GENERAL INFORMATION

00

TABLE OF CONTENTS

DIMENSIONS 3

SPECIFICATIONS 4

VEHICLE IDENTIFICATION 6

MAINTENANCE SCHEDULE 9

RECOMMENDED FLUIDS AND LUBRICANTS 11

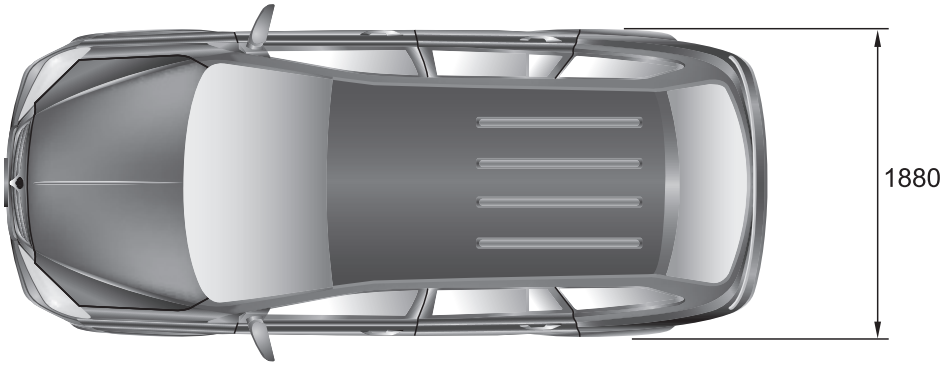
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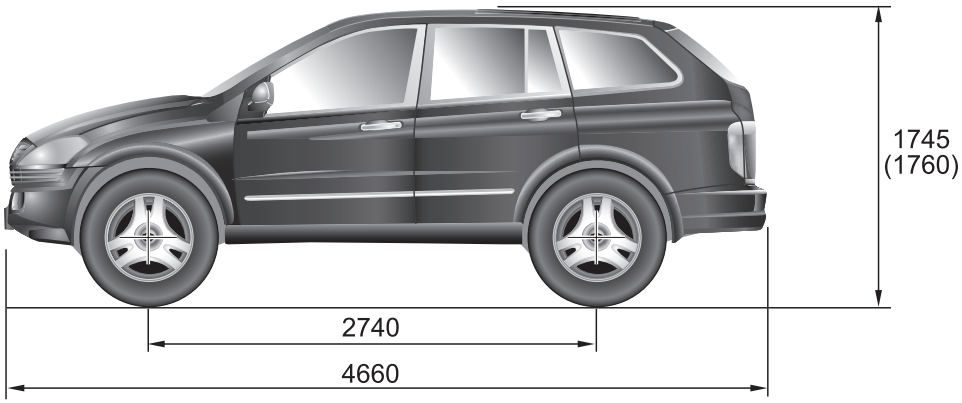
DIMENSIONS

Unit: mm

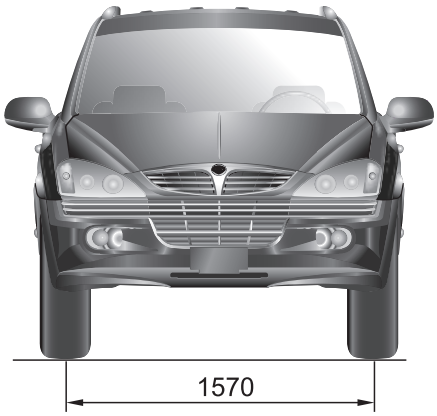
Top View



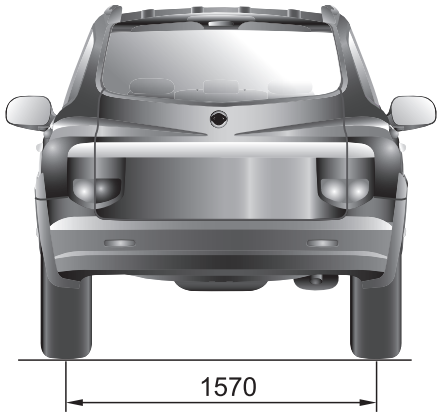
Side View



Front View



Rear View



* ( ) : Optional

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SPECIFICATIONS

Descriptions			D20DT	D27DT
General	Overall length (mm)		4,660	4,660
	Overall width (mm)		1,880	1,880
	Overall height (mm)		1,740 (1,755: with roof rack)	1,740 (1,755: with roof rack)
	Gross vehicle weight (kg)	A/T	2,530	2,530
		M/T	2,530	2,530
	Curb vehicle weight (kg)	A/T	2WD: 1,920 / 4WD: 2,028	4WD: 2,071
		M/T	2WD: 1,893 / 4WD: 2,001	4WD: 2,030
	Fuel		Diesel	Diesel
	Fuel tank capacity (ℓ)		75	75
Engine	Engine name		D20DT	D27DT
	Numbers of cylinders/Compression ratio		4 / 17.5:1	5 / 18:1
	Total displacement (cc)		1,998	2,696
	Camshaft arrangementMax. power		DOHC	DOHC
	Max. power	A/T	141 ps / 4,000 rpm	165 ps / 4,000 rpm
		M/T	141 ps / 4,000 rpm	165 ps / 4,000 rpm
	Max. torque	A/T	310 Nm / 1,800 ~ 2,750 rpm	340 Nm / 1,800 ~ 3,250 rpm
		M/T	310 Nm / 1,800 ~ 2,750 rpm	340 Nm / 1,800 ~ 3,250 rpm
	Idle speed		750 ± 20 rpm	750 ± 20 rpm
	Cooling system		Water- cooled / forced circulation	Water- cooled / forced circulation
	Coolant capacity (ℓ)		11.5	11.5
	Lubrication type		Gear pump, forced circulation	Gear pump, forced circulation
	Max. oil capacity (ℓ)		8.2	9.2
	Turbocharger and cooling type		Turbocharger, air-cooled	Turbocharger, air-cooled
Manual Transmission	Operating type		Semi- Remote control, floor change type	Semi- Remote control, floor change type
	Gear ratio	1st	4.315	4.315
		2nd	2.475	2.475
		3rd	1.536	1.536
		4th	1.000	1.000
		5th	0.807	0.807
		Reverse	3.919	3.919
Automatic Transmission	Model		Electronic, 5-speed	Electronic, 5-speed
	Operating type		Floor change type	Floor change type

* ( ) Optional

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Descriptions			D20DT	D27DT
Automatic Transmission	Gear ratio	1st	3.951	3.595
		2nd	2.423	2.186
		3rd	1.486	1.405
		4th	1.000	1.000
		5th	0.833	0.831
		Reverse 1st	3.147	3.167
		Reverse 2nd	1.930	1.926
Transfer Case	Model		Part-time	Part-time
	Type		Planetary gear type	Planetary gear type
	Gear ratio	High (4H)	1.000 : 1	1.000 : 1
		Low (4L)	2.483 : 1	2.483 : 1
Clutch (M/T)	Operating type		Hydraulic type	Hydraulic type
	Disc type		Dry single diaphragm type	Dry single diaphragm type
Power Steering	Type		Rack and pinion	Rack and pinion
	Steering angle	Inner	36.2°	36.2°
		Outer	32.4°	32.4°
Front Axle	Drive shaft type		Ball joint type	Ball joint type
	Axle housing type		Build-up type	Build-up type
	Gear ratio	M/T	4.27	3.91
		A/T	3.54	3.31
Rear Axle	Drive shaft type	5-Link type	Semi-floating type	Semi-floating type
		Independent type	Independent type	Independent type
	Axle housing type		Build-up type	Build-up type
	Gear ratio	M/T	4.27	3.91
		A/T	3.54	3.31
Brake	Master cylinder type		Tandem type	Tandem type
	Booster type		Vacuum assisted booster type	Vacuum assisted booster type
	Brake type	Front wheels	Disc type	Disc type
		Rear wheels	Drum (disc)	Drum (disc)
	Parking brake		Cable type (internal expansion)	Cable type (internal expansion)
Suspension	Front suspension		Wishbone + coil spring	Wishbone + coil spring
	Rear suspension	Solid axle suspension	5-link + coil spring	5-link + coil spring
Air Conditioner	Refrigerant (capacity)		R-134a (650 ± 30g)	R-134a (650 ± 30g)
Electrical	Battery type / Capacity (V-AH)		MF / 12 - 90	MF / 12 - 90
	Starter capacity (V-kW)		12 - 2.2	12 - 2.2
	Alternator capacity (V-A)		With PTC: 12 - 140 (With FFH: 12 - 115)	With PTC: 12 - 140 (With FFH: 12 - 115)

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VEHICLE IDENTIFICATION

Chassis Number

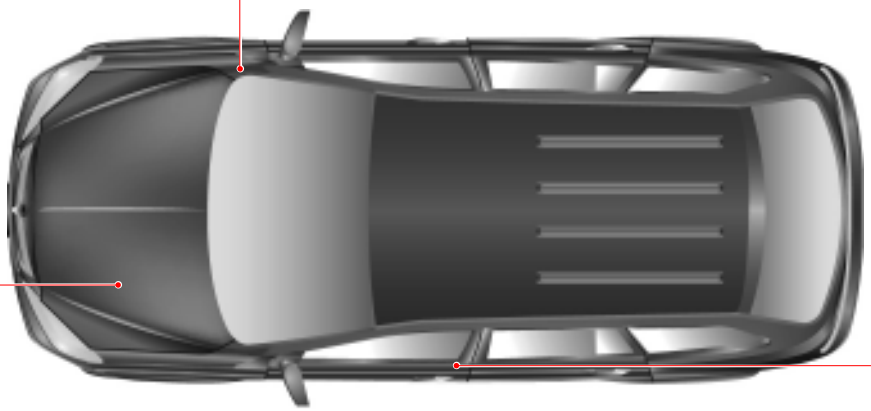


The chassis number is stamped on the frame behind the front right tire.

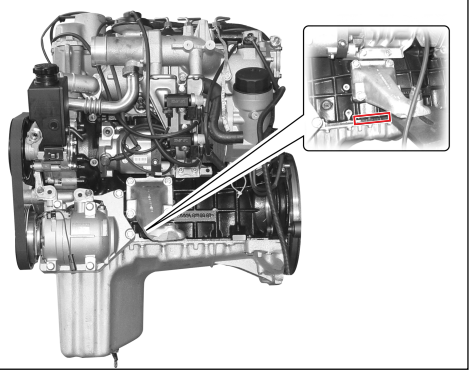
Certification Label



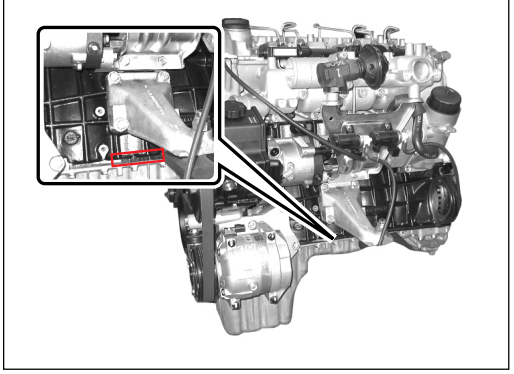
The certification label is located on the driver's door sill.



Engine Number (D20DT)



Engine Number (D27DT)



The engine number is stamped on the lower area of cylinder block in the intake manifold side.

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AFFECTED VIN	

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1. Vehicle Identification Number



Vehicle identification number (VIN) is is on the right front axle upper frame.

[KPTS0A1KS5P 122357]

K .. Nation	(K: Korea)
P .. Maker Identification	(P: Ssangyong Motor Company)
T .. Vehicle Type	(T: Passenger car - 4WD)
S .. Line Models	(S: Kyron)
0 .. Body Type	(0: 5-door)
A .. Trim Level	(A: Standard, B: Deluxe, C: Super deluxe)
1 .. Restraint System	(0: No seatbelts, 1: 3-point seatbelts, 2: 2-point seatbelt)
K .. Engine Type	(9: 3199cc, In-line 6 cylinders, Gasoline E32) (K: 1998cc - common rail direct injection (D20DT), F: 2696cc - common rail direct injection (D27DT))
S .. Check Digit	(S: All area except North America)
5 .. Model Year	(3: 2003, 4: 2004, 5: 2005)
P .. Plant Code	(P: Pyungtaek plant)
122357	(Production serial number)

2. Certification Label

The certification label is affixed on the bottom of driver's side B-pillar.



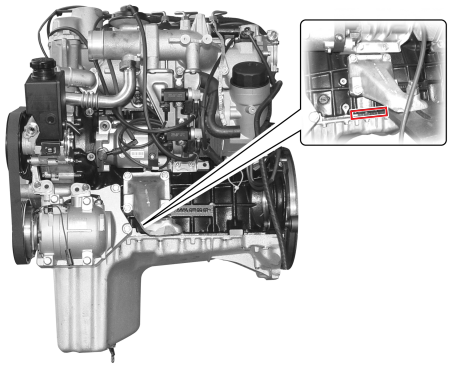
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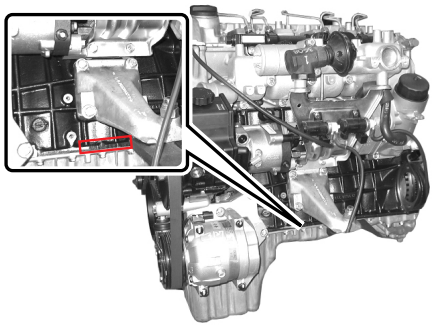
3. Engine Serial Number

The engine serial number is stamped on the lower area of cylinder block in intake manifold side.

D20DT



D27DT

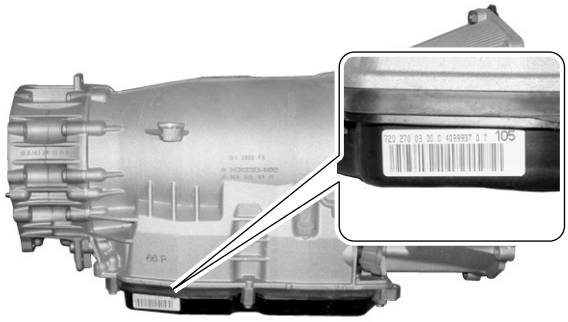


4. Manual Transmission Number

The transmission label is affixed on the upper area of clutch housing.

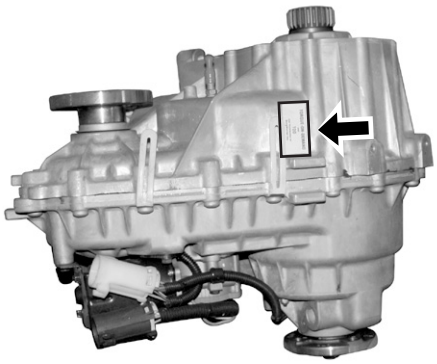
5. Automatic Transmission Number

The transmisson label is affixed on the right area of transmission housing.



6. Transfer Case Number

The transfer case label is affixed on the transfer case housing.



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MAINTENANCE SCHEDULE

▶ General

* Use only approved Ssangyong genuine parts.

Descriptions		Daily Check	Weekly Check	Service Interval
Engine Oil and Oil Filter		○	–	Initial change: 5,000 km, change every 10,000 km or 12 months (But, shorten the service interval under severe conditions)
Coolant		○	–	Change every 60,000 km or 3 years. And, inspect and replenish as necessary.
Additional Water Separator: A.W.S.		–	–	Inspect 10,000 km, change every 150,000 km or 5 years
Brake / Clutch Fluid		○	–	Change every 2 years (Inspect frequently)
Brake Pipes and Hoses		–	–	Initial check: 1,000 km, periodic check: every 20,000 km or 1 year, replace as necessary.
Brake Pad, Shoe, and Disc		–	–	Periodic check: every 10,000 km, adjust or replace as necessary.
Air Cleaner Element		–	○	Initial clean: 5,000 km, clean every 10,000 km, replace every 30,000 km (But, shorten the service interval under severe conditions)
Fuel Filter		–	–	Replace every 25,000 km (Draining water from fuel filter: every 10,000 km)
Automatic Transmission Fluid		–	–	Inspect every 10,000 km or 6 months (But change every 60,000 km under severe conditions)
Manual Transmission Fluid		–	–	Inspect 10,000 km, change every 60,000 km (Frequent check of oil leak)
Transfer Case Fluid		–	–	Inspect 10,000 km, change every 60,000 km (Frequent check of oil leak)
Axle Oil	Front	–	–	Inspect frequently, change every 30,000 km
	Rear	–	–	Inspect frequently, change every 30,000 km
Air Conditioner Filter		–	–	Change every 10,000 km (But, shorten the service interval under severe conditions)

Severe Conditions in Engine

1. 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
2. Driving in hilly or mountainous terrain, sandy or dusty area
3. High load driving such as trailer towing

Severe Conditions in Automatic Transmission and Axle

1. Towing a trailer or off-road driving
2. Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

Severe Conditions in Air Conditioner Filter

1. Pollutant area or off-road driving, extended air conditioner or heater operation

Sever Conditions in Air Cleaner Element

1. Pollutant area or off-road driving

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▶ EU ONLY

* Use only approved Ssangyong genuine parts.

Descriptions		Daily Check	Weekly Check	Service Interval
Engine Oil and Oil Filter		○	–	Change every 15,000 km or 12 months (But, shorten the service interval under severe conditions)
Coolant		○	–	Change every 60,000 km or 3 years. And, inspect and replenish as necessary.
Brake / Clutch Fluid		○	–	Change every 2 years (Inspect frequently)
Brake Pipes and Hoses		–	–	Periodic check: every 15,000 km or 1 year, replace as necessary.
Brake Pad, Shoe, and Disc		–	–	Periodic check: every 15,000 km, adjust or replace as necessary.
Air Cleaner Element		–	○	Clean every 15,000 km, replace every 30,000 km (But, shorten the service interval under severe conditions)
Fuel Filter		–	–	Replace every 30,000 km (Draining water from fuel filter: every 10,000 km)
Automatic Transmission Fluid		–	–	Inspect every 15,000 km or 12 months (But change every 60,000 km under severe conditions)
Manual Transmission Fluid		–	–	Inspect 15,000 km, change every 60,000 km (Frequent check of oil leak)
Transfer Case Fluid		–	–	Inspect 15,000 km, change every 60,000 km (Frequent check of oil leak)
Axle Oil	Front	–	–	Inspect frequently, change every 30,000 km
	Rear	–	–	Inspect frequently, change every 30,000 km
Air Conditioner Filter		–	–	Change every 10,000 km (But, shorten the service interval under severe conditions)

Severe Conditions in Engine

1. 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
2. Driving in a hilly or mountainous terrain, sandy, or dusty area
3. High load driving such as trailer towing

Severe Conditions in Automatic Transmission and Axle

1. Towing a trailer or off-road driving
2. Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

Severe Conditions in Air Conditioner Filter

1. Pollutant area or off-road driving, extended air conditioner or heater operation

Sever Conditions in Air Cleaner Element

1. Pollutant area or off-road driving

*** EU Countries**

1. Only countries that belong to EU. (It does not apply to all countries in EU.)

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RECOMMENDED FLUIDS AND LUBRICANTS

Descriptions			Capacity		Specifications
			D20DT	D27DT	
Engine Oil			≒ 7.5 ℓ	≒ 8.5 ℓ	Ssangyong genuine engine oil (Approved by MB Sheet 229.1 or 229.3)
Engine Coolant			≒ 11.5 ℓ	≒ 11.5 ℓ	Ssangyong genuine coolant
Automatic Transmission Fluid			≒ 8.0 ℓ	≒ 8.0 ℓ	Shell AFT 3353 or Fuchs AFT 3353
Manual Transmission Fluid			4WD: ≒ 3.6 ℓ 2WD: ≒ 3.4 ℓ	4WD: ≒ 3.6 ℓ	Ssangyong genuine oil (ATF DEXRON II)
Transfer Case Fluid			≒ 1.3 ℓ	≒ 1.3 ℓ	Ssangyong genuine oil (ATF DEXRON III)
Axle Oil	Front	Automatic Transmission	≒ 1.4 ℓ	≒ 1.4 ~ 1.5 ℓ	Ssangyong genuine oil (API GL-5 or SAE 80W/90)
		Manual Transmission	≒ 1.4 ℓ	≒ 1.4 ℓ	
	Rear	Solid Axle Suspension	≒ 1.9 ℓ	≒ 2.2 ℓ	Ssangyong genuine oil (API GL-5 or SAE 80W/90)
Brake/Clutch Fluid			As required	As required	Ssangyong genuine oil (DOT4)
Power Steering Fluid			≒ 1.0 ℓ	≒ 1.0 ℓ	Ssangyong genuine oil (ATF DEXRON 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.**

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MEMO

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AUTOMATIC TRANSMISSION (DC 5-SPEED)

3650 / 3660 / 3110

TABLE OF CONTENTS

GENERAL INFORMATION 2

1. Overview 2

AUTOMATIC TRANSMISSION (DC 5-SPEED) 4

1. Appearance 4
2. Structure and specifications 5
3. Power flow 11

FUNCTION AND DESCRIPTION 19

1. Selector lever 19
2. Torque converter 24
3. Planetary gear set 27
4. Multiple-disc clutch 28
5. Freewheel 29
6. Others 30

REMOVAL AND INSTALLATION 33

1. Selector lever and link 33
2. Front and rear propeller shaft 36
3. Transmission assembly 38
4. Replacing the o-ring on parking pawl guide sleeve 42
5. Disassembly and reassembly (DC 5-SPEED A/T) 46
6. Valve body 65

SPECIAL TOOLS AND EQUIPMENT 68

VALVE BODY 72

HYDRAULIC CIRCUIT 80

1. Hydraulic circuit diagram 80
2. Hydraulic circuit 85
3. Adapter plug 91
4. Valve body 93

TCU (Transmission Control Unit) 99

TROUBLE CODE AND DIAGNOSIS ... 104

1. Trouble diagnosis with SCAN-100 104
2. DTC (Diagnosis Trouble Code) of DC5AT 105
3. Removal and installation of TCU 112

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GENERAL INFORMATION

1. OVERVIEW

DC 5-speed Automatic Transmission Assembly



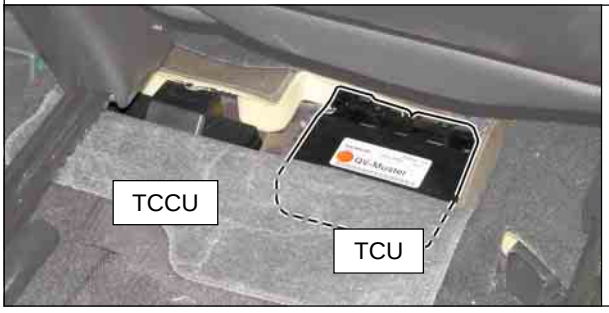
T-Tronic DC 5-speed automatic transmission is an electronically controlled 5-speed transmission with a lockup clutch in the torque converter. The ratios for the gears are realized by three planetary gear sets. The 5th gear is designed with a step-up ratio of 0.83 as an overdrive. The selector lever is controlled by electronically and mechanically. The gears are shifted by the corresponding combination of three hydraulically actuated multiple-disc brakes, three hydraulically actuated multiple-disc clutches and two mechanical one-way clutches. **This electronically controlled automatic transmission** adjusts the operating pressure to provide proper shifting in relation to engine power. This function improves shifting quality significantly. And, the driver can select “S” (Standard) mode or “W” (Winter) mode according to the driving conditions.

Instrument Panel





TCU Assembly





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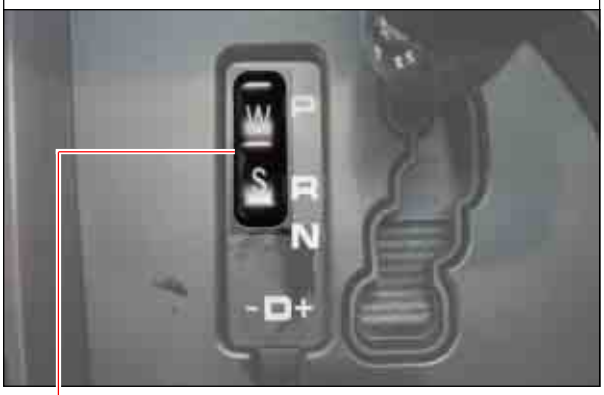
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Releasing Lock-up Solenoid Valve



* When the gear selector lever cannot be moved from “P” position to other positions, manually release the lock-up function as shown in figure.

Standard Mode / Winter Mode



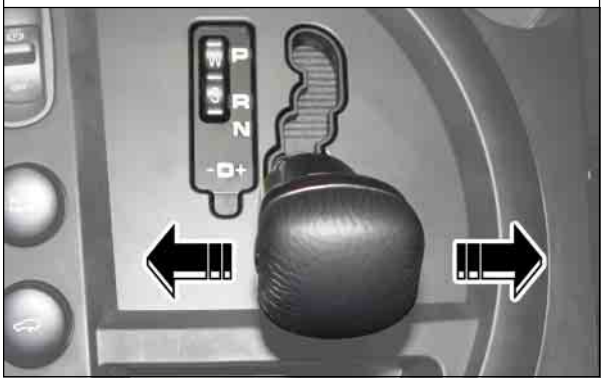


“S” mode is used in normal driving.

When “W” mode is selected, the vehicle starts from 2nd gear (forward and reverse) to achieve smooth starting on the slippery road.



Selector Lever



Downshift (Manual Mode)

1 ← 2 ← 3 ← 4 ← D

The shiftable gear is down by one step as the lever is moved to left (-) direction.

Upshift (Manual Mode)

1 → 2 → 3 → 4 → D

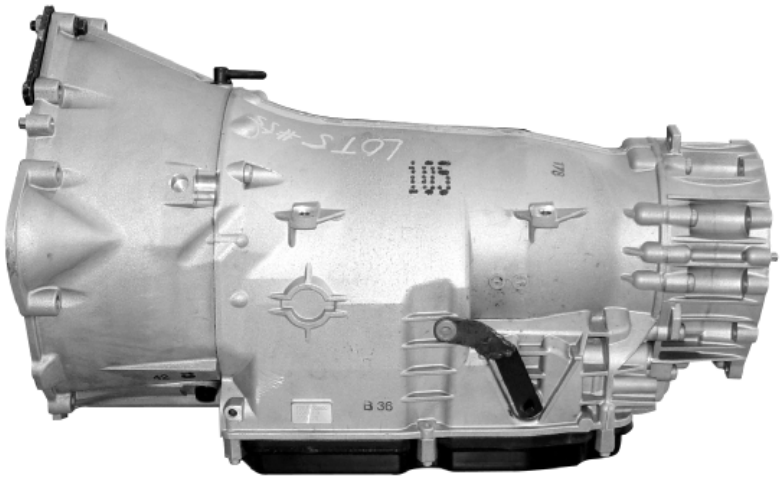
The shiftable gear is up by one step as the lever is moved to right (+) direction.

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AUTOMATIC TRANSMISSION (DC 5-SPEED)

1. APPEARANCE

Left Side





With Torque Converter	Without Torque Converter
	

Rear View


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AFFECTED VIN	

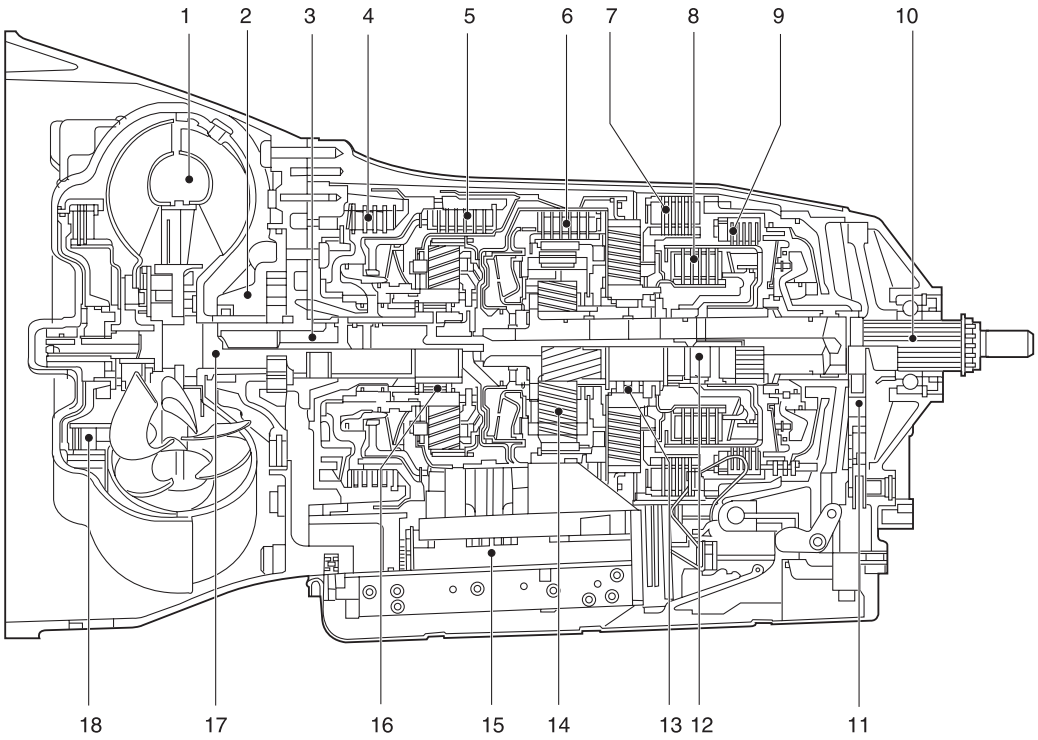
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2. STRUCTURE AND SPECIFICATIONS

▶ Structure







※ This sectional drawing is based on DC 5-speed A/T 2WD model. 4WD model has also same structure.

1. Torque converter
2. Oil pump
3. Input shaft
4. Disc brake B1
5. Disc clutch C1
6. Disc clutch C2
7. Disc brake B3
8. Disc clutch C3
9. Disc brake B2
10. Output shaft
11. Parking lock gear
12. Intermediate shaft
13. Freewheel F2
14. Center planetary gear set
15. Electric control unit (valve body)
16. Freewheel F1 (Front planetary gear set)
17. Stator shaft
18. Converter lockup clutch

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▶ Specifications

Item		5-Speed Automatic Transmission	
		D20DT	D27DT
Input torque		2WD (580 Nm), 4WD (400 Nm)	
Weight (including ATF)		76 kg (2WD), 78 kg (4WD)	
Diameter (torque converter)		270 mm	
Lockup function		Yes	
Gear ratios	1st	3.951	3.595
	2nd	2.423	2.186
	3rd	1.486	1.405
	4th	1.000	1.000
	5th	0.833	0.831
	Rev. 1st: S / Rev. 2nd: W	3.147/1.93	3.167/1.926
Driving type		2WD/4WD	
Fluid specification		Fuchs ATF 3353 or Shell ATF 3353	
Fluid capacity		Approx. 8 ℓ	
Selector lever position	P.R.N.D	Mechanical	
	D+/D-	Electrical	
Parking lock system		Brake switch (signal) →TGS lever	
Selected lever indication	P.R.N.D	Lever position	
	4, 3, 2, 1	CAN	
Oil temperature sensor	Resistance: R, D	0.5 ~ 2.5 kΩ	
TCU		EGS 52	
Shift solenoid valve (25°C)	Resistance	3.8 ± 0.2 Ω	
	Operating distance	0.2 mm	
	Operating current	1.5 ~ 2 A	
M/P, S/P solenoid valve (23°C)	Resistance	5.0 ± 0.2 Ω	
	Operating distance	0.6 mm	
	Operating current	0 ~ 1.2 A	
Lockup solenoid valve (25°C)	Resistance	2.5 ± 0.2 Ω	
	Operating distance	0.2 mm	
	Operating current	1.5 ~ 2.0 A	
	Operating range	3rd to 5th gears	
Speed sensor	Type	HALL type	
	Operating voltage	6 V	
Start lockout switch	Switch contact	ON (D, R position)	
	Switch contact	OFF (P, N position)	

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Item		5-Speed Automatic Transmission
Mode switch		W (Winter)
		S (Standard)
One-way clutch		F1, F2
Planetary gear set	Number of planetary gear set pinion (Front, Center, Rear)	4, 4, 4
Disc clutch	C1	Single side friction plate
	C2	Double side friction plate
	C3	Single side friction plate
Disc brake	B1	Single side friction plate
	B2	Double side friction plate
	B3	Double side friction plate

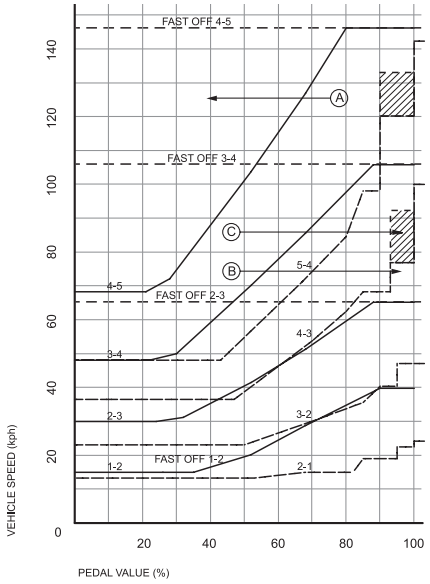
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▶ Characteristics of Automatic Transmission

Performance Curve

D20DT

Standard Mode



Upshift: ——————

Downshift: —— · —— · ——

Lockup (slipping): – – —— – – —

Unlock (open): ——————

FAST OFF: – – – – – – – – – –

Dynamic shift zone: ZZZZZZZZZZZZZ

FAST OFF: When abruptly releasing the accelerator pedal, the transmission remains at 4th gear other than 4 →5 shift (when slowly releasing the accelerator pedal, the transmission is shifted to 5th gear).

Dynamic shift zone:

When operating the accelerator pedal (Ⓑ), the 4 → 3 shift is completed by kick-down signal after completion of 4 →3 shift (100% of pedal position). When promptly operating the accelerator pedal (Ⓒ), the 4 → 3 shift is done in shaded area (93% of pedal position).

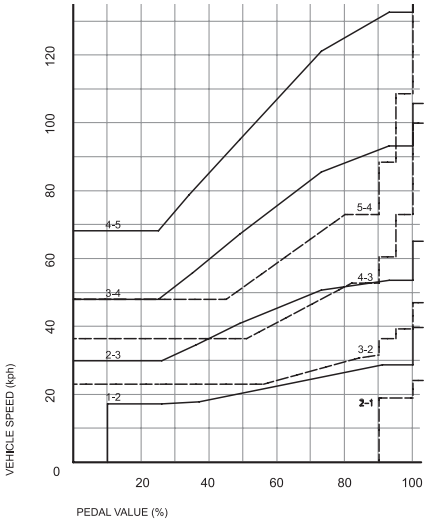
4th gear: 1.000

5th gear: 0.833

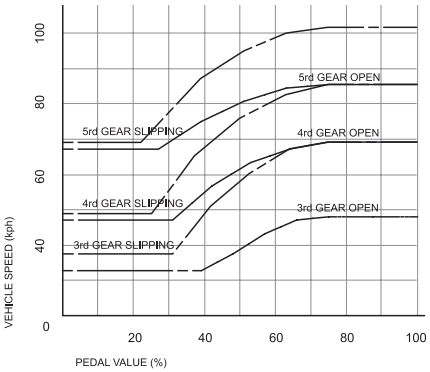
Rev. 1st gear: 3.147

Rev. 2nd gear: 1.93

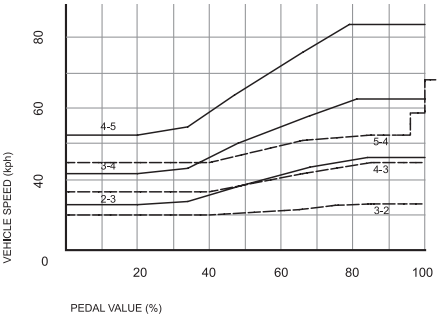
WINTER Mode (2WD)



Lockup Mode (Open/Slipping)



Low Mode (4WD)

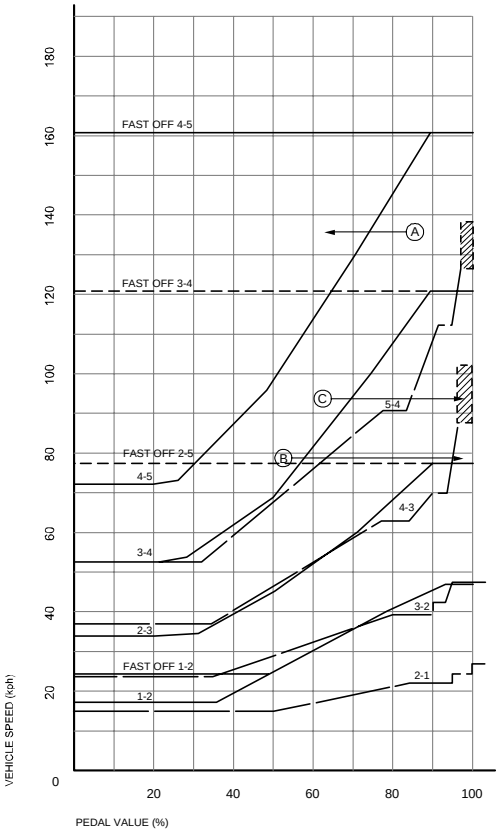


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D27DT

Standard Mode



Upshift: ——————————

Downshift: ——·——·——

Lockup (slipping): – – ——————

Unlock (open): ——————

FAST OFF: – – – – – – – – – –

Dynamic shift zone: ZZZZZZZZZZZZZ

FAST OFF: When abruptly releasing the accelerator pedal, the transmission remains at 4th gear other than 4 →5 shift (when slowly releasing the accelerator pedal, the transmission is shifted to 5th gear).

Dynamic shift zone:

When operating the accelerator pedal (Ⓑ), the 4 → 3 shift is completed by kick-down signal after completion of 4 →3 shift (100% of pedal position). When promptly operating the accelerator pedal (Ⓒ), the 4 → 3 shift is done in shaded area (93% of pedal position).

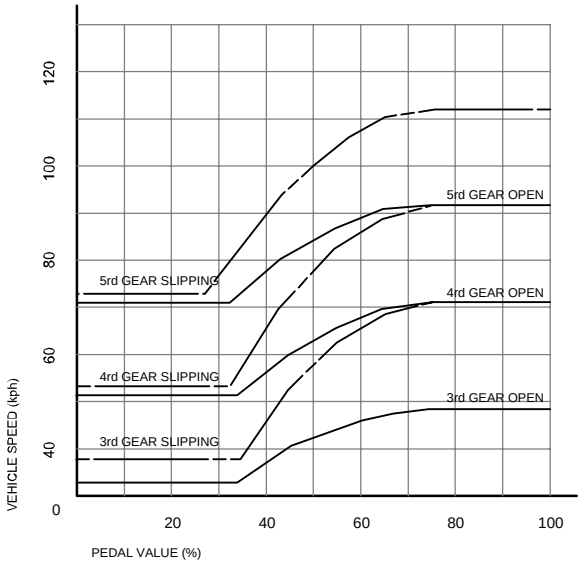
4th gear: 1.000

5th gear: 0.831

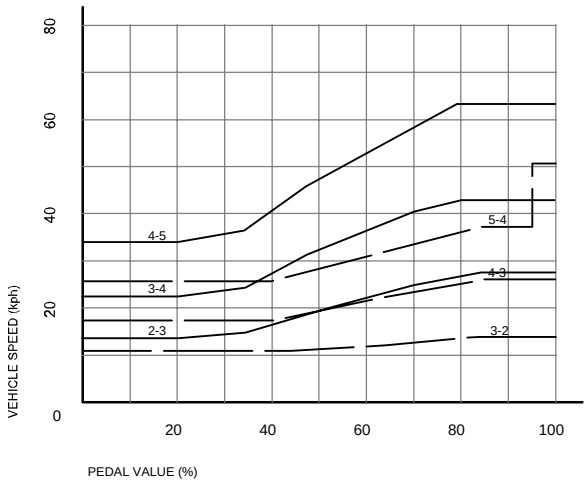
Rev. 1st gear: 3.167

Rev. 2nd gear: 1.926

Lockup Mode (Open/Slipping)



WINTER Mode

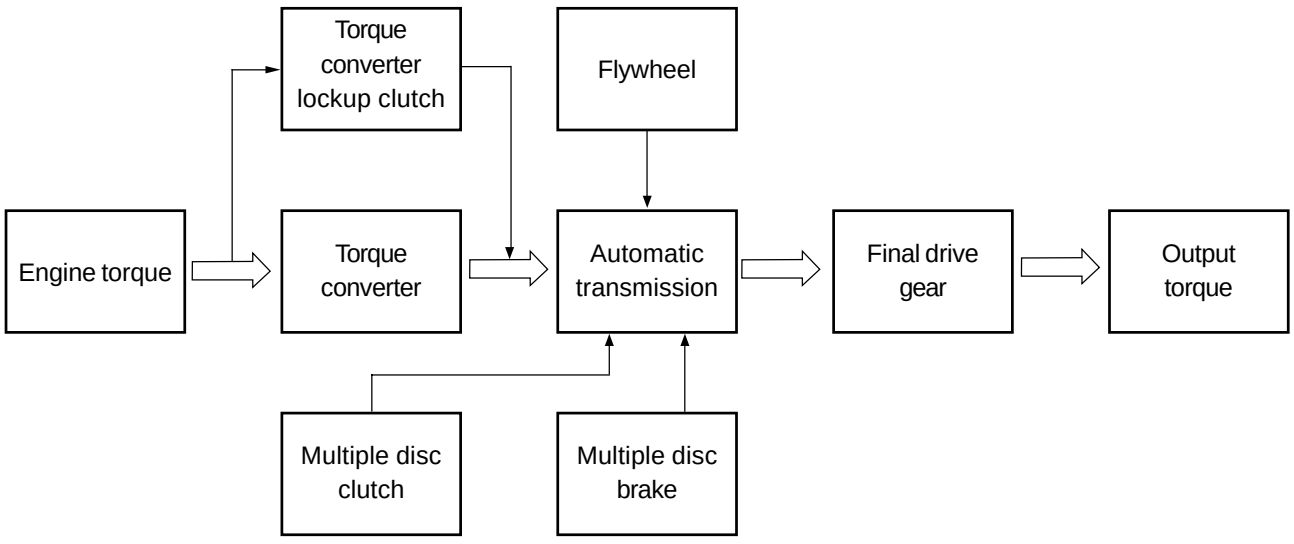


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▶ General Characteristics

Characteristic	Function and Effect
Slope recognition (down hill, up hill)	Slope is recognized based on engine RPM and accelerator pedal position. →**Delays up shift**
Engine torque reduction	Ignition timing is delayed to reduce torque at all shifting moments. →**Improves shift quality**
Engine rpm limitation	Engine rpm is limited until the gears are fully engaged when shifting from “N” to “D”. →**Prevents shift shock**
ESP Operation	When the ESP is controlling the engine torque, shifting is not available and vehicle starts off with 2nd gear. →**Cannot use kick-down function and shift at maximum rpm**
ABS Operation	Brake control is not affected.
Fast-off function	It is not shifted up when accelerator pedal is abruptly released. →**To get engine brake effect during cornering**
Altitude recognition	As altitude increases (atmospheric pressure reduces), engine torque decreases. To compensate this torque reduction, shift up occurs when depressing the accelerator pedal more than usual operation (adjusting shift diagram). →**Improves driving performance and increases torque**
Oil temperature	If transmission fluid temperature is too low, the shifting point gets delayed in full throttle and kick down. →**Improves driving performance**
Hydraulic pressure is produced in emergency driving mode	When starting the engine with cycling the ignition switch (“OFF” and “ON”) due to transmission trouble, the selector lever should be placed in “P” position. If starting the engine with selector lever “N” position, the lever should be moved into “P” position. The selector valve changes the path of hydraulic pressure in selector lever “P” position. → **The hydraulic pressure flows to direct operation mode via “R” and “D” valve to operate “reverse 2nd” and “forward 2nd” gear.**
Adaptation	Function to optimize the shifting quality. →**Compensates the shifting quality according to play and wear**

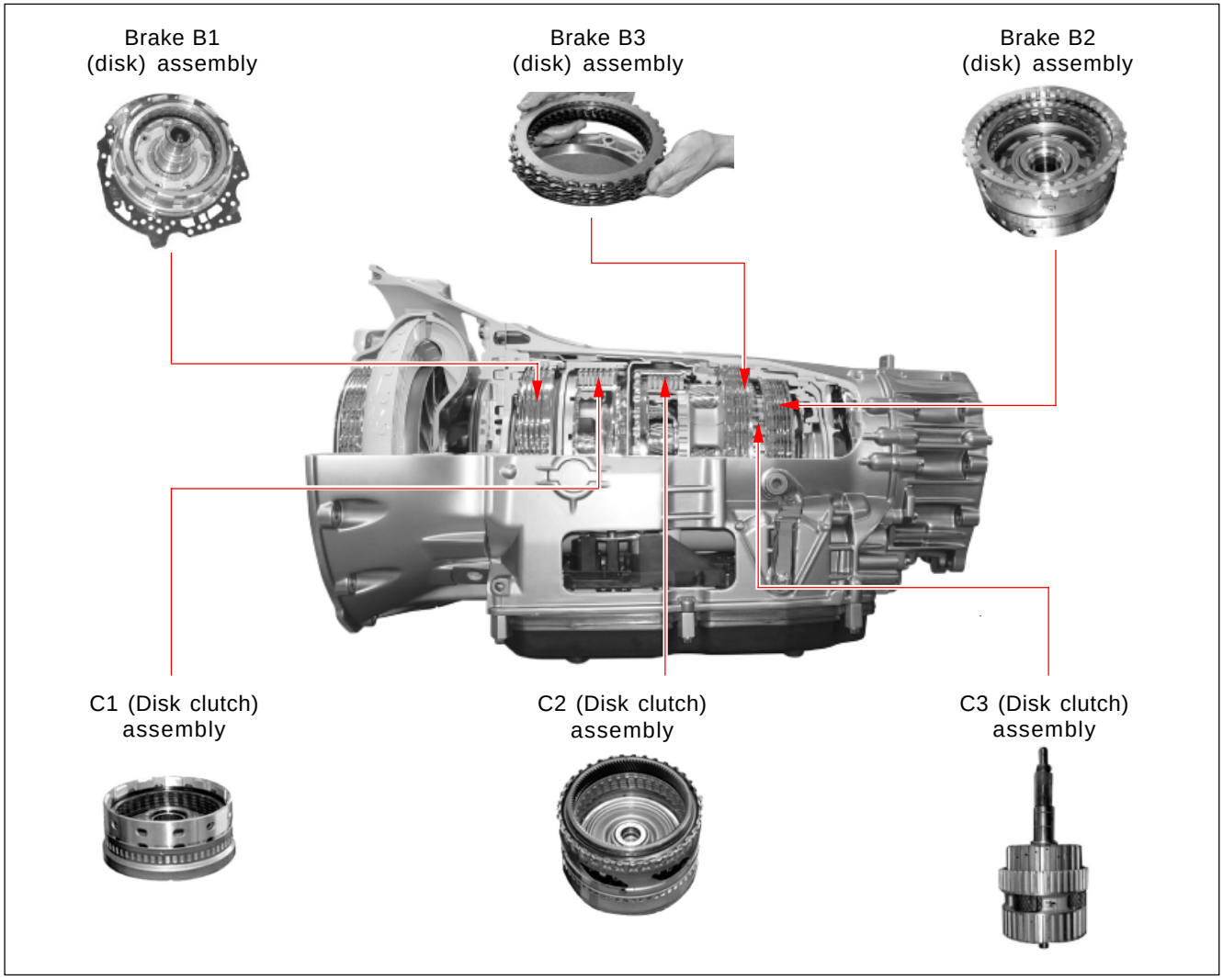


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3. POWER FLOW

▶ Sectional View



Shifting Elements

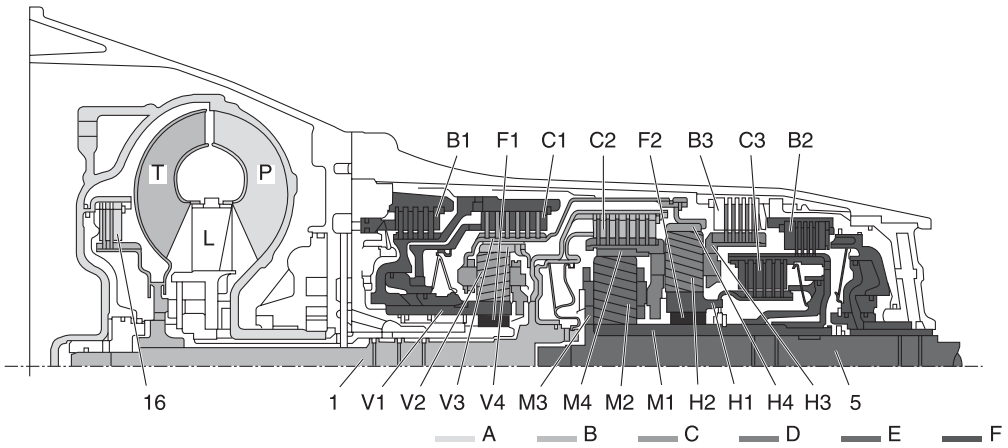
Gear	C1	C2	C3	B1	B2	B3	F1	F2
1			● 3)	● 3)	●		●	●
2	●		● 3)		●			●
3	●	●			●			
4	●	●	●					
5		●	●	● 3)			●	
P/N 1)			●	●				
P/N 2)	●		●					
R 1)			●	● 3)		●	●	
R 2)	●		●			●		

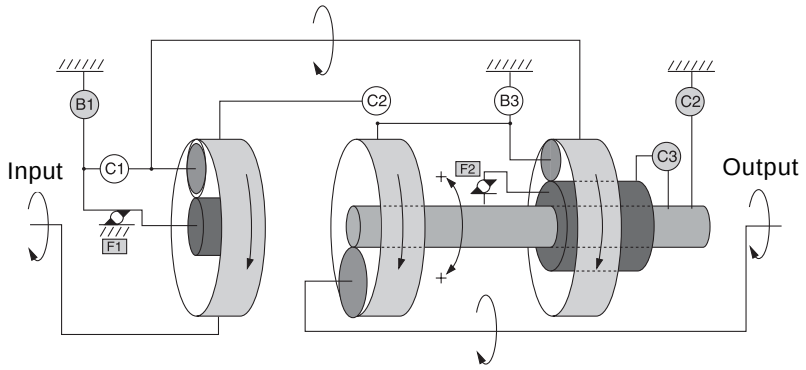
1) Selector program switch: S mode 2) Selector program switch: W mode 3) Overrun

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▶ 1st Gear (D20DT: 3.951, D27DT: 3.595)





16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. 2nd gear ratio
E. 3rd gear ratio
F. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

1. Input shaft: Clockwise rotation
2. Front sun gear: Locked by F1 and B1, Planetary gear carrier: Rotation with reduced speed
3. Rear ring gear: Counterclockwise rotation
4. Rear sun gear: Locked by F2 and B2, Planetary gear carrier: Clockwise rotation with reduced speed
5. Center ring gear: Clockwise rotation
6. Center sun gear: Locked by B2, Rotation with reduced speed
7. Output shaft: Clockwise rotation

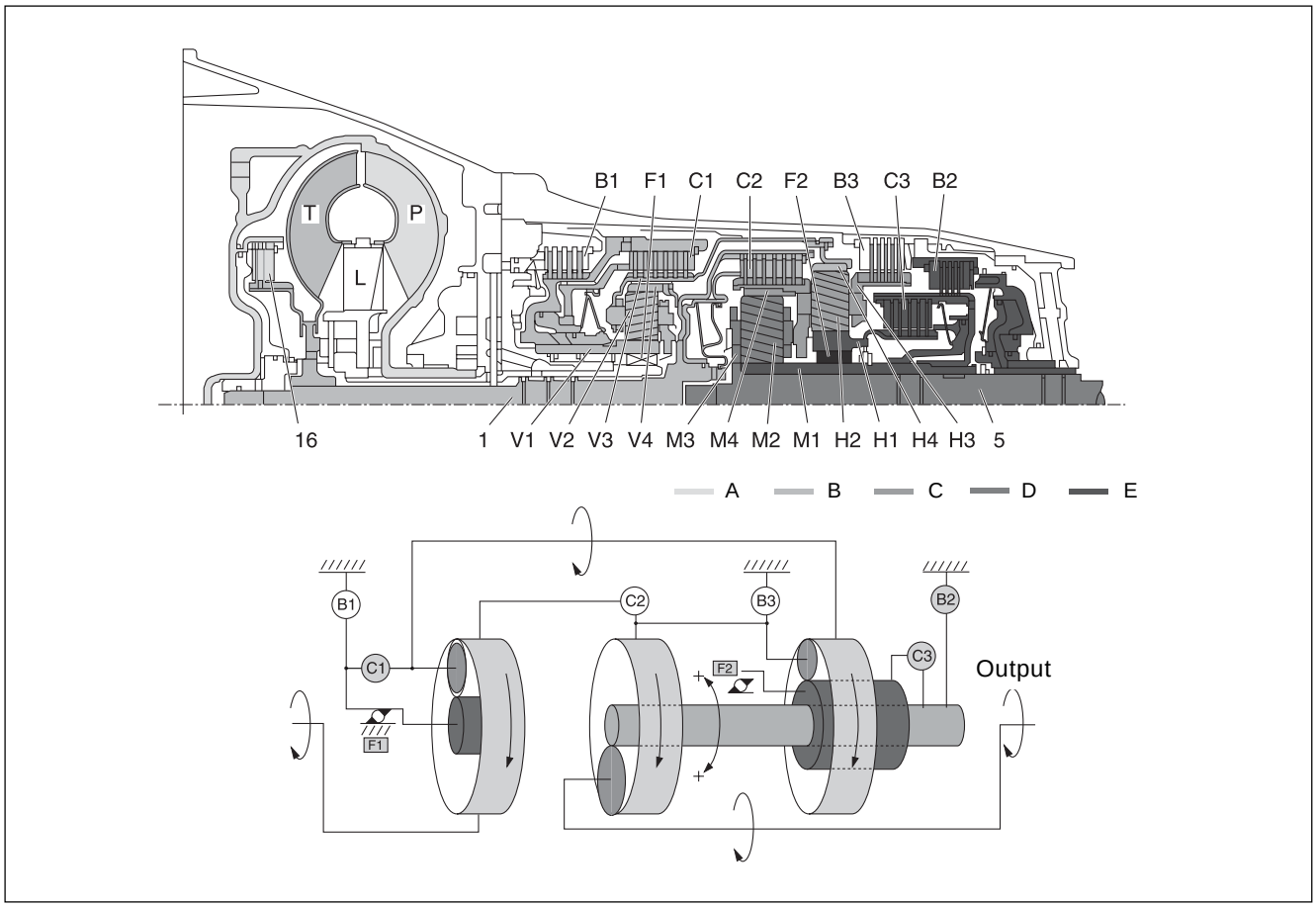
Gear	C1	C2	C3	B1	B2	B3	F1	F2	Lockup clutch
1			● 3)	● 3)	●		●	●	

3) Overrun

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AFFECTED VIN	

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▶ 2nd Gear (D20DT: 2.423, D27DT: 2.186)



16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. 2nd gear ratio
E. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

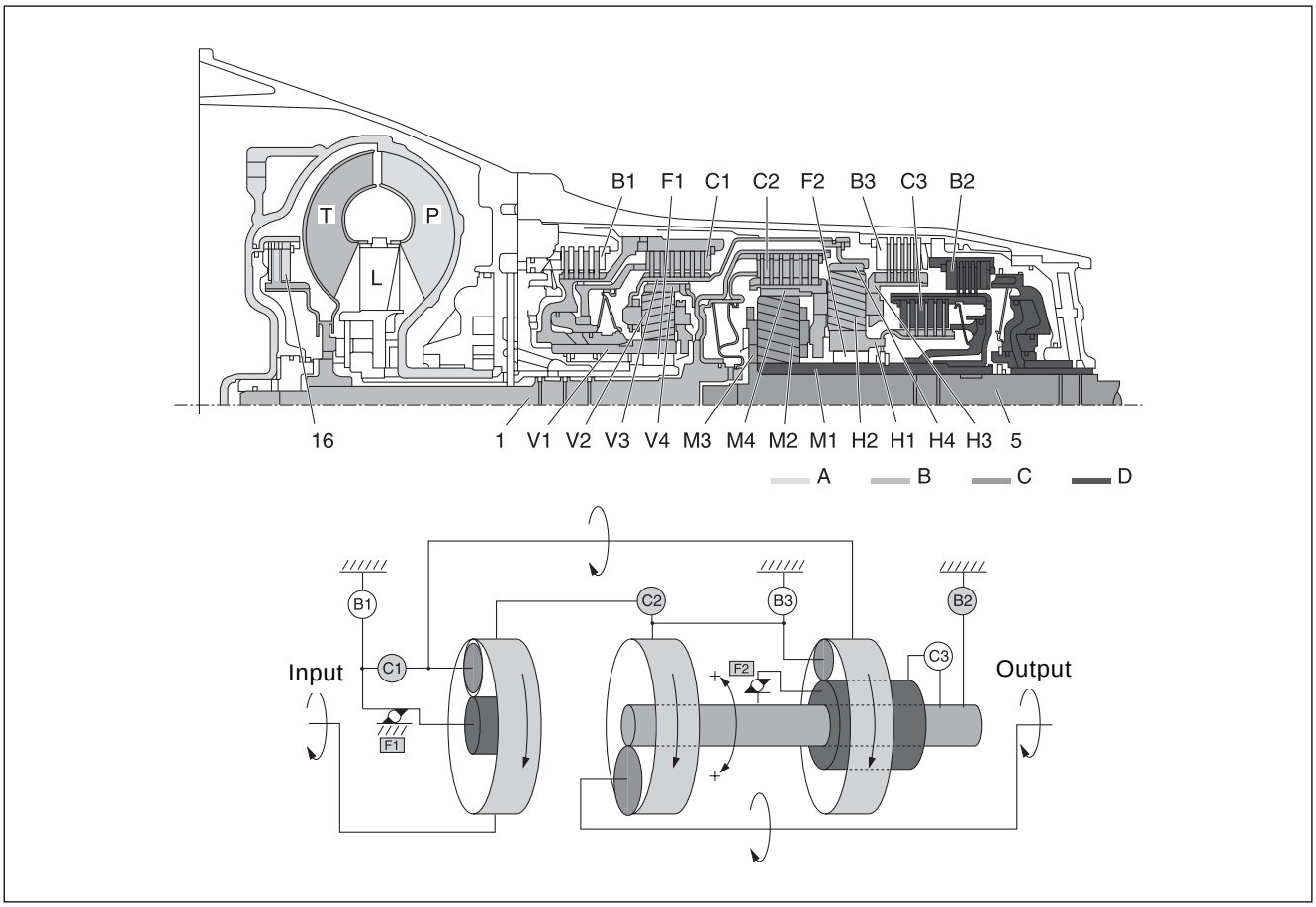
1. Input shaft: Clockwise rotation
2. Sun gear and planetary gear carrier: Clockwise rotation by C1 activation
3. Rear ring gear: Clockwise rotation
4. Rear sun gear: Locked by F2 and B2, Planetary gear carrier: Rotation with reduced speed
5. Center ring gear: Clockwise rotation
6. Sun gear: Locked by B2, Planetary gear carrier: Rotation with reduced speed
7. Output shaft: Clockwise rotation

Gear	C1	C2	C3	B1	B2	B3	F1	F2
2	●		● 3)		●			●

3) Overrun

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▶ 3rd Gear (D20DT: 1.486, D27DT: 1.405)



16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

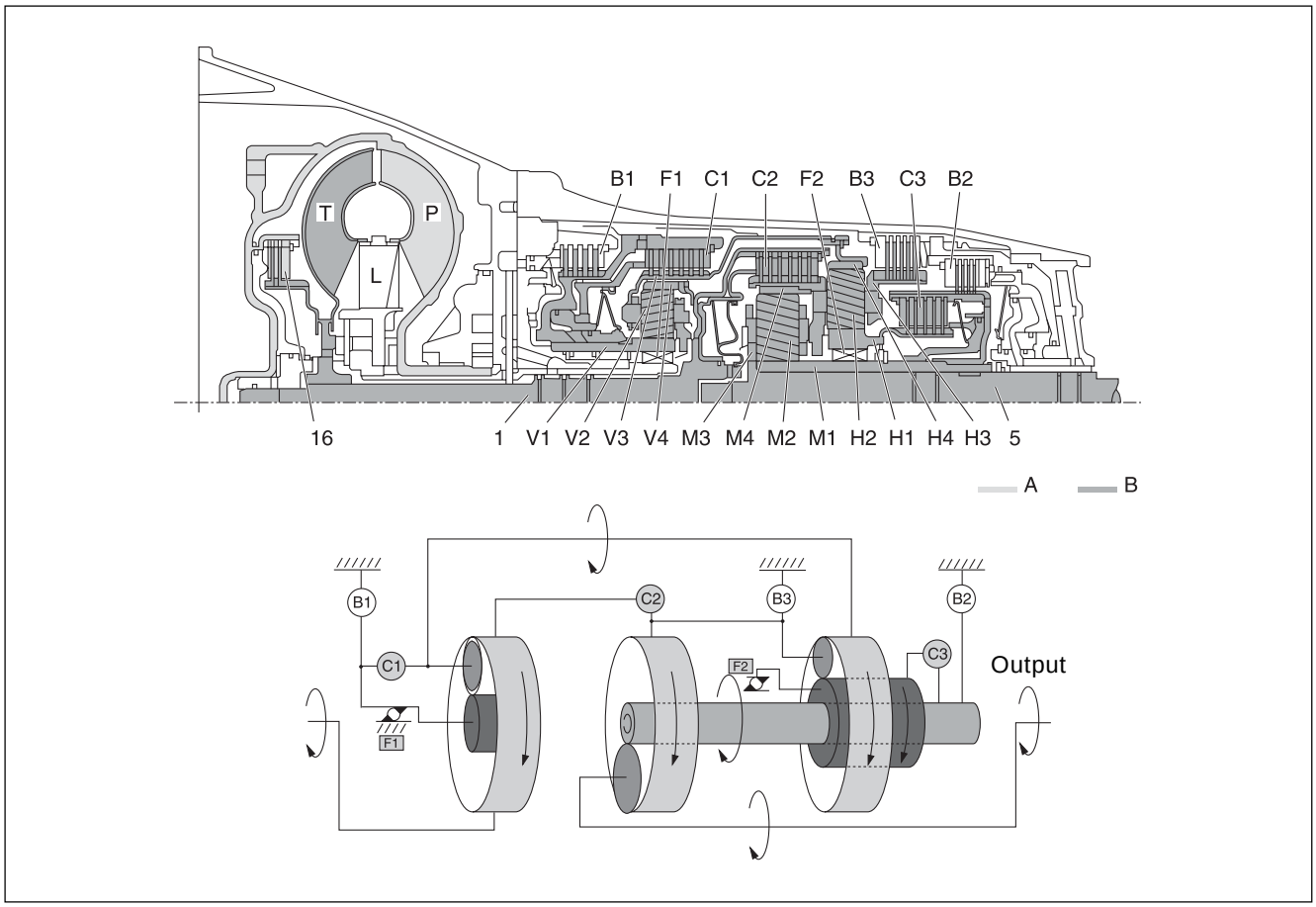
1. Input shaft: Clockwise rotation
2. Front ring gear: Clockwise rotation
3. Center ring gear: Clockwise rotation by clutch 2 activation (direct connection)
4. Center sun gear: Locked by B2, Planetary gear carrier: Clockwise rotation with reduced speed
5. Output shaft: Clockwise rotation

Gear	C1	C2	C3	B1	B2	B3	F1	F2
3	●	●			●			

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▶ 4th Gear (1.000)



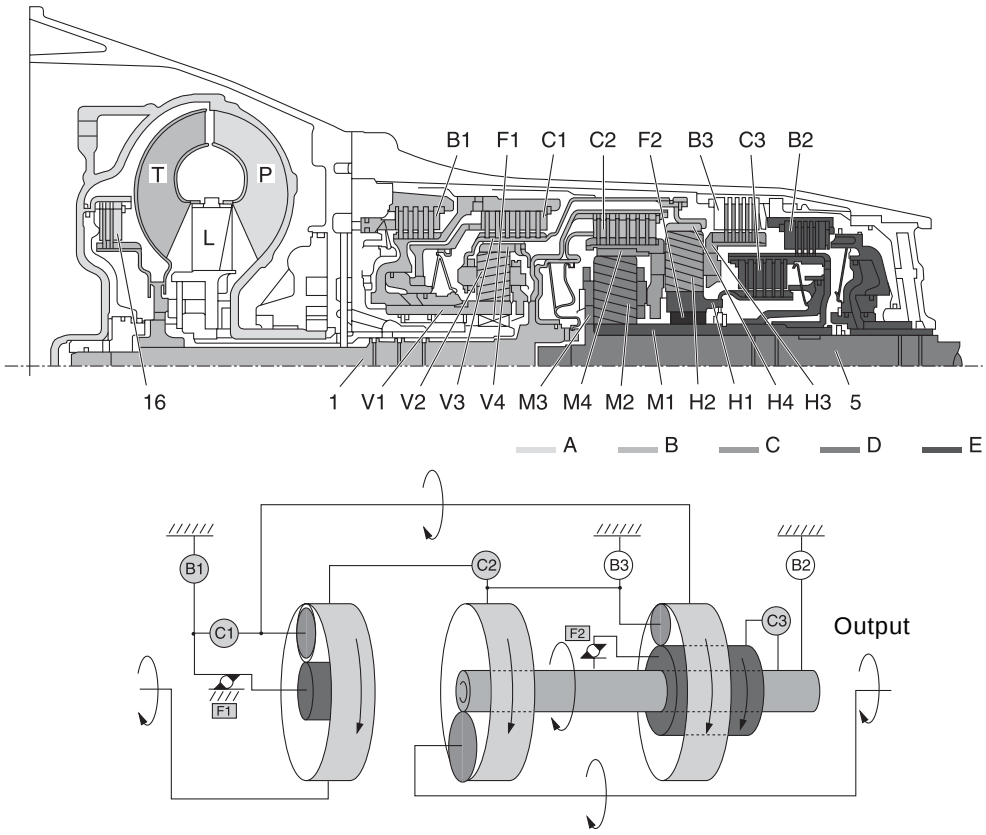
16. Torque converter lockup clutch
A. Engine speed
B. Planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

1. Input shaft: Clockwise rotation
2. Front ring gear: Clockwise rotation
3. Center ring gear and rear planetary gear carrier: Clockwise rotation
4. Front sun gear and planetary gear carrier: Clockwise rotation (direct connection)
5. Rear ring gear: Clockwise rotation
6. Rear sun gear: Rotation by ring gear and planetary gear carrier (direct connection)
7. Center sun gear: Clockwise rotation by C3 activation
8. Planetary gear carrier: Clockwise rotation by center sun gear and ring gear (direct connection)
9. Output shaft: Clockwise rotation

Gear	C1	C2	C3	B1	B2	B3	F1	F2
4	●	●	●					

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▶ 5th Gear (D20DT: 0.833, D27DT: 0.831)



16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. 2nd gear ratio
E. 3rd gear ratio
F. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

1. Input shaft: Clockwise rotation
2. Front sun gear: Locked by B1, Planetary gear carrier: Rotation with reduced speed
3. Rear planetary gear ring gear: Clockwise rotation with reduced speed
4. Center ring gear and rear planetary gear carrier: Clockwise rotation by clutch C2 activation
5. Rear sun gear: Clockwise rotation because rear planetary gear carrier rotates faster than rear ring gear (increased speed)
6. Center sun gear: Clockwise rotation with increased speed by clutch C3 activation
7. Center planetary gear carrier: Clockwise rotation (increased speed)
8. Output shaft: Clockwise rotation (increased speed)

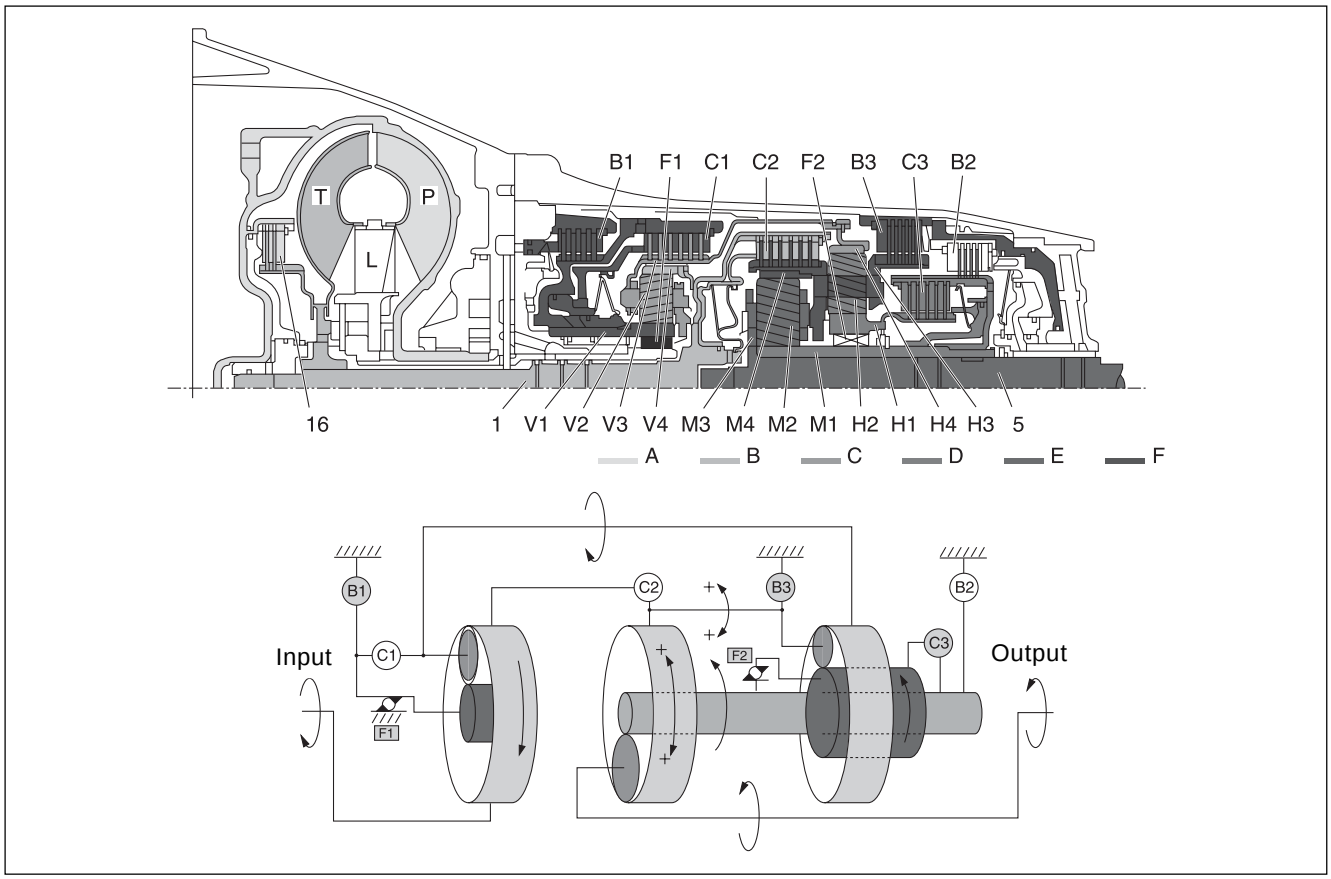
Gear	C1	C2	C3	B1	B2	B3	F1	F2
5		●	●	● 3)			●	

3) Overrun

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AFFECTED VIN	

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▶ Reverse 1st Gear (D20DT: 3.147, D27DT: 3.167) - Standard (S) Mode



16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. 2nd gear ratio
E. Locking elements
F. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

1. Input shaft: Clockwise rotation
2. Front ring gear: Clockwise rotation
3. Front sun gear: Locked by one-way clutch F1
4. Front planetary gear carrier: Clockwise rotation (reduced speed)
5. Rear planetary gear ring gear: Clockwise rotation
6. Rear planetary gear carrier: Locked by B3
7. Rear sun gear and center sun gear: Counterclockwise rotation (increased speed)
8. Center ring gear: Locked by B3
9. Center planetary gear carrier: Counterclockwise rotation (reduced speed)
10. Output shaft: Counterclockwise rotation

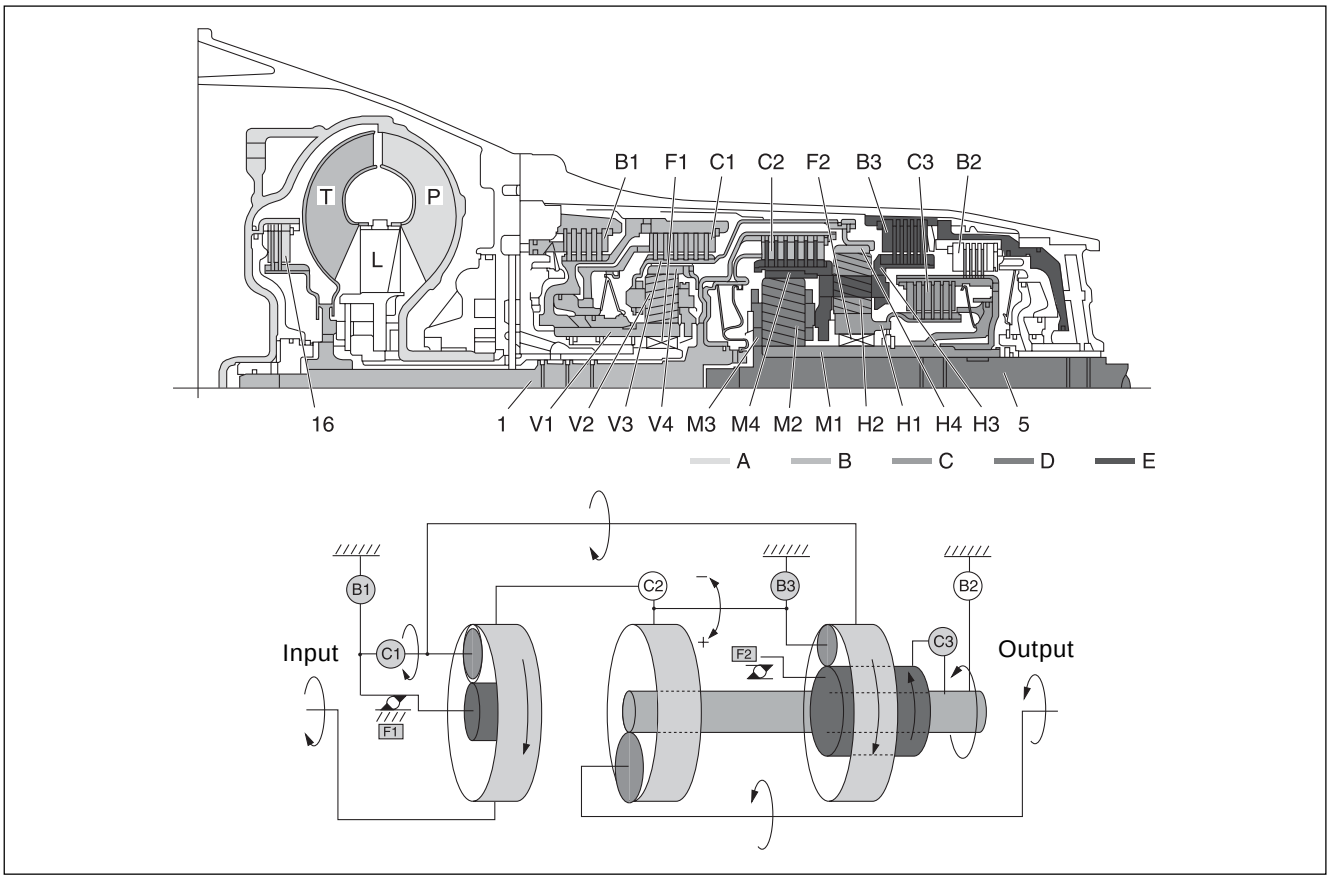
Gear	C1	C2	C3	B1	B2	B3	F1	F2
R (S)			●	● 3)		●	●	

3) Overrun

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▶ Reverse 2nd Gear (D20DT: 1.93, D27DT: 1.926) - Winter (W) Mode Mode



16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. 2nd gear ratio
E. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

1. Input shaft: Clockwise rotation
2. Front ring gear: Clockwise rotation
3. Front planetary gear carrier: Clockwise rotation by clutch C1 activation (direct connection)
4. Rear ring gear: Clockwise rotation
5. Rear planetary gear carrier and center ring gear: Locked by brake B3
6. Rear sun gear and center sun gear: Counterclockwise rotation (increased speed)
7. Center planetary gear carrier: Counterclockwise rotation (reduced speed)
8. Output shaft: Counterclockwise rotation

Gear	C1	C2	C3	B1	B2	B3	F1	F2
R (W)	●		●			●		

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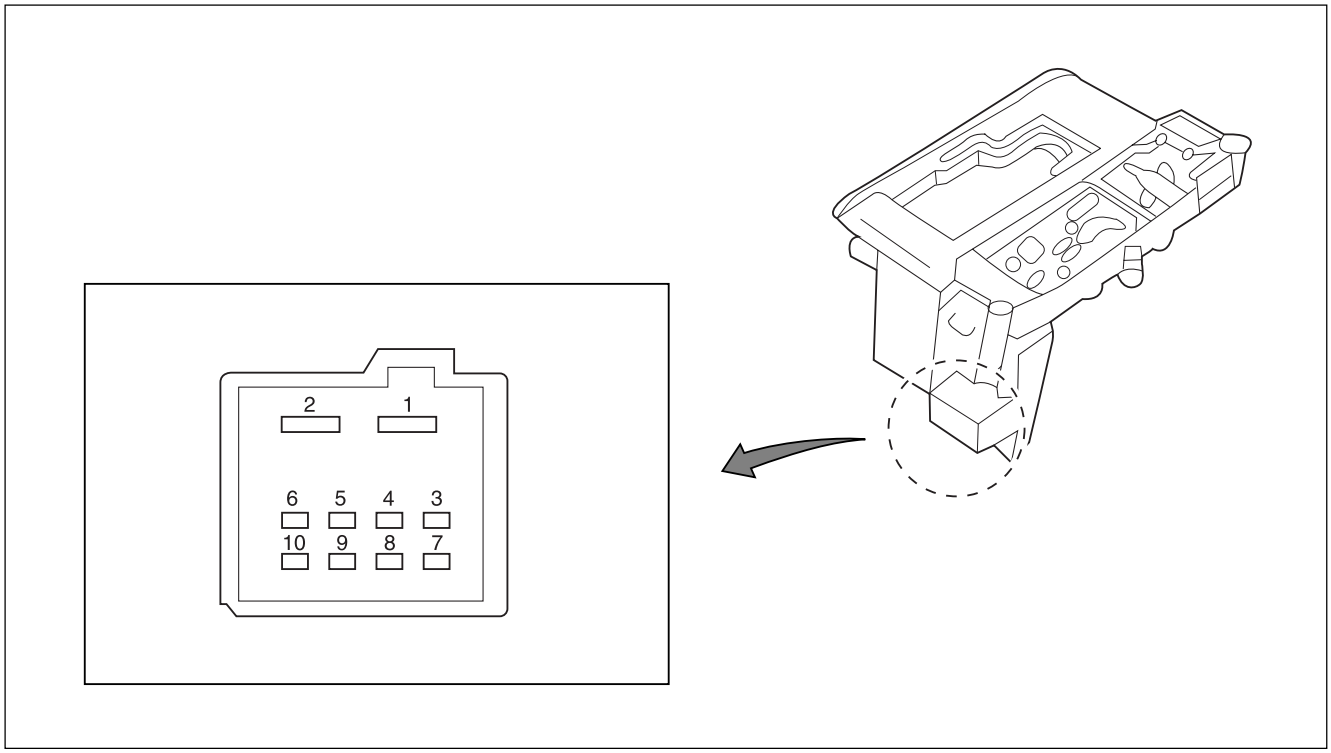
FUNCTION AND DESCRIPTION

1. SELECTOR LEVER

Function

Selector lever control unit functions as follows:

1. Informing the selector lever's position to other units via CAN.
2. Turning on the selector lever indicator while tail lamp is turning on.
3. Turning on the back-up lamp during reverse driving.
4. Operating the parking/reverse lock system.

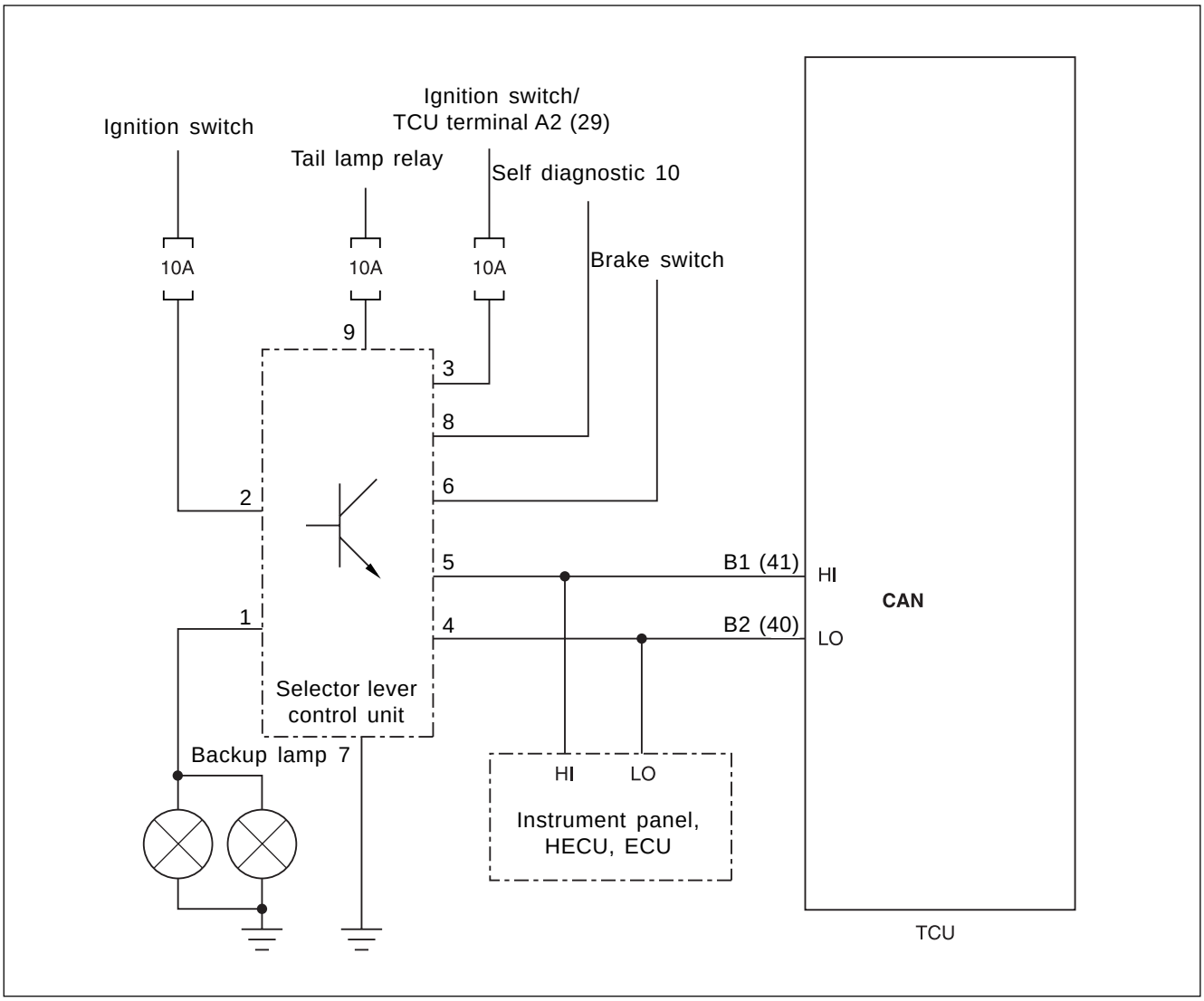


Terminals

Pin No.	Use For	Remark
1	Back-up lamp power supply	
2	Ignition power	
3	Selector lever unit power	-
4	CAN LO	Connected to ABS/ESP HECU, engine ECU, TCU, instrument panel etc.
5	CAN HI	
6	Brake switch signal	
7	Ground	
8	Self diagnosis connector	Selector lever position indicator comes on when tail lamp is turned ON
9	Tail lamp relay	

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Circuit Diagram



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Shifting Mode

P (Parking and engine starting position)

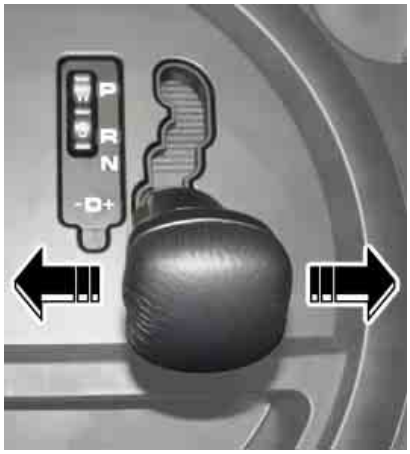
: This position is used to park the vehicle, start the engine and let the vehicle be stationaly. To shift into any other positions, must depress the brake pedal (parking lock system).

R (Reverse driving)

: This position is used to reverse the vehicle.

N (Neutral, starting and towing position)

: The engine can be started in this position. And, this position is used in temporary stop. (Depress the brake pedal for safty.)



Downshift (Manual mode)

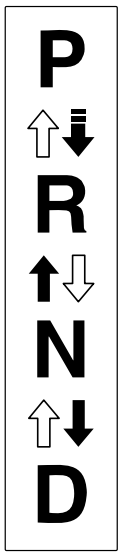
1 ← 2 ← 3 ← 4 ← D

The shiftable gear is down by one step as the lever is moved to left (-) direction.

Upshift (Manual mode)

1 → 2 → 3 → 4 → D

The shiftable gear is up by one step as the lever is moved to right (+) direction.



Selector lever moves only when the brake pedal is depressed.

Selector lever can be moved without depressing the brake pedal, however for safety reasons, the brake pedal should be depressed.

Selector lever can be moved without depressing the brake pedal.

WARNING

- **Turn the ignition key to OFF position before doing this operation.**



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Mode Switch

W (Winter Mode)

: When “W” mode is selected, the Winter mode indicator in meter cluster comes on, and the vehicle starts off with 2nd gear to achieve smooth starting on the icy or slippery road. (forward and reverse driving)



S (Standard Mode)

: “S” mode is used in normal driving (starts off with 1st gear). TCU (Transmission Control Unit) provides pleasant driving by changing the shifting pattern according to the driving habits.

In winter mode, the up shift becomes faster and the down shift becomes slower for improving fuel consumption. The “W” mode is automatically changed to “S” mode in full throttle or kick-down operation. The vehicle can starts off with 2nd reverse gear (gear ratio: 1.92 ~ 1.93) when the “W” mode is selected. It is very useful on icy and slippery road. However, in this case, the “W” switch should be selected before placing the selector lever to “R” position. Even though “W” mode is selected, the vehicle starts off with 1st gear in following:

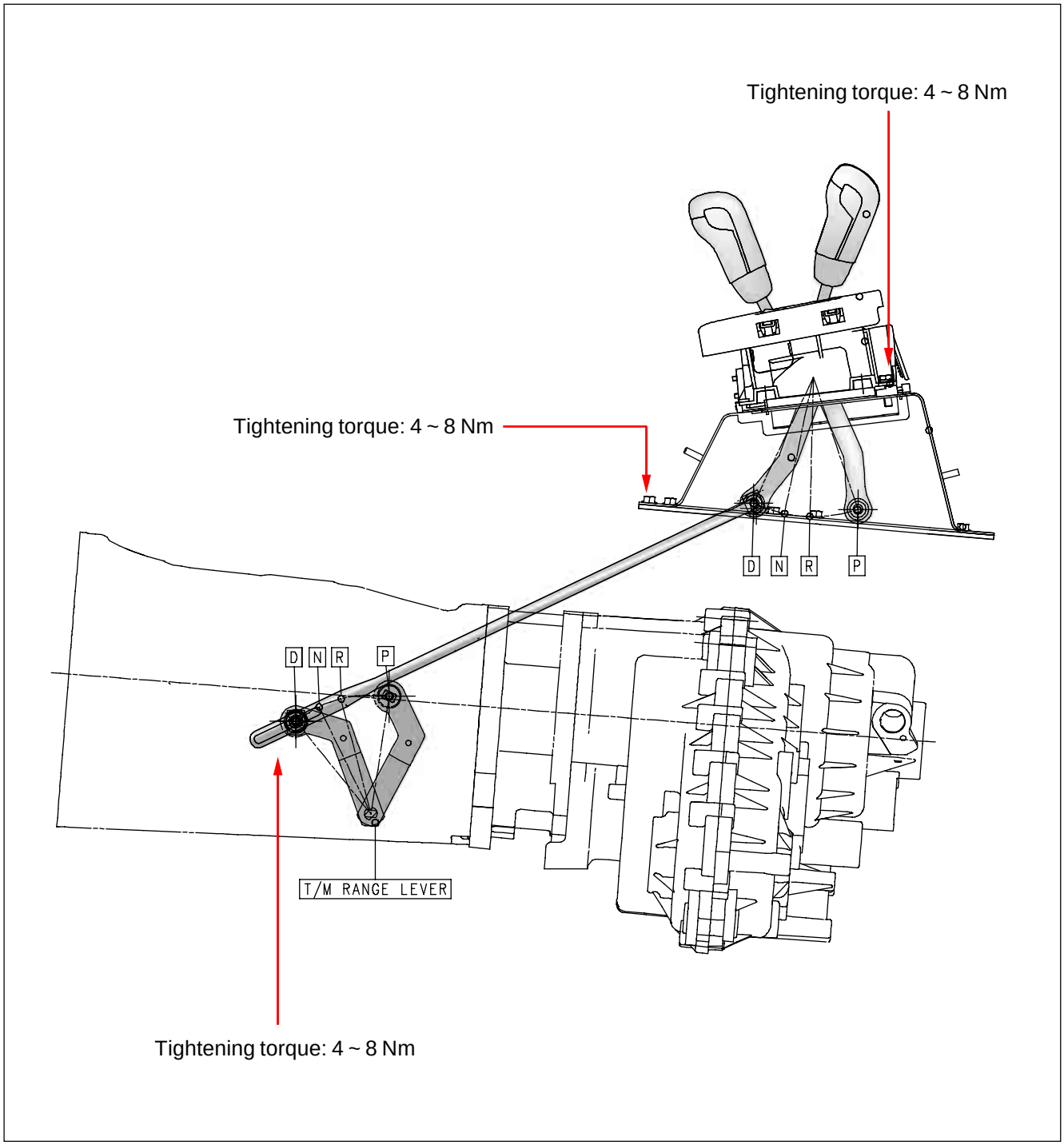
1. When the selector lever is in “1” position.
2. When fully (85% or more) depressing the accelerator pedal.

When the system recognizes the mode switch operation, the selector lever control unit sends the control signal TCU via CAN communication.

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Connection Between Selector Lever and A/T

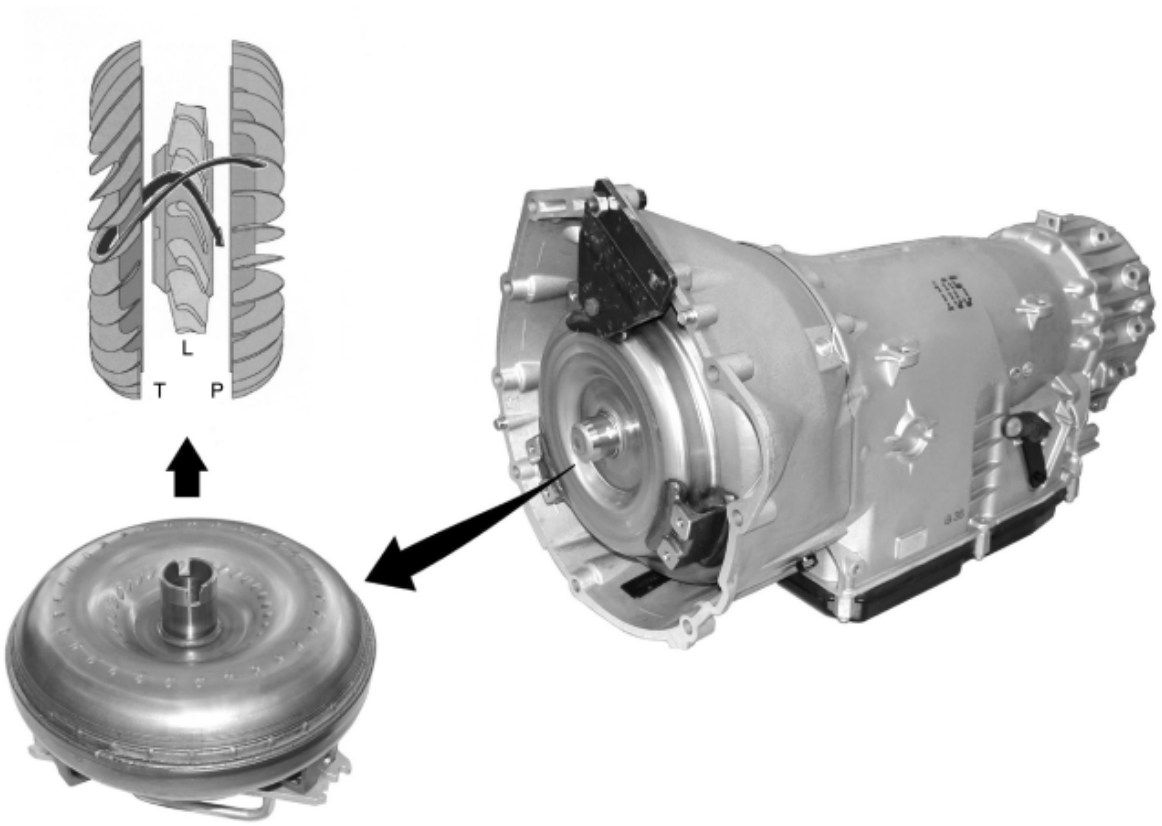
Tighten the bolts to the specified tightening torques as shown in the figure so that the selector lever position should be input correctly. The transmission range lever and gear selector lever (P →R →N →D) should be positioned in **"N" position**.



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2. TORQUE CONVERTER

▶ Function (4WD)



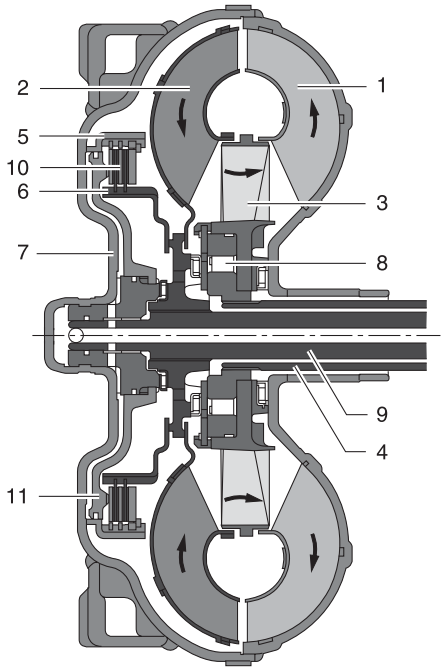
Torque converter is installed between engine and automatic transmission. It consists of pump impeller, turbine and stator. The pump impeller is welded at converter housing and the converter housing is bolted at the drive plate.

The torque converter converts the mechanical energy from engine to hydraulic energy, and the turbine connected to transmission input shaft converts this hydraulic energy to mechanical energy again.

The **stator** between pump and turbine increases the output torque from turbine by converting the flowing direction. The stator has a torque converter area that changes the flowing direction and a fluid coupling area where the stator rotates. And, the lockup clutch integrated in torque converter prevents the power from losing and reduces fuel consumption.

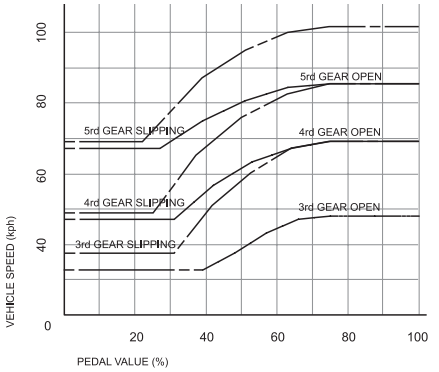
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▶ Lock Up Clutch

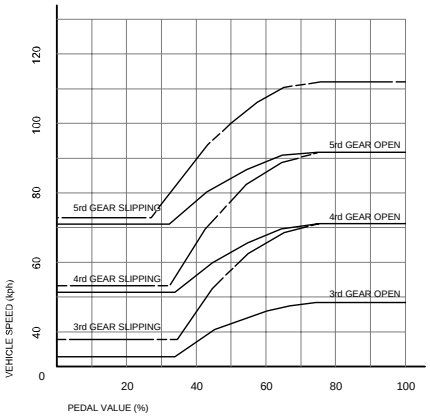


Lockup Mode (Open/Slipping)

D20DT



D27DT



1. Pump
2. Turbine
3. Stator
4. Stator shaft
5. Outer multiple disc
6. Inner multiple disc
7. Converter cover
8. One-way clutch
9. Input shaft
10. Disk
11. Piston

Lockup clutch consists of multiple disc clutches as shown in the figure and is activated in 3rd, 4th and 5th gears.

The aim of using torque converter lockup clutch is to reduce the fuel consumption and exhaust gas emissions of the vehicle by reducing torque converter slip. This stands in contradiction to the ride comfort demands made on the drive train with regard to its vibration behaviors. The task of the electronic transmission control is therefore to close the clutch in all driving situations relevant to fuel consumption, if possible, and ensure that the engine vibrations are isolated from the drive train.

The characteristic curves shown in the diagram illustrate the different operating states of the torque converter lockup clutch in relation to the accelerator pedal position and the transmission output speed, plotted for one transmission gear.

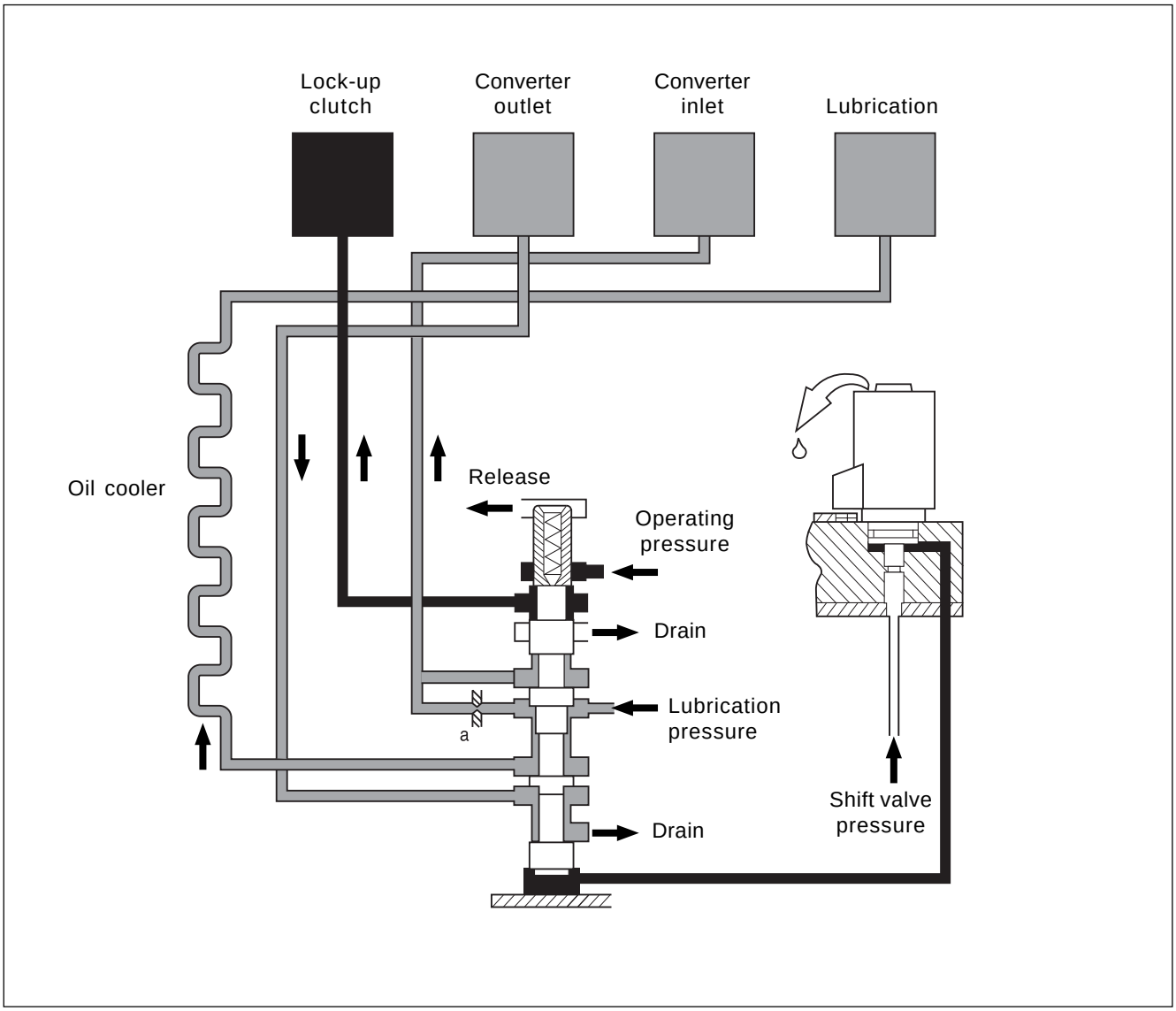
Variables influencing the states of the torque converter lockup clutch:

1. Accelerator pedal movement
2. Uphill and downhill gradients
3. Transmission shift functions
4. Transmission oil temperature
5. Load conditions
6. Engine control influences
7. If the fluid temperature is over 130°C, the lock up clutch is operated at 1st and 2nd gears. (to reduce the fluid temperature)

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Lock-up Clutch Control Valve

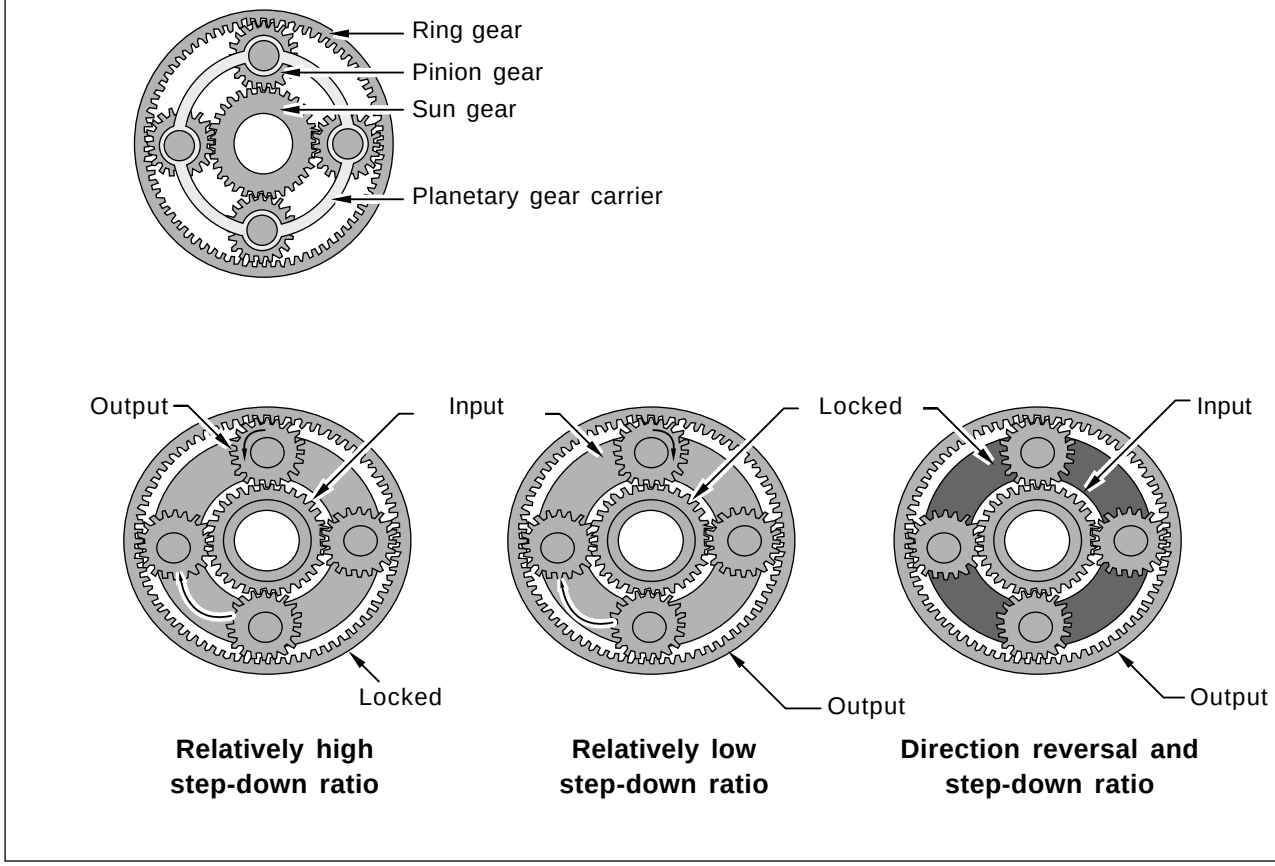


Lockup clutch regulating valve controls the lockup clutch in torque converter and distributes the lubricating oil to the friction parts. TCU generates the lockup clutch control pressure by duty controlling the lockup solenoid valve, and this pressure is applied to the lockup clutch regulating valve to engage, disengage and slip the lockup clutch.

When the lockup clutch control pressure is increased, the lockup clutch regulating valve moves up and the working pressure is applied to lockup clutch. In its regulating position (slipping, torque converter lockup clutch pressurized), a reduced volume of lubricating oil flows through the annular passage bypassing the torque converter and passing direct through the oil cooler into the transmission. The rest of the lubricating oil is directed via the throttle “a” into the torque converter in order to cool the torque converter lockup clutch.

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3. PLANETARY GEAR SET



Relatively high step-down ratio

Ring gear locked

Sun gear driving (clockwise)

Planet gears driven (rotating counterclockwise)

Planet carrier driven (revolving clockwise)

Relatively low step-down ratio

Sun gear locked

Ring gear driving (clockwise)

Planet gears driven (rotating clockwise)

Planet carrier driven (revolving clockwise)

Direction reversal and step-down ratio

Planet carrier locked

Sun gear driving (clockwise)

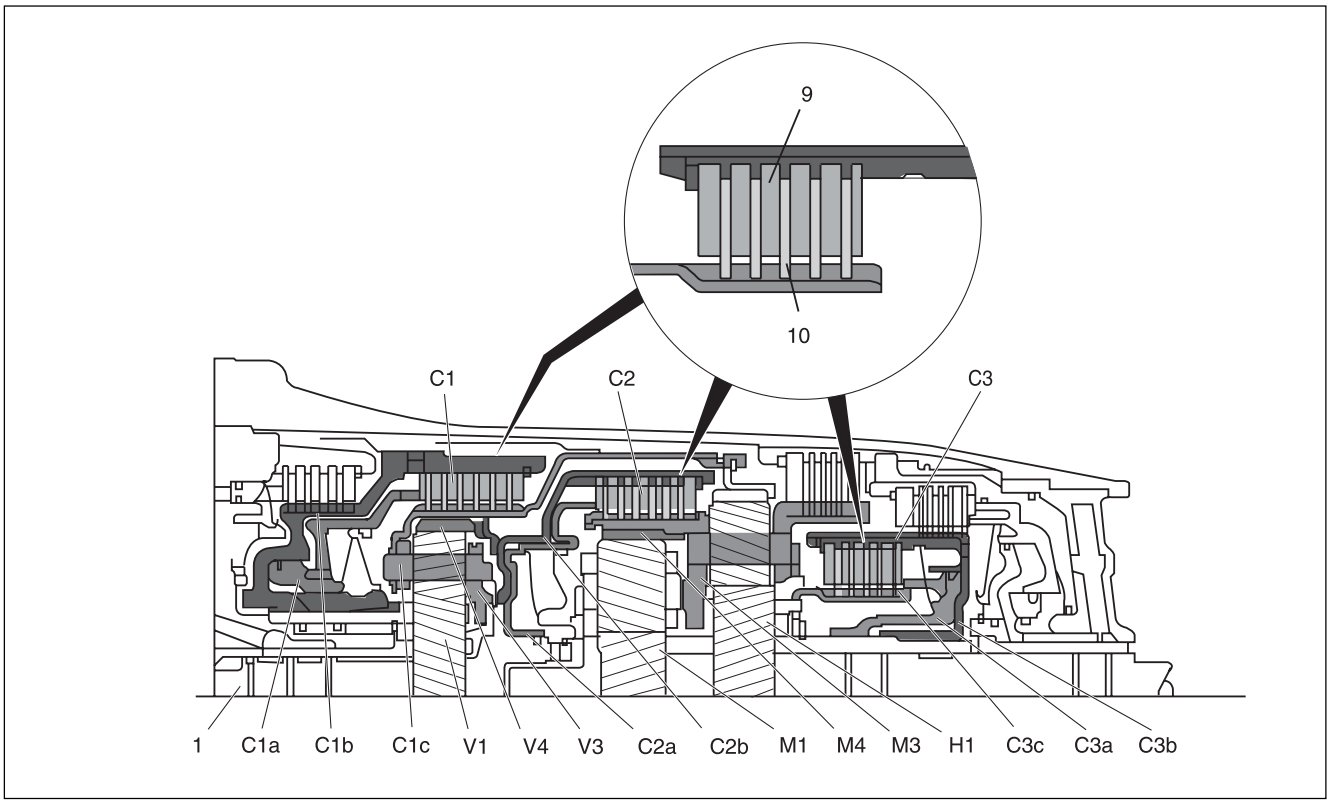
Planet gears driven (counterclockwise)

Ring gear driven (counterclockwise)

Gear ratio: teeth of sun gear / teeth of ring gear

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4. MULTIPLE-DISC CLUTCH



1. Input shaft
9. Externally toothed disc
10. Internally toothed disc
H1. Rear sun gear
C1a. Piston C1
C1b. Externally toothed disc carrier C1
C1c. Internally toothed disc carrier C1
C2a. Piston C2
C2b. Externally toothed disc carrier C2
C3a. Piston C3
C3b. Externally toothed disc carrier C3
C3c. Internally toothed disc carrier C3
M1. Middle sun gear
M3. Middle planet carrier
M4. Middle ring gear
V1. Front sun gear
V3. Front planet carrier
V4. Front ring gear

Location

Three multiple-disc clutches, the front, middle and rear multiple-disc clutches K1, K2 and K3, are located in the planetary gear sets in the transmission housing.

Function and description

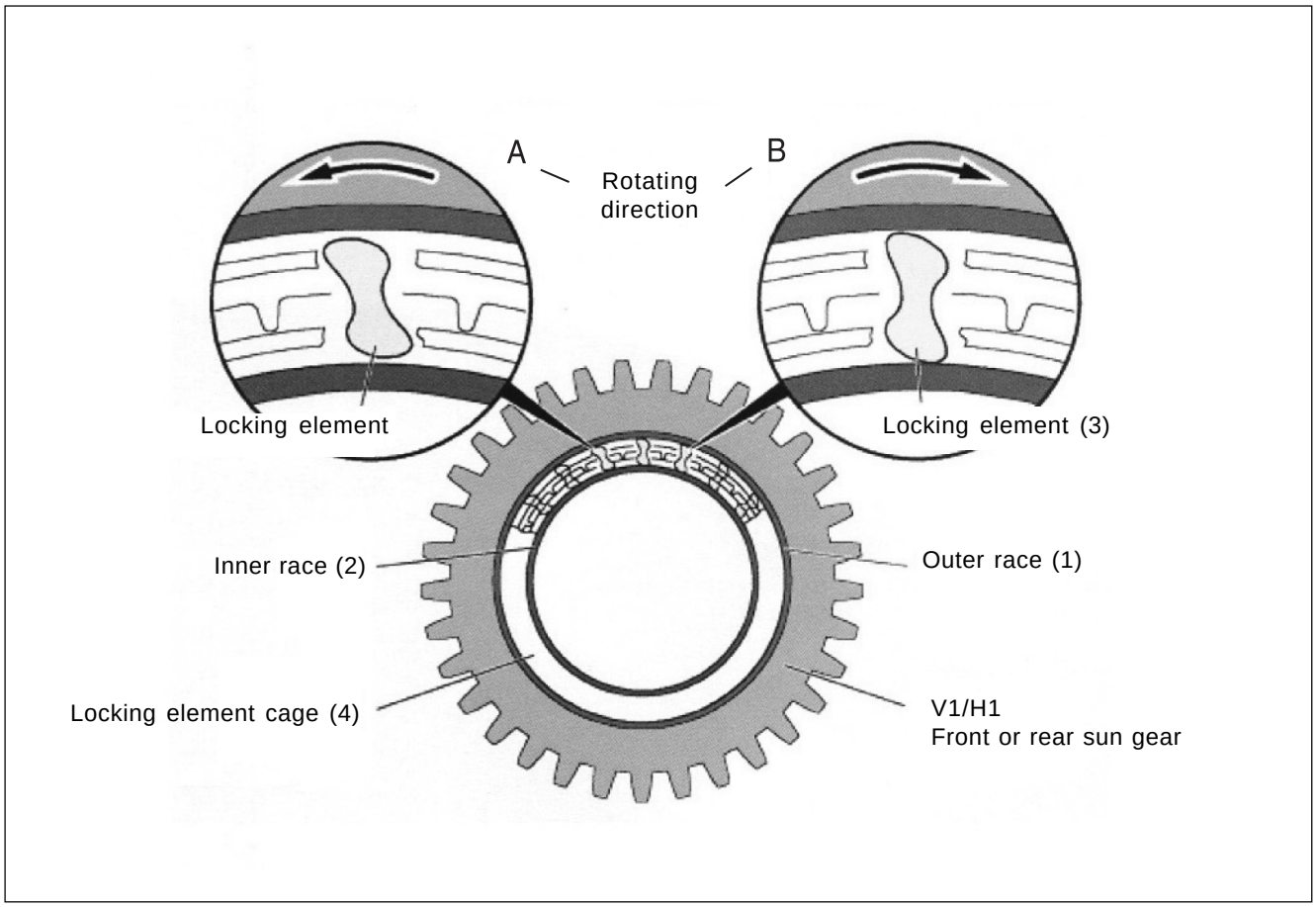
A multiple-disc clutch consists of a number of internally toothed discs (10) on an internally toothed disc carrier and externally toothed discs (9) on an externally toothed disc carrier. If the piston (C1a) on multiple-disc clutch C1 is subjected to oil pressure, it presses the internal and external discs of the disc set together.

The sun gear (V1) is locked with the planet carrier (V3) via the externally toothed disc carrier (C1b) and the internally toothed disc carrier (C1c). The front planetary gear set is thus locked and turns as a closed unit. If the multiple-disc clutch C2 is actuated via the piston (C2a), the piston compresses the disc set.

The ring gear (V4) of the front planetary gear set is locked with the ring gear (M4) of the middle planetary gear set via the externally toothed disc carrier (C2b) and the middle planet carrier (M3) on which the internally toothed discs are seated. Ring gear (V4) and ring gear (M4) turn at the same speed as the input shaft (1). If the multiple-disc clutch C3 is actuated via the piston (C3a), the piston compresses the disc set. The sun gear (M1) of the middle planetary gear set is locked with the sun gear (H1) of the rear planetary gear set via the externally toothed disc carrier (C3b) and the internally toothed disc carrier (C3c).Sun gear (M1) and sun gear (H1) turn at the same speed.

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5. FREEWHEEL



Location

Freewheels are installed in the front planetary gear set between the sun gear and the stator shaft, and in the rear planetary gear set between the sun gear and the intermediate shaft.

Function and description

The freewheel consists of an outer race (1), an inner race (2), a number of locking elements (3) and a cage (4) for these locking elements. If the inner race (2) of the freewheel is locked and the outer race (1) turns in direction “A”, the locking elements (3) adopt a diagonal position on account of their special contours, allowing the freewheel function. The outer race (1) slides over the locking elements (3) with negligible friction. If the rotation of the outer race (1) changes to direction “B”, the locking elements (3) stand up and lock the outer and inner races (1, 2) together.

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6. OTHERS

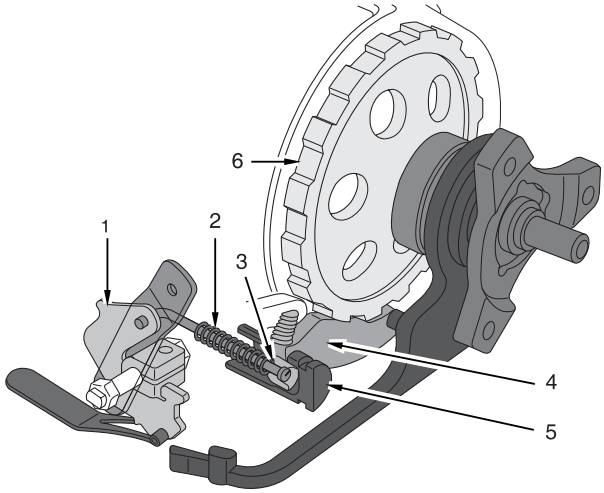
▶ Parking Lock Mechanism

Location and function

The parking lock gear (6) is located on the output shaft in the rear section of the transmission housing. In selector lever position “P”, the cone (3) slides between the parking lock pawl(4) and the guide sleeve (5). The parking lock pawl (4) is therefore

pushed against the parking lock gear (6). If the tooth of the parking lock pawl (4) does not engage in a tooth space when the vehicle is stationary, but rather touches a tooth of the parking lock gear (6), the cone (3) is pre-tensioned by the spring (2) and positioned ready for operation.

If **the parking lock gear (6)** continues to turn, the parking lock pawl (4) engages in the next tooth space. To prevent damage due to misuse, the widths of the tooth spaces are designed such that the parking lock pawl (4) can only engage when the vehicle is stationary or moving very slowly. If the vehicle rolls faster, the shape of the teeth prevents the parking lock pawl (4) from engaging.



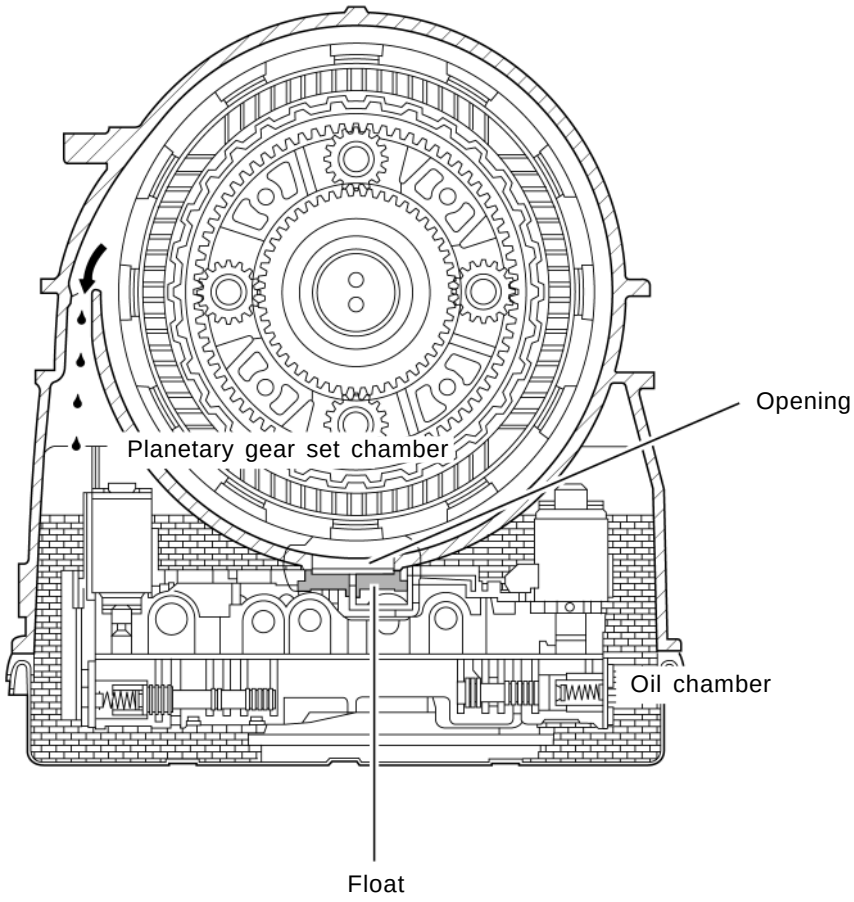
1. Detent plate
2. Spring
3. Cone
4. Parking lock pawl
5. Guide sleeve
6. Parking lock gear

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▶ OIL LEVEL CONTROL

Function



This is the function that closes the opening between oil chamber and planetary gear set chamber, so that the gear set does not splash in oil if the oil level rises.

The lubricating oil flowing continuously out of the gear sets returns through the opening (2) into the oil chamber. If the oil level rises, the oil forces the float (1) against the housing.

The float separates the oil chamber from the gear set chamber. The lubricating oil which escapes further from the gear sets is thrown against the housing wall by the rotating parts and flows now through the upper opening (arrow) back into the oil chamber.

Reduction of power losses and prevention of fluid loss from the transmission at high fluid level.

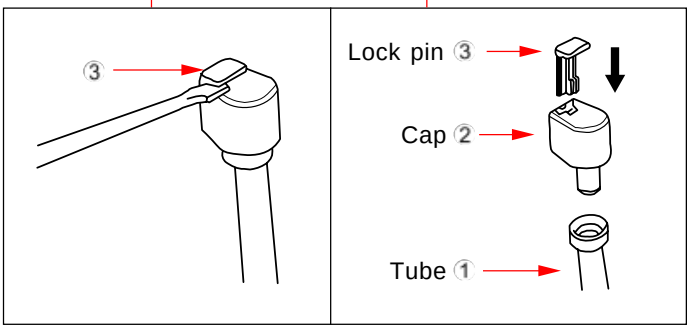
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▶ Oil Check and Specification











O-ring

* Install cap (2) on tube (1) and insert lock pin (3) into the cap.

Tips for checking and adding

1. Place the vehicle on level ground. Pull out the lock pin ③ and remove the cap ② (add 4 to 5 liter if oil has been completely drained out).
2. Place the selector lever to “P” position. Start the engine and leave it idling.
3. Warm the engine up while moving the selector lever to all positions. Check if the oil temperature is approx. 80°C with a scanner (apply the parking brake).
   : Selector lever position - R or D
4. Check the oil level with oil dipstick while engine is running in “P” position.
5. Check several times with attention, and add or drain the oil as required.
6. After checking and adding oil, install the cap in the reverse order of removal.



Automatic transmission fluid capacity and specification

Fluid capacity	Approx. 8 ℓ (initial filling)
Specification	Fuchs ATF 3353 or Shell ATF 3353

NOTICE

- **The oil temperature should be checked at “D” or “R” position.**

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REMOVAL AND INSTALLATION

1. SELECTOR LEVER AND LINK

1. Place the gear selector lever at “D” position. Release the lock and remove the knob from the selector lever.



2. Remove the center console upper cover and disconnect the cigarette lighter. Remove the selector lever cover



3. Separate the selector lever pin with a flat blade screwdriver.

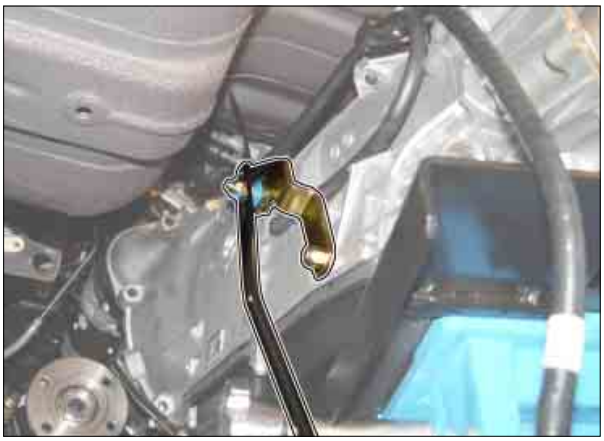


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4. Unscrew the bolt and remove the link from the shift lever.

Installation Notice

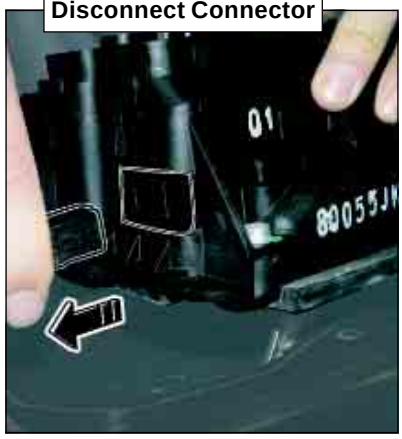
Shift rod mounting nut	15 ~ 23 Nm



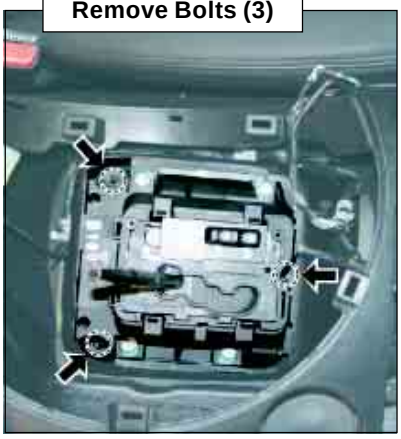
5. Disconnect the selector lever connector, unscrew the mounting bolts (three hexagon bolts), and remove the selector lever assembly.



Disconnect Connector

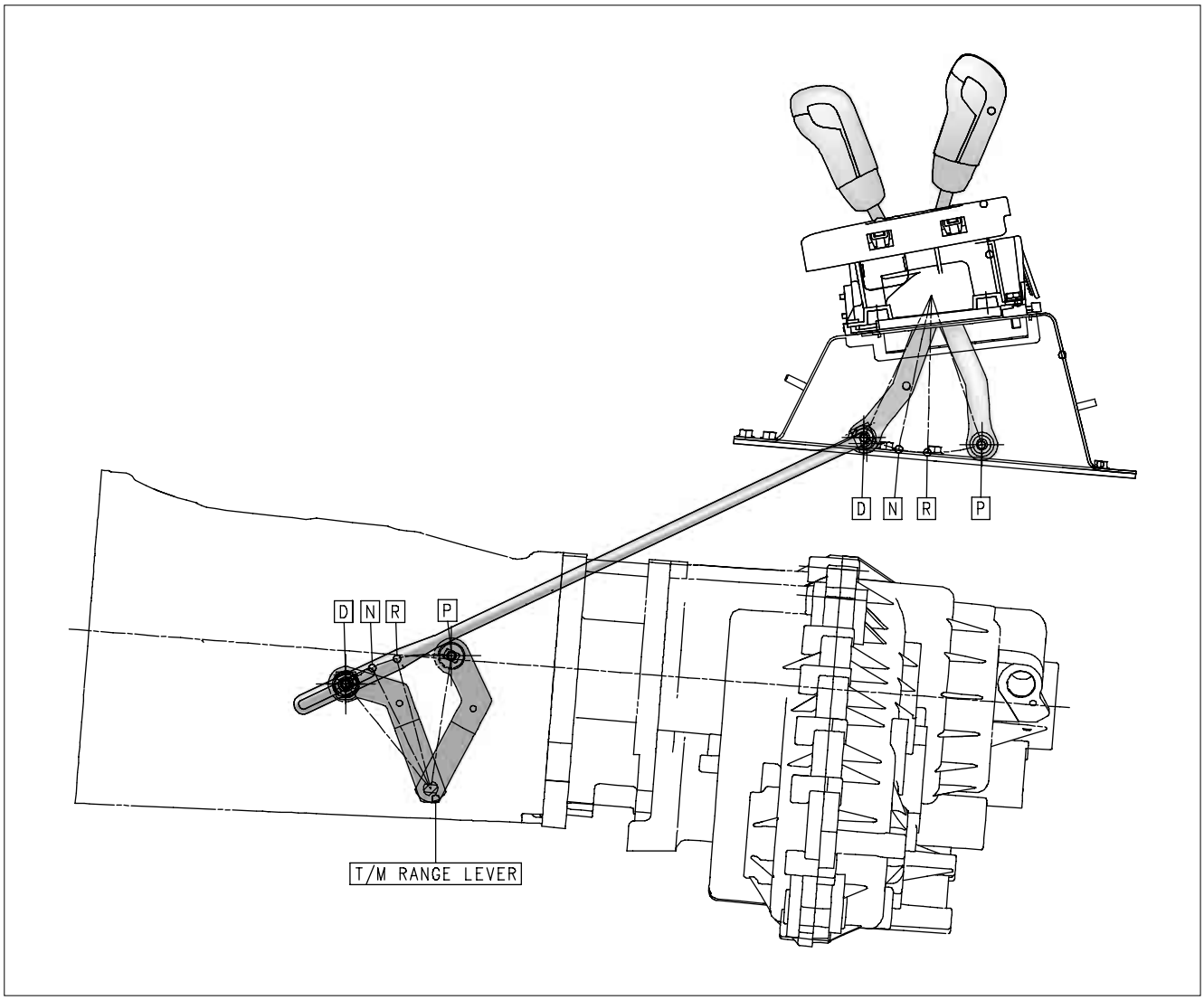


Remove Bolts (3)



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6. Install in the reverse order of removal. Make sure the selector lever and the shift lever are at the same position.



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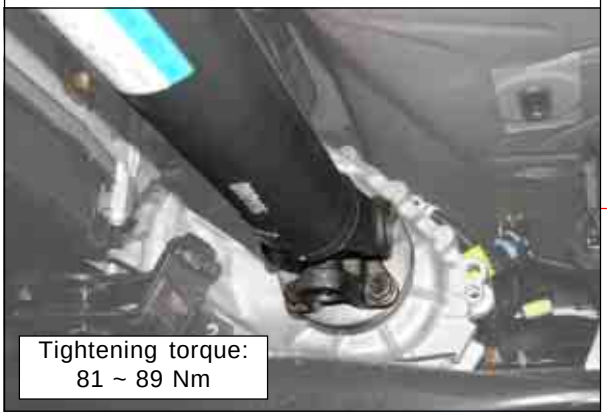
2. FRONT AND REAR PROPELLER SHAFT

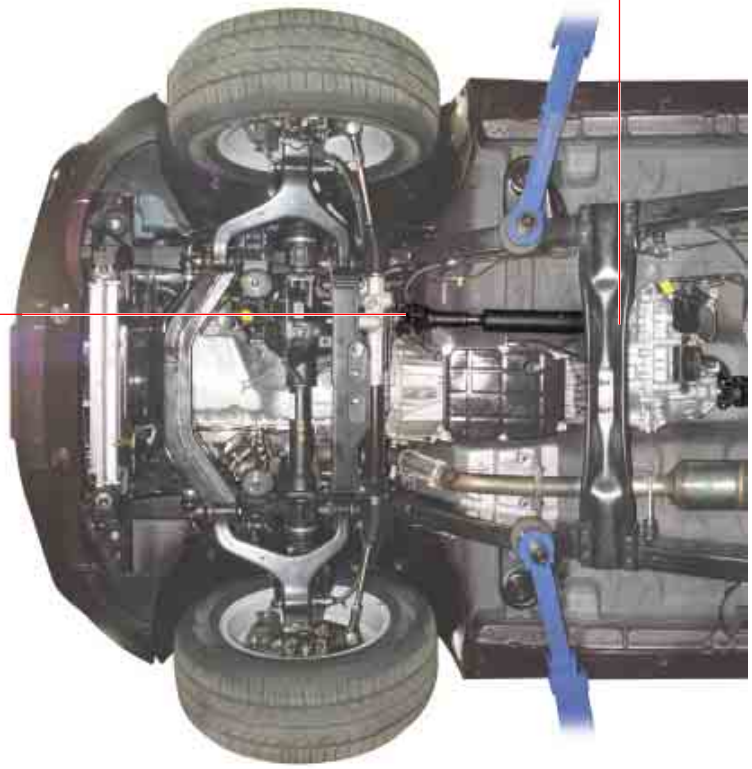
1. Before removing the front and rear propeller shaft, make installation marks on the yoke and flange.

Preceding Work

1. Drain the automatic transmission fluid.
2. Disconnect the negative cable from battery.

Front Propeller Shaft (Transfer Case Side)





Front Propeller Shaft (Axle Side)



Front Propeller Shaft



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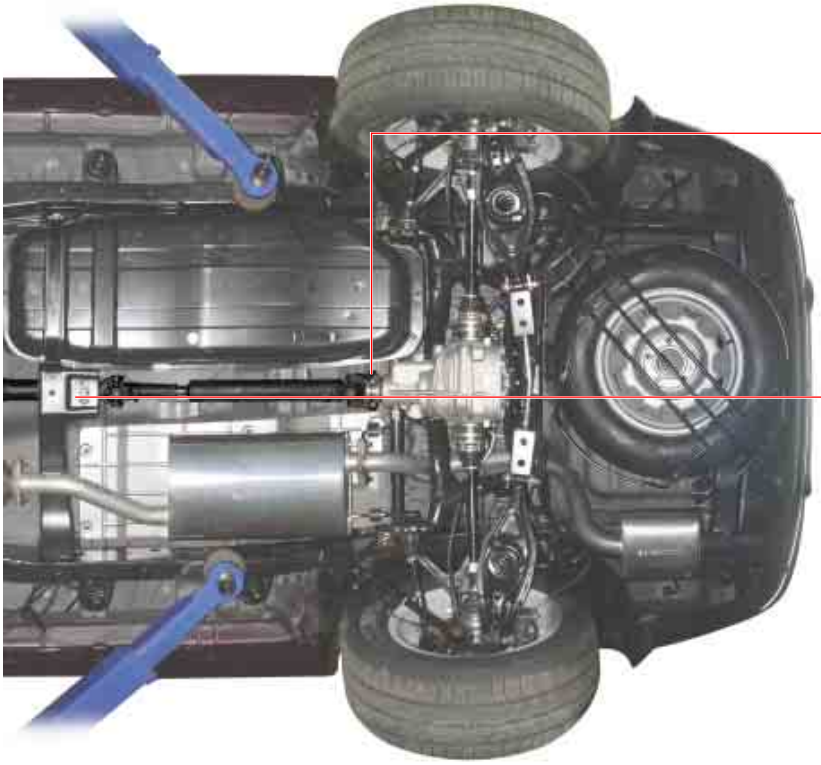
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Rear Propeller Shaft (Transfer Case Side)



Rear Propeller Shaft (Axle Side)





Rear Propeller Shaft Mounting Bracket



Rear Propeller Shaft



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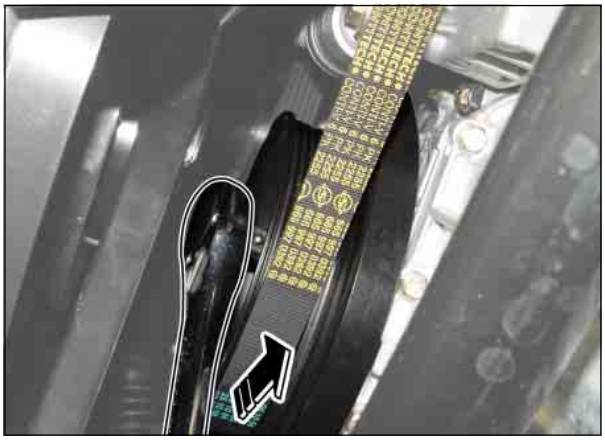
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3. TRANSMISSION ASSEMBLY

1. Remove the under cover from the vehicle.

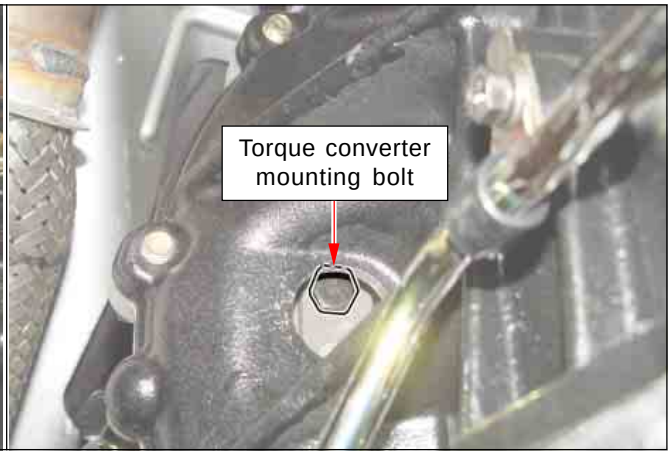


2. Unscrew the crankshaft pulley mounting bolt (27 mm) with a wrench.



3. Remove the protective cover from the service hole for torque converter mounting bolts. Remove six torque converter mounting bolts while aligning them with service hole by rotating the crankshaft bolt.

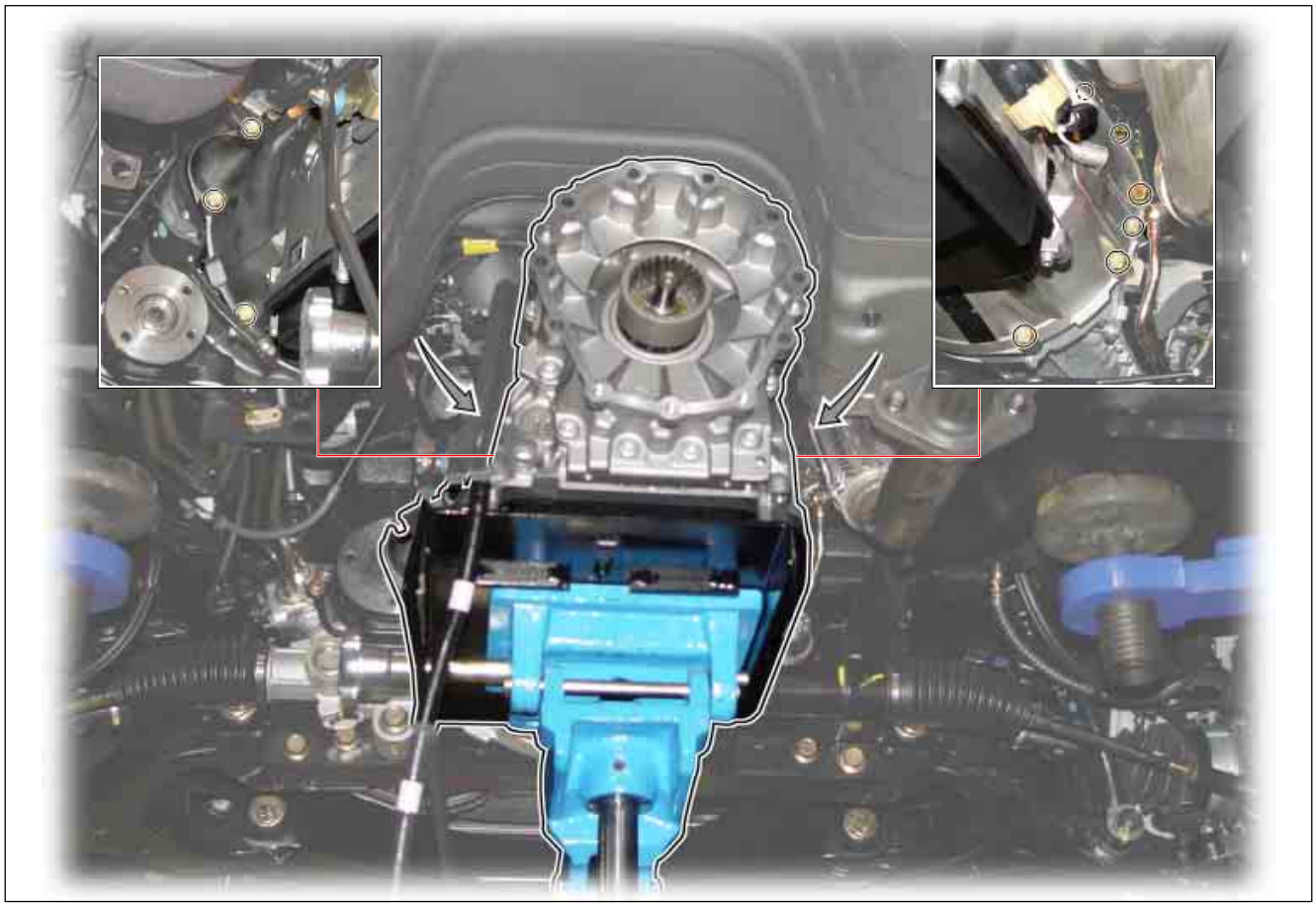




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4. Unscrew the transmission mounting bolts and carefully remove the transmission with a transmission jack.



NOTICE

- **Be careful not to drop the torque converter when removing the automatic transmission assembly.**

5. Remove the torque converter with a special service tool from the transmission.



6. Install in the reverse order of removal.

NOTICE

- **Apply a small amount of transmission oil on the drive flange of torque converter before installation.**

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Others

NOTICE

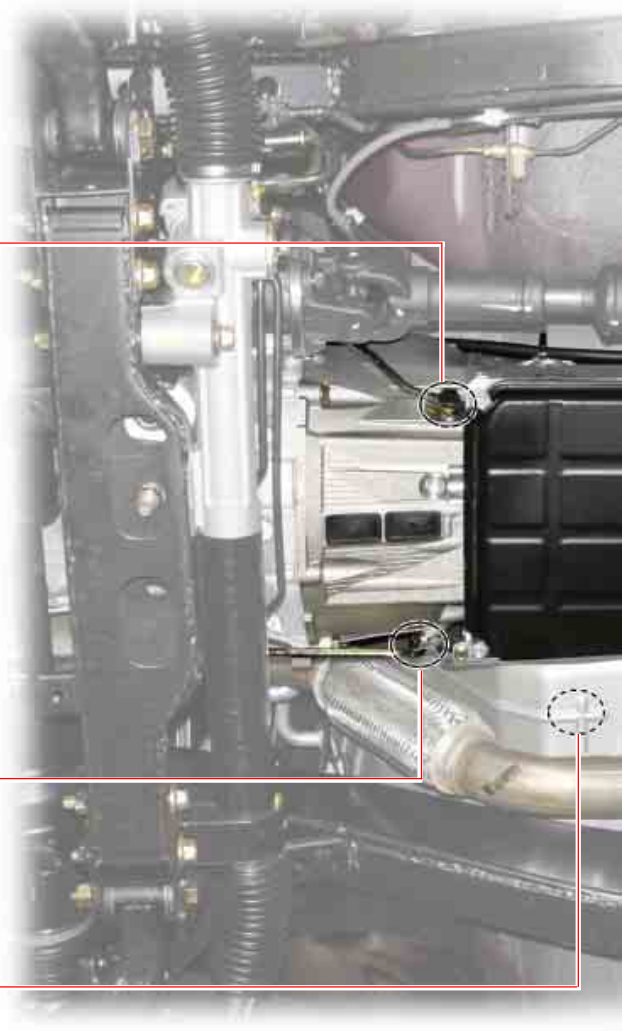
- **Be careful not to damage the O-ring when removing the dipstick gauge.**

Oil Cooling Pipe (Outlet)

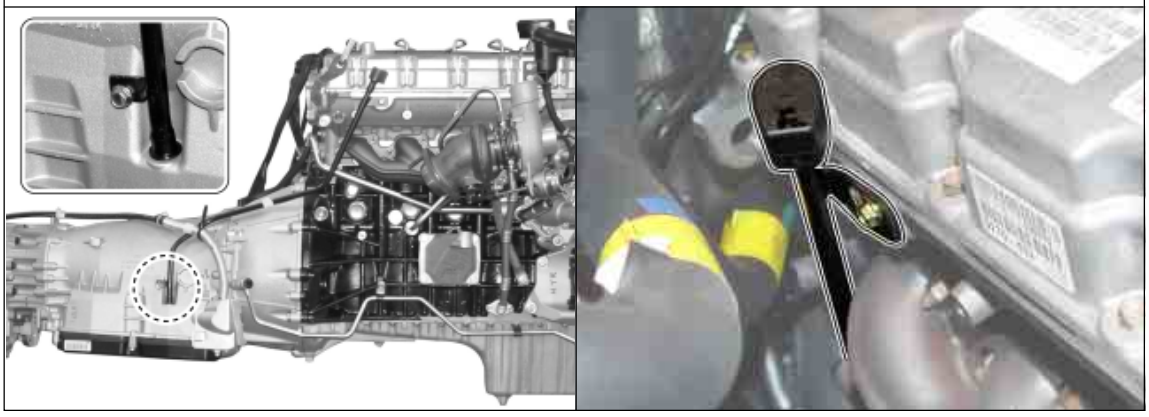


Oil Cooling Pipe (inlet)





Oil Dipstick Gauge



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Shift Lever Link



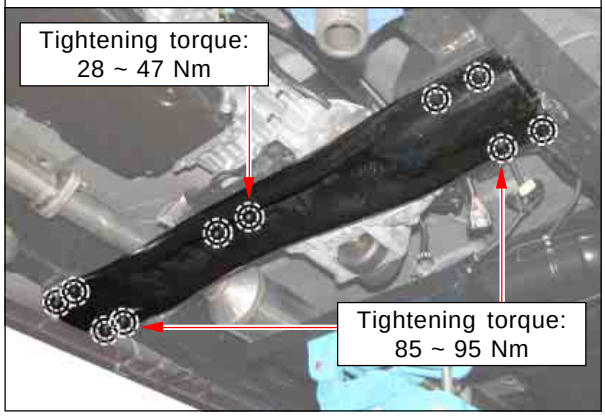
Transmission Mounting Insulator and Bracket



Transfer Case Assembly



Cross Member Assembly



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4. REPLACING THE O-RING ON PARKING PAWL GUIDE SLEEVE

※ **Preceding Works:** Removing valve body

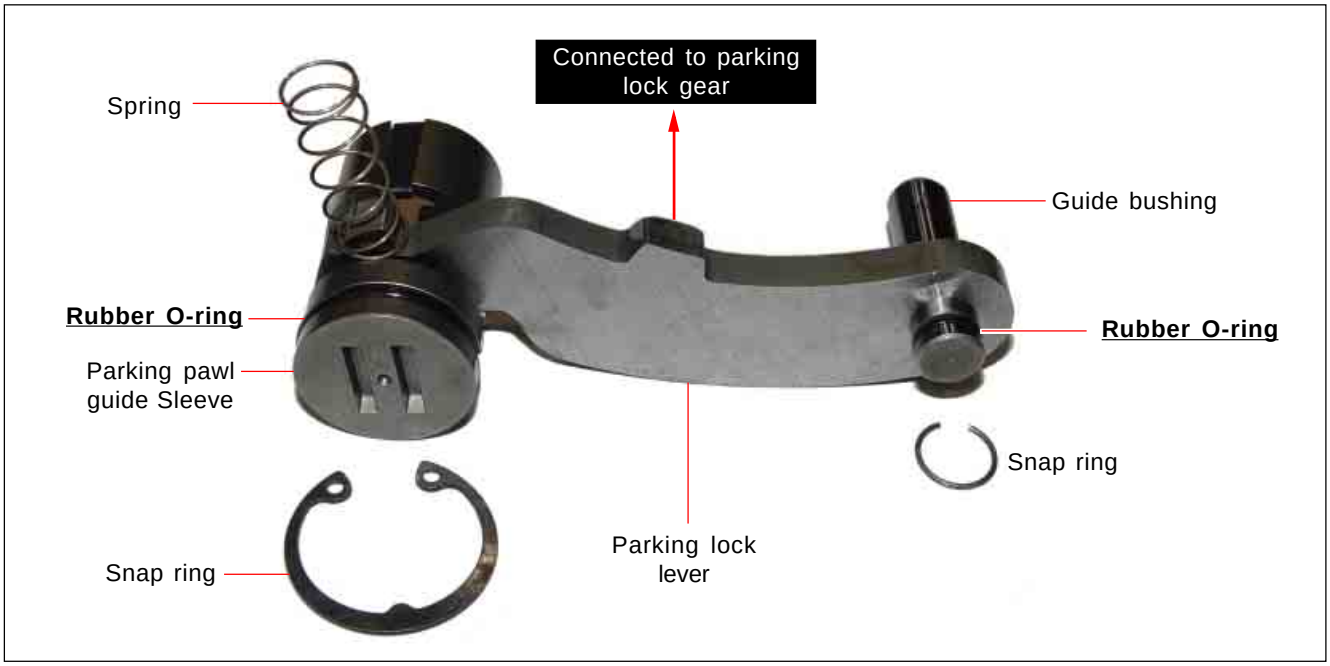


When the oil is leaking due to wear or hardening of O-ring on the parking pawl guide sleeve, the O-ring should be replaced with new one.

▶ Parking Pawl Guide Sleeve

NOTICE

- **Once the O-rings have been removed on the parking pawl guide sleeve and the guide bushing, replace them with new ones.**



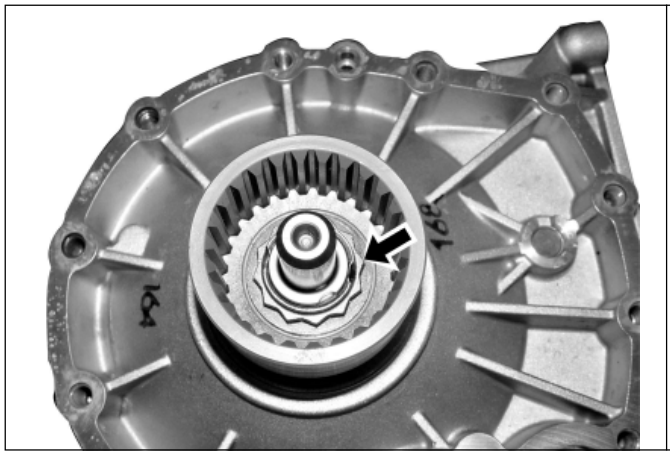
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1. Remove the rear housing cover from the automatic transmission.



2. Stretch out the bent point (arrow) of 12-sided collar nut on output shaft. Remove the color nut on output shaft with special tool and then separate the flange from the output shaft.





Installation Notice

Tightening torque	200 Nm

* Bend the collar nut to lock it during installation.

3. Remove the snap ring on the parking pawl guide sleeve in the transmission housing.





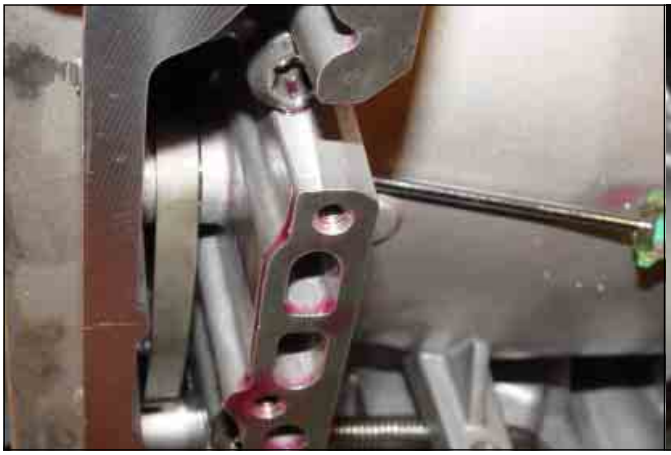
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4. Remove the snap ring on the parking pawl guide bushing.



5. Push out the parking pawl guide bushing from inside with a proper tool.

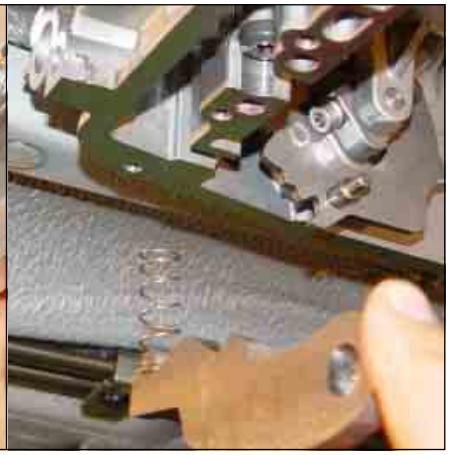




6. Pull up the parking lock lever and remove the parking guide sleeve, parking lock lever and spring.







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Pull up this lever to remove the parking pawl guide sleeve.

7. Replace the O-rings of the parking pawl guide sleeve and bushing.







Guide bushing

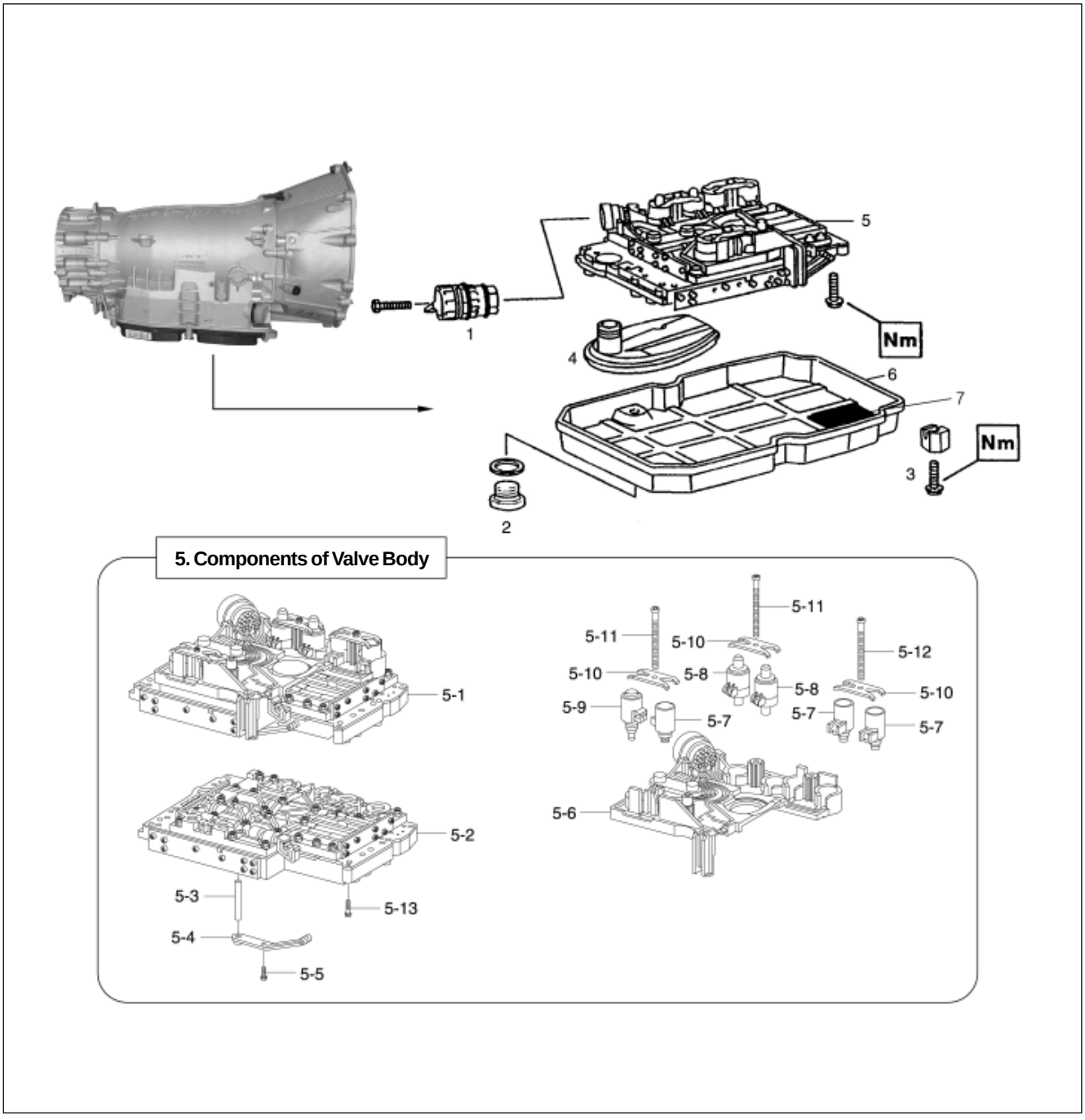
NOTICE

- **Keep clean when installing the O-ring. Open the package of new O-ring just prior to installation.**
- **Especially, do not work with cotton gloves wearing.**

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5. DISASSEMBLY AND REASSEMBLY (DC 5-SPEED A/T)

▶ Valve Body Assembly



1. Adapter plug
2. Drain plug
3. Fixing bolts
4. Oil filter
5. Valve body
5-1. Valve body assembly
5-2. Body assembly
5-3. Pin
5-4. Leaf spring
5-5. Bolts
5-6. Electric kit
5-7. Solenoid valve
5-8. Lifting solenoid valve
5-9. Solenoid valve
5-10. Plate spring
5-11. Screw
5-12. Screw
5-13. Bolts
6. Oil pan
7. Magnet

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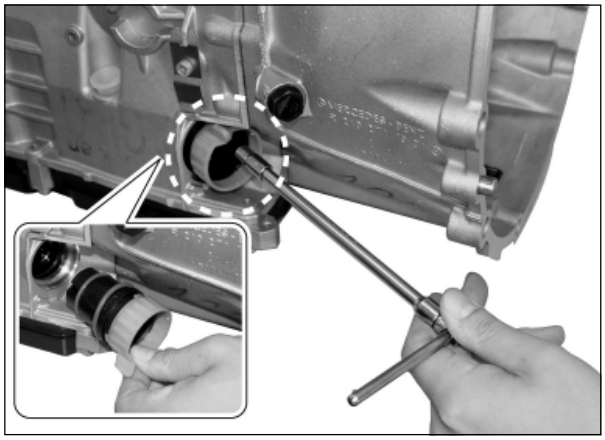
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Disassembly and Reassembly

NOTE

- **To eliminate unnecessary working time and process, prepare general tools, special tools, and gaskets before starting the work.**
- **The automatic transmission is very precise equipment. Keep the transmission clean and tighten the bolts with specified tightening torque.**

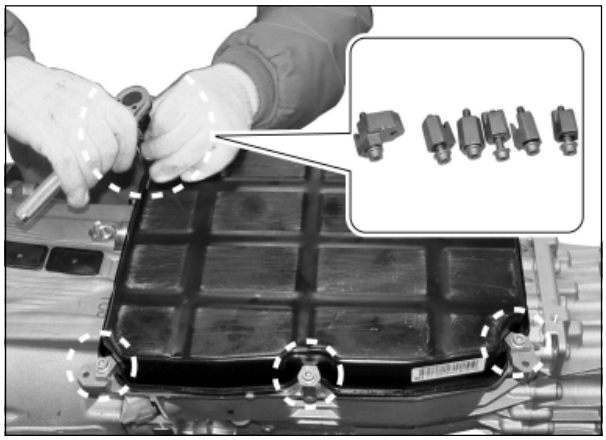
1. Unscrew the hexagon bolts (7 mm) of the adapter plug and remove the guide bush from transmission housing.



Installation Notice

Tightening torque	4 Nm

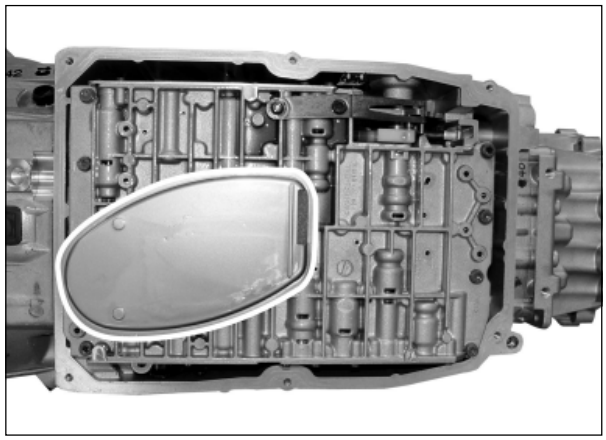
2. Unscrew the oil pan (6) fixing bolts and remove the oil pan.



Installation Notice

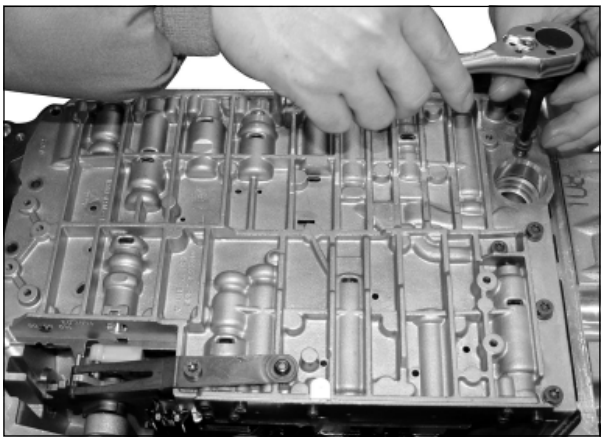
Tightening torque	8 Nm

3. Remove the oil filter.



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4. Unscrew the bolts and remove the valve body from transmission housing.



Installation Notice

Tightening torque	8 Nm

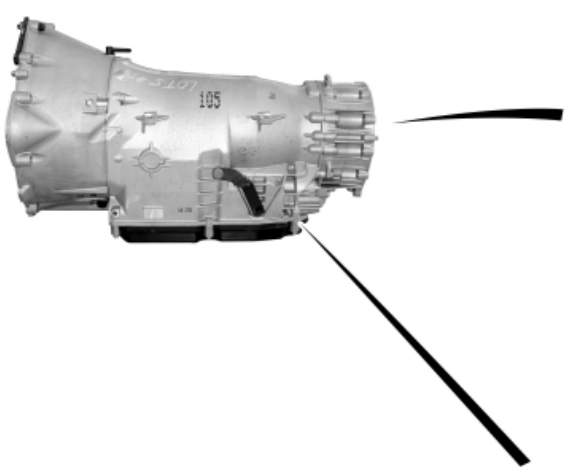
5. Disassemble and reassemble the valve body assembly.

NOTE

- **Refer to Valve Body (page 72) section.**

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▶ Converter Housing and Transmission Housing



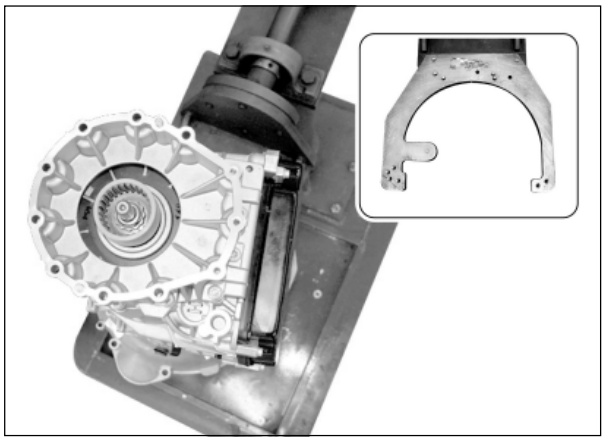
Transmission housing



Converter housing assembly

Disassembly and Reassembly

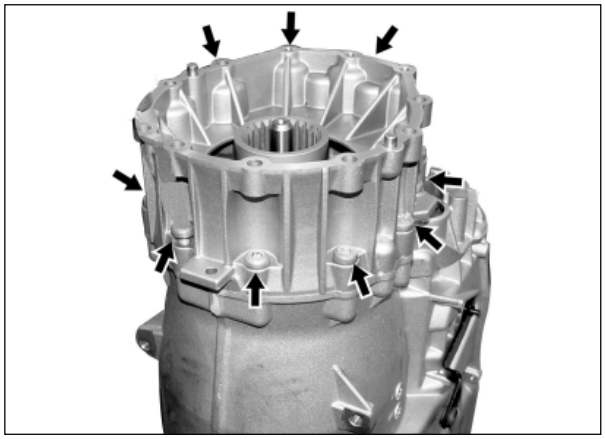
1. Install the transmission assembly on the workbench.



2. Remove the rear extension housing from transmission housing.

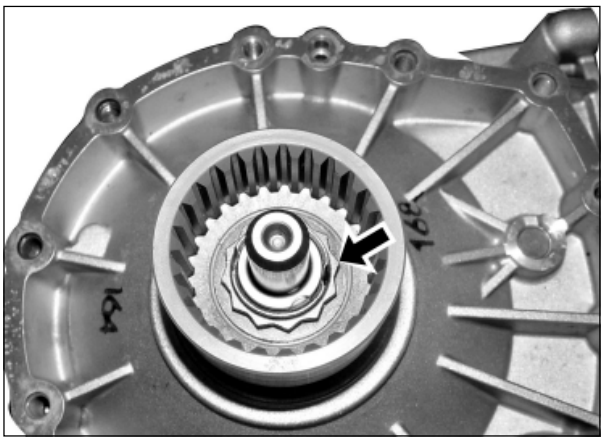
Installation Notice

Tightening torque	30 ~ 35 Nm



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3. Stretch out the bent point (arrow) in 12-sided collar nut on output shaft.



4. Unscrew the collar nut with special tool and remove the output shaft flange.

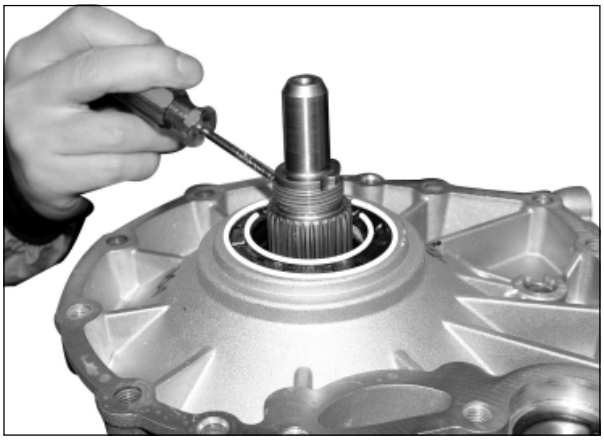
Installation Notice

Tightening torque	200 Nm

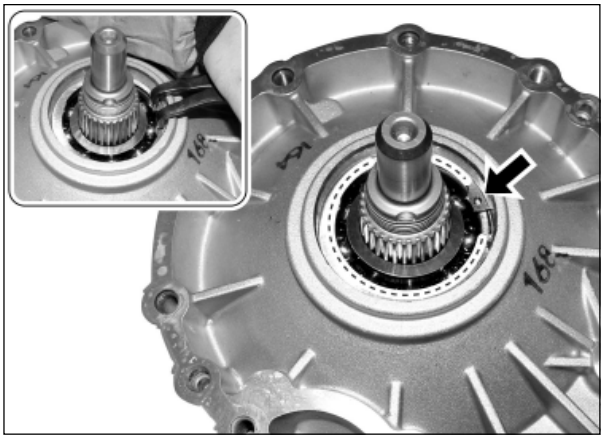
* Bend the collar nut to lock it during installation.



5. Remove the rear oil seal ring.



6. Remove the circlip with a circlip pliers and remove the washer.



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7. Remove the ball bearing from transmission housing.
   1) Install the flare clamping pliers.
   2) Install the puller onto inner bearing race.
   3) Rotate the clamping pliers counterclockwise (arrow direction) to tighten.
      - Puller 001 589 50 33 00 (P99420041B)
      - Collet chuck 140 589 06 34 00 (P99360031C)
   3) Remove the ball bearing from transmission housing.

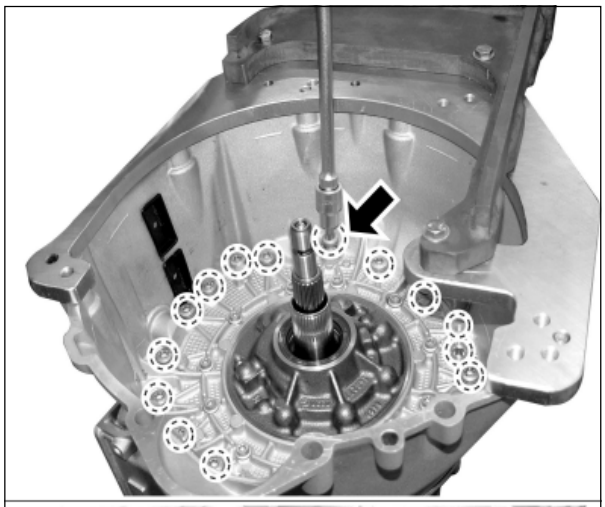


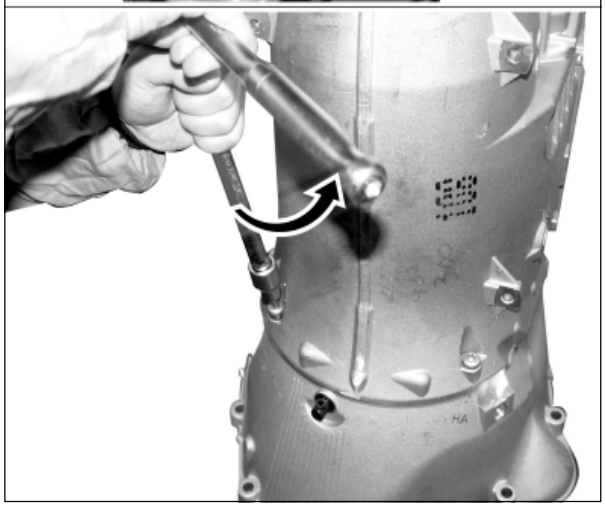
8. Unscrew the socket bolts separate the transmission housing from converter housing.

Installation Notice

Tightening torque	20 Nm

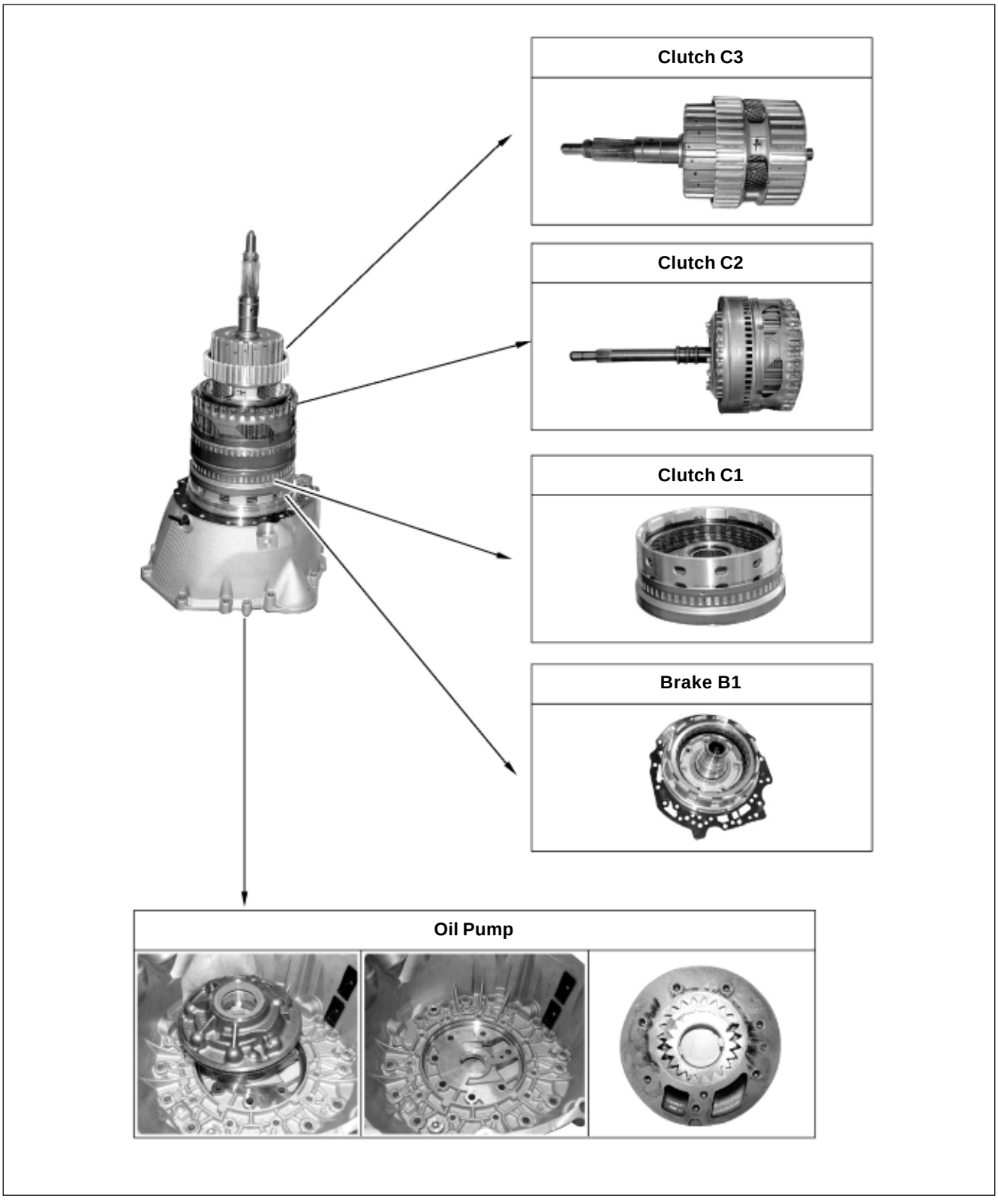
NOTE
- **Gently rock the transmission housing to make the removal process easier.**





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▶ Converter Housing Assembly



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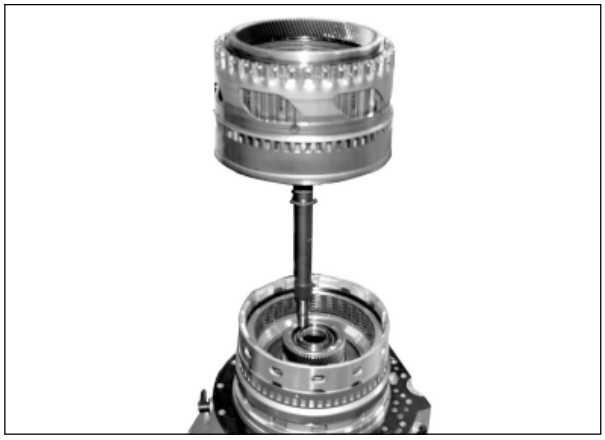
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Disassembly and Reassembly

1. Remove the clutch C3 from converter housing assembly.



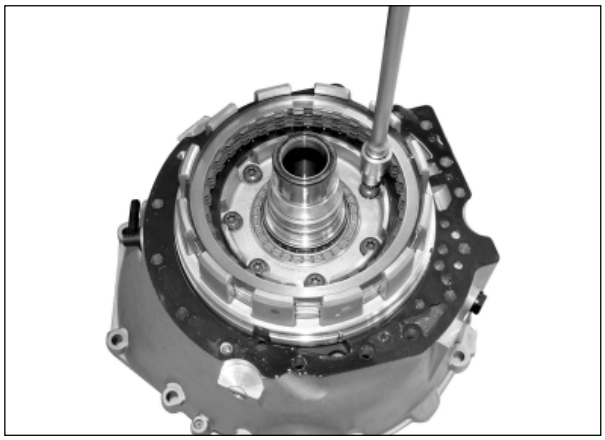
2. Remove the clutch C2 from converter housing assembly.



3. Remove the clutch C1 from converter housing assembly.



4. Remove the brake B1.
   1) Remove the bolts on brake B1.

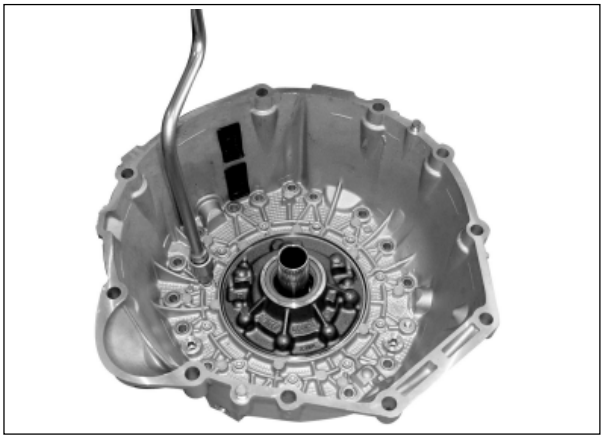


Installation Notice

Tightening torque	16 Nm

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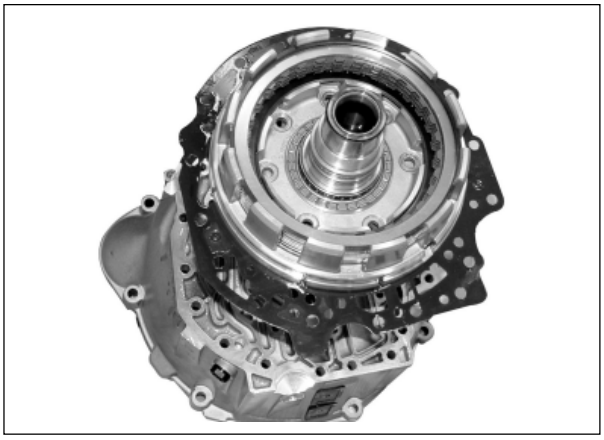
2) Remove the bolts in converter housing.



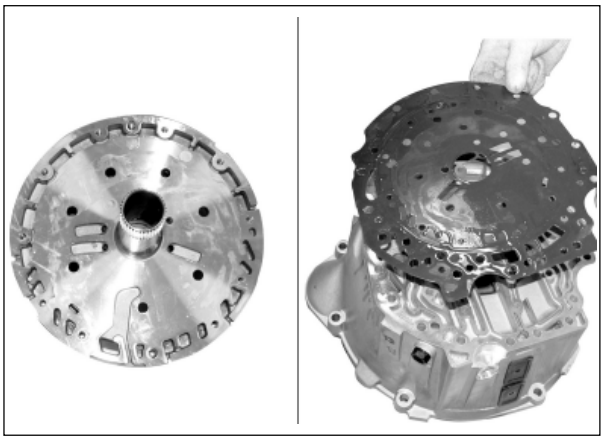
Installation Notice

Installation Notice	8 Nm

3) Remove the brake B1 from converter housing.



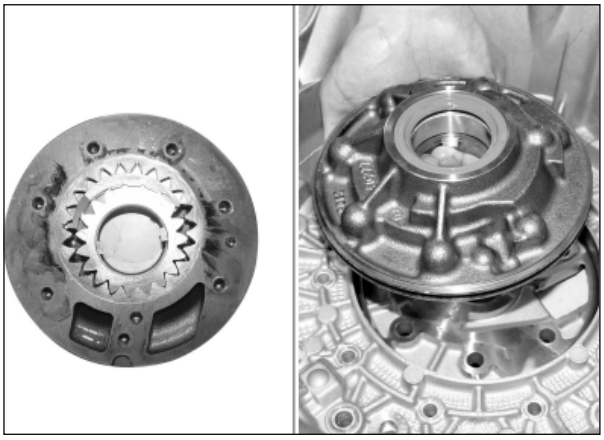
4) Separate the plate from valve body.



NOTICE

- **Install two bolts on the opposite side of disc brake B1 and tap the surface of disc brake B1 with plastic hammer to remove it from converter housing.**
- **Align the dowel pin (arrow) on disc brake B1 and groove in converter housing when installing.**
- **Apply the sealant on the socket bolts and tighten them.**

5. Unscrew the bolts and remove the oil pump.



Installation Notice

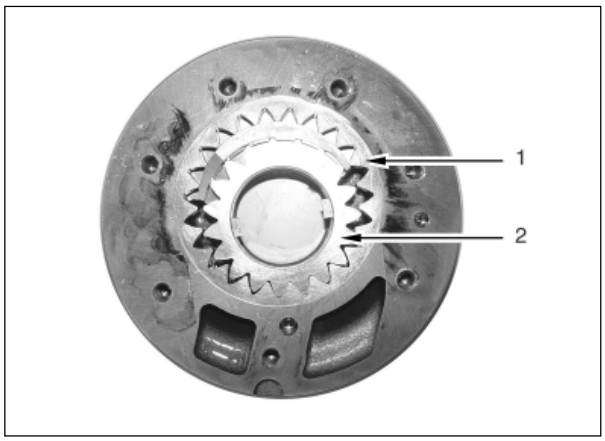
Tightening torque	20 Nm

NOTICE

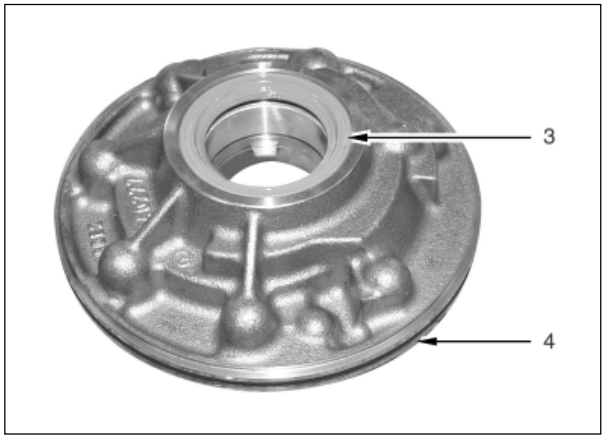
- **Install two bolts on the opposite side of oil pump housing and tap the surface of oil pump with plastic hammer to remove it from converter housing.**

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1) Remove the pump gears (1, 2) from pump housing.



2) Check the radial seal ring (3), and replace if necessary.
3) Replace the O-ring (4) with new one.



NOTICE

- **Lubricate the pump gears (1, 2) before installation.**
- **Place the pump gear (2) into pump housing and install the pump gear (1) onto the pump housing chamber.**

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▶ Transmission Housing Assembly



Parking Lock Gear



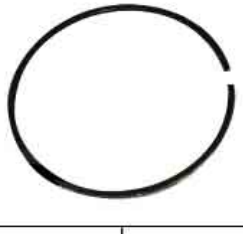
Brake B2



Brake B3

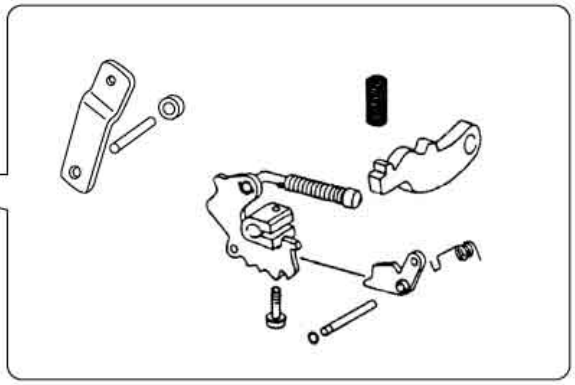


Snap Ring





Components of Selector Lever

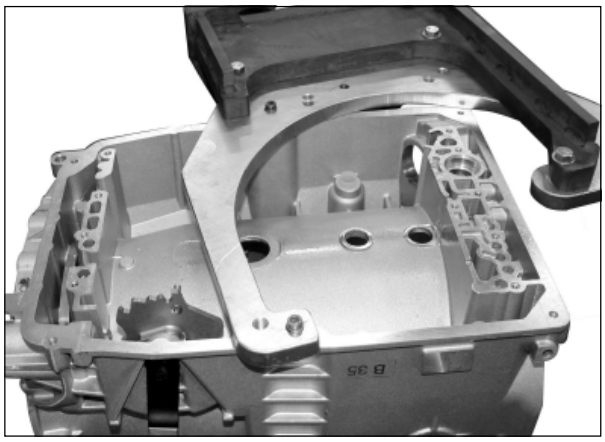


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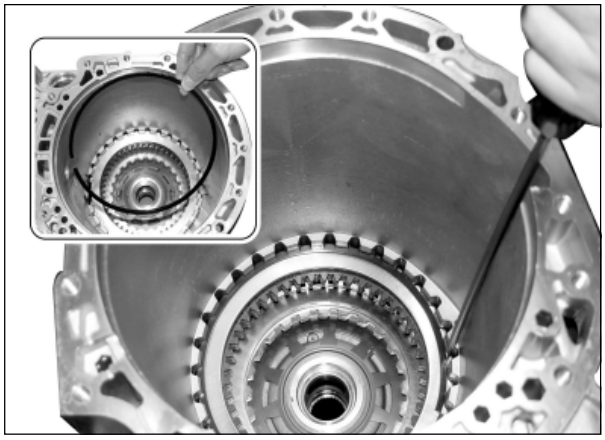
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Disassembly and Reassembly

1. Install the transmission housing assembly on workbench.



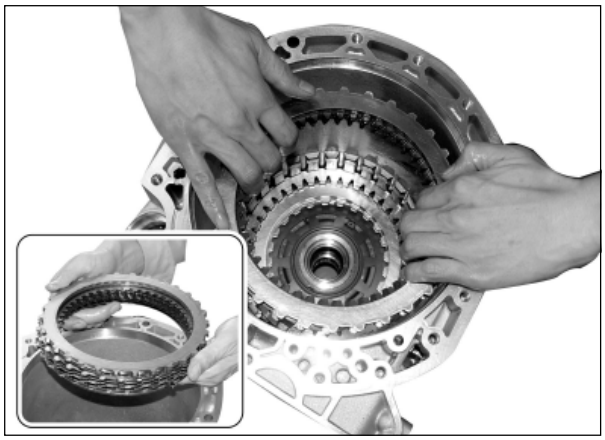
2. Remove the snap ring from transmission housing.



3. Remove the spring washer and disc pack B3 from transmission housing.

NOTICE

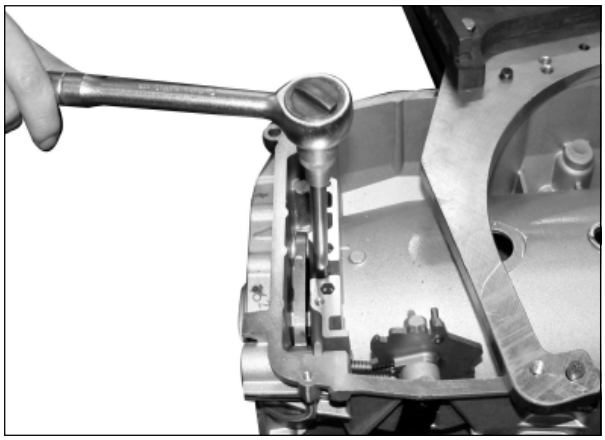
- **To make the removal of snap ring (133a) easier, remove the disc pack B3 while compressing it.**
- **Check each disc for wear and burnt out.**



4. Remove the fixing bolts for brake B2 from transmission housing.

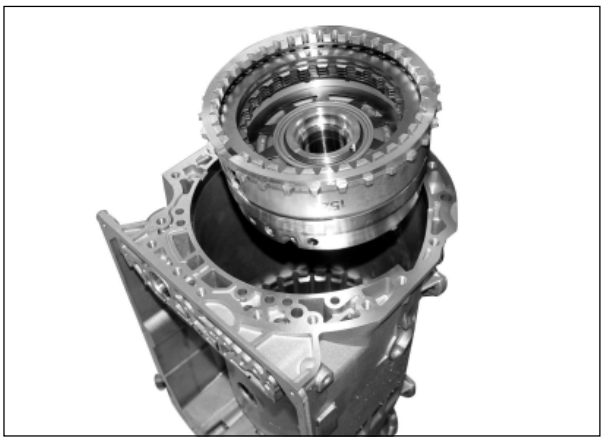
Installation Notice

Tightening torque	16 Nm

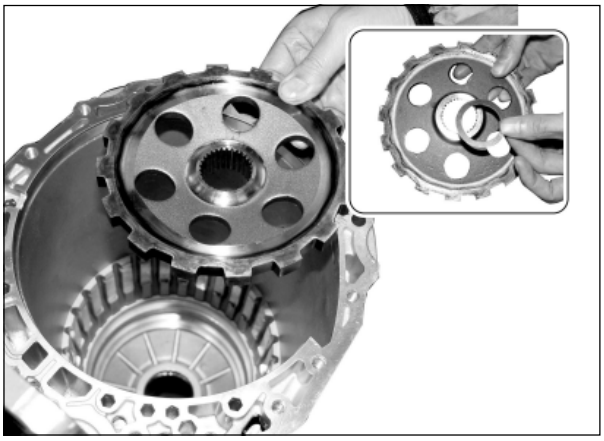


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5. Remove the disc brake B2 from transmission housing.



6. Remove the parking lock gear.



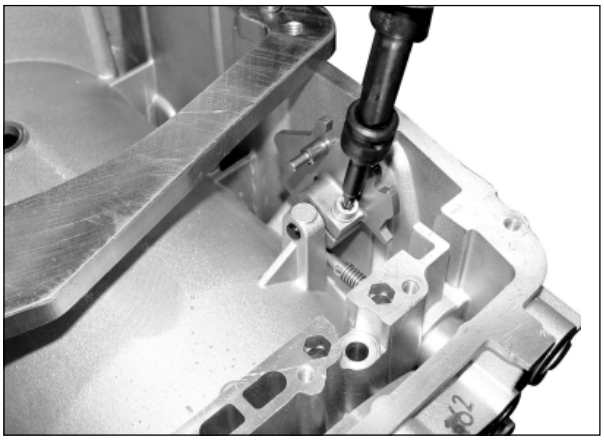
7. Remove the fixing bolts for range selector lever.

Installation Notice

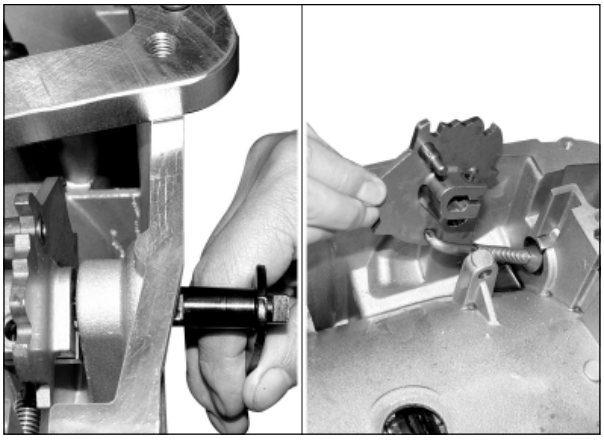
Tightening torque	8 Nm

NOTICE

- **Check the sealing ring for damage.**

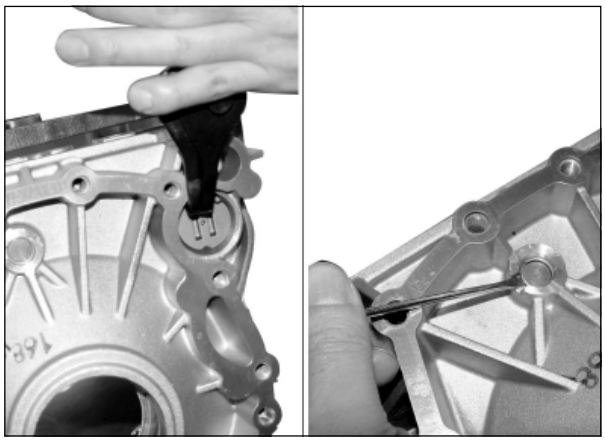


8. Remove the range selector lever, rod and detent plate.

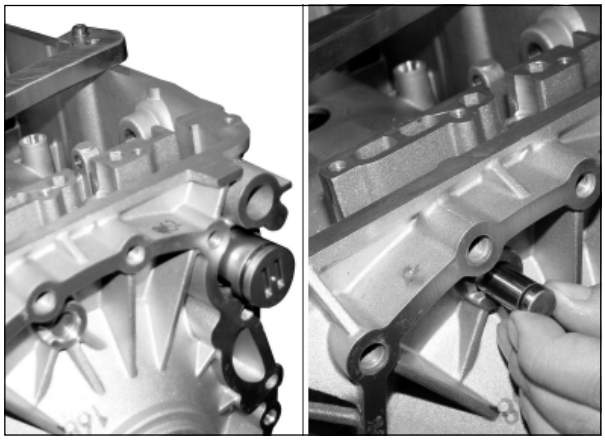


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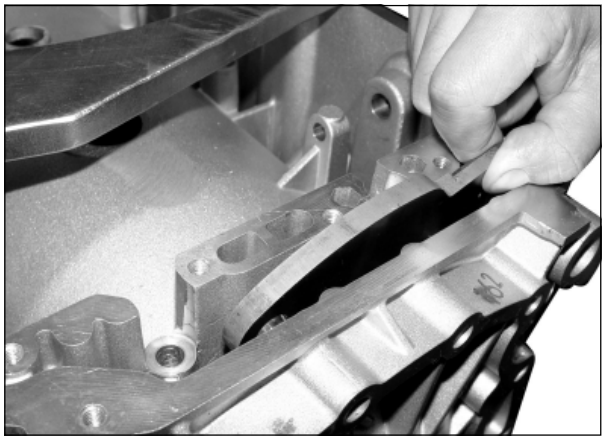
9. Remove the snap rings from parking lock pawl.



10. Remove the pin from transmission housing.



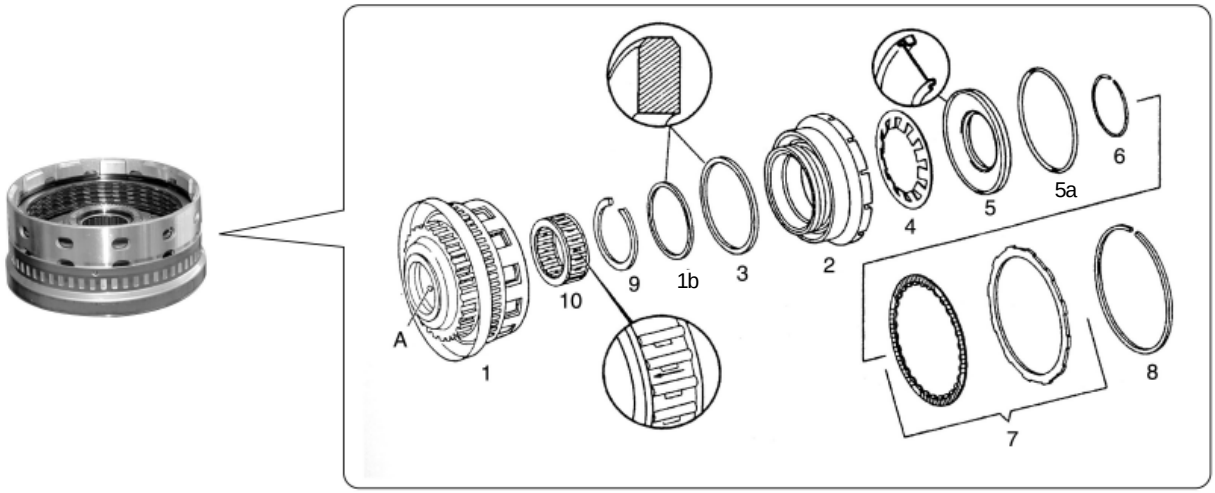
11. Remove the parking lock pawl from transmission housing.



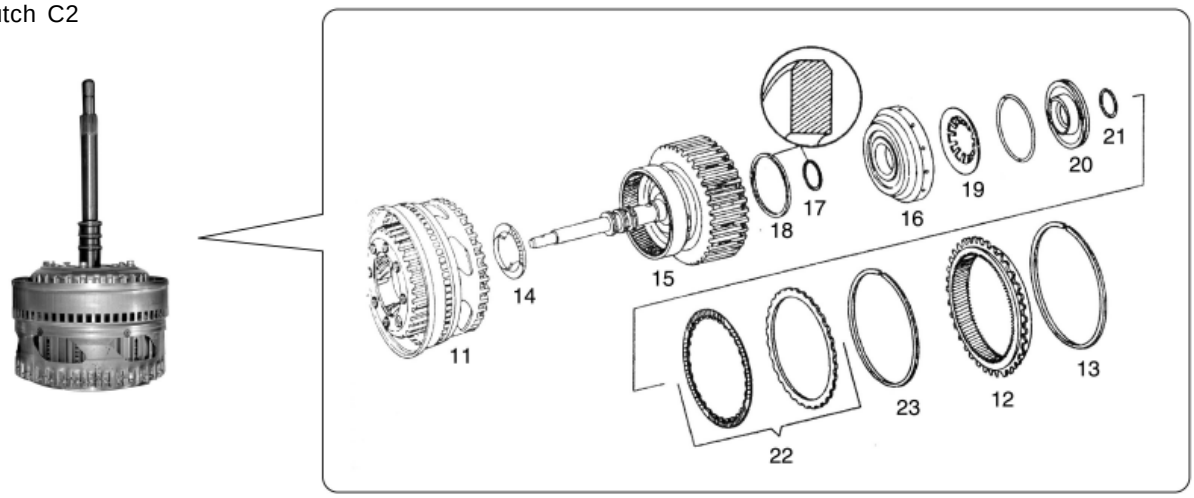
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▶ Components of Each Assembly

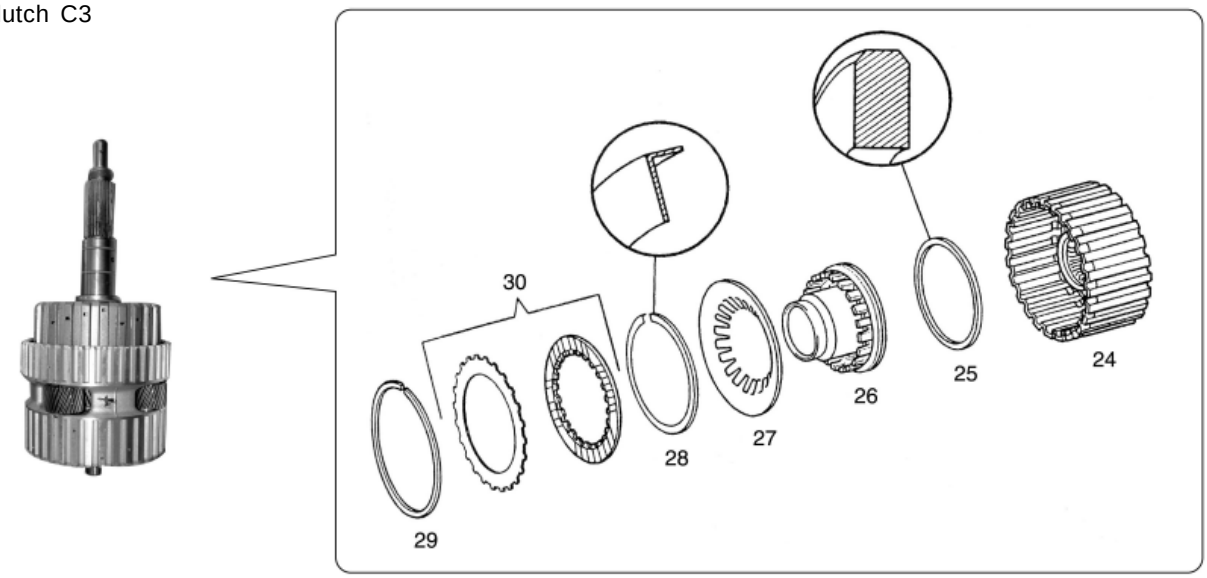
Clutch C1



Clutch C2



Clutch C3



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Clutch C1

1. Outer multiple-disc carrier/clutch C1
1b. Sealing ring
2. Piston
3. Sealing ring in piston
4. Disc spring
5. Spring plate
5a. Sealing ring
6. Snap ring
7. Multiple-disc pack
8. Snap ring
9. Snap ring
10. Front freewheel
A. Oil pressure bore

Clutch C2

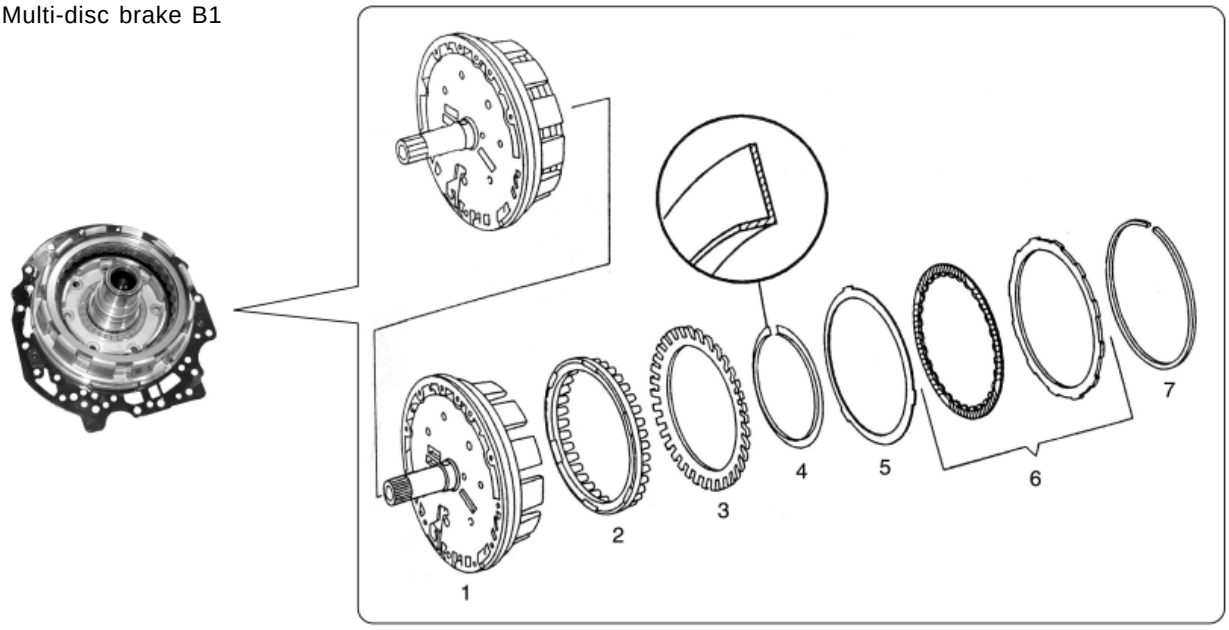
11. Inner multiple-disc carrier/clutch C1 with integrated foot gear set
12. Hollow gear
13. Snap ring
14. Axial needle bearing
15. Clutch C2 and input shaft
16. Piston
17. Inner sealing ring in piston
18. Outer sealing in piston
19. Disc spring
20. Spring retainer
21. Snap ring
22. Multiple-disc set
23. Snap ring

Clutch C3

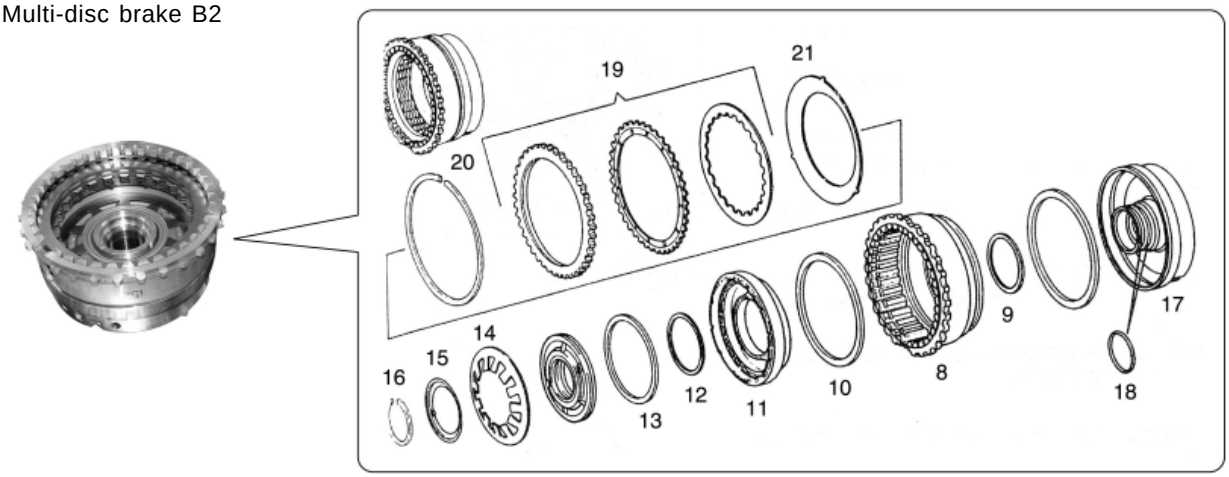
24. Outer multiple-disc carrier
25. Sealing ring
26. Piston
27. Spring plate
28. Disc spring
29. Snap rig
30. Multiple-disc pack

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Multi-disc brake B1



Multi-disc brake B2



Multi-disc brake B1

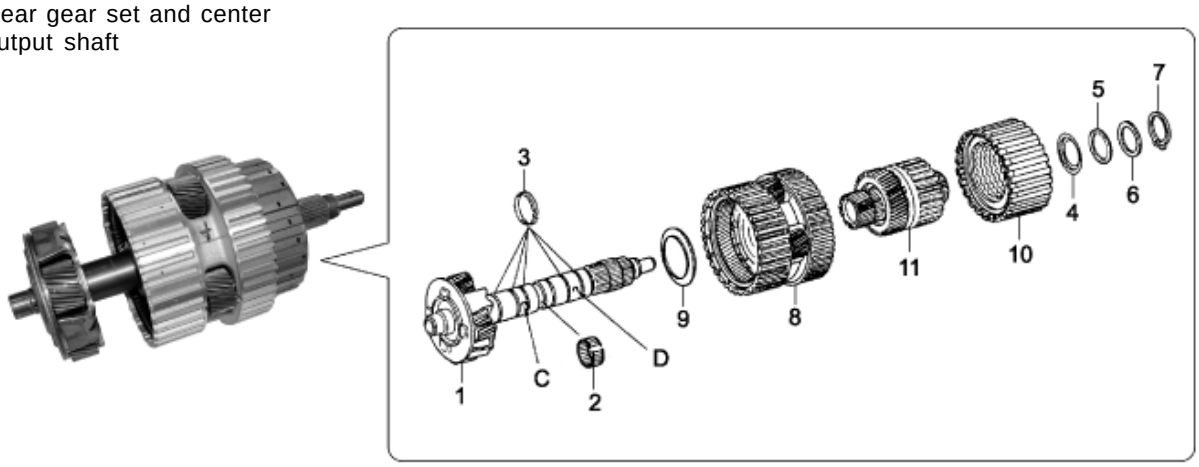
1. Externally toothed disc carrier/multiple-disc brake B1
2. Piston
3. Spring washer, back pressure/piston
4. Snap ring
5. Spring washer/multiple-disc pack
6. Multiple-disc pack
7. Snap ring

Multi-disc brake B2

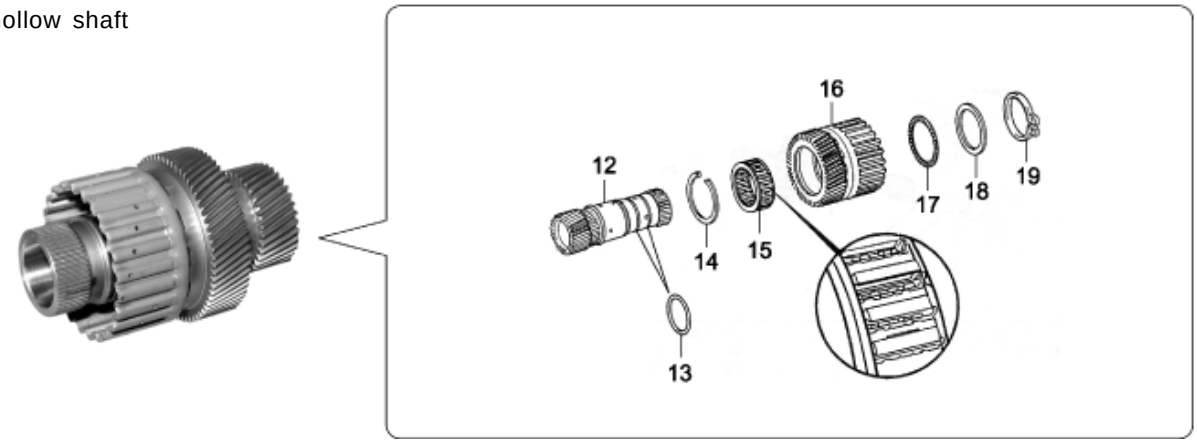
8. Disc carrier B2
9. Sealing ring
10. Sealing ring
11. Piston in B2
12. Sealing ring in piston guide ring
13. Sealing ring in piston guide ring
14. Piston disc spring
15. Spring plate
16. Snap ring
17. Piston guides in B2 and B3
18. O-ring
19. Multiple-disc pack
20. Snap ring
21. Disc spring

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Rear gear set and center output shaft



Rear freewheel and rear hollow shaft



Rear gear set and center output shaft

1. Output shaft in center gear set
2. Needle bearing
3. Teflon ring
4. Thrust washer
5. Thrust needle bearing
6. Shim
7. Circlip
8. Rear gear set
9. Thrust washer
10. Clutch C3
11. Rear hollow shaft

C. Oil outlet port in clutch C3
D. Oil inlet port in clutch C3

Rear freewheel and rear hollow shaft

12. Hollow shaft
13. O-ring
14. Snap ring
15. Freewheel
16. Inner disc carrier and rear sun gear/clutch C3
17. Thrust needle bearing
18. Shim
19. Circlip

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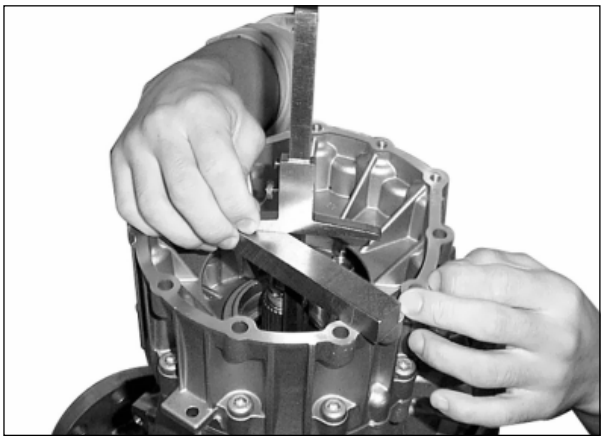
▶ When Installing the Transmission

1. Measure the clearance between the ball bearing and the parking lock gear.
   1) Place the measuring bridge on the top of transmission housing and measure the distance from the parking lock gear (a) to the measuring bridge.
   2) Measure the distance from measuring bridge to the ball bearing groove on mating surface with gauge (b).
   3) Adjust the axial play “E” with adjusting shim.

ex):

Distance a	49.90 mm
Distance b	49.00 mm
Difference	0.90 mm
Axial play E	0.40 mm
Shim size	0.50 mm

Axial play	0.3 ~ 0.5 mm



NOTICE

- **Select a proper thickness of shim: 0.2, 0.3, 0.4, 0.5 mm**

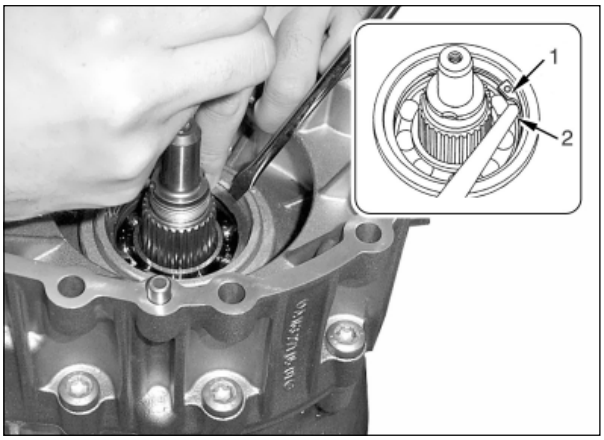
2. Install a shim.

Measuring bridge 126 589 04 31 00

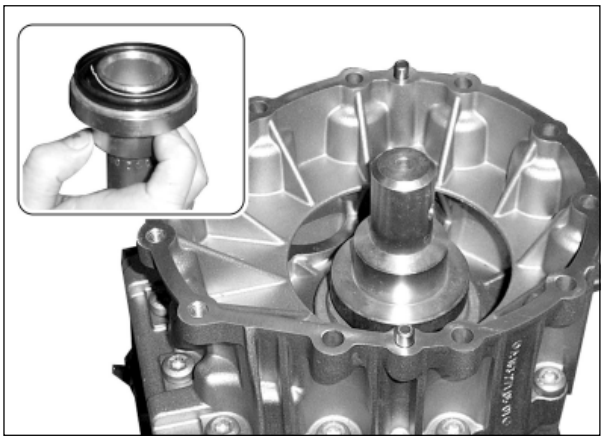
3. Insert the ball bearing into rear part of transmission housing.

NOTICE

- **Measure the clearance between ball bearing (2) and circlip. Install the appropriate size of circlip (2.0, 2.1, 2.2 mm).**



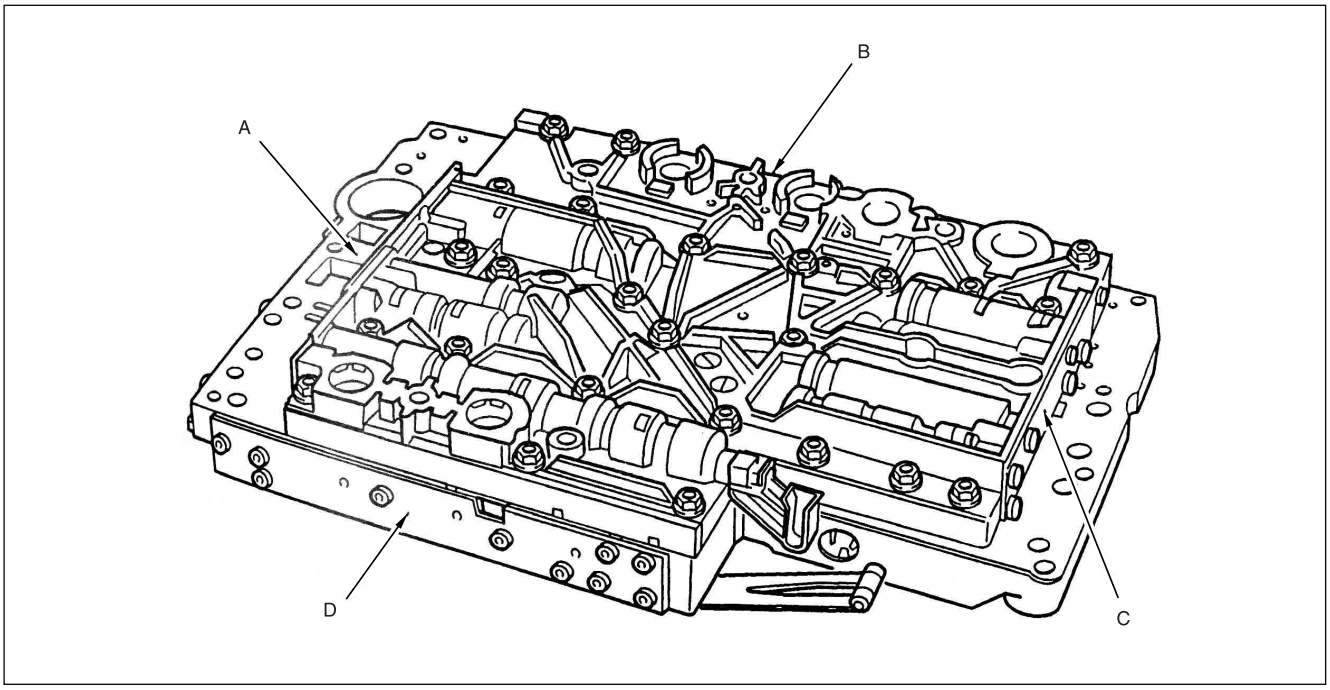
4. Install the radial sealing with a special tool.



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6. VALVE BODY

▶ Structure of Electro-hydraulic Control Module (Shift Plate)



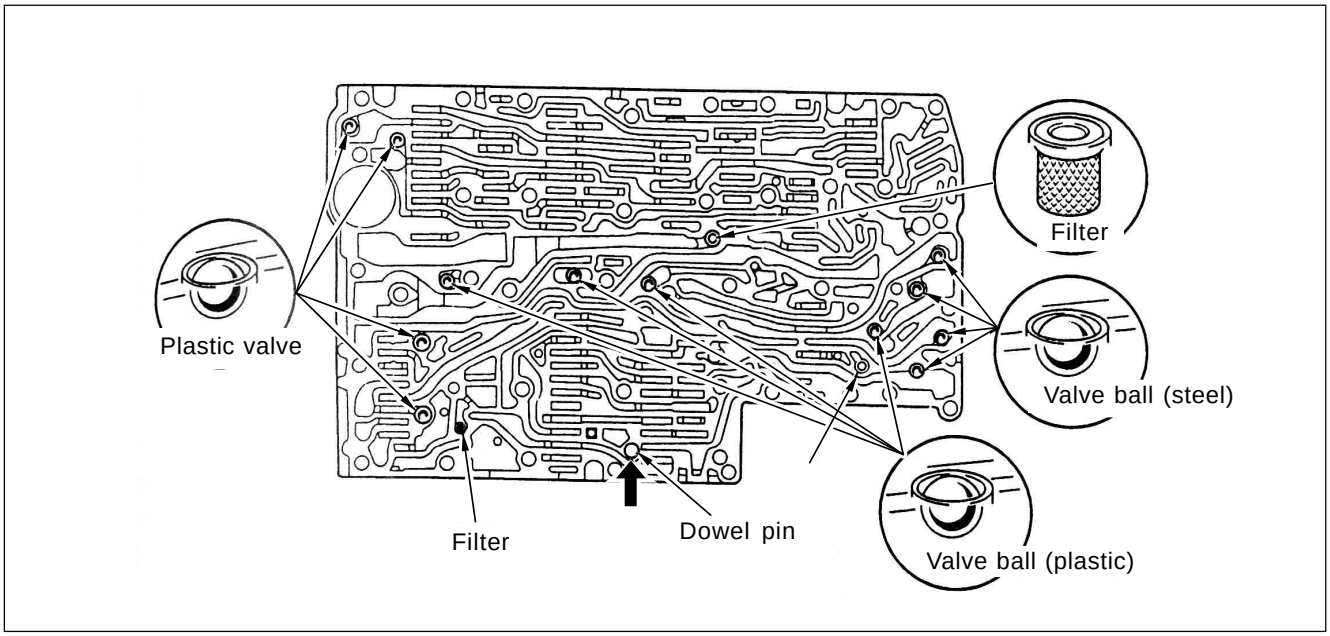
A. Adjusting valve/operating pressure, adjusting valve/ Lubricating pressure, adjusting valve/2-3 group overlap

B. 1-2/4-5 shift group, adjusting valve/shift pressure, adjusting valve/control valve pressure, adjusting valve/shift valve pressure

C. 3-4 shift group

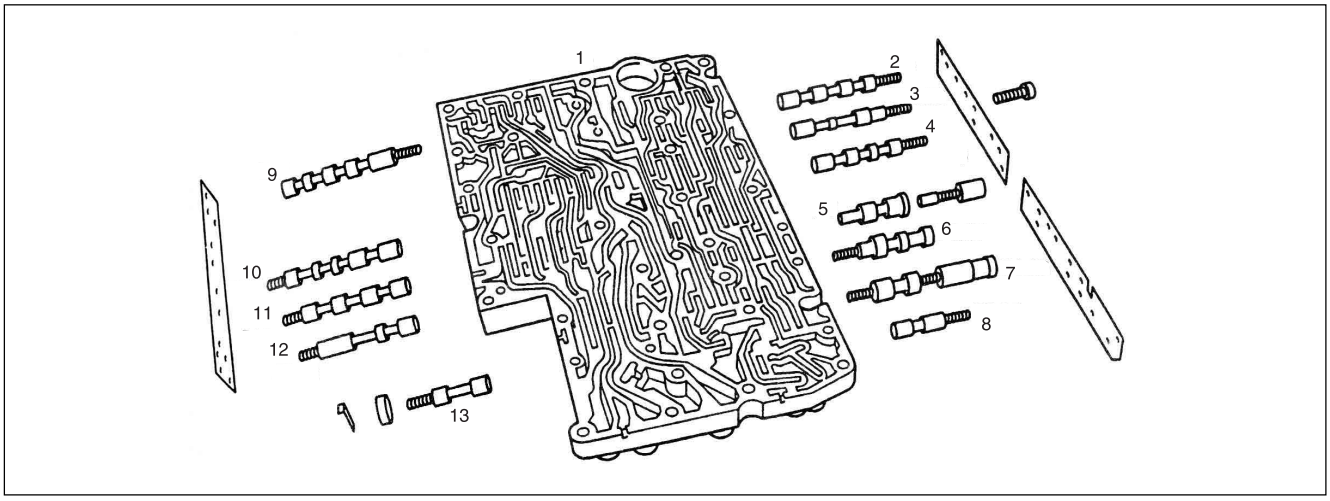
D. Clutch lockup control valve, shift valve B2

▶ Rear Section



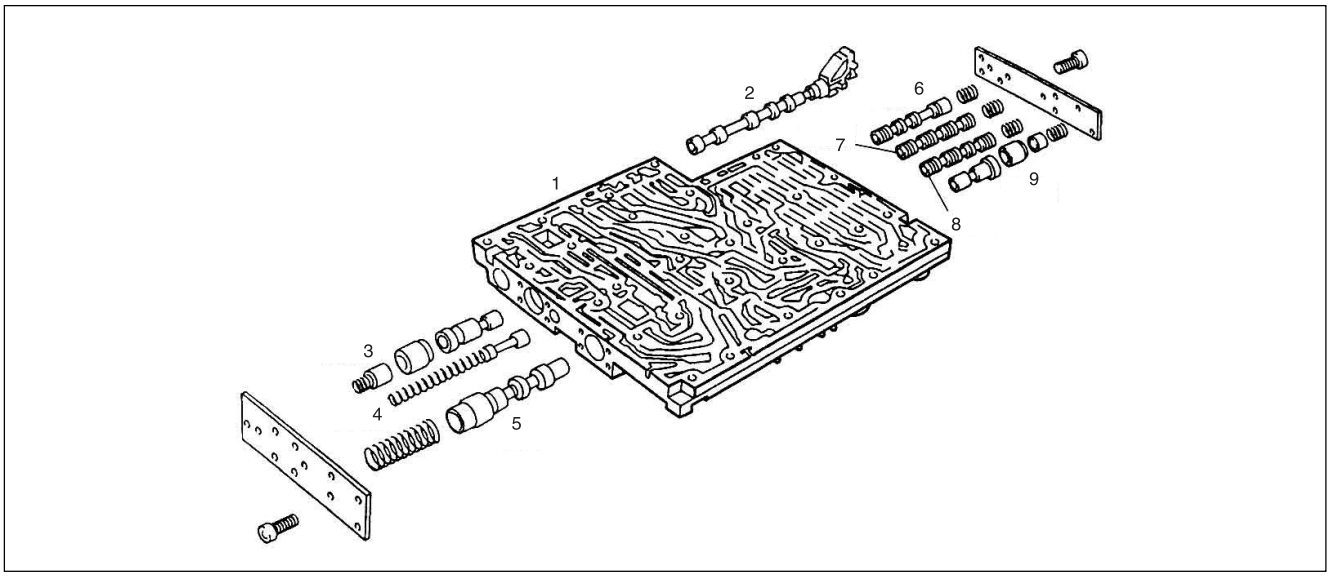
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▶ Left Section



1. Shift housing
2. 1-2/4-5 command valve
3. 1-2/4-5 holding pressure shift valve
4. 1-2/4-5 shift pressure shift valve
5. 1-2/4-5 overlap control valve
6. Shift pressure control valve
7. Regulating pressure control valve
8. Shift valve pressure control valve
9. Torque converter lockup clutch control valve
10. 2-3 shift pressure shift valve
11. 2-3 command valve
12. 2-3 holding pressure shift valve
13. Shift valve B2

▶ Right Section



1. Valve housing
2. Selector valve
3. 2-3 overlap control valve
4. Lubricating pressure control valve
5. Operating pressure control valve
6. 3-4 holding pressure shift valve
7. 3-4 command valve
8. 3-4 shift pressure shift valve
9. 3-4 overlap control valve

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Disassembly and Reassembly

1. Remove the leaf spring (5)
2. Remove the bolt (1).

Installation Notice

Tightening torque	8 Nm

3. Remove the shift housing (4) from valve housing (2).

NOTICE
- **Before installation, make sure to insert the dowel pin into correct position.**

4. Remove the sealing plate (3).

NOTICE
- **Do not forget that there are 4 plastic balls and 8 steel balls in shift housing.**

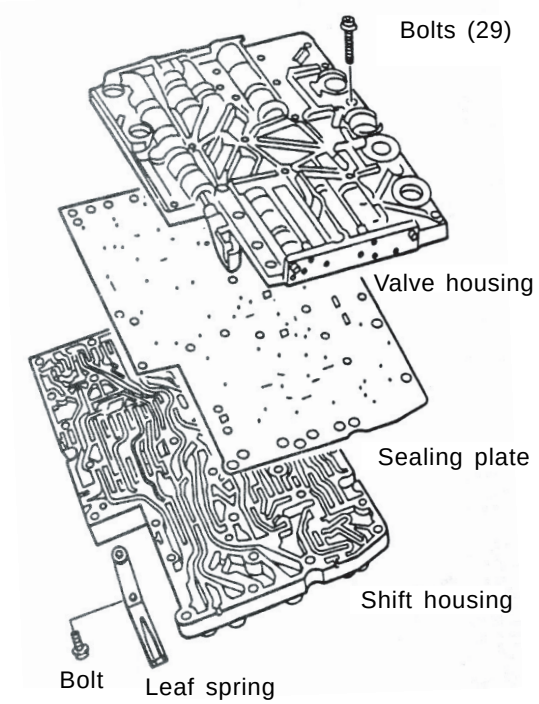
5. Unscrew the bolts from shift housing and valve housing and remove the side cover.

Installation Notice

Tightening torque	14 Nm

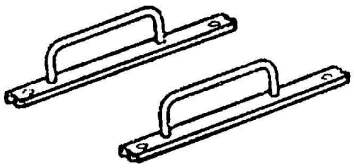
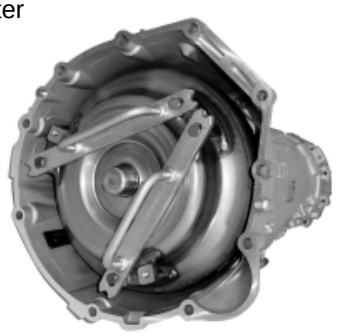
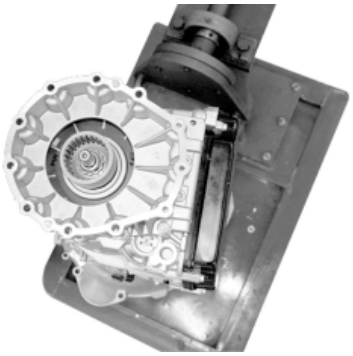
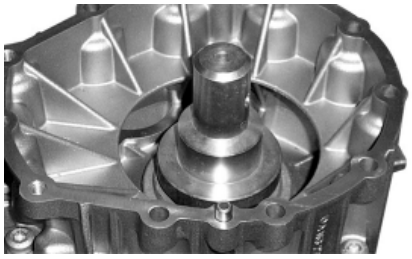
NOTICE
- **Check the valves for damage and replace them, if necessary.**

6. Install in the reverse order of removal.

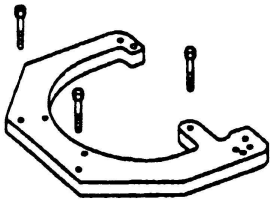
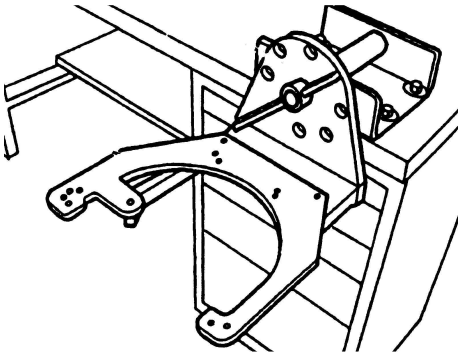
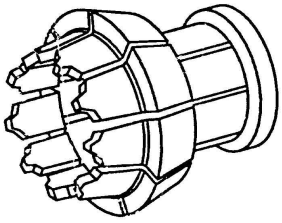
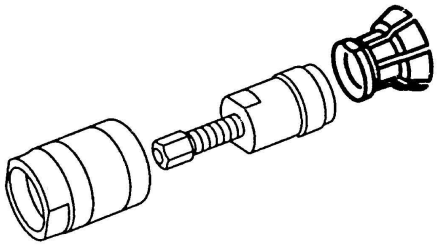
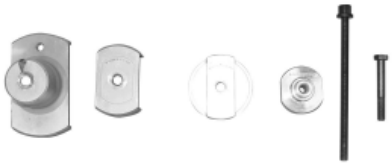


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SPECIAL TOOLS AND EQUIPMENT

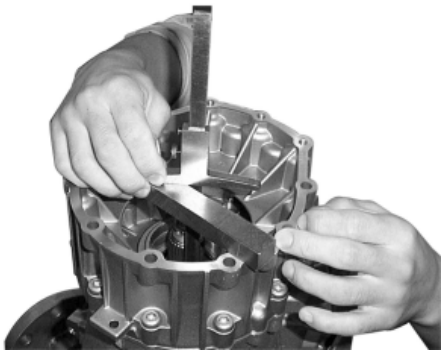
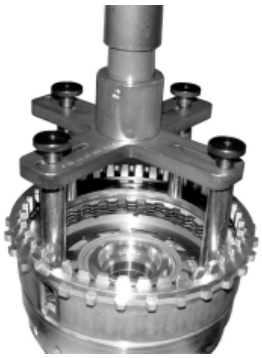
Name and Part Number	Application
126 589 01 62 00 (W99360220B) Handle 	Removal/installation of torque converter 
116 589 06 59 00 (W99360180B) Fixing plate 	Fixing automatic transmission 
140 589 12 15 00 (P99360041C) Drift punch 	Installation of sealing ring 
001 589 50 33 00 (P99420041B) Puller 	Removal and installation of transmission housing ball bearing 

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Name and Part Number	Application
140 589 34 63 00 (A99360030B) Mounting plate 	Fixing automatic transmission 
140 589 06 34 00 (P99360031C) Collet chuck 	Removal and installation of transmission housing ball bearing 
140 589 13 43 00 (P99360021C) Piston puller 	Removal and installation of B1, B2 and B3 pistons 
126 589 02 09 00 Socket 	Removal and installation of collar nut for output shaft 

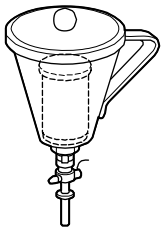
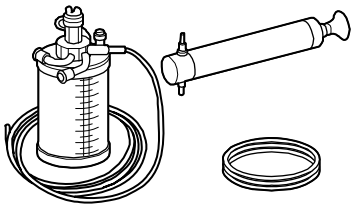
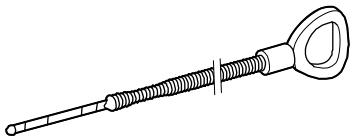
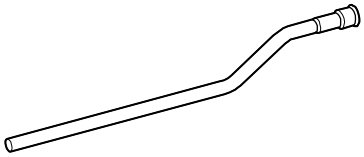
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Name and Part Number	Application
128 589 04 31 00 (W99360242C) Measuring bridge 	Measuring the clearance between ball bearing and parking lock gear 
Compressor 	Compressing clutch and disc brake 

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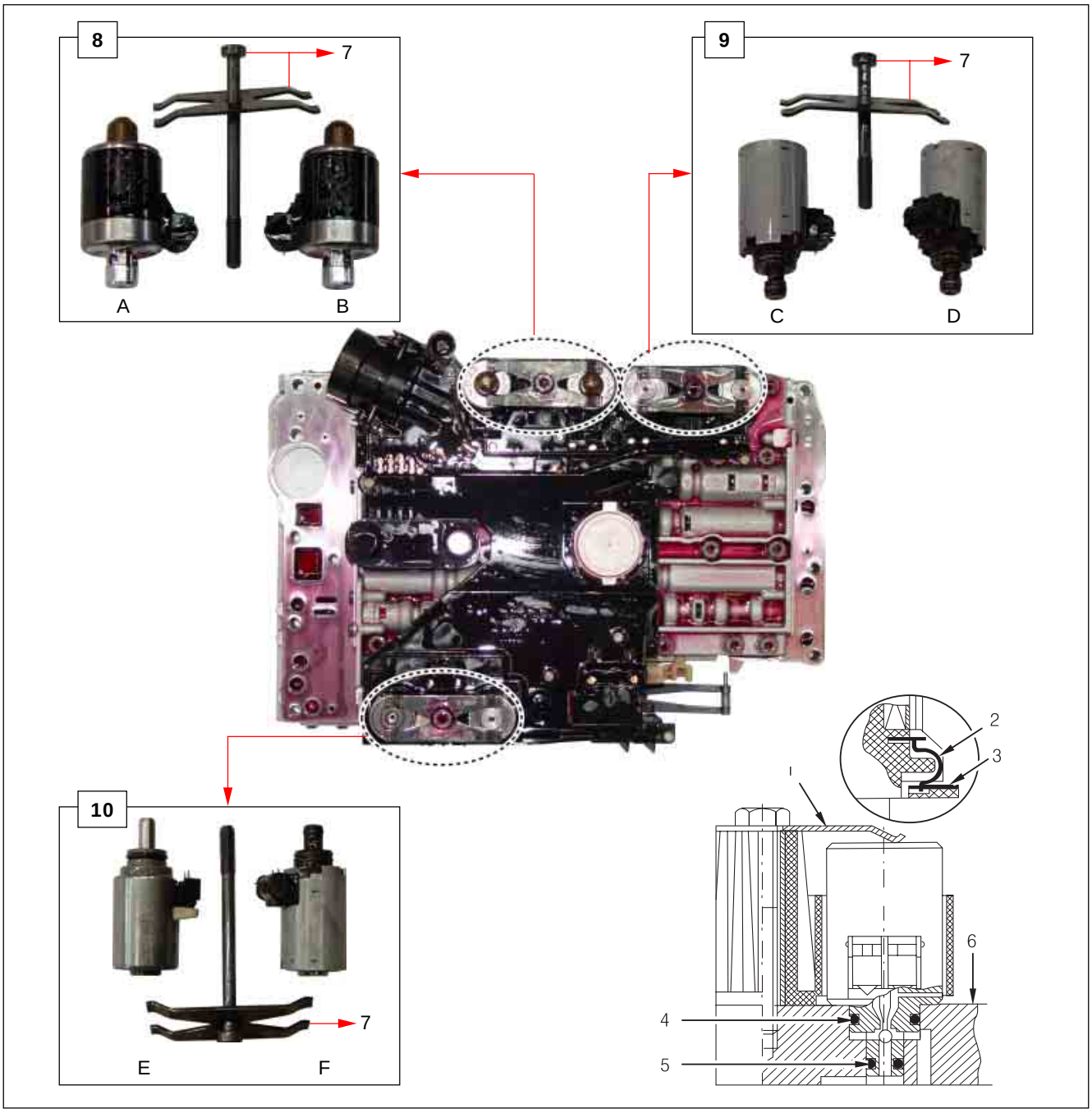
*** Tool for ATF checking only**

Name and Part Number	Name and Part Number
126 589 12 63 00 (W99360282A) Funnel 	**210 589 00 71 00 (P99360012C)** Hand pipe 
140 589 15 21 00 Dipstick gauge 	**140 589 49 63 00** Filling pipe 

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VALVE BODY

▶ Shift Pressure Control Solenoid Valve



1. Leaf spring
2. Contact spring
3. Conductor track
4. O-ring
5. O-ring
6. Shift plate
7. Leaf spring and socket bolt
8. Solenoid valve
   A. 1-2, 4-5 shift solenoid valve
   B. 3-4 shift solenoid valve
9. Solenoid valve
   C. Shift pressure control solenoid valve
   D. Modulating pressure control solenoid valve
10. Solenoid valve
    E. Lockup PWM solenoid valve
    F. 2-3 shift solenoid valve

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Function

The plastic Electric Hydraulic Control Unit (EHU) is installed on the top of valve body. Speed sensor, start lock-out switch and oil temperature sensors are integrated in EHU.

The 13-pin connector is connected to automatic transmission via PCB.

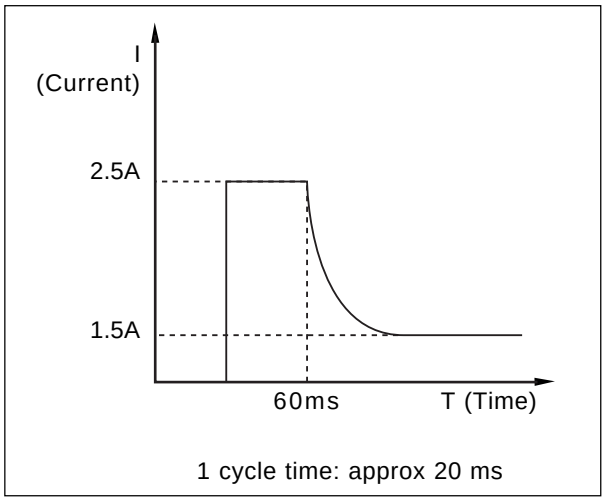
Three up/downshift solenoid valves are installed on the top of hydraulic control unit.

The solenoid valves are sealed with two O-rings against the valve body. The solenoid valves are pressed against the valve body by the leaf springs.

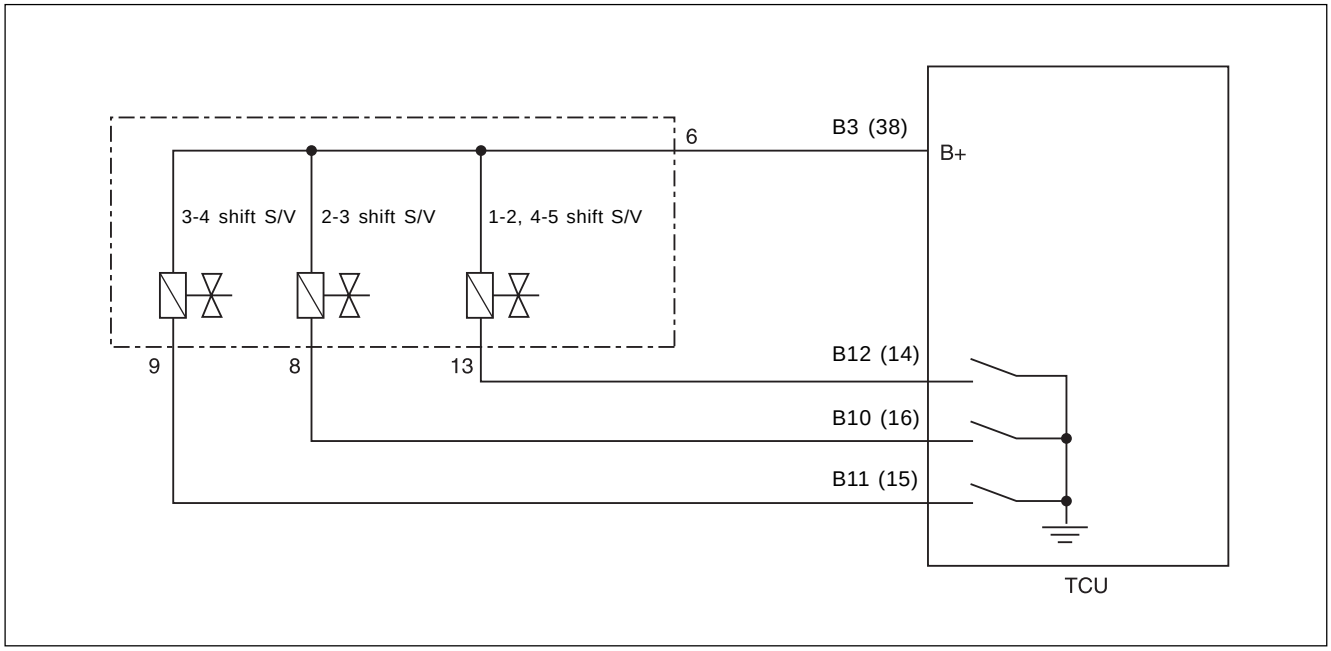
Characteristics of up/downshift solenoid valve

The solenoid valve remains energized and therefore open until the shift process is completed according to the engine and transmission conditions. If a solenoid valve is energized, it opens and transmits the shift valve pressure to the corresponding command valve.

Working current	1.5 ~ 2.0 A
Operating distance	0.2 mm
Resistance	3.91 ± 0.12 Ω (25°C)



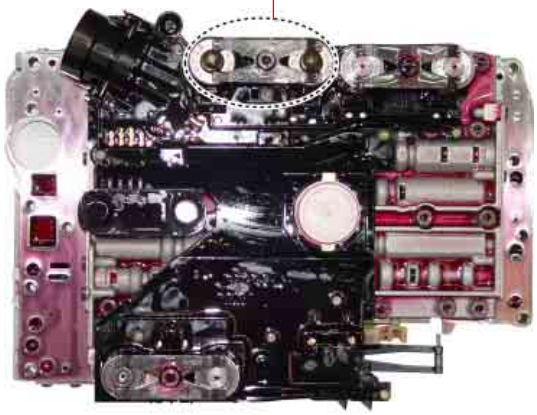
Circuit Diagram

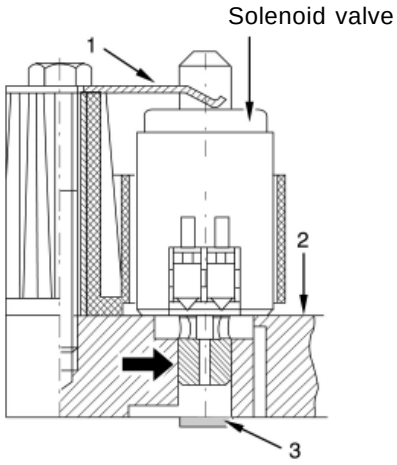


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▶ Modulating Pressure (MP) and Shift Pressure (SP) Control Solenoid Valve





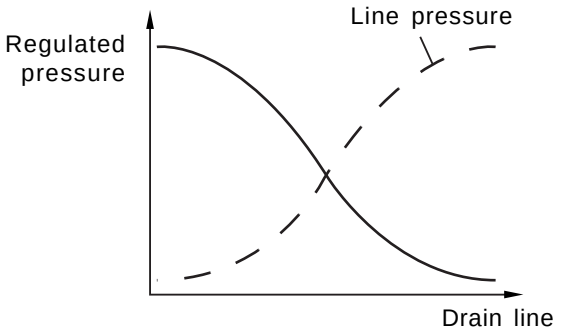


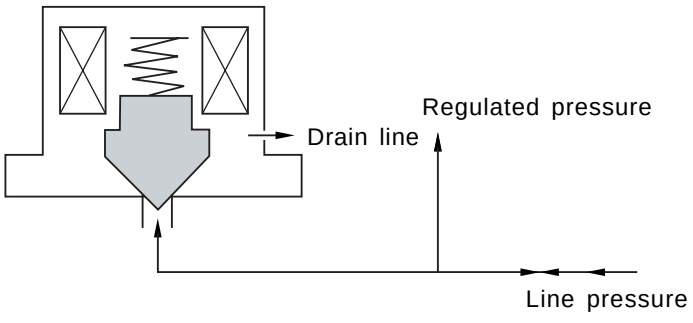
1. Leaf spring
2. Shift plate
3. Strainer
4. MP control solenoid valve
5. SP control solenoid valve

Function

These valves control the modulating pressure and the shift pressure by applying appropriate current to solenoid valves according to driving condition of engine and transmission. When the current value from TCU is high or low, accordingly the regulated pressure decreases or increases.

Working current	0 ~ 1.2 A
Operating distance	0.6 mm
Resistance	5.0 ± 0.3 Ω (23°C)

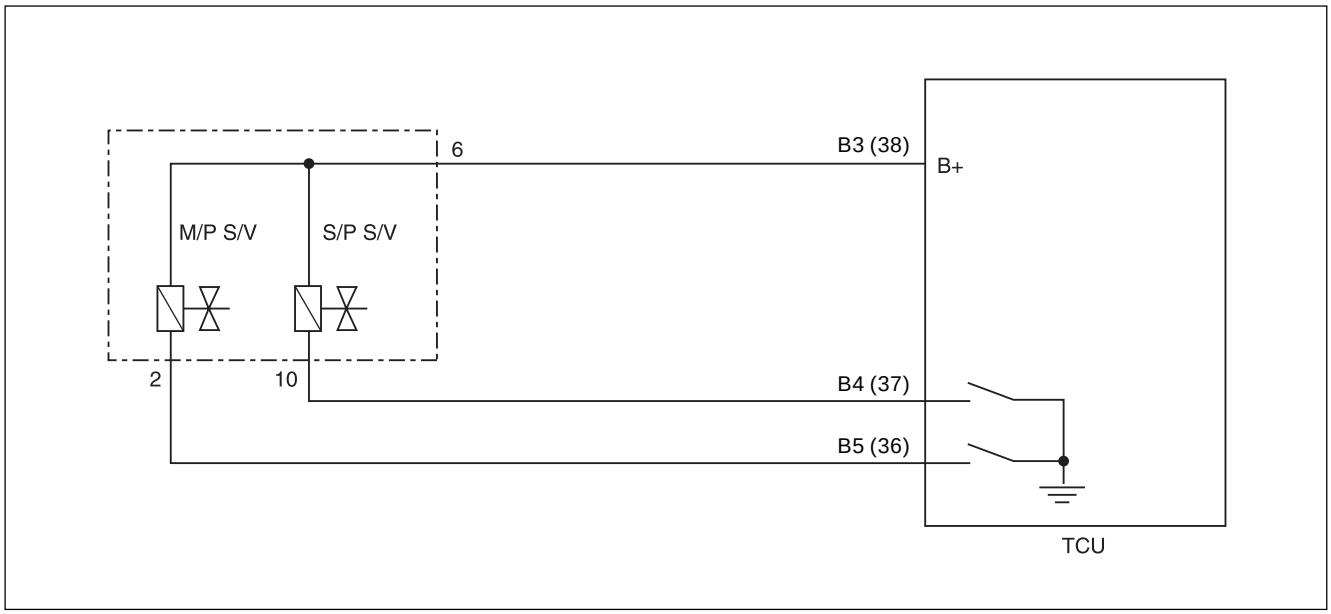




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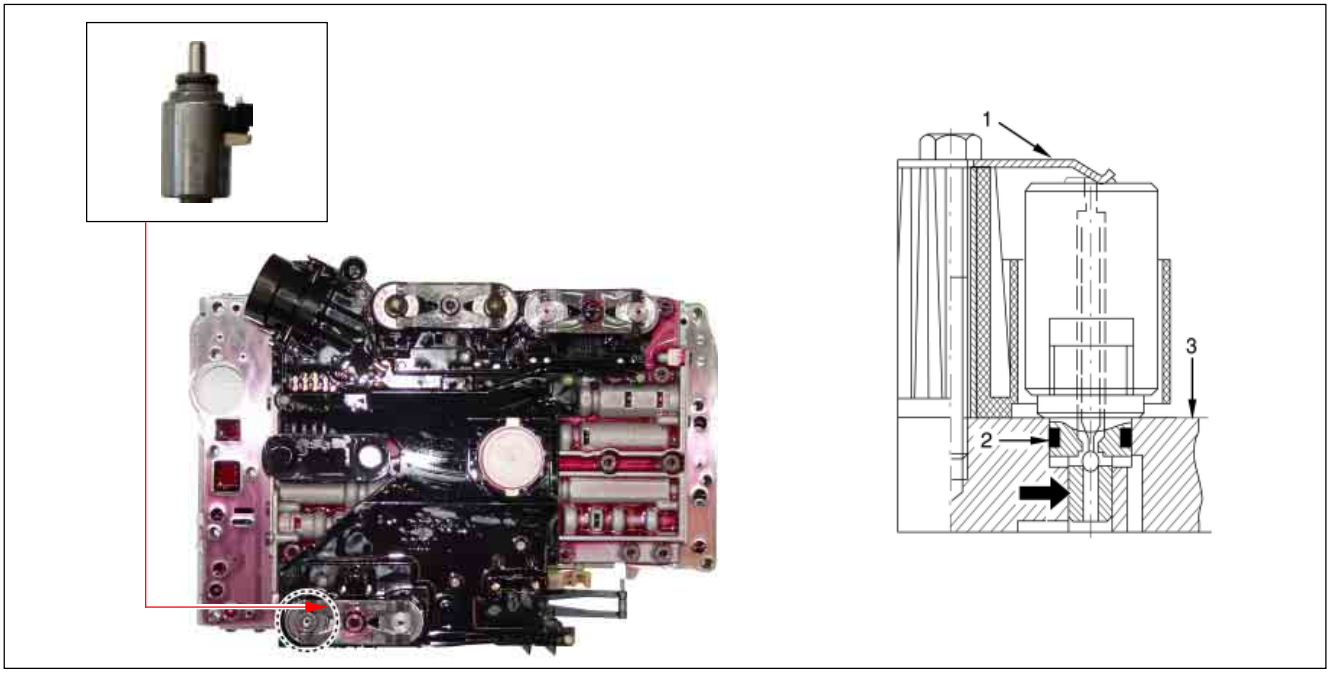
Circuit Diagram



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▶ Lockup Solenoid Valve



1. Leaf spring
2. O-ring
3. Shift plate

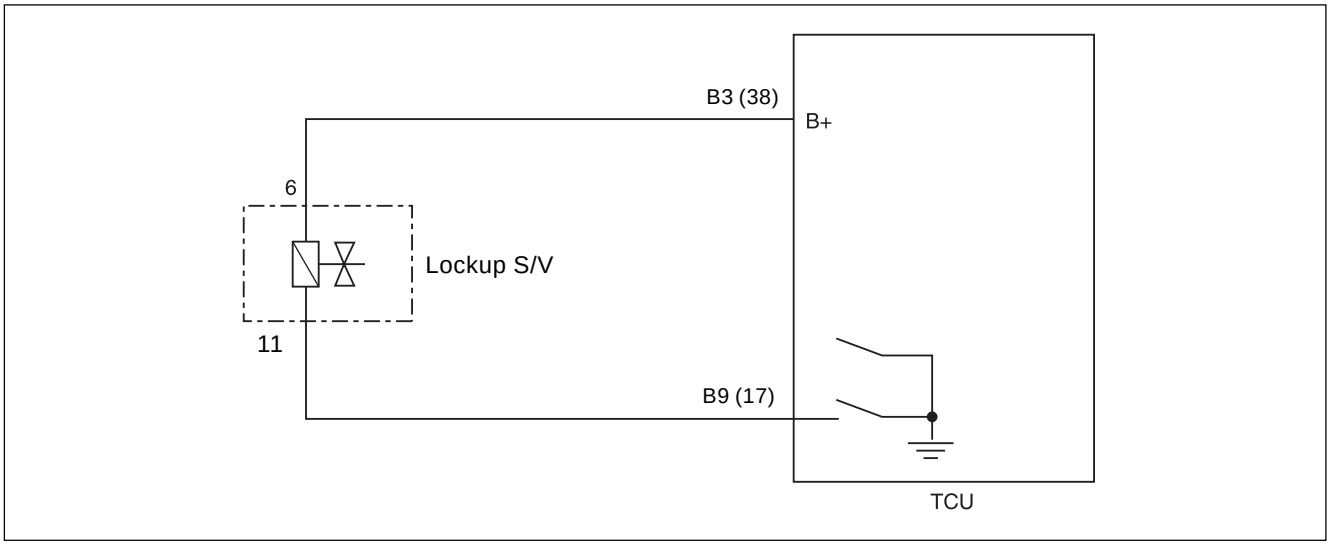
Function

This valve activates and releases the lockup clutch by adjusting the current to solenoid valve according to engine throttle opening value and output shaft speed.

The lockup clutch operates in 3rd, 4th and 5th gear step by step in order to reduce shift shocks.

Working current	1.5 ~ 2.0 A
Operating distance	0.2 mm
Resistance	2.5 ± 0.2 Ω (25°C)
Operating range	3, 4, 5

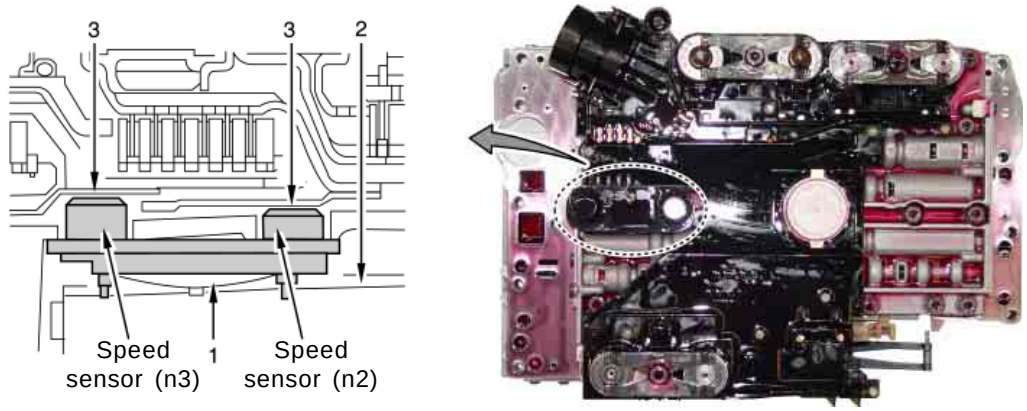
Circuit Diagram



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▶ Speed Sensor



1. Leaf spring
2. Valve body
3. Pulse ring

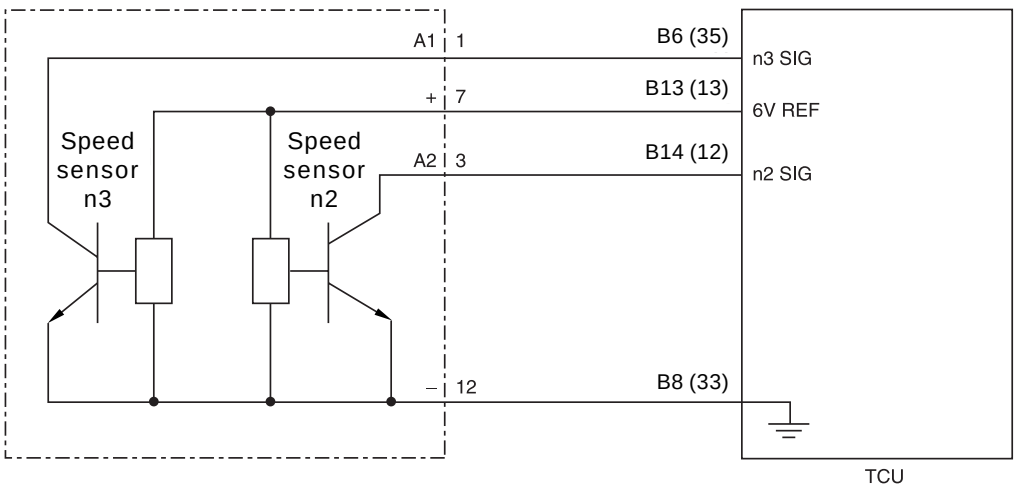
Function

The speed sensors are fixed to the shell of the hydraulic control unit via the contact tabs. A leaf spring, which rests against the valve body, presses the speed sensors against the transmission housing. This ensures a precise distance between speed sensors and impulse rings. The speed sensor (n3) detects the speed of the front sun gear and the speed sensor (n2) detects the speed of the front planetary carrier.

If the speed sensor is defective, the transmission is operated in emergency driving mode. Below diagram shows the detection of speed sensor.

Gear	N2	N3
1	•	-
2	•	•
3	•	•
4	•	•
5	•	-
R (S mode)	•	-
R (W mode)	•	•

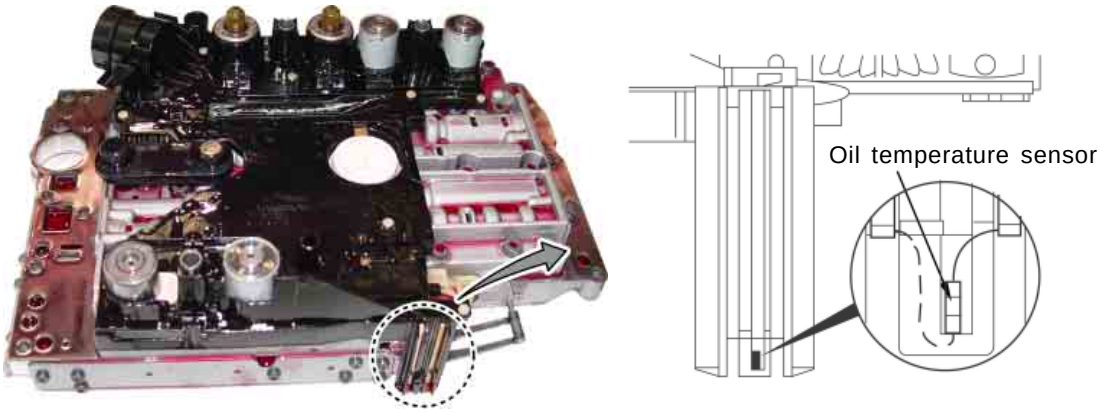
Circuit Diagram



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▶ Oil Temperature Sensor



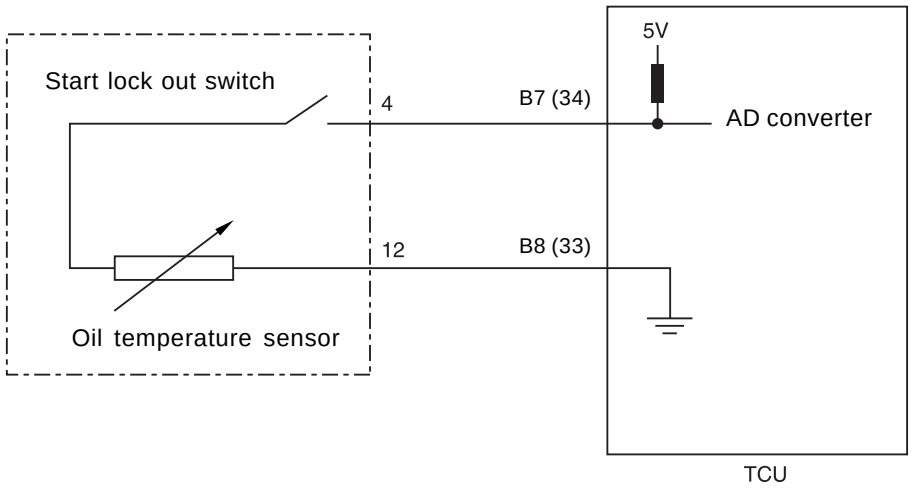
Function

The oil temperature sensor is installed in the hydraulic control unit and is connected in series with the starter lock-out contact.

This means that the temperature signal is transferred to TCU when the starter lock-out contact is closed.

The oil temperature has a considerable effect on the shifting time and therefore the shift quality. By measuring the oil temperature, shift operations can be optimized in all temperature ranges.

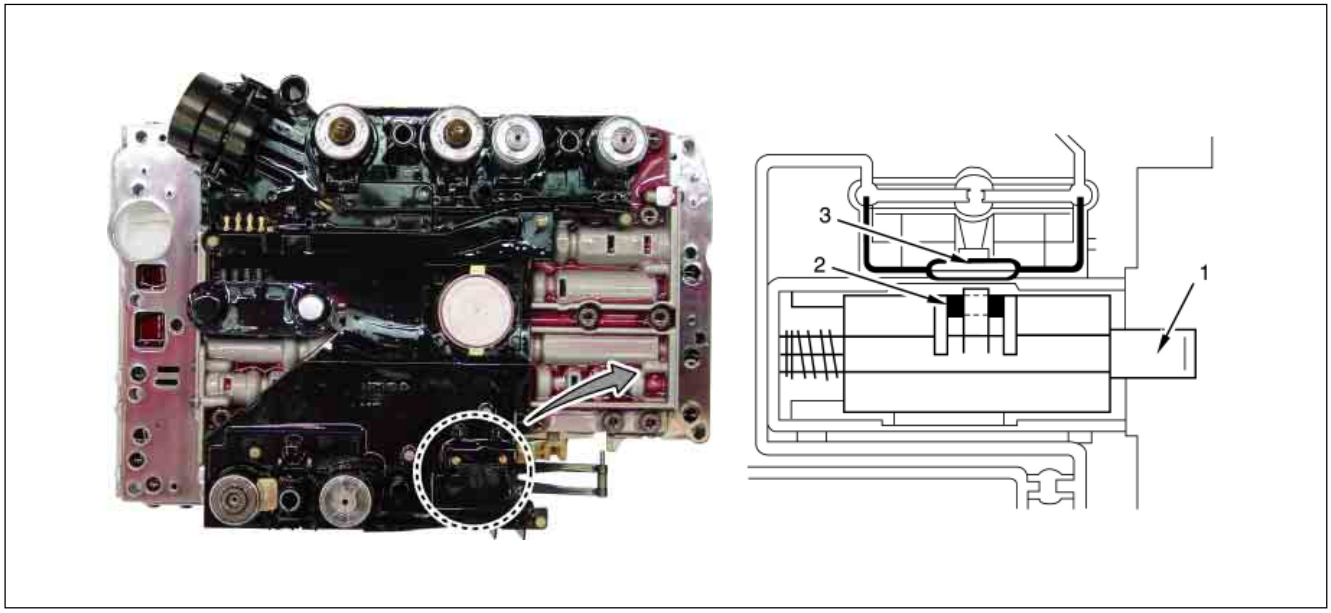
Circuit Diagram



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▶ Starter Lock-out Switch



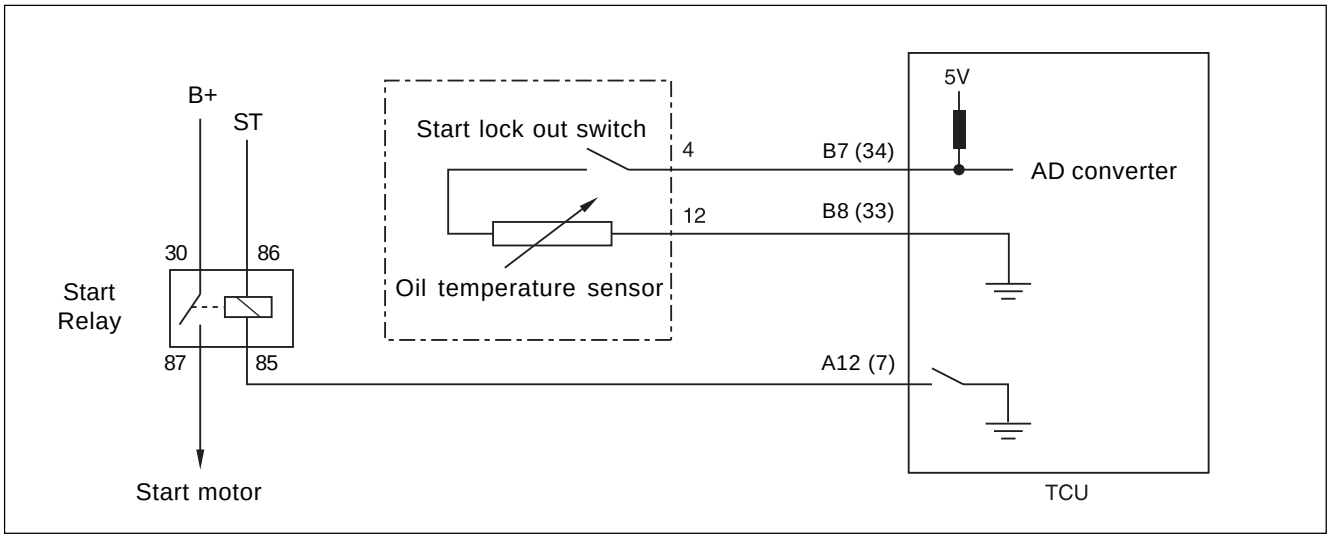
1. Plunger
2. Permanent magnet
3. Reed contact

Function

The starter lock-out switch is installed beside the oil temperature sensor and is actuated by a cam rail, which is located on the latching plate.

In the selector lever positions “P” and “N”, the permanent magnet is moved away from the reed contact. This opens the reed contact and the transmission control module receives an electrical signal. The transmission control module activates the starter lock-out relay module. This closes the electrical circuit to the starter in selector lever positions “P” and “N” via the starter lock-out relay module. In other words, when the selector lever is in driving positions, the switch contact is closed and the starter cannot be operated.

Circuit Diagram

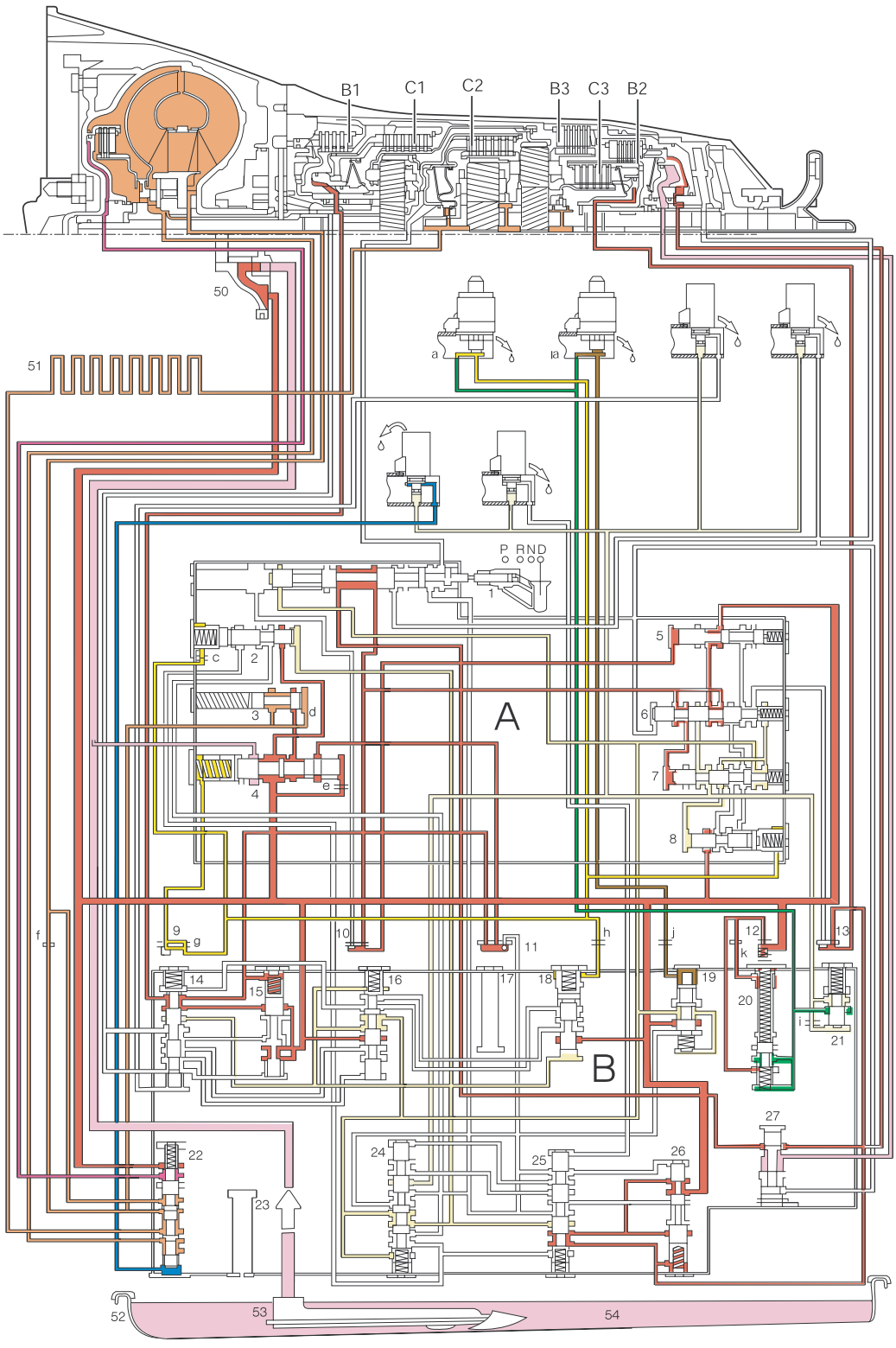


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HYDRAULIC CIRCUIT

1. HYDRAULIC CIRCUIT DIAGRAM



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A. Valve Housing

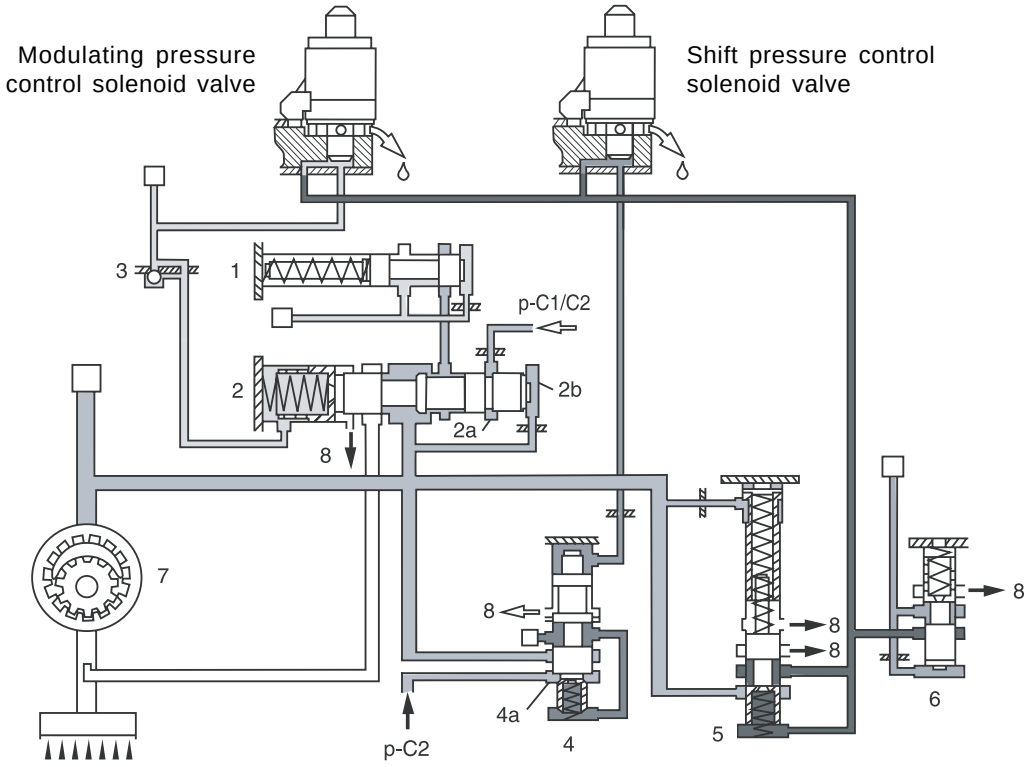
1. Selector valve
2. 2-3 overlap control valve
3. Lubricating pressure control valve
4. Operating pressure control valve
5. Holding pressure shift valve
6. Command valve
7. 3-4 shift valve
8. 3-4 overlap control valve
9. One-way throttle valve

B. Shift Housing

10. Ball change over valve
11. Ball change over valve
12. Filter screen
13. Ball change over valve
14. 1-2/4-5 command valve
15. 1-2/4-5 holding pressure shift valve
16. 1-2/4-5 shift valve
18. 1-2/4-5 overlap control valve
19. Shift pressure control valve
20. Regulating pressure control valve
21. Shift valve pressure control valve
22. Lock-up clutch control valve
24. 2-3 shift valve
25. 2-3 command valve
26. 2-3 holding pressure shift valve
27. B 2 shift valve
50. Oil pump
51. Oil cooler
52. Oil pan
53. Oil filter
54. Oil sump

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▶ Oil Pressure



1. Lubricating pressure control valve
2. Operating pressure control valve
3. One-way throttle valve
4. Shift pressure control valve
5. Control valve - control valve pressure
6. Shift pressure control valve
7. Oil pump
8. Drain

p-A. Operating pressure

Operating Pressure (P-A)

The inscribed gear type oil pump is installed into the torque converter housing and is driven via the drive flange of the torque converter.

The operating pressure produced from oil pump supplies oil pressure to main line in hydraulic system to operate the actuator. The operating pressure is the highest pressure in the hydraulic system. All other pressures are derived from it.

The operating pressure is regulated at the operating pressure control valve depending on load (modulating pressure) and driving range (C1, C2 pressure). The spring in the operating pressure control valve adjusts a minimum pressure level (base pressure).

Lubricating Pressure (P-sm)

This pressure limits the pressure in torque converter and lubricates and cools down the mechanical transmission parts. At the operating pressure control valve, excess fluid is diverted to the lubricating pressure control valve (1) and, from there, regulated for transmission lubrication use (including torque converter).

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Control Valve Pressure (P-rv)

The control valve pressure is set at the control pressure regulating valve (5) in relation to the operating pressure up to 8 bar.

This pressure supplies oil to modulating pressure (MP) solenoid valve, shift pressure (SP) solenoid valve and shift valve pressure control valve (6).

Modulating Pressure (P-m)

The modulating pressure is adjusted at the modulating pressure control solenoid valve. The height of modulating pressure is dependent on engine load by TCU. It acts on the operating pressure control valve and the pressure overlap control valve. It increases the operating pressure (line pressure) when the load is heavy.

Shift Pressure (P-s)

The shift pressure is adjusted at the shift pressure control solenoid valve and shift pressure control valve (4). Additional pressure from clutch C2 acts on the shift pressure control valve. As a result, the shift pressure in 2nd gear is reduced.

Shift Valve Pressure (P-sv)

The shift valve pressure converts the control valve pressure (p-RV) to shift valve pressure. Then it supplies oil to command valve, lockup solenoid valve, and shift pressure control solenoid valves.

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▶ Shift Groups

The hydraulic control range (including shift elements), which is responsible for the pressure distribution before, during and after a gear change, is called a shift group.

The hydraulic system consists of 3 shift groups.

A shift group can be in two phases.

1. Shift phase
2. Stationary phase

In the shift phase, a change takes place in one shift group of the engaged clutch/brake. The other two shift groups are then in the stationary phase.

Shift group C1/B1 (gear change 1-2/4-5) is responsible for the up/down shifts 1-2/2-1 and 4-5/5-4. It includes:

1. Clutch C1
2. Brake B1
3. Command valve
4. Holding pressure shift valve
5. 1-2/4-5 shift solenoid valve
6. Pressure overlap control valve
7. 1-2/4-5 shift solenoid valve

Shift group C2/C3 (gear change 2-3) is responsible for the up/down shifts 2-3/3-2.

It includes:

1. Clutch C2
2. Clutch C3
3. Command valve
4. Holding pressure shift valve
5. 2-3 shift solenoid valve
6. Pressure overlap control valve
7. 2-3 shift solenoid valve

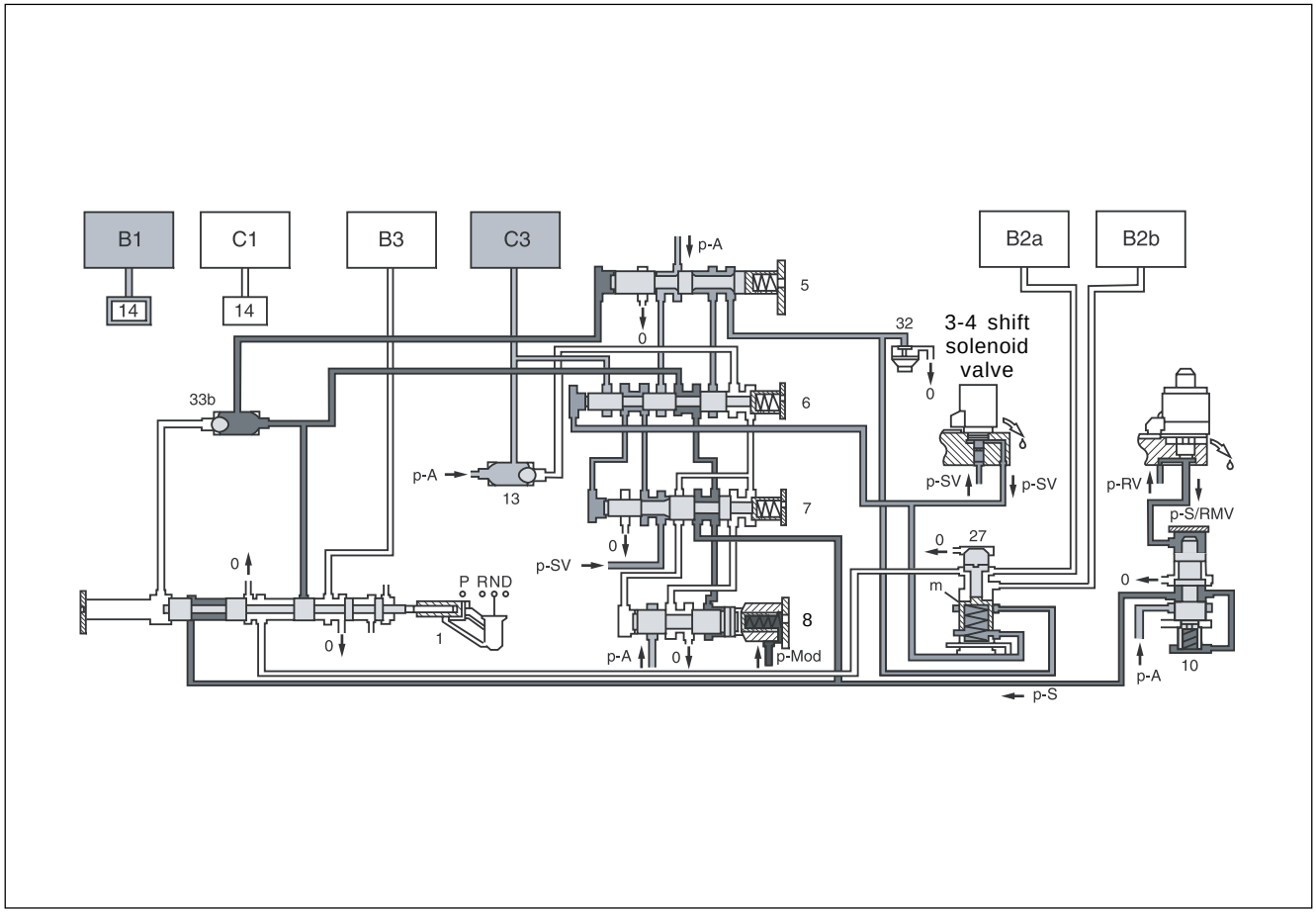
Shift group C3/B2 (gear change 3-4) is responsible for the up/down shifts 3-4/4-3 and the engagement process. It includes:

1. Clutch C3, 3-4 pressure overlap control valve
2. Brake B2, 3-4 shift solenoid valve
3. Brake B3
4. Command valve
5. Holding pressure shift valve
6. 3-4 shift solenoid valve

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2. HYDRAULIC CIRCUIT

▶ Selector Lever "N"



1. Selector valve
5. 3-4 holding pressure shift valve
6. 3-4 command valve
7. 3-4 shift pressure shift valve
8. 3-4 overlap control valve
10. Ball valve
13. Ball valve
14. 1-2/4-5 command valve
19. Shift pressure control valve
27. B2 shift valve

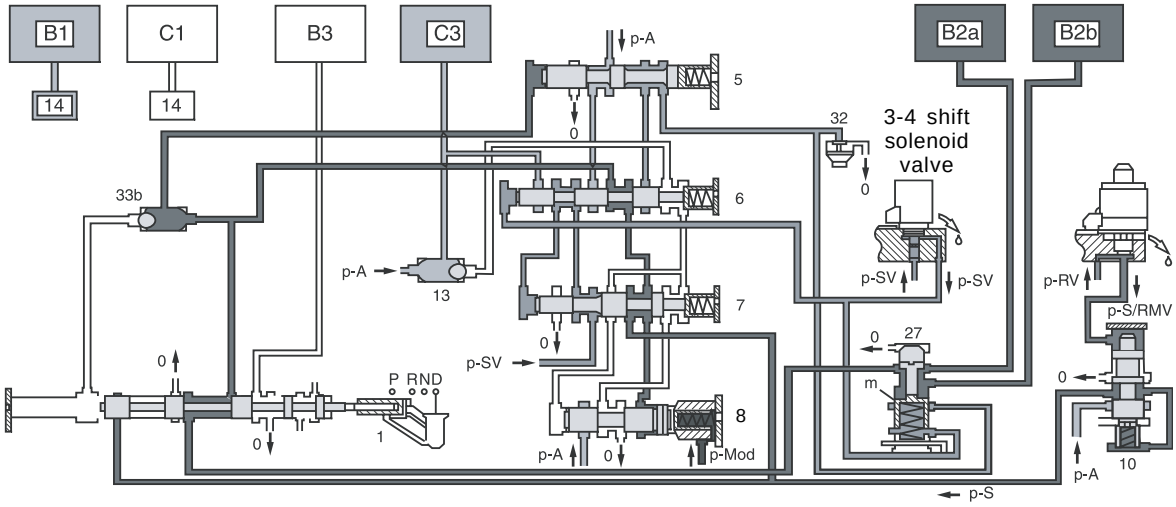
B2a : B2 piston
B2b : Opposite face of B2 piston
m : Annular surface
p-A : Operating pressure
p-Mod : Modulating pressure
p-RV : Control valve pressure
p-S : Shift pressure
p-S/RMV : Shift pressure/control solenoid valve
p-SV : Shift valve pressure

The operating pressure (p-A) is formed and travels via the 2-3 holding pressure shift valve, the 2-3 command valve and ball valve (13) to clutch C3 and via the 3-4 command valve (6) to the end face of the 3-4 shift pressure shift valve (7). At the same time, the 3-4 solenoid valve is energized. This allows shift valve pressure (p-SV) to enter the spring chamber of the shift valve B2 (27) and to reach the end face of the 3-4 command valve (6).

The shift valve B2 (27) is held in the upper position and the 3-4 command valve (6) moves towards the right. At the end face of the 3-4 shift pressure shift valve (7), the operating pressure (p-A) is replaced by shift valve pressure (p-SV).

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▶ Hydraulic Circuit when Selector Lever is in “D” Position (Shift Phase)



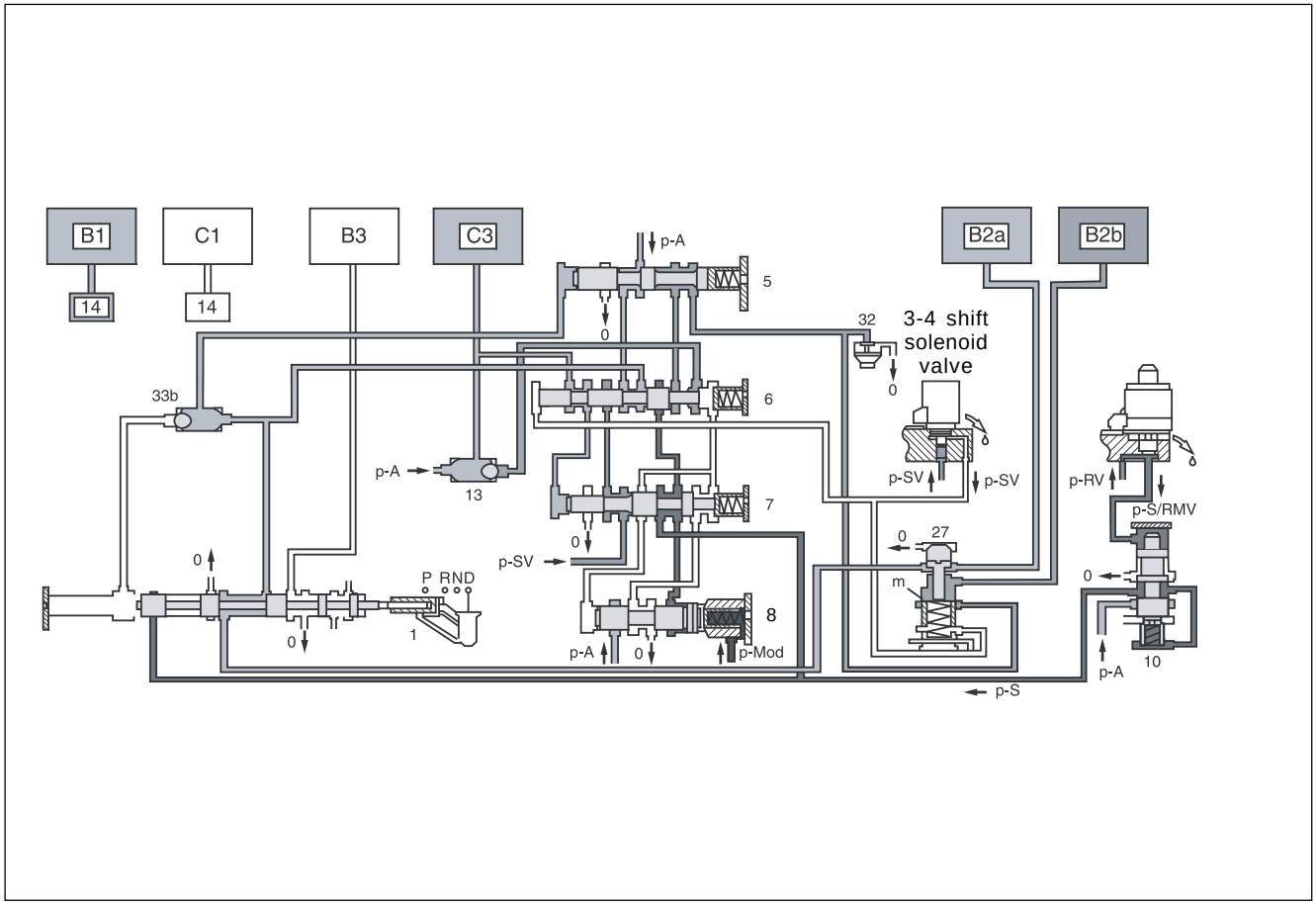
1. Selector valve
5. 3-4 holding pressure shift valve
6. 3-4 command valve
7. 3-4 shift valve
8. 3-4 overlap control valve
10. Ball valve
13. Ball valve
14. 1-2/4-5 command valve
19. Shift pressure control valve
27. B2 shift valve

B2a : B2 piston
B2b : Opposite face of B2 piston
m : Annular surface
p-A : Operating pressure
p-Mod : Modulating pressure
p-RV : Control valve pressure
p-S : Shift pressure
p-S/RMV : Shift pressure/control solenoid valve
p-SV : Shift valve pressure

The selector valve (1) opens the shift pressure (p-S) feed connection from the ball valve (10) with the shift valve B2 (27). With the shift valve B2 (27) in the upper position, shift pressure (p-S) travels behind the piston B2 (B2a) and simultaneously to the opposite face of the piston B2 (B2b). The brake B2 begins to activate.

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▶ Hydraulic Circuit when Selector Lever is in “D” Position (1st Gear)



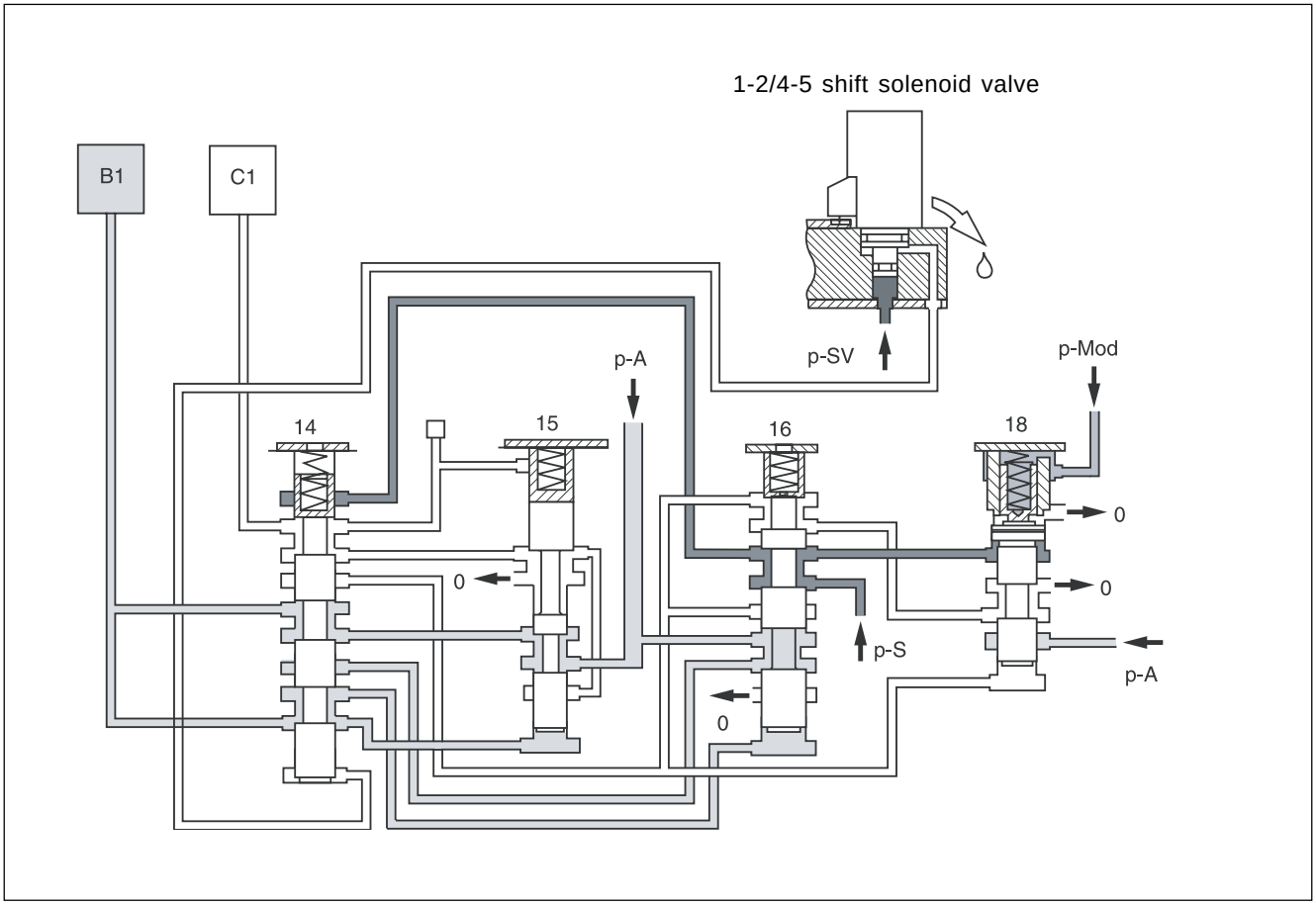
1. Selector valve
5. 3-4 holding pressure shift valve
6. 3-4 command valve
7. 3-4 shift valve
8. 3-4 overlap control valve
10. Ball valve
13. Ball valve
14. 1-2/4-5 command valve
19. Shift pressure control valve
27. B2 shift valve
32. Pressure holding valve

B2a : B2 piston
B2b : Opposite face of B2 piston
m : Annular surface
p-A : Operating pressure
p-Mod : Modulating pressure
p-RV : Control valve pressure
p-S : Shift pressureShift pressure
p-S/RMV : Shift pressure/control solenoid valve
p-SV : Shift valve pressure

The pressure on the opposite face of the piston B2 (B2b) ensures a soft activation of the brake B2. The TCU monitors the activation sequence via the speed of input shaft, which slows down as the frictional connection in the brake increases. When the speed drops to the specified level, TCU shuts off the power to the 3-4 shift solenoid valve. The spring chamber of the shift valve B2 (27) is depressurized and moves downwards. This connects the line to the opposite face of the piston B2 (B2b) with the pressure holding valve (32). The pressure on the opposite face of the piston B2 (B2b) drops to a residual pressure. The 3-4 command valve (6) moves to the left. The operating pressure (p-A) travels via the holding pressure shift valve (5) and the 3-4 command valve (6) to the piston of brake B2 (B2a).

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▶ Hydraulic Circuit after Shifted to 1st Gear



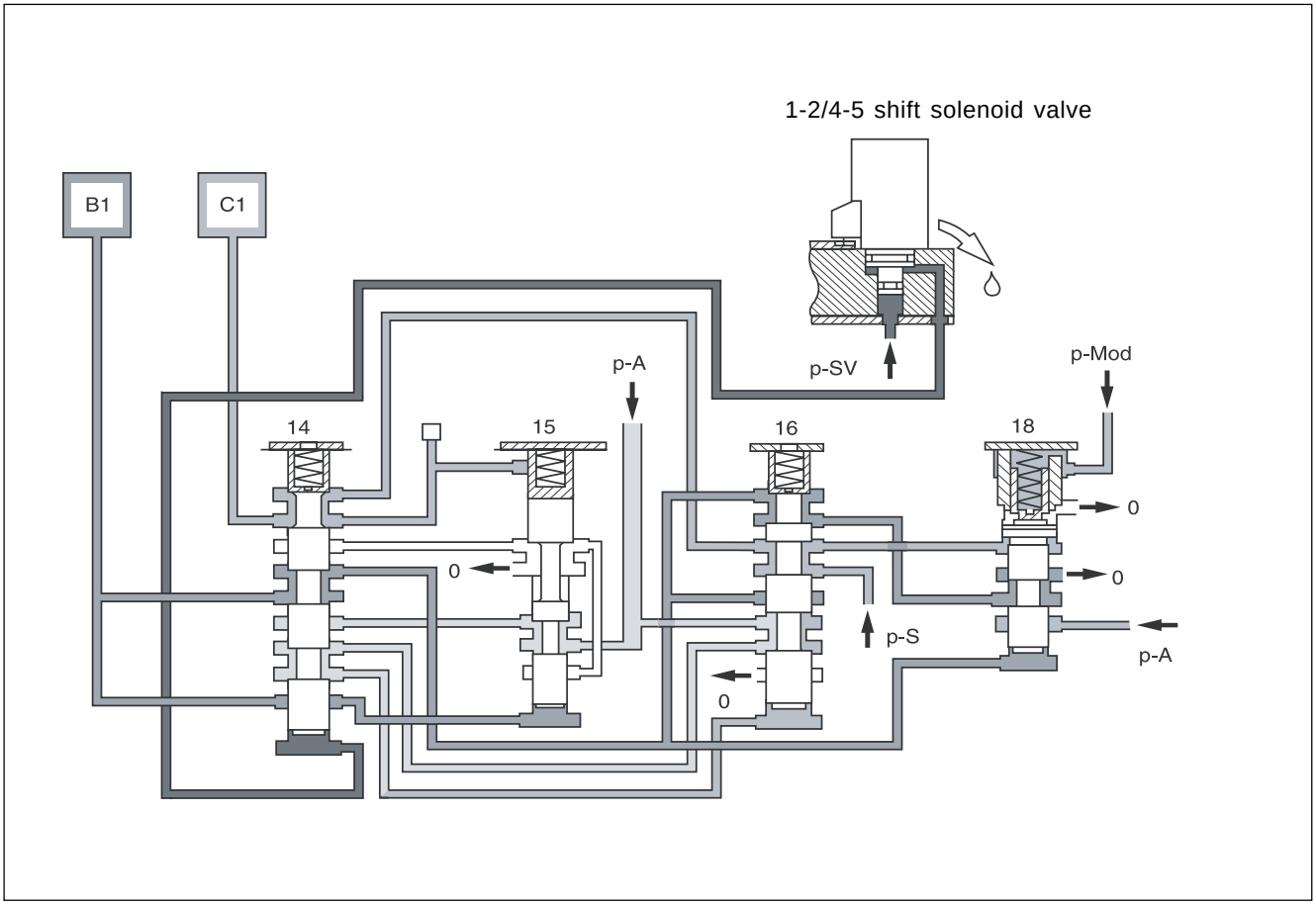
14. 1-2/4-5 command valve
15. 1-2/4-5 holding pressure shift valve
16. 1-2 /4-5 shift valve
18. 1-2/4-5 overlap control valve

0 : Return flow to oil sump
p-A : Operating pressure
p-MOD : Modulating pressure
p-S : Shift pressure
p-SV : Shift valve pressure

The end face of 1-2/4-5 command valve (14) is kept unpressurized via the 1-2/4-5 solenoid valve. The operating pressure is applied to the brake B1 via the holding pressure shift valve (15). The clutch C1 is unpressurized. The operating pressure from brake B1 acts against the holding pressure shift valve (15) and the end face of 1-2/4-5 shift pressure shift valve (16).

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▶ Hydraulic Circuit During Shift Phase (2nd Gear)



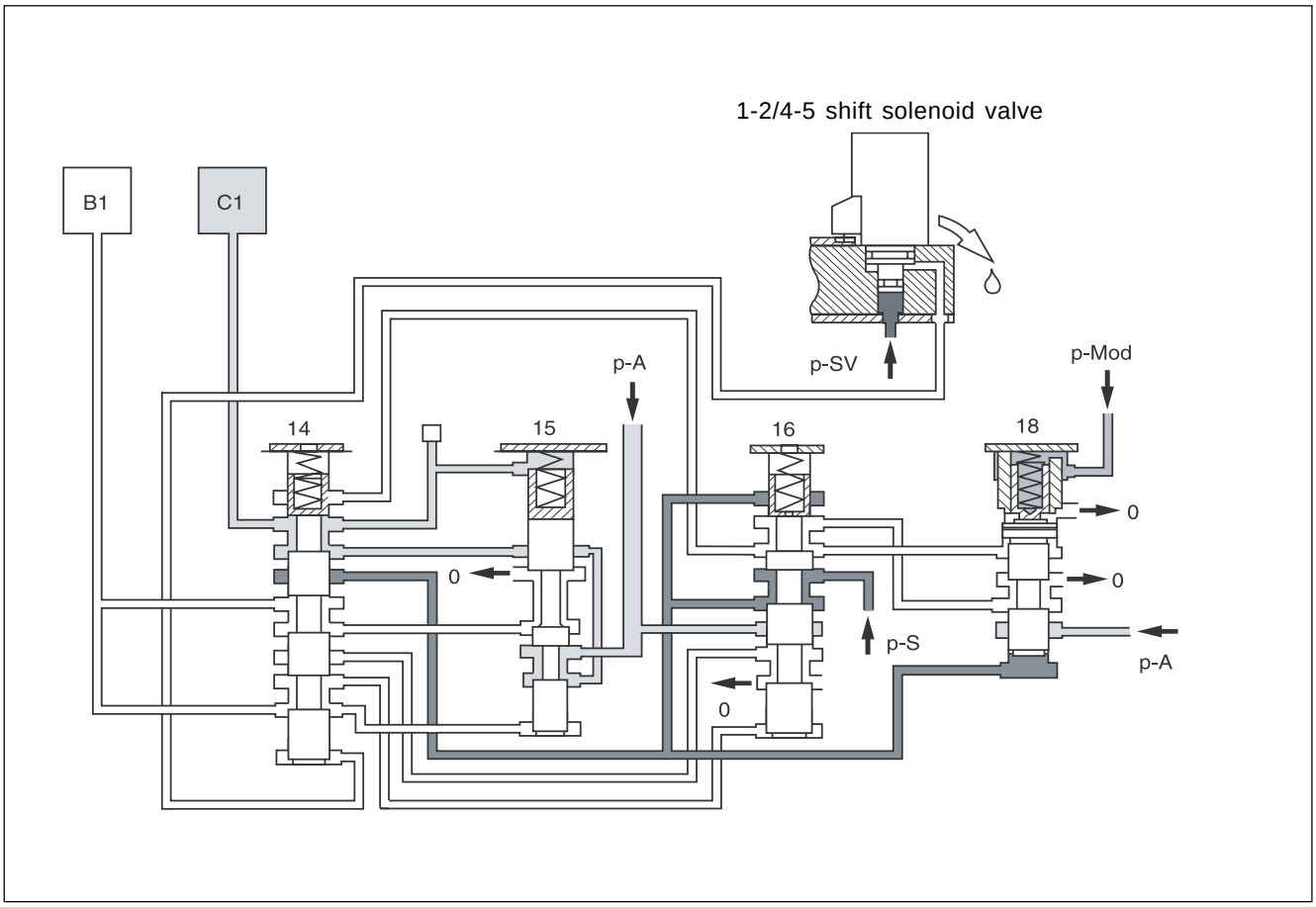
14. 1-2/4-5 command valve
15. 1-2/4-5 holding pressure shift valve
16. 1-2/4-5 shift valve
18. 1-2/4-5 overlap control valve

o : Return flow to oil sump
p-A : Operating pressure
p-MOD : Modulating pressure
p-S : Shift pressure
p-SV : Shift valve pressure

The shift valve pressure (p-SV) is directed onto the end face of the 1-2/4-5 command valve (14) via the 1-2/4-5 shift solenoid valve. The command valve (14) moves up and the shift pressure (p-S) coming from the 1-2/4-5 shift pressure shift valve (16) is routed via the command valve (14) to clutch C1. Overlap pressure is simultaneously applied to brake (B1) from the pressure overlap control valve (18). The B1 pressure acting on the end face of shift pressure shift valve (16) is replaced by operating pressure (p-A). The increasing shift pressure (p-S) on clutch C1 acts on the annular surface of the pressure overlap control valve (18) and reduces the overlap pressure controlled by the pressure overlap control valve (18). It will shift at a corresponding pressure on the holding pressure shift valve (15).

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▶ Hydraulic Circuit after Completed Gear Change (2nd Gear)



14. 1-2/4-5 command valve
15. 1-2/4-5 holding pressure shift valve
16. 1-2/4-5 shift valve
18. 1-2/4-5 overlap control valve

o : Return flow to oil sump
p-A : Operating pressure
p-MOD : Modulating pressure
p-S : Shift pressure
p-SV : Shift valve pressure

The 1-2/4-5 shift solenoid valve interrupts the pressure on the end face of the command valve (14) and it returns to its base position. The operating pressure (p-A) is now applied to clutch C1 via the holding pressure shift valve (15) and the command valve (14). The brake B1 is disengaged (unpressurized). The spring of the shift pressure shift valve (16) moves it into base position.

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3. ADAPTER PLUG

The adapter plug is an input and output terminal assembly for TCU to control the valve body. It is installed to the valve body with 7 mm bolts. To prevent oil leakage, two O-rings are installed on the plug.

1. Remove the heat shield for adapter plug wire next to exhaust tube.



2. Turn the adapter plug lock counterclockwise and disconnect the plug connector.



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3. Unscrew the bolts (7 mm) and carefully remove the adapter plug.

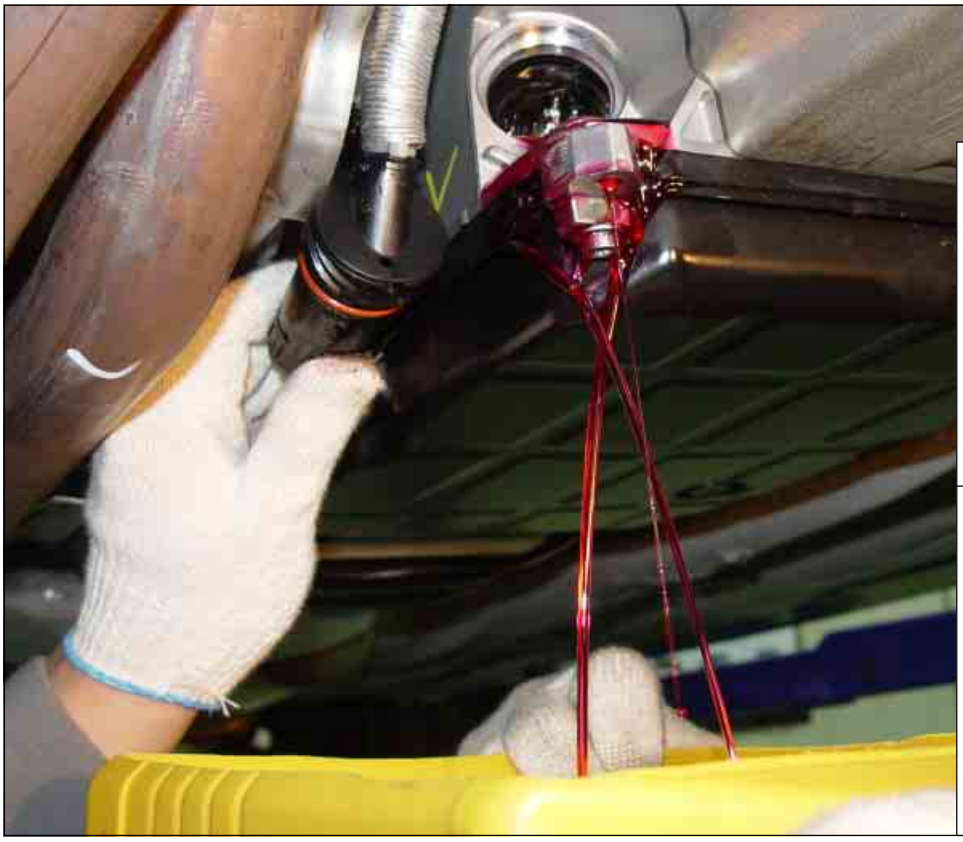
NOTICE

- **Keep the specified tightening torque (4 Nm ± 0.5 Nm). Otherwise, it may result in unnecessary replacement of electric kit in assembly due to oil leakage.**
- **Do not apply an excessive force to remove the adapter plug. It may cause an internal damage to electrci kit.**





4. Place an empty container under the adapter plug and remove the adapter plug.







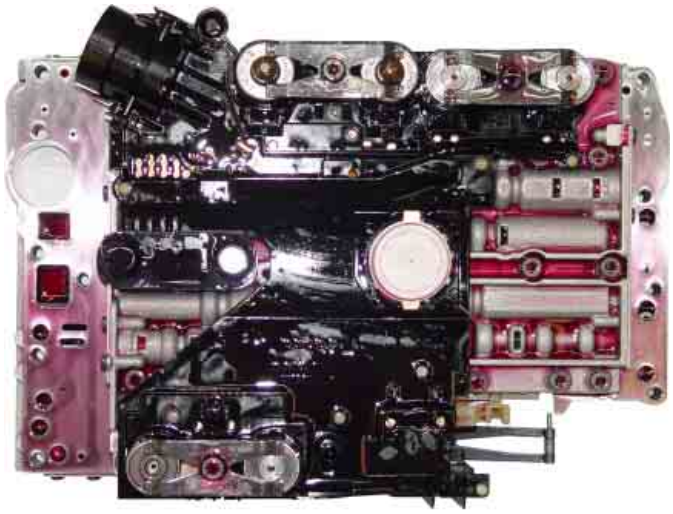
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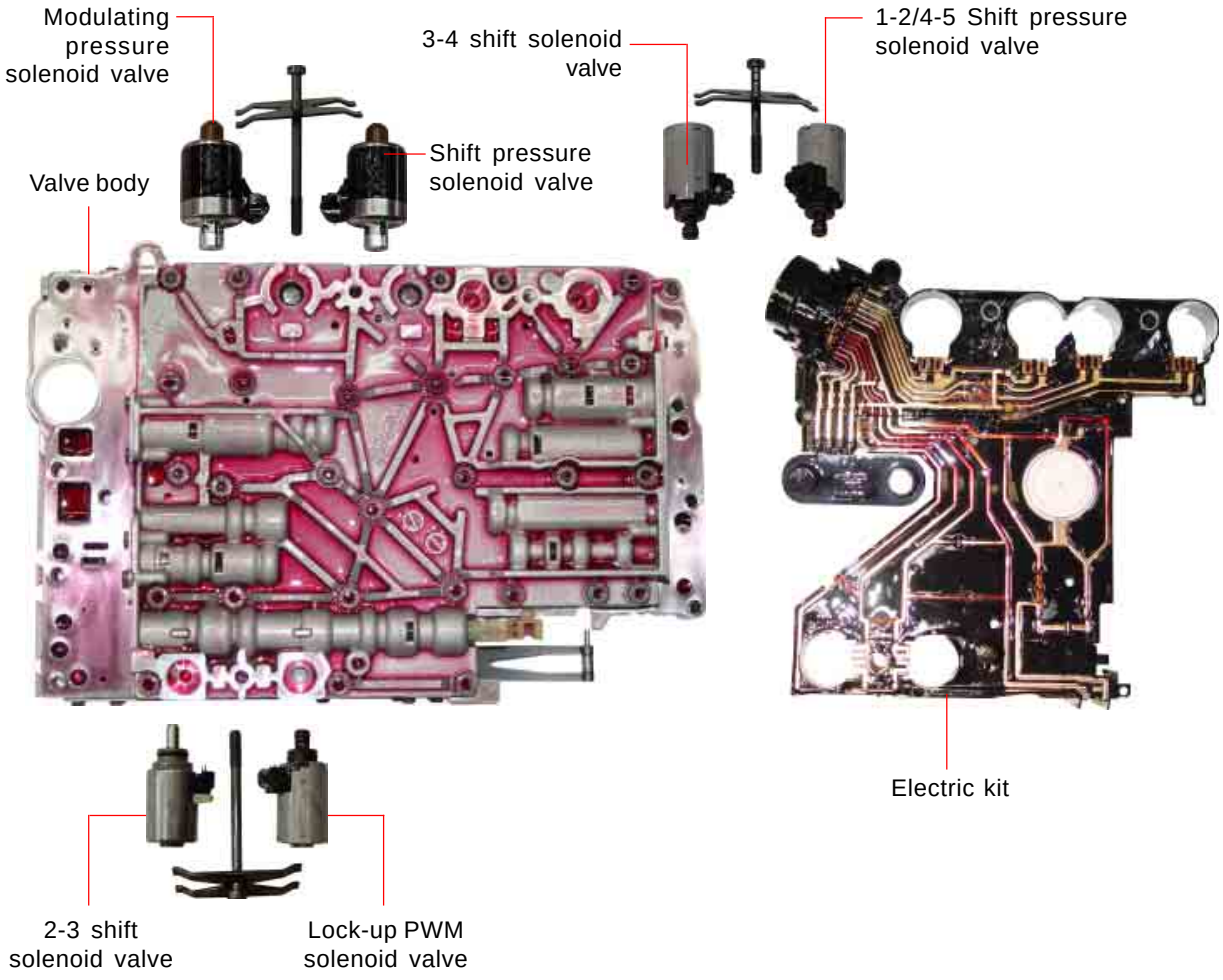
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4. VALVE BODY

Valve body can be replaced from onboard and from removed transmission.

Valve Body Assembly





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Valve Body Replacement (Onboard)

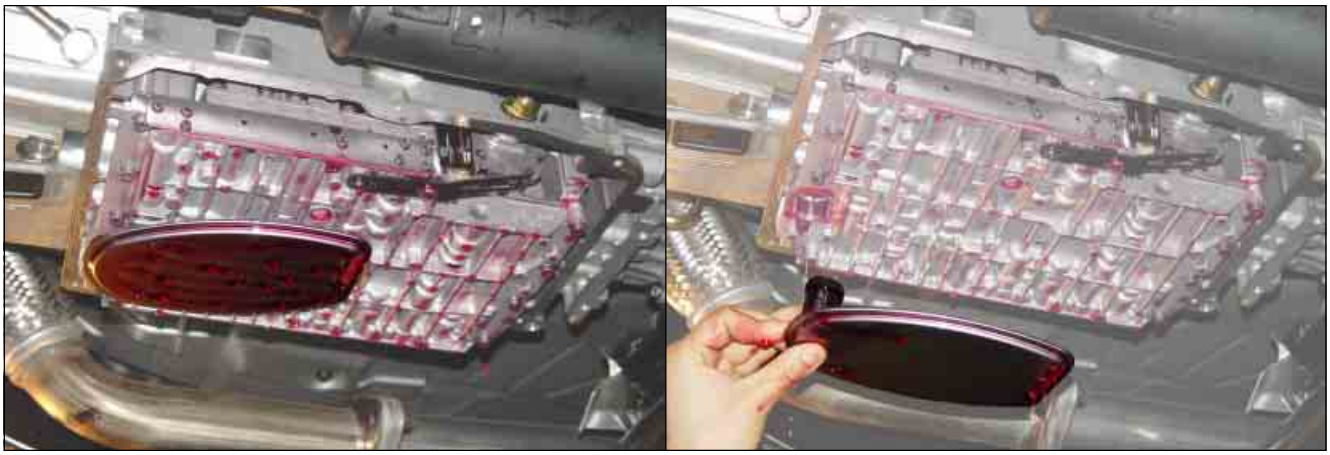
1. Remove the oil pan drain plug and drain the oil completely.



2. Unscrew the six oil pan bolts (T30) and carefully lower the oil pan (6).

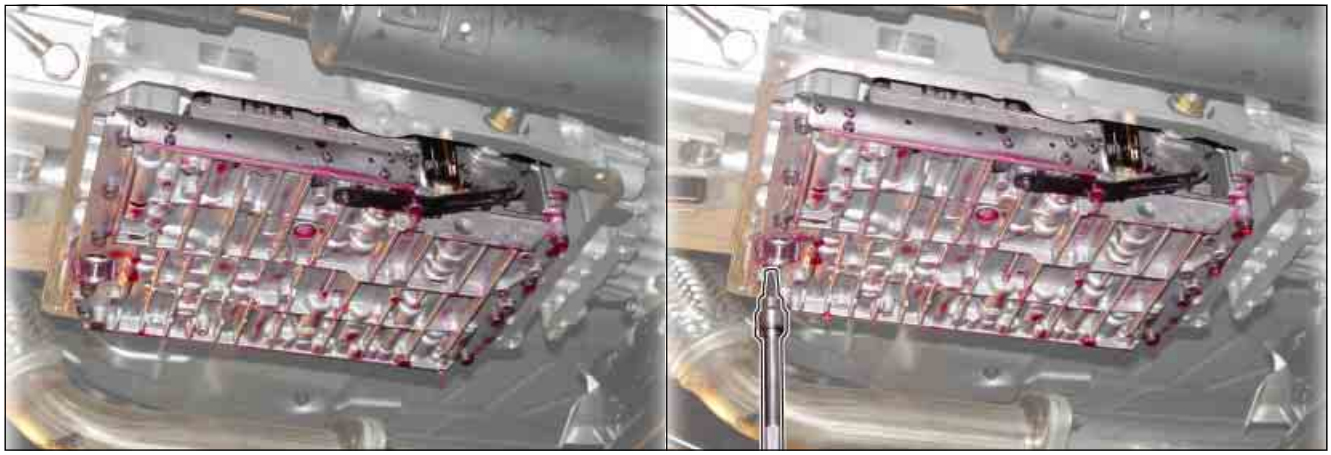


3. Carefully remove the oil filter.

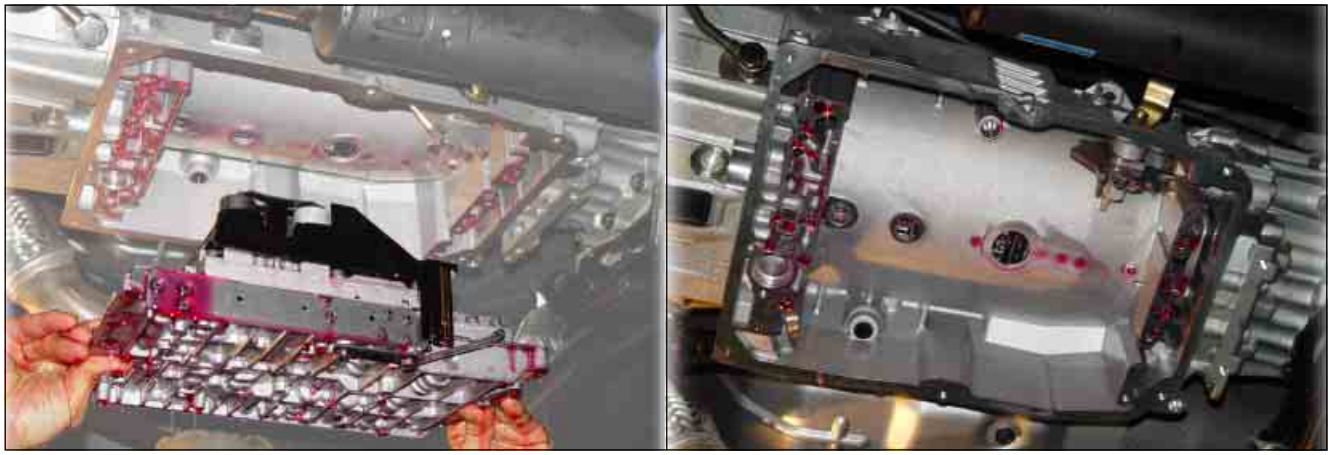


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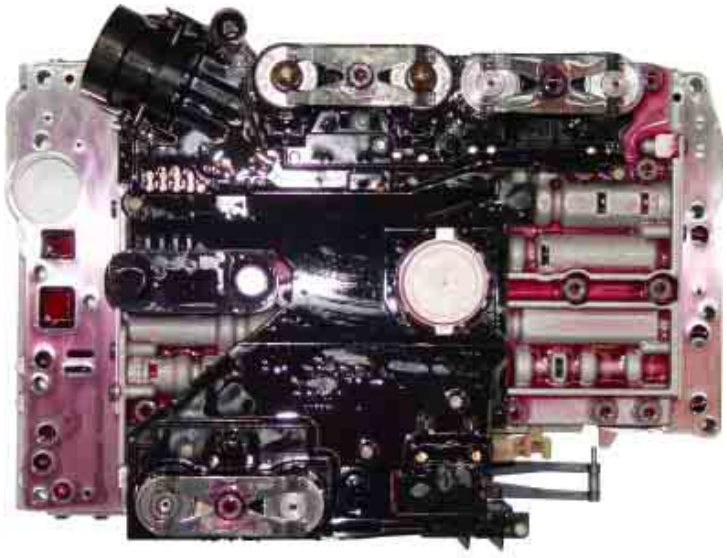
4. Unscrew the fixing bolts (T30).



5. Carefully remove the valve body from transmission housing.



Valve Body Assembly



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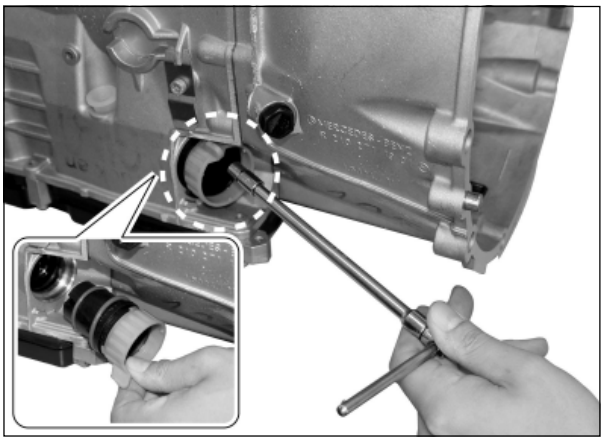
Valve Body Replacement (From Removed T/M)

※ **Preceding Works:** Install the transmission on the workbench.

NOTE

- **To eliminate unnecessary working time and process, prepare general tools, special tools, and gaskets before starting the work.**
- **The automatic transmission is very precise equipment. Keep the transmission clean and tighten the bolts with specified tightening torque.**

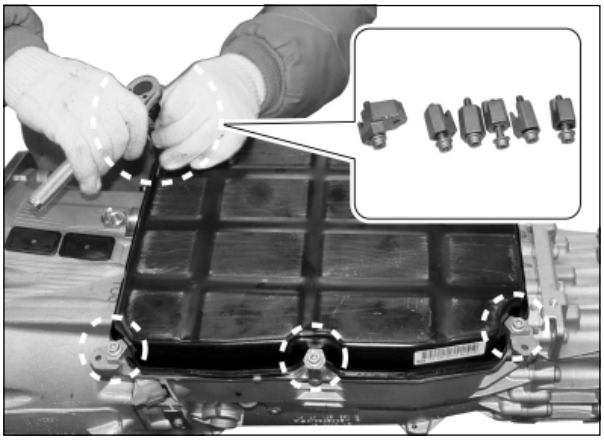
1. Unscrew the hexagon bolt (7 mm) and remove the guide bush from transmission housing.



Installation Notice

Tightening torque	4 Nm

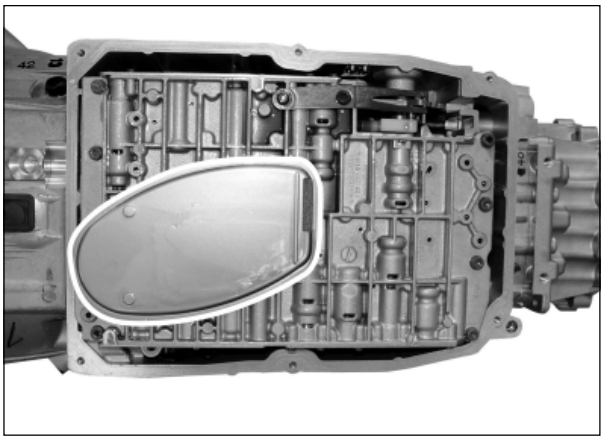
2. Unscrew the oil pan bolts and remove the oil pan.



Installation Notice

Tightening torque	8 Nm

3. Remove the oil filter.

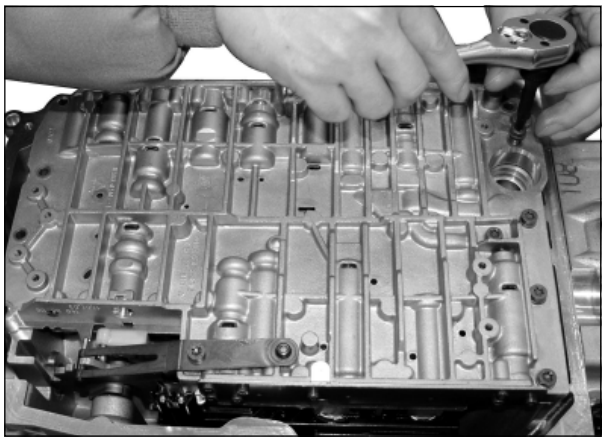


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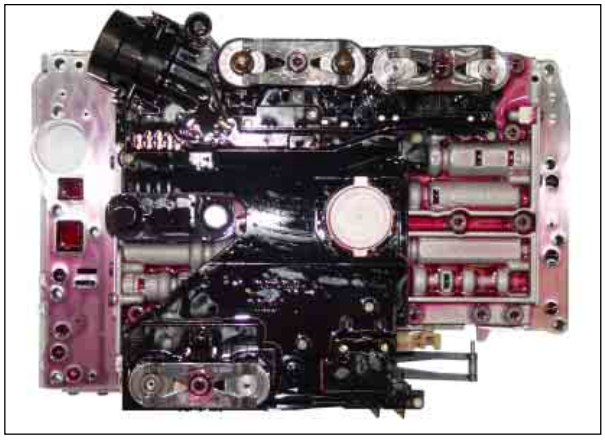
4. Unscrew the bolts and remove the valve body from transmission housing.

Installation Notice

Tightening torque	8 Nm



5. Disassemble the valve body assembly.



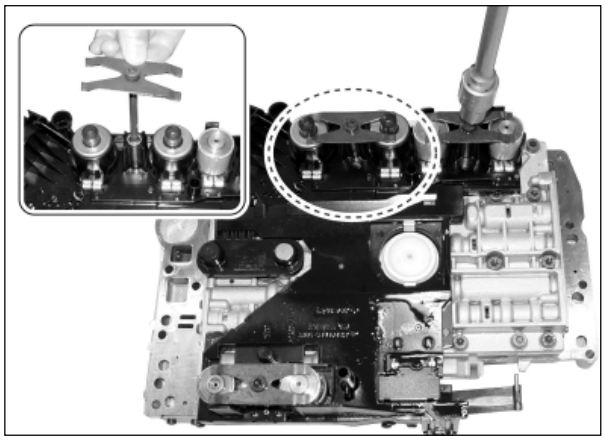
5-1. Unscrew the socket bolts on the solenoid valve and remove the leaf springs.

Installation Notice

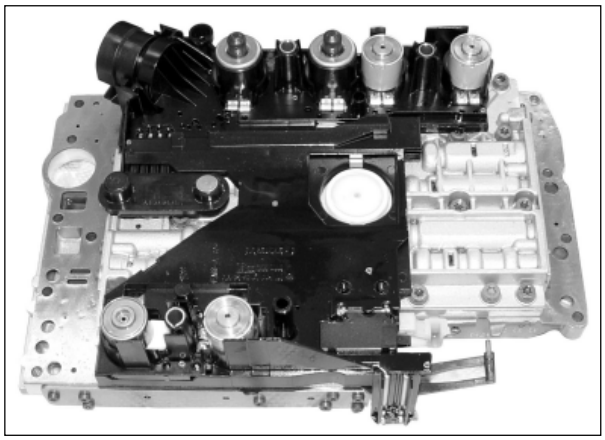
Tightening torque	8 Nm

NOTICE

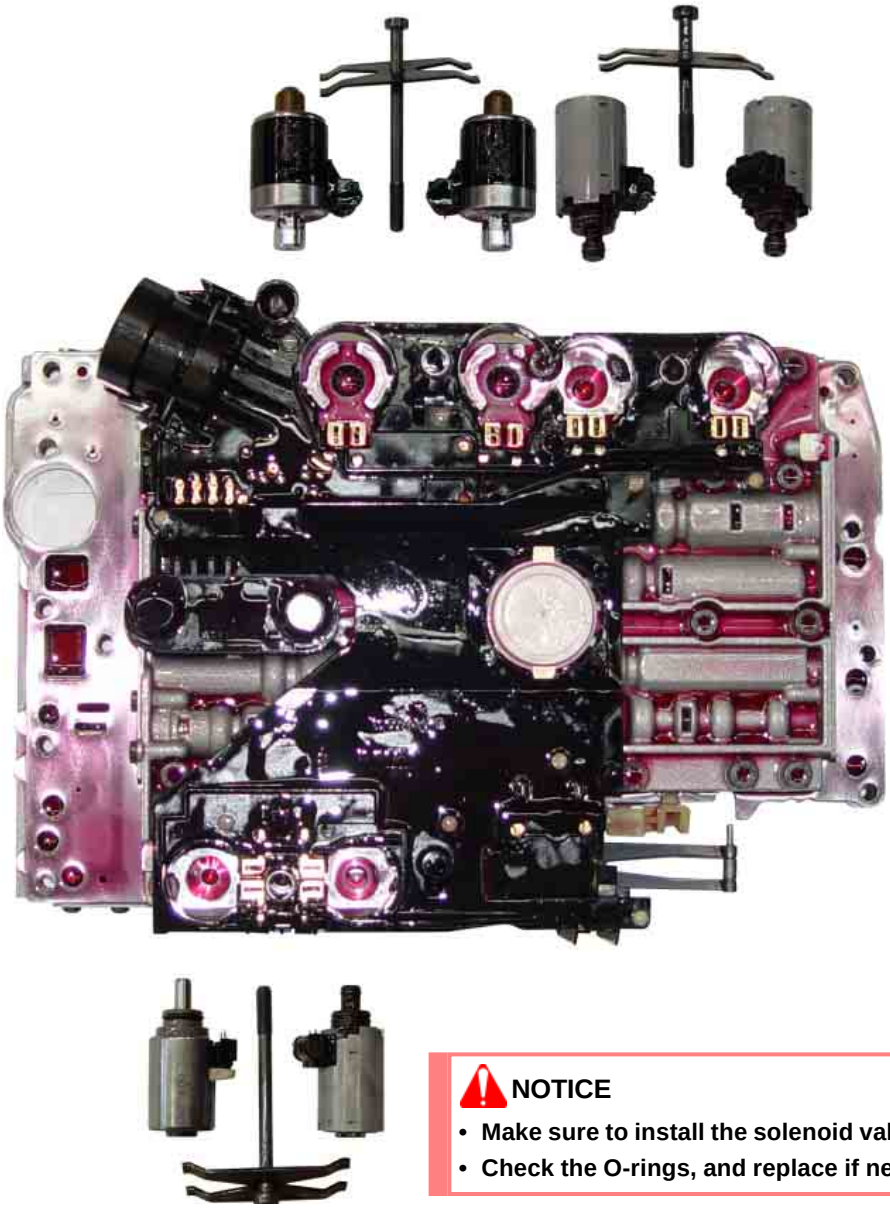
- **The length of socket bolts vary. Be careful not to mix up.**



5-2. Remove the solenoid valves from the valve body.



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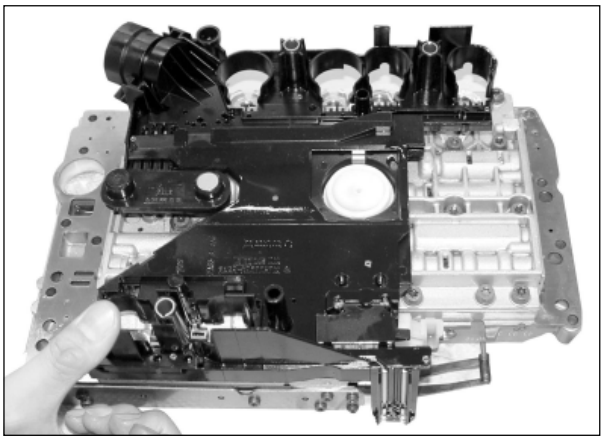
NOTICE

- **Make sure to install the solenoid valves in place**
- **Check the O-rings, and replace if necessary.**

5-3. Remove the electronic control module from the shift plate.

NOTICE

- **Correctly align the electronic control module onto the shift plate by using two central pins when installing.**



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TCU (Transmission Control Unit)

▶ Function

TCU controls the gear groups according to the driving conditions. It receives the driving data from many sensors and switches as input signals. It is also connected with ECU, HECU, instrument panel and selector lever control unit.



TCU

1. Shifting Method

Basic shift operation includes up-shift and down-shift for all gear groups. The shift control unit determines driving resistance, accelerator pedal position, vehicle speed and some parameters (road surface condition, up hill and down hill gradients, trailer driving conditions, catalytic converter conditions, driving habits and automatic transmission oil temperature) to select a shift gear.

2. Down Shift

When engine speed increases excessively, the down shift does not occur. To get an engine brake effect during downhill driving, **the current gear is maintained in speed control mode**.

3. Engine RPM Adjustment

During shifting, the engine torque is reduced to optimize the shift operation by delaying the ignition time.

4. Lock-Up Clutch Control

The lockup clutch in torque converter is activated in 3rd, 4th and 5th gear and operates in sequence via PWM solenoid valve.

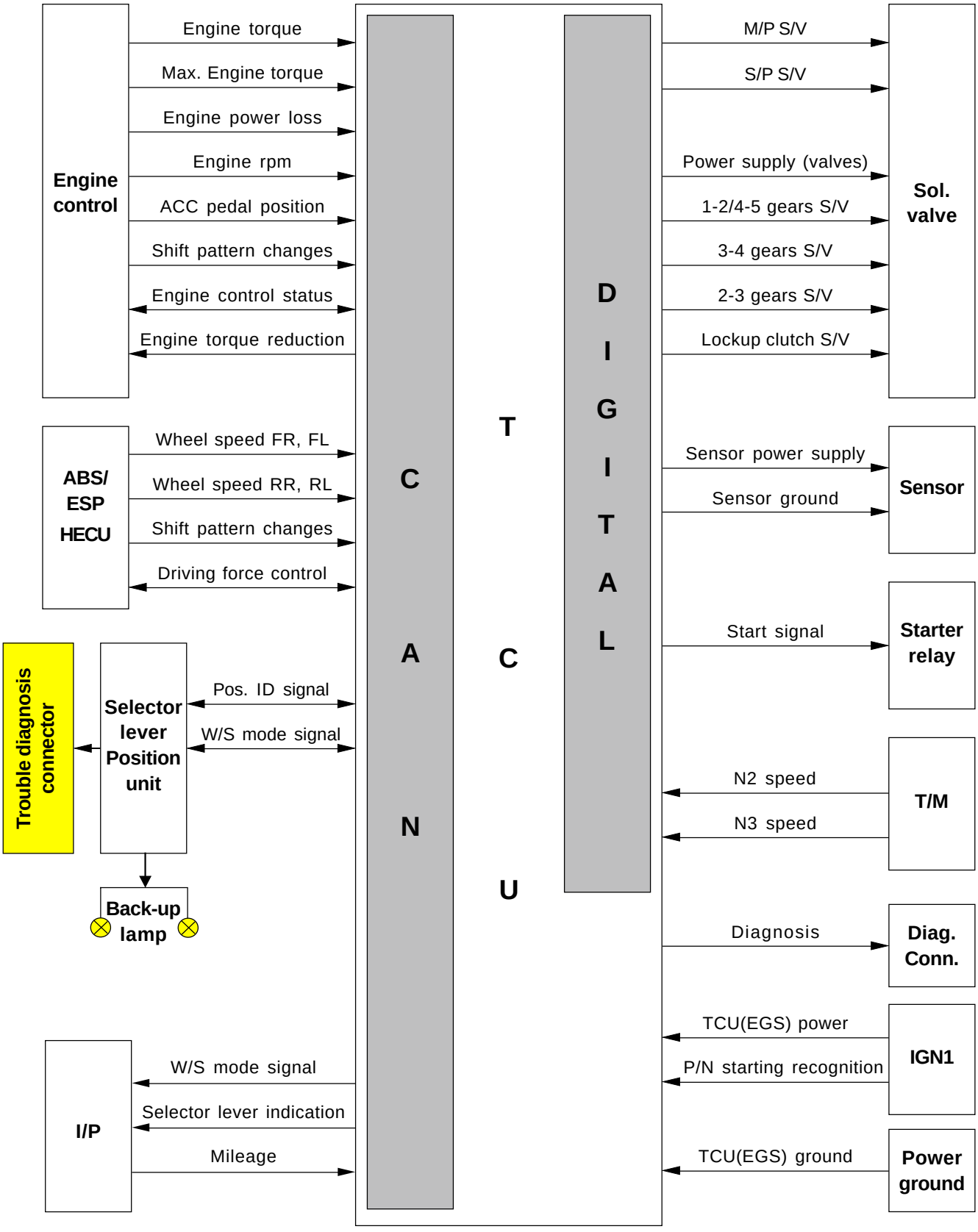
5. Others

The transmission is automatically controlled to compensate durability and wear.

