizes malfunction and then determines as an error when no data has been received from DICS_MAIN during the memory return. • Input data from a respective unit when operating the memory switch • Check CAN communication between DICS_MAIN and MSDOS • During the memory return, DICS_MAIN, DICS-SUB and ESIMS send the memory return operation signals continuously through CAN communication. MSDOS recognizes malfunction and then determines as an error when no data has been received from DICS_MAIN during the memory return.
0 X 69	No return data input from DICS-Sub	• Input data from a respective unit when operating the memory switch • Check CAN communication between DICS_SUB and MSDOS • During the memory return, DICS_MAIN, DICS-SUB and ESIMS send the memory return operation signals continuously through CAN communication. MSDOS recognizes malfunction and then determines as an error when no data has been received from ESIMS during the memory return.
0 X 70	No return data input from ESIMS	• Input data from a respective unit when operating the memory switch • Check CAN communication between ESIMS and MSDOS

▶ MSDOS Input / Output Data

No.	Input/ Output	Sensor value item	Information				Help
1	Input	Driver side seatback reverse switch	Not operating	Vcc	Operating	GND	• A driver operates the seat recliner (seatback angle adjustment) switch backward • Ground level when operating • Vcc level when not operating
2	Input	Driver side seatback forward switch	Not operating	Vcc	Operating	GND	• A driver operates the seat recliner (seatback angle adjustment) switch forward • Ground level when operating • Vcc level when not operating
3	Input	Driver side seat height down switch	Not operating	Vcc	Operating	GND	• A driver operates the seat height (rear part of the seat bottom) adjustment switch downward • Ground level when operating • Vcc level when not operating
4	Input	Driver side seat height up switch	Not operating	Vcc	Operating	GND	• A driver operates the seat height (rear part of the seat bottom) adjustment switch upward • Ground level when operating • Vcc level when not operating
5	Input	Driver side seat tilt-down switch	Not operating	Vcc	Operating	GND	• A driver operates the seat tilting (front part of the seat bottom) switch downward • Ground level when operating • Vcc level when not operating
6	Input	Driver side seat tilt-up switch	Not operating	Vcc	Operating	GND	• A driver operates the seat tilting (front part of the seat bottom) switch upward • Ground level when operating • Vcc level when not operating
7	Input	Driver side seat slide-backward switch	Not operating	Vcc	Operating	GND	• A driver operates the seat slide switch backward • Ground level when operating • Vcc level when not operating
8	Input	Driver side seat slide-forward switch	Not operating	Vcc	Operating	GND	• A driver operates the seat slide switch forward • Ground level when operating • Vcc level when not operating
9	Input	Driver side seatback declining MTR	Not operating	GND	Operating	12 V	• When the recliner (seatback) is moving backward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

No.	Input/ Output	Sensor value item	Information				Help
10	Output	Driver side seatback inclining MTR	Not operating	GND	Operating	12 V	• When the recliner (seatback) is moving forward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.
11	Output	Driver side seat height down MTR	Not operating	GND	Operating	12 V	• When the seat height adjustment (rear part of the seat bottom) is moving downward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.
12	Output	Driver side seat height up MTR	Not operating	GND	Operating	12 V	• When the seat height adjustment (rear part of the seat bottom) is moving upward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.
13	Output	Driver side seat tilt-down MTR	Not operating	GND	Operating	12 V	• When the seat tilts (front part of the seat bottom) downward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.

No.	Input/ Output	Sensor value item	Information				Help
14	Output	Driver side seat tilt-up MTR	Not operating	GND	Operating	12 V	• When the seat tilts (front part of the seat bottom)upward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.
15	Output	Driver side seat slide-backward MTR	Not operating	GND	Operating	12 V	• When the seat (forward/backward movement of seat) slides backward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.
16	Output	Driver side seat slide-forward MTR	Not operating	GND	Operating	12 V	• When the seat (forward/backward movement of seat) slides forward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.
17	Output	Driver side seat slide sensor value	Sensor value				• Sensor value when seat slides (forward or backward movement of the seat) is moving • Sensor value when moving forward: Increase • Sensor value when moving backward: Decrease
18	Input	Driver side seat tilting sensor value	Sensor value				• Sensor value when seat tilting (front part of the seat bottom) is moving • Sensor value when moving upward: Increase • Sensor value when moving downward: Decrease
19	Input	Driver side seat height sensor value	Sensor value				• Sensor value when seat height (rear part of the seat bottom) is moving • Sensor value when moving upward: Increase • Sensor value when moving downward: Decrease
20	Input	Driver side seatback sensor value	Sensor value				• Sensor value when seat recliner (seatback) is moving • Sensor value when moving forward: Increase • Sensor value when moving backward: Decrease

DIAGNOSIS OF ESIMS

Code	Malfunction	Help
0 X 81	Defective steering column tilt	- ESIMS continuously monitors the sensor values when the driver operates the steering column or the steering column is in motion. When the teering wheel column operation is engaged but the sensor value remains unchanged, the motor or the sensor may be malfunction. - Measure the sensor values and check the relevant position • Steering column tilt-up (ESIMS sensor value: No. 1) • Steering column tilt-down (ESIMS sensor value: No. 2) • Steering column tilt-up motor (ESIMS sensor value: No. 13) • Steering column tilt-down motor (ESIMS sensor value: No. 14)
0 X 82	Defective steering column telescope	- ESIMS continuously monitors the sensor values when the driver operates the steering column or the steering column is in motion. When the steering wheel column operation is engaged but the sensor value remains unchanged, the motor or the sensor may be malfunction. - Measure the sensor values and check the relevant position • Steering column tilt-up (ESIMS sensor value: No. 3) • Steering column tilt-down (ESIMS sensor value: No. 4) • Steering column tilt-up motor (ESIMS sensor value: No. 15) • Steering column tilt-down motor (ESIMS sensor value: No. 16)
0 X 83	Defective inside rearview mirror left or right movement	- ESIMS continuously monitors the sensor values when the driver adjusts the inside rearview mirror horizontally or the inside rearview mirror is in motion. When the inside rearview mirror horizontal operation is engaged but the sensor value remains unchanged, the motor or the sensor may be malfunction. **NOTE** **• When it's operated continuously at the stall position, it can be recognized as an error and the motor may not respond. You should erase the stored errors then test the inside rearview mirror from the mid position.** - Measure the sensor values and check the relevant position • Inside rearview mirror moves right (ESIMS sensor value: No. 5) • Inside rearview mirror moves left (ESIMS sensor value: No. 6) • Inside rearview mirror left movement motor (ESIMS sensor value: No. 11) • Inside rearview mirror right movement motor (ESIMS sensor value: No. 12)
0 X 84	Defective inside rearview mirror up or down functions	- ESIMS continuously monitors the sensor values when the driver adjusts the inside rearview mirror vertically or the inside rearview mirror is in motion. When the inside rearview mirror vertical operation is engaged but the sensor value remains unchanged, the motor or the sensor may be malfunction. **NOTE** **• When it's operated continuously at the stall position, it can be recognized as an error and the motor may not respond. You should erase the stored errors then test the inside rearview mirror from the mid position.** - Measure the sensor values and check the relevant position • Inside rearview mirror moves down (ESIMS sensor value: No. 7) • Inside rearview mirror moves up (ESIMS sensor value: No. 8) • Inside rearview mirror down movement motor (ESIMS sensor value: No. 10) • Inside rearview mirror up movement motor (ESIMS sensor value: No. 9)

▶ ESIMS Input / Output Data

No.	Input/ Output	Sensor value item	Information				Help
1	Input	Steering wheel tilt-up switch	Not operating	Vcc	Operating	GND	1. A driver operates the tilt switch at the steering column upward 2. Ground level when operating 3. Vcc level when not operating
2	Input	Steering wheel tilt-down switch	Not operating	Vcc	Operating	GND	1. A driver operates the tilt switch at the steering column downward 2. Ground level when operating 3. Vcc level when not operating
3	Input	Steering wheel telescope up switch	Not operating	Vcc	Detected	GND	1. A driver operates the telescopic switch on the steering column toward extract 2. Ground level when operating 3. Vcc level when not operating
4	Input	Steering wheel telescope down switch	Not operating	Vcc	Operating	GND	1. A driver operates the telescopic switch on the steering column toward retract 2. Ground level when operating 3. Vcc level when not operating
5	Input	Inside rearview mirror right moving switch	Not operating	Vcc	Operating	GND	1. A driver presses the right side of the mirror operation switch when the mirror selector switch is in the neutral position (center) (at this moment, the mirror can be adjusted) 2. Ground level when operating 3. Vcc level when not operating 4. When this switch is detected, the mirror moves right (*Note: The mirror operates when the ignition switch is in ACC or other position) 5. Receives CAN data from DICS-Main
6	Input	Inside rearview mirror left moving switch	Not operating	Vcc	Detected	GND	1. A driver presses the left part of the mirror operation switch when the mirror selector switch is in center position (at this moment, the mirror can be adjusted) 2. Ground level when operating 3. Vcc level when not operating 4. When this switch is detected, the mirror moves left (*Note: The mirror operates when the ignition switch is in ACC or other position) 5. Receives CAN data from DICS-Main
7	Input	Inside rearview mirror down moving switch	Not operating	Vcc	Operating	GND	1. A driver presses the lower part of the mirror operation switch when the mirror selector switch is in center position (at this moment, the mirror can be adjusted) 2. Ground level when operating 3. Vcc level when not operating 4. When this switch is detected, the mirror tilts down (*Note: The mirror operates if ignition switch is in ACC or more) 5. Receives CAN data from DICS-Main
8	Input	Inside rearview mirror up moving switch	Not operating	Vcc	Operating	GND	1. A driver presses the upper part of the mirror operation switch when the mirror selector switch is in center position (at this moment, the mirror can be adjusted) 2. Ground level when operating 3. Vcc level when not operating 4. When this switch is detected, the mirror tilts up (*Note: The mirror operates if ignition switch is in ACC or more) 5. Receives CAN data from DICS-Main

No.	Input/ Output	Sensor value item	Information				Help
9	Output	Inside rearview mirror up motor	Not operating	GND	Operating	12 V	1. When the mirror (motor for vertical movement) is moving upward 2. Battery level when operating 3. Ground level when not operating
10	Output	Inside rearview mirror down motor	Not operating	GND	Operating	12 V	1. When the mirror (motor for vertical movement) is moving downward 2. Battery level when operating 3. Ground level when not operating
11	Output	Inside rearview mirror left moving motor	Not operating	GND	Operating	12 V	1. When the mirror (motor for vertical movement) is moving downward 2. Battery level when operating 3. Ground level when not operating
12	Output	Inside rearview mirror right moving motor	Not operating	GND	Operating	12 V	1. When the mirror (motor for horizontal movement) is moving right side 2. Battery level when operating 3. Ground level when not operating
13	Output	Steering wheel tilt-up motor	Not operating	GND	Operating	12 V	1. When the tilt motor on the steering column is moving upward 2. Battery level when operating 3. Ground level when not operating
14	Output	Steering wheel tilt-down motor	Not operating	GND	Operating	12 V	1. When the tilt motor on the steering column is moving downward 2. Battery level when operating 3. Ground level when not operating
15	Output	Steering wheel telescope up MTR	Not operating	GND	Operating	12 V	1. When the telescopic motor on the steering column is moving towards the driver 2. Battery level when operating 3. Ground level when not operating
16	Output	Steering wheel telescope down MTR	Not operating	GND	Operating	12 V	1. When the telescopic motor on the steering column is moving away from the driver 2. Battery level when operating 3. Ground level when not operating
17	Input	Steering wheel column tilting sensor	Sensor value				1. Sensor value when the tilt motor on the steering column is moving up/down 2. Sensor value when moving up: Decrease 3. Sensor value when moving down: Increase
18	Input	Steering wheel column telescope sensor	Sensor value				1. Sensor value when the telescopic motor on the steering column is moving up/down 2. Sensor value when moving long extraction : Decrease 3. Sensor value when moving short retraction : Increase
19	Input	Inside rearview mirror left and right movement sensor	Sensor value				1. Sensor value when the longitudinal motor in the mirror moves left or right 2. Sensor value when moving toward right: Increase 3. Sensor value when moving toward left: Decrease
20	Input	Inside rearview mirror up and down movement sensor	Sensor value				1. Sensor value when the vertical motor in the mirror moves up or down 2. Sensor value when moving upward: Increase 3. Sensor value when moving downward: Decrease

MEMO

ACTYON

ACTYON SPORTS

SUPPLEMENT SERVICE MANUAL

ISSUED BY
OVERSEAS A/S TEAM
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ACTYON

(EURO IV - LHD)

ELECTRICAL WIRING DIAGRAM

SsangYong Motor Co., Ltd.

PYUNGTAEK, KOREA

SECTION INDEX

POSITION OF CONNECTORS AND GROUNDS	1
USAGE AND CAPACITY OF FUSES IN FUSE BOX	2
WIRING DIAGRAM FOR POWER SUPPLIES	3
ELECTRICAL WIRING DIAGRAMS	4

SECTION 1

POSITION OF CONNECTORS AND GROUNDS

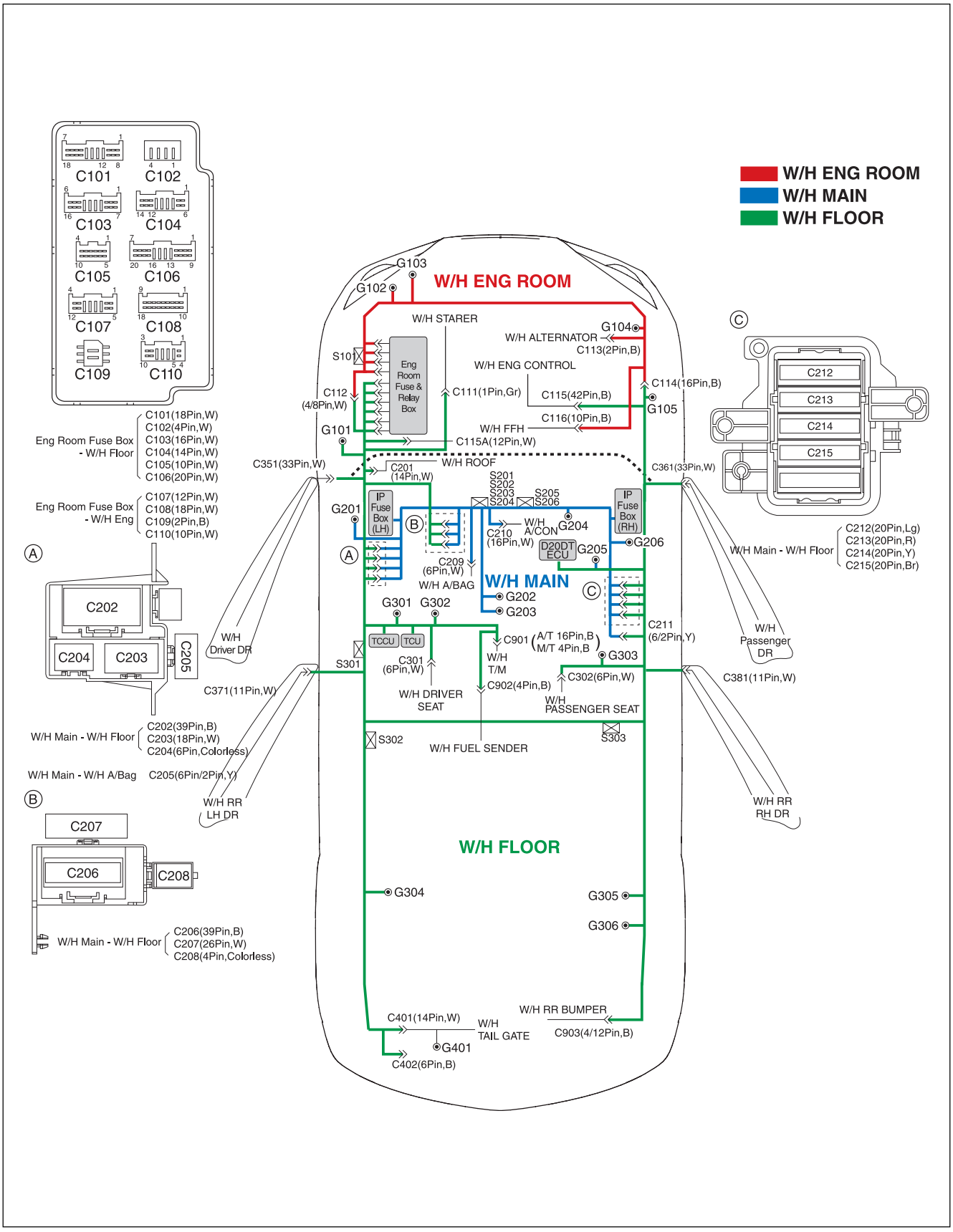
TABLE OF CONTENTS

1. WIRING HARNESS, COMPONENTS LOCATION 0000 1-2

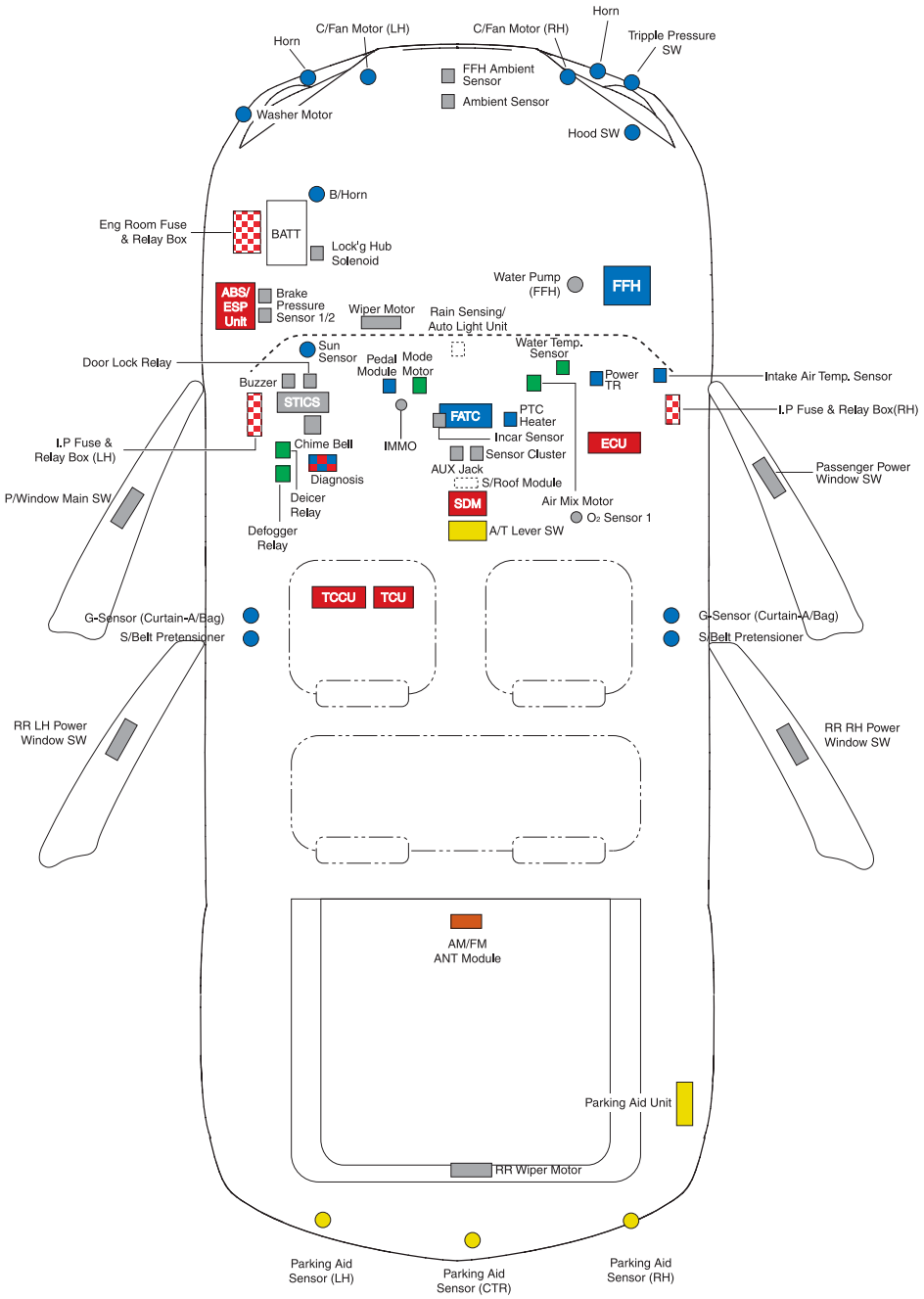
1) WIRING HARNESS 1-2
2) COMPONENTS LOCATION 1-3
3) CONNECTOR, GROUND & SPLICE PACK INFORMATION 1-4
4) SPLICE PACK CIRCUIT 1-7
5) CONNECTOR 1-11

1. WIRING HARNESS, COMPONENTS LOCATION 0000

1) WIRING HARNESS



2) COMPONENTS LOCATION



3) CONNECTOR, GROUND & SPLICE PACK INFORMATION

▶ CONNECTOR

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C109 (2Pin, Black)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C110 (10Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C111 (1Pin, Gray)	W/H Floor - Starter Motor	Under the Preheating Time Relay	Solenoid
C112 (8Pin, White)	W/H Eng - W/H Floor	Inside Eng Room Fuse& Relay Box	ABS/ESP
C112 (4Pin, White)	W/H Eng - W/H Floor	Inside Eng Room Fuse& Relay Box	-ABS
C113 (2Pin, Black)	W/H Eng - W/H Alternator	Backside RH Head Lamp	
C114 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C115A (12Pin, White)	W/H Eng - W/H Floor	Beside ABS/ESP Unit	
C116 (10Pin, Black)	W/H Eng - W/H FFH	Right Eng Room Dash PNL	FFH
C201 (14Pin, White)	W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C205 (2Pin, Yellow)	W/H Main - W/H A/Bag	Driver Cowl Side C/Holder	
C205 (6Pin, Yellow)	W/H Main - W/H A/Bag	Driver Cowl Side C/Holder	Curtain A/Bag
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C208 (4Pin, Colorless)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C209 (6Pin, White)	W/H Main - W/H A/Bag	Upper the Driver Legroom	A/Bag
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C211 (2Pin, Yellow)	W/H Main - W/H A/Bag	Passenger Cowl Side C/Holder	
C211 (6Pin, Yellow)	W/H Main - W/H A/Bag	Passenger Cowl Side C/Holder	Curtain A/Bag
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C215 (20Pin, Brown)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C301 (6Pin, White)		W/H Floor - W/H Driver Seat	Under the Driver Seat	
C302 (6Pin, White)		W/H Floor - W/H Passenger Seat	Under the Passenger Seat	
C351 (33Pin, White)		W/H Floor - W/H Driver DR	Under the LH “A” PLR	
C361 (33Pin, White)		W/H Floor - W/H Passenger DR	Under the RH “A” PLR	
C371 (11Pin, White)		W/H Floor - W/H RR LH DR	Under the LH “B” PLR	
C381 (11Pin, White)		W/H Floor - W/H RR RH DR	Under the RH “B” PLR	
C401 (14Pin, White)		W/H Floor - W/H T/Gate	Under the LH T/Gate	
C402 (6Pin, Black)		W/H Floor - W/H Trailer	Under LH Bumper	
C901	(16Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	A/T
	(4Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	M/T
C902 (4Pin, Black)		W/H Floor - W/H Fuel Sender	Upper the T/M	
C903	(12Pin, Black)	W/H Floor - W/H PAS	Under LH Bumper	PAS, RR FOG
	(4Pin, Black)	W/H Floor - W/H PAS	Under LH Bumper	RR FOG

▶ GROUND

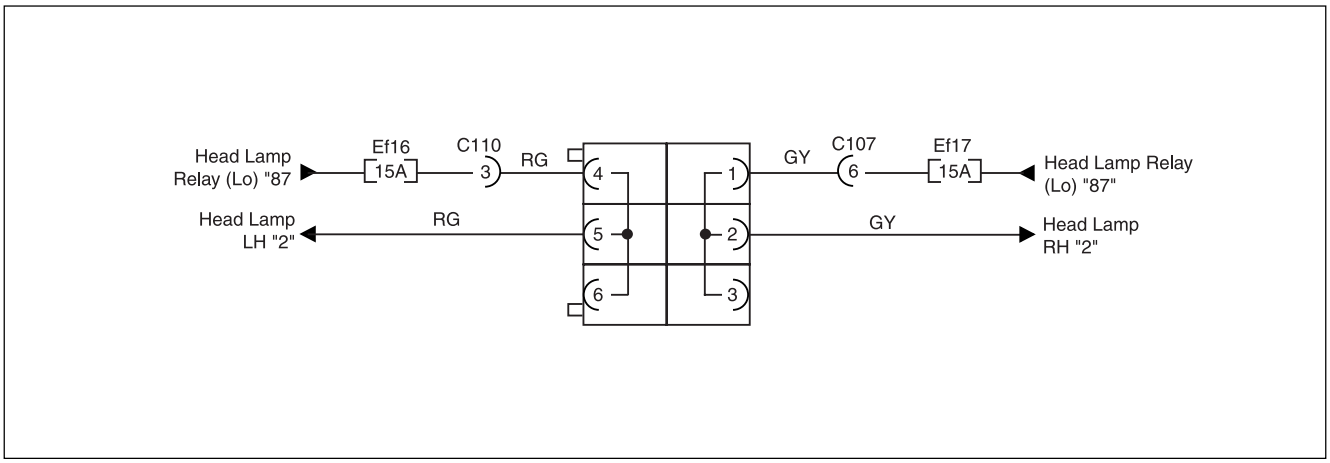
Connector Number	Connecting Wiring Harness	Connector Position	Remark
G101	W/H Floor	ABS/ESP Modulator	ABS/ESP
G102	W/H Eng Room	Behind LH Head Lamp	
G103	W/H Eng Room	LH FRT END PNL (LH Head Lamp Side)	
G104	W/H Eng Room	Behind RH Head Lamp	
G105	W/H Floor	RH Cowl Side PNL (Beside C114)	A/Bag
G201	W/H Main	Under the Driver Cowl Side PNL	Under C/Holder
G202	W/H Main	Backside A/T Lever Unit	Audio
G203	W/H Main (W/H A/Bag)	Backside A/T Lever Unit	A/Bag
G204	W/H Main	LH Eng ECU	PTC
G205	W/H Floor	RH Eng ECU	ECU
G206	W/H Main	Inner the Passenger Cowl Side PNL	
G301	W/H Floor	Under the Driver Seat	
G302	W/H Floor	Under the Driver Seat	
G303	W/H Floor	Under the Passenger Seat	
G304	W/H Floor	Driver QTR PNL (Under the QTR Glass)	
G305	W/H Floor	Passenger QTR PNL (Under the QTR Glass)	
G306	W/H Floor	Passenger QTR PNL (Under the QTR Glass)	Audio
G401	W/H T/Gate	Center the T/Gate	

▶ SPLICE PACK

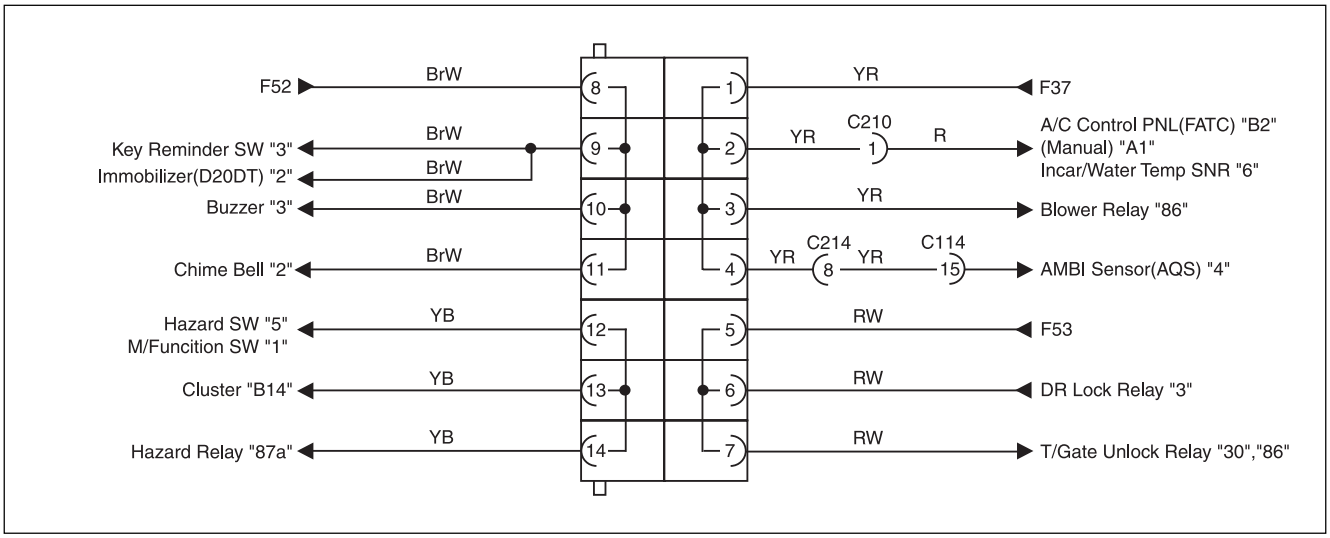
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
S101 (6Pin, Black)	W/H Eng	Inside the Eng Room Fuse & Relay Box	Head Lamp
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN1, T/Signal
S301 (14Pin, Black)	W/H Floor	Beside Driver Seat W/H Protector	CAN
S302 (14Pin, Black)	W/H Floor	Beside RR LH Seat W/H Protector	
S303 (8Pin, Black)	W/H Floor	Under the Passenger “B” PLR W/H Protector	DR Lock

4) SPLICE PACK CIRCUIT

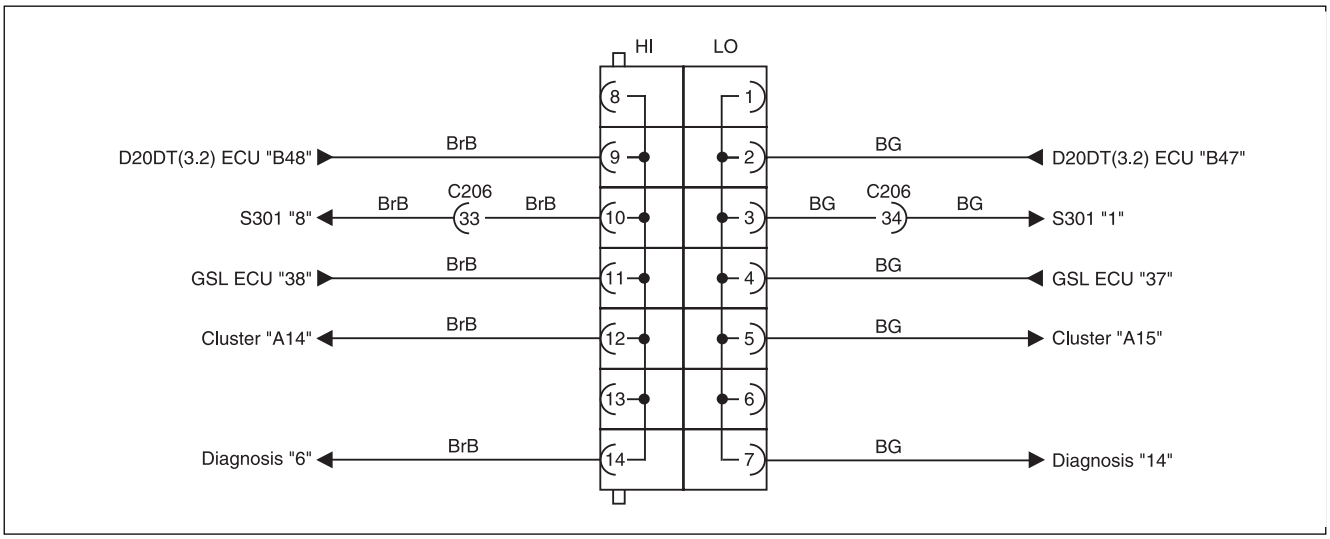
• **S101**



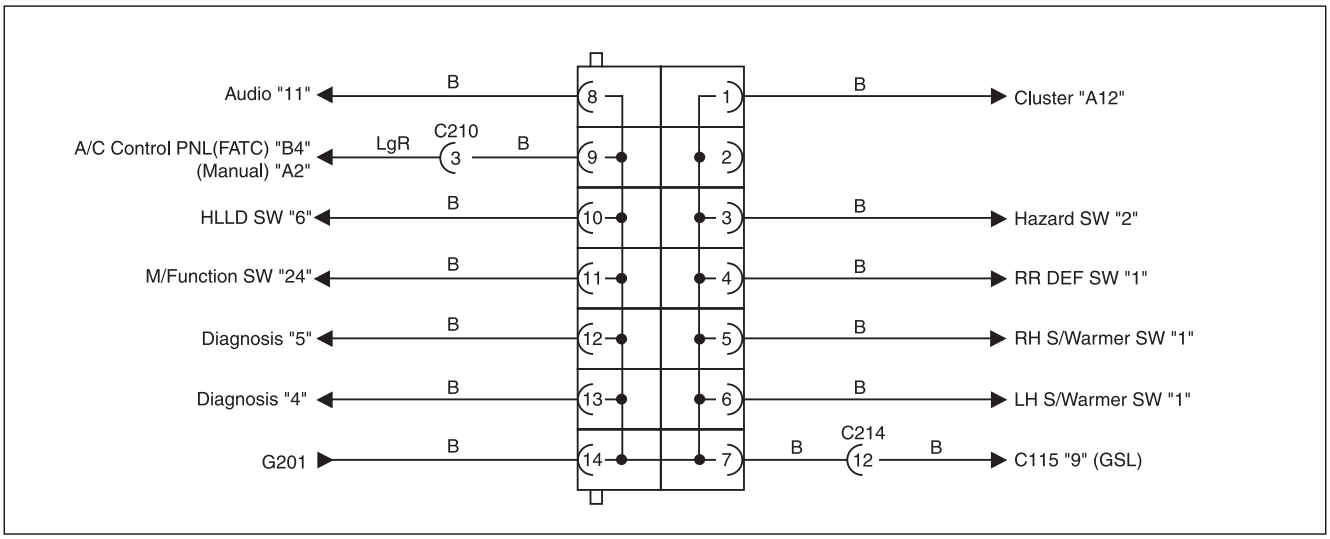
• **S201**



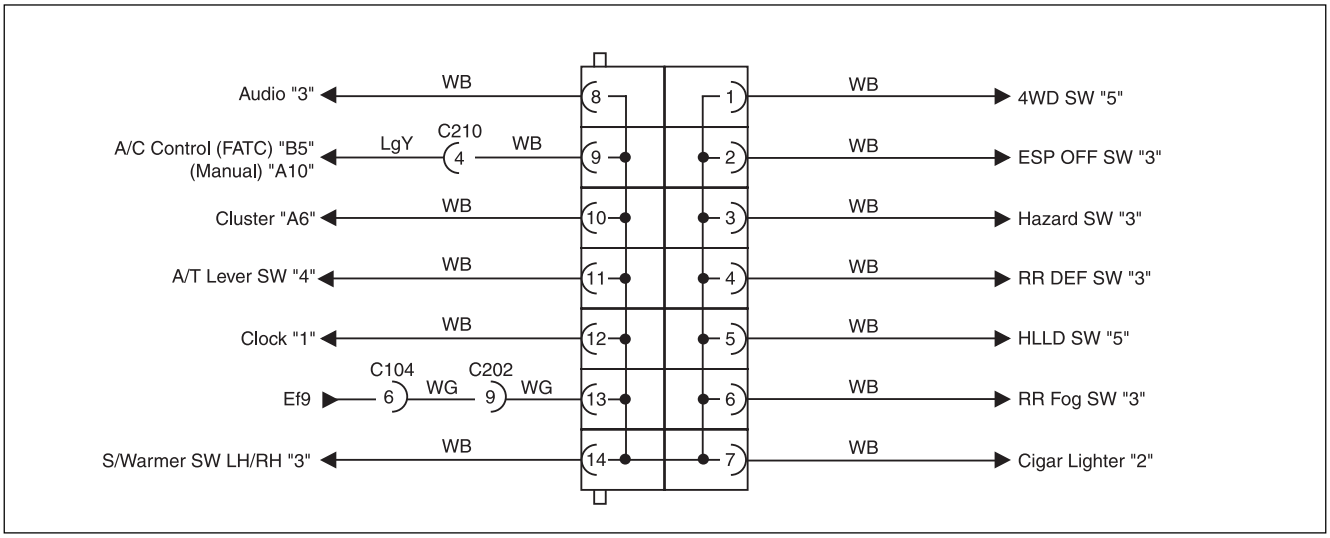
• **S202 (CAN)**



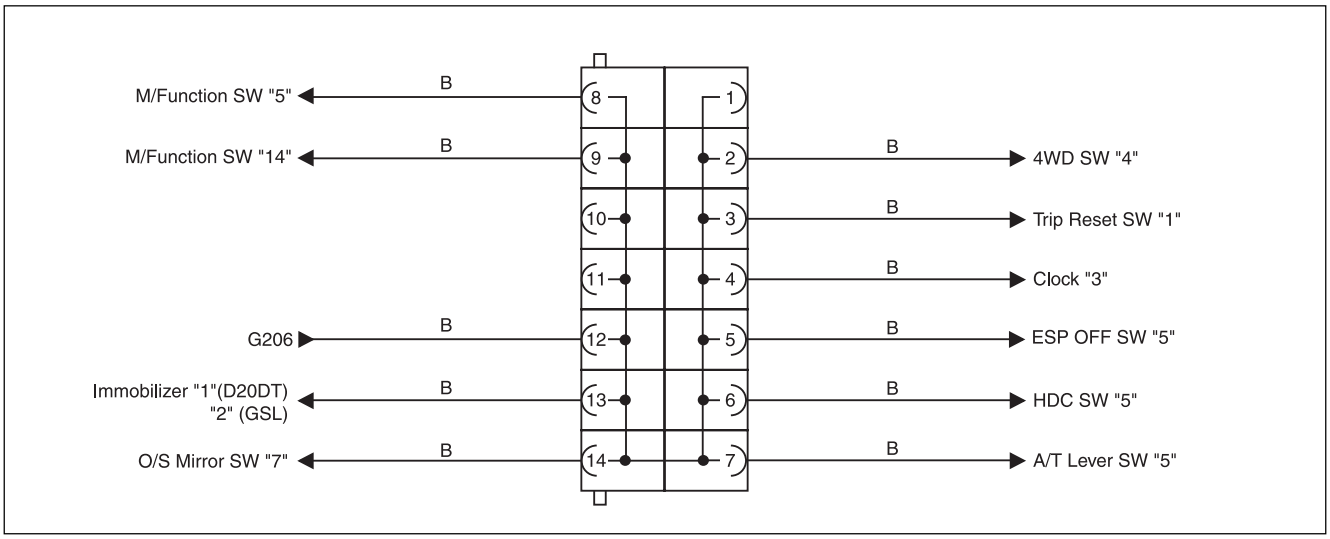
• **S203 (GND)**



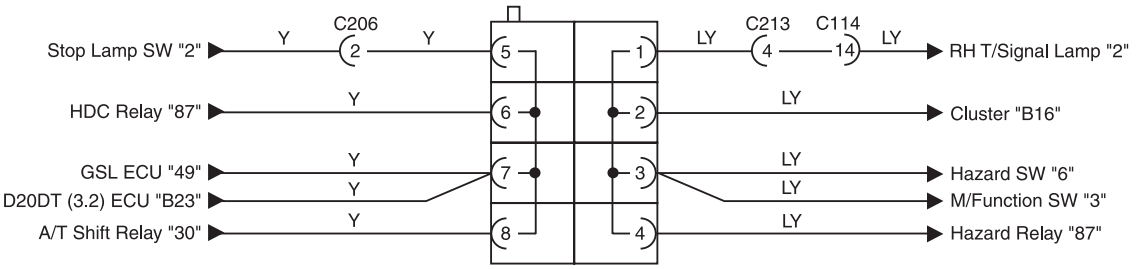
• **S204 (ILL+)**



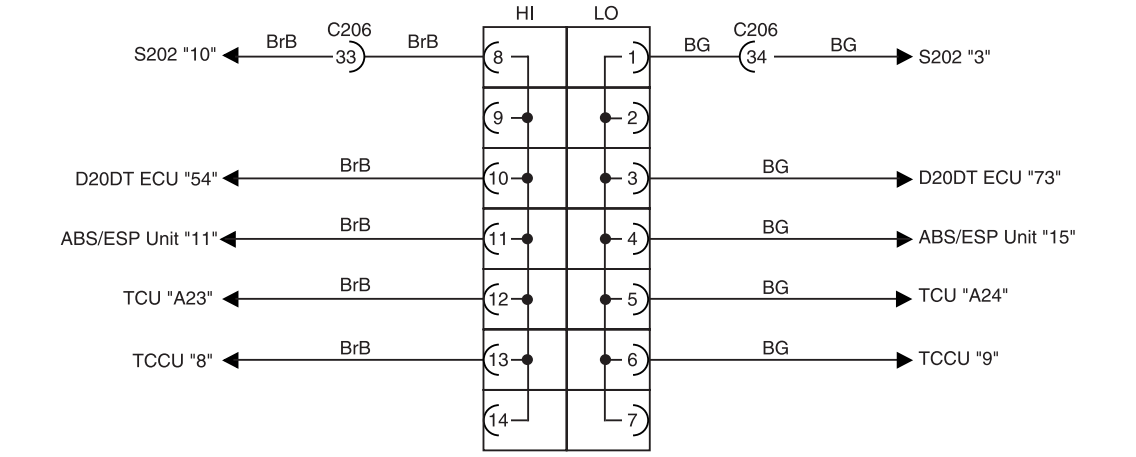
• **S205 (GND)**



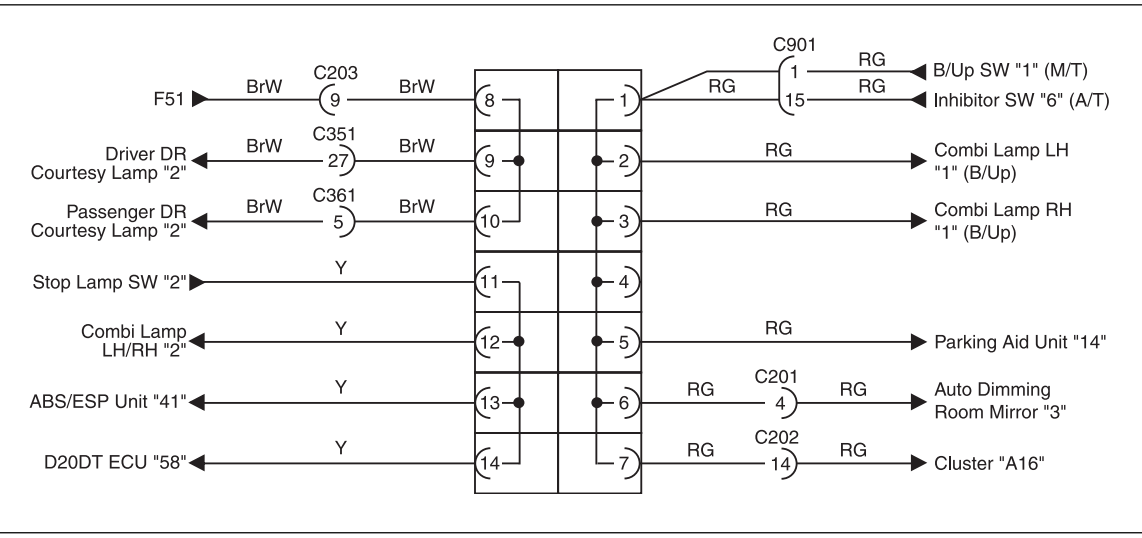
• **S206**



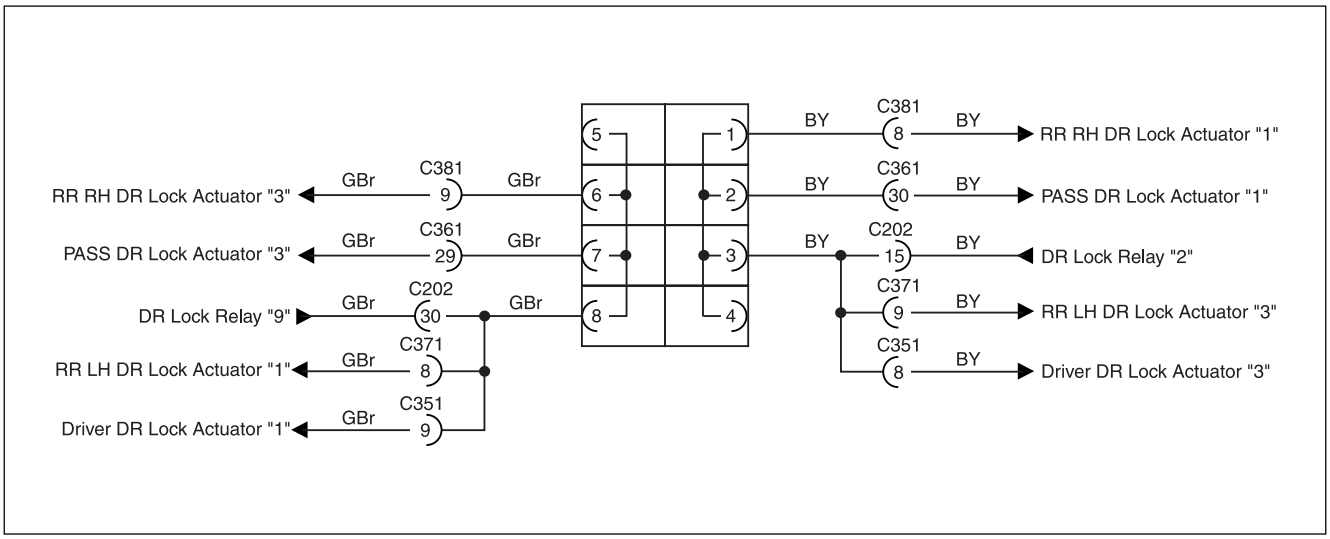
• **S301 (CAN)**



• **S302**

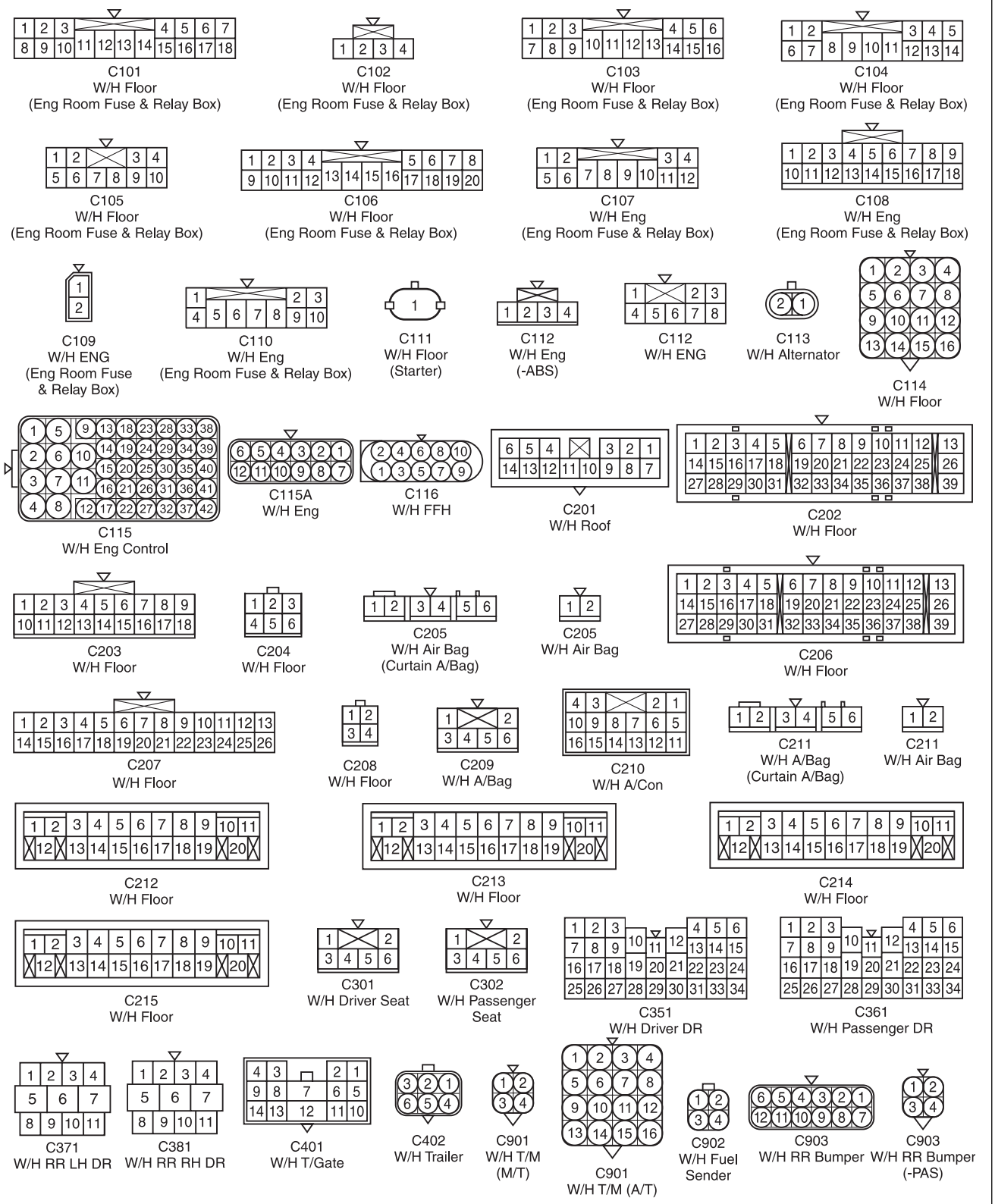


• **S303**

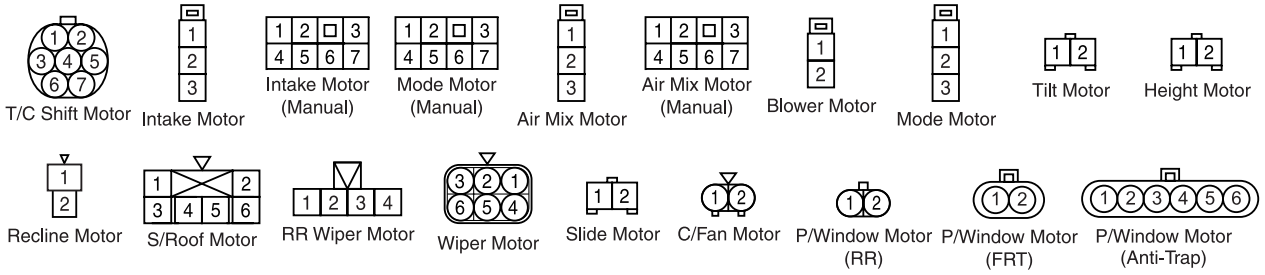

RR RH DR Lock Actuator "3"
GBr
C381
9
GBr
PASS DR Lock Actuator "3"
GBr
C361
29
GBr
DR Lock Relay "9"
GBr
C202
30
GBr
RR LH DR Lock Actuator "1"
GBr
C371
8
Driver DR Lock Actuator "1"
GBr
C351
9
5
6
7
8
1
2
3
4
BY
C381
8
BY
RR RH DR Lock Actuator "1"
BY
C361
30
BY
PASS DR Lock Actuator "1"
BY
C202
15
BY
DR Lock Relay "2"
C371
9
BY
RR LH DR Lock Actuator "3"
C351
8
BY
Driver DR Lock Actuator "3"

