GENERAL INFORMATION

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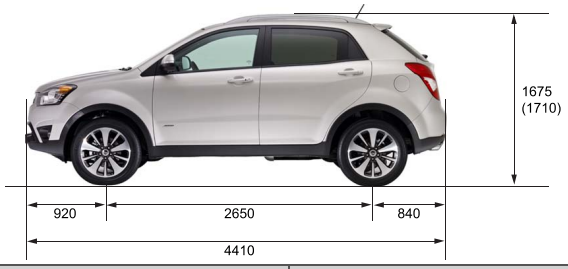
GENERAL INFORMATION

1. MAJOR DIMENSION

Top view



Side view



Front side



Rear view



2. VEHICLE IDENTIFICATION

1) The engine number (671 950 0 2 5000001) is stamped on the lower area of cylinder block in exhaust manifold side.

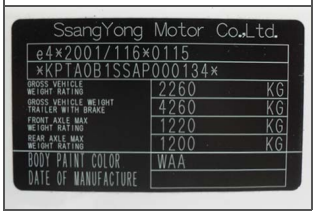


2) The chassis number (KPTA0B1SSAP012345) is stamped on the right side in the engine compartment (passenger side).





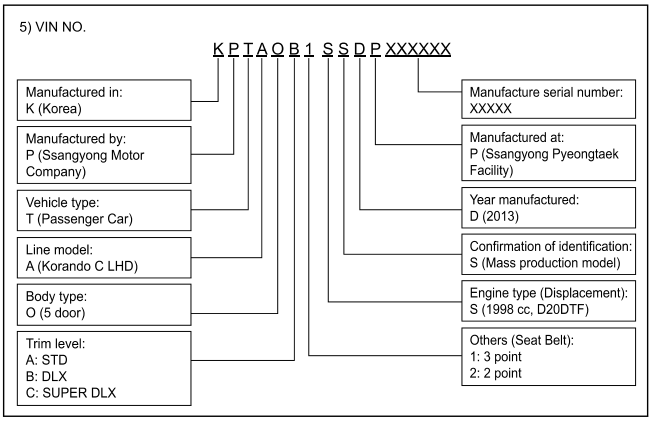
3) The certification label is affixed on the bottom of driver side B-pillar. (30 psi)



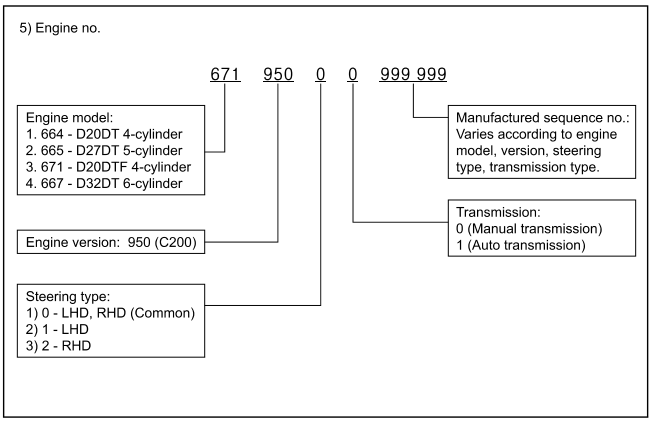
Modification basis	
Application basis	
Affected VIN	

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▶ **VIN number**



▶ **Engine number**



3. SPECIFICATION

* ( ) Optional

Descriptions			Diesel 2,0 Engine	Gasoline 2,0 Engine
General	Overall length (mm)		4410	←
	Overall width (mm)		1830	←
	Overall height (mm)		1675 (1710: including roof rack)	←
	Gross vehicle weight (kg)		4WD: 2260, 2WD: 2180	4WD: 2170, 2WD: 2100
	Curb vehicle weight (kg)	A/T	4WD: 1747, 2WD: 1665	4WD: 1680, 2WD: 1599
		M/T	4WD: 1727, 2WD: 1645	4WD: 1673, 2WD: 1592
	Fuel		Diesel	Gasoline
	Fuel tank capacity (ℓ)		57	←
Engine	Engine		D20DTF	G20DF
	Number of cylinders/ Compression ratio		4 / 16.5:1	4 / 10.5:1
	Total displacement (cc)		1998	←
	Camshaft arrangement		DOHC	←
	Max. power	Normal power	175 ps / 4000 rpm	149 ps / 6000 rpm
		Low power	149 ps / 3000~4000 rpm (149 ps / 3400~4000 rpm)	-
	Max. torque	Normal power	360 Nm / 2000~3000 rpm	197 Nm / 4000 rpm
		Low power	360 Nm / 2000~2500 rpm (360 Nm / 1500~2800 rpm)	-
	Idle speed	A/T	780 ± 20 rpm	700 ± 50 rpm
		M/T	750 ± 20 rpm	700 ± 20 rpm
	Cooling system		Water-cooled / forced circulation	←
	Coolant capacity (ℓ)		8.5	←
	Lubrication type		Gear pump, forced circulation	←
	Max. oil capacity (ℓ) (when shipping)		6.0	4.5
	Turbocharger and cooling type		Turbocharger, water-cooled	-

Modification basis	
Application basis	
Affected VIN	

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* ( ) Optional

Descriptions			Diesel 2,0 Engine	Gasoline 2,0 Engine
Manual Transaxle	Operating type		Floor change type	←
	Gear ratio	1st	3.538 (3.385)	3.616
		2nd	1.909 (1.708)	1.957
		3rd	1.179 (1.033)	1.207
		4th	0.814 (0.786)	0.905
		5th	0.734 (0.730)	0.842
		6th	0.628 (0.595)	0.714
		Reverse	3.910 (3.747)	3.747
Automatic Transaxle	Model		Electronic 6-speed	←
	Operating type		Floor change type	←
	Gear ratio	1st	4.156	4.212
		2nd	2.375	2.637
		3rd	1.522	1.800
		4th	1.144	1.386
		5th	0.859	1.000
		6th	0.676	0.772
		Reverse	3.178	3.385
Transfer Case	Model		AWD	←
	Type		On demand type	←
Clutch (M/T)	Operating type		Hydraulic type	←
	Disc type		Dry single diaphragm type	←
Power Steering	Type		Rack and pinion (EPS, HPS)	←
	Steering angle	Inner	38.62°	←
		Outer	31.07°	←
Rear Axle	Drive shaft type	Independent suspension	Ball joint type	←
	Axle housing type		Build-up type	←

Descriptions			Diesel 2,0 Engine	Gasoline 2,0 Engine
Brake	Master cylinder type		Tandem type	←
	Booster type		Vacuum assisted booster type	←
	Brake type	Front wheel	Disc	←
		Rear wheel	Disc	←
	Parking brake		Mechanical type	←
Suspension	Front suspension		Macpherson + Coil spring	←
	Rear suspension		Multi link + Coil spring	←
Air Conditioner	Refrigerant (capacity)		R-134a (430 ± 30g)	←
Electrical	Battery type / Capacity (V-AH)		MF / 12 - 90	←
	Starter capacity (V-KW)		12 - 2.3	12 - 1.4
	Alternator capacity (V-A)		12V - 140A (EPS), 120A (HPS)	12V - 140A

Modification basis	
Application basis	
Affected VIN	

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4. RECOMMENDED FLUIDS AND LUBRICANTS

Descriptions			Capacity	Specifications
Engine Oil	Diesel Engine	D20DTF	≒ 6.0 ℓ	Quality class: Ssangyong genuine engine oil (Total Quartz INEO ECS 5W 30, SK ZIC SY 5W 30 or oil Approved by MB 229,51 SAE 5W30)
	Gasoline Engine	G20DF	≒ 4.5 ℓ	Quality class: Ssangyong genuine engine oil (Approved by MB 229.51 SAE 5W30)
Engine Coolant	Diesel Engine	D20DTF	≒ 8.5 ℓ	Ssangyong genuine coolant Anti-Freeze: SYC-1025 Anti-Freeze:Water = 50:50 ORGANIC ACID TYPE, COLOR:BLUE
	Gasoline Engine	G20DF	≒ 8.5 ℓ	
Automatic Transaxle Fluid		DSI 6A/T	≒ 7.5 ℓ	Ssangyong genuine oil (FUCHS TITAN ATF 3292)
		HPT 6A/T	≒ 7.1 ℓ	Ssangyong genuine oil (SK ATF SP-IV M)
Manual Transaxle Fluid			≒ 1.65 ℓ	Ssangyong genuine oil (HD MTF 75W/85 (SHELL) or HK MTF 75W/85 (SK))
Transfer Case (PTU) Fluid		AWD	≒ 0.58 ℓ	Ssangyong genuine oil (IDEMITSU LW 80W/90)
Rear Axle Oil		AWD	≒ 0.7 ℓ	Ssangyong genuine oil (SAE 80W/90, API GL-5)
Brake / Clutch Fluid			As required	Ssangyong genuine oil (DOT4)
Power Steering Fluid			≒ 1.0 ℓ	Ssangyong genuine oil (S-PSF-3) * TOTAL FLUIDE DA (Extreme cold condition only)

WARNING
- 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.

5. SCHEDULED MAINTENANCE SERVICES

1) Diesel Engine(EU)

* Use only approved Ssangyong genuine parts.

Maintenance service and record retention are the owner's responsibility. You should retain evidence that proper maintenance has been performed on your vehicle in accordance with the scheduled maintenance service chart.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first								
	x1000 km	20	40	60	80	100	120	140	160
	x1000 miles	12.5	25	37.5	50	62.5	75	87.5	100
	Months	12	24	36	48	60	72	84	96
ENGINE CONTROL SYSTEM									
Drive belt	I	I	I	I	I	I	I	I	
* Engine oil & filter *1 (1)* (3)* (4)*	R	R	R	R	R	R	R	R	
	Shorten the service interval under severe conditions								
Cooling system hose & connections	I	I	I	I	I	I	I	I	
Engine coolant (3)* (4)	Change every 200000 km or 5 years. And, inspect and replenish if necessary.								
Fuel filter (1)*		R		R		R		R	
	Drain the water from fuel filter when the warning light comes on								
Fuel line & connections	I	I	I	I	I	I	I	I	
Air cleaner (2)*	R	R	R	R	R	R	R	R	
	Shorten the service interval under severe conditions								

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.
*1 Check the engine oil level and leak every 3000 km (2000 miles) or before starting a long trip.

R- Replace or change.

(1)* If vehicle is operated under severe condition:
Shorten the service interval.
- Frequent stop-and-go traffic, extended idling, short driving distance below 6 km, driving distance below 16 km when the outside temperature remains below freezing
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- High load driving such as trailer towing
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

(2)* If vehicle is operated under severe condition, driving in dusty condition or sandy condition, pollutant area or off-road driving, frequently inspect the air cleaner, if necessary, change the air cleaner.

(3)* More frequent maintenance is required if under dusty driving condition.

(4)* Refer to "Recommended fluids, coolant and lubricants".

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* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first							
x1000 km	20	40	60	80	100	120	140	160
x1000 miles	12.5	25	37.5	50	62.5	75	87.5	100
Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY								
Exhaust pipes & mountings	I	I	I	I	I	I	I	I
Brake / Clutch fluid (3)*	Change every 2 years (inspect frequently)							
Parking brake / Brake pads (Front & Rear) (4)*	I	I	I	I	I	I	I	I
Brake line & connections (including booster)	I	I	I	I	I	I	I	I
Manual transaxle oil (5)*			I			I		
Clutch & brake pedal free play	I	I	I	I	I	I	I	I
Power transfer unit oil (6)*	I	I	I	I	I	I	I	I
	Severe driving condition: Change every 60000 km							
Rear axle oil	Inspect every 20000 km, change every 100000 km (Frequnt check of oil leak)							
Automatic transaxle fluid (6)*	I	I	I	I	I	I	I	I
	Change every 60000 km under severe condition							
Chassis & underbody bolts & nuts tight / Secure (6)*	Check frequently and adjust or replace if necessary							
Tire condition & inflation pressure	Check frequently and adjust or replace if necessary							
Wheel alignment (7)*	Inspect when abnormal condition is noted							
Steering wheel & linkage	I	I	I	I	I	I	I	I

Chart Symbols:
I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.
R- Replace or change.
(3)* Refer to “Recommended fluids and lubricants”.
(4)* More frequent maintenance is required if the vehicle is operated under any of the following conditions:
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(5)* Inspect and replenish every 60000 km (or 3 years)
Normal driving condition: Fill for Life
(Severe driving condition: Change every 120000 km)
(6)* If vehicle is operated under severe condition: Shorten the service interval.
- Towing a trailer or off-road driving (Inspect the leak of fluid at any time, occasionlly)
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)
- Frequent stop-and-go traffic, extended idling, short driving distance
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- Driving frequently at high speed over 170 km/hour
- Driving frequently in area where heavy traffic under the ambient temperature above 32°C

(7)* If necessary, rotate and balance wheels.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first							
x1000 km	20	40	60	80	100	120	140	160
x1000 miles	12.5	25	37.5	50	62.5	75	87.5	100
Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY								
Power steering fluid & lines (3)*	I	I	I	I	I	I	I	I
Drive shaft boots (8)*	I	I	I	I	I	I	I	I
Seat belts, buckles & anchors	I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch	Check frequently and adjust or replace if necessary							
Wheel bearing grease	I	I	I	I	I	I	I	I
Propeller shaft grease - Front / Rear (9)*	I	I	I	I	I	I	I	I
Air conditioner filter (10)*	R	R	R	R	R	R	R	R
	Shorten the service interval under severe conditions							

Chart Symbols:
I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.
R- Replace or change.
(3)* Refer to “Recommended fluids and lubricants”.
(8)* After completion of off-road operation, the drive shaft boots should be inspected.
(9)* Inspect propeller shaft grease every 5000 km or 3 months if the vehicle is mainly driven under severe condition.
- In off-road or dusty road, or
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain.

(10)* Severe Conditions in Air Conditioner Filter
- Pollutant area or off-road driving, extended air conditioner or heater operation

Modification basis	
Application basis	
Affected VIN	

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2) Diesel Engine(General)

* Use only approved Ssangyong genuine parts.

Maintenance service and record retention are the owner's responsibility. You should retain evidence that proper maintenance has been performed on your vehicle in accordance with the scheduled maintenance service chart.

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first								
	x1000 km	15	30	45	60	75	90	105	120
	x1000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96
ENGINE CONTROL SYSTEM									
Drive belt		I	I	I	I	I	I	I	I
* Engine oil & filter *1 (1)* (3)* (4)*		R	R	R	R	R	R	R	R
		Shorten the service interval under severe conditions							
Cooling system hose & connections		I	I	I	I	I	I	I	I
Engine coolant (3)* (4)		Change every 200000 km or 5 years. And, inspect and replenish if necessary.							
Fuel filter (1)*				R			R		
		Drain the water from fuel filter when the warning light comes on							
Fuel line & connections		I	I	I	I	I	I	I	I
Air cleaner (2)*		R	R	R	R	R	R	R	R
		Shorten the service interval under severe conditions							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

*1 Check the engine oil level and leak every 3000 km (2000 miles) or before starting a long trip.

R- Replace or change.

(1)* If vehicle is operated under severe condition:
Shorten the service interval.
- Frequent stop-and-go traffic, extended idling, short driving distance below 6 km, driving distance below 16 km when the outside temperature remains below freezing
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- High load driving such as trailer towing
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

(2)* If vehicle is operated under severe condition, driving in dusty condition or sandy condition, pollutant area or off-road driving, frequently inspect the air cleaner, if necessary, change the air cleaner.

(3)* More frequent maintenance is required if under dusty driving condition.

(4)* Refer to "Recommended fluids, coolant and lubricants".

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first								
	x1000 km	15	30	45	60	75	90	105	120
	x1000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY									
Exhaust pipes & mountings		I	I	I	I	I	I	I	I
Brake / Clutch fluid (3)*		Change every 2 years (inspect frequently)							
Parking brake / Brake pads (Front & Rear) (4)*		I	I	I	I	I	I	I	I
Brake line & connections (including booster)		I	I	I	I	I	I	I	I
Manual transaxle oil (5)*					I				I
Clutch & brake pedal free play		I	I	I	I	I	I	I	I
Power transfer unit oil (6)*		I	I	I	I	I	I	I	I
		Severe driving condition: Change every 60000 km							
Rear axle oil		Inspect every 15000 km, change every 100000 km (Frequnt check of oil leak)							
Automatic transaxle fluid (6)*		Inspect every 15000 km or 12 month (But change every 60000 km under severe condition)							
Chassis & underbody bolts & nuts tight / Secure (6)*		Check frequently and adjust or replace if necessary							
Tire condition & inflation pressure		Check frequently and adjust or replace if necessary							
Wheel alignment (7)*		Inspect when abnormal condition is noted							
Steering wheel & linkage		I	I	I	I	I	I	I	I

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R- Replace or change.

(3)* Refer to "Recommended fluids and lubricants".

(4)* More frequent maintenance is required if the vehicle is operated under any of the following conditions:
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(5)* Inspect and replenish every 60000 km (or 4 years)
Normal driving condition: Fill for Life
(Severe driving condition: Change every 120000 km)

(6)* If vehicle is operated under severe condition: Shorten the service interval.
- Towing a trailer or off-road driving (Inspect the leak of fluid at any time, occasionlly)
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)
- Frequent stop-and-go traffic, extended idling, short driving distance
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- Driving frequently at high speed over 170 km/hour
- Driving frequently in area where heavy traffic under the ambient temperature above 32°C

(7)* If necessary, rotate and balance wheels.

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MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first								
	x1000 km	15	30	45	60	75	90	105	120
	x1000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY									
Power steering fluid & lines (3)*		I	I	I	I	I	I	I	I
Drive shaft boots (8)*		I	I	I	I	I	I	I	I
Seat belts, buckles & anchors		I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch		Check frequently and adjust or replace if necessary							
Wheel bearing grease		I	I	I	I	I	I	I	I
Propeller shaft grease - Front / Rear (9)*		I	I	I	I	I	I	I	I
Air conditioner filter (10)*		R	R	R	R	R	R	R	R
		Shorten the service interval under severe conditions							

Chart Symbols:
I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.
R- Replace or change.
(3)*Refer to "Recommended fluids and lubricants".
(8)*After completion of off-road operation, the drive shaft boots should be inspected.
(9)*Inspect propeller shaft grease every 5000 km or 3 months if the vehicle is mainly driven under severe condition.
- In off-road or dusty road, or
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain.

(10)*Severe Conditions in Air Conditioner Filter
- Pollutant area or off-road driving, extended air conditioner or heater operation

3) Gasoline Engine

* Use only approved Ssangyong genuine parts.

Maintenance service and record retention are the owner's responsibility. You should retain evidence that proper maintenance has been performed on your vehicle in accordance with the scheduled maintenance service chart.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first								
	x1000 km	15	30	45	60	75	90	105	120
	x1000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96
ENGINE CONTROL SYSTEM									
Drive belt		I	I	I	I	I	I	I	I
Engine oil & engine oil filter (1)* (3)* (Initial change: 10,000 km)		R**	R	R	R	R	R	R	R
		Shorten the service interval under severe conditions							
Cooling system hose & connections		I	I	I	I	I	I	I	I
Engine coolant (3)*		Change every 200,000 km or 5 years. And, inspect replenish if necessary.							
Fuel filter (2)*		Replace every 100,000 km (if using poor quality of fuel, replace every 30,000 km)							
Fuel line & connections		I	I	I	I	I	I	I	I
Air cleaner (2)*		R	R	R	R	R	R	R	R
		Shorten the service interval under severe conditions							
Ignition timing		I	I	I	I	I	I	I	I
Spark plugs (G20DF)		Change every 160,000 km or 5 years.							
Charcoal canister & vapor lines		-	-	I	-	-	I	-	-

Chart Symbols:
I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.
R- Replace or change.
**- In order to secure engine long life and effective break-in, first oil (factory filled) would be recommended to drain with in 10,000 km.
(1)*If vehicle is operated under severe condition:
Shorten the service interval.
- Frequent stop-and-go traffic, extended idling, short driving distance below 6 km, driving distance below 16 km when the outside temperature remains below freezing
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- High load driving such as trailer towing
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

(2)*If vehicle is operated under severe condition, pollutant area or off-road driving, driving in dusty condition or sandy condition, frequently inspect the air cleaner, if necessary, change the air cleaner.
(3)*Refer to "Recommended fluids and lubricants".

Modification basis	
Application basis	
Affected VIN	

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* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM		Kilometers (miles) or time in months, whichever comes first							
	x1000 km	15	30	45	60	75	90	105	120
	x1000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY									
Exhaust pipes & mountings		I	I	I	I	I	I	I	I
Brake / Clutch fluid (3)*		Change every 2 years (inspect frequently)							
Parking brake / Brake pads (Front & Rear) (4)*		I	I	I	I	I	I	I	I
Brake line & connections (including booster)		I	I	I	I	I	I	I	I
Manual transaxle oil (5)*					I				I
Clutch & brake pedal free play		I	I	I	I	I	I	I	I
Power transfer unit oil (6)*		I	I	I	I	I	I	I	I
		Severe driving condition: Change every 60000 km							
Rear axle oil		Inspect every 15000 km, change every 100000 km (Frequnt check of oil leak)							
Automatic transaxle fluid (6)*	General	Change every 100000 km under severe condition							
	EU	Change every 90000 km under severe condition							
Chassis & underbody bolts & nuts tight / Secure (6)*		Check frequently and adjust or replace if necessary							
Tire condition & inflation pressure		Check frequently and adjust or replace if necessary							
Wheel alignment (7)*		Inspect when abnormal condition is noted							
Steering wheel & linkage		I	I	I	I	I	I	I	I

Chart Symbols:
I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.
R- Replace or change.
(3)* Refer to “Recommended fluids and lubricants”.
(4)* More frequent maintenance is required if the vehicle is operated under any of the following conditions:
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(5)* Inspect and replenish every 60000 km (or 4 years)
Normal driving condition: Fill for Life
(Severe driving condition: Change every 120000 km)
(6)* If vehicle is operated under severe condition: Shorten the service interval.
- Towing a trailer or off-road driving (Inspect the leak of fluid at any time, occasionlly)
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)
- Frequent stop-and-go traffic, extended idling, short driving distance
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- Driving frequently at high speed over 170 km/hour
- Driving frequently in area where heavy traffic under the ambient temperature above 32°C

(7)* If necessary, rotate and balance wheels.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM		Kilometers (miles) or time in months, whichever comes first							
	x1000 km	15	30	45	60	75	90	105	120
	x1000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY									
Power steering fluid & lines (3)*		I	I	I	I	I	I	I	I
Drive shaft boots (8)*		I	I	I	I	I	I	I	I
Seat belts, buckles & anchors		I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch		Check frequently and adjust or replace if necessary							
Wheel bearing grease		I	I	I	I	I	I	I	I
Propeller shaft grease - Front / Rear (9)*		I	I	I	I	I	I	I	I
Air conditioner filter (10)*		R	R	R	R	R	R	R	R
		Shorten the service interval under severe conditions							

Chart Symbols:
I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.
R- Replace or change.
(3)* Refer to “Recommended fluids and lubricants”.
(8)* After completion of off-road operation, the drive shaft boots should be inspected.
(9)* Inspect propeller shaft grease every 5000 km or 3 months if the vehicle is mainly driven under severe condition.
- In off-road or dusty road, or
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain.

(10)* Severe Conditions in Air Conditioner Filter
- Pollutant area or off-road driving, extended air conditioner or heater operation

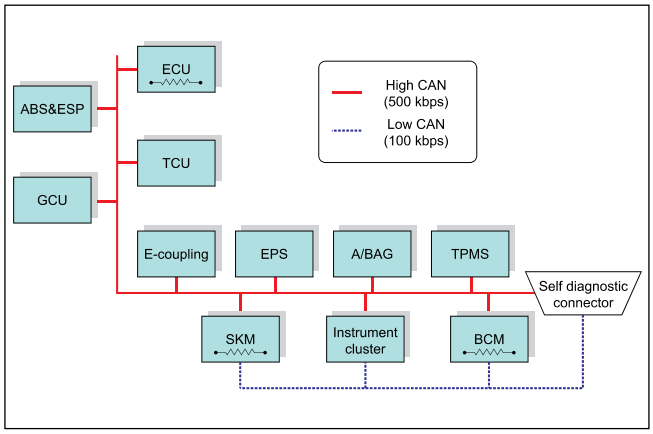
Modification basis	
Application basis	
Affected VIN	

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6. CAN COMMUNICATION CONFIGURATION

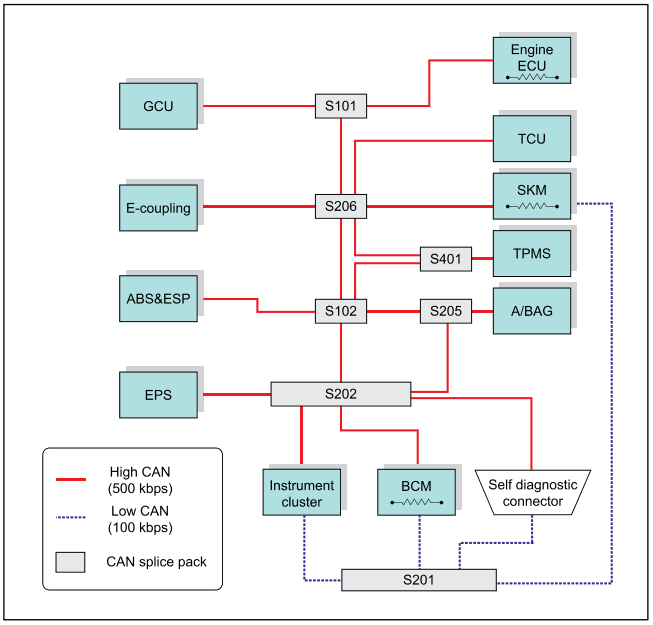
There are two types (P-CAN and B-CAN) of communication according to the communication speed. The instrument cluster and BCM (Body Control Module) communicate through both P-CAN and B-CAN at the same time.

1) CAN Configurations (P-CAN/B-CAN)



Abbreviations	Meaning	Function
GCU	Glow Control Unit	Glow Control Unit
EPS	Electronic Power Steering Unit	Electronic Power Steering Unit
BCM	Body Control Module	Body Control Module
SKM	Smart Key Module	Smart Key Module
TPMS	Tire Pressure Monitering System	Tire Pressure Monitering System

2) CAN Communication Wiring Diagram



Splice pack	Wiring	Location
S101	W/H Floor(LH)	Glow Control Unit
S102	W/H Floor(RH)	Inside RH Fender
S202	W/H Main	Backside Cluster(LH Cowl Cross Member)
S204	W/H Main	Backside Cluster(Upper ICM Relay Box)
S205	W/H Main	Backside Audio(CTR Cowl Cross Member)
S206	W/H Floor(LH)	Under Driver Seat
S401	W/H Floor(LH)	Beside PAS Unit(Inside LH QTR Trim)

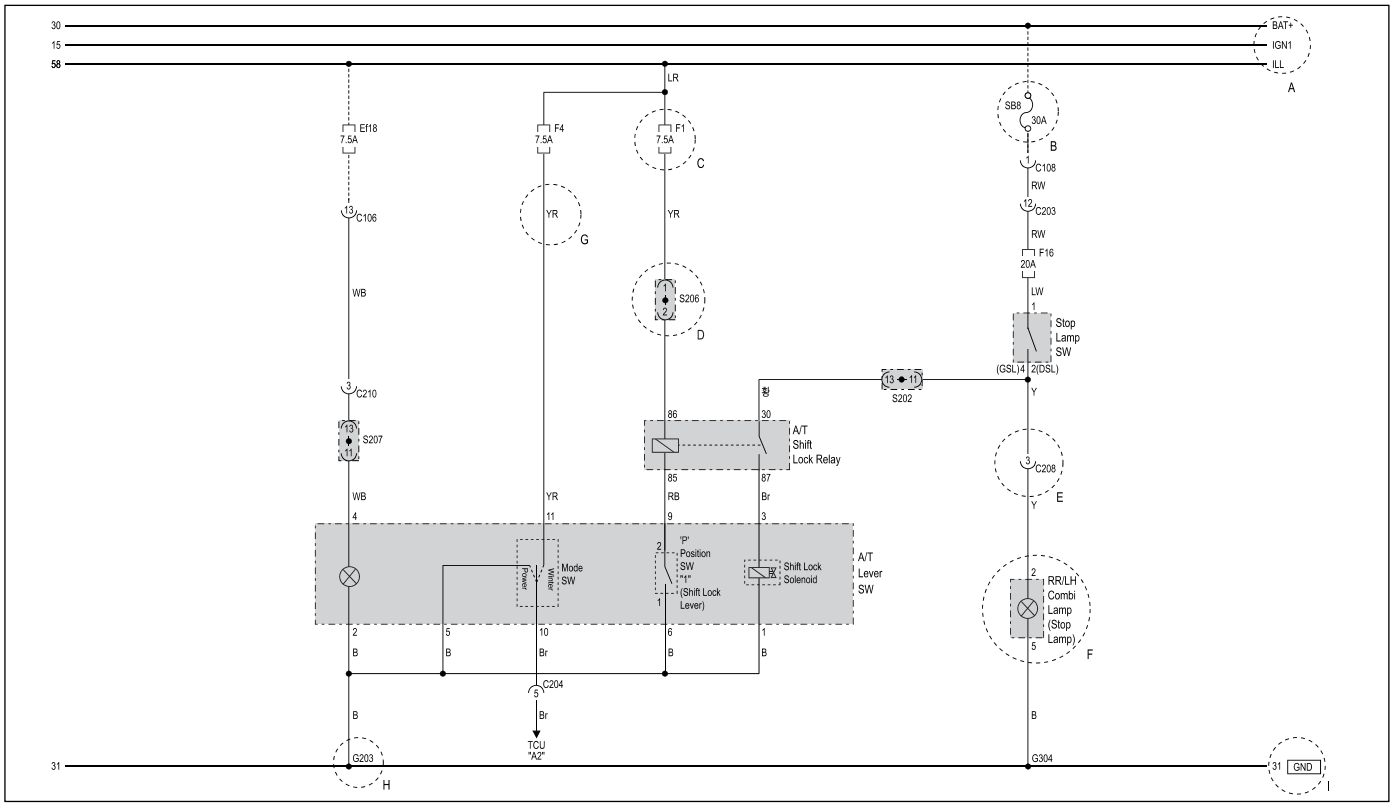
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Application basis	
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ELECTRIC DEVICE GENERAL INFORMATION

1. HOW TO READ ELECTRICAL WIRING DIAGRAM

(1) HOW TO READ ELECTRICAL WIRING DIAGRAM



Modification basis	
Application basis	
Affected VIN	

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(2) CONTENTS OF ELECTRICAL WIRING DIAGRAM(CIRCUIT)

Position	Emplanation
A	A top of horizontal line means Power supply and it is separated depending on condition of power supply. (For more information, please refer to the Function of power supply No.appendix)
B	This means Blow-slow Fuse No.8 in an Engine Room Fuse-Box and it is Main Fuse which supplies the power to each Fuse.
C	These mean both a Fuse No. and a Fuse location. And Ef 'means an Engine Room Fuse, F means an indoor Fuse. 7.5A means Fuse capacity.
D	"S" means Splice Pack and 206 'means Splice Pack Number.
E	"C" means Connector and '208' means Connector Number.
F	This means inner circuit and it is displayed one-point-center-line.
G	This means wiring color, so at the head of character Y means background color of wiring and the rear character R means middle color of wiring.
H	"G" means Ground and 203 means Ground Number.
I	Below horizontal line means Ground. -Ground position (G101~G401) -B : Body Ground

(3) CIRCUIT IDENTIFICATION SYMBOL

Identification Symbol	Meaning
C	Connector
D	Diode
Ef	Fuse in Engine room Fuse & Relay Box
F	Indoor Fuse Box
G	Ground
S	Splice pack (Junction connector)
SB1 ~ SB10	Slow Blow Fuse (Engine room fuse & relay Box)

(4) FUNCTION OF POWER SUPPLY LINE(NUMBER)

Power supply NO.	Power supply condition
15	Battery Voltage (B+) Supply in Ignition Switch ON and ST" (IGN 1)
15A	Battery Voltage (B+) Supply in Ignition Switch ON (IGN 2)
15C	Battery Voltage (B+) Supply in Ignition Switch ACC (ACC)
30	Battery Voltage (B+) Supply directly regardless of Ignition Switch
31	Ground Connnected to Battery(-)
50	Battery Voltage (B+) Supply in Ignition Switch ST" "
58	Battery Voltage (B+) Supply in Head Lamp Switch 1st and 2nd step(Illumination circuit)

(5) WIRING HARNESS COLOR IDENTIFICATION

Abbreviation	Color	Abbreviation	Color
Br	Brown	Sb	Sky Blue
G	Green	R	Red
V	Violet	L	Blue
P	Pink	Y	Yellow
W	White	Gr	Gray
O	Orange	B	Black
Lg	Light Green		

Modification basis	
Application basis	
Affected VIN	

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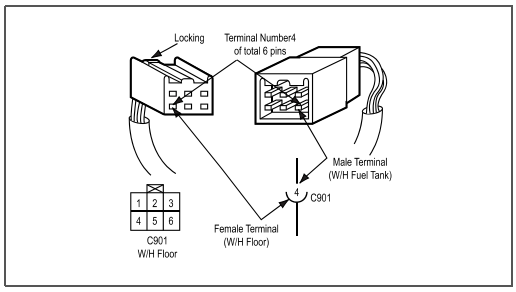
(6) ELECTRIC SYMBOLS

Items	Symbols	Items	Symbols
Resistance		Lamp	
Rheostat		Single Bulb	
Coil, Inductance		Double Bulb	
Condenser, Capacitor		Transistor : PNP type	
Ground, Earth		Transistor : NPN type	
Diode		~Meter, ~Gauge	
Zener Diode		Voltmeter	V
Photo Diode		Amperemeter	A
Light Emitting Diode		Switch	
Battery		Thermistor	
Disconnected Wire		Junction Point	
Fuse		Fusible Link	
Motor	M	Connector	No.
Speaker		Horn	

2. HOW TO CHECK TERMINAL NUMBER OF CONNECTOR

▶ **Terminal number is given based on Female Terminal Male Connector**

- ex) Terminal Number 4 of C901 connection



▶ **Terminal number of Connector**

- Generally, the Connector terminal number is given from left to right direction of Locking upper position through the Female Terminal.
- Exceptionally, Control unit such as Engine ECU, TCU and Instrument Cluster was used a specific number which marked on the draft.
- If a lot of connectors was connected to one parts, the connector was marked as A, B, C in front of terminal number.
- In case of terminal number was carved into connector or each parts, we will use the carved number exceptionally.

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3. PART LOCATION ACCORDING TO CONNECTOR NUMBER

▶ C : Symbol Character for Connector ex) C102

Symbol Character	Description
C	Connector (Connecting part that connects two wiring harness)
D	Diode
G	Ground
S	Splice pack (Joint connector that connects various wiring harness)

▶ 1 : Connector location Number



▶ Connector Number according to locating Section

Connector Number	Location
□1□□	Engine Compartment
□2□□	Instrument panel
□3□□	In Door
□4□□	Tail Gate
□9□□	Under Body

- In the locating section, the assignment for part number startsfrom left bottom and proceeds clockwise.
- In the fuse and relay box or the instrument panel, the partnumber is assigned from left top to light bottom.

▶ 02 : Connector Numbering Order

Modification basis	
Application basis	
Affected VIN	

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1413-02/8210-00/8210-01/8211-01/8212-01/8212-02 /8213-03/8213-04/8213-06/8213-09/8213-108810-22/8810-23

WIRING HARNESS

8210-00 WIRING HARNESS, COMPONENTS LOCATION..... 2
8210-00 CONNECTOR, GROUND / SPLICE PACK..... 4

CONNECTOR/GROUND

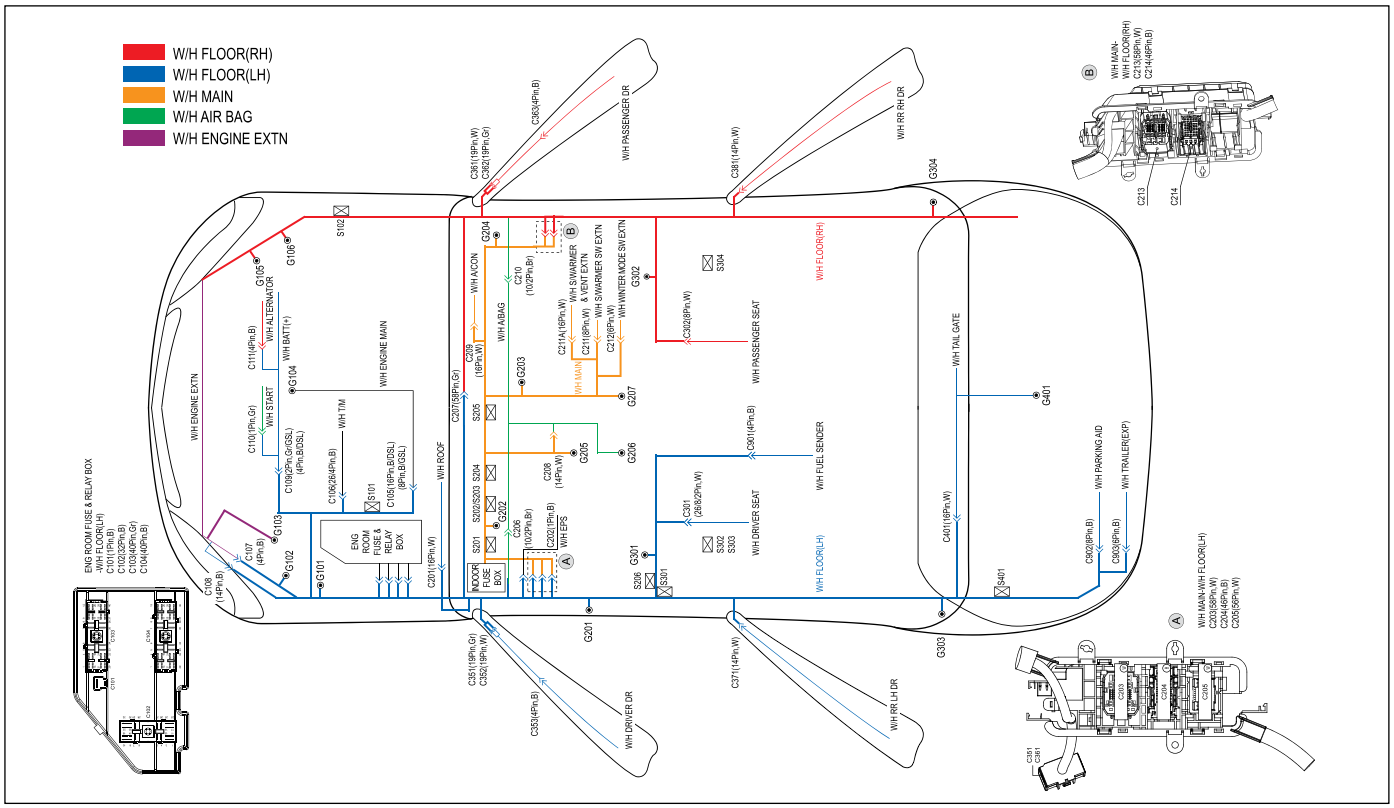
8210-01 W/H MAIN..... 14
8212-01 W/H FLOOR(LH)..... 16
8212-02 W/H FLOOR(RH)..... 18
1413-02 W/H ENGINE MAIN..... 19
8211-01 W/H ENGINE EXTN..... 21
8213-09 W/H ROOF..... 22
8810-22 W/H AIR BAG..... 23
8810-23 W/H AIR BAG EXTN..... 23
8213-03 W/H DRIVER DOOR..... 24
8213-04 W/H PASSENGER DOOR..... 24
8213-06 W/H REAR DOOR..... 25
8213-10 W/H TAIL GATE..... 25

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WIRING HARNESS

8210-00 **WIRING HARNESS, COMPONENTS LOCATION**

(1) WIRING HARNESS



CONNECTOR/GROUND

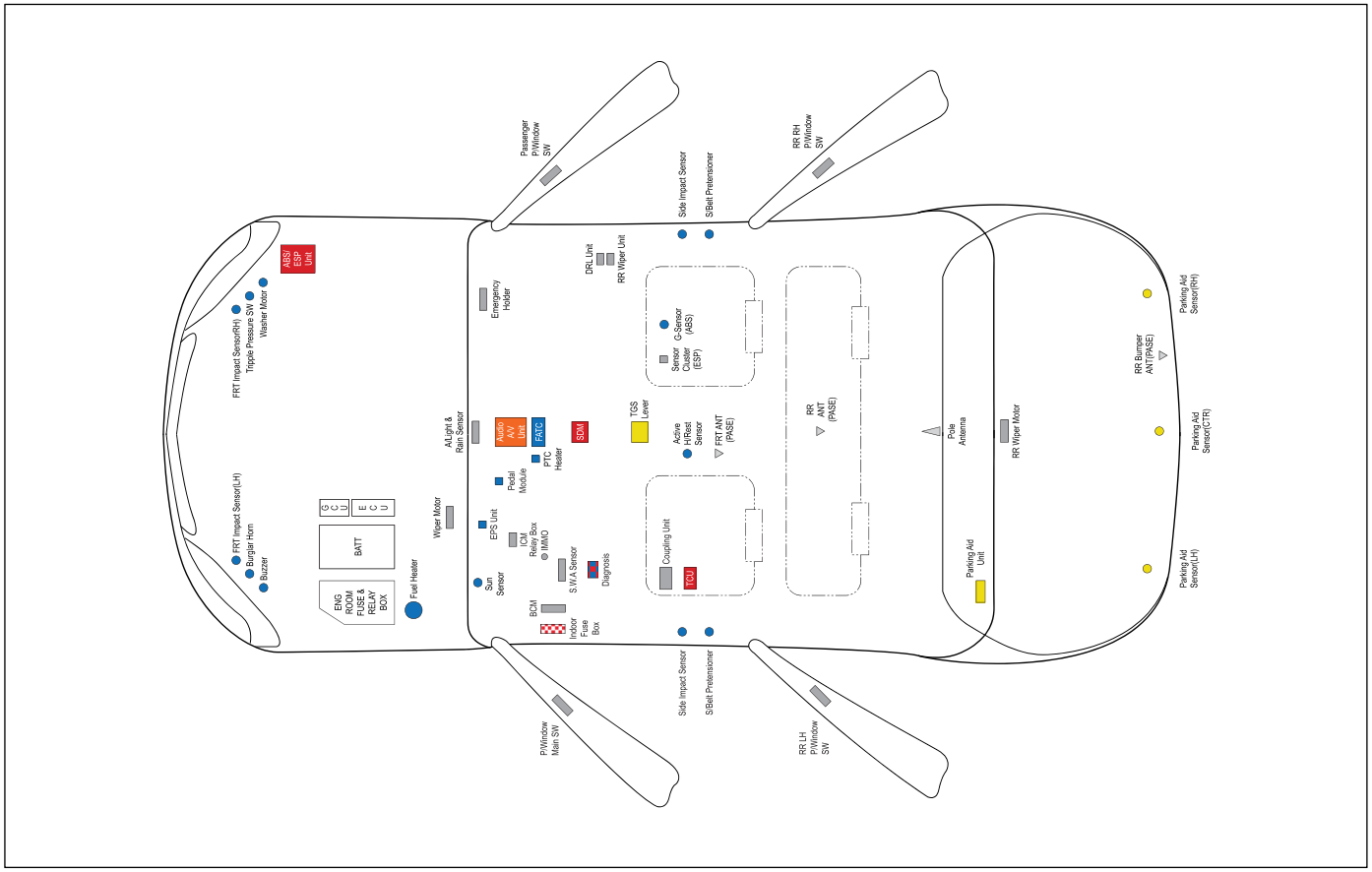
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Modification basis	
Application basis	
Affected VIN	

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WIRING HARNES
CONNEC TOR/GR

(2) COMPONENTS LOCATION



Modification basis	
Application basis	
Affected VIN	

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8210-00 CONNECTOR, GROUND / SPLICE PACK

(1) CONNECTOR, GROUND, SPLICE PACK

▶ **CONNECTOR**

Connector Number (Pin Number/Color)			Connecting Wiring Harness	Connector Position	Remark
C101	1	Black	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102	32	Black	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103	40	Gray	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104	40	Black	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105	8	Black	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	GSL
	16	Black	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	DSL
C106	26	Black	W/H Floor(LH) - W/H T/M	Upper T/M(Under BATT Tray)	A/T
	4	Black	W/H Floor(LH) - W/H T/M	Upper T/M(Under BATT Tray)	M/T
C107	4	Black	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C108	14	Black	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C109	2	Gray	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	GSL
	4	Black	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	DSL
C110	1	Gray	W/H BATT(+) - Start Solenoid	Beside Starter Motor	
C111	4	Black	W/H BATT(+) - Alternator	Beside Alternator	
	2	Black	W/H BATT(+) - Alternator	Beside Alternator	LOW CO_2
C201	16	White	W/H Floor(LH) - W/H Roof	Upper Driver Cowl Side Connector Holder	
C202	1	Black	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	EPS
C203	58	White	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204	46	Black	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C205	56	White	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C206	10	Brown	W/H Air Bag - W/H Air Bag EXTN	Driver Cowl Side Connector Holder	Curtain/Side A/Bag
	2	Brown	W/H Air Bag - W/H Air Bag EXTN	Driver Cowl Side Connector Holder	
C207	58	Gray	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C208	14	White	W/H Main - W/H Air Bag	Inside I.P (Upper Driver LegRoom)	
C209	16	White	W/H Main - W/H Air Con	Inside I.P (Upper CTR Cowl Cross Member)	
C210	10	Brown	W/H Air Bag - W/H Air Bag EXTN	Passenger Cowl Side Connector Holder	Curtain/Side A/Bag
	2	Brown	W/H Air Bag - W/H Air Bag EXTN	Passenger Cowl Side Connector Holder	
C211	8	White	W/H Main - W/H Seat Warmer switch EXTN	Inside Console	A/T, M/T DLX
C211A	16	White	W/H Main - W/H Seat Warmer/VENT switch EXTN	Inside Console	VENT SW
C212	6	White	W/H Main - W/H Winter Mode switch EXTN	Inside Console	A/T, DSL
C213	58	White	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C214	46	Black	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C301	26	White	W/H Floor(LH) - W/H Driver Seat	Under Driver Seat	Vent & Power Seat
	8	White	W/H Floor(LH) - W/H Driver Seat	Under Driver Seat	S/Warmer, Active
	2	White	W/H Floor(LH) - W/H Driver Seat	Under Driver Seat	
C302	8	White	W/H Floor(RH) - W/H Passenger Seat	Under Passenger Seat	
C351	19	Gray	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C352	19	White	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C353	4	Black	W/H Driver DR - W/H Smart Key	Inside Driver DR	Smart Key
C361	19	White	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C362	19	Gray	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C363	4	Black	W/H Passenger DR - W/H Smart Key	Inside Passenger DR	Smart Key
C371	14	White	W/H Floor(LH) - W/H RR LH DR	Under LH B Pillar	
C381	14	White	W/H Floor(RH) - W/H RR RH DR	Under RH B Pillar	
C401	16	White	W/H Floor(LH) - W/H Tail Gate	Upper Tail Gate LH	
C901	4	Black	W/H Floor(LH) - W/H Fuel Sender	FRT Fuel Tank	
C902	8	Black	W/H Floor(LH) - W/H RR Bumper	Under RR LH Bumper	PAS
C903	6	Black	W/H Floor(LH) - W/H Trailer	Under RR LH Bumper	

▶ **GROUND**

Connector Number	Connecting Wiring Harness	Connector Position	Remark
G101	W/H Floor(LH)	Behind LH Head Lamp	
G102	W/H Floor(LH)	Under BATT Tray	ECU
G103	W/H Eng EXTN	Under BATT Tray	
G104	W/H Eng Main	FRT Intake Valve	
G105	W/H Floor(RH)	Behind RH Head Lamp	
G106	W/H Floor(RH)	Beside ABS/ESP Unit	ABS/ESP
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G202	W/H Main	Backside Cluster(LH Cowl Cross Member)	AUDIO
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
G205	W/H Main	Left Side I.P(Beside CTR Support BRKT)	PTC
G206	W/H Main	Left Under TGS Lever	AIR BAG
G207	W/H Main	Right Under TGS Lever	EPS
G301	W/H Floor(LH)	Under Driver Seat	
G302	W/H Floor(RH)	Under Passenger Seat	
G303	W/H Floor(LH)	Driver QTR PNL	
G304	W/H Floor(RH)	Passenger QTR PNL	
G401	W/H Tail Gate	CTR Under Tail Gate	

▶ **SPLICE PACK**

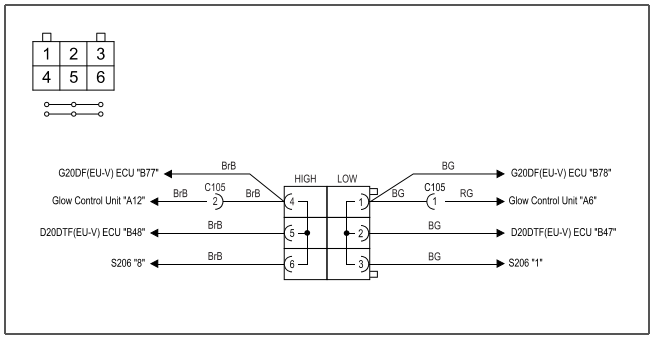
Connector Number (Pin Number/Color)		Connecting Wiring Harness	Connector Position	Remark
S101	6	W/H Floor(LH)	Under Eng Room Fuse & Relay Box	HS-CAN
S102	6	W/H Floor(RH)	Inside RH Fender	HS-CAN
S201	8	W/H Main	Backside Cluster(LH Cowl Cross Member)	LS-CAN
S202	20	W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S203	20	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204	20	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND
S205	8	W/H Main	Backside Audio(CTR Cowl Cross Member)	HS-CAN
S206	14	W/H Floor(LH)	Under Driver Seat	HS-CAN
S301	14	W/H Floor(LH)	Under Driver Seat	
S302	14	W/H Driver Seat	Inside Driver Seat(Seat Frame)	Power Seat
S303	14	W/H Driver Seat	Inside Driver Seat(Seat Frame)	Manual Seat
S304	8	W/H Passenger Seat	Inside Passenger Seat(Seat Frame)	
S401	8	W/H Floor(LH)	Beside PAS Unit(Inside LH QTR Trim)	HS-CAN

Modification basis	
Application basis	
Affected VIN	

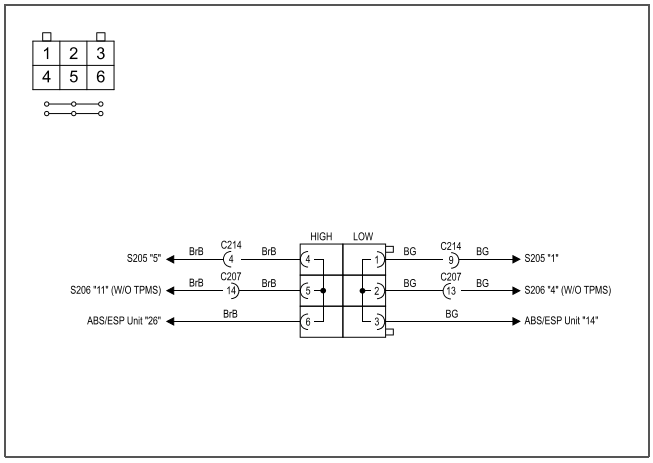
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(2) SPLICE PACK CIRCUIT

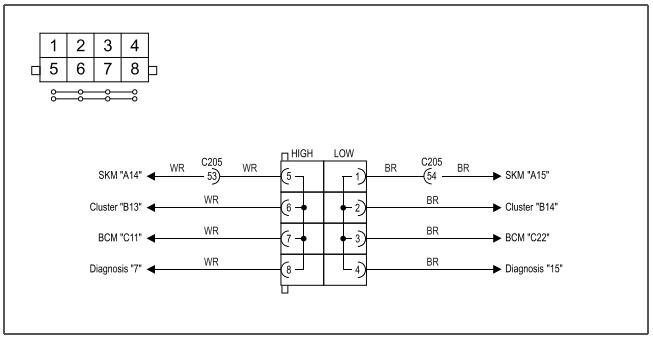
1) S101 (HS-CAN)



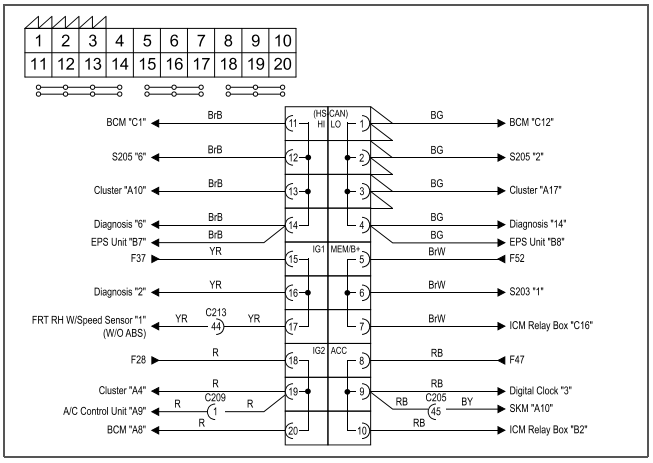
2) S102 (HS-CAN)



3) S201 (LS-CAN)