The shift control values such as shifting point, shifting time, pressure during shifting, and lockup clutch control are permanently saved and the diagnosis is partially available.

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TCU Block Diagram



*** Refer to the circuit diagram for the detailed wiring connection and related pin number.**

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▶ Characteristics of TCU and Automatic Transmission (LHM: Limp-Home Mode)

The emergency driving mode is to minimize the vehicle's operation, which is a mode for maintaining minimum driving condition if the automatic transmission is defective. In emergency driving mode, excessively long driving and unreasonable driving should be avoided to prevent a critical fault occurence in advance.

Emergency driving mode can largely be divided in electrical defective and hydraulic pressure/mechanical defective.

Electrical defect

1. If an electrical defective occurs in transmission during driving, current shift gear position is held.
   1) Shut off of various solenoid valves
   2) Internal pressure in transmission increases (shift shock gets bigger when changing selector lever due to maximized MP and SP)
   3) Lockup clutch is released

2. If the shift operation cannot be activated, the driver must reset the system as follows:
   1) Stop the vehicle and place the selector lever to "P" position.
   2) Wait for 10 seconds after stopping the engine (release hydraulic pressure)
   3) Start the engine.
   4) Place the selector lever to "D" or "R" position.

Mechanical/hydraulic pressure defect

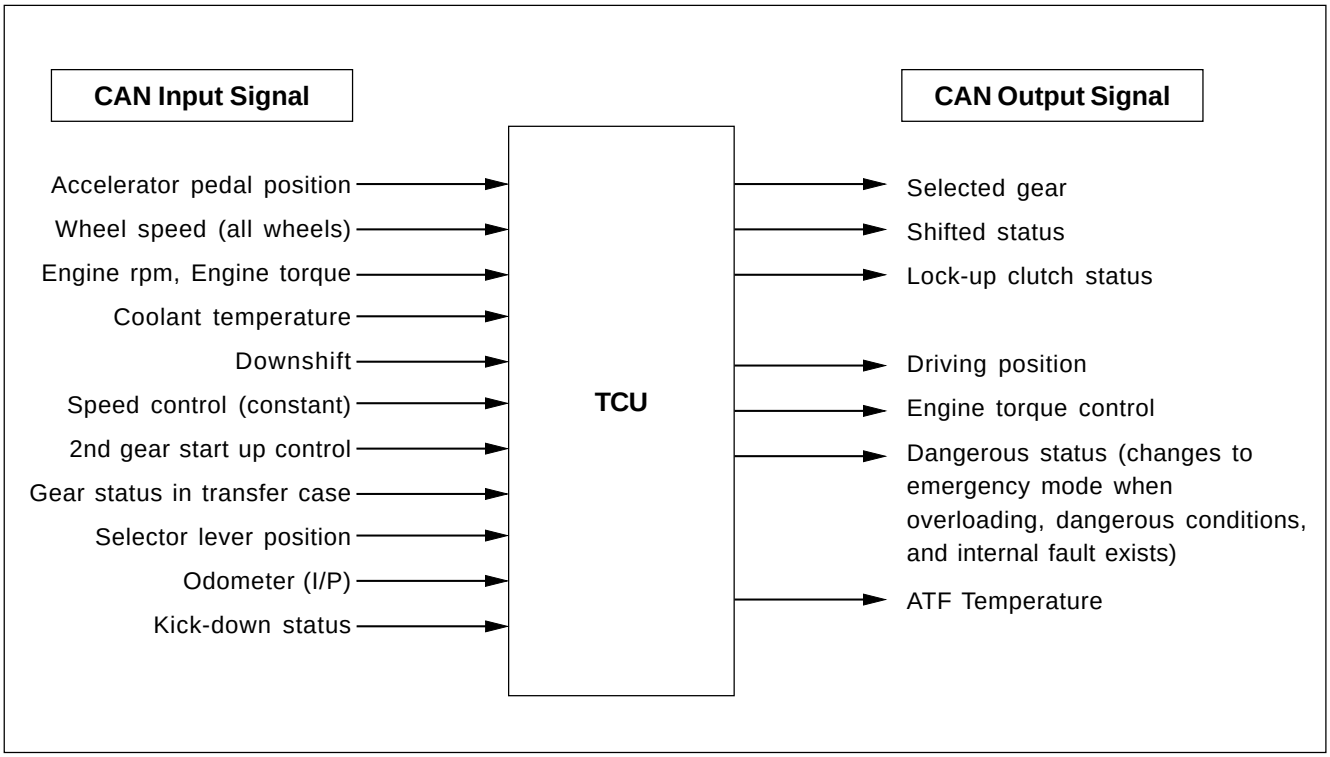
1. Characteristics that appears in the vehicle are as below:
   1) Holds at 3rd gear (It can be held at proper gear if the fault occurs at 3rd gear)
   2) Electrical devices operate normally and the shift shock is acceptable during shift operation.

2. If the shift operation cannot be activated, the driver must reset the system as follows:
   1) Stop the vehicle.
   2) Stop the engine.
   3) In most cases, it is reset when the engine is started and the vehicle operate normally.

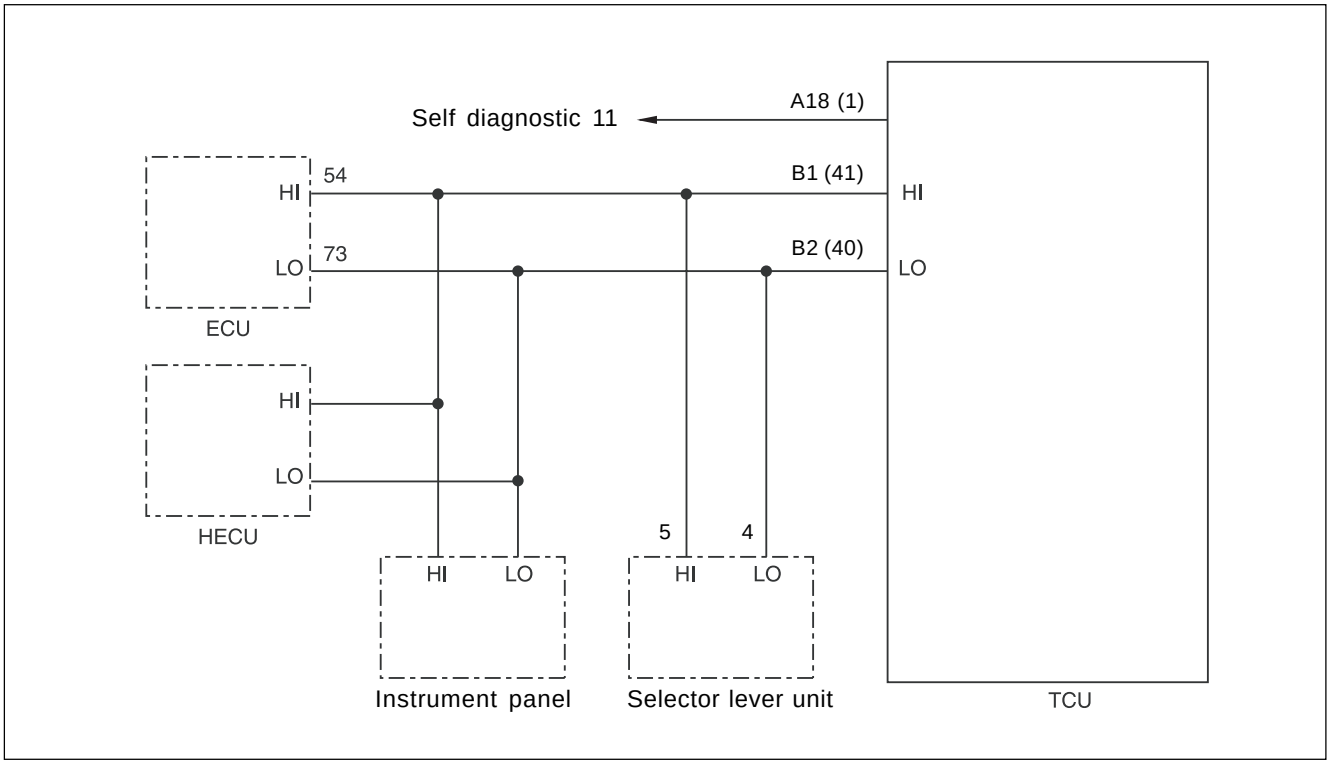
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▶ CAN (Controller Area Network)

Function



Circuit Diagram

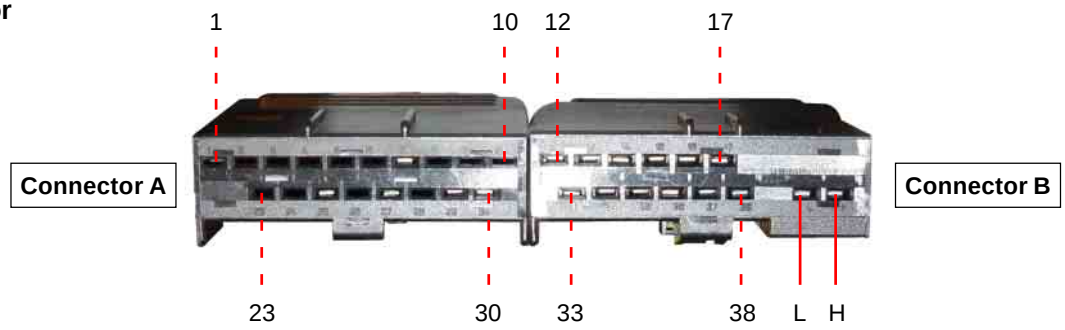


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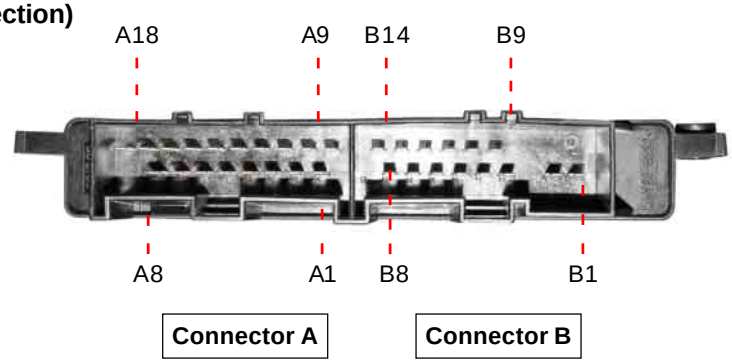
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Connector Arrangement and Pin Functions

Connector



TCU (Connector connection)



Pin No.		Description	Connected to
DC No.	EWD No.		
1	A18	Diagnostic	Diagnostic connector pin No.11
7	A12	Initiating the starter relay	Starter relay
12	B14	Speed sensor N2	13-pin plug No.3
13	B13	Speed sensor voltage supply	13-pin plug No.7
14	B12	1-2, 4-5 solenoid valve	13-pin plug No.13
15	B11	3-4 solenoid valve	13-pin plug No.9
16	B10	2-3 solenoid valve	13-pin plug No.8
17	B9	Lockup clutch solenoid valve	13-pin plug No.11
29	A2	TCU voltage supply	-
30	A1	Ground	-
33	B8	Speed sensor ground	13-pin plug No.12
34	B7	ATF temperature, Starter lock-out contact	13-pin plug No.4
35	B6	Speed sensor N3	13-pin plug No.1
36	B5	Modulating pressure solenoid valve	13-pin plug No.2
37	B4	Shift pressure solenoid valve	13-pin plug No.10
38	B3	Each solenoid valve voltage	13-pin plug No.6
L	B2	CAN LOW	ECM, HECU, selector lever unit, instrument panel
H	B1	CAN HIGH	ECM, HECU, selector lever unit, instrument panel

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TROUBLE CODE AND DIAGNOSIS

1. TROUBLE DIAGNOSIS WITH SCAN-100



▶ Scan-100 Diagnosis Procedure



1. Connect the Scan-100 harness connector to the diagnostic socket.
2. Turn the ignition switch to “ON” position.
3. Select [TROUBLE CODE] in [FUNCTION SELECTION] screen and press [ENTER].
4. Select [KYRON] in [VEHICLE SELECTION] screen and press and press [ENTER].
5. Select [TCU] in [CONTROL UNIT SELECTION] screen and press [ENTER].
6. Select DC 5-speed transmission.
7. Select [SELF-DIAGNOSTICS] in [SELECT TEST ITEM] screen.
8. Determine the DTC and locate the trouble cause.

NOTE

- **Choose “data list” item to check sensors and other informative data.**

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2. DTC (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.
P2011	Faulty TCU variant coding	- Self-diagnosis with IGN ON. - When the TCU coding is faulty. - Check again after TCU coding.

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Trouble Code	Defectives	Action
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.

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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.

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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 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 Ω - Turn the IGN OFF, then disconnect TCU connector.
P2301	Faulty CAN communication	- Check the communication line for open, short and contact. - Measure the resistance of CAN line: B1, B2 • Specified value : approx. 120 Ω
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.

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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.

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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.

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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 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.
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

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3. REMOVAL AND INSTALLATION OF TCU

1. Disconnect the negative battery cable.
2. Slide the drive's seat and fold up the carpet.



3. Unscrew the two bolts (10 mm) on TCU.



Installation Notice

Tightening torque	10 Nm

4. Disconnect the TCU connect and remove the TCU.





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MANUAL TRANSMISSION

3170

TABLE OF CONTENTS

GENERAL INFORMATION 3

1. Overview and characteristics of manual transmission 3
2. Manual transmission system 5

MANUAL TRANSMISSION 10

1. Location 10
2. System components 11
3. Shifting mechanism 19
4. Diagnostic information and procedures 26
5. Removal and installation 30
6. Disassembly and reassembly 36
7. Inspection/maintenance 67
8. Special tools and equipment 70

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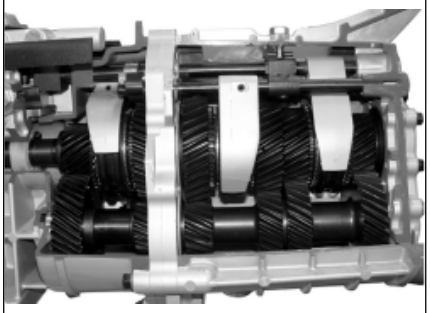
GENERAL INFORMATION

1. OVERVIEW AND CHARACTERISTICS OF MANUAL TRANSMISSION

▶ SYSTEM COMPONENTS

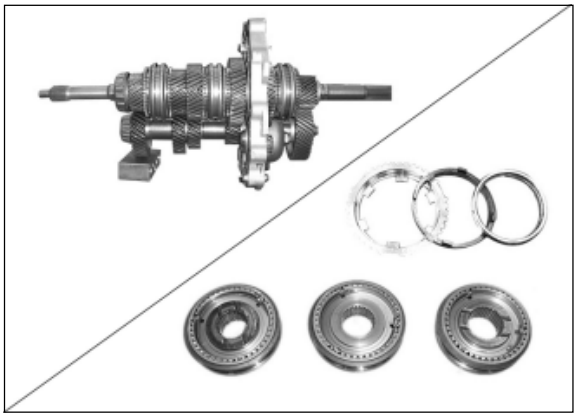


Inside



Front View





▶ Features

1. All gears use 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.

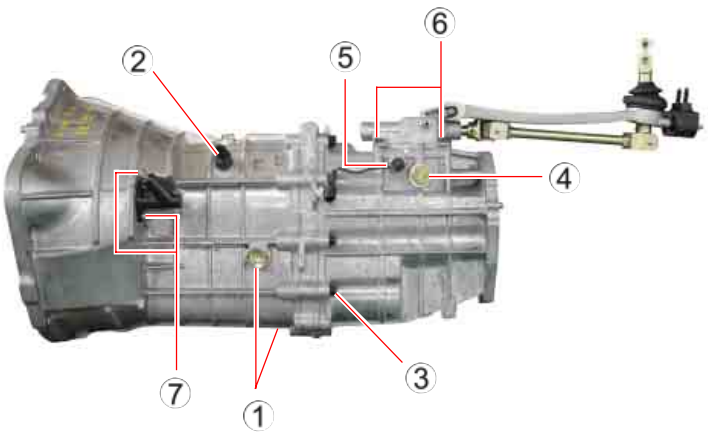
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Specifications

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)	3.6 ℓ / 3.4 ℓ (4WD / 2WD)
	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

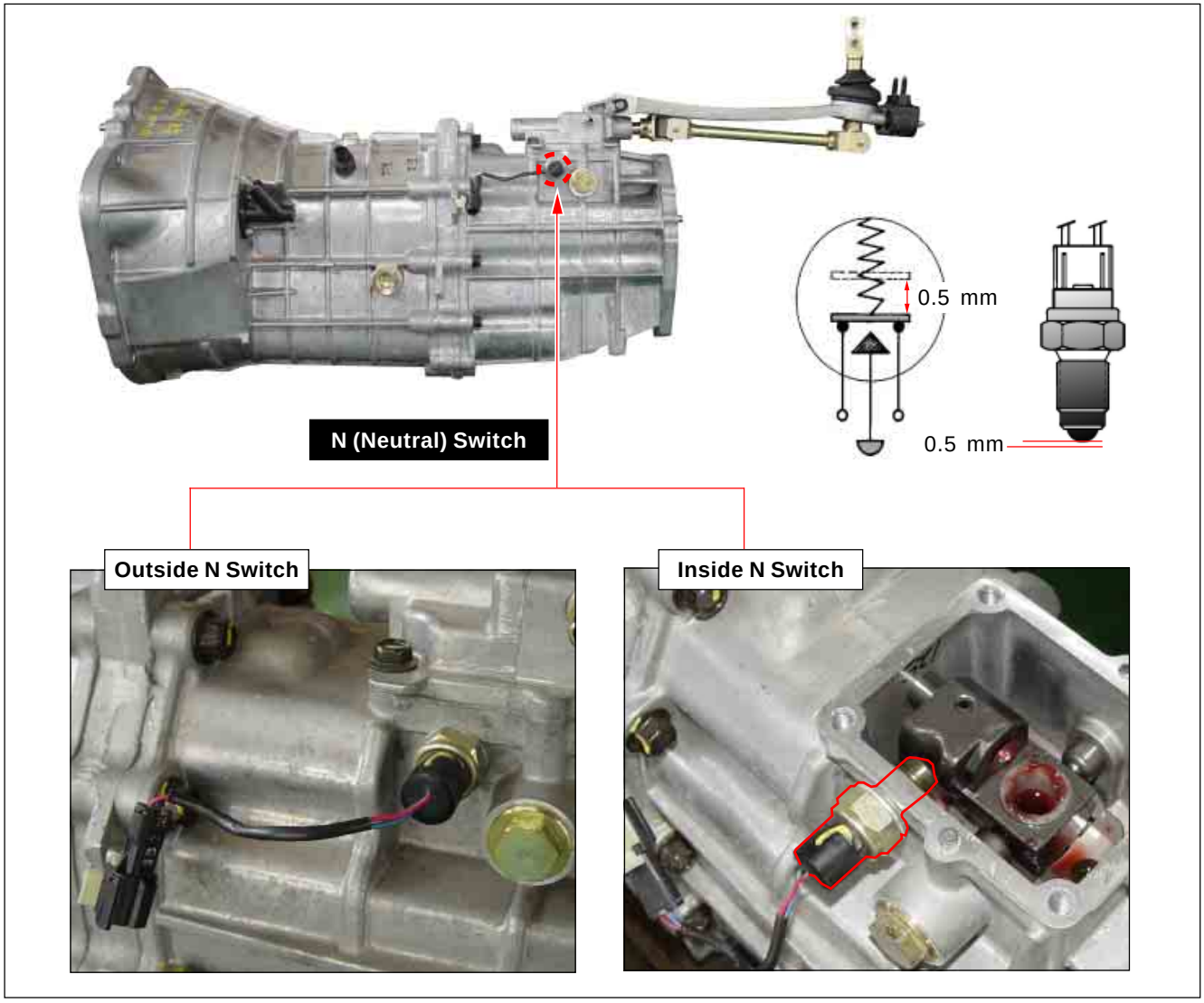


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2. MANUAL TRANSMISSION SYSTEM

▶ Neutral Switch



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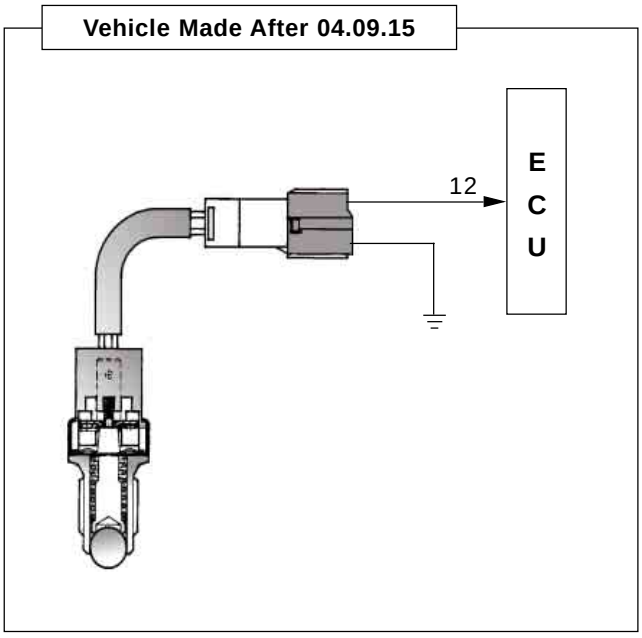
Function of N Switch

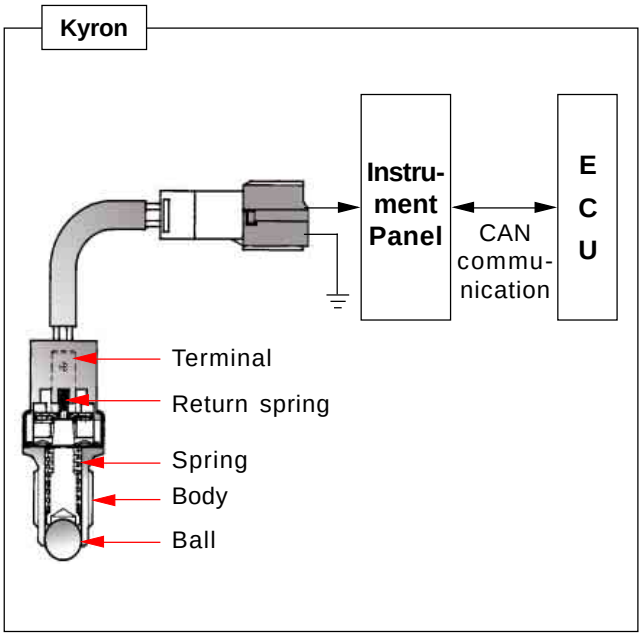
1. Aids a smooth start of the vehicle by raising the RPM during the gear shifting when the engine is cold.

When the vehicle is trying to start from the stopped state (vehicle speed below 3 km/h), the N switch determines the shifting timing by using the clutch switch and the N switch. It raises the engine RPM (100 ~ 200 rpm). Operation conditions are as follows.

1) The vehicle speed is at the stopped state (Vehicle speed below 3km/h detection).
2) While depressing the clutch (Clutch switch detection).
3) The gear lever is at a position other than neutral (N switch detection).
4) Start the vehicle while depressing the clutch pedal (Clutch switch detection).
5) The RPM increases in accordance with the temperature of the engine coolant (Engine coolant temperature sensor detection).
   : appx. 100 rpm increase
   : appx. 100 ~ 170 rpm increase
   : appx. 80°C (normal temperature of the engine coolant): around 200 rpm increase
6) 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 Kyron, 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.





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2. Detects the position of the shifting lever for the HDC operation among ABS/ESP functions.

It is used for the second item of the 6 operation conditions of the ABS/ESP's HDC function. Please refer to the ABS/ESP section for the specific information related to the HDC.

1) **HDC Operation switch ON** and

2) **Forward/Reverse Shifting lever location** and

Manual transmission: operates in the 1st gear or reverse gear position (does not operate in the neutral position).

Automatic transmission: possibly operates except in the P (parking) or N (neutral) position.

NOTICE

- **The vehicle with the manual transmission does not have a separate device or switch that detects the 1st gear. It only detects the forward/reverse direction of the vehicle through the back-up light switch and the neutral switch, and cannot solely detect the 1st gear position. The reason for noting the 1st gear above, though the HDC also operates in the 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 aids the slowdown of the vehicle when driving down a steep hill and cannot sufficiently decelerate only with the engine brake. Thus, a driver must operate the HDC only in the 1st gear when driving a vehicle with the manual transmission.**

3) **When not depressing the accelerator pedal or brake pedal.** and

4) **The vehicle speed is above 7 km/h (based on the automatic transmission/4H drive mode).** and

5) **The ESP's vehicle position control function and HBA function are not in operation.** and

The HDC is added to aid drivers when driving down the hill, but when any basic function of the ESP is in operation prior to the HDC system operation, the ESP takes priority over the HDC.

6) **The inclination of the driving road exceeds 10%.**

When the inclination of the driving road exceeds 10%, the HDC operates until the vehicle reaches the speed condition given in step 4).

When the Inclination is 10% ~ 20% During the HDC Operation

When depressing the accelerator pedal or brake pedal, it converts to the stand-by mode, and when depressing the accelerator pedal again, the HDC operates again. Therefore, driver may maintain a desired speed by repeating this depressing and releasing process of the accelerator pedal.

When the Inclination Exceeds 20% During the HDC Operation

When depressing the accelerator pedal, it converts to the HDC operation stand-by mode. When depressing the brake pedal, the HDC operation state is maintained and the braking power is enhanced.

In this case, the HECU emits an abnormal noise and the brake pedal may feel very rigid, but this is a normal occurrence resulted from the HDC operation.

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Note: Overview of HDC Operation

HDC (Hill Descent Control) System

The HDC system is an automatic descent control device that allows the vehicle to automatically decelerate to about 7 km/h with increment of 0.1G, on steep roads (inclination 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.

The HDC does not have a separate sensor for the input signal and detects the inclination of hills by using the G sensor (acceleration sensor) in the sensor cluster.

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 inclination exceeding 10%, the ESP's HDC function operates. When this occurs, the green HDC indicator goes off along with a loud operation noise.



HDC Switch



Sensor Cluster



The G Sensor within the sensor cluster detects the inclination of driving roads. When the HDC switch is in operation, if the G sensor detects a downhill inclination exceeding 10%, it transmits the HDC operation signal to the ESP HECU.

HDC Indicator (Instrument panel)



When pressing the HDC switch, the green HDC indicator on the instrument panel comes on, and when the HDC operates, the green HDC indictor blinks with 0.5 seconds of interval.

HDC
Red Letters

HDC
Green Letters

NOTICE

- **The G sensor within the sensor cluster measures the actual road inclination. However, it may recognize a sharp turn or rough road as a downhill with a inclination exceeding 10%, and the HDC may operate.**

*** For the specific information, please refer to the ABS/ ESP section.**

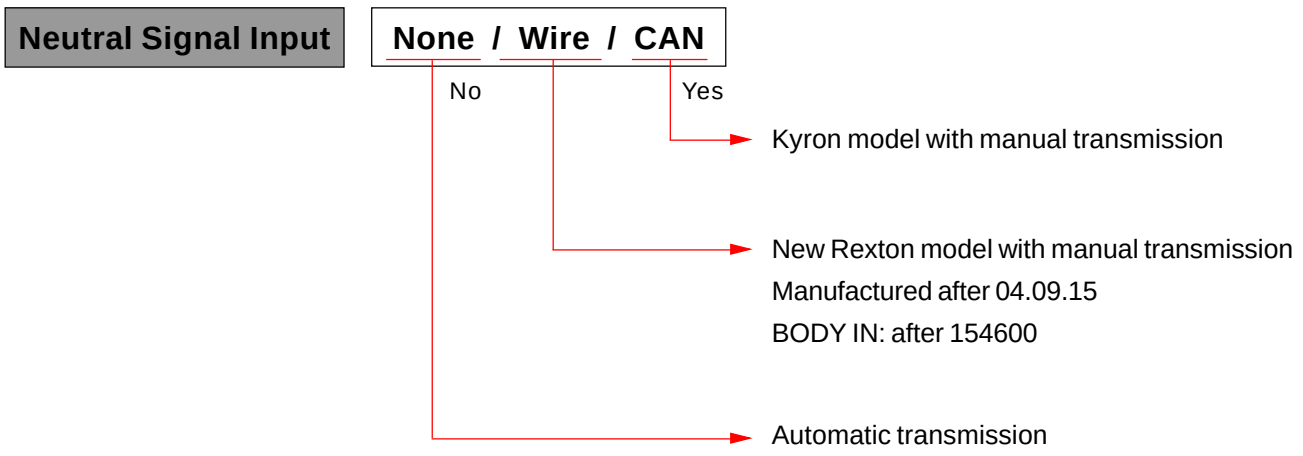
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Variant Coding Related to N Switch

Kyron's 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.

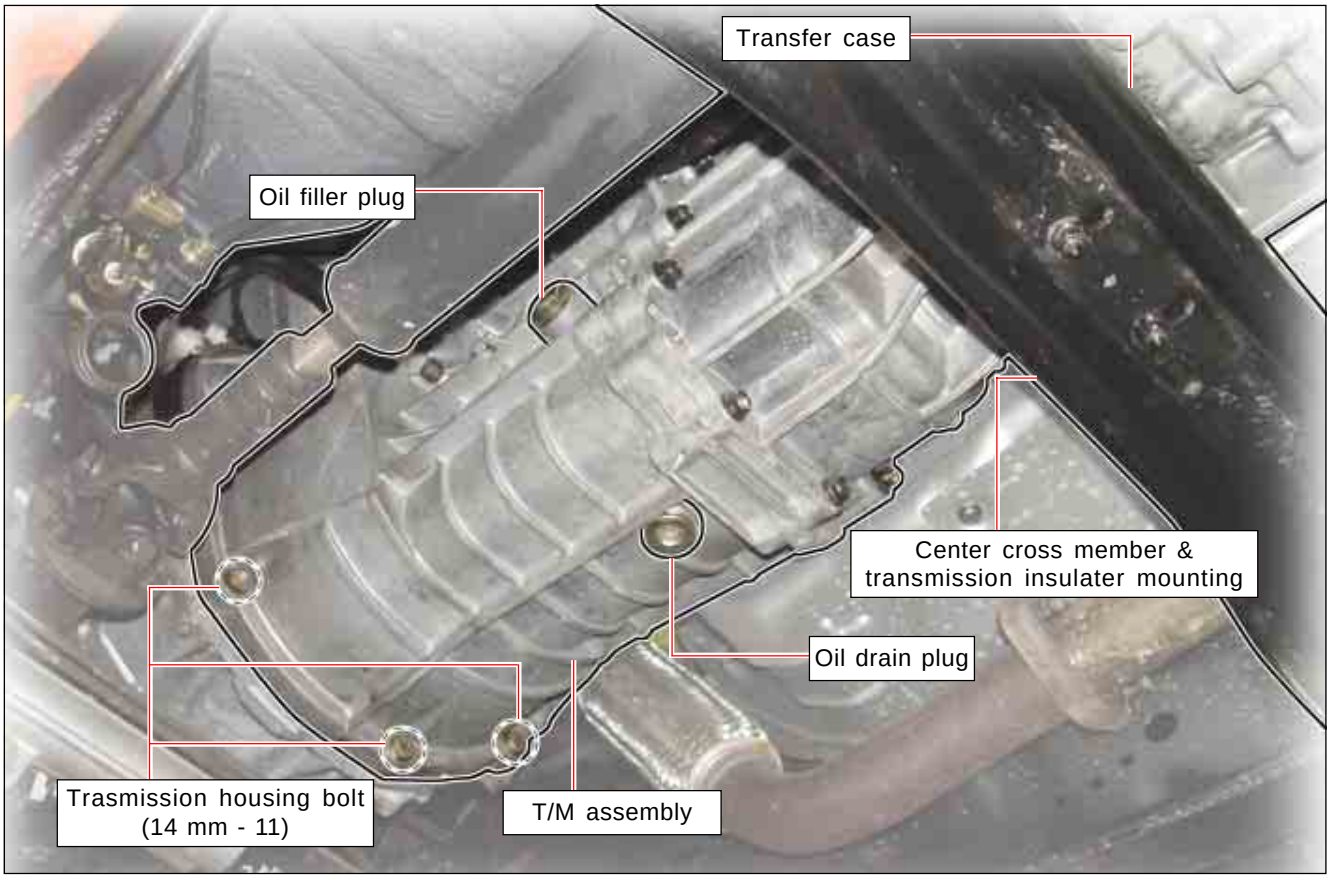
Variant Coding Options



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MANUAL TRANSMISSION

1. LOCATION



T/M Assembly

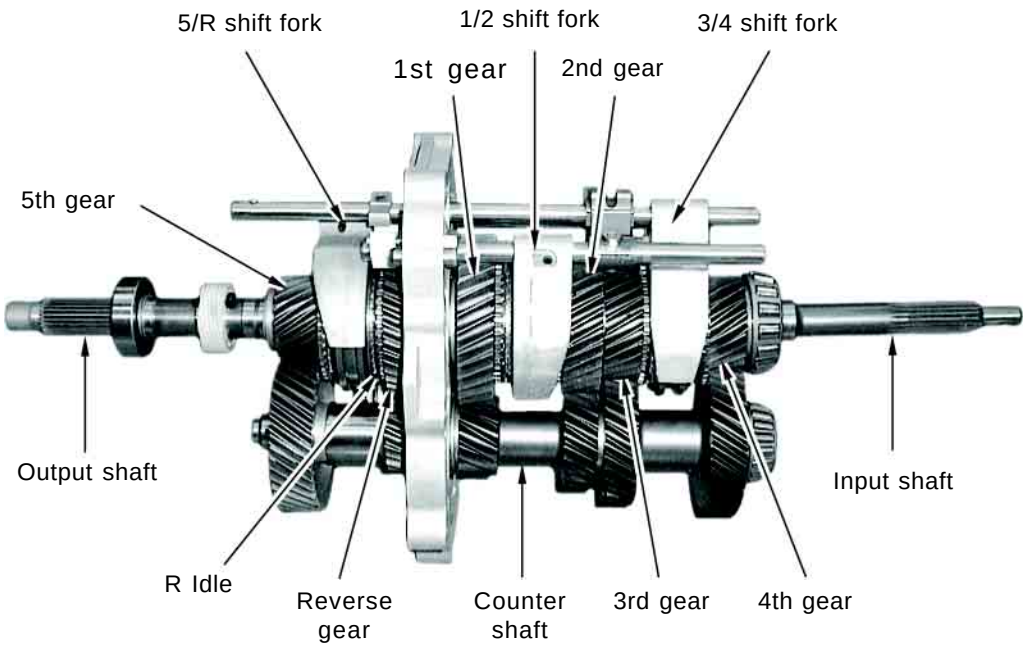


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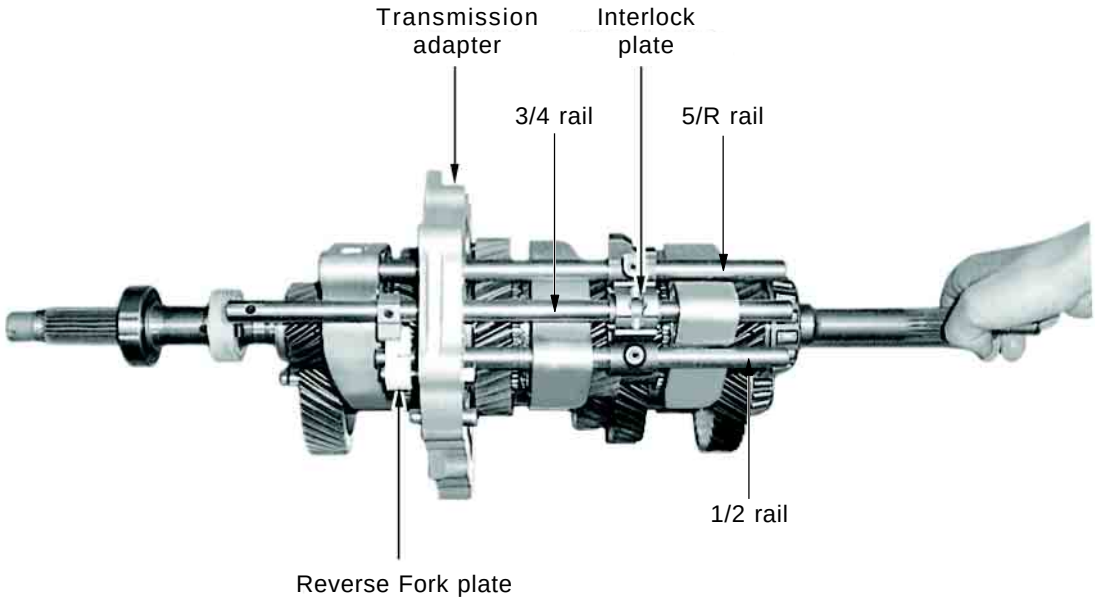
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2. SYSTEM COMPONENTS

▶ Gear Combinations

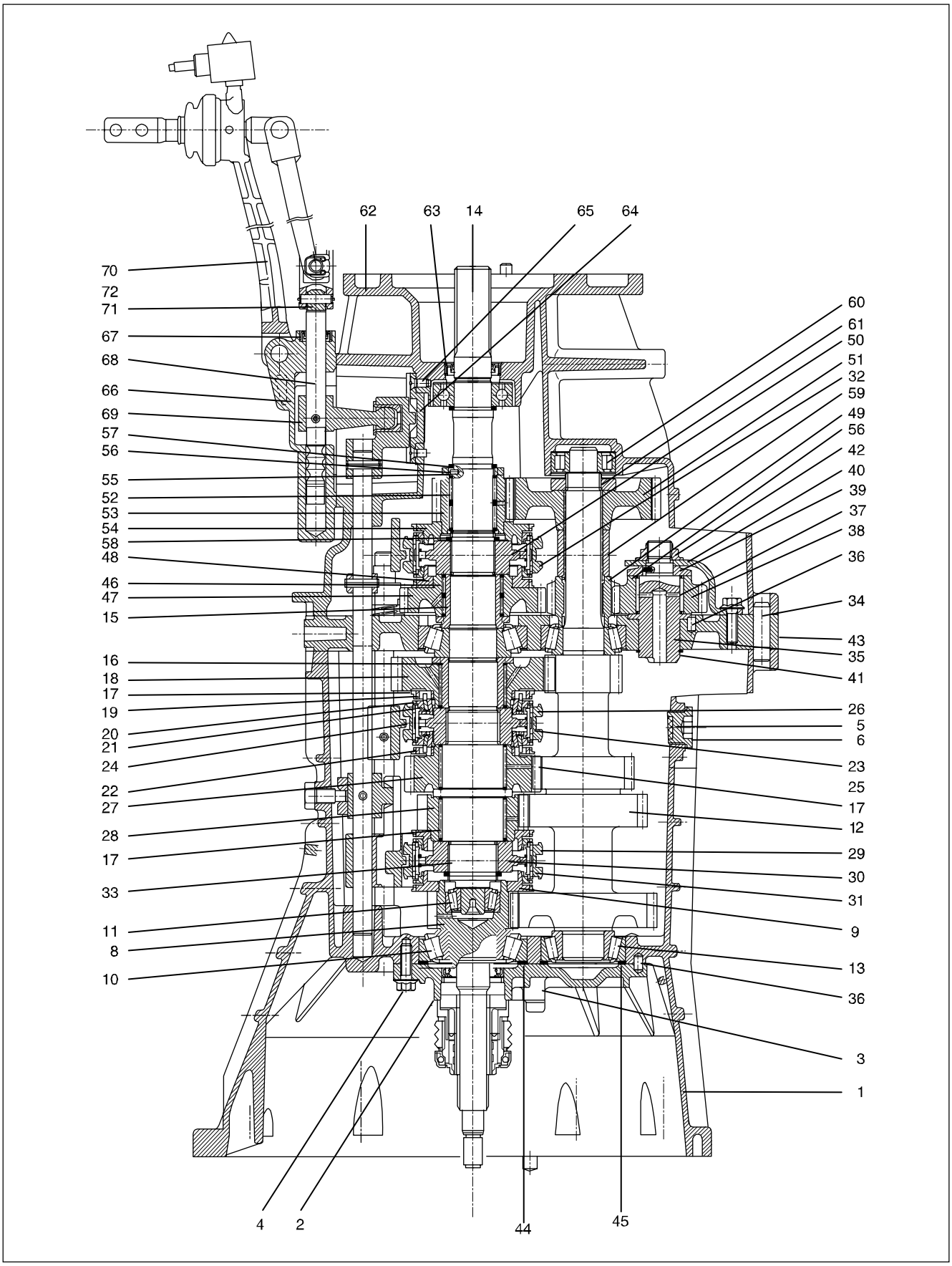


▶ Shift Fork and Rail Combinations



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▶ Sectional View



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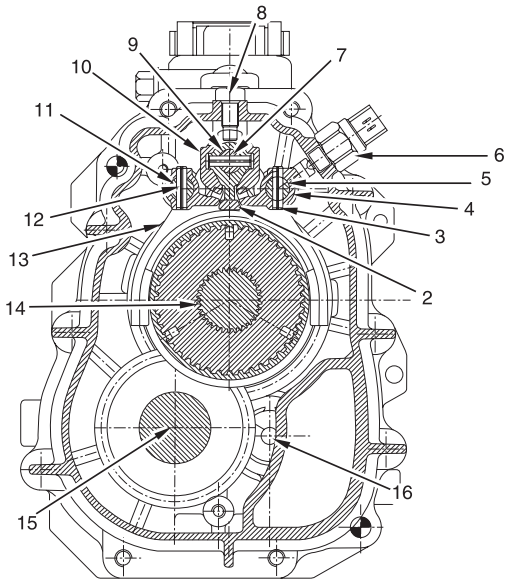
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1. Transmission front housing
2. Input shaft oil seal
3. Front cover (DWF)
4. Hexagon flange bolt (17 ~ 26 Nm)
5. Oil drain plug (40 ~ 50 Nm)
6. Sealing
7. Pin
8. Input shaft
9. 4th clutch gear
10. Taper roller bearing (main)
11. Taper roller bearing
12. Counter shaft
13. Taper roller bearing (counter)
14. Output shaft
15. Inner race (reverse)
16. Inner race (1st)
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)
26. Double synchro sleeve
27. 2nd gear
28. 3rd gear
29. 3rd clutch gear
30. Synchro hub (3 & 4th)
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

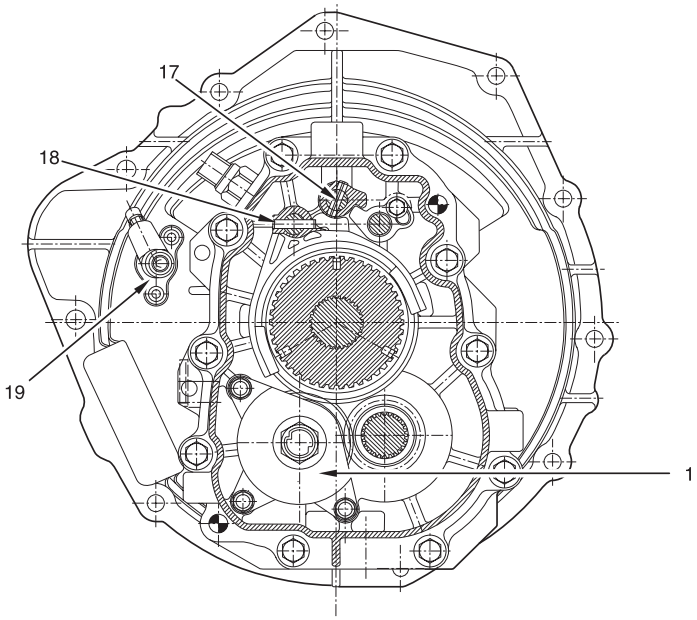
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▶ Front View and Rear View

Front View



Rear View



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 & 2nd)
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. Concentric slave cylinder adapter (tightening torque: 10 ~ 16 Nm)

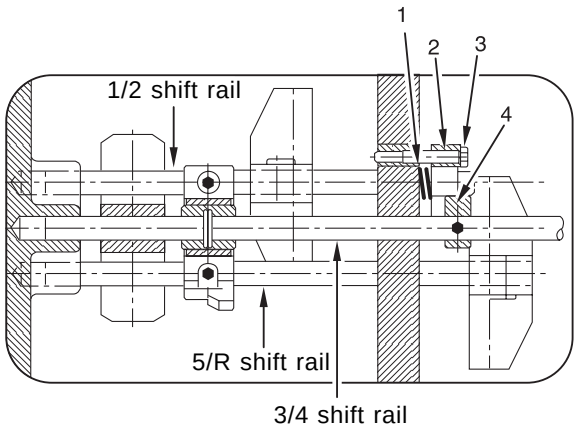
(8) Bond-592 loctite

(6) Bond-592 loctite

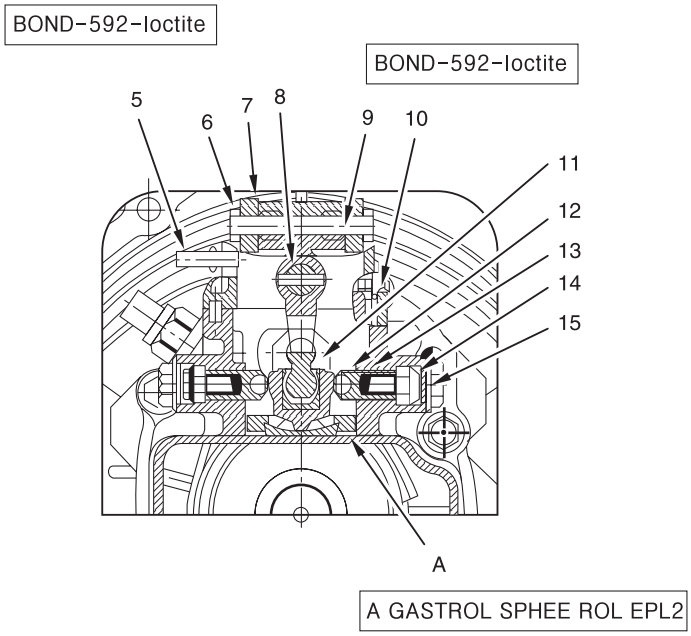
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Cross Sectional Diagram of Major Components

Shift Rail and 5/R Gear



Offset Lever

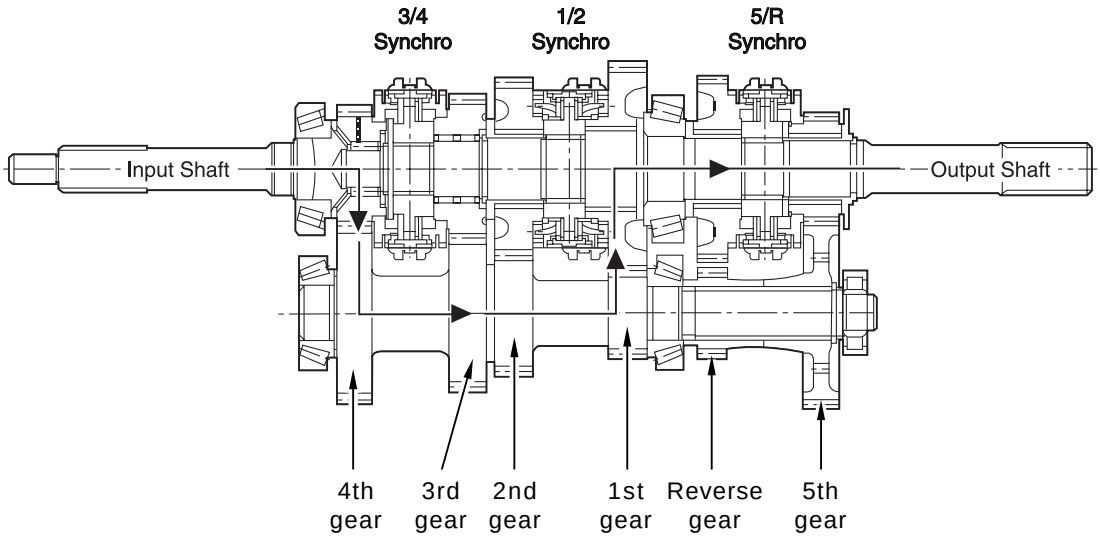


1. Reverse lock spring
2. Reverse lock plate
3. Reverse lock bolt (tightening torque: 8 ~ 12 Nm)
4. Stopper plate
5. Air vent (tightening torque: 20 ~ 35 Nm)
6. Lock washer
7. TGS bushing
8. Outer spring pin
9. TGS pin
10. Lock bolt (tightening torque: 17 ~ 26 Nm)
11. Offset lever
12. Offset lever bushing
13. Rolling plunger
14. Return spring
15. Spring plug (tightening torque: 70 ~ 100 Nm)

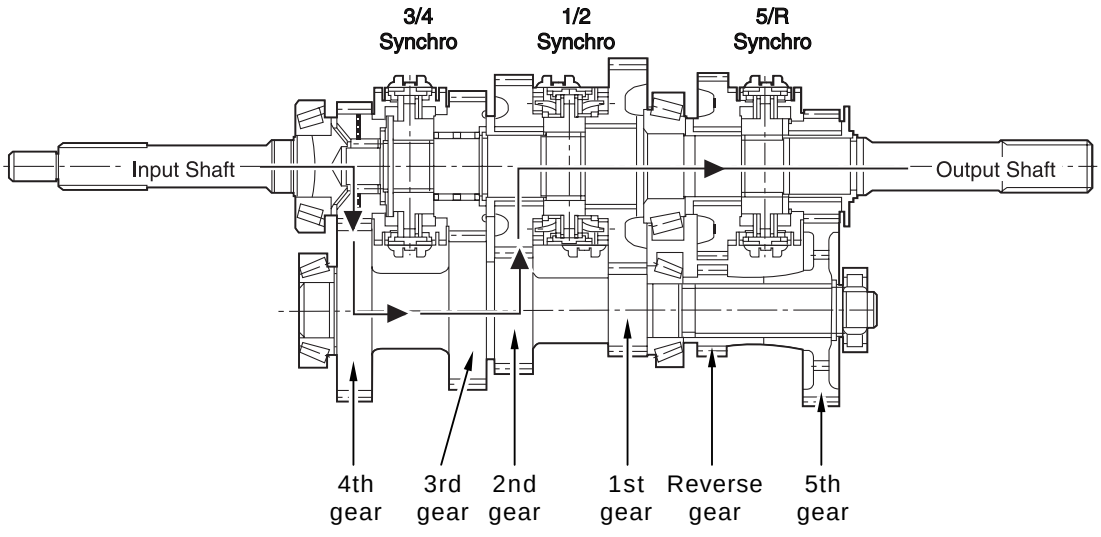
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▶ Power Flows

1st gear
Counter shaft



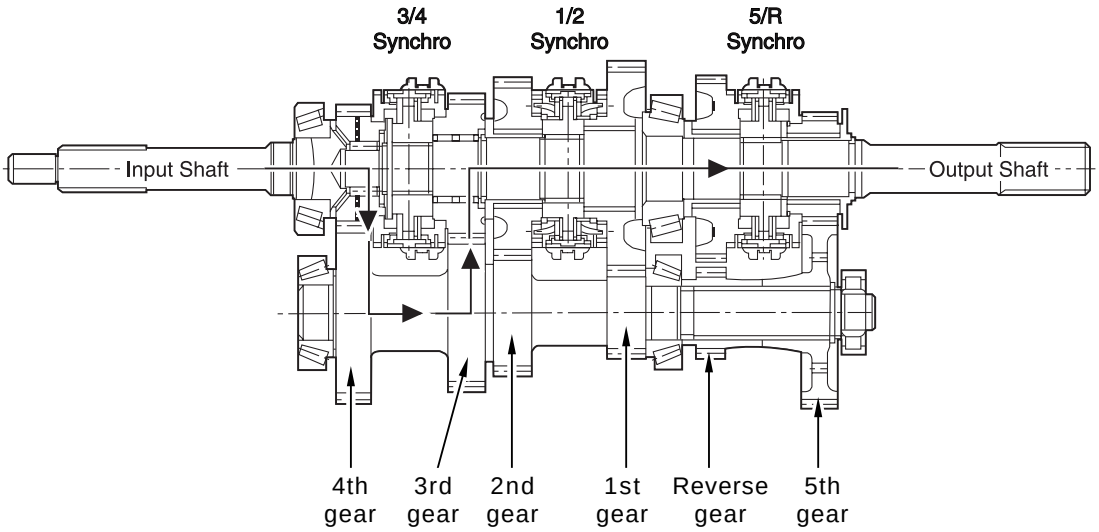
2nd



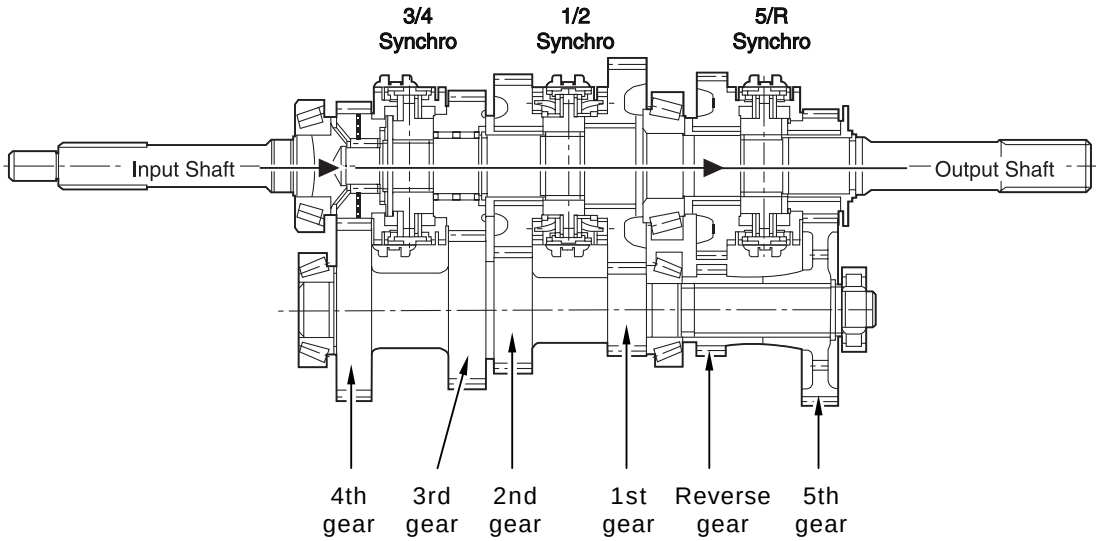
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▶ Power Flows (Cont'd)

3rd



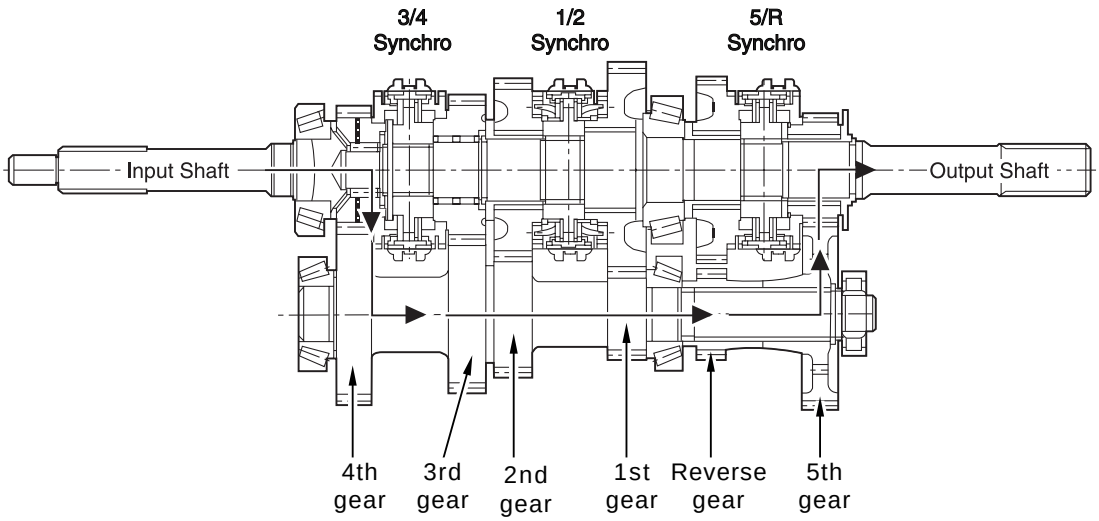
4th



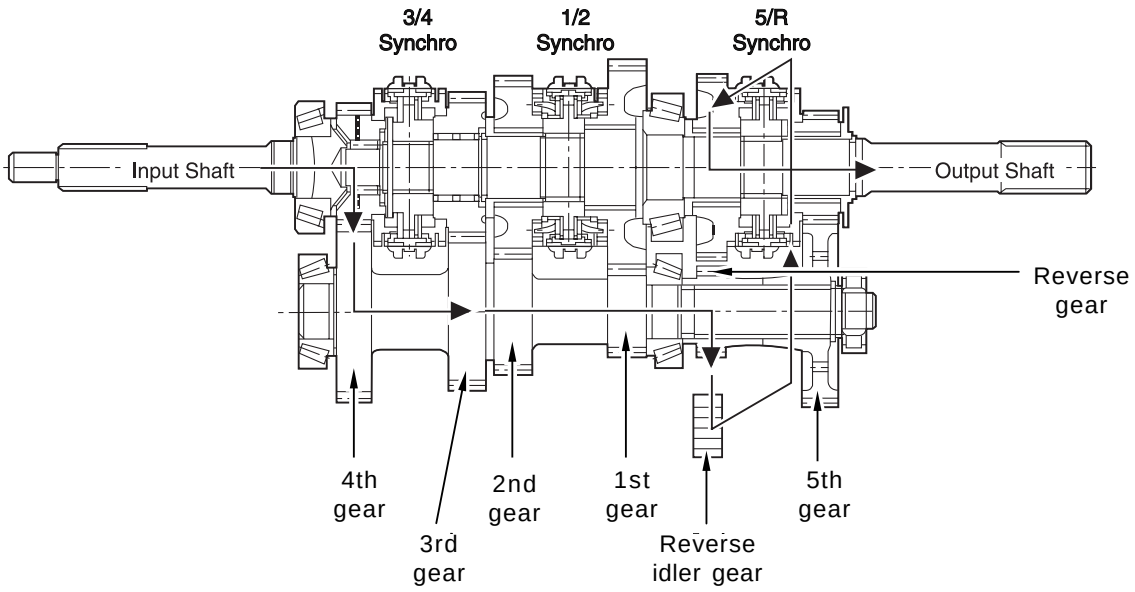
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▶ Power Flows (Cont'd)

5th



Reverse gear



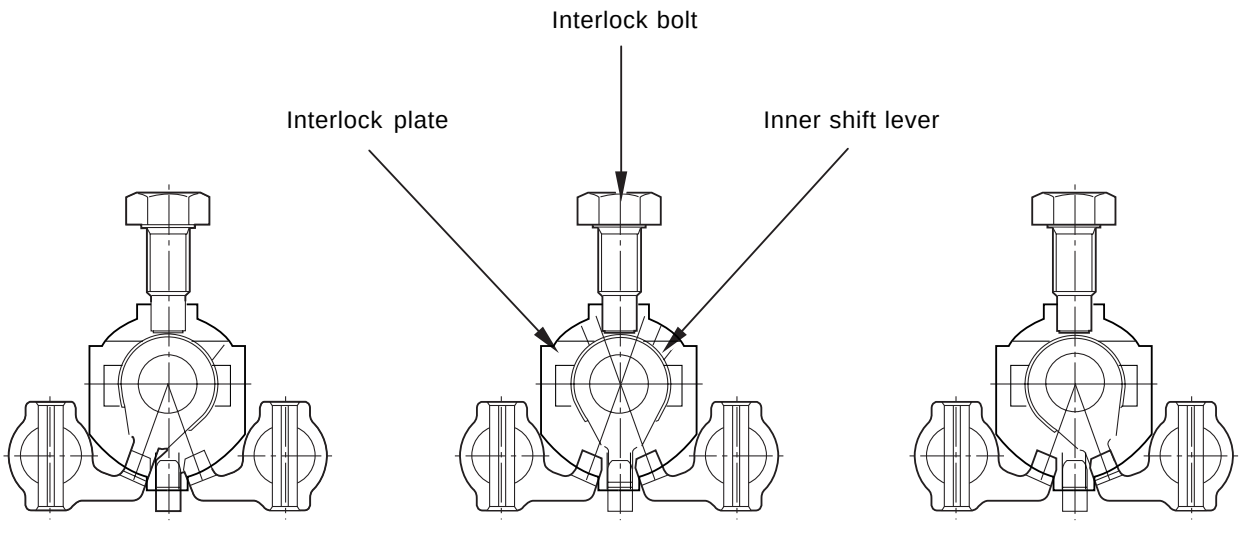
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3. SHIFTING MECHANISM

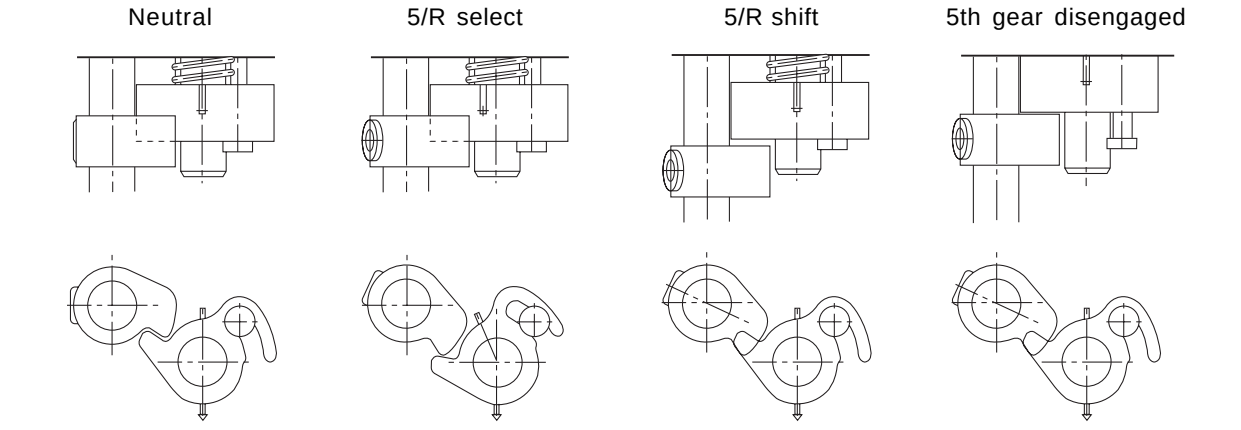
▶ Interlock System

Interlock system prevents the gears from meshing over two sets.



▶ Reverse Interlock System

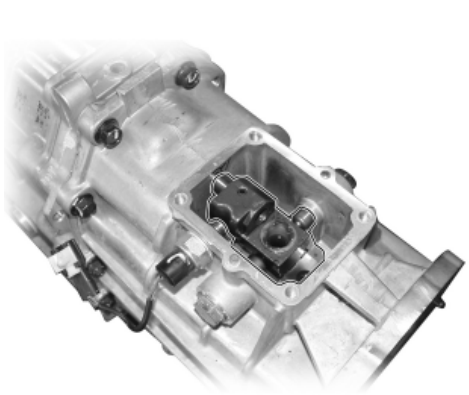
Reverse interlock system prevents the gear from shifting to reverse driving position while driving forward.

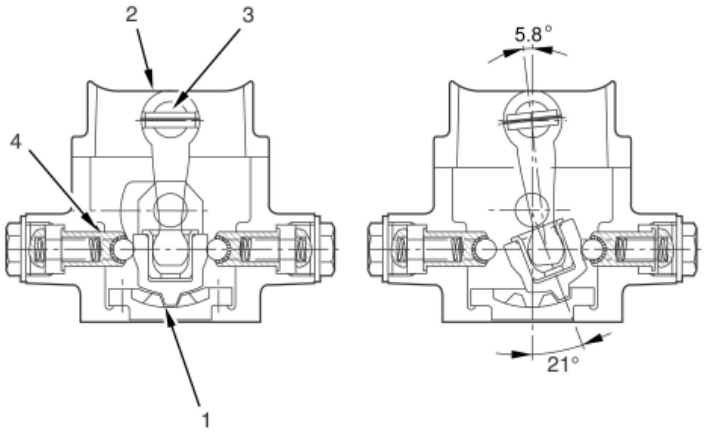


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▶ Offset Lever and Rolling Plunger

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.



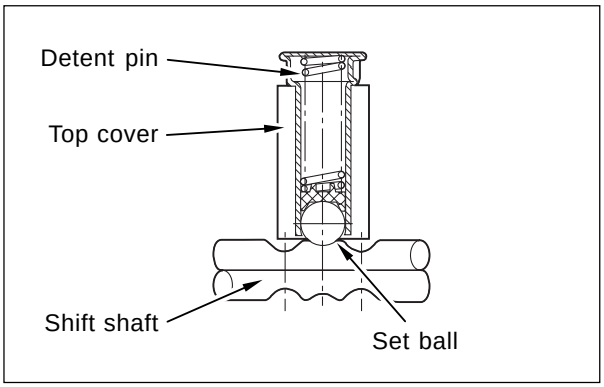


1. Offset lever
2. Shift lever
3. Shift lever
4. Rolling plunger (rolling plunger return spring and ball)

1. Shift check device

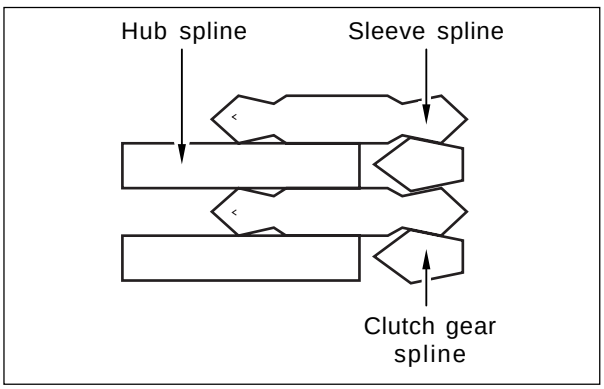
It determines the shift fork position (N or each gear) and gives a detent movement to notice a shift lever seating when operating the shift lever.

Also, it prevent the selected gear from getting out of its meshed position.



2. Gear jump out locking device

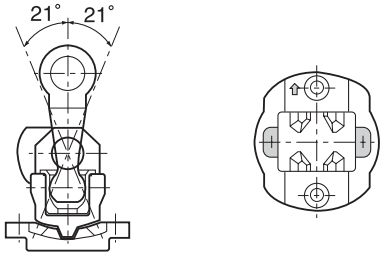
It prevents the shift lever is beyond the correct shift position while shifting.



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3. **Guiding a control direction and preventing an over stroke.**



Offset lever

Offset plate

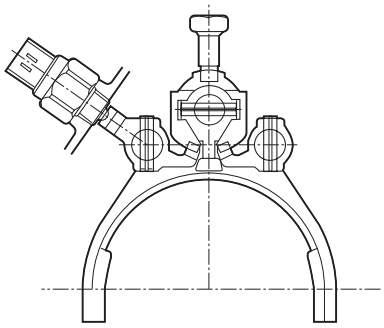
▶ Backup Lamp Switch

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**



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▶ Synchronizer

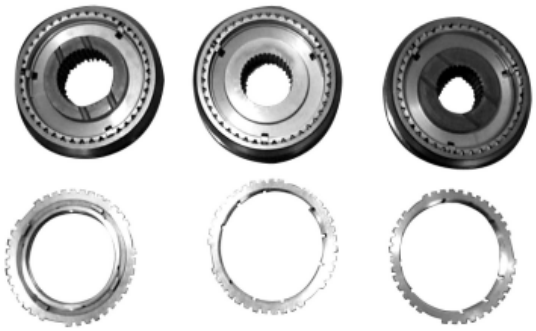
Composition

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)

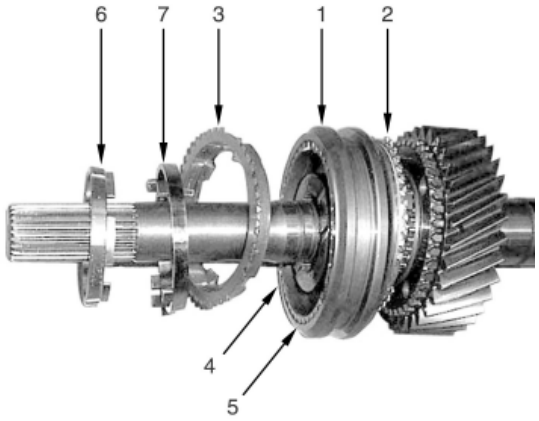
Single Cone Type





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

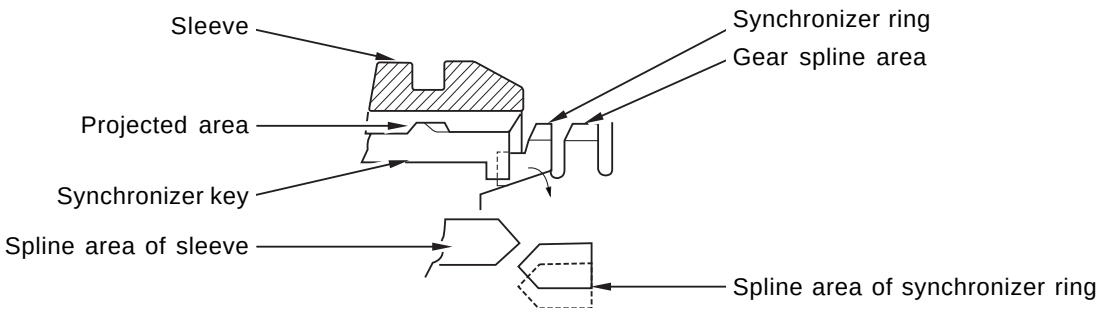
- **Be careful not to mix up the 1/2 shift synchronizer sleeve with 3/4 or 5/R shift synchronizer sleeve.**
- **The 3/4 synchronizer hub also different from 1/2 and 5/R synchronizer hub (different oil gallery).**

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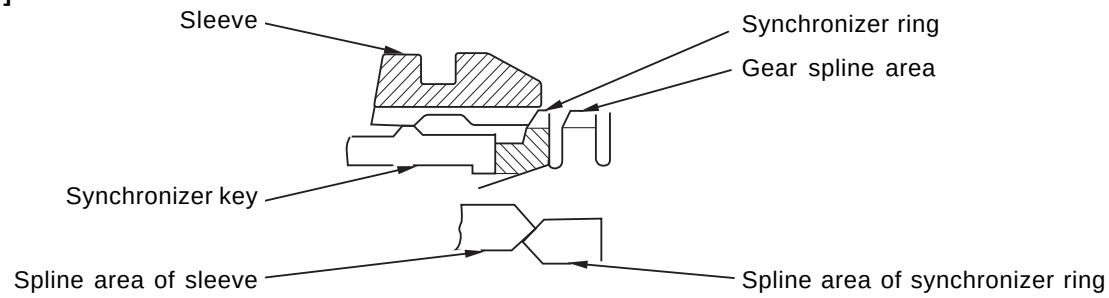
Synchronizer element

A cone 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 turning and the clutch gear is spinning. Even though the clutch is disengaged, 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.

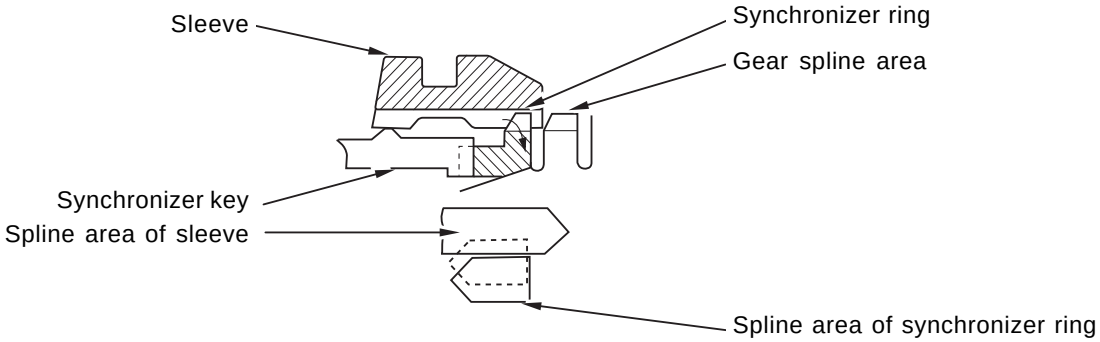
[1st step]



[2nd step]



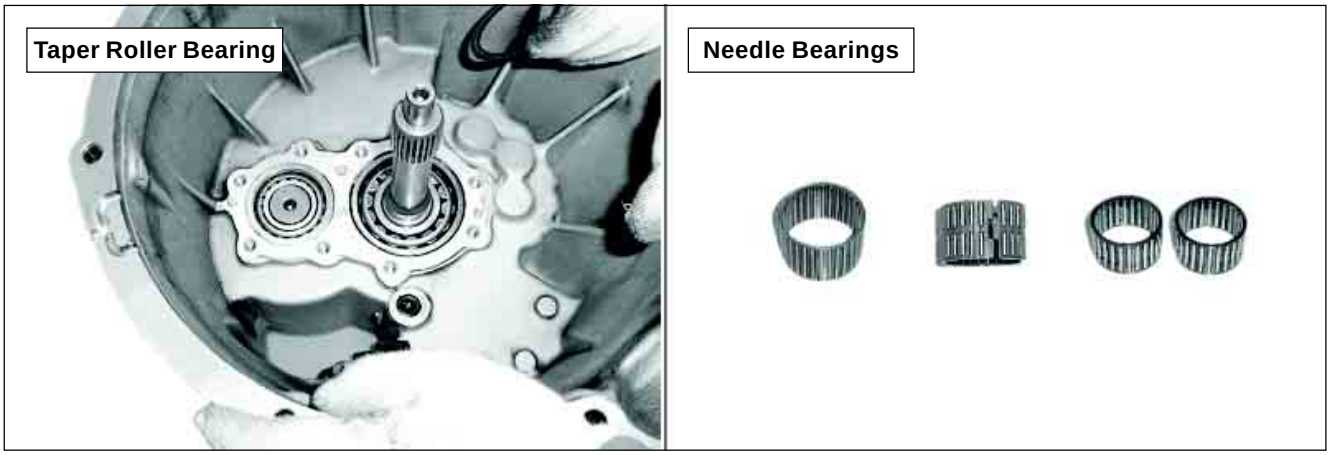
[3rd step]



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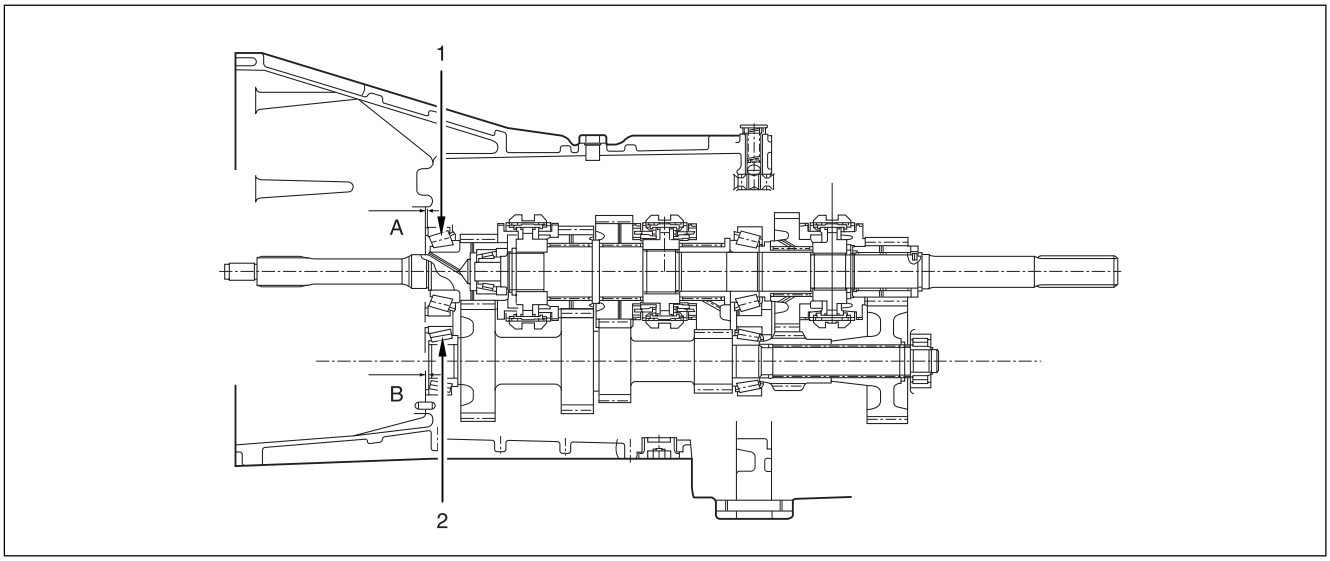
▶ Bearing

The needle bearings are introduced to each gear and the taper roller bearings are used for input and counter shaft in transmission housing.



1. Taper roller bearing (input shaft, counter shaft and output shaft)
2. Needle bearings for 1/2 and 3/4 shift
3. Needle bearing for reverse gear (with cut out area)
4. Needle bearing for 5th gear

▶ 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)

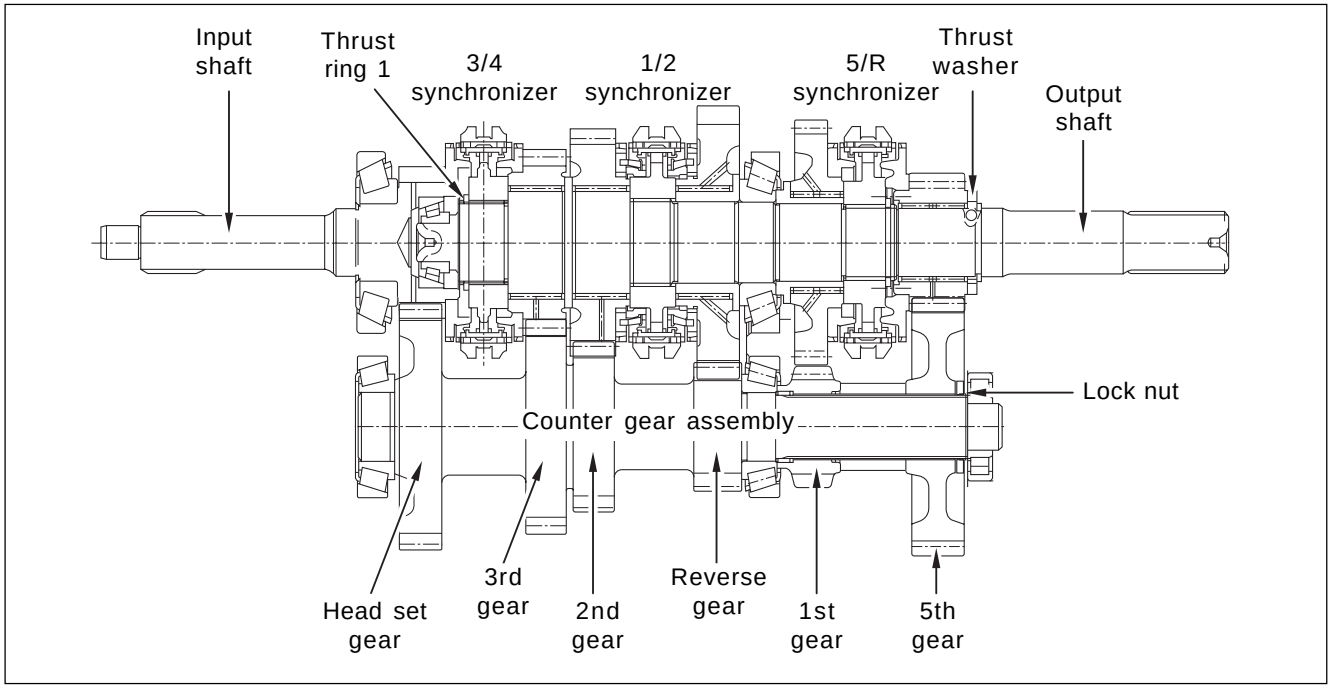
- **For input shaft: 0.75 ~ 1.45 mm (15 spacers with increment of 50 μm)**
- **For output shaft: 0.4 ~ 1.45 mm (10 spacers with increment of 50 μm)**

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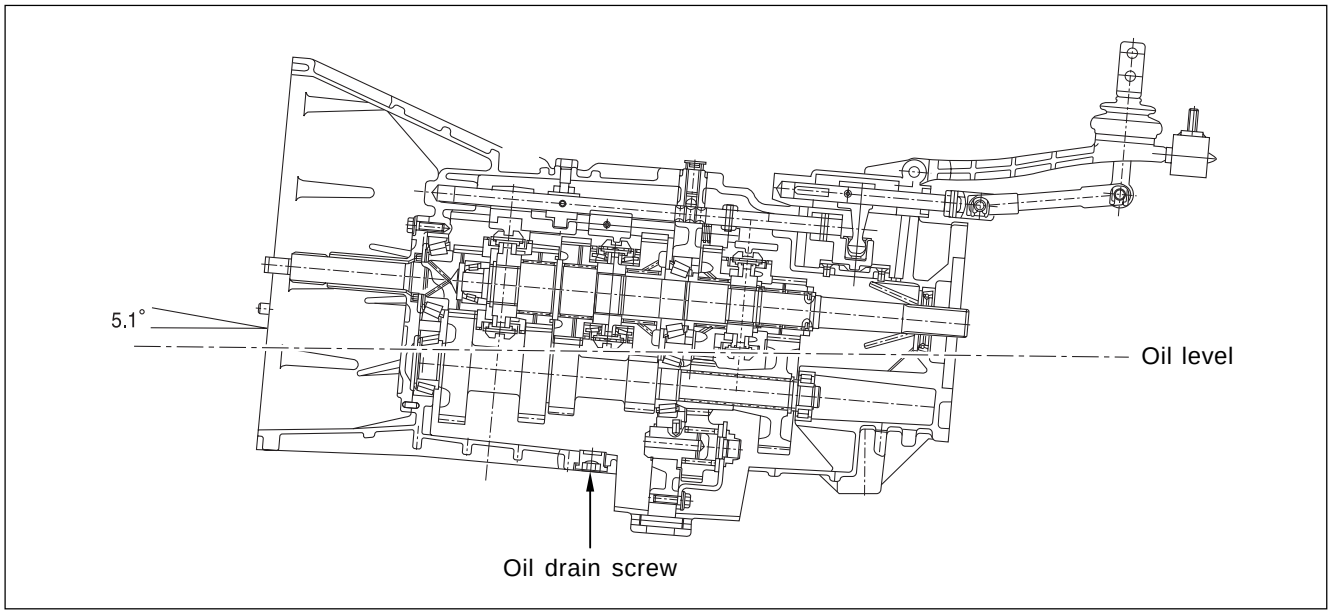
▶ Thrust Ring (Washer)

When the driving force from engine is transmitted to the output shaft of transmission, each shaft and gear assembly receives the axial force and this force acts as a resistance to rotating gears.



▶ Lubrication

Transmission oil: ATF DEXRON III 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**

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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 place 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 or case cover. Check or replace damaged parts.
	Binding of sliding synchronizers or gears.	Remove extension, adapter or case cover. Check synchronizers and gears and replace damaged parts.
	If reverse only, 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.

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▶ 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.

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▶ Diagnosis Table

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	Application / 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

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▶ 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 check 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

- **If the oil level is up to the bottom line (5 ~ 7 mm) of plug hole, it is OK.**

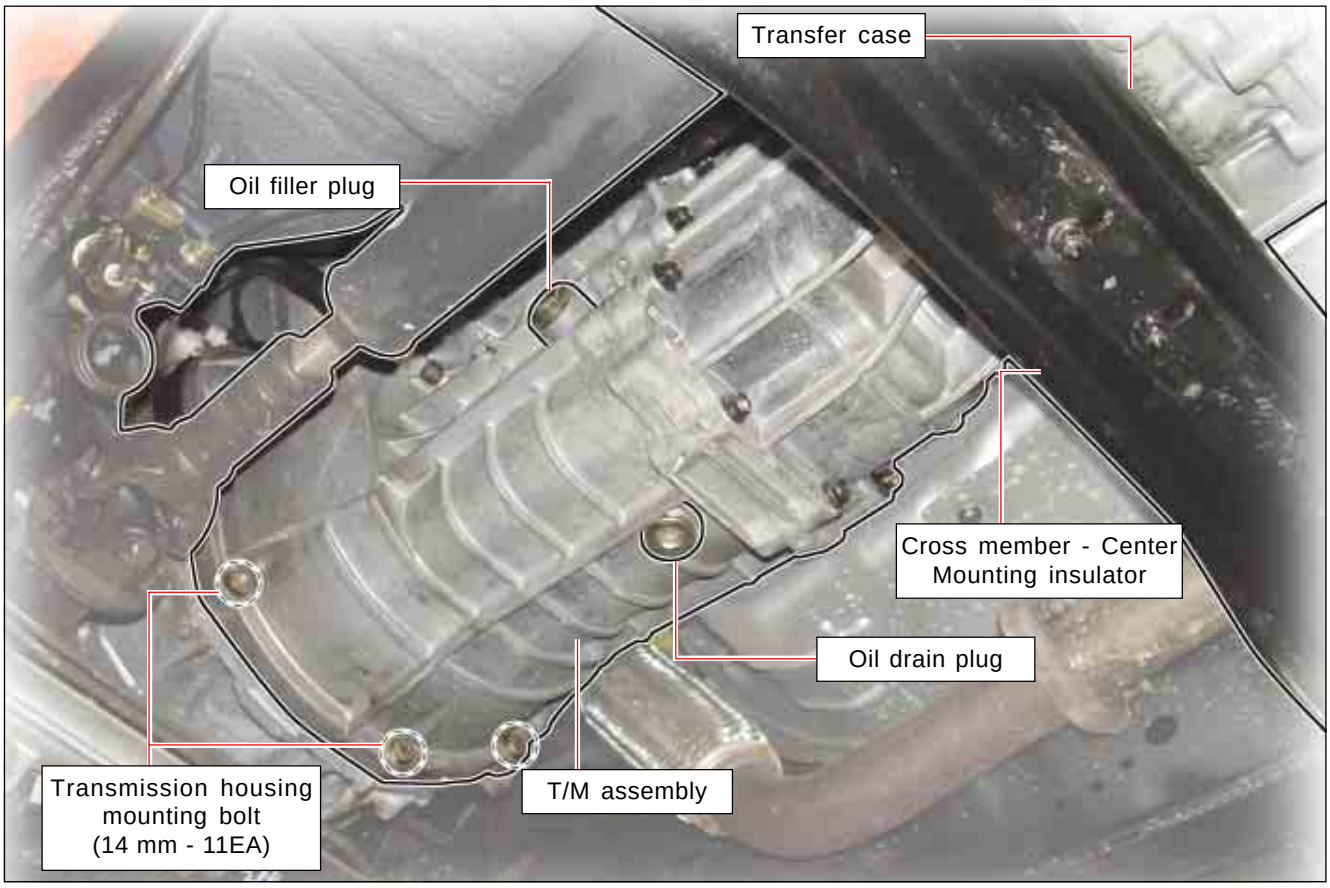
2. If needed, add the oil through the oil level plug hole (1).
3. Fully tighten the plug and check the oil leaks.
4. If the oil level is up to the bottom line (5 ~ 7 mm) of plug hole, it is OK.

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.**

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5. REMOVAL AND INSTALLATION



Removal and Installation

※ **Preceding Work:** Disconnect the battery negative cable and remove the center console.



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1. Unscrew two bolts (12 mm) and remove the change lever from shift lever.

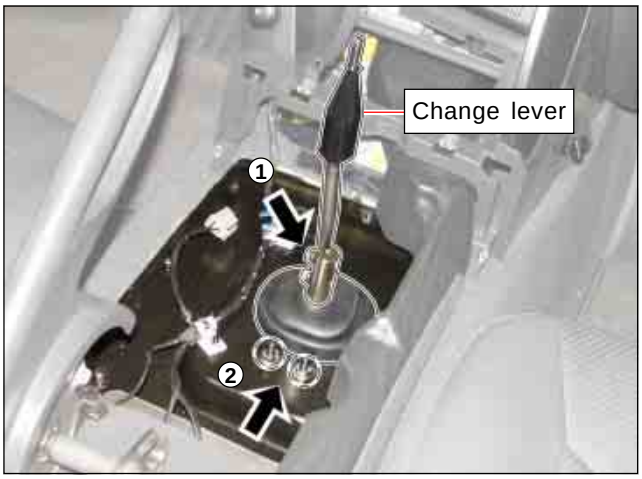
Installation Notice

Tightening torque	12 ~ 23 Nm

2. Unscrew two bolts (12 mm) 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. Compress the propeller shaft and bind to torsion bar not to disturb the operation.





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5. Disconnect the air bleeder hose, neutral switch connector, back up lamp switch connector and transfer case connectors.

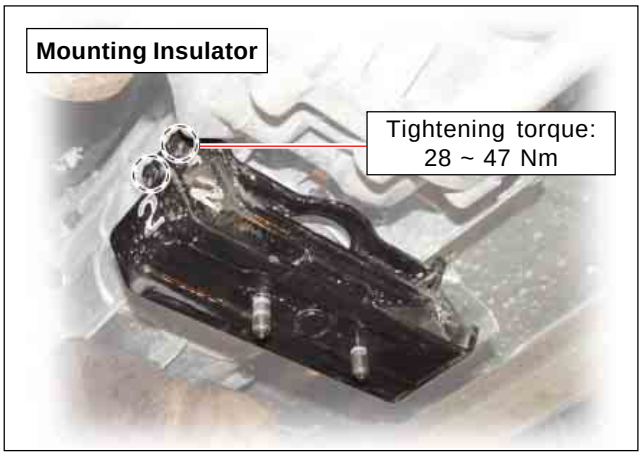


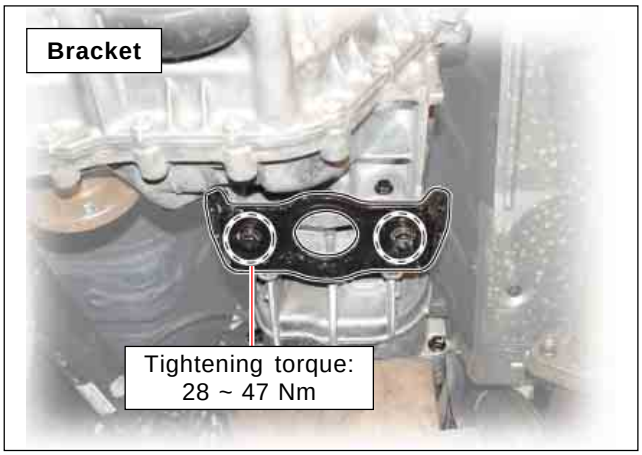


6. Support the underbody of transmission with a hydraulic jack not to deflect it and unscrew the bolts (14 mm - 4EA) and cross nuts (14 mm - 2EA) and remove the cross member.



7. Unscrew two bolts (14 mm) at both sides and remove the transmission mounting insulator. Unscrew the mounting bolts (14 mm, 2) at both sides and remove the mounting insulator bracket.

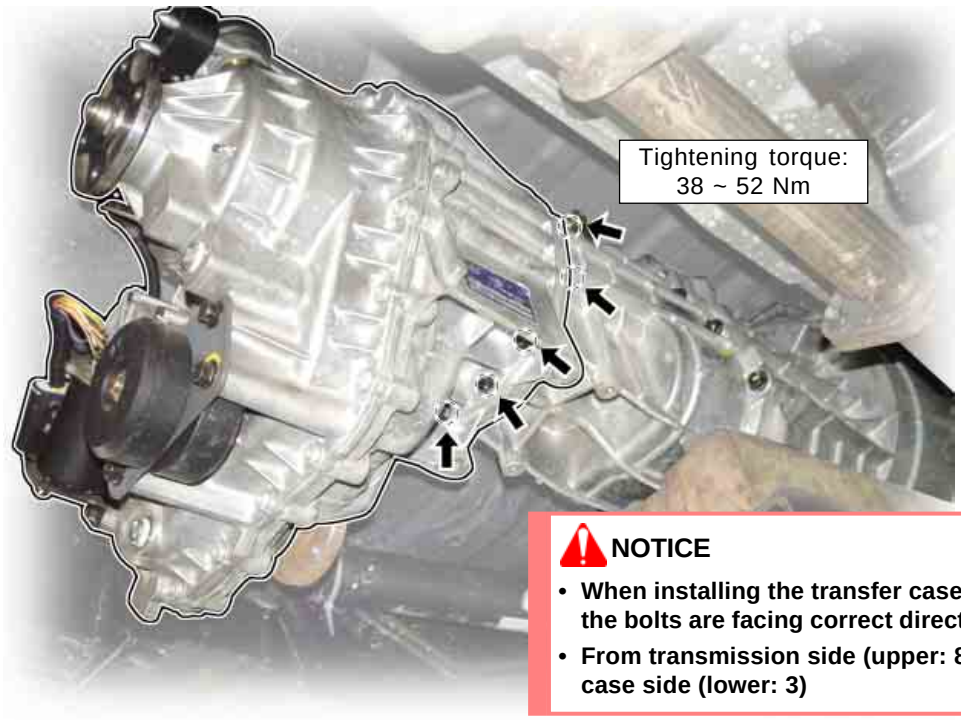




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8. Unscrew eleven bolts (14 mm) and remove the transfer case with a hydraulic jack.



NOTICE

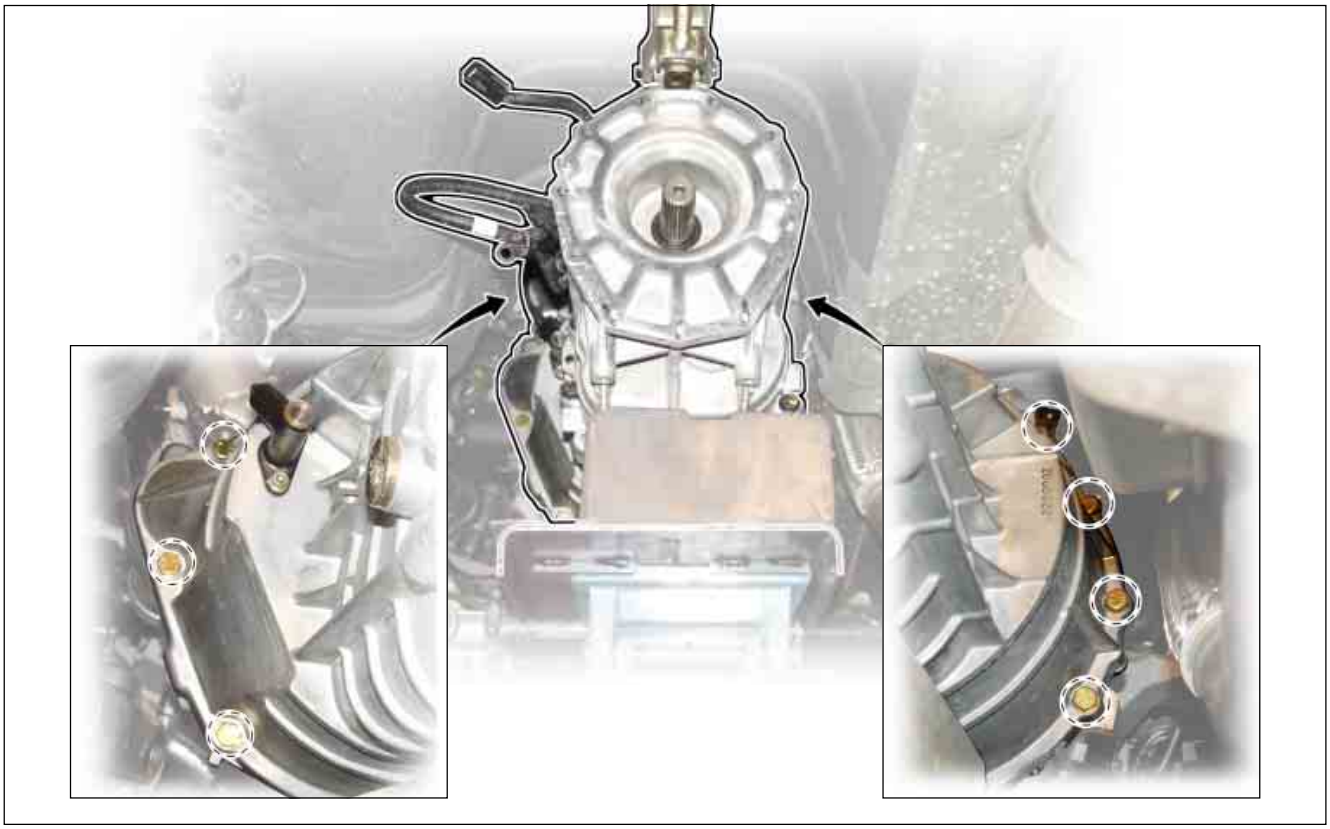
- **When installing the transfer case, make sure that the bolts are facing correct direction.**
- **From transmission side (upper: 8), From transfer case side (lower: 3)**

9. Disconnect the clutch oil hose from adapter.



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10. Support the transmission housing with a hydraulic jack and unscrew eleven transmission bolts (17 mm). (Tightening torque: 50 ~ 60 Nm)



11. Carefully lower the hydraulic jack with transmission assembly.



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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 spring plate for wear.

NOTICE

- **The excessively worn components should be replaced.**

3. Check the alignment conditions of clutch housing as follows:
   1) Install the magnetic holder on pressure spring.
   2) Alignment check for housing bore
      - Install a dial gauge in the housing bore.
      - Note the measurement while rotating the crankshaft for one revolution.



   3) Alignment check for clutch housing surface
      - Install a dial gauge on the clutch housing surface.
      - Note the measurement while rotating the crankshaft for one revolution.

NOTICE

- **If the pointer indicates beyond 0.010 inch, align the clutch housing by inserting shims between housing and clutch.**

4. Check the following parts, if necessary
   1) Pressure plate spring assembly
   2) Disc
   3) Flywheel



NOTICE

- **The excessively worn components should be replaced.**
- **SAT clutch cover can not be re-installed if disassembled. SST is needed for re-vse.**
- **Refer to the P.11 at the of this book clutch section.**

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6. DISASSEMBLY AND REASSEMBLY

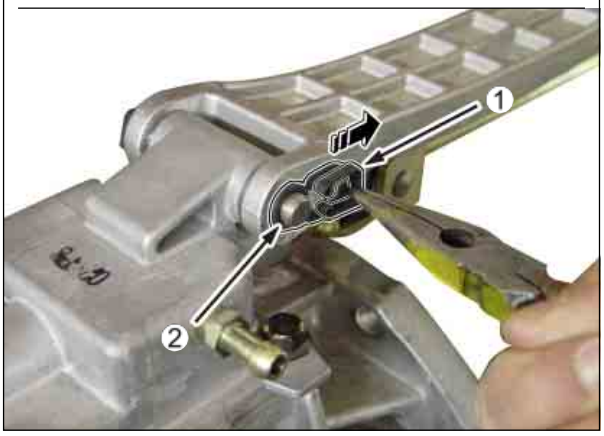
▶ MANUAL TRANSMISSION ASSEMBLY

Disassembly

1. Remove the transmission oil drain plug (hexagon, 14 mm) and completely drain the oil. Place the removed transmission on the workbench.

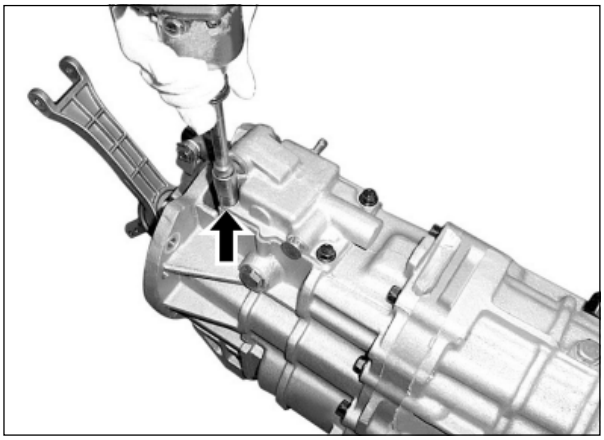


2. Pull out the lock washer (1) and remove the TGS pin (2).

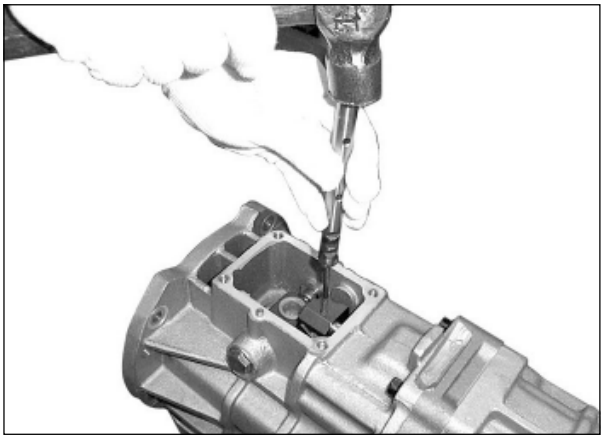


3. Push the semi remote lever rearward and unscrew the mounting bolts (4) with a wrench (12 mm) to remove the top cover.

NOTE
- **Be careful not to lose the disassembled components.**



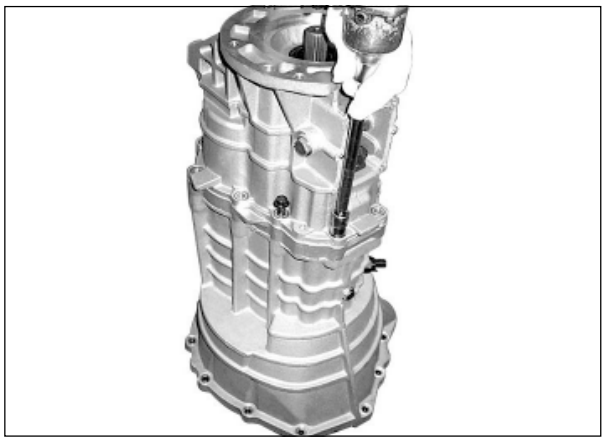
4. Pull out the spring pin (6 x 25) and remove the offset lever.



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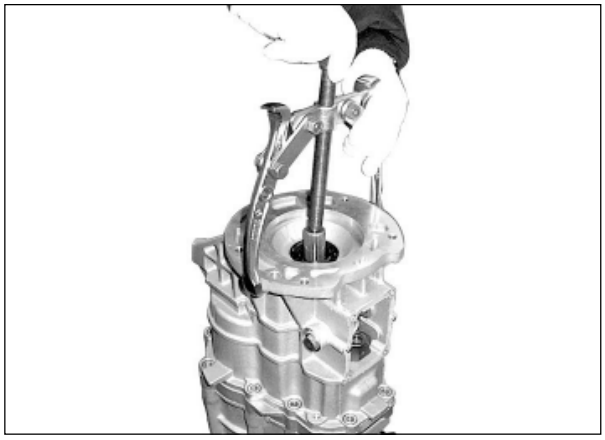
5. Remove the bolts from the extension housing with a wrench (14 mm).



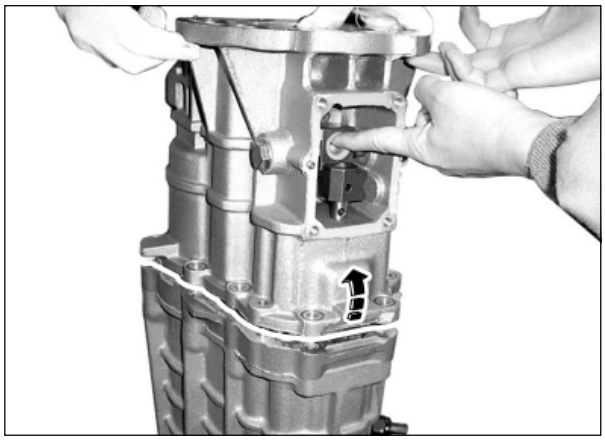
6. Remove the extension housing with a special tool.

NOTICE

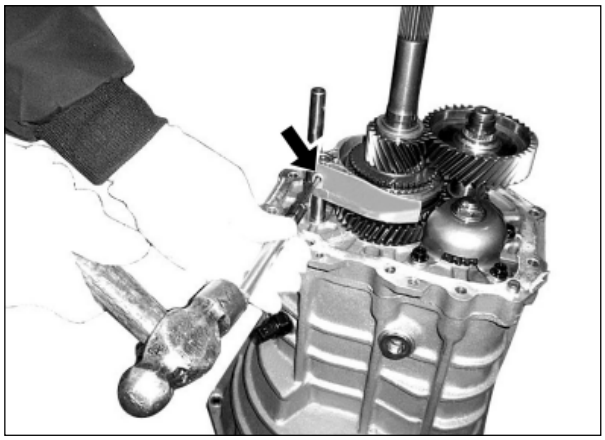
- **Remove the offset lever and rolling plunger with the extension housing. Be careful not to drop them.**



7. Remove the rear ball bearing with a puller and remove the speedometer driven gear.

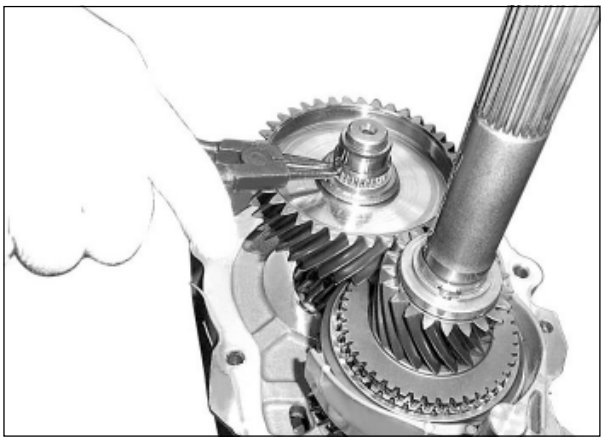


8. Remove the 5/R shift fork spring pin (6 x 28).



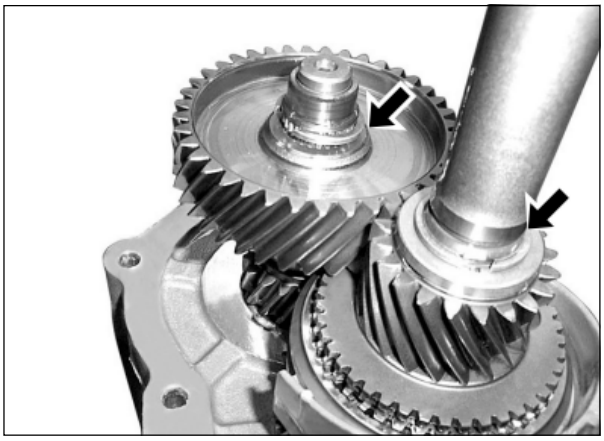
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1) Pull the counter gear (5th gear) retainer ring out from the ring groove with a ring pliers.

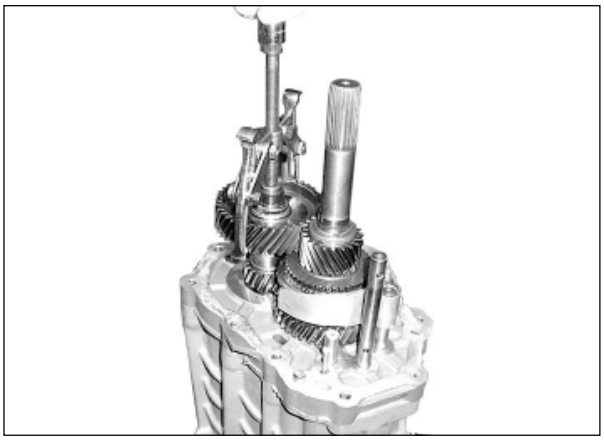


NOTICE

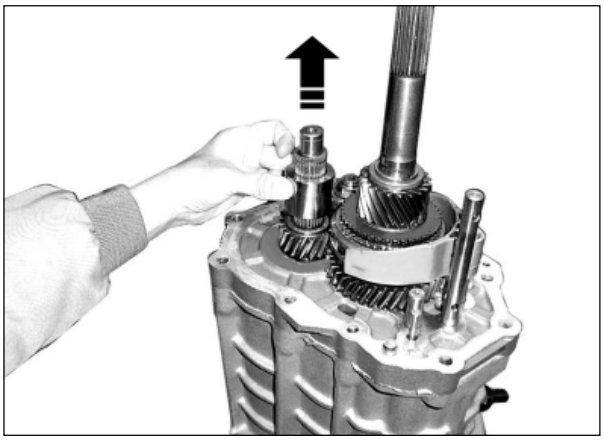
- **Be careful not to stiffen the retainer ring.**



9. Spread the retainer ring and remove the 5th counter gear with a puller.

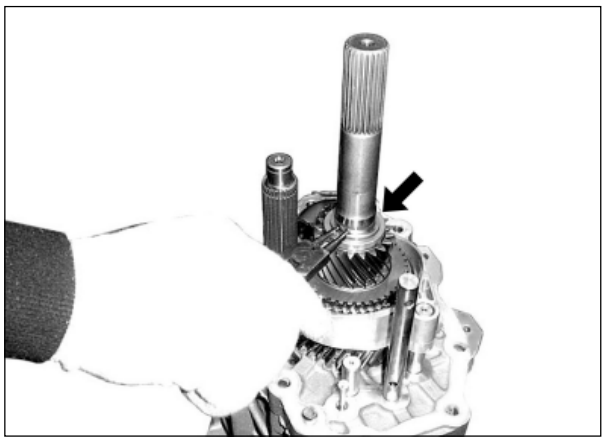


10. Remove the counter reverse spacer.

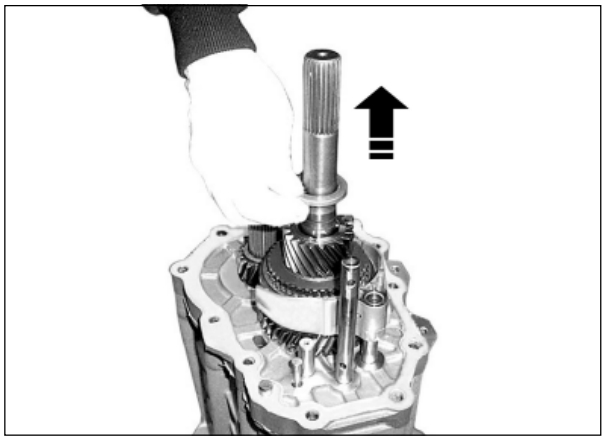


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11. Remove the 5th gear retainer ring with a ring pliers.



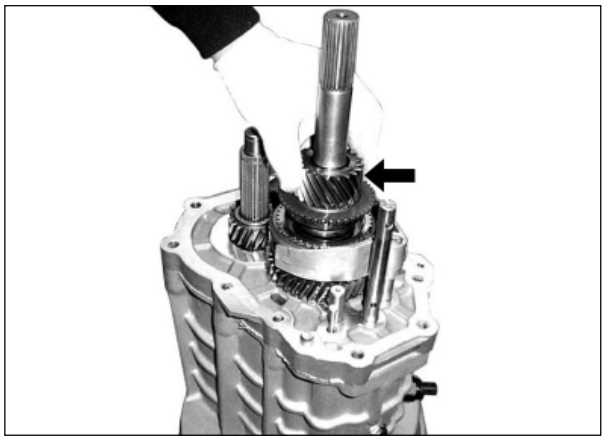
12. Remove the thrust washer from the shaft.



13. Remove the 5th gear and pull out the spring pin.

NOTICE

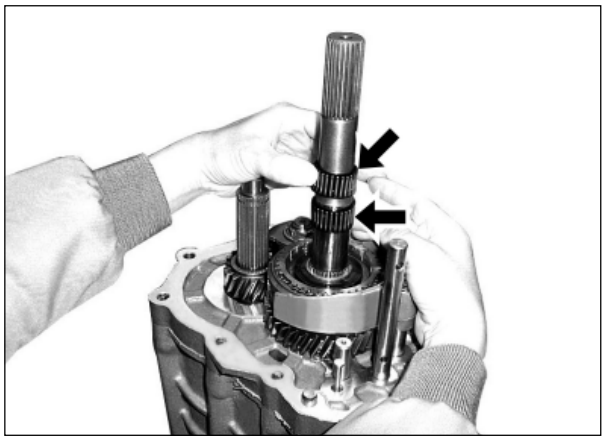
- **Be careful not to lose or mix the spring pins.**



14. Remove the 5th gear needle bearings (2).

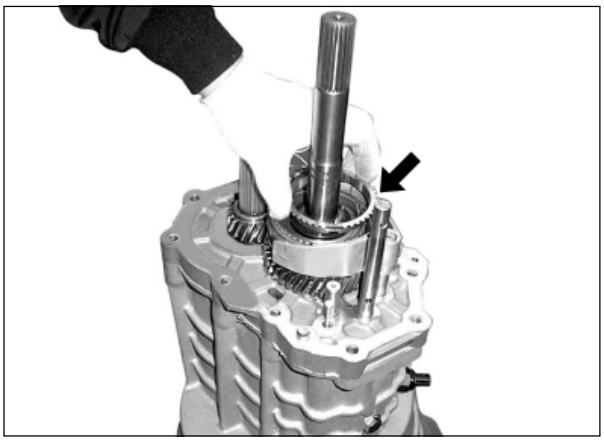
NOTICE

- **Be careful not to lose or mix the needle bearings.**



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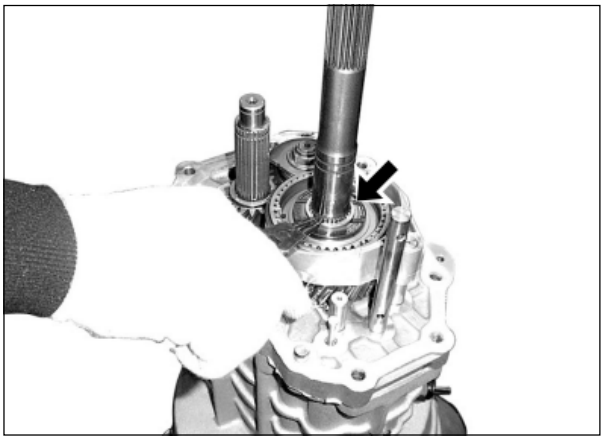
15. Remove the 5th gear synchronizer ring.



NOTICE

- **Store at a safe place not to be mixed with other synchronizer rings.**

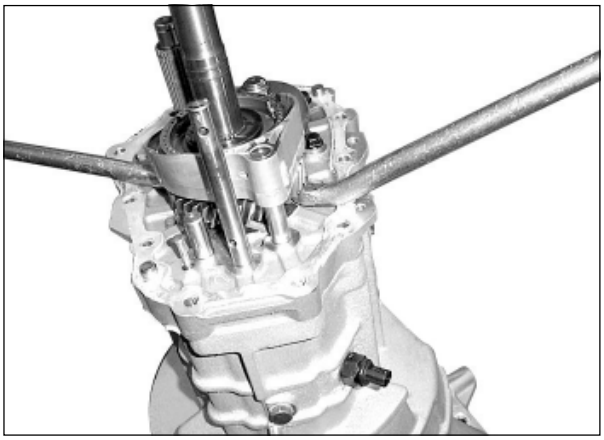
16. Remove 5/R gear retainer ring from the shaft with a ring pliers.



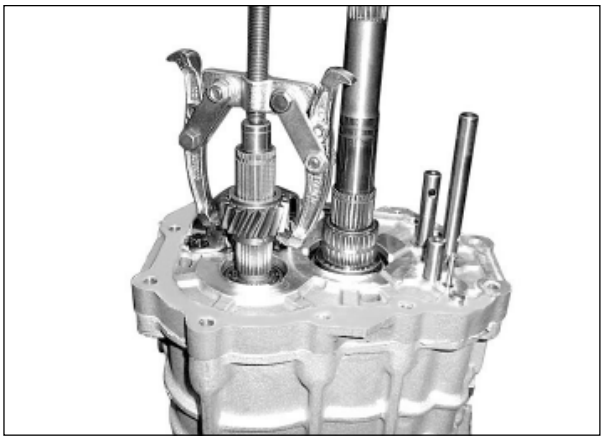
NOTICE

- **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.



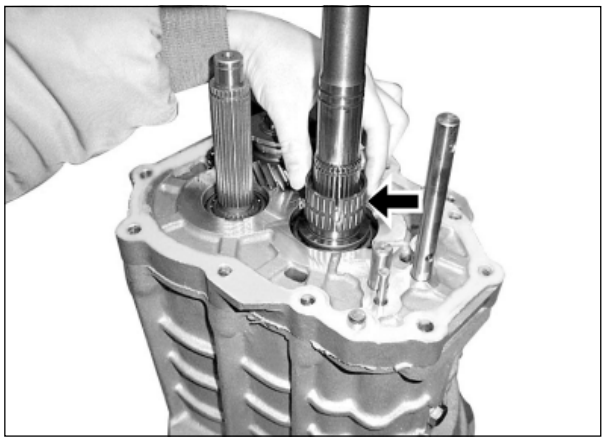
18. Remove the counter reverse gear.



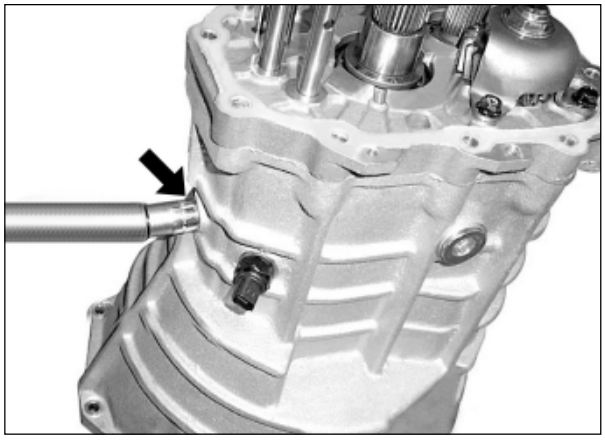
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19. Remove the counter reverse gear needle bearing.

NOTICE
- **Store the needle bearing with the relevant gear.**

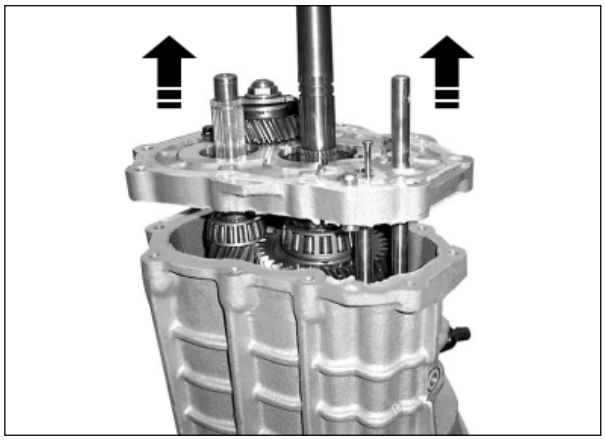


20. Remove the interlock bolt (17 mm).



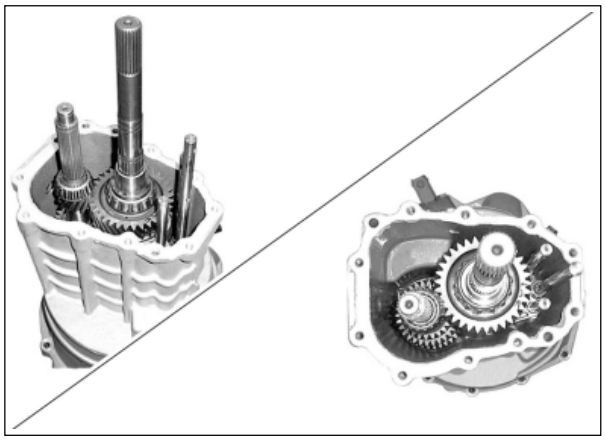
21. Remove the transmission adapter from the surface.

NOTICE
- **Be careful not to damage the adapter mating surface.**



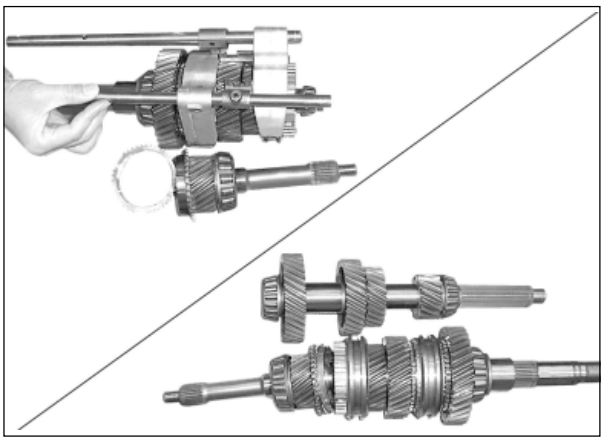
22. Remove the gear assembly from the housing.

NOTICE
- **Do not forcefully remove the gear assembly. It may damage the level grooves resulting in incorrect installation. Carefully remove the gear assembly.**



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23. Remove the main and counter gear assembly.
    1) Pull out the pins from 5/R and 1/2 shift rails and remove the shift rails
    2) Pull out the locking pins from shift forks.

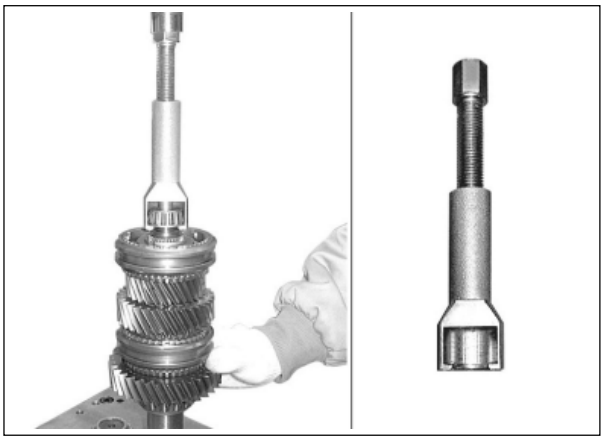


24. Remove the shift rail and shift fork. Place the output shaft and counter gear on the special tool.



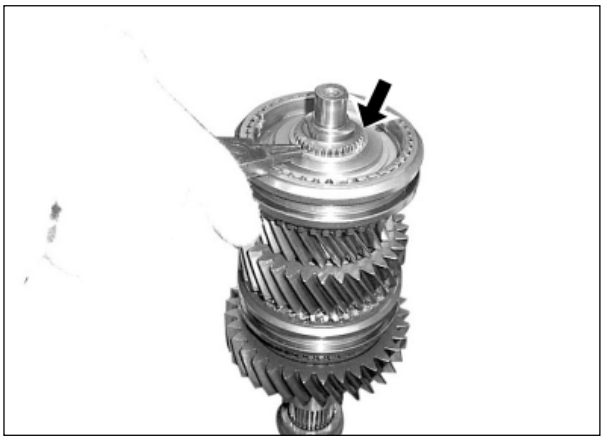
25. Place the output shaft assembly with the 1st gear facing down and remove the intermediate taper roller bearing with a special tool.

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.**

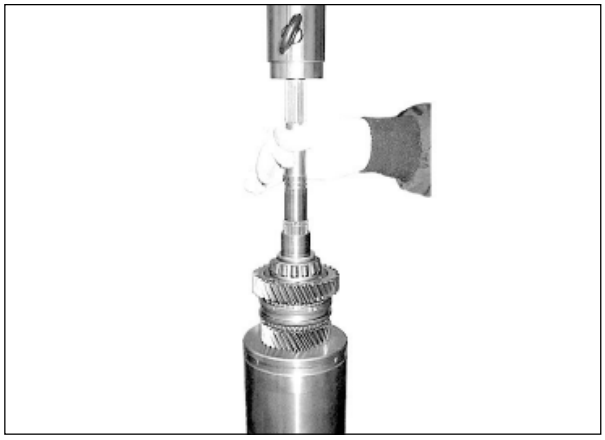


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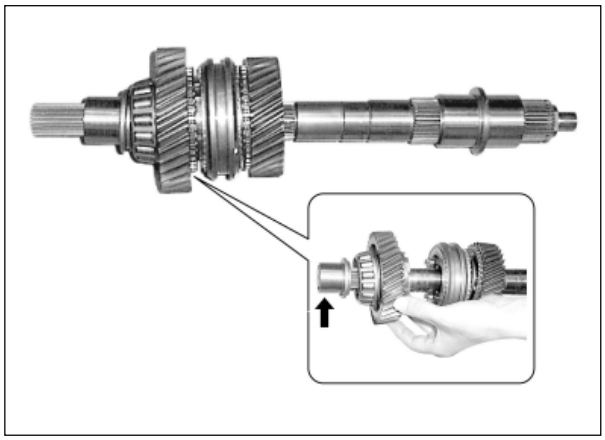
27. Remove the 3/4 gear synchronizer hub and single synchronizer sleeve and 3rd gear with a special tool. Pull out the needle bearing.



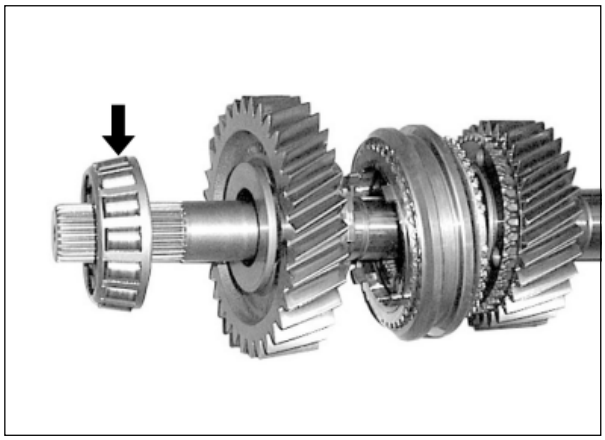
28. Loose the 1/2 gear and hub and double synchronizer sleeve with a press.



29. Remove the reverse gear inner race.

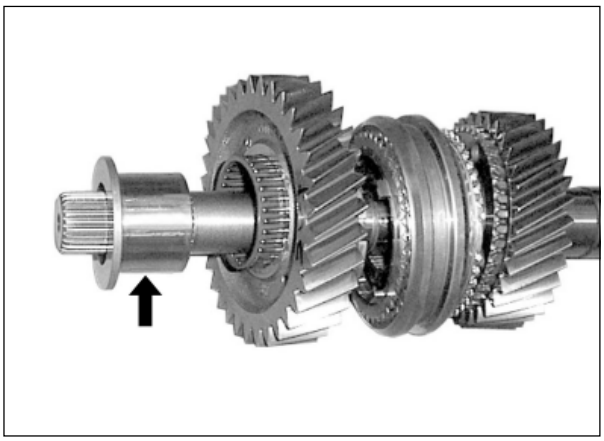


30. Remove the main taper roller bearing.



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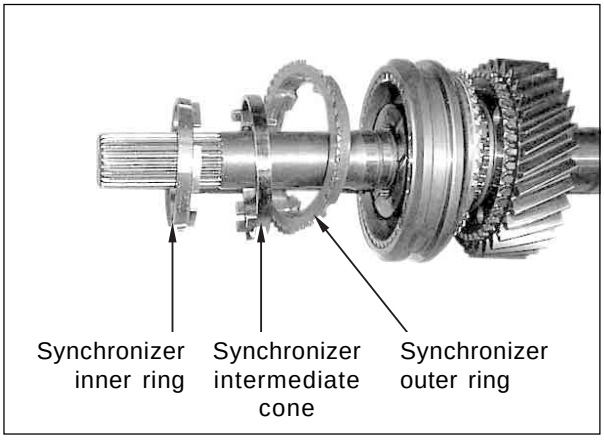
31. Remove the inner race from 1st gear and 1st gear from 1st gear, and remove the needle bearing from the shaft.



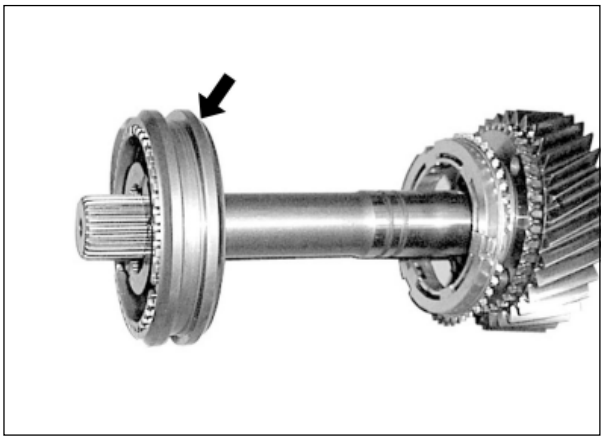
NOTICE

- **Store the disassembled gears by relevant components.**

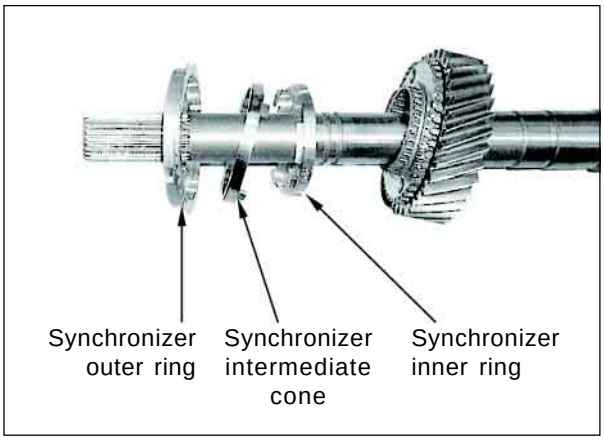
32. Remove the synchronizer inner intermediate cone and outer ring in 1st gear side.



33. Remove the 1/2 gear synchronizer hub along with double synchronizer sleeve.



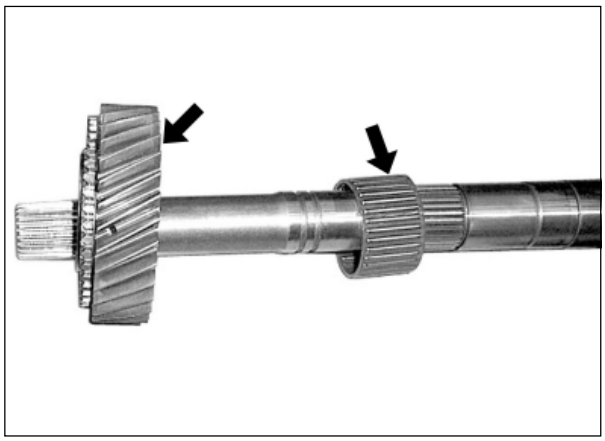
34. Remove the synchronizer inner intermediate cone and outer ring in 2nd gear side.



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35. Remove the 2nd gear and needle bearing.



36. Remove the oil seal from the extension housing.



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Inspection Before Reassembly

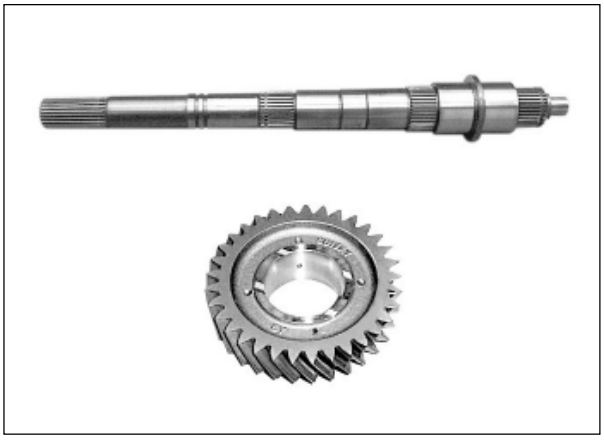
1. Clean all the disassembled components with solvent and dry them with compressed air.

   Check the components for crack, wear and damage.

   1) Case, extension housing, shift lever
   2) Input bearing retainer
   3) 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:

   1) Input shaft
   2) Main shaft and gears
   3) Counter shaft and 5th drive gear

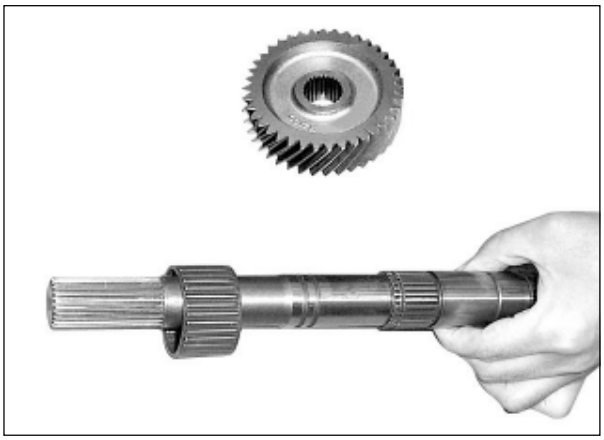




4. Reverse idler shaft and gears

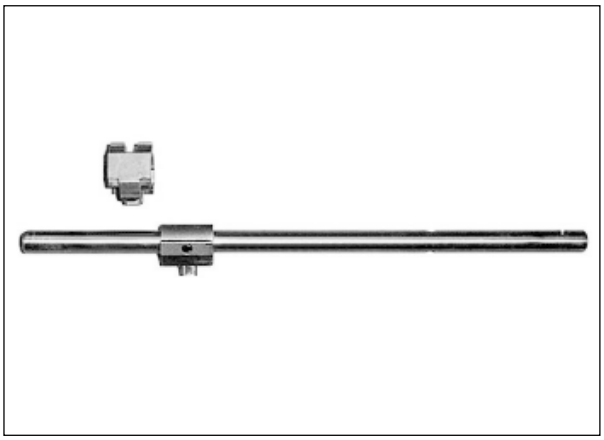
NOTICE

- **Replace the excessively worn components. Do not grind the precisely machined components.**



5. Check the following components for wear:

   1) Selector arm
   2) Interlock plate
   3) 1/2 and 3/4 shift fork
   4) Shift shaft
   5) Detent/guide plate and offset lever
   6) Each shift lever shift fork



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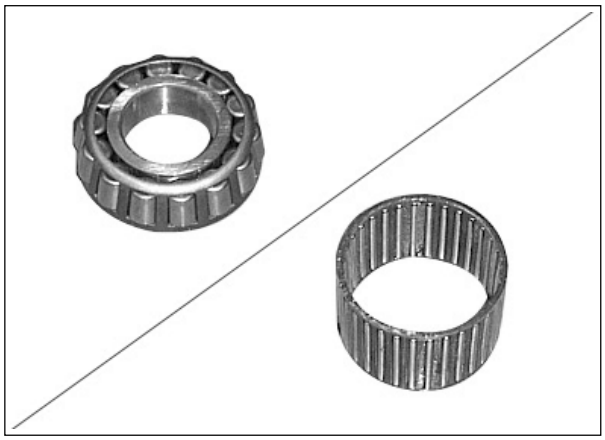
7) Hub and sleeve
8) 1/2 shift fork, pads, synchronizer sleeve



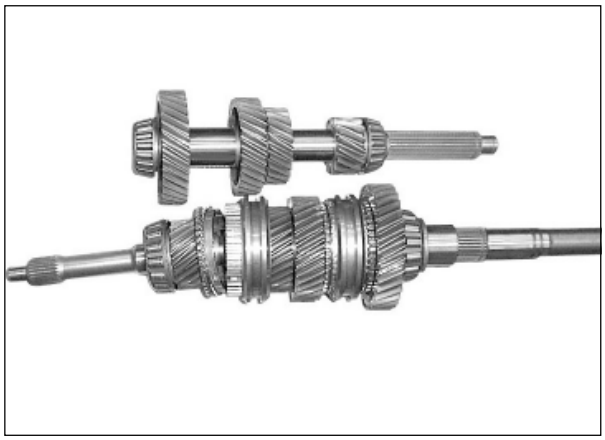
9) 3/4 shift fork, pads, synchronizer sleeve
10) 5th gear shift rail/fork, pads, synchronizer sleeve
11) Reverse fork and reverse idler gear sleeve



6. Check the following components for excessive wear:
   1) Crankshaft pilot bushing in front of input shaft
   2) Clutch release bearing
   3) Main shaft pilot bearing roller
   4) Main shaft thrust bearing mating surface
   5) Main shaft speed gear roller bearing
   6) Main shaft rear bearing
   7) Counter shaft front and rear bearing



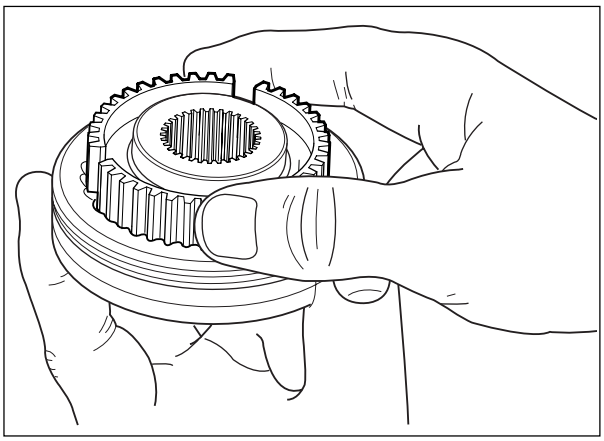
7. Check the gear sets for wear in teeth surface.
8. Check the gear sets for excessive wear, crack and break and replace if needed.



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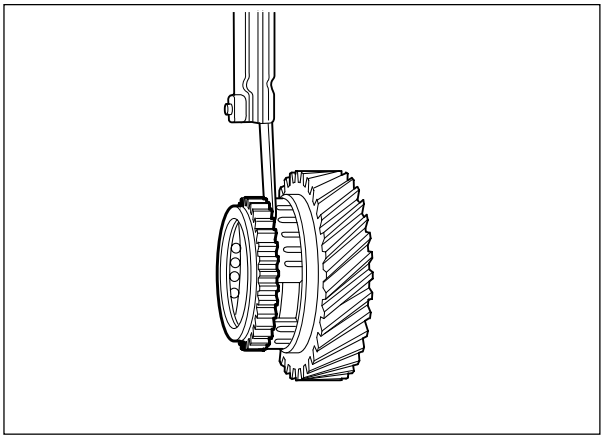
9. Check the conditions of each synchronizer sleeve and hub.
   1) Engagement of hub and sleeve
   2) Wear on cone clutch surface in synchronizer ring (brass) engaging the gears



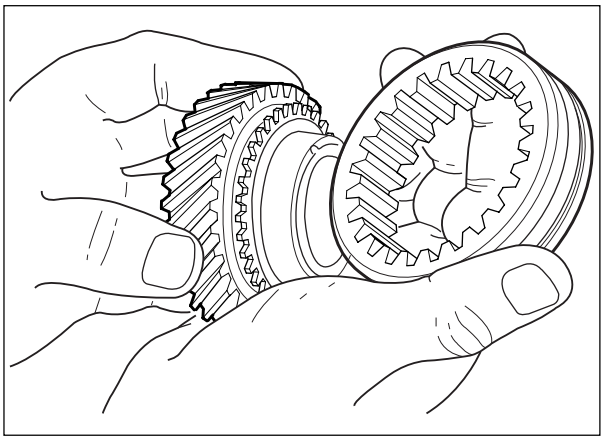
10. Measure the clearance between blocking ring and speed gear.
    1) New 1/2 gear synchronizer ring: 0.87 ~ 1.4 mm
    2) New 3/4 gear synchronizer ring: 0.88 ~ 1.5 mm

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.



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Reassembly

1. Install the 2nd gear needle bearing.

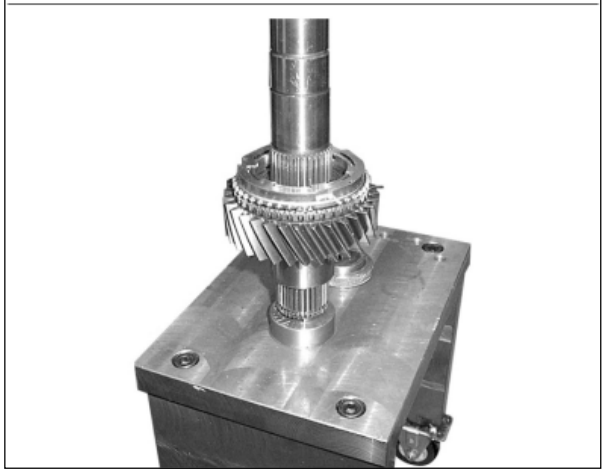


NOTICE

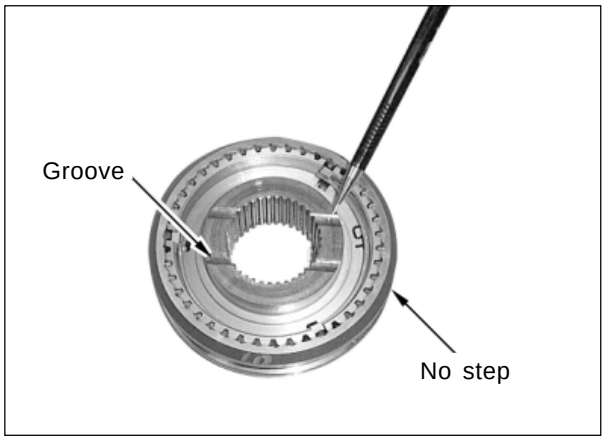
- **The 1st/2nd/3rd gear needle bearings have one bearing row and the sizes of them are same. The reverse needle bearing has two bearing rows. The 5th needle bearing is smaller than others and consists of two bearings.**

2. Install the 2nd gear and synchronizer outer ring, intermediate cone and inner ring in turns.





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.

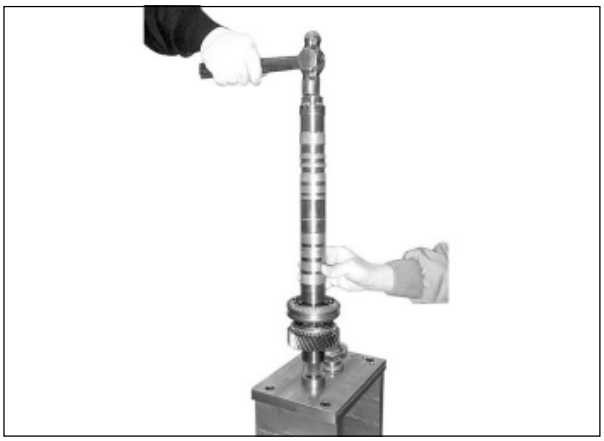


NOTICE

- **1/2 gear double synchronizer sleeve doesn't have a step at edge, however, 3/4 and 5/R gears have it.**

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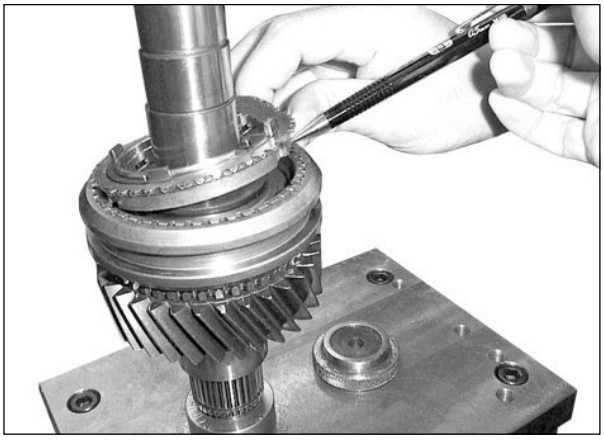
4. Install the 1/2 synchronizer hub and double synchronizer sleeve into the output shaft by using a press.



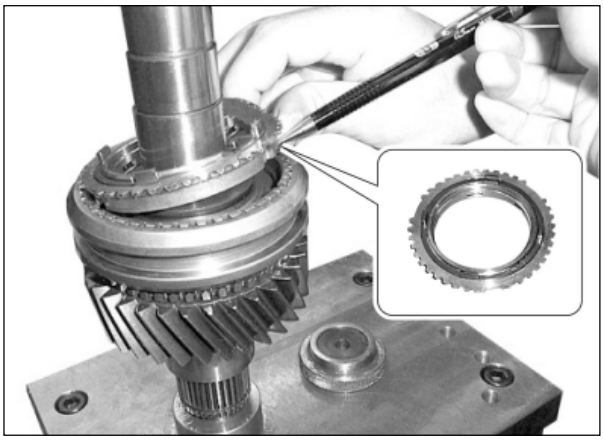
NOTICE

- **Make sure that the hub groove faces to 2nd gear. Align the synchronizer key and the synchronizer ring groove in 2nd gear.**

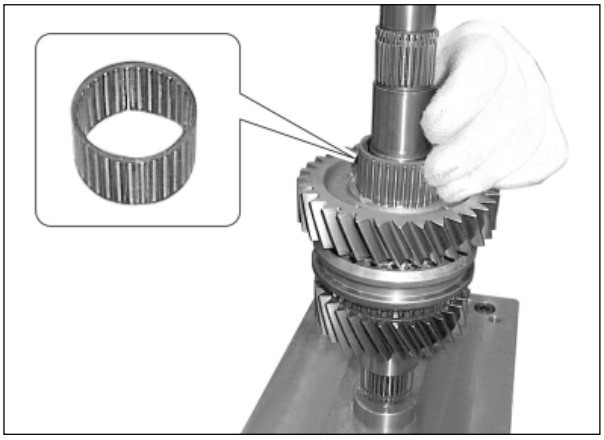
5. Install the synchronizer outer ring, intermediate cone and inner ring in turns.



6. Install the 1st gear.



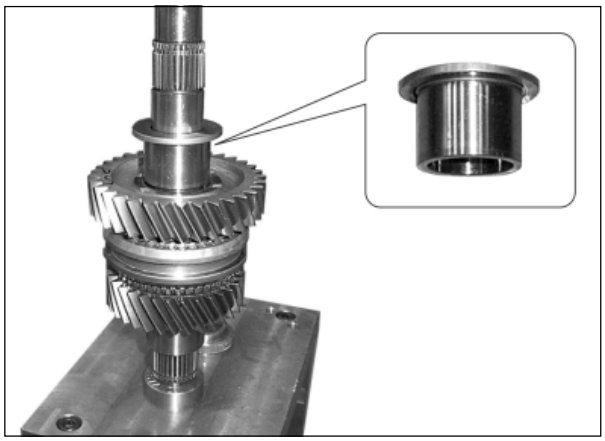
7. Install the 1st gear needle bearing.



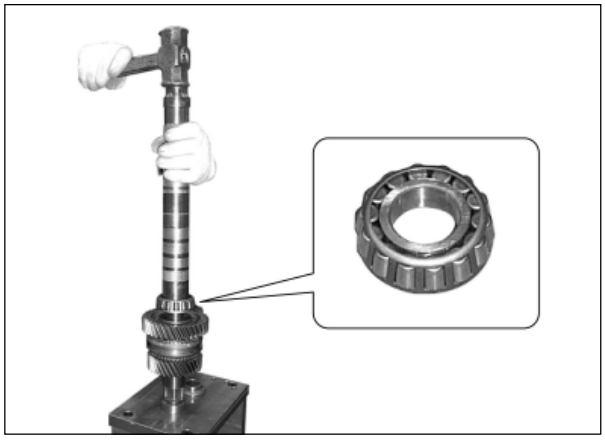
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8. Install the 1st gear inner race by using a press.

NOTICE
- **The 1st inner race doesn't have a step at edge.**

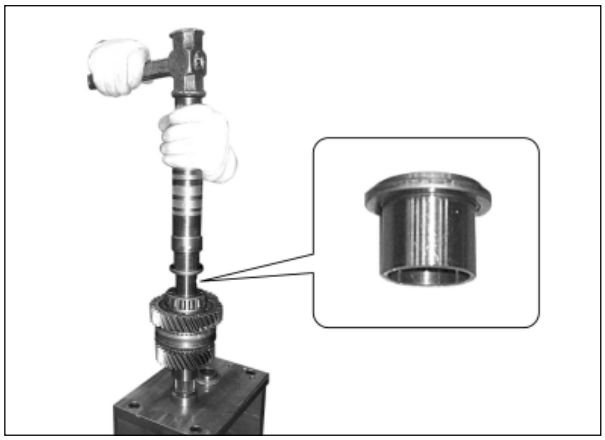


9. Install the main taper roller bearing by using a press.

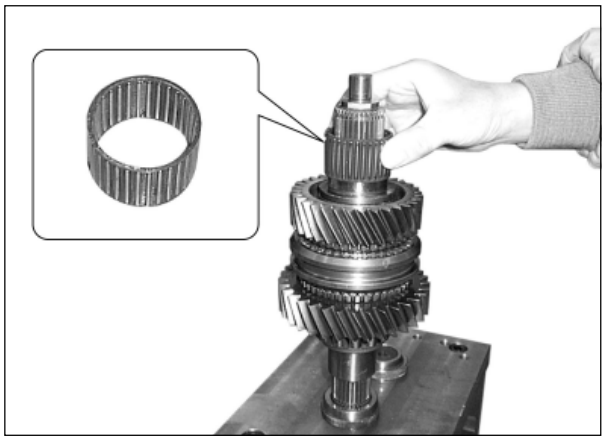


10. Install the reverse gear inner race by using a press.

NOTICE
- **The reverse gear inner race has a step at edge.**

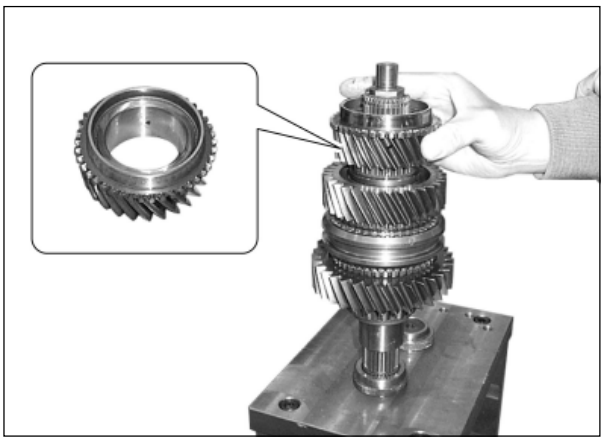


11. Place the output shaft assembly with the 1st gear facing downward and install the 3rd gear needle bearing.

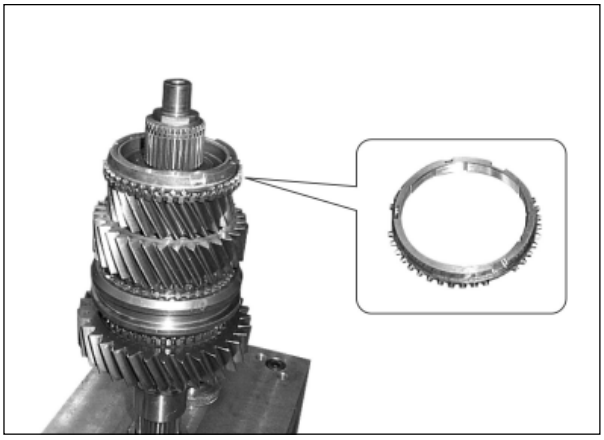


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12. Install the 3rd gear.



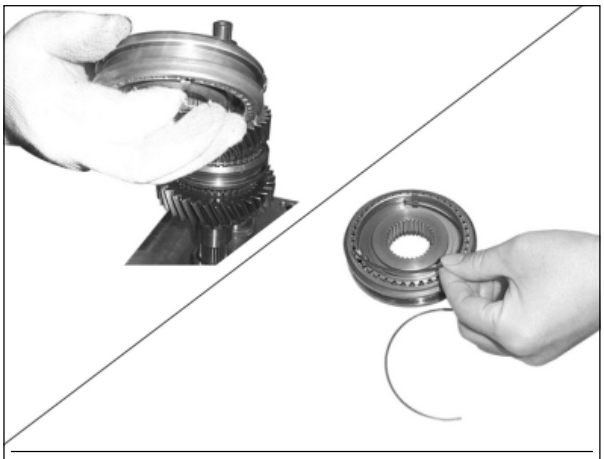
13. Install the synchronizer ring on the 3rd gear.



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.**



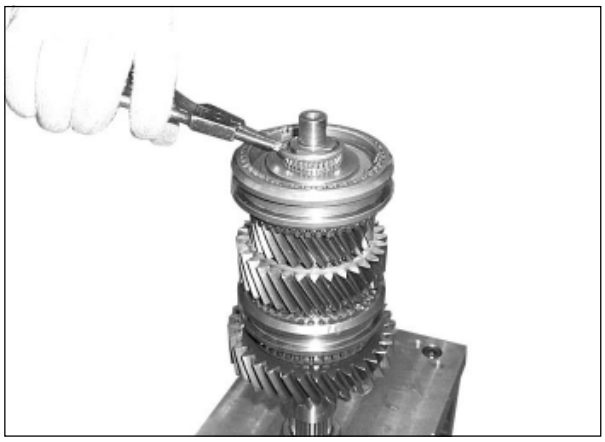


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15. Install the 3/4 gear retainer ring.

NOTICE

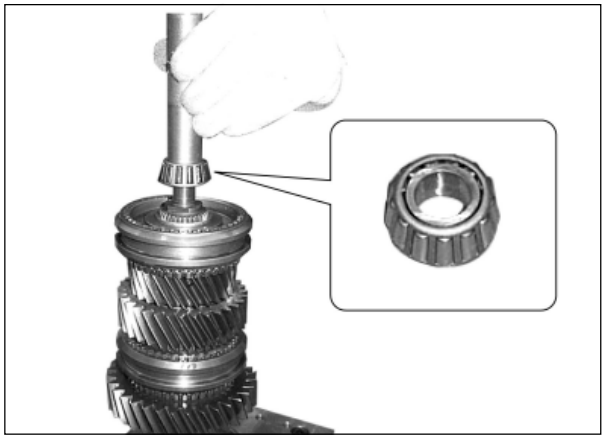
- **Adjust the end play between retainer ring and hub to a range of 0.0 to 0.5 mm by using a feeler gauge.**



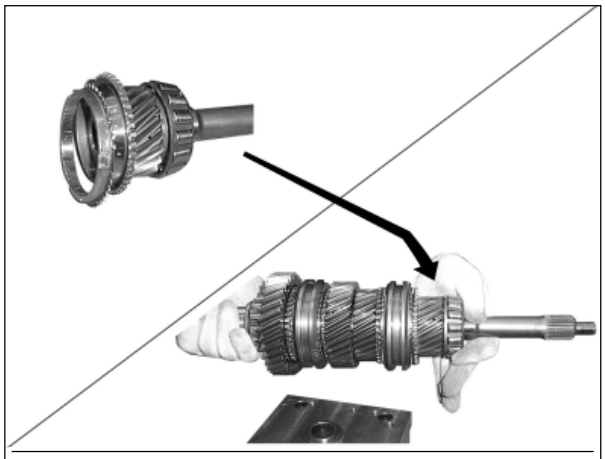
16. Install the intermediate taper roller bearing by using a press. Install the intermediate taper roller bearing by using a press.

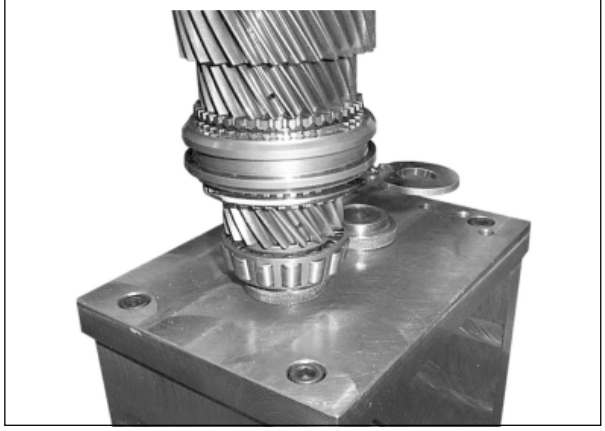
NOTICE

- **Apply the force on the inner race other than other points.**



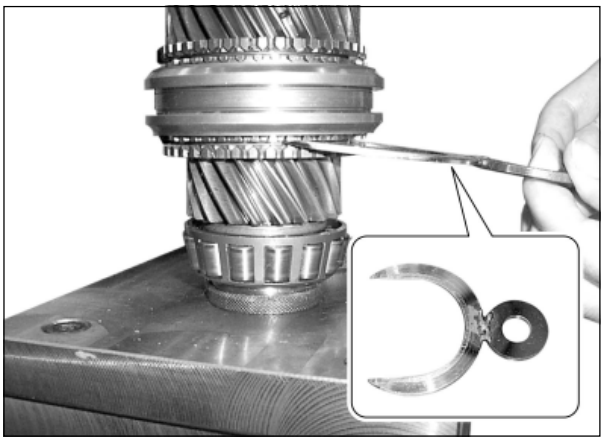
17. Install the input shaft along with the 4th synchronizer ring. Place the input shaft to face downward on the work bench.



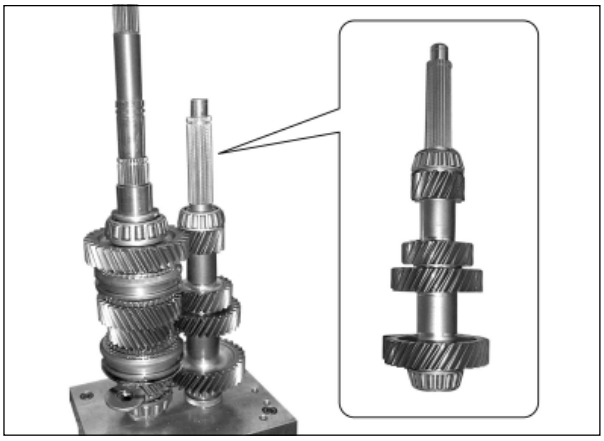


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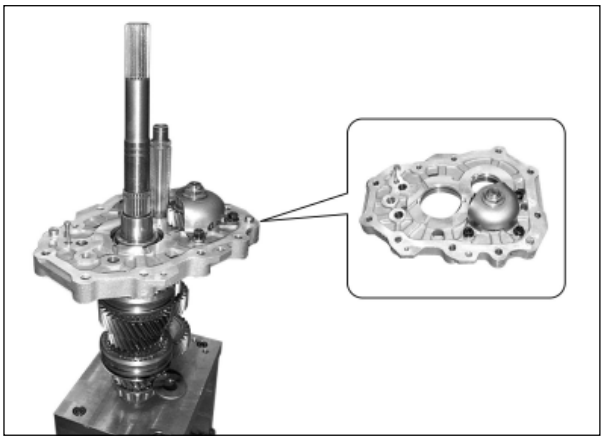
18. To relieve the load and to provide a clearance to the shaft bearing, insert a special tool.



19. Place the counter gear with input/output shaft on the workbench.



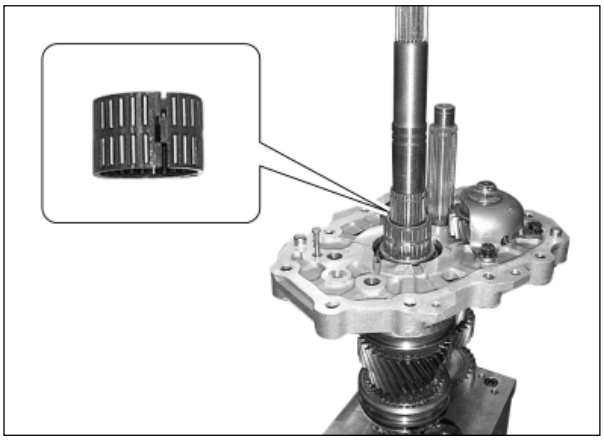
20. Install the transmission adapter on the input shaft and the counter gear.



21. Install the reverse gear needle bearing.

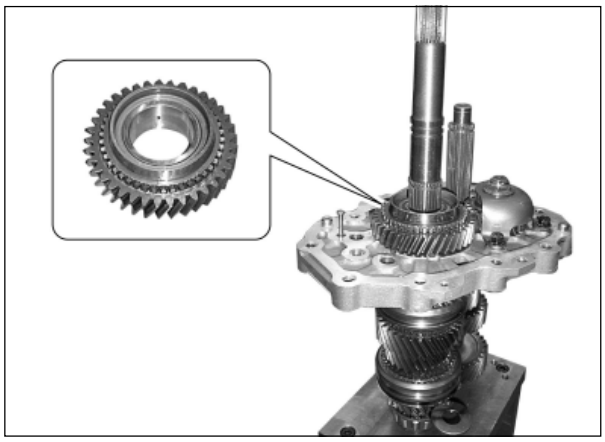
NOTICE

- **The reverse gear needle bearing has two bearing rows and the others consist of two bearings.**

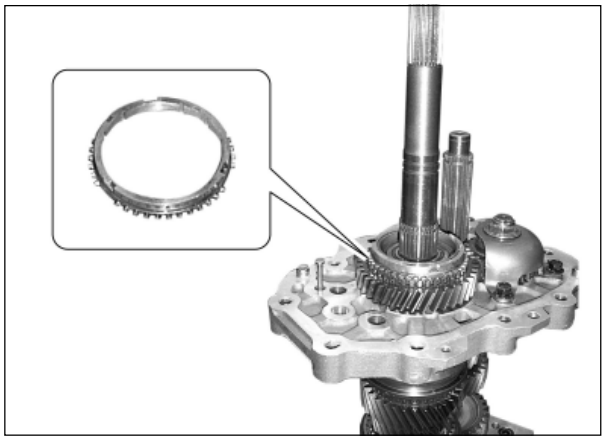


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22. Install the reverse gear in the shaft.



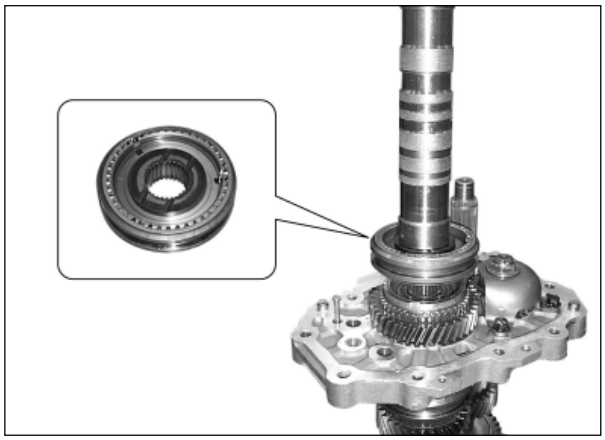
23. Install the synchronizer ring on the reverse gear.



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

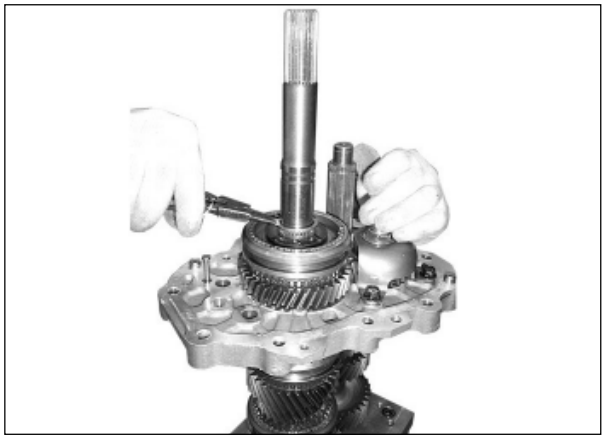
- **Place the groove in hub to face the 5th gear and align the synchronizer key and the synchronizer ring groove in reverse gear.**



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.**

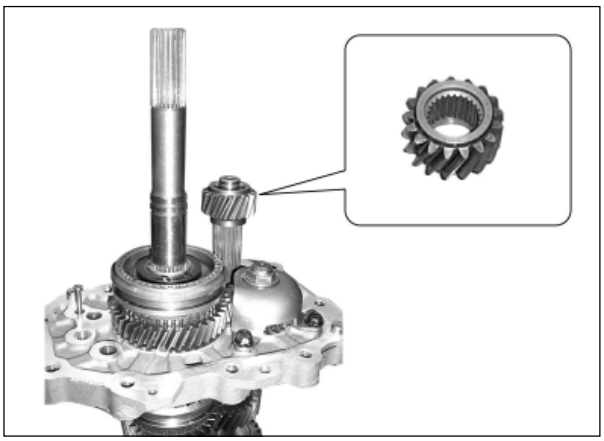


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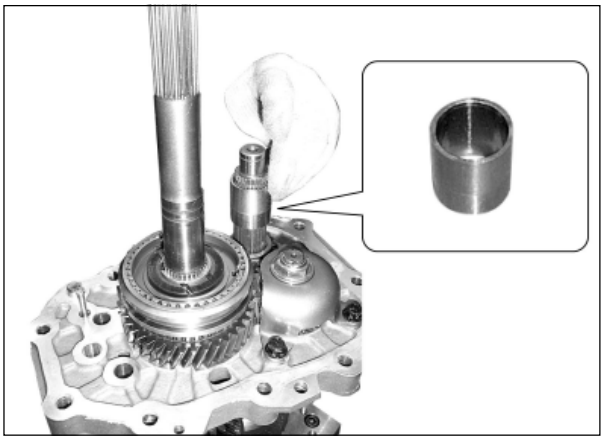
26. Install the counter reverse gear by using a press.

NOTICE

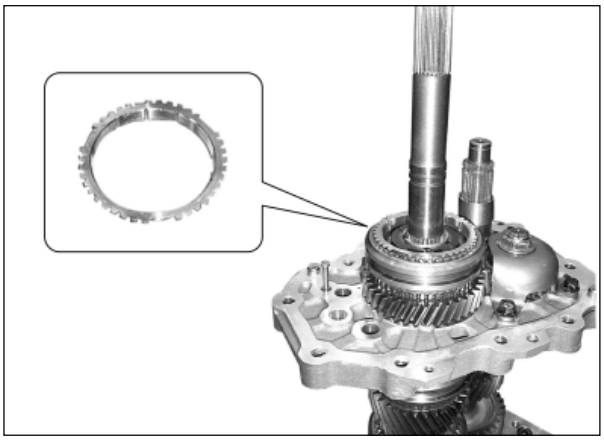
- **Place the counter reverse gear with a longer protrusion facing to the adapter.**



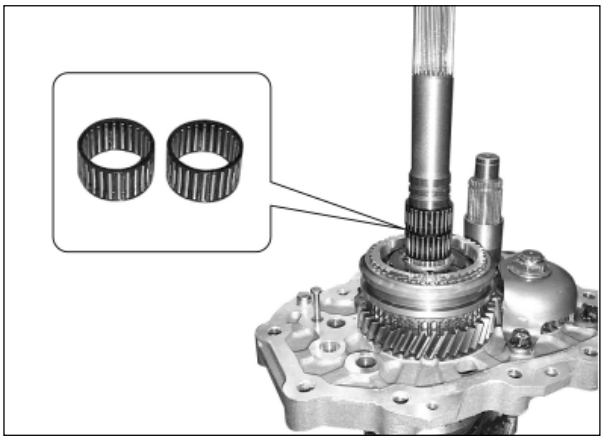
27. Install the counter reverse spacer.



28. Install the 5th synchronizer ring.

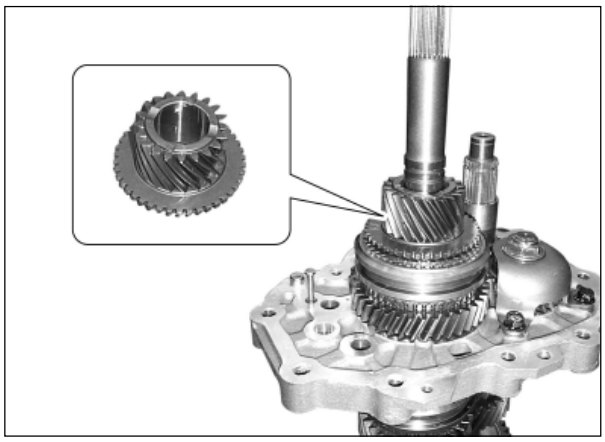


29. Install two 5th gear needle bearings in line.

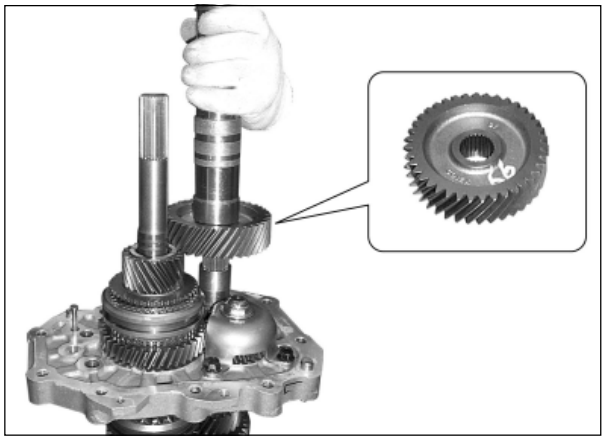


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30. Install the 5th gear.



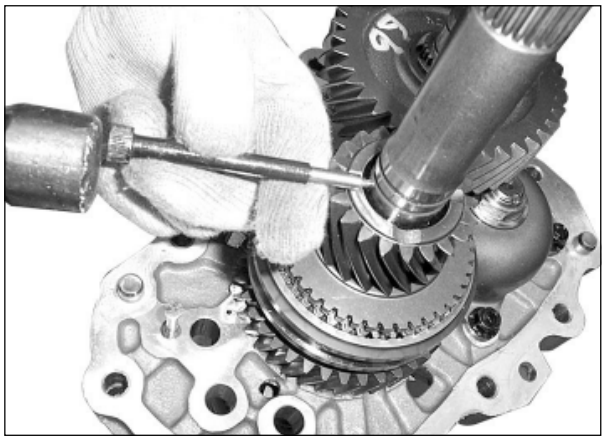
31. Install the 5th counter gear by using a press. At this time, place it with a longer protrusion area facing to the adapter.



32. Install the counter 5th gear retainer ring.

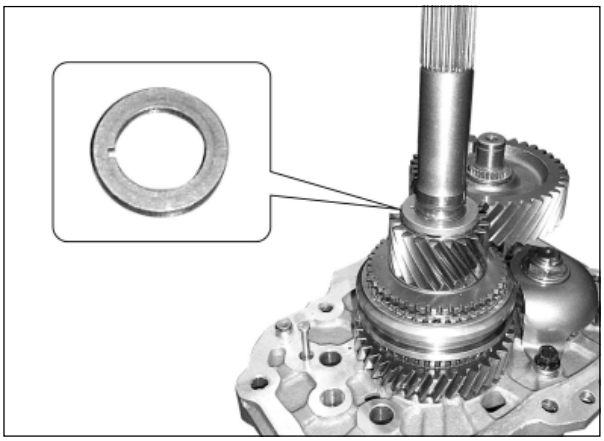


33. Install the locking ball.



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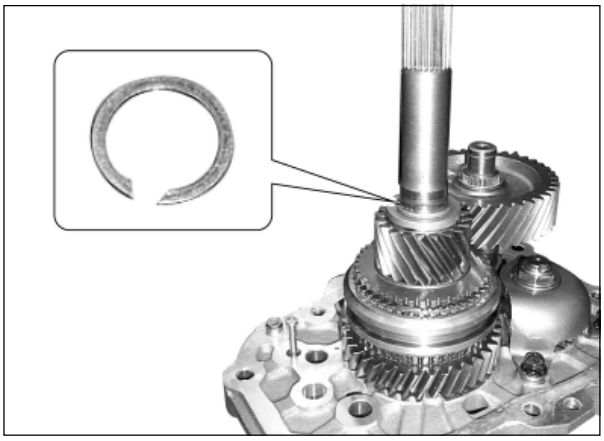
34. Install the thrust washer (t= 5.0) while aligning the key grooves.



35. Install the retainer ring.

NOTICE

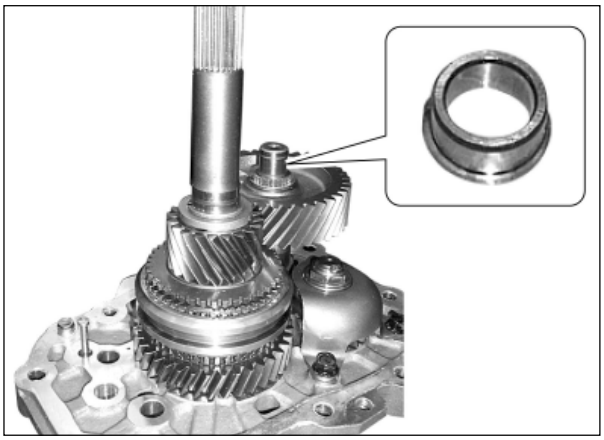
- **Adjust the end play between retainer ring and hub to a range of 0.08 to 0.22 mm by using a feeler gauge.**



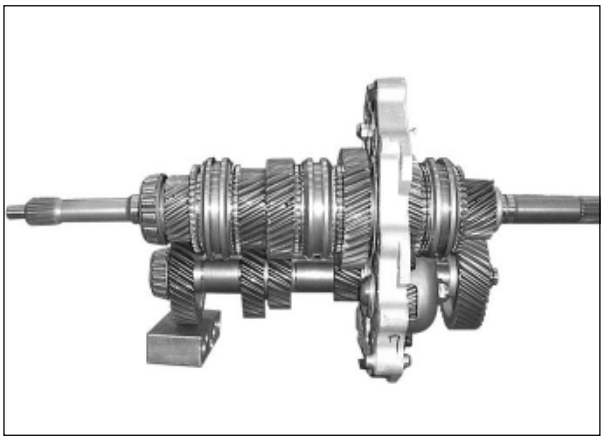
36. Install the inner race of counter roller bearing by using a press.

NOTICE

- **Place it with a protrusion area facing to the 5th gear.**



37. Place the gear assembly on a workbench in parallel.

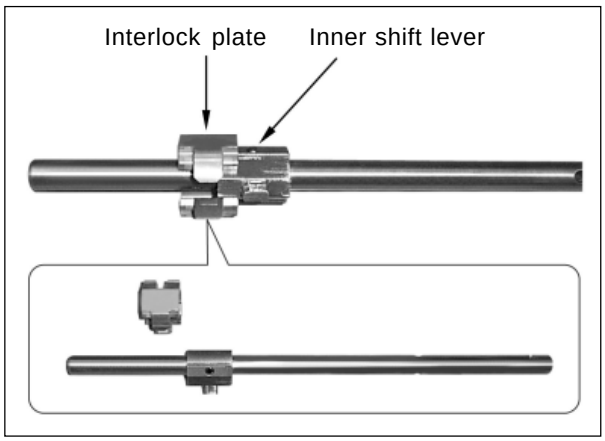


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38. Install the inner shift lever and interlock plate in the 3/4 gear shift rail.

NOTICE

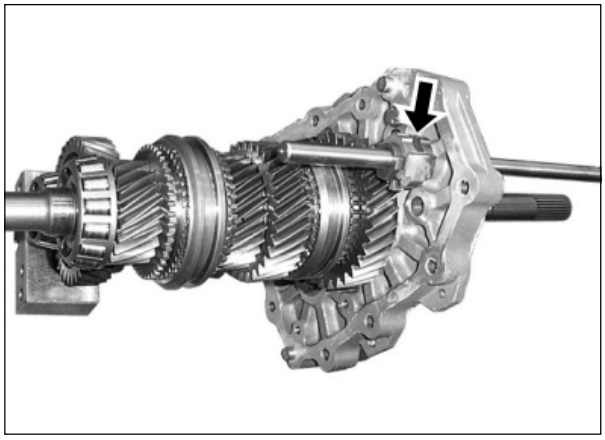
- **The spring pin for locking the inner shift lever is small (6 × 22) and its slot should face to the shaft.**



39. Install the 3/4 gear shift rail in the transmission adapter.

NOTICE

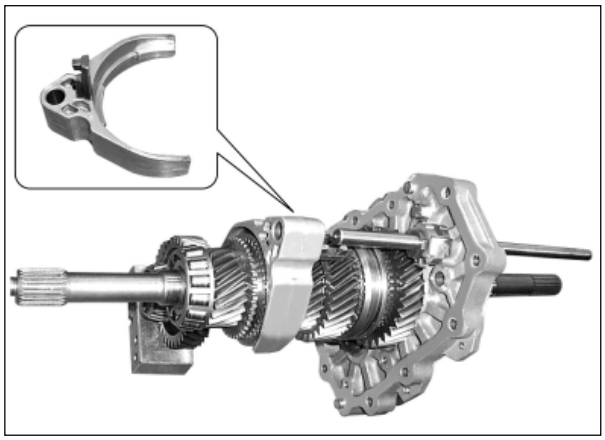
- **The part which is longer the distance between the left hold of shift rail and the end of shift rail should face to the input shaft.**



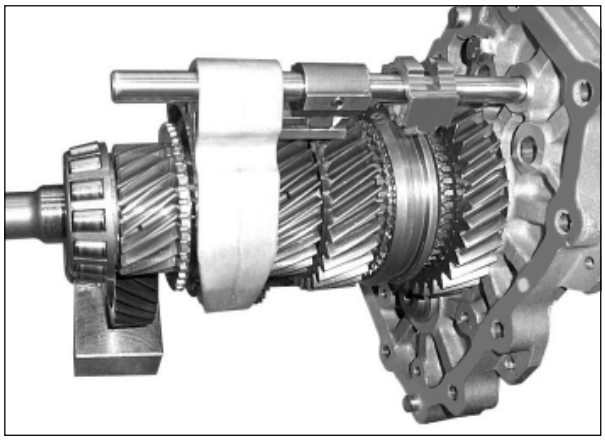
40. Install the 3/4 gear shift fork.

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.**

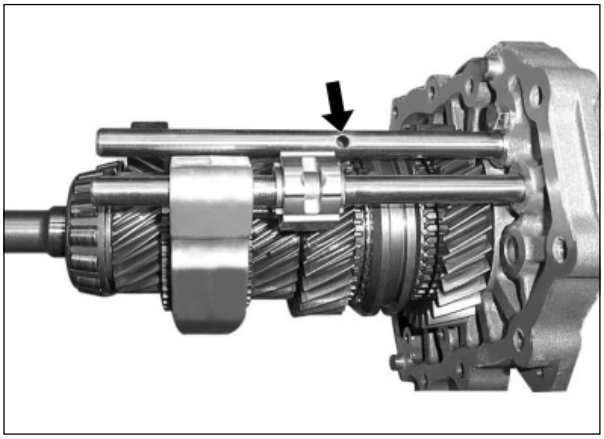


41. Install the 3/4 shift fork and shift rail while aligning the grooves.

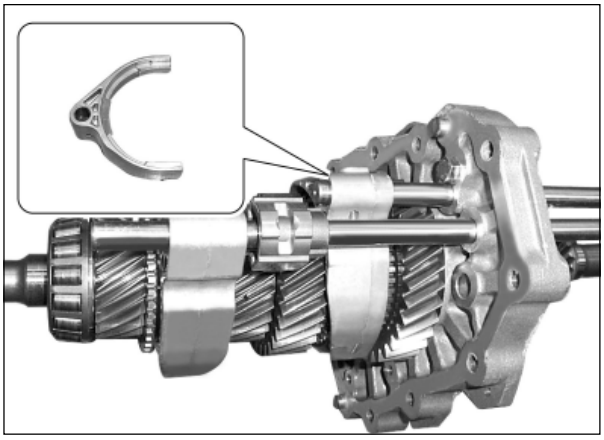


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42. Install the 1/2 gear shift rail in the transmission adapter.



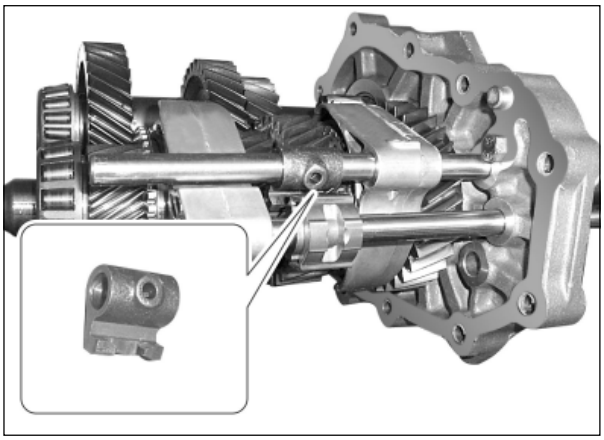
43. Partially engage the 1/2 shift fork to the shift rail.



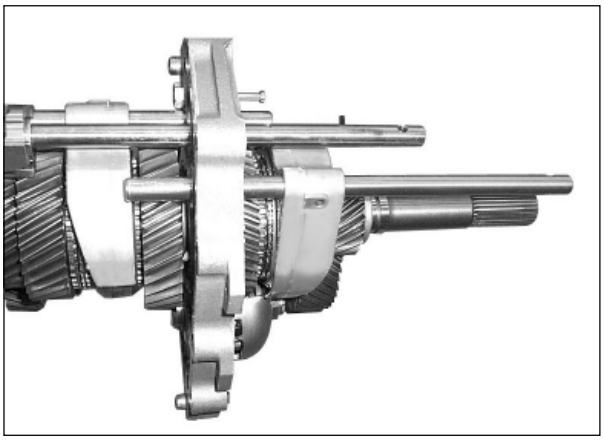
44. Install the shift lug on the 1/2 shift rail. Install the reverse lock spring, reverse lock plate and reverse lock bolts.

NOTICE

- **Align the 1/2 gear shift lug and interlock plate mating surface.**



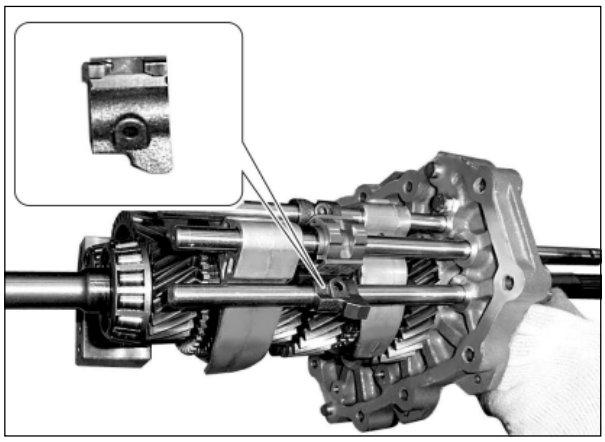
45. Partially engage the 5/R gear shift fork to the shift rail.



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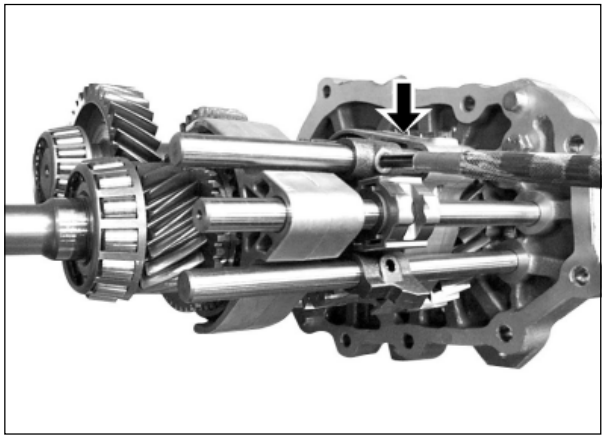
46. Install the 5/R shift lug and 5/R shift fork on the shift rail.

NOTICE
- **Align the 5/R shift lug and the interlock plate surface.**



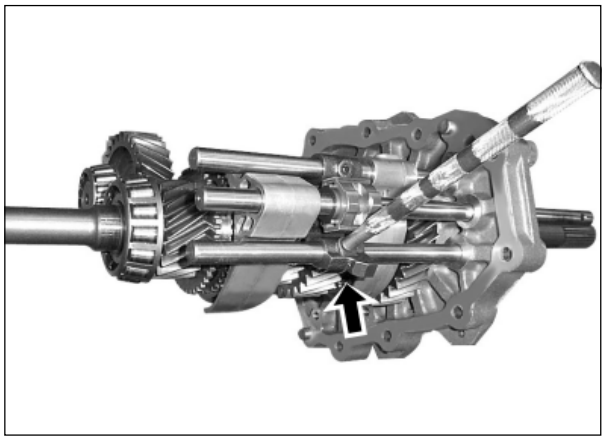
47. Install the spring pin into the 1/2 shift lug.

NOTICE
- **Place the spring pin with the pin slot facing to the shaft.**



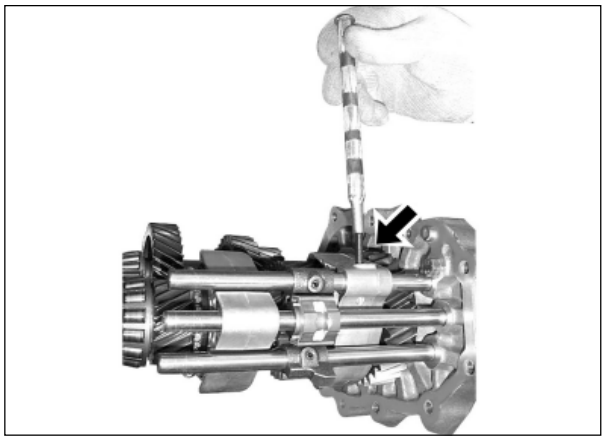
48. Install the spring pin into the 5/R shift lug.

NOTICE
- **Place the spring pin with the pin slot facing to the shaft.**



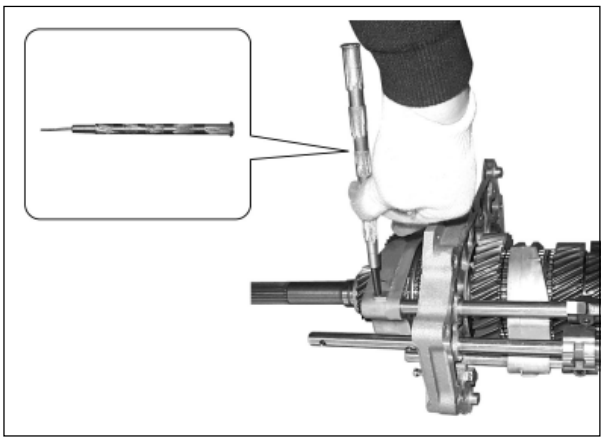
49. Install the spring pin into the 1/2 shift fork.

NOTICE
- **Place the spring pin with the pin slot facing to the shaft.**



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50. Install the spring pin into the 5/R shift fork.



NOTICE

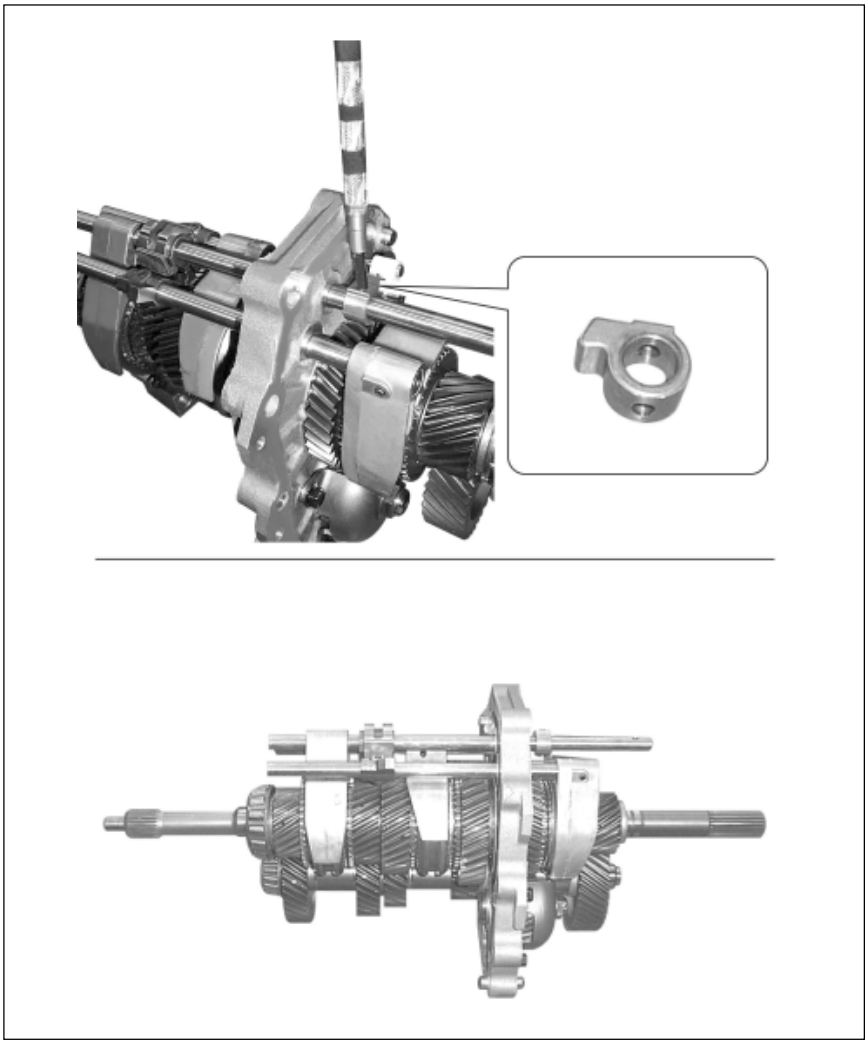
- **Place the spring pin with the pin slot facing to the shaft.**

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

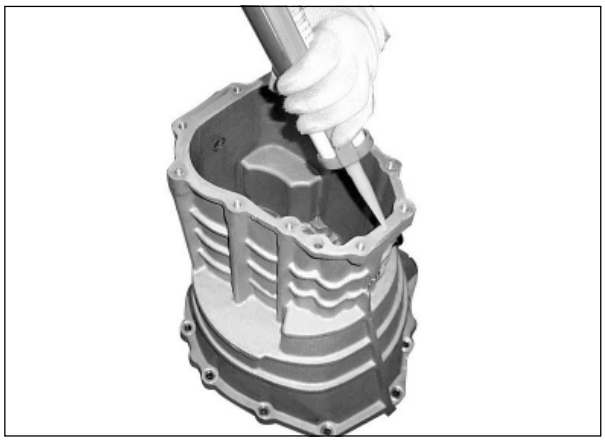
- **Place the spring pin with the pin slot facing to the shaft.**



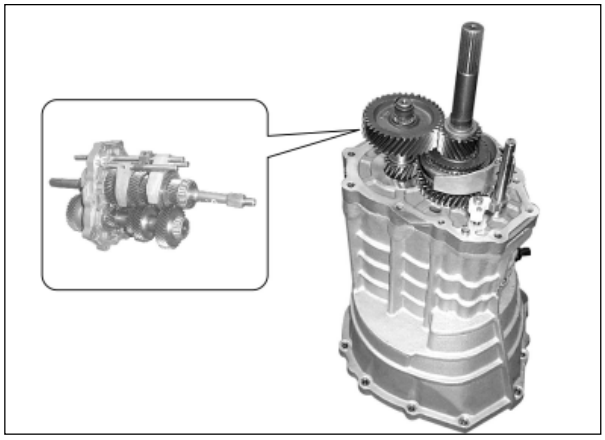
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53. Apply the sealant to the transmission housing.

NOTICE
- **Sealant: Silicon sealant - bulk #732**

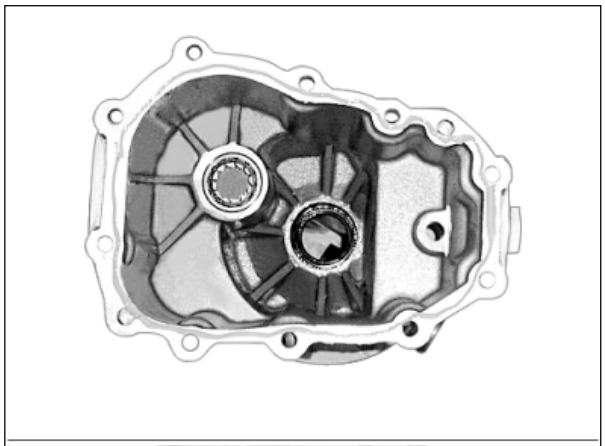


54. Install the gear assembly and the adapter to the transmission housing.
55. Install the speedometer driven gear on the output shaft and install the ball bearing by using a press.



56. Apply the sealant to the extension housing.
    Press down the extension housing against the adapter.

NOTICE
- **Sealant: Silicon sealant -bulk #732**



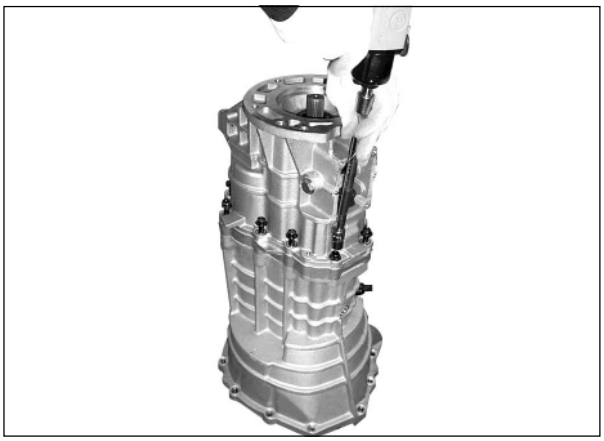


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57. Tighten the extension housing bolts (14 mm-10EA).

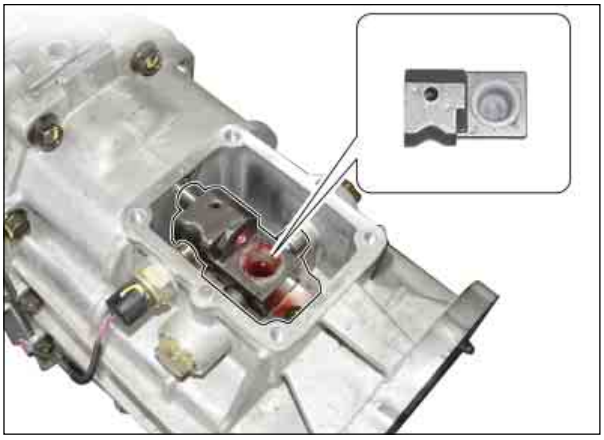
Installation Notice

Tightening torque	42 ~ 57 Nm



58. Insert the offset lever into the 3/4 rail and install the spring pin.

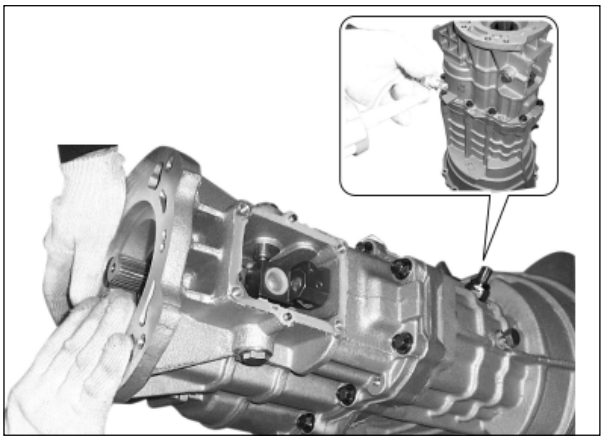
59. Apply the grease into the offset lever bushing.



60. Apply the grease to the interlock bolt (17 mm) and insert it into the interlock plate hole and bolt hole.

NOTICE

- **Make sure that the gear is at 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

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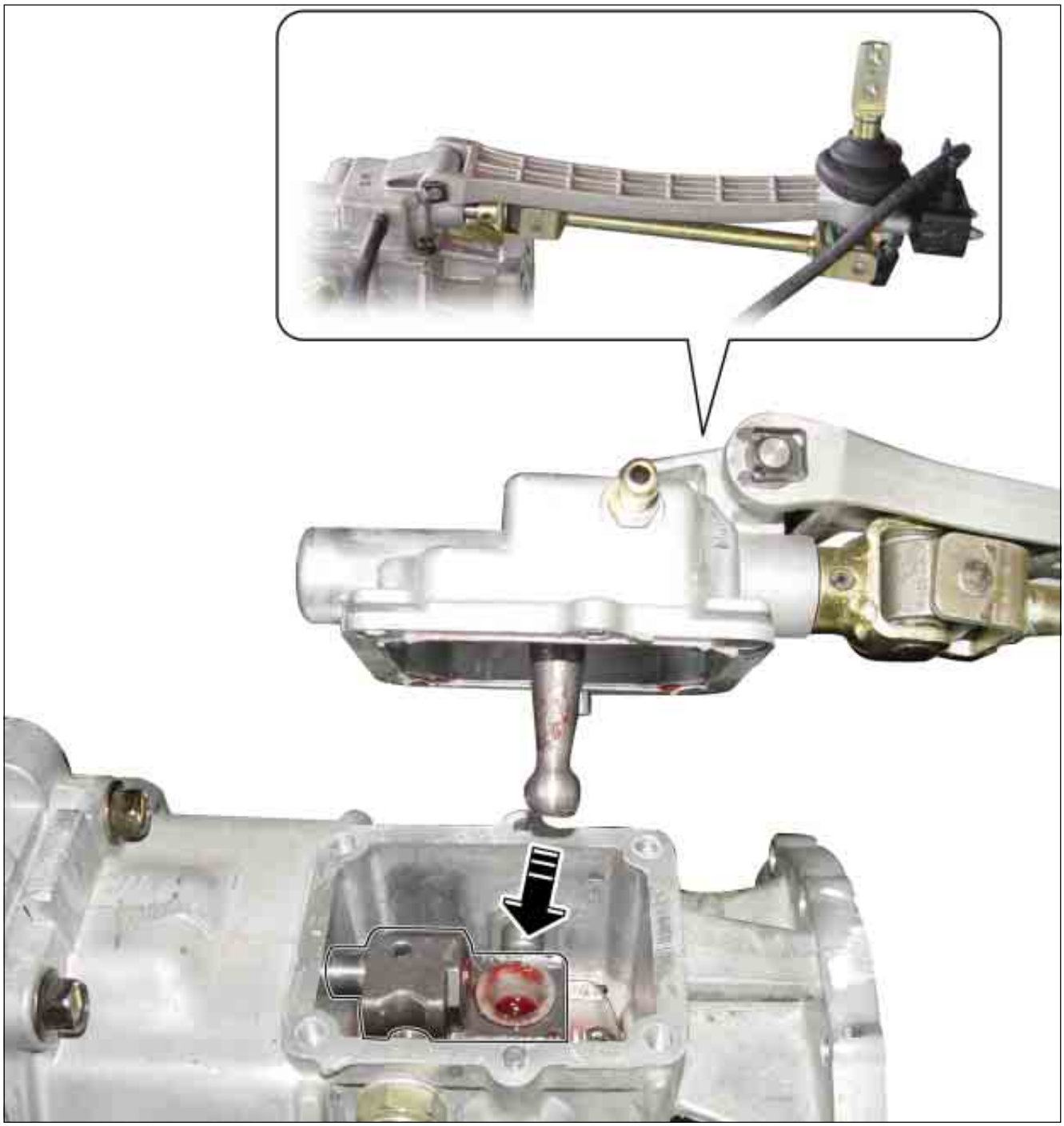
61. Apply the grease to the top cover and install four bolts (12 mm).

NOTICE

- **Make sure that the gear is at neutral position.**

Installation Notice

Sealant	Silicon sealant -bulk #732
Tightening torque	17 ~ 26 Nm

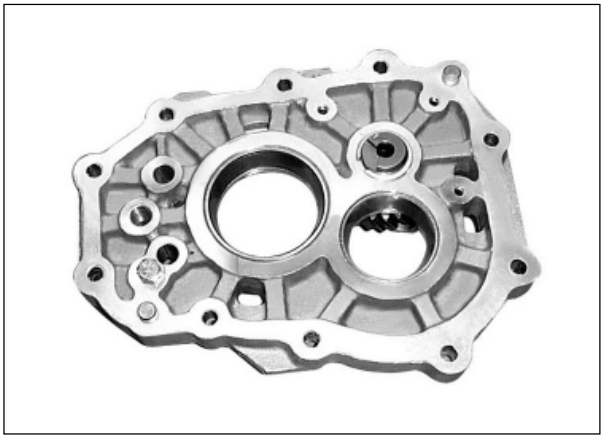


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▶ TRANSMISSION ADAPTER

Disassembly and Assembly

1. Remove the reverse idler retainer ring.



2. Remove the components as follows and install in the reverse order of removal.
   1) Unscrew the reverse lock nut and idler bracket bolts and remove the bracket and spacer.
   2) Remove the reverse idler gear and the needle bearing.
   3) 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





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

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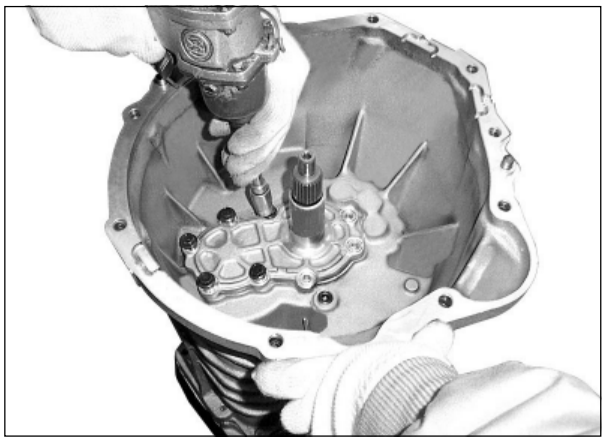
7. INSPECTION/MAINTENANCE

▶ SHIM ADJUSTMENT

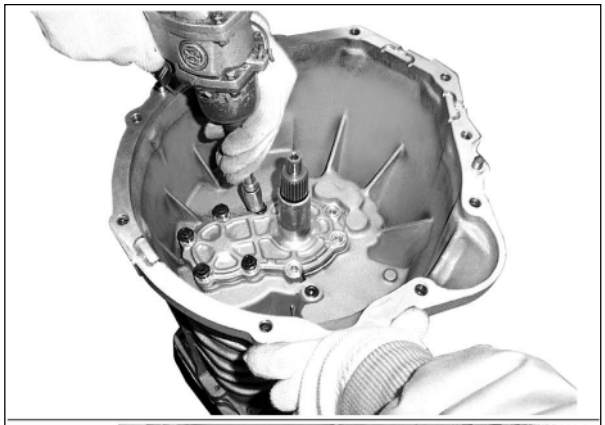
1. Unscrew nine bolts (14 mm) and remove the front fork cover.

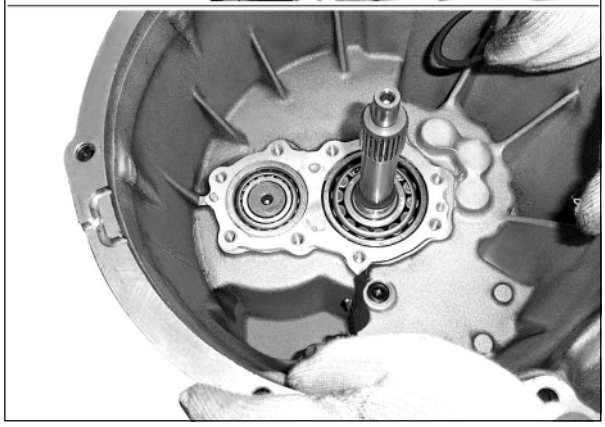
NOTICE

- **The shim adjustment is necessary when replacing the housings, counter gear, input shaft and output shaft.**

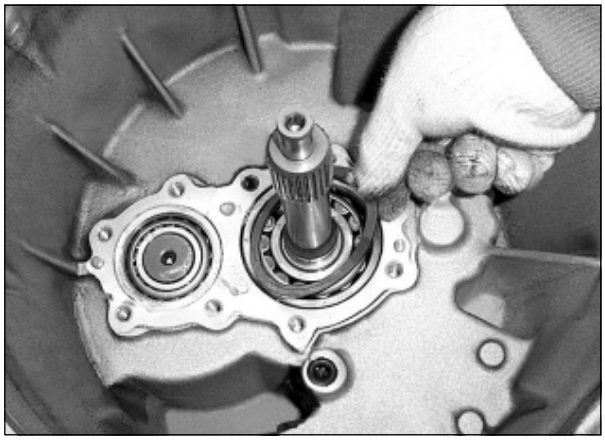


2. Separate the front fork cover from the housing.



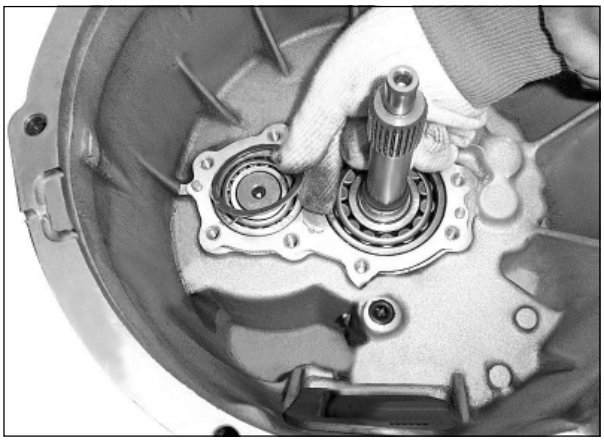


3. Remove the input spacer.

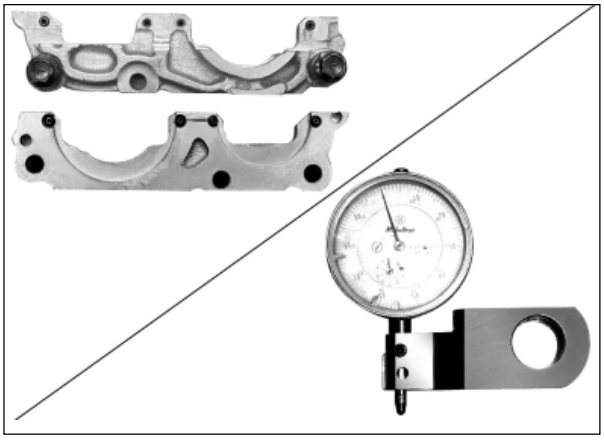


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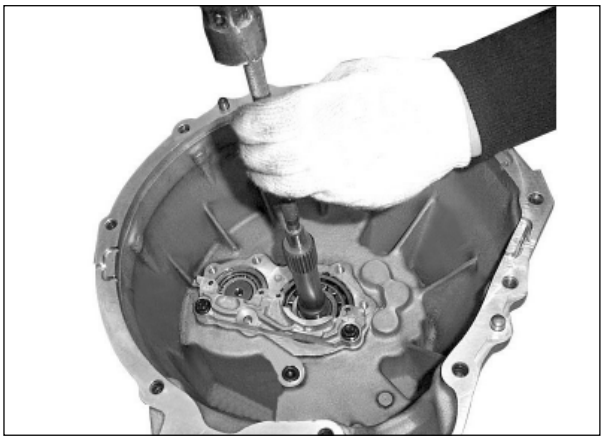
4. Remove the counter spacer.



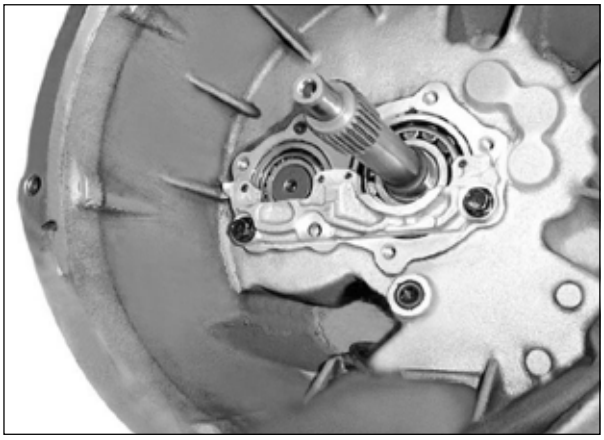
5. Prepare the special tools and dial gauge.



6. Prepare the special tools and dial gauge. Place the transmission 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.



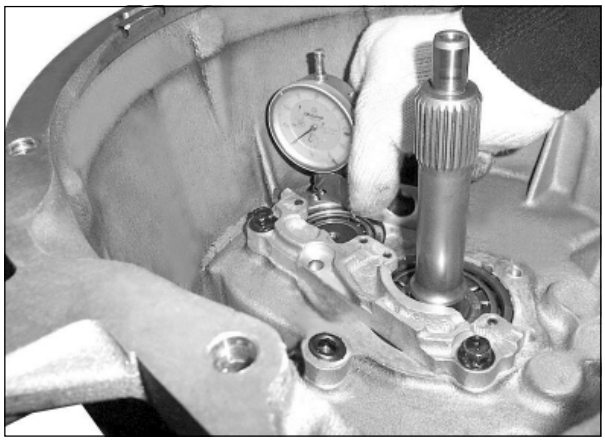
7. Tighten the adjusting bolt on the special tool to hold the bearings.



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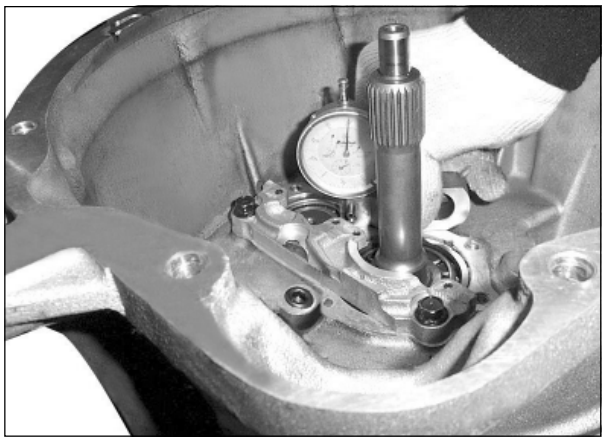
8. Set up the dial gauge on the transmission housing surface and put the gauge needle to “0” point.
9. Put the probe end of the gauge on the taper roller bearing outer race in counter gear and measure the end play.
   1) If the measured value is out of the specified range, adjust it by using spacers.

End play	0 ~ 0.05 mm



10. Put the probe end of the gauge on the main taper roller bearing outer race and measure the end play.
    1) If the measured value is out of the specified range, adjust it by using spacers.

End play	0 ~ 0.05 mm

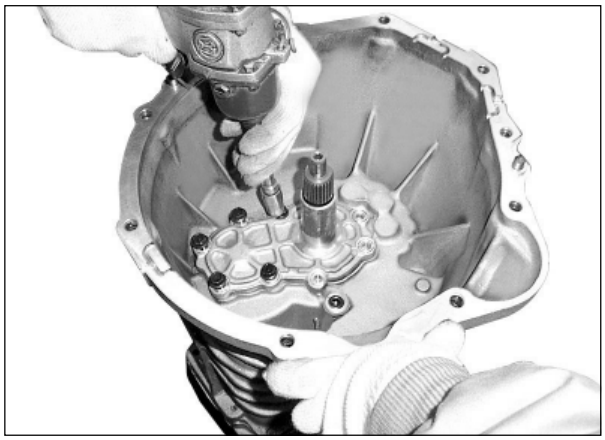


11. Apply the sealant to the front fork cover and tighten the bolts (14 mm).

    Measure the starting torque after installation.

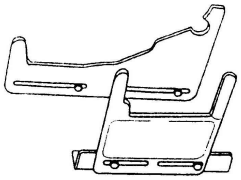
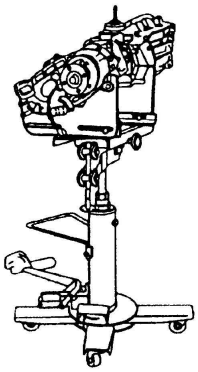
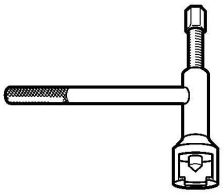
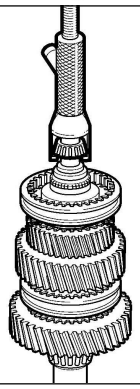
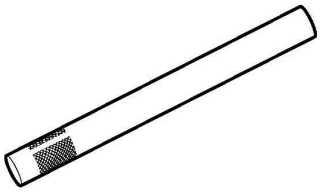
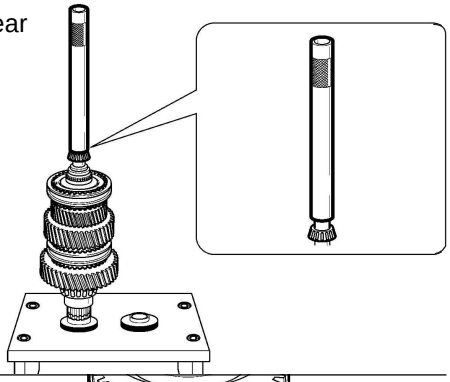
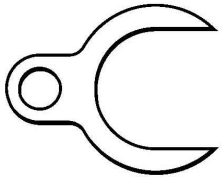
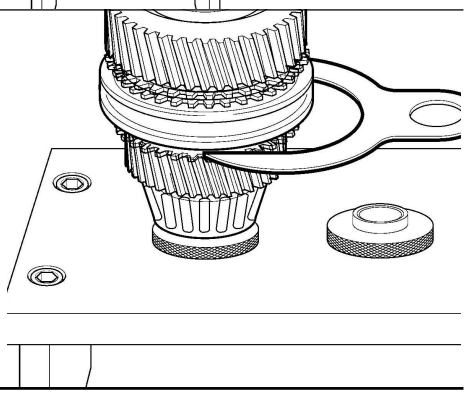
Installation Notice

Starting torque	20 ~ 25 Nm
Sealant	Silicon sealant -bulk#732
Tightening torque	17 ~ 26 Nm

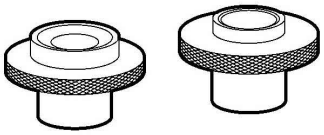
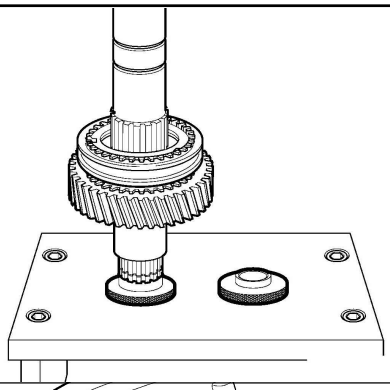
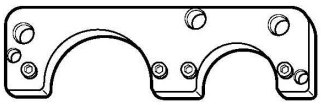
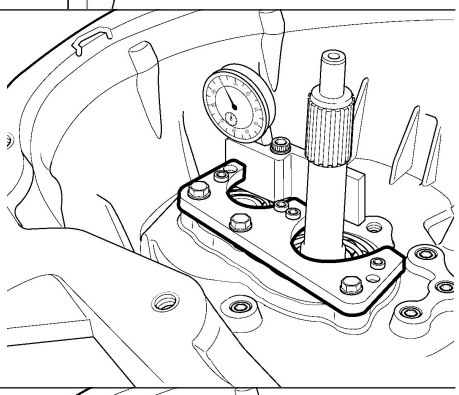
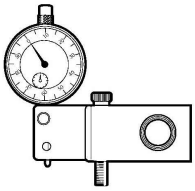
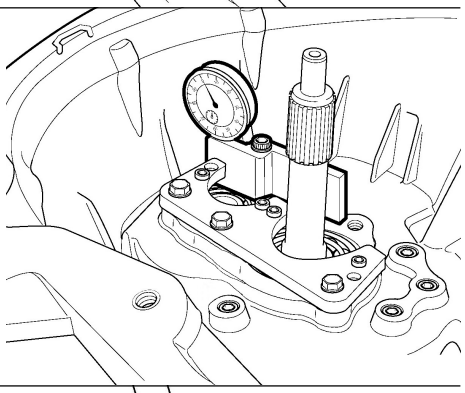
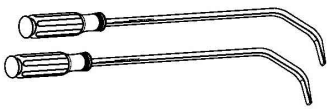
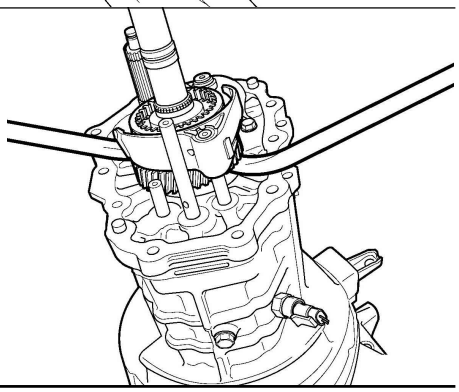


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8. SPECIAL TOOLS AND EQUIPMENT

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 

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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 taper roller bearing end play 
W 99 31 007 1B Drift 	Removal of 5/R synchronizer hub assembly, reverse gear and shift fork at one time 

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PART TIME TRANSFER CASE & LOCKING HUB SYSTEM

3240 / 3410

TABLE OF CONTENTS

GENERAL 2

1. Overview 2

PART TIME TRANSFER CASE 3

1. Structure 3
2. System layout and functions 5
3. Locking hub system 6
4. Transfer case 15

POWER FLOW 20

1. Power flow 20
2. 2H mode (2WD) 21
3. 4H mode (4WD - high speed) 22
4. 4L mode (4WD - low speed) 23

TROUBLE SHOOTING 24

1. General diagnosis 24

MAINTENANCE AND REPAIR 25

1. Oil level check and change 25

REMOVAL AND INSTALLATION 26

1. Components location 26
2. Removal and installation of IWE (Integrated Wheel End) 34

SPECIAL TOOLS AND EQUIPMENT 41

TCCU (TRANSFER CASE CONTROL UNIT) 42

1. Major changes in TCCU 42

SYSTEM OPERATION 44

1. TCCU (Transfer Case Control Unit) 44
2. Trouble diagnosis test 47
3. Self-diagnosis test 48
4. Diagnostic trouble code 49

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GENERAL

1. OVERVIEW

By using the planetary gear sets, two-gears shift type part time transfer case achieves direct connection when selecting 4WD “HIGH” and 2.48 of reduction gear ratio when selecting 4WD “LOW”. The silent chain in transfer case transfers the output power to front wheels.

The simple operation of switches on instrument panel allows to shift between “2H” and “4H” easily while driving (for 4L: stop vehicle first). The warning lamp warns the driver when the system is defective.

The 4WD system integrated in KYRON 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. **No additional coding is required when replacing TCCU.**
2. Delete the devices (tone wheel speed sensor, 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.
3. The new TCCU is available to install on the vehicle with the conventional DI engine part time TCCU.

Note : 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.

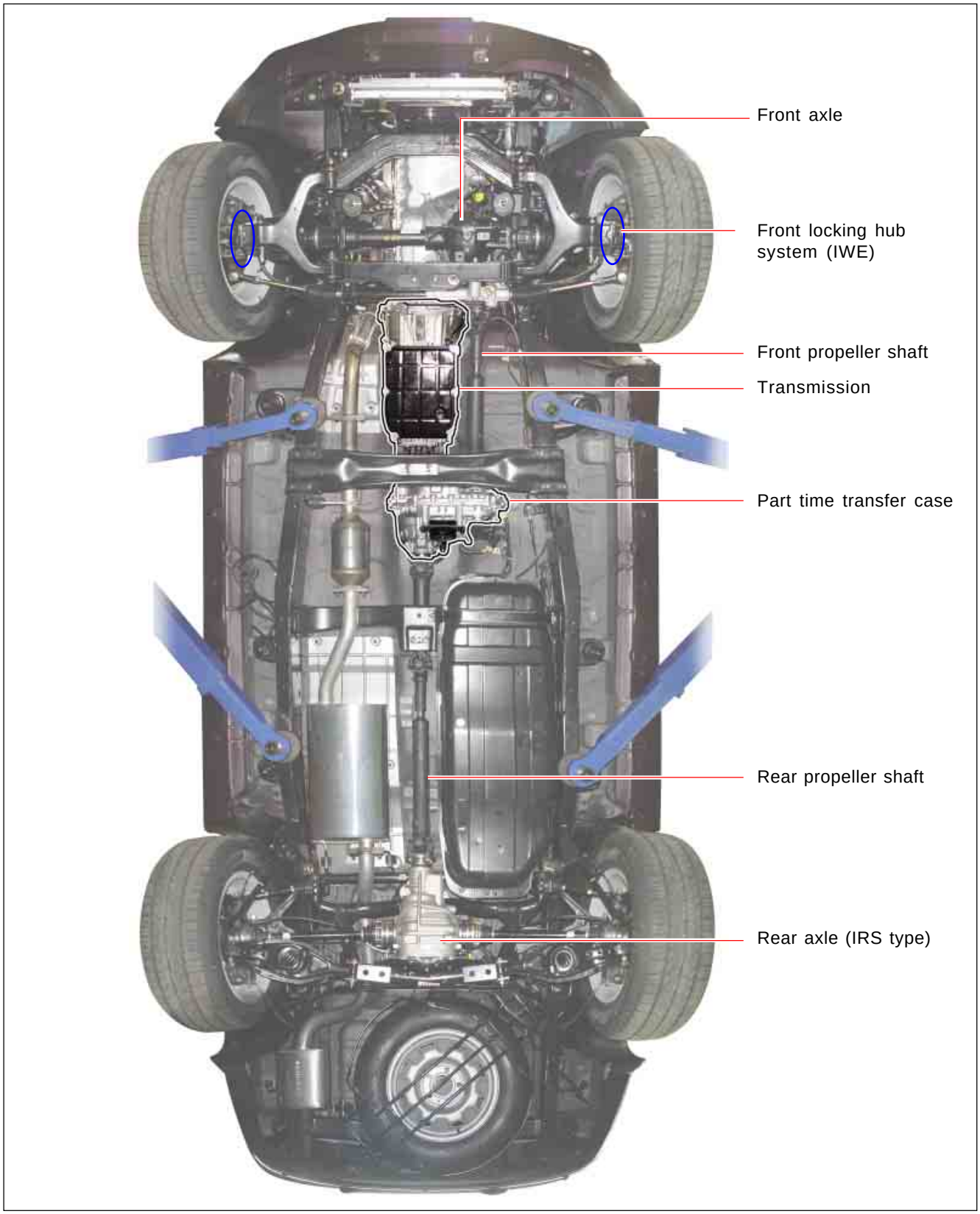
Specifications

Description		Part Time T/C
Total length		343 mm
Mating surface of front flange		40 mm
Weight		33.9 Kg (without oil)
Oil capacity		1.4 L
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
	Ring gear	Inserted into housing groove
	Sun gear	Separated input shaft and sun gear

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PART TIME TRANSFER CASE

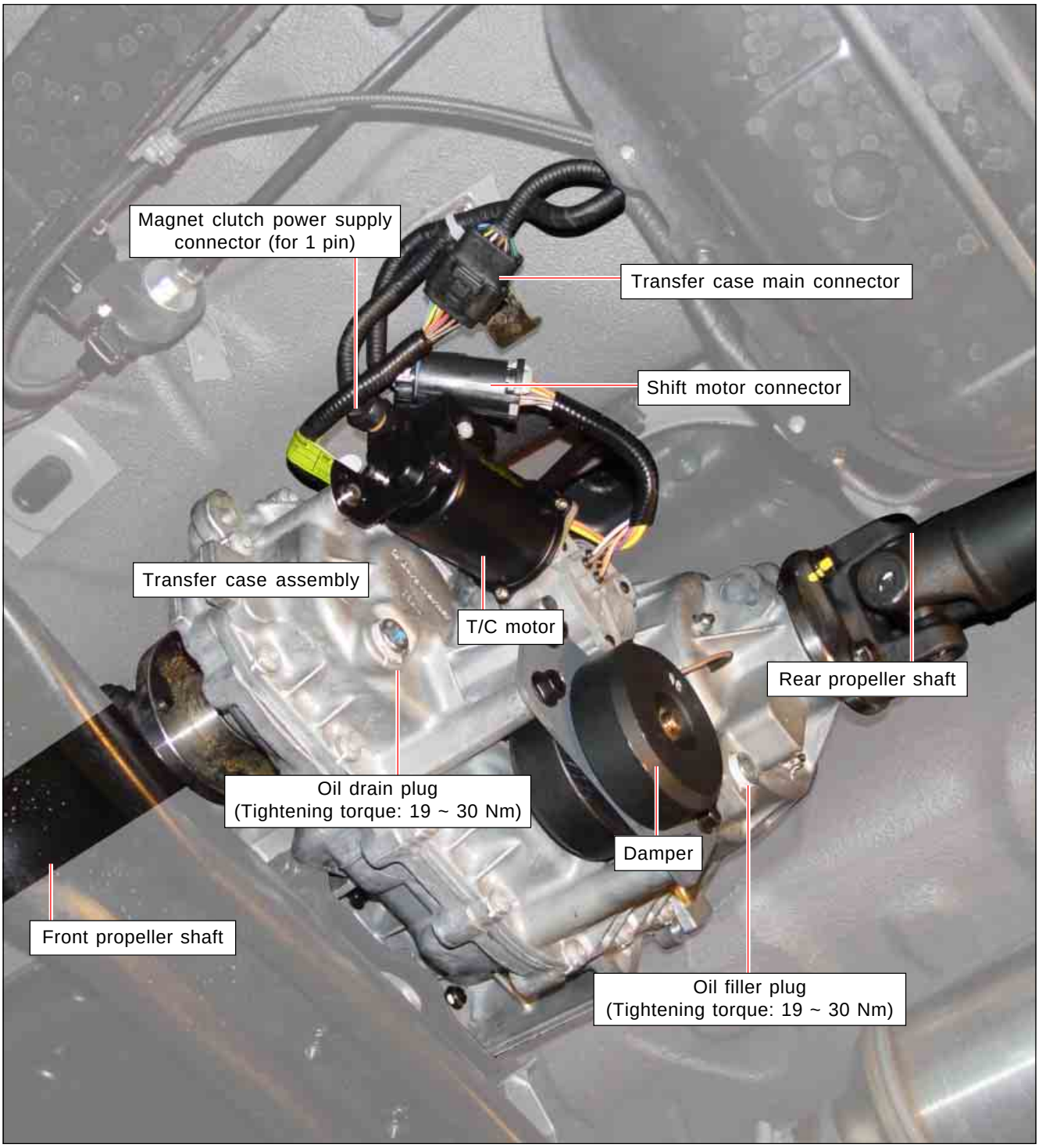
1. STRUCTURE



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▶ Components Location

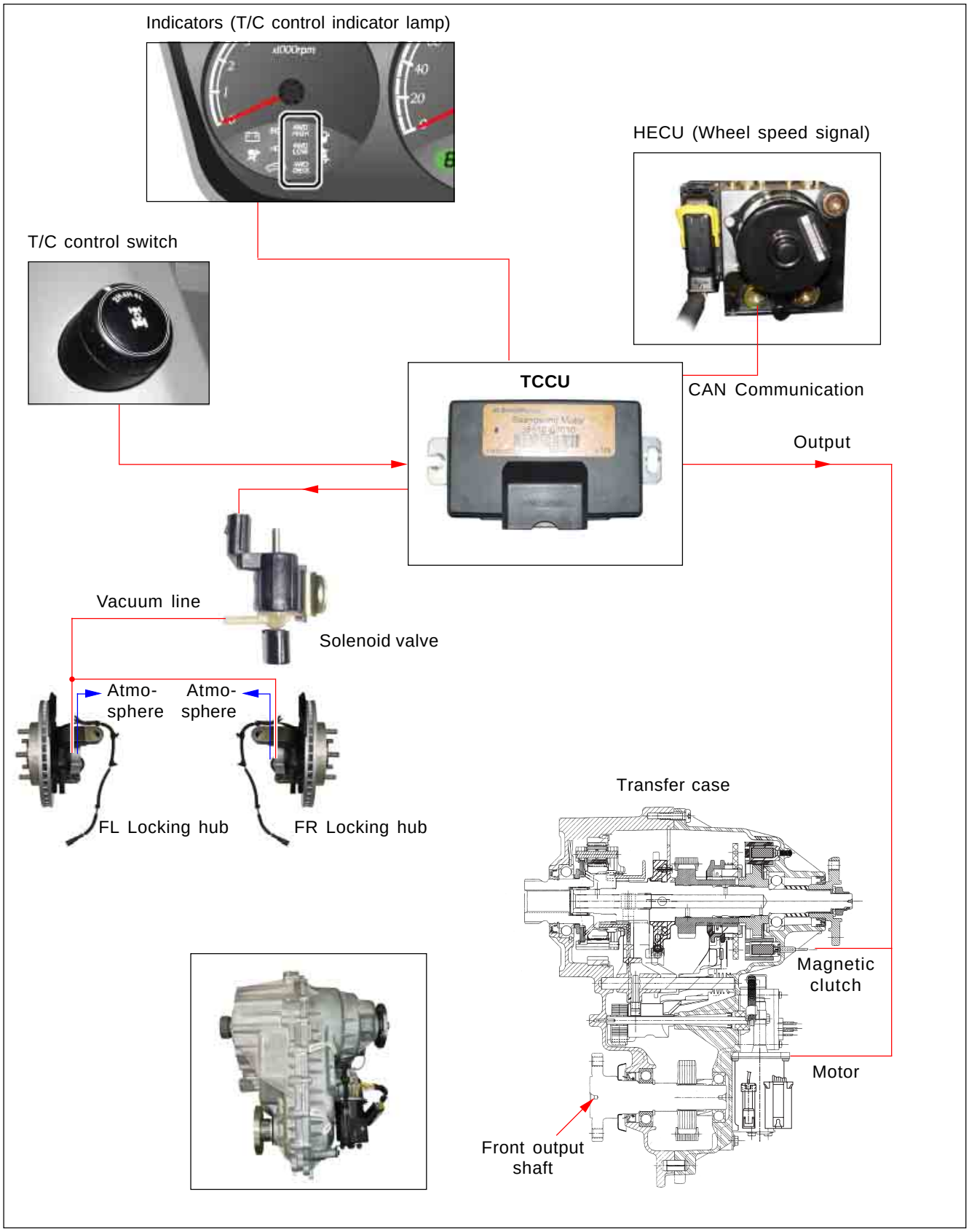


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2. SYSTEM LAYOUT AND FUNCTIONS

▶ System Layout



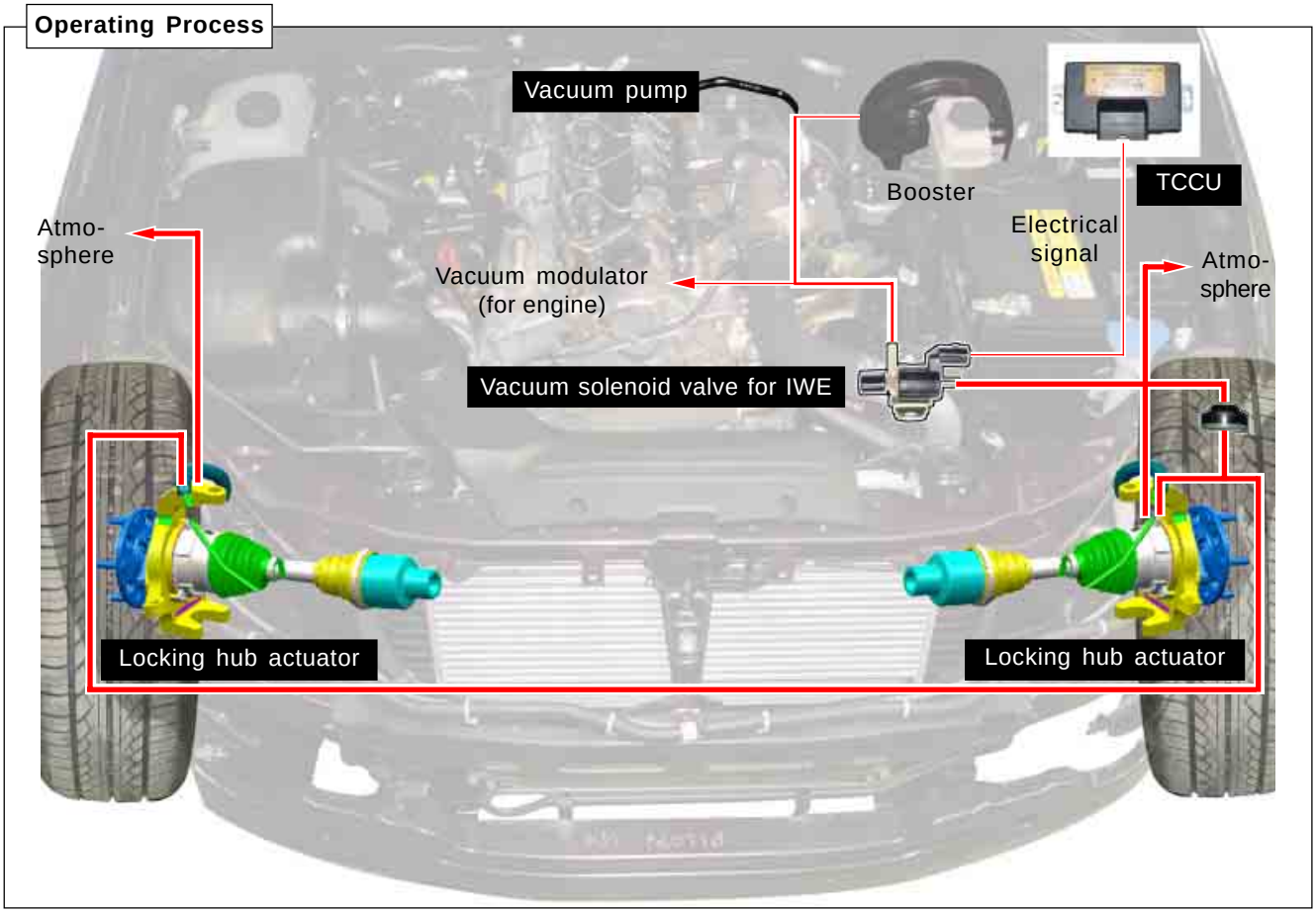
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3. LOCKING HUB SYSTEM

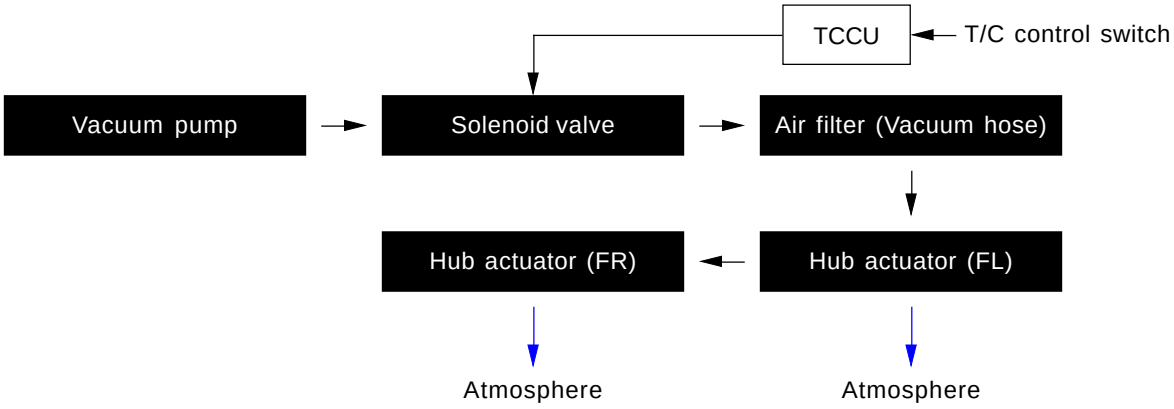
The transfer case and the TCCU differ from previous models only in the speed sensor related parts. However, the vacuum locking hub operation system works oppositely from previous models and its components also have changed.

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.



Vacuum generation process in front hub actuator:



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▶ Vacuum System



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

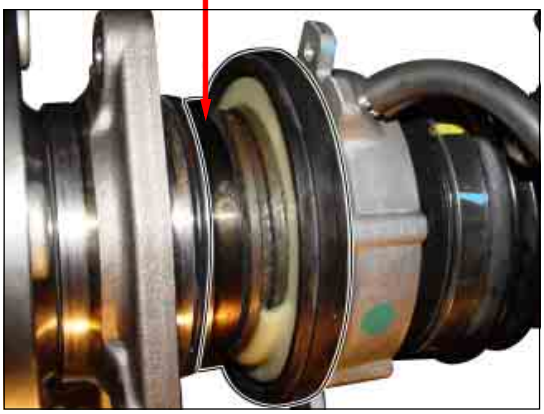




Atmosphere (in 4WD mode)

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.



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▶ 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.

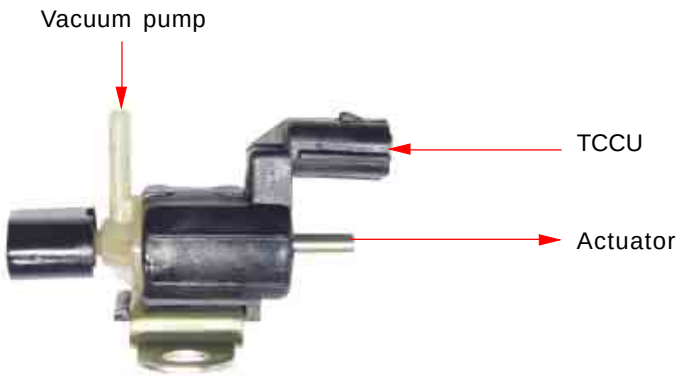


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Solenoid Valve

The vacuum solenoid valve is installed at bottom of the battery tray (theft warning horn side) and serves the function that allows to connect and block the vacuum pressure from vacuum pump to hub actuator.

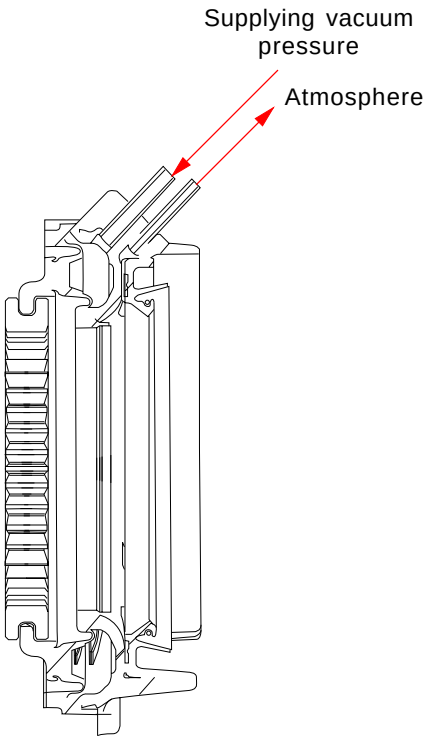
During the 2WD mode, a vacuum line is established between vacuum pump and hub actuator. During the 4WD mode, the TCCU applies 12V to the vacuum solenoid to block the vacuum pressure.



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.

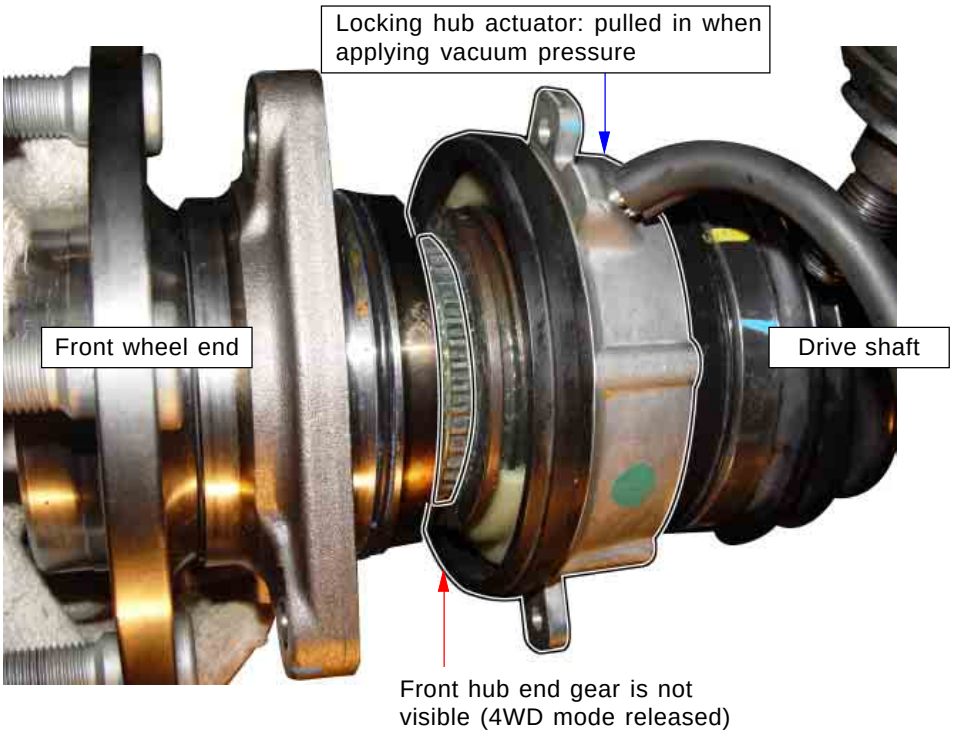




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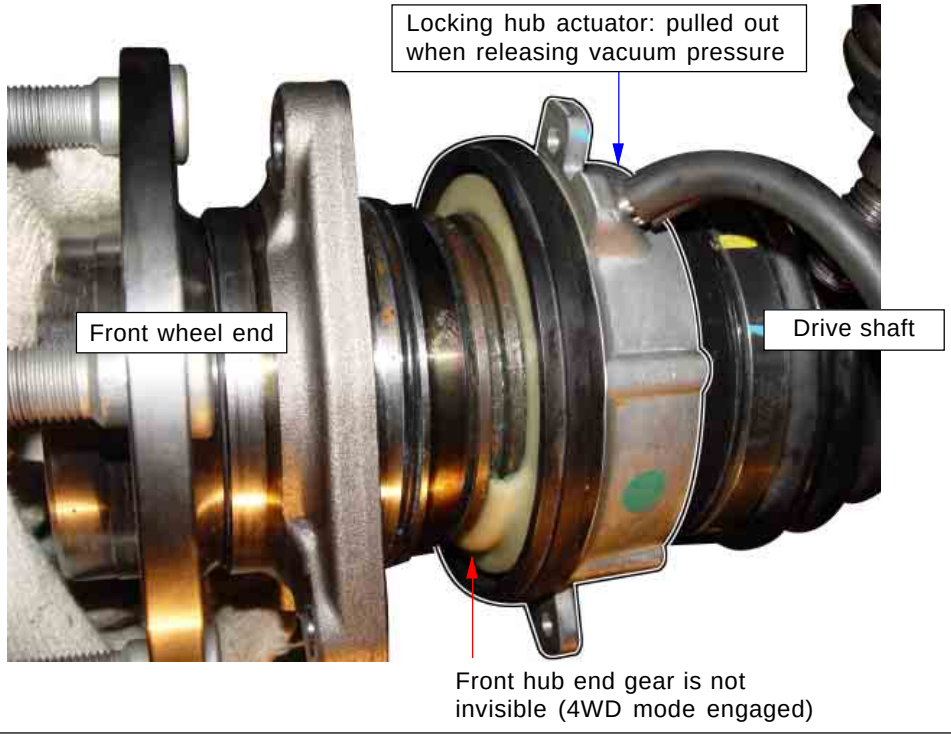
2WD:

The locking hub actuator is out of the front wheel hub end gear when applying the vacuum pressure.



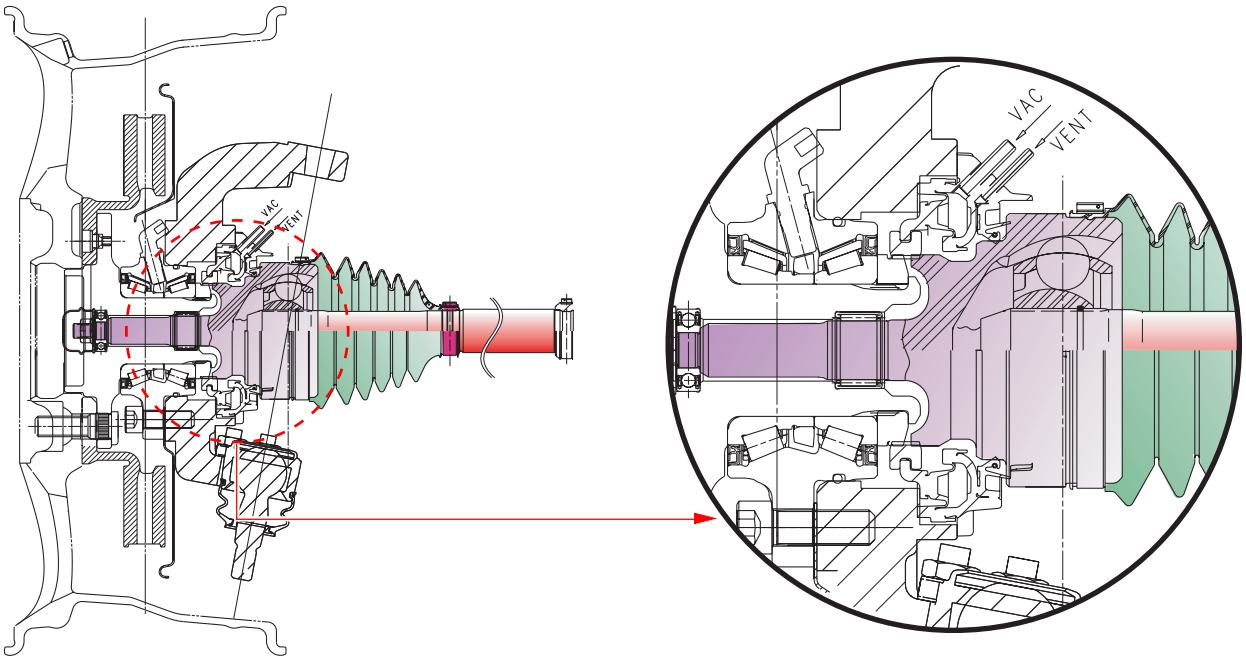
4WD:

The locking hub actuator is engaged with the front wheel hub end gear when releasing the vacuum pressure.

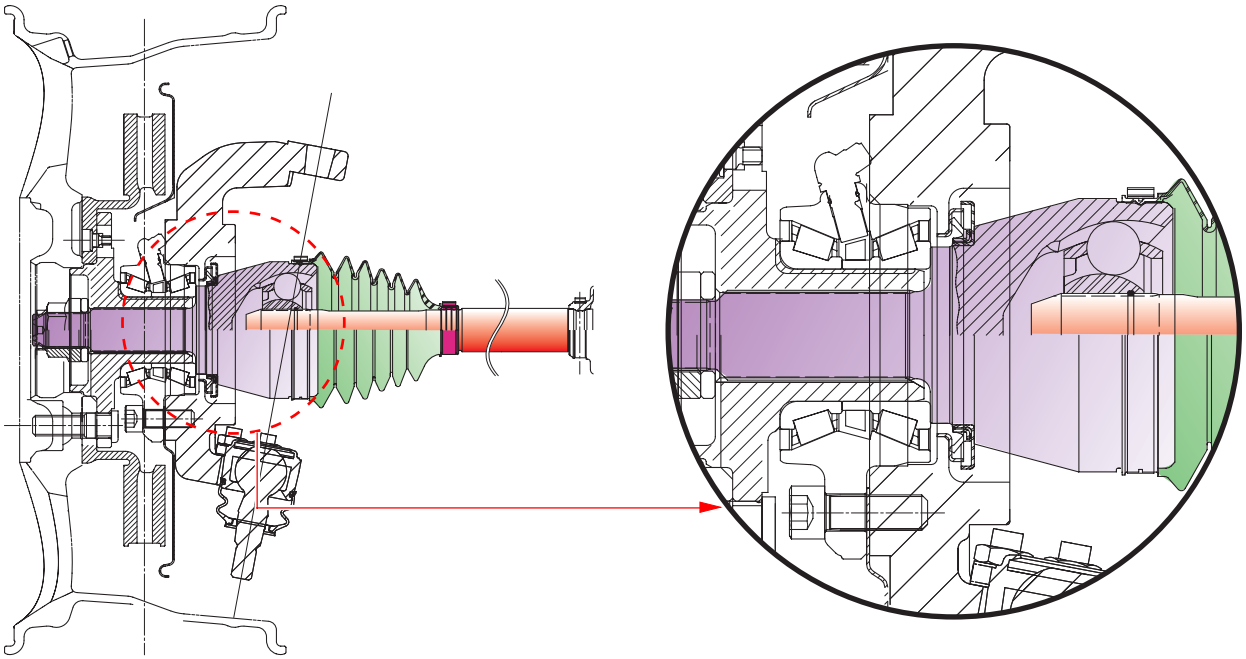


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Front Wheel End in Vehicle with 4WD



Front Wheel End in Vehicle without 4WD



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▶ 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, the 4WD system may not operate. 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.

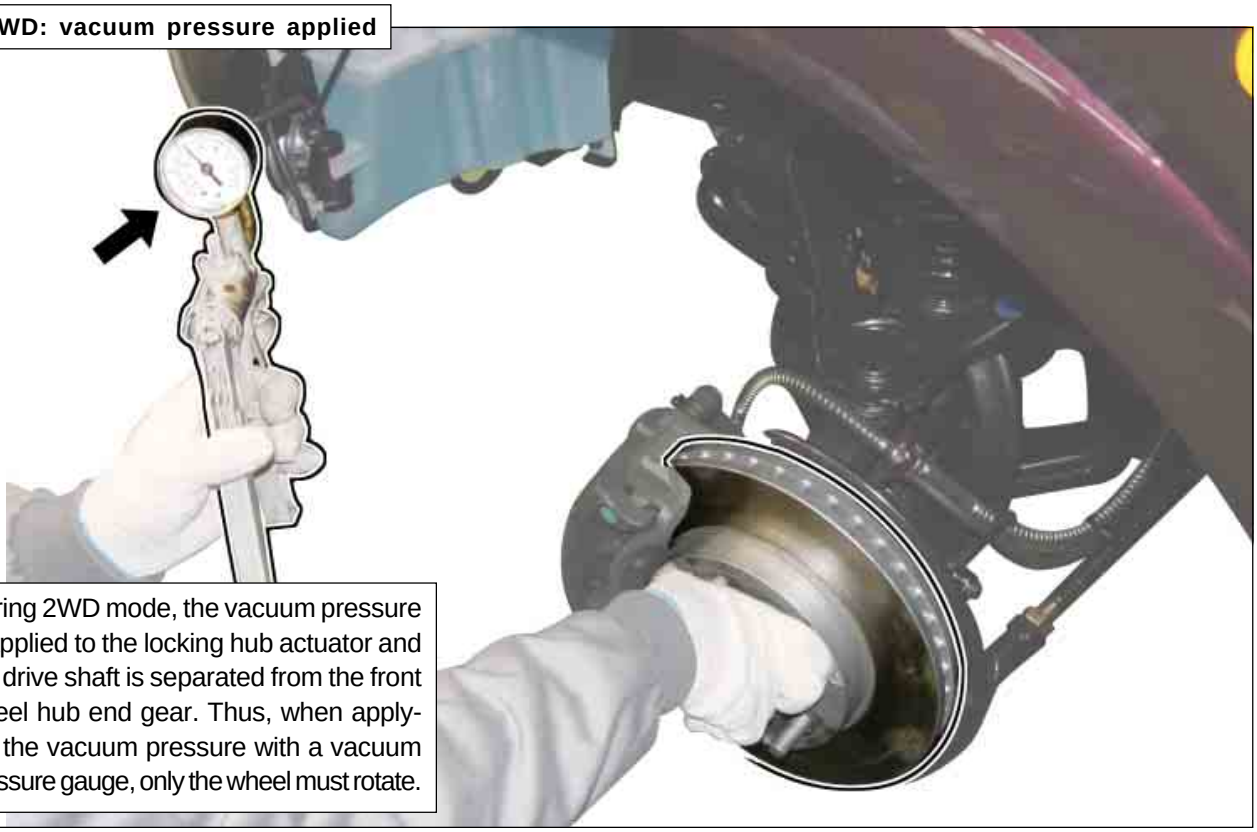


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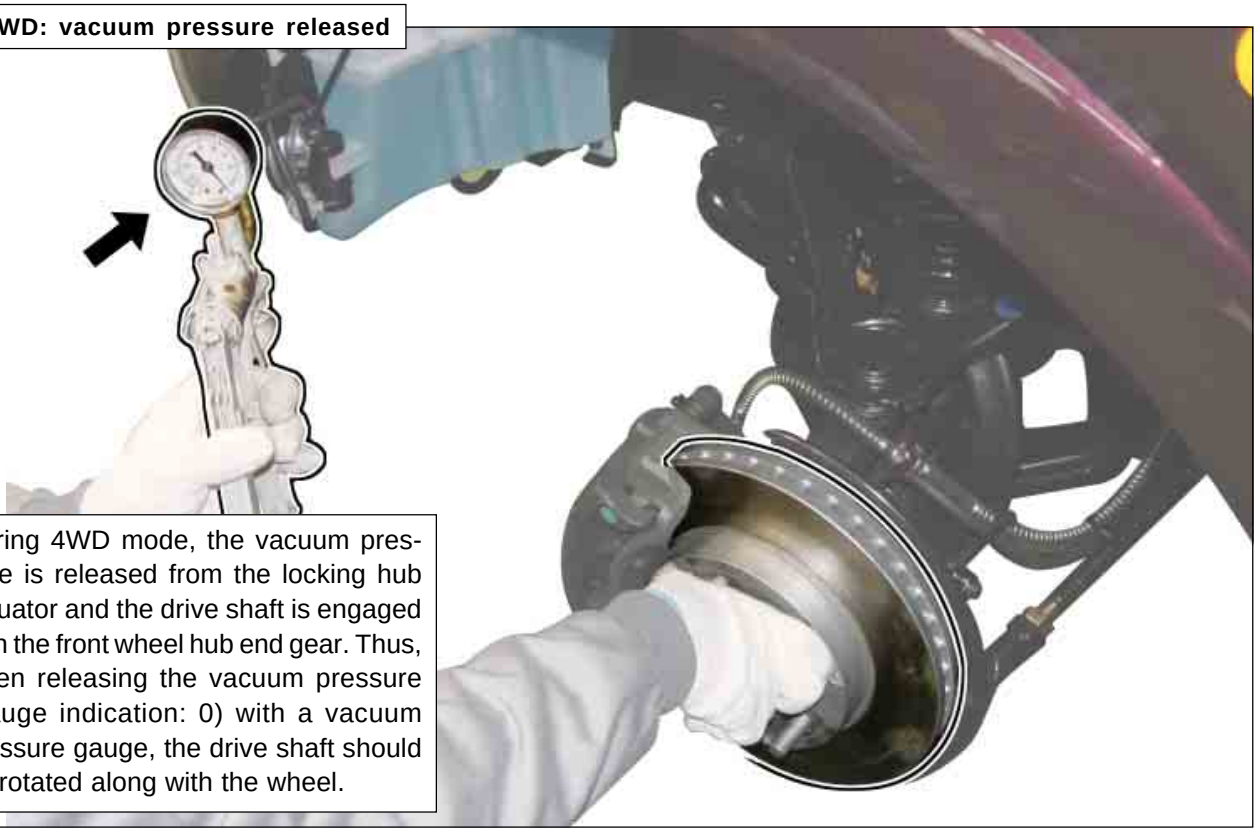
3. Check vacuum pressure with vacuum pressure gauge.

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.

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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 condition.

Normal



If the vacuum pressure is maintained, the actuator hub component condition is OK.

Leakage



If the vacuum pressure is not maintained, replace the actuator with a new one.

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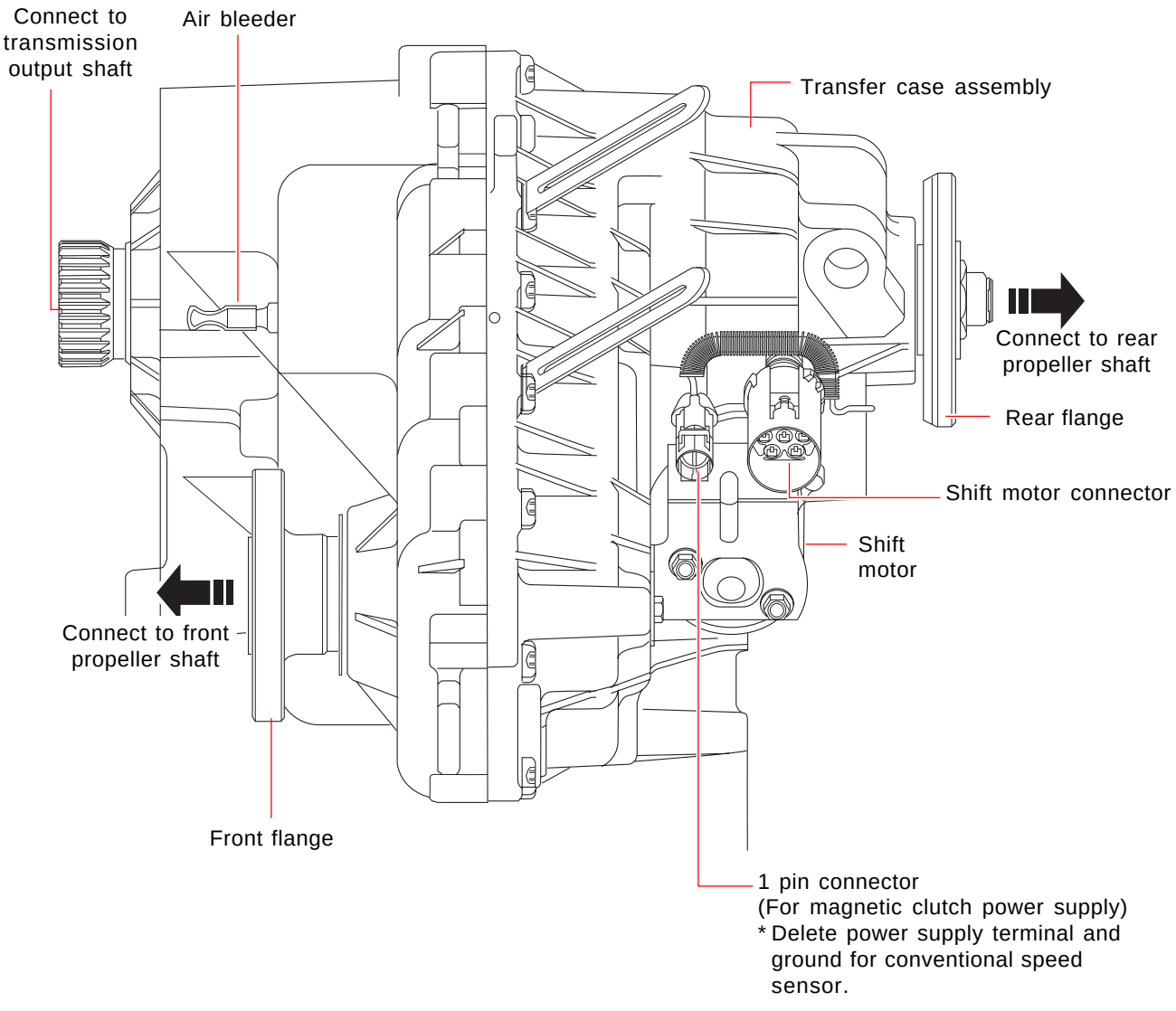
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4. TRANSFER CASE

▶ Appearance

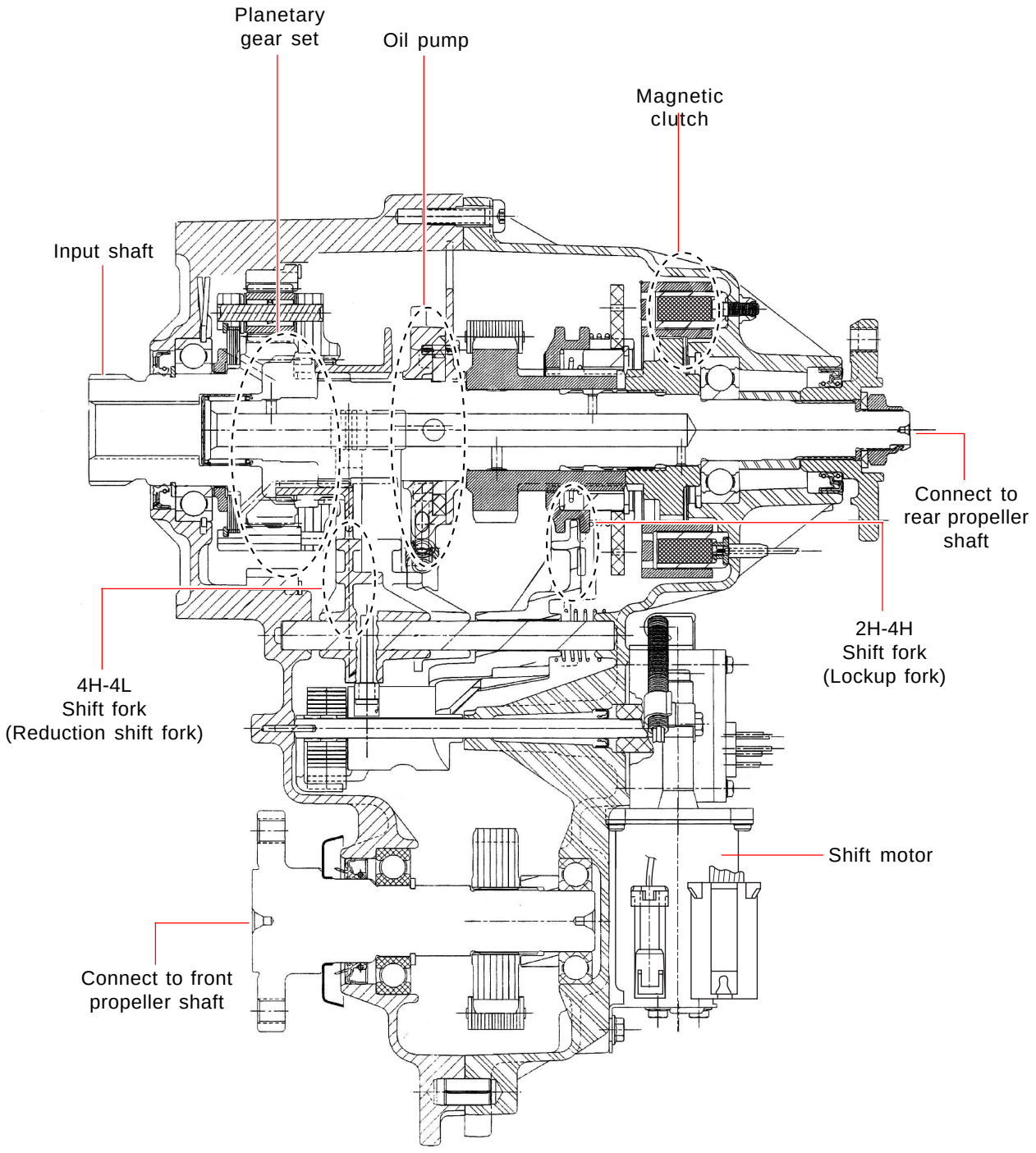






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▶ Sectional Drawing



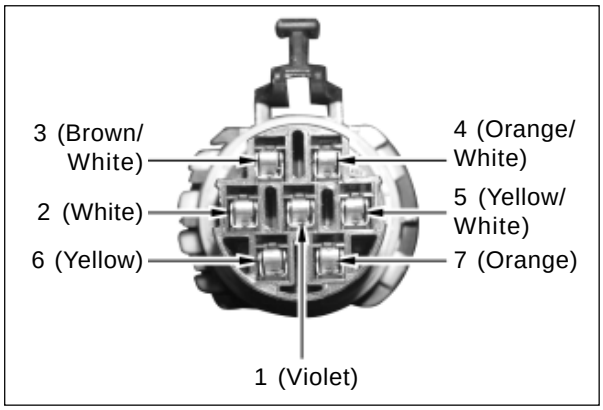
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▶ Shift Motor Connector

When selecting a position in the 4WD switch (2H, 4H, 4L), TOD control unit exactly changes the motor position to 2H, 4H and 4L 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 (4L - 4H -2H)
7	Control (2H - 4H - 4L)



Rear view of connector

▶ Connector Shape and Function

Magnetic Clutch Coil Power Supply Connector

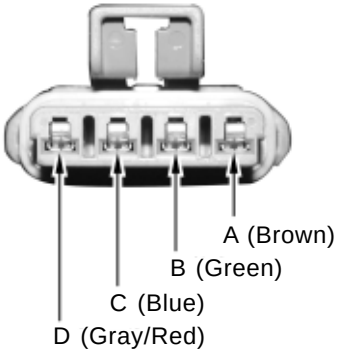
The transfer case integrated in KYRON doesn't have an internal speed sensor and receives the speed signal from ABS/ESP HECU or the instrument panel (Non-ABS vehicle) via CAN communication. Therefore, there are not extra terminals for speed sensor power supply and ground.

Pin	Function
A	Magnetic clutch coil power supply



Note (Old Version)

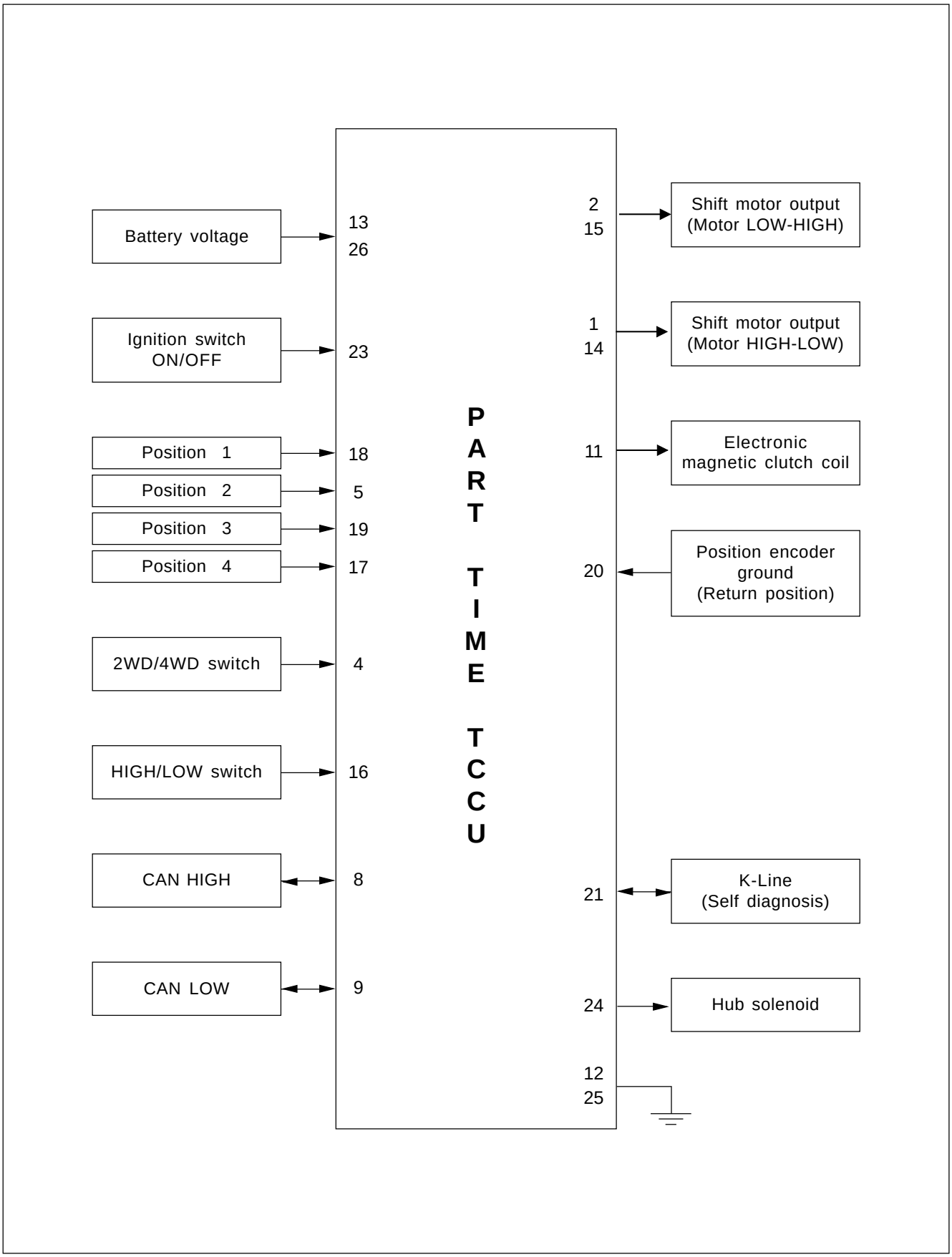
The rear speed sensor utilizes the hall effect. It generates 0V and 5V of square type digital wave according to the rotation of the wheel with teeth of transfer case rear output shaft. The speed signal from rear propeller shaft is entered into control unit. When the control unit determines that 4WD HIGH 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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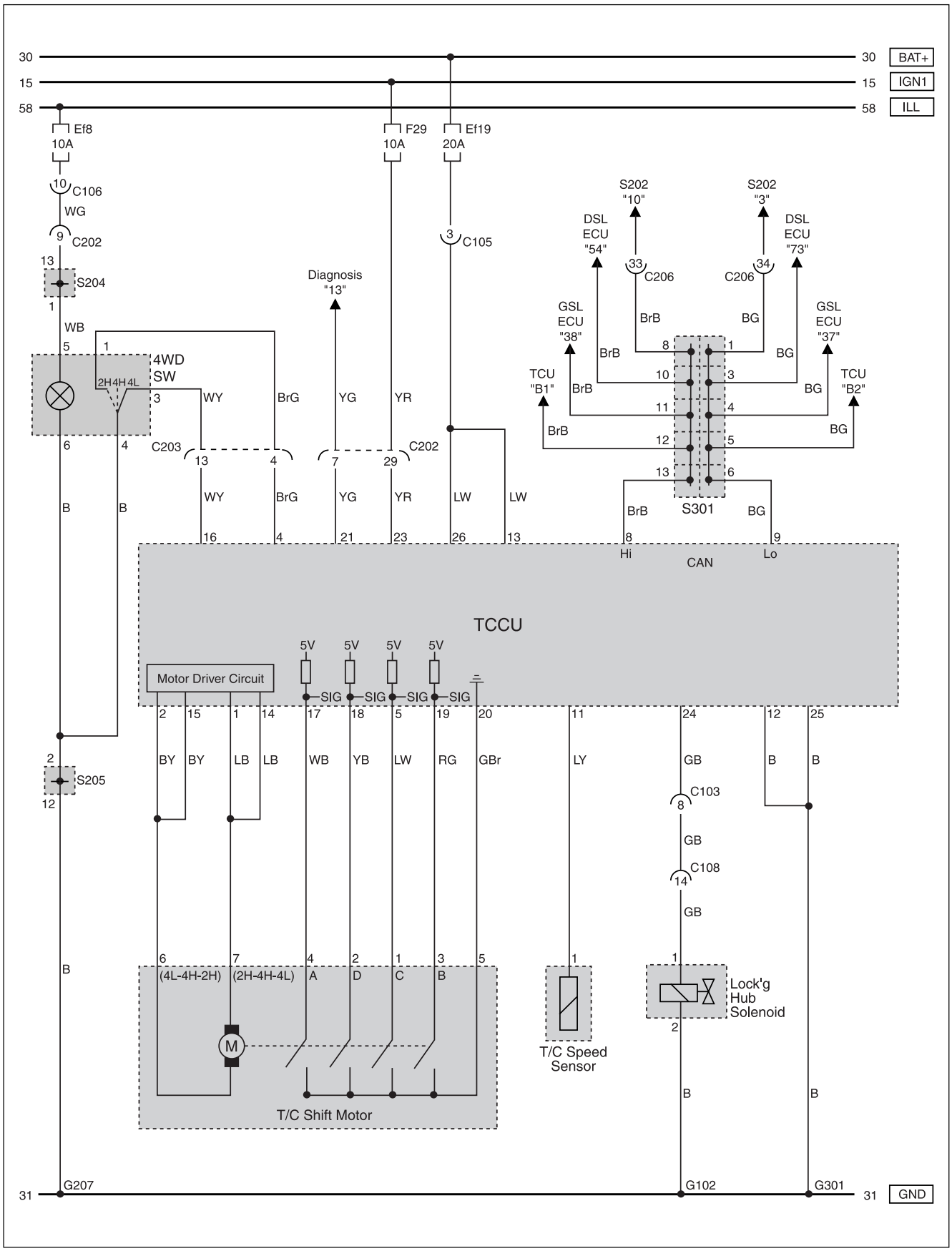
▶ Transfer Case Block Diagram



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Transfer Case Circuit Diagram

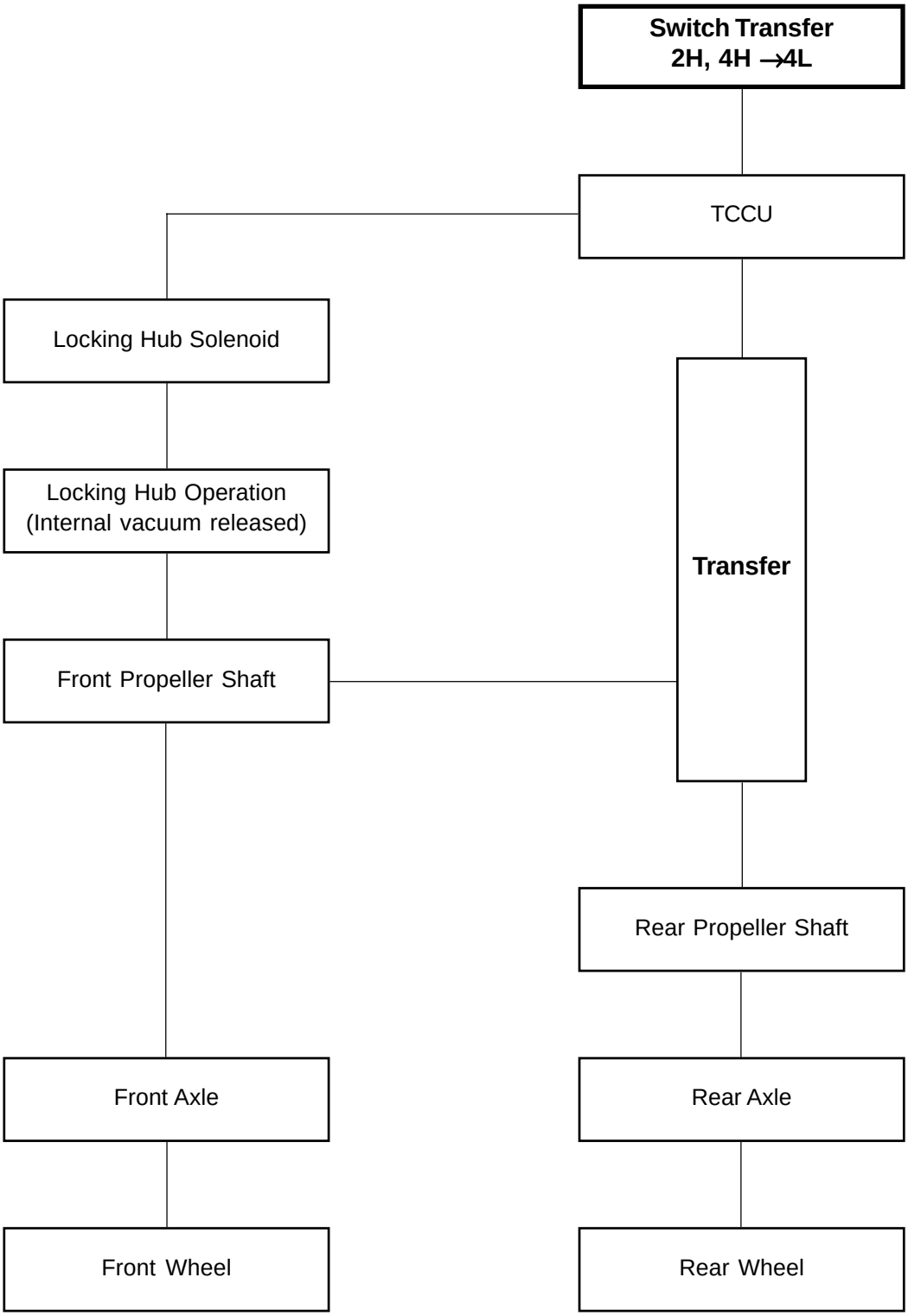


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POWER FLOW

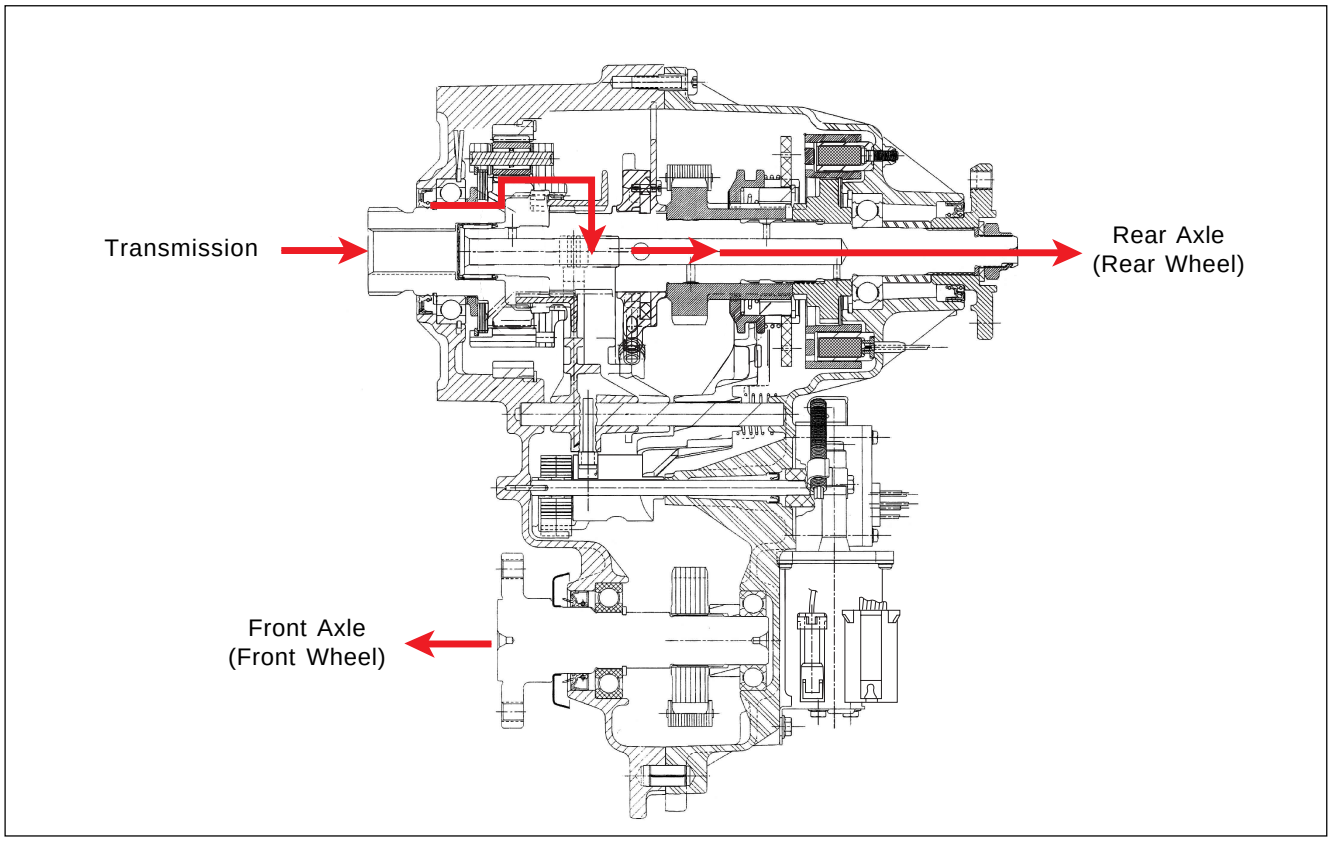
1. POWER FLOW



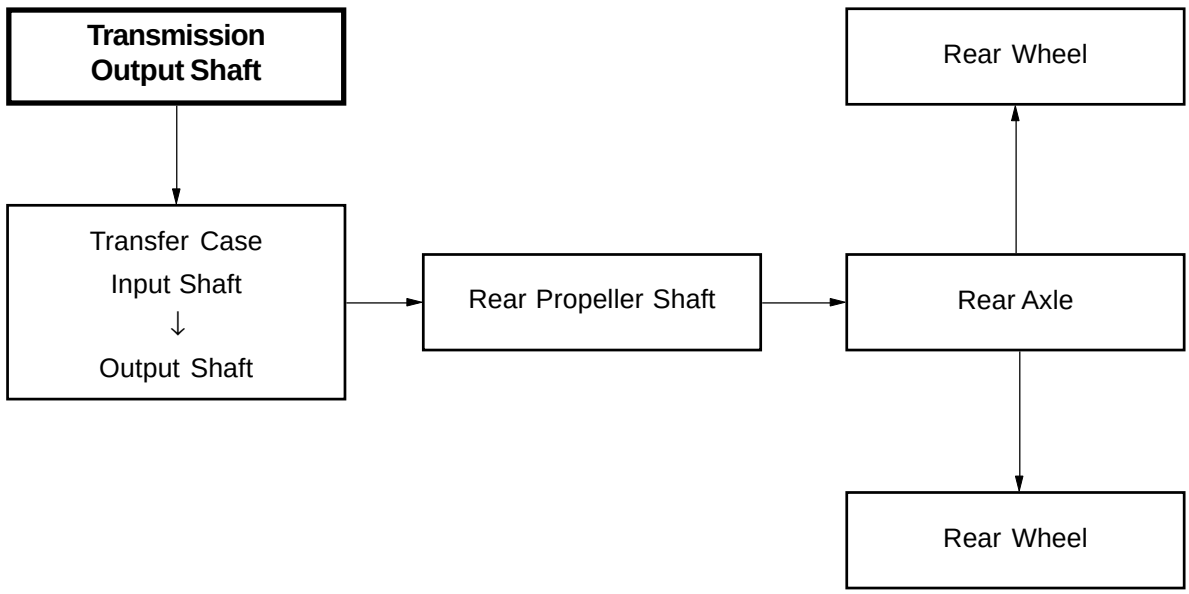
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2. 2H MODE (2WD)

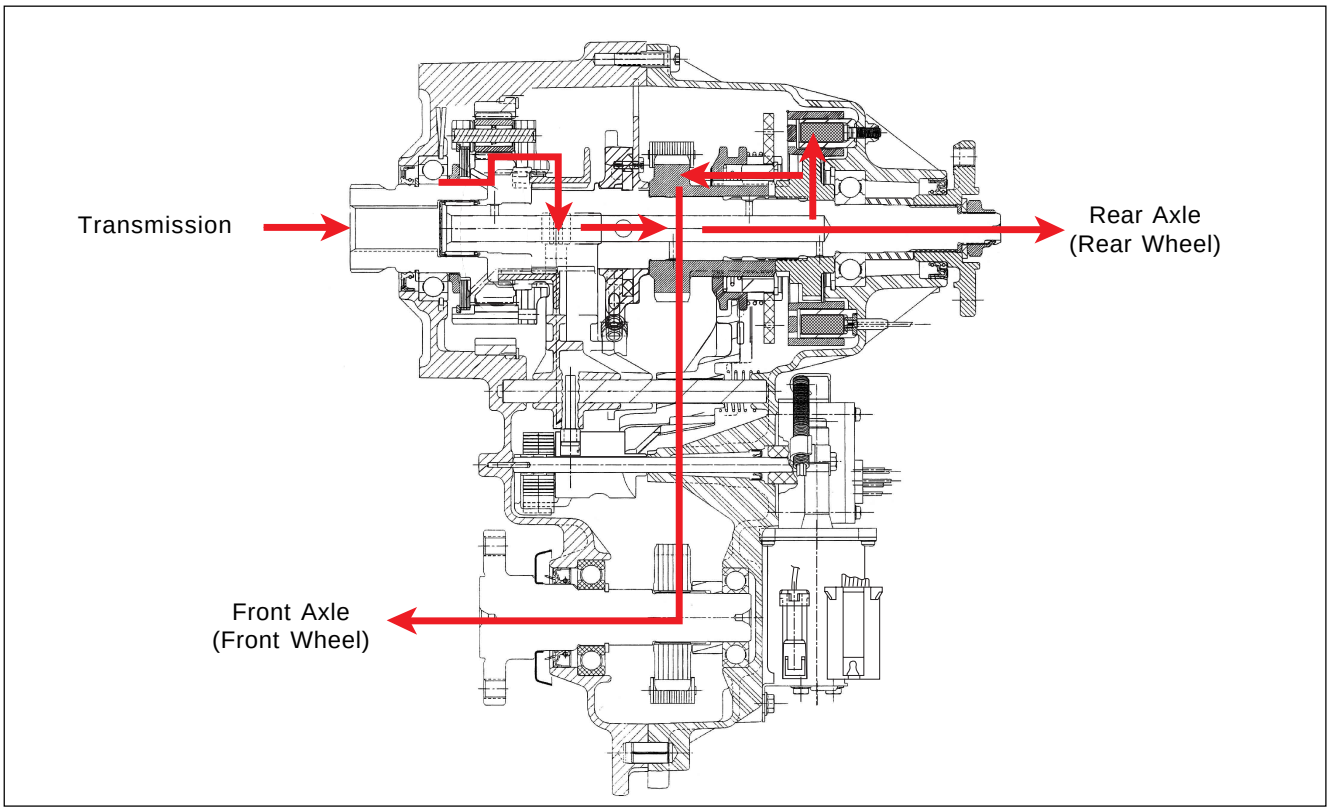


▶ Power Flow

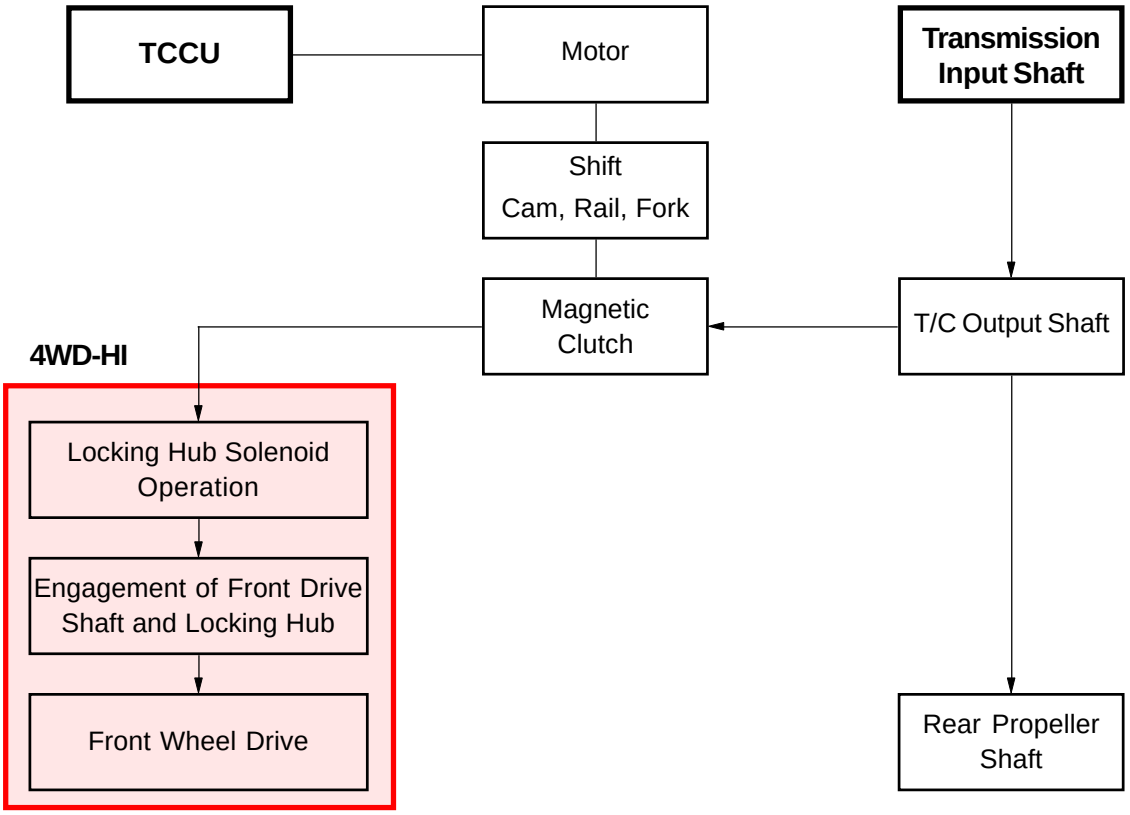


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3. 4H MODE (4WD - HIGH SPEED)



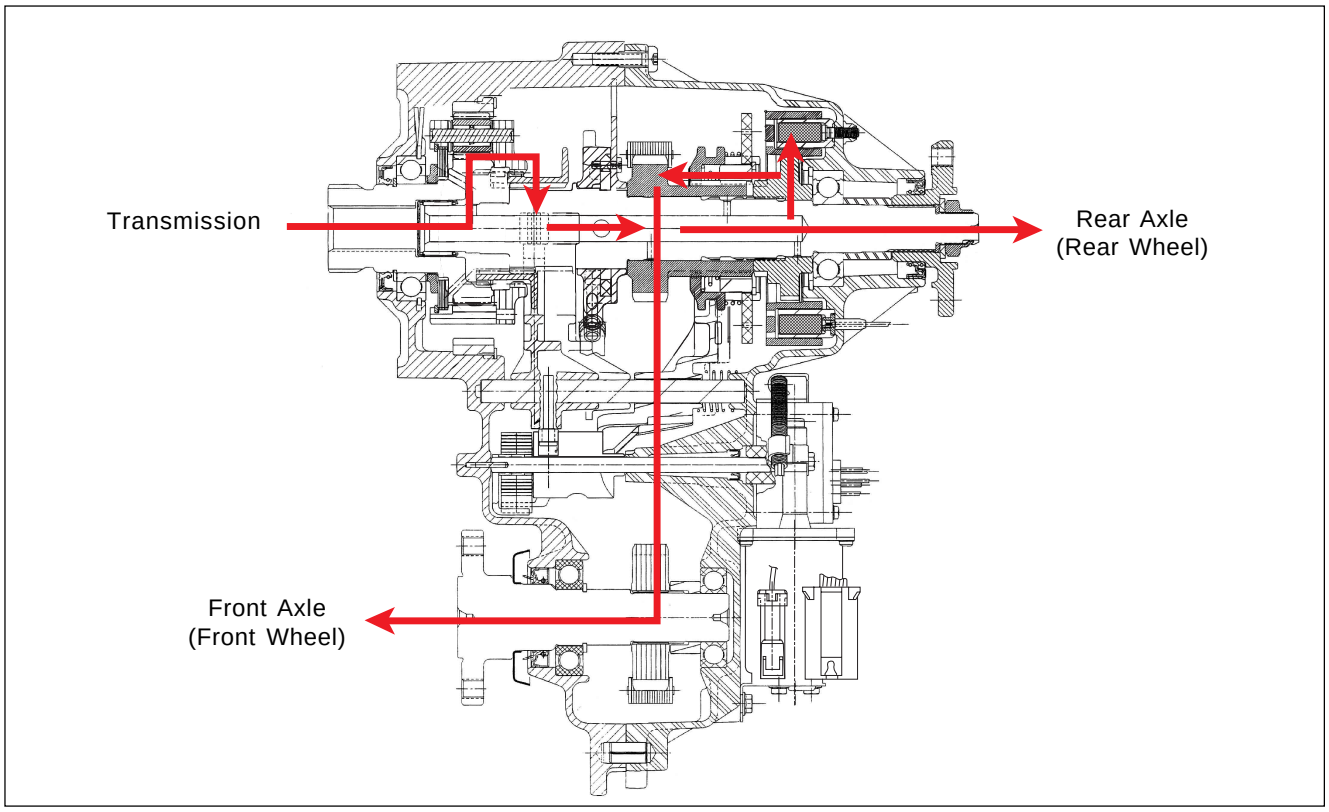
▶ Power Flow



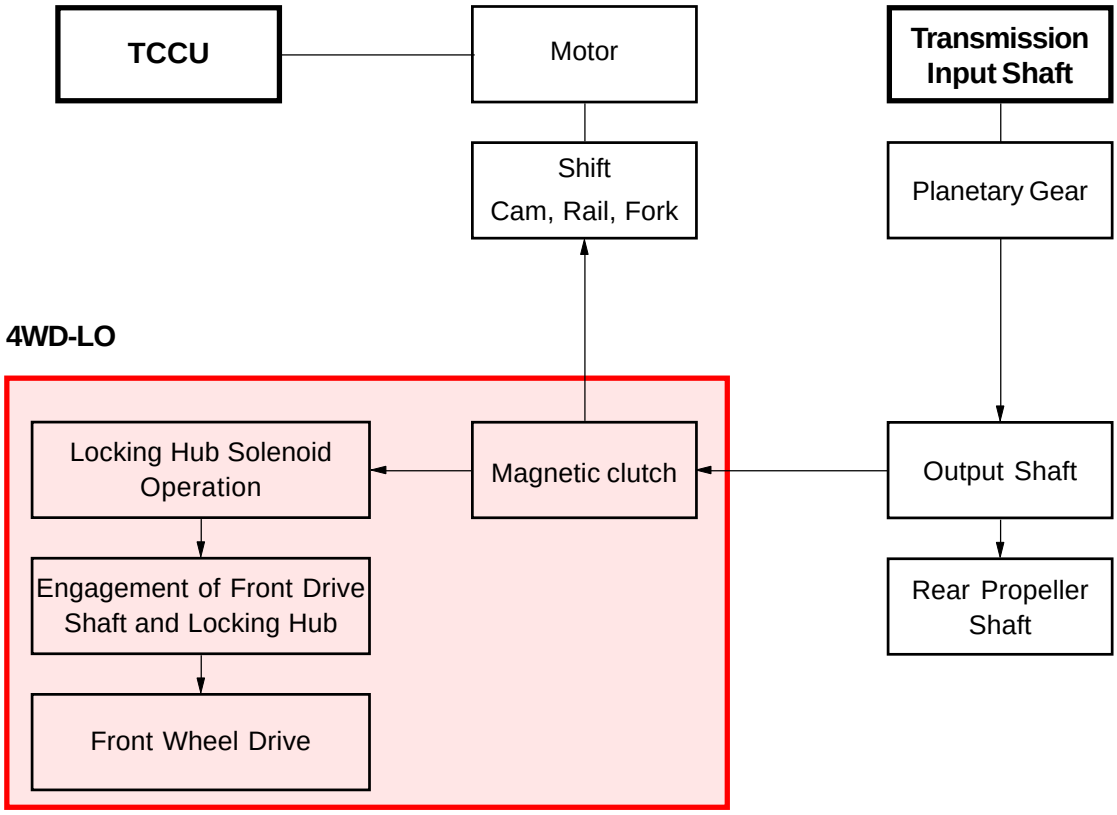
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4. 4L MODE (4WD - LOW SPEED)



▶ Power Flow



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TROUBLE SHOOTING

1. GENERAL DIAGNOSIS

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 speed-ometer 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.

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MAINTENANCE AND REPAIR

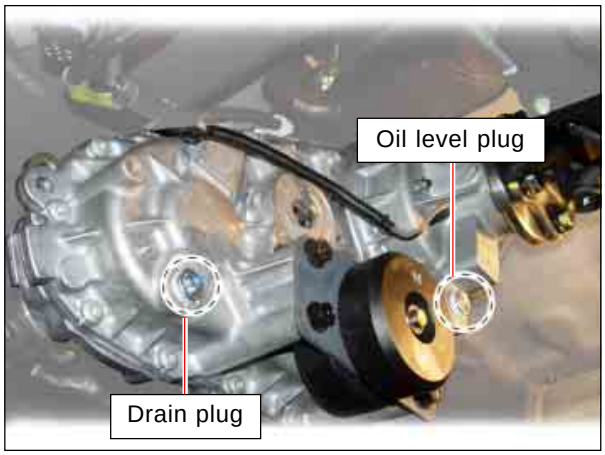
1. OIL LEVEL CHECK AND CHANGE

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, 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



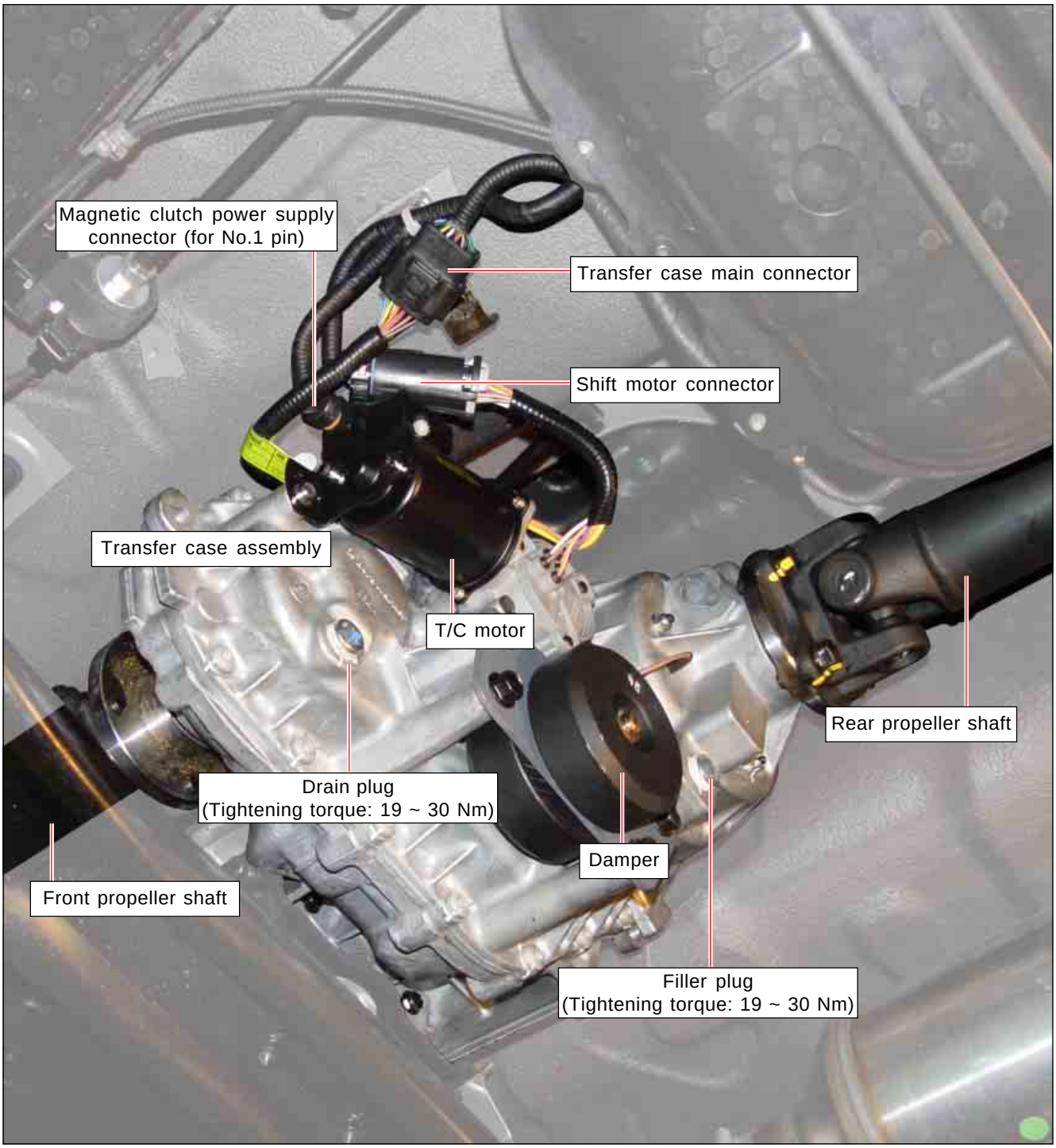
Cautions for Oil Level Check and Plugs

1. Be careful of hot oil when draining.
2. Do not use an impact wrench to remove or tighten the oil level plug or drain plug since this will damage the threads in the plug.

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REMOVAL AND INSTALLATION

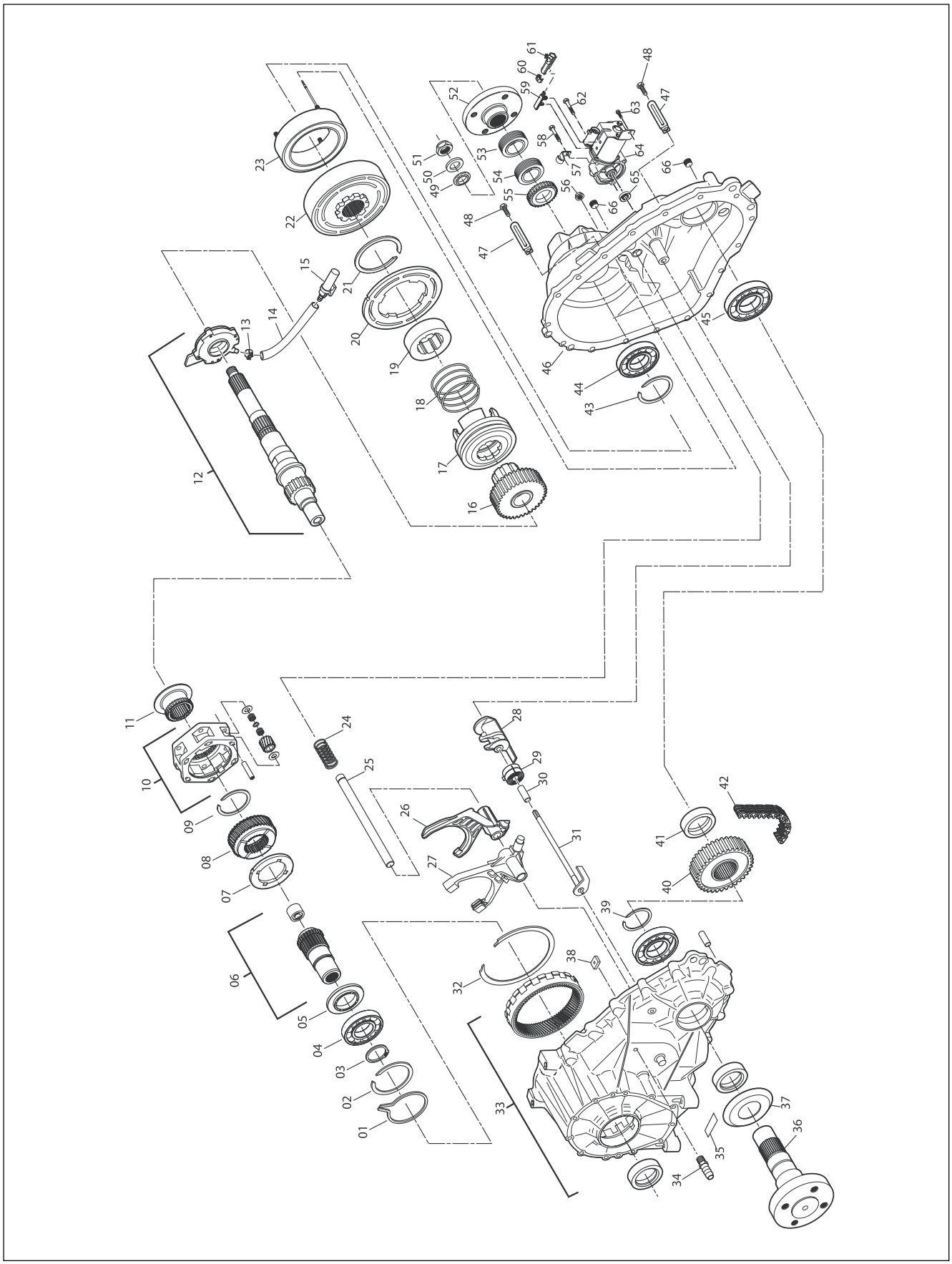
1. COMPONENTS LOCATION



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▶ Exploded View



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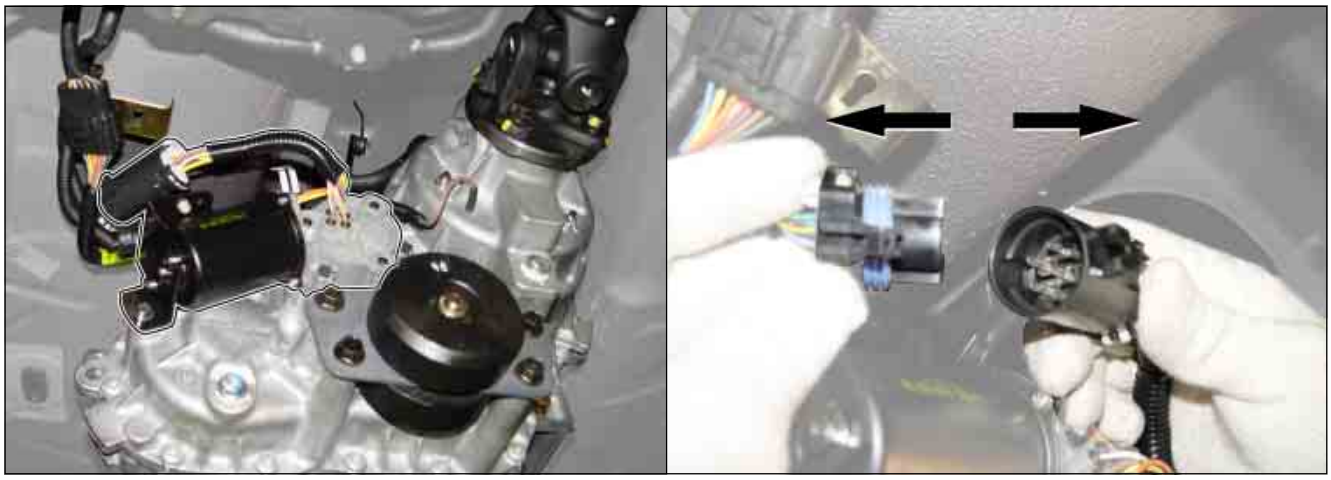
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1. Snap ring
2. Snap ring
3. Snap ring
4. Bearing
5. Hub
6. Input shaft assembly
7. Thrust plate
8. Sun gear
9. Snap ring
10. Carrier assembly
11. Reduction hub
12. Main shaft
13. Clamp
14. Hose
15. Filter assembly
16. Driving sprocket
17. Lockup collar
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 shield
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. Hexagon bolt
63. Hexagon cap screw
64. Electric motor assembly
65. Oil seal
66. Pipe plug

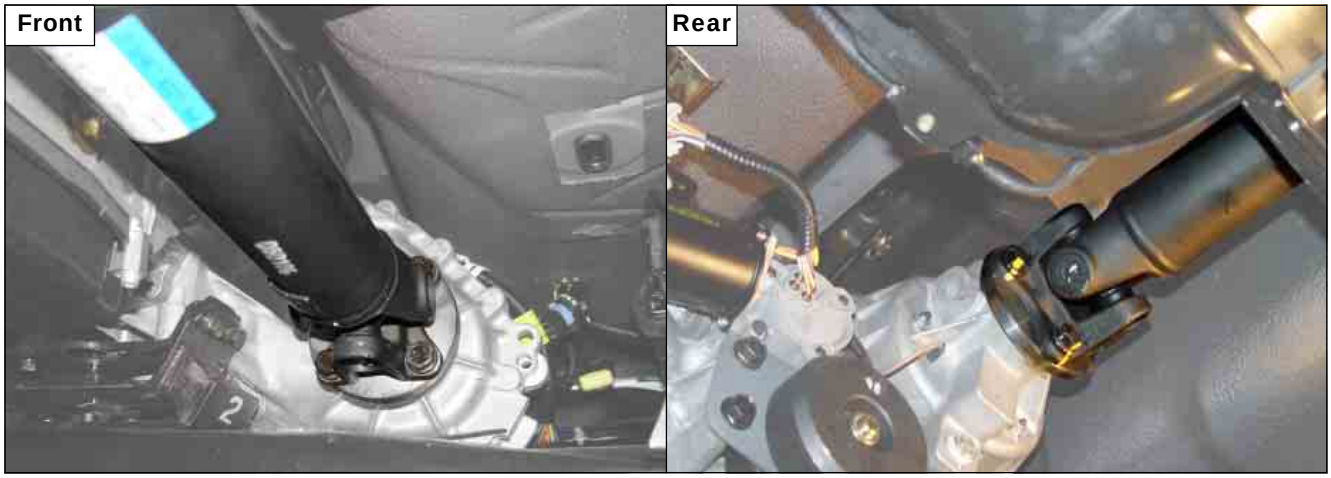
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Transfer Case

1. Disconnect the motor connector from the transfer case.



2. Remove the rear propeller shaft. And separate the front propeller shaft from transfer case.



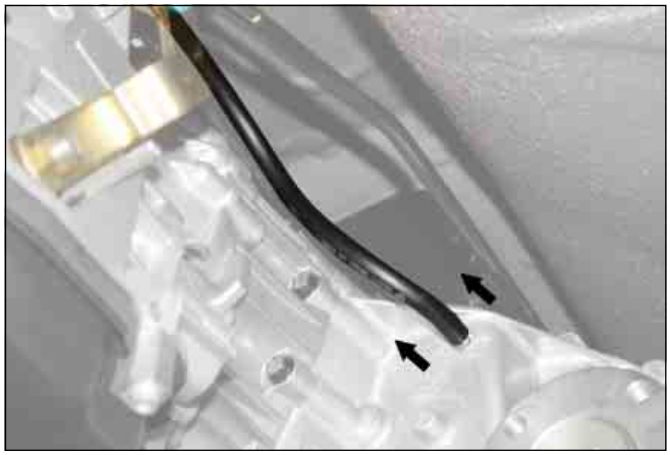
Installation Notice

Tightening torque	81 ~ 89 Nm (T/C)

Installation Notice

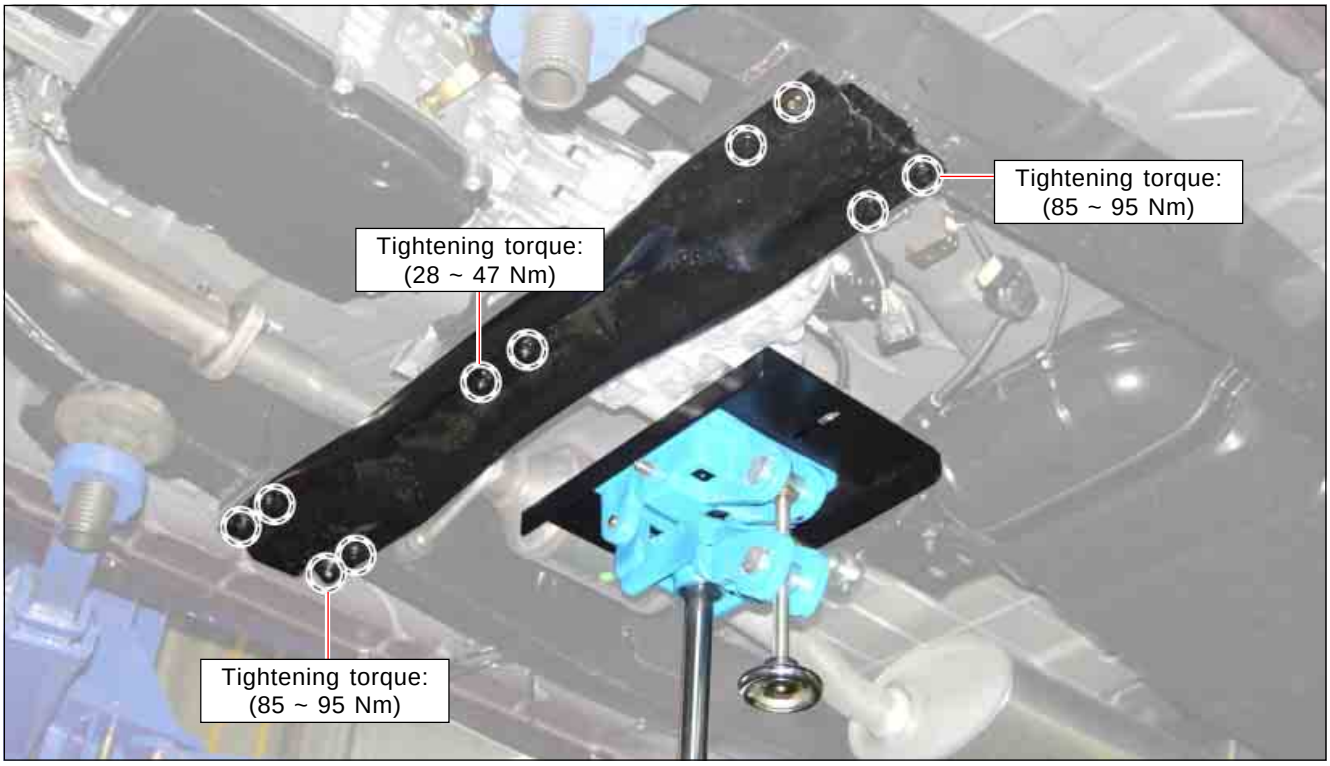
Tightening torque	81 ~ 89 Nm (T/C)
	70 ~ 80 Nm (Axle)

3. Disconnect the air hose from the transfer case.



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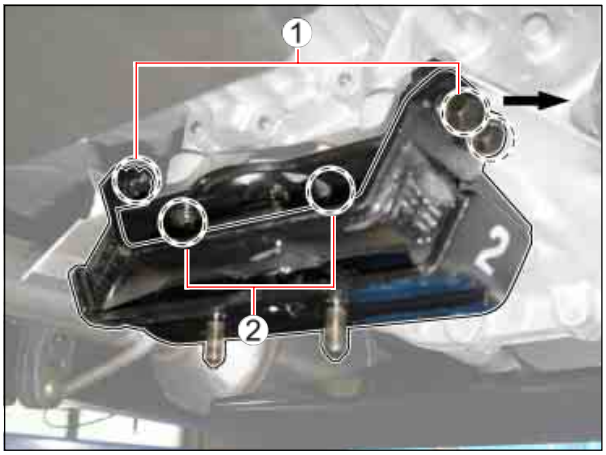
4. Place the safety jack under the transfer case and automatic transmission. Unscrew the transmission cross member bolts (14 mm) and the center bolt (14 mm), and remove the transmission cross member.



5. Unscrew the bolts (14 mm) and remove the transfer case mounting insulator and insulator bracket.

Tightening torque

Mounting insulator ①	28 ~ 47 Nm
Bracket bolt ②	28 ~ 47 Nm



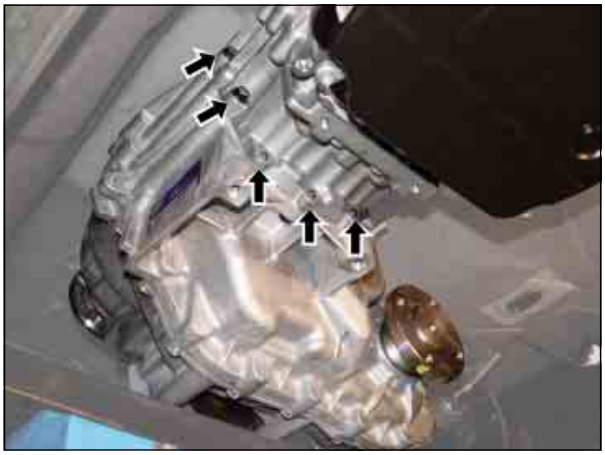
6. Unscrew eleven bolts (12 mm) and carefully remove the transfer case.

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)



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7. When installing, keep the tightening torque and install in reverse order of removal.

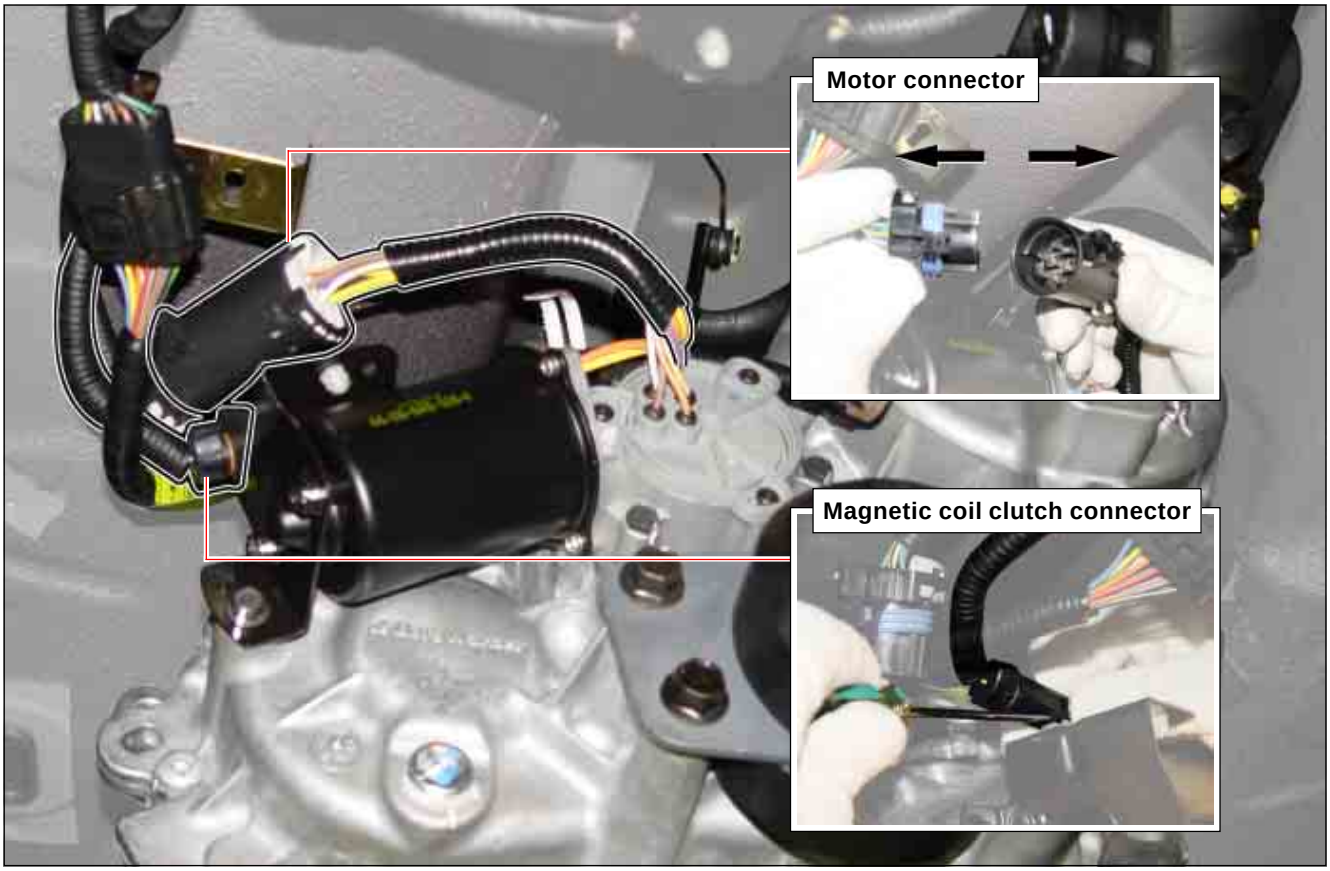
Side View	Front View
	

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Transfer Case Motor

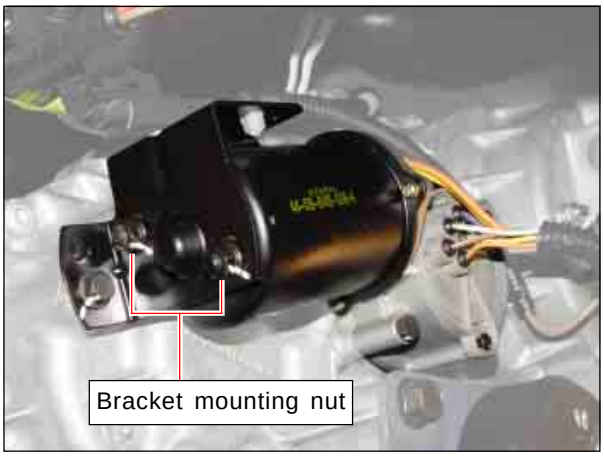
※ **Preceding Work:** Disconnect the negative battery cable.

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.



NOTICE

- **Remove two nuts to separate the bracket and motor.**



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3. Pull the shift motor assembly out 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 mating surface of the mode switch selection is matched with the motor's driving position before installation.



NOTICE

- **To do that, install a new shift motor on the same location that the used shift motor was on.**



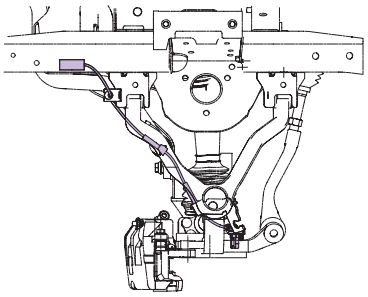
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2. REMOVAL AND INSTALLATION OF IWE (INTEGRATED WHEEL END)

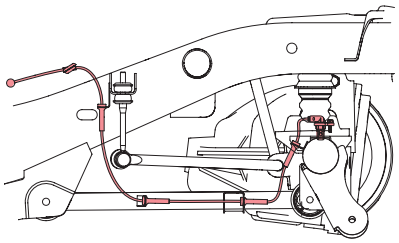
▶ Wheel Speed Sensor

※ **Preceding Work:** Disconnect the negative battery cable and remove the tires.

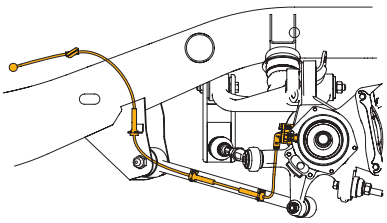
Note: Wheel speed sensor location



Front side (2WD)



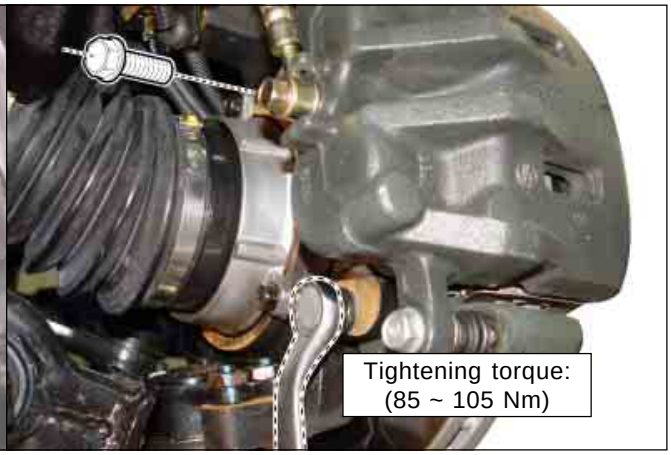
Rear side (5-link type)



Rear side (IRS 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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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 (10 mm).

Installation Notice

Tightening torque	100 ~ 130 Nm



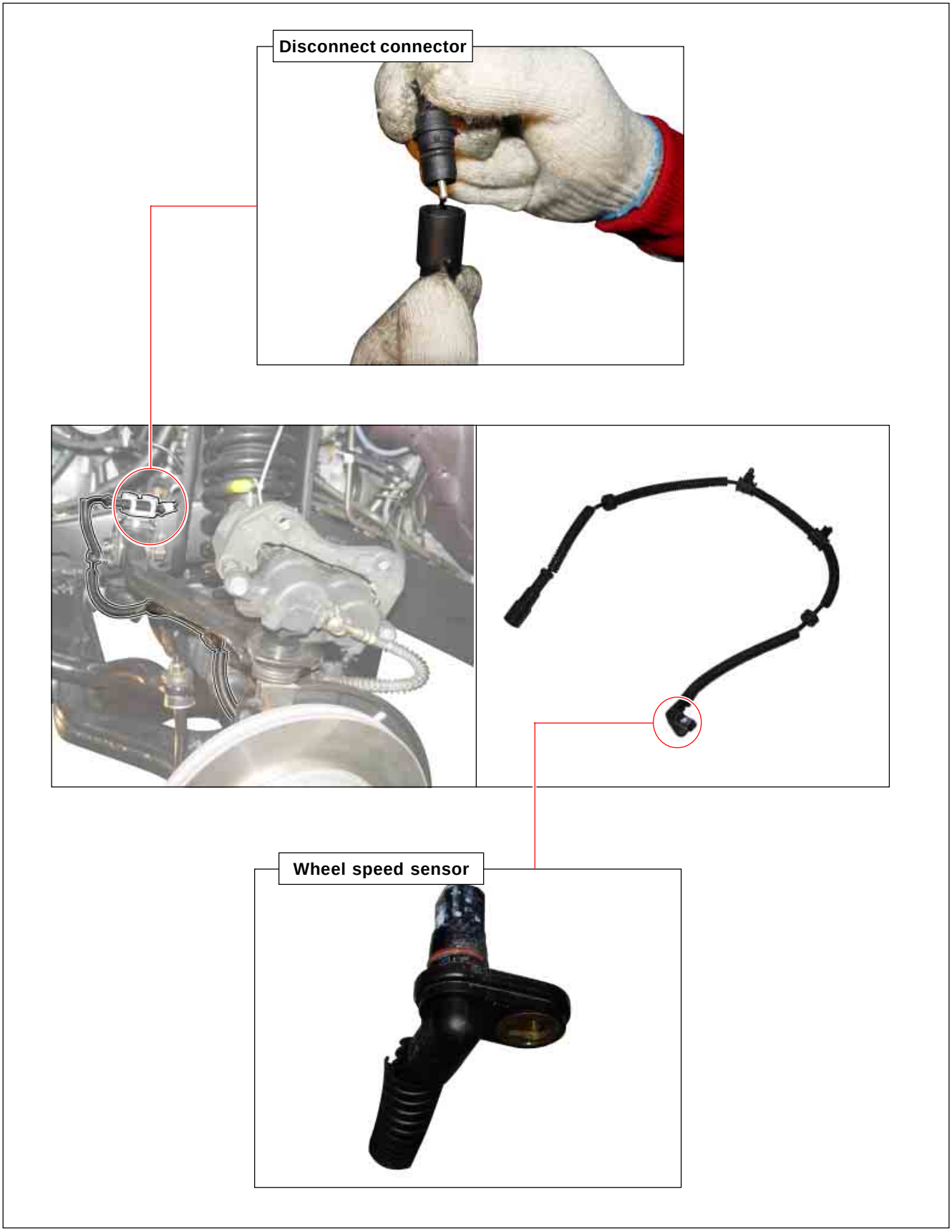
5. Slightly pull the wheel end hub until the wheel speed sensor is visible. Unscrew the mounting bolt (5 mm) and remove the wheel speed sensor.





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6. Disconnect the wheel speed sensor and the cable.



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▶ 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.



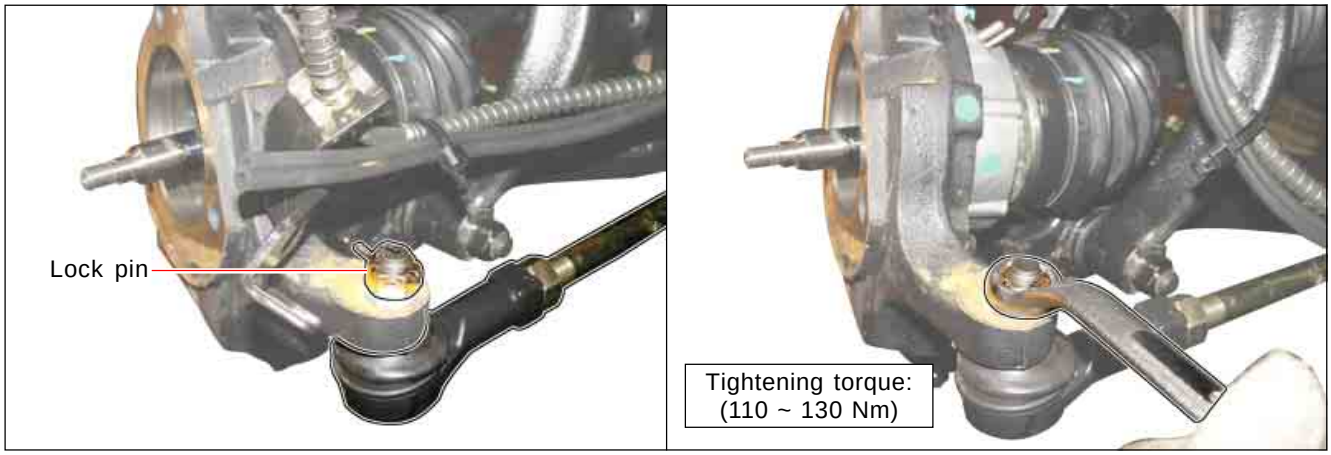
Installation Notice

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.

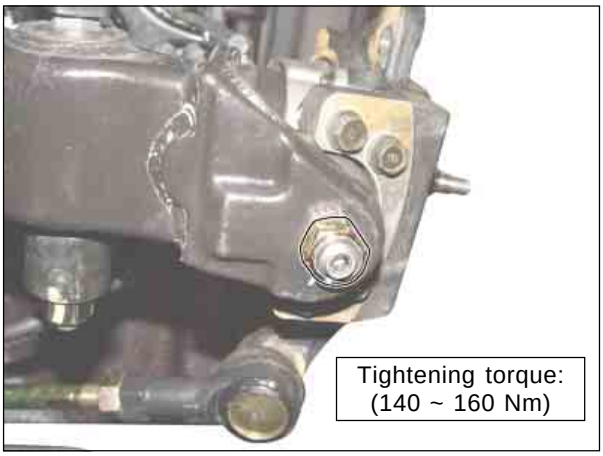


3. Pull out the steering gear linkage lock pin from the knuckle. Unscrew the mounting nut (19 mm) and remove the tie rod end.

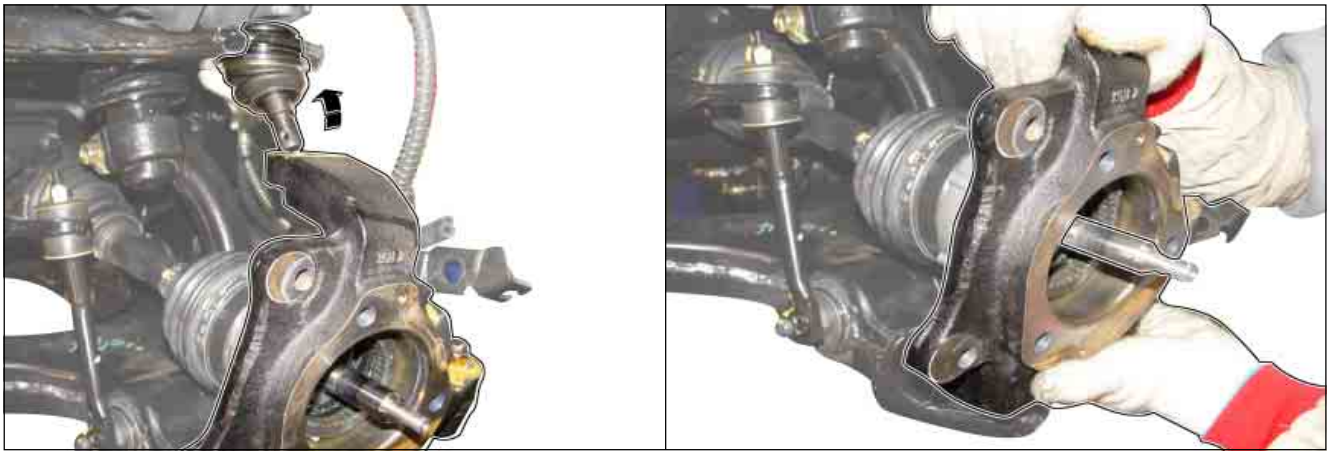


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4. Unscrew the lower arm mounting nut (22 mm).