5) CONNECTOR

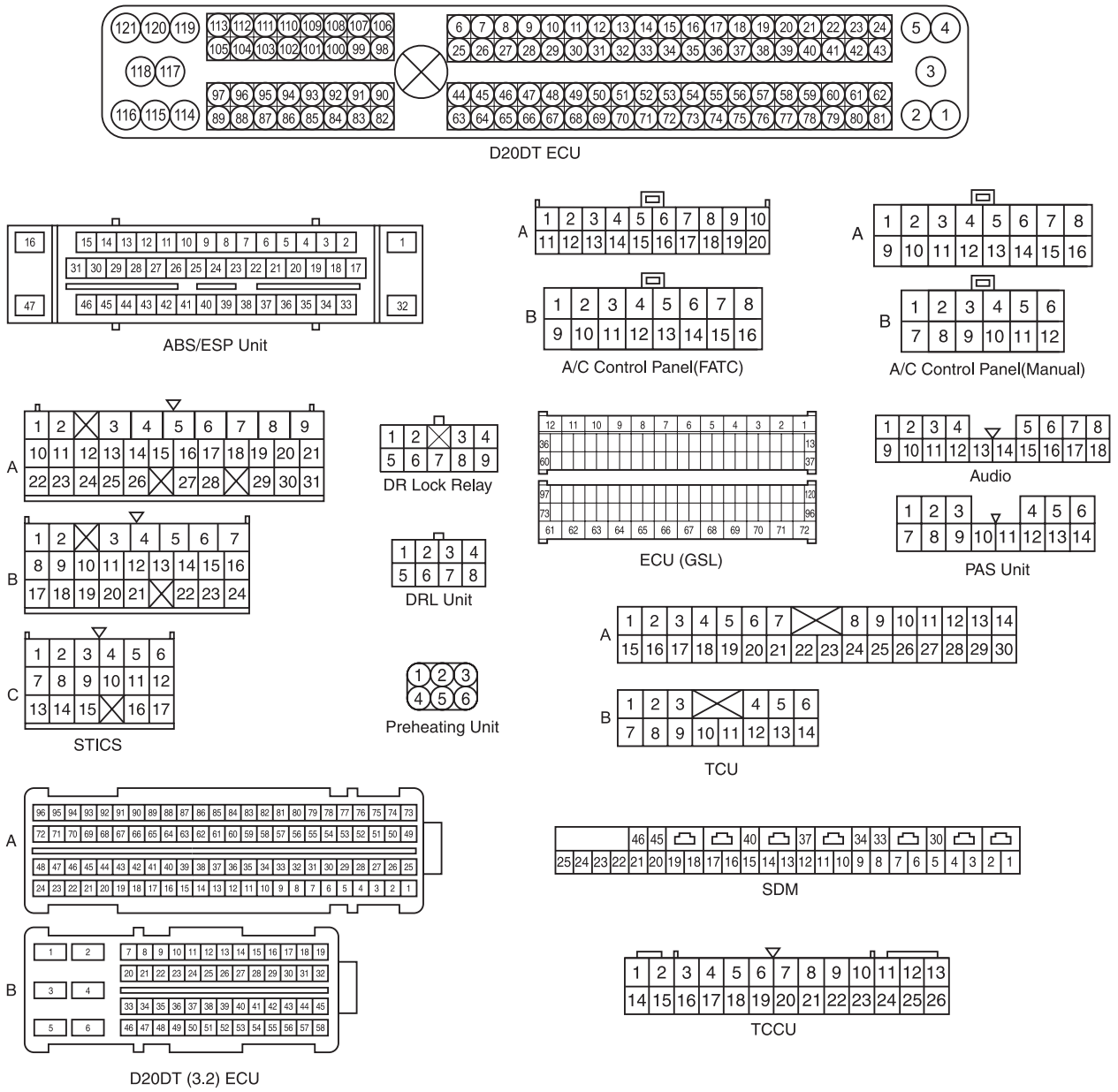
• WIRING CONNECTOR



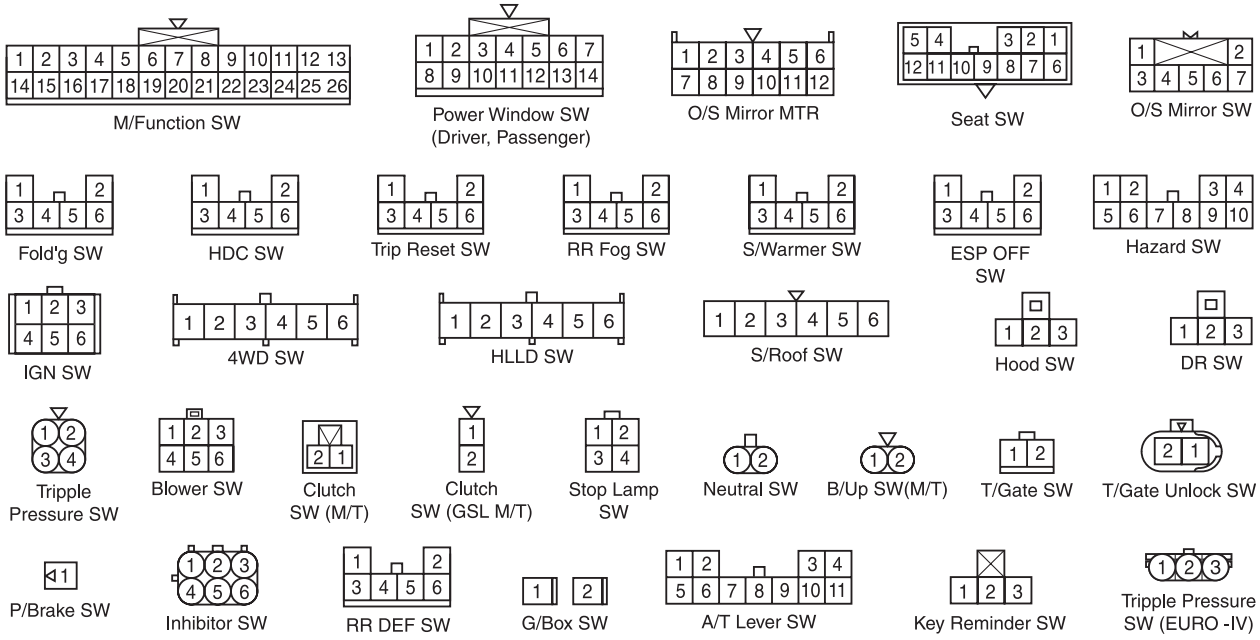
• MODE CONNECTOR



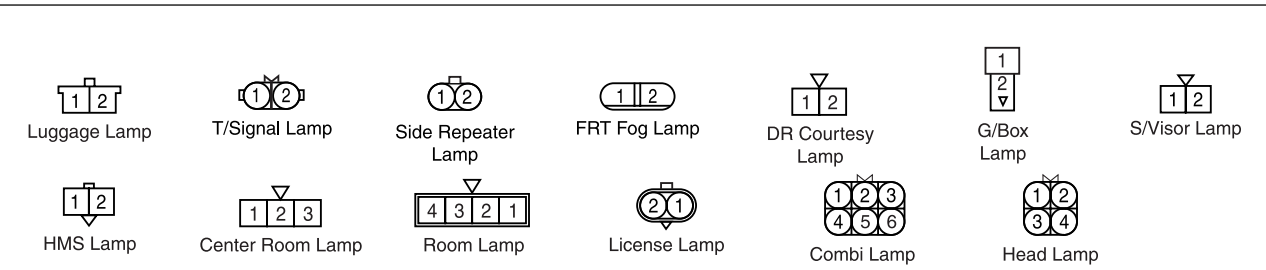
• UNIT CONNECTOR



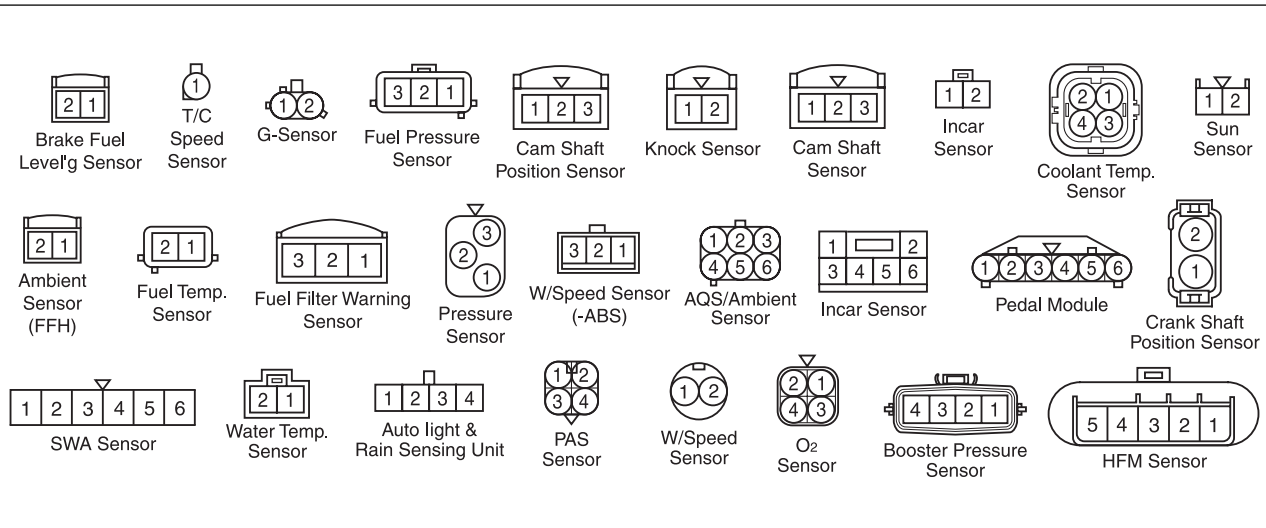
• SWITCH CONNECTOR



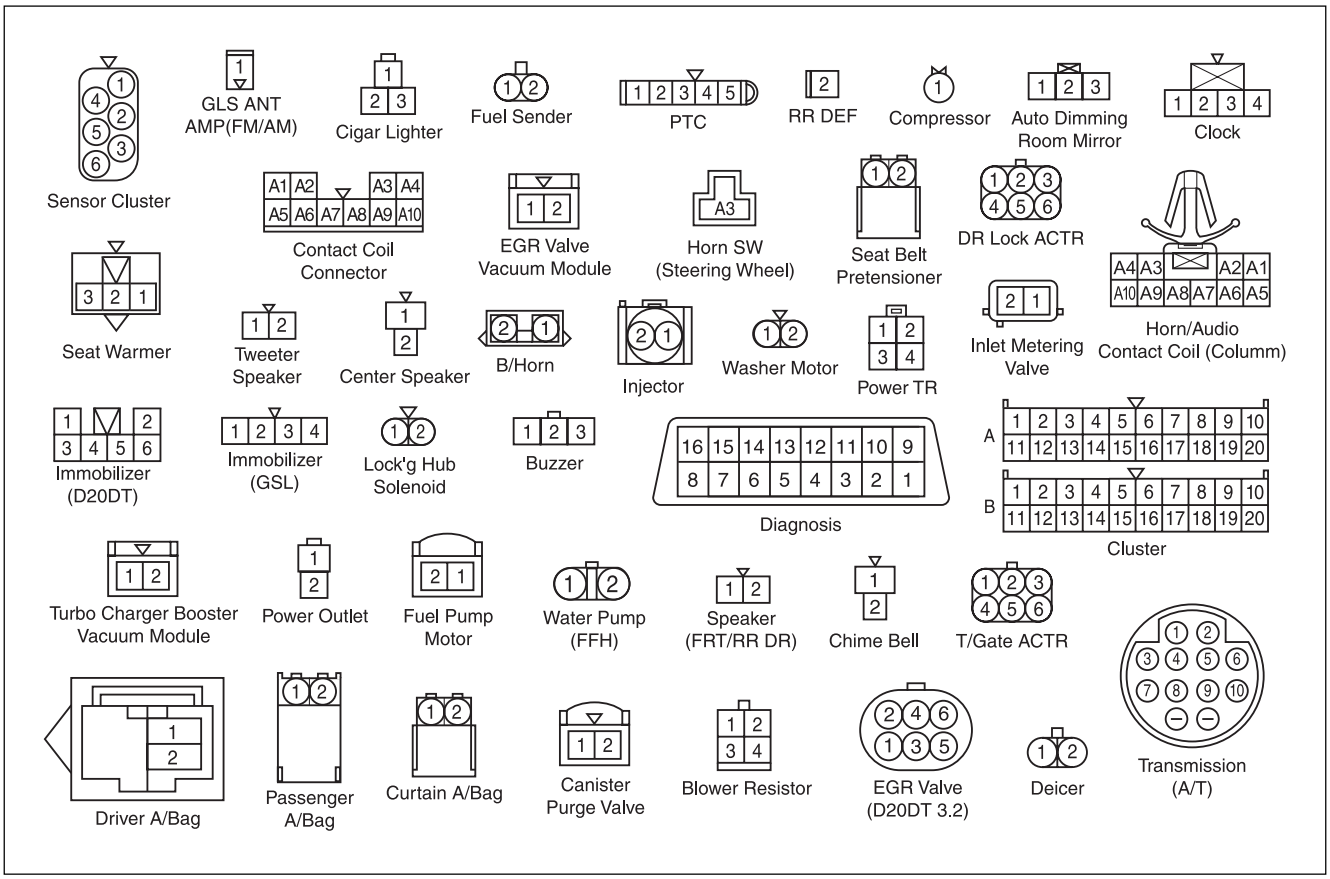
• LAMP CONNECTOR



• SENSOR CONNECTOR



• **ETC.**


Sensor Cluster
GLS ANT AMP(FM/AM)
Cigar Lighter
Fuel Sender
PTC
RR DEF
Compressor
Auto Dimming Room Mirror
Clock
Contact Coil Connector
EGR Valve Vacuum Module
Horn SW (Steering Wheel)
Seat Belt Pretensioner
DR Lock ACTR
Seat Warmer
Tweeter Speaker
Center Speaker
B/Horn
Injector
Washer Motor
Power TR
Inlet Metering Valve
Horn/Audio Contact Coil (Columm)
Immobilizer (D20DT)
Immobilizer (GSL)
Lock'g Hub Solenoid
Buzzer
Diagnosis
Cluster
Turbo Charger Booster Vacuum Module
Power Outlet
Fuel Pump Motor
Water Pump (FFH)
Speaker (FRT/RR DR)
Chime Bell
T/Gate ACTR
Driver A/Bag
Passenger A/Bag
Curtain A/Bag
Canister Purge Valve
Blower Resistor
EGR Valve (D20DT 3.2)
Deicer
Transmission (A/T)

SECTION 2

USAGE AND CAPACITY OF FUSES IN FUSE BLOCK

TABLE OF CONTENTS

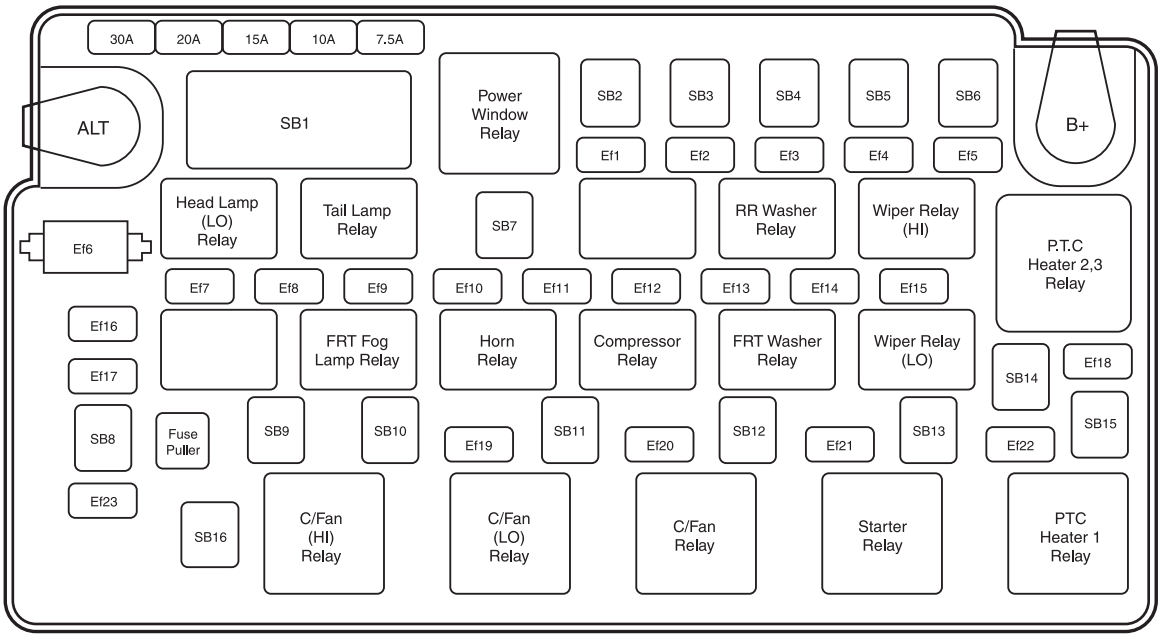
1. ENGINE ROOM FUSE & RELAY BOX 8410 2-2

2. I/P - LH FUSE & RELAY BOX 8410 2-5

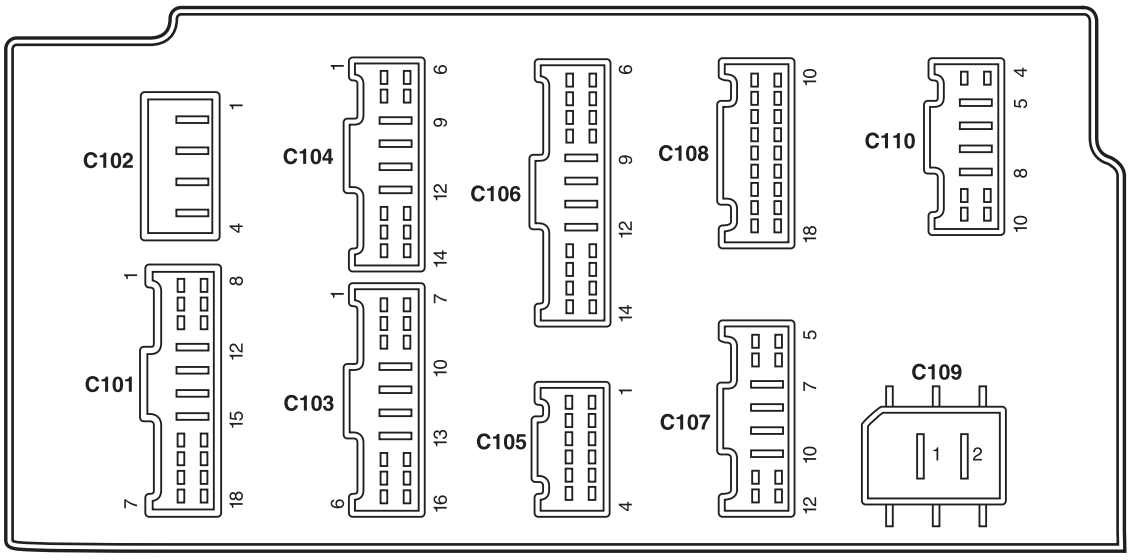
3. I/P - RH FUSE & RELAY BOX 8410 2-7

1. ENGINE ROOM FUSE & RELAY BOX 8410

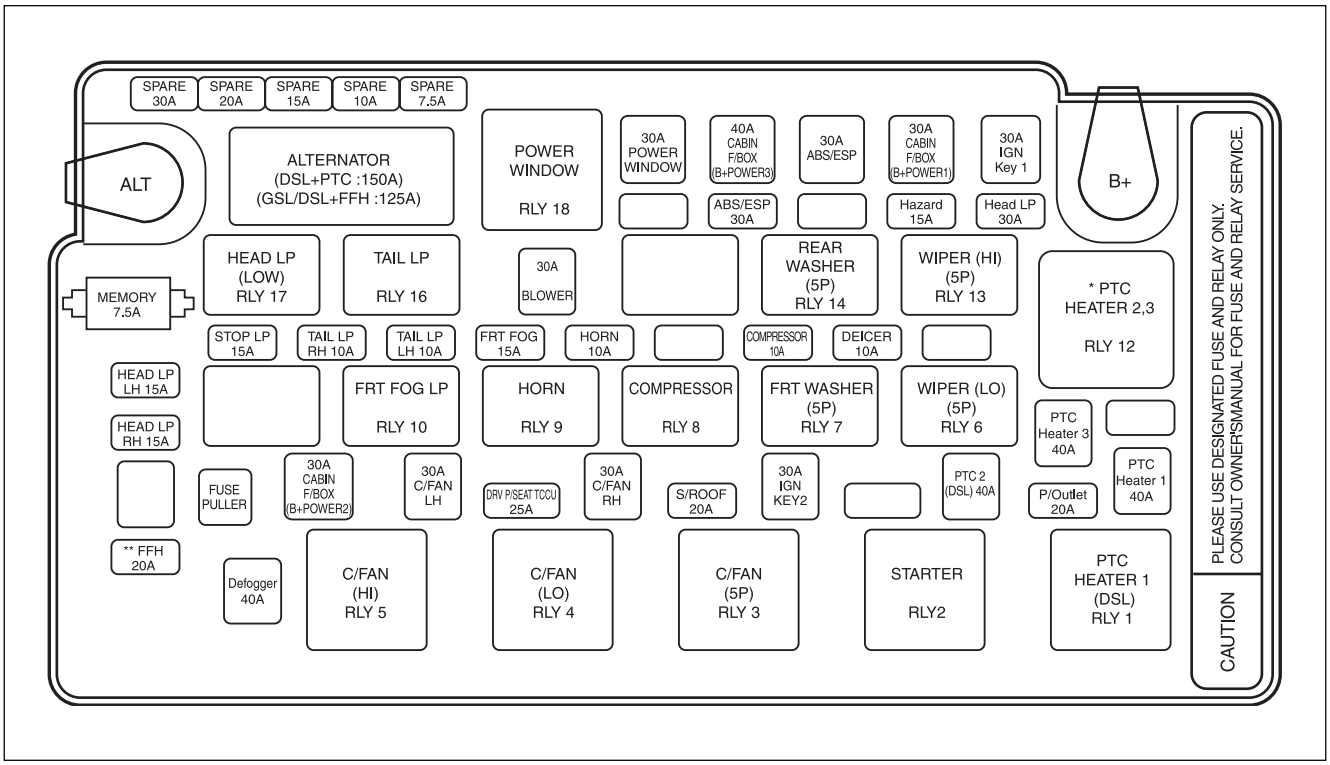
1) UPPER



2) LOWER



3) ENGINE ROOM FUSE & RELAY BOX



4) USAGE OF FUSE IN ENGINE ROOM FUSE BOX

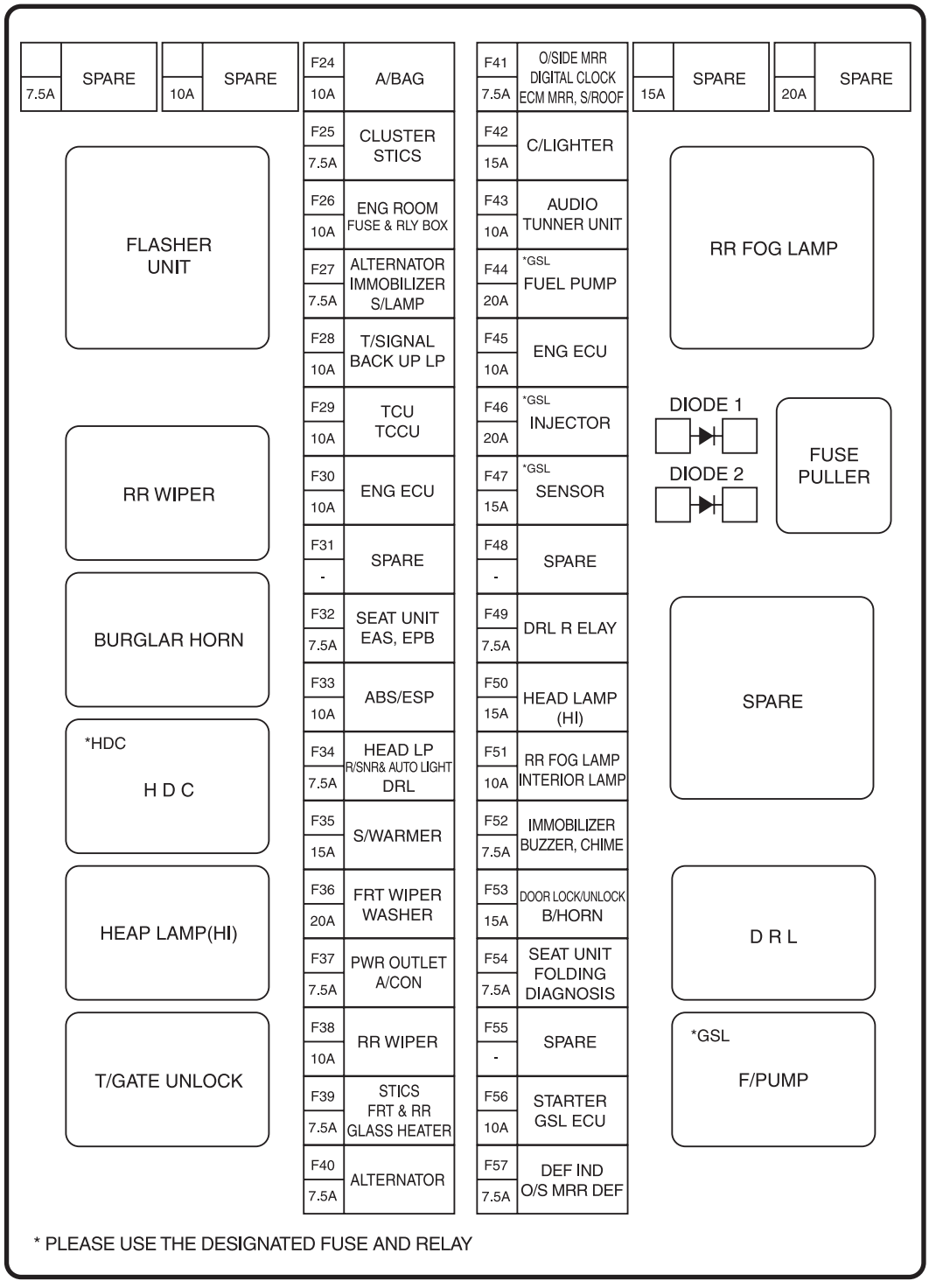
Fuse No.	Capacity	Usage	Fuse No.	Capacity	Usage
SB1	150A/125A	Alternator (PTC/FFH)	Ef5	30A	Head Lamp
SB2	30A	Power Window	Ef6	7.5A	Memory
SB3	40A	IP-RH Fuse Box (B+) F65~F71	Ef7	15A	Stop Lamp
SB4	30A	ABS/ESP	Ef8	10A	Tail Lamp (LH)
SB5	30A	IP-LH Fuse Box (B+) F44~F50	Ef9	10A	Tail Lamp (RH)
SB6	30A	IGN Key 1	Ef10	15A	FRT Fog
SB7	30A	Blower Motor	Ef11	10A	Horn
SB8	-	-	Ef12	-	-
SB9	30A	IP-LH Fuse Box (B+) F51~F55	Ef13	10A	Compressor
SB10	30A	C/Fan LH	Ef14	10A	Deicer
SB11	30A	C/Fan RH	Ef15	-	-
SB12	30A	IGN Key 2	Ef16	15A	Head Lamp (LH)
SB13	40A	P.T.C Heater 2 (DSL)	Ef17	15A	Head Lamp (RH)
SB14	40A	P.T.C Heater 3 (DSL)	Ef18	-	-
SB15	40A	P.T.C Heater Relay 1 (DSL)	Ef19	25A	Driver P/Seat, TCCU
SB16	40A	Defogger	Ef20	20A	S/Roof
Ef1	-	-	Ef21	-	-
Ef2	30A	ABS/ESP	Ef22	20A	P/Outlet
Ef3	-	-	Ef23	20A	FFH
Ef4	15A	Hazard			

5) ENGINE ROOM FUSE BOX CONNECTOR NUMBER

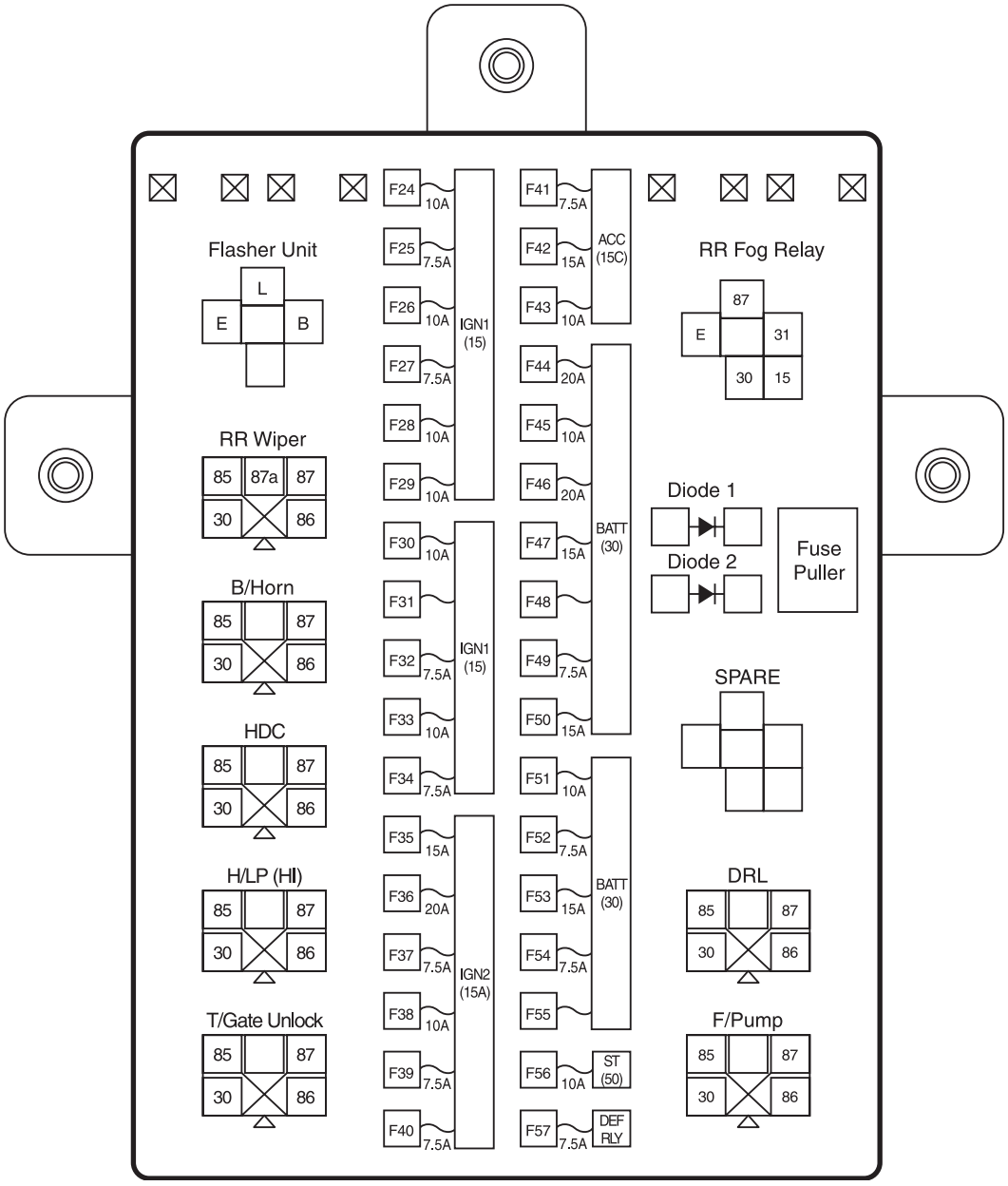
Connector No.	Pin No.	Connector Color
C101	18	White
C102	4	White
C103	16	White
C104	14	White
C105	10	White
C106	20	White
C107	12	White
C108	18	White
C109	2	Black
C110	10	White

2. I/P - LH FUSE & RELAY BOX 8410

1) I/P - LH FUSE & RELAY BOX

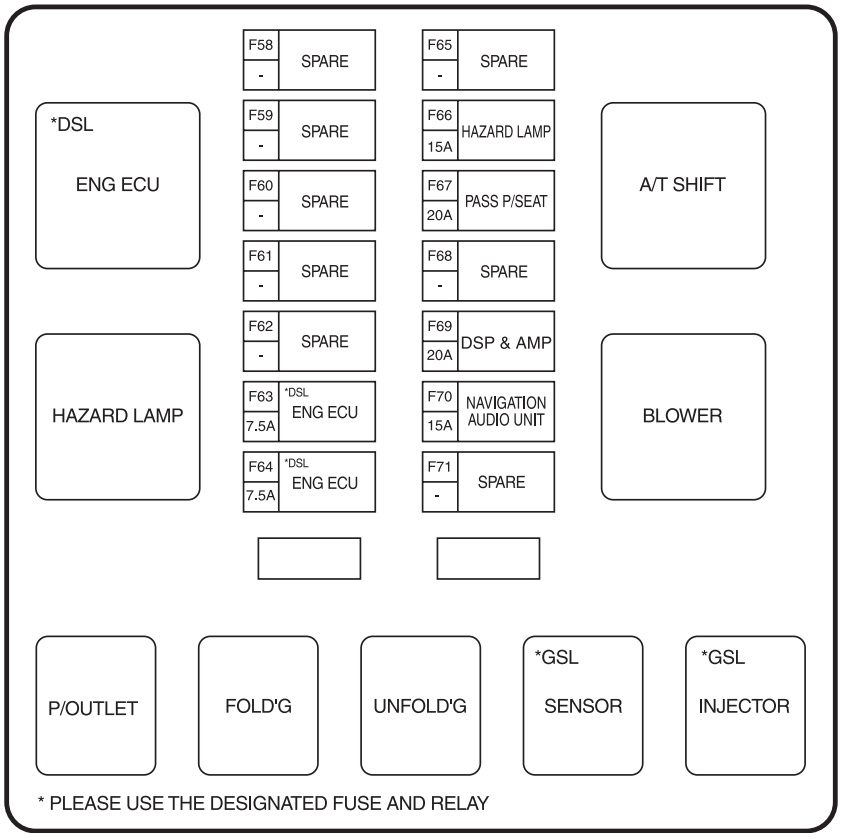


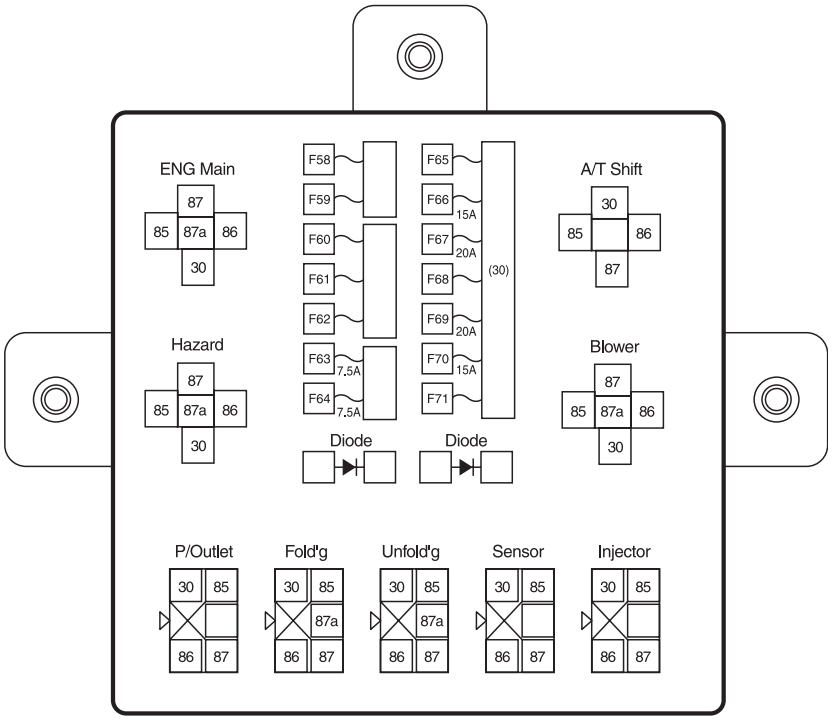
2) POWER SUPPLY



3. I/P - RH FUSE & RELAY BOX 8410

1) I/P - RH FUSE & RELAY BOX





MEMO

SECTION 3

WIRING DIAGRAM FOR POWER SUPPLIES

TABLE OF CONTENTS

1. ENGINE ROOM FUSE & RELAY BOX CIRCUIT 8410 3-2

1) SB5, SB6, Ef4, Ef5, Ef11, Ef16, Ef17, Horn Relay, Head Lamp Relay (LO) 3-2
2) SB2 ~ SB4, SB7 ~ SB9, Ef3, P/Window Relay 3-3
3) SB10 ~ SB11, Condensor Fan Relay (HI, LO) 3-4
4) SB12 ~ SB16, Start Relay, PTC Relay 3-5
5) Ef1, Ef2, Ef6, Ef7 3-6
6) Ef8 ~ Ef10, Tail Lamp Relay, FRT Fog Lamp Relay 3-7
7) Ef12 ~ Ef15, Ef18 ~ Ef23, Compressor Relay 3-8
8) Wiper Motor Relay (HI, LO), Washer Relay (FRT, RR) 3-9

2. I/P - LH FUSE & RELAY BOX CIRCUIT 8410 3-10

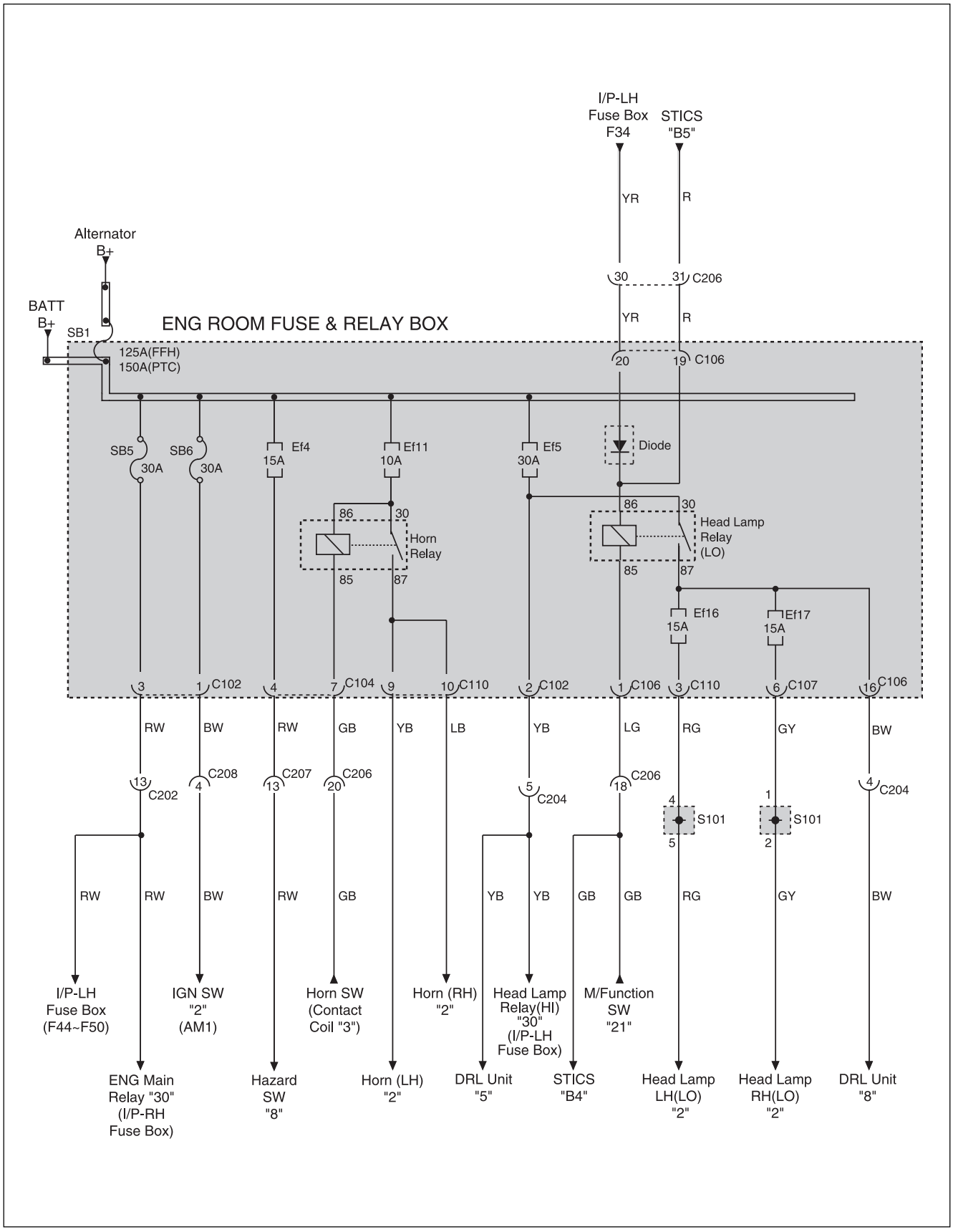
1) F24 ~ F28 3-10
2) F29 ~ F34 3-11
3) F35 ~ F40, RR Wiper Relay 3-12
4) F41 ~ F48, Fuel Pump Relay 3-13
5) F49 ~ F51, DRL Relay, Head Lamp Relay(HI), RR Fog Lamp Relay 3-14
6) F52 ~ F55, Burglar Horn Relay, T/Gate Unlock Relay 3-15
7) F56 ~ F57, HDC Relay, Flasher Unit 3-16

3. I/P - RH FUSE & RELAY BOX CIRCUIT 8410 3-17

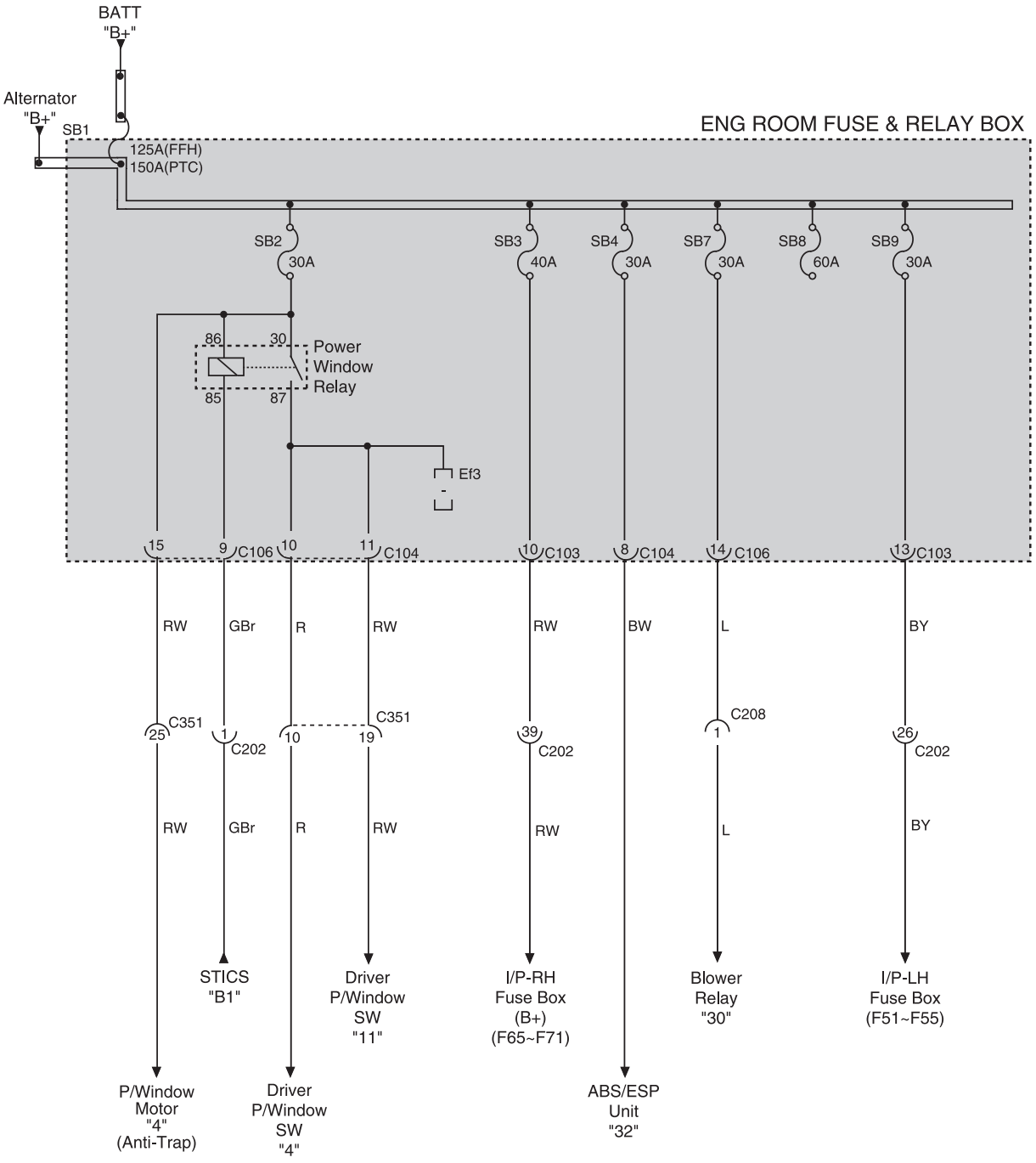
1) F58 ~ F64, ENG Main Relay 3-17
2) F65 ~ F71, Hazard Relay 3-18
3) Blower Relay, P/Outlet Relay, Injector Relay, SNR Relay 3-19
4) A/T Shift Relay, Fold'g Relay, Unfold'g Relay 3-20

1. ENGINE ROOM FUSE & RELAY BOX CIRCUIT 8410

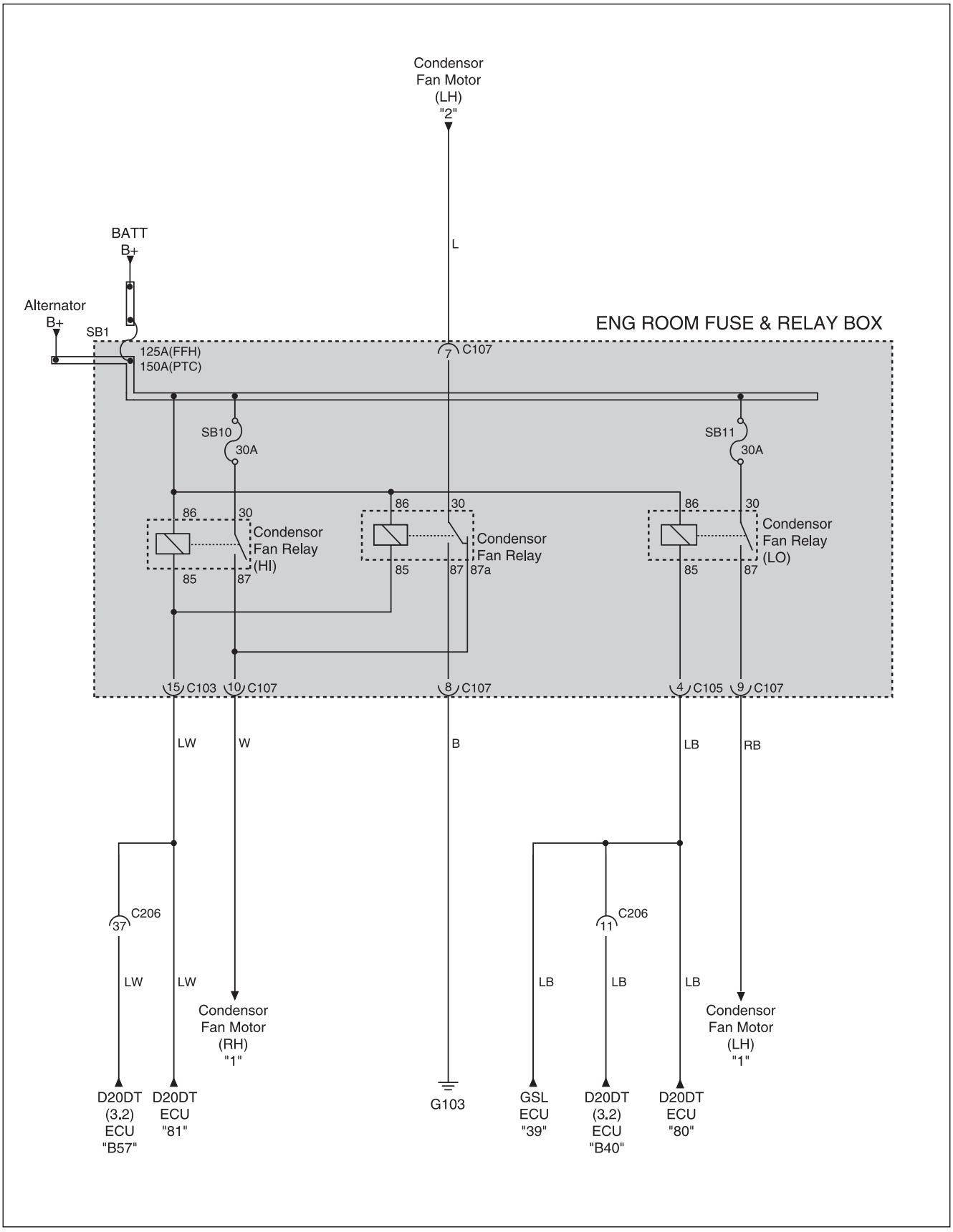
1) SB5, SB6, Ef4, Ef5, Ef11, EF16, EF17, HORN RELAY, HEAD LAMP RELAY (LO)