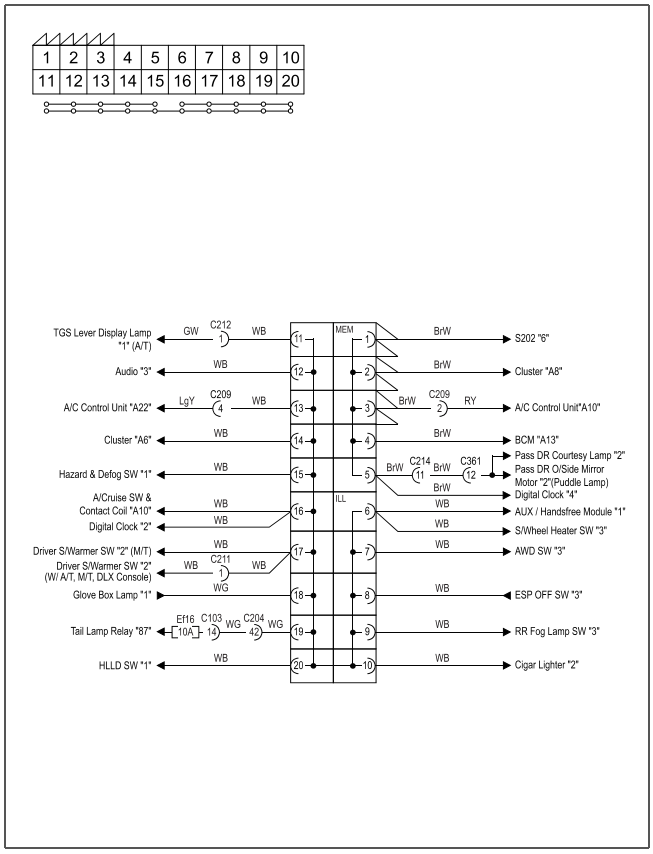
4) S202 (HS-CAN)



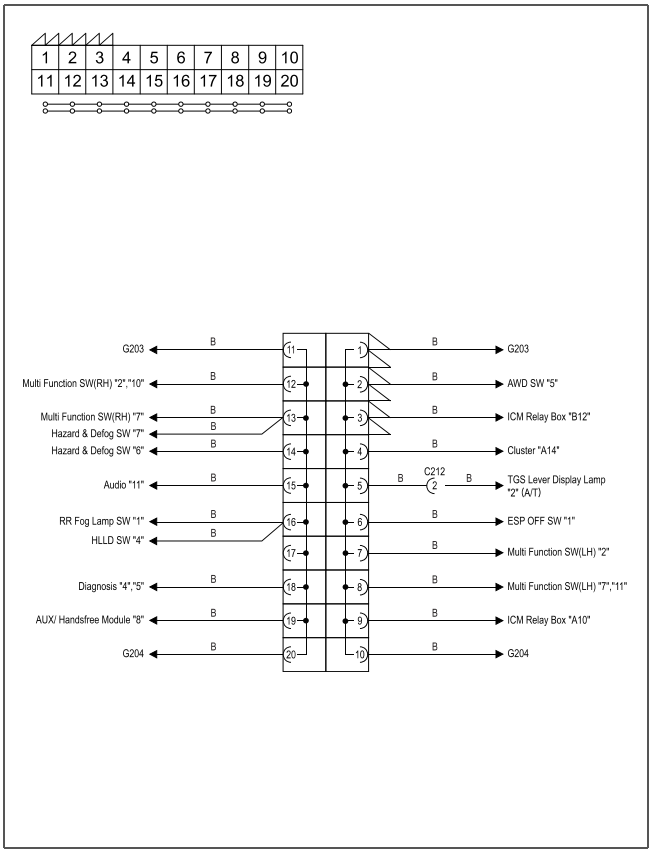
Modification basis	
Application basis	
Affected VIN	

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5) S203 (ILL+)



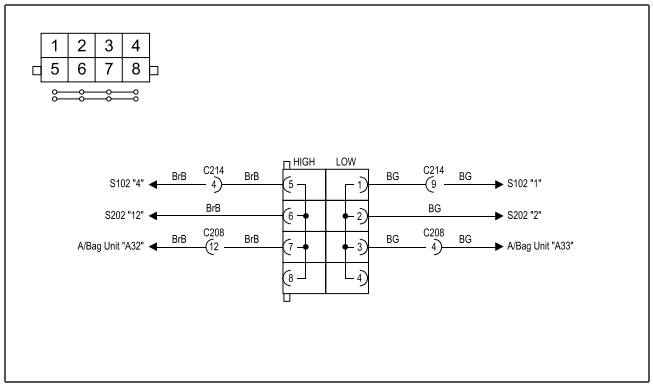
6) S204 (GND)



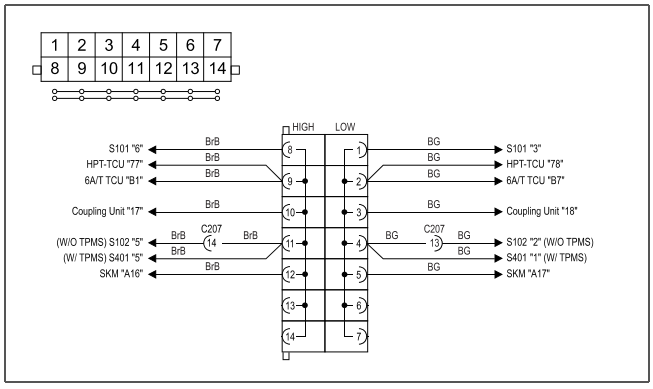
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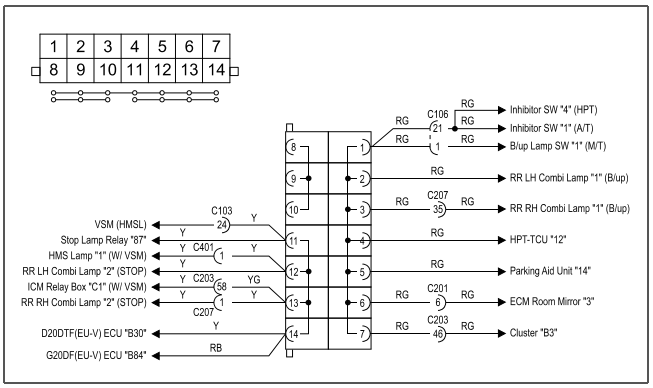
7) S205 (HS-CAN)



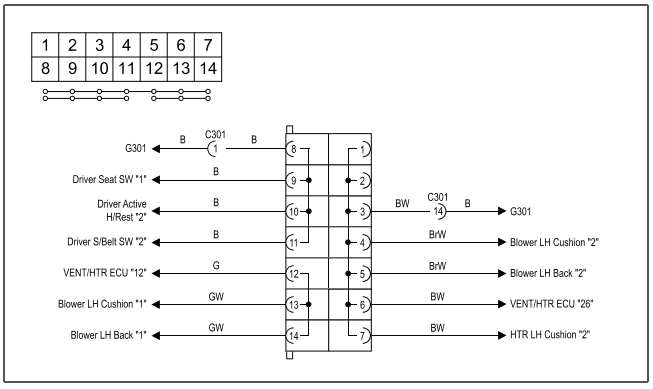
8) S206 (HS-CAN)



9) S301



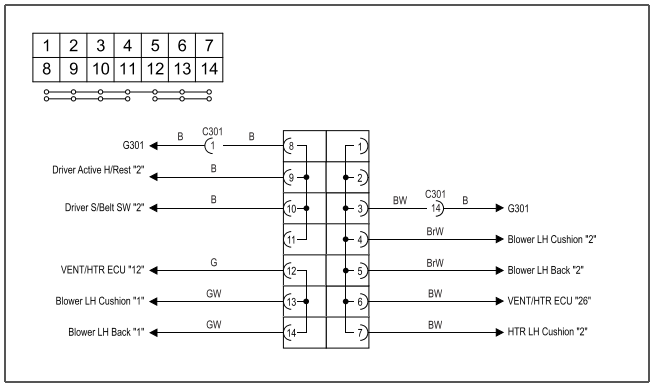
10) S302 (DRIVER POWER SEAT - VENT/FRT SEAT WARMER)



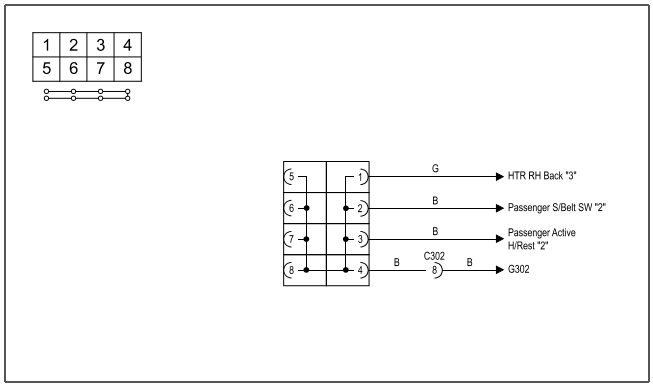
Modification basis	
Application basis	
Affected VIN	

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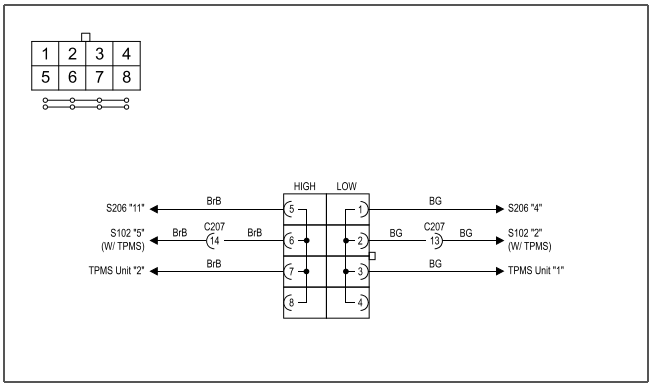
11) S303 (DRIVER MANUAL SEAT - VENT/FRT SEAT WARMER)



12) S304 (PASSENGER SEAT)



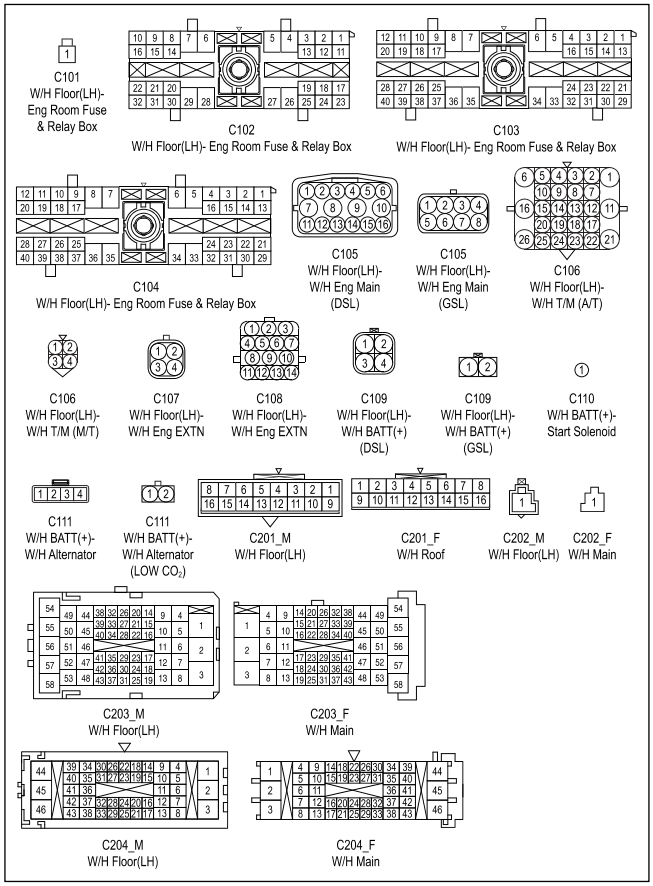
13) S401 (HS-CAN)

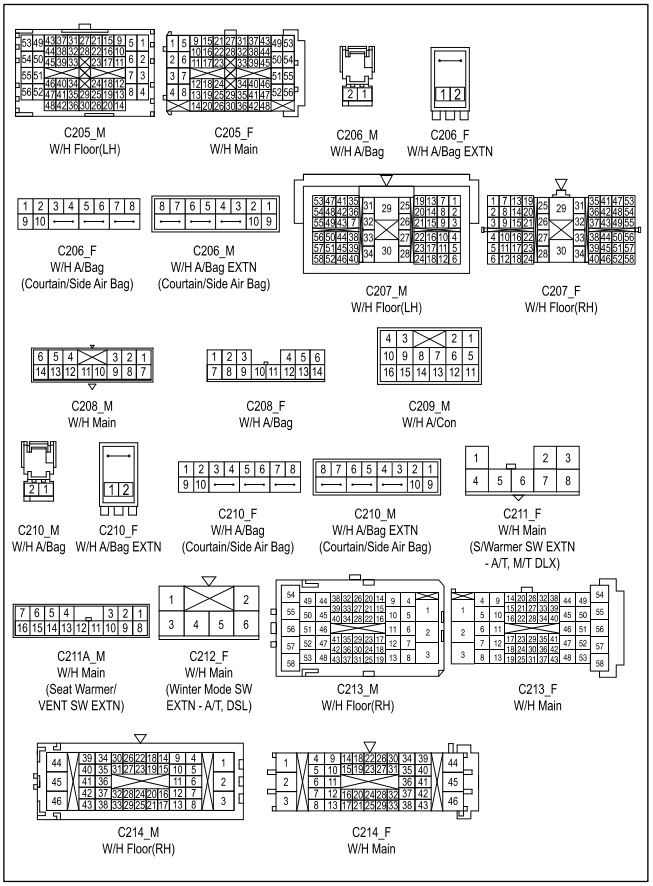


Modification basis	
Application basis	
Affected VIN	

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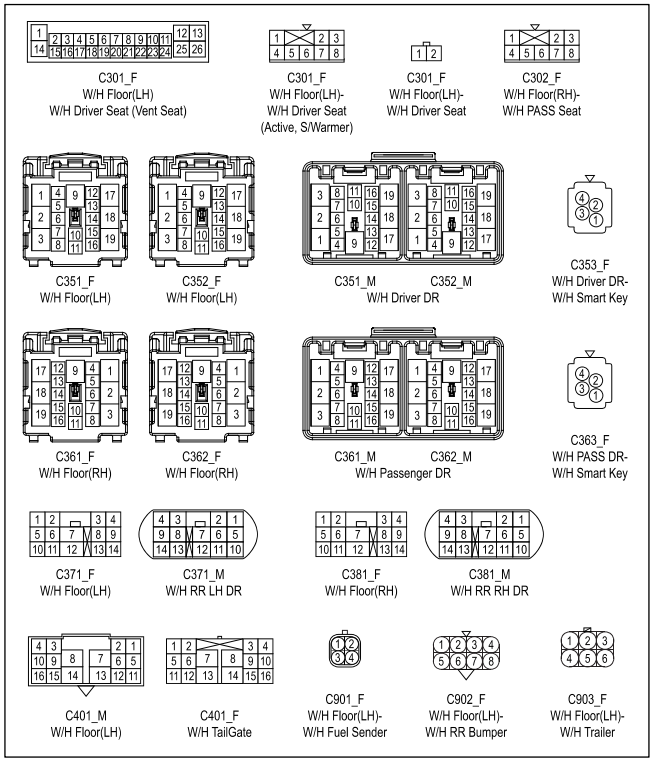
(3) WIRING CONNECTOR PARTS SHAPE / NUMBERING

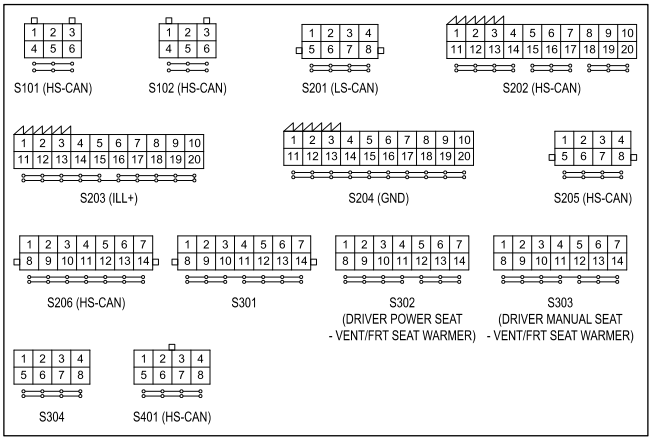




Modification basis	
Application basis	
Affected VIN	

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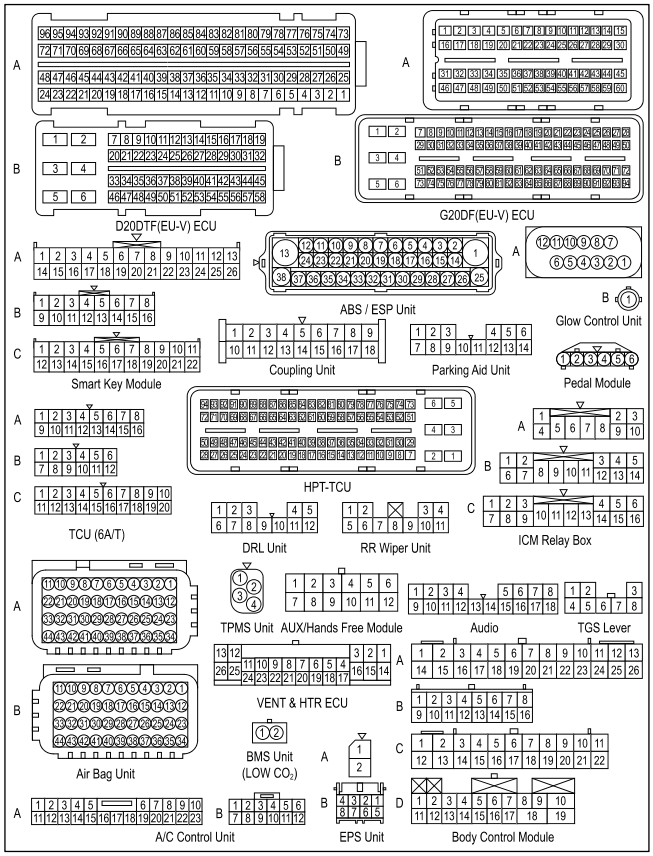


Modification basis	
Application basis	
Affected VIN	

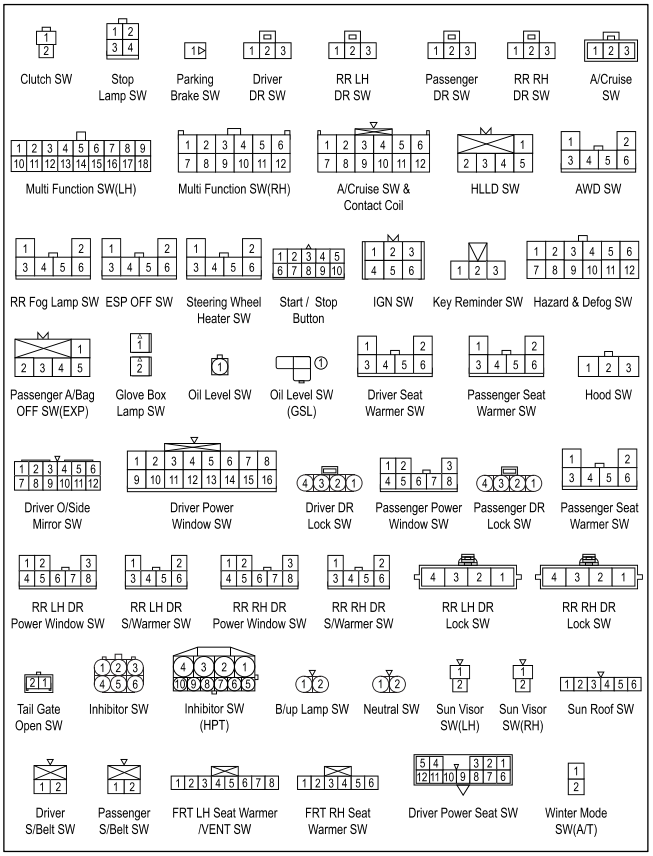
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(4) THE OTHERS PARTS SHAPE / NUMBERING

▶ UNIT PART



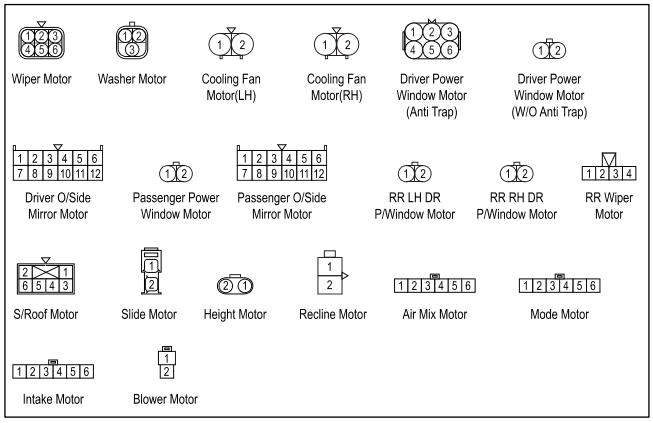
▶ SWITCH PART



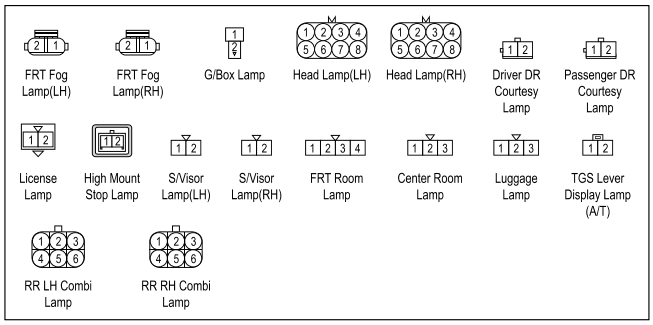
Modification basis	
Application basis	
Affected VIN	

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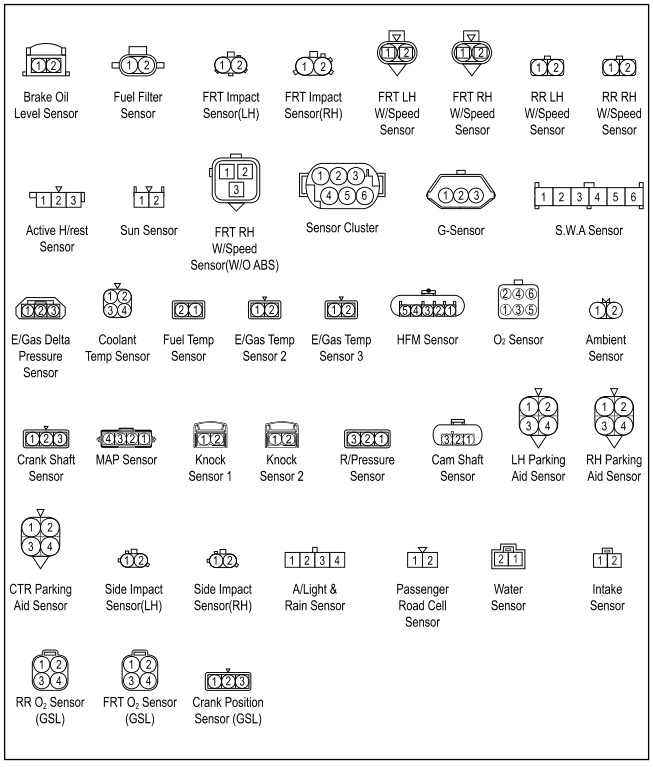
▶ **MOTOR PART**



▶ **LAMP PART**



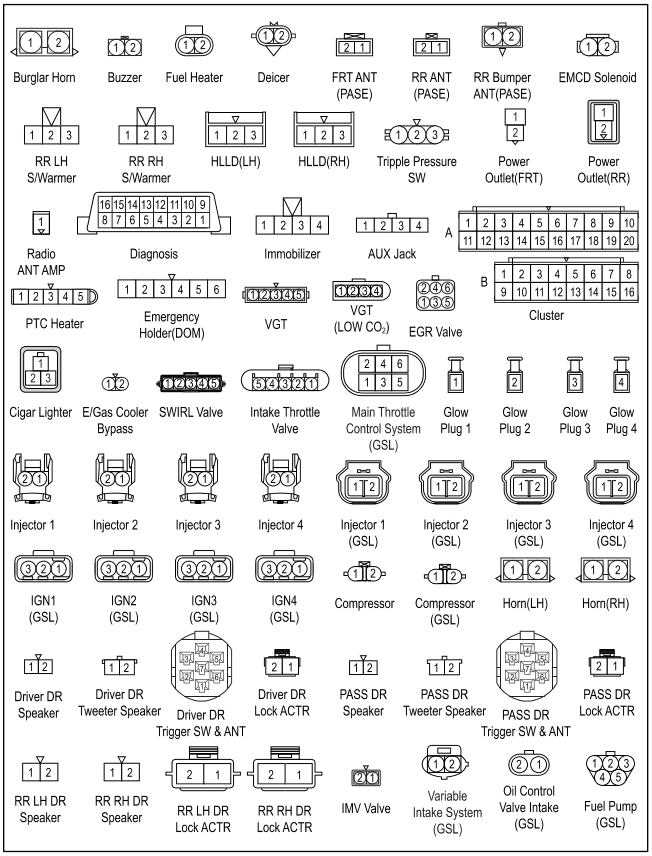
▶ **SENSOR PART**

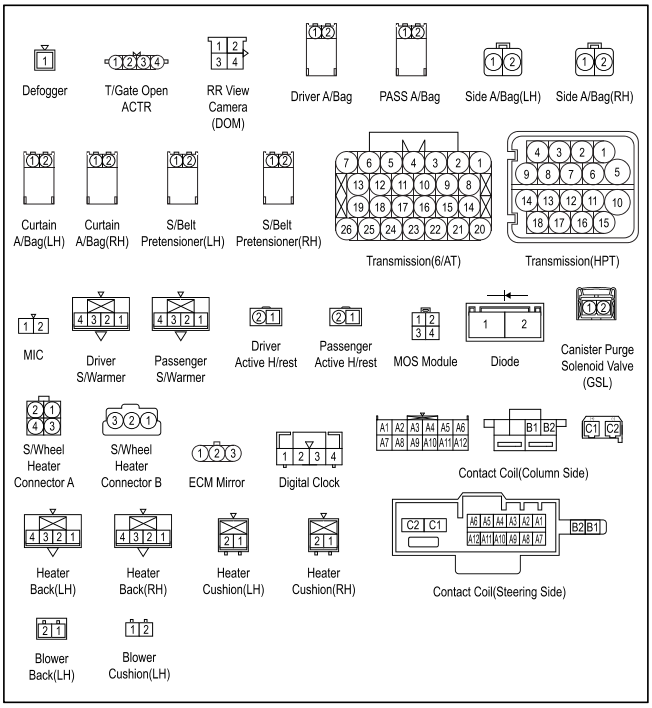


Modification basis	
Application basis	
Affected VIN	

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▶ **THE OTHER PART**



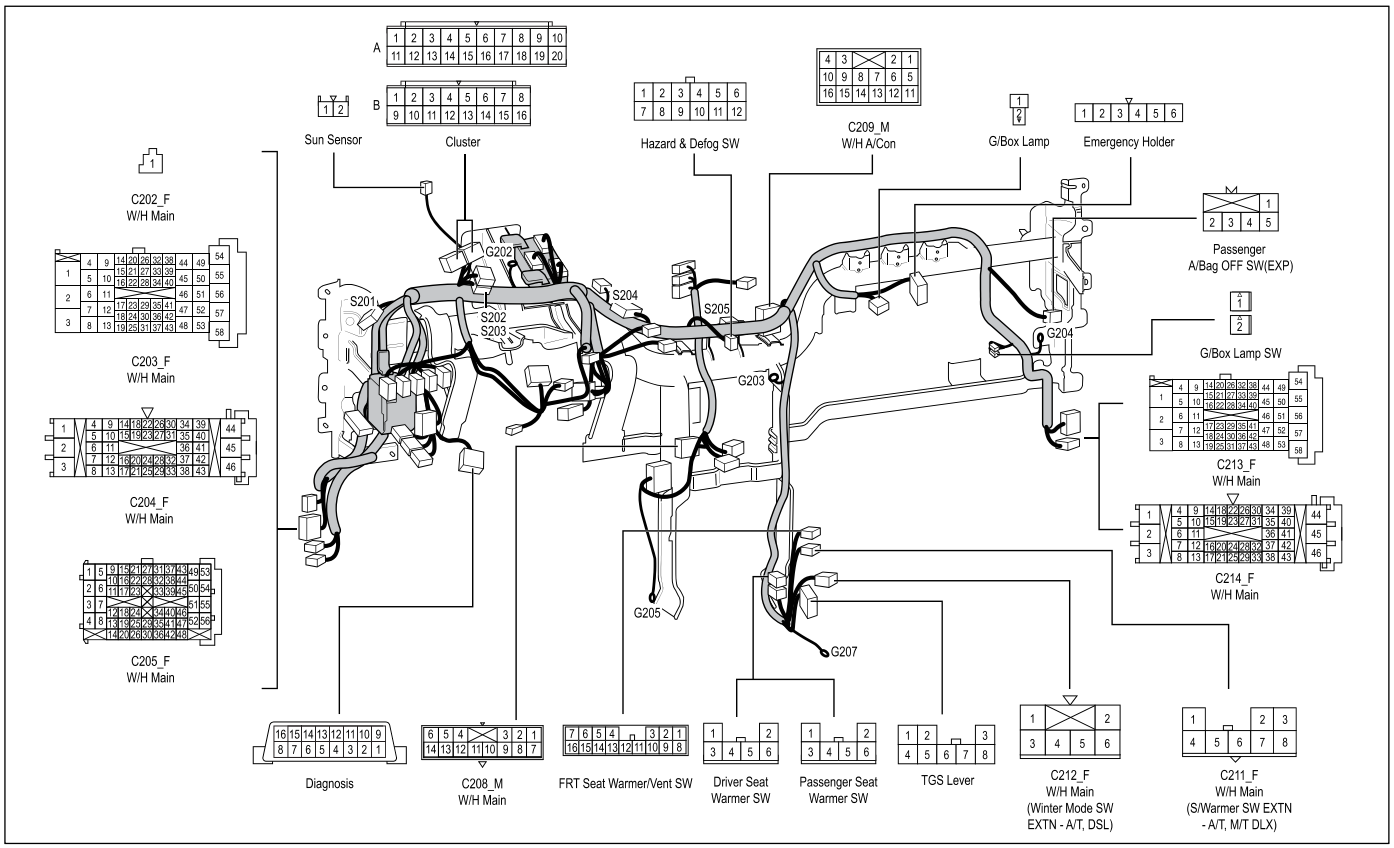


Modification basis	
Application basis	
Affected VIN	

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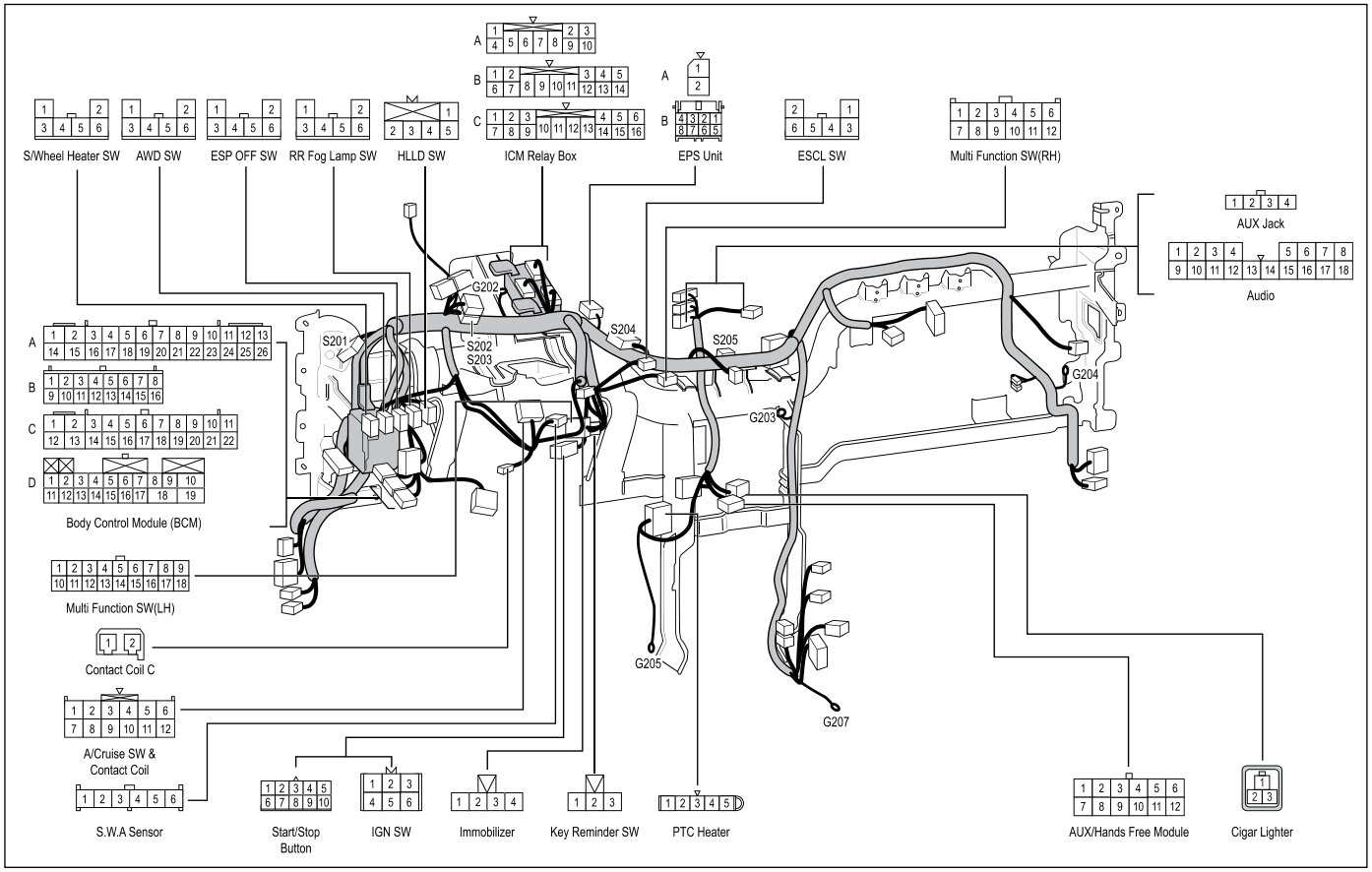
CONNECTOR/GROUND

8210-01 **W/H MAIN**



Modification basis	
Application basis	
Affected VIN	

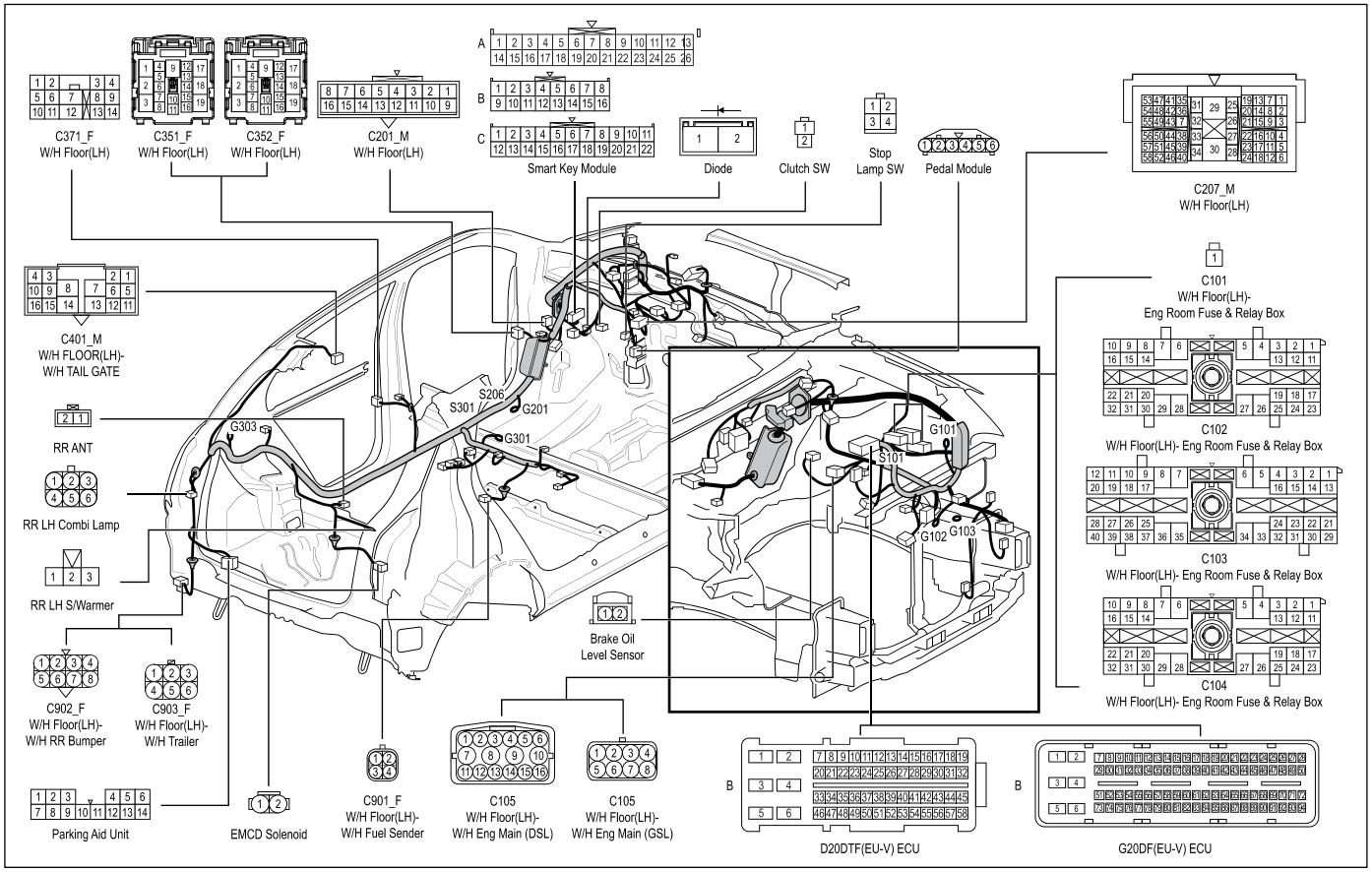
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Modification basis	
Application basis	
Affected VIN	

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8212-01 W/H FLOOR(LH)

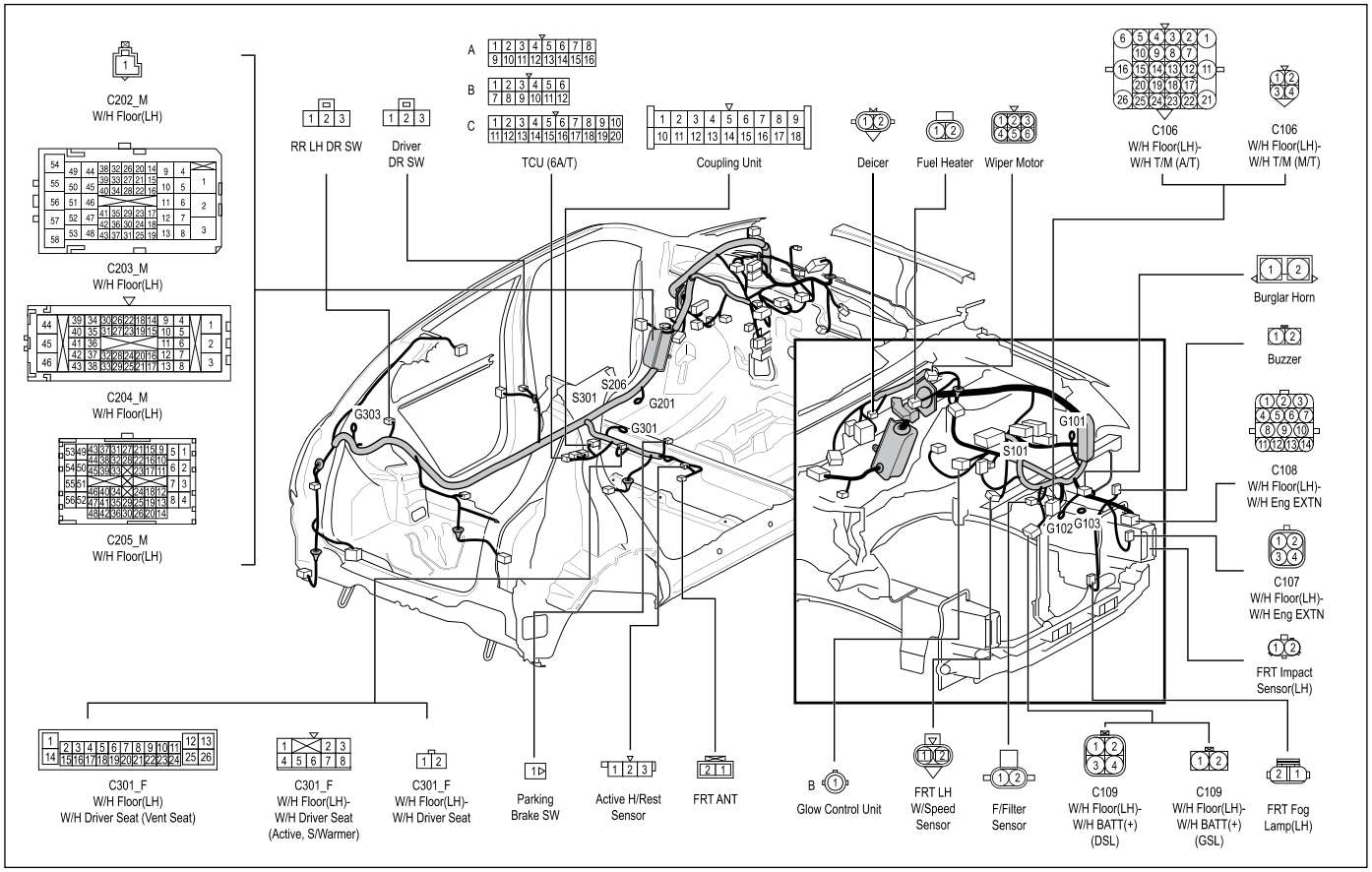


CONNECTOR/GROUND

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Modification basis	
Application basis	
Affected VIN	

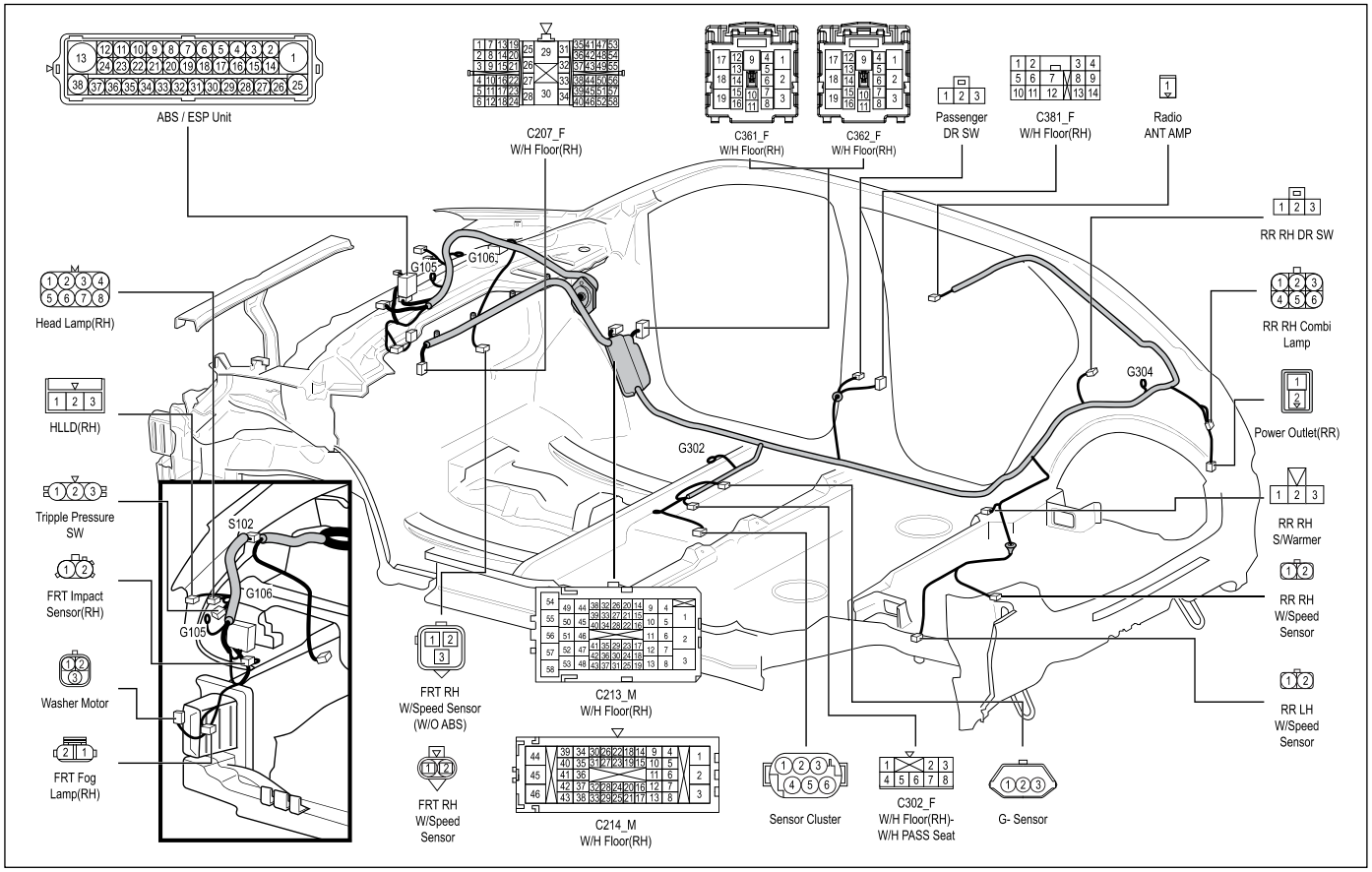
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Modification basis	
Application basis	
Affected VIN	

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8212-02 W/H FLOOR(RH)



CONNECTOR/GROUND

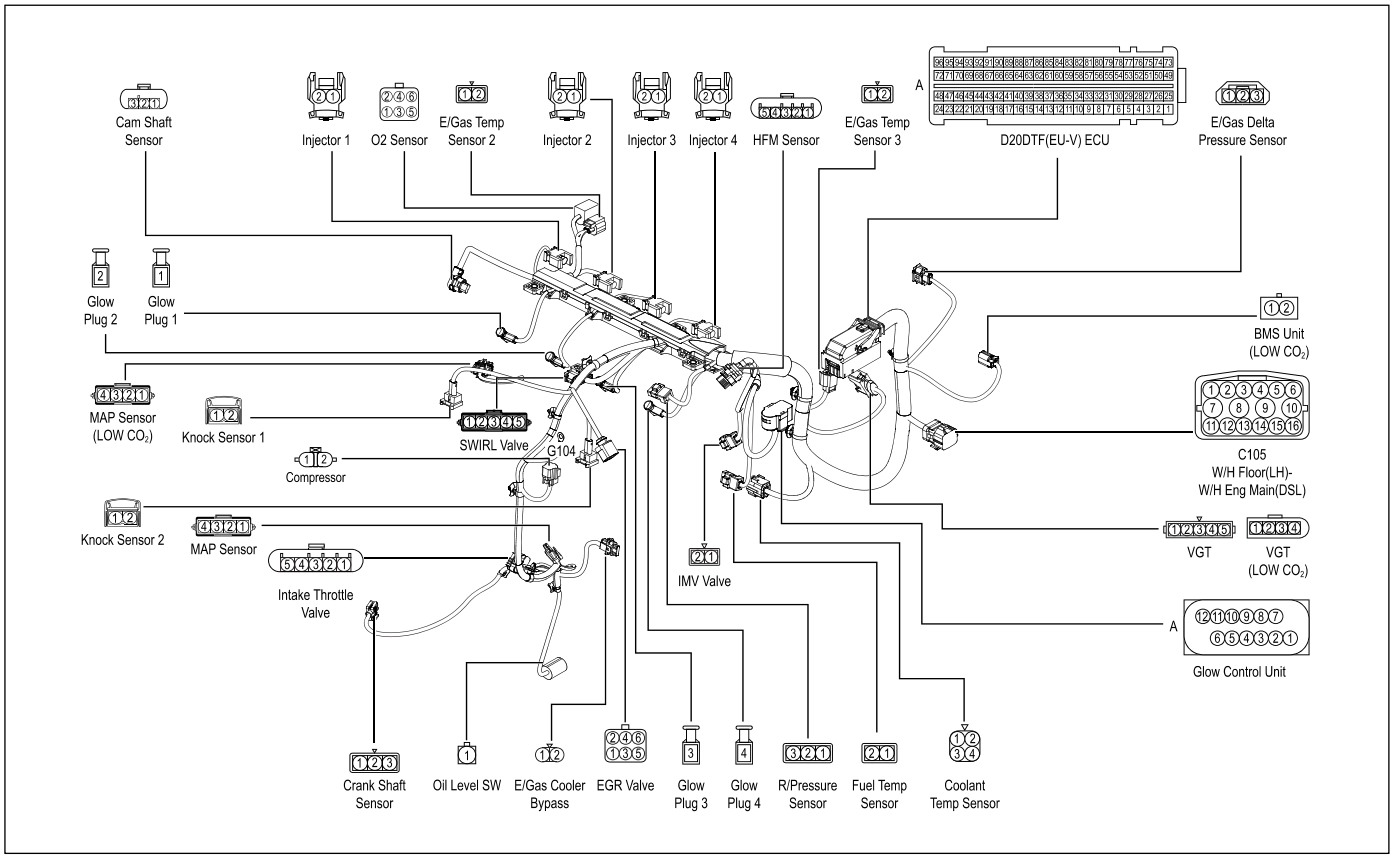
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Modification basis	
Application basis	
Affected VIN	

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1413-02 W/H ENGINE MAIN

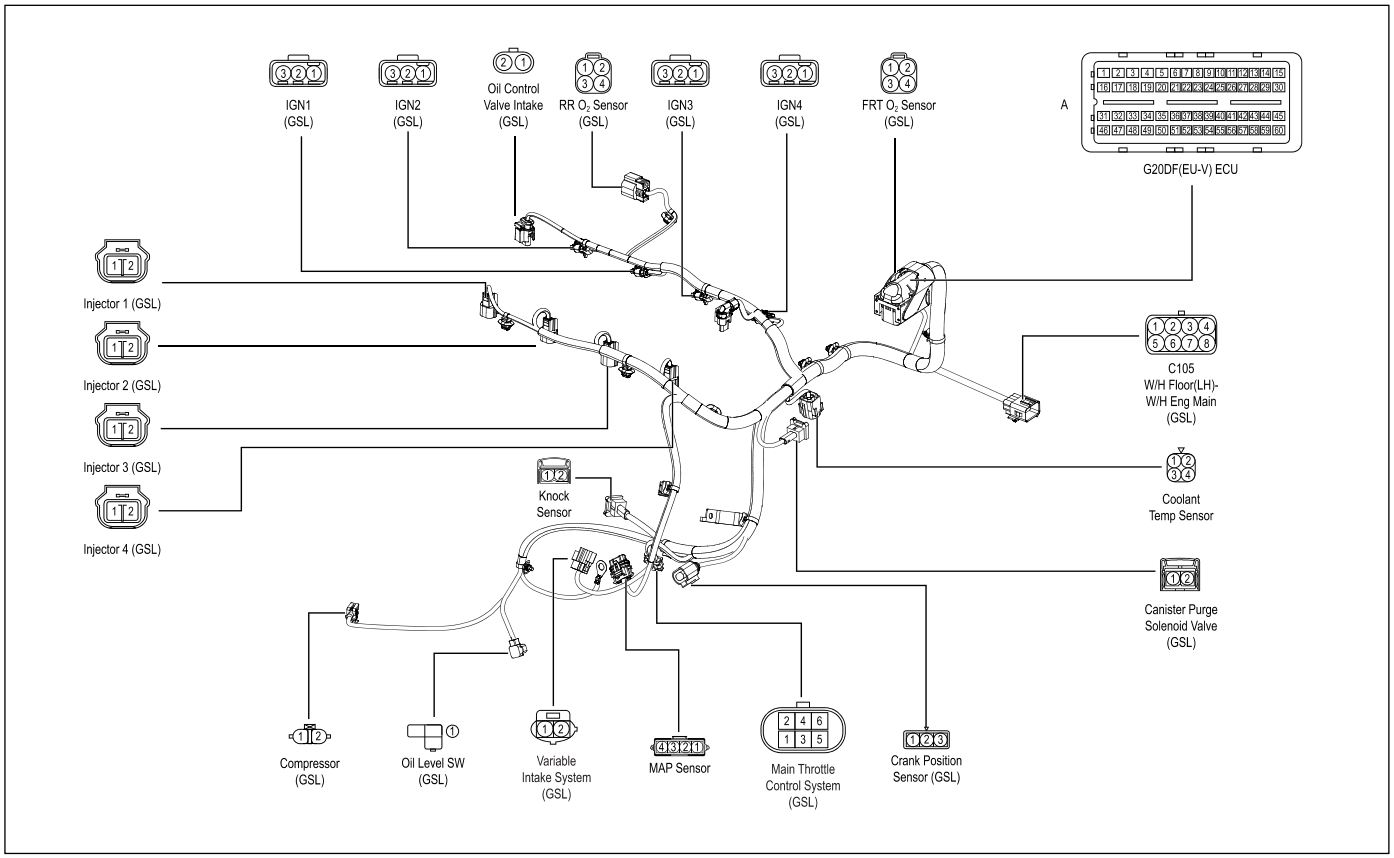
▶ D20DTF



Modification basis	
Application basis	
Affected VIN	

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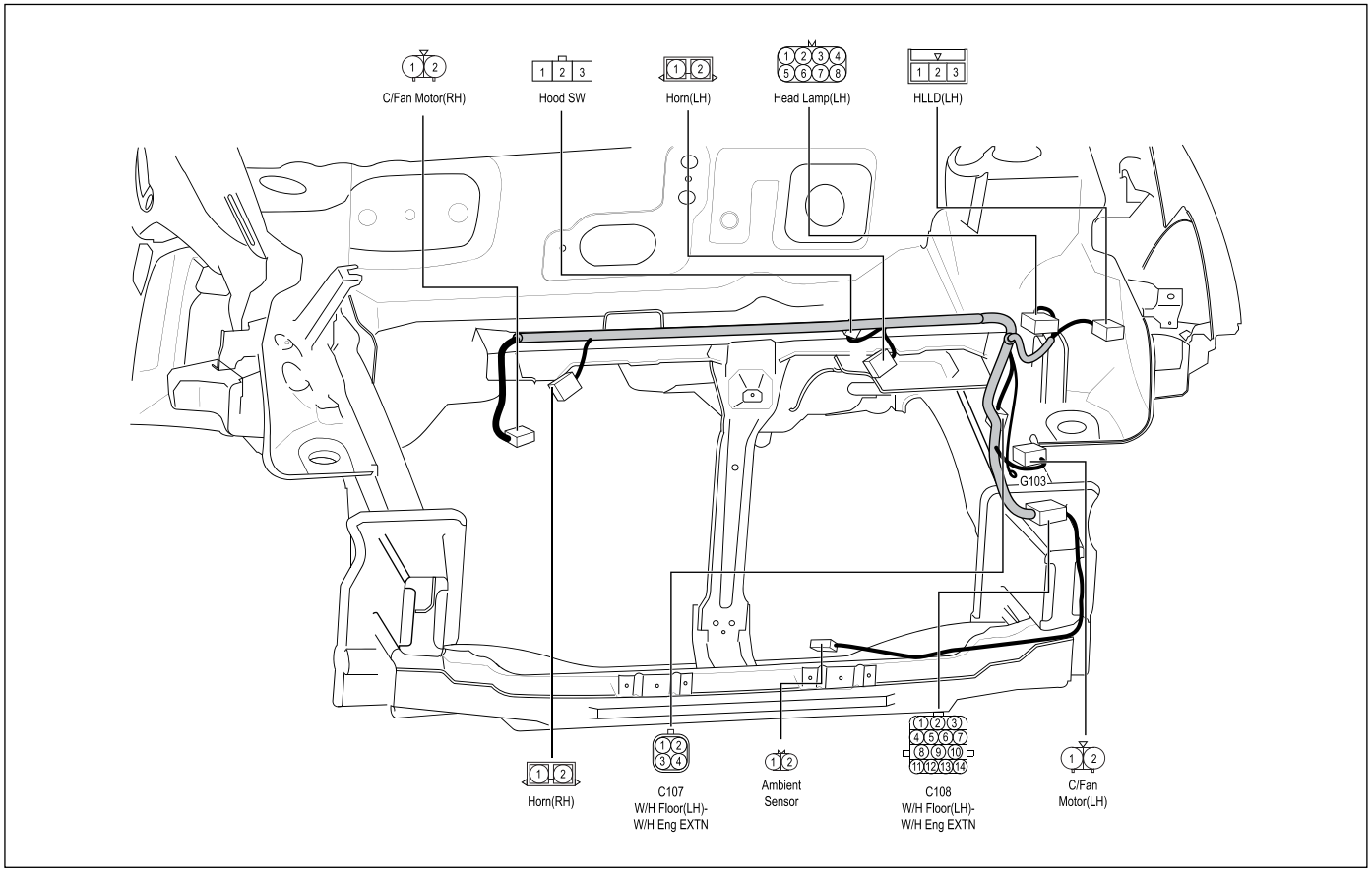
▶ **G20DTF**