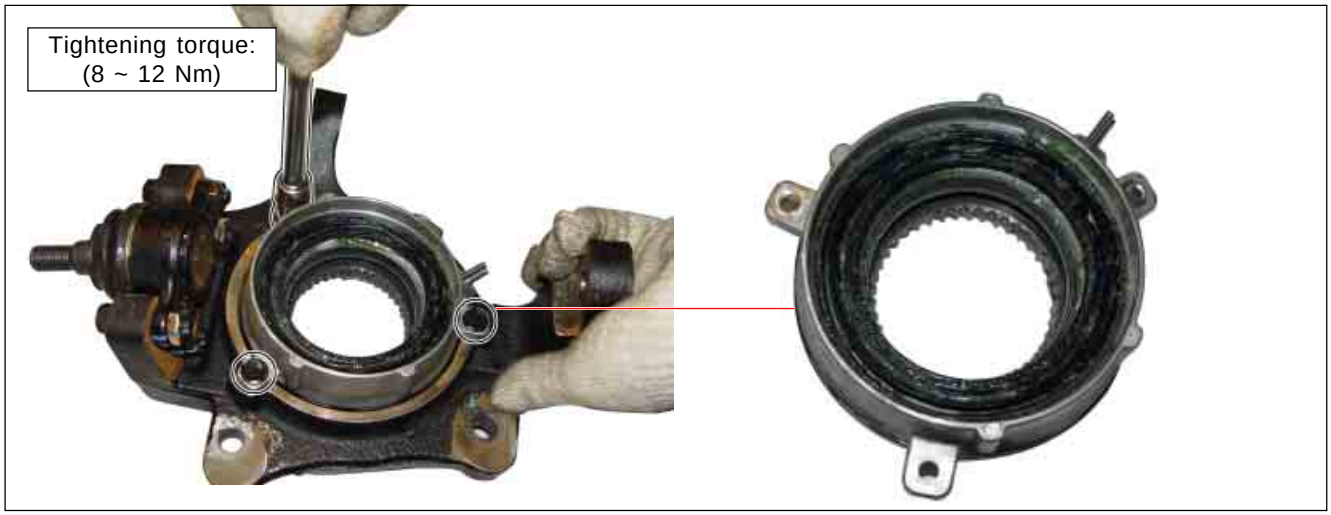
5. Remove the knuckle between upper arm and lower arm with special tool.



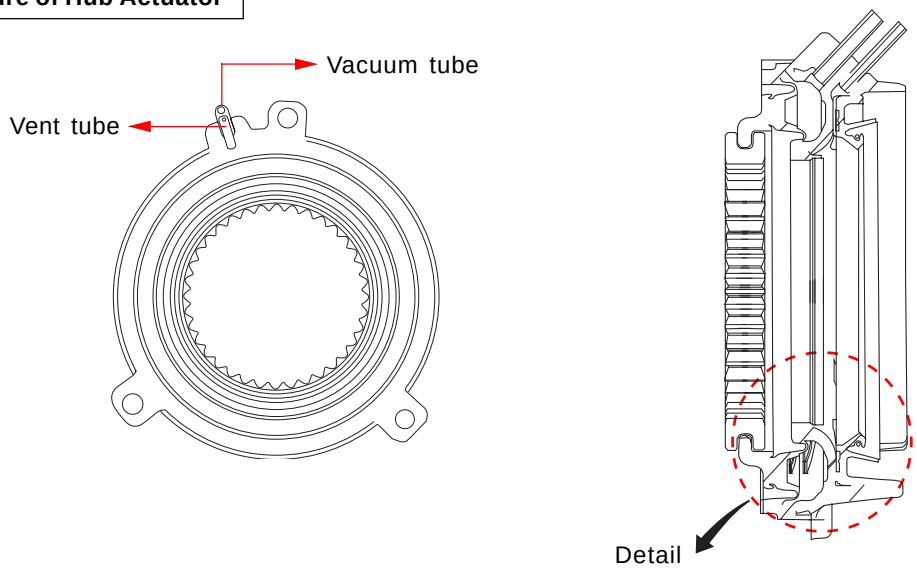
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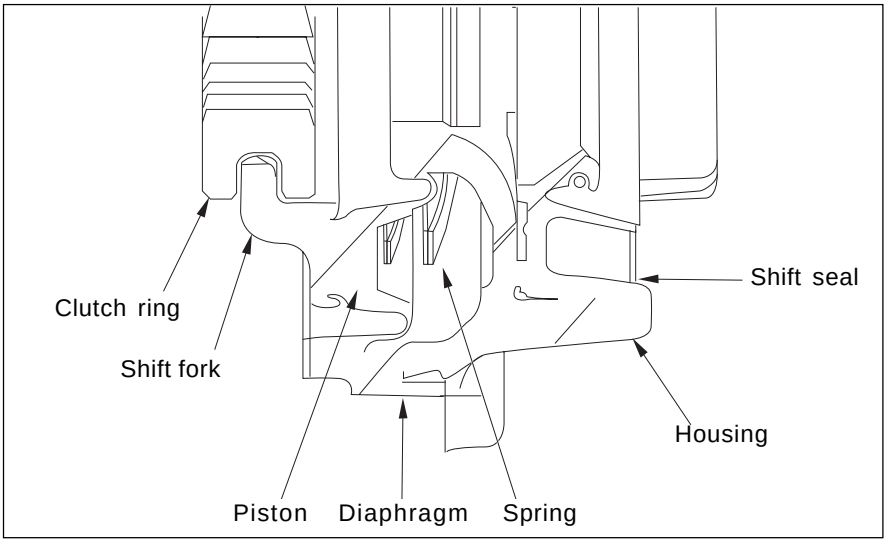
Hub Actuator

1. Unscrew the three bolts (10 mm) on the disassembled locking hub actuator assembly and remove the hub actuator.



Structure of Hub Actuator





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▶ 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.



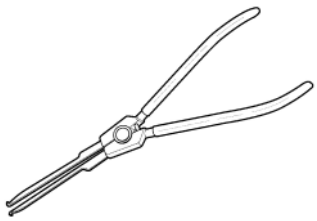
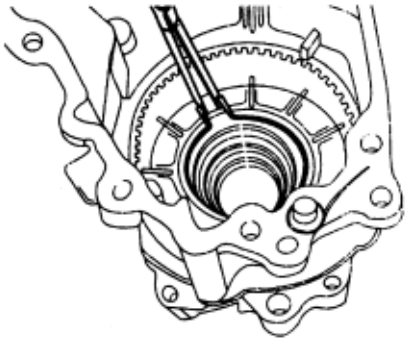
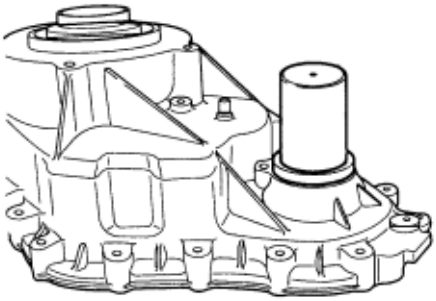
Installation Notice

* Completely clean the parts and apply the grease them before installation.
  Be careful not to damage the internal seal ring of the hub actuator.



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SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
661 589 01 37 00 (W 99 31 001 1B) Pliers 	Removal/installation of carrier assembly in transfer case 
DW 220 - 080 (W 99 31 005 0B) Oil seal installer 	Installation of oil seal to transmission case 

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TCCU (Transfer Case Control Unit)

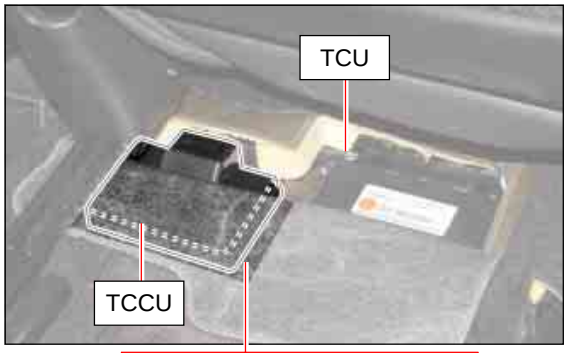
1. MAJOR CHANGES IN TCCU

TCCU controls the 4WD system and is located under the driver's seat.

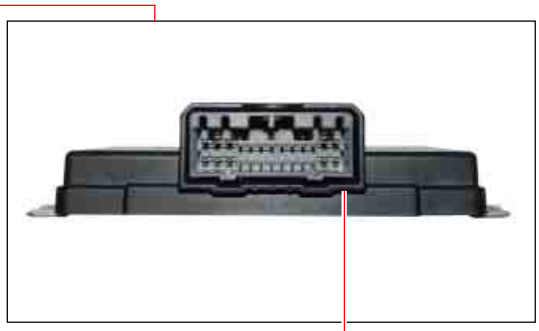
The new TCCU makes some difference compared with TCCU for the conventional part time transfer case and the differences are as follows:

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.
   This system receives the speed signals from ABS/ESP HECU or instrument panel (for non-ABS vehicle(Note 1)) through the CAN communication.
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 (Power and ground related to the speed sensor).
5. The new TCCU is available to install on the vehicle with the conventional DI engine part time TCCU.

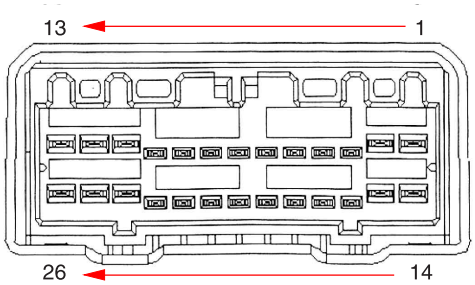
Location







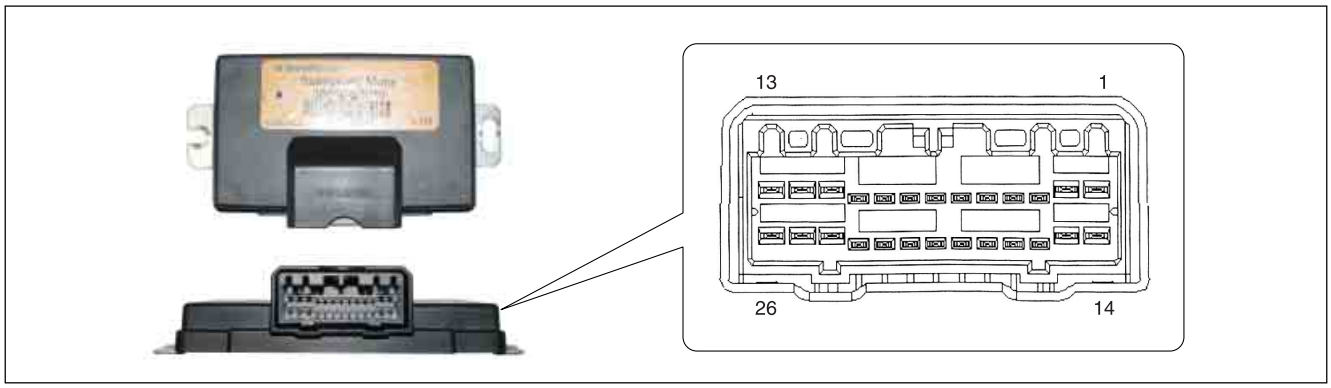
Pin Arrangement



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▶ 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		

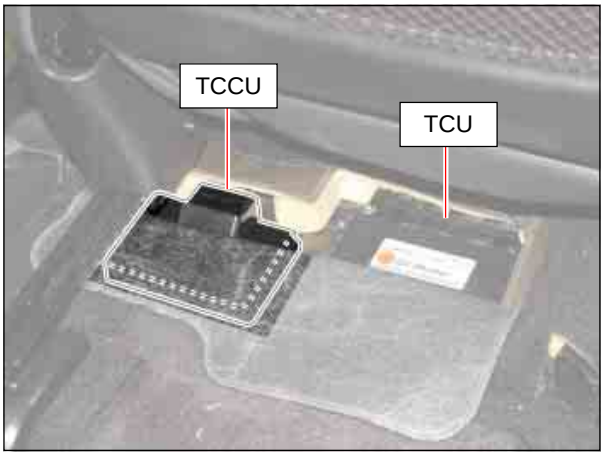
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SYSTEM OPERATION

1. TCCU (TRANSFER CASE CONTROL UNIT)

▶ 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 (for the shifting between 4WD HIGH and 4WD LOW, stop the vehicle).



1. 2H →4H

1) Change the 4WD switch in instrument panel from 2H to 4H.
2) This shift is available during driving.
3) The "4WD HIGH" indicator in meter cluster comes on.

When the System is Defective

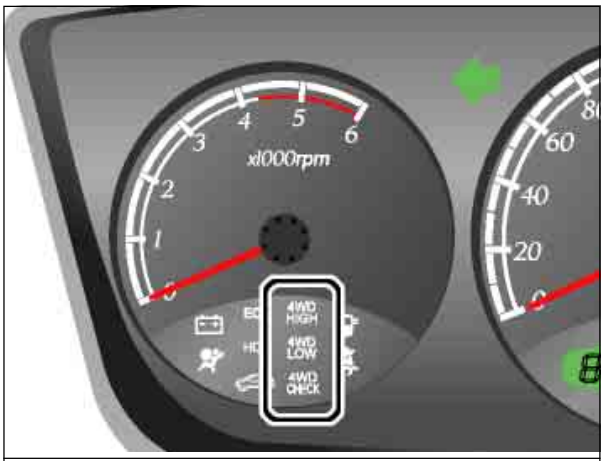
- **The "4WD CHECK" warning lamp comes on**

2. 4H →2H

1) Change the 4WD switch in instrument panel from 4H to 2H.
2) This shift is available during driving.
3) The "4WD HIGH" indicator in meter cluster goes out.

3. 4H →4L

1) This function is only available when the speed signal from speed sensor is about to stop (below 2 km/h).
2) This function is only available when the clutch pedal is depressed (manual transmission) or the selector lever is selected to the "N" position (automatic transmission). (TCCU must recognize the clutch pedal signal or "N" signal.)
3) Change the 4WD switch in instrument panel from 4H to 4L.
4) The "4WD LOW" warning lamp in meter cluster flickers during this process, then goes out when the shift is completed.
5) The "4WD CHECK" warning lamp comes on when the system is defective.





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Reading 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	
0	0	0	1	Zone 4	
1	0	0	1	Zone 5	
1	0	0	0	Zone 6	
1	1	0	0	4 L	
0	0	0	0	Right stop	
1	1	1	1	Encoder Off State	

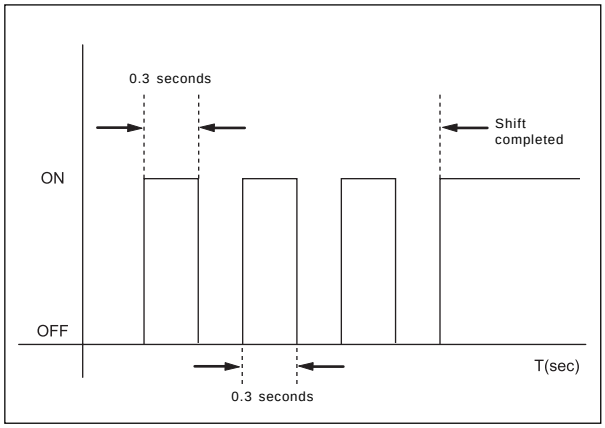
Operation

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 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.

Function of indicating lamp during shifting

1. As the operation of shift motor starts, the indicator flickers in the interval of 0.3 seconds and stops after the shifting operation is completed or cancelled.
   1) Operation diagram of "4H" indicator when changing the switch to 4H from 4L
   2) Operation diagram of "4H" indicator when changing the switch to 4L from 2H/4H



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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.
3. The shift operation between 4H and 4L is only available when the vehicle speed is below 11 rpm or 2 kph.

Motor Controls

1. The shift steps have the sequence of 2H →4H →4L and 4L →4H →2H. 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 due to timeout occurs. This failure appears when the shifting time between 2H and 4H and between 4H and 4L 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 or 4L). 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/4L.
2. The shift motor moves in 4H mode.
3. The 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.

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2. 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 and 3 seconds after completion of 4H-4L 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.
   1) General encoder fault: Invalid position code input
   2) 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.

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3. 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:
   1) The “4WD CHECK” indicator remains on after 0.6 second when turning the ignition switch ON.
   2) 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.**

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4. DIAGNOSTIC TROUBLE CODE

Code	Description	Action
P1806	Defective 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.

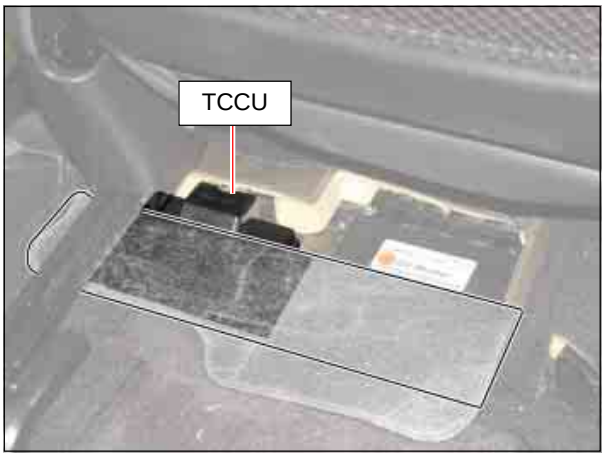
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Code	Description	Action
P1850	Defective position encoder	- When the position encoder is defective - Check the relevant harnesses. - Check the relevant connectors for contact. - Check the shift motor.
P1851	Short to ground for position encoder 1	- Short 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.

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Removal and Installation of TCCU

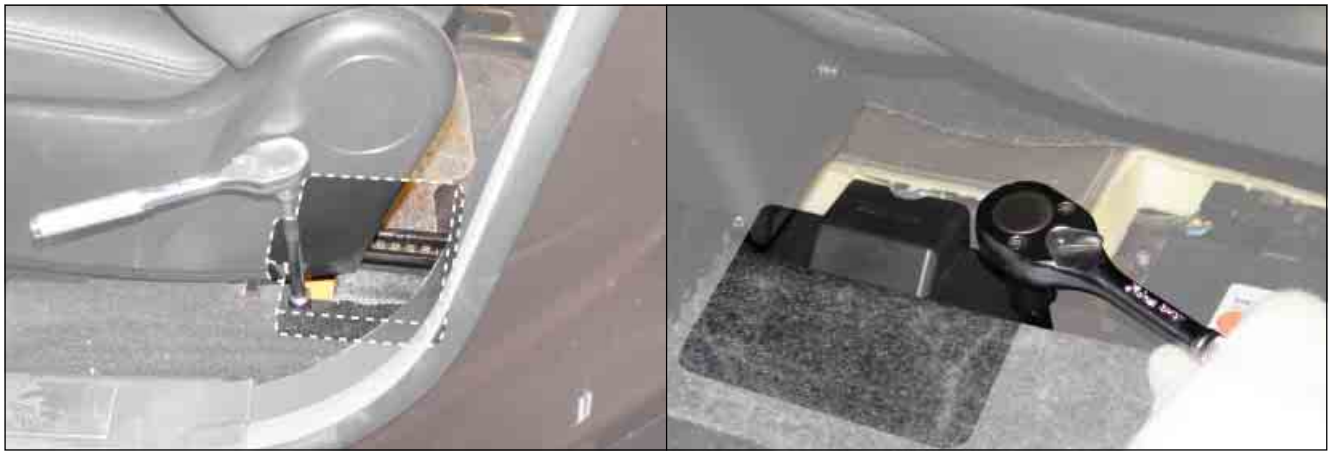
1. Slide the drive's seat and fold up the carpet.



2. Unscrew two nuts on the TCU.

Installation Notice

Tightening torque	10 Nm



3. Disconnect the TCCU connect and remove the TCCU.

NOTICE

- **Be careful not to apply any impact to TCCU body.**



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MEMO

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CLUTCH

3010

TABLE OF CONTENTS

GENERAL 3

1. Function and overview 3
2. Specifications 8
3. Trouble diagnosis 9
4. Maintenance 10

CLUTCH ASSEMBLY 12

1. Removal and installation 12
2. Special tools ane epuipment 22

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GENERAL

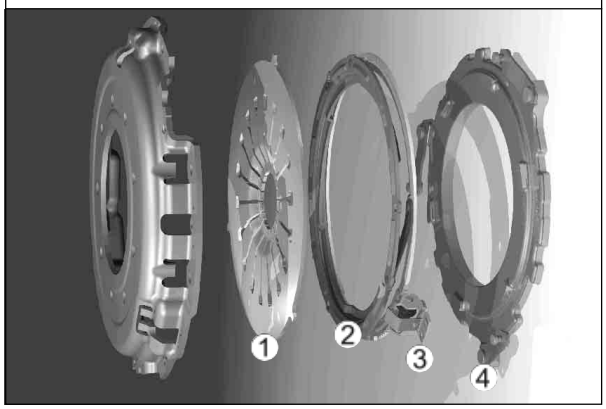
1. FUNCTION AND OVERVIEW

▶ SAT (Self Adjusting Technology) Clutch System

1. Function

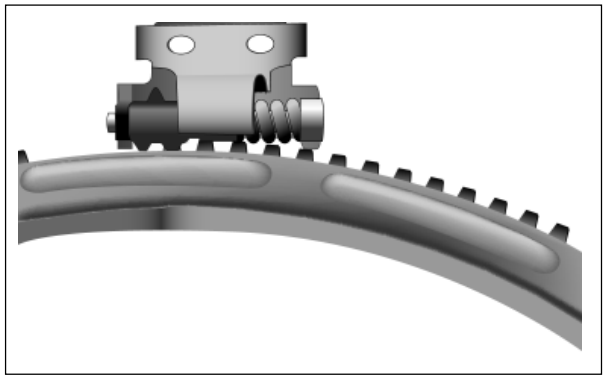
SAT is new clutch system which adjusts the clutch free play according to the wear of clutch disc.

Internal Components of Clutch Cover



2. Operation description

1) 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.
2) 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, which is bolted to the flywheel.

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.

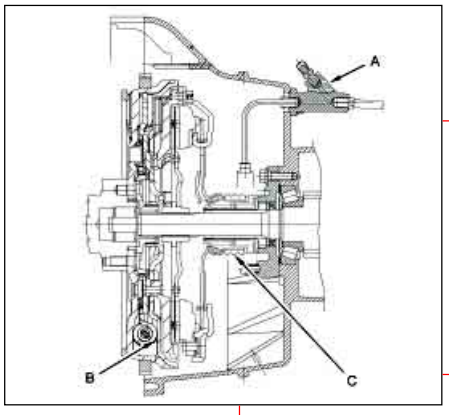
This system directly releases the clutch by using hydraulic pressure while the conventional clutch system releases the clutch by using release lever and release fork. This system provides higher efficiency than conventional clutch system, and its durability is superior.

1) Clutch master cylinder (mounted on clutch pedal)
2) Concentric slave cylinder pipe (mounted inside of transmission)

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▶ Functions

Components of Clutch Assembly



A. Adapter/Pipe Assembly



B. Clutch Assembly



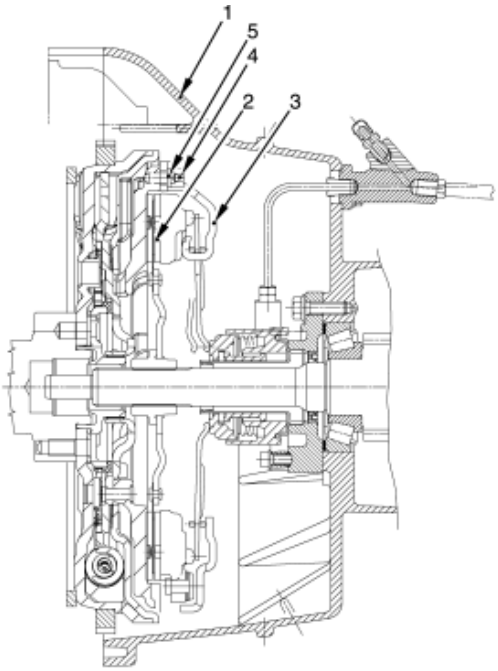


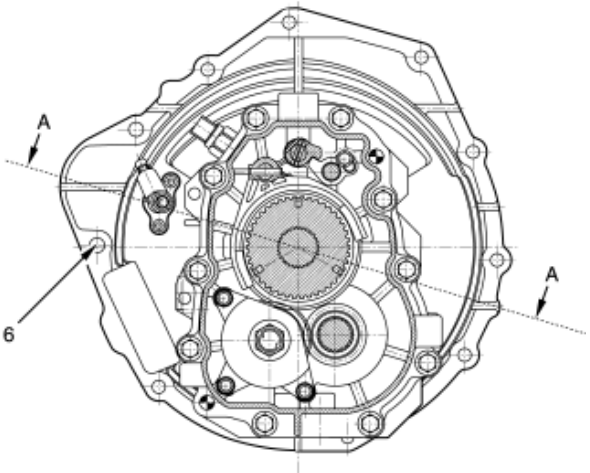
C. Concentric Slave Cylinder





Cross Sectional View of Clutch Assembly





1. Transmission housing
2. Clutch disc assembly
3. Clutch disc cover assembly
4. Bolt
5. Washer
6. Bolt

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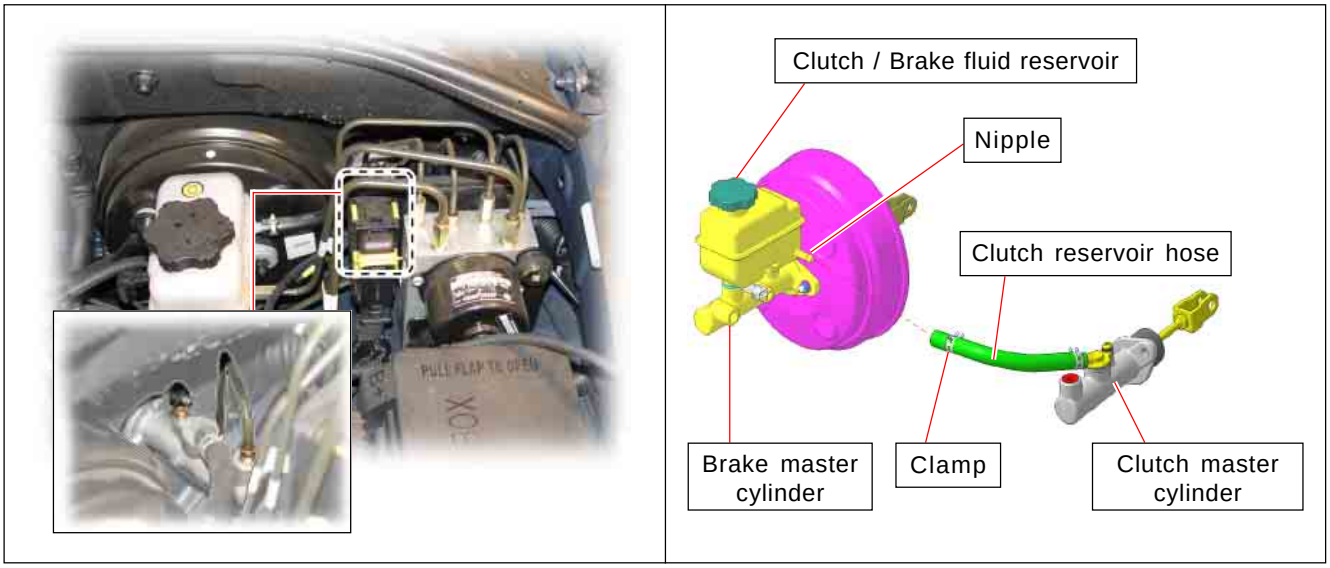
Clutch Master Cylinder and Reservoir

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:

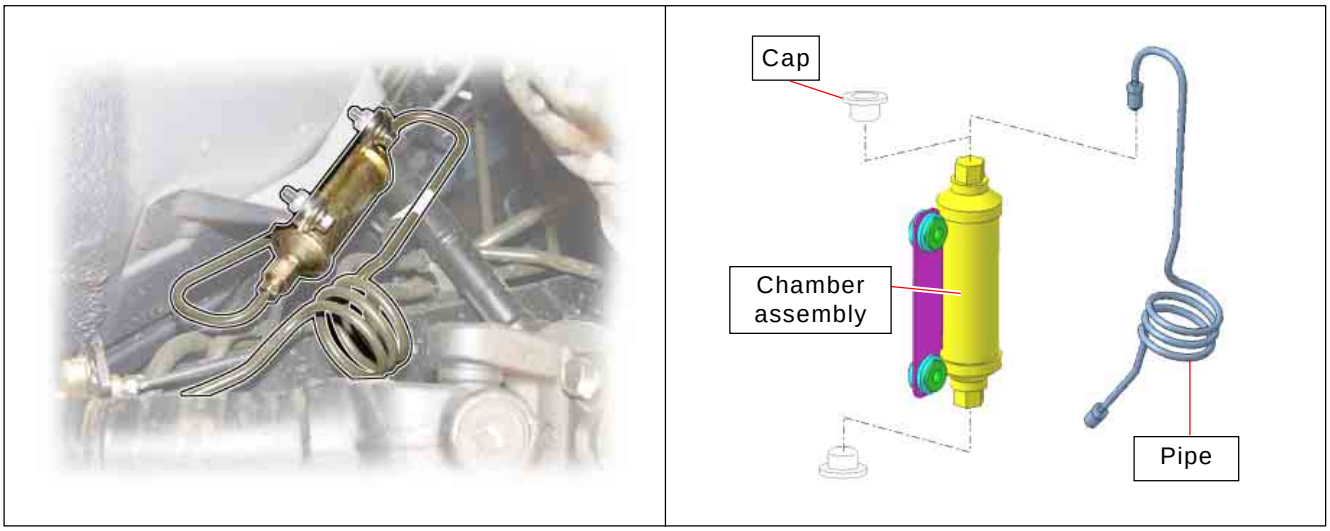
When depressing the clutch pedal, the push rod pushes the piston and the piston cup, which sends the oil in the oil reservoir tank to the concentric slave cylinder through the hose and pipe. During this operation, an oil pressure is produced within the master cylinder and transmitted as follows: concentric slave cylinder →clutch cover →clutch disc.

When releasing the clutch pedal, it returns to its original position through the motion of the clutch cover and the spring within the cylinder, and the clutch operation stops. The piston in cylinder returns to its original position.



Clutch Release Chamber

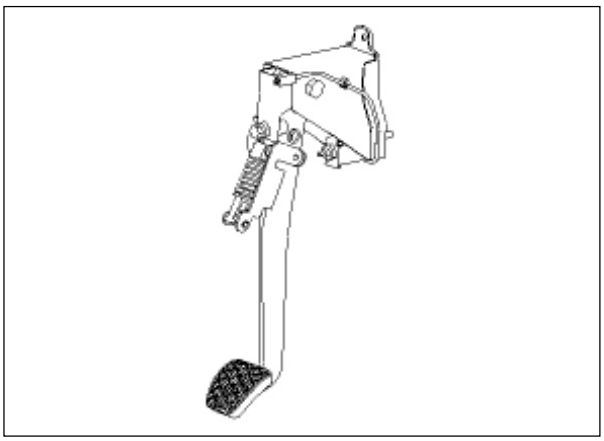
The clutch release chamber keeps the oil pressure in the clutch hose and pipe stable and also helps the oil pressure to transfer quickly and generates the remaining pressure in the hose and pipe when the clutch is operated.



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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.

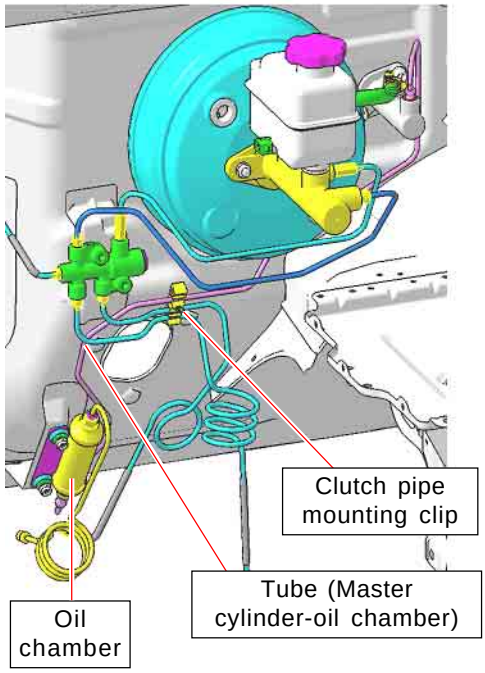
Clutch Cover Assembly

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.

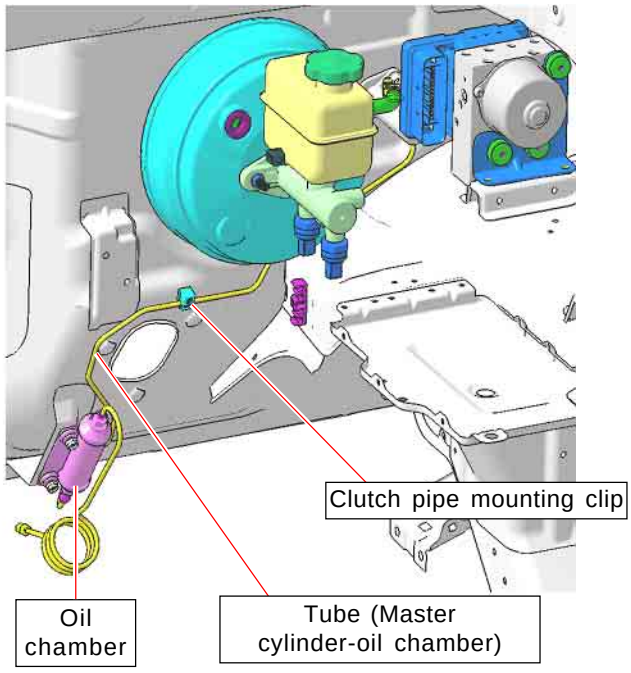
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Mounting on Dash Panel

Models without ABS/ESP



Models with ABS/ESP



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2. SPECIFICATIONS

▶ Specifications

Description		Specification
Operating type		Hydraulic
Clutch pedal	Type	Suspended
	Maximum pedal stroke	Diesel engine equipped vehicle: 140 mm
	Pedal free play	5 ~ 10 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	28.4 mm
	Inner diameter	ϕ 17.04 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) 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 ~ 22 Nm
Clutch pedal bracket mounting bolt	8 ~ 18 Nm
Stopper bolt	16 ~ 22 Nm

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3. TROUBLE DIAGNOSIS

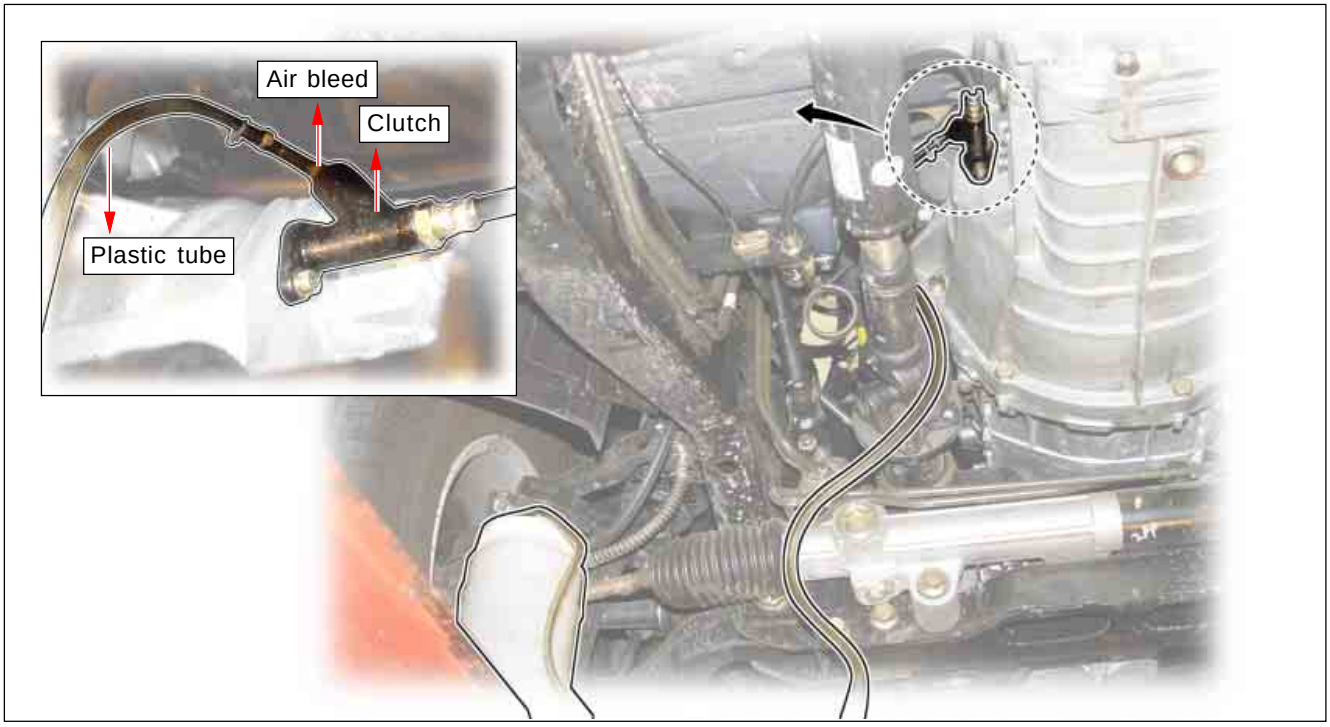
Check		Possible Cause	Action
Clutch slips		Excessive wear of facing	Replace
		Hard or oily facing	Adjust or replace
		Damaged diaphragm or flywheel	Replace
		Damaged or burnt diaphragm spring	Replace
		Insufficient clutch pedal free play	Adjust
		Faulty operation of clutch pedal	Repair or replace
		Worn 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 will 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 burred 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	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

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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 on the release cylinder. Connect a plastic tube to the bolt.
2. Put the other side of the tube into a empty container.
3. Slowly pump 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.**

Clutch fluid	DOT 3, 4

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▶ 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 & cover →Apply the zig set (SST) on the clutch cover set.
   (Example: engine removal and reinstallation, flywheel related job, checking the clutch assy)

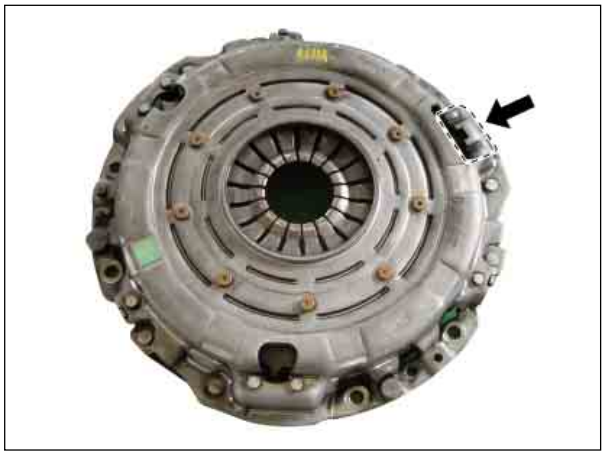
NOTICE

- **When reinstall the clutch assembly without the special zig, disc can be slipped and worn easily.**

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).





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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

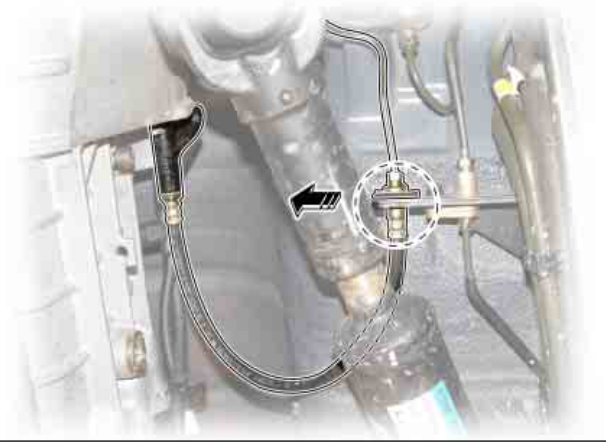
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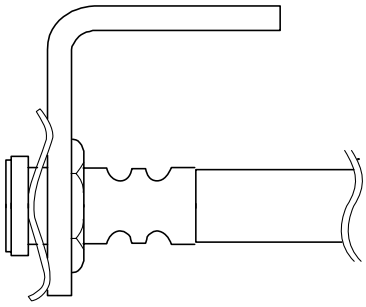
▶ Removal and Installation of Components

Clutch Assembly

1. Disconnect the clutch fluid hose from the adapter.



Hose connection (clip mounted)



2. Remove the transmission assembly.



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

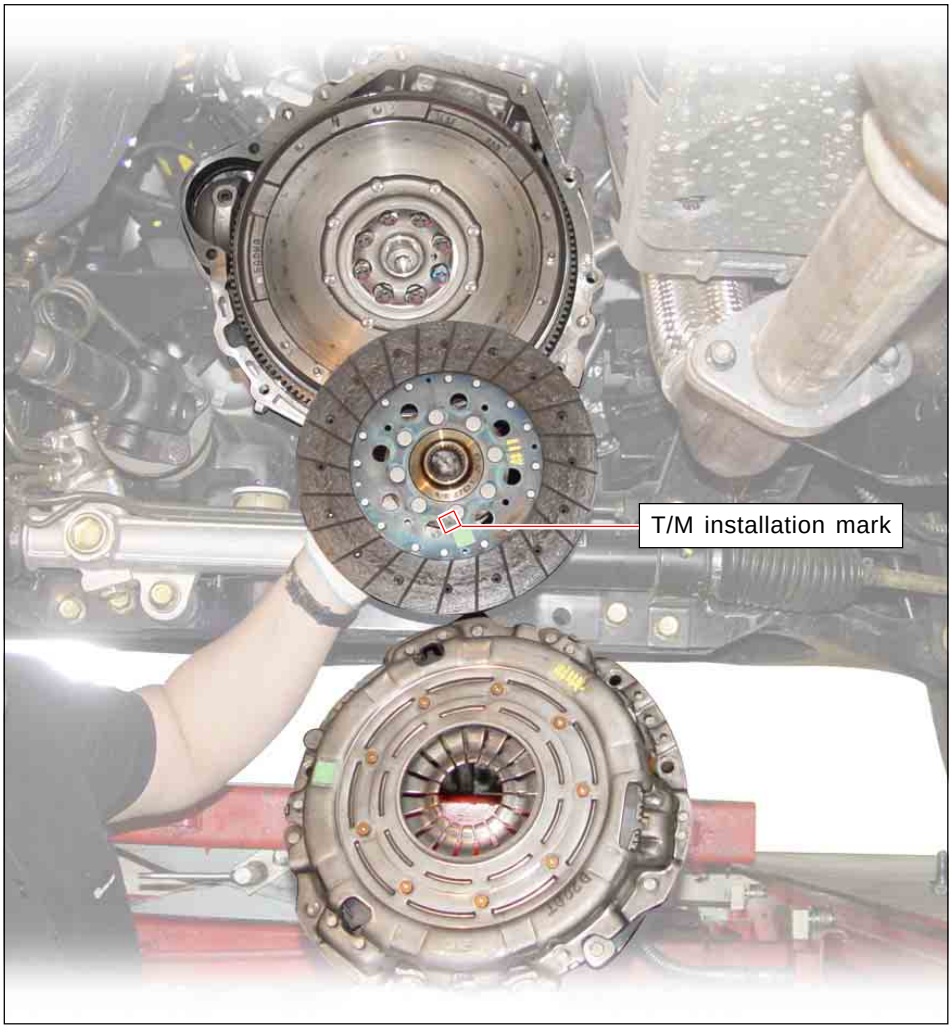
Tightening torque	24 ± 3 Nm

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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.**



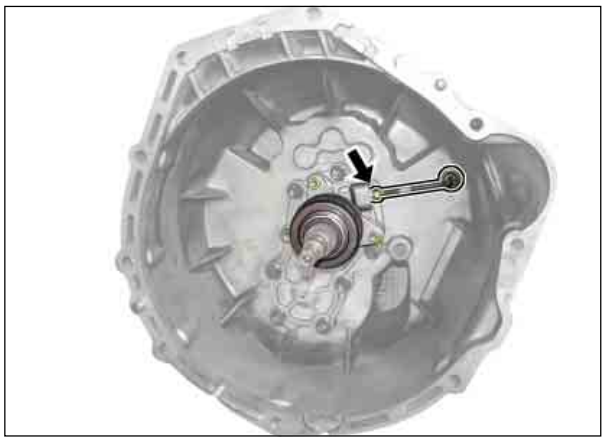


Clutch disc Pressure plate

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Concentric Slave Cylinder

1. Unscrew the nut and remove the oil pipe from the clutch housing.



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.**
- **Apply a small amount of clutch fluid on the internal components such as piston.**
- **Replace parts if necessary.**

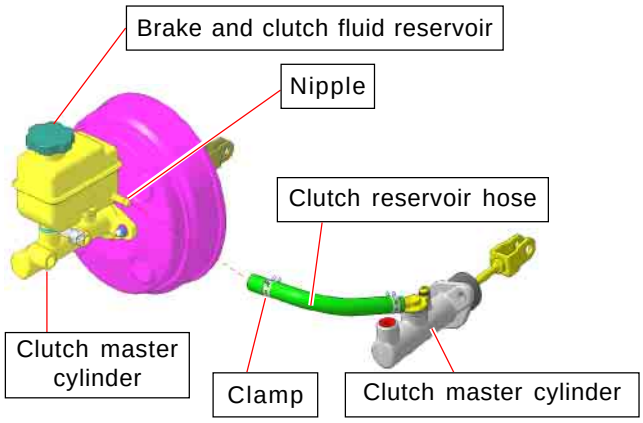
Keep the specified tightening torque.

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Clutch Master Cylinder

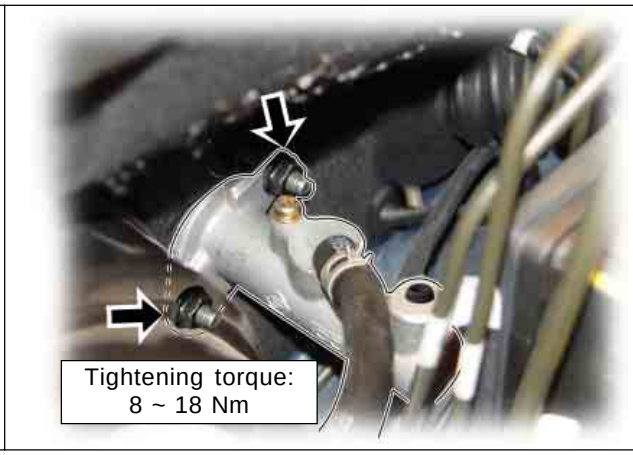
1. Drain the clutch fluid.
2. Disconnect the clutch fluid feed hose from the brake reservoir.





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.
5. Install in the reverse order of removal and check “air bleeding and clutch pedal operation” after installation.



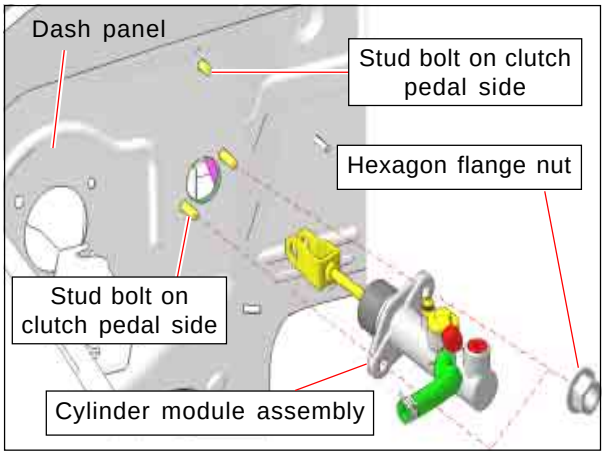
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Clutch Pedal

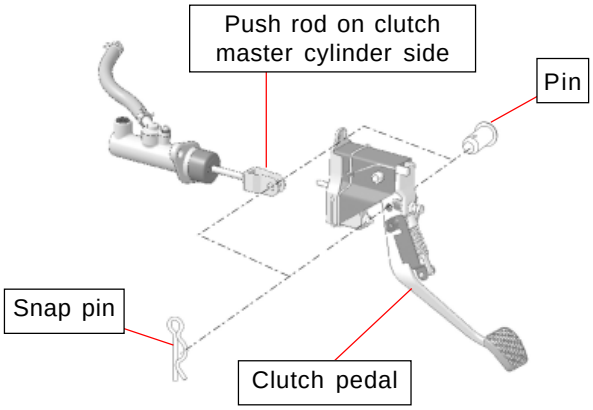
1. Unscrew the clutch master cylinder mounting bolts.

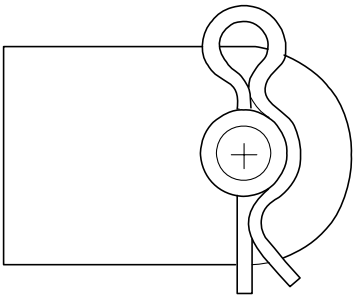
Installation Notice

Tightening torque	8 ~ 18 Nm



2. Remove the snap pin from master cylinder push rod.





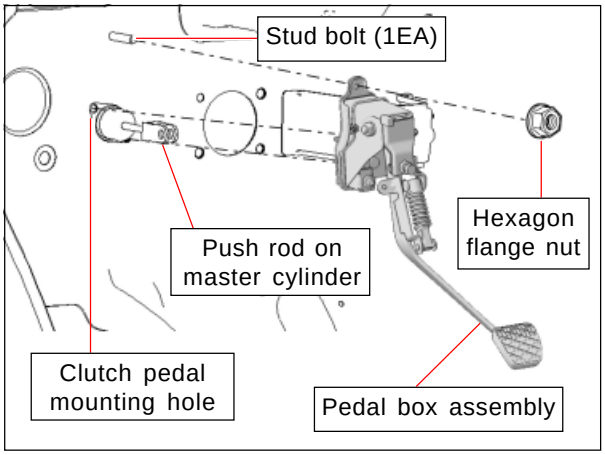
INSTALLATION NOTICE

- **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



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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 stroke, 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.**

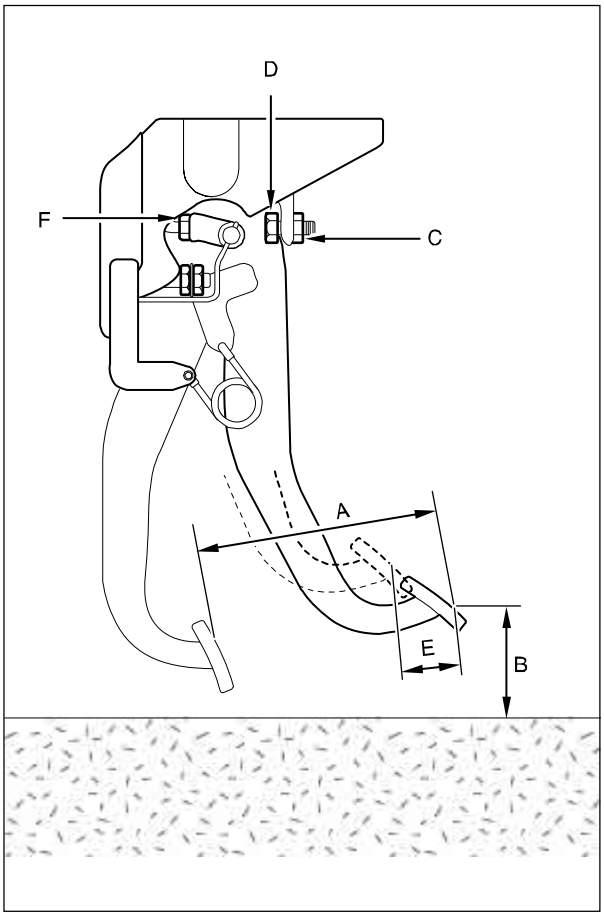
3. Pedal Free Play (E)

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.



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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

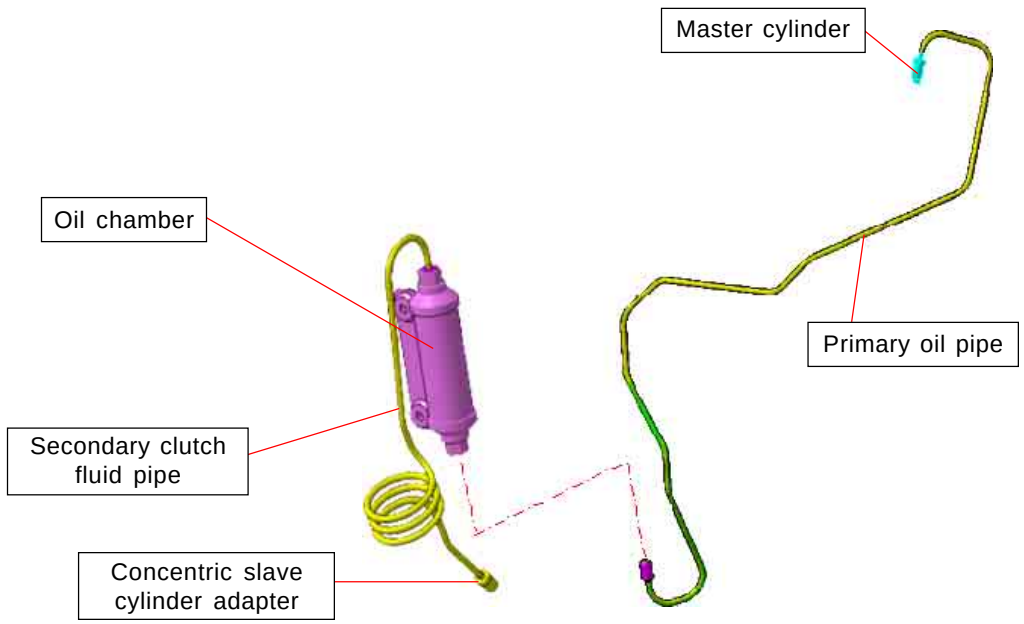
3. Unscrew the supply pipe bolt and remove primary oil pipe from clutch fluid chamber.
4. Unscrew the pipe bolt and remove the secondary clutch fluid pipe from concentric slave cylinder adapter.
5. Install the pipes. Be careful not to mix the pipes.



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



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▶ Inspection and Maintenance

1. Clutch Cover Assembly
   1) Check the diaphragm spring tip for wear and height unevenness.

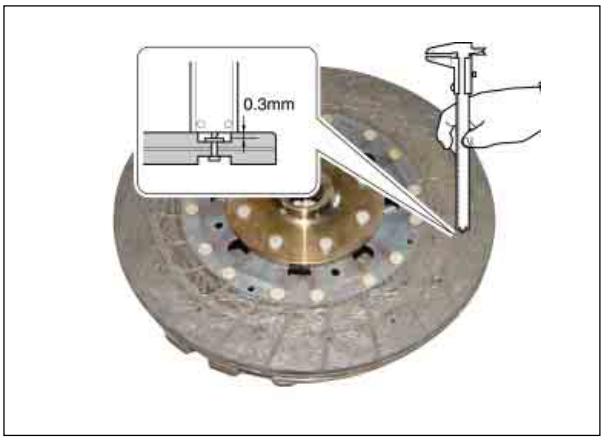
Unevenness limit	0.8 mm

   2) Check the pressure plate surface for wear, crack and discoloration.
   3) Check the strap plate rivet for looseness and replace the clutch cover if necessary.



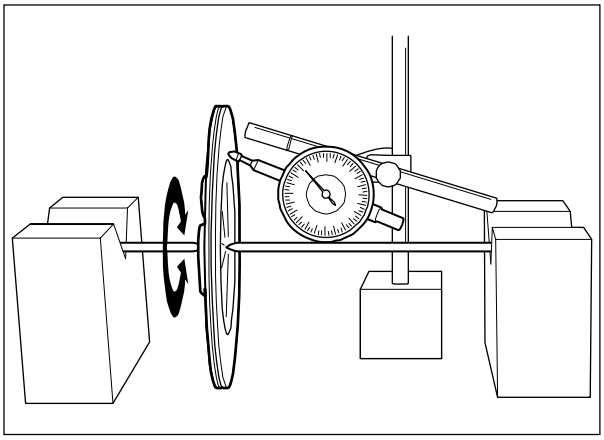
2. Clutch Disc
   1) Check the facing for rivet looseness, sticks, oil and grease.
   2) Measure the rivet head depth. If it is out of limit, replace the disc.

Wear limit	0.3 mm



3. Clutch Disc Run-Out
   1) Measure the clutch disc run-out and if it is out of limit, replace the disc.

Run-out limit	Within 0.7 mm



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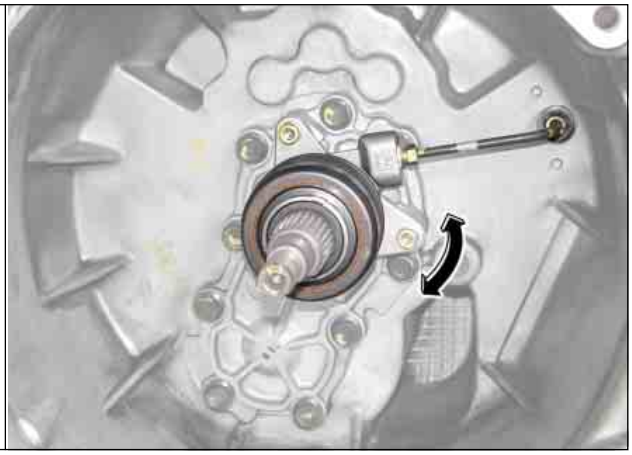
4. Pressure Plate
   1) Check the pressure spring for wear.

NOTICE
- **The excessively worn components should be replaced.**



5. Concentric Slave Cylinder
   1) Check any heat damage, abnormal noise, poor rotation and wear of the concentric slave cylinder bearing.





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2. SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
D9930 - 0010C Zig set - diaphram spring 	Support diaphram spring when disassembled 

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AXLE

4120 / 4210 / 4220

TABLE OF CONTENTS

GENERAL 3

1. Overview 3

FRONT AXLE 5

FRONT AXLE ASSEMBLY 6

REMOVAL AND INSTALLATION 8

5-LINK TYPE REAR AXLE 15

1. Location 15
2. Removal and installation 18

INDEPENDENT SUSPENSION TYPE REAR AXLE ... 24

1. Overview 24
2. Exploded view 26
3. IRDA (Independent Rear Drive Axle) 28
4. Removal and installation 30
5. Trouble diagnosis 32

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GENERAL

1. OVERVIEW

Compared to previous models, in addition to existing 5-link suspension, the IRDA (Independent Rear Drive Axle) is adopted for the independent type suspension in this vehicle.

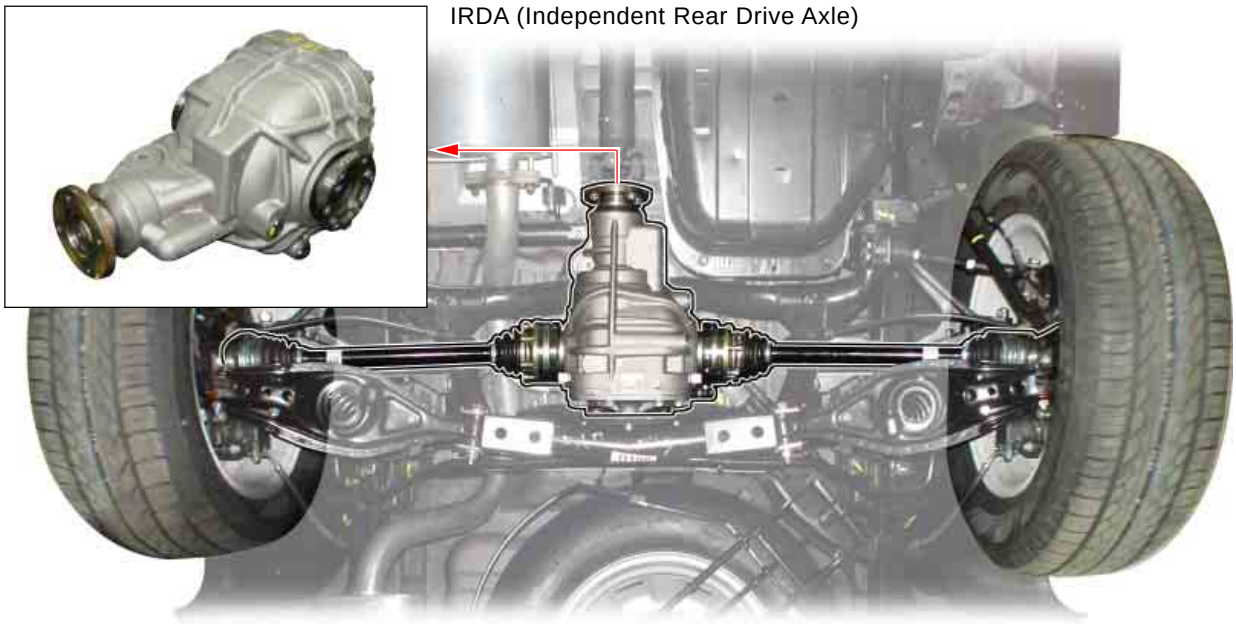
The below figures for rear axle show the rear axle with the independent type suspension (4WD, A/T).

Front Axle



Rear Axle

IRDA (Independent Rear Drive Axle)



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Location		Front axle				Rear axle	
Specification		M/T		A/T		Independent suspension	5-link
Torque		-		-		5,164 Nm	-
Gear ratio		D20DT	D27DT	D20DT	D27DT	←	←
		4.27	3.91	3.54	3.31		
Gear	Type	→		→		Hypoid	←
	Size	ϕ 198.1 mm		←		218 mm (diameter)	ϕ 243.8 mm
	Offset	30 mm		←		Less than 30 mm	-
Housing		Steel casting (steel, aluminum cover)		←		Aluminum die casting	Steel casting (steel, aluminum cover)
Oil	Specification	SAE 80W/90		←		SAE 75W/90 (Synthetic)	SAE 80W/90
	Capacity	1.4 L		1.4 L		1.5 L	1.9 L
Length		448.0 mm		←		412 mm	469.0 mm
Width		681.9 mm		←		292 mm	1717.7 mm
Weight		45 kg		←		30 kg	100 kg

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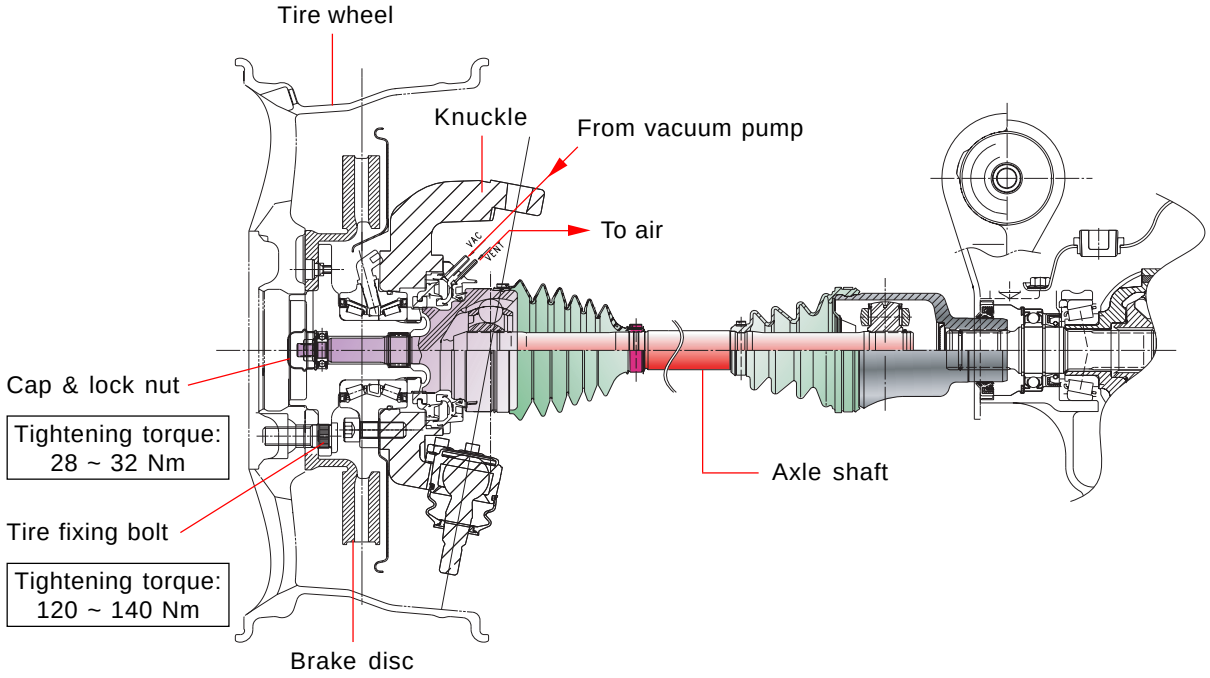
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FRONT AXLE

▶ Location



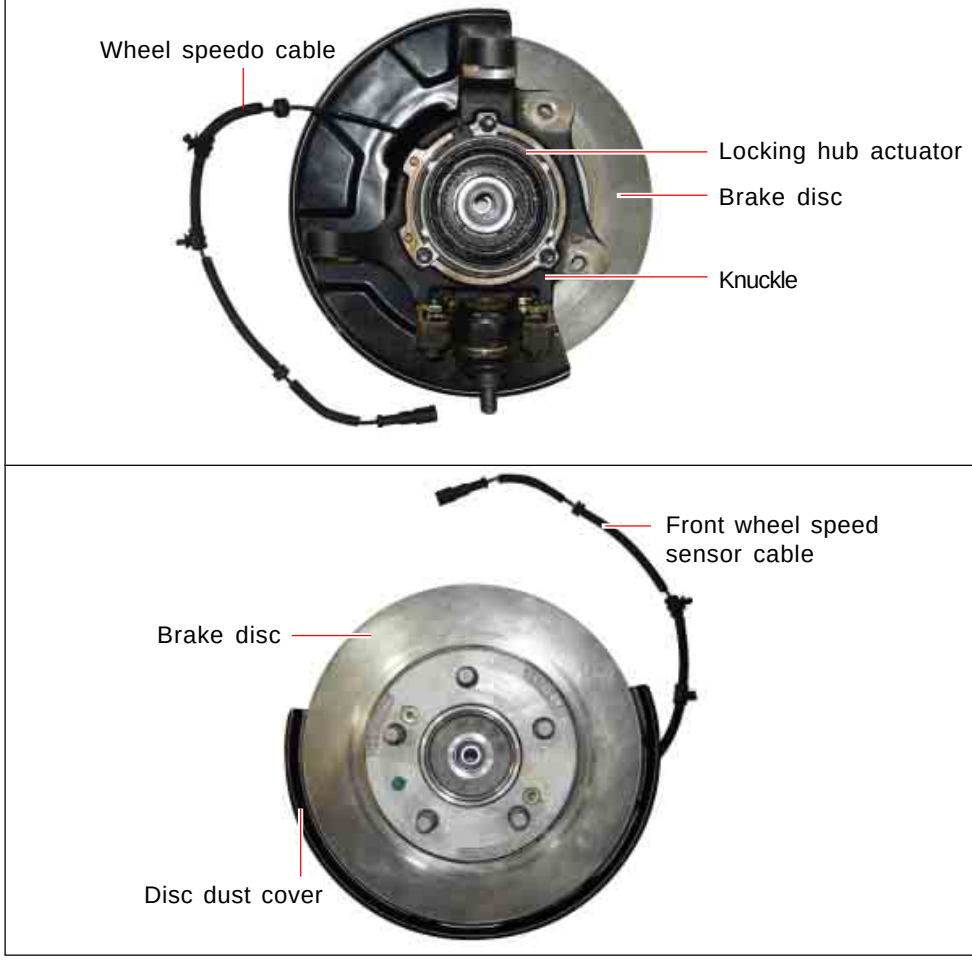
Sectional Diagram



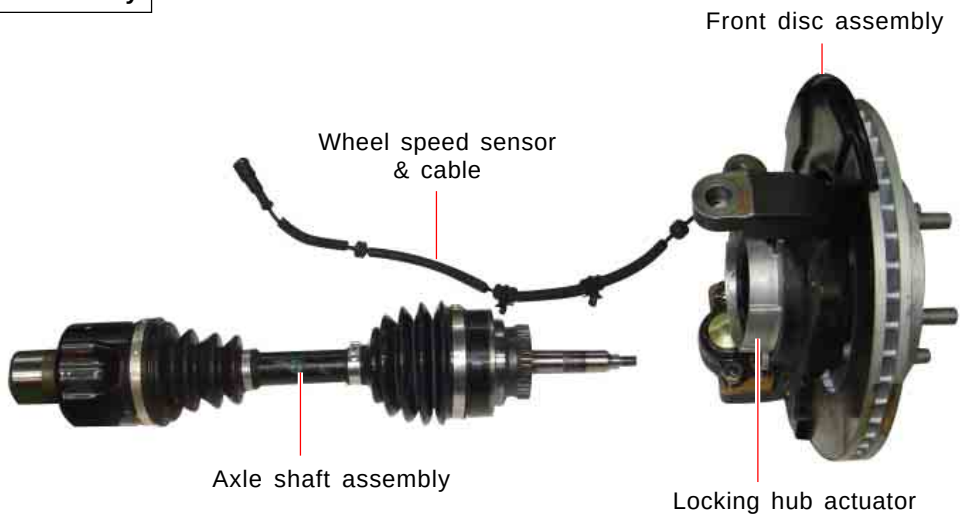
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FRONT AXLE ASSEMBLY

Front Disc & Wheel end Assembly

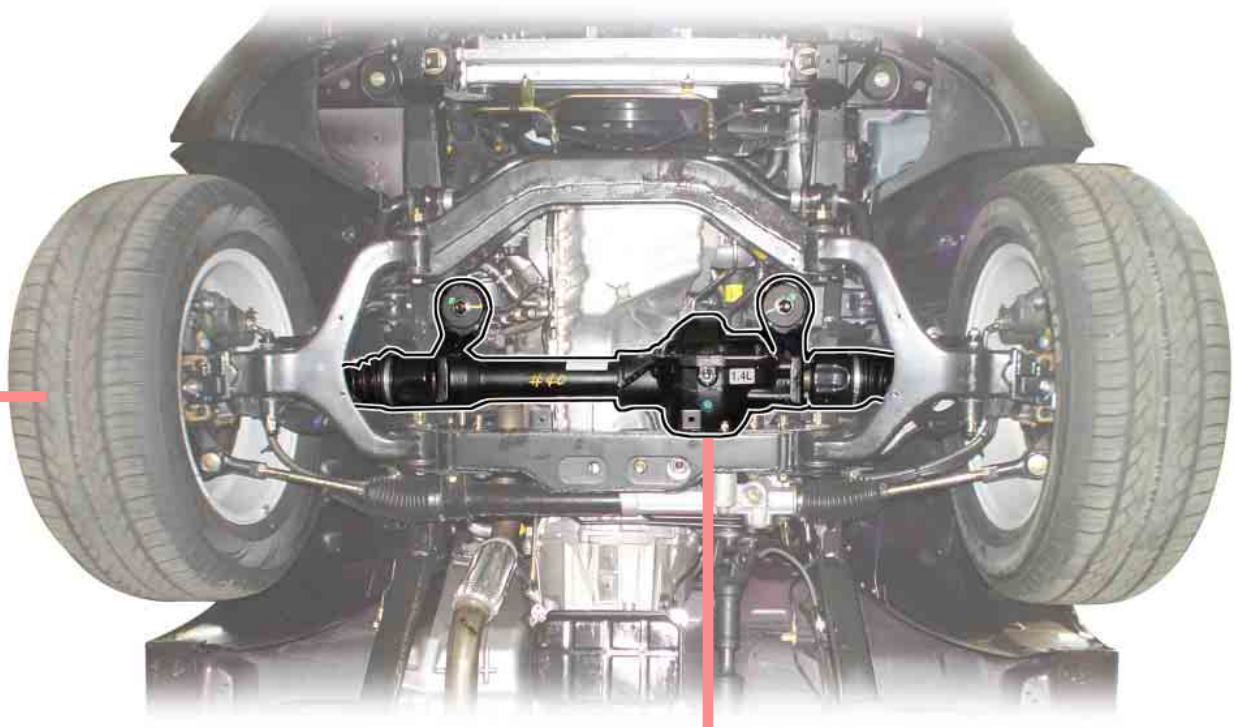


Axle Shaft Assembly

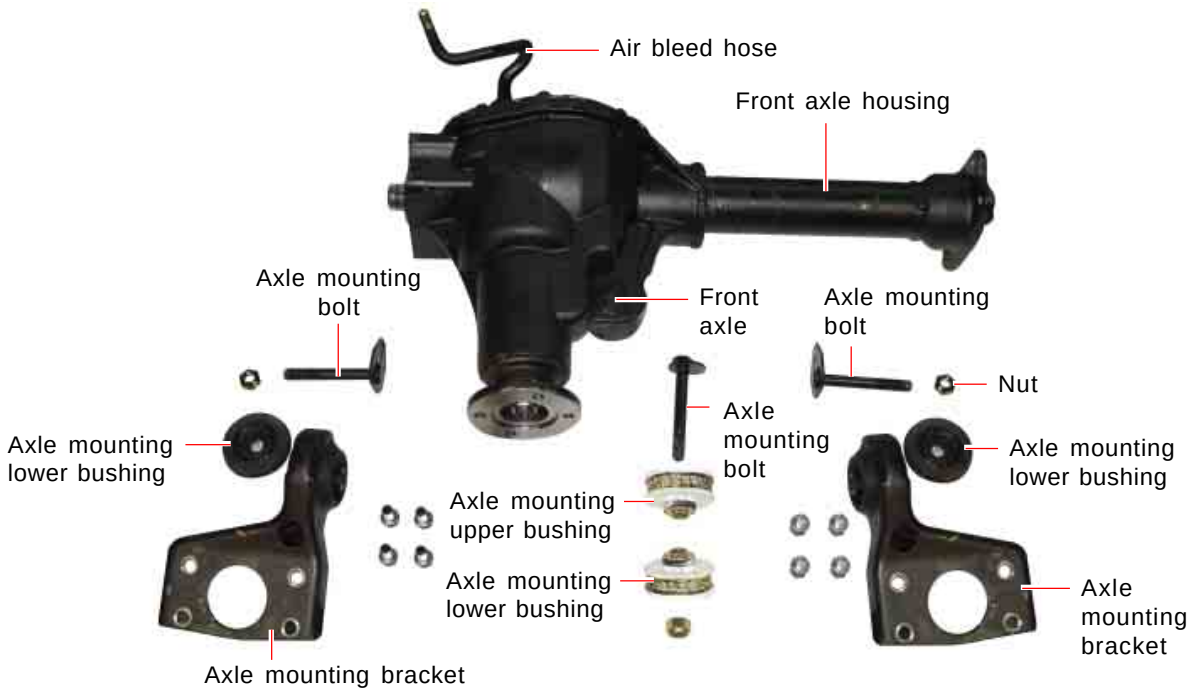


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Front Axle Housing Assembly



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REMOVAL AND INSTALLATION

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.

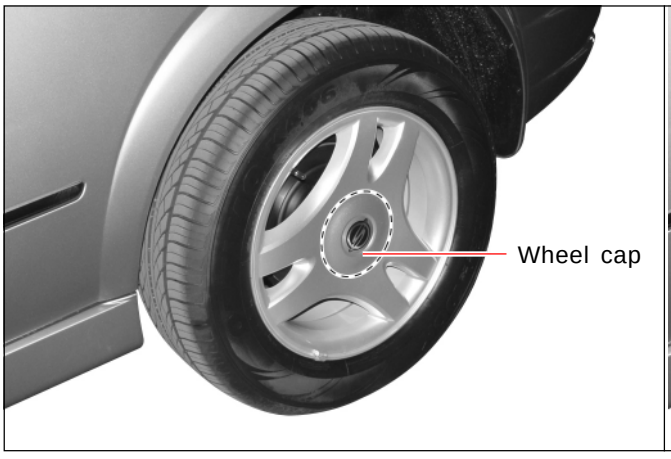


1. Removal of the front tire

Remove the front tire wheel caps. Unscrew five wheel nuts (21 mm) in diagonal direction and remove tires.

Installation Notice

Tightening torque	120 ~ 140 Nm



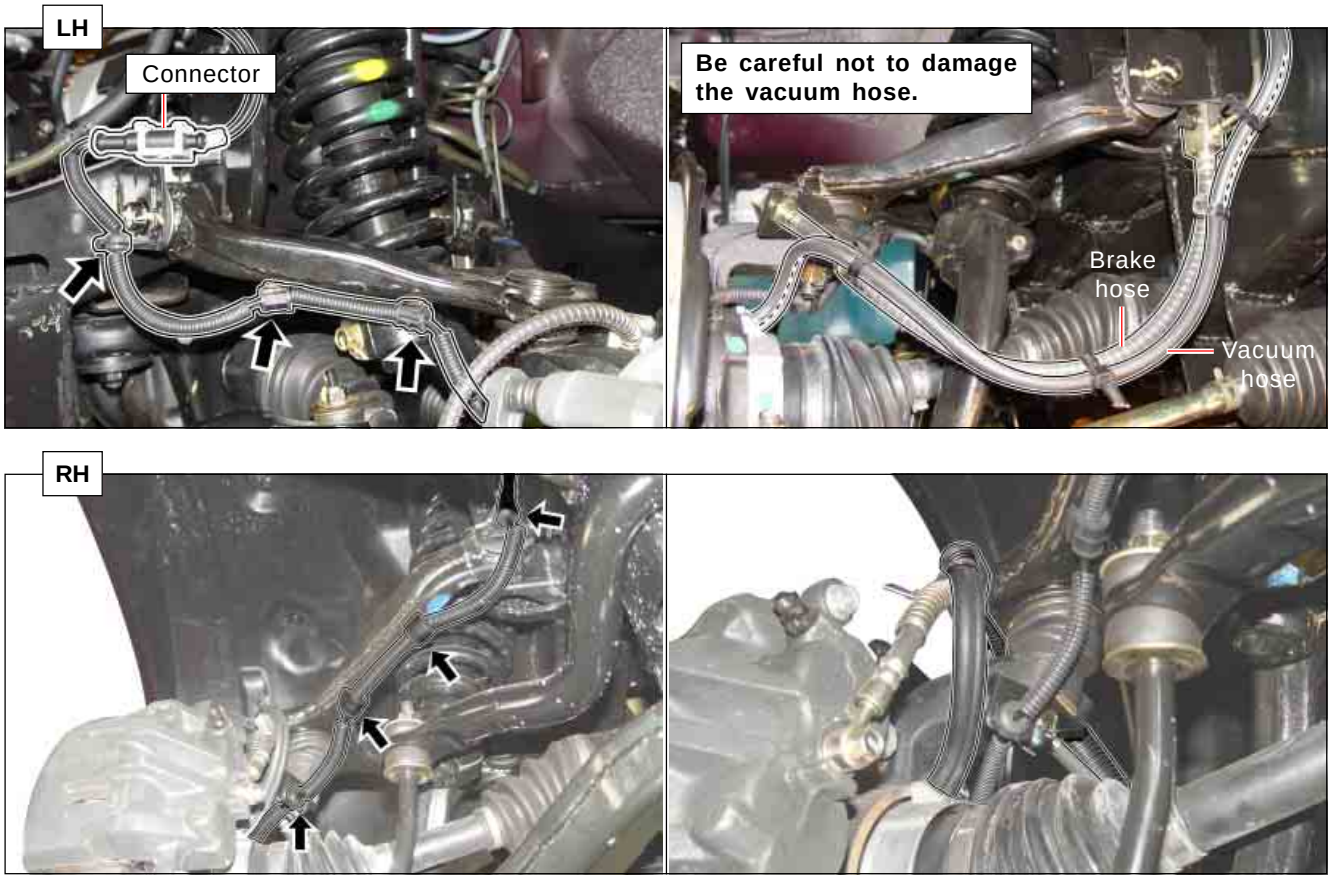


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2. Wheel speed sensor connector and vacuum hose

Disconnect the wheel speed sensor cable and connector, and disconnect the vacuum hose from the locking hub actuator.

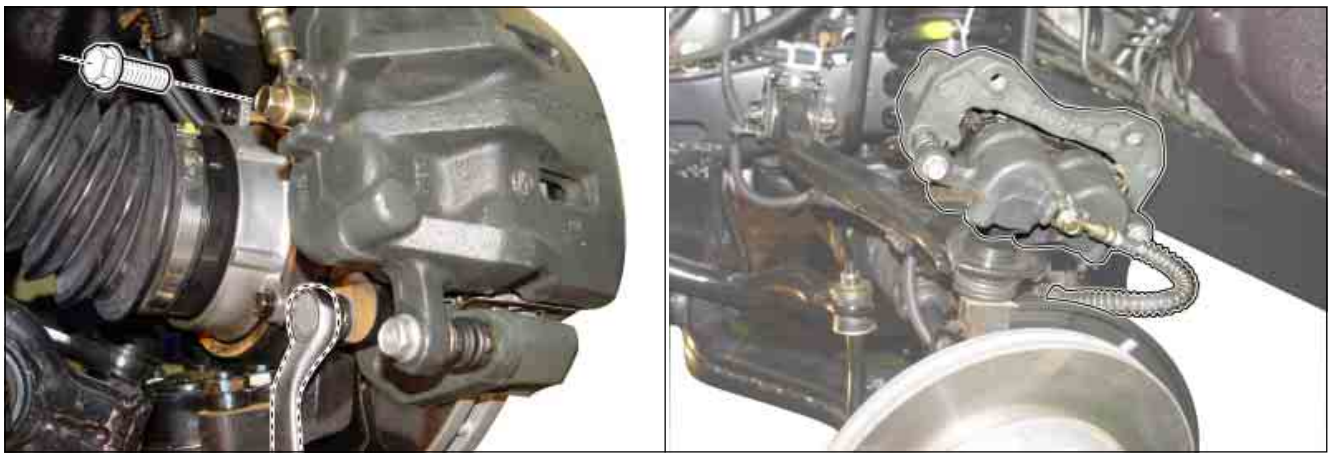


3. Brake disc caliper

Unscrew two mounting bolts (19 mm) and remove the brake disc caliper. Set the removed caliper on the vehicle frame.

Installation Notice

Tightening torque	85 ~ 105 Nm



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▶ Axle Shaft

Removal and Installation

1. Remove the hub bearing cap and unscrew the lock nut (14 mm) on the brake disc.

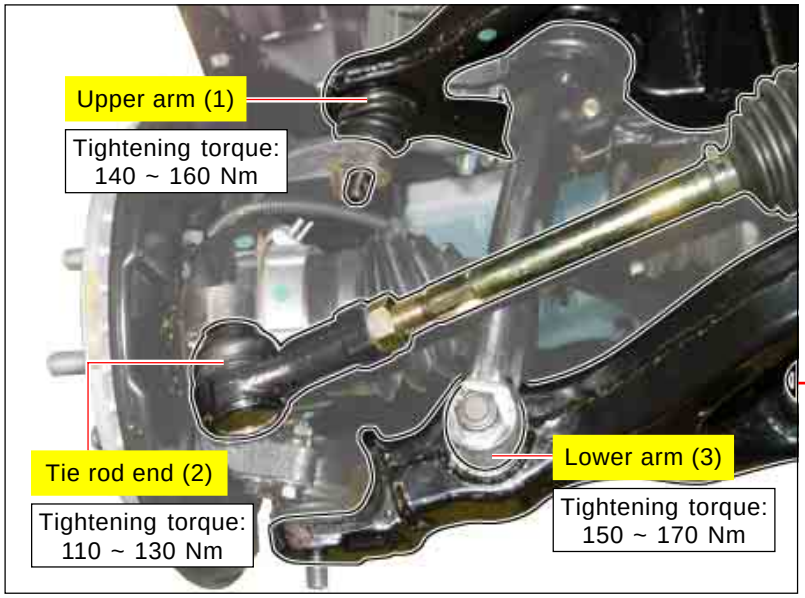




NOTICE

- **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.

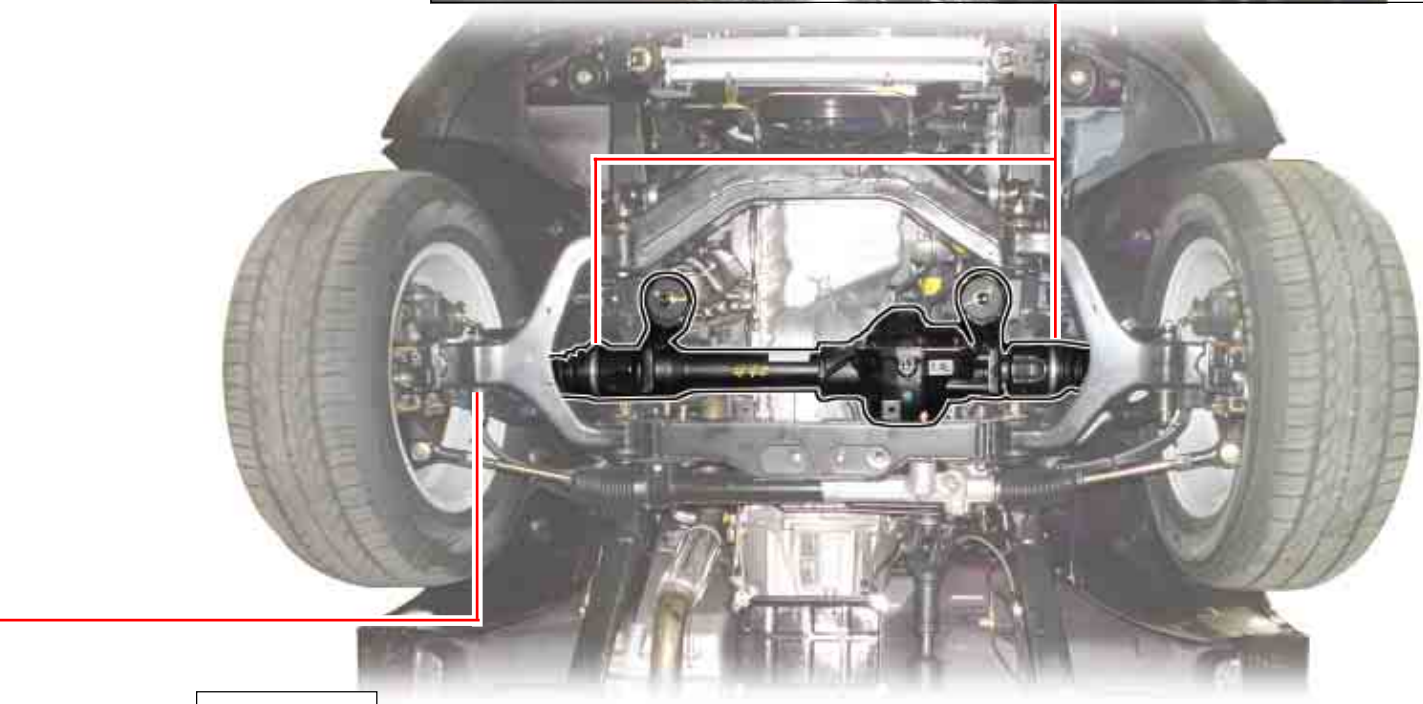


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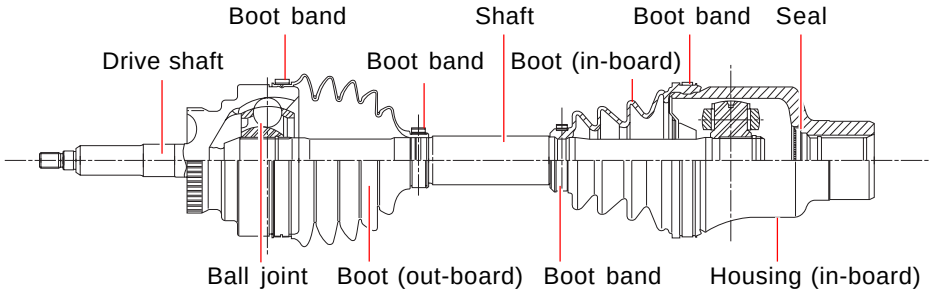
4. Remove the axle shaft.





Components





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▶ Axle Housing

1. Remove the axle shaft from the axle housing. Remove the propeller shaft and secure it to frame.



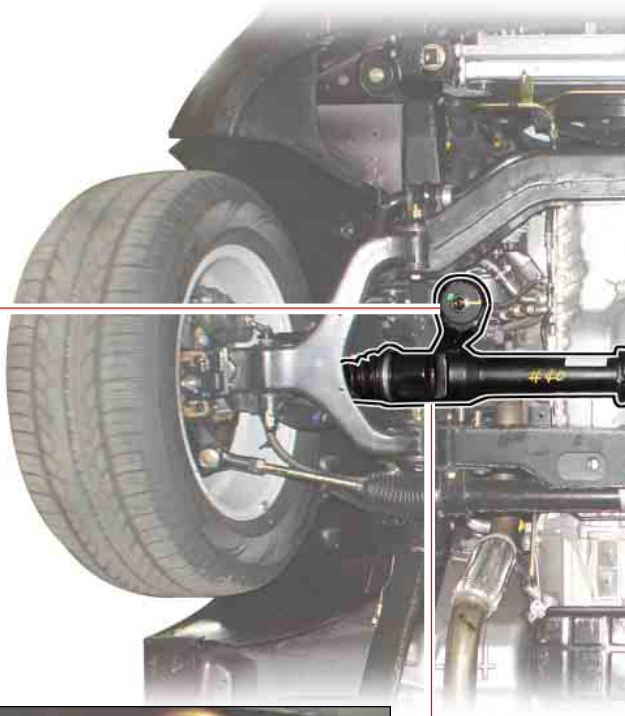
2. Removal of mounting bolt

Unscrew the mounting nut (22 mm) at right side 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



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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 the axle mounting bolts (22 mm).

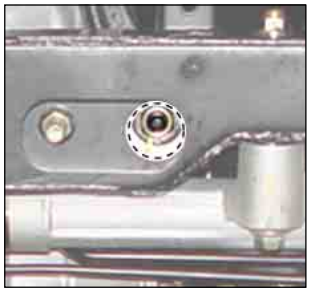
Installation Notice

Tightening torque	95 ~ 142 Nm



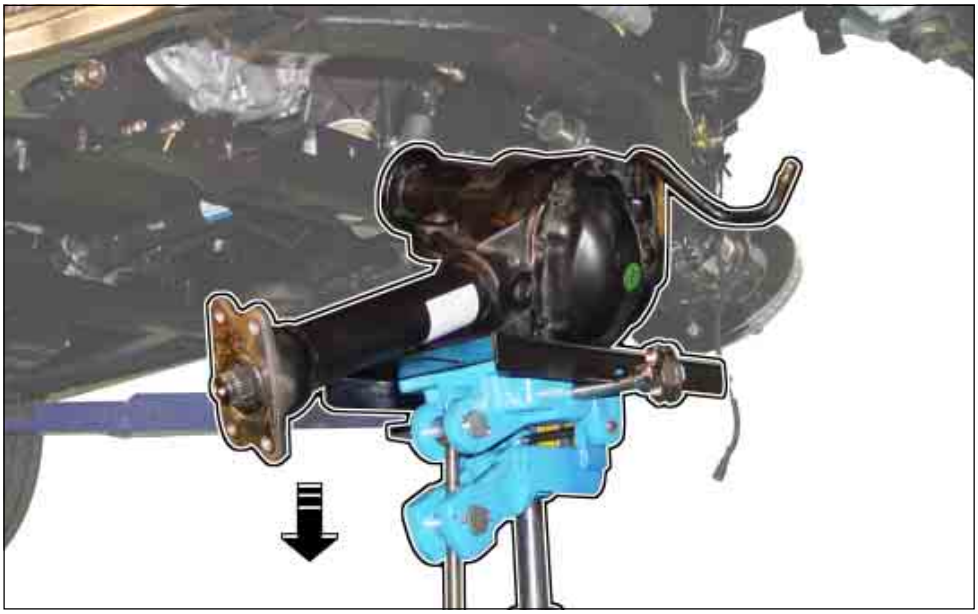






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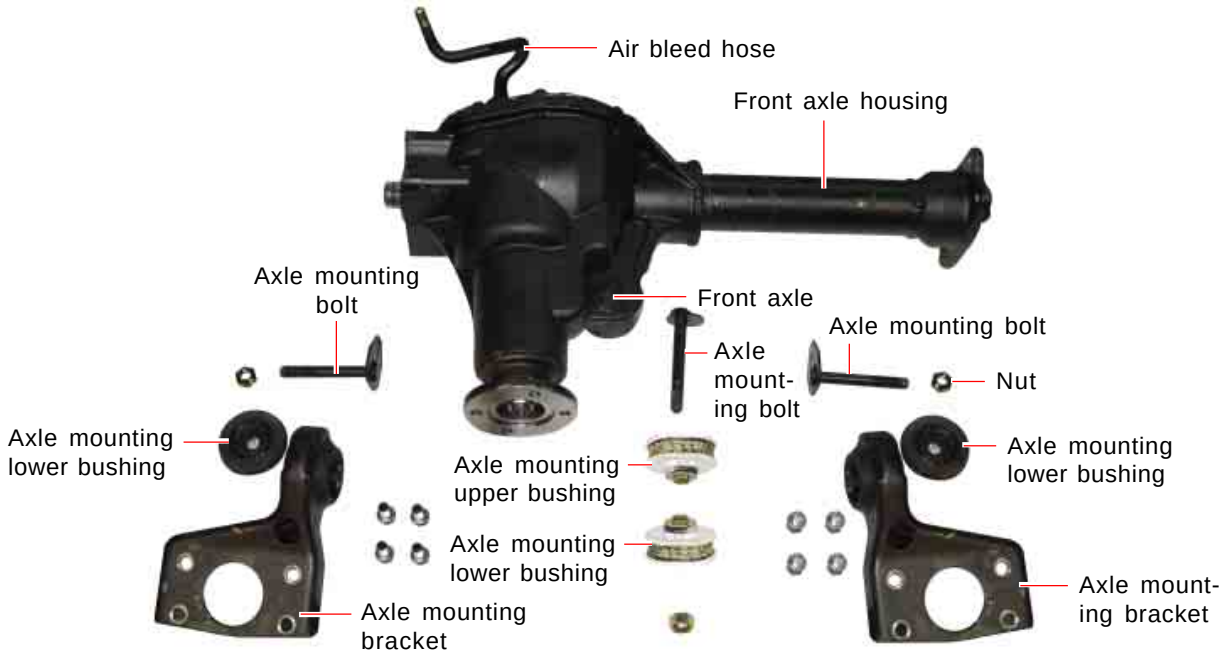
6. Remove the fixing clip on the air bleed hose above the axle housing and carefully lower the safety jack.



Axle Housing Assembly

NOTICE

- **Be careful not to damage the left and right seals in axle housing when removing the axle mounting bracket and axle assembly.**

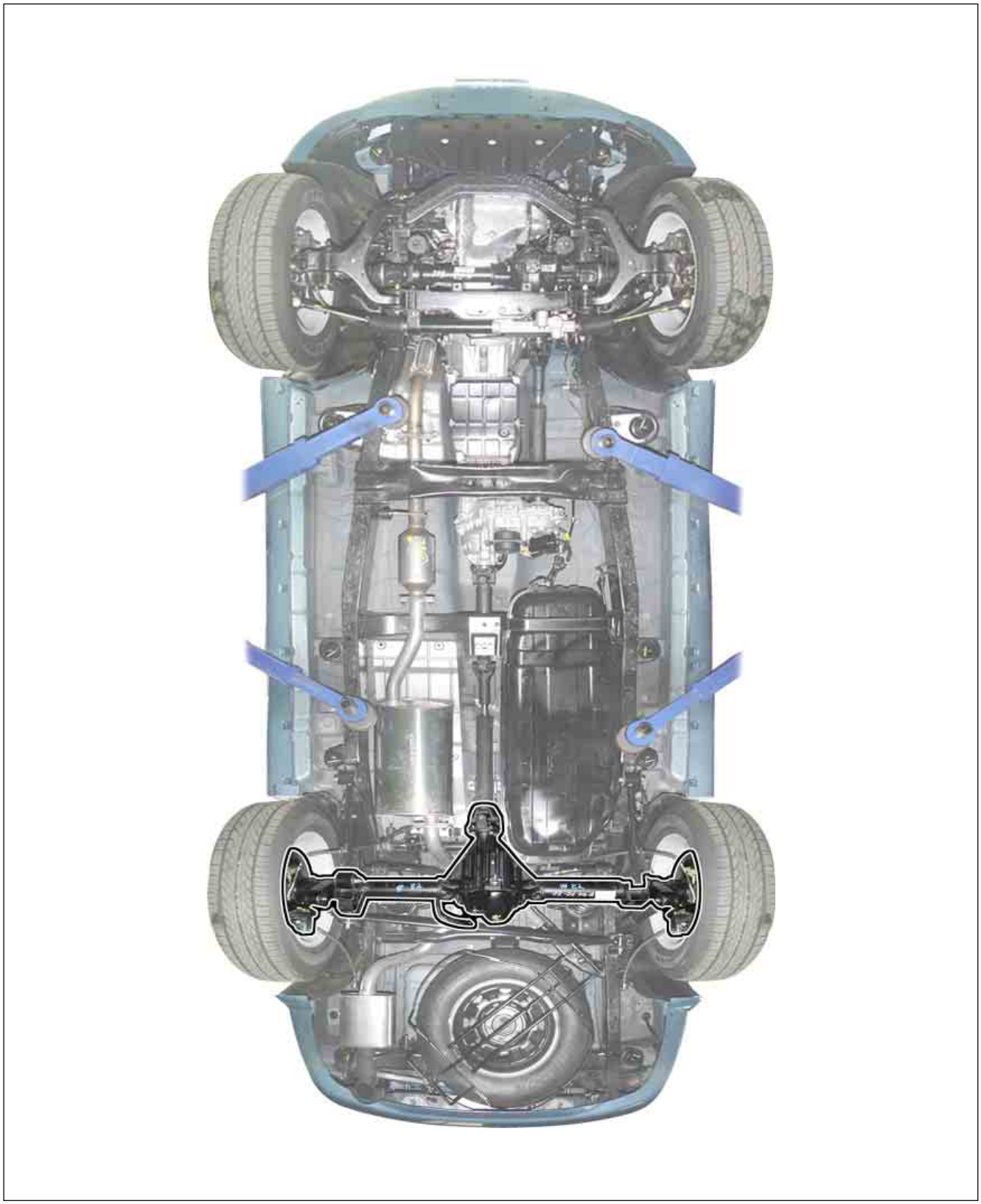


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5-LINK TYPE REAR AXLE

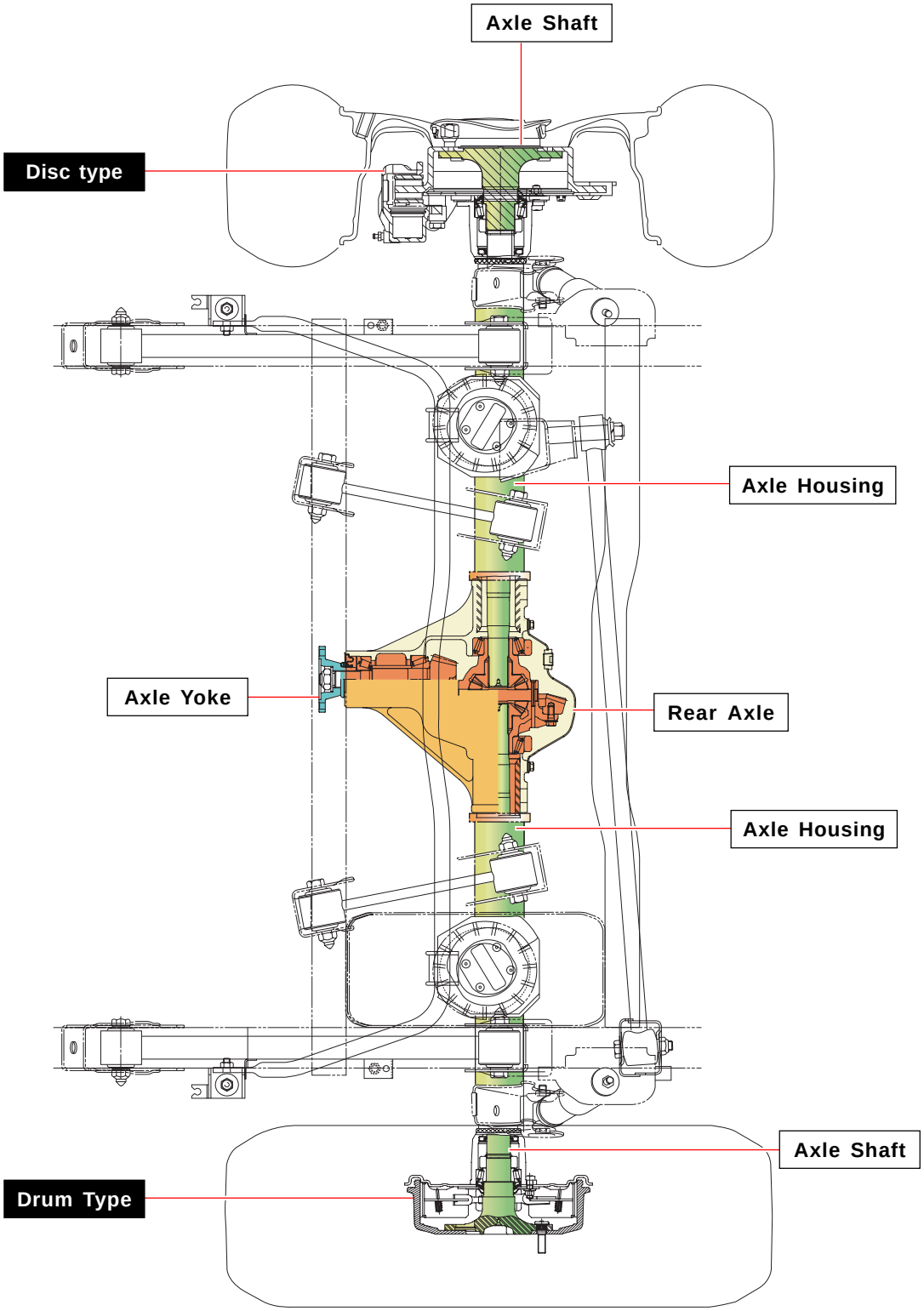
1. LOCATION



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Components



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▶ 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 (D20DT / D27DT)	4.27 / 3.91
	DI engine + A/T (D20DT / D27DT)	3.54 / 3.31
Oil	Capacity	1.9 L
	Specification	SAE 80W/90 or API GL-5

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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 brake disc caliper. Set the removed caliper on the vehicle frame.

Caliper mounting bolt	85 ~ 105 Nm





2. Unscrew the mounting bolt (10 mm) and disconnect the wheel speed sensor cable.

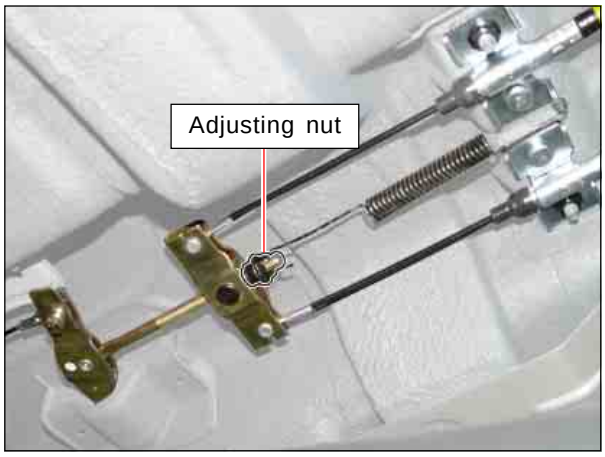
Installation Notice

Tightening torque	6 ~ 8 Nm

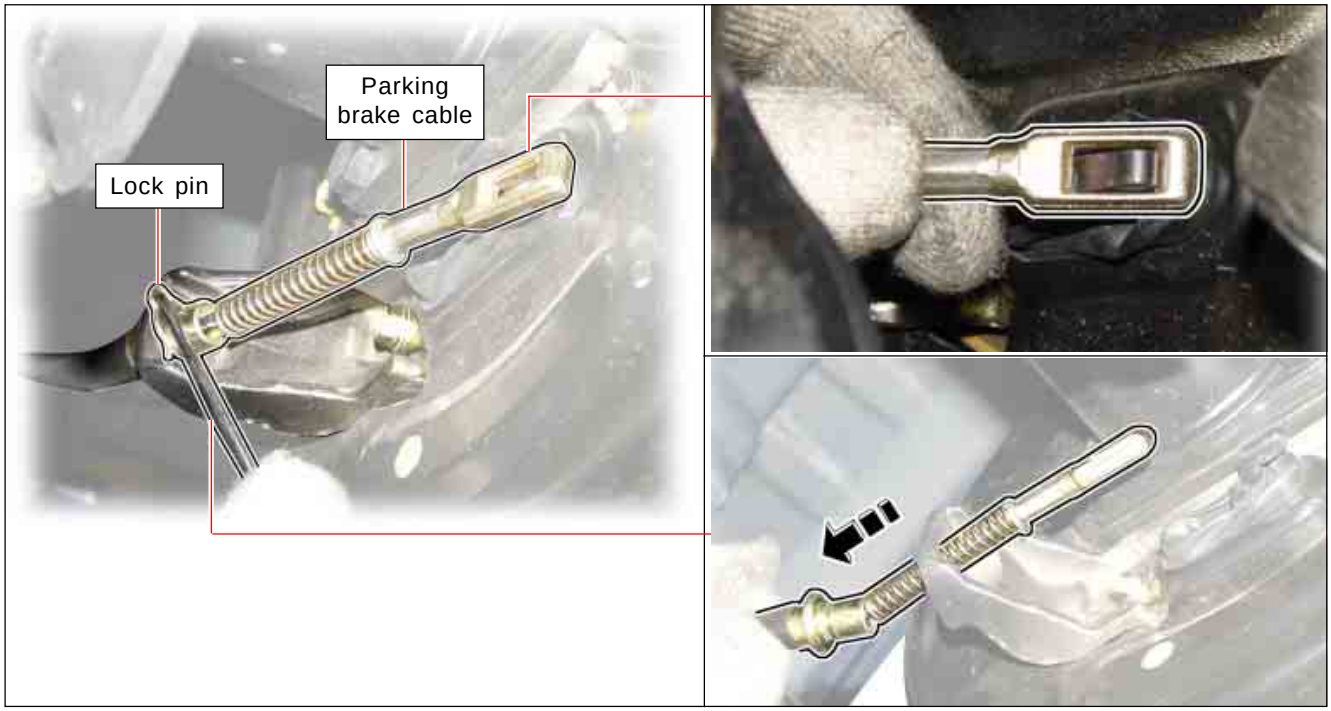


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3. Unscrew the adjusting nut of the parking brake cable equalizer to loosen the parking brake cable.



4. Remove the lock pin and disconnect the parking brake cable.



5. Remove the brake disc.



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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

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▶ Rear Axle Housing

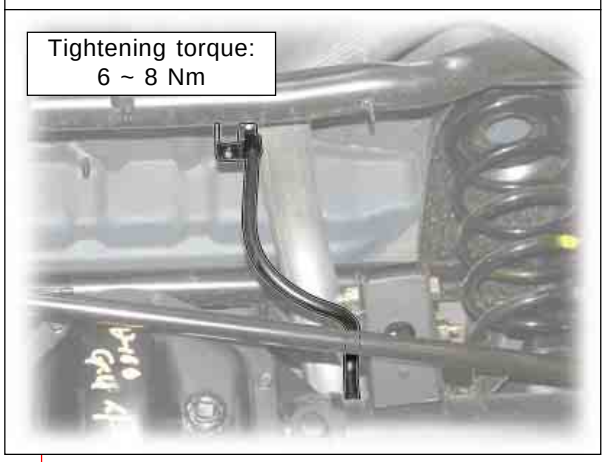
※ **Preceding Works:** Remove the tire.

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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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)

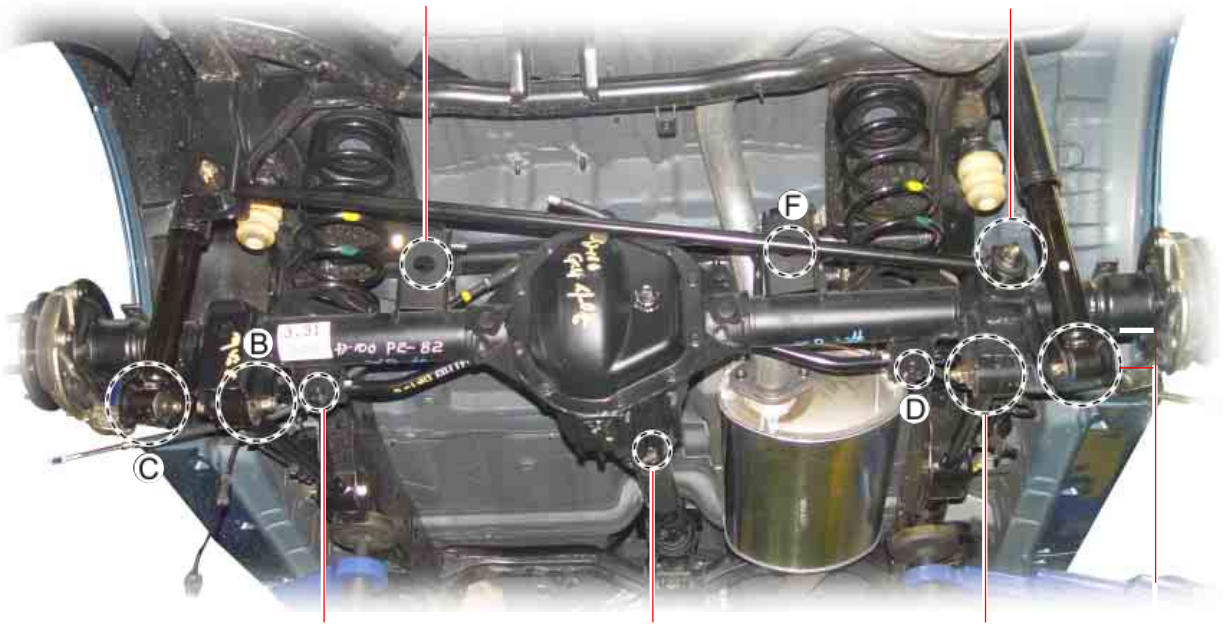


Tightening torque	150 ~ 180 Nm

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. Propeller shaft



Tightening torque	70 ~ 80 Nm

F. Upper arm bolt/nut (22 mm)



Tightening torque	150 ~ 180 Nm

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3. Carefully lower the safety axle to remove the rear axle assembly from the vehicle frame.

Front View



Rear View



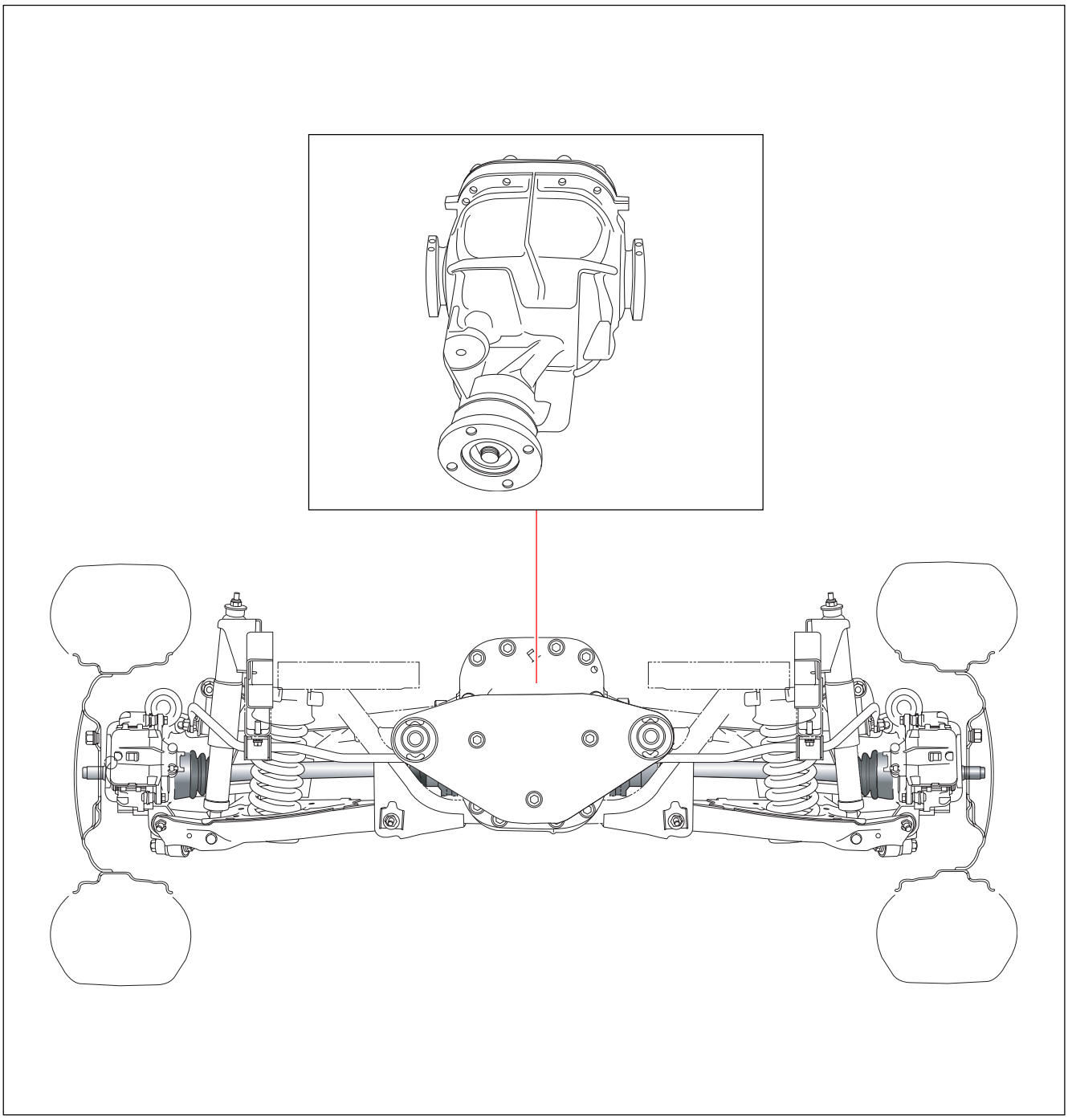
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INDEPENDENT SUSPENSION TYPE REAR AXLE

1. OVERVIEW

▶ Introduction

Compared to previous models, in addition to existing 5-link suspension, the IRDA (Independent Rear Drive Axle) is adopted for the independent type suspension in this vehicle.



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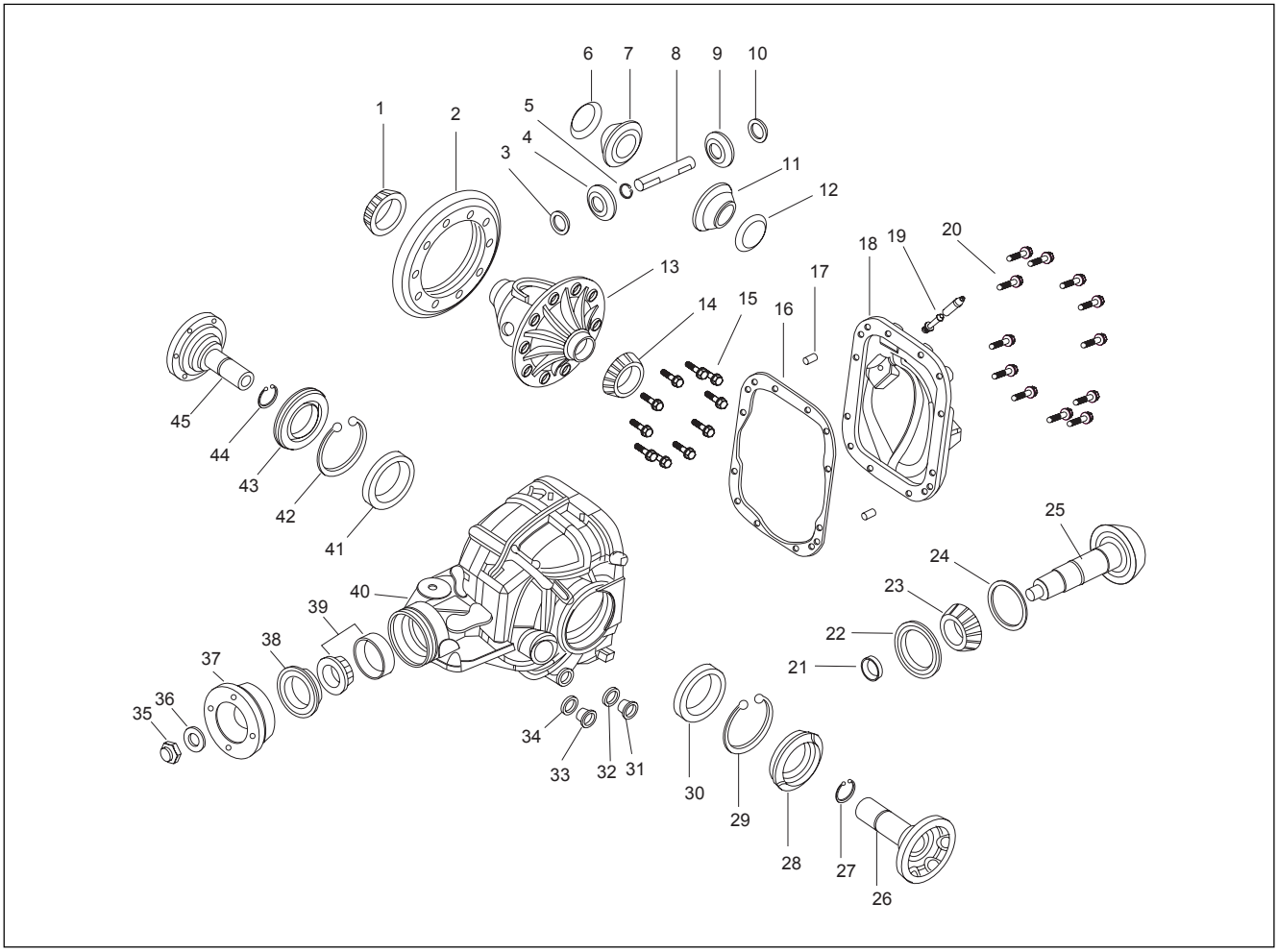
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Specifications

Description		Rear axle	
Type		Independent suspension	5-link
Torque		5,164 Nm	-
Gear ratio	M/T	4.27 / 3.91 (D20DT / D27DT)	←
	A/T	3.54 / 3.31 (D20DT / D27DT)	
Gear	Type	Hypoid	←
	Size	218 mm (diameter)	ϕ 243.8 mm
	Offset	Less than 30 mm	-
Housing		Aluminum die casting	Steel casting (steel, aluminum cover)
Oil	Specification	SAE 75W/90 (Synthetic)	SAE 80W/90
	Capacity	1.5 L	1.9 L
Length		412 mm	469.0 mm
Width		292 mm	1717.7 mm
Weight		30 kg	100 kg

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2. EXPLODED VIEW

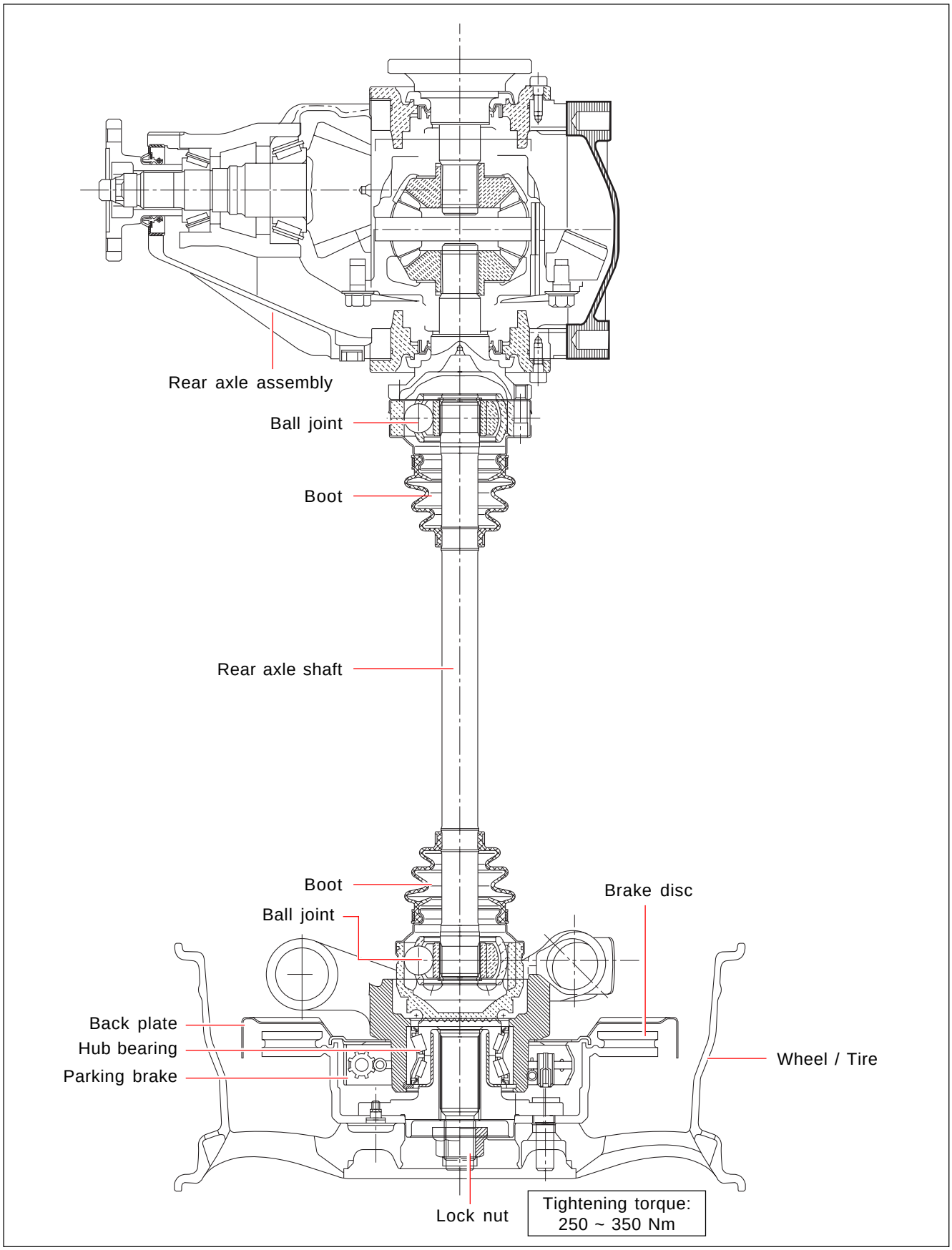


1. Differential case side bearing assembly
2. Ring gear
3. Differential pinion thrust washer
4. Differential pinion gear
5. Cross shaft snap ring
6. Differential side gear thrust washer
7. Differential side gear
8. Differential case cross shaft
9. Differential gear
10. Differential thrust washer
11. Differential side gear
12. Differential side gear thrust washer
13. Differential case
14. Differential case side bearing assembly
15. Ring gear bolt
16. Cover fan gasket
17. Dowel pin
18. Cover fan
19. Vent connector
20. Cover fan bolt
21. Dowel pin
22. Pinion spacer
23. Pinion head bearing assembly
24. Pinion shim
25. Pinion gear
26. Output shaft
27. Output shaft snap ring
28. Shaft seal assembly
29. Differential case side bearing snap ring
30. Differential bearing race
31. Drain plug
32. Drain plug washer
33. Fill plug
34. Fill plug washer
35. Pinion flange nut
36. Pinion flange washer
37. Pinion flange assembly
38. Pinion seal assembly
39. Pinion tail bearing assembly
40. Carrier housing
41. Differential bearing assembly
42. Differential case side bearing snap ring
43. Shaft seal assembly
44. Output shaft snap ring
45. Output shaft

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▶ Sectional Drawing

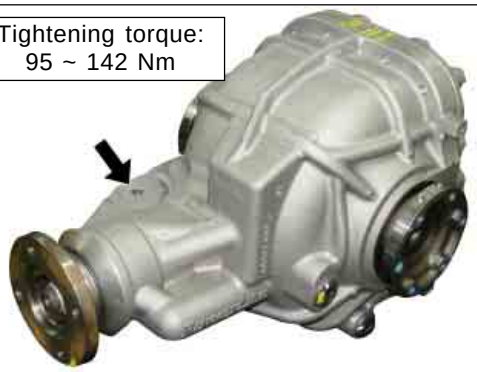


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3. IRDA (INDEPENDENT REAR DRIVE AXLE)

IRDA Axle Mounting Bolt (30 mm - 1 EA)

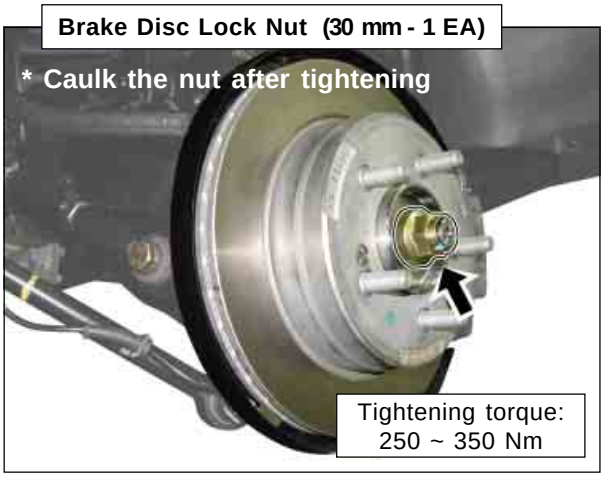
Tightening torque:
95 ~ 142 Nm





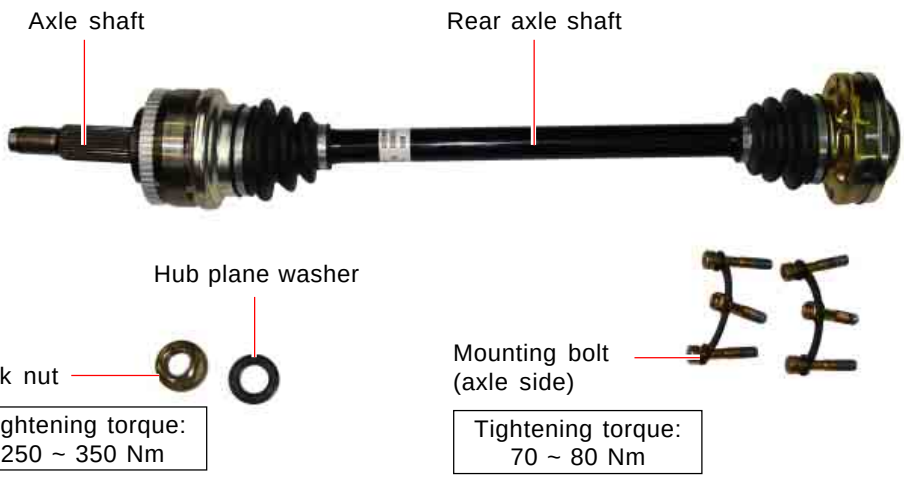
Brake Disc Lock Nut (30 mm - 1 EA)

* Caulk the nut after tightening



Tightening torque:
250 ~ 350 Nm

Axle Shaft Assembly

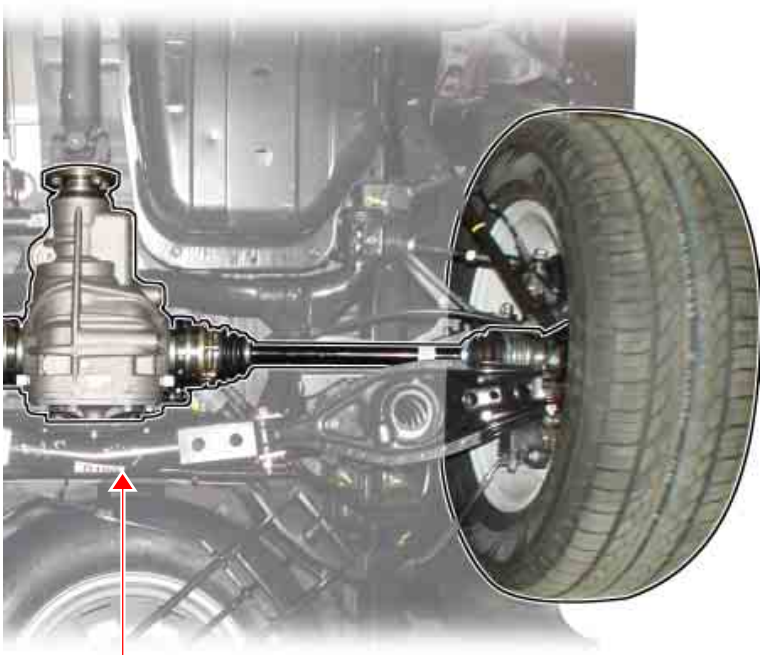


Tightening torque:
250 ~ 350 Nm

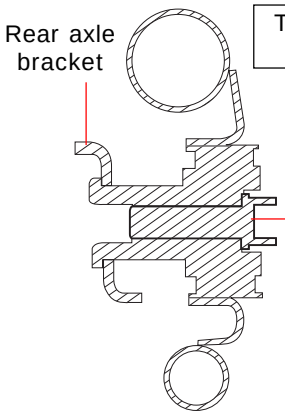
Tightening torque:
70 ~ 80 Nm

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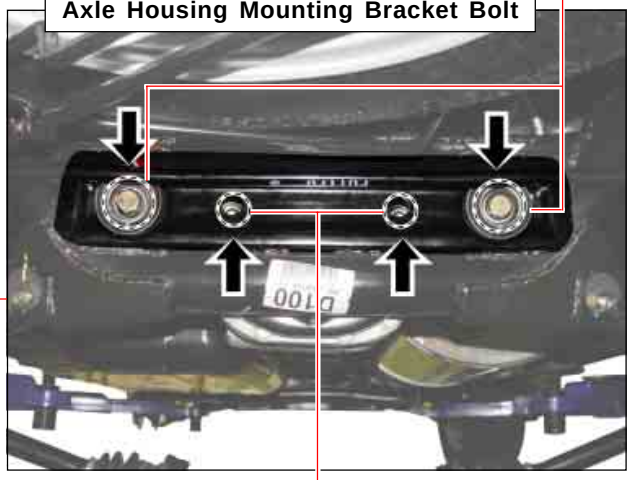
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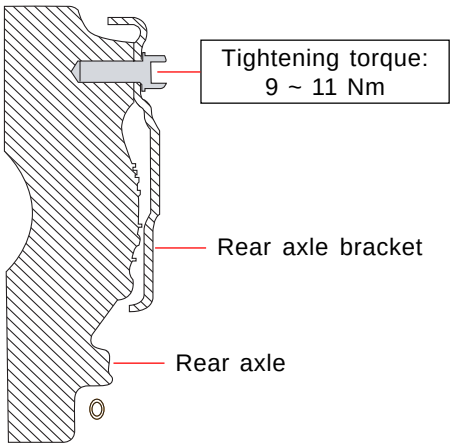
Axle Housing Bracket Mounting Bolt



Axle Housing Mounting Bracket Bolt



Axle Housing Mounting Bolt

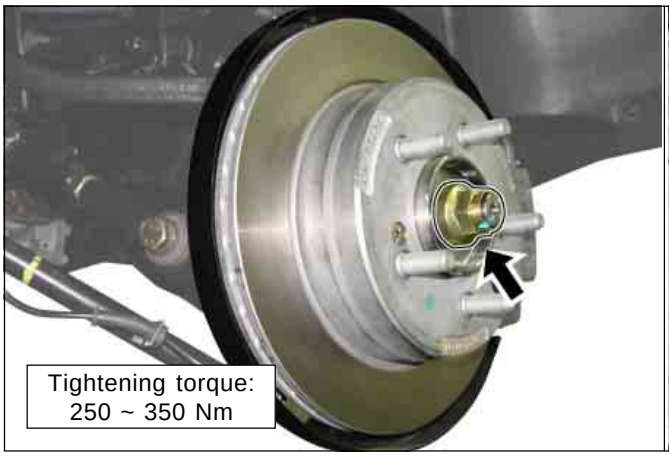


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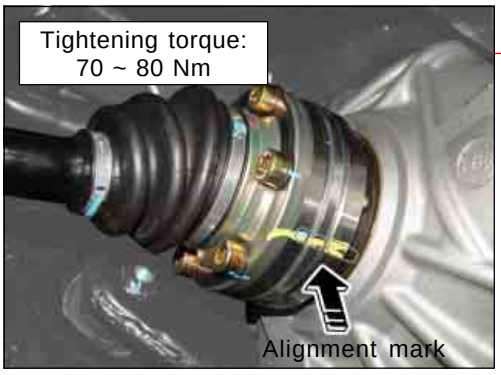
4. REMOVAL AND INSTALLATION

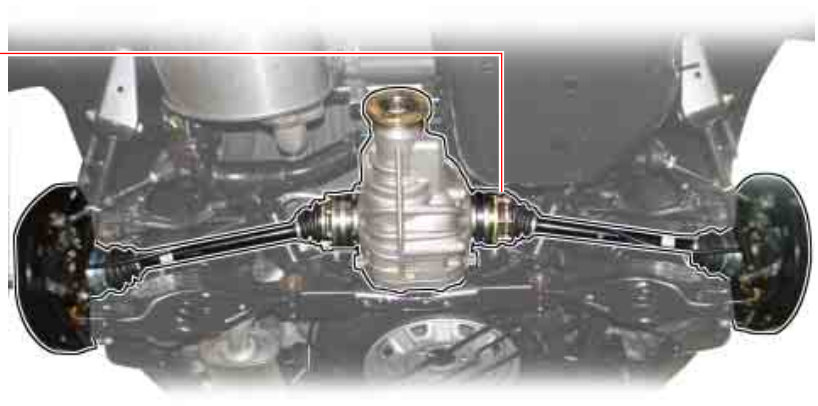
1. Loosen the locked positions and remove the lock nut (24 mm).





2. Make an alignment mark on the flanges of the axle shaft and the axle housing. Unscrew the six bolts (Torx 10 mm) and remove the axle shaft while lowering the axle shaft flange.







① Lower the axle shaft.
② Remove the axle shaft.

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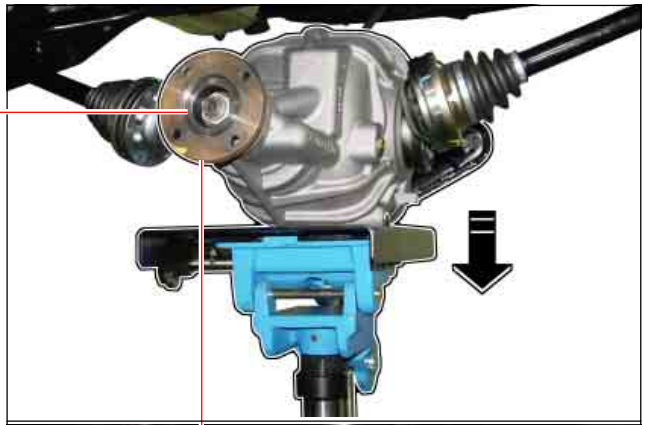
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3. Unscrew the two axle housing mounting bolts (22 mm).



4. Unscrew the mounting bolt (30 mm) and carefully lower the safety jack with axle housing assembly.





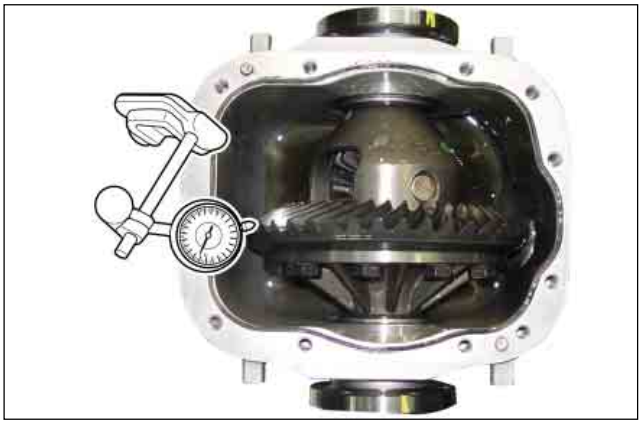




Backlash Check

Measure the backlash between the drive pinion and ring gear.

Specified value	0.15 ~ 0.20 mm



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5. TROUBLE DIAGNOSIS

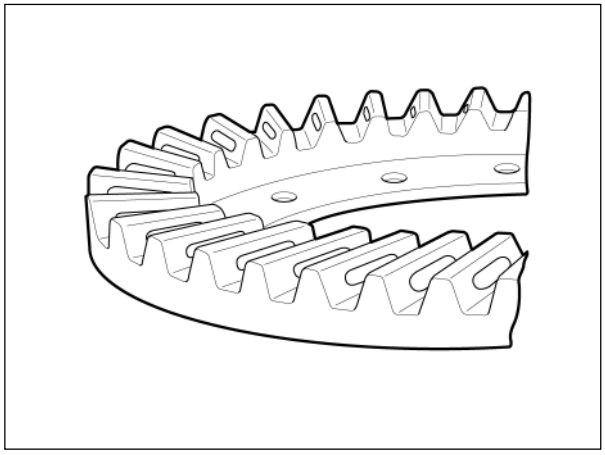
Symptom	Cause	Action
Noise (during driving straight ahead)	Lack of oil	Replenish
	Low viscosity of oil	Replace
	Inferior oil	Replace
	Excessive backlash of ring gears	Adjust
	Worn or damaged tooth of ring and pinion gear	Replace
	Worn or damaged drive pinion bearing	Replace
	Wear of side bearing and side gear spline	Replace
	Bending of axle housing	Replace
	Distortion of differential case	Replace
	Wear of pinion shaft	Replace
	Incorrect drive pinion preload	Adjust
	Incorrect contact of ring gear and pinion	Reassembly
Oil leakage	Excessive oil	Adjust
	Fault seal of carrier contact surface	Correct
	Axle housing crack	Replace
	Worn or damaged oil seal	Replace
Noise (during turning)	Worn or damaged tooth of pinion or side gear	Replace
	Wear of 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
	Axle housing crack	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
Heating	Lack of oil	Replenish
	Insufficient backlash of gears	Adjust
	Excessive preload of bearing	Adjust

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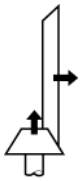
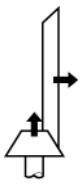
Inspection of Ring Gear Tooth Contact Pattern

1. Normal contact

   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 occurred	Adjust backlash (Decrease backlash) • Select proper shin 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 (Increase 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 occurred	Adjust backlash (Increase pinion shim) • 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 occurred	Adjust backlash (Decrease pinion shim) • Move the ring gear toward the drive pinion (toward the ring gear center line)  B

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SUSPENSION

4411 / 4510 / 4520

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

5-LINK (RIGID TYPE) REAR SUSPENSION 19

1. Overview 19
2. System layout 20
3. Trouble diagnosis 25
4. Removal and installation 26

IRS TYPE REAR SUSPENSION 32

1. Overview 32
2. Specifications 34
3. Trouble diagnosis 34
4. Removal and installation 36

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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. Component

   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



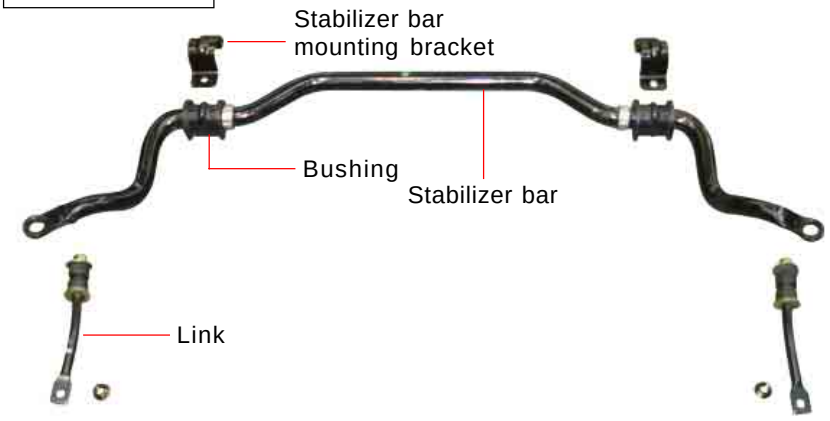
The lower arm is mounted to the knuckle and the shock absorber. It relieves the load delivered from the tire to the knuckle. This enables to absorb the various impacts according to the load shapes and to ensure the drivability.

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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

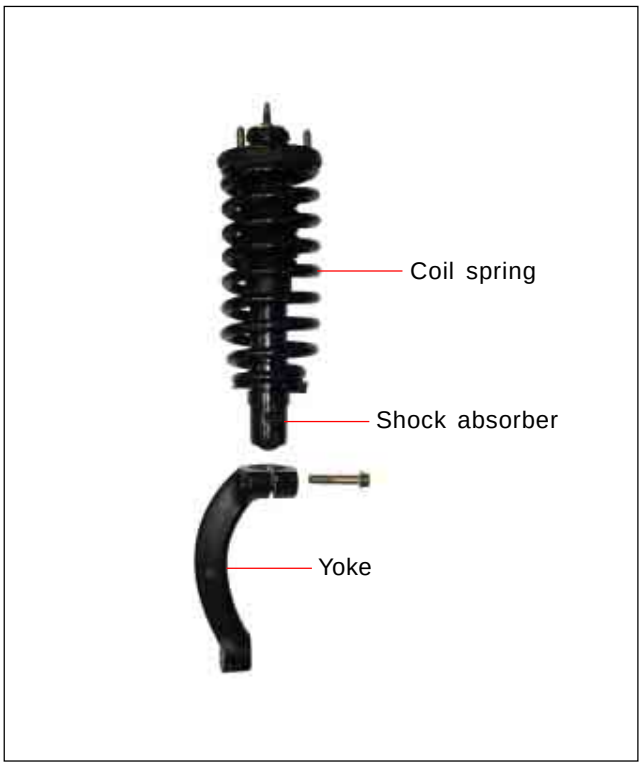


A section of spring steel rod is wound in a spiral pattern or shape coil provides a cushion to absorb road imperfections and returns the vehicle to a predetermined ride height. It is amajor contributor to a vehicle's handling balance and ride quality. Higher spring rates and shorter overall lengths are commonly used to lower the vehicle's ride height for enhanced appearance and improved handling.

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Shock Absorber Assembly

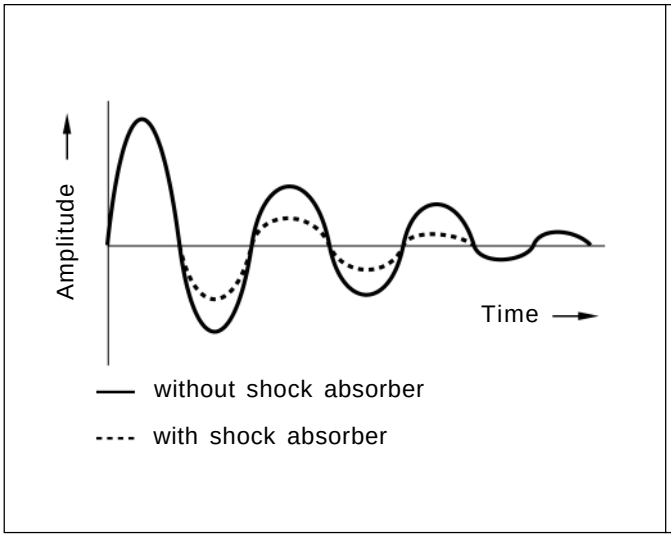
1. This vehicle uses the strut type shock absorber. This shock absorber is connected to the piston rod in the strut. This relieves the vertical vibrations of vehicle to provide ride comforts, prevents the spring break, enhances drivability, and extends the life span of steering components.

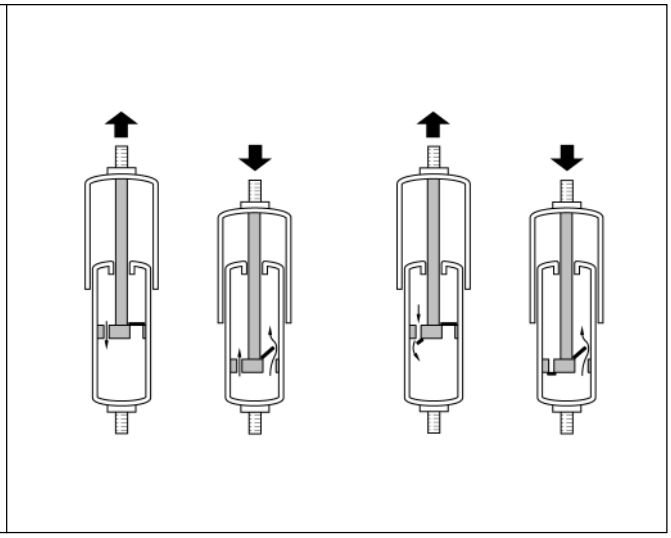


2. The telescopic shock absorber consists of a tube with piston and rod, and a cylinder tube. The piston has an orifice and valve and the cylinder is filled with oil.

   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.

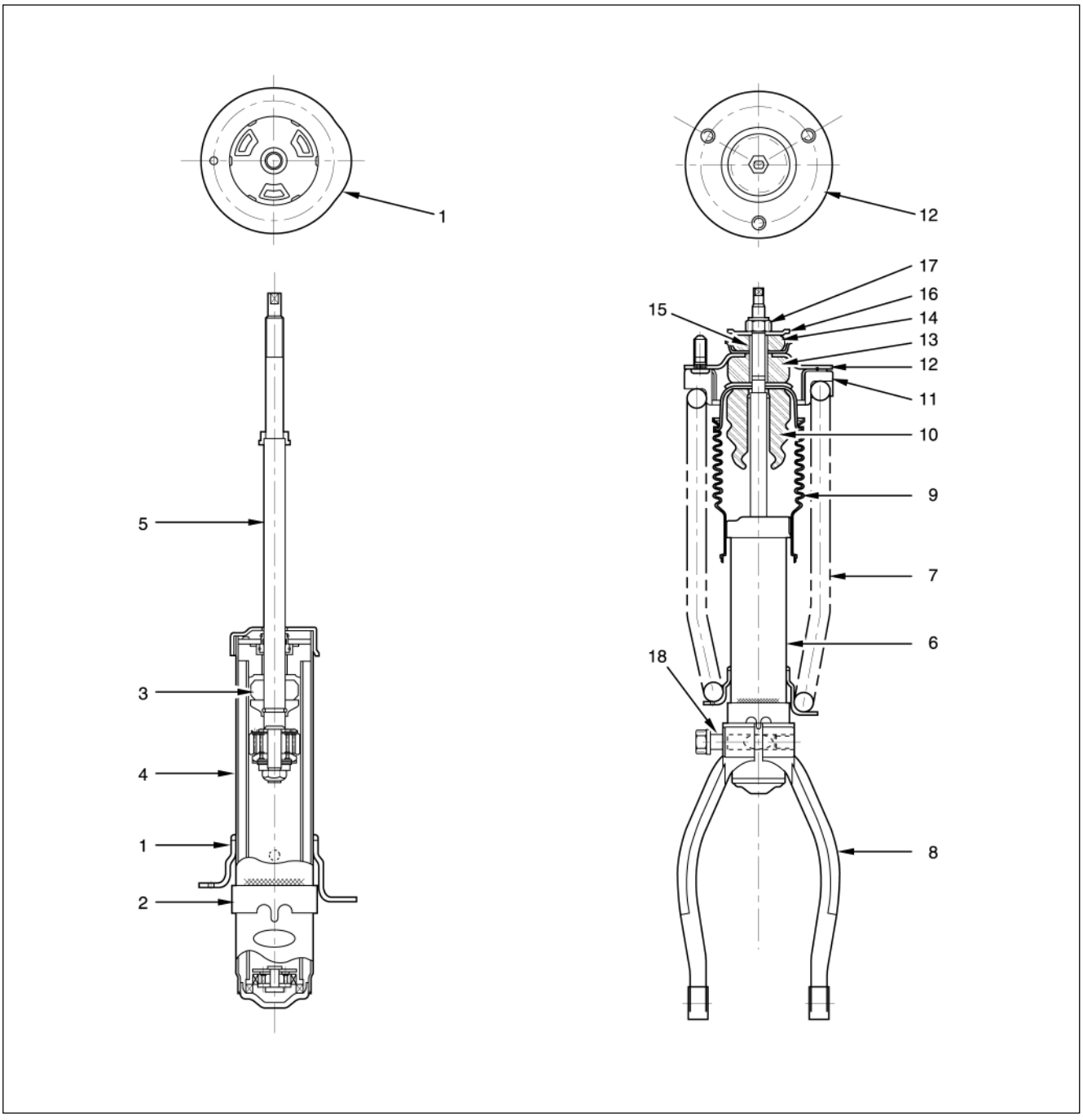




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▶ Sectional Drawing of Shock Absorber



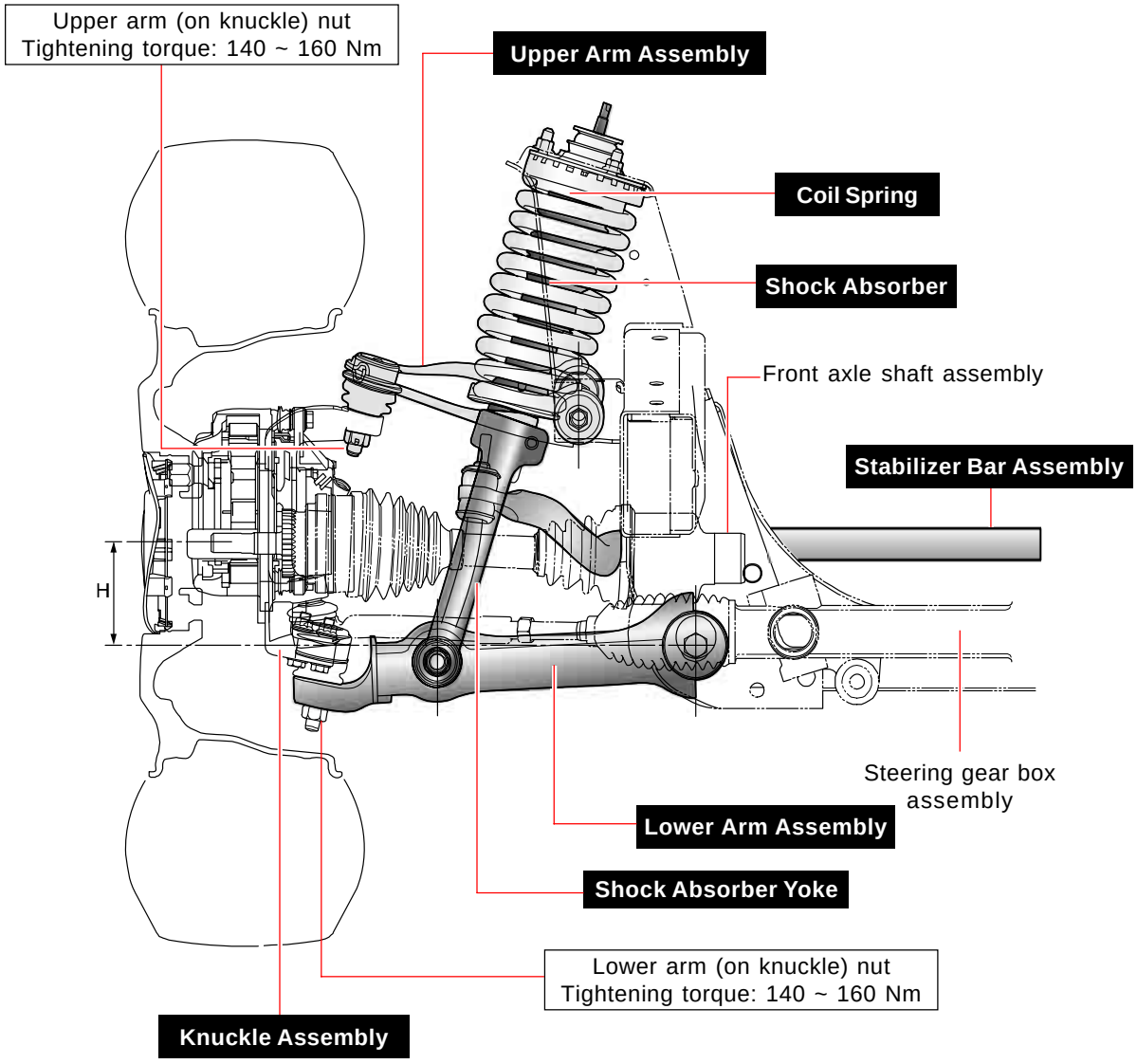
1. Lower spring seat
2. Yoke bracket
3. Rebound stopper
4. Cylinder
5. Piston
6. Shock absorber assembly
7. Spring
8. Yoke
9. Boot
10. Bumper stopper
11. Spring seat rubber
12. Upper spring seat
13. Rubber
14. Rubber
15. Spacer
16. Washer
17. Nut
18. Bolt

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2. SYSTEM LAYOUT

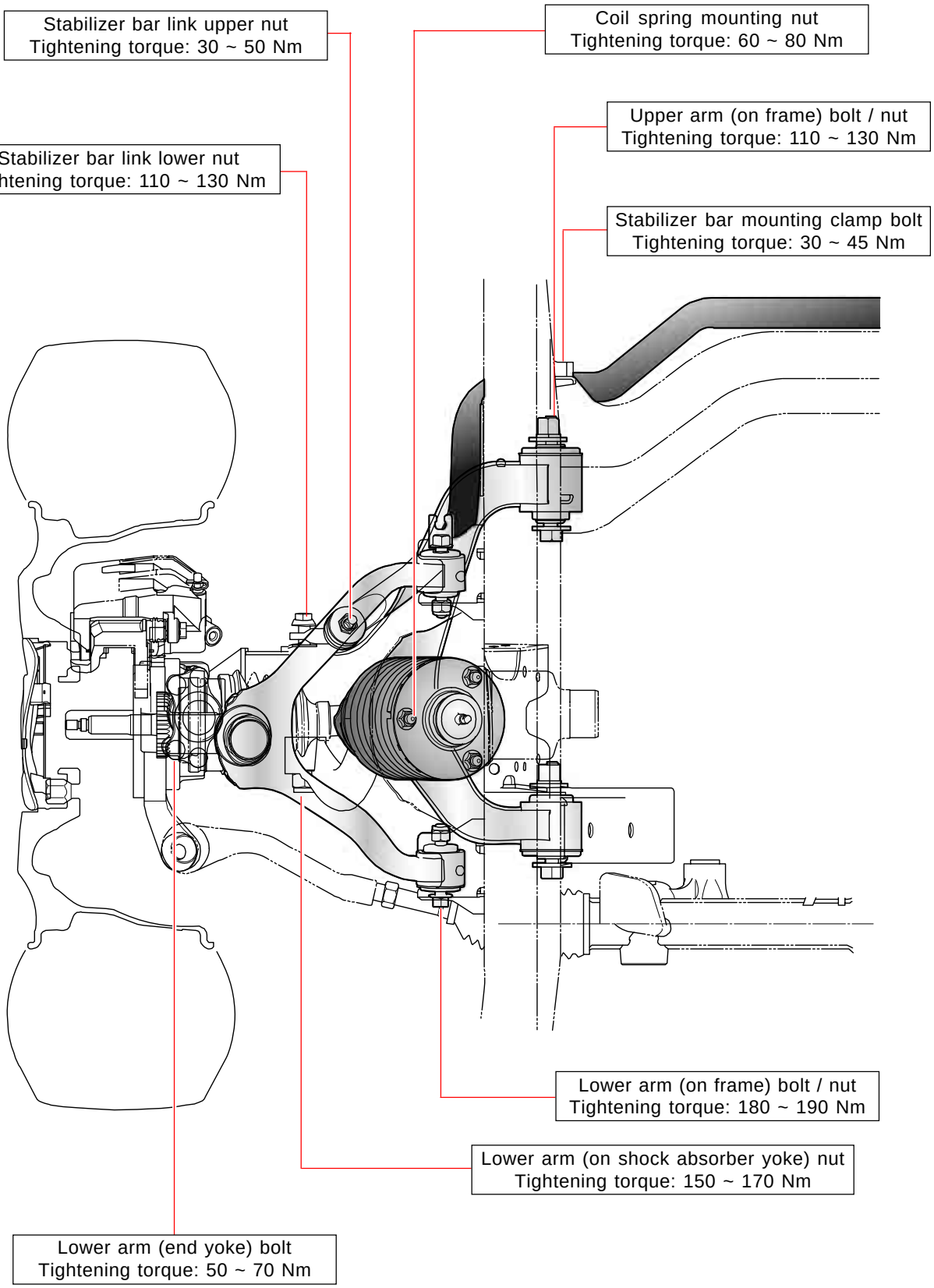
Specifications

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
	Camber	-0.19° ± 0.3° (the difference between both ends is should be below 30′)
	Caster	4.4° ± 0.5° (the difference between both ends is should be below 30′)
Height “H”		96.5 ± 5 mm



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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



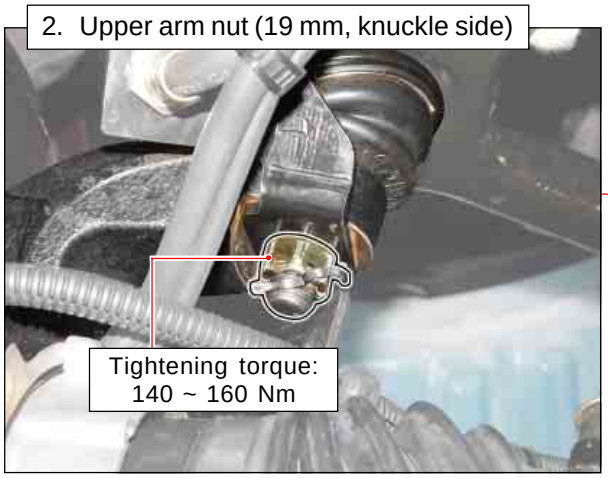
1. Wheel speed sensor cable



: Remove the wheel speed sensor cable and the connector from the upper arm.



2. Upper arm nut (19 mm, knuckle side)



: Remove the split pin first and then remove the mounting nut.

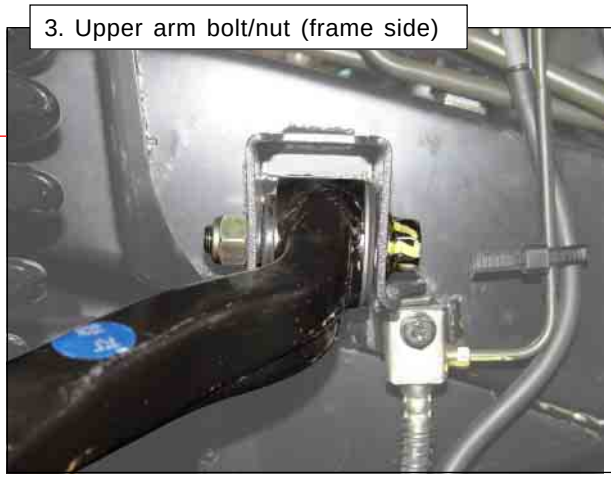
NOTICE

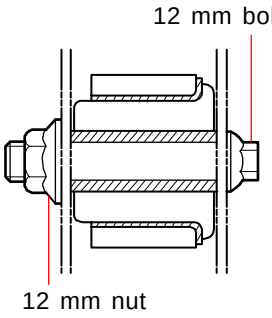
- **Replace the split pin with a new one when installing.**

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3. Upper arm bolt/nut (frame side)





Tightening torque:
110 ~ 130 Nm

: Remove the upper arm mounting bolts and nuts (LH/RH).

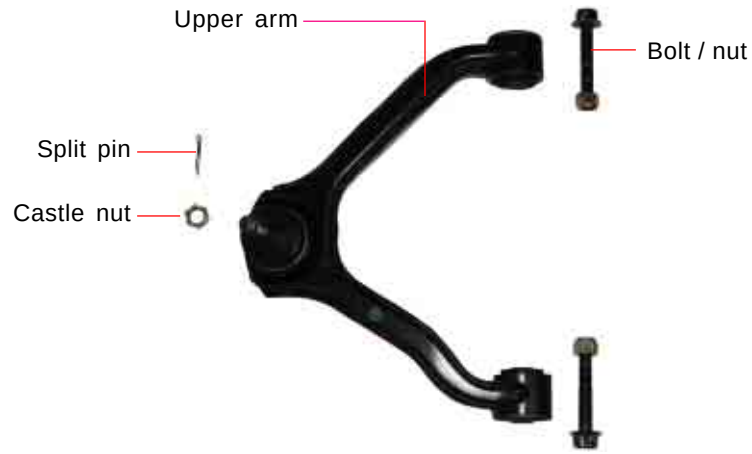


4. Upper arm



: Separate the upper arm from the frame first, and then separate it from the knuckle with a special tool.

Upper Arm Assembly



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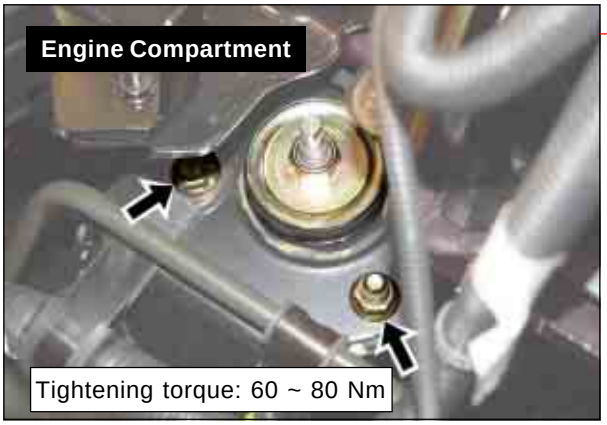
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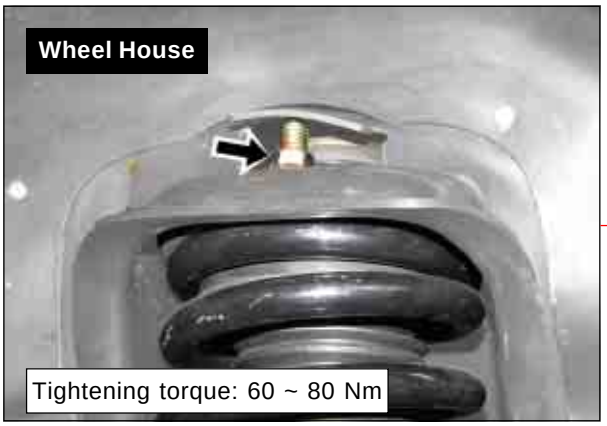
4. COIL SPRING & SHOCK ABSORBER ASSEMBLY

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.



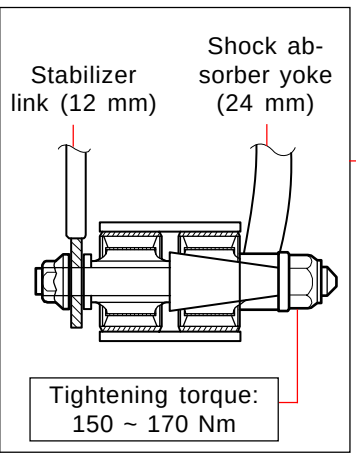


: Unscrew the upper mounting nut (14 mm) under the wheel house.



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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3. Remove the coil spring/shock absorber.





Coil Spring Assembly



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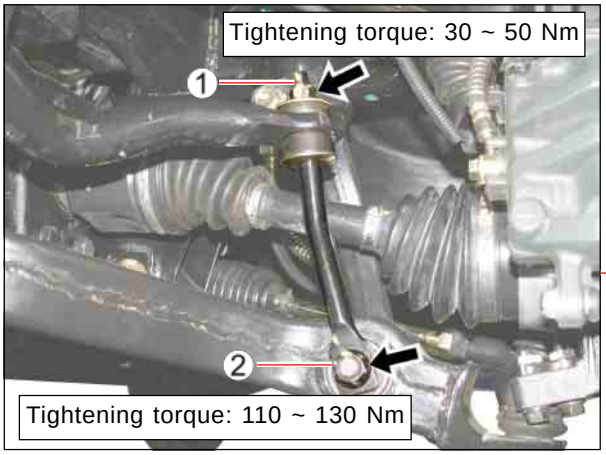
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5. STABILIZER BAR

Preceding Work

Remove the tires.

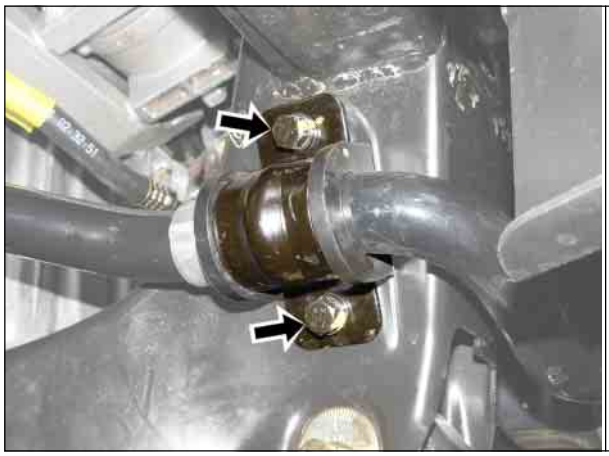
1. Remove the stabilizer bar link.

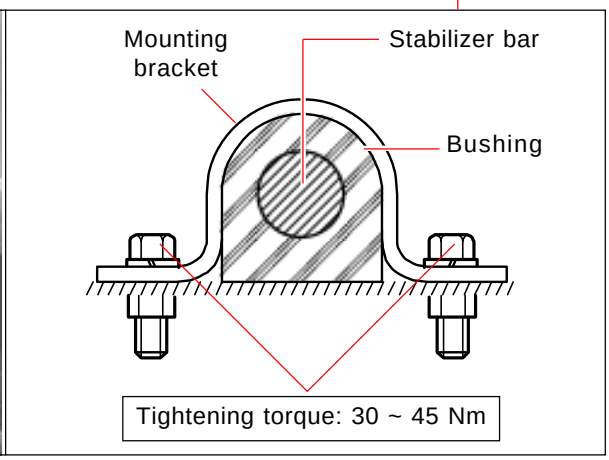




: Unscrew the lower mounting nut (12 mm) and upper mounting nut (10 mm) to remove the stabilizer bar link assembly.

2. Unscrew the two bracket mounting bolts (14 mm) and remove the stabilizer bar assembly.



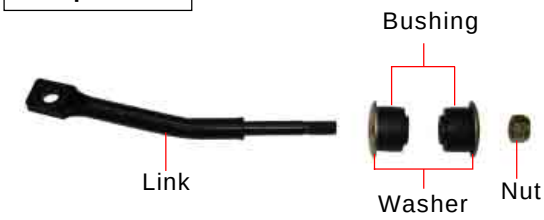


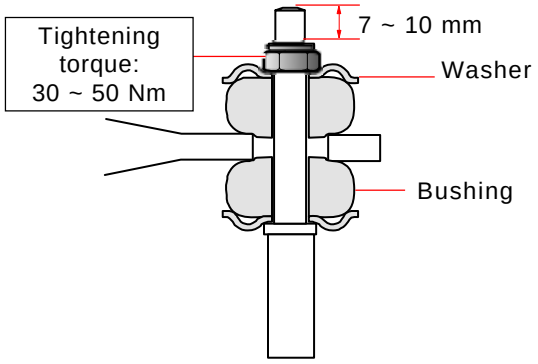
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Components

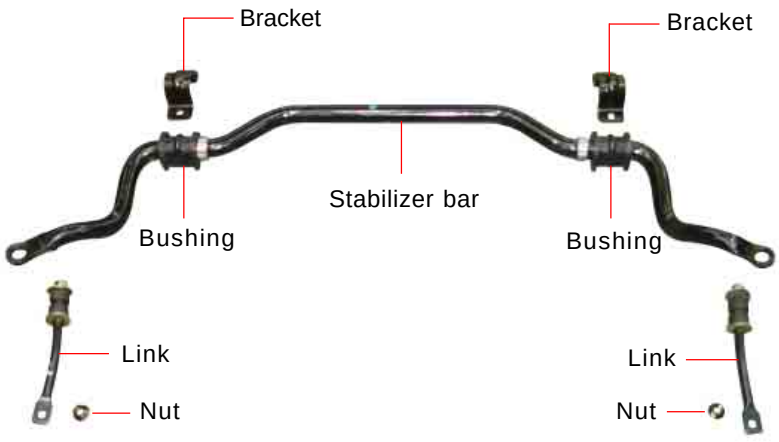




NOTICE

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



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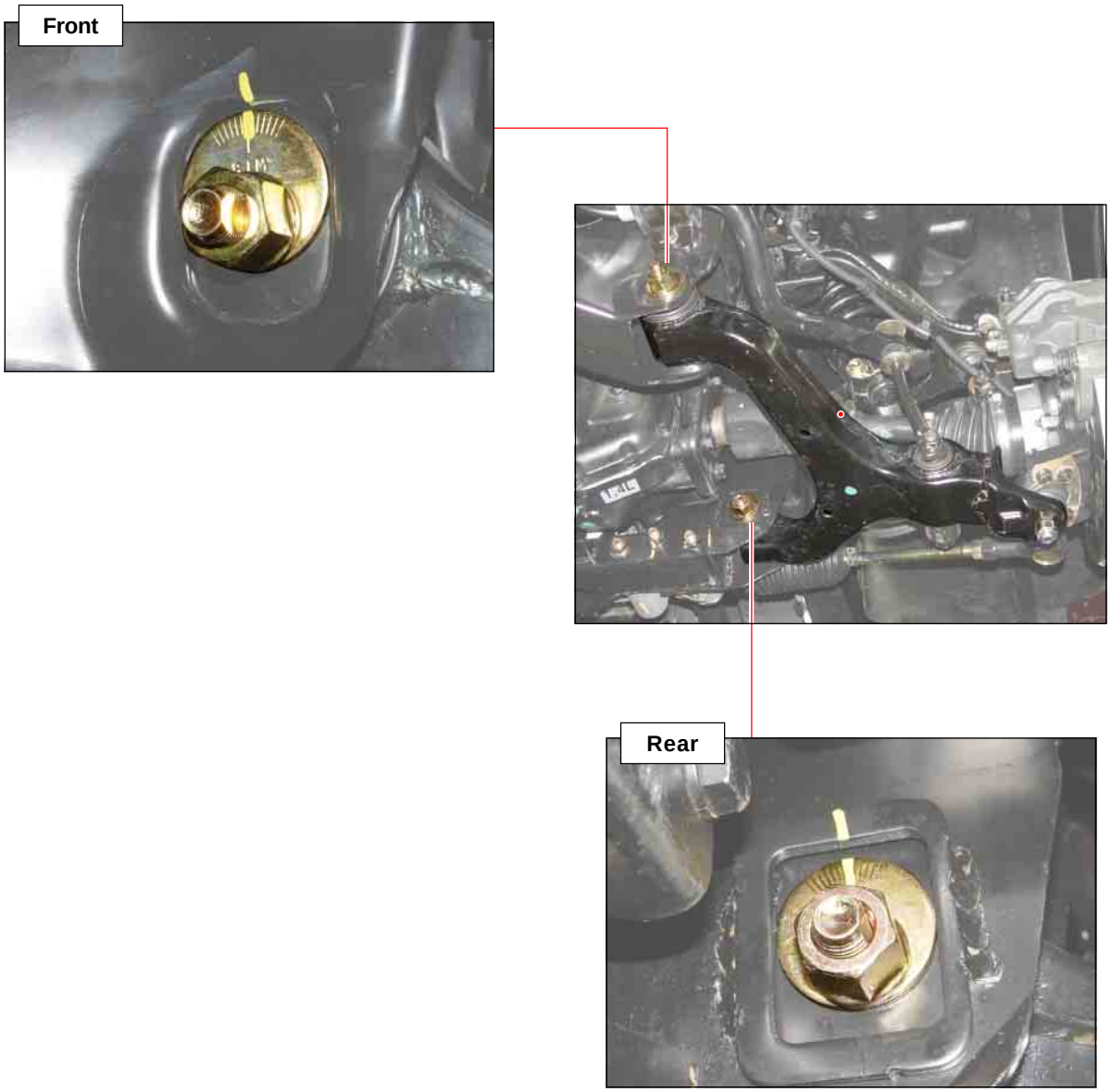
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6. LOWER ARM

※ **Preceding Works:** 1. Remove the tires.
2. Make an alignment mark on the camber adjusting bolt of lower arm (frame side).

Wheel Alignment

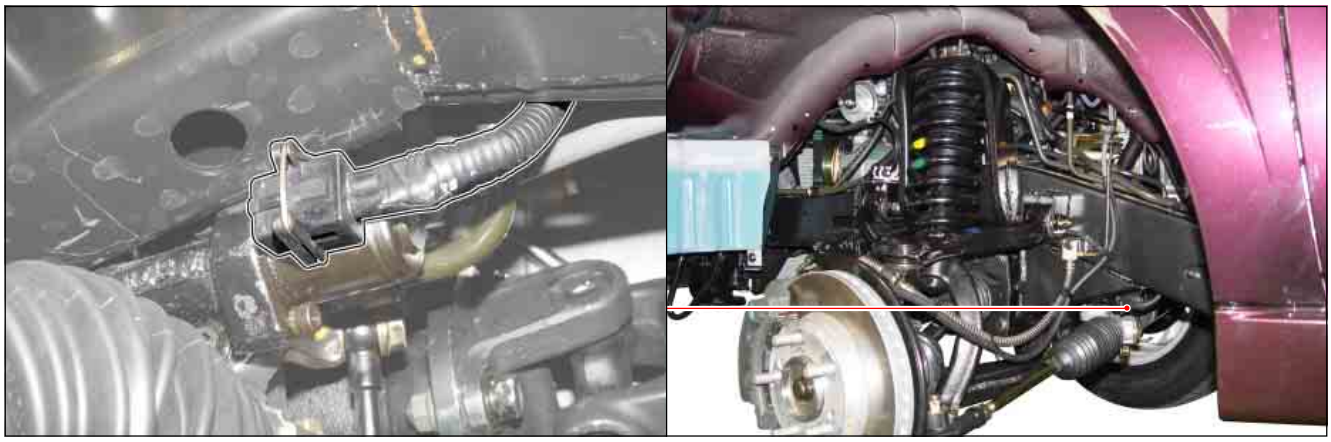
Description	Specification
Toe-in	2 ± 2 mm
Camber	-0.19° ± 0.3° (the difference between both ends is should be below 30′)
Caster	4.4° ± 0.5° (the difference between both ends is should be below 30′)



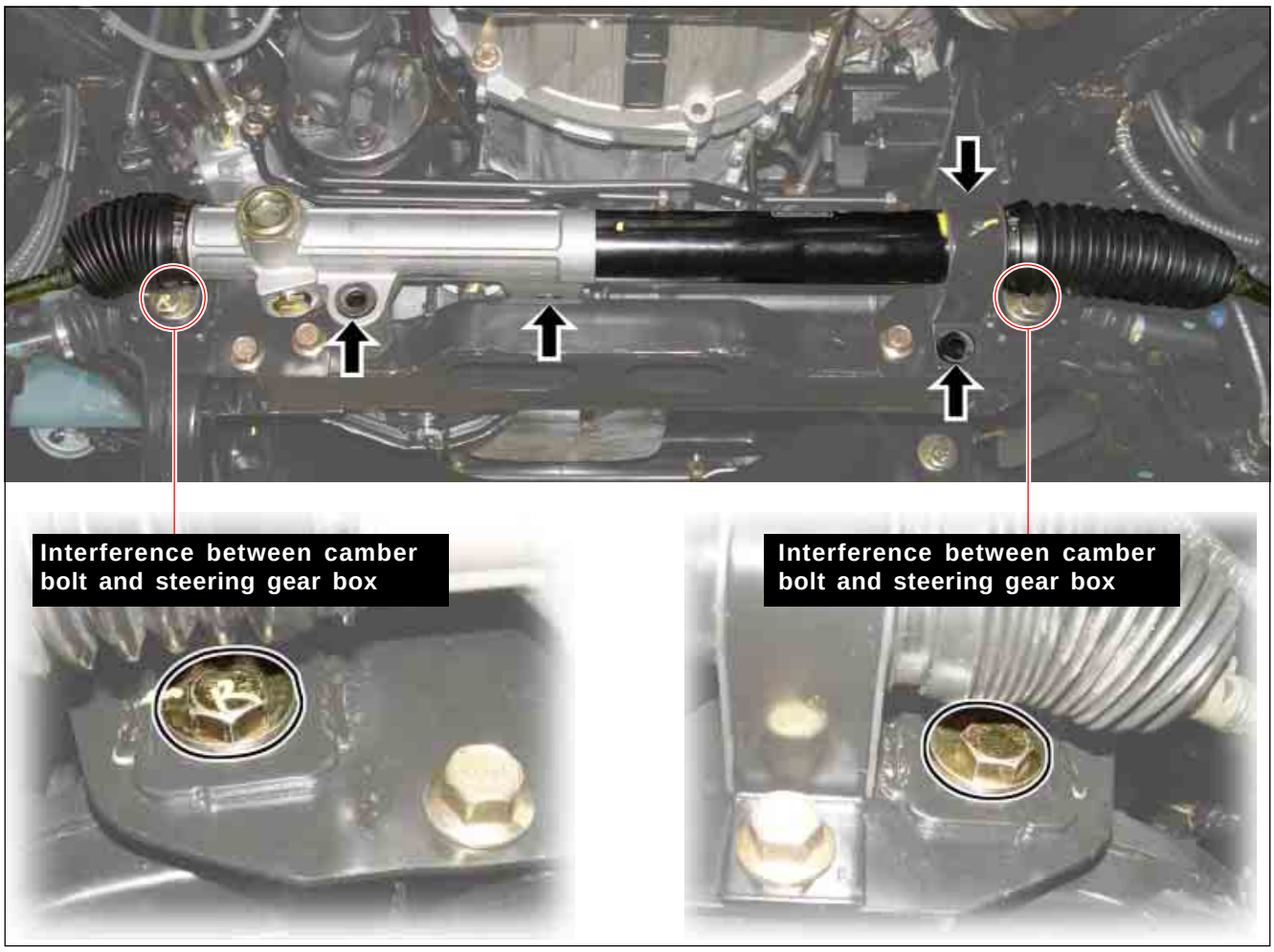
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3. Disconnect the SSPS solenoid valve connector.



4. Loosen the steering gear box by unscrewing the steering gear box mounting bolts (arrows) and remove the camber adjusting bolts.



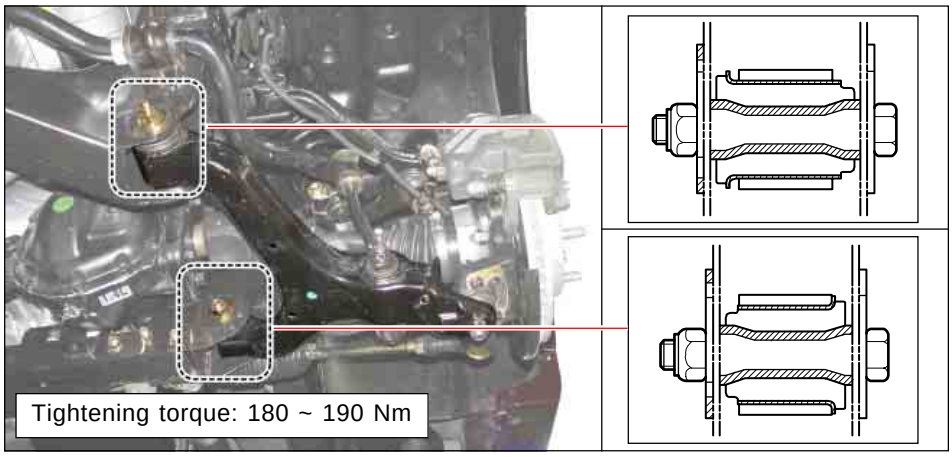
NOTICE

- **Be careful not to damage the SSPS solenoid valve connector.**

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Removal and Installation

1. The lower arm mounting bolts/nuts on the frame (LH/RH)



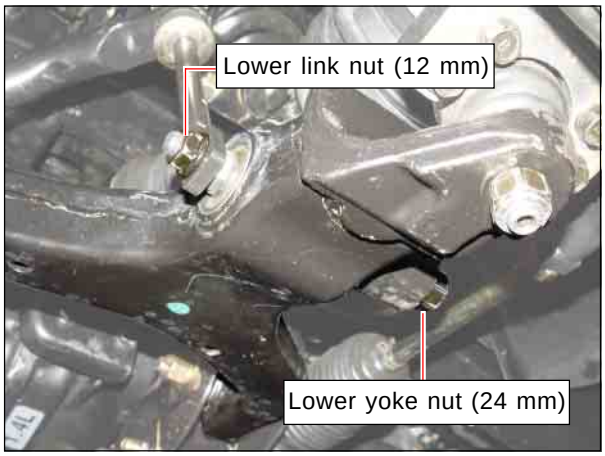
: Before removing lower arm assembly, make the alignment marks on the mounting nut (14 mm) on the frame and camber adjusting bolt (14 mm).

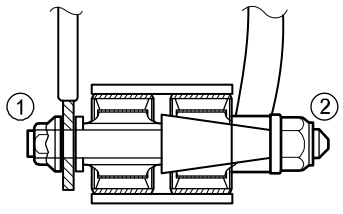


NOTE

- **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.

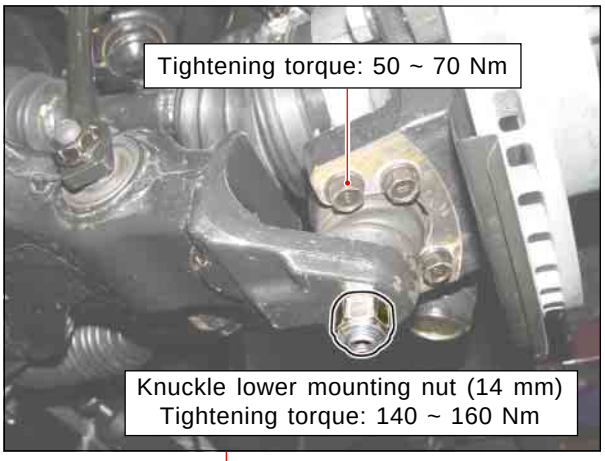




Tightening torque
1. Lower link nut (110 ~ 130 Nm)
2. Lower shock absorber yoke nut (150 ~ 170 Nm)

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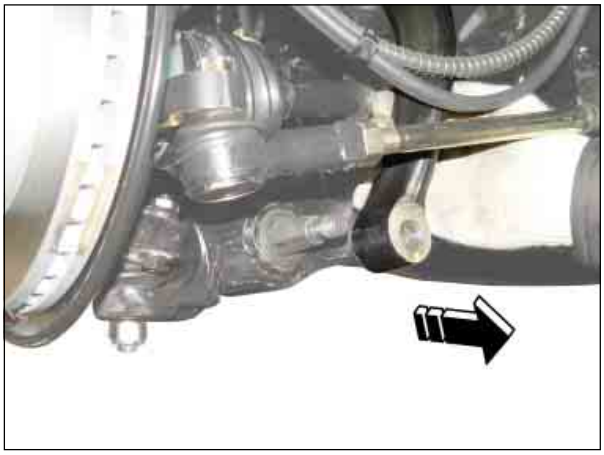
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3. Unscrew the lower mounting nut (14 mm) and remove the lower arm from knuckle end bolt with special tool.



4. Place a safety jack under the lower arm and unscrew the lower shock absorber yoke bolt. Remove the yoke while raising the safety jack with lower arm.



5. Remove the lower arm assembly from the vehicle.

Components



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MEMO

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5-LINK (RIGID TYPE) REAR SUSPENSION

1. OVERVIEW

The rear suspension is also to keep the ride comforts and drivability 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:

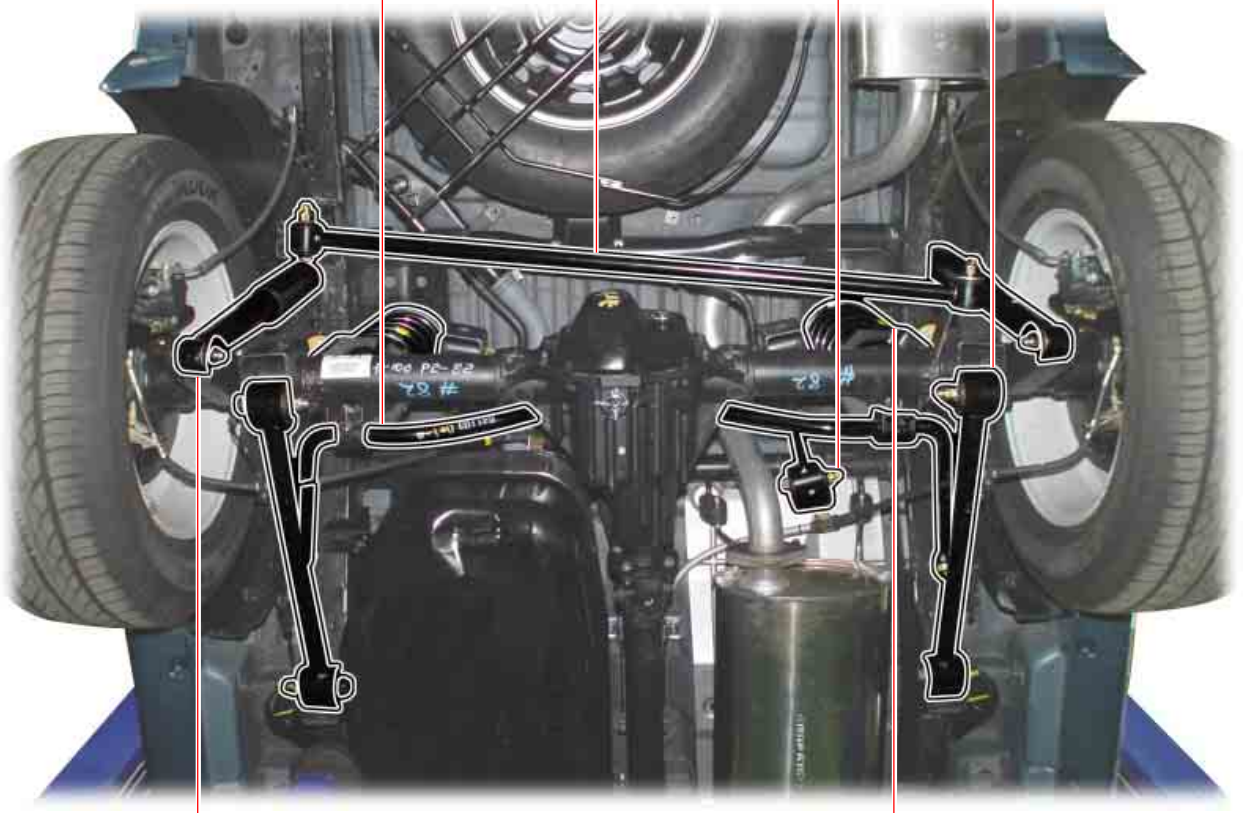
It maintains the balance of the vehicle when turning, and minimizes the vehicle's slope when the wheels are moving up and down separately.

2. Lateral Rod:

It controls the transverse load to the vehicle.

3. Upper/Lower Arm:

It controls the longitudinal load to the vehicle.



4. Shock Absorber:

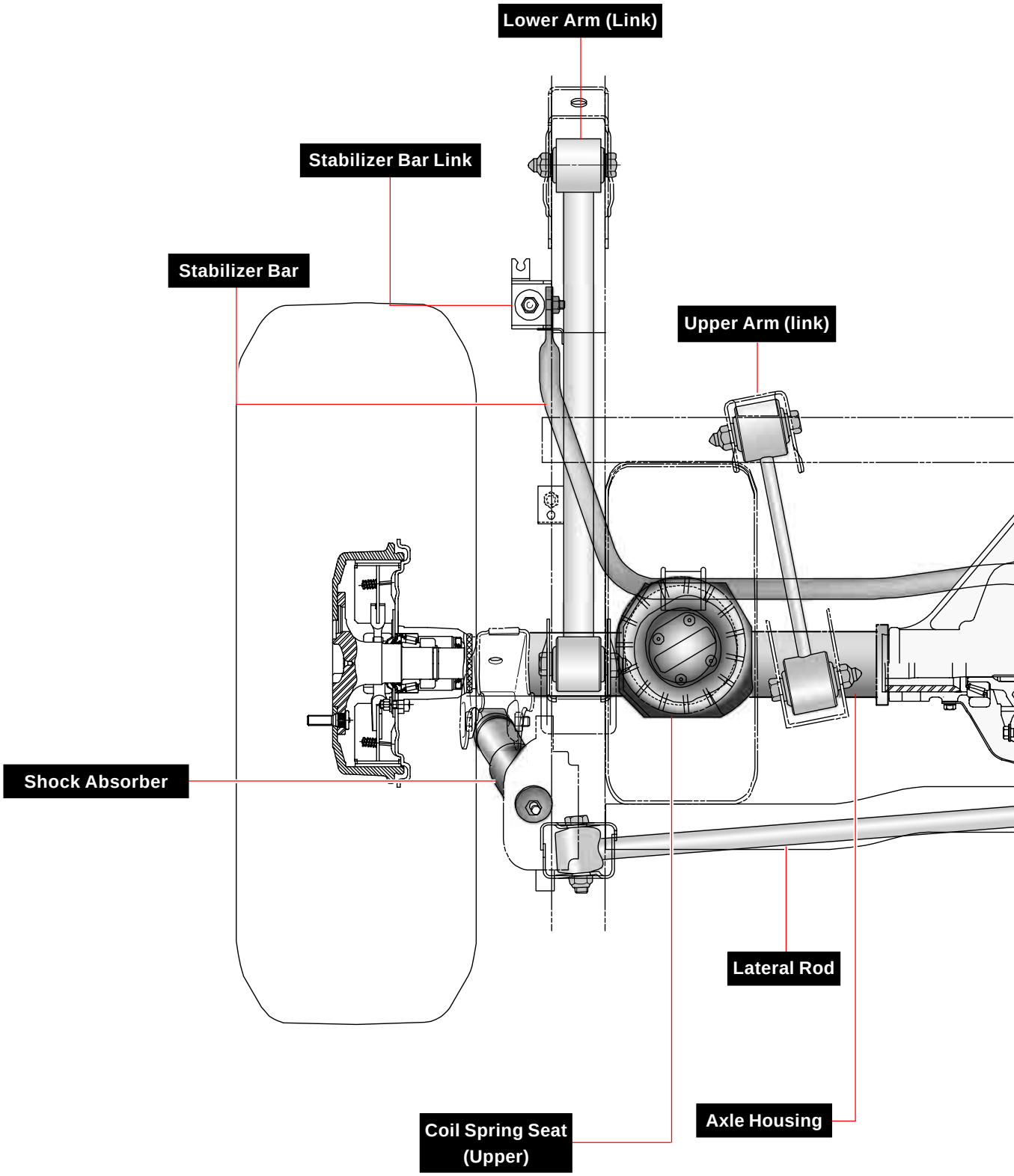
It absorbs the vertical vibration of the vehicle body. It enhances the ride comforts and prevents the fatigue break of the spring.

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.

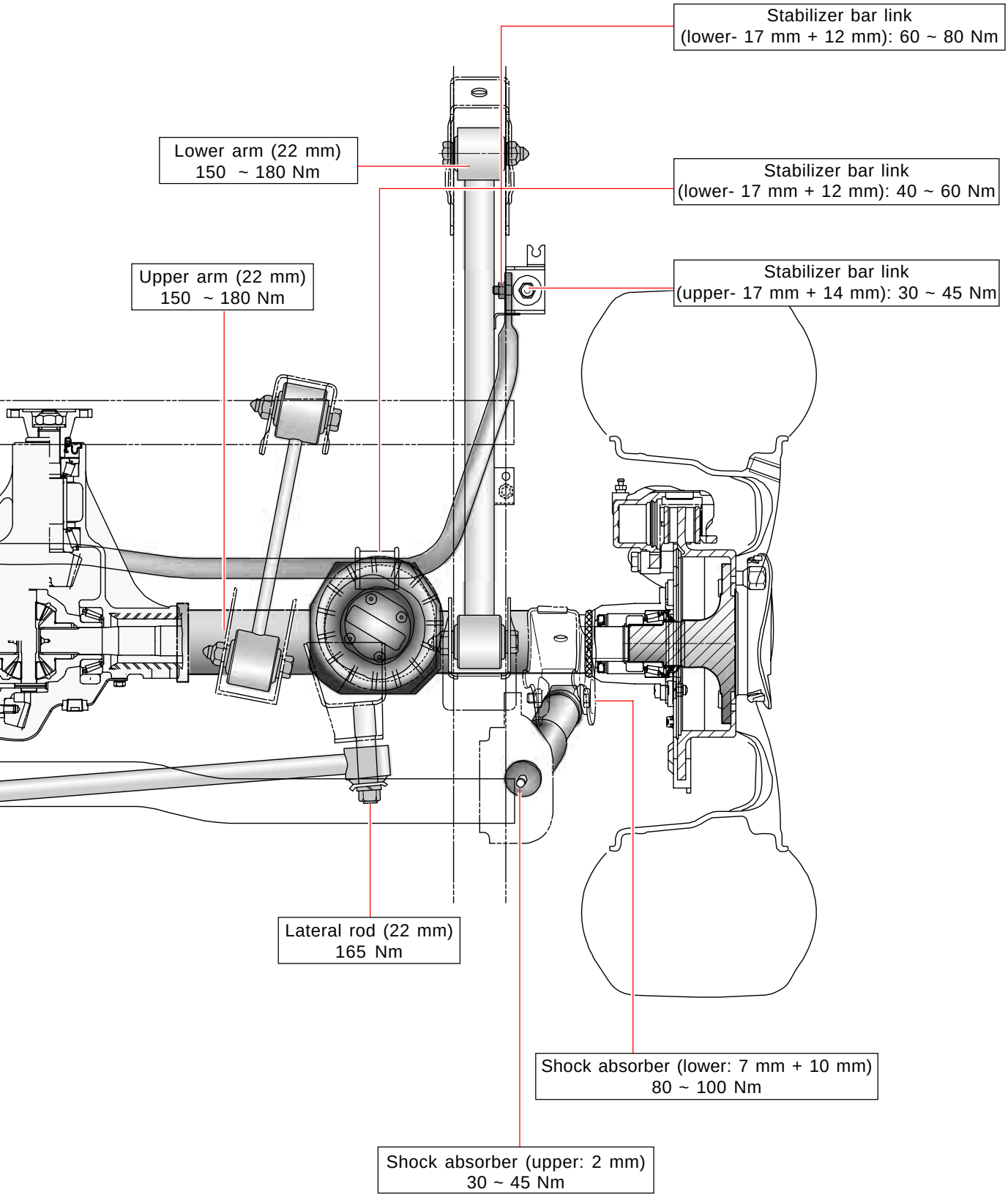
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2. SYSTEM LAYOUT



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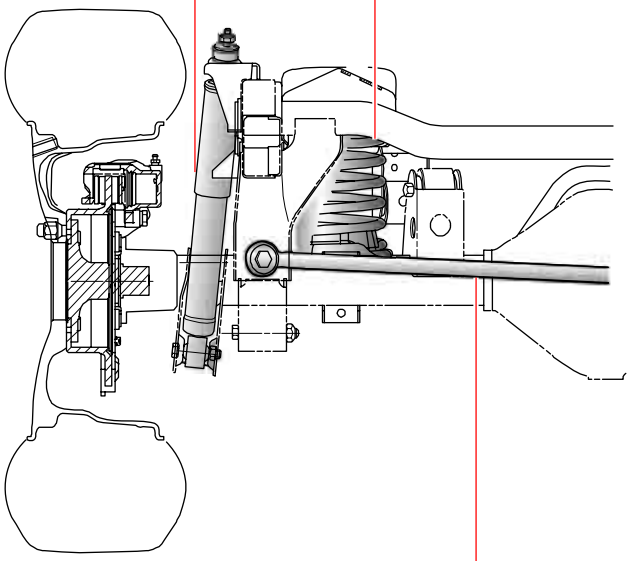
▶ Location

Shock Absorber Assembly



Coil Spring Assembly





Lateral Rod Assembly

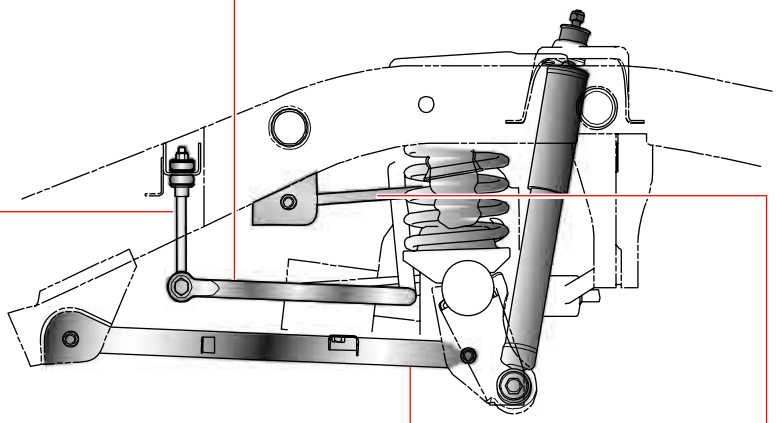


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Stabilizer Assembly





Stabilizer Bar Link



Upper/Lower Arm Assembly



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▶ Installation Drawing

Front View



Rear View



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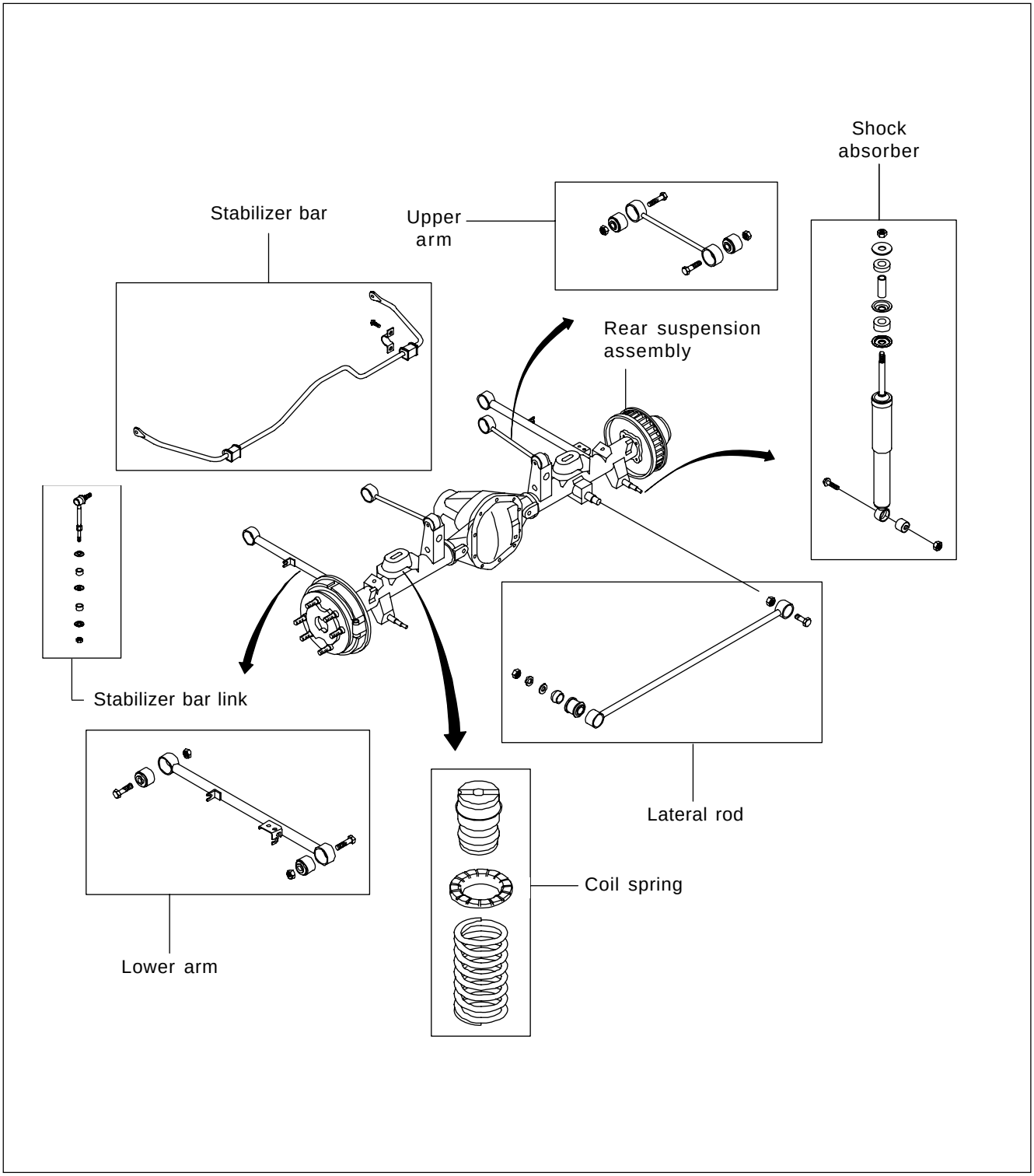
3. TROUBLE DIAGNOSIS

Symptom	Cause	Action
Vehicle rolling	Broken stabilizer bar	Replace
	Faulty shock absorber	Replace
Abnormal noises	Loosening mountings	Re-tighten
	Damaged or worn wheel bearing	Replace
	Damaged shock absorber	Replace
	Damaged tire	Replace
Poor riding	Over inflated tire	Pressure adjust
	Faulty shock absorber	Replace
	Loosened wheel nut	Tighten as 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

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4. REMOVAL AND INSTALLATION

▶ System Layout



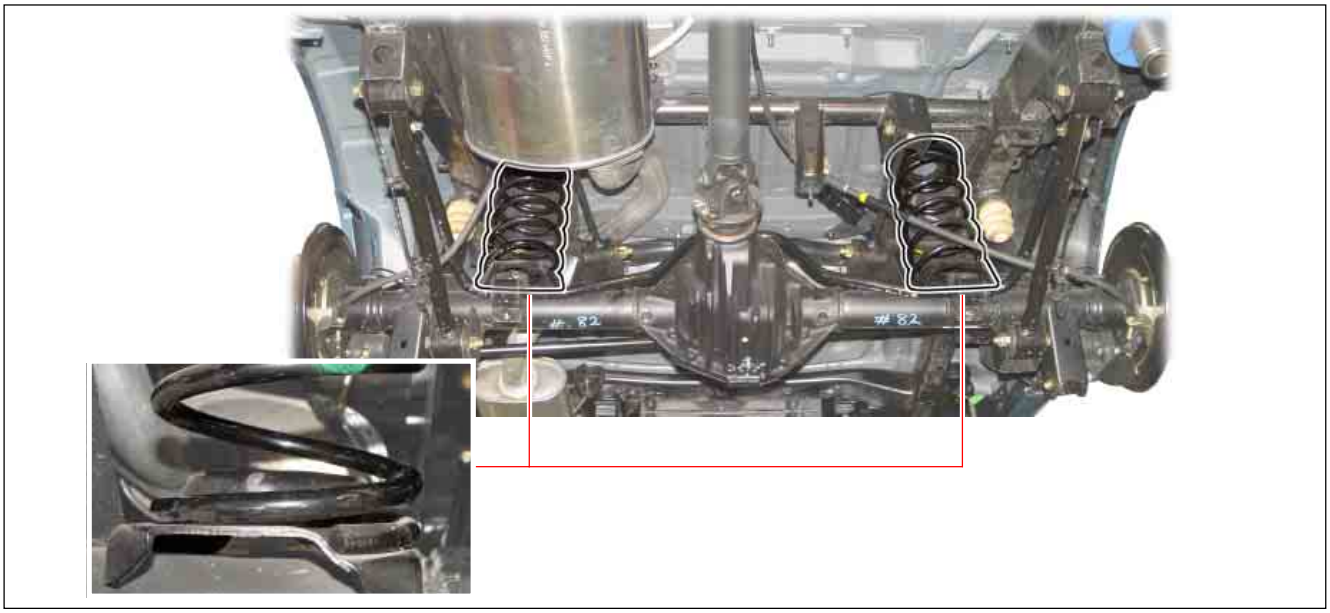
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Removal of Components

Remove the rear suspension components in order.

1. Remove the coil spring using a special tool.



2. Remove the lateral rod.

1) Unscrew the lateral rod mounting nut (22 mm) on axle.



Installation Notice

Tightening torque	165 Nm





2) Unscrew the lateral rod mounting bolt/nut (22 mm) on frame.

Installation Notice

Tightening torque	165 Nm

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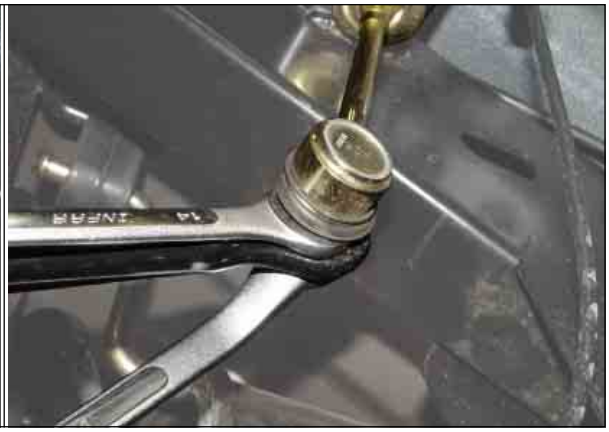
3. Disconnect the link and the bracket from the stabilizer bar to remove the stabilizer bar.

1) Unscrew the stabilizer bar link mounting nuts (upper/lower) and remove the link.

Installation Notice

Tightening torque	30 ~ 45 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	40 ~ 60 Nm



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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	27 mm



2) Remove the lower bolt/nut (17 mm).

Installation Notice

Tightening torque	80 ~ 100 Nm



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5. Remove the upper arm between frame and the 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

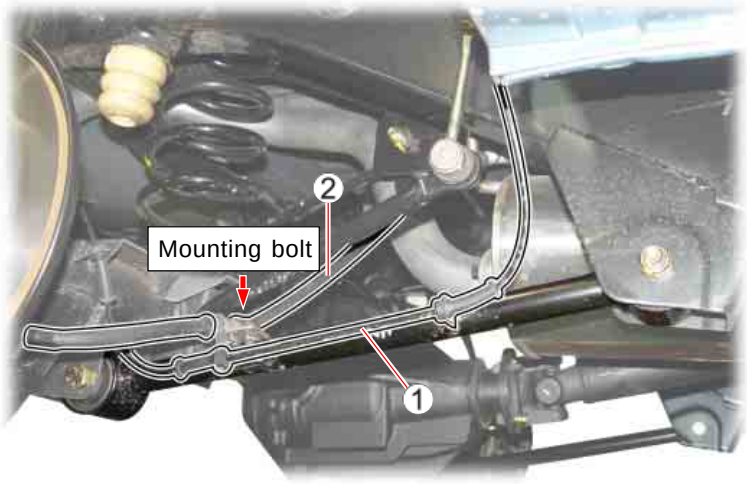
NOTICE

- **The fuel tank should be removed before removing the rear left bolts (upper arm and lower arm).**

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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



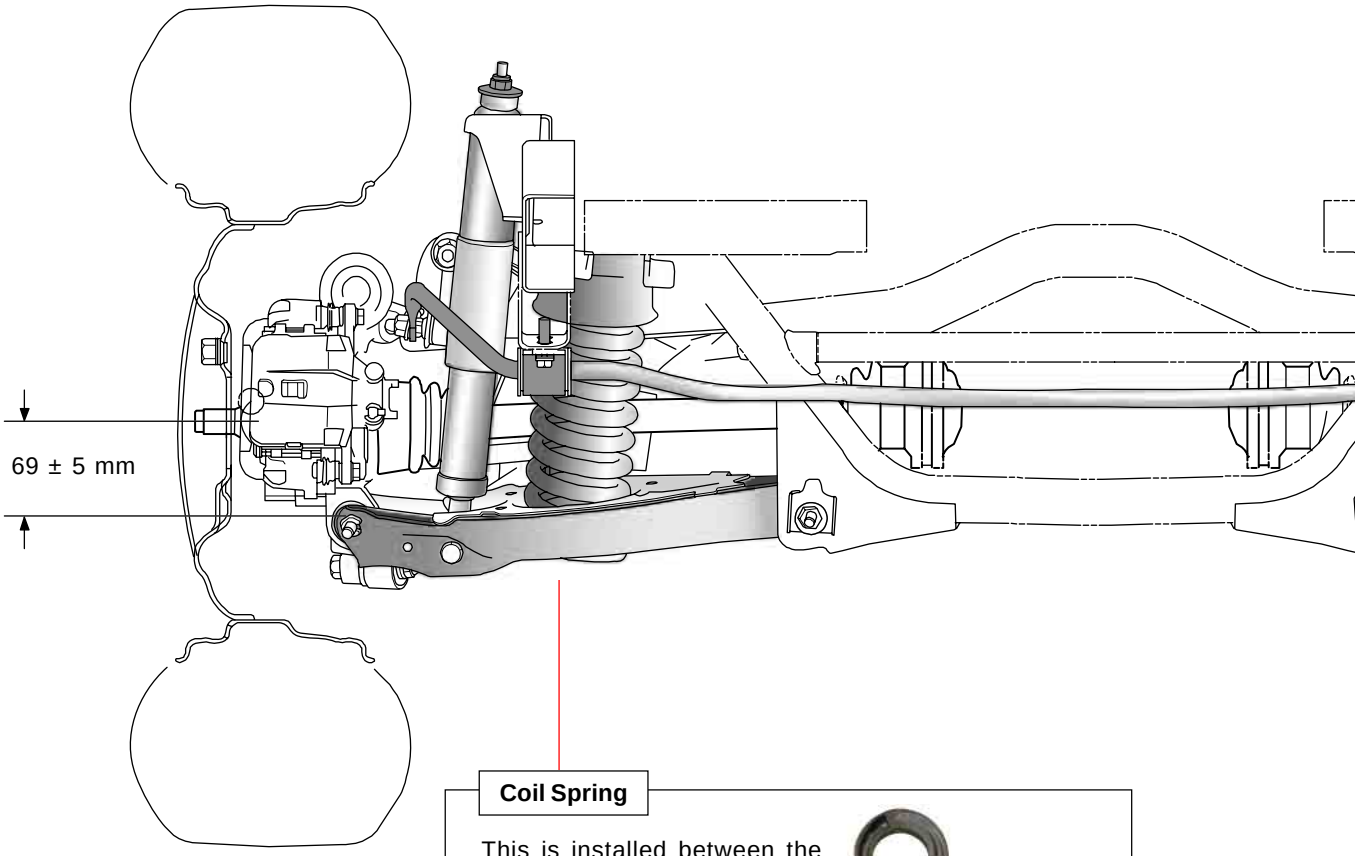
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IRS TYPE REAR SUSPENSION

1. OVERVIEW

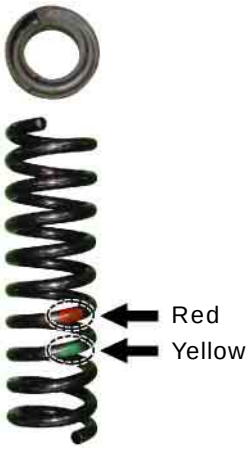
Overview

The rear suspension is also to keep the ride comforts and drivability and this vehicle uses IRS (Independent Rear Suspension) and RIGID type. It consists of coil spring, shock absorber, upper arm, track rod, thrust link and stabilizer bar.



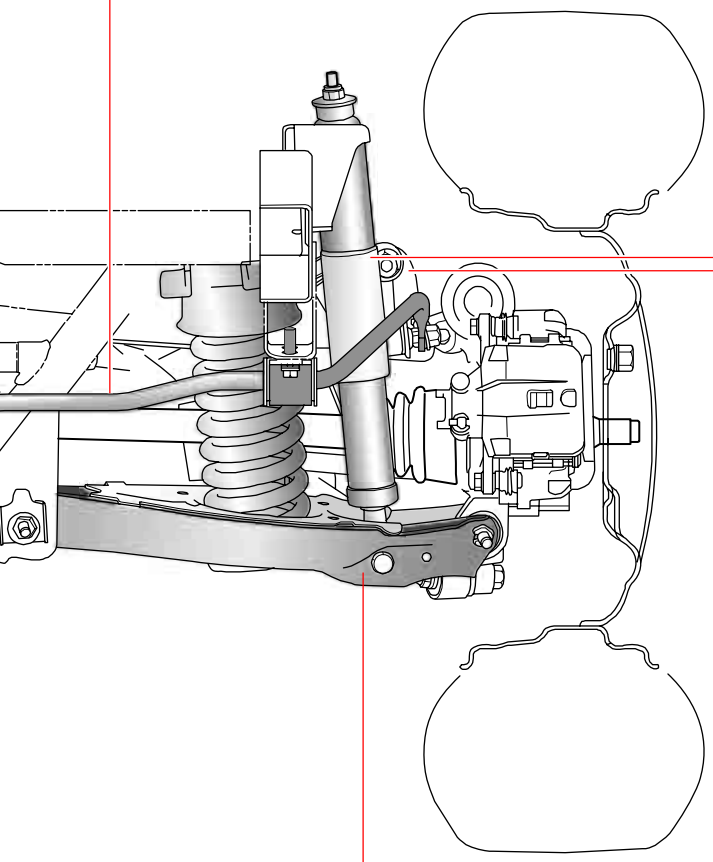
Coil Spring

This is installed between the rear axle and body frame. It relieves the vibrations and impacts delivered from wheels to vehicle body.
The spring should be installed as the red mark is over the yellow mark.



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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.



Shock Absorber

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.



Upper Arm/Coil Spring Link

Upper Arm:
This is connected to the knuckle and body frame and controls the longitudinal load to the vehicle.



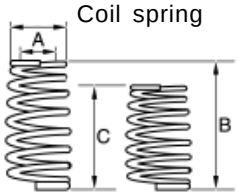
Coil Spring Link:
This is connected to the knuckle and body frame and reduces the weight to coil spring and shock absorber. It means that this controls the vertical load to the vehicle.



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2. SPECIFICATIONS

Description		Specification
Suspension type		IRS type
Spring type		Coil spring
Stabilizer bar type		Torsion bar
Shock absorber	Type	Cylindrical double tube
	Max. length	463 mm
	Min. length	310 mm
Coil spring 	Coil thickness	14.9 mm
	Inner diameter of coil (A)	ϕ 70.1 mm
	Free length (B)	344.9 mm
	Length at load (C)	252.1 mm
	Spring rate	8.68 ± 5 %

3. TROUBLE DIAGNOSIS

▶ Trouble Diagnosis

Symptom	Cause	Action
Vehicle rolling	Broken stabilizer bar	Replace
	Faulty shock absorber	Replace
Abnormal noises	Loosening mountings	Re-tighten
	Damaged or worn wheel bearing	Replace
	Damaged shock absorber	Replace
	Damaged tire	Replace
Poor riding	Over inflated tire	Pressure adjust
	Faulty shock absorber	Replace
	Loosened wheel nut	Tighten as 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

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▶ Inspection

Wheel Bearing End Play



1. Release the parking brake.
2. Raise the rear wheel.
3. Check if the wheel bearing end play exists while rocking the wheel.
4. If the end play is excessive, retighten the castle nut.
5. If the end play still exists, replace the wheel bearing.

Wheel Bearing Preload



1. Release the parking brake.
2. Raise the rear wheel and rotate it several times.
3. Remove the tire.
4. Hook a spring gauge on a hub bolt and pull it. Read the scale on the gauge at the point when the drum starts to move. It is preload.
5. Check if the preload is within the specified range.

Specified value	1.4 ~ 4.3 kg.cm

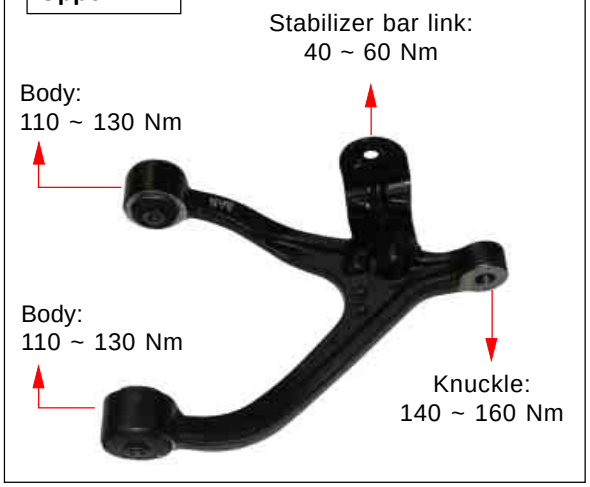
6. If the measured preload is out of the specified range, retighten the castle nut to the specified torque.
7. If the trouble still exists, replace the wheel bearing with a new one.

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4. REMOVAL AND INSTALLATION

▶ Components and Tightening Torque

Upper Arm

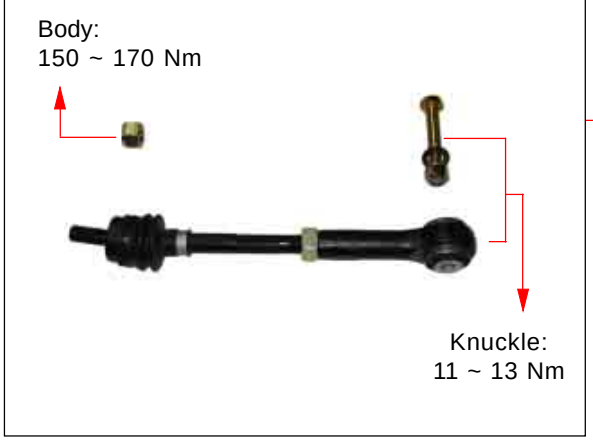


Coil Spring



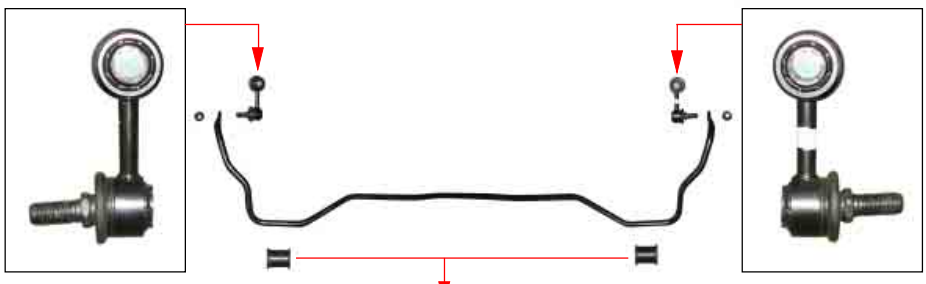
* The spring should be installed so that the red mark is over the yellow mark.

Track Rod





Stabilizer Bar



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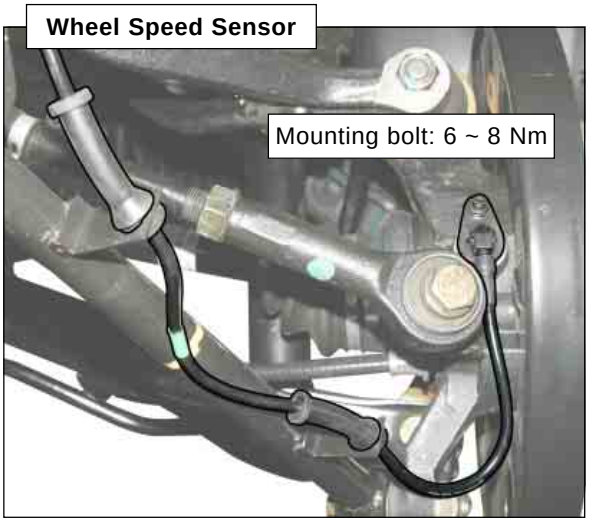
Thrust Link



Body:
150 ~ 170 Nm

Knuckle:
110 ~ 130 Nm

Wheel Speed Sensor





Coil Spring Link

Body:
110 ~ 130 Nm



Knuckle:
120 ~ 150 Nm

Shock Absorber

Body:
30 ~ 45 Nm



Coil spring link:
60 ~ 80 Nm



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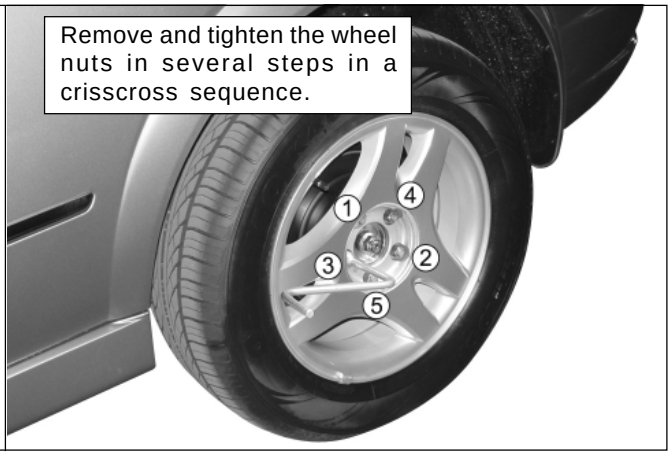
Rear Suspension Module

1. Remove the tire (21 mm - 5 wheel nuts).

Installation Notice

Tightening torque	120 ~ 140 Nm





2. Remove the brake disc caliper and set the removed caliper on the frame (17 mm - 2 bolts).





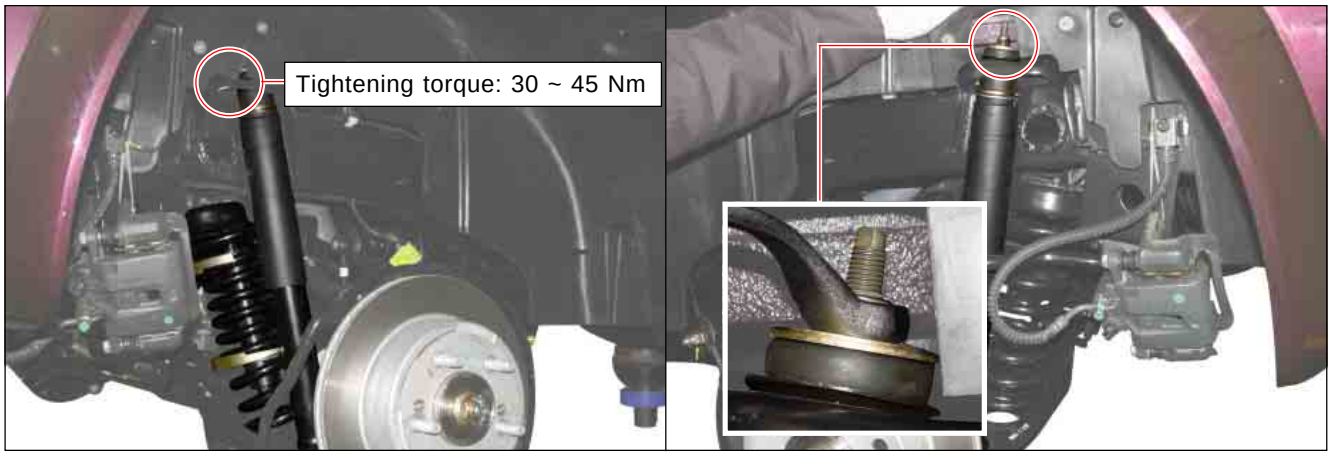
3. Unscrew the two stabilizer bar mounting bracket bolts (14 mm) from body (frame) and remove the stabilizer bar.





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4. Install the special tool to the coil spring and compress the coil spring with the tool. Unscrew the upper nut (17 mm) on the shock absorber.



5. Tighten the special tool to compress the coil spring. Remove the coil spring and spring seat while pulling down the coil spring link.



6. Unscrew the bolt (10 mm) and remove the parking brake cable and wheel speed sensor.



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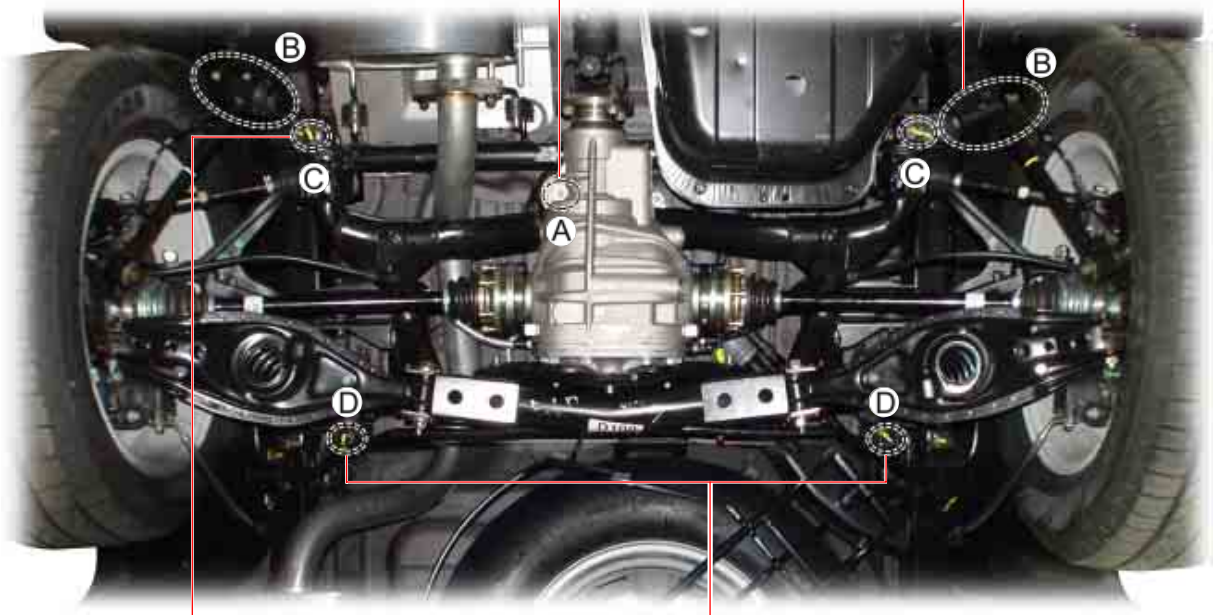
7. Place the safety jack under the rear sub frame and unscrew the sub frame mounting bolts (body side : 22 mm - 4 EA) and the axle housing hexagon nut (22 mm - 1 EA). Unscrew the thrust link mounting bolt/nut (14 mm) on body.

A. Axle housing mounting nut (22 mm)
Tightening torque: 95 ~ 142 Nm



B. Thrust link bolt/nut on body
Tightening torque: 150 ~ 170 Nm







C. Sub frame coil bolt (front - 14 mm)
Tightening torque: 95 ~ 142 Nm



D. Sub frame bolt (rear - 14 mm)
Tightening torque: 95 ~ 142 Nm

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8. Lower the safety jack and remove the sub frame from the vehicle.





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Shock Absorber Assembly

※ **Preceding Work:** Remove the tire.

1. Compress the coil spring with special tool and unscrew the shock absorber upper nut on body (frame) (17 mm - 1EA).





Tightening torque: 30 ~ 45 Nm

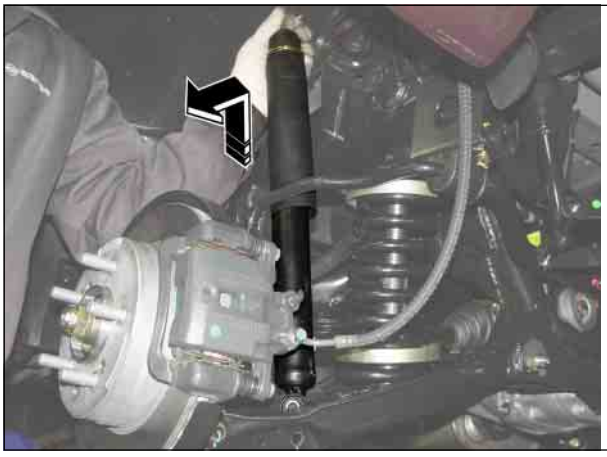
2. Unscrew the shock absorber lower bolt/nut (bolt: 14 mm / nut: 17 mm) on coil spring link.



Tightening torque: 60 ~ 80 Nm



3. Remove the shock absorber from the rear suspension.





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Coil Spring Assembly

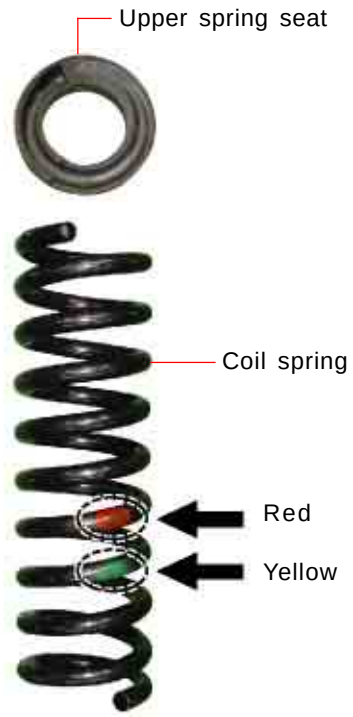
※ **Preceding Works:** 1. Remove the tires.
2. Unscrew the bolt and lower the stabilizer bar.

1. Compress the coil spring with special tool.



2. Release the compression force of coil spring by loosening the lower shock absorber bolt/nut and remove the coil spring and upper spring seat.





NOTICE

- **The spring should be installed so that the red mark is over the yellow mark.**

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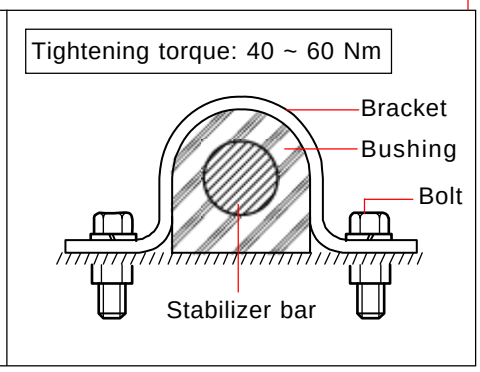
Stabilizer Bar Assembly

※ **Preceding Work:** Remove the tires.

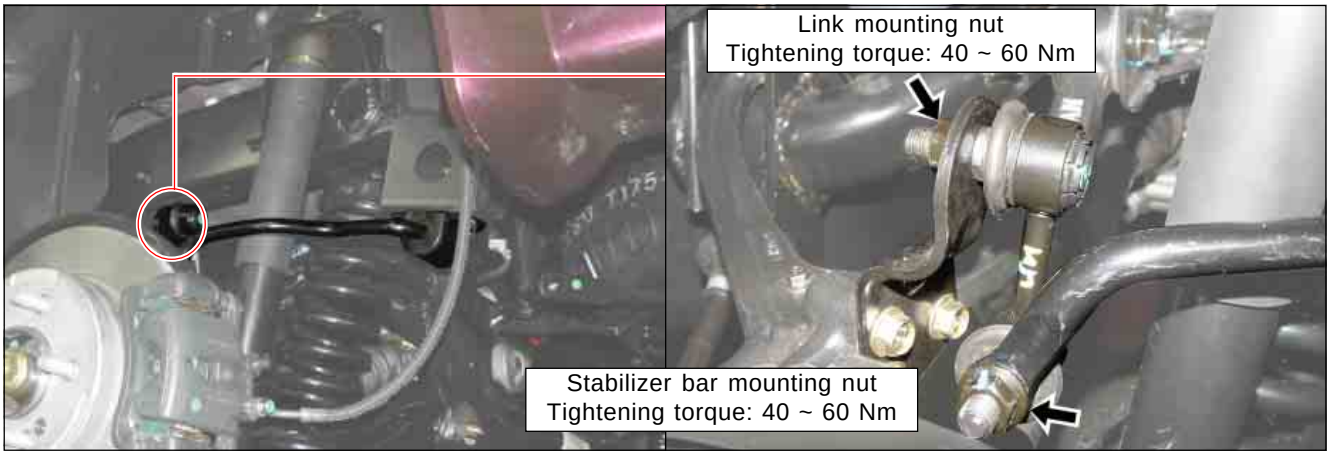
1. Unscrew the two bolts (14 mm) and remove the stabilizer bar bracket.







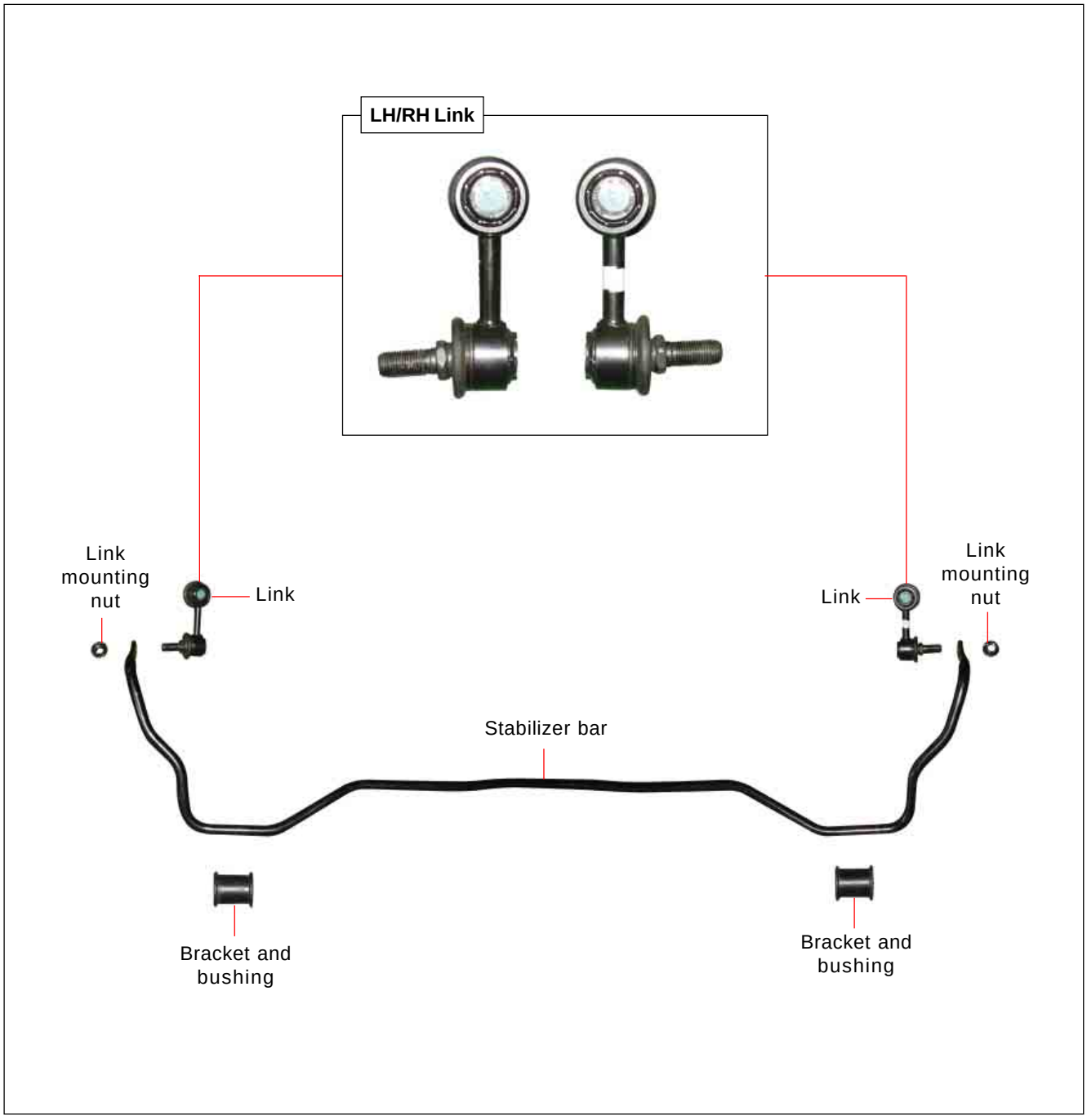
2. Unscrew the bolt/nut (14 mm) on the link and stabilizer bar and remove the stabilizer bar. Also, unscrew the bolt (12 mm) on the knuckle and remove the link.



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3. Install the stabilizer link. Be cautious of the installing direction.



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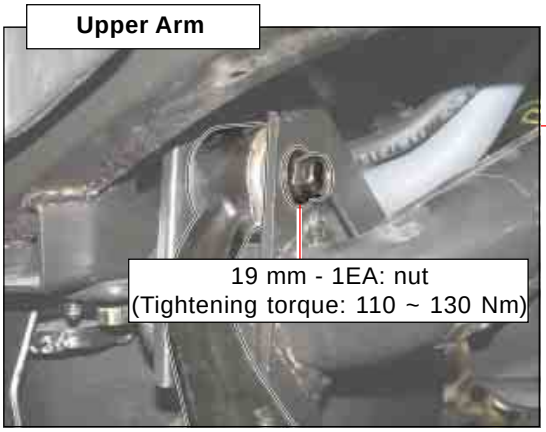
Suspension Assembly

※ **Preceding Work:** Install a special tool to the coil spring.

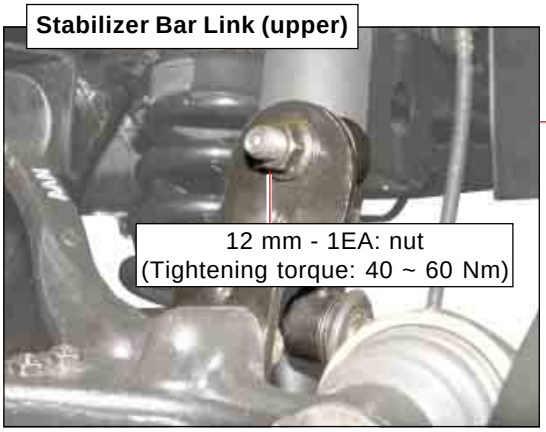
Upper Arm

: Unscrew the bolt/nut and remove the upper arm.

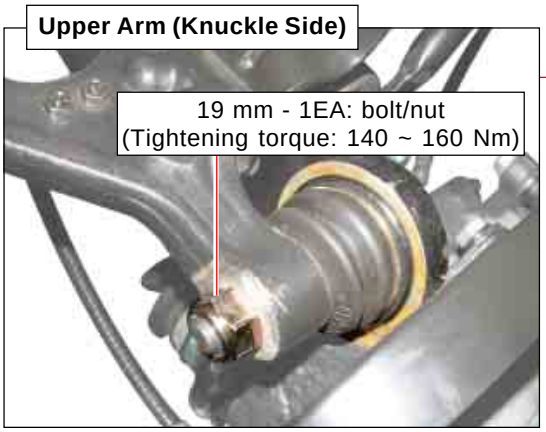
Upper Arm

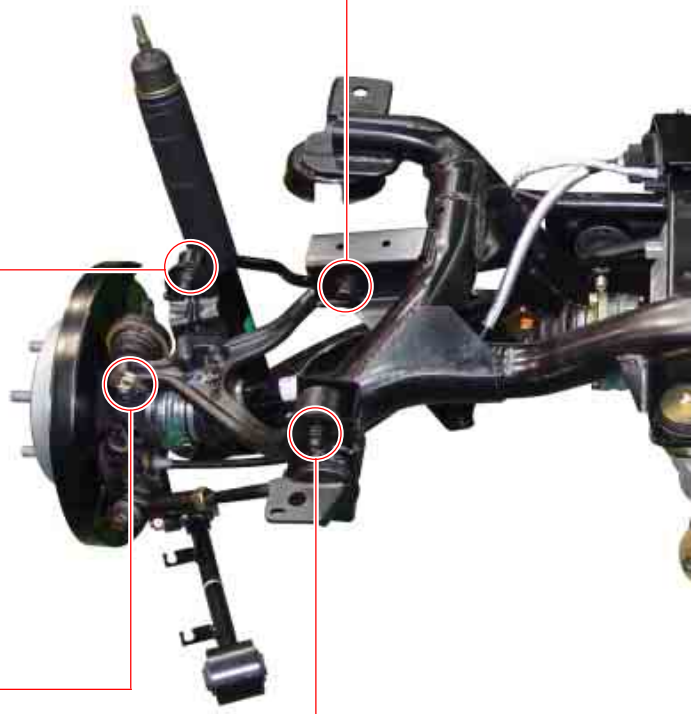


Stabilizer Bar Link (upper)

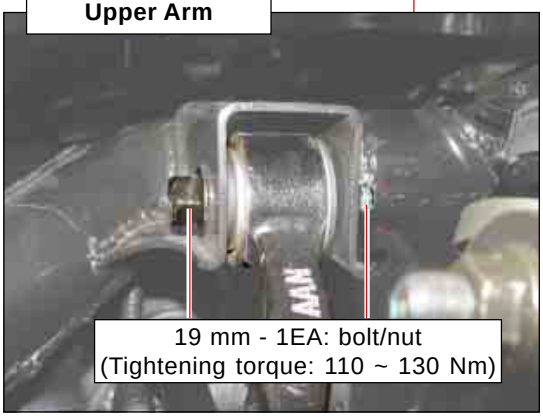


Upper Arm (Knuckle Side)





Upper Arm



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Track Rod

: Unscrew the nut and remove the track rod.

Track Rod on Sub Frame

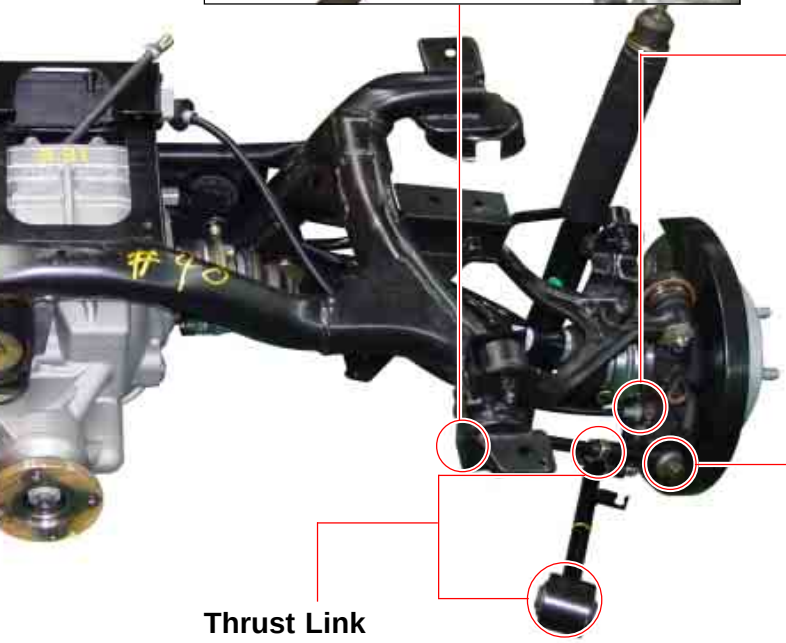


17 mm - 1EA: nut
(Tightening torque: 150 ~ 170 Nm)

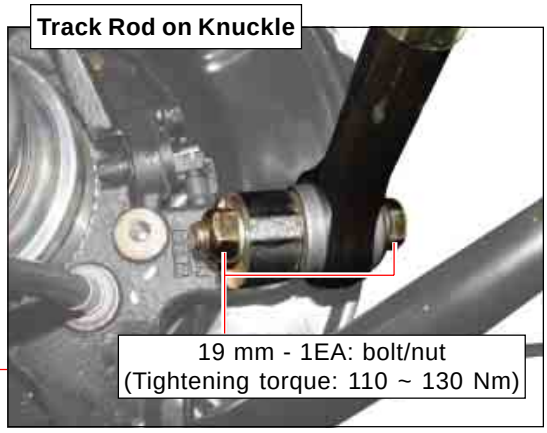
Upper Arm



Make an alignment mark on toe-in adjusting nut.



Track Rod on Knuckle

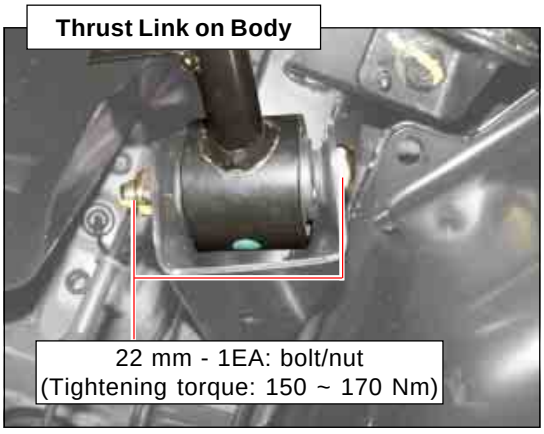


19 mm - 1EA: bolt/nut
(Tightening torque: 110 ~ 130 Nm)

Thrust Link

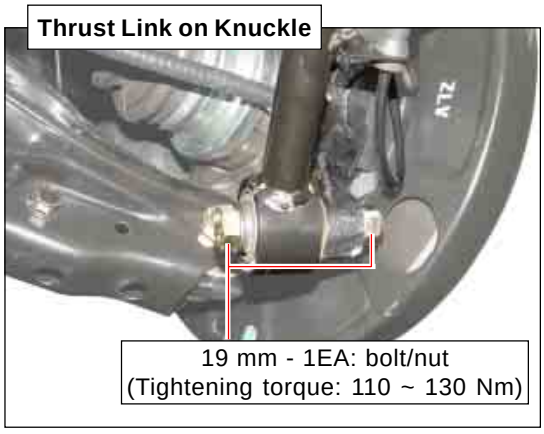
: Unscrew the bolt/nut and remove the thrust link.

Thrust Link on Body



22 mm - 1EA: bolt/nut
(Tightening torque: 150 ~ 170 Nm)

Thrust Link on Knuckle



19 mm - 1EA: bolt/nut
(Tightening torque: 110 ~ 130 Nm)

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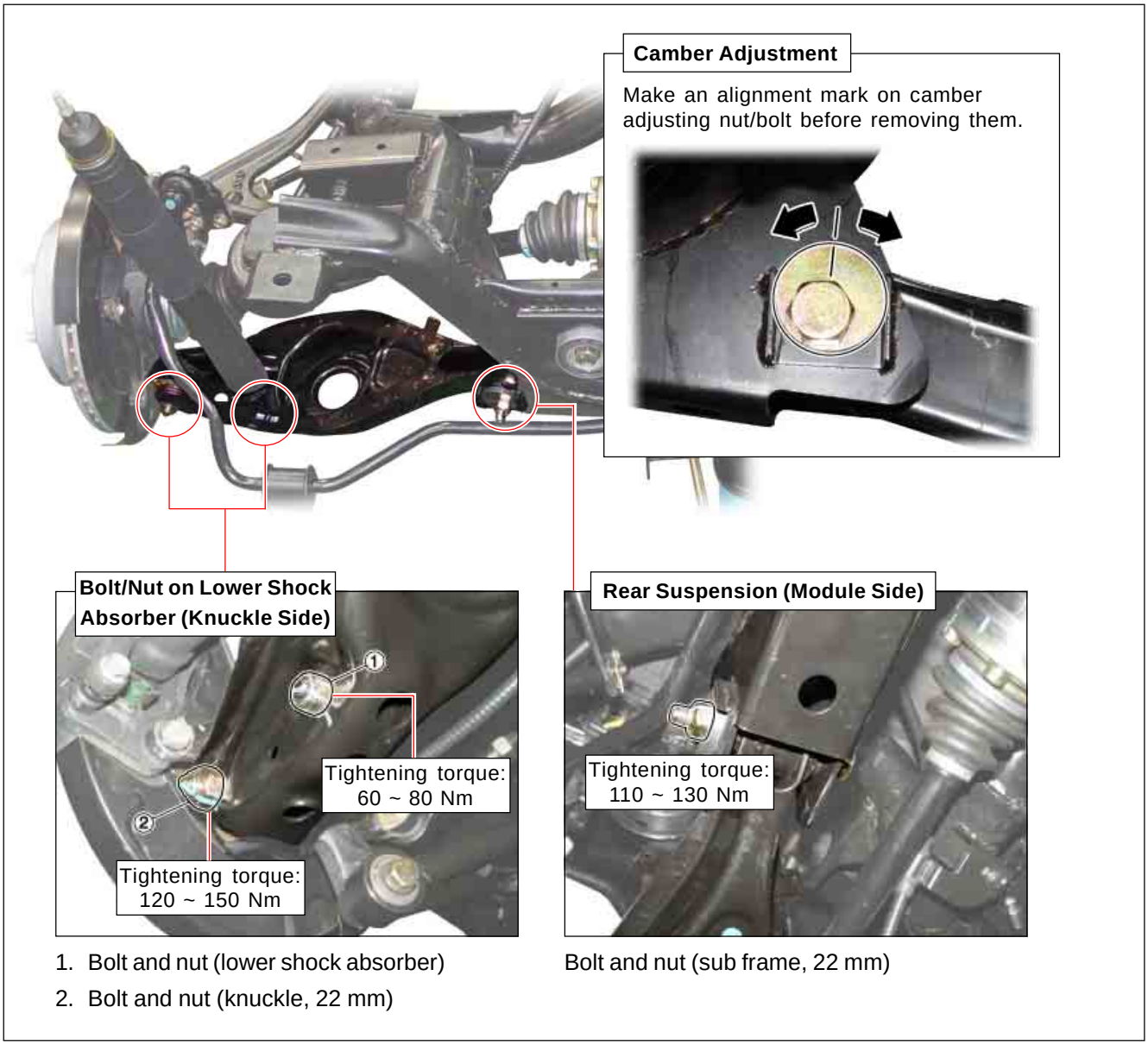
Coil Spring Link Assembly



※ **Preceding Works:**

1. Remove the tires.
2. Unscrew the bracket bolts and lower the stabilizer bar.
3. Remove the coil spring.

Unscrew the lower shock absorber bolt on coil spring link and the bolt/nut on sub frame of the coil spring link and knuckle to remove the coil spring link assembly.



1. Bolt and nut (lower shock absorber)
2. Bolt and nut (knuckle, 22 mm)

Bolt and nut (sub frame, 22 mm)

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POWER STEERING SYSTEM

4610 / 4620

TABLE OF CONTENTS

GENERAL INFORMATION 3

1. Overview 3
2. System layout 4

SSPS (SPEED SENSING POWER STEERING) 8

1. General information 8
2. Trouble diagnosis 15
3. Removal and installation 24

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GENERAL INFORMATION

1. OVERVIEW

The power steering has been designed to make the wheel move more easily than in a manual steering system. The hydraulic power assists the process utilizing hydraulic fluid. The fluid increases pressure in the power steering pump and aids the movement of the steering mechanism.

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 valve in the rack and the 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.

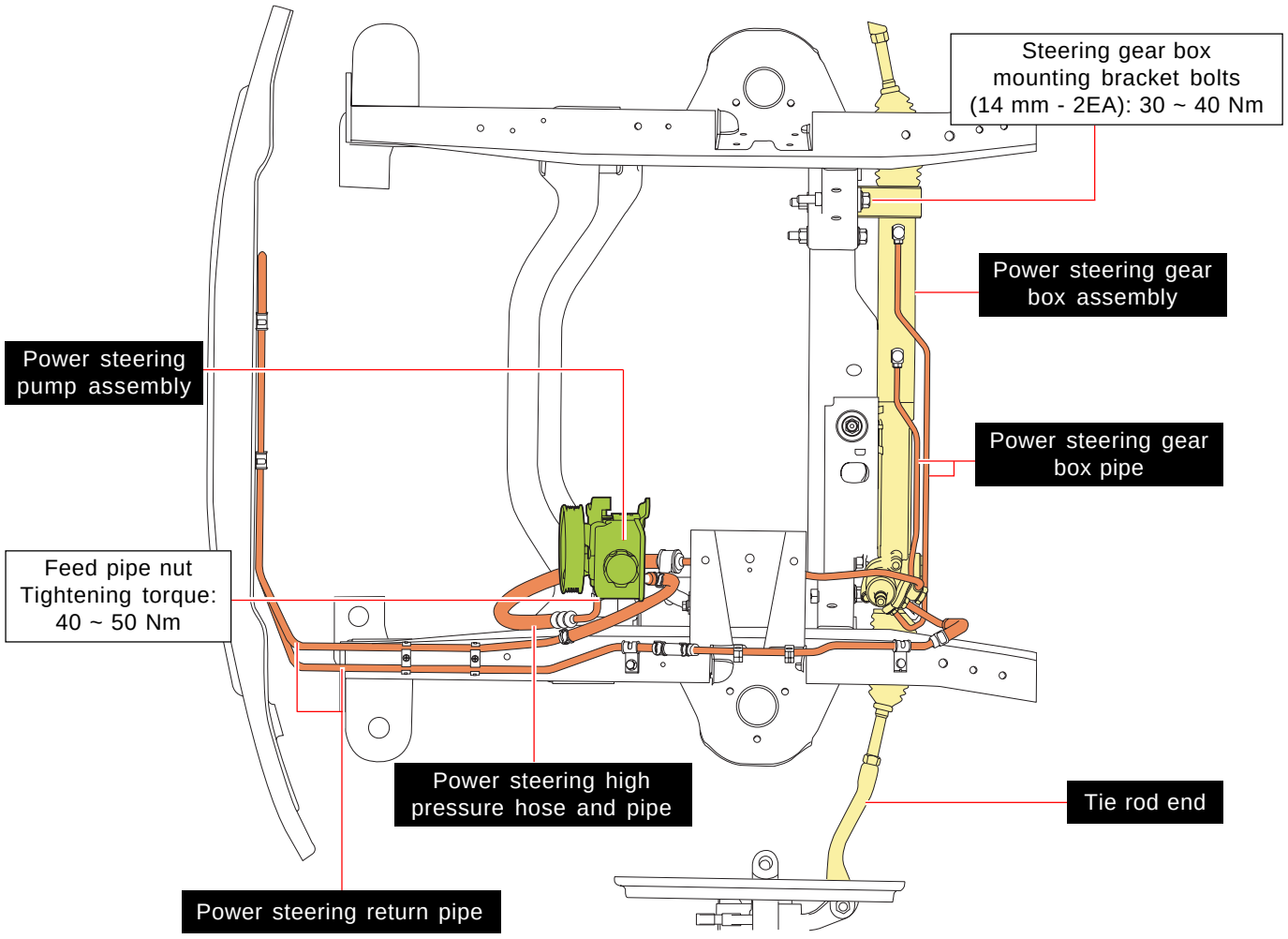
In this case, the operating force of the steering wheel is conveyed to the pinion, and the movement of the pinion moves the rack through the pinion gear combined to the rack gear.

Specifications

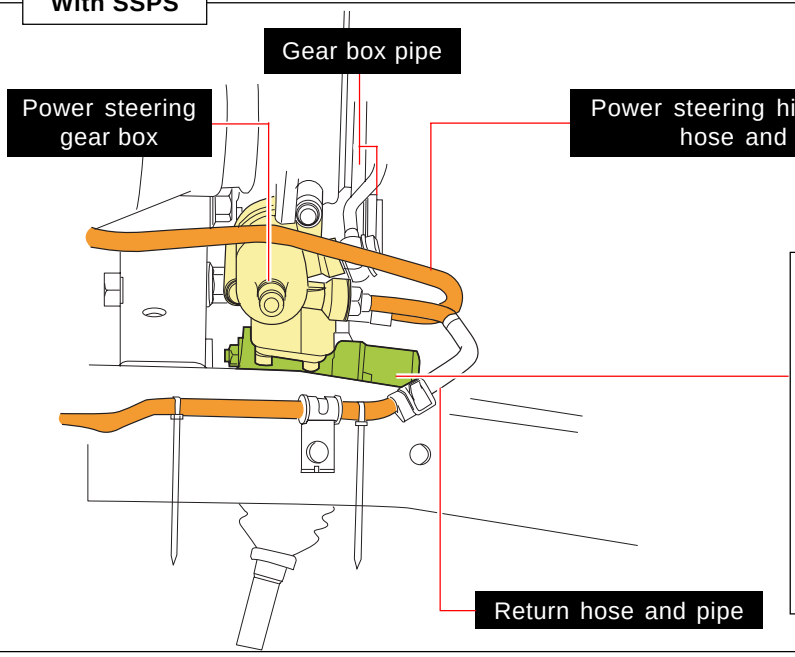
Description			Specification
Steering wheel	Type		4-spoke type
	Outer diameter (mm)		390
Steering gear box	Type		Rack and pinion
	Gear ratio		∞
	Steering angle	Inner	36° 20′
		Outer	32° 40′
Oil pump	Type		Vane type
	Maximum pressure (kgf/cm²)		85 ~ 92
	Displacement (ℓ/min)		10.5
	Pulley size (mm)		124
Tilt column adjusting angle	Up		4°
	Down		8°
Minimum turning radius (m)			5.7
Oil	Specification		ATF Dexron III
	Capacity (ℓ)		1.0

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2. SYSTEM LAYOUT



With SSPS



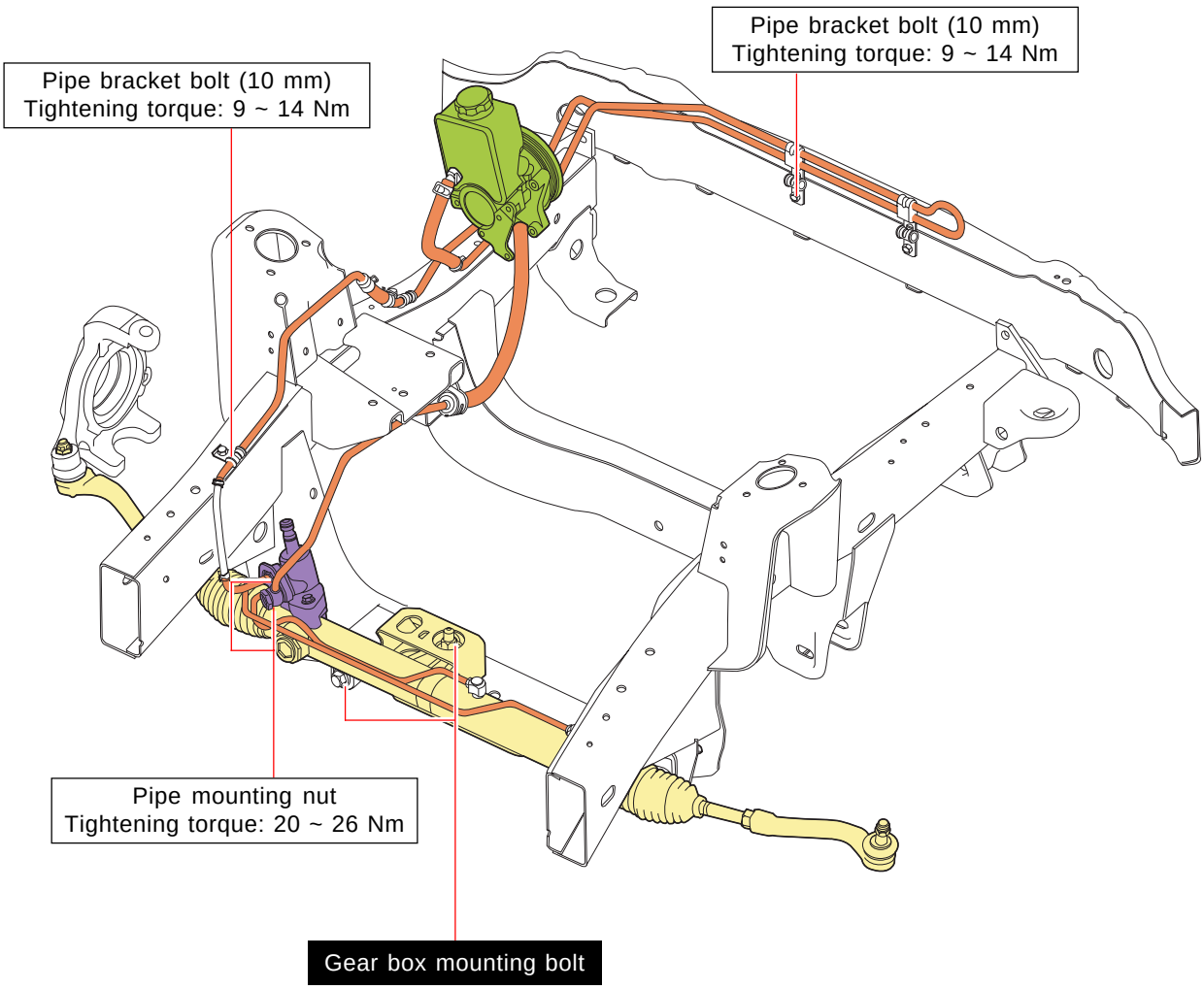
SSPS Solenoid Valve



* cannot be replaced

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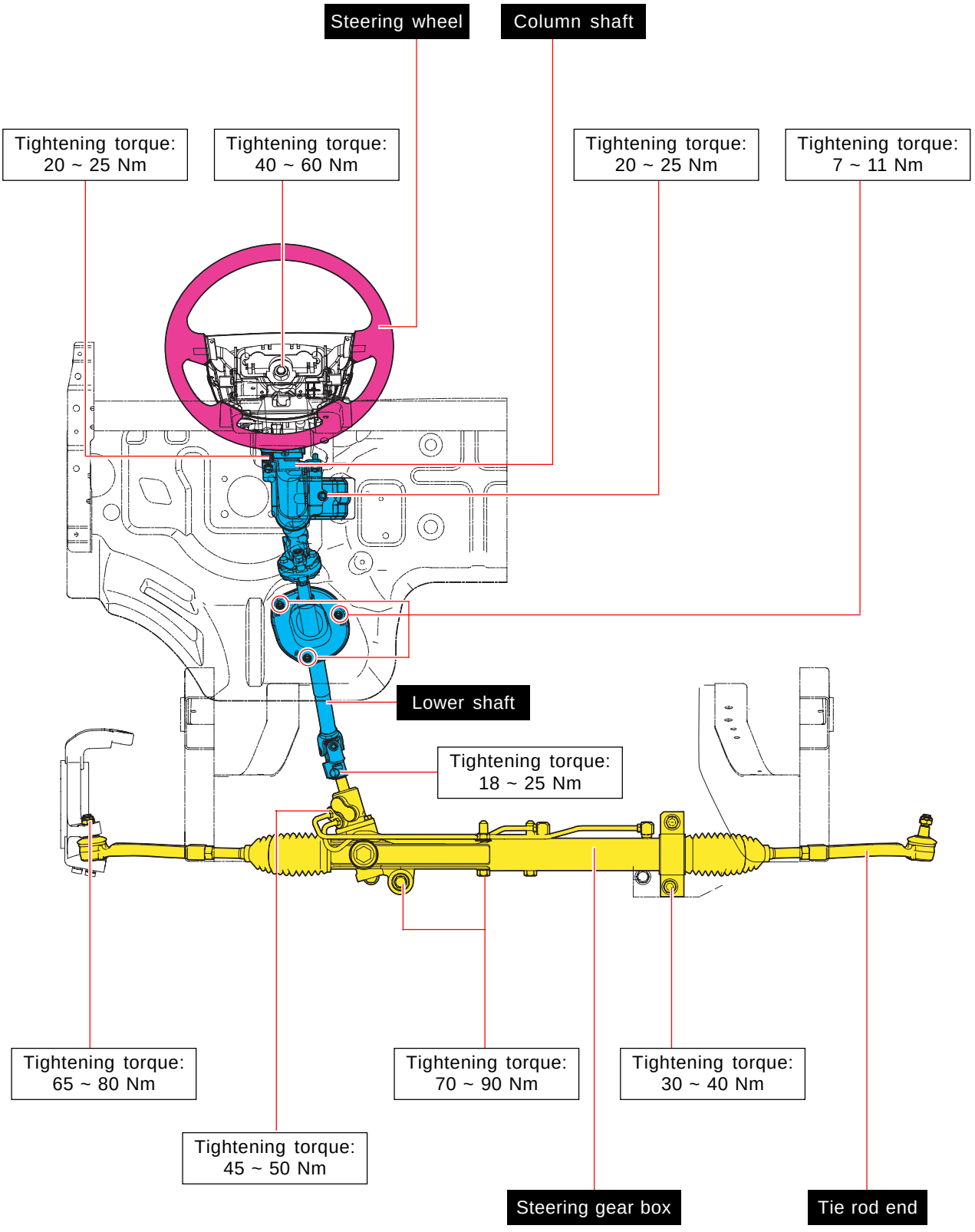
Installation Drawing of SSPS



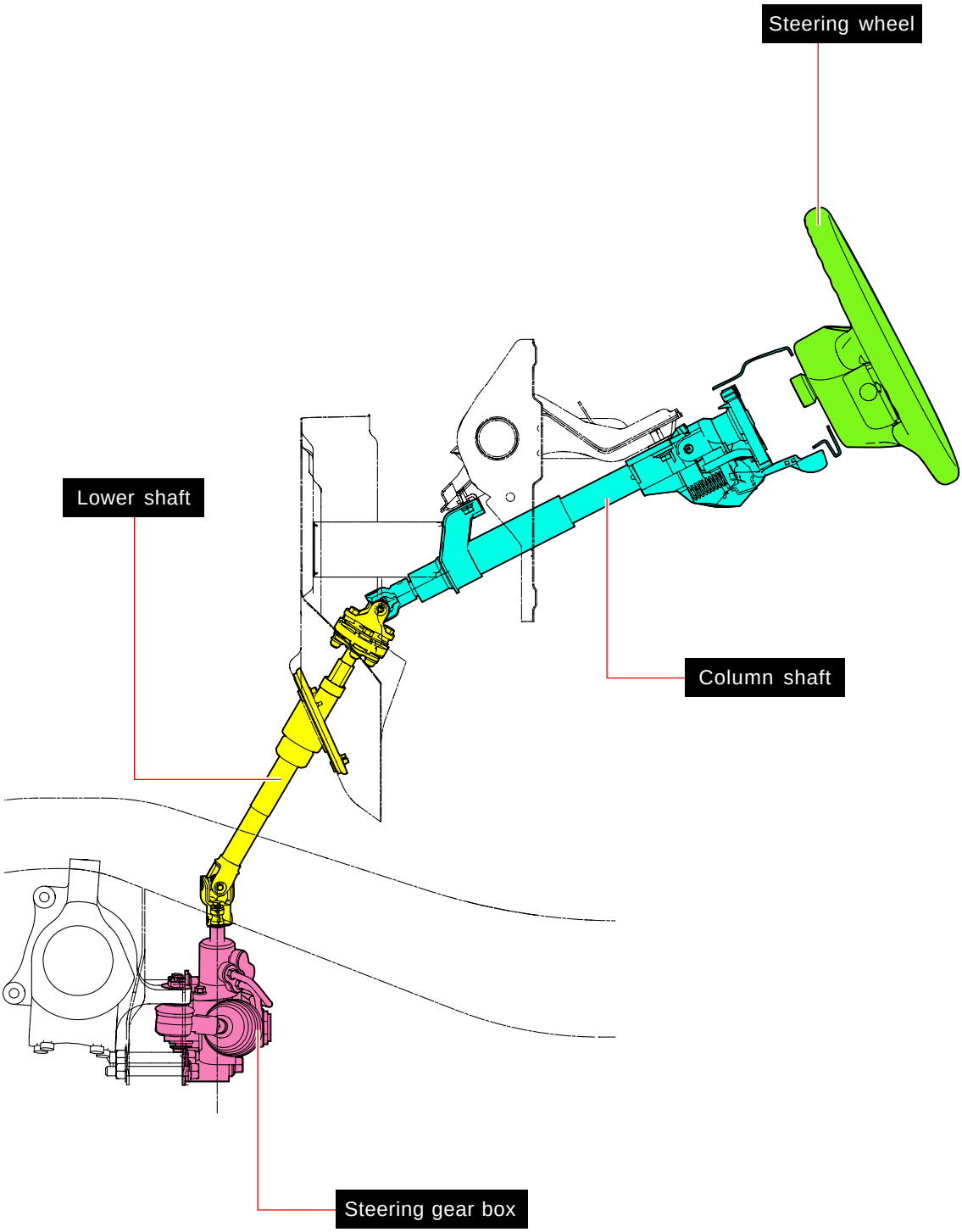
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▶ Components



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SSPS (Speed Sensing Power Steering)

1. GENERAL INFORMATION

▶ Overview

In the conventional constant power assist steering system, the steerability gets lighter as vehicle speed rises, and this may cause a dangerous situation. Where as having heavy steerability in high speed driving makes it difficult to manipulate the steering wheel when vehicle is in stop. This steering system solves this problem as the steerability is changed according to the vehicle speed, which is called Speed Sensitive Power Steering (SSPS).

SSPS, by providing appropriate steerability to a driver according to the changes of vehicle speed, gives steering stability. The power steering control unit adjusts the hydraulic pressure to reaction plunger by controlling the pressure solenoid valve located in the gear box to optimize the steerability. In other words, the steering wheel gets lighter by adjusting steerability in stop or low speed and provides steering stability by adjusting steering wheel to become heavier in high speed.



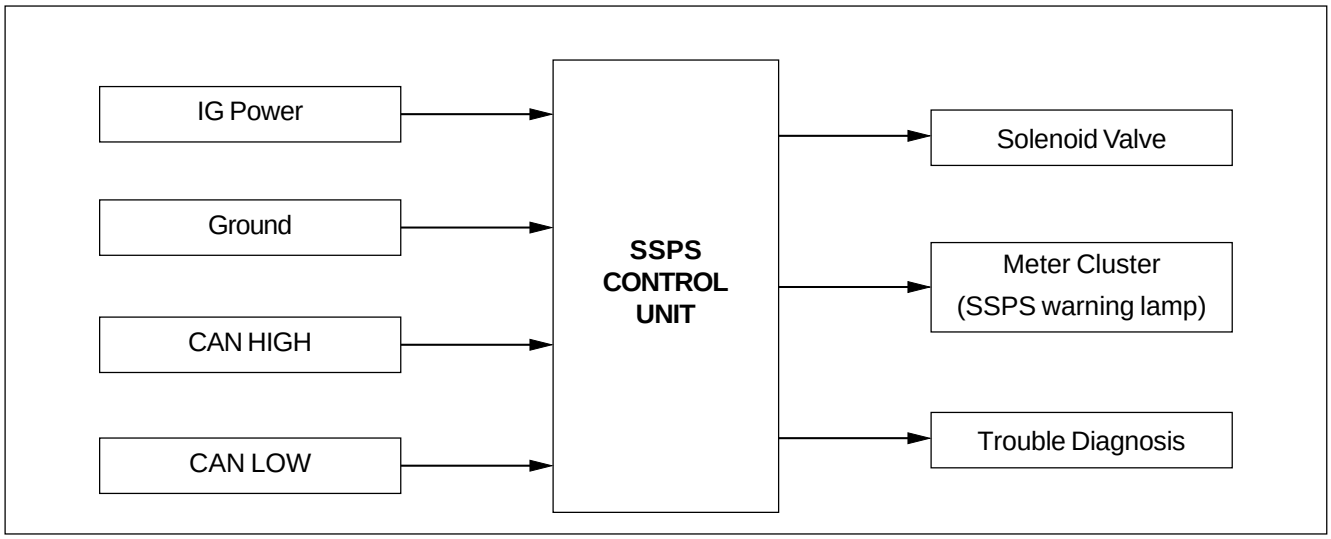
NOTICE

- **If the SSPS solenoid valve is defective, the power steering assembly should be replaced.**

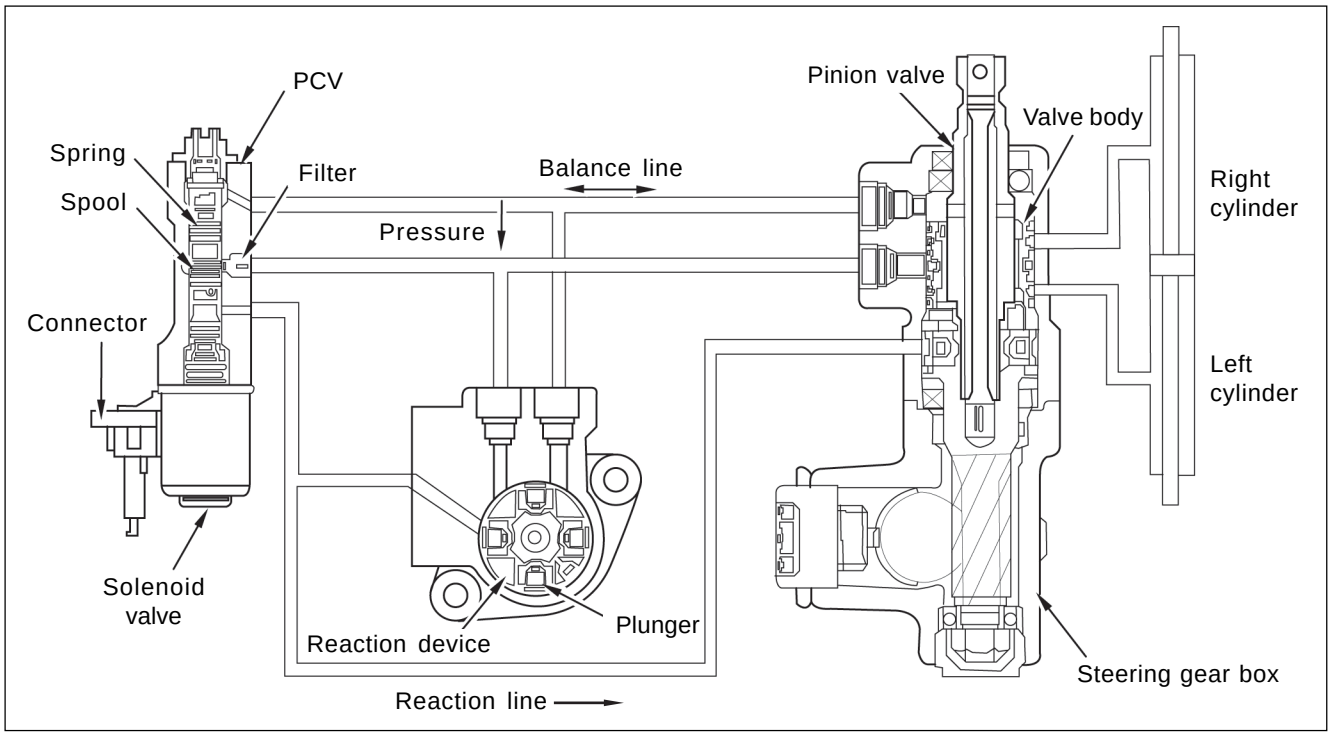
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▶ Function

Input/Output of SSPS Control Unit



SSPS Configuration



PCV (Pressure Control Valve)

This valve controls the hydraulic pressure supplied to reaction device by moving the spool valve according to the changes of solenoid valve.

Reaction device

This device increases the steerability effect by binding the input shaft with supplied hydraulic pressure from PCV.

Solenoid valve

This valve determines the valve spool position in PCV with the electric current supplied from SSPS control unit.

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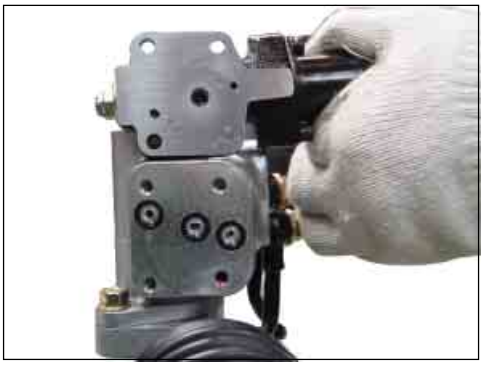
Solenoid Valve

Location





Cannot be replaced



The SSPS control unit controls the amount of electric current to the solenoid valve according to the vehicle speed. In other words, the solenoid valve controls the hydraulic pressure applied to reaction plunger by changing the valve spool position that is linked with solenoid valve according to the amount of electric current. The changes of hydraulic pressure applied to input shaft according to the pressure changes applied to the reaction plunger provide proper steerability based on the amount of electric current.

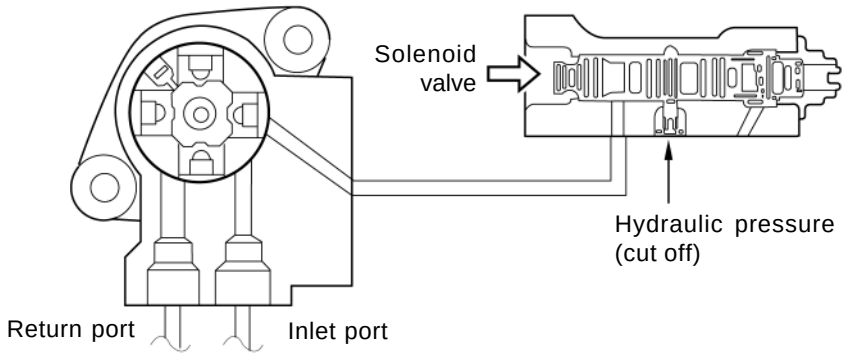
Specifications

Description	Specification
Voltage Rating	DC 12 V
Current Rating	1.0 A
Resistance	6.7 ± 1 Ω

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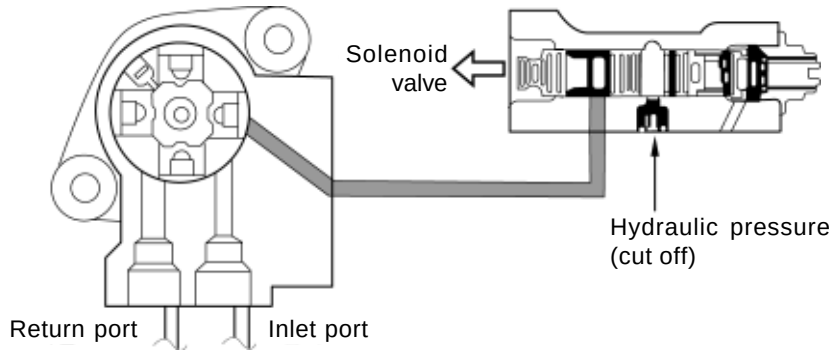
Operation

1. During parking and low speed driving



1) The SSPS control unit outputs nearly maximum electrical current.
2) The solenoid rod pushes the PCV spool to the right side.
3) The hydraulic pressure coming from pump is not supplied to the reaction device as the spool orifice is cut off.
4) The hydraulic pressure is cut off and the manipulation of steering wheel becomes lighter.

2. In medium and high speed driving

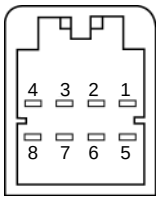


1) The shaft operating force of solenoid rod is reduced due to the reduction of output current from the SSPS control unit.
2) The coil spring pulls the PCV spool toward solenoid valve to open it.
3) The hydraulic pressure from pump flows to pinion reaction area through orifice and applies reaction force to reaction plunger.
4) At this time, the reaction plunger transmits the reaction force to V-groove in input shaft to provide heavy steerability.

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SSPS Control Unit

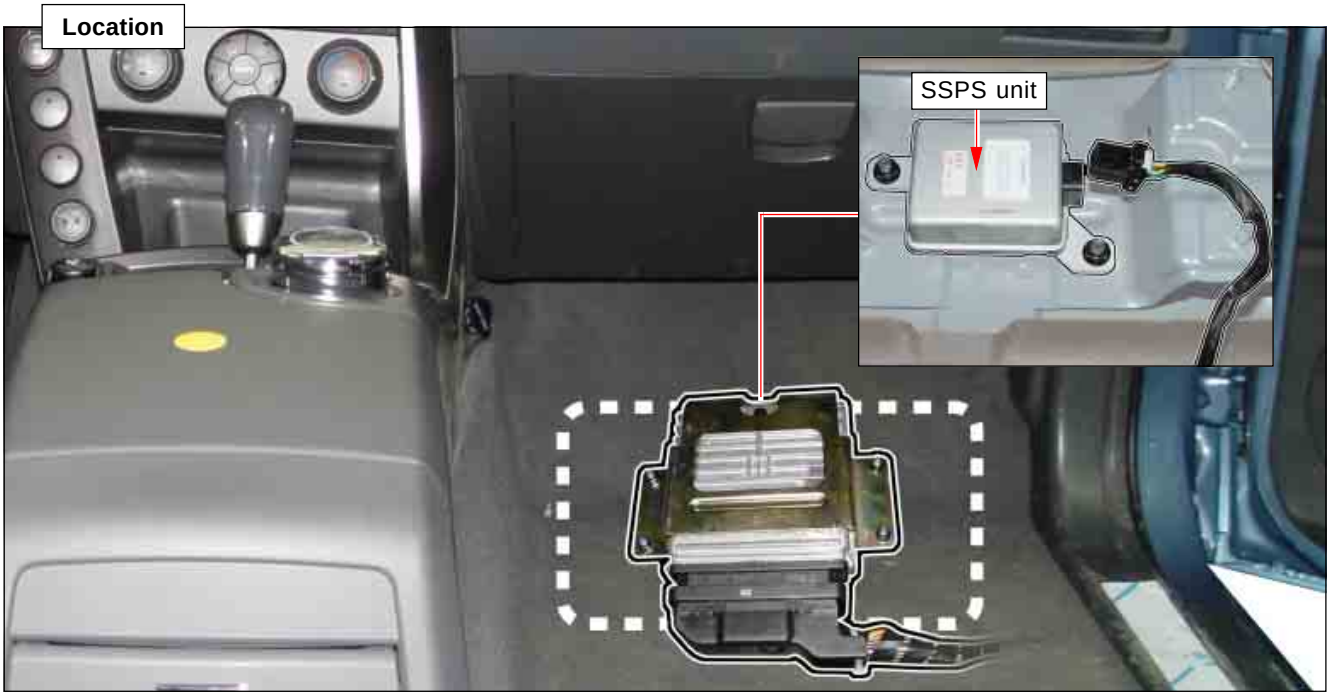
1. To provide proper steerability to a driver, the SSPS control unit controls the solenoid valve by receiving the vehicle speed and the throttle position data via CAN communication.
2. The SSPS control unit controls the working current for the solenoid valve with PWM type duty ratio of 333 Hz frequency and sets the target current to 1A during 1 second after the ignition is “ON”.
3. When a trouble occurs in the system, the SSPS control unit generates a trouble code using fail safe function.





Pin No.	Function
1	Ignition Power Supply
2	CAN HIGH
3	Solenoid
4	Solenoid
5	Ground
6	Warning Lamp (SSPS)
7	CAN LOW
8	Self Diagnosis

Location

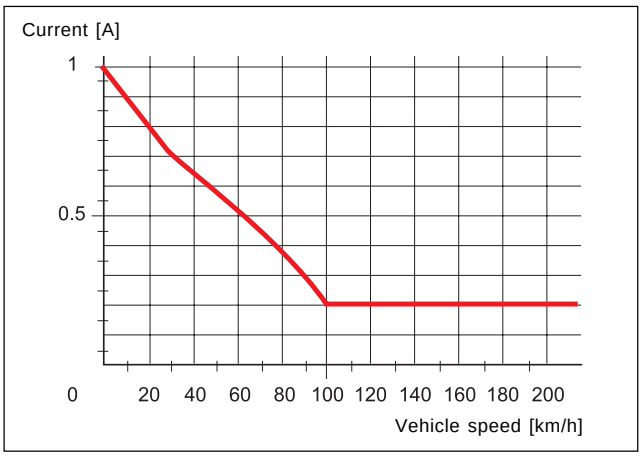


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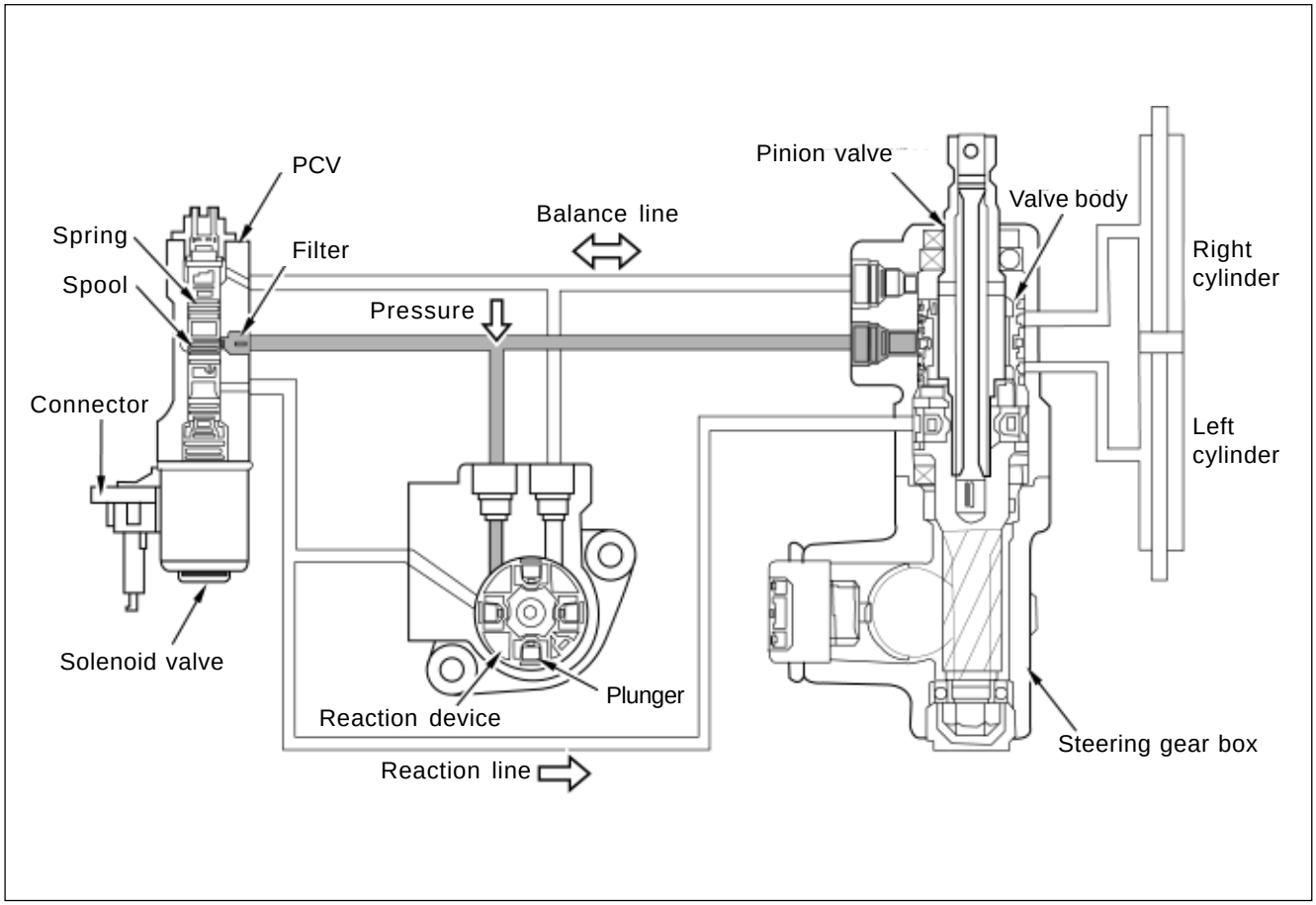
System Control

The SSPS system, according to the vehicle speed, enables to achieve proper steering characteristics by controlling hydraulic pressure to reaction plunger located in input shaft of power steering gear box. In other words, the SSPS control unit enhances the parking conveniences by controlling duty type current control. It provides heavy steerability with low current as the vehicle speed increases. Also, it provides light steerability with high current as the vehicle speed decreases.



1. During parking and low speed driving

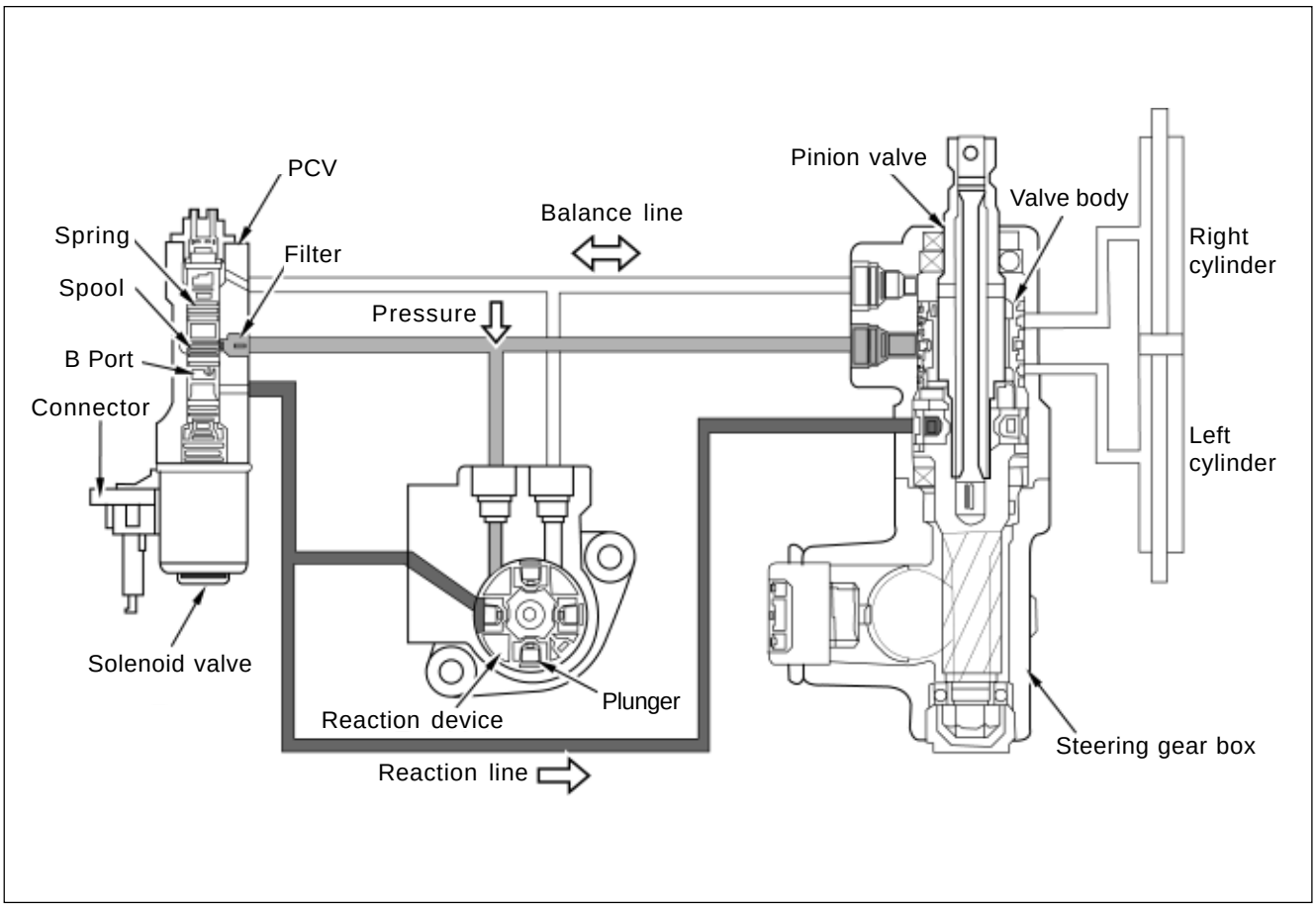
During parking and driving in low speed, the control unit supplies approx. 1 A of electric current to solenoid valve. Then, the spool located in PCV compresses the upper spring and elevates upward, and the working pressure from oil pump (A port) is not able to flow to the reaction plunger (C port). As a result, the pressing force from the reaction plunger disappears and the steerability enhances.



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2. During high speed driving

During high speed driving, the control unit supplies weak electric current to solenoid valve. Then, the spool located PCV moves from top to bottom, and the working pressure (A port) from oil pump is applied to reaction plunger (C port) through B port. As a result, the pressing force from reaction plunger against input shaft is increased and the steerability becomes heavier.



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2. TROUBLE DIAGNOSIS

Electric Current Check

1. Disconnect the solenoid valve connector (waterproof connector) and install the ammeter between the solenoid valve connector and the wiring harness.

NOTICE

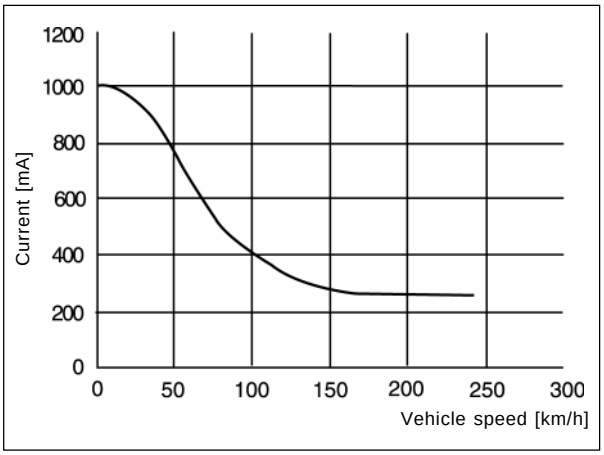
- **Do not ground the solenoid terminal.**

SSPS solenoid valve



2. When the vehicle speed is at 0 km/h, check whether the electric current for solenoid is in specified range and check that the current is reduced as the vehicle speed increases.

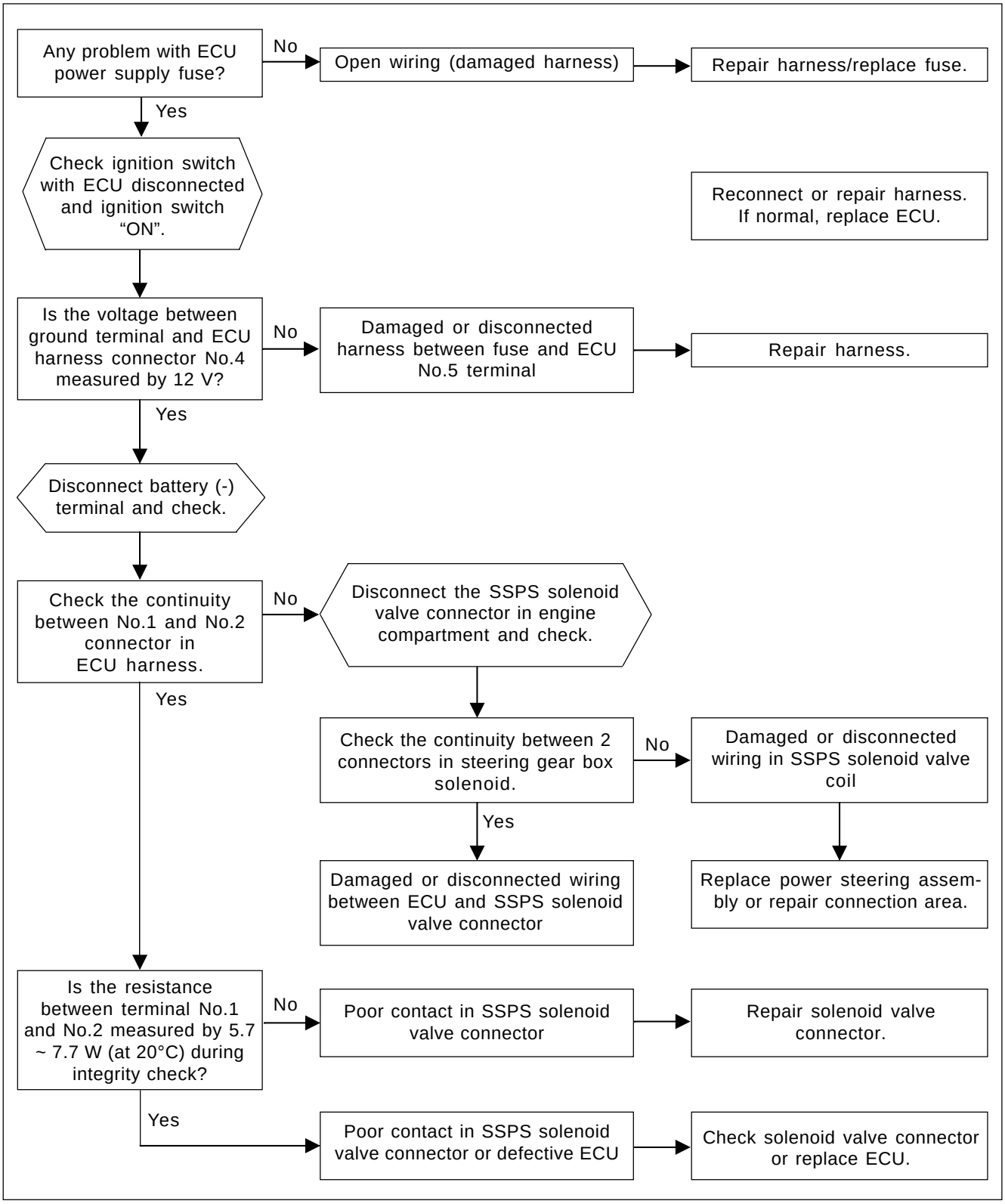
Current	0.9 ~ 1.1 A (vehicle speed at 0 km/h)



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Flow Chart for Trouble Diagnosis

NOTE
- **Use a Scan-I to check.**
- **Refer to the circuit diagram for the SSPS ECU.**



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Fail Safe Function

No.	Trouble	Trouble Condition	Detecting Time	Trouble Code	Action	Description
1	Over voltage	V_{IG} > 17 V	1 sec	C1104	Solenoid current: 0 A	10 V < V_{IG} < 16 V
2	Low voltage	V_{IG} < 8 V	1 sec	C1105	Solenoid current: 0 A	10 V < V_{IG} < 16 V
3	Vehicle speed sensor	PW > 30 %, vehicle speed 0 km/h	60 sec	*C1212	Vehicle speed: 80 Km/h	Input signal of vehicle speed of 5 km/h for over 1 second
4	ECU error	Faulty EEPROM Read/Write, PWM management error	1 sec	C1604	Solenoid current: 0 A	IGN ON/OFF
5	Detected current	Detected current > 1.28 A	1 sec	C2203	Solenoid current: 0 A	Power On Reset
		When solenoid is disconnected	1 sec			
		Target current - detected current > 0.2 A and V_{IG} > 13 V	2 sec			
6	CAN error	No CAN messages	30 sec	C1623	Vehicle speed: 80 Km/h	Received messages more than once

C1212 Help

C1212 Trouble Code: displayed when the vehicle speed sensor is faulty.

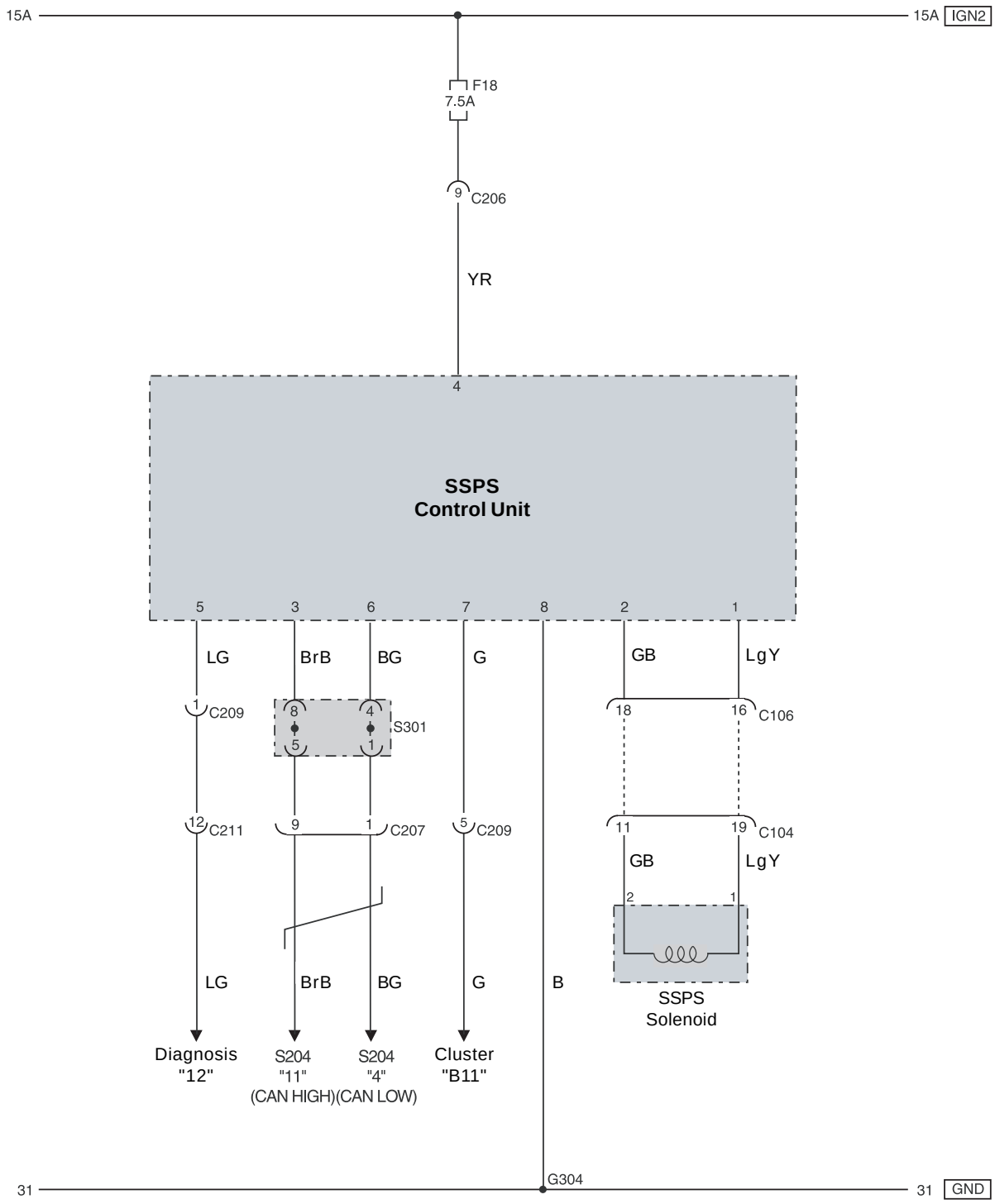
1. If the vehicle is 0 km/h for 60 seconds while depressing the accelerator pedal, it is determined by 80 km/h.
2. Release condition: goes back to normal status when the vehicle speed is over 5 km/h for 1 second.
3. Check for CAN communication line (pin No. 3 and 6).
4. Check the connectors for poor contact.

NOTICE

- **When the Fail Safe function is activated, the steering wheel operation needs much more force due to no currents to SSPS solenoid.**

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▶ Circuit Diagram



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▶ Trouble Diagnosis

Symptom	Cause	Action
Hard steering	Lack of lubrication, Abnormal wear or binding of steering ball joint	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 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

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▶ General Inspection

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 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.**

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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. 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.
9. Measure the oil pressure with the gauge valve fully open.
10. If the pump pressure is in specified range, the pump is normal. If not, replace the power steering pump.



NOTICE

- **To prevent internal damage, do not close the gauge valve over 10 seconds.**

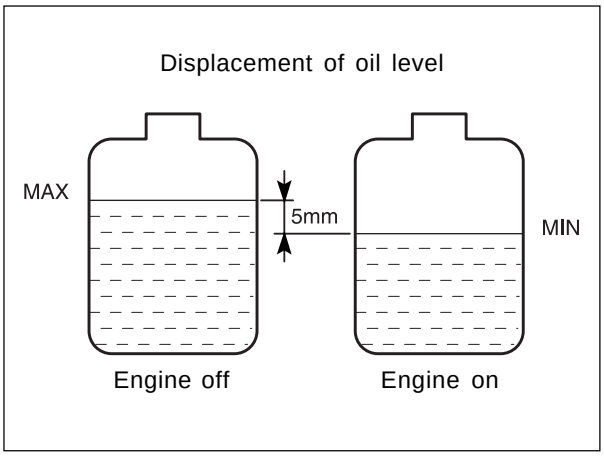
Pump relief valve pressure	89 ~ 97 kg/cm^2
Pump pressure at no load	3 ~ 5 kg/cm^2

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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.

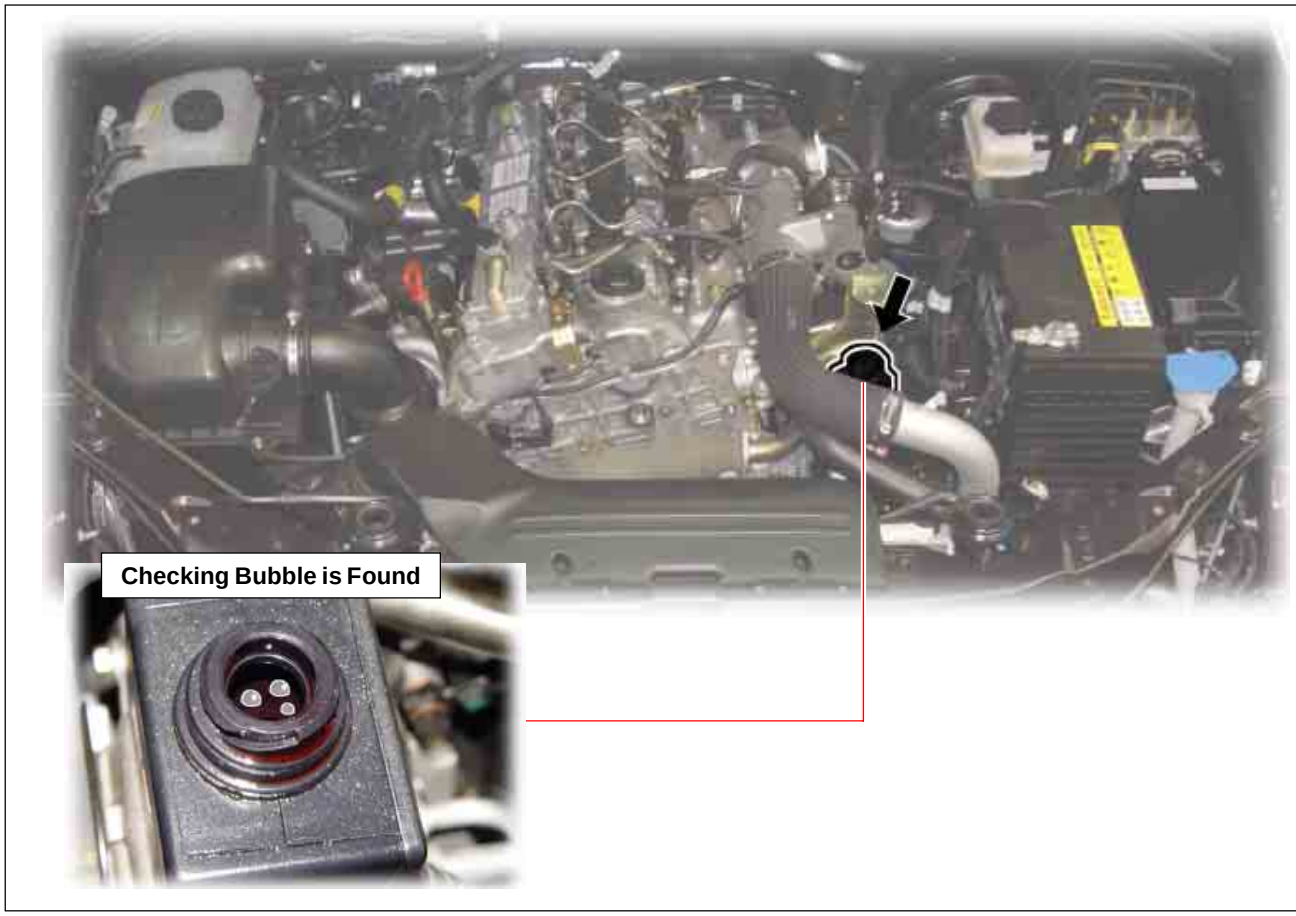


Checking

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.

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AIR BLEEDING



Air Bleeding

1. Lift up the vehicle in straight ahead direction of the steering wheel (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 repeatedly until any bubble cannot be seen in the reservoir.
4. If any bubble is not found anymore, add the specified oil into the reservoir to the specified level.

*** Checking ***

1. Start the engine and repeat the second and third step above.
2. This process should be performed to check if air still exists in the power steering system.

NOTICE

- **Position the gear shift lever to “N (M/T)” or “P (A/T)”, and apply the parking brake before starting the engine.**

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3. REMOVAL AND INSTALLATION

The SSPS unit is installed on the bottom of engine ECU located in the passenger foot wall.

NOTICE

- **If the SSPS solenoid valve is defective, the power steering assembly should be replaced.**

SSPS Control Unit

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the engine ECU under the floor carpet.





2. Disconnect the SSPS control unit connector and separate the SSPS control unit from engine ECU.



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SSPS Control Unit







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▶ 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). Disconnect the airbag module connector.



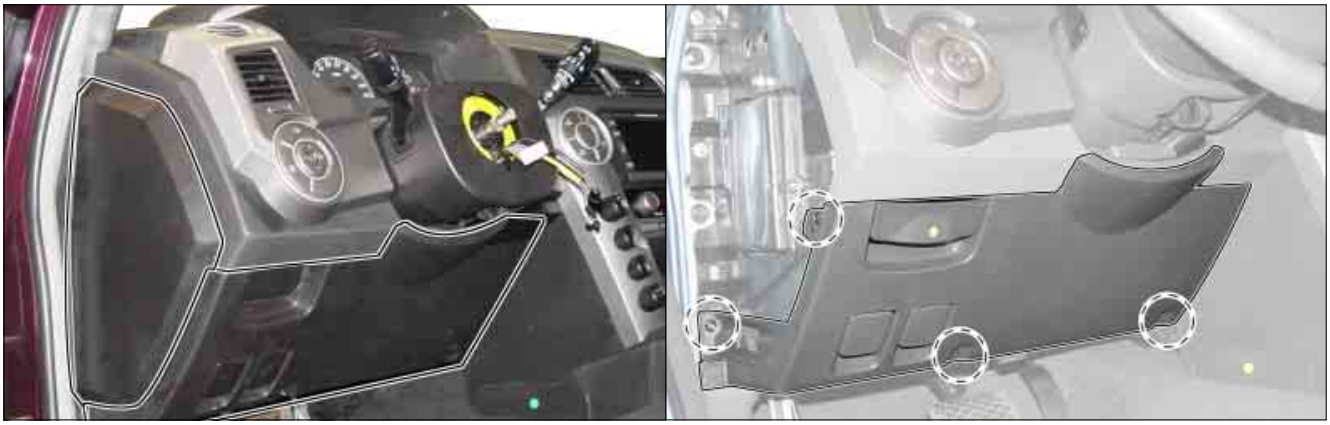
2. Unscrew the steering wheel lock nut and remove the wheel with special tool.

NOTICE

- **Make an alignment marks on the column shaft and steering wheel for correct installation.**



3. Remove the instrument panel side cover and unscrew the side lock bolt and screws to remove the instrument lower panel.



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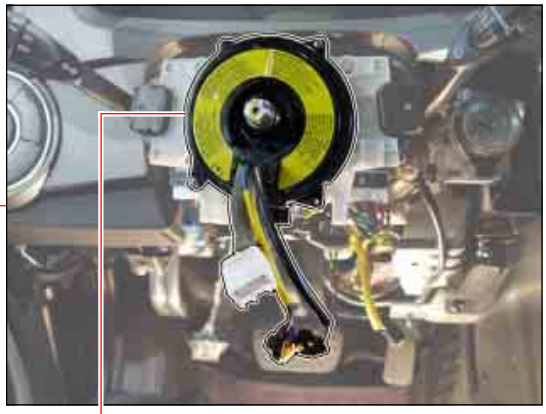
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4. Remove the protective panel and undercover from the lower panel and remove the upper/lower column covers.

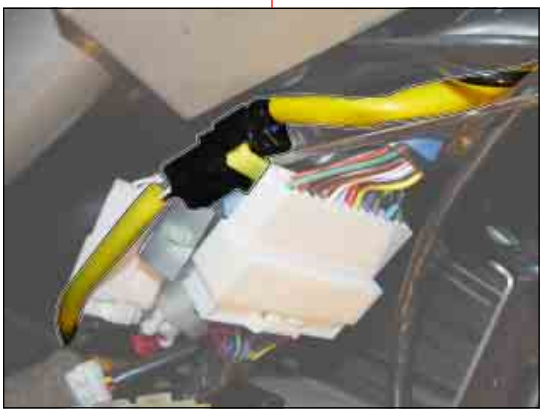


5. Disconnect the contact coil and connector from the column shaft and remove the contact coil assembly.





Contact coil mounting screw



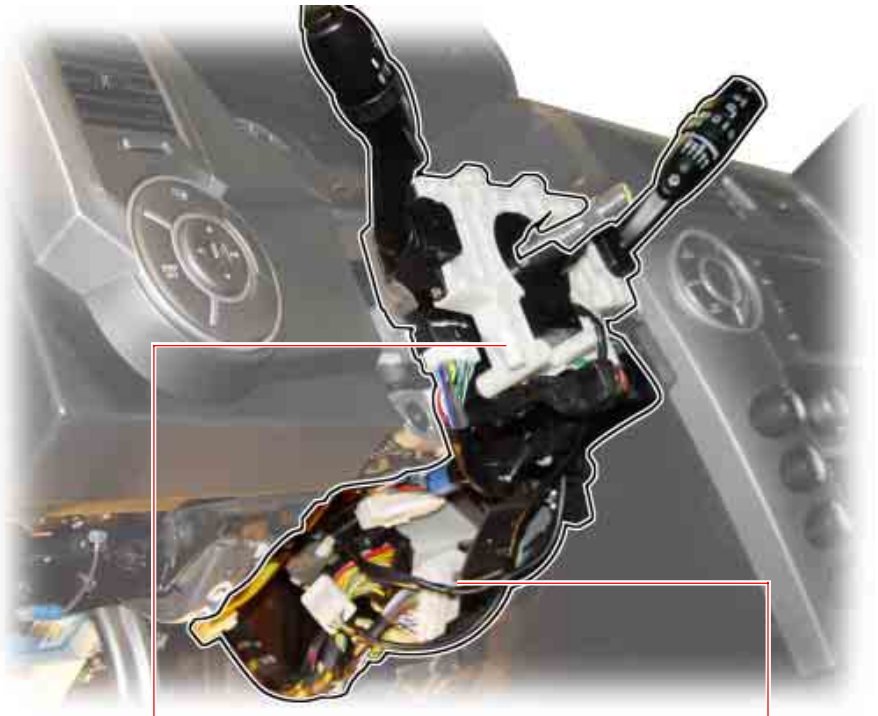
Inlet portDisconnect the connector



Align the alignment marks when installing

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6. Disconnect connectors and remove the combination switch from the steering column.





Unscrew the mounting screws



Disconnect the connectors

Combination Switch Assembly

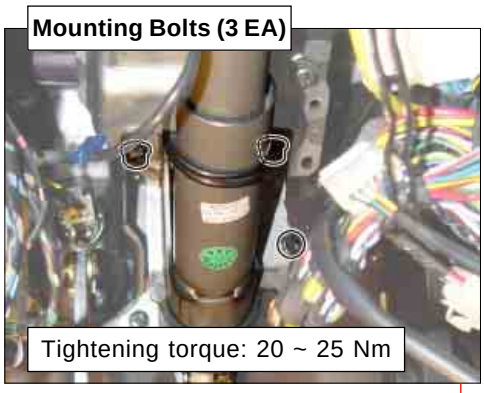


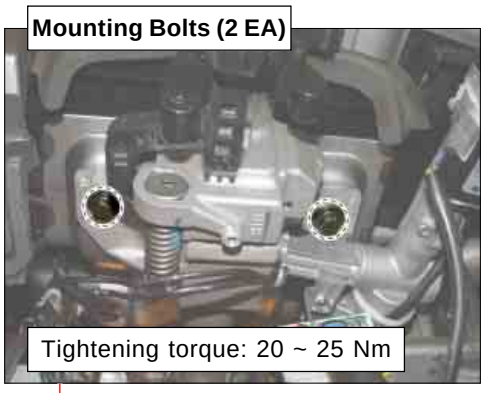


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7. Unscrew the bolts and nuts and remove the steering column shaft assembly while pulling down it.











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▶ Lower Shaft

1. Remove the upper lock bolt inside the vehicle and the lower lock bolt in underbody.





2. Remove the lower shaft mounting nuts on floor.

Installation Notice

Tightening torque	7 ~ 11 Nm



3. Remove the lower shaft.

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 Assembly



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▶ Steering Gear Box

※ **Preceding Works:** 1. Disconnect the negative battery cable.
2. Remove the tire.

1. Remove the cotter pin and lock nut. Remove the tie rod from steering knuckle by using a special tool.

661 589 13 33 00 (W 99 44 002 0A)
Ball Joint Puller





2. Remove the SSPS connector.



3. Unscrew the lower bolts and remove the lower shaft and gear box.



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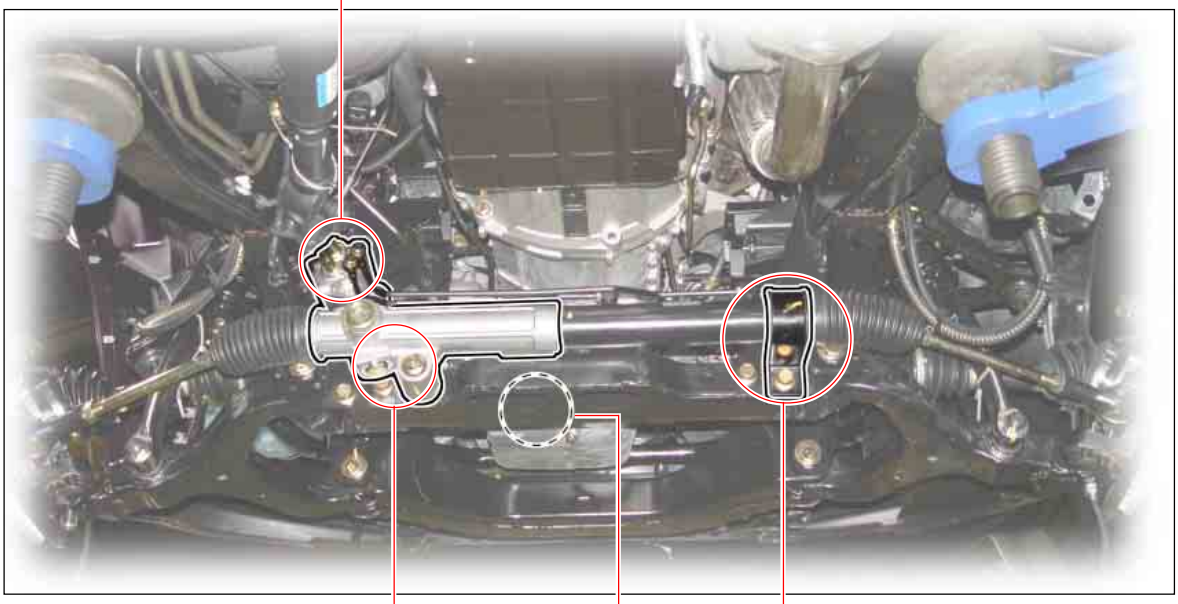
4. Disconnect the power steering pipes and remove the steering gearbox mounting bolts.

Supply and Return Pipes



NOTICE

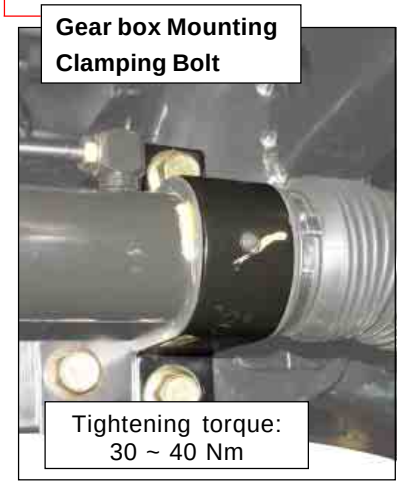
- **Plug the pipe openings with caps.**
- **Be careful not to spill the oil on the floor and vehicle body.**



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.**

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▶ Steering Gear Pump

1. Remove the drive belt.



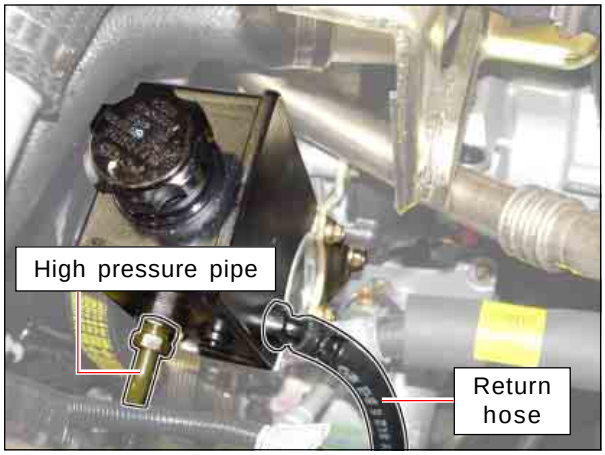
2. Disconnect the power steering return hose and remove the high pressure pipe nut.

Installation Notice

Tightening torque	40 ~ 50 Nm

NOTICE

- **Plug the openings so that power steering fluid doesn't leak out.**



3. Unscrew the nuts and remove the pump assembly with bracket.

Installation Notice

Tightening torque	20 ~ 23 Nm



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MEMO

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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 SYSTEM 7

1. General information 7
2. General information of ESP system 8
3. Principle of ESP 12
4. HBA (Hydraulic Brake Assist system) 15
5. ARP (Active Roll-over Protection) 16
6. HDC (Hill Descent Control) 17
7. Components and locations 24
8. Input and output diagram 26
9. ESP system related precautions 27
10. Hydraulic circuit diagram 28
11. Hydraulic pressure for each ESP operating range 29
12. Hydraulic circuit of HBA (Hydraulic Brake Assist) 31
13. Components description 32
14. Bleeding ESP system 46
15. ABS/ESP trouble diagnosis 48

ABS SYSTEM 60

1. General information 60
2. Configuration of ABS system 63
3. Input and output diagram 64
4. Hydraulic circuit of ABS 65
5. ABS circuit in each operation range 66
6. Components and location 67
7. Components description 68
8. Removal and installation 69

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GENERAL INFORMATION

1. GENERAL INFORMATION

For **the front brake system**, the ventilated disc type is applied regardless of the ABS/ESP system installation. Two 43 mm diameter calipers (non-ABS/ESP equipped vehicles) and two 45 mm diameter calipers (ABS/ESP equipped vehicles) are installed.



Front Ventilated Disc and Caliper (2 internal Cylinders)

For **the rear brake system**, specifications differ between ABS/ESP system equipped vehicles and non-ABS/ESP system equipped vehicles. The drum type brake is installed on non-ABS equipped vehicles. When ABS/ESP is installed on the 5-link type suspension, the solid disc (disc thickness: approx. 10.4 mm) is installed. When ABS/ESP is installed on the independent suspension, the ventilated disc (disc thickness: approx. 20 mm) is installed.



ABS/ESP + 5Link Suspension: solid type disc
ABS/ESP + Independent suspension: ventilated disc

Rear Disc and Caliper (1 Internal Cylinder)

Parking brake system: The hand operated type parking brake is installed on vehicles with the manual transmission and the foot operated type parking brake is installed on vehicles with the automatic transmission.



Hand Operated Type (Vehicle with Manual Transmission)



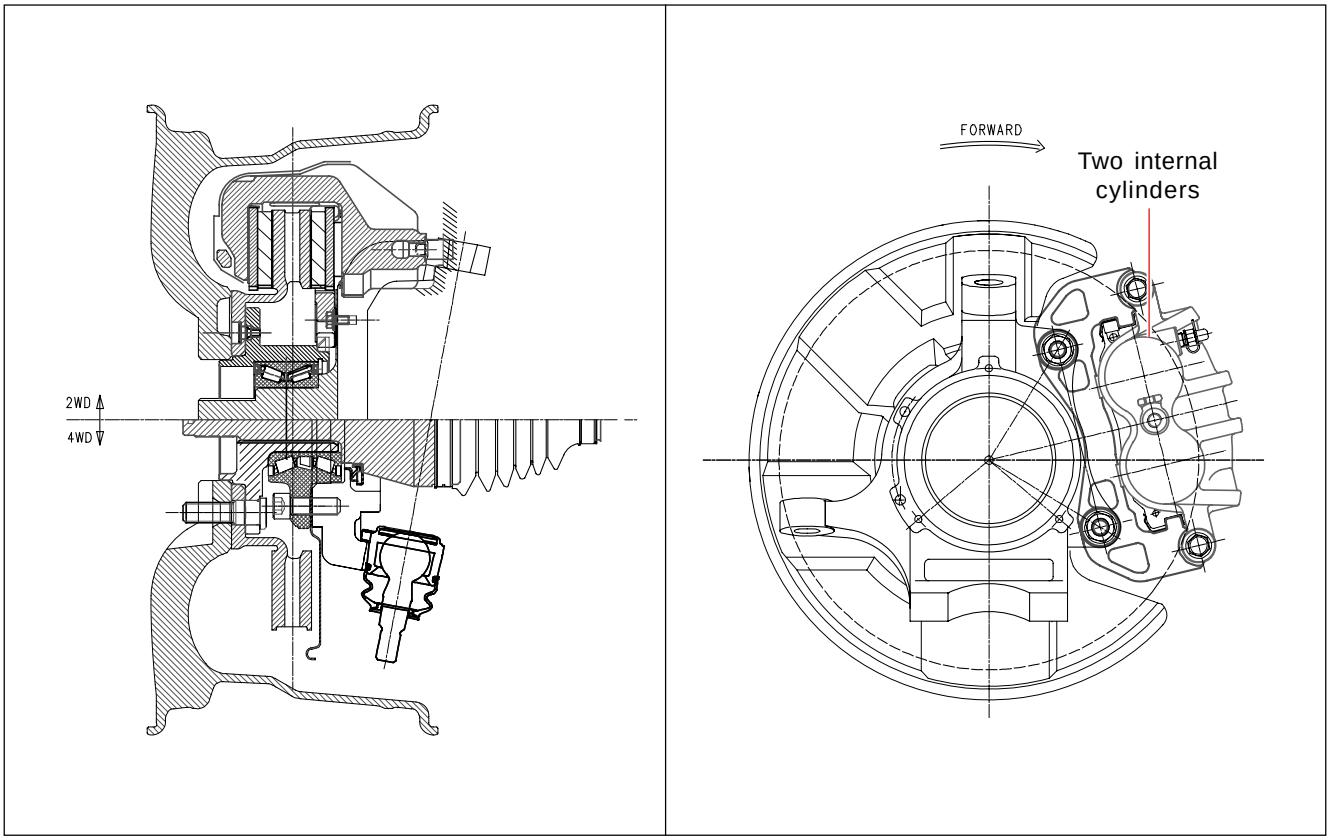
Foot Operated Type (Vehicle with Automatic Transmission)

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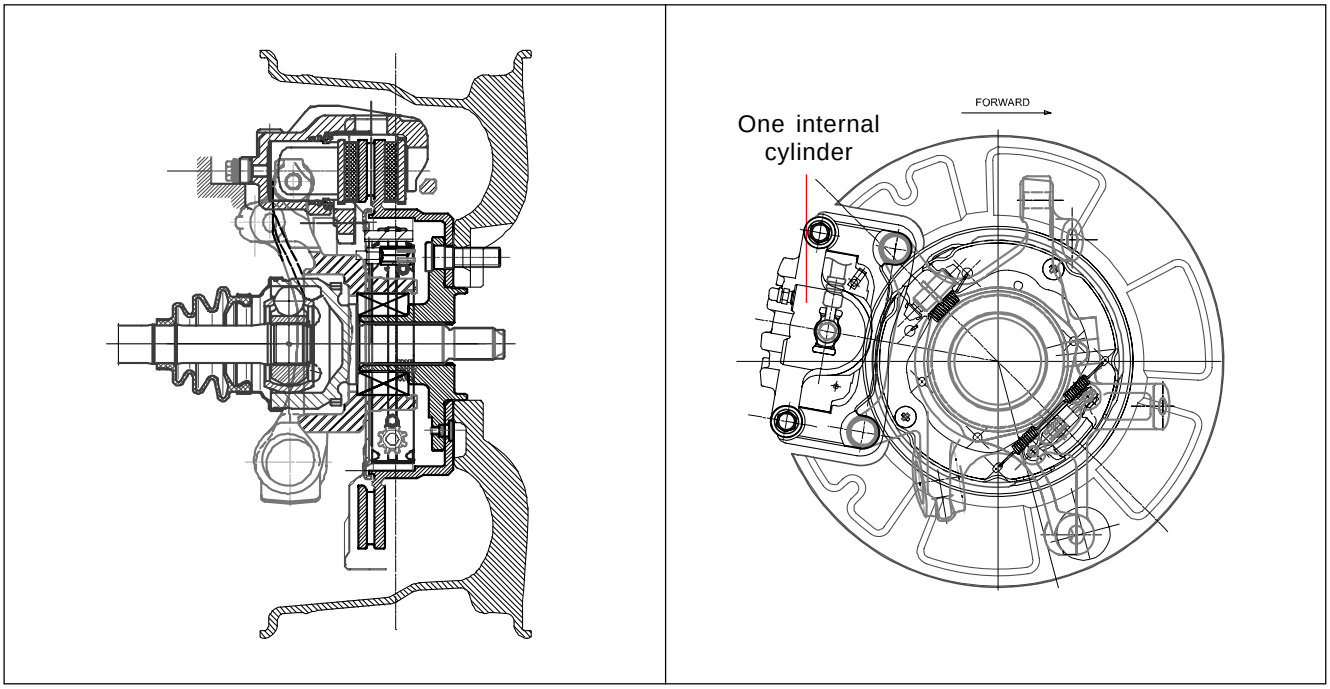
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▶ Sectional Drawing

Front Disc Brake



Rear Disc Brake

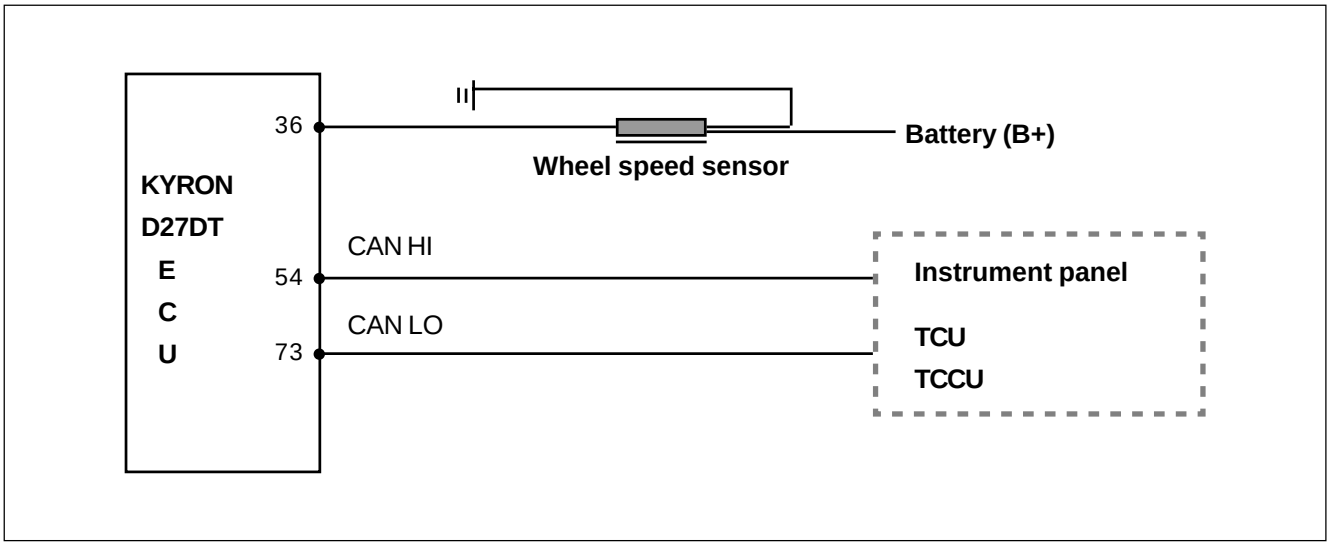


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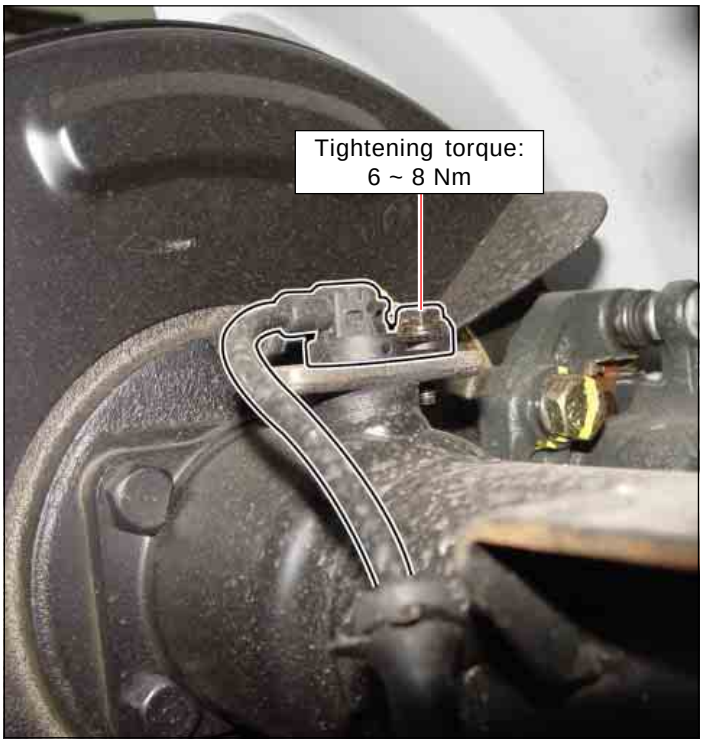
▶ Non-ABS Equipped Vehicle – With One Wheel Speed Sensor

The wheel speed sensor is installed on the rear right wheel regardless of the ABS/ESP installation.