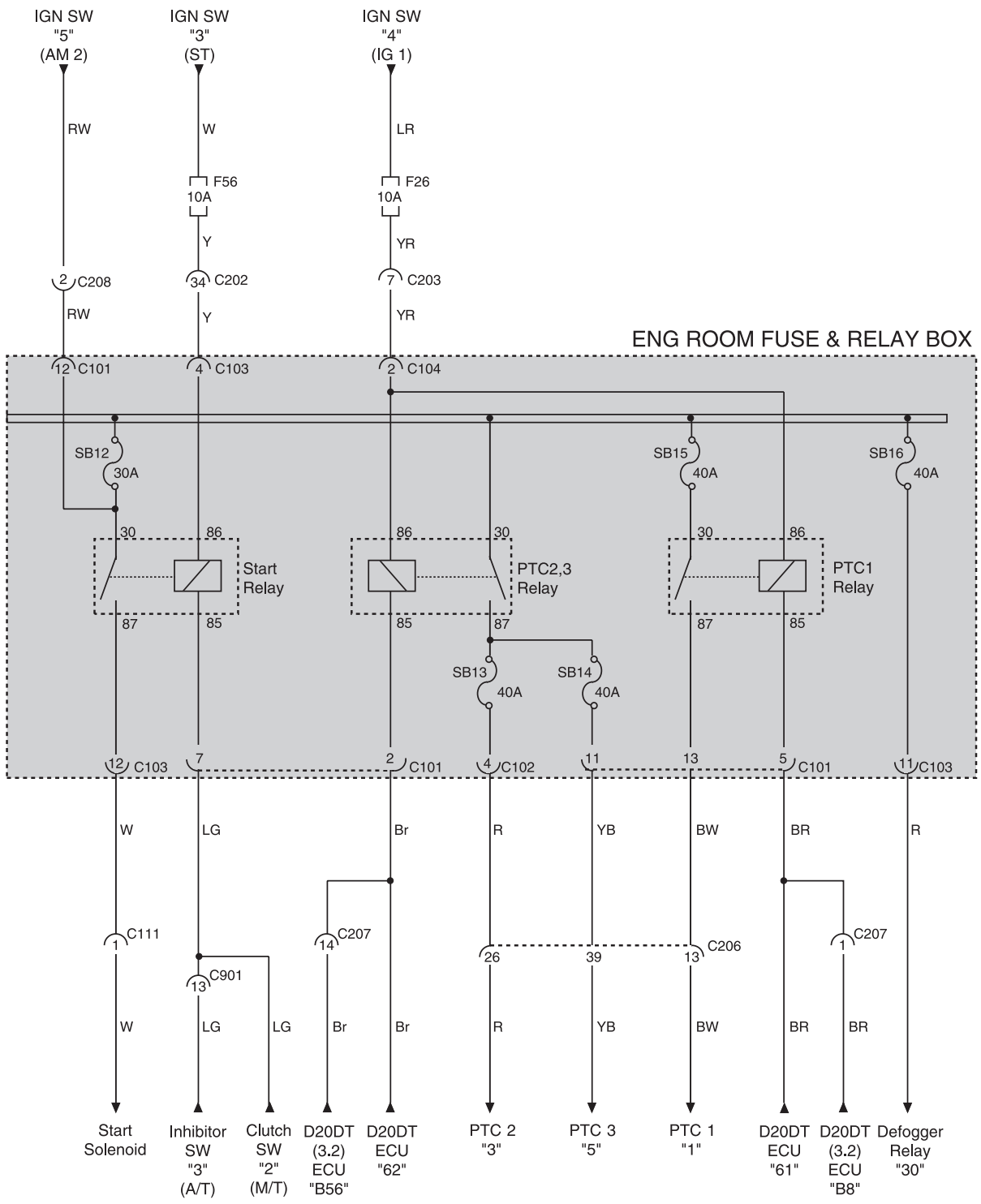
2) SB2~SB4, SB7~SB9, Ef3, POWER WINDOW RELAY



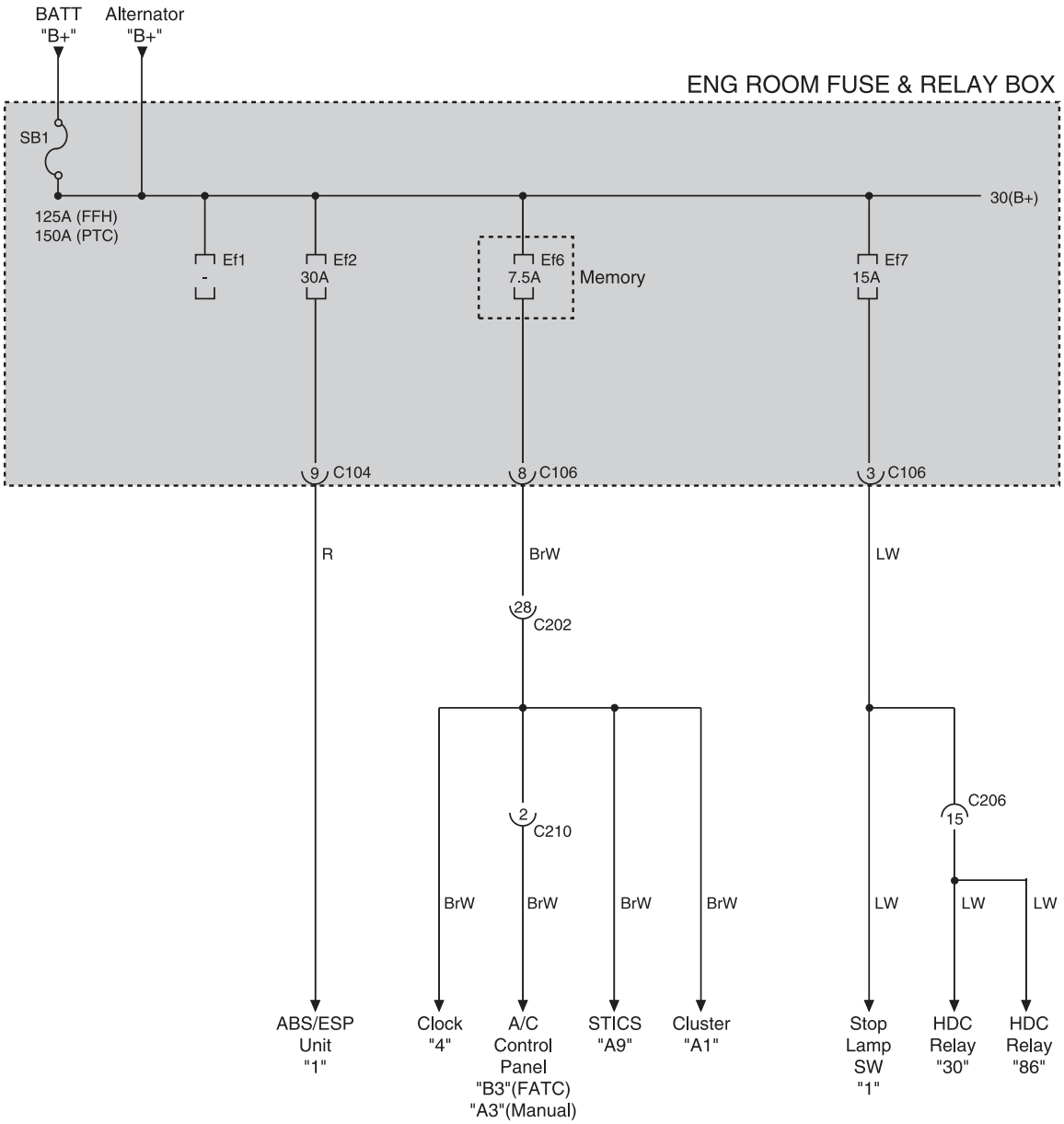
3) SB10 ~ SB11, CONDENSOR FAN RELAY (HI, LO)



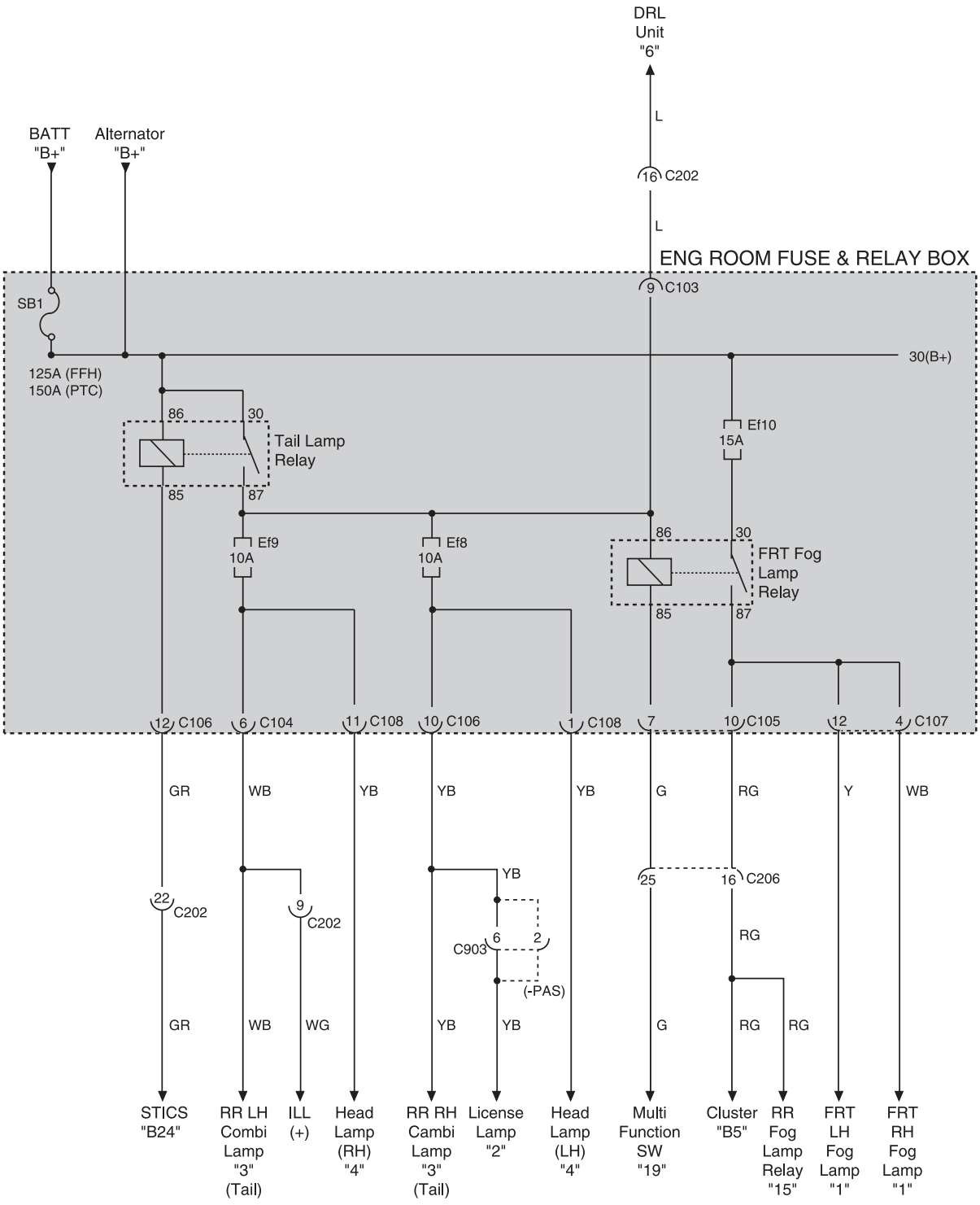
4) SB12 ~ SB16, START RELAY, PTC RELAY



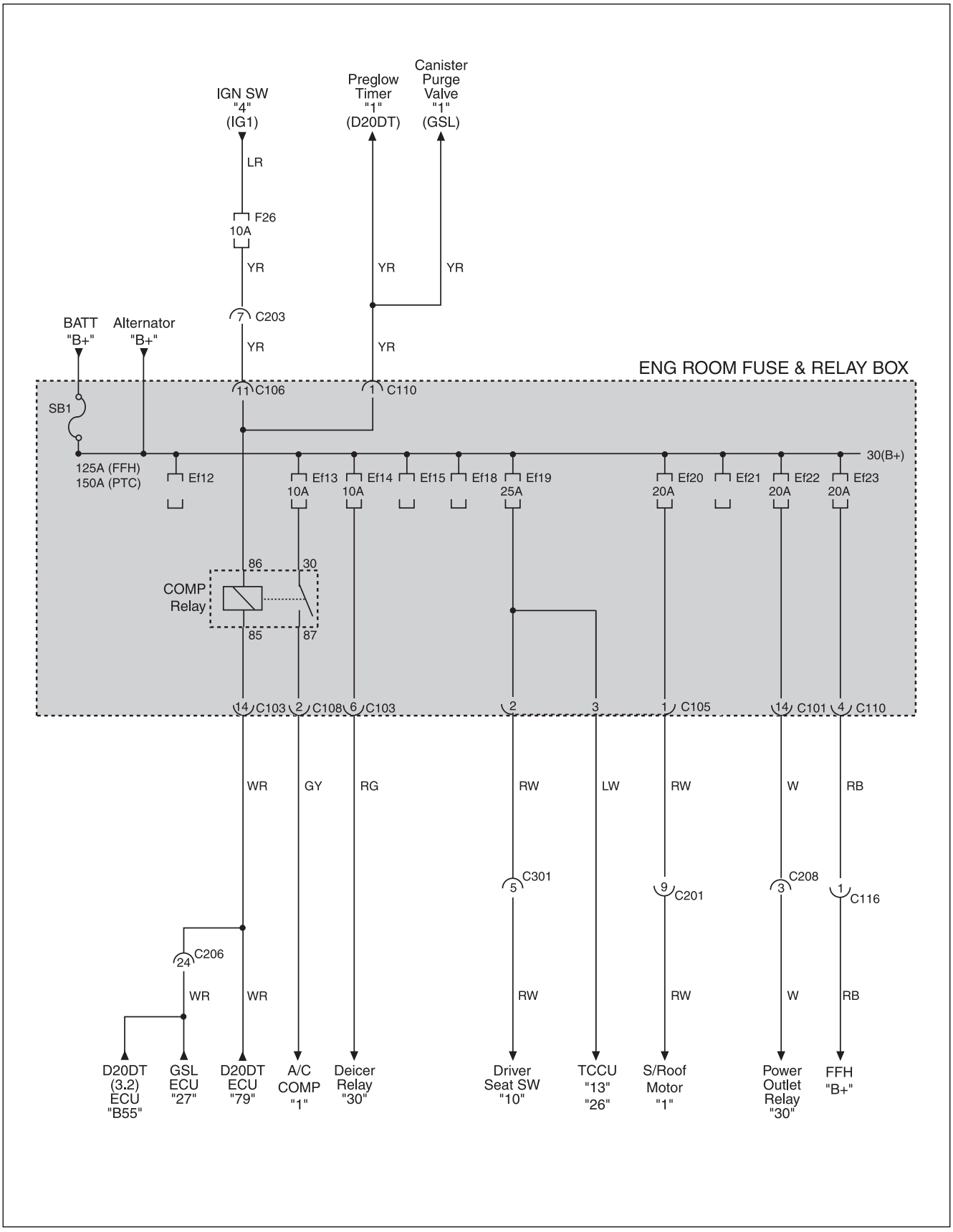
5) Ef1, Ef2, Ef6, Ef7



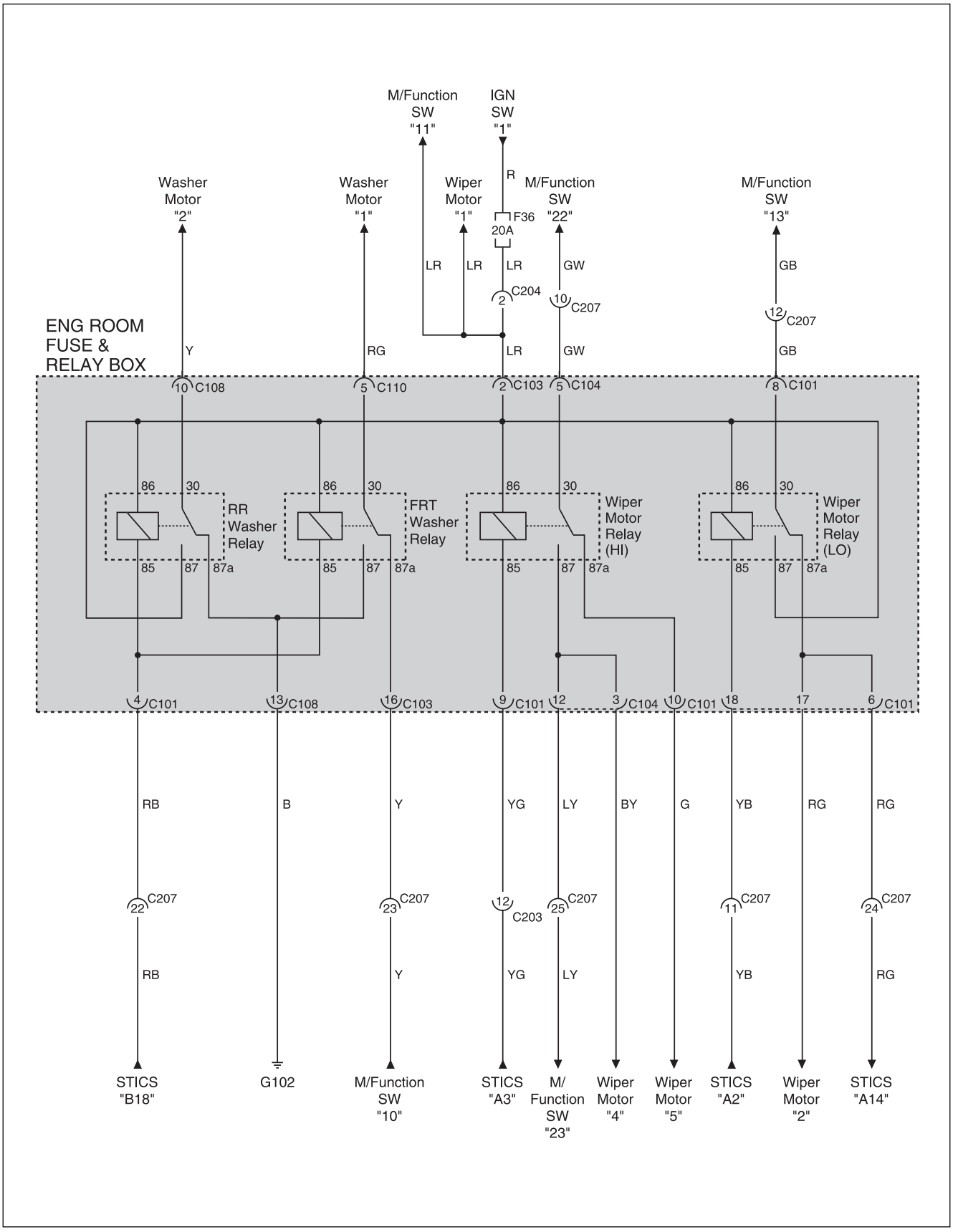
6) Ef8 ~ Ef10, TAIL LAMP RELAY, FRT FOG LAMP RELAY



7) Ef12 ~ Ef15, Ef18 ~ Ef23, COMPRESSOR RELAY

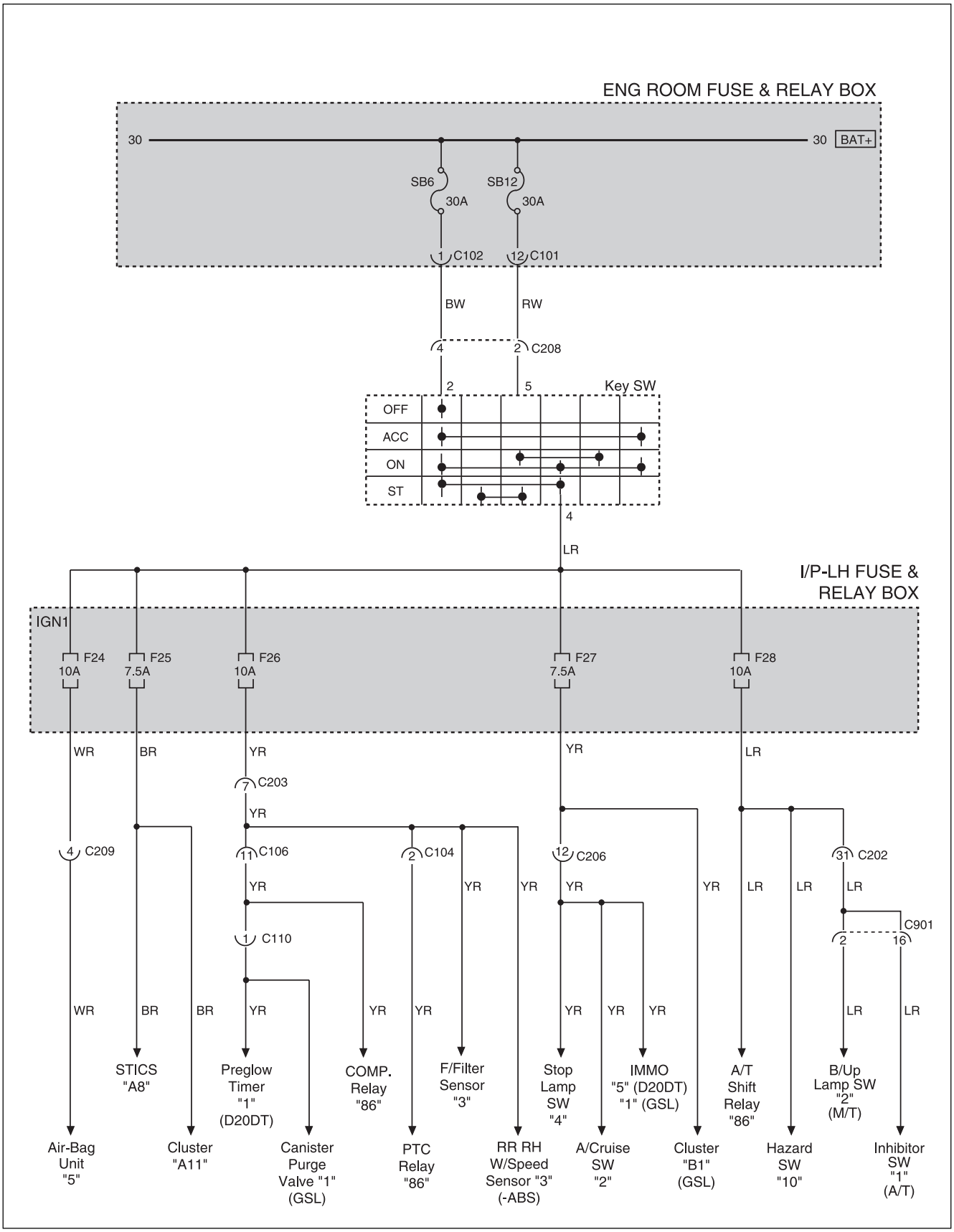


8) WIPER MOTOR RELAY (HI, LO), WASHER RELAY (FRT, RR)

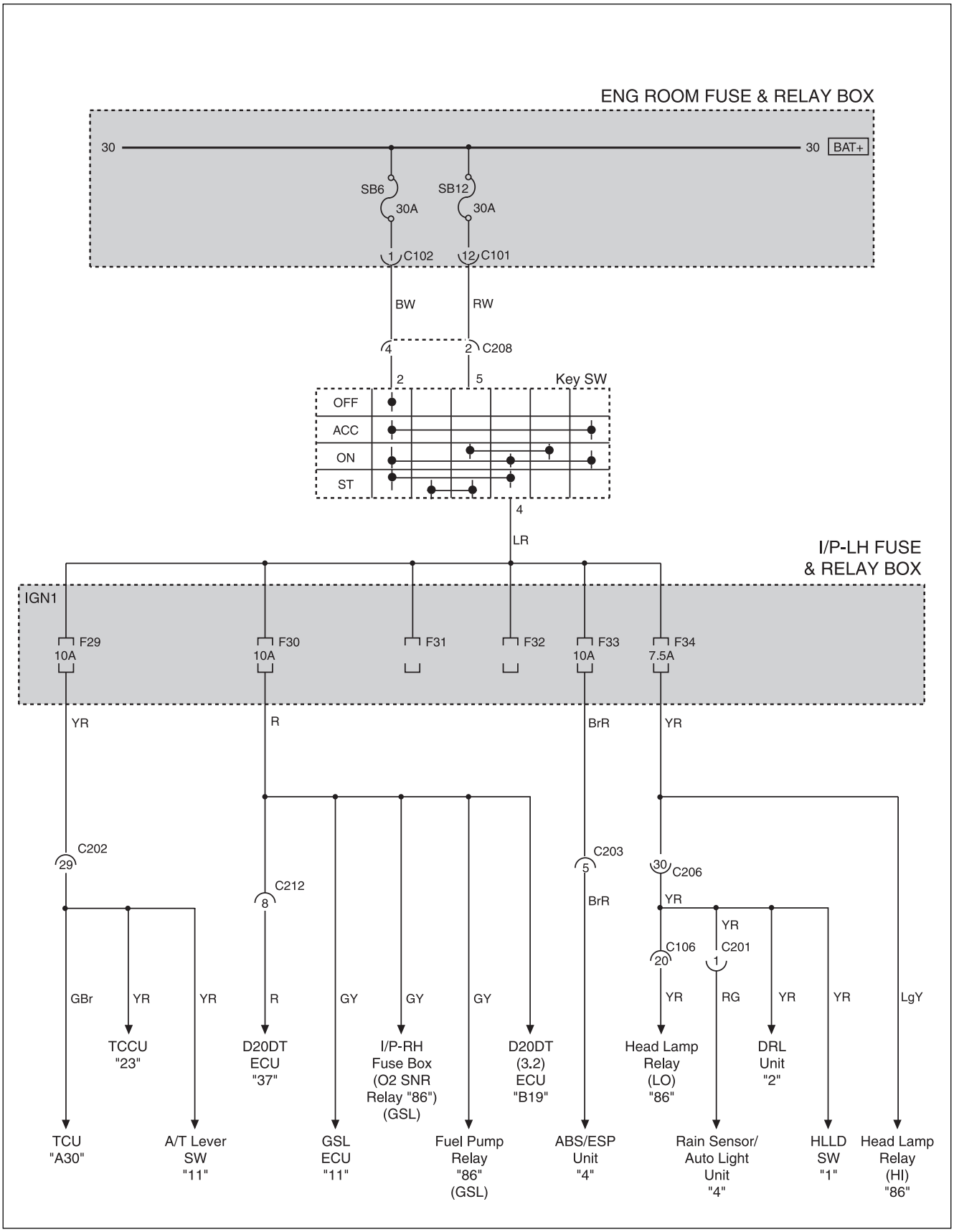


2. I/P - LH FUSE & RELAY BOX CIRCUIT 8410

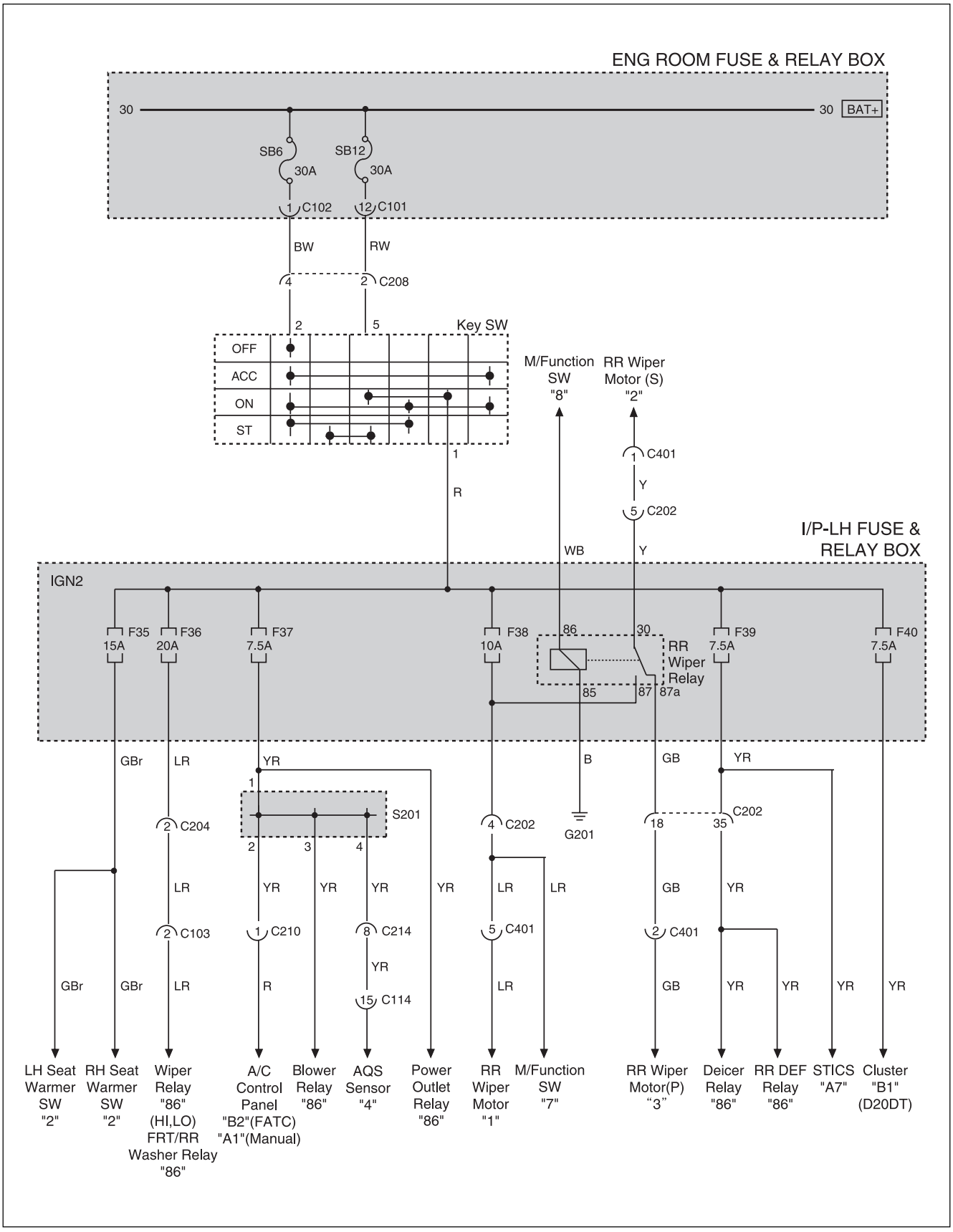
1) F24 ~ F28



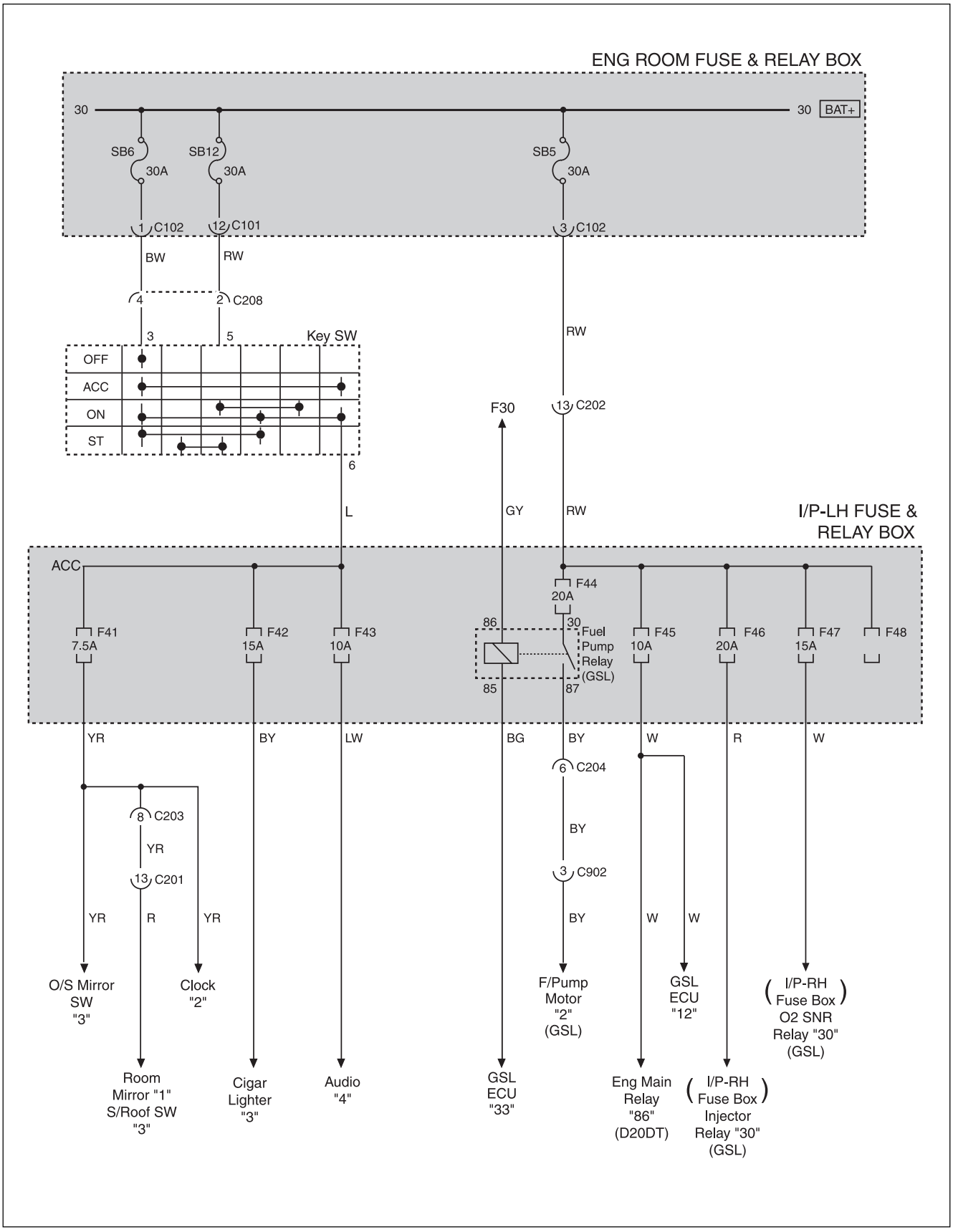
2) F29 ~ F34


ENG ROOM FUSE & RELAY BOX
30
30 BAT+
SB6
30A
SB12
30A
1 C102
12 C101
BW
RW
4
2 C208
2
5
Key SW
OFF
ACC
ON
ST
4
LR
I/P-LH FUSE
& RELAY BOX
IGN1
F29
10A
F30
10A
F31
F32
F33
10A
F34
7.5A
YR
R
BrR
YR
C202
29
C212
8
C203
5
30 C206
BrR
YR
YR
C106
20
C201
1
GBr
YR
YR
R
GY
GY
GY
YR
RG
YR
YR
LgY
TCCU
"23"
D20DT
ECU
"37"
I/P-RH
Fuse Box
(O2 SNR
Relay "86")
(GSL)
D20DT
(3.2)
ECU
"B19"
Head Lamp
Relay
(LO)
"86"
DRL
Unit
"2"
TCU
"A30"
A/T Lever
SW
"11"
GSL
ECU
"11"
Fuel Pump
Relay
"86"
(GSL)
ABS/ESP
Unit
"4"
Rain Sensor/
Auto Light
Unit
"4"
HLLD
SW
"1"
Head Lamp
Relay
(HI)
"86"