Modification basis	
Application basis	
Affected VIN	

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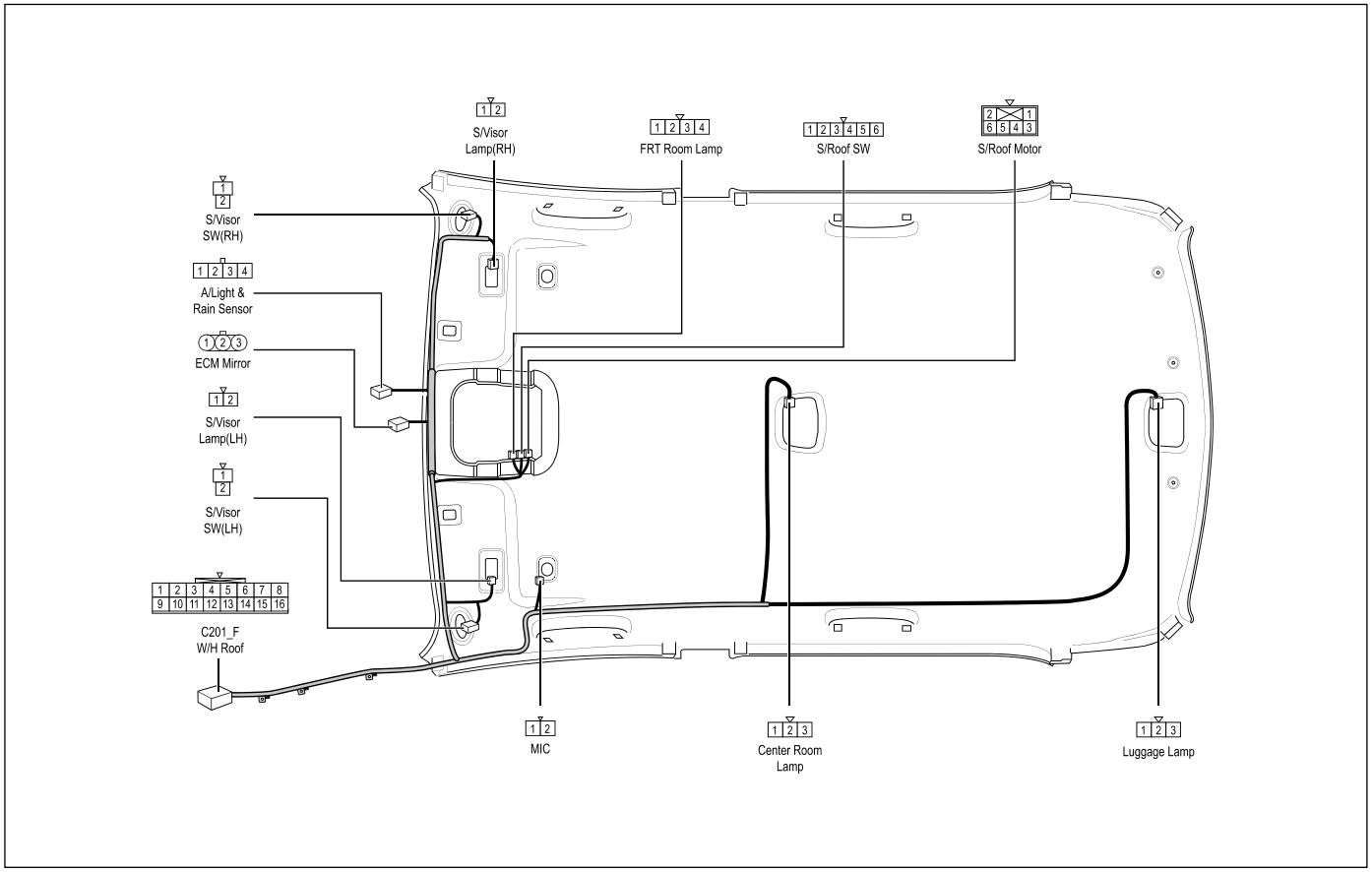
8211-01 W/H ENGINE EXTN



Modification basis	
Application basis	
Affected VIN	

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8213-09 W/H ROOF



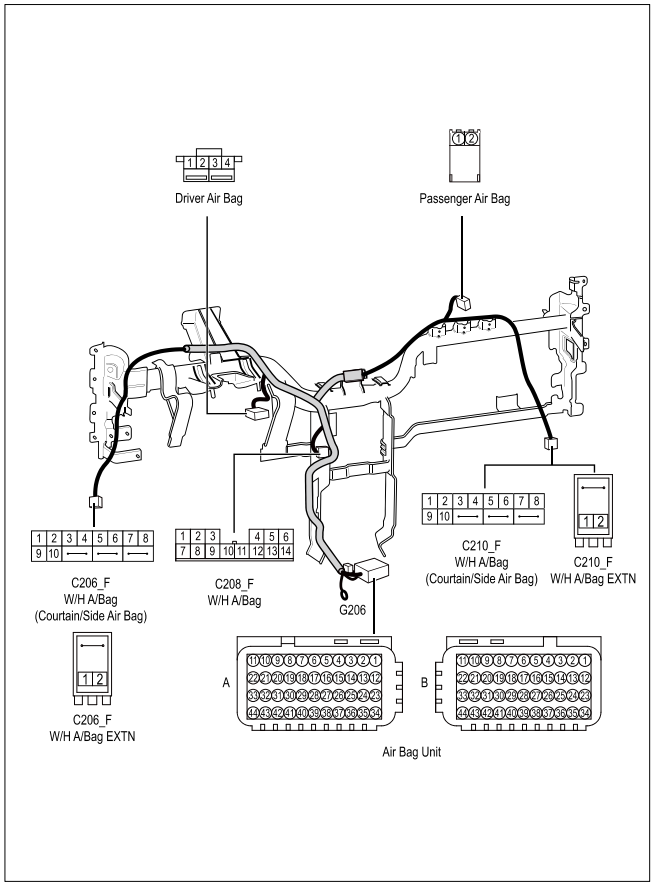
CONNECTOR/GROUND

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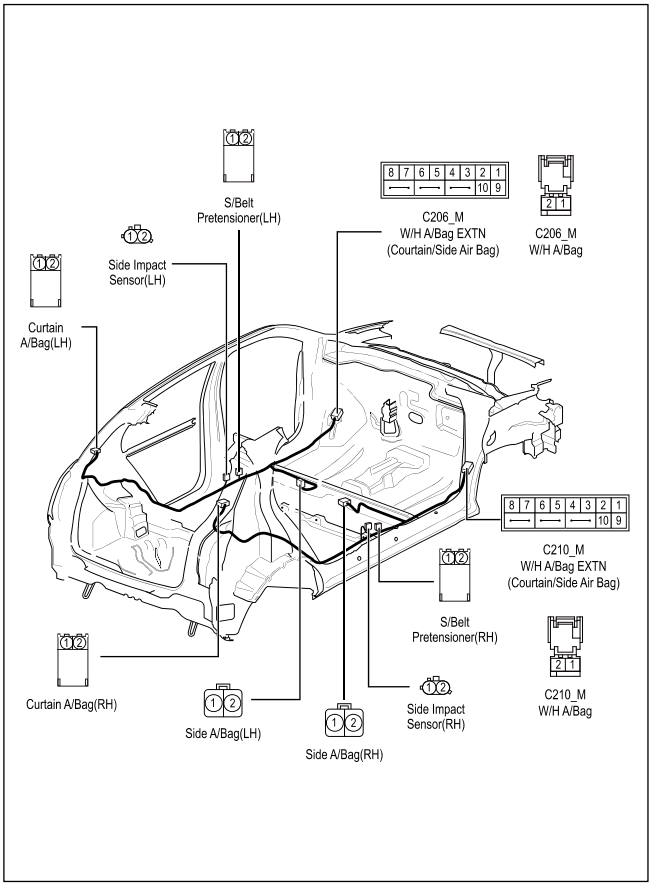
Modification basis	
Application basis	
Affected VIN	

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8810-22 W/H AIR BAG



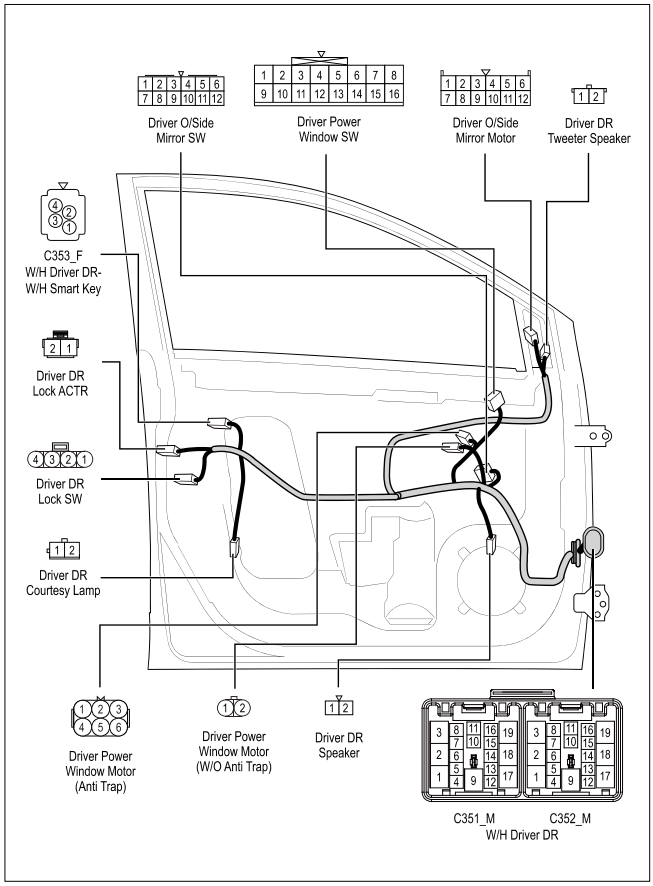
8810-23 W/H AIR BAG EXTN



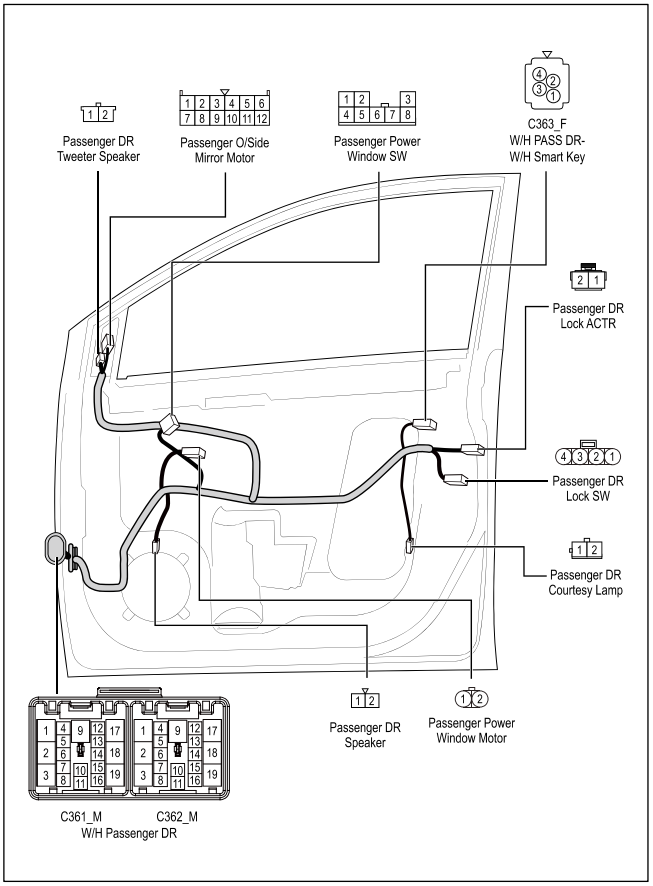
Modification basis	
Application basis	
Affected VIN	

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8213-03 W/H DRIVER DOOR



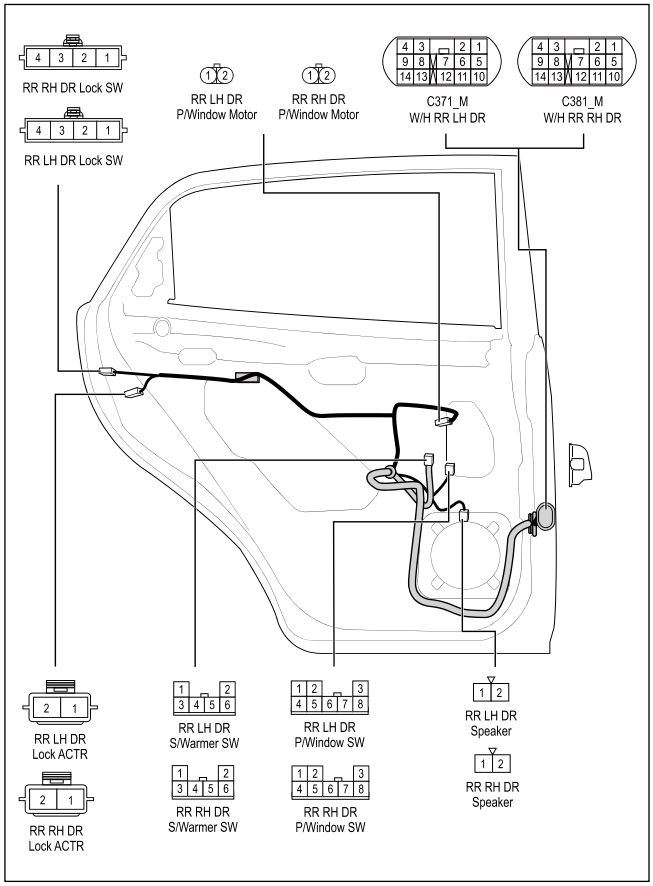
8213-04 W/H PASSENGER DOOR



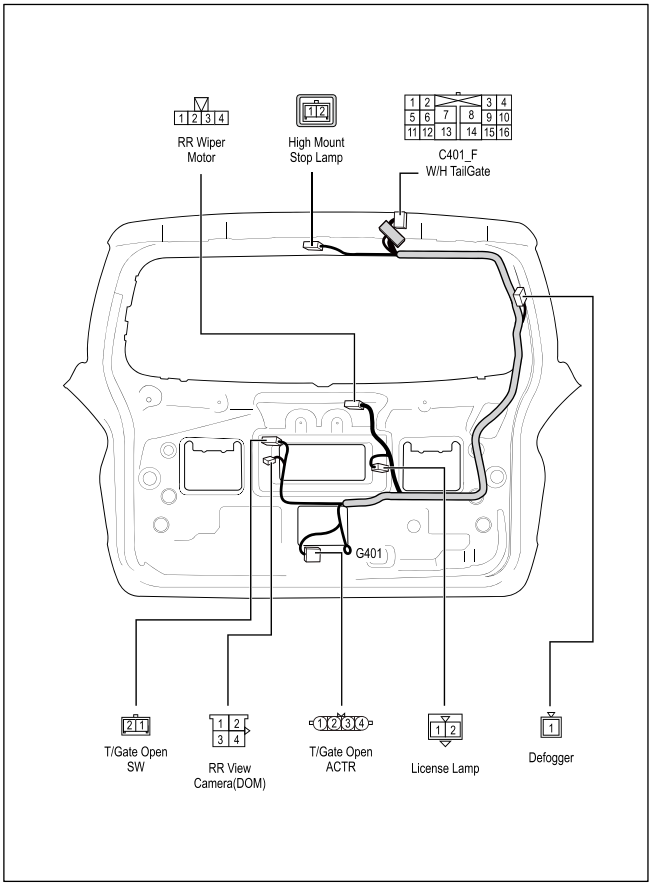
Modification basis	
Application basis	
Affected VIN	

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8213-06 W/H REAR DOOR



8213-10 W/H TAIL GATE



Modification basis	
Application basis	
Affected VIN	

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1461-01/2820-01/1491-01/1491-04/6810-15/8210-01/3110-01/3110-17/4892-01/4610-04/4190-01/8810-01/8510-30/7410-01/7410-01/7410-02/8510-48/8620-01/8510-05/8510-52/7810-01/7810-01/8610-06/7632-16/7840-01/8710-03/7340-03/8310-01/8320-01/8210-03/8310-10/4810-08/7770-02/8790-01/8610-04/8930-03/8930-40/6810-20/2112-02/8210-01/8712-03/8610-16

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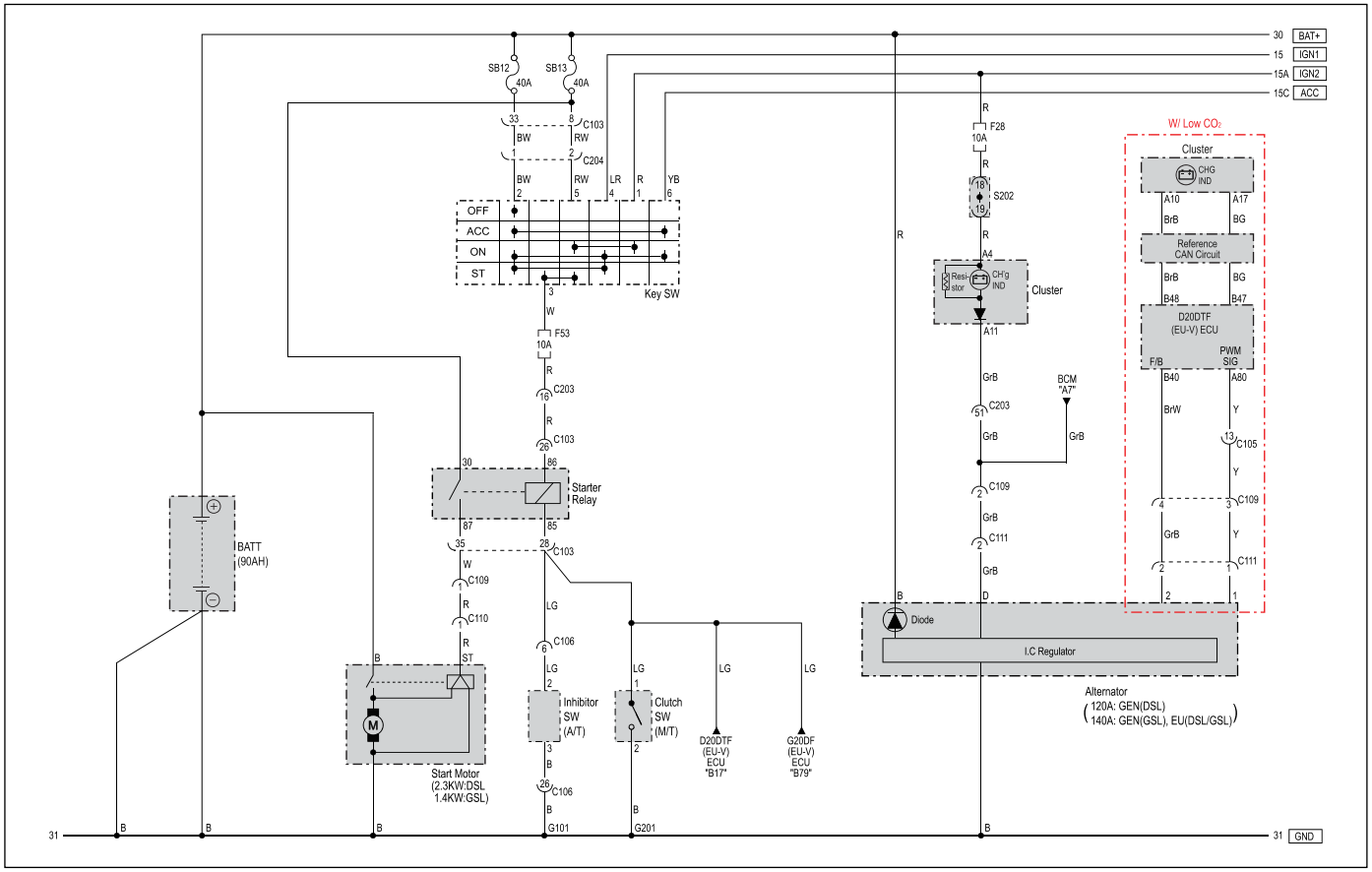
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1461-01 STARTING / CHARGING(W/O SMART KEY)



CIRCUIT

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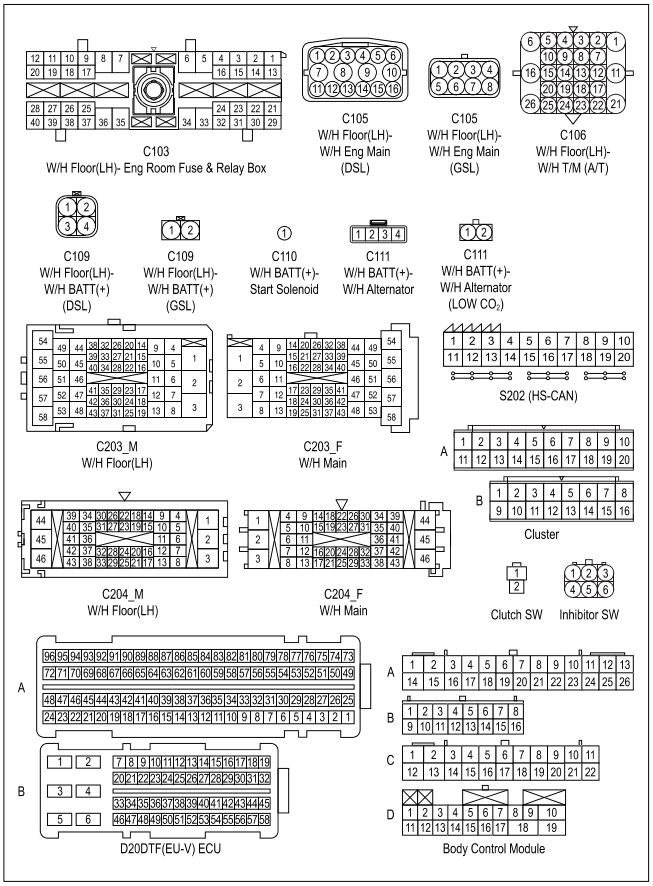
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105	(8Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	GSL
	(16Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	DSL
C106 (26Pin, Black)		W/H Floor(LH) - W/H T/M	Upper T/M(Under BATT Tray)	A/T
C109	(2Pin, Gray)	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	GSL
	(4Pin, Black)	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	DSL
C110 (1Pin, Gray)		W/H BATT(+) - Start Solenoid	Beside Starter Motor	
C111	(4Pin, Black)	W/H BATT(+) - Alternator	Beside Alternator	
	(2Pin, Black)	W/H BATT(+) - Alternator	Beside Alternator	LOW CO_2
C203 (58Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
G101		W/H Floor(LH)	Behind LH Head Lamp	
G201		W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
S202 (20Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN

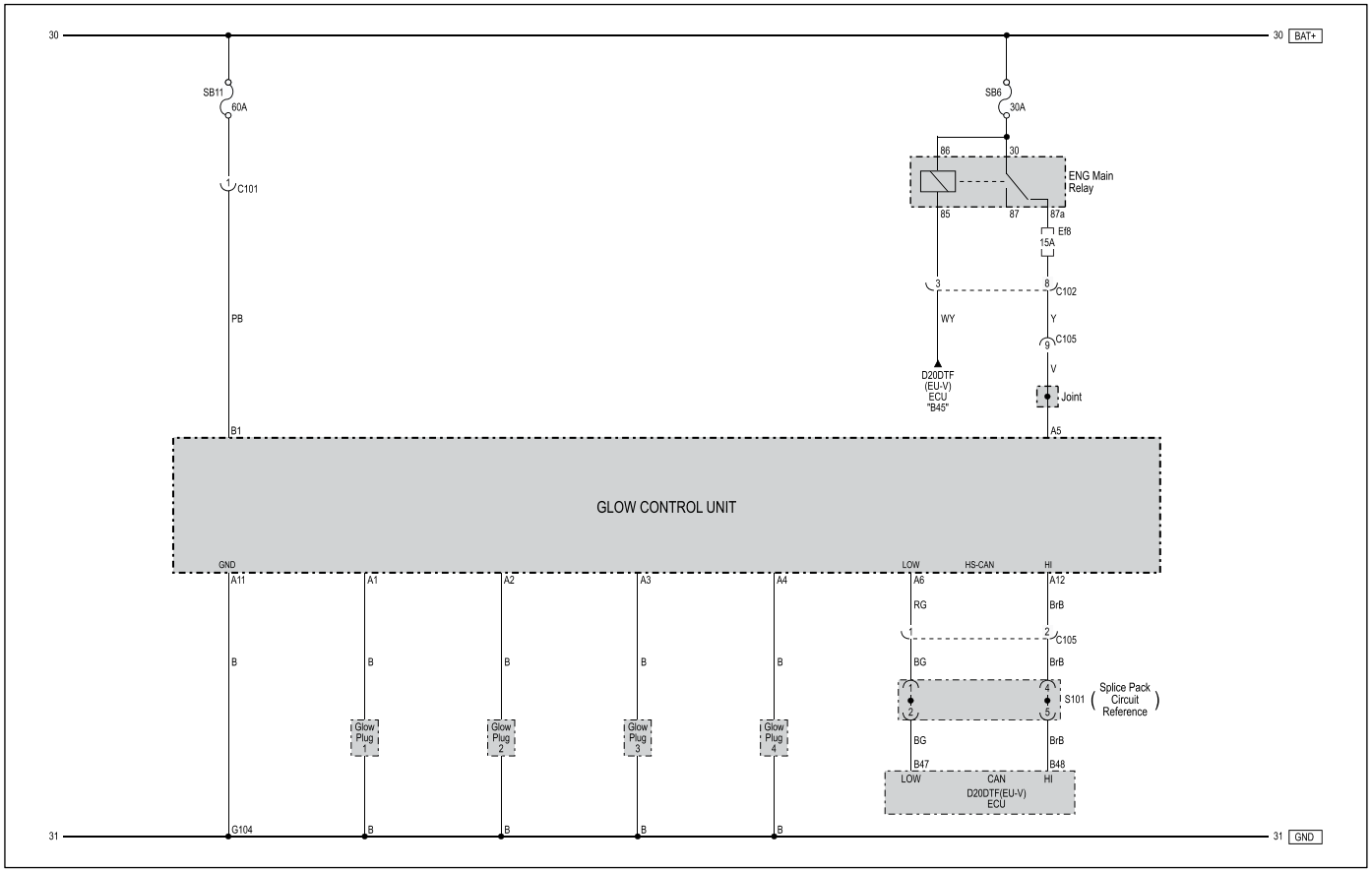
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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2820-01 GLOW CONTROL UNIT



CIRCUIT

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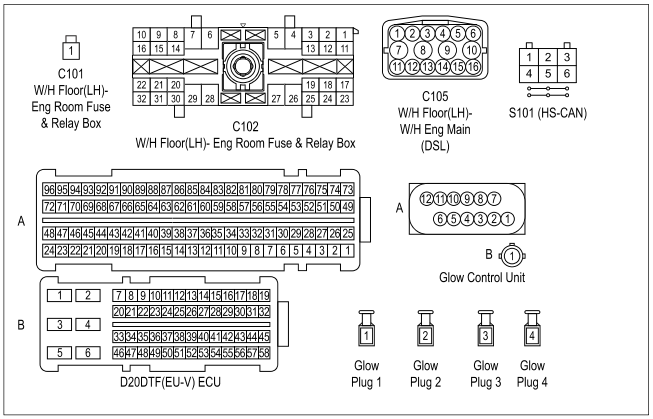
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (1Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (16Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	DSL
G104	W/H Eng Main	FRT Intake Valve	
S101 (6Pin)	W/H Floor(LH)	Under Eng Room Fuse & Relay Box	HS-CAN

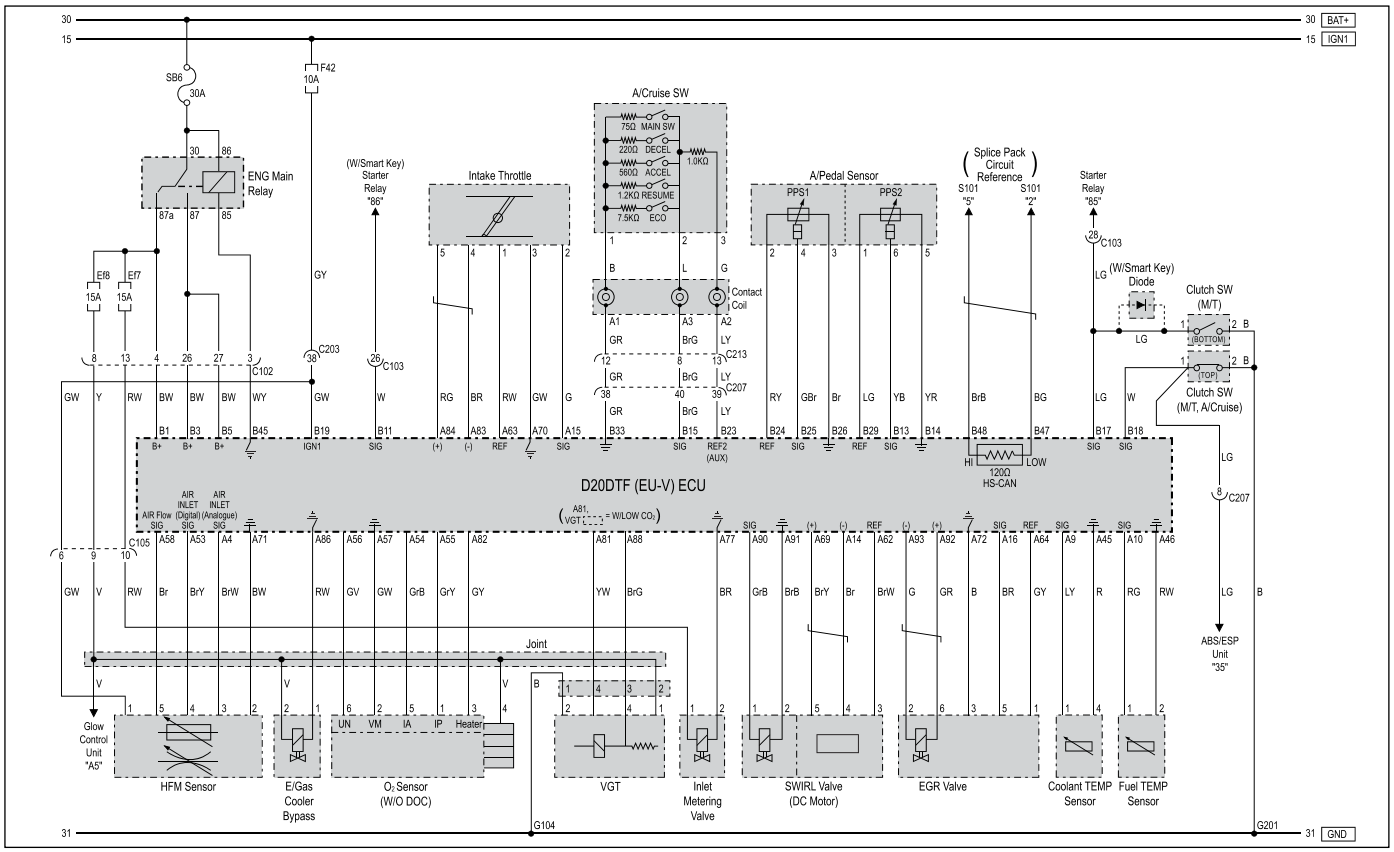
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



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1491-01 ECU(D20DTF EU-V -ENGINE CONTROL UNIT)

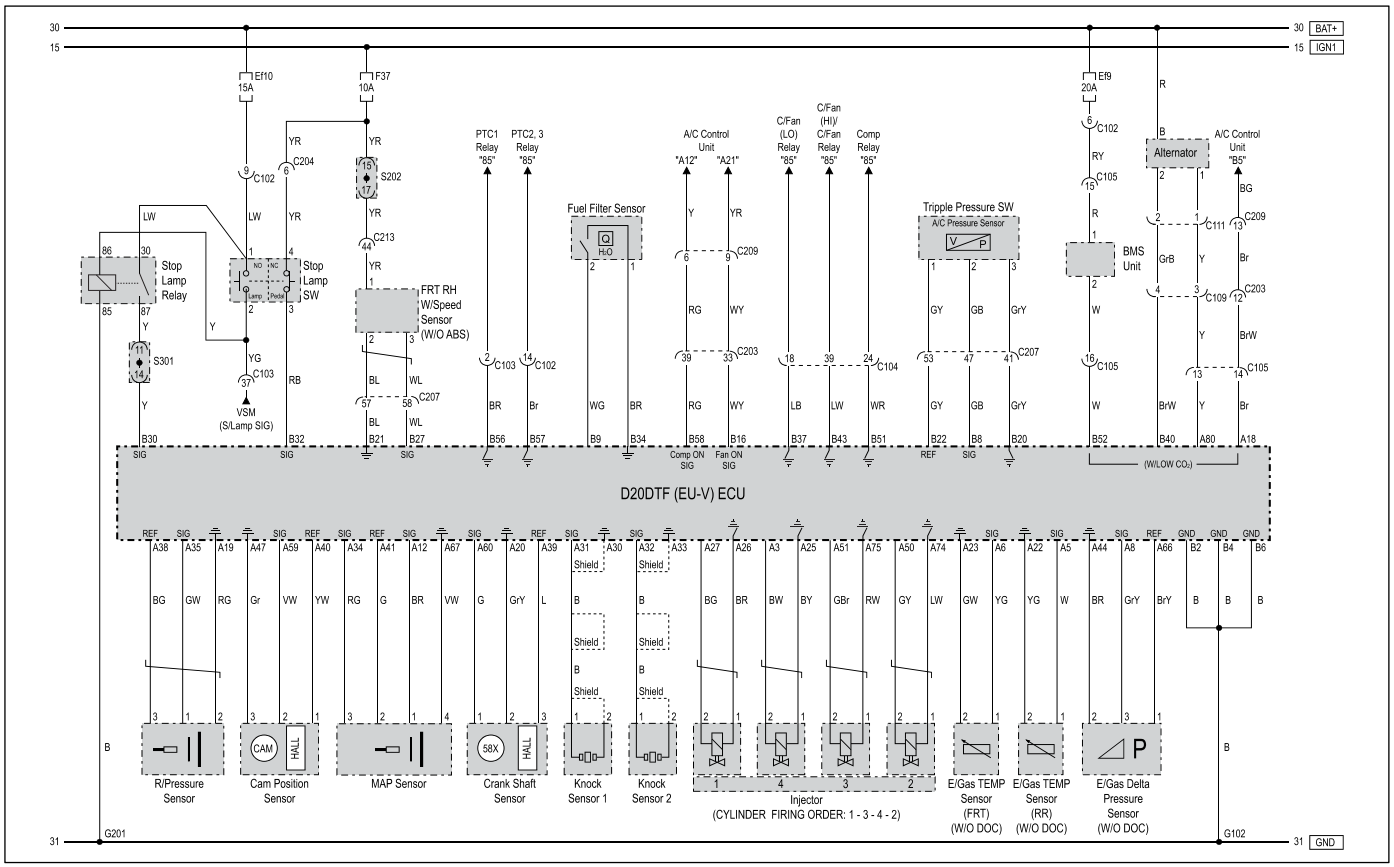
(1) ENG MAIN RELAY, PEDAL MODULE, VALVE(THROTTLE, INLET METERING, EGR), SENSOR(HFM, O2, COOLANT TEMP, FUEL TEMP)



Modification basis	
Application basis	
Affected VIN	

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(2) STOP LAMP, W/SPEED SENSOR, T/PRESSURE SW, INJECTOR, SENSOR(FUEL FILTER, R/PRESSURE, CAM POSITION, MAP, KNOCK, E/GAS TEMP)



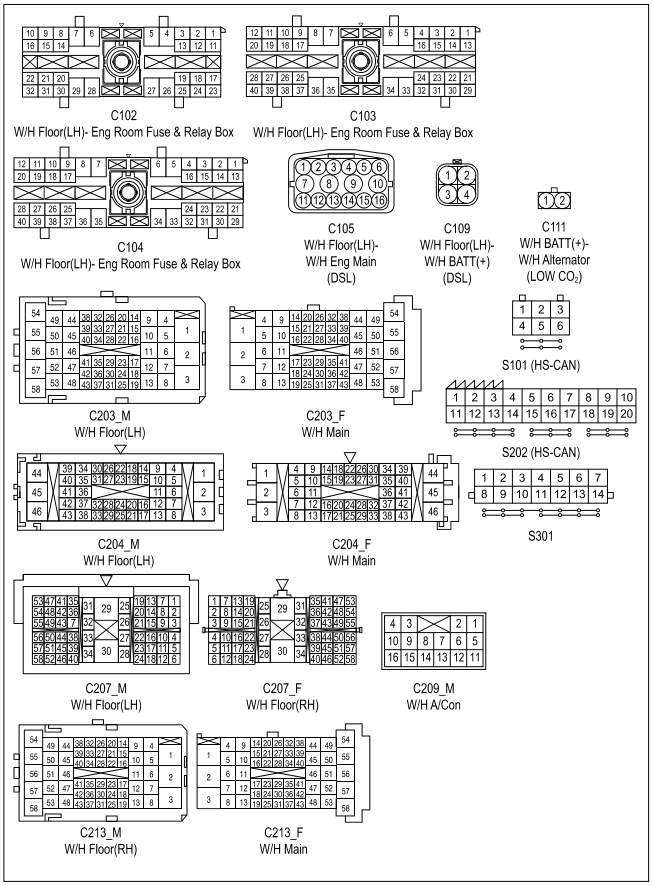
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

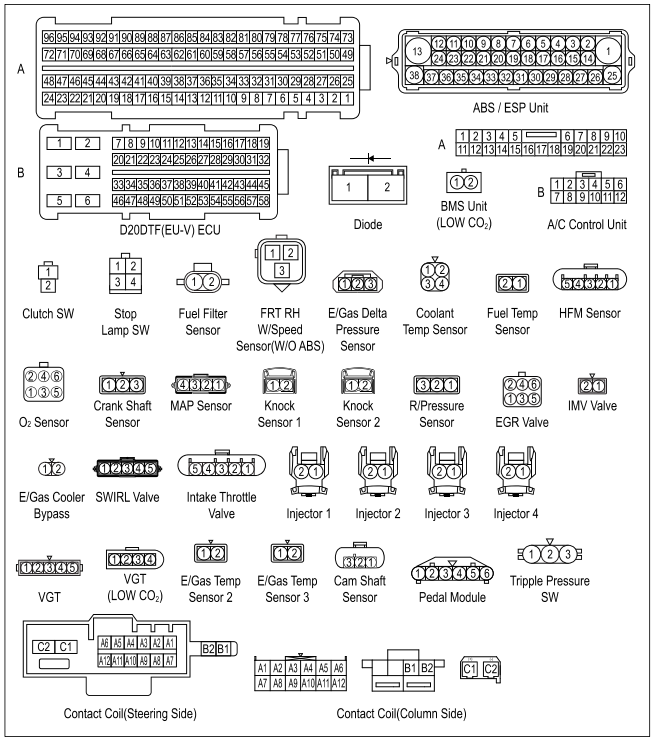
Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (40Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (16Pin, Black)		W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	DSL
C109 (4Pin, Black)		W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	DSL
C111	(4Pin, Black)	W/H BATT(+) - Alternator	Beside Alternator	
	(2Pin, Black)	W/H BATT(+) - Alternator	Beside Alternator	LOW CO_2
C203 (58Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)		W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C209 (16Pin, White)		W/H Main - W/H Air Con	Inside I.P (Upper CTR Cowl Cross Member)	
C213 (58Pin, White)		W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
G102		W/H Floor(LH)	Under BATT Tray	ECU
G104		W/H Eng Main	FRT Intake Valve	
G201		W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
S101 (6Pin)		W/H Floor(LH)	Under Eng Room Fuse & Relay Box	HS-CAN
S202 (20Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S301 (14Pin)		W/H Floor(LH)	Under Driver Seat	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

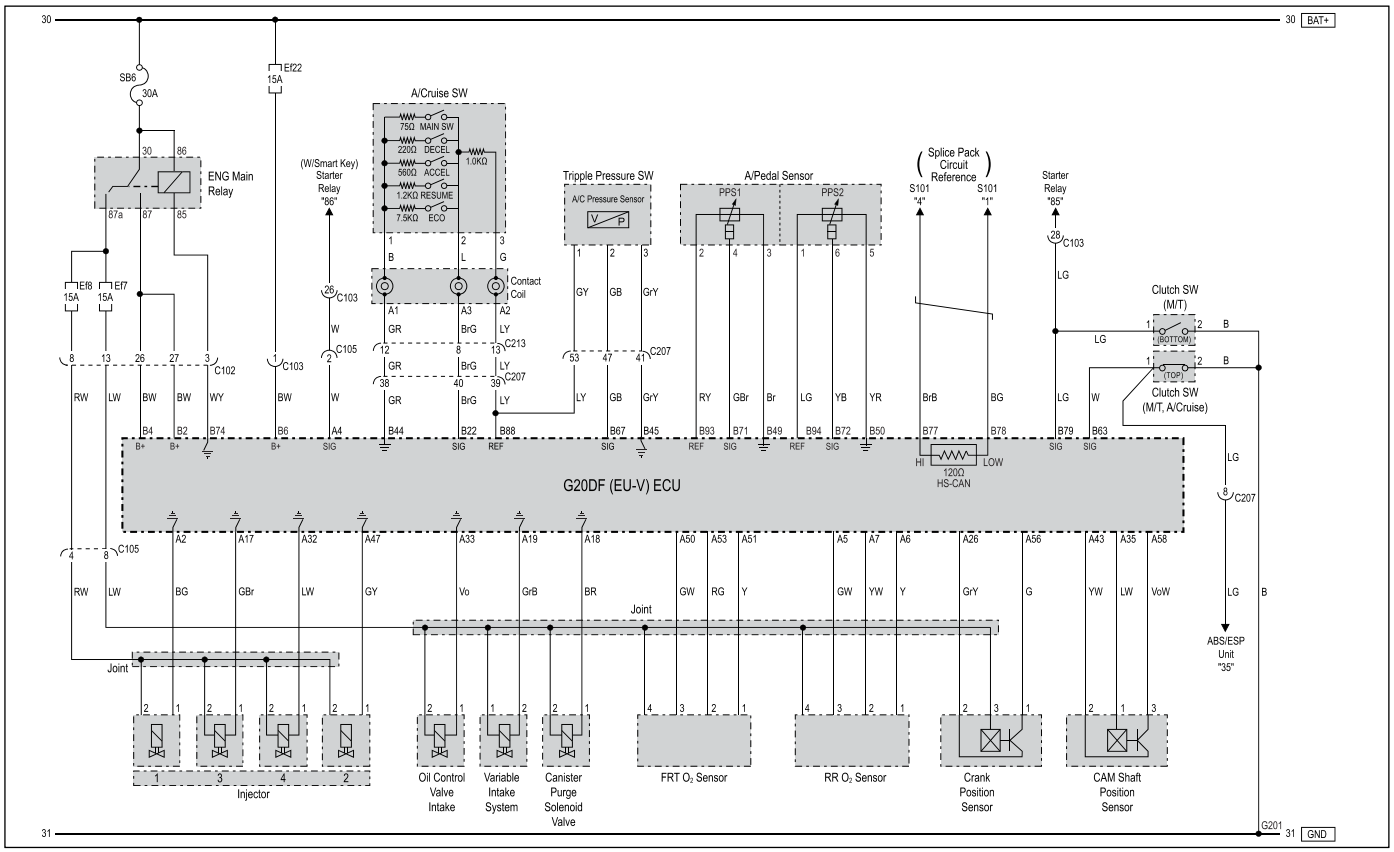
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1491-04 ECU(G20DF EU-V -ENGINE CONTROL UNIT)

(1) ENG MAIN RELAY, PEDAL MODULE, INJECTOR, SENSOR(FRT/RR O2, CRANK POSITION, CAM SHAFT POSITION)



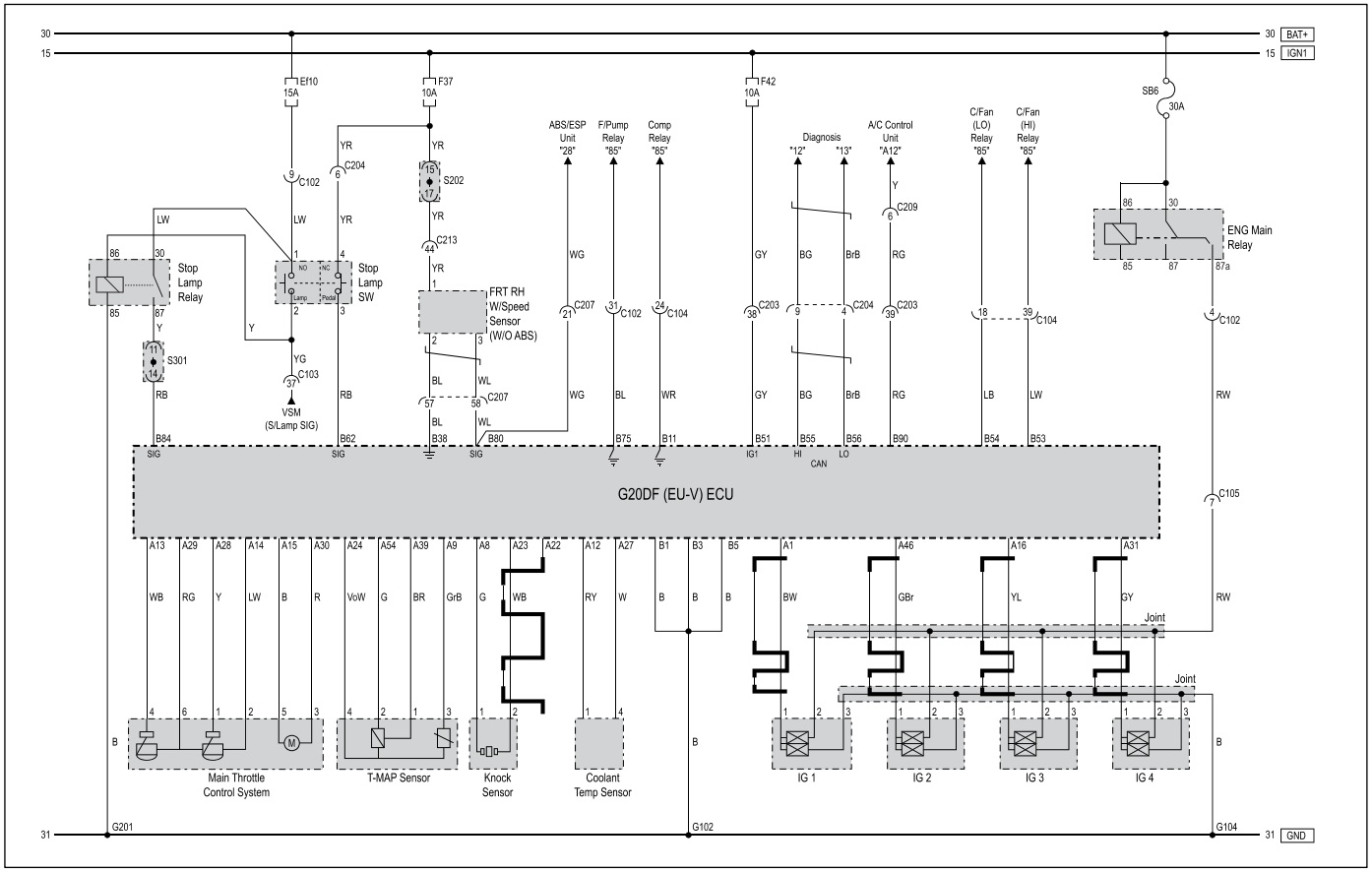
CIRCUIT

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Modification basis	
Application basis	
Affected VIN	

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(2) STOP LAMP, W/SPEED SENSOR, THROTTLE CONTROL, IGN, SENSOR(T-MAP, KNOCK, COOLANT TEMP)



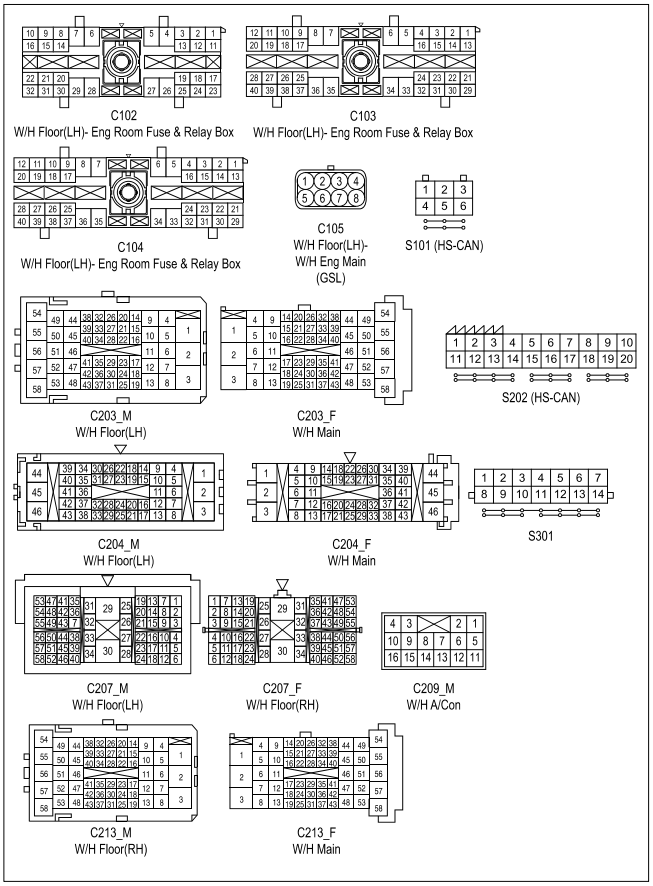
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

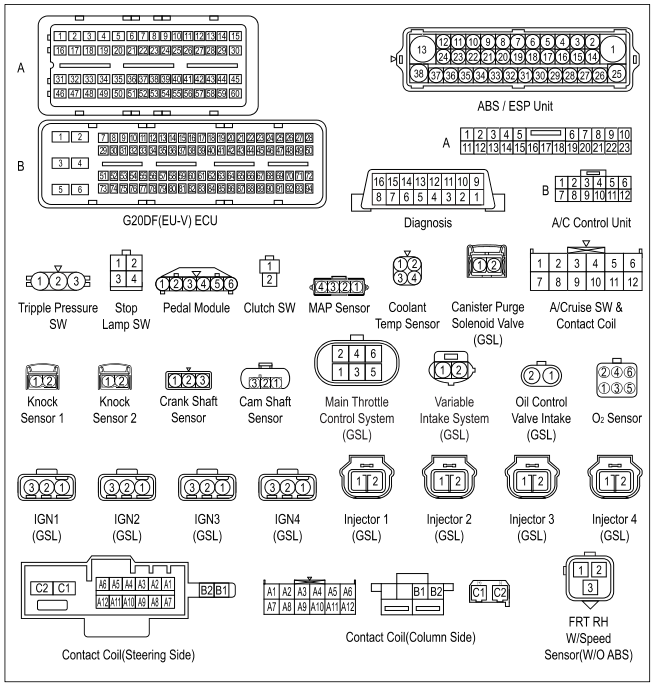
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (40Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (8Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	GSL
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C209 (16Pin, White)	W/H Main - W/H Air Con	Inside I.P (Upper CTR Cowl Cross Member)	
C213 (58Pin, White)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
G102	W/H Floor(LH)	Under BATT Tray	ECU
G104	W/H Eng Main	FRT Intake Valve	
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
S101 (6Pin)	W/H Floor(LH)	Under Eng Room Fuse & Relay Box	HS-CAN
S202 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S301 (14Pin)	W/H Floor(LH)	Under Driver Seat	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