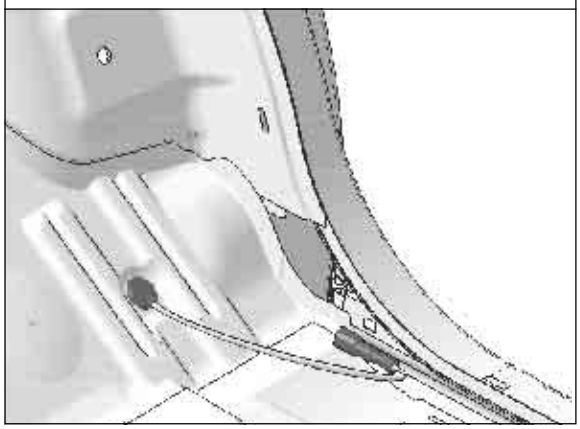
This sensor is to signal the vehicle speed to the engine ECU, TCCU, transmission, and instrument panel. There is no separate unit to process the wheel speed sensor signal. The wheel speed sensor is connected to the engine ECU (terminal 36), where its signal is processed, and is connected to other related systems through CAN communication.



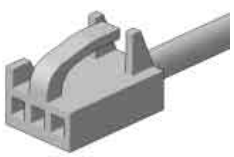
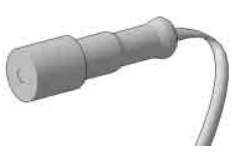
Location of the wheel speed sensor (rear right wheel)



Location of the Sensor Connector



Connector Appearance

In vehicle without ABS	In vehicle with ABS/ESP
	

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2. SPECIFICATIONS

Description		NON-ABS (5-link suspension)	ABS/ESP	
			5-link suspension	Independent suspension (IRS)
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	
	Pad thickness	10.5 mm	10.5 mm	
	Brake pad wear limit	2 mm	2 mm	
	Disc plate thickness	26 mm	28 mm	
	Disc plate wear limit	24 mm	25.4 mm	
	I.D./O.D. of disc plate	ϕ294 /ϕ184 mm	ϕ294 /ϕ184 mm	
Rear brake	Type	Drum type	Solid disc type	Ventilated 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	ϕ42.9 mm
	Brake pad thickness	-	10 mm	10 mm
	Wear limit of brake pad	-	2 mm	2 mm
	Disc plate thickness	-	10.4 mm	20 mm
	Wear limit of disc plate	-	8.5 mm	18.4 mm
	I.D./O.D. of disc plate	-	ϕ299/ϕ220 mm	ϕ307/ϕ214 mm
Parking brake	Type	Mechanical type, rear wheels operated		Mechanical type, rear wheels operated
	Operation type	Manual type - Hand (MT)/Foot (AT)		Manual type - Foot
	I.D. of drum	ϕ254 mm	ϕ190 mm	ϕ190 mm
Brake fluid	Capacity	0.7 ~ 0.8 ℓ		
	Specification	DOT4		

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3. BRAKE OPERATION AND NOISE

This section describes the noise phenomena possibly occurring 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 when the engine is cold, “screeching” sound always occurs and, after driving for a while, it 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 disk 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.

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ESP SYSTEM

1. GENERAL INFORMATION

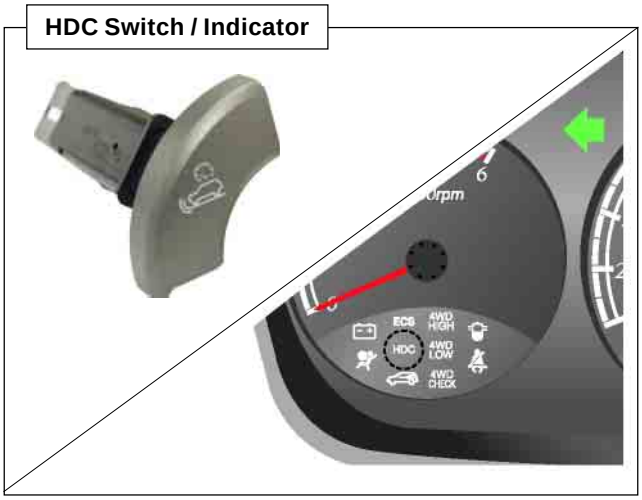
The ESP system consists of basic ABS functions, the vehicle position control depending on the driving conditions and the road conditions, the HBA (Hydraulic Brake Assist System) that improves the braking power in an emergency, the ARP (Active Rollover Protection) that obstructs the physical tendency 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%: about 5.71° (degree)).

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)**

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2. GENERAL INFORMATION OF ESP SYSTEM

Differences compared to other models: Appearance of wheel speed sensor, Location, Layout of relevant components



ESP HECU



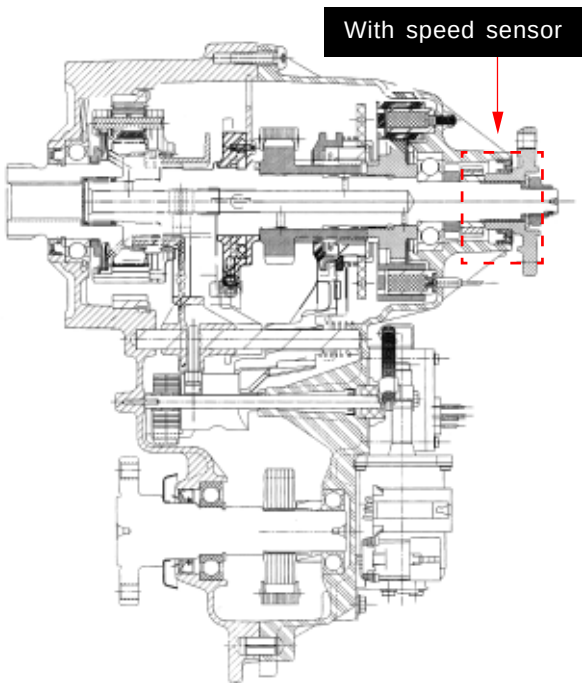
Active Wheel Speed Sensor



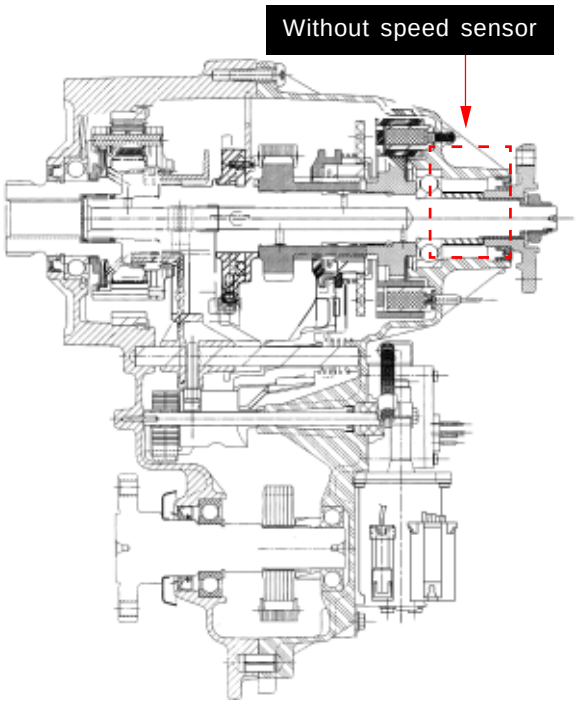
HDC Switch

The transfer case (T/C) installed on this vehicle doesn't have the internal speed sensing device and receives the speed signal for T/C control from ESP HECU via CAN bus.

[Conventional T/C]



[New T/C]

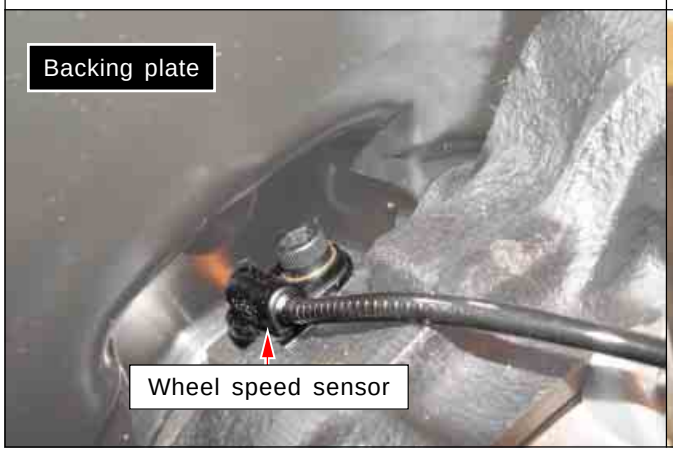


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Cautions When Removing the Front Wheel Speed Sensor

The locking hub system of the KYRON part time 4WD utilizes a different hub actuator from the conventional approach. It 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 (4WD)	Rear Wheel Speed Sensor (IRS Type)
	

Wheel Speed Sensor





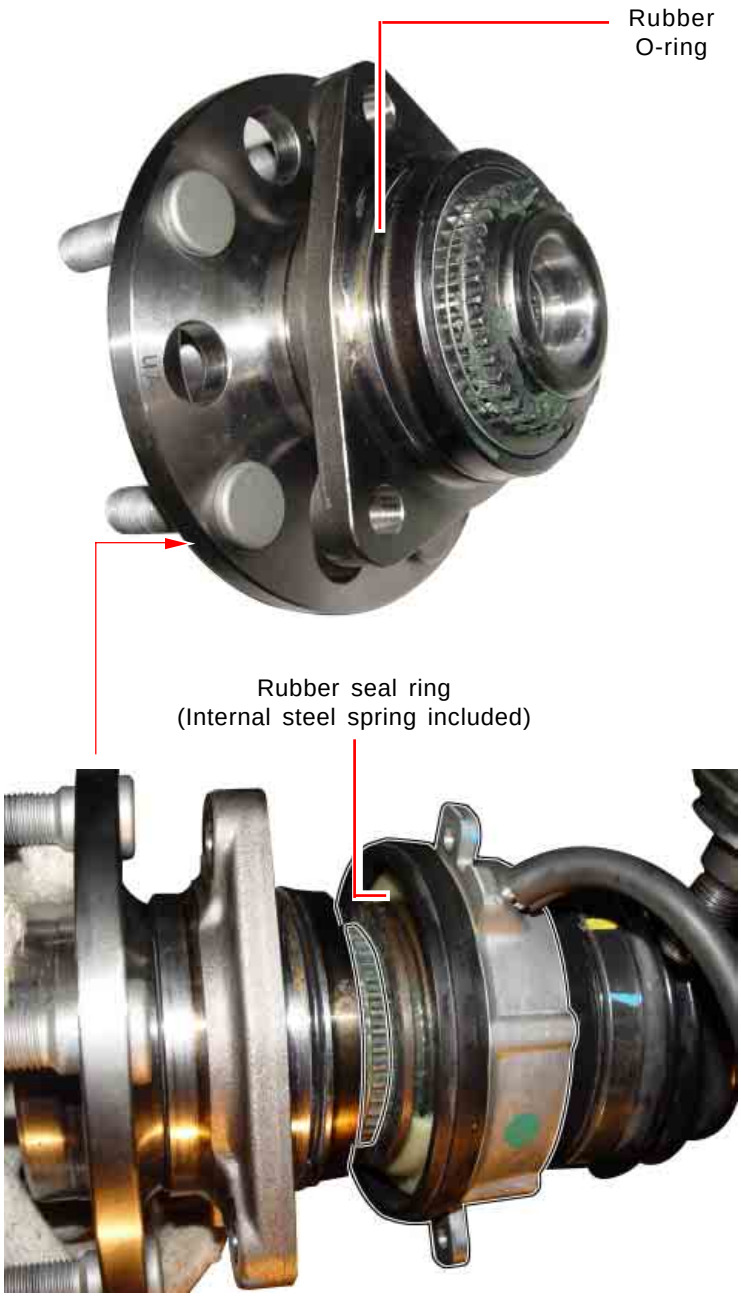
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The rubber O-ring in IWE (Integrated Wheel End) should be replaced with new one when the front wheel end has been removed.

The rubber O-ring prevents moisture and foreign materials from entering the IWE system.

In addition, when installing the hub actuator of the IWE system, you must install it from the same angle as the drive shaft to prevent the rubber seal ring inside the actuator from being squeezed.



Please refer to the part time transfer case section for more specific information.

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When the ESP system is added to the ABS system, some devices will be added to the HECU (Hydraulic & Electronic Control Unit) and wheel speed sensor used in the ABS system. The devices are as follows:

1. 2 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 (32 bit) Clock Frequency: 28 MHz Memory: 512 KB EEP ROM: 1 KB	CPU: PEC 1 (32 bit) Clock Frequency: 33 MHz Memory: 512 KB EEP ROM: 1 KB New software version: KM 20	beside of brake booster
Wheel Speed Sensor	Active Type	Active Type	Mounted in each wheel (×4EA) Front airgap: 0.335 ~ 0.945 mm Rear airgap: 0.309 ~ 0.958 mm
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 and lateral sensor. Also, used for sensing G value for HDC (Hill Descent Control).	Behind the center audio in instrument panel
Pressure Sensor	N/A	Analog Output	Under master cylinder

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3. PRINCIPLE OF ESP

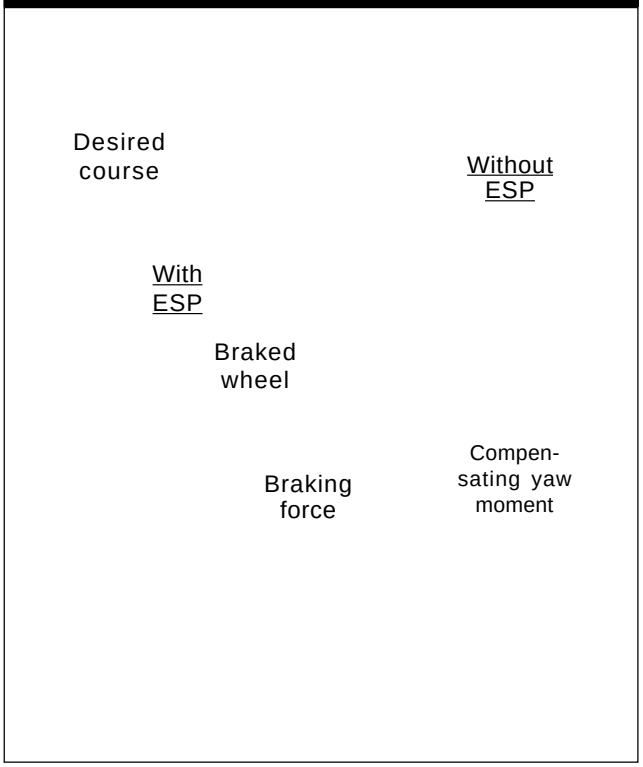
▶ Understeer & Oversteer Control

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.

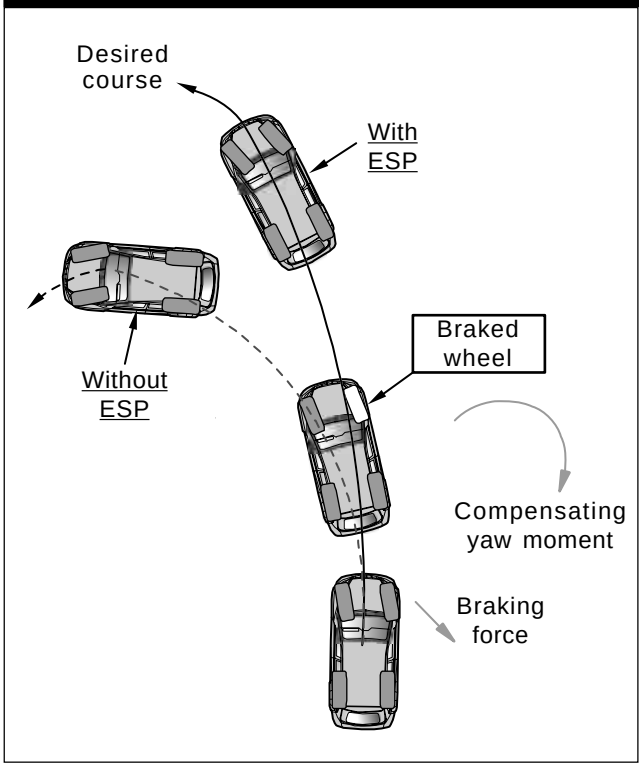
The yaw rate sensor, lateral sensor and longitudinal sensor in the sensor cluster and the steering wheel angle sensor under the steering column detect the spin present at any wheels during over-steering, under-steering or cornering. The ESP ECU controls against over-steering or under-steering during 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.

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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.

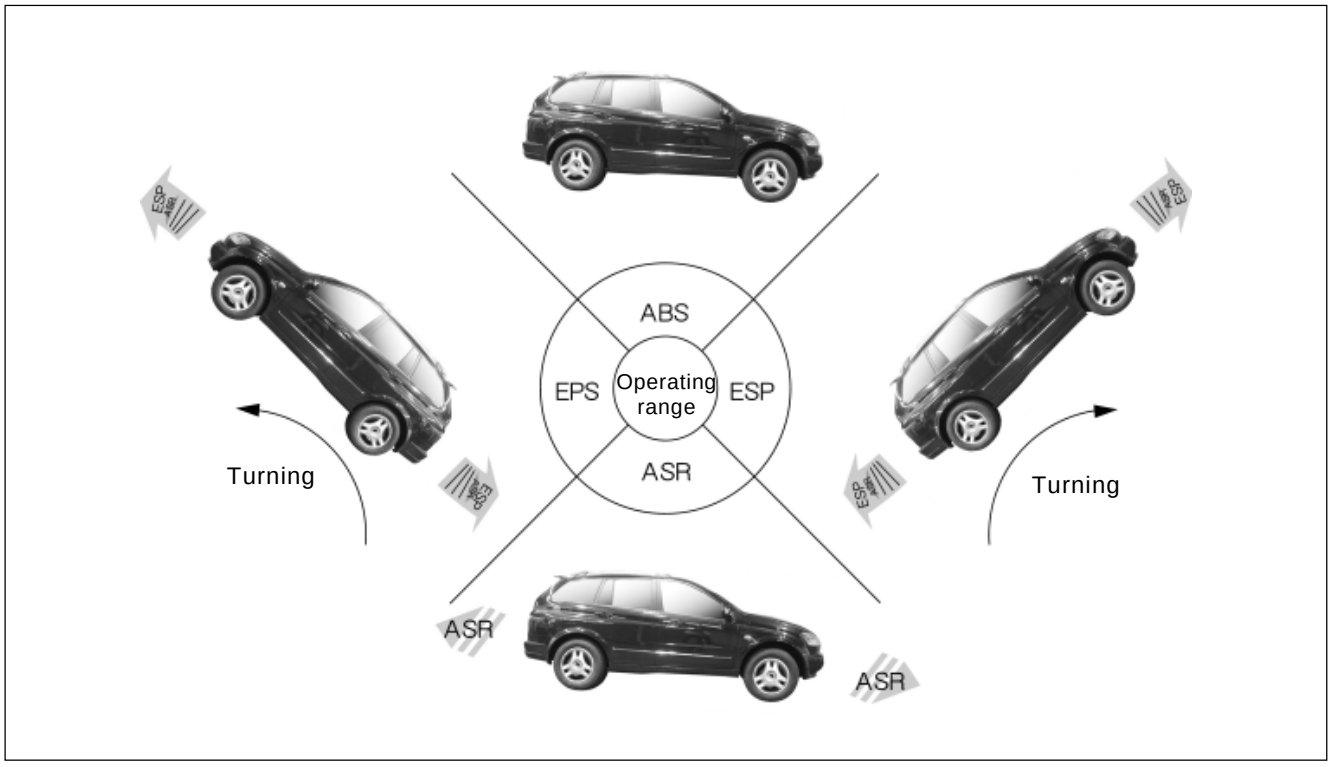
ESP controls during oversteering

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.

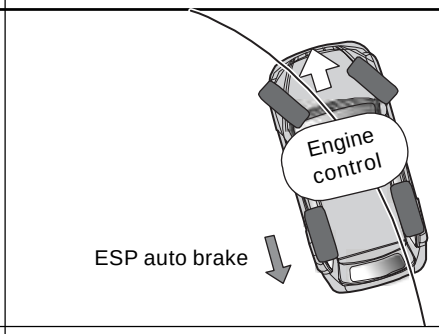
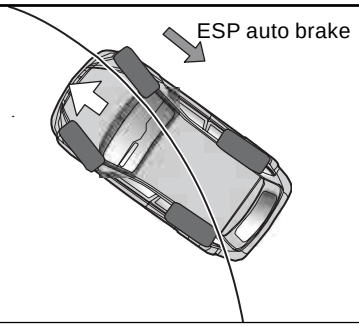
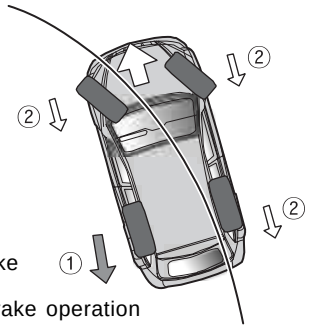
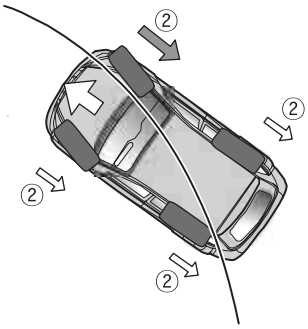
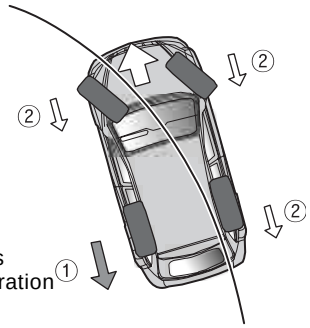
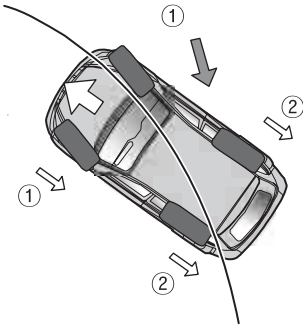
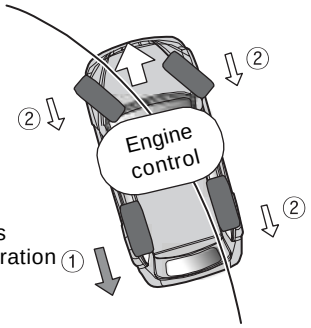
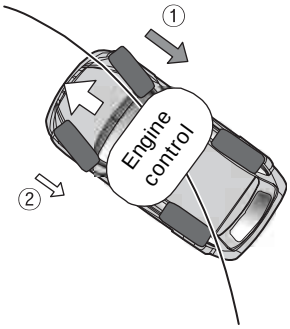
When various systems operate simultaneously under a certain situation, there may be vehicle control problems due to internal malfunction of a system or simultaneous operations. In order to compensate to this problem, the ESP system sets the priority among systems. The system operates in the order of TCS (ASR or ABD), ESP and ABS. The order may be changed depending on the vehicle driving situations and driving conditions.



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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)		

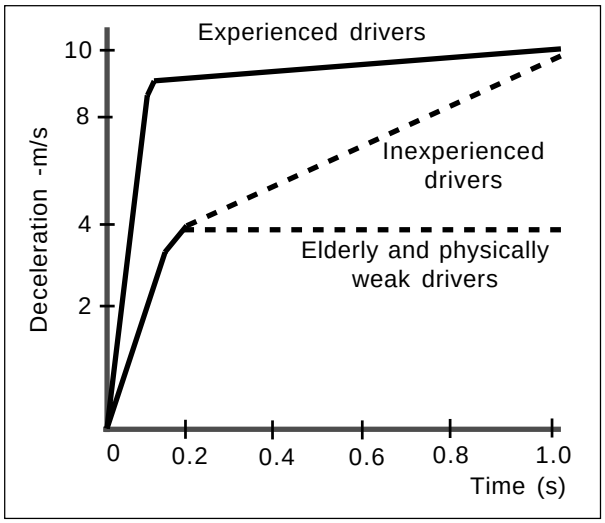
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4. HBA (HYDRAULIC BRAKE ASSIST SYSTEM)

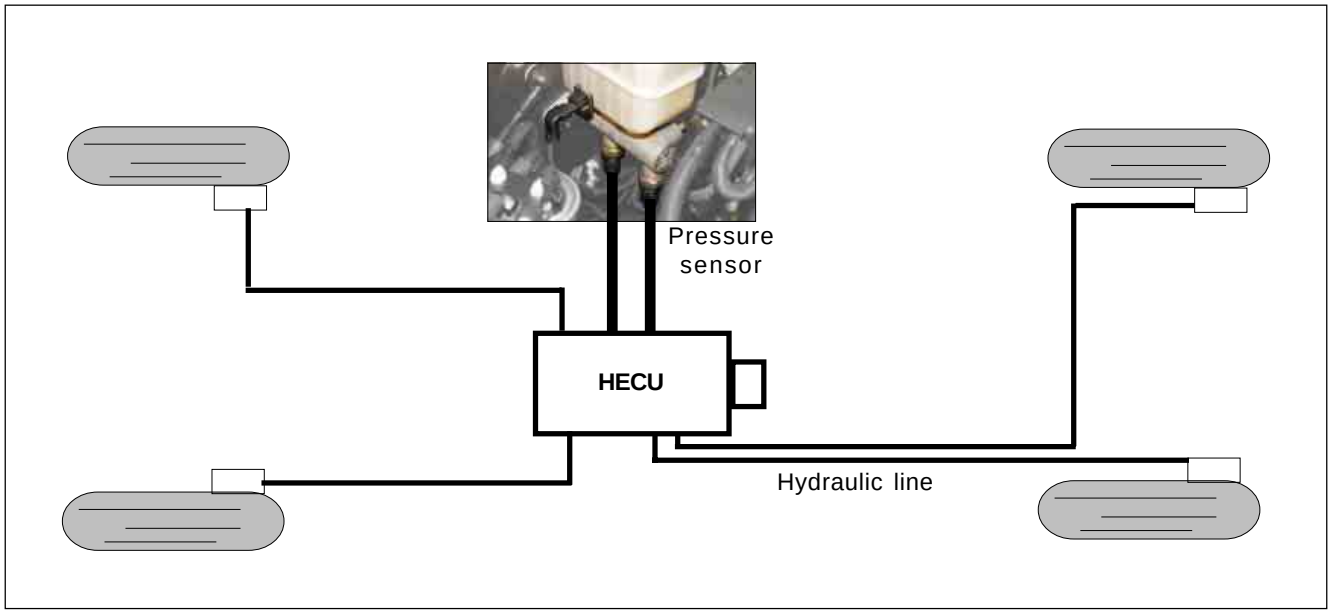
HBA (Hydraulic Brake Assist) system helps in an emergency braking situation when the driver applies the brake fast, but not with sufficient pressure, which leads to dangerously long braking distance. ECU recognizes the attempt at full braking and transmits the signal calling for full brake pressure from 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 HBA 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 HBA 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

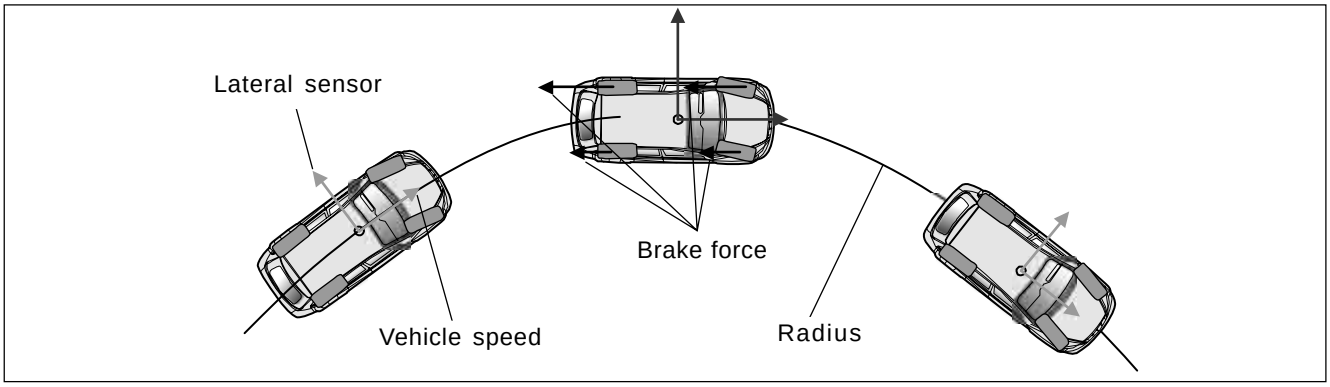
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5. ARP (ACTIVE ROLL-OVER PROTECTION)

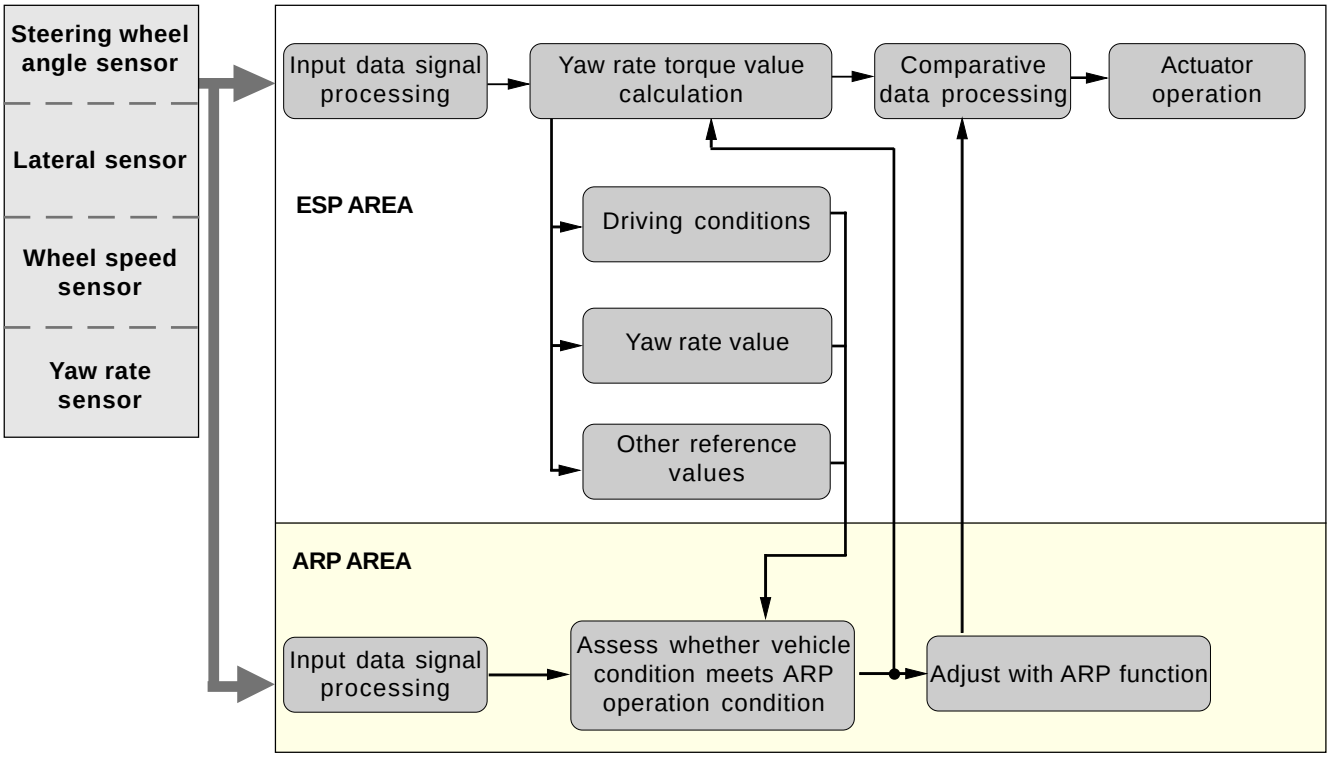
The ARP (Active Roll-over Protection) system is a safety assistant device that minimizes, by controlling brakes and the engine, the physical tendency of the vehicle rollover during sharp lane changes or U-turns. For the system, software is added to the existing ESP system and no additional device or 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.**

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6. HDC (HILL DESCENT CONTROL)

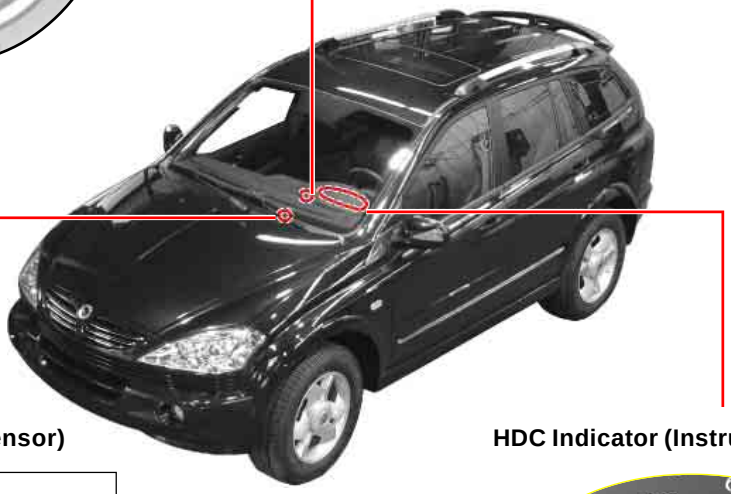
▶ System Overview

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.

HDC Switch



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.



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.

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**

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.**

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▶ 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 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%)

4L mode: vehicle speed below 25 km/h (operation slope level: 10%, termination slope level: when it reaches 5%)

Reverse driving

2H/4H mode: vehicle speed below 50 km/h (operation slope level: 8%, termination slope level: when it reaches 5%)

4L mode: vehicle speed below 25 km/h (operation slope level: 8%, termination slope level: when it reaches 4%)

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)

3) HDC target speed in 4L mode

Forward and reverse driving: 3 km/h

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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.

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▶ 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.** 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 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 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.

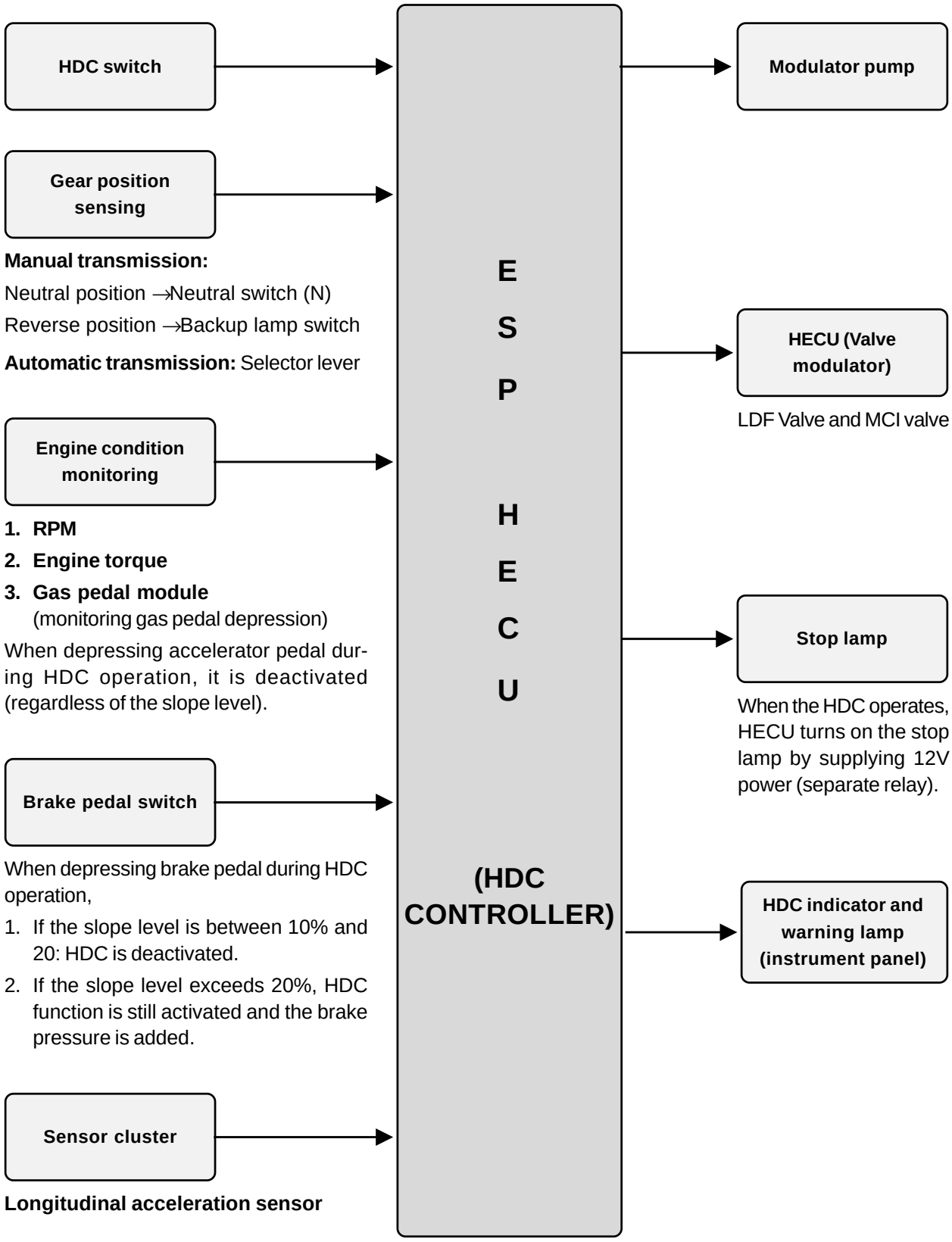
When the slope level exceeds 20% during the HDC operation

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 sounds an abnormal noise and brake pedal may be very rigid, but this is a normal condition due to HDC operation.

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▶ Input/Output Signals for HDC Operation



Manual transmission:

Neutral position →Neutral switch (N)

Reverse position →Backup lamp switch

Automatic transmission: Selector lever

1. **RPM**
2. **Engine torque**
3. **Gas pedal module**
   (monitoring gas pedal depression)

When depressing accelerator pedal during HDC operation, it is deactivated (regardless of the slope level).

When depressing brake pedal during HDC operation,

1. If the slope level is between 10% and 20: HDC is deactivated.
2. If the slope level exceeds 20%, HDC function is still activated and the brake pressure is added.

Longitudinal acceleration sensor

LDF Valve and MCI valve

When the HDC operates, HECU turns on the stop lamp by supplying 12V power (separate relay).

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▶ 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 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="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**

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▶ 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 influence 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.**

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7. COMPONENTS AND LOCATIONS



Master cylinder pressure sensor



Sensor cluster: (Yaw rate + lateral sensor + longitudinal sensor)



Steering wheel angle sensor

HECU (Valve body and ECU integrated type)

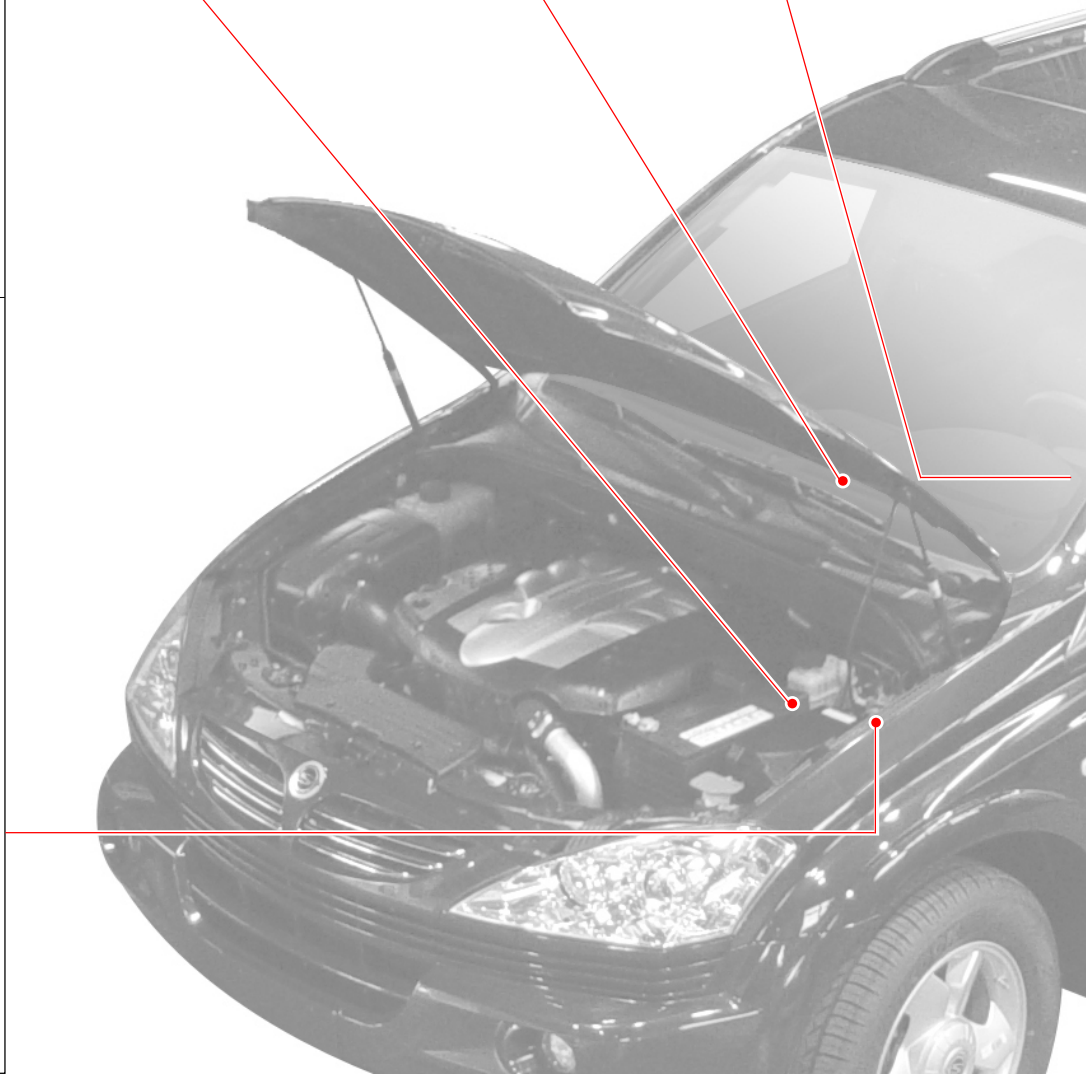


Valve body



Motor pump





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▶ Comparison with ABS System

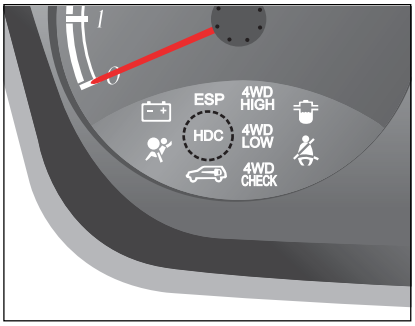
No	Name	ESP Component		Remark
1	HECU	0	0	ESP system contains ESP OFF switch and HDC switch.
2	Pressure sensor	0	N/A	
3	Wheel speed sensor	0	0	
4	Sensor cluster	0	N/A	
5	Steering wheel angle sensor	0	N/A	



Active Wheel Speed Sensor



HDC Switch

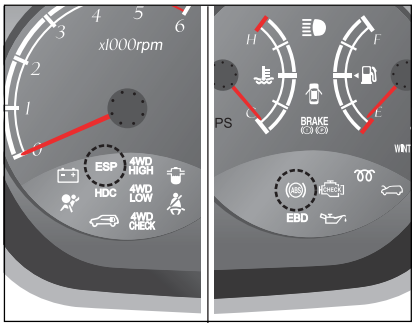


HDC Indicator





ESP OFF Switch



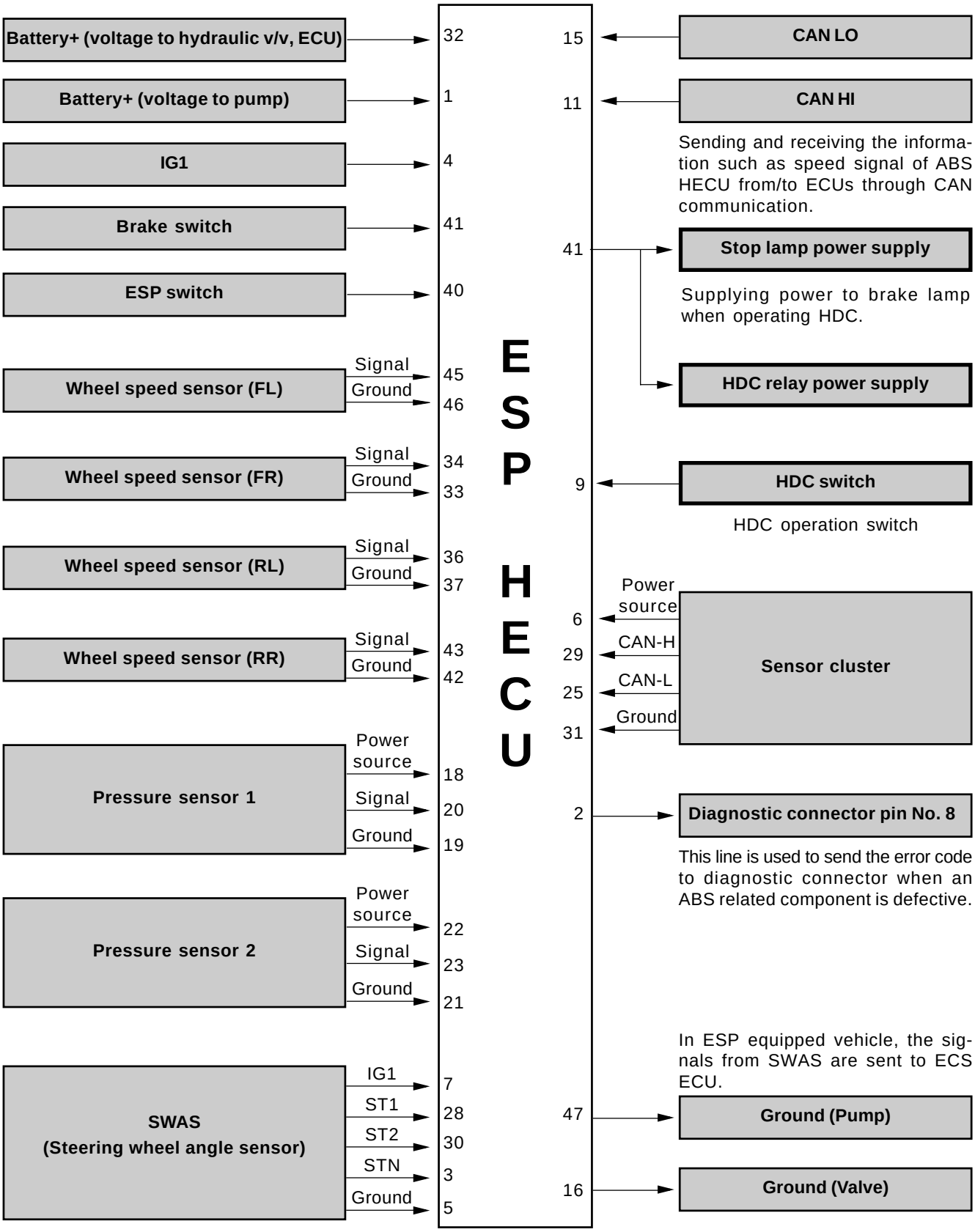
ABS / ESP Indicator

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8. INPUT AND OUTPUT DIAGRAM

Input/Output of ESP System



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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 influence 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.

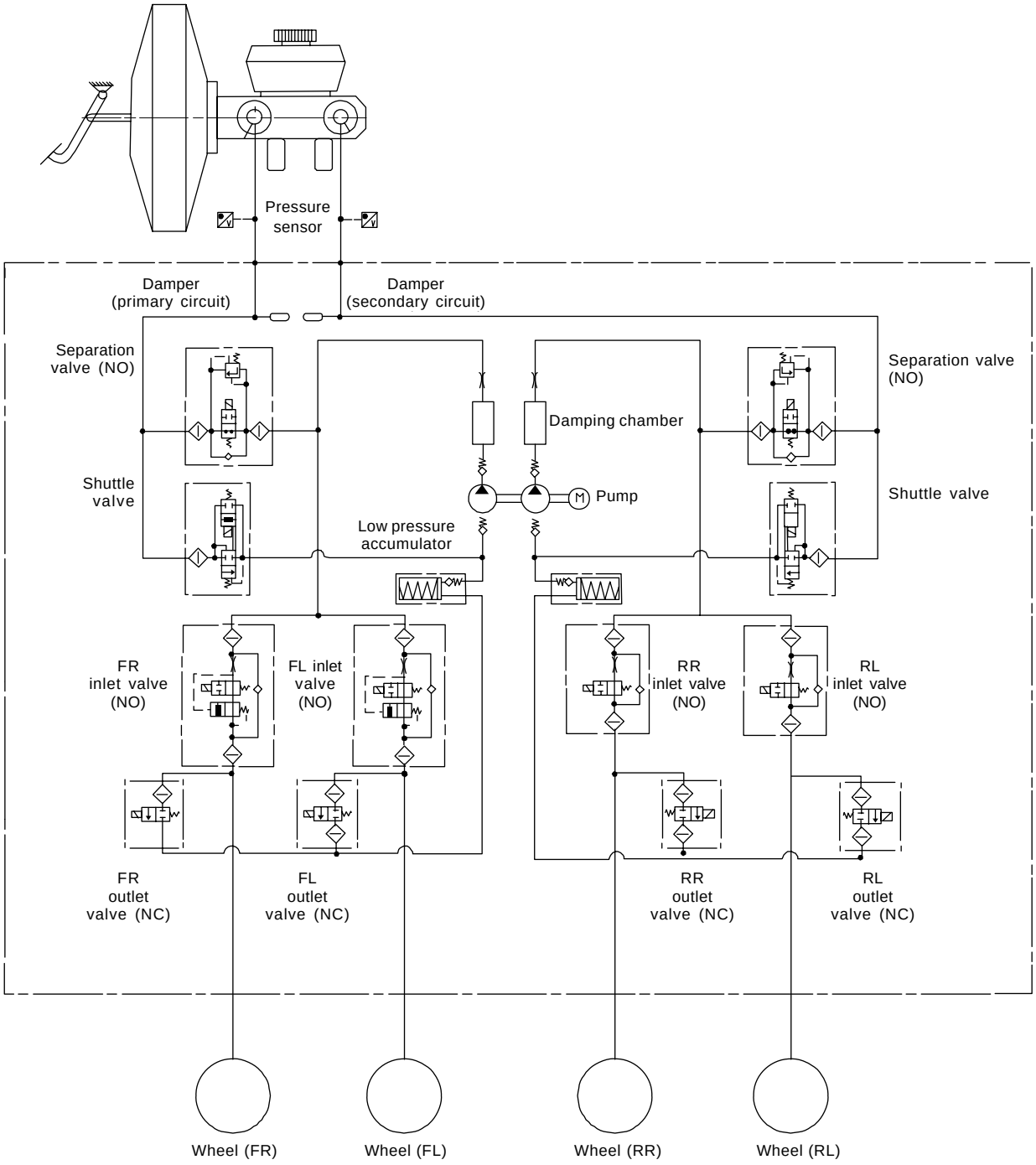
4. **During the HDC operation, a loud noise and the vehicle vibration may occur from the HECU and the brake system, but this is a normal condition during the HDC operation.**

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.

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10. HYDRAULIC CIRCUIT DIAGRAM

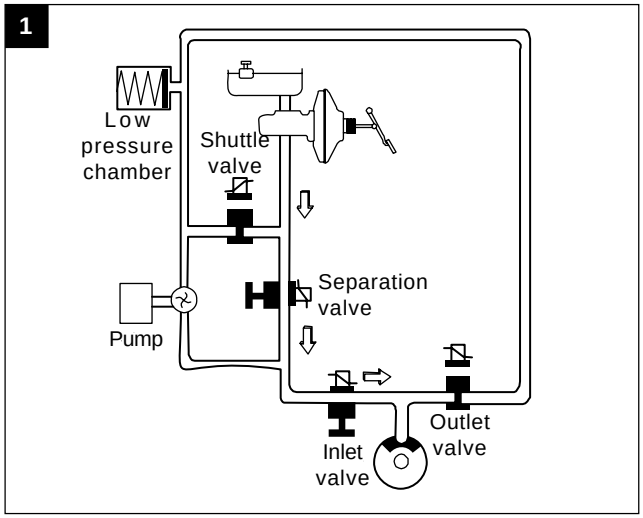


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When equipped with ABS, the braking force at each wheel will be controlled with 3-channel 4-sensor method. And when equipped with ESP, 4 wheels will be controlled independently with 4-channel method. (When controlling ABS system only, it will be operated with 3-channel method.) When compared to the vehicle equipped with ABS/EBD 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"**.

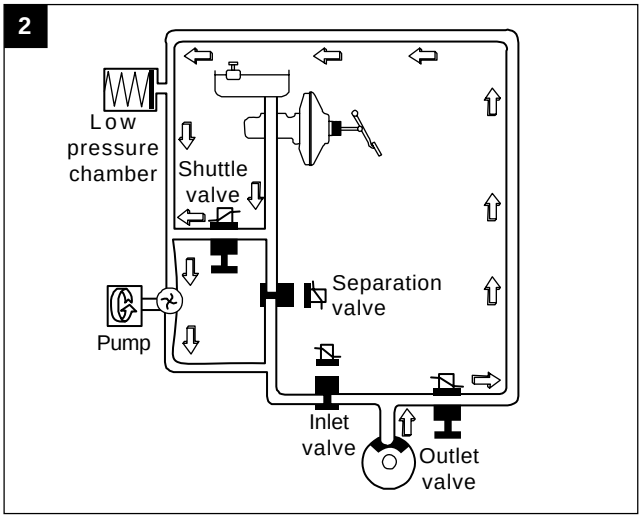
11. HYDRAULIC PRESSURE FOR EACH ESP OPERATING RANGE



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.

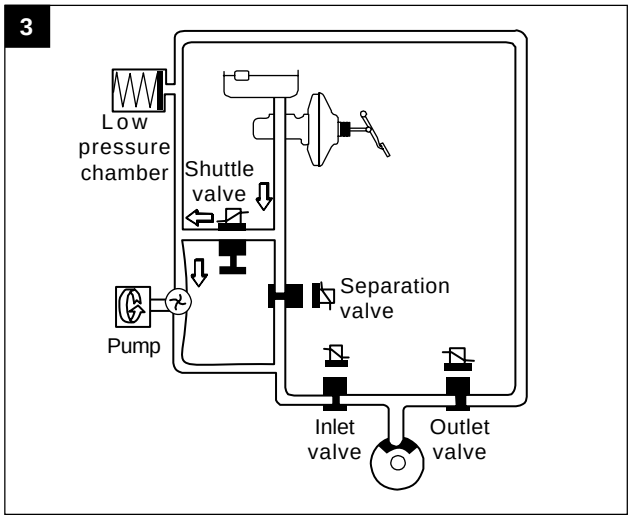


ESP Hydraulic unit (decreased pressure)

The pressure decreases just before the wheel speed drops and the wheels. 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.

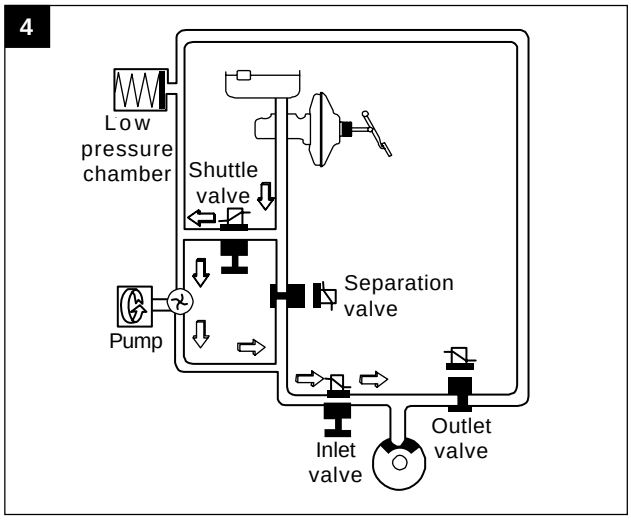
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ESP unit circuit (when the pressure is maintained)



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)

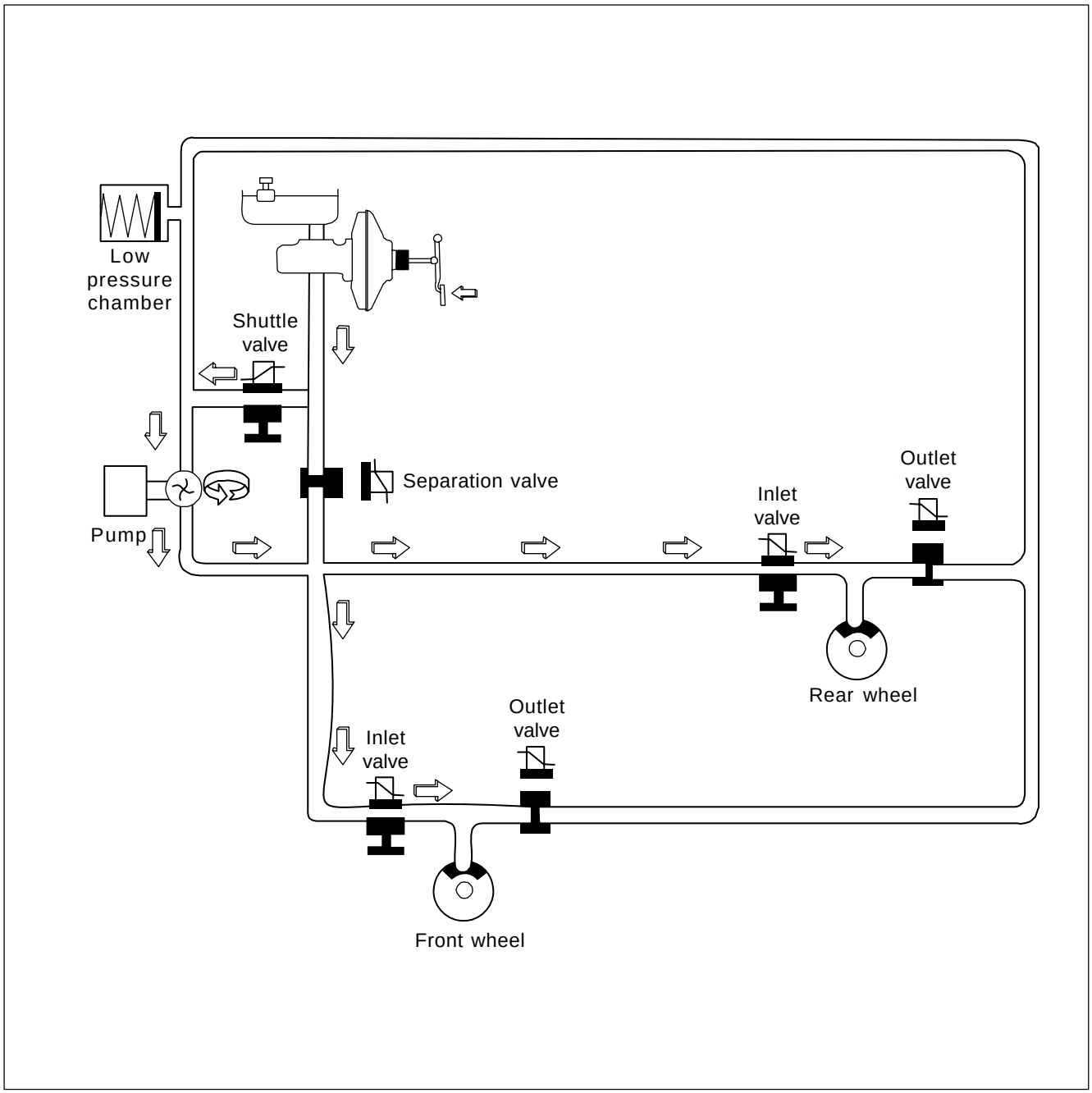


The shuttle valve and inlet valve will be open and the separation valve and outlet valve will be closed. Then, the pump is operated.

When ESP operates while the ABS is operating, the pressure will be increased continuously until just before the corresponding wheel gets locked.

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12. HYDRAULIC CIRCUIT OF HBA (HYDRAULIC BRAKE ASSIST)



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 are will stay closed.

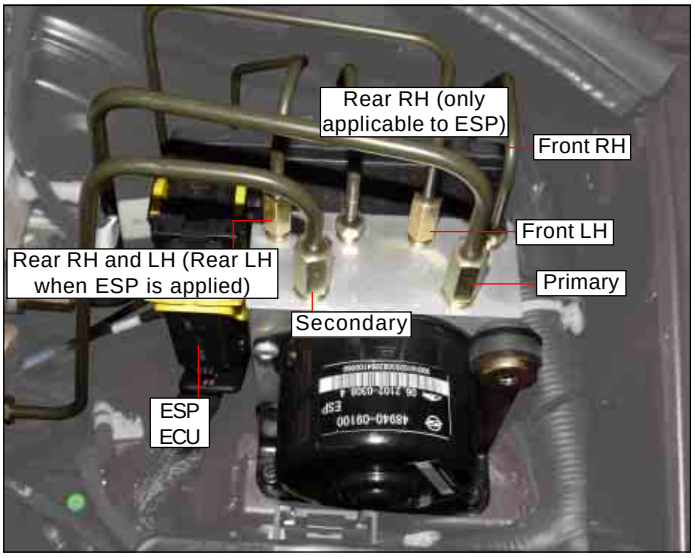
When the wheel starts to lock, the HBA function cancels and switches to ABS operation.

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13. COMPONENTS DESCRIPTION

▶ HECU (Hydraulic & Electronic Control Unit)

1. HECU installed in a vehicle



HECU consists of motor pump, solenoid valve and ECU.

ECU connector has 47 pins and the number of valves in valve body is 12 when equipped with ESP (6 valve for ABS), and they cannot be disassembled.

2. Comparison ESP HECU and ABS/EBD HECU

ABS HECU



ESP HECU



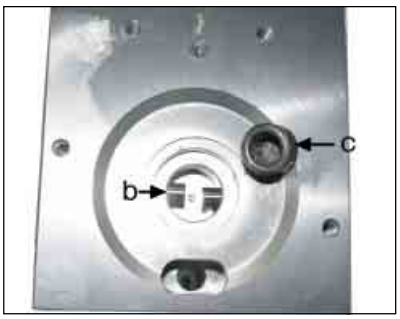
3. Other components



HECU



Pump Motor



Valve Body

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Removal and Installation

1. Disconnect the control unit connector.



2. Disconnect the primary and secondary master cylinder pipes from HECU.

Tightening torque

Master cylinder to HECU	13 ~ 20 Nm



3. Disconnect the front and rear wheel brake pipes.

Tightening torque

HECU to each hydraulic line	13 ~ 20 Nm



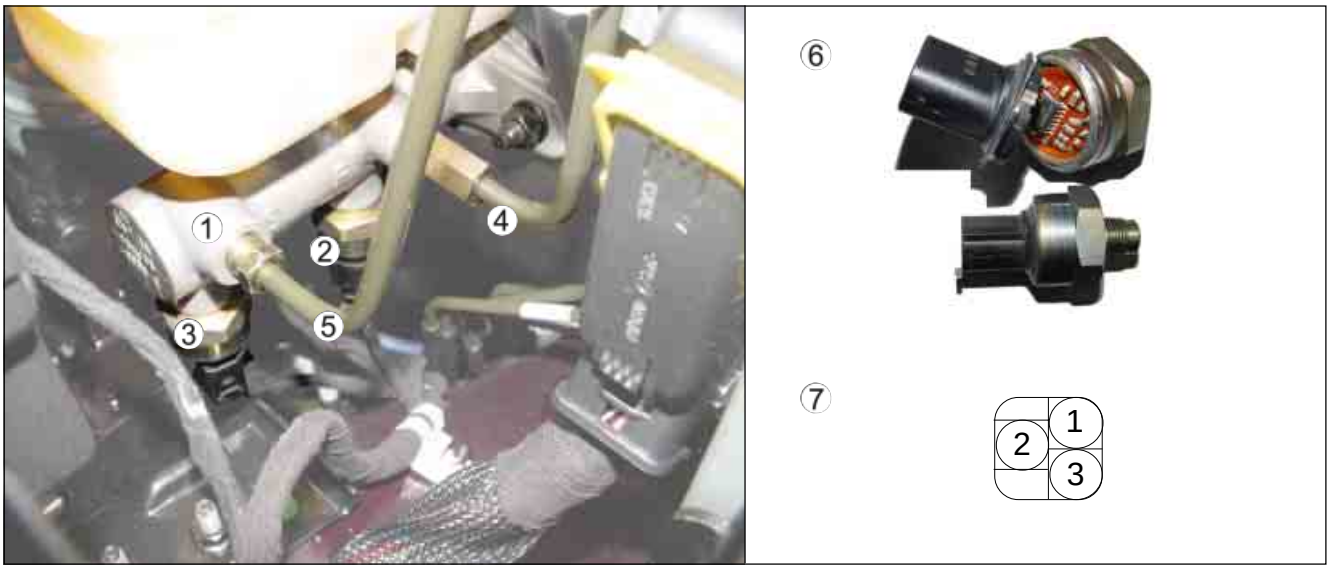
NOTICE

- **Be careful not to damage the HECU pipes and nut threads when reinstalling.**

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▶ Pressure Sensor

Location



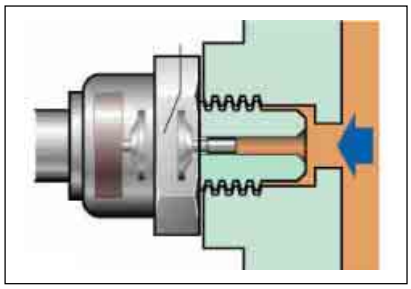
1. Master cylinder
2. Primary pressure sensor
3. Second pressure sensor
4. Hydraulic pipe in primary circuit
5. Hydraulic pipe in secondary circuit
6. Inside of pressure sensor
7. Connector

Specifications

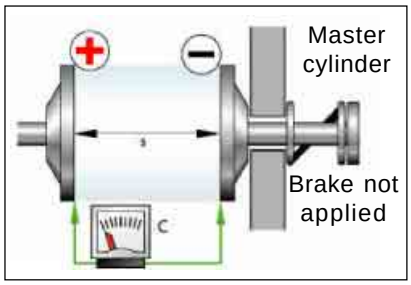
Supplying voltage	4.75 ~ 5.25 V
Output voltage	0.25 ~ 4.75 V (This is linearly changed from 0.5 V (brake not applied) to 4.75 V (brake applied))
Output range	0 ~ 170 bar

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Description



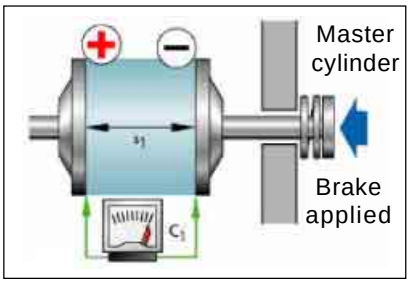
The sensor consists of two ceramic disks, one of which is stationary and the other movable. The distance between these disks changes when pressure is applied.



The pressure sensors operate on the principle of changing capacitance (a).

The distance (S) between the disks and, thus, the capacitance changes when pressure is applied to the movable disk by a braking intervention.

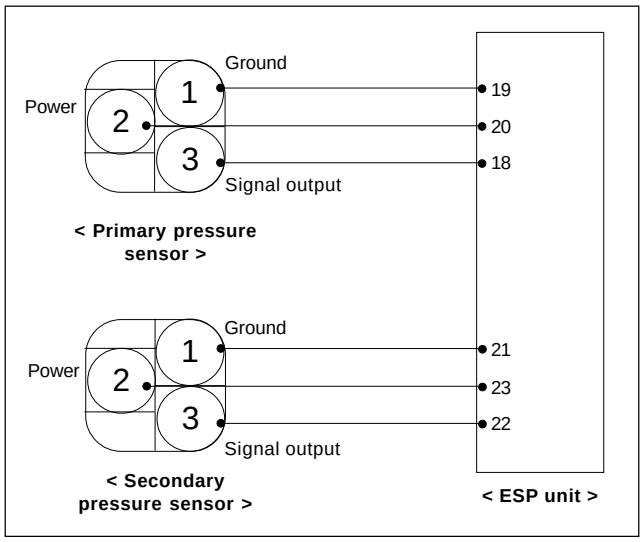
The voltage value is approx. 0.5 V when the brake is not operated.



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.

HBA operating conditions:

1. Pressure: 20 bar

2. Pressure changes: over 1500 bar/sec

3. Vehicle speed: over 7 km/h

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Removal and Installation

1. Disconnect the battery negative terminal.

2. Remove the connector of the pressure sensor.

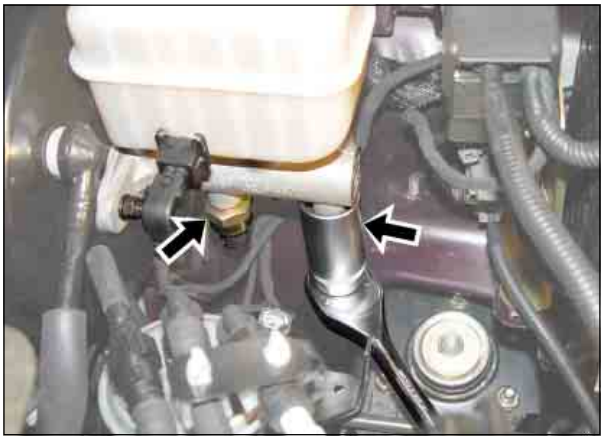


3. Remove the fuel filter bracket to remove the pressure sensor.



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.

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▶ Sensor Cluster

Location



1. Center fascia panel (left/right)
2. Sensor cluster
3. Installed sensor cluster
4. Inside of sensor cluster

Specification (sensor cluster: yaw rate sensor + lateral acceleration sensor + Longitudinal acceleration sensor)

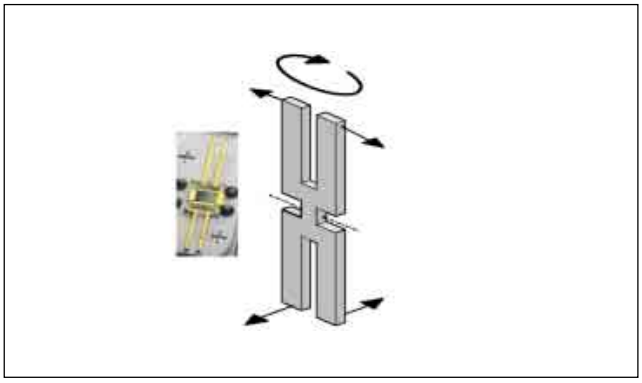
Supplying voltage	Approx. 5V (4.75 ~ 5.25V)
Output voltage during stopping	Approx. 2.5V (Ignition switch “ON”)
Yaw rate sensor operating range	-75°/S ~ +75°/S
Lateral acceleration sensor operating range	-1.7 ~ +1.7g (16.7m/s^2)
Longitudinal acceleration sensor operating range	-1.7 ~ +1.7g (16.7m/s^2)

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 communicate with CAN.

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.

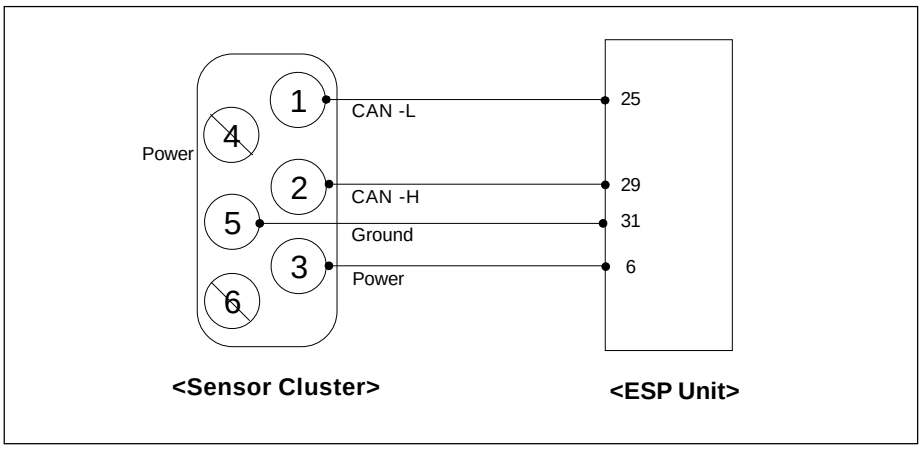
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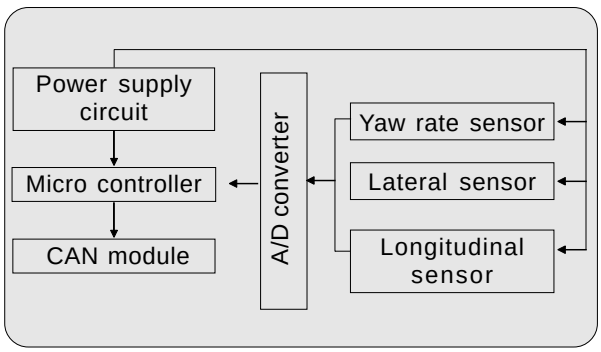
The Microscopic tuning forks in the yaw rate sensor measures the acceleration on the vertical axis of the vehicle. When the angular acceleration occurs on the vertical axis of the vehicle (Z axis) and this acceleration occurs more than 4° (4 degree) per second, vibration occurs at the top and bottom 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 intent differs from the vehicle position). Therefore, the occurrence of vehicle yawing does not imply the ESP operation.

Sensor Cluster 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).



< Internal electric circuit of sensor cluster >

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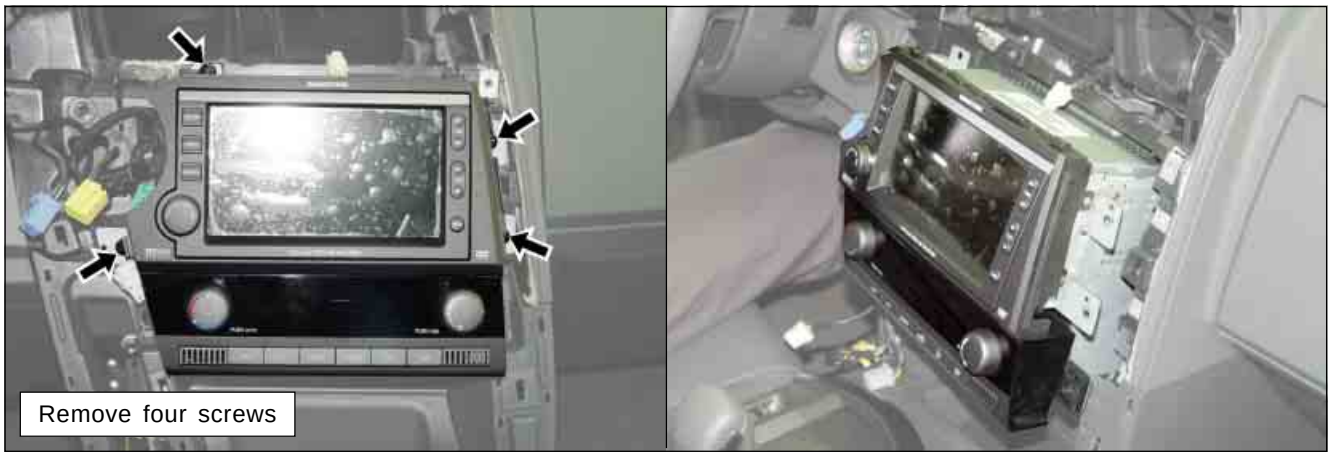
Removal and Installation

※ **Preceding Work:** Disconnect the battery negative cable.

1. Remove the center fascia panels (left/right).



2. Remove the AV head unit assembly.



NOTE

- **AV head unit may have different connectors according to the specifications.**



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3. Disconnect the sensor cluster connector and unscrew the cluster mounting bolts.



When installing

Tightening torque	7 ~ 9Nm

4. 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.**

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▶ SWAS: Steering Wheel Angle Sensor

Location

SWAS is installed at the bottom of air bag clock spring in steering handle and sends the steering angle signal to ESP HECU.



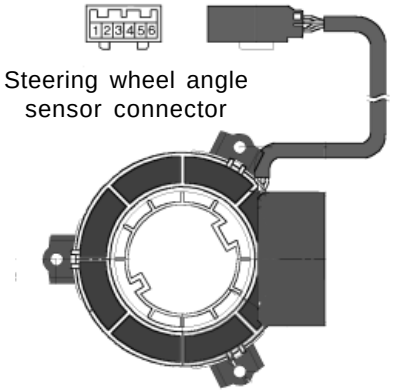


1. SWAS (Steering Wheel Angle Sensor)
2. Combination switch assembly

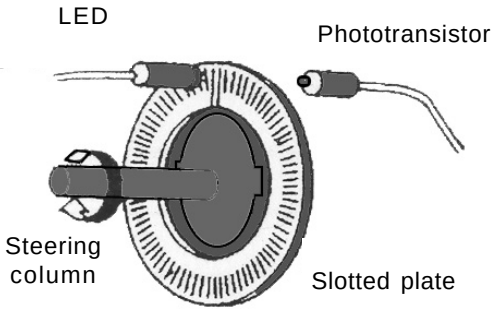
Specifications

Working voltage	9 ~ 16V
Max. output current	10 mA
Detected max. angular velocity	1500°/S
Working temperature	- 30 ~ 75°C
Supplying voltage	9 ~ 16V (battery voltage)
Output voltage (HI)	Approx. 3.50V (3.0 ~ 4.1V)
Output voltage (LO)	Approx. 1.50V (1.3 ~ 2.0V)

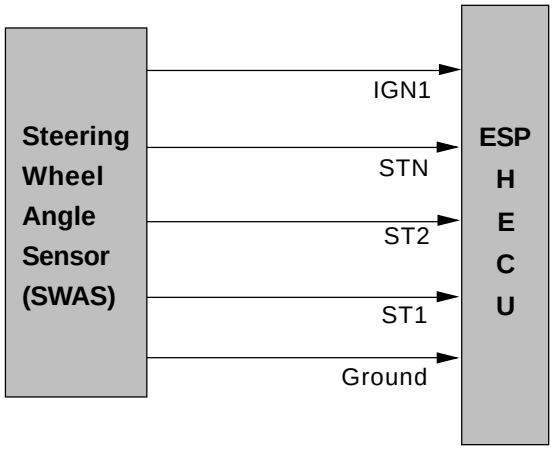
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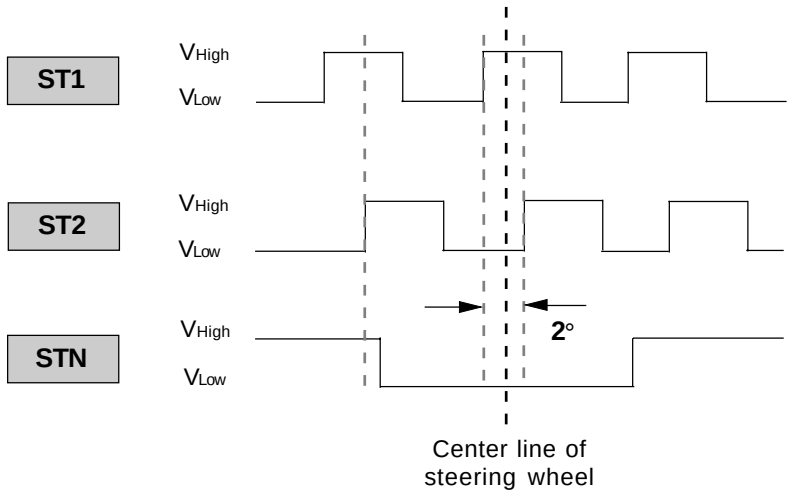
Steering wheel angle sensor



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 ECS unit 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.



Working 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



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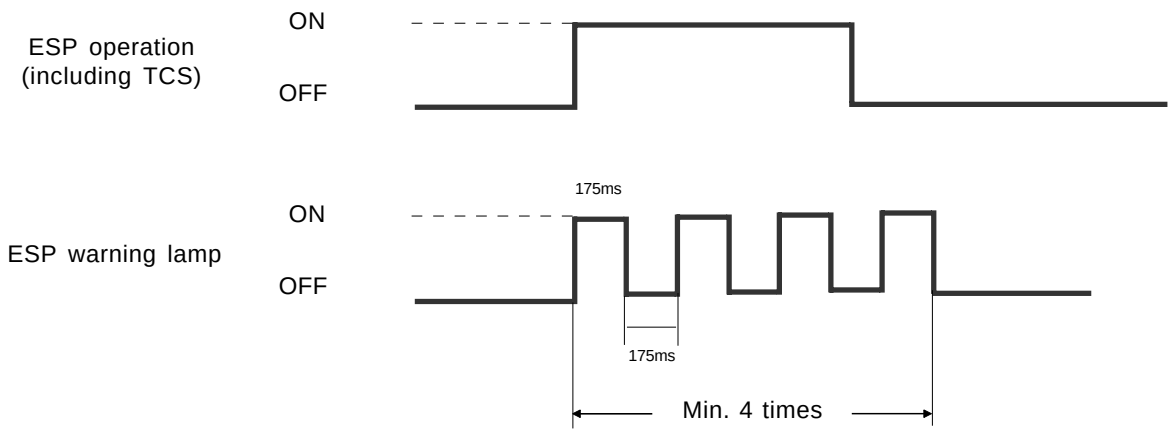
▶ ESP OFF Switch

Location



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.



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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.

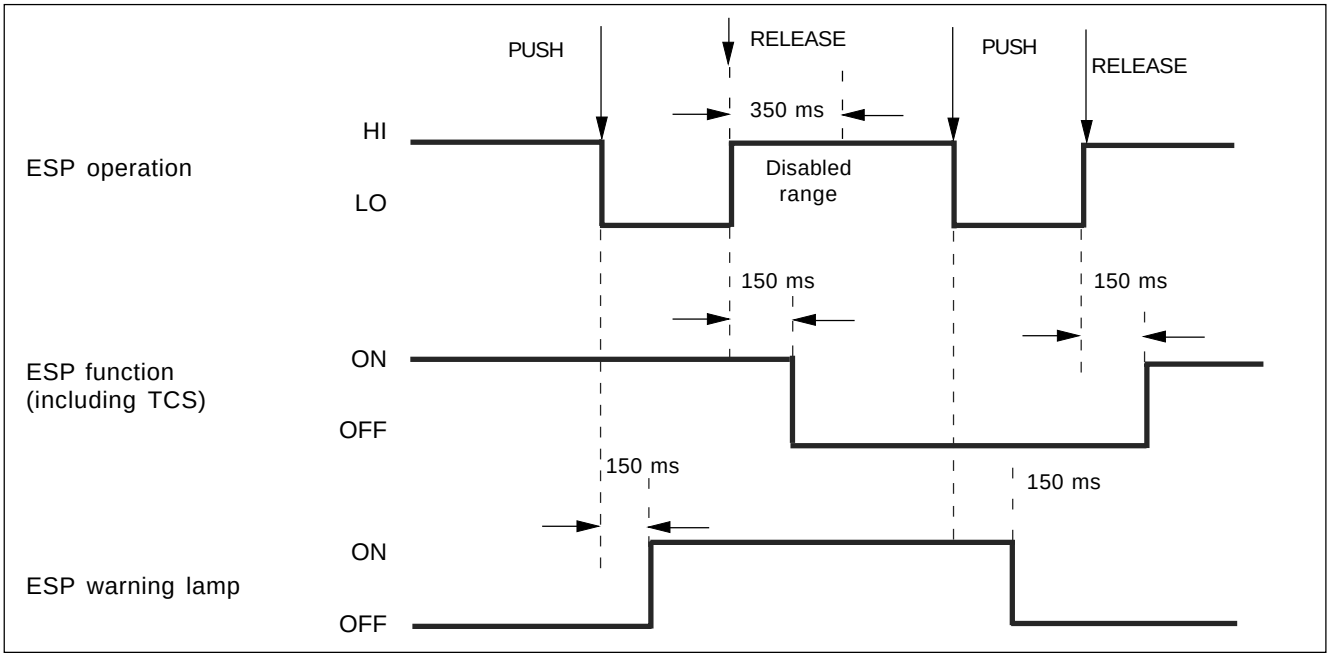
Based on the above procedures, we can see that the ESP system will be cancelled after a certain period (approx. 150 ms) from releasing the switch to the original position. The ESP system does not get canceled immediately when the ESP warning lamp is turned on by pressing the ESP OFF switch. When you 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

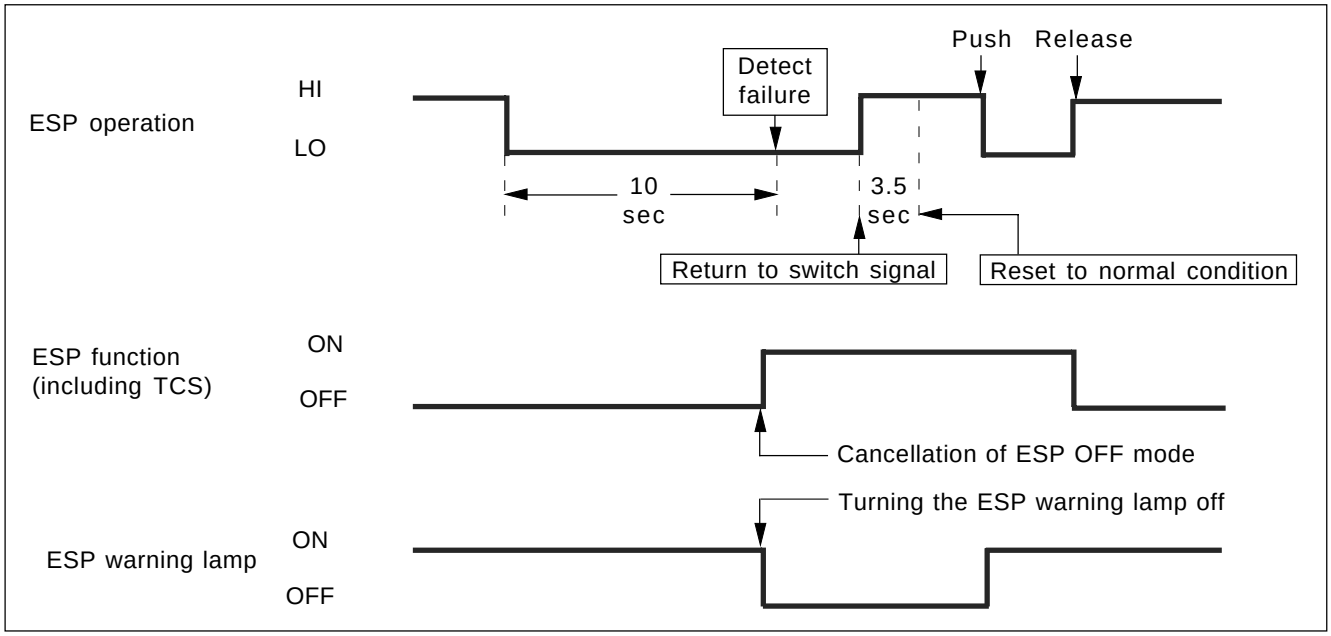
- **When turning the ignition switch off while the ESP system is activated, the ESP system will be resumed when ignition switch is turned on again.**
- **When the vehicle is controlled by ESP system during driving, the ESP OFF switch does not operate.**
- **The ESP OFF switch operates when it is pushed 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.**

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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 [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.**

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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 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. 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:

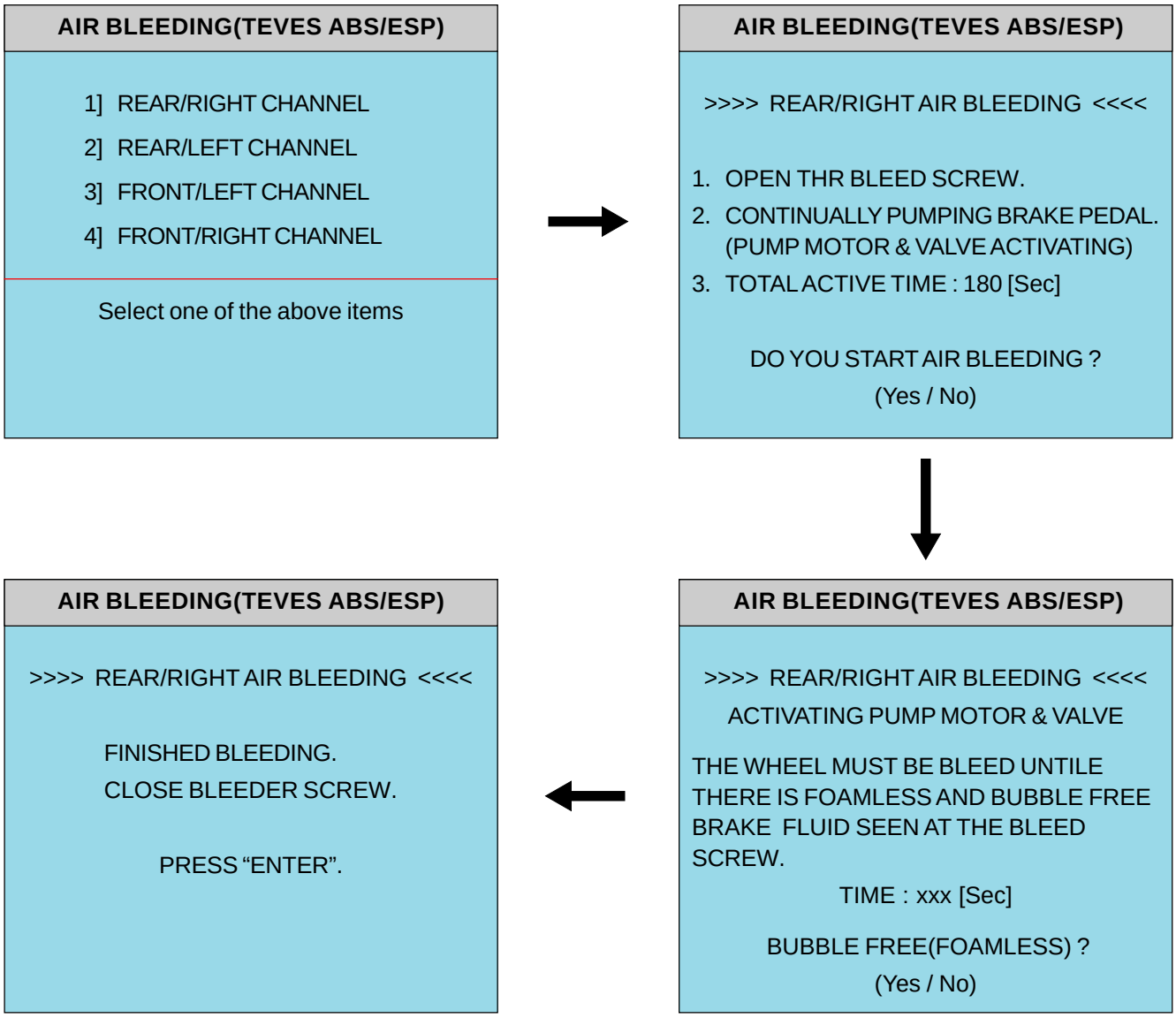
1) Collect the bleeding oil into the container.
2) Depress the brake pedal repeatedly.
3) Check the conditions of oil supply device.

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.

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▶ Air Bleeding by Using Scan-100



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15. ABS/ESP TROUBLE DIAGNOSIS

o: Applied x: N/A

Function	Defective Components	Trouble Code	Descriptions	System	
Sensor Monitoring	**Front LH Wheel speed sensor**	C1011 (5011) C1012 (5012)	Wheel speed sensor front left-electrical Wheel speed sensor front left-other	**ABS**	**ESP**
	1. C1011 (5011) **Cause** - Defective front LH wheel speed sensor - Short or poor contact wire to sensor **Action** - Check the wheel speed sensor connector - Check HECU connector - Check the harness connection **2. C1012 (5012)** **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 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			**O**	**O**
	Front RH Wheel speed sensor	C1021 (5021) C1022 (5022)	Wheel speed sensor front right-electrical Wheel speed sensor front right-other		
	1.C1021 (5021) **Cause** - Defective front RH wheel speed sensor - Short or poor contact wire to sensor **Action** - Check the wheel speed sensor connector - Check HECU connector - Check the harness connection **2.C1022 (5022)** **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 and tooth wheel mounting (Specified air gap: 0.335 ~ 0.945 mm) - Check the number of teeth (48) in tooth wheel			**O**	**O**

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Function	Defective Components	Trouble Code	Descriptions	System	
Sensor Monitoring	**Rear RH Wheel speed sensor**	C1031 (5031) C1032 (5032)	Wheel speed sensor rear left-electrical Wheel speed sensor rear left-other	**ABS**	**ESP**
	1. C1031 (5031) **Cause** - Defective rear RH wheel speed sensor - Short or poor contact wire to sensor **Action** - Check the wheel speed sensor connector - Check the HECU connector - Check the harness connection **2. C1032 (5032)** **Cause** - 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 **Action** - 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			**O**	**O**
	Rear LH Wheel speed sensor	C1041 (5041) C1042 (5042)	Wheel speed sensor rear left-electrical Wheel speed sensor rear left-other		
	1. C1041 (5041) **Cause** - Defective rear LH wheel speed sensor - Short or poor contact wire to sensor **Action** - Check the wheel speed sensor connector - Check the HECU connector - Check the harness connection **2. C1042 (5042)** **Cause** - 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 **Action** - 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			**O**	**O**

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<table>
<tr><th>Function</th><th>Defective Components</th><th>Trouble Code</th><th>Descriptions</th><th>System</th><th></th></tr>
<tr><td rowspan="8">Sensor Monitoring</td><td>Pressure sensor</td><td>C1051 (5051)</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 pressure sensor connector</td><td>X</td><td>O</td></tr>
<tr><td>Steering wheel angle sensor</td><td>C1061 (5061)</td><td>Defective steering wheel angle sensor</td><td></td><td></td></tr>
<tr><td colspan="3"><u>Cause</u>
- 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
<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>Sensor cluster</td><td>C1073 (5073)
C1074 (5074)</td><td>Sensor cluster -electrical
Sensor cluster-internal</td><td></td><td></td></tr>
<tr><td colspan="3">1. C1073 (5073)
<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 sensor cluster connector
- Replace the sensor cluster

2. C1074 (5074)
<u>Cause</u>
- 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
<u>Action</u>
- Replace the sensor</td><td>X</td><td>O</td></tr>
</table>

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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**

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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**

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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**

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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**

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▶ ABS/ESP Sensor Value

No	Content	Unit	ESP	ABS
1	Wheel Speed FR	1 km/h	O	O
2	Wheel Speed FL	1 km/h	O	O
3	Wheel Speed RR	1 km/h	O	O
4	Wheel Speed RL	1 km/h	O	O
5	Battery Voltage	0.1V	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
14	Engine TCS Control	Operation / Non-operation	O	X
15	ESP Control	Operation / Non-operation	O	X
16	ESP/TCS OFF Switch	ON / OFF	O	X
17	ABS Control	Operation / Non-operation	O	O
18	Stop Lamp Switch	ON / OFF	O	O

(O: Applied, X: N/A)

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▶ 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

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▶ Sensor Initialzation (ABS & ESP)

SENSOR INITIALIZE (Only ESP)
1] LONGITUDINAL SENSOR (4WD only) 2] LATERAL SENSOR 3] PRESSURE SENSOR 4] ABOVE 1,2,3 ALL SENSOR
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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▶ 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

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▶ Clearing Code

CLEAR VARIANT CODE

↓

VEHICLE CODING CLEAR

DO YOU START TO CLEAR?

(YES / NO)

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ABS SYSTEM

1. GENERAL INFORMATION

Differences compared to other models: Appearance of wheel speed sensor, Location, Layout of relevant components



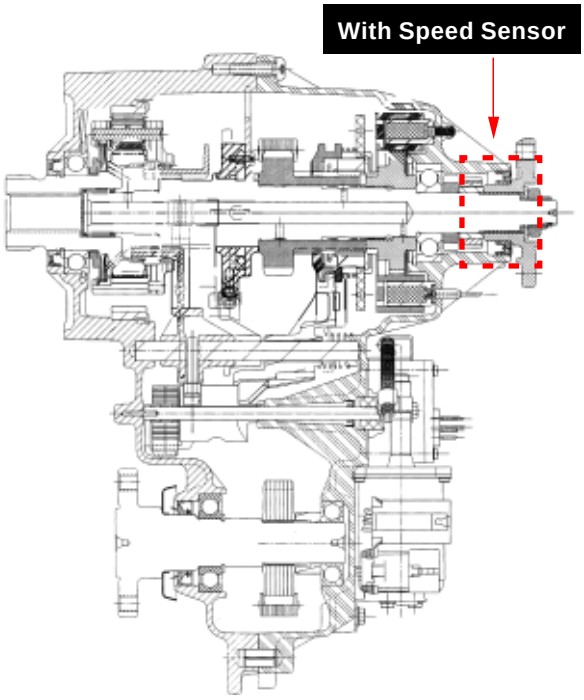
ABS HECU



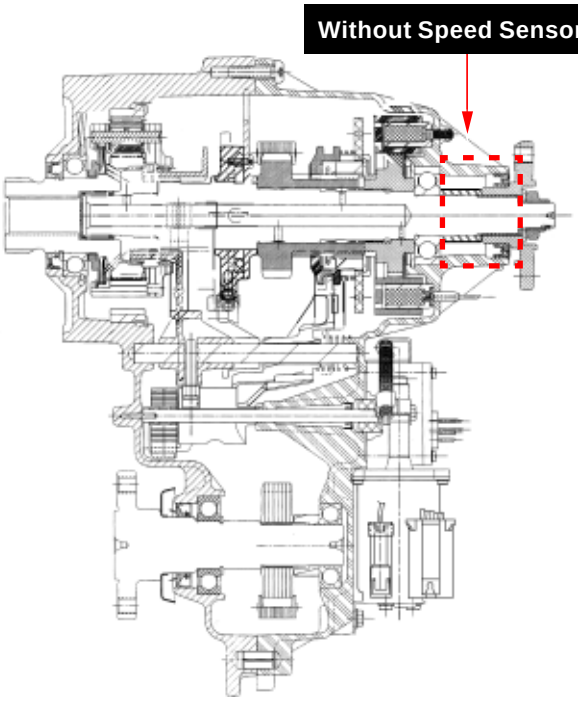
Active Wheel Speed Sensor (for 4WD)

The transfer case (T/C) installed on this vehicle doesn't have the internal speed sensing device and receives the speed signal for T/C control from ABS HECU.

Conventional Transfer Case



New Transfer Case



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Cautions When Removing the Front Wheel Speed Sensor

The locking hub system of the KYRON part time 4WD utilizes a different hub actuator from the conventional approach. It 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



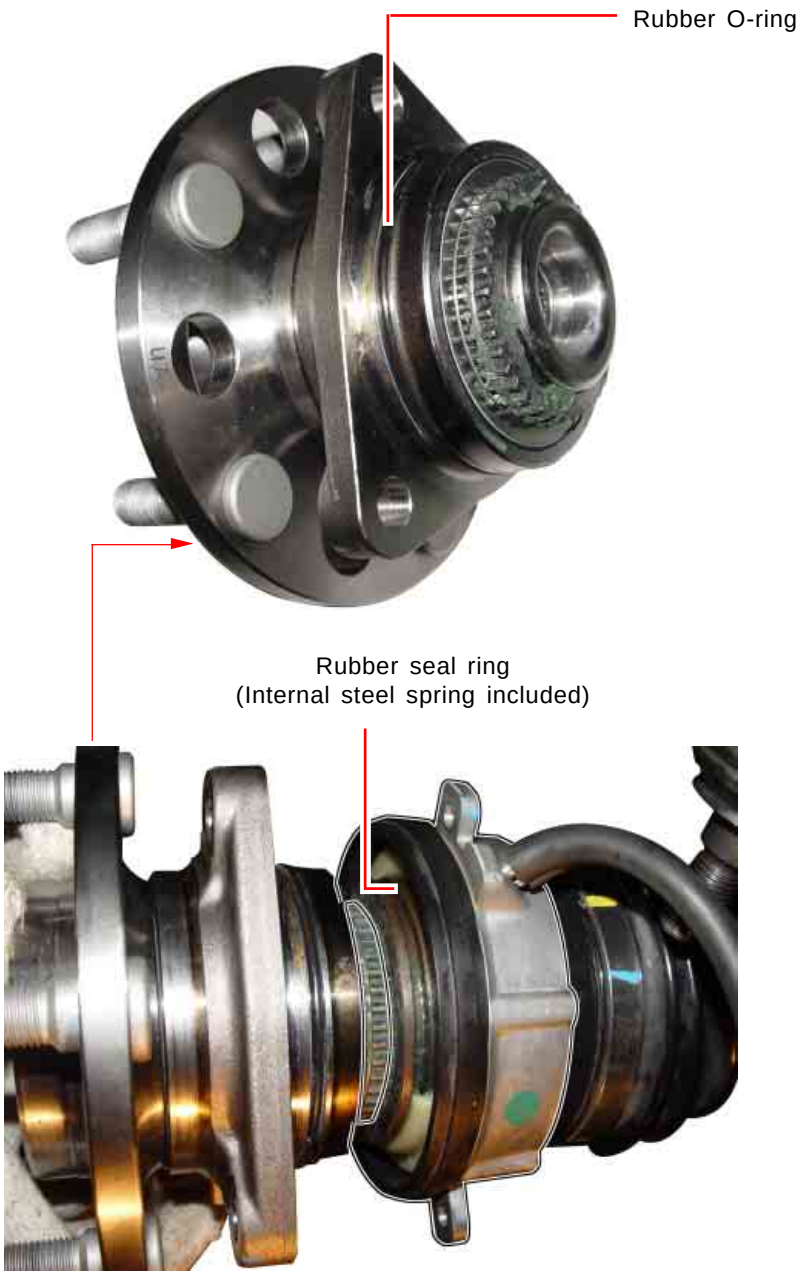


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The rubber O-ring in IWE (Integrated Wheel End) should be replaced with new one when the front wheel end has been removed.

The rubber O-ring prevents moisture and foreign materials from entering the IWE system.

In addition, when installing the hub actuator of the IWE system, you must install it from the same angle as the drive shaft to prevent the rubber seal ring inside the actuator from being squeezed.



Please refer to the part time transfer case section for more specific information.

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2. CONFIGURATION OF 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)



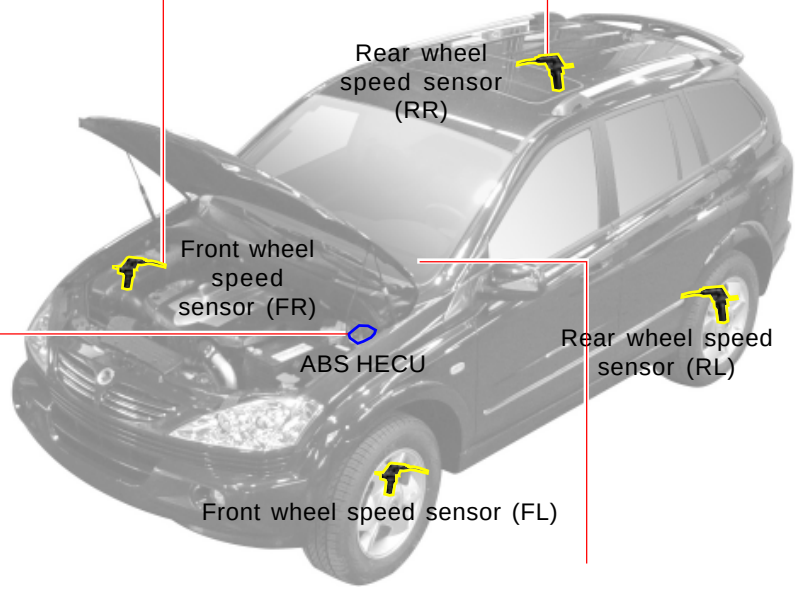
Valve body



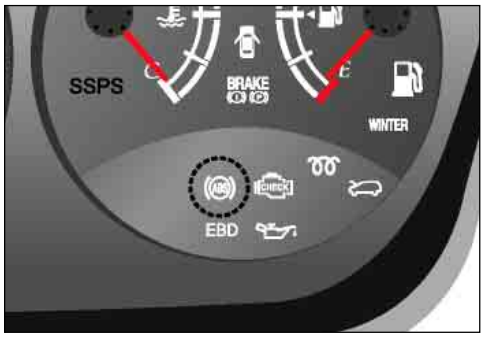
B: Plunger C: Can bushing

Motor pump





ABS warning lamp

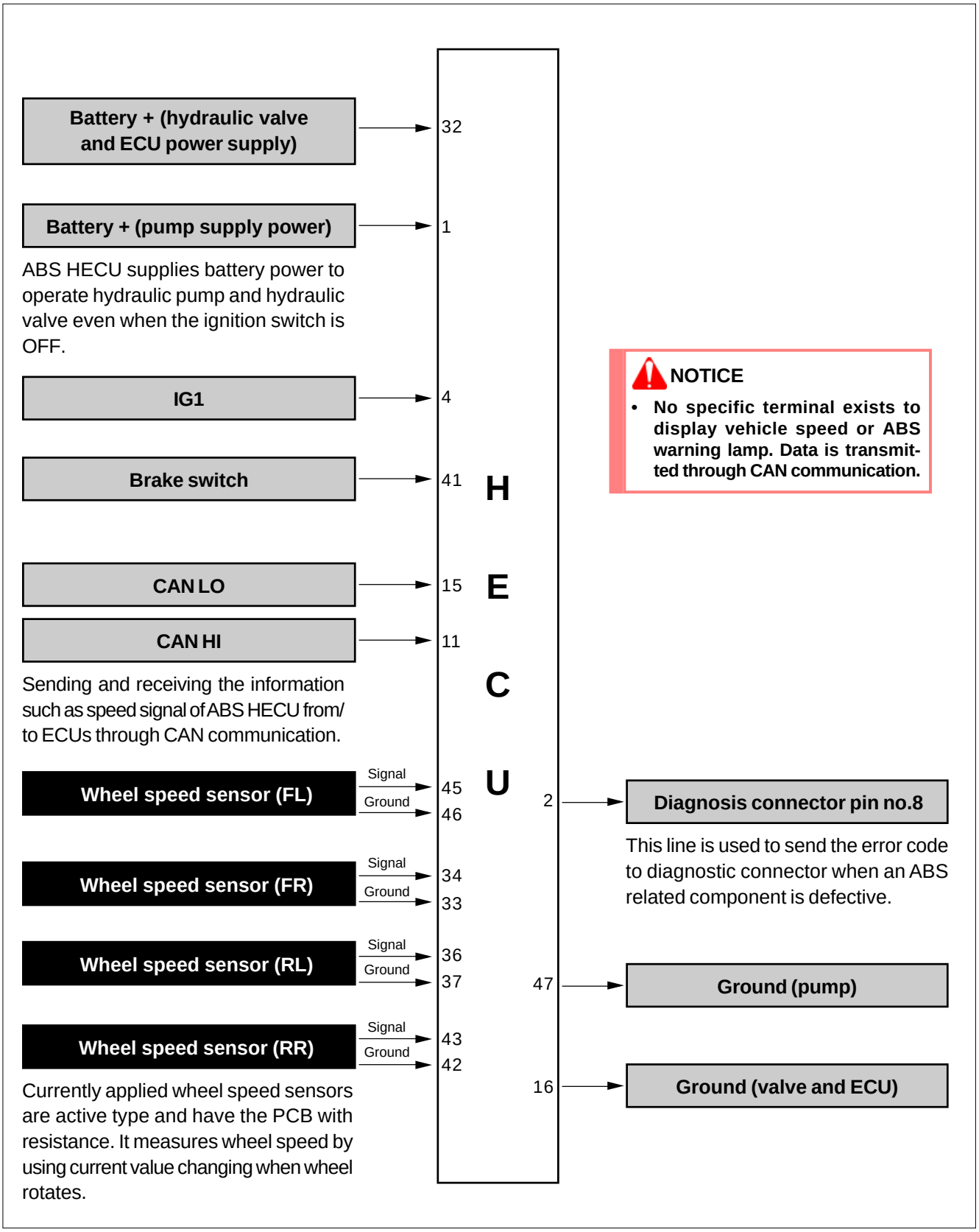


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3. INPUT AND OUTPUT DIAGRAM

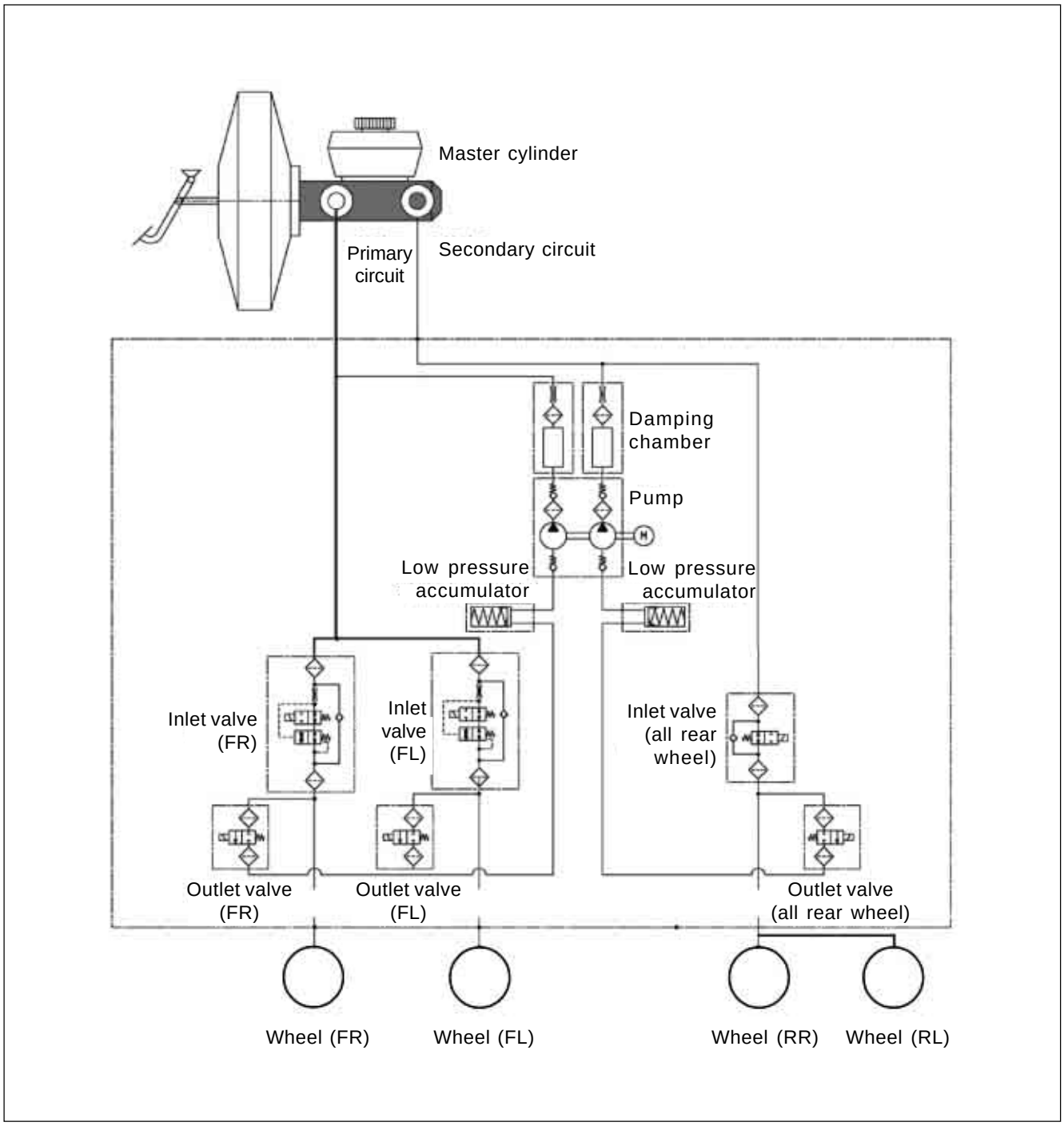
Input/Output of ABS (without TPMS)



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4. HYDRAULIC CIRCUIT OF ABS

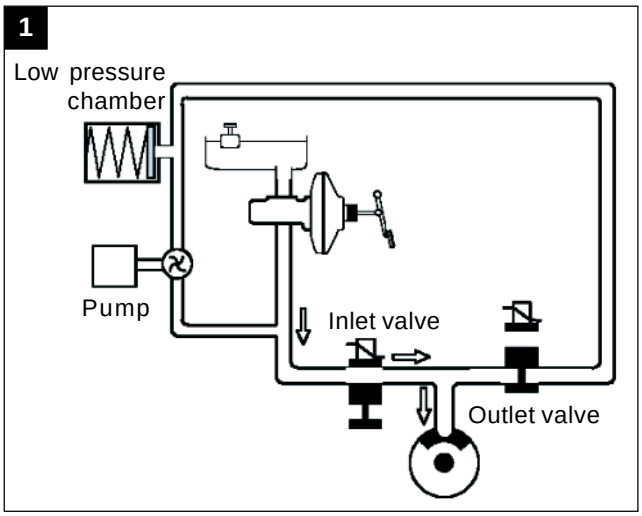


The vehicle equipped only with the ABS controls the wheel's braking force using or channel 4-sensor method.

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.

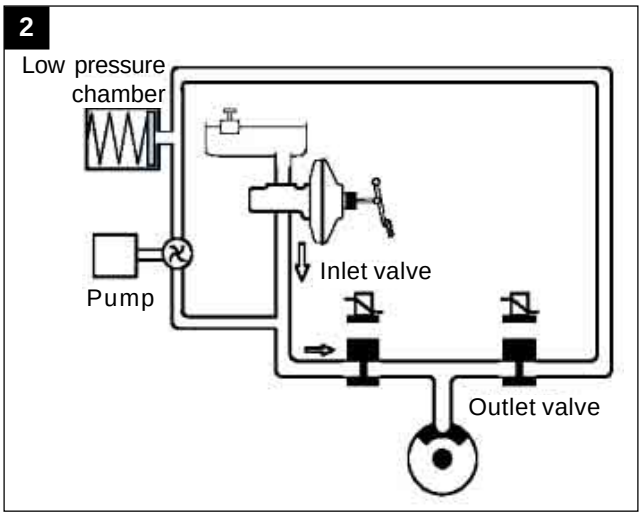
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5. ABS CIRCUIT IN EACH OPERATION RANGE



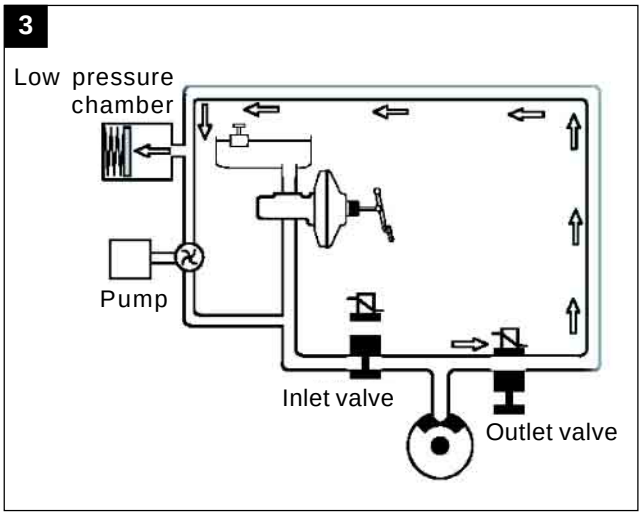
Hydraulic Pressure Circuit when ABS is Not Operating

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.



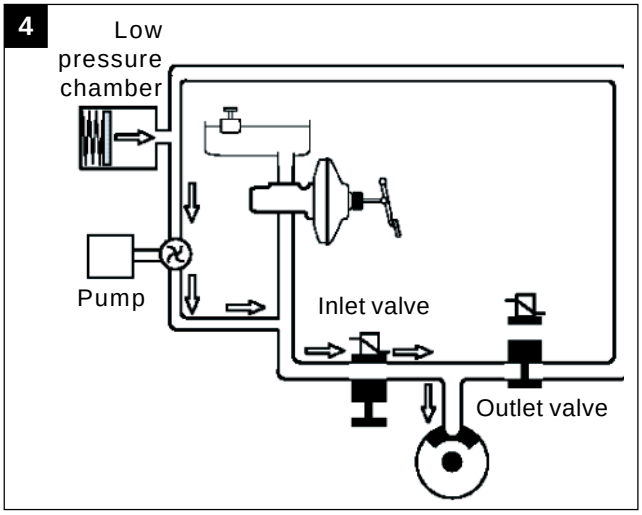
No Hydraulic Pressure Circuit when ABS is Operating

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.



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 noises.

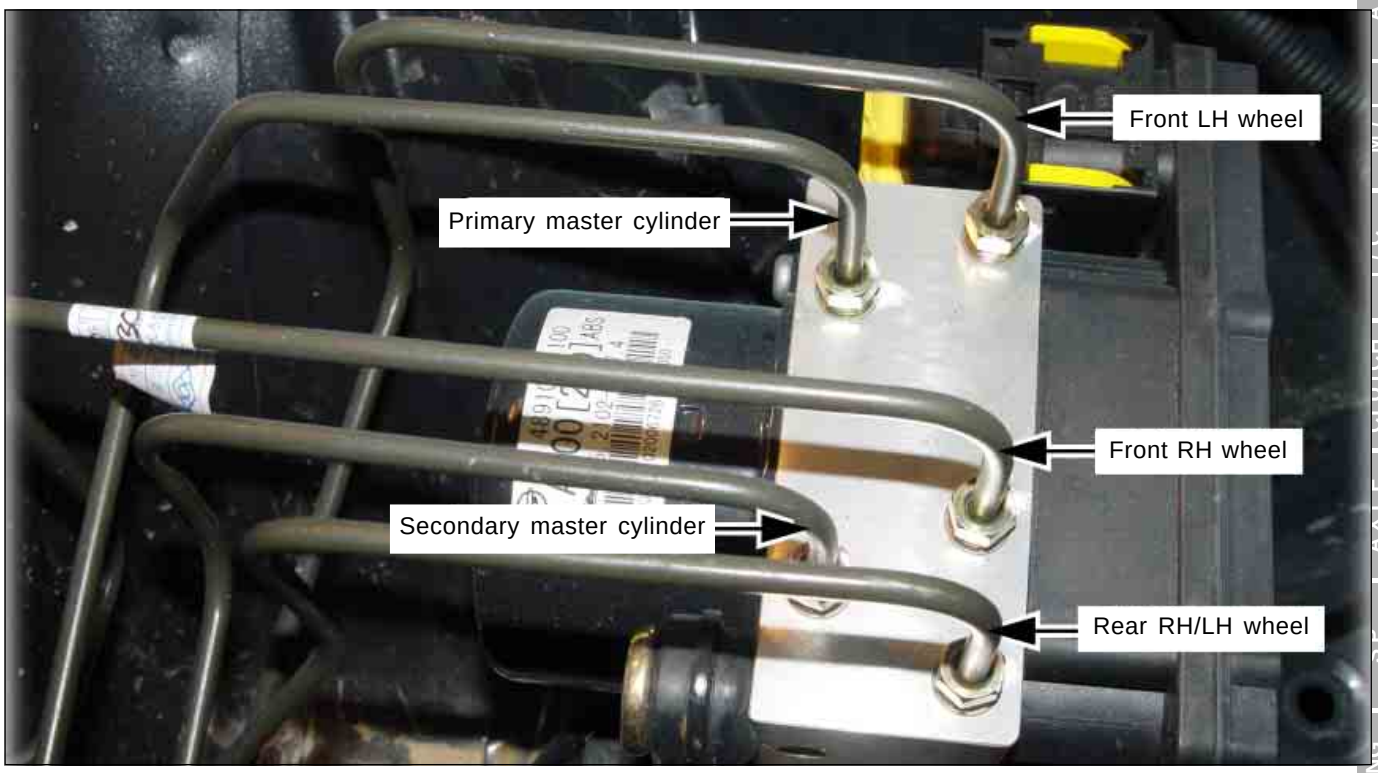


Pressure Increases in the Circuit when ABS is Operating

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 and the wheel speed decreases as the hydraulic pressure at wheel increases. 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.

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6. COMPONENTS AND LOCATION



Wheel Speed Sensor - Front (for 4WD)



Wheel Speed Sensor - Rear



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7. COMPONENTS DESCRIPTION

1) 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, solenoid valve and ECU.

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



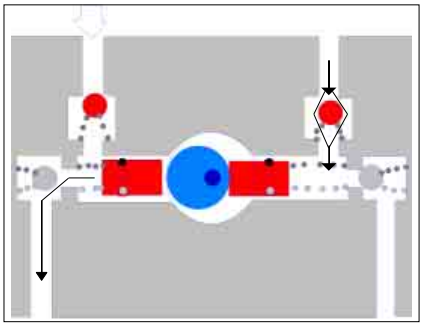
The motor is operated when ABS is activated. The cam-shaped output shaft of the motor (a) enables the brake system to receive and supply the brake fluid during the motor operation.

2. Valve body



The cam bushing (c) is installed between plungers (b) and it draws and discharges the brake fluid.

<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

1) Overall control of ABS functions
2) Monitoring of ABS electric components
3) 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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8. REMOVAL AND INSTALLATION

▶ HECU Assembly

1. Disconnect the battery negative cable.

2. Disconnect the ABS hydraulic unit connector.



3. Disconnect the primary and secondary master cylinder pipes from HECU.

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

- **Be careful not to damage the HECU pipe and nut thread when reinstall.**



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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.**
- **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.

NOTICE

- **When you install a new HECU to the vehicle, coding is executed automatically. Thus, no additional coding is necessary.**

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▶ AWSS: Active Wheel Speed Sensor

The 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>



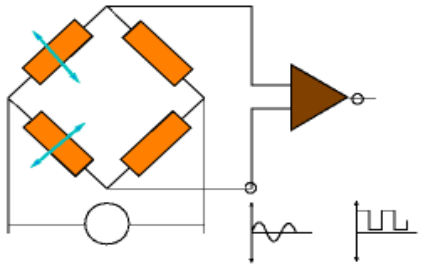
<Rear wheel speed sensor>



<Active wheel speed sensor>



<Wheatstone bridge type>



This sensor contains:

1. Four resistance **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.

Specification

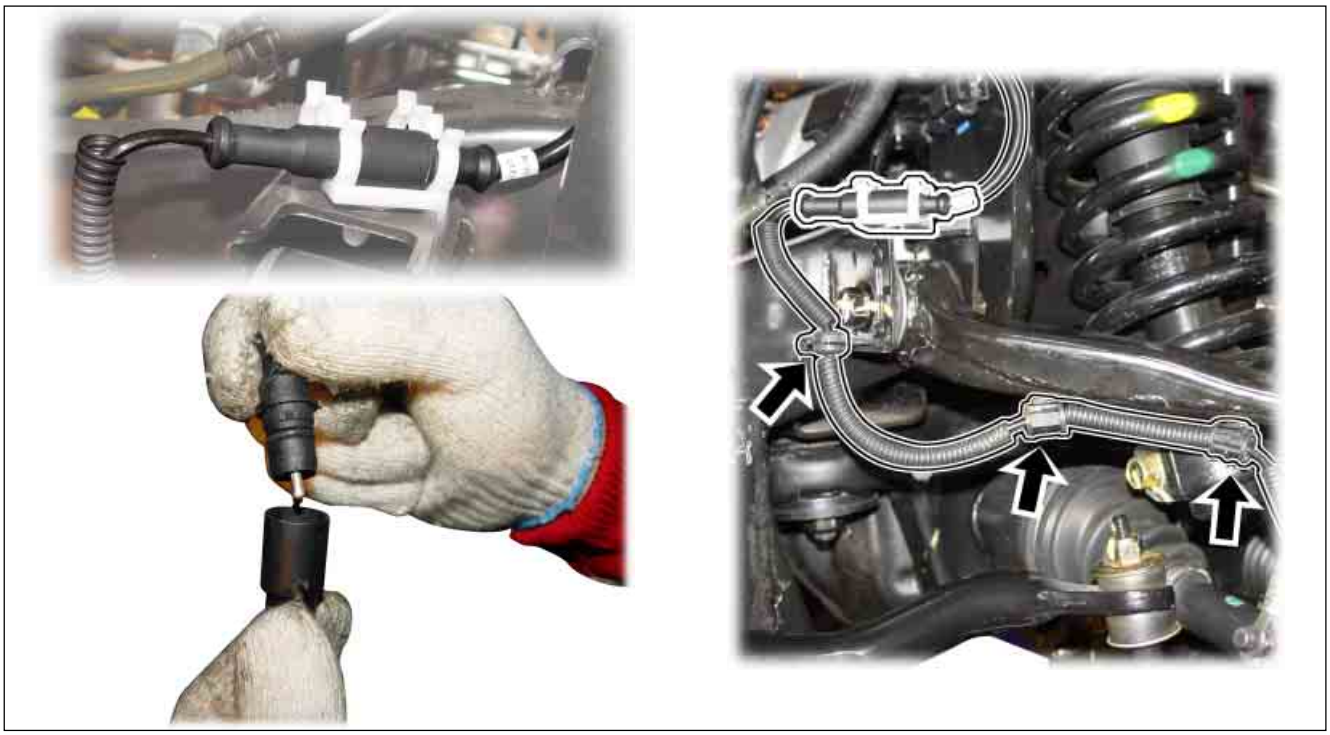
Air gap between sensor and rotor	Front:	2WD: 0.475 ~ 1.453 mm (Tightening torque: 6 ~ 8 Nm) 4WD: 0.1 ~ 0.7 mm (Tightening torque: 15 ~ 20 Nm)
	Rear:	0.037 ~1.175 mm (5-link suspension) 0.489 ~1.039 mm (Independent suspension)
Wheel speed sensor current (vehicle speed: at approx. 2.75 Km/h)		I_{HIGH} : Approx. 14 mA I_{LOW} : Approx. 7 mA
Wheel speed sensor voltage (one rotation per a second at -40 ~ +60)		7.5 ~ 20 V

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AFFECTED VIN	

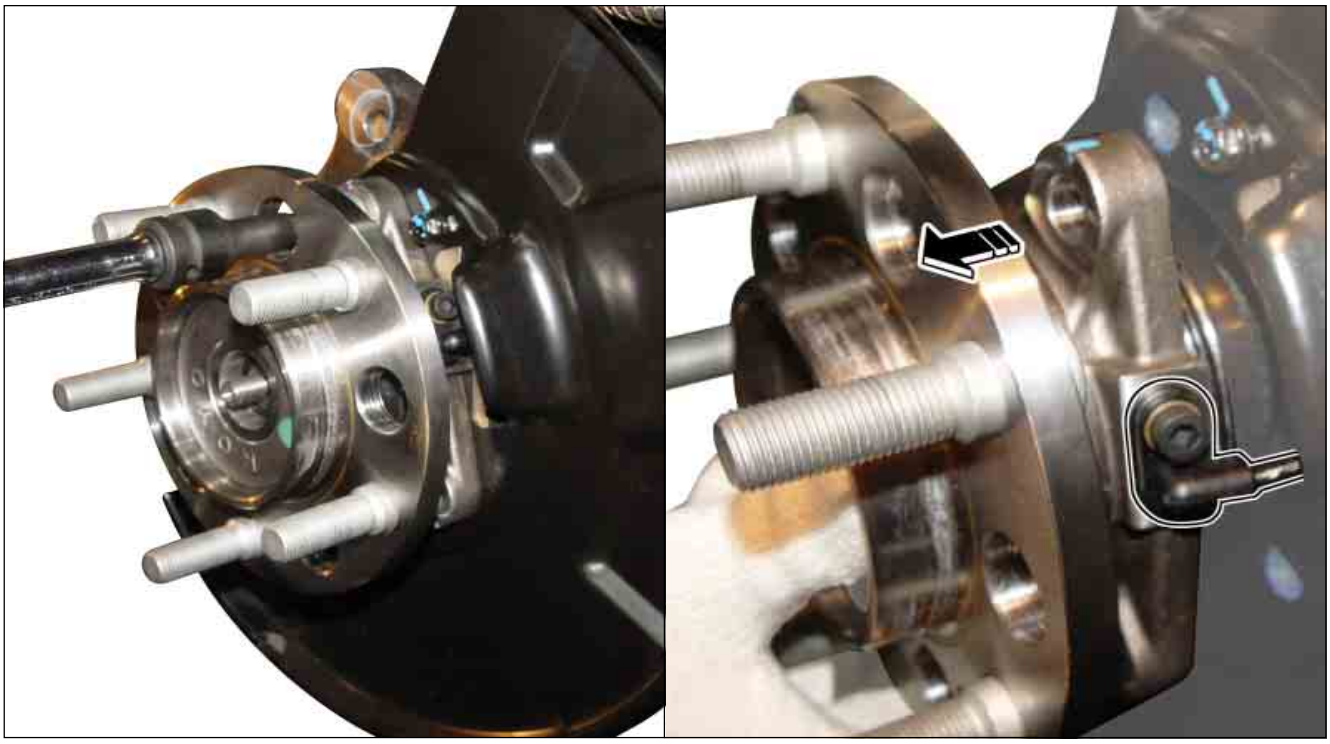
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Front Wheel Speed Sensor

1. Disconnect 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.



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3. Remove one of self-locking hexagon bolt.



When Installing

Keep the specified tightening torque and air gap.

Tightening torque

Front wheel speed sensor	2WD	6 ~ 8 Nm
		15 ~ 20 Nm
Airgap	4WD	0.475 ~ 1.453 mm
		0.1 ~ 0.7 mm



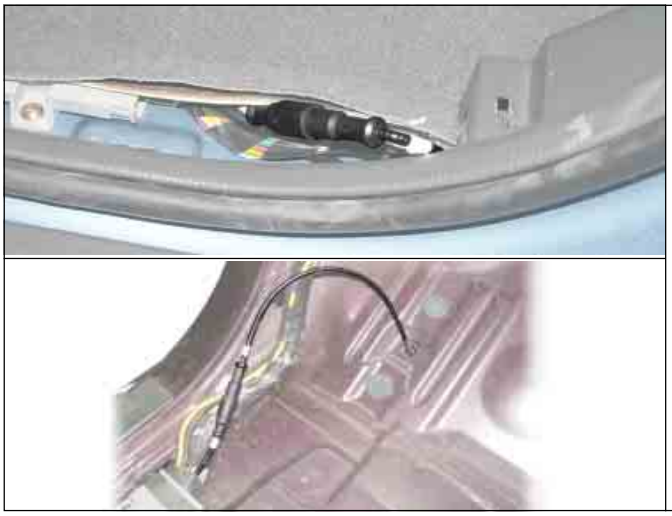
NOTICE

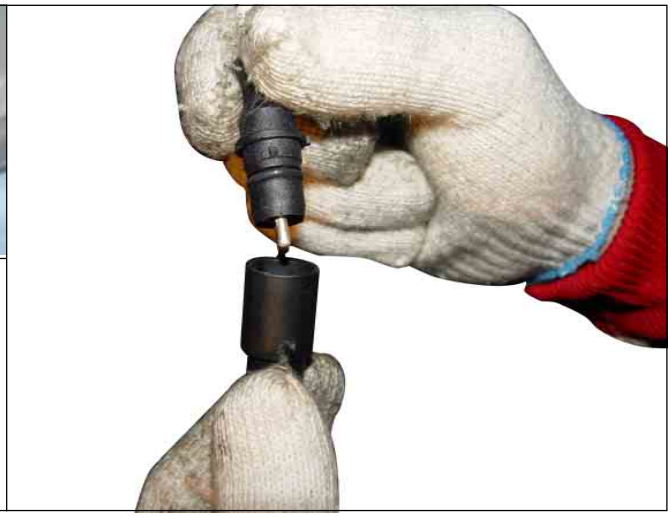
- **Tighten the bolts with the specified tightening torque.**
- **Otherwise, the air gap between the wheel speed sensor and wheel rotor may be out of specified value, and this may cause an incorrect input value to HECU.**

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Rear Wheel Speed Sensor

1. Disconnect the speed sensor connector. Set aside the wheel speed sensor cable.





2. Remove one of self-locking bolt (10 mm). Remove rear wheel speed sensor.





When Installing

Keep the specified tightening torque and air gap.

Tightening torque

Wheel speed sensor	6 ~ 8 Nm
Airgap (mm)	0.037 ~ 1.175 (5-link)
	0.489 ~ 1.039 (IRS)

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.**



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AIR BAG SYSTEM

8810

TABLE OF CONTENTS

AIR BAG SYSTEMS (INCLUDING CURTAIN AIR BAGS) 3

1. Overview 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. Reminder for air bag related component replacement 20
10. Servicing the air bag system 21
11. Diagnosis 31

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AIR BAG SYSTEMS (INCLUDING CURTAIN AIR BAGS)

1. OVERVIEW

The air bag systems for this vehicle are not much different from the previous air bag system installed in REXTON.



The curtain air bags are installed at the bottom of the roof trim 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 the air bags are deployed. 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.

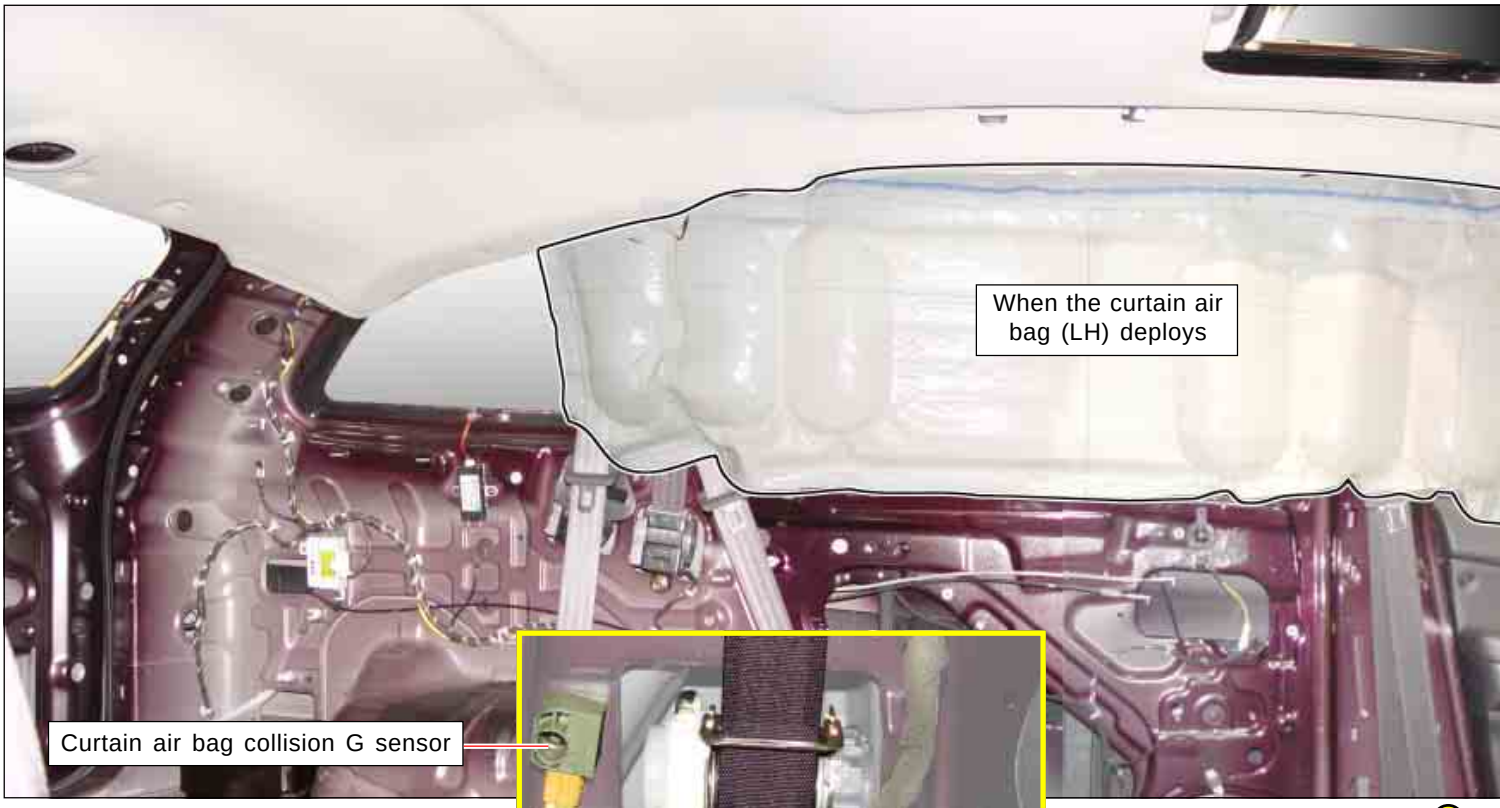
NOTICE

- **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-100 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.**

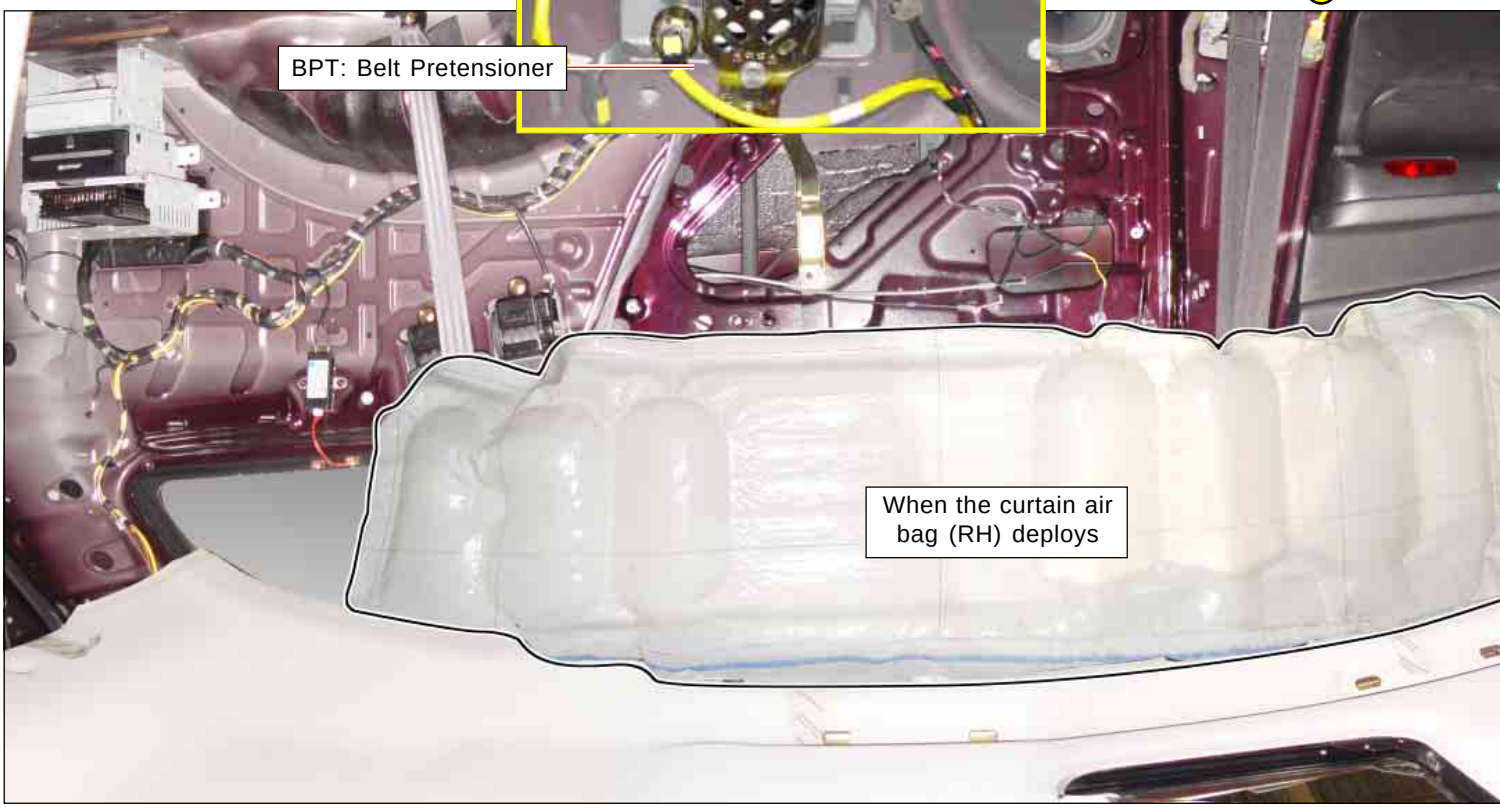
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2. LOCATIONS AND RELATED COMPONENTS

▶ LH



▶ RH



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DAB: Driver Air Bag



Air bag warning lamp



STICS

40 ms after receiving the air bag deployment signal at the vehicle speed 3 or higher km/h, it sends out the door UNLOCK signal for 5 seconds.





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 or the driver's and passenger's curtain air bag. 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.



PAB: Passenger Air Bag

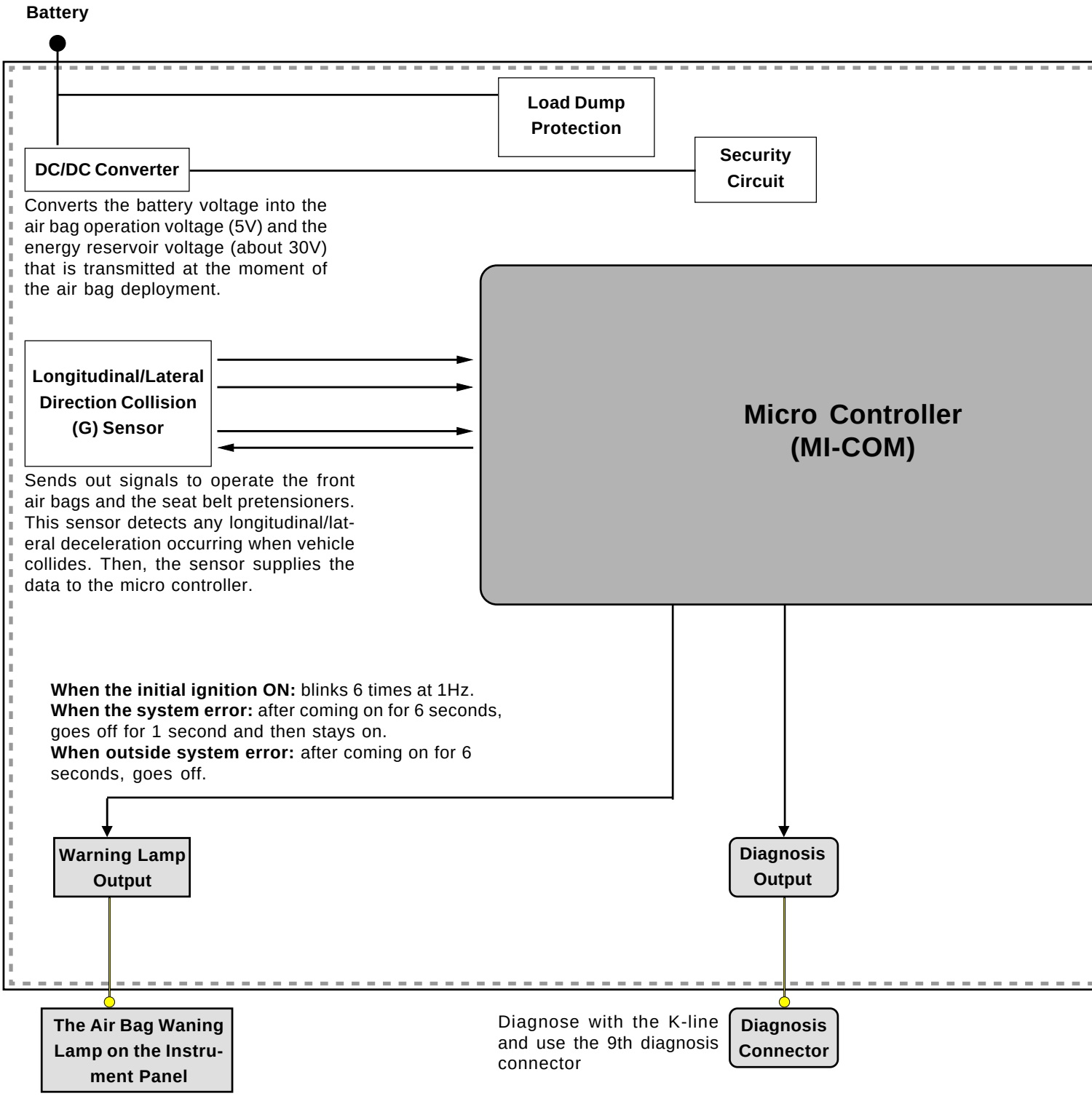
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3. AIR BAG SYSTEM OPERATION PROCESS

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)

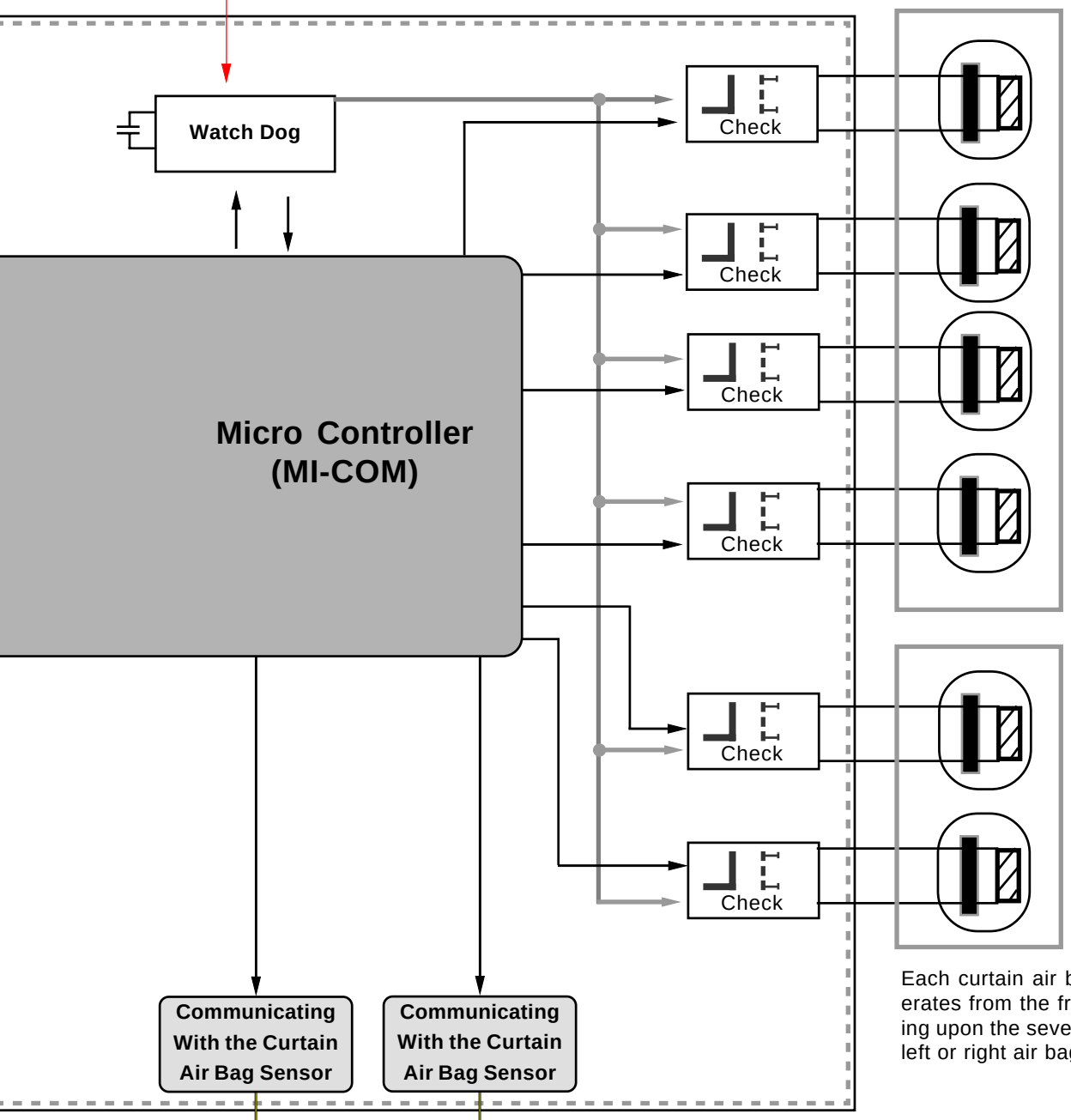


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The watchdog monitors the micro controller, the air bags, and the seat belt pretensioners. When any error occurs, it turns on the air bag warning lamp.

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 from the front air bags. Depending upon the severity of impact, only the left or right air bag may deploy.

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 decesion to its air bag unit.

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4. AIR BAG MODULE AND OTHER COMPONENTS

This section describes the air bag module installed in Kyron. 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.

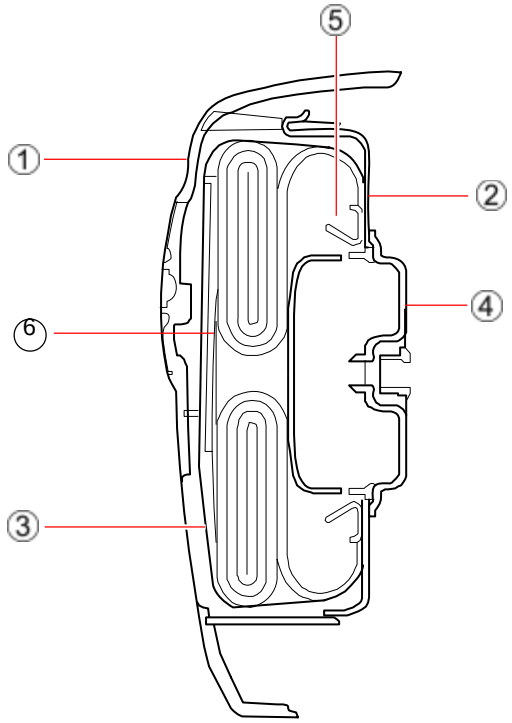


Front View



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.

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▶ 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).

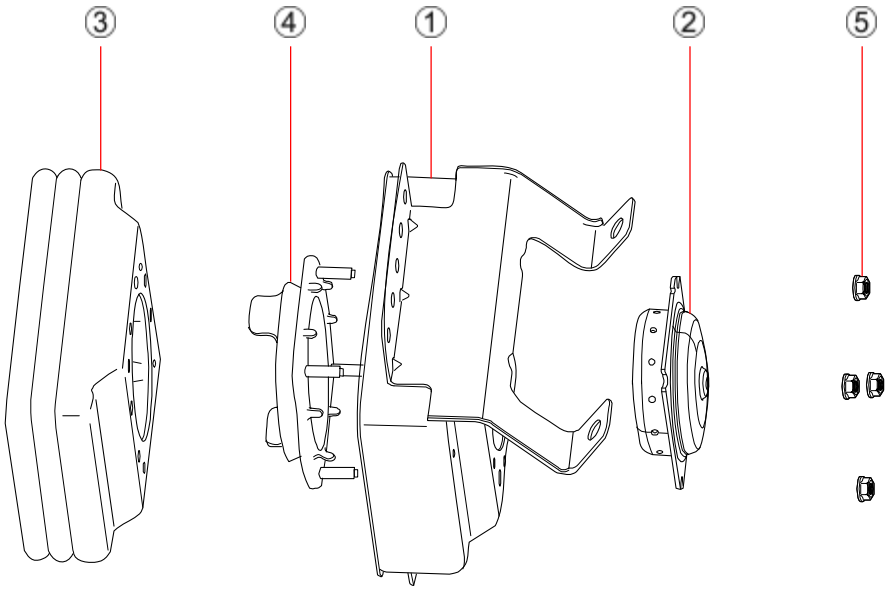


Front View



Rear View

Components



1. Passenger's air bag module housing
2. Inflator
3. Air bag cushion
4. Retainer
5. Nut

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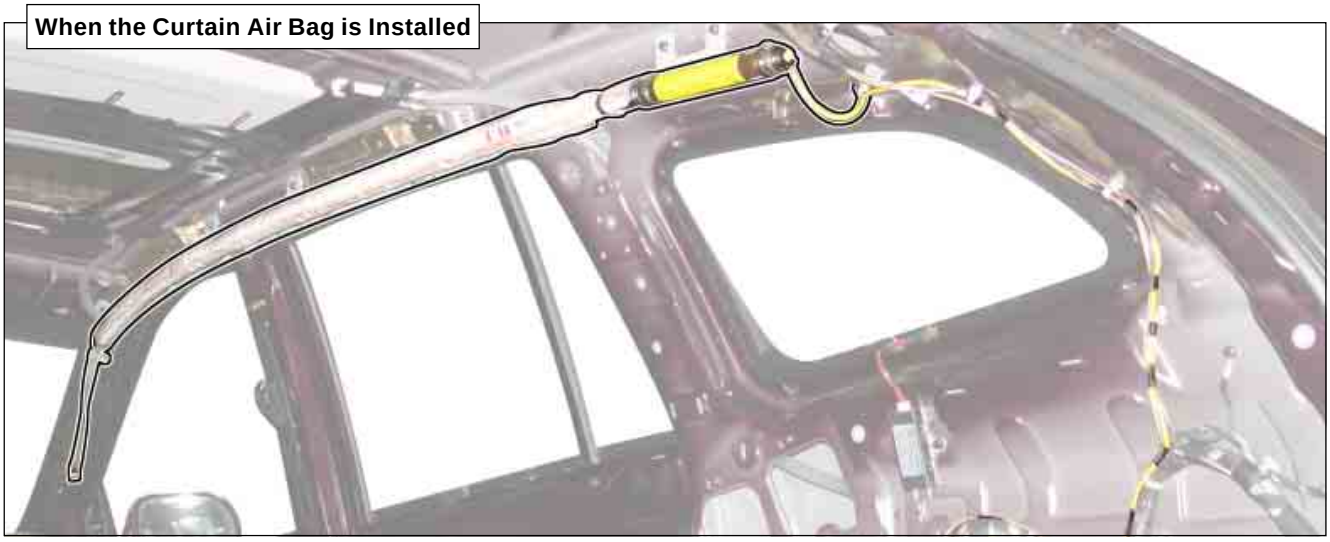
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▶ Curtain Air Bag (CAB)

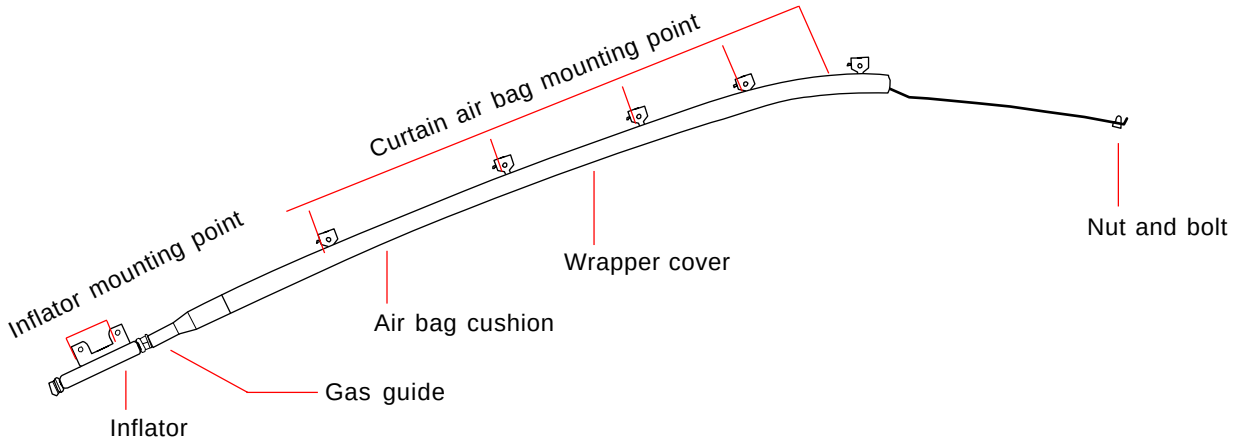
The curtain air bags are installed on both sides of the roof side rails and inside the headlinings. Each curtain air bag is also composed of the air bag cushion and the inflator that has the detonator, explosives, and the gas generator.

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.

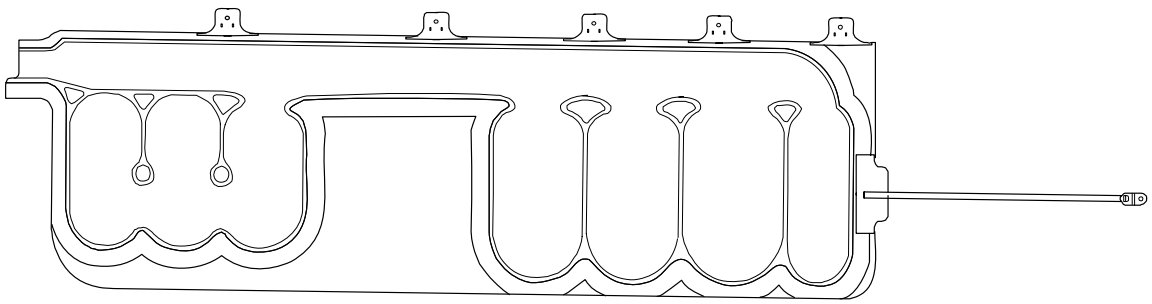
When the Curtain Air Bag is Installed



Terms of the Curtain Air Bag



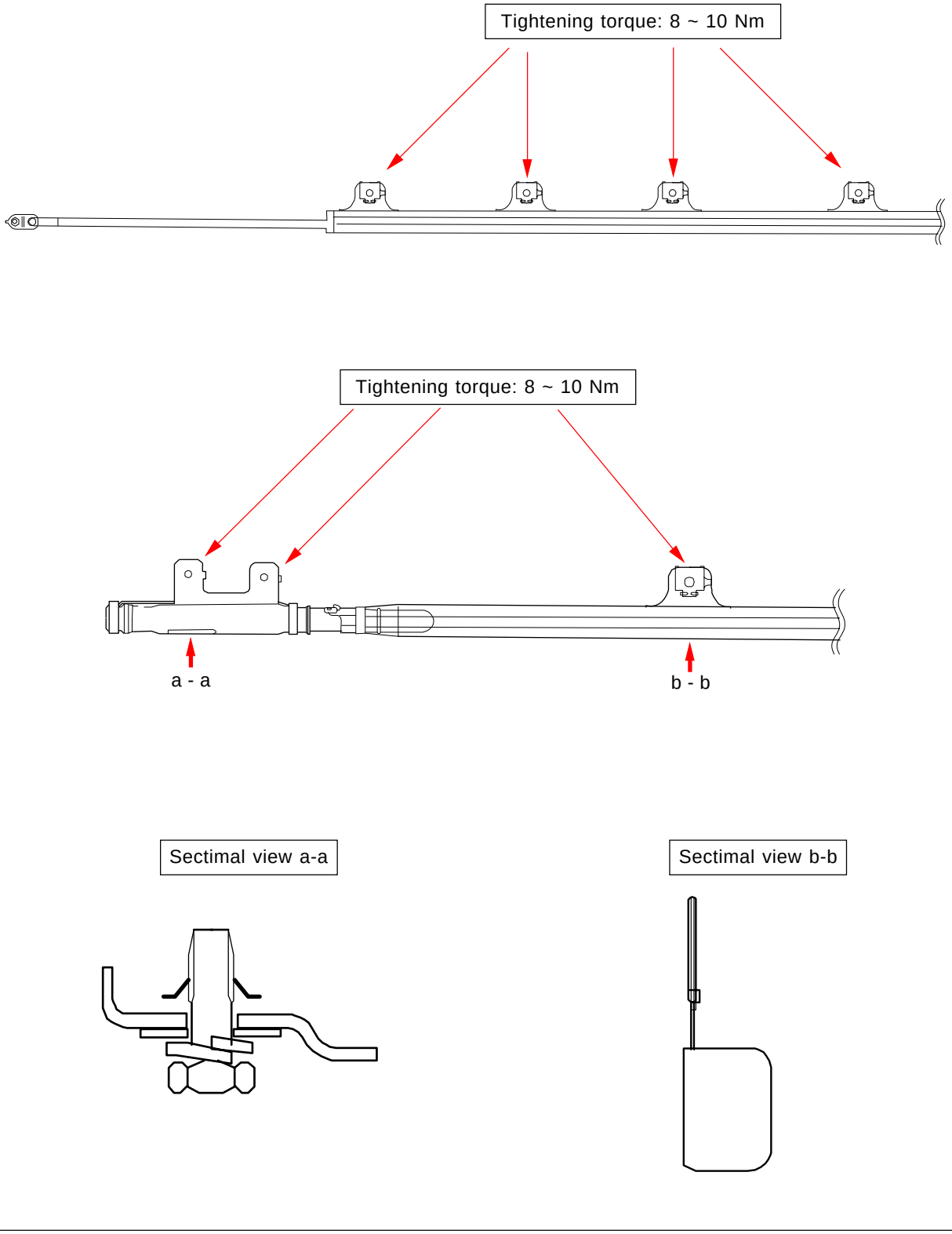
When the Curtain Air Bag Deploys



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Components



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▶ Driver and Passenger BPT (Belt Pre-Tensioner)

The belt pretensioner retracts the seat belt to tighten or take up slack in the wearer's belt. 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.

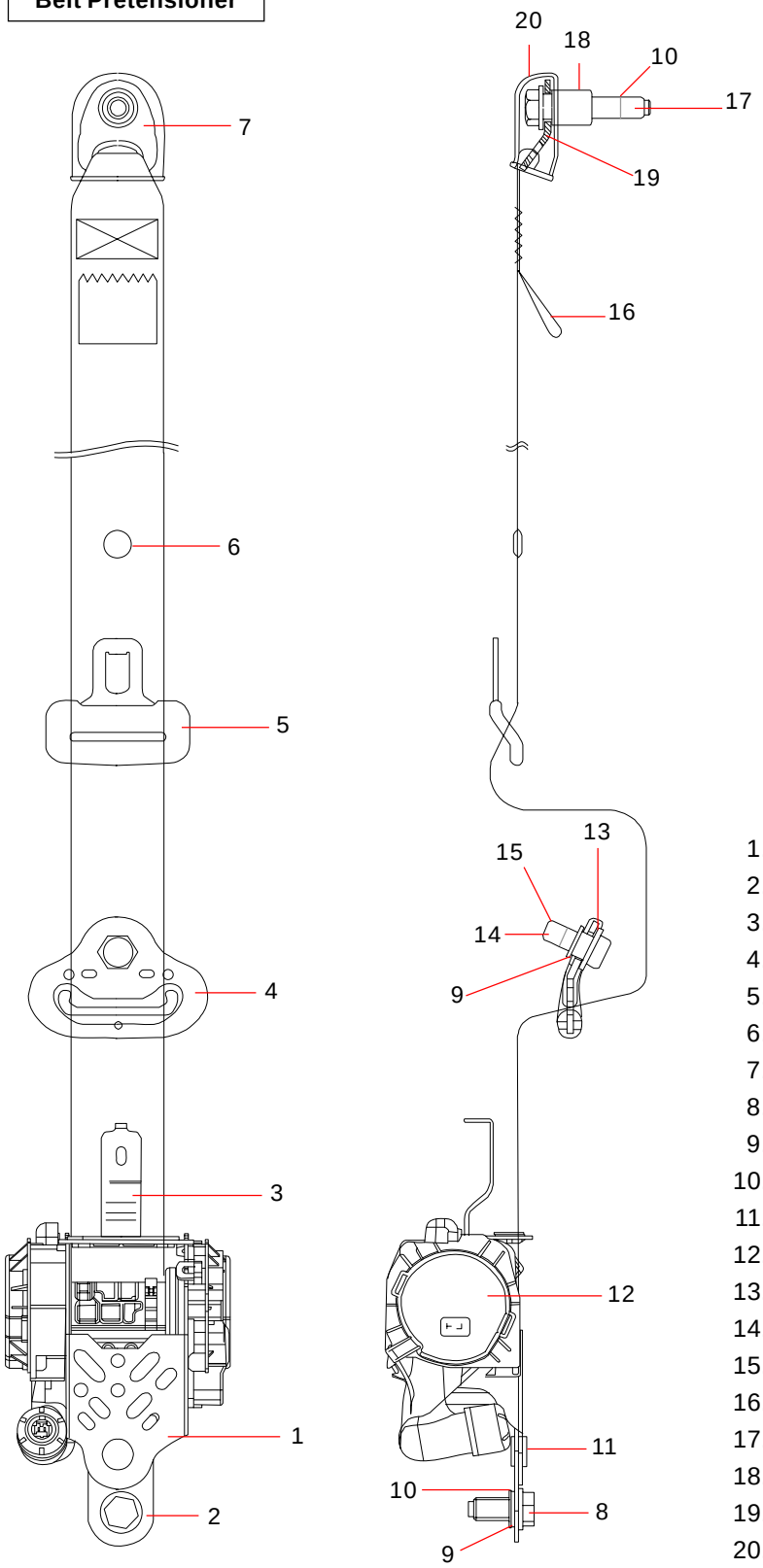


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Components

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

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▶ Air Bag Unit

Air bag unit is installed under the AV head unit in center fascia panel.







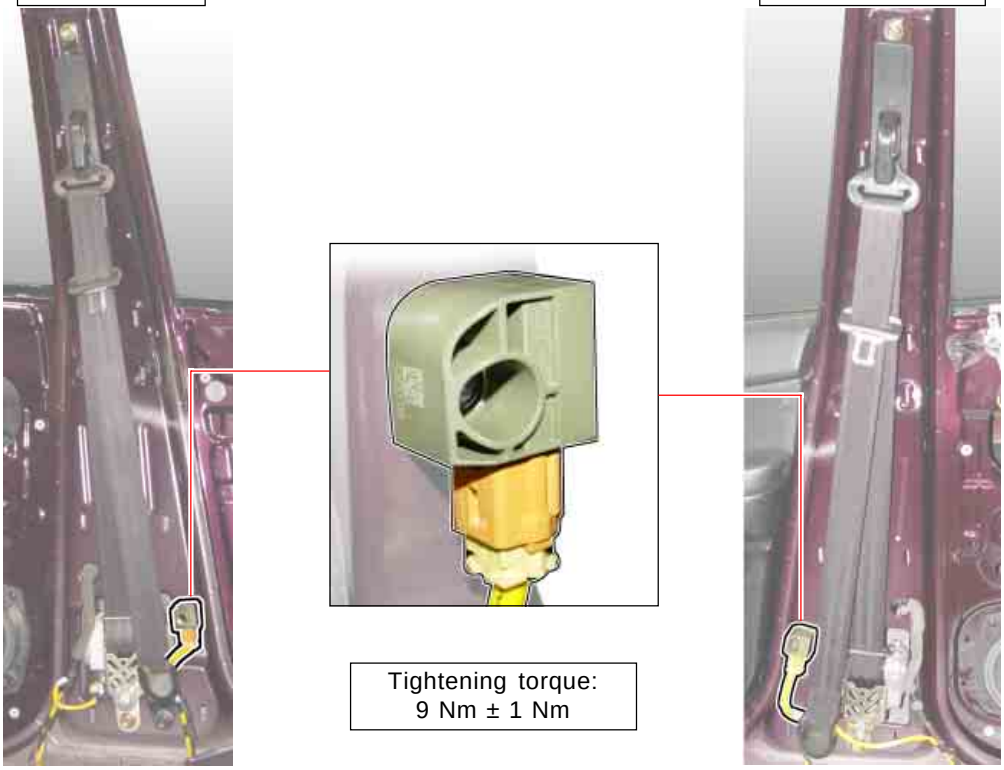


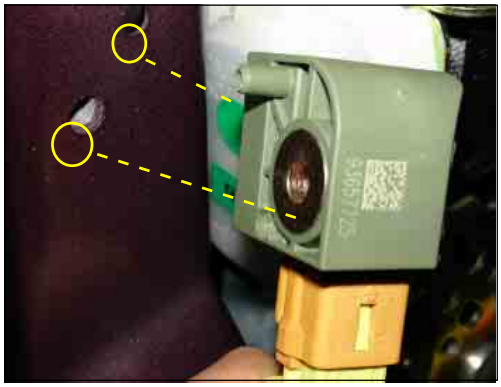
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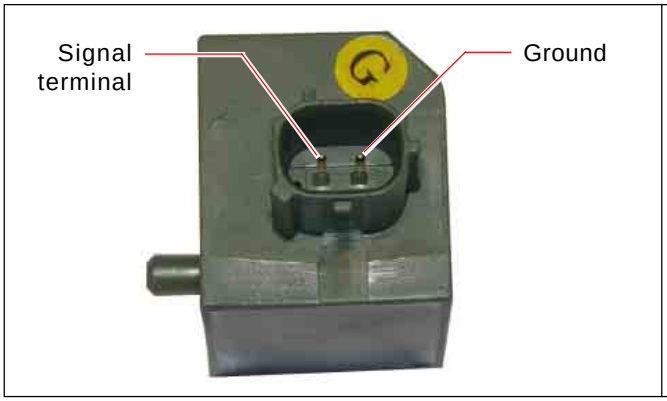
▶ Curtain Air Bag Sensor

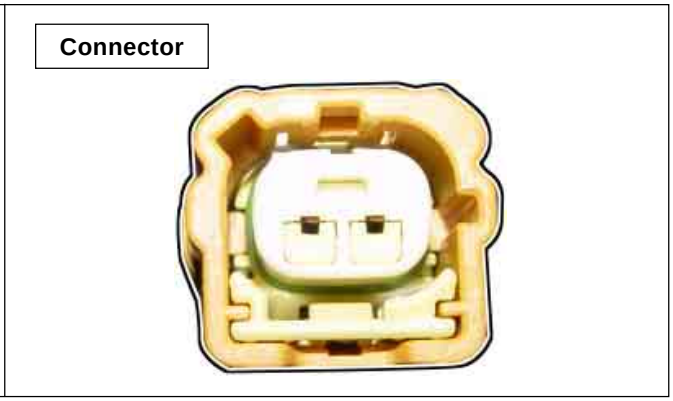
The curtain air bag sensor is installed inside each B-pillar of the driver's and passenger's seats (that is, around the pretensioner reel). The body panel has guiding holes to ensure its correct installation. But incorrect tightening torque may break the sensor or make it insecure. As a result, the sensor may have inaccurate judgment and have the air bag deployed inaccurately.







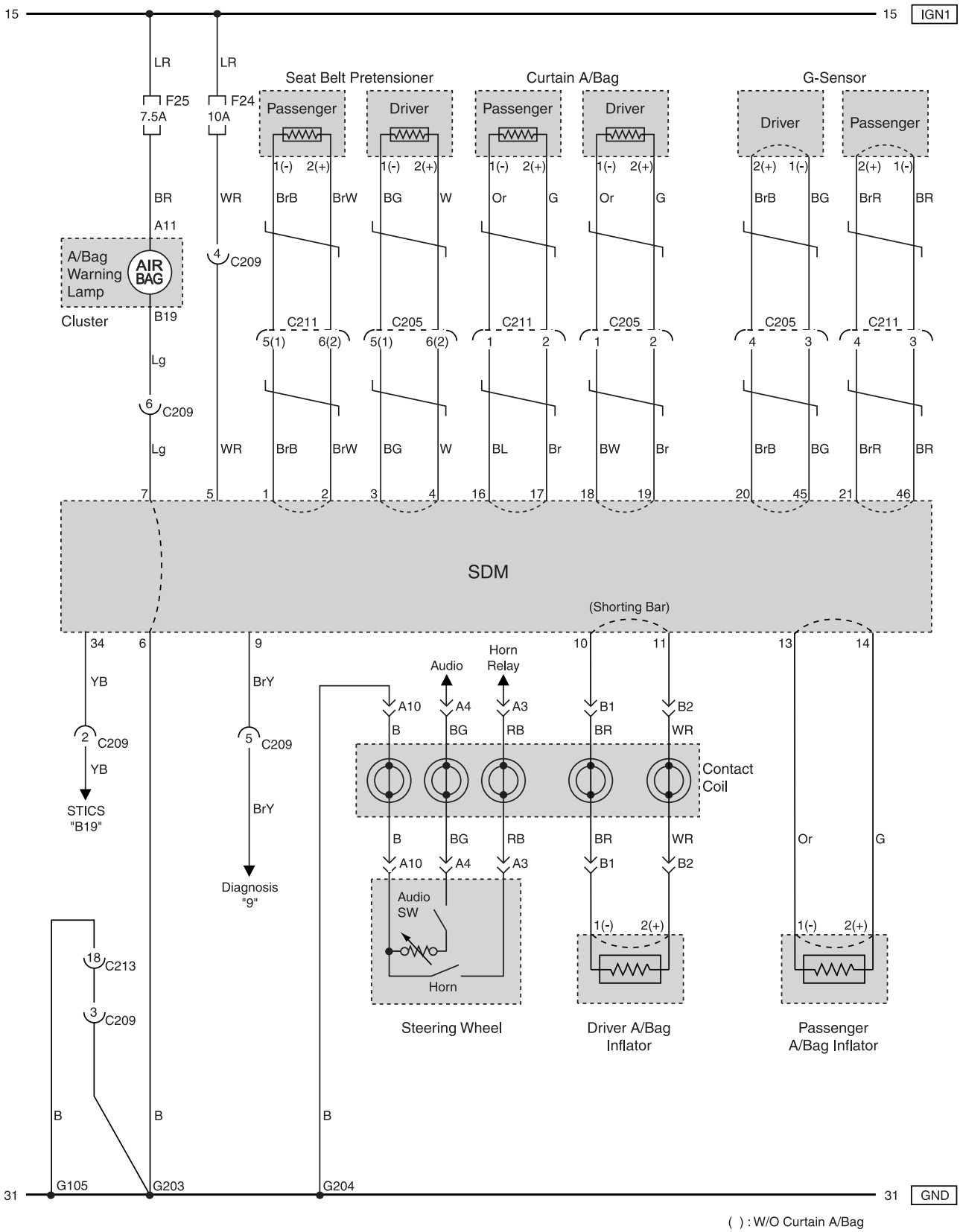




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5. ELECTRICAL WIRING DIAGRAM



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6. AIR BAG SYSTEM DEPLOY (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 a 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 for 2msec (at -35°C)	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.**

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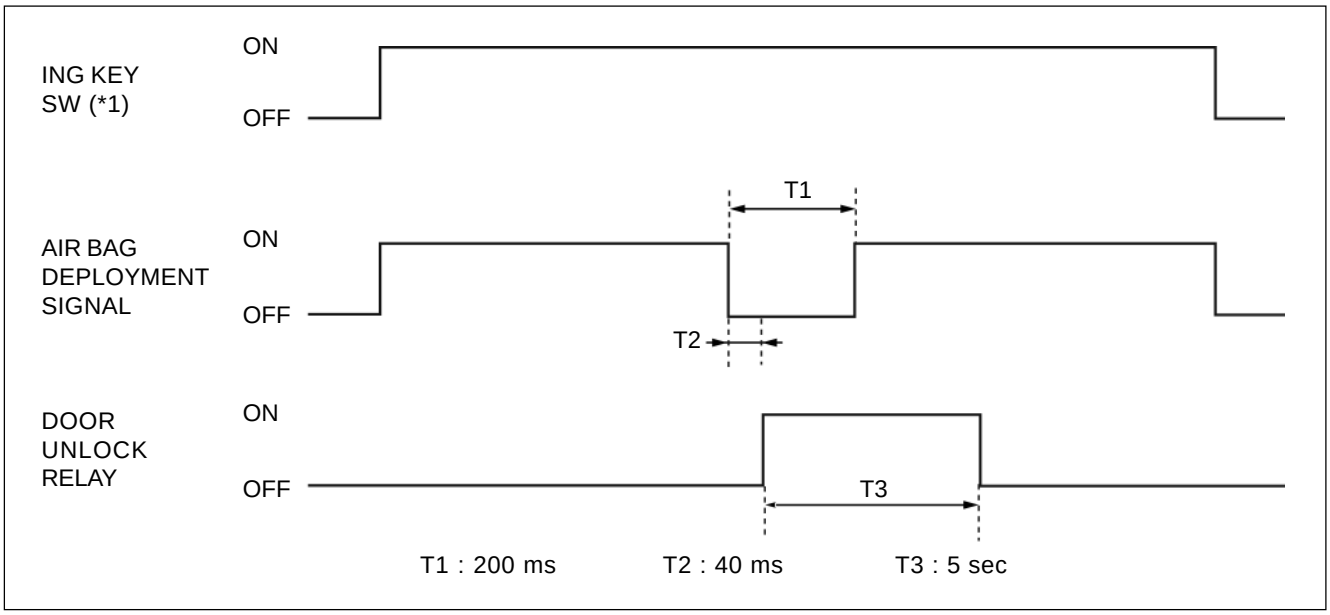
7. AIR BAG DEPLOYMENT SIGNAL OUTPUT (CRASH OUT)

When any air bag deploys, another signal is sent to the sticks to do two basic security operations. One operation is the automatic door unlock function that cancels 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 sticks 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 will be performed and the unlock will be ignored.**

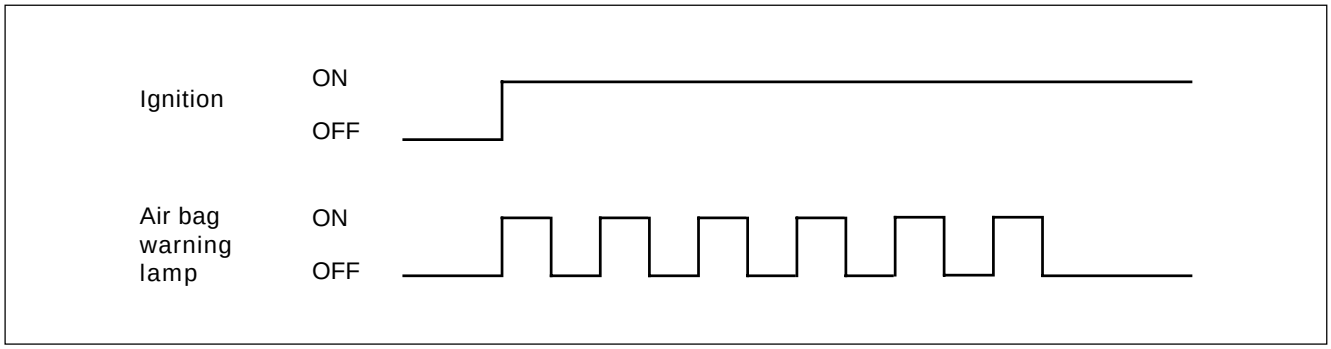
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8. AIR BAG WARNING LAMP OPERATIONAL CONDITIONS

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

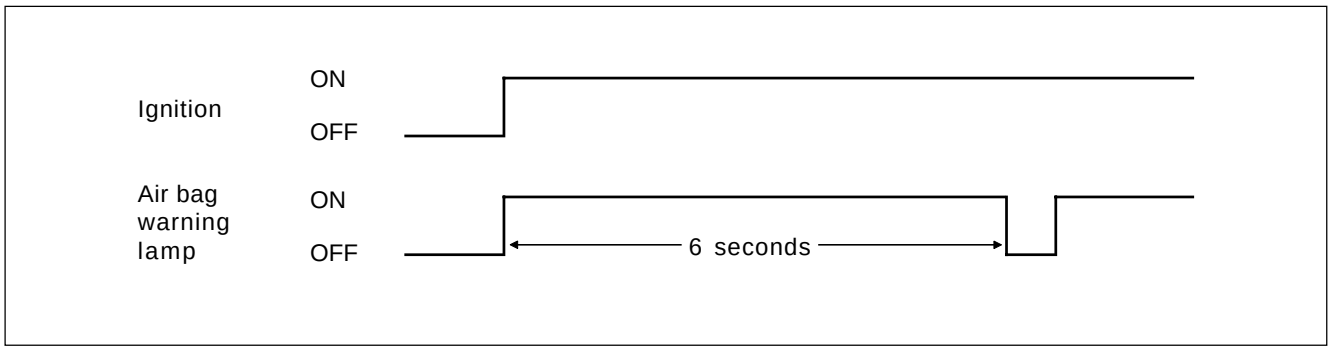
The air bag unit performs a turn-on test when the ignition is turned on. The air bag unit flashes the air bag warning lamp six times by supplying an intermittent ground to the warning lamp circuit. After flashing six times, the air bag warning lamp will turn off if no more malfunctions have been detected.



▶ When Turning the Ignition Switch to the ON Position

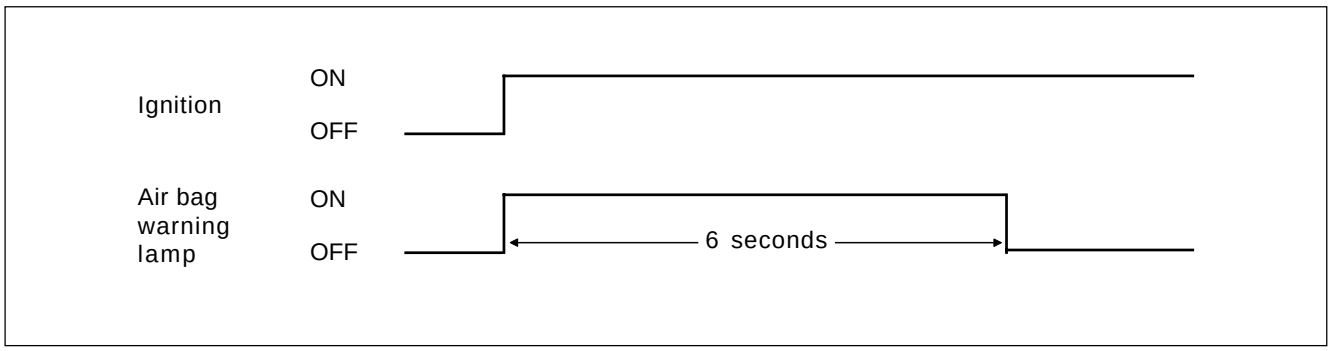
When the air bag unit detects any malfunctions in its unit

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.



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9. REMINDER FOR AIR BAG RELATED COMPONENT REPLACEMENT

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-100 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.**

Collision sensors, a kind of impact G (acceleration) sensor, detect the front and longitudinal collisions and determine whether or not the air bags are deployed. 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 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.

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10. SERVICING THE AIR BAG SYSTEM

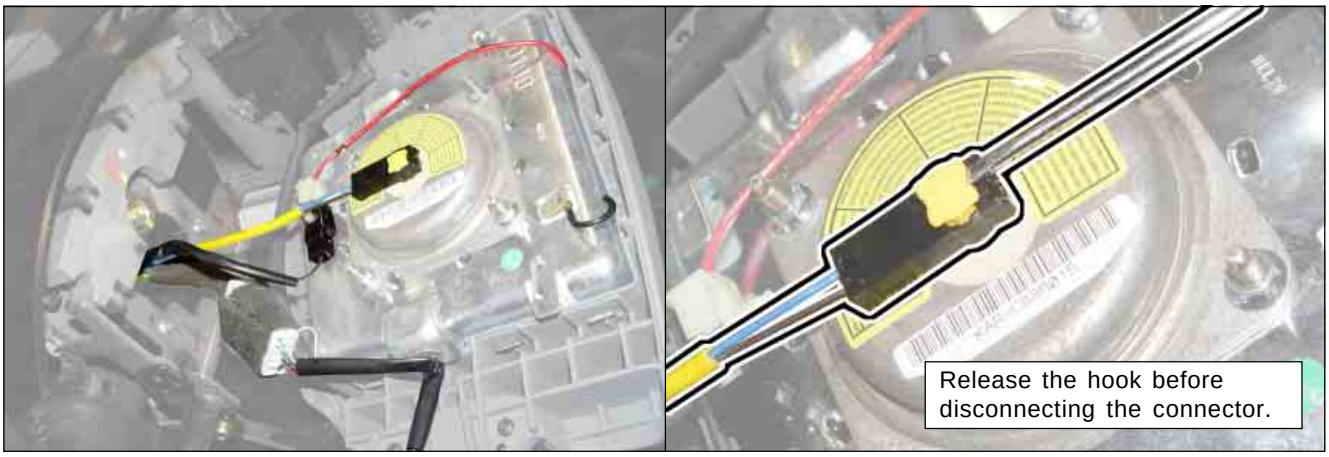
▶ DAB: Driver Air Bag

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the air bag module assembly from steering wheel.



2. Disconnect all connectors and remove the air bag assembly.



Components

Front View



Rear View



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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 a turning. Restricted turning ability may cause the vehicle to crash. Improper alignment of the contact coil also may make the SIR system inoperative, preventing 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.**

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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.



2. Unscrew five nuts on the air bag module (10 mm).



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3. Remove the air bag module assembly from the instrument panel.

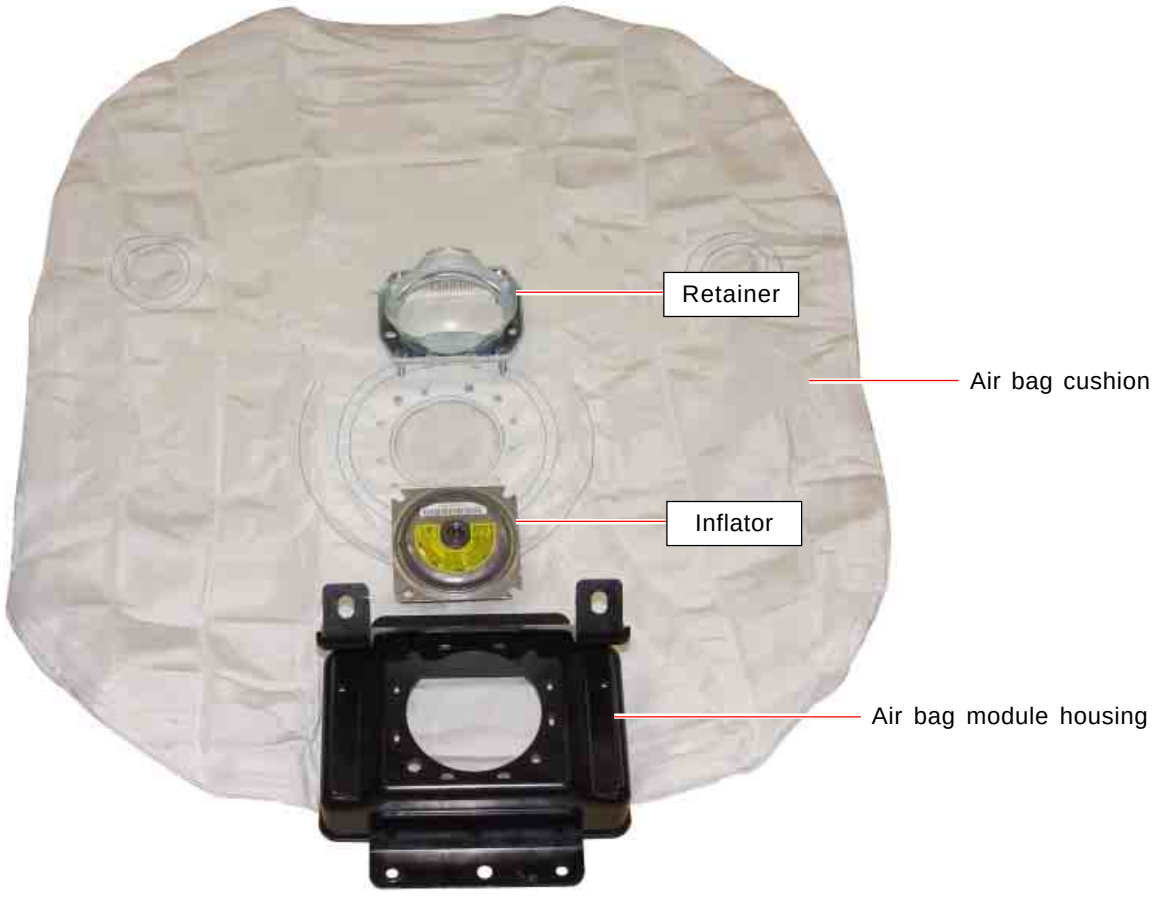




WARNING

- **The air bag module cannot be removed. Below picture is only for reference.**

Components



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CAB: Curtain Air Bag

※ **Preceding Work:** Disconnect the battery negative cable and remove the instrument panel assembly. (For details, refer to “Body” section.)



1. Disconnect the connector of the curtain air bag while releasing the hook.

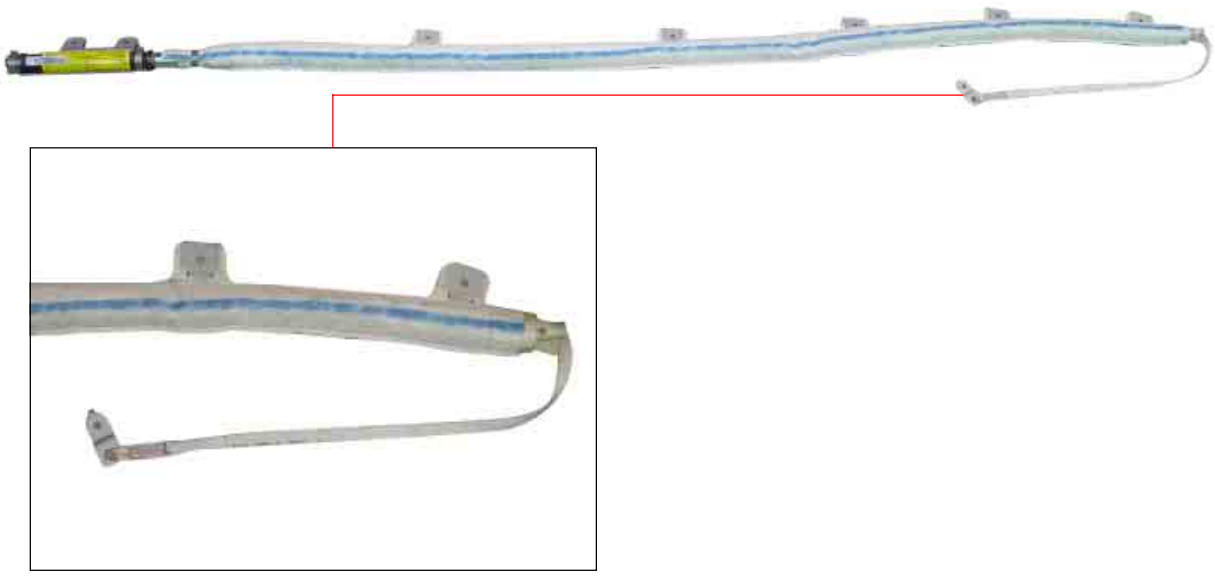


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2. Remove the handle bracket and then remove the curtain air bag assembly.



Components



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Air Bag Unit (SDM)

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the center fascia, driver's lower panel, passenger's lower panel and center console.
   (For details, refer to "Body" section.)



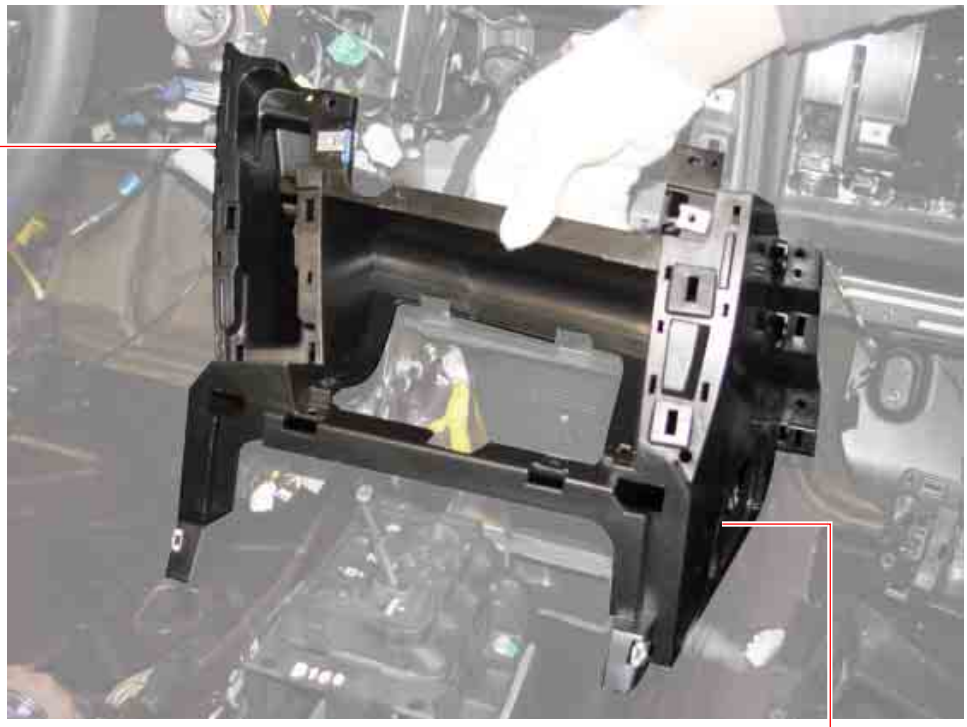
1. Center fecia (LH/RH)
2. Driver's lower panel
3. Passenger's lower panel
4. Center console

2. Remove the AV head unit assembly.
   (For details, refer to "AV System" section.)



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3. Unscrew the screws on the instrument panel and remove the relevant components (power socket/shift lever cover).



Mounting Screw (Same at Both Sides)



Power Socket Cover Mounting Screw

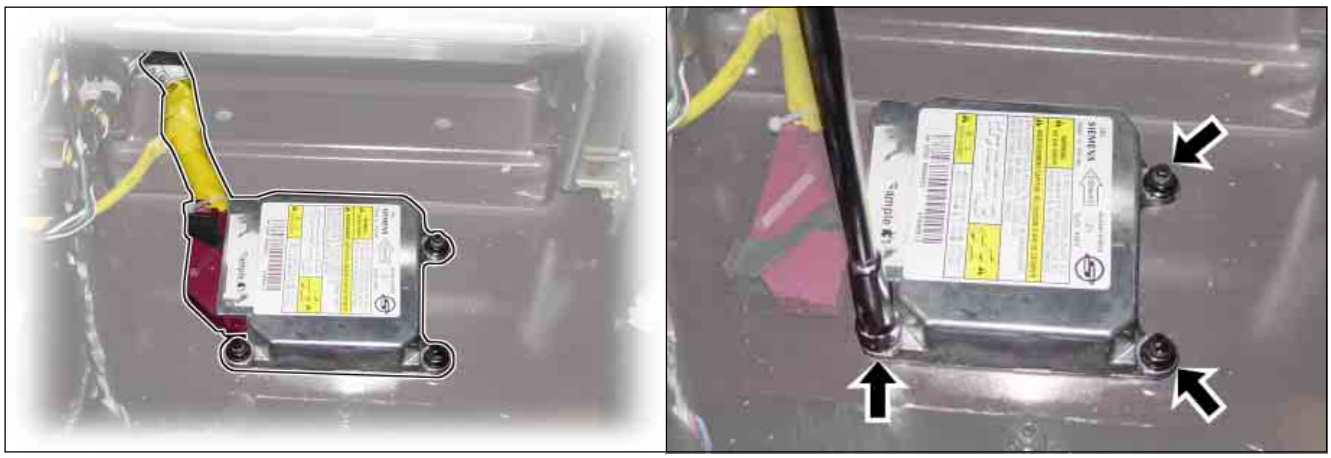


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4. Unscrew two screws and remove the lower center air duct.



5. Disconnect the connector and 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.**

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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 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.**

Passenger's Side





Components





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11. DIAGNOSIS

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

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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

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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.

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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.

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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 module wiring and layout 5
4. Air conditioner controller (unit) 9
5. Self diagnosis (only for FATC air conditioner) 18
6. System diagram 23
7. Sensors and actuators 24
8. Air quality system (AQS) 26
9. Air conditioner module sensors and actuators 30
10. Removal and installation 40

FFH (FUEL FIRED HEATER) SYSTEM 61

1. Overview 61
2. FFH layout 62
3. Specifications 64
4. FFH operating process 65
5. Components and functions 70
6. Removal and installation 75
7. Trouble diagnosis 82

PTC (Positive Temperature Coefficient) SYSTEM 86

1. Overview 86
2. Components 87
3. PTC operating process 88
4. Removal and installation 90

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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

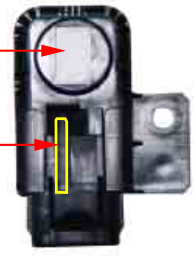


A function that turns on/off the air source selection and air quality system.

Compressor



AQS Sensor and Ambient Temperature Sensor

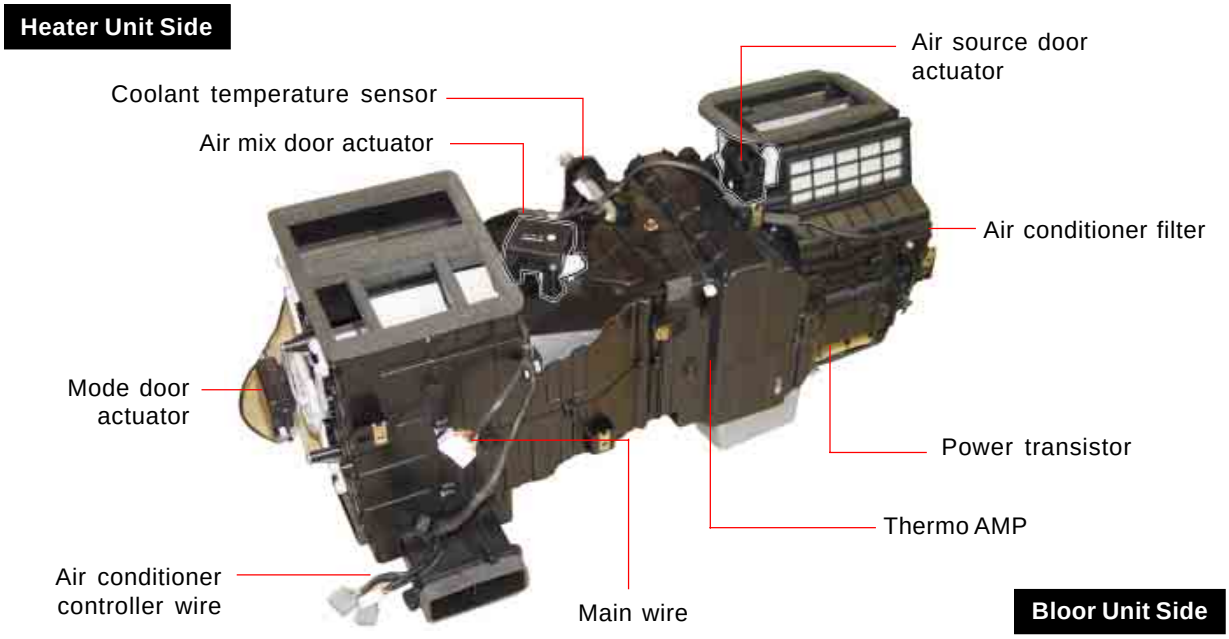


This sensor is installed at the front bottom of engine compartment. This changes the air source mode by detecting the air pollution.

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Front 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)



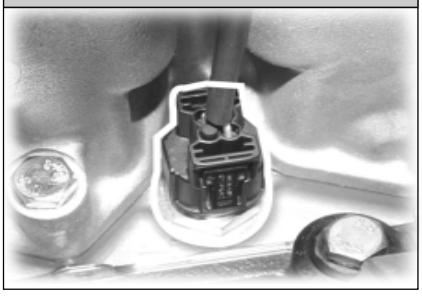
* Absorbs moisture in the refrigerant and reserves refrigerant to supply smoothly.

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 to engine ECU.

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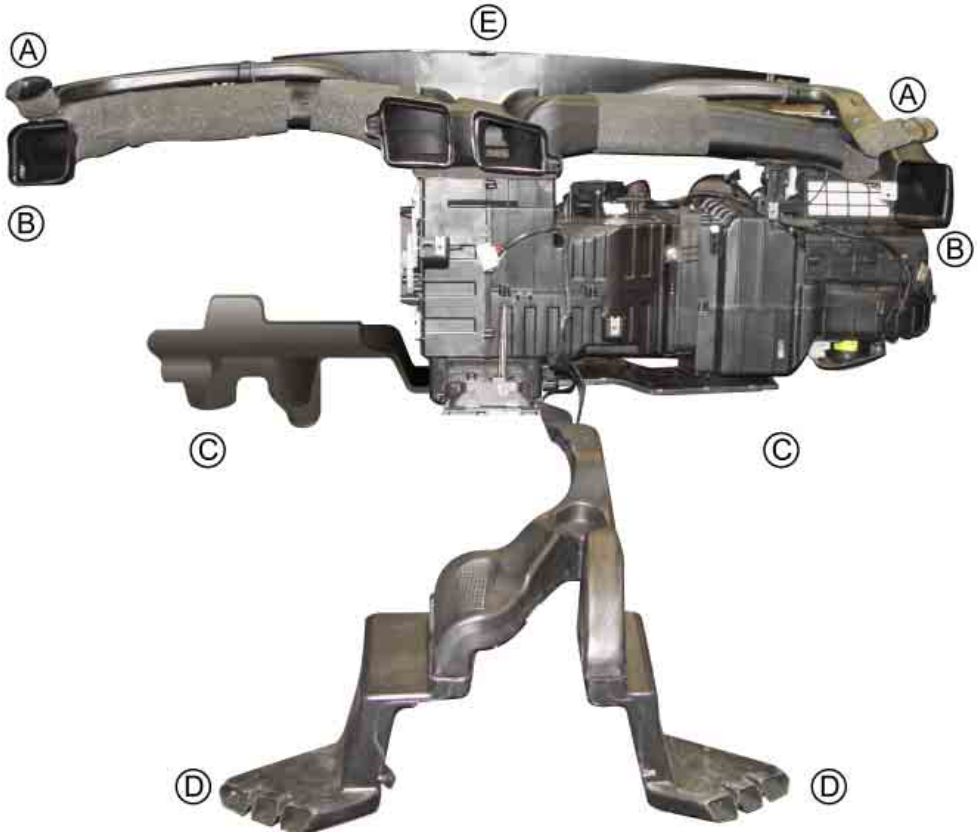
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2. VENTILATION SYSTEM

▶ Locations of Vents



▶ Air Duct



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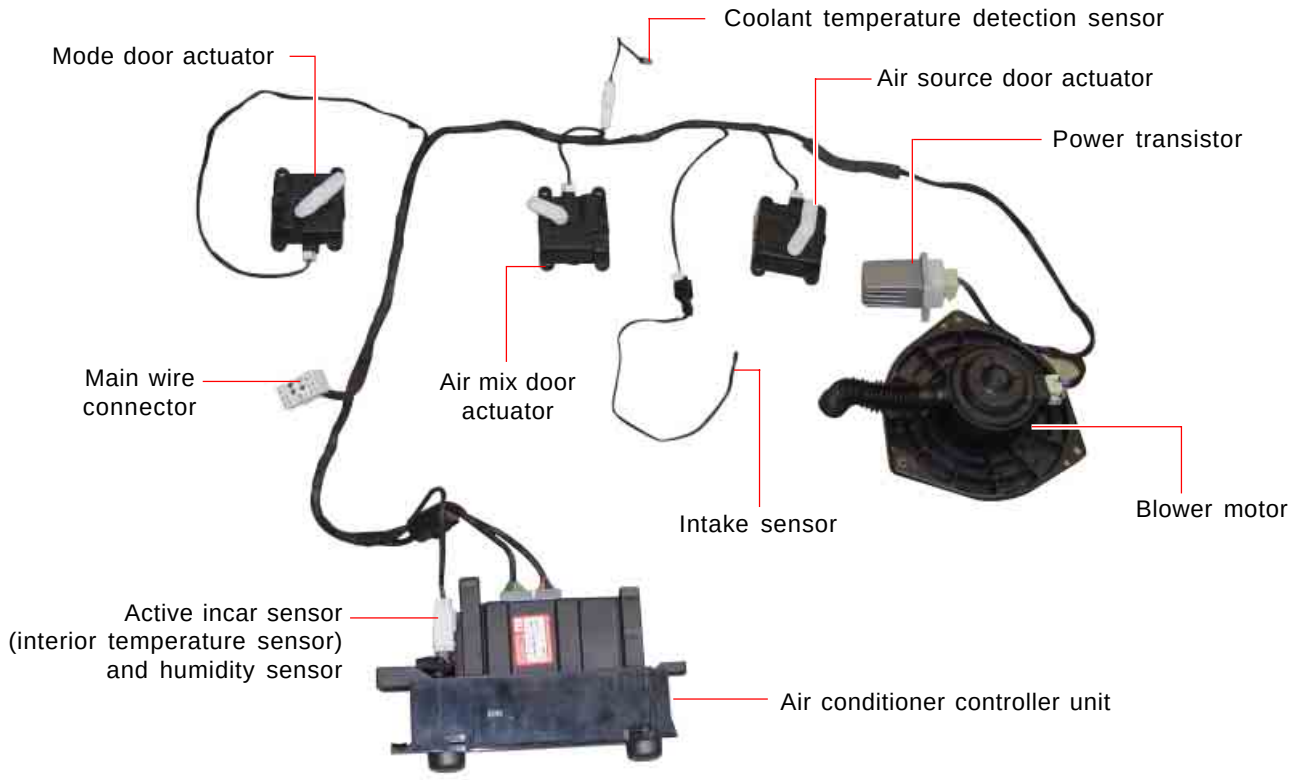
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▶ Air Duct Layout



3. AIR CONDITIONER MODULE WIRING AND LAYOUT

Front Air Conditioner Module Wiring Layout



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▶ Air Conditioner Module And Sensors

Locations

Coolant Temperature Sensor



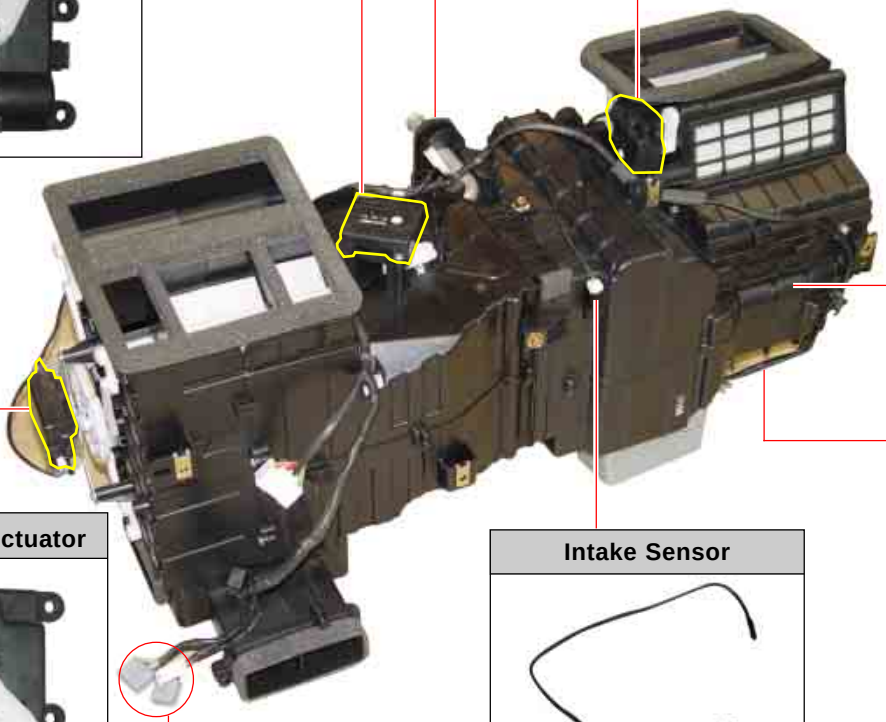
Air Source Door Actuator



Air Conditioner Filter



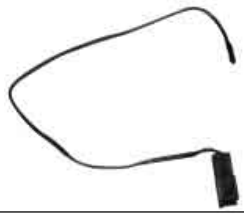




Mode Door Actuator



Intake Sensor



A/C Controller Unit

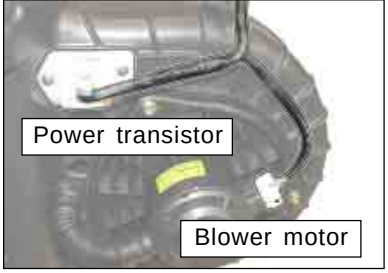


Interior temperature and humidity sensor

Interior Temperature Sensor (Interior Humidity Sensor)



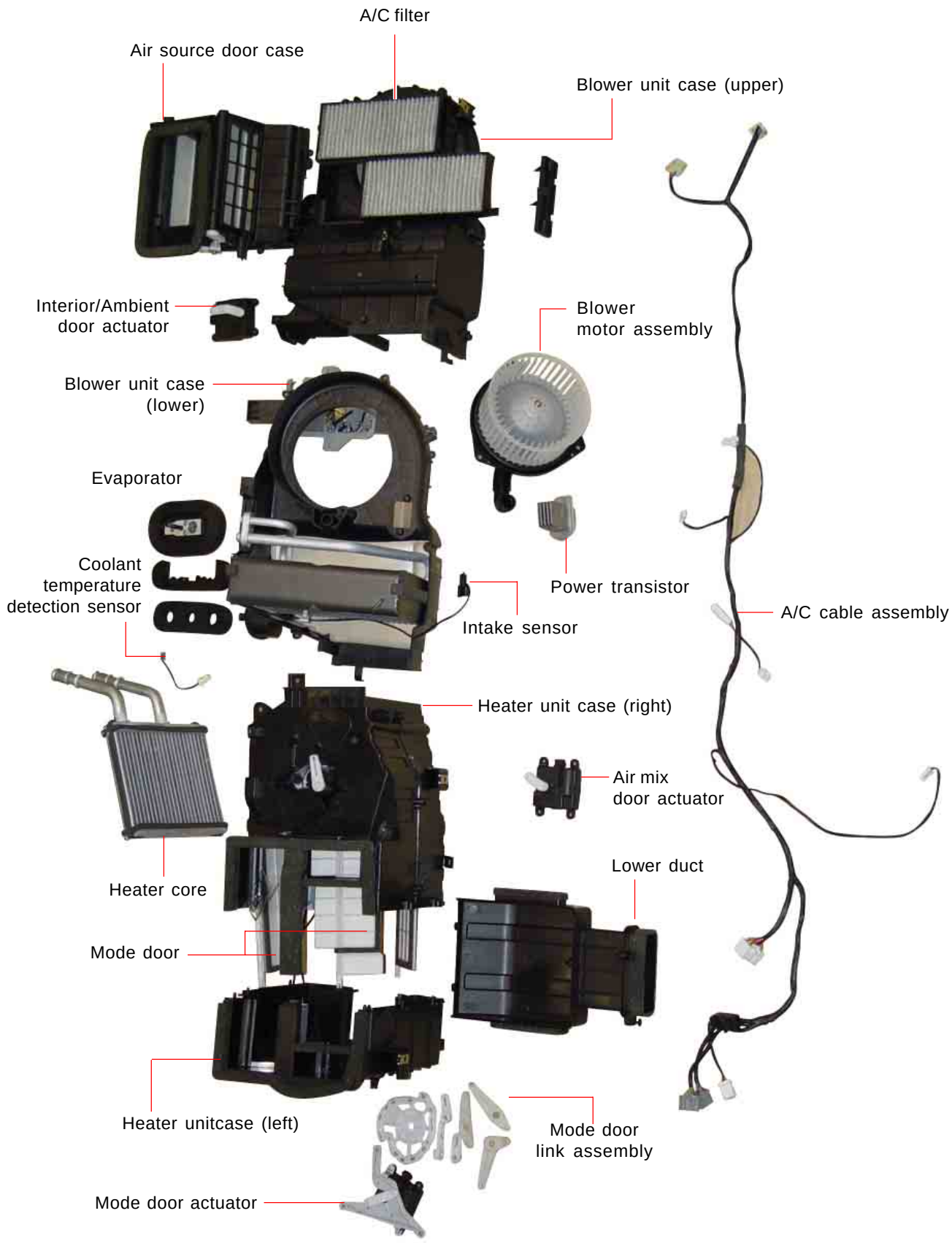
Power Transistor/Blower Motor



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Components

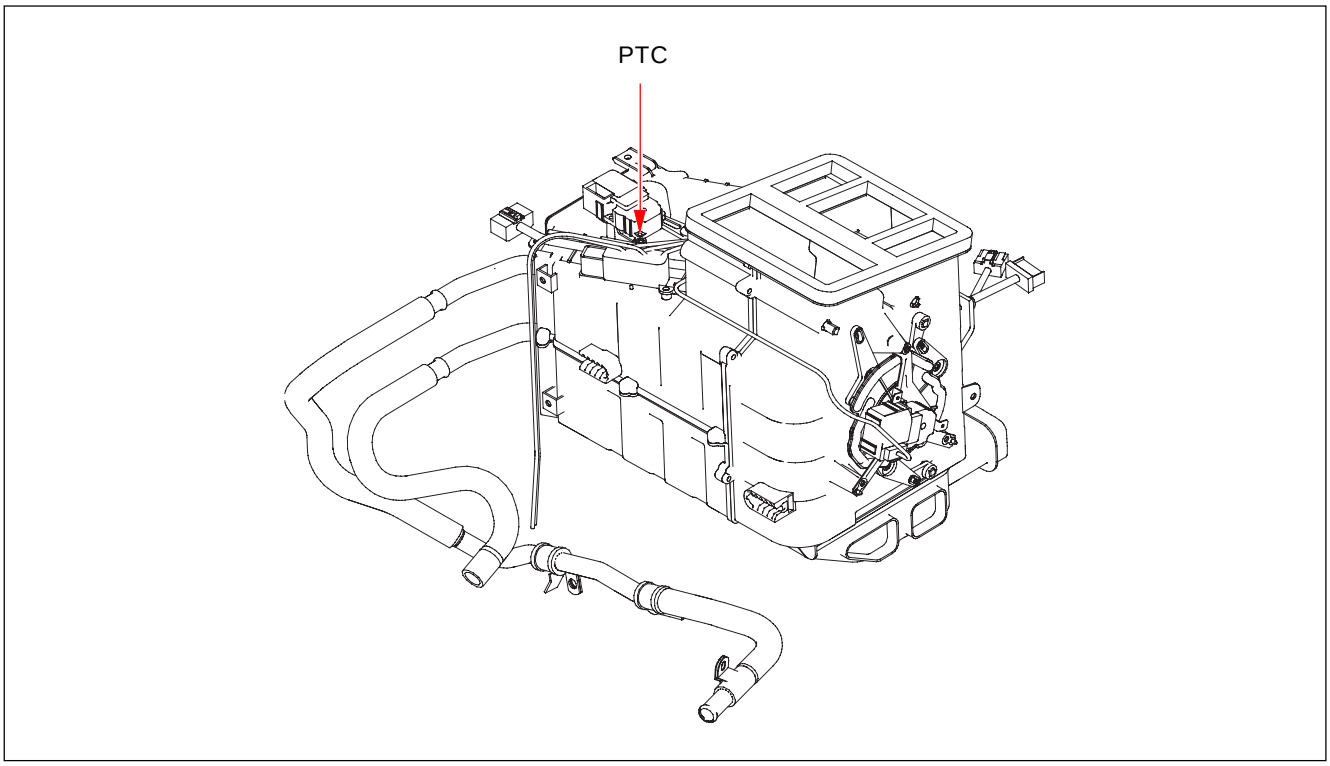


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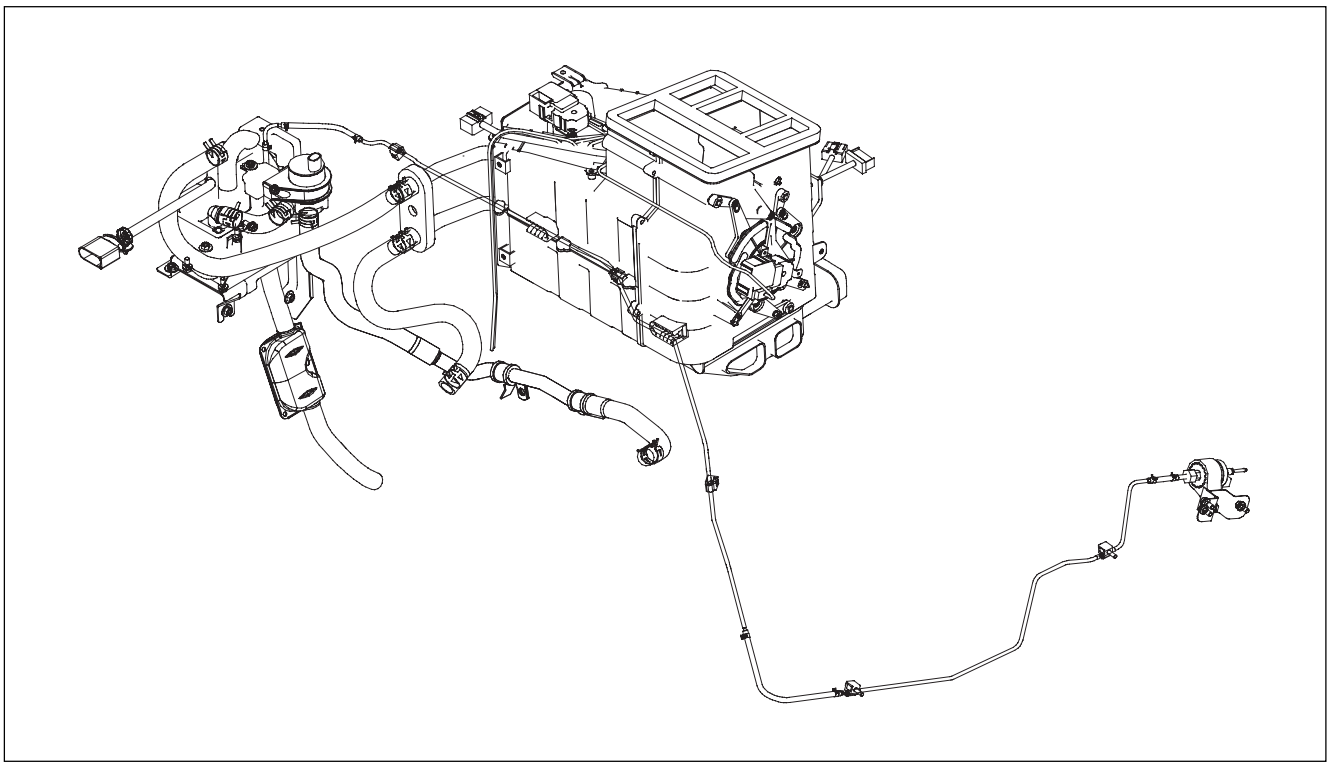
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▶ PTC Heater and FFH Heater Layout

PTC Heater Assembly Layout



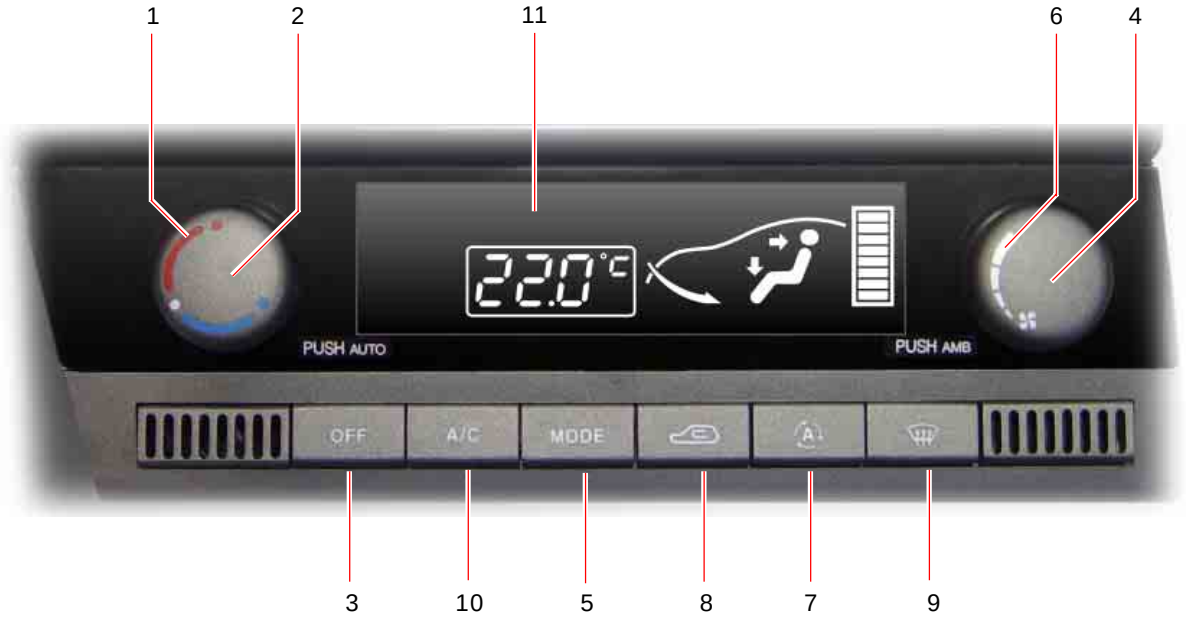
FFH Heater Assembly Layout



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4. AIR CONDITIONER CONTROLLER (UNIT)

▶ Functions of Full Automatic Air Conditioner Controller (I)



1. TEMP switch
2. AUTO switch
3. OFF switch
4. AMB switch
5. Mode switch
6. Blower switch
7. AQS switch
8. FRE switch
9. Defroster switch
10. A/C switch
11. VFD (Display)

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▶ 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. To get the desired temperature, the air conditioner controls compressor, door mode, air source door, air mix door and blower motor automatically.

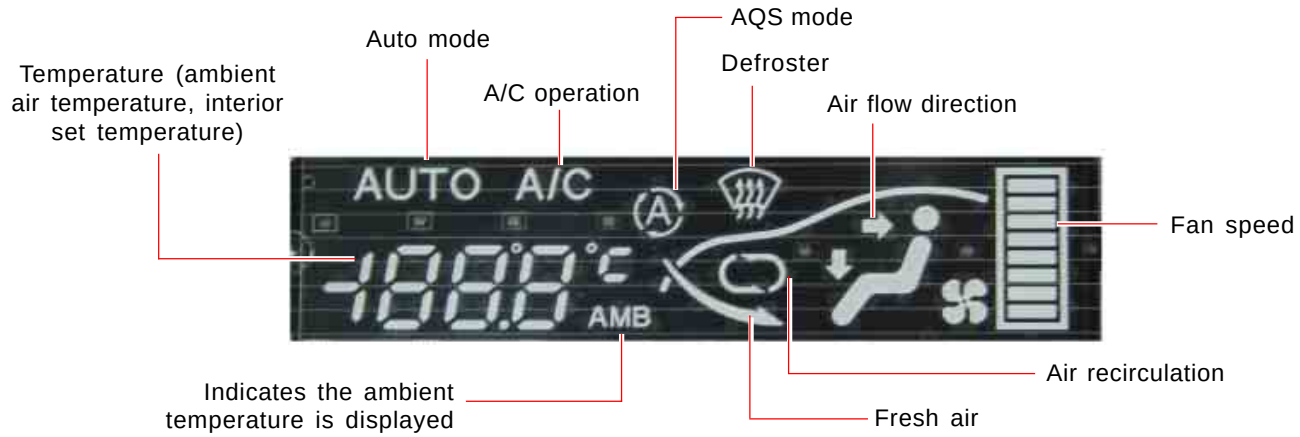
Active Incar/Humidity Sensor (AIH Sensor)



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 stages.
- 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

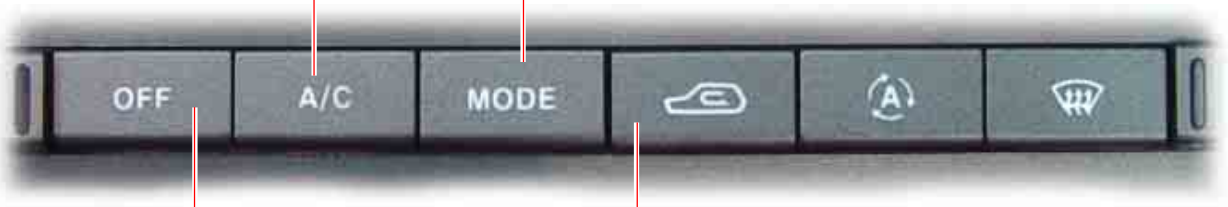
- By depressing this switch, the airflow mode is changed.



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

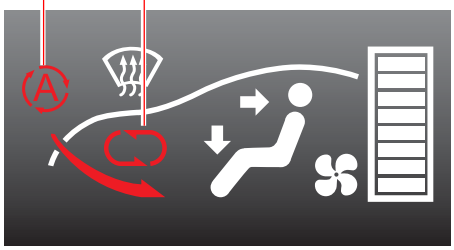
AQS System

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).

Air Source Selection Switch

When pressing this switch, the air recirculates in the vehicle inside 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.)



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 normal operations.

When pressing the AUTO switch, the defroster mode appears on the VFD until the coolant temperature reaches at a certain level.

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▶ Full Automatic Air Conditioner Controller









Interior temperature and humidity sensor

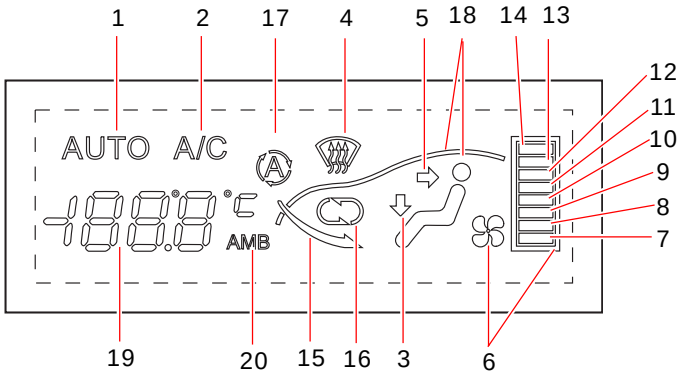


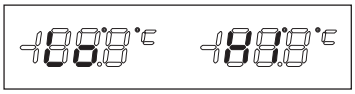


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▶ Full Automatic Air Conditioner Controller Operation Table





If the TEMP DIAL is set under 18.0°C, this shows Lo. If it is set over 32.0°C, this 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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▶ Full Automatic Air Conditioner Operations

This section describes the main operations of full automatic air conditioner.

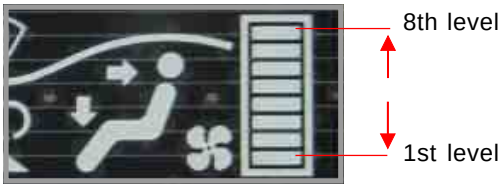
Blower Motor Control

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)

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)



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 at 55°C, the blower motor is set to 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.

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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 (Max.)	32.5°C (Min.)
Mode	Foot	VENT
Inside air/Ambient 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 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

- Intake air temperature control: COMP OFF when the thermo AMP temperature is below 2°C, COMP ON when it is over 4°C.

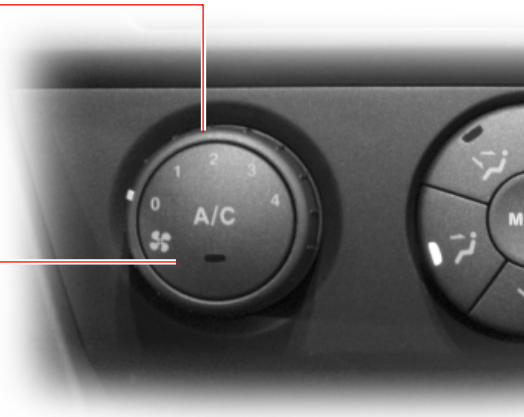
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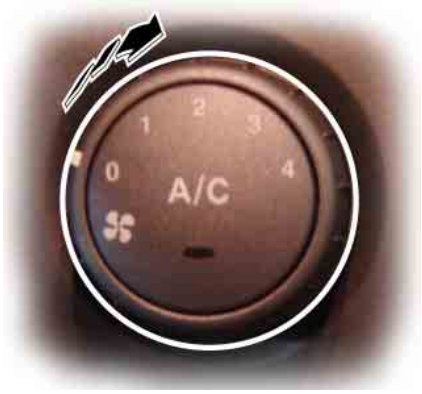
▶ Manual Air Conditioner Controller

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 stages.





A/C Switch

When the A/C switch is pressed, the indicator comes on and the air conditioner starts to operate. When the switch is pressed again, the air conditioner stops its operation and indicator goes out.



Bi-level Mode

The air flows towards front windshield and floor and the indicator comes on.

Vent Mode

The air flows towards face and the indicator comes on.

Foot Mode

The air flows towards floor and the indicator comes on.



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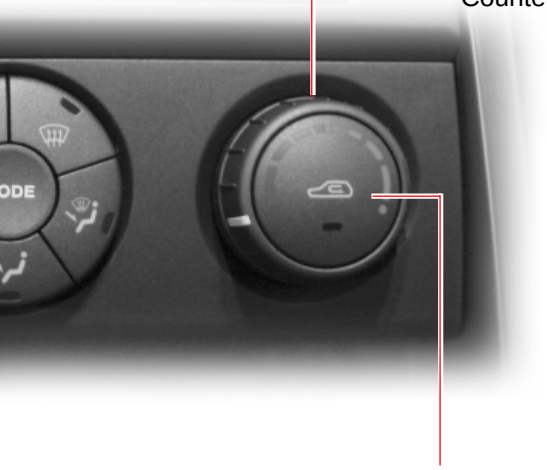
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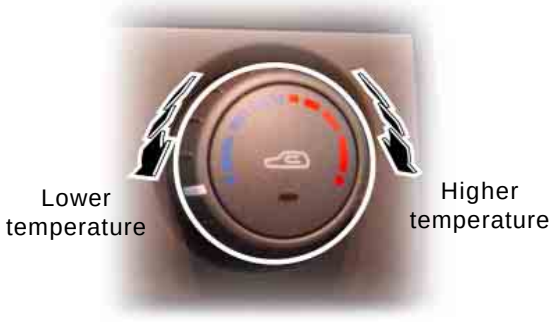
Temperature Control Switch

The temperature can be adjusted by rotating the switch.

Clockwise direction (red): Higher temperature

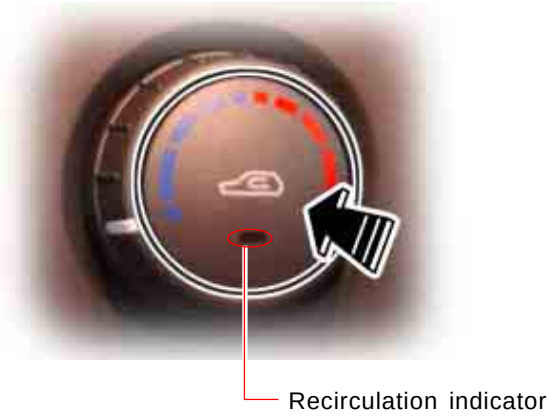
Counterclockwise direction (blue): Lower temperature





Air Source Selection Switch

When pressing this switch, the air recirculates in the vehicle inside and indicator comes on. When pressing it again, the indicator goes off and the fresh air comes in.



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 indicator comes on. When the defrosting is completed, press the switch to return to normal operations.



Defroster & Foot Mode

The air flows towards face and floor and the indicator comes on.

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5. SELF DIAGNOSIS (ONLY FOR FATC AIR CONDITIONER)

▶ 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.

2) Check LED segments on the vacuum fluorescent display (VFD).



1) Press OFF switch more than 5 seconds.

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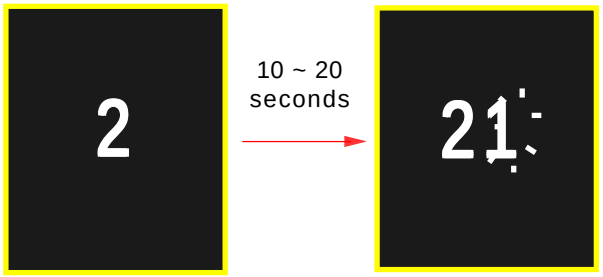
2. Set in Trouble Diagnosis Step 2

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

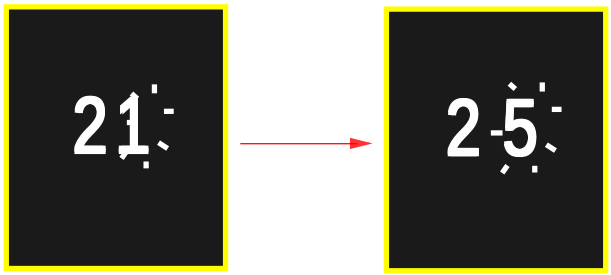




2) Indication of Step 2. Starting self diagnosis

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

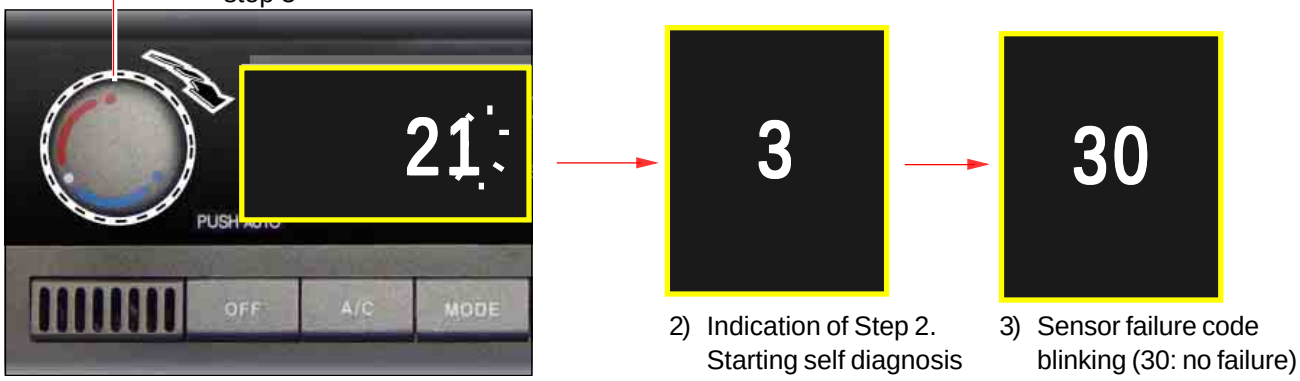
Trouble Code

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	-	

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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	

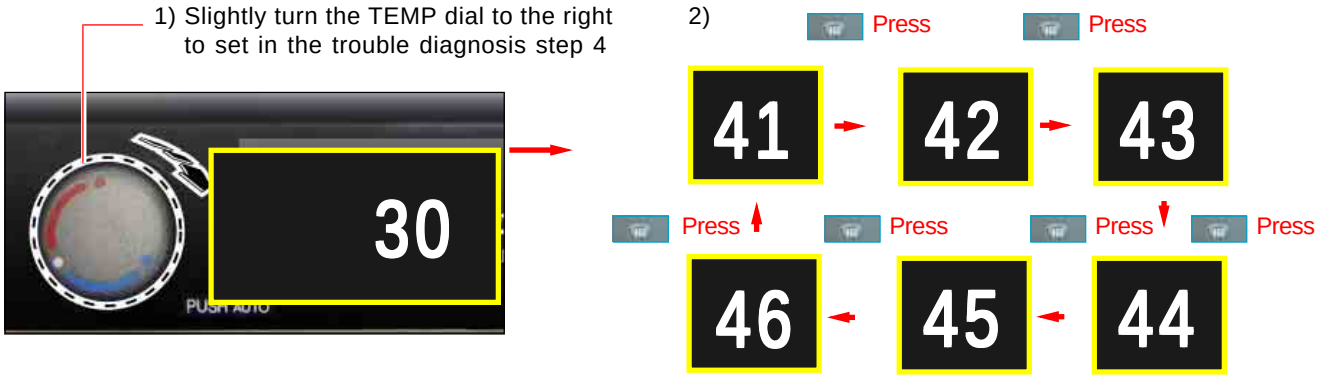
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4. Set in Trouble Diagnosis Step 4

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.



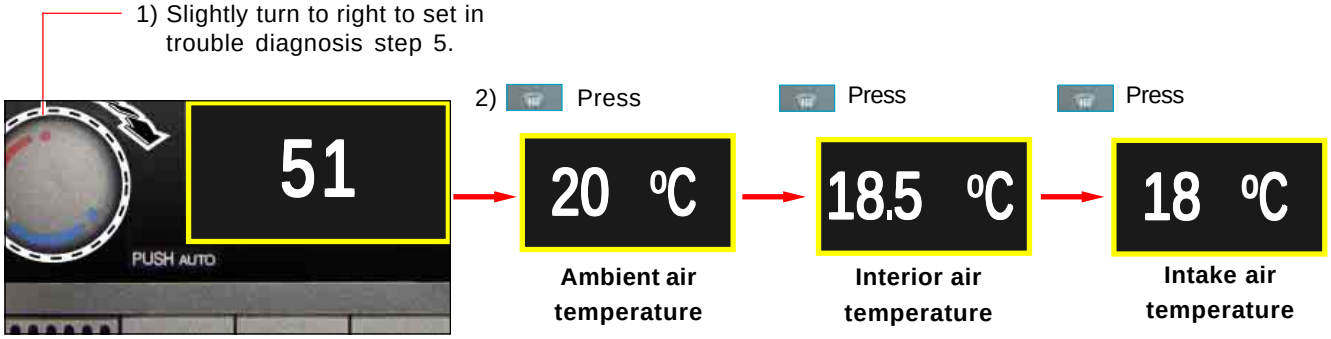
Function Check

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.



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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**

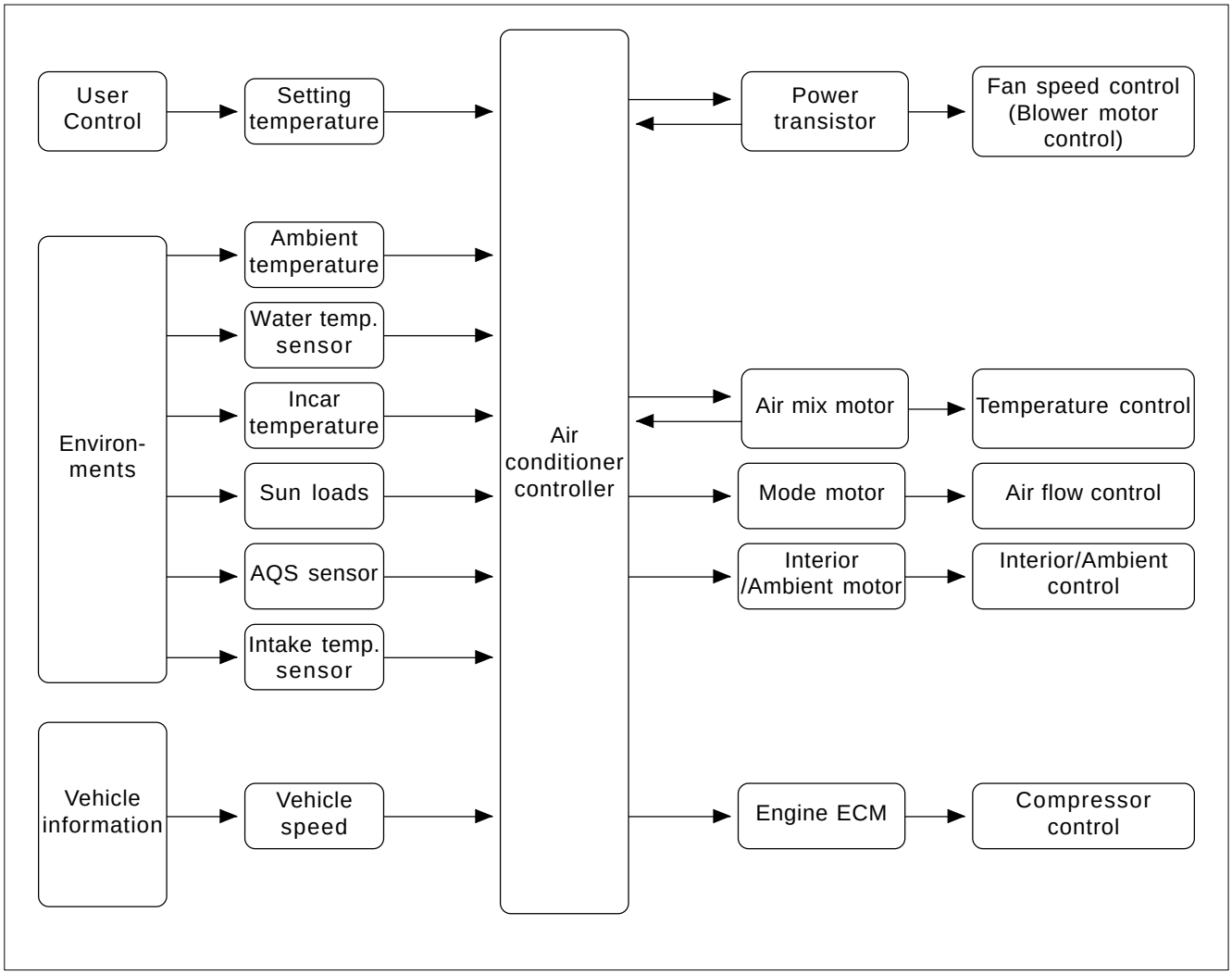
7. Canceling the Trouble Diagnosis

Turn the AUTO switch ON or turn the ignition key OFF.

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6. SYSTEM DIAGRAM

This figures shows the input and output system between A/C components and A/C controller.



▶ Air Conditioner Compressor Control by Engine ECU

In case of current 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

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7. 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, 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

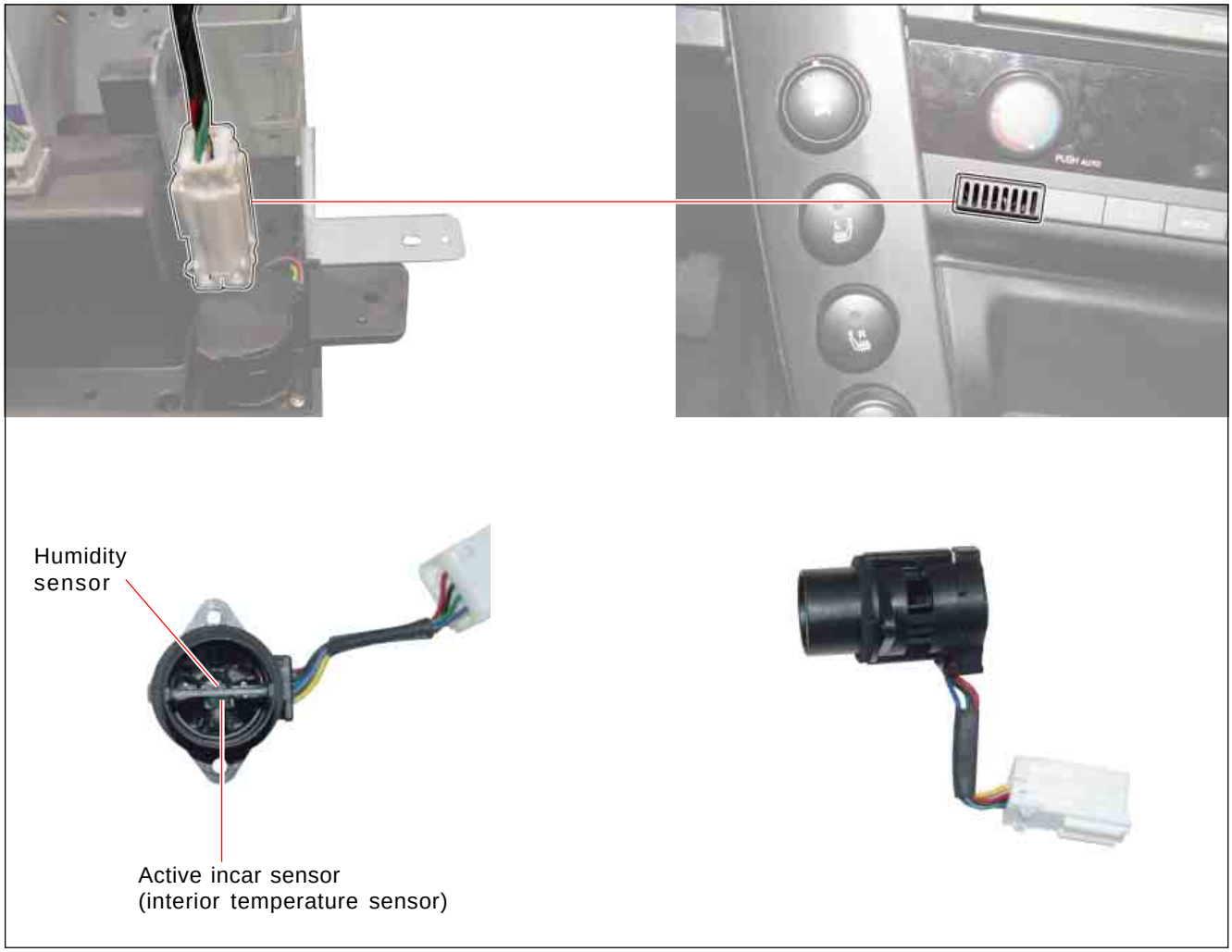
1. Remove the sun sensor and measure the current between terminals under sunlight.
2. Measure the current again under shade. It is in normal conditions if the measured value is less than the measured value under sunlight.
3. Turn the ignition switch to “ON” position.
4. Measure the voltage to the sun 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.

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▶ 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 senor hole and then sends the voltage value according to the changed resistance to FATC controller.

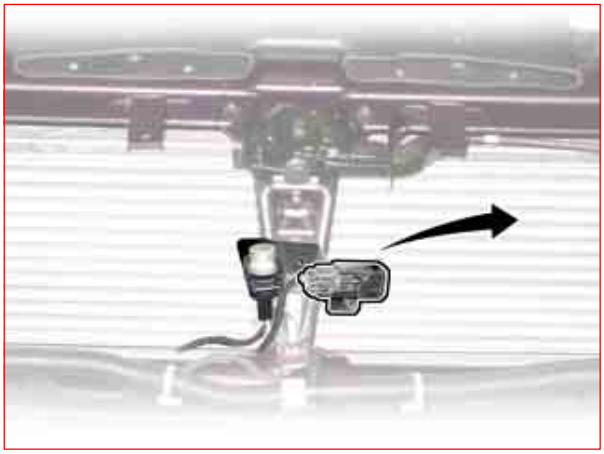
Humidity sensor

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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8. AIR QUALITY SYSTEM (AQS)

▶ Components of AQS



AQS sensor and ambient temperature sensor



▶ AQS Operation

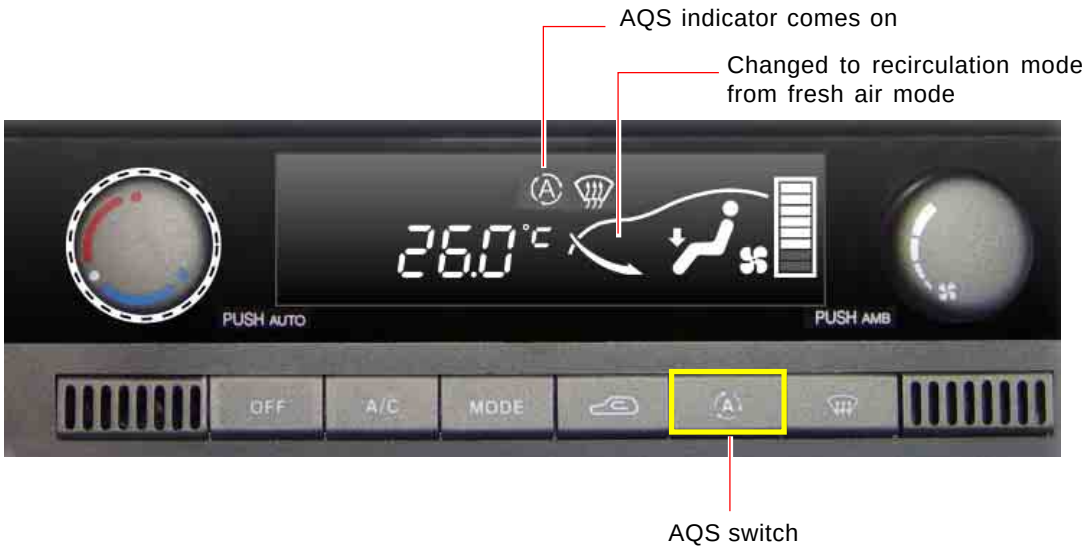
1. Air Quality System (AQS) changes the air source selection to recirculation mode when polluted air is detected through AQS sensor. The air source selection returns back to fresh air intake mode after a specified period or the polluted air disappears.



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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

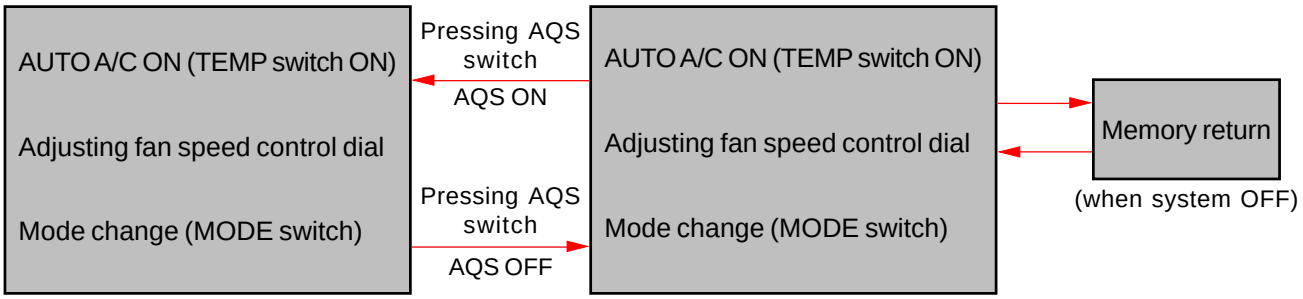
- **If the AQS switch is pressed in, the AQS function works regardless of air conditioner controller operation.**

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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
   2) When pressing the recirculation mode switch

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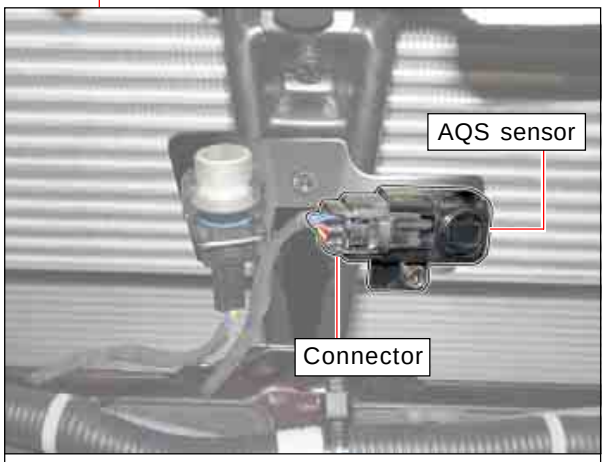
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Removal and Installation

1. Disconnect the negative battery cable and remove headlamps.



2. Disconnect the AQS sensor connector, unscrew two bolts (10 mm) and remove the AQS sensor assembly. (Install in the reverse order of removal.)



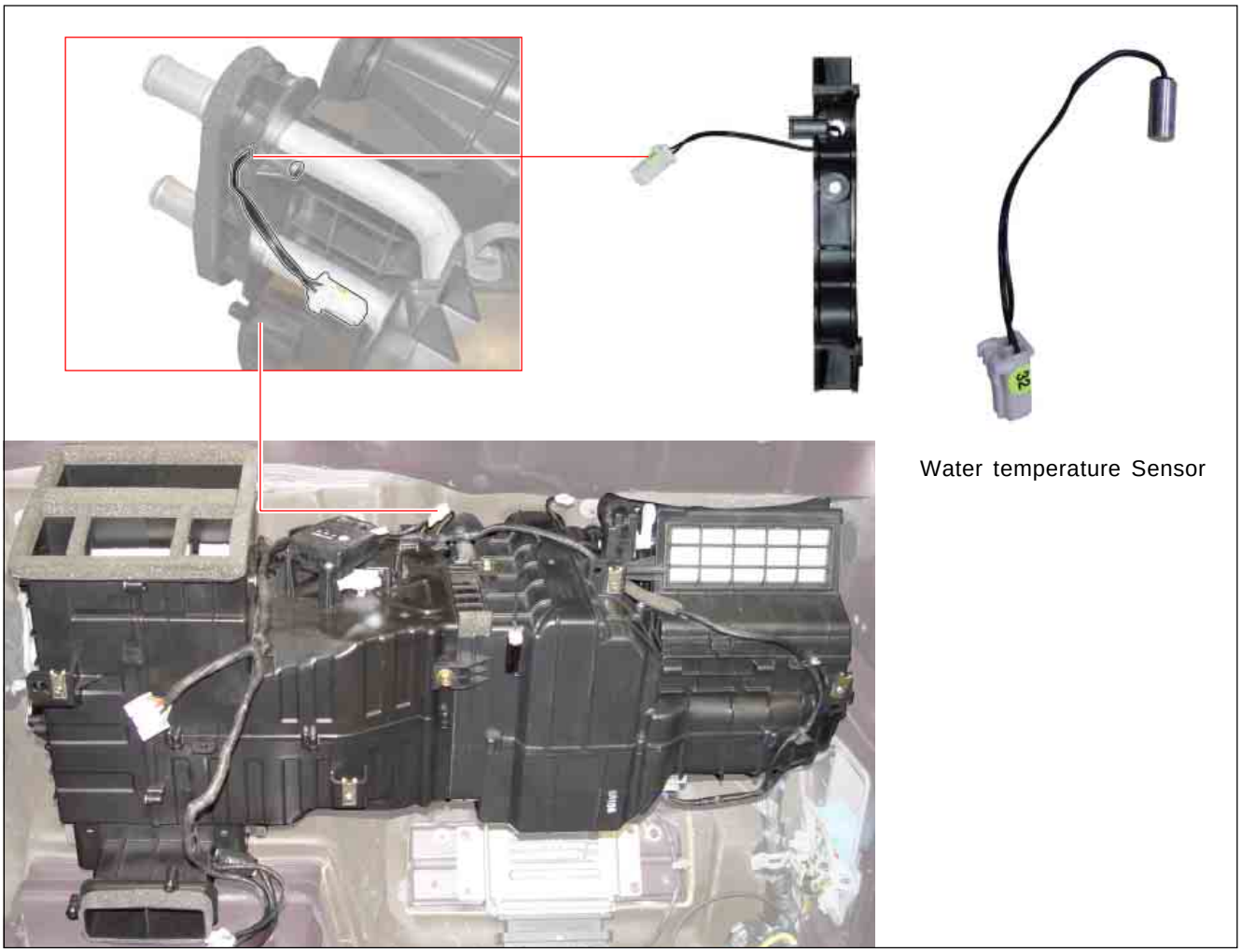


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9. AIR CONDITIONER MODULE SENSORS AND ACTUATORS

▶ Water Temperature Sensor



Water temperature Sensor

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: approx. 25°C, 2.2 kΩ)

   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: 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.

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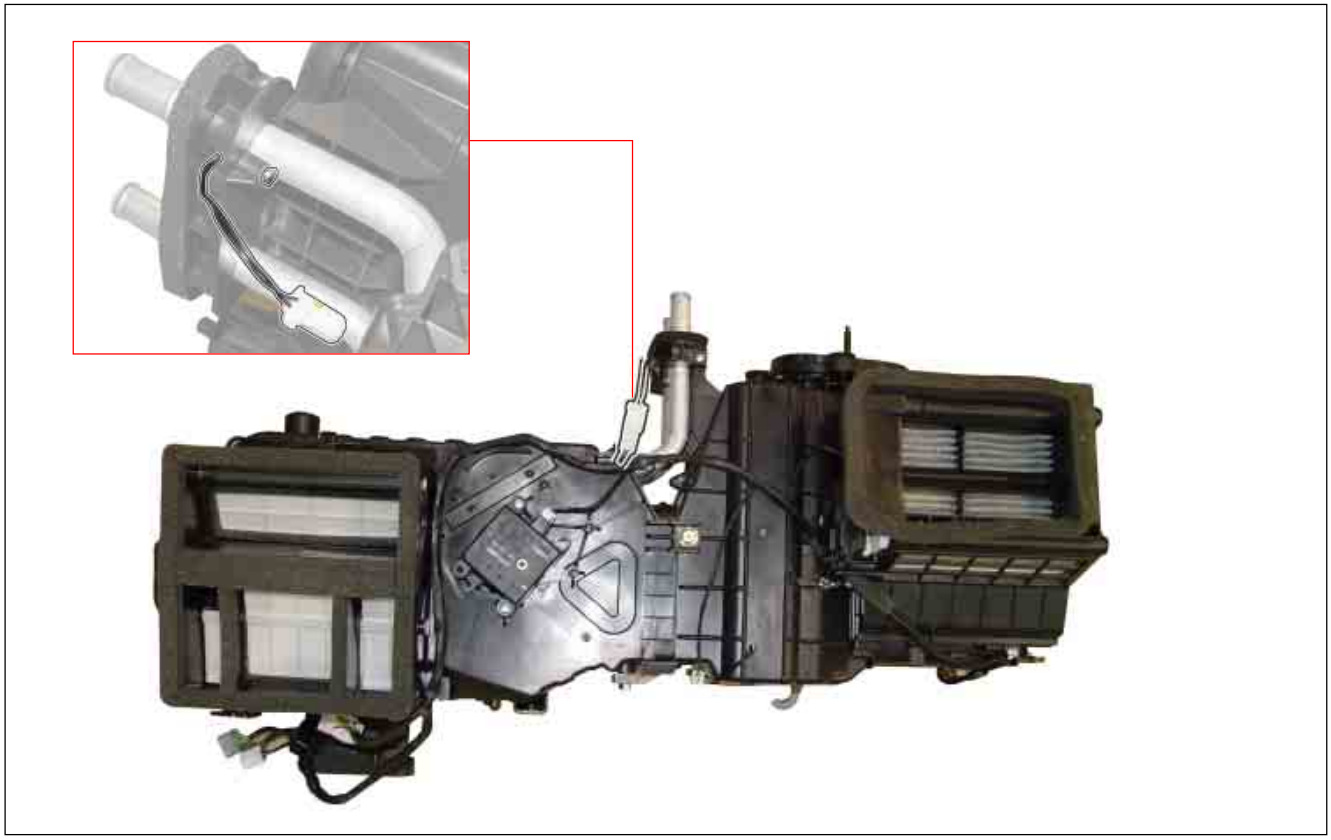
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Removal and Installation

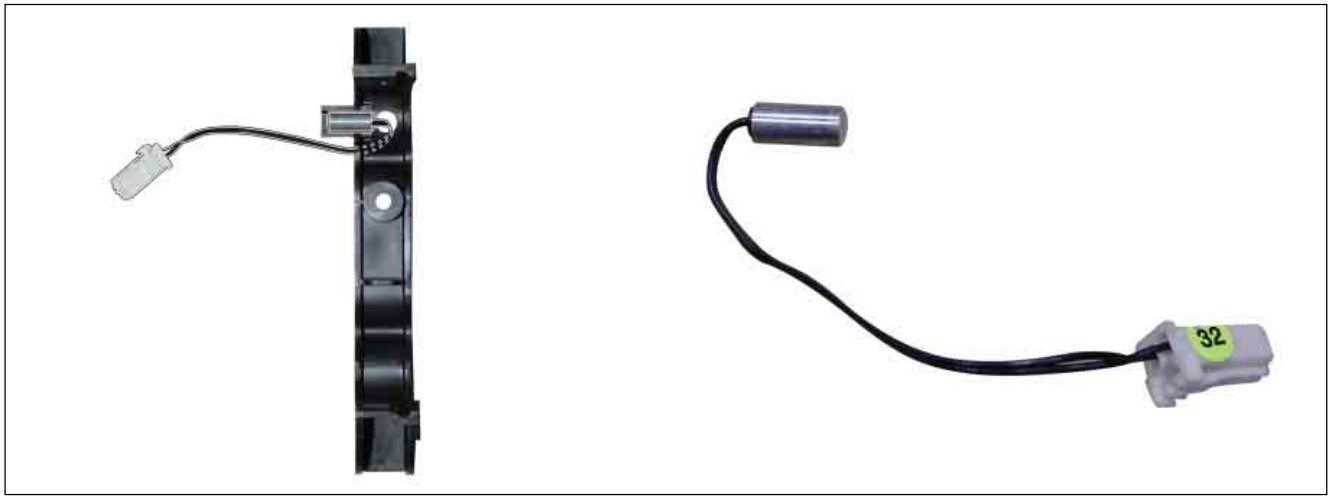
※ **Preceding Work:** Disconnect the negative battery cable and remove the instrument panel assembly.

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 and separate the water temperature sensor from bracket.



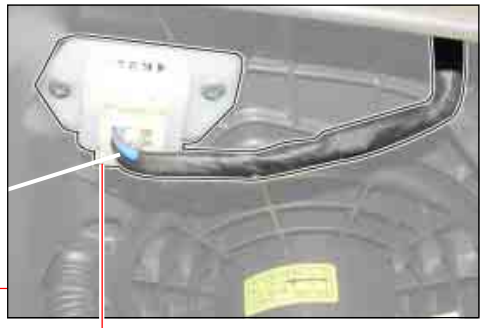
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▶ Power Transistor

The power transistor controls the fan speed. It controls the blower motor operating speed without stages 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 terminals while changing the fan speed from stage 1 to stage 6.
3. The specified voltage value in each stage:

Stage	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Blower (V)	4.5	6.0	7.5	9.0	11	Max HI

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.

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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.





2. Unscrew the mounting screws and remove the power transistor.



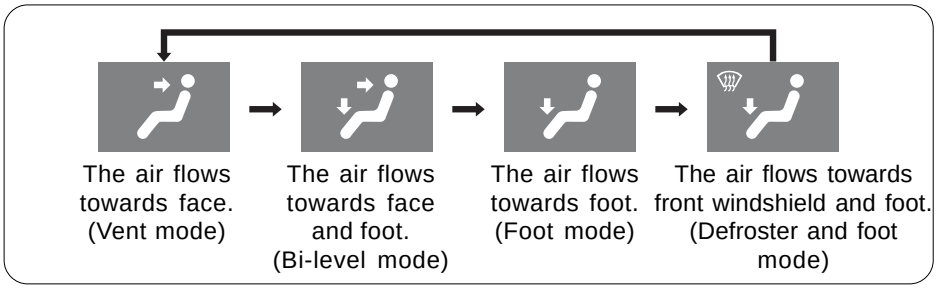


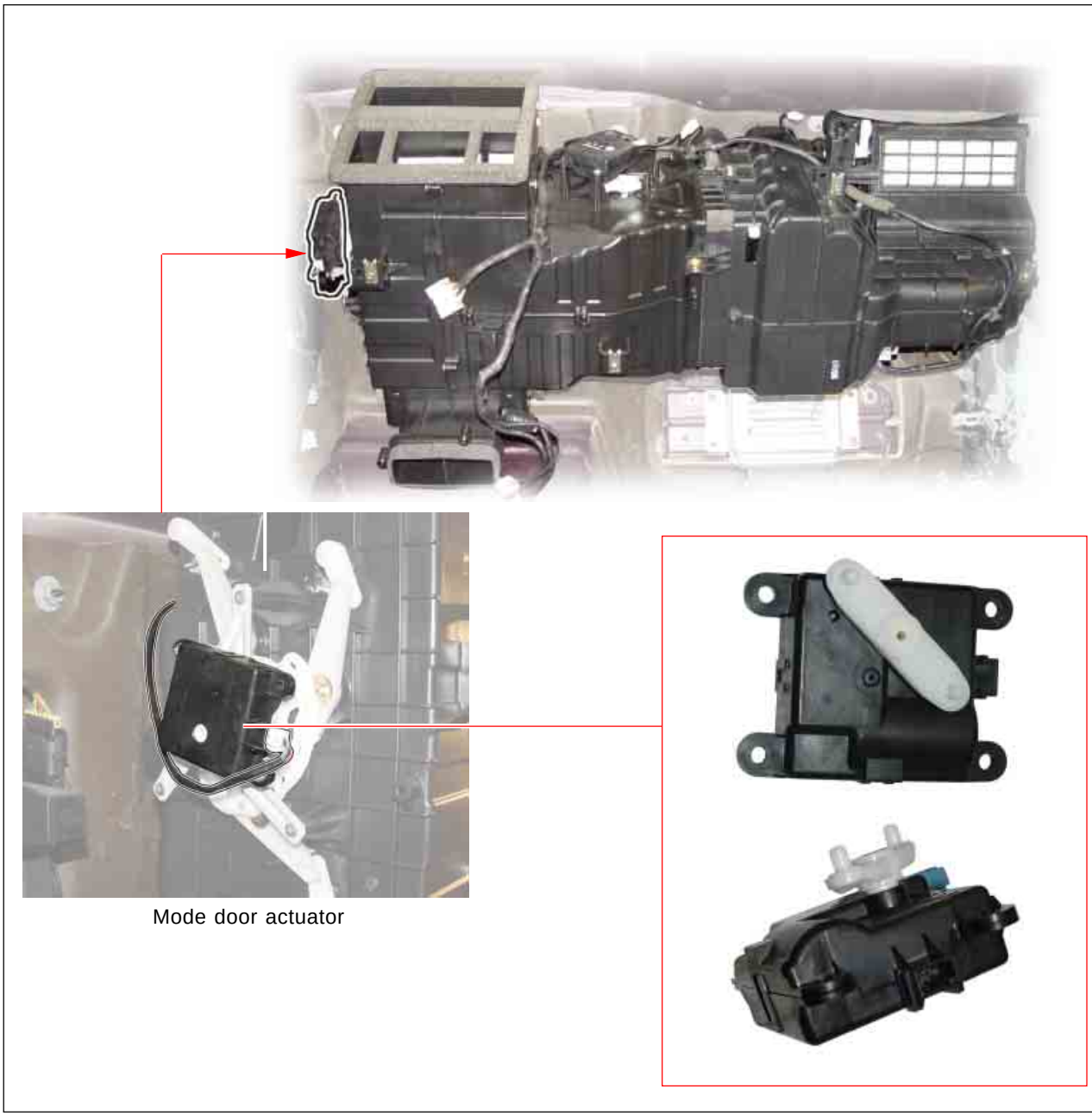
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▶ Mode Door Actuator

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 according to 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.







Mode door actuator

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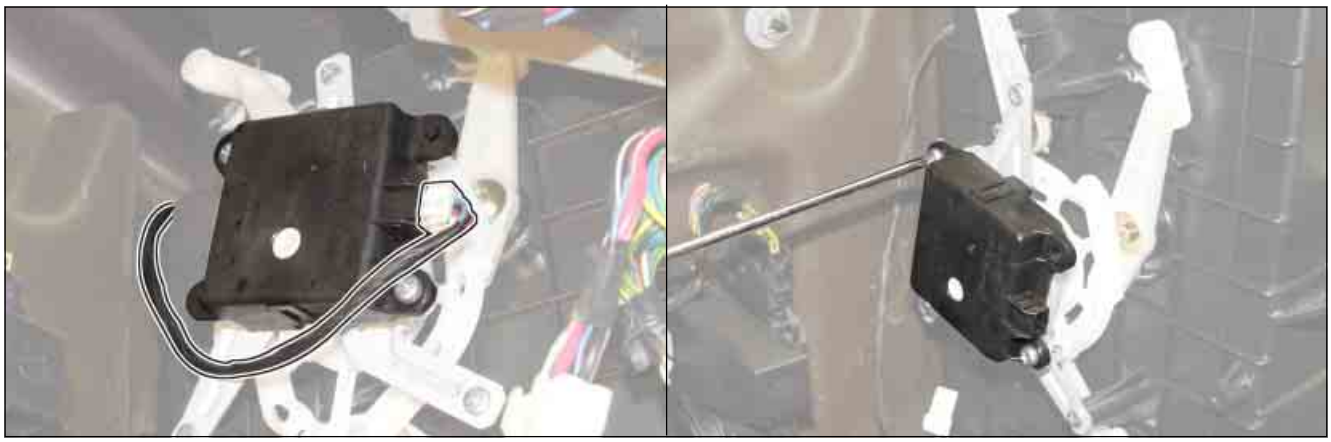
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Removal and Installation

※ **Preceding Work:** Disconnect the negative battery cable.

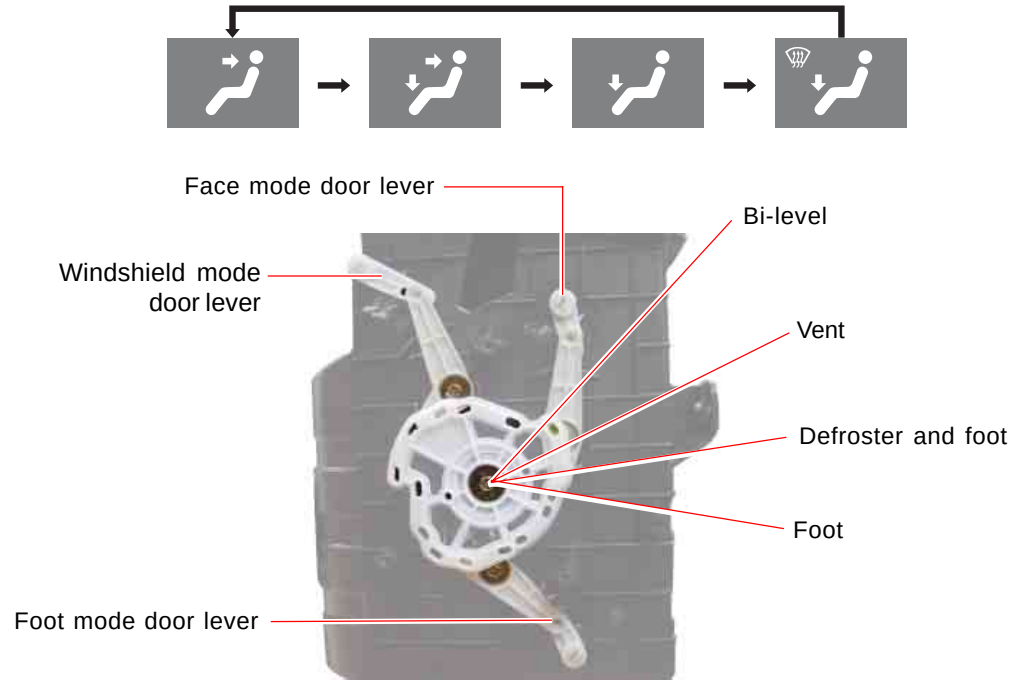
First remove the driver side instrument lower panel in order to remove and install mode door actuator. For removal and installation of the panel, refer to "BODY" section.

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.





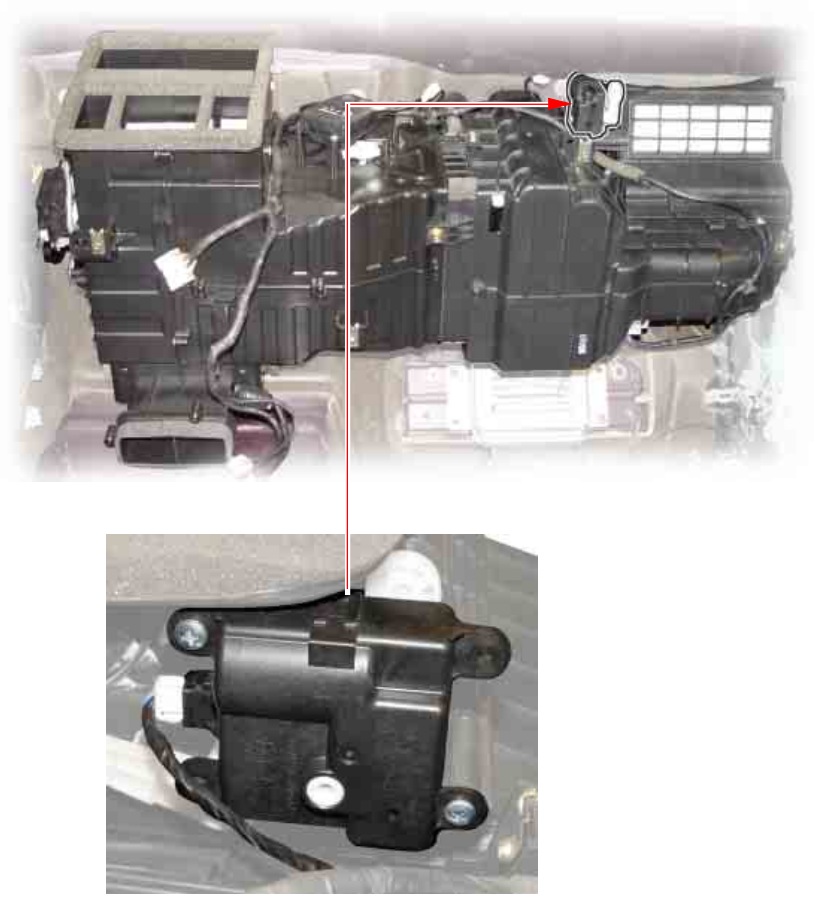
NOTE

- **Make sure that the mode door link mounted on the air conditioner module assembly. When installing, if the location of the mode door link is not correct, may not operate properly.**

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▶ IN/EX - Air Door Actuator

The air source door actuator sets the intake door mode according to the control signal from FATC.



In/ex air door actuator location

In/ex air actuator component



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 connection connector of the mode door actuator and the mounting screws (2EA). Remove the in/ex air door actuator.

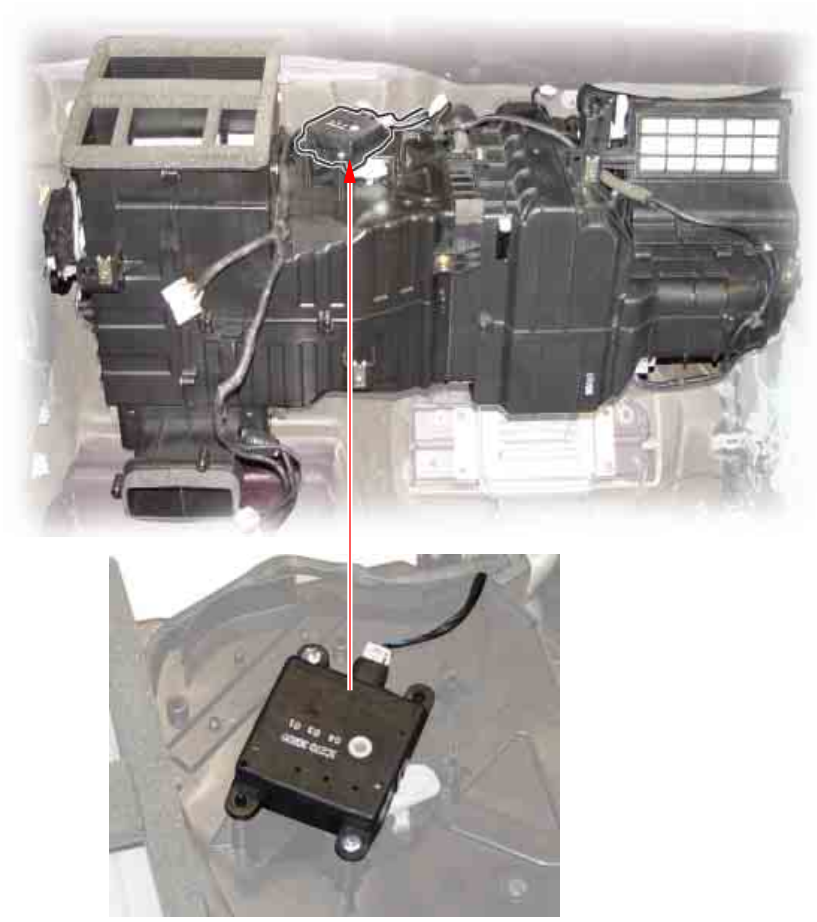


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▶ Air Mix Door Actuator

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 and unscrew two mounting screws to remove the air mix door actuator.



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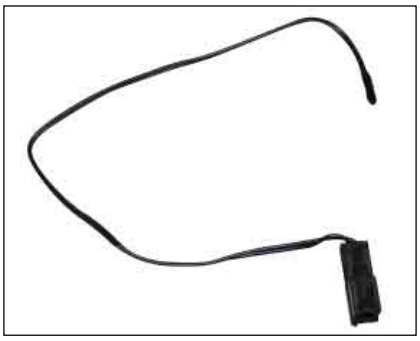
▶ Intake Temperature Sensor

The Intake Sensor outputs the compressor ON or OFF signal to ECU to prevent evaporator from freezing. The sensing part of the thermistor is the evaporator fin contact type.





Intake Sensor location



Intake Sensor

If the air conditioner does not turn on, check as below.

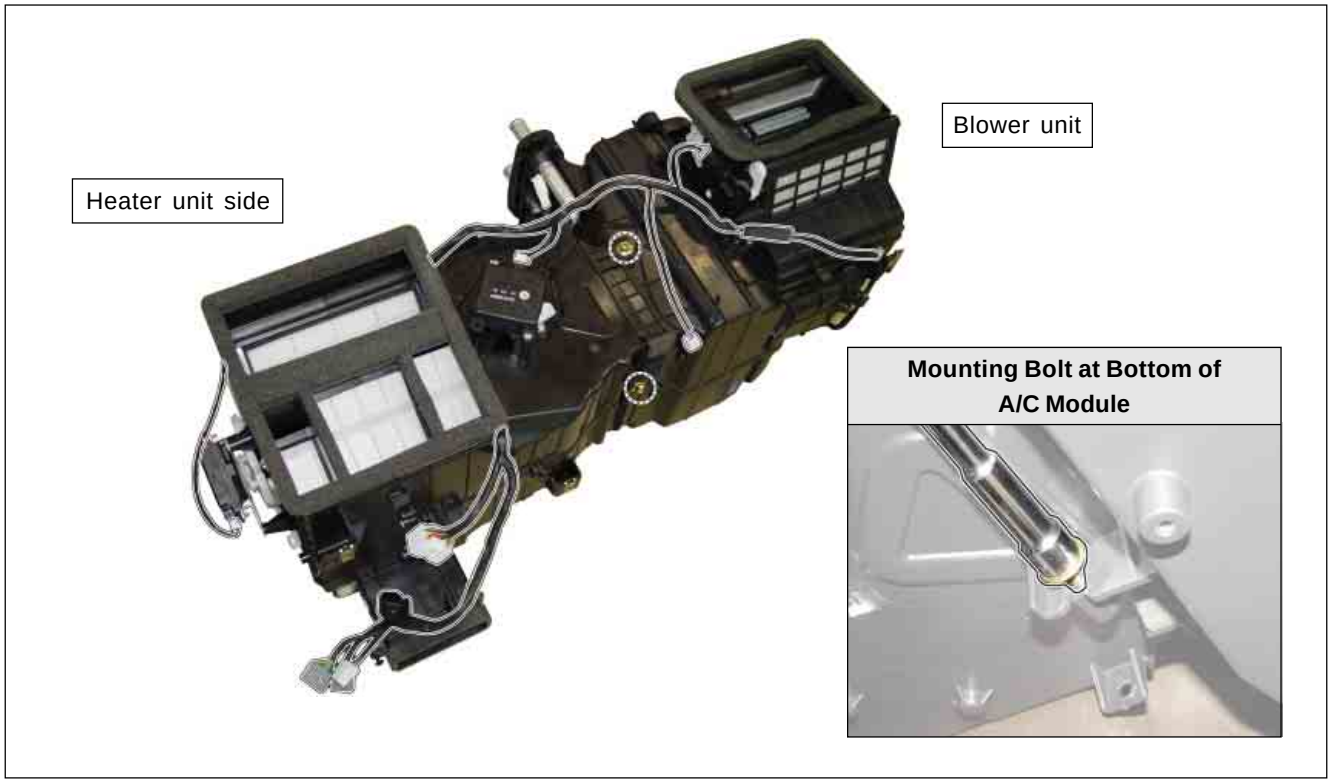
1. Remove the Intake Sensor and measure the voltage between terminal No. 1 and 2 on the connector.
2. Check whether the output voltages (ON: approx. 12 V, off: 0 V).
3. If the voltage value is out of the specified value, replace the Intake Sensor. If the circuit is in normal condition, check as below.
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 within the specified range, replace the FATC controller.

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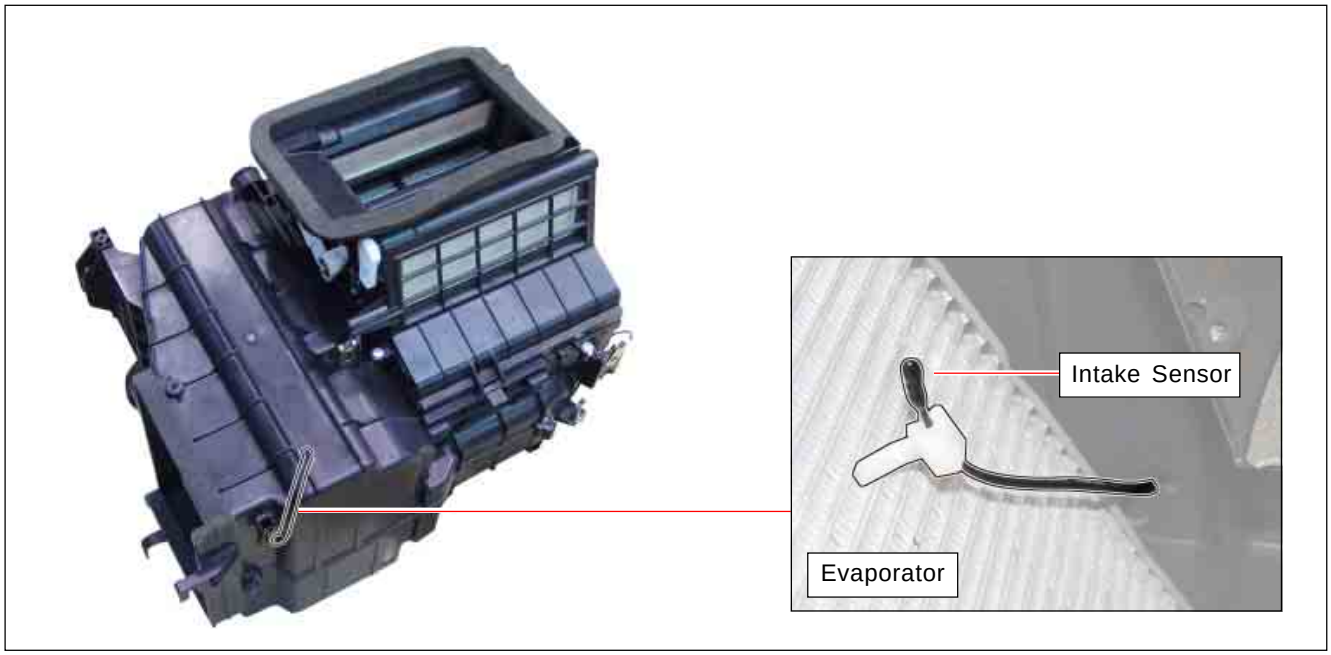
Removal and Installation

※ **Preceding Work:** Disconnect the negative battery cable and remove the instrument panel assembly.

1. Unscrew three mounting bolts (10 mm) on air conditioner module assembly and remove the sensor wire of air conditioner module. Separate the blower unit from the heater unit.



2. Separate the upper case and lower case of blower unit and remove the Intake Sensor from the evaporator.



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10. REMOVAL AND INSTALLATION

▶ 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.

A. Inner/outer heater hose and clamp

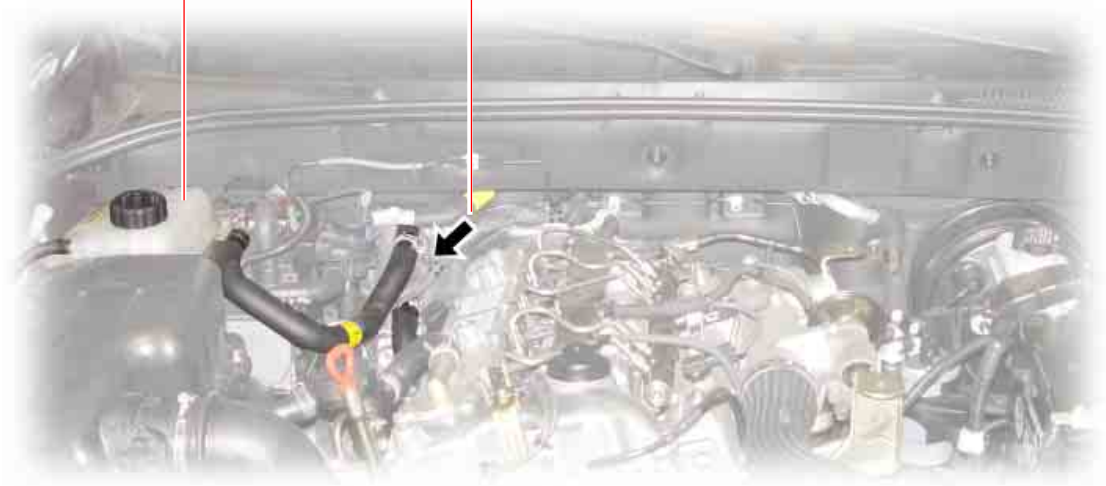


* Remove the mounting nut and loosen the coolant reservoir.



B. A/C joint pipe mounting nut

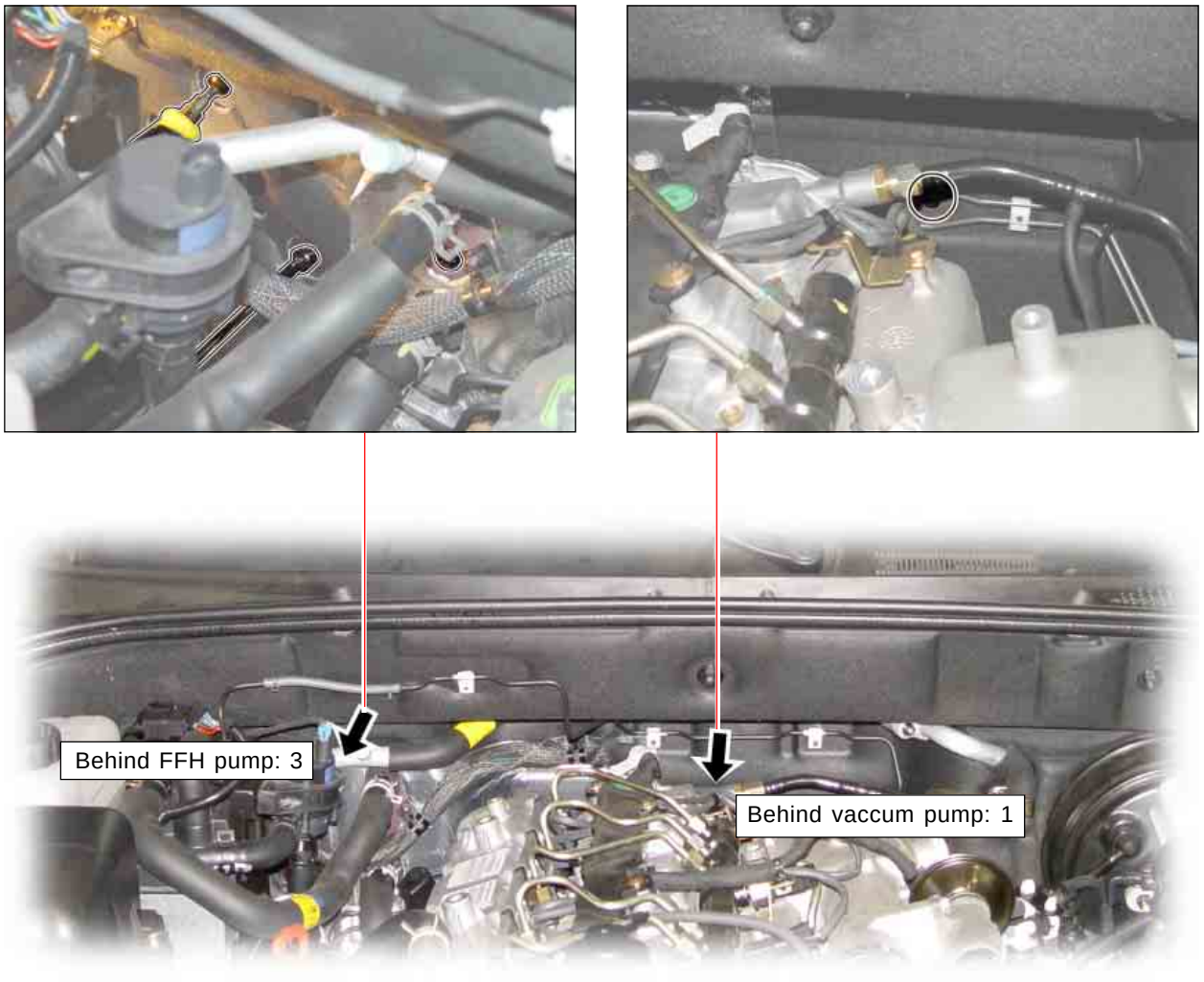




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2. Unscrew four mounting screws on A/C module assembly (in engine compartment).



3. Carefully remove the A/C module assembly.



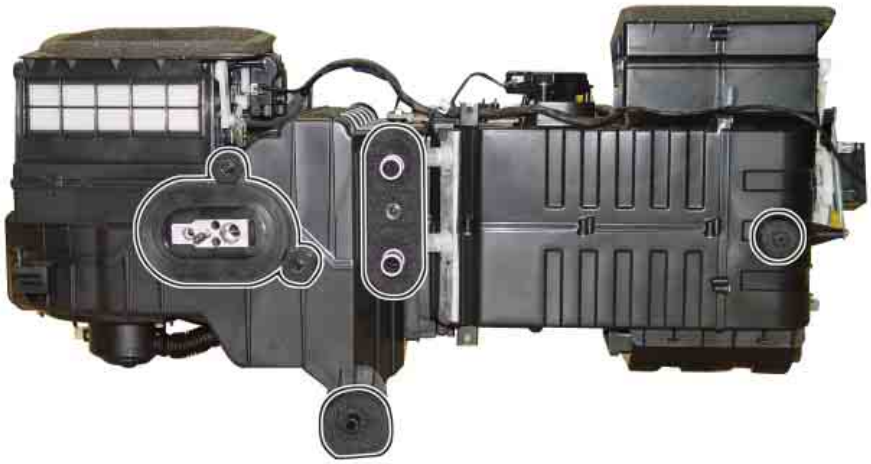
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A/C Module Mounting Location

Mounting locations inside of vehicle



Mounting locations on backide of A/C module



Front View



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▶ Air Controller Switch And Active Incar/Humidity Sensor

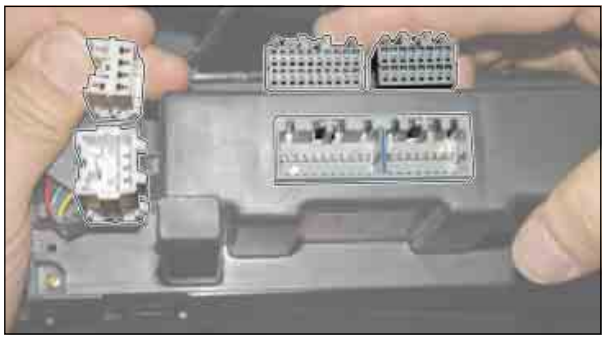
※ **Preceding Work:** Disconnect the negative battery cable and remove the center fascia panel assembly.

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.



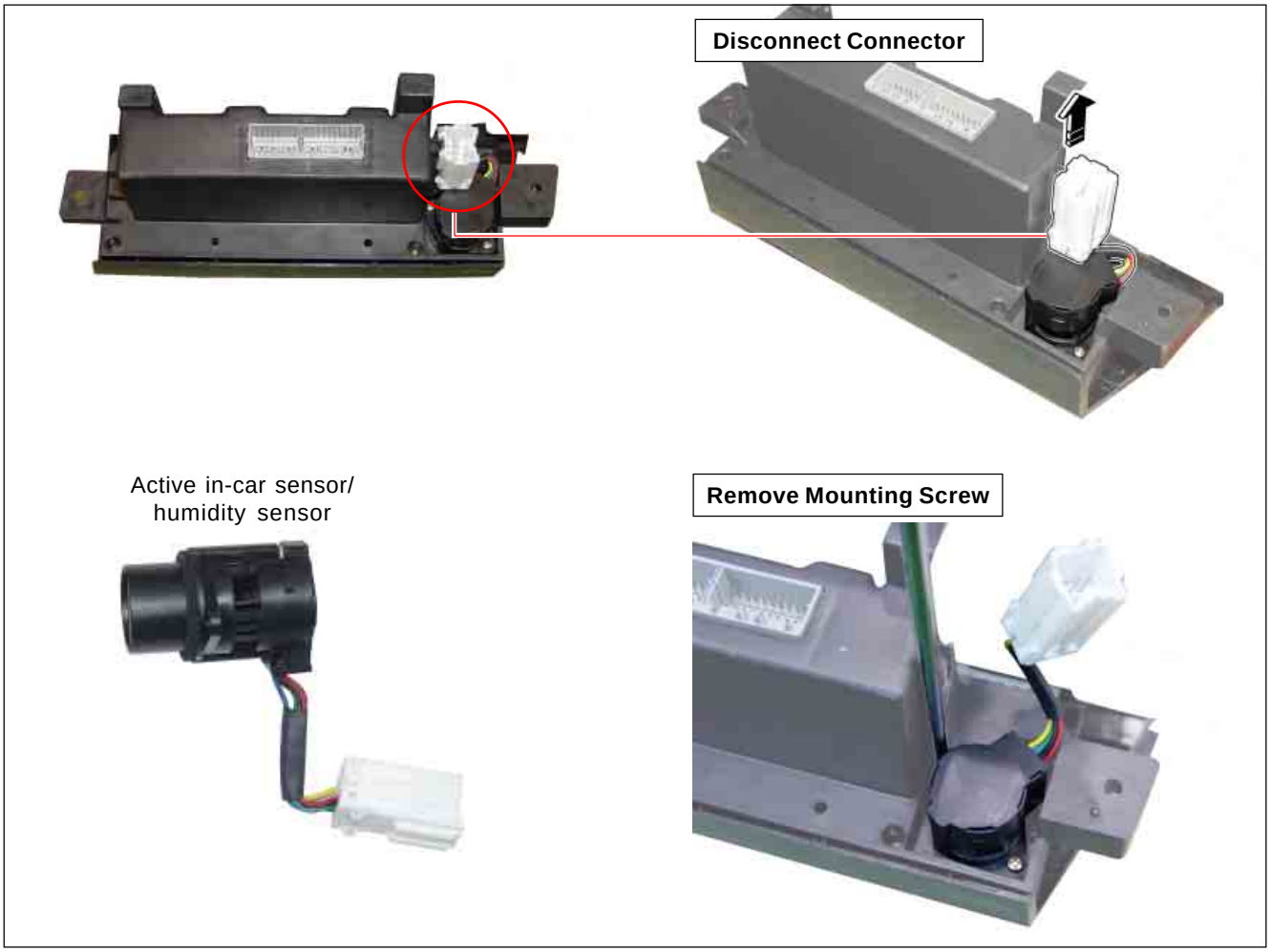
3. Remove the A/C controller switch assembly.



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Active In-Car/humidity Sensor

Disconnect the sensor connector, unscrew two mounting screws, and remove the sensor from the air conditioner controller switch.



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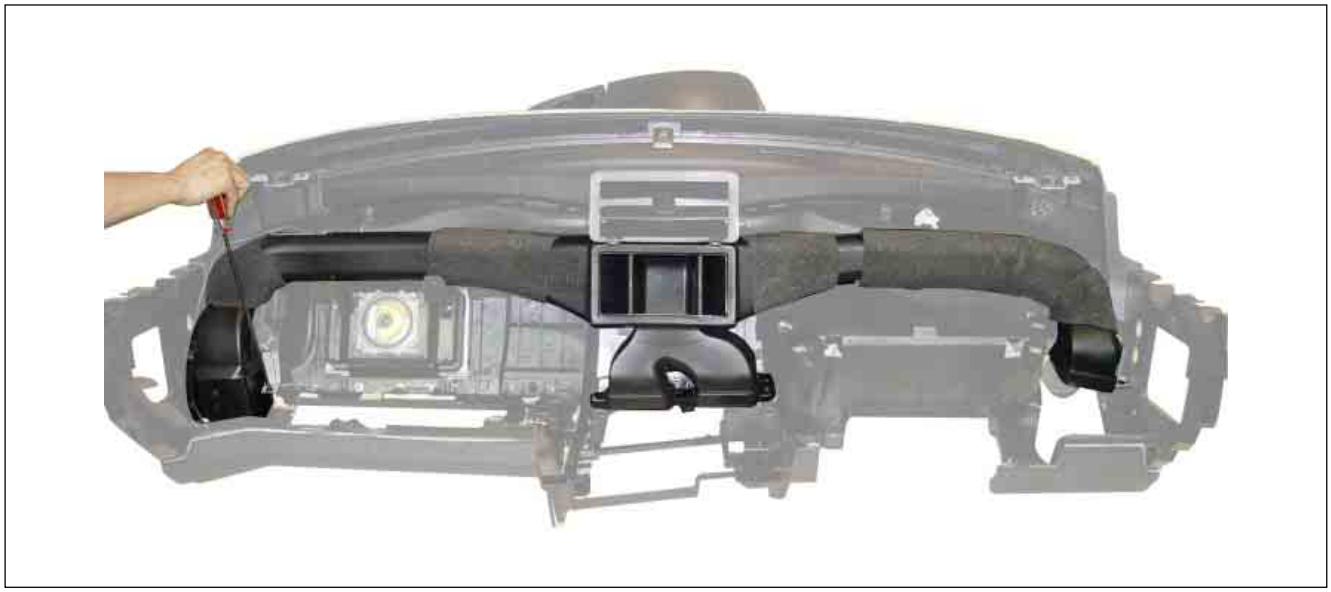
▶ Air Duct Assembly

Air Duct (On Instrument Panel)

※ **Preceding Work:** Disconnect the negative battery cable and remove the instrument panel assembly.



1. Unscrew the mounting screws (one at each side and four in center area) and remove the front air duct.



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2. Unscrew the mounting screws (one at each side) and remove the left and right air ducts.



3. Unscrew the mounting screws (one at each side) and remove the upper air duct.



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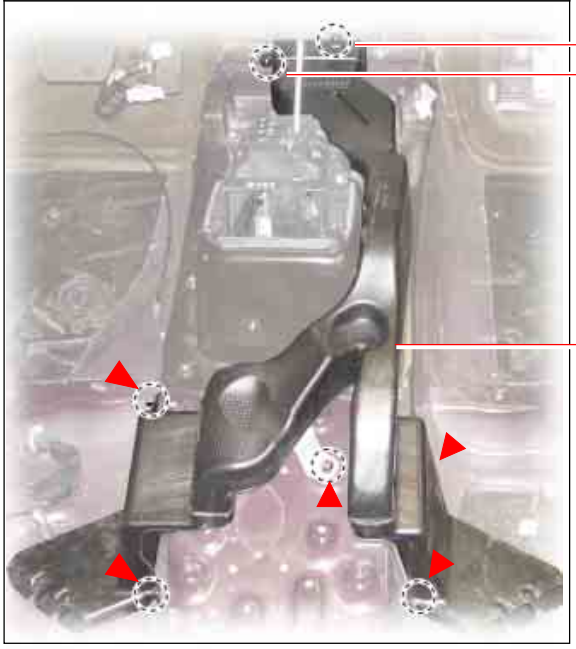
▶ Floor Air Duct

※ **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

1. Unscrew two center mounting screws in floor air duct.
2. Unscrew the mounting bolts and remove the air duct.

Vehicle with Foot Parking Brake



Mounting Screws



Lower Air Duct Assembly



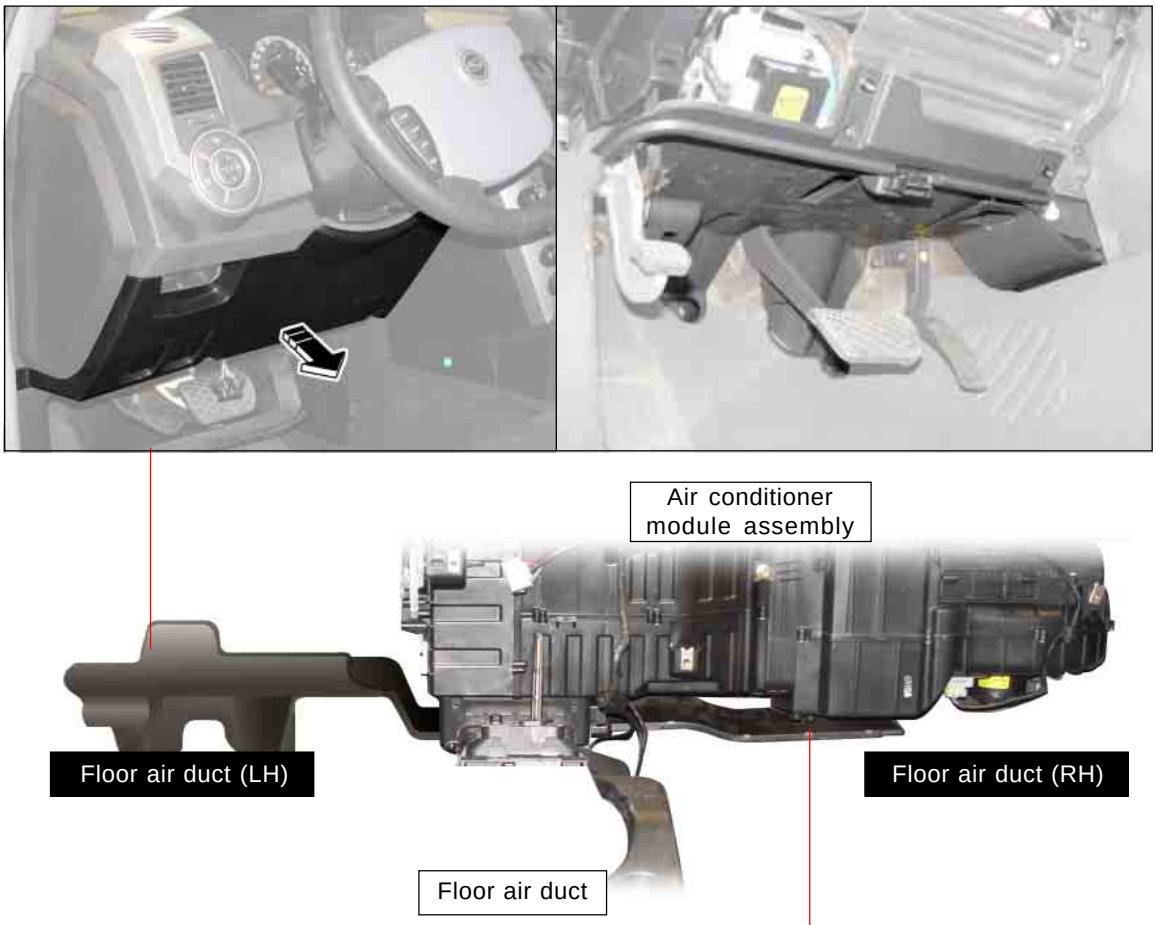
Vehicle with Hand Parking Brake



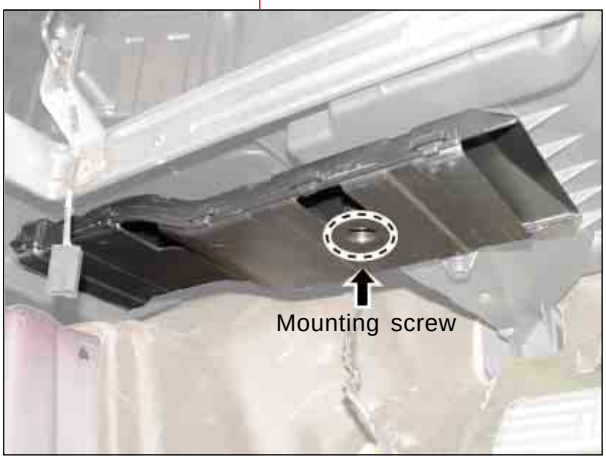
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▶ Front Floor Air Duct

1. Driver side lower air duct is installed behind the lower instrument panel. Remove it according to the procedures for removal of lower panel.



2. Passenger side floor air duct is located under the air conditioner module.



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▶ Vent Grille Assembly

※ **Preceding Work:** Disconnect the negative battery cable.

The vent center grille and the vent side grille should be removed after removing the relevant panel.

▶ Side Vent Grille



The driver side vent grille is located on the outside mirror switch bezel assembly.



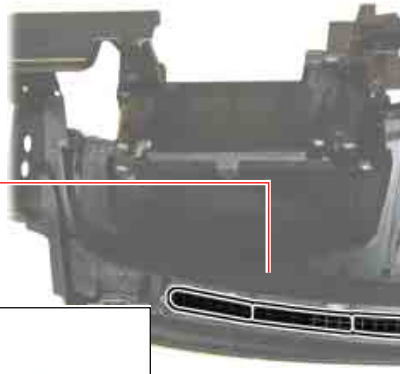
Removal/Installation

Unscrew four mounting screws and remove the vent grille assembly.



▶ Front Vent Grille

Front vent grille is mounted on the instrumetn panel with one screw. Unscrew the mounting screw and pull the vent grille out of the instrument panel.



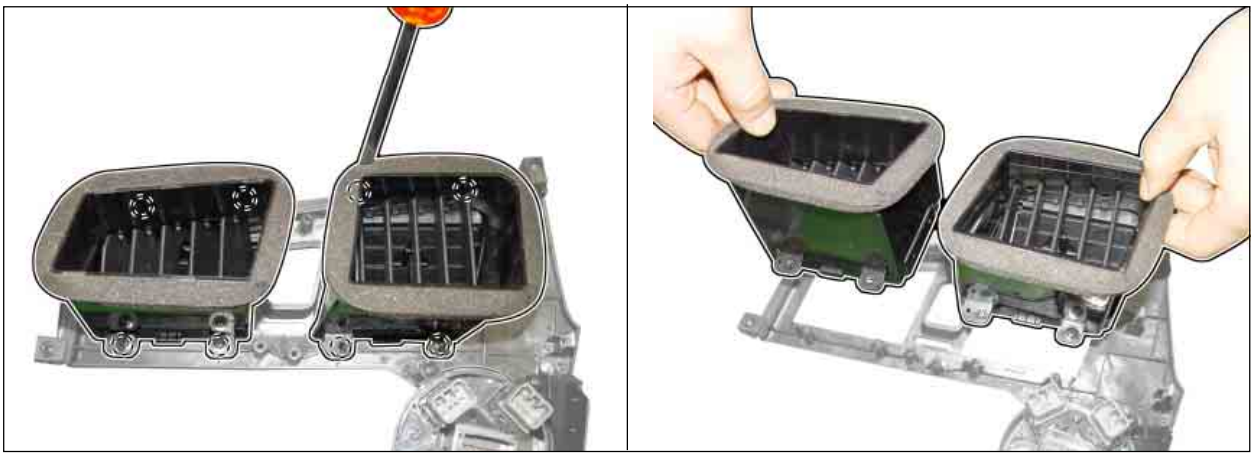


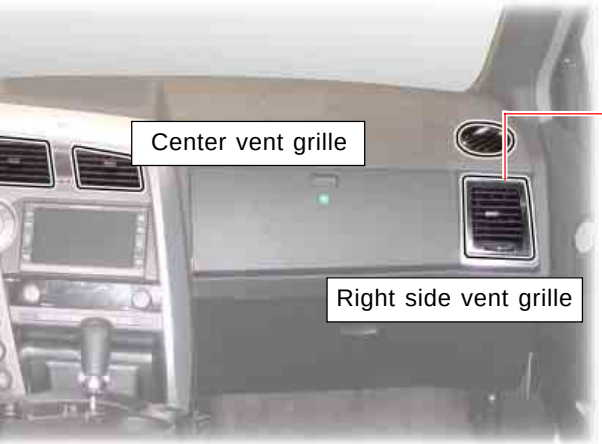
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▶ Center Vent Grille

Center vent grille is mounted on the center facia panel with four screws (two at each side).







▶ Side Vent Grille

1. Unscrew the mounting screws with the front air duct removed.



2. Pull the vent grille out of instrument panel.



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▶ Condenser Assembly

※ Preceding Work:

1. Collect the A/C refrigerant.
2. Remove the front bumper assembly.
3. 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.

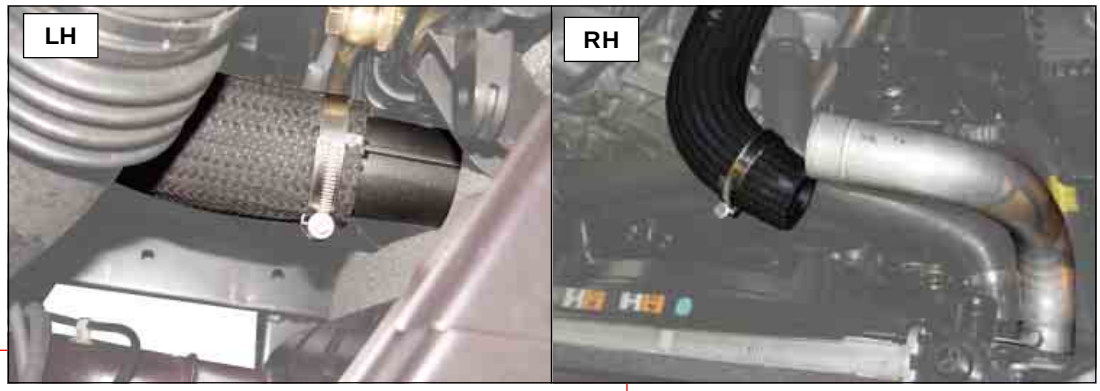
Installation Notice

Tightening torque	25 ~ 35 Nm



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3. Remove the right and left hoses from the inter cooler.





4. Remove the inlet/outlet hoses and return hose from the radiator.

Radiator Inlet Hose



Return Hose



5. Remove the air conditioner hose and pipe at condenser side.

High-pressure Pipe: Compressor Side



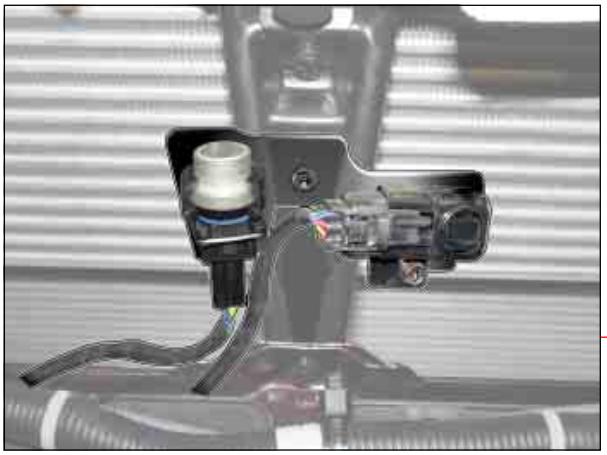
Low-pressure Pipe: Receiver Dryer Side

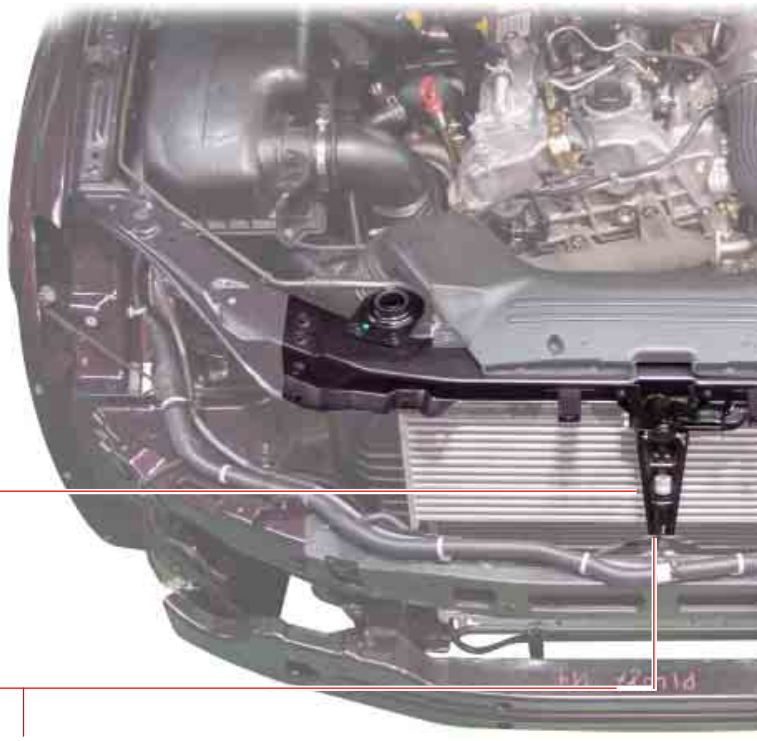


Plug the pipe openings with a seal caps after disconnecting the high/ low pressure pipes.

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6. Disconnect the ambient temperature switch connector and the AQS sensor connector and remove the ambient temperature switch.





7. Unscrew three mounting bolts (10 mm) and remove the hood latch mounted on the front end panel and support panel.



8. Unscrew the mounting bolt (10 mm) and remove the front support panel.



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9. Unscrew four bolts and remove the radiator mounting bracket.





10. Unscrew three mounting bolts (10 mm) and then remove the front end panel.





11. Remove the mounting clips and remove the radiator assembly.









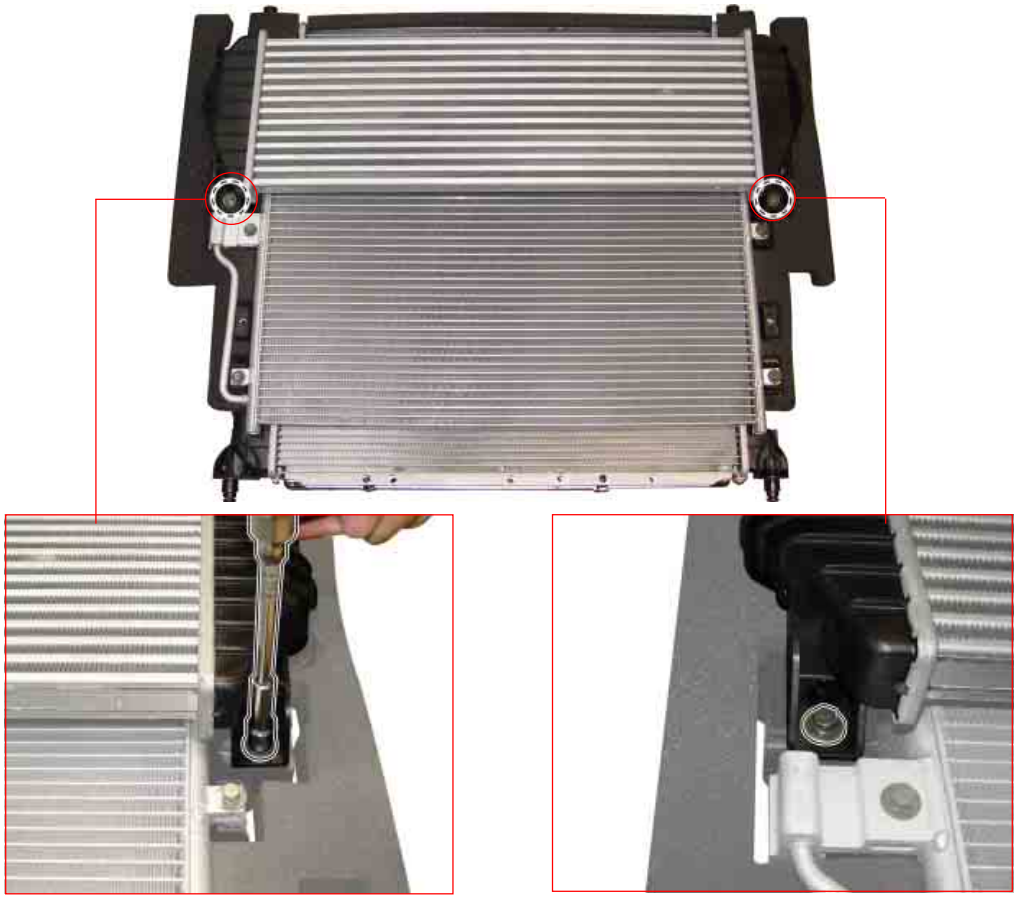
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12. Remove the outlet pipe from the inter cooler.

Remove Two Mounting Bolts (10 mm).	
	

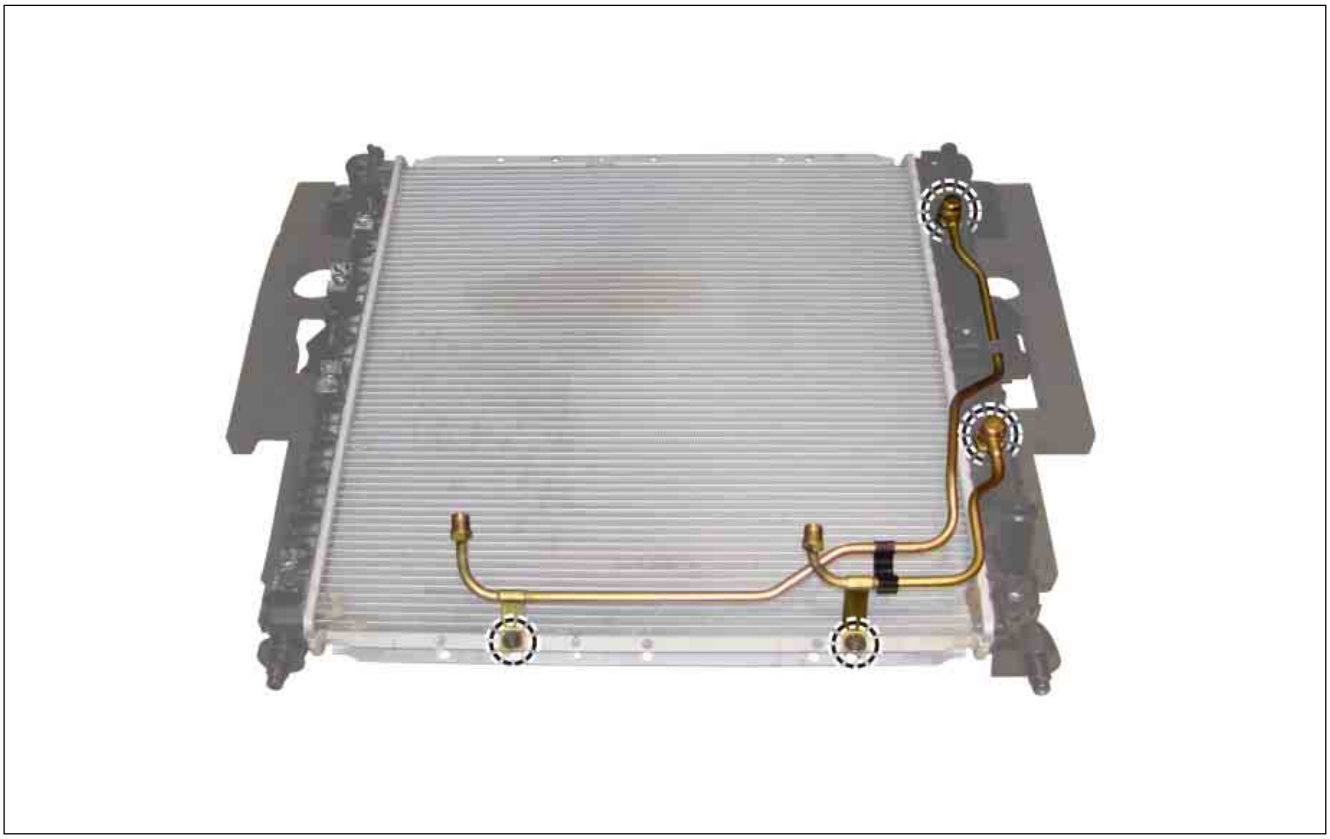
13. Unscrew the upper and lower mounting bolts (10 mm) and remove the inter cooler from the radiator.



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14. Remove the oil cooler pipes for automatic transmission from the radiator assembly.



15. Unscrew five mounting bolts (10 mm) and remove the air conditioner condenser assembly.



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▶ Receiver Dryer Assembly

※ **Preceding Work:** 1. Disconnect the negative battery cable.
2. Collect the air conditioner refrigerant.

1. Disconnect the connector from the receiver dryer.





2. Unscrew the mounting nuts on the receiver dryer and remove the high/low pressure pipes.





The oil rings on the pressure pipes should be replaced with new ones once removed.

3. Unscrew the mounting bolt and remove the receiver dryer.





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▶ Compressor Assembly

※ **Preceding Work:** Disconnect the negative battery cable and collect the air conditioner refrigerant.

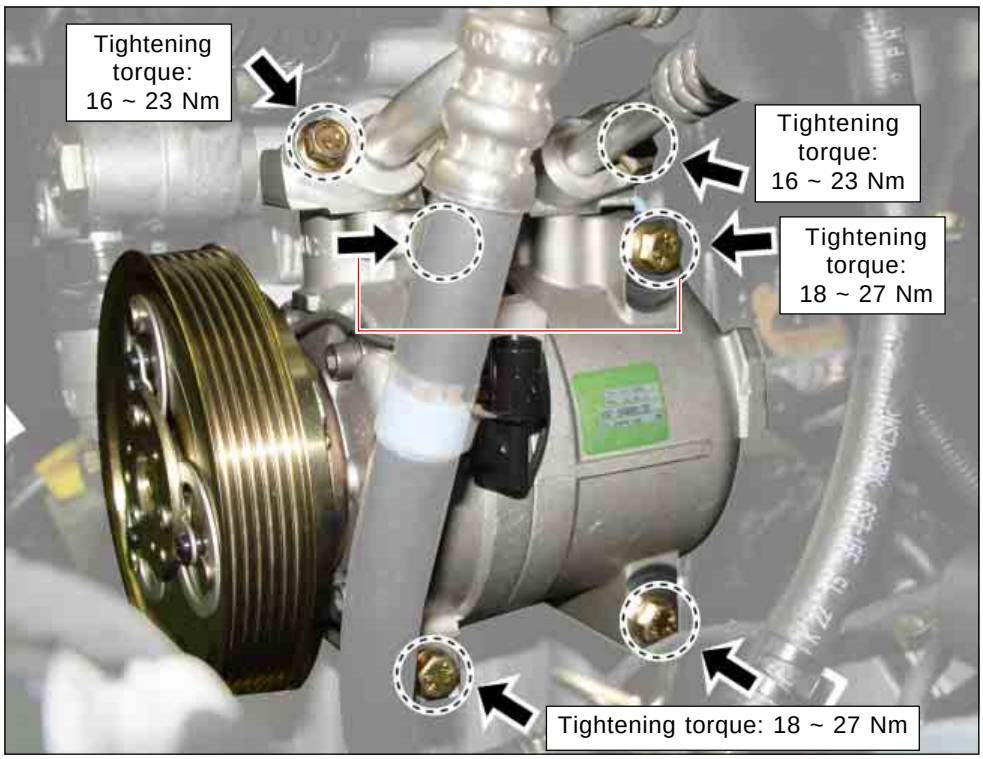
1. Remove the cooling fan belt from the engine.



2. Disconnect the connector from the compressor.

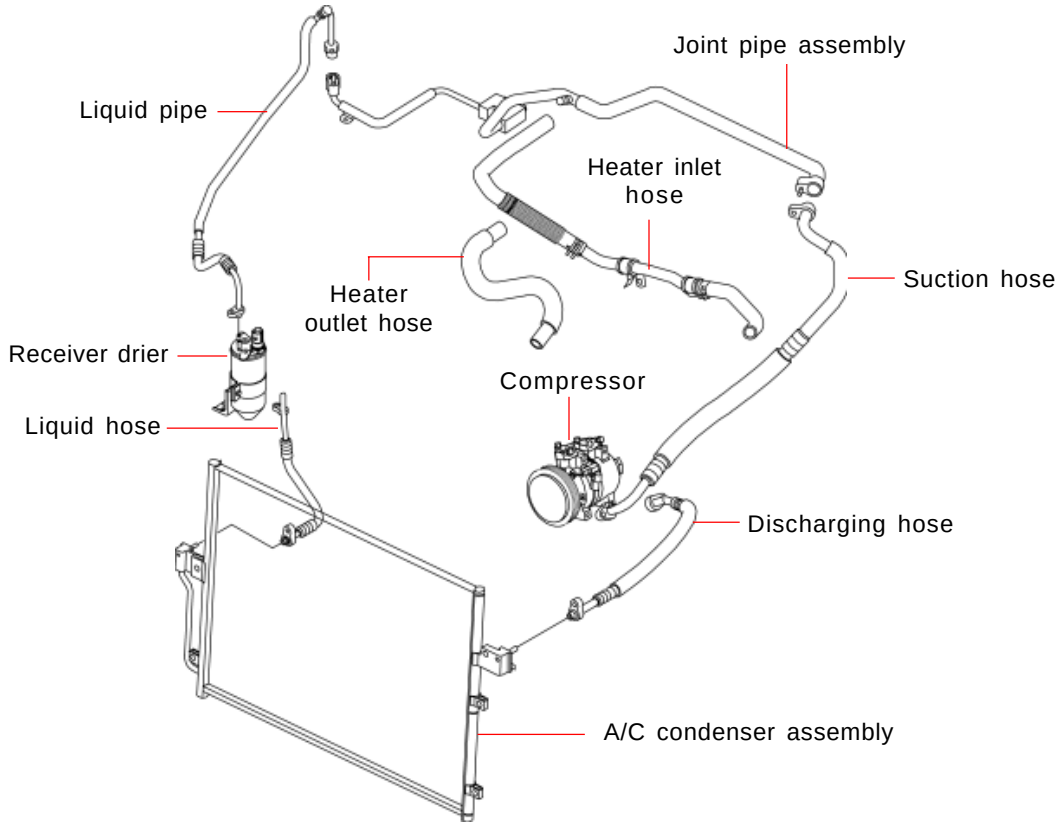


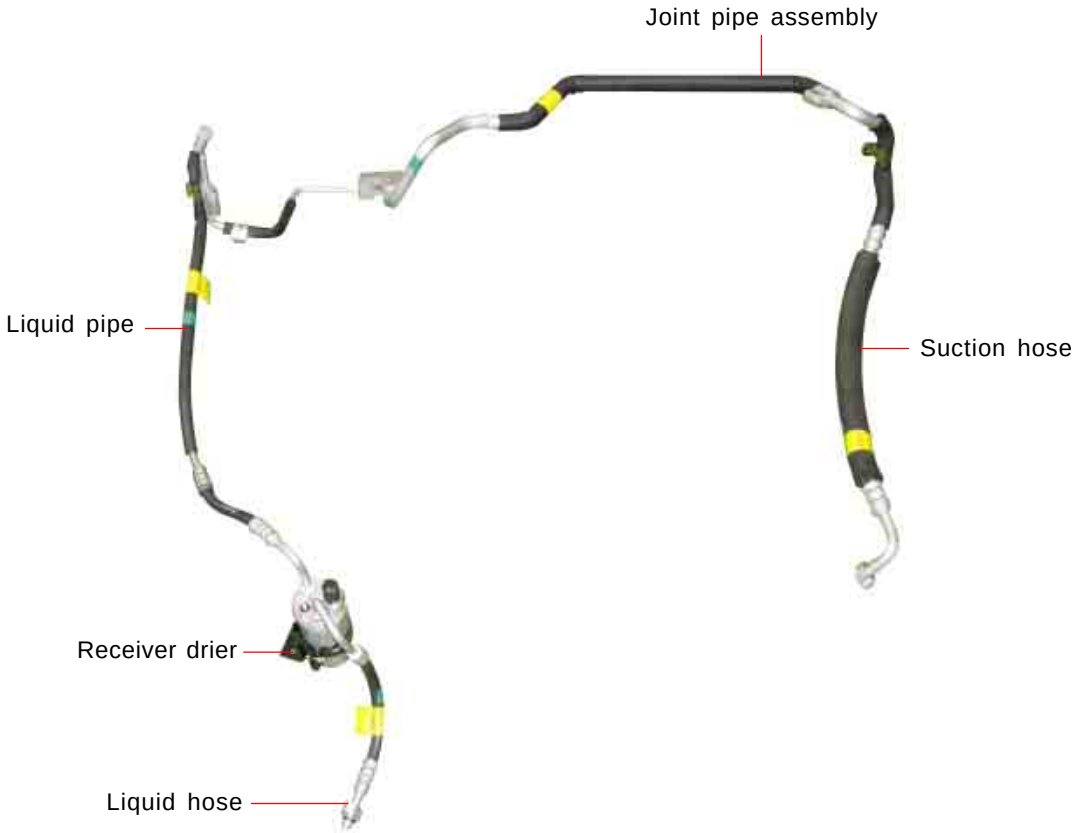
3. Unscrew the flange nuts of pressure pipes and compressor mounting bolts and remove the compressor assembly.