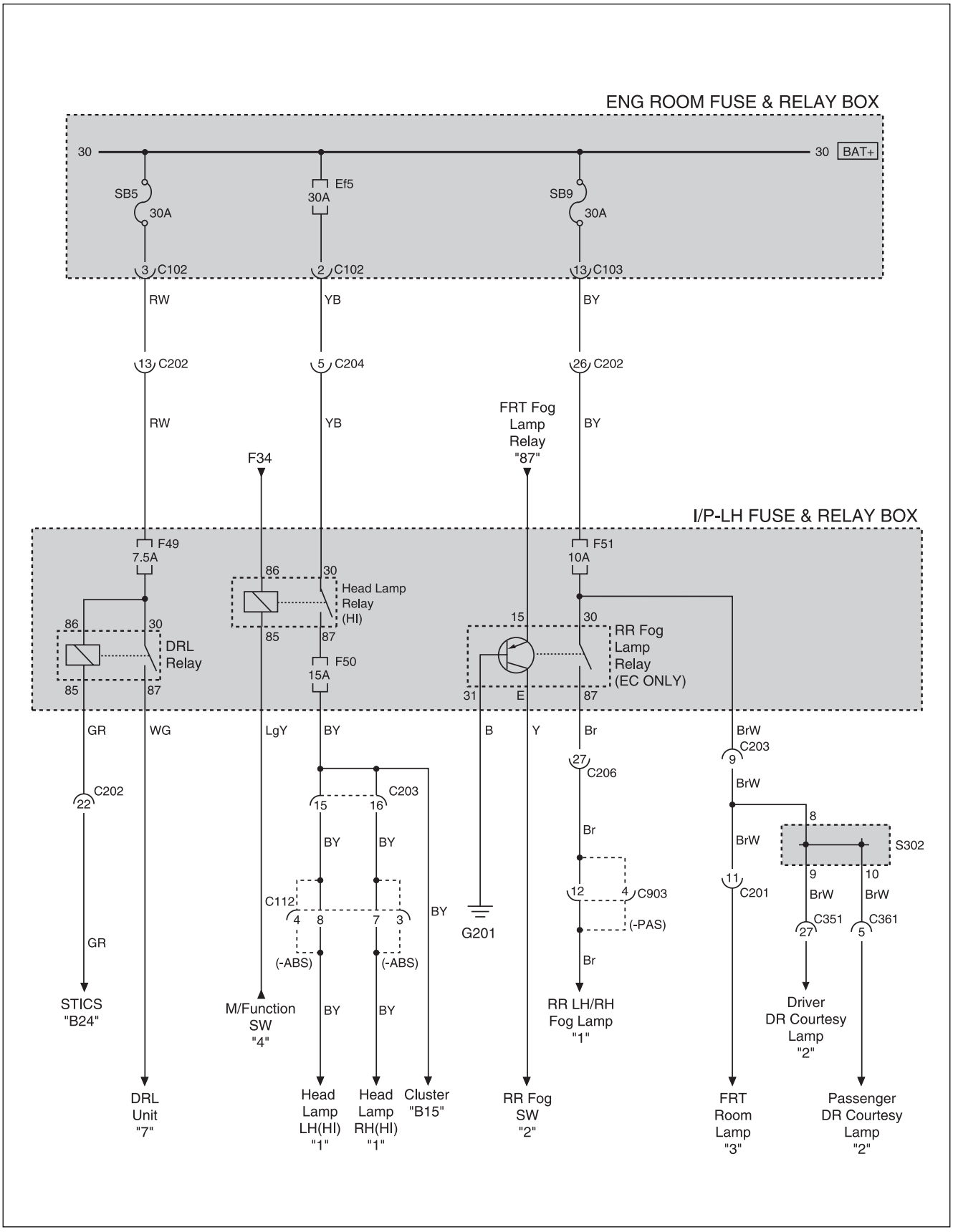
3) F35 ~ F40, RR WIPER RELAY



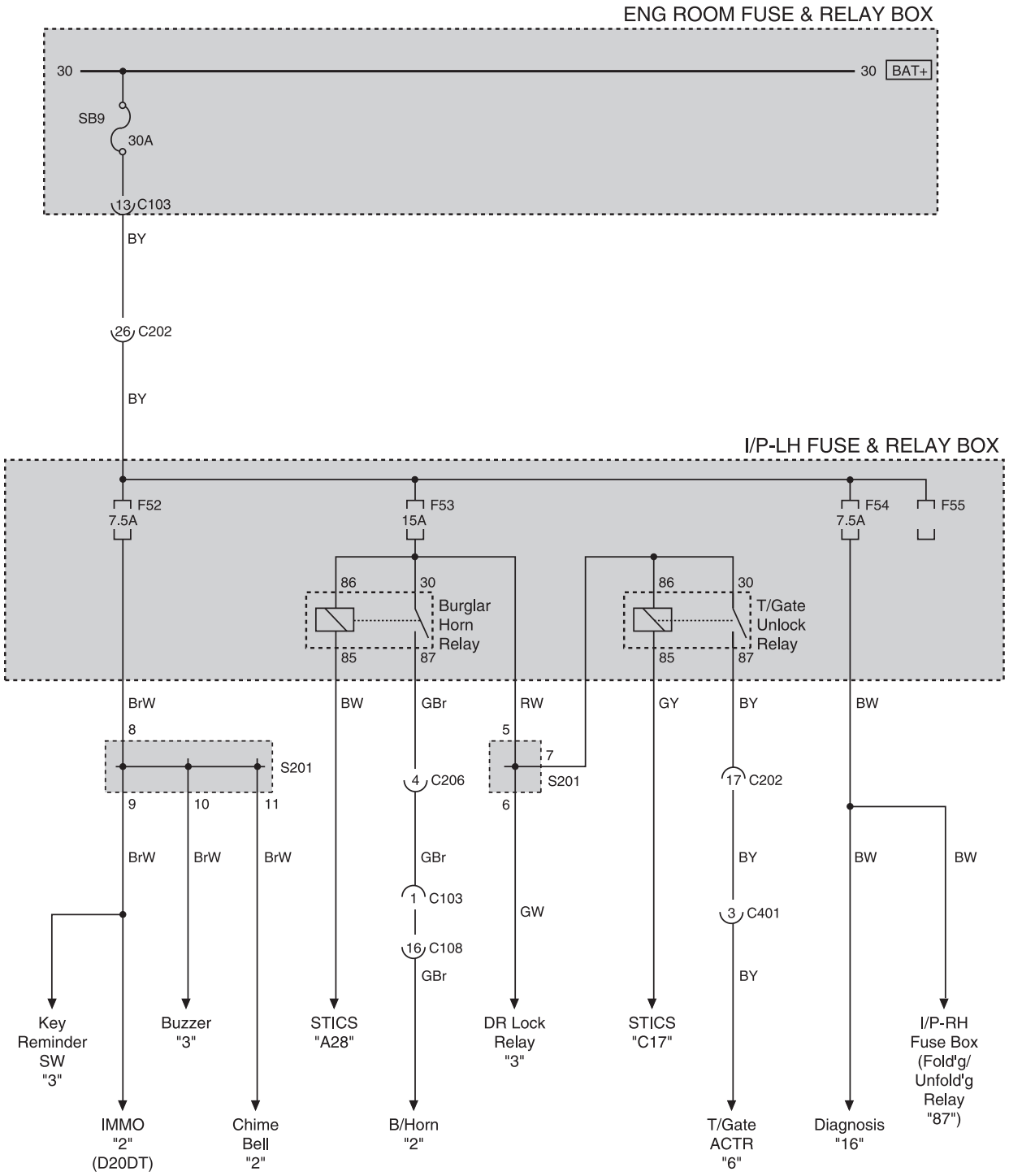
4) F41 ~ F48, FUEL PUMP RELAY



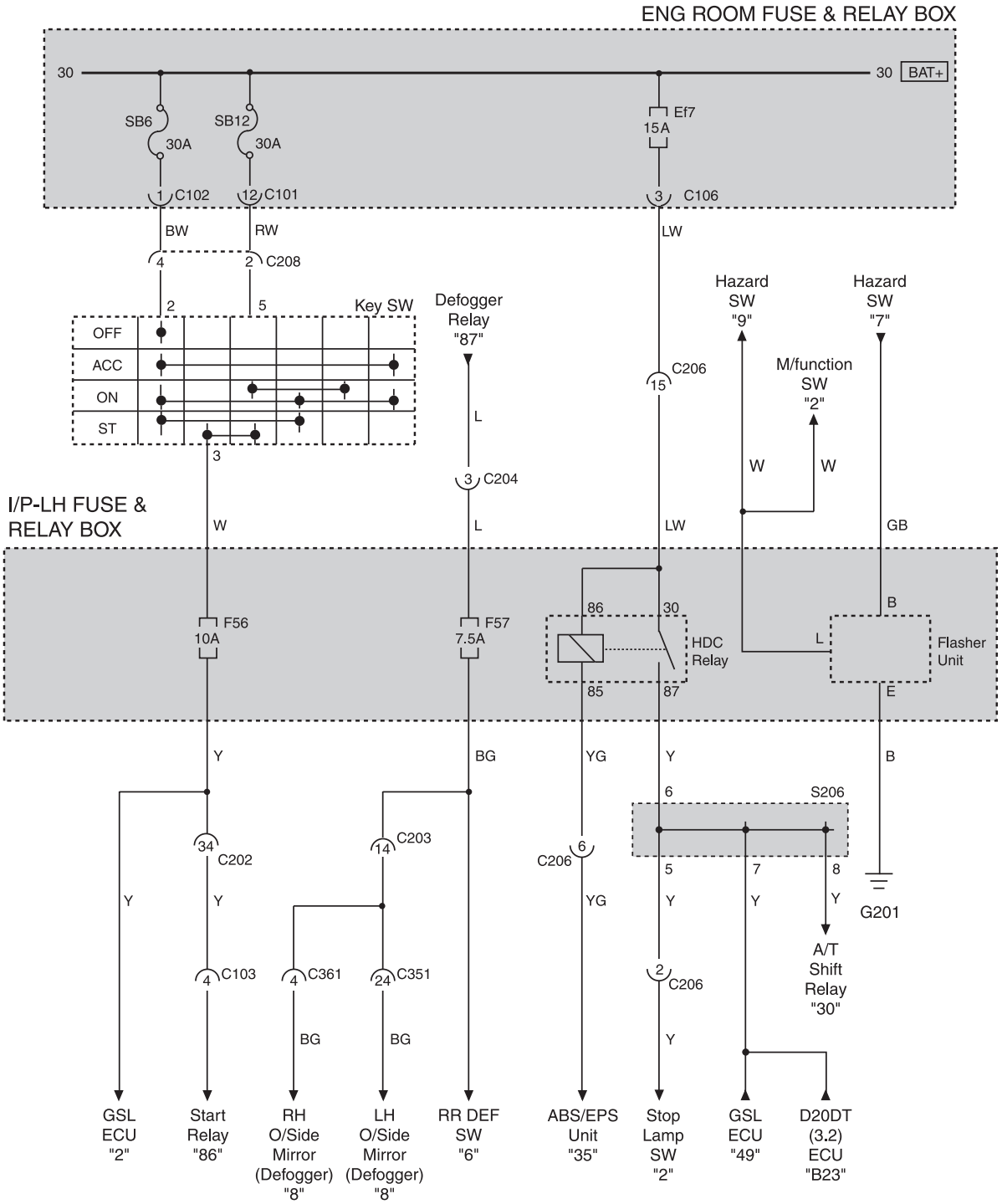
5) F49 ~ F51, DRL RELAY, HEAD LAMP RELAY (HI), RR FOG LAMP RELAY



6) F52 ~ F55, BURGLAR HORN RELAY, T/GATE UNLOCK RELAY

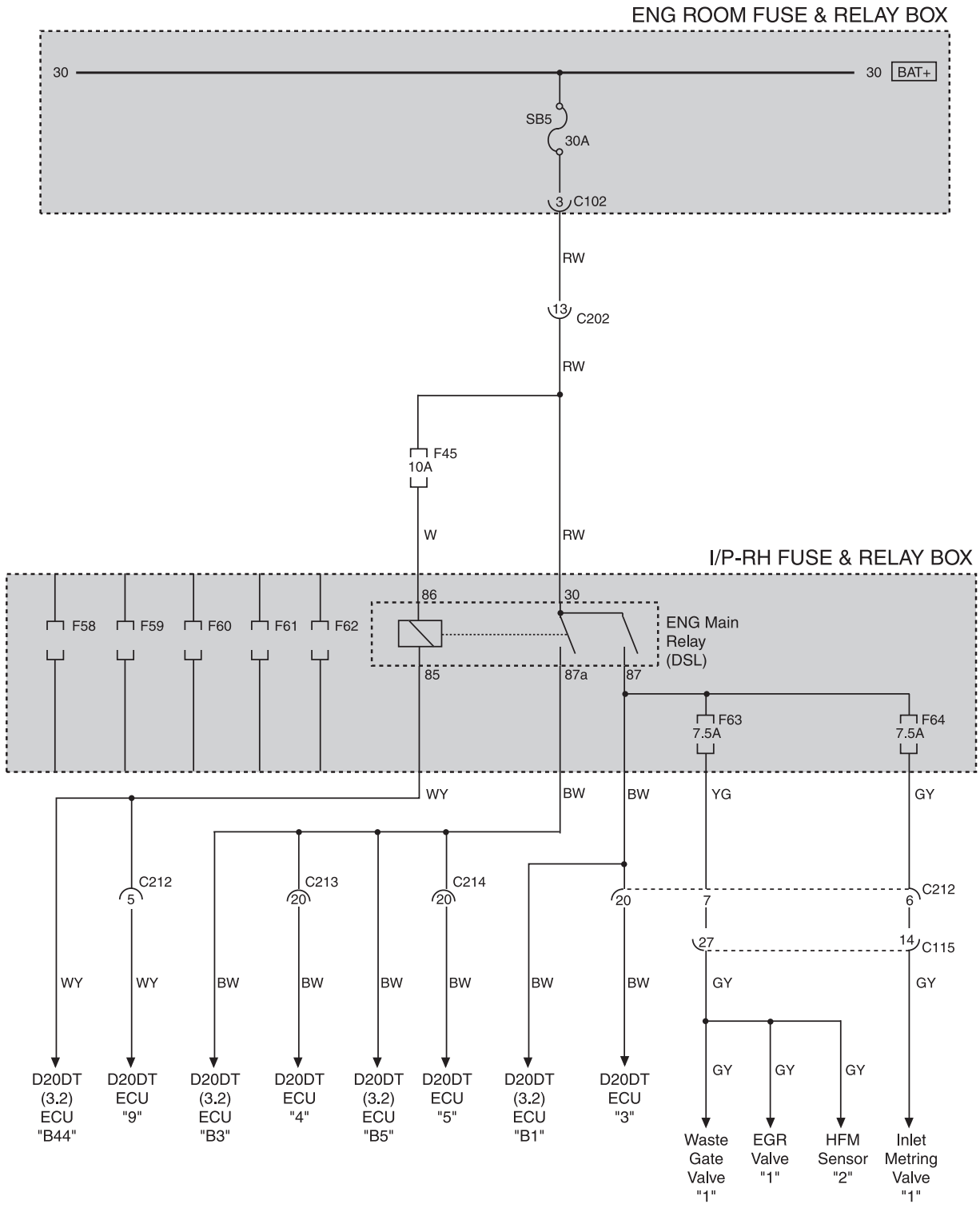


7) F56 ~ F57, HDC RELAY, FLASHER UNIT

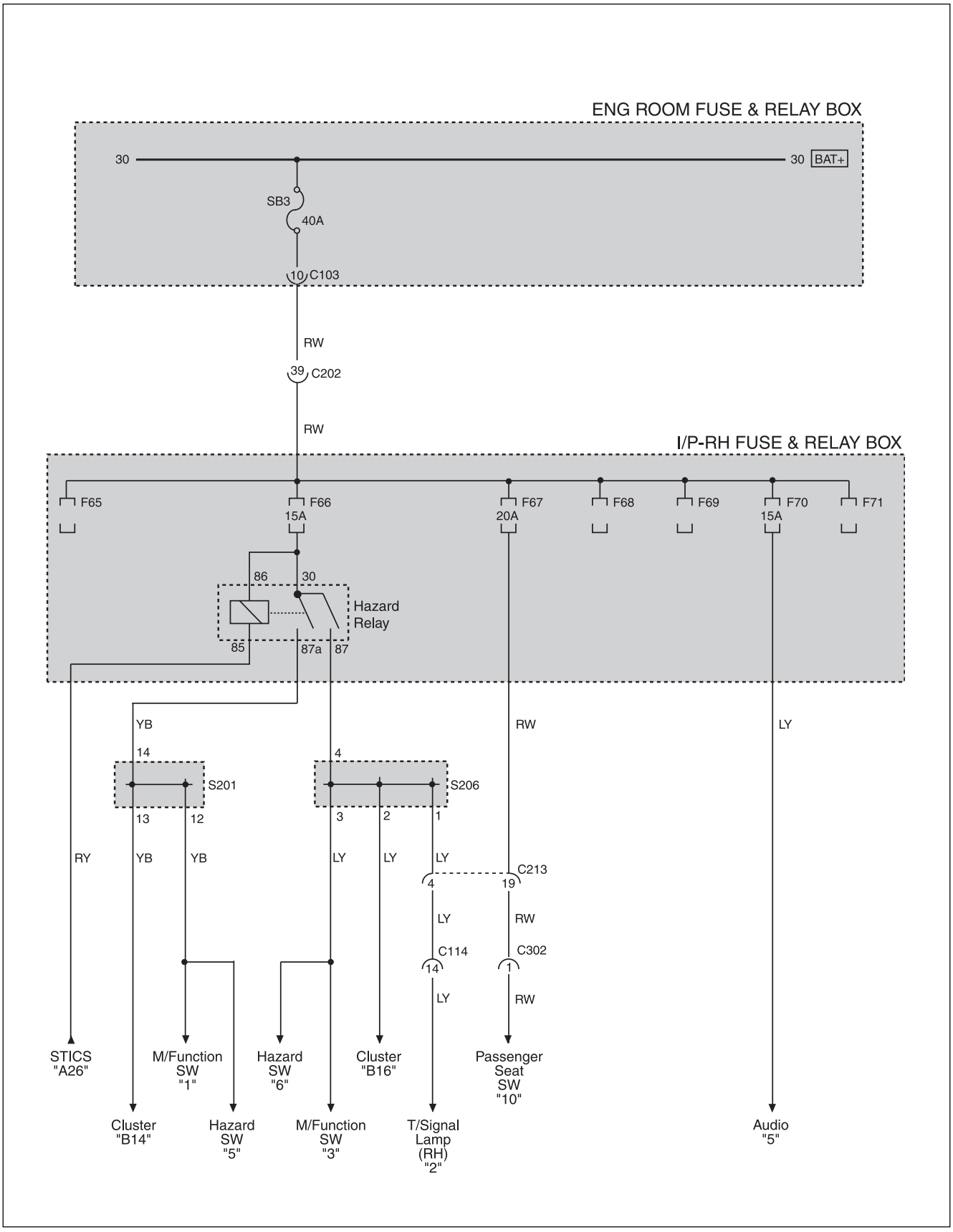


3. I/P - RH FUSE & RELAY BOX CIRCUIT 8410

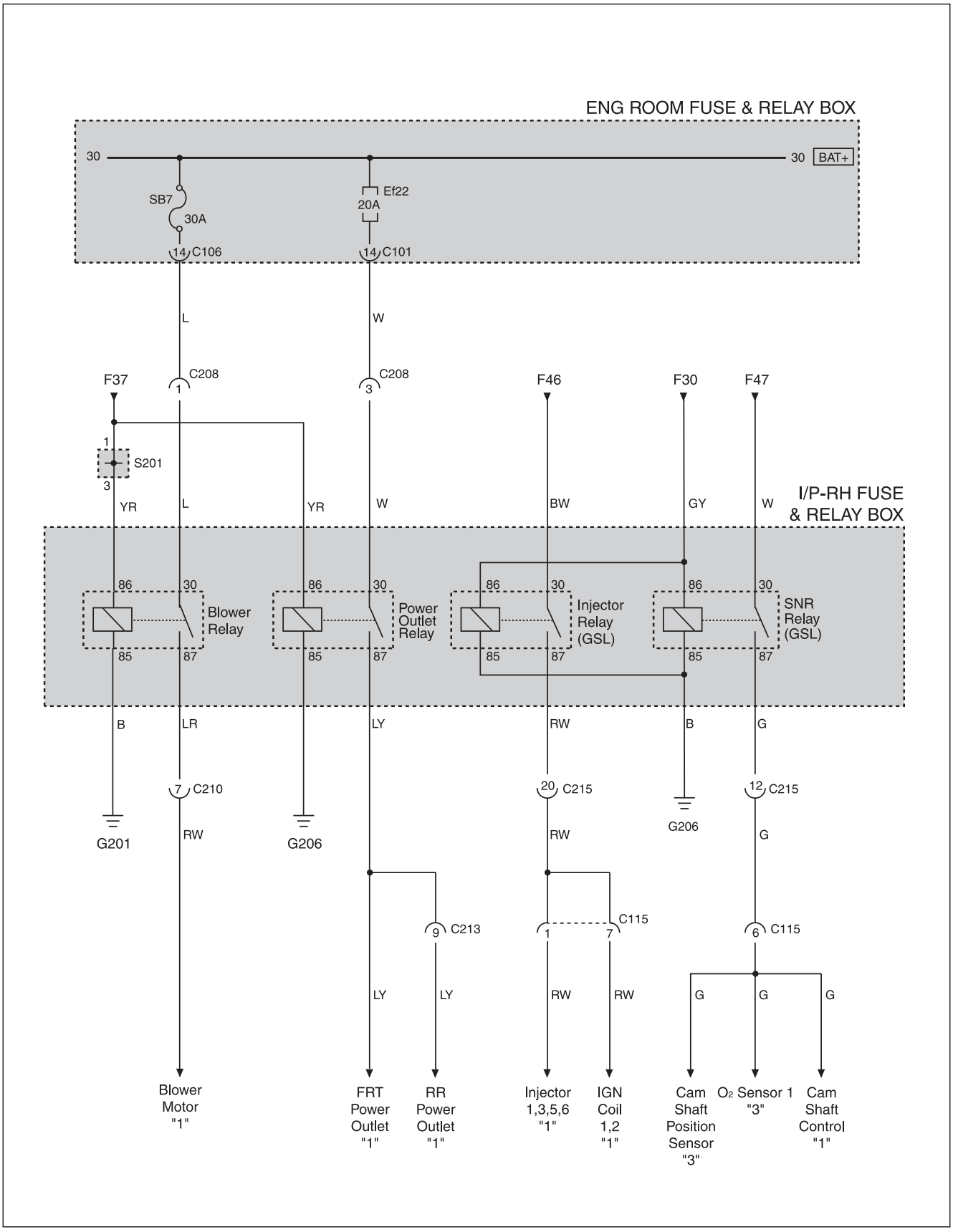
1) F58 ~ F64, ENG MAIN RELAY



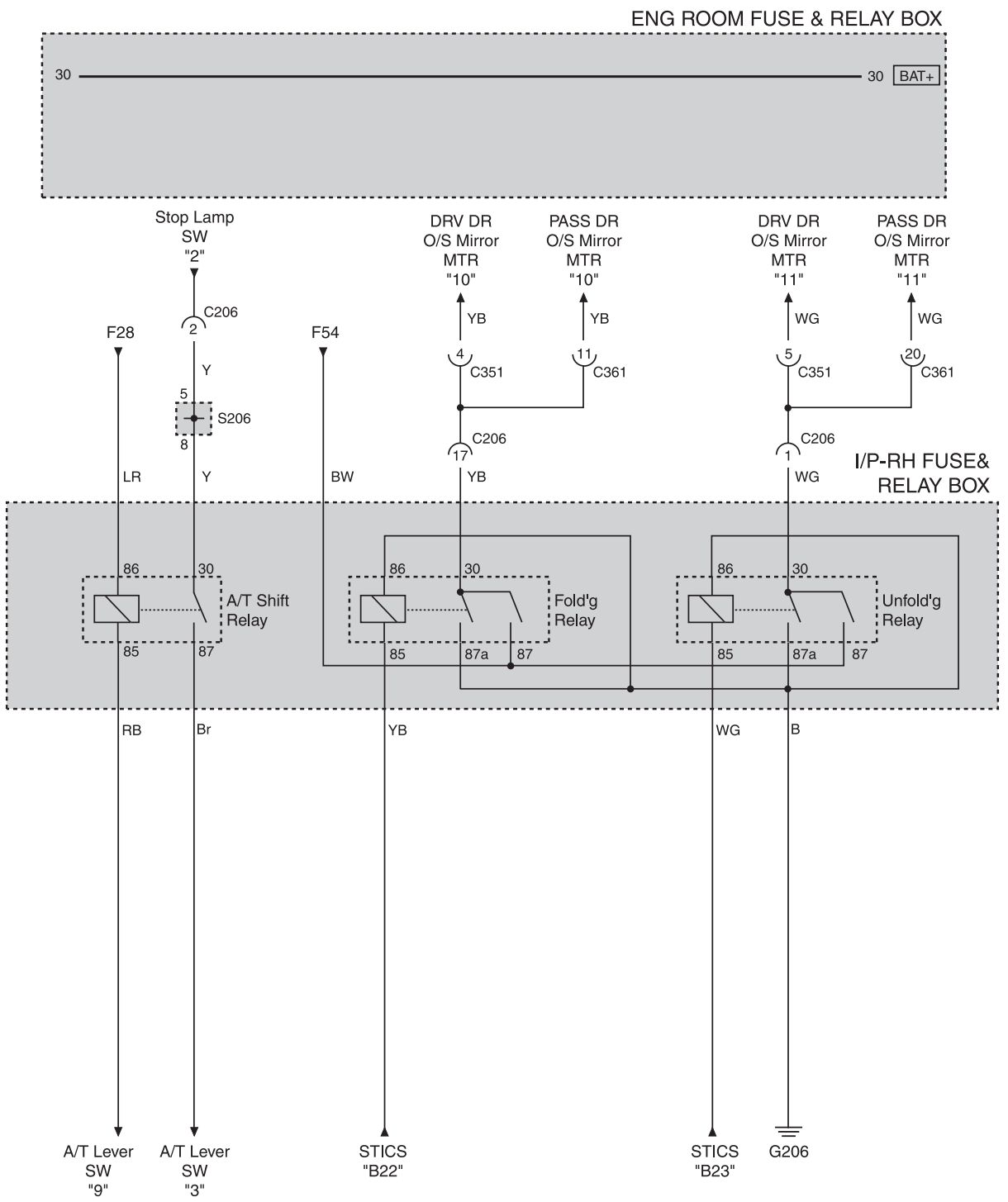
2) F65 ~ F71, HAZARD RELAY



3) BLOWER RELAY, P/OUTLET RELAY, INJECTOR RELAY, SNR RELAY



4) A/T SHIFT RELAY, FOLD'G RELAY, UNFOLD'G RELAY



SECTION 4

ELECTRICAL WIRING DIAGRAMS

TABLE OF CONTENTS

1. STARTING & CHARGING ..... 1461 .. 4-4

2. PREHEATING CIRCUIT ..... 2820 .. 4-6

3. ECU (ENGINE CONTROL UNIT - GSL G23) ..... 1490 .. 4-8

1) IGN Coil, Injector, Pedal Module, Throttle Sensor 4-8
2) O_2 Sensor, CPS, Knock Sensor, MAP Sensor, Canister Purge Valve 4-10
3) Stop Lamp, Cruise Control SW, Fuel Pump, Immobilizer 4-12

4. ECU (ENGINE CONTROL UNIT - D20DT 3.2) 1491 4-14

1) ENG Main Relay, Pedal Module, HFM Sensor, Valve, Cruise Control SW 4-14
2) Fuel Filter Warning Lamp, Immobilizer, Sensor Circuit (Fuel Pressure, Camshaft, Booster Pressure, Crankshaft, Knock, Coolant/Fuel Temp.) 4-16
3) Injector, Stop lamp, Immobilizer, Cluster, Preheating Unit, Sensor, Tripple Pressure SW 4-14

5. DIAGNOSIS CIRCUIT 8210 4-20

6. A/T SHIFT LOCK 3740 4-22

7. TCCU 3410 4-24

8. CLUSTER 8010 4-26

1) Gauge (Speed, RPM, Fuel, Temp), Warning Lamp (Fuel, Fuel Filter, ABS/ESP, Brake, HDC, 4WD) 4-26
2) Warning Lamp (BATT Charge, Oil, Hood, Door, ENG Check, Air Bag, Seat Belt), Turn Signal, Fog Lamp, Hazard 4-28

9. POWER SEAT - DRIVER 7410 4-30

10. FRT SEAT WARMER 8510 4-32

11. STICS 7410 4-34
1) Power/Ground, Chime Bell, Buzzer, Warning Lamp (Brake, Seat Belt, DR Open) 4-34
2) Central Door Lock Circuit 4-36
3) Tail Lamp, Hazard, Power Window 4-38
4) Defogger 4-40
5) Panic, Auto Light & Rain Sensing, Room Lamp 4-42
6) FRT Wiper/Washer & RR Washer 4-44
7) Mirror Fold'g/Unfold'g Fold SW 4-46

12. ELECTRIC OUTSIDE MIRROR 8510 4-48

13. SUN ROOF CIRCUIT 7340 4-50

14. HEAD LAMP & DRL (DAY TIME RUNNING LIGHT) UNIT CIRCUIT 8310 4-52

15. FOG LAMP CIRCUIT 8310 4-54

16. STOP & BACK-UP LAMP CIRCUIT 4810 4-56

17. INTERIOR LAMP CIRCUIT 7770 4-58

18. AUTO DIMMING ROOM MIRROR CIRCUIT 7770 4-60

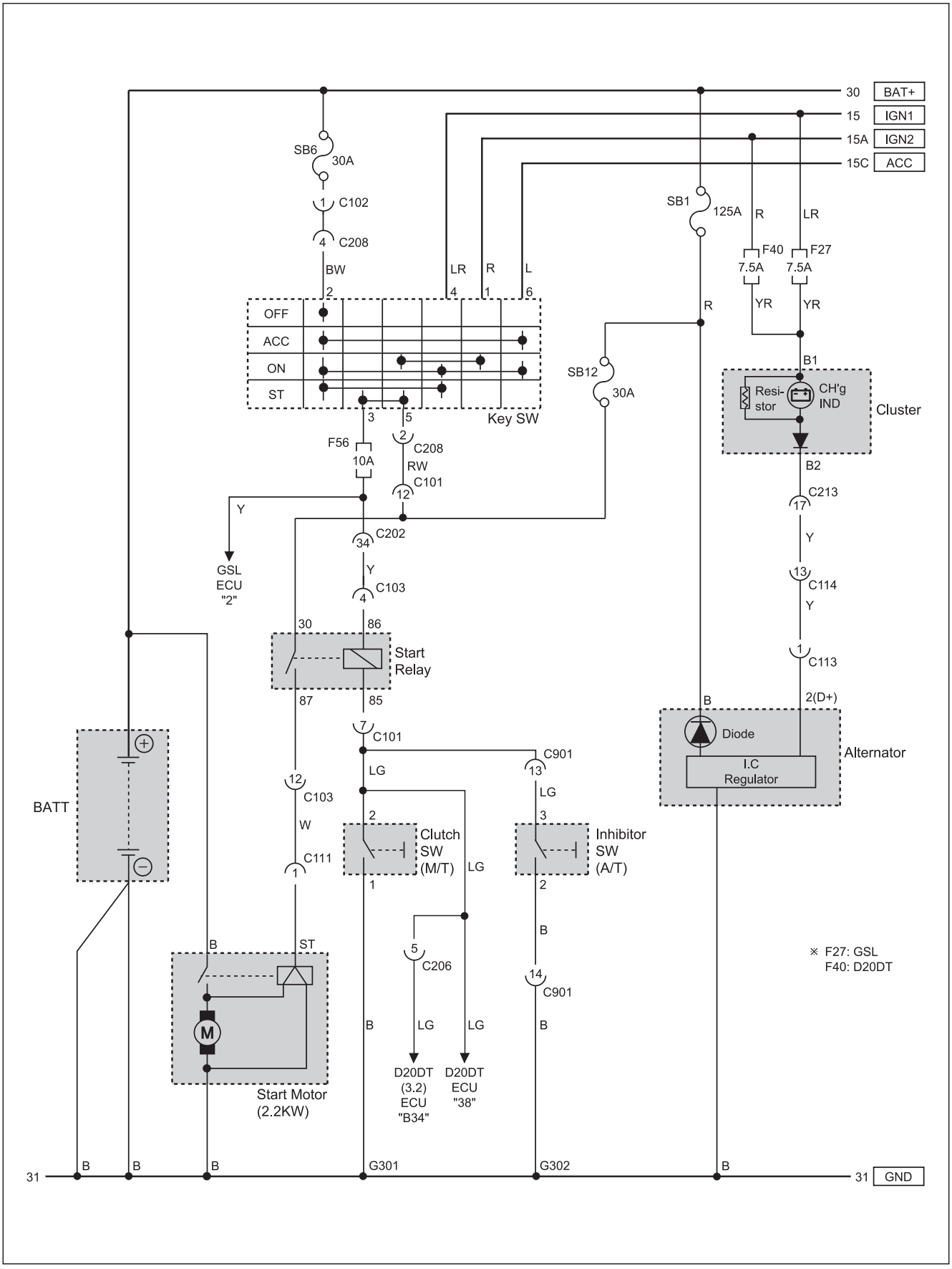
19. PARKING AID CIRCUIT 8790 4-62

20. PTC (POSITIVE TEMPERATURE COEFFICIENT) HEATER 6810 4-64

21. FATC (FULL AUTO TEMP. CONTROL) CIRCUIT 6810 4-66
1) Condensor Fan, Air Mix Motor, Sun Sensor, Water Temp Sensor 4-66
2) Blower, Actuator (Mode, Intake), AQS Sensor 4-68

22. AIR-CON (MANUAL) CIRCUIT 6810 4-70
1) Compressor, Motor (Mode, Intake, Air Mix) 4-70
2) Blower 4-72

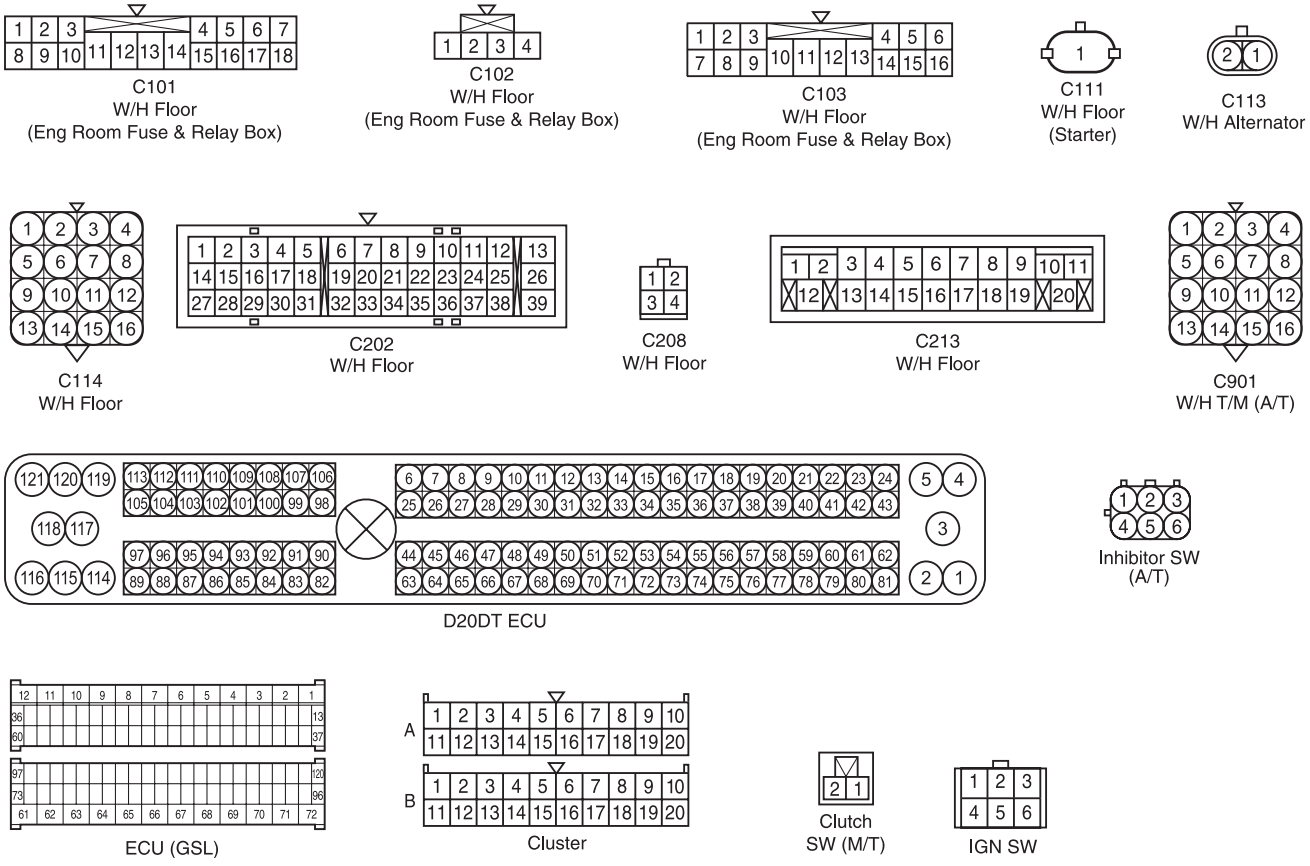
1. STARTING & CHARGING 1461



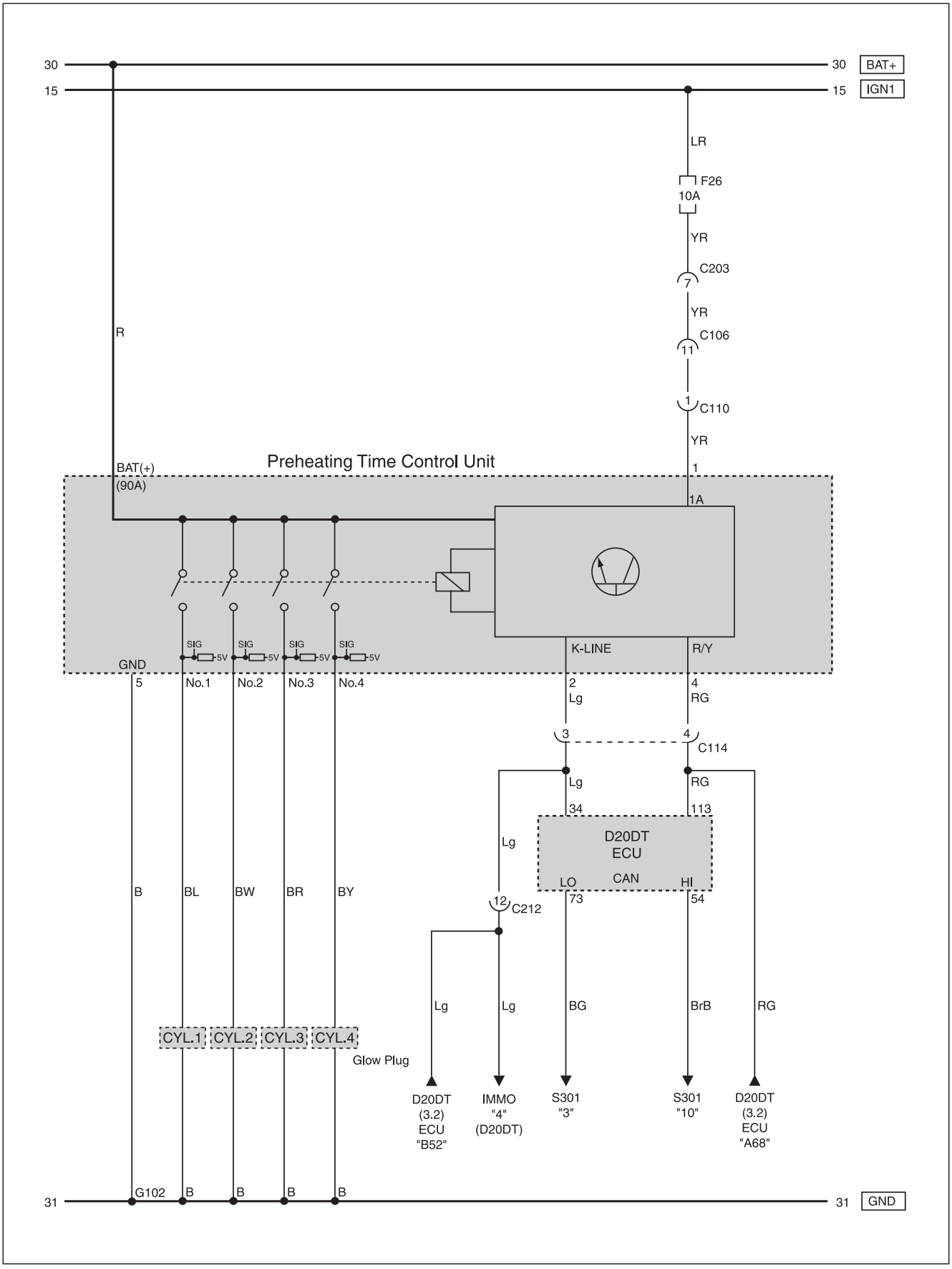
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C111 (1Pin, Gray)	W/H Floor - Starter Motor	Under the Preheating Time Relay	Solenoid
C113 (2Pin, Black)	W/H Eng - W/H Alternator	Backside RH Head Lamp	
C114 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C208 (4Pin, Colorless)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C901 (16Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	A/T
G301	W/H Floor	Under the Driver Seat	
G302	W/H Floor	Under the Driver Seat	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



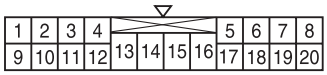
2. PREHEATING CIRCUIT 2820



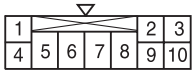
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C110 (10Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C114 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
S301 (14Pin, Black)	W/H Floor	Beside Driver Seat W/H Protector	CAN

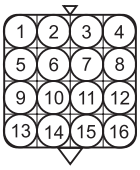
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



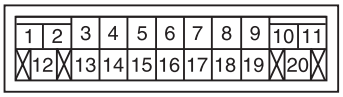
C106
W/H Floor
(Eng Room Fuse & Relay Box)



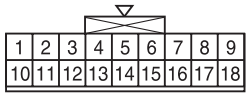
C110
W/H ENG
(Eng Room Fuse & Relay Box)



C114
W/H Floor



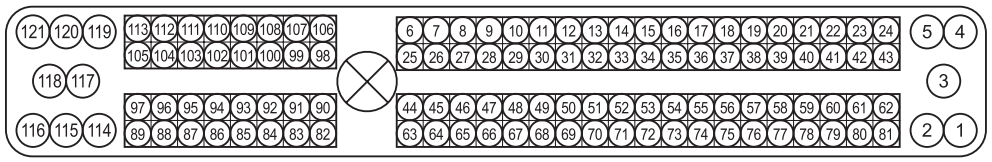
C212
W/H Floor



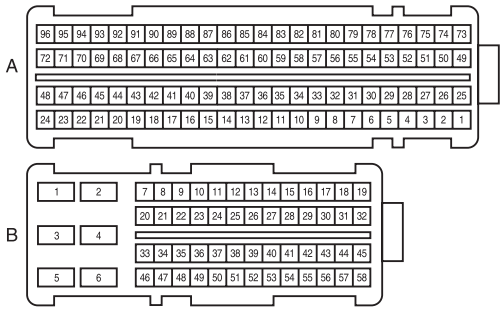
C203
W/H Floor



Preheating Time
Control Unit



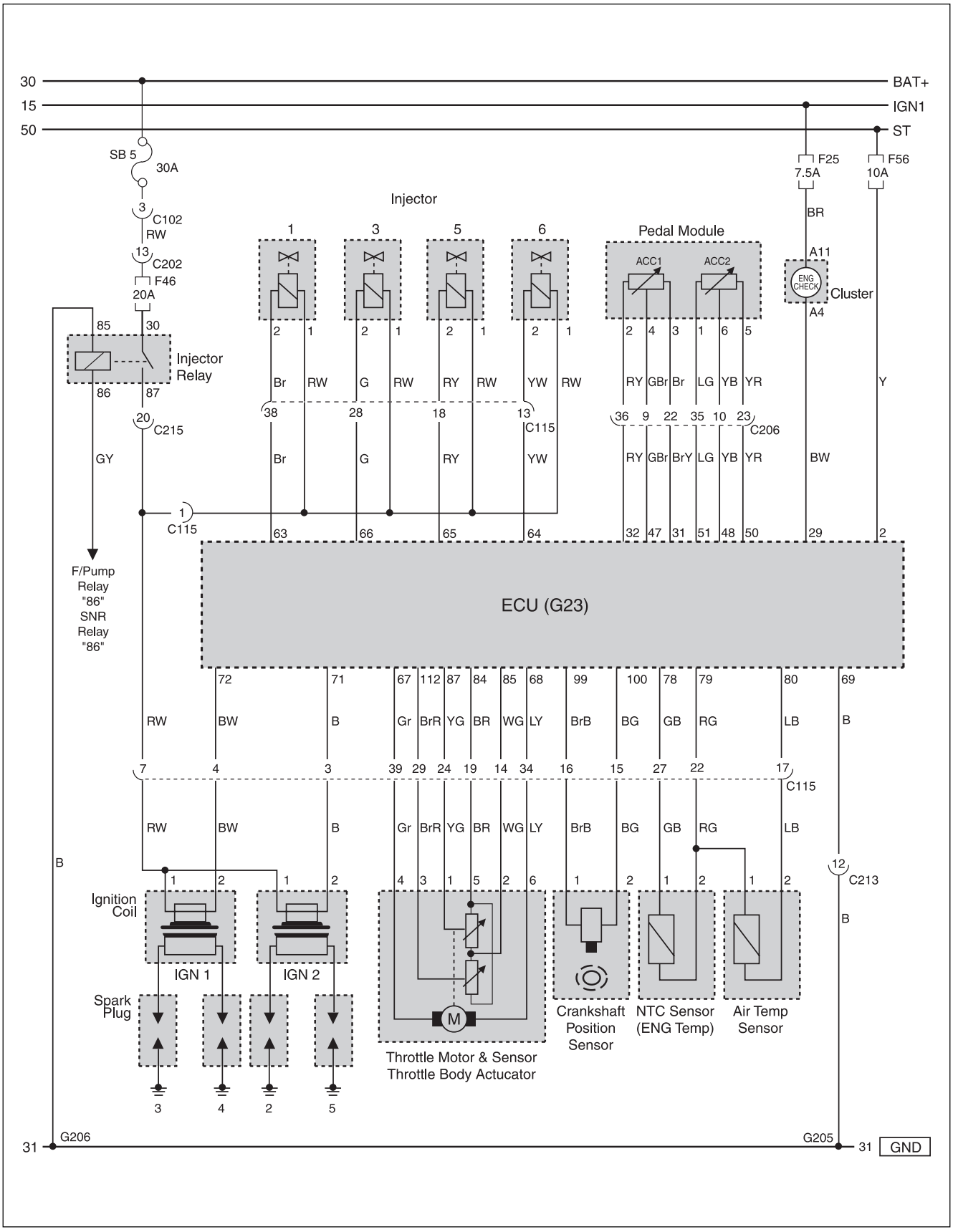
D20DT ECU



D20DT (3.2) ECU

3. ECU (ENGINE CONTROL UNIT - GSL G23) 1490

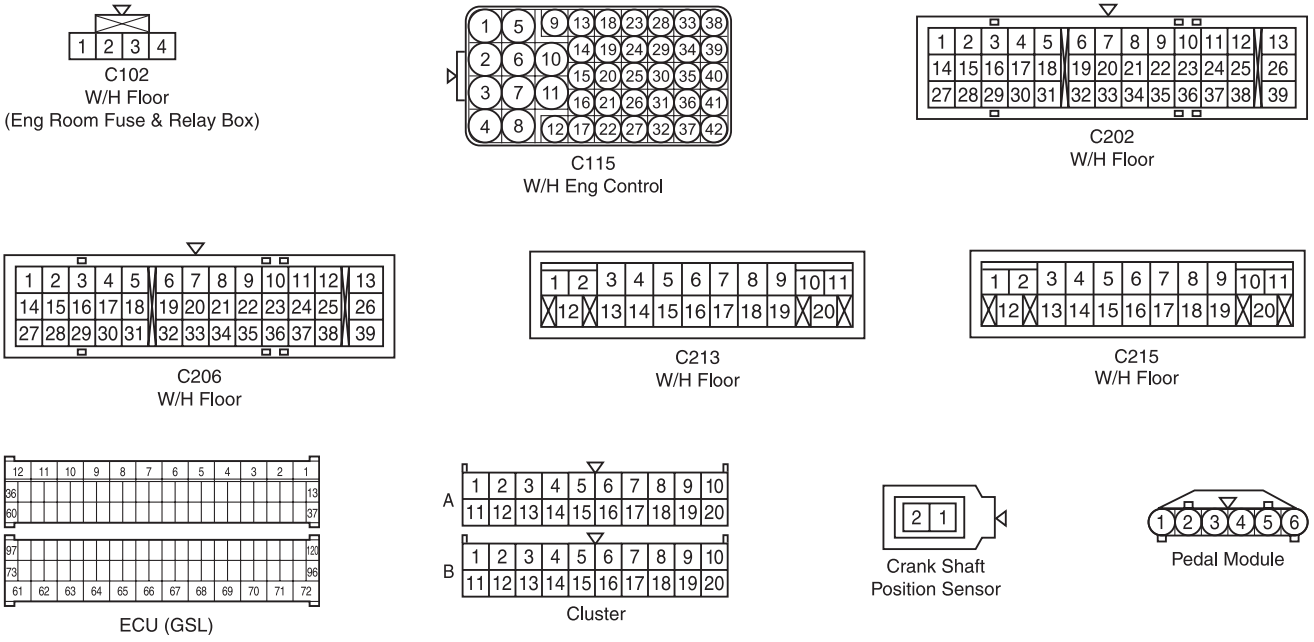
1) IGN COIL, INJECTOR, PEDAL MODULE, THROTTLE SENSOR



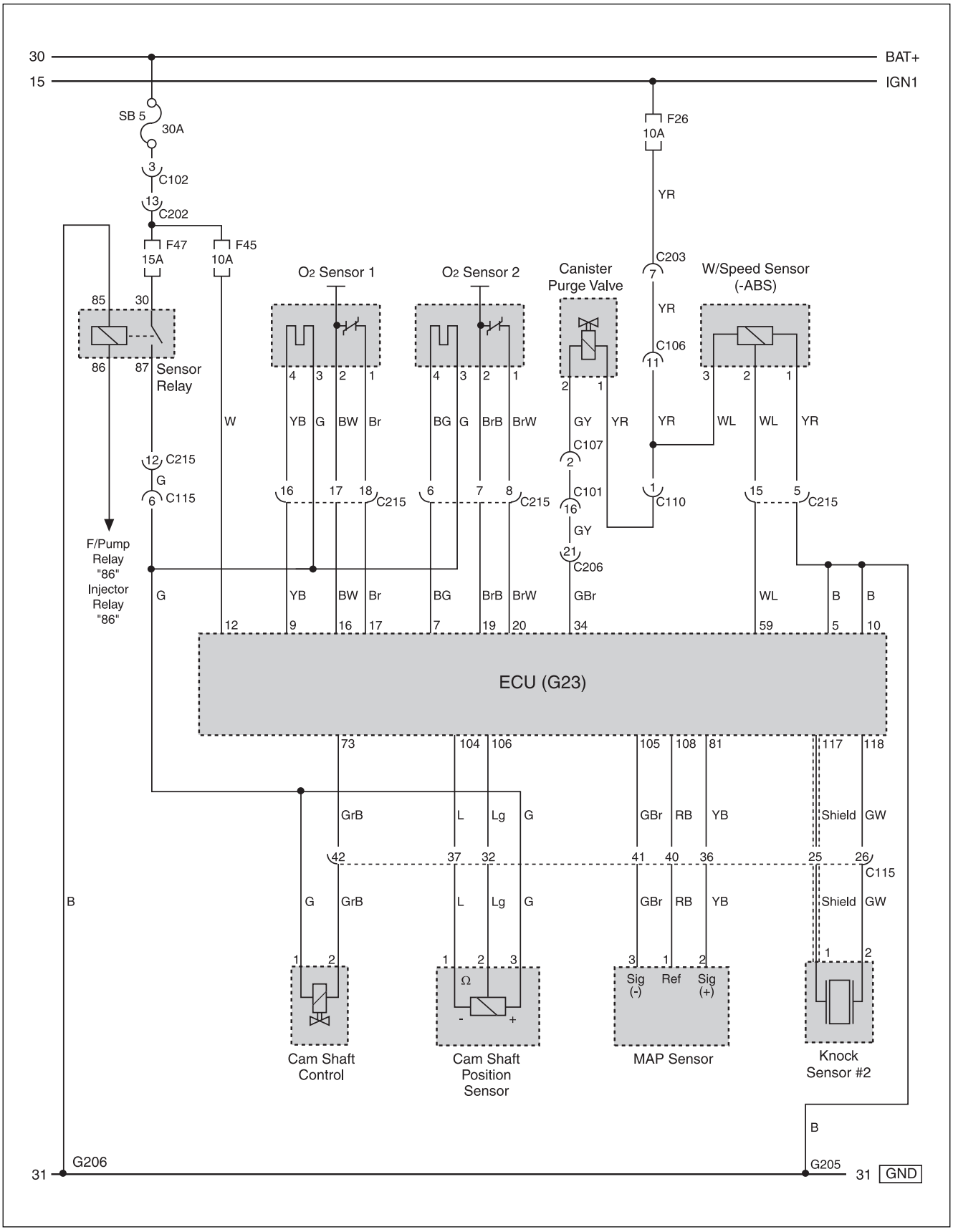
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C215 (20Pin, Brown)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G205	W/H Floor	RH Eng ECU	ECU
G206	W/H Main	Inner the Passenger Cowl Side PNL	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



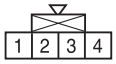
2) O_2 SENSOR, CPS, KNOCK SENSOR, MAP SENSOR, CANISTER PURGE VALVE



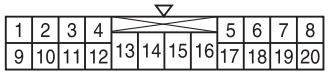
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C110 (10Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C215 (20Pin, Brown)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G205	W/H Floor	RH Eng ECU	ECU
G206	W/H Main	Inner the Passenger Cowl Side PNL	

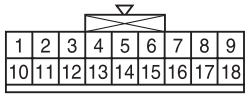
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



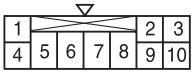
C102
W/H Floor
(Eng Room Fuse & Relay Box)



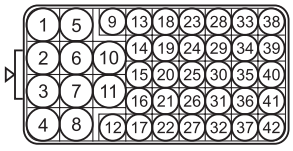
C106
W/H Floor
(Eng Room Fuse & Relay Box)



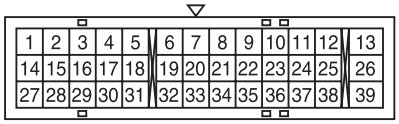
C108
W/H Engine
(Eng Room Fuse & Relay Box)



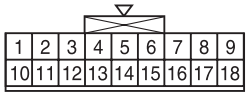
C110
W/H ENG
(Eng Room Fuse & Relay Box)



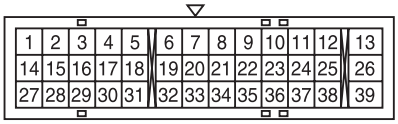
C115
W/H Eng Control



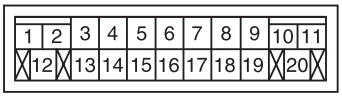
C202
W/H Floor



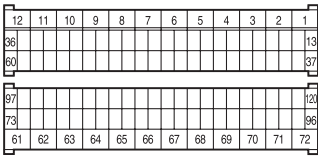
C203
W/H Floor



C206
W/H Floor



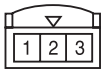
C215
W/H Floor



ECU (GSL)



Knock Sensor



Cam Shaft
Position Sensor



Canister
Purge Valve

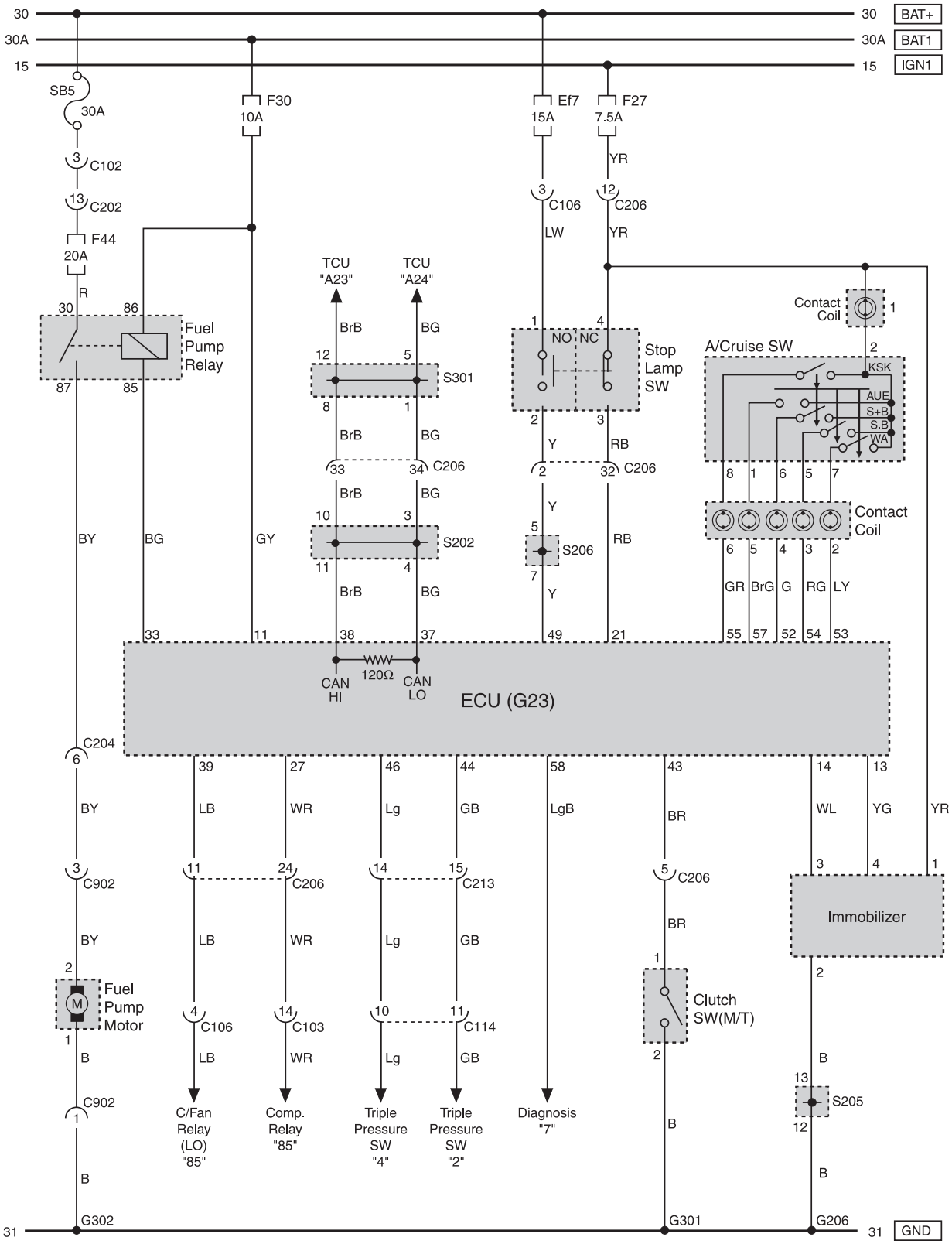


W/Speed Sensor
(-ABS)



O_2 Sensor
1

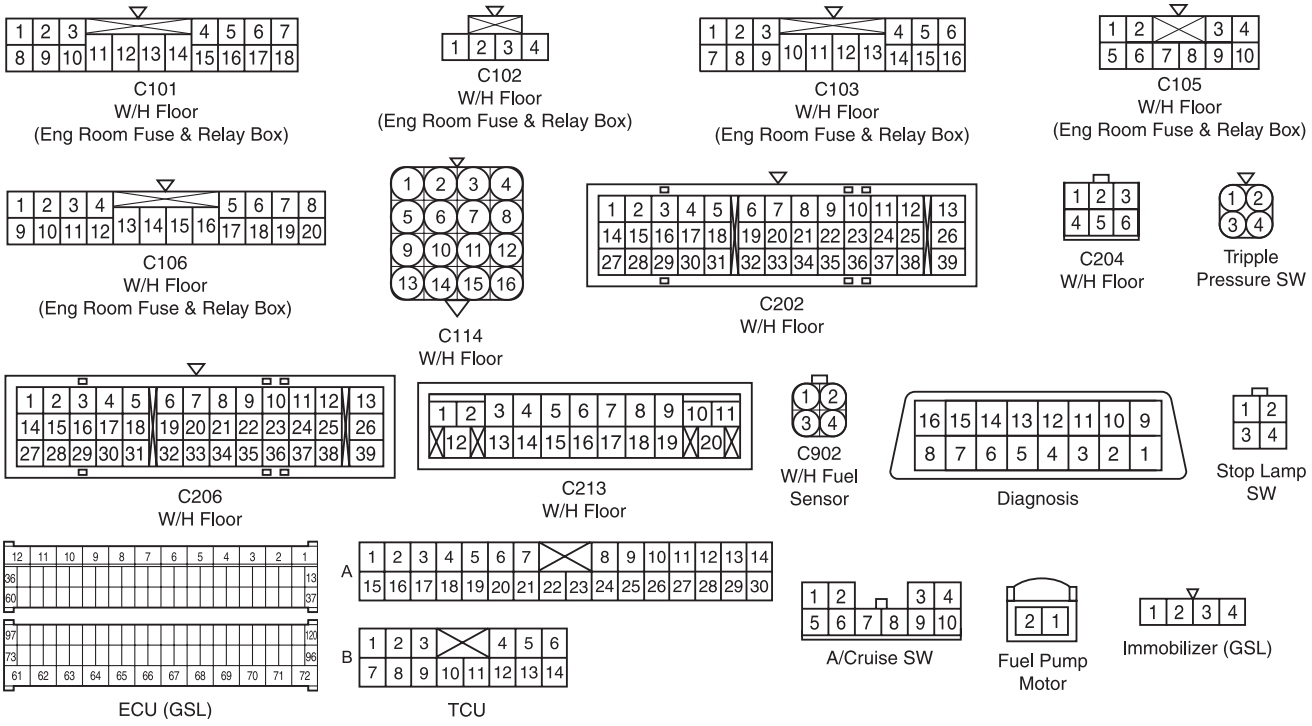
3) STOP LAMP, CRUISE CONTROL SW, FUEL PUMP, IMMOBILIZER



A. CONNECTOR INFORMATION

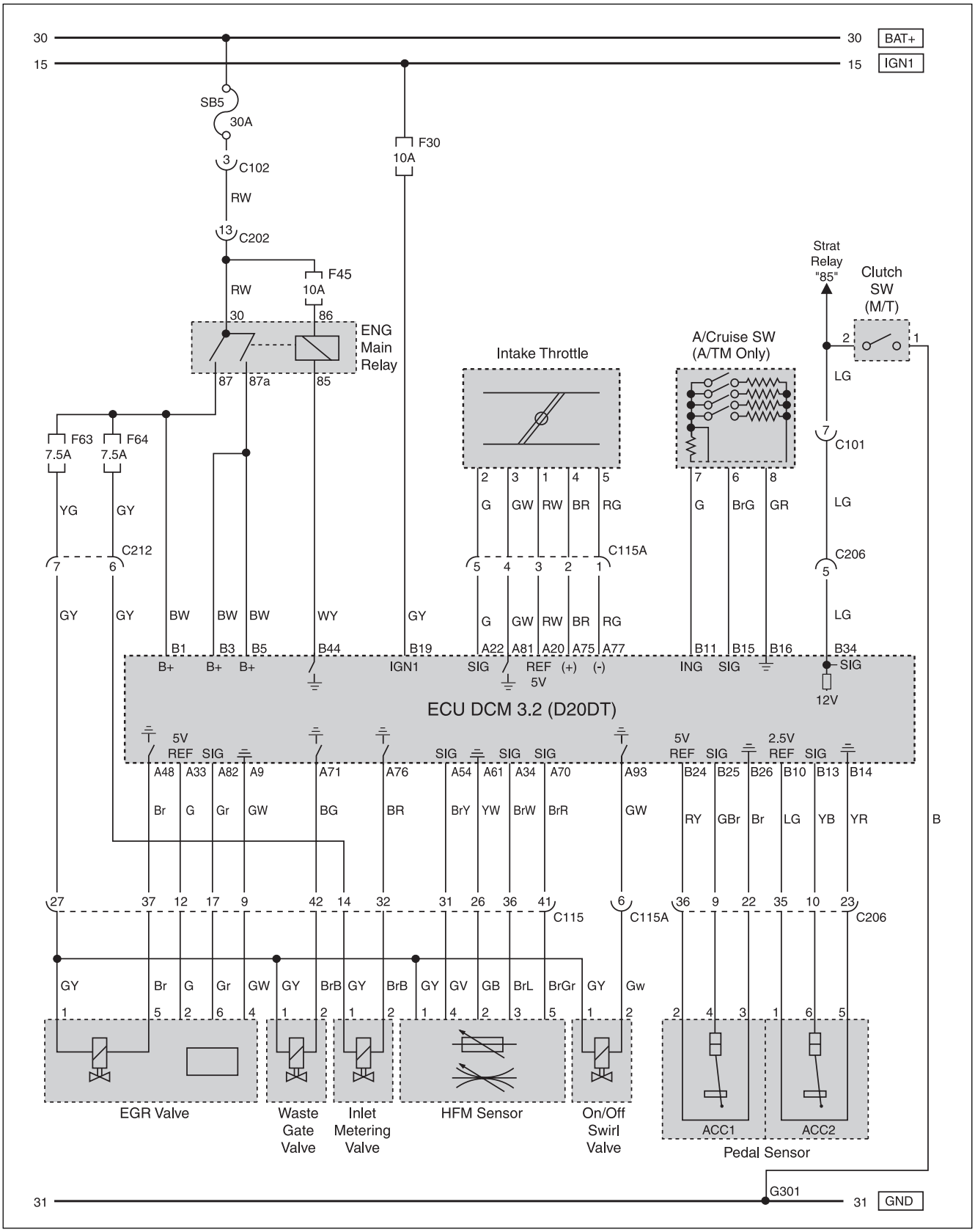
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C114 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C902 (4Pin, Black)	W/H Floor - W/H Fuel Sender	Upper the T/M	
G206	W/H Main	Inner the Passenger Cowl Side PNL	
G301	W/H Floor	Under the Driver Seat	
G302	W/H Floor	Under the Driver Seat	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN1,T/Signal
S301 (14Pin, Black)	W/H Floor	Beside Driver Seat W/H Protector	CAN