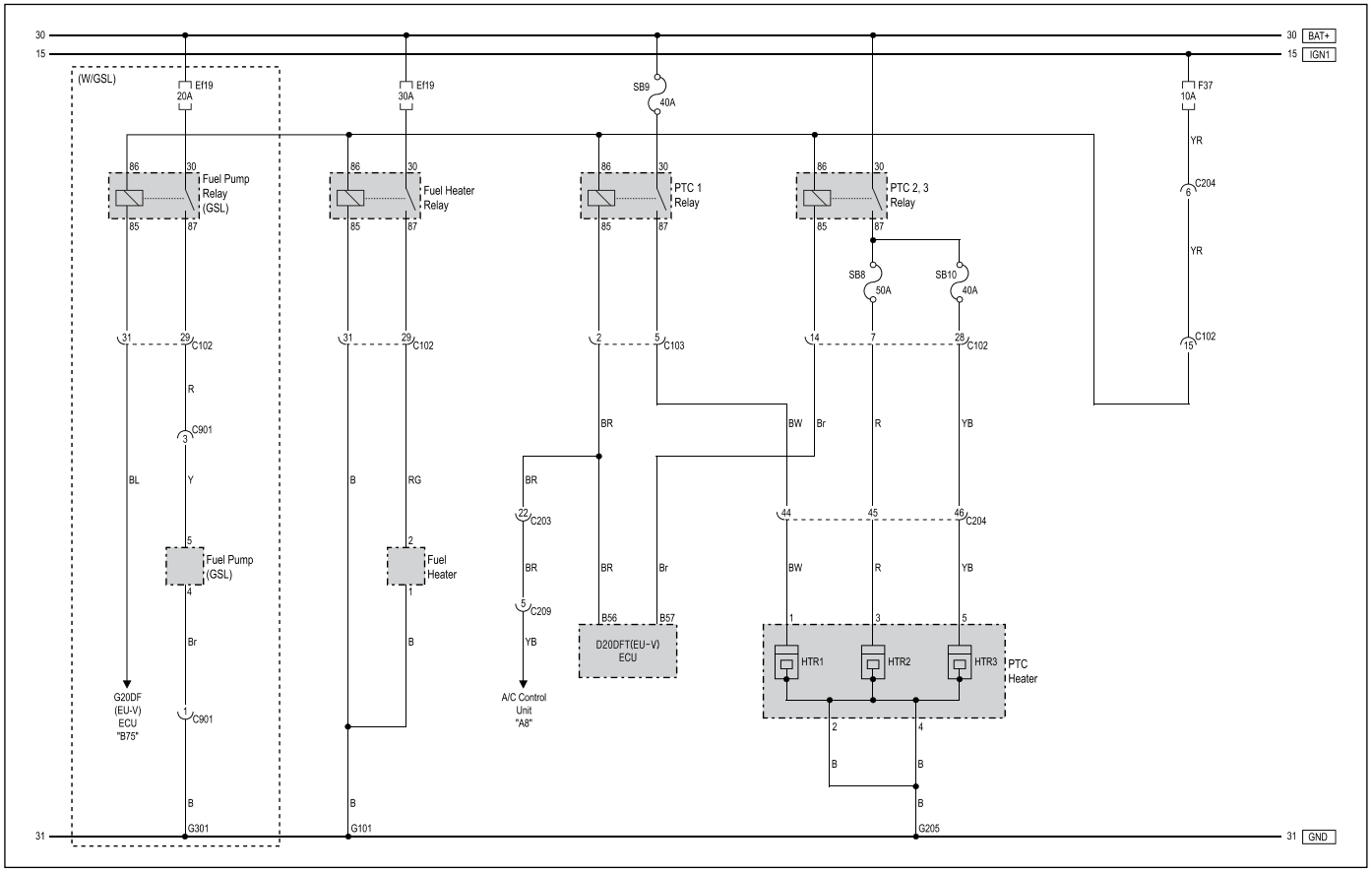
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Modification basis	
Application basis	
Affected VIN	

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6810-15 PTC HEATER, FUEL PUMP(GSL)



CIRCUIT

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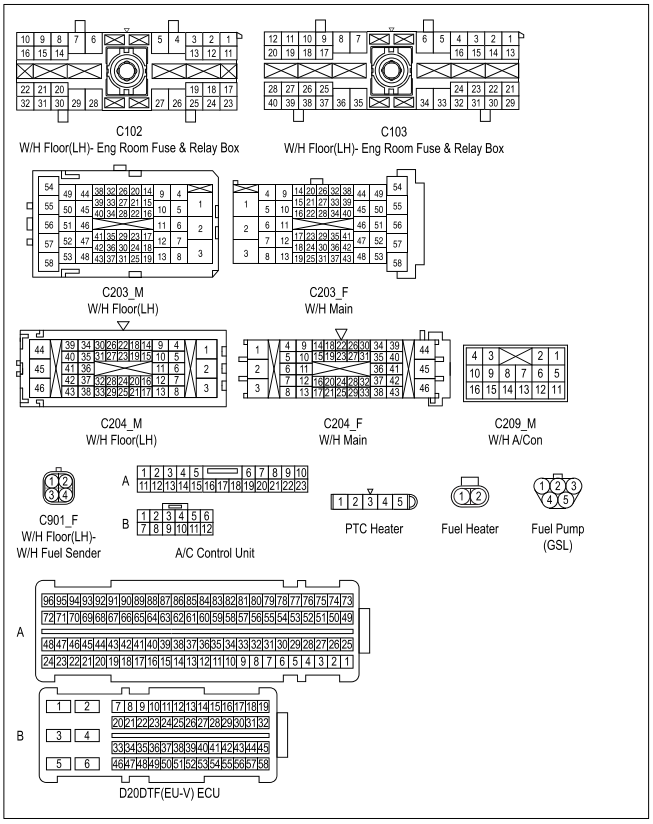
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

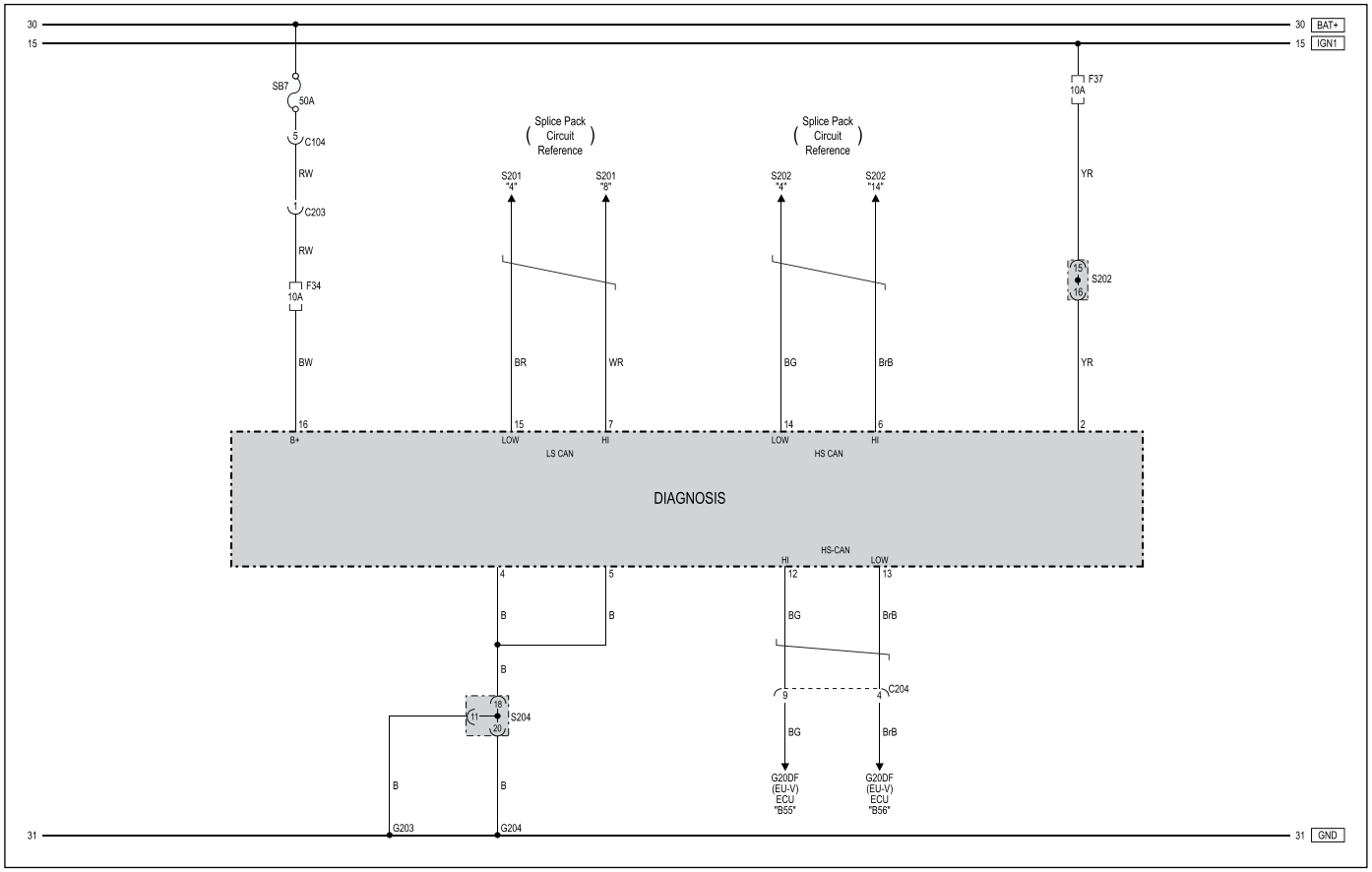
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C209 (16Pin, White)	W/H Main - W/H Air Con	Inside I.P (Upper CTR Cowl Cross Member)	
C901 (4Pin, Black)	W/H Floor(LH) - W/H Fuel Sender	FRT Fuel Tank	
G101	W/H Floor(LH)	Behind LH Head Lamp	
G205	W/H Main	Left Side I.P(Beside CTR Support BRKT)	ECU
G301	W/H Floor(LH)	Under Driver Seat	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



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8210-01 DIAGNOSIS CONNECTOR



CIRCUIT

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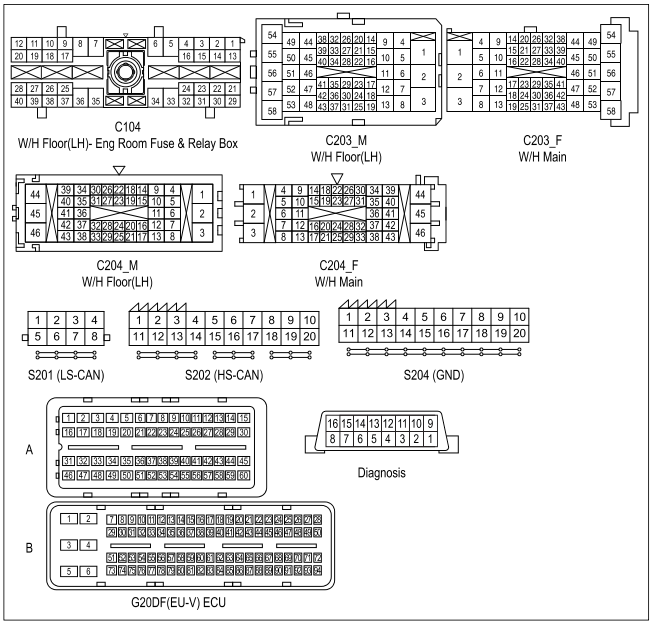
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (40Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
S201 (8Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	LS-CAN
S202 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

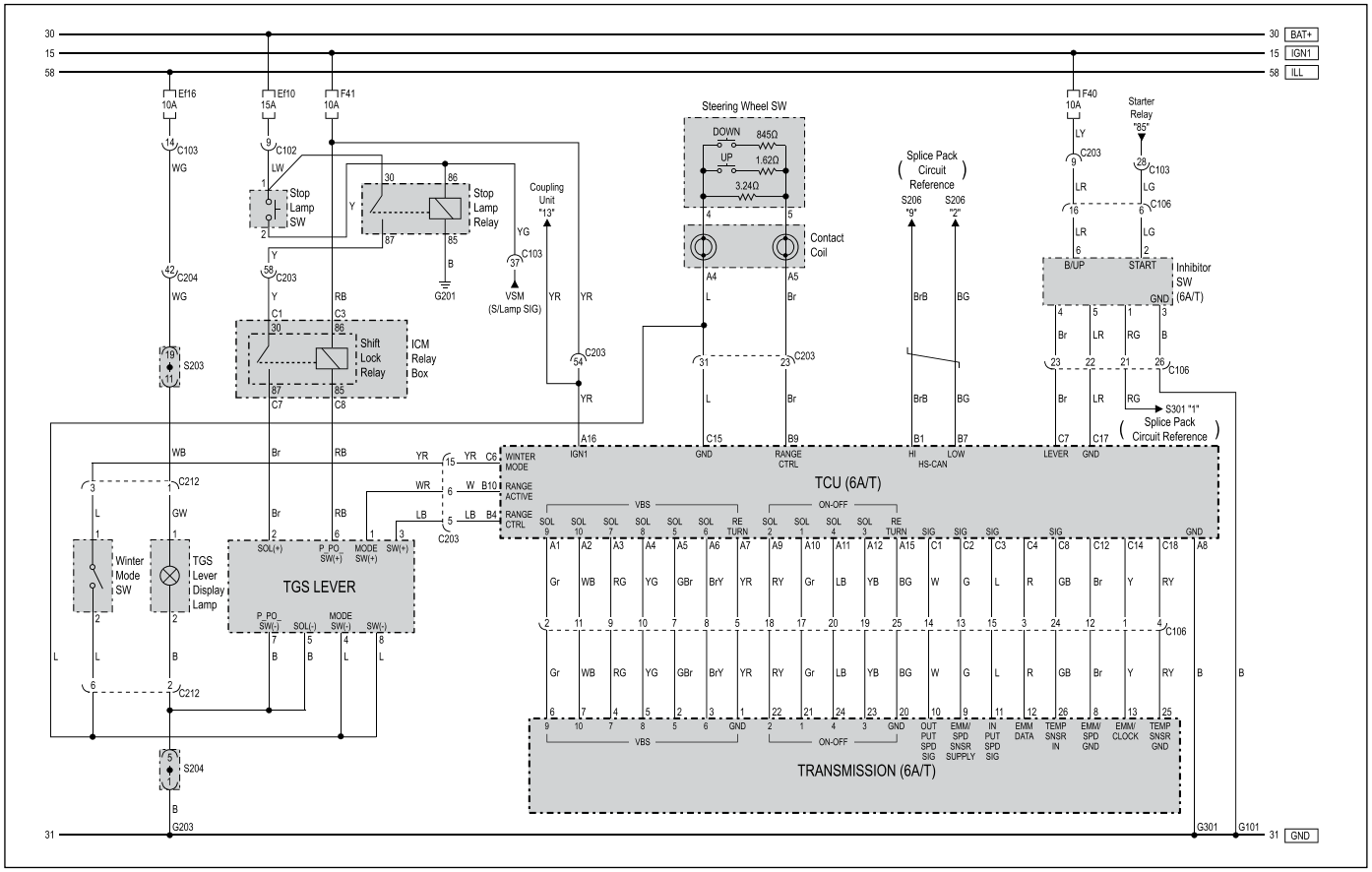
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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3110-01 DSI TCU(6A/T)



CIRCUIT

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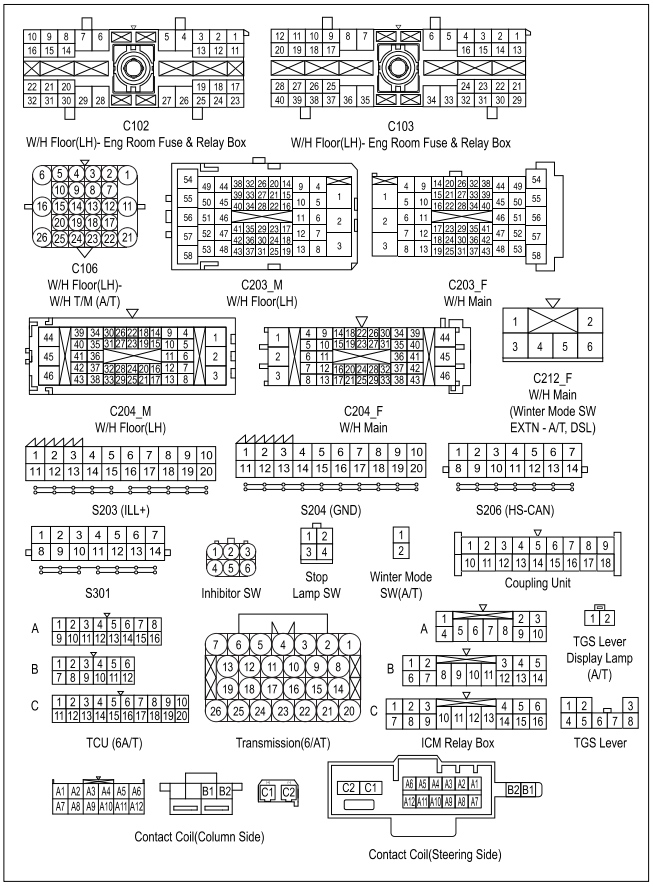
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

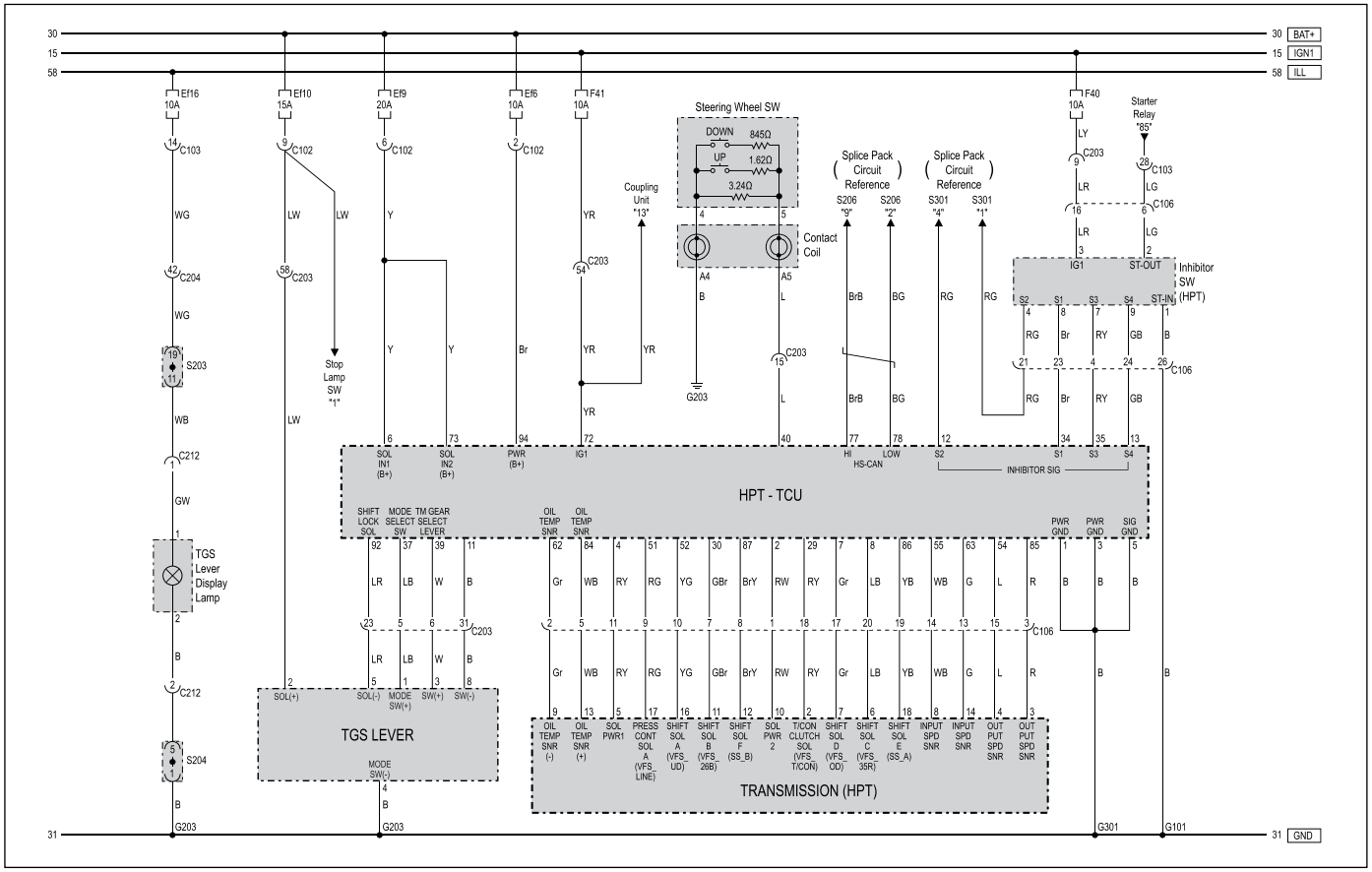
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (26Pin, Black)	W/H Floor(LH) - W/H T/M	Upper T/M(Under BATT Tray)	A/T
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C212 (6Pin, White)	W/H Main - W/H Winter Mode switch EXTN	Inside Console	M/T
G101	W/H Floor(LH)	Behind LH Head Lamp	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G301	W/H Floor(LH)	Under Driver Seat	
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	HS-CAN
S206 (14Pin)	W/H Floor(LH)	Under Driver Seat	HS-CAN
S301 (14Pin)	W/H Floor(LH)	Under Driver Seat	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



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3110-01 HPT TCU(6A/T)



CIRCUIT

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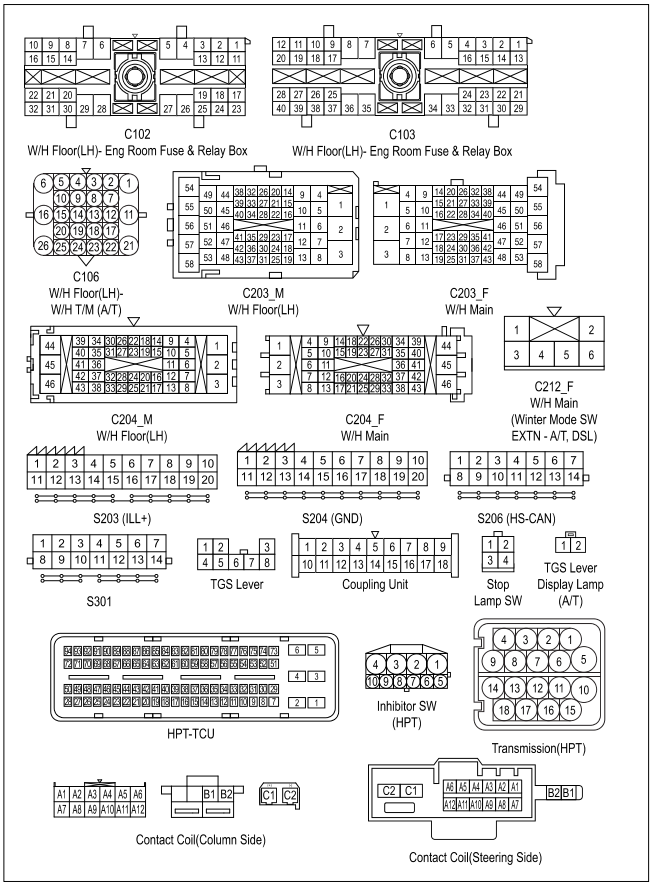
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

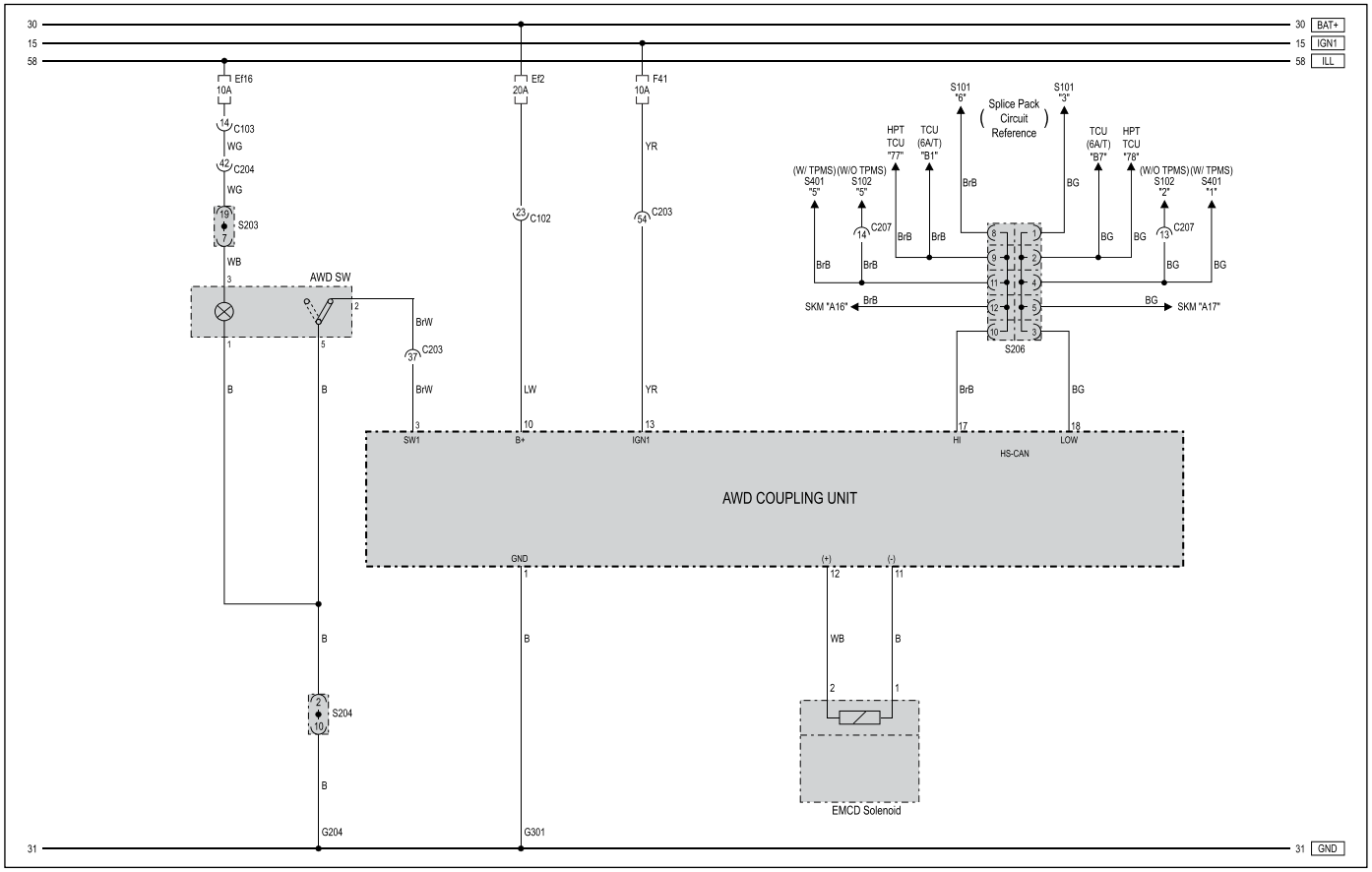
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (26Pin, Black)	W/H Floor(LH) - W/H T/M	Upper T/M(Under BATT Tray)	A/T
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C212 (6Pin, White)	W/H Main - W/H Winter Mode switch EXTN	Inside Console	M/T
G101	W/H Floor(LH)	Behind LH Head Lamp	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G301	W/H Floor(LH)	Under Driver Seat	
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	HS-CAN
S206 (14Pin)	W/H Floor(LH)	Under Driver Seat	HS-CAN
S301 (14Pin)	W/H Floor(LH)	Under Driver Seat	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



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3110-17 AWD COUPLING UNIT



CIRCUIT

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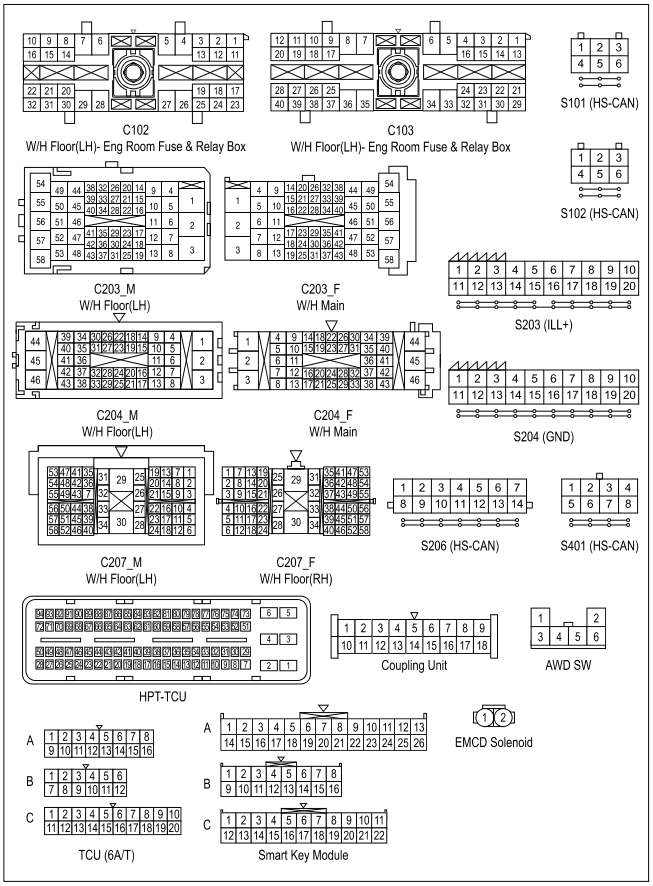
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
G204	W/H Main	Inside I.P(RH Glove Box)	
G301	W/H Floor(LH)	Under Driver Seat	
S101 (6Pin)	W/H Floor(LH)	Under Eng Room Fuse & Relay Box	HS-CAN
S102 (6Pin)	W/H Floor(RH)	Inside RH Fender	HS-CAN
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND
S206 (14Pin)	W/H Floor(LH)	Under Driver Seat	HS-CAN
S401 (8Pin)	W/H Floor(LH)	Beside PAS Unit(Inside LH QTR Trim)	HS-CAN

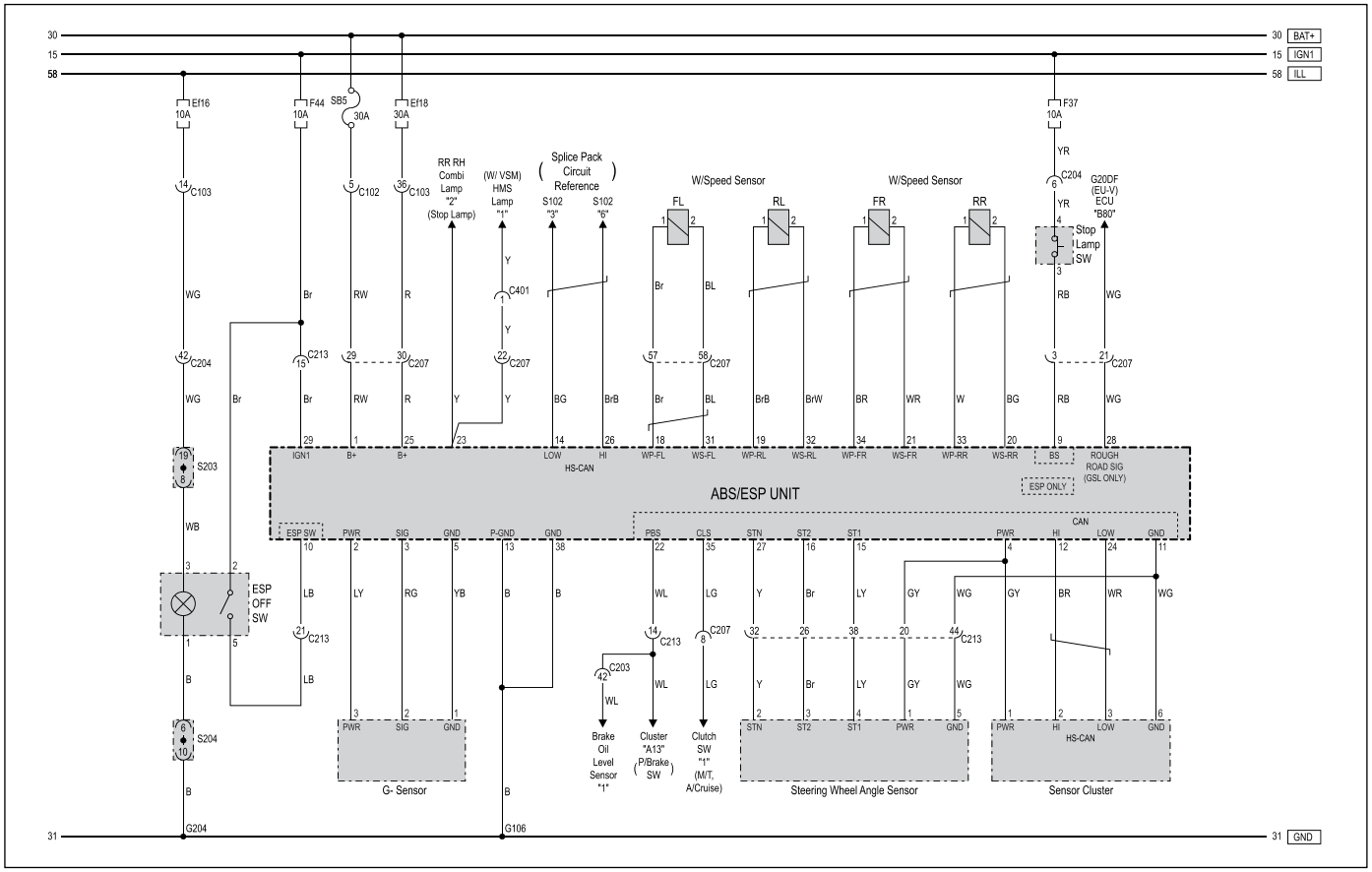
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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4892-01 ABS/ESP



CIRCUIT

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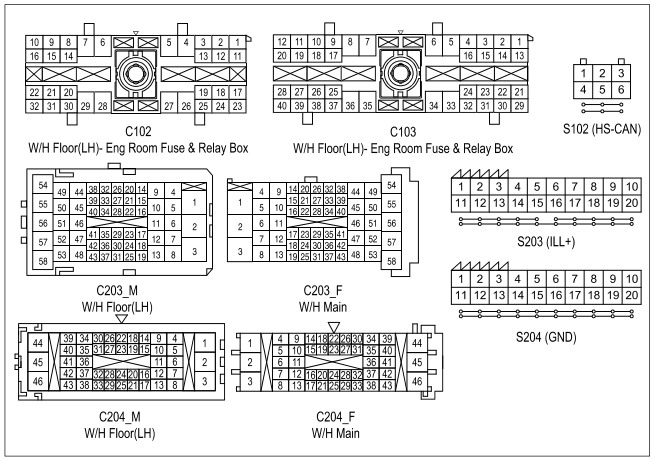
Modification basis	
Application basis	
Affected VIN	

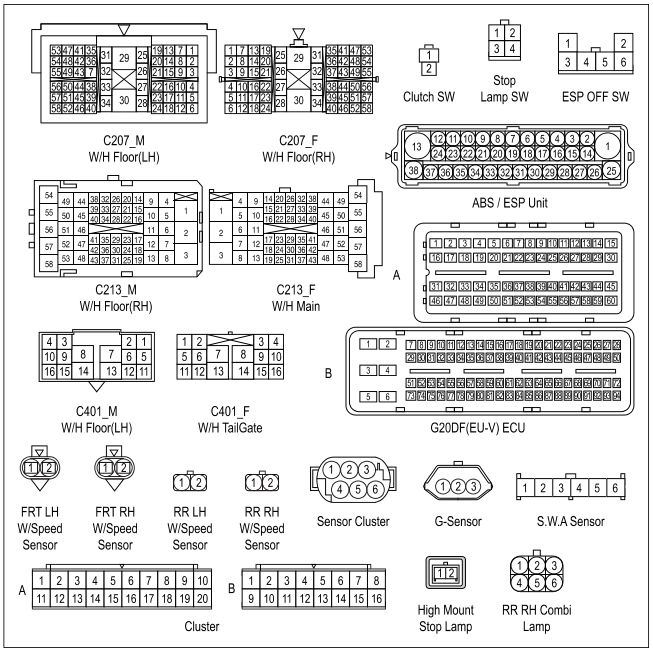
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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C213 (58Pin, White)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C401 (16Pin, White)	W/H Floor(LH) - W/H Tail Gate	Upper Tail Gate LH	
G106	W/H Floor(RH)	Beside ABS/ESP Unit	ABS/ESP
G204	W/H Main	Inside I.P(RH Glove Box)	
S102 (6Pin)	W/H Floor(RH)	Inside RH Fender	HS-CAN
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

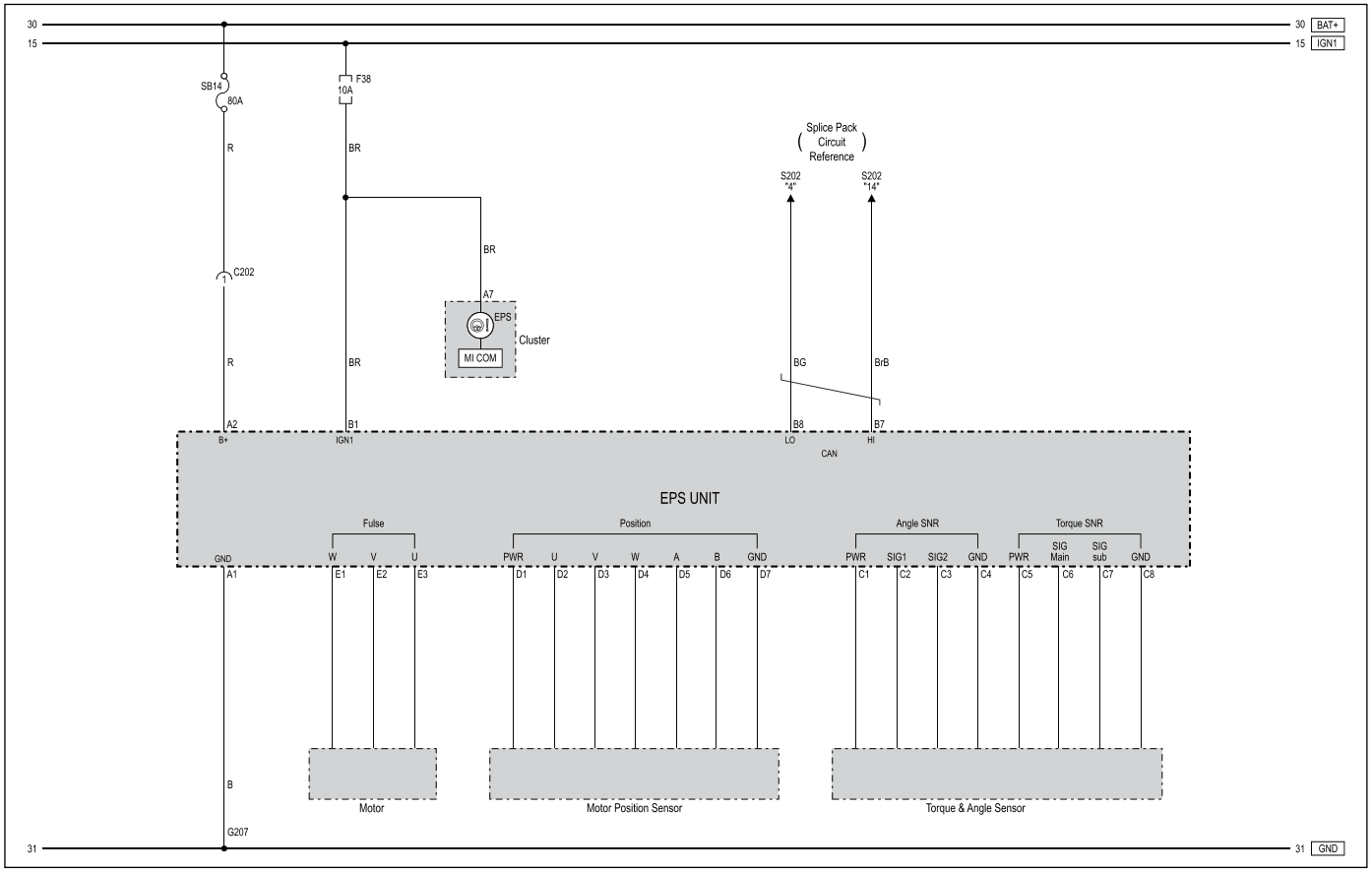
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION





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4610-04 EPS



CIRCUIT

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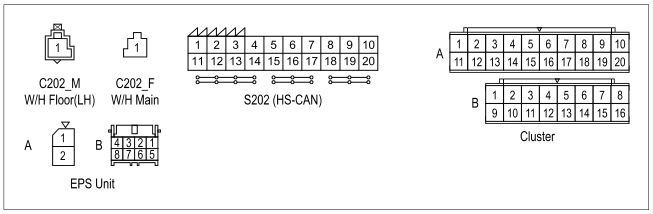
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

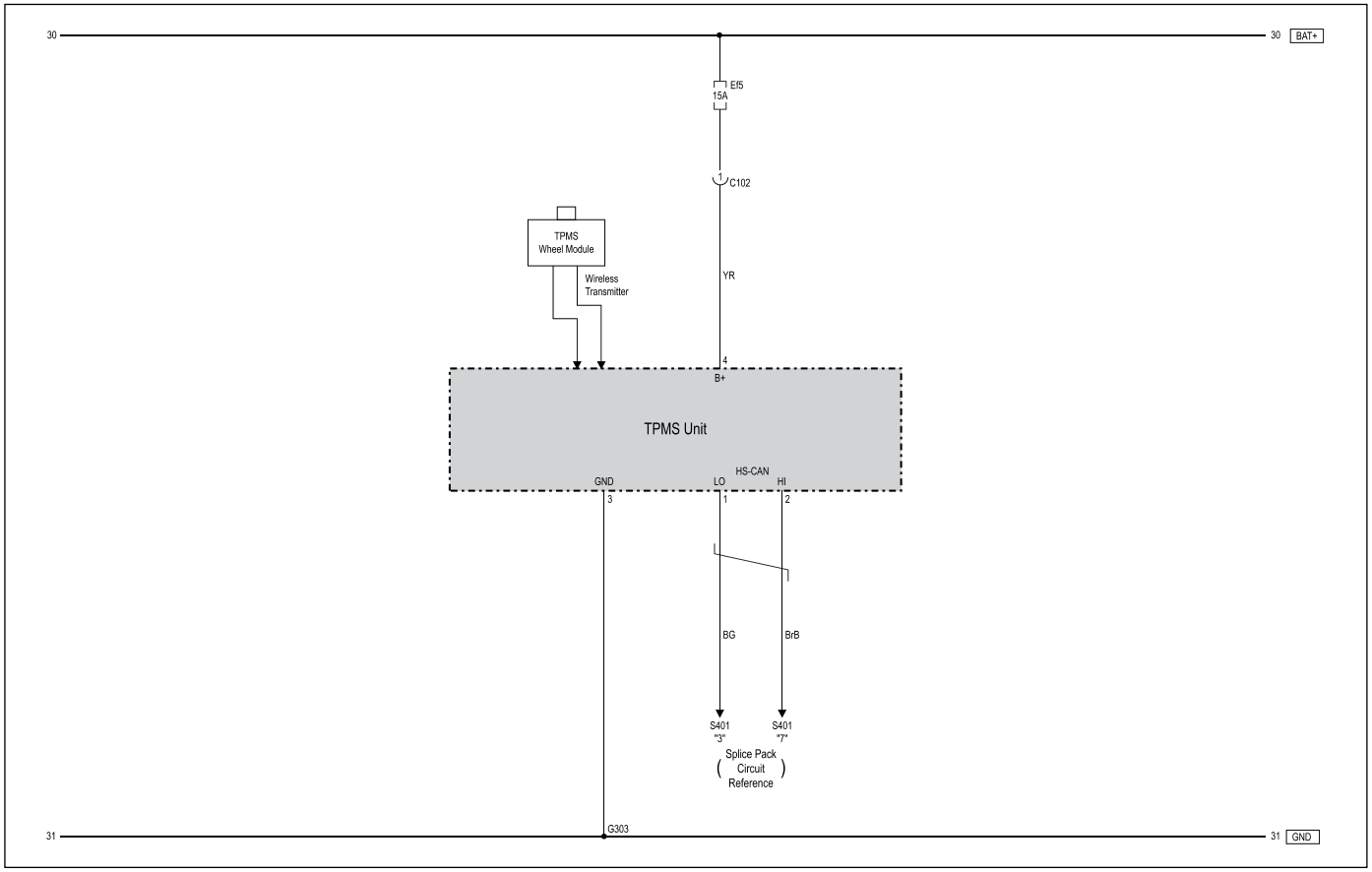
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C202 (1Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	EPS
G207	W/H Main	Right Under TGS Lever	EPS
S202 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



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4190-01 TPMS



CIRCUIT

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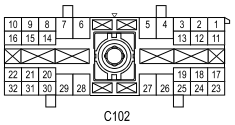
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
G303	W/H Floor(LH)	Driver QTR PNL	
S401 (8Pin)	W/H Floor(LH)	Beside PAS Unit(Inside LH QTR Trim)	HS-CAN

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



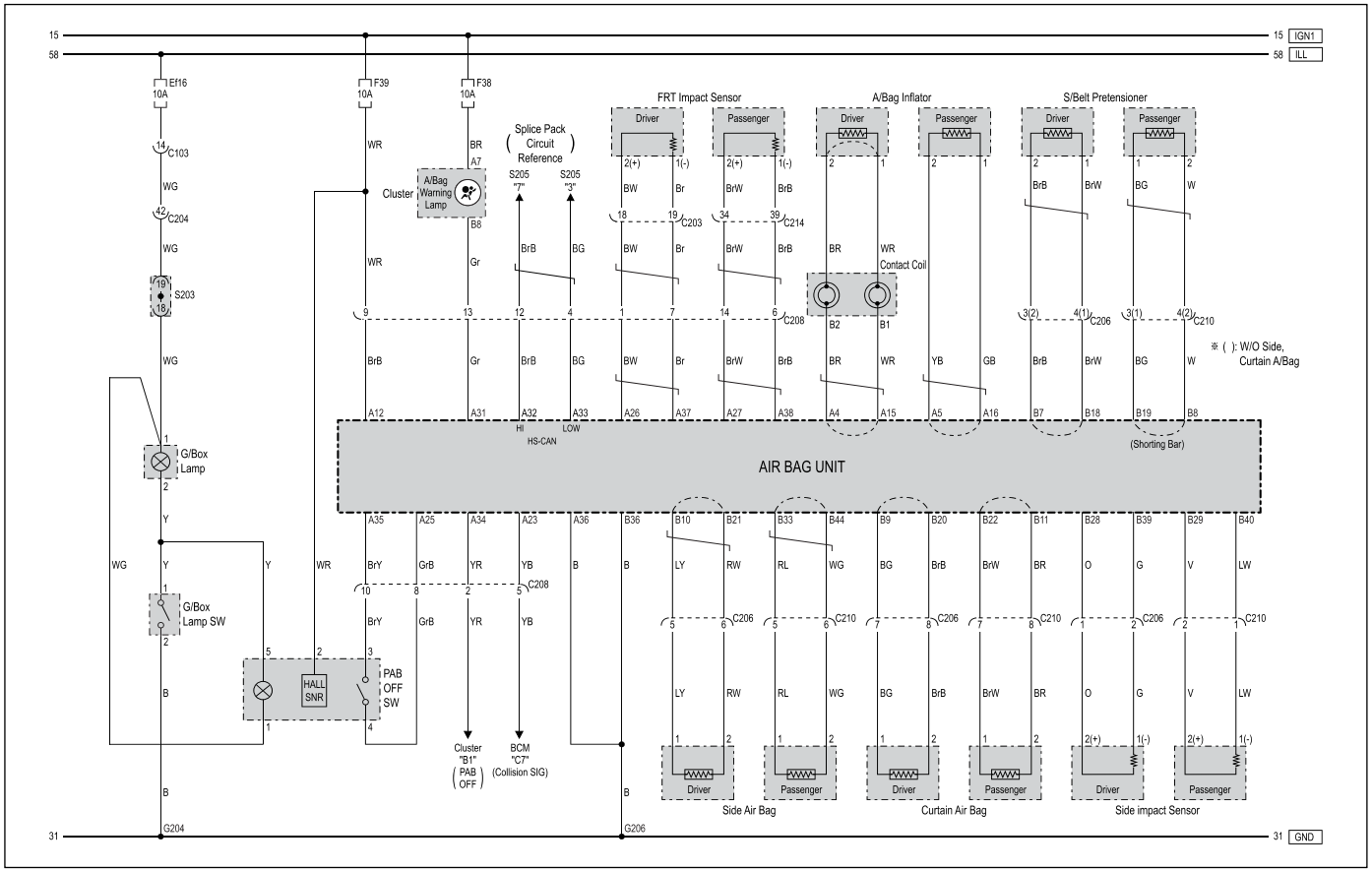
C102
W/H Floor(LH)- Eng Room Fuse & Relay Box

S401 (HS-CAN)

TPMS Unit

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8810-01 AIR BAG (DUAL/SIDE/CURTAIN) SYSTEM



CIRCUIT

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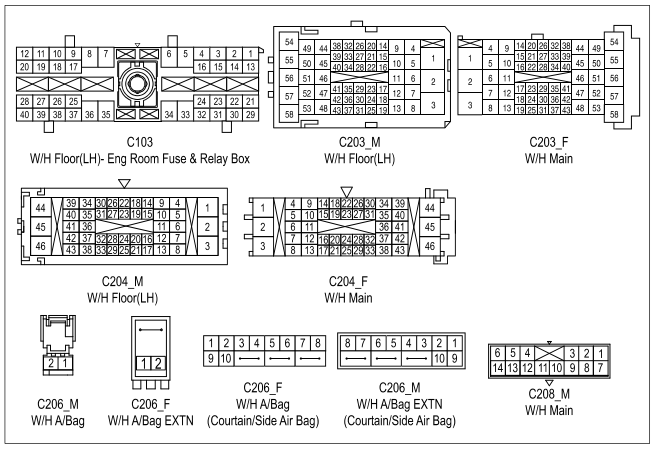
Modification basis	
Application basis	
Affected VIN	

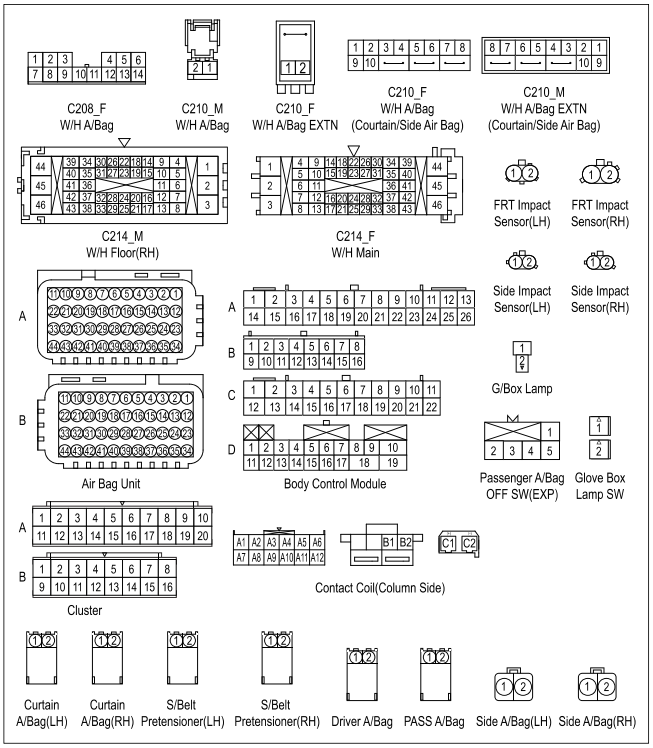
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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (58Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C206	(10Pin, Brown)	W/H Air Bag - W/H Air Bag EXTN	Driver Cowl Side Connector Holder	Curtain/Side A/Bag
	(2Pin, Brown)	W/H Air Bag - W/H Air Bag EXTN	Driver Cowl Side Connector Holder	
C208 (14Pin, White)		W/H Main - W/H Air Bag	Inside I.P (Upper Driver LegRoom)	
C210	(10Pin, Brown)	W/H Air Bag - W/H Air Bag EXTN	Passenger Cowl Side Connector Holder	Curtain/Side A/Bag
	(2Pin, Brown)	W/H Air Bag - W/H Air Bag EXTN	Passenger Cowl Side Connector Holder	
C214 (46Pin, Black)		W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
G204		W/H Main	Inside I.P(RH Glove Box)	
G206		W/H Main	Left Under TGS Lever	AIR BAG
S203 (20Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S205 (8Pin)		W/H Main	Backside Audio(CTR Cowl Cross Member)	HS-CAN