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▶ Piping Layout of Air Conditioner and Heater





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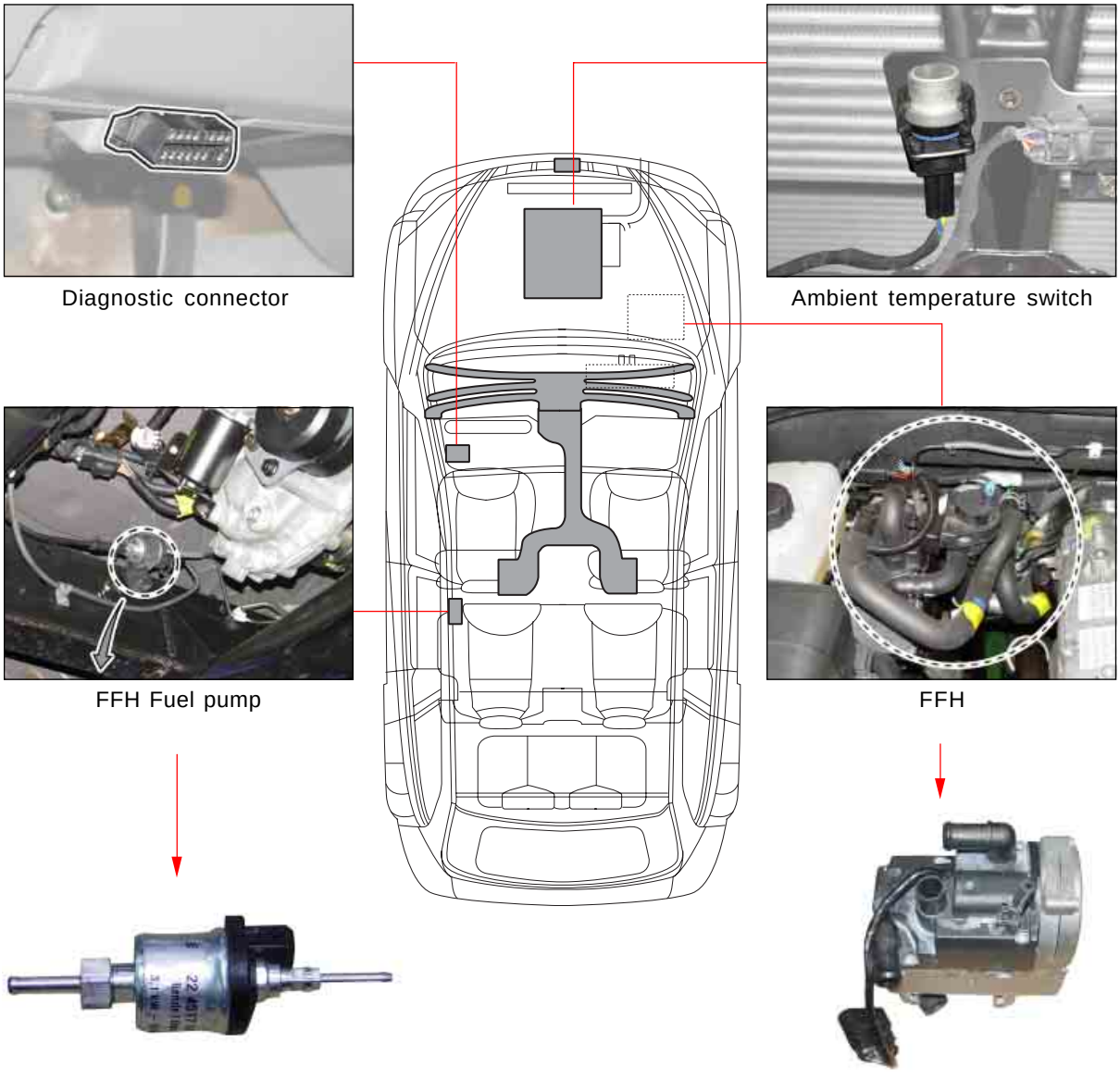
FFH (FUEL FIRED HEATER) SYSTEM

1. OVERVIEW

The system is to increase the coolant temperature quickly by firing diesel fuel in the burner that is installed in engine cooling system when in winter time the ambient temperature and engine coolant temperature is low. (Option) 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 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 is automatically operated by the coolant temperature and the ambient temperature. 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 Locator

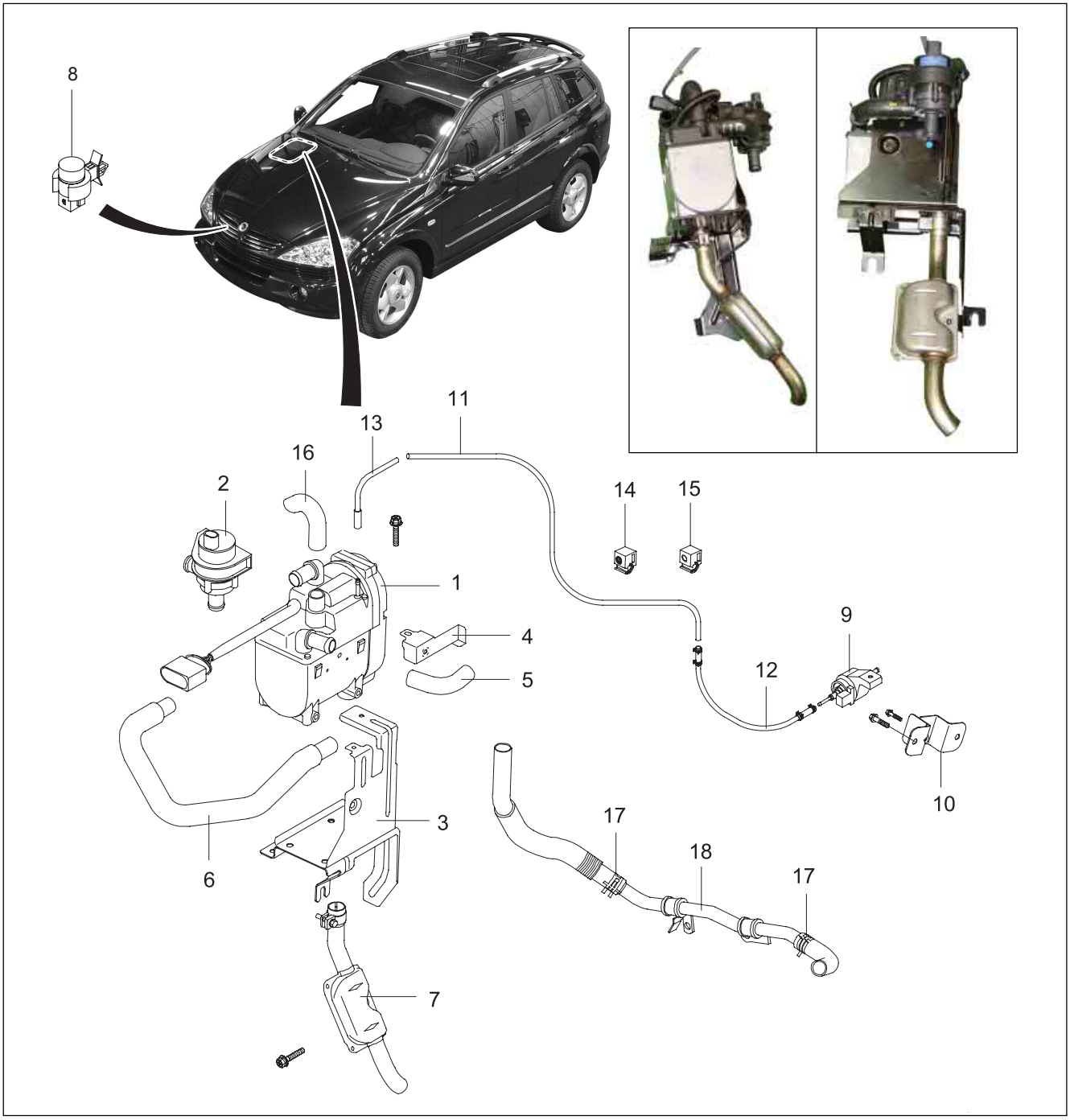


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2. FFH LAYOUT

▶ Components

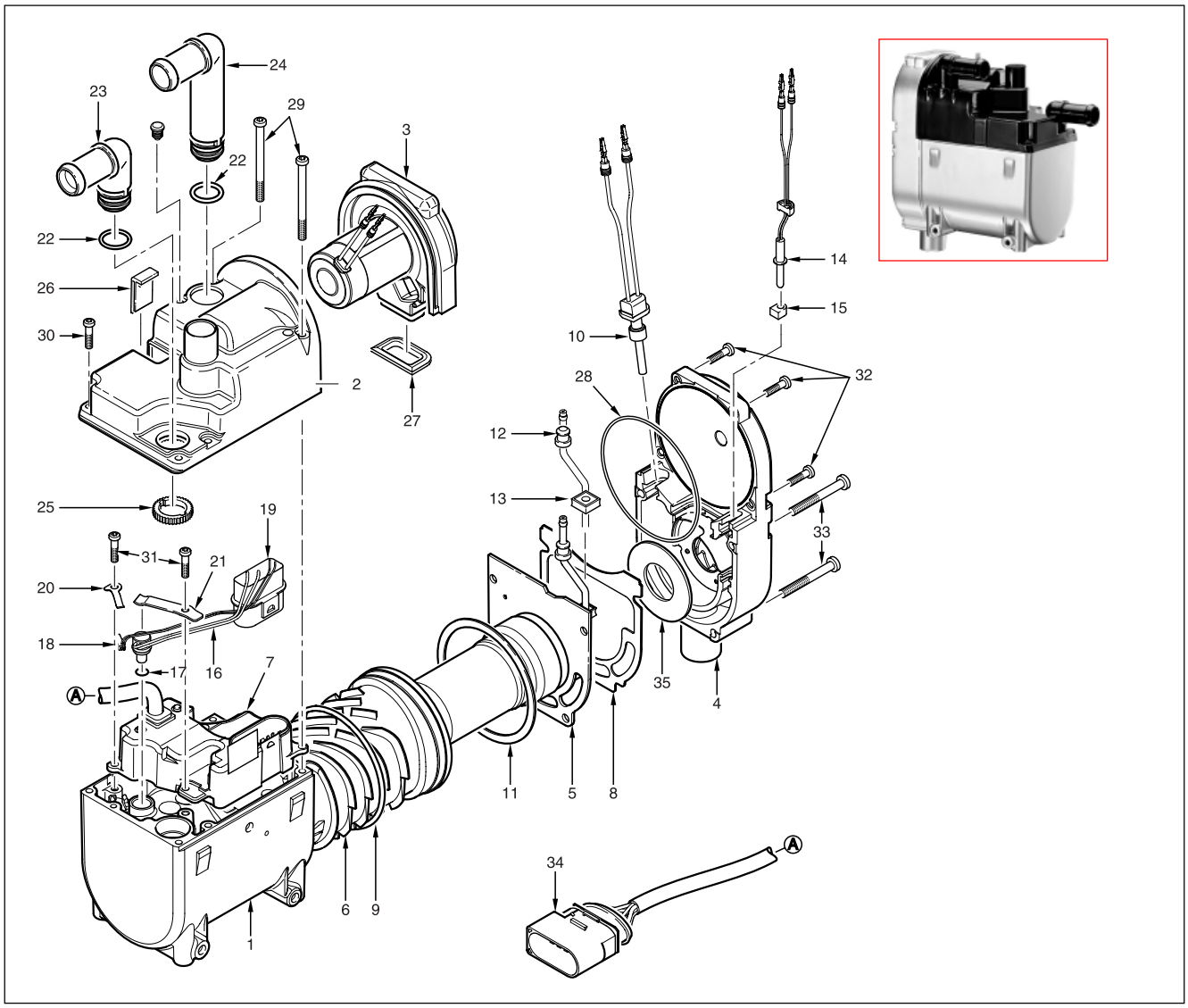


1. FFH assembly
2. Water pump and bracket assembly
3. FFH bracket assembly
4. FFH water pump bracket
5. FFH NO.3 inlet hose
6. FFH NO.2 inlet hose
7. FFH pipe assembly & silencer
8. Ambient temperature switch
9. FFH fuel pump
10. Fuel pump bracket
11. Fuel pipe NO.1
12. Fuel pipe NO.2
13. Fuel pipe NO.3
14. Tube clip mounting
15. Tube clip mounting
16. Intake hose
17. Clamp
18. FFH NO.1 inlet hose

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▶ 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. Screw (M4 x 55 TORX / 2x)
30. Screw (M4 x 16 TORX / 2x)
31. Screw (M4 x 12 TORX / 2x)
32. Screw (M4 x 16 TORX / 4x)
33. Screw (M4 x 44 TORX / 4x)
34. Controller cable harness
35. Insulation washer

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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	
	After-running	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	

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4. FFH OPERATING PROCESS

▶ Operating Condition

FFH is operated according to the ambient temperature and coolant tempreature.

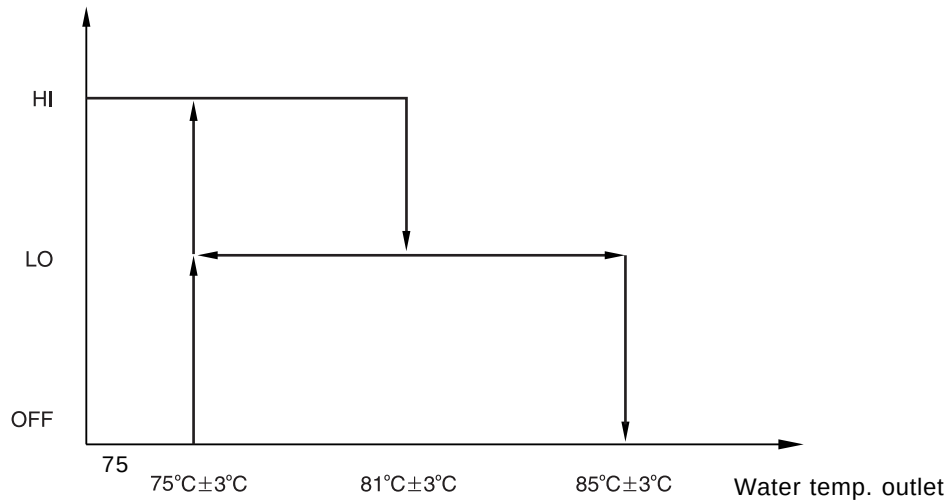
Initial Operating Conditions of FFH

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 at 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.

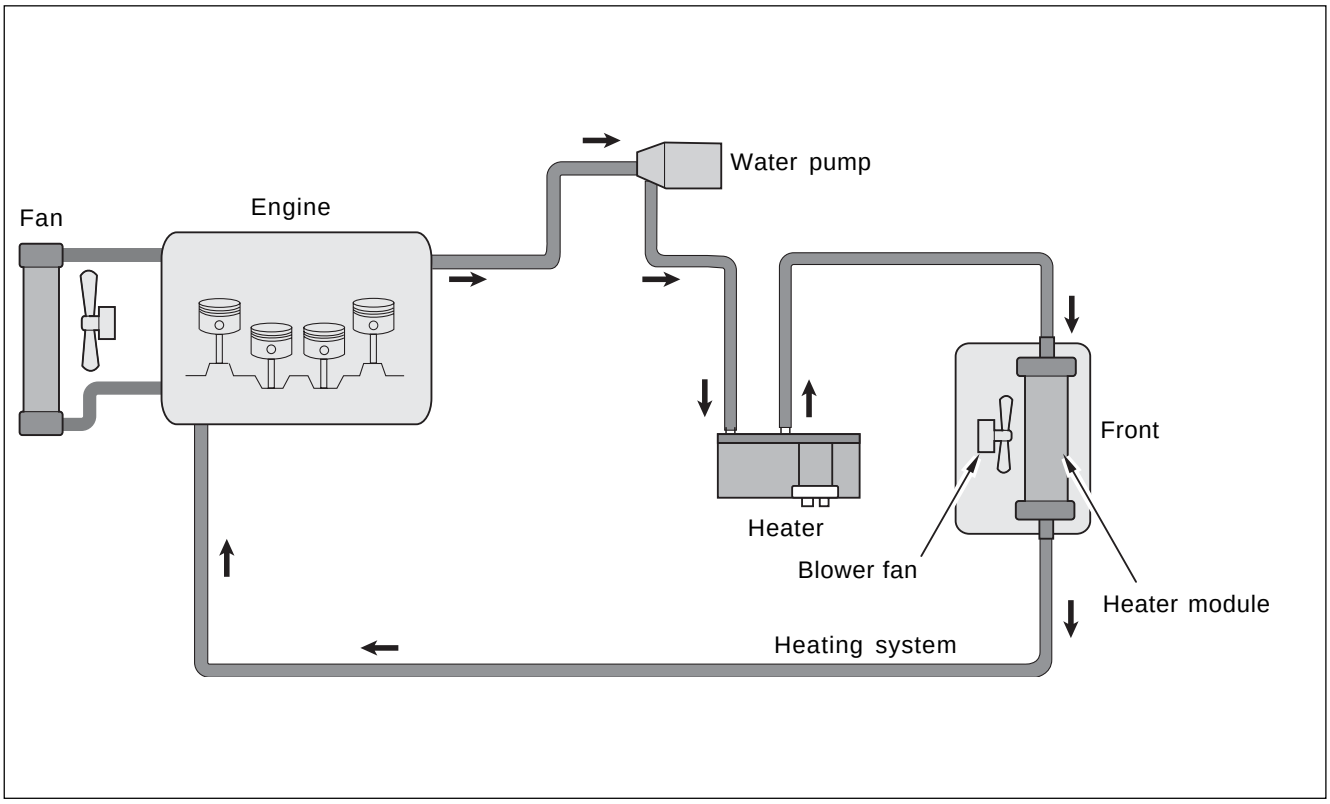
The control element is coolant temperature as shown in the graph.

The FFH is operated in HI mode (high output: approx. 5,000 W) until the coolant temperature reaches at 80°C and starts to be operated in LO mode (low output: approx. 2,300 W) from 81°C.

When the coolant temperature reaches at approx. 85°C, FFH stops its operation until the operating conditions will be met again.

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▶ Coolant Circulating Route



▶ Connecting the Coolant Circuit

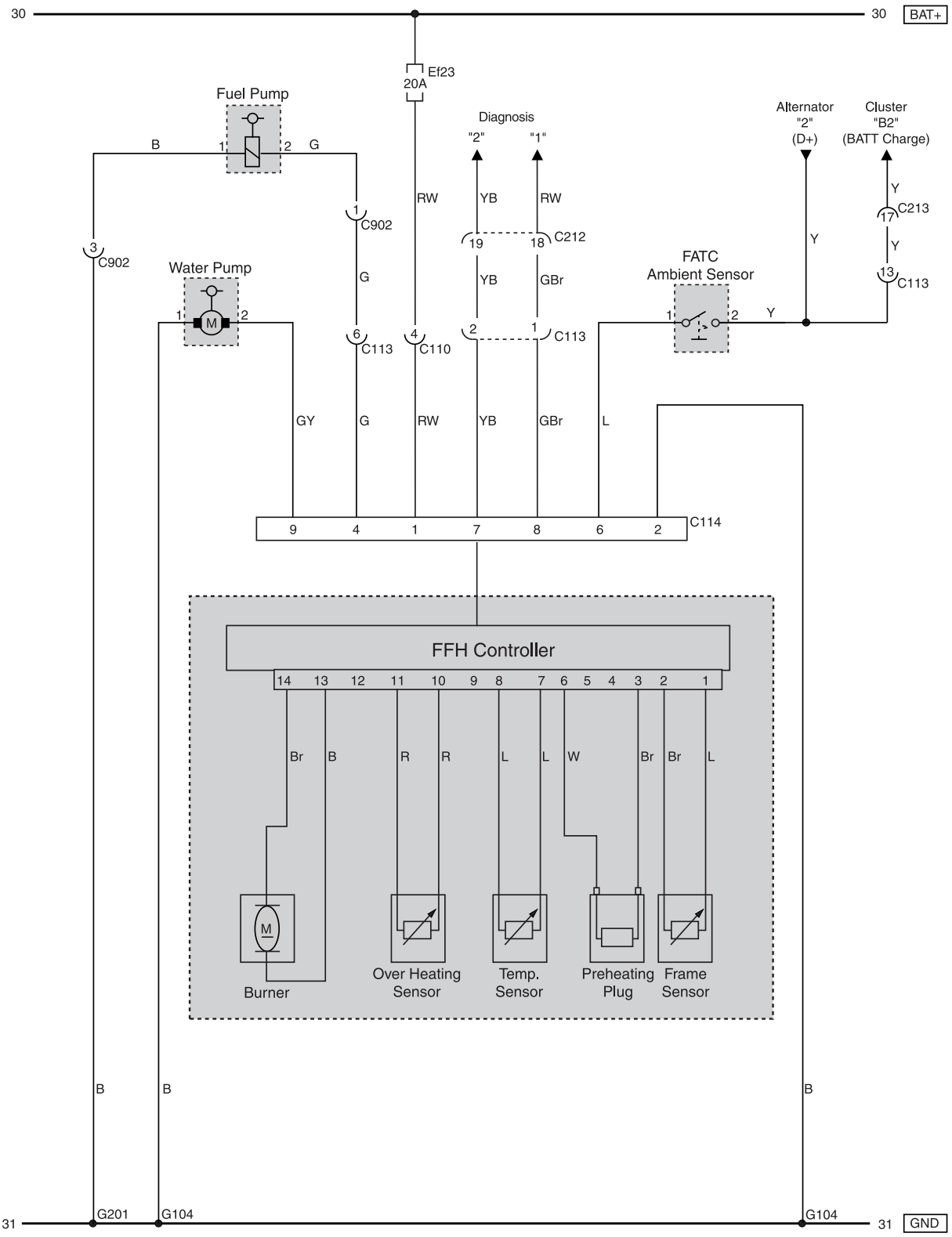
The heater is connected to the coolant circuit in the coolant feed pipe from the vehicle engine to the heat exchanger.

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 heater and water hoses with coolant before connecting to 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 temperatures.**
- **Secure all hose connections with hose clamps.**

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▶ 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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▶ Control and Safety Mode

Heater Operations and Safety Mode

1. If the fuel pump fails to ignite within 90 seconds after fuel pumping starts, the start procedure is repeated as described. If after a further 90 seconds fuel pumping the fuel pump still fails to ignite, 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, firstly a new start is activated. 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 (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 defect 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, is blocked or if the speed falls below 40% of the nominal speed, 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]

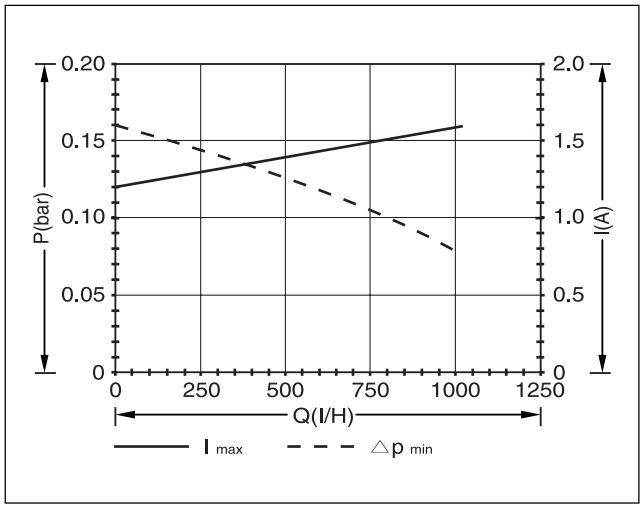
If an emergency shutdown -EMERGENCY OFF- is necessary during operation, proceed as follows;

- **Pull the fuse (Ef6: 20A) out.**
- **Disconnect the heater from the battery.**

▶ 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

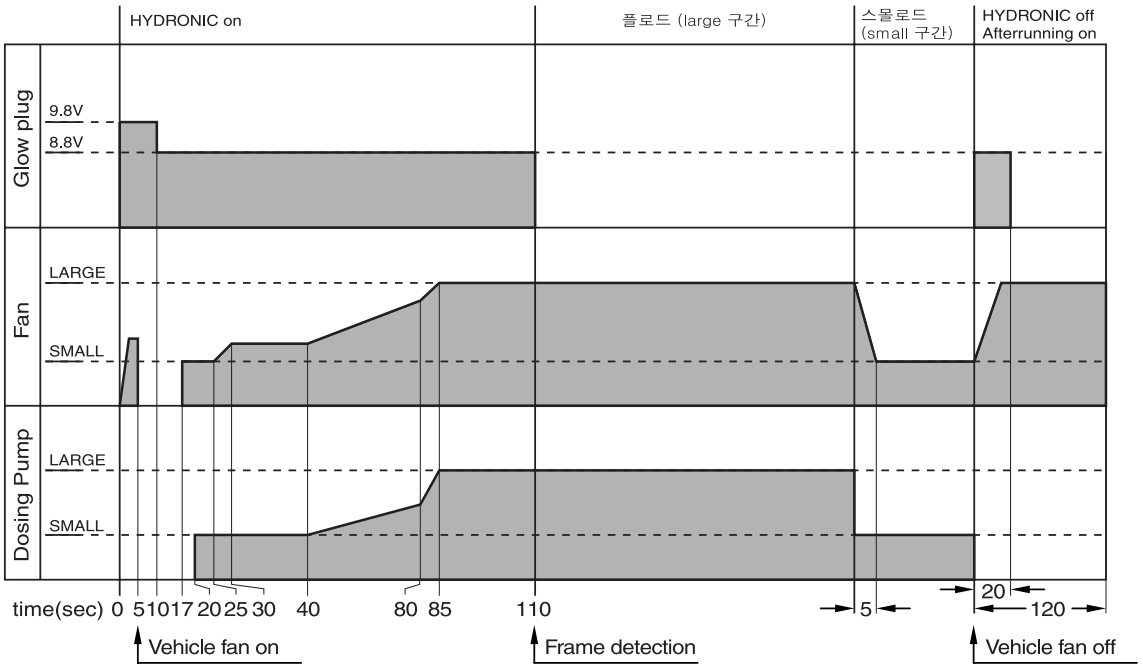
▶ Characteristic Curve of Water Pump (12 V)



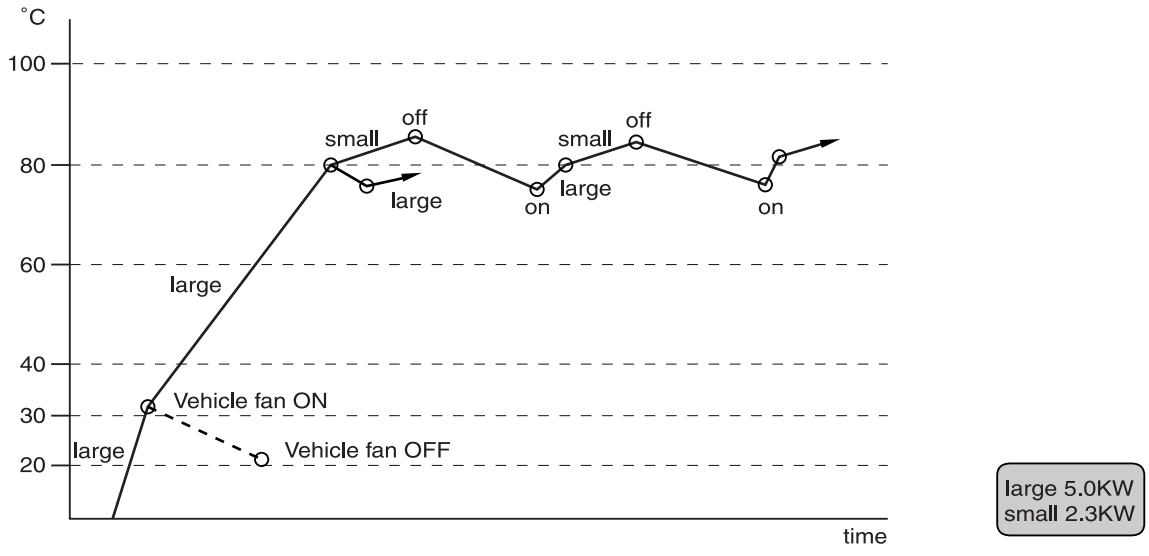
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▶ Function Diagram



▶ Switching Diagram According to Temperature Changes



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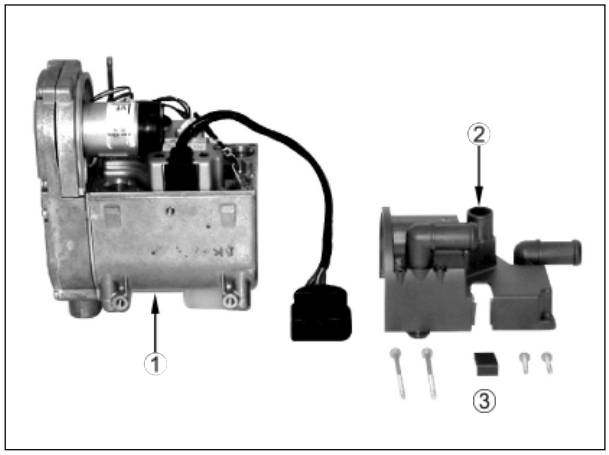
5. COMPONENTS AND FUNCTIONS

NOTICE

- **There is no need to disassemble the FFH unit for repair. This section is to show the internal components of the FFH unit.**

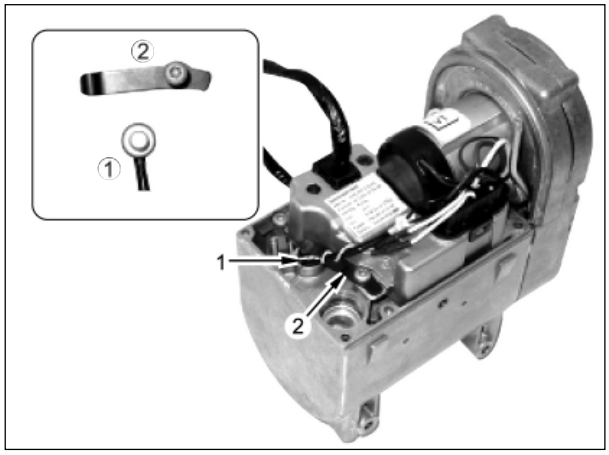
Jacket cover

1. The O-rings are installed between jacket cover and two coolant hoses.
2. The coolant hoses should be connected to right side.
   1) Jacket
   2) Jacket cover
   3) Cable harness cover



Control and overheating sensor

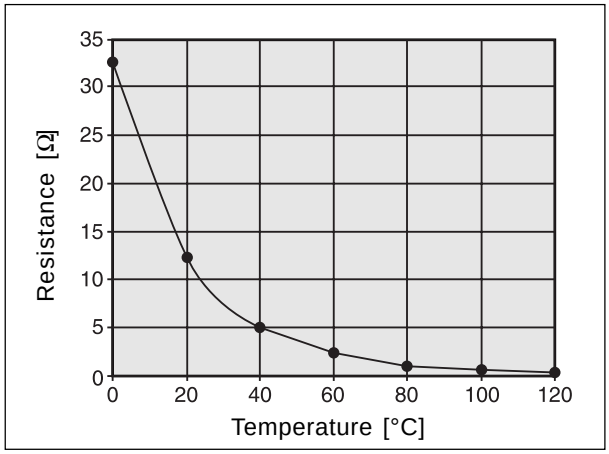
1. The Control and overheating sensor and cable harness make up one component.
   1) Control and overheating sensor
   2) Mounting spring



Check controller and overheating sensor

Check the control and overheating sensor with a digital multimeter. If the resistance according to the changes of flame.

sensor temperature is out of specified values, the flame sensor is defective.



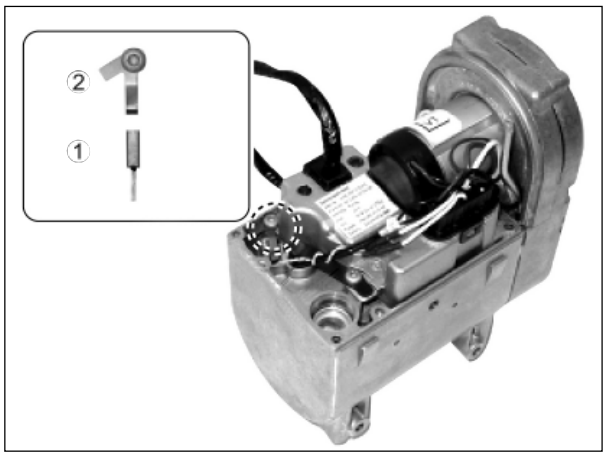
Specified value

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

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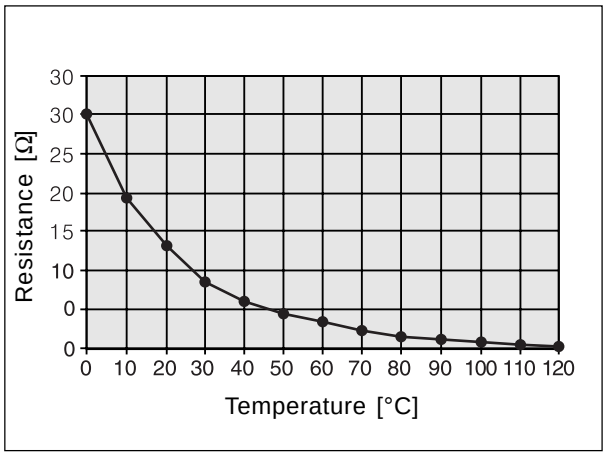
Surface Sensor

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 flame sensor is out of specified values, the flame sensor is defective.



Specified value

Temperature [°C]	0	10	20	30	40	50	60	70	80	90	100		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		0.62

Controller

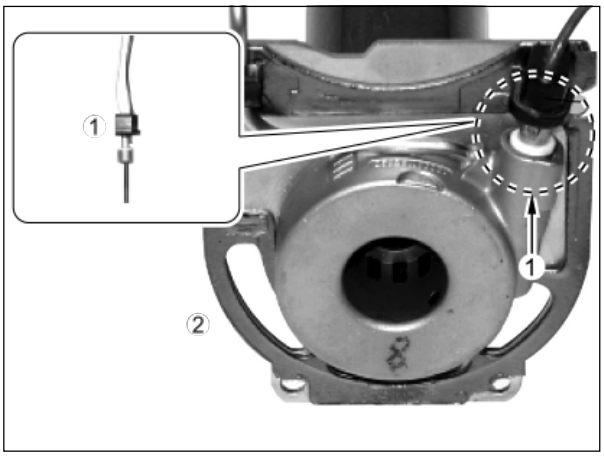
The surface heater and cable harness make up one component.

1) Controller
2) Jacket
3) Combustion chamber housing
4) Mounting screw

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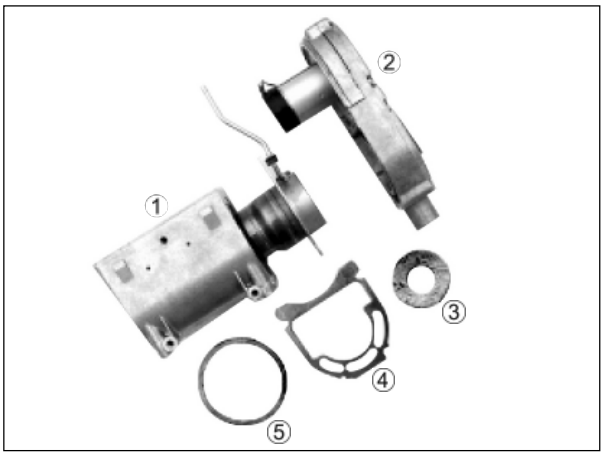
Glow Plug

1) Glow plug
2) Combustion chamber with flame pipe



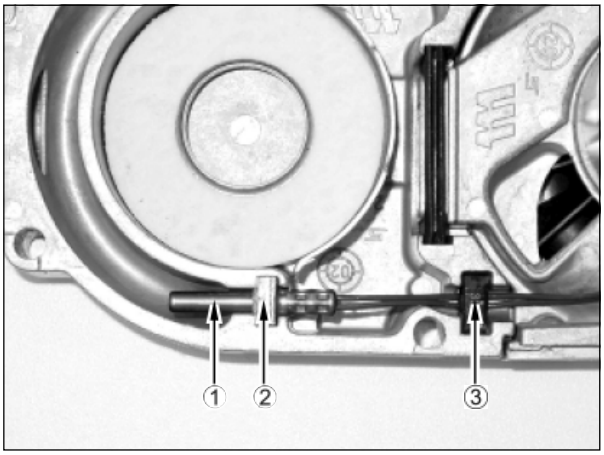
Combustion Chamber Housing

1) Jacket
2) Combustion chamber housing
3) Insulation washer
4) Seal - combustion chamber / combustion air fan
5) Seal - combustion chamber / heat exchanger



Flame Sensor

1) Flame sensor
2) Graphite bush
3) Bush

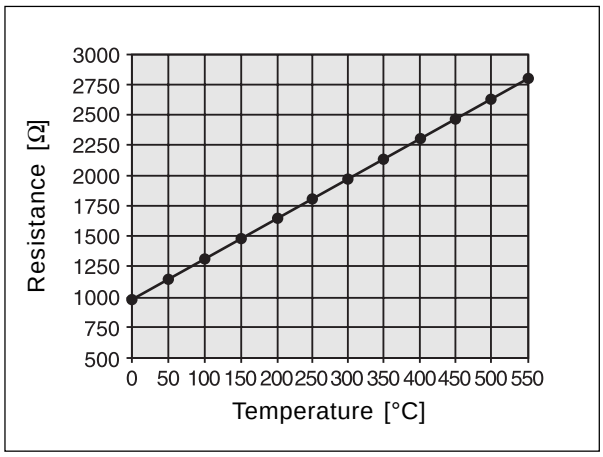


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Check Flame Sensor

Check the surface sensor with a digital multimeter. If the resistance of flame sensor is out of specified values, the flame sensor is defective.

1. Jacket
2. Combustion chamber
3. Combustion chamber housing
4. Insulation washer
5. Seal - combustion chamber / combustion air fan
6. Seal - combustion chamber / heat exchanger

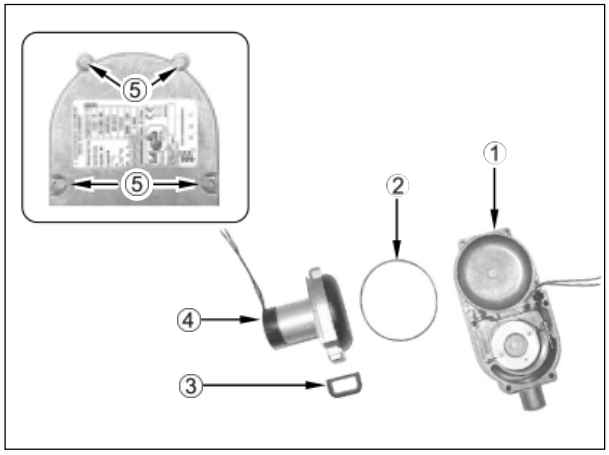


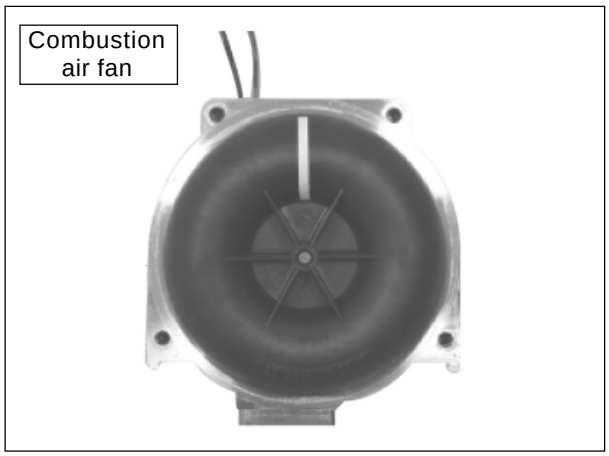
Specified value

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

1) Combustion chamber
2) O-ring
3) Rubber seal
4) Combustion air fan
5) Screw

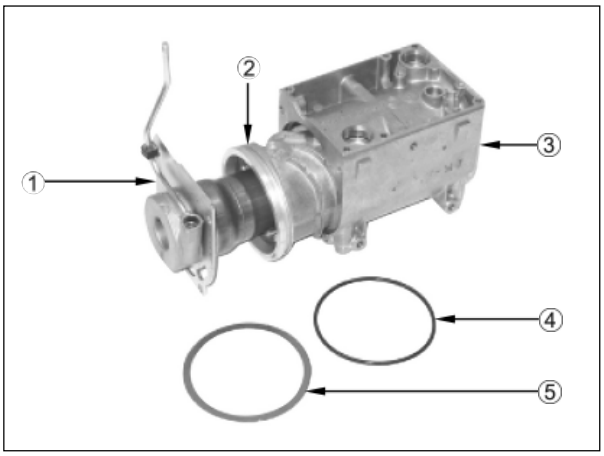




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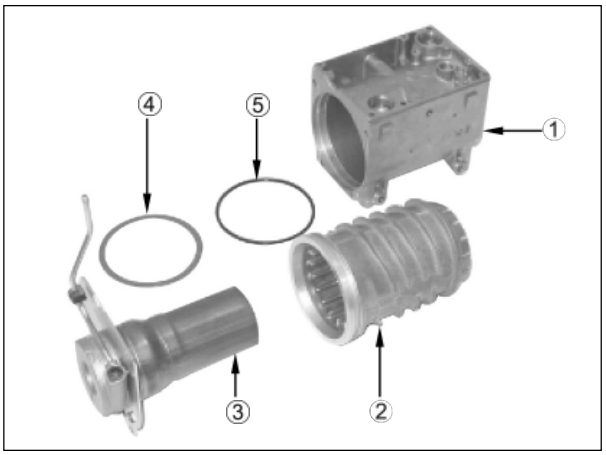
Combustion Chamber

1) Combustion chamber
2) Heat exchanger
3) Jacket
4) O-ring
5) Seal - combustion chamber / heat exchanger



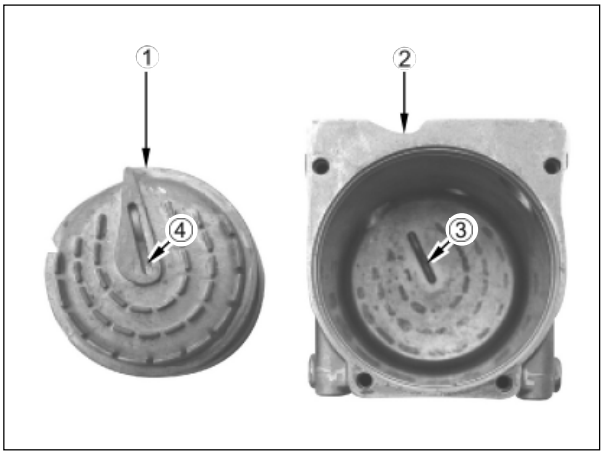
Heat Exchanger

1) Jacket
2) Combustion chamber with flame tube
3) Heat exchanger
4) Seal - combustion chamber / heat exchanger
5) O-ring (for heat exchanger)



Heat Exchanger

1) Heat exchanger
2) Jacket
3) Stopper
4) Groove (bottom of heat exchanger)



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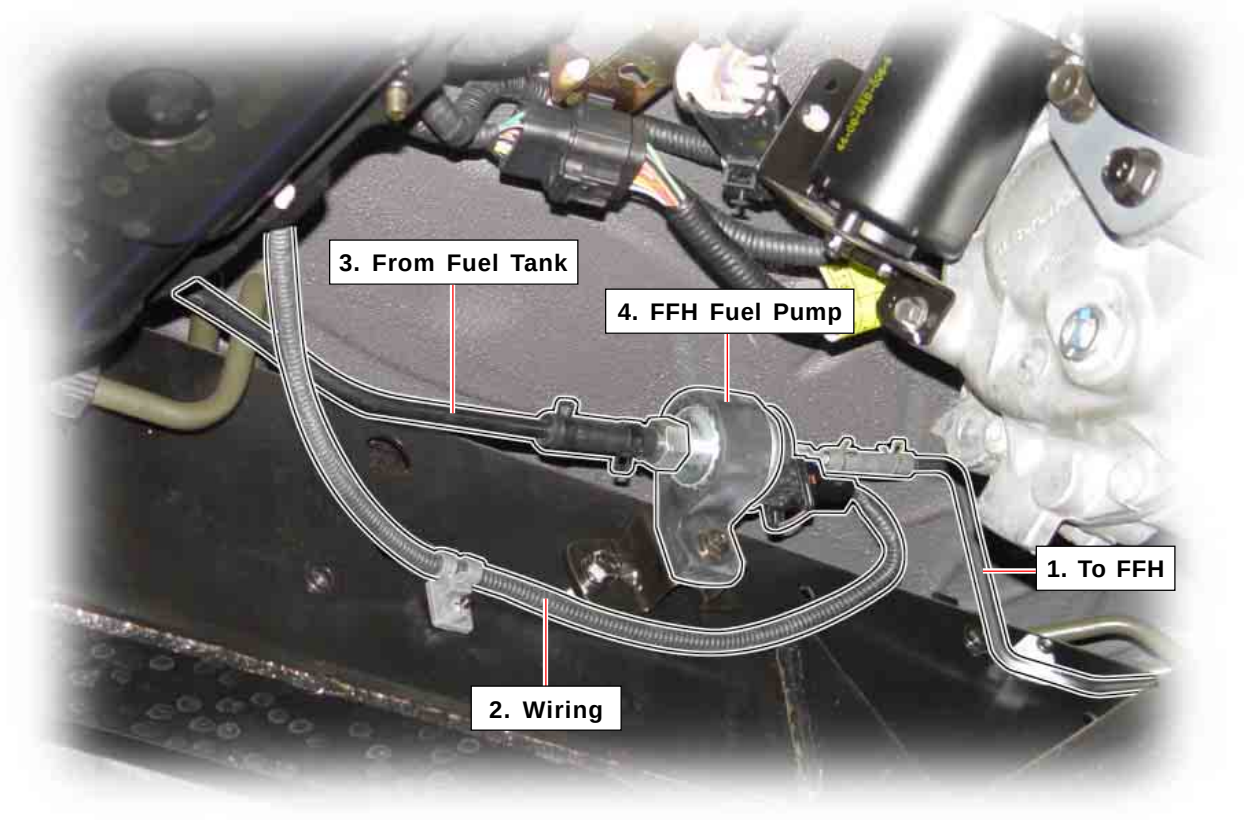
6. REMOVAL AND INSTALLATION

※ **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



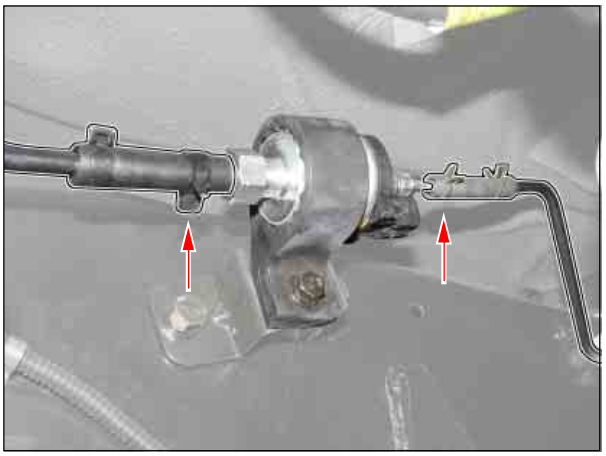


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1. Disconnect the fuel pump connector with the vehicle lifted.



2. Disconnect the fuel hose from fuel pump.



3. Unscrew the bracket mounting bolt (10 mm) and remove the fuel pump assembly.



NOTICE

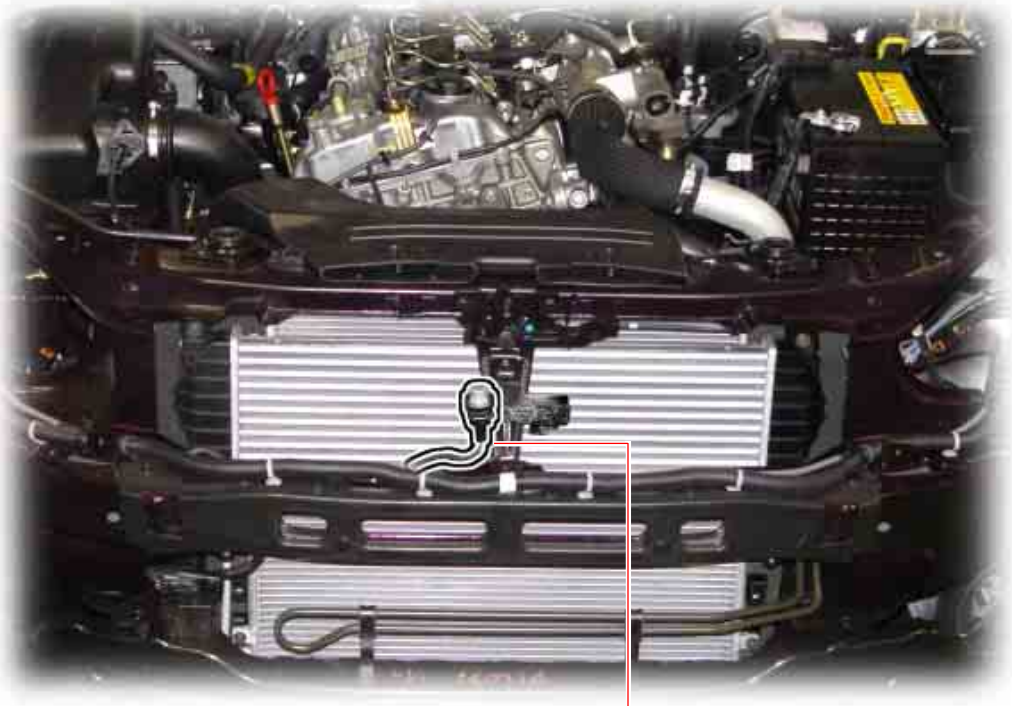
- **Plug the hose opening with a seal cap to prevent oil leakage**



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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 after removing the headlamp.

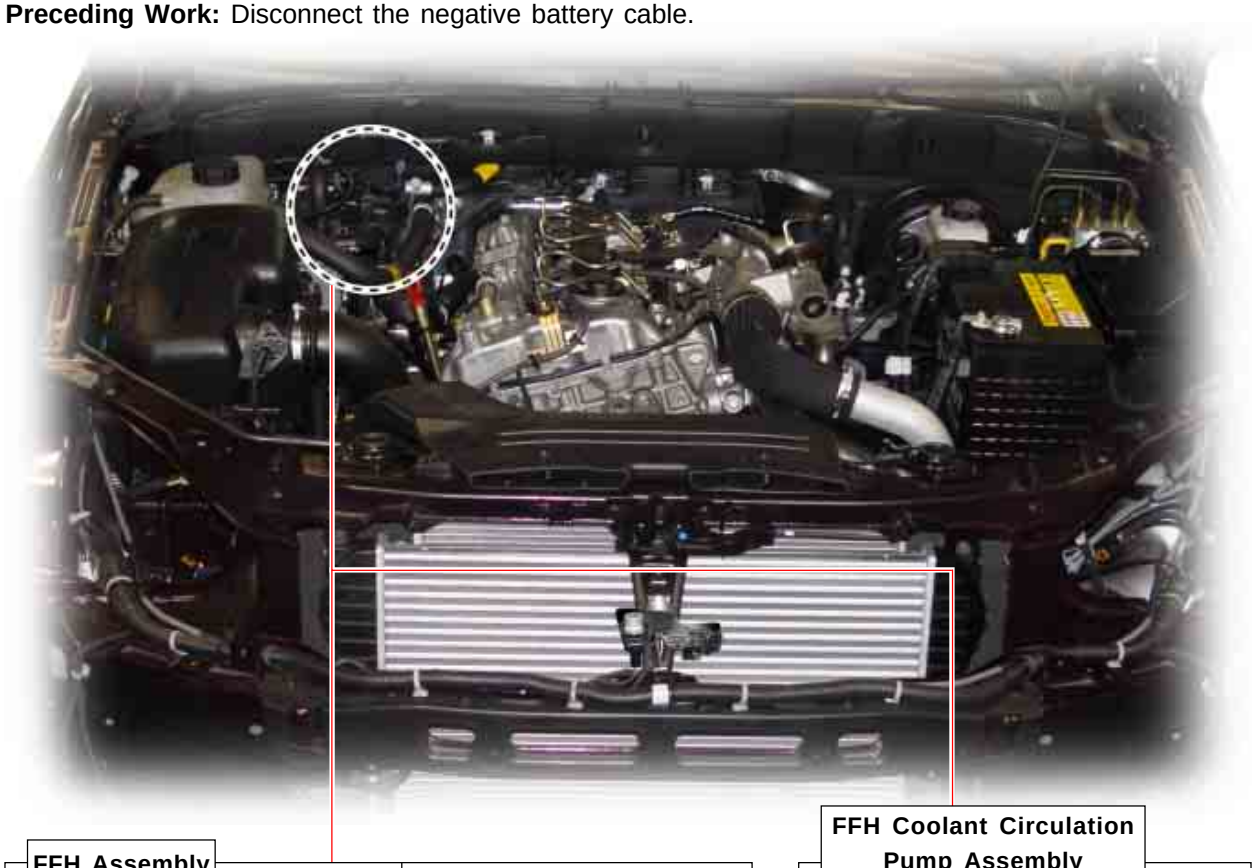
1. Remove the ambient temperature sensor from holder.
2. Disconnect sensor connector while pushing the connector pin.



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FFH Assembly

※ **Preceding Work:** Disconnect the negative battery cable.



FFH Assembly



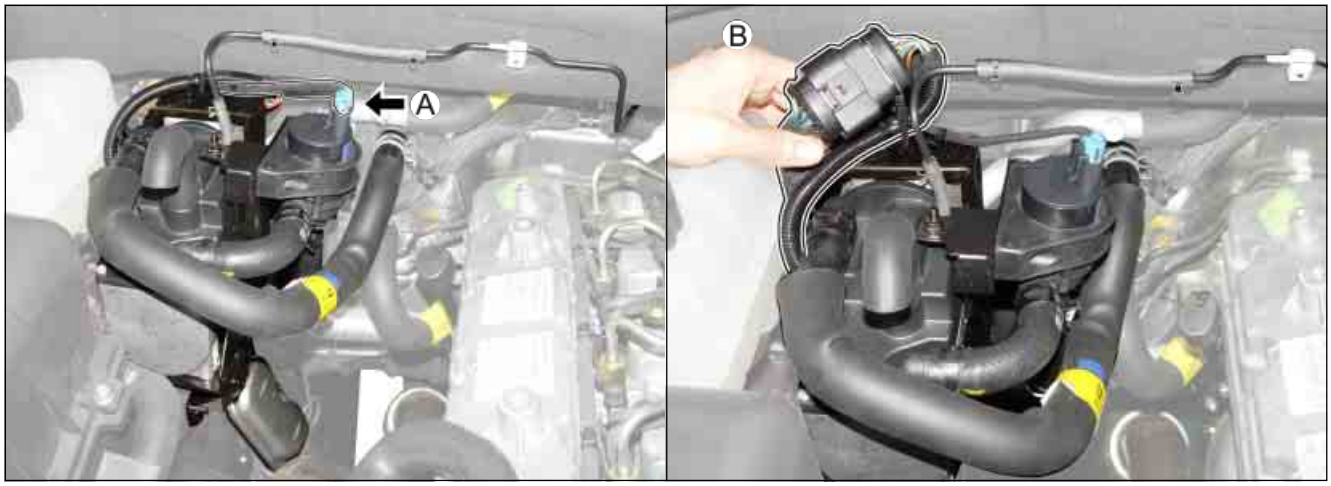
FFH Coolant Circulation Pump Assembly



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1. Disconnect the FFH coolant circulation pump (A) connector and FFH connector (B).



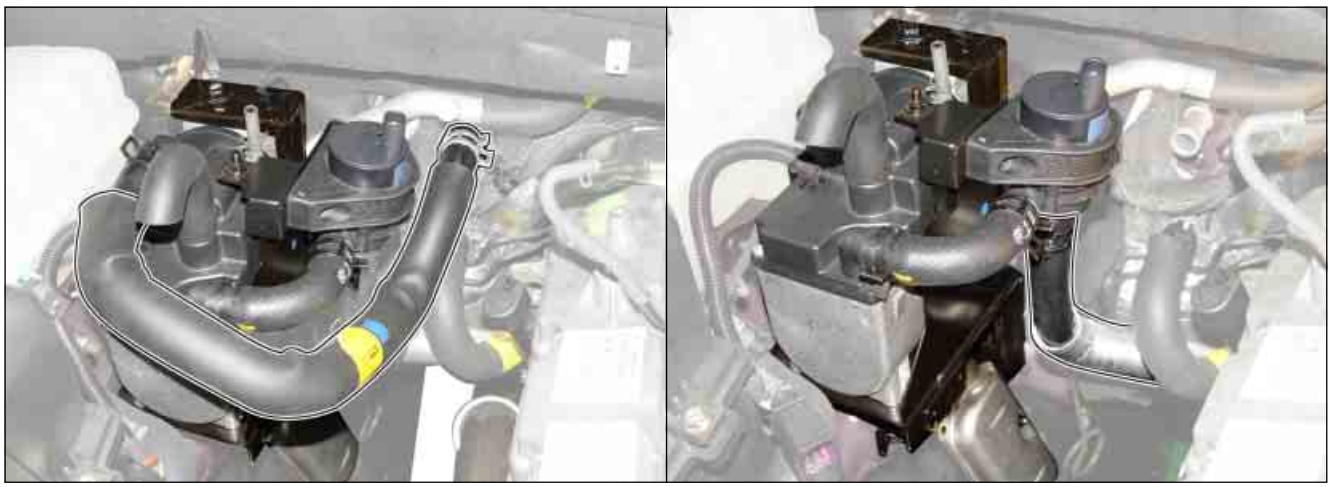
2. Remove the hose and pipe from the fuel pump.

NOTICE

- **Plug the hose openings with seal caps to prevent oil leakage.**



3. Unscrew the hose clamps on the FFH coolant circulation pump and remove the inlet and outlet hoses.



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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.





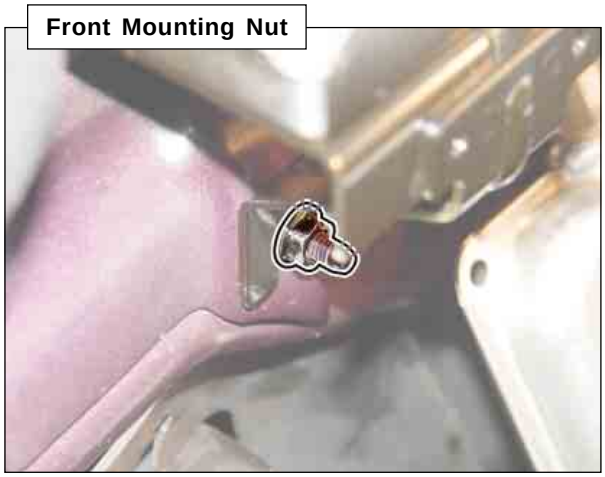
FFH Assembly





   2) Unscrew the mounting nuts from the FFH coolant circulation pump.

Front Mounting Nut



FFH Exhaust Pipe Side



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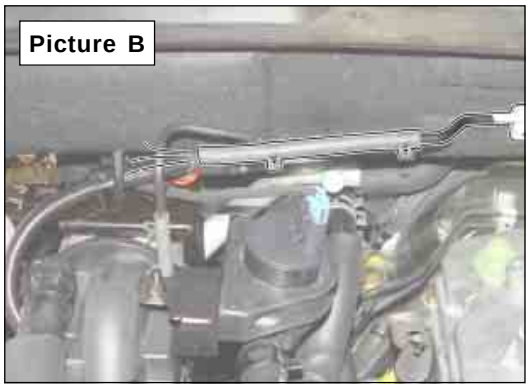
5. Fuel feeding operation should be performed after replacing FFH assembly or fuel lines.

Fuel Feeding Operation

NOTICE

- **Otherwise, FFH system could make white smoke with abnormal noise.**

Picture B



1. Connect 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)



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



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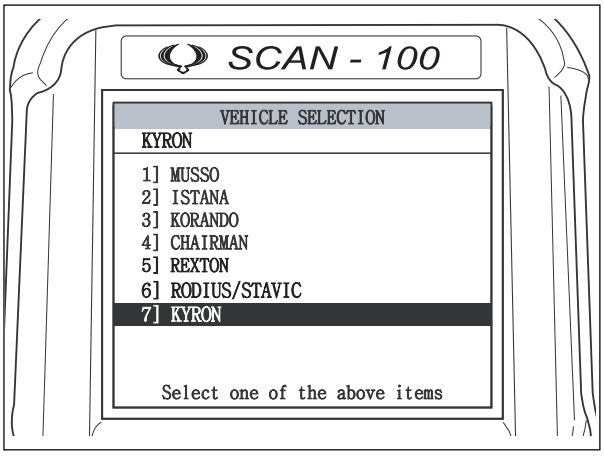
7. TROUBLE DIAGNOSIS

FFH Heater Trouble Diagnosis Precedure

Connect Scan-100 to the diagnostic connector located at the lower instrument panel.



1. Select [KYRON] in [VEHICLE SELECTION].



2. Select “FFH (FUEL FIRED HEATER)” in [CONTROL UNIT SELECTION].
3. Select the trouble code out of check items.

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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 motor0	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.
43	Abnormal output of water pump	-

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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 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.

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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.

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PTC (POSITIVE TEMPERATURE COEFFICIENT) SYSTEM

1. OVERVIEW

The supplementary electrical heater is installed in DI engine equipped vehicle as a basic equipment. The PTC system is operated according to two temperature values measured at the coolant temperature sensor and HFM sensor.

This device is mounted in the heater air outlet and increase the temperature of air to the passenger compartment.

Because PTC system is heated by electrical power, high capacity alternator is required. (Alternator of 12V 75A/ 90A has changed to 12V 140A)

Non-operational Condition
- During engine cranking
- When too low battery voltage (Below 11V)
- During preheating process of glow plugs

PTC Assembly





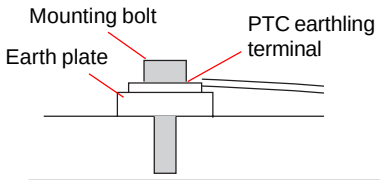
Engine ECU



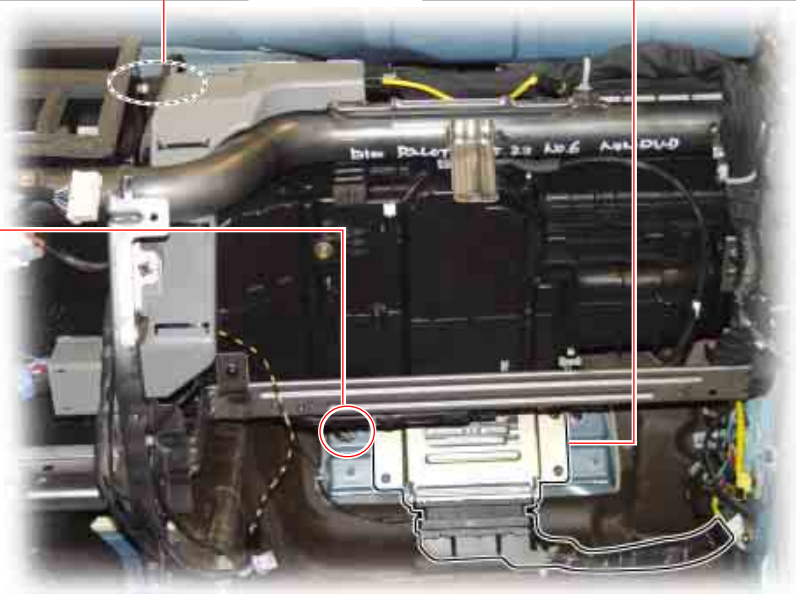
PTC Ground



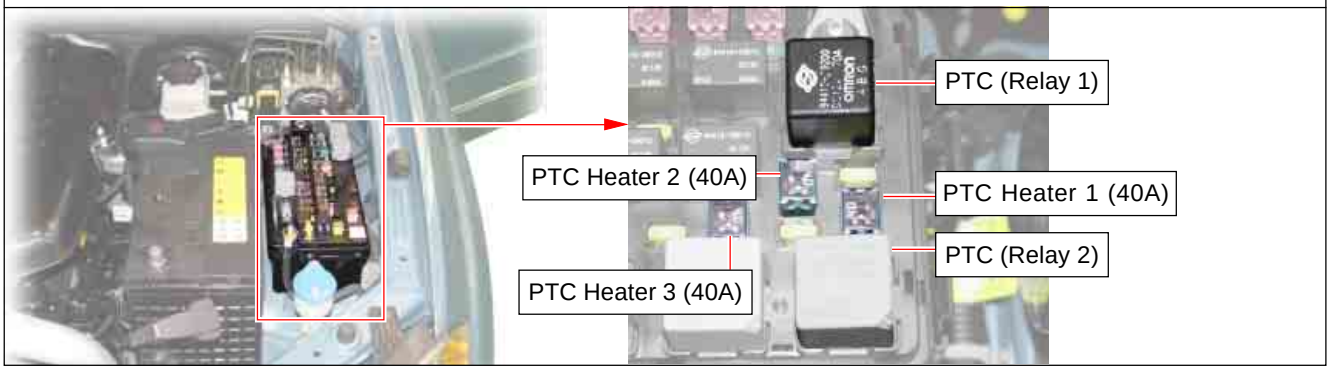
* The ground ring terminal should be secured as shown in below figure.



Tightening torque: 6 ~ 10 Nm



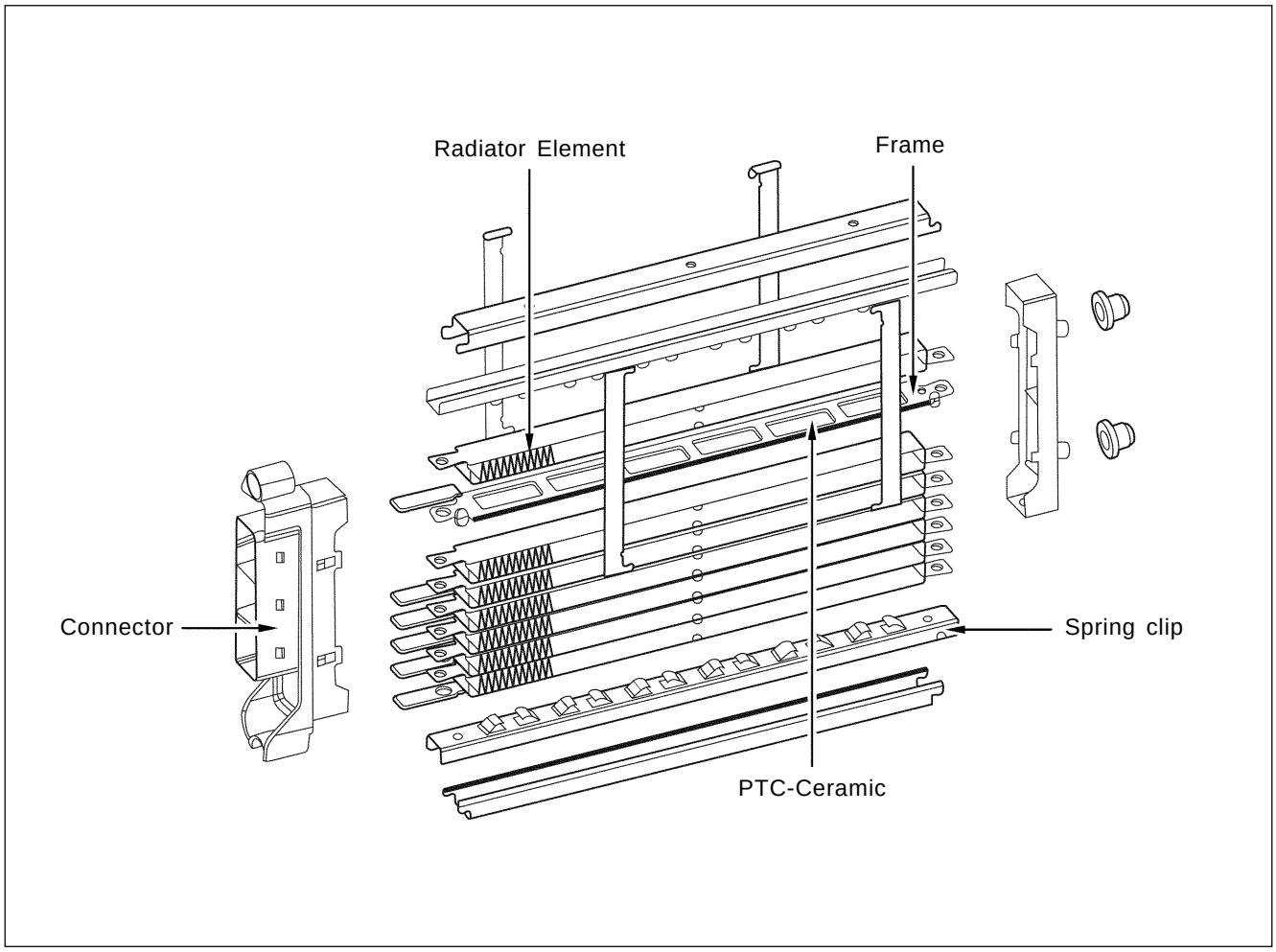
PTC Relay and Fuse



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2. COMPONENTS



▶ Characteristics of PTC

	P.T.C Heater
Heating type	Air heating type
Element	Ceramic PTC (BaTio3)
Advantages	1. Stable output regardless of voltage changes 2. Block the overcurrent with switch effect of PTC element 3. High heating capacity in a moment 4. Excellent durability of heating element against high current

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3. PTC OPERATING PROCESS

▶ PTC Operating (ON) Condition

The operating condition of PTC is controlled by two step.

Generally, ECU control the power relay for PTC depending on the coolant temperature and ambient temperature sensor.

1st step (Initial PTC operating condition)

1. When coolant temperature < 15°C, PTC is operating (ON).
2. When coolant temperature ≥ 15°C, tow conditions described below must be satisfied.

2nd step (Coolant temperature: 15°C)

1. When coolant temperature 65°C ≤ and ambient temperature ≤ -10°C PTC operates (ON)
2. When coolant temperature 65 ~ 60°C and ambient temperature -10°C ~ 0°C PTC operates (ON)
3. When coolant temperature ≤ 60°C and ambient temperature ≤ 0°C ~ 5°C, PTC operates (ON)

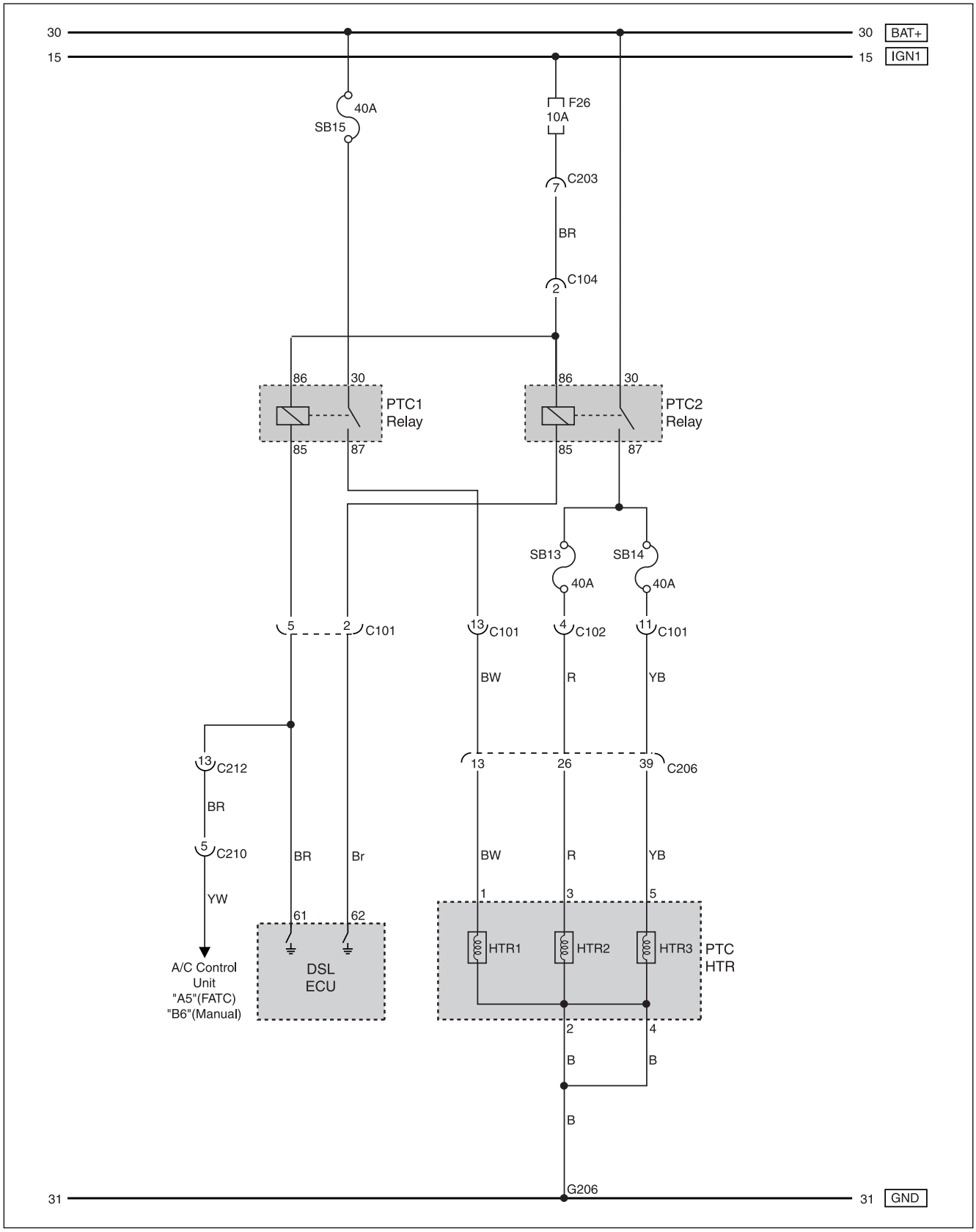
▶ PTC "OFF" Condition

1. Air conditioner blower switch OFF
2. Ambient temperature sensor error (wiring short or open)
3. When engine cranking
4. Battery voltage is lower than 11V
5. When preheating the engine (Glow indicator "ON")

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▶ Electrical Wiring



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4. REMOVAL AND INSTALLATION

※ **Preceding Work:** Disconnect the negative battery cable and the instrument panel.

1. Disconnect the PTC connector while pulling out it (A).



2. Unscrew two mounting bolts and remove the PTC assembly from the A/C module assembly.







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STICS

8710

TABLE OF CONTENTS

RKSTICS (REKES+STICS) / STICS 3

1. Overview 3
2. Specifications 4
3. Functions and specifications 8
4. Trouble shooting 18
5. Diagnosis trouble code and help tips 47
6. Electrical wiring diagrams 49

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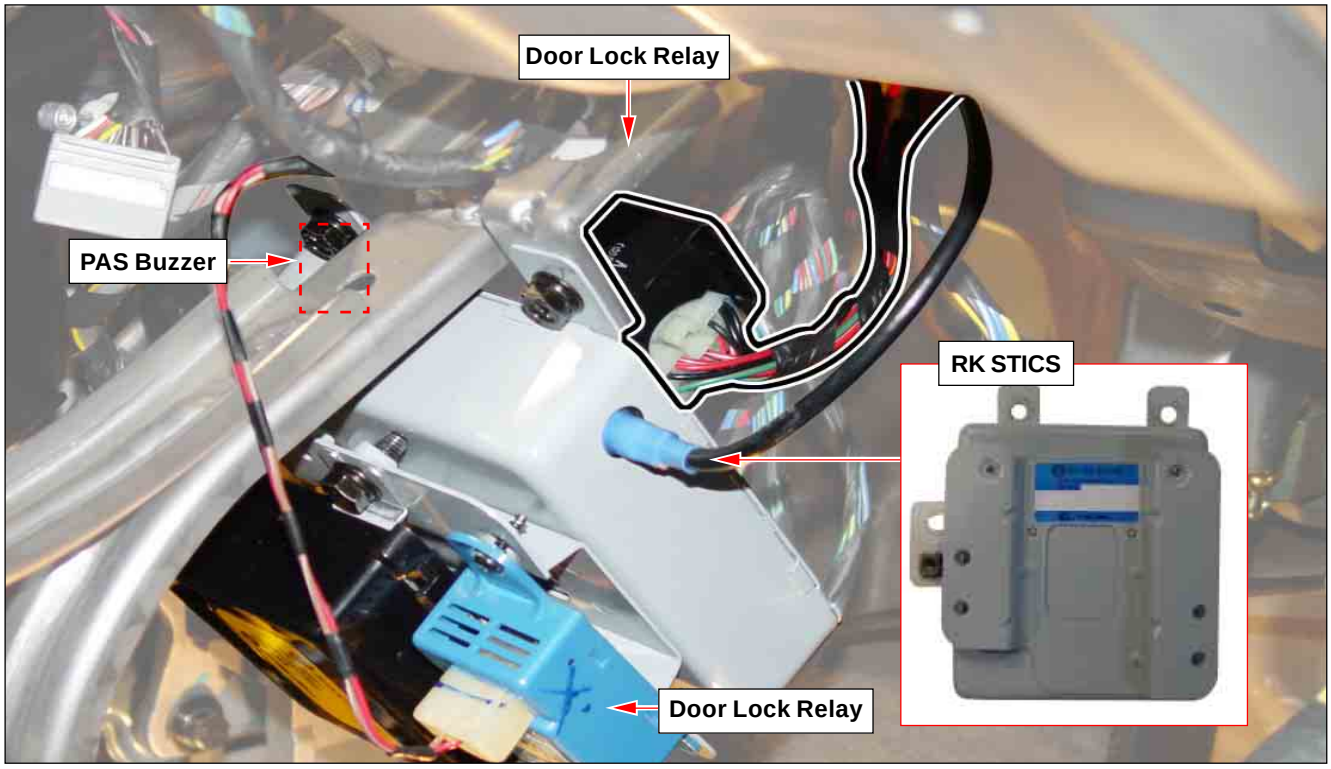
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RKSTICS (REKES+STICS) / STICS

1. OVERVIEW

The RKSTICS (REKES + STICS (Super Time & Integrated Control System)) communicates with the transmitter (remote controller) and other electronic systems to transmit and receive the data.

The STICS also includes a diagnosis function that can inspect the error for related devices.



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2. 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.
Parasitic 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)

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Rated Load

NO.	Description	Rated Load
1	Chime bell / Buzzer	DC 12 V 350 mA (Inducted 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	Seatbelt 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 (Inducted load)
9	Door unlock relay	DC 12 V 200 mA (Inducted load)
10	Horn relay	DC 12 V 200 mA (Inducted load)
11	Tail lamp relay	DC 12 V 200 mA (Inducted load)
12	Hazard warning relay	DC 12 V 200 mA (Inducted load)
13	Power window relay	DC 12 V 200 mA (Inducted load)
14	Rear defogger relay	DC 12 V 200 mA (Inducted load)
15	Wiper LOW relay	DC 12 V 250 mA (Inducted load)
16	Wiper HIGH relay	DC 12 V 250 mA (Inducted load)
17	Front washer motor	DC 12 V 1.5 A
18	Rear washer motor relay	DC 12 V 500 mA (Inducted load)
19	Headlamp relay	DC 12 V 750 mA (Inducted load)
20	Front defogger relay	DC 12 V 200 mA (Inducted load)

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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	Seatbelt 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	Central door lock switch	ON = GND, OFF = OPEN
28	Rear washer switch	ON = BAT, OFF = OPEN
29	Multifunction auto light switch	ON = GND, OFF = OPEN
30	Indicator lamp switch	ON = BAT/GND, OFF = OPEN (Approx. 5.1 V ~ 9.2 V)
31	Seat adjustment and switch memory unit	ON = GND (PWM), OFF = OPEN
32	Rain sensor	ON = GND (DATA), OFF = BAT
33	Diagnosis (SCAN-100)	ON = GND (DATA), OFF = BAT (KWP2000)
34	Immobilizer	ON = GND (DATA), OFF = BAT (KWP2000)

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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.

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3. 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.

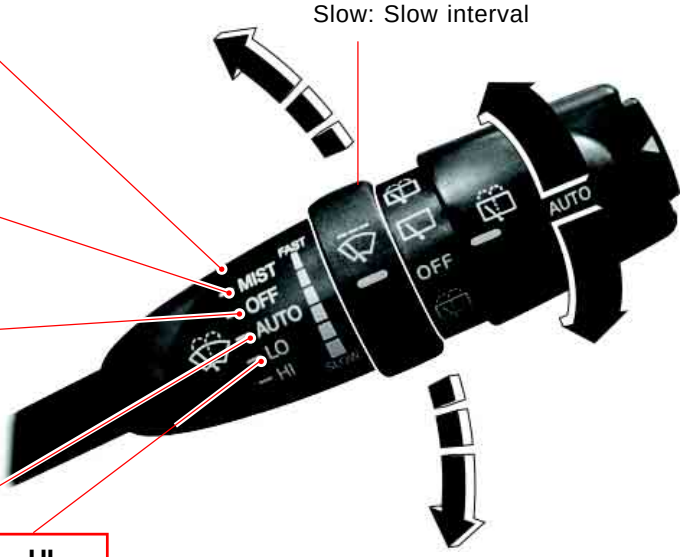
LO

Continuous wipe, slow operation.

HI

Continuous wipe, fast operation

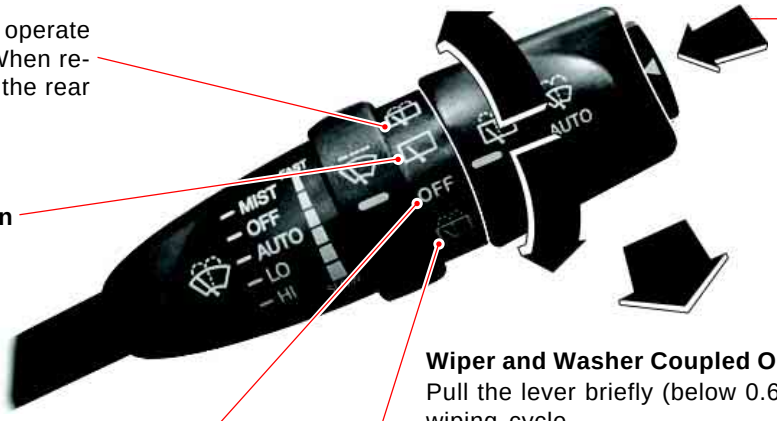
Front Automatic Wiping Speed Control Switch
The interval of wiper swings can be adjusted by twisting the control knob upward or downward when the windshield wiper switch is in the AUTO position.
Fast: Fast interval
Slow: Slow interval



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



Rear Wiper Stops

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

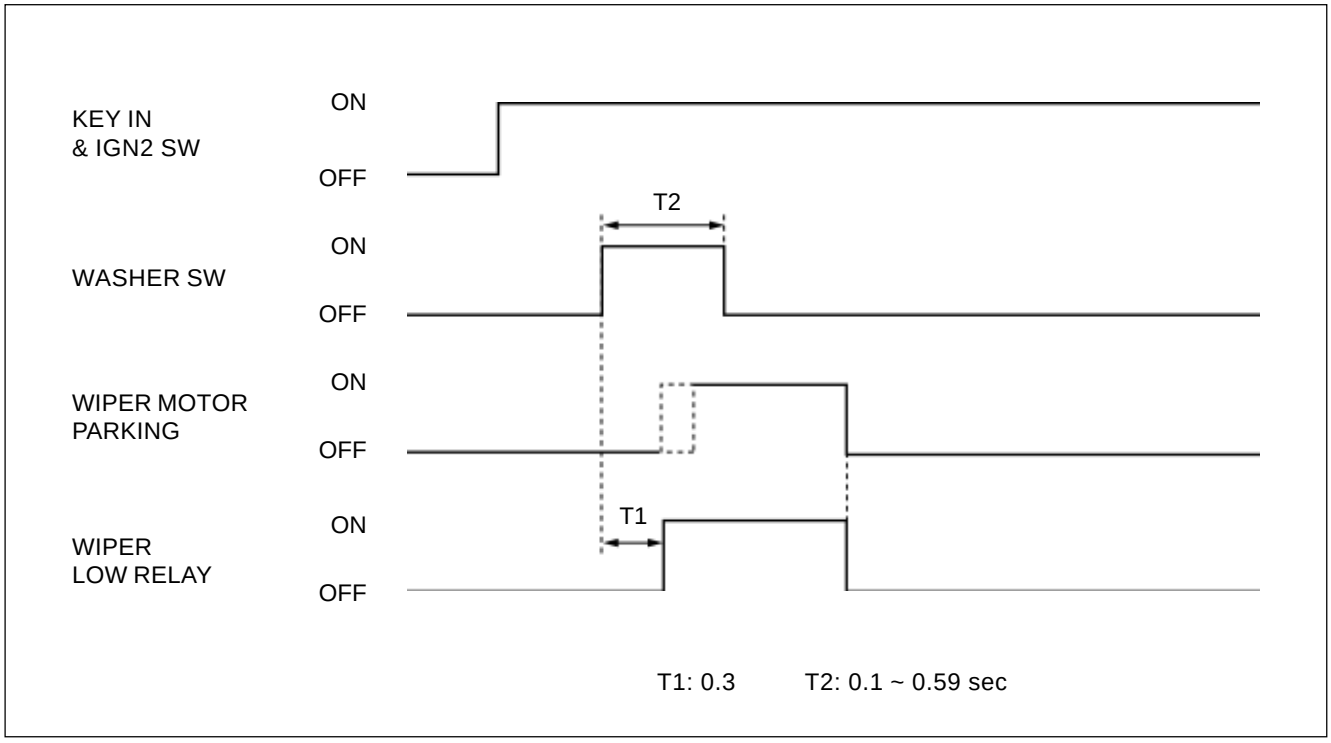
Rear Washer and Wiper
The rear washer and the wiper operate only while holding the switch. When releasing the switch, it returns to “OFF” position.

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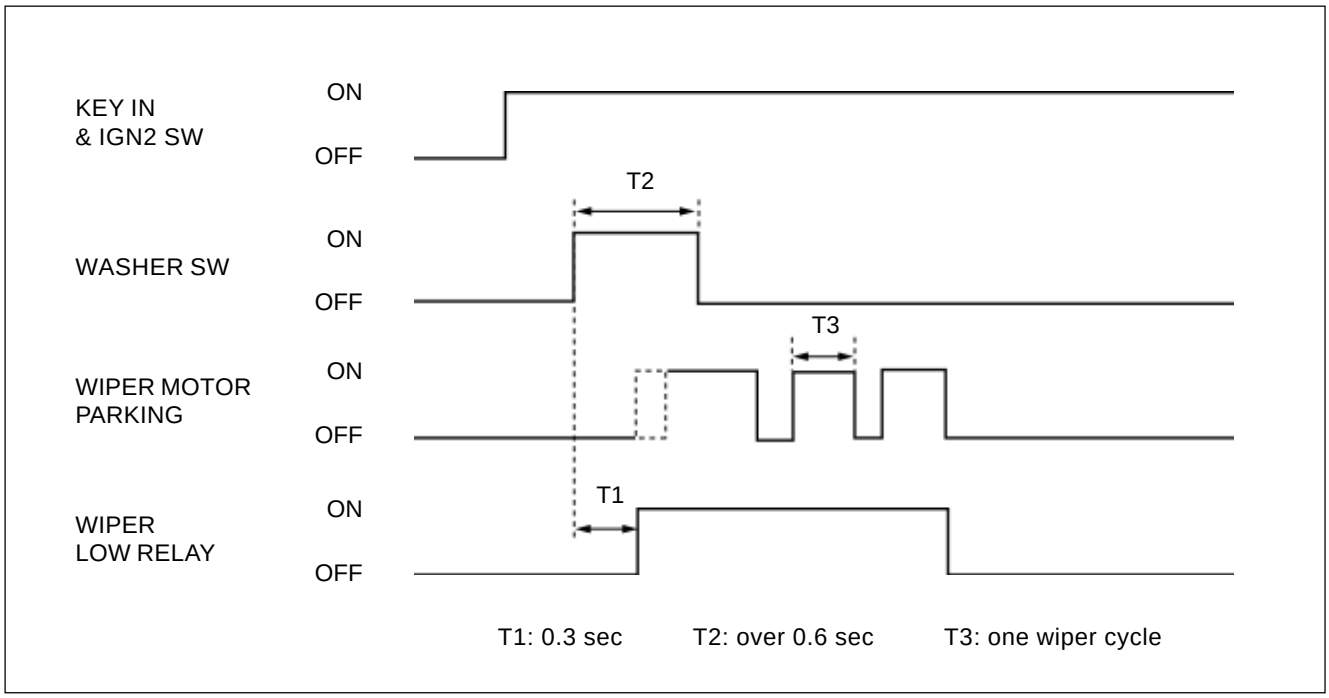
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Wiper MIST and Front Washer Coupled Wiper

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.

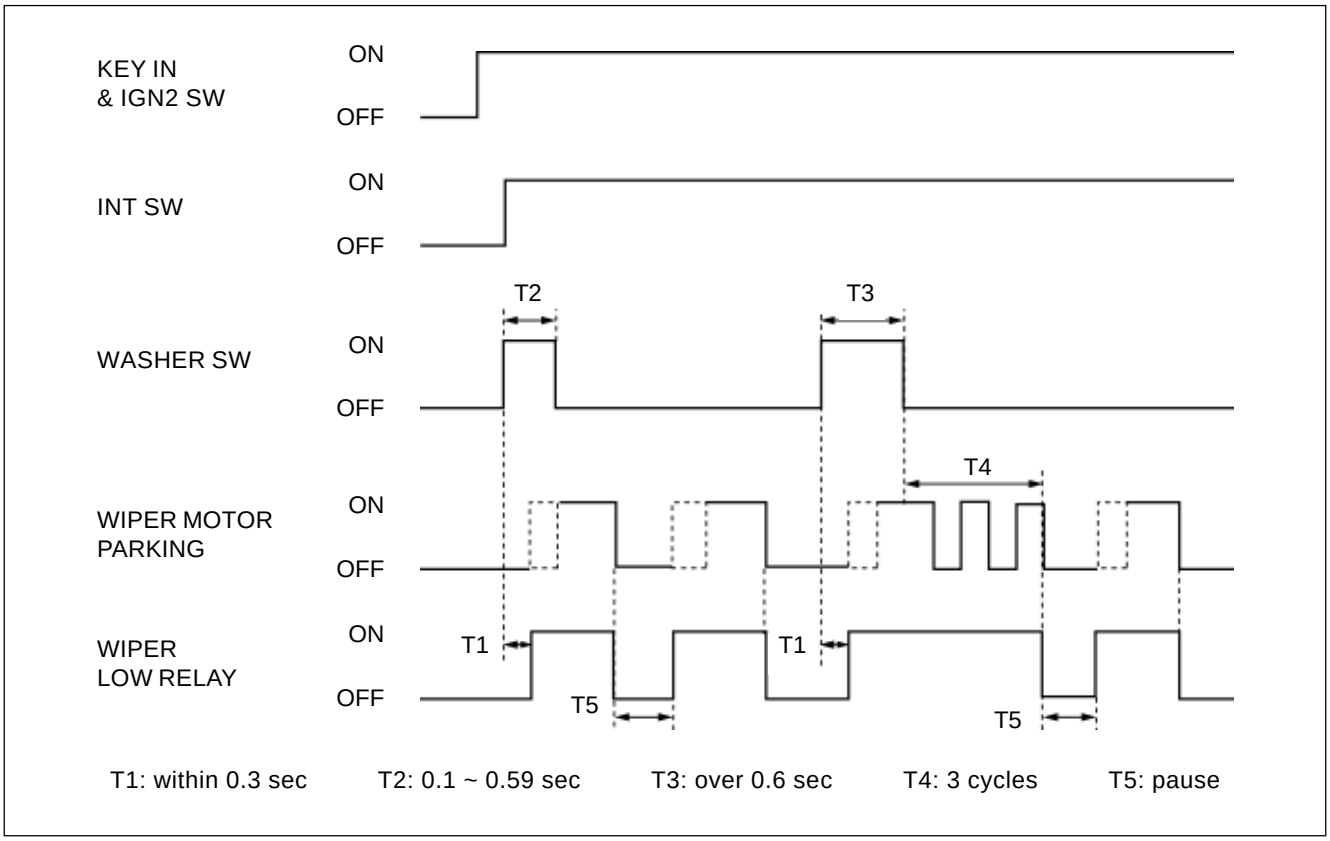


2. The wiper relay is turned on 0.3 seconds after turning “ON” the washer switch over 0.6 seconds with the ignition key “ON”, and it is turned on three times immediately after turning off the washer switch.



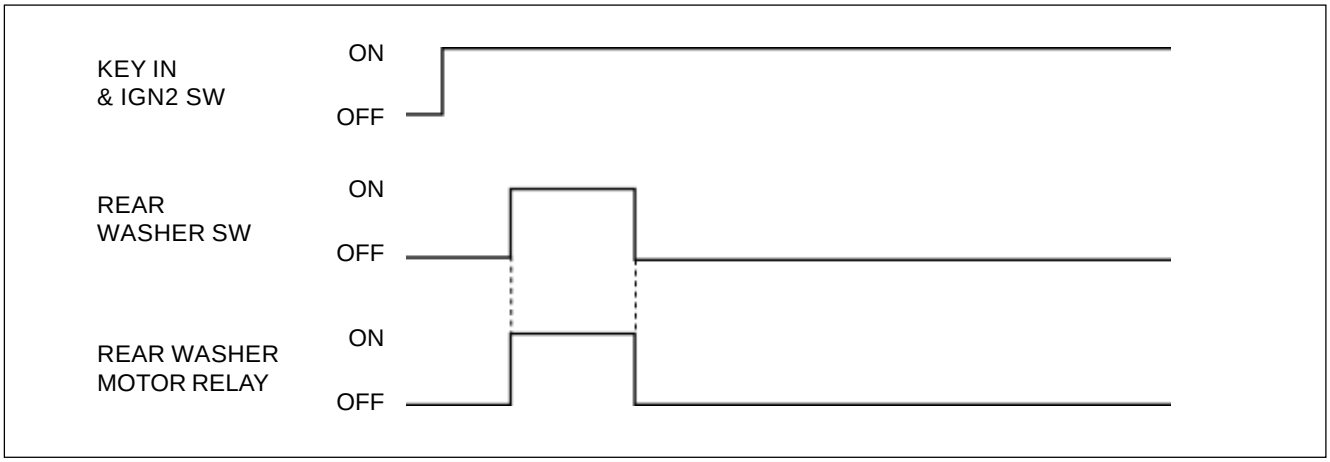
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3. When the washer switch is ON for more than 0.6 seconds during the wiper operation by the INT switch, the operation in step (2) is performed. When it is ON for a certain period of time (0.1 to 0.59 seconds), the operation in step (1) is performed.



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.

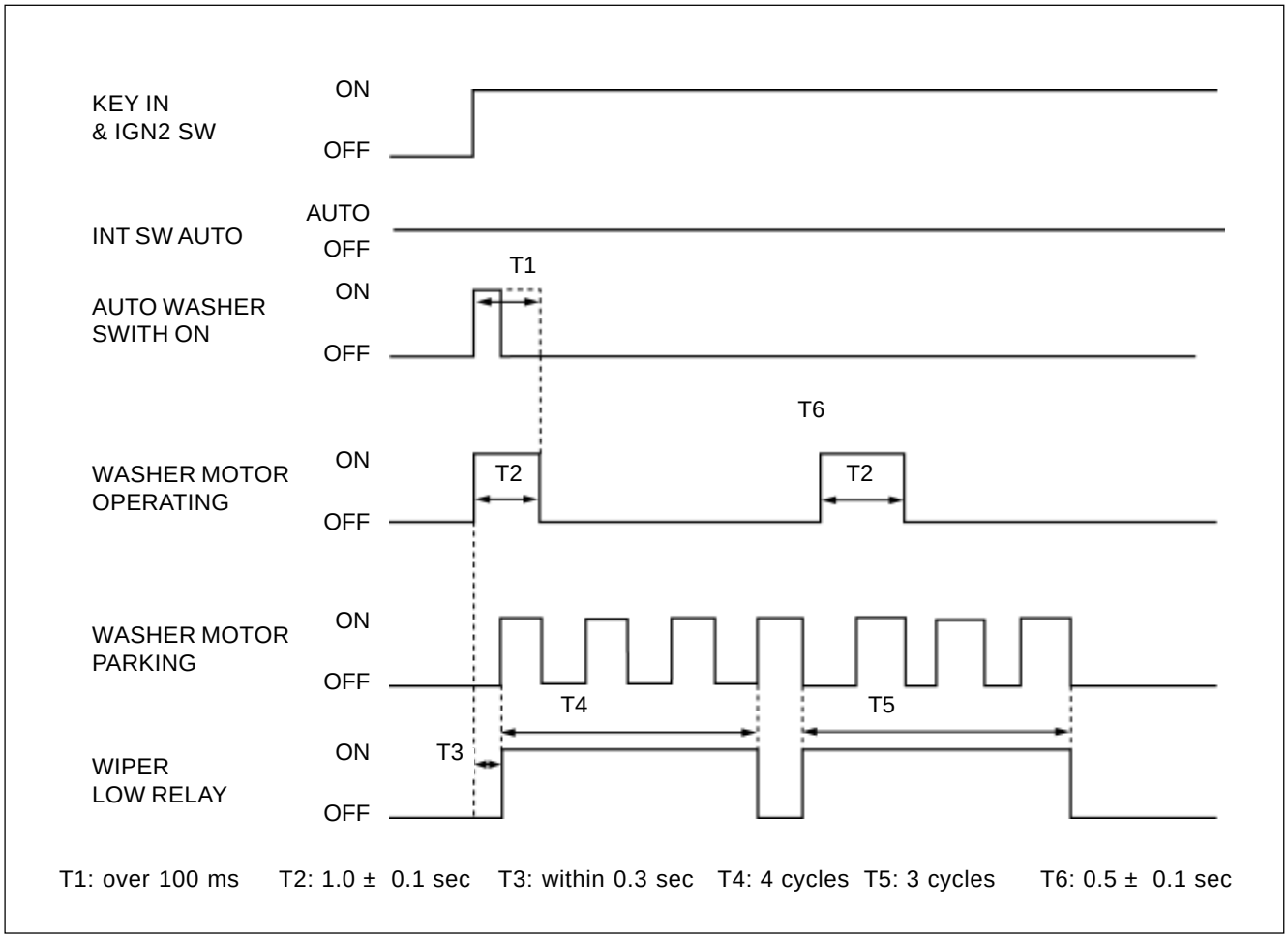


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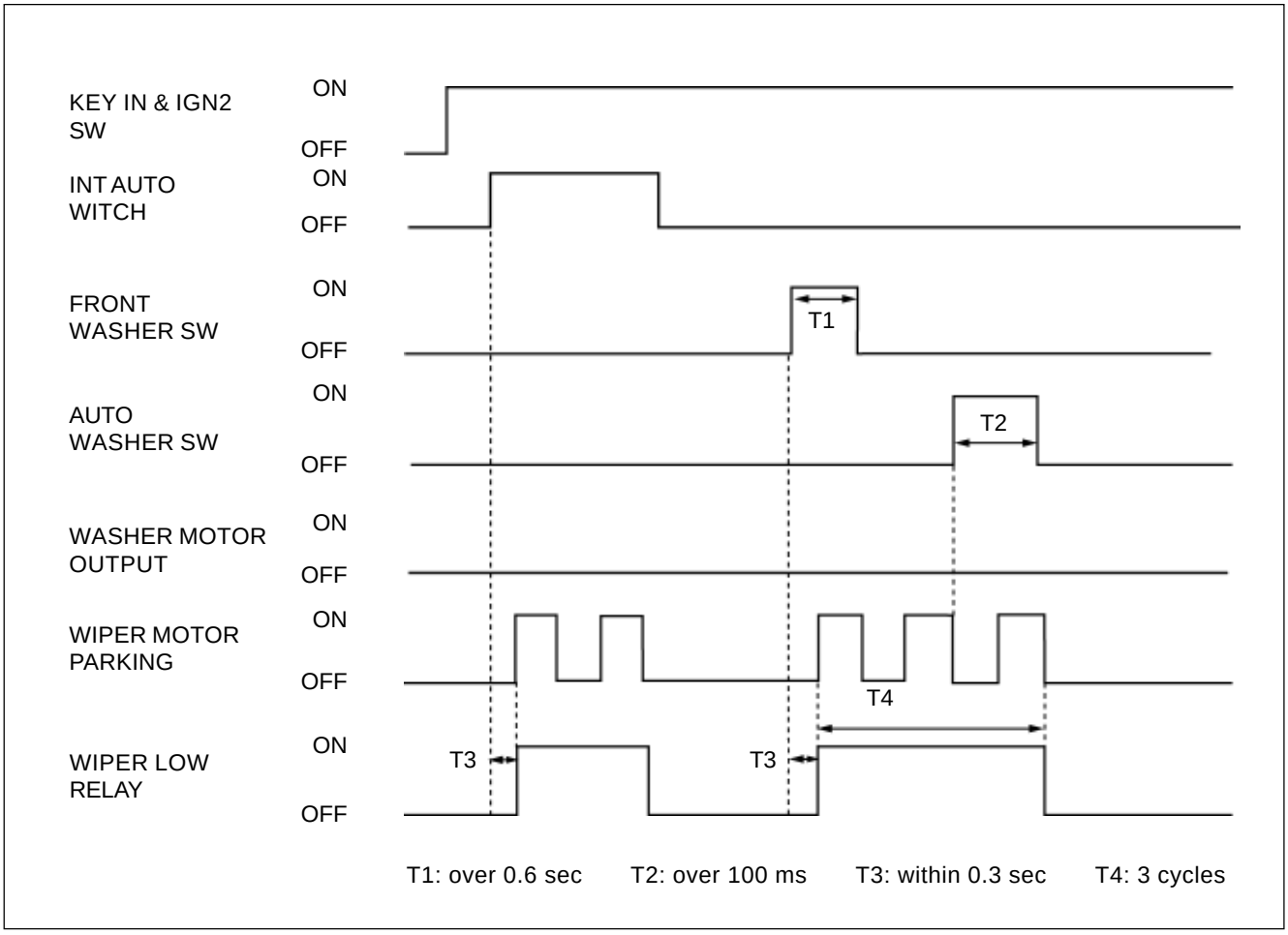
Auto Washer and Wiper Switch (AFW)

1. When the auto washer switch is turned on with the ignition switch “ON” and the INT switch “OFF”, the washer motor output is activated for 1 second. If the system recognizes this output, the wiper relay output is activated during 4 cycles and the washer motor output is activated for 1 second. Then, the wiper relay output is deactivated after 3 cycles.



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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.



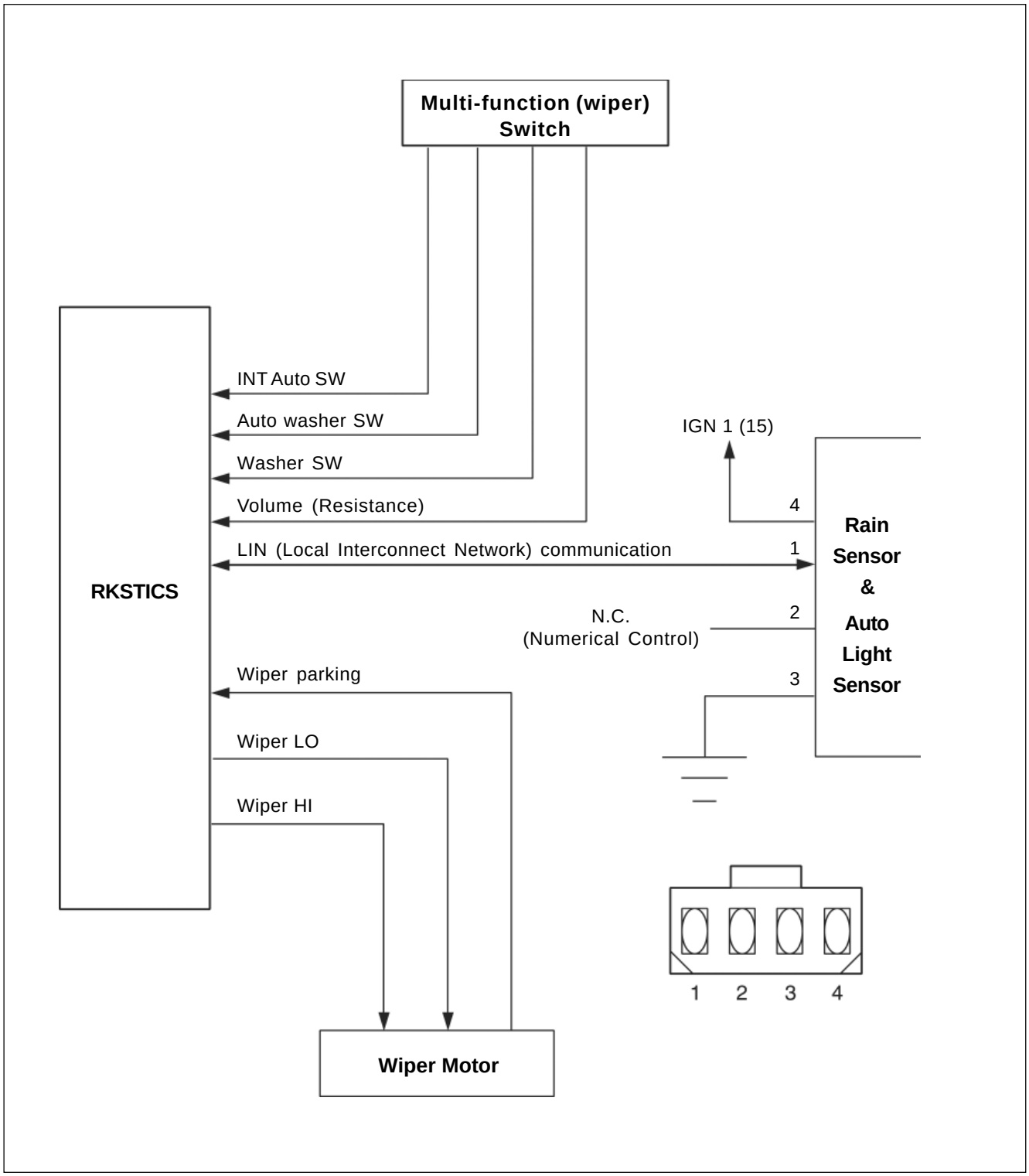
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Rain Sensor Coupled Wiper and Auto Light Control

If equipped with RKSTICS rain sensor, it has following operation system.

System layout

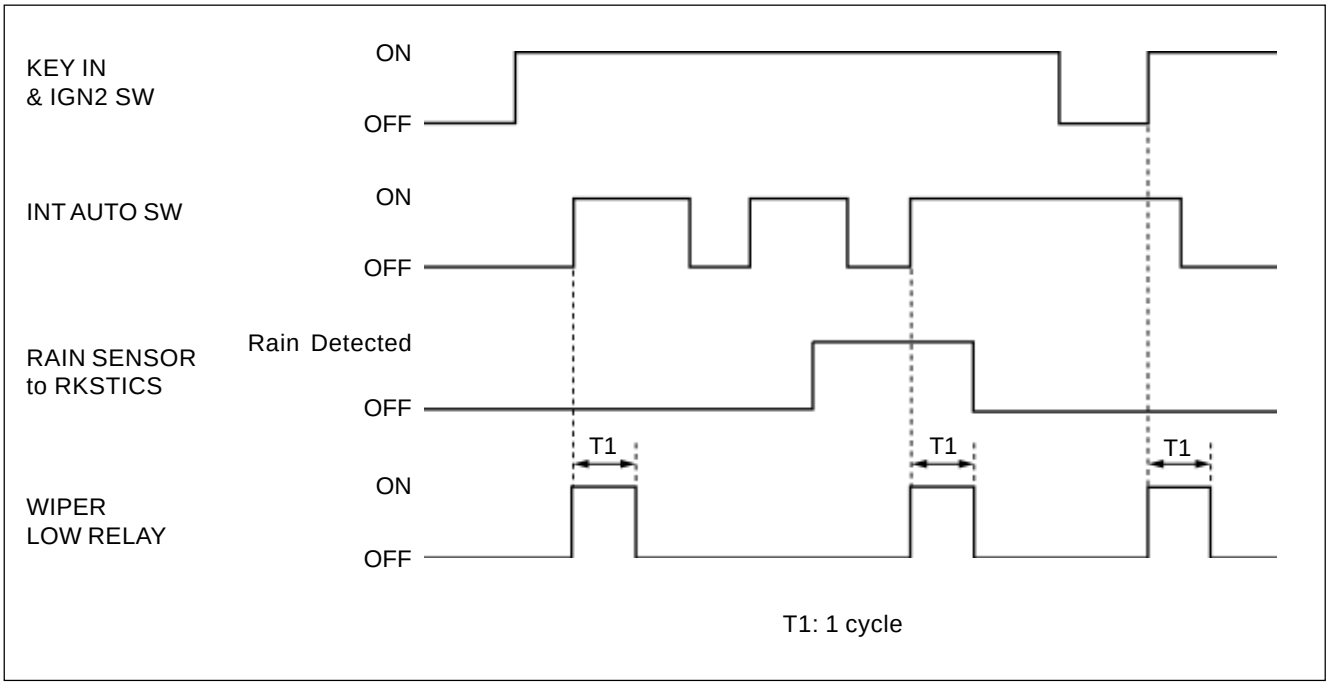


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INT Switch Auto Position Reminder (Power-Up Reminder Wiper)

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



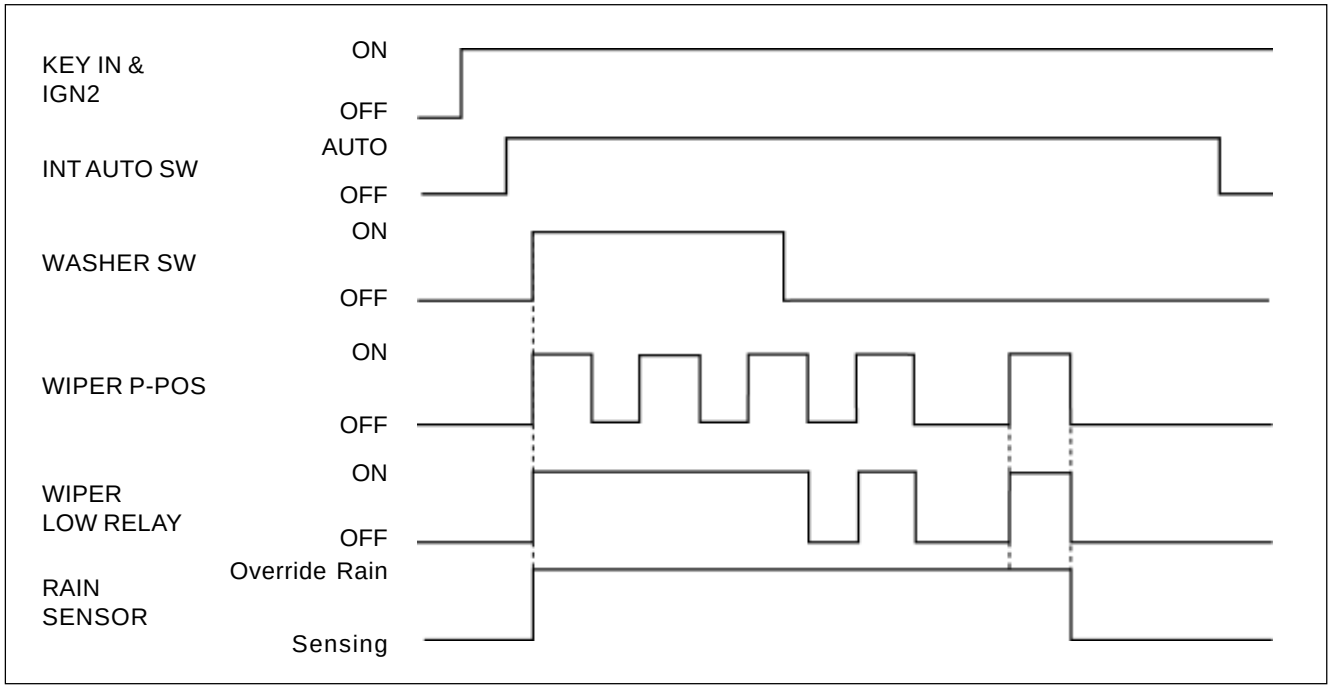
AUTO: Wiper operates automatically by rain sensor

FAST ↔ SLOW: Auto delay/Auto speed control. A position that can control sensitivity against rains in the windshield and transmits wiping demand signal accordingly

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Washer Coupled Wiper in Rain Sensing Mode

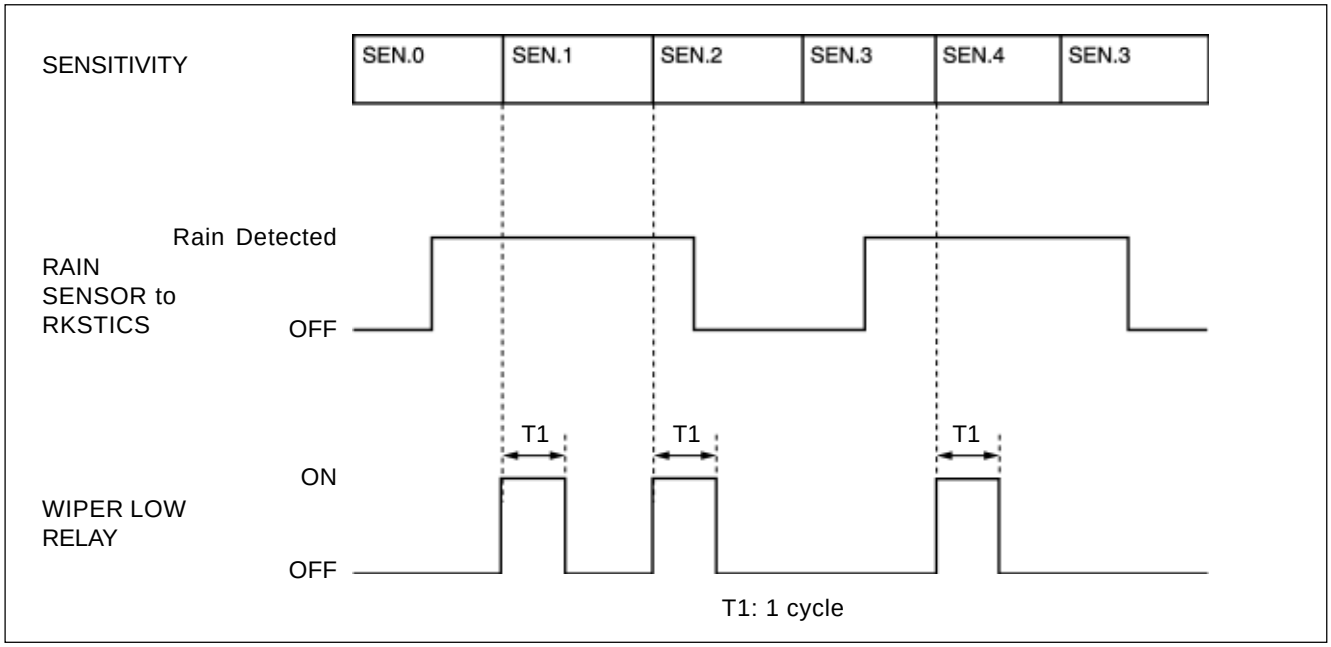
1. The washer coupled wiper is operated when receiving the washer switch input with the ignition switch “ON” and the auto INT switch “ON” in the rain sensing mode. At this moment, the communication with the rain sensor is overridden. However, the washer switch input is overridden during the continuous 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.



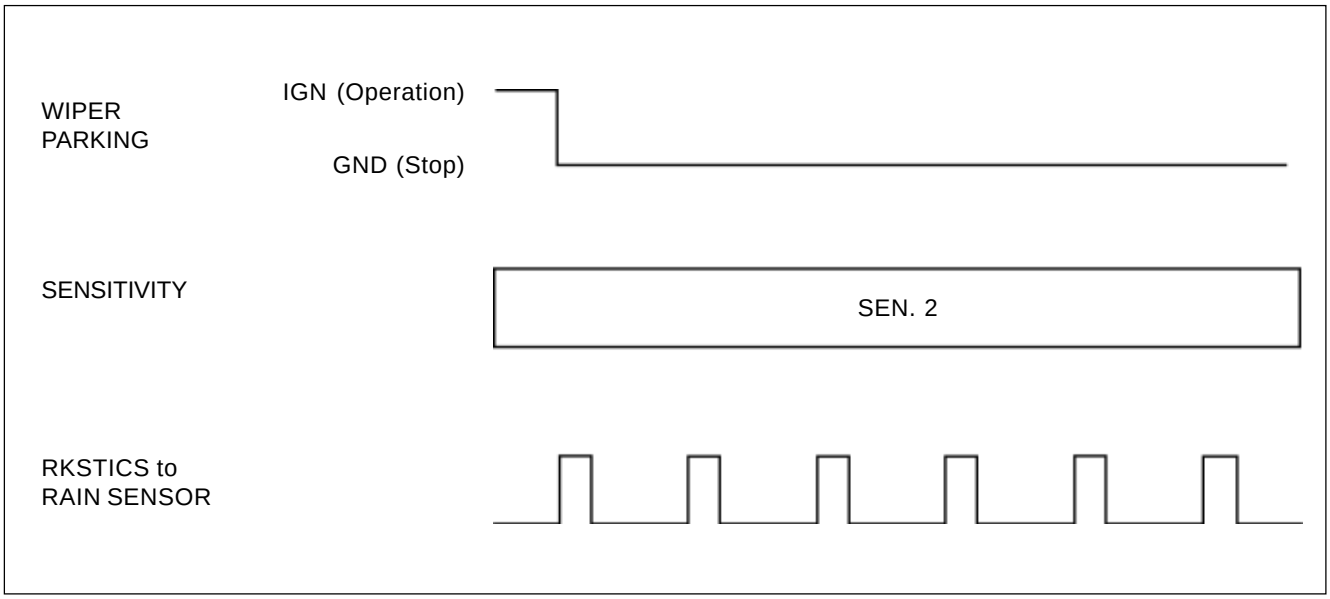
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Wiper Operation When the Wiper Parking Terminal Is Grounded

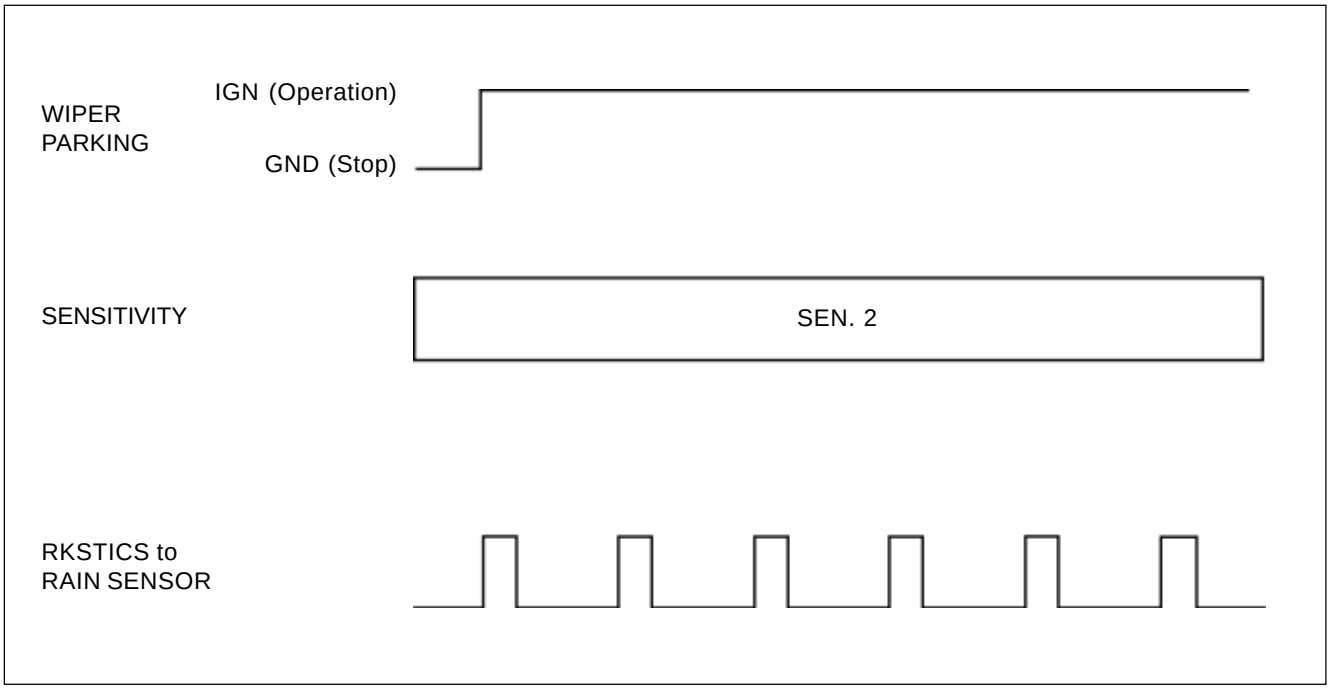
1. The wiper system continuously outputs the parking signal of current sensitivity when the parking terminal is grounded (while the ignition key is in “ON” position and the wiper switch is in “ON” position).

   * The wiper motor runs only when the rain sensor requires.



2. When the parking terminal is fixed to IGN (HIGH), the wiper system outputs the operating signal of current sensitivity for 2 seconds, then continuously outputs the parking signal of current sensitivity.

   * The wiper motor runs only when the rain sensor requires.

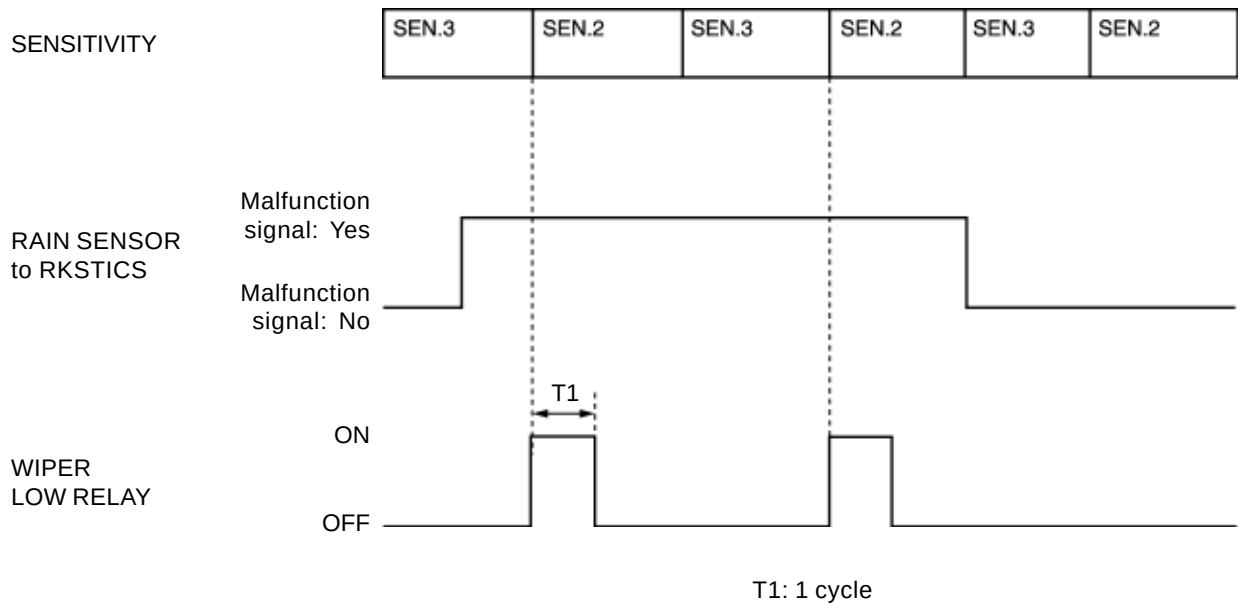


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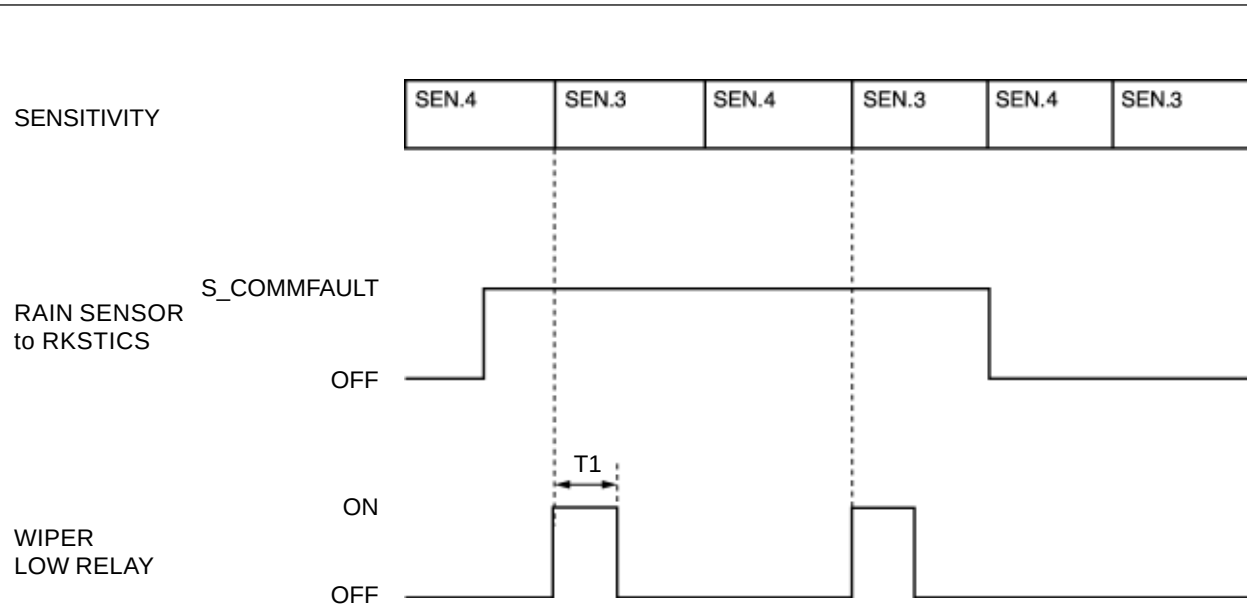
Defective Rain Sensor

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 wiper switch is in “ON” position).



T1: 1 cycle

2. The wiper relay (LOW) 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 wiper switch is in “ON” position).



T1: 1 cycle

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4. 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.**

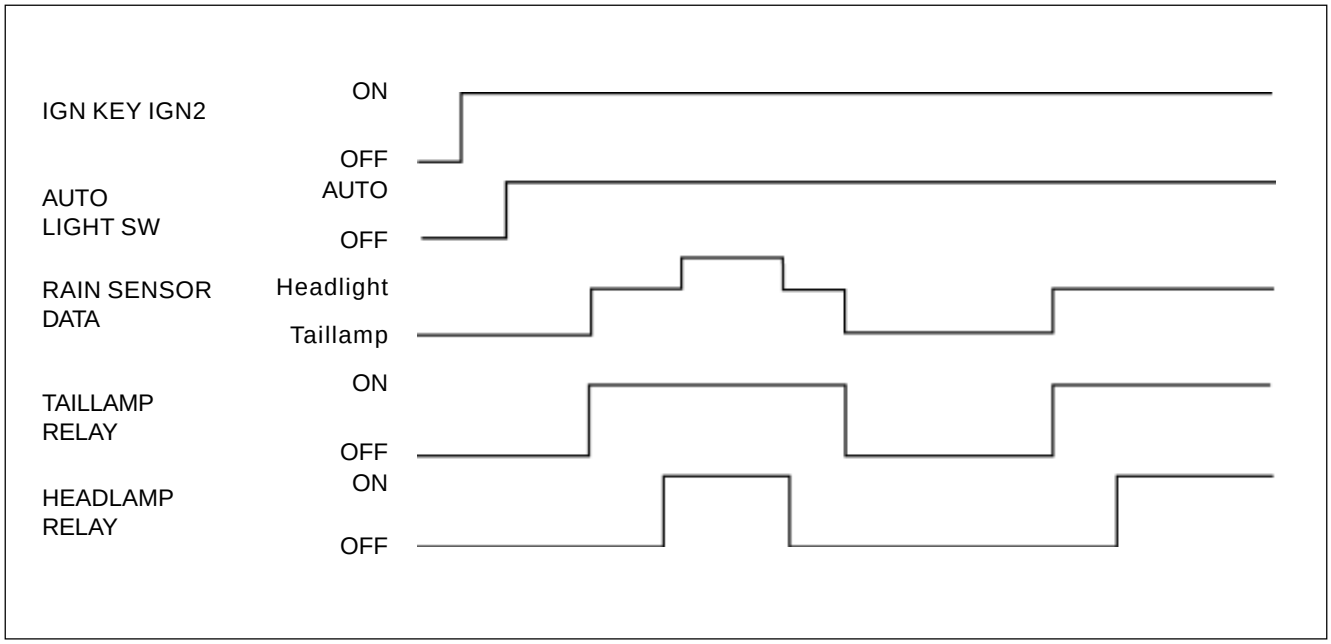
Check whether the variable resistance knob on the wiper switch is set in “FAST" or "SLOW”.

Notify that the customer can select the sensitivity by selecting the variable resistance value. And, select a proper stage.

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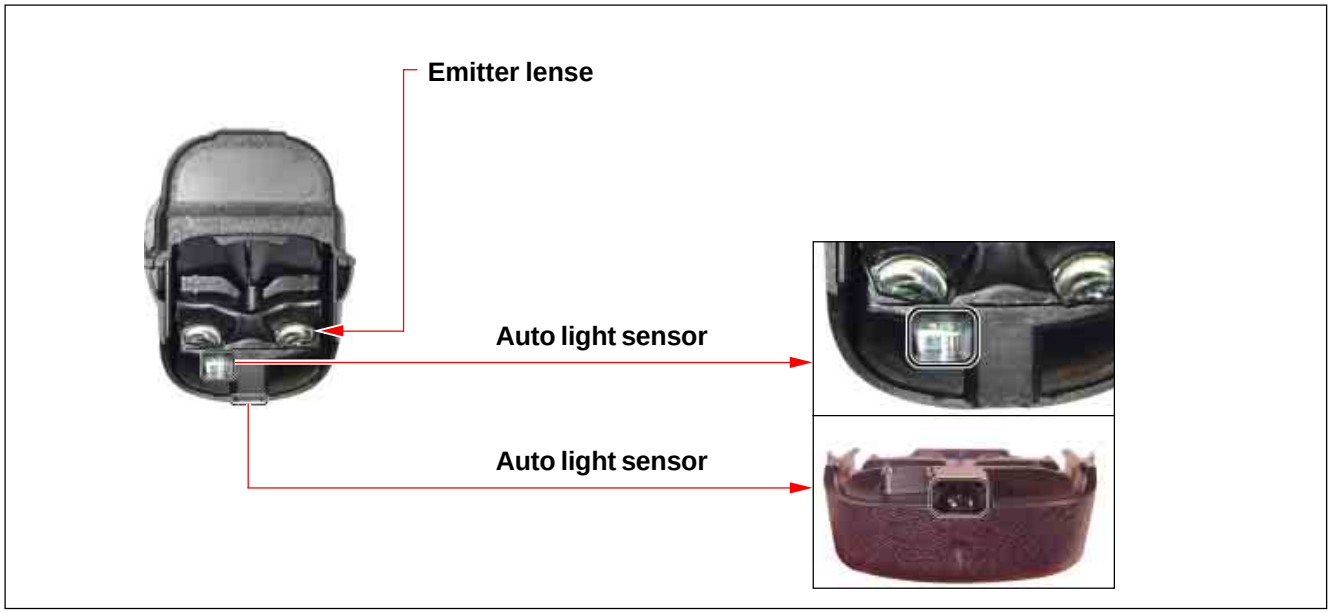
Auto Light Control

1. The tail lamps and headlamps can be controlled with the communication with the rain sensor only when the auto light switch is in the “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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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

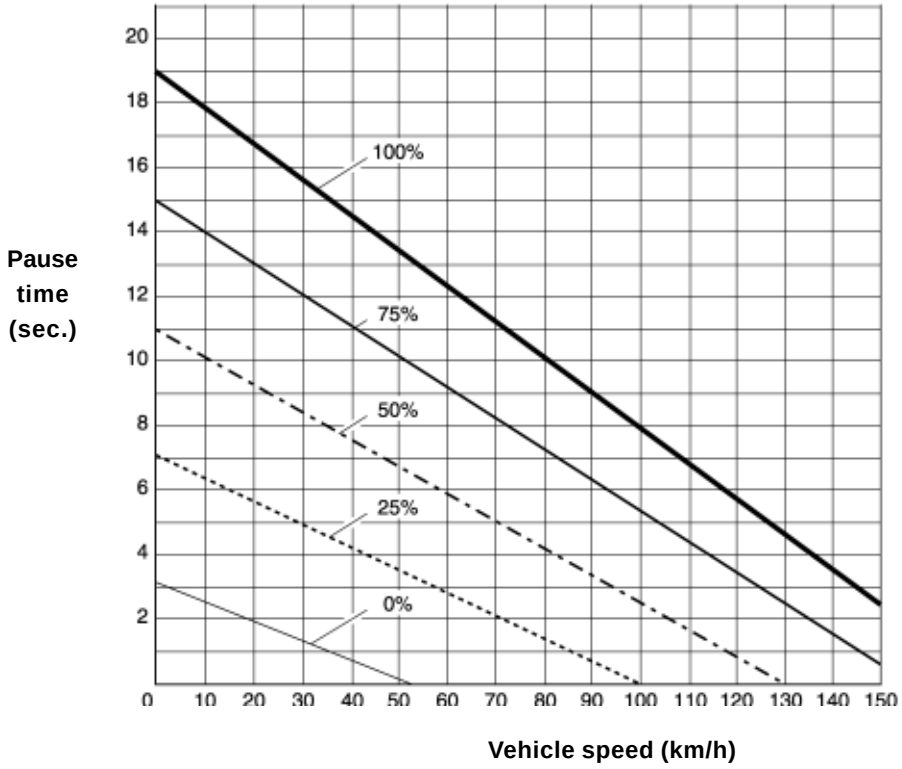
   The pause time of the vehicle speed sensitive INT wiper is calculated by the INT volume (input voltage). Each level has the hysteresis.

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.

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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

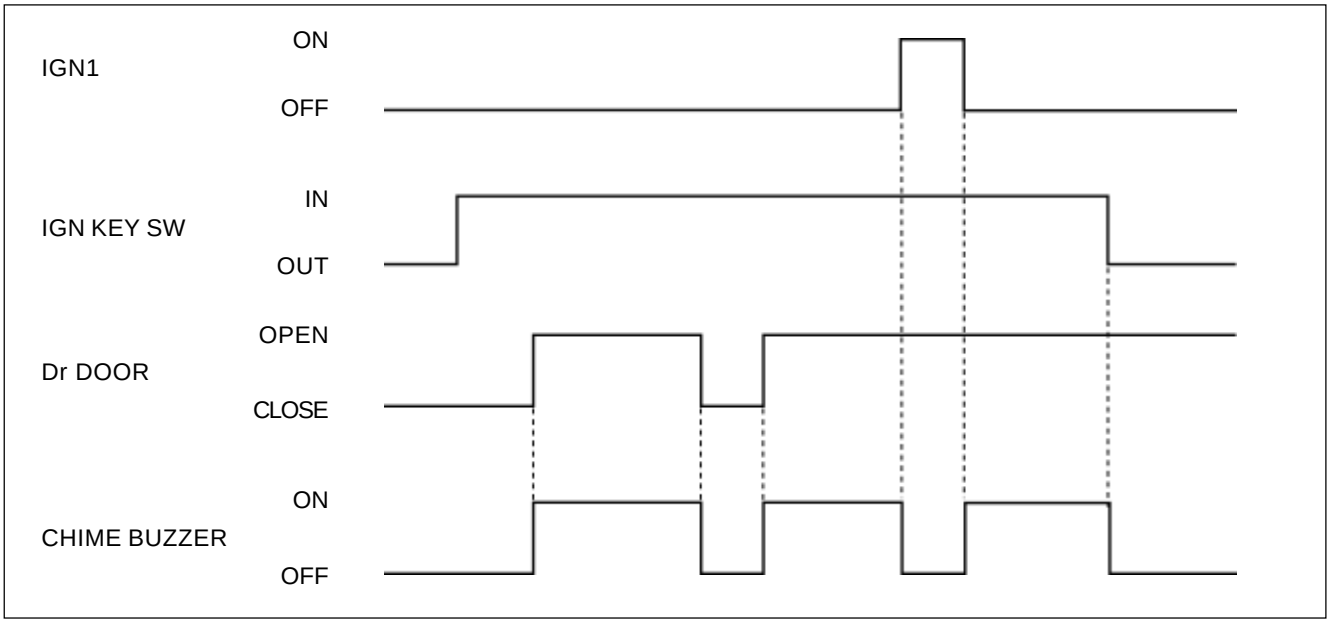
- **Speed sensitive INT (intermittent) wiper**
  1) **The wiper relay continues to output for remaining “ON” time even when the INT switch is turned off.**
  2) **IGN 2 switch “ON”, INT switch “OFF”: Resume the intermittent time when turning “ON”**
  3) **IGN 2 switch “OFF”, INT switch “ON”: Resume the 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.)**

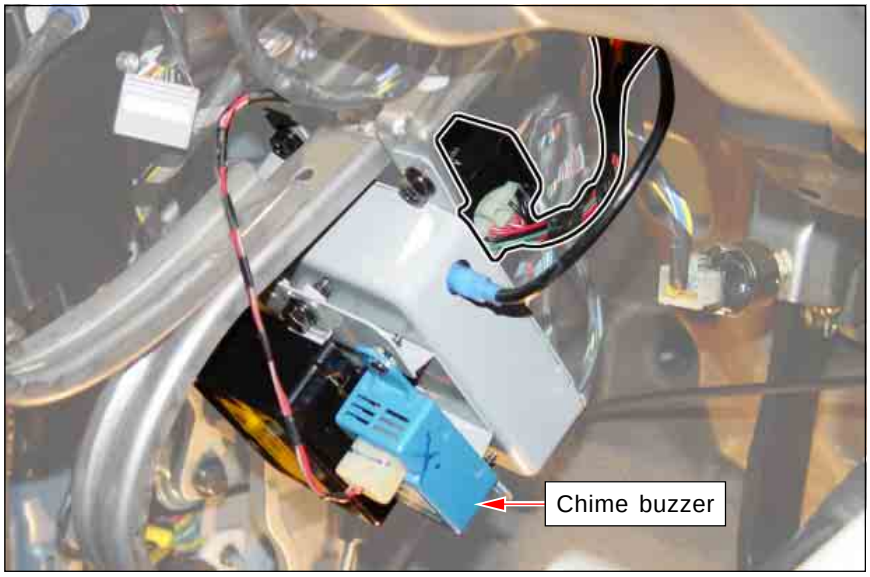
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Ignition Key Reminder Warning

(The ignition key reminder warning has priority over the "TAILLAMP ON WARNING".)

1. The chime buzzer output in the ICM box continues when opening the driver's door while the ignition key is inserted the into ignition switch.
2. When removing the ignition key or closing the driver's door during chime buzzer output, the output turns off.
3. This function is not available when the ignition switch is "ON".

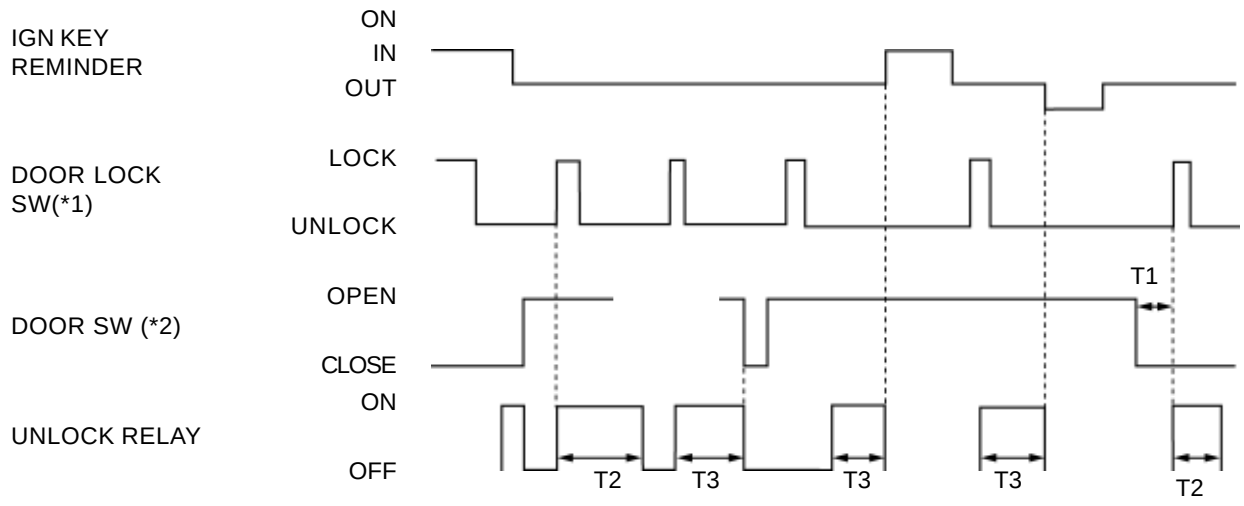




Ignition Key Reminder

1. The system outputs "UNLOCK" 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" 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 UNLOCK output should be unconditionally activated. However, if the ignition key is removed after the door lock switch is changed from UNLOCK to LOCK, the UNLOCK output is not activated.

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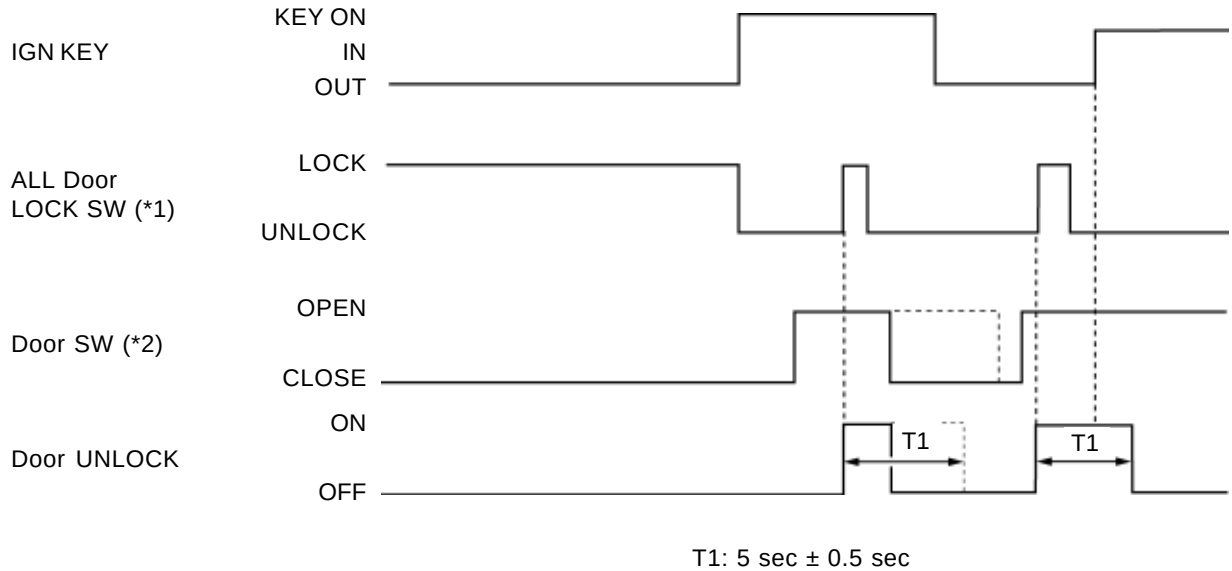


T1: within 0.5 sec T2: 5.0 sec T3: OFF during T2 output

(*1): Driver's door is opened and driver's door lock switch is turned to LOCK,
(*2): Driver's door is opened and passenger's door lock switch is turned to LOCK

All Door Lock Prevention Function when a Door is Opened

1. All doors, except the tailgate and hood, output "UNLOCK" for 5 seconds when the "LOCK" signal is inputted (while the ignition key is removed and one of doors is opened).
2. When the door is closed during the unlock output for 5 seconds, the unlock output stops.
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

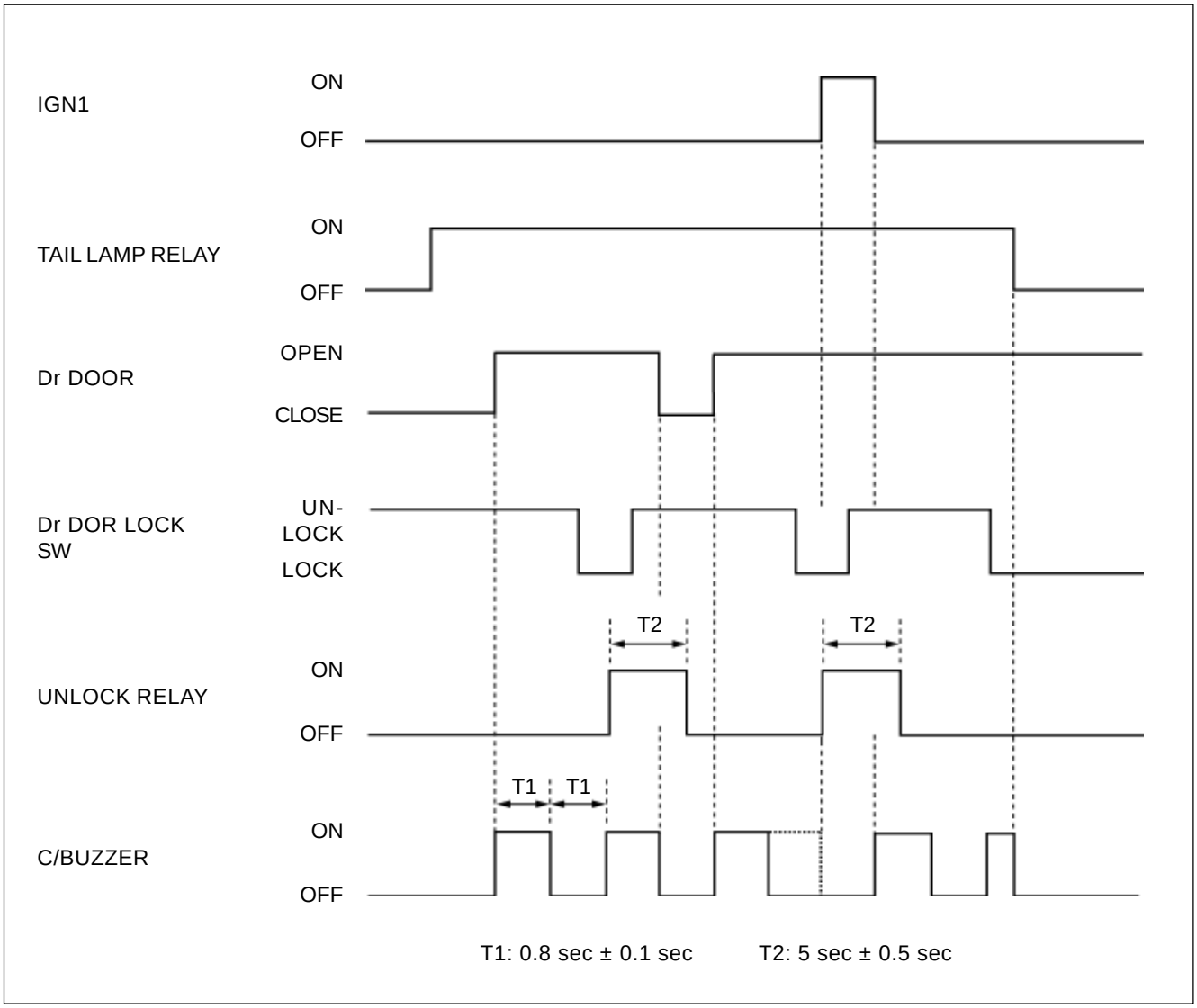
(*1) DR & PS & RR DOOR LOCK SW & T/GATE LOCK SW, (*2) DR or PS or RR DOOR SW

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Mark Lamp Left on Warning

1. The chime buzzer in the ICM box 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" 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.

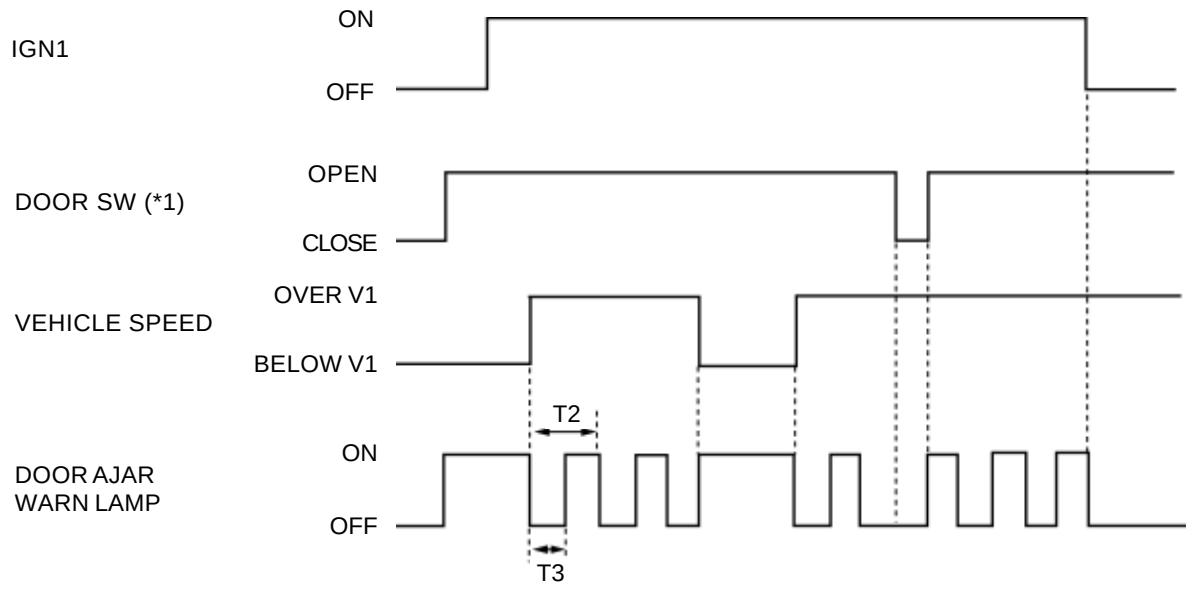


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Door Ajar Warning

1. The warning light in indicator display comes on when opening any of the driver's door, the passenger's door, the rear doors or the 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 is below 10 km/h under step 3.



T2: 0.6 sec T3: 0.3 sec V1 = 10 Km/h

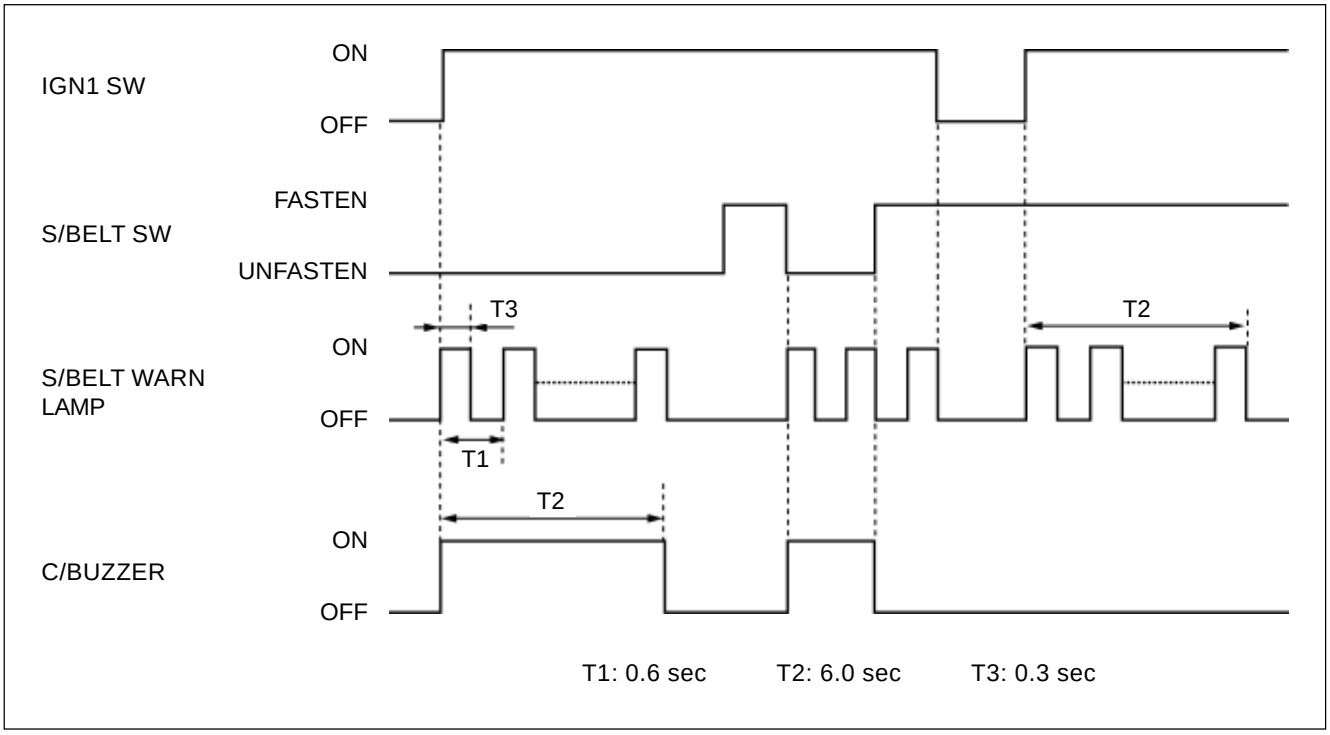
(*1) DOOR OPEN: Dr or Ps or Rr or T/GATE = OPEN
CLOSE: Dr & Ps &r Rr & T/GATE = CLOSE

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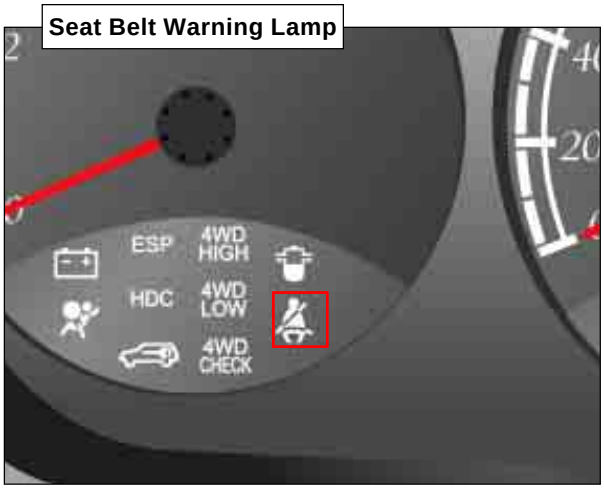
Seat Belt Warning

1. The seat belt warning light comes on and the chime buzzer in the ICM box sounds for 6 seconds when turning the ignition key to “ON” from “OFF”.

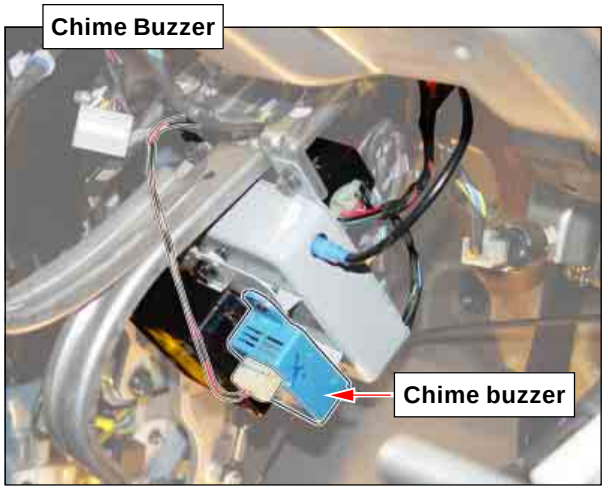
   If the seat belt is fastened before turning the ignition key to the the “ON” position, the warning light in the indicator display blinks, however, the chime buzzer does not sound.
2. The seat belt warning light goes off and the chime buzzer in the ICM box stops when turning the ignition switch to the “OFF” position.
3. The chime buzzer stops and the seat belt warning light stays on for the specified duration 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 the “ON” position.



Seat Belt Warning Lamp



Chime Buzzer

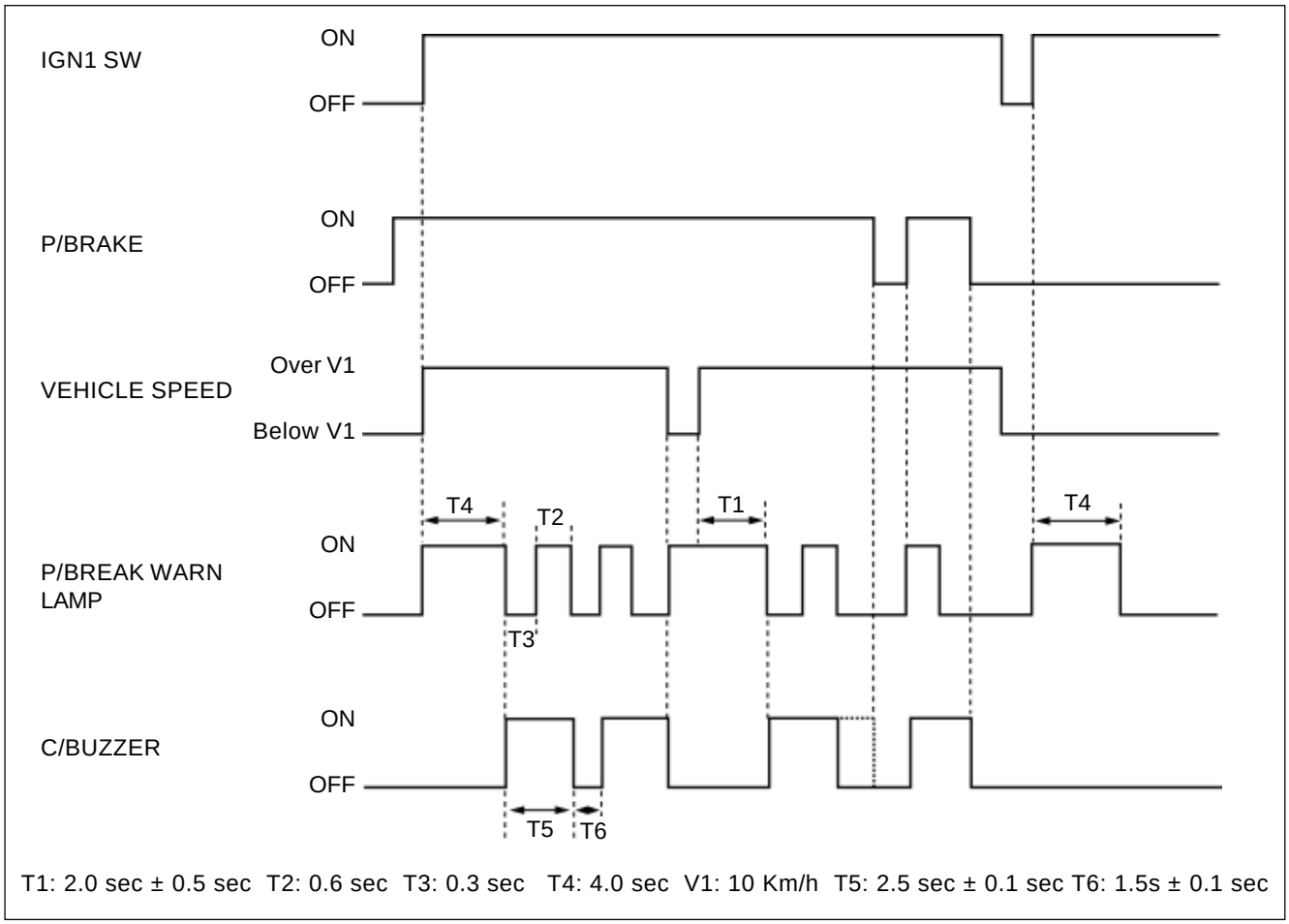


The seat belt warning light comes on and the chime buzzer in the ICM box sounds for 6 seconds when turning the ignition key to “ON” from “OFF”. After fastening the seat belt, the chime buzzer stops.

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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

Parking Brake: Hand operated type (manual transmission equipped vehicle), Foot operated type (automatic transmission equipped vehicle)



Hand Operated Type
(Manual Transmission Equipped Vehicle)



Foot Operated Type
(Automatic Transmission Equipped Vehicle)

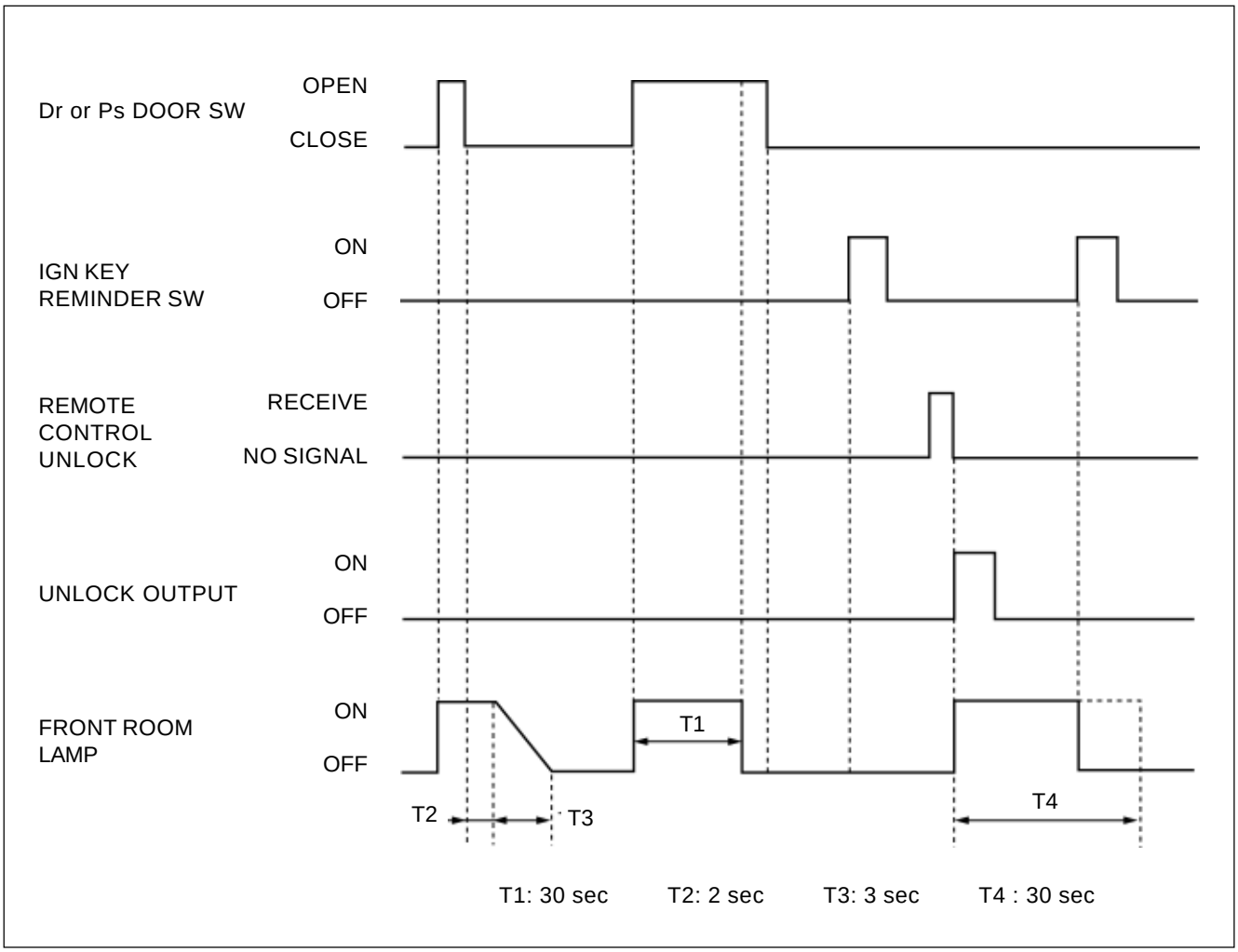
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Center/Luggage Room Lamp Control

The overhead console lamp (front room lamp) and the center room lamp come on when opening the door while the center/luggage room lamp switch is at the coupled operating position and the key reminder switch is “OFF”.

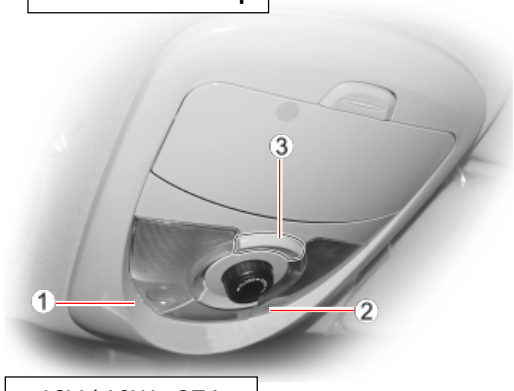
1. When the door (Driver’s/Passenger’s/Rear) is opened, the front and center room lamps come on and automatically go off after 30 seconds.
2. The room lamp stays on for 2 seconds and then decays through 3 seconds when closing the driver’s door, passenger’s door or rear doors.
3. The decaying operation must have greater than 32 steps per one second.
4. The room lamp output should stop immediately after turning on the ignition key during the decaying 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 door is 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 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 opening the tailgate while the tailgate coupled luggage room lamp switch is pressed.



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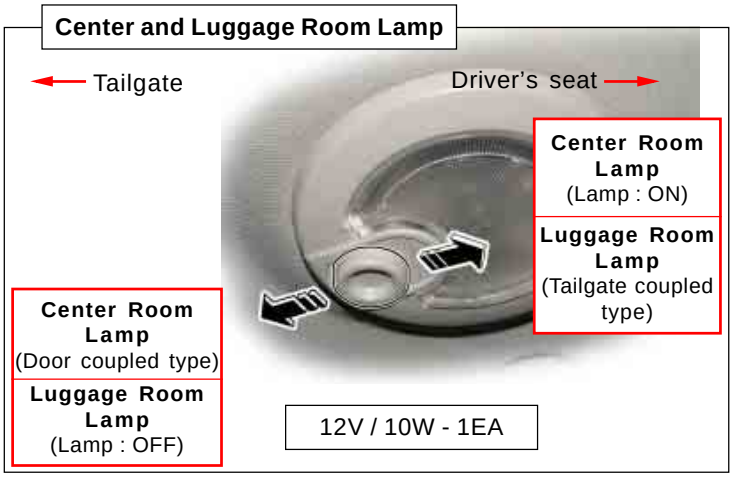
Front Room Lamp



12V / 10W - 2EA

Front room lamp (driver's or passenger's) is turned on and off when pressing in this switch (1 or 2). However, it comes on when the door is open 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 and Luggage Room Lamp



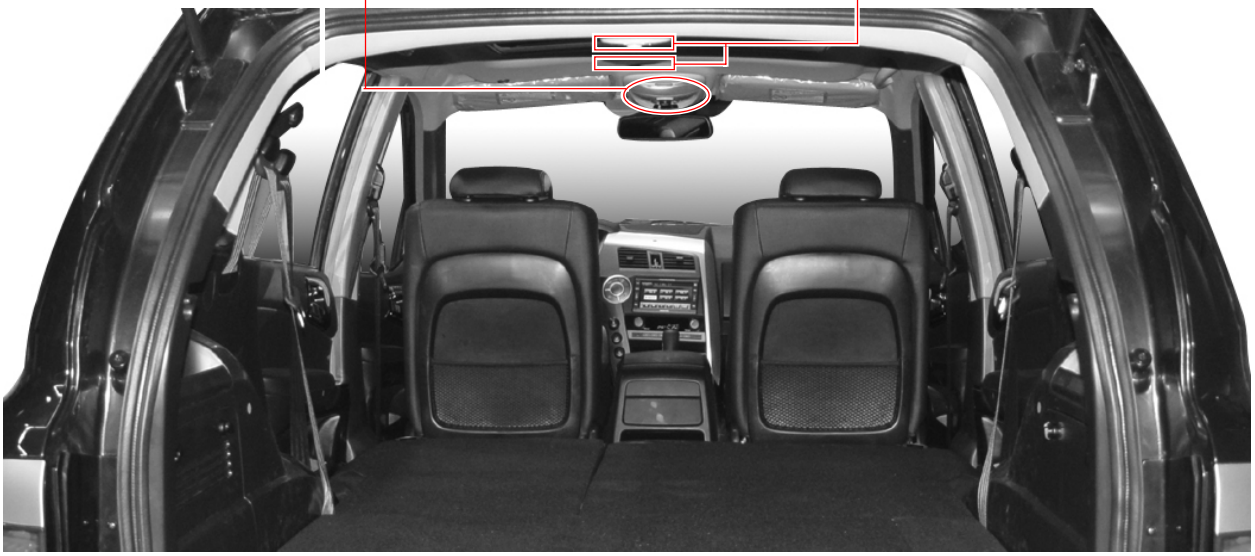
12V / 10W - 1EA

Center Room Lamp

The center room lamp comes on while the switch is at the door coupled position when the door is open. The lamp always comes on while the switch is at the other position.

Luggage Room Lamp

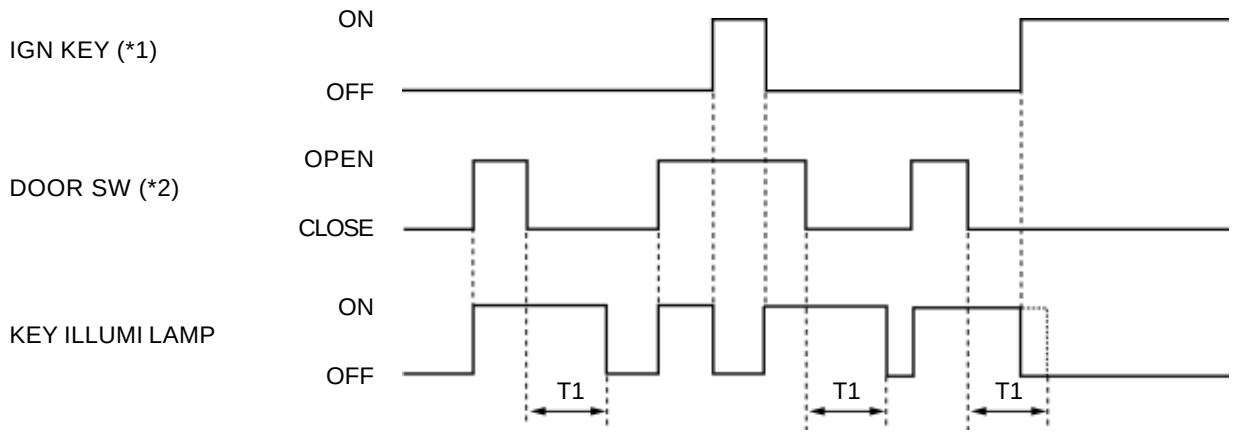
The luggage room lamp comes only when the tail-gate is open while the switch is at the tailgate coupled position.



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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 key is removed.
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 the "ON" position.
4. The output stops when receiving the lock signal from the remote control key (under armed mode).



T1 : 10 sec

(*1) ON : IGN KEY = ON
OFF : IGN KEY = OFF

(*2) OPEN : Dr or Ps DOOR = OPEN
CLOSE : Dr & Ps DOOR = CLOSE

Key cylinder with key hole illumination

For diesel and gasoline engine equipped vehicle



Without immobilizer
→With key hole illumination

For diesel engine equipped vehicle



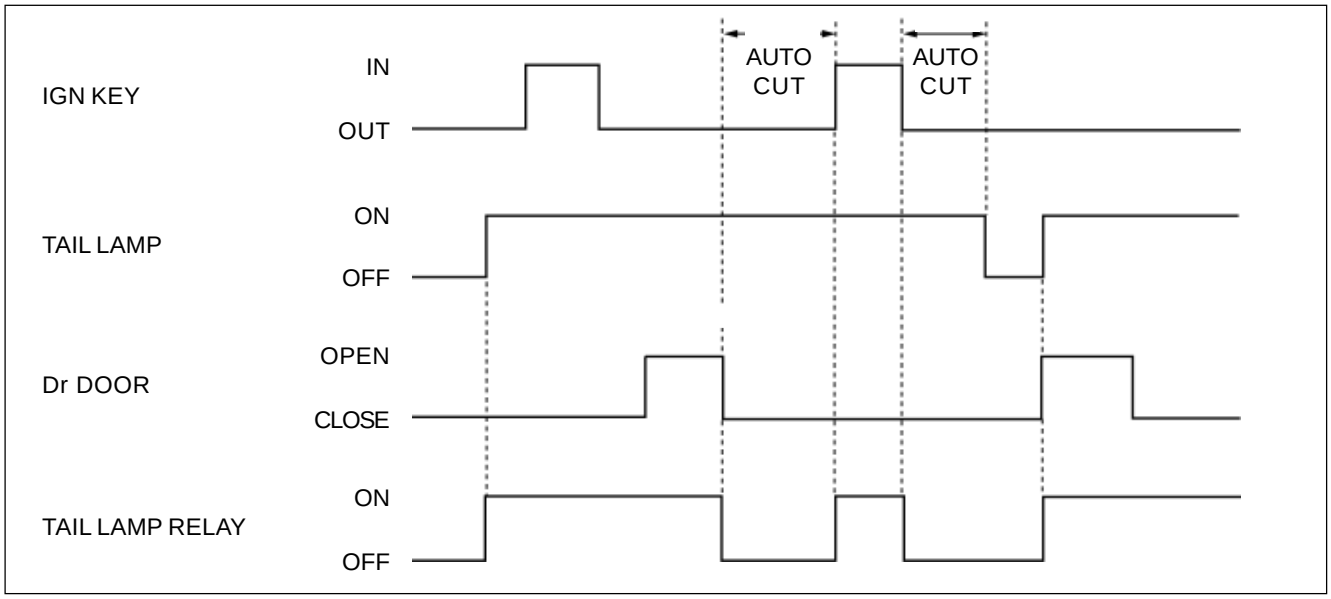
With immobilizer
→With key hole illumination

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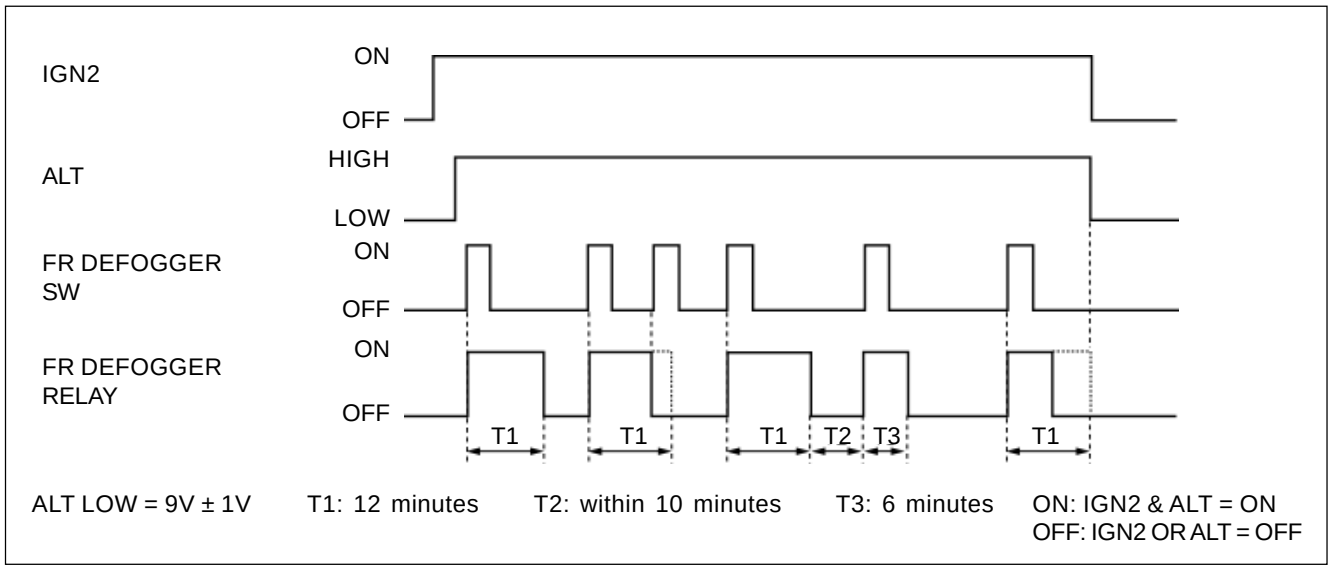
Battery Saver (Tail Lamp Auto Cut)

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.



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”.

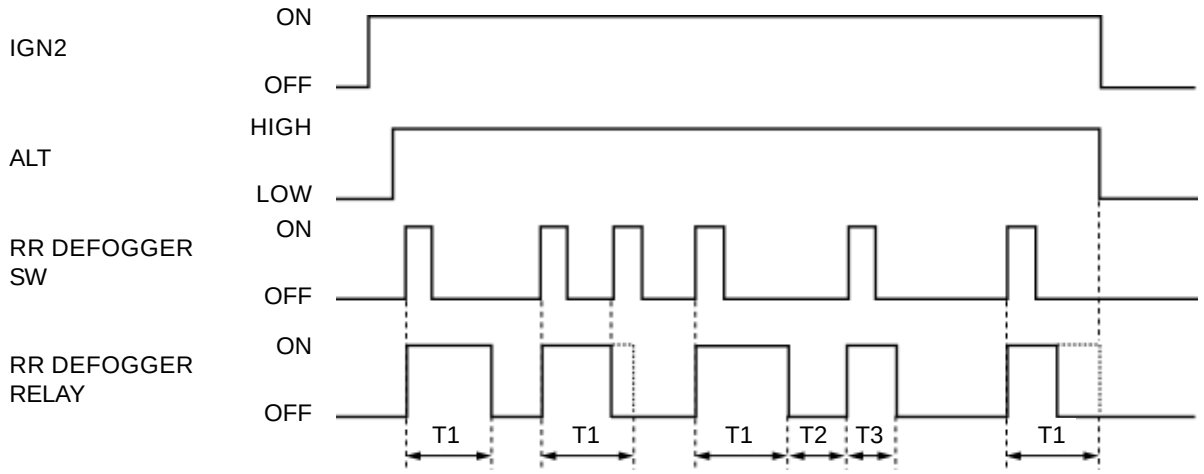


ALT LOW = 9V ± 1V T1: 12 minutes T2: within 10 minutes T3: 6 minutes ON: IGN2 & ALT = ON OFF: IGN2 OR ALT = OFF

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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



Tailgate and outside rearview mirror heated glass switch

Press this switch to turn on the tailgate and the outside rearview mirror heated glass. It will operate for about 12 minutes.

Windshield heated glass switch

Press this switch to turn on the windshield heated glass. It will operate for about 12 minutes.

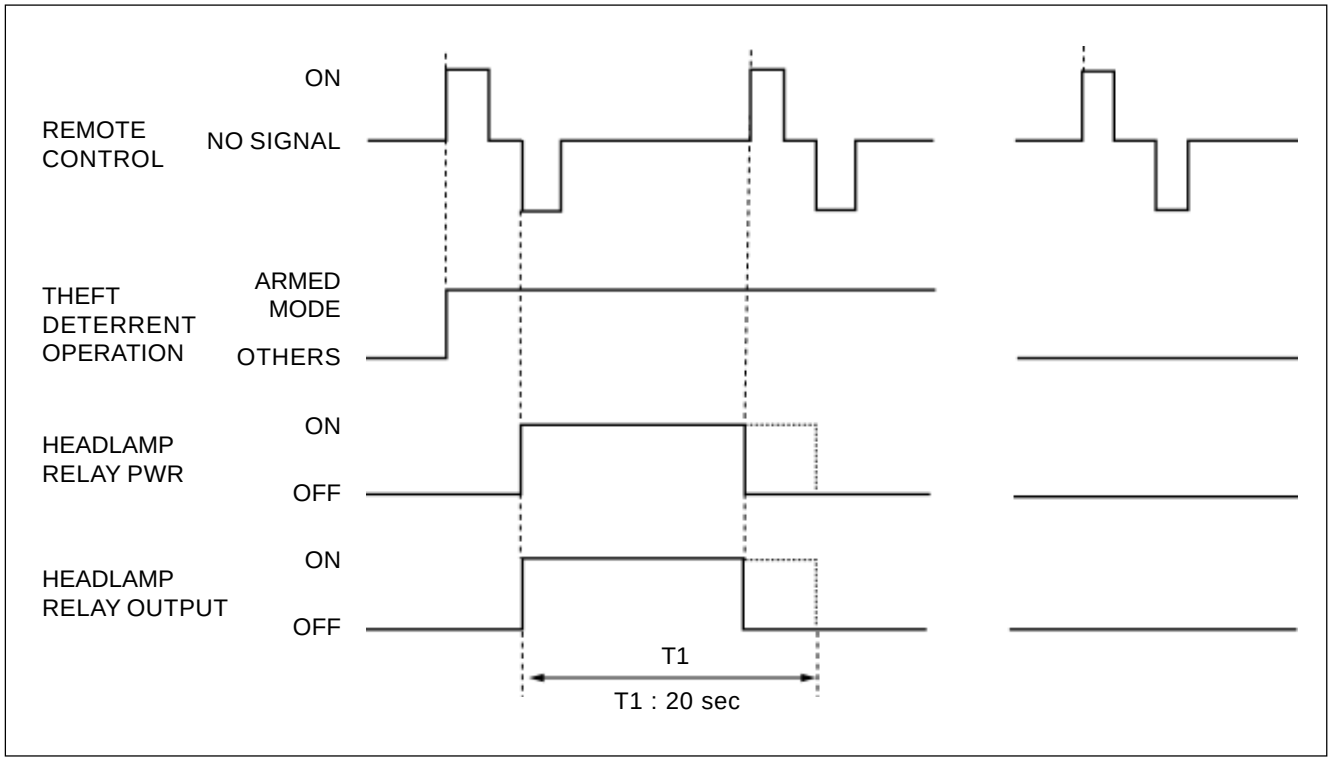
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Headlamp Control

1. When the system receives the remote control key after receiving the LOCK signal (theft deterrent mode) with the ignition switch “OFF”, it supplies the power to the headlamp relay to turn on the headlamp (turned off after 20 seconds).
2. The output is “OFF” when receiving the “LOCK” signal from the remote control key while outputting the headlamp relay.

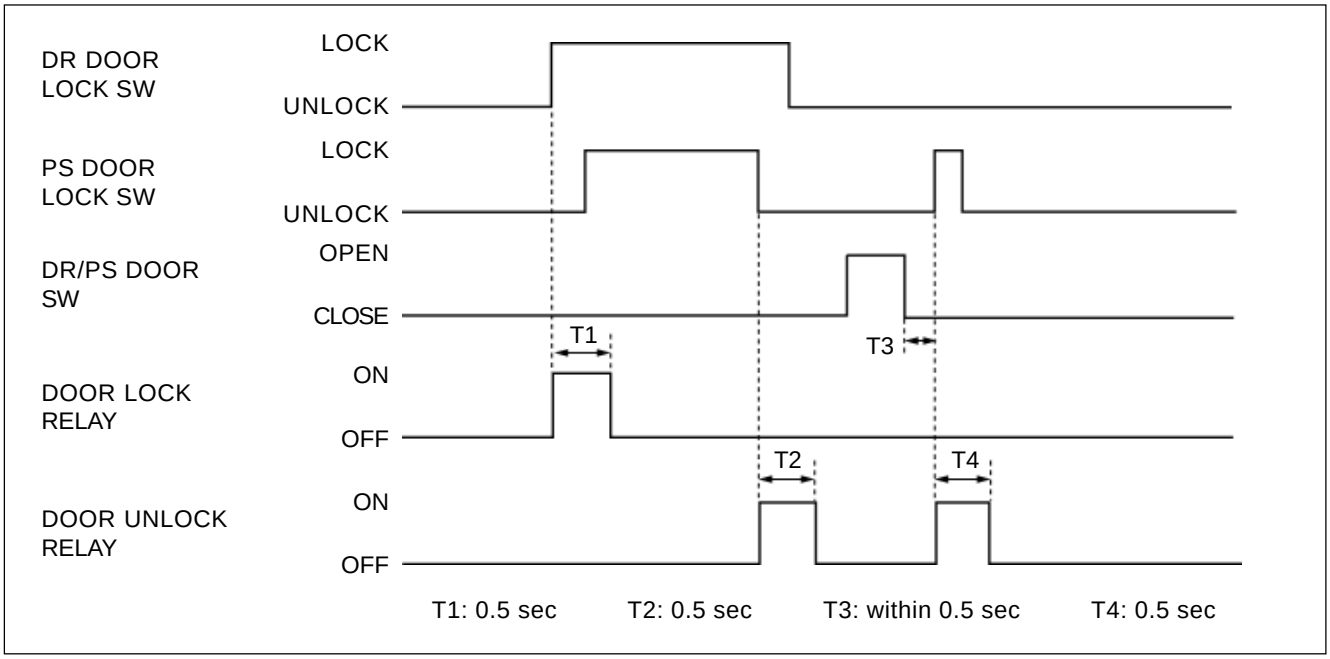
   However, other signals other than “LOCK” are overridden.
3. The output is “OFF” when inserting the ignition key and turning it to the “ON” position while outputting the headlamp relay.



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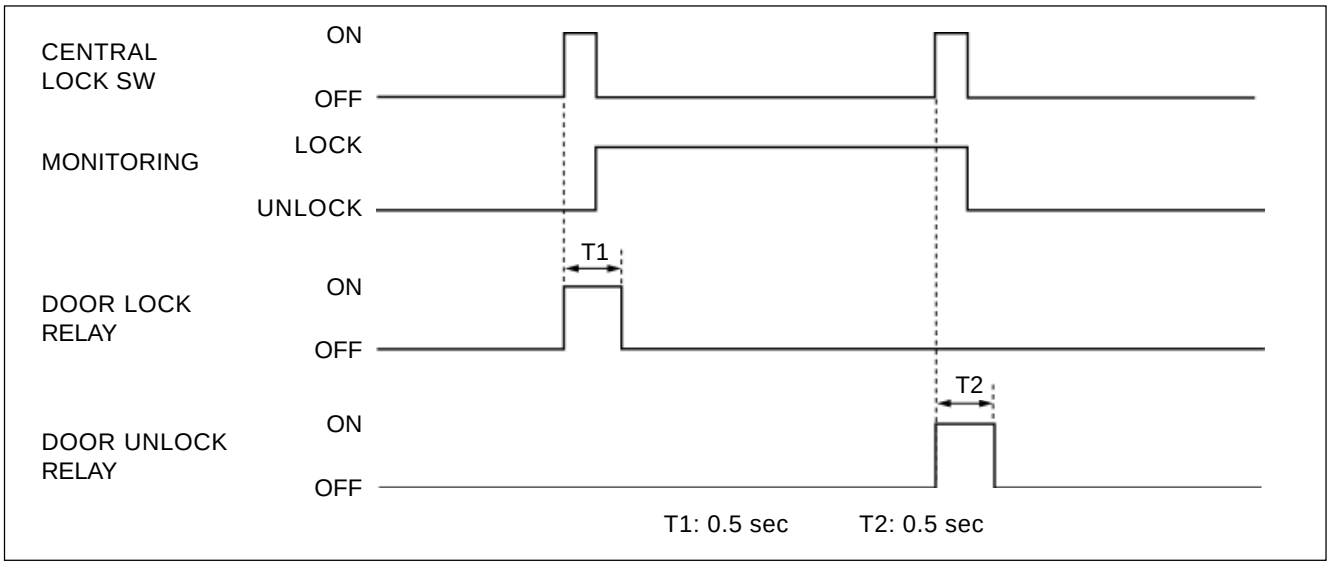
Door Lock/Unlock Control by Door Lock Switch

1. The door lock system outputs “LOCK” 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” 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” 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.



Door Lock/Unlock by Central Door Lock Switch

1. The door lock system outputs “LOCK/UNLOCK” 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 armed mode are ignored.

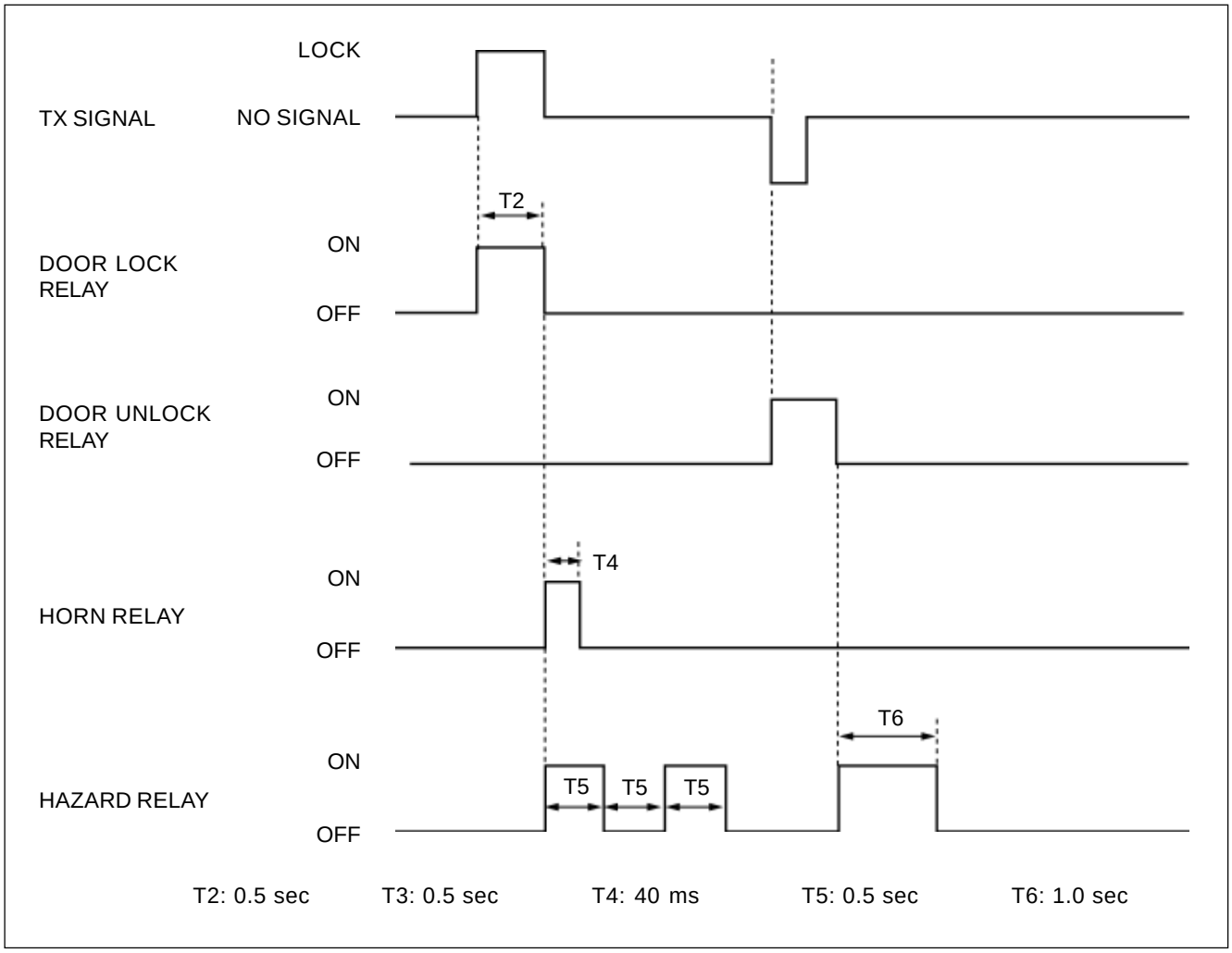


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Door LOCK/UNLOCK by Remote Control Key

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.





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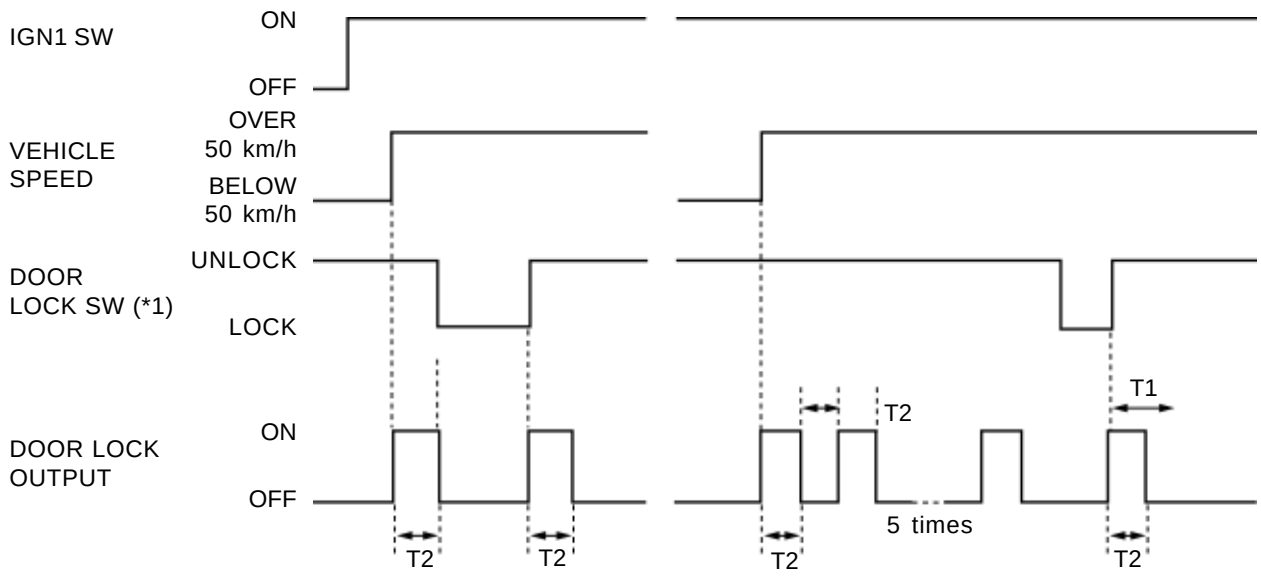
Auto Door Lock

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

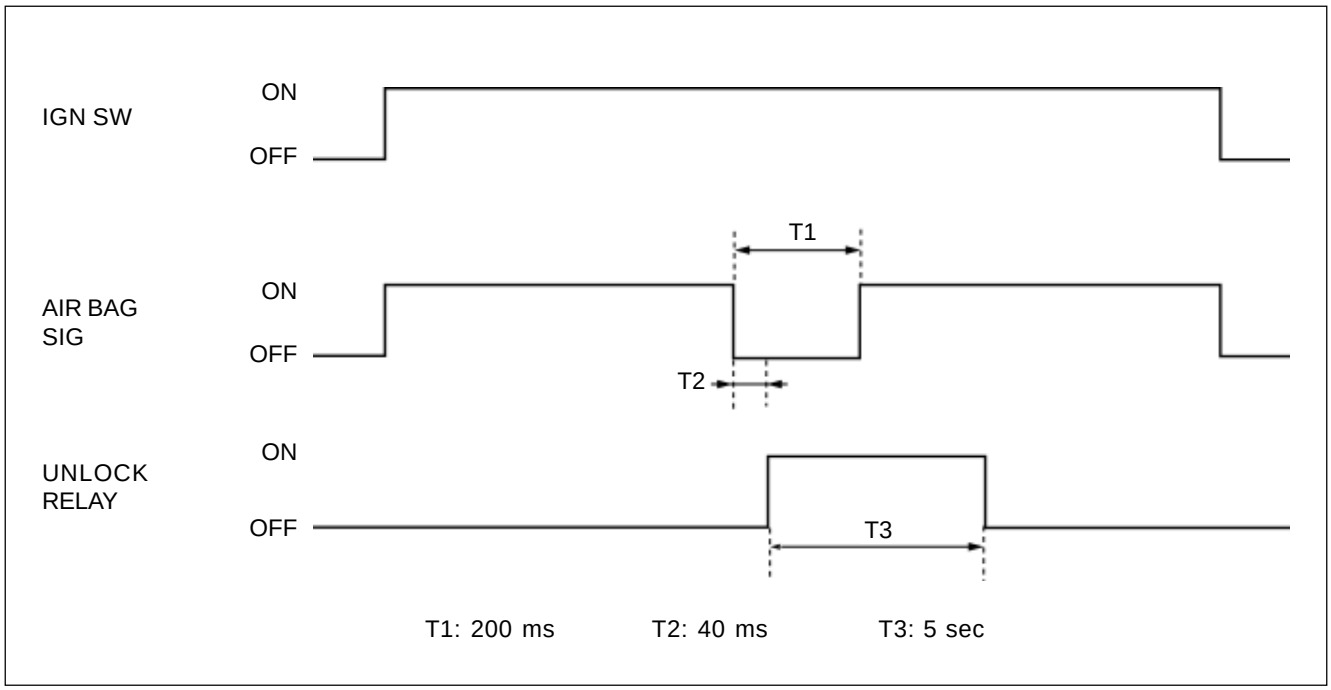
(*1) LOCK: Dr & Ps & Rr & T/GATE DOOR LOCK SW = LOCK
UNLOCK: Dr or Ps or Rr or T/GATE DOOR LOCK SW = UNLOCK

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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

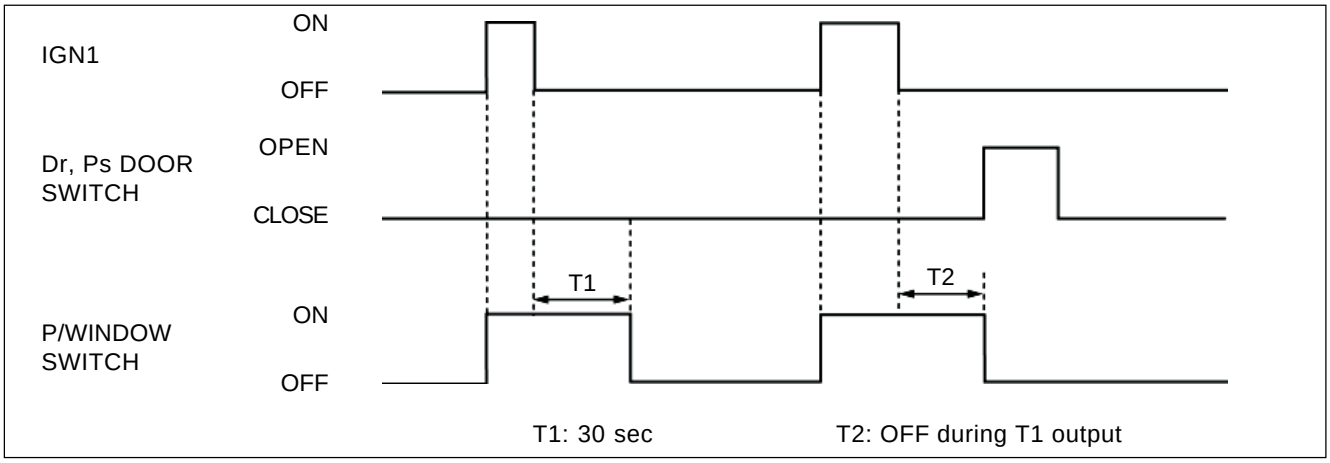
- **The “Unlock” control by air bag signal prevails over any “LOCK” or “UNLOCK” control by other functions.**
- **The “LOCK/UNLOCK” request by other functions will be ignored after/during the output of “UNLOCK” by the air bag.**

  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.**

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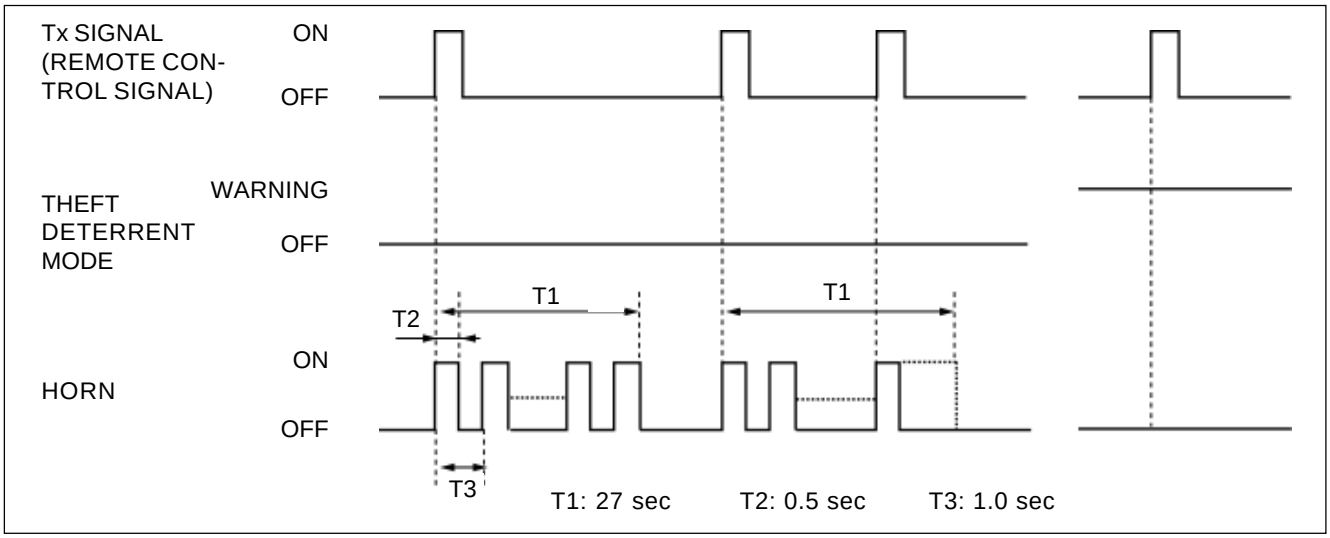
Time Lag Power Window Control

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.



PANIC Warning (With ignition key in)

1. The PANIC warning output is “ON” (theft deterrent horn) 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:
   1) The theft deterrent warning is canceled when receiving PANIC signal from the remote control key during theft deterrent.
   2) The theft deterrent warning output is “ON” when the theft deterrent conditions are established during PANIC warning (PANIC output is “OFF”).
   3) 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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Description of Burglar Alarm Function

1. Definitions of Door Open and Close
   1) Definitions in theft deterrent mode
      Door OPEN: Any of door switches (engine hood, front doors, rear doors, tailgate) output “OPEN” signal.
      Door CLOSE: All door switches (engine hood, front doors, rear doors, tailgate) output “CLOSE” signal.
   2) Door LOCK: Any of door lock switches (front doors, rear doors, tailgate) output “LOCK” signal.
      Door UNLOCK: All lock switches (front doors, rear doors, tailgate) output “UNLOCK” signal.

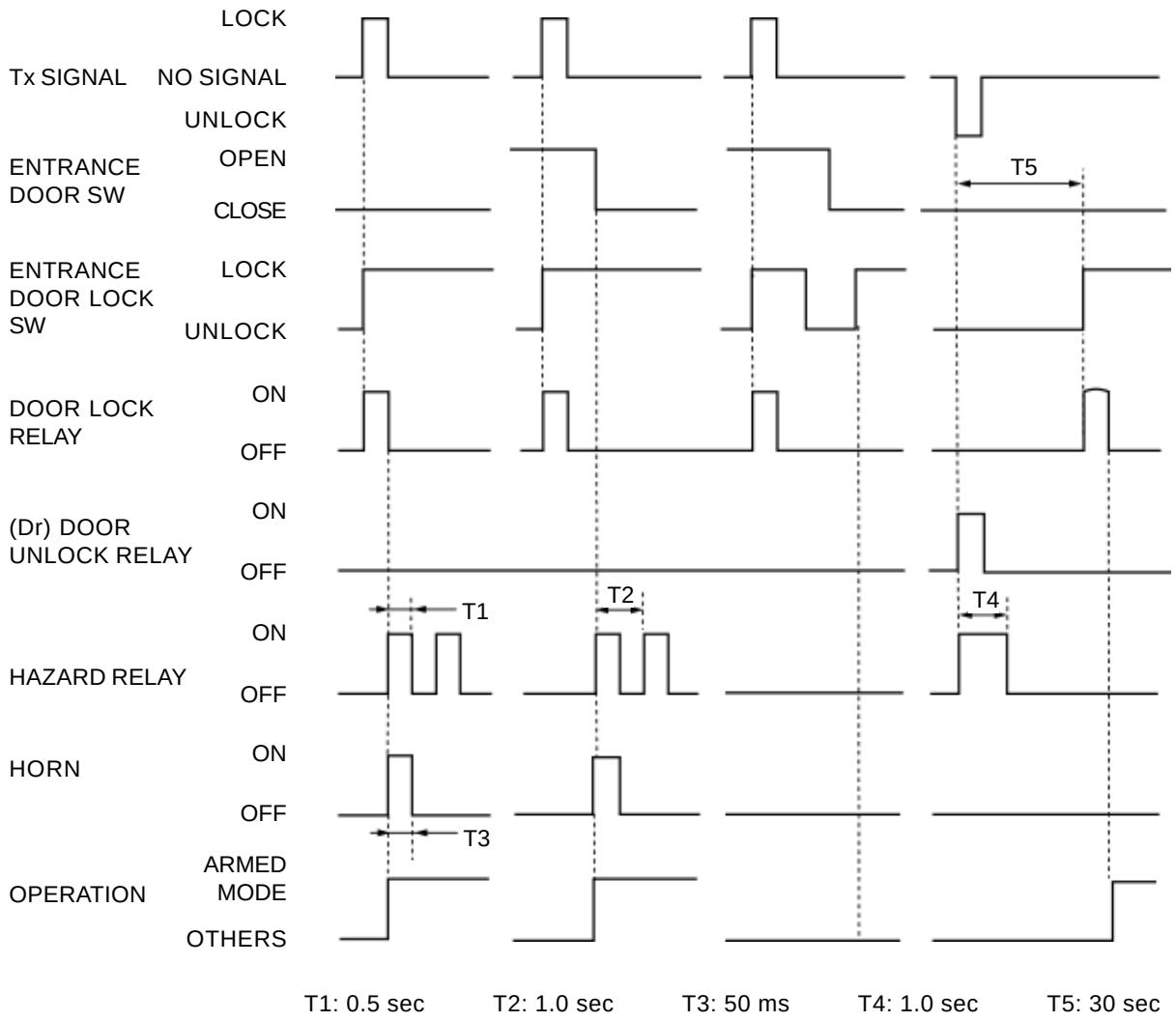


Engine hood open warning lamp
The warning lamp comes on when the engine hood is open.

2. 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.

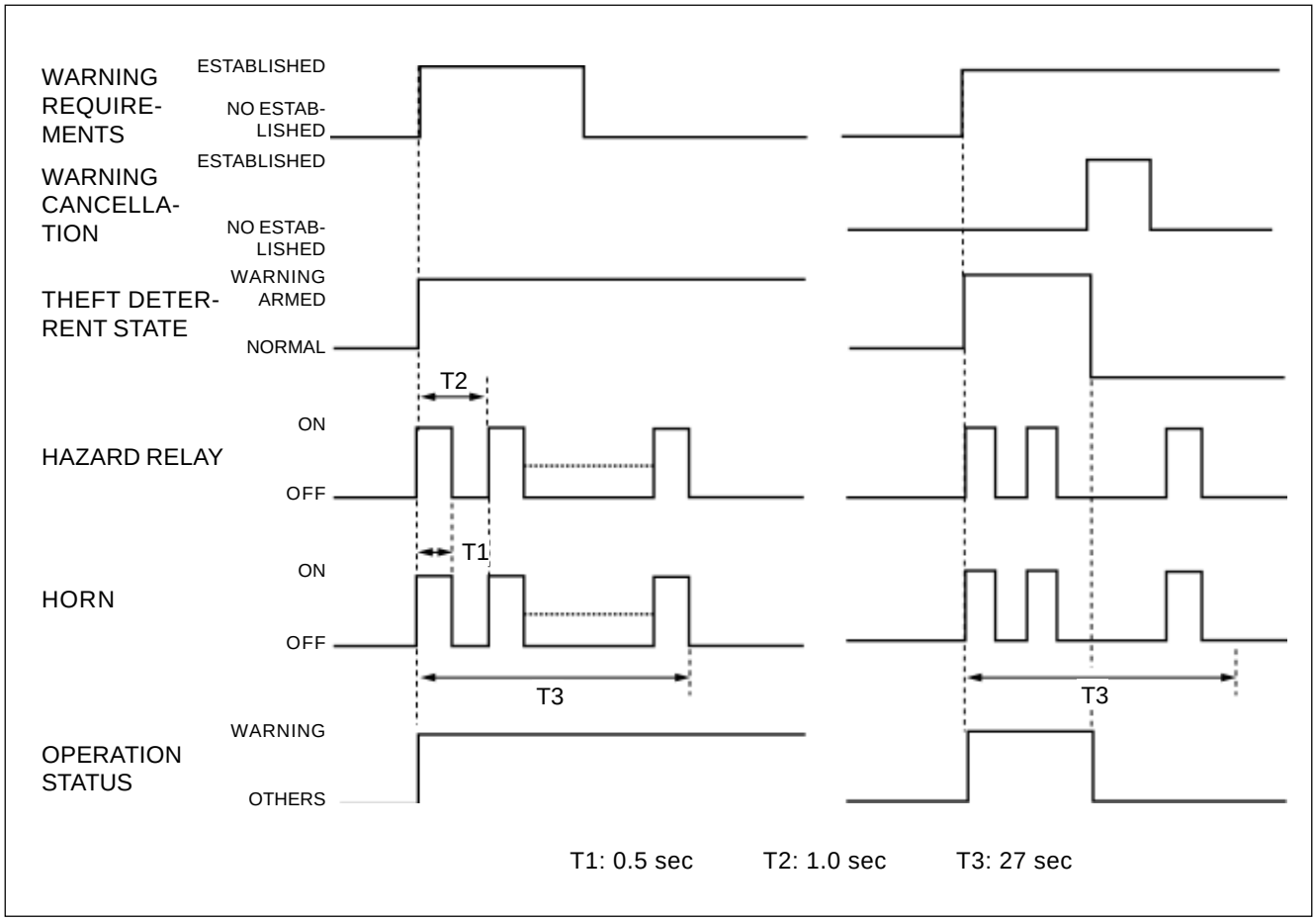
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3. Armed mode cancellation requirements
   1) Unlocking by remote control key or engine starting.
4. Warning operation requirements
   1) When opening the door in armed mode
   2) When unlocking the door lock switch in armed mode by other than the remote control key
   3) When closing and then opening the door after completion of warning (27 seconds)
5. Warning operation
   1) The theft deterrent horn and hazard warning flasher output is “ON” for 27 seconds with the interval of 1 second.
6. 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).
7. Operation when warning is cancelled
   1) The theft deterrent horn and hazard warning flasher outputs are “OFF”.



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8. Operations when removing and installing the battery

Removed \ Installed	Normal	Armed	Warning	Remark
Normal Armed	○			
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.

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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



Panic button

1. Panic function
   1) The theft deterrent horn sounds approx. 27 seconds when pressing this button for 0.1 ~ 0.5 seconds.
   2) It stops when pressing any of the buttons on the remote control key.

Door button

1. Door lock (short press)
   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 (long press)
   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.

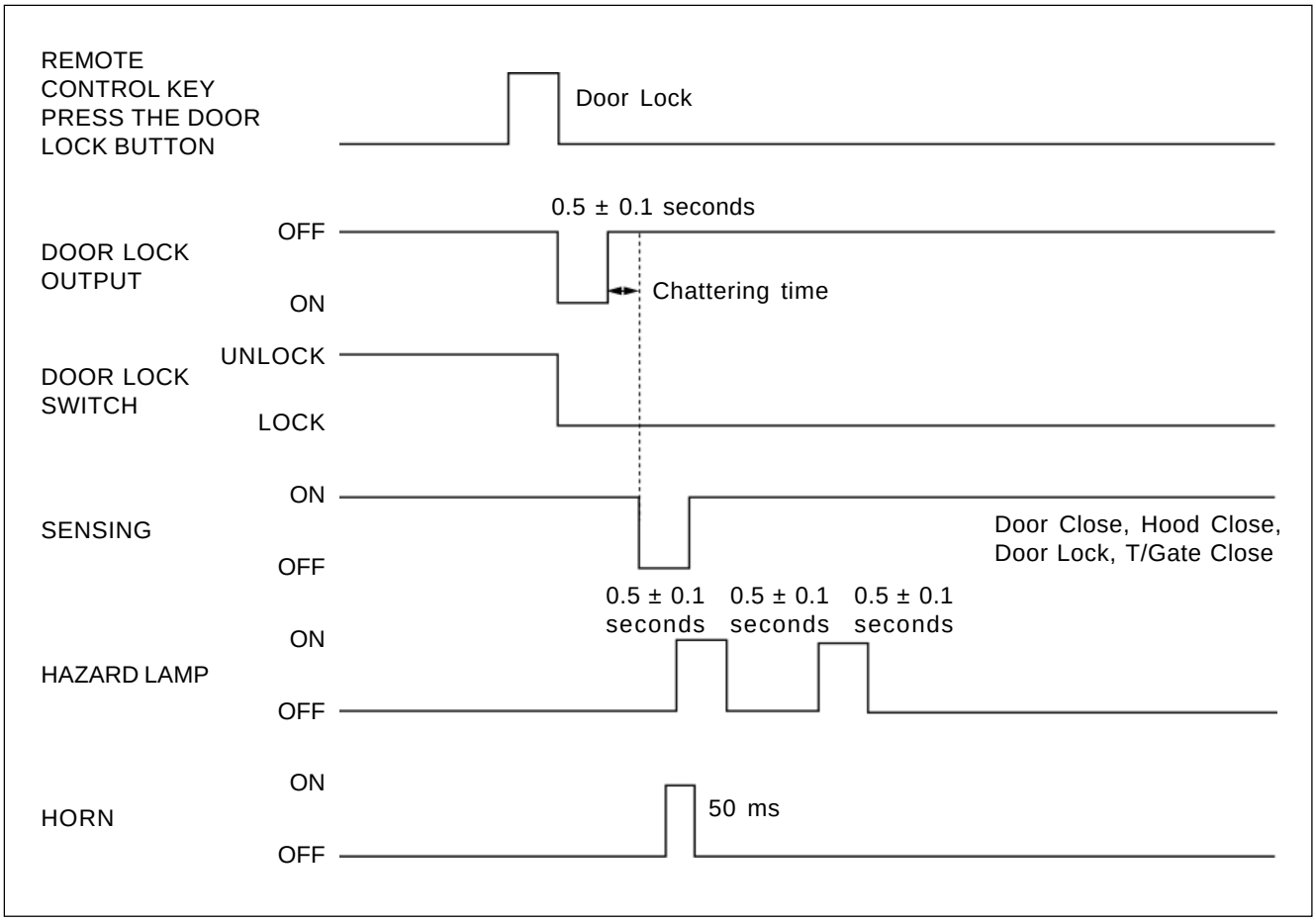
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Receiver

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 two 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.

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.).

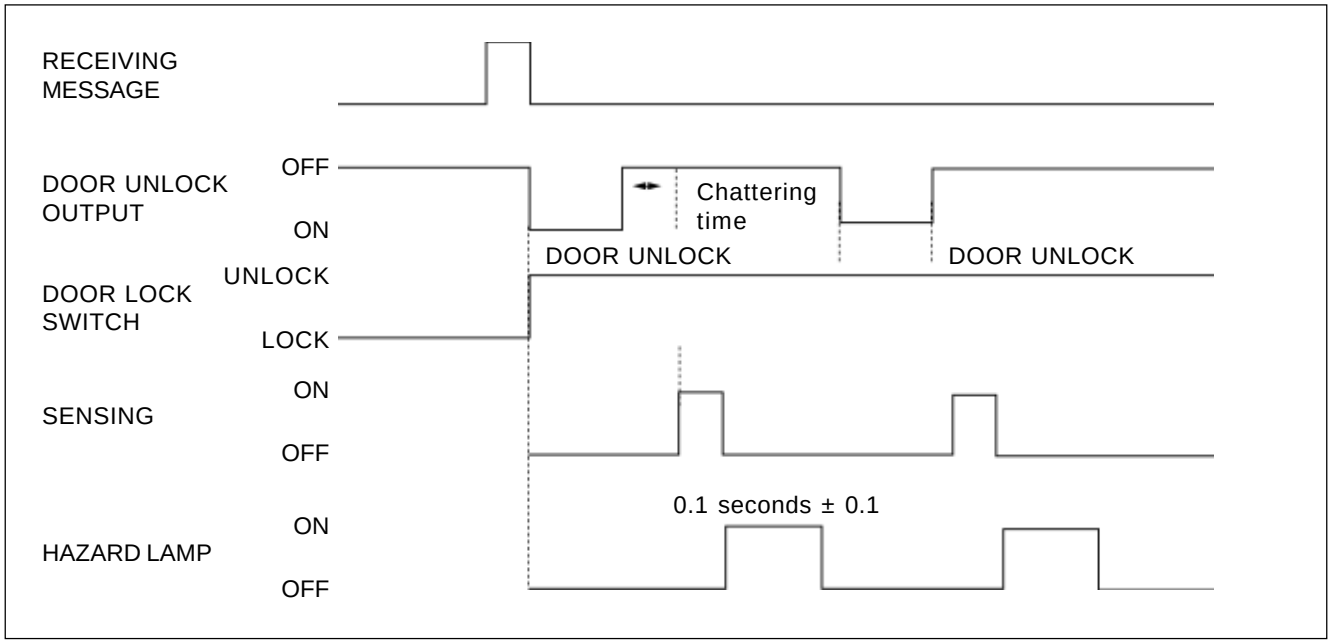


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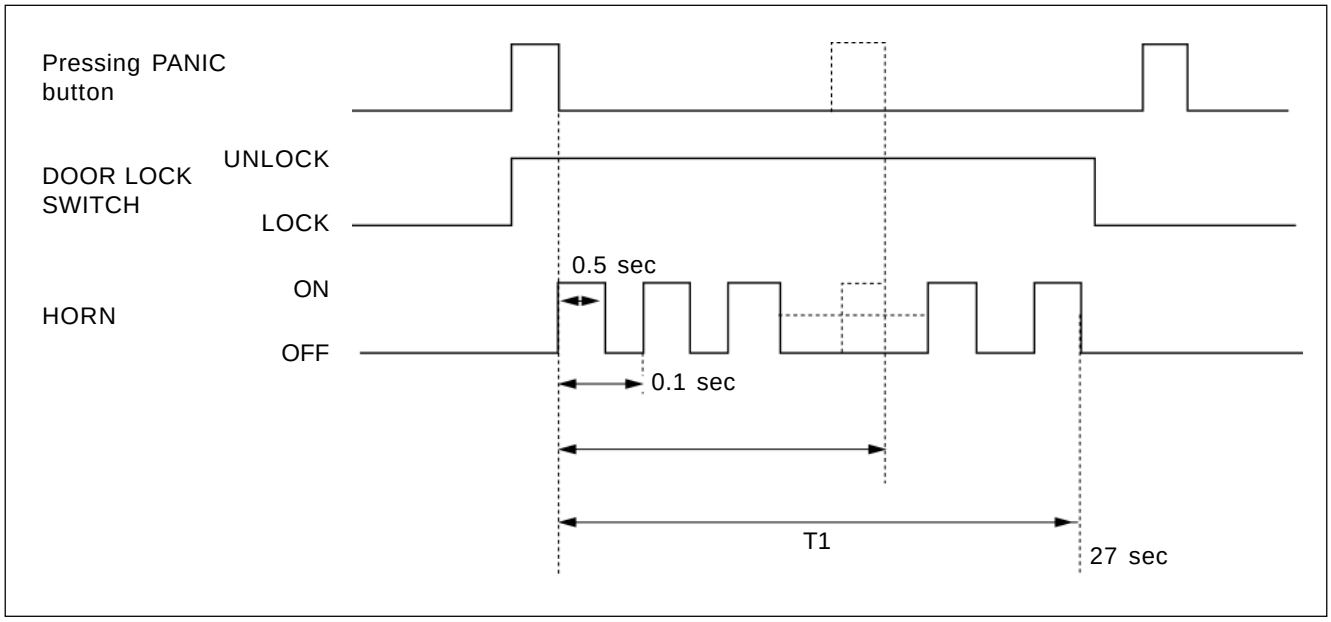
Door Unlock

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.



PANIC

1. This function operates when pressing the PANIC switch on the remote control key for less than 0.5 seconds.
2. The horn sounds for 27 seconds when receiving the PANIC message from the remote control key.

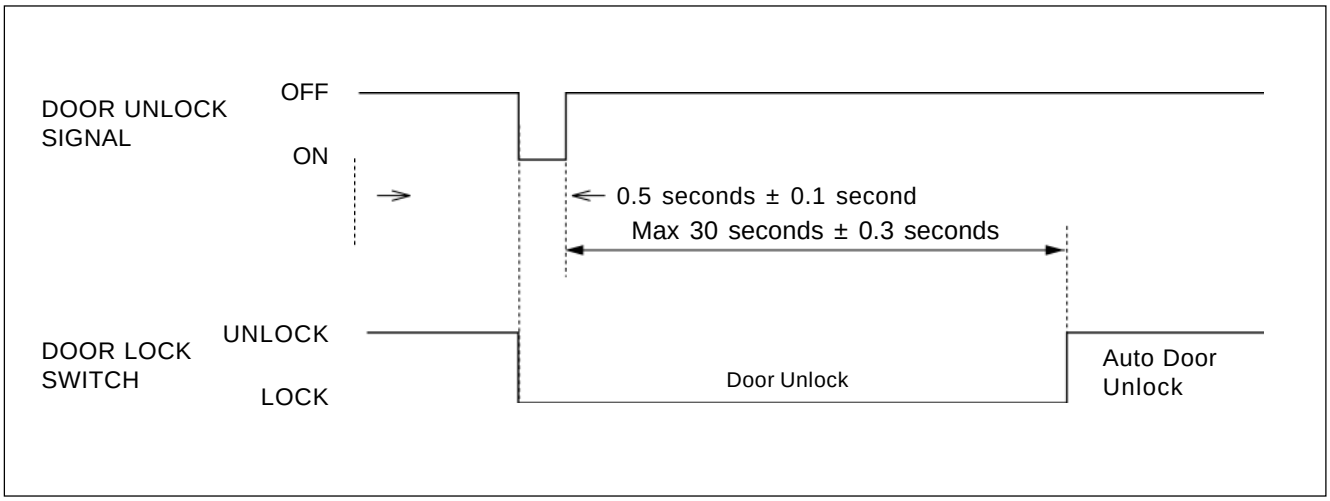


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Auto Door Lock

1. It the door is not opened within 30 seconds after unlocking the door with remote control key, the system outputs “LOCK” signal and activates the armed mode (Relock function).



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5. 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).

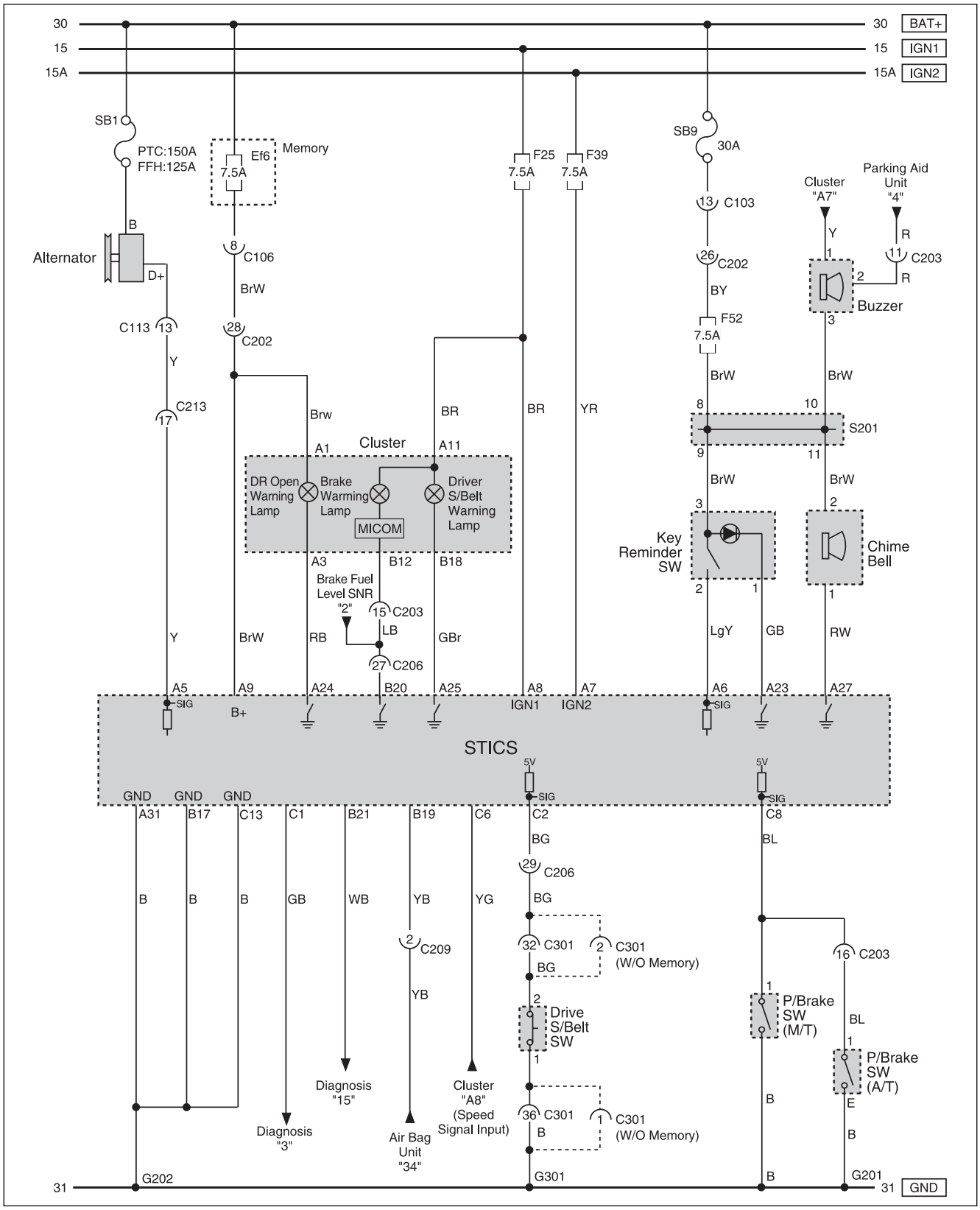
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Fault Code	Malfunction	Descriptions
23	REMOCON VOLTAGE CHECK	The voltage from remote control key is saved as history error.
24	SBR S/BELT SW (Only EU)	When the seat belt switch circuit is OPEN (HIGH) in KEY OUT & ARMED MODE, the system recognizes it 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.

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6. ELECTRIC WIRING DIAGRAMS

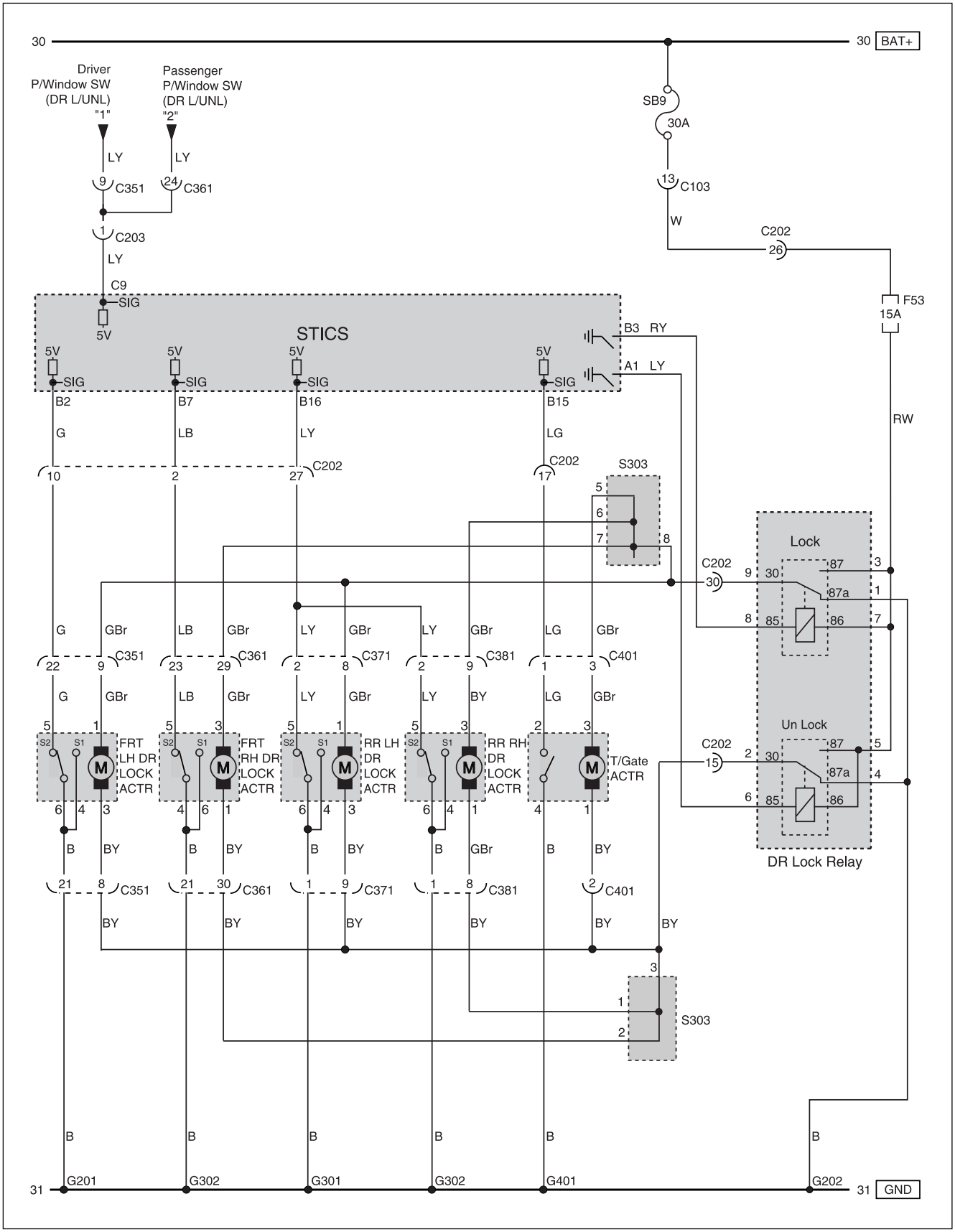
▶ Power/Ground, Chime Bell, Buzzer, Warning Lamp (Brake, Seat Belt, DR Open)



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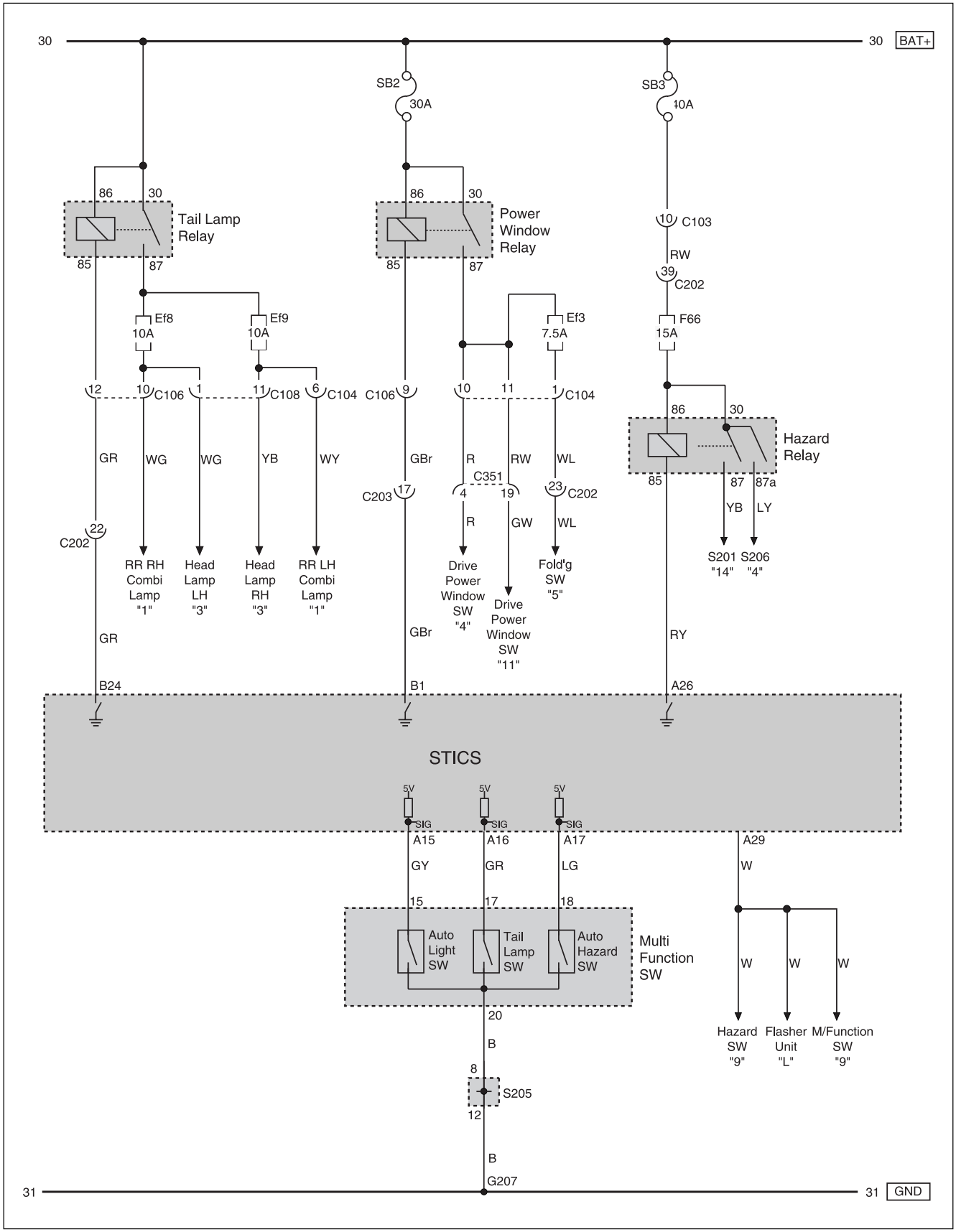
▶ Central Door Lock Circuit



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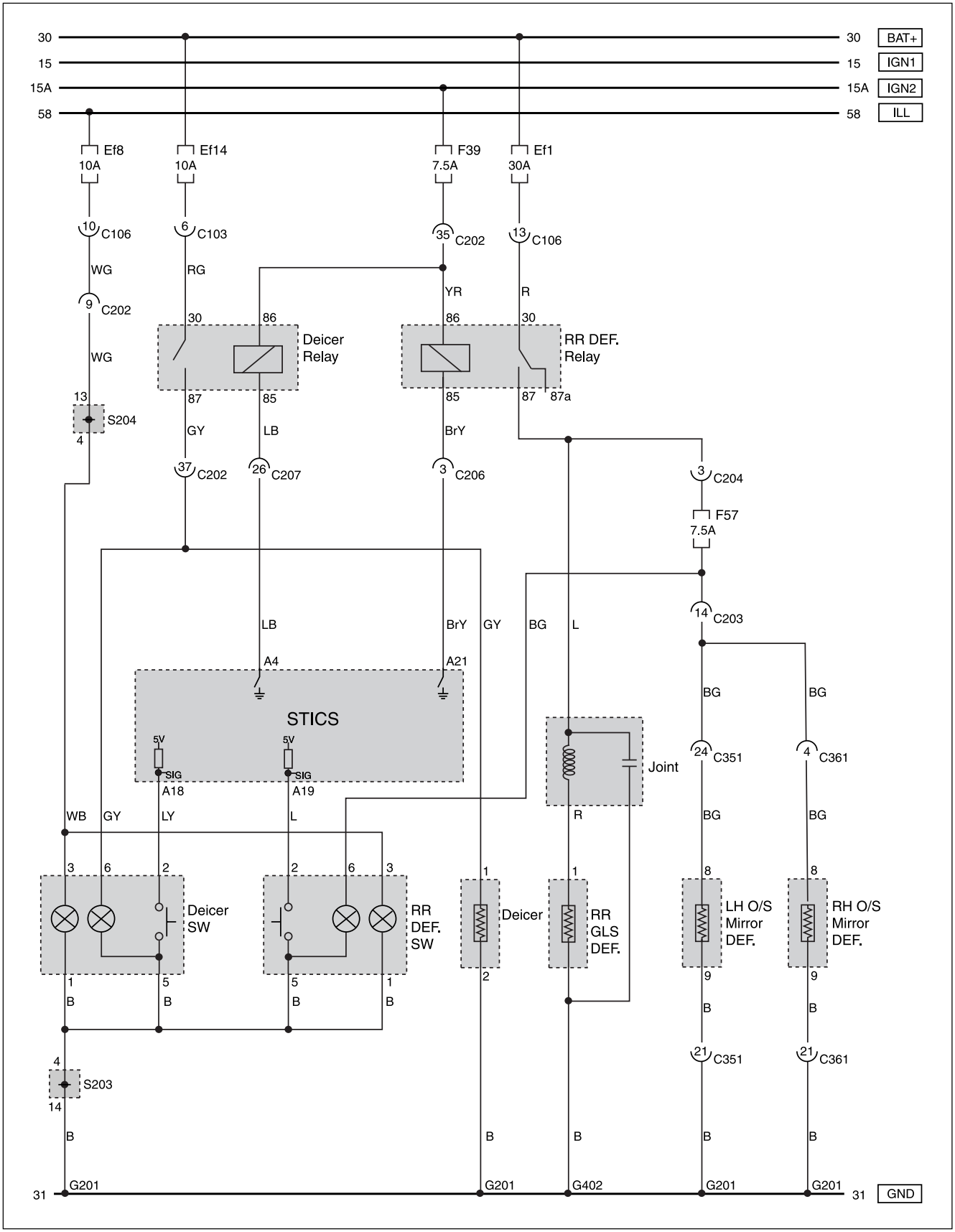
▶ Tail Lamp, Hazard, Power Window



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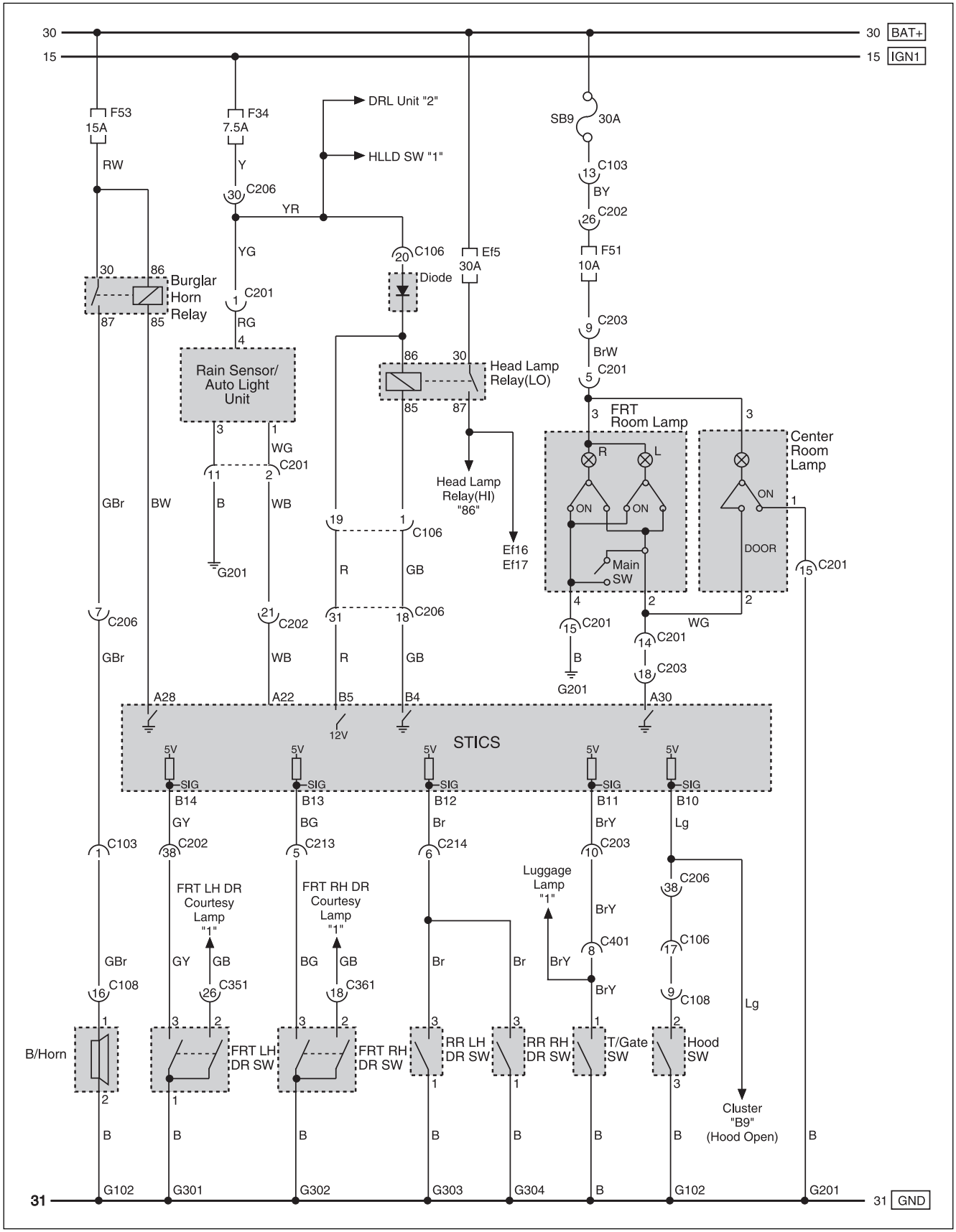
▶ Windshield Heated Glass (Defogger)



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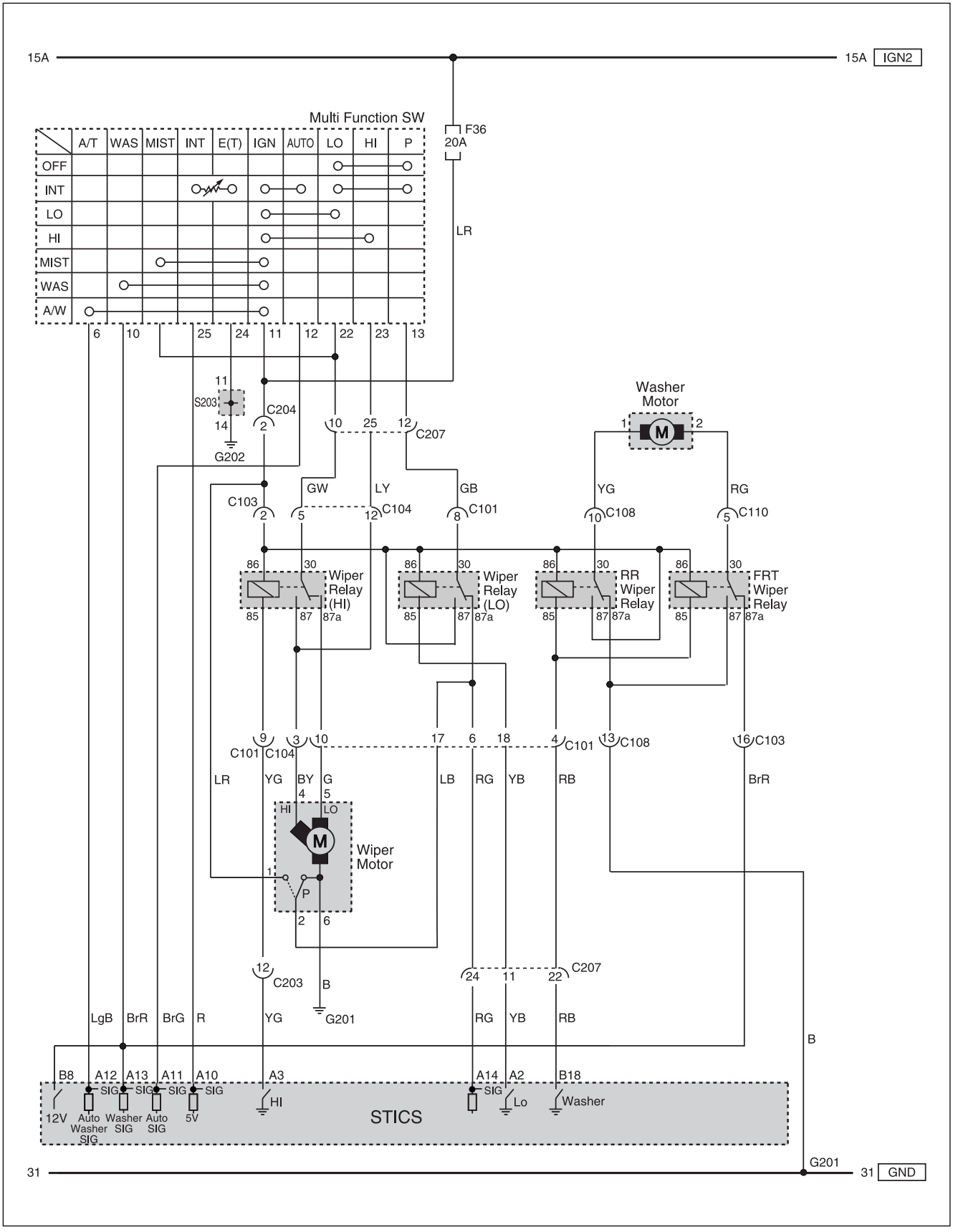
▶ Panic, Auto Light & Rain Sensing, Room Lamp



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▶ FRT Wiper/Washer & RR Washer



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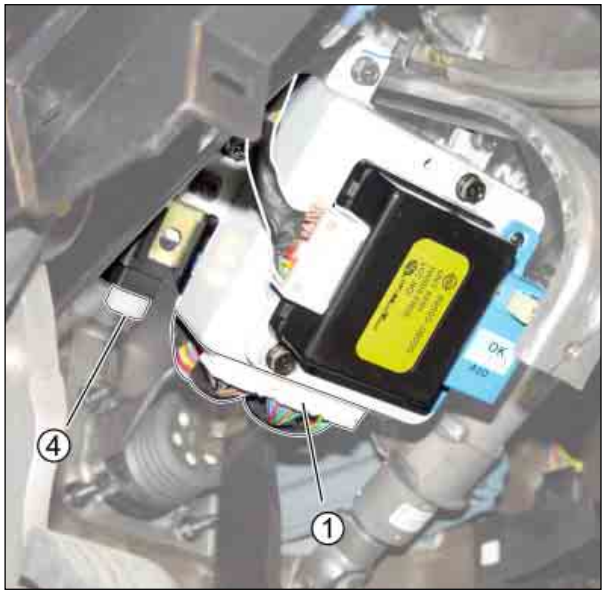
Removal and Installation

※ **Preceding Works:**

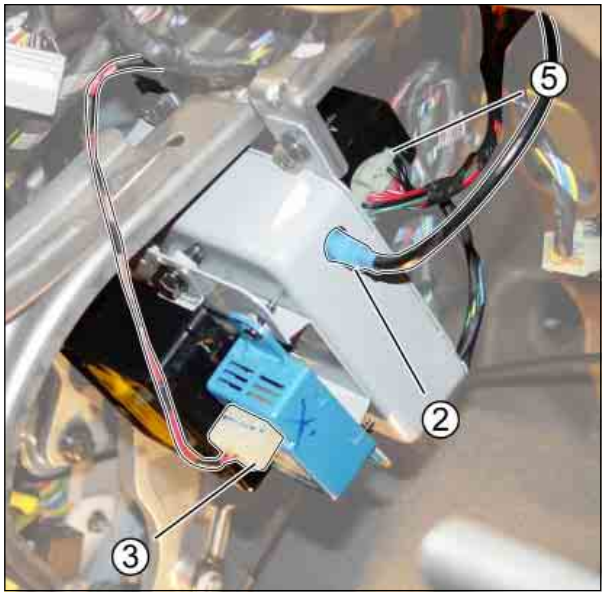
1. Disconnect the negative battery cable.
2. Remove the lower panel in front of driver's seat. (For details, refer to BODY section.)



1. Disconnect the connectors from STICS unit and remove the RKSTICS antenna.



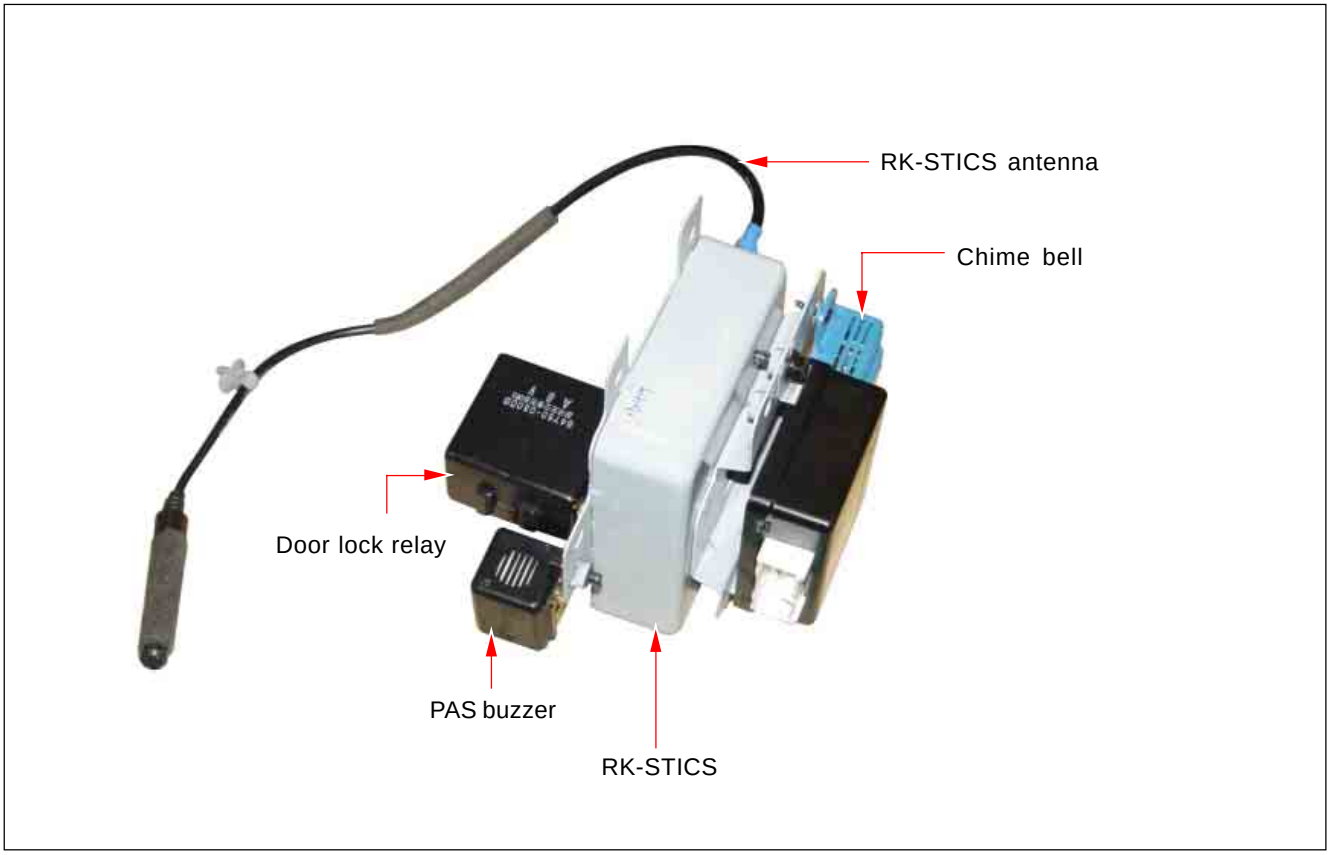
1. STICS connector
2. STICS antenna
3. Chime/buzzer connector



4. PAS buzzer connector
5. Door lock/unlock relay connector

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2. Unscrew two mounting bolts (10 mm - 2EA) and remove the STICS unit.



3. Separate the STICS unit.

STICS Unit



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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. Replacement of electronic head part (excluding key plate) ... 6
5. REKES operation logic 7
6. Dual REKES coding 10
7. Immobilizer coding and removal of immobilizer unit 12

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IMMOBILIZER SYSTEM

1. OVERVIEW

The immobilizer unit communicates with the engine control unit to enable the engine starting.



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.



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2. BASIC FUNCTIONS OF IMMOBILIZER KEY (REKES FUNCTION)

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).



PANIC function (with ignition key in)

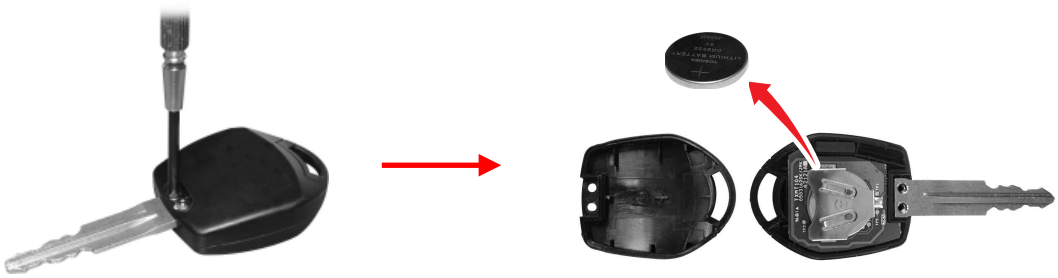
Theft deterrent horn sounds approx. 27 seconds.

NOTICE

- **The doors cannot be locked by remote control if they are not closed. The PANIC function operates only in theft deterrent mode.**

The PANIC function operates only in theft deterrent mode.

Specification	CR 2032
Quantity	one

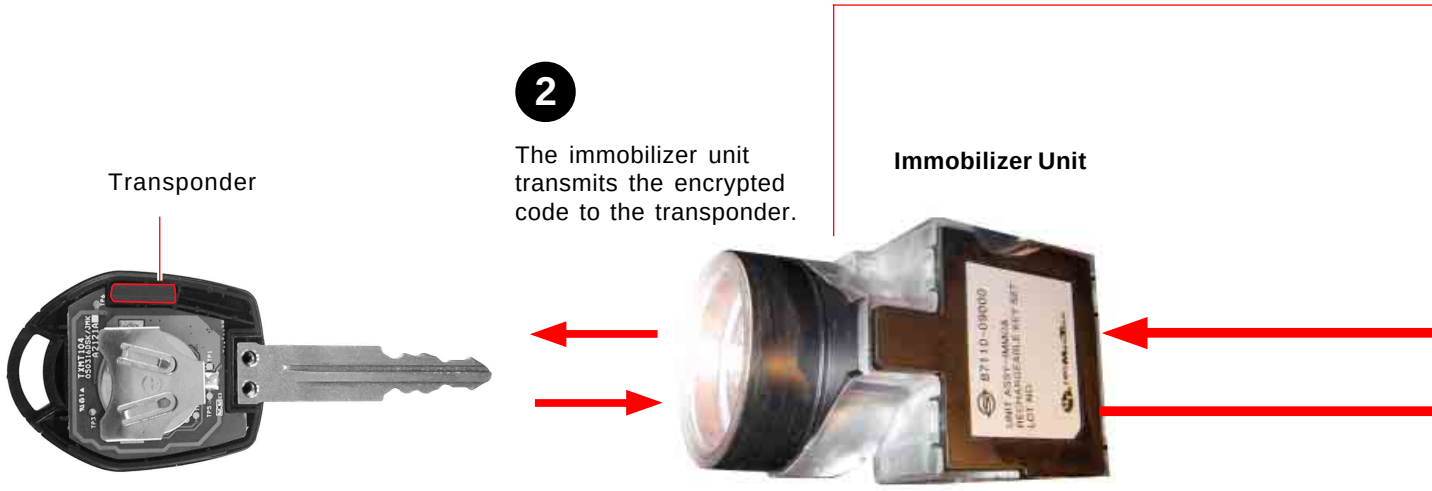


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3. OTHER FUNCTIONS IN SYSTEM

▶ 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.**

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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

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 starts the engine.

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.**

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4. REPLACEMENT OF ELECTRONIC HEAD PART (EXCLUDING KEY PLATE)

▶ Replace the Electronic Head Part of the Immobilizer When:

1. The transponder (immobilizer key) is broken or damaged.
2. The immobilizer system is not properly functioning.



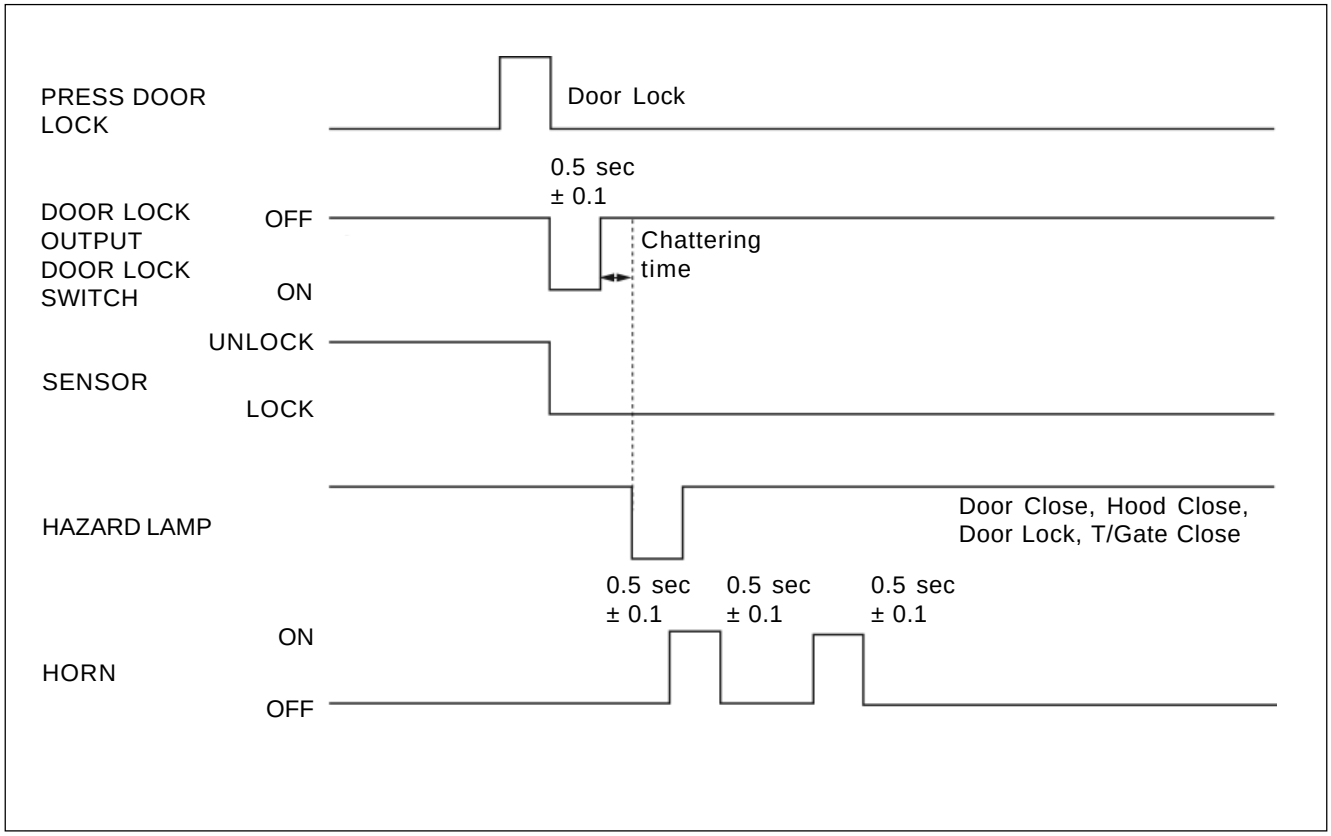
Remove the rubber cover on the back of the key assembly. Remove two screws to uncover the key plate. Install the new electronic head assembly on the key plate.

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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).

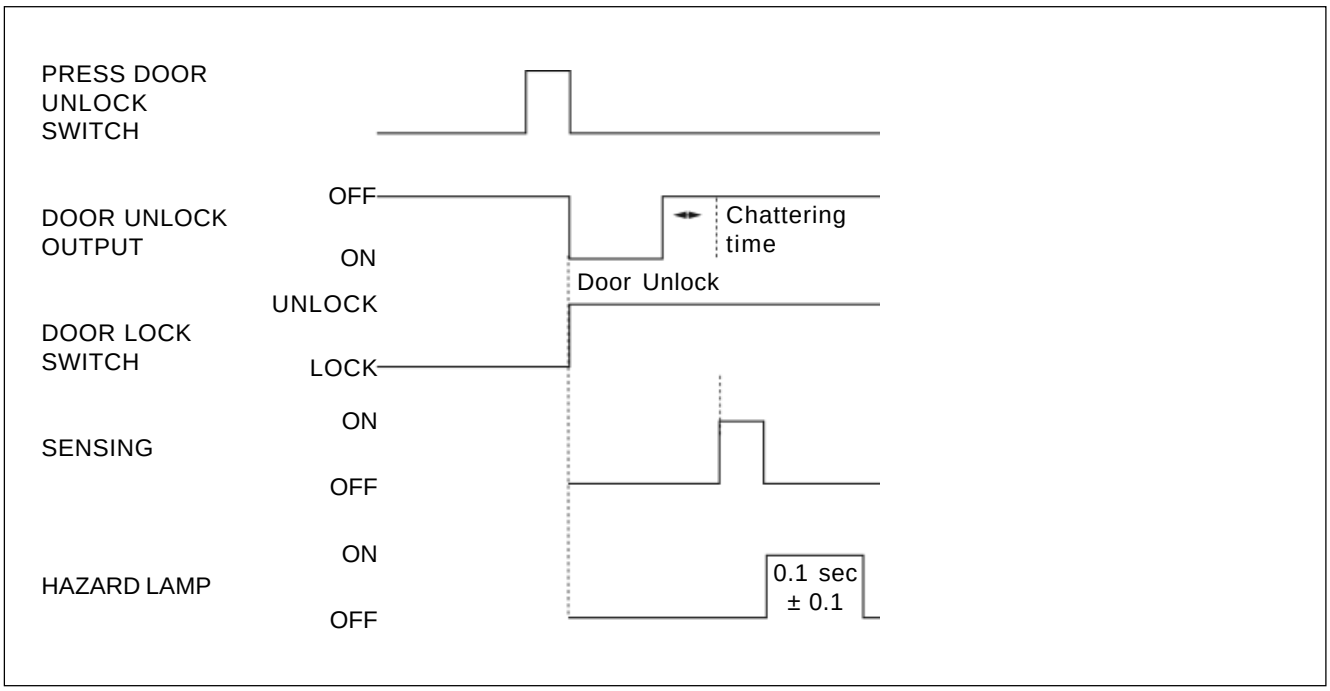


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▶ Door Unlock

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.

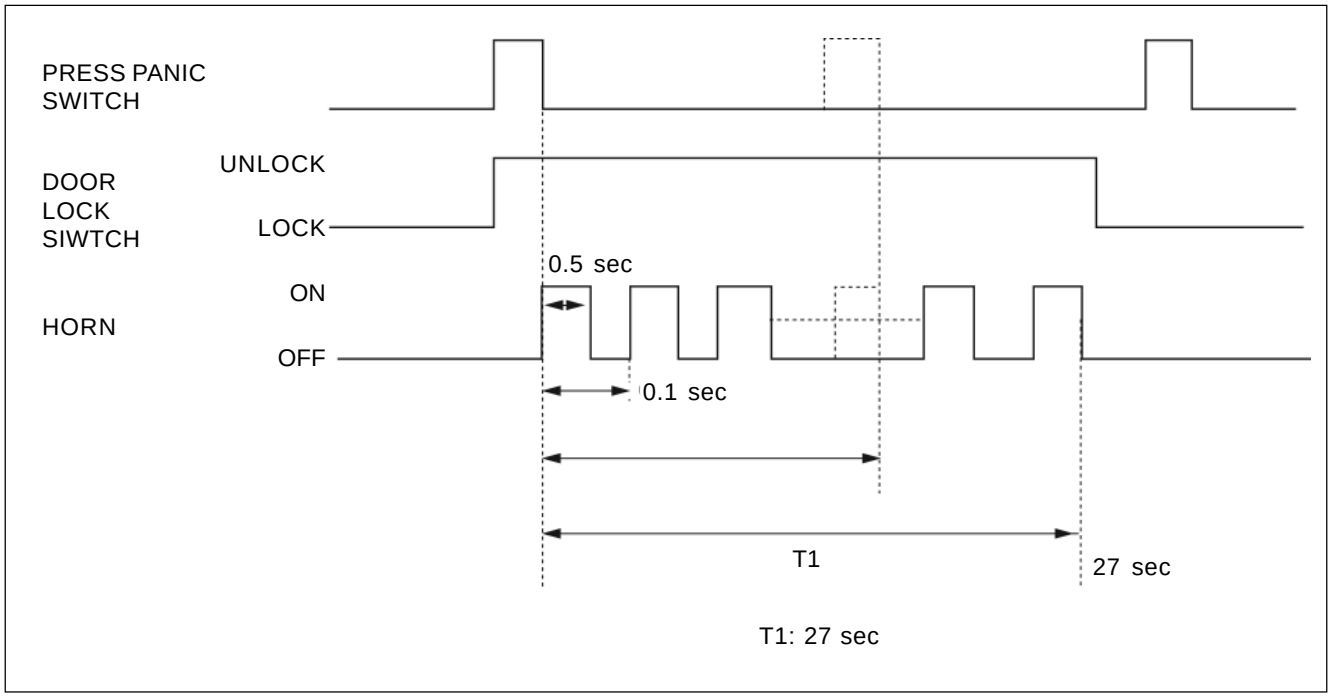


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▶ Remote PANIC (With ignition key in)

1. When briefly pressing the PANIC switch on the remote control key for less than 0.5 seconds, the PANIC function is activated.
2. When receiving the PANIC message from the remote control key, the horn sounds for 27 seconds.



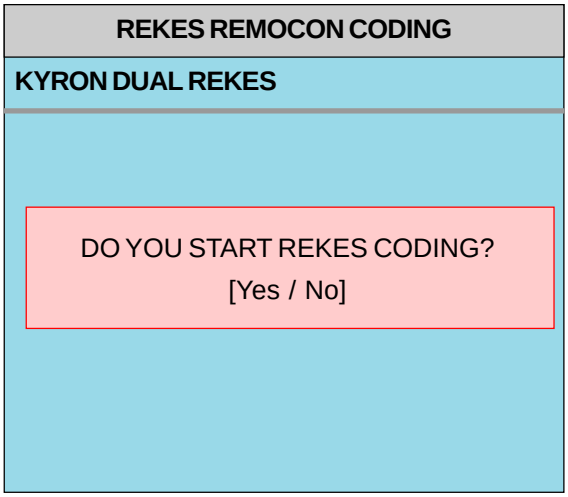
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6. DUAL REKES CODING

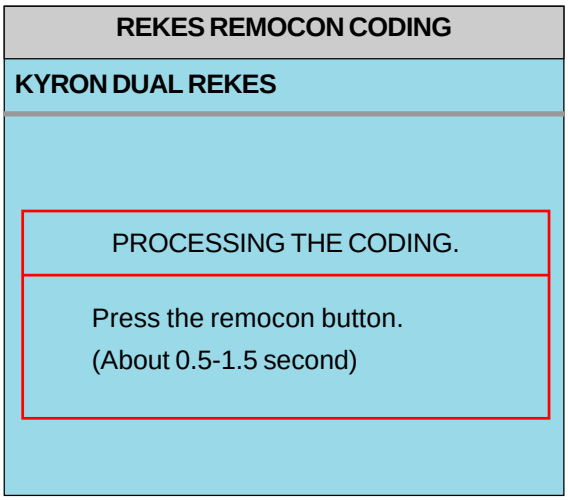
The new coding is required by using the scanner when lost the transmitter. Vehicles with REKES function only have one REKES remote control key and vehicles with immobilizer system have two keys with remote control function. Therefore, there is a need to code two immobilizer keys.

1. After connecting the scanner and selecting KYRON, then select DUAL REKES.

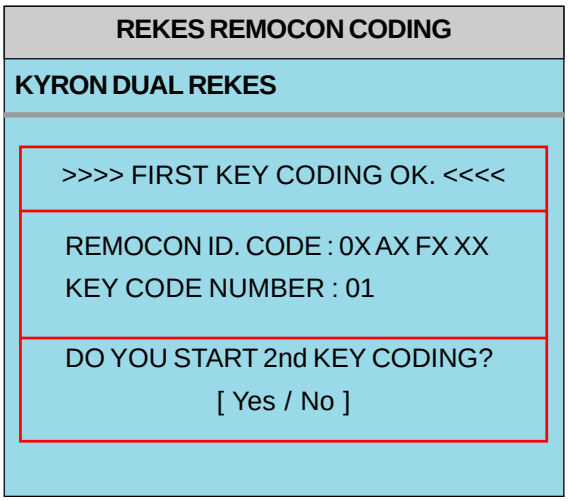
2. To start to code, press YES in the below screen. **<u>This results in clearing the key codings of the old REKES.</u>**



3. Press one button of a remote control key once for 0.5 - 1.5 sec. You can hear a beep sound.



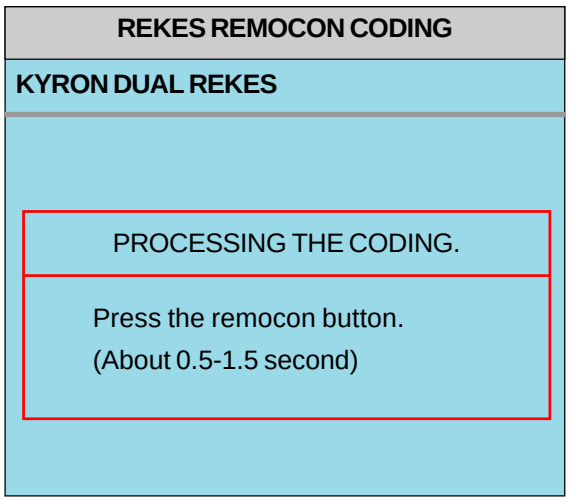
4. The below screen is displayed when the first key coding is completed.
   To start the second coding, press YES.



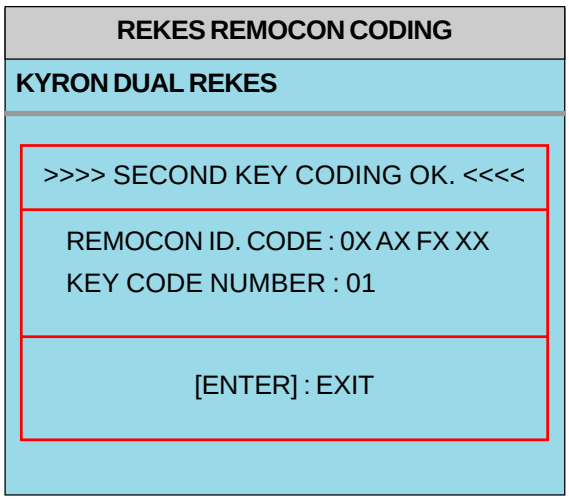
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5. Press one button of a second remote control key once for 0.5 - 1.5 sec. You can hear a beep sound.



6. The below screen is displayed when the second key coding is completed.
   To exit REKES key coding, press ENTER.



7. Back to return the main screen when you have finished coding.

8. After exiting the SCAN-100 and disconnecting it from the diagnostic connector, perform the function tests for the remote control keys. If they do not work, repeat the above dual REKES key coding procedures.

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7. 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 of Immobilizer Unit

※ **Preceding Works:** Remove the battery negative cable.

1. Remove the lower panel from the driver's seat.
   (For details, refer to BODY section.)
2. Remove the steering column shaft assembly.
   (For details, refer to STEERING section.)





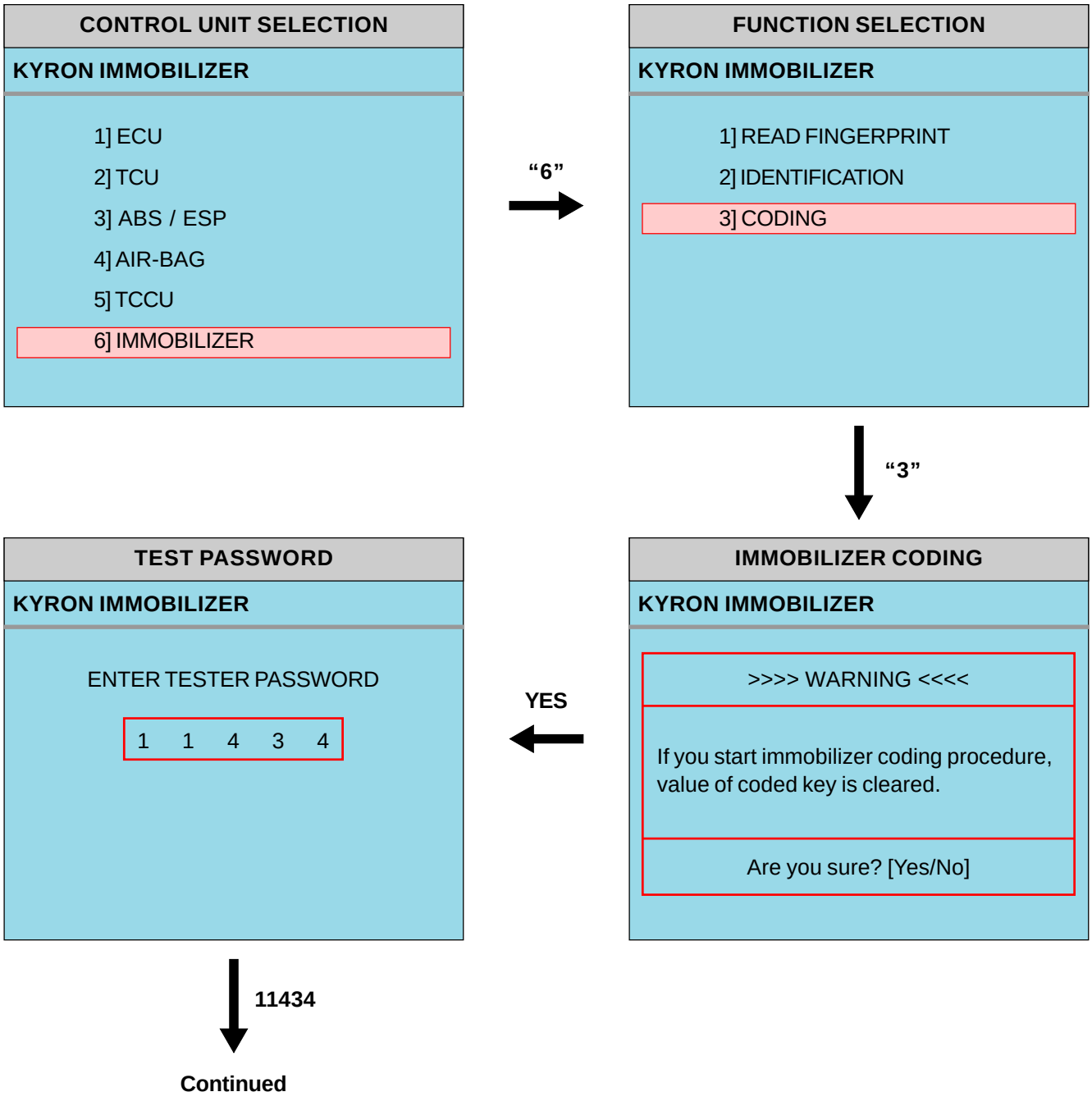
3. Remove the connector from the key switch and disconnect the immobilizer unit.



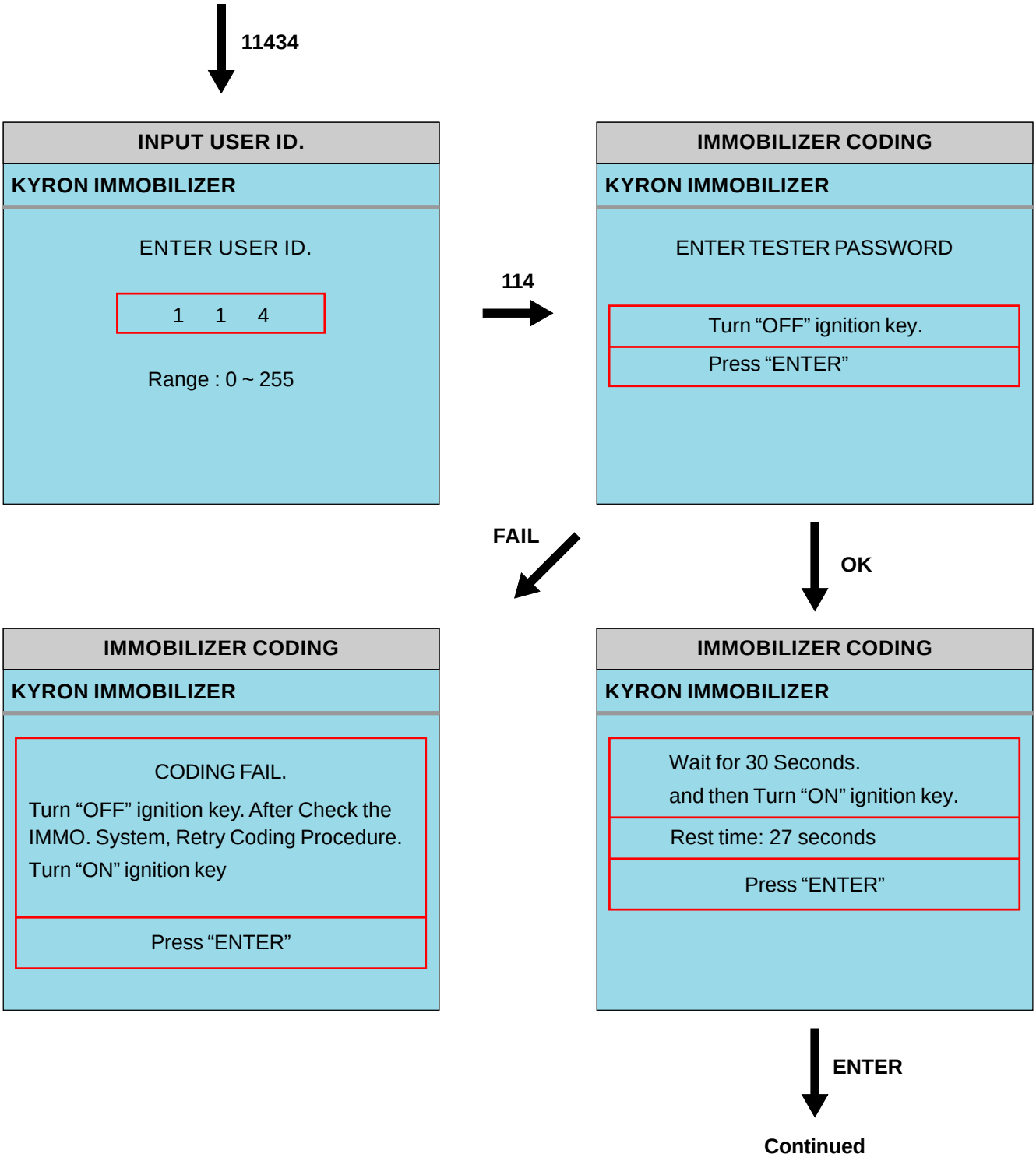
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▶ Immobilizer Coding

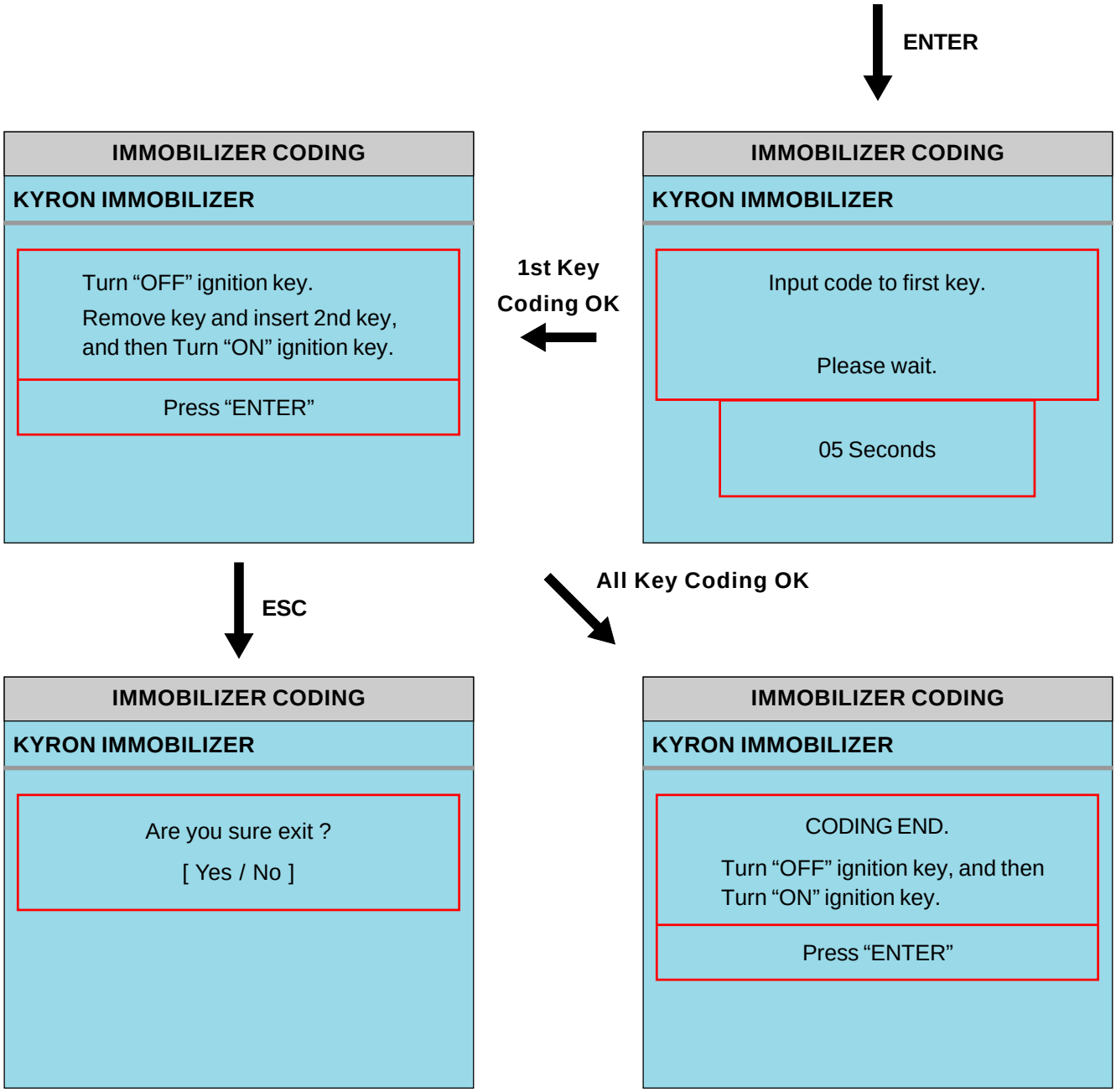


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SEAT POSITION WITH MEMORY

7410

TABLE OF CONTENTS

SPWM (Seat Position With Memory) UNIT 3

1. Overview 3
2. Components 4
3. Operations 5
4. Input/output of SPWM unit 8
5. Control and operating conditions 9
6. Removal and installation of seat 15

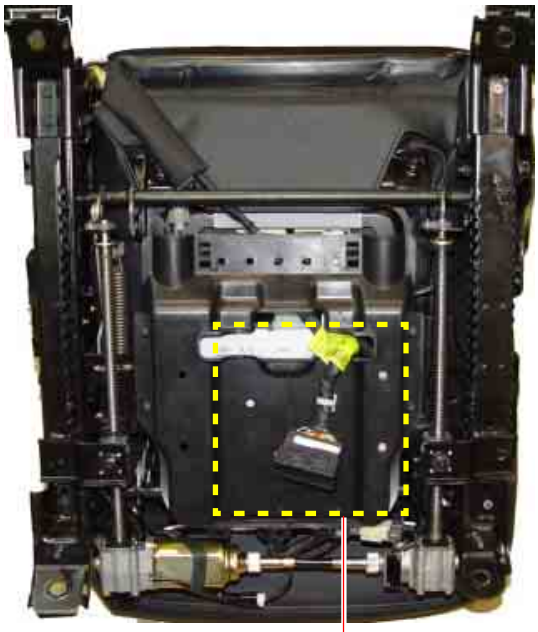
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SPWM (Seat Position With Memory) UNIT

1. OVERVIEW

The memory setting of seat position is available availabe for up to 3 different drivers. Each driver can set his/her own driver's seat and outside rearview mirrors positions and they will be stored in the computer. Even if someone have moved your seat and outside rearview mirrors, the memory positions will be recalled automatically by pressing the position button.



Location
(Bottom of diver's seat)



SPWM

▶ Functions of SPWM

Seat Position With Memory

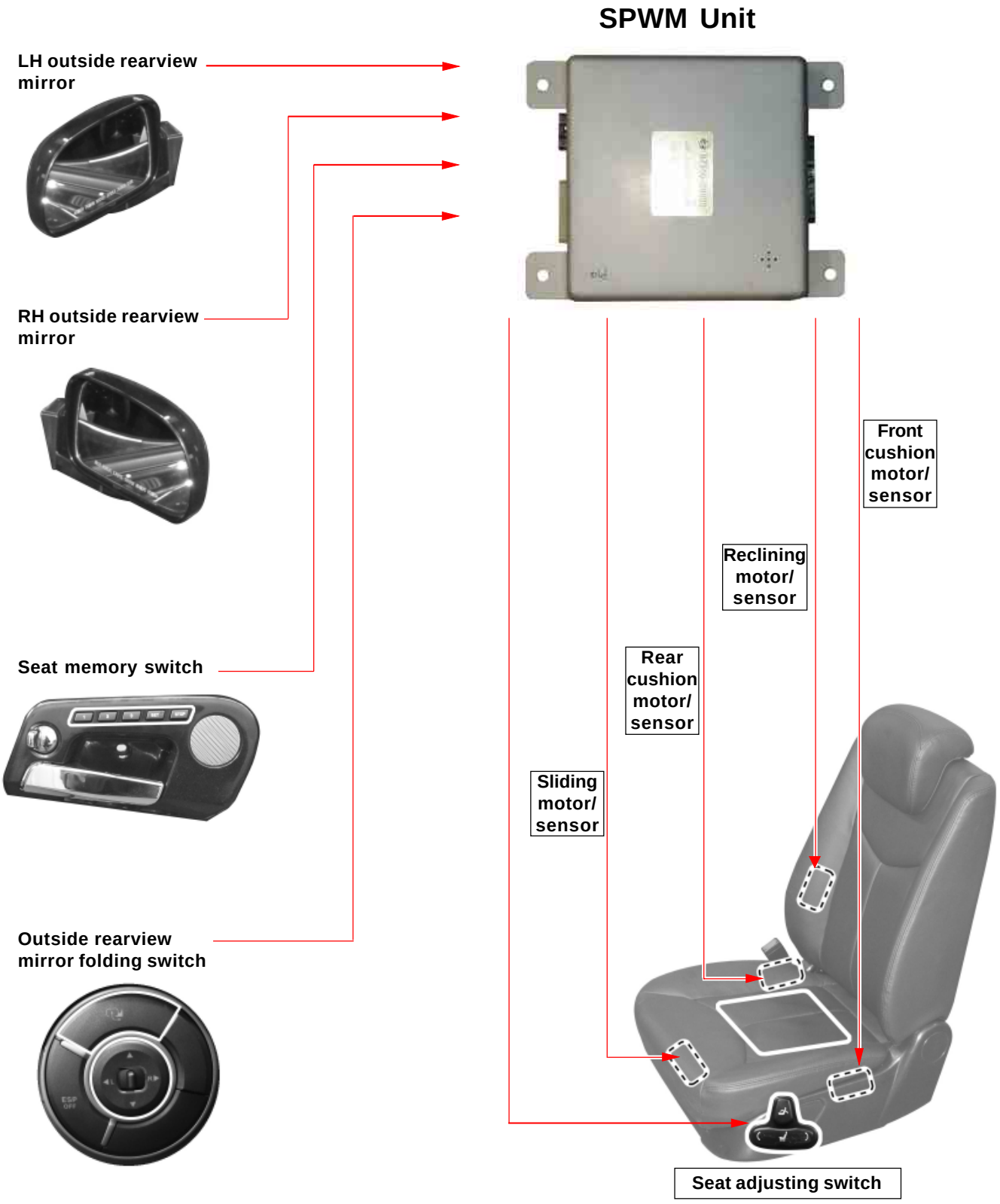
- **Power seat control**
- **Outside rearview mirror control**
- **Driver's seat and outside mirror position memory**

1. Adjusting the power seat's position with the seat adjusting switch
2. Adjusting the angle of the outside rearview mirrors (OSRVM)
3. Seat memory positions: for 3 persons
4. Folding/Unfolding the outside rearview mirrors

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2. COMPONENTS

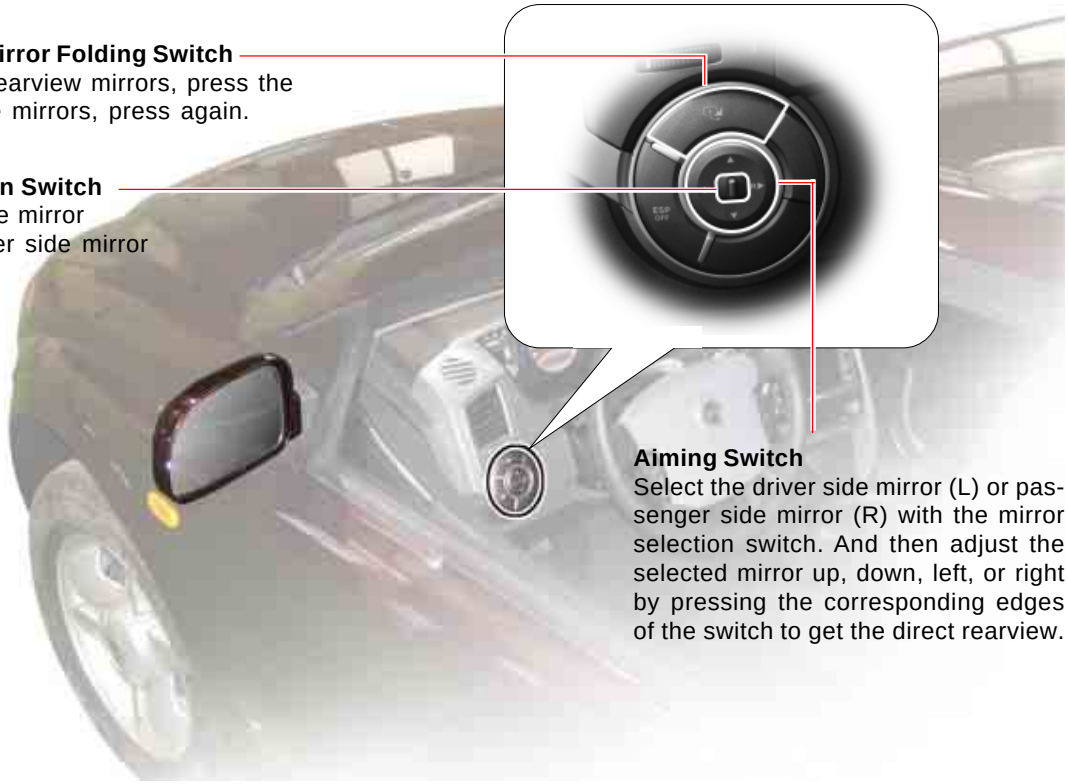


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3. OPERATIONS

▶ Outside Rearview Mirror Control

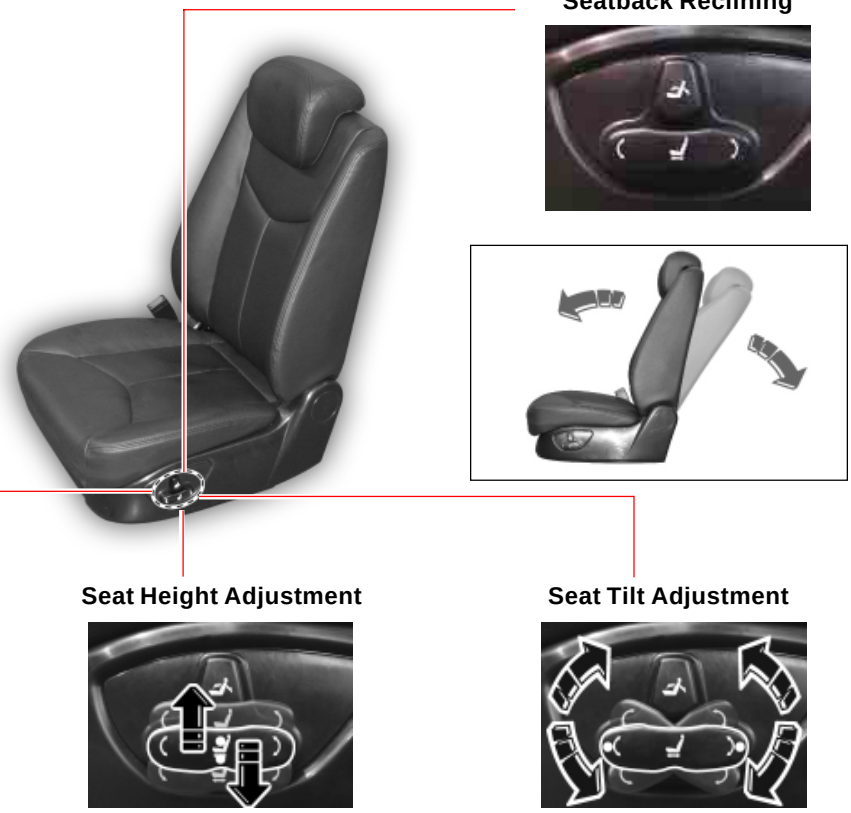


Outside Rearview Mirror Folding Switch
To fold the outside rearview mirrors, press the switch. To unfold the mirrors, press again.

Mirror Selection Switch
- "L": Driver side mirror
- "R": Passenger side mirror

Aiming Switch
Select the driver side mirror (L) or passenger side mirror (R) with the mirror selection switch. And then adjust the selected mirror up, down, left, or right by pressing the corresponding edges of the switch to get the direct rearview.

▶ Seat Position Control



Seatback Reclining

Seat Slide Adjustment

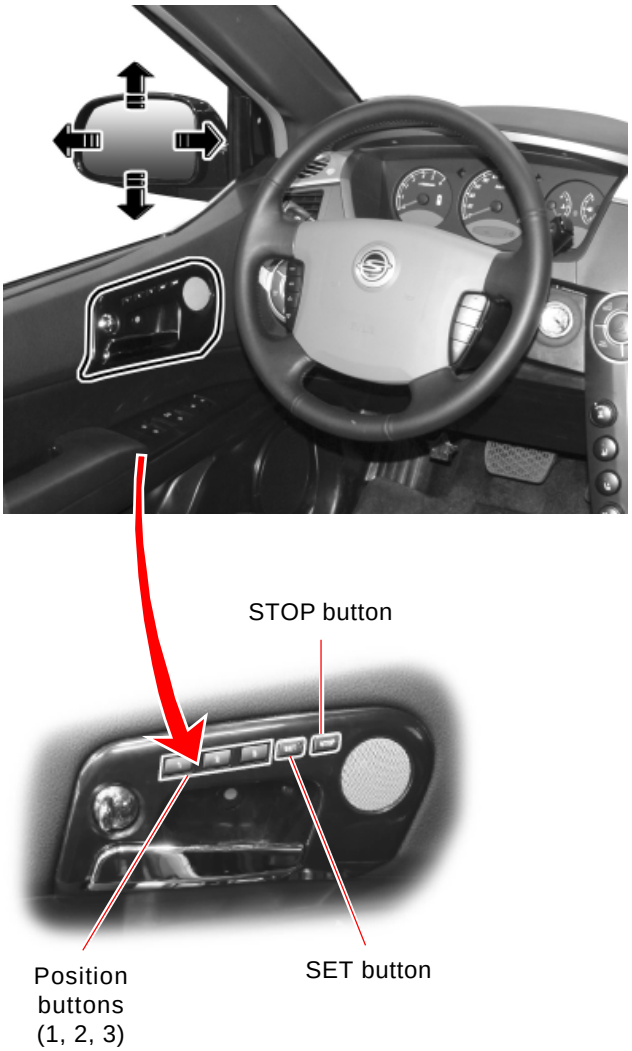
Seat Height Adjustment

Seat Tilt Adjustment

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▶ Driver's Seat Position Memory Function

The position memory is available for up to three drivers. Each driver can set his/her own driver's seat outside rearview mirrors and interior rearview mirror positions and they will be separately stored in the integrated computer. If somebody has moved the seat, the memory positions can be recalled automatically by pressing the position button.





Storing Memory Settings

1. Position the transmission shift lever to "P" with the ignition switch "ON" (for your safety, do not start the engine). Apply the parking brake if the vehicle is equipped with M/T.
2. Adjust the driver's seat and outside rearview mirrors to the desired positions.
3. Press the "SET" button. The indicator on the button will come on.
4. Within 5 seconds, press the buttons (1), (2) or (3) you want to set. The indicator on the set button blinks 3 times.

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Operating Memory Settings

1. Press and hold the desired buttons (1, 2 or 3) for more than 1.5 seconds.
2. Driver's seat and outside rearview mirrors start to move. The position memory recall is canceled if moving the vehicle during its operation.
3. Wait until they stop moving.
4. When the position memory recall is completed, the buzzer sounds twice. (If failed, the buzzer sounds three times.)

CAUTION

- **The position memory recall is canceled if operating the seat or the outside rearview mirrors during its operation.**
- **In the vehicle equipped with automatic transmission, the position memory recall is not available if the parking brake is released and the gear shift lever is not in "P" position.**
- **In the vehicle equipped with manual transmission, the position memory recall is not available if the parking brake is released.**
- **If the position memory recall is successfully completed the buzzer sounds twice. If it failed, the buzzer sounds three times.**

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4. INPUT/OUTPUT OF SPWM UNIT

Seat memory power →

Seat sliding, rear lift power →

Seat reclining, front lift power →

Instrument panel:
gear shift lever at "P" position →

In the vehicle equipped with automatic transmission, the position memory recall is not available if the gear shift lever is not in "P" position.

Parking brake operation →

In the vehicle equipped with manual transmission, the position memory recall is not available if the parking brake is released.

Vehicle speed signal →

If vehicle speed is over 3 km/h, the position memory recall is not available.

Outside rearview mirror folding switch  →

Outside rearview mirror adjusting switch →

Power seat control switch  →

Seat memory switch  →

SPWM UNIT

→ **Sliding motor**

→ **Cushion front motor**

→ **Cushion rear motor**

→ **RH outside rearview mirror folding/unfolding motor**

→ **LH outside rearview mirror folding/unfolding motor**

→ **RH outside mirror Up/ Down adjustment motor**

→ **RH outside mirror Left/ Right adjustment motor**

→ **LH outside mirror Up/ Down adjustment motor**

→ **LH outside mirror Left/ Right adjustment motor**

The changes of each motor are always monitored by the sensor in the motor.

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AFFECTED VIN	

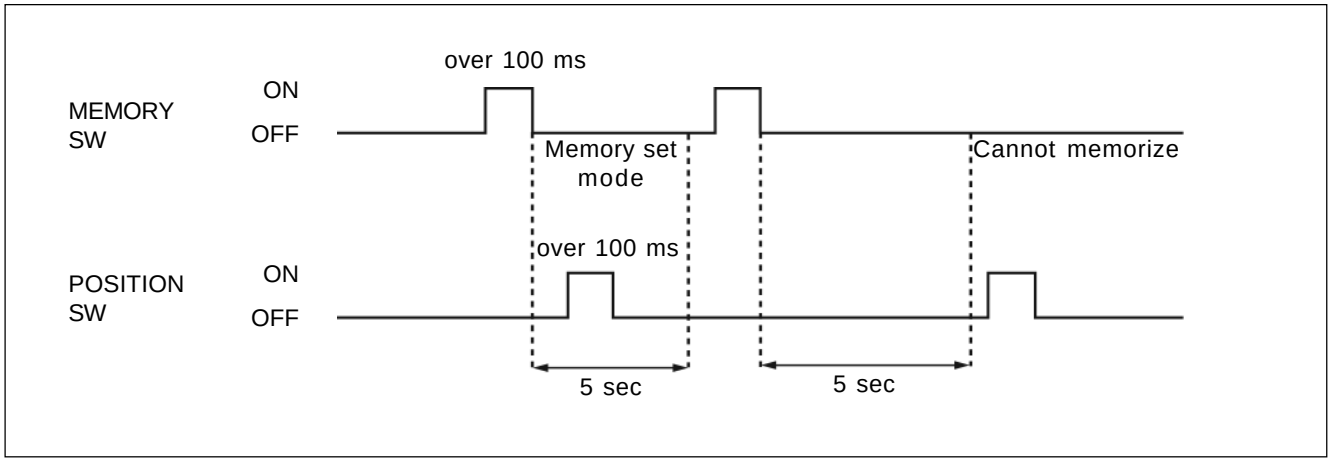
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5. CONTROL AND OPERATING CONDITIONS

▶ Seat Position Memory

Seat Position Memory Operation

1. To store the seat position and the outside rearview mirror position, press the SET button and, within 5 seconds, press one of position switches. The memory setting is available for up to 3 different drivers.
2. The memory set mode is only available within 5 seconds after pressing the SET button.



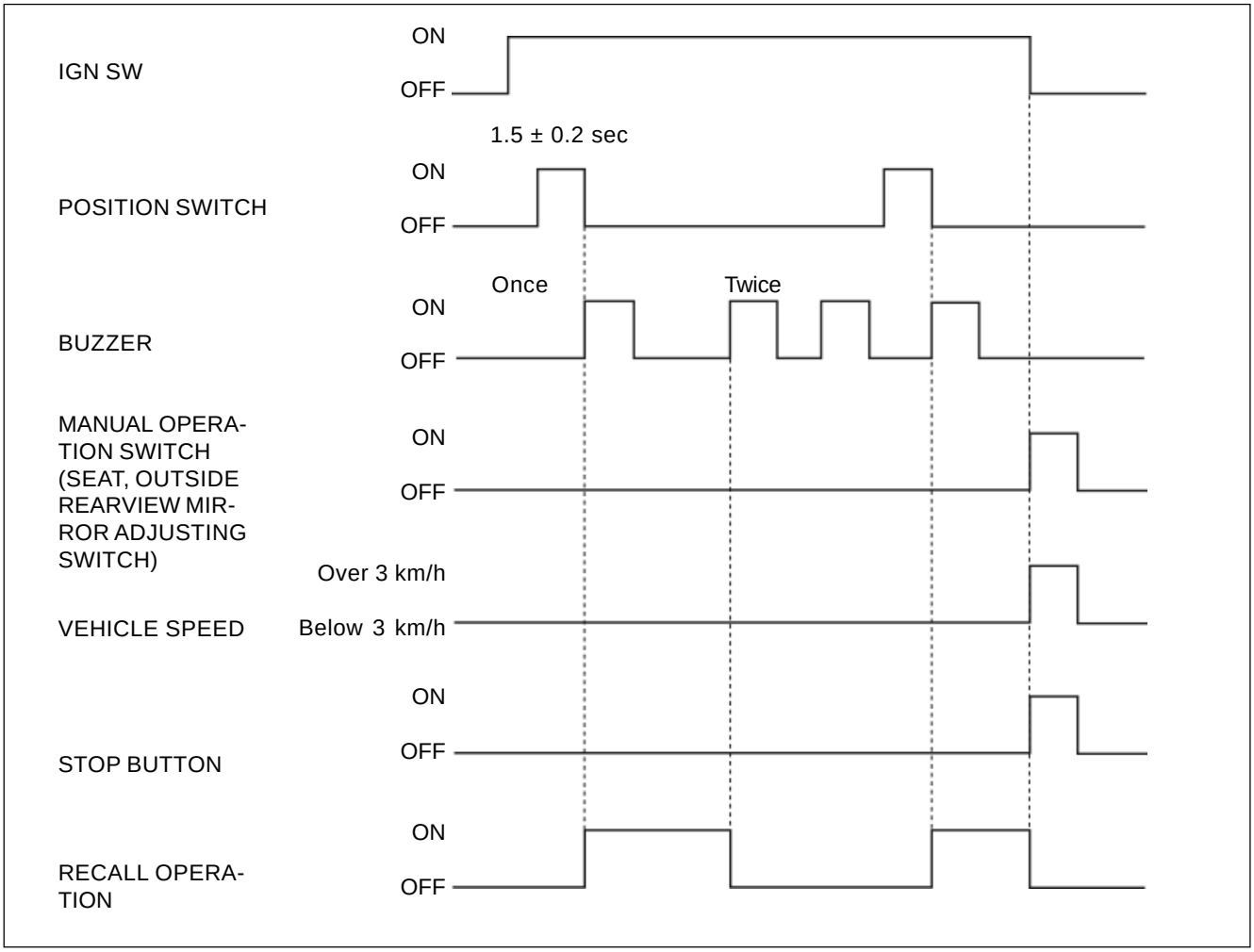
3. If any of the following conditions is met, the memory set mode is canceled.
   1) No switch inputs within 5 seconds after pressing SET button.
   2) When adjusting the seat or outside rearview mirror positions during the memory recall operation.
   3) When turning off the ignition switch.
   4) When pressing the STOP button
   5) When the memory setting is completed.
4. The memory recall is not available when the vehicle speed is over 3 km/h or the gear shift lever is not in “P” position with the parking brake released.
5. The memory set can be unlimitedly renewed.
6. The stored positions are erased when disconnecting the battery cables.
7. The buzzer sounds once if the memory set mode is activated.
8. The buzzer sounds twice if the memory setting/recalling is completed.
9. The buzzer sounds three times if an error is found in the sensor during the memory recall operation.

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Seat Memory Recall Operation

1. When pressing the position switch with the ignition switch ON, the seat and outside rearview mirrors move to the memorized positions.
2. When pressing another position switch during previously activated memory recall operation, the newly pressed position switch takes priority and recalls its stored position.
3. The buzzer sounds once if a position switch is pressed.
4. If any of the following conditions is met, the memory recall function is deactivated.
   1) When turning off the ignition switch.
   2) When the gear shift lever is not in “P” position with the parking brake released.
   3) When the parking brake is released (only for the vehicle equipped with manual transmission)
   4) When the vehicle speed is over 3 km/h.
   5) When pressing the STOP button during the memory recall operation.
   6) When adjusting the seat or outside rearview mirrors during the memory recall operation.
5. The seat will not move unless a position switch has a memory setting.

6. Timing Chart



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AFFECTED VIN	

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▶ POWER SEAT

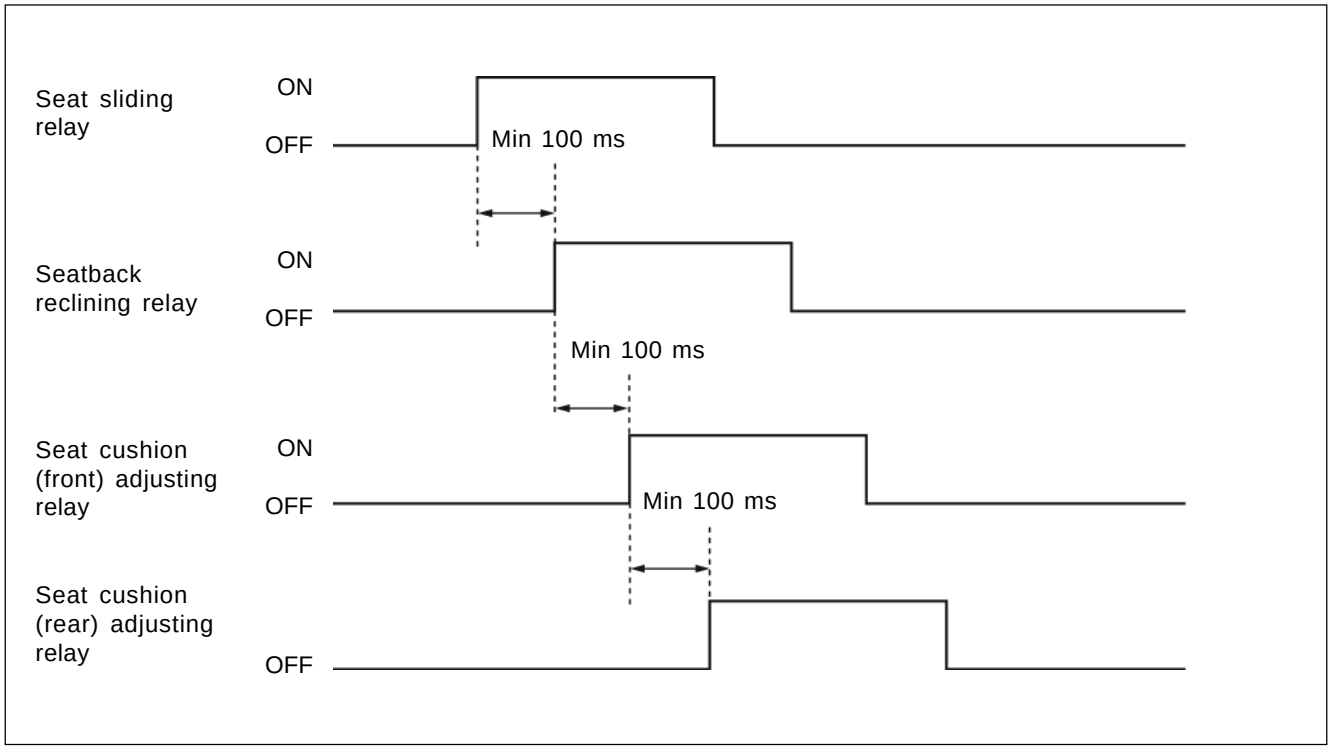
Seat Position Control

1. The position sensor senses the changes of motor in the seat.
2. The seat position is stored by the memory order of position switch.
3. The stored seat position is recalled by the recall order of position switch.
4. The manual adjustment of seat positions takes priority over the memory and recall orders.

Motor Drive Control

1. In the case of the automatic control, each motor drive is delayed for 100 msec to prevent the irruptive current from being overlapped. The priorities are as follows.

   Seat sliding →Seatback reclining →Seat cushion height adjusting (front) →Seat cushion height adjusting (rear)



2. Continuous motor driving time

   Seat sliding: 16 seconds, Seatback reclining: 50 seconds, Cushion height adjusting: 6 seconds

3. Reverse control

   When reversing the control motor, the motor starts to rotate in the opposite direction 100 msec after the forward driving is completed.

4. The motor doesn't operate if the difference between the stored position and the current position is out of the specified range.
   1) Sliding: 12 edges (6 pulses)
   2) Cushion height: 6 edges (3 pulses)
   3) Reclining: 100 mV

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Error Detection

After the motor starts to drive, if the position sensor value doesn't change for about 3 seconds during the seat sliding or seatback reclining adjustment and for 1.6 seconds during the seat cushion height adjustment, it is determined that the harness circuit is open or the sensor failure occurred.

If an error is detected,

The memory recall operation stops. However, the seat can be adjusted by manual switches.

The memory recall operation can be activated after the failure is corrected. This is determined when the system detects the value changes from the position sensor. This is called the Release of automatic control stop

Relay Protection

Once the relay is turned on, it will not be turned off within 60 ms.

Specifications

1. Rated voltage: DC 12 V
2. Operating voltage: DC 9 ~ 16 V
3. Current consumption: Max. 500 mA (not including the load)
4. Operating temperature range: -30°C ~ 75°C
5. Reserve temperature range: -40°C ~ 85°C
6. Parasitic current: Max. 2 mA

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▶ Outside Rearview Mirror (OSRVM)

Mirror Position Control

1. The position sensor senses the changes of motors in the mirrors.
2. The mirror position is stored by the memory order of position switch.
3. The mirror position is recalled by the recall order of position switch.
4. The manual adjustment of mirror positions takes priority over the memory and recall orders.

Motor Drive Control

1. Driving sequence

   Horizontal →Vertical

2. Control during memory recall

   Specifications of the field of vision

   1) Horizontal direction: 1.5 ~ 3.7 V
   2) Vertical direction: 1.5 ~ 3.7 V

Field of vision:

- The control range of mirror that is not limited mechanically.
- The control range of that doesn't affect the sensor characteristics

3. LOCK detection

   Timer monitors the motor driving time to detect LOCK condition.

   1) Monitoring the memory recall time

      If the memory recall operation cannot be finished within 40 seconds after activating it, the system stop the motor output and terminate the control.

Error Detection

Even though the motor runs, if the drive input change (for 5 seconds) from the position sensor doesn't change, it is determined that the harness circuit is open or the motor/sensor failure occurred.

When an error is detected, any memory set or recall operations are prohibited, but the manual operation is possible.

When the sensor input changes by a manual operation, this error is cleared.

Specification

1. Rated voltage: DC 12 V
2. Operating voltage: DC 9 ~ 16 V
3. Current consumption: Max. 300 mA (not including the load)
4. Operating temperature range: -30°C ~ 75°C
5. Reserve temperature range: -40°C ~ 85°C

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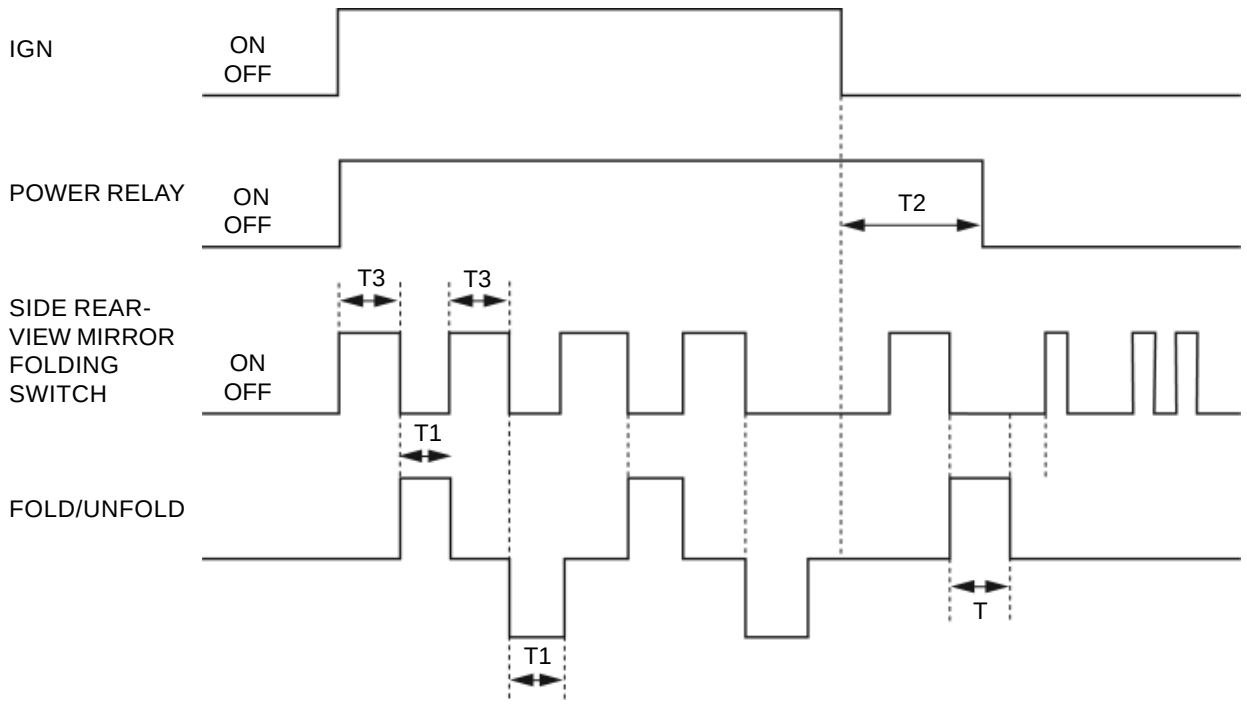
▶ Folding/Unfolding of Outside Rearview Mirror

Operation Logic

1. When pressing the outside rearview mirror folding switch, the outside rearview mirrors are folded.
2. Normal operation mode

   Mode changes between Folding and Unfolding
3. The outside rearview mirrors can be folded and unfolded within 30 ± 6 seconds even after turning off the ignition switch.
4. To prevent the outside rearview mirrors from stopping during its operation, the mirror operating time is extended 13 seconds when pressing the switch again.

Timing Chart



T : T < T1 , T1 : 13 ± 3 sec , T2 : 30 ± 6 sec , T3 : 1 sec ± 0.1 sec

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6. REMOVAL AND INSTALLATION OF SEAT

Driver's Seat (Power Seat)

1. Slide the seat all the way to the rear and remove the seal rail mounting bolts (LH/RH: 14 mm - 1EA).



Installation Notice

Tightening torque	35 ~ 55 Nm

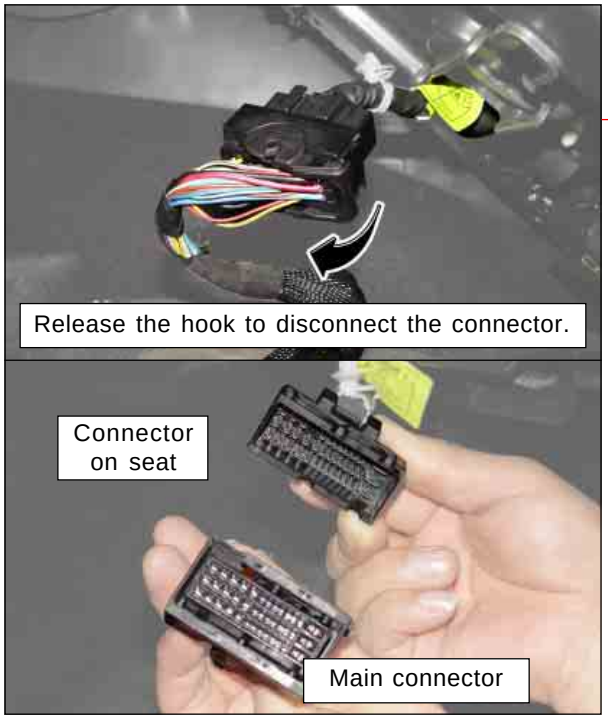
2. Slide the seat to the front stop and remove the seat rear mounting bolts (LH/RH: 14 mm - 1EA).



Installation Notice

Tightening torque	35 ~ 55 Nm

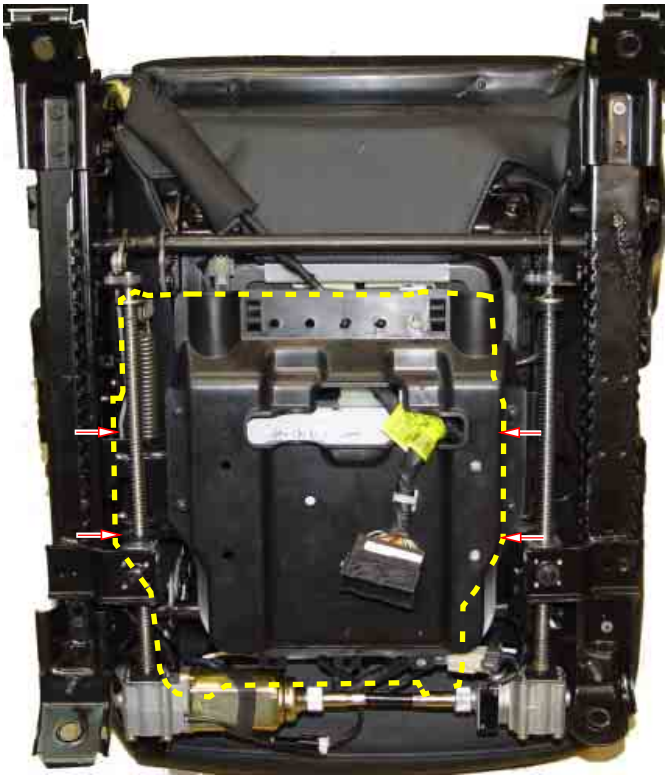
3. Pull up the seat and disconnect the harness connector. Remove the seat assembly.



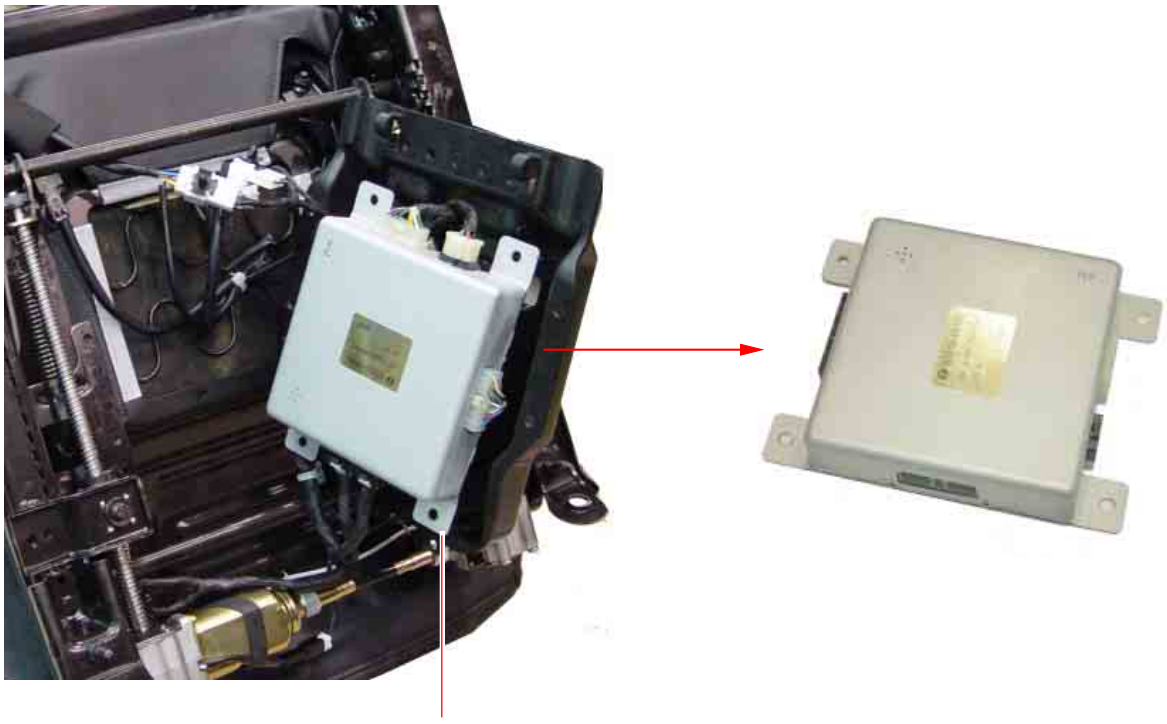


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4. Unscrew the screws (arrows) and remove the protective cover.



5. Disconnect the harness connector and remove the SPWM unit.



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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 18
4. Electrical wiring diagrams 21

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INSTRUMENT CLUSTER

The instrument cluster sends and receives the data through CAN communication.
The HDC warning light and the engine hood open warning light are newly introduced.

1. DESCRIPTIONS OF INDICATOR DISPLAY



1. Tachometer
2. Speedometer
3. Left turn signal indicator
4. Right turn signal indicator
5. Engine coolant temperature gauge
6. Fuel gauge
7. Engine overheat warning light
8. Fog lamp indicator
9. High beam indicator
10. Door ajar warning light
11. Sea belt reminder (passenger's seat)
12. Brake warning light
13. Low fuel level warning light
14. Winter mode indicator
15. ESP warning light
16. 4WD HIGH indicator
17. Battery charge warning light
18. Air bag warning light
19. HDC indicator
20. Immobilizer indicator
21. Water separator warning light
22. Seat belt reminder (driver's seat)
23. 4WD LOW indicator
24. 4WD CHECK warning light
25. Auto shift indicator (for automatic transmission)
26. ODOmeter/ Trip odometer
27. ABS warning light
28. EBD warning light
29. Engine hood open warning light
30. Glow indicator
31. Engine check warning light
32. Engine oil pressure warning light
33. Auto cruise indicator

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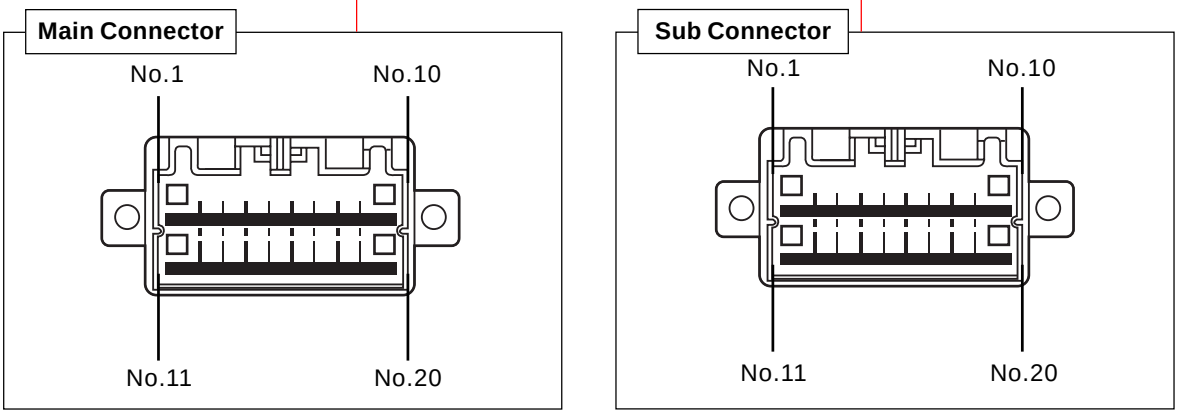
▶ Configuration

Front View



Rear View

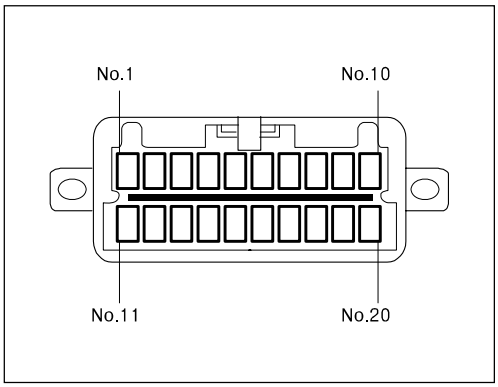




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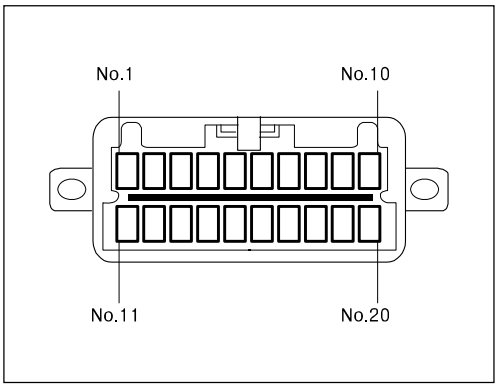
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Connector Pin Arrangement



Main Connector - 20 pins

1. A/T N (Neutral) output
2. Hood open
3. Seat belt (passenger)
4. SSPS
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. RESET / MODE switch
14. M/T N (Neutral) input
15. M/T P (Parking) input
16. CAN Low
17. CAN High
18. AGND (Fuel -)
19. MGND (Micom -)
20. IGN

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▶ 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	

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.

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Speedometer



The speedometer indicates the vehicle speed by calculating the signals from the rear (right 8 LEFT) wheel speed sensor through ABS or ESP unit. In this model, the wheel speed sensor is installed at the rear 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.

1. ABS/ESP (equipped): ABS/ESP ECU (208h), RR RH wheel speed sensor
2. ABS/ESP (not equipped): ENG ECU (320h), RR RH wheel speed sensor

If the speedometer pointer vibrates, stands at a certain range or sounds abnormal noise, there could be defectives in speedometer. However, these symptoms also could be appeared 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 pointer 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.**

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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.

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Coolant Temperature Gauge



The coolant temperature gauge displays the coolant temperature with a pointer. The angle of pointer that changes 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 - 2449W ± 5%
50°C - 826W ± 5%
80°C - 321W ± 5%
100°C - 12W ± 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.

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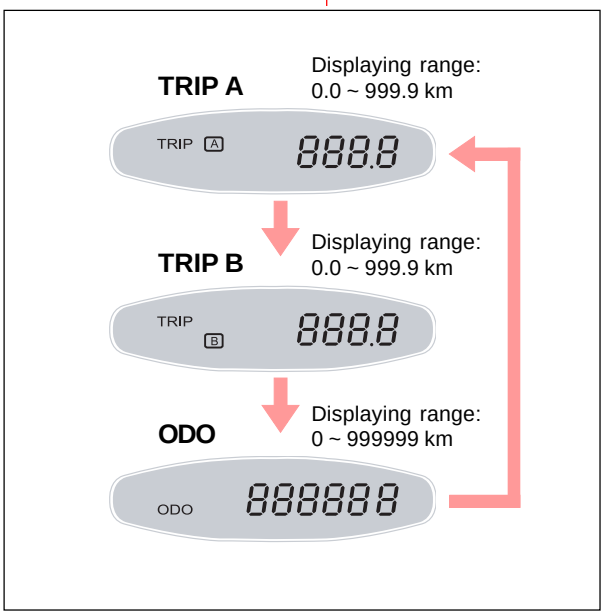
TRIP ODOmeter (TRIP A, TRIP B) and ODOmeter



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.





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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

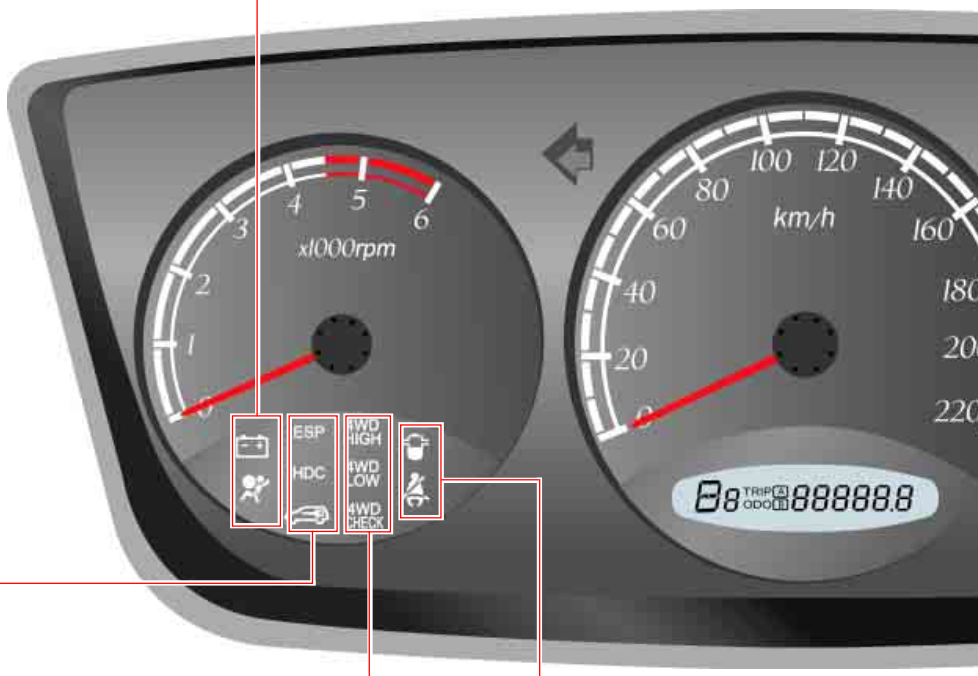
This indicator comes on when the ignition key is communicating with the engine control unit (during engine starting) for approx. 0.5 seconds.

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.



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 LOW Indicator
When shifting the driving mode between "4WD LOW" and "4WD HIGH", this indicator blinks until the shifting operation is completed. After completion of mode change, the indicator goes out.

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.

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.