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



4. ECU (ENGINE CONTROL UNIT - D20DT 3.2) 1491

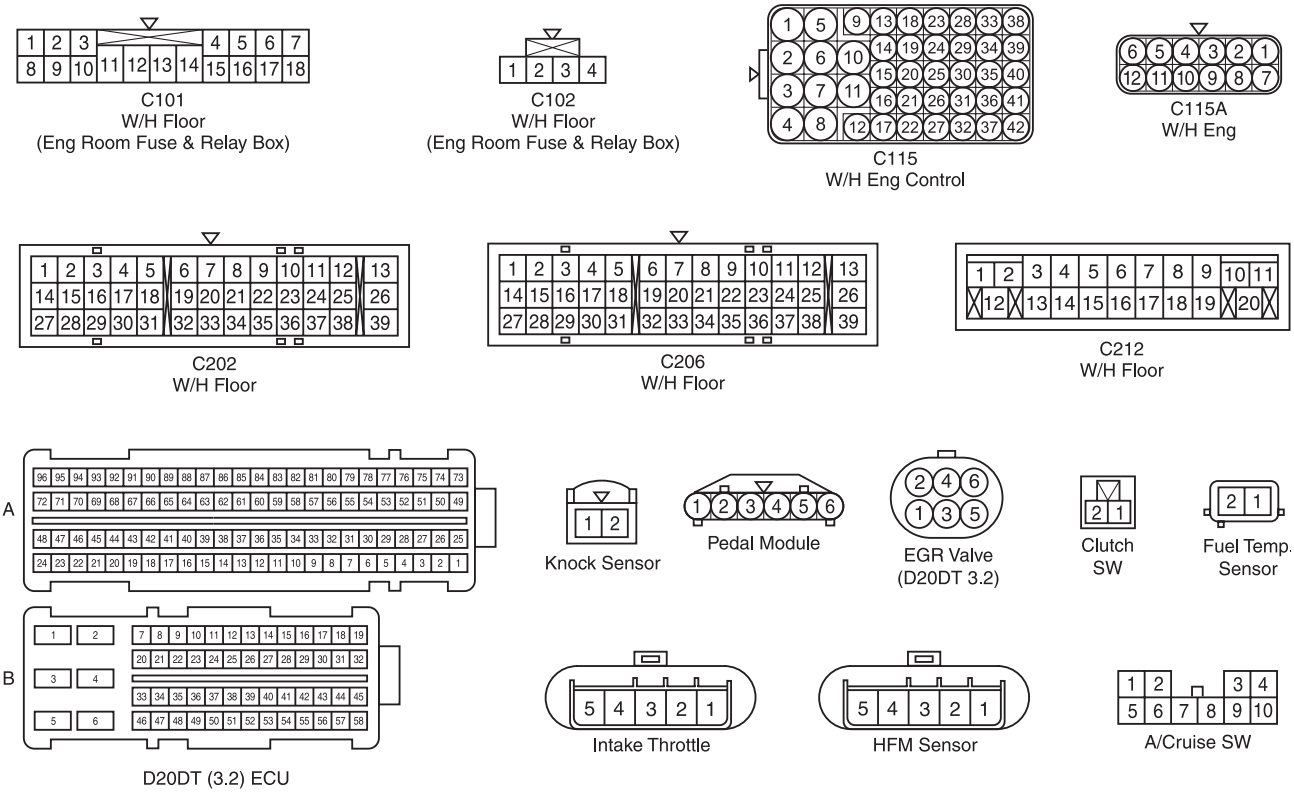
1) ENG MAIN RELAY, INTAKE THROTTLE, A/CRUISE SW, VALVE (EGR, WASTE GATE, INLET METERING), SENSOR (HFM, PEDAL)



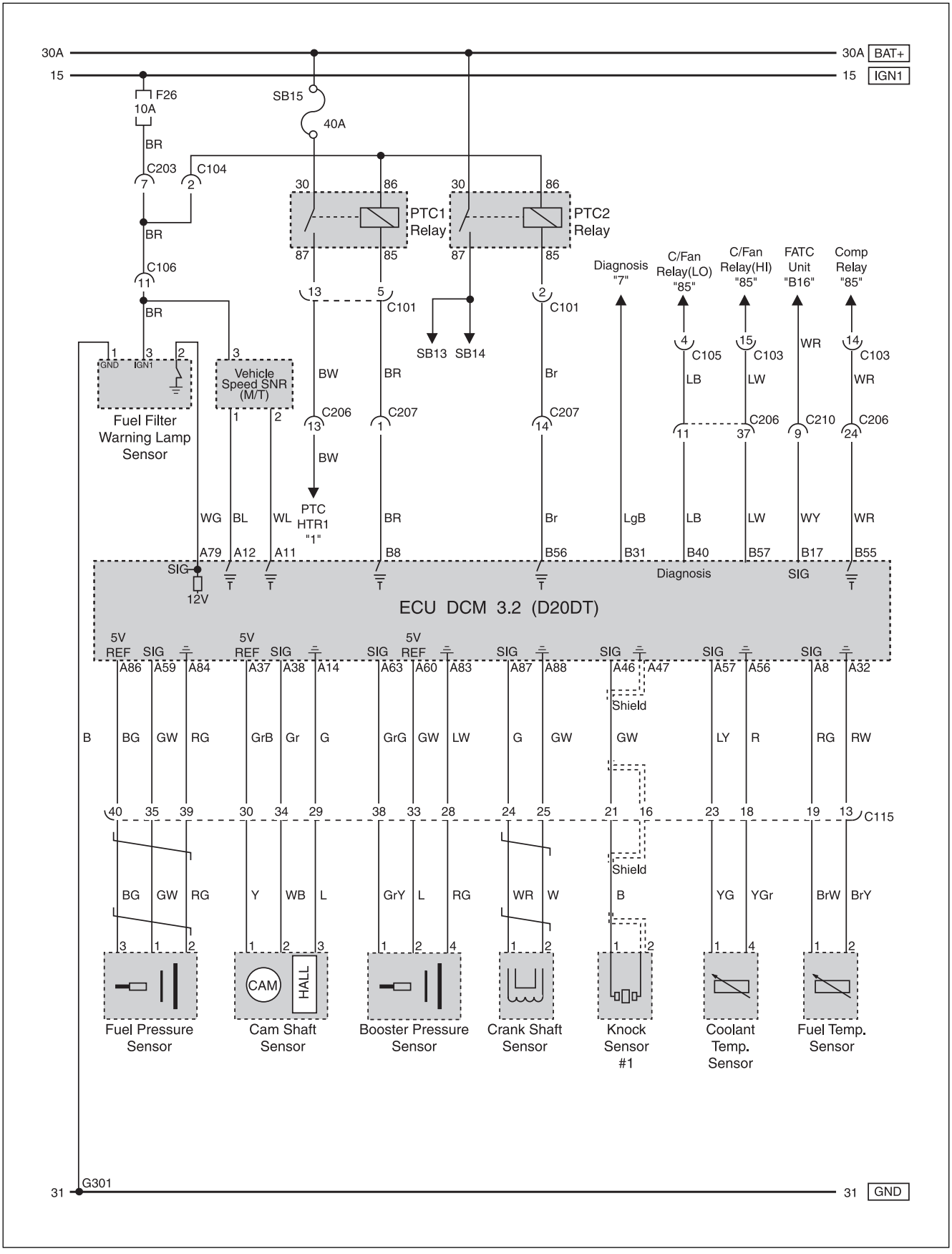
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C115A (12Pin, White)	W/H Eng - W/H Floor	Beside ABS/ESP Unit	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G301	W/H Floor	Under the Driver Seat	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



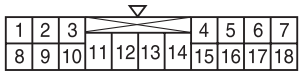
2) SENSOR (FUEL PRESSURE, CAM SHAFT, BOOSTER PRESSURE, CRANK SHAFT, KNOCK, FUEL TEMP, FUEL FILTER WARNING), PTC RELAY

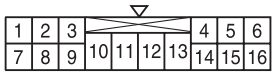


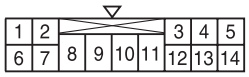
A. CONNECTOR INFORMATION

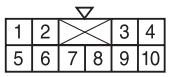
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
G301	W/H Floor	Under the Driver Seat	

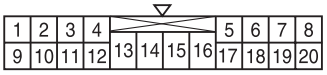
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

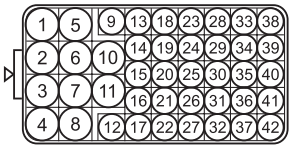

C101
W/H Floor
(Eng Room Fuse & Relay Box)

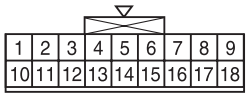

C103
W/H Floor
(Eng Room Fuse & Relay Box)

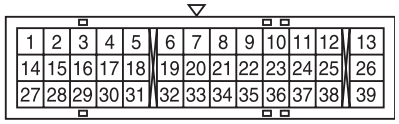

C104
W/H Floor
(Eng Room Fuse & Relay Box)

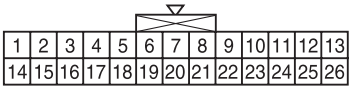

C105
W/H Floor
(Eng Room Fuse & Relay Box)

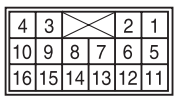

C106
W/H Floor
(Eng Room Fuse & Relay Box)

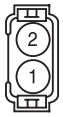

C115
W/H Eng Control

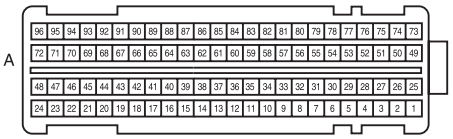

C203
W/H Floor


C206
W/H Floor


C207
W/H Floor

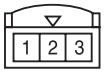

C210
W/H A/Con


Crank Shaft
Position Sensor

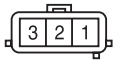


D20DT (3.2) ECU


Fuel Filter Warning
Sensor


Cam Shaft
Sensor


Knock Sensor


Fuel Pressure
Sensor

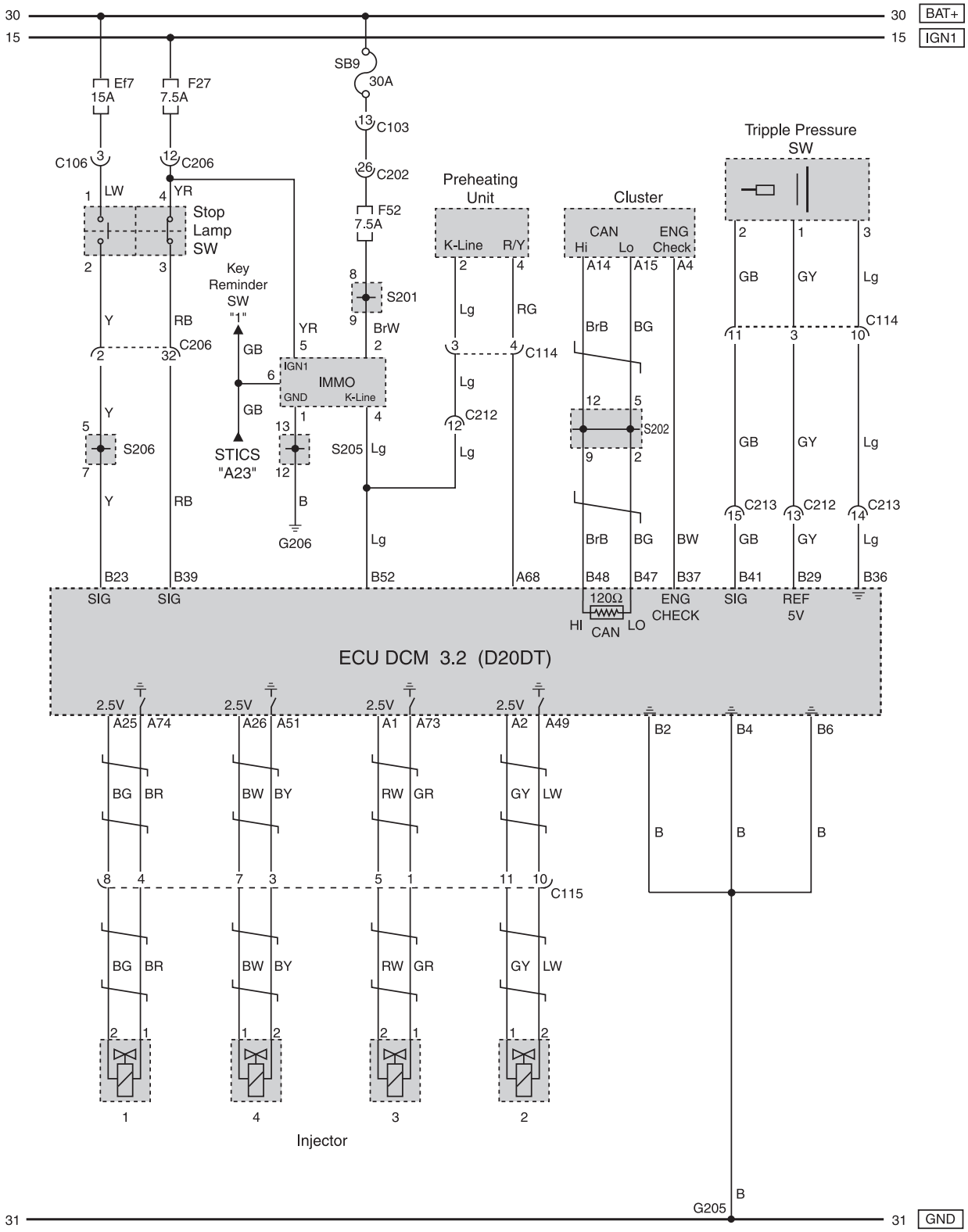

W/Speed Sensor
(-ABS)


Booster Pressure
Sensor


Fuel Temp.
Sensor


Coolant Temp.
Sensor

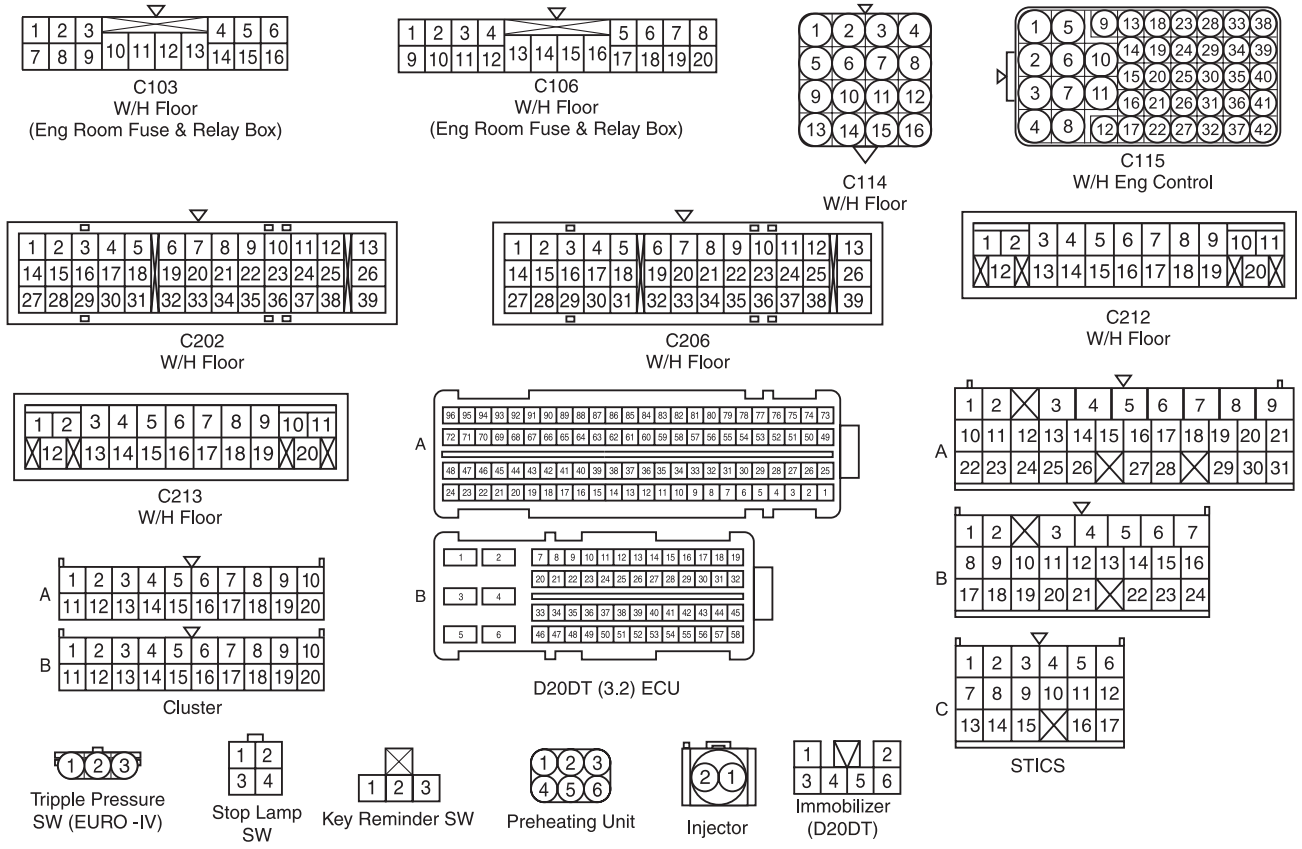
3) INJECTOR, STOP LAMP, IMMOBILIZER, CLUSTER, PREHEATING UNIT, SENSOR, TRIPPLE PRESSURE SW



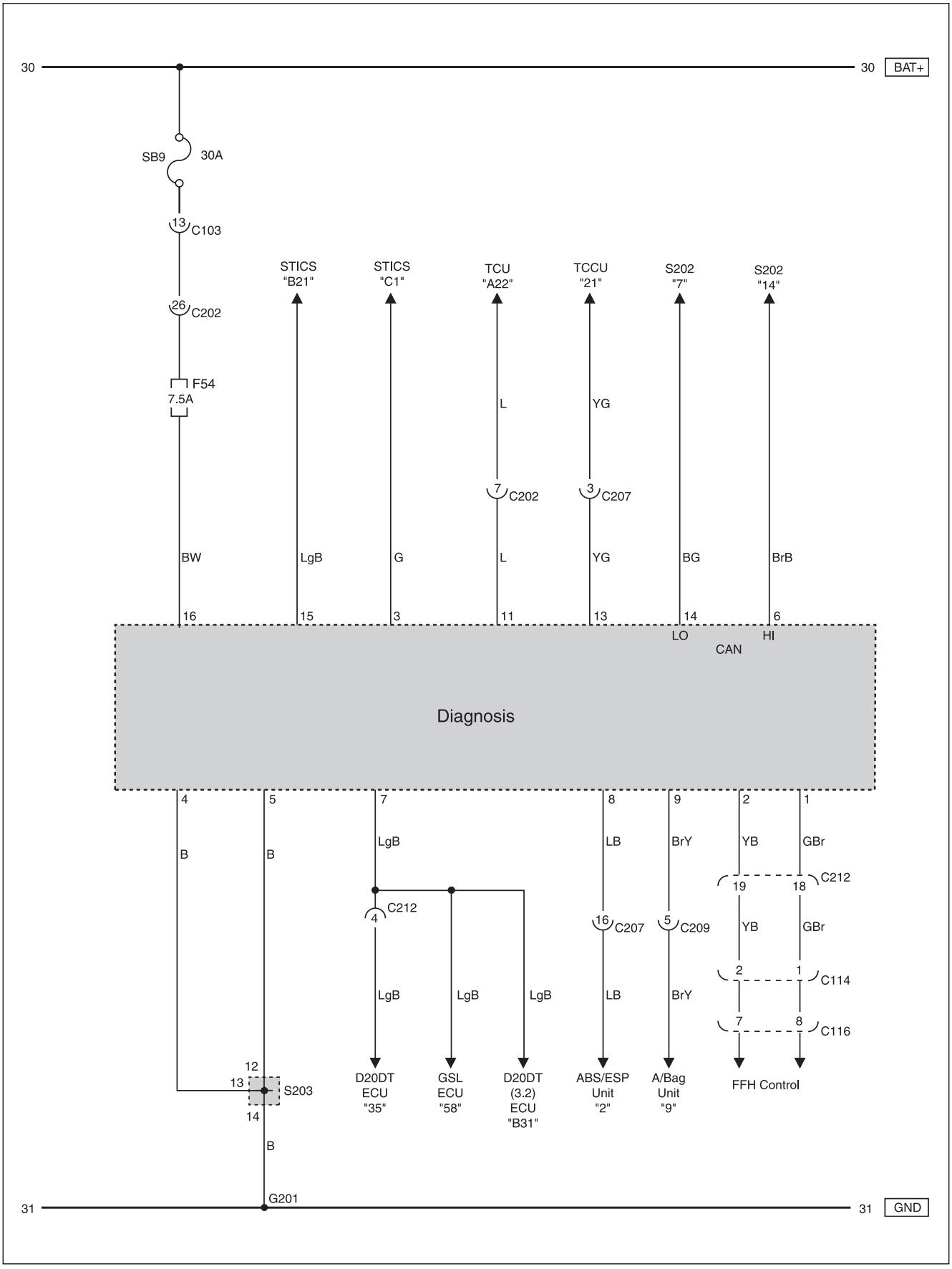
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	.
C114 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G205	W/H Floor	RH Eng ECU	ECU
G206	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN1, T/Signal

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



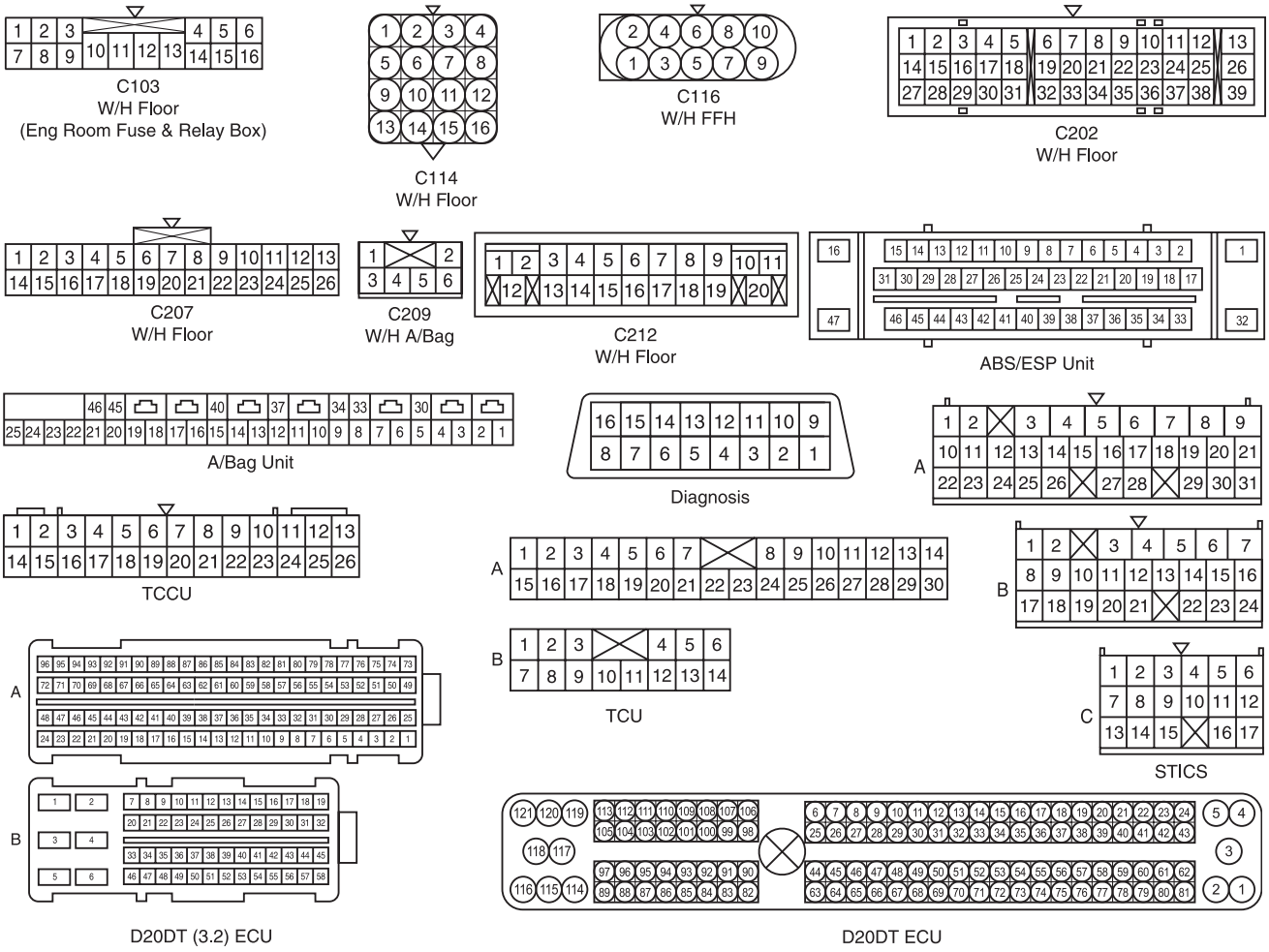
5. DIAGNOSIS CIRCUIT 8210



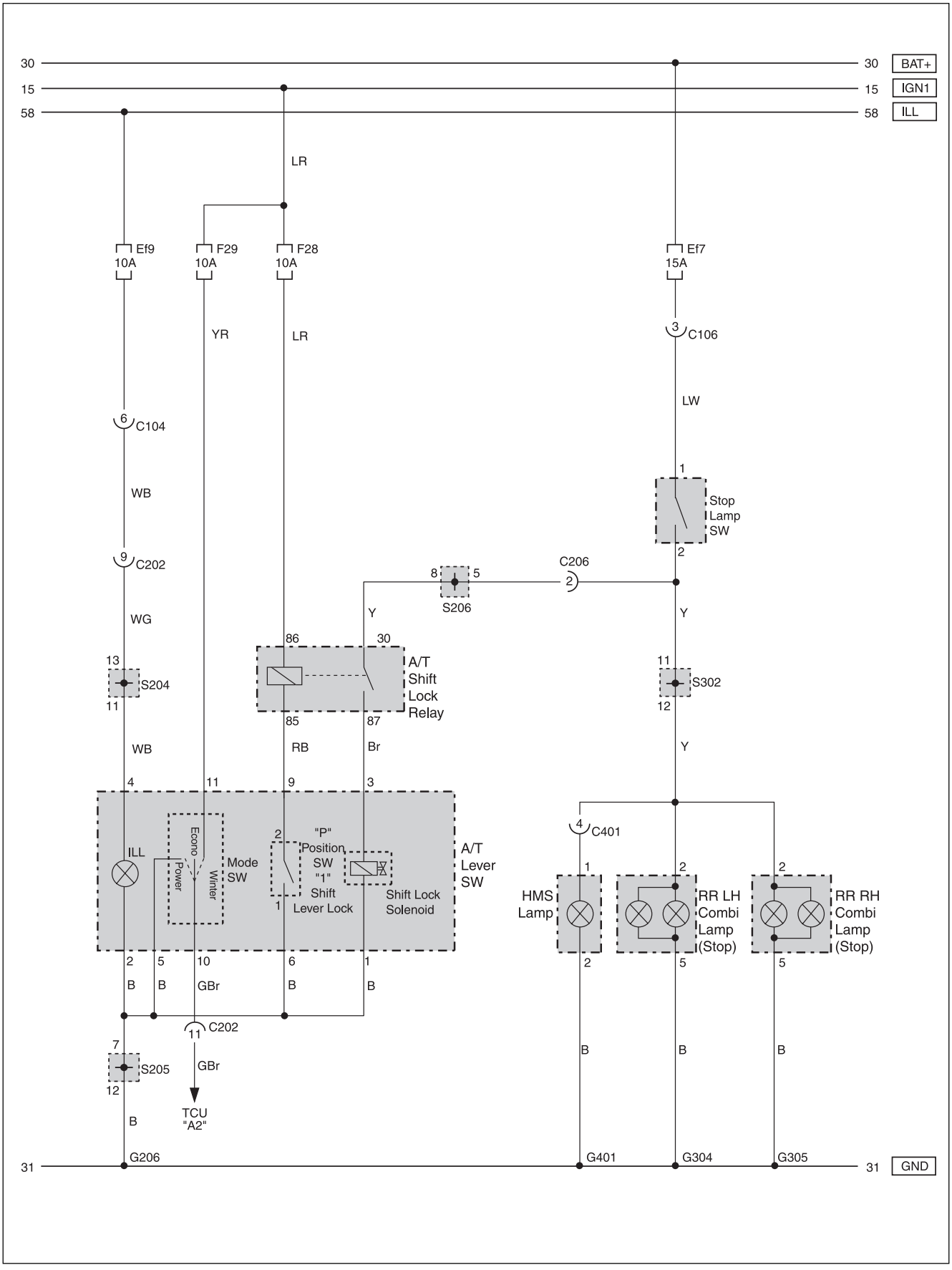
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C114 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C116 (10Pin, Black)	W/H Eng - W/H FFH	Right Eng Room Dash PNL	FFH
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C209 (6Pin, White)	W/H Main - W/H A/Bag	Upper the Driver Legroom	A/Bag
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G201	W/H Main	Under the Driver Cowl Side PNL	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



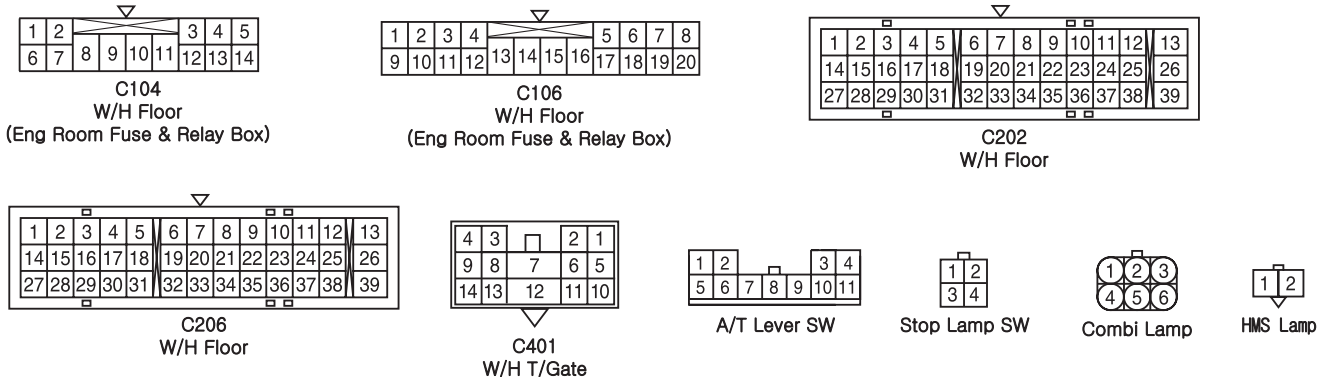
6. A/T SHIFT LOCK 3740



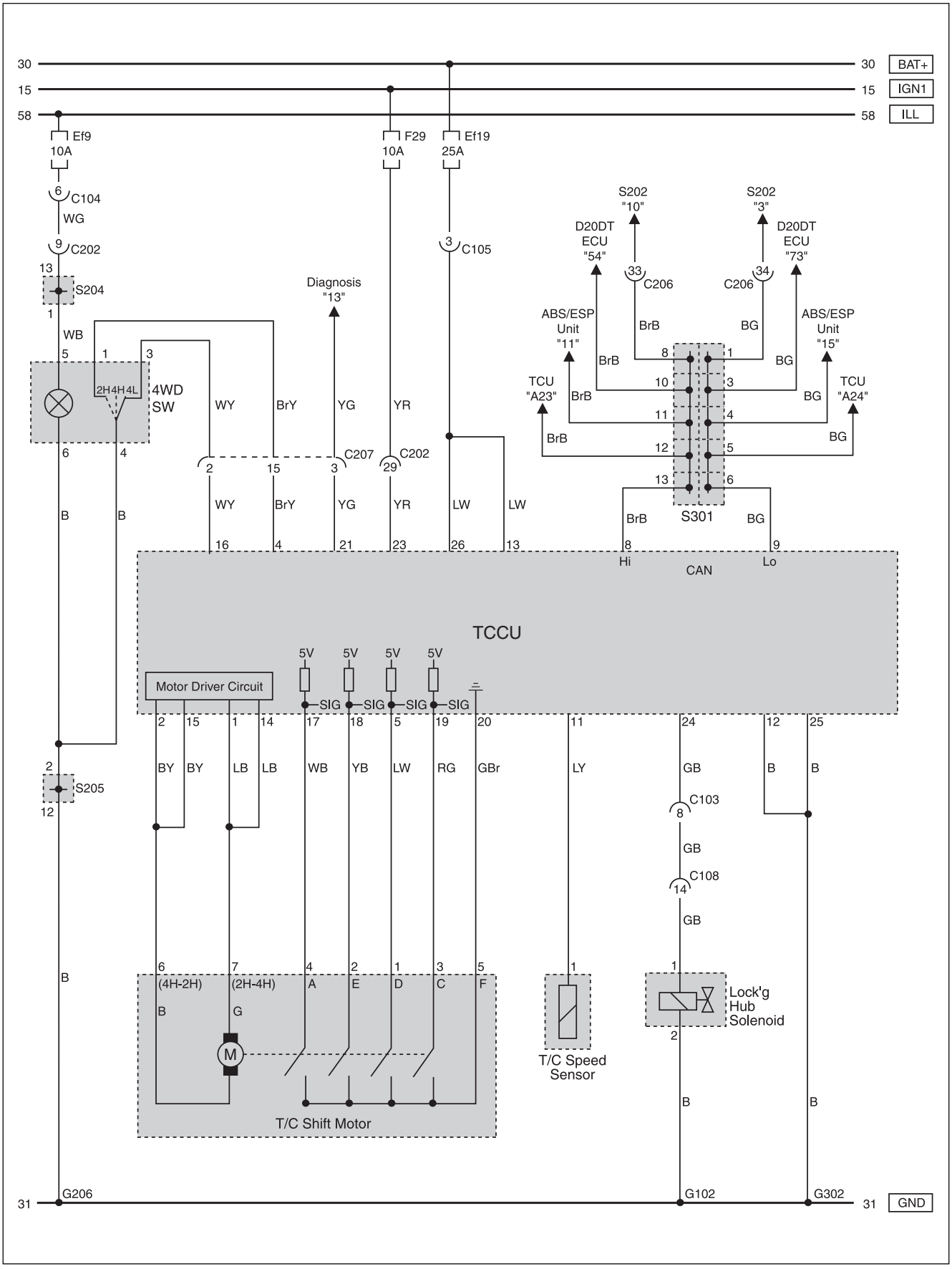
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C401 (14Pin, White)	W/H Floor - W/H T/Gate	Under the LH T/Gate	
G206	W/H Main	Inner the Passenger Cowl Side PNL	
G304	W/H Floor	Driver QTR PNL (Under the QTR Glass)	
G305	W/H Floor	Passenger QTR PNL (Under the QTR Glass)	
G401	W/H T/Gate	Center the T/Gate	
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN1, T/Signal
S302 (14Pin, Black)	W/H Floor	Beside RR LH Seat W/H Protector	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



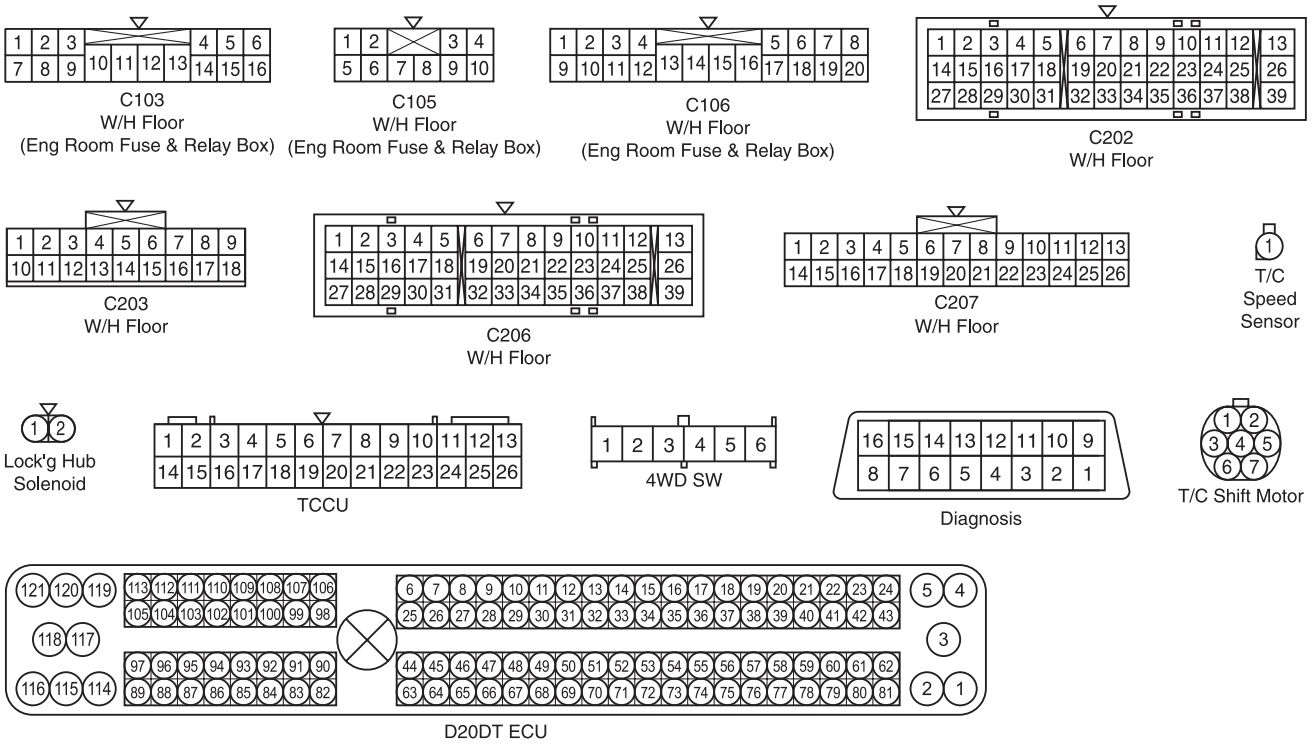
7. TCCU 3410


30
15
58
BAT+
IGN1
ILL
Ef9
10A
F29
10A
Ef19
25A
C104
WG
C202
S204
C105
Diagnosis
"13"
S202
"10"
S202
"3"
D20DT
ECU
"54"
D20DT
ECU
"73"
C206
C206
ABS/ESP
Unit
"11"
ABS/ESP
Unit
"15"
TCU
"A23"
TCU
"A24"
4WD
SW
2H 4H 4L
WB
WY
BrY
YG
YR
LW
BrB
BG
C207
C202
S301
CAN
Hi
Lo
TCU
Motor Driver Circuit
5V
SIG
BY
LB
WB
YB
LW
RG
GBr
LY
GB
C103
C108
S205
(4H-2H)
(2H-4H)
A
E
D
C
F
M
T/C Shift Motor
T/C Speed
Sensor
Lock'g
Hub
Solenoid
G206
G102
G302
31
GND

A. CONNECTOR INFORMATION

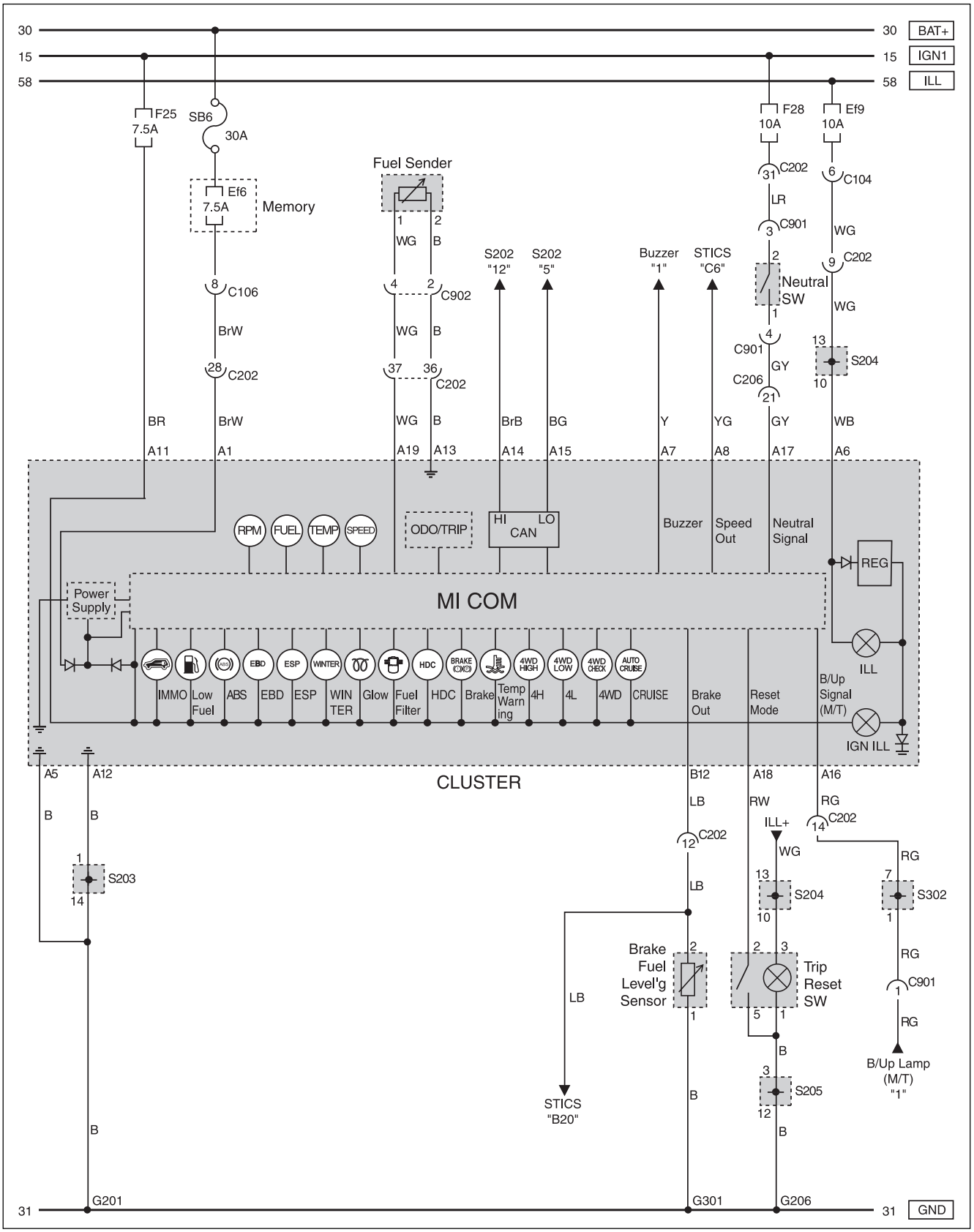
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
G102	W/H Eng Room	Behind LH Head Lamp	
G206	W/H Main	Inner the Passenger Cowl Side PNL	
G302	W/H Floor	Under the Driver Seat	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S301 (14Pin, Black)	W/H Main	Beside Driver Seat W/H Protector	CAN

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



8. CLUSTER 8010

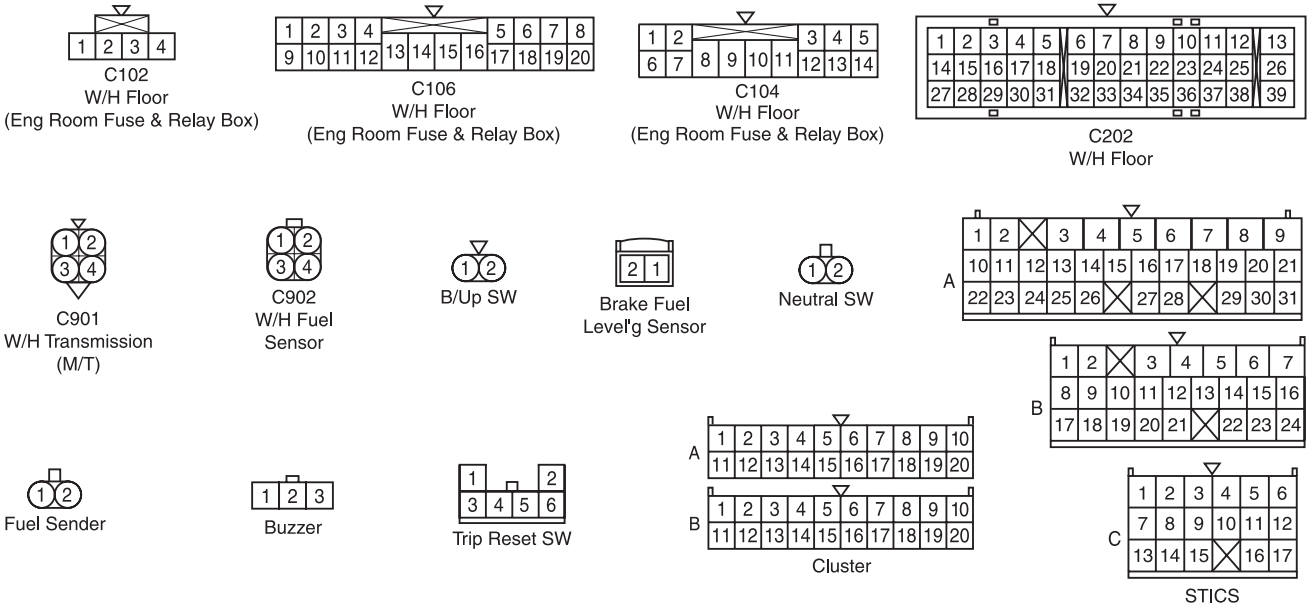
1) GAUGE (SPEED, RPM, FUEL, TEMP), WARNING LAMP (FUEL, FUEL FILTER, ABS/ESP, BRAKE, HDC, 4WD)