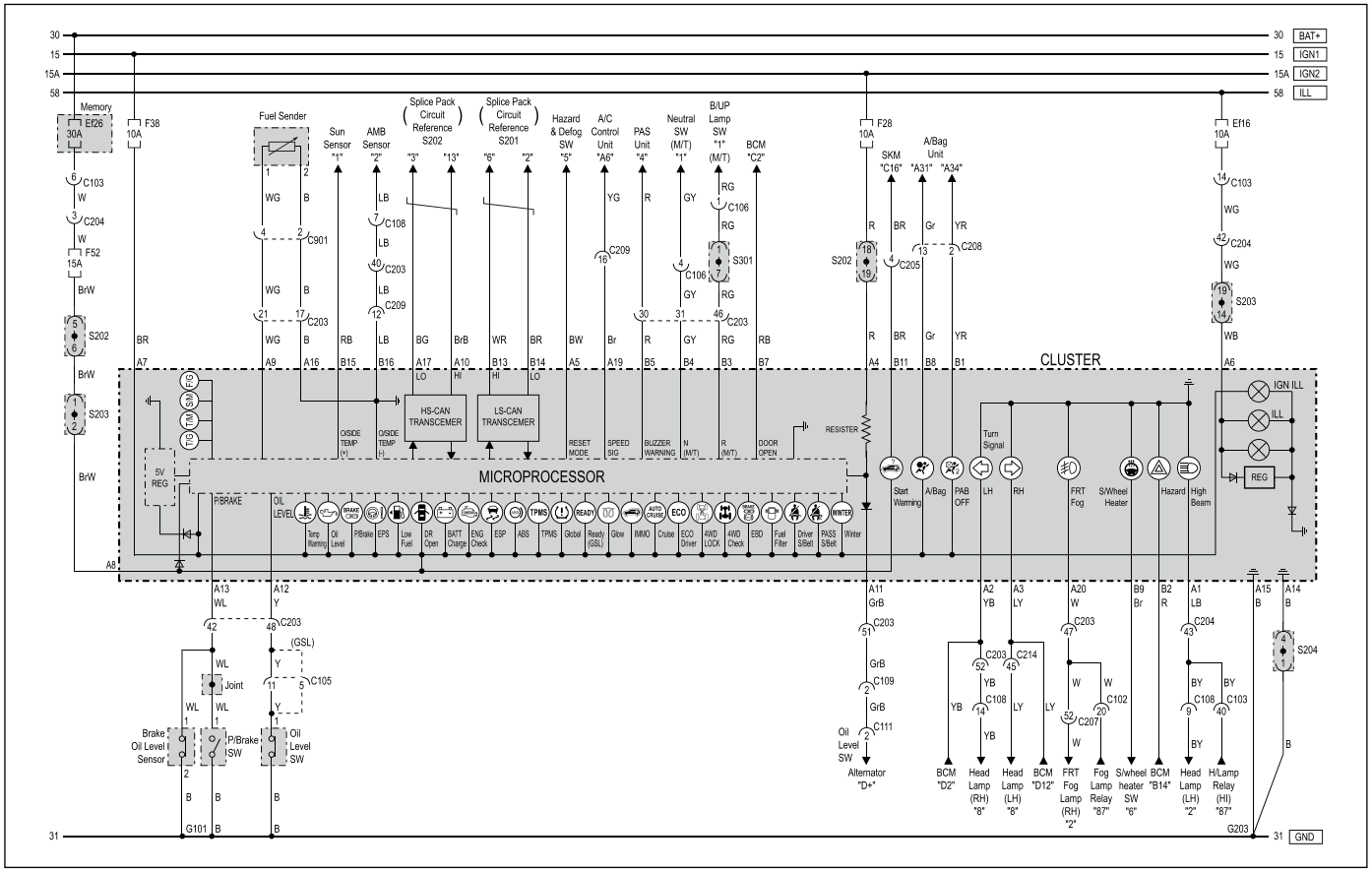
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION





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8010-01 CLUSTER



CIRCUIT

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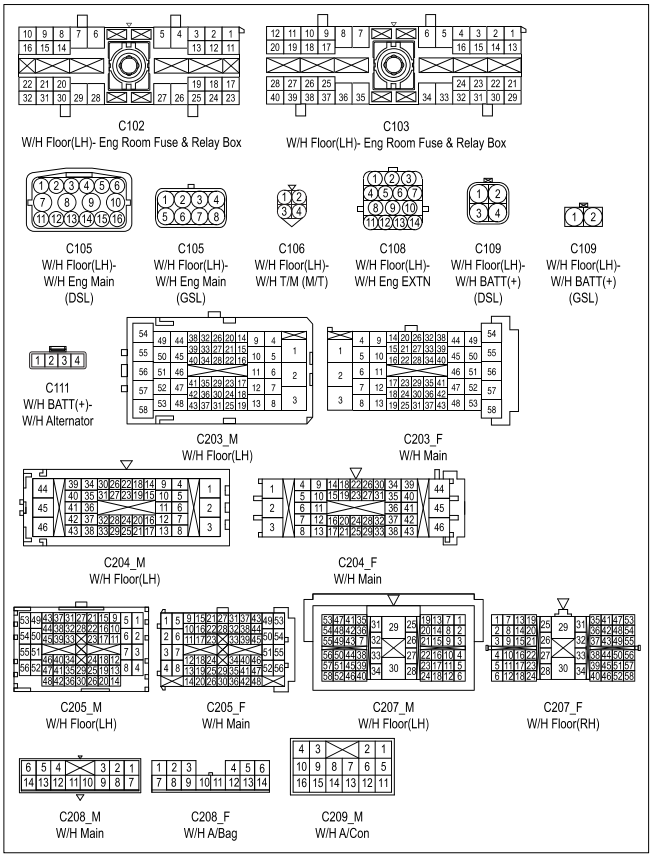
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

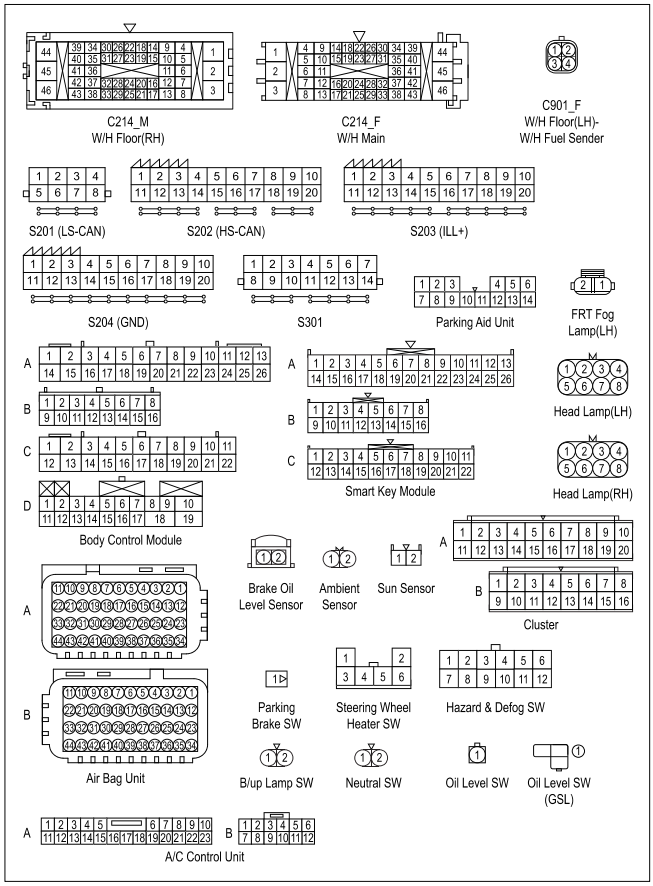
Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105	(8Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	GSL
	(16Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	DSL
C106 (4Pin, Black)		W/H Floor(LH) - W/H T/M	Upper T/M(Under BATT Tray)	M/T
C108 (14Pin, Black)		W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C109	(2Pin, Gray)	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	GSL
	(4Pin, Black)	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	DSL
C111 (4Pin, Black)		W/H BATT(+) - Alternator	Beside Alternator	
C203 (58Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C205 (56Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)		W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C208 (14Pin, White)		W/H Main - W/H Air Bag	Inside I.P (Upper Driver LegRoom)	
C209 (16Pin, White)		W/H Main - W/H Air Con	Inside I.P (Upper CTR Cowl Cross Member)	
C214 (46Pin, Black)		W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C901 (4Pin, Black)		W/H Floor(LH) - W/H Fuel Sender	FRT Fuel Tank	
G101		W/H Floor(LH)	Behind LH Head Lamp	
G203		W/H Main	Backside Audio(CTR Cowl Cross Member)	
S201 (8Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	LS-CAN
S202 (20Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S203 (20Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204 (20Pin)		W/H Main	Backside Cluster(Upper ICM Relay Box)	GND
S301 (14Pin)		W/H Floor(LH)	Under Driver Seat	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

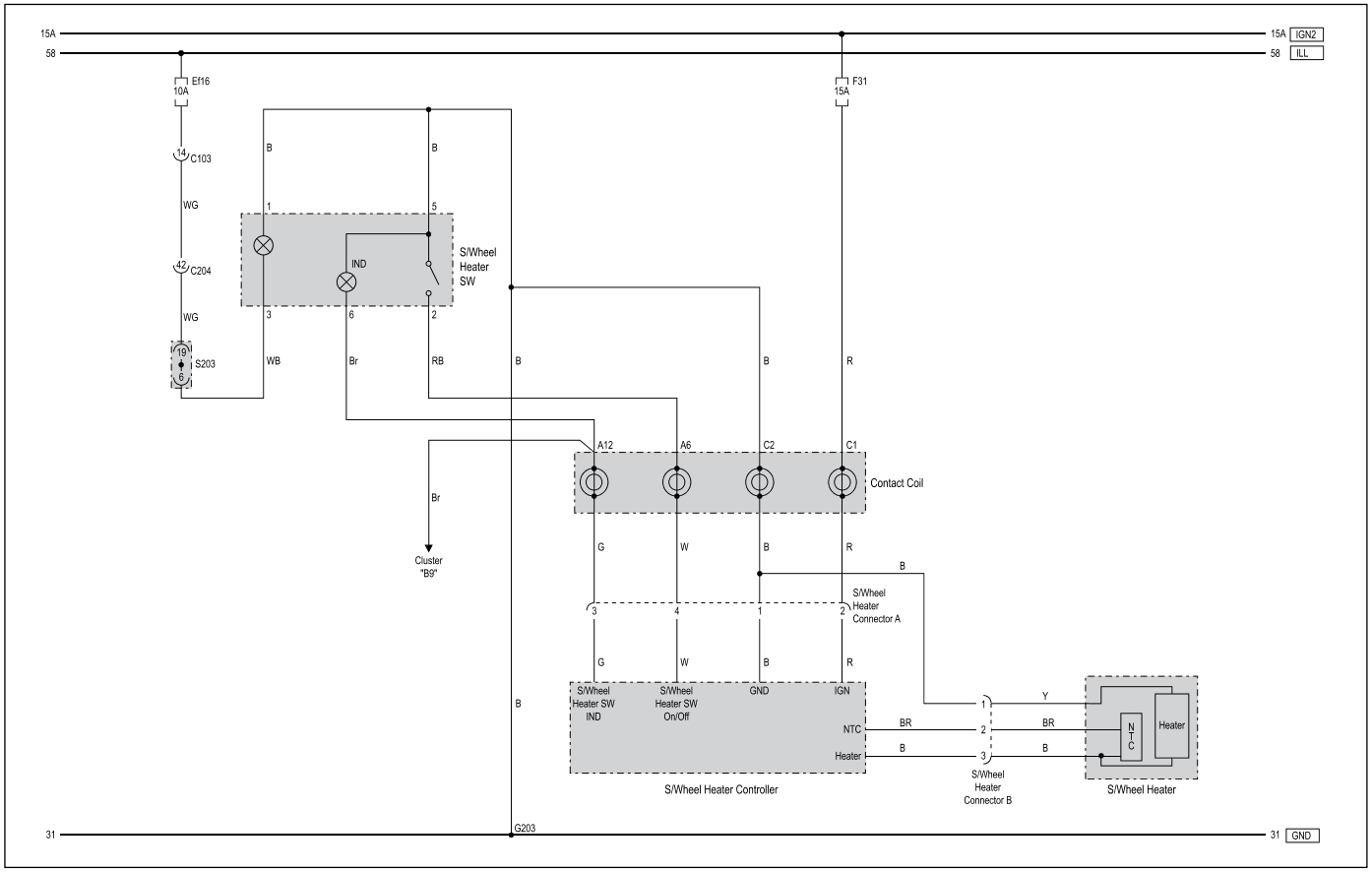
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Modification basis	
Application basis	
Affected VIN	

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8510-30 STEERING WHEEL HEATING



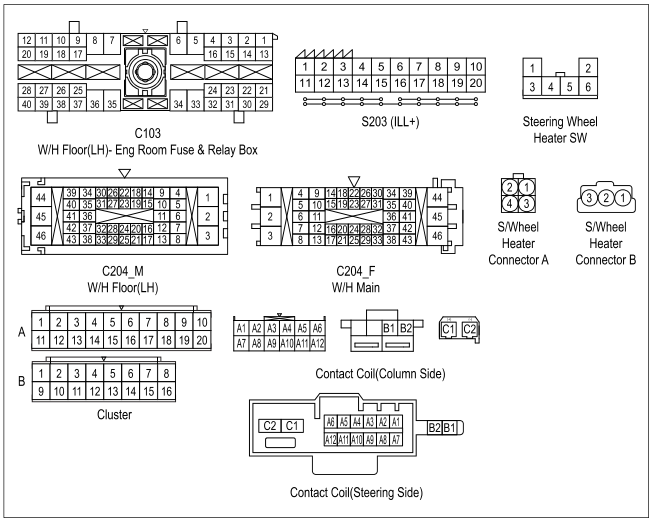
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	

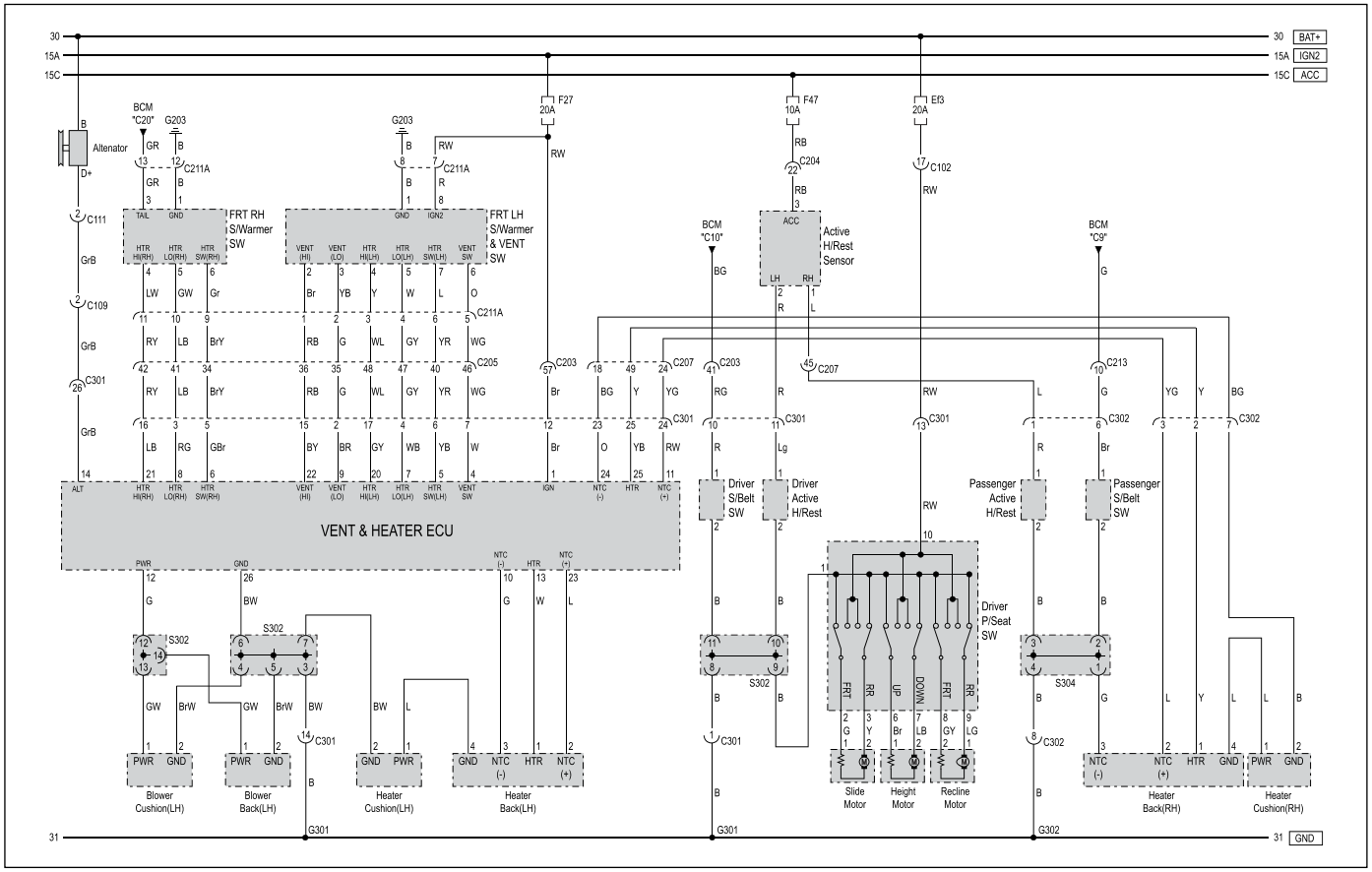
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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7410-01 DRIVER POWER SEAT - VENT/FRT SEAT WARMER



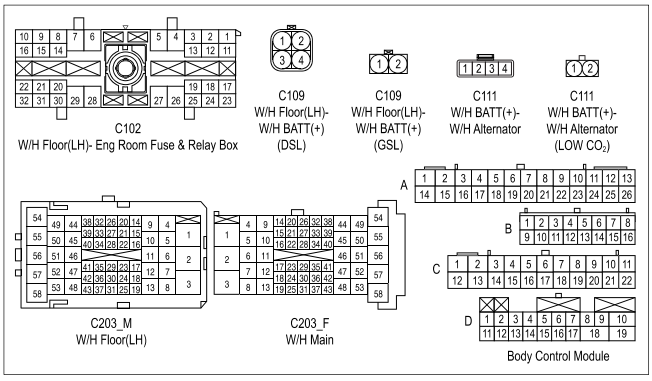
Modification basis	
Application basis	
Affected VIN	

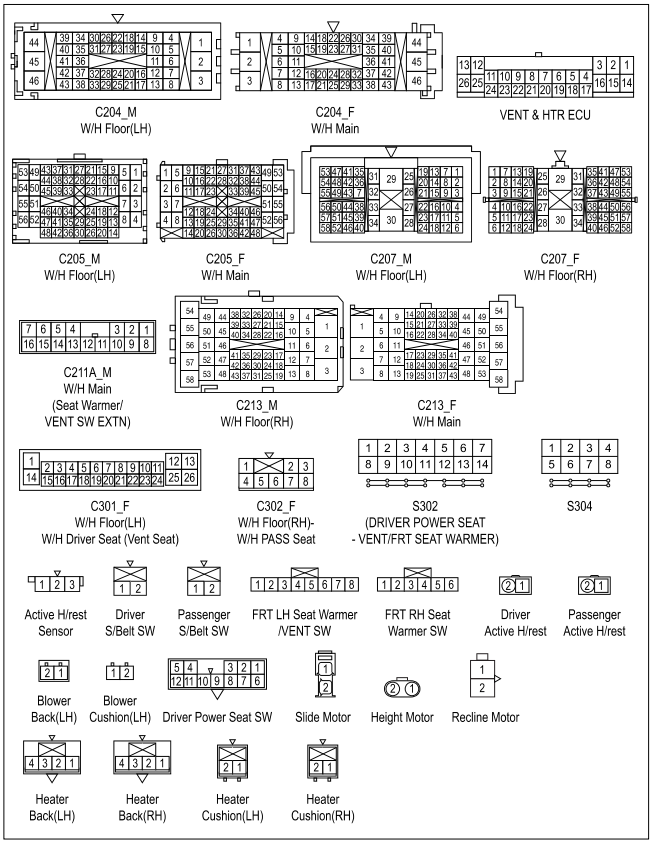
Downloaded from www.Manualslib.com manuals search engine

(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C109	(2Pin, Gray)	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	GSL
	(4Pin, Black)	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	DSL
C111	(2Pin, Black)	W/H BATT(+) - Alternator	Beside Alternator	LOW CO_2
	(4Pin, Black)	W/H BATT(+) - Alternator	Beside Alternator	
C203 (58Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C205 (56Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)		W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C211A (16Pin, White)		W/H Main - W/H Seat Warmer/VENT switch EXTN	Inside Console	VENT SW
C213 (58Pin, White)		W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C301 (26Pin, White)		W/H Floor(LH) - W/H Driver Seat	Under Driver Seat	Vent & Power Seat
C302 (8Pin, White)		W/H Floor(RH) - W/H Passenger Seat	Under Passenger Seat	
G203		W/H Main	Backside Audio(CTR Cowl Cross Member)	
G301		W/H Floor(LH)	Under Driver Seat	
G302		W/H Floor(RH)	Under Passenger Seat	
S302 (14Pin)		W/H Driver Seat	Inside Driver Seat(Seat Frame)	Power Seat
S304 (8Pin)		W/H Passenger Seat	Inside Passenger Seat(Seat Frame)	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

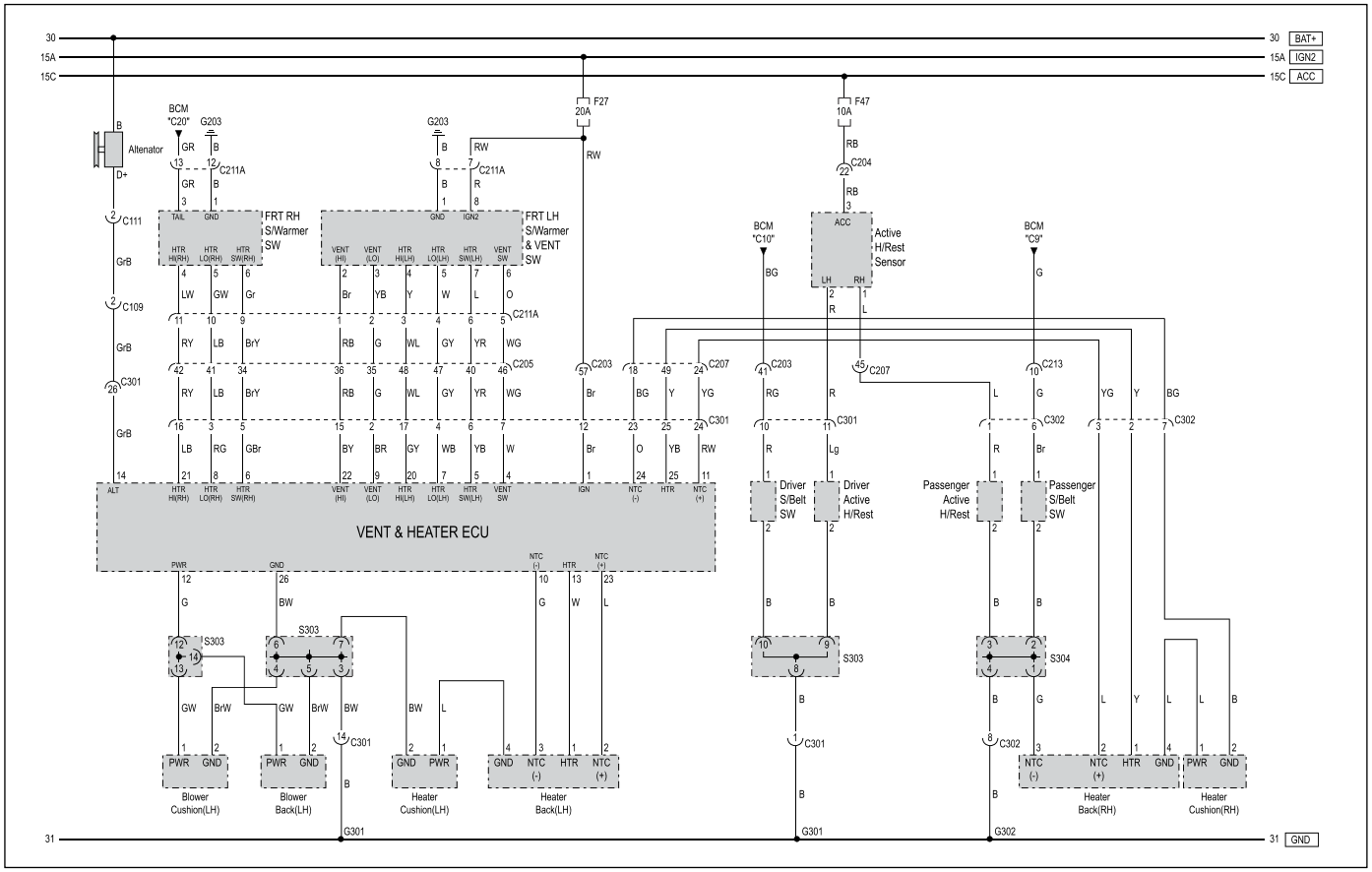




Modification basis	
Application basis	
Affected VIN	

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7410-01 DRIVER MANUAL SEAT - VENT/FRT SEAT WARMER



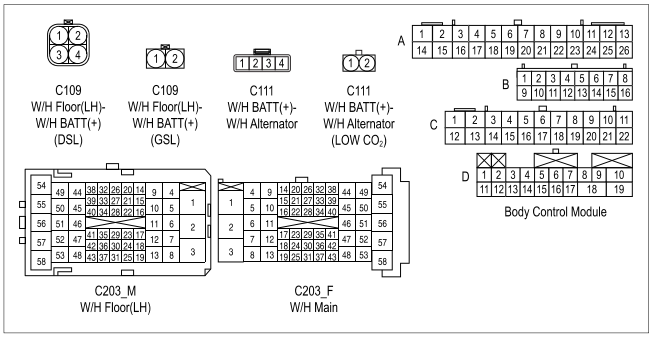
Modification basis	
Application basis	
Affected VIN	

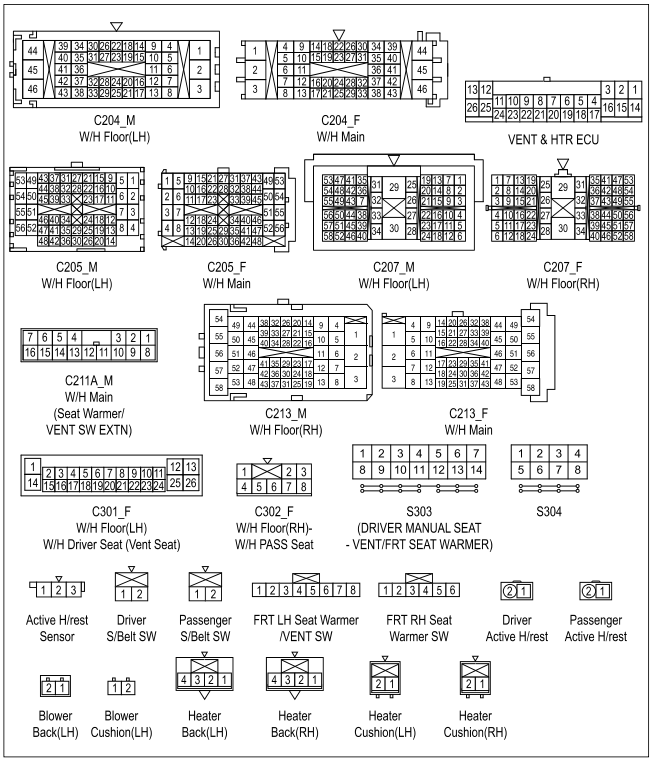
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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C109	(2Pin, Gray)	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	GSL
	(4Pin, Black)	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	DSL
C111	(2Pin, Black)	W/H BATT(+) - Alternator	Beside Alternator	LOW CO_2
	(4Pin, Black)	W/H BATT(+) - Alternator	Beside Alternator	
C203 (58Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C205 (56Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)		W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C211A (16Pin, White)		W/H Main - W/H Seat Warmer/VENT switch EXTN	Inside Console	VENT SW
C213 (58Pin, White)		W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C301 (26Pin, White)		W/H Floor(LH) - W/H Driver Seat	Under Driver Seat	Vent & Power Seat
C302 (8Pin, White)		W/H Floor(RH) - W/H Passenger Seat	Under Passenger Seat	
G203		W/H Main	Backside Audio(CTR Cowl Cross Member)	
G301		W/H Floor(LH)	Under Driver Seat	
G302		W/H Floor(RH)	Under Passenger Seat	
S303 (14Pin)		W/H Driver Seat	Inside Driver Seat(Seat Frame)	Manual Seat
S304 (8Pin)		W/H Passenger Seat	Inside Passenger Seat(Seat Frame)	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

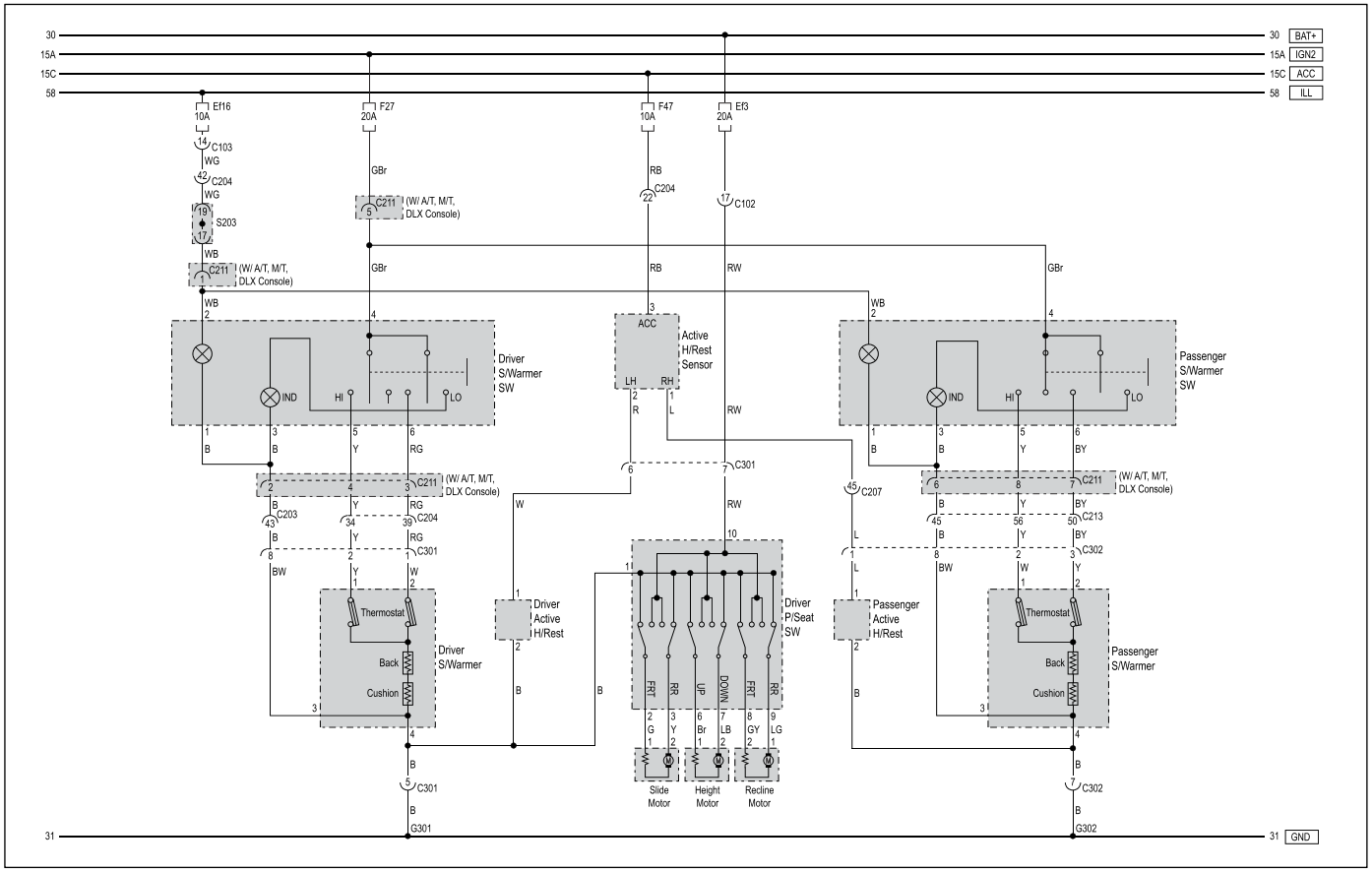




Modification basis	
Application basis	
Affected VIN	

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7410-02 DRIVER SEAT - FRT SEAT WARMER



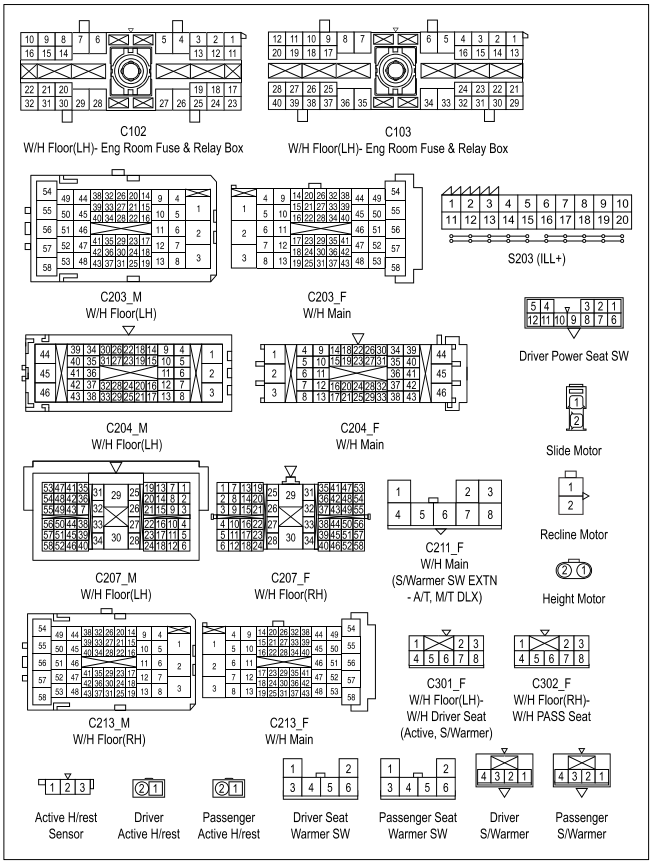
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C211 (8Pin, White)	W/H Main - W/H Seat Warmer switch EXTN	Inside Console	A/T, M/T DLX
C213 (58Pin, White)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C301 (8Pin, White)	W/H Floor(LH) - W/H Driver Seat	Under Driver Seat	S/Warmer, Active
C302 (8Pin, White)	W/H Floor(RH) - W/H Passenger Seat	Under Passenger Seat	
G301	W/H Floor(LH)	Under Driver Seat	
G302	W/H Floor(RH)	Under Passenger Seat	
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +

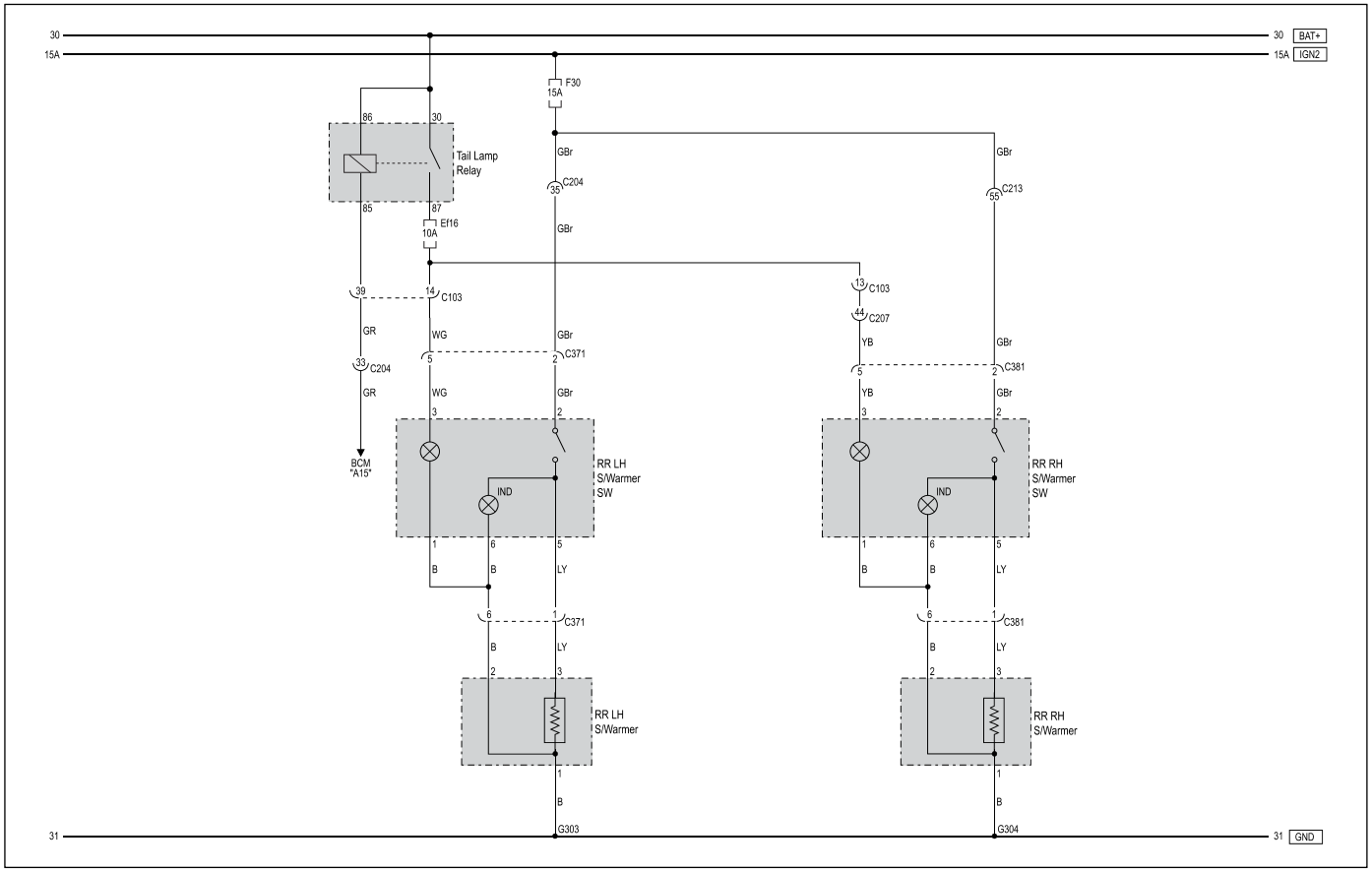
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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8510-48 REAR SEAT WARMER



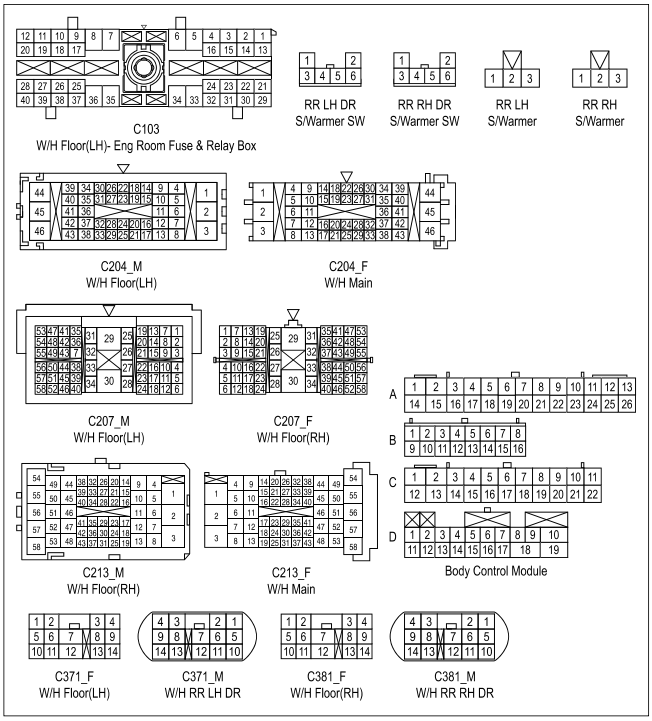
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C213 (58Pin, White)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C371 (14Pin, White)	W/H Floor(LH) - W/H RR LH DR	Under LH B Pillar	
C381 (14Pin, White)	W/H Floor(RH) - W/H RR RH DR	Under RH B Pillar	
G303	W/H Floor(LH)	Driver QTR PNL	
G304	W/H Floor(RH)	Passenger QTR PNL	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

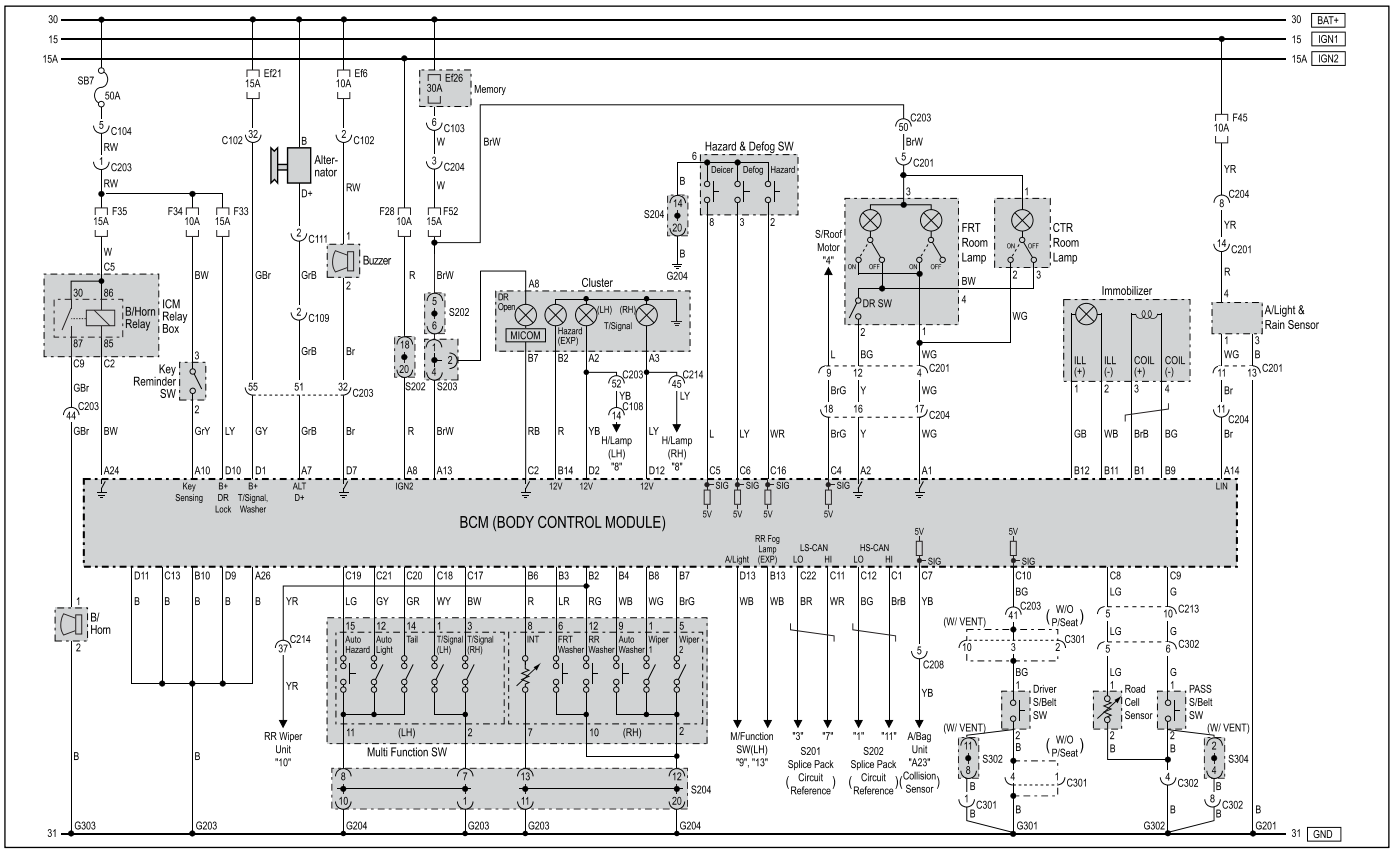


Modification basis	
Application basis	
Affected VIN	

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8620-01 BCM(BODY CONTROL MODULE)

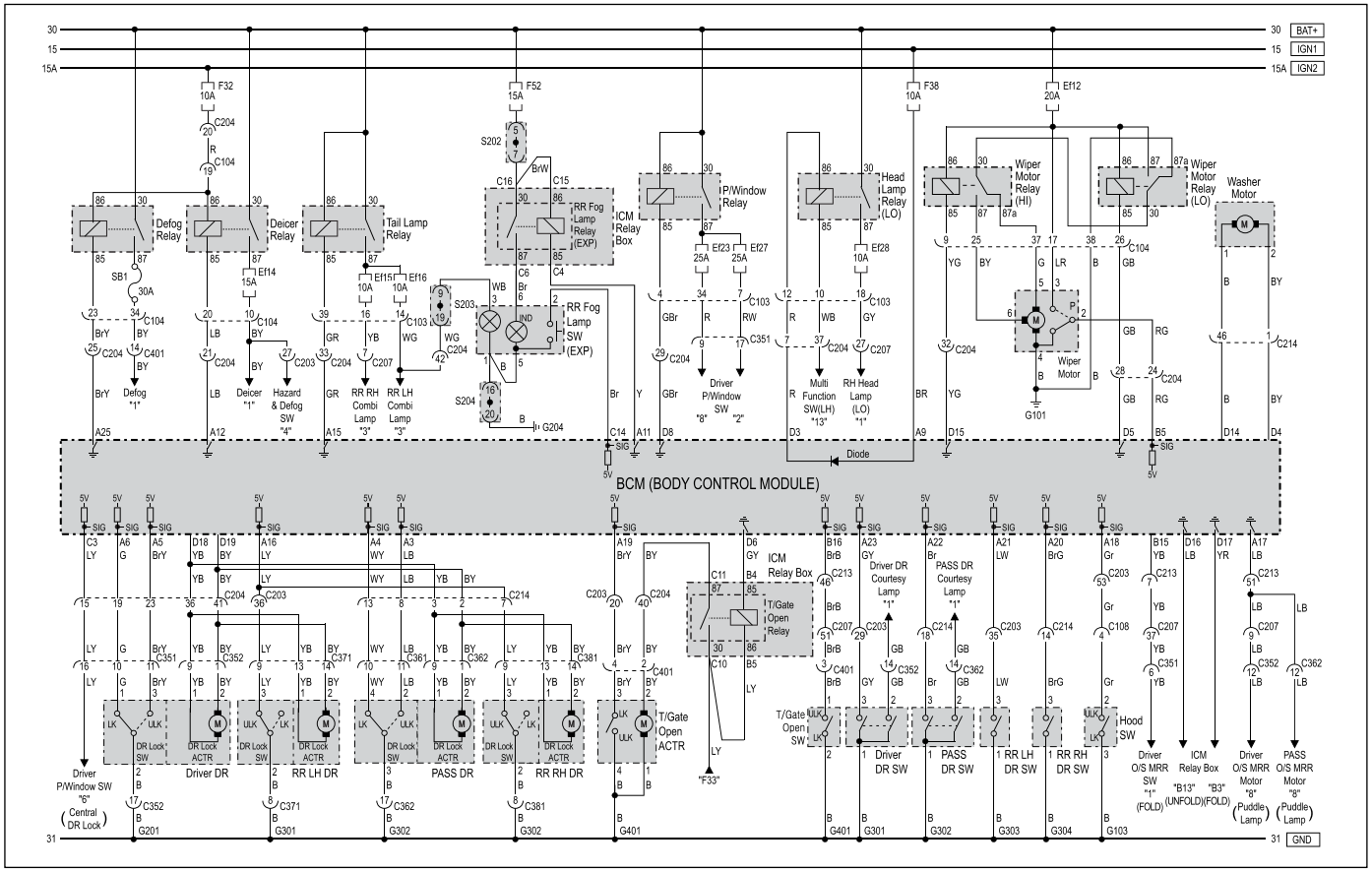
(1) POWER/GROUND, B/HORN, BUZZER, CLUSTER, HAZARD, ROOM LAMP, M/FUNCTION SW, IMMO, A/LIGHT



Modification basis	
Application basis	
Affected VIN	

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(2) DR LOCK, FOLDING, DEFOG/DEICER, P/WINDOW, WIPER/WASHER, DR SWITCH



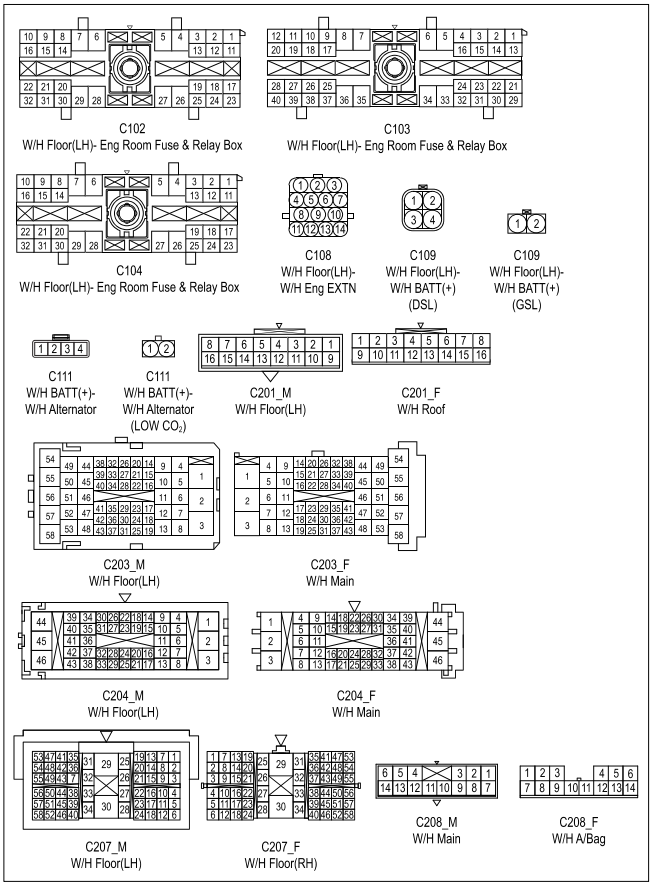
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

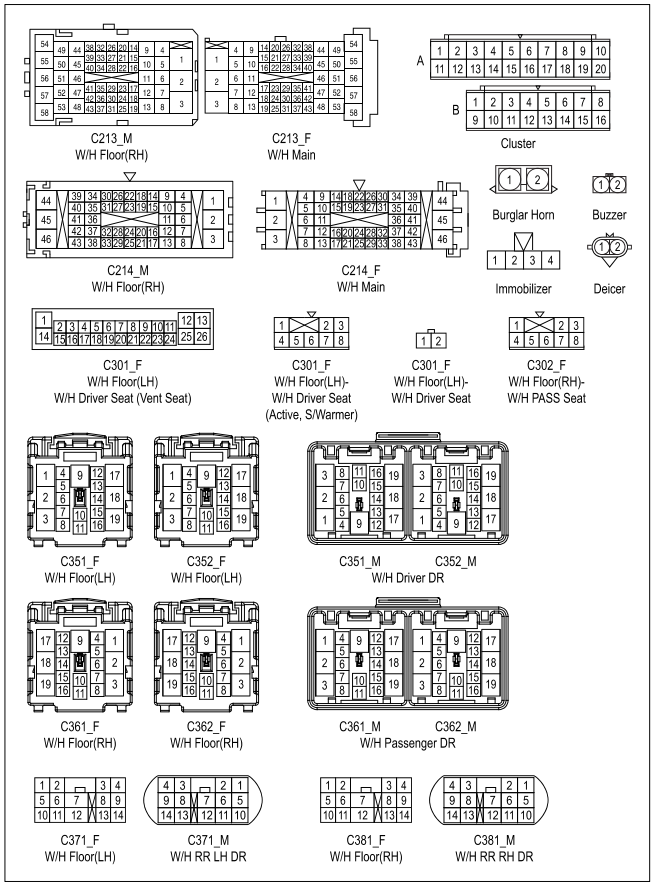
Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (40Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (14Pin, Black)		W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C109	(2Pin, Gray)	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	GSL
	(4Pin, Black)	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	DSL
C111	(2Pin, Black)	W/H BATT(+) - Alternator	Beside Alternator	LOW CO_2
	(4Pin, Black)	W/H BATT(+) - Alternator	Beside Alternator	
C201 (16Pin, White)		W/H Floor(LH) - W/H Roof	Upper Driver Cowl Side Connector Holder	
C203 (58Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)		W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C208 (14Pin, White)		W/H Main - W/H Air Bag	Inside I.P (Upper Driver LegRoom)	
C213 (58Pin, White)		W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C214 (46Pin, Black)		W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C301	(26Pin, White)	W/H Floor(LH) - W/H Driver Seat	Under Driver Seat	Vent & Power Seat
	(8Pin, White)	W/H Floor(LH) - W/H Driver Seat	Under Driver Seat	S/Warmer, Active
	(2Pin, White)	W/H Floor(LH) - W/H Driver Seat	Under Driver Seat	
C302 (8Pin, White)		W/H Floor(RH) - W/H Passenger Seat	Under Passenger Seat	
C351 (19Pin, Gray)		W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C352 (19Pin, White)		W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C361 (19Pin, White)		W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C362 (19Pin, Gray)		W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C371 (14Pin, White)		W/H Floor(LH) - W/H RR LH DR	Under LH B Pillar	
C381 (14Pin, White)		W/H Floor(RH) - W/H RR RH DR	Under RH B Pillar	
C401 (16Pin, White)		W/H Floor(LH) - W/H Tail Gate	Upper Tail Gate LH	
G103		W/H Eng EXTN	Under BATT Tray	
G201		W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G203		W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204		W/H Main	Inside I.P(RH Glove Box)	
G301		W/H Floor(LH)	Under Driver Seat	
G302		W/H Floor(RH)	Under Passenger Seat	
G303		W/H Floor(LH)	Driver QTR PNL	
G304		W/H Floor(RH)	Passenger QTR PNL	
G401		W/H Tail Gate	CTR Under Tail Gate	
S201 (8Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	LS-CAN
S202 (20Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S203 (20Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204 (20Pin)		W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