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Over Temp. Warning Light

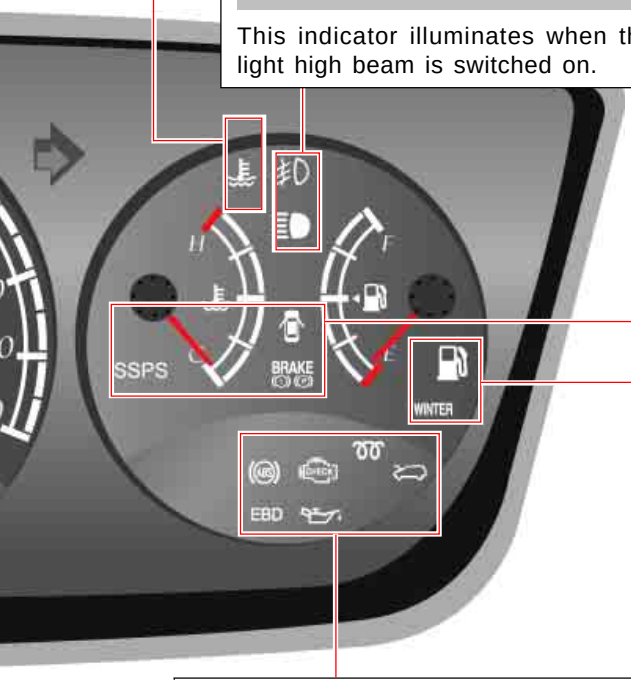
When the engine coolant temperate is abnormally hot (over 120ºC), the engine overheat warning light blinks and a warning buzzer sounds. (check the coolant system)

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.



SSPS Warning Light

This warning light comes on when the SSPS system is defective. When this warning light comes one, the steerability becomes heavy.

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.

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.

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.

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.

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▶ 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> 
</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</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="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:

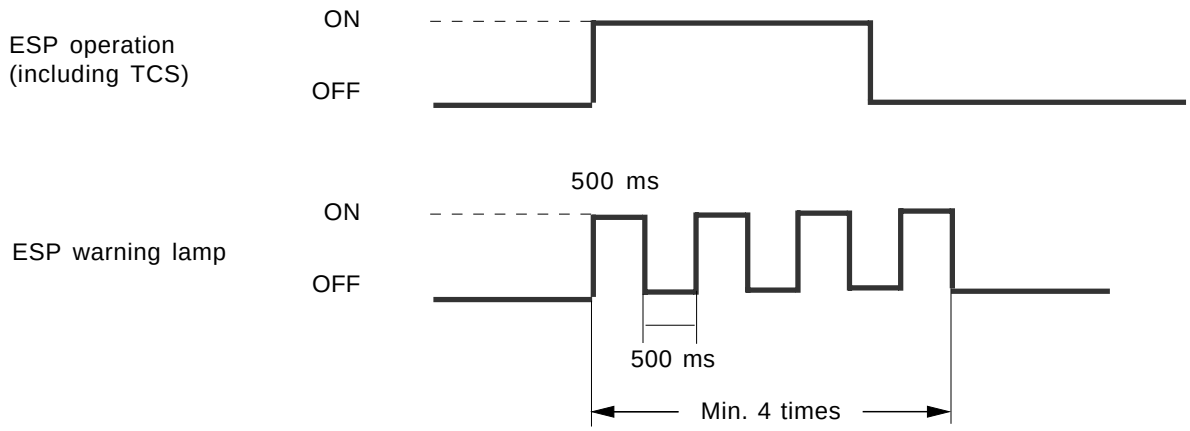
- **Initial ignition ON**
- **HDC system error occurs**
- **Brake system overheat**

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▶ 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.**

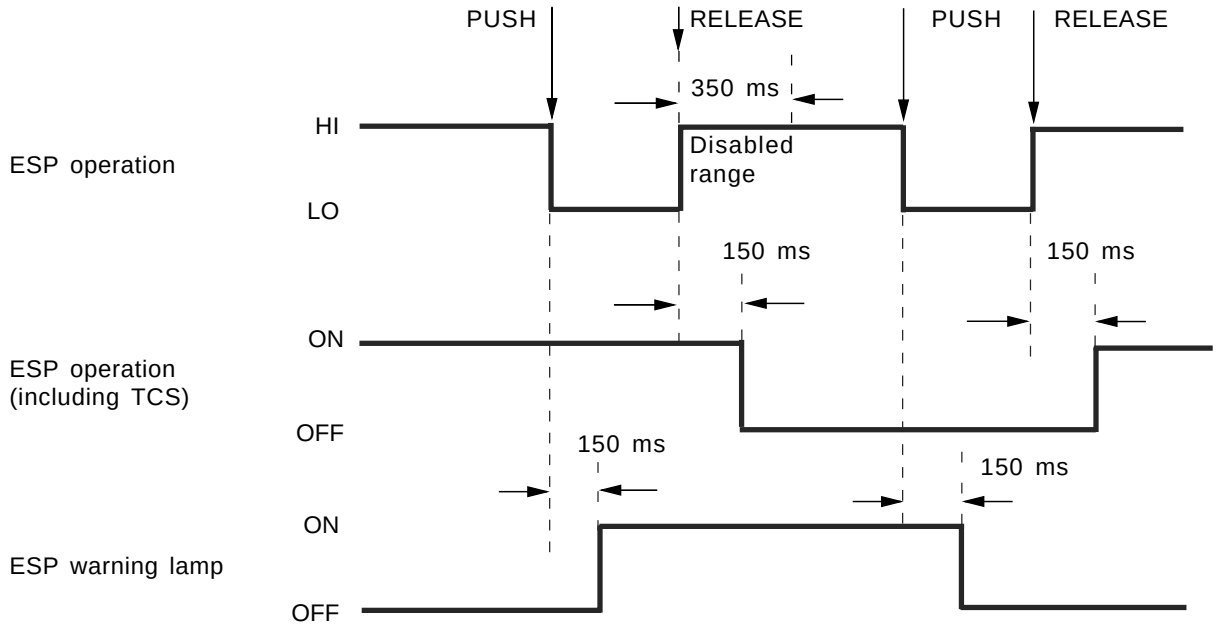
Resuming the ESP System by Using the ESP OFF Switch

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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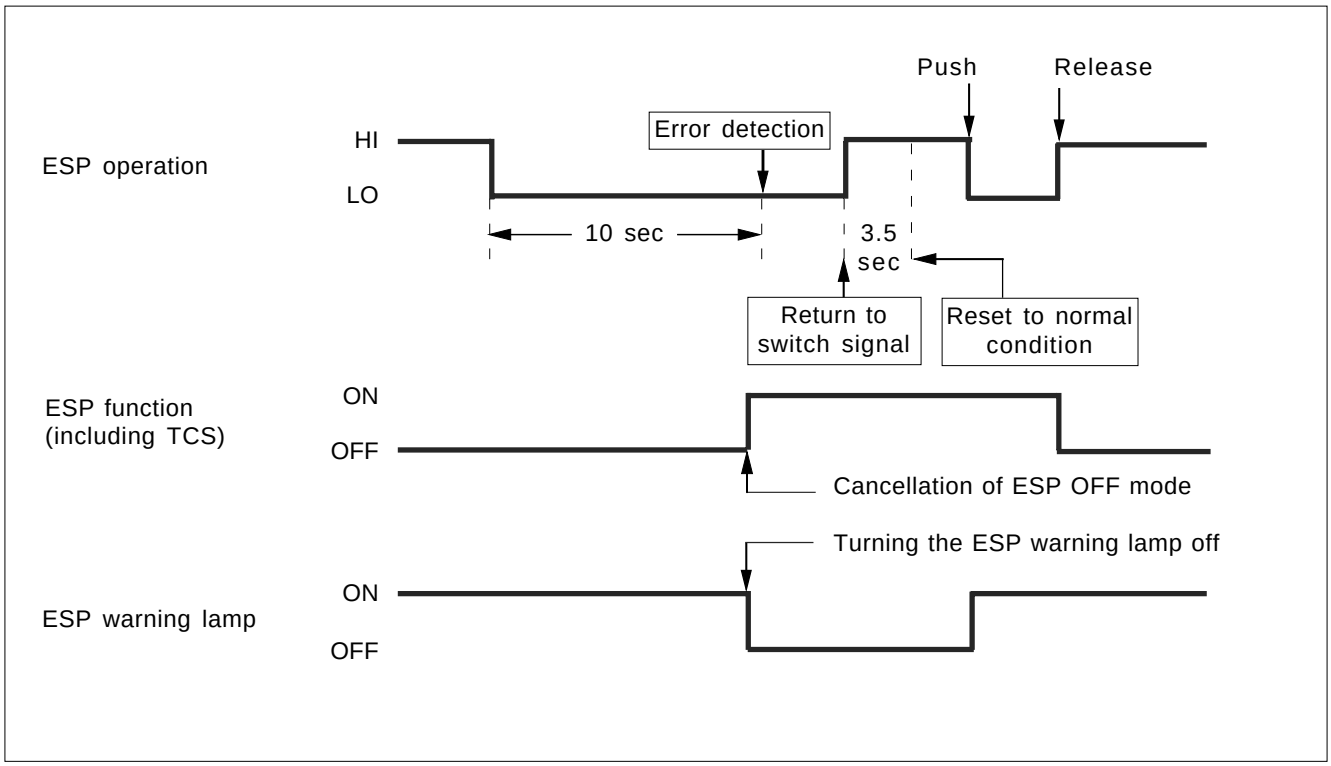
NOTICE

- **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.

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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 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.**

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Reasons why N Switch Signal is Transmitted to Instrument Panel *(1)

1. HDC operation signal

The HDC function operates when the HDC switch is turned on with gear shift lever is in forward/reverse driving positions. Vehicles with the automatic transmission receive the signal from the gear shift lever unit and vehicles with manual transmission receive the neutral signal from the N (neutral) switch.

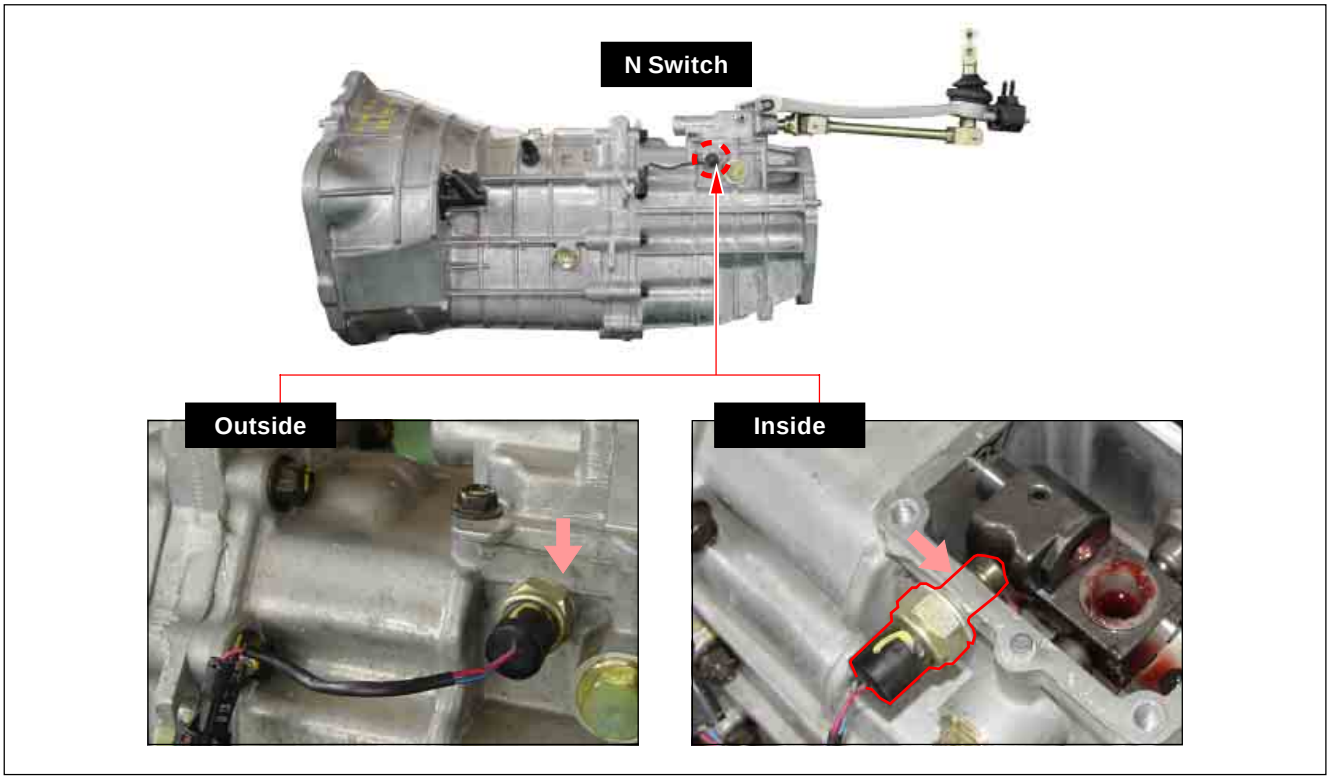
1) Manual transmission: operates in the 1st gear or reverse gear position (does not operate in the neutral position).
2) Automatic transmission: operates in all hear positions except P (parking) and N (neutral) position.

The vehicle with the manual transmission doesn't have a independent device or switch that detects the 1st gear position. It detects only the forward/reverse direction through the rear light switch and the neutral switch, and cannot solely detect the 1st gear position. The reason for noting the 1st gear above, although the HDC also operates at over the 2nd gear, is because the engine may be turned off during the HDC operation.

The HDC operates on the very steep road. Thus, it should be used only when the transmission is in the 1st gear position.

2. Raising the RPM in vehicles with the manual transmission.

This switch detects whether the gear is in N position or in other positions. The instrument cluster sends the signal to the engine ECU. The engine ECU receives the N switch signal, the vehicle speed, the clutch operating conditions, and the engine coolant temperature and raises the engine speed by 100-200 rpm. This helps the vehicle start smoothly during gear shifting.



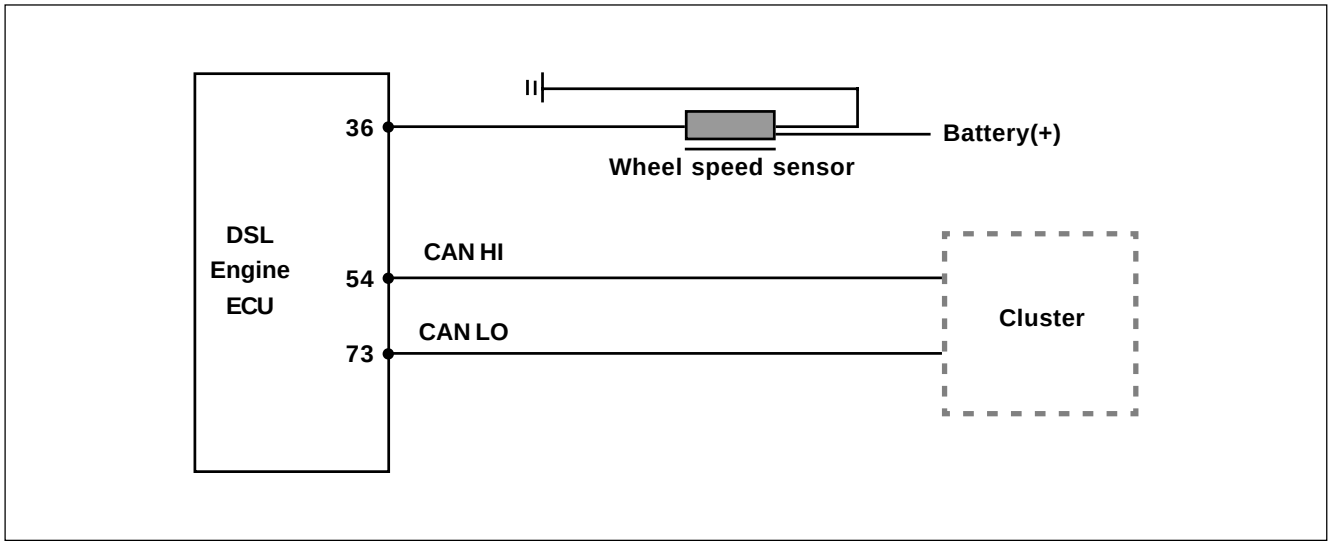
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Vehicle Speed Input to Non-ABS Equipped Vehicle

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.



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3. REMOVAL AND INSTALLATION OF METER CLUSTER

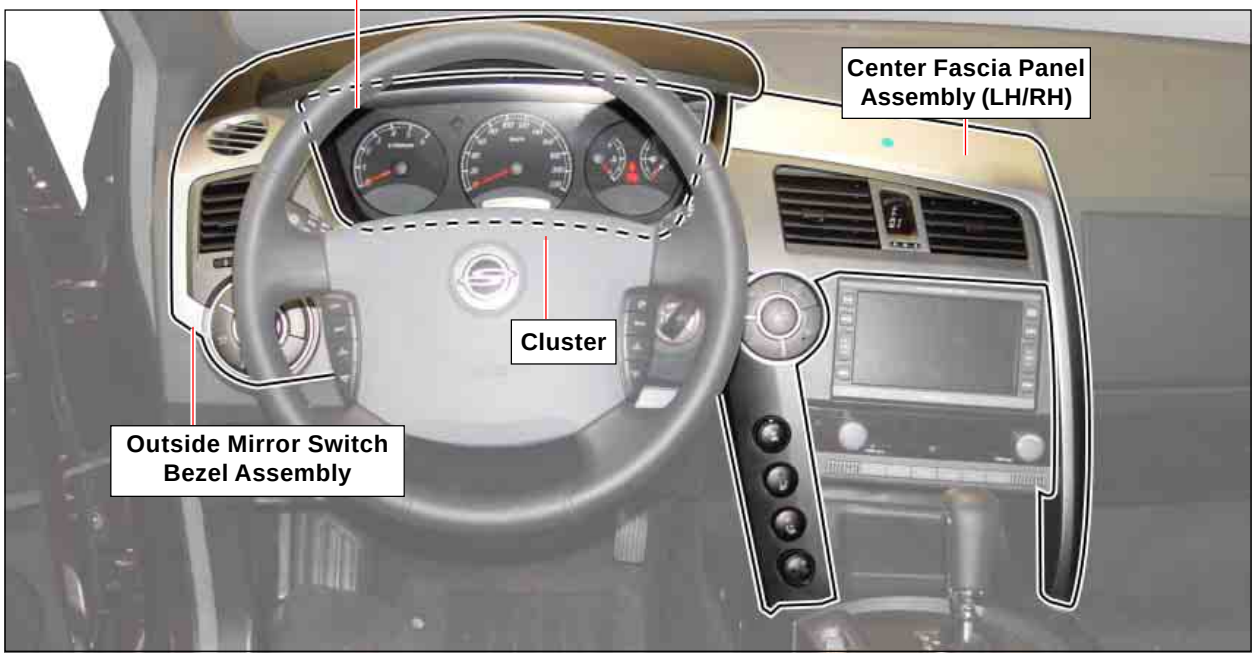
※ **Preceding Works:** Disconnect the negative battery cable.

▶ Location

Cluster







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Removal and Installation

1. Remove the left center fascia panel and unscrew three mounting screws on the hazard switch bezel assembly.

NOTE
- **Remove the bottom of the center fascia panel first.**
- **For details, refer to "Removal and Installation of Instrument Panel".**



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.**

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4. Unscrew four cluster mounting screws.



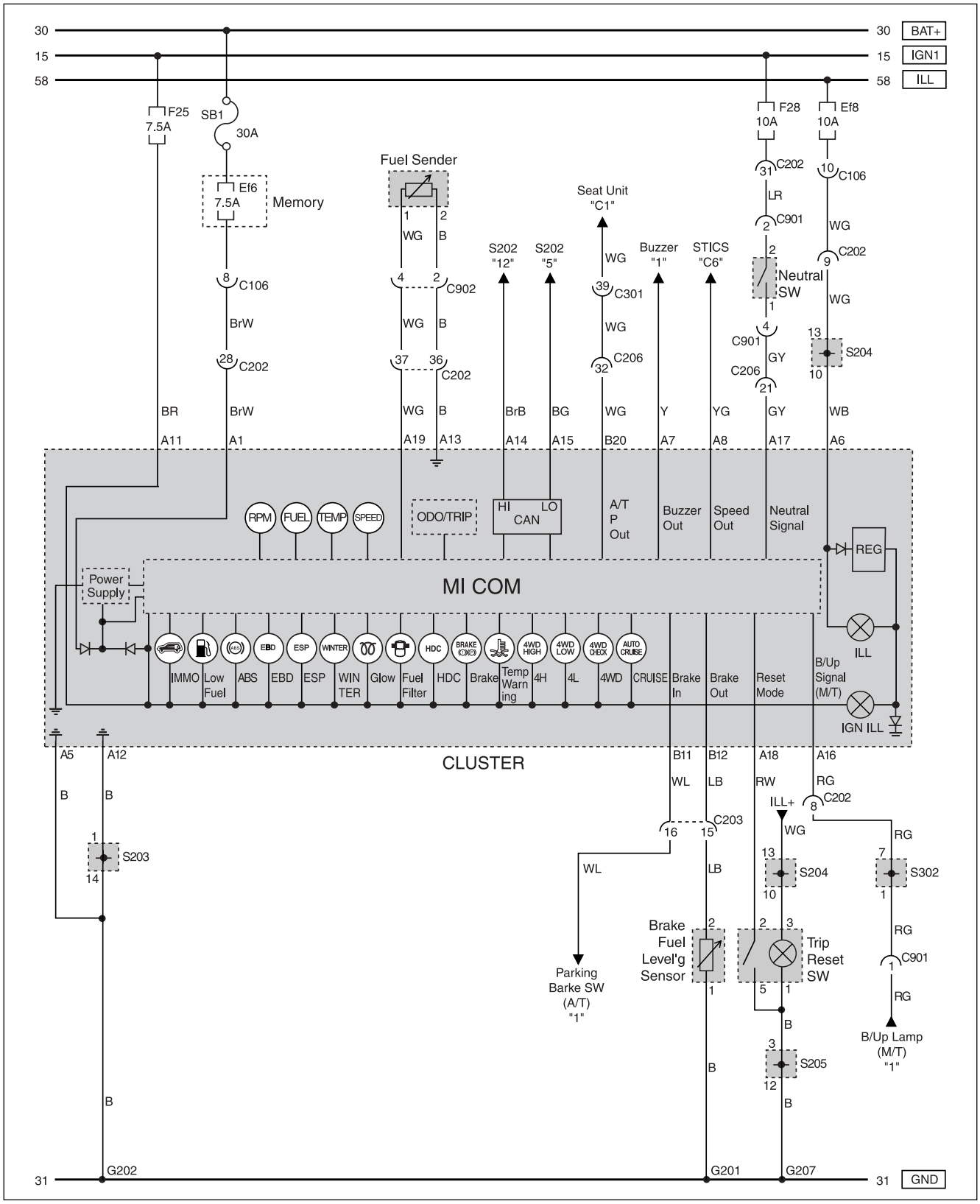
5. Disconnect the connectors from the back of meter cluster and remove the cluster from the instrument panel.



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4. ELECTRICAL WIRING DIAGRAMS

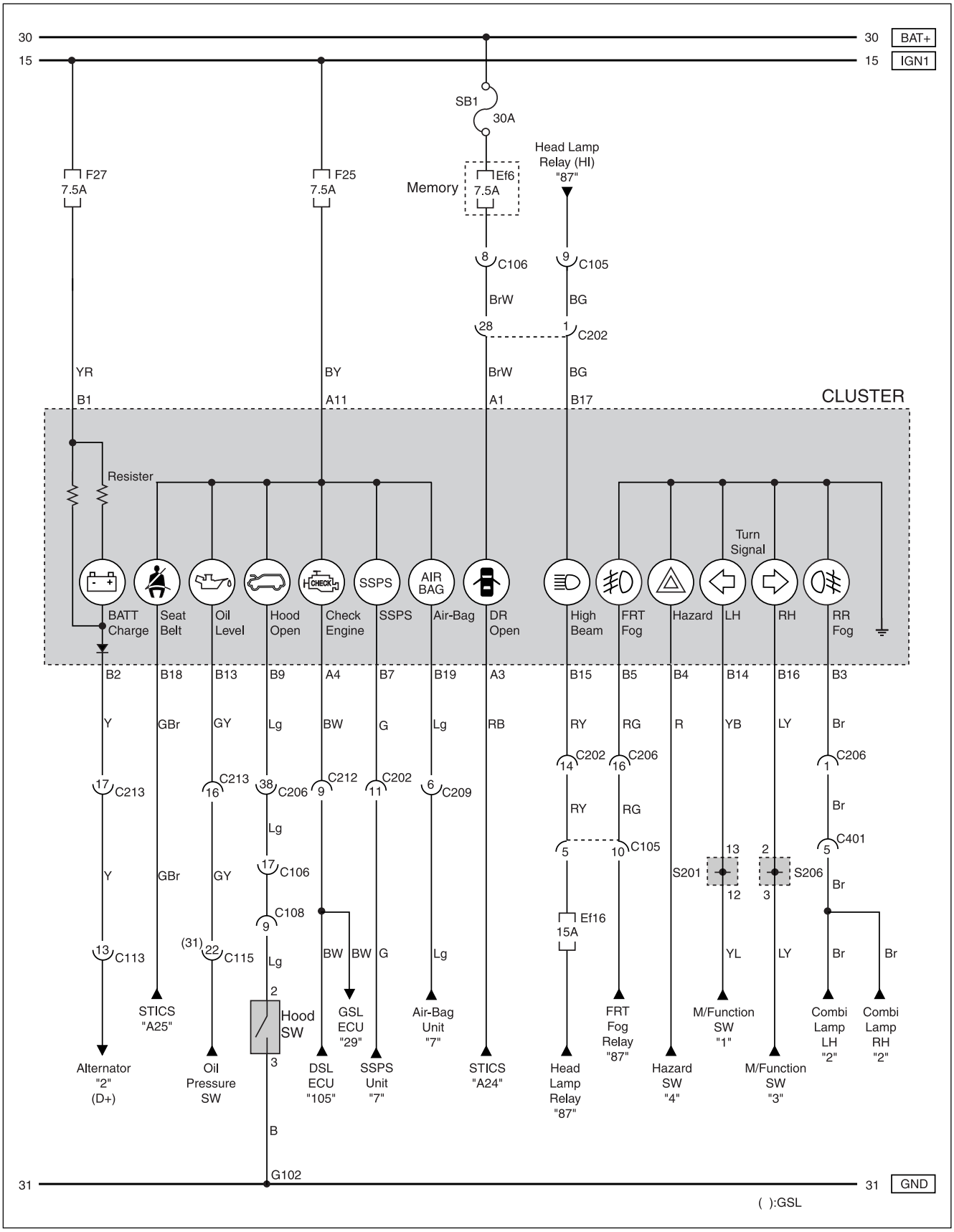
▶ Gauge (speed, RPM, fuel, temp), Warning Lamp (fuel, fuel filter, ABS/ ESP, brake, HDC, 4WD)



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▶ Warning Lamp (batt charge, oil, hood, door, eng check, air bag, ssps, seat belt), Turn Signal, Fog Lamp, Hazard



CLUSTER

KYRON SM - 2005.09

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AFFECTED VIN	

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SWITCHES / ELECTRIC DEVICES

8510 / 7770 / 8610 / 7632 / 7610

TABLE OF CONTENTS

SWITCH ARRANGEMENT 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
5. Center fascia switch bezel assembly 19
6. Removal and installation of hazard & bezel switch assembly 21

OUTSIDE REARVIEW MIRROR SWITCH BEZEL ASSEMBLY 27

1. Location 27
2. Switch arrangement 28
3. Switches in outside rearview mirror switch bezel assembly 29
4. Removal and installation 36

OVERHEAD CONSOLE SWITCH 41

1. Location 41
2. Components 42
3. Switches in overhead console switch assembly 43
4. Removal and installation of overhead console switch 50

SWITCH ASSEMBLY ON DRIVER'S DOOR ARMREST 53

1. Locations and functions 53
2. Switch arrangement and appearance 54
3. Power window operations 55
4. Circuit diagram of power window 56
5. Central door lock/unlock switch 58
6. Removal and installation of power window switch 64

SEAT POSITION MEMORY SWITCH 72

1. Location and functions 72
2. Switch arrangement 73
3. Exploded view 74
4. Output voltage in each switch position 74
5. Functions and operations 75
6. Removal and installation of seat position memory switch 77
7. Electrical diagram of power seat & outside rearview mirror 79

AUDIO REMOTE CONTROL SWITCH ON STEERING WHEEL 81

1. Locations and functions 81
2. Components 82
3. Circuit diagram 83
4. Removal and installation 84

MULTIFUNCTION SWITCH 86

1. Overview 86
2. Functions and operations 87
3. Operating range 90
4. Connector pin arrangement 91
5. Removal and installation 92

DIGITAL CLOCK 96

CIGARETTE LIGHTER 98

POWER OUTLET 100

HORN (INCLUDING THEFT WARNING HORN) 103

1. Location 103
2. Electrical wiring diagram of horn 104
3. STICS control for theft deterrent mode 105
4. Removal and installation 110

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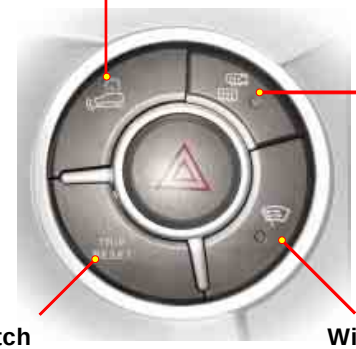
SWITCH ARRANGEMENT

Outside Rearview Mirror Folding Switch
To fold the outside rearview mirrors, press the switch. To unfold the mirrors, press it again.



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.)



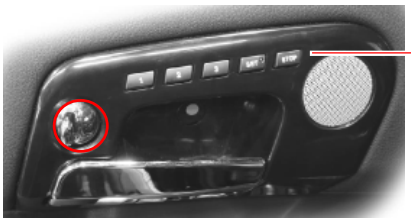
Tailgate Glass and Outside Rearview Mirror Heated Glass Switch
Press this switch to turn on the tailgate and outside rearview mirror defogger. It will operate for about 12 minutes.

TRIP Switch
To choose a desired driving distance display mode, press the switch: Changing sequence: ODO - TRIP A - TRIP B - ODO

Windshield Heated Glass Switch
Press this switch to turn on the windshield heated glass. It will operate for about 12 minutes.



Seat Position Memory Switch



The position memory is available for up to three drivers. Each driver can set his/ her own driver's seat and outside rearview mirrors' positions and it will be separately stored in the integrated computer. If somebody has moved the seat, the memory positions can be recalled automatically by pressing the position button.

Driver's Power Window Switch



Driver can controls all door windows (Open/Close/Lock/Unlock) and doors (Lock/Unlock) with this switch unit.

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EFFECTIVE DATE	
AFFECTED VIN	

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Additional Functions of Multifunction Switch

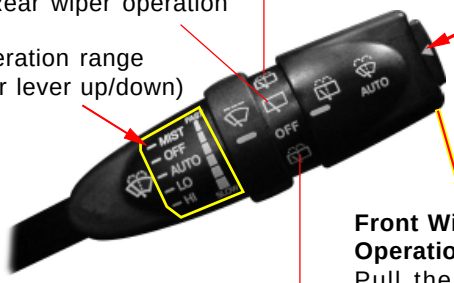


Auto light position

Washer fluid will be sprayed onto the rear window glass once during rear wiper operation.

Rear wiper operation

Front wiper operation range (move the wiper lever up/down)

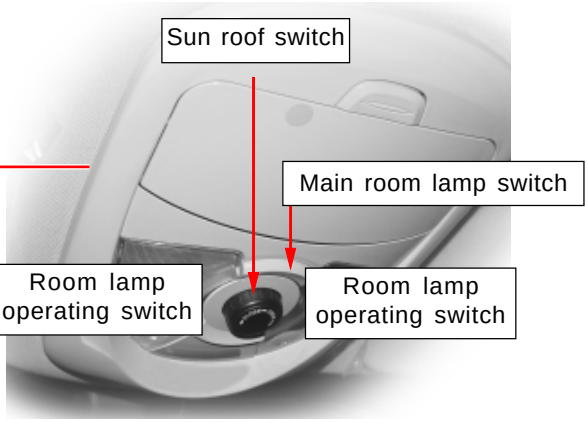


Washer fluid will be sprayed onto the rear window glass and the wiper will also operate once.

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.

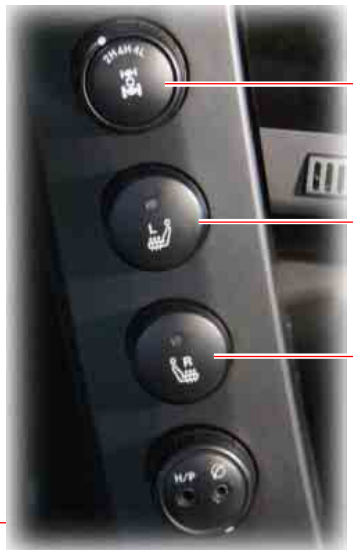
Front Wiper and Washer Coupled Operation
Pull the lever briefly (below 0.6 seconds): One wiping cycle
Pull and hold the lever for more than 0.6 seconds: Three wiping cycles with washer spray







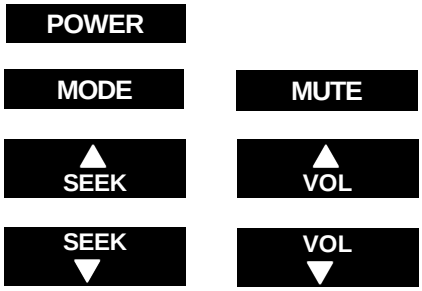
Audio Remote Control Switch



T/C Control Switch

Driver's Seat Warmer Switch

Passenger's Seat Warmer Switch



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CENTER FASCIA & BEZEL SWITCH ASSEMBLY

1. LOCATION

The center fascia switch consists of hazard switch bezel assembly, T/C control switch and seat warmer switch.



Center Fascia Assembly

[Front View]



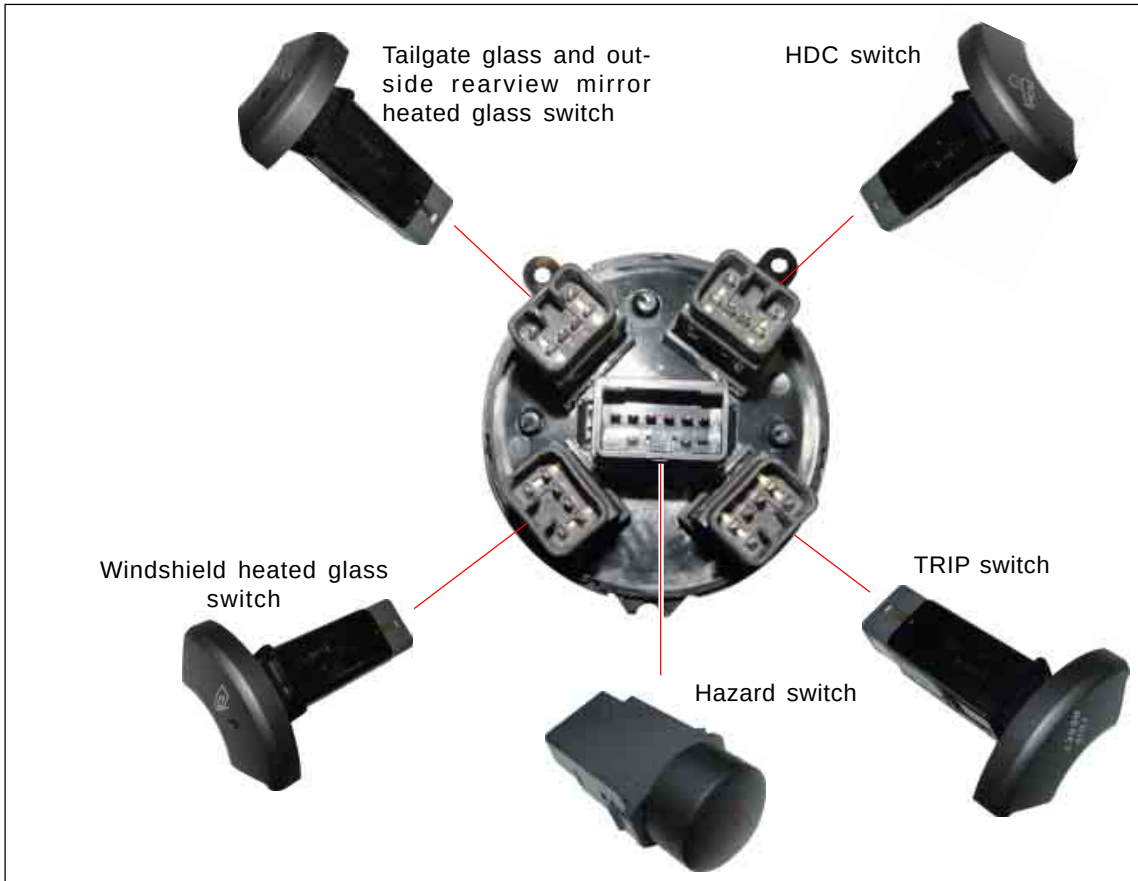
[Rear View]



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2. SWITCH ARRANGEMENT









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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.**



Tailgate Glass & Outside Rearview Mirror Heated Glass Switch

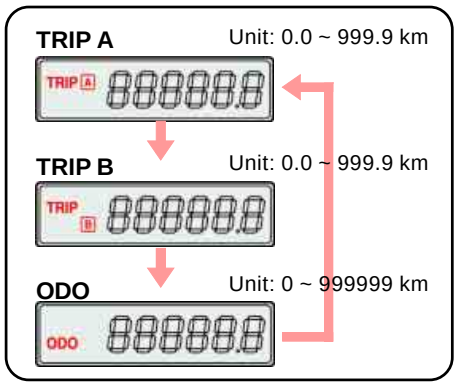
1. Press this switch to turn on the tailgate and outside rearview mirror heated glass. It will operate for about 12 minutes.
2. Press the switch again to stop the operation.
3. This switch is designed to defrost and defog on tailgate glass and outside rearview mirrors.
4. The heated glass will operate 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.

Hazard Switch

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.



Windshield Heated Glass Switch

This switch is designed to defrost and defog on windshield.

1. Press this switch to turn on the windshield heated glass. It will operate for about 12 minutes.
2. Press the switch again to stop the operation.
3. The indicators in the switch come on when in use.

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T/C Control Switch

Choose a proper mode according to the road conditions.

4WD HIGH

This indicator blinks during mode changes to 4 H mode, then goes off after completion of mode change.

4WD LOW

This indicator blinks during mode changes to 4 L mode, then goes off after completion of mode change.

4WD CHECK

This warning light comes on when the 4WD system is defective.

Driver's Seat Warmer Switch

Passenger's Seat Warmer Switch

Headlight Leveling Switch

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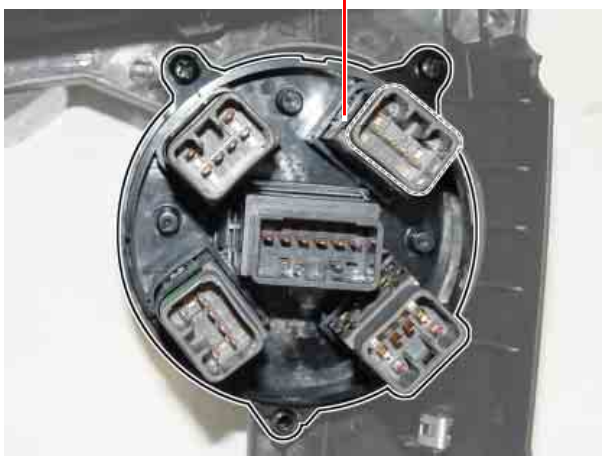
4. SWITCHES IN HAZARD & BEZEL SWITCH ASSEMBLY

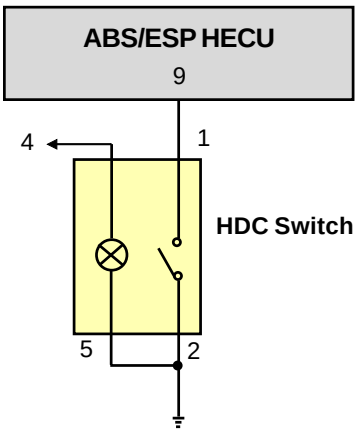
▶ HDC Switch

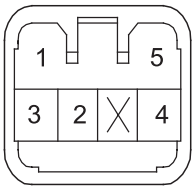
Overview

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-)	○	⊗

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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.

HDC Operation Mode			HDC Indicator	HDC Warning Lamp
			Green	Red
			HDC	HDC
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.)			OFF	ON (goes off after 1.8 seconds)
Not available	HDC switch OFF		OFF	OFF
	HDC system error		OFF	ON
Stand-by	HDC switch ON		ON	OFF
	The HDC switch is turned ON, but HDC system is in stand-by mode because the operating requirements are not met.			
In operation	HDC system is operating.		Blinking (0.5 second of interval)	OFF
	The HDC switch is turned ON, and the operating requirements are met. HDC is operating with operating sound.			
System overheat	High brake system temperature (over 350°C)	HDC stand-by mode	OFF	Blinking
		HDC is operating	Alternate blinking of green and red lamp (0.5 second of interval)	
	Too high brake system temperature (over 450°C)		OFF	ON
	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).			

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**

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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%)

4L mode: vehicle speed below 25 km/h (operation slope level: 10%, termination slope level: when it reaches 5%)

Reverse driving

2H/4H mode: vehicle speed below 50 km/h (operation slope level: 8%, termination slope level: when it reaches 5%)

4L mode: vehicle speed below 25 km/h (operation slope level: 8%, termination slope level: when it reaches 4%)

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)

3) HDC target speed in 4L mode

Forward and reverse driving: 3 km/h

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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.

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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 the selector lever unit**

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 sounds an abnormal noise and brake pedal may be very rigid, but this is a normal condition due to HDC operation.

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▶ Tailgate/Outside Rearview Mirror Heated Glass Switch

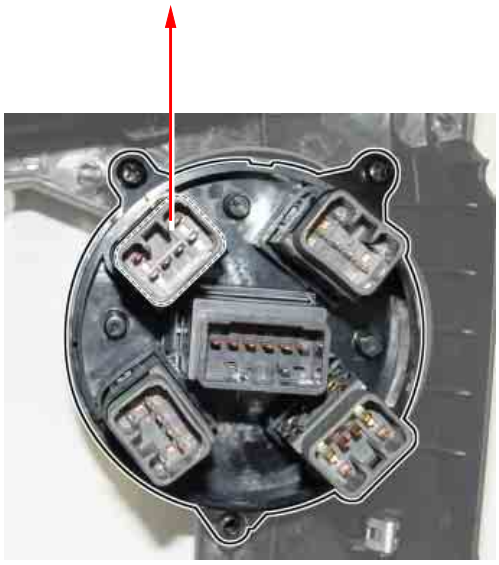
Overview

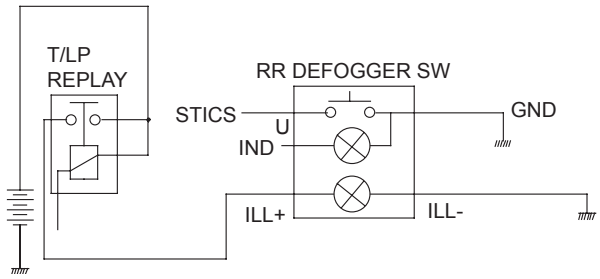
Tailgate/Outside rearview mirror heated glass switch is a Push & Self Return type switch.

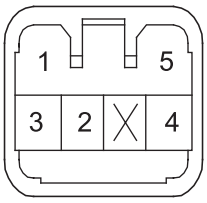
1. The outside rearview mirror & tailgate glass defogger operates for approx. 12 minutes when pressing this switch while the ignition switch is turned on.
2. It stops when pressing the switch again during its operation.
3. If pressing this switch again within 10 minutes after completion of first operation, it will operate for about 6 minutes.
4. It stops when the ignition switch is turned to “OFF”.









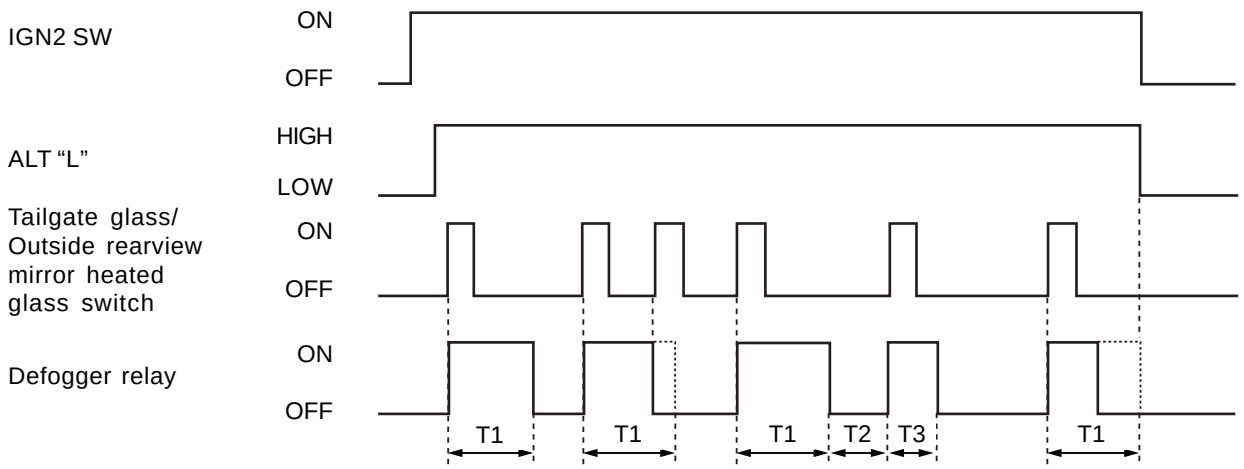


	ON	OFF
1(U)	○	
2(GND)	○	⊗
3(IND)	○	⊗
4(ILL+)	○	⊗
5(ILL-)	○	⊗

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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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▶ Windshield Heated Glass Switch

Overview

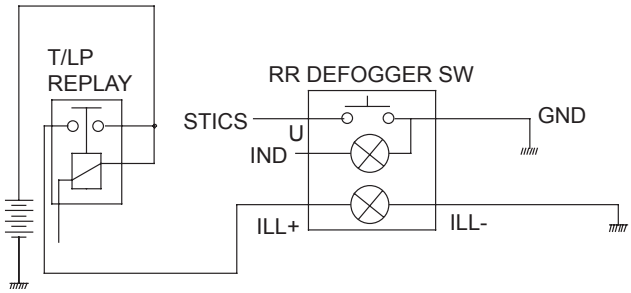
Windshield heated glass switch is a Push & Self Return type switch.

1. The windshield 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”.

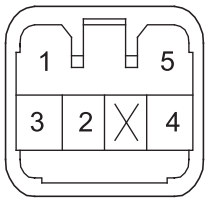






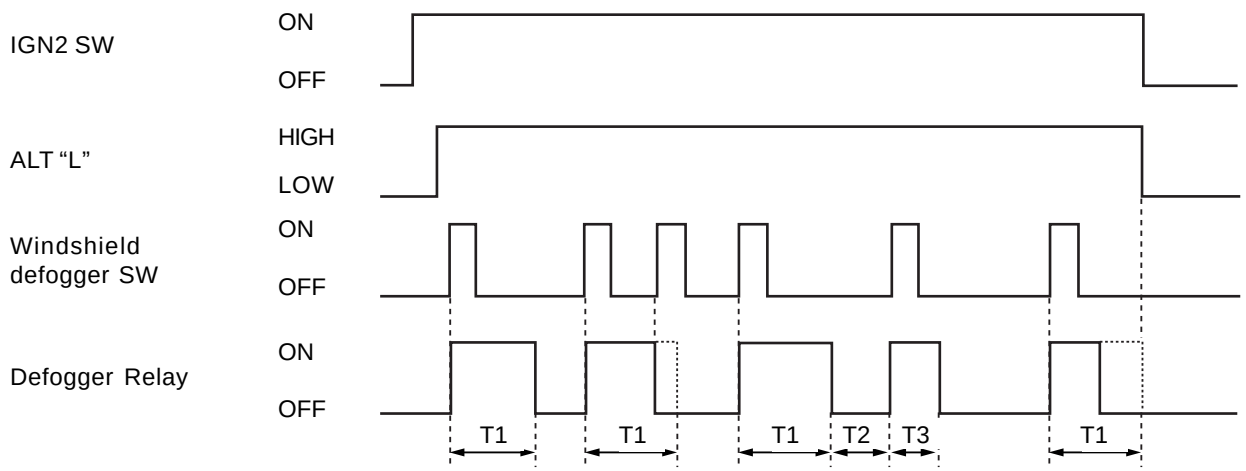


	ON	OFF
1(U)	○	
2(GND)	○	⊗
3(IND)	○	
4(ILL+)	○	⊗
5(ILL-)	○	



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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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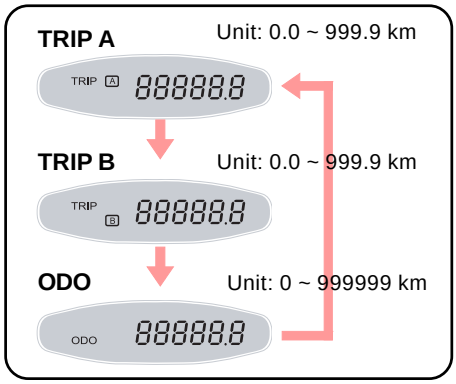
▶ TRIP Switch

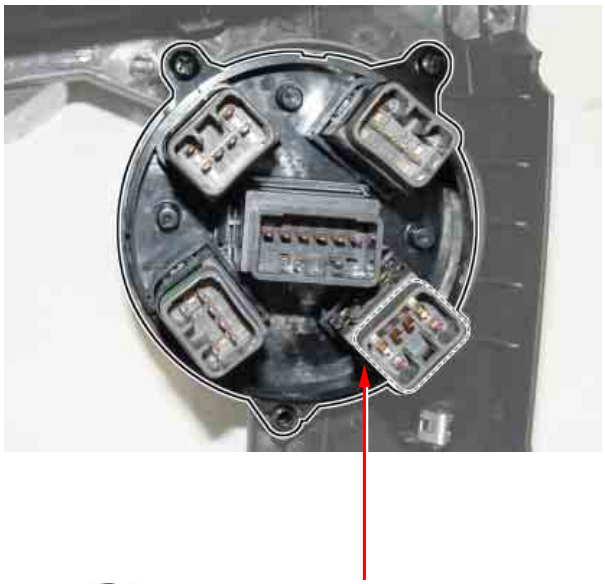
Overview

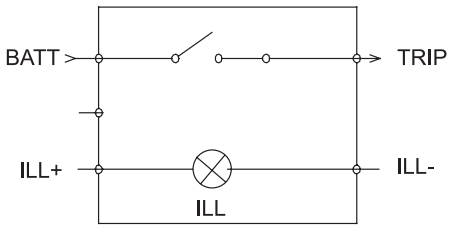
Trip switch is a Push & Self Return type switch.

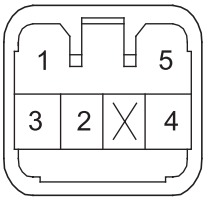
To choose a desired driving distance display mode, press the switch: Changing sequence: ODO - TRIP A - TRIP B - ODO

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-)	○	⊗

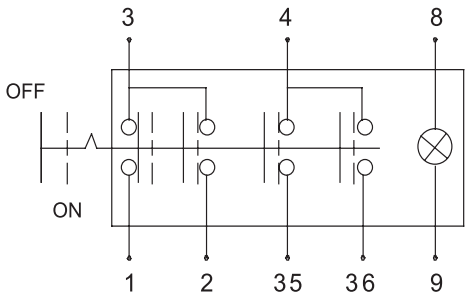
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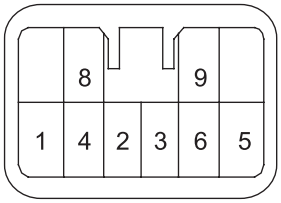
▶ Hazard Switch

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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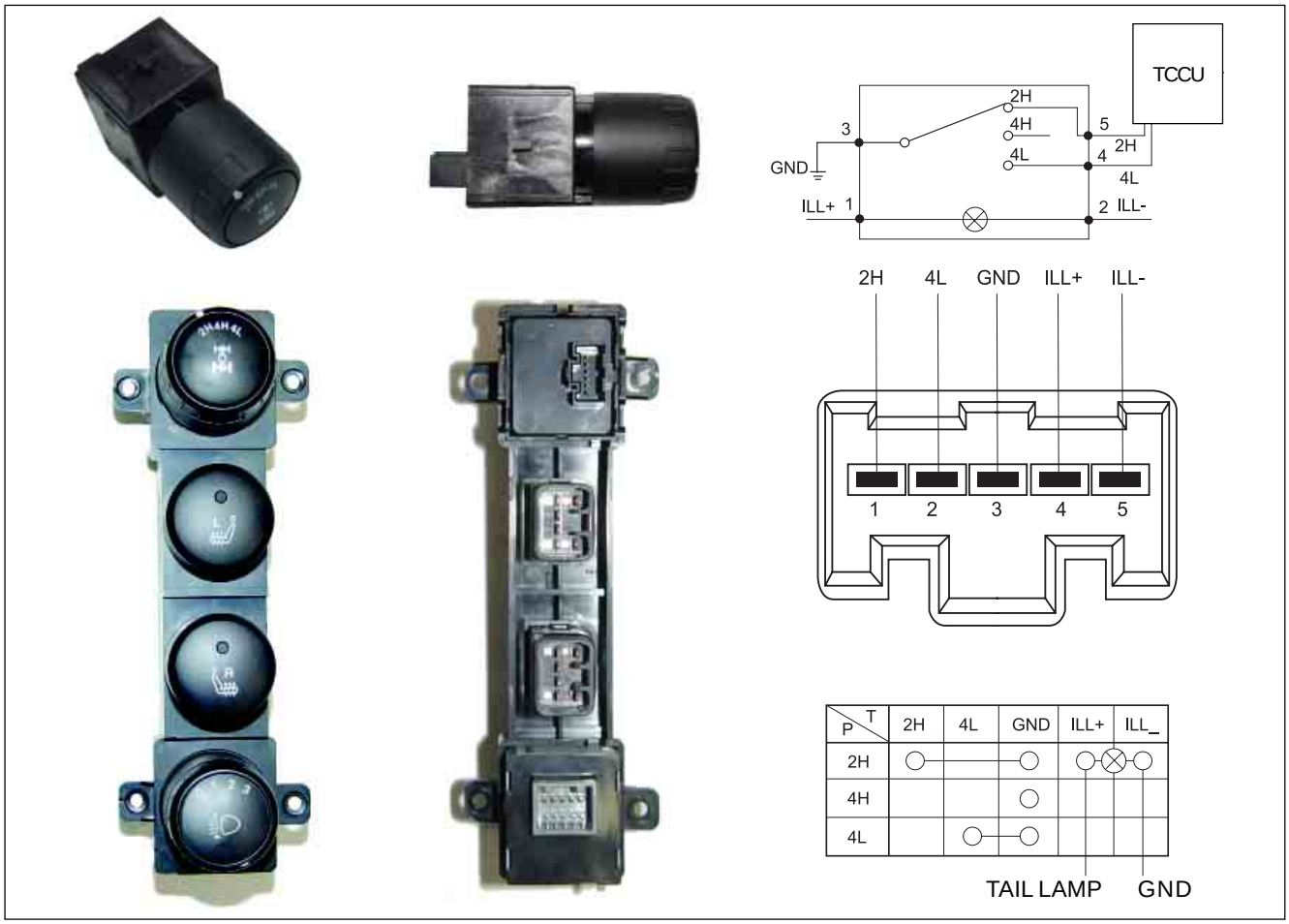
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5. CENTER FASCIA SWITCH BEZEL ASSEMBLY

▶ T/C Control Switch

Overview

T/C control switch is the rotary type switch with steps and the switch operation is recognized by TCCU. This switch has an illumination lamp connected to the tail lamp circuit.



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.
- To shift from “4L” into another mode or vice versa, stop the vehicle and depress the brake pedal before any shift.
- 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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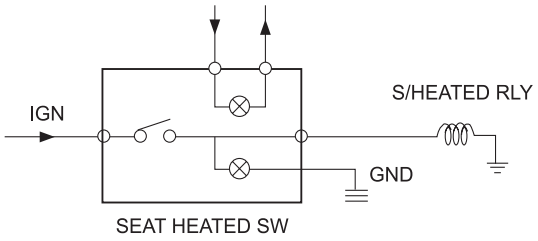
▶ Seat Warmer Switch

Overview

Seat warmer switch is Push lock type switch. When the seat warmer 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.

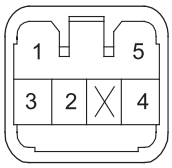












	ON	OFF
1(IGN)	○	
2(S/H RLY)	○	⊗
3(GND)	○	
4(ILL+)	○	⊗
5(ILL-)	○	

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.**

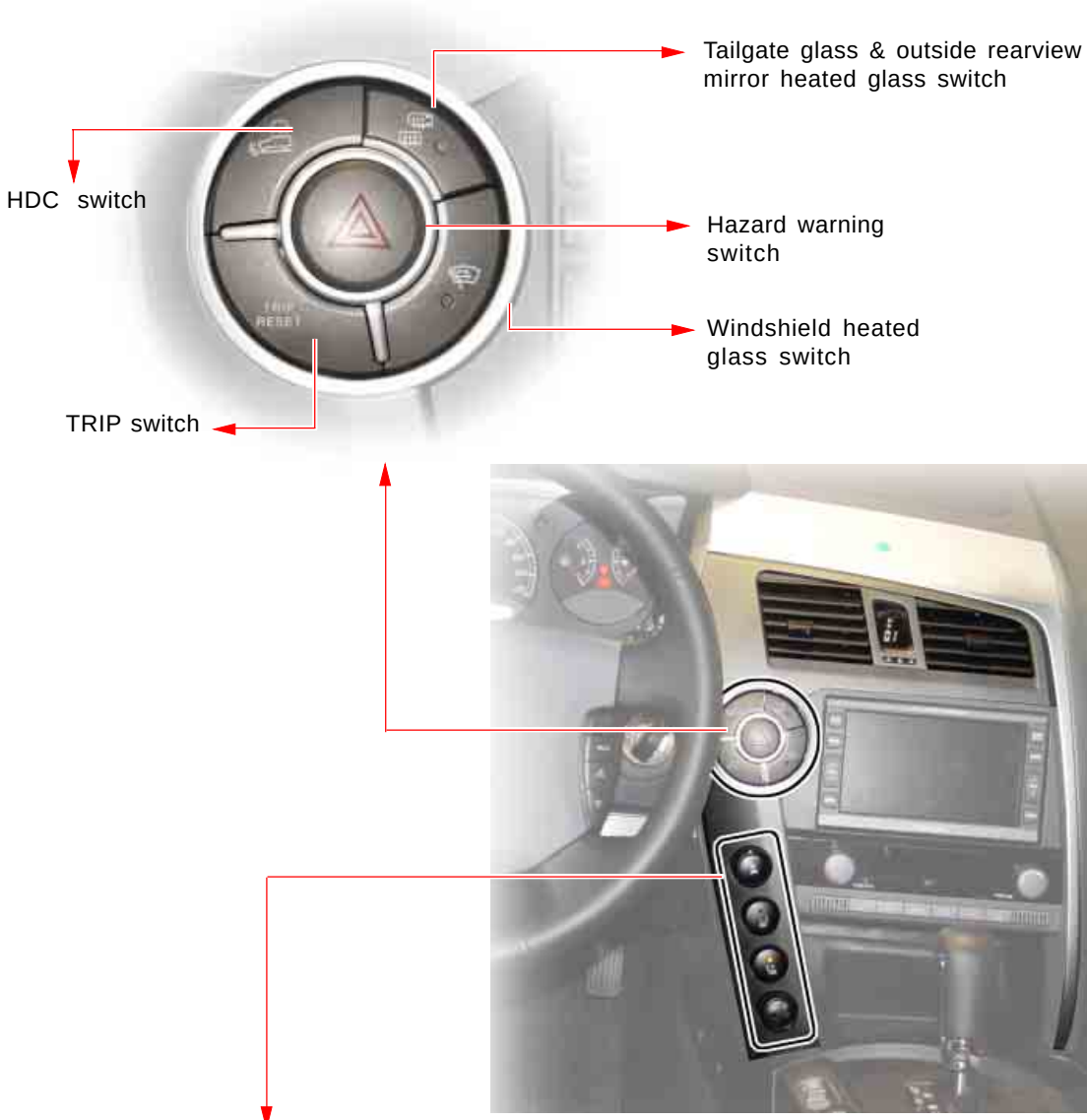
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6. REMOVAL AND INSTALLATION OF HAZARD & BEZEL SWITCH ASSEMBLY

※ **Preceding Works:** Disconnect the negative battery cable.

▶ Location



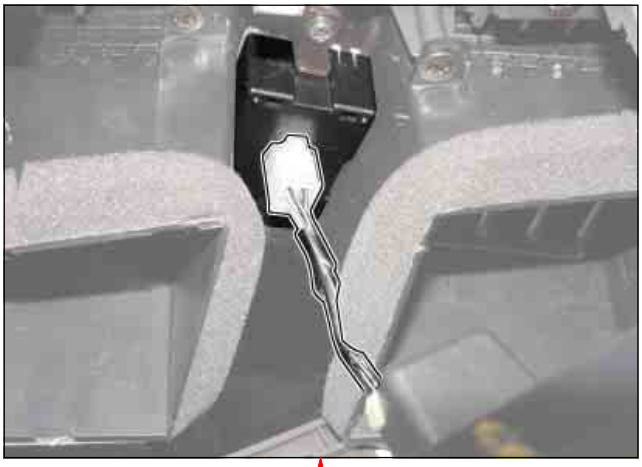
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▶ Removal and Installation

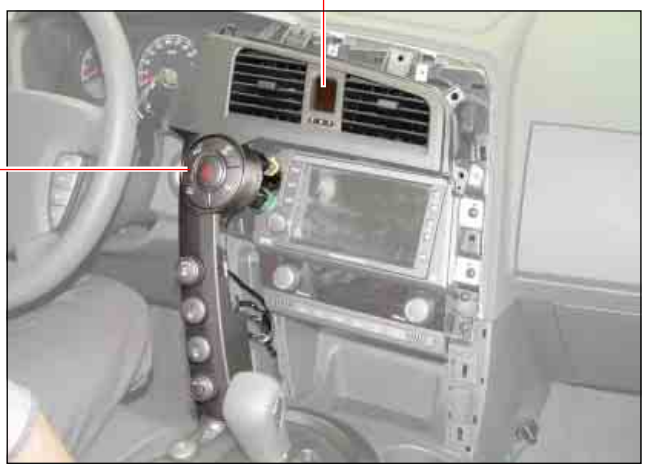
1. Remove the RH panel from the center fascia panel and unscrew three screws from the center fascia panel.



2. Disconnect the switch connectors and remove the center fascia panel assembly.







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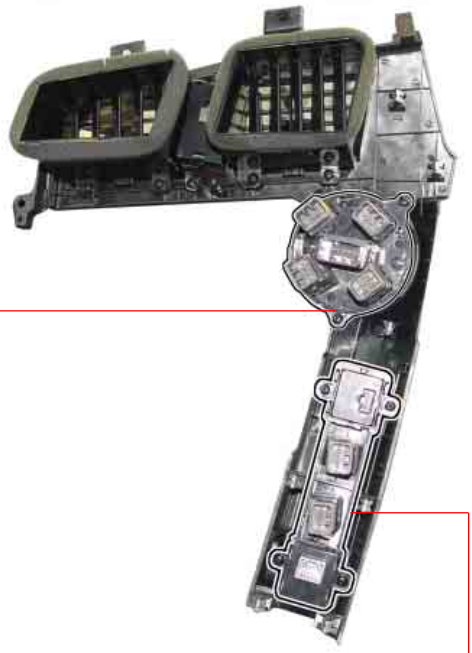
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3. Remove the hazard switch bezel assembly and miscellaneous switch assembly from the removed center fascia panel.

Front View



Rear View



Remove Three Mounting Screws



Remove Four Mounting Screws



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4. Remove each switch from the hazard switch bezel assembly.

Front View | Side View | Rear View



1) Remove the round cover and switches.



2) Remove the hazard switch mounting bracket and remove the hazard switch.



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5. Remove each switch from the miscellaneous switch assembly.



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Center Fascia Panel



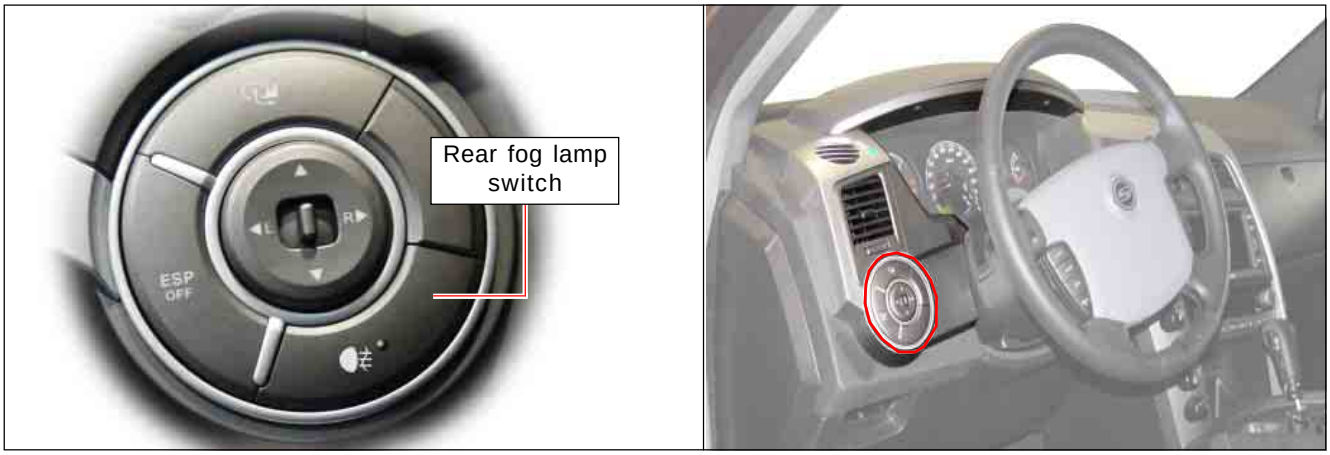
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OUTSIDE REARVIEW MIRROR SWITCH BEZEL ASSEMBLY

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



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2. SWITCH ARRANGEMENT

Outside Rearview Mirror Folding Switch



ESP OFF Switch





Outside Rearview Mirror Angle Adjusting Switch







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3. SWITCHES IN OUTSIDE REARVIEW MIRROR SWITCH BEZEL ASSEMBLY

▶ Outside Rearview Mirror Folding and Adjusting Switch

Overview

Outside rearview mirror folding switch is Self return type switch and outside rearview mirror control switch is Seesaw & Self return type switch.

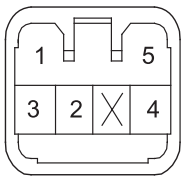
The outside rearview mirrors folding/unfolding function is not available when the vehicle speed is over 3 km/h. You can fold and unfold the mirros for 30 seconds after ignition OFF. Do not fold or unfold the outside rearview mirrors manually. It may cause a malfunction of the mirror folding system.



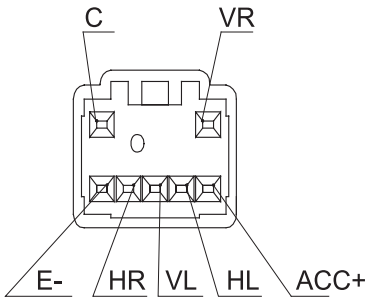




To fold the outside rearview mirrors, press the switch. To unfold the mirrors, press it again.



	ON	OFF
1(B)	○	
2(GND)	○	
3(IND)		
4(ILL+)	○	⊗
5(ILL-)	○	

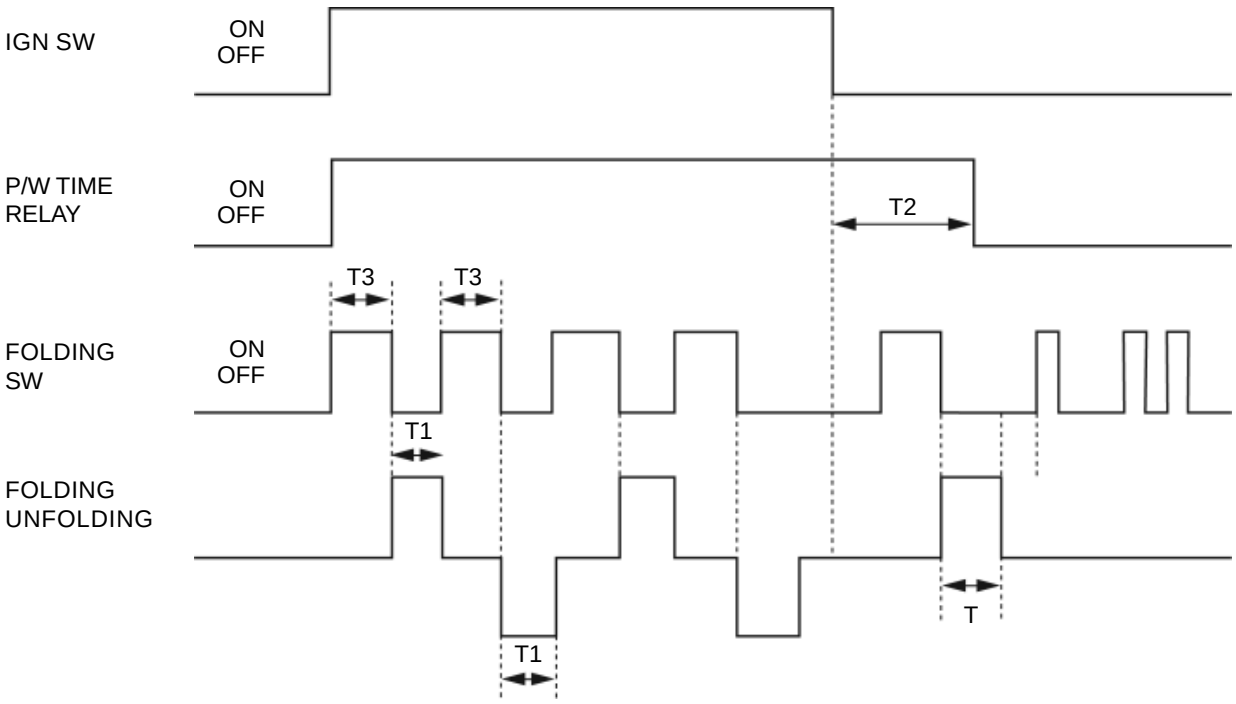


CLASS	DIR	VL	HL	VR	HR	C	ACC	B
LEFT HAND	UP	○	○			○		○
	DOWN	○	○			○		○
	OFF	○	○			○		○
	LEFT	○				○	○	○
	RIGHT	○				○	○	
RIGHT HAND	UP			○	○	○		○
	DOWN			○	○	○		○
	OFF			○	○	○		○
	LEFT			○		○	○	○
	RIGHT			○		○	○	○

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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.

Timing Chart

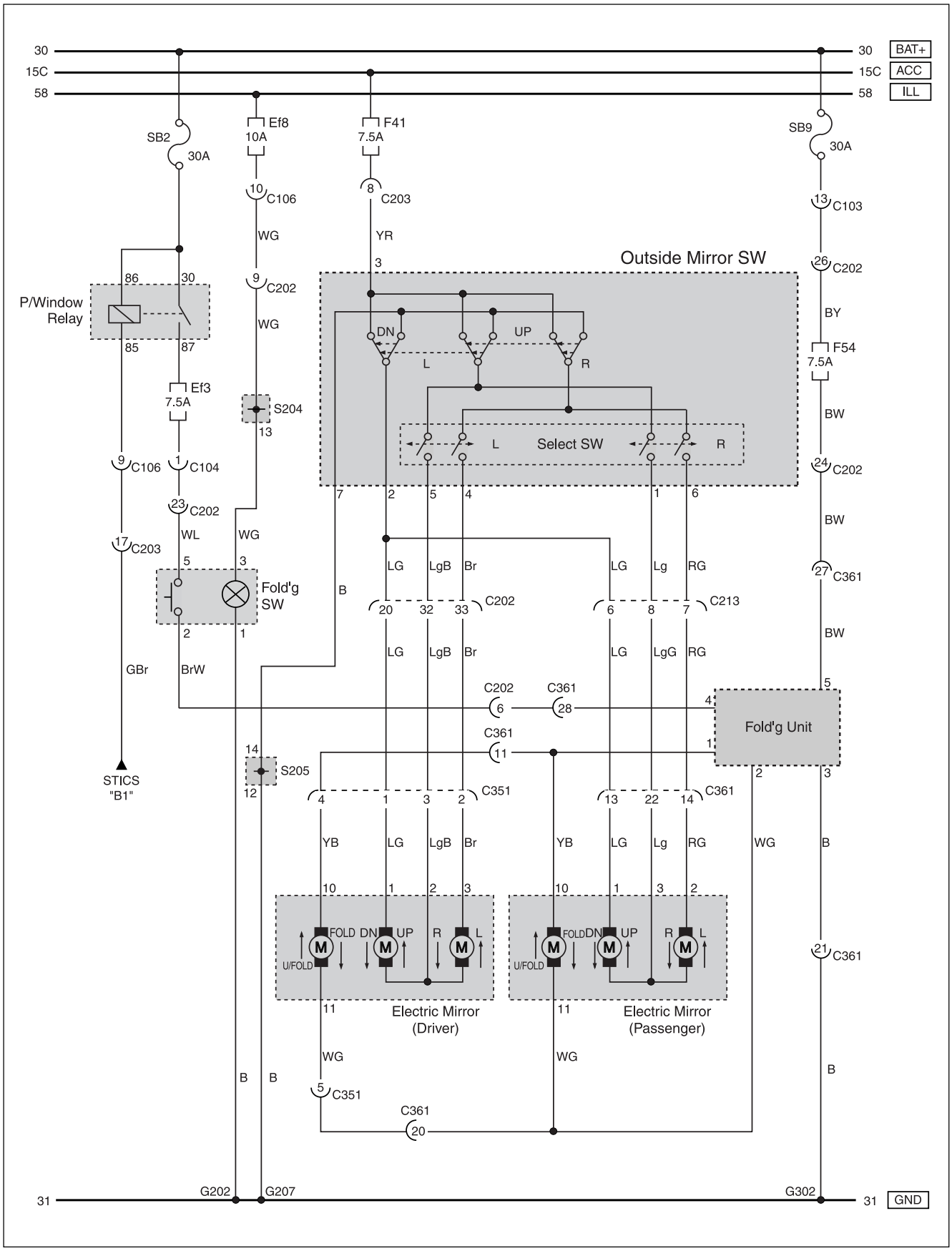


T: T < T1, T1: 13 ± 3 sec, T2: 30 ± 6 sec, T3: 1 Sec ± 0.1 sec

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Electrical Wiring Diagrams



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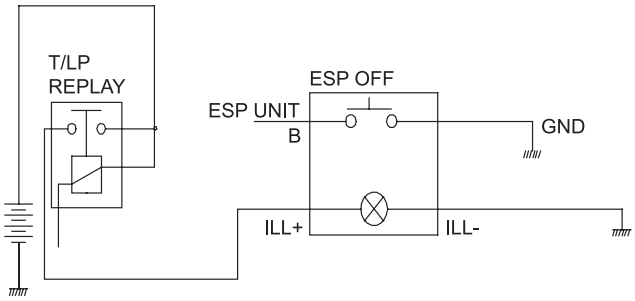
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▶ ESP OFF switch

Overview

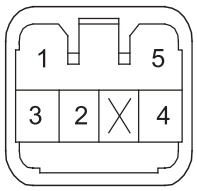
ESP OFF switch is Self return type switch.







	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.

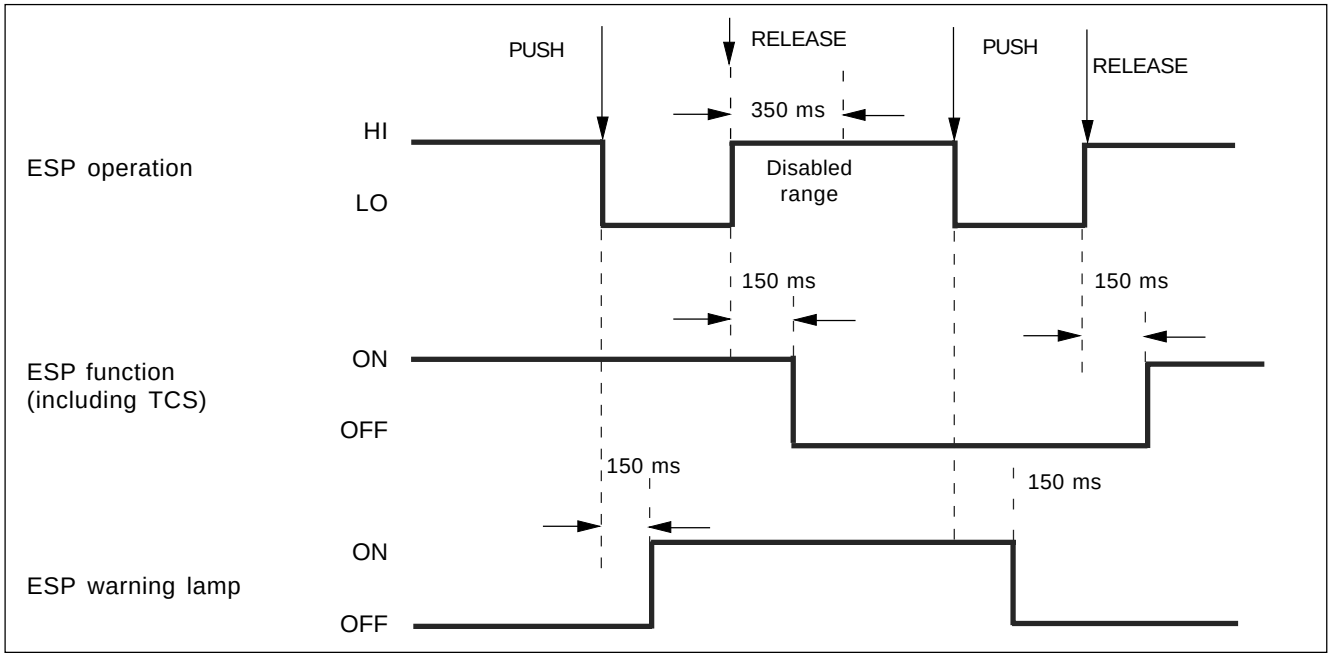
Based on the above procedures, we can see that the ESP system will be cancelled after a certain period (approx. 150 ms) from releasing the switch to the original position. The ESP system does not get canceled immediately when the ESP warning lamp is turned on by pressing the ESP OFF switch. When you 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.



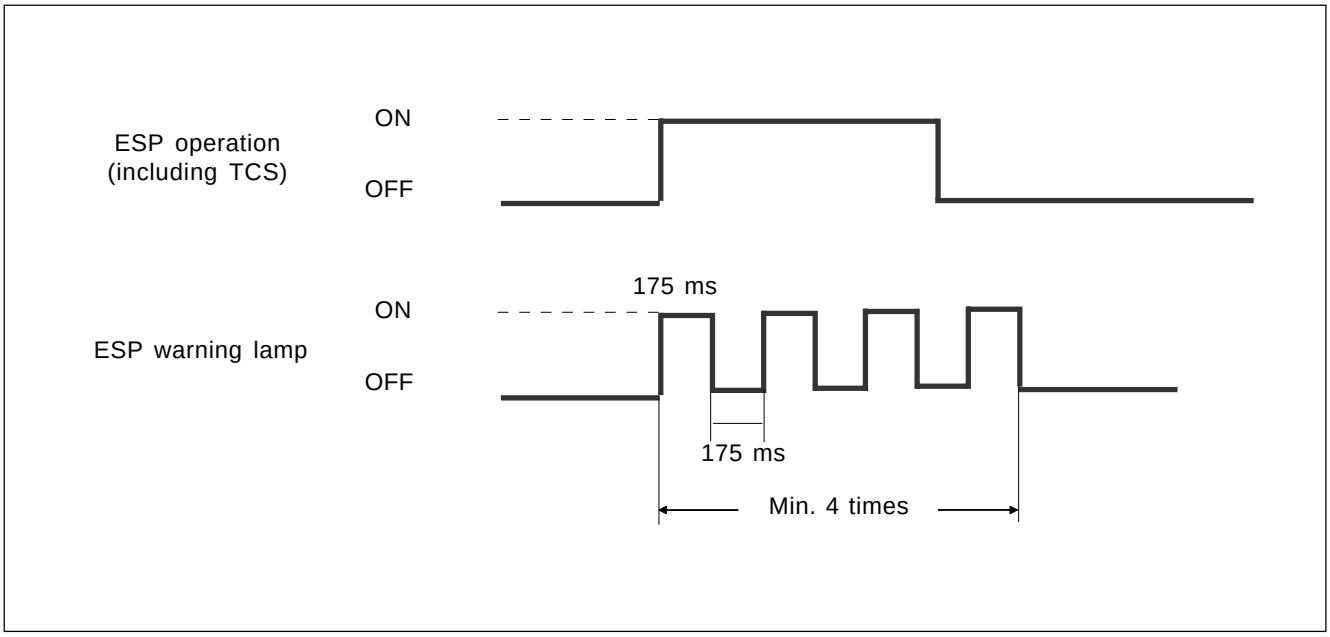
NOTICE

- **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.**

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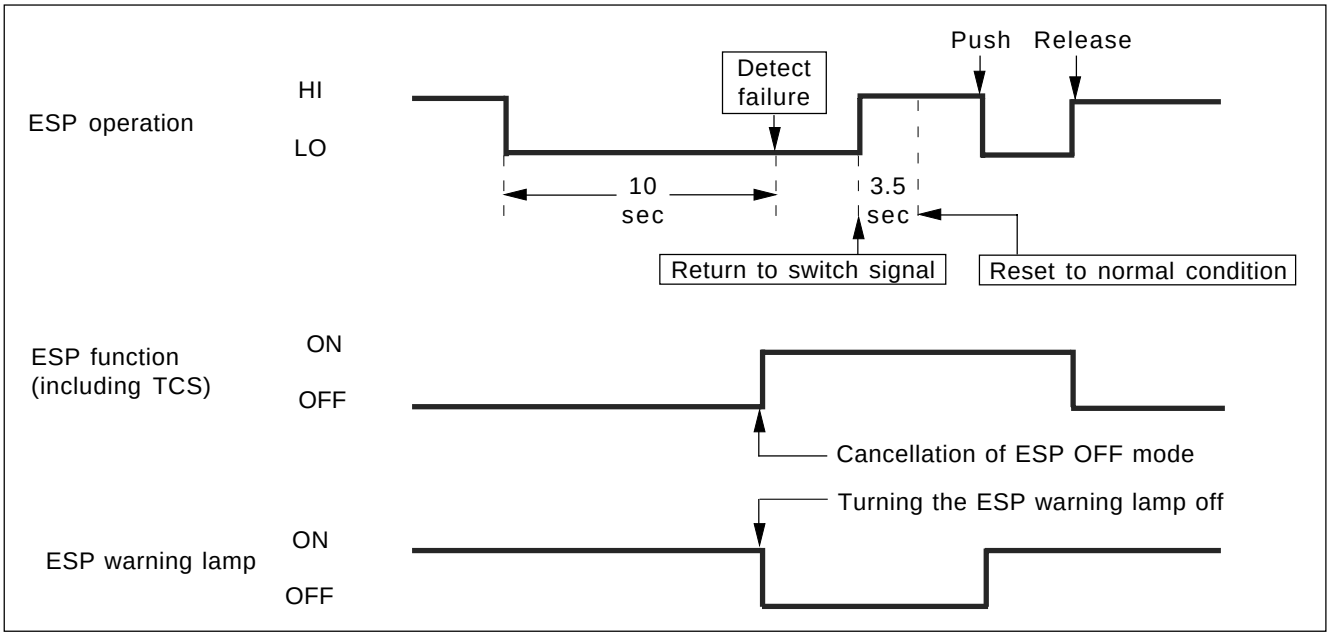
ESP Warning Lamp Blinking in Control

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.**

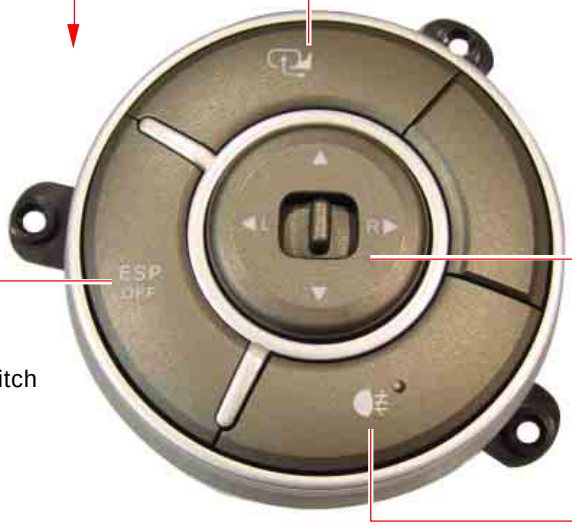
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4. REMOVAL AND INSTALLATION

※ **Preceding Works:** Disconnect the negative battery cable.

▶ Location





Outside rearview mirror folding switch

Outside rearview mirror angle adjusting switch

ESP OFF switch

Rear fog lamp switch

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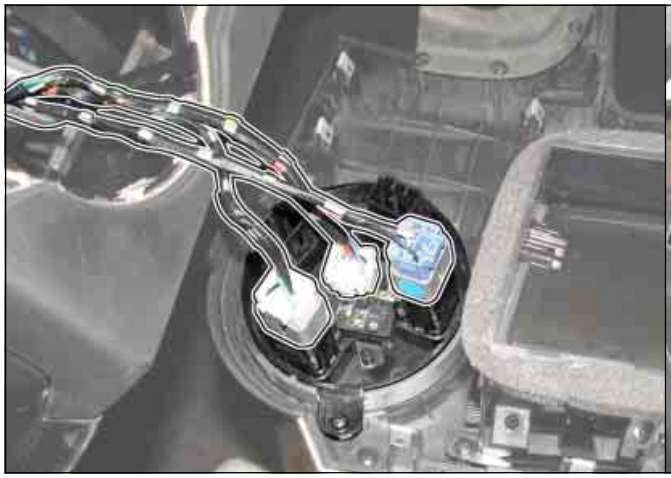
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▶ Removal and Installation

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

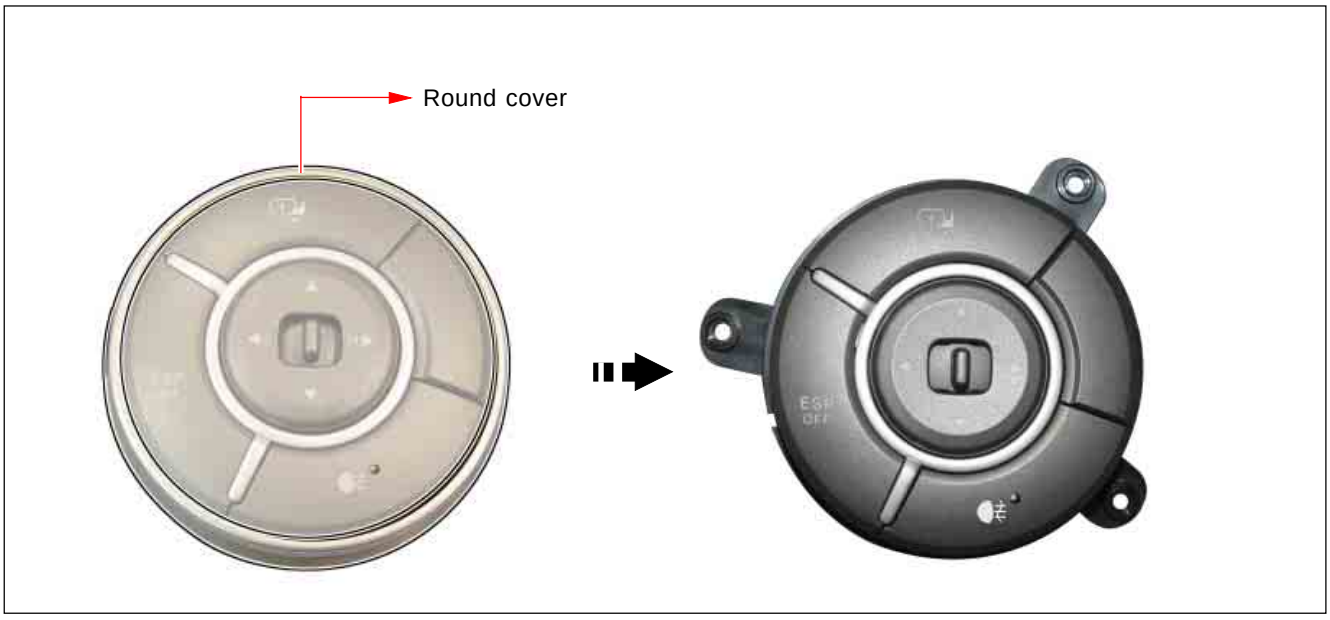
- **To make the operation easier, move down the steering wheel.**

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3. Remove the switch assembly from the removed meter cluster fascia panel.



4. Remove the round cover on the switch assembly.



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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



Outside Rearview Mirror Adjusting Switch





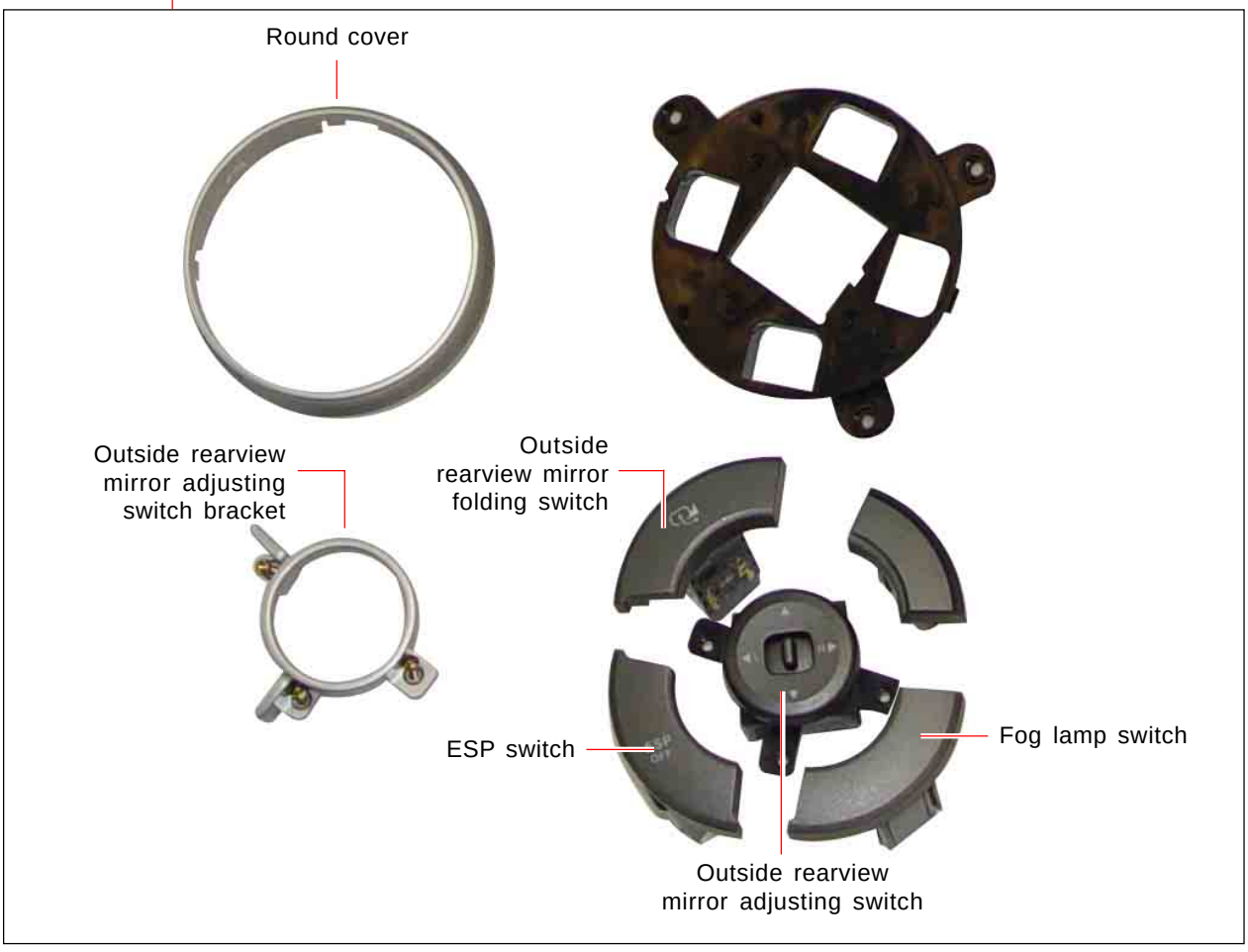
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Meter Cluster Fascia Panel







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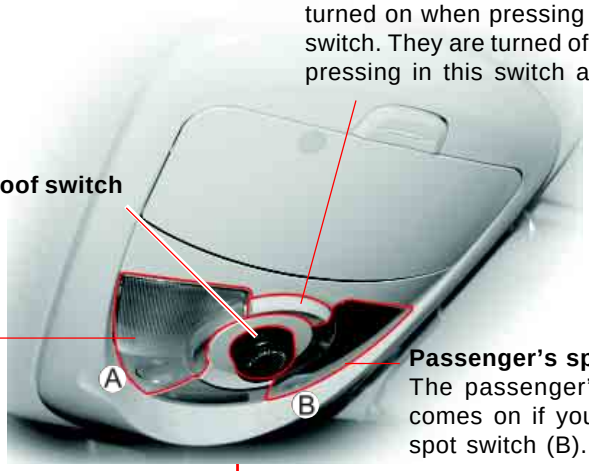
OVERHEAD CONSOLE SWITCH

1. LOCATION

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.

Sunroof switch

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).







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2. COMPONENTS

▶ Front Room Lamp (Overhead Console Lamp)



▶ Center Room Lamp and Luggage Room Lamp

Center Room Lamp



Luggage Room Lamp



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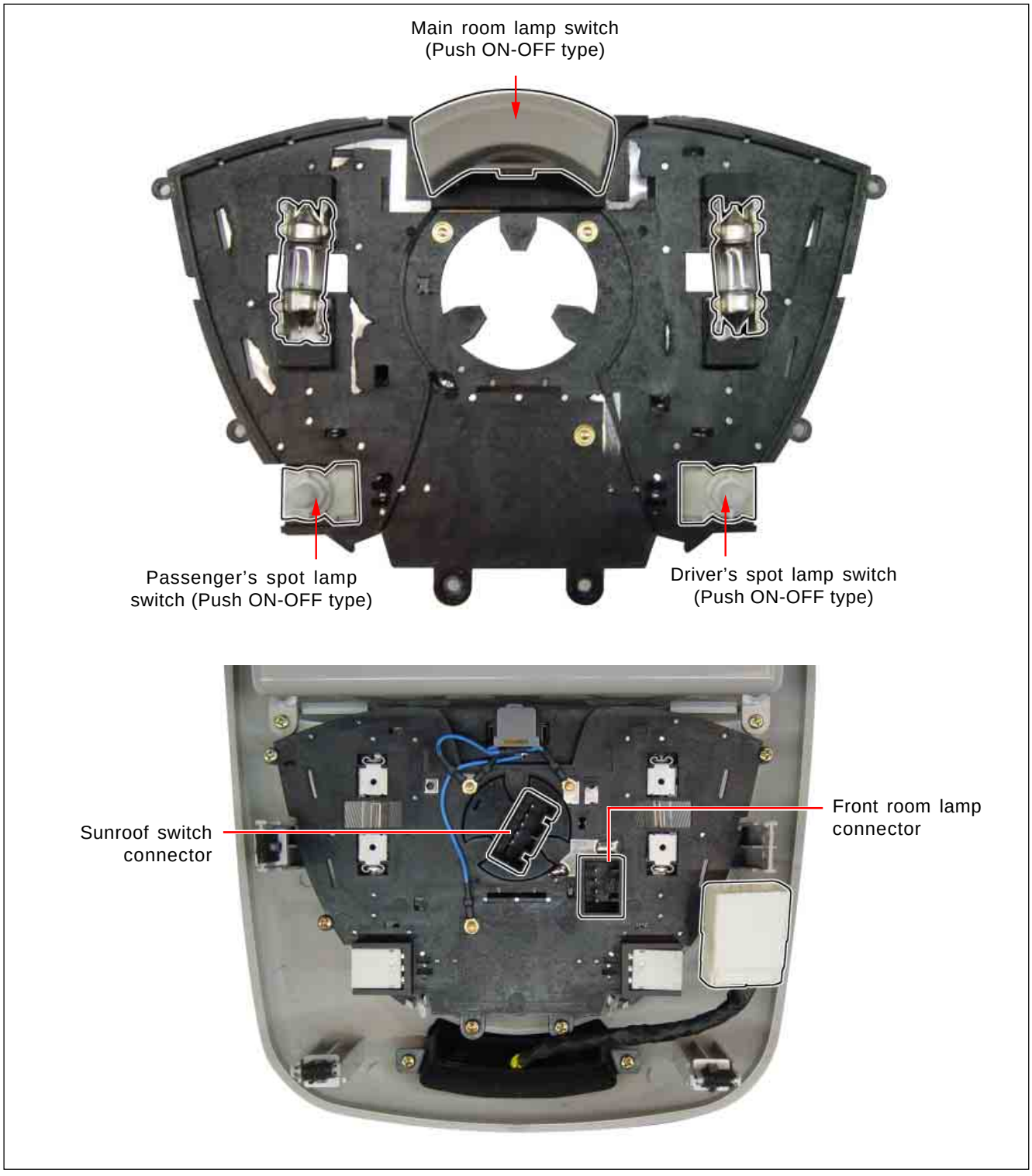
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3. SWITCHES IN OVERHEAD CONSOLE SWITCH ASSEMBLY

Overview

Front room lamp switches in overhead console: Push ON/OFF type

Sunroof switch: Rotary, self return type

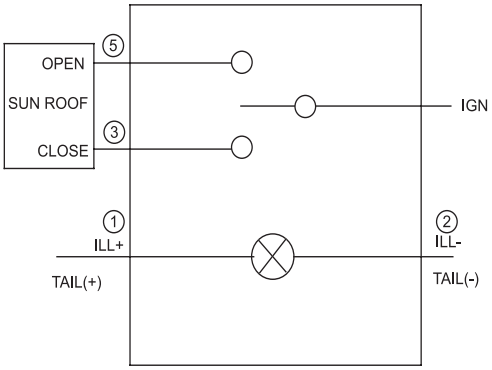


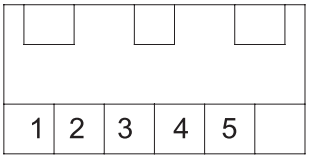
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Sunroof Switch







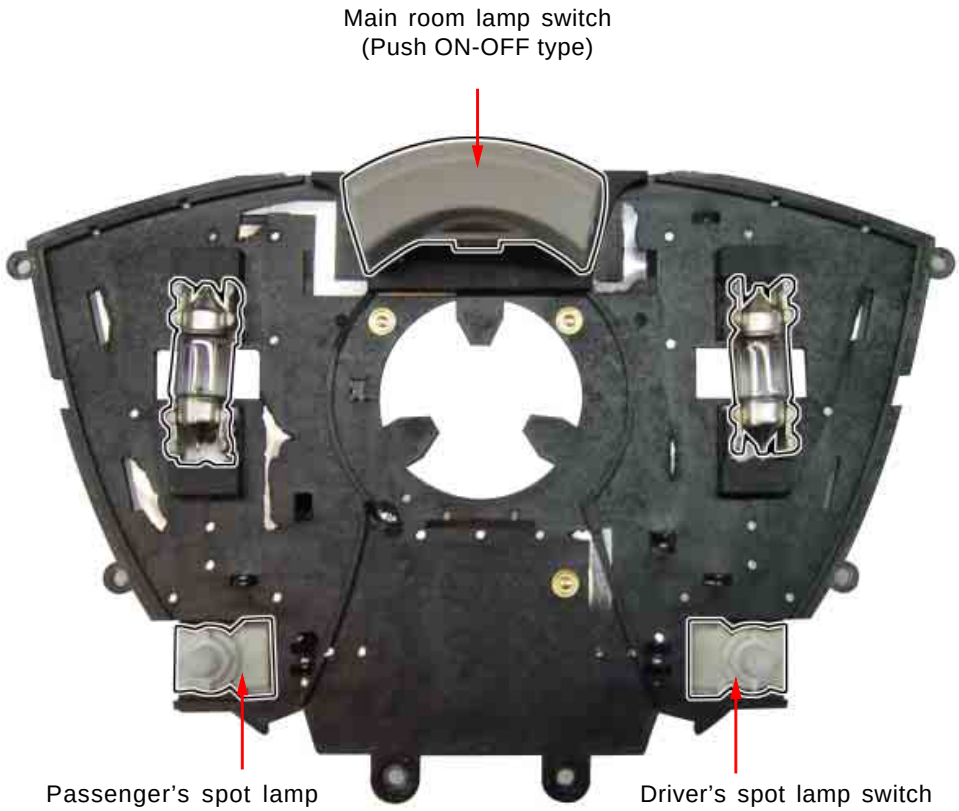




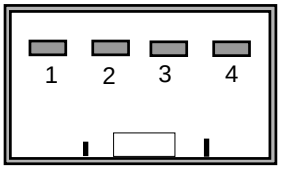
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Front Room Lamp





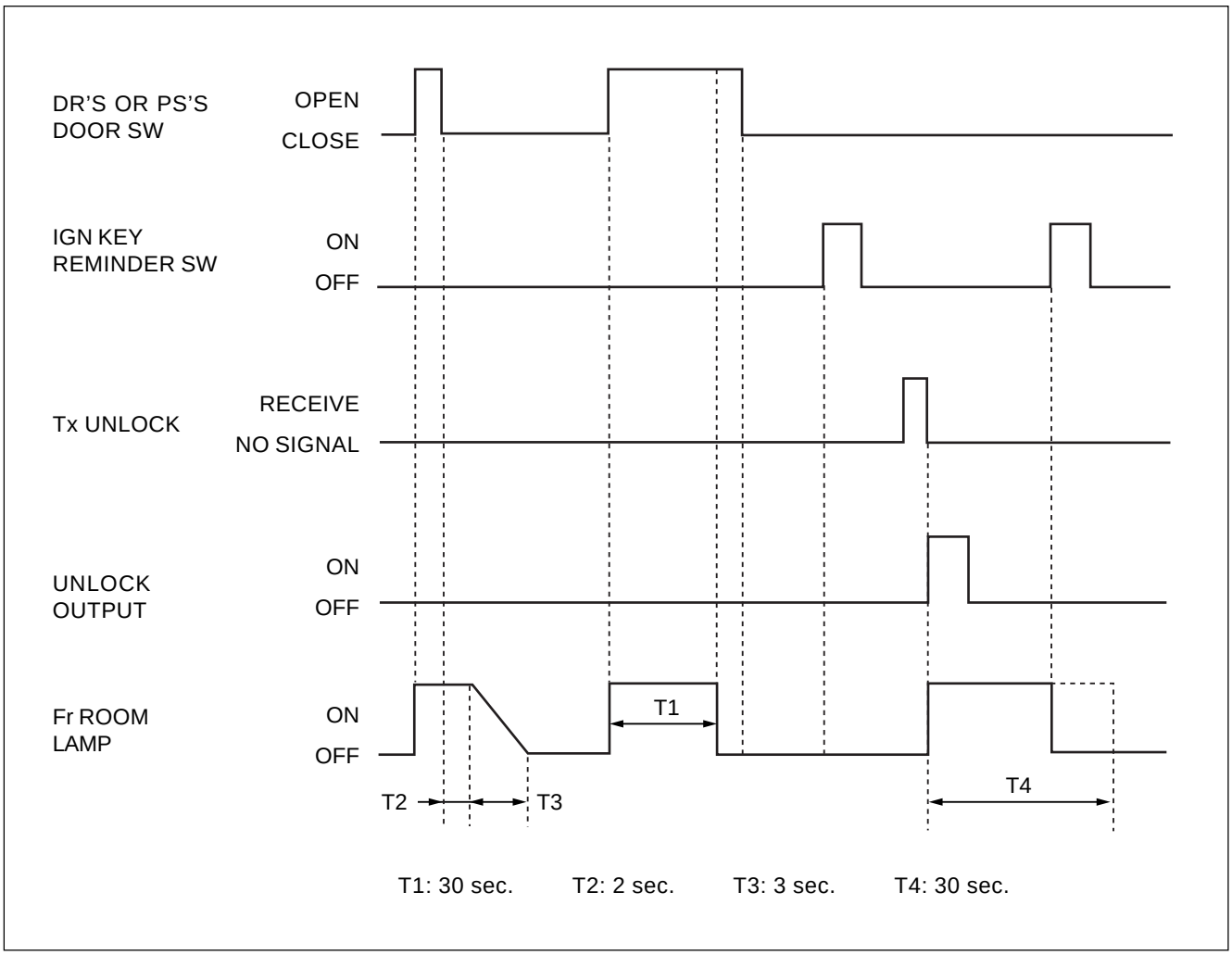


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Room Lamp Control

The overhead console lamp (front room lamp) and the center room lamp come on when opening the door while the center/luggage room lamp switch is at coupled operating position and the key reminder switch is OFF.

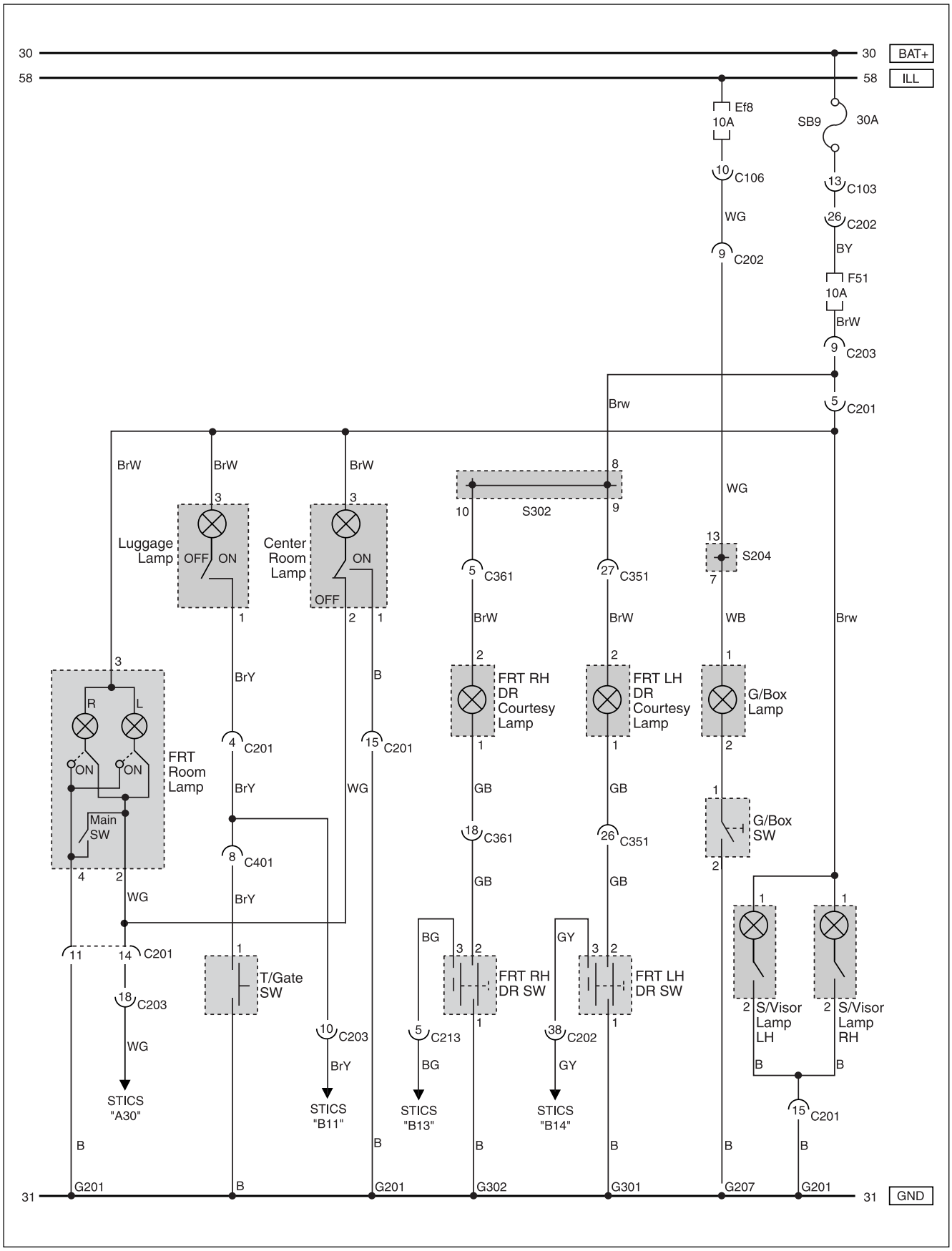
1. The front room lamp comes on when opening the door (driver's/passenger's/rear) and goes off automatically in 30 seconds.
2. The room lamp stays on for 2 seconds and then decays through 3 seconds when closing the door within 30 seconds.
3. The decaying operation must have greater than 32 steps per 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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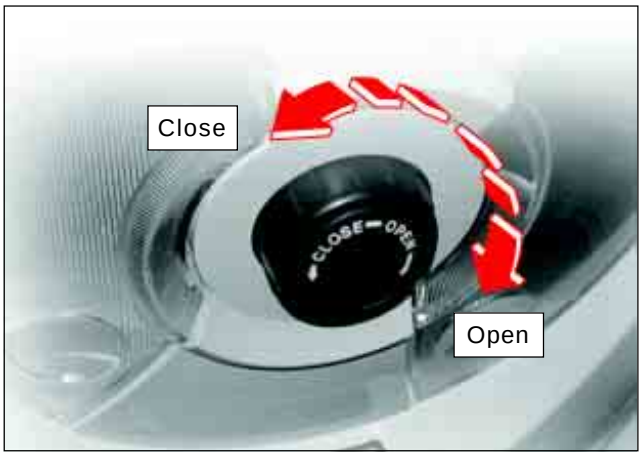
Electrical Wiring Diagram of Room Lamp



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Sunroof Switch





Sunroof Sliding Operation

▶ Open

To fully open the sunroof, briefly rotate the sunroof switch clockwise (OPEN direction) with the sunroof closed. To partially open the sunroof, rotate and hold the sunroof switch until it reaches at the desired position.

▶ Close

To fully close the sunroof, briefly 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

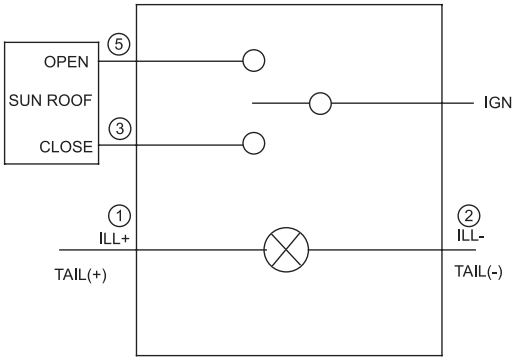
▶ Tilt-up

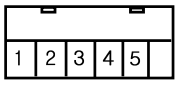
To tilt-up the sunroof, rotate the sunroof switch counter-clockwise (CLOSE direction) with the sunroof fully closed.

▶ Tilt-down

To tilt-down the sunroof, rotate the sunroof switch clock-wise (OPEN direction) with the sunroof tilted-up.

▶ Circuit Diagram of Sunroof Switch





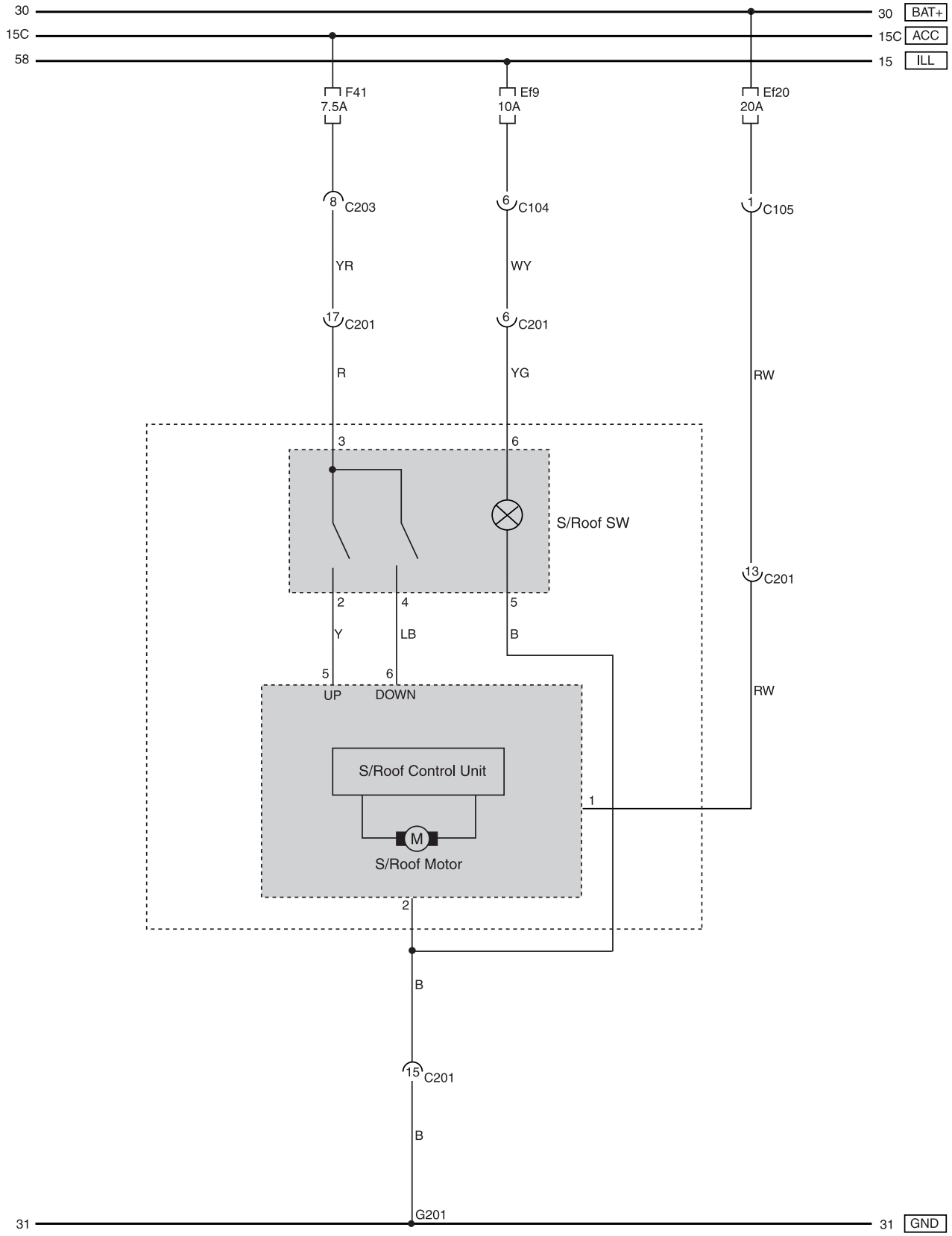
Sunroof switch connector

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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Circuit Diagram of Sunroof



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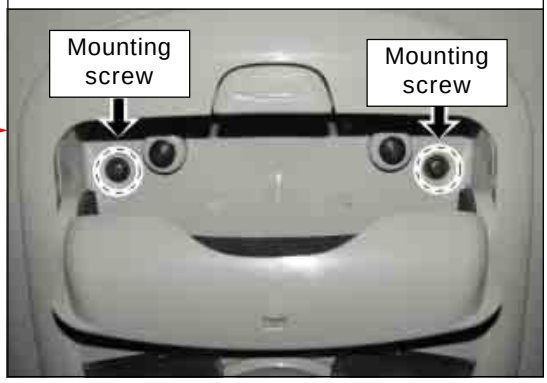
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4. REMOVAL AND INSTALLATION OF OVERHEAD CONSOLE SWITCH

※ **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.





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Components



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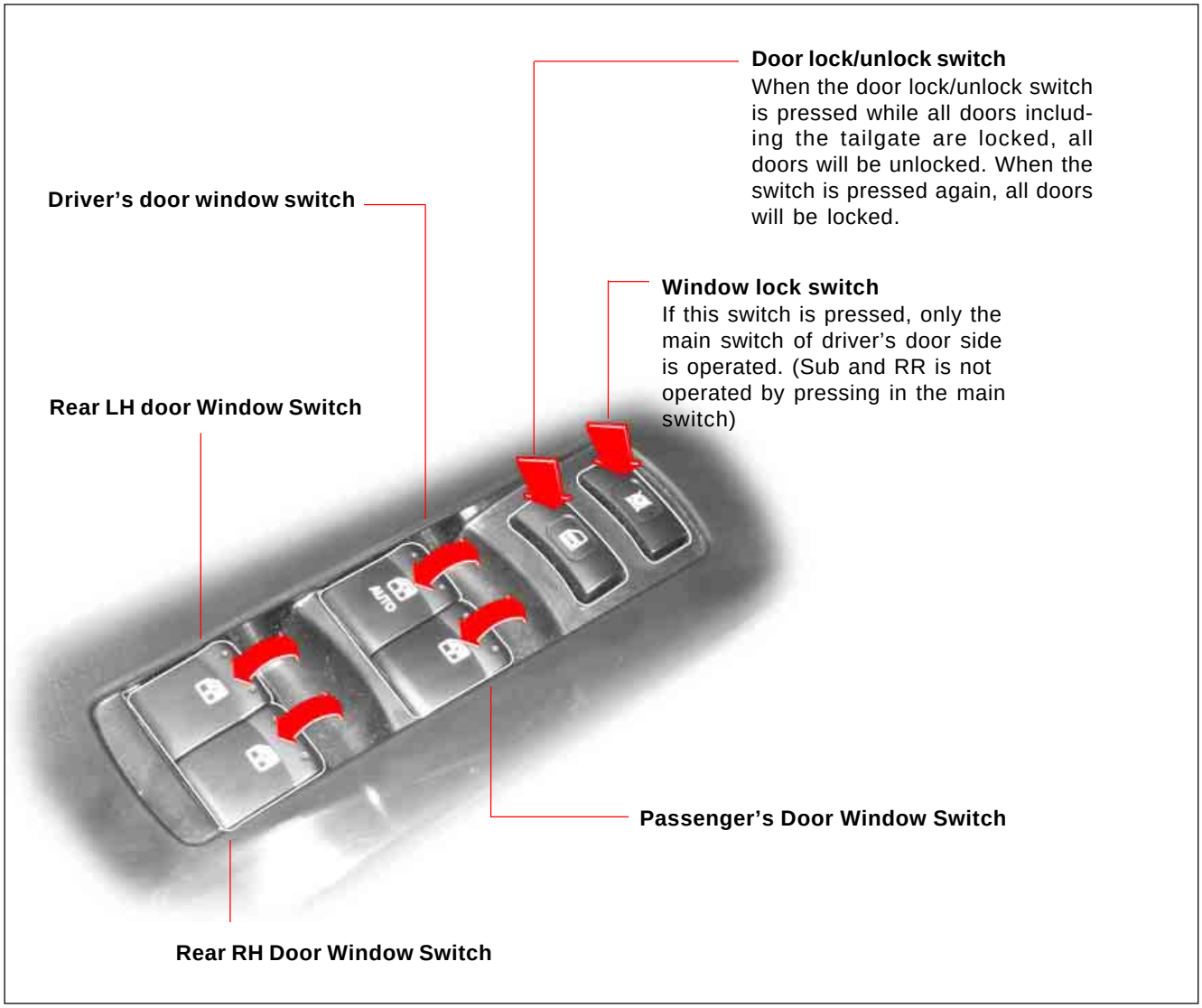
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SWITCH ASSEMBLY ON DRIVER'S DOOR ARMREST

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).



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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

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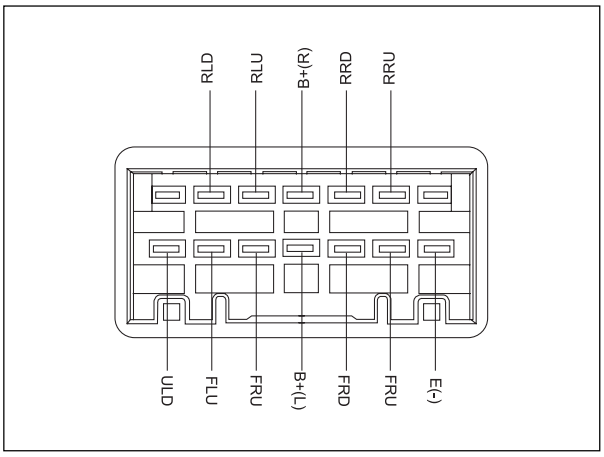
3. POWER WINDOW OPERATIONS

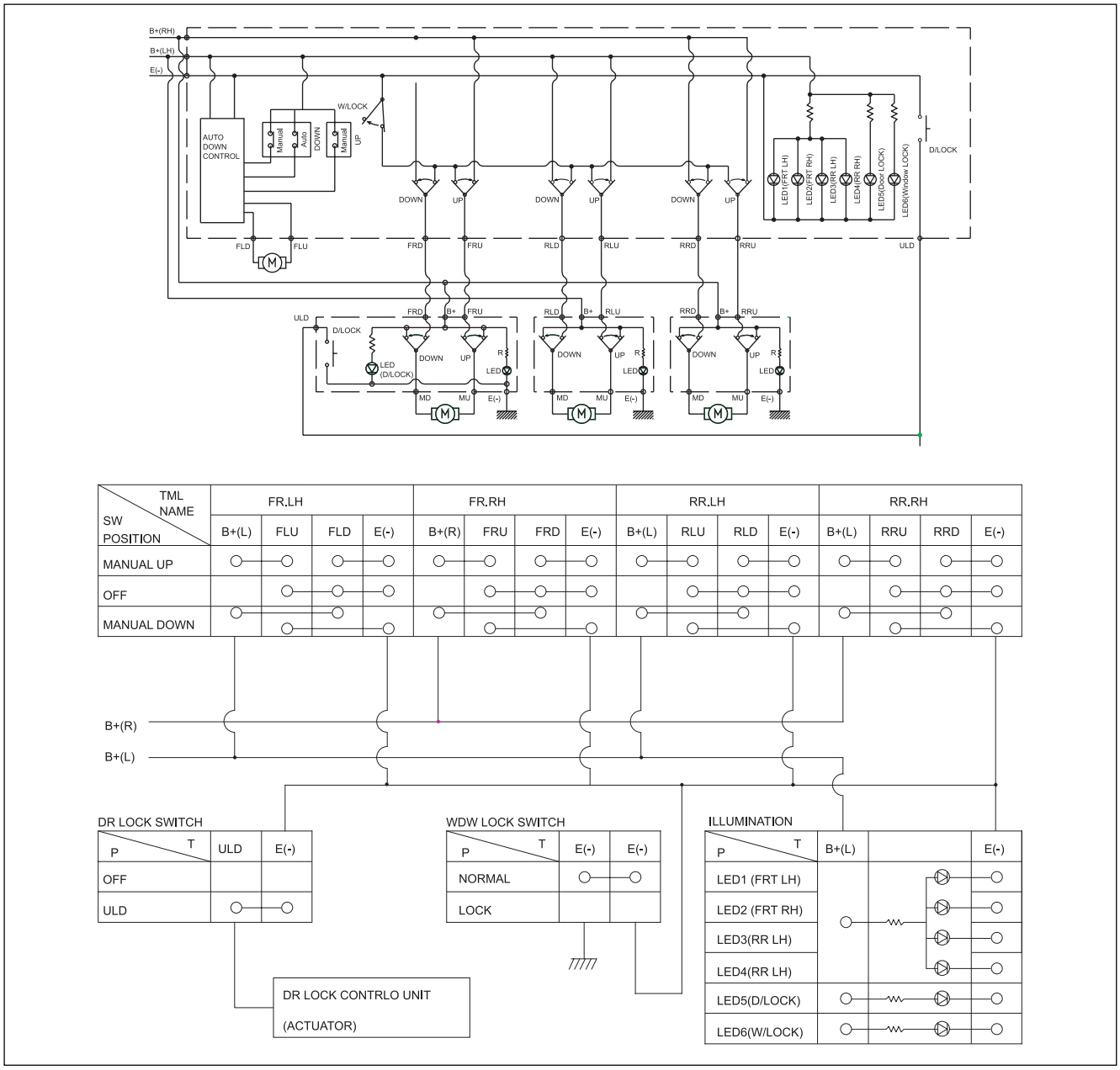
▶ Power Window Auto-down

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.





SW POSITION \ TML NAME	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	○		○	○	○		○	○	○		○	○	○		○	○

DR LOCK SWITCH

P \ T	ULD	E(-)
OFF		
ULD	○	○

WDW LOCK SWITCH

P \ T	E(-)	E(-)
NORMAL	○	○
LOCK		

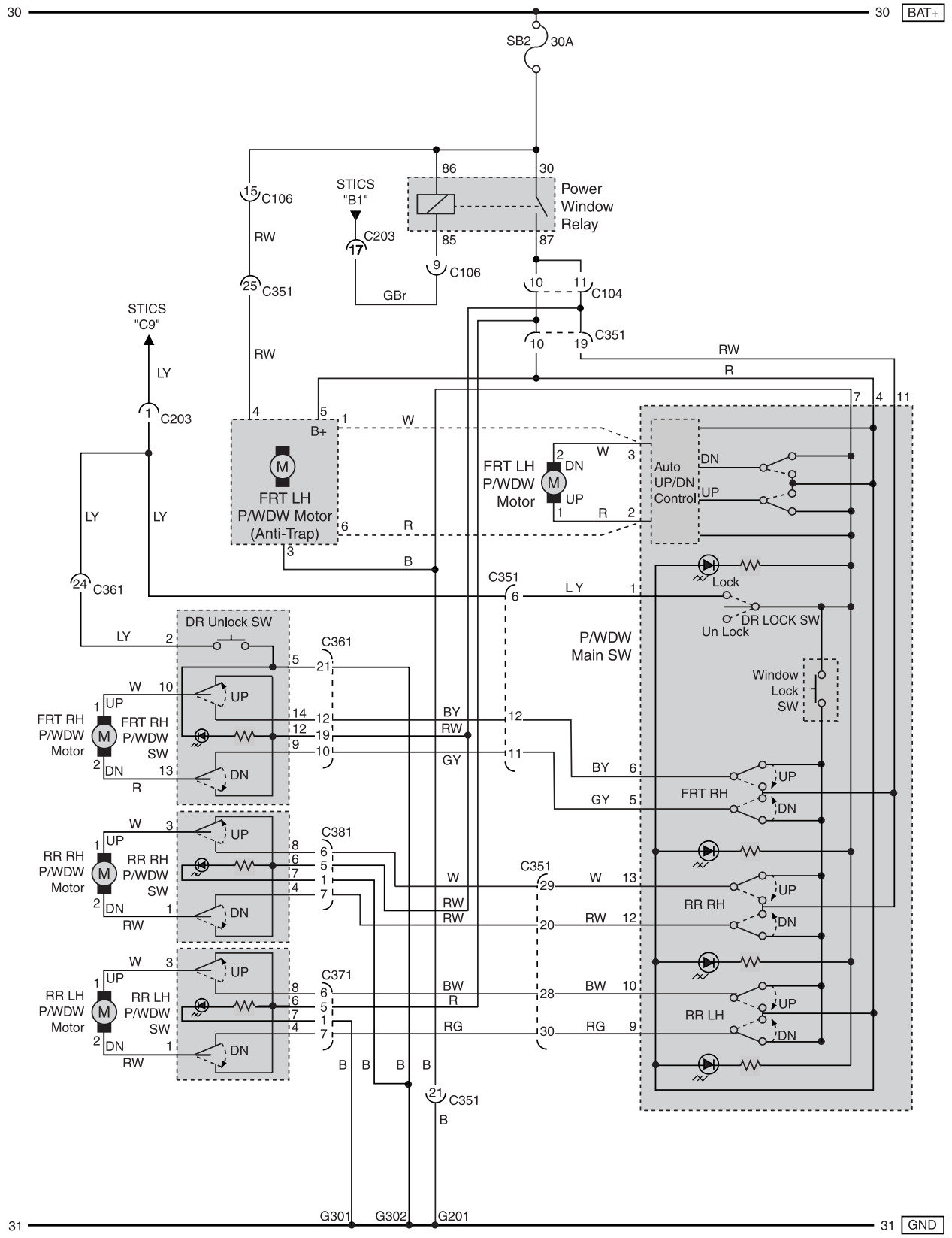
ILLUMINATION

P \ T	B+(L)		E(-)
LED1 (FRT LH)			○
LED2 (FRT RH)			○
LED3(RR LH)	○		○
LED4(RR LH)			○
LED5(D/LOCK)	○		○
LED6(W/LOCK)	○		○

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4. CIRCUIT DIAGRAM OF POWER WINDOW



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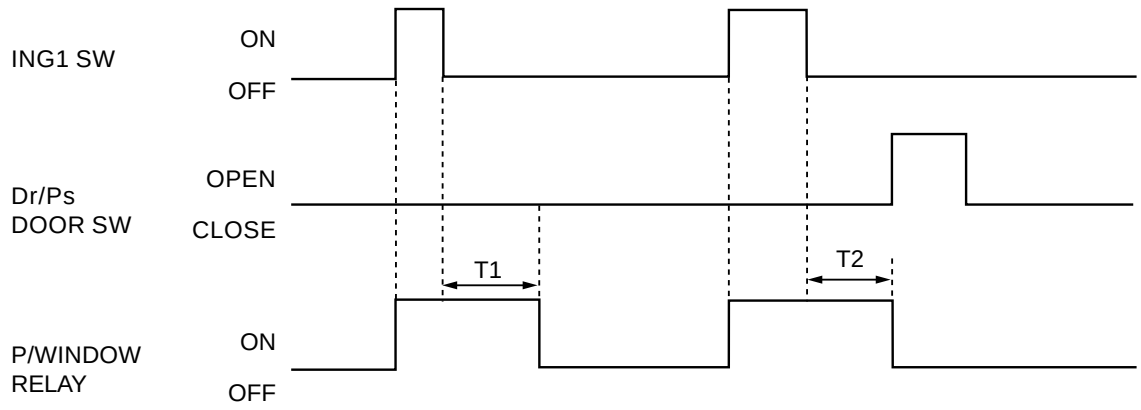
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Time Lag Power Window Control

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.



T1: 30 sec. T2: OFF during T1 output

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5. CENTRAL DOOR LOCK/UNLOCK SWITCH

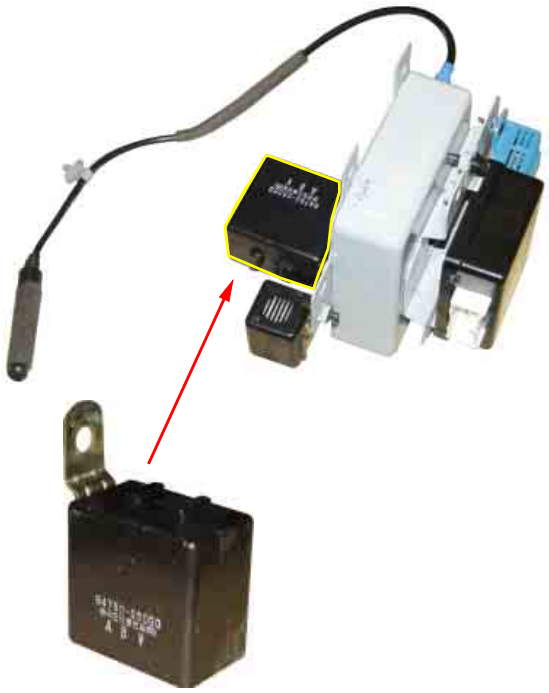
▶ Switch Arrangement and Functions

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





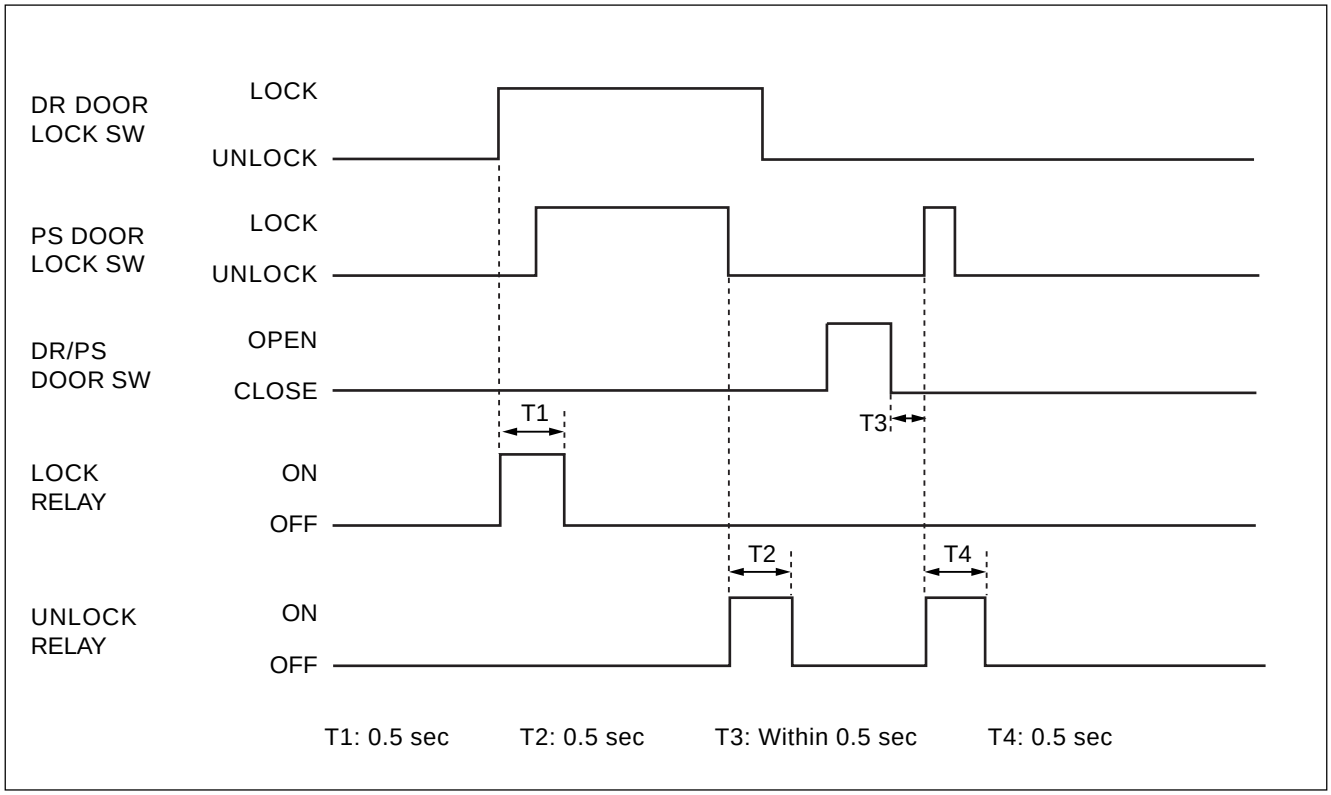
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▶ Door LOCK/UNLOCK Control

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” 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)

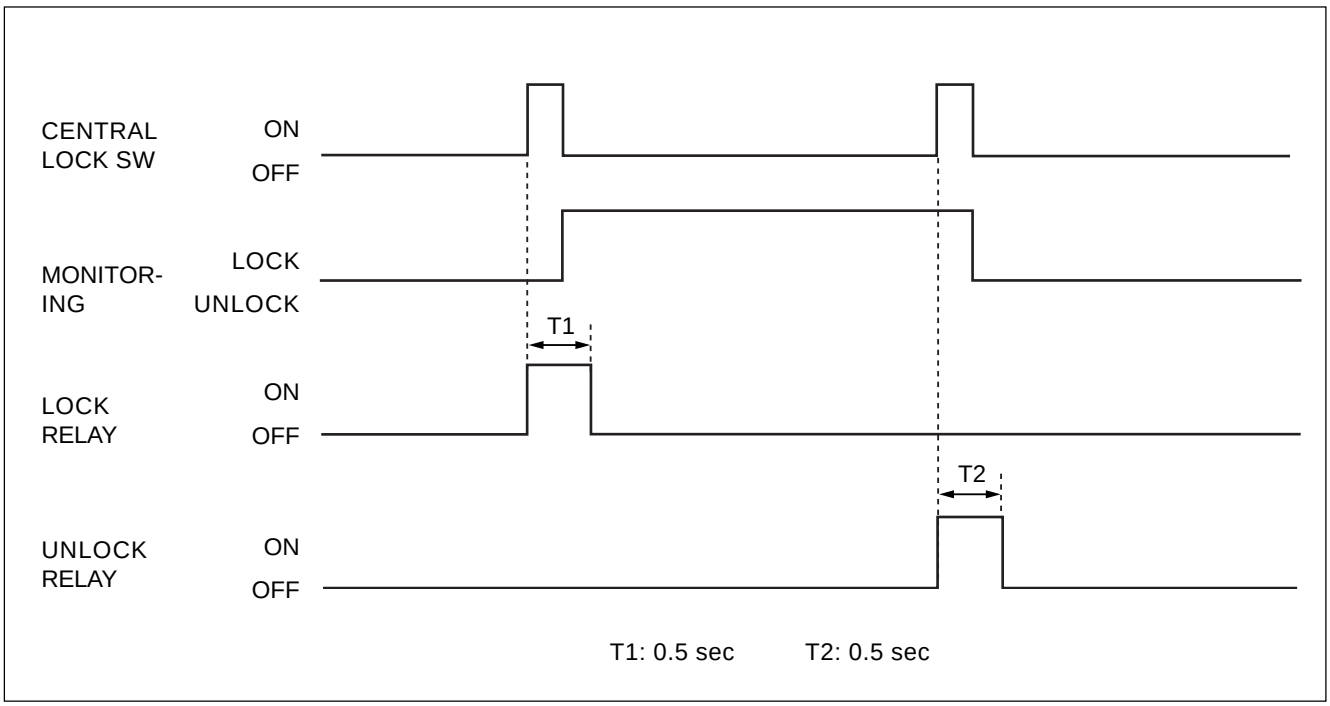


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Door Lock/Unlock by Central Door Lock Switch

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.

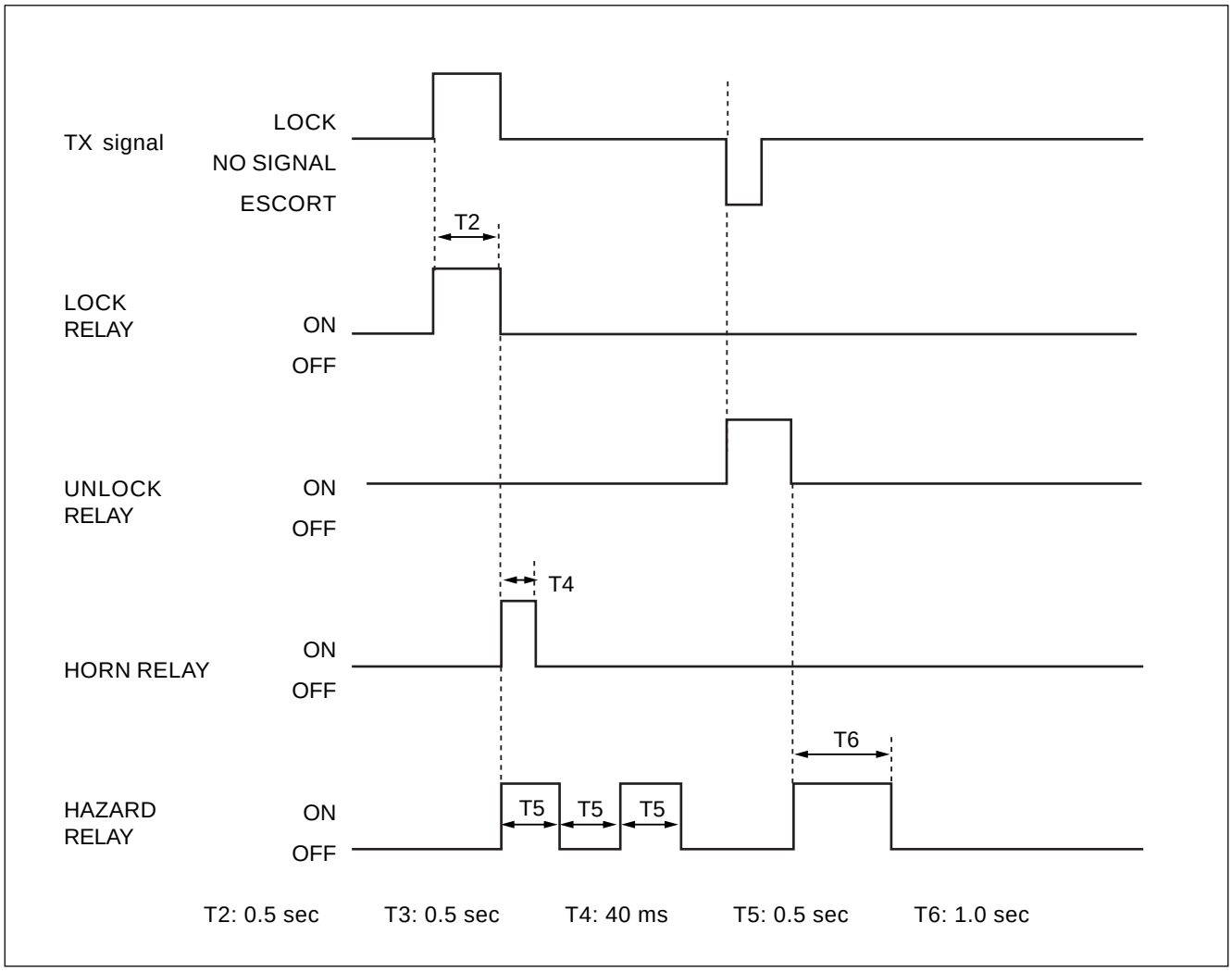


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Door LOCK/UNLOCK by Remote Control Key

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.



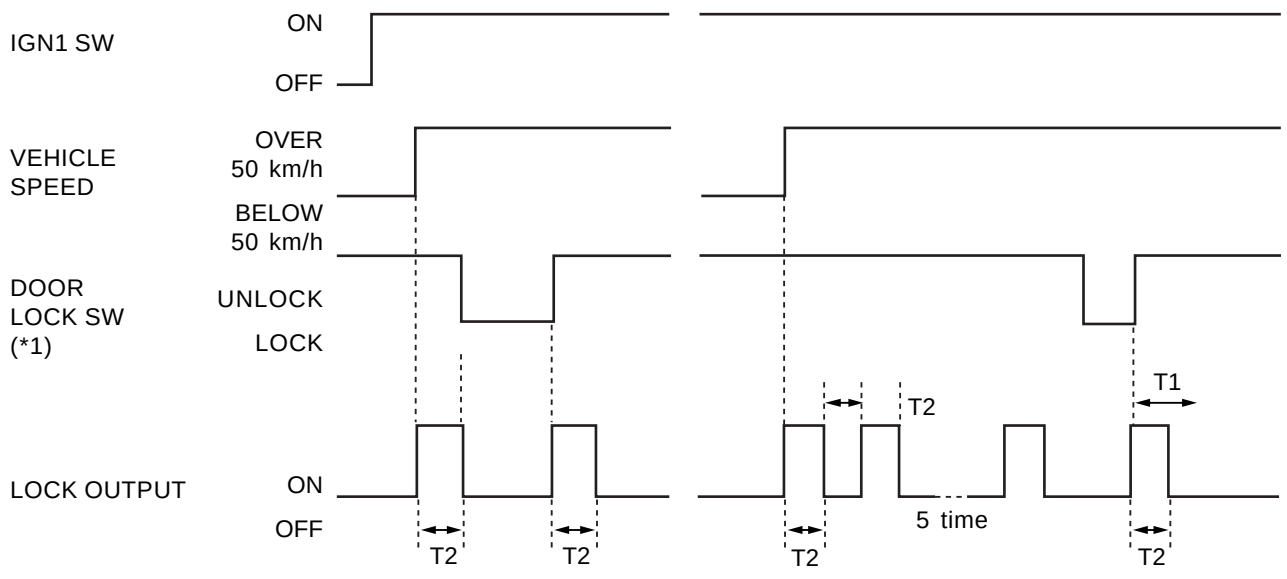
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Auto Door Lock

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.

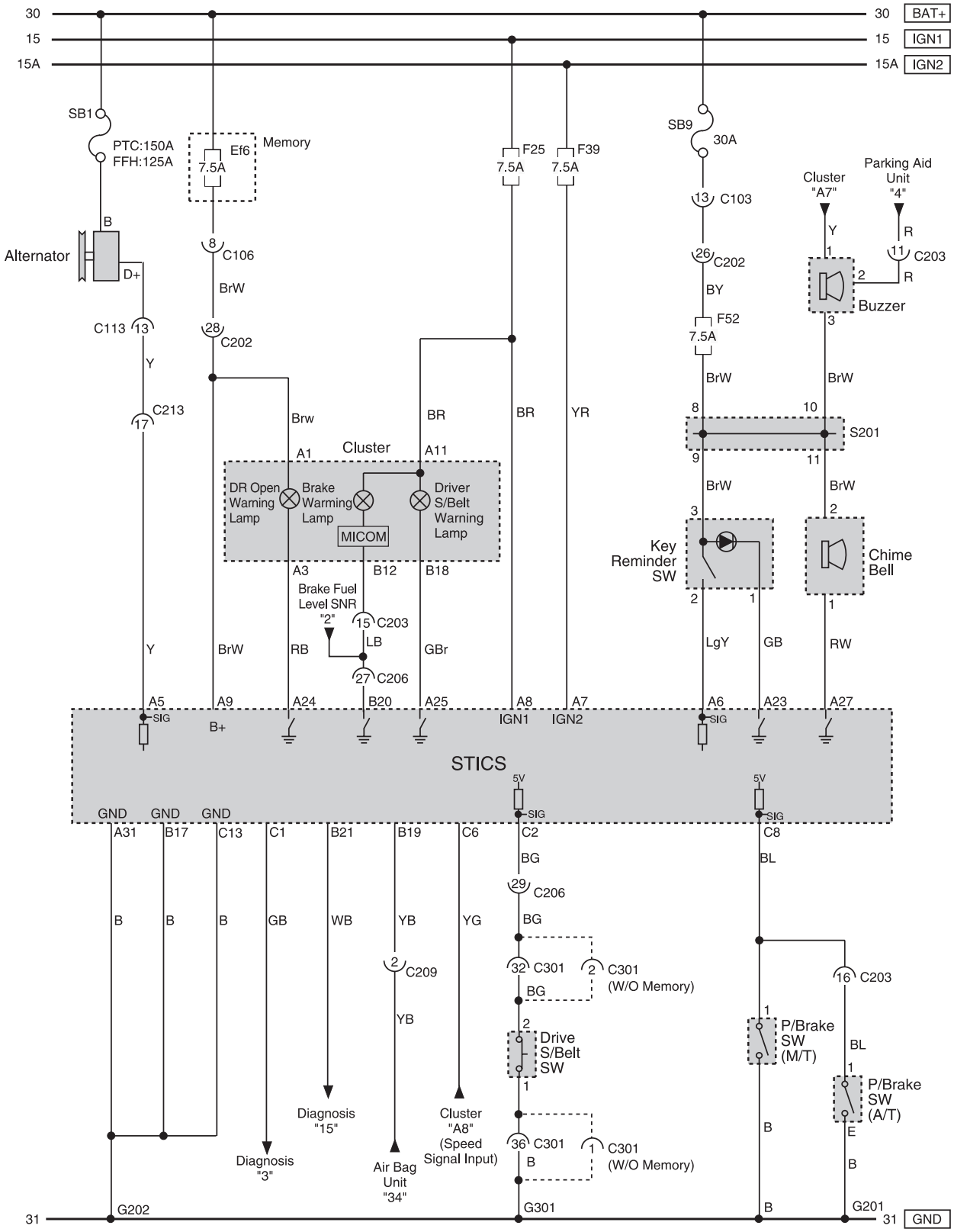


T2: 0.5 sec
1 LOCK: Dr & Ps & Rr & T/GATE DOOR LOCK SW = LOCK
UNLOCK: Dr or Ps or Rr or T/GATE DOOR LOCK SW = UNLOCK

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▶ Electrical Wiring Diagram



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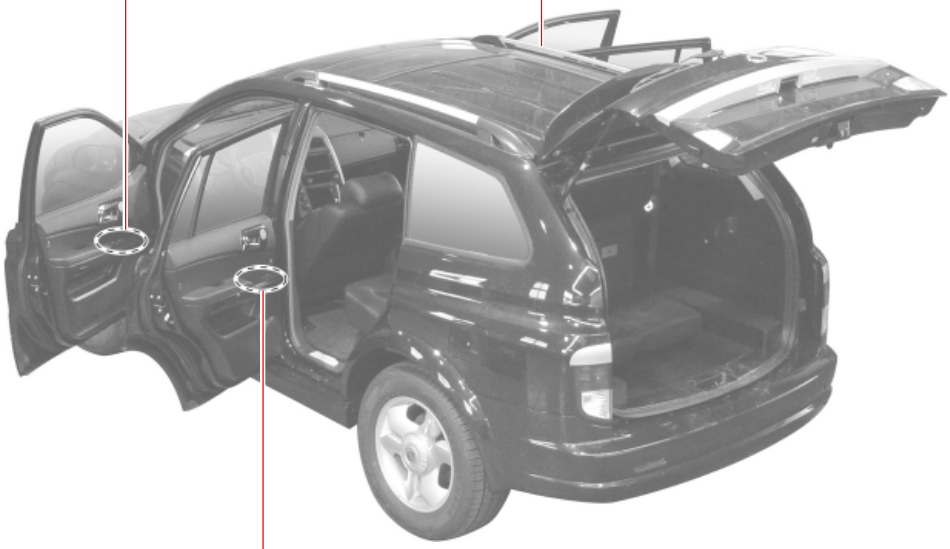
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6. REMOVAL AND INSTALLATION OF POWER WINDOW SWITCH

※ **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)	
	

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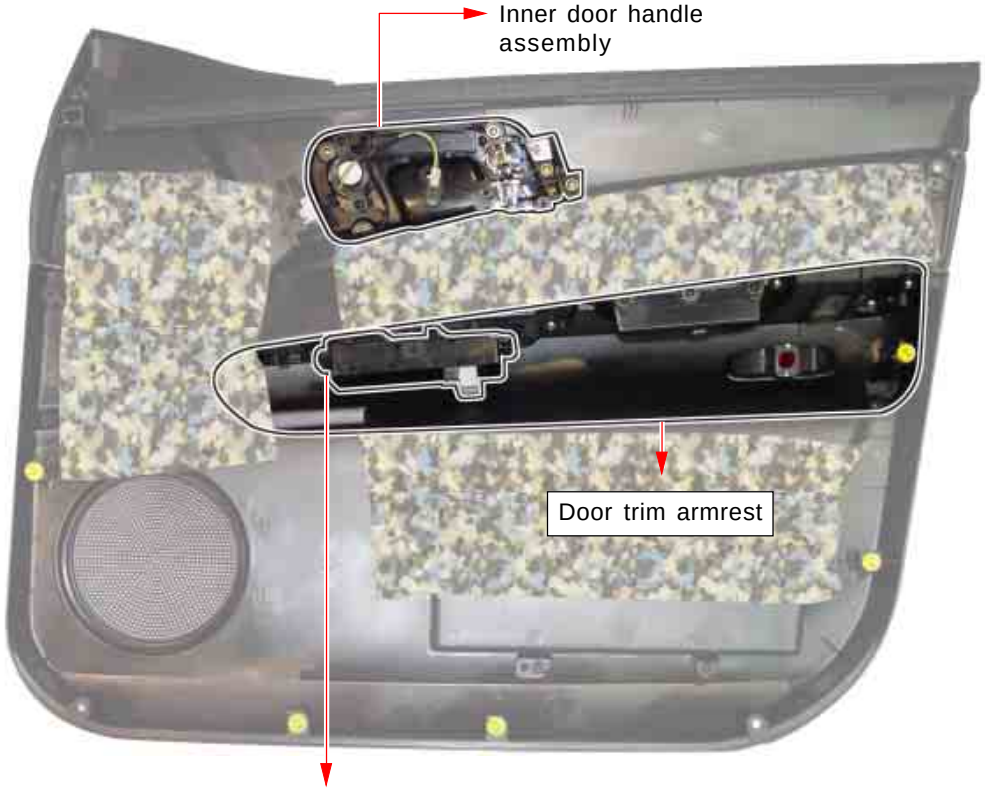
Front Door (Driver's)

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



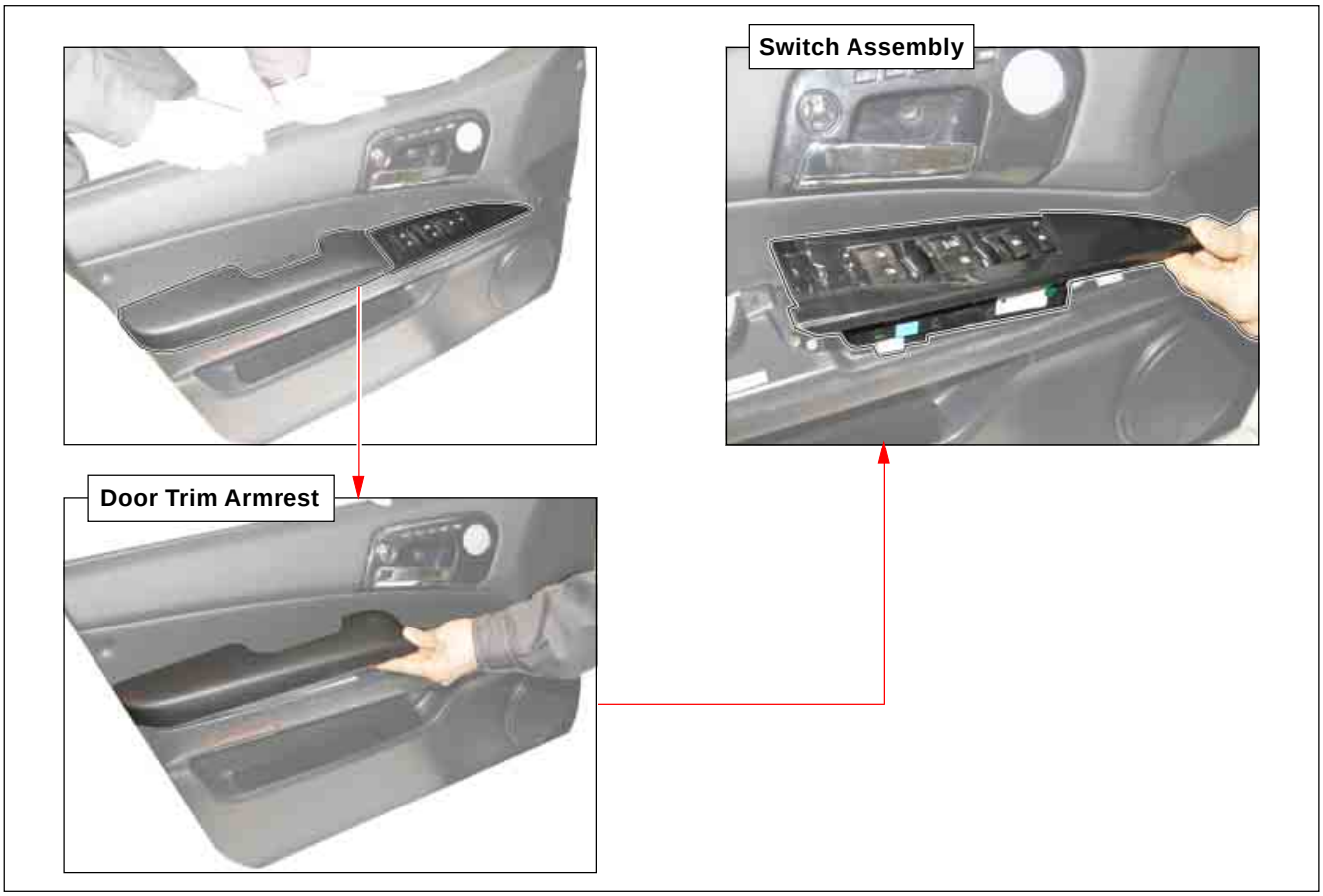


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2. Unscrew ten mounting screws on the inner door handle of the door trim.



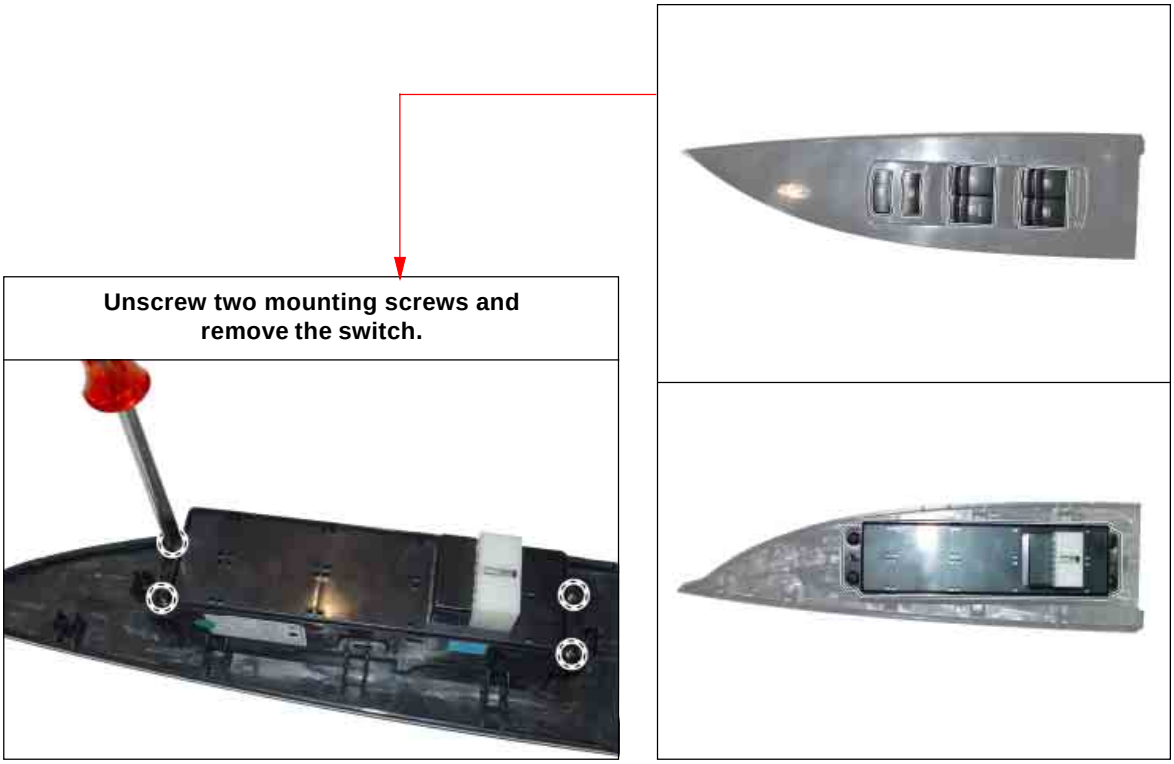
3. Remove the inner door handle and the memory seat switch assembly.



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4. Remove the switch from the memory seat switch assembly.



Unscrew two mounting screws and remove the switch.

Front View



Side View



Connector



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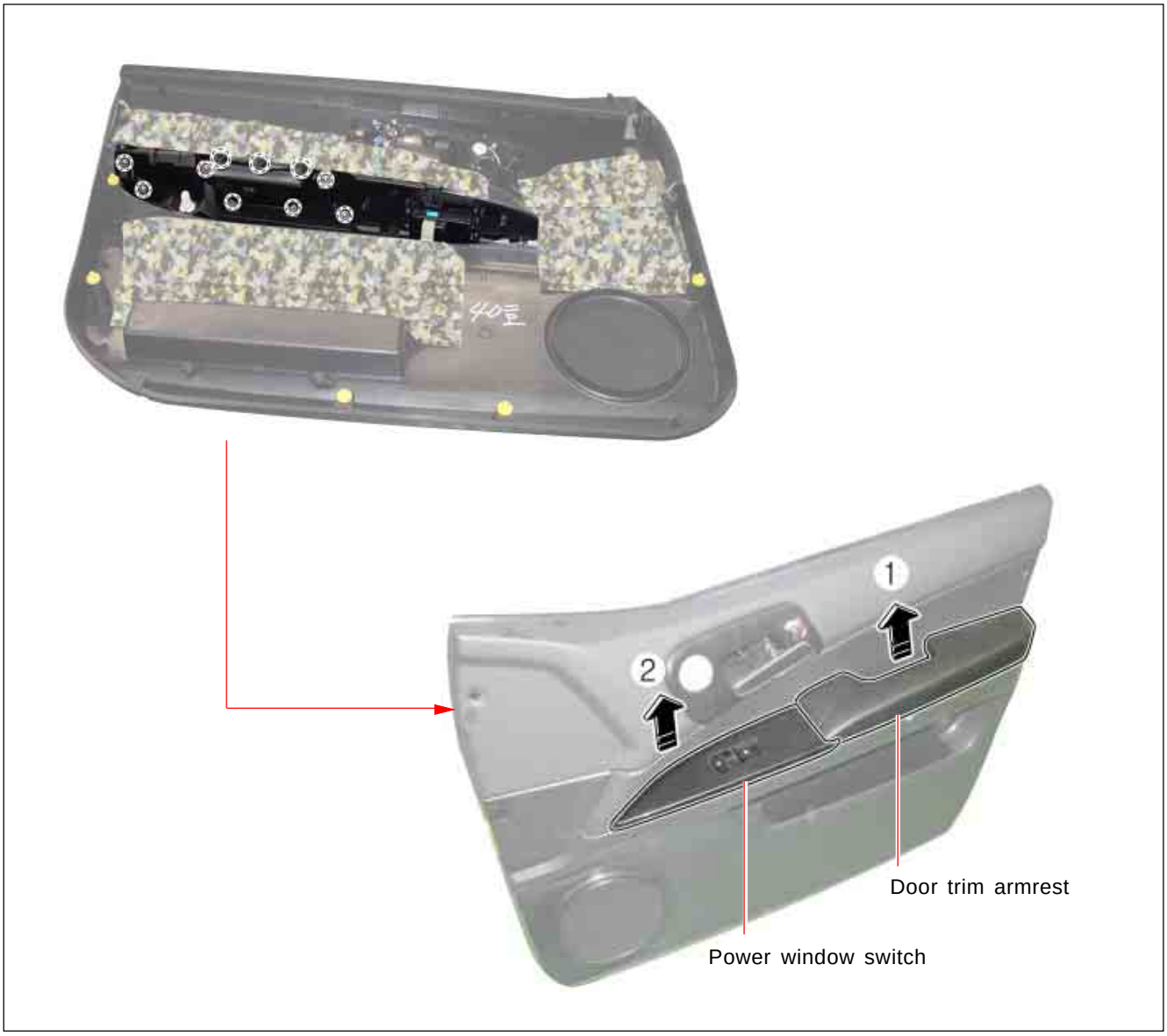
Front Door (Passenger's)

1. Remove the passenger's door trim.



NOTE
- **Be careful not to damage the door trim.**
- **For more information, refer to the "Body" section.**

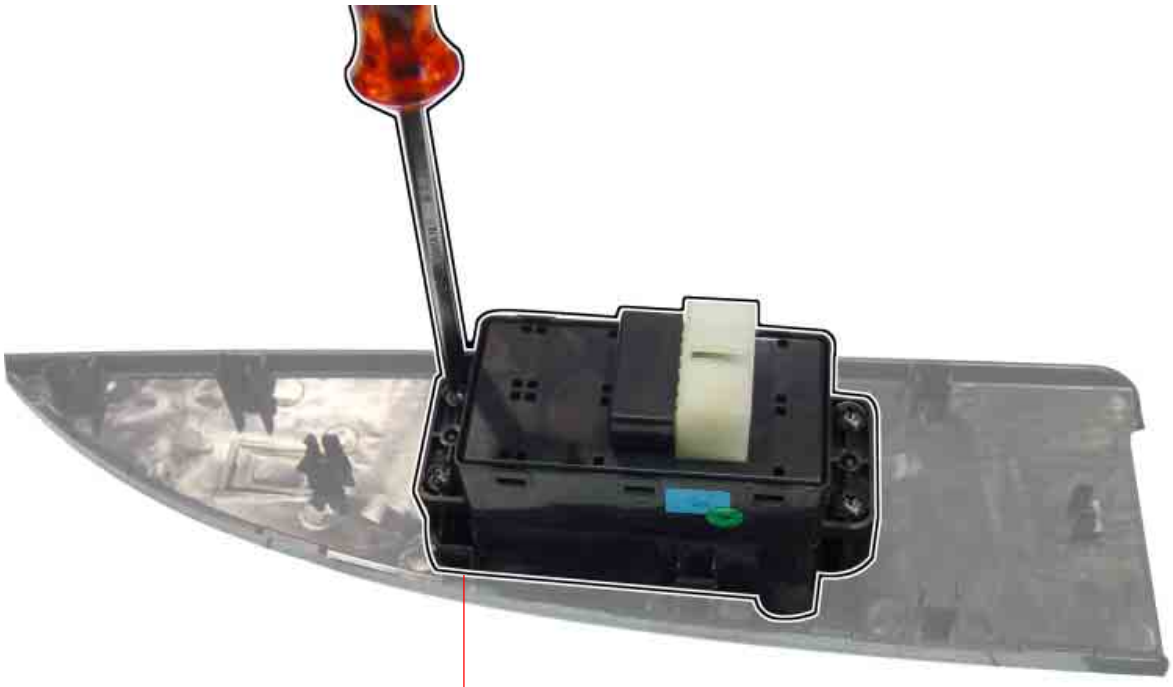
2. Unscrew the mounting screws and remove the inner door handle and the memory seat switch assembly from the passenger's door trim.



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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.



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3. Remove the switch.



Front View



Side View



Connector



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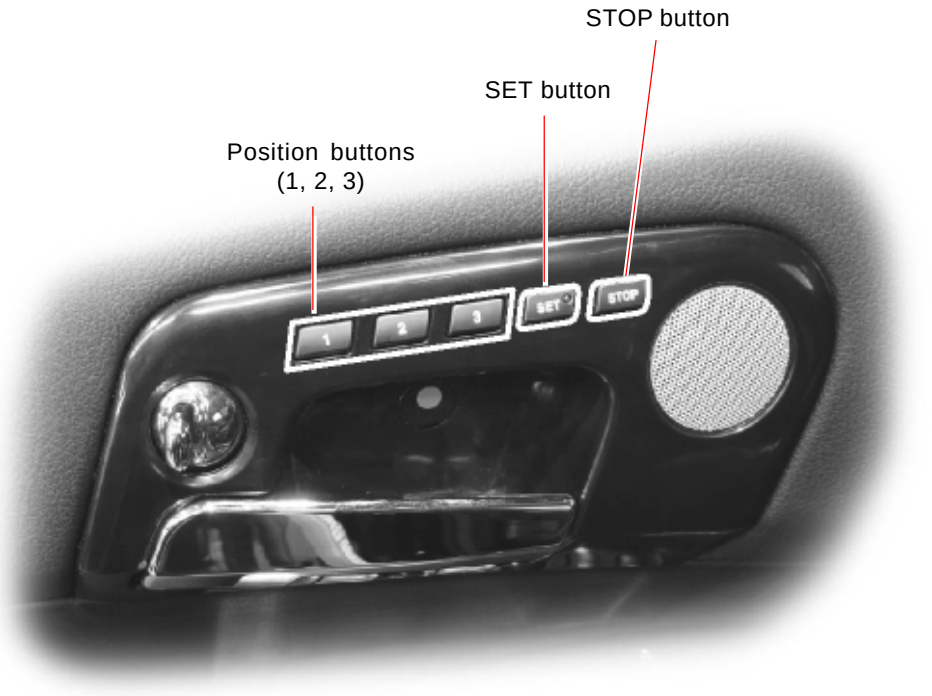
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SEAT POSITION MEMORY SWITCH

1. LOCATION AND FUNCTIONS

The position memory is available for up to three drivers. Each driver can set his/ her own driver's seat, outside rearview mirror positions and it will be separately stored in the integrated computer. If somebody has moved the seat, the memory positions can be recalled automatically by pressing the position button.

▶ Driver's Seat Memory Function



To Store the Memory Settings

1. Place the selector lever in "P" (automatic transmission) or "N" (manual transmission) position, and apply the parking brake with the ignition switch "ON".
2. Adjust the driver's seat and outside rearview mirrors to the desired positions.
3. Press the "SET" button. Indicating light on the button will come on.
4. Within 5 seconds, press the button (1), (2) or (3) you want to set.

To Operate the Memory Settings

1. Press and hold the one of position buttons (1, 2 or 3) for approx. 1.5 seconds.) At this moment, the buzzer sounds once.
2. The driver's seat and the outside rearview mirrors start to move. (The memory function stops during its operation when driving off the vehicle)
3. Wait until they stop moving (The buzzer sounds twice).

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2. SWITCH ARRANGEMENT

The driver's seat position memory switch is installed in door trim and its connector (4 pins) is connected to the SPWM (Seat Position With Memory) unit.



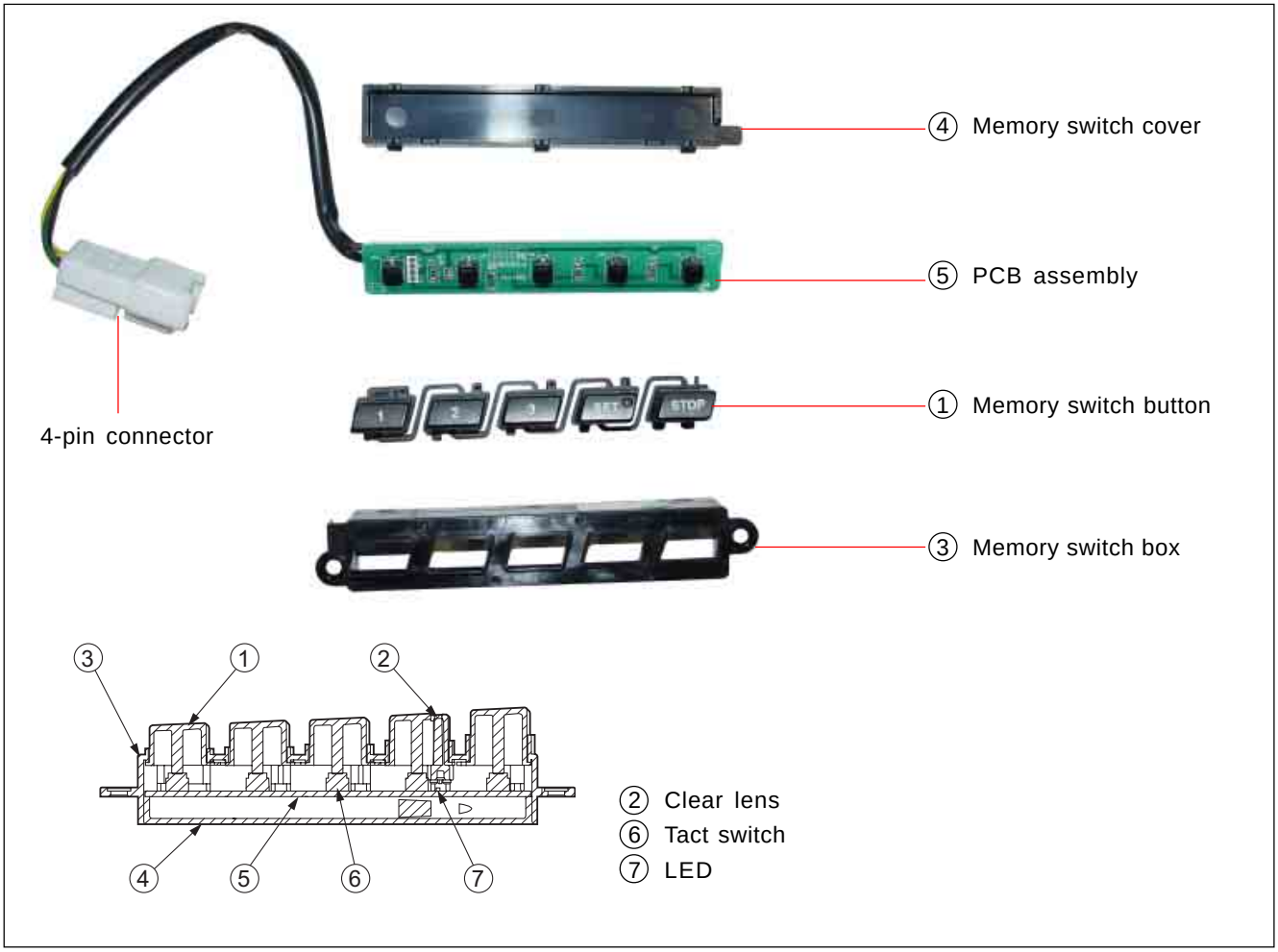
▶ Driver's Seat Memory Switch



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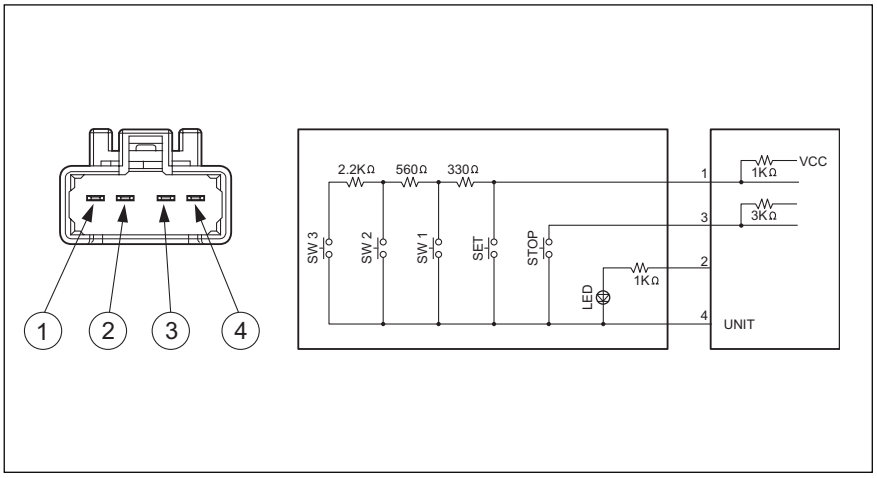
3. EXPLODED VIEW



4. OUTPUT VOLTAGE IN EACH SWITCH POSITION

The memory switch connector receives the position switch signal at the pin no. 1 and the resistance value and output voltage in each switch differs from others.

The table below shows the output voltage for each switch and the supply voltage is 5 V.



Output Voltage	
Function	Output voltage
SET	0 ~ 100 mv
STOP	0 ~ 100 mv
Position 1	0.12 ~ 1.36 mv
Position 2	2.12 ~ 2.59 mv
Position 3	3.4 ~ 4.15 mv

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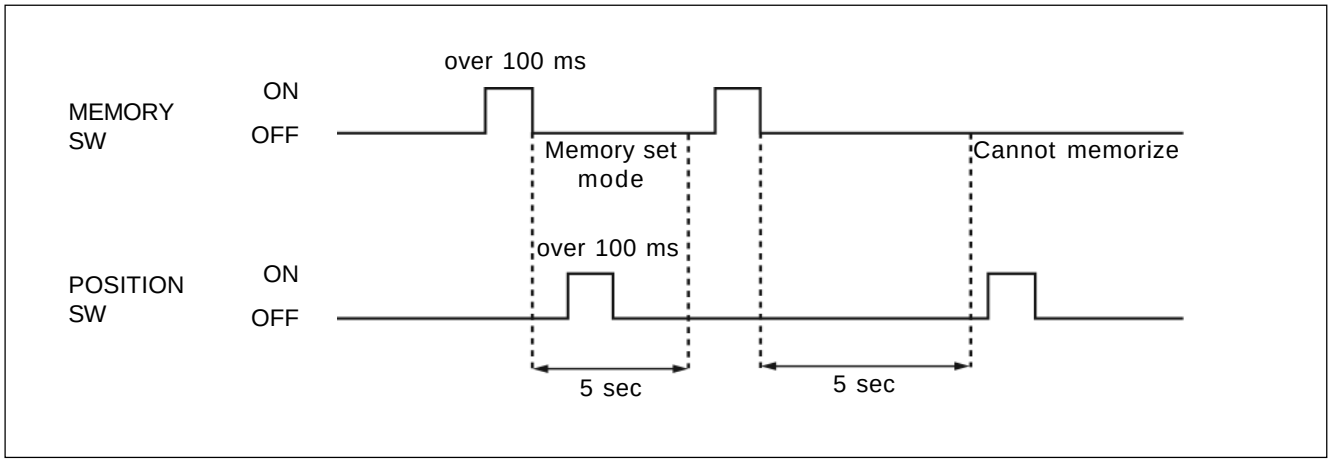
5. FUNCTIONS AND OPERATIONS

NOTICE

- **The position memory recall is canceled when operating the seat or the outside rearview mirrors during its operation.**
- **In the vehicle equipped with automatic transmission, the position memory recall is not available when the parking brake is released and the gear shift lever is not in "P" position.**
- **In the vehicle equipped with manual transmission, the position memory recall is not available when the parking brake is released.**
- **The memory recall is canceled if any position switch is not pressed within 5 seconds after pressing "SET" switch.**

▶ Seat Position Memory Operation

1. To store the seat position and the outside rearview mirror position, press the SET button and, within 5 seconds, press one of position switches. The memory setting is available up to 3 different drivers.
2. The memory set mode is only available within 5 seconds after pressing the SET button.



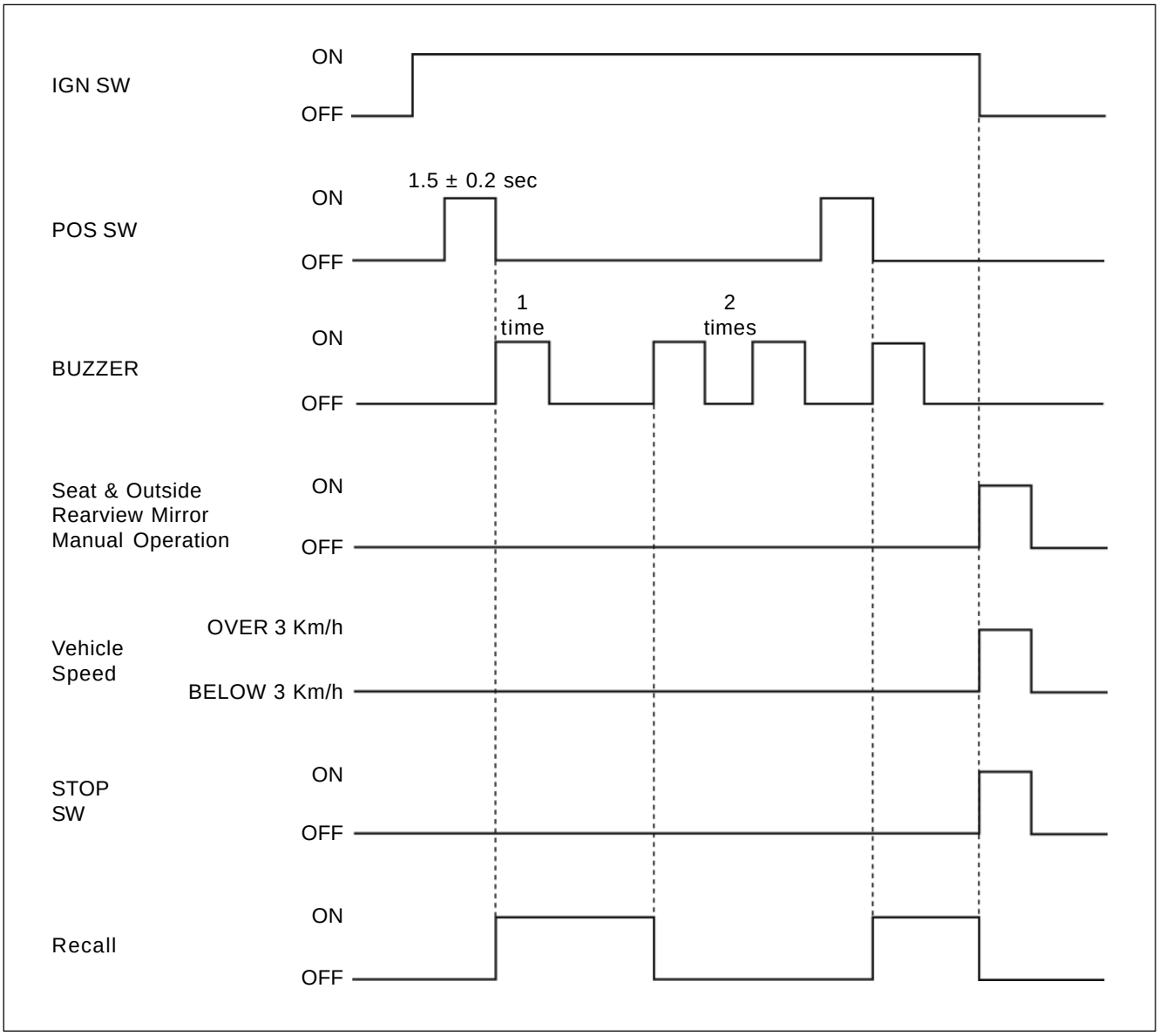
3. If any of the following conditions is established, the memory set mode is canceled.
   1) No switch inputs within 5 seconds after pressing SET button.
   2) When adjusting the seat or outside rearview mirror positions during the memory recall operation.
   3) When turning off the ignition switch.
   4) When pressing the STOP button
   5) When the memory setting is completed.
4. The memory recall is not available when the vehicle speed is over 3 km/h or the gear shift lever is not in “P” position with the parking brake released.
5. The memory set can be unlimitedly renewed.
6. The stored positions are erased when disconnecting the battery cables.
7. The buzzer sounds once when the memory set mode is activated.
8. The buzzer sounds twice when the memory setting/recalling is completed.
9. The buzzer sounds three times when an error is found from the sensor during the memory recall operation.

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▶ Seat Memory Recall Operation

1. When pressing the position switch with the ignition switch ON, the seat and outside rearview mirrors move to the memorized positions.
2. When pressing another position switch during previously activated memory recall operation, the newly pressed position switch takes priority and recalls its stored positions.
3. The buzzer sounds once when a position switch is pressed.
4. If any of the following conditions is established, the memory recall function is deactivated.
   1) When turning off the ignition switch.
   2) When the gear shift lever is not in “P” position with the parking brake released.
   3) When the parking brake is released (only for the vehicle equipped with manual transmission)
   4) When the vehicle speed is over 3 km/h.
   5) When pressing the STOP button during the memory recall operation.
   6) When adjusting the seat or outside rearview mirrors during the memory recall operation.

5. Timing Chart



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6. REMOVAL AND INSTALLATION OF SEAT POSITION MEMORY SWITCH

※ **Preceding Works:** Disconnect the negative battery cable.

1. Remove the driver's door trim.



NOTE
- **For details, refer to the "Body" section.**

Location



Memory Seat Switch



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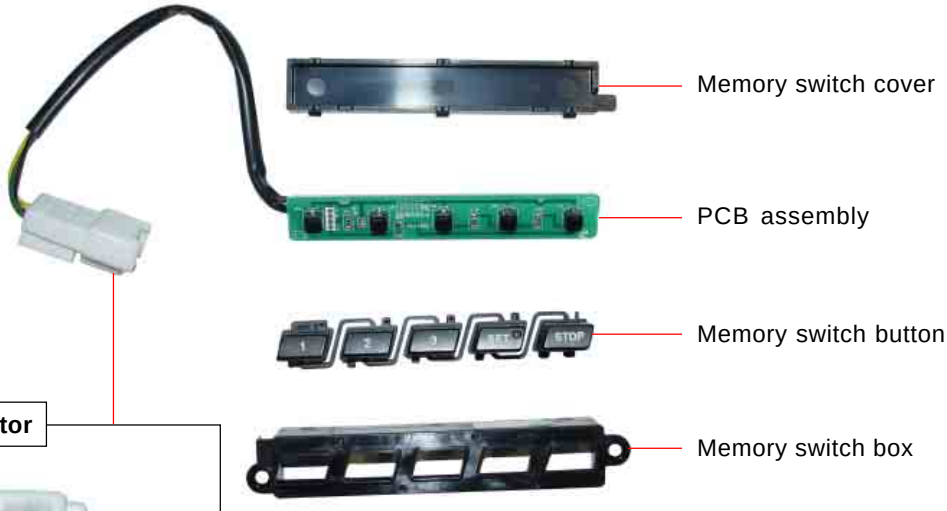
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2. Remove the memory seat switch from the door trim.



Switch Arrangement





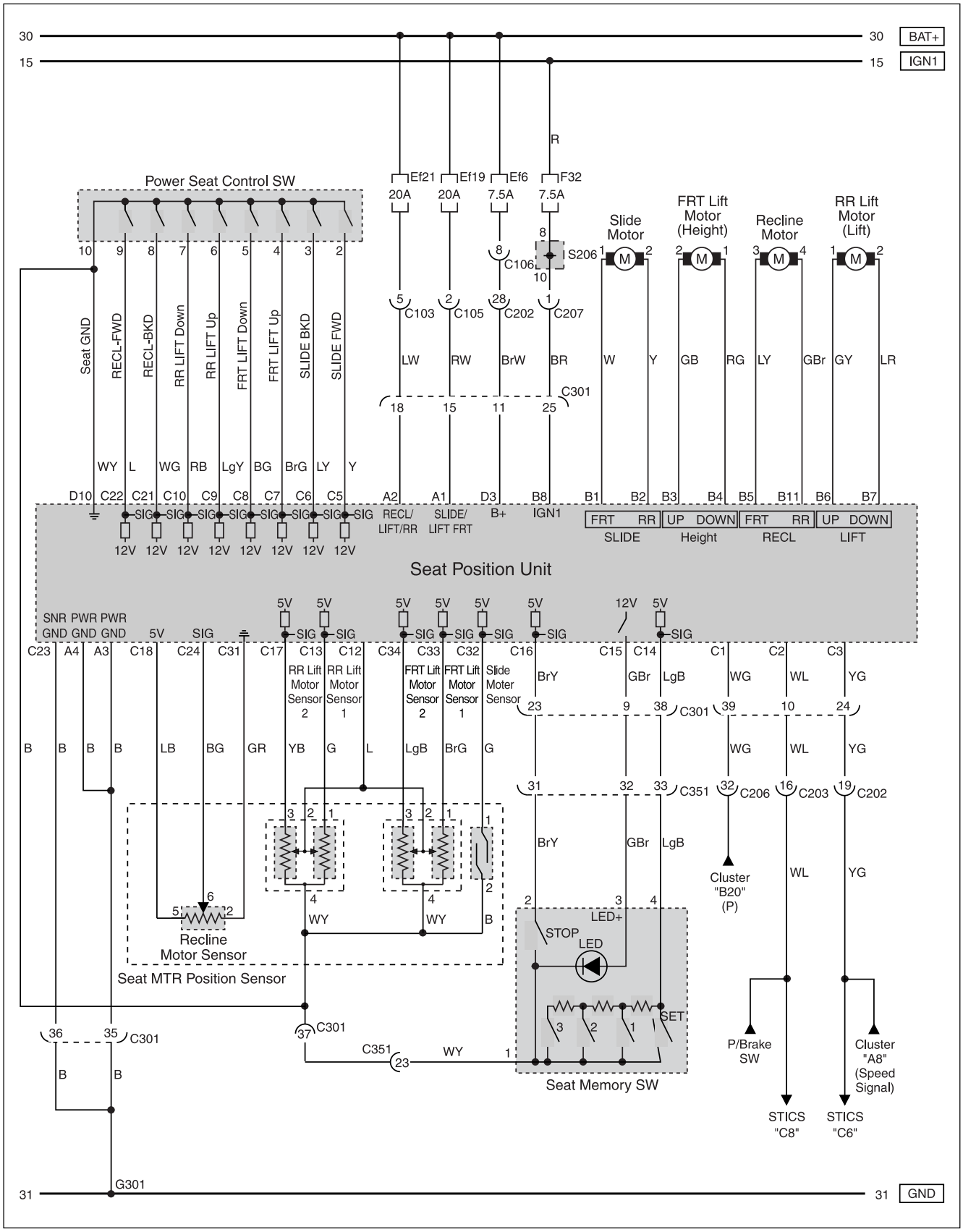
4-pin Connector



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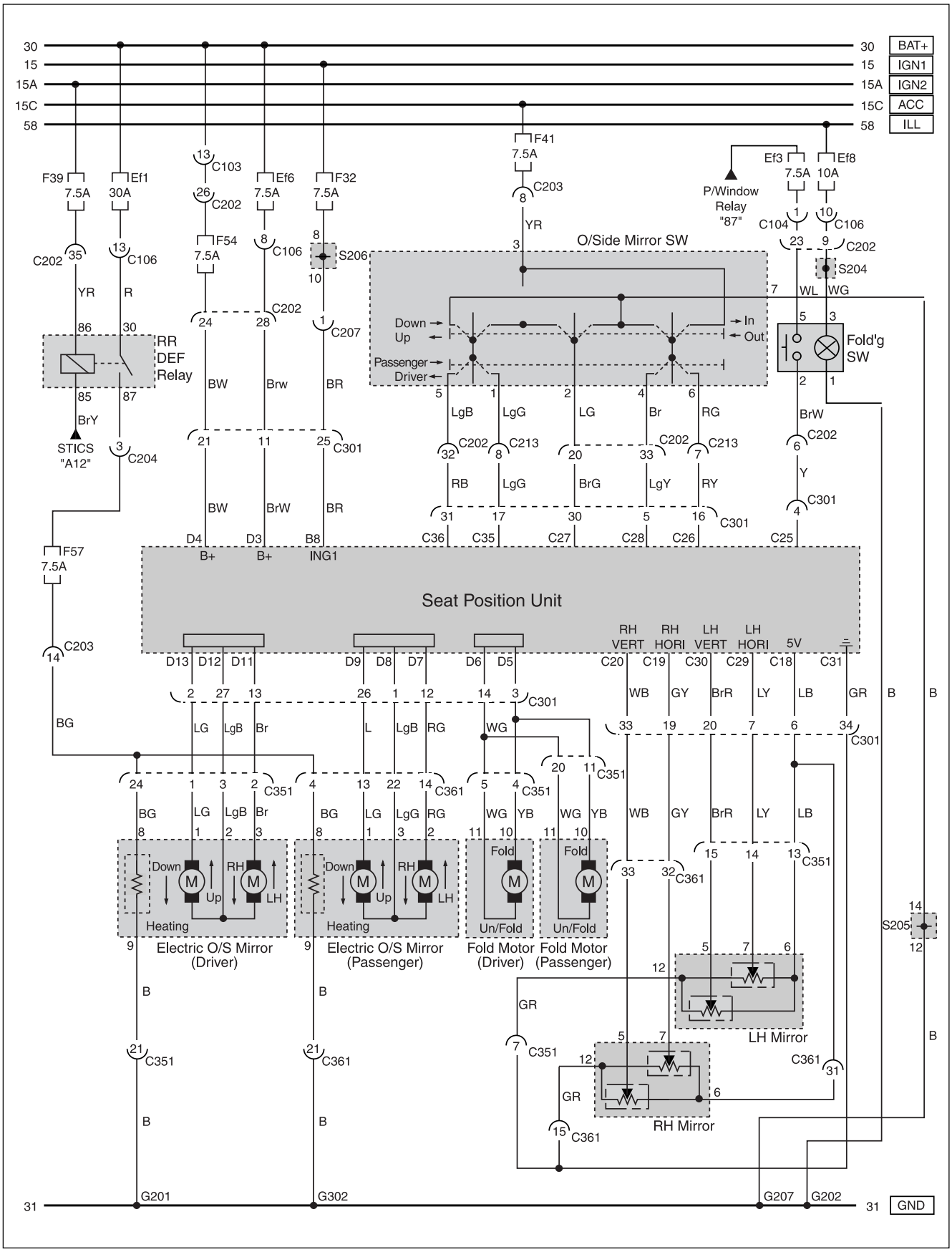
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7. ELECTRICAL DIAGRAM OF POWER SEAT & OUTSIDE REARVIEW MIRROR



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SWITCHES / ELECTRIC DEVICES

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AUDIO REMOTE CONTROL SWITCH ON STEERING WHEEL

1. LOCATIONS AND FUNCTIONS



POWER

Turns on and off the audio system.

MUTE

Stops audio output from audio system. To resume the audio output, press the button again.

MODE

Changes the audio mode in order.

▲ VOL

▼ VOL

Increases or decreases the volume.

▲ SEEK **SEEK ▼**

In radio mode
- Press briefly: Manual searching for a station.
- Press and hold: Automatic searching for a station.

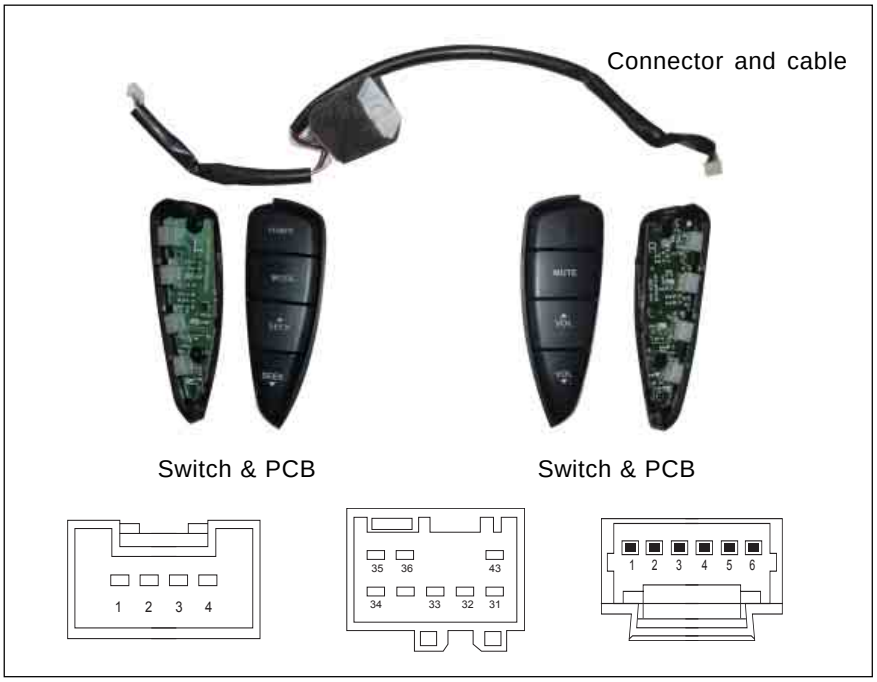
In CD (DVD) player/Cassette tape mode
- Press briefly: Replay next/previous track.
- Press and hold: Move forward/backward in current tract.

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2. COMPONENTS

The remote audio control switch is installed on the the steering wheel. Its rated voltage is 5 V and has three connectors.



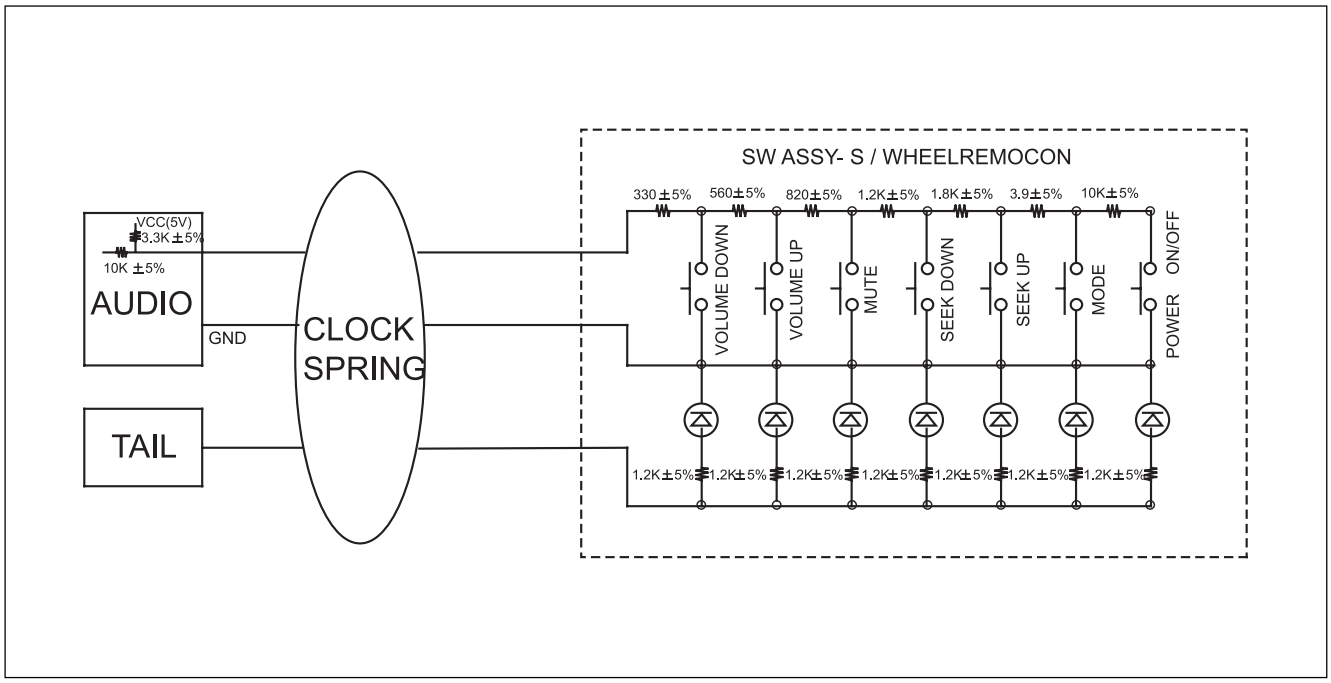


Main Connector	
Pin No.	Output voltage
31	Audio signal
32	Audio ground
33	Tail lamp power

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3. CIRCUIT DIAGRAM



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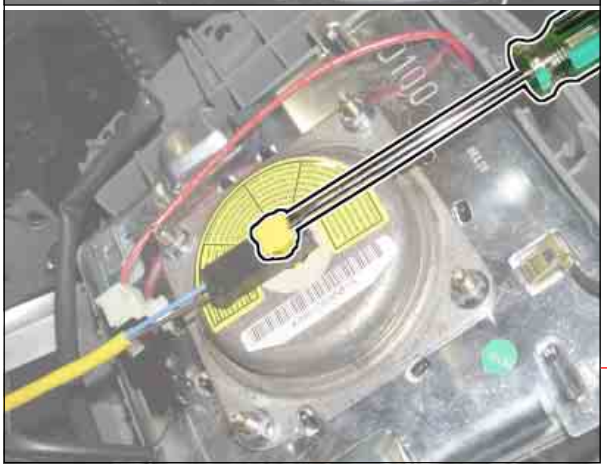
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4. REMOVAL AND INSTALLATION

※ **Preceding Works:** Disconnect the negative battery cable.

1. Remove the airbag module assembly from the steering wheel.











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2. Unscrew mounting screws at both sides of the removed airbag module and remove the audio remote control switch.











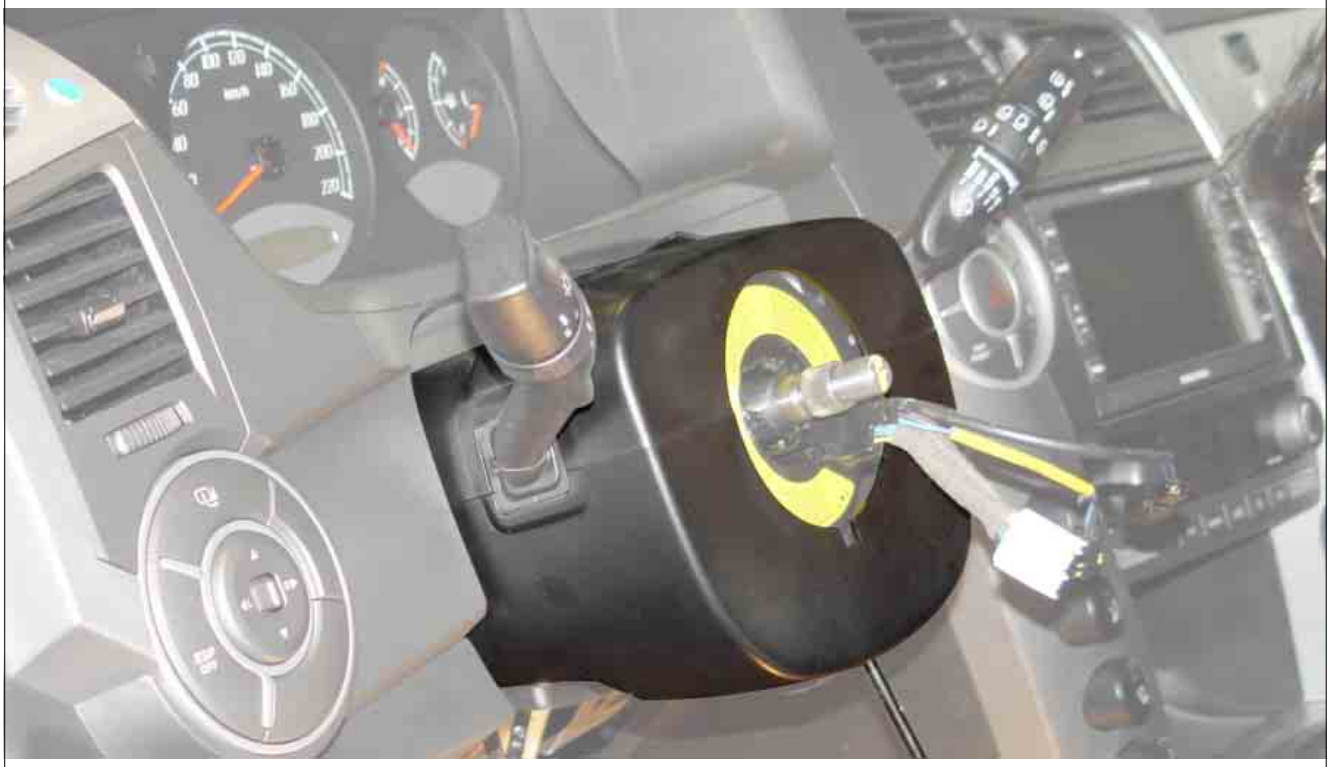
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MULTIFUNCTION SWITCH

1. OVERVIEW

The multifunction switch in this vehicle contains basic multifunction switch functions, Auto washer & wiper, fog lamp switch and Auto hazard lamp switch. When serving the multifunction switch, pay particular attention not to damage the air bag spring clock installed on the multifunction switch.

Mounted View



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.



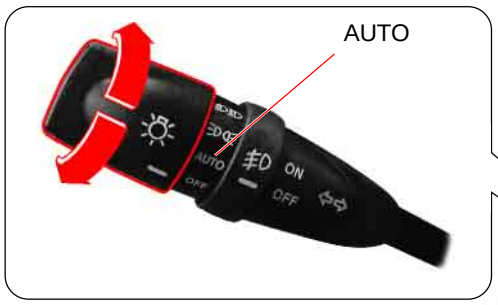
<For detailed operation logics, refer to “STICS”>

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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).



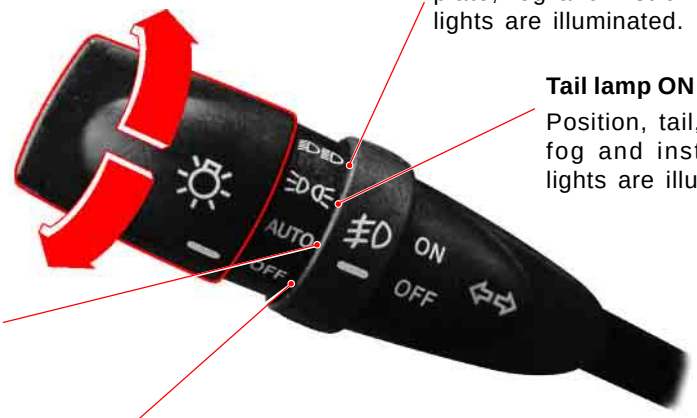
▶ Light Switch

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

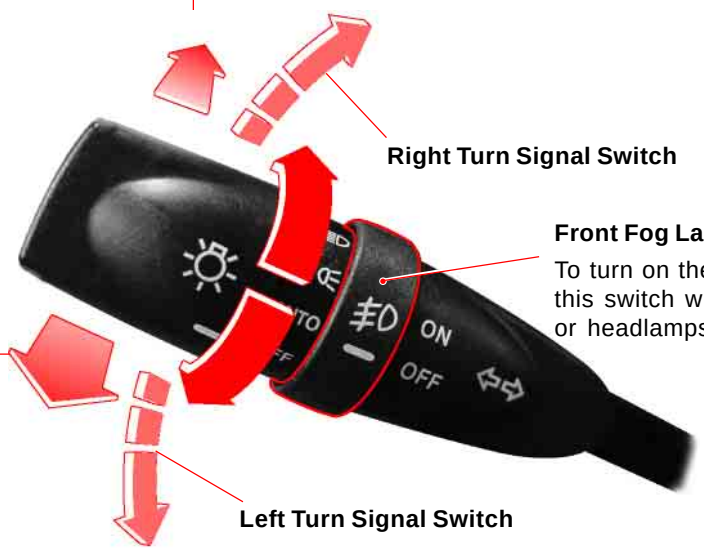
Headlamps and tail lamps automatically turn on or off based upon the intensity of the sunlight analyzed by the automatic light sensor.

All lights are off.

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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.



Right Turn Signal Switch

Front Fog Lamp Switch

To turn on the fog lamps, turn this switch while the tail lamps or headlamps are 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.

Left Turn Signal Switch

▶ Front Wiper Switch

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

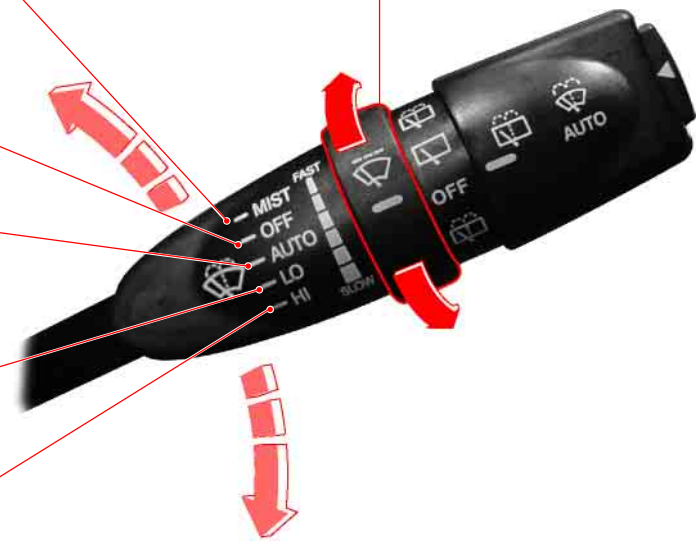
Continuous wipe, slow operation

HI

Continuous wipe, fast operation

Front Automatic Wiping Speed Control Switch

Fast: Fast interval
Slow: Slow interval



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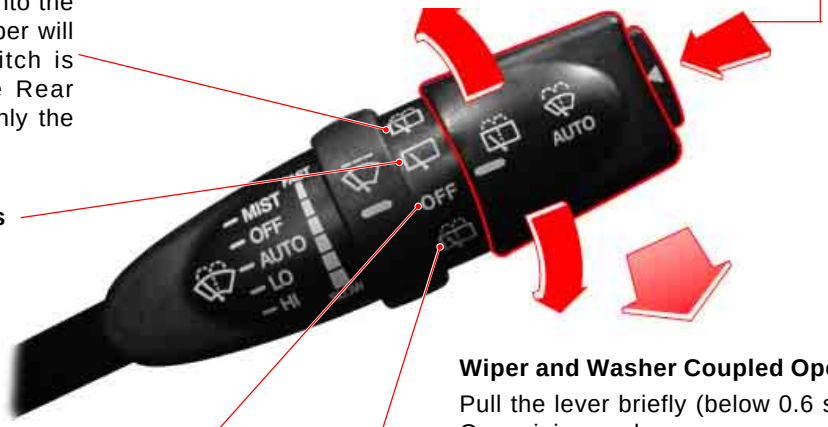
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Front Auto Washer Switch (AFW)

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 (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 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.

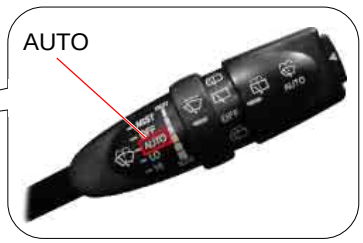
Rain & AUTO Light Sensor



It controls the wiping speed by detecting the amount of rain drops.

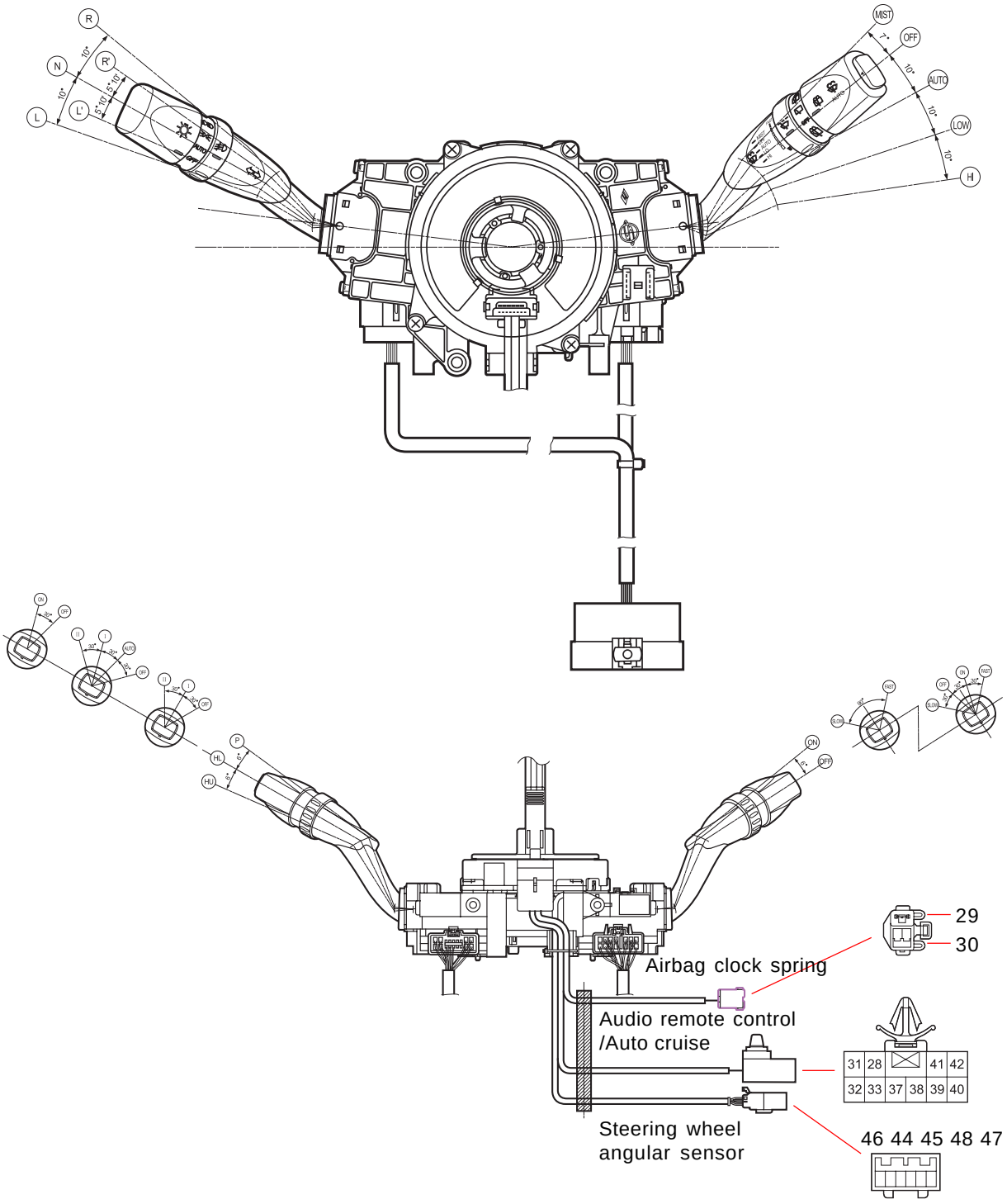


Wiper Switch AUTO Position



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3. OPERATING RANGE

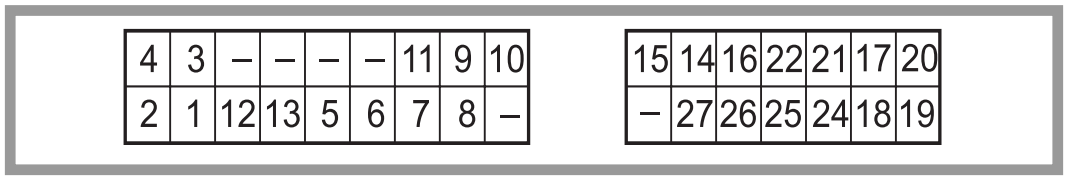


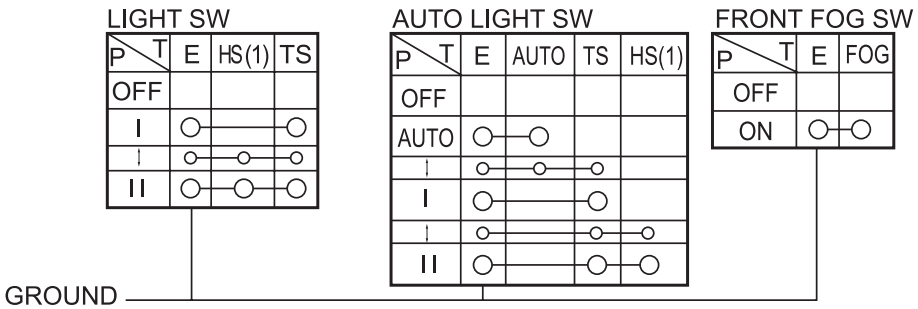
29	Air bag (-)
30	Air bag (+)
43	Sound switch
37 ~ 42	Auto cruise
31 ~ 33	Audio remote control
44 ~ 48	Steering wheel angular sensor

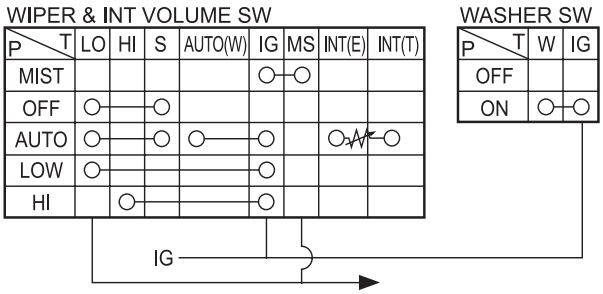
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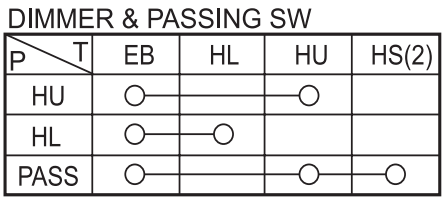
4. CONNECTOR PIN ARRANGEMENT

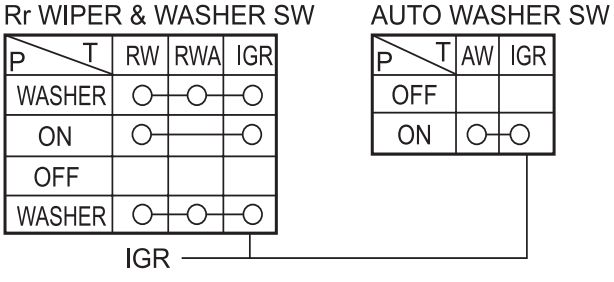






1	EB	Dimmer and passing ground
2	HL	Headlamp low beam
3	HU	Headlamp high beam
4	HS(2)	Passing
5	TS	Tail lamp switch
6	HS(1)	Headlamp switch
7	AUTO	AUTO light
8	E	Light/fog/hazard warning switch ground
9	TB	Flasher unit power
10	TL	Turn signal (LH) lamp switch
11	TR	Turn signal (RH) lamp switch
12	FOG	Front fog lamp 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





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5. REMOVAL AND INSTALLATION

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the air bag module and steering wheel.



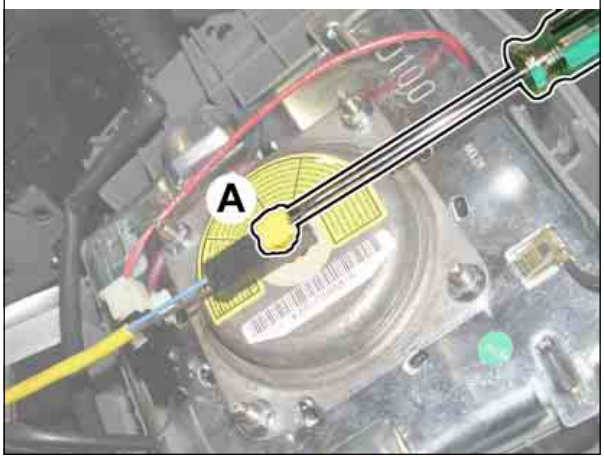
Air bag Module Assembly



NOTICE

- **Be careful not to drop or shock the air bag module during removal procedures.**

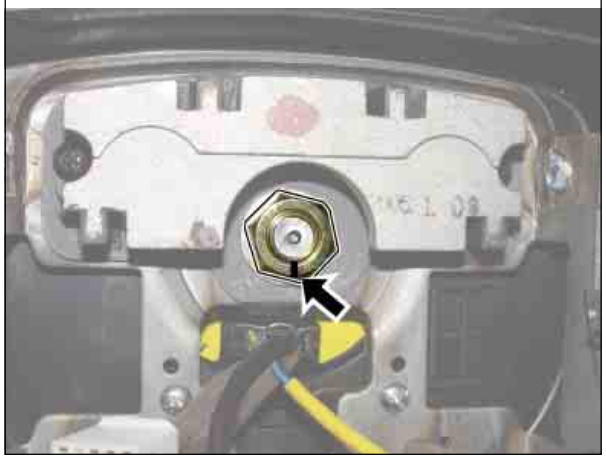
Lift up the hook when disconnecting the air bag contact coil connector (A).



Steering Wheel Assembly



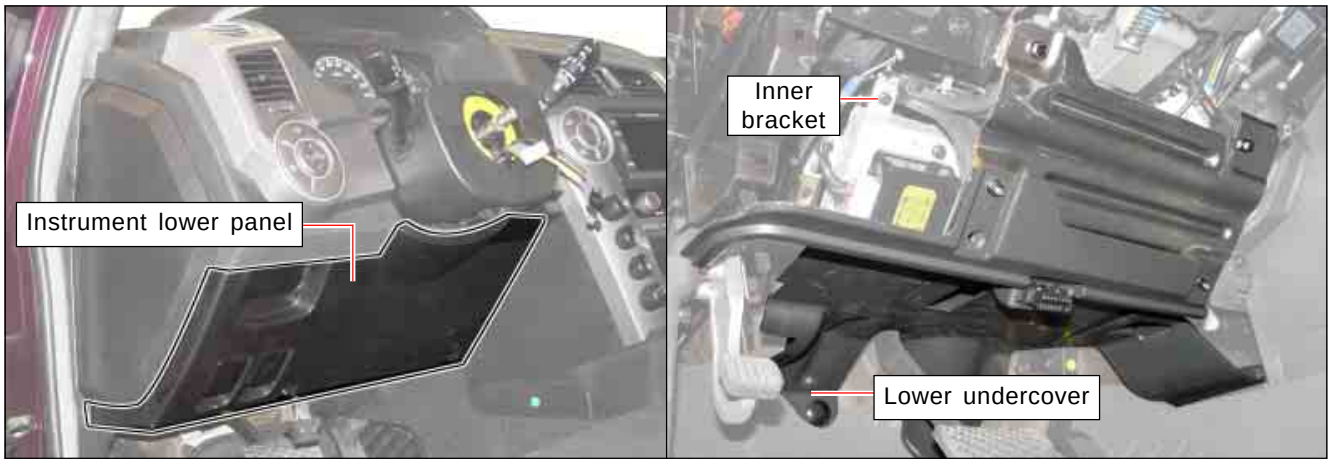
Put an installation mark on the steering wheel, column shaft and nut when removing the steering wheel. Place the steering wheel to the straight forward direction.



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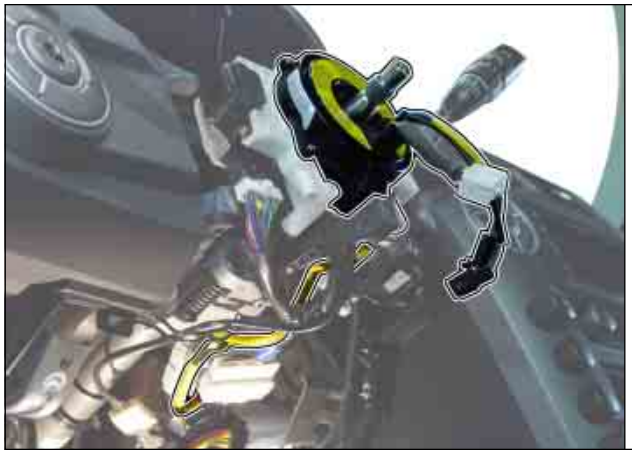
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2. Remove the driver side instrument lower panel, inner bracket and lower undercover. For details, refer to the "Body" section.



3. Unscrew four 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.



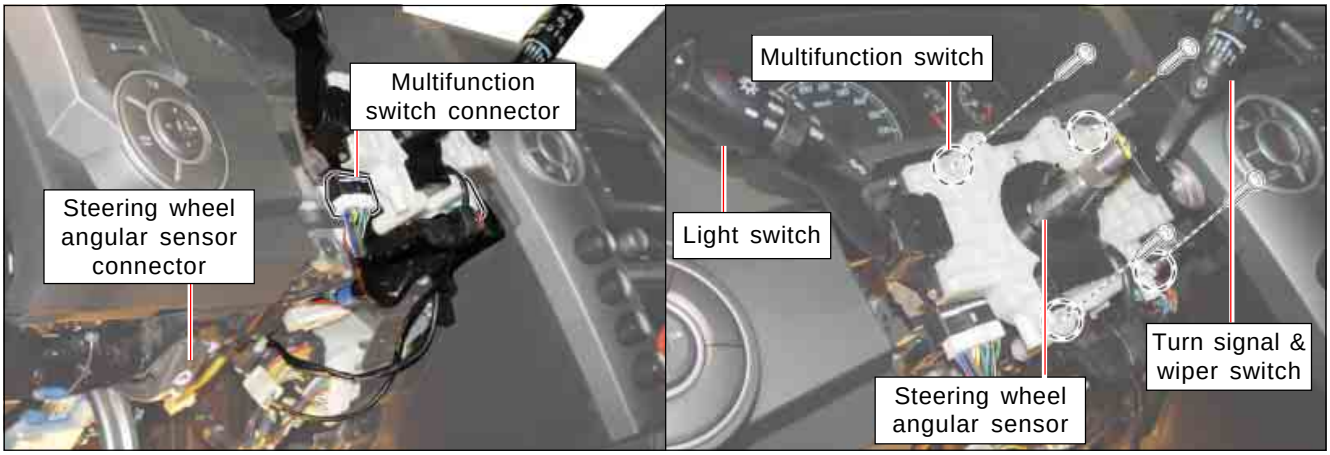




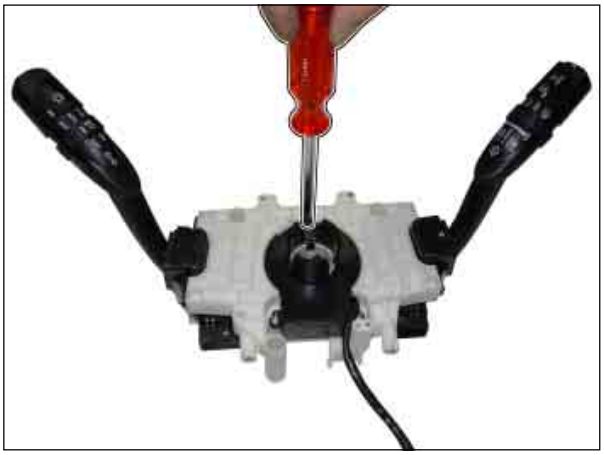
For installation, align the steering wheel to the installation mark and tighten the nut to the specified tightening torque.

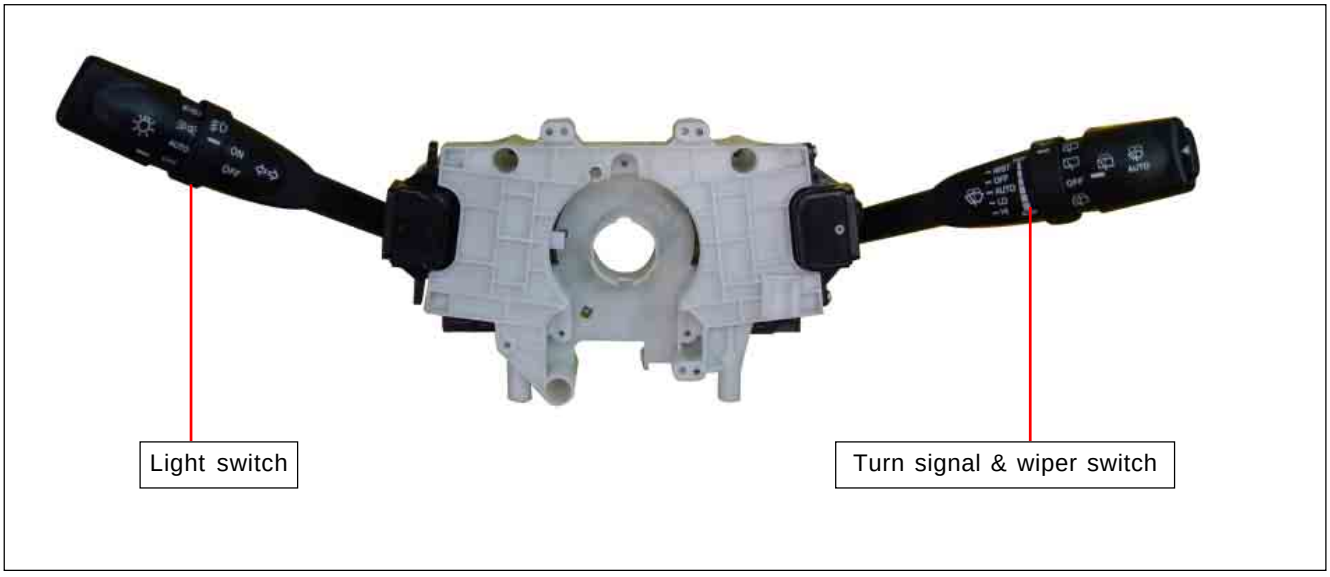
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5. Remove the mounting screws (3 EA) from the steering will steering wheel sensor and the multifunction switch (4 EA) at this moment, disconnect the connectors.



6. Remove the steering wheel angular sensor from the removed multifunction switch assembly.





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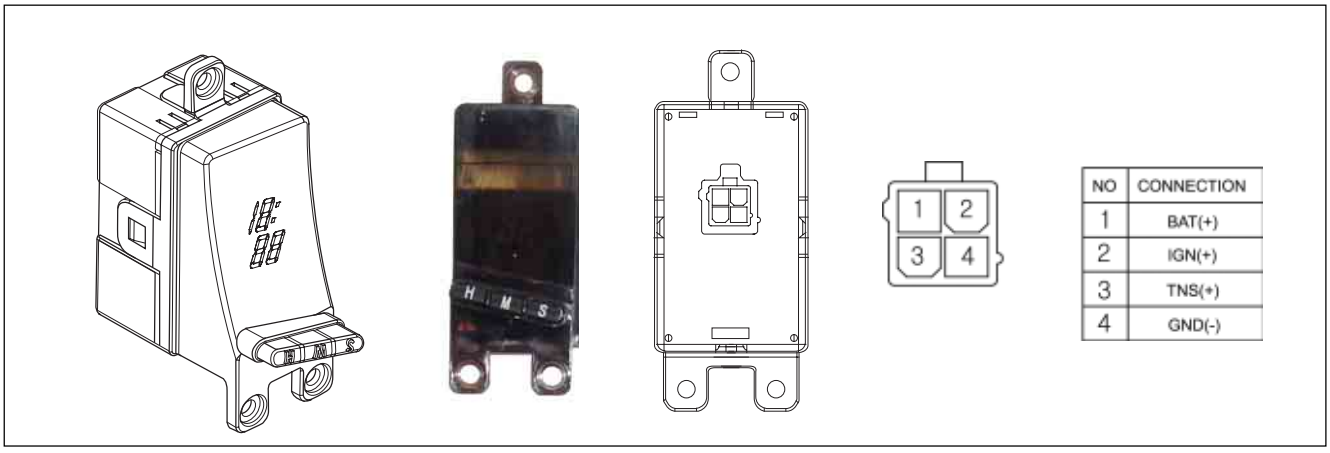
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MEMO

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DIGITAL CLOCK

※ **Preceding Works:** Disconnect the negative battery cable.



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: VFD

Brightness: 100% with Tail lamp OFF

40% with Tail lamp ON

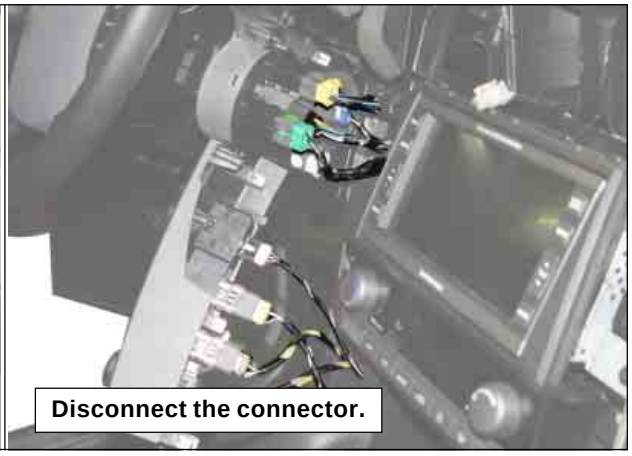
Blinking cycle of Colon: Once per second



1. Remove the center fascia panel (refer to the "Switch" section).







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2. Disconnect the digital clock connector.





3. Unscrew three mounting screws and remove the digital clock from the center fascia panel.



Digital Clock





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CIGARETTE LIGHTER

※ **Preceding Works:** Disconnect the negative battery cable.

Cigarette Lighter





1. Remove the center console cover.



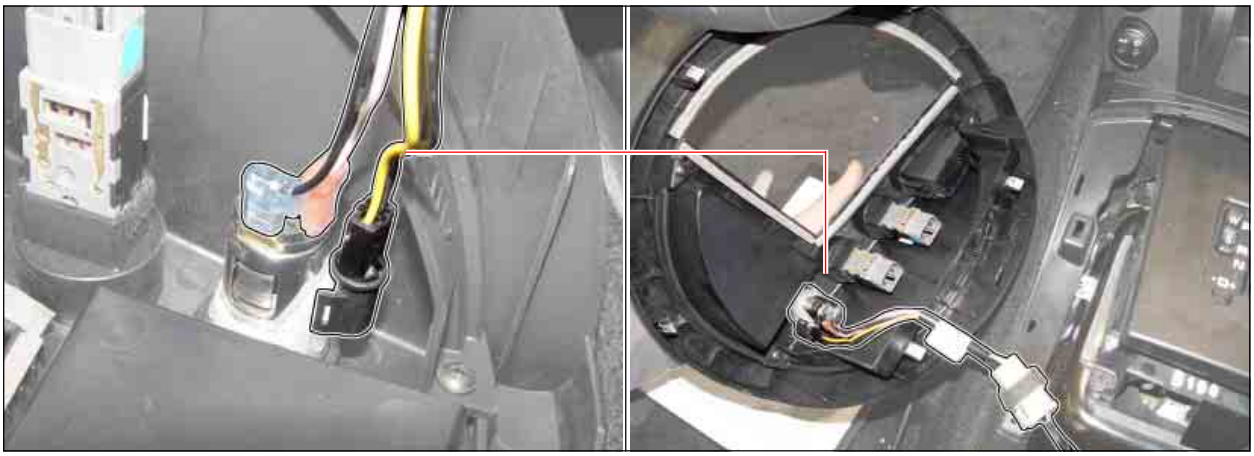
Remove the panel from bottom



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2. Disconnect the cigarette lighter connector.



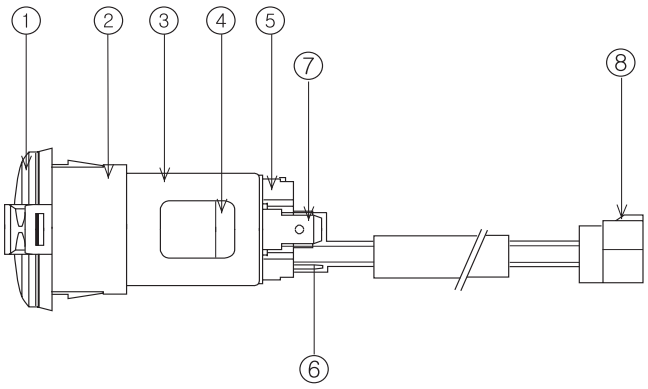


3. Remove the cigarette lighter from the cover.



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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.



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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.



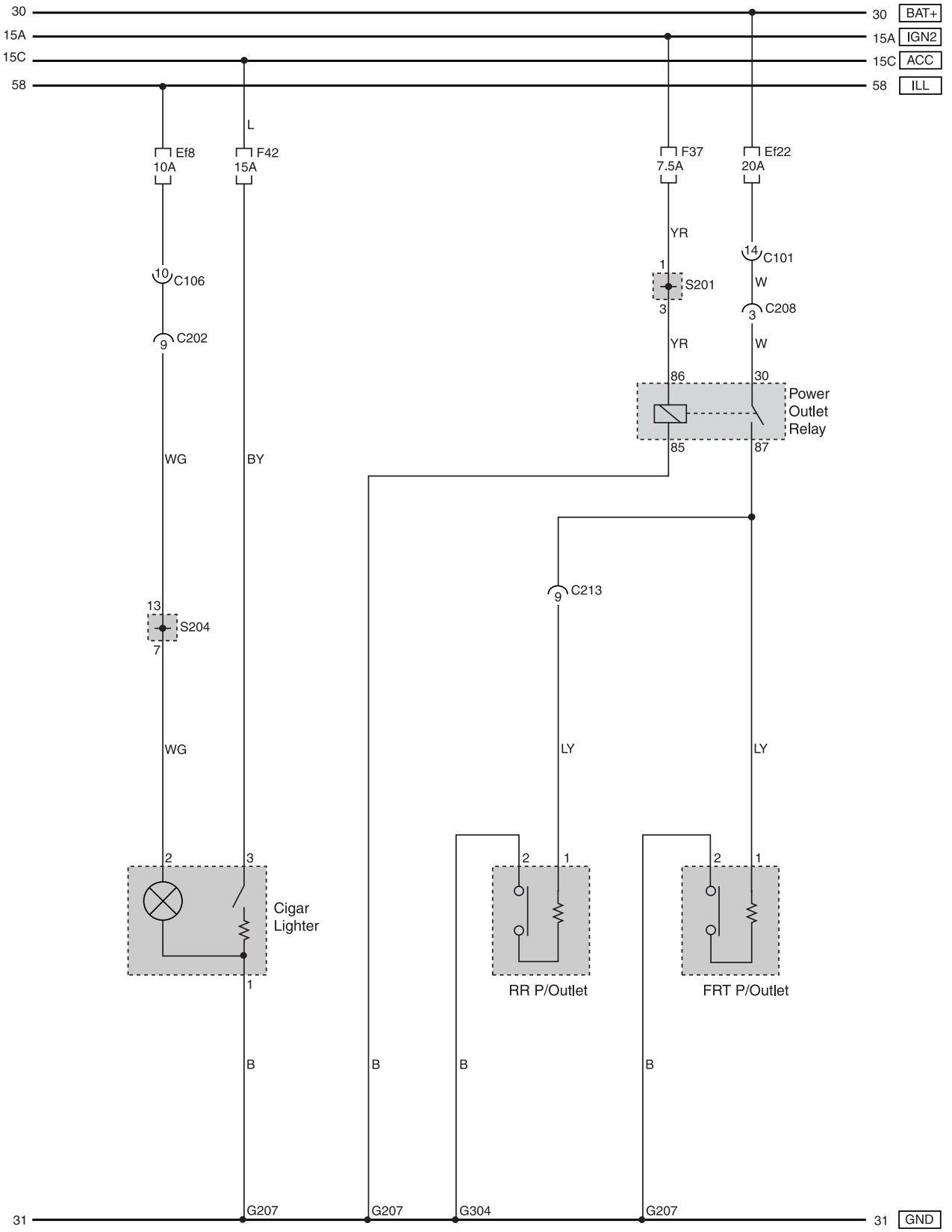
3. Remove the power outlet from the bracket.



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▶ Electrical Wiring Diagram of Cigarette and Power Outlet

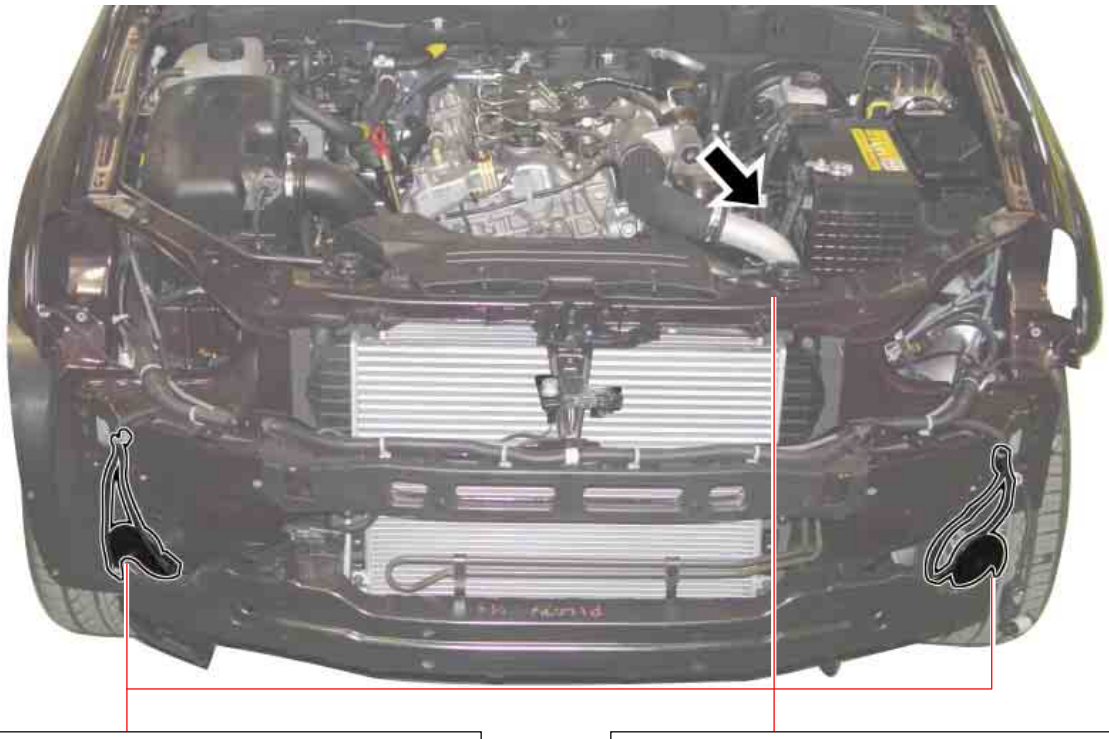


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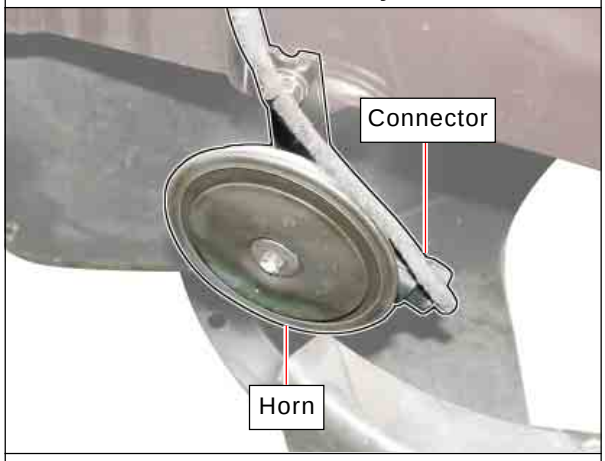
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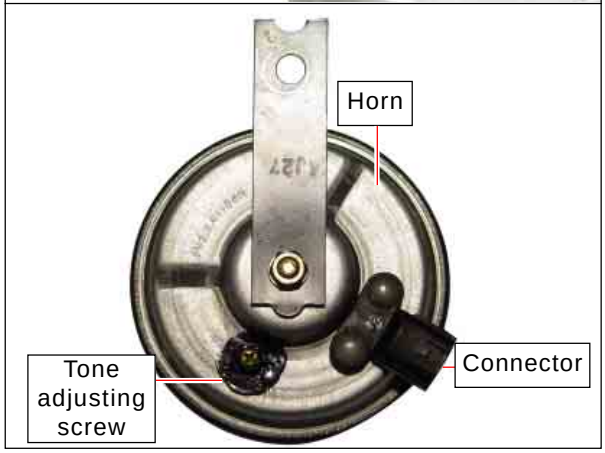
HORN (INCLUDING THEFT WARNING HORN)

1. LOCATION



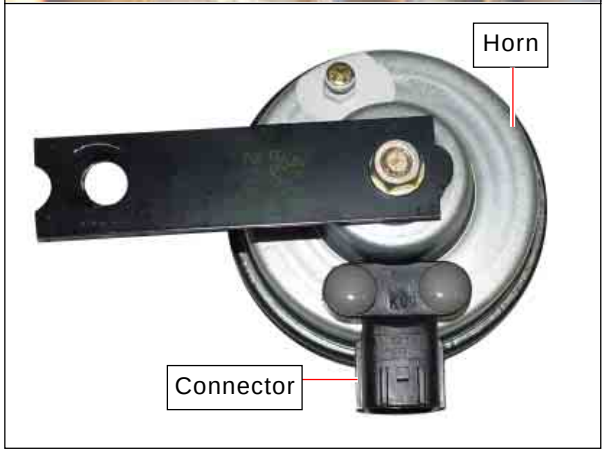
Horn Assembly





Theft Deterrent Horn





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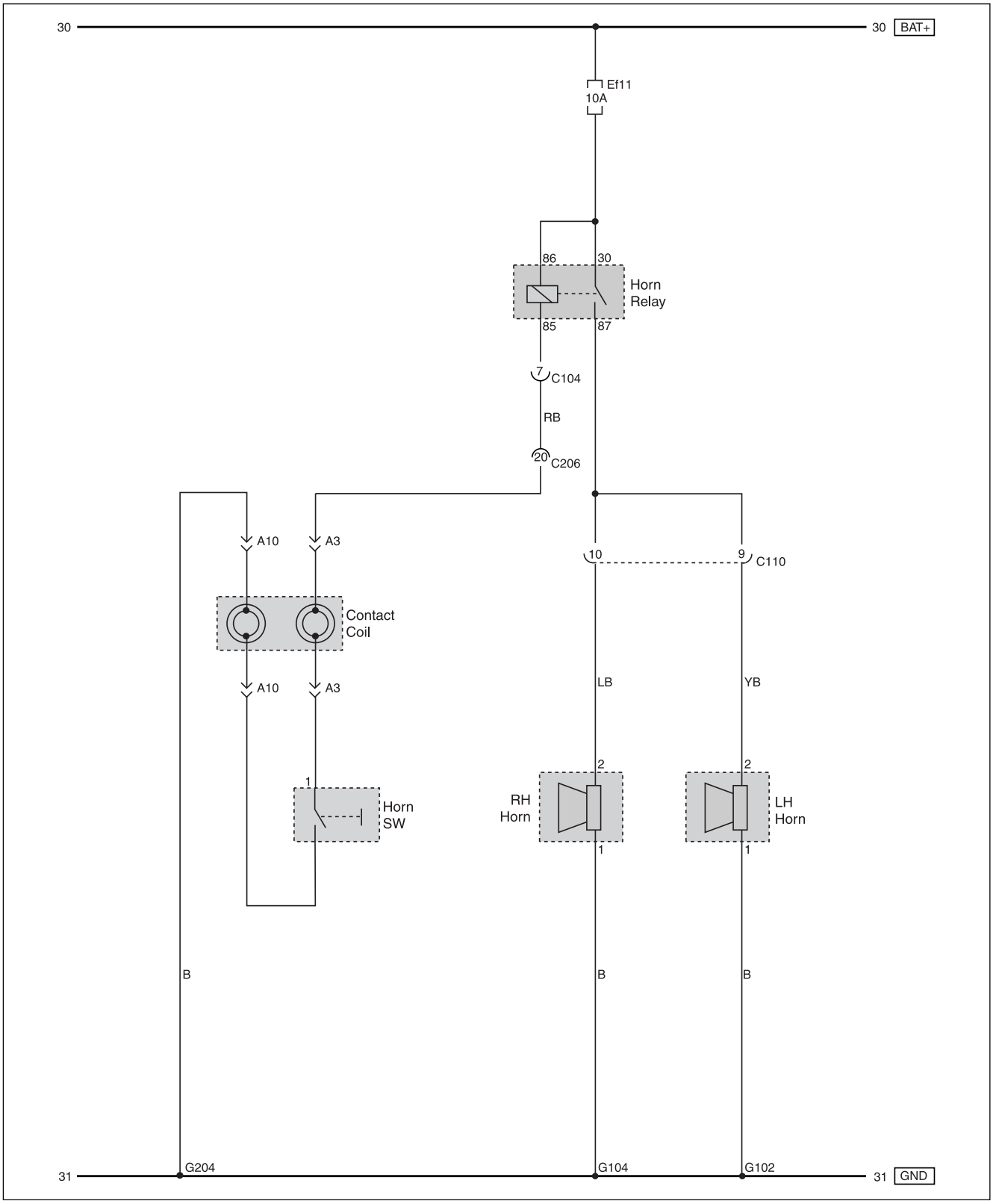
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2. ELECTRICAL WIRING DIAGRAM OF HORN

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.



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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) output “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) output “LOCK” signal.
   Door UNLOCK: All lock switches (front doors, rear doors, tailgate) output “UNLOCK” signal.

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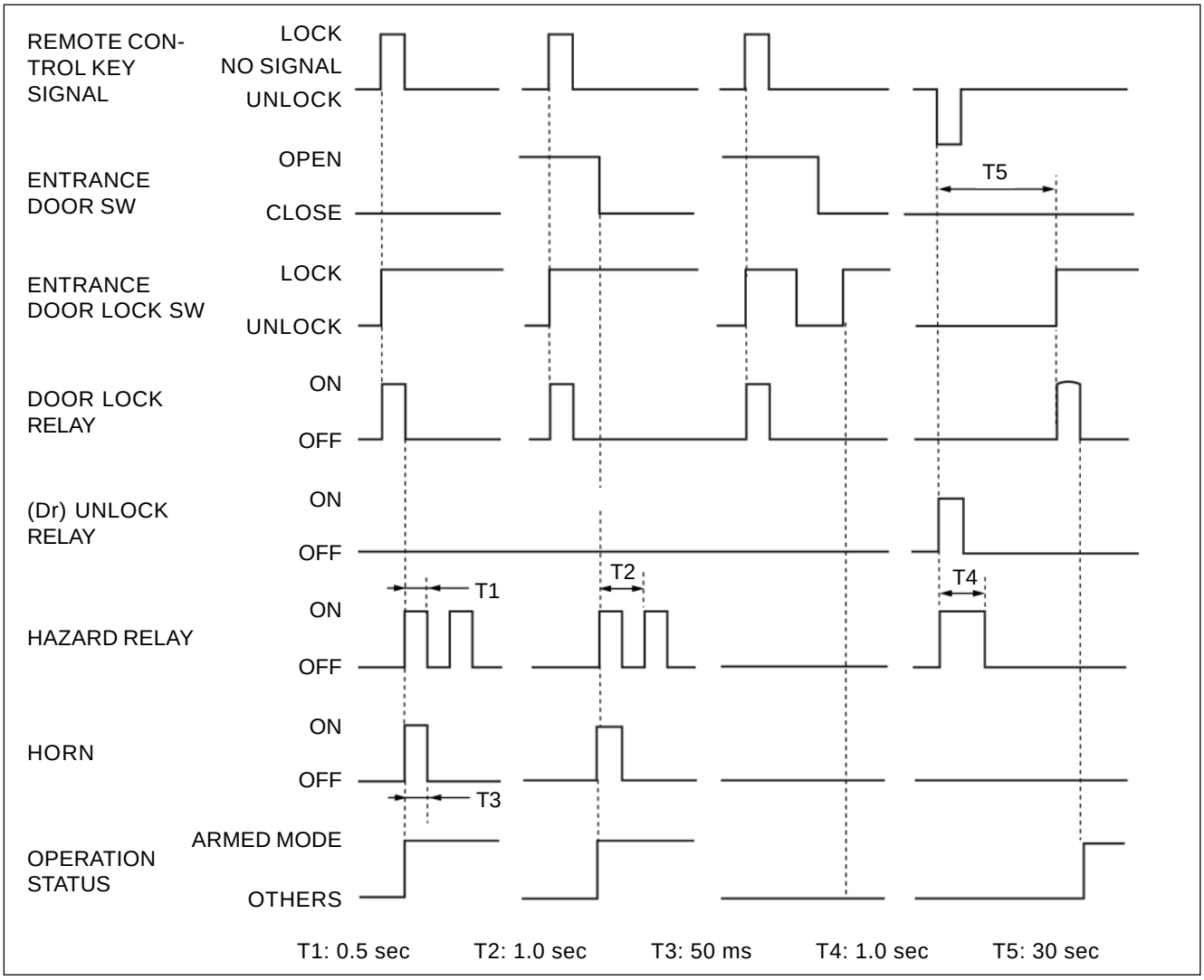
Description of Theft Deterrent Function

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 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.
4) 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.
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.



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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 not by the remote control in armed mode
3) When closing and then opening the door after completion of warning (27 seconds)

4. Warning operation

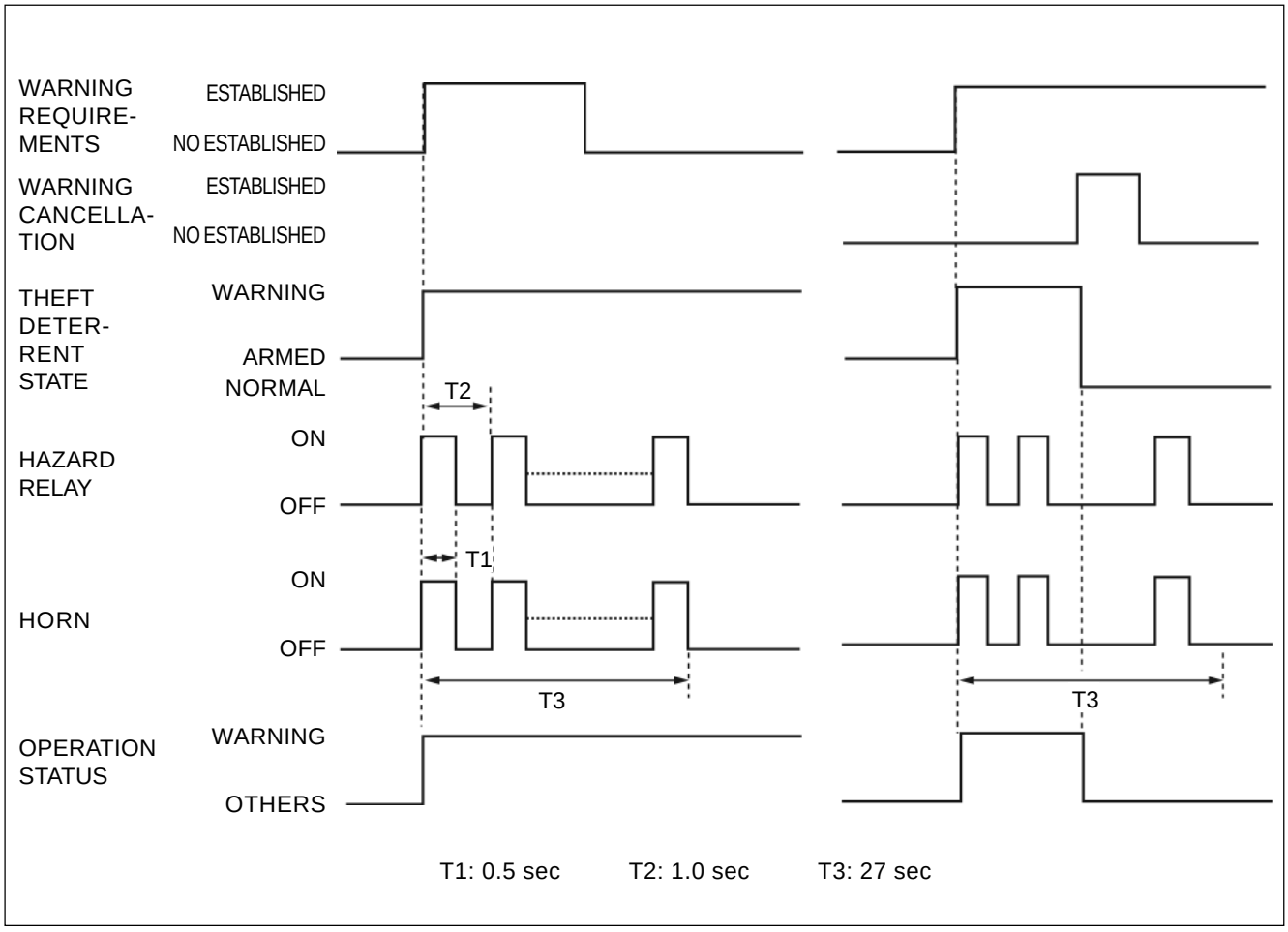
1) The theft deterrent horn and hazard warning flasher output is “ON” for 27 seconds with the interval of 1 second.

5. Warning cancellation requirements

1) Cancels warning by using any signal from the remote control key (LOCK, UNLOCK, PANIC, ESCORT) 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”.



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7. Operations when removing and installing the battery

Installed / Removed	Normal	Armed	Warning	Remark
Normal Armed	○			
Armed Ready	○			
Armed		○		
Warning			○	
Warning Completion	○	○	○	
RELOCK Ready	○			

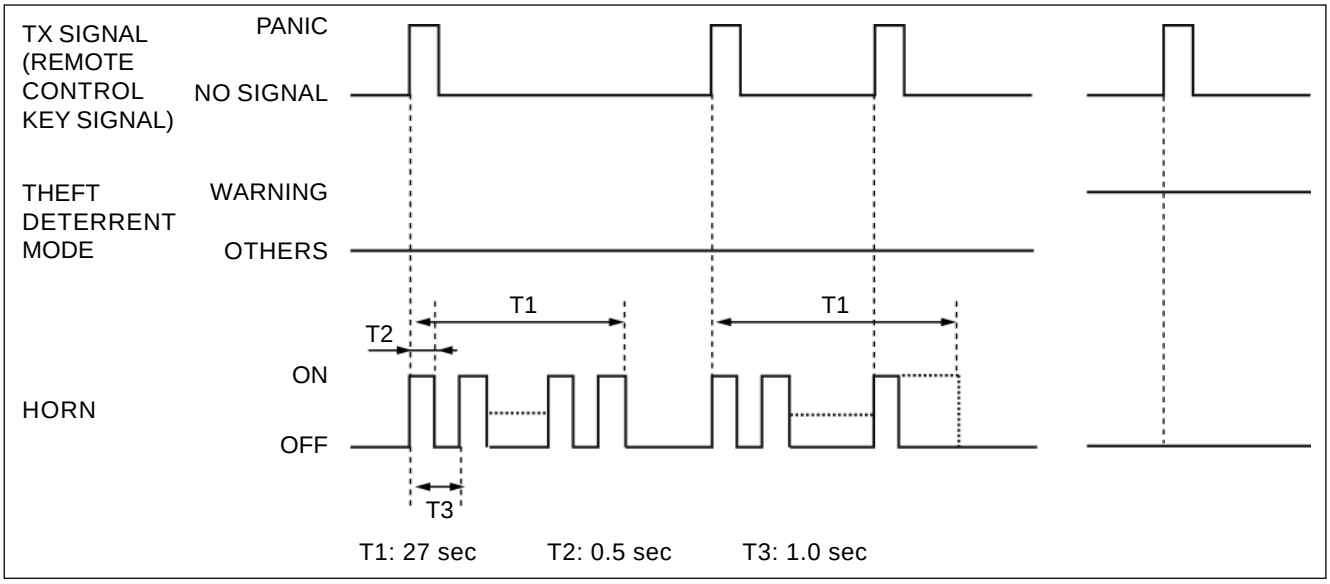
If the system is in armed mode while installing a battery, the horn sounds and the emergency warning lamp blinks (Same operations with warning in armed mode).

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

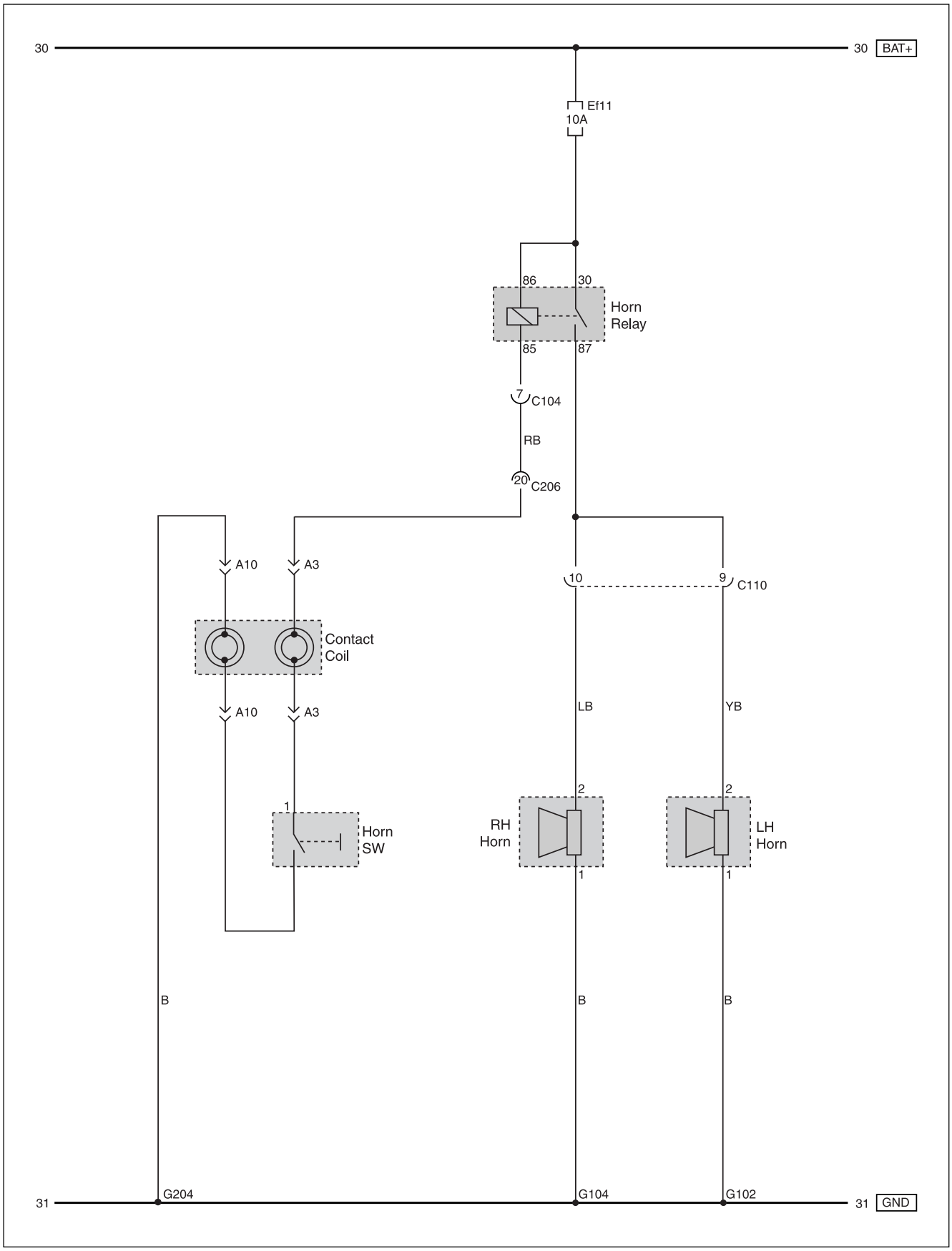
1. The PANIC warning output is “ON” (theft deterrent horn) for 27 seconds when receiving the PANIC signal from the remote control key (pressing PANIC button.
2. The PANIC warning output is “OFF” when receiving any signal from the remote control key during PANIC warning.
3. Followings are theft deterrent warnings:
   1) The theft deterrent warning is canceled when receiving PANIC signal from the remote control key during theft deterrent.
   2) The theft deterrent warning output is “ON” when the theft deterrent conditions are established during PANIC warning (PANIC output is “OFF”).
   3) 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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▶ Electrical Wiring Diagram of Theft Warning Horn



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4. REMOVAL AND INSTALLATION

▶ Horn Assembly

※ **Preceding Works:** Disconnect the negative battery cable.

1. Disconnect the horn connector and unscrew the mounting bolt (10 mm) to remove the horn assembly.



▶ Theft Deterrent Horn Assembly

※ **Preceding Works:** Disconnect the battery negative cable.

1. Disconnect the theft deterrent horn connector and unscrew the mounting bolt (10 mm) to remove the theft warning horn assembly.





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AV SYSTEM

8932 / 8930

TABLE OF CONTENTS

AV SYSTEM 2

1. AV head unit 2
2. AV system configuration 3
3. Head unit 6
4. Tuner and DSP amplifier 13
5. Subwoofer 15
6. Removal and installation of AV system 16

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AV SYSTEM

1. AV HEAD UNIT

DVD + Cassette player: 10 speakers (center speaker, woofer speakers, tweeter speakers)

1. AV head unit

DVD + Cassette + Radio



MUTE button



2. Tuner



3. DSP amplifier



4. DVD 6 DISC changer



5. Subwoofer

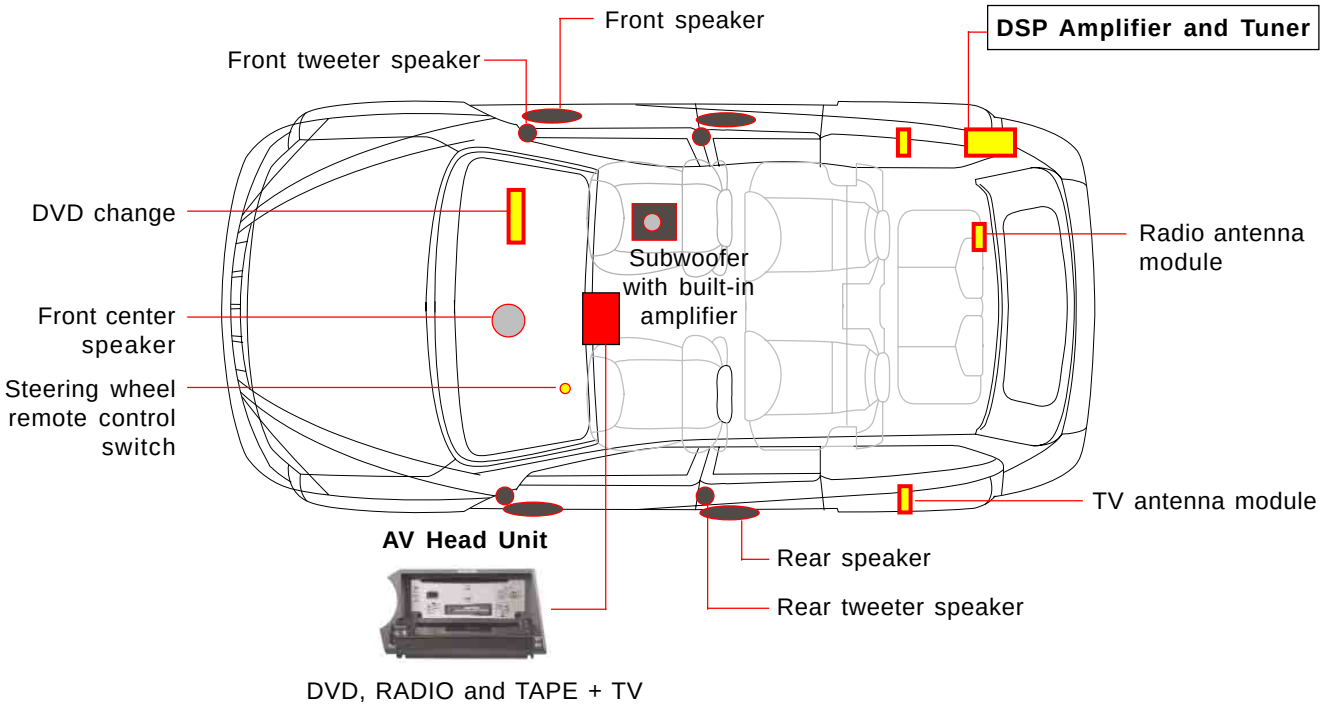


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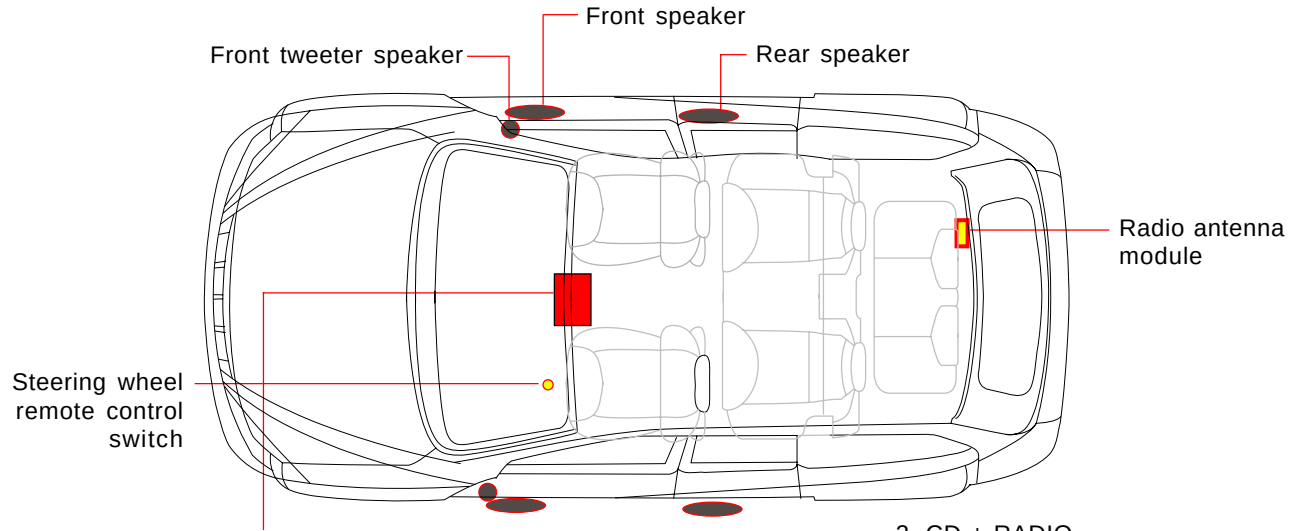
2. AV SYSTEM CONFIGURATION

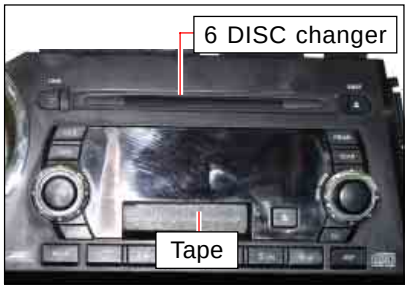
AV System (DVD Head Unit + DVD Changer)



DVD, RADIO and TAPE + TV

Audio System - 6 Speakers





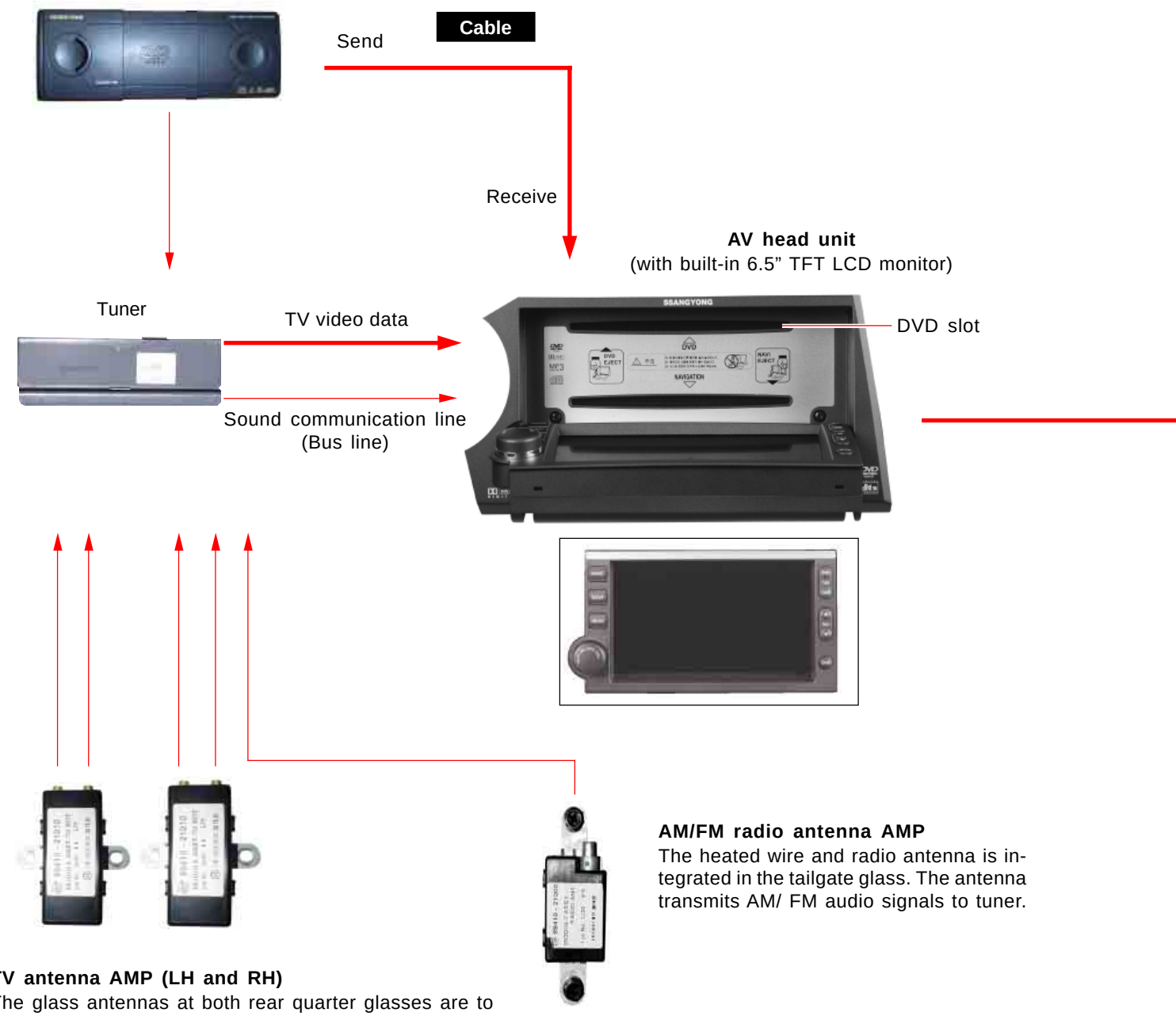


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DVD changer

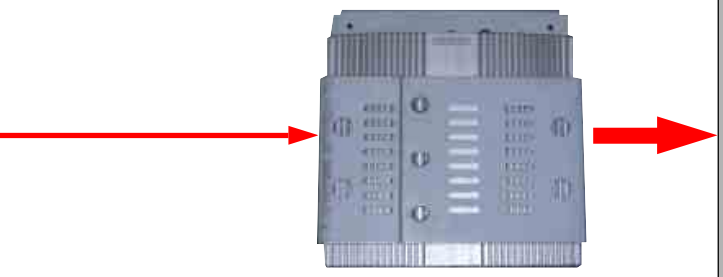
It is installed in the center console. Audio signal of DVD changer outputs to corresponding speakers through the cable. Video signal is transmitted to the monitor of AV head unit.



AM/FM radio antenna AMP
The heated wire and radio antenna is integrated in the tailgate glass. The antenna transmits AM/ FM audio signals to tuner.

TV antenna AMP (LH and RH)
The glass antennas at both rear quarter glasses are to receive TV and AM radio (quarter RH glass) signals and transmits each 2-channel video and audio signals to tuner. Each AMP amplifies receives TV signals and then transmits to tuner.

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AMP (with built-in DSP)
Power AMP in the DVD system has built-in DSP function that digitalizes sound to divide and control. It amplifies sound goes to each speaker and has function of allowing dynamic and vivid sound.

Front speaker (LH)



Tweeter speaker (FL)



Front speaker (RH)



Tweeter speaker (FR)



Rear speaker (LH)



Tweeter speaker (RL)



Rear speaker (RH)



Tweeter speaker (RR)





Center speaker (LH)



Subwoofer
(without built-in AMP)
Woofer is installed at the bottom of passenger's seat. It enforces mid-low sounds.

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3. HEAD UNIT

Functions

AV system head unit operates Radio, TV, Audio CD, DVD and Video CD.
The touch screen type 6.5” TFT LCD monitor is installed on the system.





①	Power ON/OFF, Volume control
②	AV replay, AV reset screen
③	Replay mode selection (briefly press), Current replay mode (press and hold)
④	Next channel (radio or TV) or next track (audio or video)
⑤	
⑥	The monitor moves to parking position when turning the ignition switch to OFF position. It moves to the preset position when turning the ignition switch to ON position again.

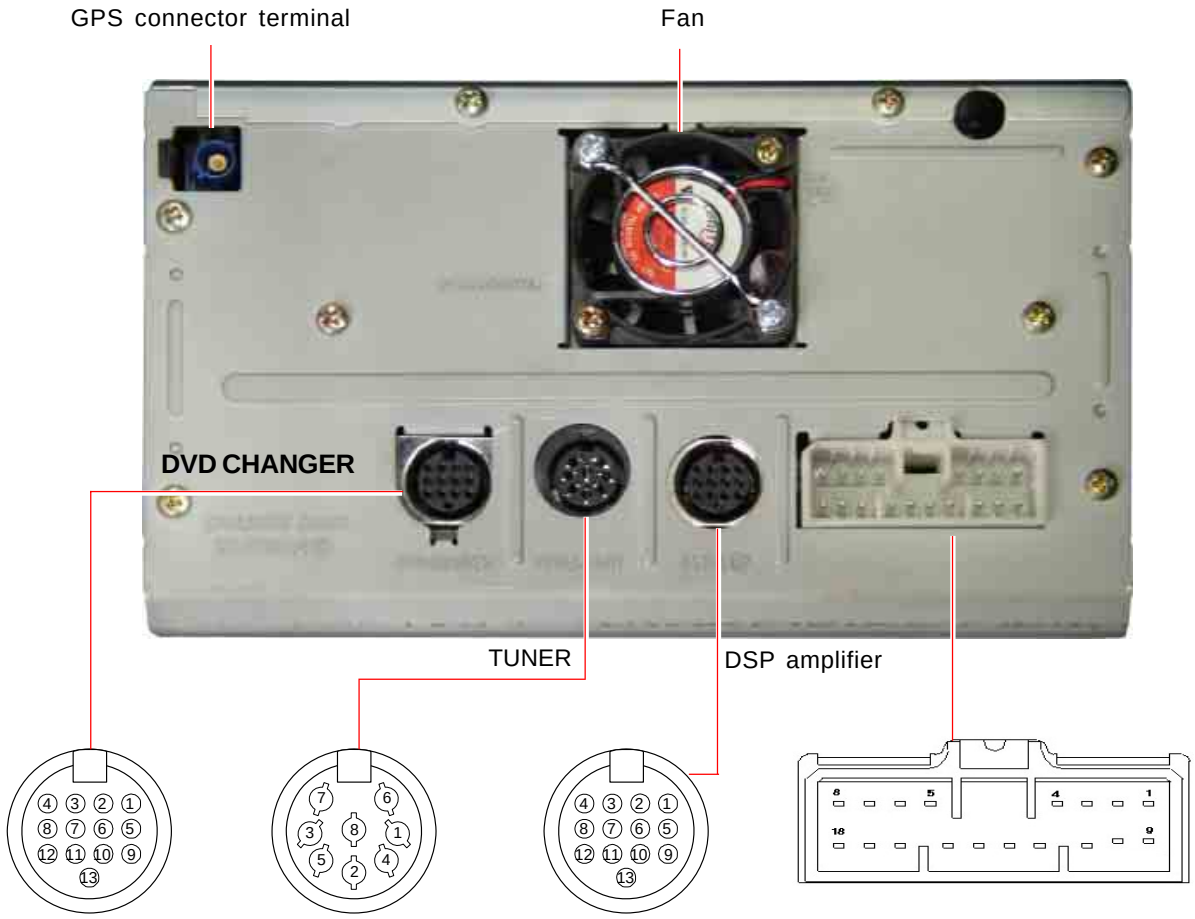
Display when turning on the monitor



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Wiring Connection



1. BACK UP
2. BACK UP
3. VIDEO GND
4. VIDEO signal
5. GND
6. -
7. RESET
8. SPDIF GND
9. SPDIF signal
10. CAN -GND
11. CAN-HI
12. CAN-LO
13. DVDC ON

1. TUNER ON
2. BACK UP +
3. VIDEO GND
4. VIDEO SIGNAL
5. GND
6. BACK UP
7. R/V VIDEO
8. R/V GND

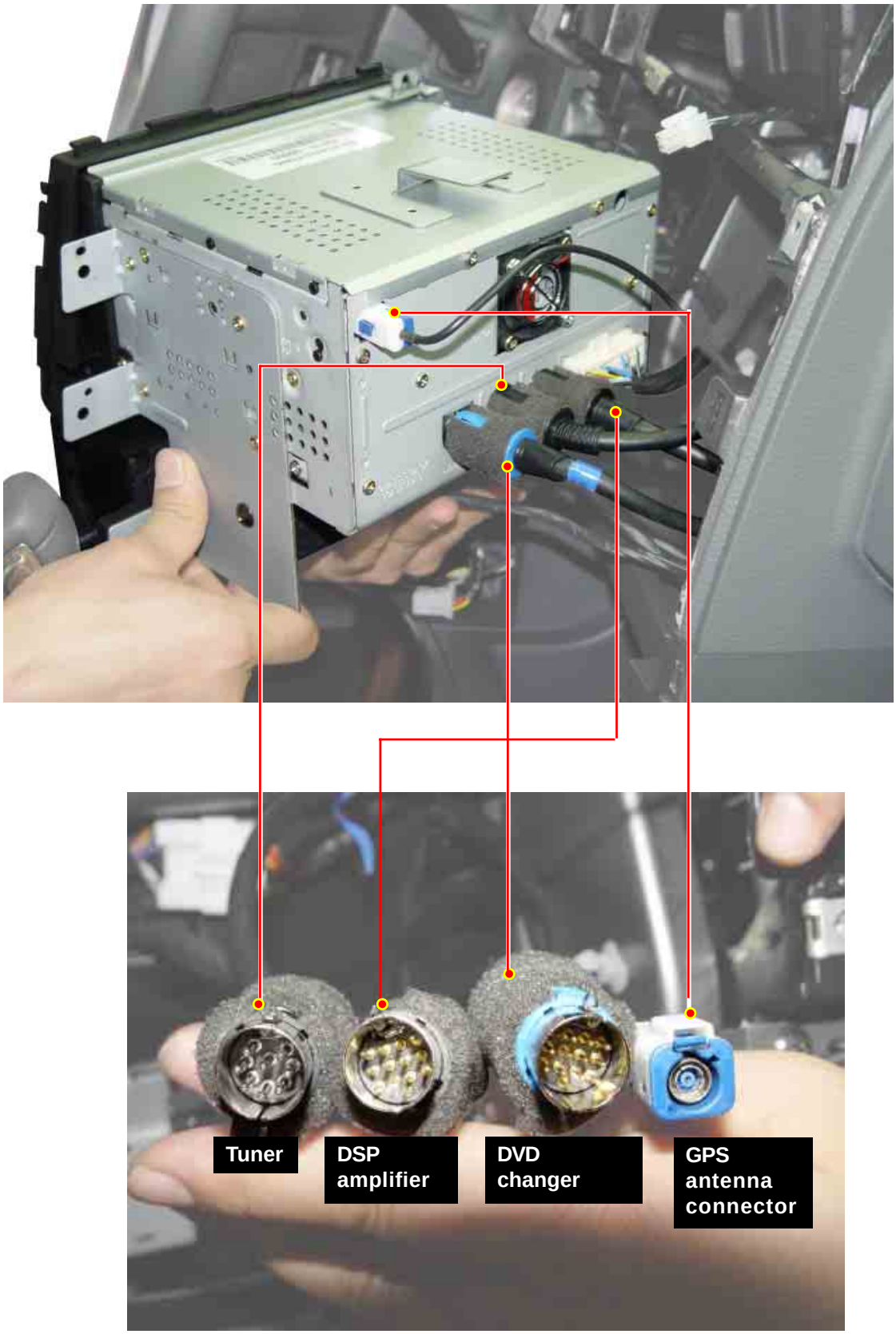
1. MUTE
2. NAVI ON/OFF
3. NAVI Voice GND
4. NAVI voice
5. GND
6. -
7. RESET
8. SPDIF GND
9. SPDIF signal
10. CAN -GND
11. CAN-HI
12. CAN-LO
13. AMP ON

1. CAN-HI
2. -
3. Illumination (+)
4. ACC+
5. BACK UP +
6. -
7. Speed pulse
8. Reverse
9. CAN-LO
10. -
11. Illumination (-)
12. -
13. -
14. GND
15. ALT D+
16. Steering wheel remote control
17. Steering wheel remote control GND
18. PARKING SENSOR

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Head Unit Wiring Connector



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Usable Discs (DVD Head Unit)

Following disc types can be used on the system.

Disc Type and Logo	Disc Size	Play Time (Max.)
DVD video		approx. 133 minutes (SS/SL) approx. 242 minutes (SS/DL) approx. 266 minutes (SD/SL) approx. 484 minutes (DS/DL) SS = Single side SL = Single layer DL = Double layer
Video CD	5 inch (12 cm)	Video CD spec 2.0 PCB compatible disc
Audio CD	5 inch (12 cm)	approx. 74 minutes
CD-R	5 inch (12 cm)	Support MP3, WMA, MP3 + WMA
CD-ROM		ISO / IEC 10148 (Yellow book)

DVD head unit and DVD changer cannot play following discs.

1. DVD-R
2. DVD-RAM
3. DVD-ROM
4. DVD-Audio
5. CD-G
6. Mlxed CD (Date)
7. Active Audio (Date)
8. VSD
9. Multi-section disc
10. DVD with region code other than (2), (3) or (6)

Bulk CD-R or CD-RW that their quality cannot be secured may not be recognized.

Region code (2, 3, 6)

DVD player and DVD video disc has designated region code. If region code is different, the disc cannot be played. This system cannot play the disc if the region code is other than (2), (3) or (6).

Region Code: 2 →Middle East, 3 →General Area, 6 →China

PBC (Play back control) - compatible video CD

This system can play PBC - compatible video CD.

Typical audio and video CDs can be played and PBC-compatible video CD uses recorded PBC menu on the disc to play the CD interactively.

Double layer DVD video disc

When playing the double layer disc, there occurs time lag between at the end of first layer and start of second layer causing broken display and sound for seconds. It normal for double layer disc so it is not malfunction of the system.

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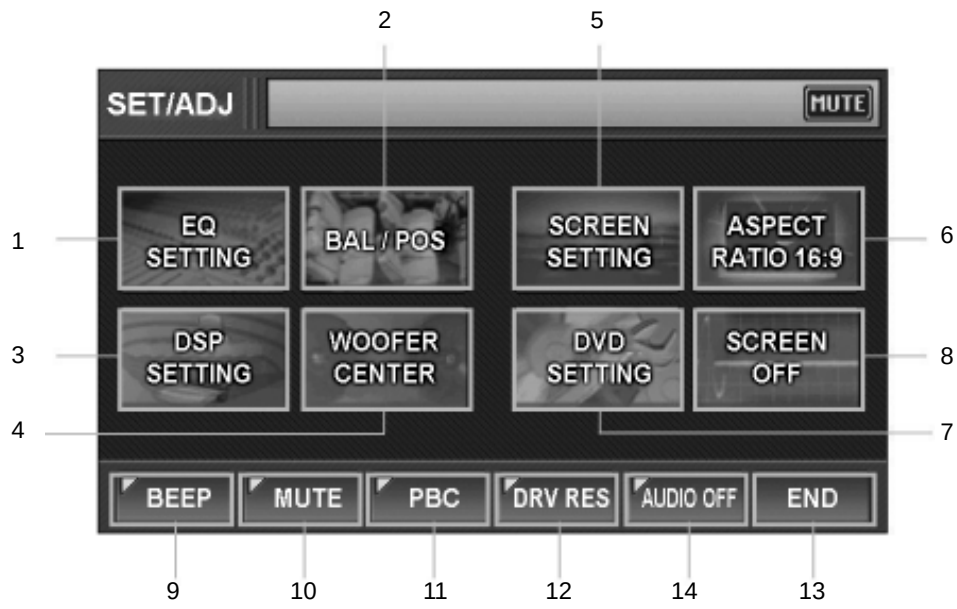
Functions of AV Unit

Display	6.5 Wide TFT LCD Aspect ratio: Full/16x9/4:3 Touch screen key: Full touch
TV	Diversity Antenna with high reception performance Automatic station selection
Radio	Automatic station selection Station memory: 8 channels in each band (AM1, AM2, FM1, FM2)
DVD	Automatic replay: Audio CD, DVD title Playback control supported Sub woofer speakers
DVD Changer (option)	Install 6-discs in the magazine Automatic replay: Audio CD, DVD title
Others	DSP function, Equalizer function



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Function Settings on Touch Panel (Example)



1	Equalizer setting: Preset value, Treble/Medium/Bass
2	Balance setting
3	DSP (Digital Signal Process) setting
4	Volume control of sub woofer and center speakers
5	Screen setting: brightness, colors, gamma, contrast
6	Aspect ratio setting: 16:9/4:3/ZOOM1/ZOOM2
7	Initial screen setting of DVD title: sound, caption etc.
8	Turning OFF the screen (however, audio system still operates)
9	Turning OFF/ON the button operating sound (“Beep” sound)
10	Turning OFF/ON the speakers
11	Turning OFF/ON the PBC function
12	Turning OFF/ON the driving restriction
13	Moves to replay mode out from SET/ADJUSTMENT mode
14	Audio OFF

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Basic display



Turn the AV system ON.

Press “MODE” button to select a mode.

When pressing “RADIO” section on the screen, the “RADIO” mode screen is displayed.

DSP control



Selecting an acoustic perspective

Press “DSP SETTING” button in “SET/ADJ” screen and select one acoustic perspective (HALL, STADIUM, THEATER, CHURCH, CLUB).

Press “OFF” button to cancel the DSP function.

EQ control



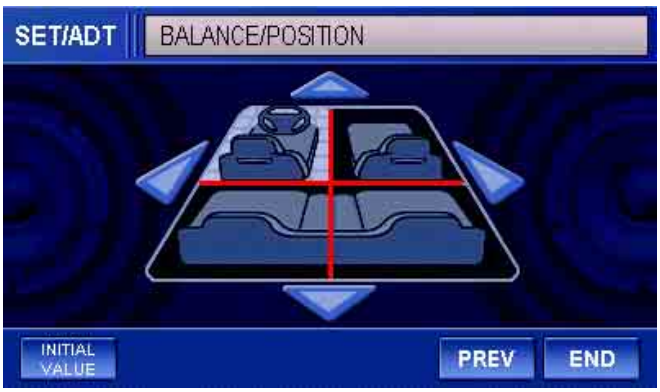
Adjusting the sound according to the music genre

Press “EQ SETTING” button in “SET/ADJ” screen and adjust the sound.

To adjust the tone, press “TONE” button.

The tone can be adjusted by BAS/MID/TRE bars on the screen.

BALANCE/POSITION control



Adjusting the sound according to the seated position.

Press “BAL/POS” button in “SET/ADJ” screen and select a seat position (driver’s, passenger’s, rear seats, all seats) on the screen (Position setting).

To, adjust the balance, use the arrows on the screen.

* BALANCE function and POSITION function cannot be used simultaneously.

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4. TUNER AND DSP AMPLIFIER

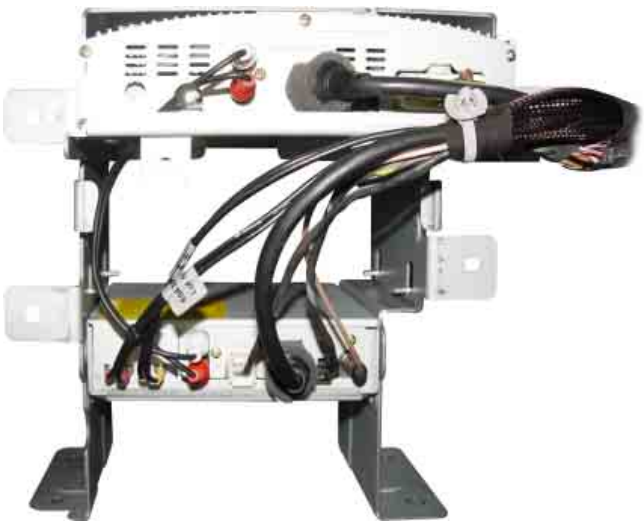
Front View



Side View

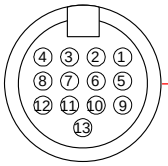


Rear View

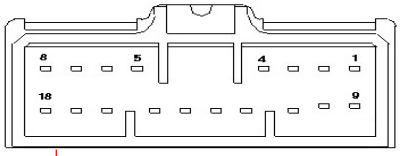


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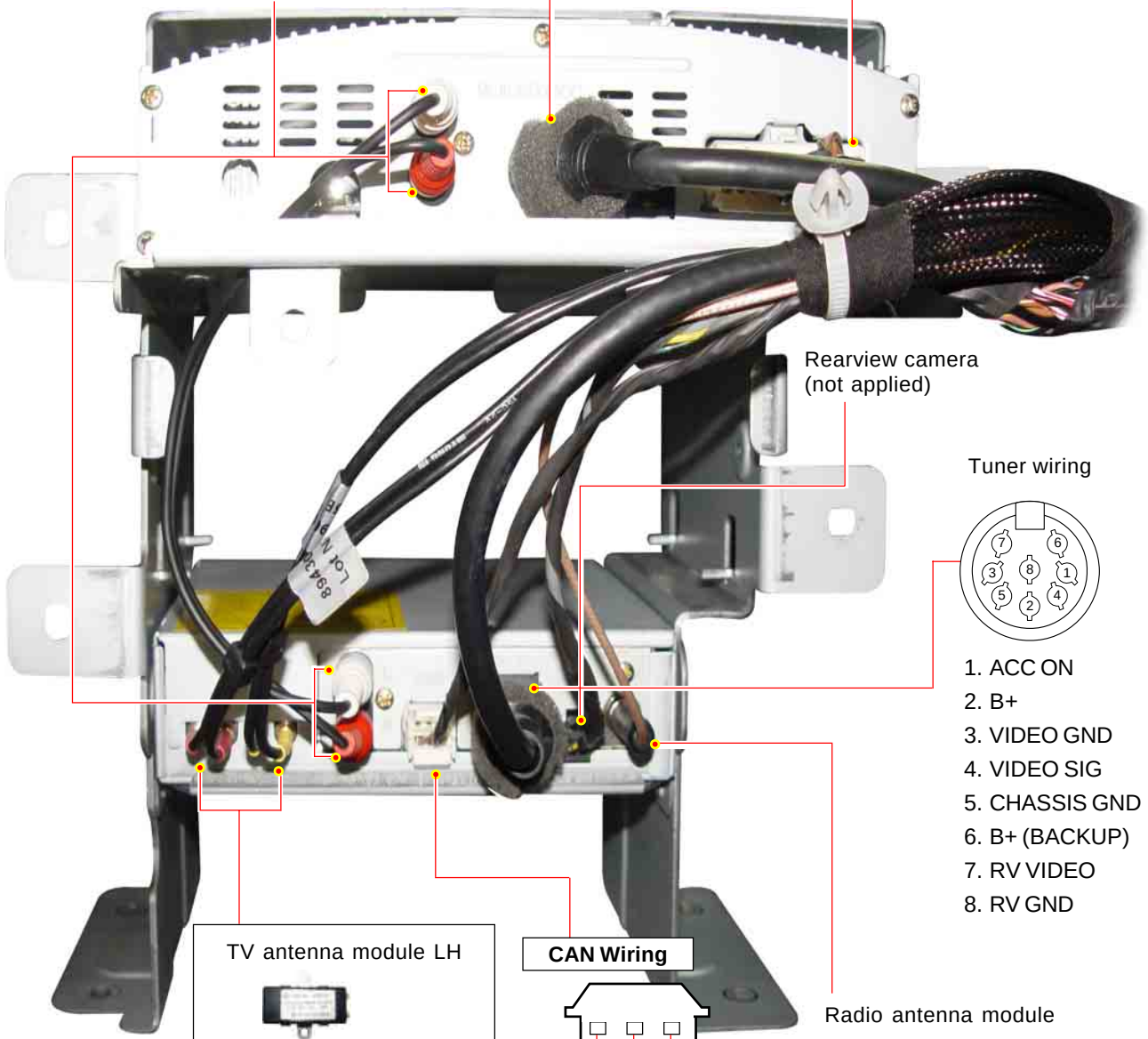
1. MUTE
2. -
3. -
4. -
5. GND
6. -
7. RESET
8. S/PDIF GND
9. S/PDIF signal
10. CAN -GND
11. CAN-HI
12. CAN-LO
13. ACC ON



1. SPEAKER FR +
2. SPEAKER RR +
3. WPEAKER WOOFER 1+
4. SPEAKER WOOFER 2+
5. BACK UP
6. BACK UP
7. SPEAKER RL +
8. SPEAKER FL +
9. SPEAKER FR -
10. SPEAKER RR -
11. SPEAKER WOOFER 1-
12. SPEAKER WOOFER 2-
13. GND
14. GND
15. SPEAKER CENTER +
16. SPEAKER CENTER -
17. SPEAKER RL -
18. SPEAKER FL -



Audio Terminal
White: AUDIO L channel output
Red: AUDIO R channel output



Rearview camera
(not applied)

Tuner wiring

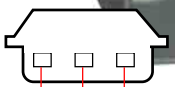
1. ACC ON
2. B+
3. VIDEO GND
4. VIDEO SIG
5. CHASSIS GND
6. B+ (BACKUP)
7. RV VIDEO
8. RV GND

TV antenna module LH

TV antenna module RH



CAN Wiring



CAN-HI
ANT-ON
CAN-LO

Radio antenna module



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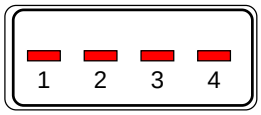
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5. SUBWOOFER



Passenger's Seat





1. Subwoofer_1 (+)
2. Subwoofer_1 (–)
3. Subwoofer_2 (+)
4. Subwoofer_2 (–)

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6. REMOVAL AND INSTALLATION OF AV SYSTEM

AV Head Unit

※ **Preceding Work:** 1. Remove the center panel.
2. Remove the center fascia panel.

1. Unscrew four mounting screws from the AV head unit and AC control panel.



2. Disconnect the head unit harness connector and the fiber optic cable.



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3. Remove the AV head unit.

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Tuner Assembly

※ **Preceding Work:** Remove the negative battery cable.

1. Remove the service cover from the right lower quarter panel in the luggage compartment.



2. Remove the OVM tool box.



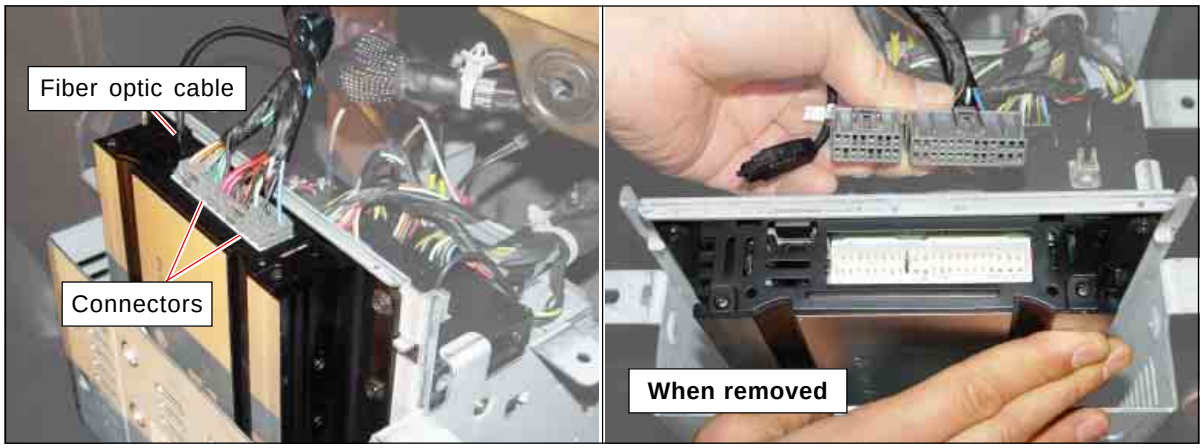
3. Unscrew eight mounting nuts from the tuner/amplifier deck assembly.



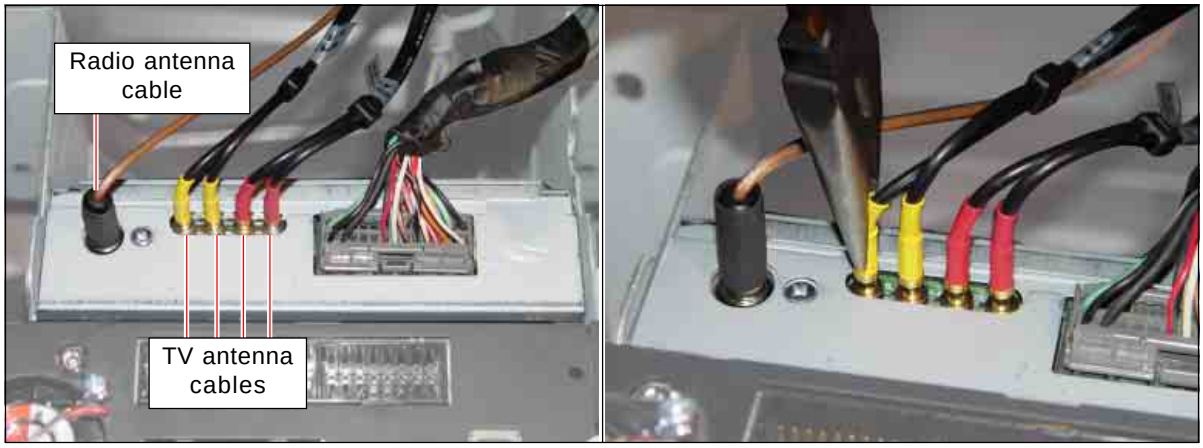
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4. Disconnect the harness connectors and the fiber optic cable from the tuner/amplifier deck assembly.

1) Fiber optic cable and connectors for DSP amplifier



2) Radio antenna cable, TV antenna cables and connectors



NOTICE

- **Use the pliers as shown in figure when disconnecting the TV antenna cables.**

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5. Unscrew the mounting screws from the removed tuner/amplifier deck assembly and remove the tuner assembly.



NOTE

- **Match the colors when inserting TV antenna cables into the connections.**



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DSP Amplifier

※ **Preceding Work:** Disconnect the negative battery cable.

1. Disconnect the connectors and the fiber optic cable from the AV head unit. Unscrew the mounting bolts and remove the amplifier assembly.



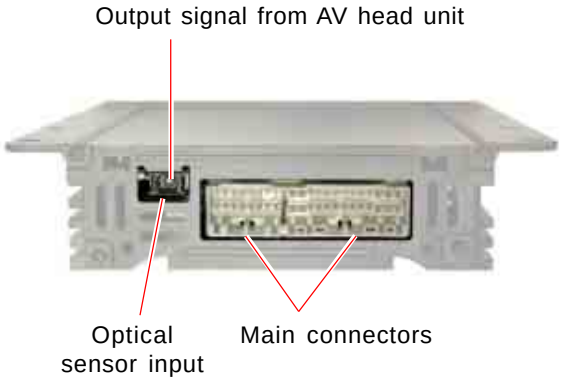
Check if the fiber optic cable is defective. If the red lamp comes on when the ignition switch is in “ON” position, the system receives the normal input signal.



Unscrew six mounting bolts (10 mm) from the amplifier.







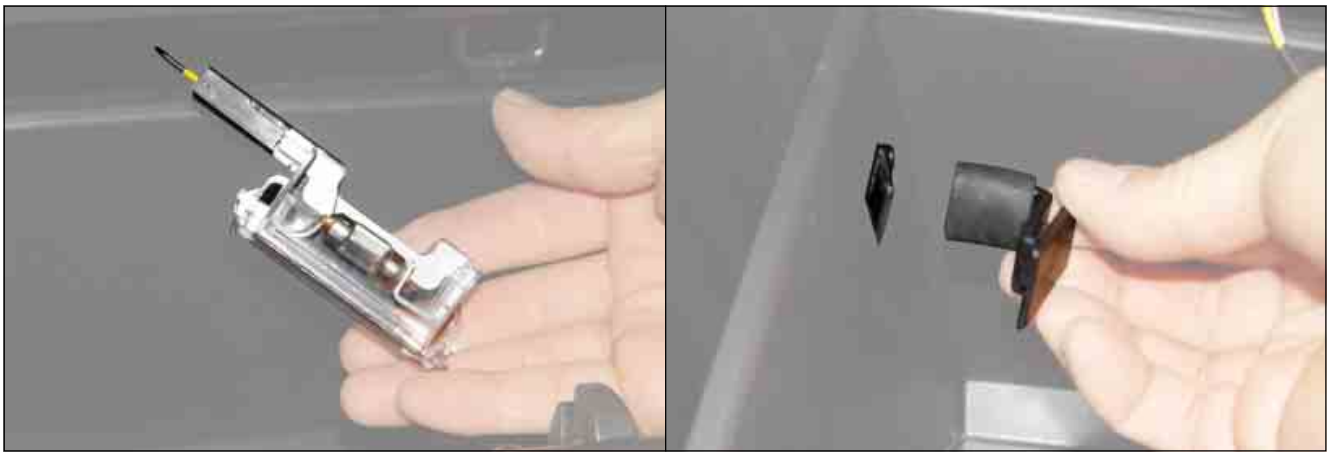
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DVD Changer

※ **Preceding Work:** Disconnect the negative battery cable.



1. Remove the glove box lamp and release the locking device to lower the glove box.



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2. Remove the side instrument panel in passenger compartment and unscrew the mounting screws for lower instrument panel.



3. Unscrew the inner and outer mounting screws from the glove box and remove the lower instrument panel.



4. Open the DVD changer cover. Unscrew the mounting screws and remove the inner cover and outer cover.



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5. Remove the DVD changer cover.



6. Unscrew the mounting screws from the DVD changer.



7. Disconnect the fiber optic cable from the DVD changer through the opening of lower instrument panel.





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8. Slide out the DVD changer and unscrew the mounting screws from the DVD changer case.





9. Disconnect the harness connector and pull out the DVD changer with case.





10. Separate the case from the DVD changer.



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DVD Changer



Front view





Fiber optic cable terminal

Connector

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▶ Speaker

Front (Center Speaker)

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the center speaker cover.



2. Unscrew the mounting screws and disconnect the harness connector to remove the center speaker.





Components



Speaker cover



Speaker assembly

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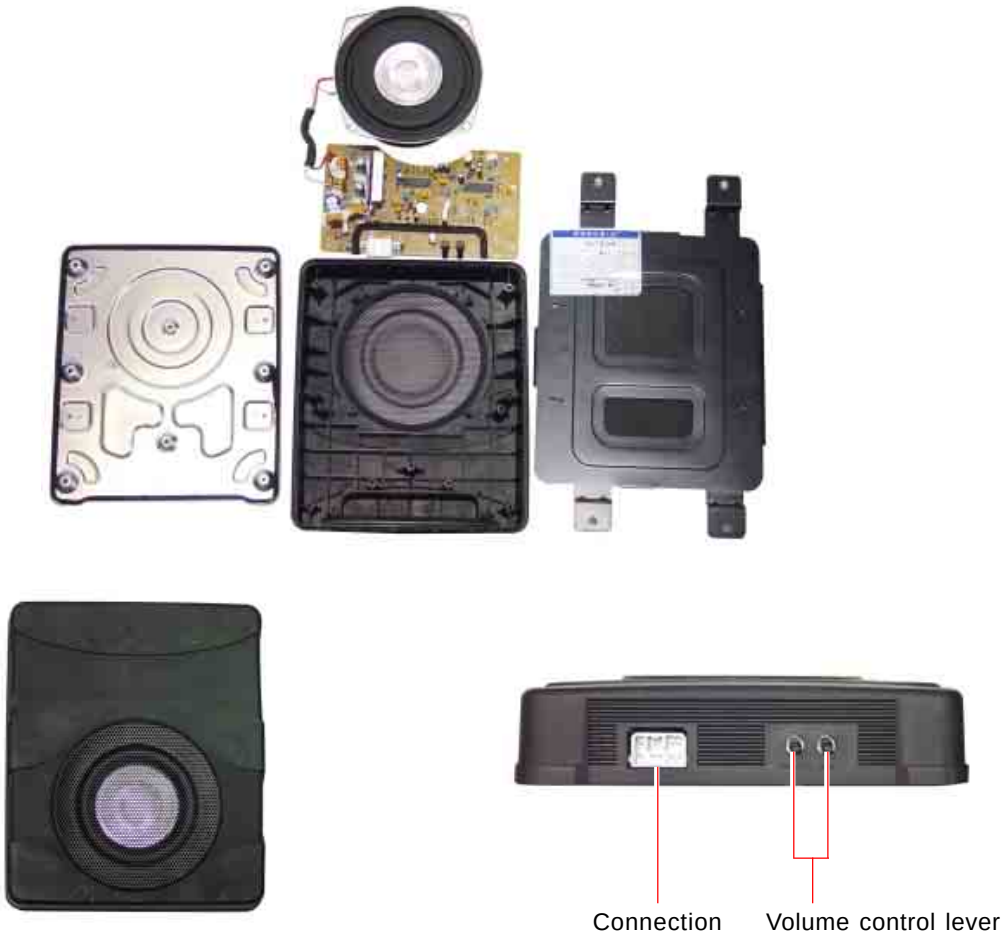
Sun Woofer Speaker

※ **Preceding Work:** Disconnect the negative battery cable and remove the passenger's seat.

1. Disconnect the harness connector and unscrew the mounting nuts to remove the sub woofer speaker.



Components



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Front/Rear Door Speakers

※ **Preceding Work:** Disconnect the negative battery cable and remove the door trim.

1. Disconnect the harness connector from the speaker.



2. Unscrew four mounting screws and disconnect the harness connector to remove the speakers from the front and rear doors.





Front door speaker	40W/2Ω
Rear door speaker	40W/2Ω



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Door Tweeter Speaker

※ **Preceding Work:** Disconnect the negative battery cable and remove the door trim. (For details, refer to "Body" section.)

1. Unscrew the mounting screws (2 EA) from the removed door trim and remove the speaker.



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TV Antenna Module (LH/RH)

※ **Preceding Work:** Remove the rear quarter upper panel.

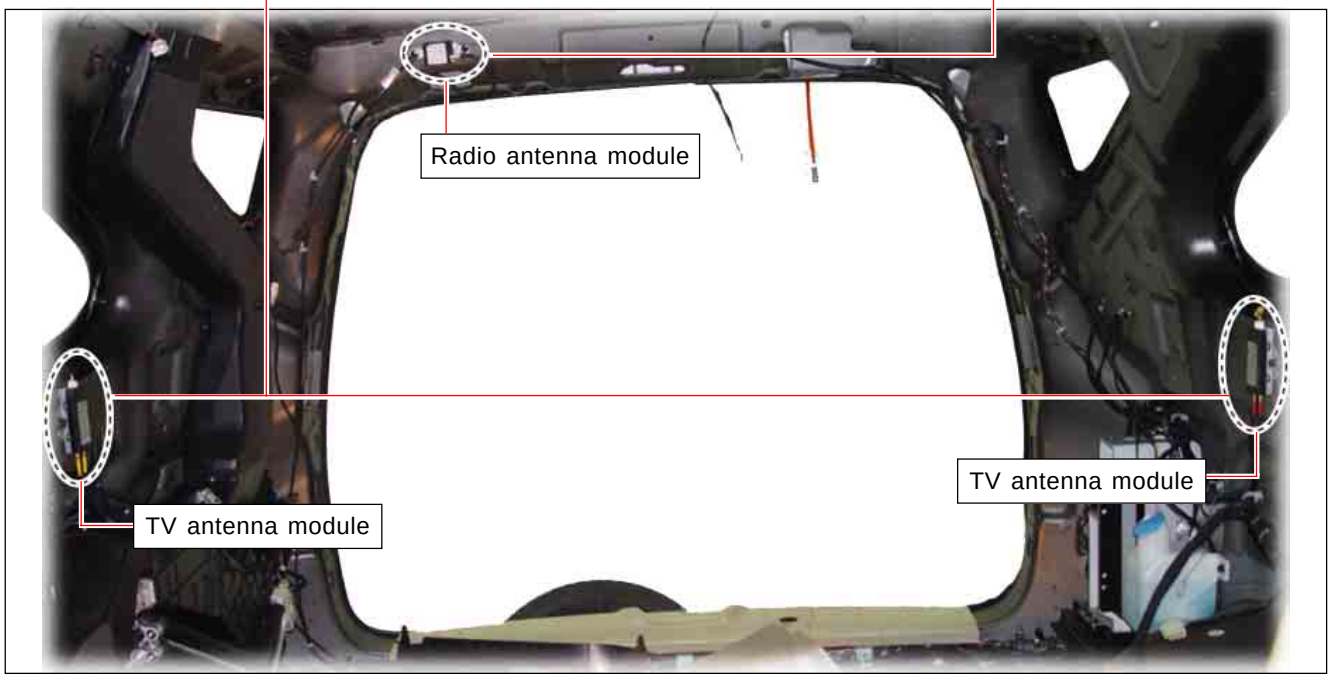


Radio Antenna Module

※ **Preceding Works:**

1. Remove the luggage room lamp assembly.
2. Remove the third row and fourth row seats.
3. Remove the rear quarter upper and lower trims.
4. Remove the rear headlining.





TV antenna connection at tuner



Radio antenna connection at tuner



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WIPER & WASHER SYSTEM

7810 / 7820 / 7830

TABLE OF CONTENTS

WIPER AND WASHER SYSTEM 2

1. System layout of wiper and washer (with rain sensor) 4
2. Wiper & washer related function and specification 6
3. Wiper and washer system related circuit 11
4. Removal and installation 12

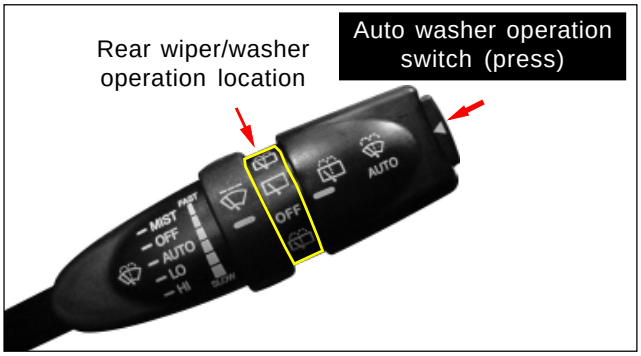
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WIPER AND WASHER SYSTEM

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.

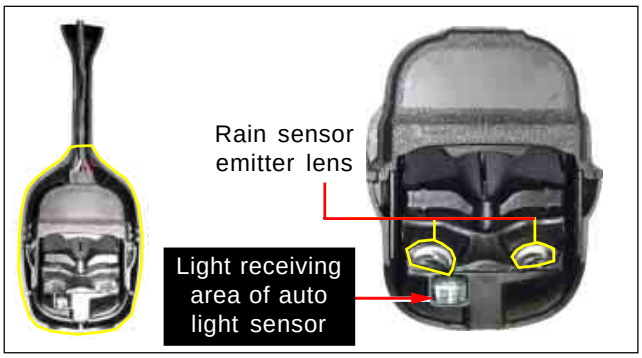
The characteristics of the wiper and washer system including basic functions of manual wiper are as follows.

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.

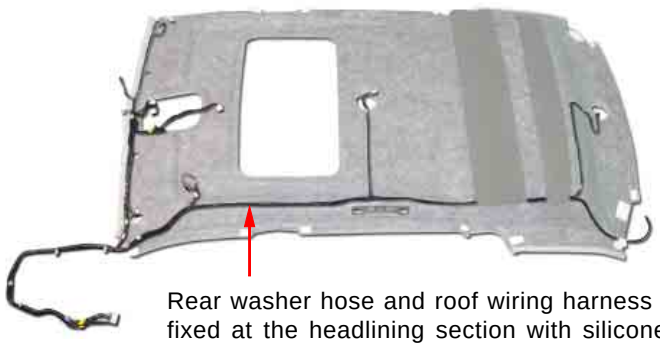
2. Integrated auto light sensor in rain sensor unit



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



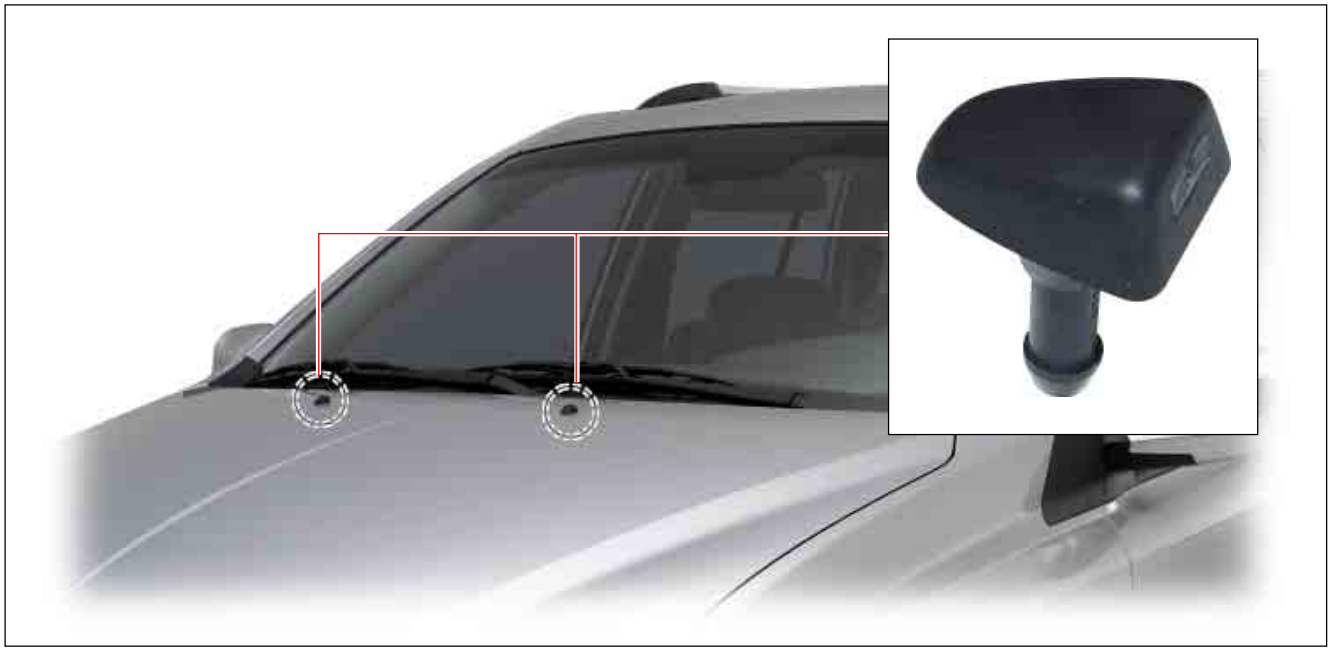
Rear washer hose and roof wiring harness are fixed at the headlining section with silicone.

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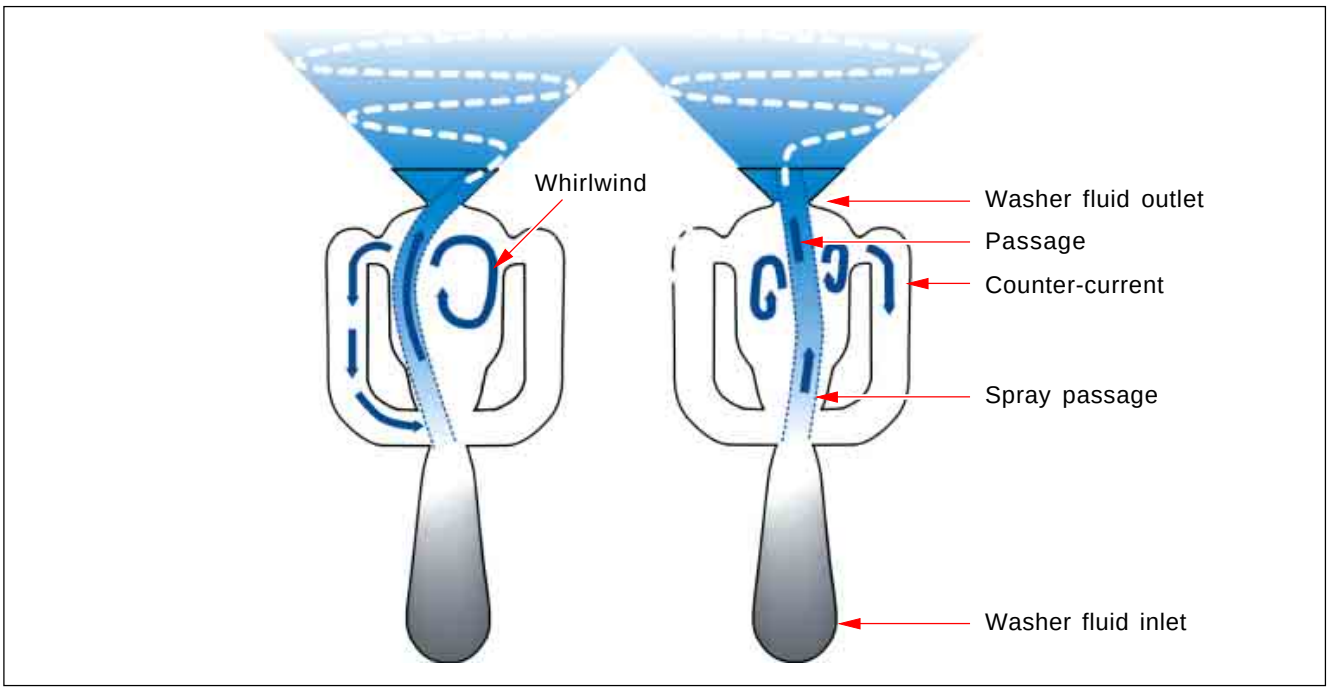
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4. Fluidic washer nozzle

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.



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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1. 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



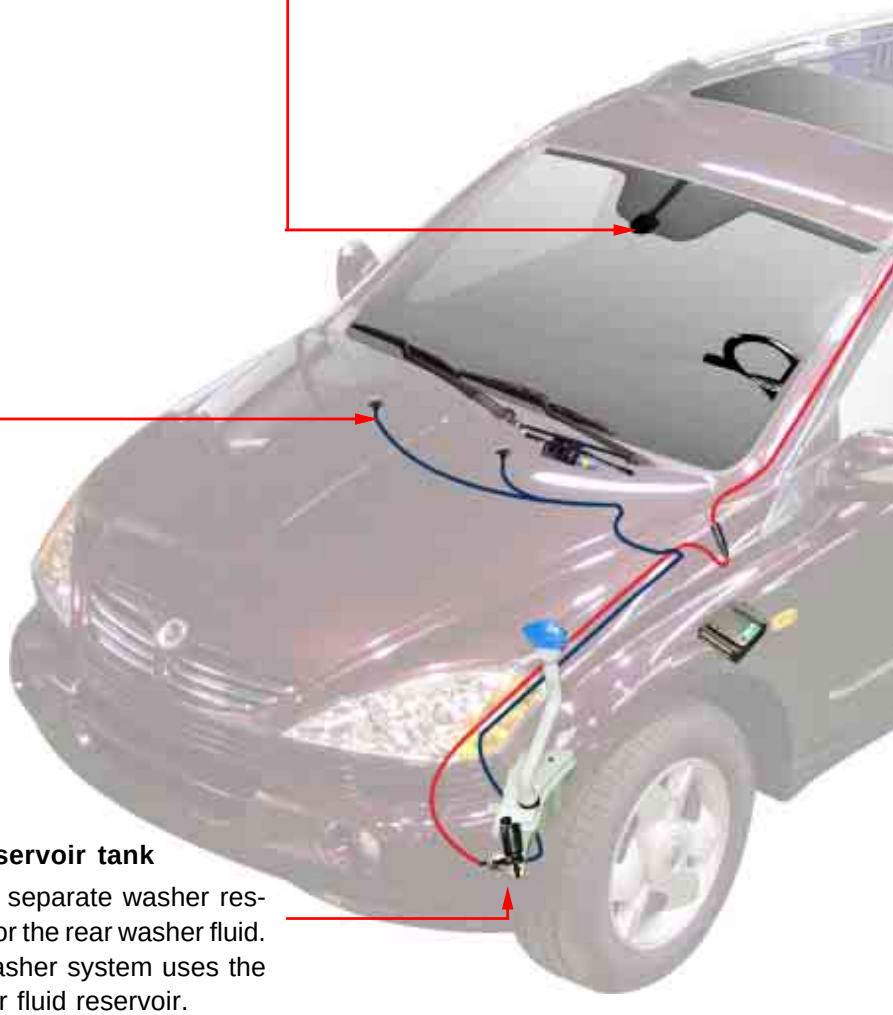
The rain sensor unit is integrated into the auto light sensor. It sends the amount of rain drops to STICS.

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.

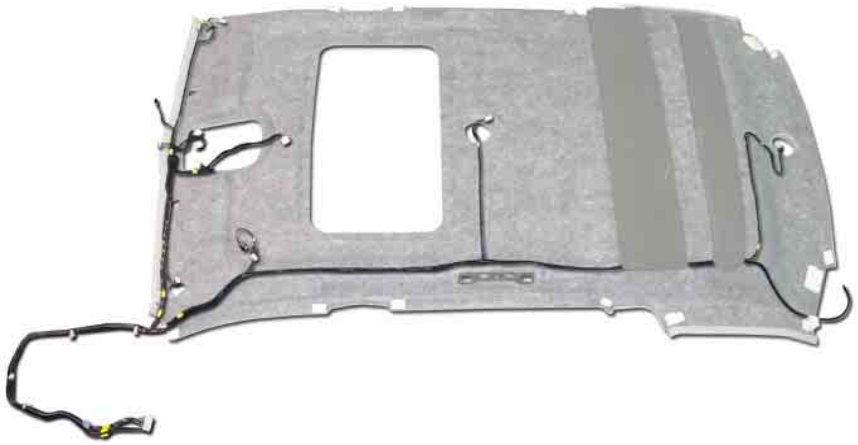
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Rear washer hose mounting

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.

Rear Washer Hose Mounting





Rear Washer Nozzle and Check Valve



STICS



STICS

STICS receives the rain sensing data from the rain sensor and controls the wiper and washer systems.

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2. 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

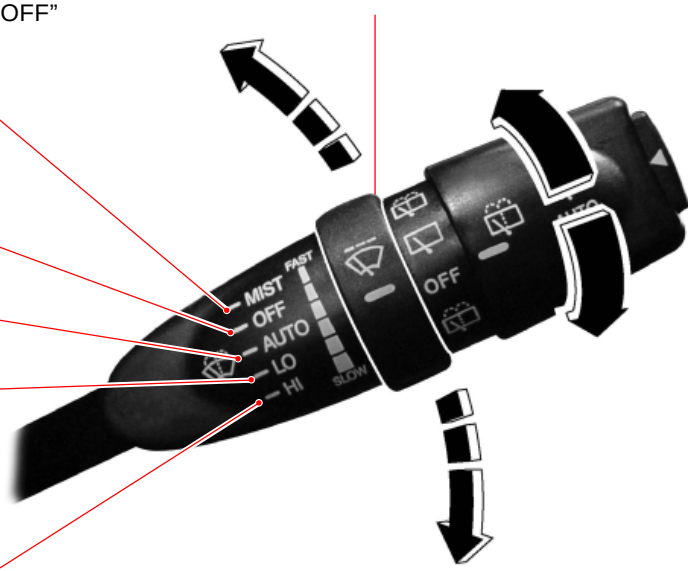
Wiping speed gets slower when placing the pointer at the “LO” positon.

Wiping speed gets faster when placing the pointer at the “HI” positon.

HI

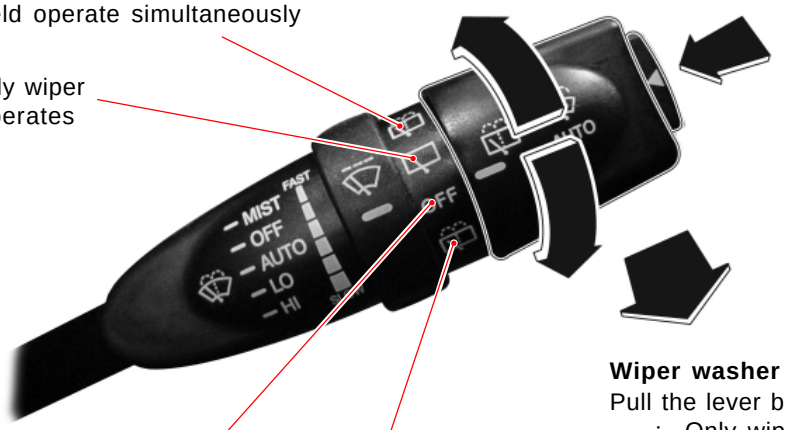
Wiper speed control switch

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)
: Only wiper operates
Pull and hold the lever for more than 0.6 seconds
: Wiper operates 3 times
Washer fluid coupled operation

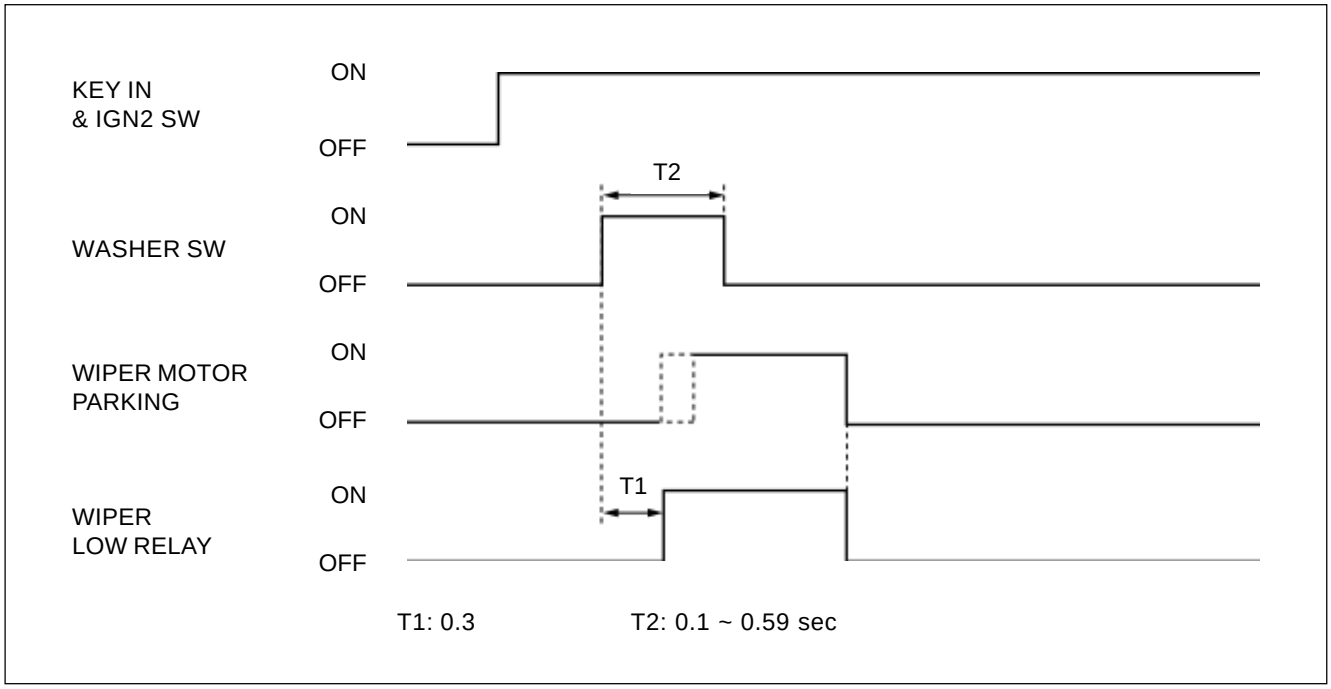
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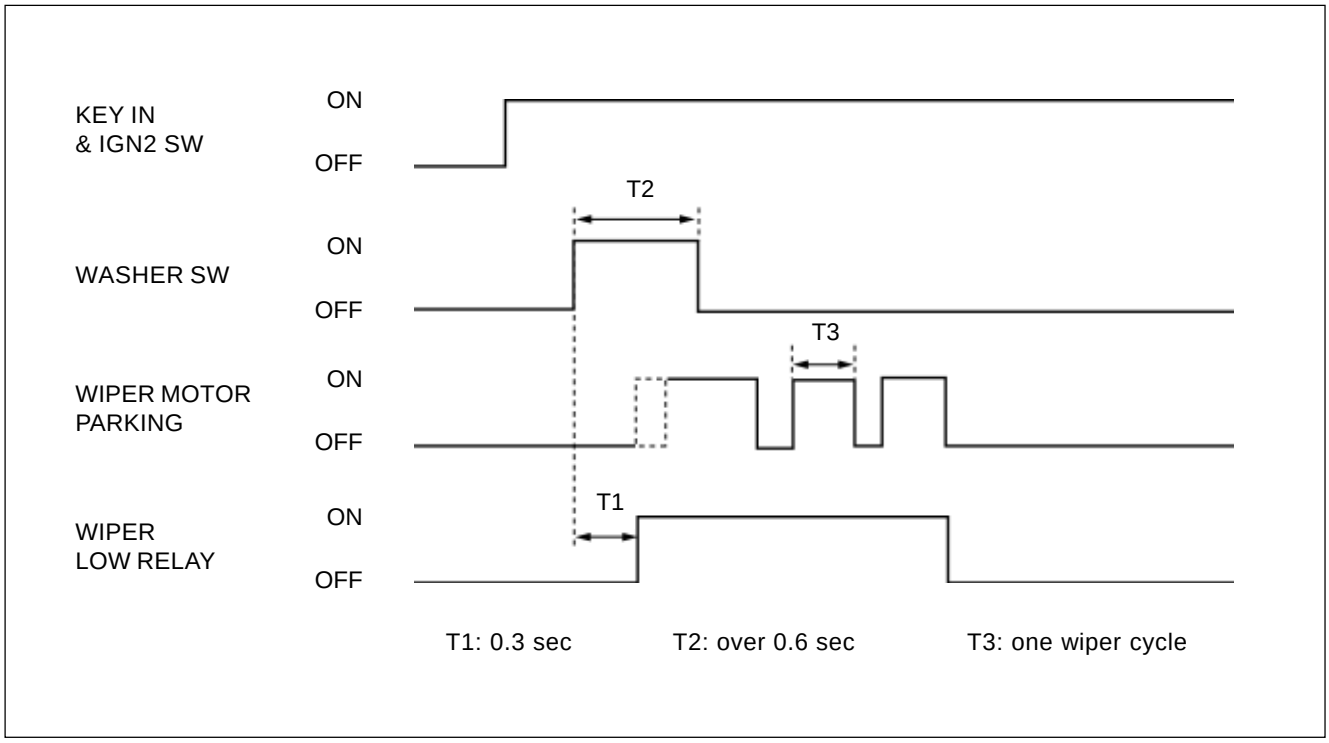
▶ STICS Control Logic Related to Wiper and Washer

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.