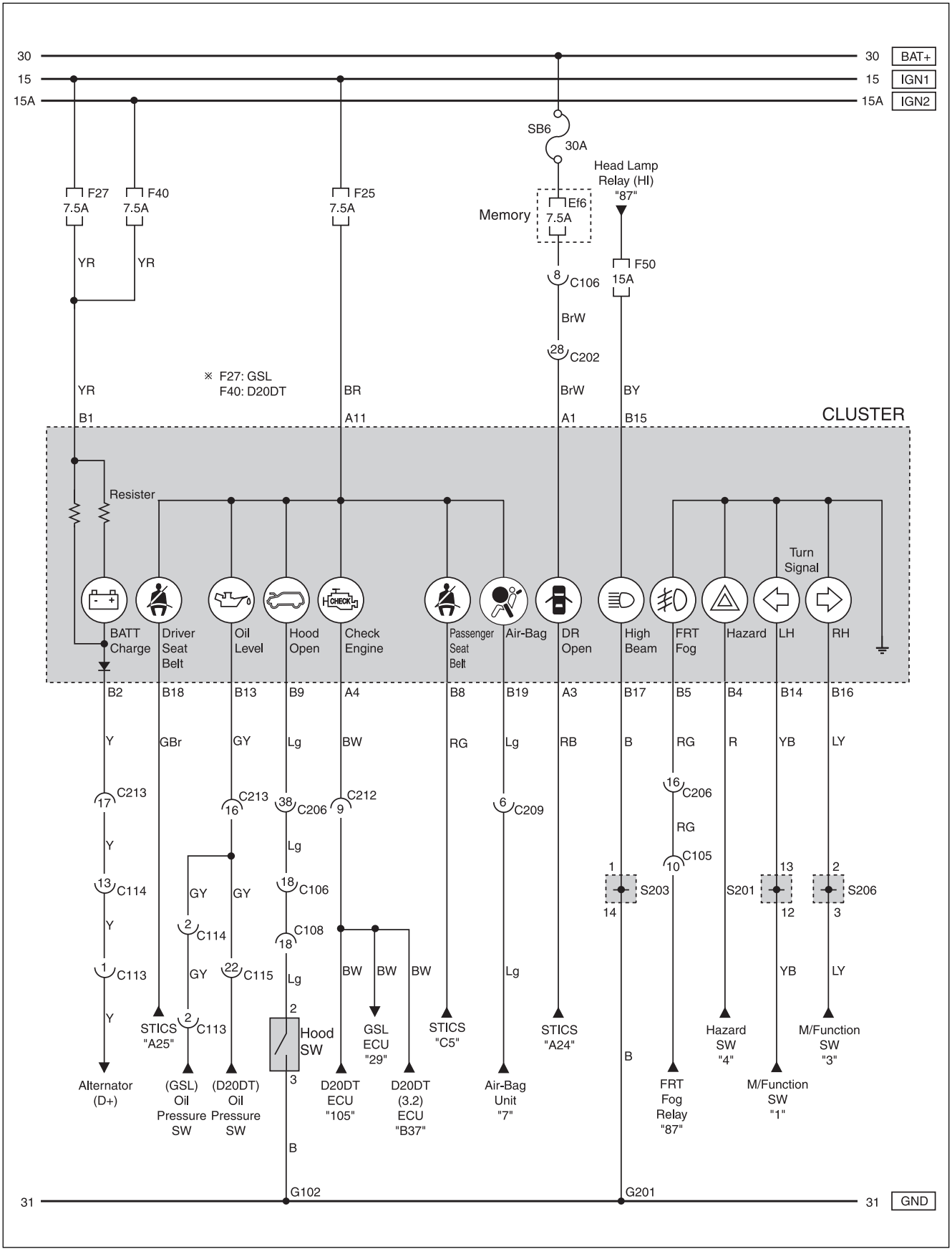
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C901 (4Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	M/T
C902 (4Pin, Black)	W/H Floor - W/H Fuel Sender	Upper the T/M	
G201	W/H Main	Under the Driver Cowl Side PNL	Under C/Holder
G206	W/H Main	Inner the Passenger Cowl Side PNL	
G301	W/H Floor	Under the Driver Seat	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S302 (14Pin, Black)	W/H Floor	Beside RR LH Seat W/H Protector	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



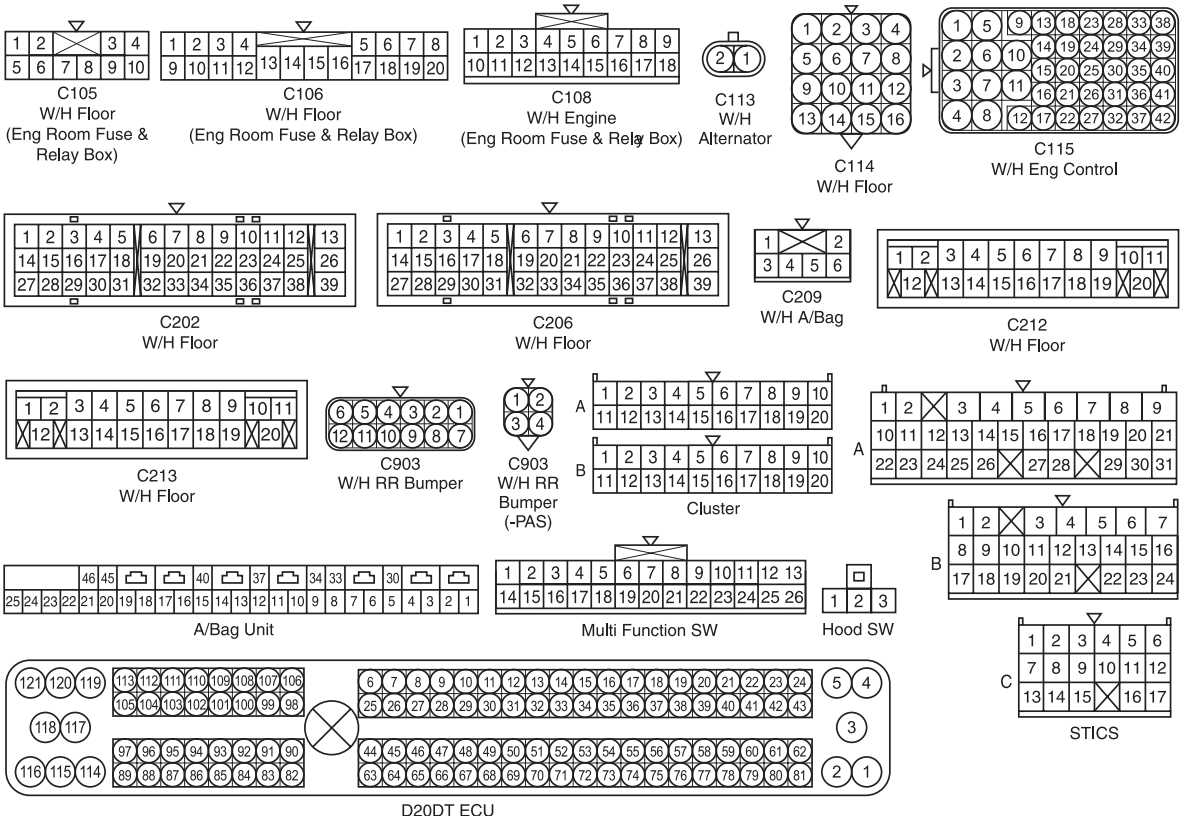
2) WARNING LAMP (BATT CHARGE, OIL, HOOD, DOOR, ENG CHECK, AIR BAG, SEAT BELT), TURN SIGNAL, FOG LAMP, HAZARD



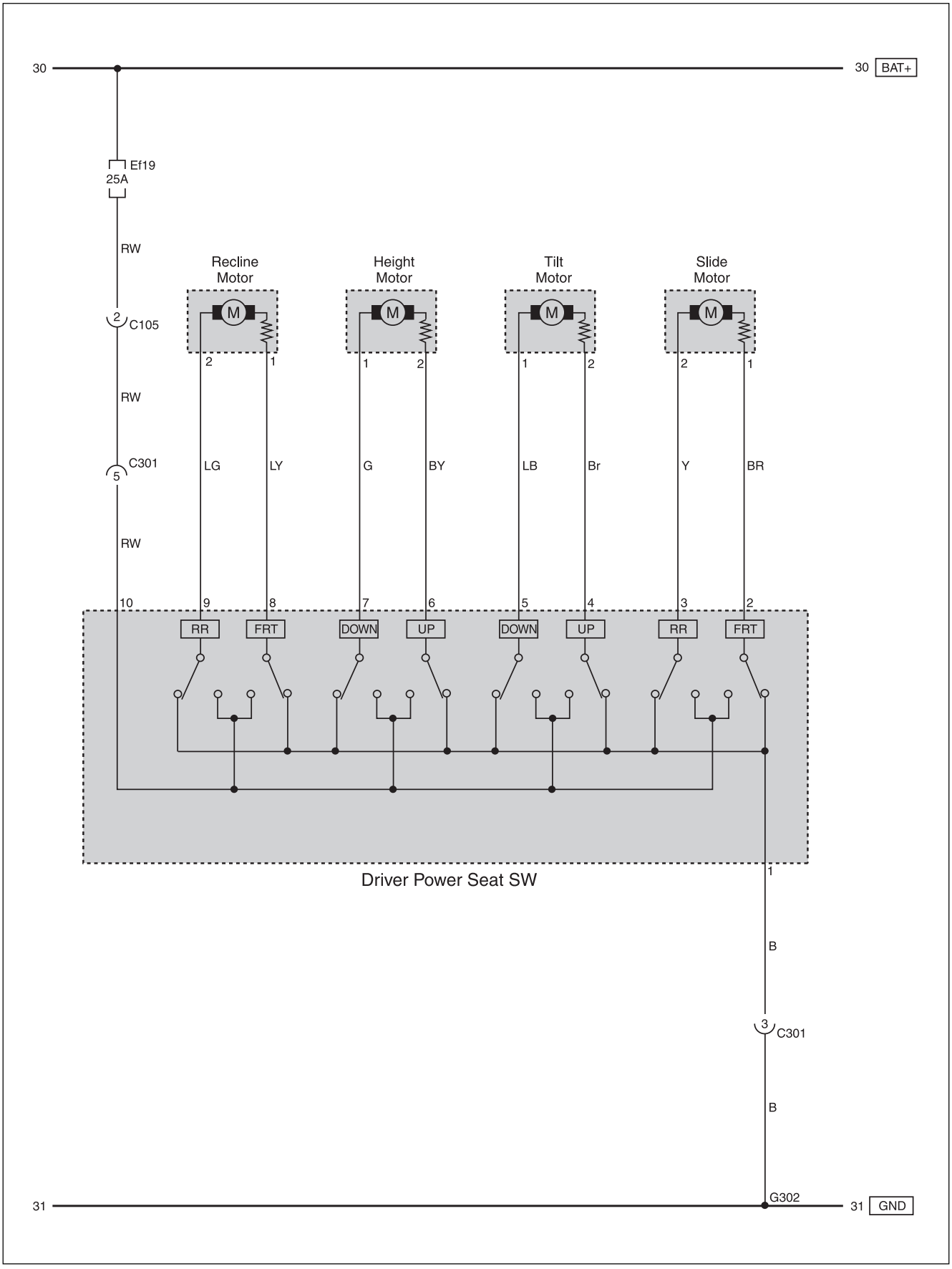
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C105 (10Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)		W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (2Pin, Black)		W/H Eng - W/H Alternator	Backside RH Head Lamp	
C114 (16Pin, Black)		W/H Eng - W/H Floor	Inside RH Fender PNL	
C115 (42Pin, Black)		W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C202 (39Pin, Black)		W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)		W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C209 (6Pin, White)		W/H Main - W/H A/Bag	Upper the Driver Legroom	A/Bag
C212 (20Pin, L/Green)		W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)		W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C903	(12Pin, Black)	W/H Floor - W/H PAS	Under LH Bumper	PAS, RR Fog
	(4Pin, Black)	W/H Floor - W/H PAS	Under LH Bumper	RR Fog
G102		W/H Eng Room	Behind LH Head Lamp	
G201		W/H Main	Under the Driver Cowl Side PNL	Under C/Holder
S201 (14Pin, Black)		W/H Main	RH Protector of the Driver Legroom	
S206 (8Pin, Black)		W/H Main	Upper the PTC Protector	IGN1, T/Signal

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



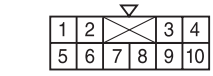
9. POWER SEAT - DRIVER 7410



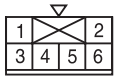
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C301 (6Pin, White)	W/H Floor - W/H Driver Seat	Under the Driver Seat	
G302	W/H Floor	Under the Driver Seat	

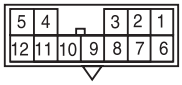
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



C105
W/H Floor
(Eng Room Fuse & Relay Box)



C301
W/H Driver Seat



Power Seat SW



Slide Moter



Recline Motor

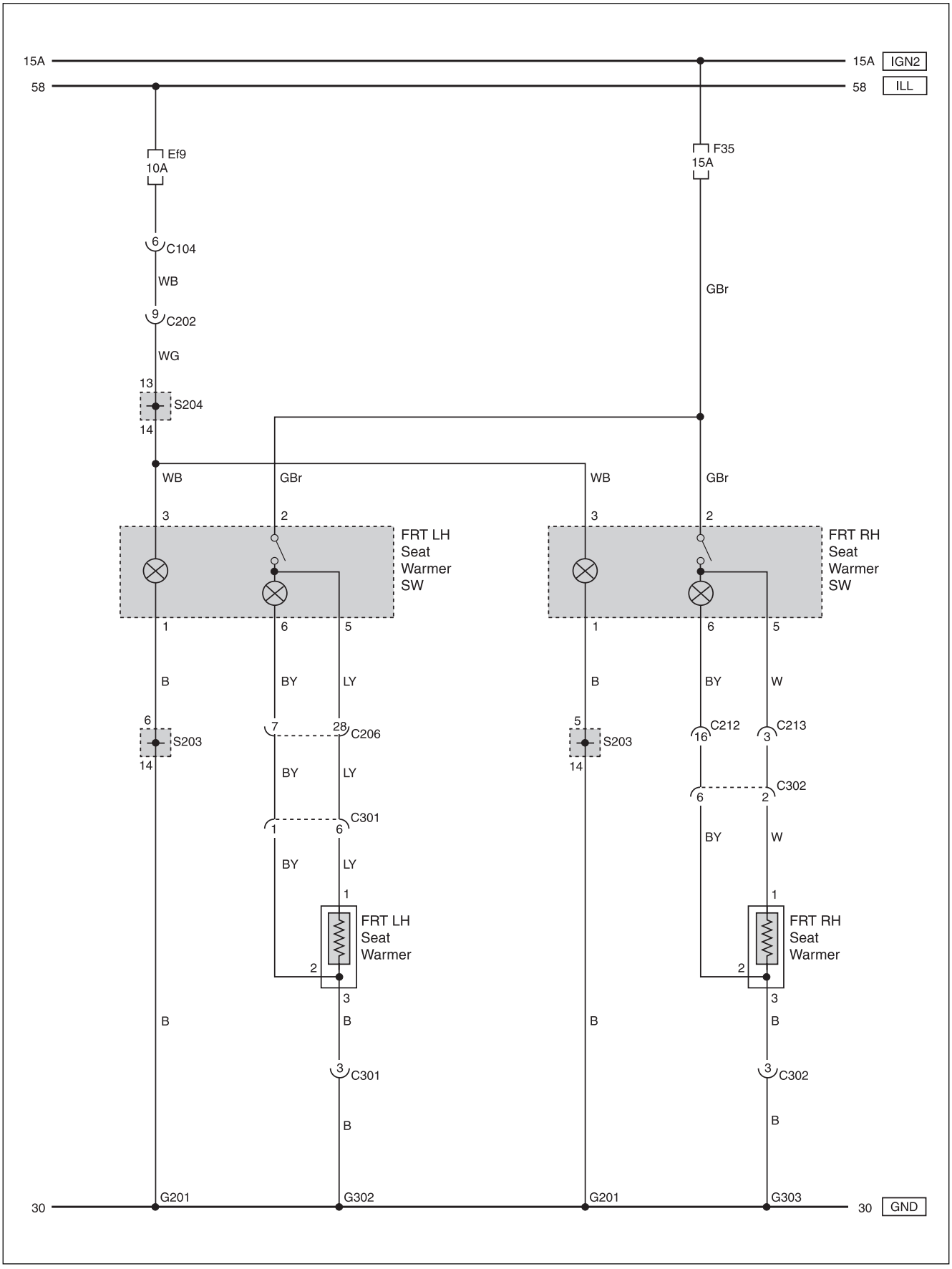


Height Motor



Tilt Motor

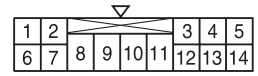
10. FRT SEAT WARMER 8510



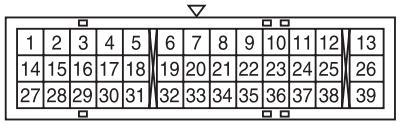
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C301 (6Pin, White)	W/H Floor - W/H Driver Seat	Under the Driver Seat	
C302 (6Pin, White)	W/H Floor - W/H Passenger Seat	Under the Passenger Seat	
G201	W/H Main	Under the Driver Cowl Side PNL	Under C/Holder
G302	W/H Floor	Under the Driver Seat	
G303	W/H Floor	Under the Passenger Seat	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL

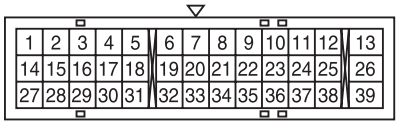
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



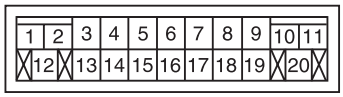
C104
W/H Floor
(Eng Room Fuse & Relay Box)



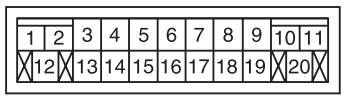
C202
W/H Floor



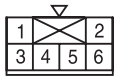
C206
W/H Floor



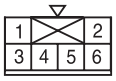
C212
W/H Floor



C213
W/H Floor



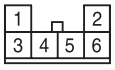
C301
W/H Driver Seat



C302
W/H Passenger Seat



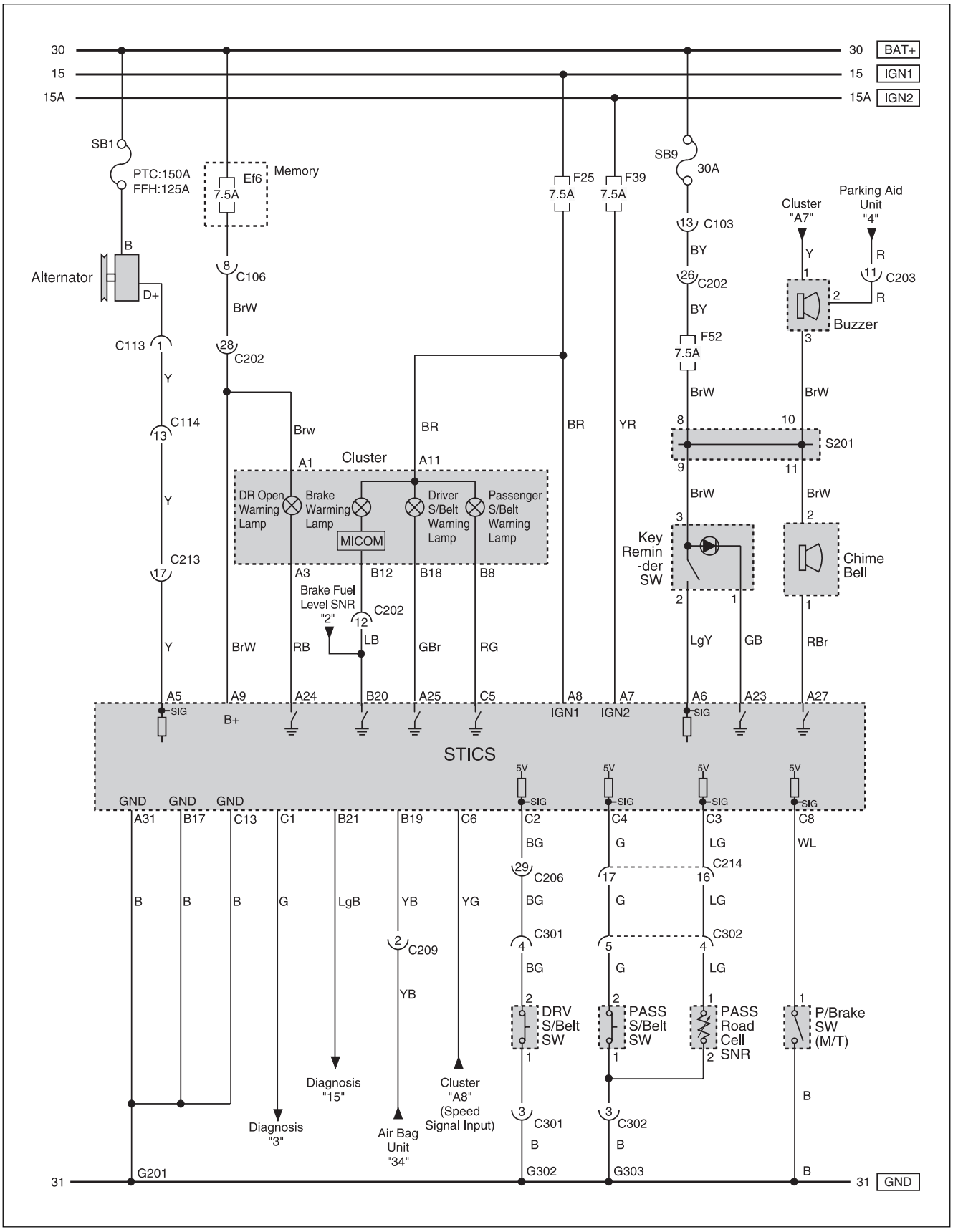
Seat Warmer



Seat Warmer
SW

11. STICS 8710

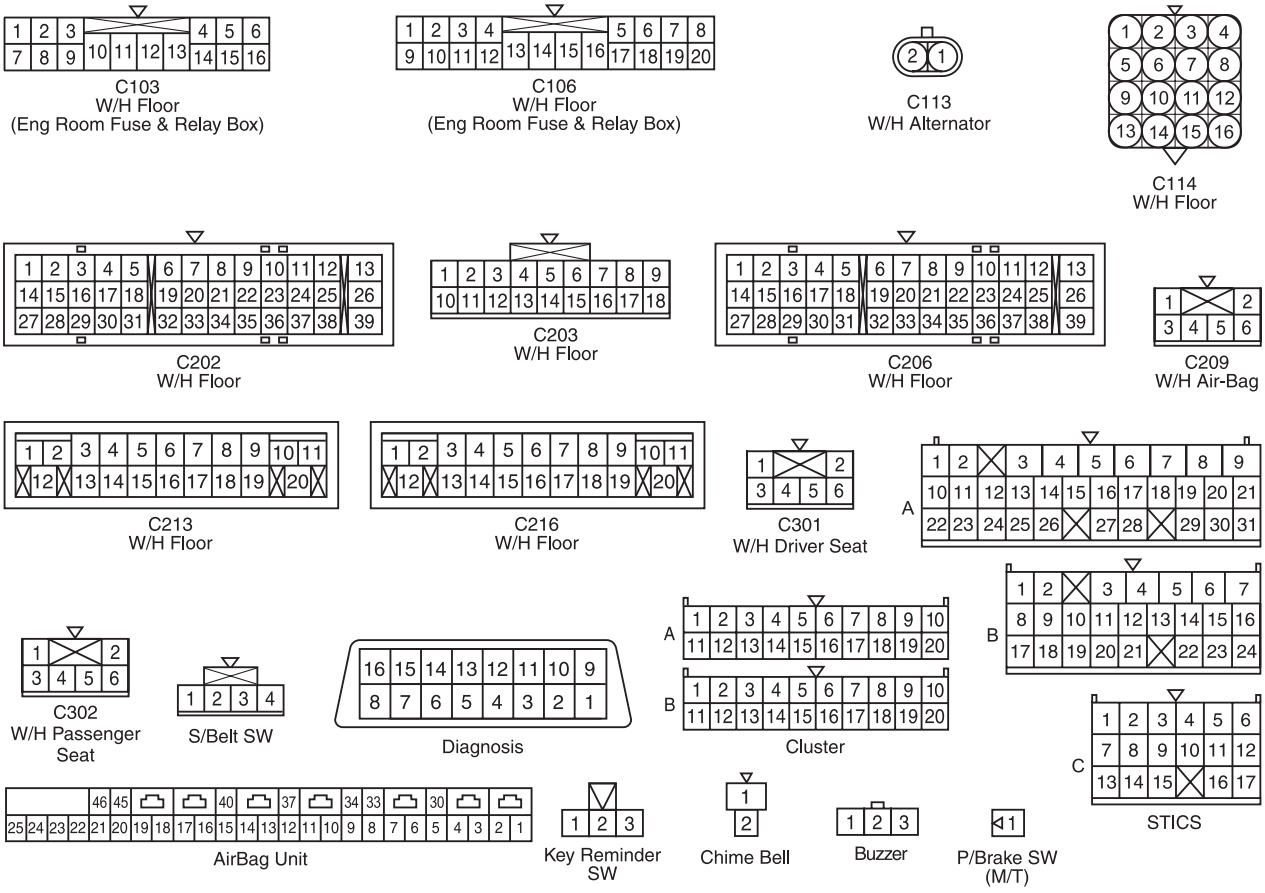
1) POWER/GROUND, CHIME BELL, BUZZER WARNING LAMP (BRAKE, SEAT BELT, DR OPEN)



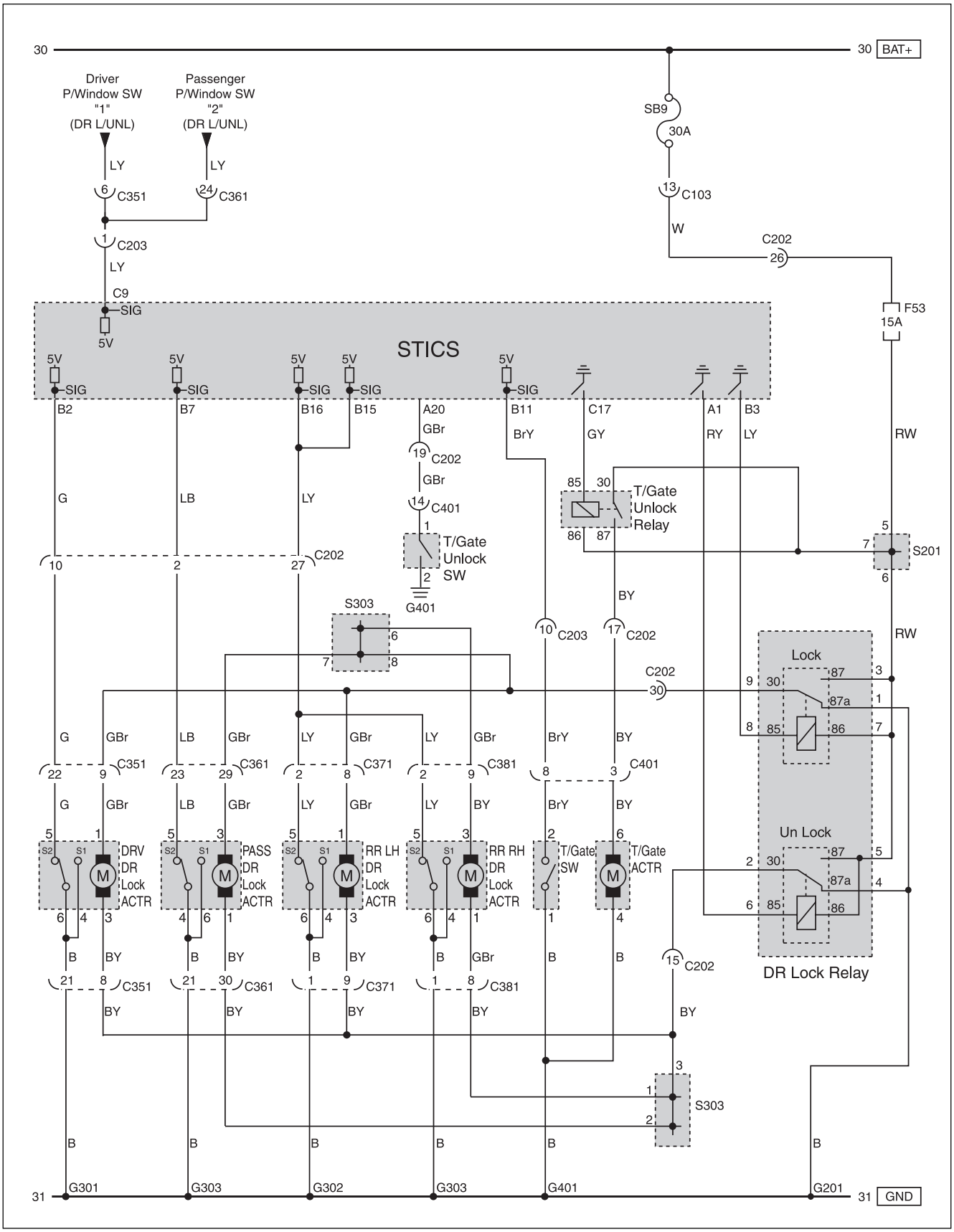
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (2Pin, Black)	W/H Eng - W/H Alternator	Backside RH Head Lamp	
C114 (16Pin, Black)	W/H Main - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	C/Holder
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	A/Bag
C209 (6Pin, White)	W/H Main - W/H A/Bag	Upper the Driver Legroom	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C301 (6Pin, White)	W/H Floor - W/H Driver Seat	Under the Driver Seat	
C302 (6Pin, White)	W/H Floor - W/H Passenger Seat	Under the Passenger Seat	
G201	W/H Main	Under the Driver Cowl Side PNL	Under C/Holder
G302	W/H Floor	Under the Driver Seat	
G303	W/H Floor	Under the Passenger Seat	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



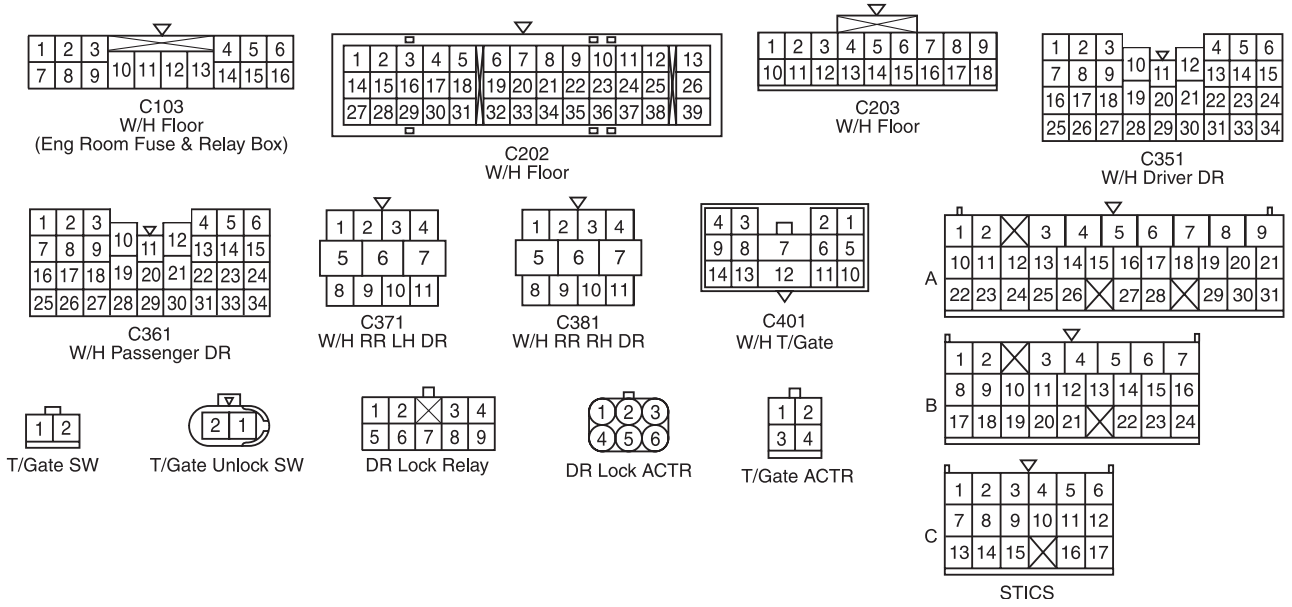
2) CENTRAL DOOR LOCK CIRCUIT



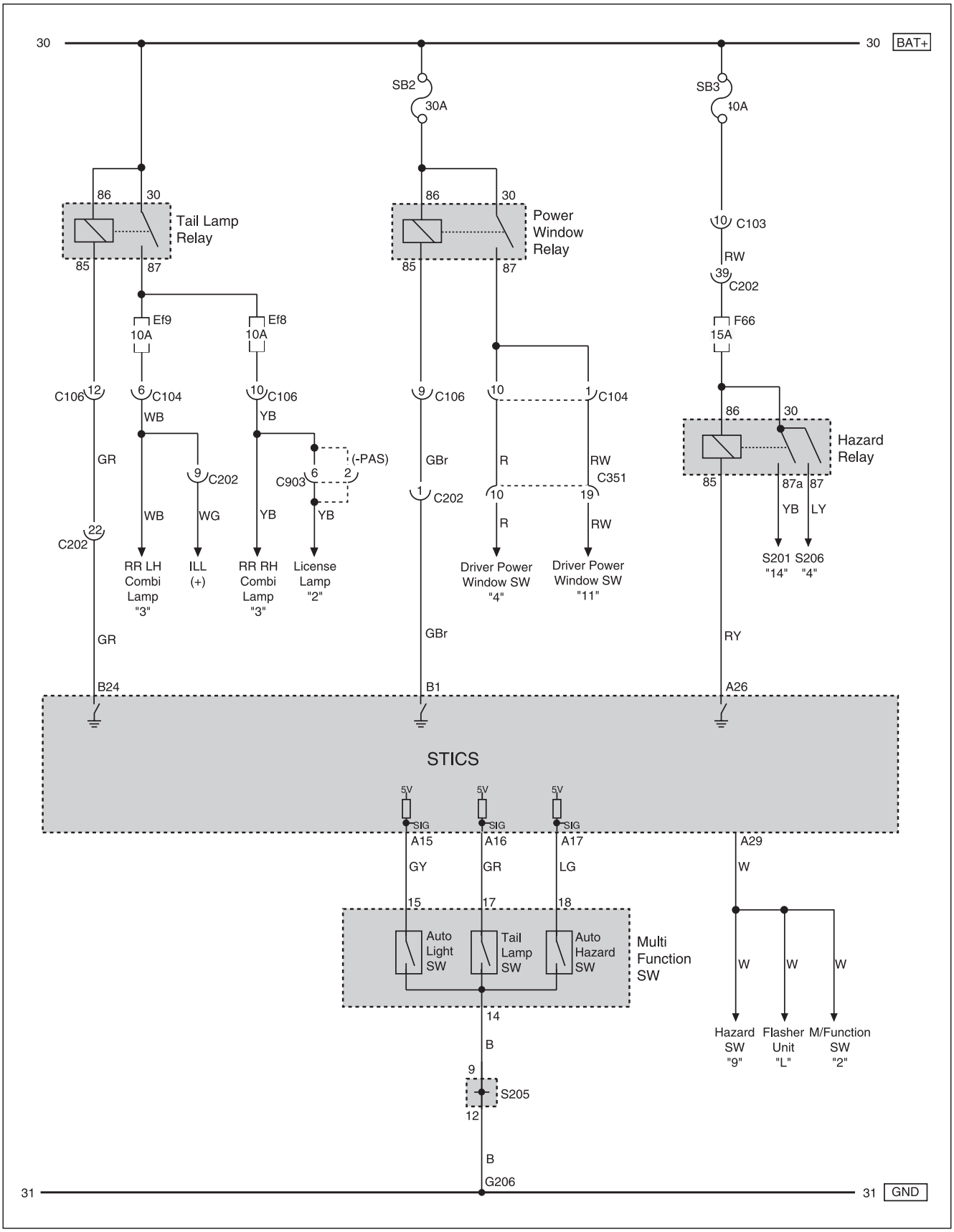
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” PLR	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH “A” PLR	
C371 (11Pin, White)	W/H Floor - W/H RR LH DR	Under the LH “B” PLR	
C381 (11Pin, White)	W/H Floor - W/H RR RH DR	Under the RH “B” PLR	
C401 (14Pin, White)	W/H Floor - W/H T/Gate	Upper the LH T/Gate	Under C/Holder
G201	W/H Main	Under the Driver Cowl Side PNL	
G301	W/H Floor	Under the Driver Seat	
G302	W/H Floor	Under the Driver Seat	
G303	W/H Floor	Under the Passenger Seat	
G401	W/H T/Gate	Center the T/Gate	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S303 (8Pin, Black)	W/H Floor	Under the Passenger “B” PLR W/H Protector	DR Lock

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



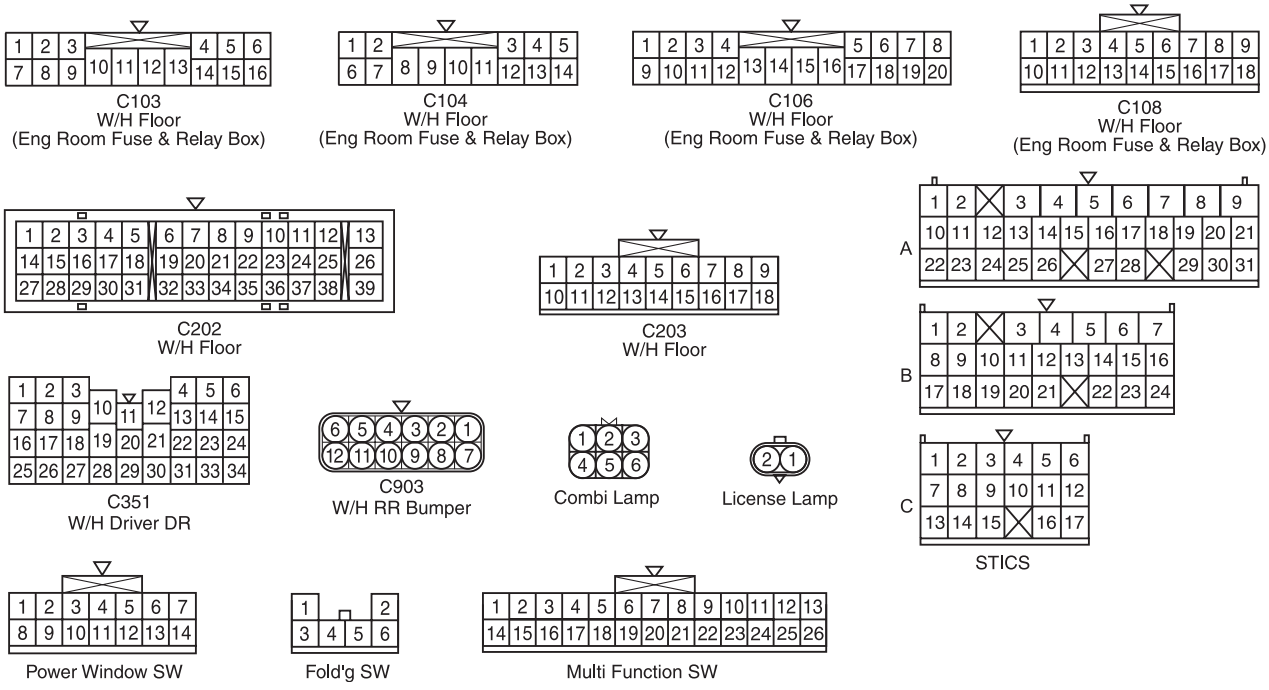
3) TAIL LAMP, HAZARD, POWER WINDOW



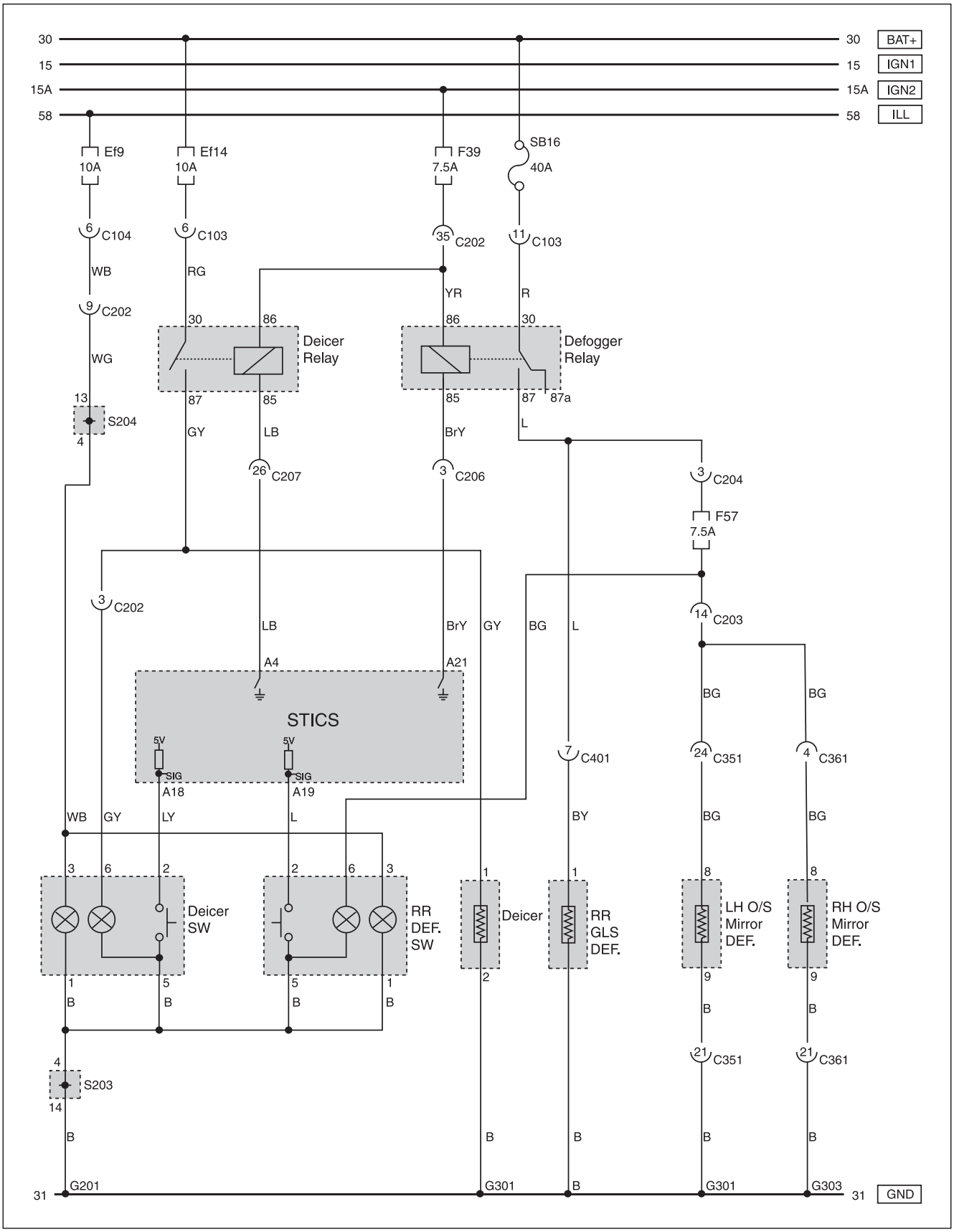
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C351(33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” PLR	
C903 (4Pin, Black)	W/H Floor - W/H PAS	Under LH Bumper	RR Fog
G206	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN1, T/Signal

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



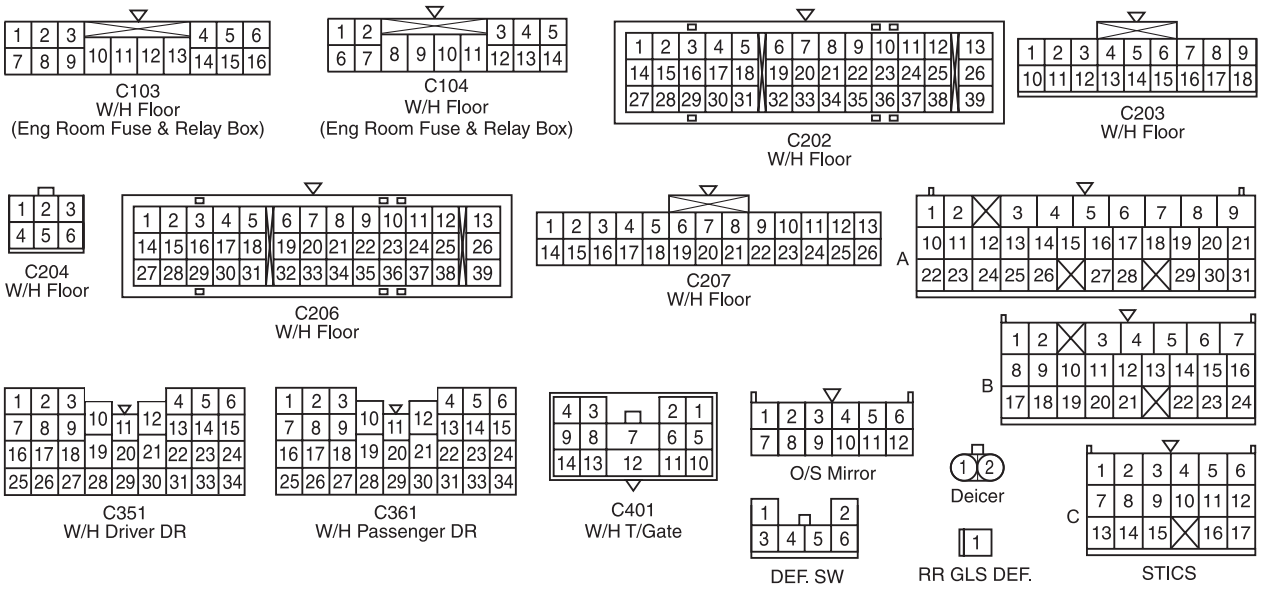
4) DEFOGGER


30
15
15A
58
30 BAT+
15 IGN1
15A IGN2
58 ILL
Ef9 10A
Ef14 10A
F39 7.5A
SB16 40A
C104
C103
C202
C103
WB
RG
YR
R
C202
Deicer Relay
Defogger Relay
WG
S204
GY
LB
BrY
L
C207
C206
C204
F57 7.5A
C202
LB
BrY
GY
BG
L
C203
A4
A21
STICS
5V
SIG
A18
A19
WB
GY
LY
L
BY
BG
C401
C351
C361
Deicer SW
RR DEF. SW
Deicer
RR GLS DEF.
LH O/S Mirror DEF.
RH O/S Mirror DEF.
B
S203
G201
G301
G303
GND

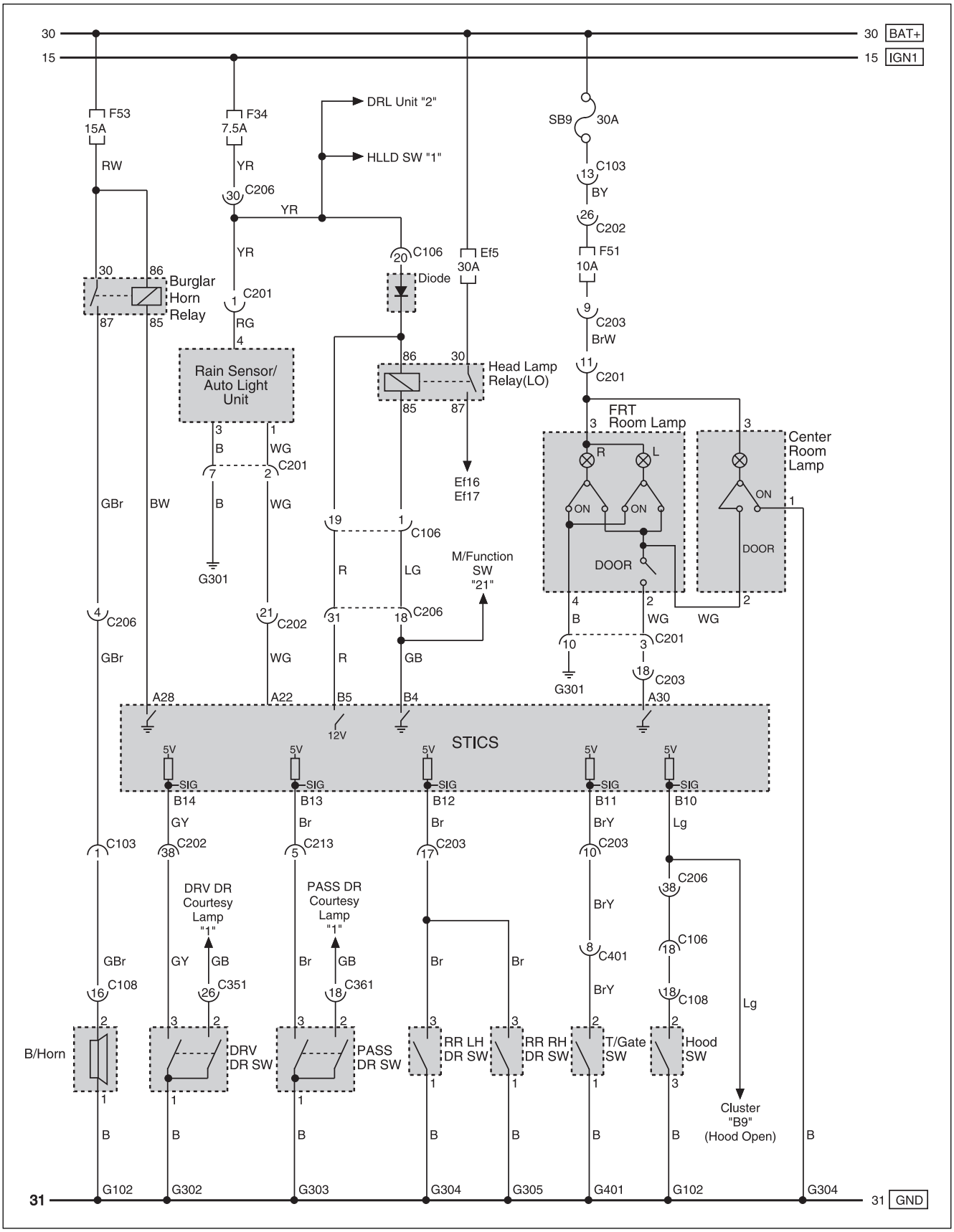
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” PLR	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH “A” PLR	
C401 (14Pin, White)	W/H Floor - W/H T/Gate	Under the LH T/Gate	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G301	W/H Floor	Under the Driver Seat	
G303	W/H Floor	Upper the Passenger Seat	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