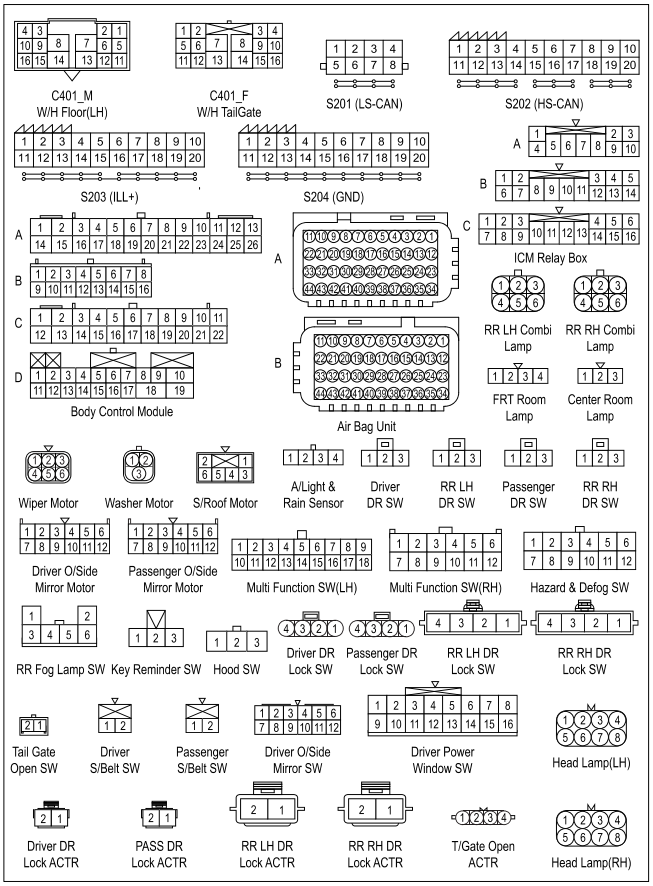
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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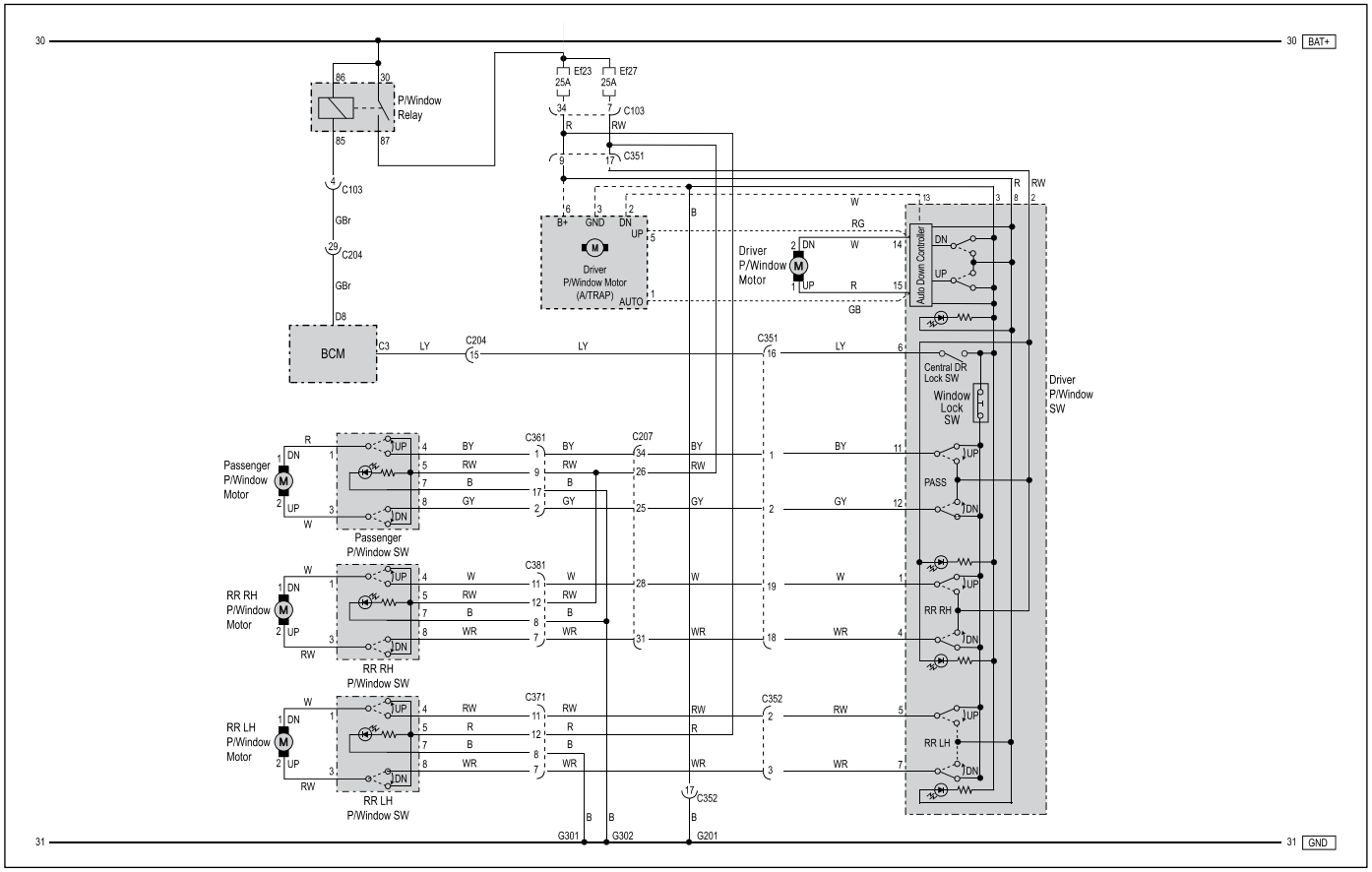




Modification basis	
Application basis	
Affected VIN	

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8510-05 POWER WINDOW



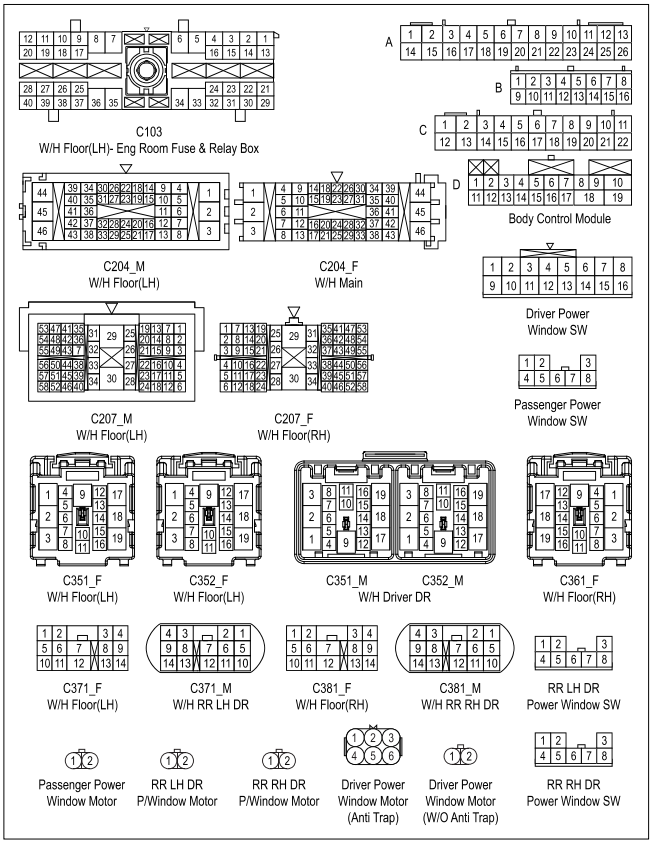
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C351 (19Pin, Gray)	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C352 (19Pin, White)	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C361 (19Pin, White)	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C371 (14Pin, White)	W/H Floor(LH) - W/H RR LH DR	Under LH B Pillar	
C381 (14Pin, White)	W/H Floor(LH) - W/H RR LH DR	Under RH B Pillar	
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G301	W/H Floor(LH)	Under Driver Seat	
G302	W/H Floor(RH)	Under Passenger Seat	

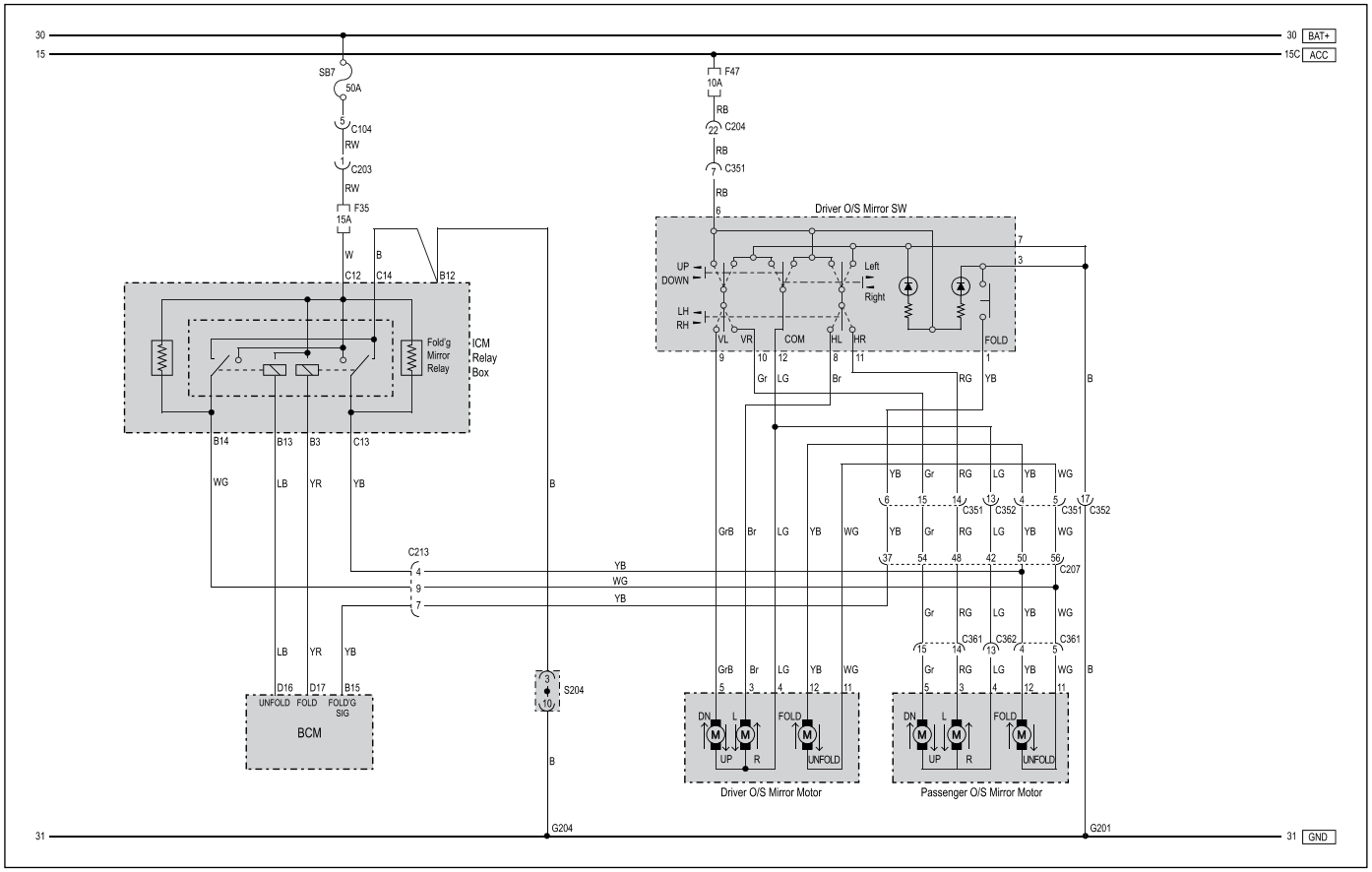
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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8510-52 OUTSIDE MIRROR



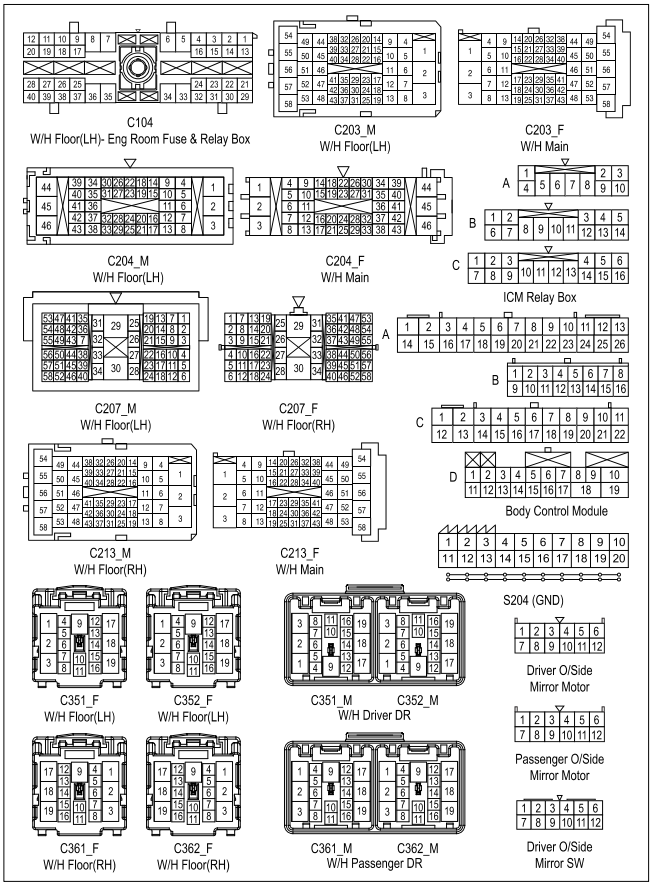
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (40Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C213 (58Pin, White)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C351 (19Pin, Gray)	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C352 (19Pin, White)	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C361 (19Pin, White)	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C362 (19Pin, Gray)	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G204	W/H Main	Inside I.P(RH Glove Box)	
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

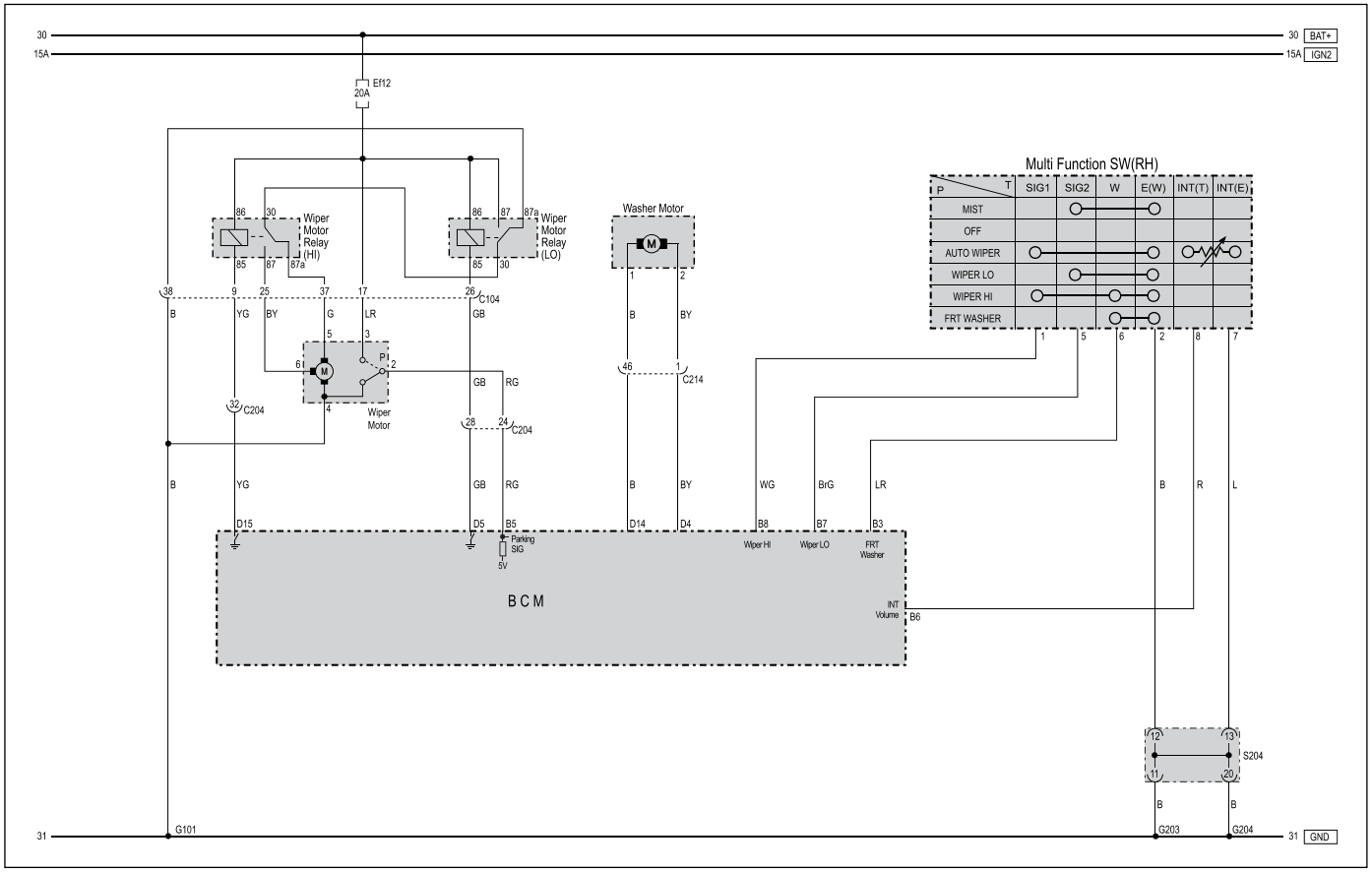
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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7810-01 FRT WIPER / WASHER



Modification basis	
Application basis	
Affected VIN	

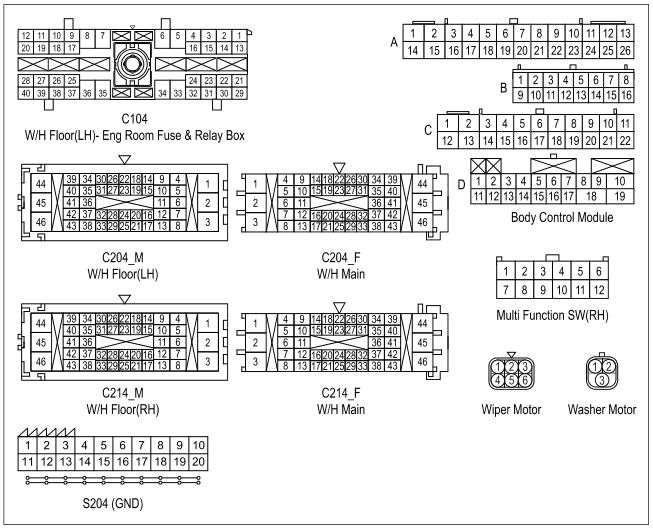
CIRCUIT
KORANDO 2013.08

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (40Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C214 (46Pin, Black)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
G101	W/H Floor(LH)	Behind LH Head Lamp	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	

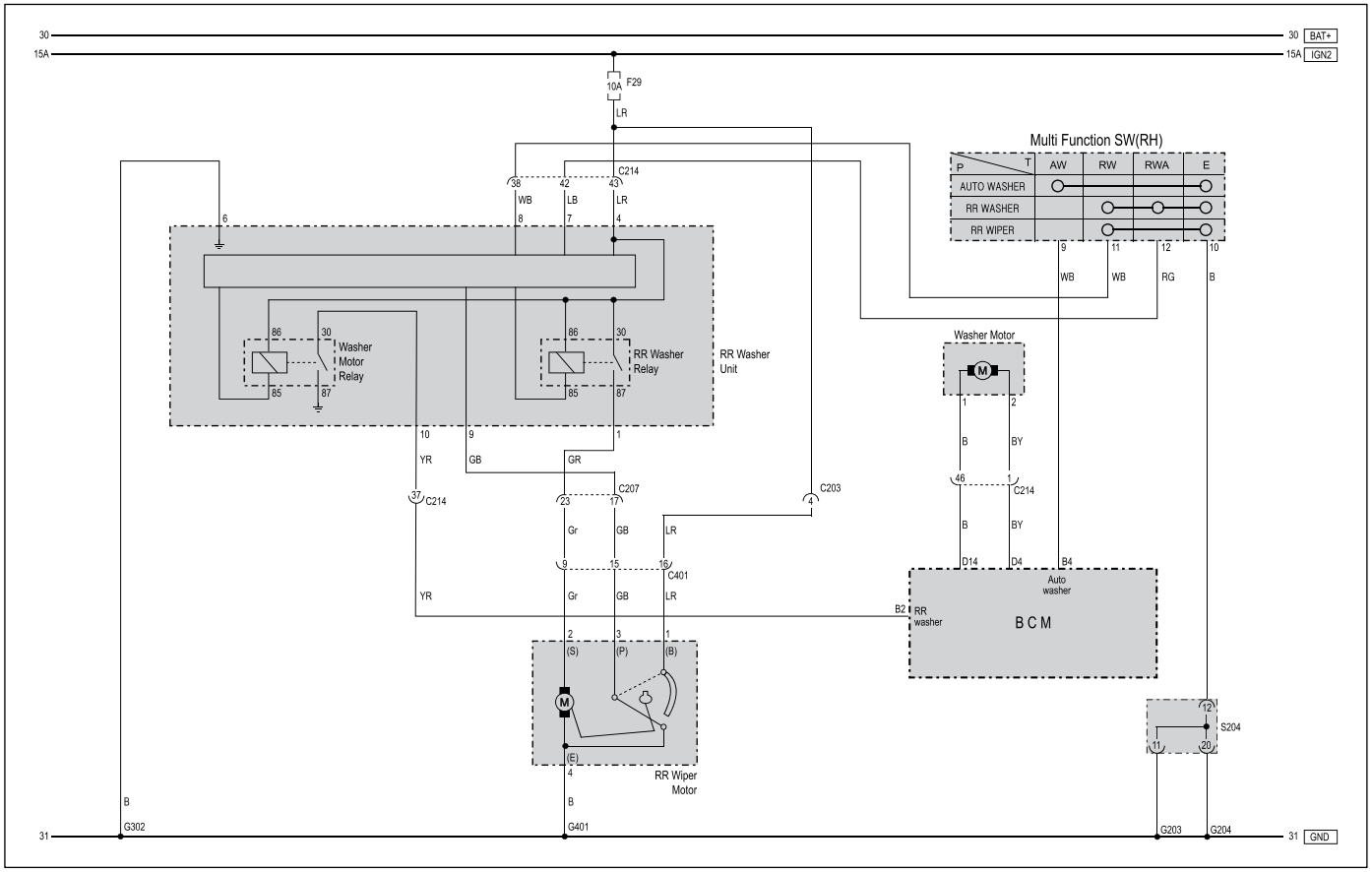
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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7810-01 RR WIPER / WASHER



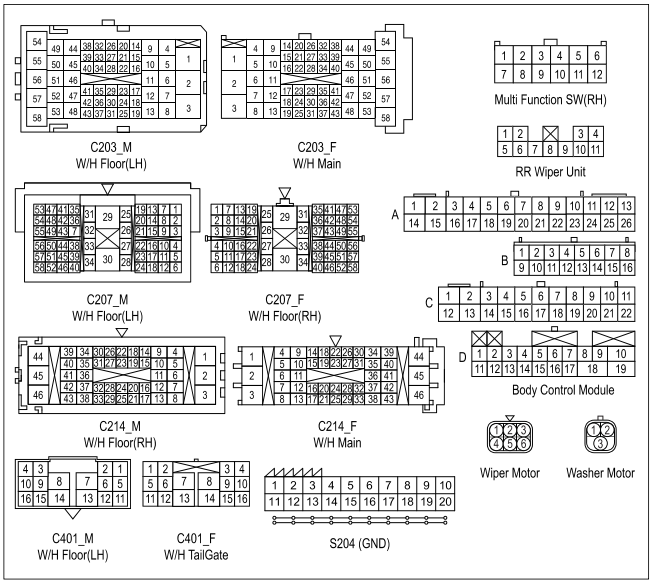
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C214 (46Pin, Black)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C401 (16Pin, White)	W/H Floor(LH) - W/H Tail Gate	Upper Tail Gate LH	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
G302	W/H Floor(RH)	Under Passenger Seat	
G401	W/H Tail Gate	CTR Under Tail Gate	
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	

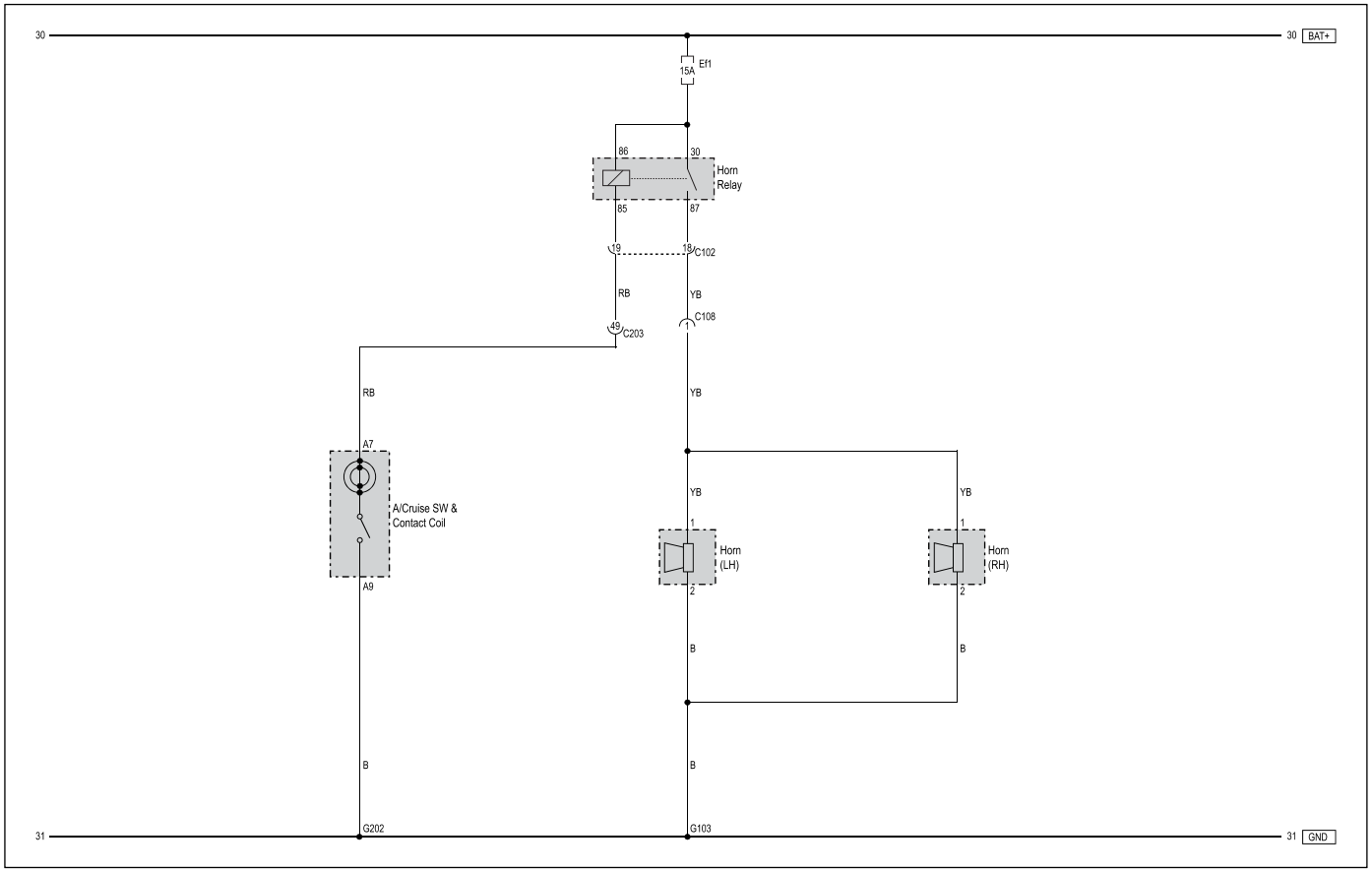
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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8610-06 HORN



Modification basis	
Application basis	
Affected VIN	

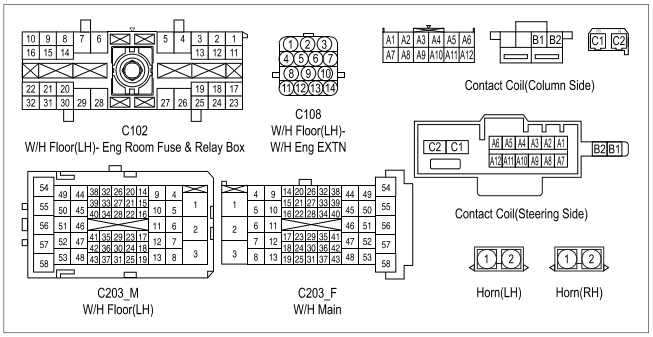
CIRCUIT
KORANDO 2013.08

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (14Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
G103	W/H Eng EXTN	Under BATT Tray	
G202	W/H Main	Backside Cluster(LH Cowl Cross Member)	AUDIO

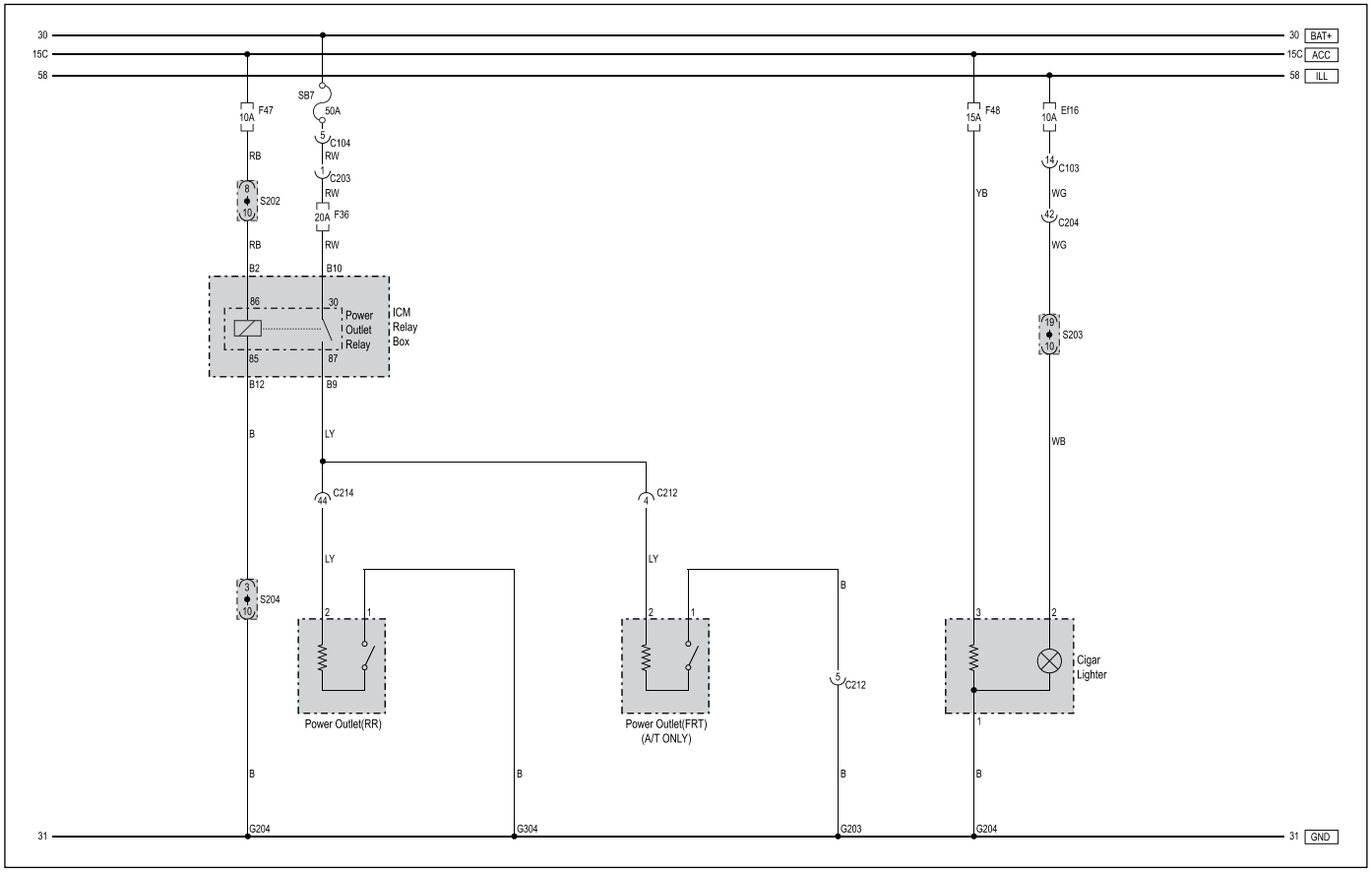
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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7632-16 CIGAR LIGHTER / POWER OUTLET



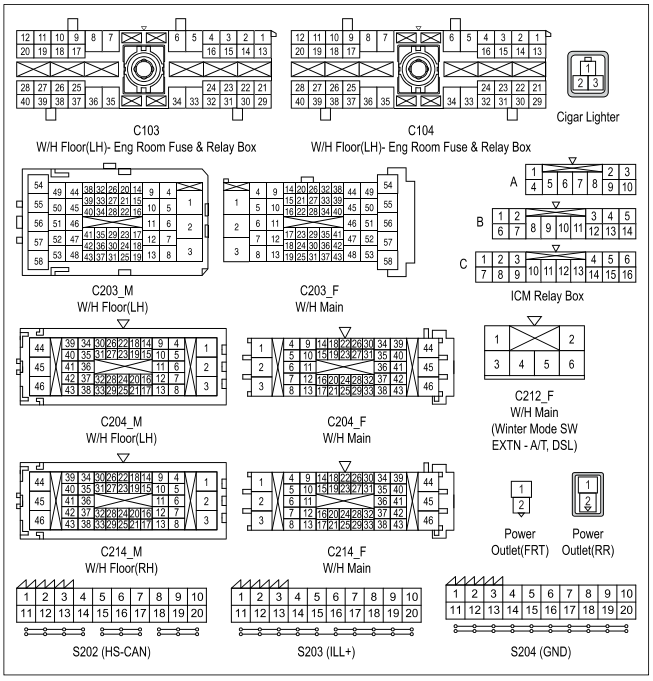
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (40Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C212 (6Pin, White)	W/H Main - W/H Winter Mode switch EXTN	Inside Console	A/T, DSL
C214 (46Pin, Black)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
G304	W/H Floor(RH)	Passenger QTR PNL	
S202 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

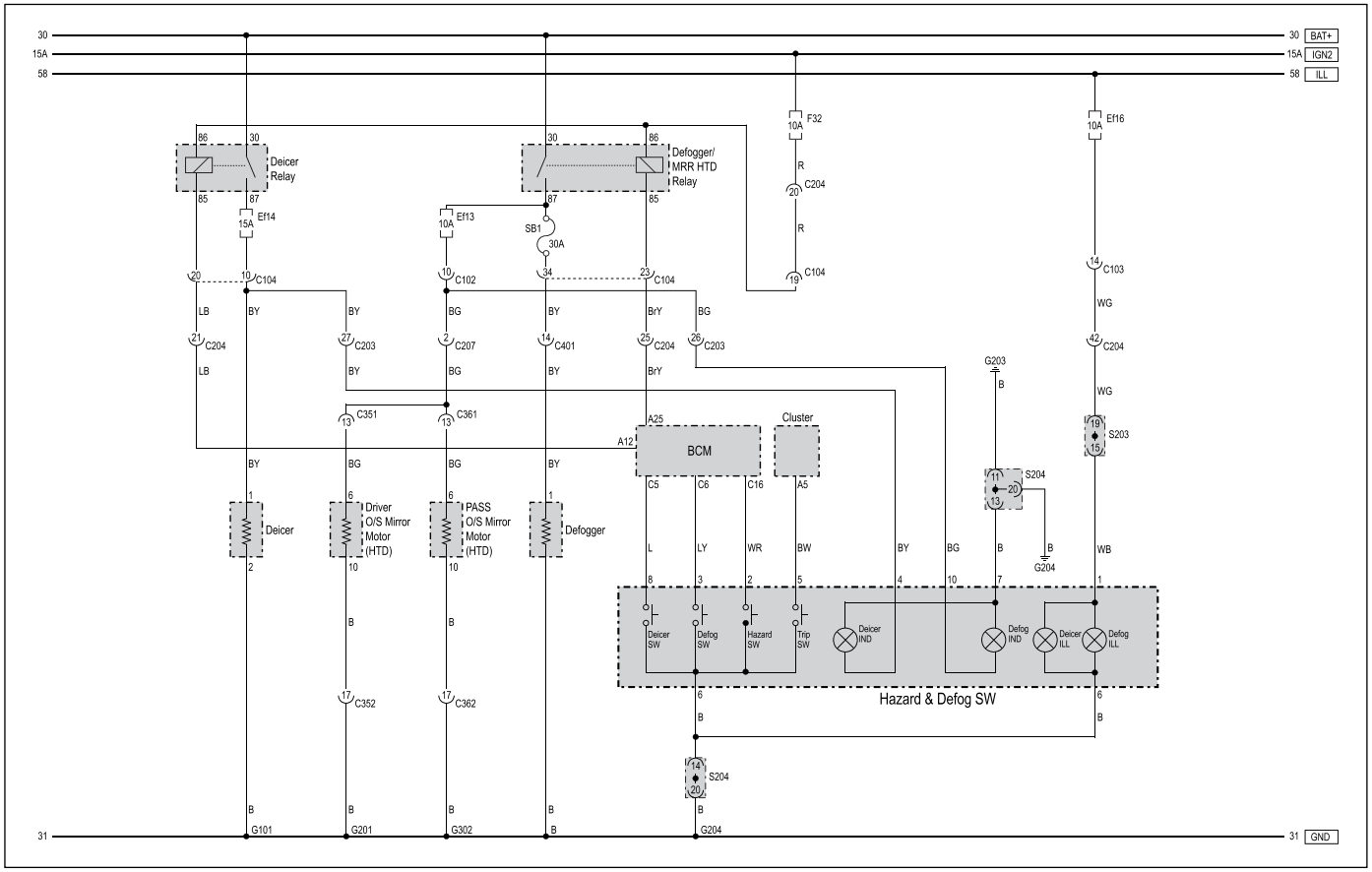
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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7840-01 DEFOGGER / DEICER



Modification basis	
Application basis	
Affected VIN	

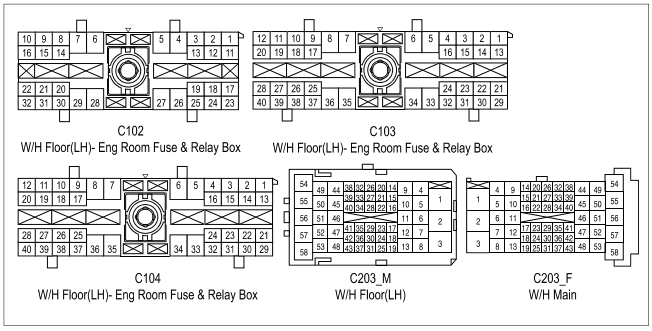
CIRCUIT
KORANDO 2013.08

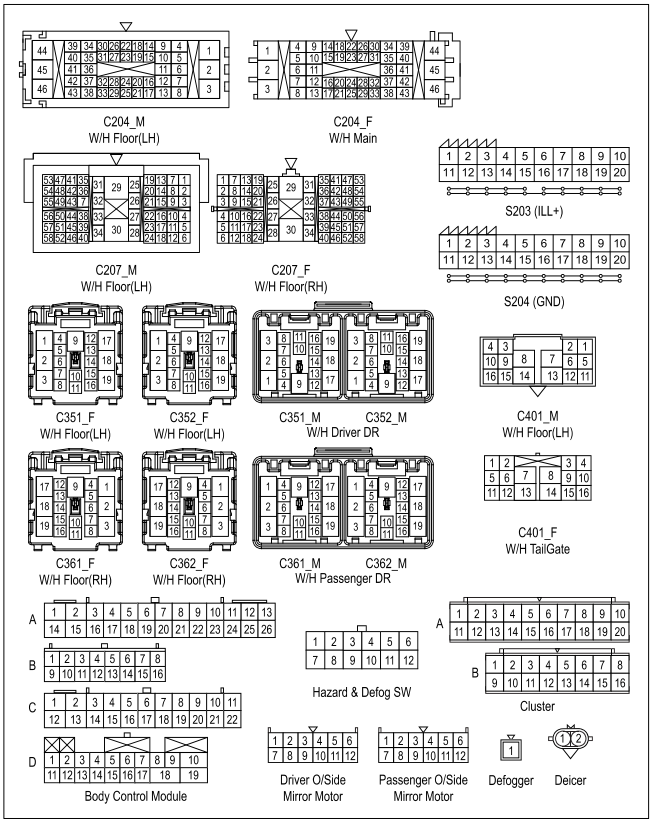
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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (40Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C351 (19Pin, Gray)	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C352 (19Pin, White)	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C361 (19Pin, White)	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C362 (19Pin, Gray)	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C401 (16Pin, White)	W/H Floor(LH) - W/H Tail Gate	Upper Tail Gate LH	
G101	W/H Floor(LH)	Behind LH Head Lamp	
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
G302	W/H Floor(RH)	Under Passenger Seat	
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

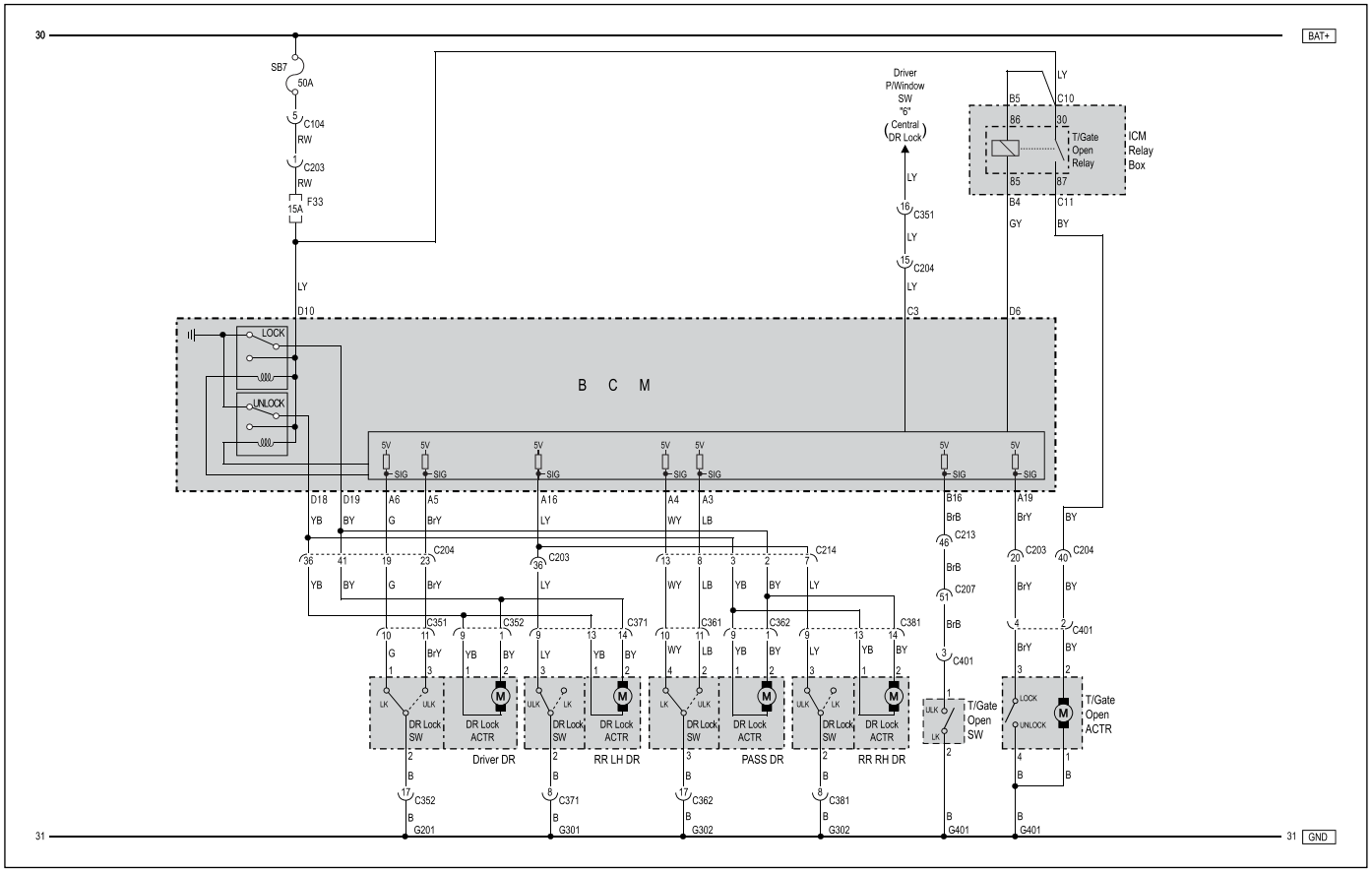




Modification basis	
Application basis	
Affected VIN	

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8710-03 DOOR LOCK CIRCUIT



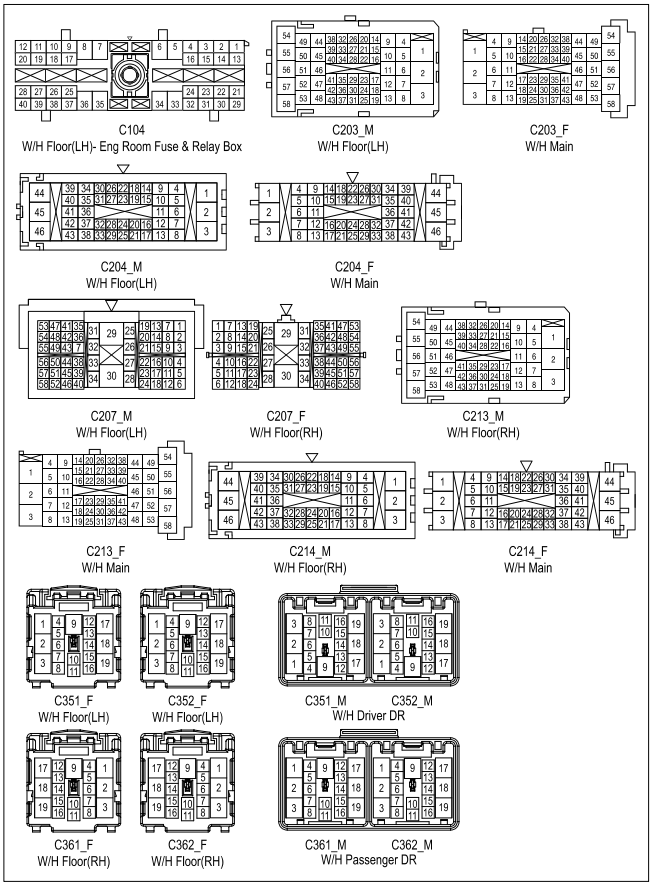
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

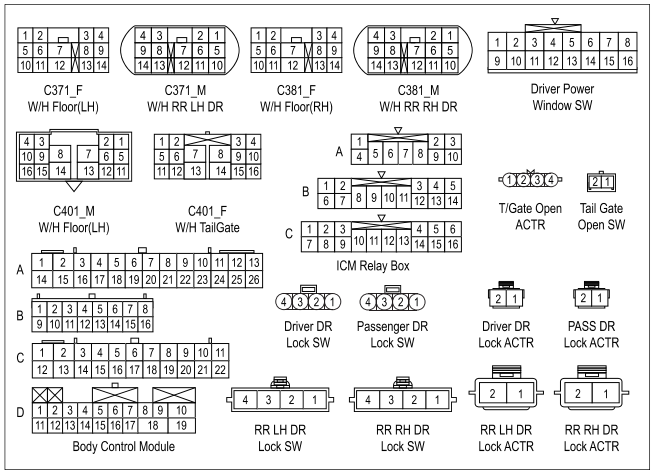
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (40Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C213 (58Pin, White)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C214 (46Pin, Black)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C351 (19Pin, Gray)	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C352 (19Pin, White)	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C361 (19Pin, White)	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C362 (19Pin, Gray)	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C371 (14Pin, White)	W/H Floor(LH) - W/H RR LH DR	Under LH B Pillar	
C381 (14Pin, White)	W/H Floor(LH) - W/H RR RH DR	Under RH B Pillar	
C401 (16Pin, White)	W/H Floor(LH) - W/H Tail Gate	Upper Tail Gate LH	
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G301	W/H Floor(LH)	Under Driver Seat	
G302	W/H Floor(RH)	Under Passenger Seat	
G401	W/H Tail Gate	CTR Under Tail Gate	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



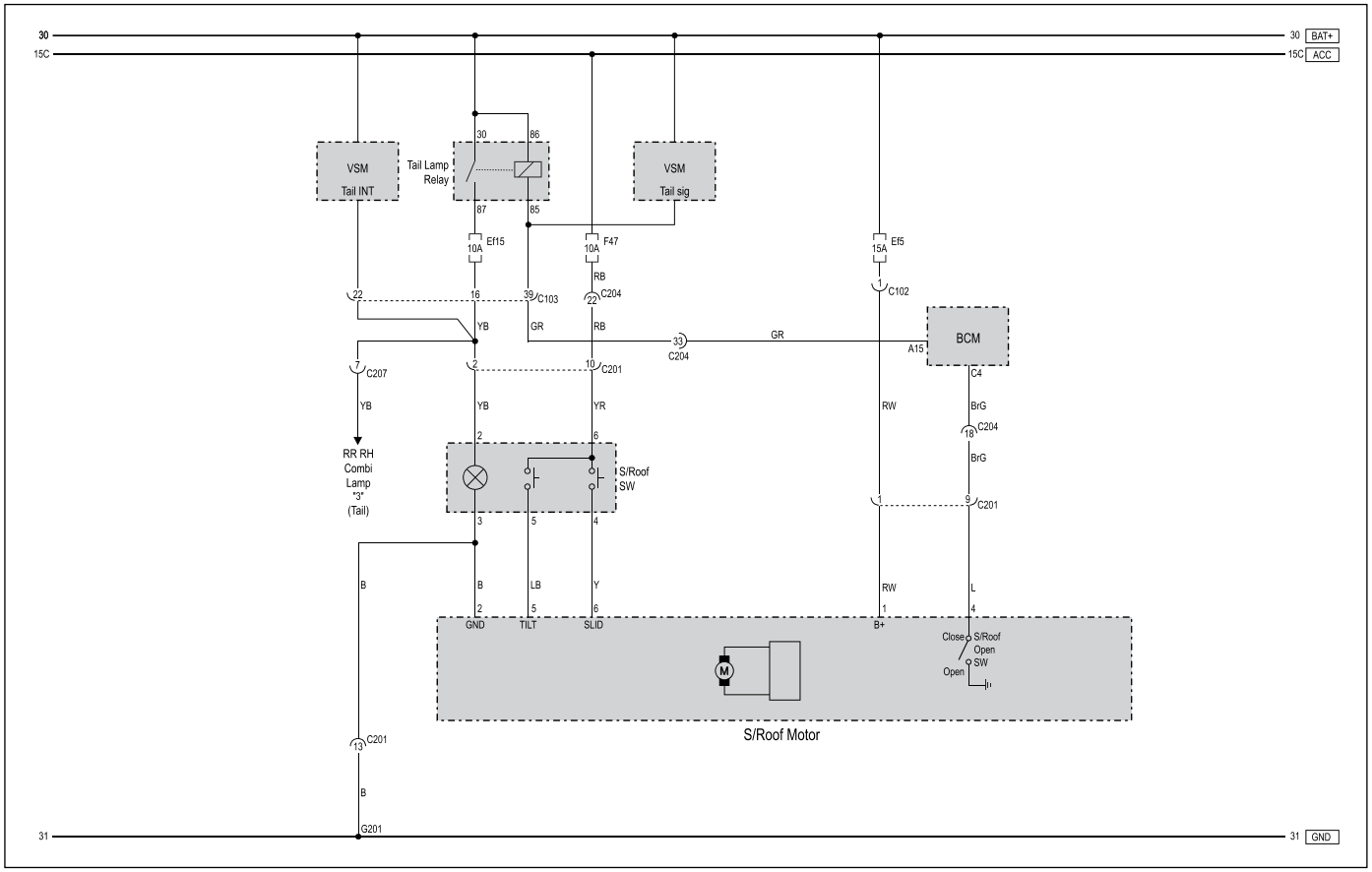
Modification basis	
Application basis	
Affected VIN	

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7340-03 SUN ROOF



CIRCUIT

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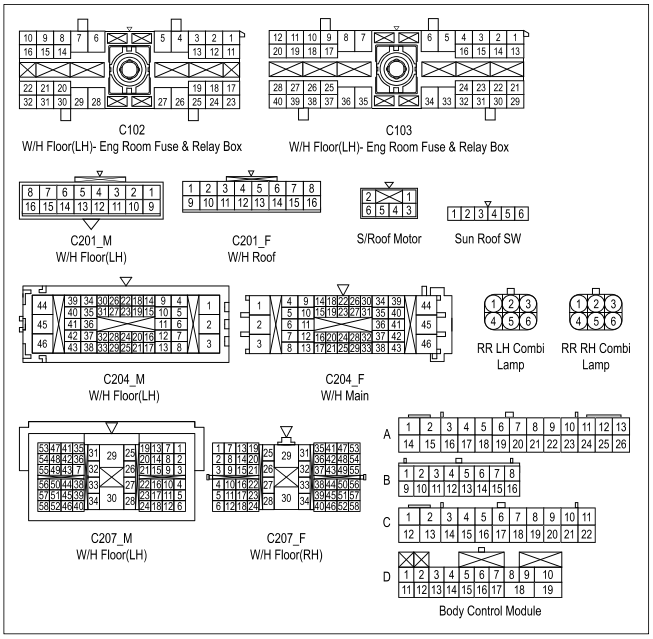
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C201 (16Pin, White)	W/H Floor(LH) - W/H Roof	Upper Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	