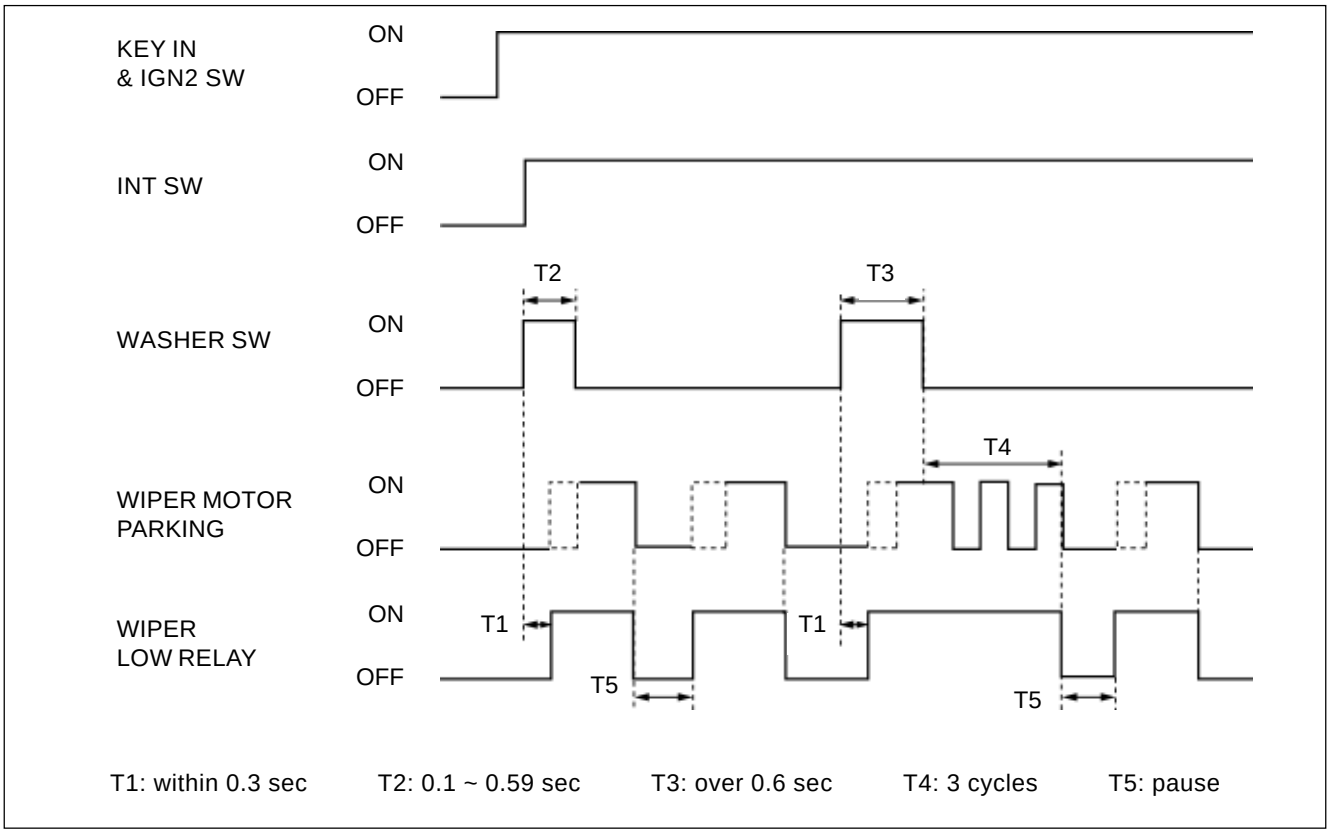


2. The wiper relay is turned on 0.3 seconds after turning “ON” the washer switch over 0.6 seconds with the ignition key “ON”, and it is turned on three times immediately after turning off the washer switch.



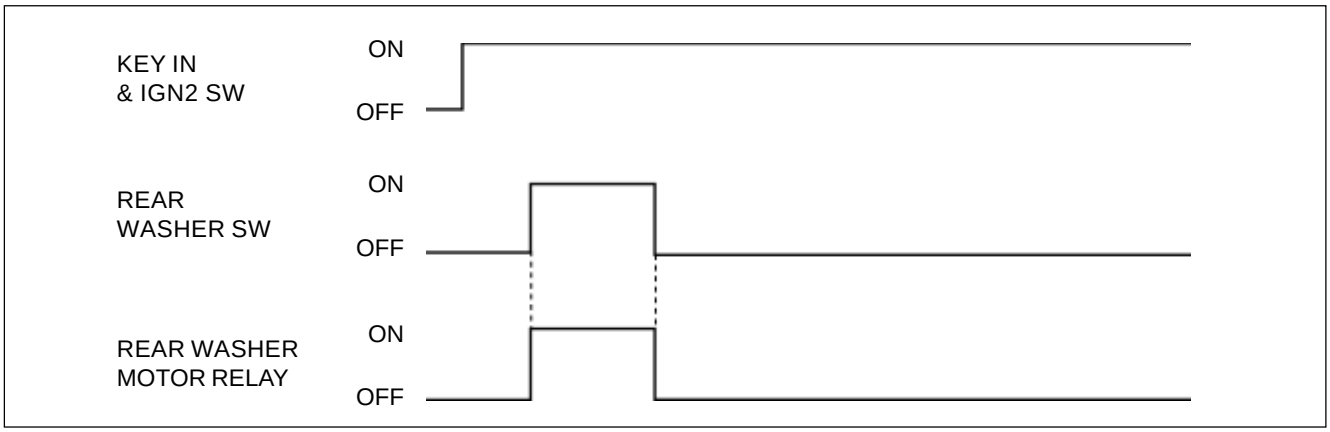
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3. When the washer switch is ON for more than 0.6 seconds during the wiper operation by the INT switch, the operation in step (2) is performed. When it is ON for a certain period of time (0.1 to 0.59 seconds), the operation in step (1) is performed.



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.

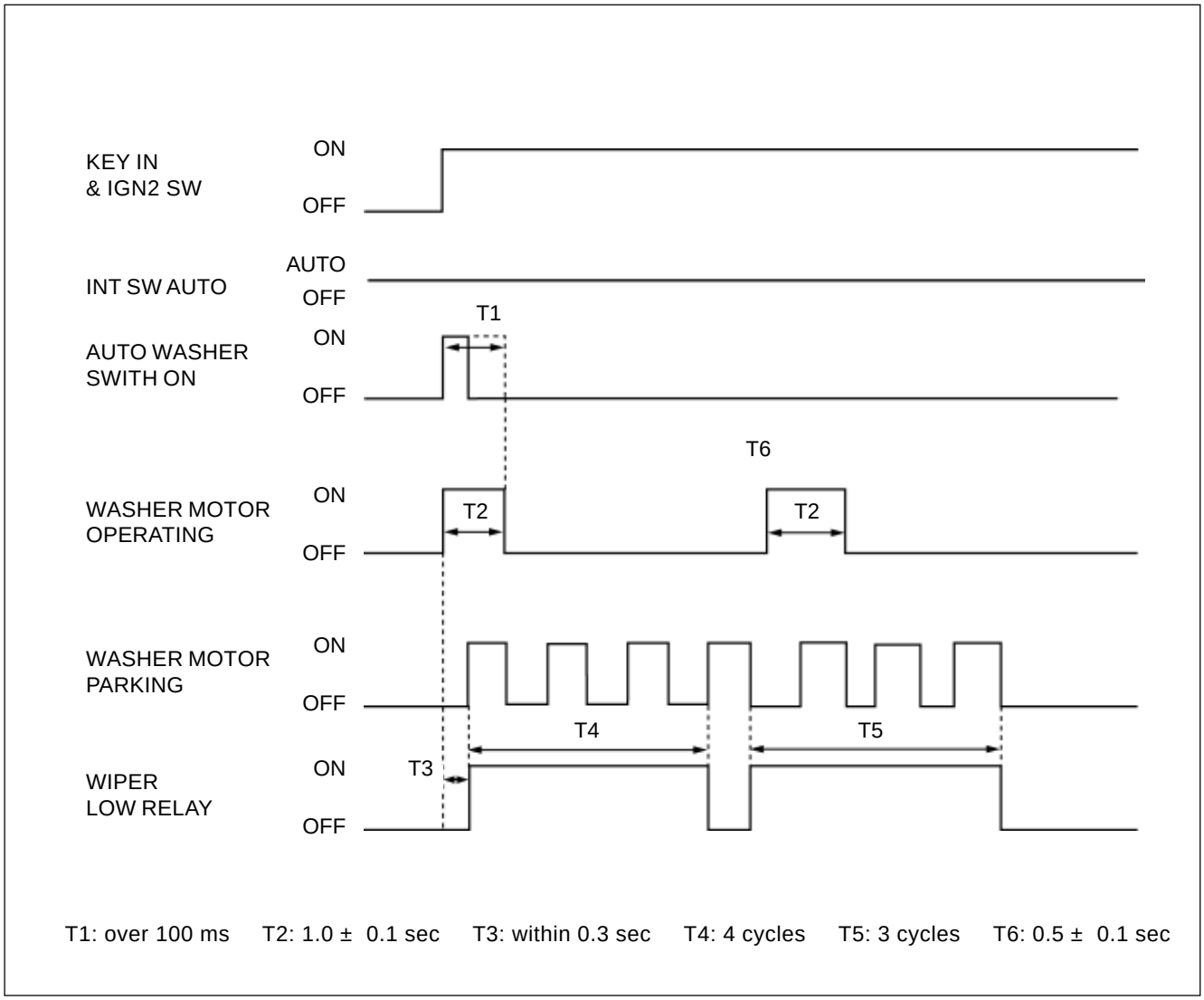


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Auto Washer and Wiper Switch (AFW)

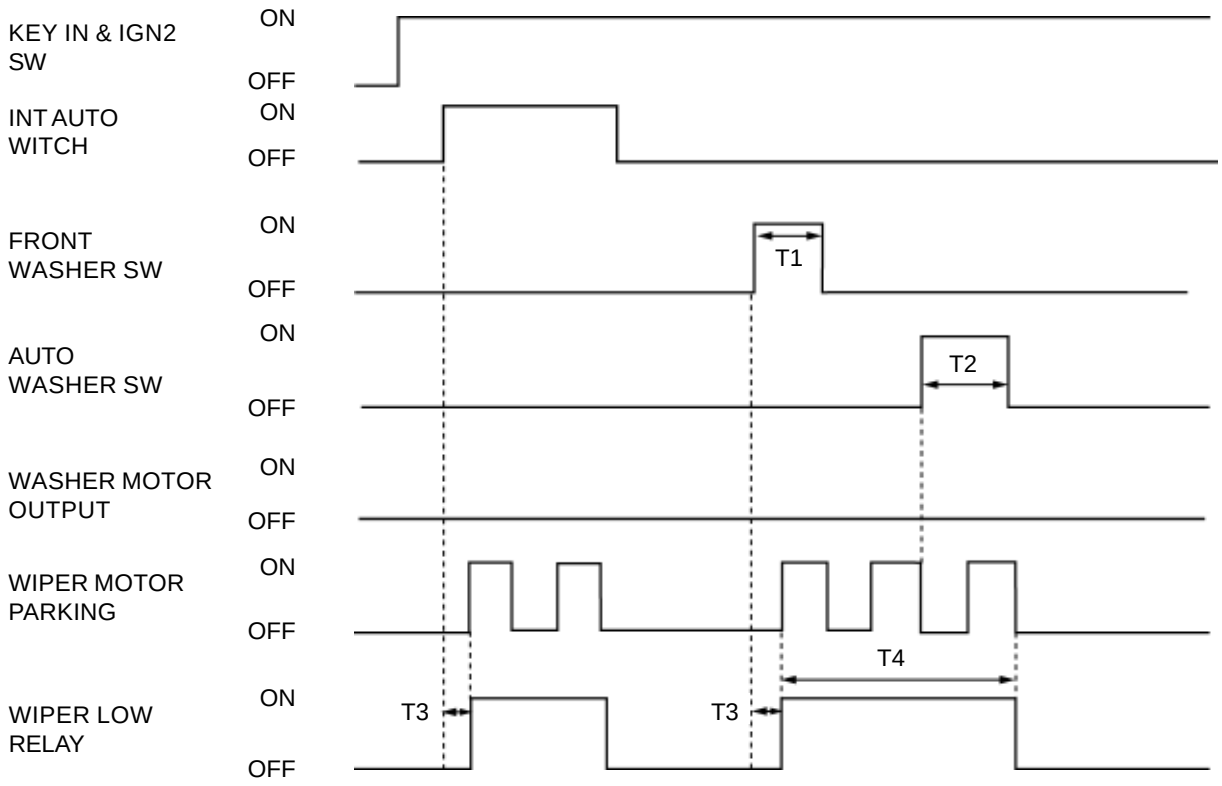
1. When the auto washer switch is turned on with the ignition switch “ON” and the INT switch “OFF”, the washer motor output is activated for 1 second. If the system recognizes this output, the wiper relay output is activated during 4 cycles and the washer motor output is activated for 1 second. Then, the wiper relay output is deactivated 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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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.

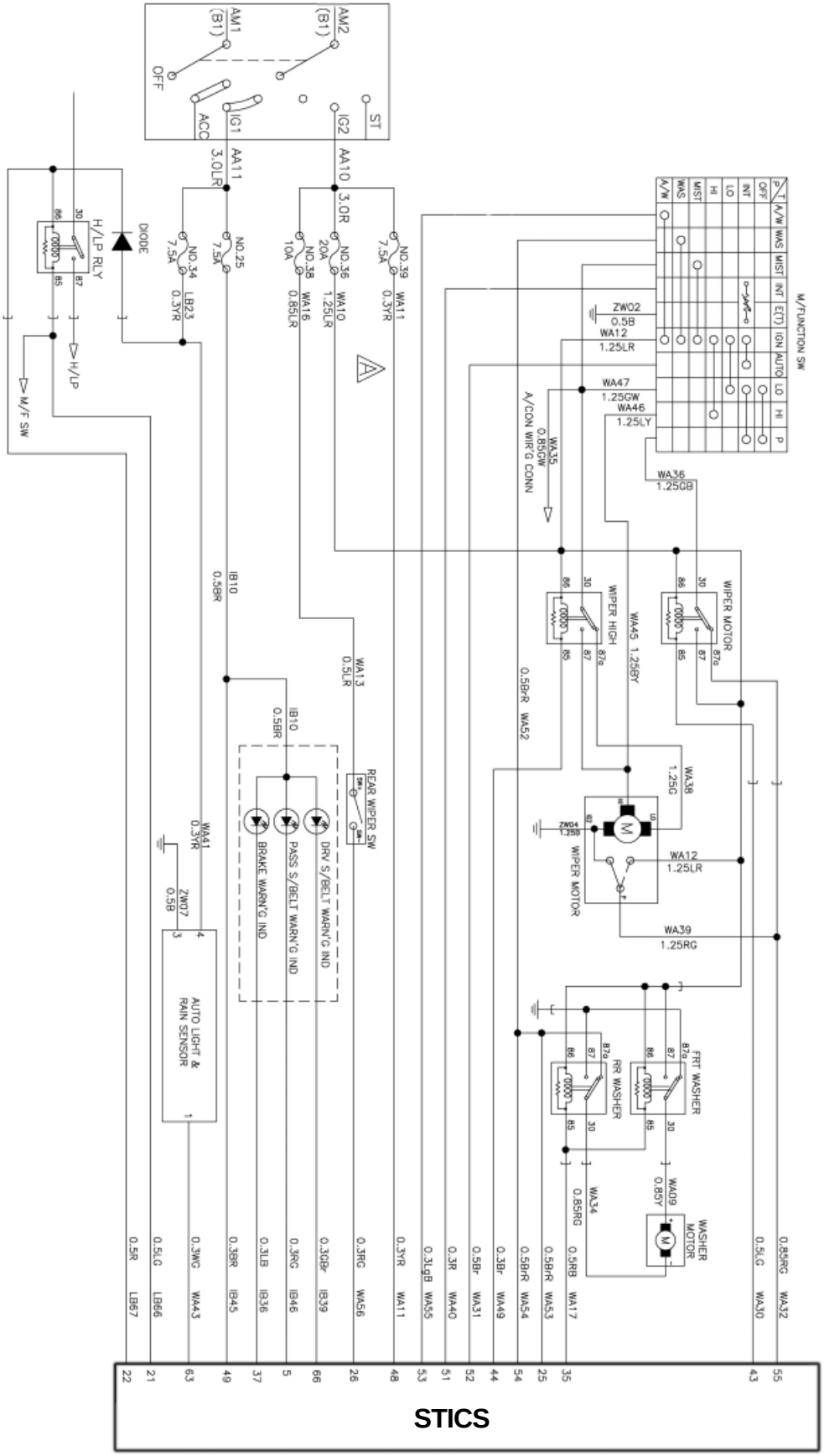


Priorities in Washer Operations

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.

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3. WIPER AND WASHER SYSTEM RELATED CIRCUIT



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4. REMOVAL AND INSTALLATION

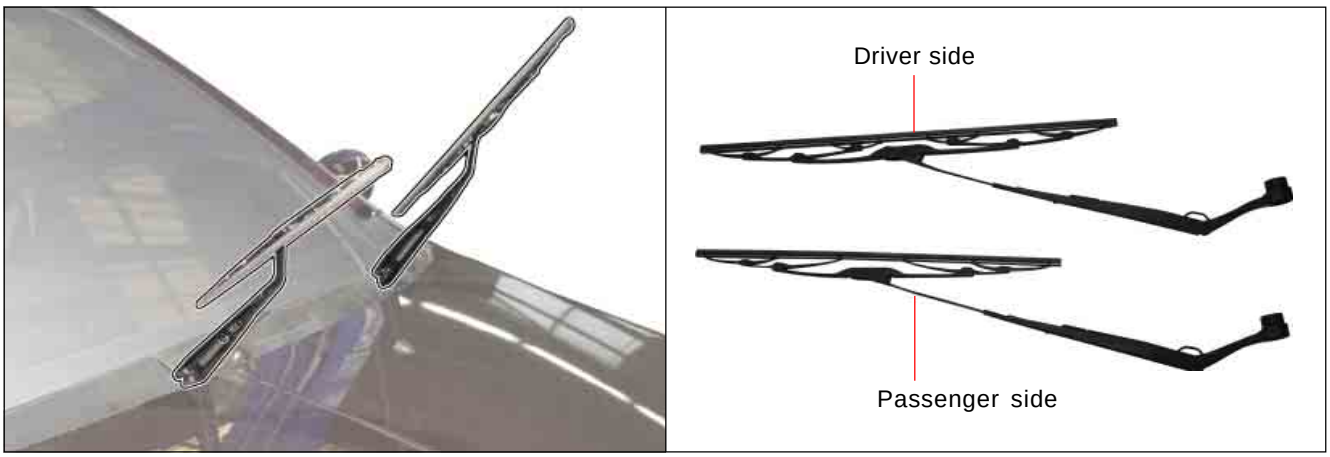
Front Wiper Assembly

※ **Preceding Work:** Disconnect the negative battery cable.

1. Disconnect the mounting nut from the wiper blade assembly and then unscrew the mounting nut.
   At this moment, perform the work with the engine hood removed or opened.



2. Close the engine hood and then remove the wiper blade asembly.



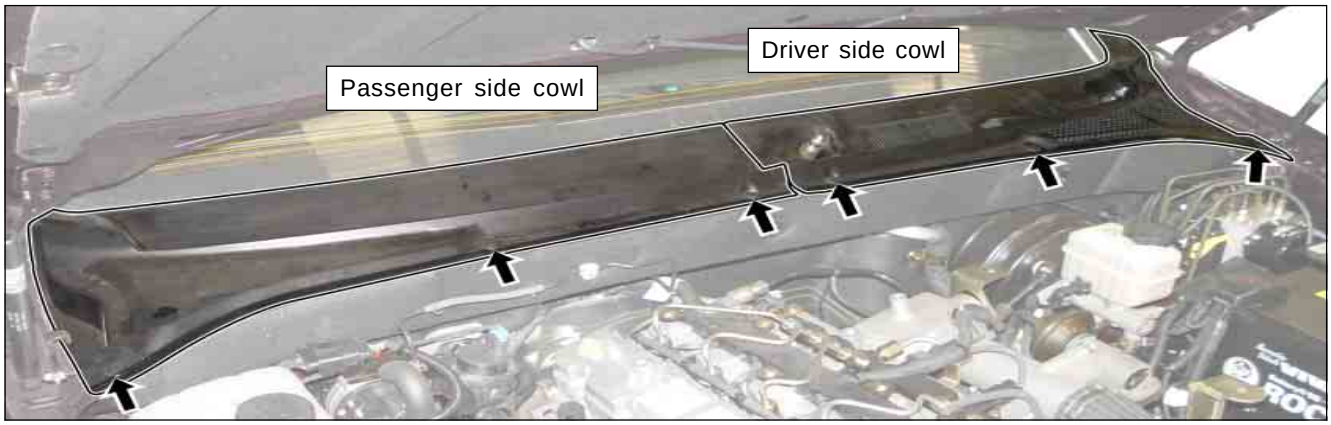
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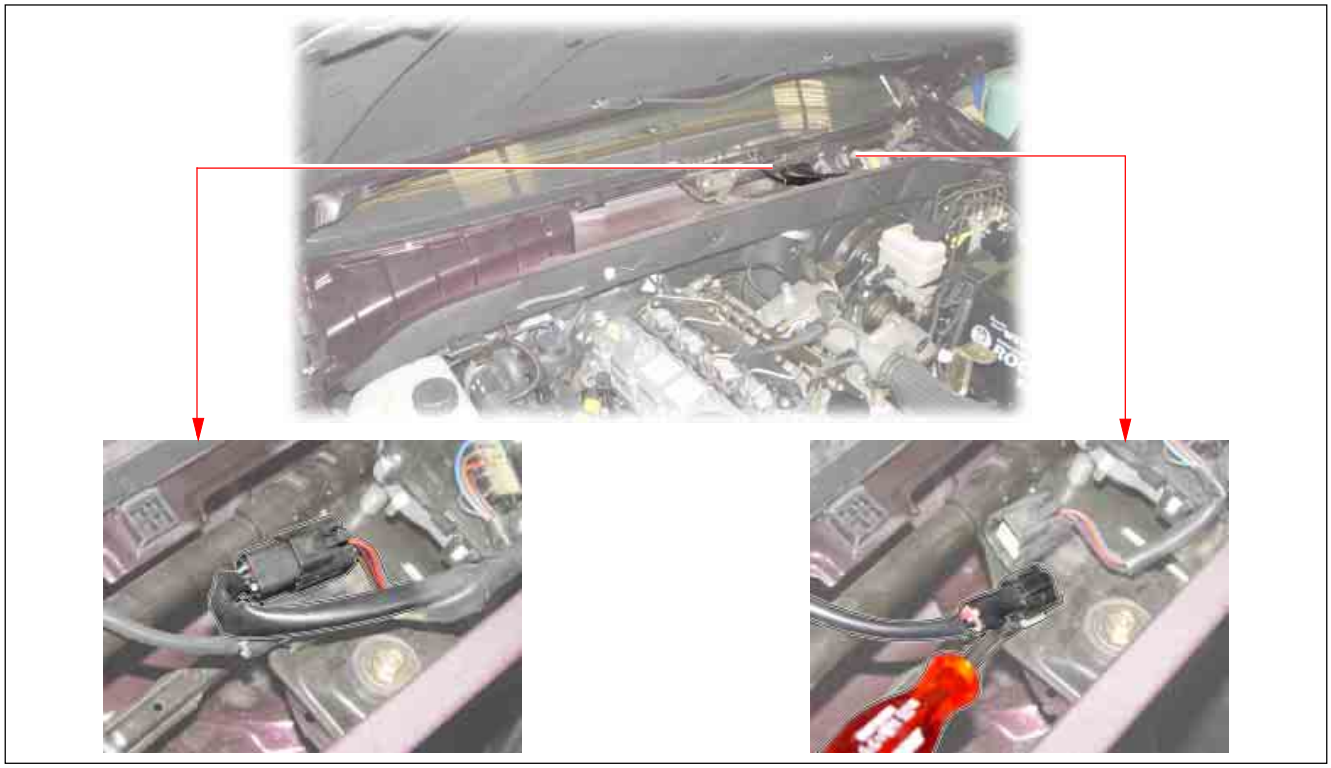
3. Remove the cowl mounting molding.



4. Remove the cowl mounting clip and then disconnect the cowl from the left (driver side).

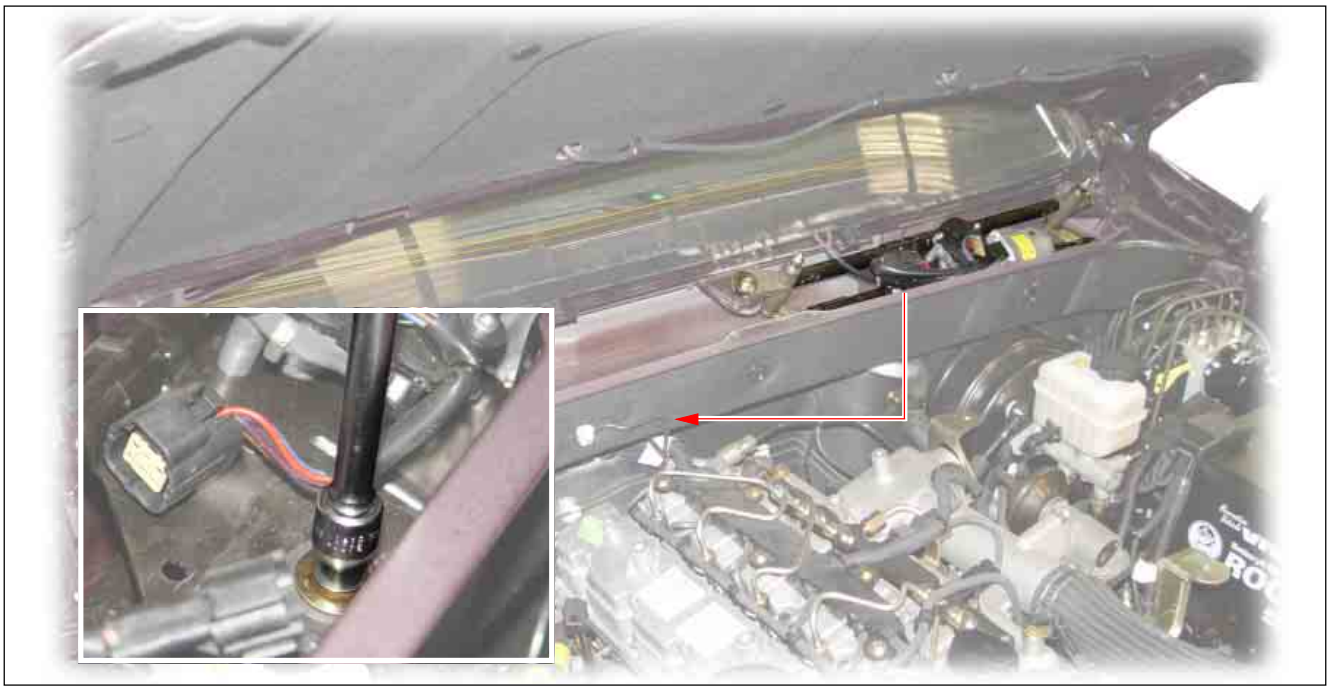


5. Disconnect the wiper motor connector (1) and front windshield heated wire connector (2) connected to the wiper link assembly.



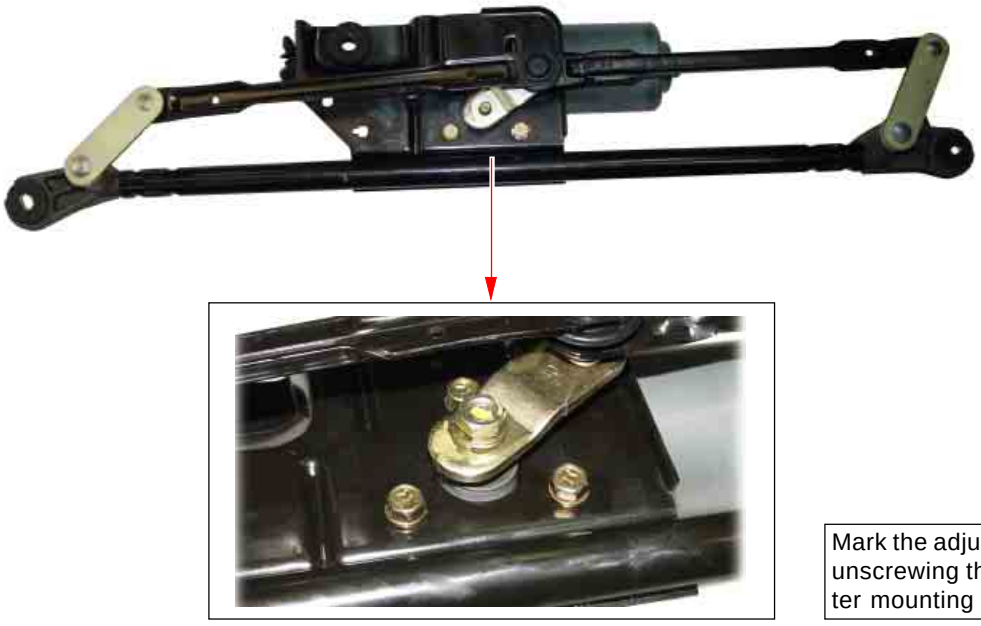
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6. Unscrew the mounting nut (10 mm - 3EA) from the wiper link assembly.





7. Unscrew the mounting nut (10 mm - 1EA) and bolts (8 mm - 3EA) from the removed wiper linkage assembly and then remove the wiper motor.

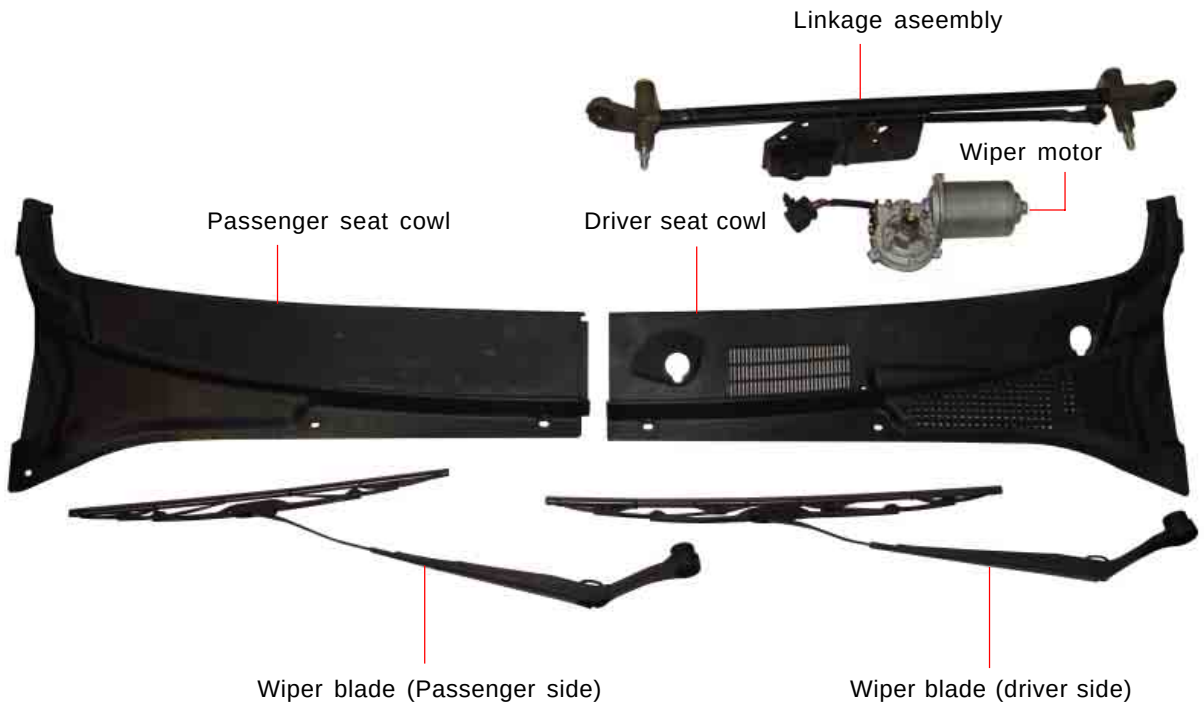


Mark the adjustment mark before unscrewing the wiper motor center mounting nut.

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Layout of Front Wiper Assembly



Wiper Motor Assembly



Connector







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Rear Wiper Assembly

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

1. Disconnect the mounting screws from the each tailgate trim part.

4. Upper mounting screw on the tailgate lower trim



1. Remove the tailgate upper trim.



5. Lower mounting screw on the tailgate lower trim



3. Disconnect the mounting clip underside the tailgate.



2. Remove the inner tailgate handle.



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2. Disconnect the mounting screw and then remove trim and vinyl cover from the tailgate underside.



Mounting Piece Position



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3. Close the tailgate and then remove the wiper blade assembly.





Open the cap



Unscrew the nut (10 mm - 1EA)

4. Remove the wiper blade and then unscrew the wiper motor cap and the mounting nut (17 mm - 1EA).





Disconnect the cap



Disconnect the nut

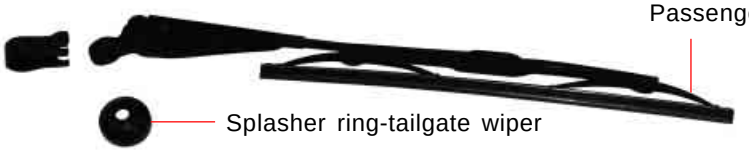
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5. Open the tailgate, unscrew the connector and mounting bolts (10 mm - 2EA) and then remove the wiper motor.





Rear Wiper Assembly



Passenger seat wiper blade assembly

Splasher ring-tailgate wiper

Mounting nut

Spacer ring-tailgate wiper



Rear wiper motor and linkage assembly



Front



Inside



Rear

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Reservoir Tank and Nozzle Assembly

※ **Preceding Work:**

1. Disconnect the battery negative cable.
2. Remove the tire.

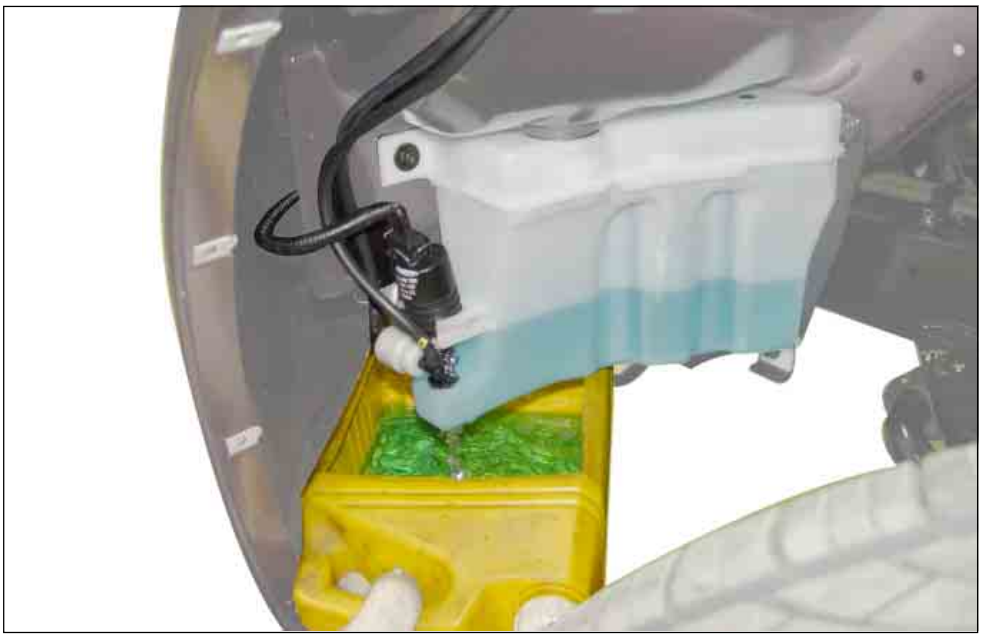


▶ Reservoir Tank

1. Remove the front wheel house cover.



2. Remove the washer motor from the reservoir tank and then drain the washer fluid.

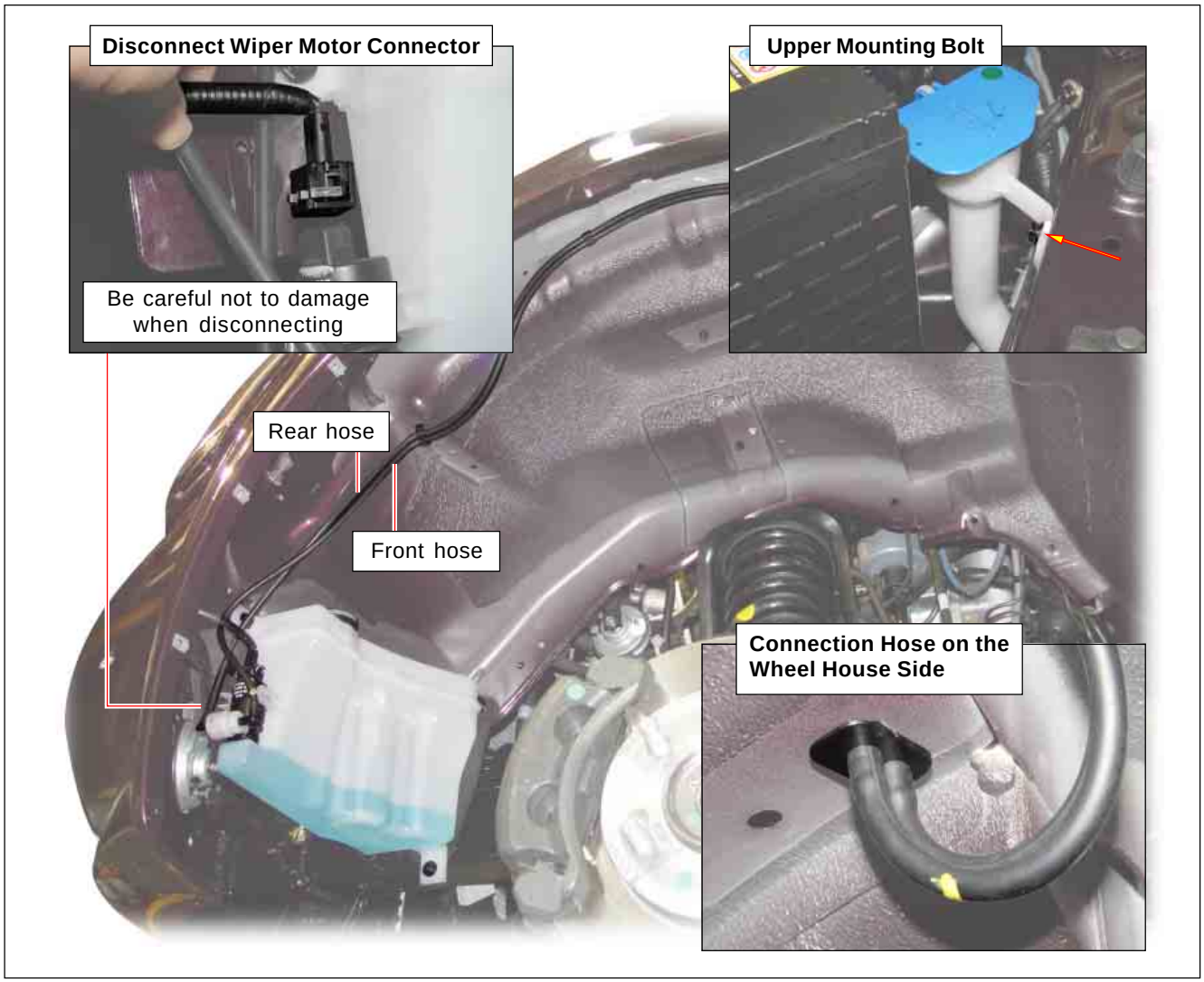


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3. Disconnect the washer motor connector from the reservoir tank. Be careful not to contact the washer fluid or foreign materials into the motor and connector after disconnecting.



4. Disconnect the washer hose connecting the reservoir tank and nozzle from the reservoir tank wheel house. Unscrew the washer reservoir tank mounting bolt and then remove it.

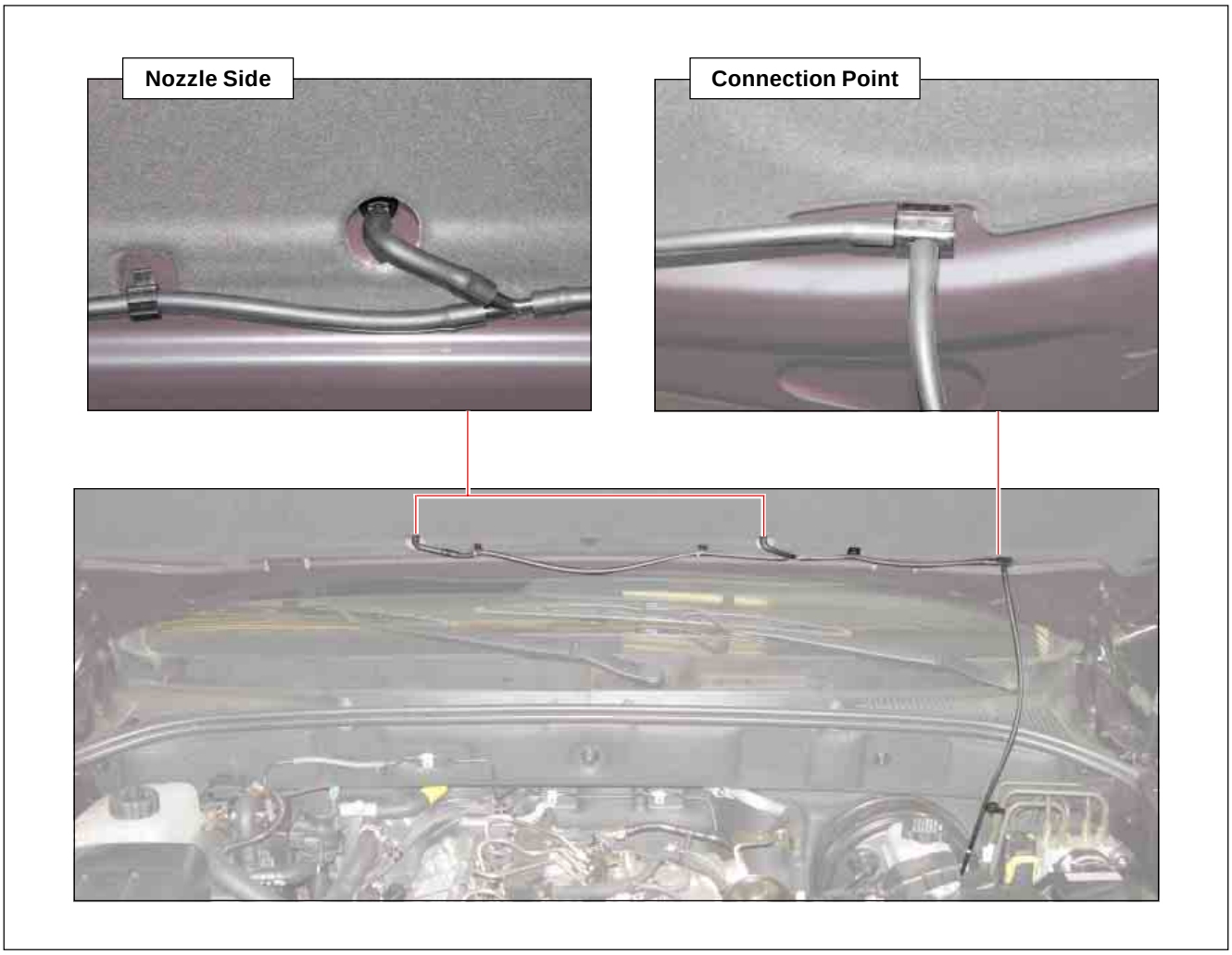


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▶ Nozzle and Hose

Front Side

1. Open the engine hood and then disconnect the hose.



2. Remove the nozzle by pressing the right/left nozzle located at the engine hood as shown in the figure.



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Rear Side

※ **Preceding Work:**

1. Remove the tailgate spoiler.
2. Remove the tailgate upper trim.

1. Open the tailgate and then disconnect the nozzle hose from the check valve.



2. Close the tailgate and then remove the nozzle with a flat blade screwdriver or special tool.





NOTICE

- **Be careful not to damage the body and the nozzle.**

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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 15
9. Electrical wiring diagram 18

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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 sensing 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 can control sensitivity against rains on the windshield and transmits wiping demand signal accordingly.

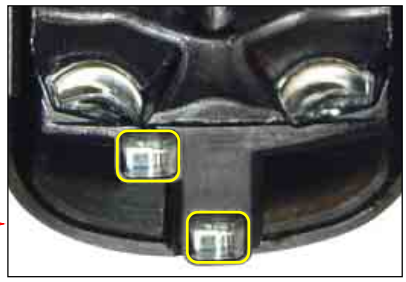


Emitter lens
The LED emits the infrared rays is located at bottom and the lens guides the infrared rays to target point.

Horizon autolight sensor

Auto light sensor

Vertical autolight sensor



Enlarged auto light sensor section

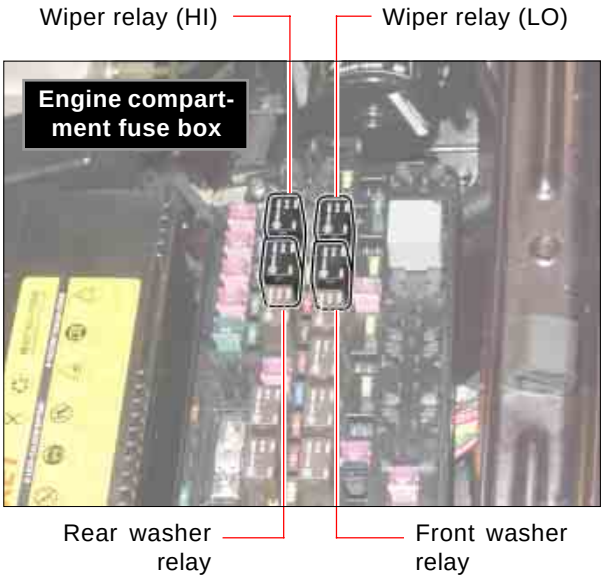
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▶ STICS

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 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. (For example, the AUTO wiper switch is at the 3rd level, but the wiper operates at the 4th level.)

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2. RAIN SENSOR 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.

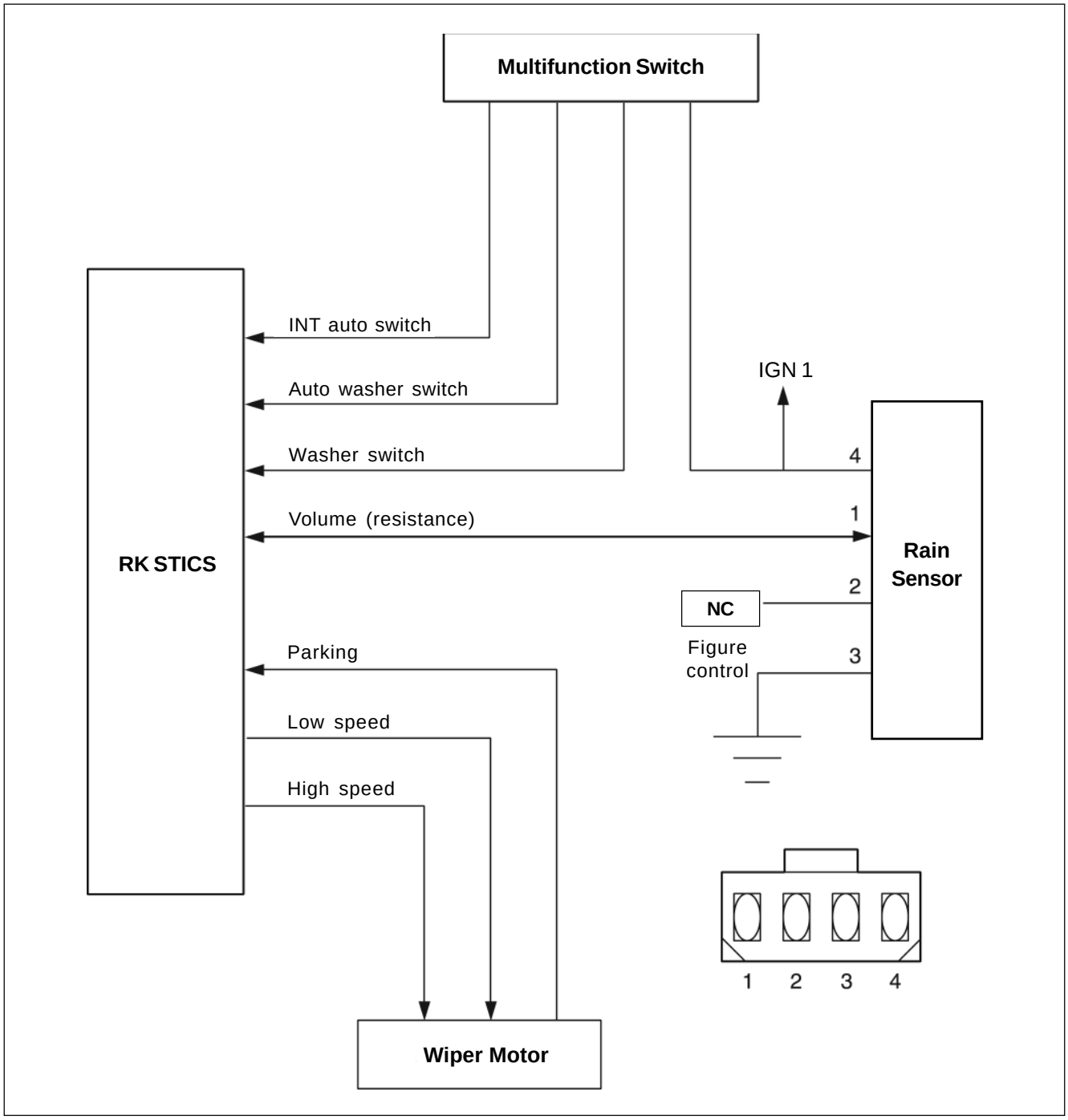
No. 2 terminal sends the wiper and washer operation information such as

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.



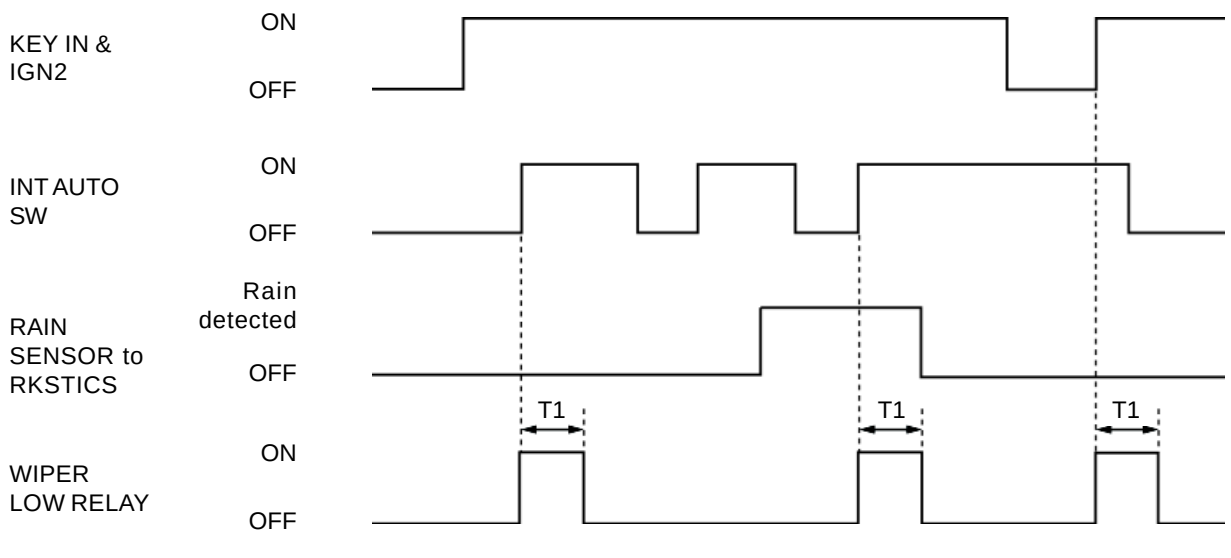
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4. FUNCTIONS AND SPECIFICATIONS OF RAIN SENSING WIPER

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 “ON” position).

   When the wiper switch is turned to “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.



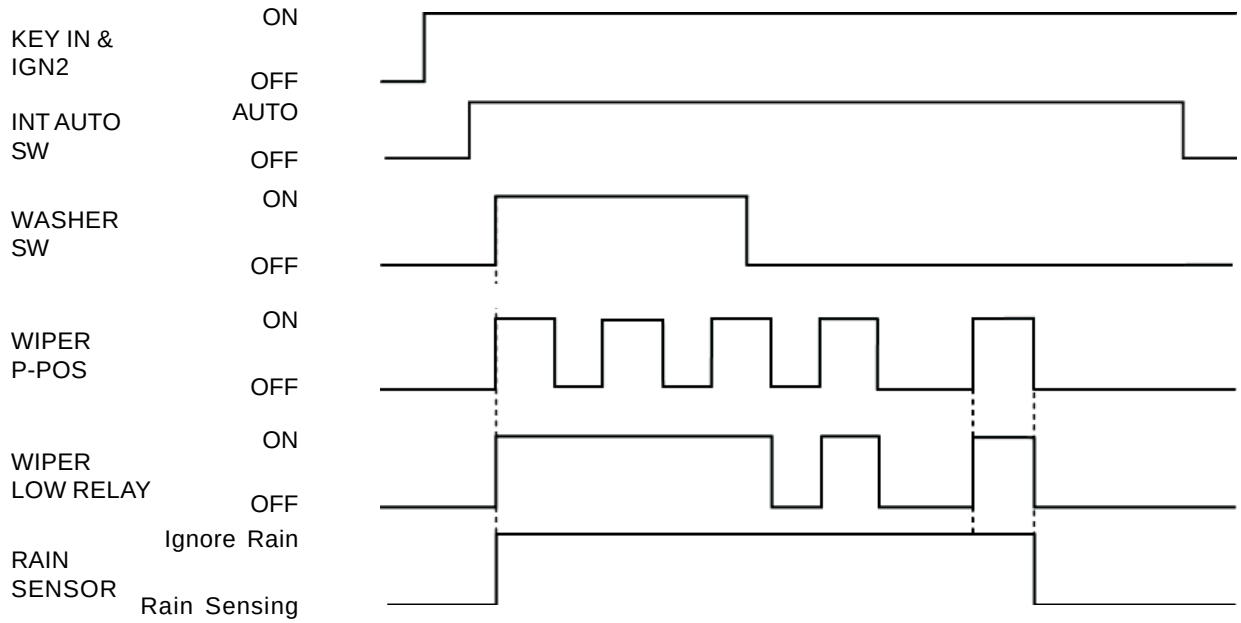
T1: 1 cycle

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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.

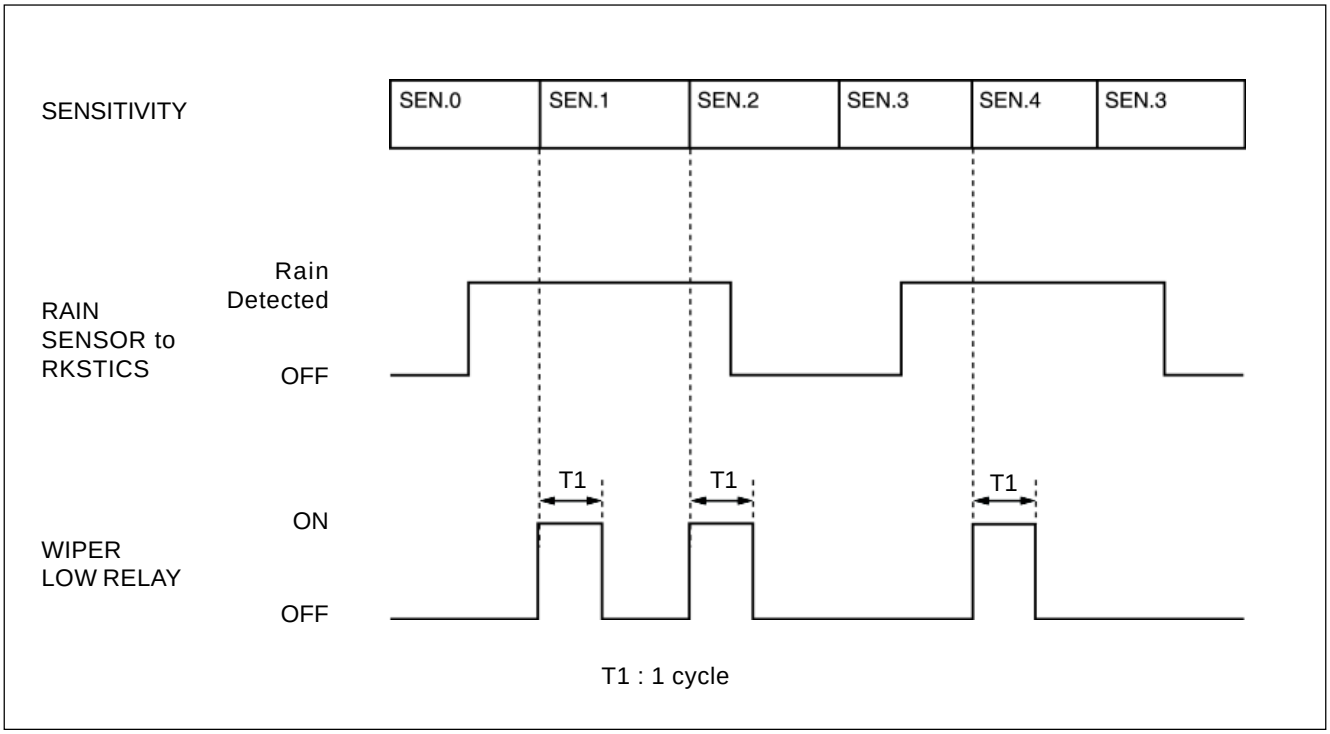


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Rain Sensing Sensitivity Control

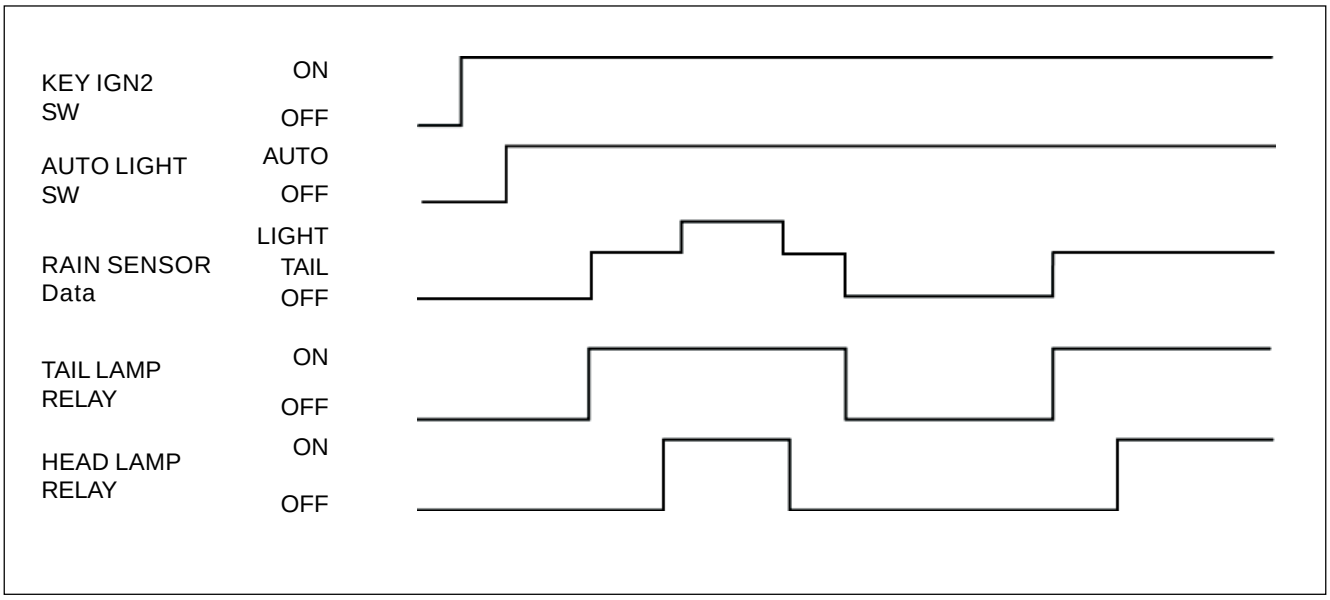
1. The wiper relay (LO) is turned on and the wiper motor runs one cycle when the volume sensitivity is increased (ex: from 0 to 1) (while the ignition key is in “ON” position, the wiper switch is in “AUTO” position, and the wiper motor is in “Parked” position). However, the wiper motor can be operated only when the rain sensor detects the “Rain Detected” signal.

   ***** If the volume sensitivity is changed more than 2 stages within 2 seconds, the wiper motor runs only one cycle.



Auto Light Control

1. Only when the auto light switch is in “AUTO” position, control the tail lamp and headlamp by communicating with the rain sensor (while the ignition key is in “ON” position).

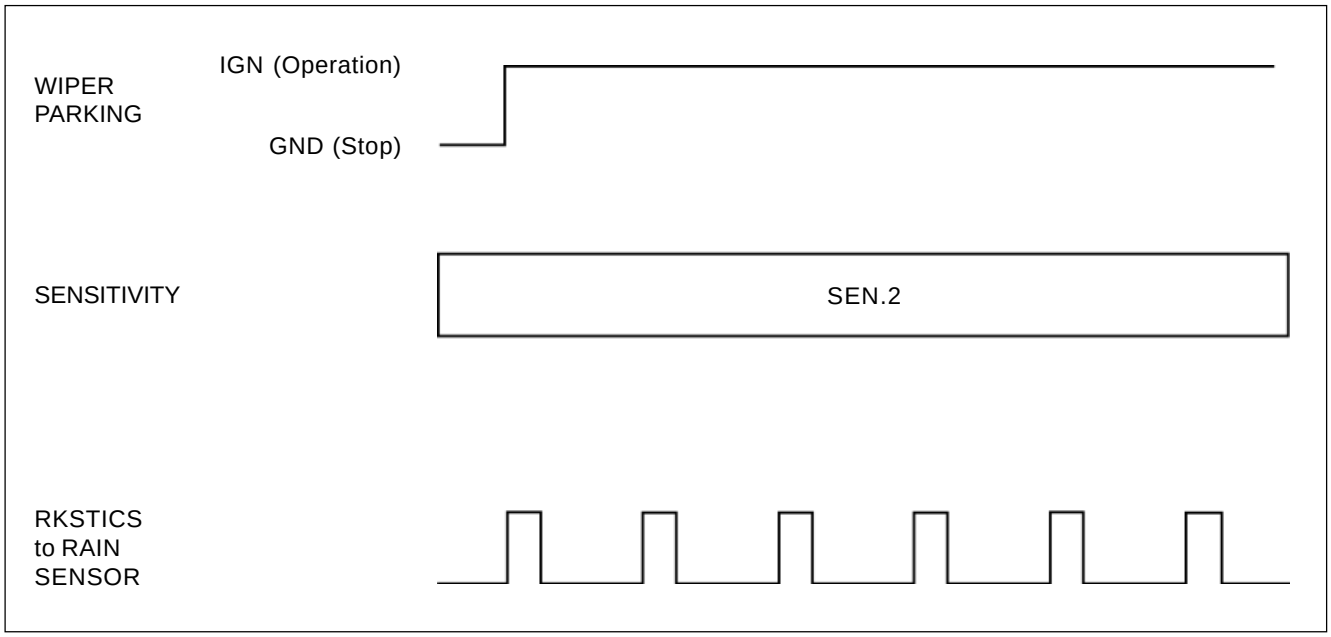


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Wiper Operation When the Wiper Parking Terminal Is Grounded

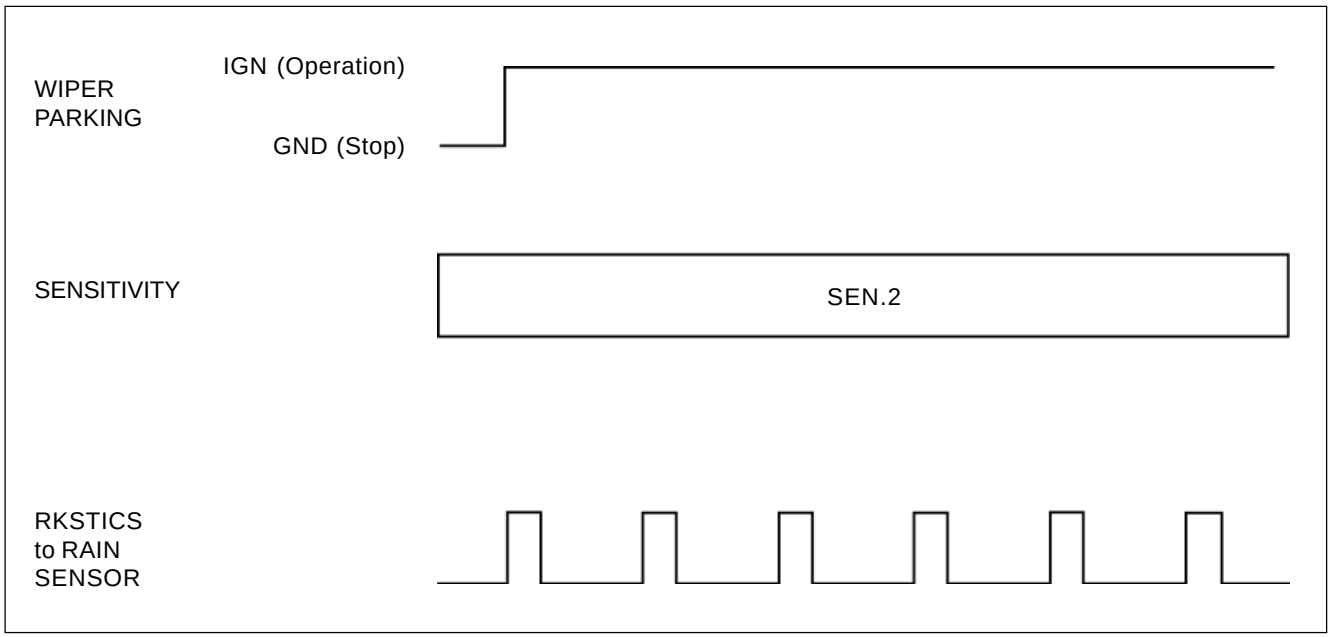
1. The wiper system continuously outputs the parking signal of current sensitivity when the parking terminal is grounded (while the ignition key is in “ON” position and the INT switch is in “ON” position).

   *** The wiper motor runs only when the rain sensor requires.**



2. When the parking terminal is fixed to IGN (HIGH), 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).

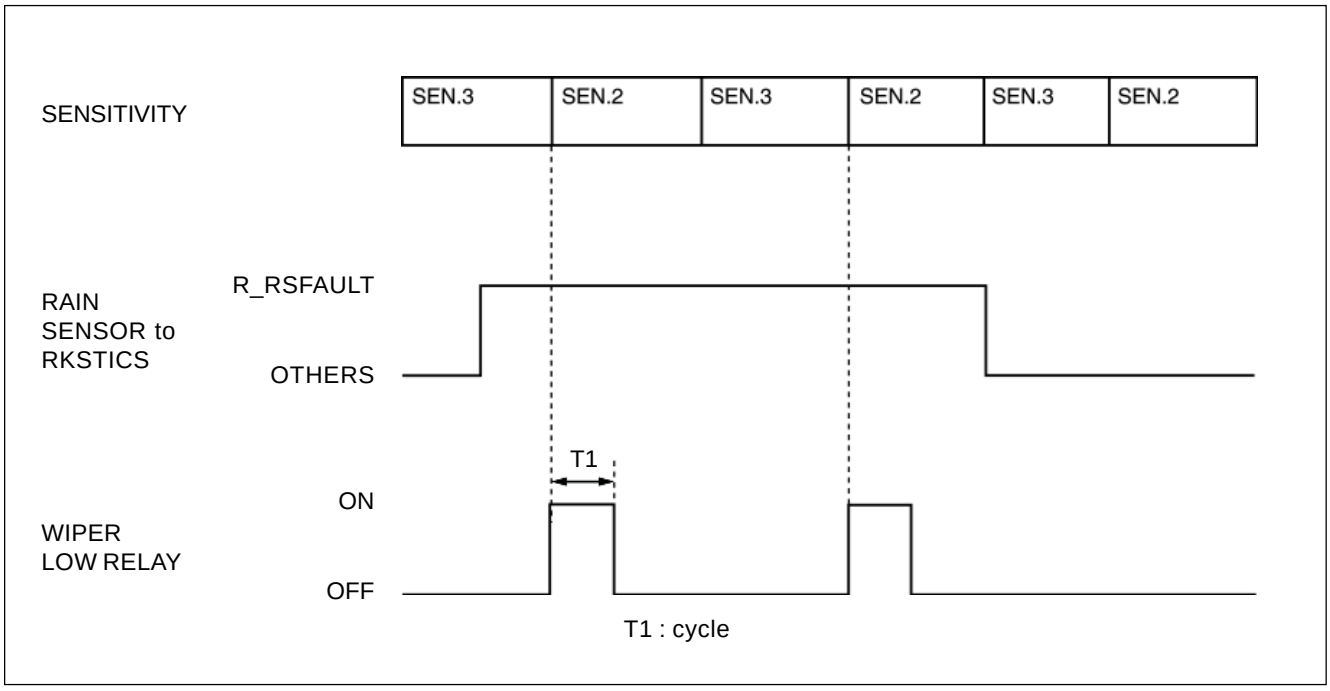
   *** The wiper motor runs only when the rain sensor requires.**



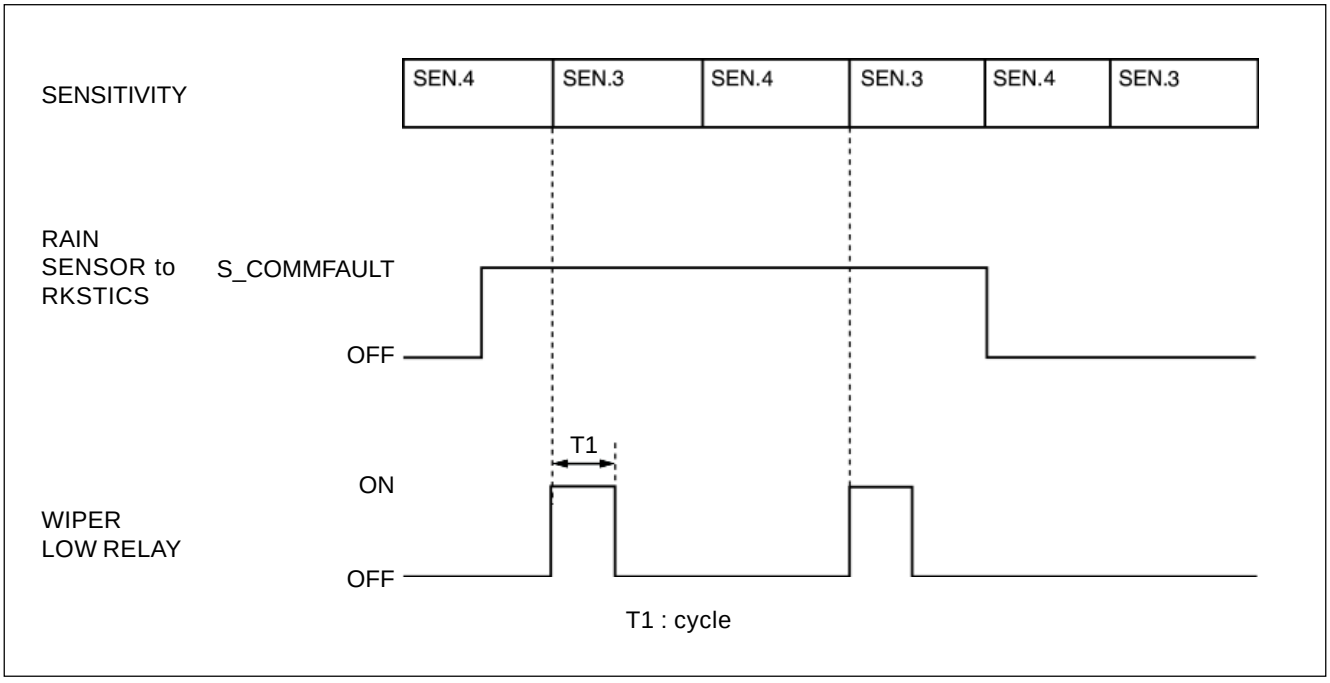
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Defective Rain Sensor

1. The wiper relay (LO) 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 (1) 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 (2) from the rain sensor (while the ignition key is in “ON” position and the INT switch is in “ON” position).



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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 at B+=13.5V (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 B+=13.5V (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.)

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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 "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 the wiper switch "AUTO" position. If there are not any 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. And, the wiper also operates during raining up to 5 minutes after rain stops.

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).**

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▶ 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 installation.
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 steps. At this moment, check if the wiper operates one cycle.

If the wiper operates, this causes when the sensor is defective or the sensor has the communication problem with STICS.

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7. DIAGNOSIS PROCEDURES

1. Check the glass and coupler for proper installation.

↓

2. Check the power up 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.

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8. 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.

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Removal and Installation of Rain Sensor

1. Pry off the rain sensor cover by inserting a small flat-blade screwdriver into service holes at both sides (refer to picture).

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 disconnect from the glass.



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Components of the Rain Sensor Unit

PCB Assembly and Emitter Lens





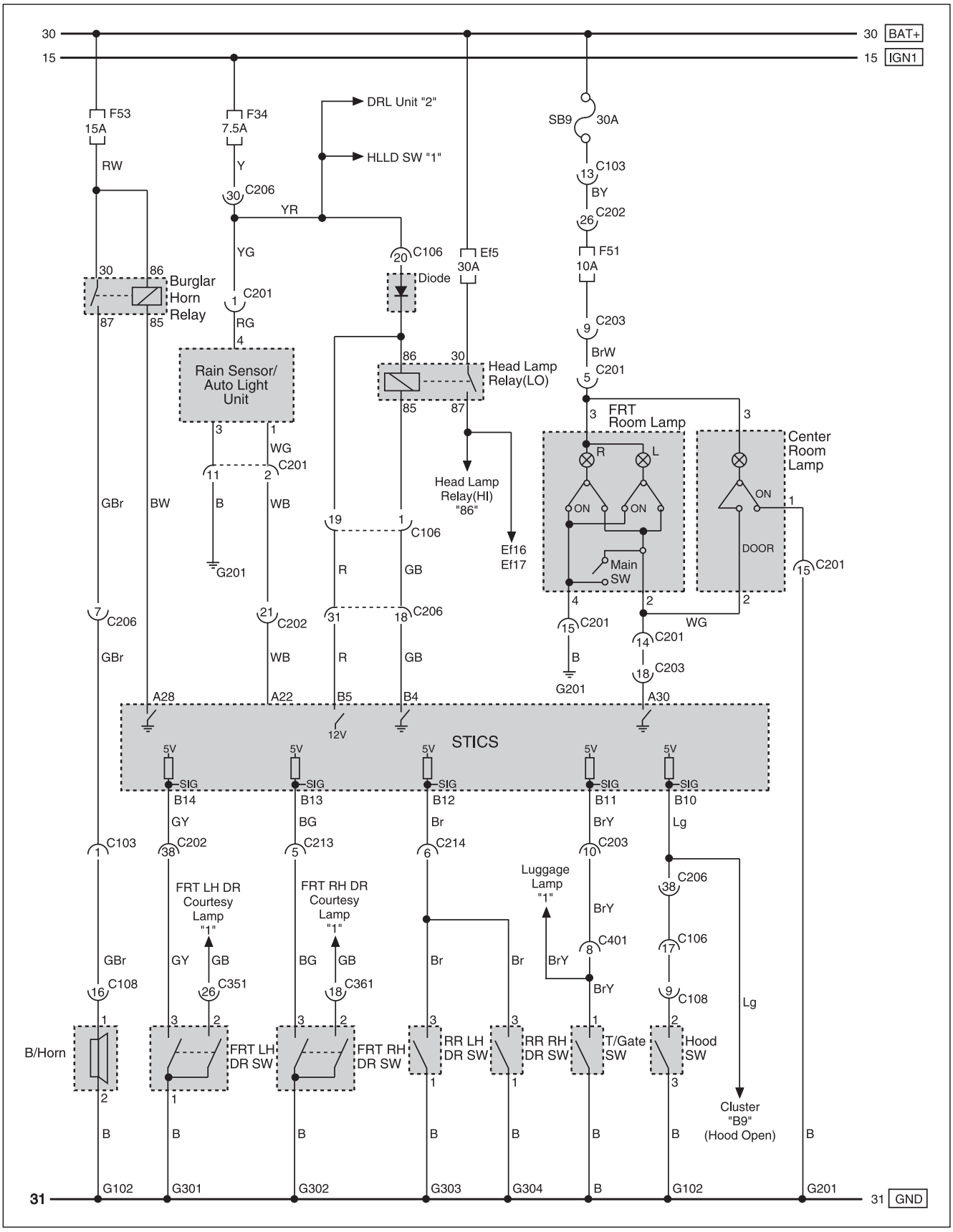
Housing and Receiver Lens





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9. ELECTRICAL WIRING DIAGRAM



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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. Removal and installation of parking aid 7
7. Circuit diagram 12

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PARKING AID SYSTEM (PAS)

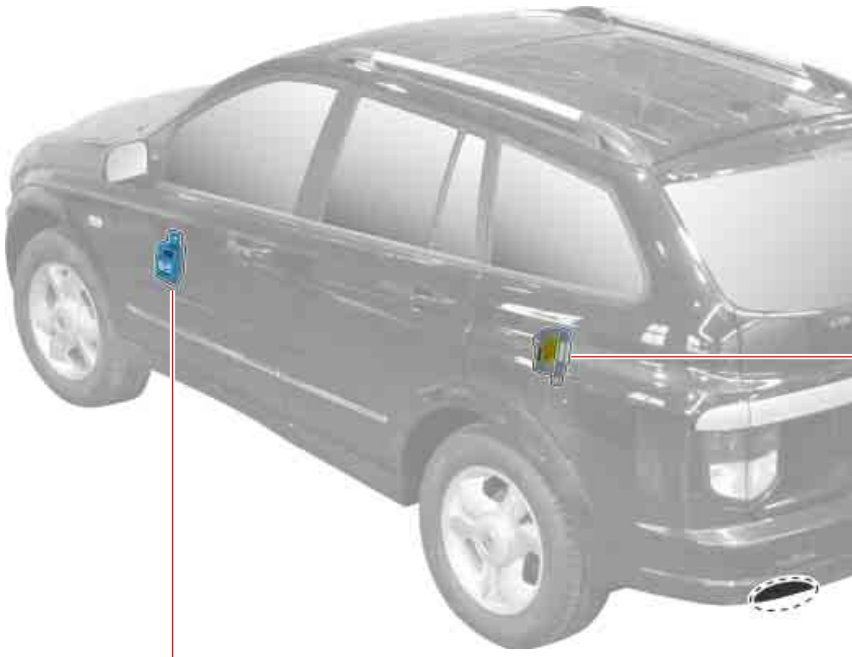
1. SYSTEM CONFIGURATION

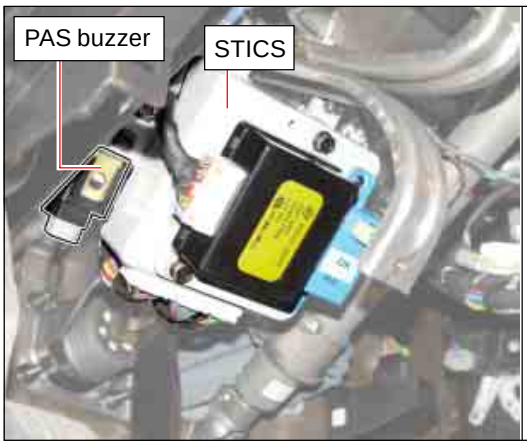
The parking aid device is integrated in the rear bumper and it uses three Piezoelectric elements to measure vertical and horizontal distance to obstacles.

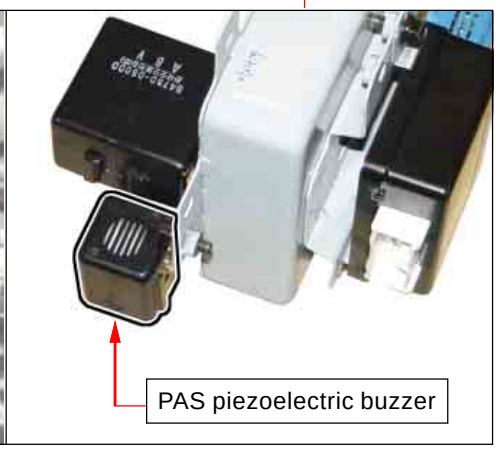
When placing the gear selector lever to “R” position, the designated unit (PAS unit) activates the parking aid sensors to measure the distance to obstacles.

Gear Selector Lever (R Position)





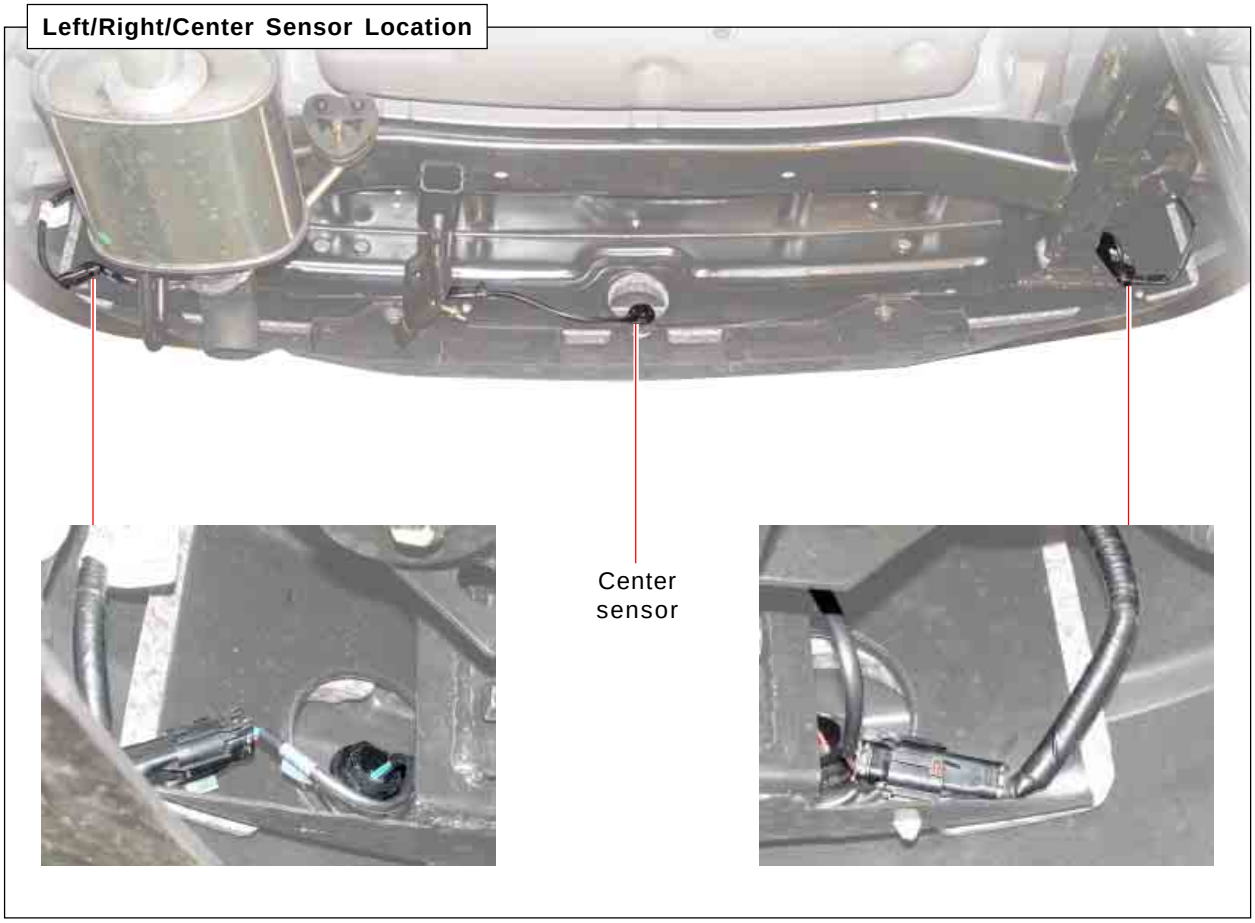




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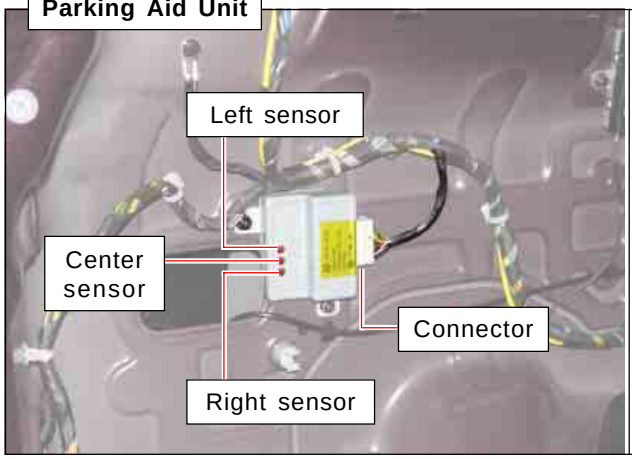
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Left/Right/Center Sensor Location





Parking Aid Unit





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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 number of displaying bars is decreased and the alarm interval becomes faster 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)
   1) Horizontal: Min. 20° at 110 ± 5 cm Min. 100° at 50 ± 5 cm
   2) Vertical: Min. 20° at 110 ± 5 cm Min. 60° at 50 ± 5 cm



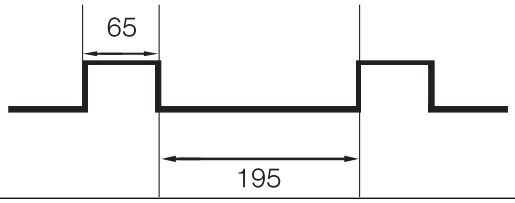
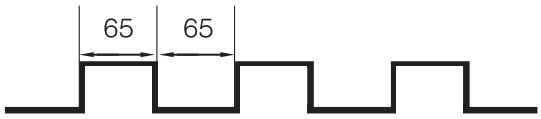


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3. ALARM INTERVAL

Alarm interval and display changes according to the distance as below:

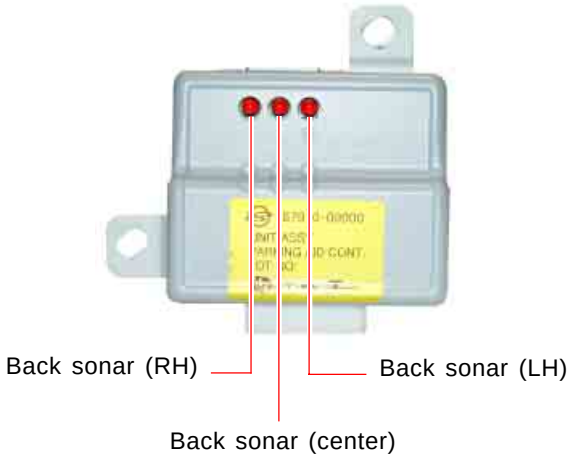
While reversing, if obstacles are within stage 1, the warning beep sounds with long intervals. If within stage 2, the warning beep sounds with short intervals and if within stage 3, the warning beep sounds continuously.

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 ——— "

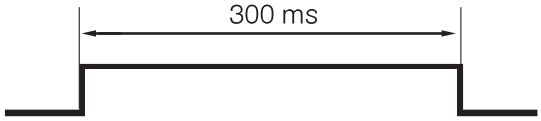
4. TROUBLESHOOTING OF SENSOR

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)
   1) Sensor failure conditions (conditions for warning beep due to failure)
   2) Open in sending circuit
   3) Open in receiving circuit
   4) Open in power circuit (+, -)



Warning beeps

When failed (also when diagnosing the unit)		
When normal		

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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.**
- **If you can not properly check back, get out of the vehicle and then 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 conditions, 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 conditions, 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
   1) Wires, ropes, chains.
   2) Cotton, sponge, clothes, snow that absorb ultrasonic waves.
   3) Obstacles lower than the bumper. (ex. drain ditch or mud puddle)
2. Not defective but improperly working
   1) When the sensing portion is frozen. (operates normally after thawed)
   2) When the sensing portion is covered by rain, water drops, snow or mud. (operates normally after cleaned)
   3) When receiving other ultrasonic signals (metal sound or air braking noises from heavy commercial vehicles).
   4) When a high-power radio is turned on.
3. Narrowed sensing area
   1) When the sensing portion is partially covered by snow or mud. (operates normally after cleaned)
   2) 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
   1) When driving on the rough roads, gravel road, hill and grass.
   2) When the bumper height is changed due to the heavy load.
   3) When the sensing portion is frozen.
   4) When the sensing portion is covered by rain, water drops, snow or mud.
   5) When receiving other ultrasonic signals (metal sound or air braking noises from heavy commercial vehicles).
   6) When a high-power radio is turned on.
   7) When some accessories are attached in detecting ranges

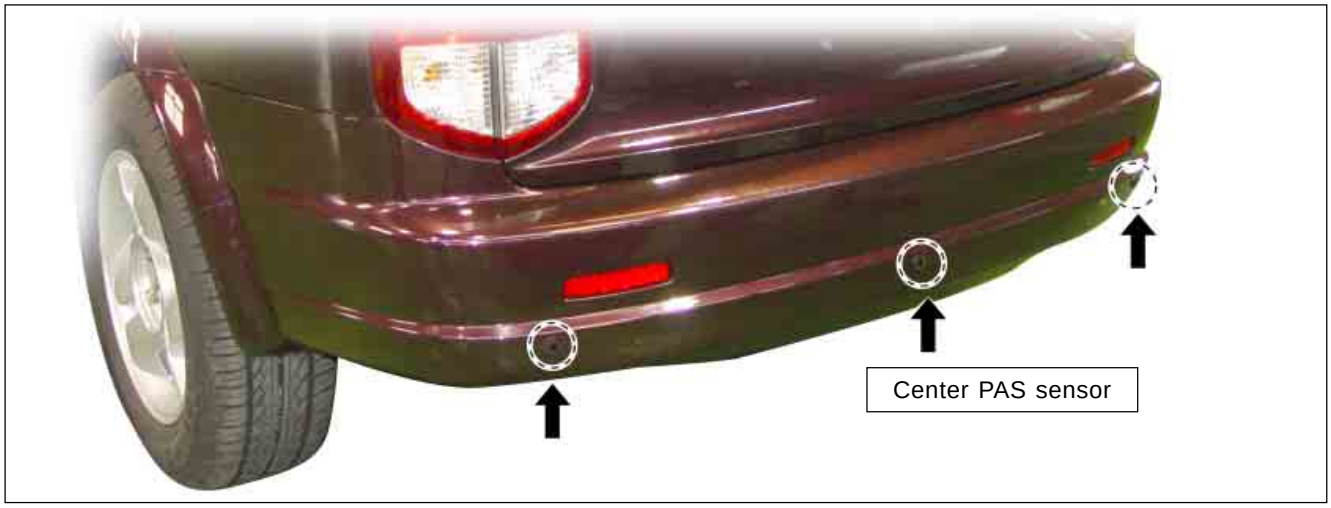
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6. REMOVAL AND INSTALLATION OF PARKING AID

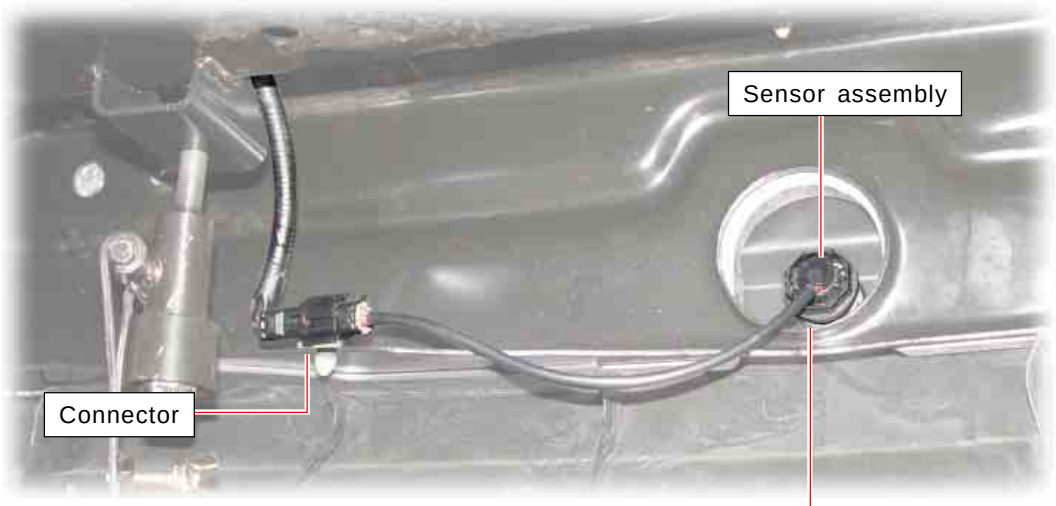
▶ Parking Aid Sensor

Center PAS Sensor

※ **Preceding Work:** Disconnect the negative battery cable and remove the spare tire.



1. Disconnect the harness connector and then remove the center sensor by turning the mounting cover.





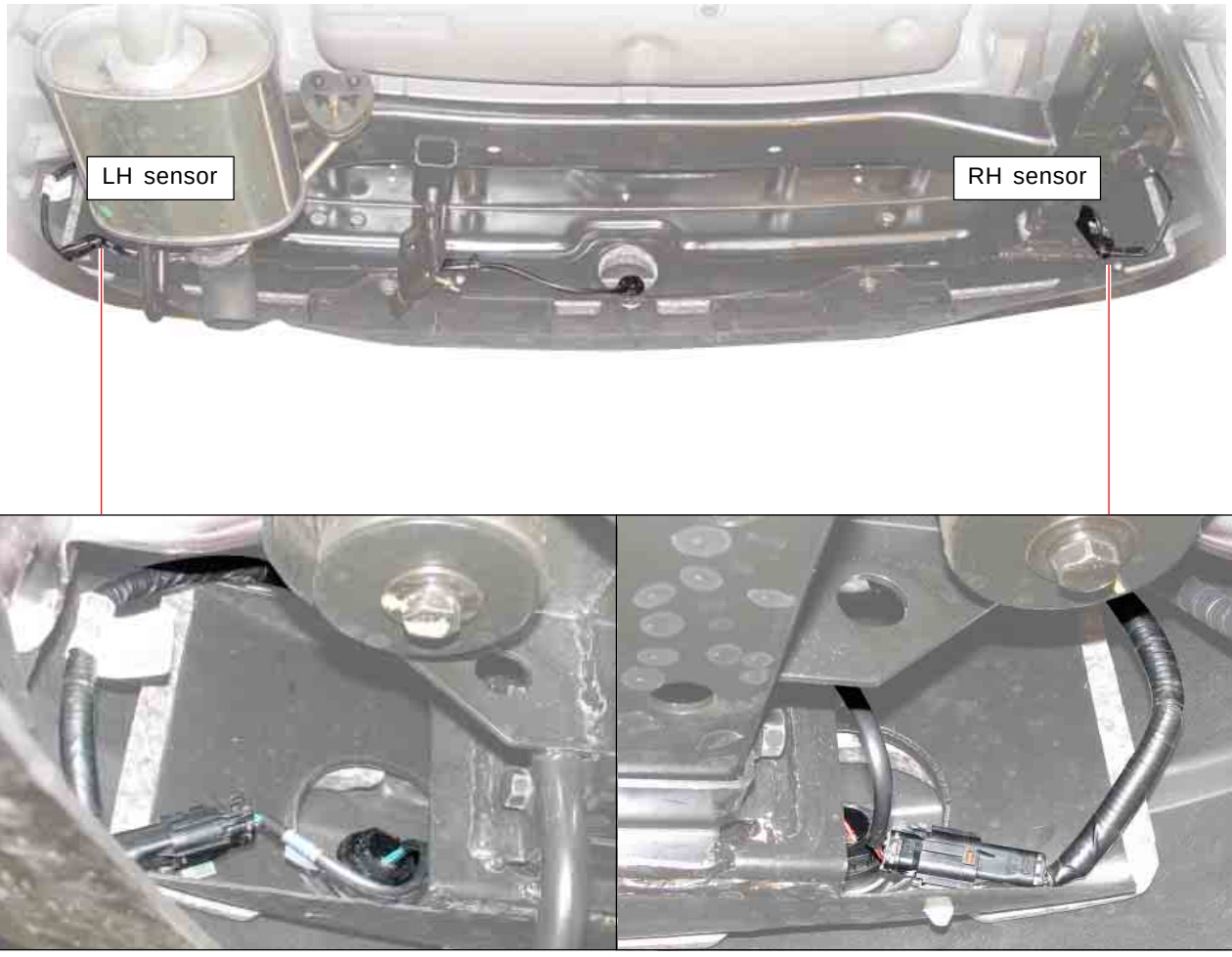
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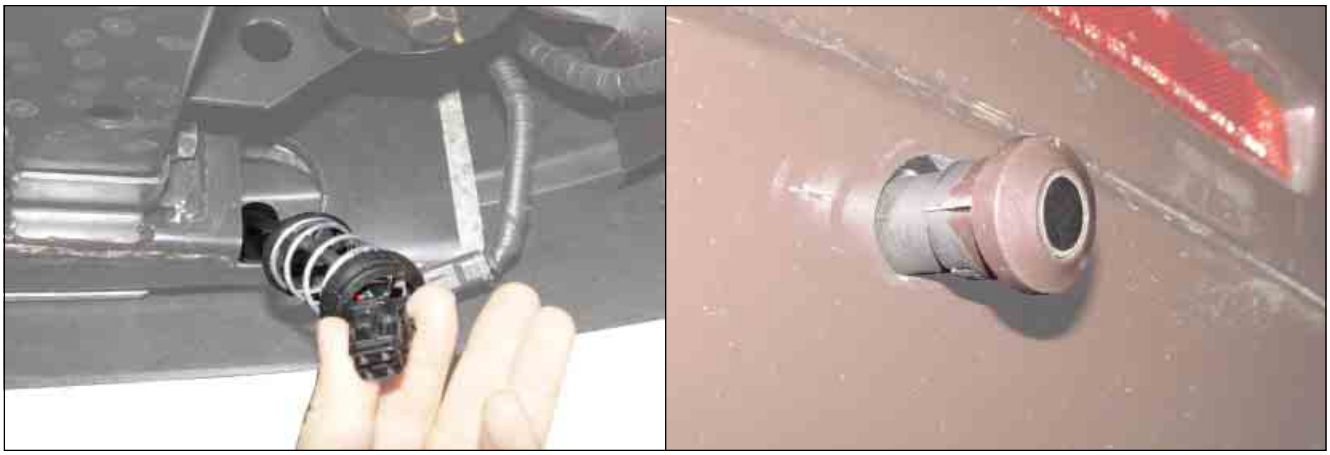
RH/LH PAS Sensor

※ **Preceding Work:** Disconnect of negative battery cable.

1. Disconnect the center connector and then remove the cover by turning it.



2. Remove the RH/LH sensor mounting cover and spring and then remove the sensor from the bumper.



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Components of PAS Sensor



Connector



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Precautions When Installing LH/RH Sensors



Fit The Sensor Into The Mounting Hole.



When Extended



When Compressed



1. Align the sensor lower cover with the sensor groove.

2. Insert the sensor upper cover into the sensor groove.

Align Wigh the Groove





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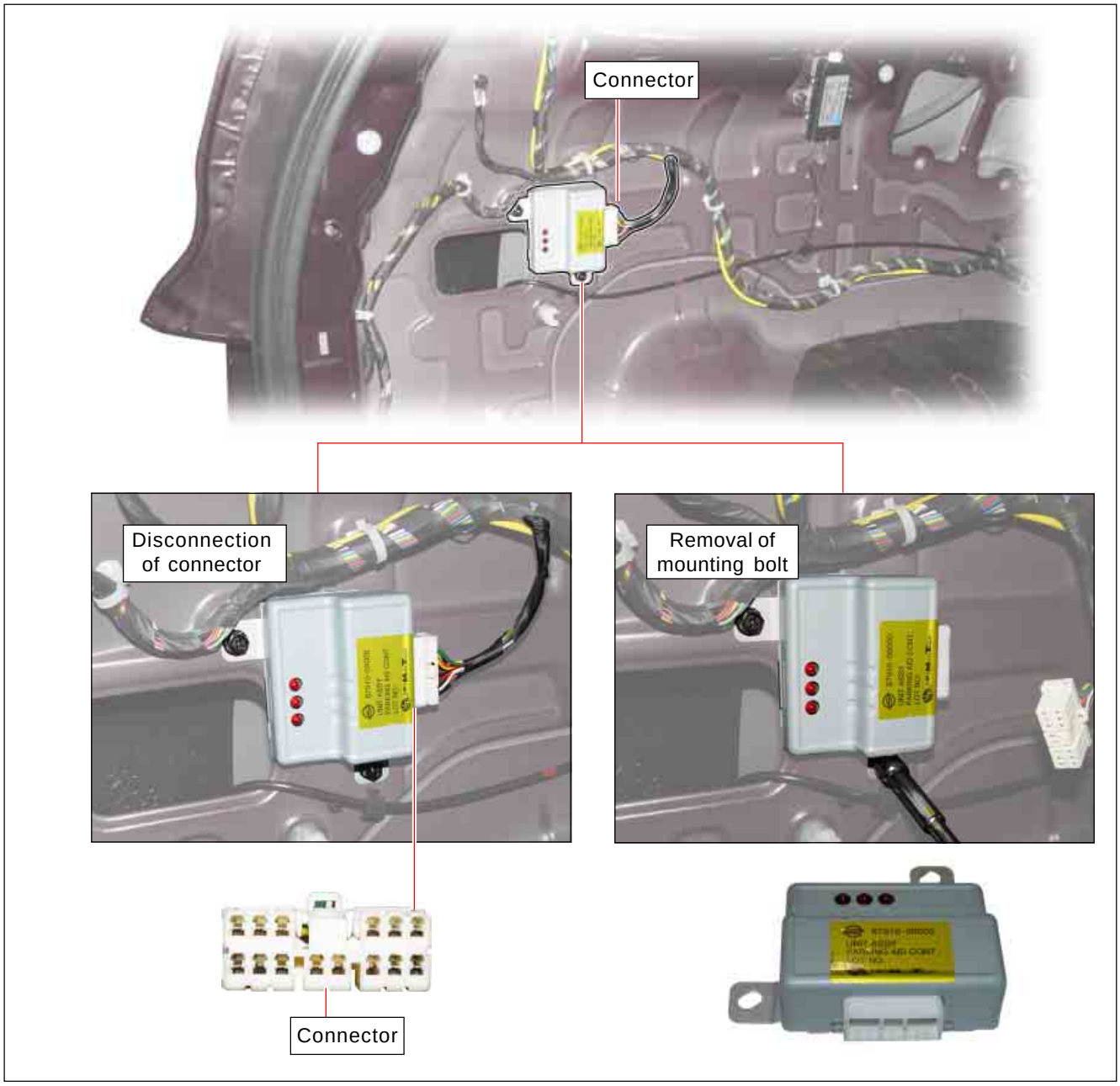
▶ PAS Unit



※ **Preceding Work:**

1. Disconnection of negative battery cable
2. Removal of rear lower quarter panel and seat belt.
   (For removal and installation, refer to the BODY section.)

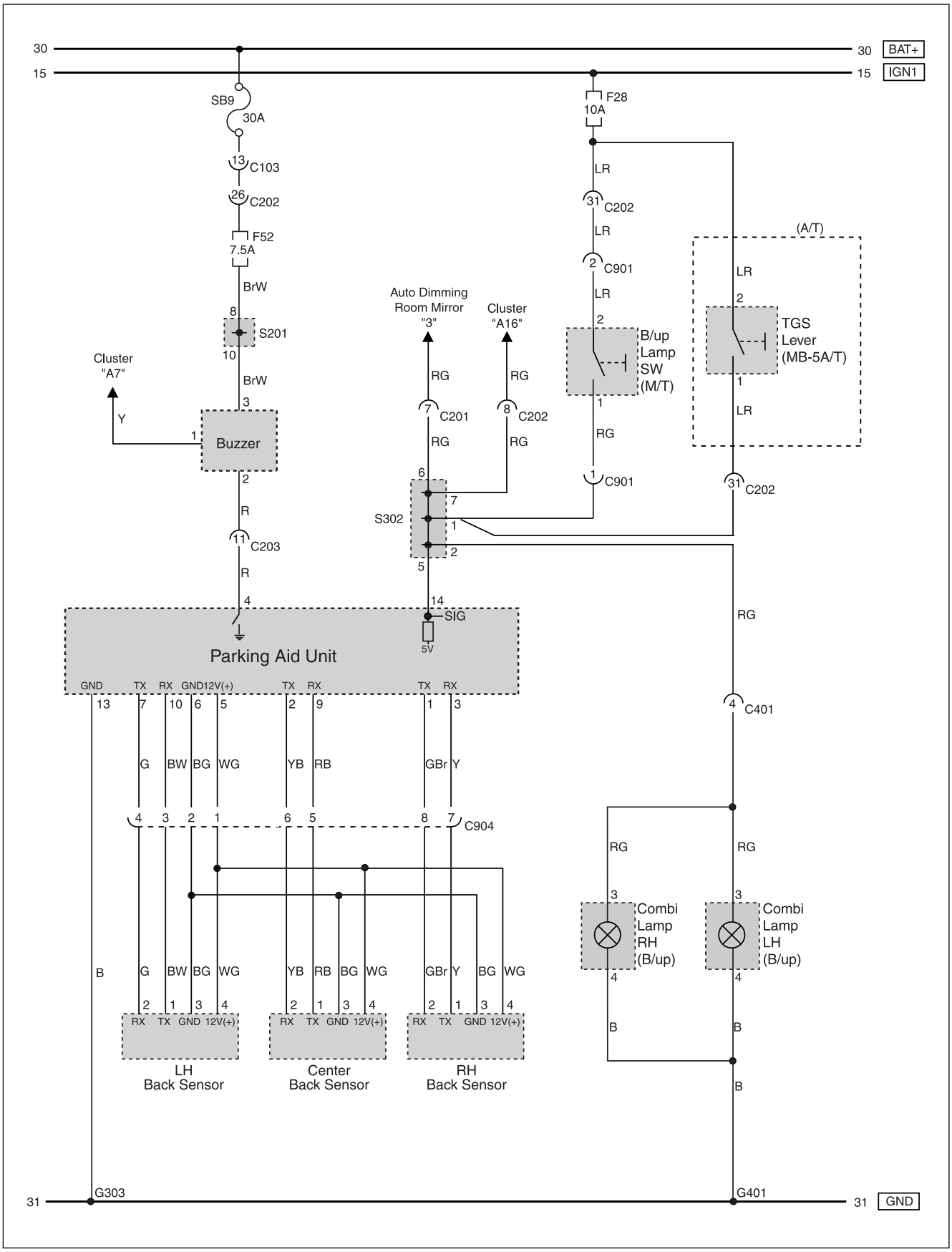
1. Disconnect the connector and mounting bolts (10 mm - 2EA) and then remove the PAS unit.



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7. CIRCUIT DIAGRAM



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AFFECTED VIN	

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ELECTRIC SYSTEM

8000

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. Audio & video system 8
5. Electric components and layout 10
6. Fuses and relays 12
7. Interior fuse box 15
8. Diagnostic connector 18
9. Electrical wiring diagrams 20

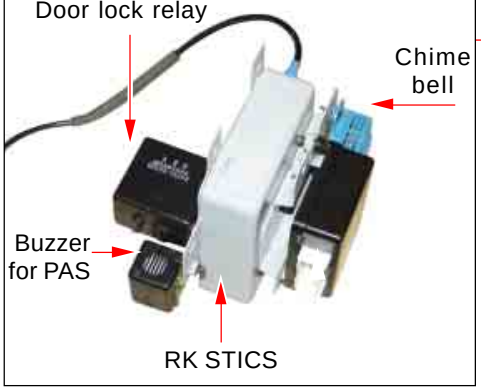
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ELECTRIC SYSTEM LAYOUT

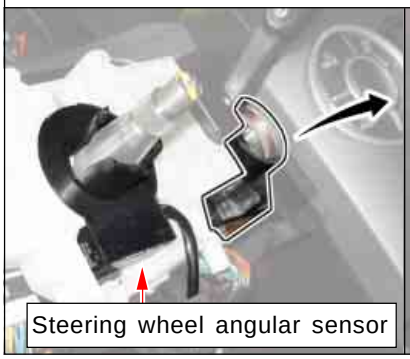
1. LOCATIONS OF INTERIOR UNITS AND SENSORS

Under Instrument Panel

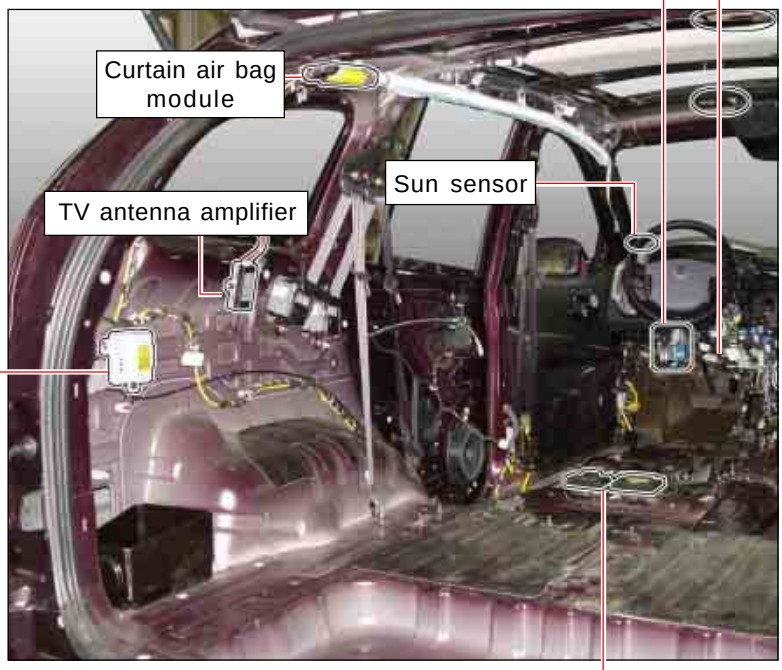




Steering Wheel Angular Sensor / Immobilizer



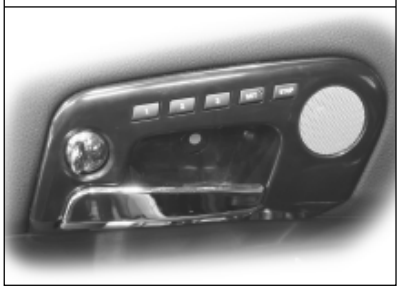




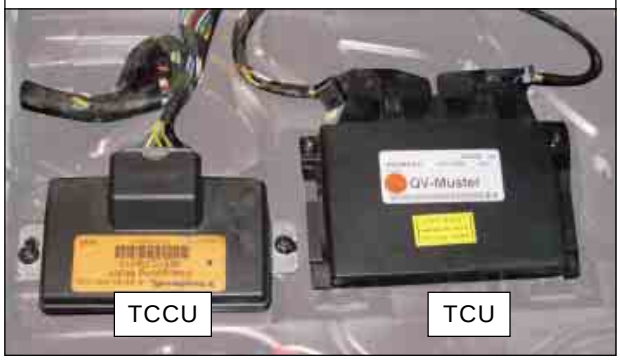
PAS Unit



Driver Seat Memory Switch



TCCU and TCU



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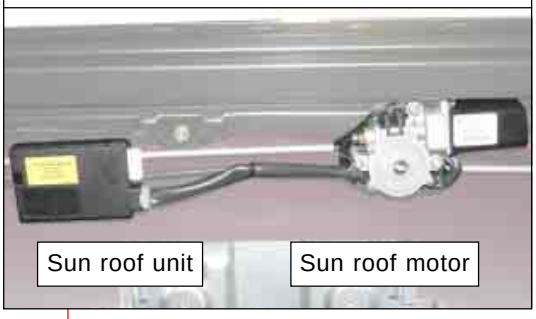
Rain Sensing Unit (Including Auto Lignt) and ECM



Sensor Cluster

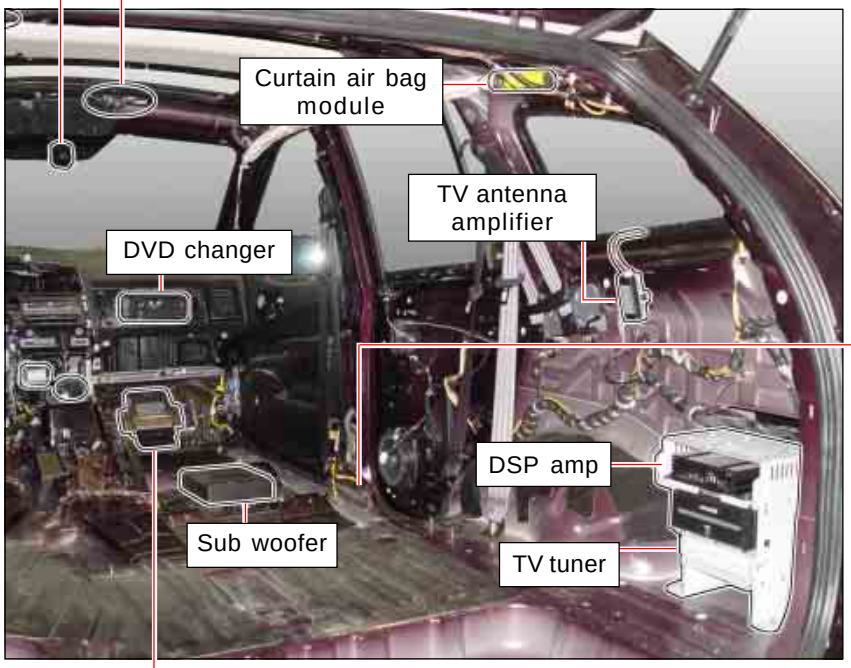


Sun Roof Unit and Motor



Air Bag ECU





Curtain Air Bag Sensor



Engine ECU and SSPS Unit



Interior Temperature and Humidity Sensor



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2. SWITCHES, UNITS AND SENSORS IN ENGINE COMPARTMENT

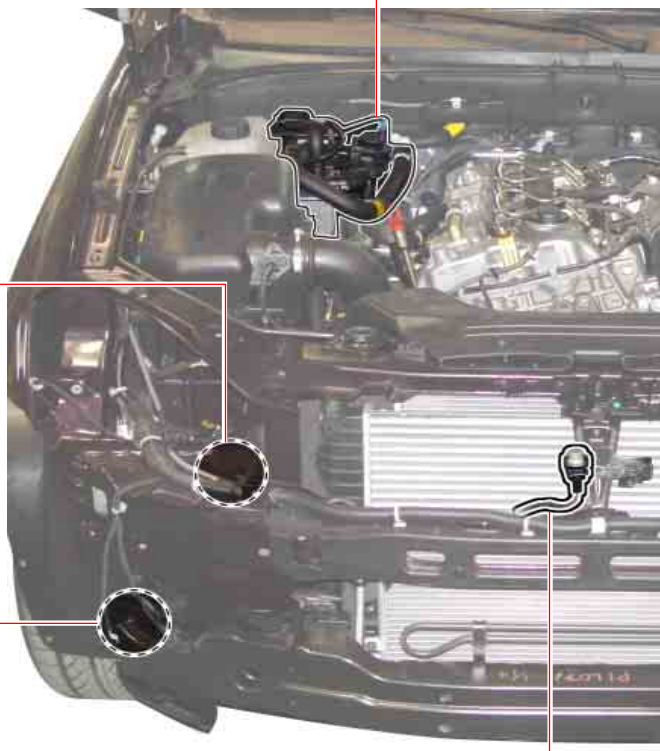
FFH Assembly





Receiver Drier and Triple Pressure Switch

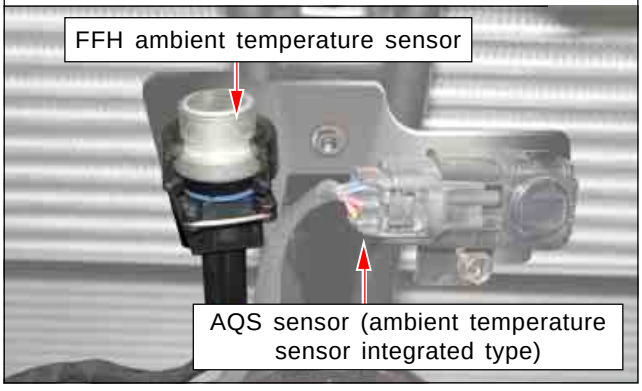




Horn (RH)



AQS Sensor and FFH Ambient Temperature Sensor



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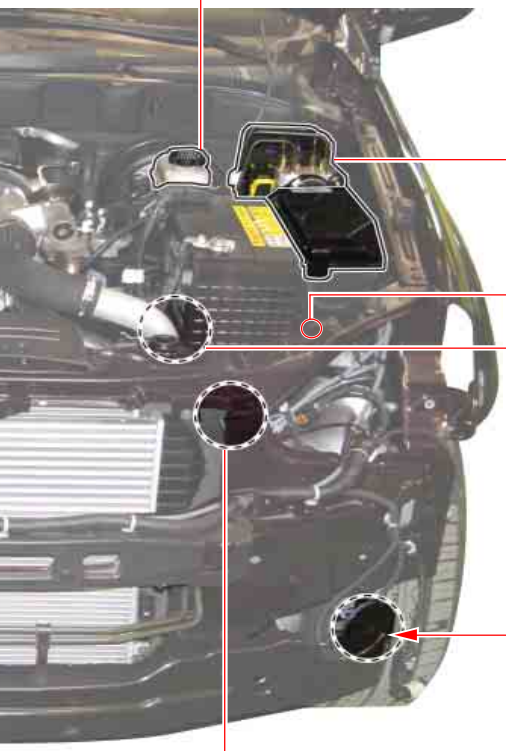
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ESP Pressure Sensor / Primary, Secondary



ABS (ESP) HECU





Hood Contact Switch

Horn (LH)

IWE Vacuum Solenoid Valve (4WD)



(on battery tray)

Theft Deterrent Horn (Under the Battery)



Fuse and Relay Box



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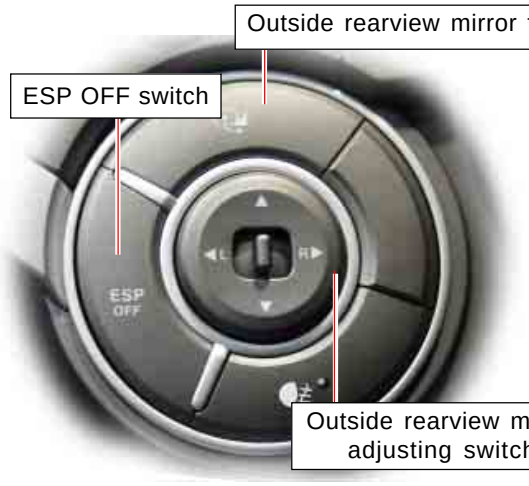
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3. INTERIOR SWITCHES

Remote Control Switch on the Steering Wheel



Bezel Assembly on Outside Rearview Mirror Adjusting Switch





Seat Position Memory Switch (Driver's Door)



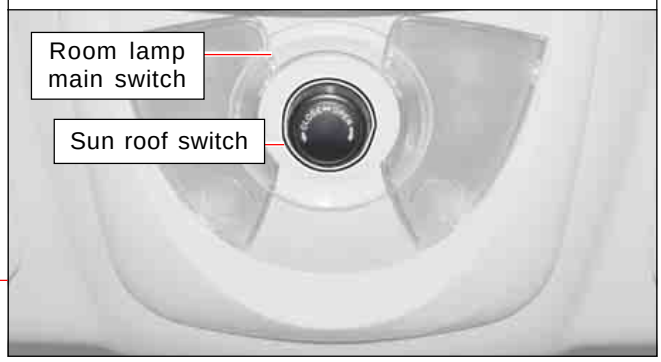
Driver's Power Window Main Switch

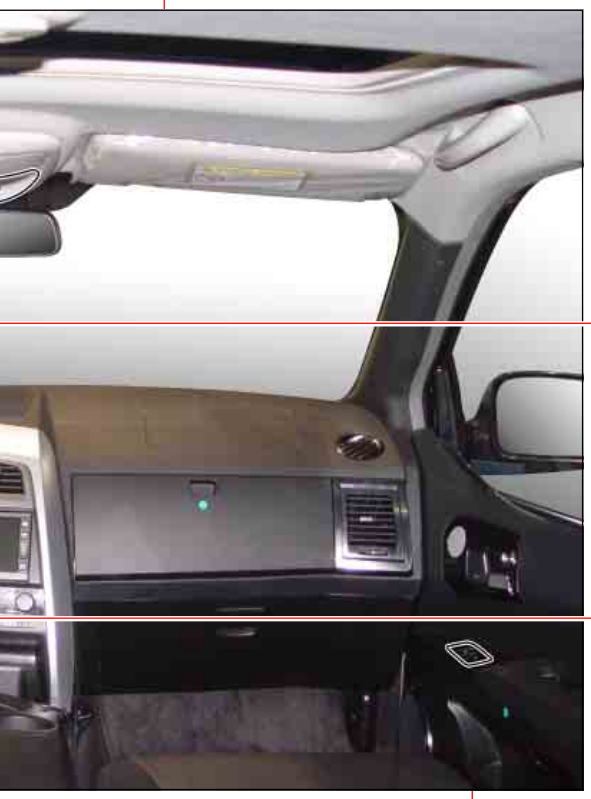


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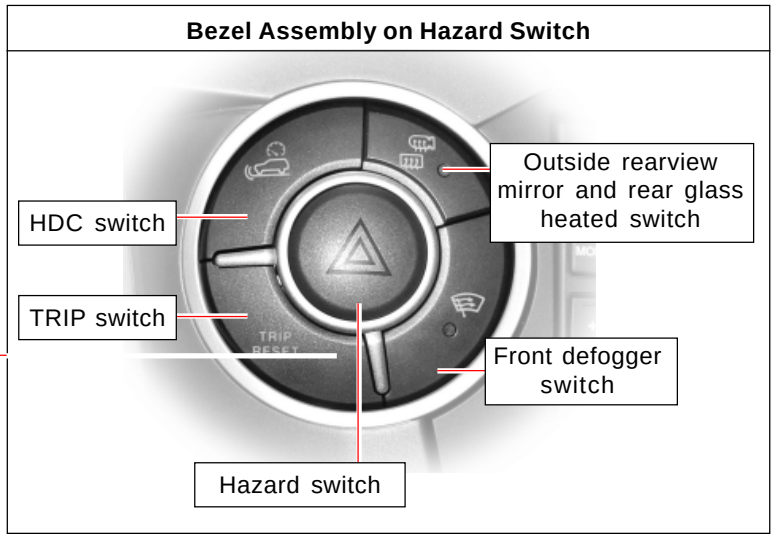
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Sun Roof Switch

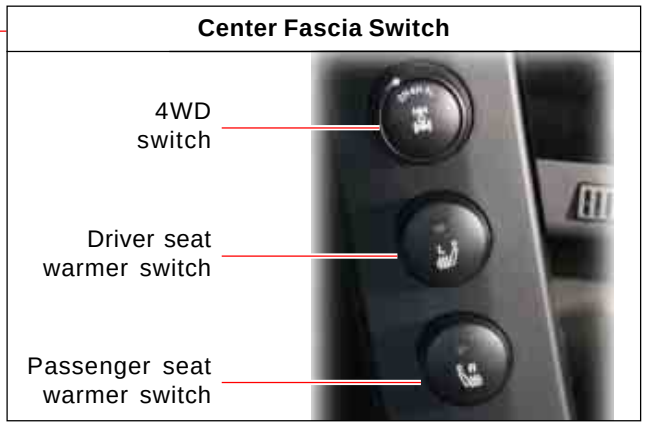




Bezel Assembly on Hazard Switch



Center Fascia Switch



Passenger's Power Window Switch



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4. AUDIO & VIDEO SYSTEM

AV System



AV Head Unit

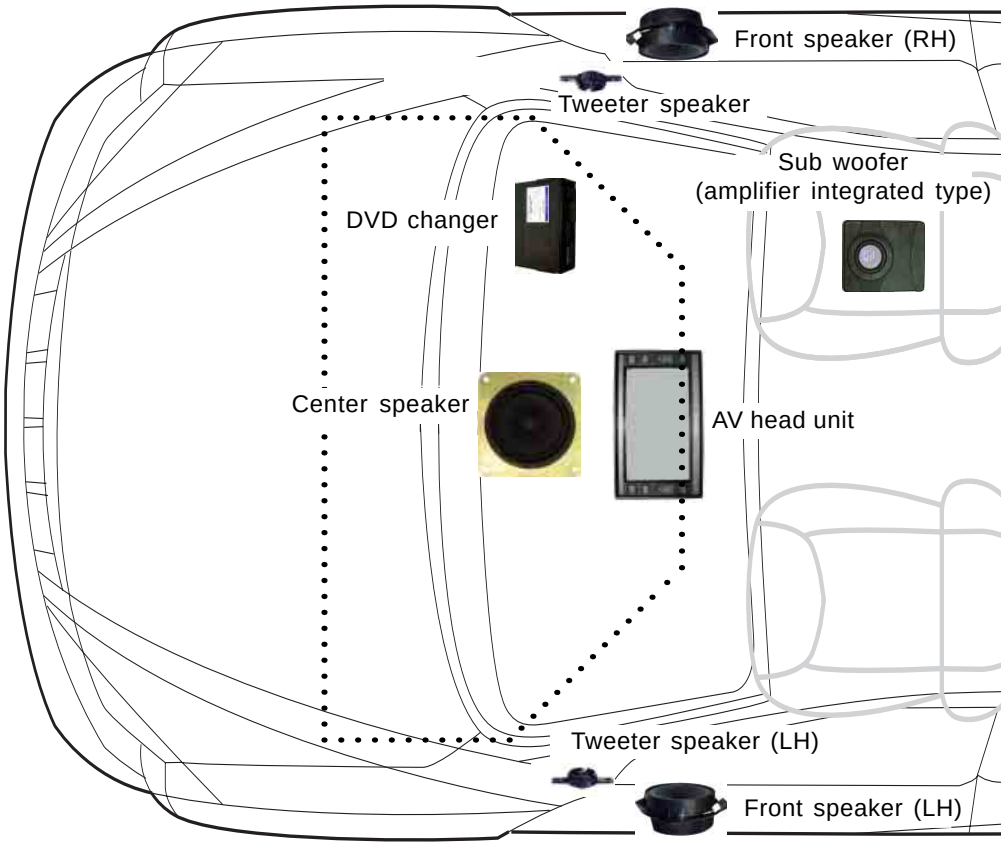


DVD+tape



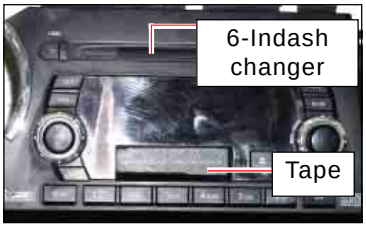
Sub Woofer





Other Audio Head Unit

1. 6-INDASH CD+TAPE+RADIO



2. CD+RADIO



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Location: Inside of panel above glove box





6 DVD changer



TV antenna amplifier (RH)

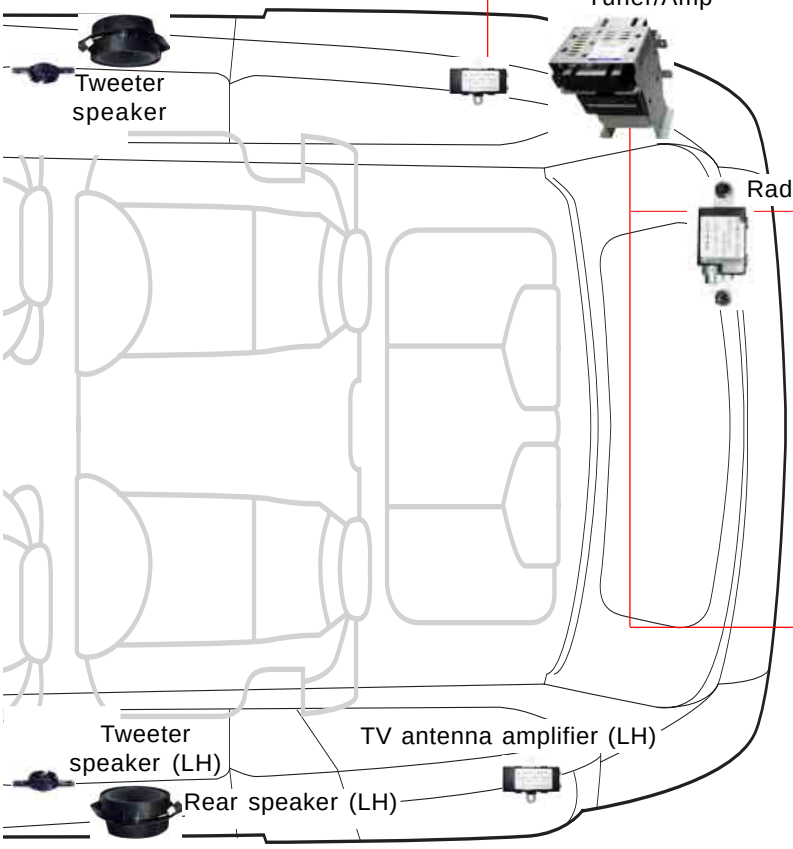
Rear speaker (RH)

Tuner/Amp

Tweeter speaker



Radio antenna amplifier

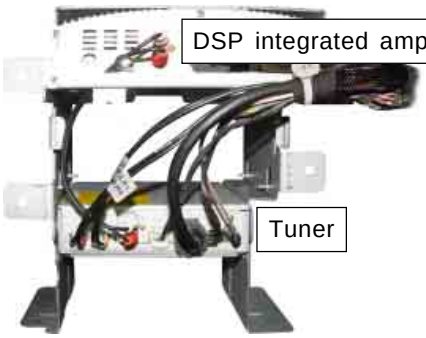


Tweeter speaker (LH)

TV antenna amplifier (LH)

Rear speaker (LH)

AV System



DSP integrated amplifier

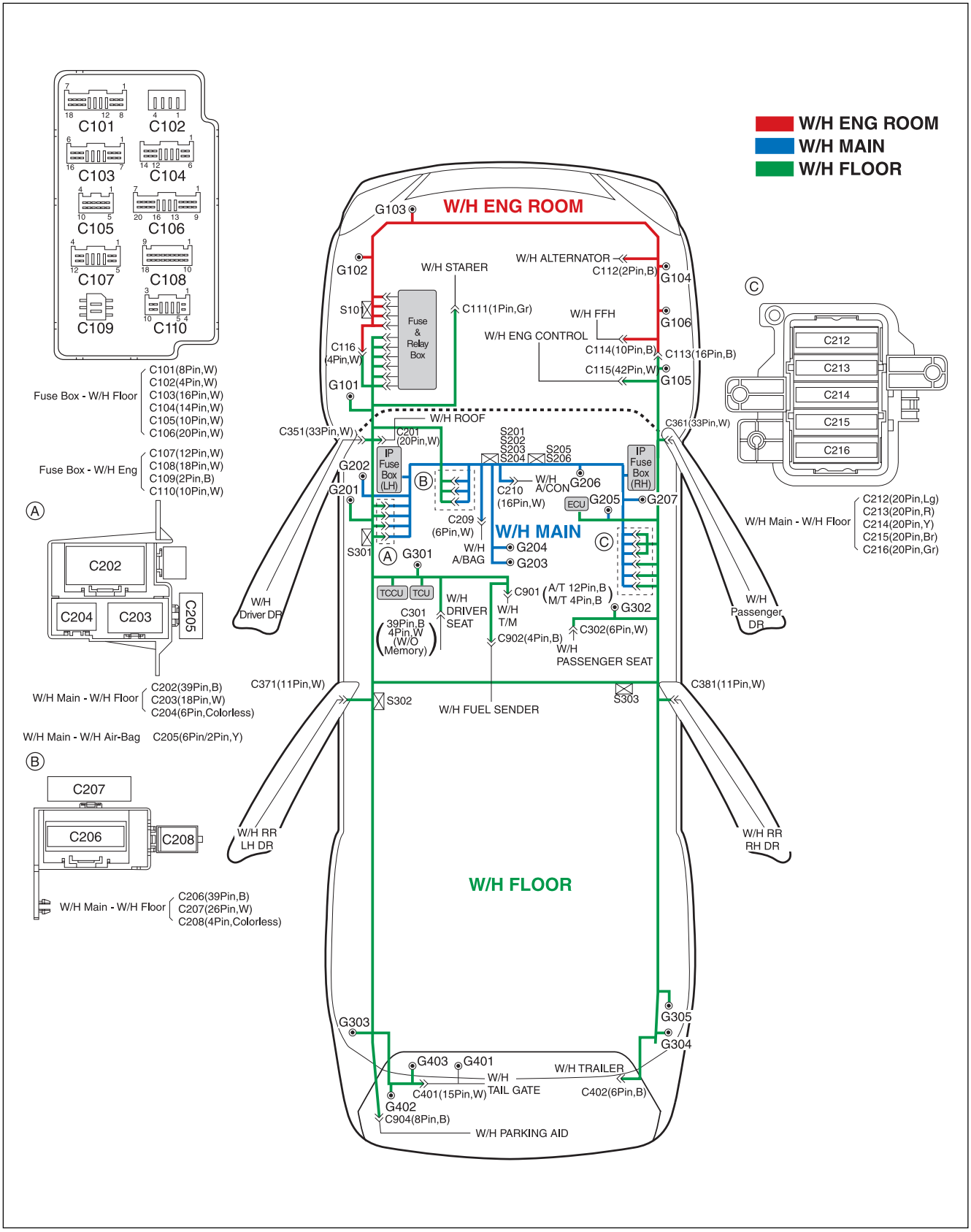
Tuner

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5. ELECTRIC COMPONENTS AND LAYOUT

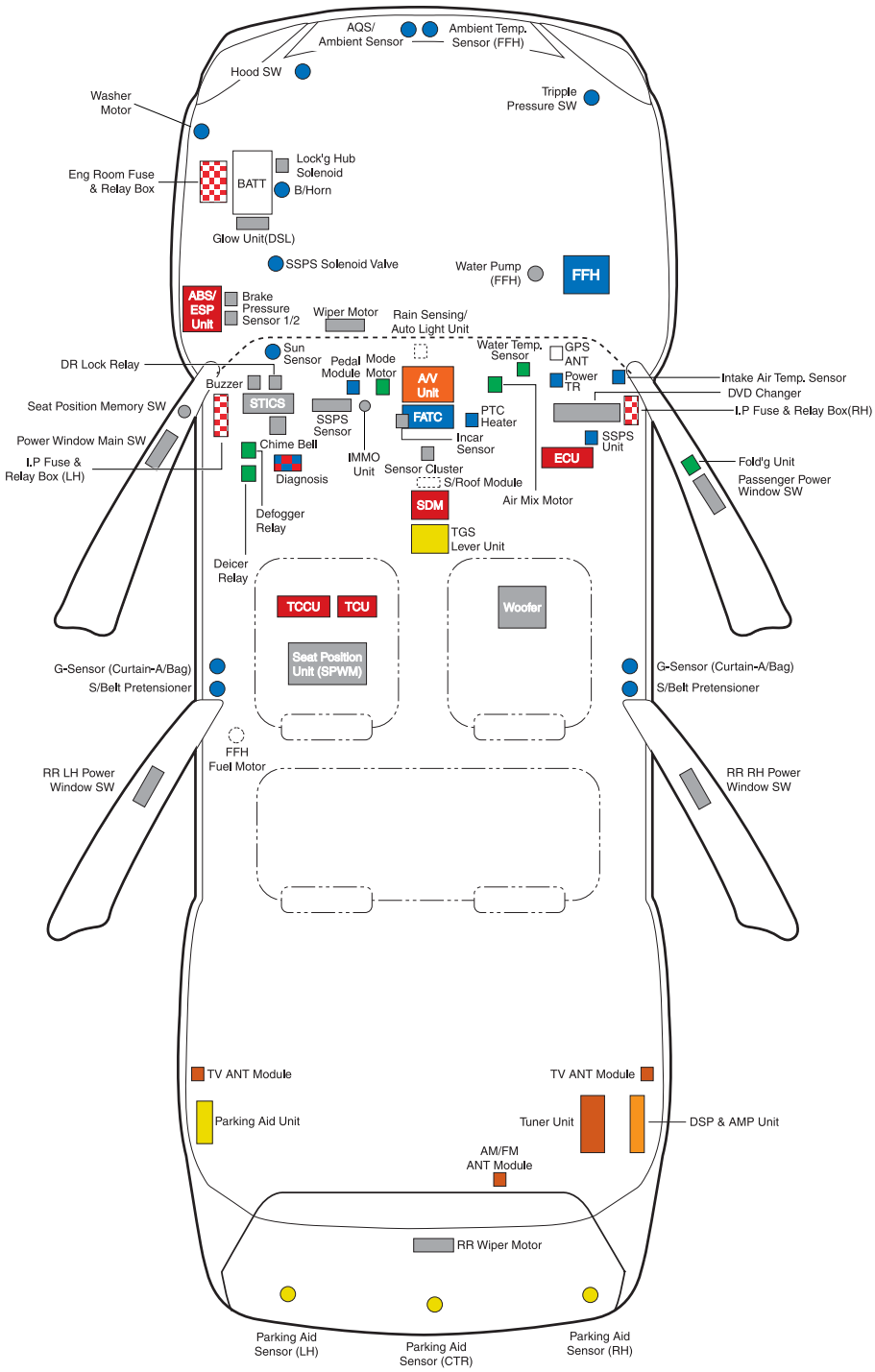
▶ Wiring Harness Arrangement



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▶ Components Locator



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6. 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.

▶ Fuse and Relay Box in Engine Compartment



Fuses and Relays

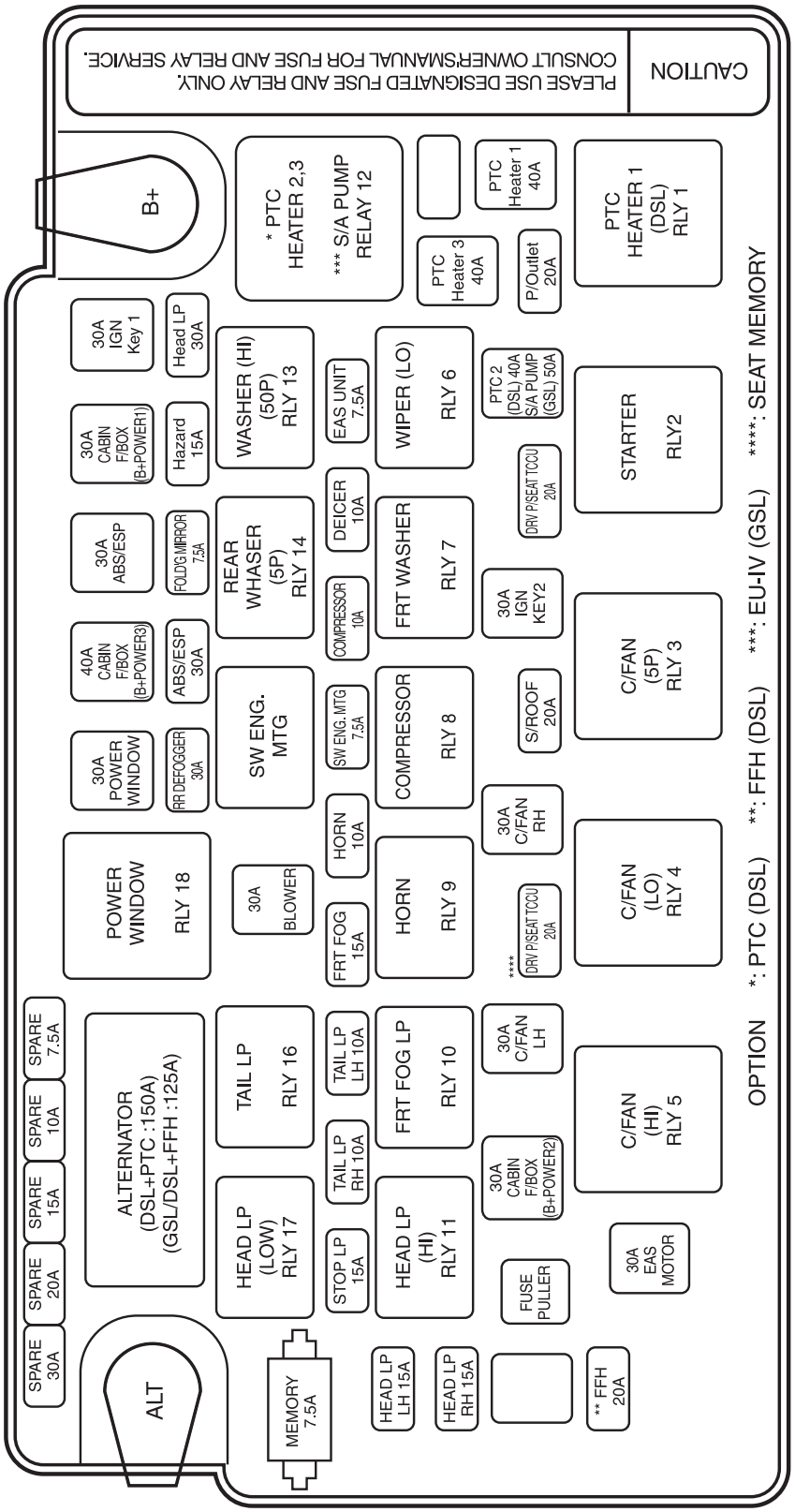


Connector Arrangement



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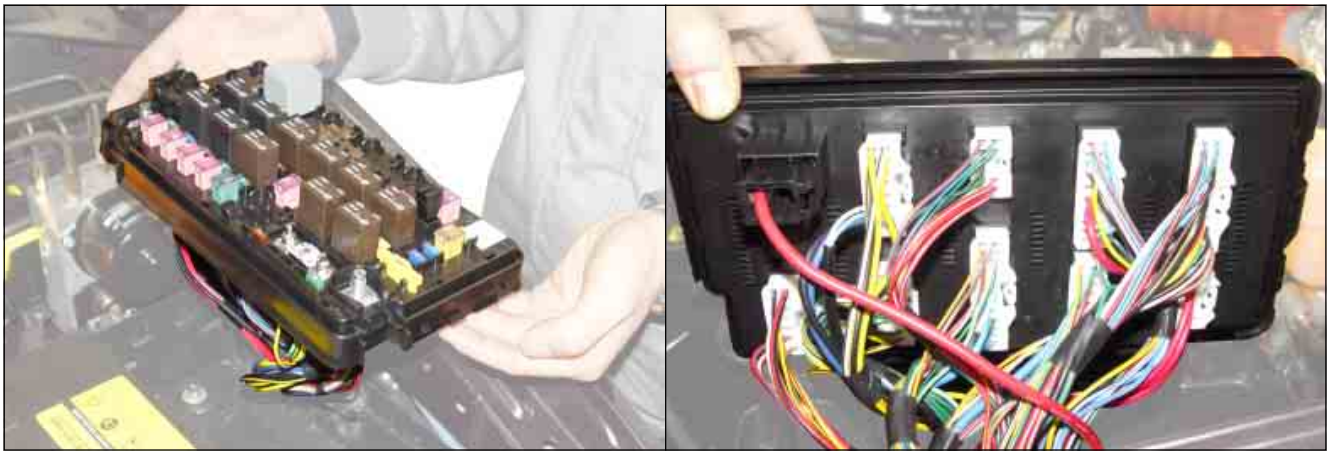
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Removal and Installation

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.



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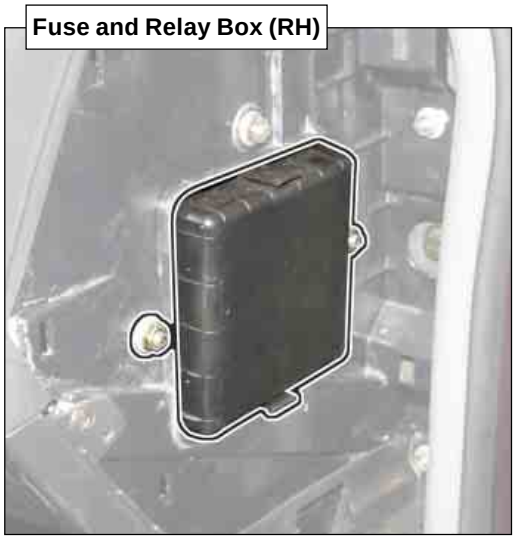
7. INTERIOR FUSE BOX



Fuse and Relay Box (LH)



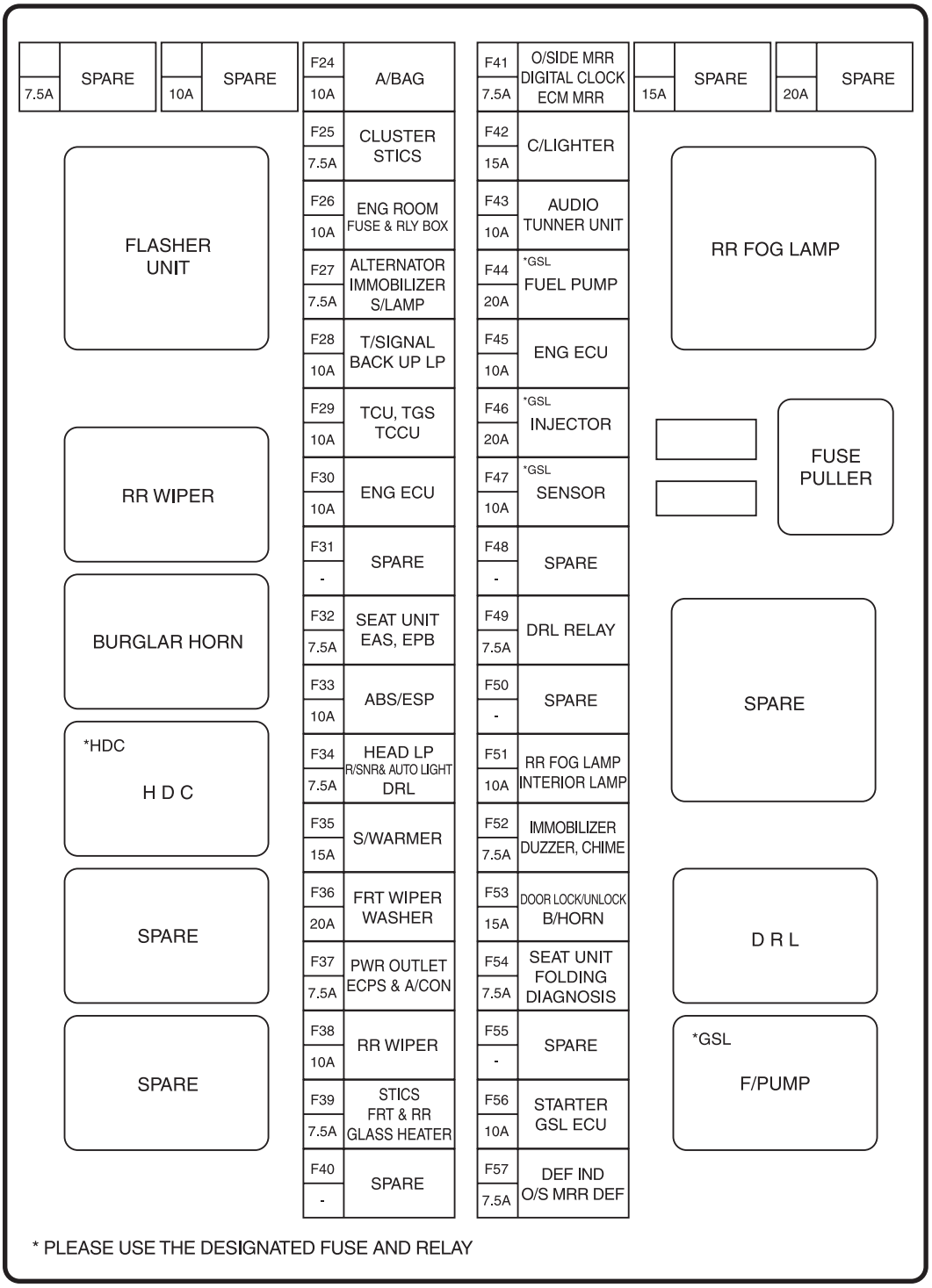
Fuse and Relay Box (RH)



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▶ Designation and Capacity

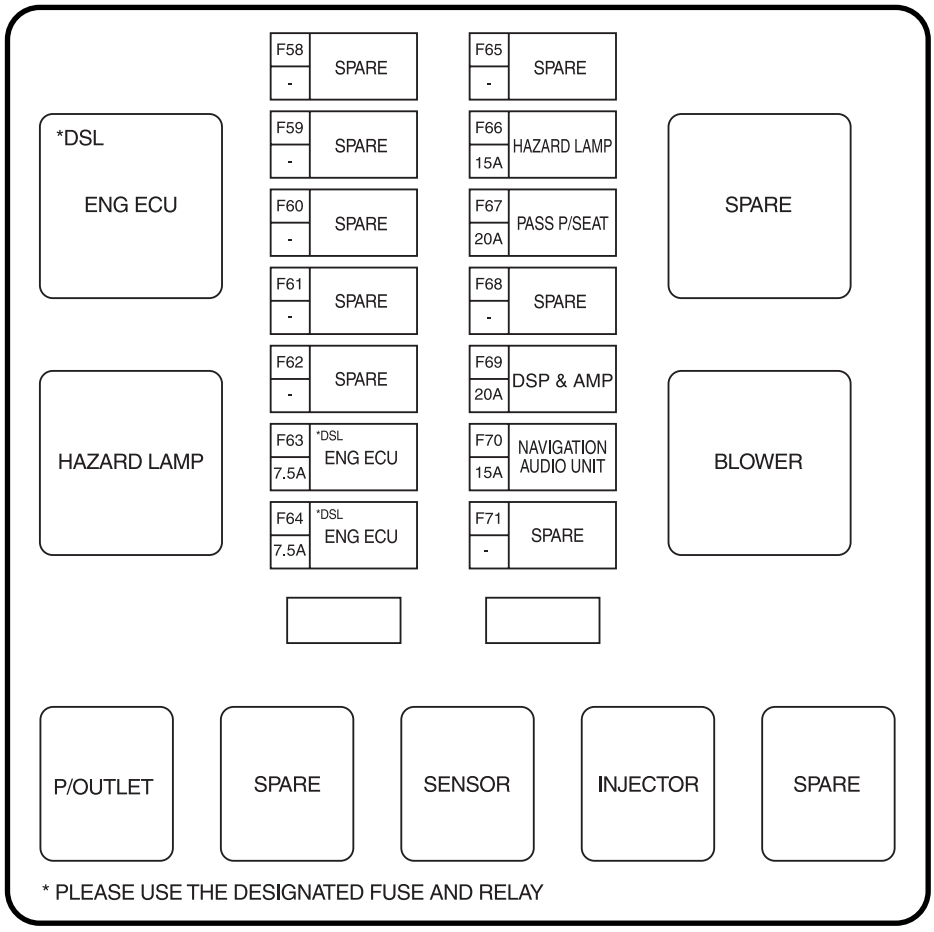
Driver Side



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Passenger Side



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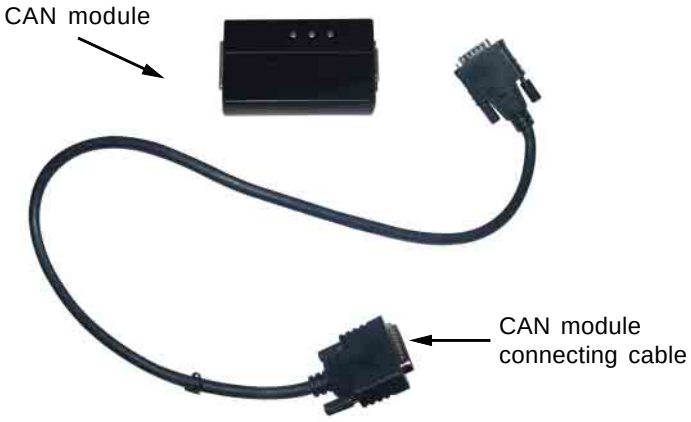
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8. DIAGNOSTIC CONNECTOR

▶ Connection Between Scan-100 and Diagnostic Connector



Additional Devices of Scan-100 (Diagnosis: EAS, EPB Only)



Connection of Scan-100 (Including CAN Module and Additional Cable)



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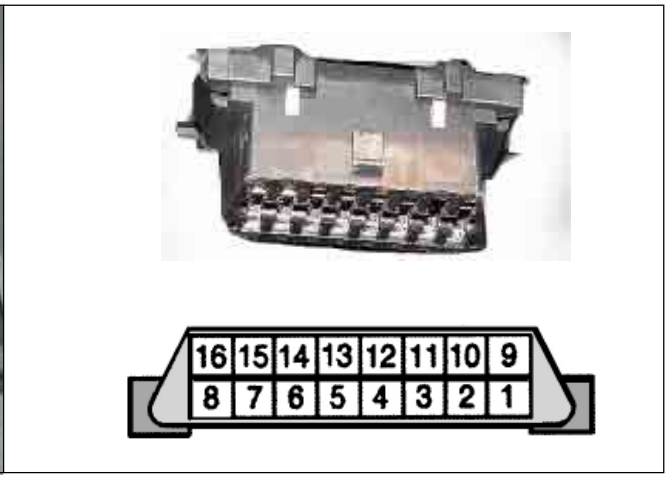
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▶ Pin Arrangement of Diagnostic Connector

It is installed under the instrument panel and consists of 16 pins.

The REKES key coding should be performed with Scan-100.



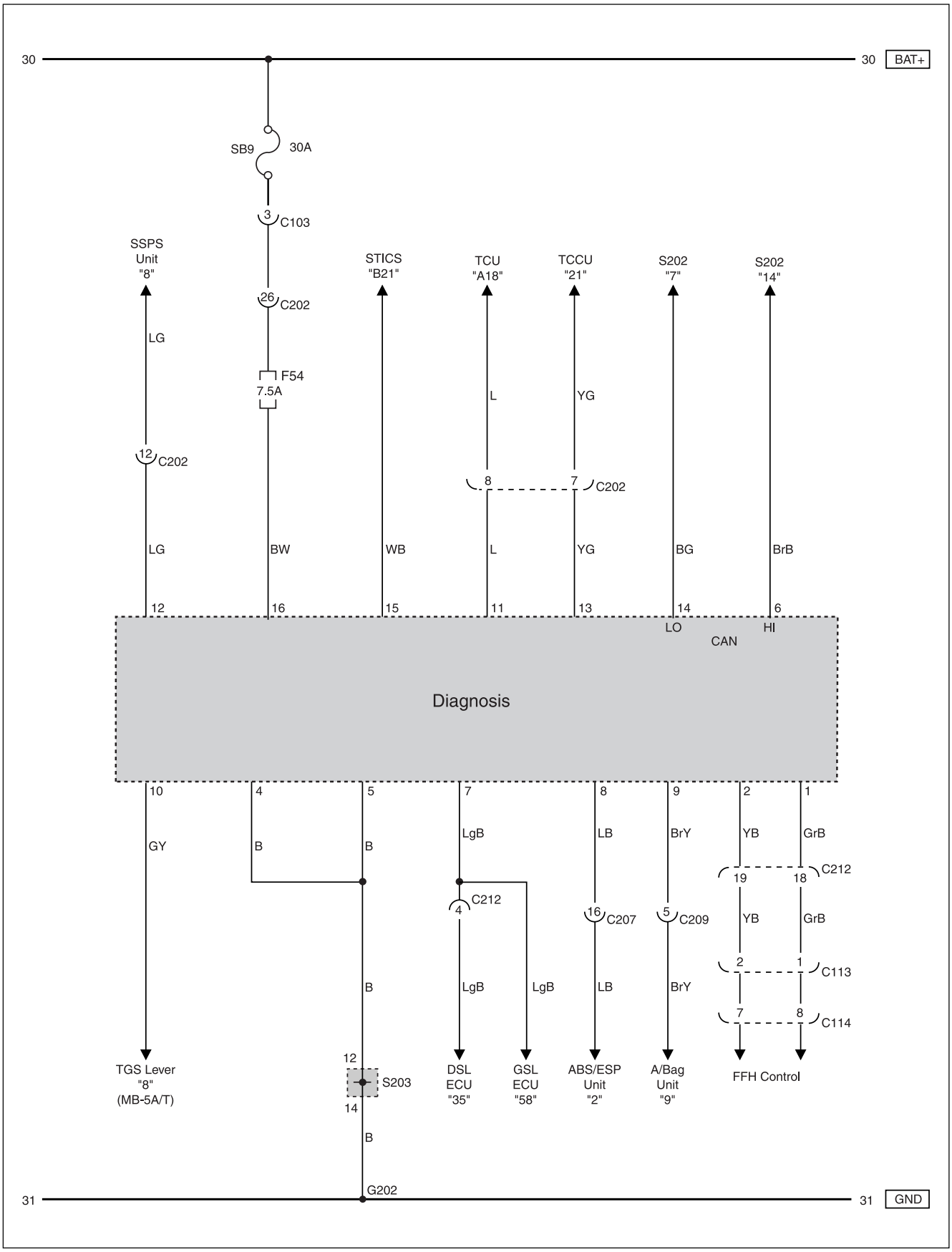


▶ Functions of Terminal

Pin no. 1	FFH diagnosis
Pin no. 2	FFH forced driving
Pin no. 3	-
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	TGS lever position unit
Pin no. 11	TCU
Pin no. 12	SSPS
Pin no. 13	TCCU
Pin no. 14	CAN - LOW
Pin no. 15	REKES coding
Pin no. 16	Battery +

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9. ELECTRICAL WIRING DIAGRAMS



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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 11

REAR COMBINATION LAMP 18

1. Composition of rear combination lamp 18
2. Removal and installation of rear combination lamp 20

INTERIOR LAMPS 28

1. Composition of interior lamps 28
2. Removal and installation of interior lamps 30

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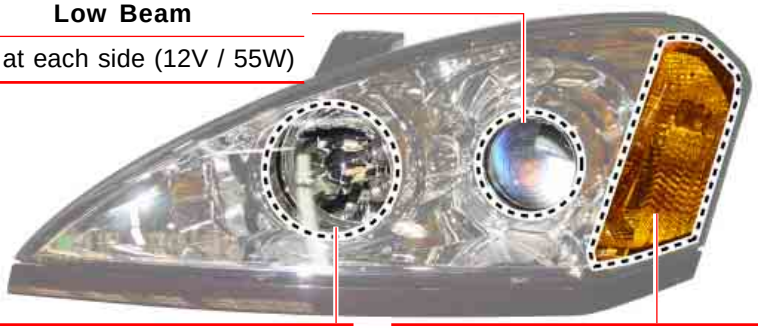
LAMPS

1. LOCATIONS OF EXTERIOR LAMPS AND SPECIFICATIONS

Headlamp Assembly

Low Beam

one at each side (12V / 55W)



High Beam

one at each side (12V/55W)

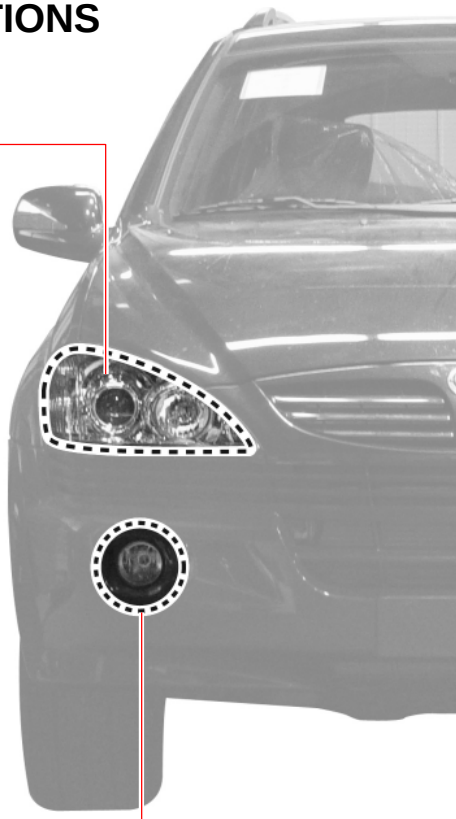
Position Lamp

EU: one at each side (12V/W5W)

Position lamp and Turn Signal Lamp

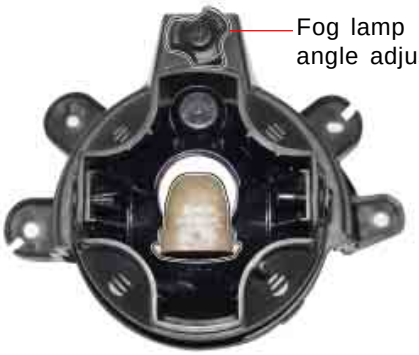
General: one at each side (12V/28W/8W)

EU: one at each side (12V/P21W)



Fog Lamp Assembly



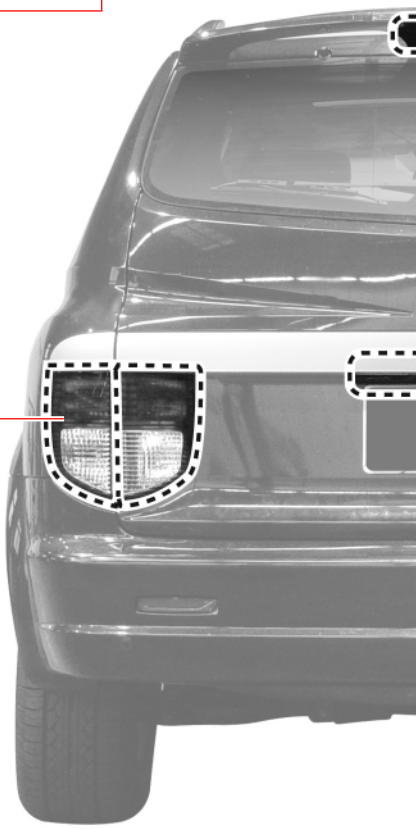


Fog lamp angle adjustment

Fog Lamp

General: one at each side (12V/27W)

EU: one at each side (12V/H27W)



Turn Signal Lamp/Stop Lamp Assembly

T/Stop Lamp

General: LH-1 (12V/27W/8W)

EU: LH-1 (12V/P21W/5W)



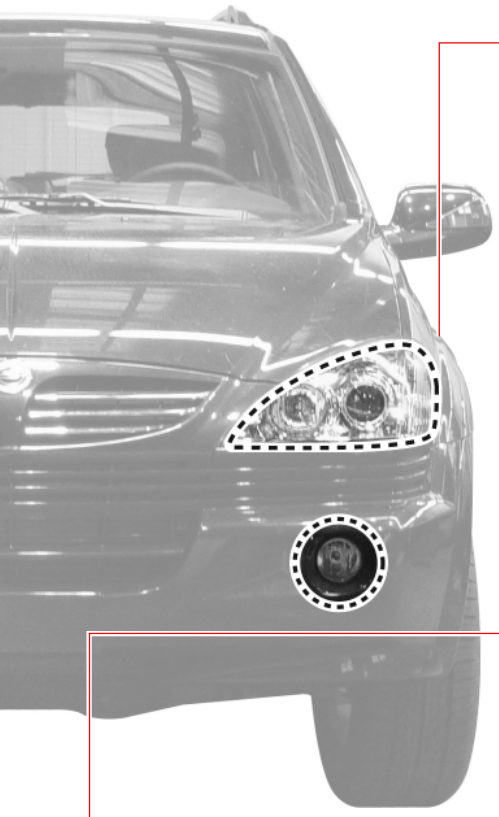
Turn Signal Lamp

General: one at each side (12V/27W)

EU: one at each side (12V/PY21W)

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Side Repeater Assembly

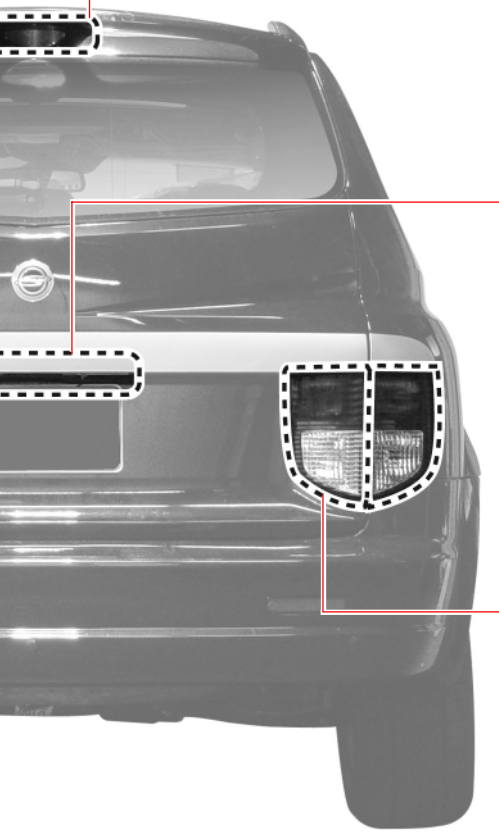


General: one at each side (12V/5W)

EU: one at each side (12V/W5W)

High Mounted Stop Lamp Assembly





License Plate Lamp Assembly



General: one at each side (12V/5W)

EU: one at each side (12V/W5W)

Reflector Assembly



Tail Lamp / Reversing Lamp / Rear Fog Lamp Assembly



Tail Lamp

General: one at each side (12V/27W/8W)

EU: one at each side (12V/P21W/5W)

Reversing Lamp

General: one at each side (12V/16W)

Rear Fog Lamp

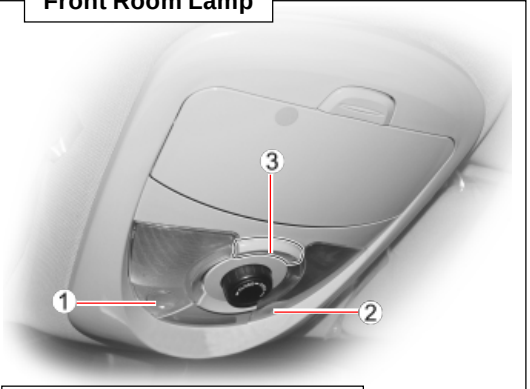
General: one at each side (12V/P21W)

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INTERIOR LAMPS

Front Room Lamp



12V/10W -Two at each lamps

Center and Luggage Room Lamp



12V/10W - One at each lamp

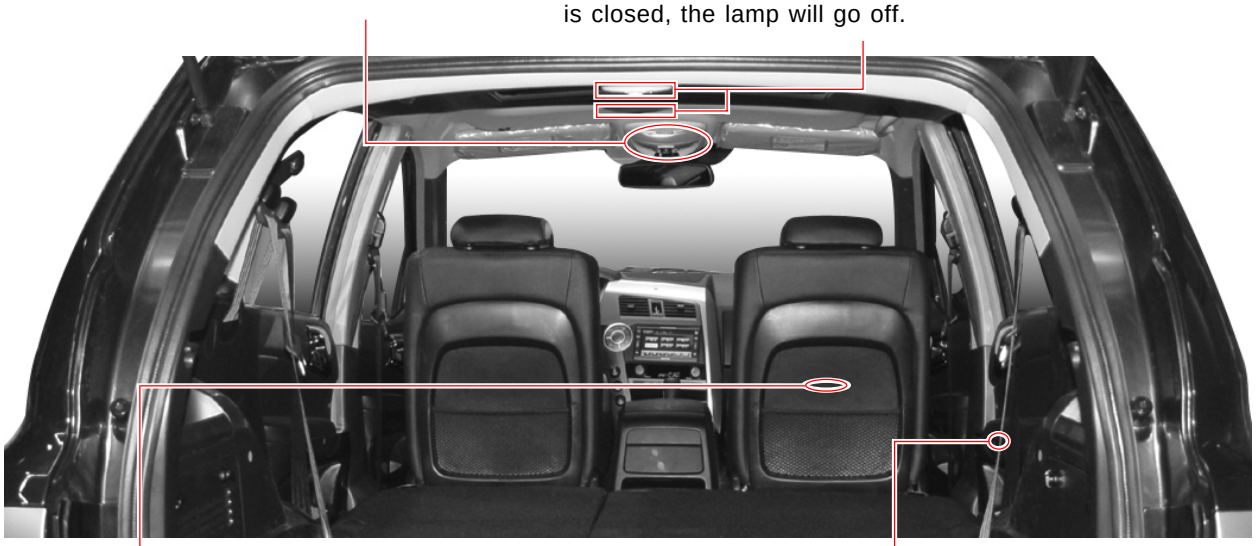
The driver's room lamp and the passenger's room lamp are separately turned on when pressing the switch (1, 2). However, the front lamps are turned on when opening a door and turned off when closing it. The front room lamps and center are turned on when pressing the room lamp main switch (3).

Center Room Lamp

When this switch is pushed towards the rear of the vehicle, the lamp comes on. If the switch is pushed to the opposite direction, the lamp will go off. But, when any door is open, the lamp comes on and stays for 30 seconds. When the door is closed, the lamp will go off.

Luggage Room Lamp

When this switch is pushed towards the tailgate, the lamp comes on when the tailgate is open. If the switch is pushed to the opposite direction, the lamp will go off and will not come on even if the tailgate is open.



Glove Box



12V/5W - One at glove box

Door Courtesy Lamp



12V/5W - one at each door

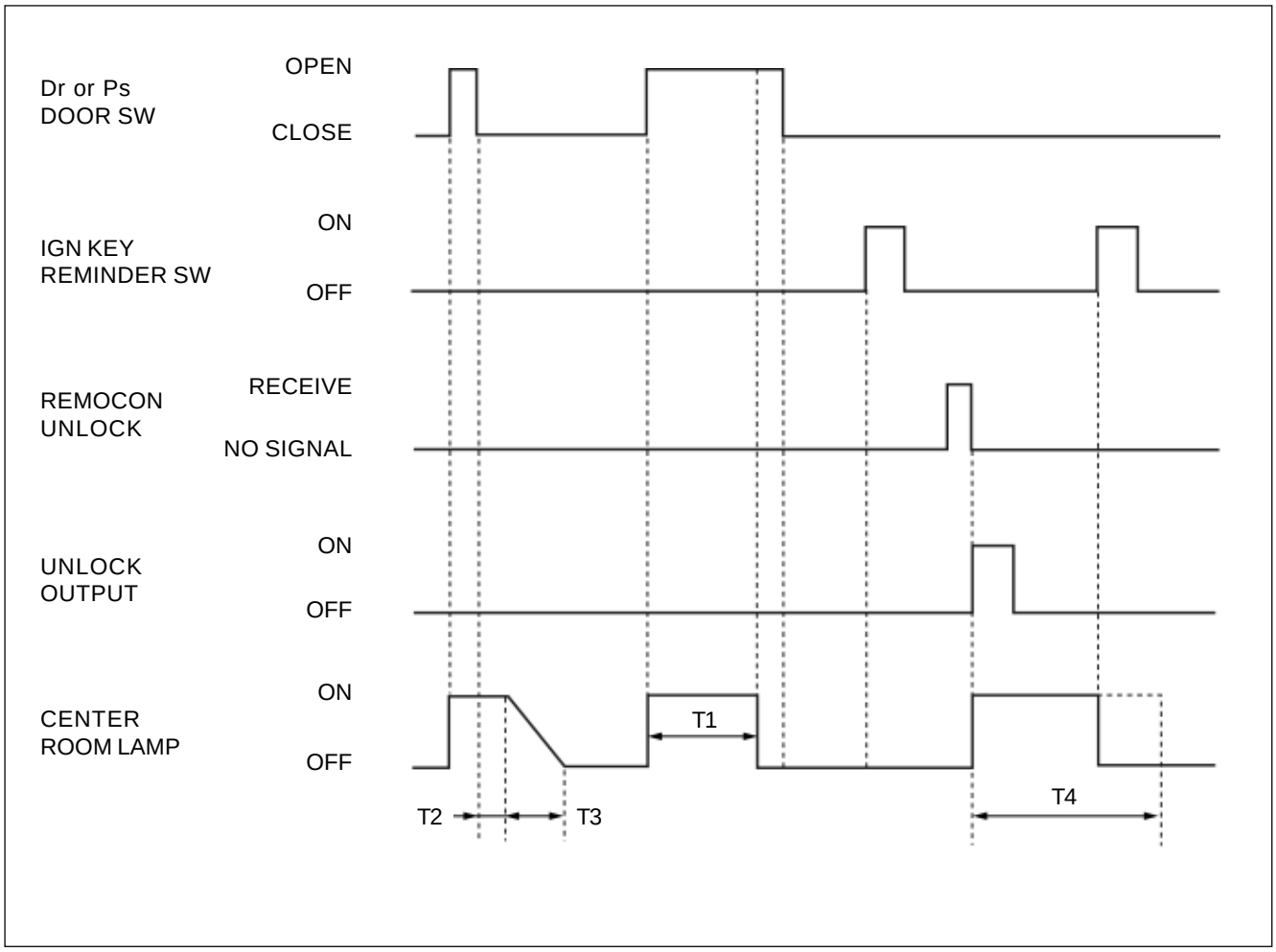
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Room Lamp Control

The overhead console lamp (front room lamp) and the center room lamp come on when opening the door while the center/luggage room lamp switch is at coupled operating position and the key reminder switch is OFF.

1. When the door (Driver's/Passenger's/Rear door) 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.
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 door is 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 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 opening the tailgate while the tailgate coupled luggage room lamp switch is pressed.



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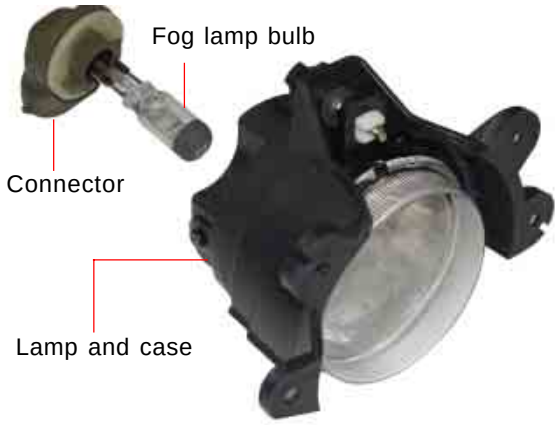
FRONT LAMPS

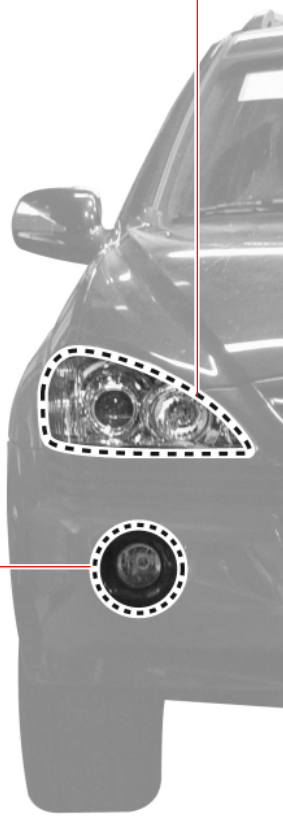
1. COMPOSITIONS OF FRONT LAMPS

Headlamp Assembly



Front Fog Lamp

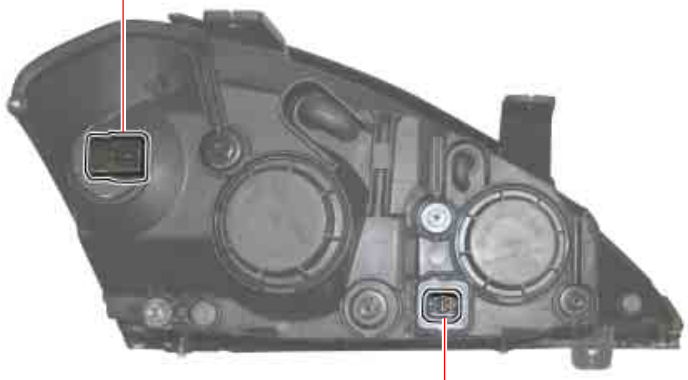




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Connection Connector When Installing

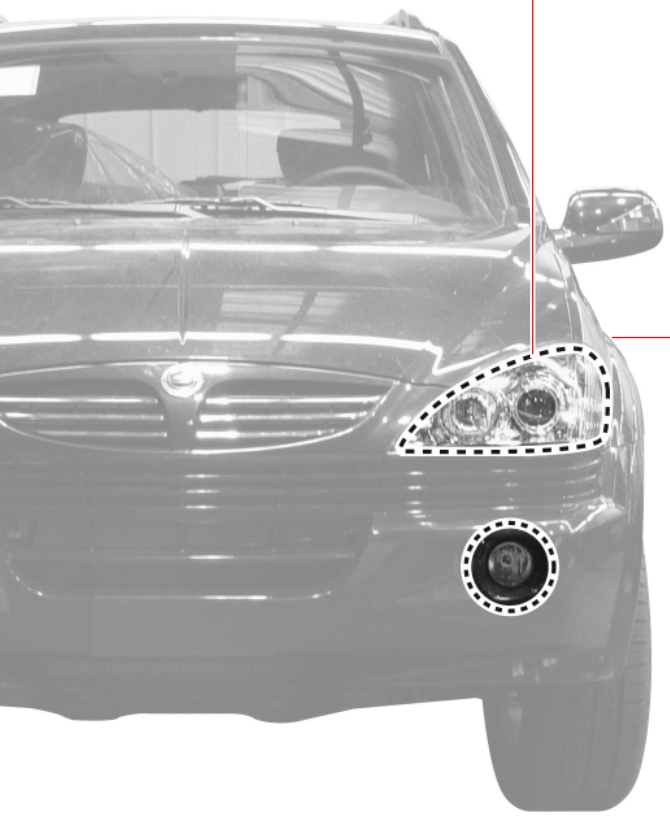




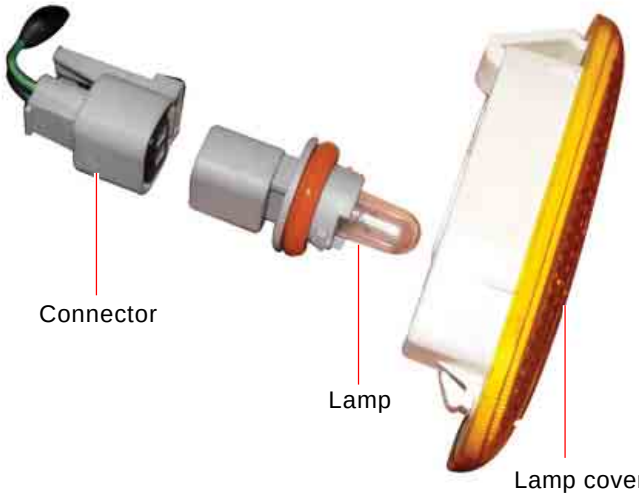
Positon lamp and turn signal lamp connector



Headlamp connector



Side Repeater



Connector

Lamp

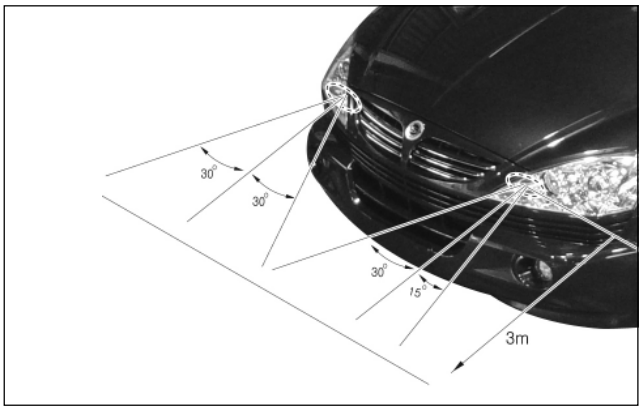
Lamp cover

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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. parking on a flat surface
2. specified tire pressure
3. one passenger (driver, 75 kg),
4. spare tire and OVM tools loaded (unlade all other loads)

Adjustment of Low Beam

No. 1 adjustment hole: Up and Down

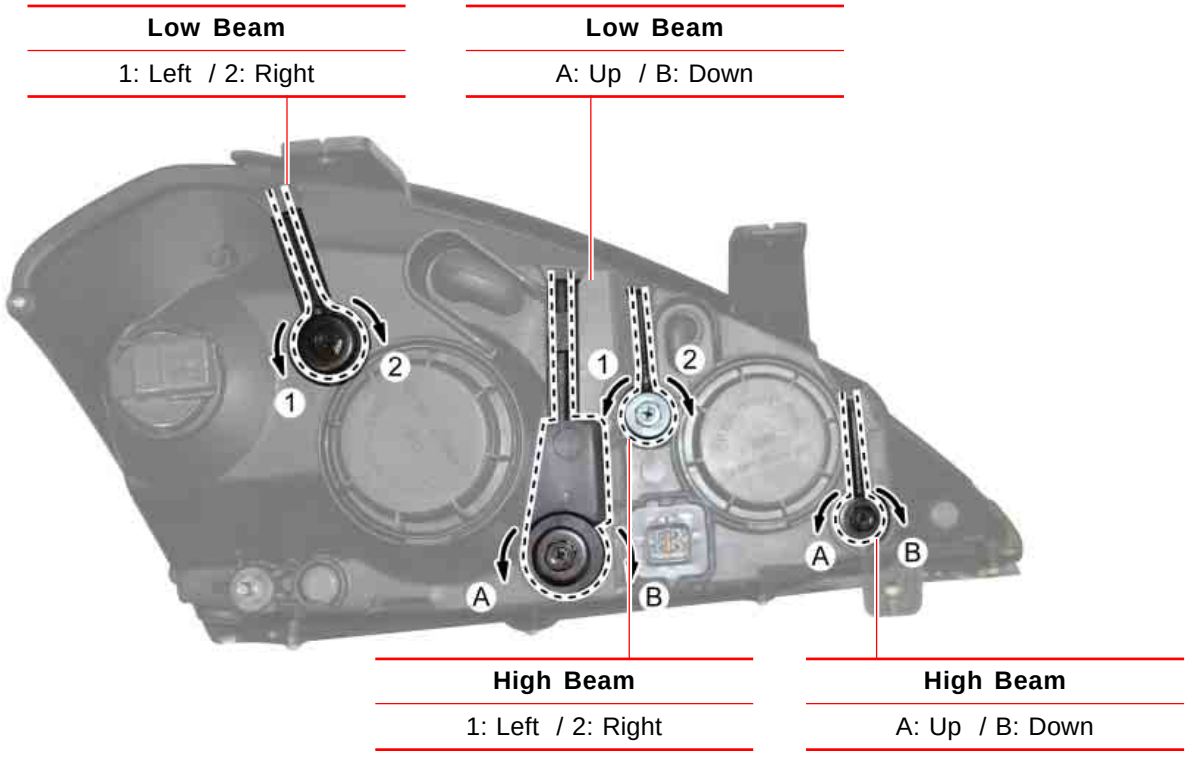
No. 2 adjustment hole: Left and Right

Adjustment of High Beam

No. 3 adjustment hole: Up and Down

No. 4 adjustment hole: Left and Right

Adjustment Direction

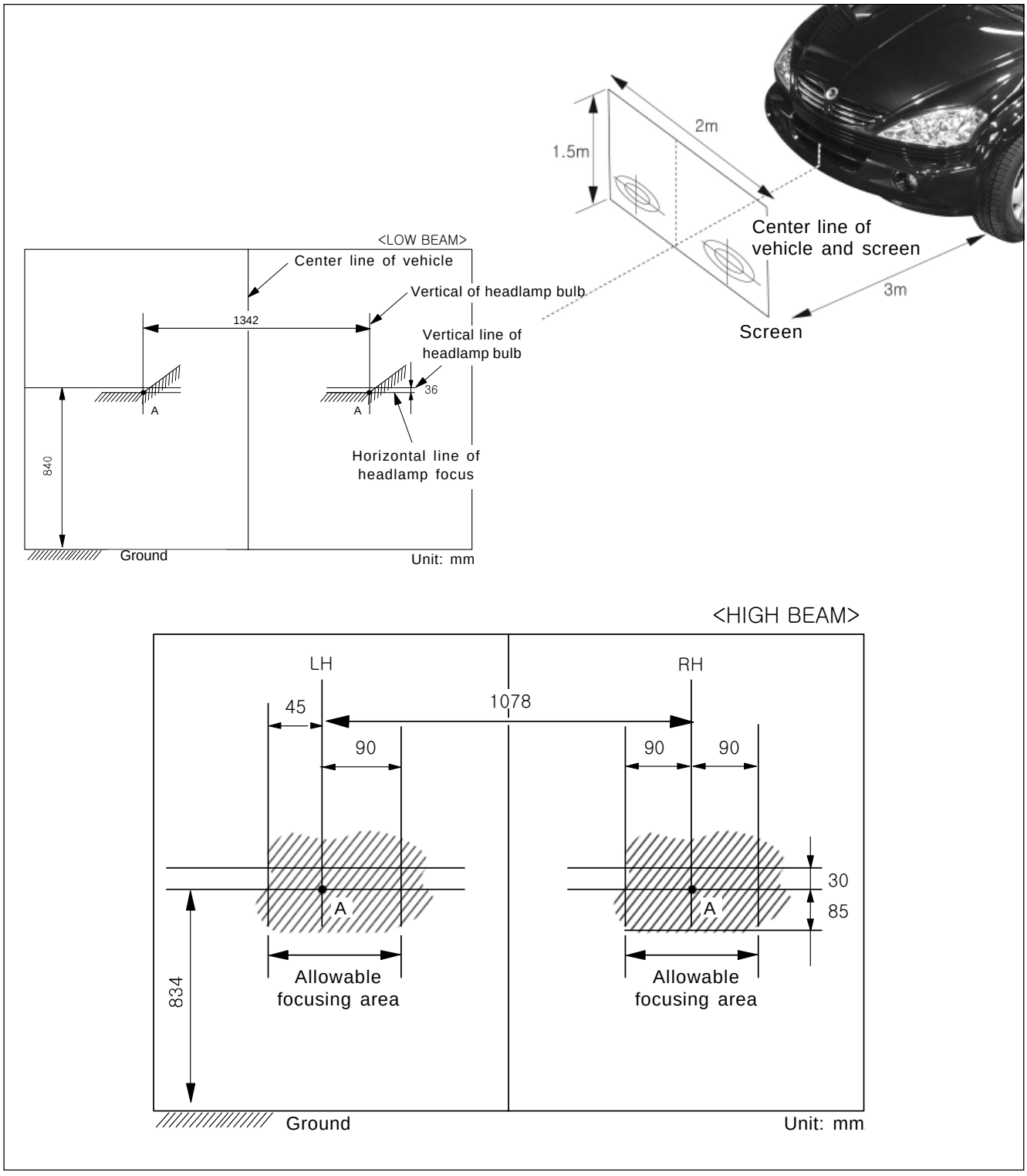


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▶ Aiming Procedures When Using a Screen

Install a screen (2 m × 1.5 m) in front of the headlamps in vertical by 3 m away and align the center lines of the vehicle and the screen.



If the focus deviates the “A” point, adjust the headlamp aiming by rotating the aiming screws (Up, Down, Left, Right) in turn with a screwdriver.

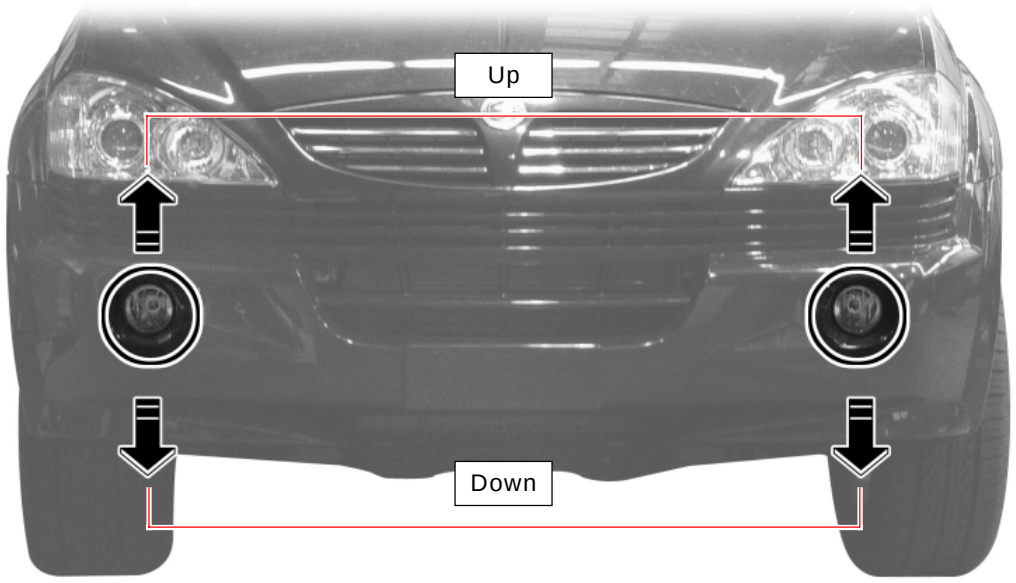
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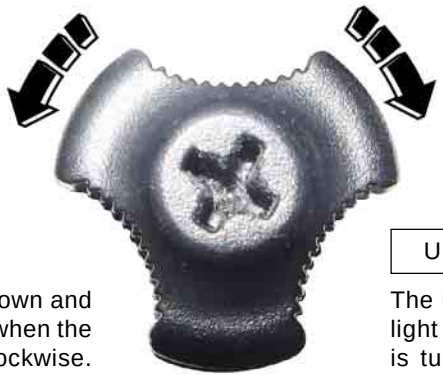
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Fog Lamp Aiming Adjustment

The front fog lamps are installed in the front bumper. Front fog lamp aiming (up/down) can be adjusted by the control knob installed on the fog lamp.







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.

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3. REMOVAL AND INSTALLATION OF HEADLAMPS

Headlamp Assembly

※ **Preceding Work:** Disconnect the negative battery cable.

1. Open the engine hood and unscrew two headlamp upper mounting bolts (10 mm).



2. Remove the headlamp lower cover from the upper front bumper and unscrew the headlamp lower mounting nut (10 mm).





NOTICE

- **Be careful not to damage the headlamp cover when removing it in order of the above number.**

3. Disconnect two headlamp connectors (Turn signal lamp/Position lamp, Low beam/High beam).





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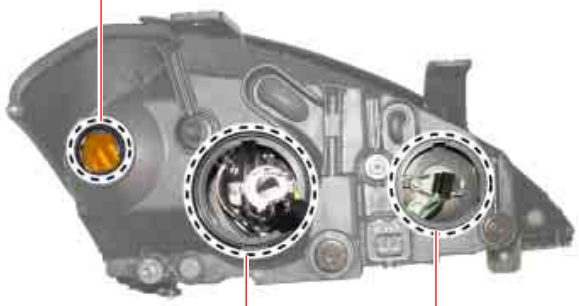
4. Be careful not to damage the headlamp assembly when removing it.



Headlamp Assembly



Turn signal lamp and Position lamp



Low beam

High beam

High beam



Low beam



Turn signal lamp and Position lamp (General)



Position lamp (EU)



NOTICE

- **If the lamp cover rubber ring is damaged while installing, replace it with new one.**

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▶ Replacement of Headlamp Bulb

1. Remove the headlamp dust cover.



NOTE

- **To make the bulb replacement easier, remove the headlamp assembly.**

2. Disconnect the high/low beam connectors from the headlamp assembly.

Low Beam Side



High Beam Side



3. Remove the clamps.

Low Beam Side

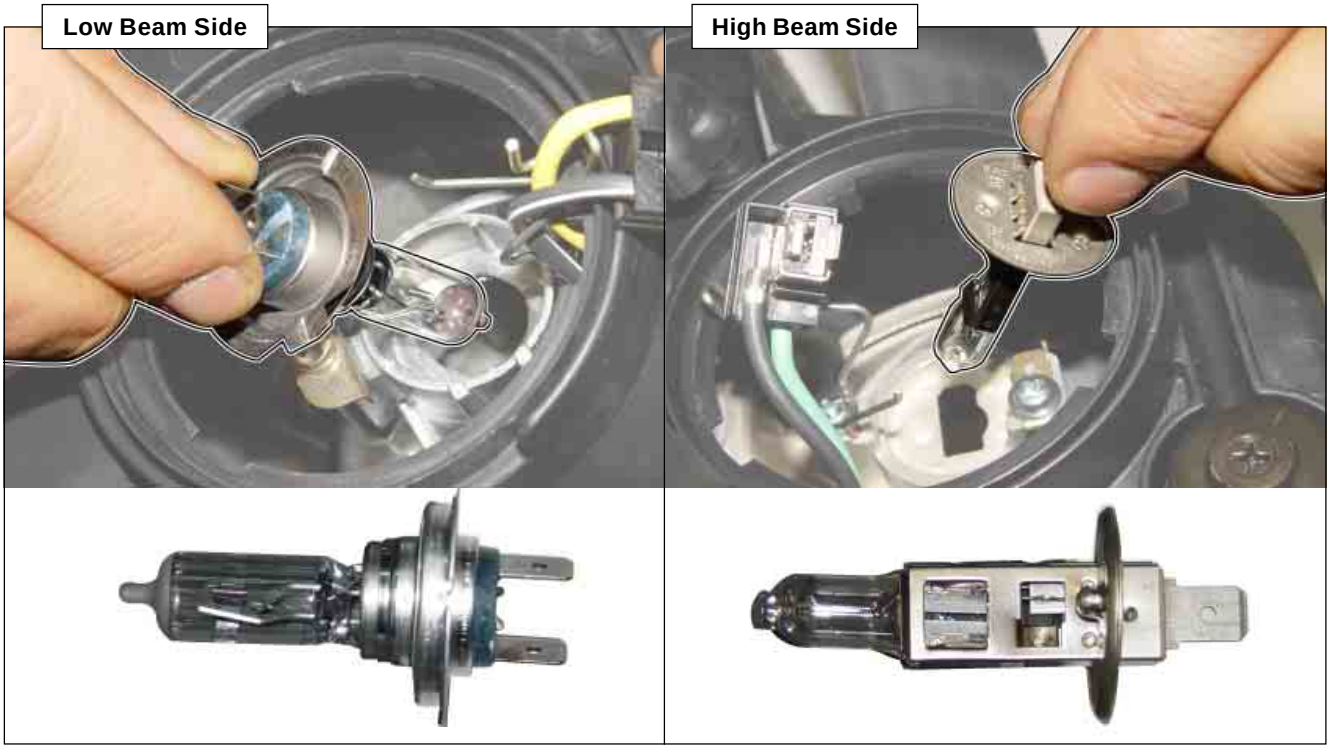


High Beam Side



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4. Remove the bulb from the headlamp assembly.



NOTICE

- **Use only specified bulb for replacement.**
- **Do not touch the bulb with bare hands when it is hot. You may get burnt.**

5. Position/turn signal lamp bulb should be removed after removing the headlamp assembly.



NOTICE

- **Use only specified bulb for replacement.**
- **Do not touch the bulb with bare hands when it is hot. You may get burnt.**

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Fog Lamp Assembly

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the front wheel house and then remove the horn assembly.



2. Disconnect the connector and unscrew four mounting screws to remove the front fog lamp assembly.





Fog lamp bulb and connector



Lamp and case

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▶ Replacement of Fog Lamp Bulb

: Disconnect the fog lamp connector located on the front bumper.

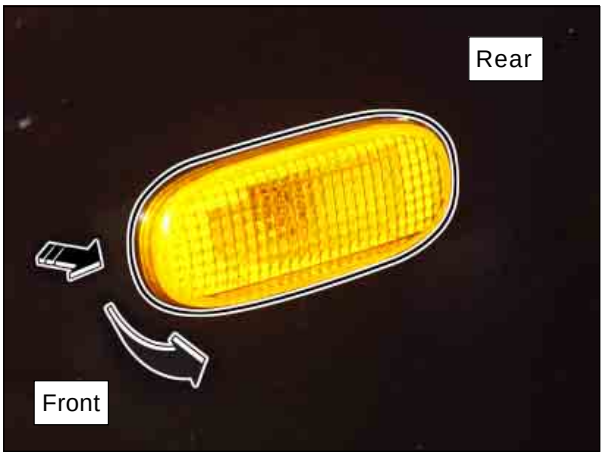




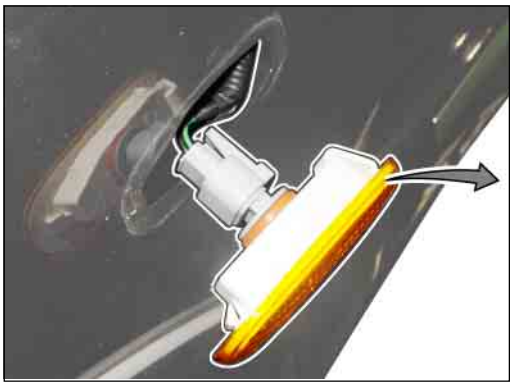
Side Repeater

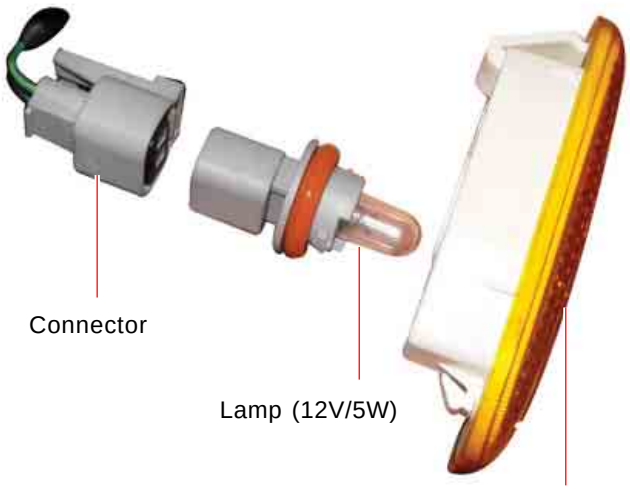
※ **Preceding Work:** Disconnection of negative battery cable

1. Push out the side repeater assembly.



2. Disconnect the connector and remove the lamp.





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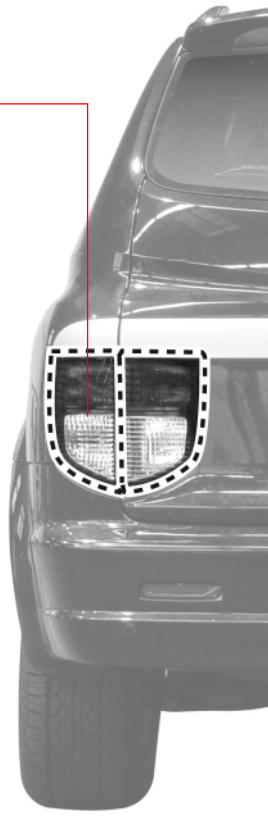
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REAR COMBINATION LAMP

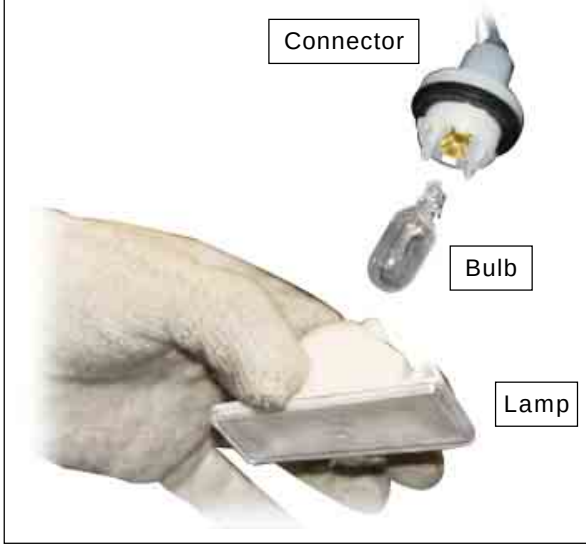
1. COMPOSITION OF REAR COMBINATION LAMP

Turn Signal Lamp/Stop Lamp Assembly





License Plate Lamp Assembly

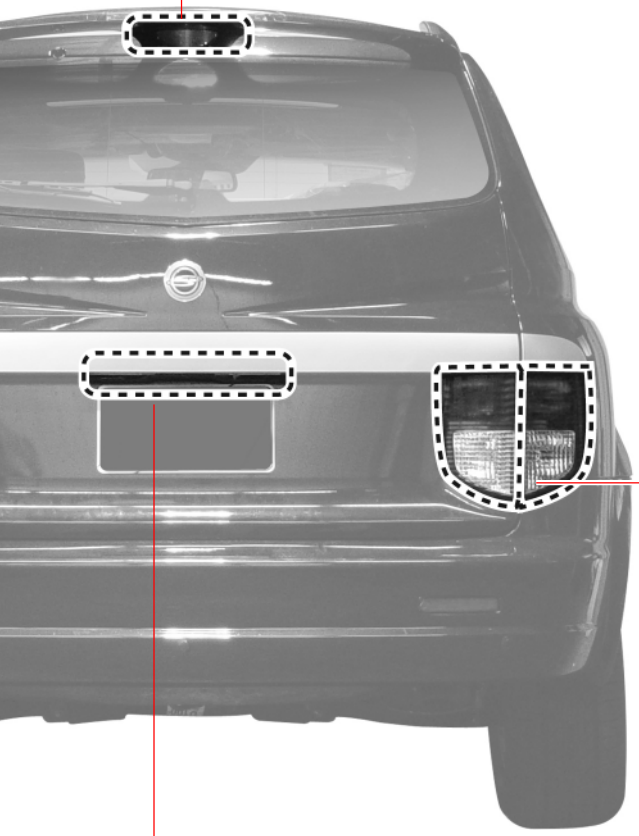


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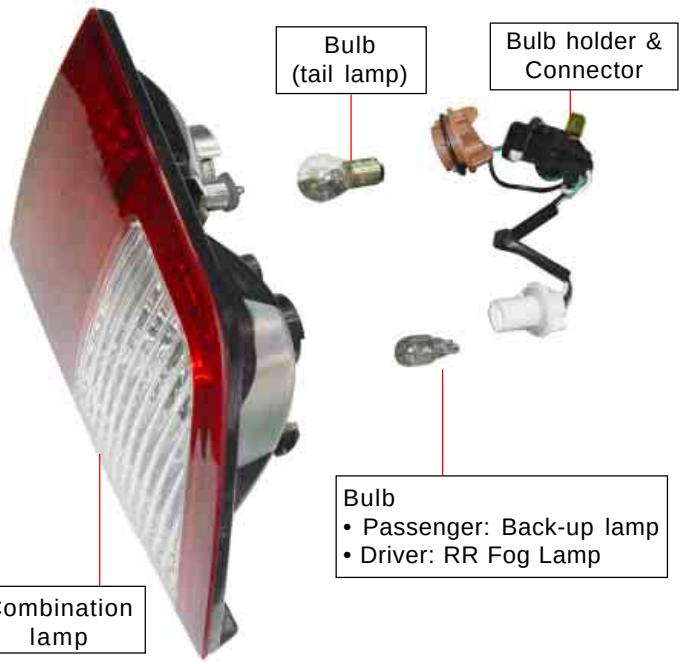
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High Mounted Stop Lamp





Tail Lamp/Back-up Lamp Assembly



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2. REMOVAL AND INSTALLATION OF REAR COMBINATION LAMP

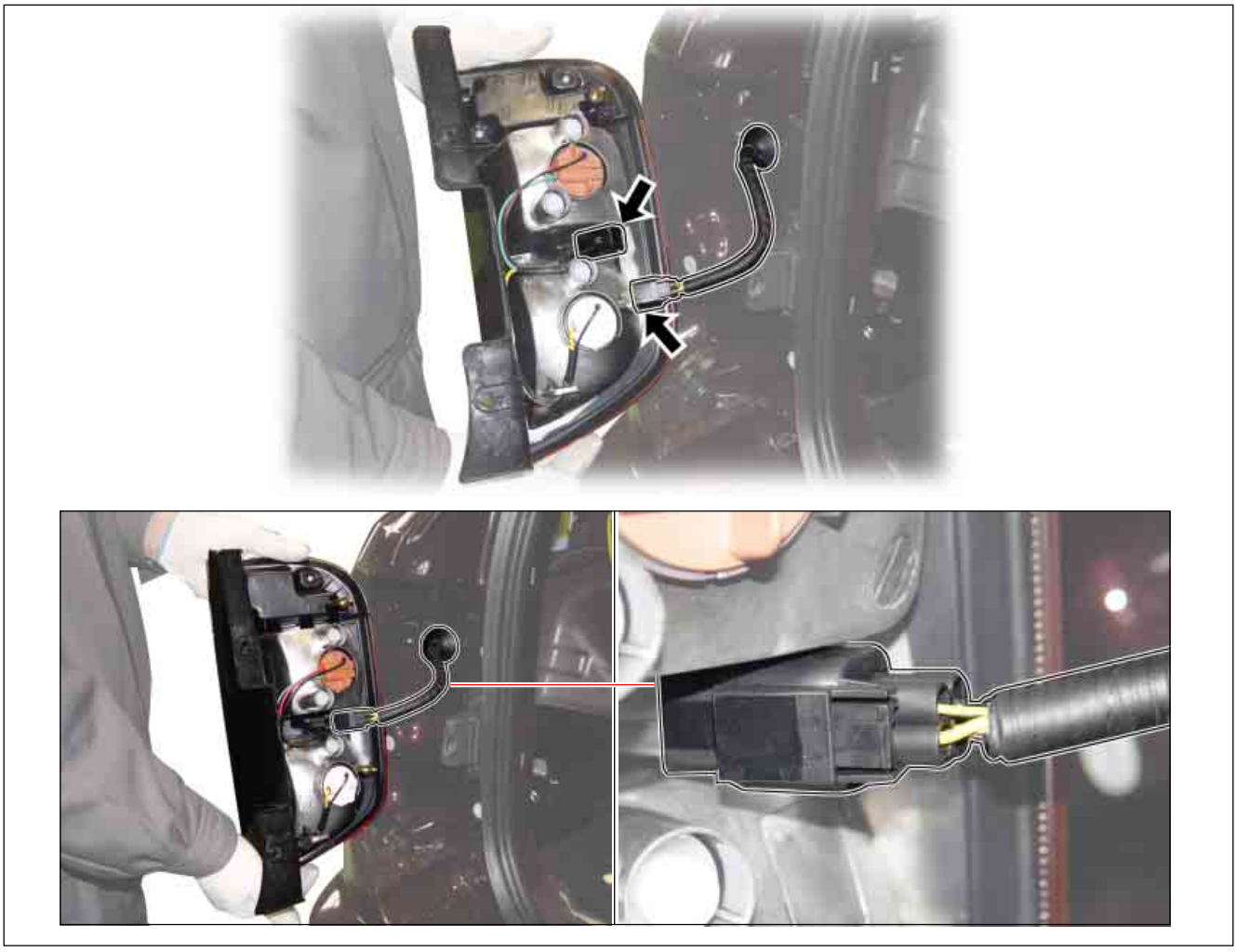
Turn Signal Lamp/Stop Lamp

※ **Preceding Work:** Disconnect the negative battery cable.

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.



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3. Open the bulb holders/connectors by turning them counterclockwise and remove the bulbs.



NOTICE

- **Use only specified bulb for replacement.**

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Tail Lamp/Back-up Lamp/RR Fog Lamp

※ **Preceding Work:** Disconnect the negative battery cable.

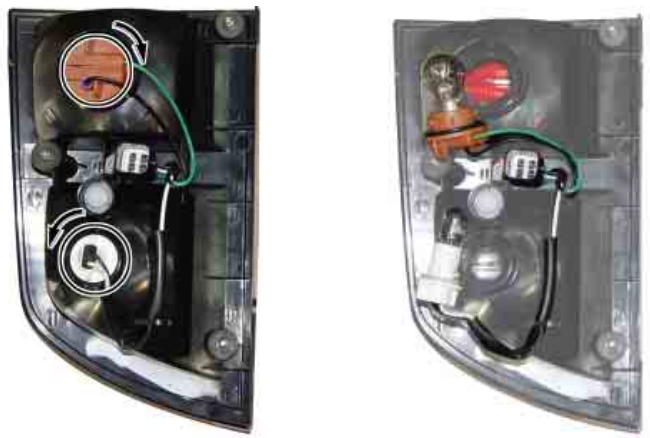
1. Open the tailgate and remove the bolt cover. Then, unscrew three mounting nuts (10 mm) and remove the rear combination lamp assembly (tail lamp/back-up lamp/RR fog lamp).



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.



NOTICE

- **Use only specified bulb for replacement.**

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License Plate Lamp Assembly

※ **Preceding Work:** Disconnect the negative battery cable

1. Remove the upper and lower trim of the tailgate. Disconnect the connectors and unscrew eight mounting nuts (10 mm) to remove the rear garnish assembly.



Tailgate Rear Garnish Assembly

Inside



Outside



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2. Disconnect the bulb and bulb cable from the removed rear garnish assembly and then remove the lamp by pressing (A) section of the lamp.



Disconnect the Bulb Connector



Remove the Lamp



Exploded View



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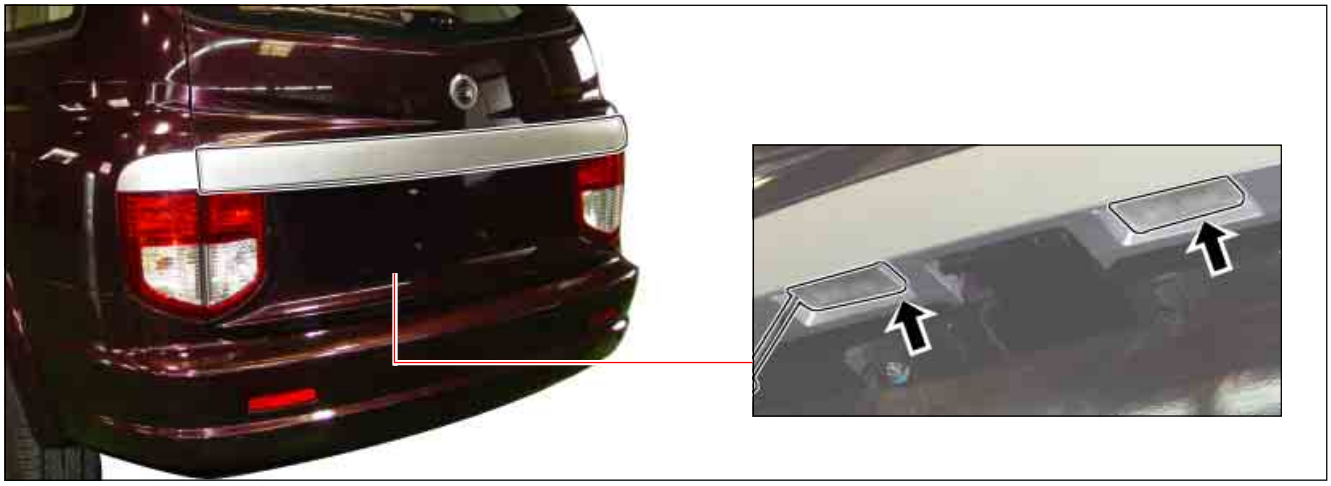
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3. Install the bulbs into the license plate lamp. Make sure the location and "LOCK" direction are correct.



▶ Replacement of Bulb

1. Pry off the license plate lamp with a flat bladed screwdriver.



2. Remove the bulb from the removed license plate lamp.



NOTICE

- **Use only specified bulb for replacement.**

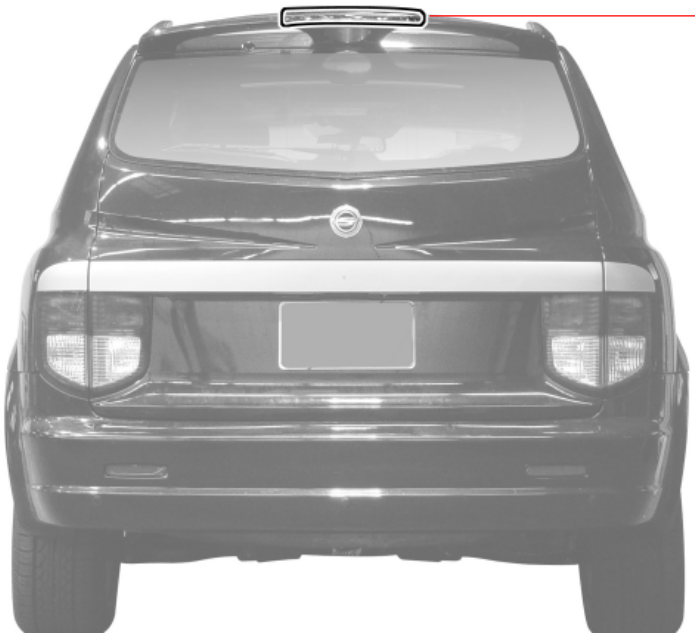
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High Mounted Stop Lamp

※ **Preceding Work:** Disconnect the negative battery cable.

NOTE

- **In the vehicle with tailgate air spoiler, the LED type high mounted stop lamp is integrated in the tailgate air spoiler. It should be replaced with the tailgate upper garnish assembly.**



1. Open the tailgate, remove the upper trim and then disconnect the high mounted stop lamp connector.



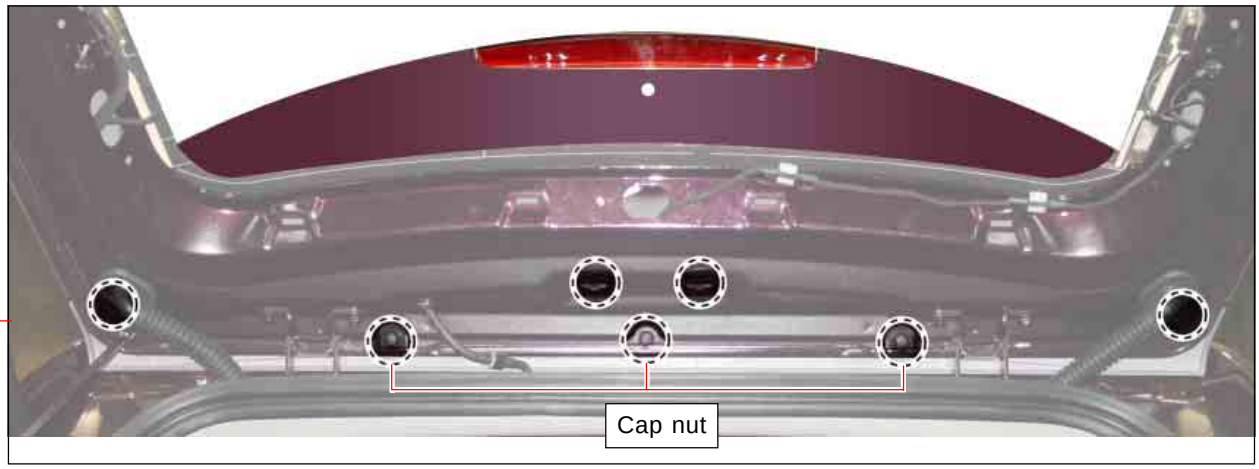
2. Disconnect the rear washer nozzle hose.



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3. Unscrew four mounting nuts (10 mm)/three cap nuts and remove the air spoiler from the tailgate.



4. Remove the tailgate upper garnish assembly from the removed air spoiler.



5. Replace the tailgate upper garnish assembly with new one.

NOTICE

- **In the vehicle with tailgate air spoiler, the LED type high mounted stop lamp is integrated in the tailgate air spoiler. It should be replaced with the tailgate upper garnish assembly.**
- **In the vehicle without tailgate air spoiler, the bulb type high mounted stop lamp is used. It can be replaced with new one after removing the tailgate upper garnish assembly.**



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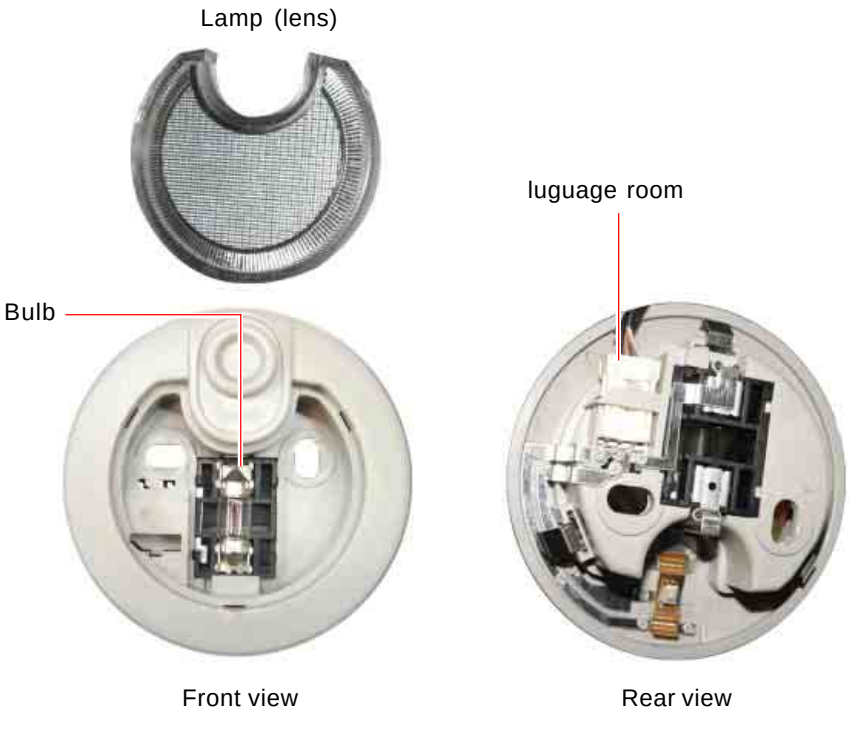
INTERIOR LAMPS

1. COMPOSITION OF INTERIOR LAMPS

Front Room Lamp Assembly



Interior Room/Luggage Room Lamp Assembly

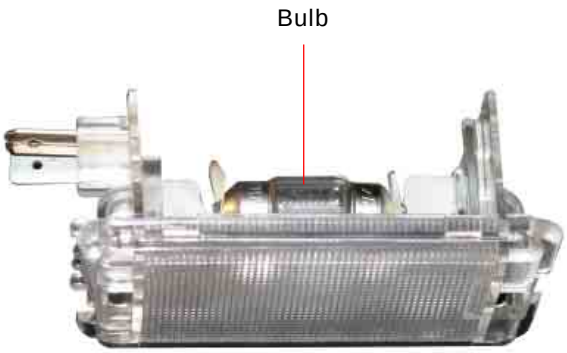




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Glove Box Lamp Assembly





Door Courtesy Lamp Assembly



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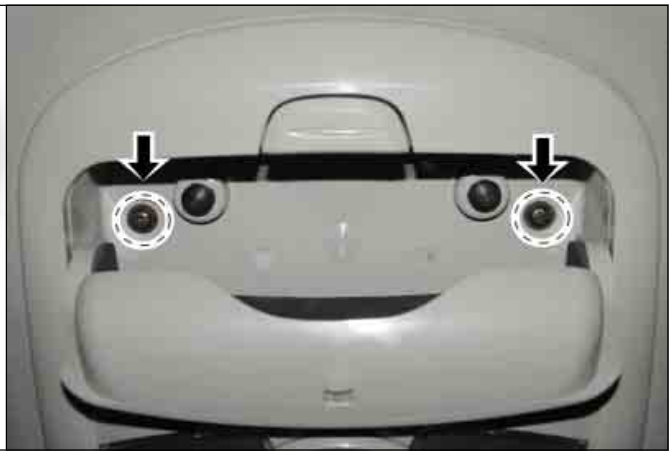
2. REMOVAL AND INSTALLATION OF INTERIOR LAMPS

▶ Front Room Lamp

※ **Preceding Work:** Disconnect the negative battery cable.

1. Open the sunglasses box and remove two front room lamp assembly mounting screws.





2. Disconnect the connector and remove the front room lamp assembly.







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Replacement of the Front Room Lamp Bulb

1. Remove the front room lamp cover.



NOTICE

- **The tab can be damaged when removing the room lamp abnormally.**

2. Carefully remove the bulb from the lamp and replace it with new one.



NOTICE

- **Use only specified bulb for replacement.**

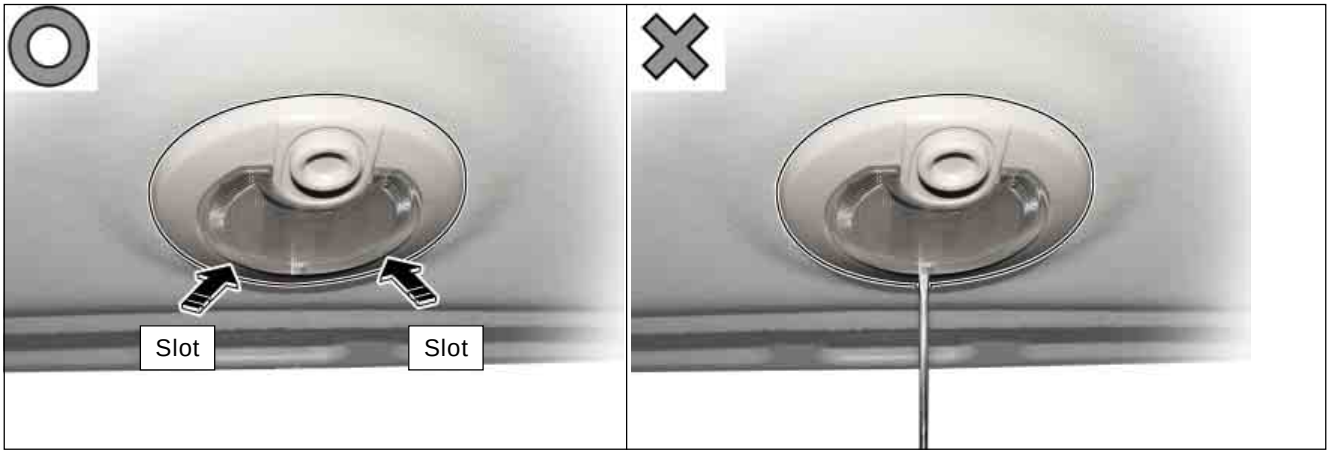
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▶ Center/Luggage Room Lamp

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the lamp cover.

NOTICE
- **Use the slot around the cover when replacing the lamp (bulb).**



2. Unscrew the lamp mounting screws (luggage room lamp) and nuts (center room lamp).



3. Disconnect the connector and remove the lamp assembly.



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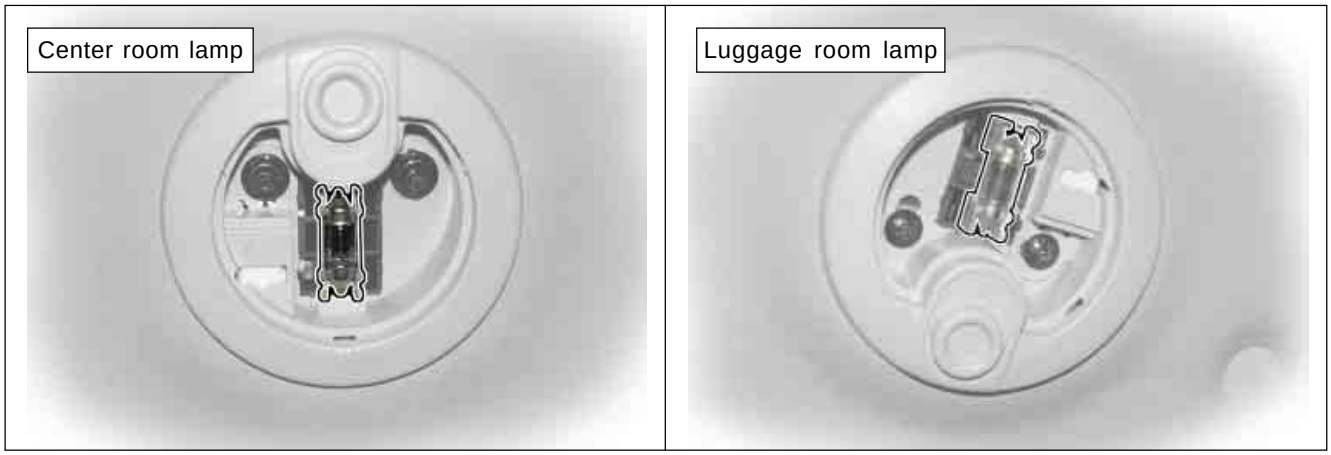
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Center Room/Luggage Room Lamp Assembly



▶ Replacement of Bulb

1. Remove the lamp cover and then carefully remove the bulb. Replace it with new one.



NOTICE

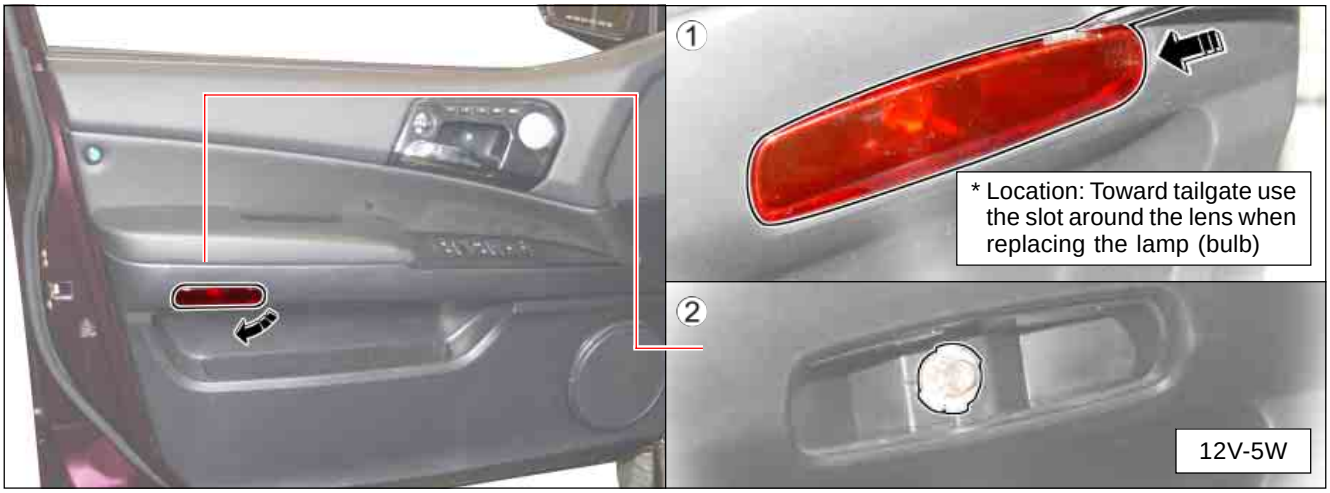
- **Use only specified bulb for replacement.**

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Door Courtesy Lamp Assembly

※ **Preceding Work:** Disconnect the negative battery cable.

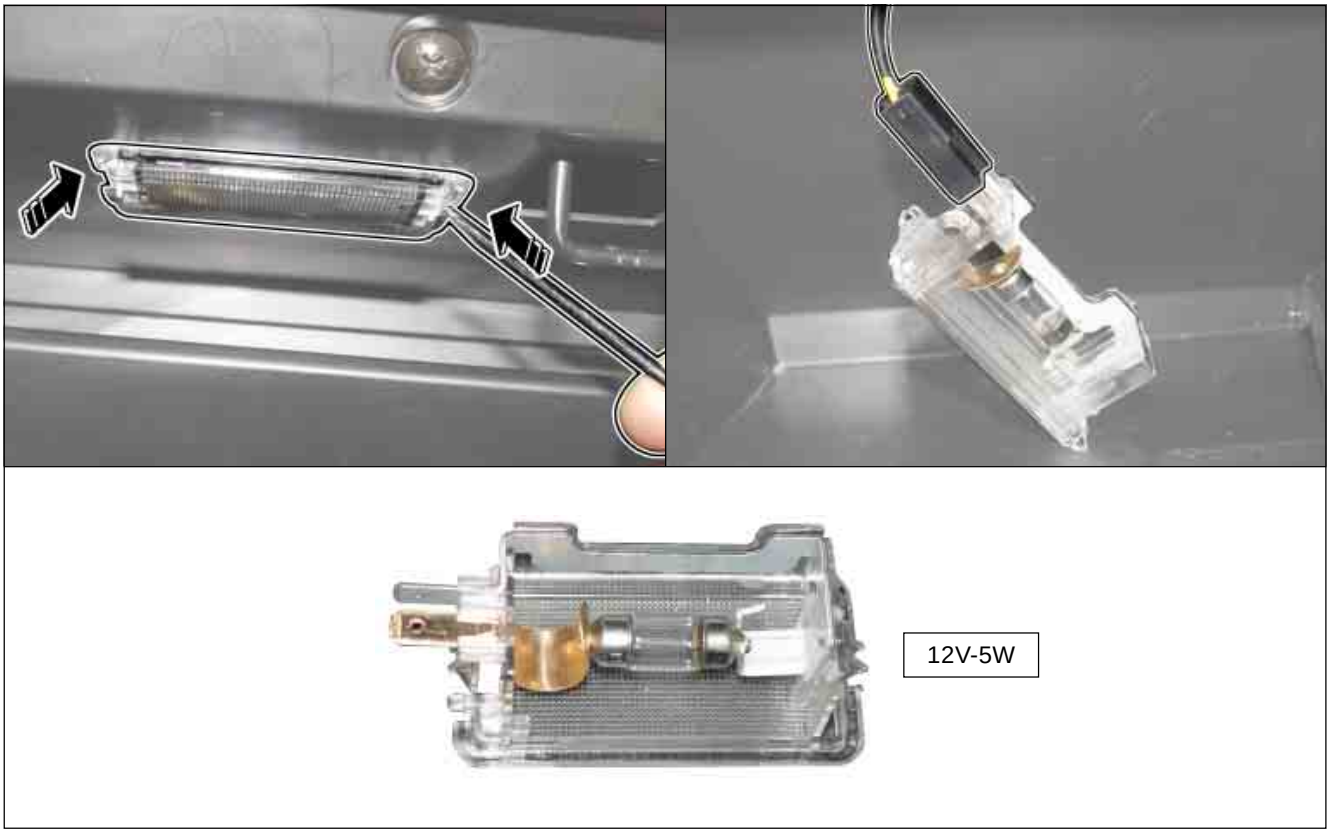
1. Disconnect the door courtesy lamp cover (1) from the door trim and remove the bulb (2). Replace the bulb with new one.



Glove Box Lamp Assembly

※ **Preceding Work:** Disconnect the negative battery cable.

1. Open the glove box and remove the lamp cover by pressing both sides of the lamp as shown in the figure.
2. Disconnect the connector and remove the lamp assembly. Replace the bulb with new one.



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SUNROOF SYSTEM

7340

TABLE OF CONTENTS

SUNROOF ASSEMBLY 2

1. Components and locations 2
2. Operation and function 3
3. Trouble diagnosis 6
4. Removal and installation of sunroof assembly 7
5. Circuit diagram 21

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SUNROOF ASSEMBLY

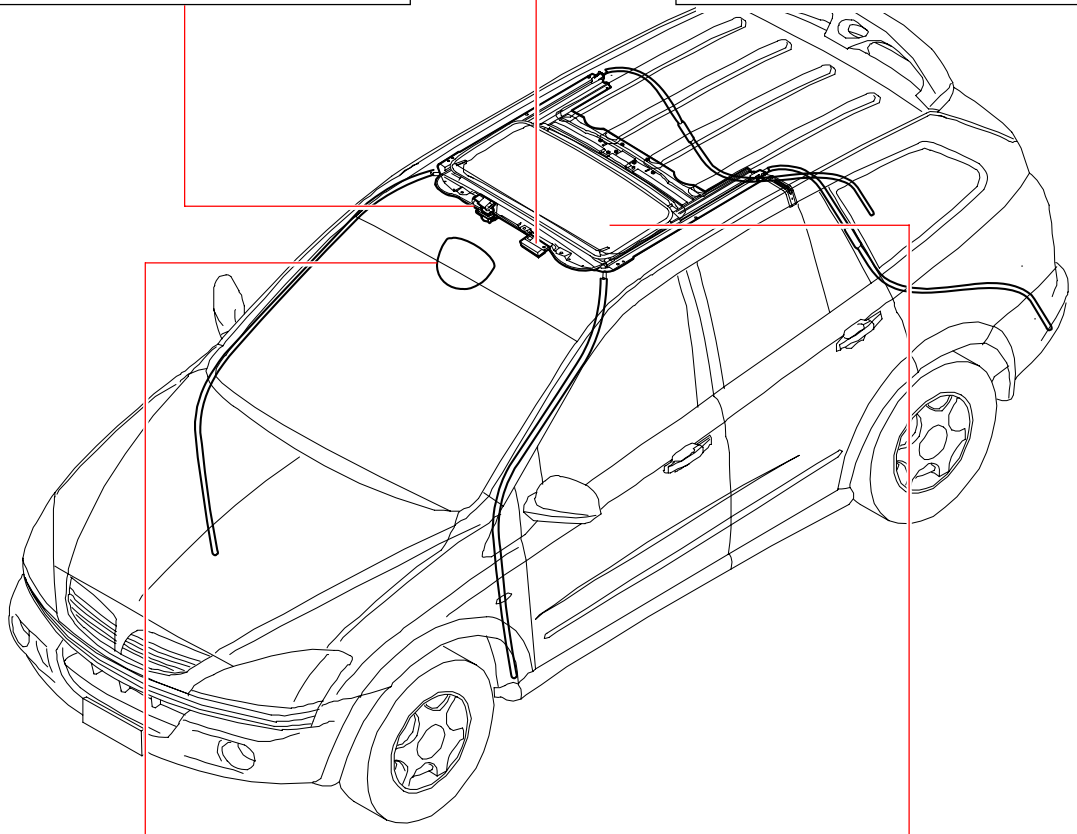
1. COMPONENTS AND LOCATIONS

Sunroof Motor



Sunroof Control Unit (SCU)





Sunroof Switch



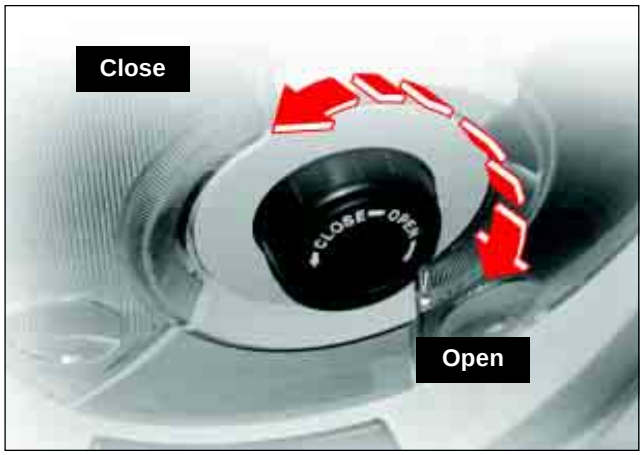
Sunroof Assembly



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2. OPERATION AND FUNCTION





▶ Sunroof Sliding Operation

Open

To fully open the sunroof, briefly rotate the sunroof switch clockwise (OPEN direction) with the sunroof closed. To partially open the sunroof, rotate and hold the sunroof switch until it reaches at the desired position.

Close

To fully close the sunroof, briefly 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

Tilt-up

To tilt-up the sunroof, rotate the sunroof switch counter-clockwise (CLOSE direction) with the sunroof fully closed.

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 force against the sunroof is less than the specified value, the Anti-Trap function doesn't operate.



Anti-trap function is built in SCU

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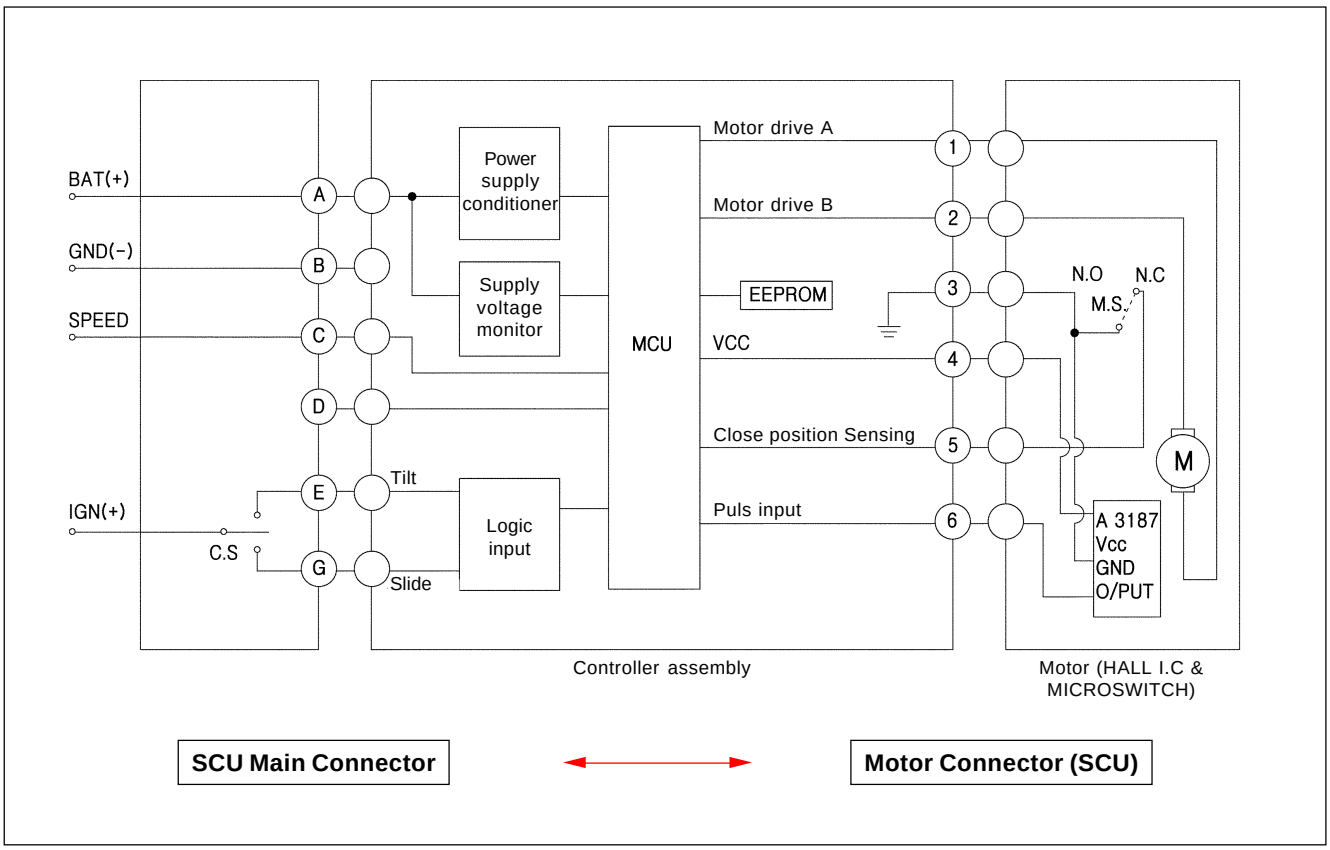
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▶ Hazard (Manual) Operation

The sunroof can be operated by rotating the motor operating hole on the sunroof motor with a proper tool.



▶ Circuit Diagram



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▶ 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 disconnected, the fuse is blown, or the abrupt voltage drop occurs due to old battery while operating the sunroof.
   2) When an undesired cancellation occurs due to mistake by a technician.
   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.
   2) If the sunroof does not operate or operates only during the switch operation even the power supply system is in normal conditions, check if the ground circuit of switch is securely tightened and reset the sunroof system again.

NOTE
- **If the power supply system is in normal conditions, replace the sunroof motor or the sunroof control unit.**
- **Replace the sunroof control unit with new one and check if the sunroof operates properly before replacing the sunroof motor.**

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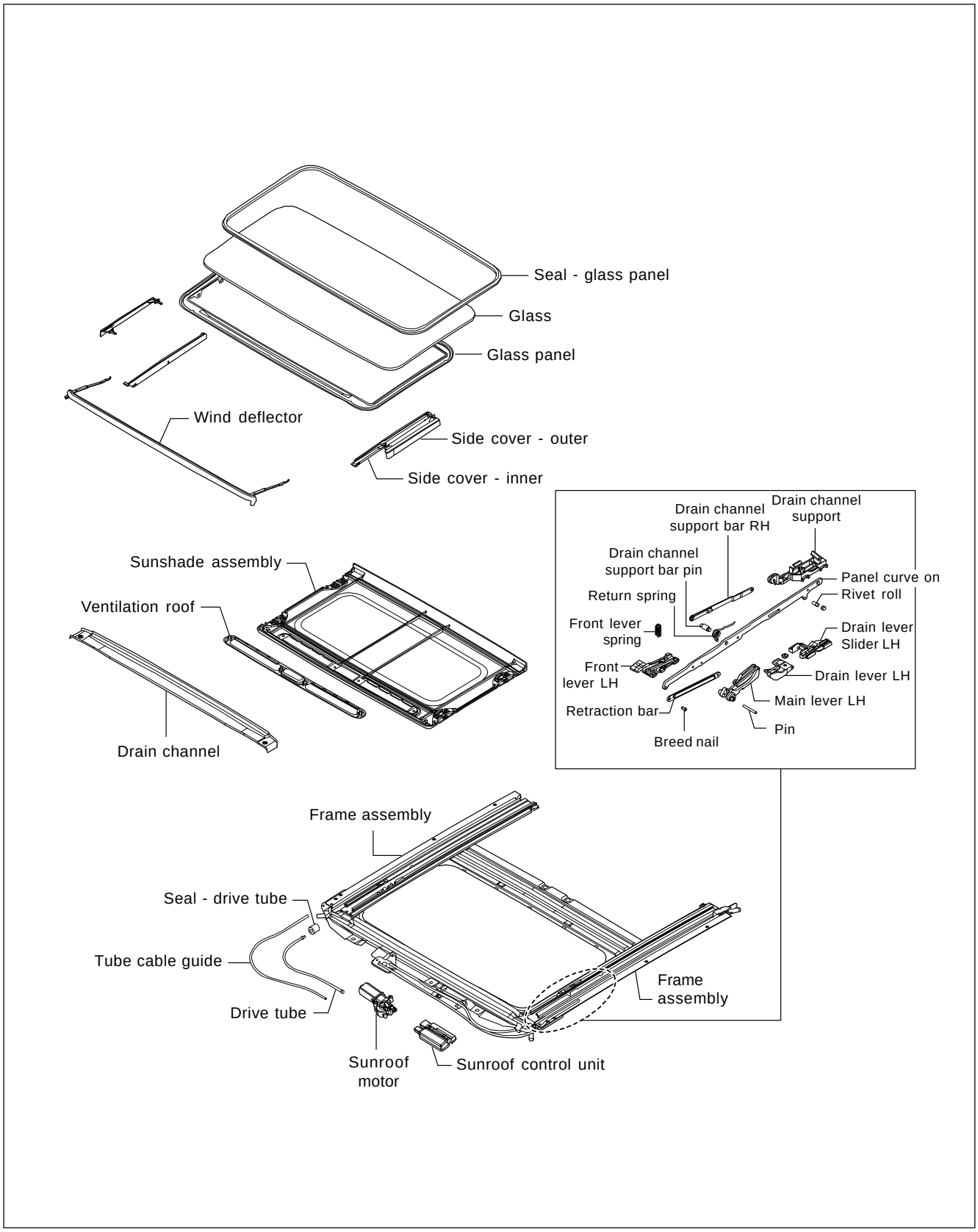
3. TROUBLE DIAGNOSIS

Symptom	Cause	Action
Leakage	Clogged or bent drain hose	Check and correct drain hose condition.
	Gap and clearance between panel and glass	Readjust glass location.
Wind noise	Gap and clearance between panel and glass	Readjust glass location.
Improper operations	Malfunction of wire, fuse and ground	Check and replace/repair.
	Malfunction of relay, motor and unit	Replace it.
	Damaged side cover by dislocation of sun shade	Reinstall sun shade and side cover. (Replace 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 damaged parts.)
	Improper operation of anti-trap function	Check interference of body and wind deflector. (Relieve spring tension.)
	Improper operation of motor	Replace it.
Operation noise	Caught side cover by dislocation of sun shade	Reinstall sun shade and side cover. (Replace damaged parts.)
	Interference between drain hose and vehicle body	Install sponge to drain hose.
	Interference between vehicle body and roof panel	Apply sealant between vehicle body and roof panel.
	Gap and clearance between roof panel and glass	Readjust glass location.

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4. REMOVAL AND INSTALLATION OF SUNROOF ASSEMBLY

▶ Exploded View



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▶ Wind Deflector

With Sunroof Opened

1. Fully open the sunroof.



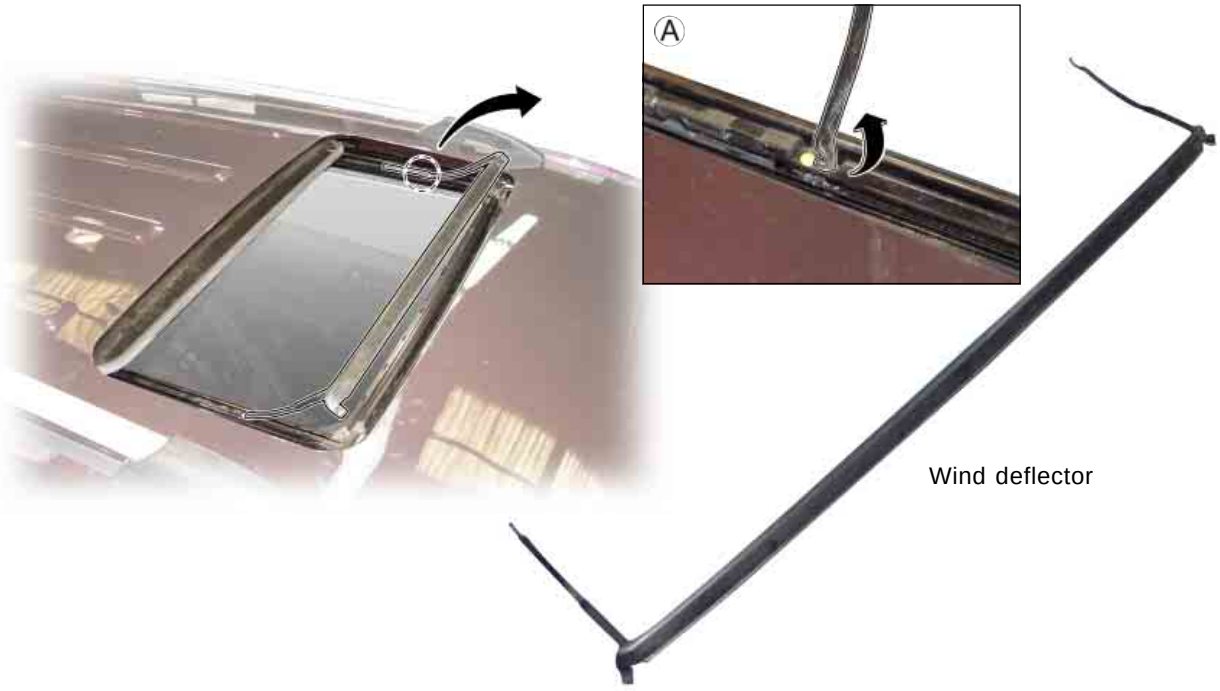
NOTICE

- **Work only when the sunroof is open.**

2. Unhook the wind deflector side locks at both sides.



3. Unhook the wind deflector bottom locks as shown in figure (A).



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▶ Glass Panel Assembly

NOTICE

- **Work only when the sunroof is tilted-up.**

Inside Cover of Glass Panel Assembly

1. Remove the inner side covers at both sides by pushing them rearward.



2. Remove the three mounting bolts (TORX bolts) of the glass panel with a special wrench (25 T).



3. Remove the glass panel.



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Outside Cover of Glass Panel

※ **Preceding Work:** Removal of glass panel and inside cover

1. Cut off the locks on the outside cover with a cutter and remove the outside cover.



2. Insert the locks of the new outside cover into the mounting holes.



3. Push down the outside cover to install into the roof panel and lock it to the sunroof system with a pliers.

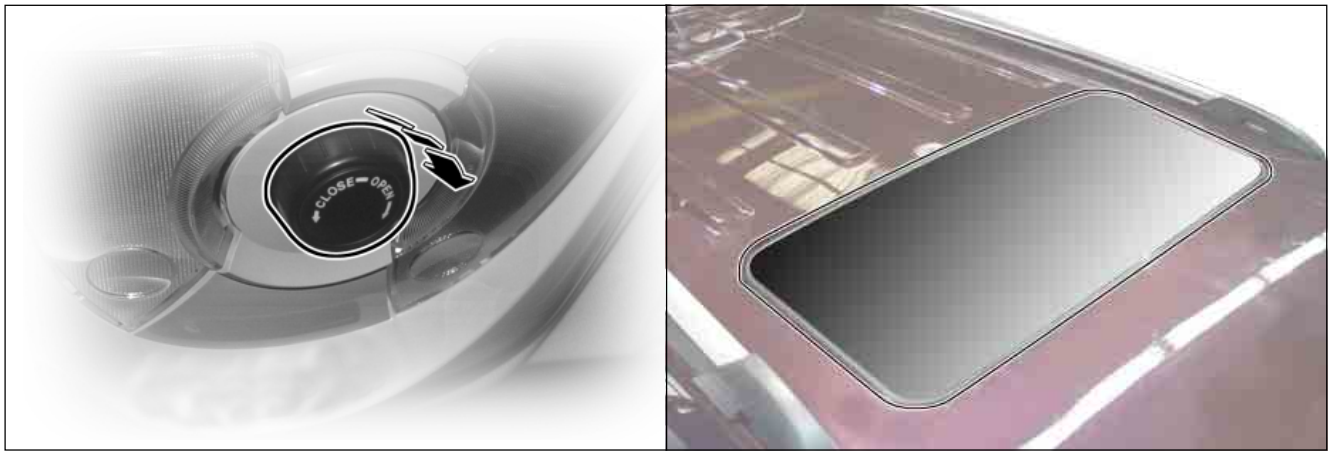


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Installation of Glass Panel

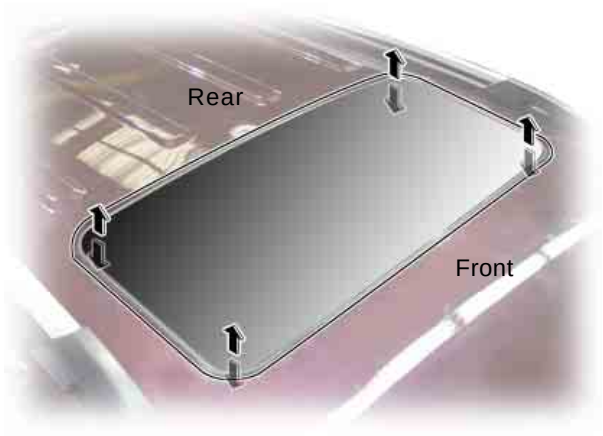
1. Place the glass panel with the sunroof tilted-up and temporarily tighten the three TORX bolts (T25) at both sides. At this moment, the logo on the glass panel should face the rear side of the vehicle.
2. Completely close the sunroof using the sunroof switch.



3. Adjust the following items with the specified value and tighten the bolts.

Gap Between Front and Rear Glass Panel

Gap: Distance from roof panel to glass



1) Front gap (-1 ~ 0 mm)

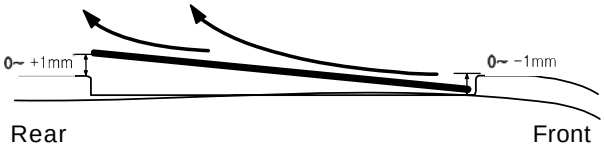


2) Rear gap (0 ~ 1 mm)



NOTE

- **To prevent the wind noise during high speed driving (over 100 km/h), the rear gap should be greater than front gap.**



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Front/Rear Gap of Glass Panel

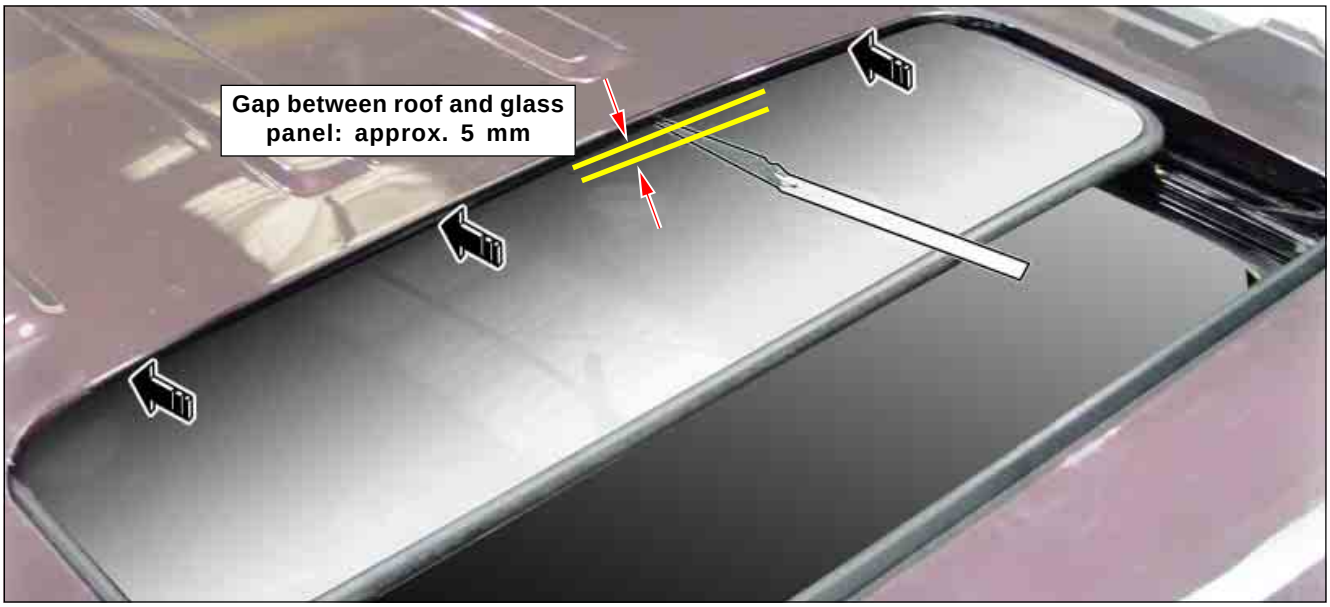
To avoid the abnormal noise due to interference between roof panel and rear section of sunroof glass panel while driving, the installation gap should be maintained the ratio of 4:6 (front:rear) when installation.



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.



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▶ Drain Channel

With Sunroof Tilted-up

※ **Preceding Work:** Removal of glass panel

1. Remove the two mounting bolts (TORX bolt) at both sides on the drain channel with the glass panel removed.



2. Unhook the locks (A) and remove the drain channel.



3. When installing

   Hook the locks (B) of the drain channel.



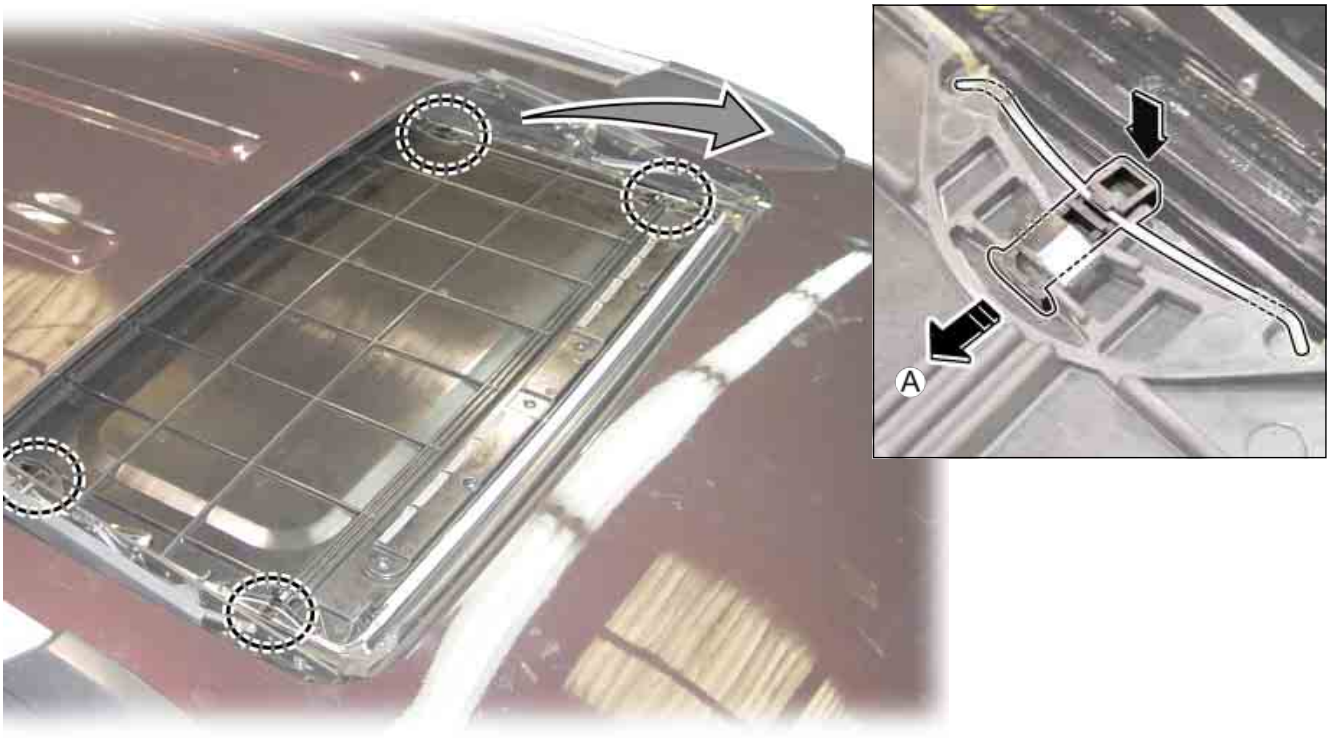
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▶ Sun Shade Panel

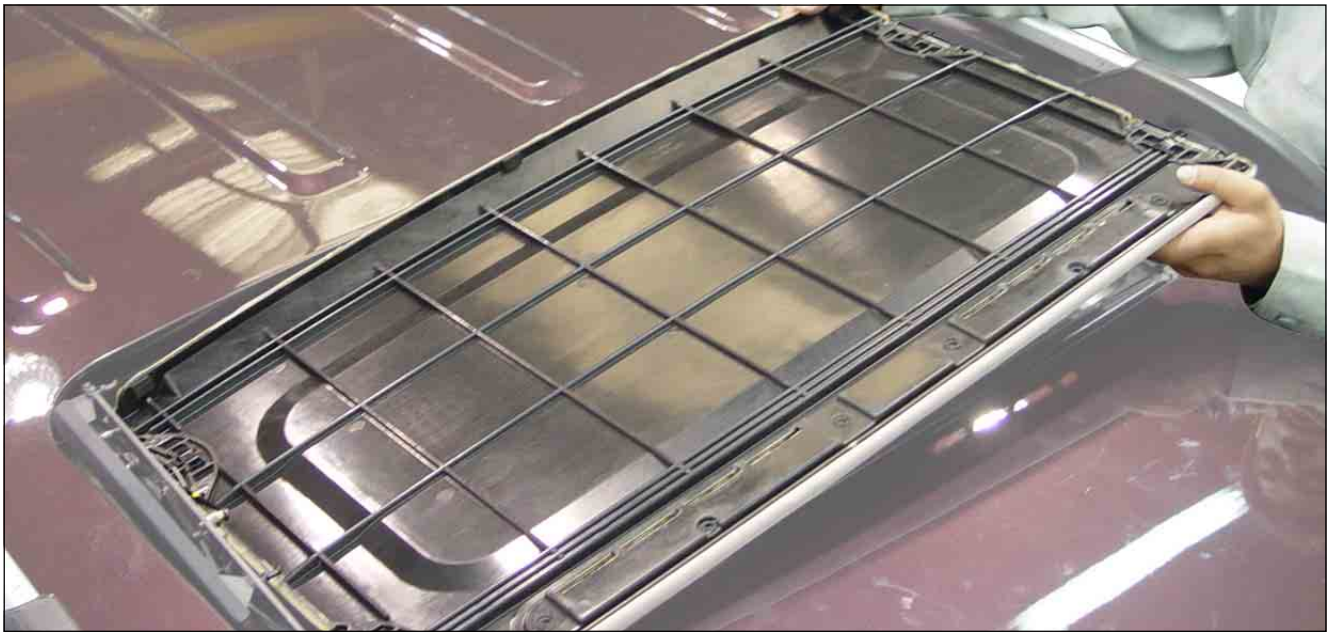
With Sunroof Tilted-up

※ **Preceding Work:** Removal of glass panel and drain channel

1. Move the sun shade panel forward and remove the slide blocks of the sun shade panel from the guide rail with a flat bladed screwdriver as shown in the figure.



2. Remove the sun shade panel from the sunroof.



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▶ Sunroof Control Unit (SCU) and Motor

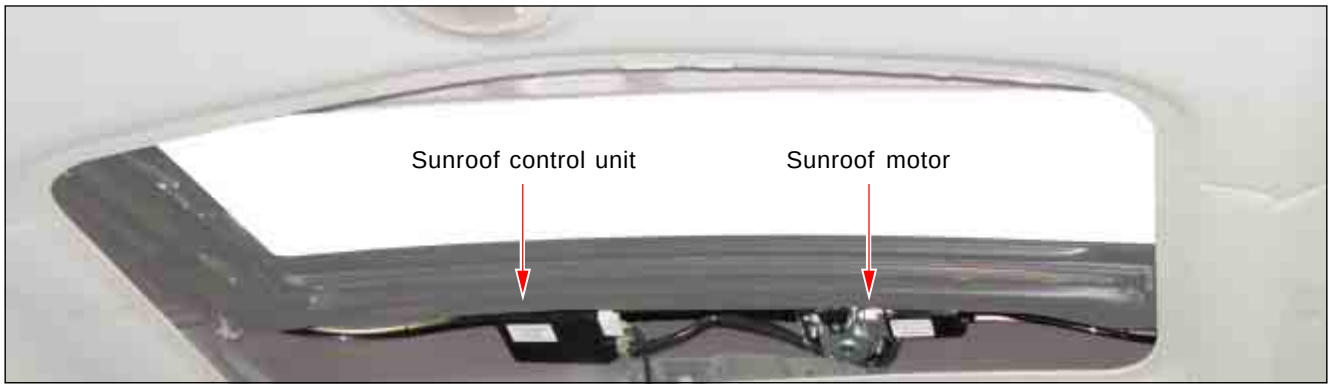
With Sunroof Fully Closed

※ **Preceding Work:** 1. Fully close the sunroof with sunroof switch.
2. Remove the sun visor/passenger's hand grip/A pillar headlining/B pillar headlining to deflect the front section of the headlining. (Be careful not to damage the headlining.)

NOTICE
- **Work only when the sunroof is closed.**

SCU Assembly

1. Disconnect the connector from the sunroof control unit.

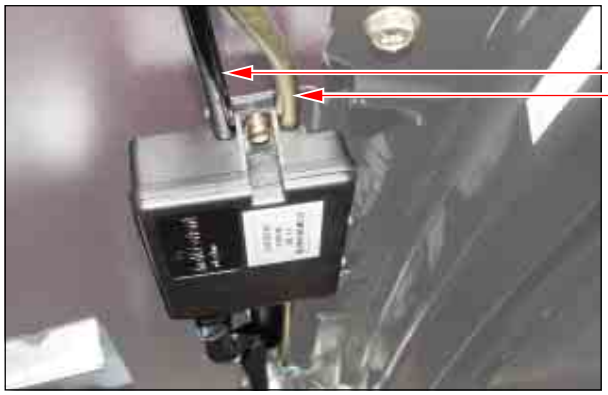


2. Unscrew the mounting screw and remove the SCU assembly.





3. When installing, completely fit the sunroof rail into the slot of sunroof control unit and tighten the screw.



NOTICE
- **Completely fit the sunroof rail into the slot of sunroof control unit.**



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Motor Assembly

NOTICE

- **Work only when the sunroof is closed.**

1. Disconnect the connector from the SCU.



2. Unscrew the three mounting bolts (25T) with a special wrench and remove the motor assembly.





NOTICE

- **To make the motor positioning easier, do not operate the motor (even for the testing) before installation.**



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▶ Sunroof Drain Hose

Removal and installation procedures of drain hoses:

Front Drain Hose	- Remove only A pillar, sun visor, sunroof molding and front section of headlining.
Rear Drain Hose	- Remove headlining and rear trim.

Release the clamps and remove hoses. (However, the fastener at rear side of rear hose should be removed.)

Rear Hose



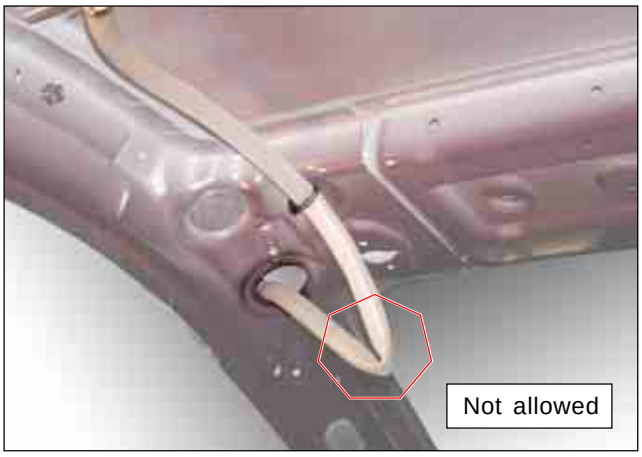
Front Hose





NOTICE

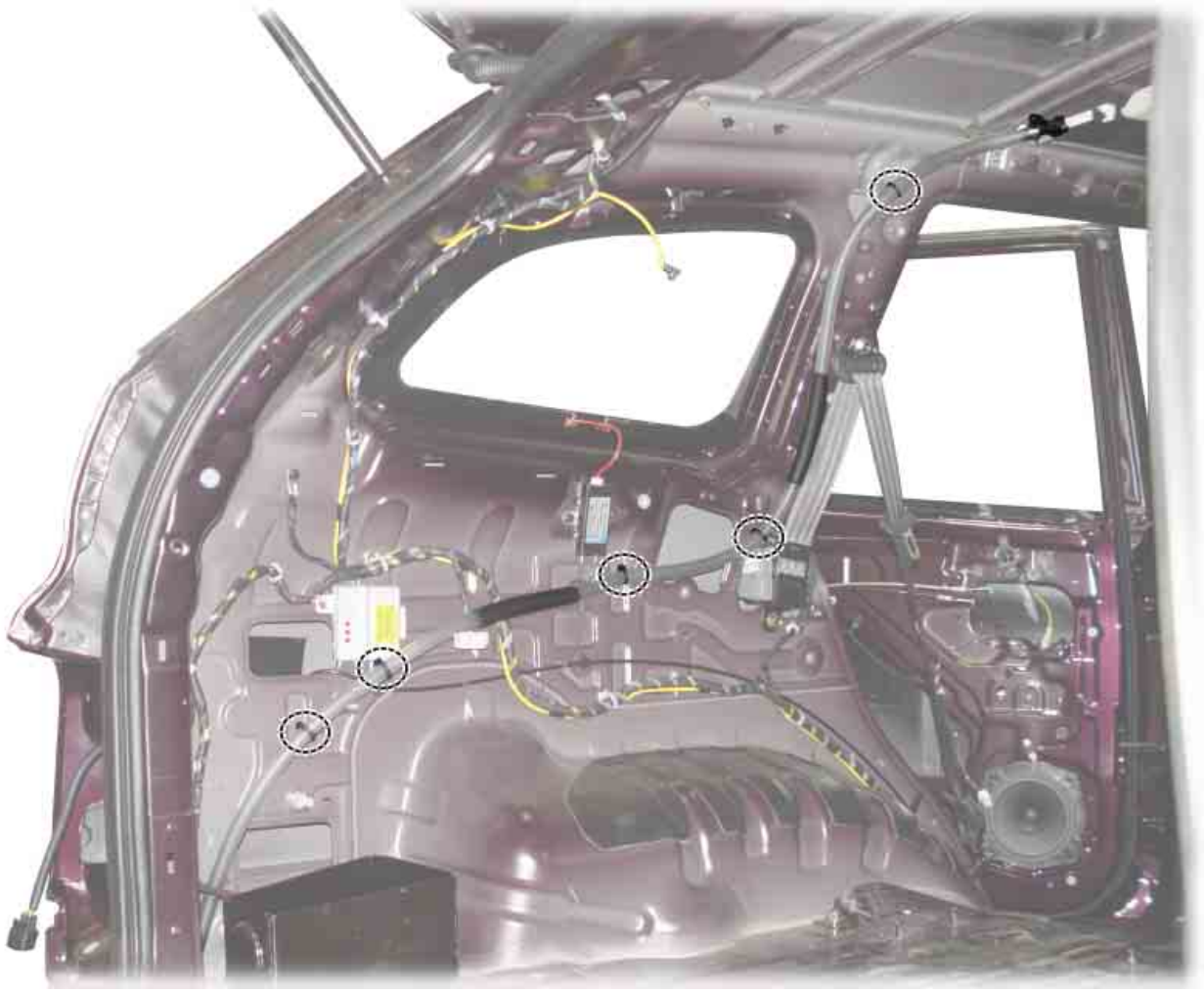
- **When installing, be careful not to kink, damage and twist the hose.**



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Note

Fastener location of rear drain hose



The rear drain hose can be removed after releasing the fasteners.

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▶ Sunroof Assembly

※ **Preceding Work:** Removal of headlining

1. Disconnect the front and rear drain hoses with the sunroof closed.

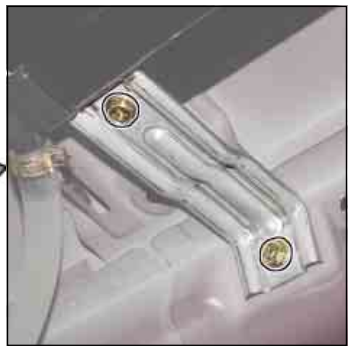






2. Unscrew the two bracket mounting bolts (10 mm) at both sides.





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3. Unscrew the mounting bolts (10 mm) at both sides.

Installation Notice

Tightening torque	6 ~ 10 Nm



4. Remove the sunroof assembly from the vehicle.



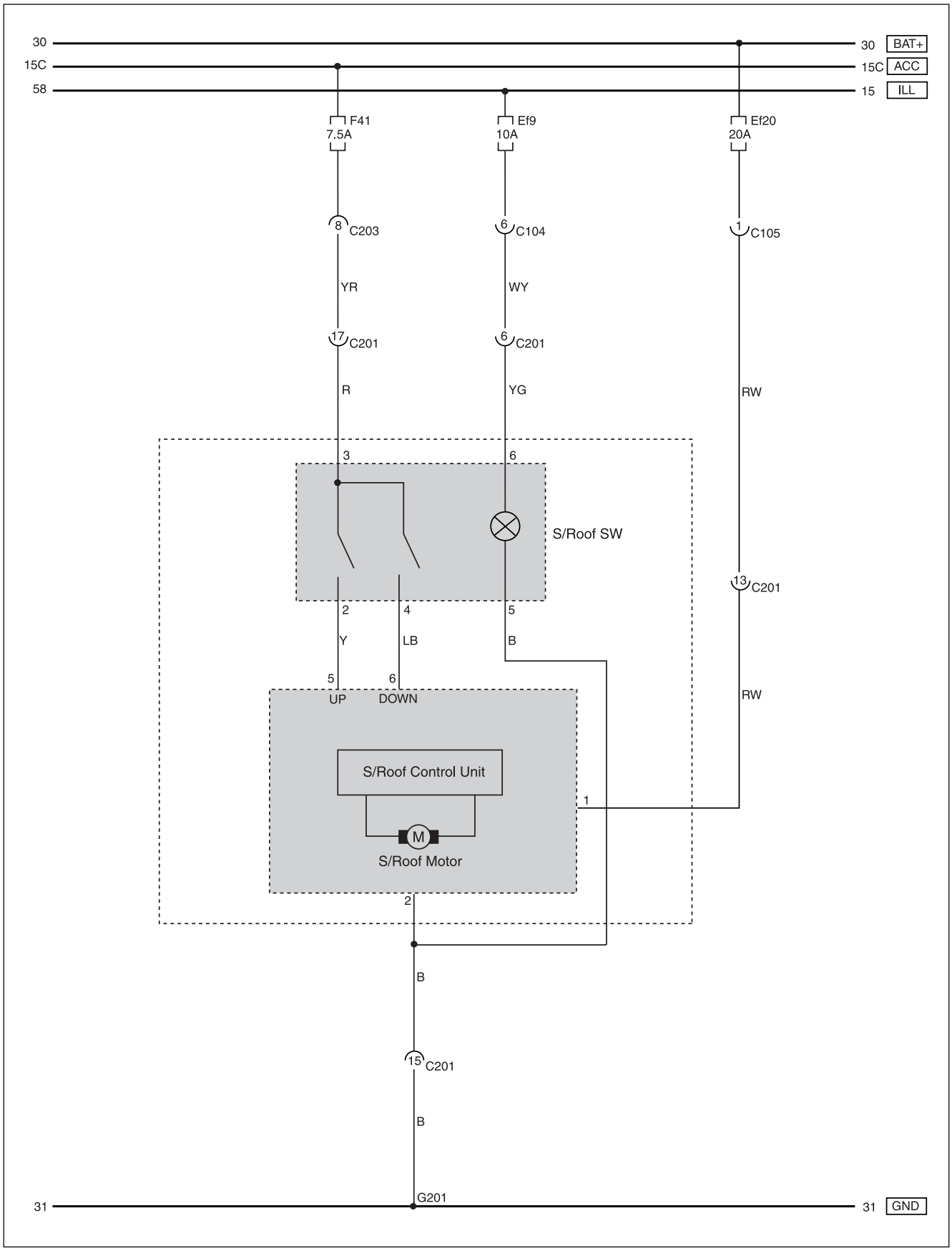
Sunroof Assembly





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5. CIRCUIT DIAGRAM



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SEAT & SEAT BELT

7410 / 7430

TABLE OF CONTENTS

SEAT ASSEMBLY 3

1. Seat mounting points 3
2. Composition of seat 4
3. Removal and installation of seat 11
4. Seat heating 17
5. Seat arrangement 17

SEAT BELT 18

1. Seat belt locations 18
2. Removal and installation of seat belt 20

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SEAT ASSEMBLY

1. SEAT MOUNTING POINTS

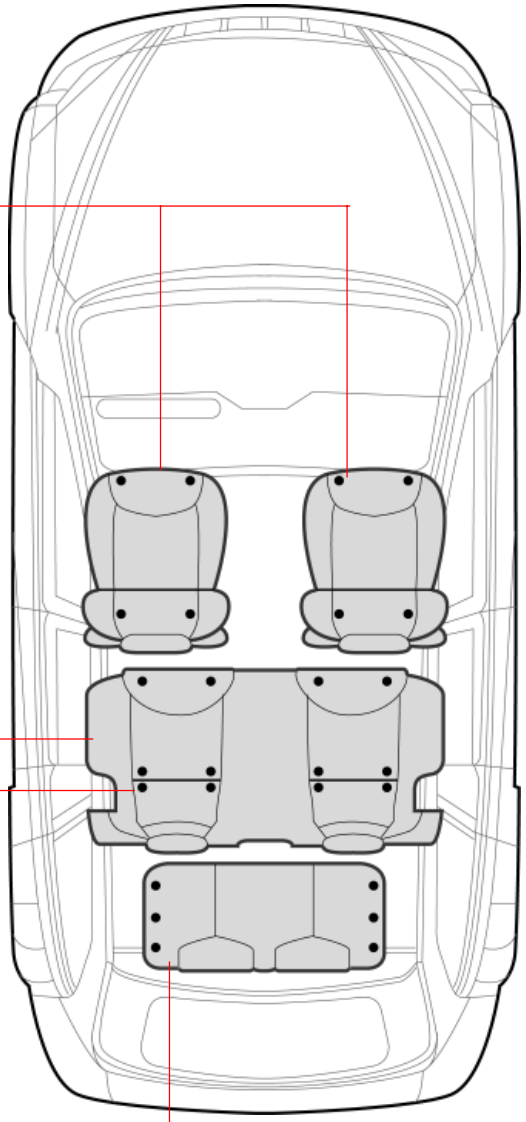
▶ Front Seat



Tightening torque:
35 ~ 55 Nm



Tightening torque:
35 ~ 55 Nm



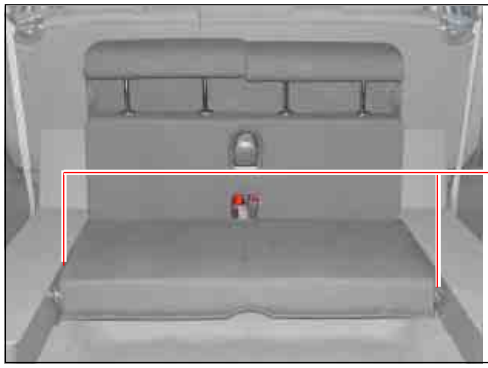
▶ Second Row Seat

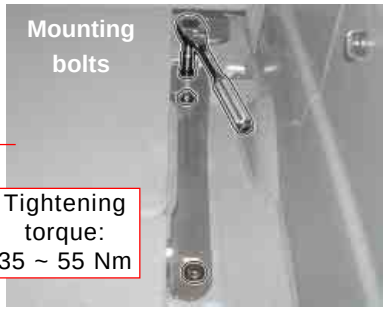




Tightening torque:
35 ~ 55 Nm

▶ Third Row Seat





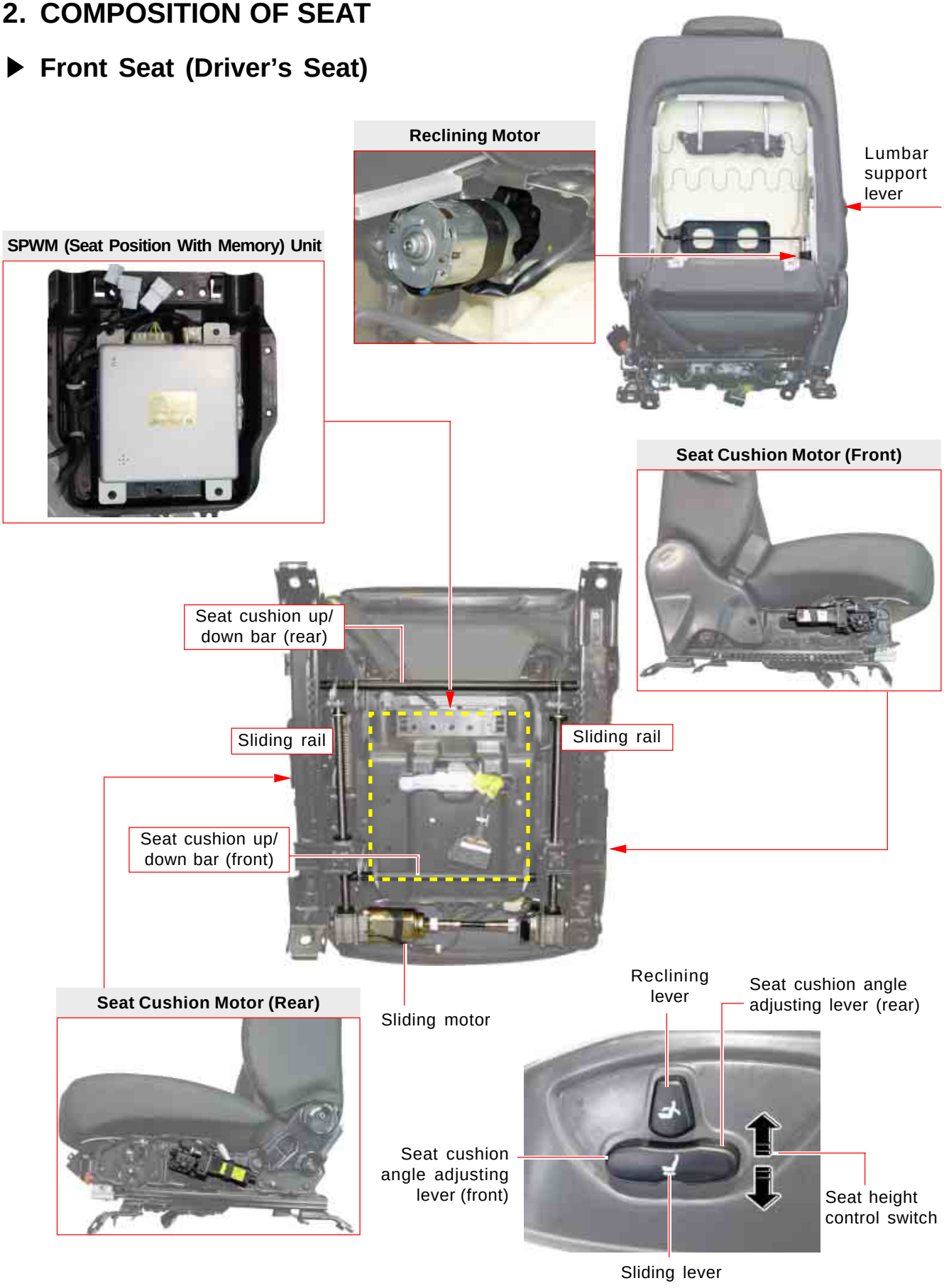
Tightening torque:
35 ~ 55 Nm

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2. COMPOSITION OF SEAT

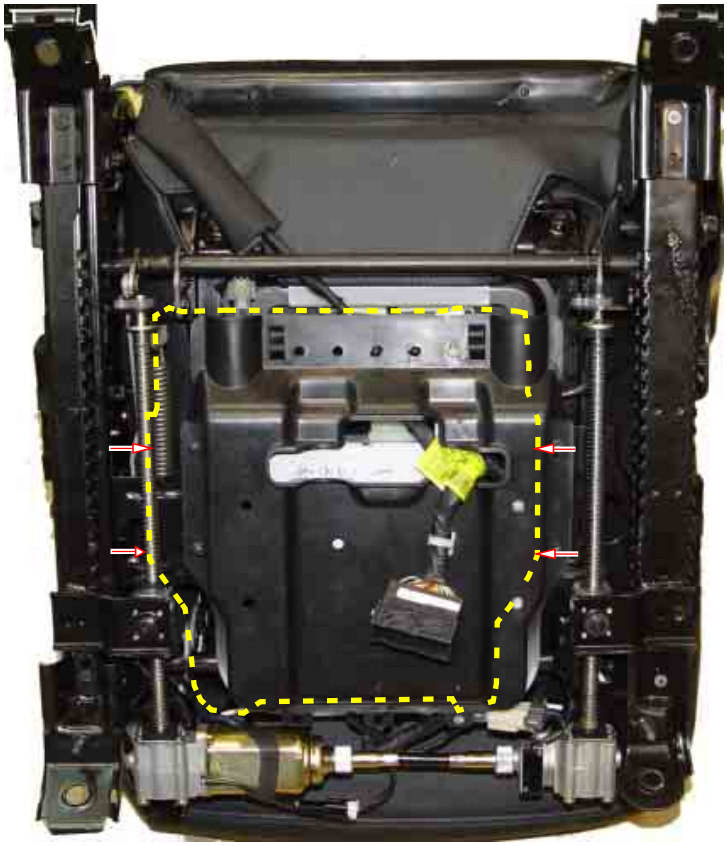
▶ Front Seat (Driver's Seat)

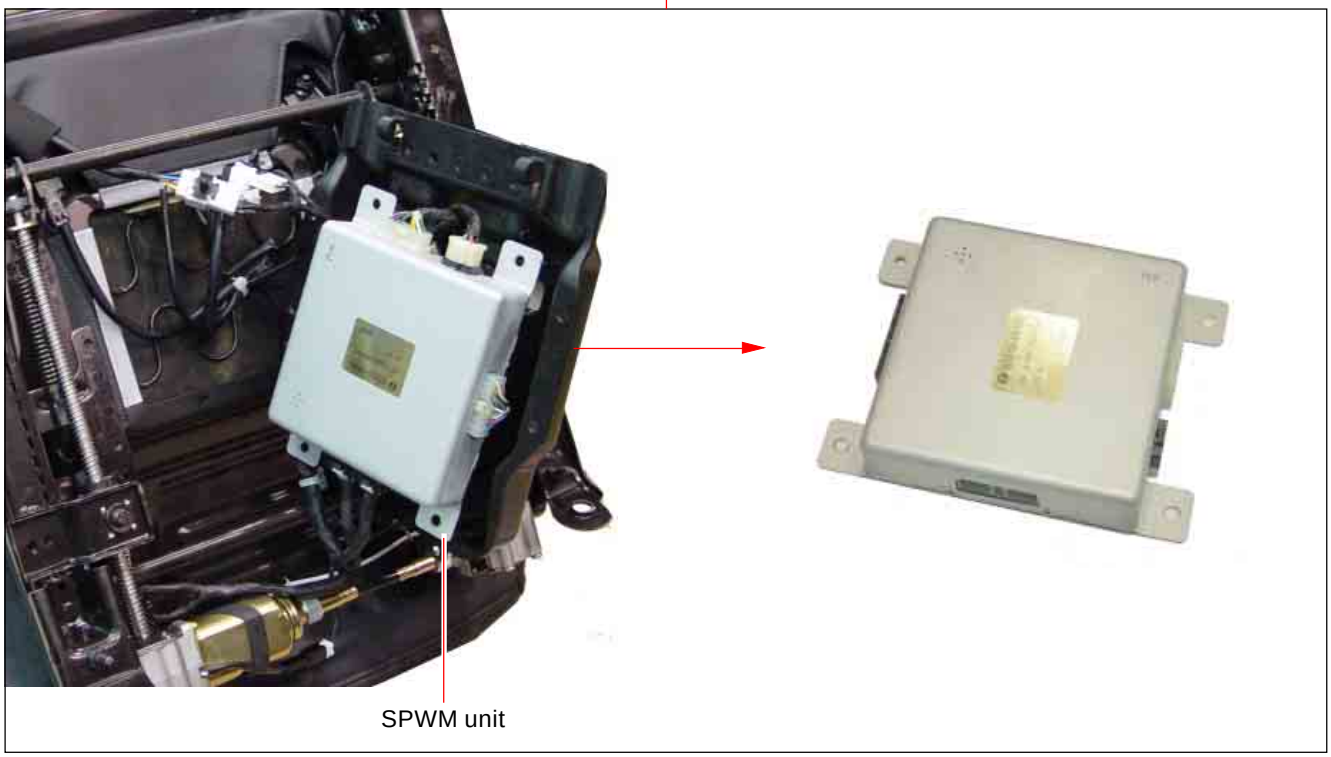


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Location of Seat Position With Memory Unit (Bottom of Driver Seat)



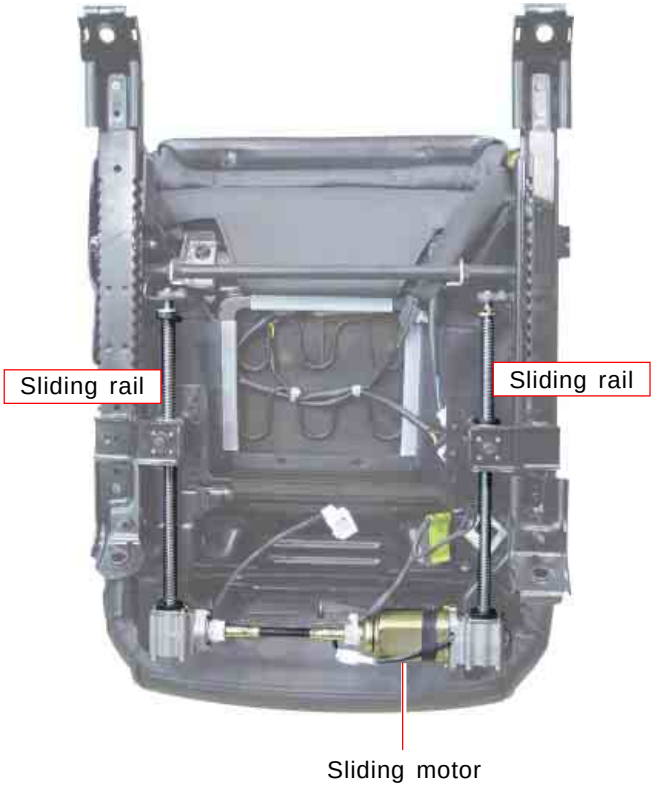


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Front Seat (Passenger Seat)







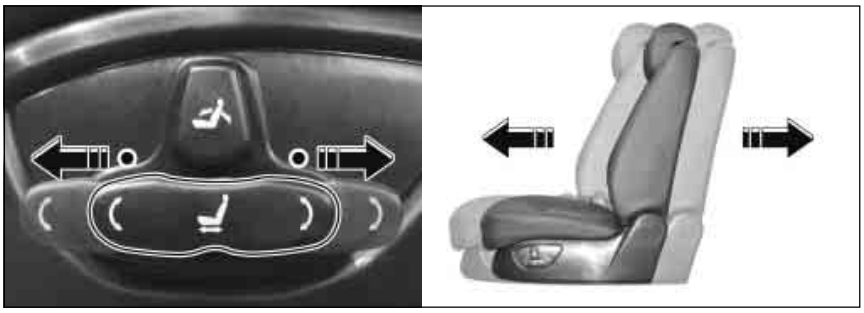
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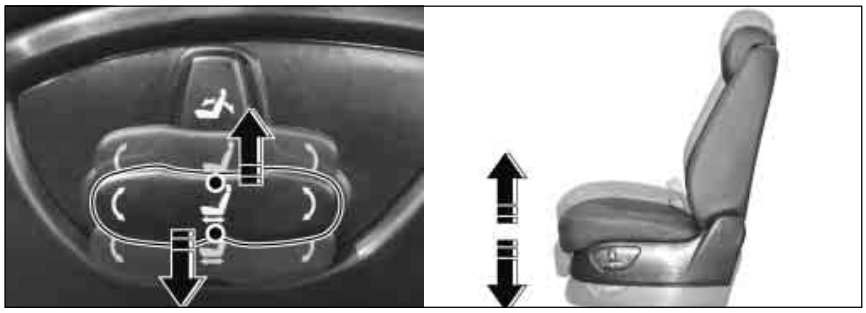
▶ Functions

Switches and Functions of Driver Seat

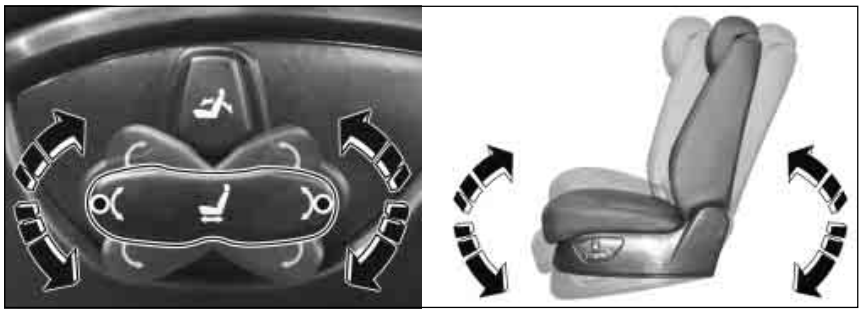
1. Seat Sliding Adjustment



2. Seat Cushion Height Adjustment



3. Seat Cushion Angle Adjustment



4. Seatback Reclining Adjustment



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Switches and Functions of Passenger 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





3. Seat Sliding Adjustment





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Second Row 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, lean forward slightly and raise the lever. Then, lean back to the desired angle and release the lever.





Full Flatting the Second Row Seat

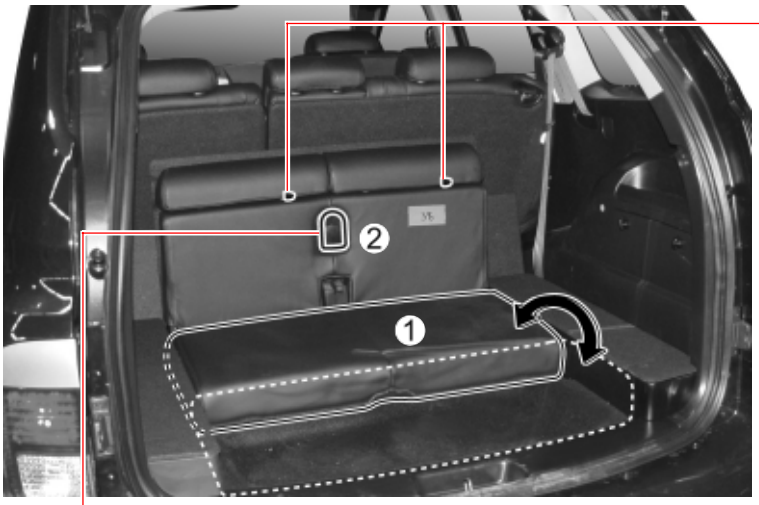




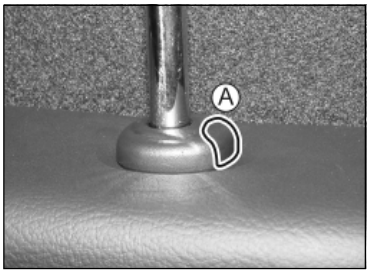
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Third Row Seat



1. Headrest Height Adjustment



To raise the headrest, pull it up without pressing the release button. To lower the headrest, press the release button (A) on top of seatback and push the headrest down.

2. Full flat lever for third row seat



Unfolding/Folding of Third Row Seat





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3. REMOVAL AND INSTALLATION OF SEAT

▶ Driver's Seat (Power Seat)

1. Move the seat rearward as far as possible and unscrew the two front mounting bolts (14 mm) at both sides.



Installation Notice

Tightening torque	35 ~ 55 Nm

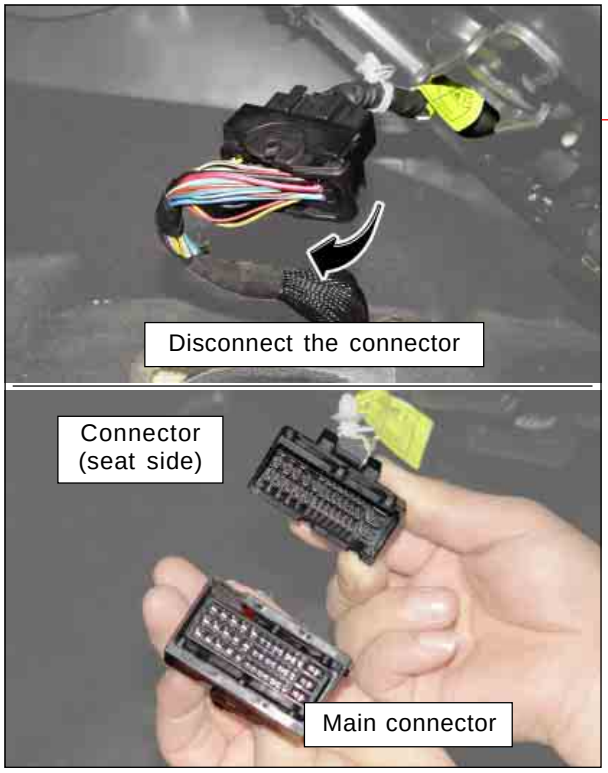
2. Move the seat forward as far as possible and unscrew the two rear mounting bolts (14 mm) at both sides.



Installation Notice

Tightening torque	35 ~ 55 Nm

3. Lay down the seatback and disconnect the connector under the seat and then remove the seat assembly.





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Passenger's Seat (Power Seat)

1. Move the seat backward as far as possible and unscrew the two front mounting bolts (14 mm) at both sides.



Installation Notice

Tightening torque	35 ~ 55 Nm

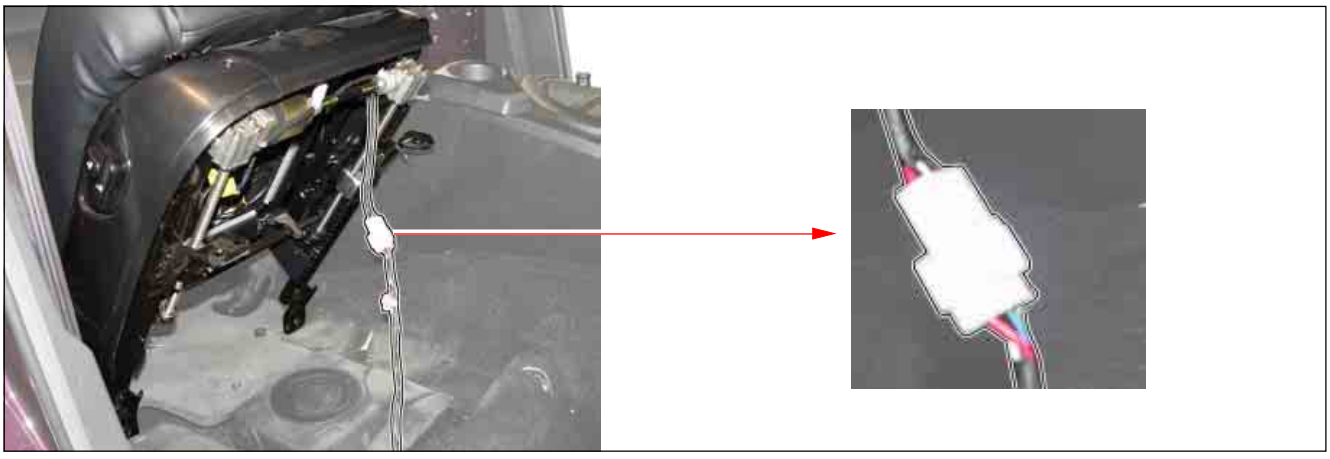
2. Move the seat forward as far as possible and unscrew the two rear mounting bolts (14 mm) at both sides.



Installation Notice

Tightening torque	35 ~ 55 Nm

3. Lay down the seatback and disconnect the connector under the seat and then remove the seat assembly.



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Second Row Seat

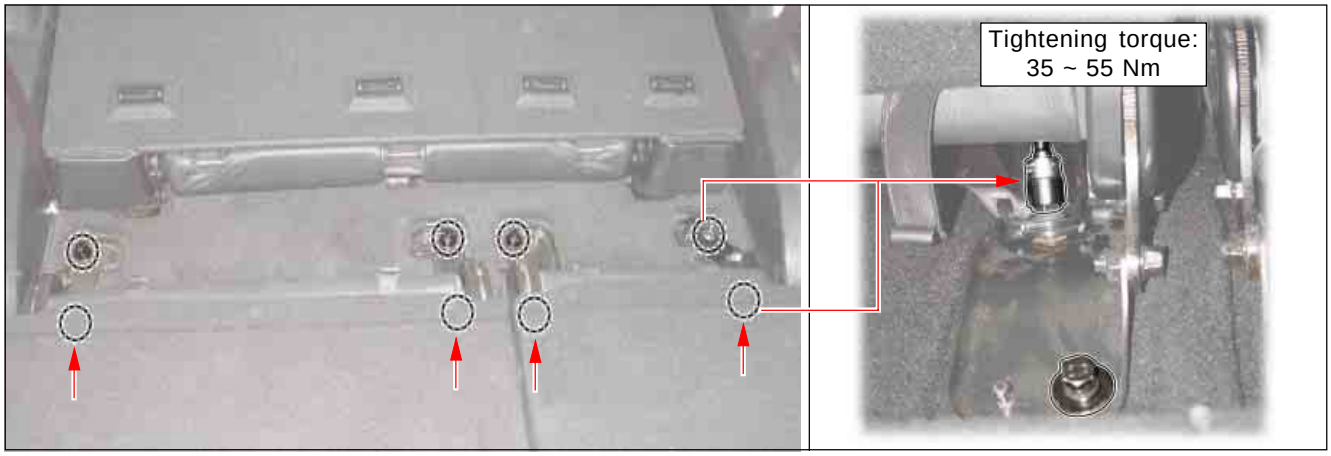
1. Slide the front seats forward and remove the four front mounting nuts (14 mm) of the second row seat.



Installation Notice

Tightening torque	35 ~ 55 Nm

2. Lay down the seatback of the second row seat and remove the eight rear mounting nuts (14 mm). Insert a wrench between seatback and cushion to remove the mounting bolts with arrow mark.



3. Remove the second row seat from the vehicle.



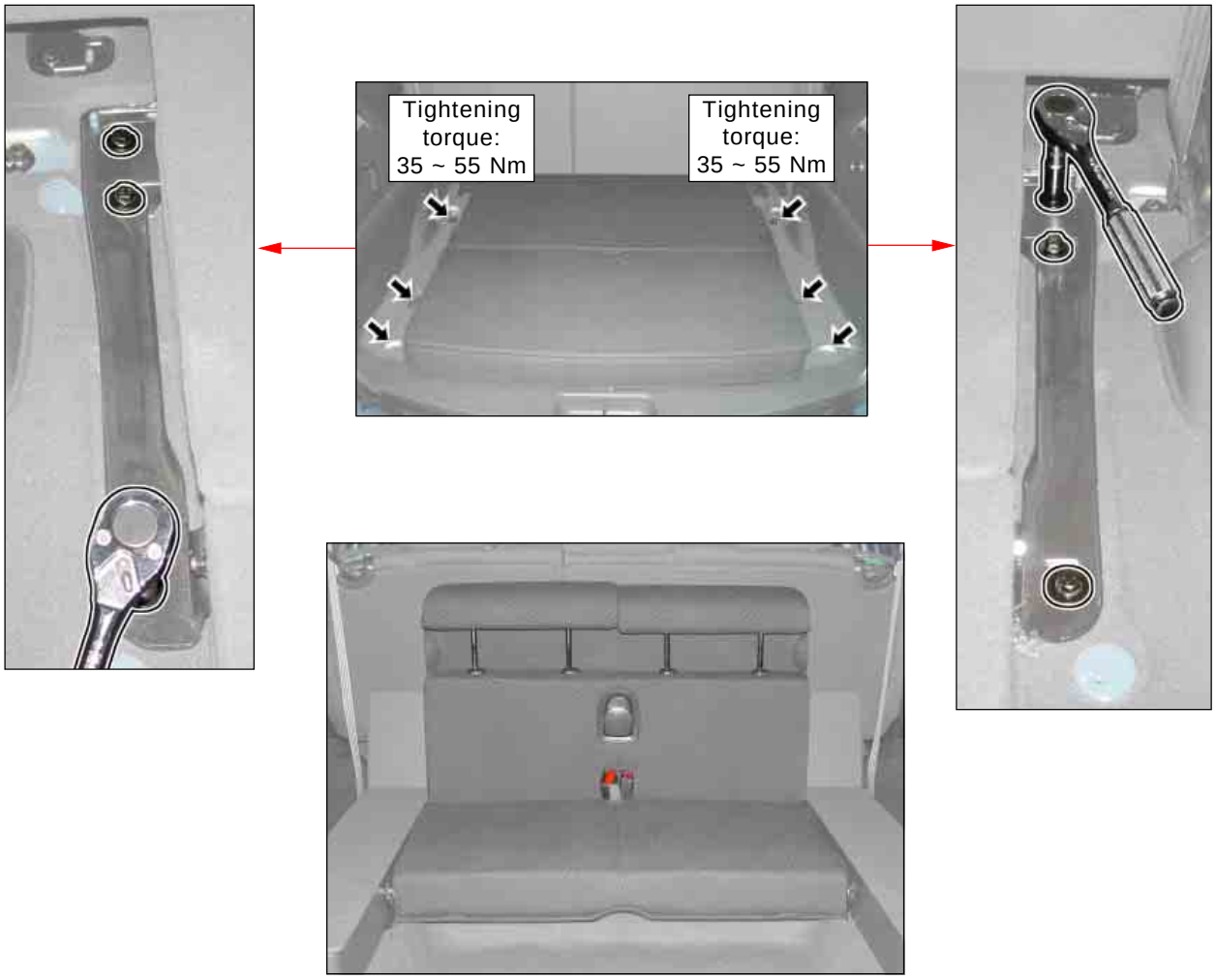
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Third Row Seat

1. Unscrew the six mounting bolts (10 mm) and remove the storage box from the luggage compartment.



2. Unscrew the mounting bolts and remove the third row seat.



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Power Seat Switch

※ **Preceding Work:** Disconnect the negative battery cable.

1. Slide the front seat forward and unscrew the mounting screws of seat side cover.



2. Disconnect the switch connector and remove the seat side cover.



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3. Remove the power seat switch cover and unscrew the two mounting screws to remove the switch.



Composition of Power Seat Switch



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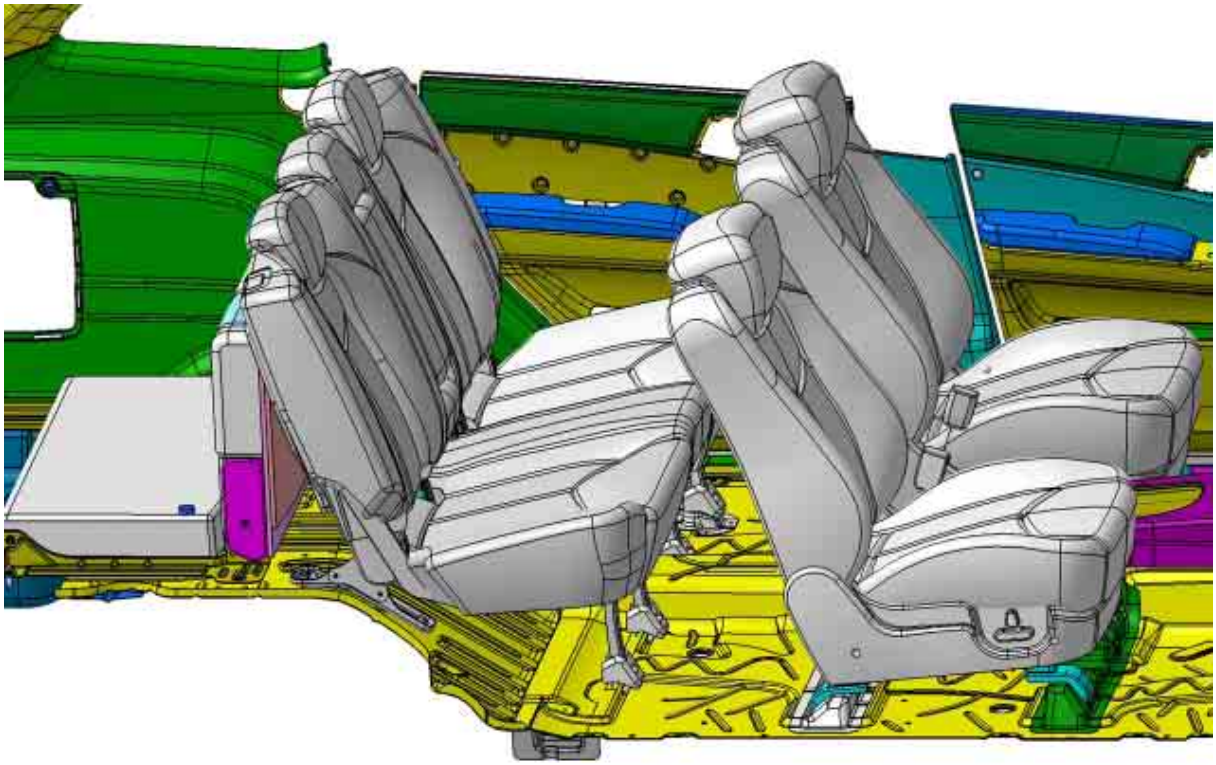
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4. SEAT HEATING



Press the button to warm the seat, and press it again to stop the operation. The indicator on the switch comes on during operation.

5. SEAT ARRANGEMENT



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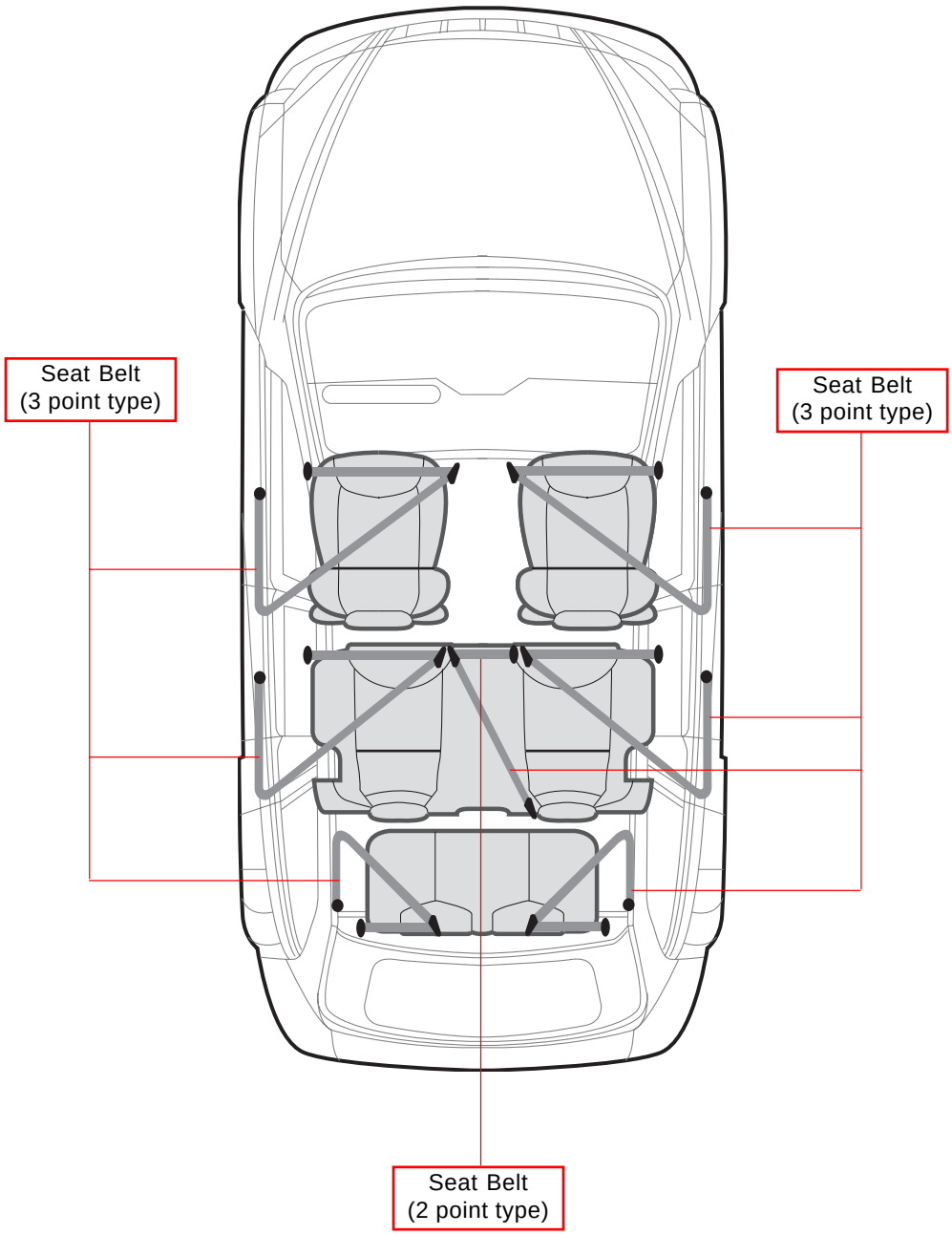
SEAT BELT

1. SEAT BELT LOCATIONS

3 Point type seat belt: driver's seat, passenger's seat, window side seats of second row seat, third row seat

2 Point type seat belt: center seat of second row seat

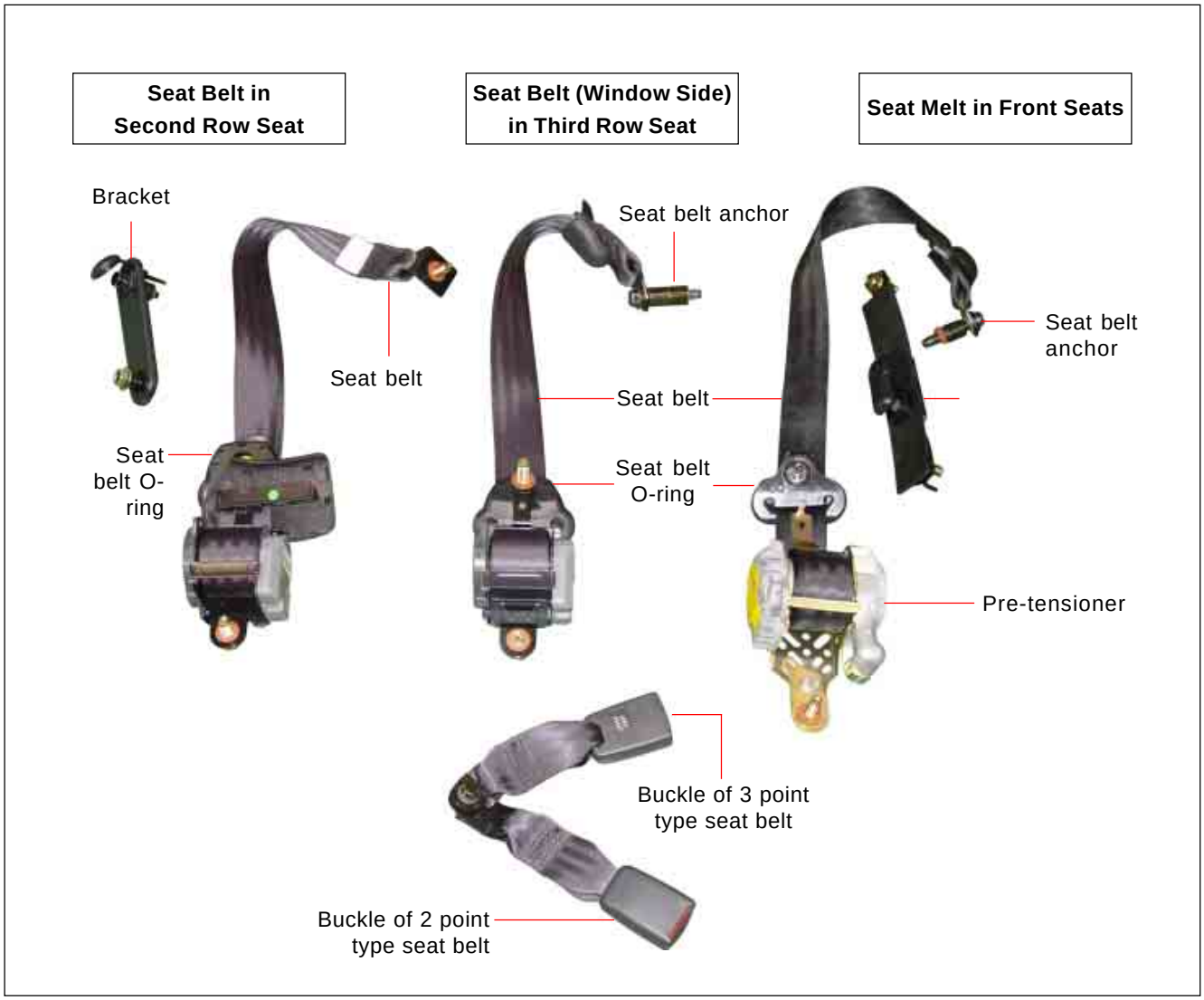
Pretensioner: Installed at front seats. The seat belt pretensioner rewinds the seat belt immediately to protect occupant's face and chest when a strong frontal collision occurs.



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Seat Belt (3 Point Type)



Seat Belt (2 Point Type)

2 point type seat belt is installed only in the center seat of second row seat.



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2. REMOVAL AND INSTALLATION OF SEAT BELT

▶ Front Seat Belt

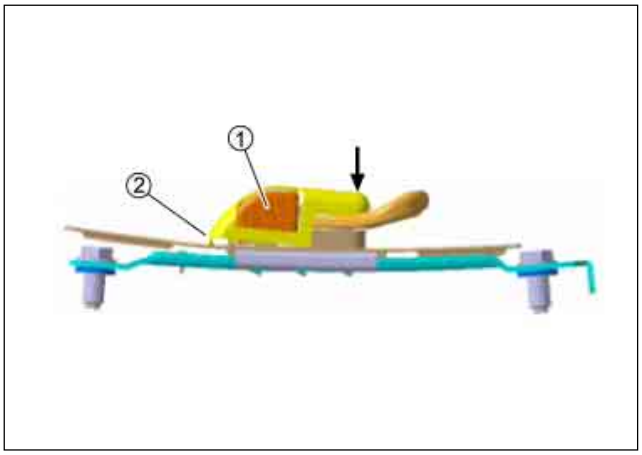
※ **Preceding Work:** Removal of front seat

1. Remove the seat belt D-ring cover.

NOTICE

- **In order not to damage the O-ring cover, be sure to observe the following procedures.**

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.

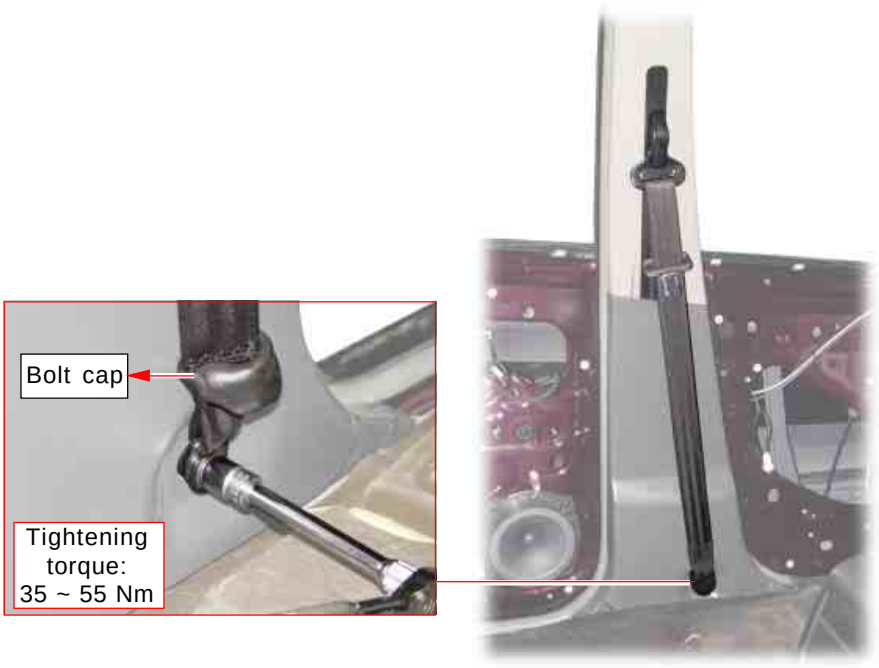




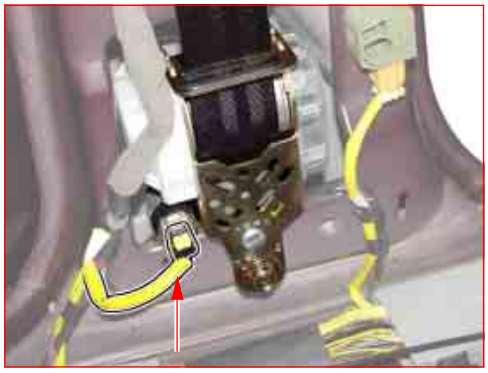
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2. Open the bolt cap and unscrew the seat belt anchor bolt.



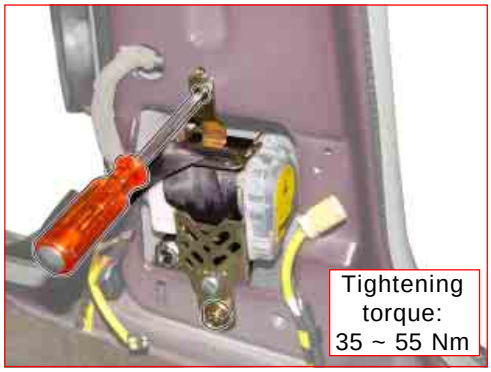
3. Remove the B pillar (lower) and disconnect the pretensioner connector.



4. Unscrew the seat belt upper mounting bolt from the height adjuster.



5. Carefully lower the seat belt and unscrew the mounting screws and bolts to remove the seat belt.





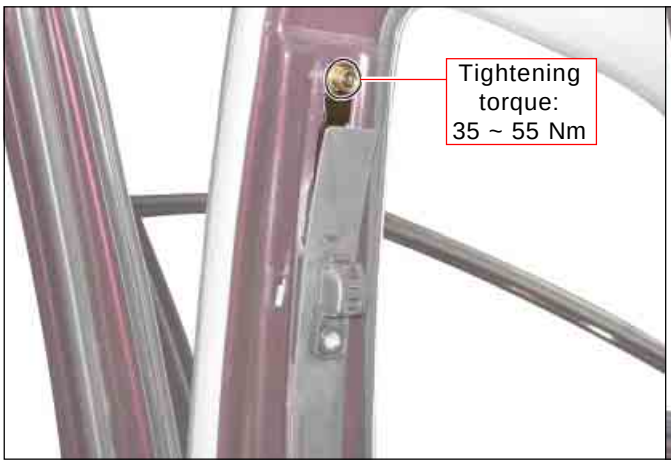
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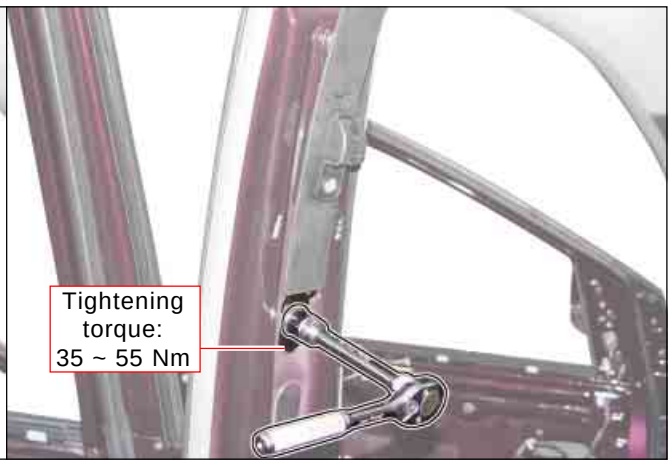
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6. Unscrew the mounting screws and remove the B pillar (upper).

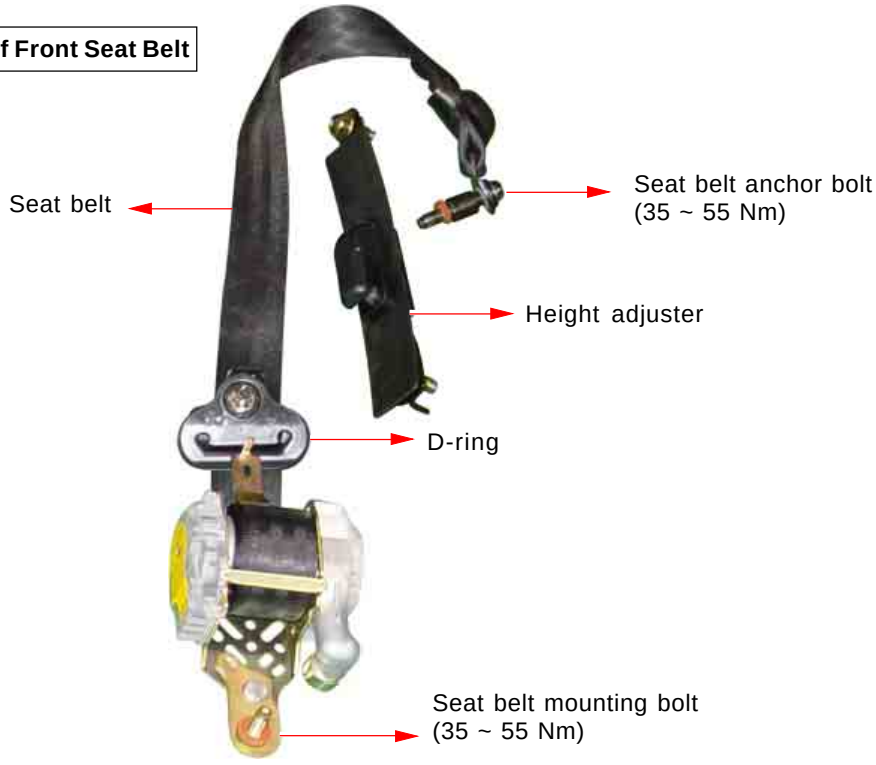


7. Unscrew the mounting bolts and remove the height adjuster.





Composition of Front Seat Belt

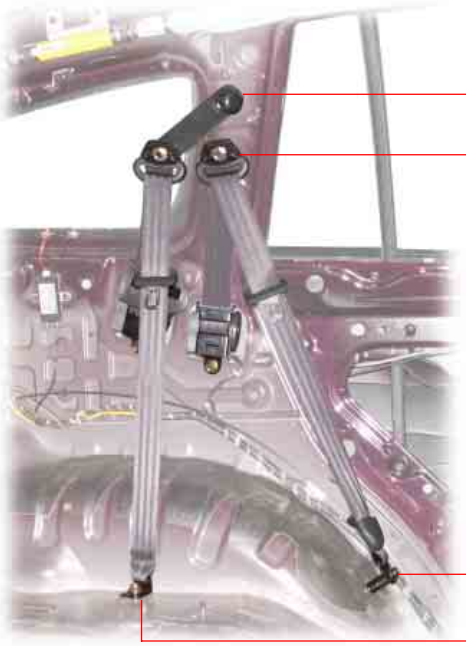


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Rear Seat Belt

※ **Preceding Work:** Removal of second row seat and third row seat



1. Open the bolt cap and unscrew the upper mounting bolt.

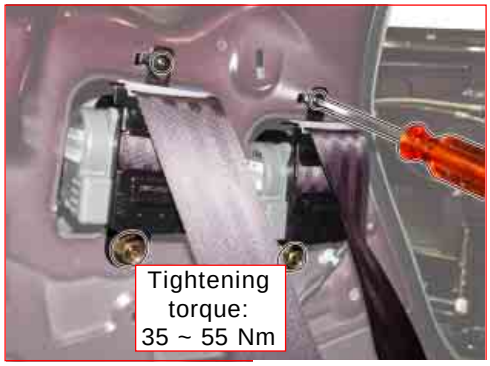


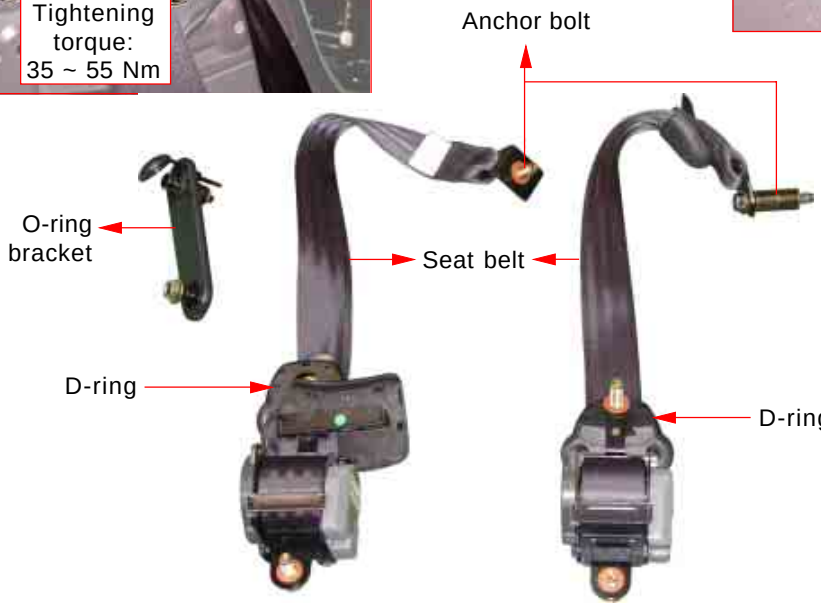
2. Unscrew the lower anchor bolt of the rear seat belt.