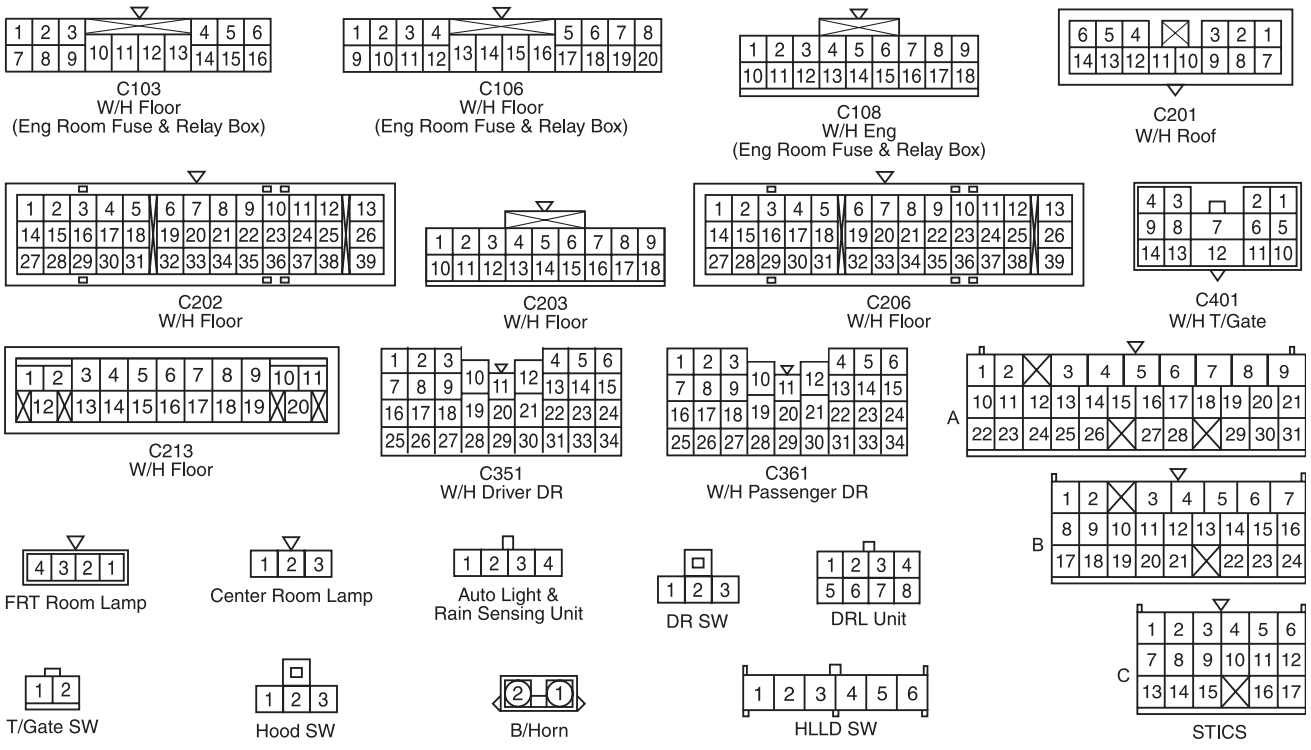
5) PANIC, AUTO LIGHT & RAIN SENSING, ROOM LAMP



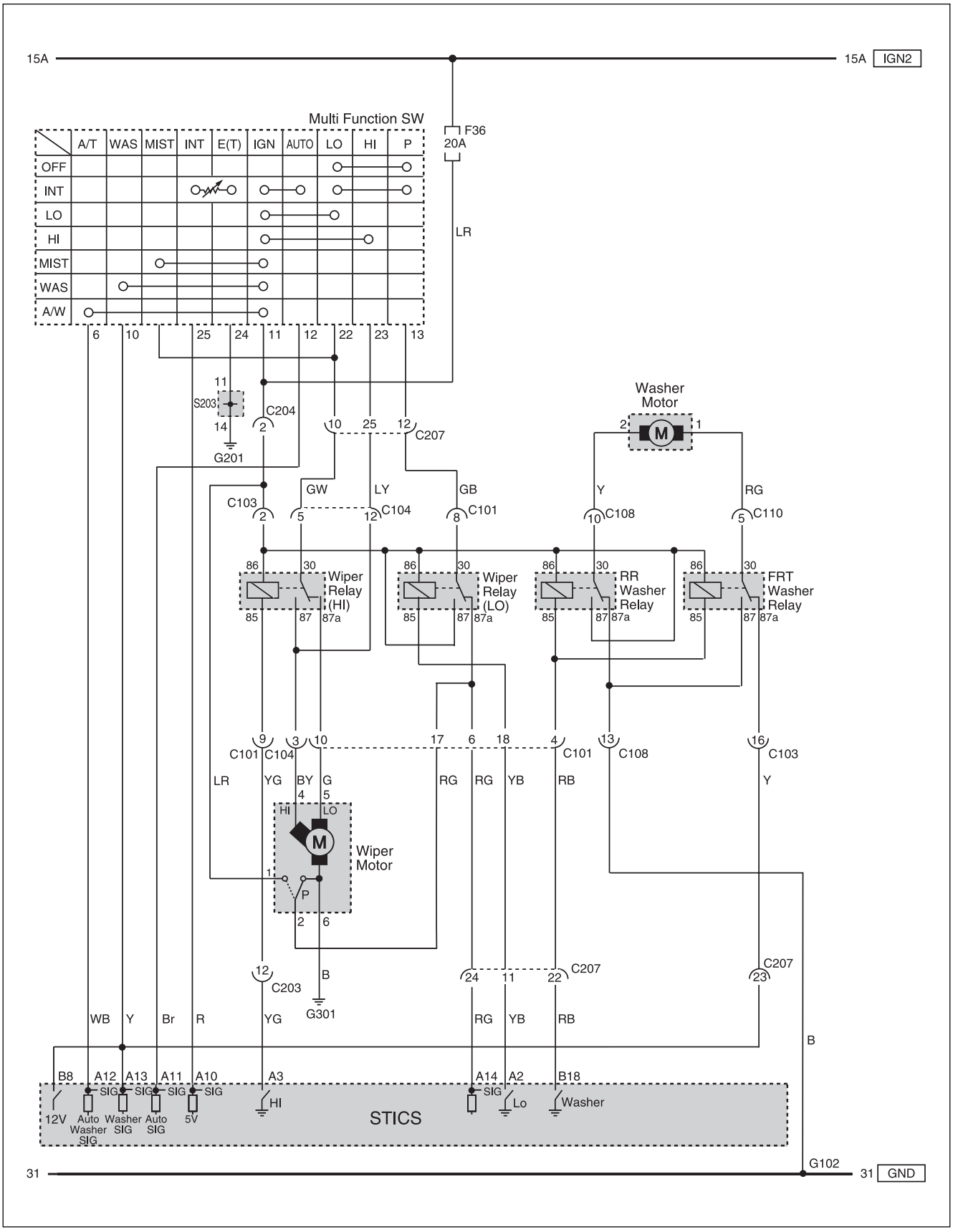
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C201 (14Pin, White)	W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” PLR	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH “A” PLR	
C401 (14Pin, White)	W/H Floor - W/H T/Gate	Upper the LH T/Gate	
G102	W/H Eng Room	Behind LH Head Lamp	
G301	W/H Floor	Under the Driver Seat	
G302	W/H Floor	Under the Driver Seat	
G303	W/H Floor	Under the Passenger Seat	
G304	W/H Floor	Driver QTR PNL (Under the QTR Glass)	
G305	W/H Floor	Passenger QTR PNL (Under the QTR Glass)	
G401	W/H T/Gate	Center the T/Gate	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



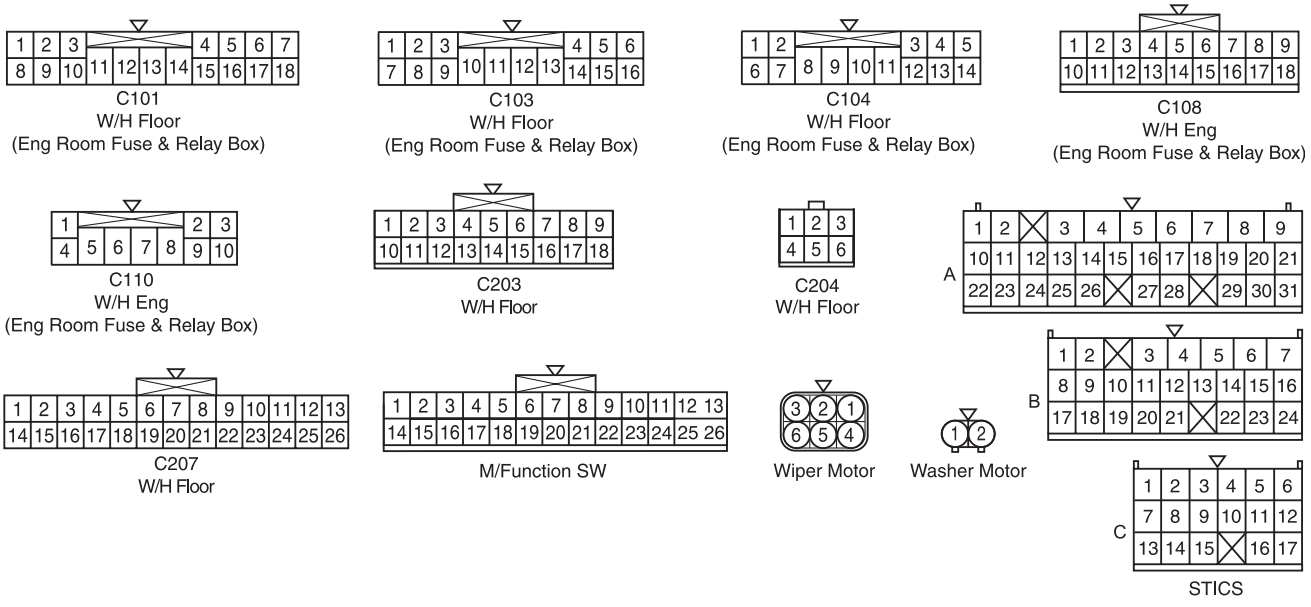
6) FRT WIPER/WASHER & RR WASHER



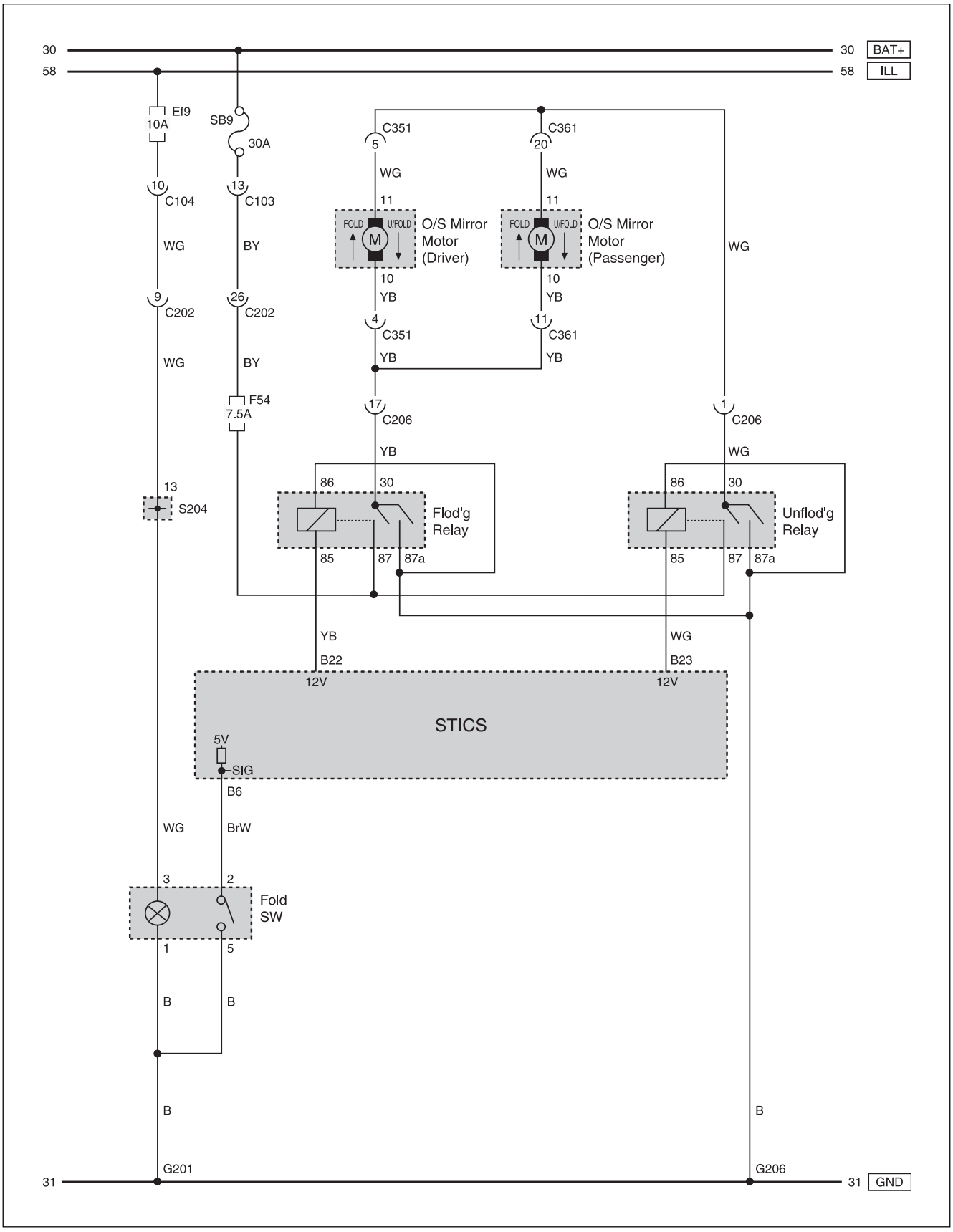
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C110 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorles)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
G102	W/H Eng Room	Behind LH Head Lamp	
G201	W/H Main	Under the Driver Cowl Side PNL	Under C/Holder
G301	W/H Floor	Under the Driver Seat	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



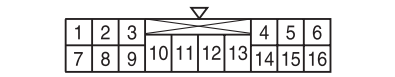
7) MIRROR FOLD'G/UNFOLD'G, FOLD SW



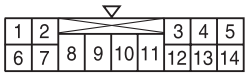
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” PLR	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH “A” PLR	
G201	W/H Main	Under the Driver Cowl Side PNL	Under C/Holder
G206	W/H Main	Inner the Passenger Cowl Side PNL	
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL

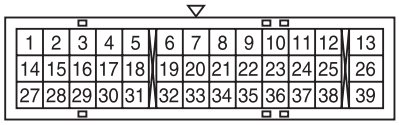
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



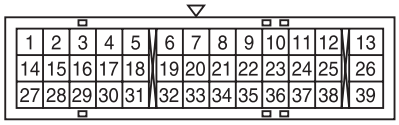
C103
W/H Floor
(Eng Room Fuse & Relay Box)



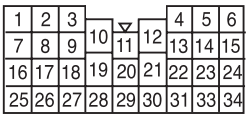
C104
W/H Floor
(Eng Room Fuse & Relay Box)



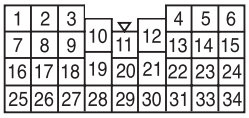
C202
W/H Floor



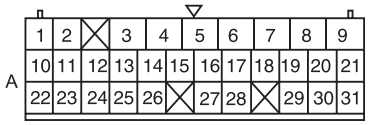
C206
W/H Floor

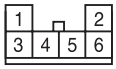


C351
W/H Driver DR

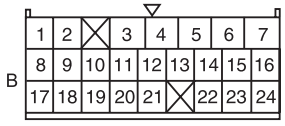


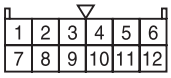
C361
W/H Passenger DR



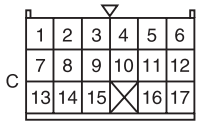


Fold'g SW



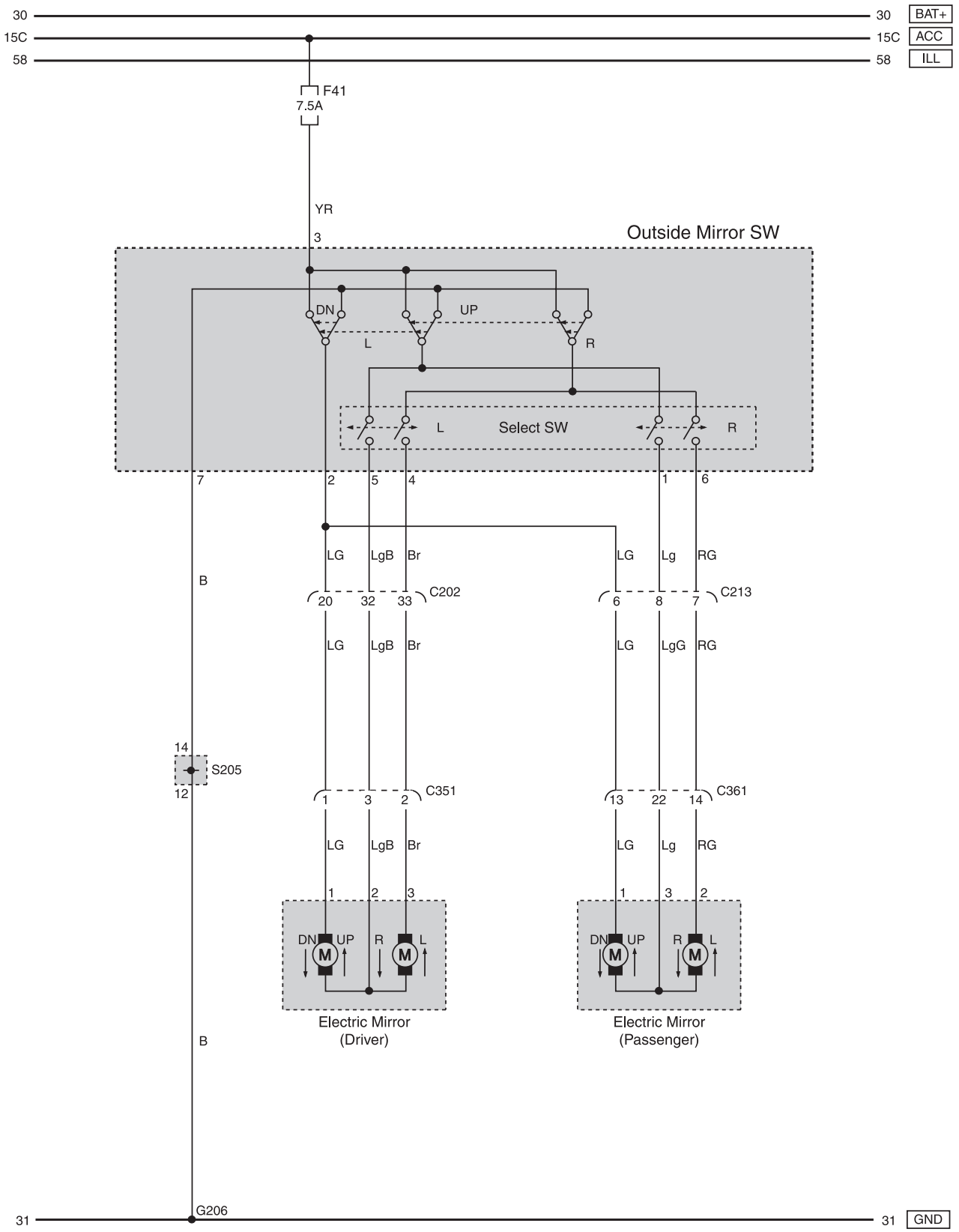


O/S Mirror MTR



STICS

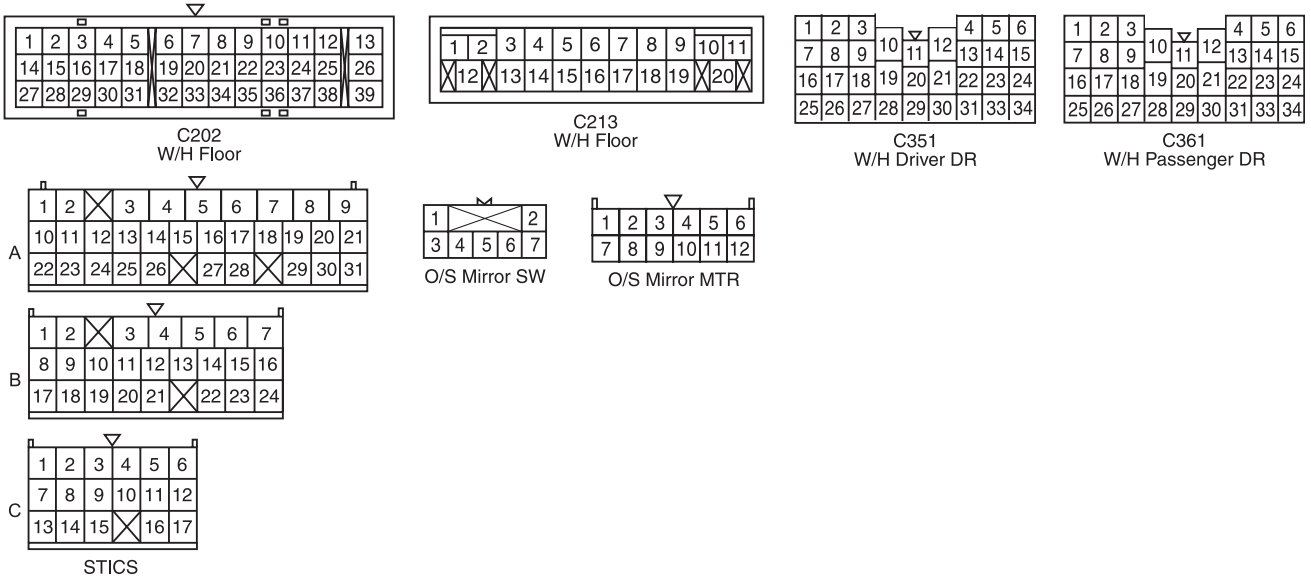
12. ELECTRIC OUTSIDE MIRROR 8510



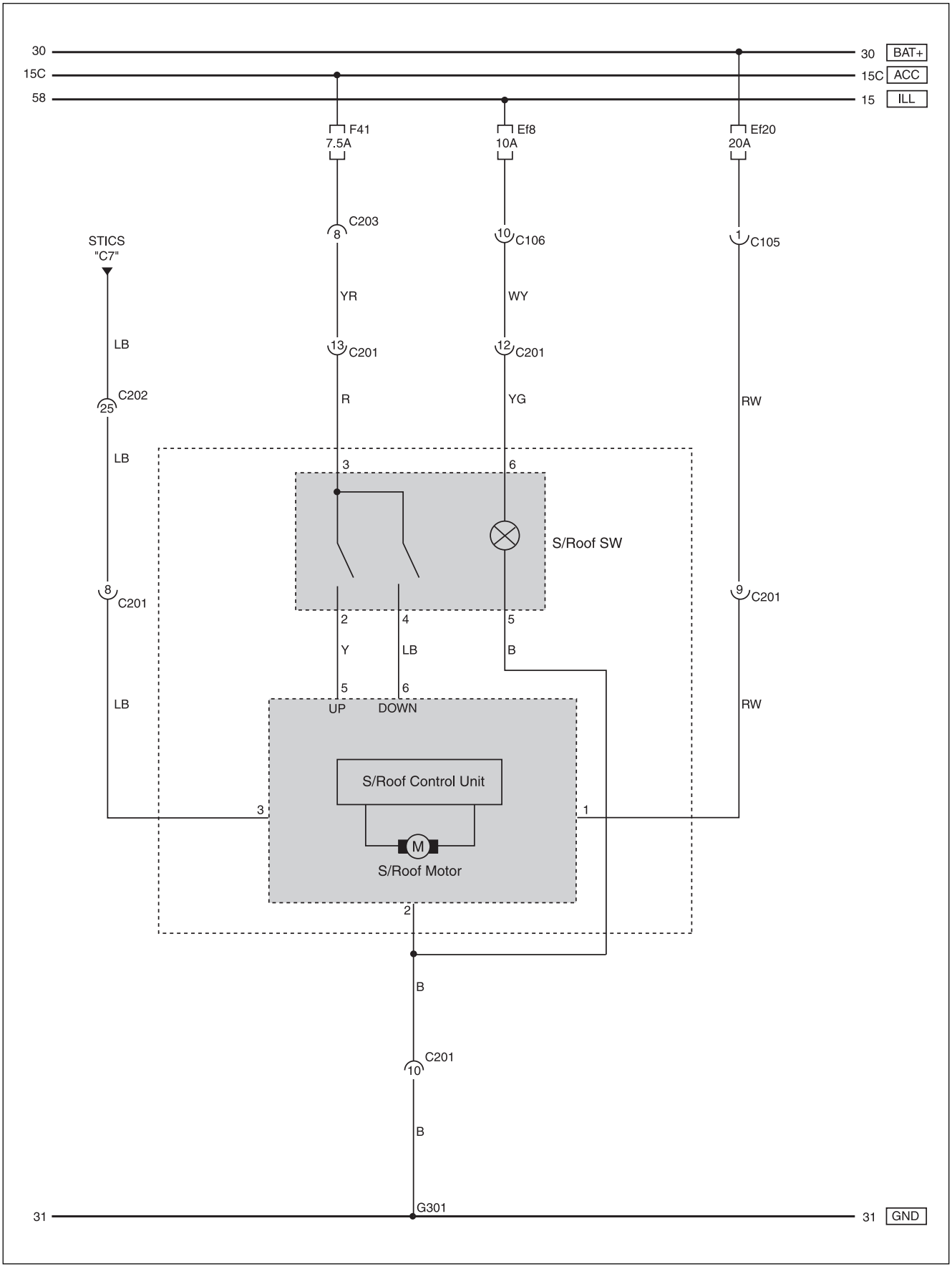
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Hoder	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” PLR	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the LH “A” PLR	
G206	W/H Main	Inner the Passenger Cowl Side PNL	
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



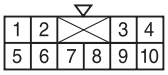
13. SUN ROOF CIRCUIT 7340



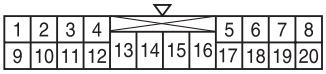
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C201 (14Pin, White)	W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
G301	W/H Floor	Under the Driver Seat	

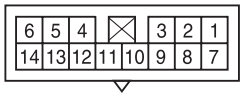
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



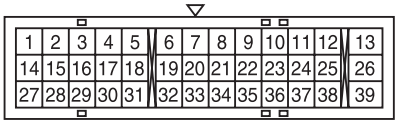
C105
W/H Floor
(Eng Room Fuse &
Relay Box)



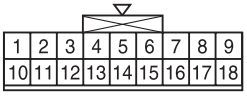
C106
W/H Floor
(Eng Room Fuse & Relay Box)



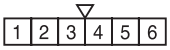
C201
W/H Roof



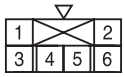
C202
W/H Floor



C203
W/H Floor

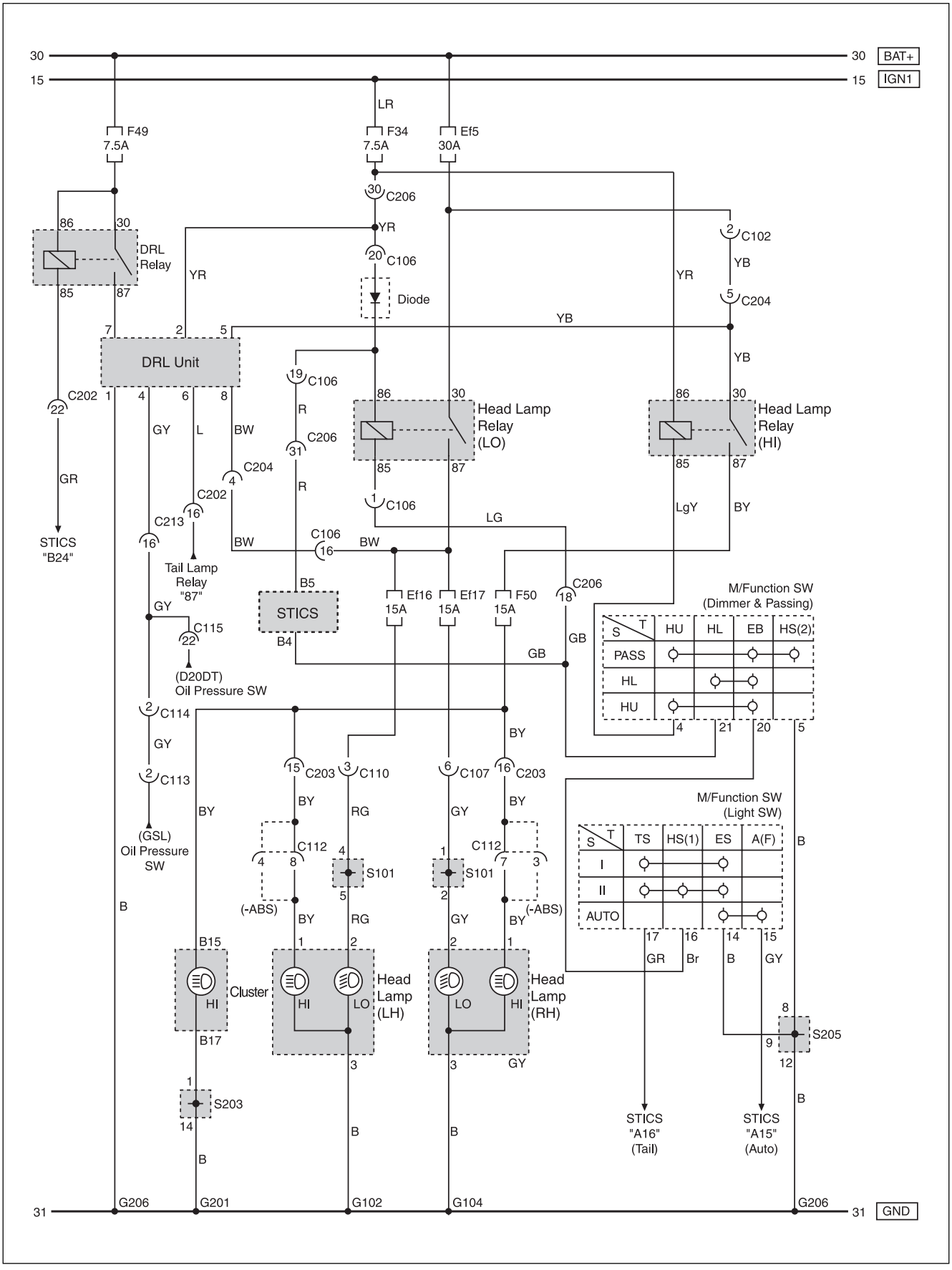


S/Roof SW



S/Roof Control Unit
(S/Roof Motor)

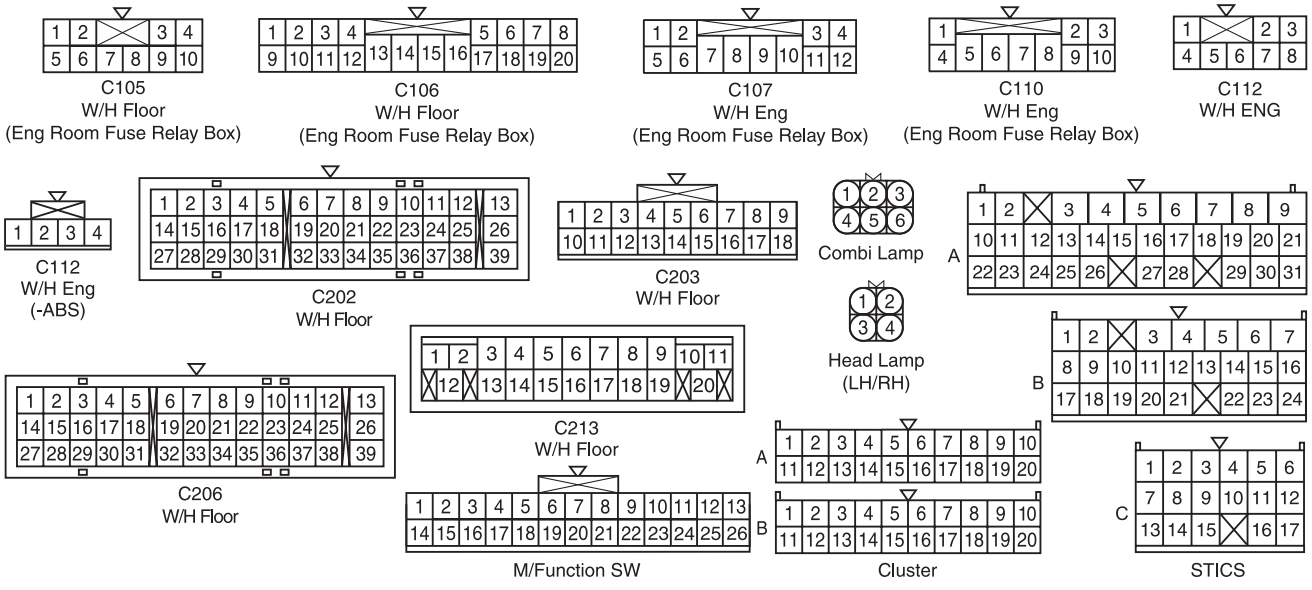
14. HEAD LAMP & DRL (DAY TIME RUNNING LIGHT) UNIT CIRCUIT 8310



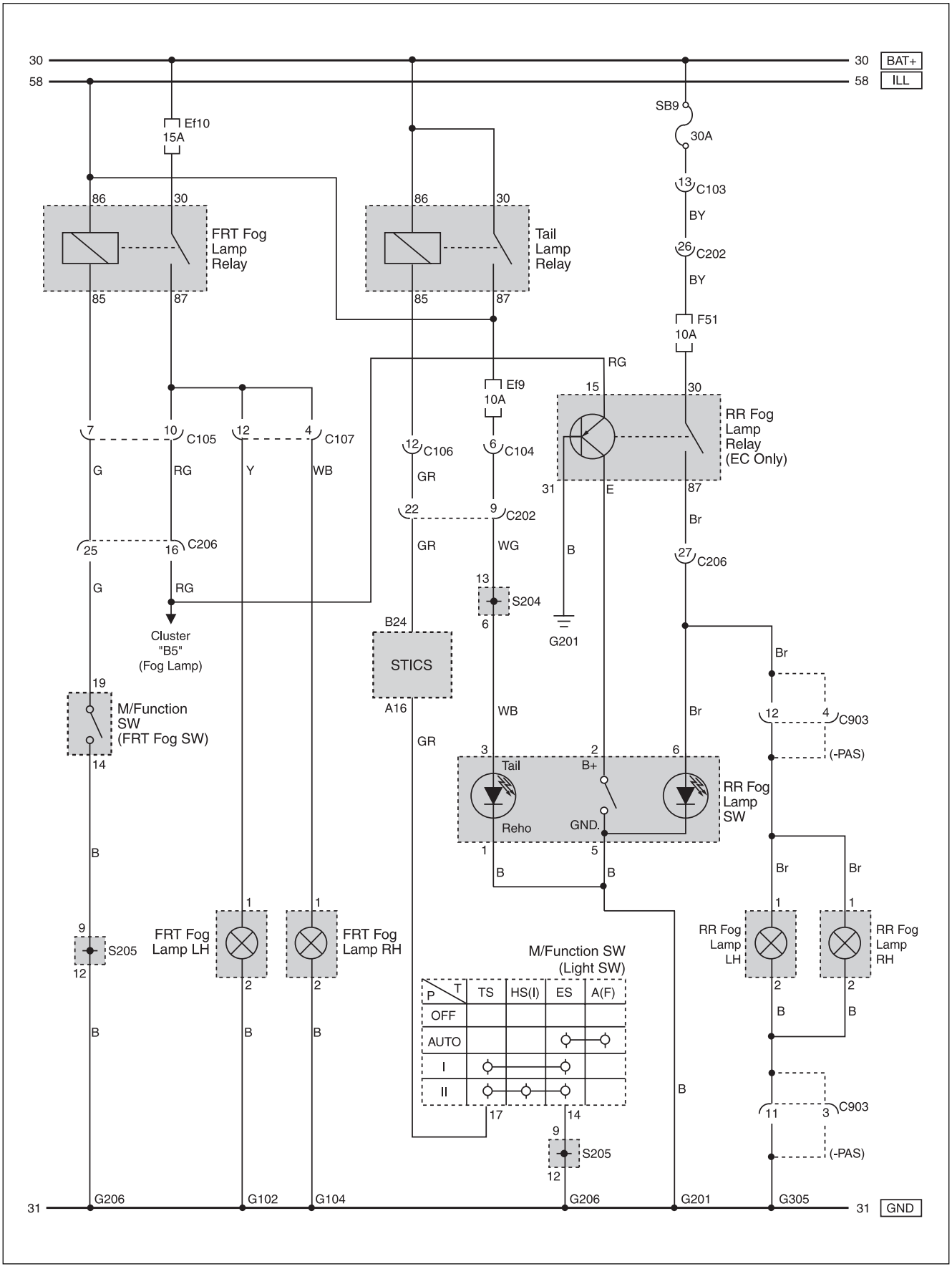
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C110 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C112 (8Pin, White)	W/H Eng - W/H Floor	Inside Eng Room Fuse & Relay Box	ABS/ESP
C112 (4Pin, White)	W/H Eng - W/H Floor	Inside Eng Room Fuse & Relay Box	-ABS
C113 (2Pin, Black)	W/H Eng - W/H Alternator	Backside RH Head Lamp	
C114 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
G104	W/H Eng Room	Behind RH Head Lamp	
G201	W/H Main	Under the Driver Cowl Side PNL	Under C/Holder
G206	W/H Main	Inner the Passenger Cowl Side PNL	
S101 (6Pin, Black)	W/H Eng	Inside the Eng Room Fuse & Relay Box	Head Lamp
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



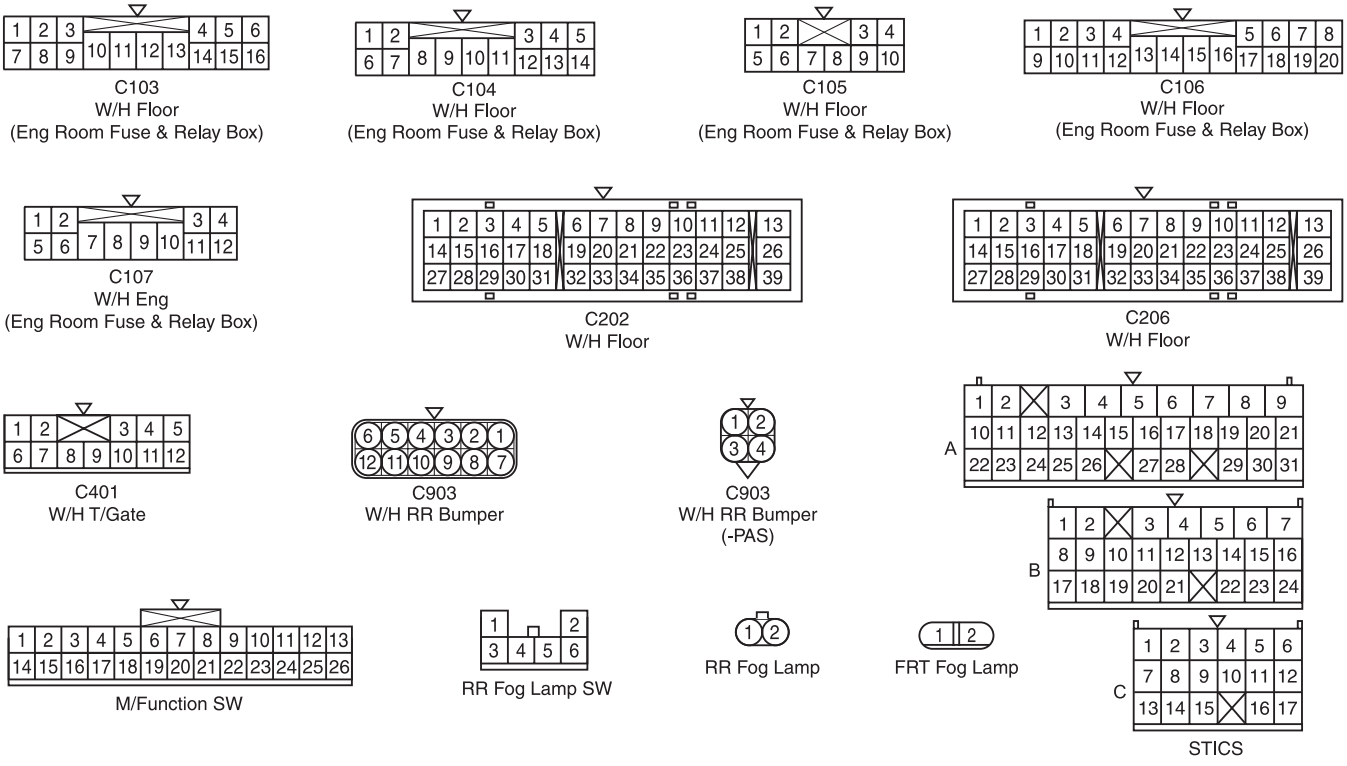
15. FOG LAMP CIRCUIT 8310



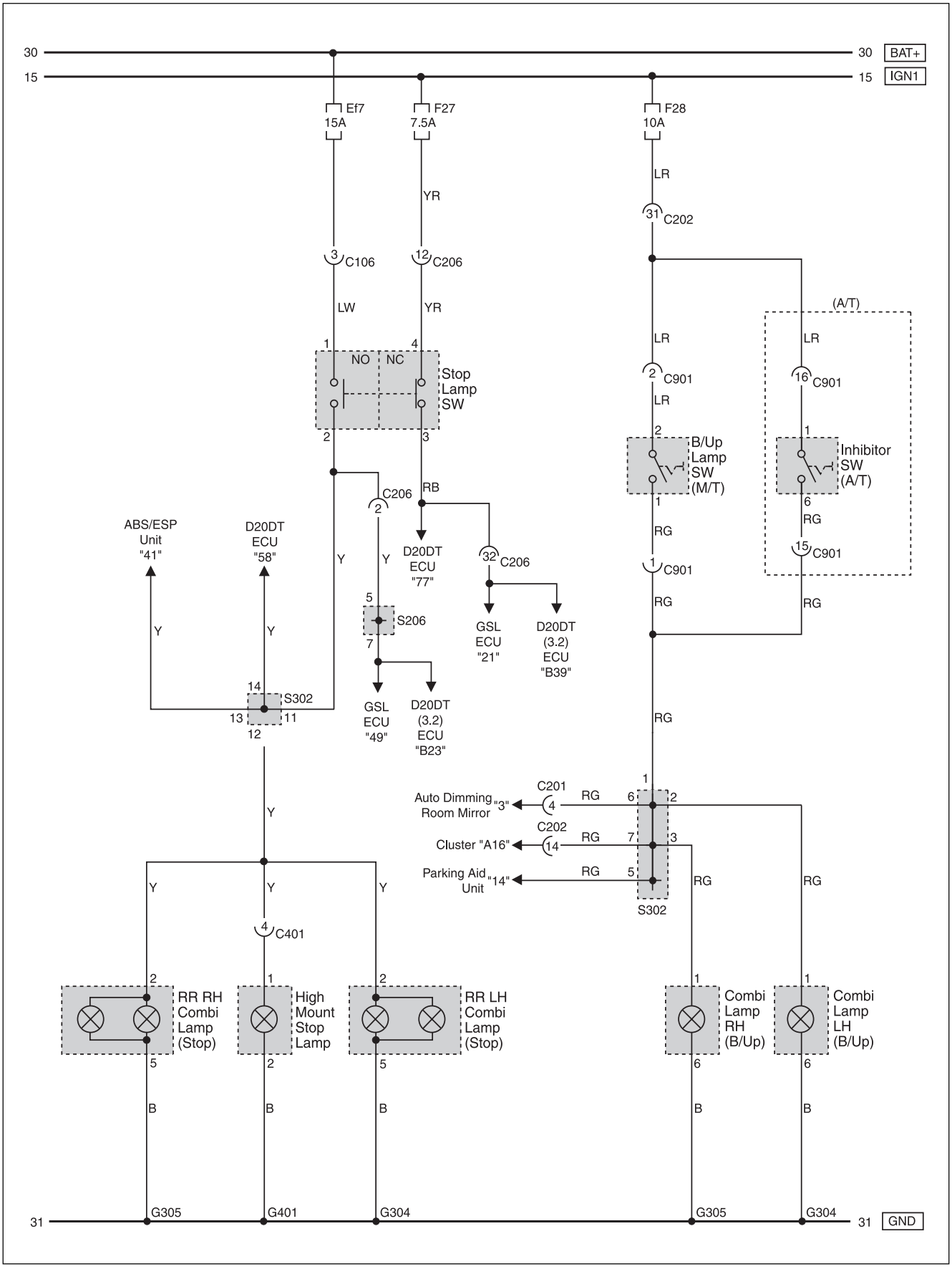
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C401 (12Pin, Black)	W/H Floor - W/H T/Gate	Upper the RH T/Gate	
C903 (12Pin, Black)	W/H Floor - W/H PAS	Under LH Bumper	PAS, RR Fog
C903 (4Pin, Black)	W/H Floor - W/H PAS	Under LH Bumper	RR Fog
G102	W/H Eng Room	Behind LH Head Lamp	
G104	W/H Eng Room	Behind RH Head Lamp	
G201	W/H Main	Under the Driver Cowl Side PNL	Under C/Holder
G206	W/H Main	Inner the Passenger Cowl Side PNL	
G305	W/H Floor	Passenger QTR PNL (Under the QTR Glass)	
S204 (14Pin, Black)	W/H Main	RH Protector of the Drvier Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



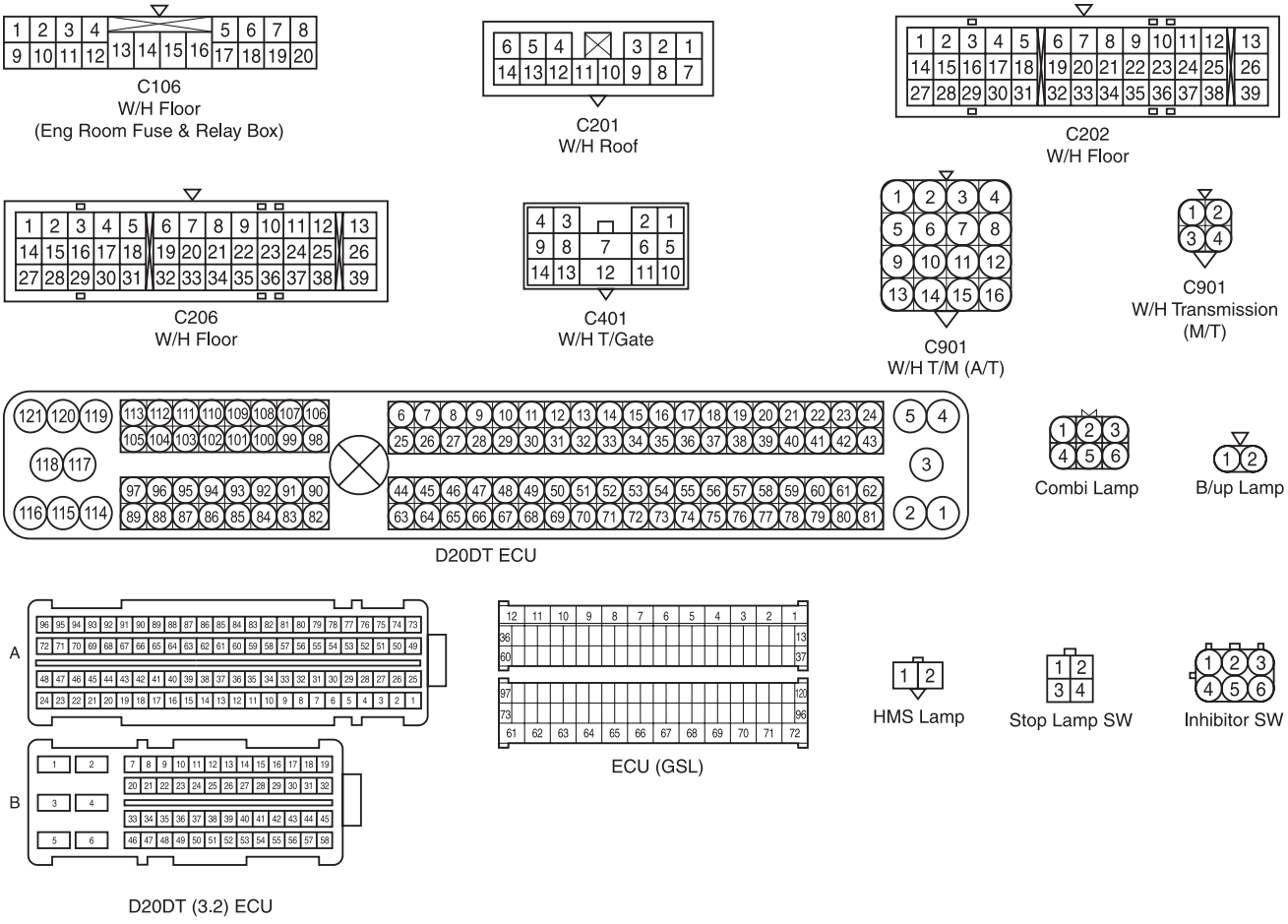
16. STOP & BACK-UP LAMP CIRCUIT 4810



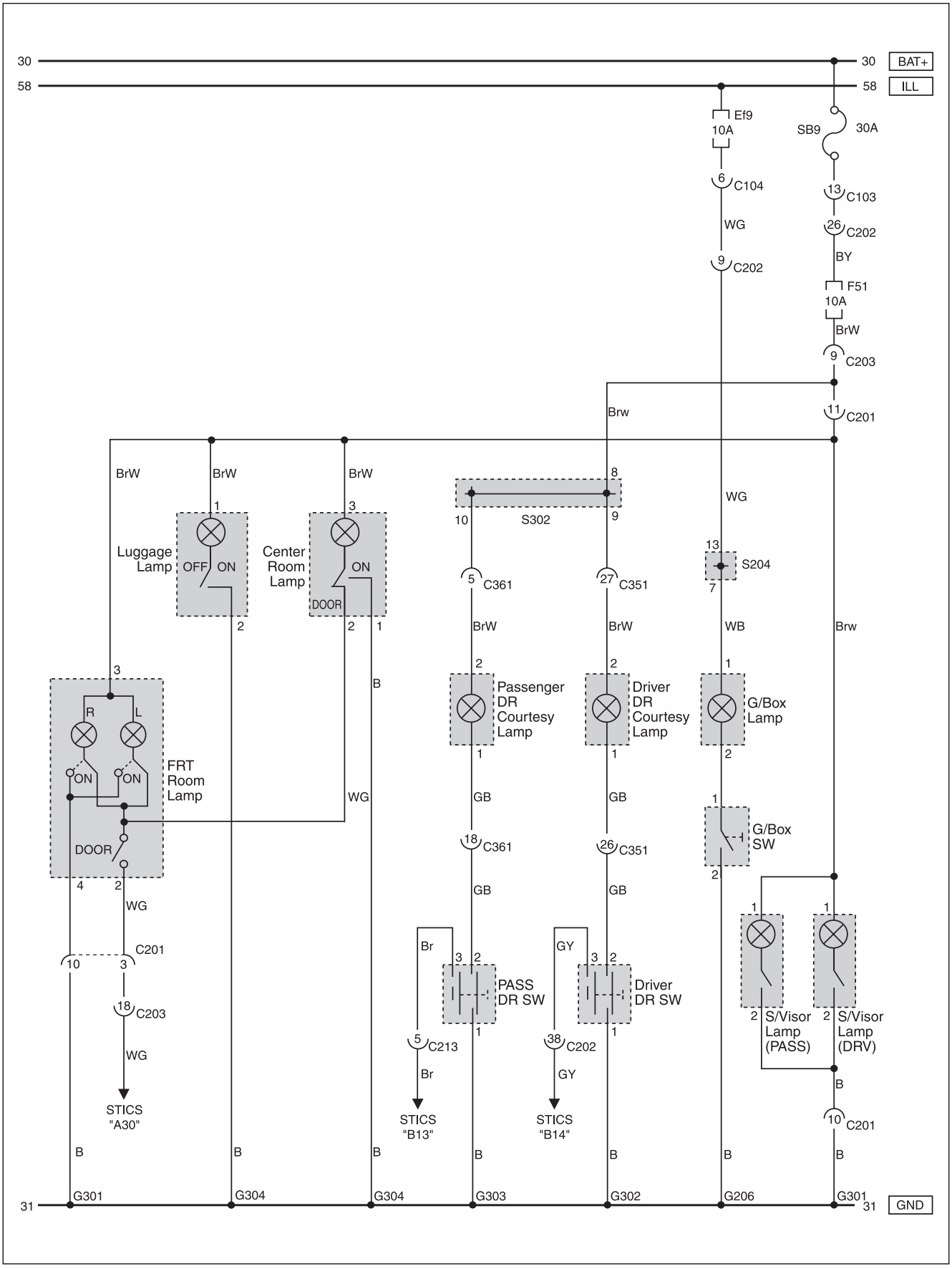
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C106 (20Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C201 (14Pin, White)		W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)		W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)		W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C401 (12Pin, Black)		W/H Floor - W/H T/Gate	Upper the RH T/Gate	
C901	(16Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	A/T
	(4Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	M/T
G304		W/H Floor	Driver QTR PNL (Under the QTR Glass)	
G305		W/H Floor	Passenger QTR PNL (Under the QTR Glass)	
G401		W/H T/Gate	Center the T/Gate	
S206 (8Pin, Black)		W/H Main	Upper the PTC Protector	IGN1, T/Signal
S302 (14Pin, Black)		W/H Floor	Beside RR LH Seat W/H Protector	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