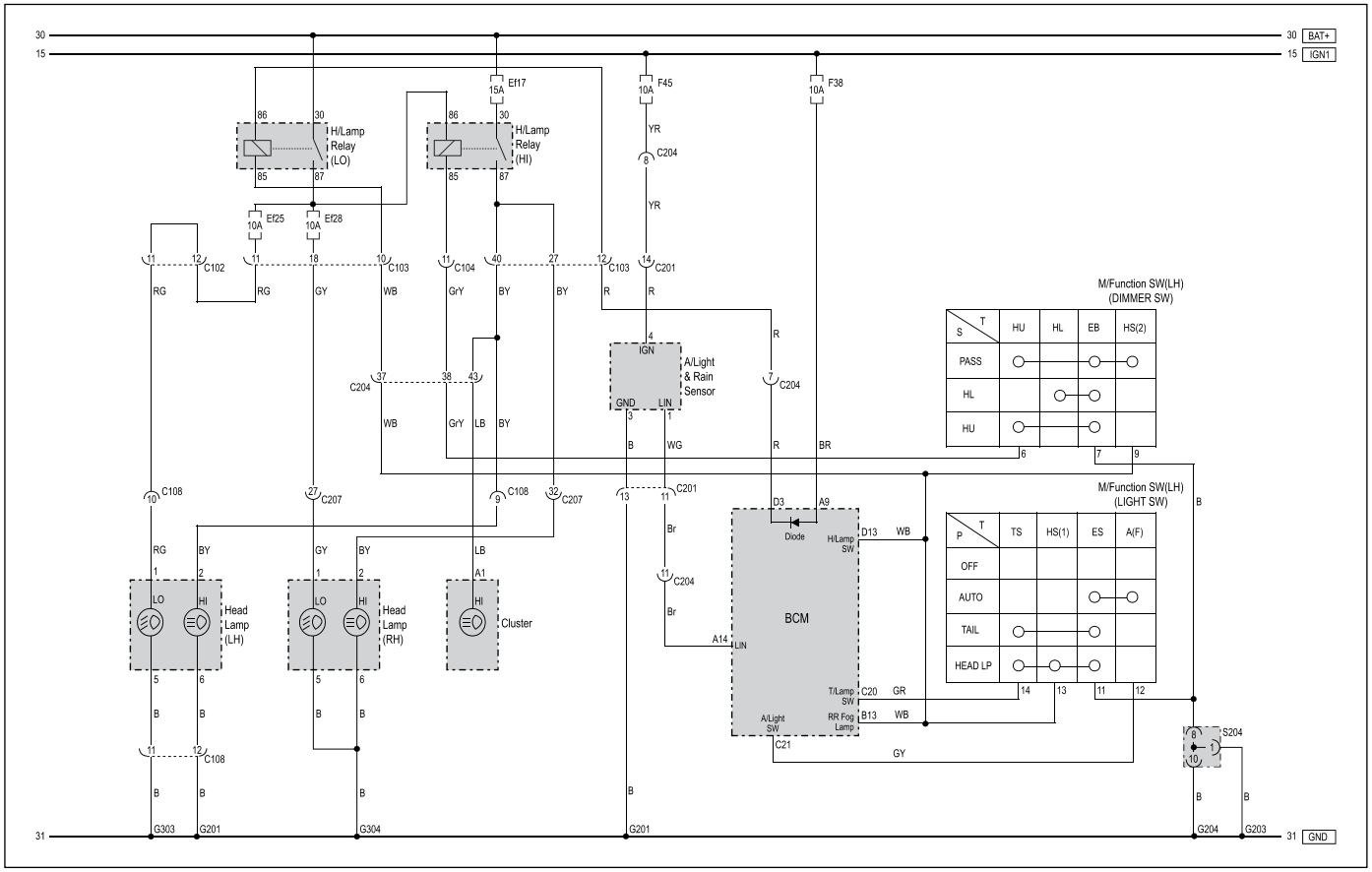
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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8310-01 HEAD LAMP



CIRCUIT

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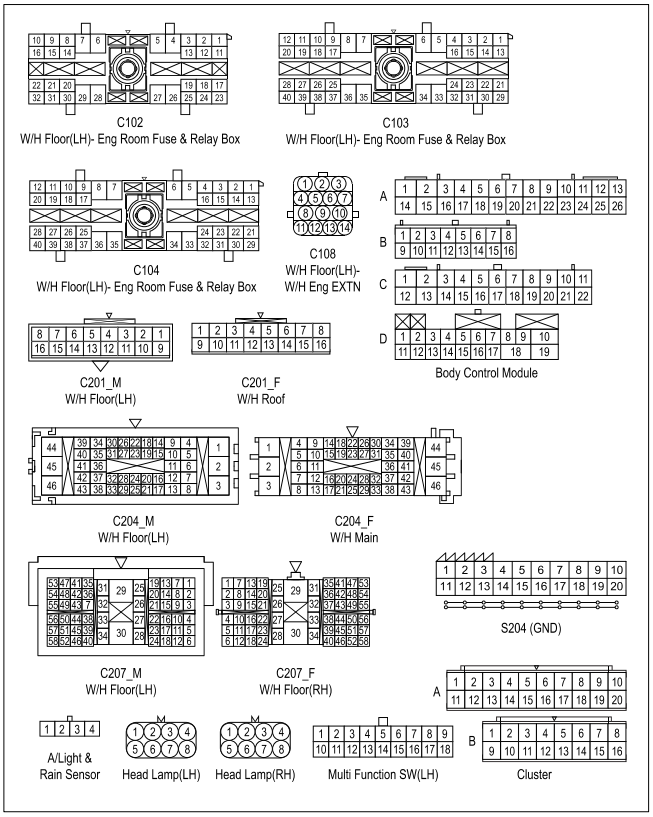
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (40Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (14Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C201 (16Pin, White)	W/H Floor(LH) - W/H Roof	Upper Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
G303	W/H Floor(LH)	Driver QTR PNL	
G304	W/H Floor(RH)	Passenger QTR PNL	
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

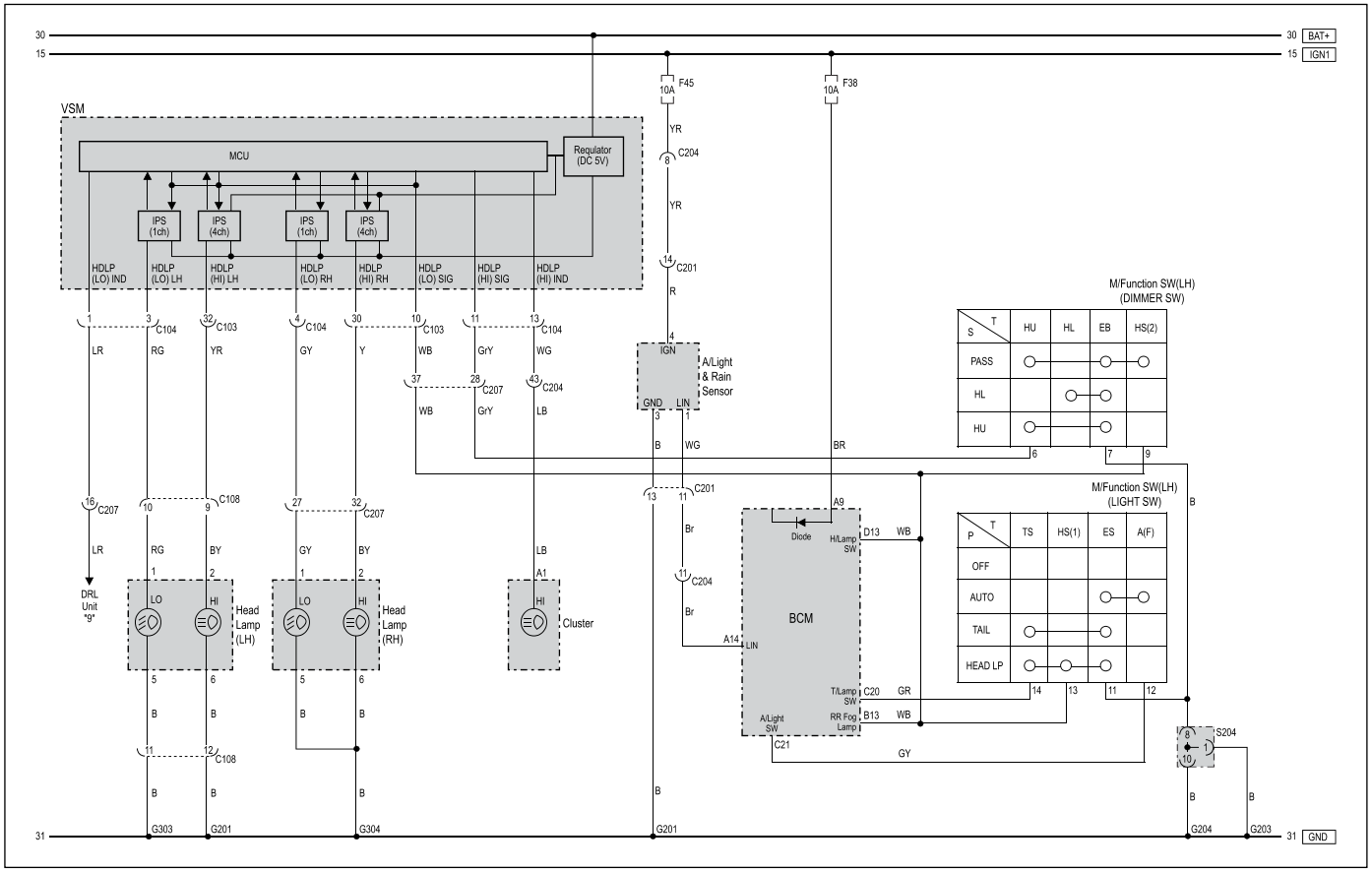
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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8310-01 HEAD LAMP(W/ VSM)



CIRCUIT

KORANDO 2013.08

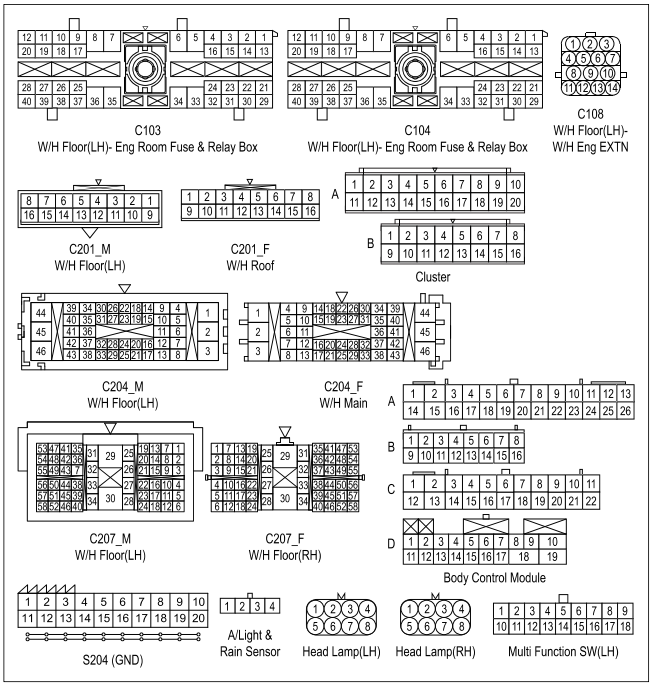
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (40Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (14Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C201 (16Pin, White)	W/H Floor(LH) - W/H Roof	Upper Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
G303	W/H Floor(LH)	Driver QTR PNL	
G304	W/H Floor(RH)	Passenger QTR PNL	
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

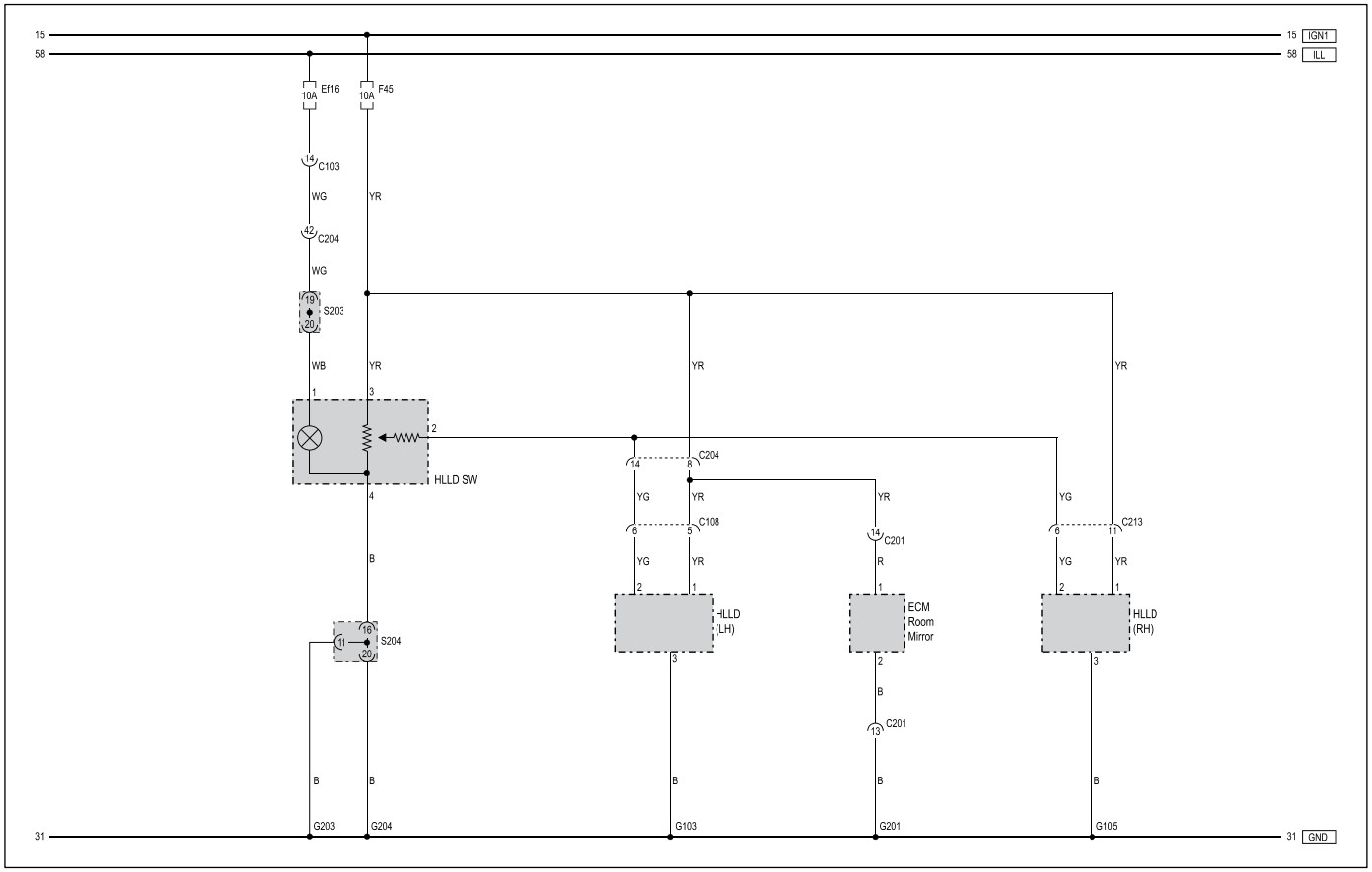
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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8310-01 HEAD LAMP LEVEL' G DEVICE



CIRCUIT

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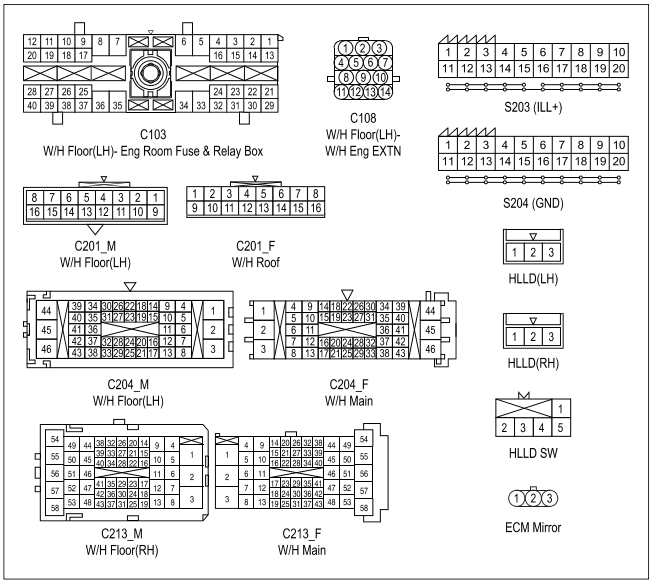
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (14Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C201 (16Pin, White)	W/H Floor(LH) - W/H Roof	Upper Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C213 (58Pin, White)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
G103	W/H Eng EXTN	Under BATT Tray	
G105	W/H Floor(RH)	Behind RH Head Lamp	
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

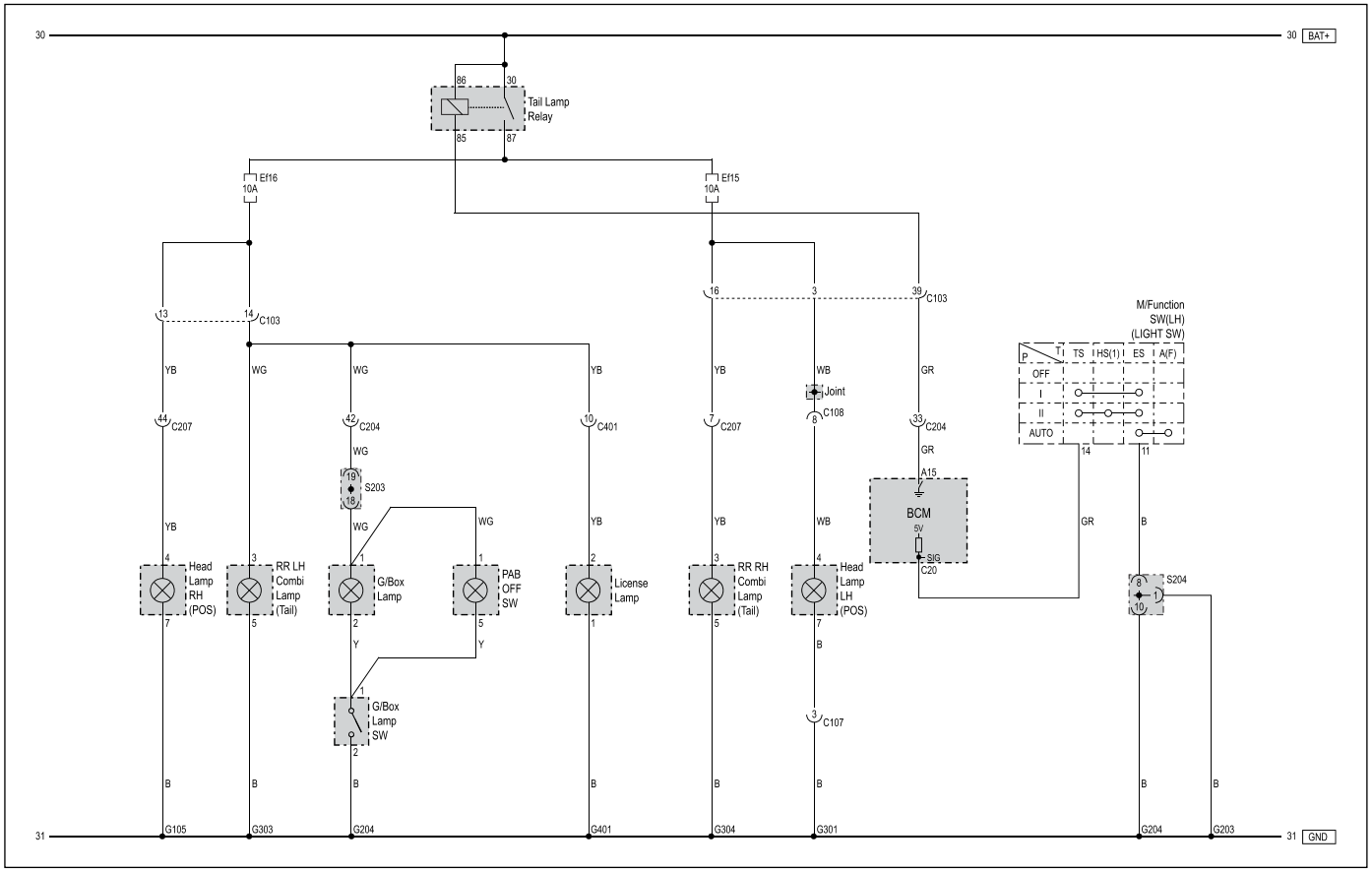
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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8320-01 TAIL LAMP



CIRCUIT

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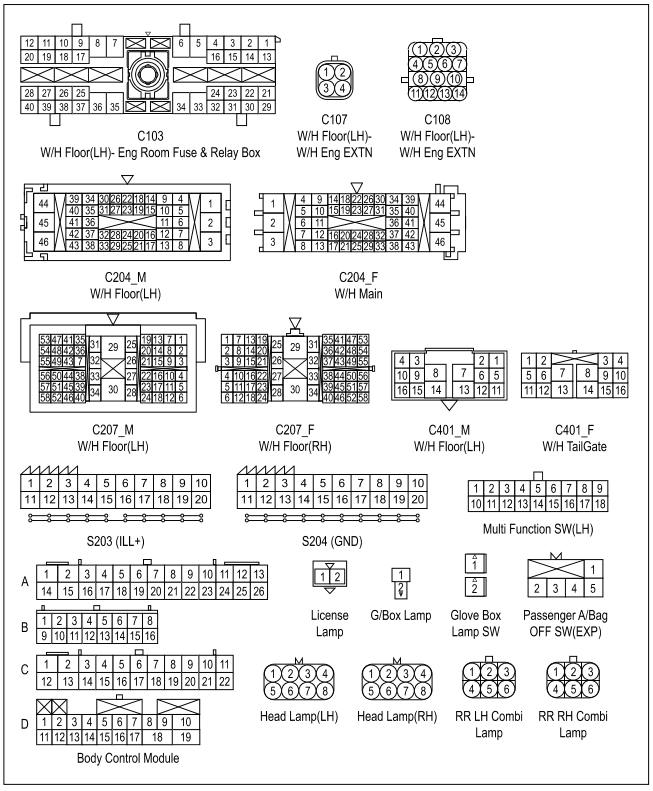
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

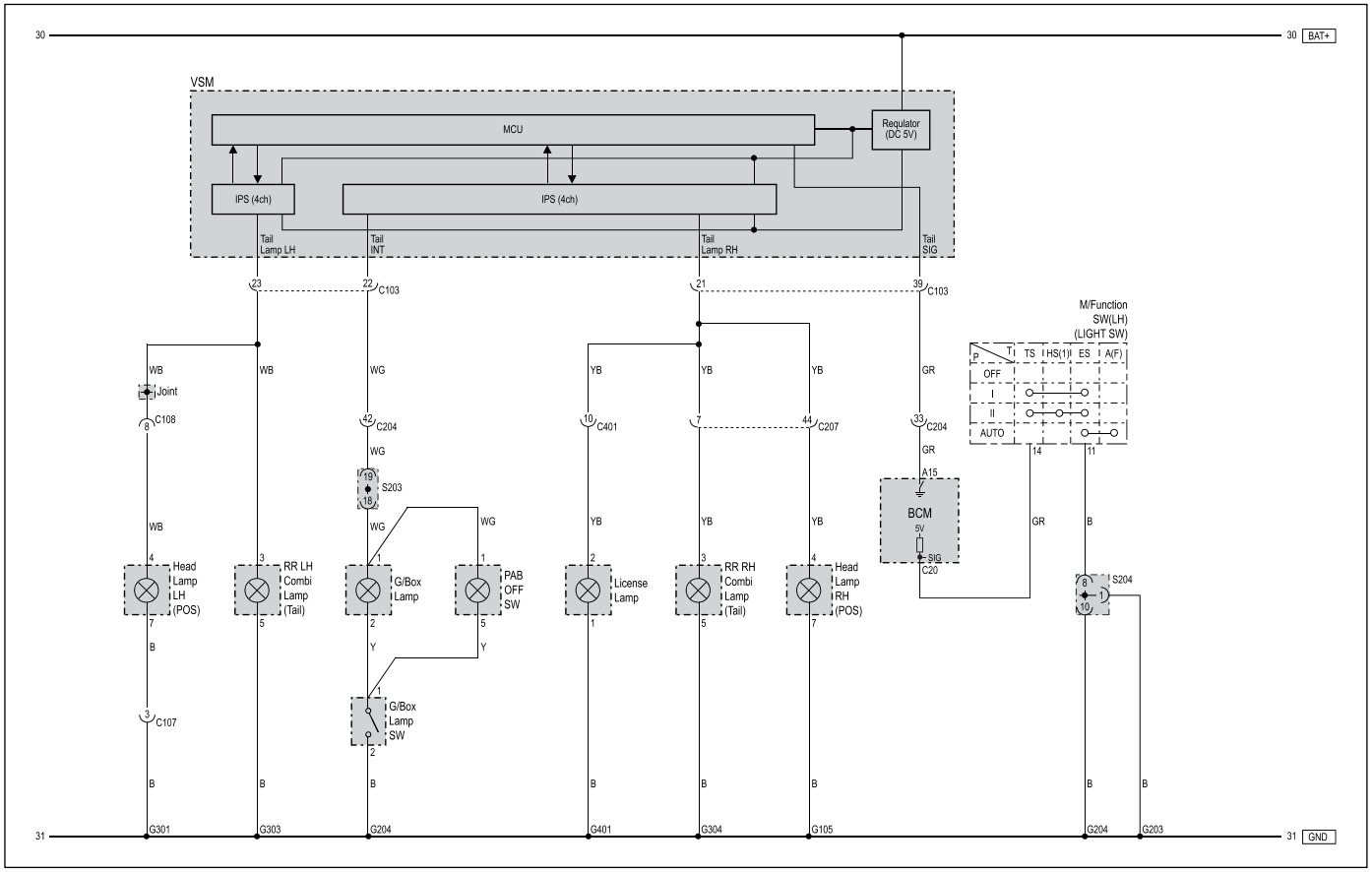
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (4Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C108 (14Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C401 (16Pin, White)	W/H Floor(LH) - W/H Tail Gate	Upper Tail Gate LH	
G105	W/H Floor(RH)	Behind RH Head Lamp	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
G301	W/H Floor(LH)	Under Driver Seat	
G303	W/H Floor(LH)	Driver QTR PNL	
G304	W/H Floor(RH)	Passenger QTR PNL	
G401	W/H Tail Gate	CTR Under Tail Gate	
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



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8320-01 TAIL LAMP(W/ VSM)



CIRCUIT

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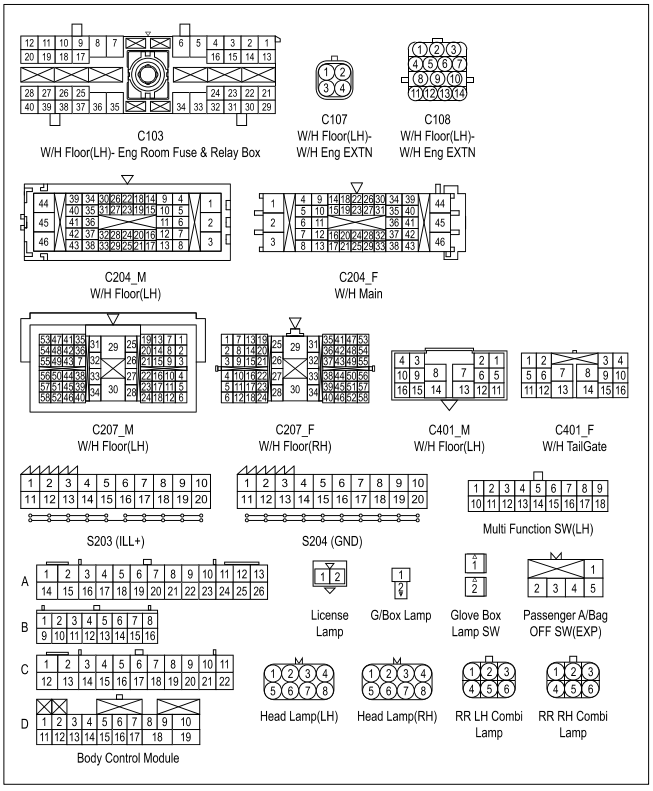
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (4Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C108 (14Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C401 (16Pin, White)	W/H Floor(LH) - W/H Tail Gate	Upper Tail Gate LH	
G105	W/H Floor(RH)	Behind RH Head Lamp	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
G301	W/H Floor(LH)	Under Driver Seat	
G303	W/H Floor(LH)	Driver QTR PNL	
G304	W/H Floor(RH)	Passenger QTR PNL	
G401	W/H Tail Gate	CTR Under Tail Gate	
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

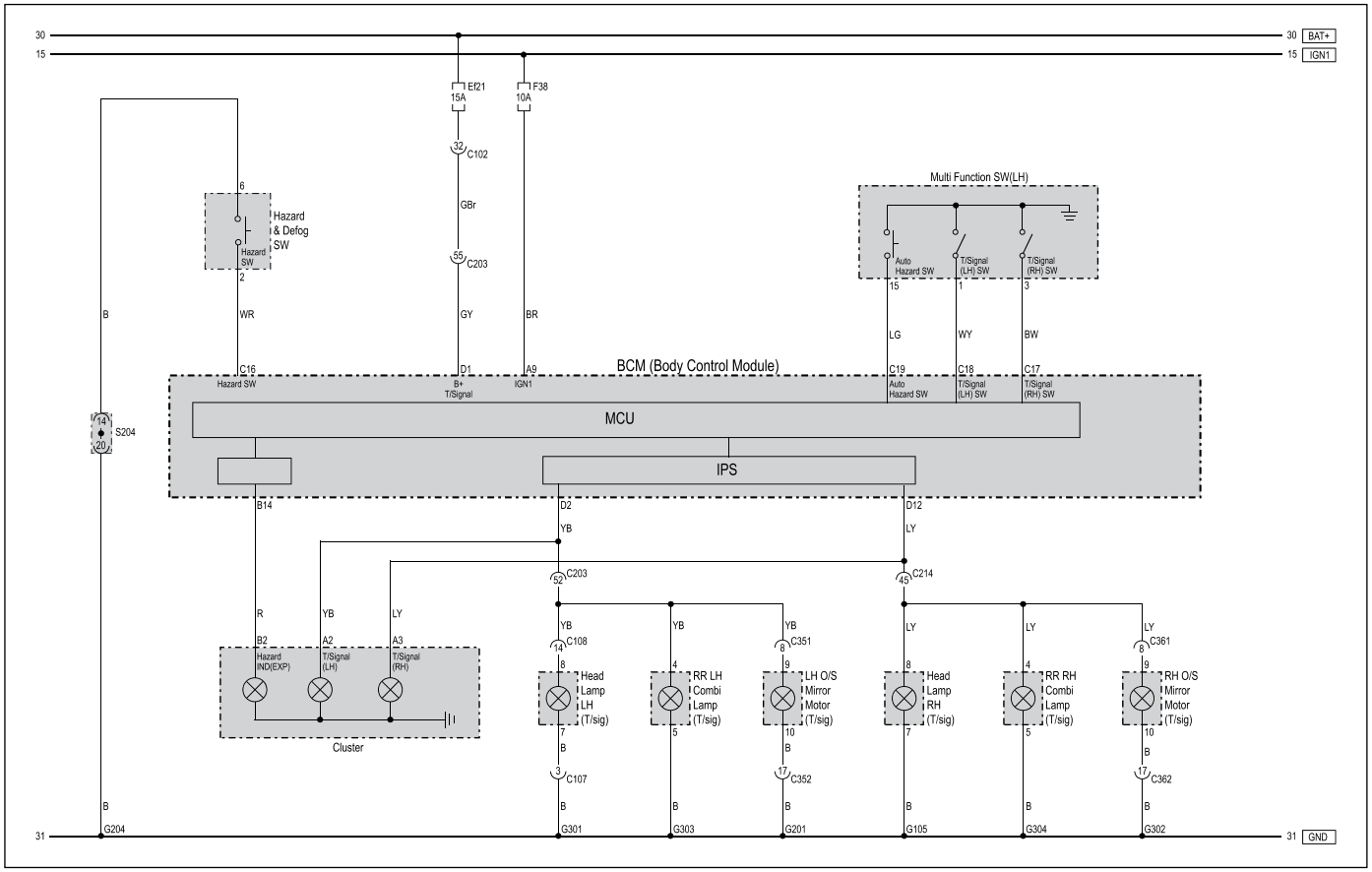
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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8310-01 TURN SIGNAL LAMP / HAZARD LAMP



CIRCUIT

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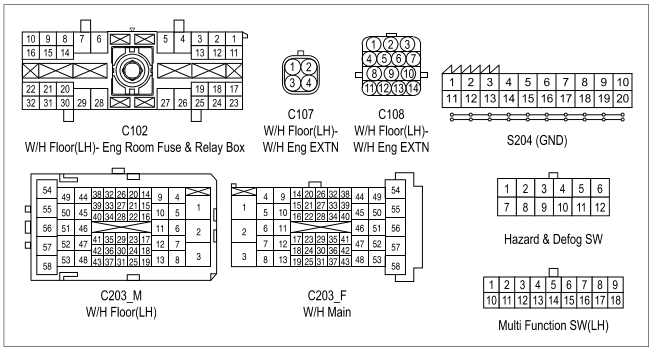
Modification basis	
Application basis	
Affected VIN	

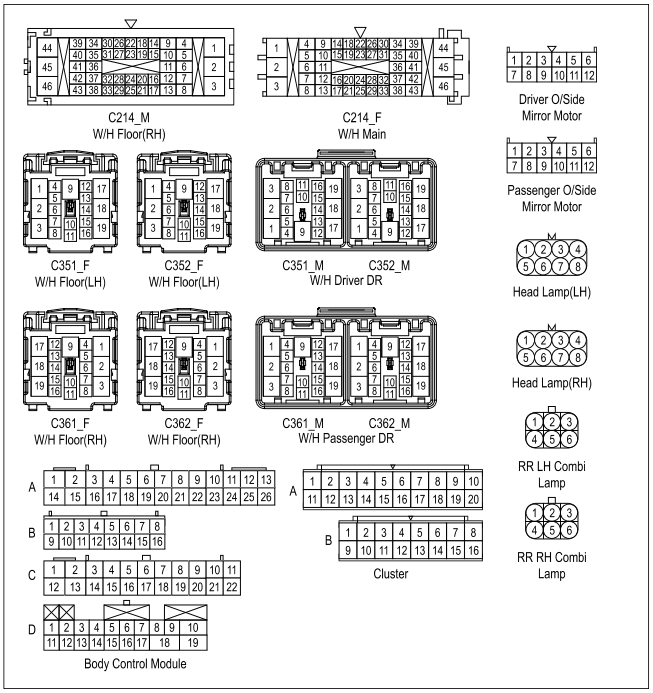
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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (4Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C108 (14Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C214 (46Pin, Black)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C351 (19Pin, Gray)	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C352 (19Pin, White)	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C361 (19Pin, White)	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C362 (19Pin, Gray)	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
G105	W/H Floor(RH)	Behind RH Head Lamp	
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G204	W/H Main	Inside I.P(RH Glove Box)	
G301	W/H Floor(LH)	Under Driver Seat	
G302	W/H Floor(RH)	Under Passenger Seat	
G303	W/H Floor(LH)	Driver QTR PNL	
G304	W/H Floor(RH)	Passenger QTR PNL	
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

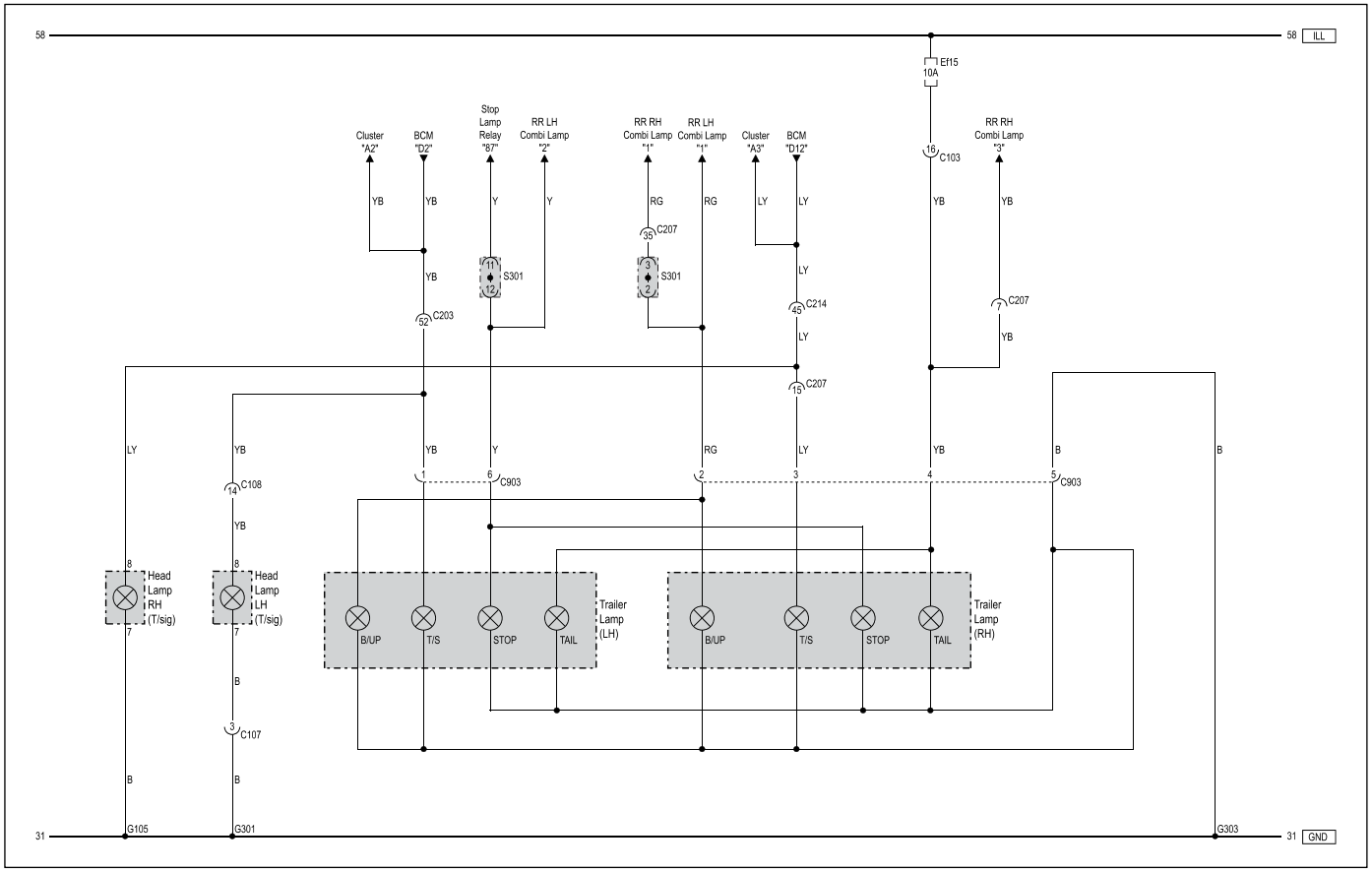
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION





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8210-03 TRAILER LAMP



CIRCUIT

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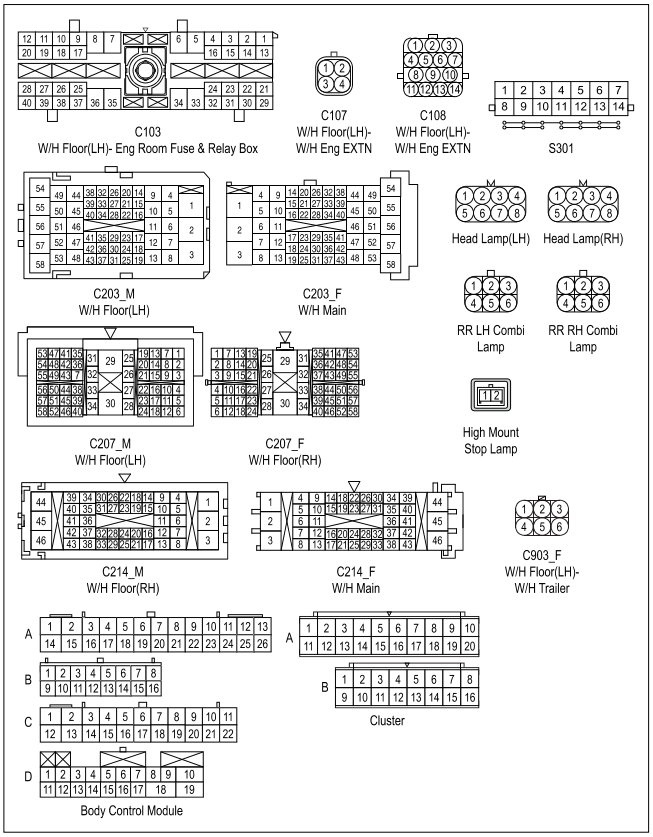
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (4Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C108 (14Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C214 (46Pin, Black)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C903 (6Pin, Black)	W/H Floor(LH) - W/H Trailer	Under RR LH Bumper	
G105	W/H Floor(RH)	Behind RH Head Lamp	
G301	W/H Floor(LH)	Under Driver Seat	
G303	W/H Floor(LH)	Driver QTR PNL	
S301 (14Pin)	W/H Floor(LH)	Under Driver Seat	

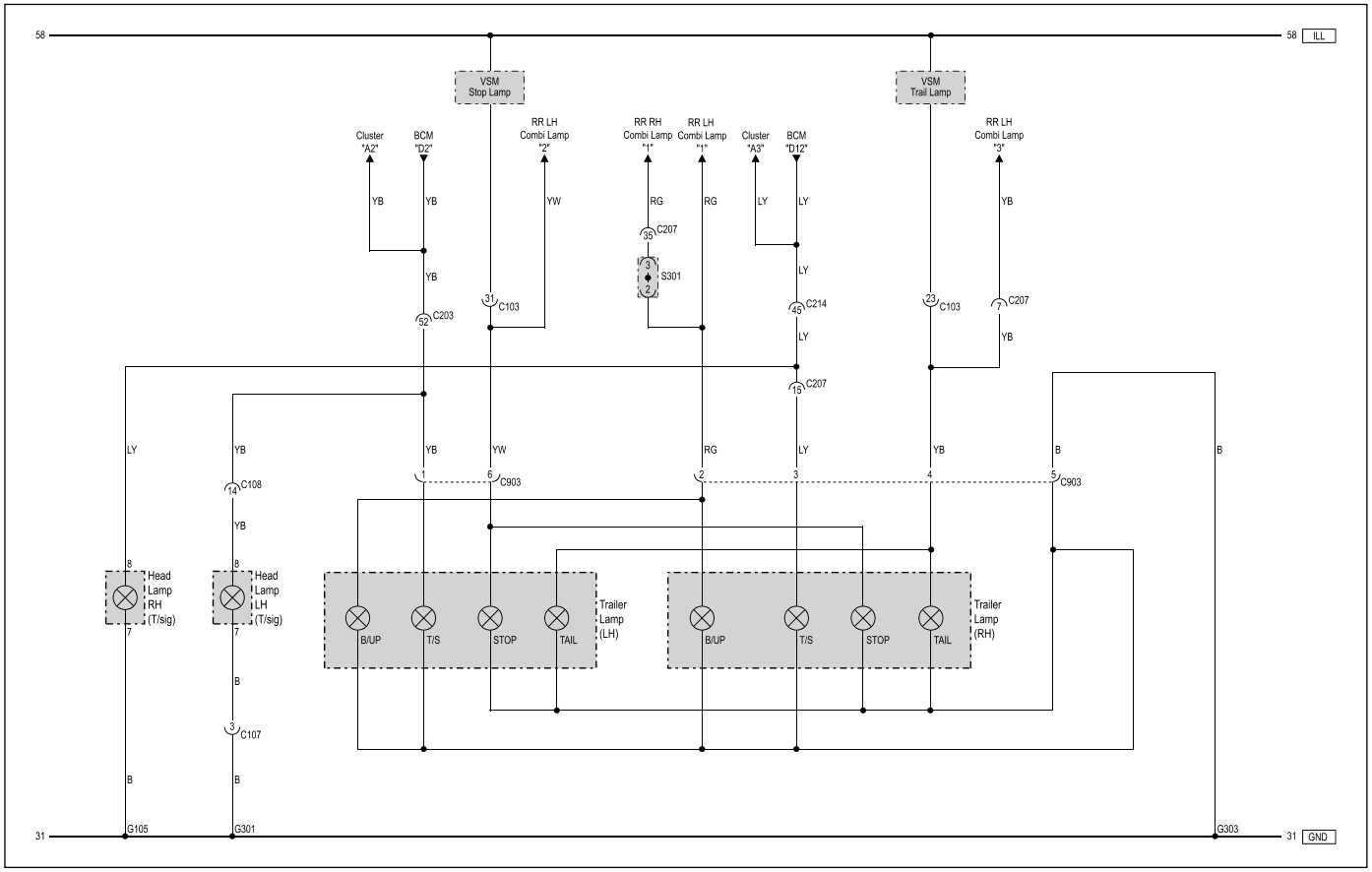
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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8210-03 TRAILER LAMP(W/ VSM)



CIRCUIT

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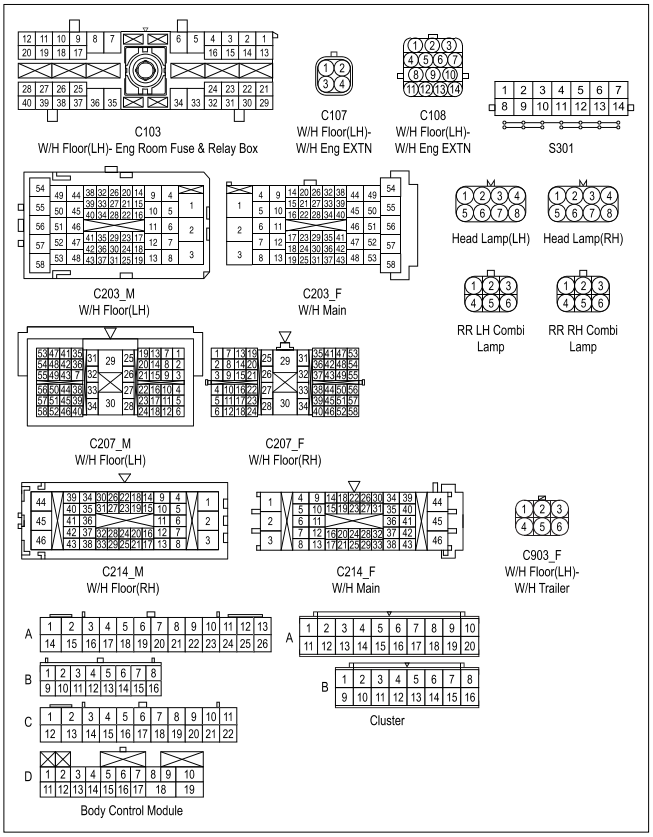
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (4Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C108 (14Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C214 (46Pin, Black)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C903 (6Pin, Black)	W/H Floor(LH) - W/H Trailer	Under RR LH Bumper	
G105	W/H Floor(RH)	Behind RH Head Lamp	
G301	W/H Floor(LH)	Under Driver Seat	
G303	W/H Floor(LH)	Driver QTR PNL	
S301 (14Pin)	W/H Floor(LH)	Under Driver Seat	

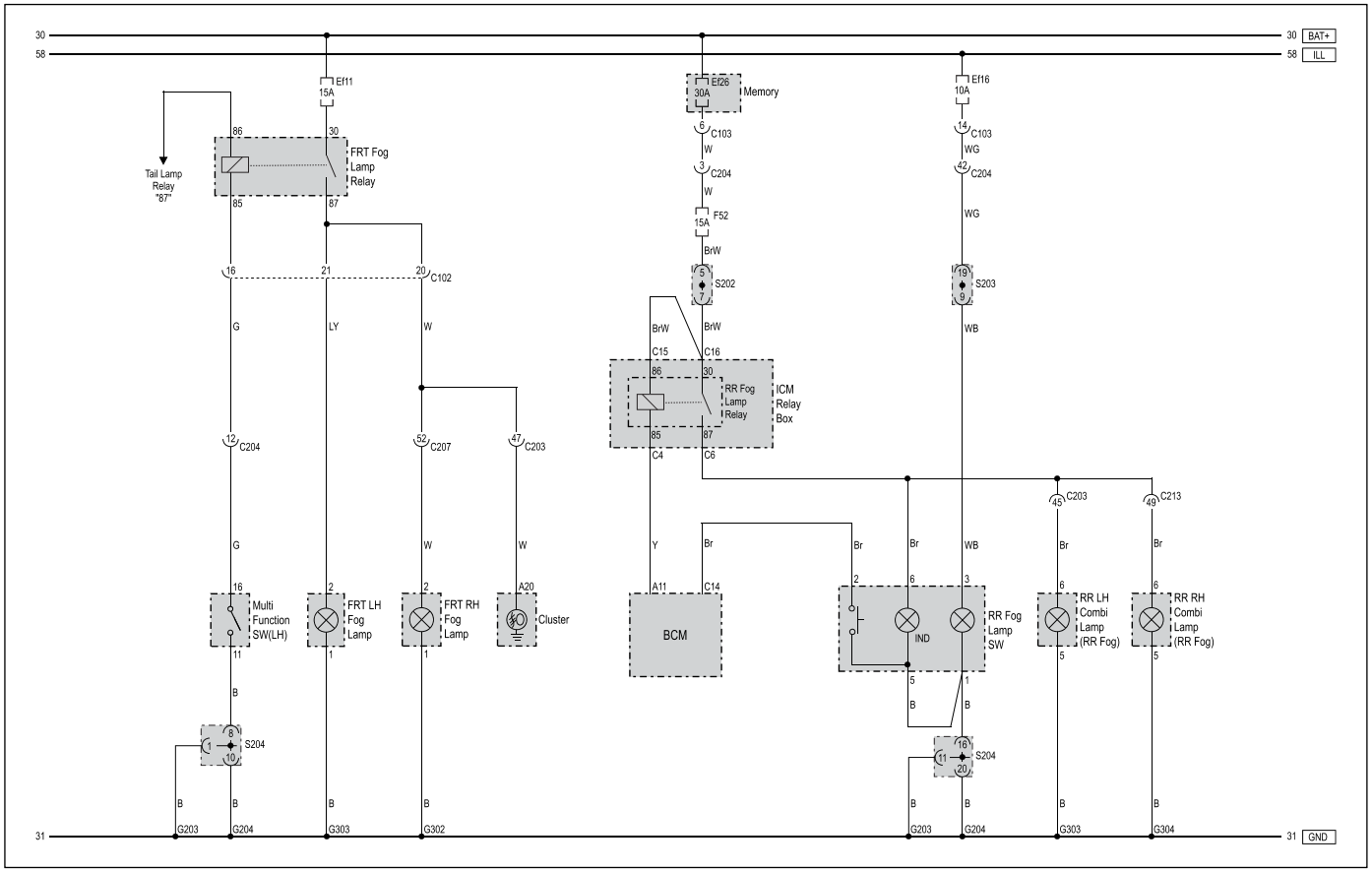
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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8310-10 FRT / RR FOG LAMP



CIRCUIT

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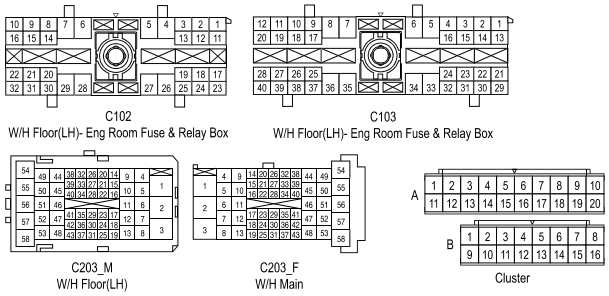
Modification basis	
Application basis	
Affected VIN	

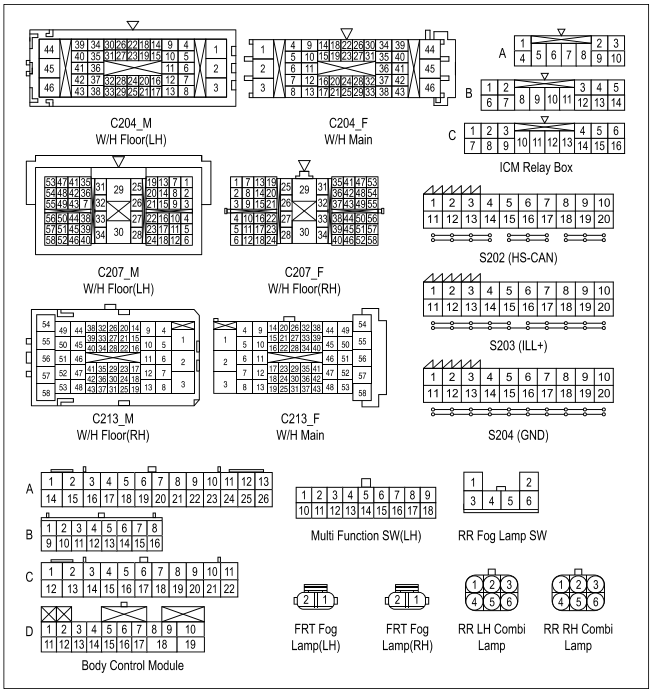
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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C213 (58Pin, White)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
G302	W/H Floor(RH)	Under Passenger Seat	
G303	W/H Floor(LH)	Driver QTR PNL	
G304	W/H Floor(RH)	Passenger QTR PNL	
S202 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