3. Remove the rear quarter panel and unscrew the guide pin screw and mounting bolts to remove the seat belt.



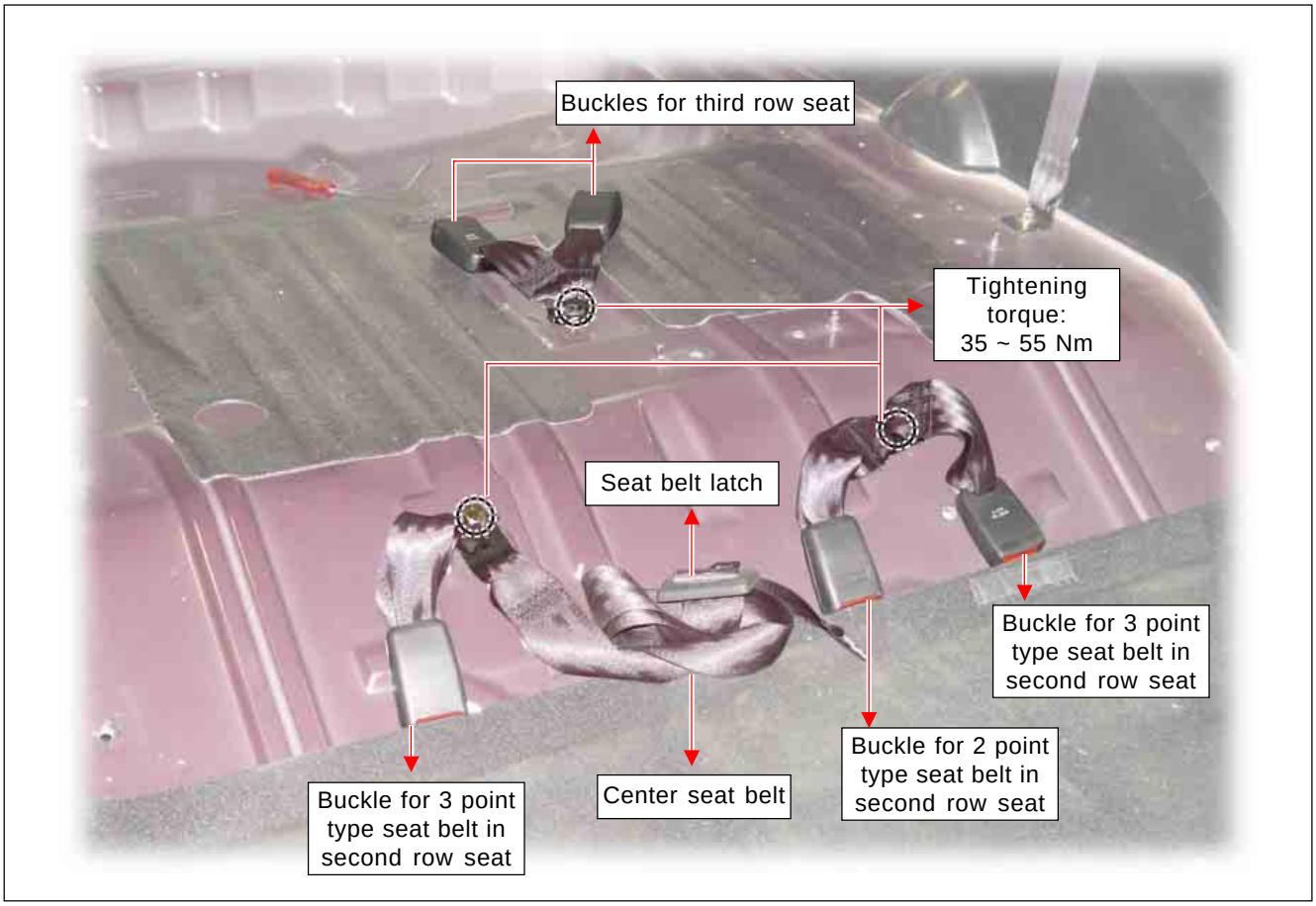


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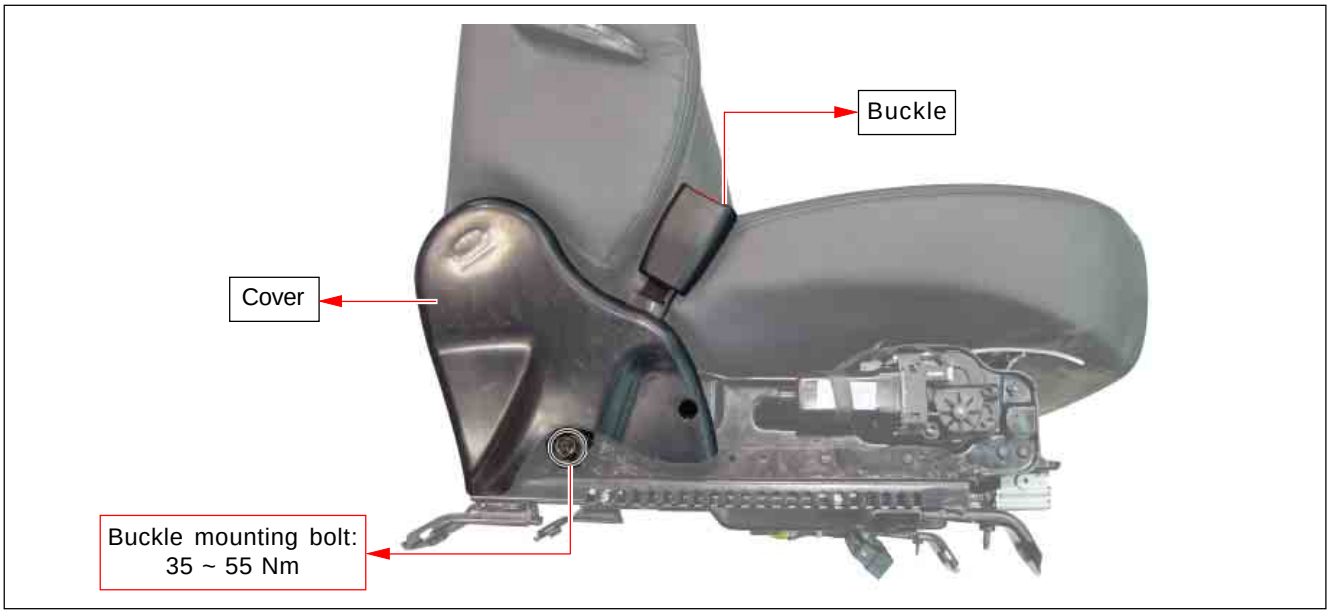
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▶ Buckles and Center Seat Belt

Reel Type Buckles and Center Seat Belt



Fixed Type Buckle (Front Seat)



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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

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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.

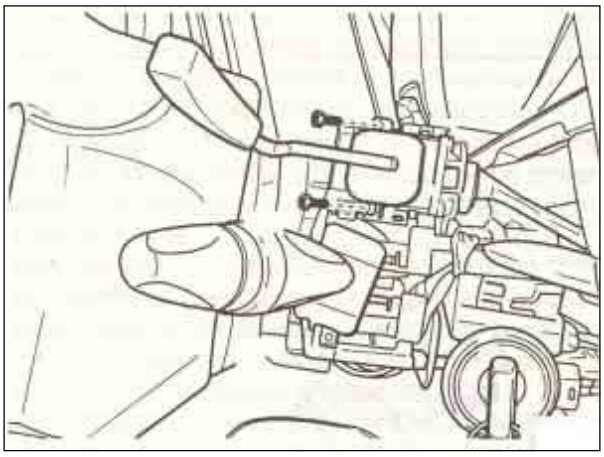
2. CURISE CONTROL SWITCH

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.

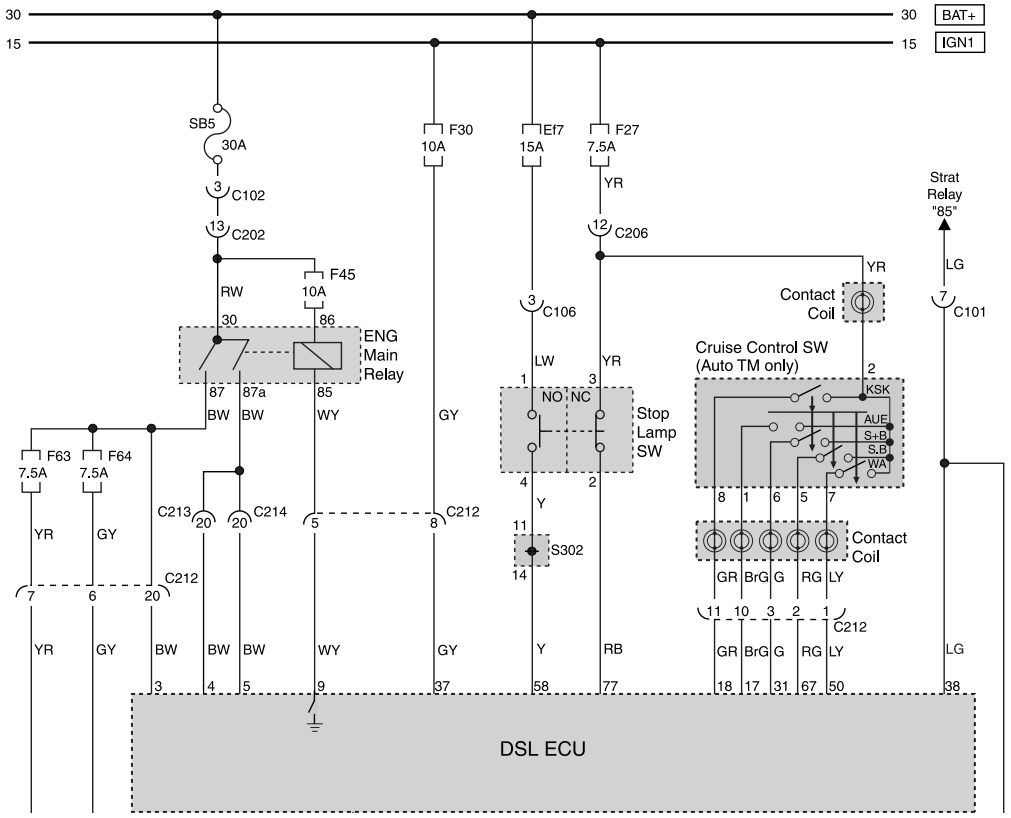


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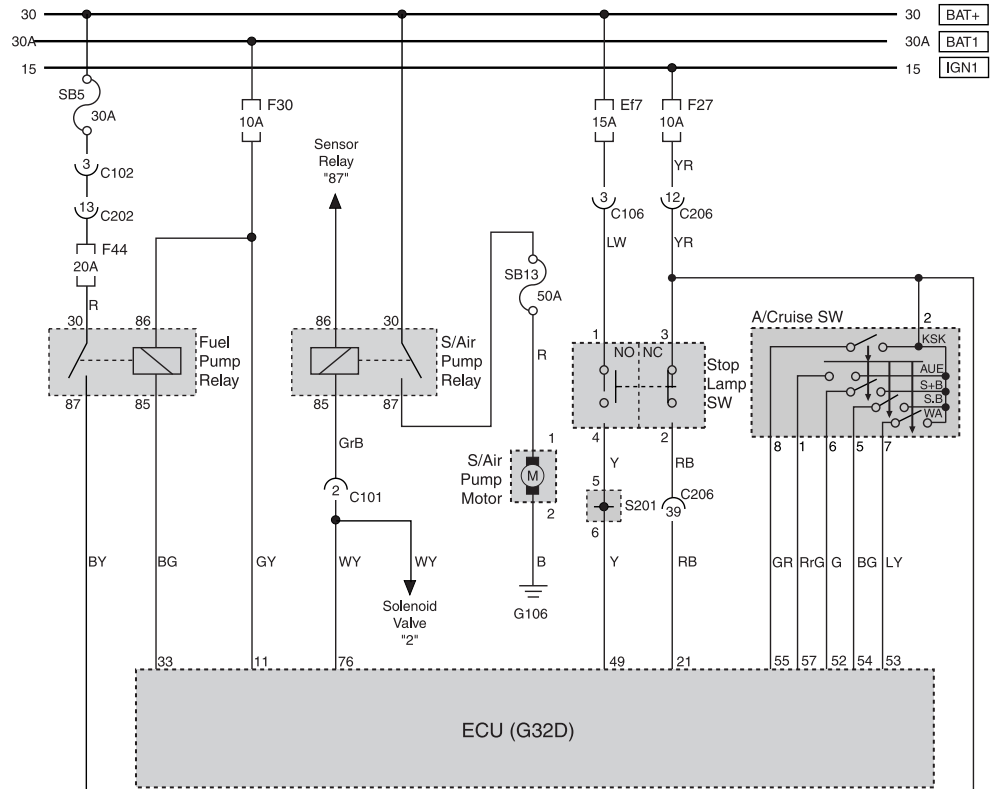
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4. ELECTRICAL WIRING DIAGRAMS

Diesel



Gasoline



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BODY INTERIOR

7730 / 7610 / 7330 / 7630 / 7632 / 7850 / 7770

TABLE OF CONTENTS

INTERIOR TRIM 2

1. Locations 2

INSTRUMENT PANEL 4

1. Removal and installation of instrument panel 4

SUN VISOR 11

1. Removal and installation of sun visor 11

REAR QUARTER TRIM AND PILLAR 12

1. Removal and installation of rear quarter trim and pillar 12

HEADLINING ASSEMBLY 14

1. Removal and installation of headlining 14

CENTER CONSOLE (A/T - DELUXE MODEL) 18

1. Removal and installation of center console (A/T) 18

CENTER CONSOLE (MANUAL TRANSMISSION) 20

1. Removal and installation of center console (M/T) 20

OUTSIDE REARVIEW MIRROR 22

1. Removal and installation of outside rearview mirror 22

INSIDE REARVIEW MIRROR 24

1. Removal and installation of inside rearview mirror 24

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INTERIOR TRIM

1. LOCATIONS

Instrument Panel Assembly



Center Console (A/T) - Deluxe Type



B Pillar Trim (Upper/Lower)



C Pillar Trim



Rear Quarter Panel



Door Trim (Driver Side Door)



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Hand Grip



Sun Visor





A Pillar Trim



Door Trim
(Passenger Side Door, Rear Doors)



Headlining Assembly



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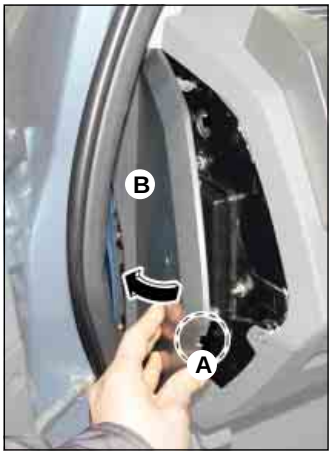
INSTRUMENT PANEL

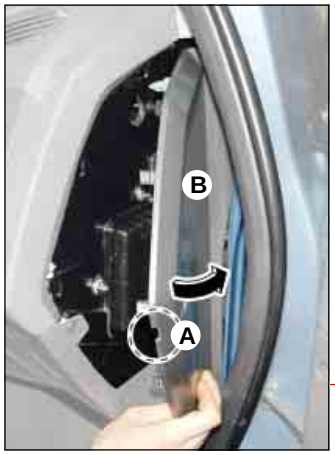
1. REMOVAL AND INSTALLATION OF INSTRUMENT PANEL

※ **Preceding Work:** Disconnect the negative battery cable.

▶ Step 1

1) Insert a flat blade screwdriver into the groove (A) and pry off the instrument side cover.



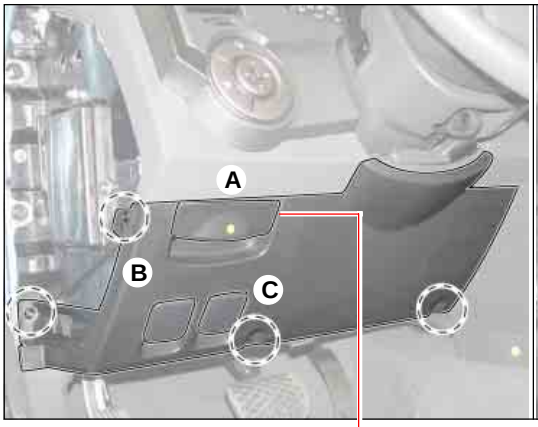


NOTICE

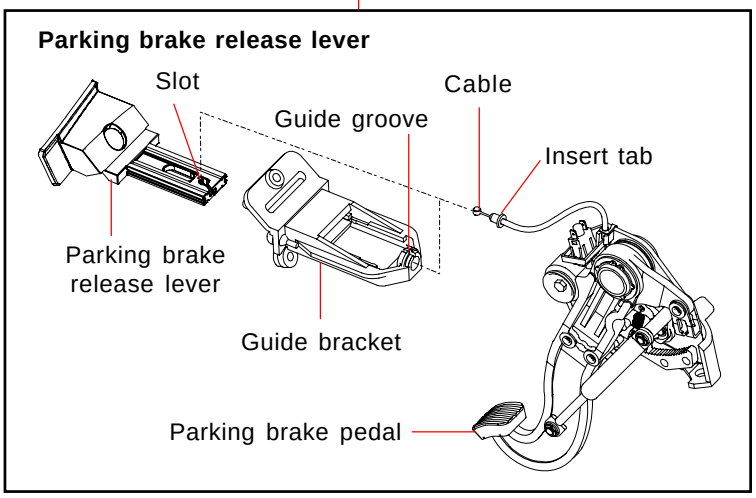
- **Be careful not to damage the components around the instrument panel and clips.**



2) Disconnect the cables for parking brake release lever (A), fuel lid opening lever (B), and engine hood release lever (C). Unscrew four mounting screws and remove the lower panel.







3) Unscrew the mounting bolts and nuts and remove the undercover and bracket.



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4) Remove the right side panel from the center fascia.





8) Remove the center console assembly and the center fascia lower tray.



5) Unscrew three mounting screws and remove the left side panel from the center fascia panel and AV head unit.



6) Remove the panel assembly of outside rearview mirror switch bezel (Refer to “Switch” section.).



7) Remove the DVD changer and passenger side lower instrument panel (Refer to “AV System” section.).



9) Remove the steering wheel assembly (steering angle sensor, air bag, air bag contact coil, multifunction switch).



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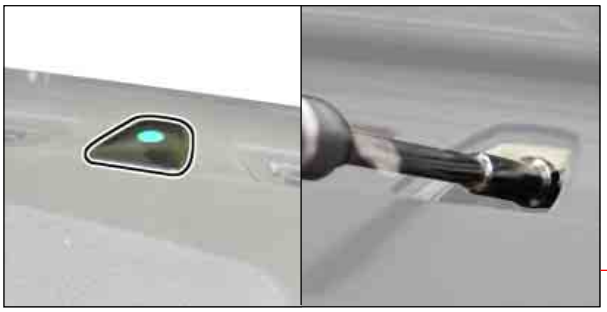
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▶ Step 2

1) Disconnect the harness and remove the sun sensor.

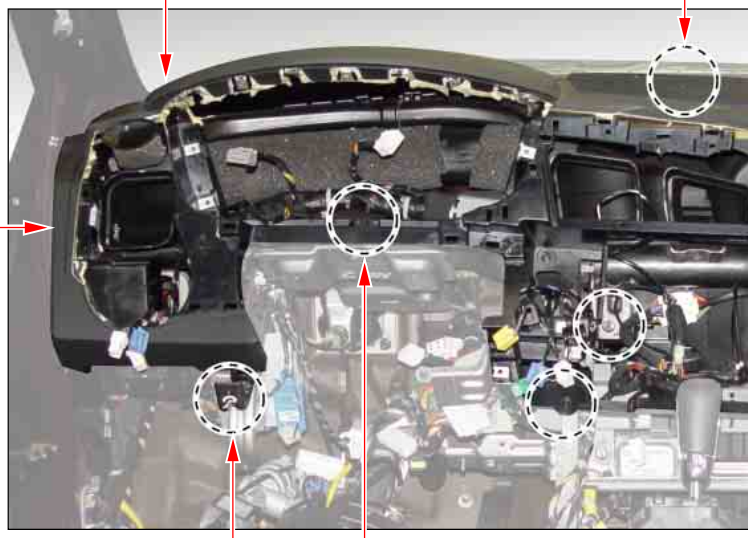


2) Unscrew the center bolt in the instrument panel.



3) Unscrew the mounting nuts and screws from the fuse/relay box and side instrument panel (at driver side).





4) Remove the parking brake lever bracket and fuse/ relay box assembly.

Parking Brake Lever Bracket	Driver Side Fuse/ Relay Box
	

5) Unscrew the meter cluster mounting nuts and lower instrument panel mounting bolts.



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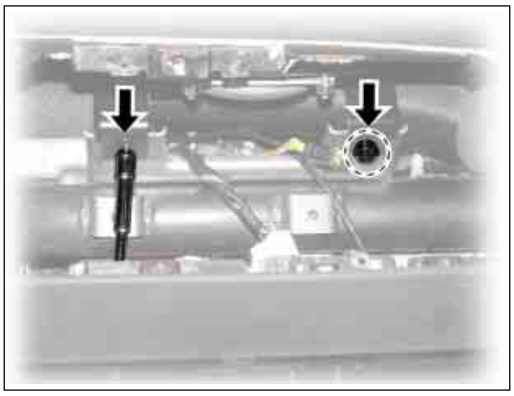
6) Remove the center speaker from the instrument panel (Refer to “AV System” section.).



7) Unscrew the nuts from the center fascia.



8) Unscrew the mounting nuts from the DVD changer in passenger side instrument panel.





9) Unscrew the mounting nuts and screws from the fuse/ relay box and side instrument panel (at passenger side).



10) Disconnect the GPS antenna connector.



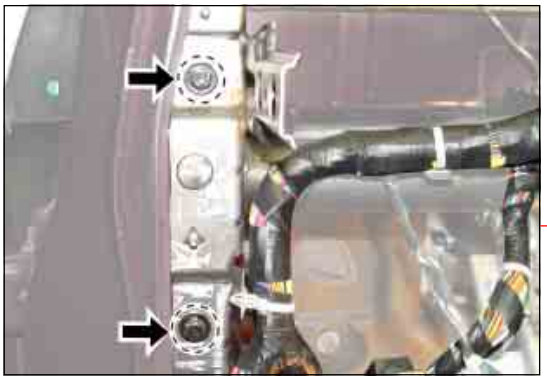
11) Remove the instrument panel assembly.



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▶ Step 3

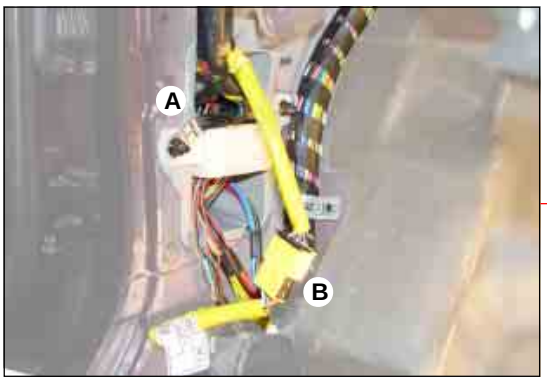
1) Unscrew the mounting bolts from the driver side instrument panel frame.



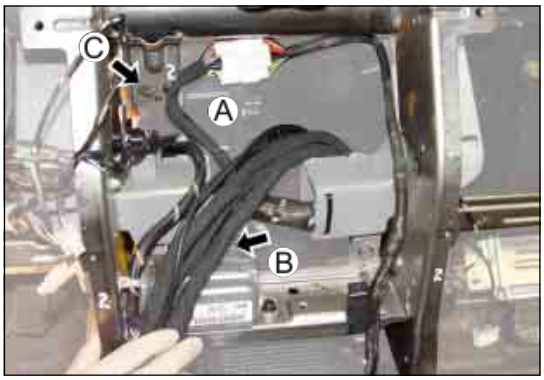
2) Unscrew the mounting bolts from the driver side steering column bracket.

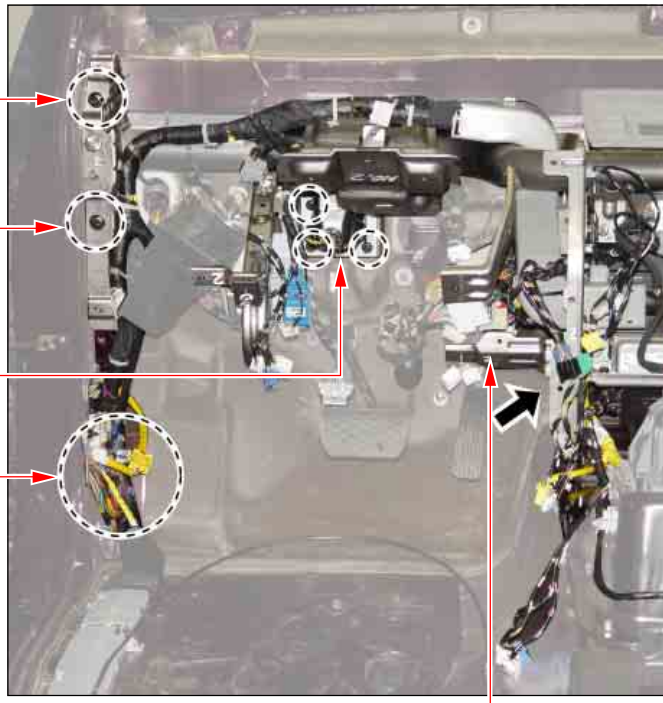


3) Disconnect the main wiring connector (A) and air bag connector (B).

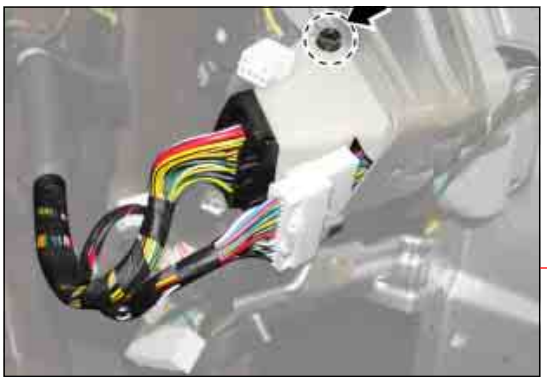


5) Disconnect the A/C main (A) cable and the sensor cluster (B) connector and the frame mounting bolt (center side).





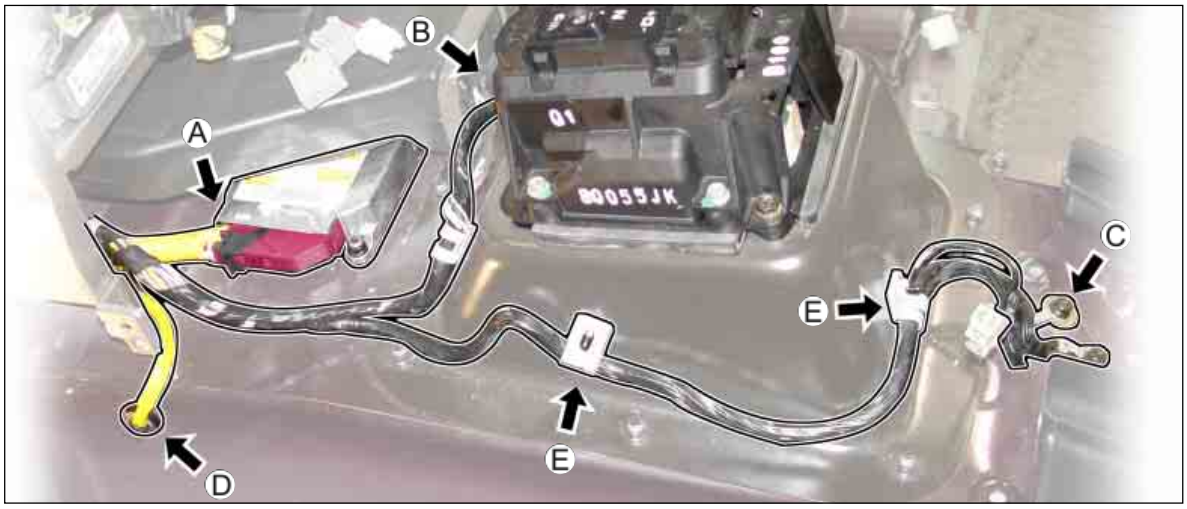
4) Disconnect the center wiring connector and unscrew the mounting bolt.

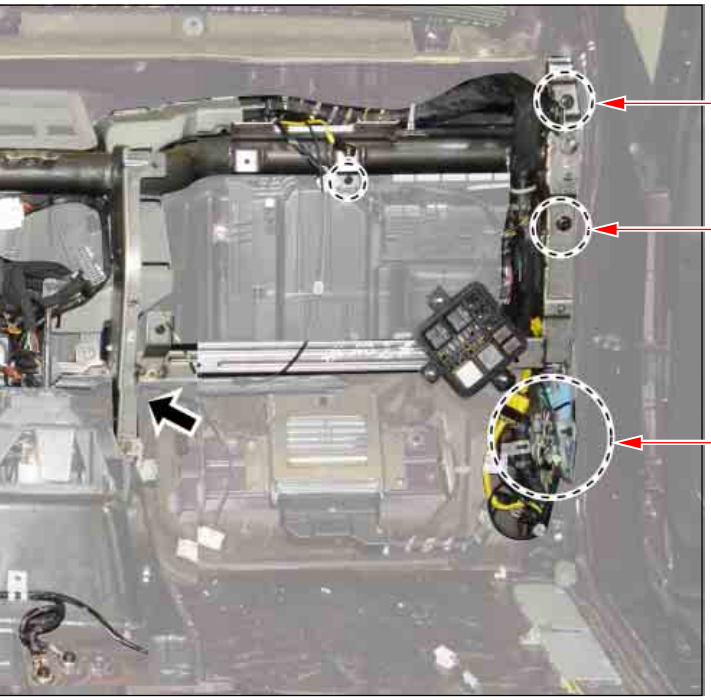


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AFFECTED VIN	

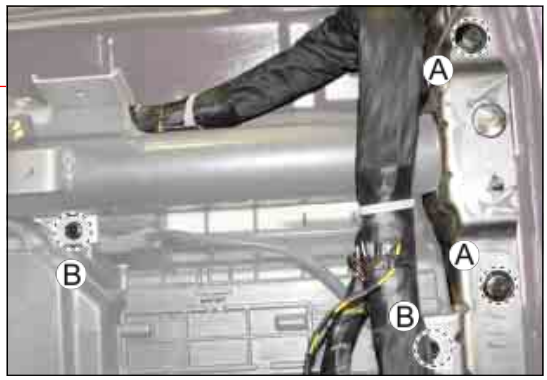
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6) Disconnect the air bag connector (A) and A/T connector (B), ground cable (C) and air bag ground cable (D), then release the clamp (E) from console box.





7) Unscrew the mounting bolts (A, B) from the passenger side instrument panel frame and air conditioner module.



8) Unscrew the center mounting bolts at both sides in the instrument panel frame.

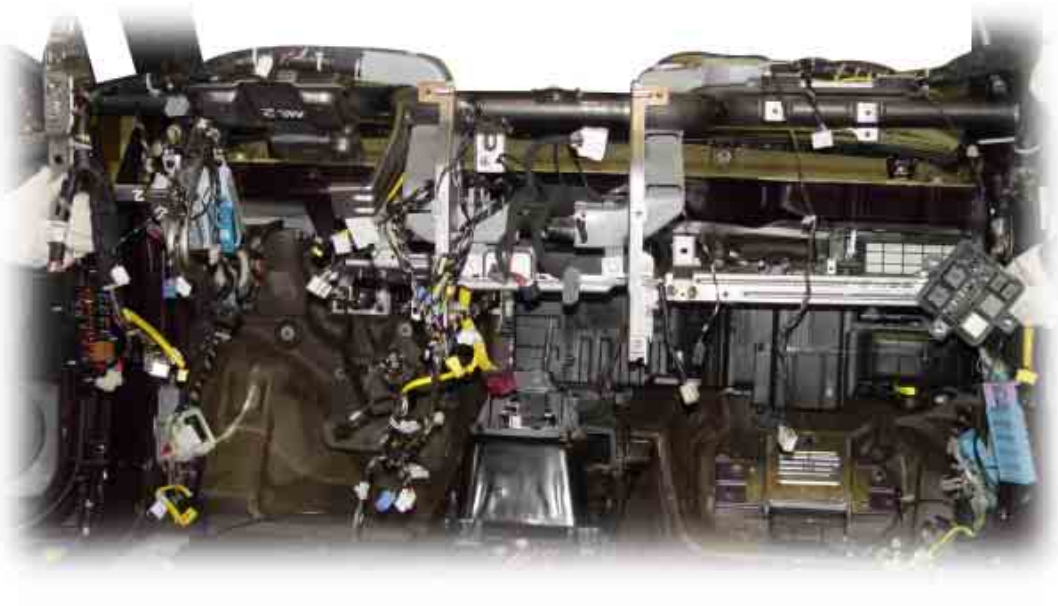


9) Disconnect the main wiring, the optical cable and the SSPS connector etc. on the passenger side.



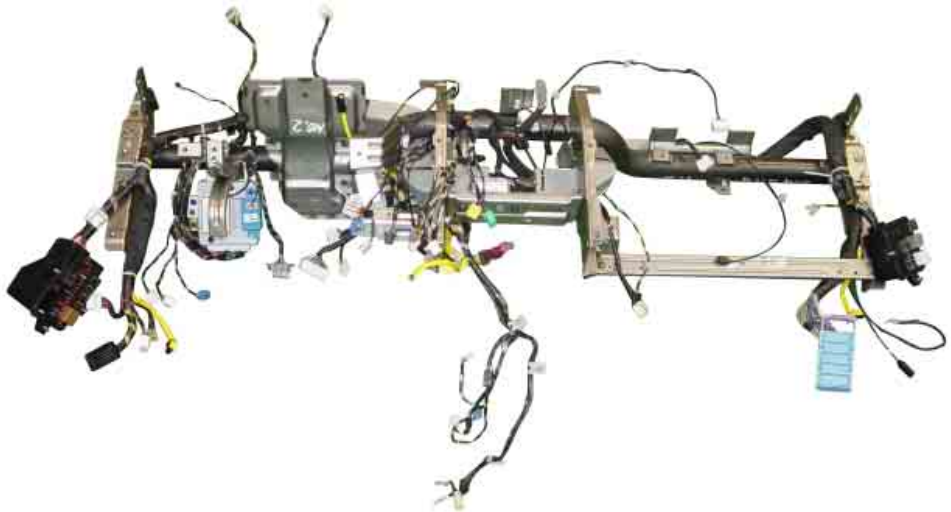
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10) Remove the instrument panel frame.



Instrument Panel and Panel Frame Assembly





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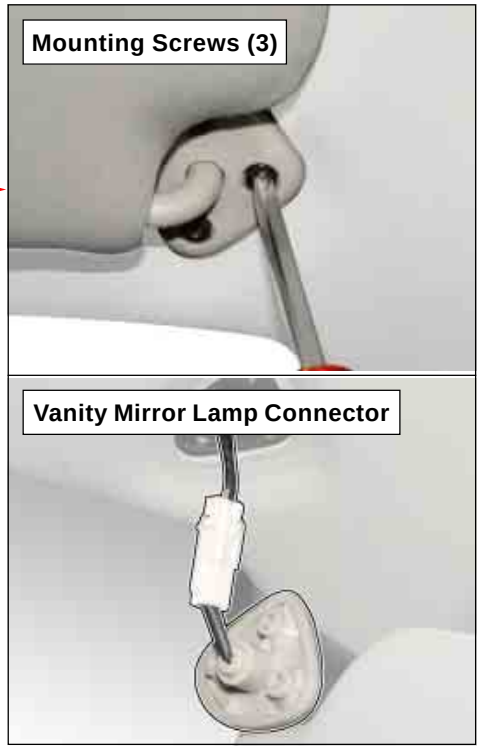
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SUN VISOR

1. REMOVAL AND INSTALLATION OF SUN VISOR

Unscrew the screws and disconnect the vanity mirror lamp connector. Remove the sun visor and sun visor hook.





Sun Visor Components



Driver side



Passenger side

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REAR QUARTER TRIM AND PILLAR

1. REMOVAL AND INSTALLATION OF REAR QUARTER TRIM AND PILLAR

※ **Preceding Works:** Disconnect the negative battery cable and remove the seats.
For seat belt, refer to “Seat and Seat Belt” section.

Rear Quarter Trim

Remove the seat belt and D pillar before removing the rear quarter trim.
Disconnect the power outlet connector before removing the passenger side rear quarter trim.

1. Unscrew the mounting screws and remove the rear quarter trim.

A. Upper Bolt (D Pillar Side)

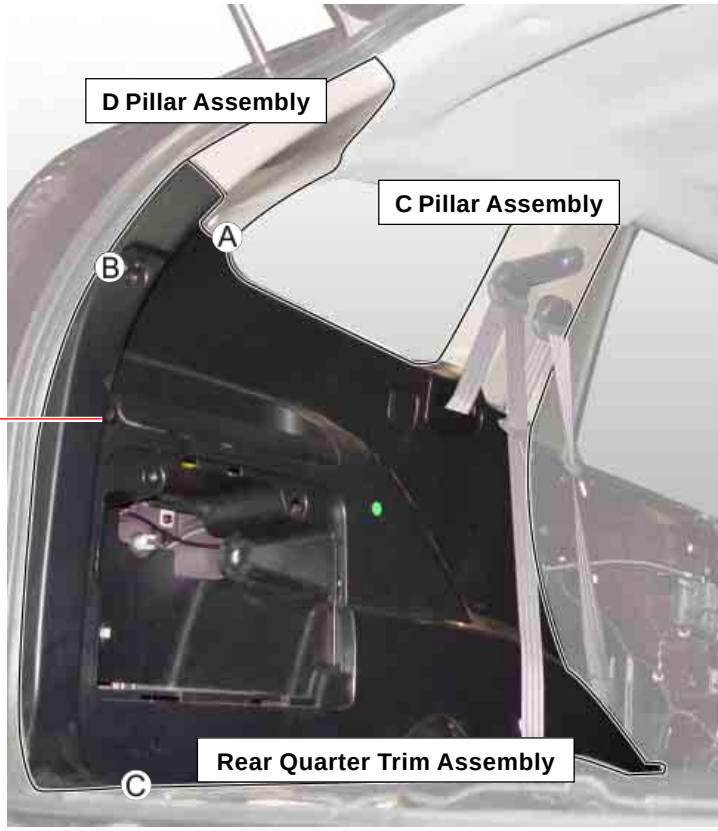


B. Side Bolt



C. Lower Bolt (Tailgate Side)





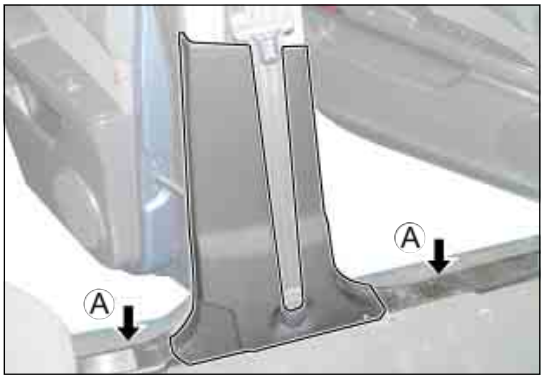
Remove the tailgate scuff trim before removing the lower screw of rear quarter trim.

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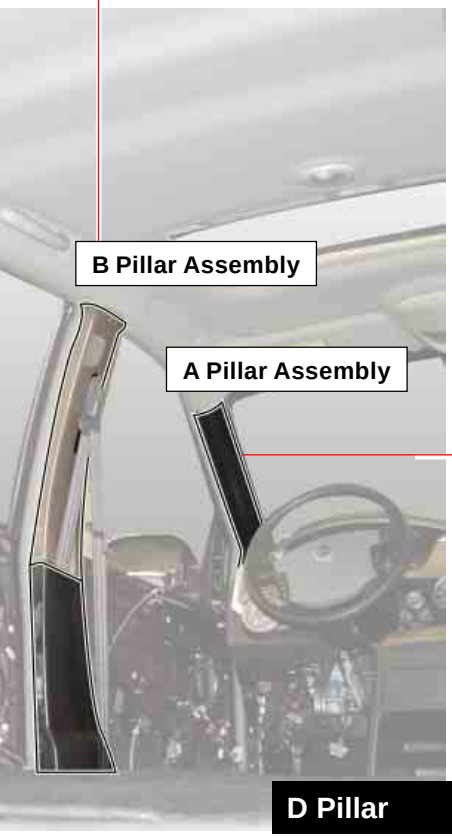
B Pillar Trim

Remove the front and rear scuff trims (A) and remove the lower B pillar.



Unscrew the upper screw and remove the upper B pillar.





A Pillar

Remove the door weather strip and unscrew the mounting screws to remove the A pillar.



C Pillar

Remove the seat belt and unscrew the mounting screws to remove the C pillar.



Be careful not to damage the pillars and fasteners.

D Pillar



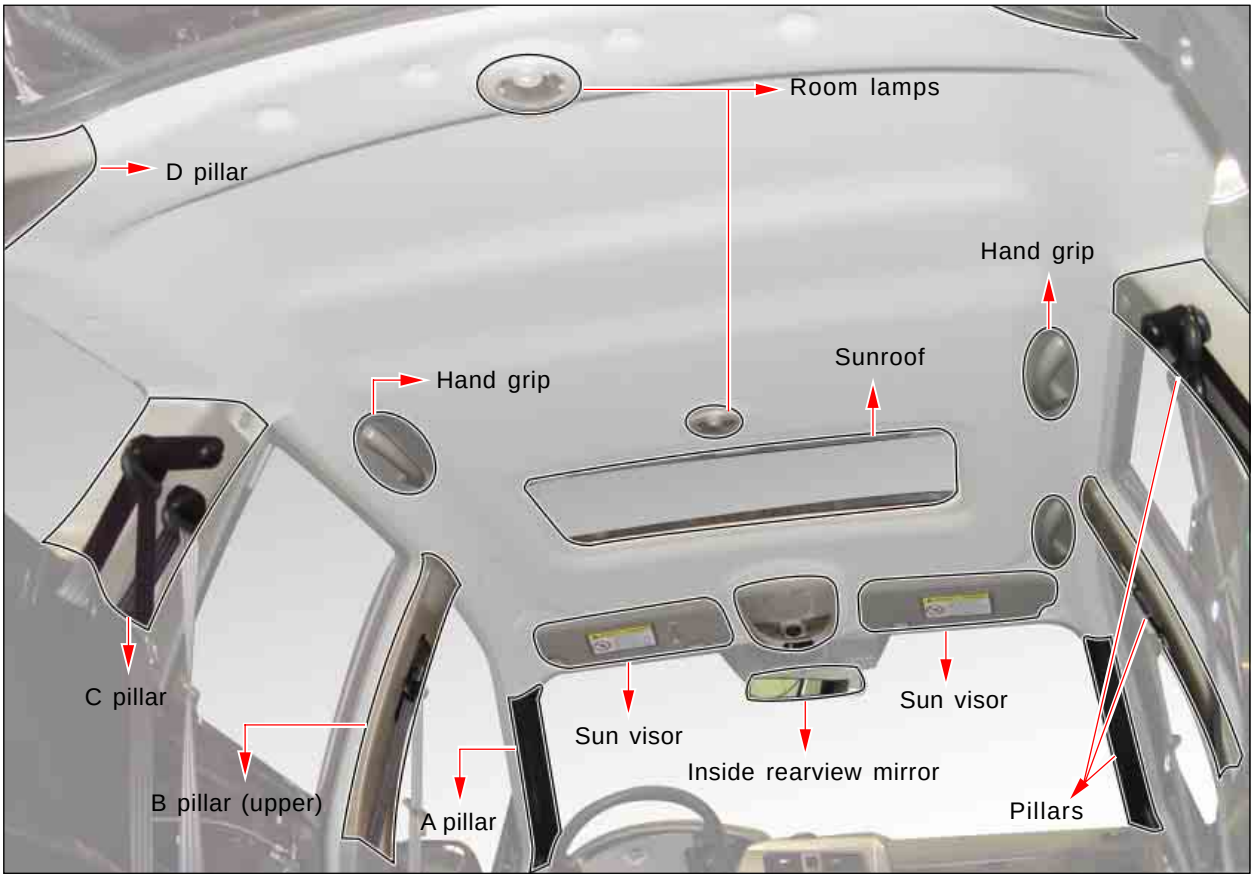
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HEADLINING ASSEMBLY

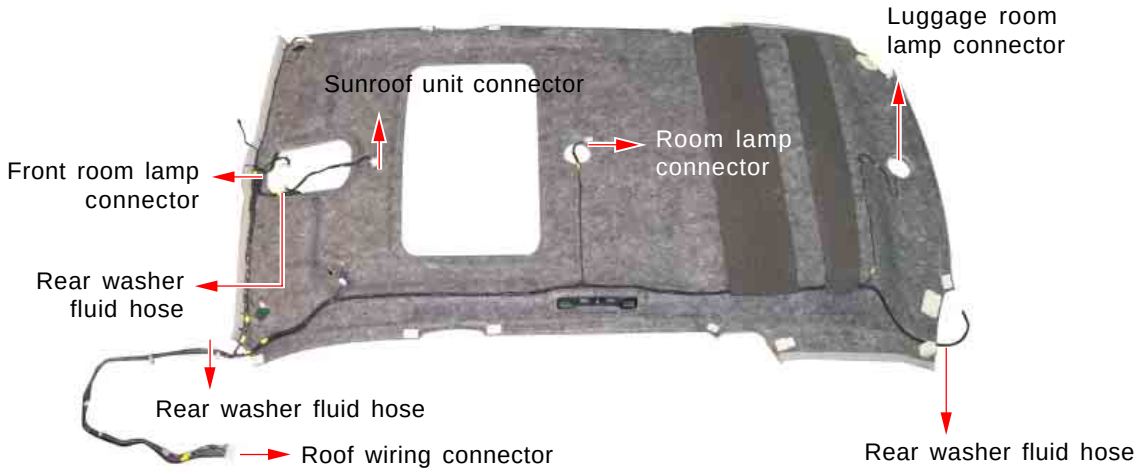
1. REMOVAL AND INSTALLATION OF HEADLINING

※ **Preceding Work:** Disconnect the negative battery cable.

1. Remove the components shown in the figure below (Refer to “Body” and “Lamp” sections.).



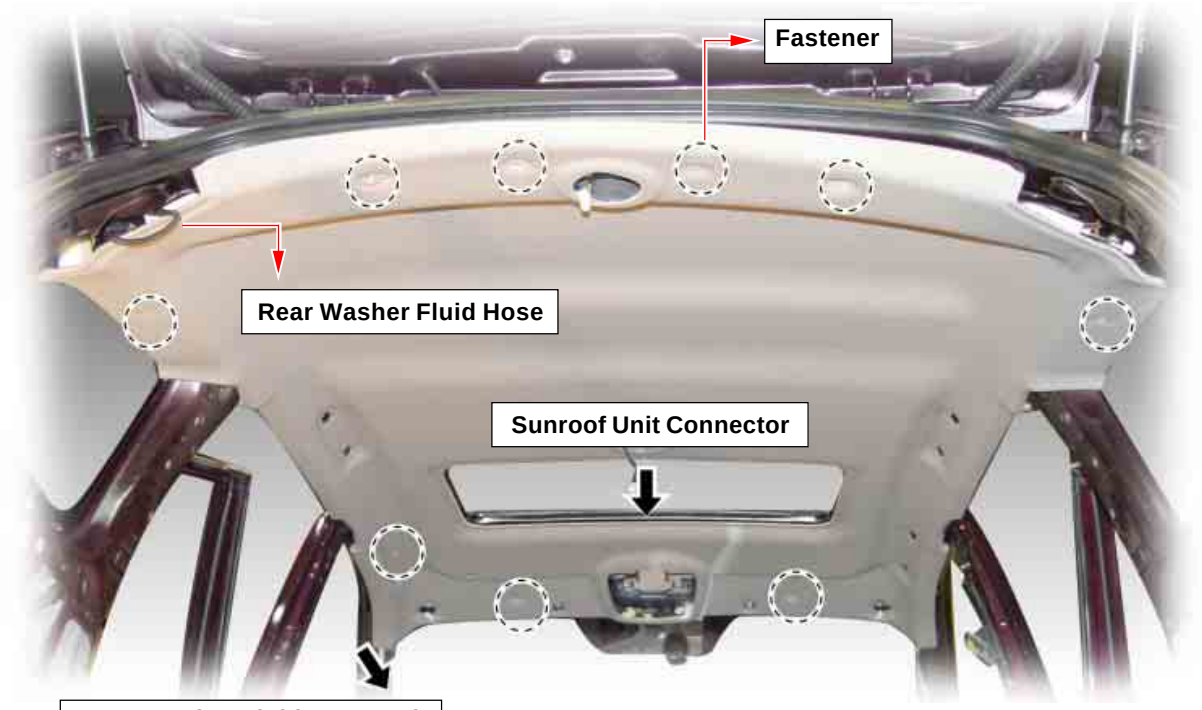
Headlining



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2. Disconnect the connectors and washer fluid hoses from the headlining and remove the fasteners.

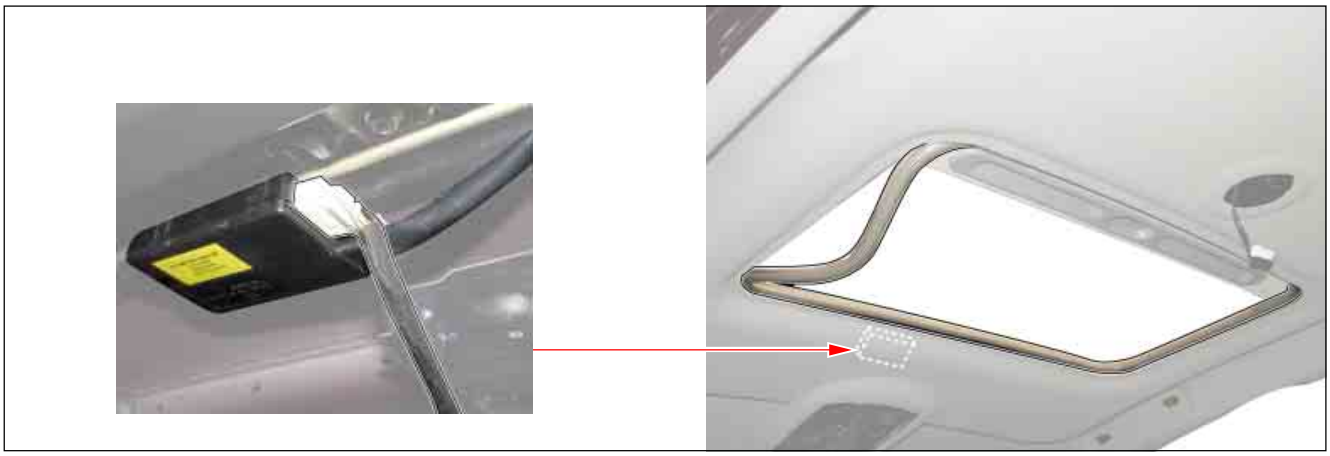




* Use only designated special tool when removing the fasteners.

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1) Remove the sunroof molding and disconnect the sunroof unit connector.



2) Disconnect the rear washer fluid hose (nozzle side).



3) Remove the roof wiring connector (A) and rear washer fluid hose (B) in driver side.



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4) Pull out the fasteners (rear - 4, front - 2, luggage compartment - 4 at each side) and remove the headlining assembly.



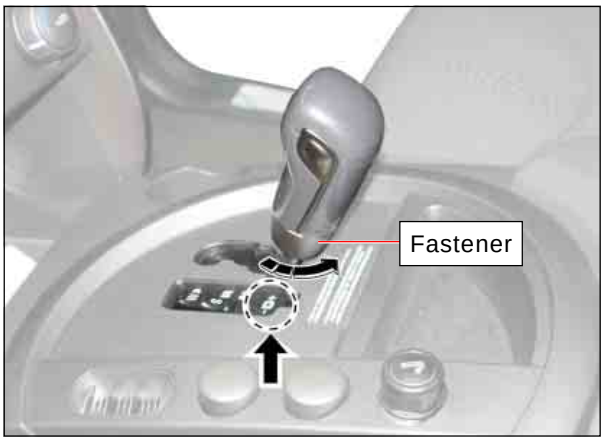
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CENTER CONSOLE (A/T - DELUXE MODEL)

1. REMOVAL AND INSTALLATION OF CENTER CONSOLE (A/T)

1. Place the gear selector lever to “D” position and remove the lever knob.
   Move the gear selector lever to “N” position.

※ To remove the lever knob, pull up the knob after turning the fastener



2. Disconnect the cigarette lighter connector and remove the console fascia cover.





3. Remove the gear selector lever cover and storage box.

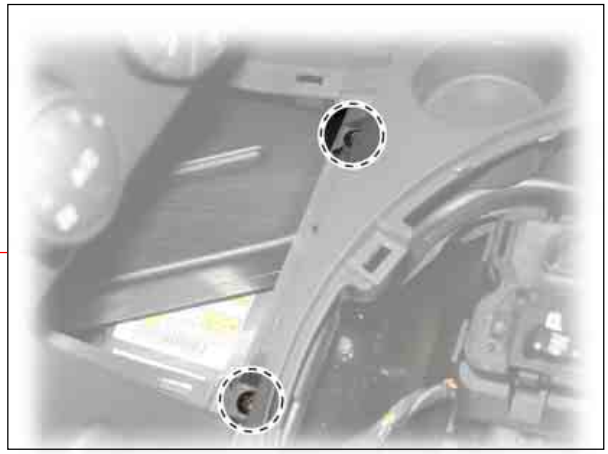




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4. Unscrew two mounting screws from the center storage box.



5. Remove the screw caps and unscrew the mounting screws at both sides of center console.





6. Remove the storage box cover and disconnect two mounting bolts (10 mm) in center console.



7. Remove the center console.



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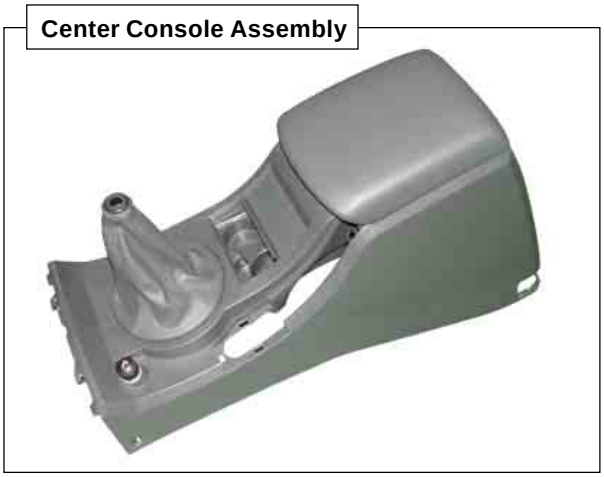
CENTER CONSOLE (MANUAL TRANSMISSION)

1. REMOVAL AND INSTALLATION OF CENTER CONSOLE (M/T)

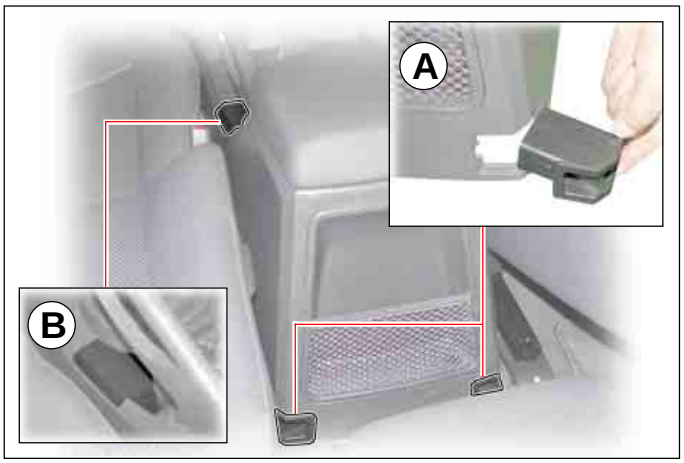
1. Remove the gear shift lever knob by turning it counterclockwise.



Center Console Assembly



2. Remove the rear duct adapter (A) and center console cover (B).





3. Remove the storage box in center console.



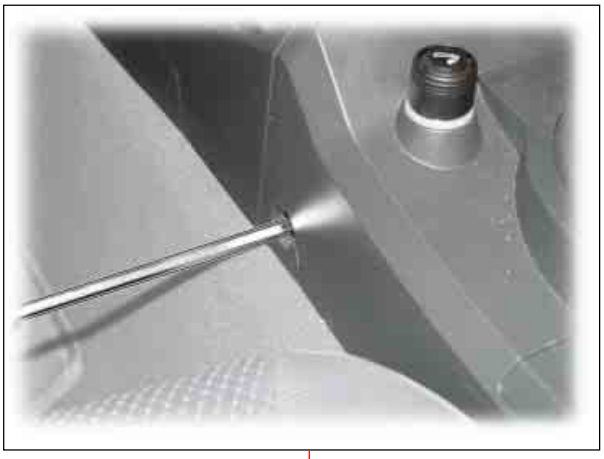
4. Unscrew two mounting screws in center storage box.



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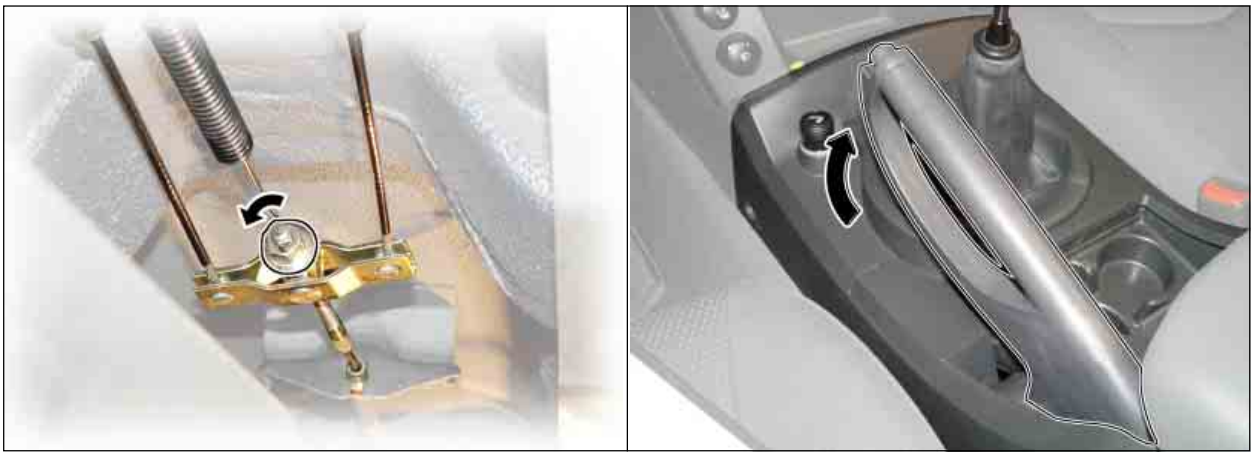
5. Unscrew the mounting screws at both sides of center console.



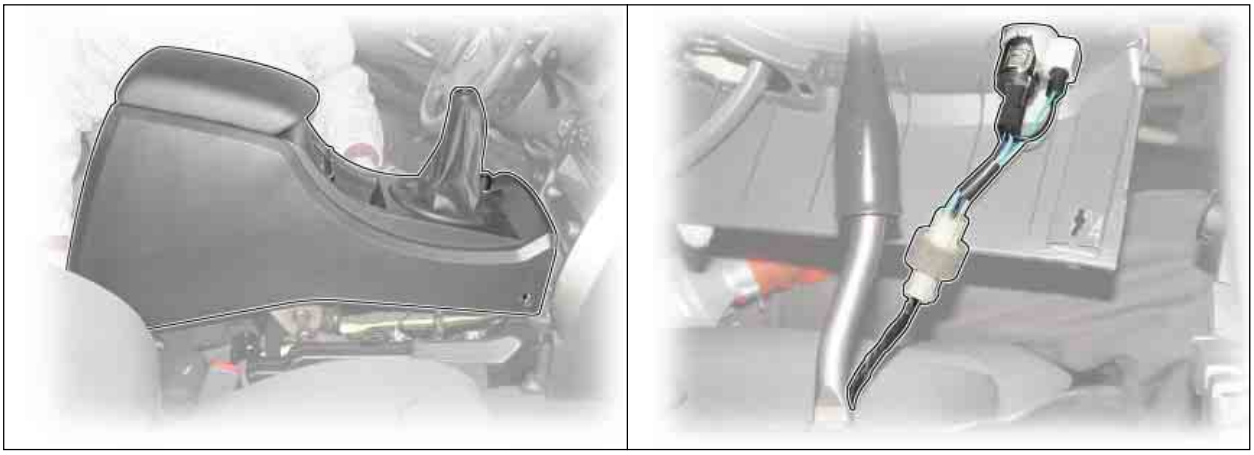
6. Remove the storage box cover and unscrew the mounting bolts in center console.



7. 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.

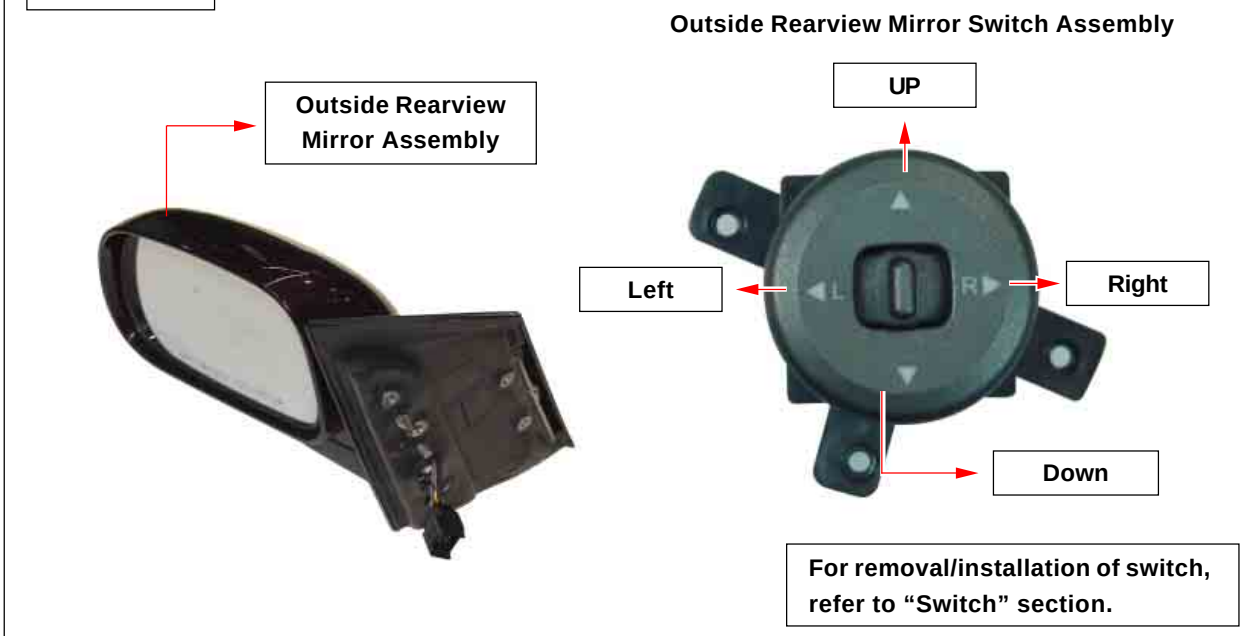


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OUTSIDE REARVIEW MIRROR

1. REMOVAL AND INSTALLATION OF OUTSIDE REARVIEW MIRROR

Components



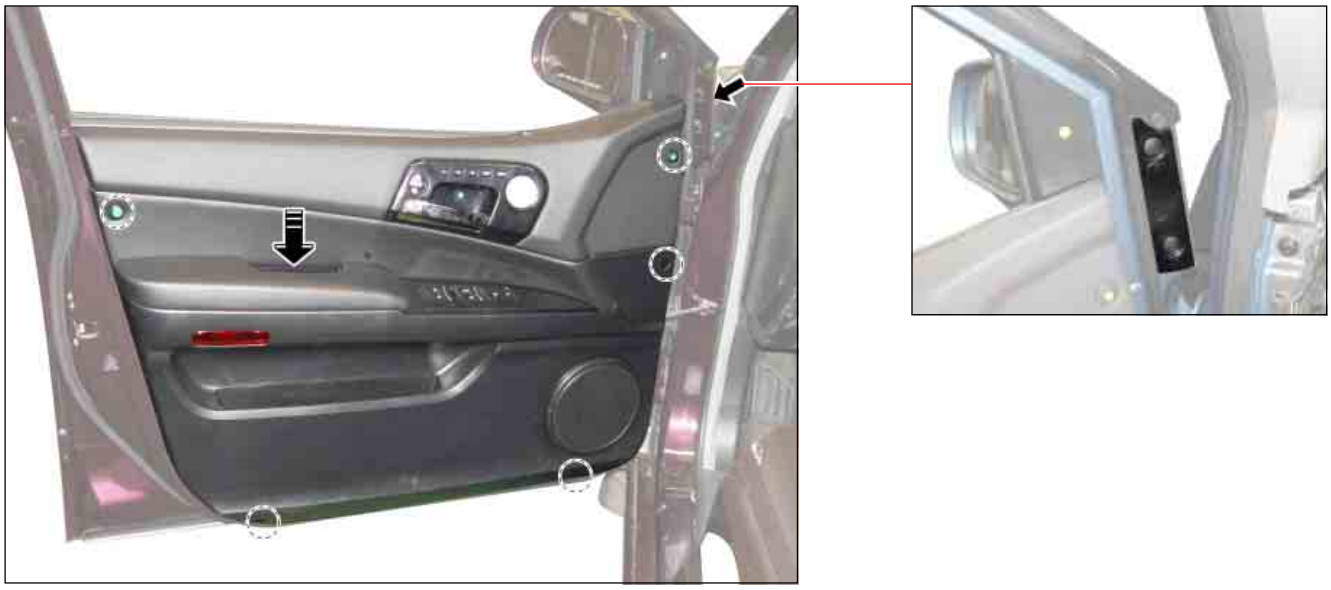
1. Remove the inner cover and disconnect the outside rearview mirror connector.



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2. Remove the door trim and then remove the inner cover of outside rearview mirror.



Unscrew the mounting screws with dotted circle and remove the door trim from lower side (For details, refer to "Door" section.).

3. Unscrew five mounting bolts (10 mm) and remove the outside rearview mirror.



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INSIDE REARVIEW MIRROR

1. REMOVAL AND INSTALLATION OF INSIDE REARVIEW MIRROR

1. Pry off the room mirror cover with a flat blade screwdriver.

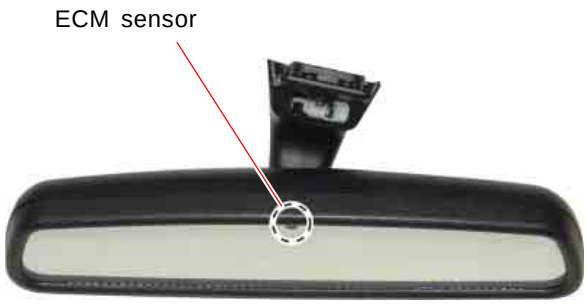


2. Disconnect the harness connector and remove the inside rearview mirror.





Inside Rearview Mirror





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BODY EXTERIOR

4610 / 4620

TABLE OF CONTENTS

BODY EXTERIOR 2

1. Front 2
2. Rear 3

BUMPER 4

1. Construction 4
2. Removal and installation of bumper 6

HOOD ASSEMBLY 11

1. Construction 11
2. Removal and installation of hood assembly 12

ROOF FASHION RAIL 16

1. Construction 16
2. Removal and installation 16

TAILGATE 17

1. Tailgate assembly 17

REAR AIR SPOILER 23

SIDE SEAL MOLDING 24

1. Construction 24

FENDER 26

1. Removal and installation of fender 26

FRONT DOOR 28

1. Removal and installation of front door 28
2. Removal and installation of front door trim 29
3. Components of front door opening system 30
4. Front window regulator 31

REAR DOOR 33

1. Removal and installation of rear door 33
2. Removal and installation of rear door trim 34
3. Components of rear door opening system 35
4. Rear window regulator 36

FUEL TANK 38

1. Removal and Installation of Fuel Tank (for removing rear left upper arm and lower arm) 38

SPARE TIRE 40

1. Removal and Installation of Spare Tire 40

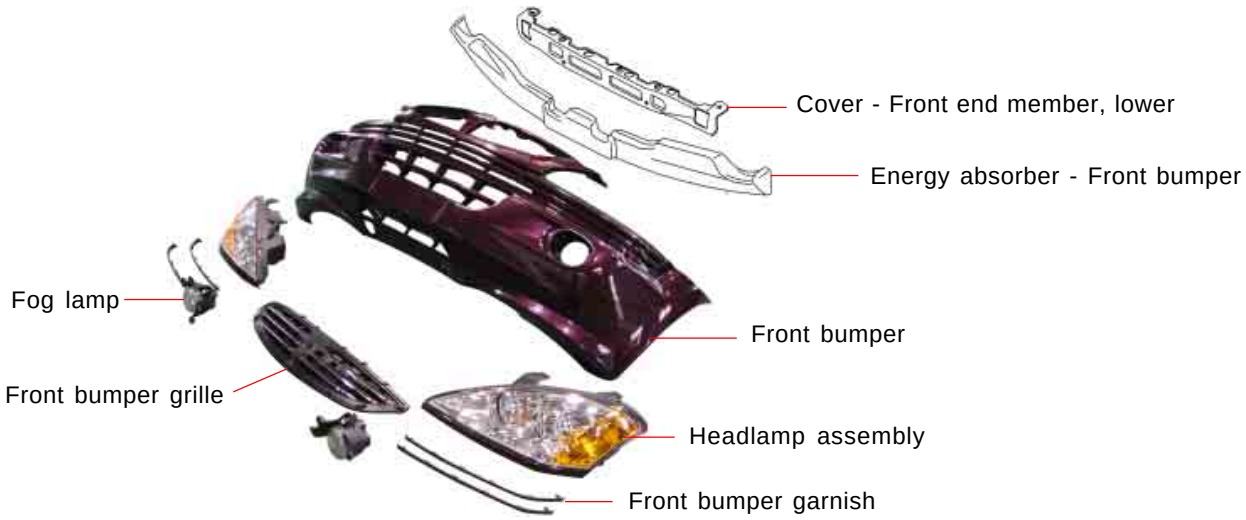
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BODY EXTERIOR

1. FRONT



Front Section



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2. REAR

Rear Door



Rear Air Spoiler





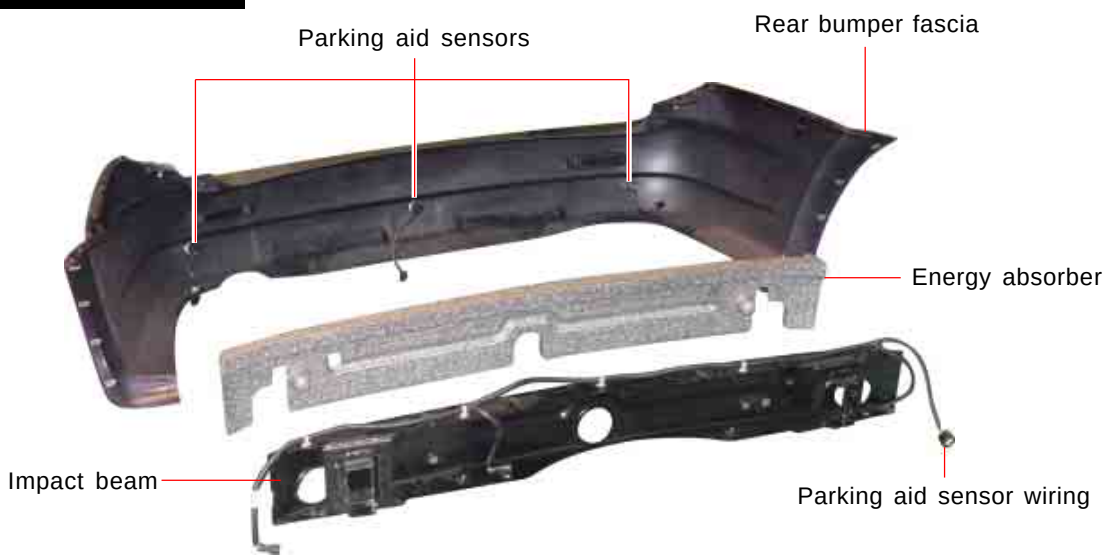
Tailgate



Roof Fashion Rail



Rear Bumper Assembly



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EFFECTIVE DATE	
AFFECTED VIN	

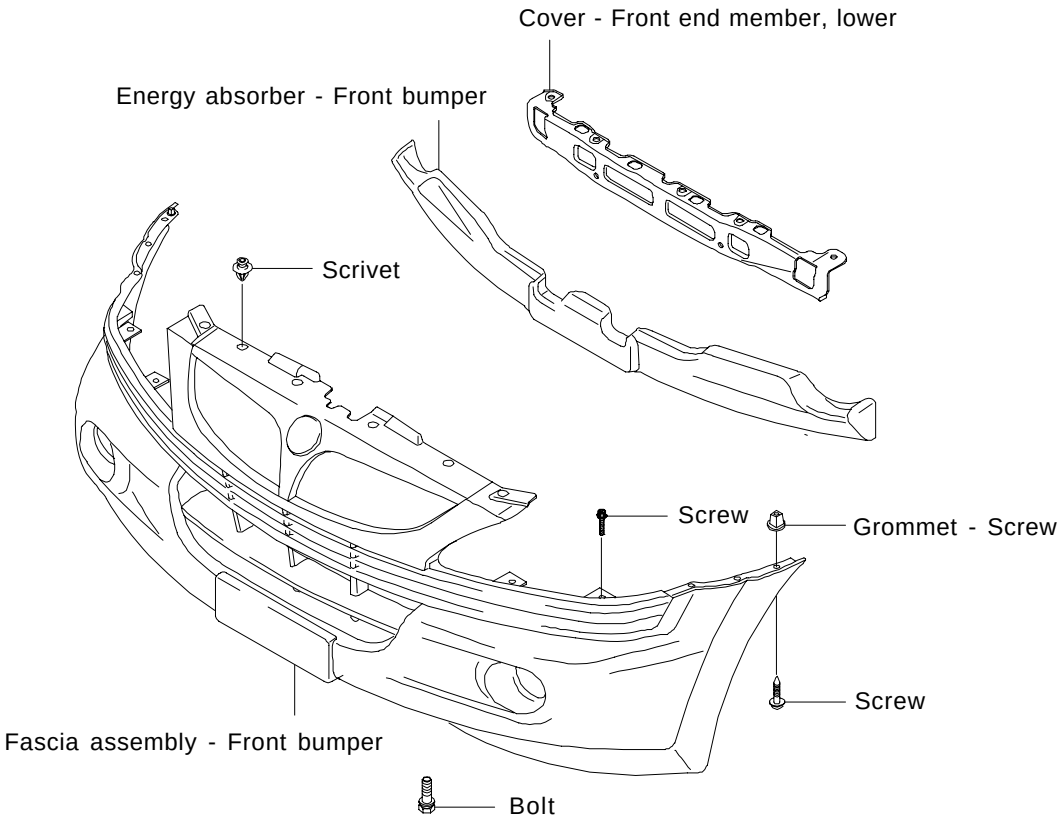
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BUMPER

1. CONSTRUCTION



Front Bumper

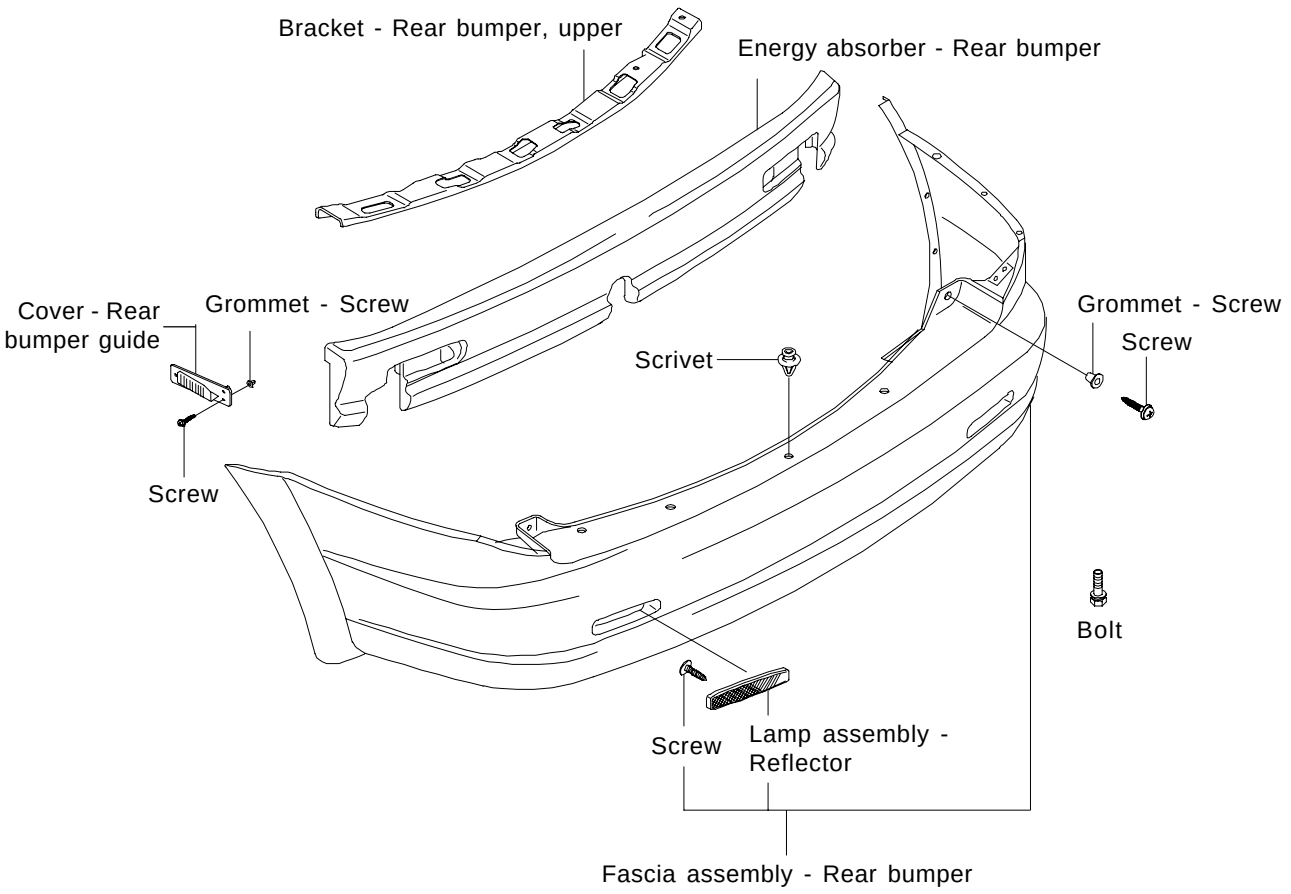


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Rear Bumper



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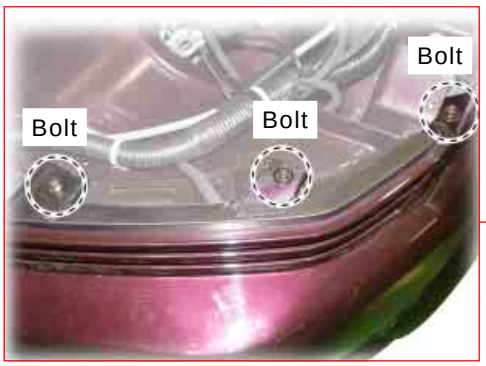
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2. REMOVAL AND INSTALLATION OF BUMPER

▶ Front Bumper

※ **Preceding Work:** Disconnect the negative battery cable and remove the headlamps and fog lamps.

1. Unscrew the bumper mounting bolts around headlamps.



2. Unscrew the center mounting bolts (10 mm).





3. Unscrew the lower mounting bolts (10 mm).



4. Remove the scrivets ( ) from the upper cover.



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5. Unscrew the mounting screws from the wheelhouse and remove the front bumper assembly.



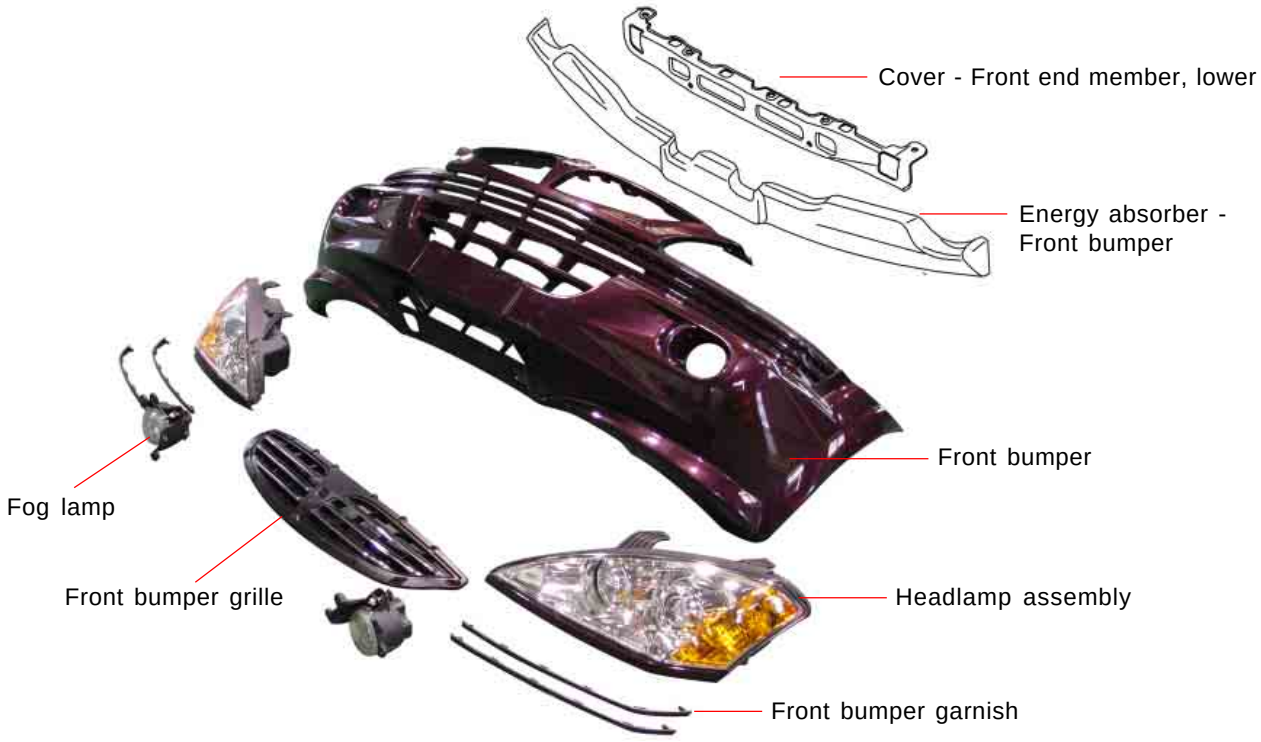
Screws (Upper Side)



Fasteners (Lower Side)



6. Install the front bumper in the reverse order of removal.

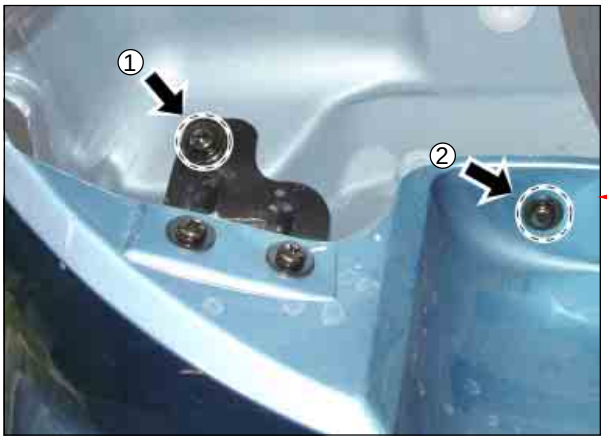


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▶ Rear Bumper

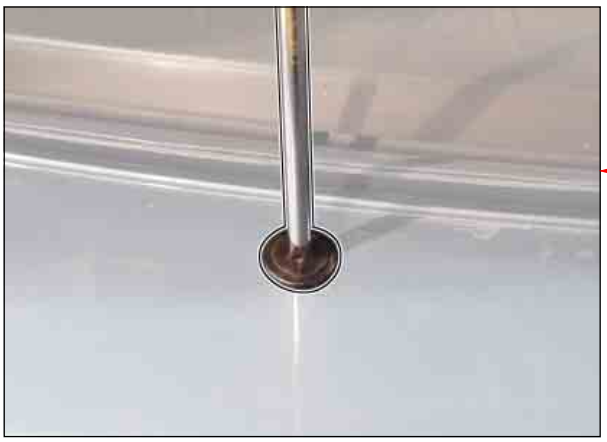
※ **Preceding Work:** Disconnect the negative battery cable and remove the rear combination lamps.

1. Unscrew the mounting bolts from the rear bumper. (arrow ①)
   Unscrew the mounting screw from the rear bumper. (arrow ②)





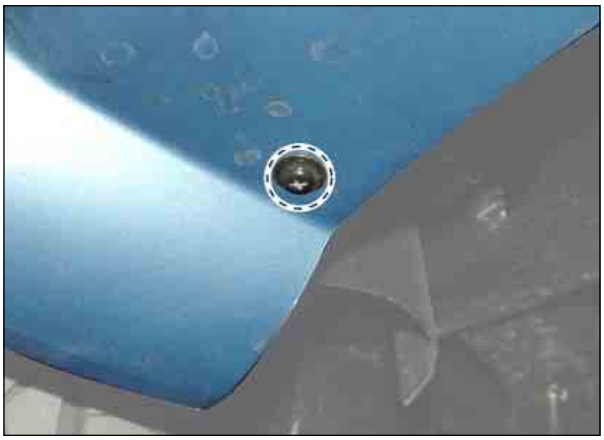
2. Remove the scrivets ( ) from the rear bumper.



3. Unscrew the mounting screws from the wheelhouse.



4. Unscrew the lower mounting screws from the bumper.



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5. Disconnect the parking aid sensor connector.



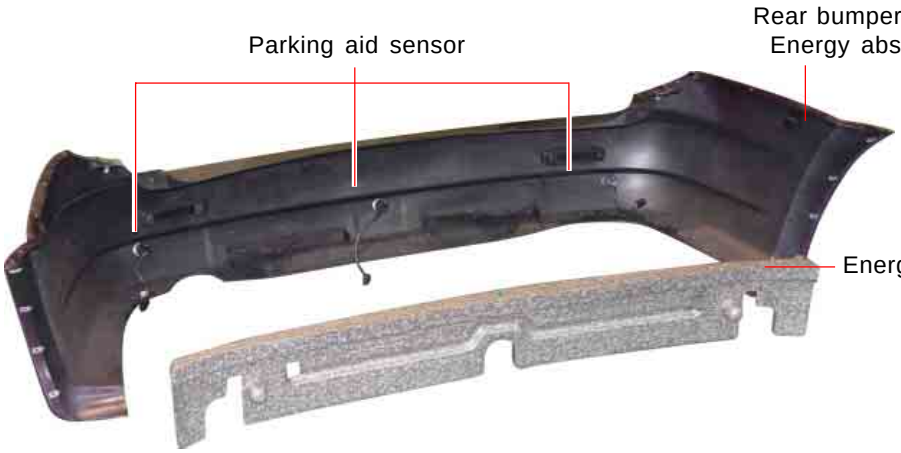
6. Unscrew the lower mounting bolts from the bumper.





7. Remove the rear bumper fascia and the energy absorber.





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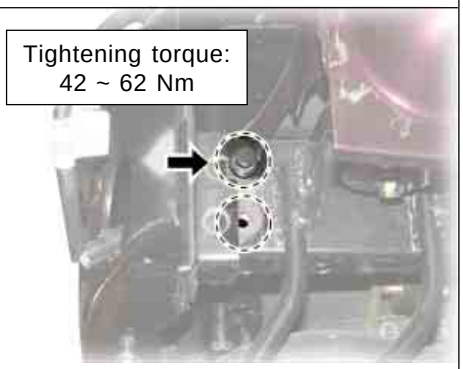
8. Disconnect the rear main wiring (parking aid sensor) connector and unscrew the two mounting bolts (12 mm) at both sides of rear bumper beam. Carefully remove the rear bumper beam assembly.

Rear Bumper Beam Bolts (LH)



Do not remove the upper bolt.

Rear Bumper Beam Bolts (RH)



Do not remove the lower bolt.



A. Disconnect the rear main wiring (parking aid sensor) connector.
At this moment, the side fastener for the connector should be removed.





9. Install the rear bumper beam assembly in the reverse order of removal.

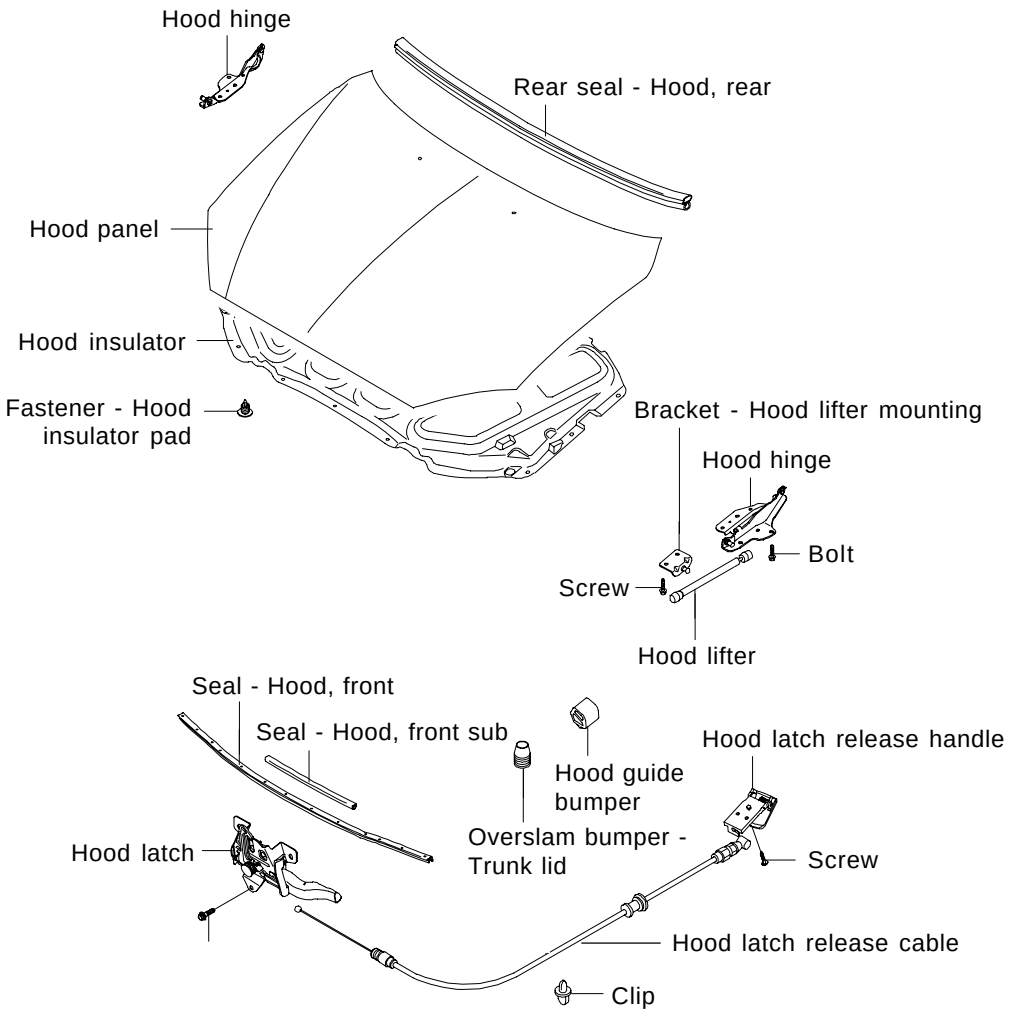
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HOOD ASSEMBLY

1. CONSTRUCTION





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2. REMOVAL AND INSTALLATION OF HOOD ASSEMBLY

※ **Preceding Work:** Cover the vehicle body and place the chocks under the tires.

Hood

1. Disconnect the washer fluid nozzle from the engine hood.



2. Unscrew the two shock absorber mounting bolts (10 mm) from the engine hood.





3. Slacken the mounting bolts on the hood hinge (Do not remove the bolts.)

NOTICE

- **Make an alignment mark on the hood and hinge for installation.**



4. Carefully remove the engine hood.

Pay particular attention to avoid vehicle damage and personal injury.

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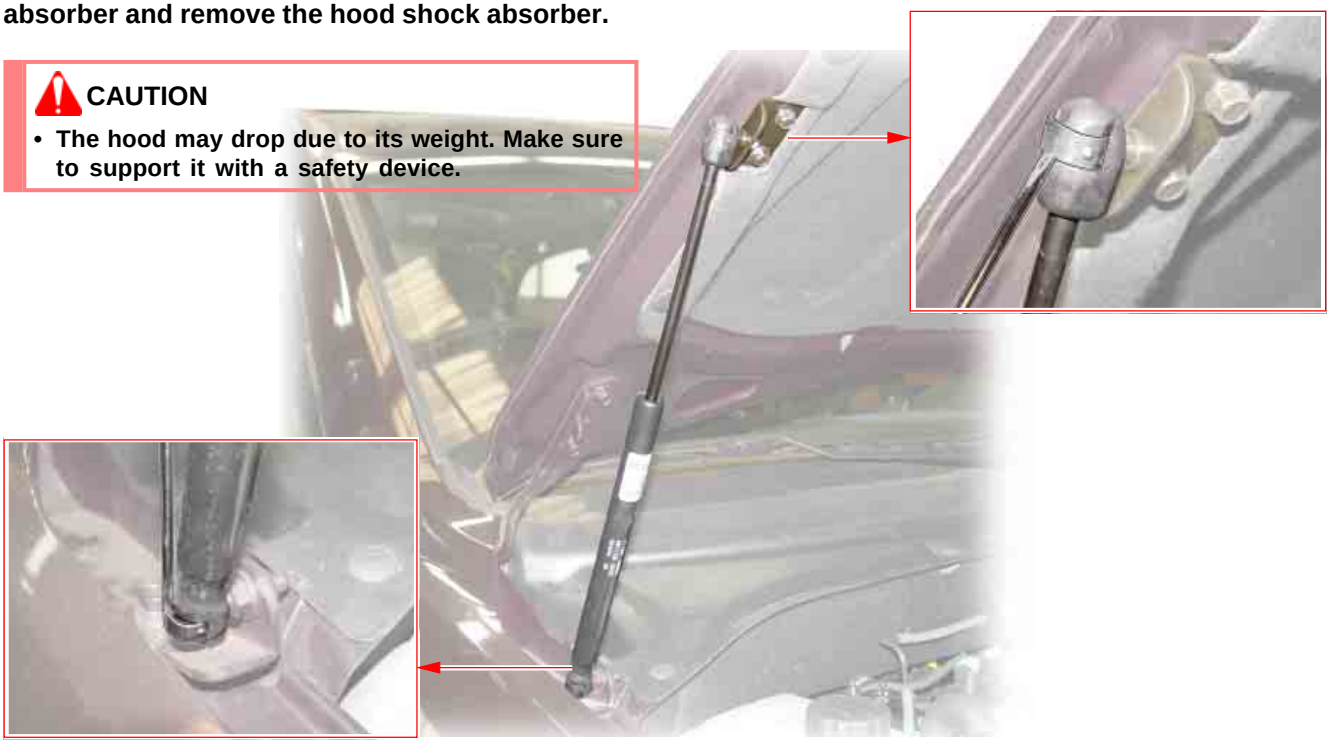
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Hood Shock Absorber

Release the upper (hood) and lower (vehicle body) clips from the shock absorber and remove the hood shock absorber.

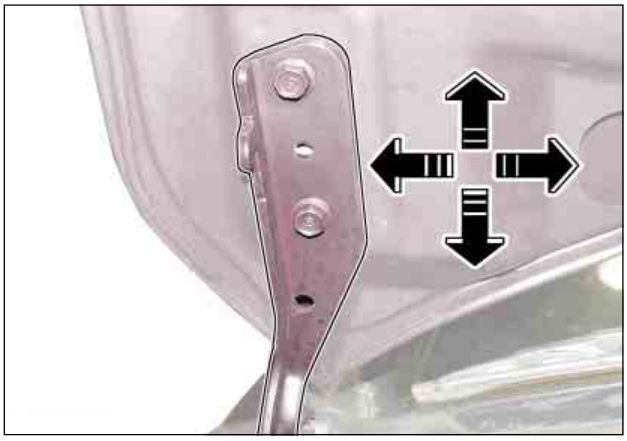
CAUTION

- **The hood may drop due to its weight. Make sure to support it with a safety device.**



Hood Adjustment

1. Up/Down/Left/Right
   : Slacken the hood hinge mounting bolts and adjust the hood position until it is placed to the desired location.



2. Hood height
   : To adjust the height of hood front end, turn the overslam bumper.



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Hood Insulation Pad

1. Remove the fasteners and remove the insulation pad.



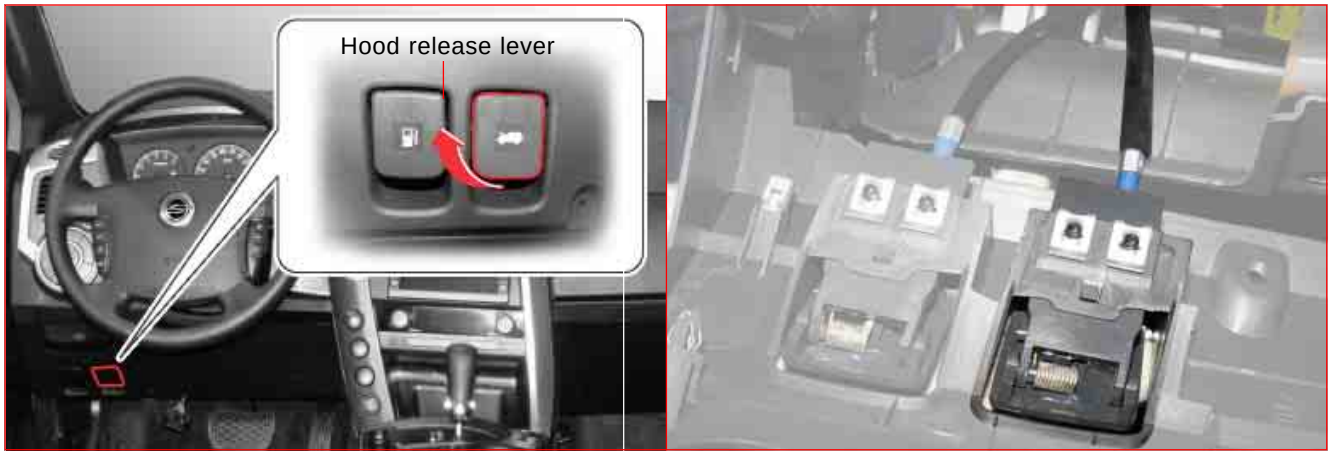
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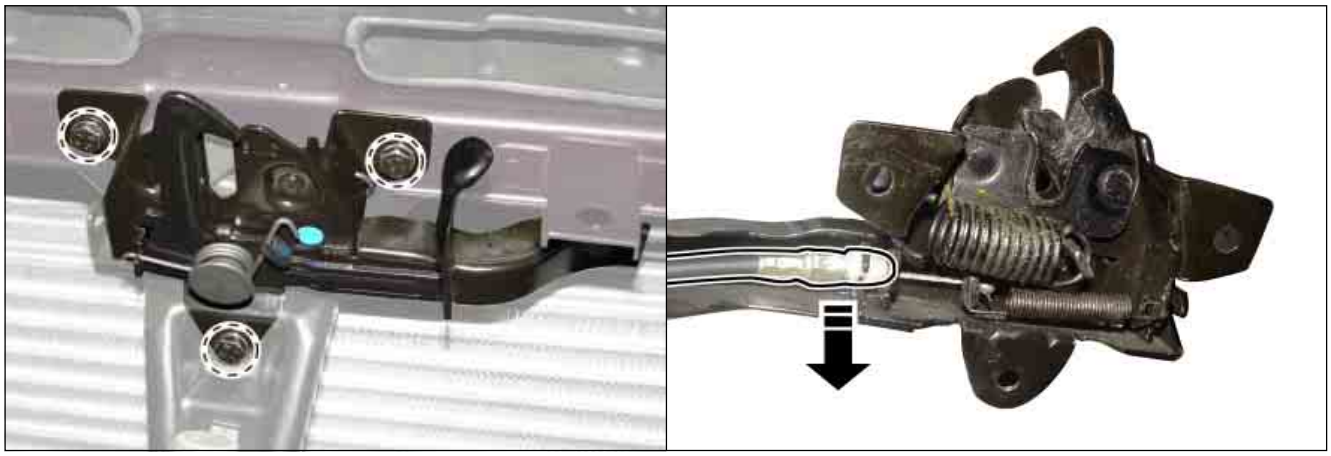
Hood Latch and Cable

※ **Preceding Work:** Remove the front bumper assembly (including headlamp).

1. Remove the lower instrument panel in front of driver's seat and disconnect the hood release lever cable.



2. Unscrew the three hood latch bolts (10 mm), disconnect the hood release cable, and remove the hood latch.

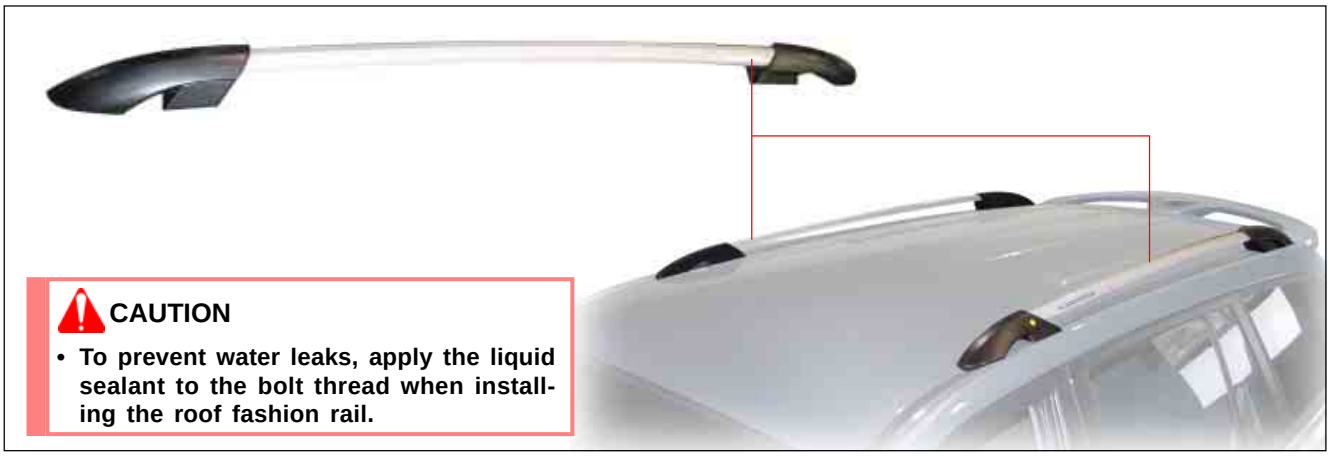


3. Remove the hood cable from the vehicle.

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ROOF FASHION RAIL

1. CONSTRUCTION



CAUTION

- **To prevent water leaks, apply the liquid sealant to the bolt thread when installing the roof fashion rail.**

2. REMOVAL AND INSTALLATION

※ **Preceding Work:** Remove the headlining assembly.

Unscrew the front and rear mounting nuts (10 mm) and remove the roof fashion rail. The front mounting nut is located behind the hand grip bracket.

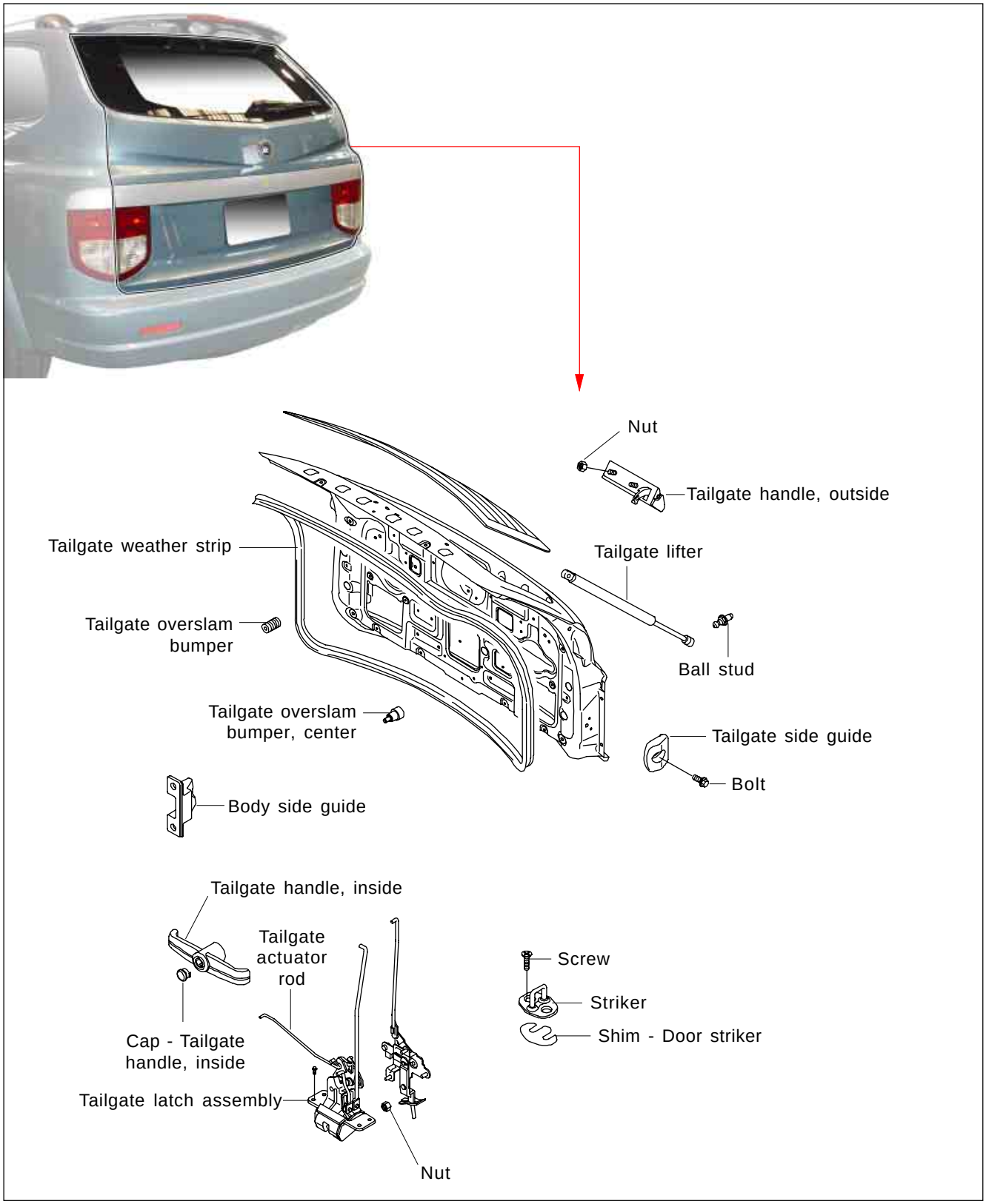


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TAILGATE

1. TAILGATE ASSEMBLY



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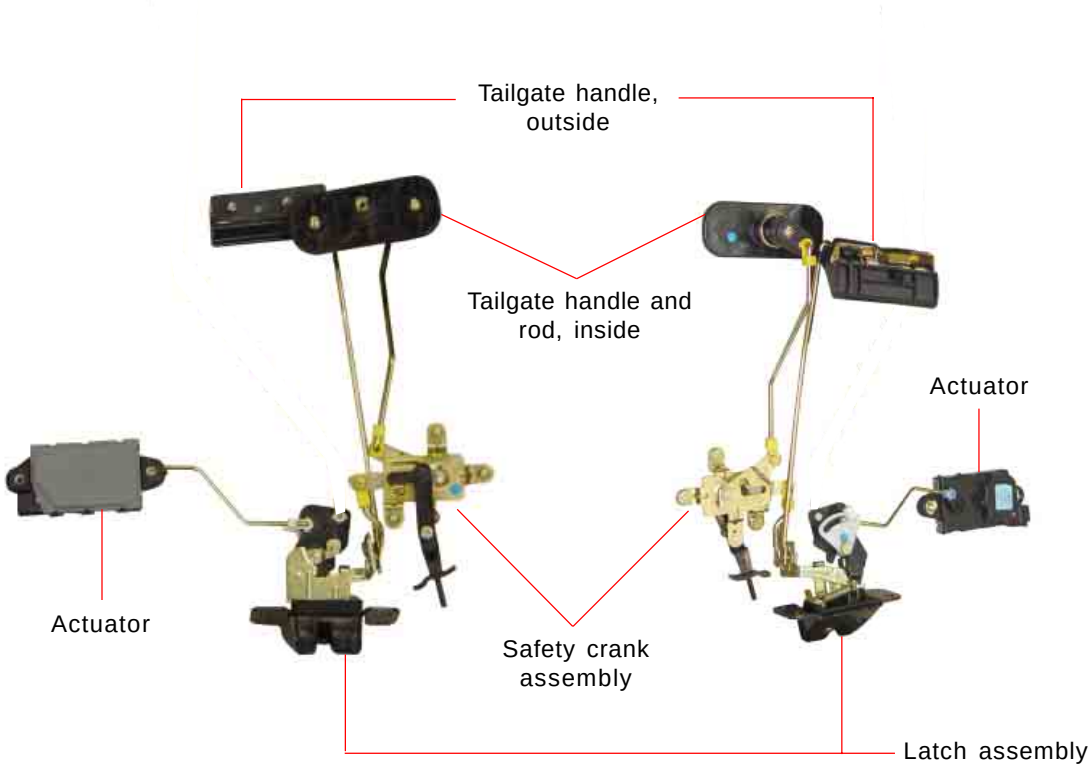
▶ Removal and Installation of Tailgate Assembly

Operating Mechanism



Construction - Inside View

Construction - Outside View



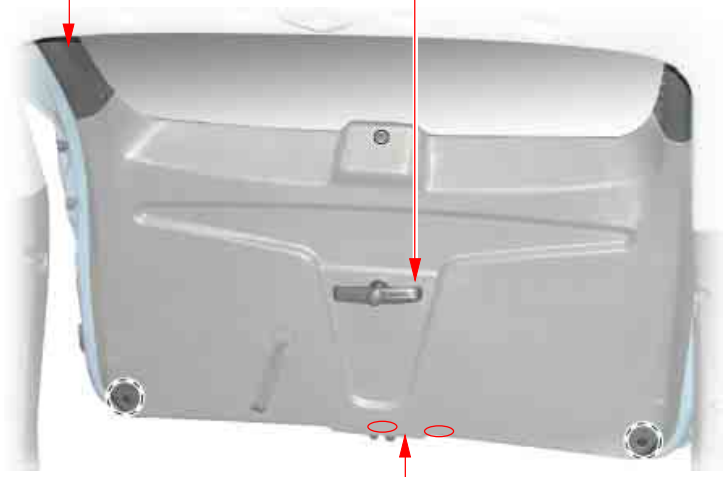
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Tailgate Trim

1. Unscrew the scrivets and remove the upper trim from the tailgate.





2. Remove the inside handle.



3. Remove the scrivets.



4. Remove the fasteners and then remove the lower trim.

Locations of Fasteners

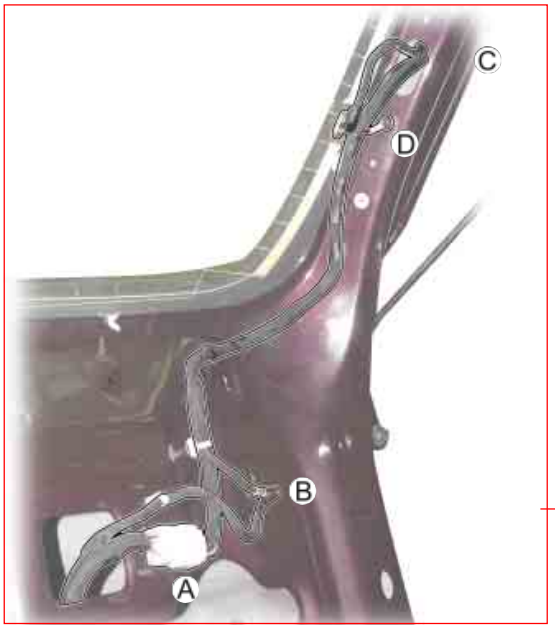


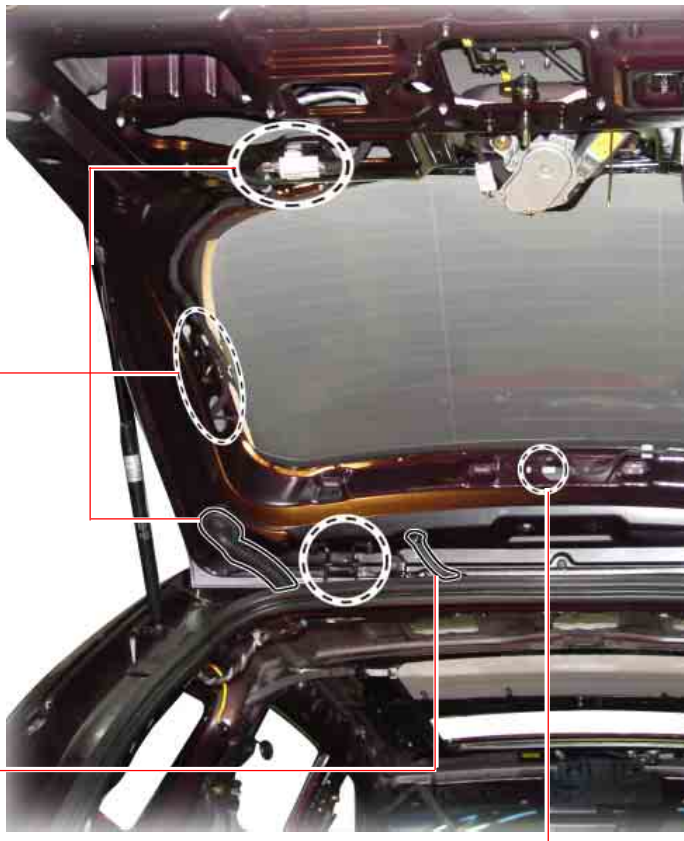
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Tailgate Assembly

※ **Preceding Work:** Remove the upper and lower trims from the tailgate.

1. Disconnect the main wiring connector (A), ground (B), heated wire (C) and heated wire ground (D). Remove the wiring harness.





2. Disconnect the rear washer nozzle hose.



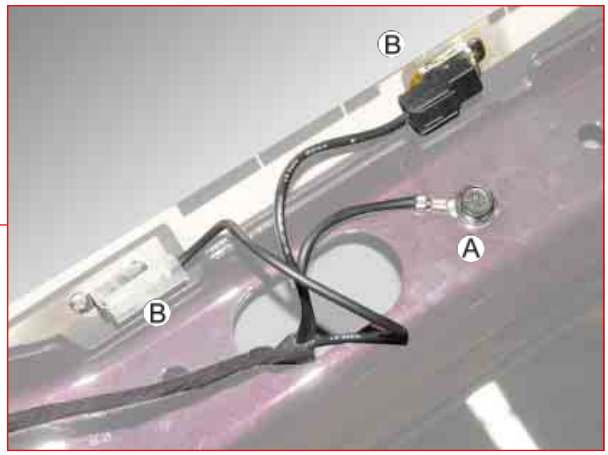
3. Disconnect the stop lamp connector from the rear air spoiler.



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4. Disconnect the ground (A) and heated wire cable (B) from the tailgate.



5. Release the fixing clips and remove both shock absorbers.





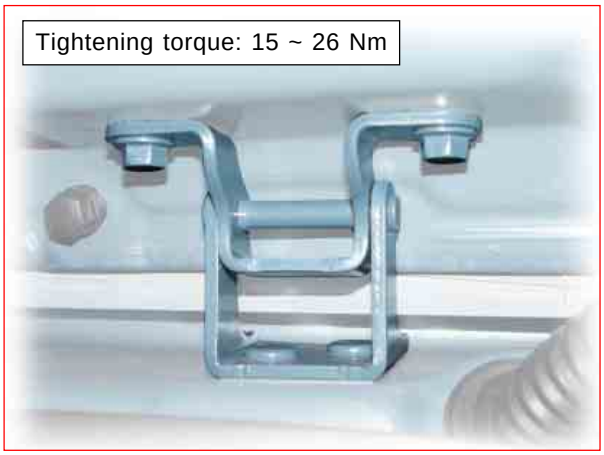
CAUTION

- **Pay particular attention to avoid vehicle damage and personal injury.**



6. Unscrew the two hinge bolts (10 mm) and remove the tailgate assembly.

Tightening torque: 15 ~ 26 Nm



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Tailgate Latch and Actuator

※ **Preceding Work:** Remove the trim.

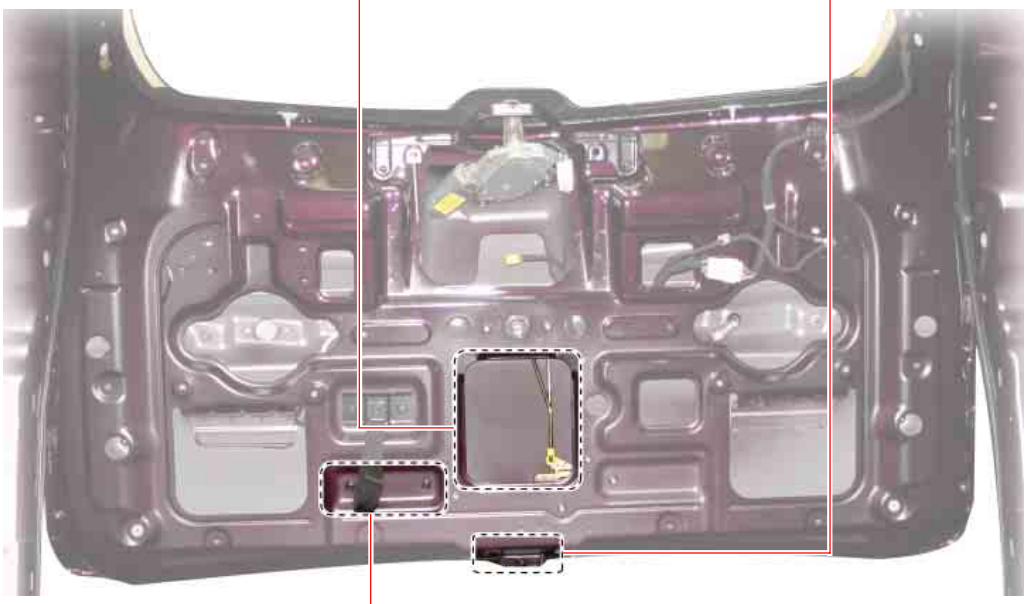
Latch

1. Disconnect the connecting rod in tailgate.



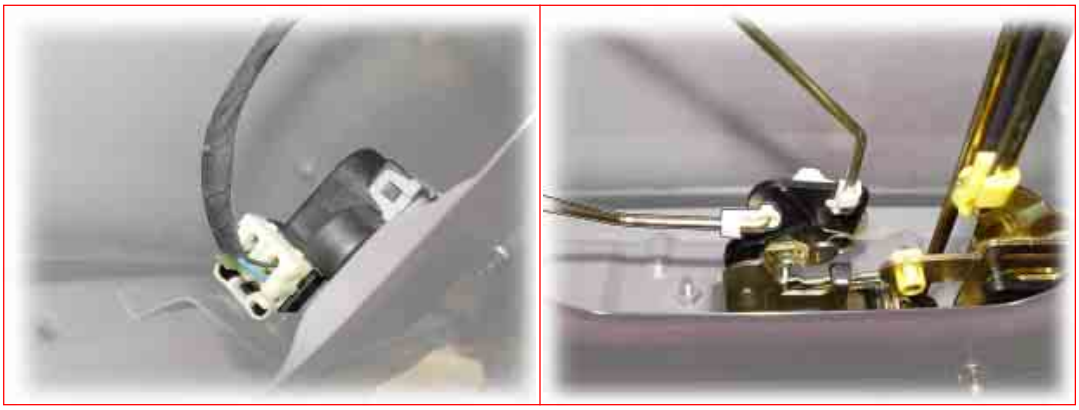
2. Remove the latch assembly.





Actuator

Disconnect the actuator rod and connector and remove the actuator assembly.



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REAR AIR SPOILER

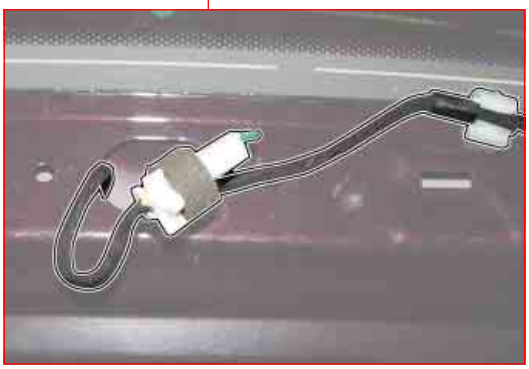


1. Unscrew four mounting nuts (10 mm) and three cap nuts (10 mm) from the rear air spoiler.





3. Disconnect the rear washer nozzle hose.



2. Remove the upper trim and disconnect the high mounted stop lamp.

4. Remove the rear air spoiler from the tailgate.

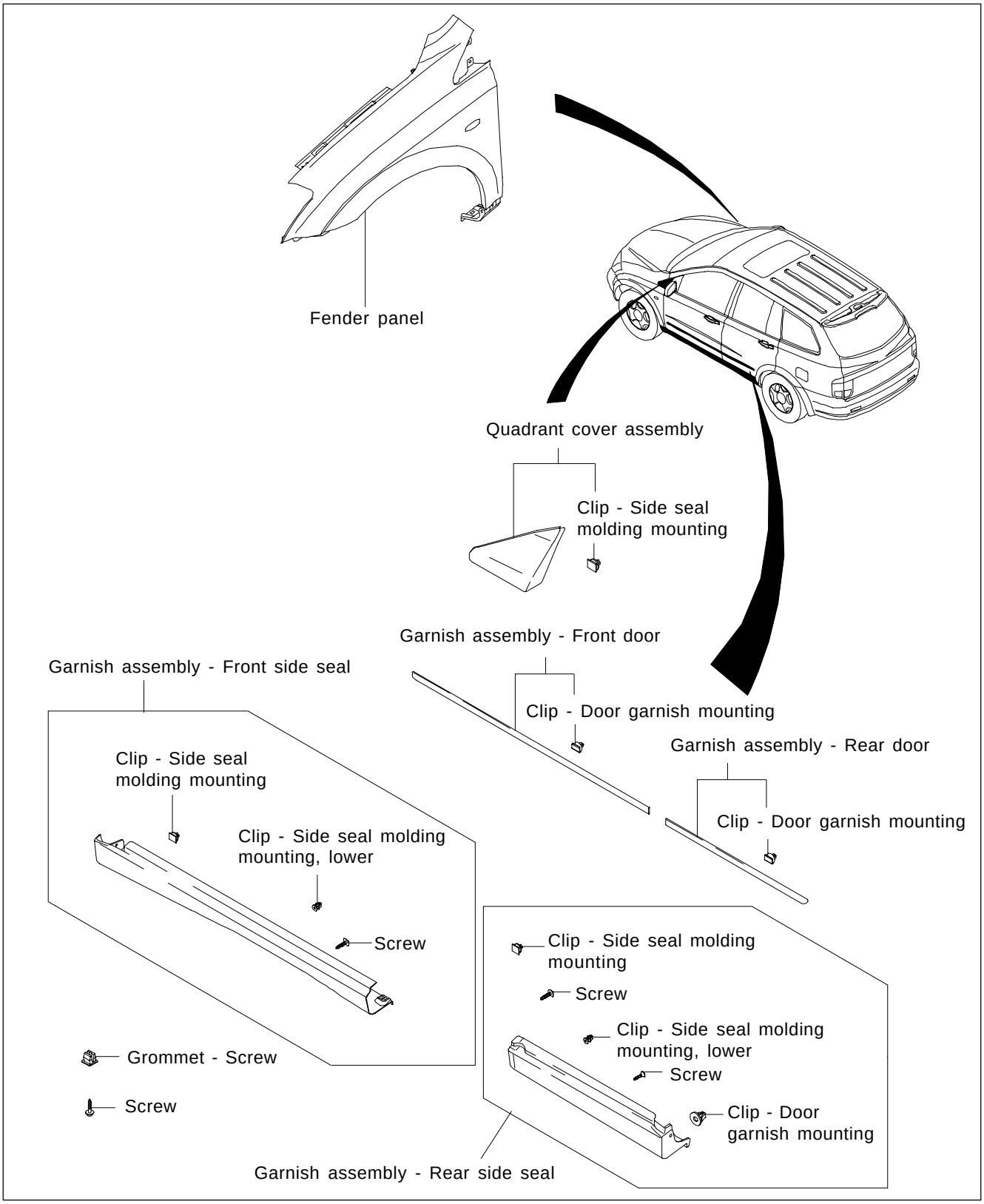


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SIDE SEAL MOLDING

1. CONSTRUCTION



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▶ Side Seal Molding

All side moldings can be removed/installed with a similar procedure.



1. Unscrew the mounting screw in wheelhouse.



2. Unscrew four mounting screws from the front/rear side seal moldings.



3. Carefully remove the side molding seal.



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FENDER

1. REMOVAL AND INSTALLATION OF FENDER

※ **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.**

3. Remove the insulator sponge in fender.





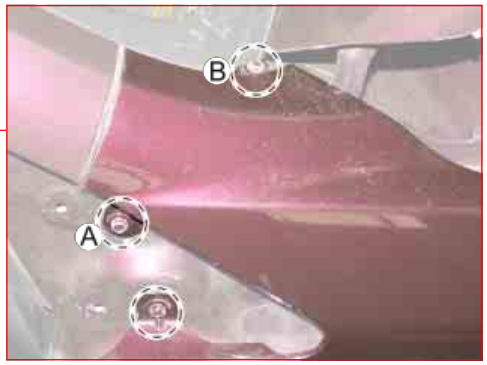
4. Disconnect the side repeater connector and remove the lamp assembly.



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5. Unscrew the quadrant cover bolts (A) and cowl bolt (B).



6. Unscrew the lower mounting bolts in fender.

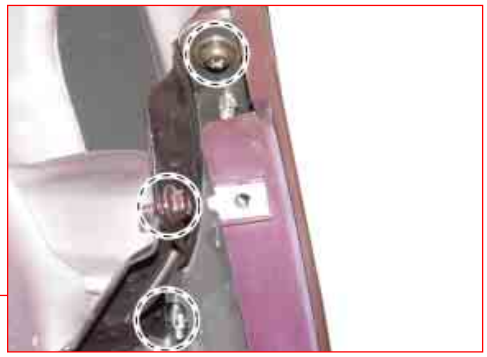




7. Unscrew the mounting bolt on the fender near the headlamp.



8. Unscrew the bolts and screws from the fender wheelhouse.



9. Unscrew the upper bolts from the fender.



10. Remove the fender from the vehicle.

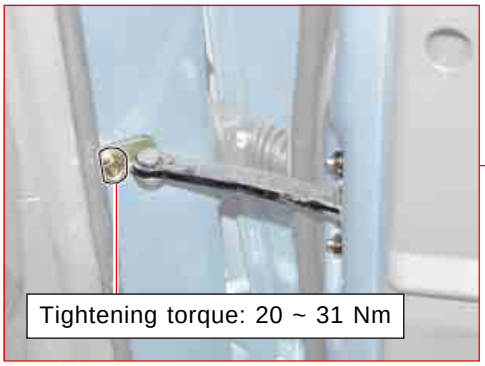


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FRONT DOOR

1. REMOVAL AND INSTALLATION OF FRONT DOOR

1. Unscrew the mounting bolt from the door check link (vehicle side).



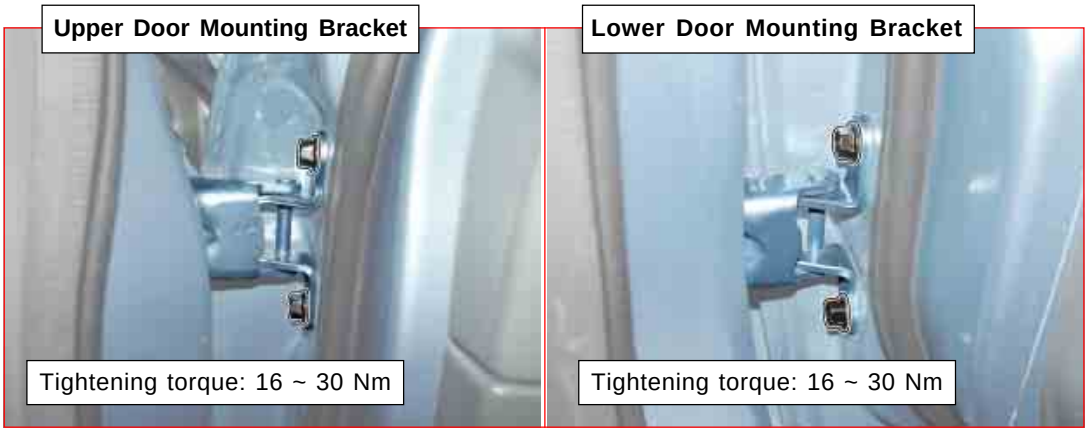
2. Remove the main wiring harness cover and disconnect the door main connector.







3. Unscrew the upper and lower hinge bolts and remove the door assembly.



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2. REMOVAL AND INSTALLATION OF FRONT DOOR TRIM

▶ Front

1. Unscrew seven mounting screws from the door trim (refer to figure below).

Tightening torque	4 ~ 6 Nm



3. Separate the bottom of door trim and pull it up to remove.

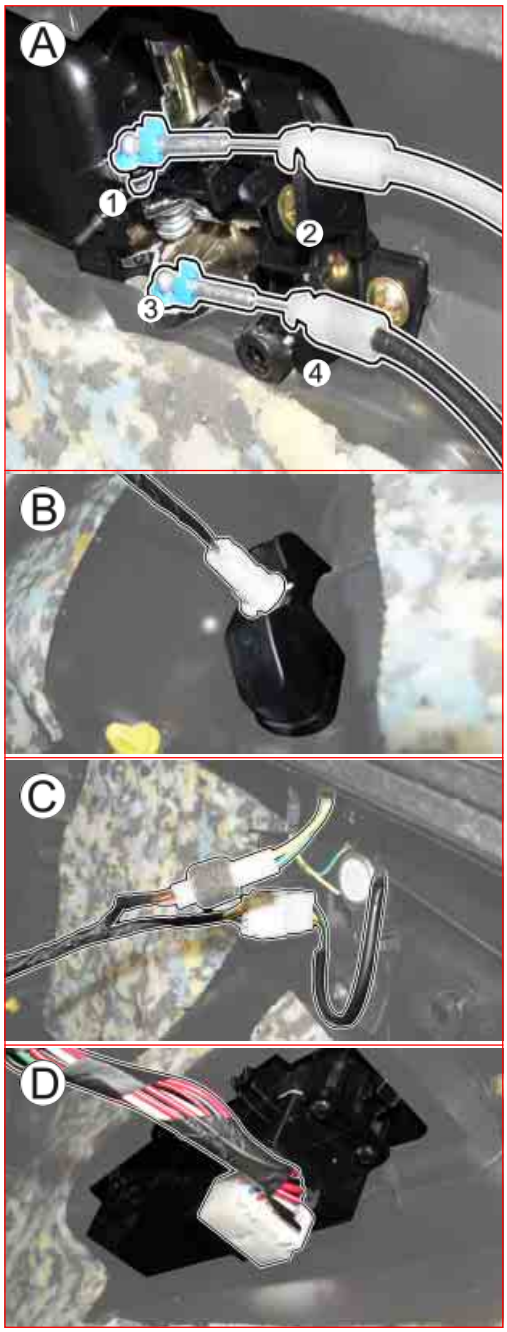


Locations of Fasteners



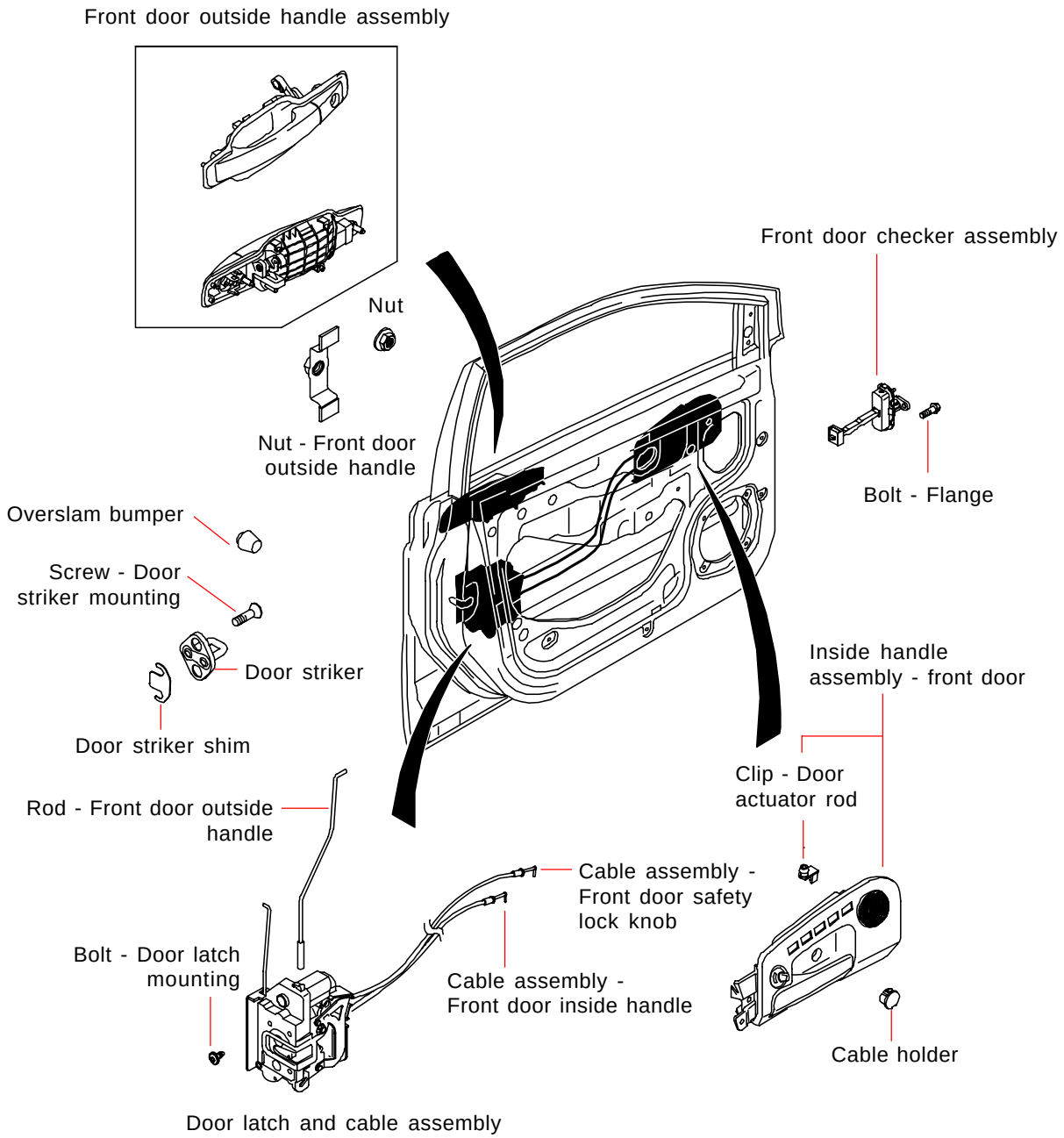
2. Remove the door handle cable (A), door courtesy lamp connector (B), door tweeter speaker/memory seat position switch connector (C) and power window switch (D) from the removed door trim.

   Remove the components as in order shown in figure below.



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3. COMPONENTS OF FRONT DOOR OPENING SYSTEM



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4. FRONT WINDOW REGULATOR

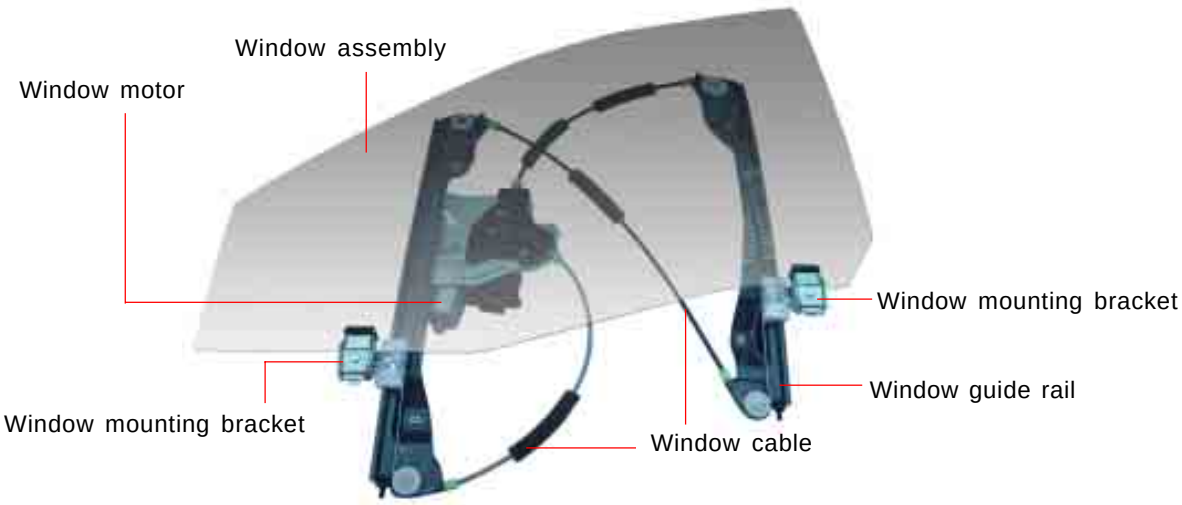
▶ Dual Rail with Regulator

1. The dual rail with regulator is installed to this vehicle. Its advantages are as below:

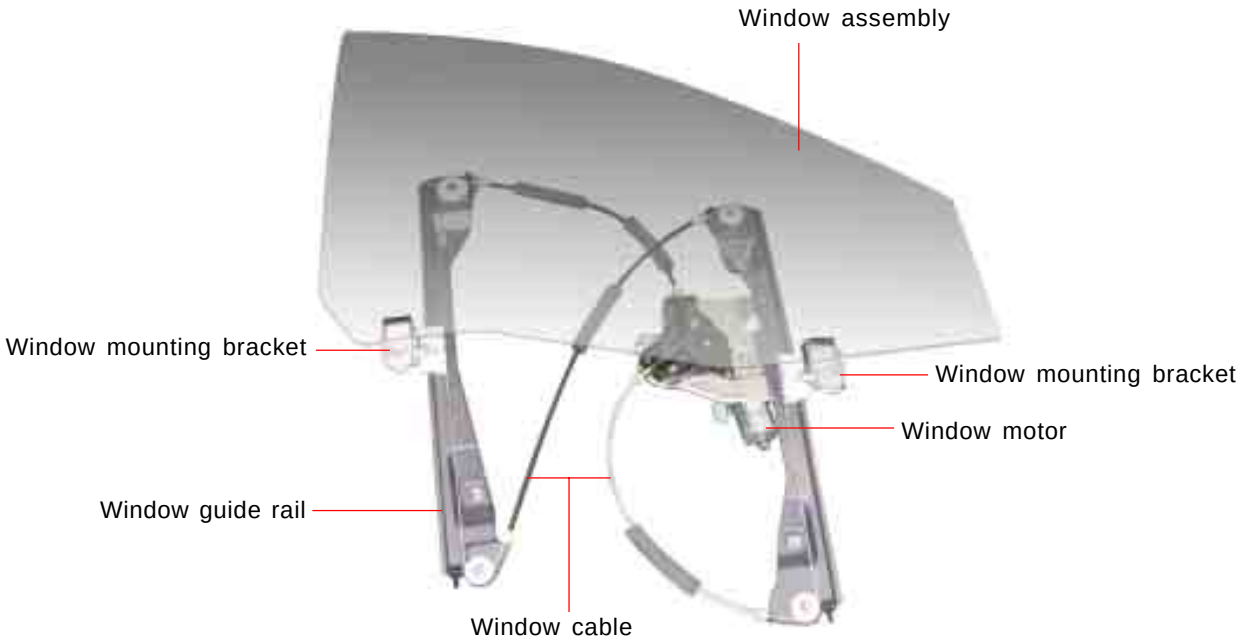
1) Smooth operation
2) Safety operation
3) Preventing the glass pinch
4) Preventing the glass tilting
5) Reduced the length of glass run
6) Increased durability of lifting mechanism (including glass run)
7) No contamination due to grease (applied solid coating)

Components

Driver Side Window and Regulator



Passenger Side Window and Regulator



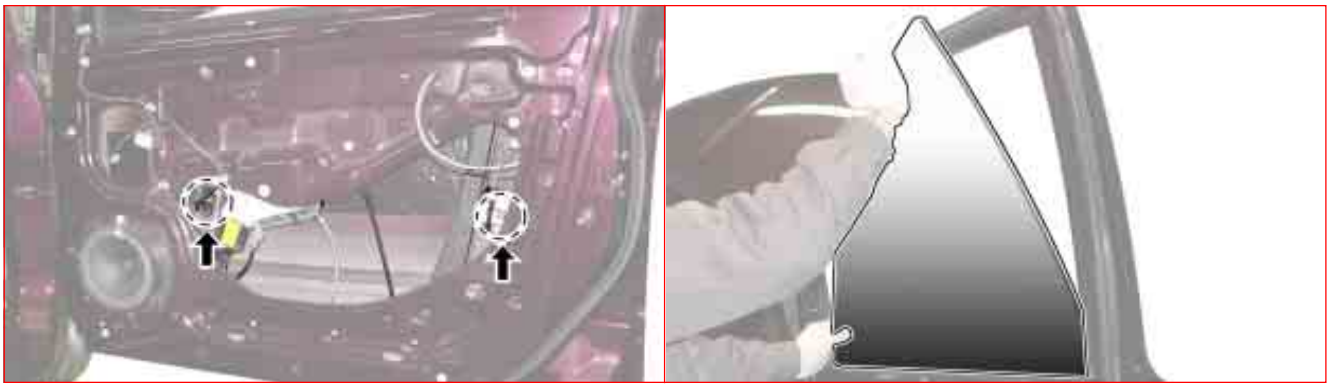
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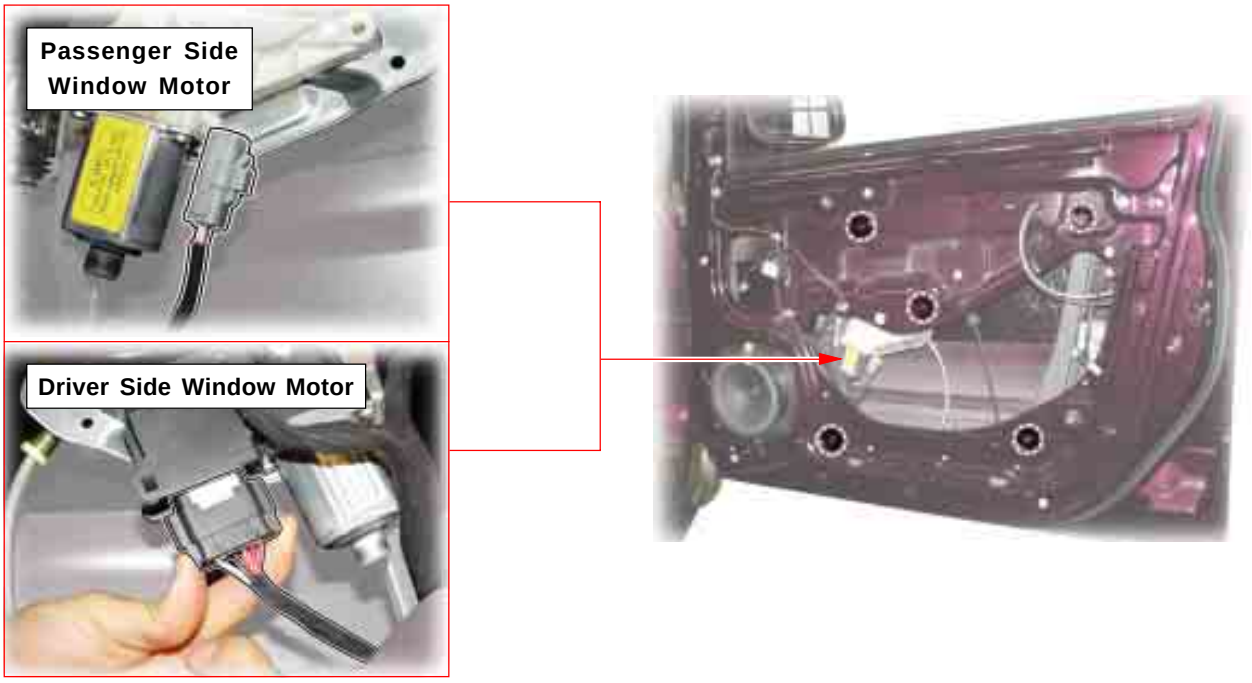
Removal and Installation of Window Regulator

※ **Preceding Work:** Disconnect the negative battery cable.

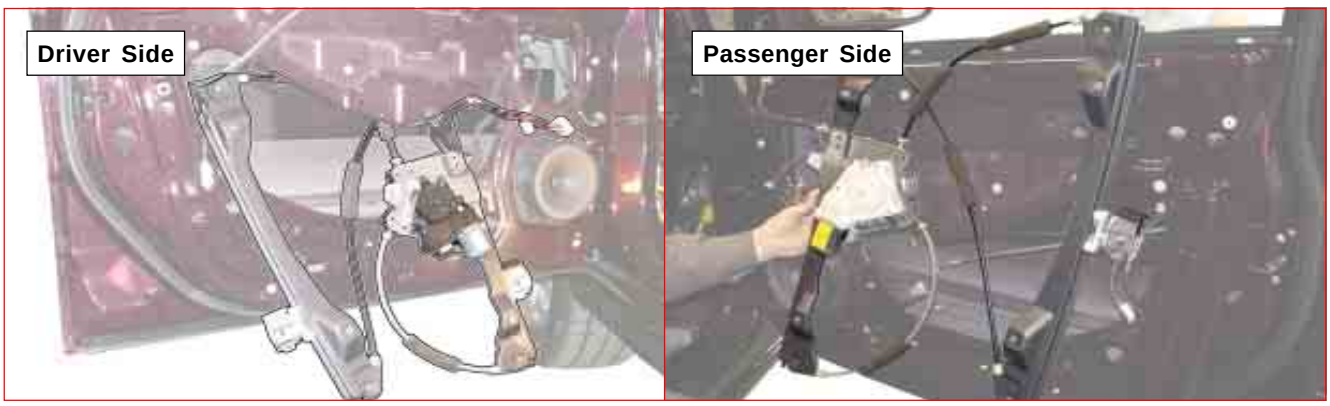
1. Lower the window until the window mounting bracket can be seen. Unscrew the nuts from the window mounting bracket and remove the window.



2. Disconnect the window motor connector and unscrew the mounting bolts from the window regulator.



3. Remove the window regulator from the door.



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REAR DOOR

1. REMOVAL AND INSTALLATION OF REAR DOOR

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.





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2. REMOVAL AND INSTALLATION OF REAR DOOR TRIM

1. Unscrew five mounting screws from the door trim (refer to the figure below).

Installation Notice

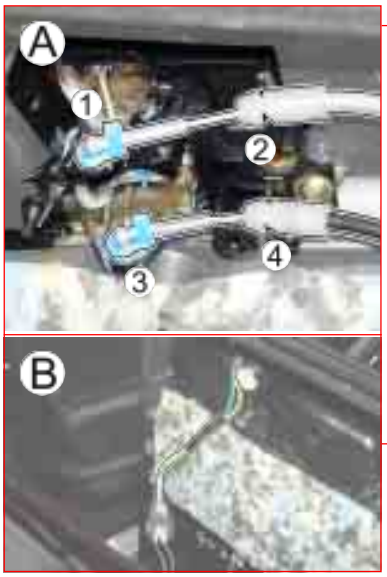
Tightening torque	4 ~ 6 Nm



2. Separate the power window switch connector and disconnect the connector. Remove the door trim.



3. Remove the door handle cable (A) and the door tweeter speaker (B) as in order shown in figure below.





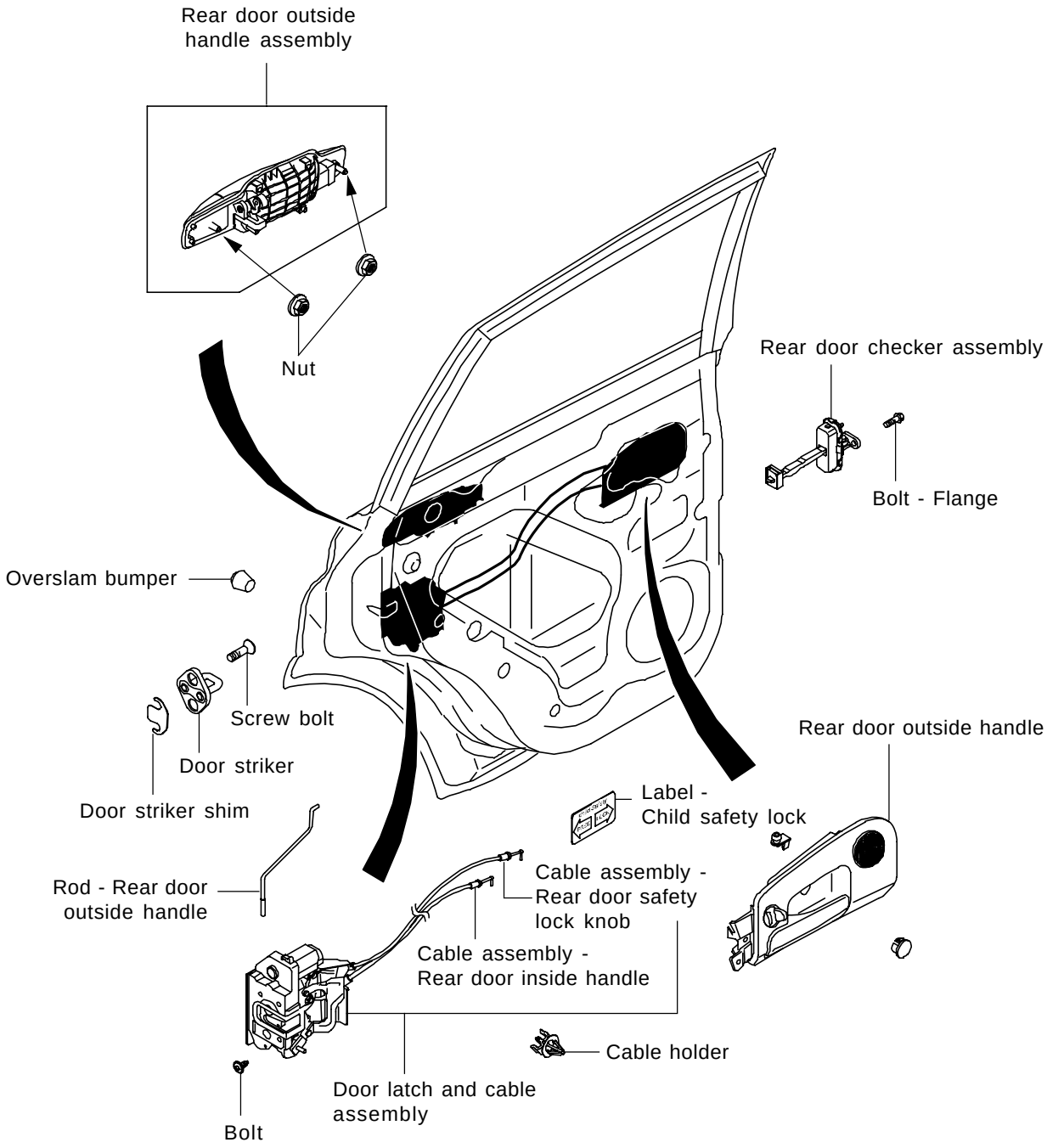
Locations of fasteners



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3. COMPONENTS OF REAR DOOR OPENING SYSTEM



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4. REAR WINDOW REGULATOR

※ **Preceding Work:** Disconnect the negative battery cable.

1. Lower the window. Unscrew the mounting screw and bolts from and remove the guide channel and windshield dam.



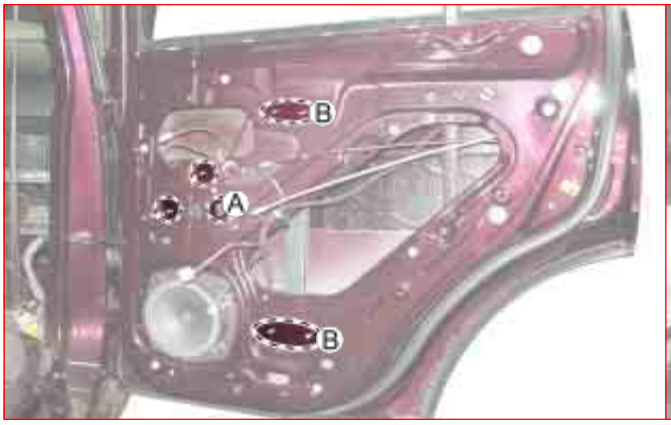


2. Disconnect the motor connector and unscrew the mounting screws from the window guide to remove the rear window.





3. Unscrew the window motor nut (A) and guide rail nut (B) and remove the window regulator from the door.





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Components



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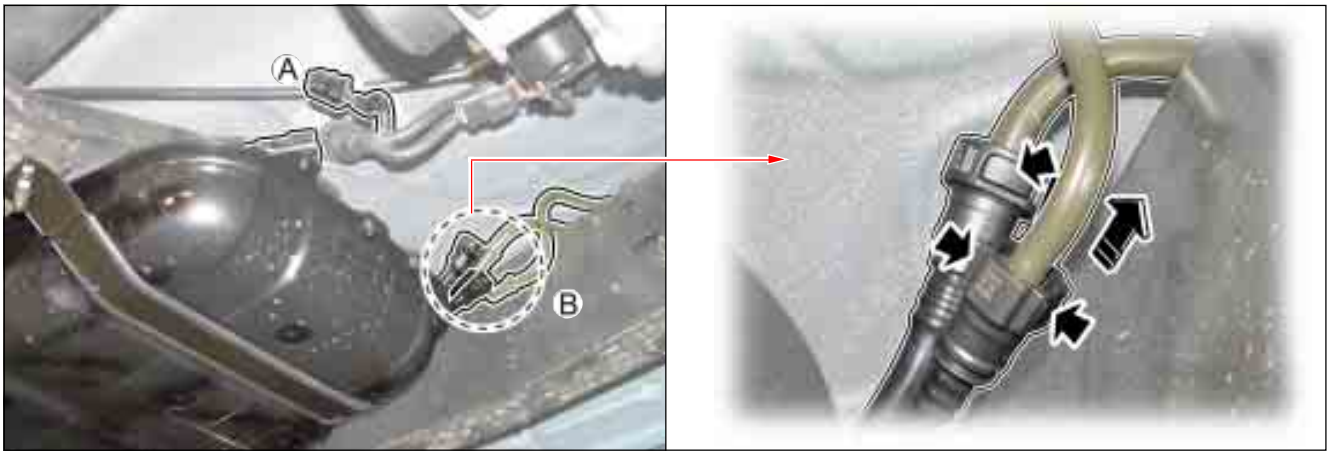
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FUEL TANK

1. REMOVAL AND INSTALLATION OF FUEL TANK (FOR REMOVING REAR LEFT UPPER ARM AND LOWER ARM)

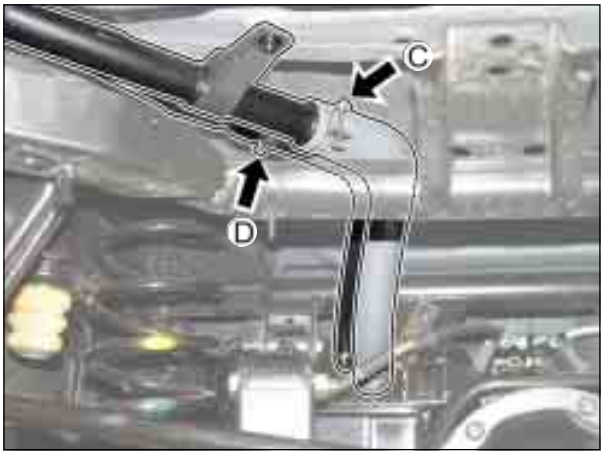
※ **Preceding Works:** 1. Remove the tires and place the safety jack under the fuel tank.
2. Drain all fuel.

1. Disconnect the fuel sender connector (A) and supply/return pipe (B).





2. Disconnect the fuel supply hose (C) and air breather hose (D).



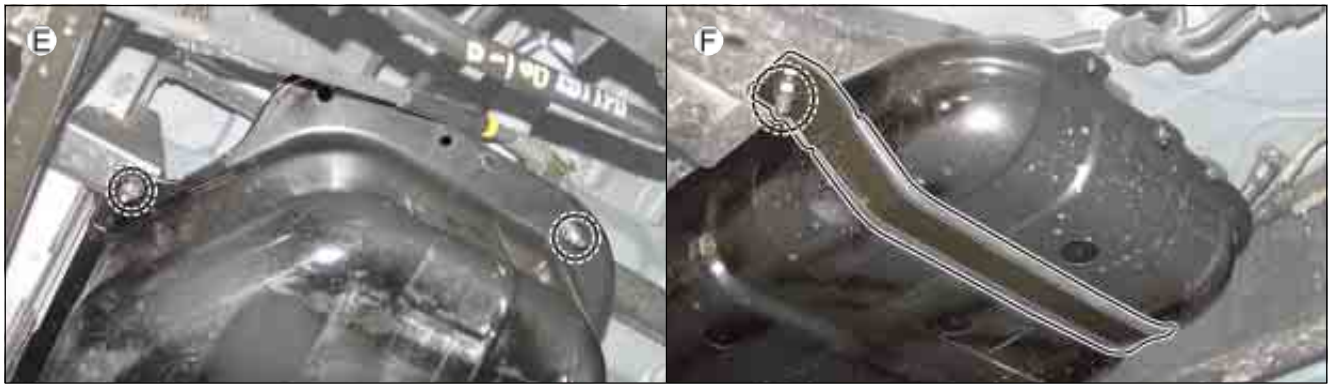
NOTICE

- **Kyron does not have service hole from passenger compartment to fuel tank. So, fuel tank must be disassembled for fuel sender related job.**

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3. Remove the two bolts (14 mm) from the fuel tank and unscrew the fuel tank bracket bolt (F: 14 mm).



4. Seal the fuel hose opening and carefully lower the fuel tank.



Fuel Tank Assembly



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SPARE TIRE

1. REMOVAL AND INSTALLATION OF SPARE TIRE

NOTICE

- **Always install the safety stand under the vehicle body before starting this operation.**



1. Remove the butterfly nut from the spare tire carrier and loosen the lock bolt until the hook is released.



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2. Remove the spare tire by pulling down the carrier.
3. Install in the reverse order of removal.



4. The spare tire carrier can be removed by pulling out the lock pin (arrow).



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BODY REPAIR

4610 / 4620

TABLE OF CONTENTS

BODY REPAIR 3

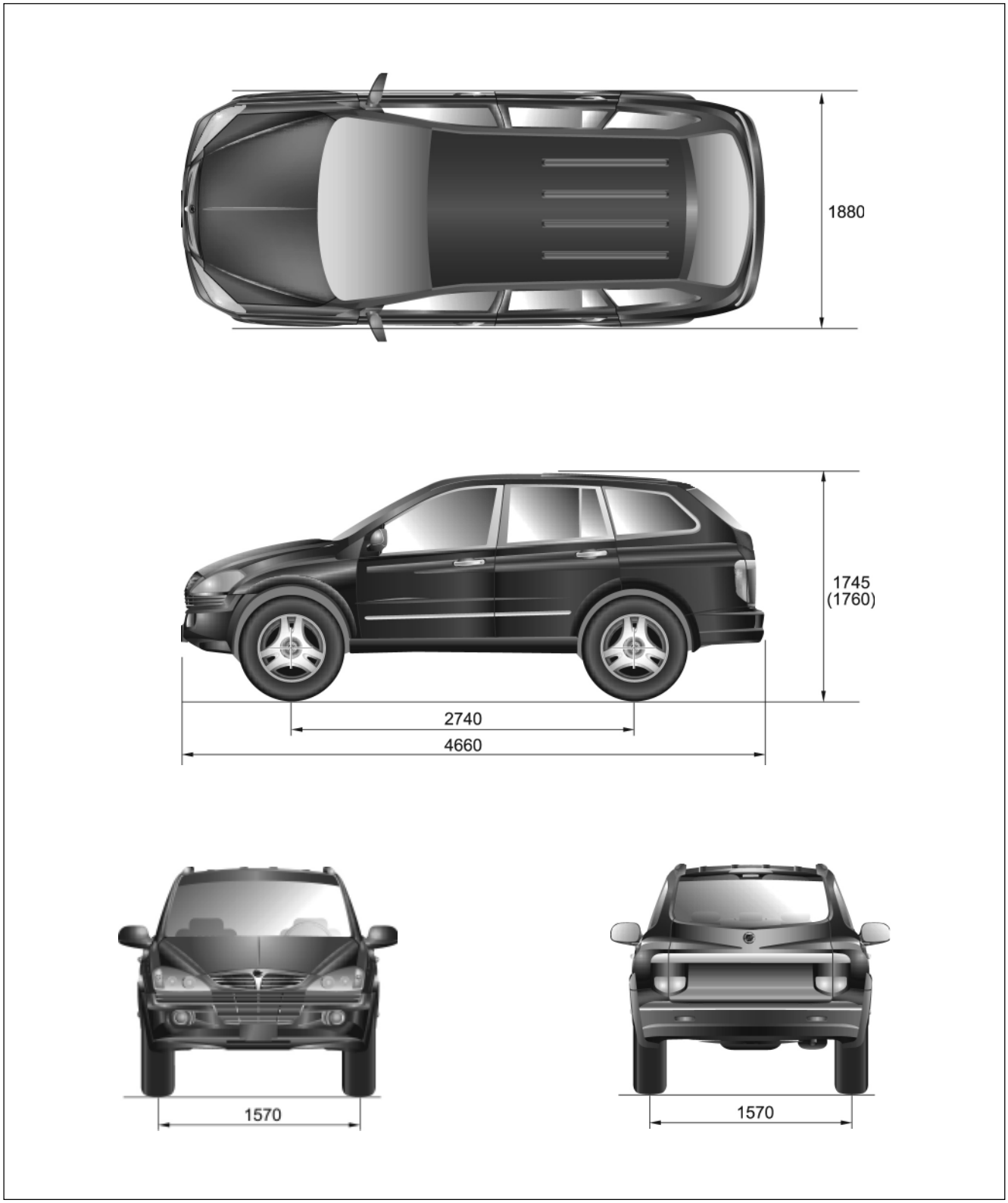
1. Dimensions 3
2. Jack-up points 4
3. Design changes for improving NVH performance 6
4. Frame 10
5. Body repair 21

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BODY REPAIR

1. DIMENSIONS

Unit: mm
( ): only for the vehicle with roof fashion rail

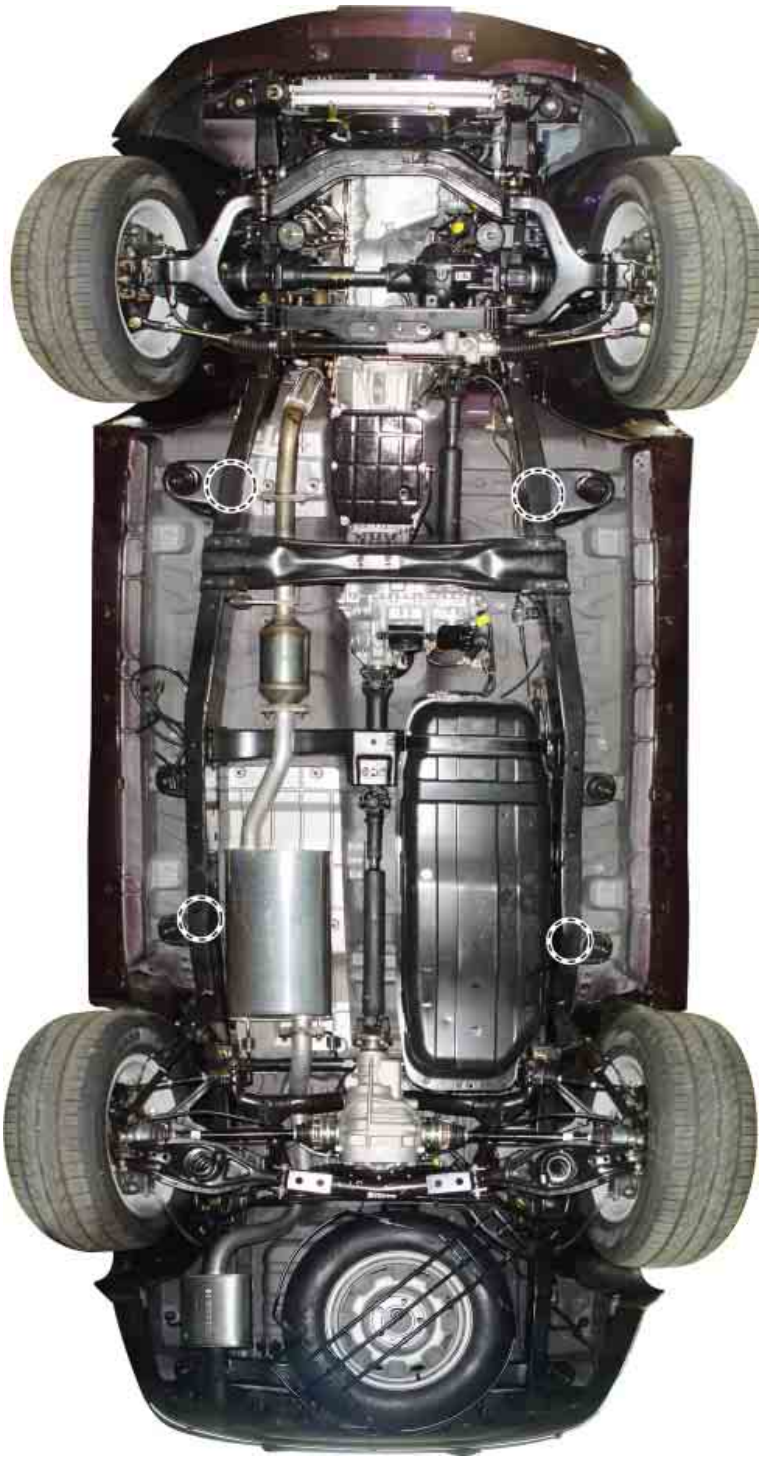


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2. JACK-UP POINTS

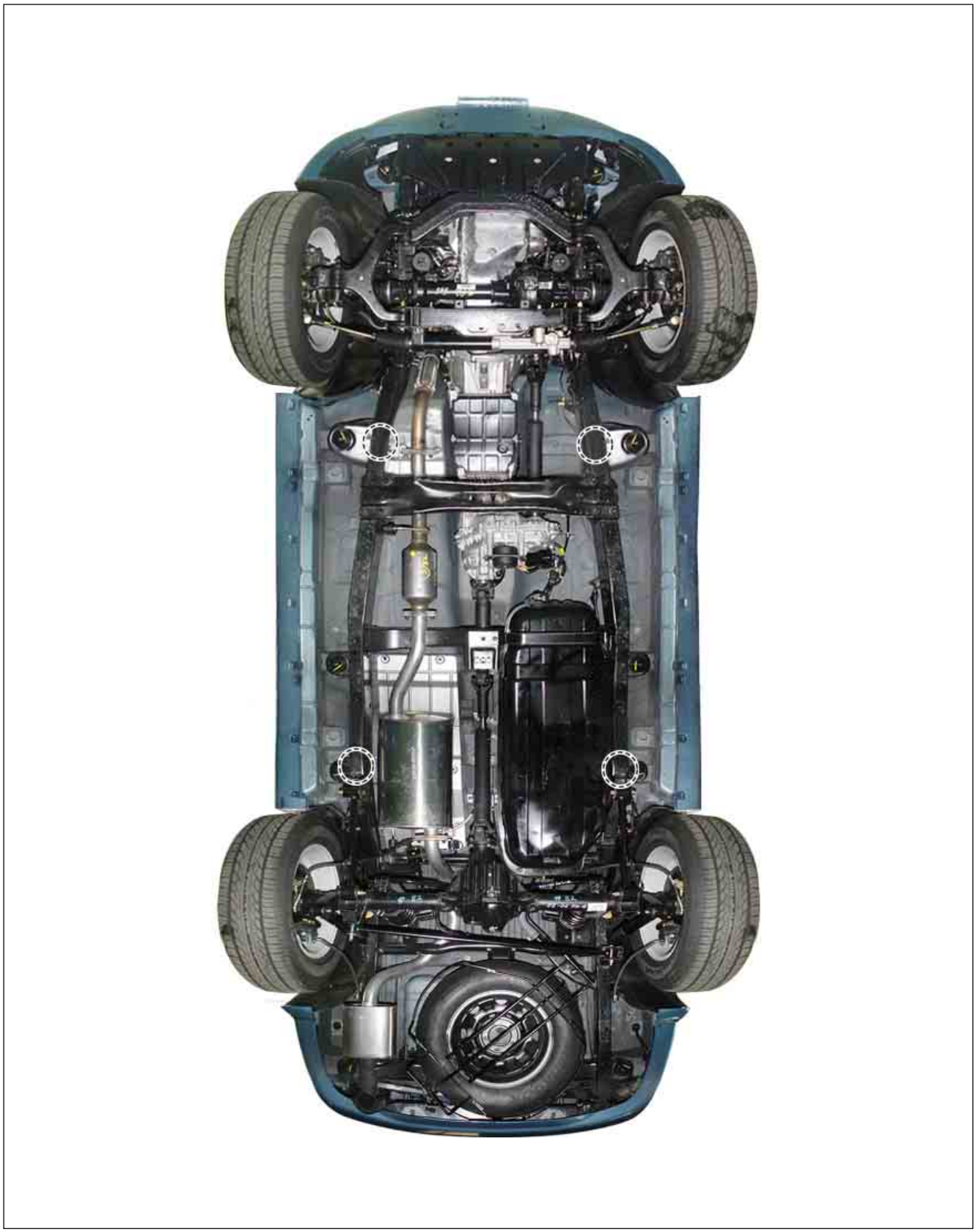
▶ IRS - Lifting Point (Dotted Circles)



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▶ 5 Link System - Lifting Point (Dotted Circles)



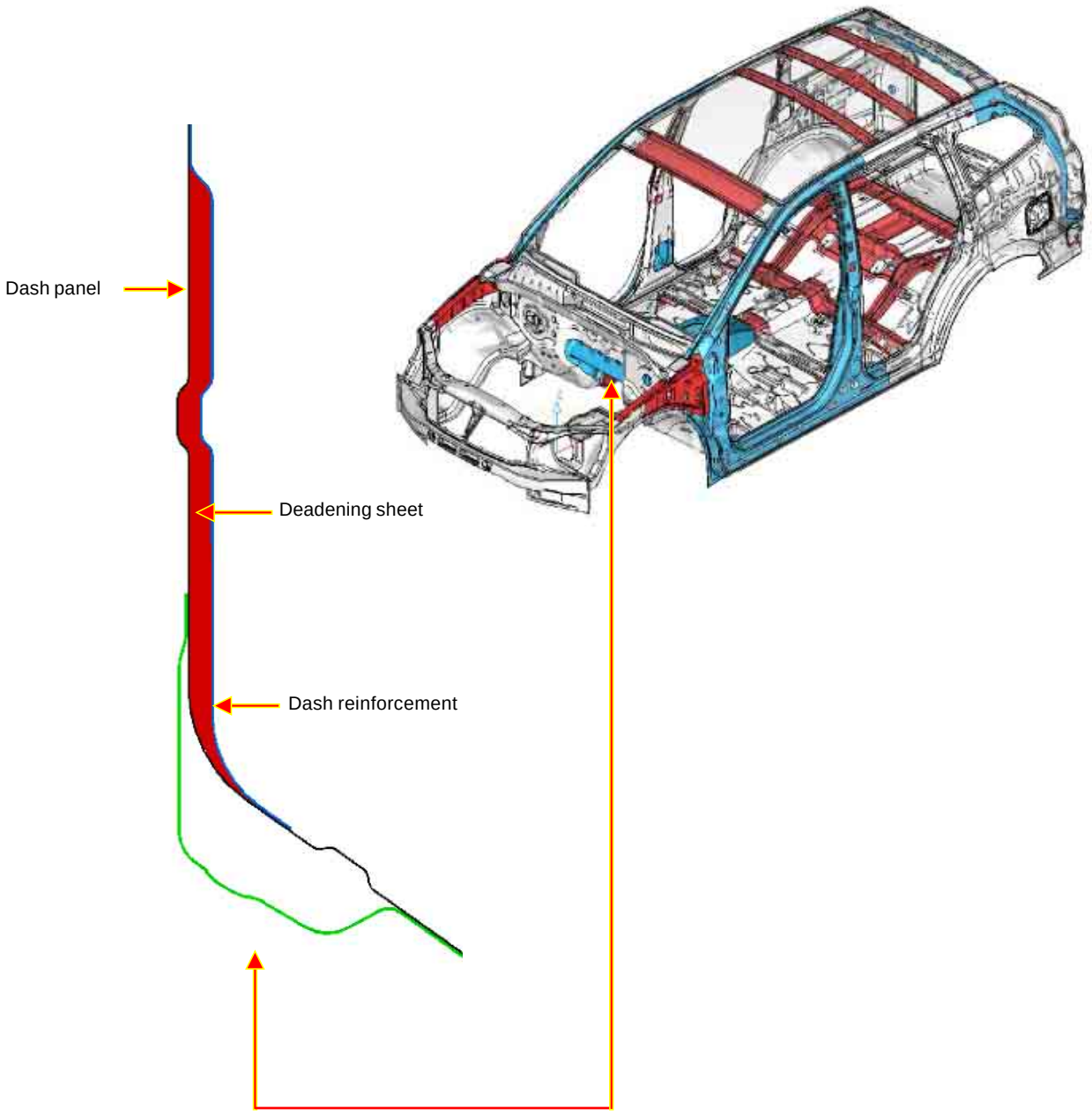
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3. DESIGN CHANGES FOR IMPROVING NVH PERFORMANCE

▶ Dual Type Dash Panel and Engine Tunnel with Foaming Pad

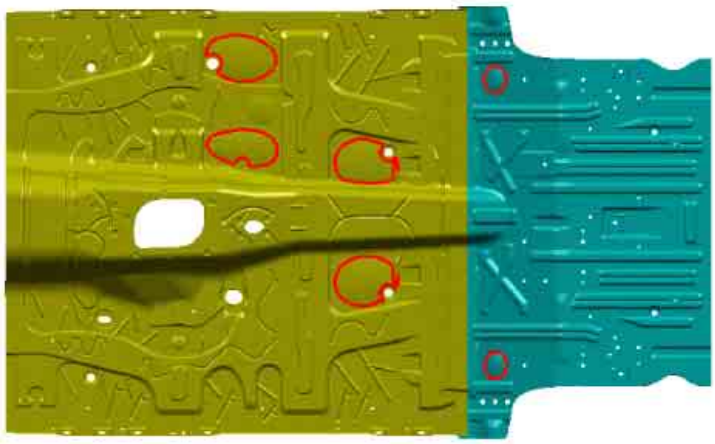
Blocks the noise from engine and transmission and improves the reinforcement of vehicle body.



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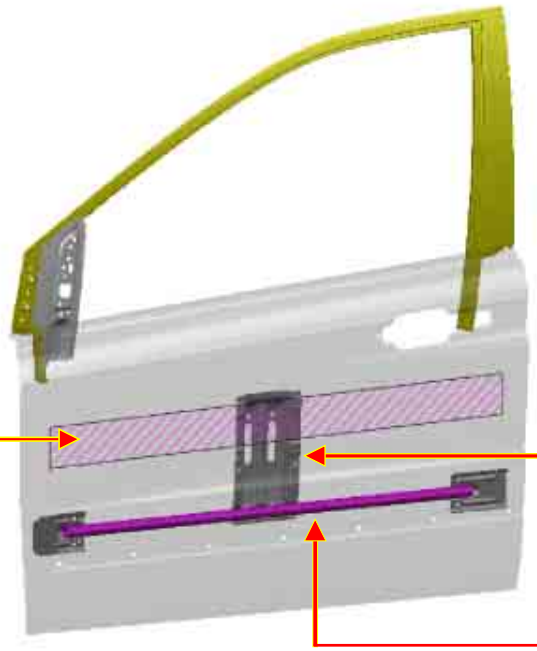
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▶ Improved Reinforcement and NVH According to the Introducing of Front Floor and Rear Floor



▶ Applied BPR (Body Panel Reinforcement) Sealer to the Door Outer Panel

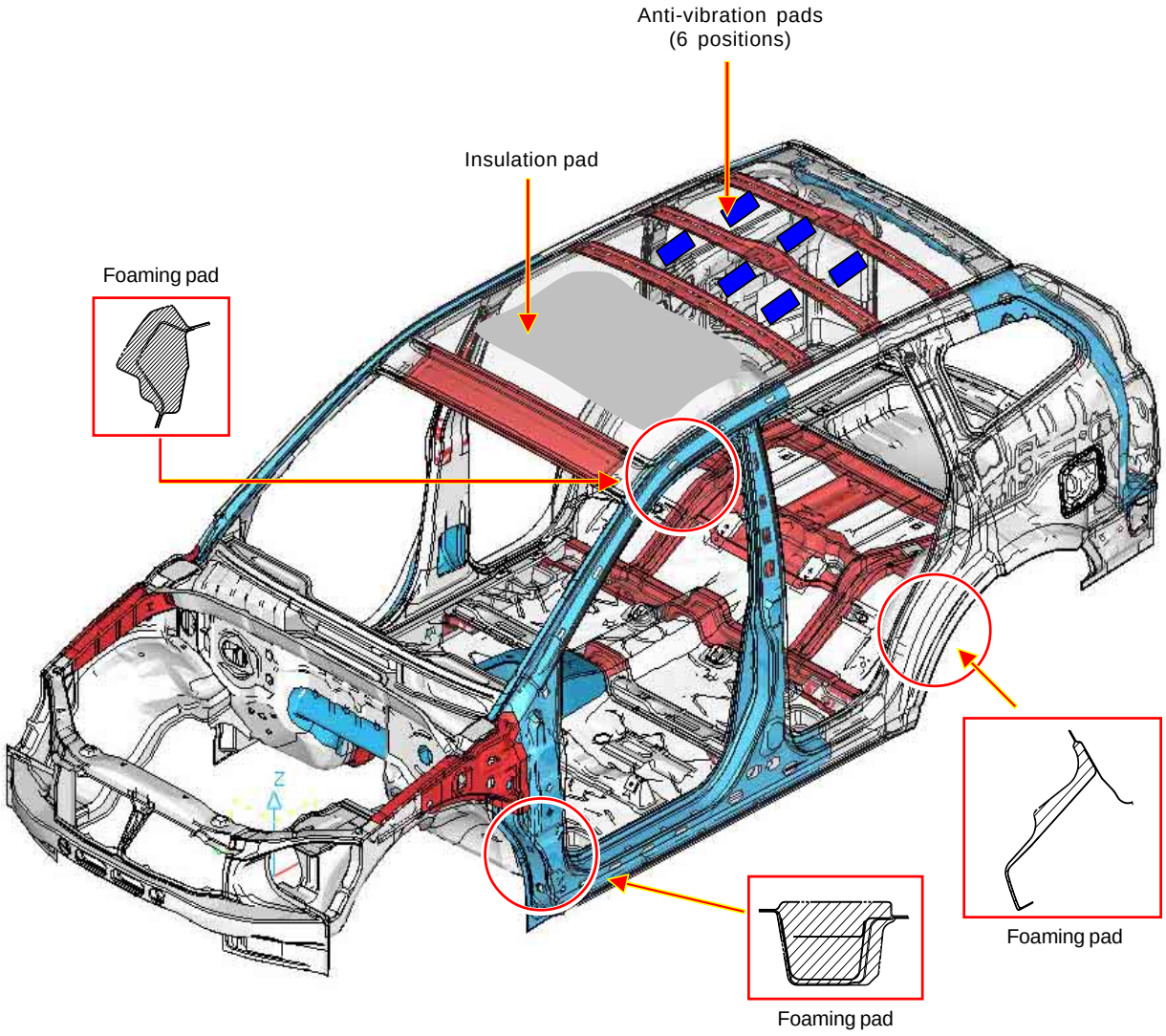
BPR sealer is sprayed by robot and is designed to reinforce the body panel and reduce the noise.



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▶ 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.

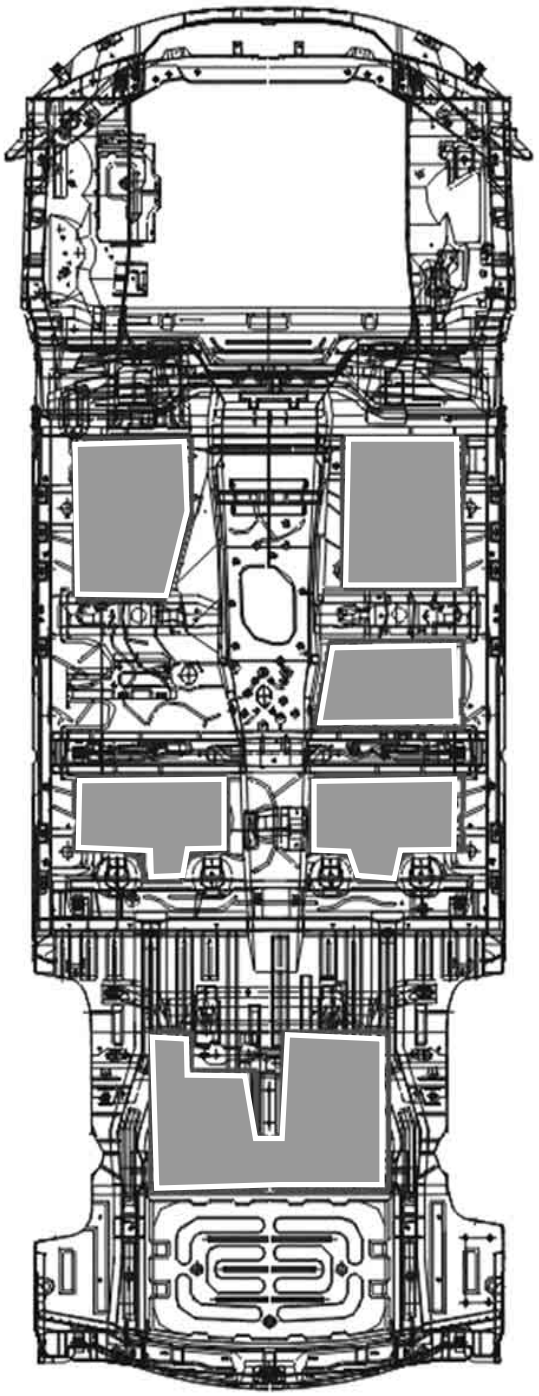


The foaming pads are applied to the symmetry surface of the vehicle.
Thus, totally 6 foaming pad are applied to the vehicle body.

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▶ Applied the Asphalt to the Body Panel (Improved Anti-Vibration)



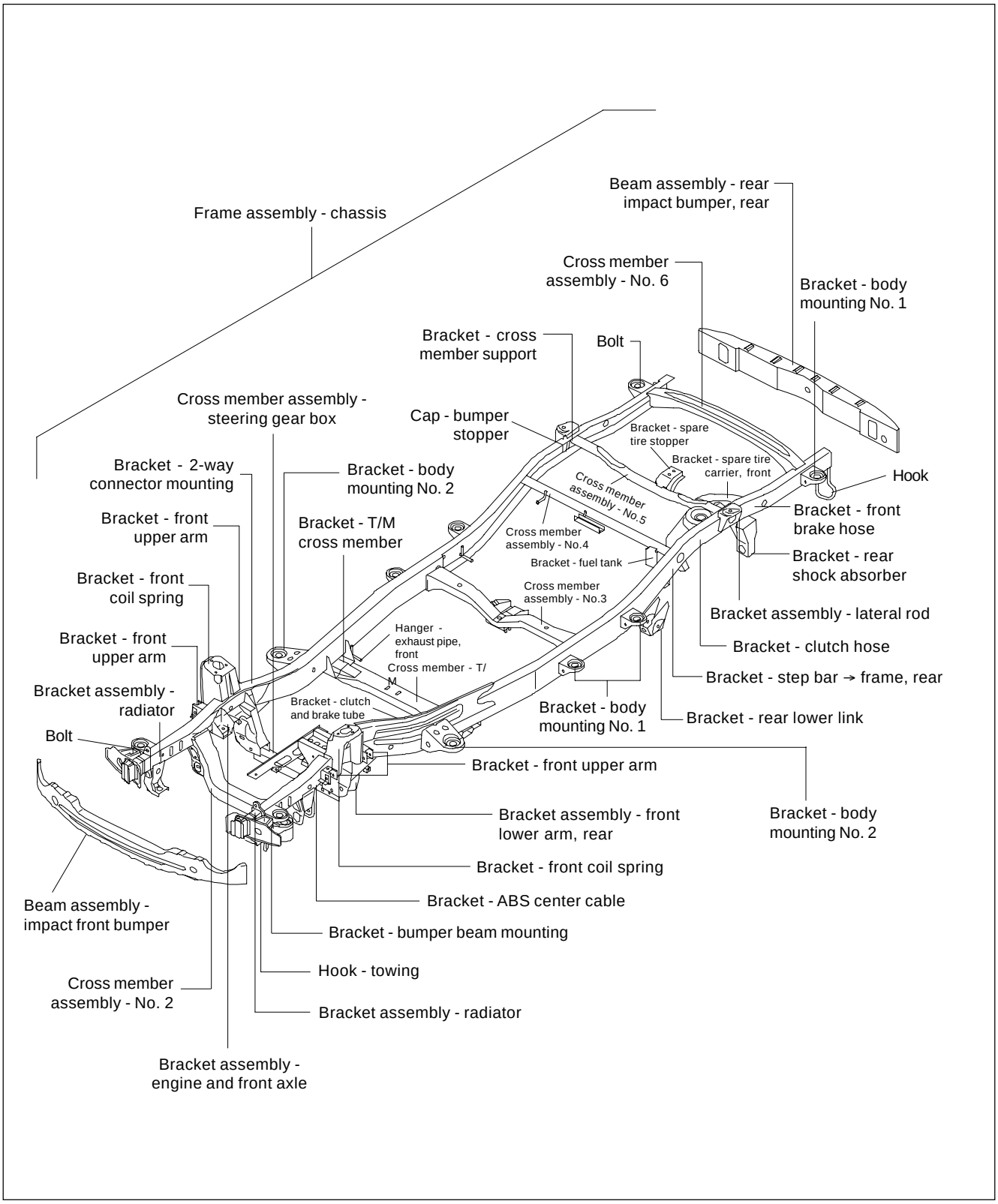
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4. FRAME

▶ Components

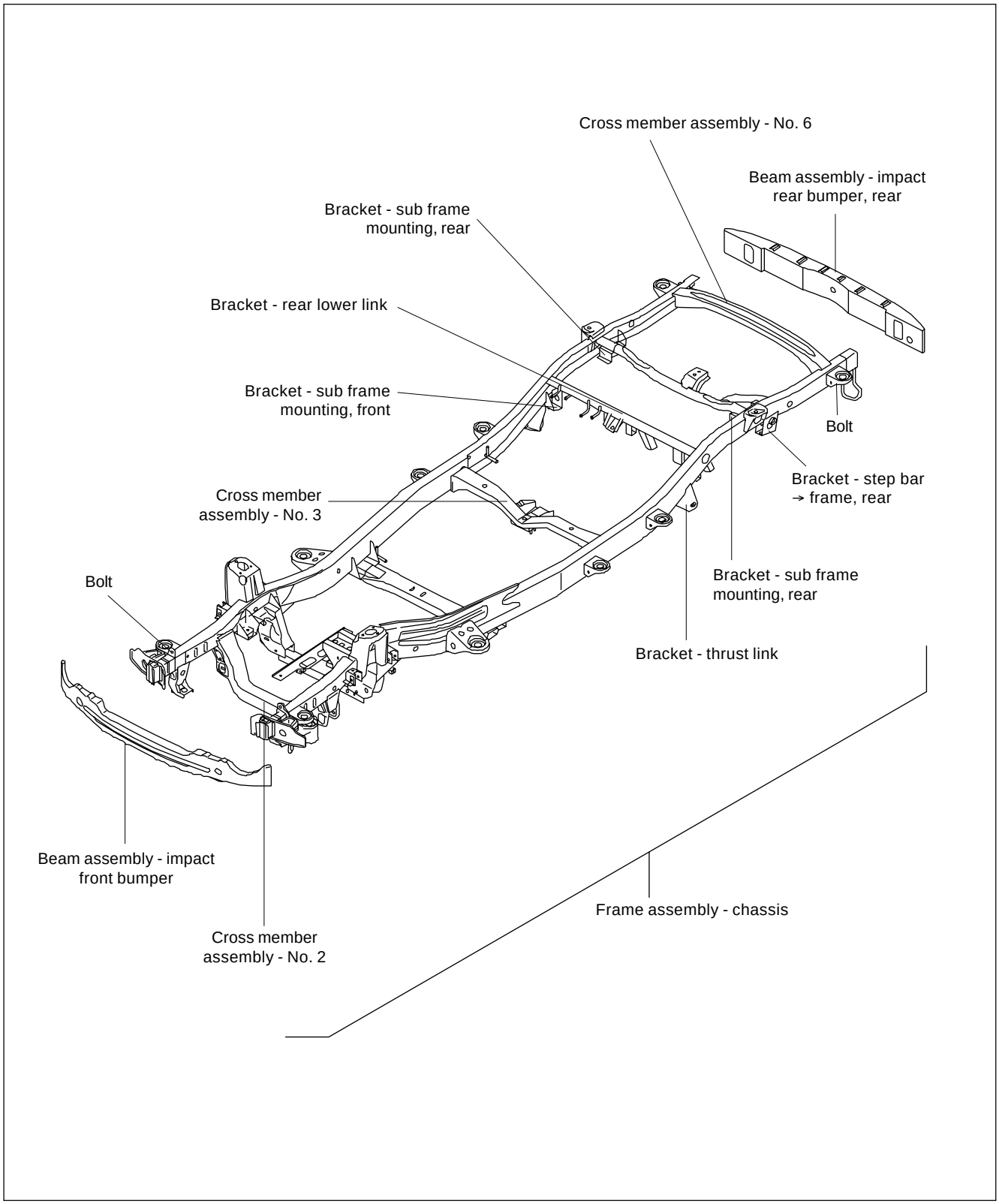
5-Link Type Suspension Frame



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IRS (Independent Rear Suspension) Type Suspension Frame



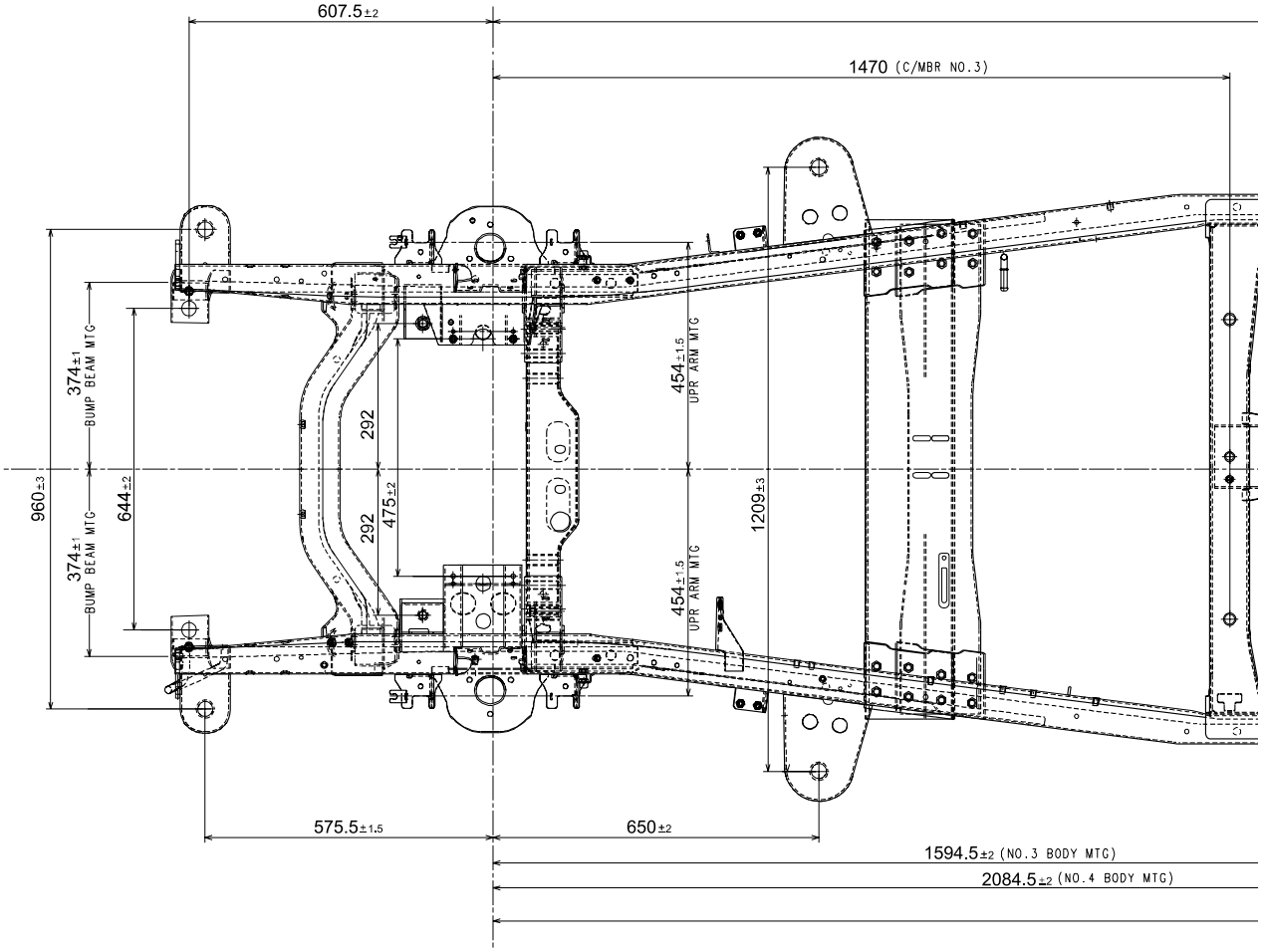
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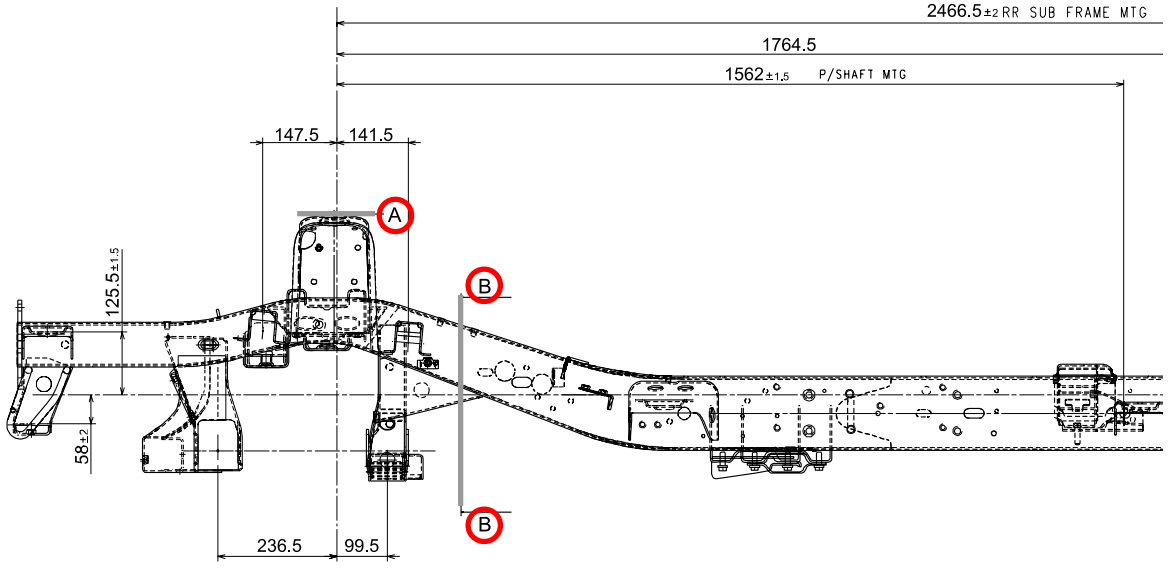
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▶ Frame Dimensions

5-Link Suspension Frame

Unit: mm

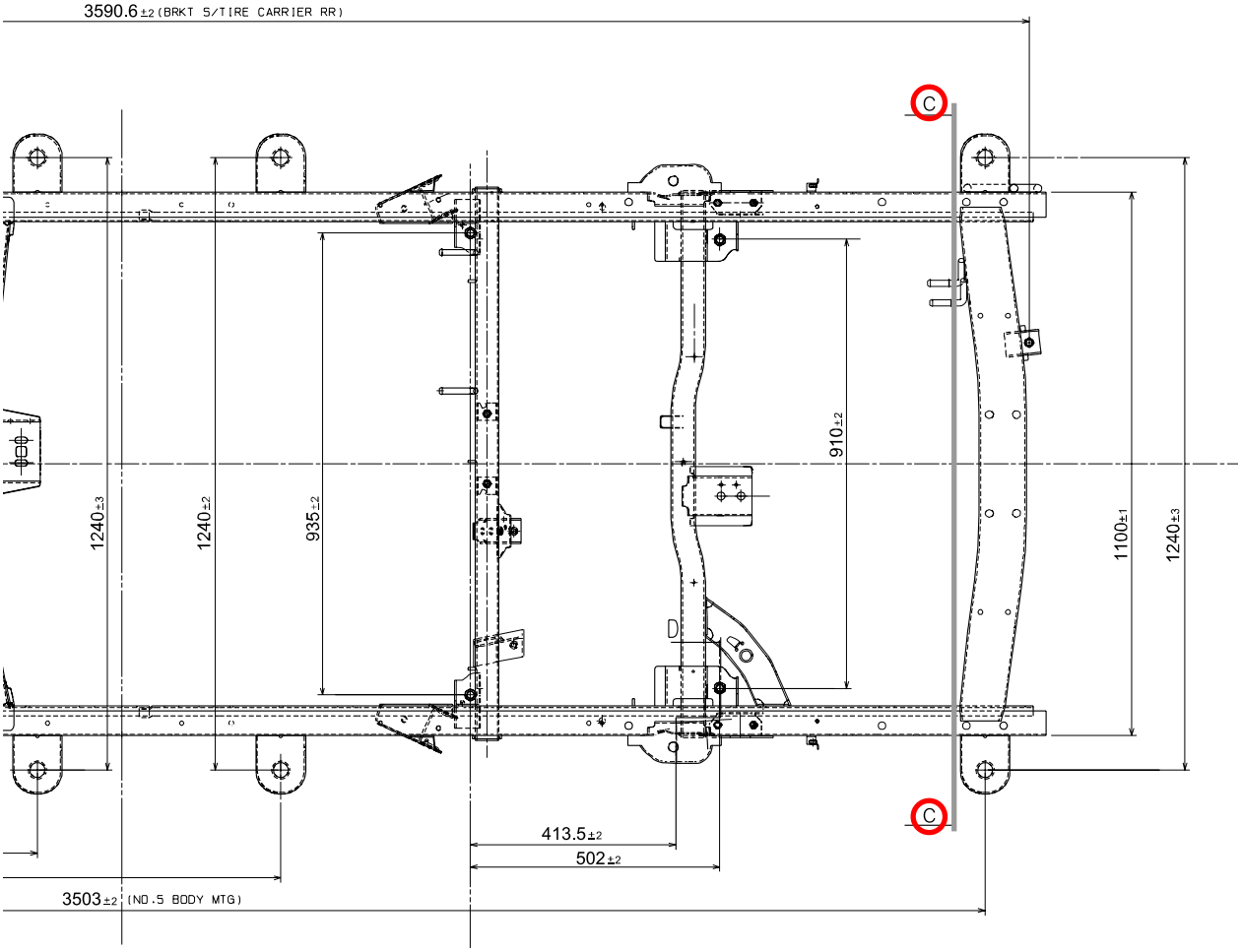


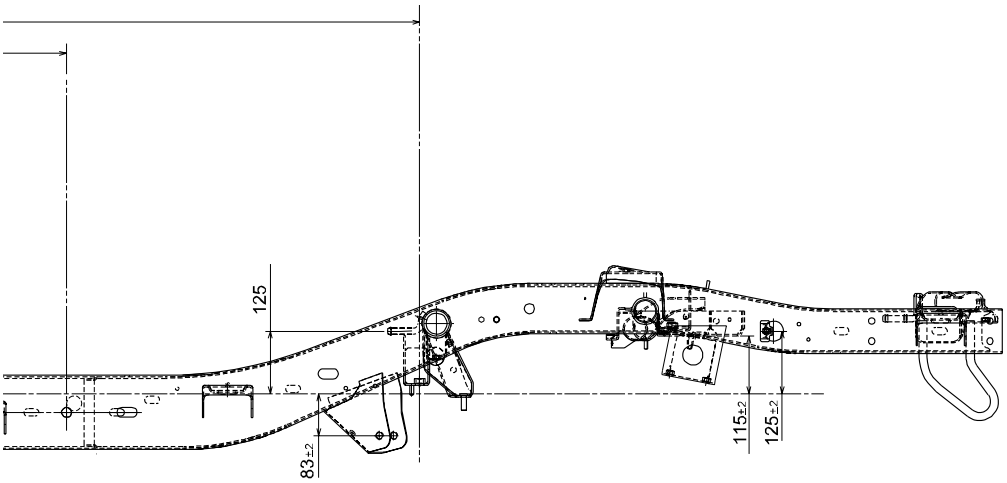


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Unit: mm



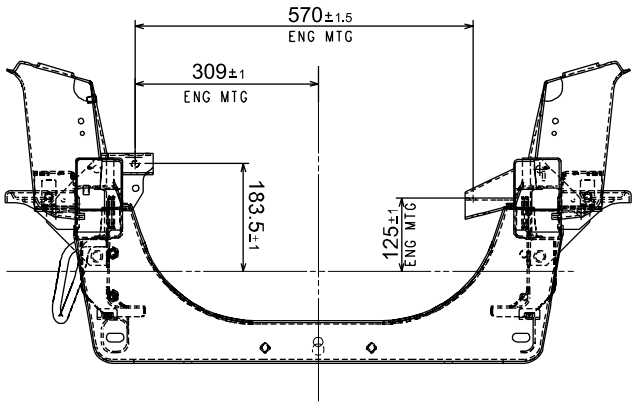


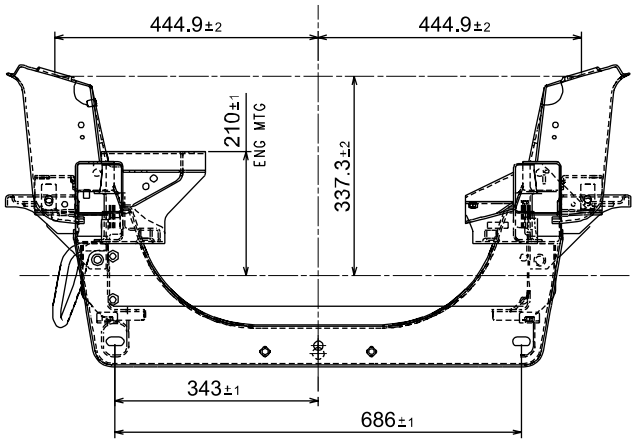
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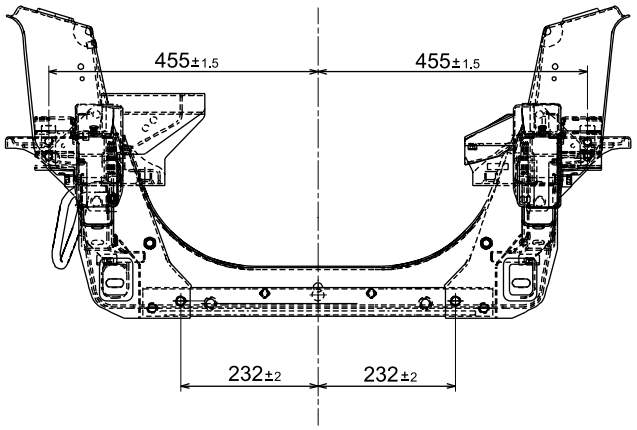
Sectional Drawing

Unit: mm





SECTION A

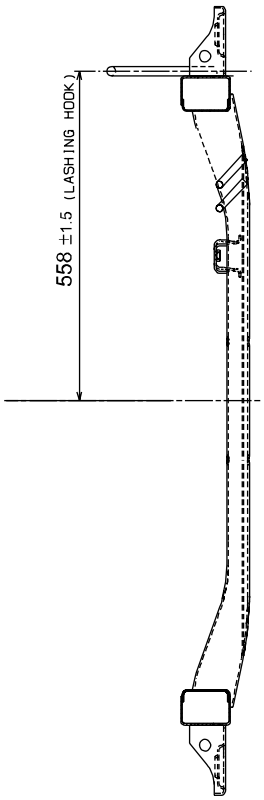


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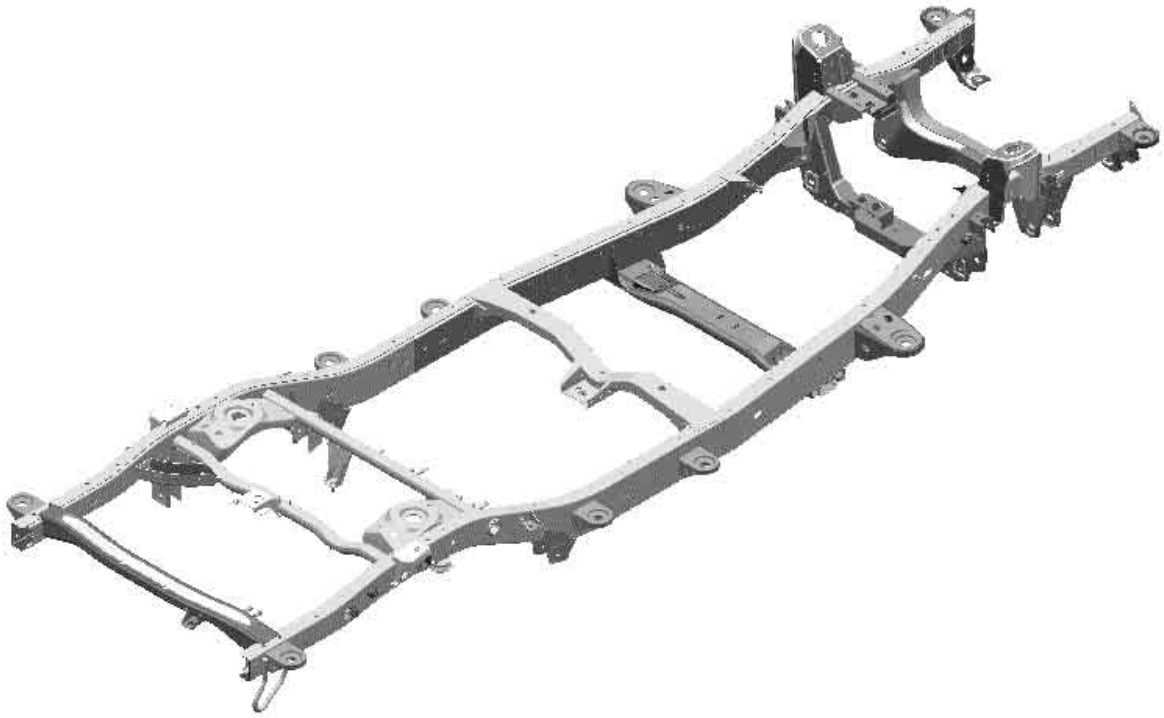
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Unit: mm



SECTION C

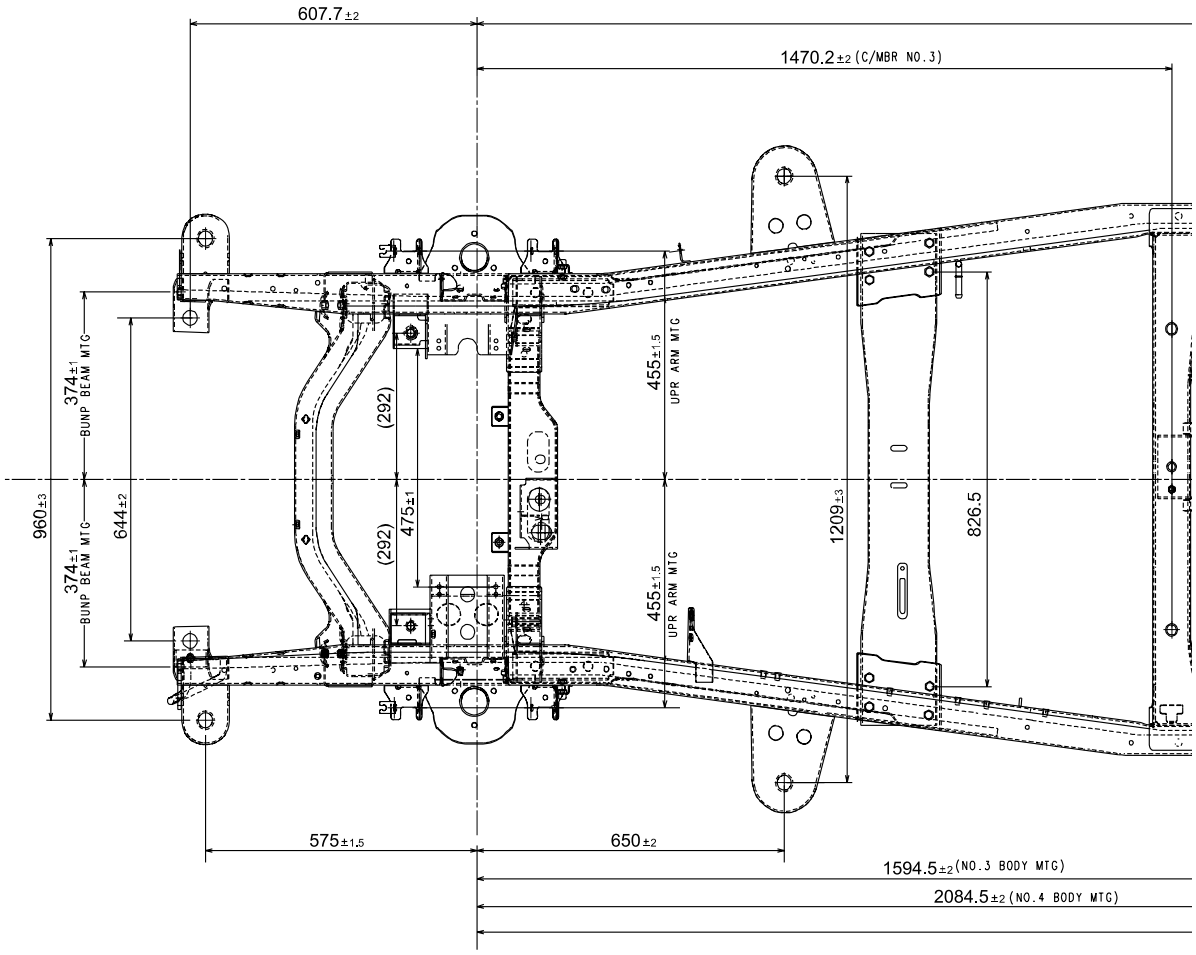


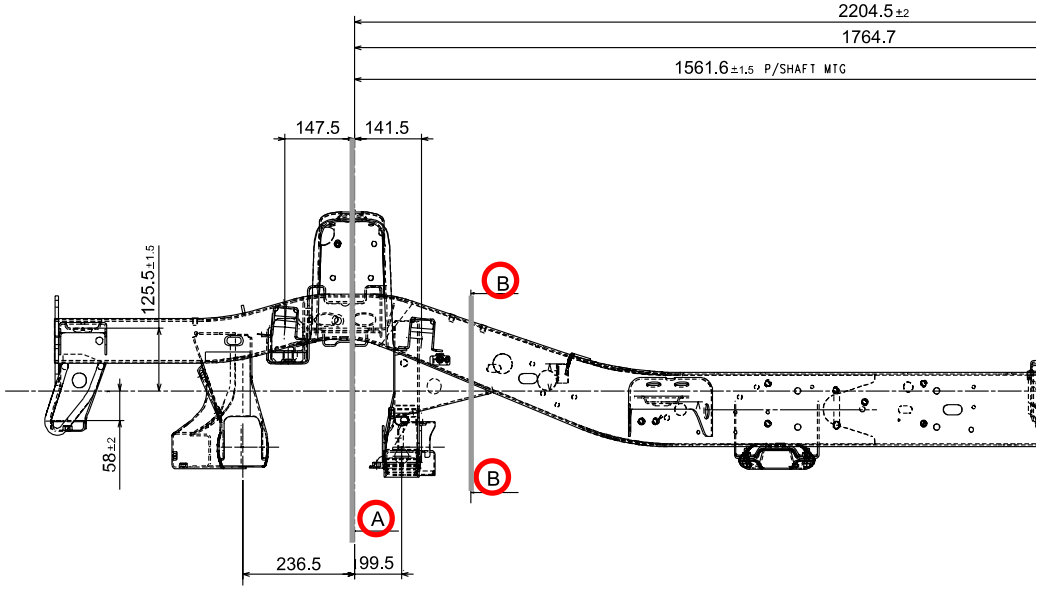
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IRS Suspension Frame

Unit: mm

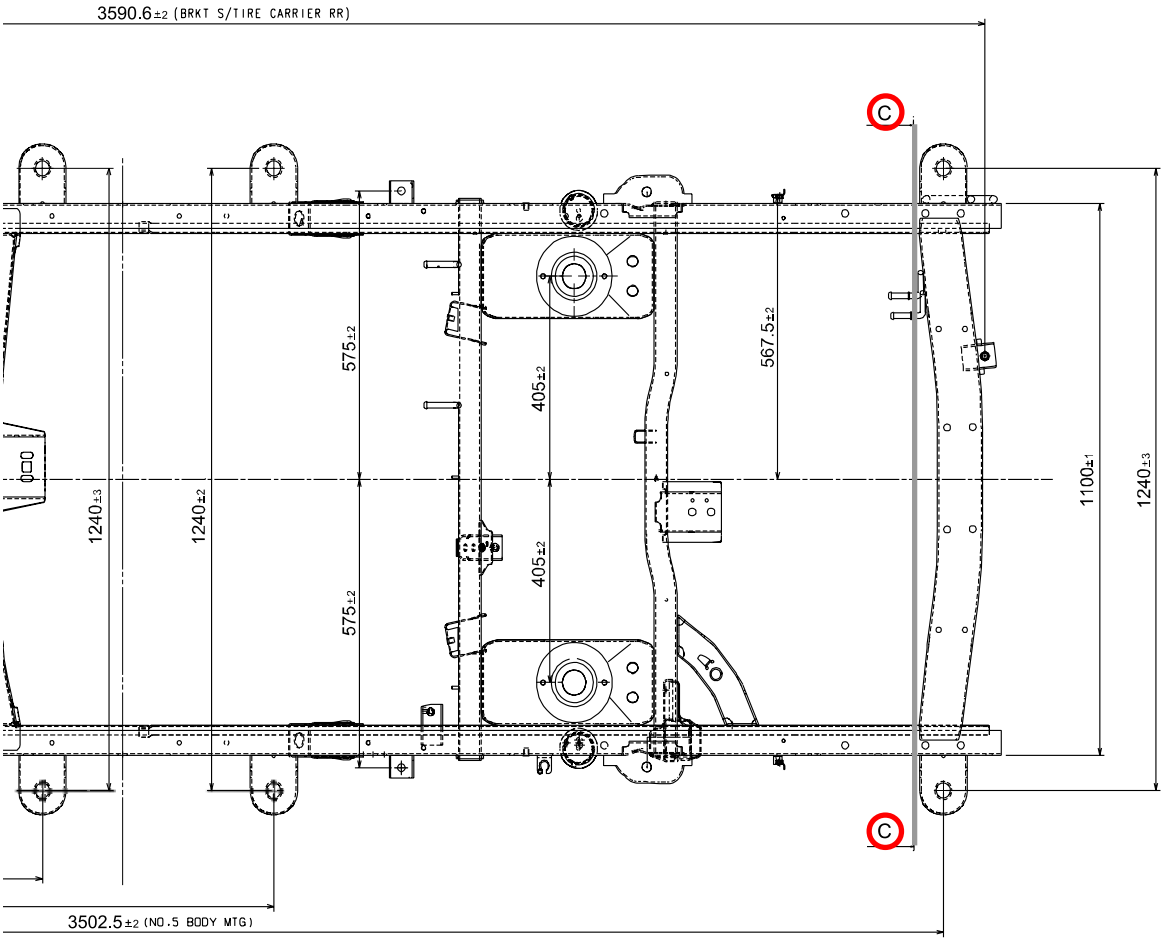


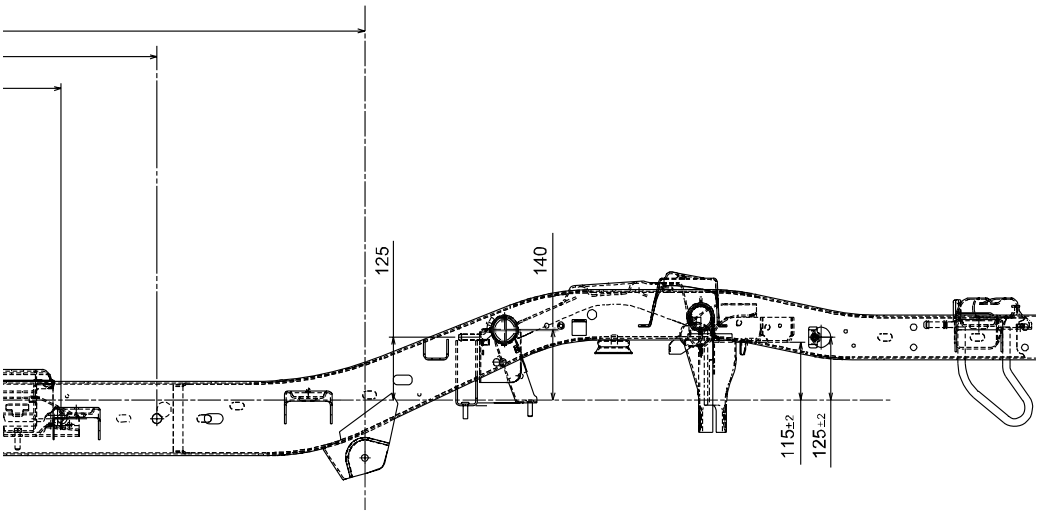


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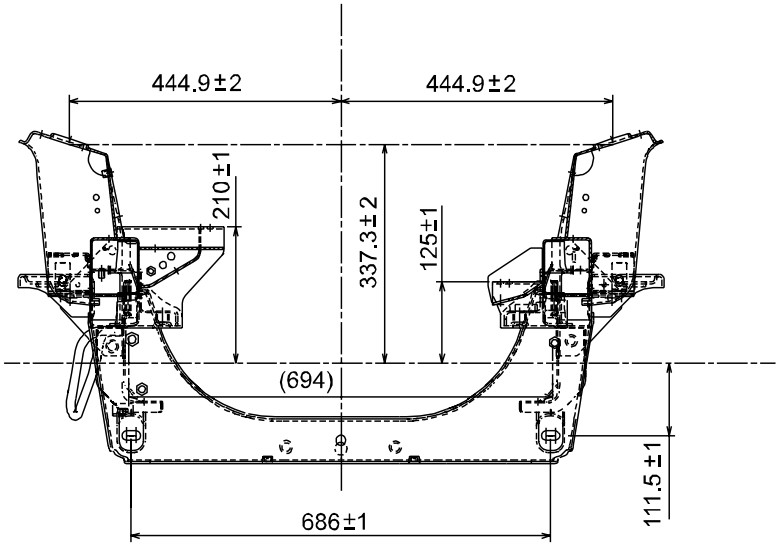


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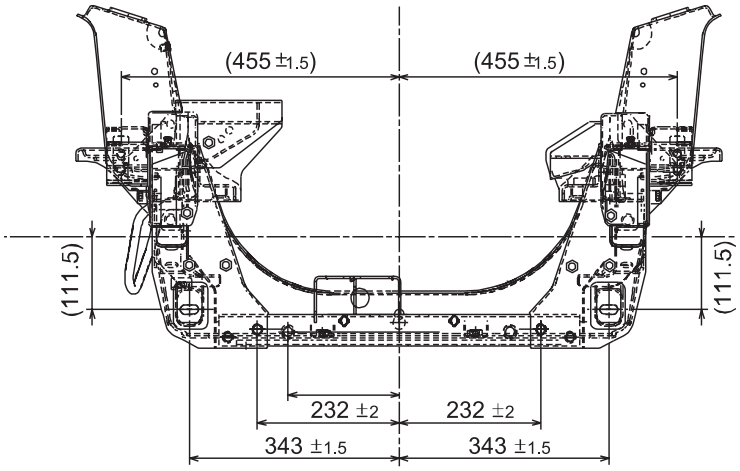
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Sectional Drawing

Unit: mm



SECTION A

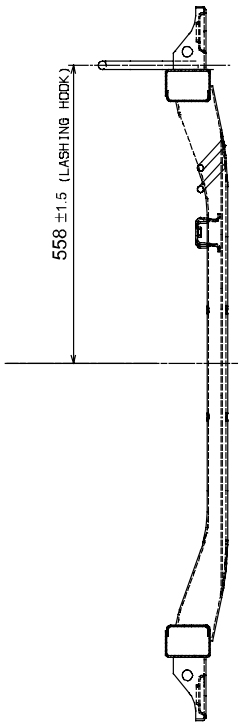


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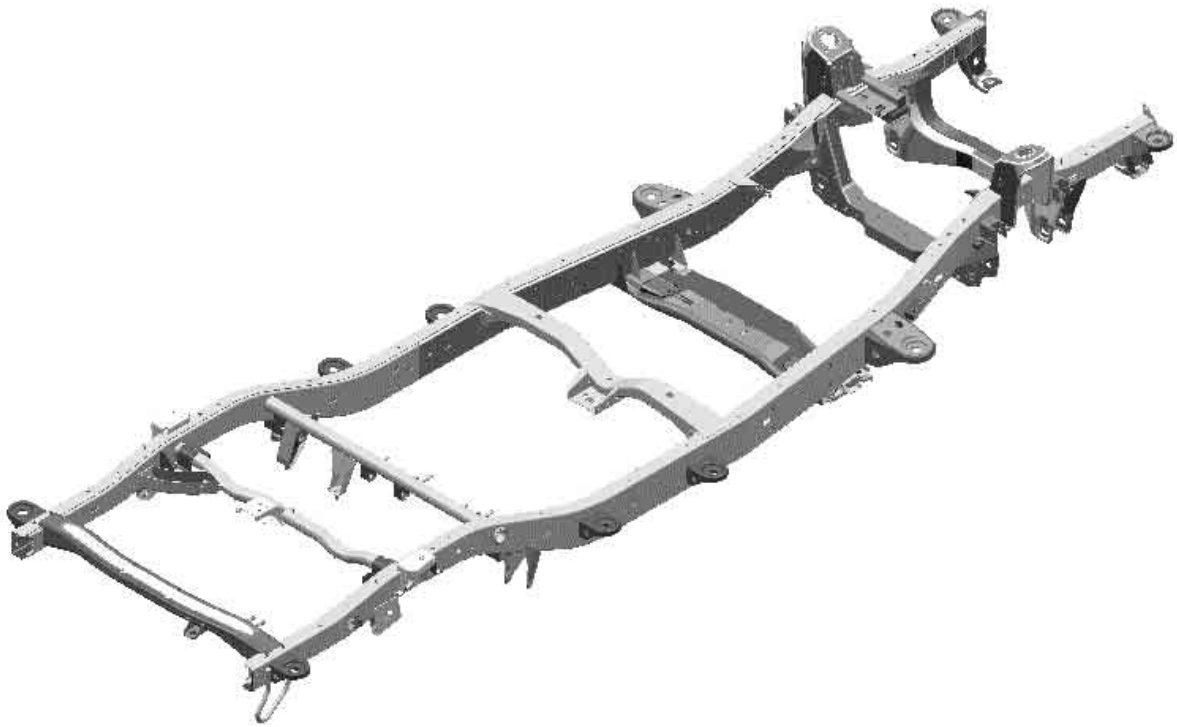
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Unit: mm



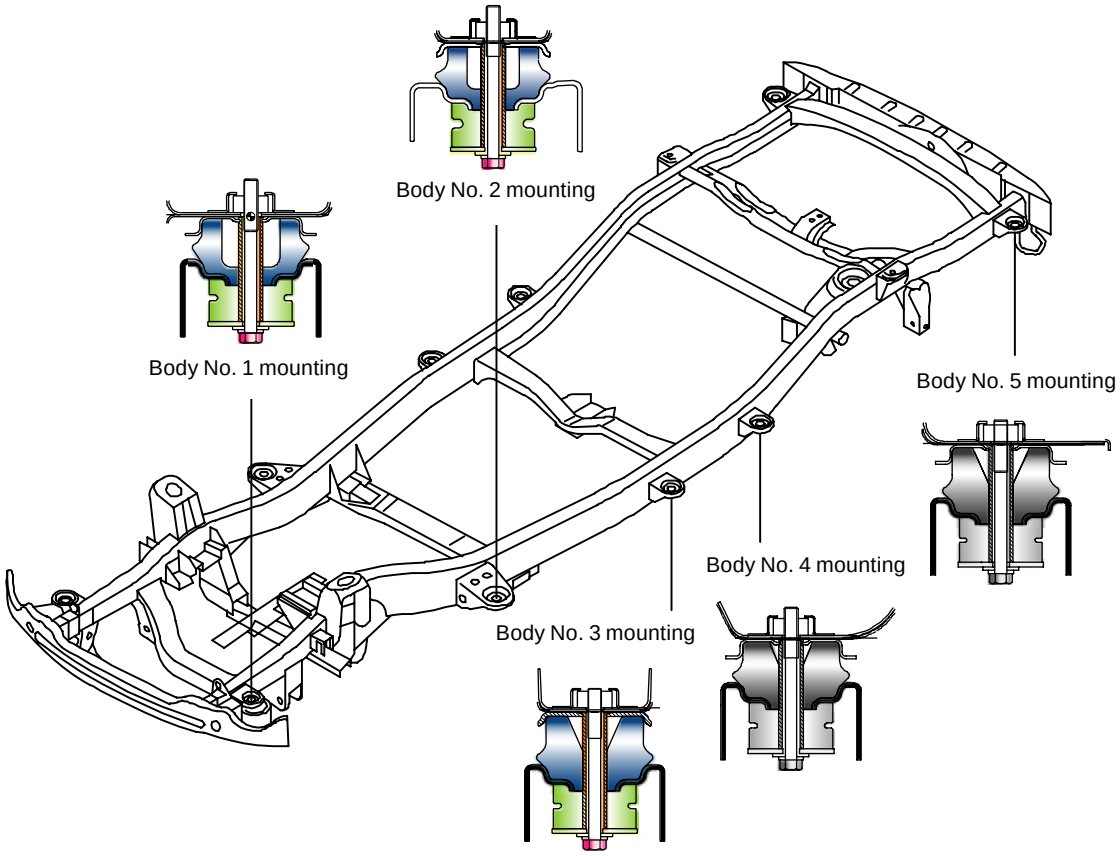
SECTION C



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▶ Frame Body Mounting



	Body No. 1 mounting	Body No. 2 mounting	Body No. 3 mounting	Body No. 4 mounting	Body No. 5 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 60 ~ 80 Nm	Bolt Tightening torque 60 ~ 80 Nm	Bolt Tightening torque 60 ~ 80 Nm	Bolt Tightening torque 60 ~ 80 Nm	Bolt Tightening torque 60 ~ 80 Nm

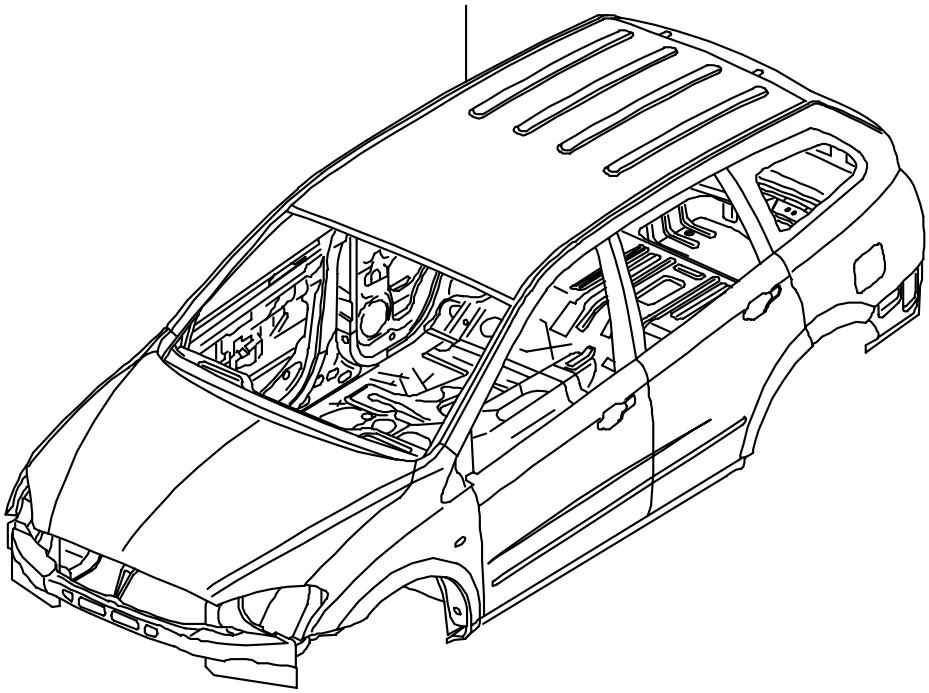
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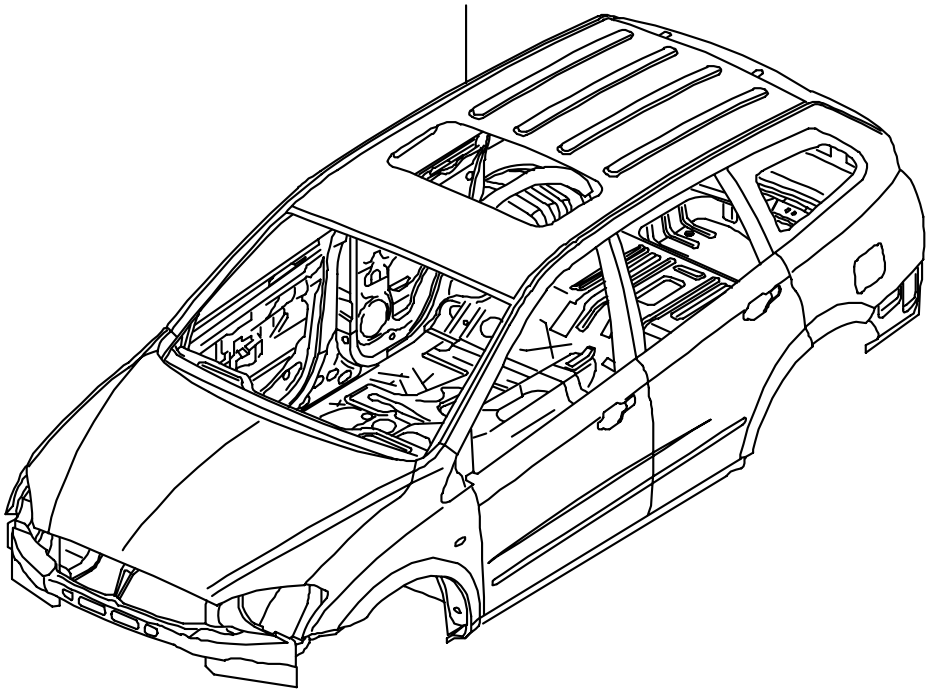
5. BODY REPAIR

▶ White Body

Without sunroof



With sunroof



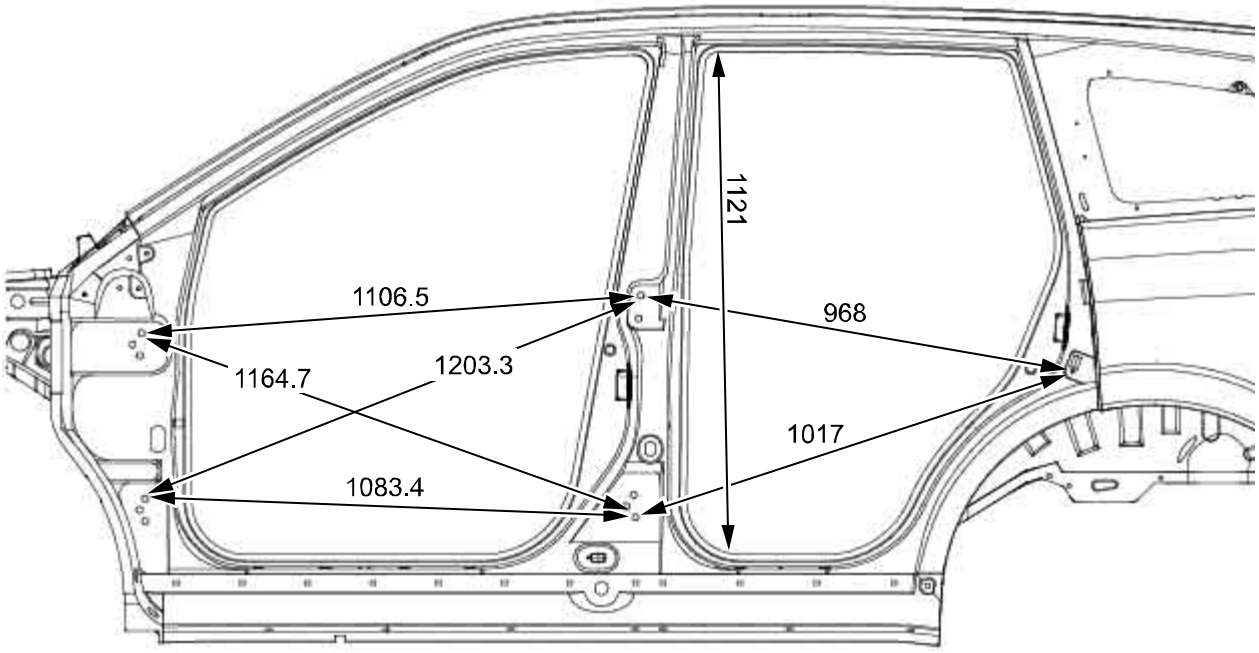
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▶ Body Dimensions

Side Structure Complete

Unit: mm

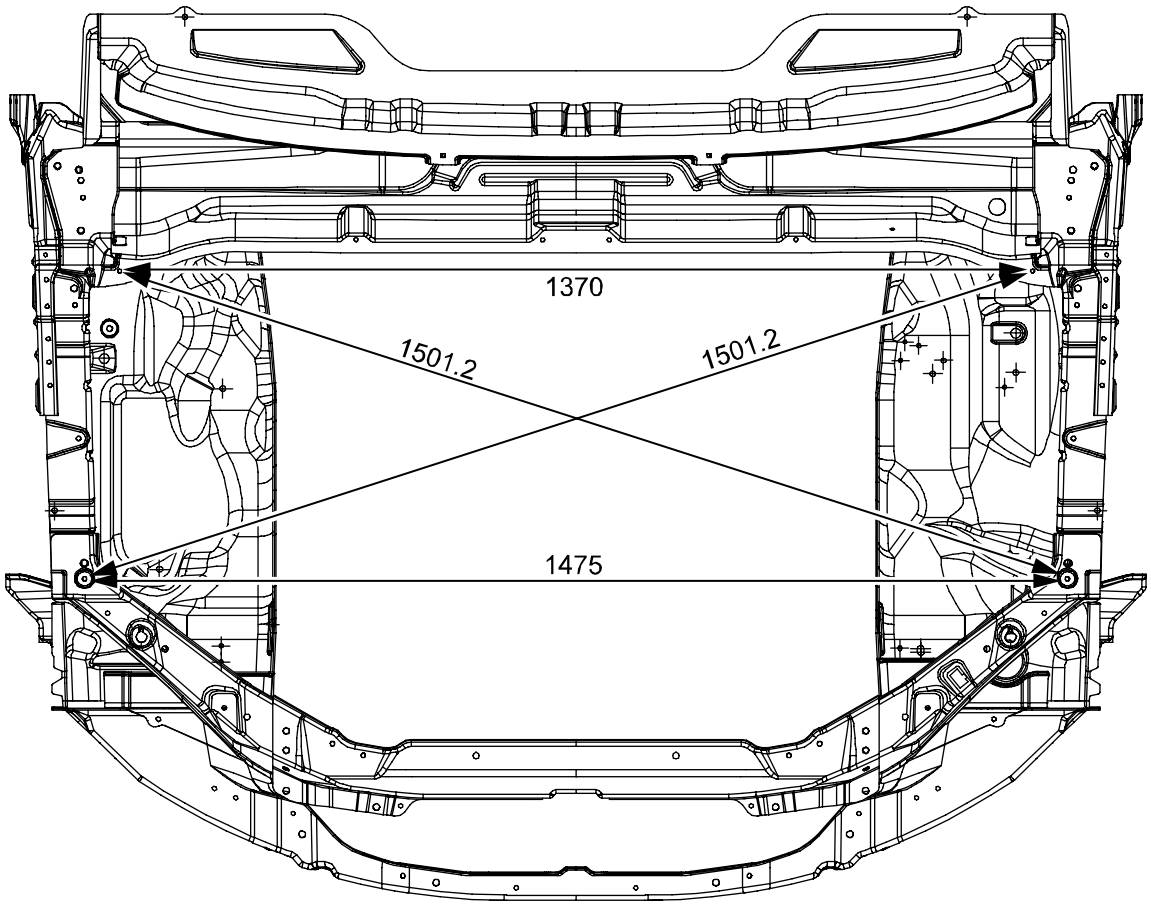


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Engine Compartment

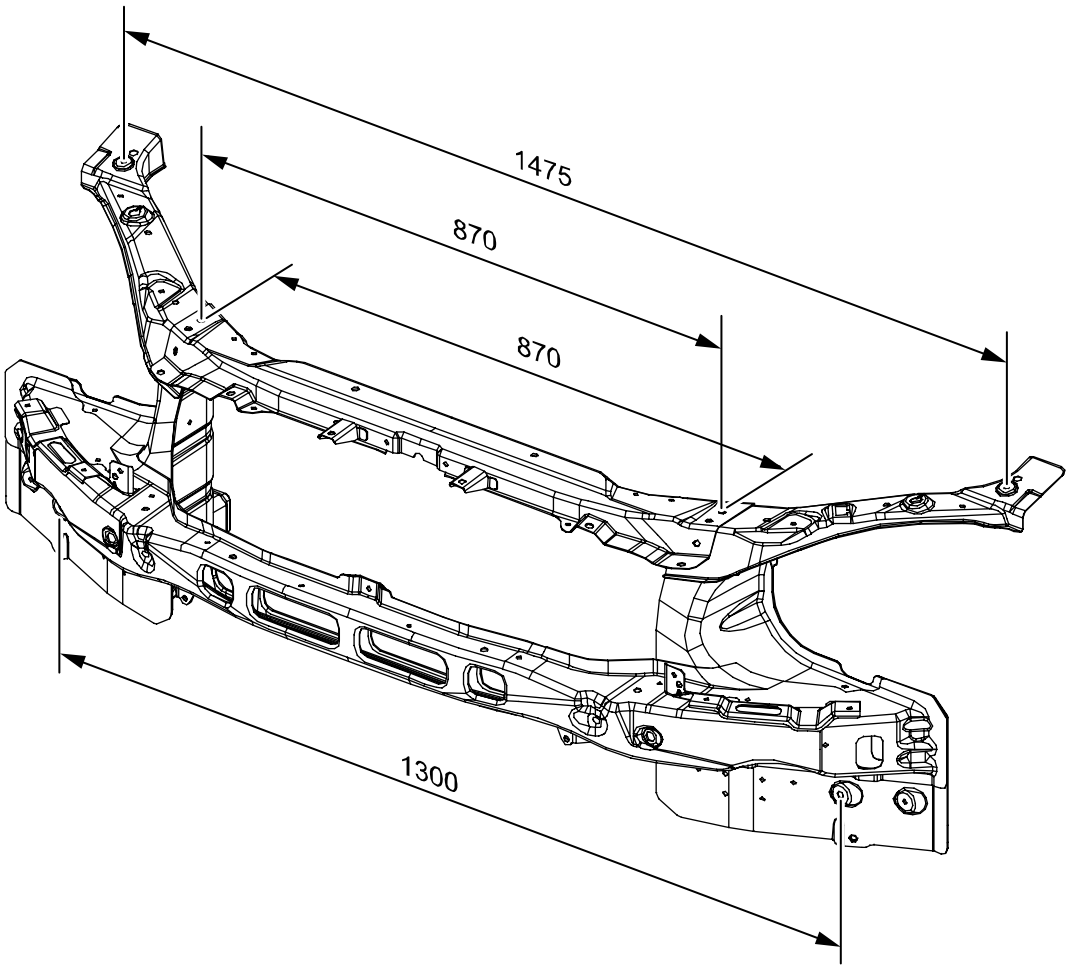
Unit: mm



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Front End

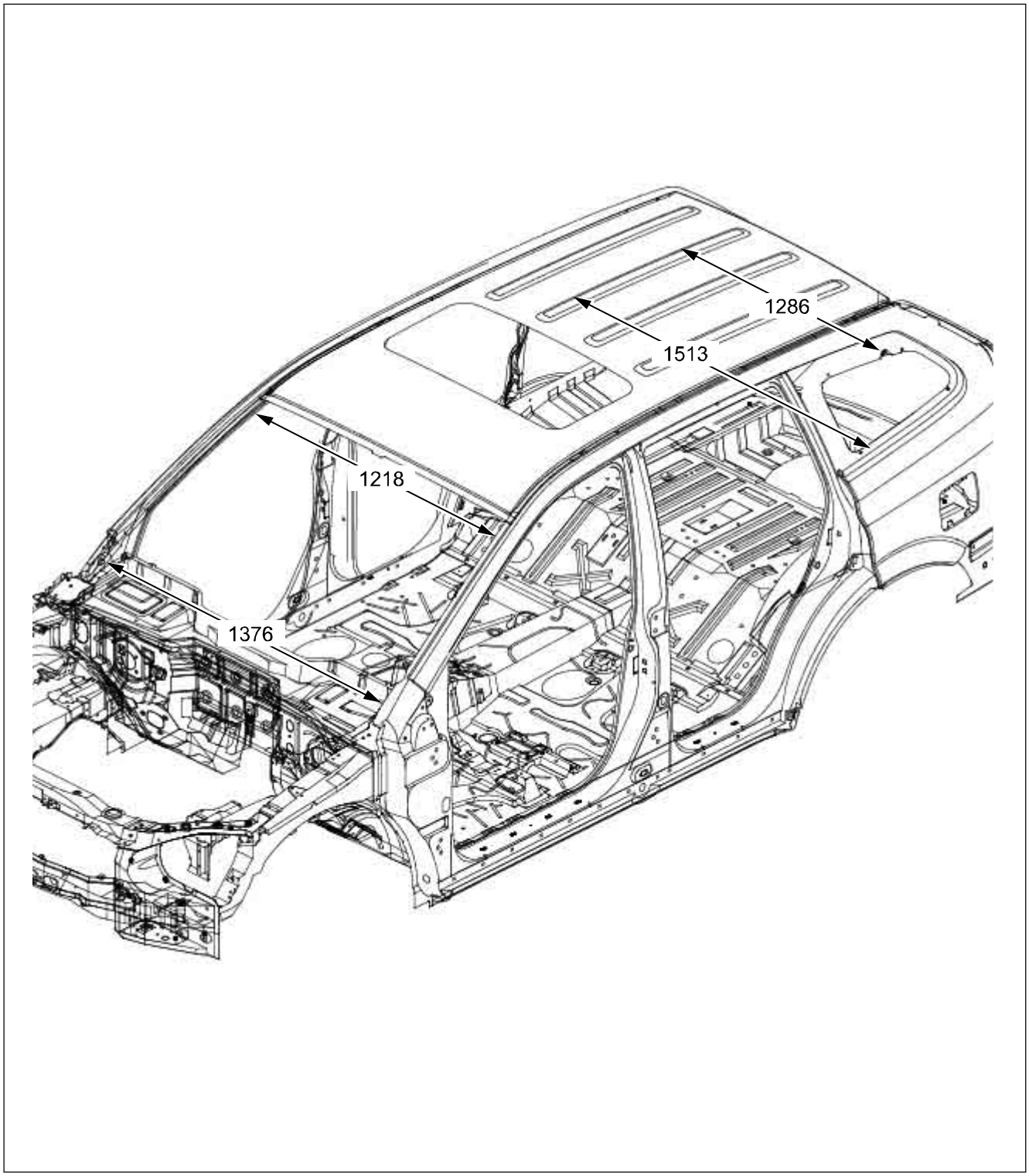
Unit: mm



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Windshield Glass Mounting Panel

Unit: mm

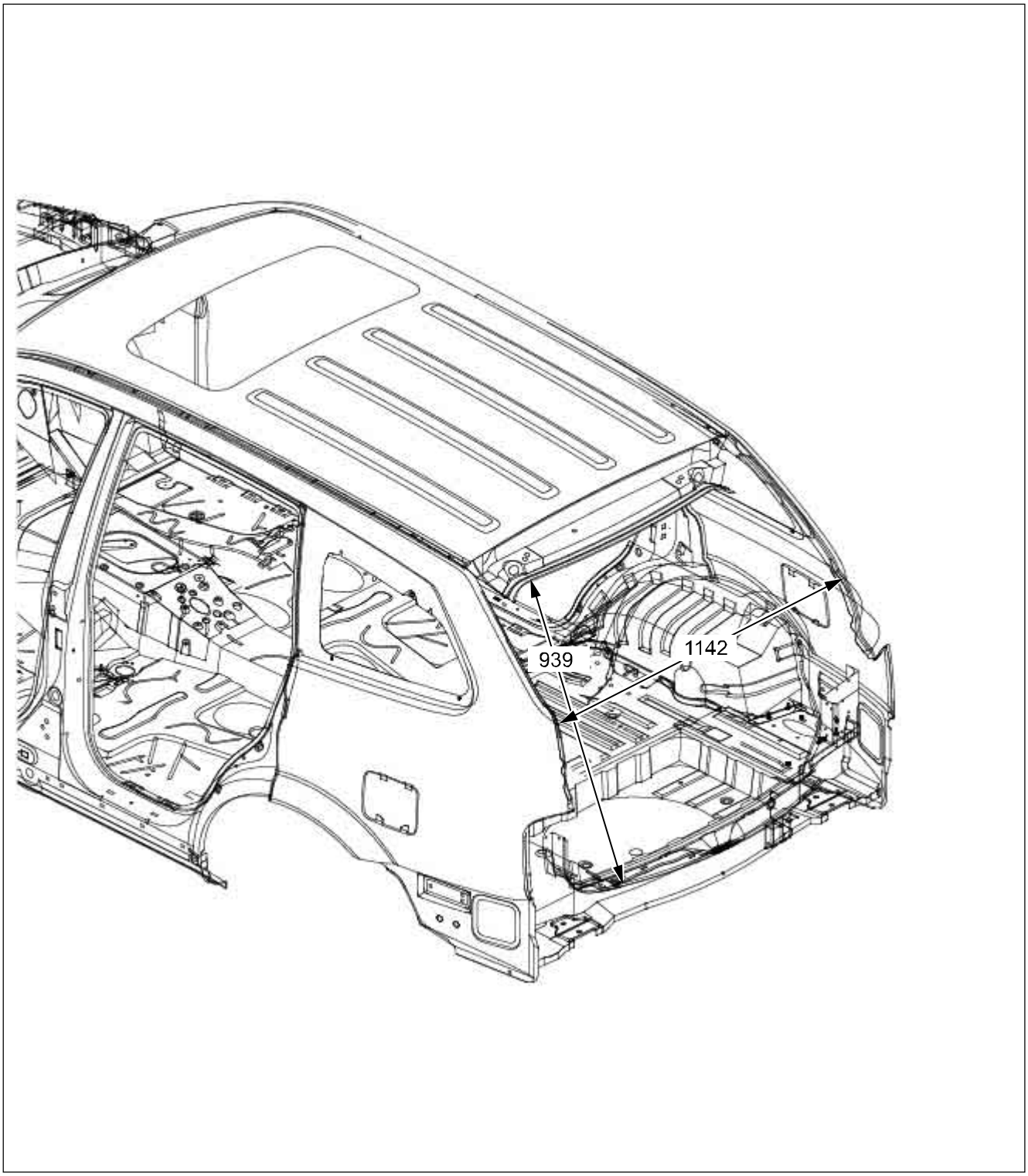


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Tailgate

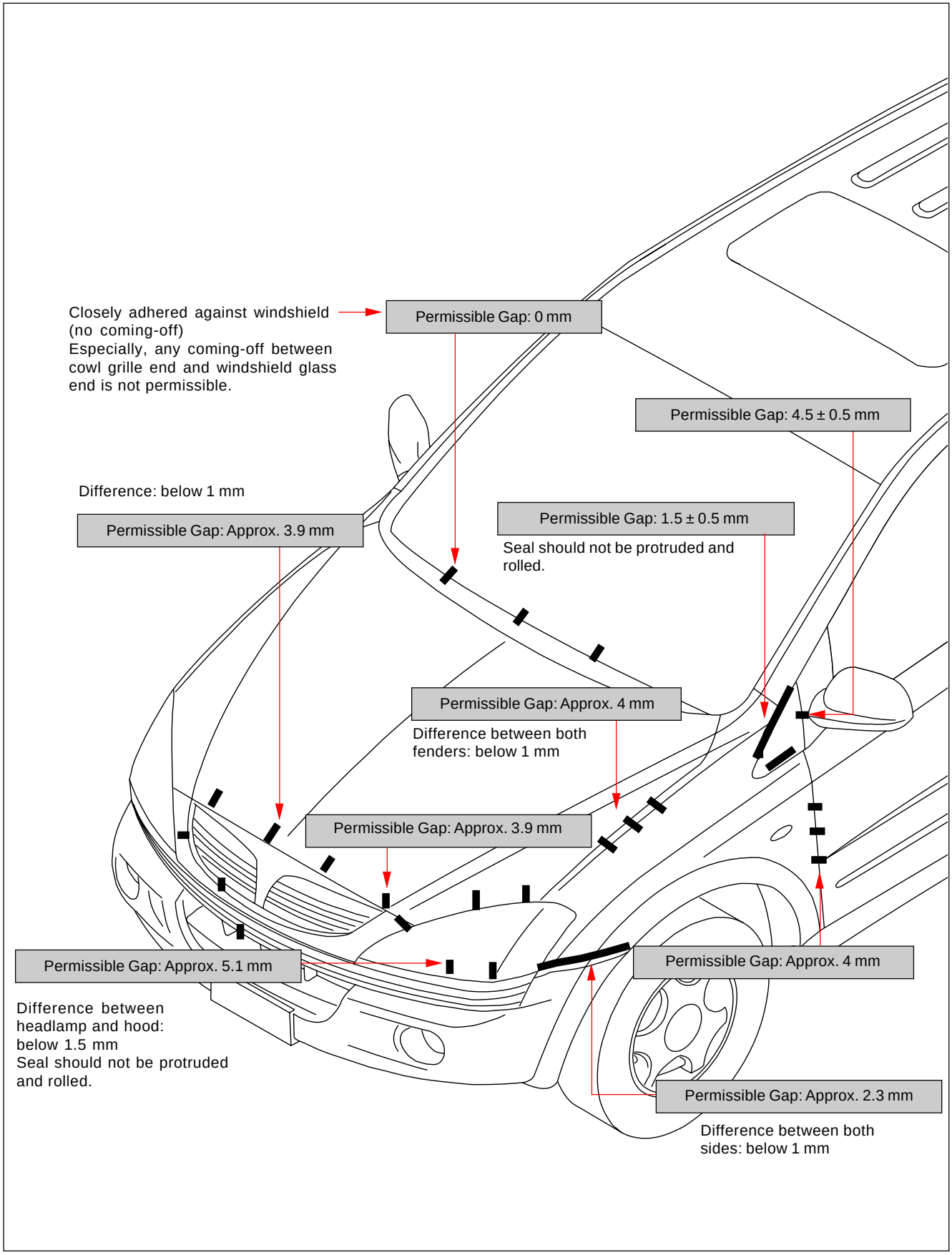
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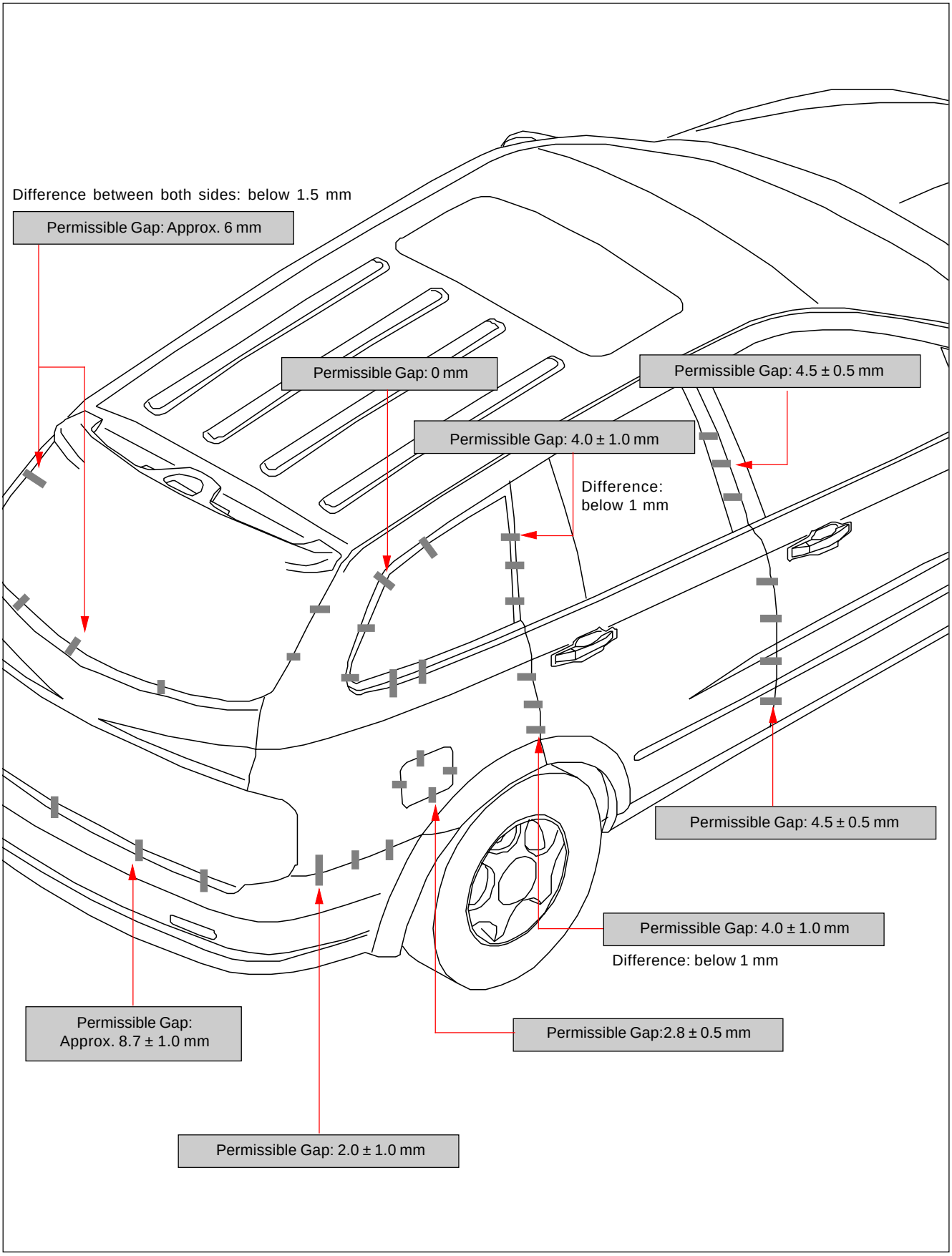
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Body Gaps



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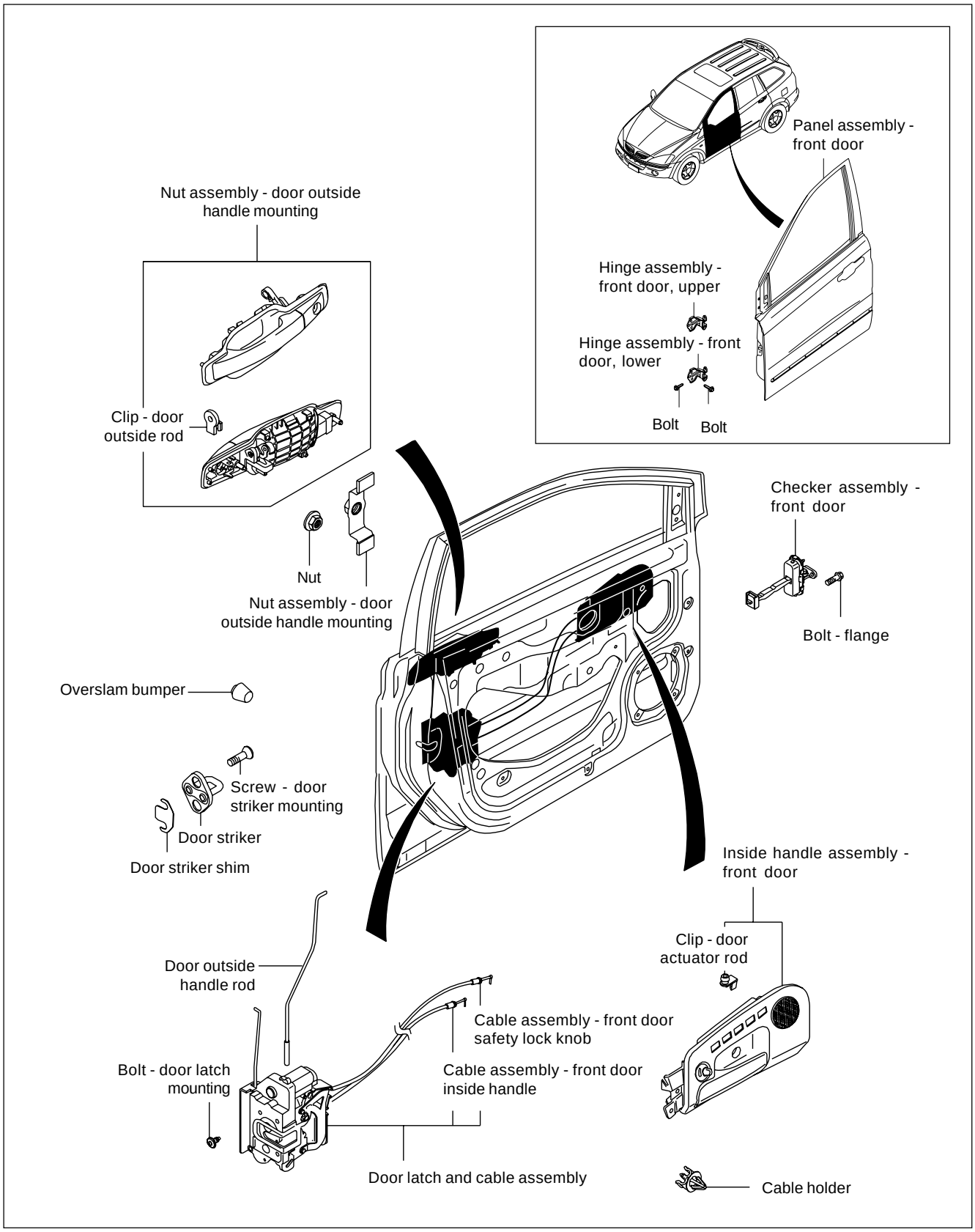


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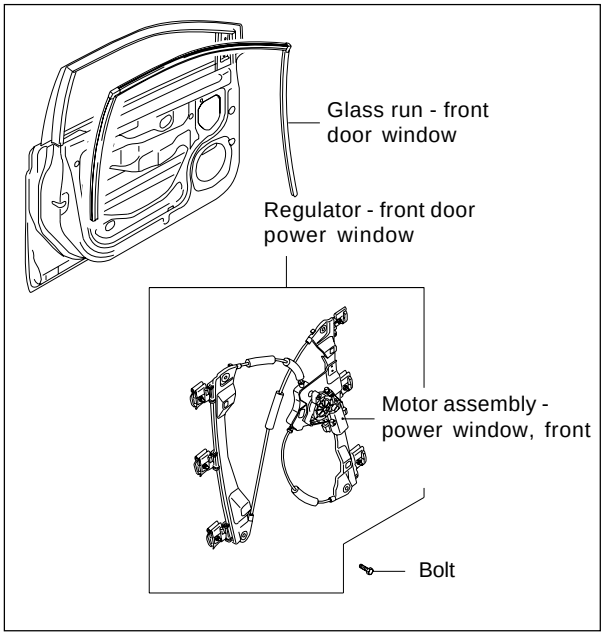
▶ Door Components (Including Engine Hood)

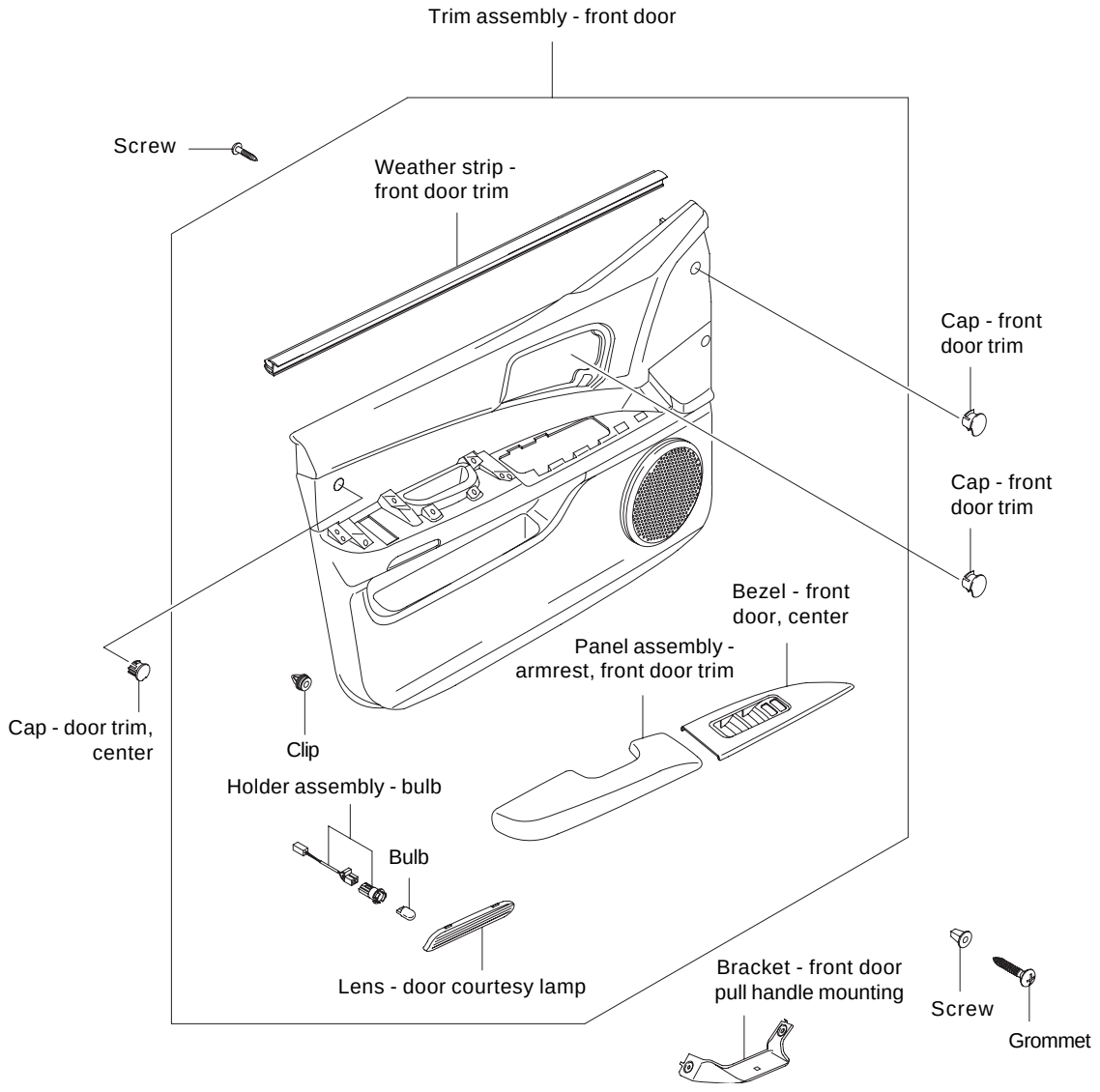
Front Door



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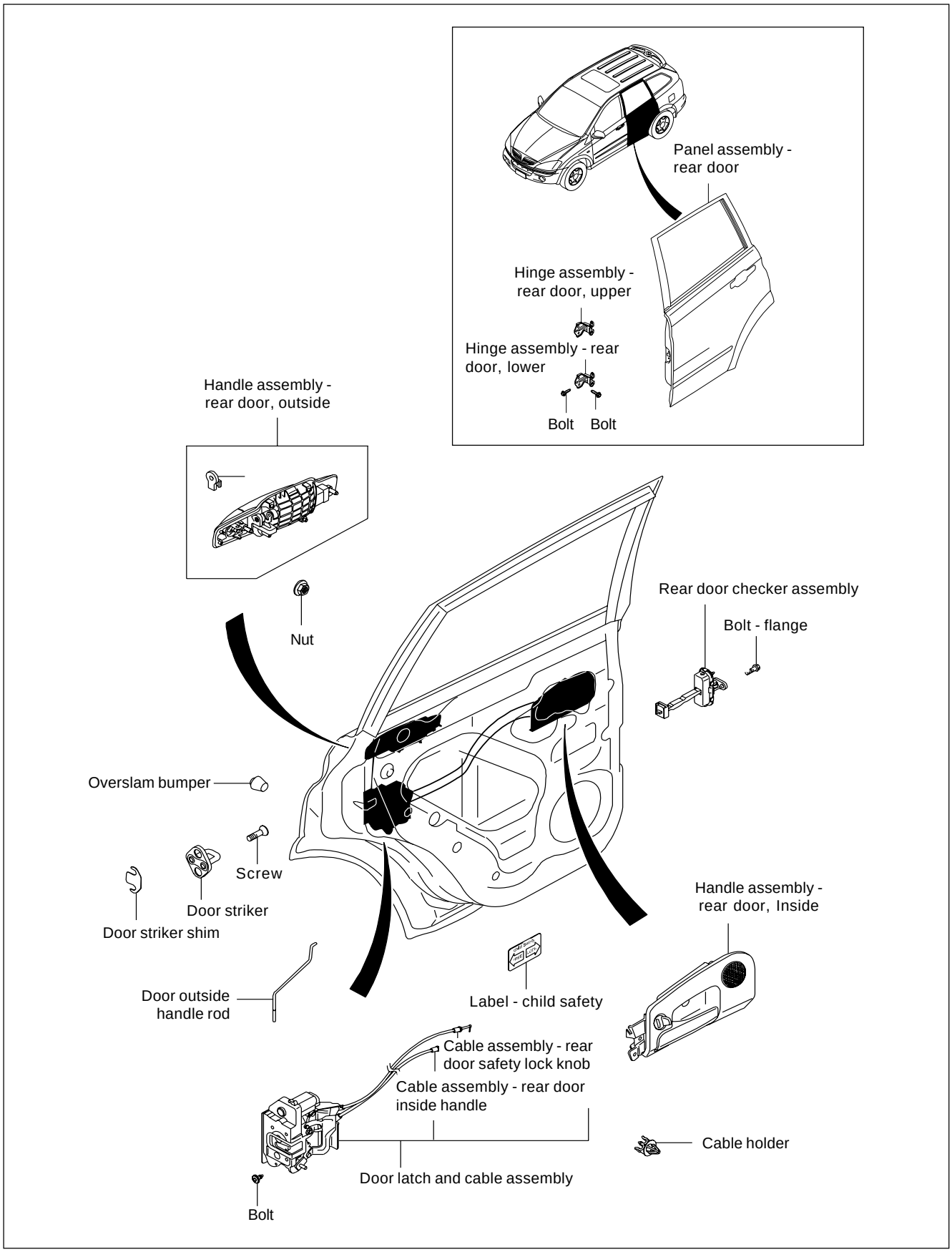




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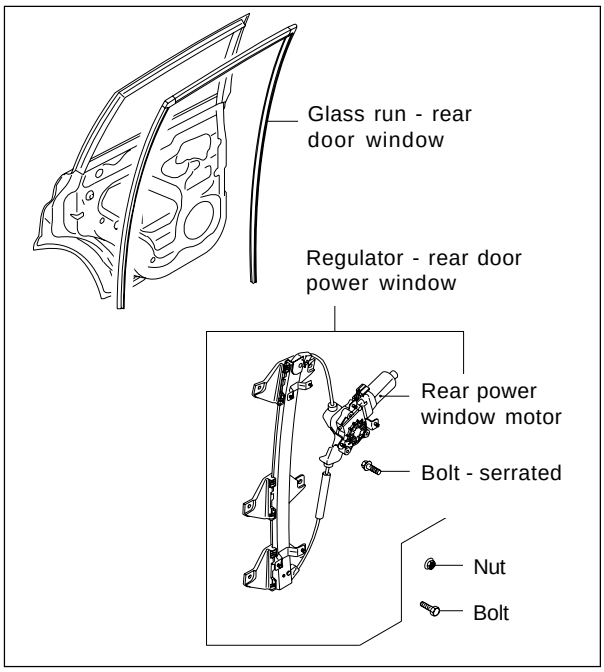
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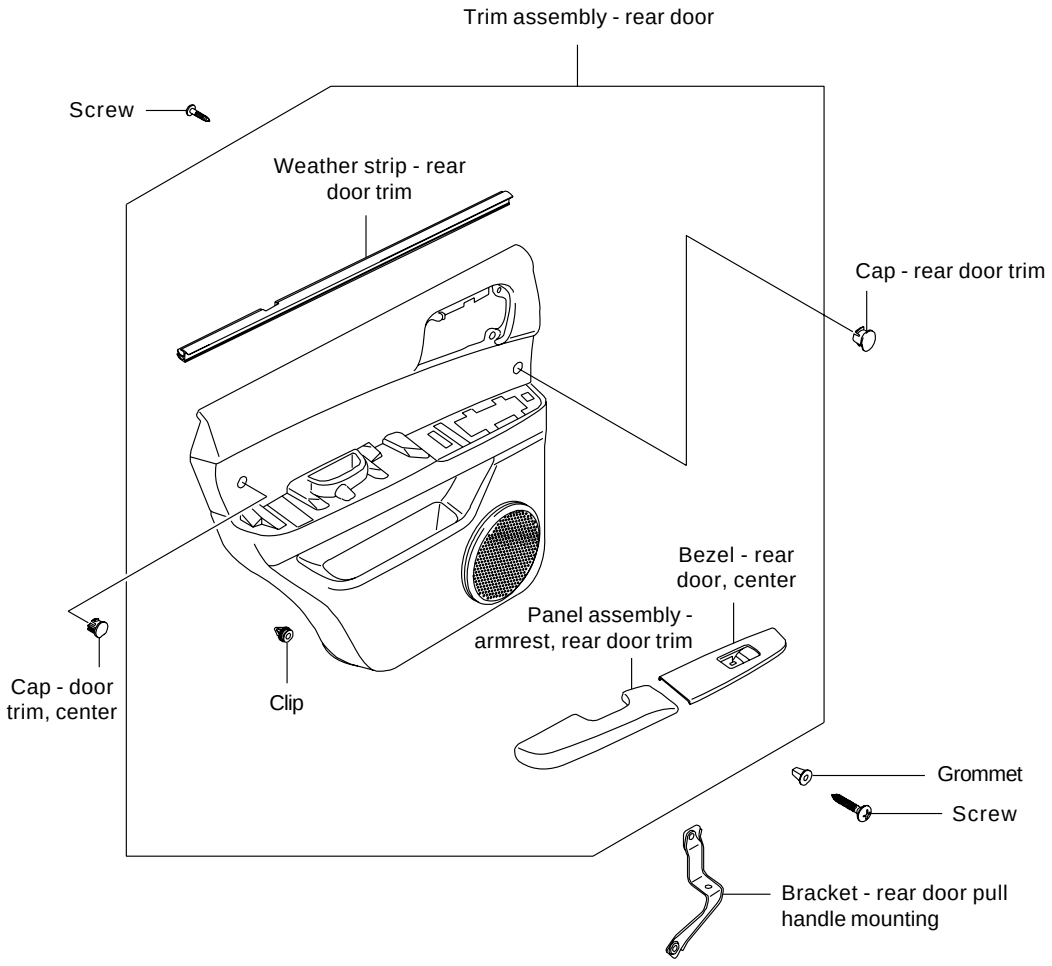
Rear Door



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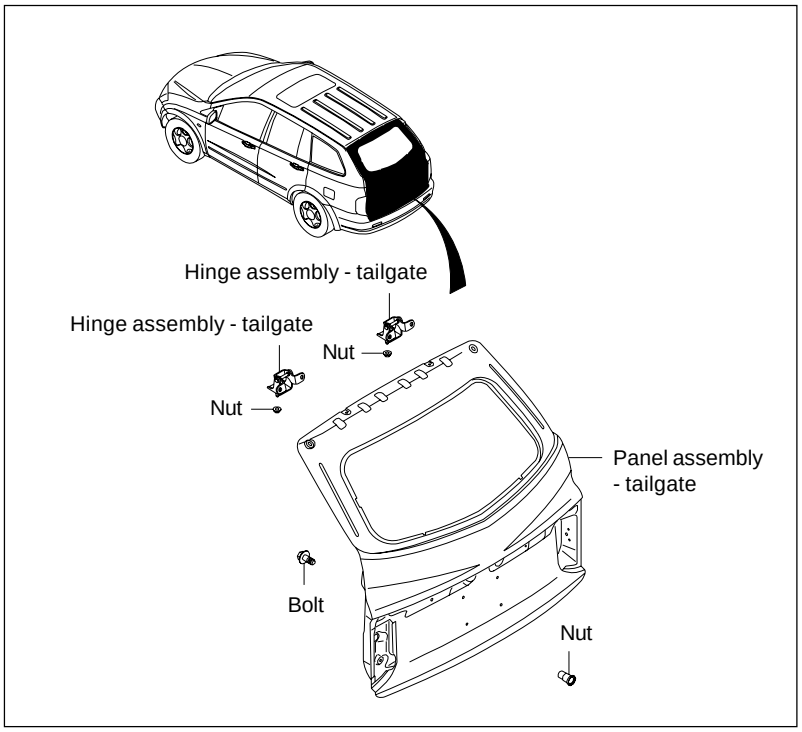


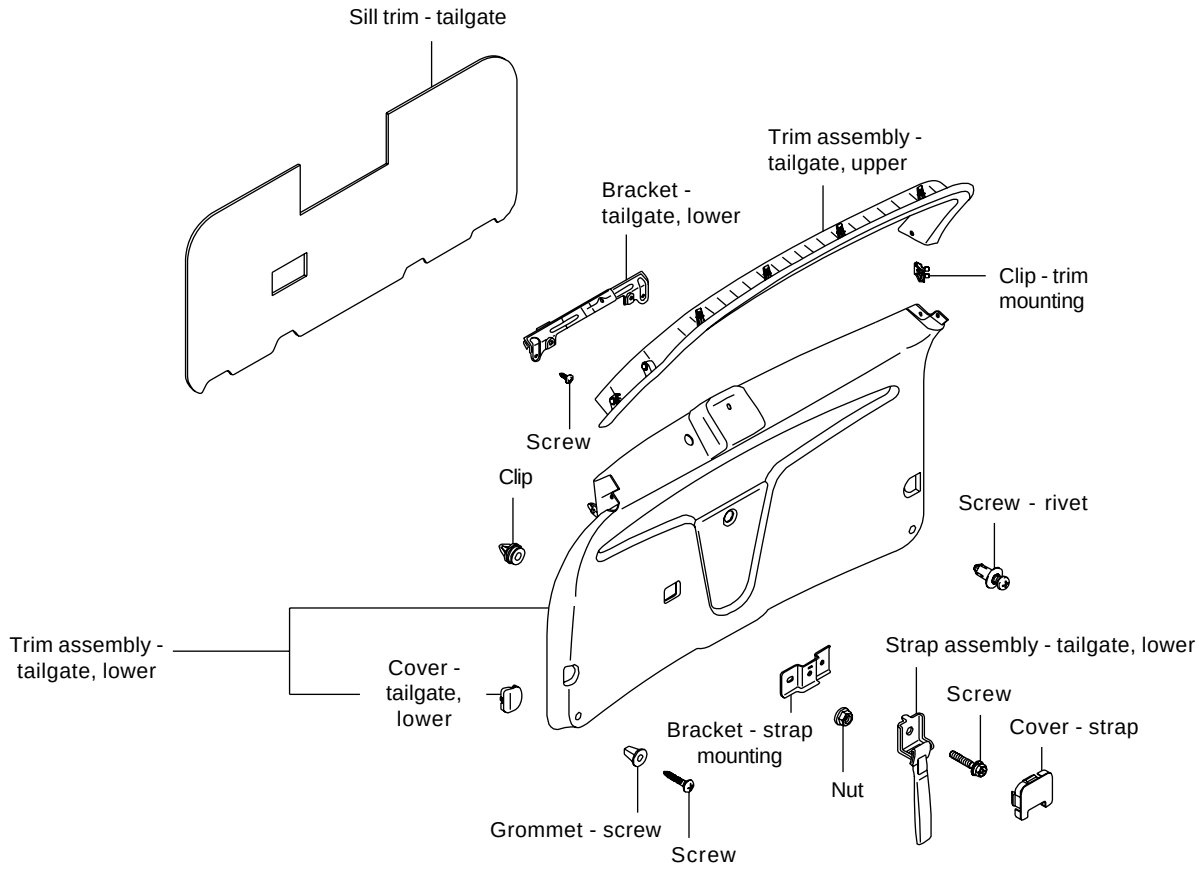


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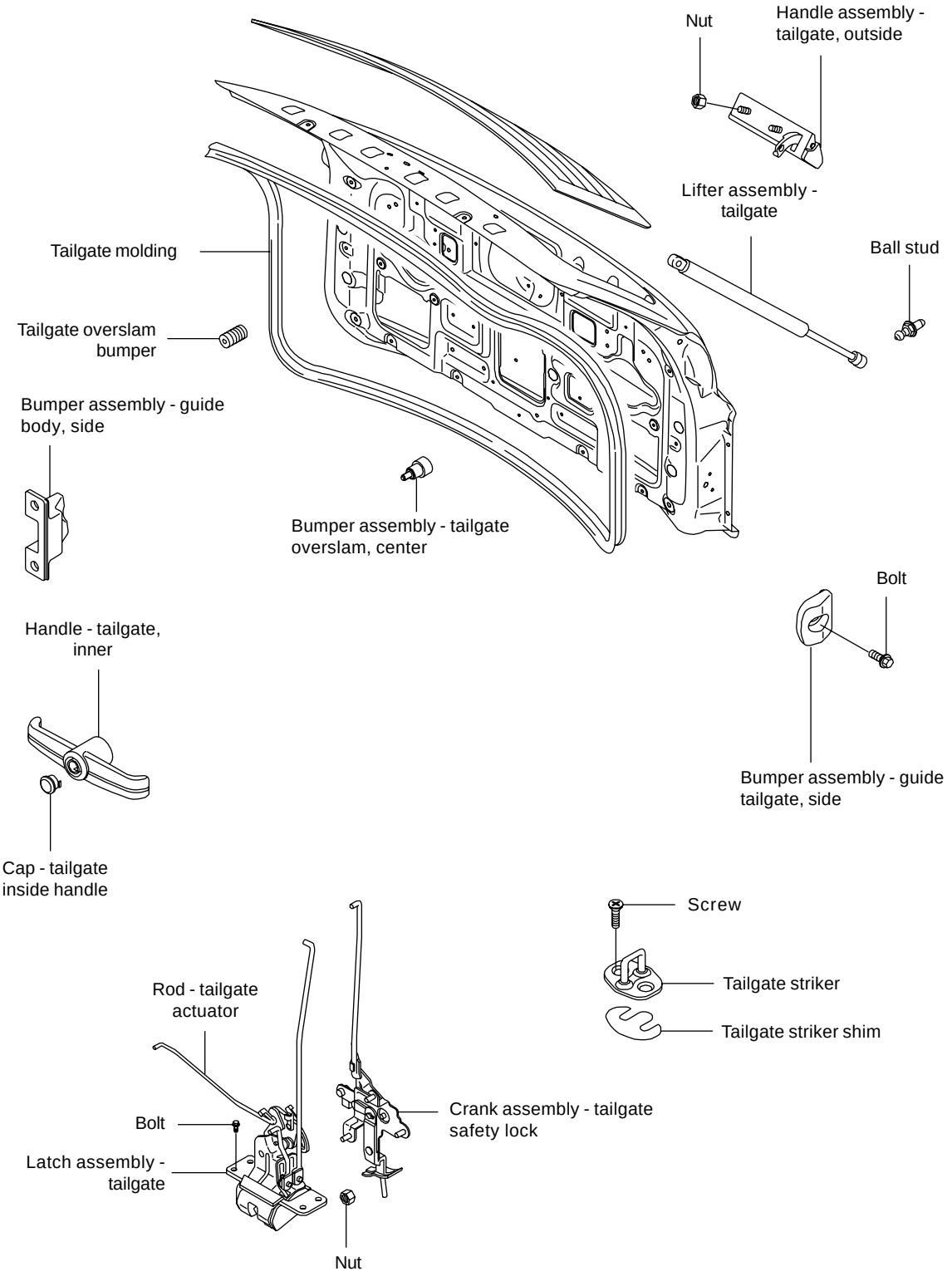
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Tailgate





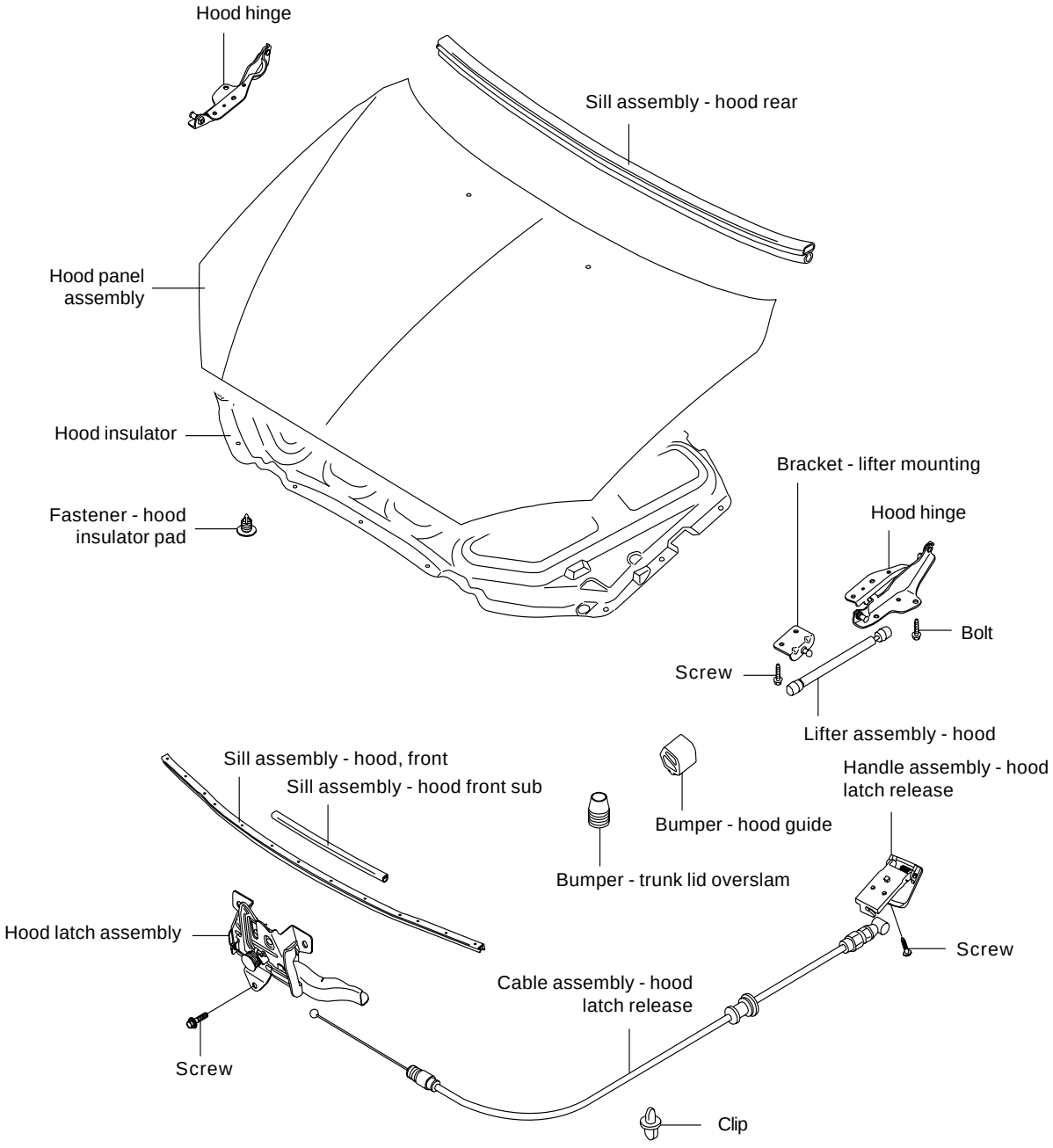
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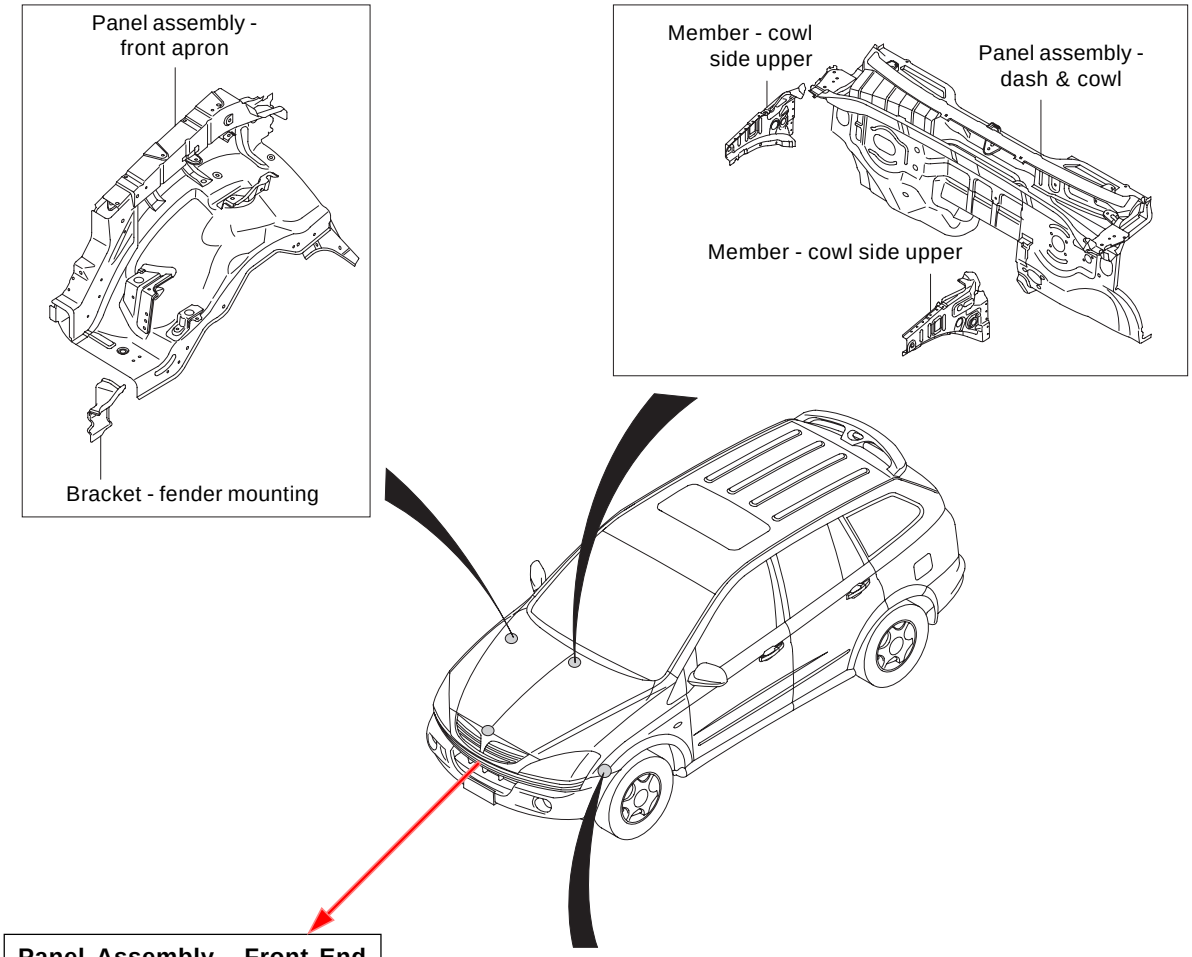
Engine Hood

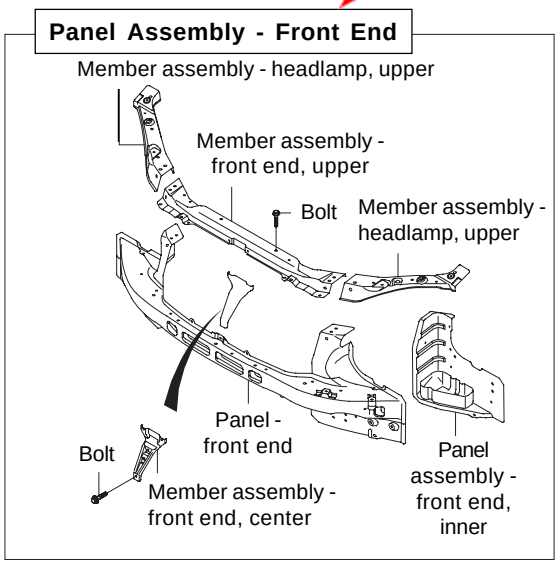


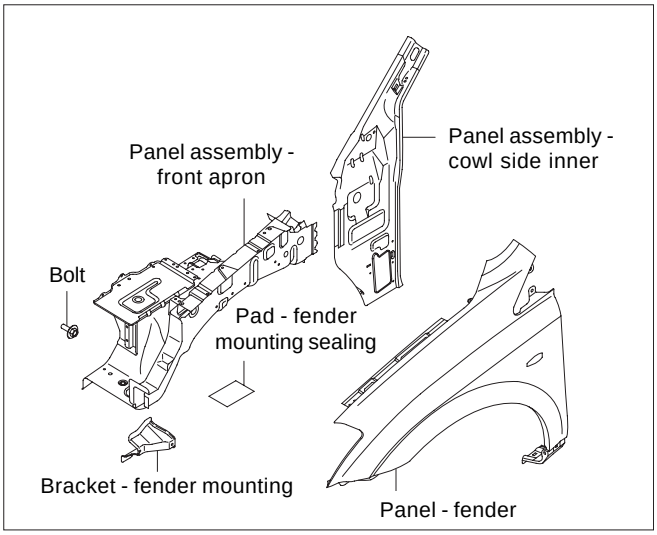
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▶ Body Panels

Firewall, Fender and Front End





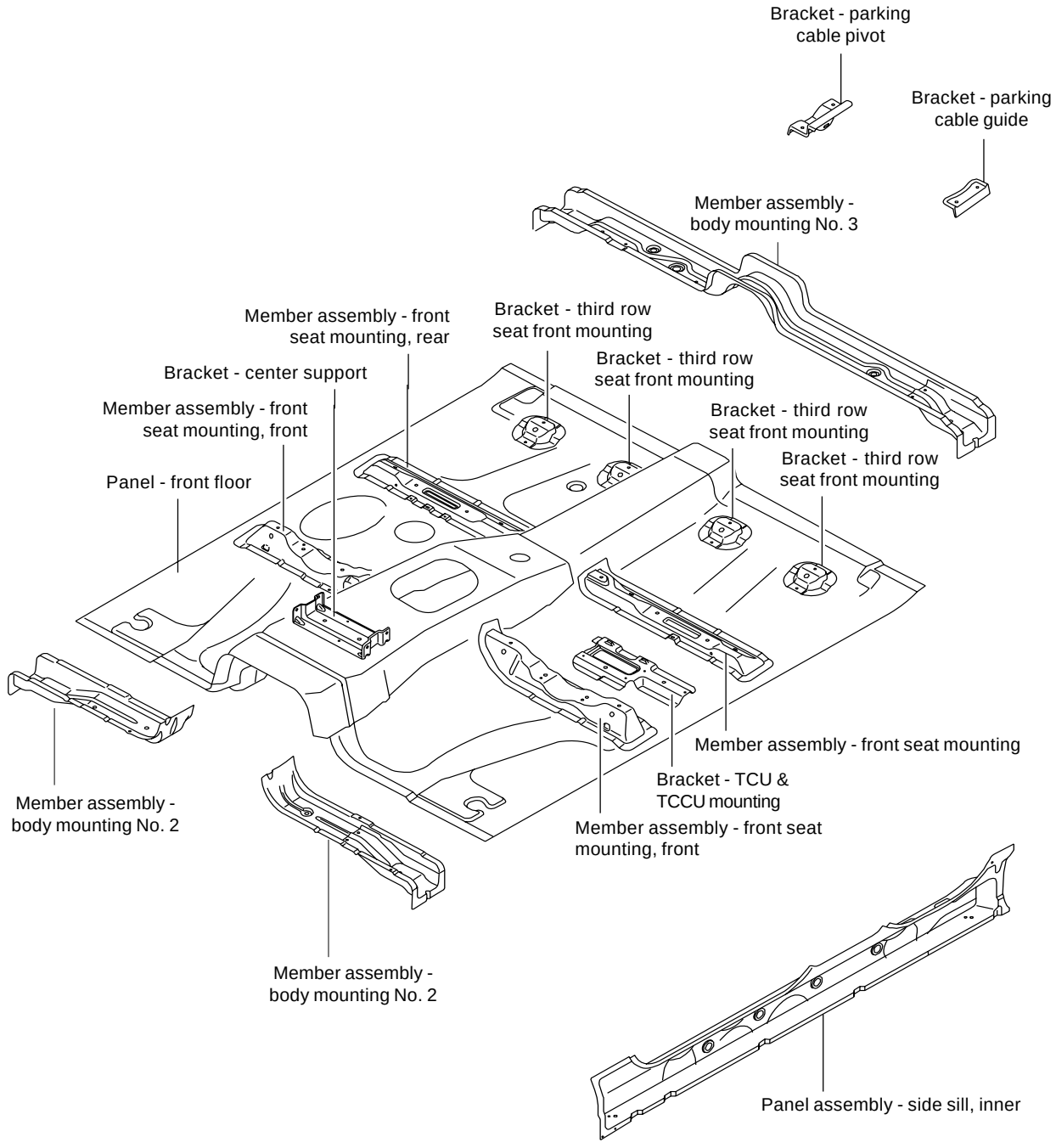


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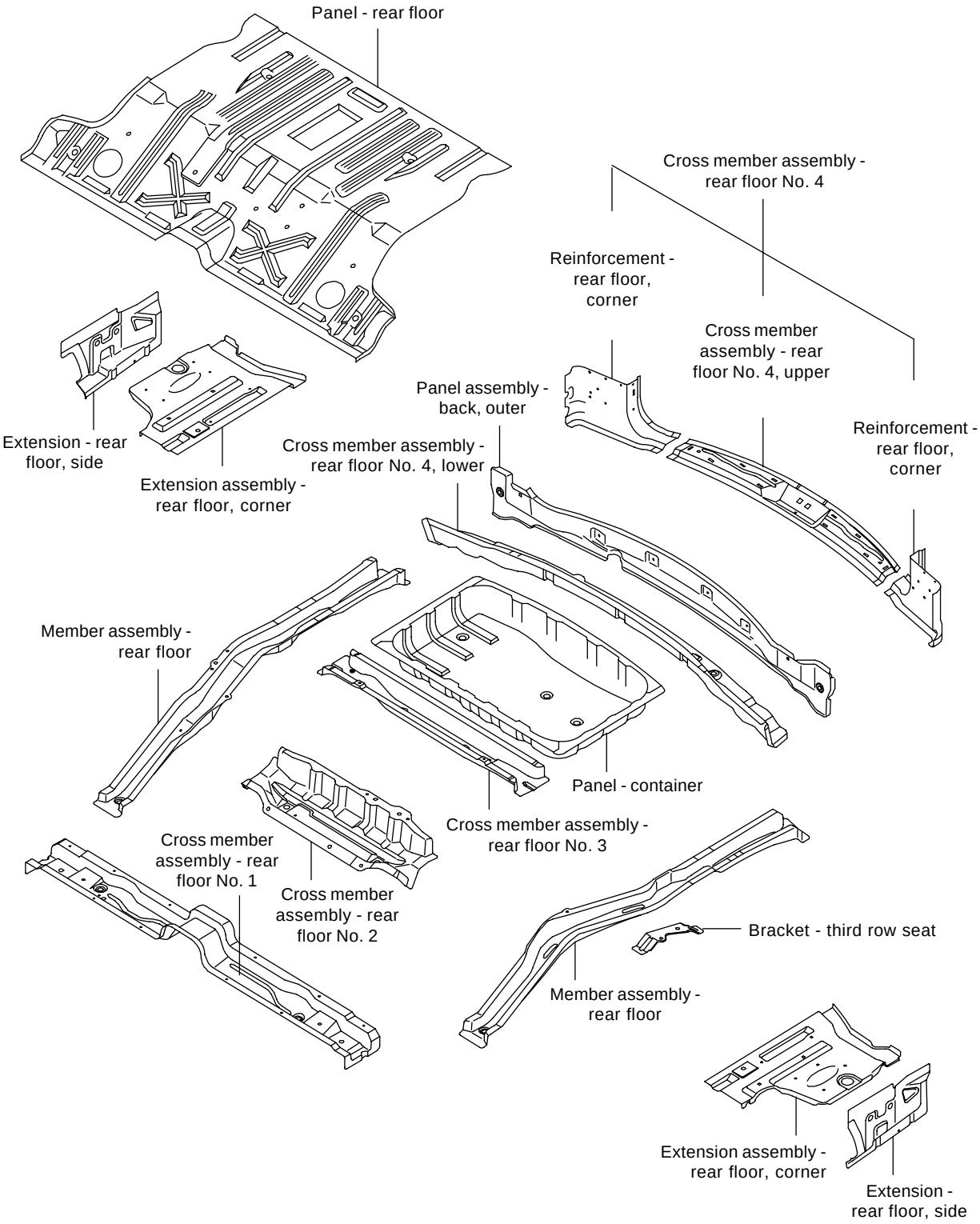
Floor Panels

Front Floor



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Rear Floor

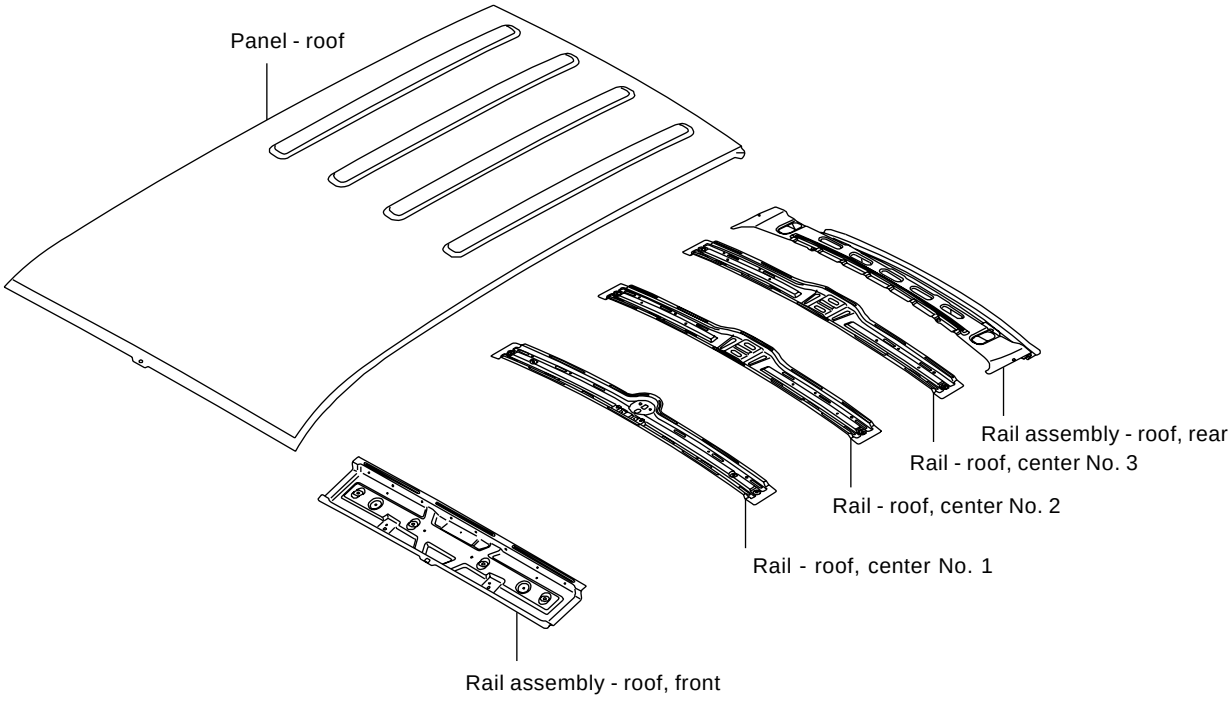


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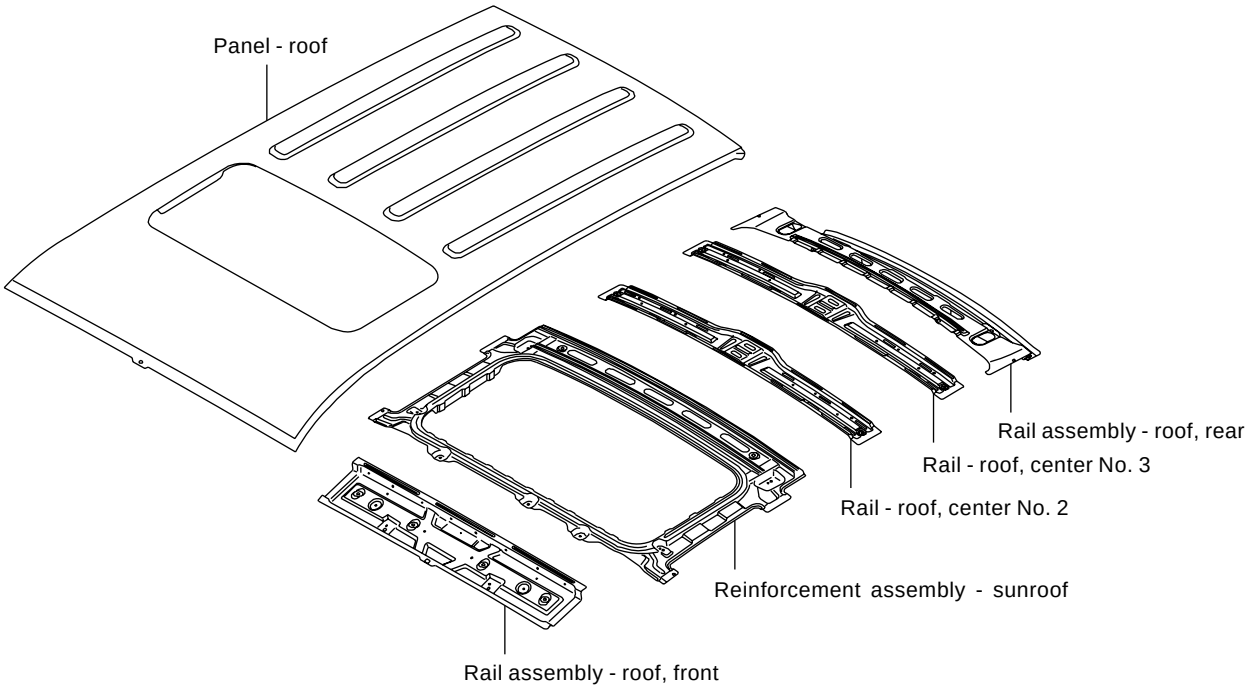
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Roof Panel

Roof Panel without Sunroof



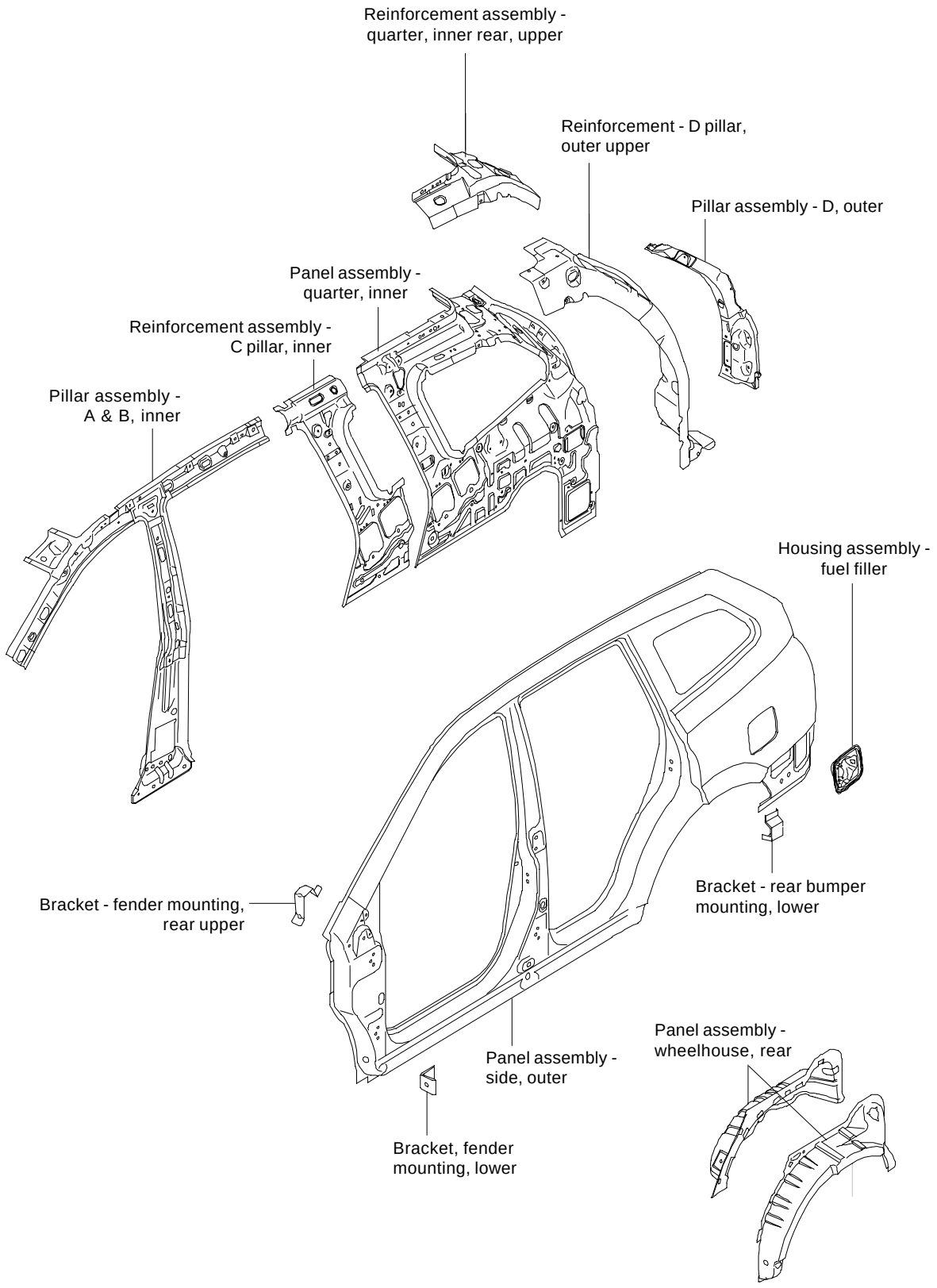
Roof Panel with Sunroof



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Side Panel

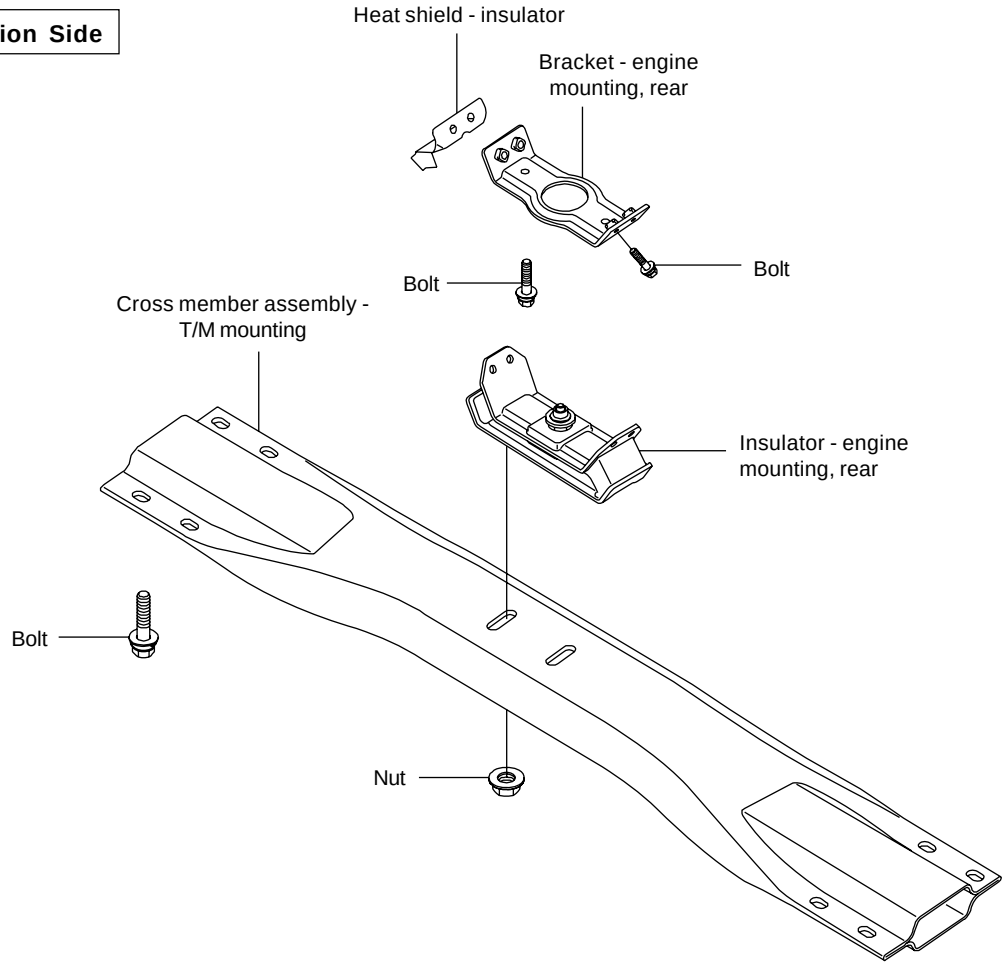


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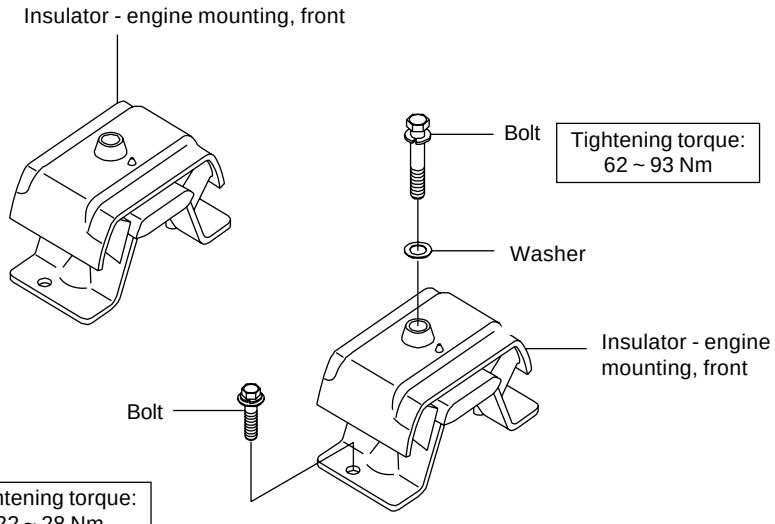
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Engine Mounting Bracket

Transmission Side



Engine Insulator Mounting

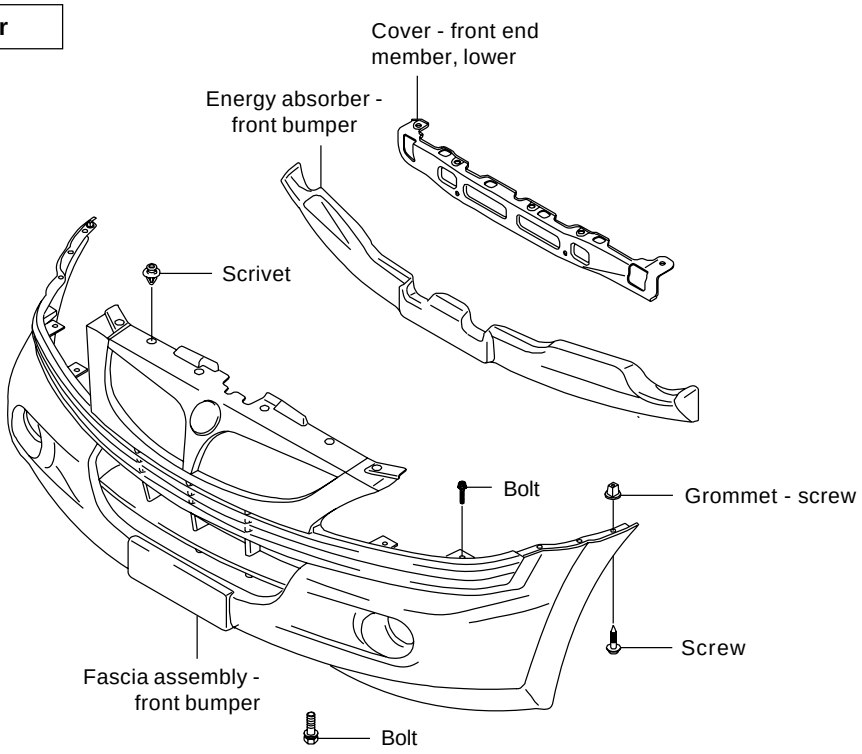


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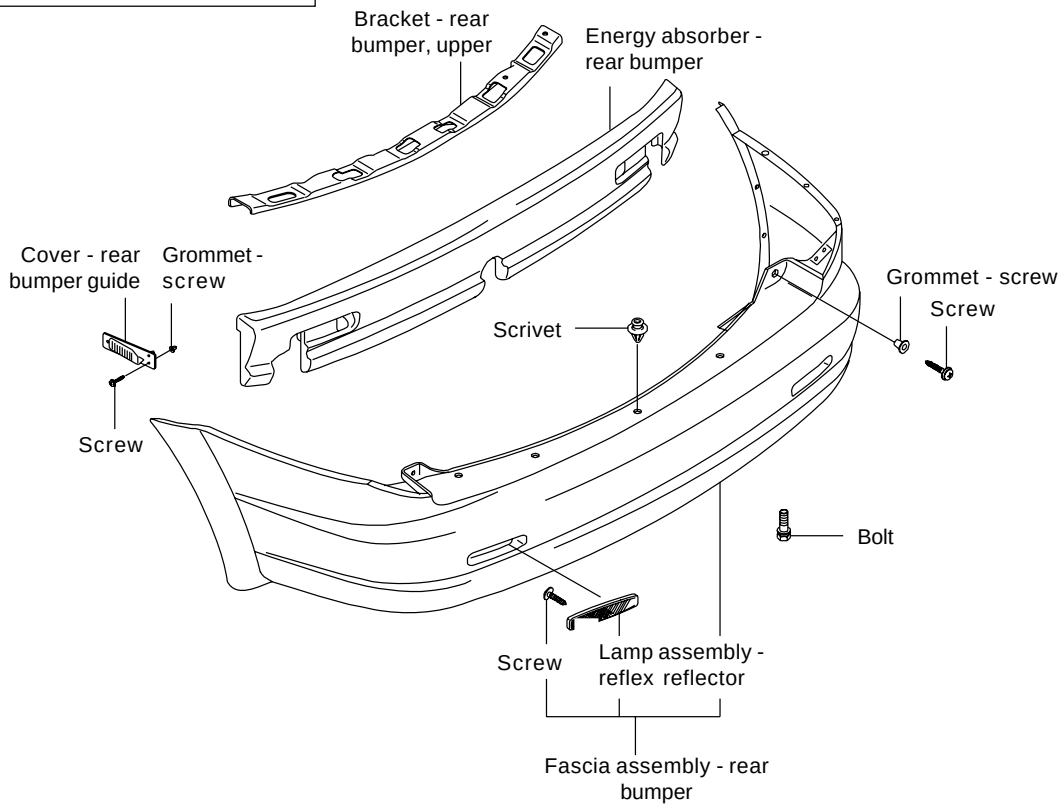
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Bumper

Front Bumper



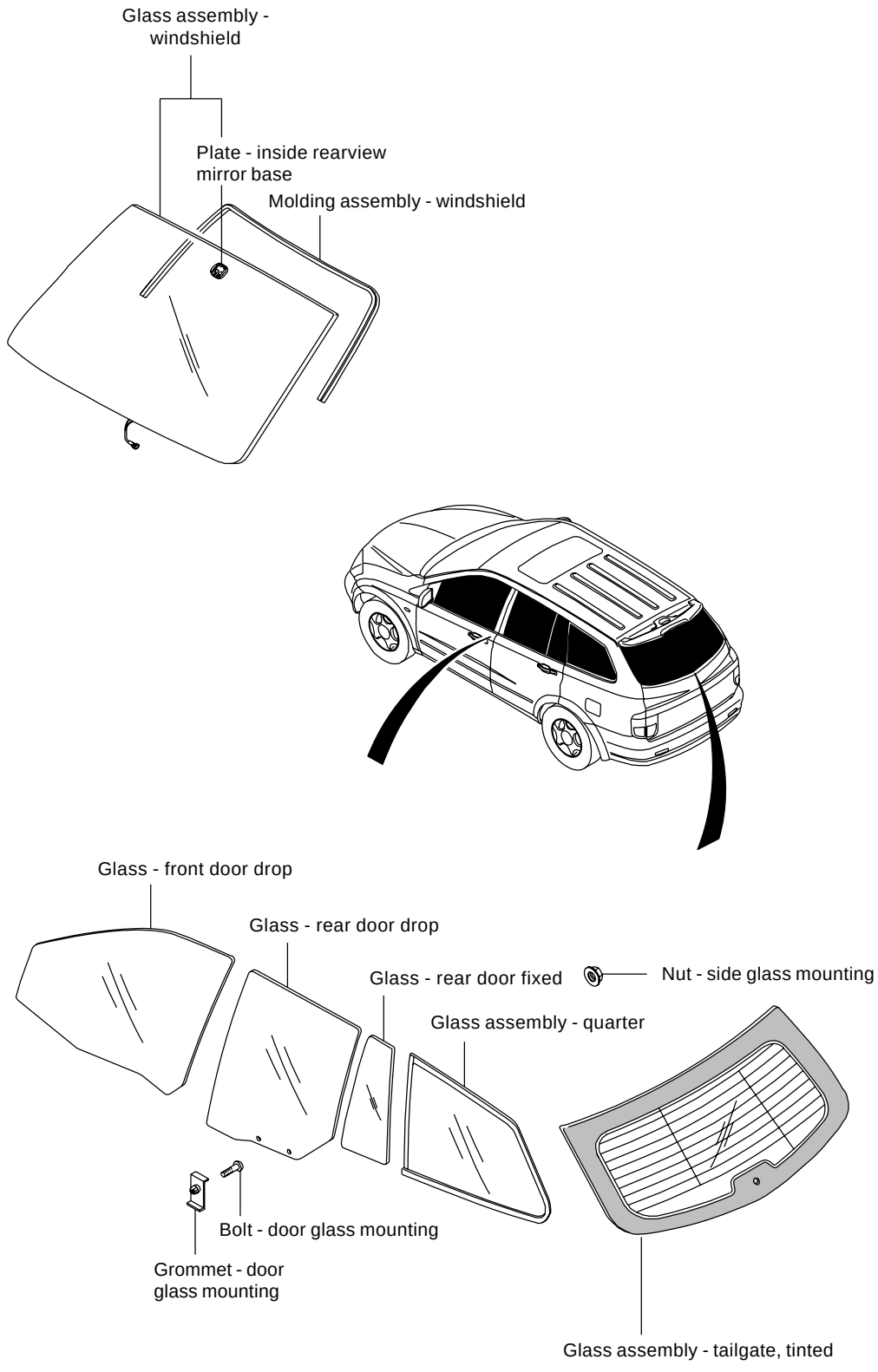
Rear Bumper (Excluding PAS)



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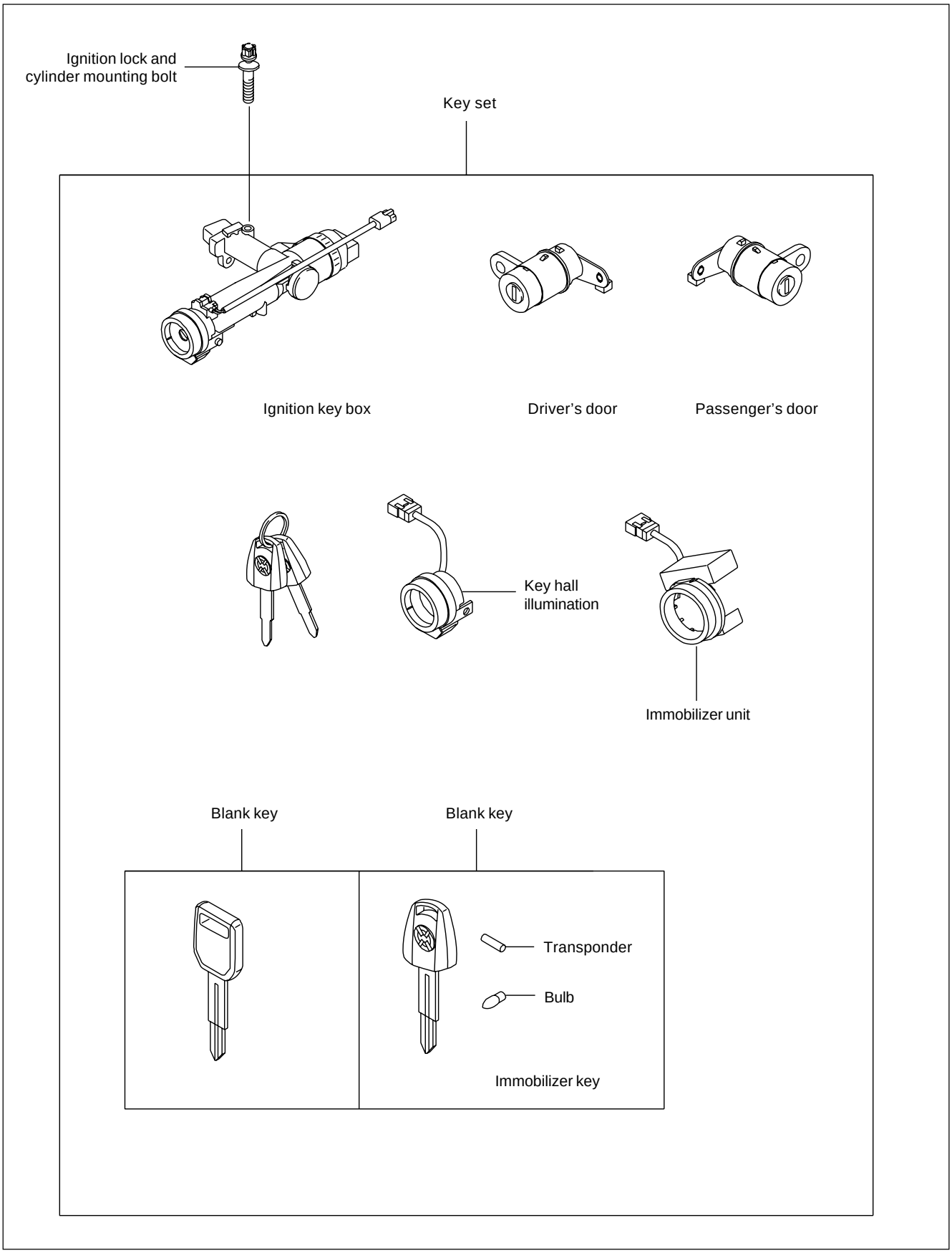
Glass



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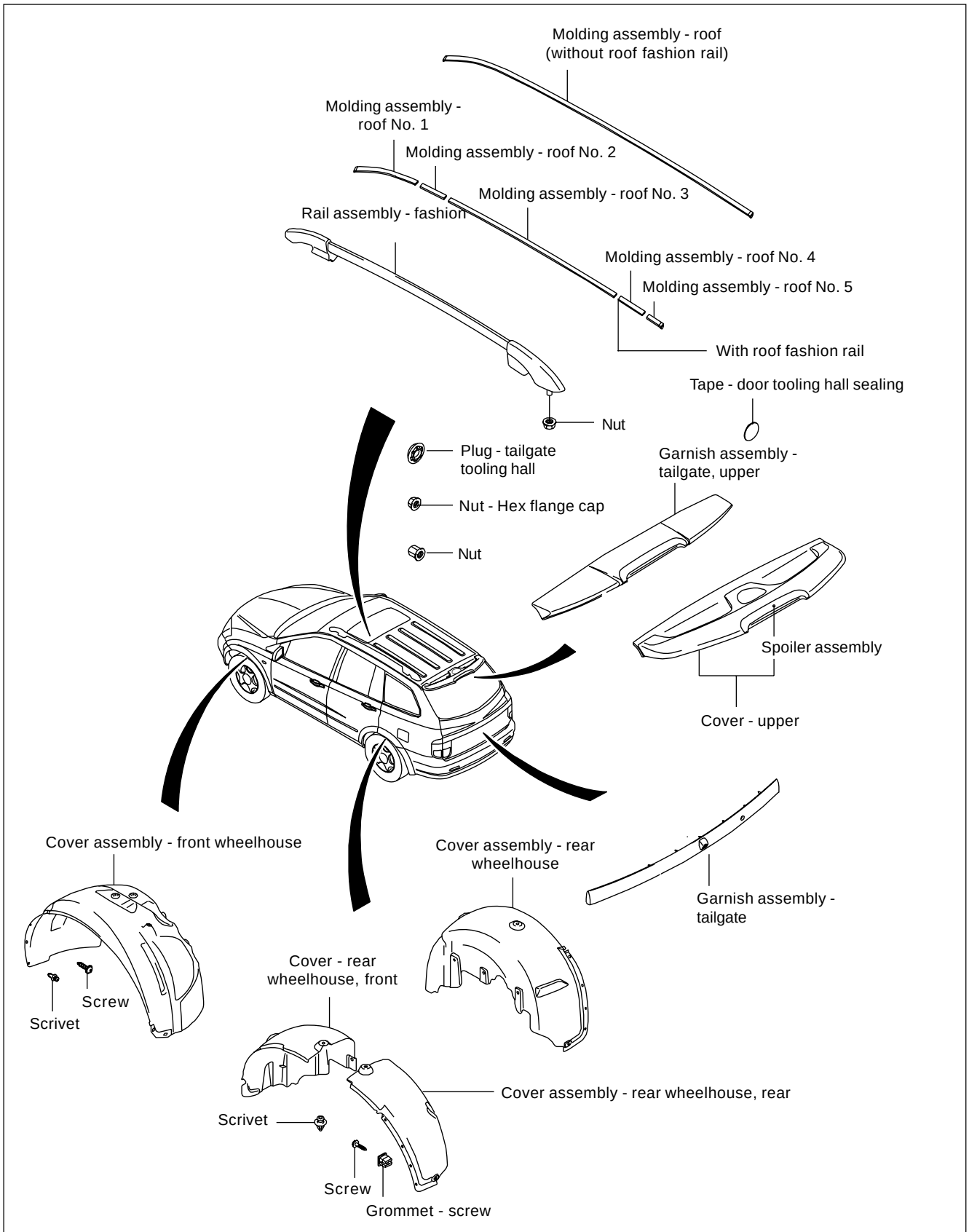
Key Set



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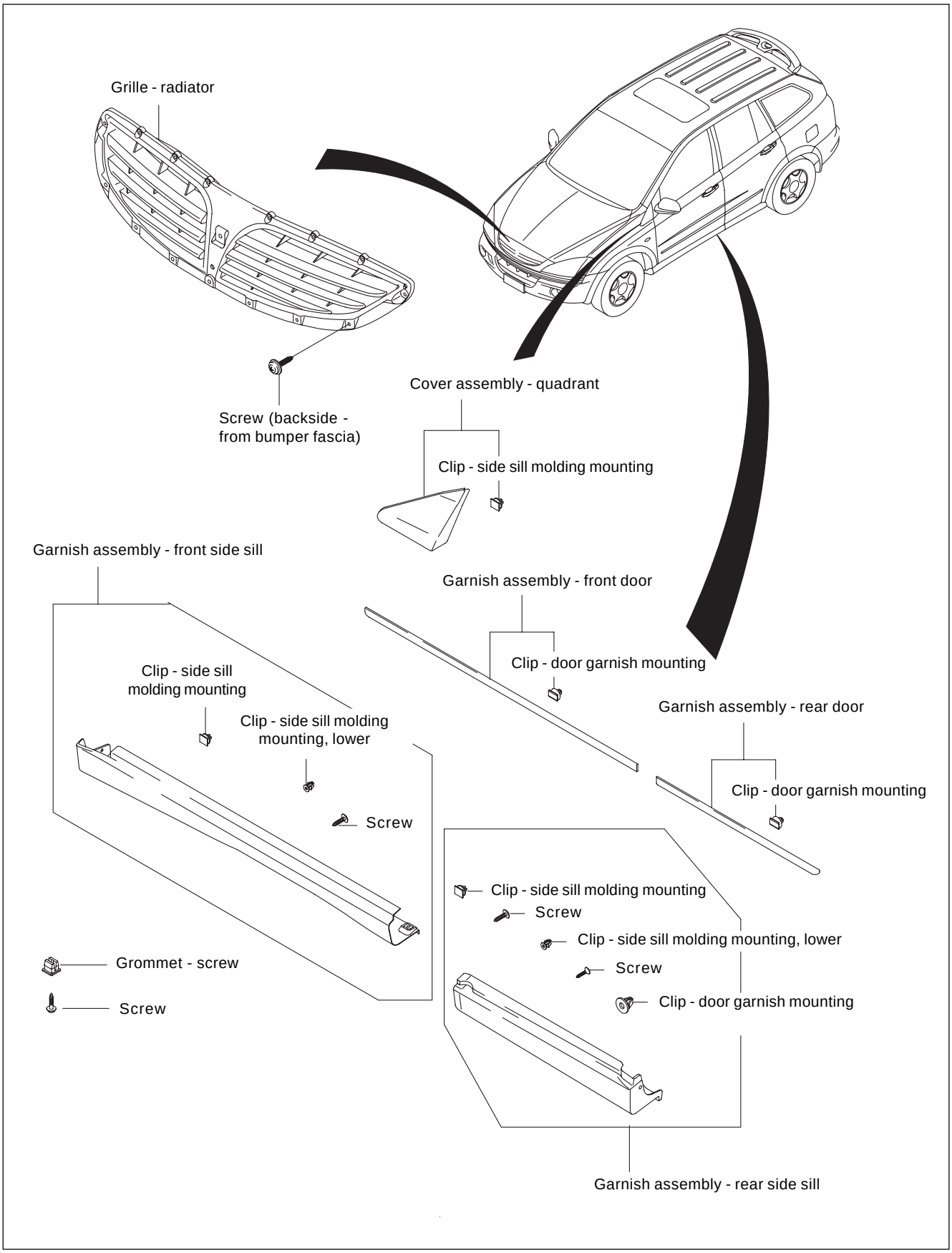
Others (I)



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Others (II)



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