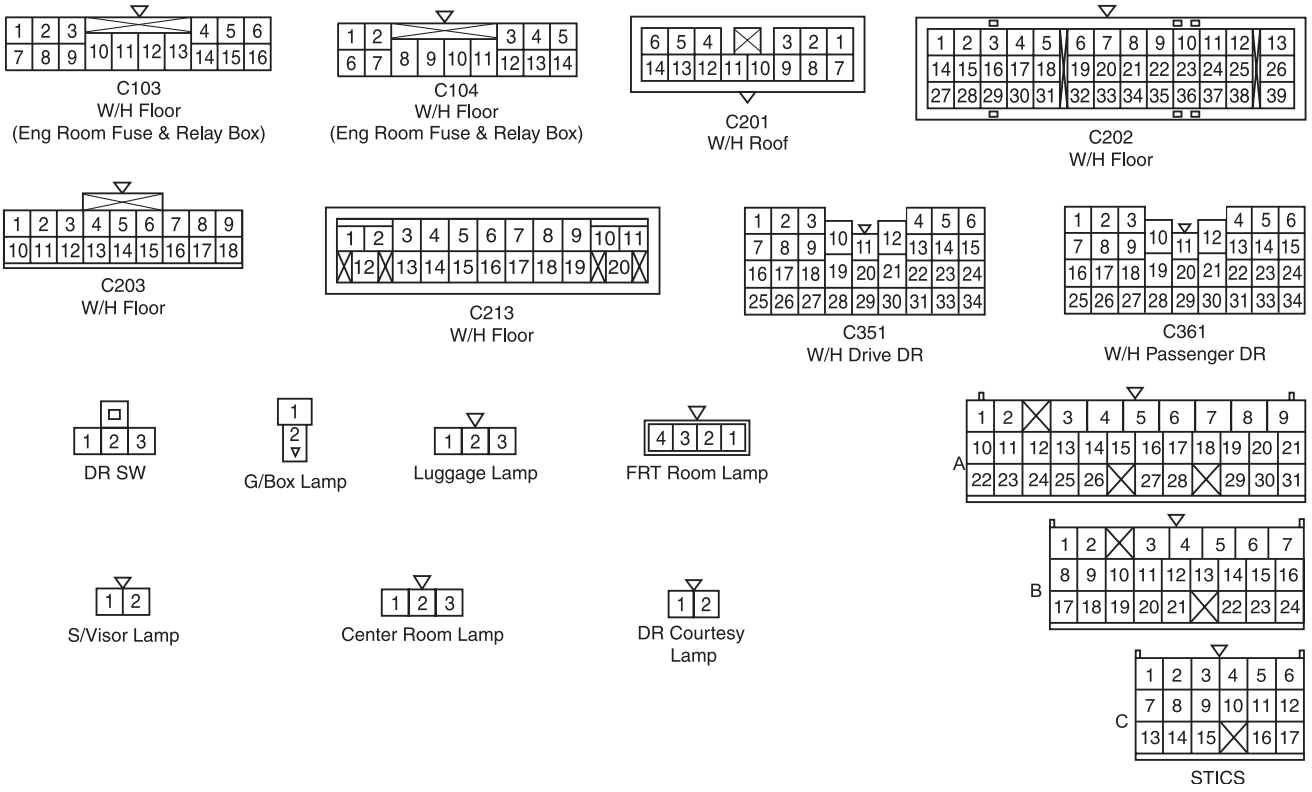
17. INTERIOR LAMP CIRCUIT 7770



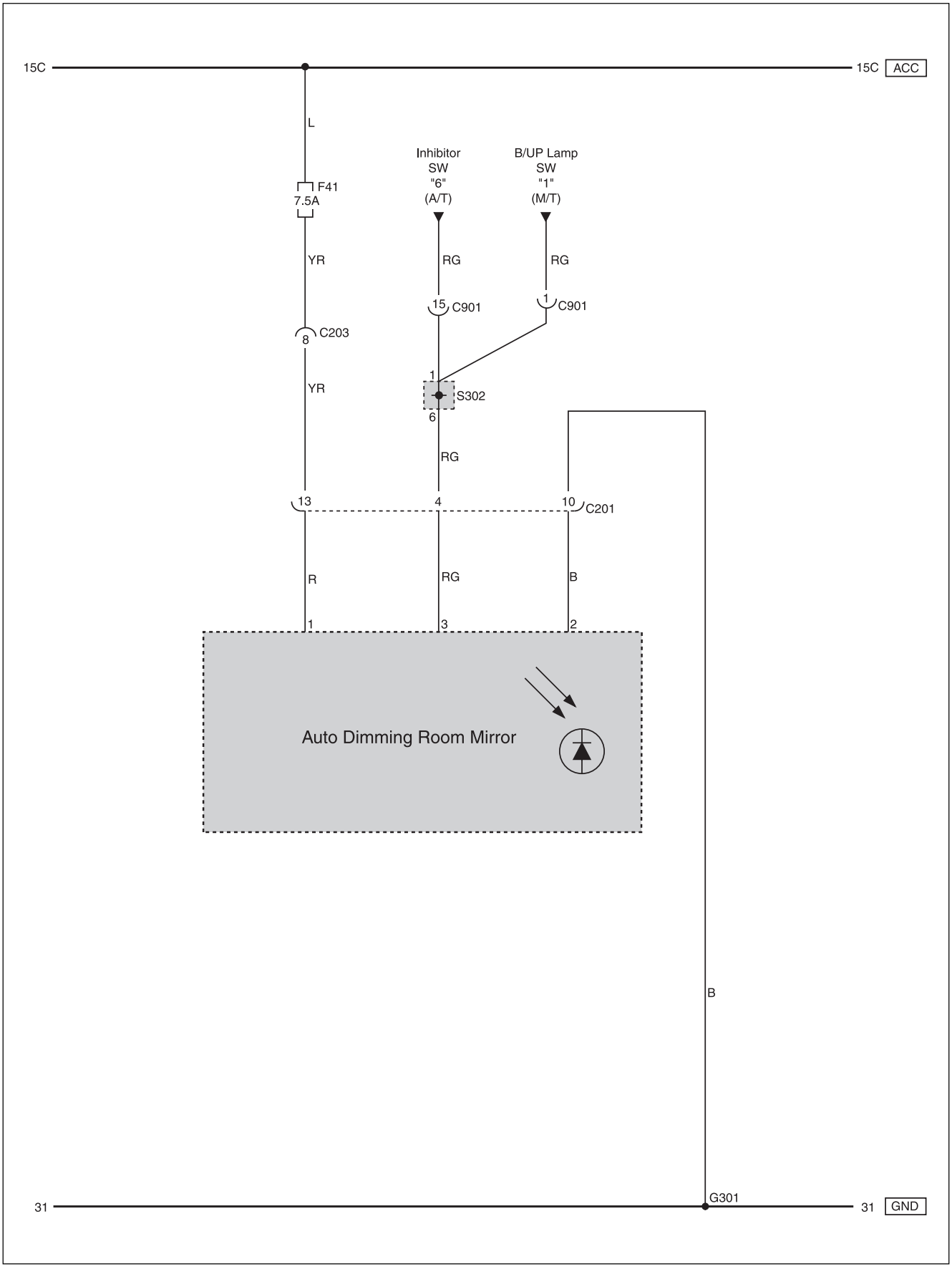
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C201 (14Pin, White)	W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” PLR	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH “A” PLR	
G206	W/H Main	Inner the Passenger Cowl Side PNL	
G301	W/H Floor	Under the Driver Seat	
G302	W/H Floor	Under the Driver Seat	
G303	W/H Floor	Under the Passenger Seat	
G304	W/H Floor	Driver QTR PNL(Under the QTR Glass)	
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S302 (14Pin, Black)	W/H Floor	Beside RR LH Seat W/H Protector	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



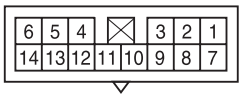
18. AUTO DIMMING ROOM MIRROR CIRCUIT 7770



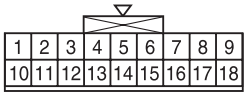
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C201 (14Pin, White)		W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C203 (18Pin, White)		W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C901	(12Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	A/T
	(4Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	M/T
G301		W/H Floor	Under the Driver Seat	
S302 (14Pin, Black)		W/H Floor	Beside RR LH Seat W/H Protector	

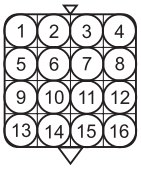
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



C201
W/H Roof



C203
W/H Floor



C901
W/H T/M (A/T)



C901
W/H T/M
(M/T)



Auto Dimming
Room Mirror

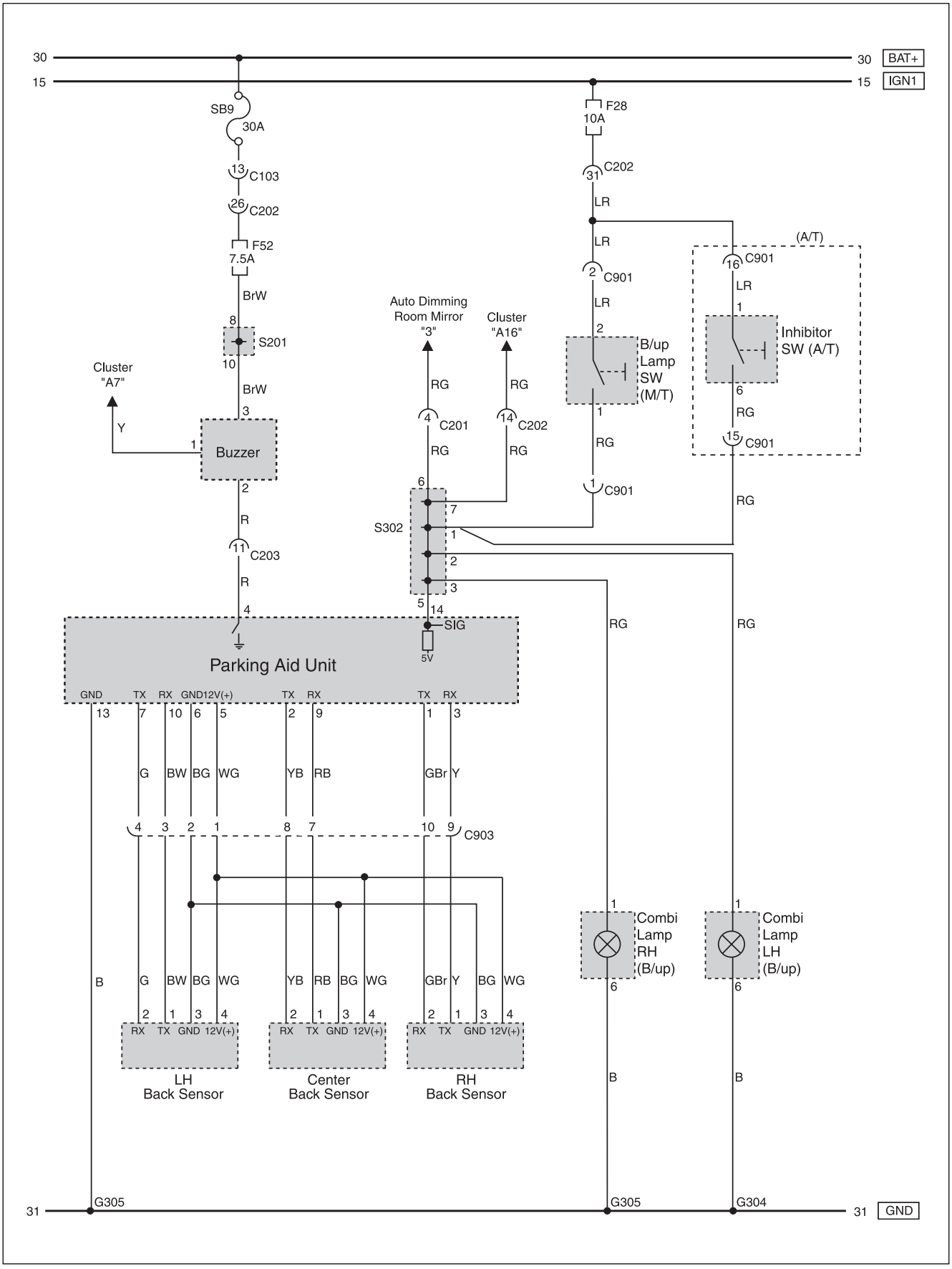


B/UP Lamp SW (M/T)



Inhibitor SW

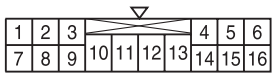
19. PARKING AID CIRCUIT 8790



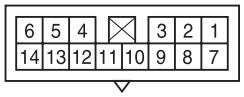
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C201 (14Pin, White)	W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C901 (16Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	A/T
C901 (4Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	M/T
C903 (12Pin, Black)	W/H Floor - W/H PAS	Under LH Bumper	PAS, RR Fog
G304	W/H Floor	Driver QTR PNL (Under the QTR Glass)	
G305	W/H Floor	Passenger QTR PNL (Under the QTR Glass)	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S302 (14Pin, Black)	W/H Floor	Beside RR LH Seat W/H Protector	

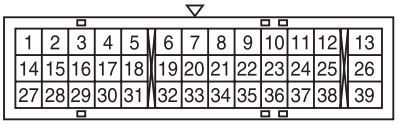
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



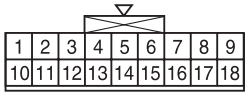
C103
W/H Floor
(Eng Room Fuse & Relay Box)



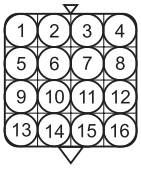
C201
W/H Roof



C202
W/H Floor



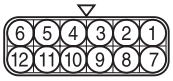
C203
W/H Floor



C901
W/H T/M (A/T)



C901
W/H T/M (M/T)



C903
W/H RR Bumper



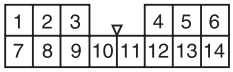
Inhibitor SW



B/Up SW(M/T)



Buzzer



Parking Aid Unit

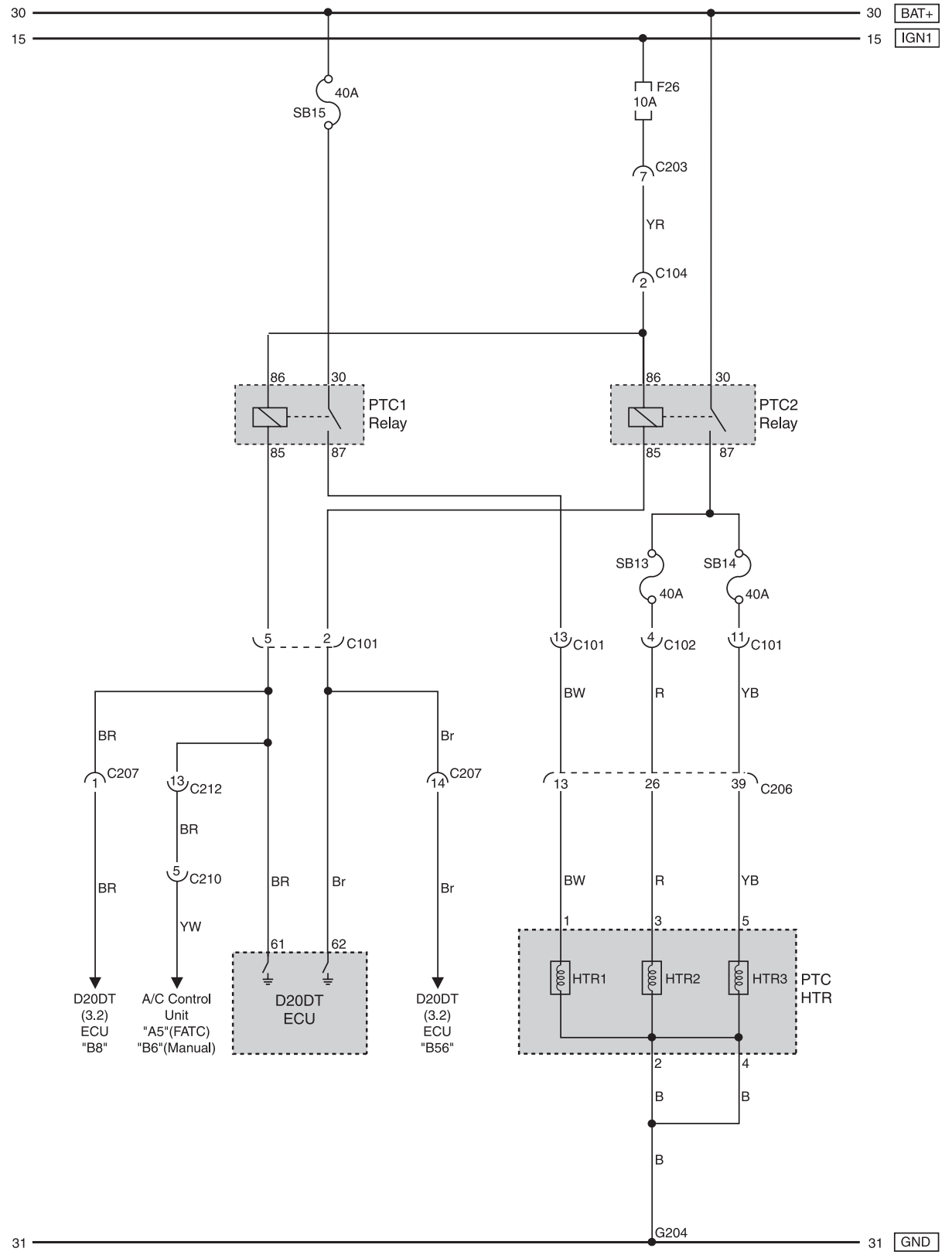


PAS Sensor



Combi Lamp

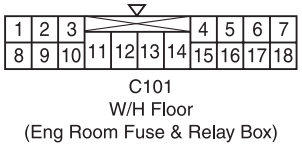
20. PTC (POSITIVE TEMPERATURE COEFFICIENT) HEATER 6810



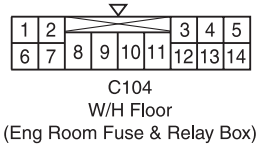
A. CONNECTOR INFORMATION

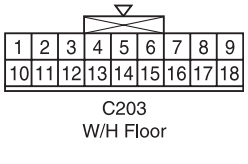
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	PTC
G204	W/H Main	LH Eng ECU	

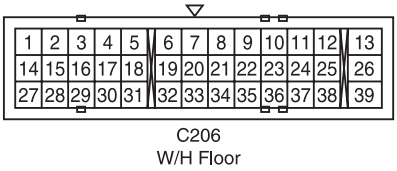
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

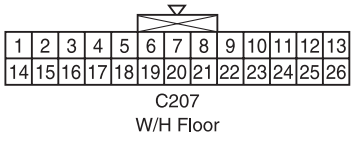


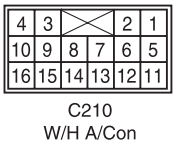


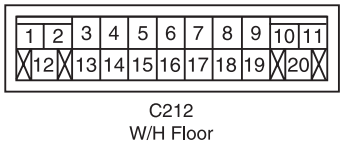


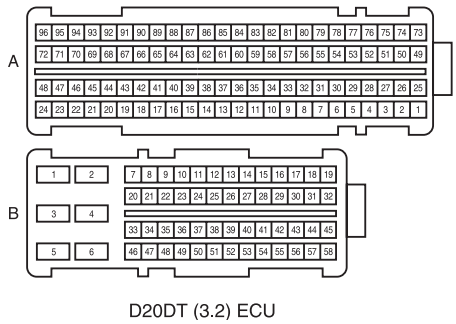


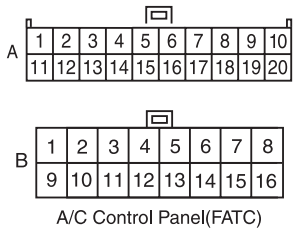


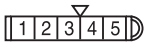


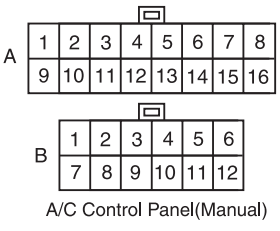






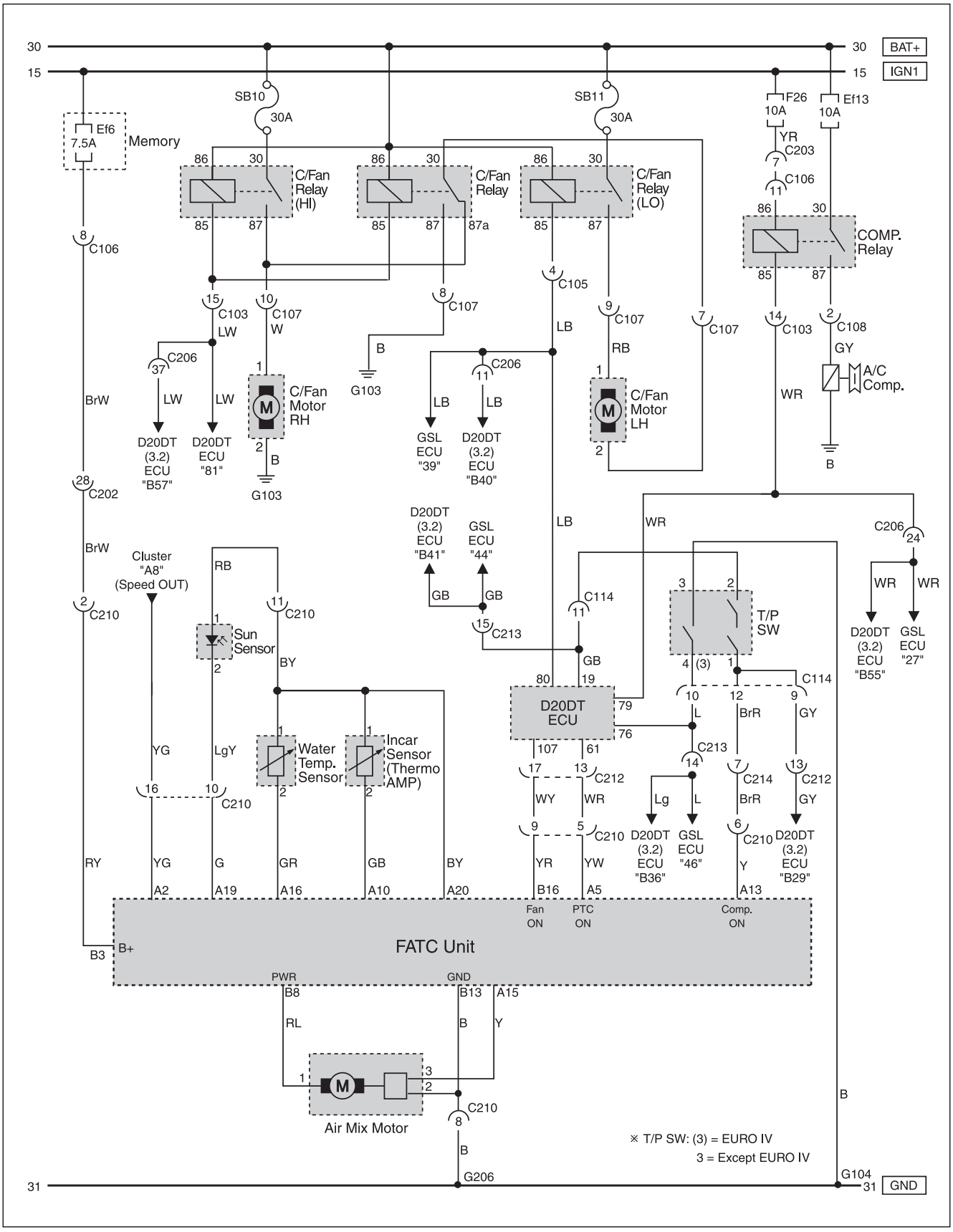






21. FATC (FULL AUTO TEMP. CONTROL) CIRCUIT 6810

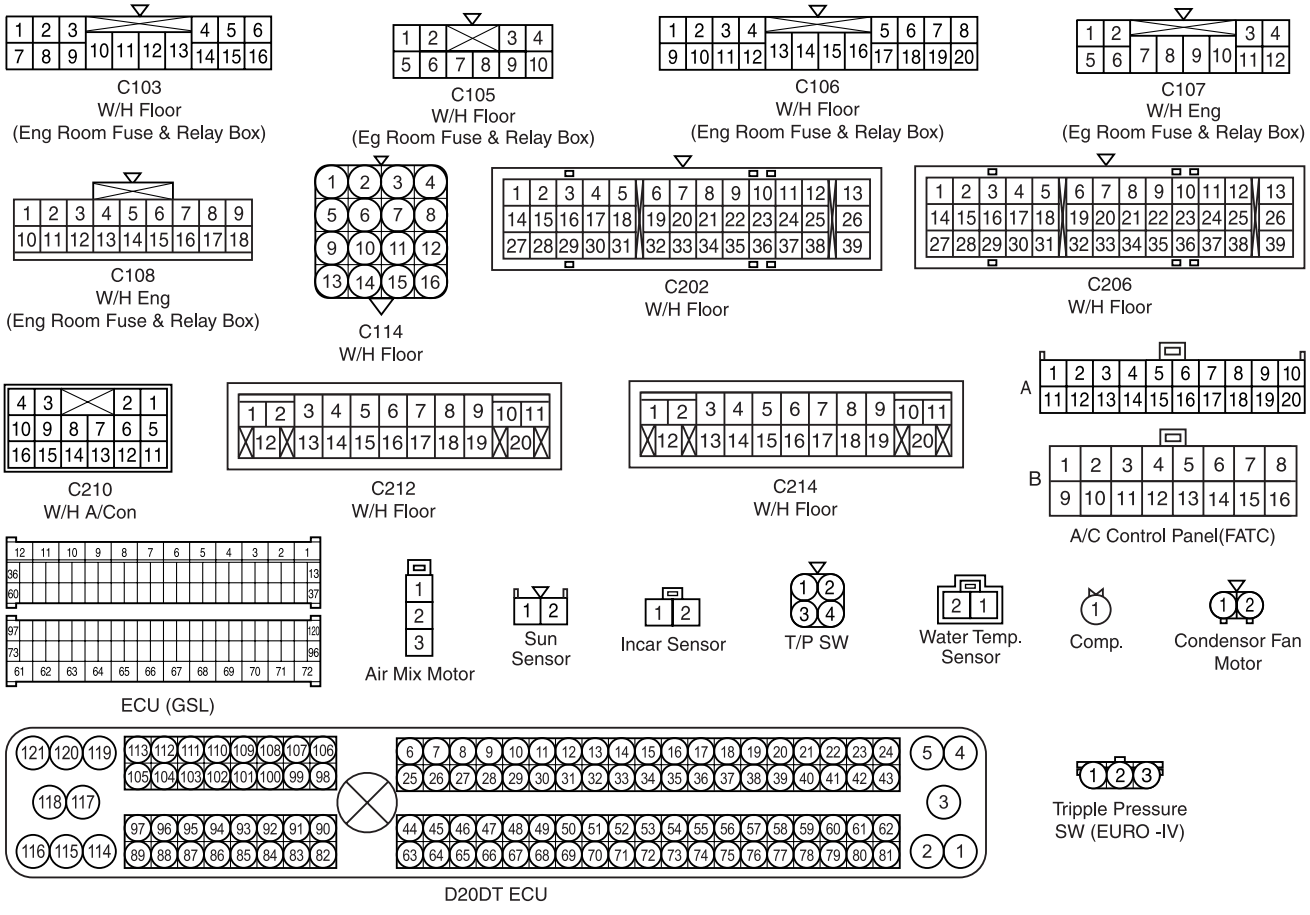
1) CONDENSOR FAN, AIR MIX MOTOR, SUN SENSOR, WATER TEMP SENSOR



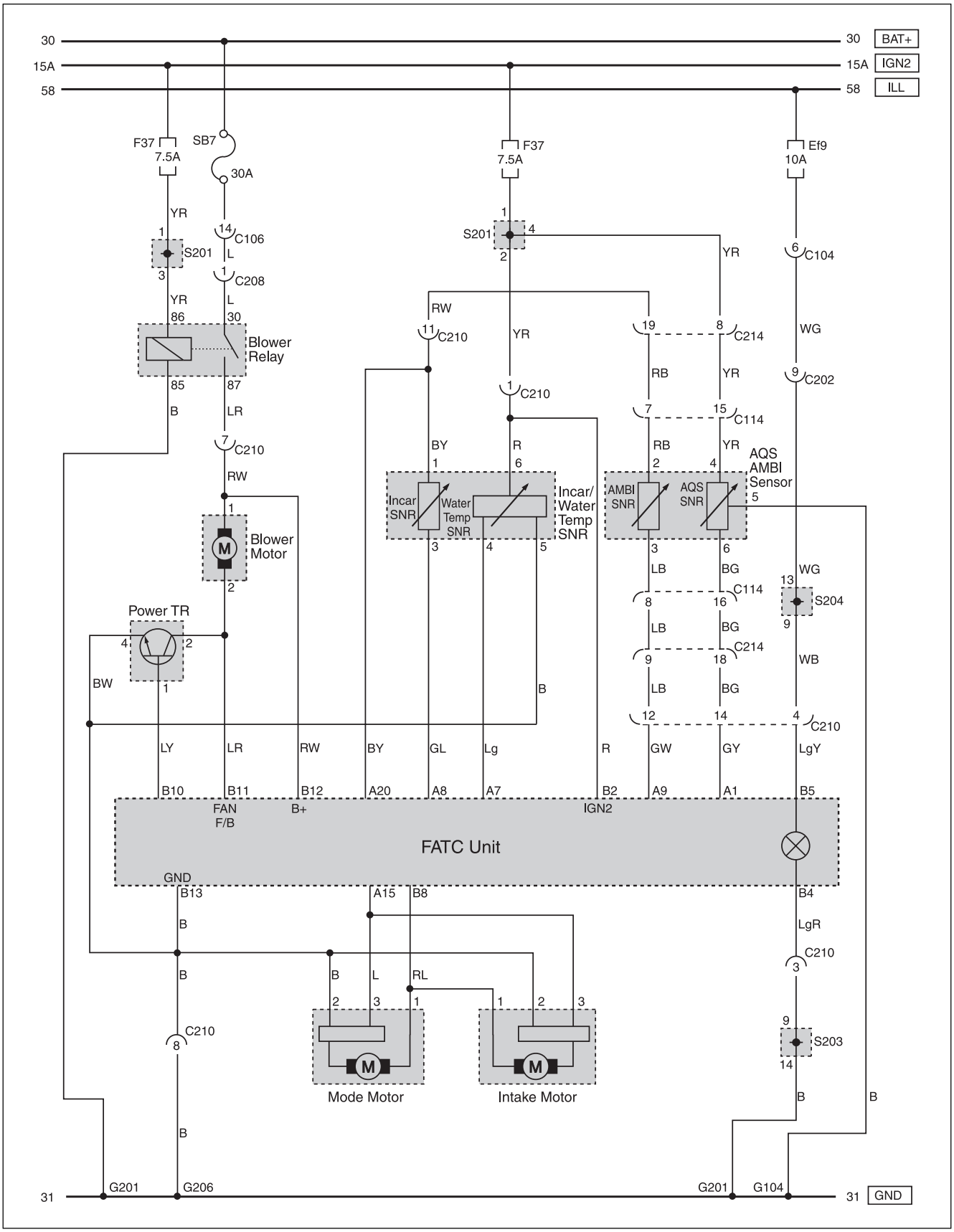
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C114 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Drvier Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G103	W/H Eng Room	LH FRT END PNL (LH Head Lamp Side)	
G104	W/H Eng Room	Behind RH Head Lamp	
G206	W/H Main	Inner the Passenger Cowl Side PNL	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



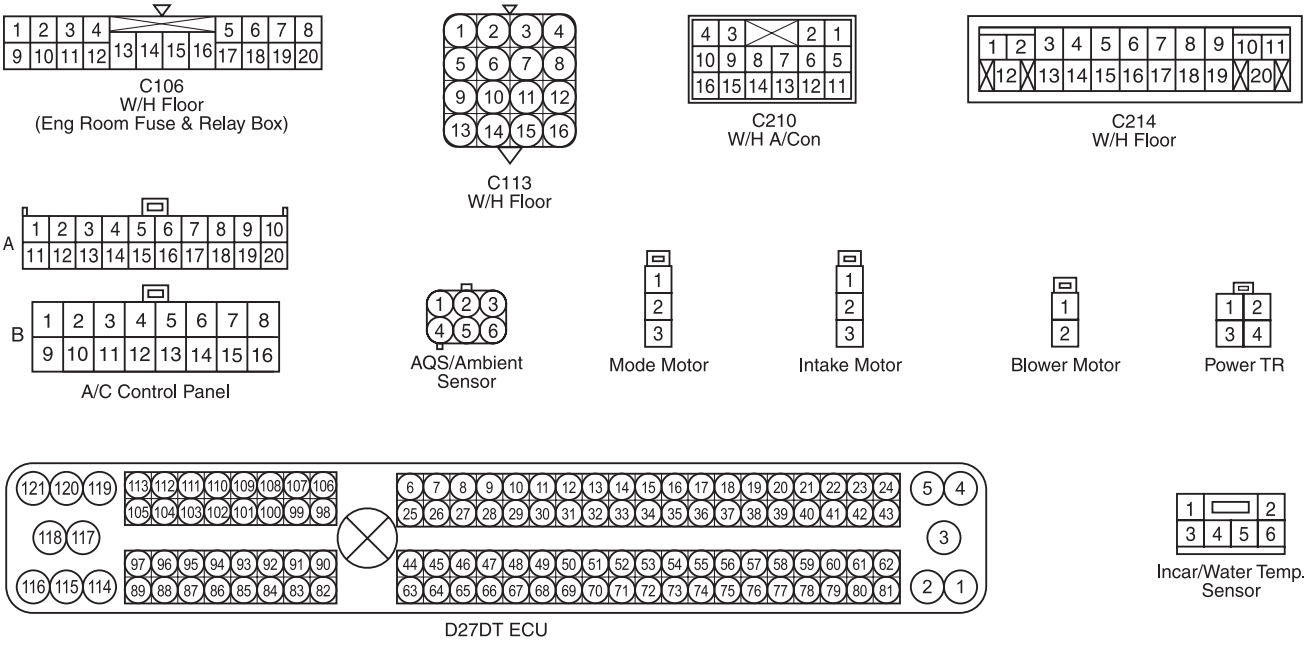
2) BLOWER, ACTUATOR (MODE, INTAKE), AQS SENSOR



A. CONNECTOR INFORMATION

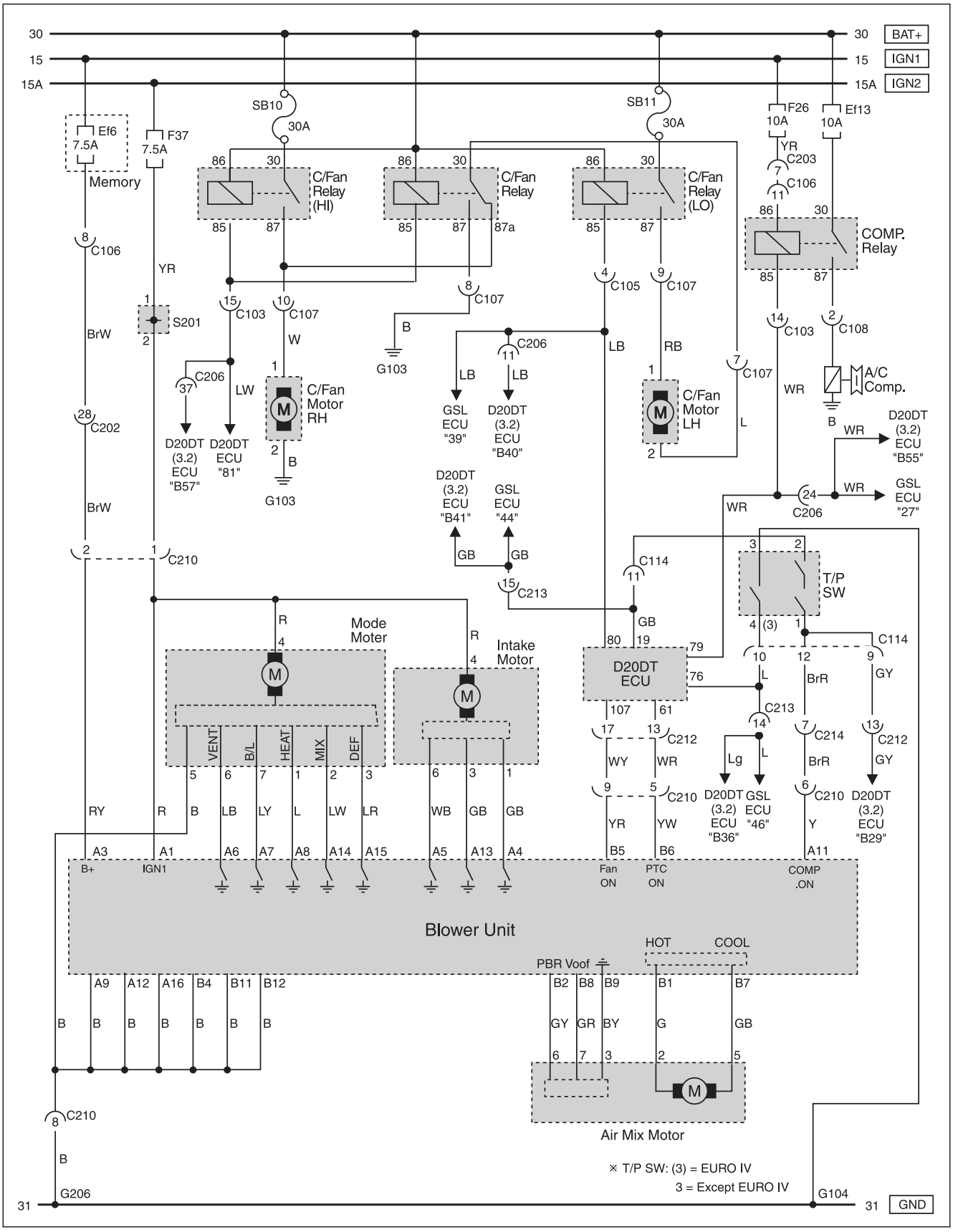
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C114 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G104	W/H Eng Room	Behind RH Head Lamp	
G201	W/H Main	Under the Driver Cowl Side PNL	Under C/Holder
G206	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



22. AIR-CON (MANUAL) CIRCUIT 6810

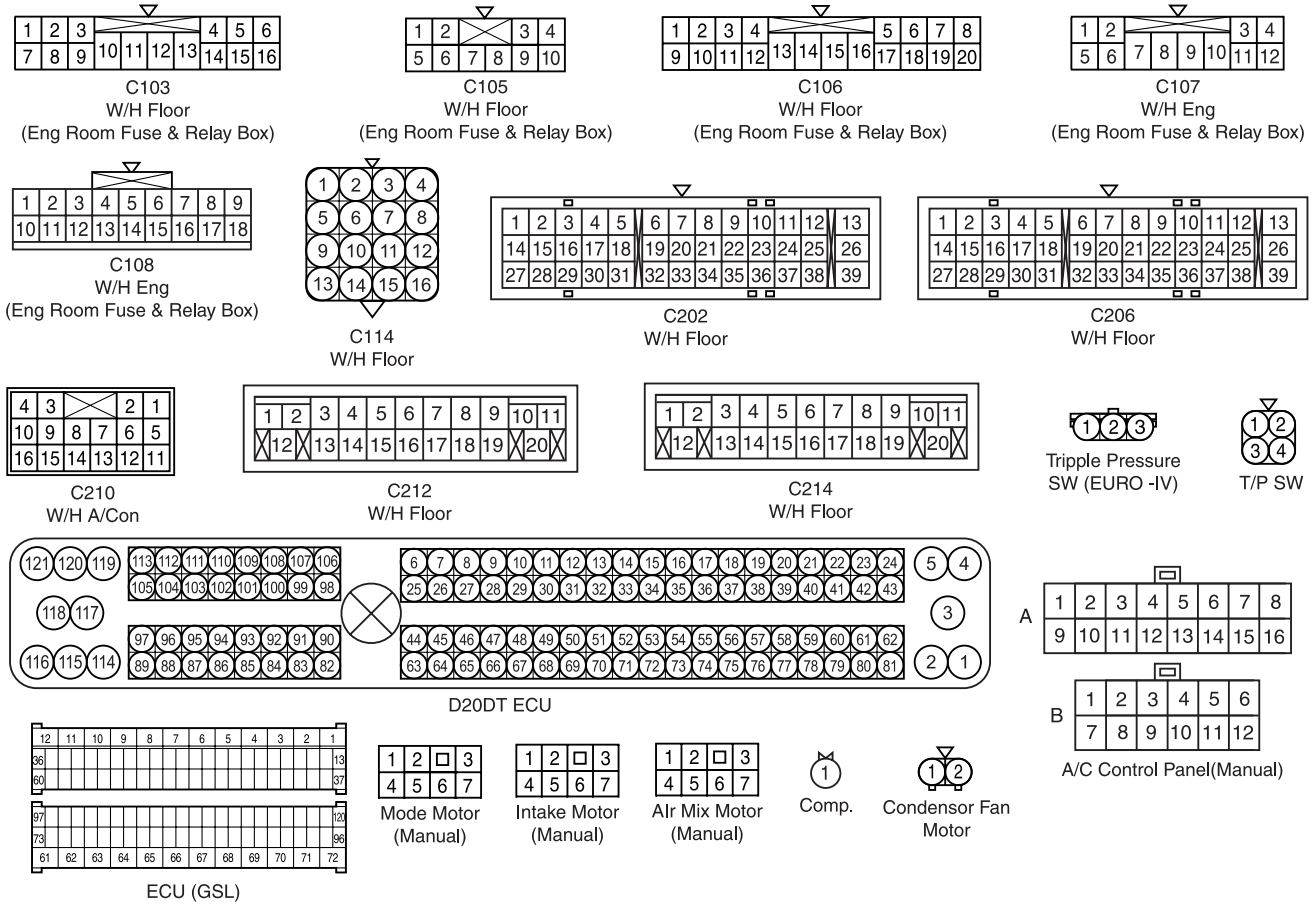
1) COMPRESSOR, MOTOR (MODE, INTAKE, AIR MIX)



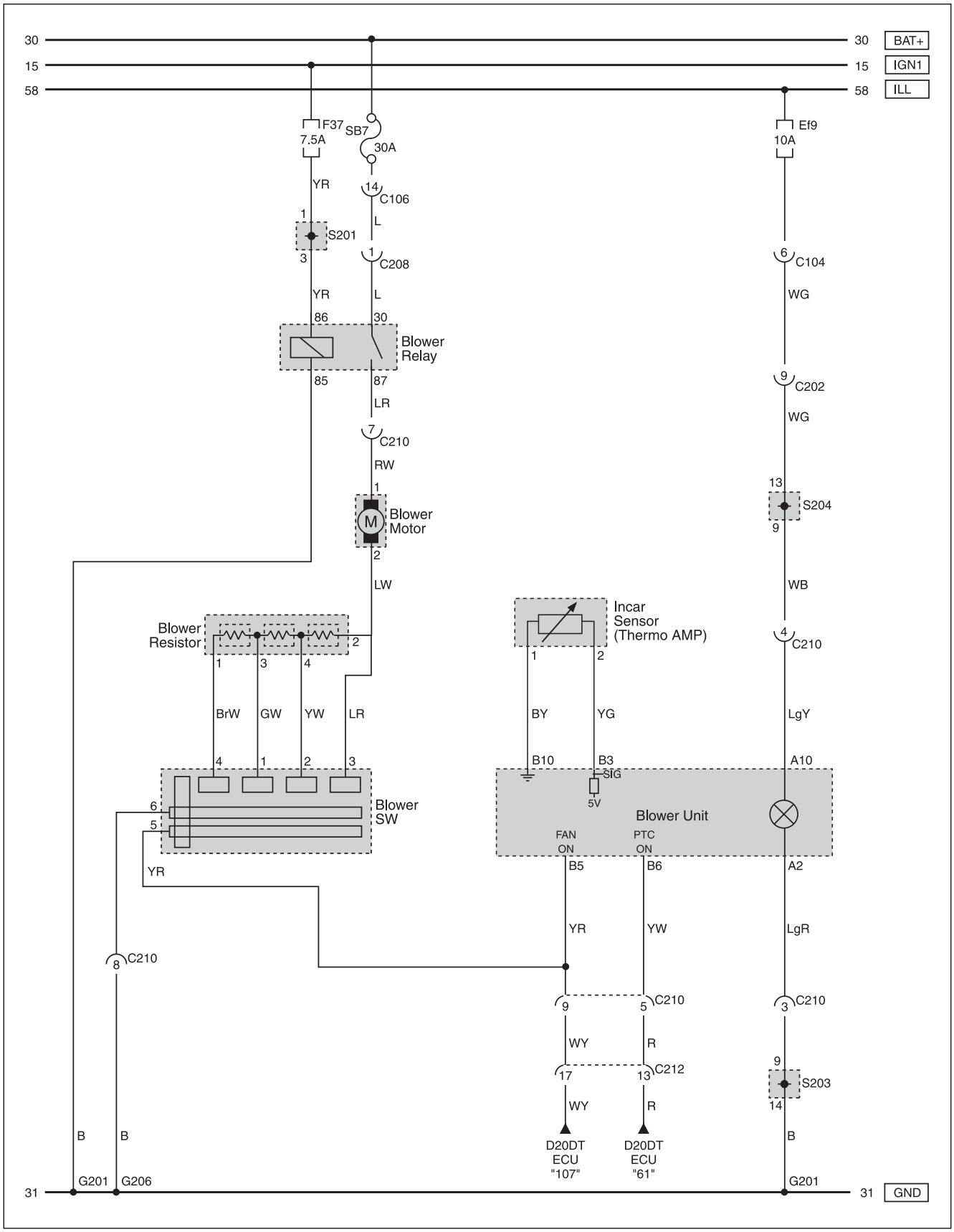
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C114 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Drvier Legroom	
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
G103	W/H Eng Room	LH FRT END PNL (LH Head Lamp Side)	
G104	W/H Eng Room	Behind RH Head Lamp	
G206	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



2) BLOWER


30
15
58
30 BAT+
15 IGN1
58 ILL
F37
7.5A
SB7
30A
Ef9
10A
YR
14
C106
L
1
S201
3
C208
6
C104
WG
YR
L
86
30
Blower
Relay
85
87
LR
9
C202
WG
7
C210
RW
1
13
S204
9
M
Blower
Motor
2
WB
LW
Incar
Sensor
(Thermo AMP)
4
C210
Blower
Resistor
2
1
2
1
3
4
BrW
GW
YW
LR
BY
YG
LgY
4
1
2
3
B10
B3
SIG
A10
5V
6
5
Blower
SW
Blower Unit
FAN
ON
PTC
ON
YR
B5
B6
A2
YR
YW
LgR
C210
8
9
5
C210
C210
3
WY
R
9
17
13
C212
S203
14
WY
R
B
B
D20DT
ECU
"107"
D20DT
ECU
"61"
B
G201
G206
31
G201
31 GND

A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C208 (4Pin, Colorless)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G201	W/H Main	Under the Driver Cowl Side PNL	Under C/Holder
G206	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