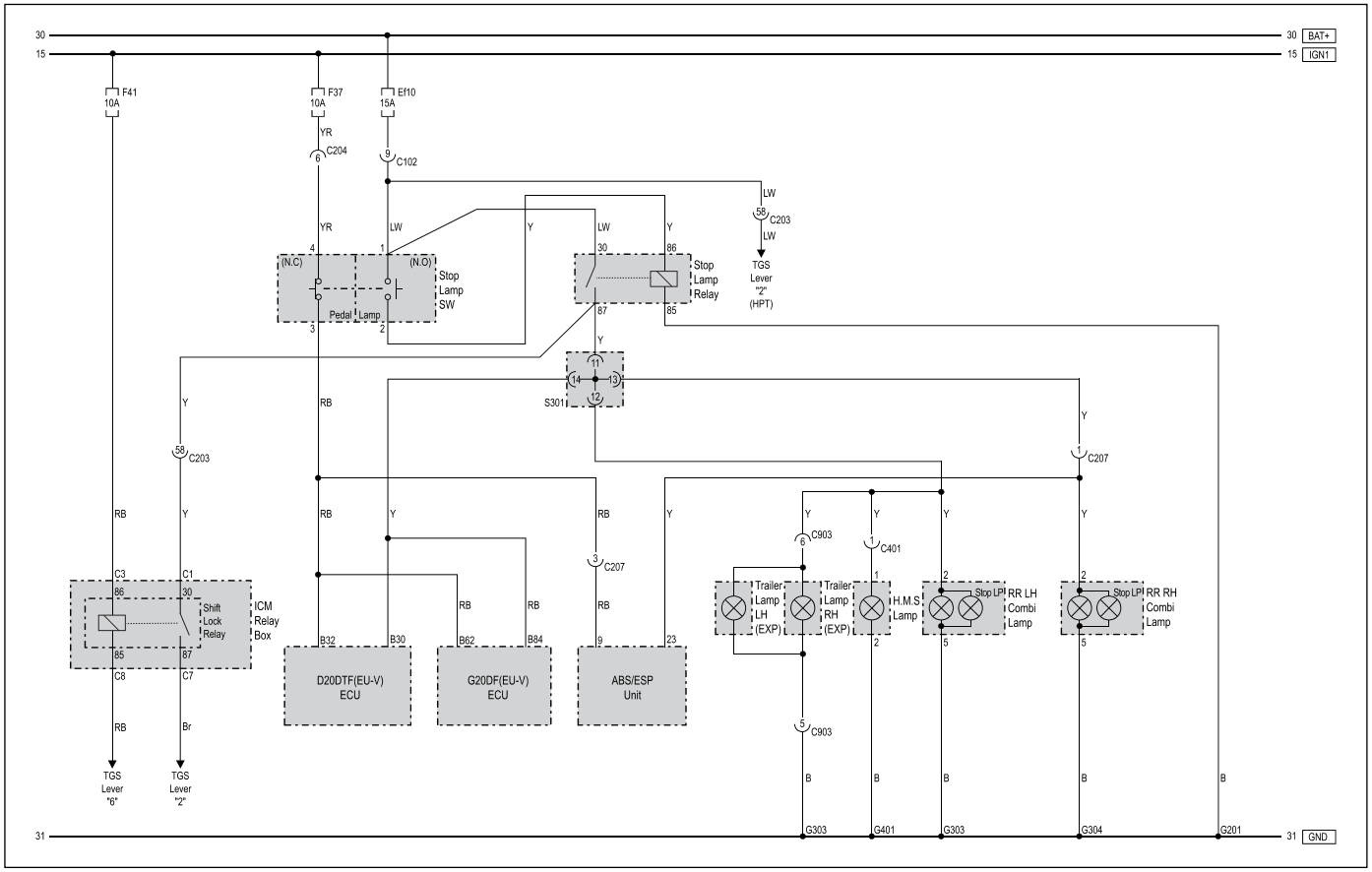
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION





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4810-08 STOP LAMP



CIRCUIT

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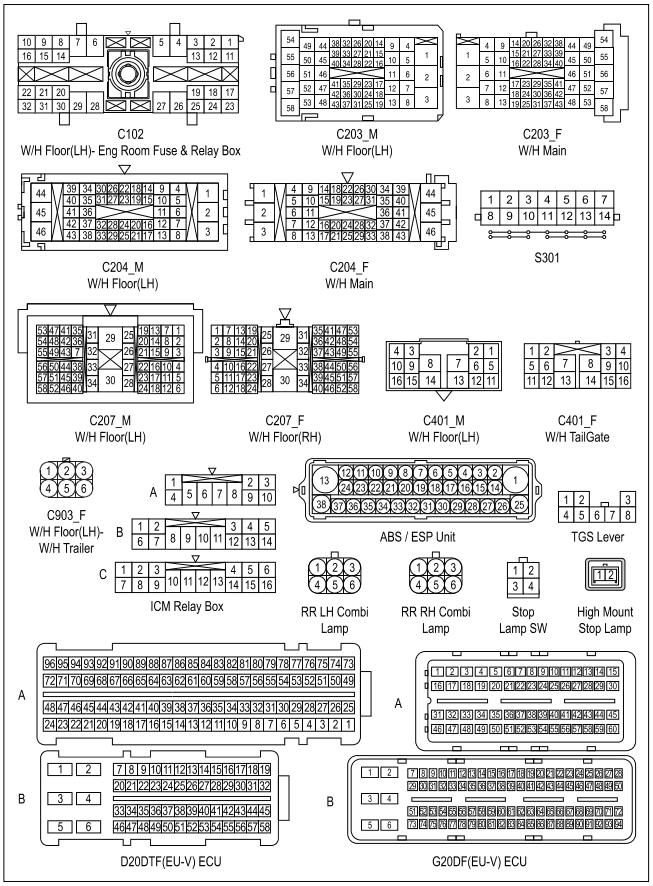
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C401 (16Pin, White)	W/H Floor(LH) - W/H Tail Gate	Upper Tail Gate LH	
C903 (6Pin, Black)	W/H Floor(LH) - W/H Trailer	Under RR LH Bumper	
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G303	W/H Floor(LH)	Driver QTR PNL	
G304	W/H Floor(RH)	Passenger QTR PNL	
G401	W/H Tail Gate	CTR Under Tail Gate	
S301 (14Pin)	W/H Floor(LH)	Under Driver Seat	

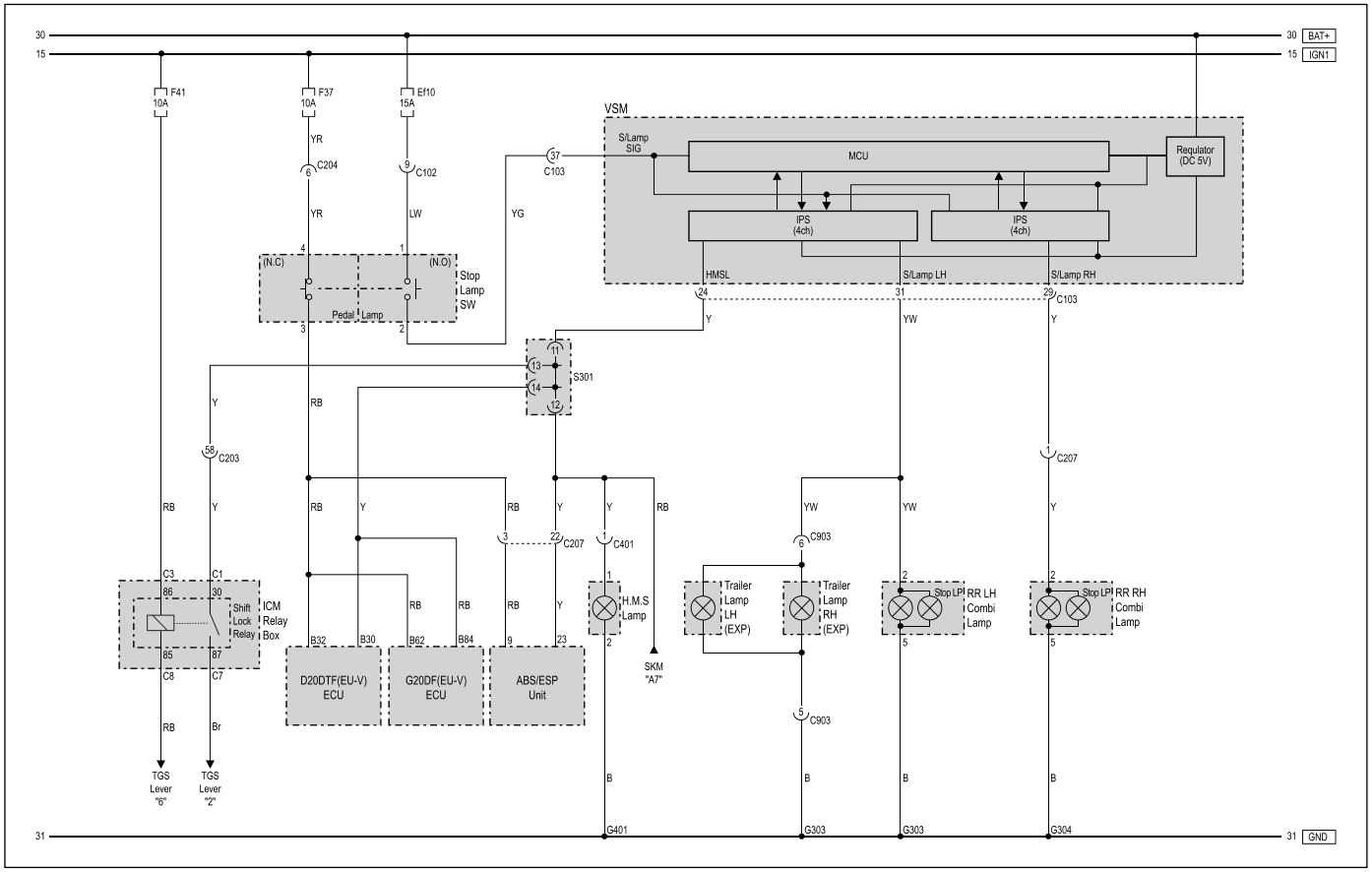
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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4810-08 STOP LAMP(W/ VSM)



CIRCUIT

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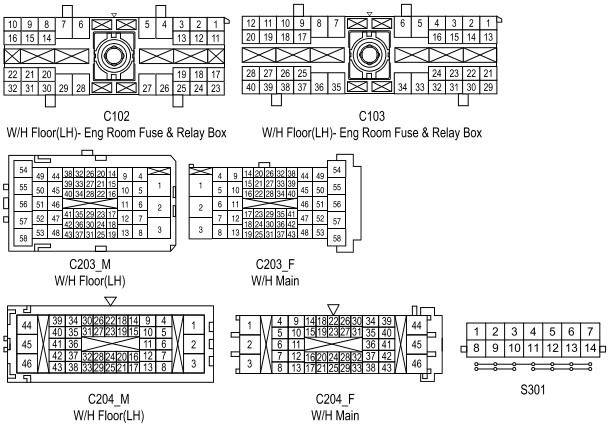
Modification basis	
Application basis	
Affected VIN	

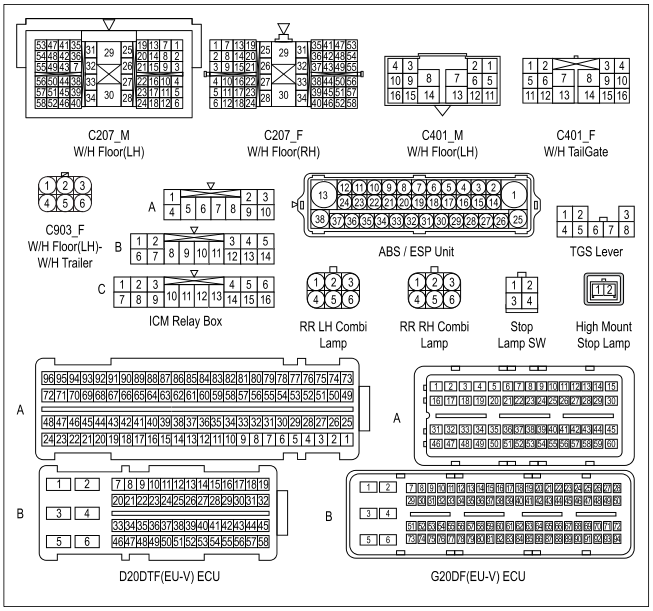
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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C401 (16Pin, White)	W/H Floor(LH) - W/H Tail Gate	Upper Tail Gate LH	
C903 (6Pin, Black)	W/H Floor(LH) - W/H Trailer	Under RR LH Bumper	
G303	W/H Floor(LH)	Driver QTR PNL	
G304	W/H Floor(RH)	Passenger QTR PNL	
G401	W/H Tail Gate	CTR Under Tail Gate	
S301 (14Pin)	W/H Floor(LH)	Under Driver Seat	

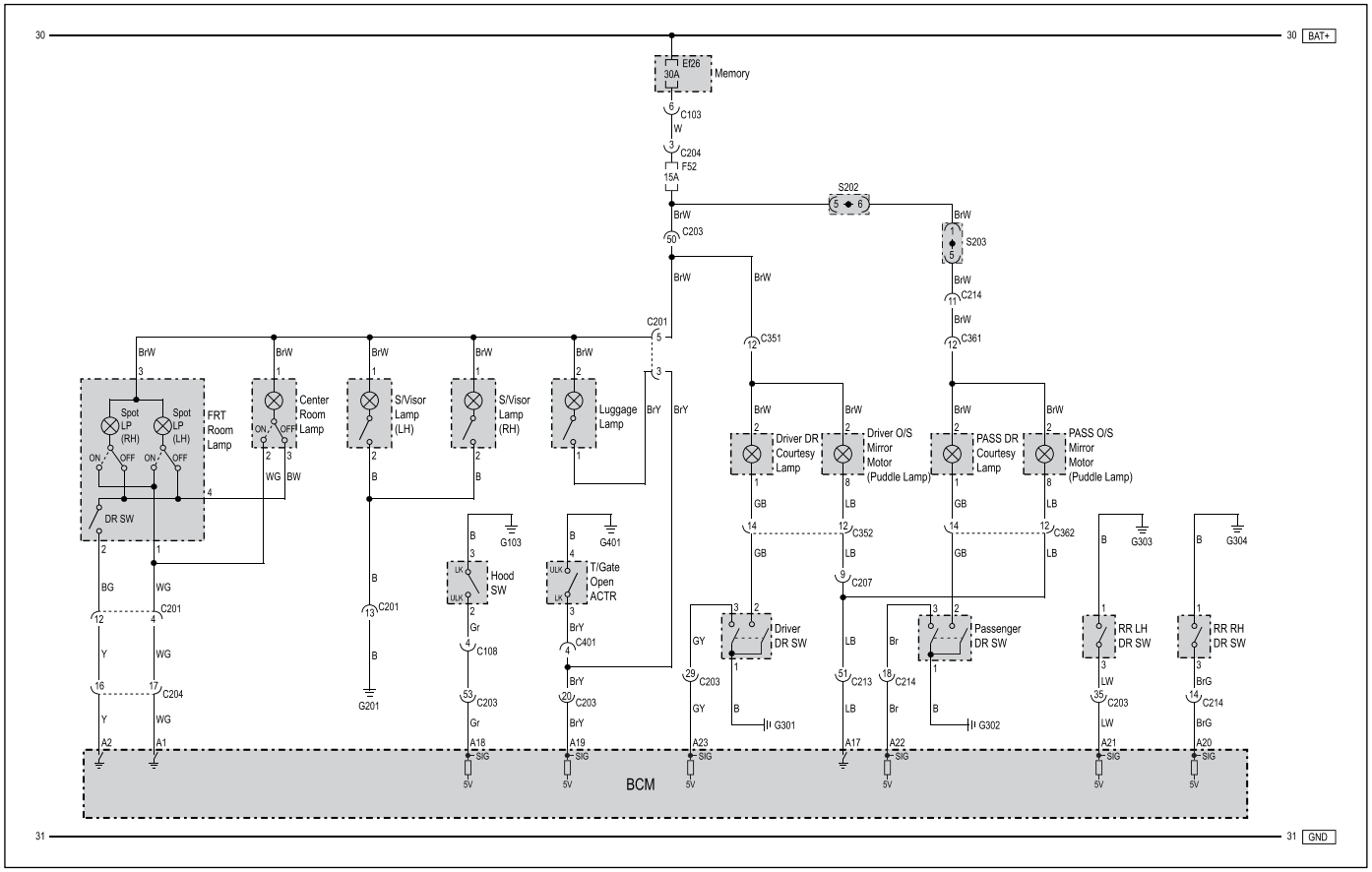
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION





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7770-02 INTERIOR / DOOR LAMP



CIRCUIT

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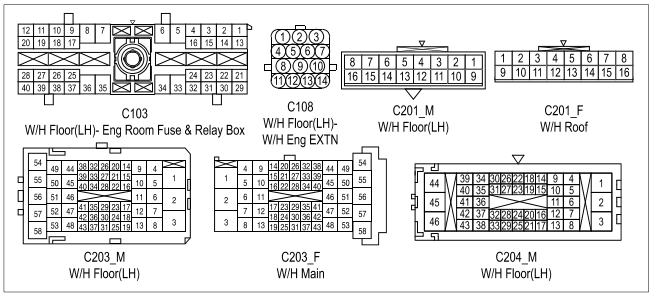
Modification basis	
Application basis	
Affected VIN	

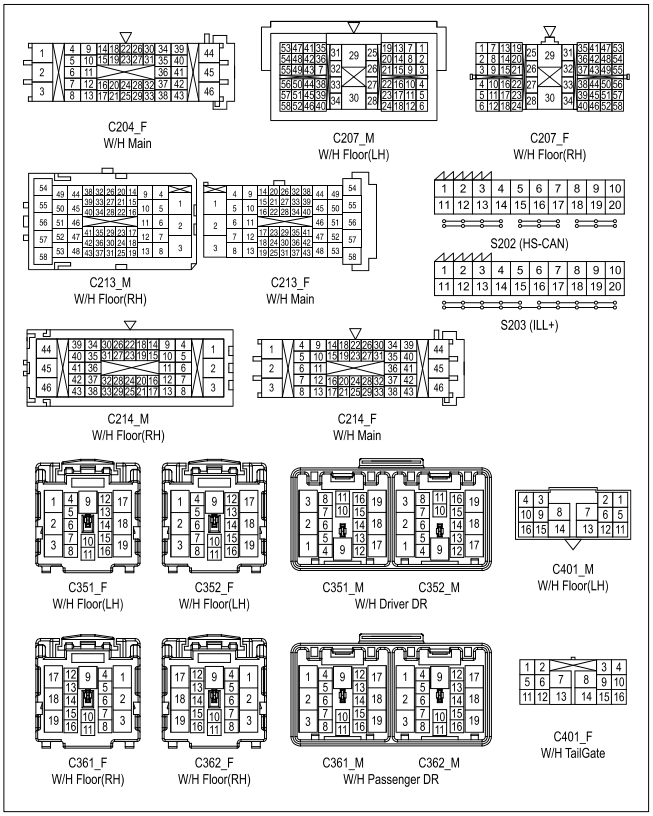
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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (14Pin, Black)	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C201 (16Pin, White)	W/H Floor(LH) - W/H Roof	Upper Driver Cowl Side Connector Holder	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C213 (58Pin, White)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C214 (46Pin, Black)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C351 (19Pin, Gray)	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C352 (19Pin, White)	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C361 (19Pin, White)	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C362 (19Pin, Gray)	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C401 (16Pin, White)	W/H Floor(LH) - W/H Tail Gate	Upper Tail Gate LH	
G103	W/H Eng EXTN	Under BATT Tray	
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G301	W/H Floor(LH)	Under Driver Seat	
G302	W/H Floor(RH)	Under Passenger Seat	
G303	W/H Floor(LH)	Driver QTR PNL	
G304	W/H Floor(RH)	Passenger QTR PNL	
G401	W/H Tail Gate	CTR Under Tail Gate	
S202 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +

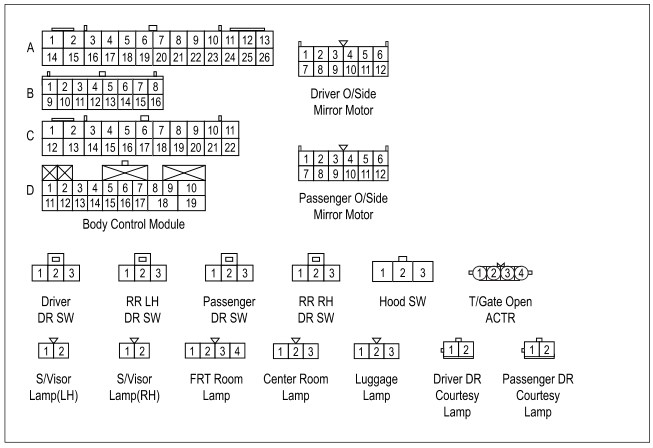
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION





Modification basis	
Application basis	
Affected VIN	

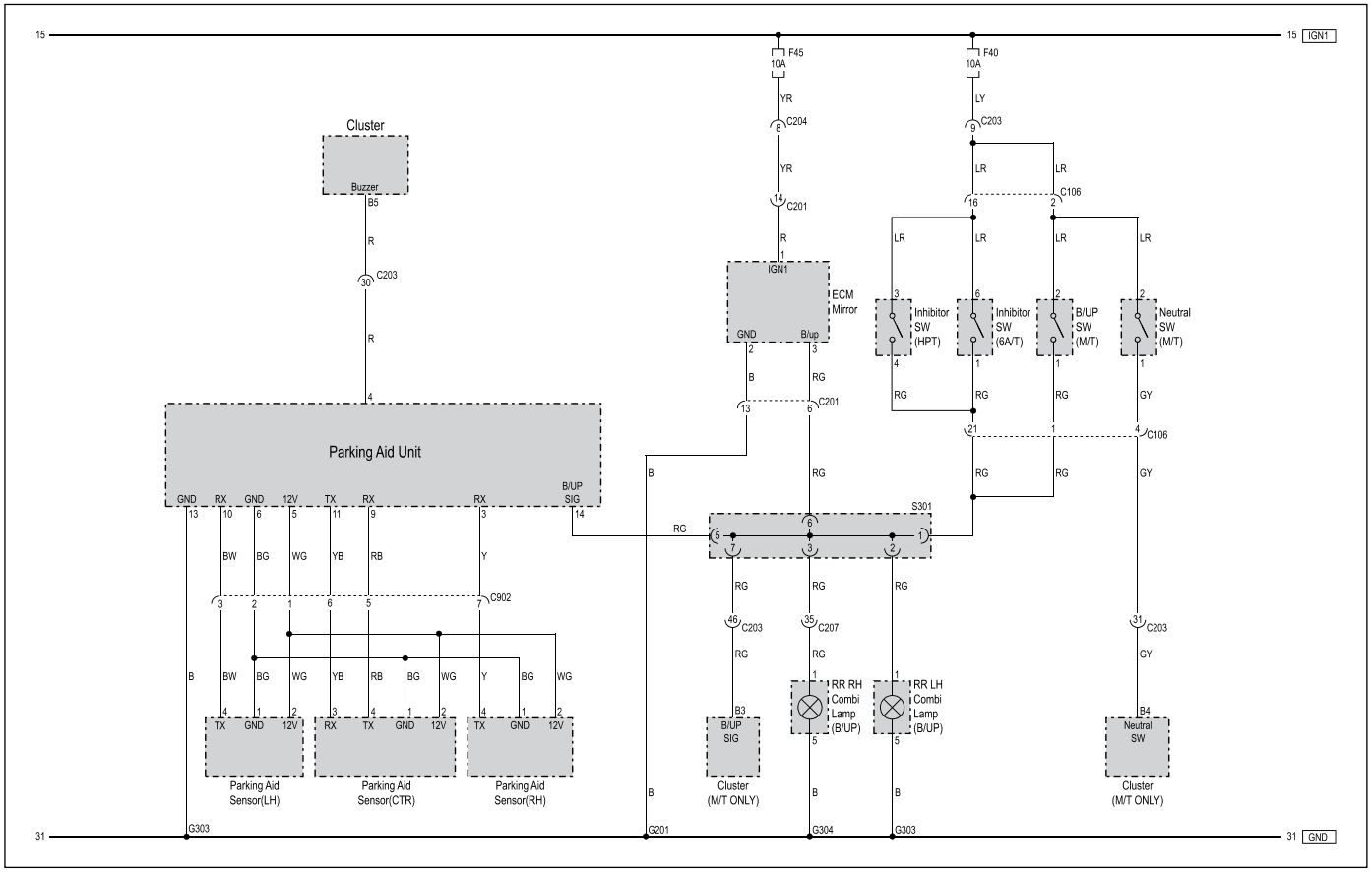
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Modification basis	
Application basis	
Affected VIN	

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8790-01 PARKING AID / BACK UP LAMP / ECM MIRROR



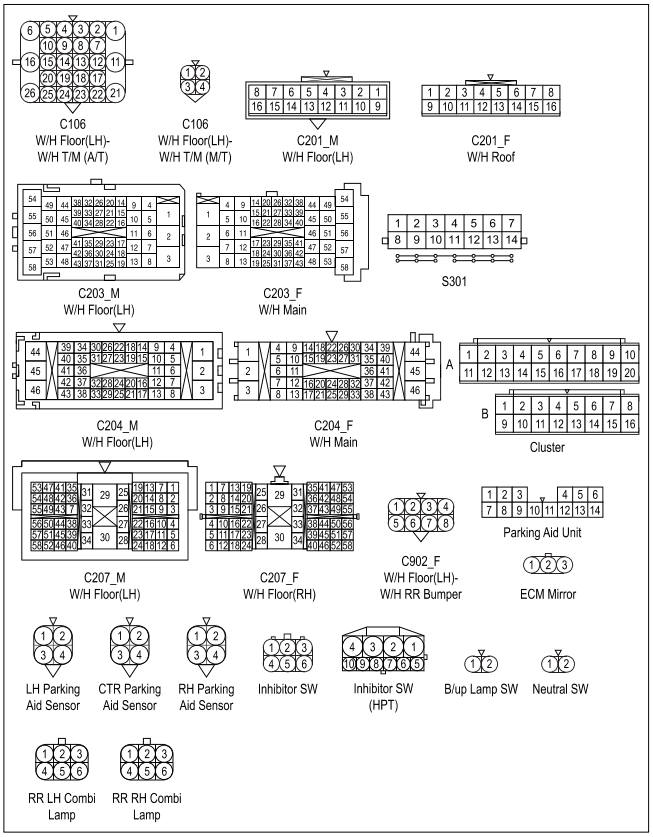
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C106	(26Pin, Black)	W/H Floor(LH) - W/H T/M	Upper T/M(Under BATT Tray)	A/T
	(4Pin, Black)	W/H Floor(LH) - W/H T/M	Upper T/M(Under BATT Tray)	M/T
C201 (16Pin, White)		W/H Floor(LH) - W/H Roof	Upper Driver Cowl Side Connector Holder	
C203 (58Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)		W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C902 (8Pin, Black)		W/H Floor(LH) - W/H RR Bumper	Under RR LH Bumper	PAS
G201		W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G303		W/H Floor(LH)	Driver QTR PNL	
G304		W/H Floor(RH)	Passenger QTR PNL	
S301 (14Pin)		W/H Floor(LH)	Under Driver Seat	

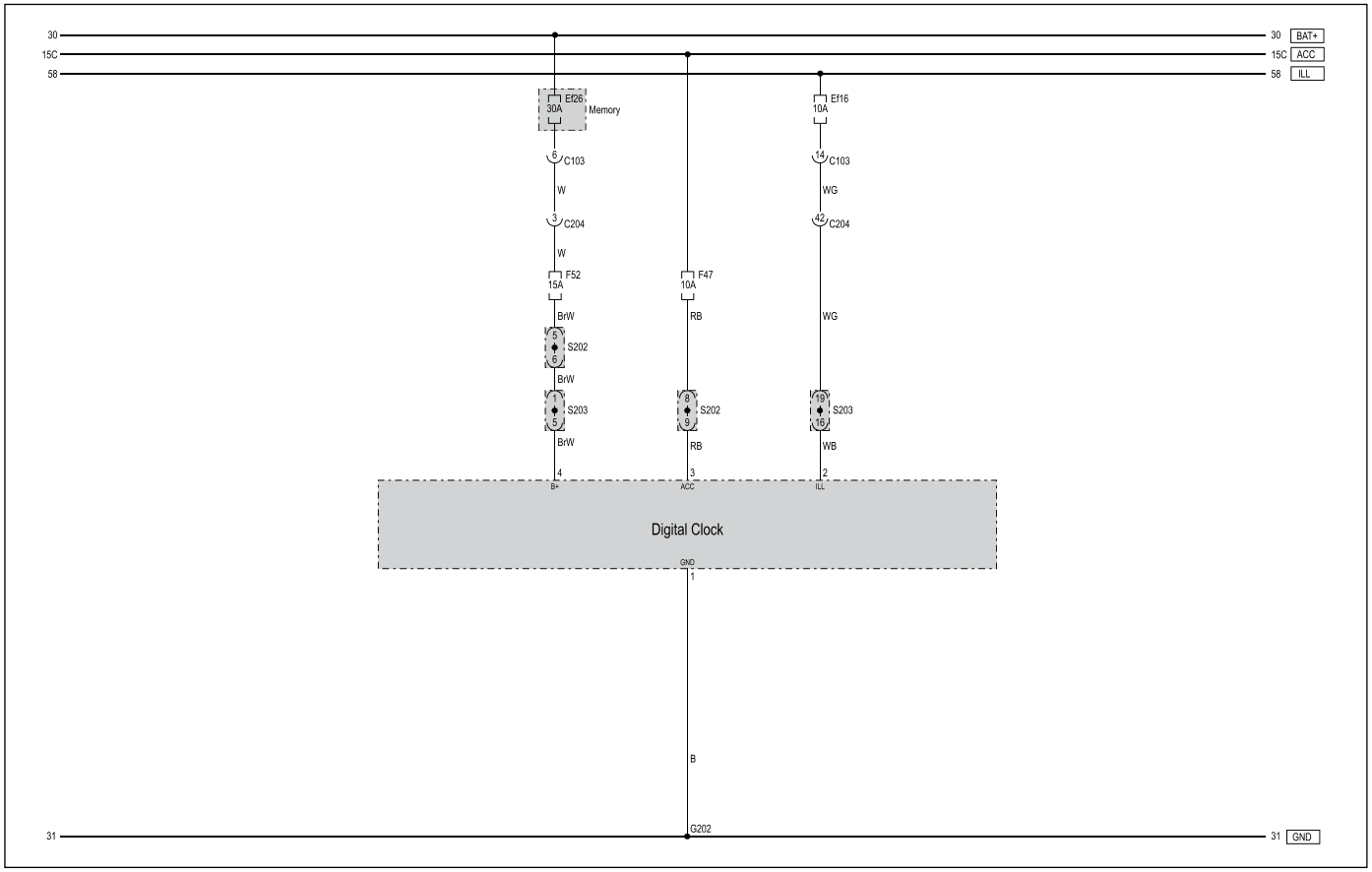
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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8610-04 DIGITAL CLOCK



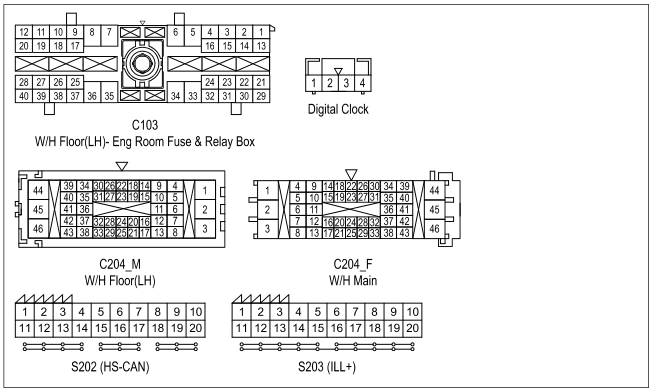
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
G202	W/H Main	Backside Cluster(LH Cowl Cross Member)	AUDIO
S202 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +

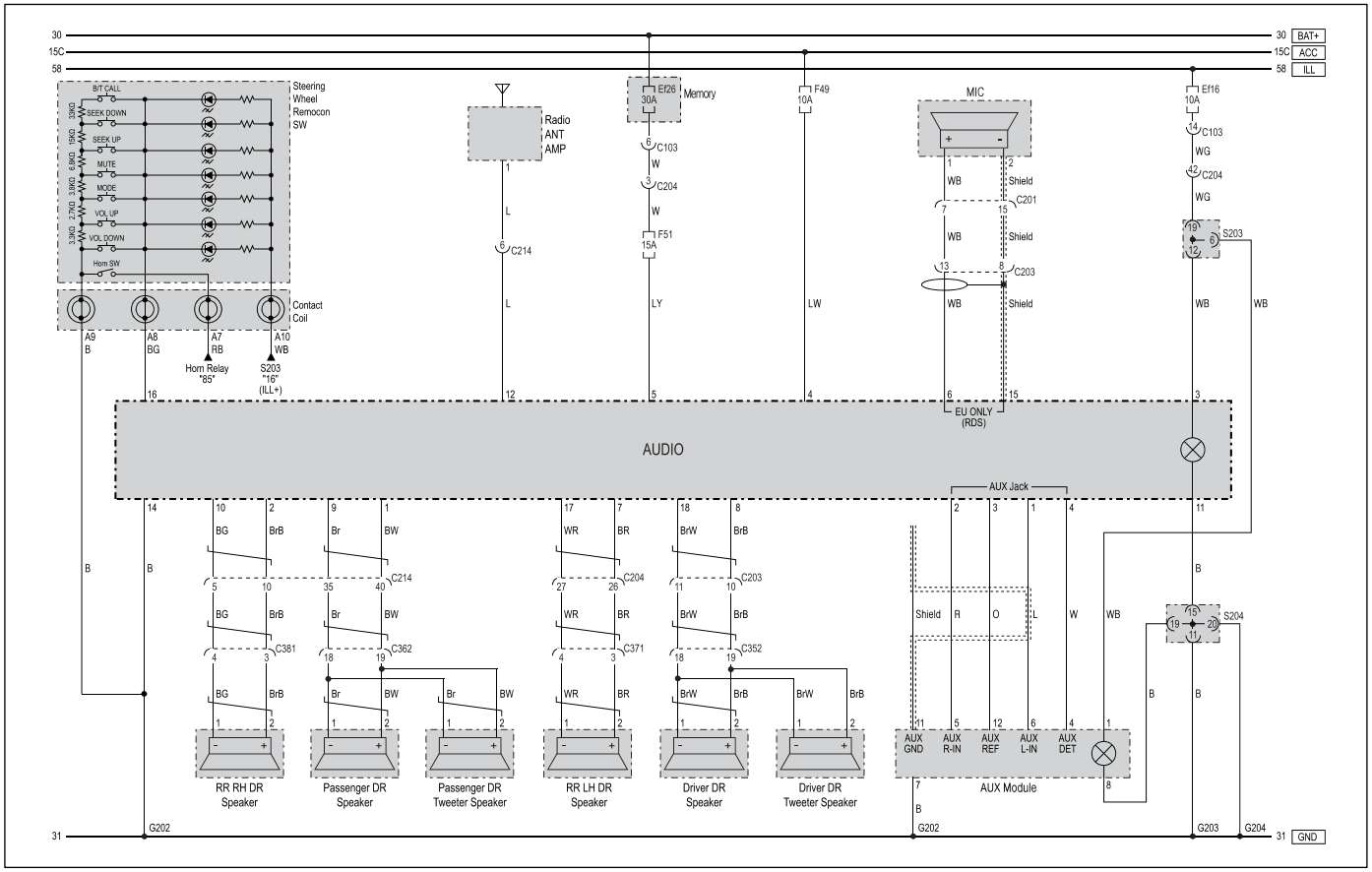
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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8930-03 **AUDIO**



Modification basis	
Application basis	
Affected VIN	

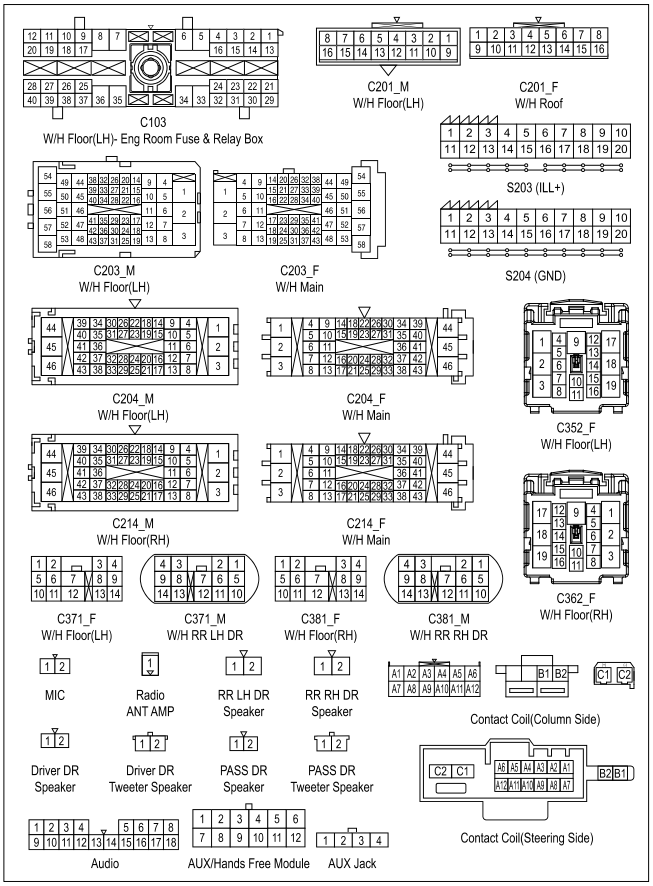
CIRCUIT
KORANDO 2013.08

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (40Pin, Gray)	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C201 (16Pin, White)	W/H Floor(LH) - W/H Roof	Upper Driver Cowl Side Connector Holder	
C203 (58Pin, White)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C214 (46Pin, Black)	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C352 (19Pin, White)	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C362 (19Pin, Gray)	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C371 (14Pin, White)	W/H Floor(LH) - W/H RR LH DR	Under LH B Pillar	
C381 (14Pin, White)	W/H Floor(RH) - W/H RR RH DR	Under RH B Pillar	
G202	W/H Main	Backside Cluster(LH Cowl Cross Member)	AUDIO
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
S203 (20Pin)	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204 (20Pin)	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND

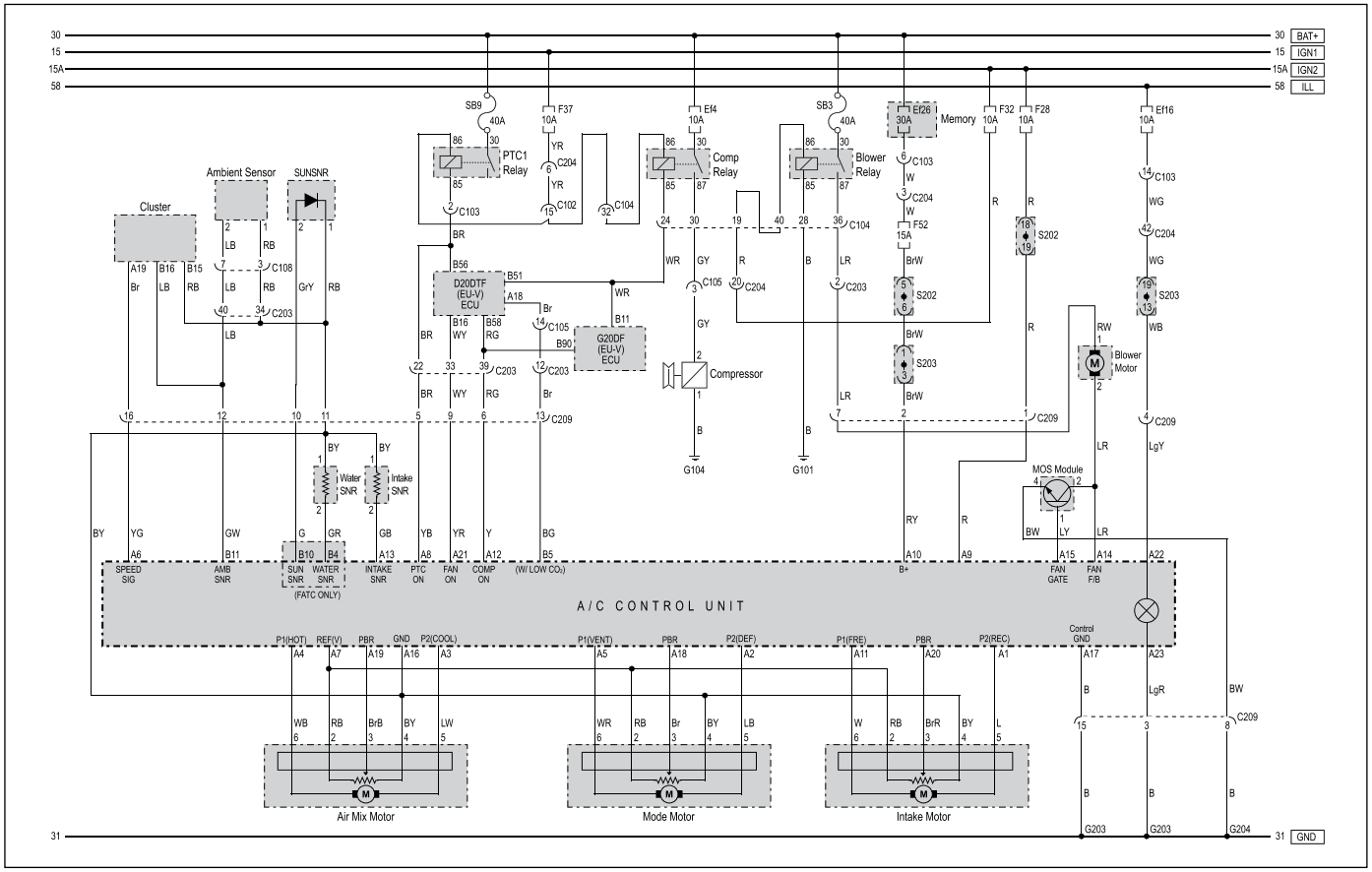
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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6810-20 AIR CONDITIONER SYSTEM



Modification basis	
Application basis	
Affected VIN	

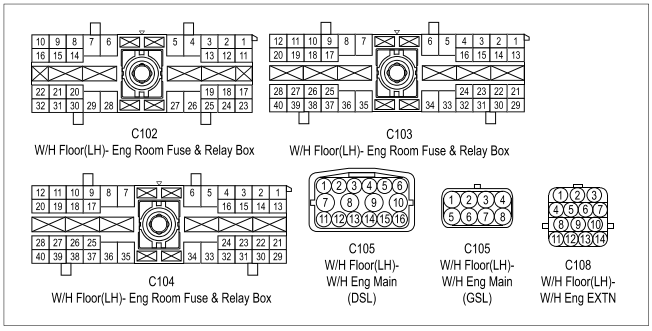
CIRCUIT
KORANDO 2013.08

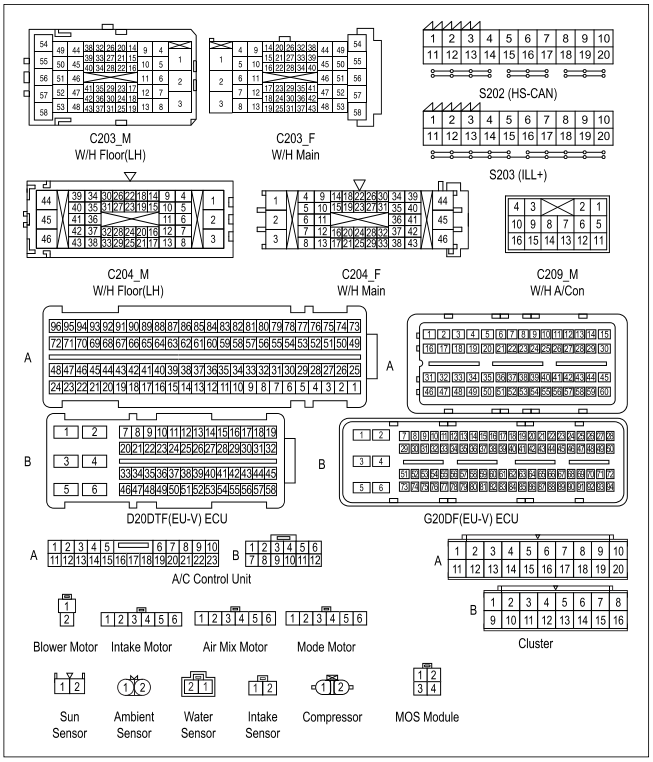
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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (40Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105	(8Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	GSL
	(16Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	DSL
C108 (14Pin, Black)		W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C203 (58Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C209 (16Pin, White)		W/H Main - W/H Air Con	Inside I.P (Upper CTR Cowl Cross Member)	
G101		W/H Floor(LH)	Behind LH Head Lamp	
G104		W/H Eng Main	FRT Intake Valve	
G203		W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204		W/H Main	Inside I.P(RH Glove Box)	
S202 (20Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S203 (20Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

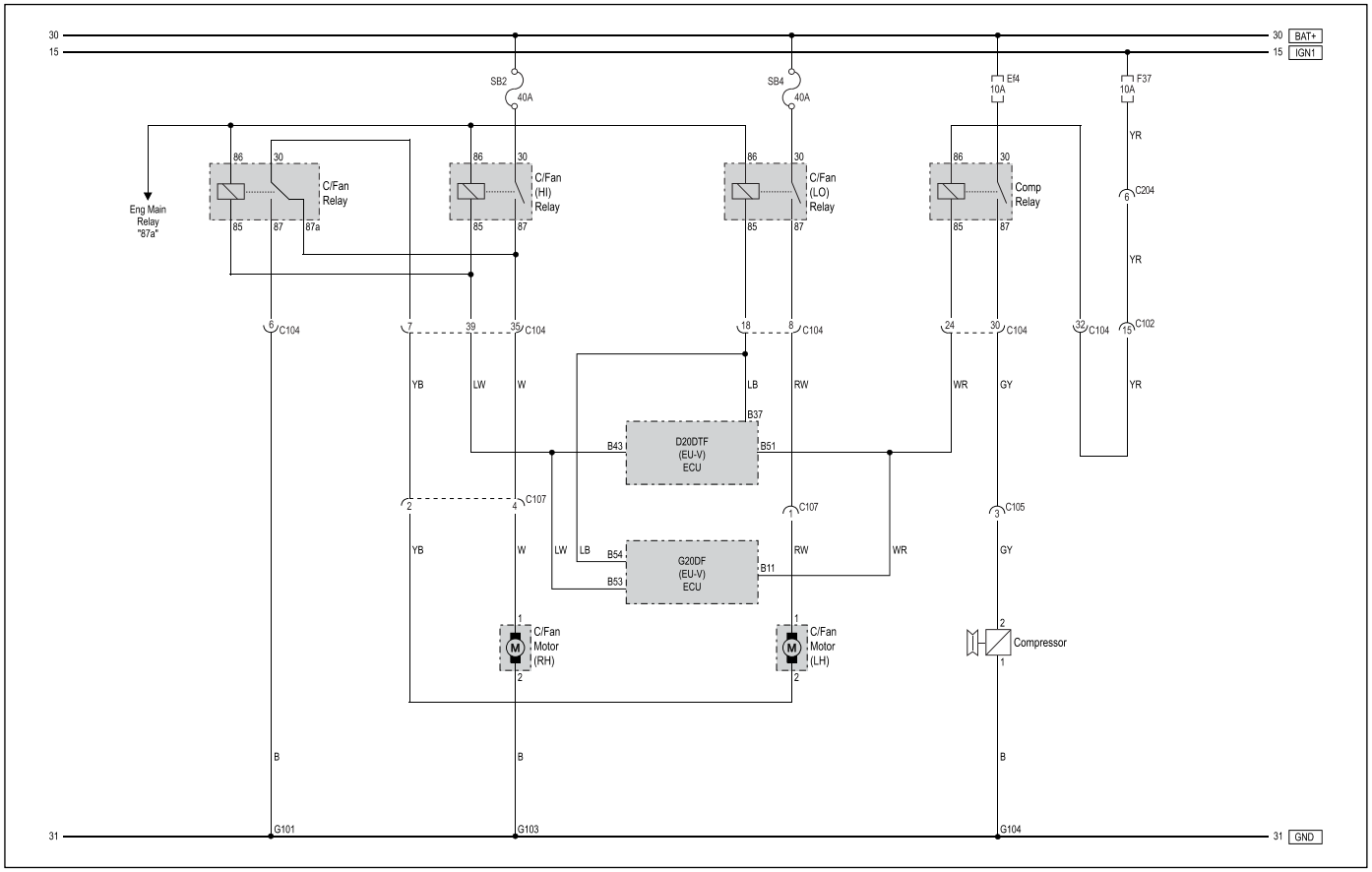




Modification basis	
Application basis	
Affected VIN	

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2112-02 COOLING FAN SYSTEM



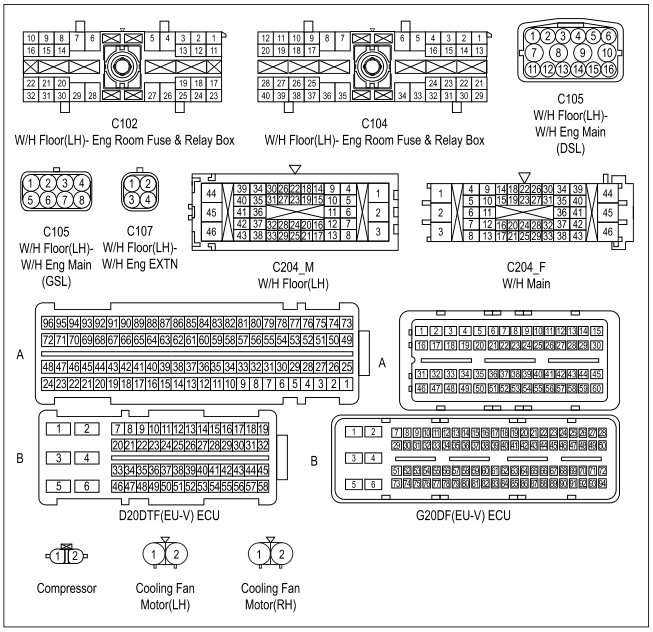
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (40Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105	(8Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	GSL
	(16Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	DSL
C107 (4Pin, Black)		W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C204 (46Pin, Black)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
G101		W/H Floor(LH)	Behind LH Head Lamp	
G103		W/H Eng EXTN	Under BATT Tray	
G104		W/H Eng Main	FRT Intake Valve	

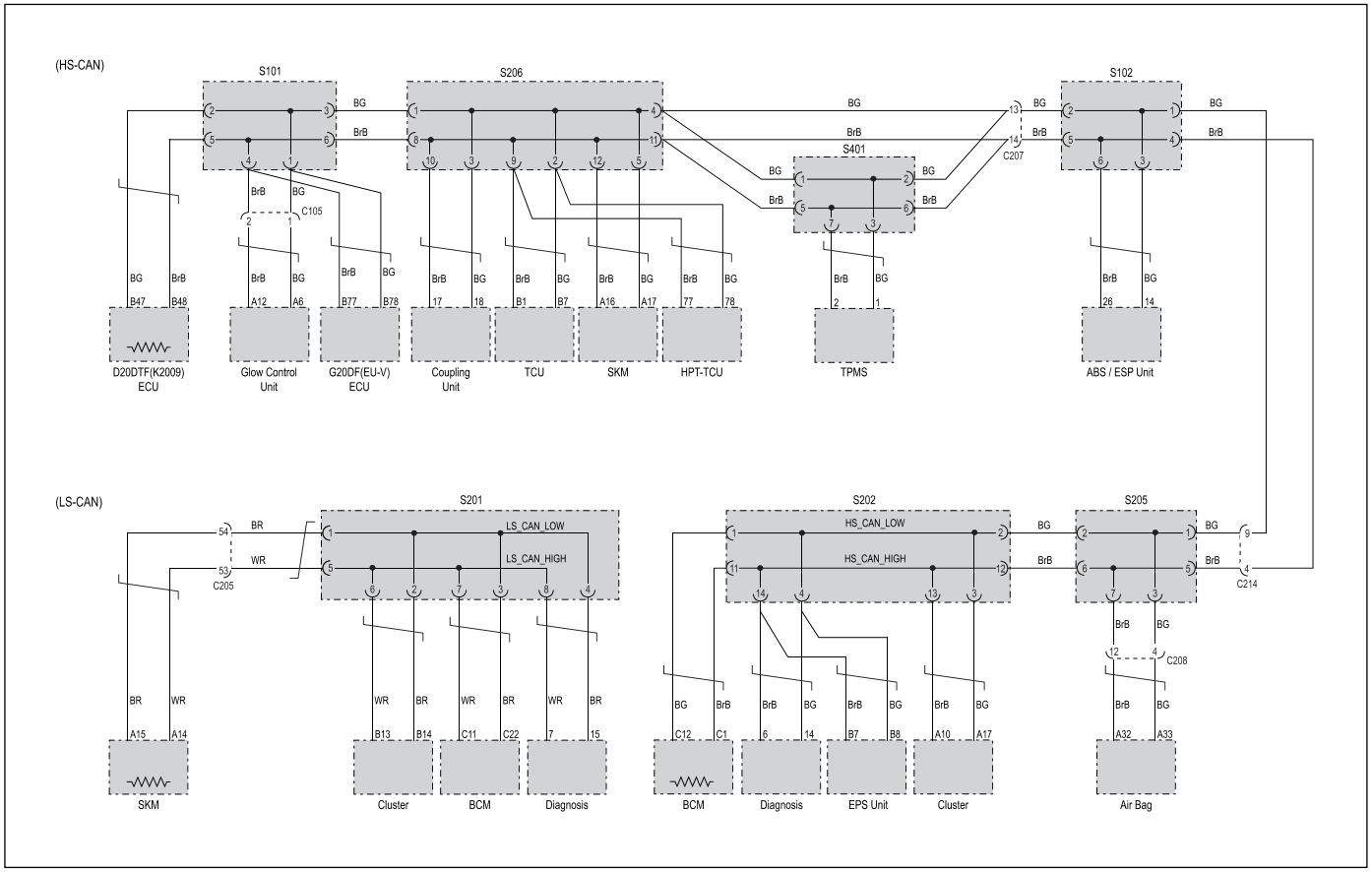
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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SYSTEM
8210-01 CAN



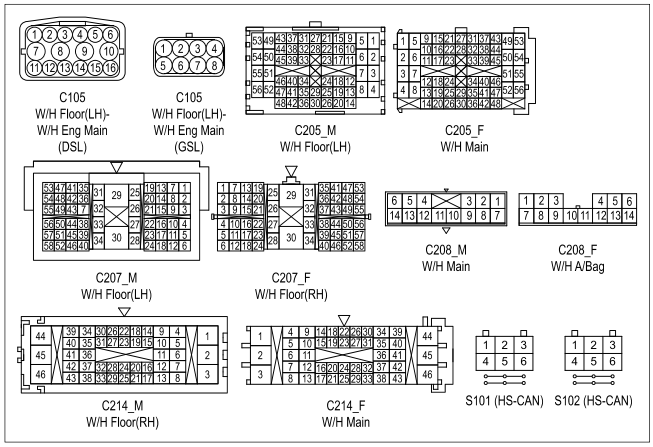
Modification basis	
Application basis	
Affected VIN	

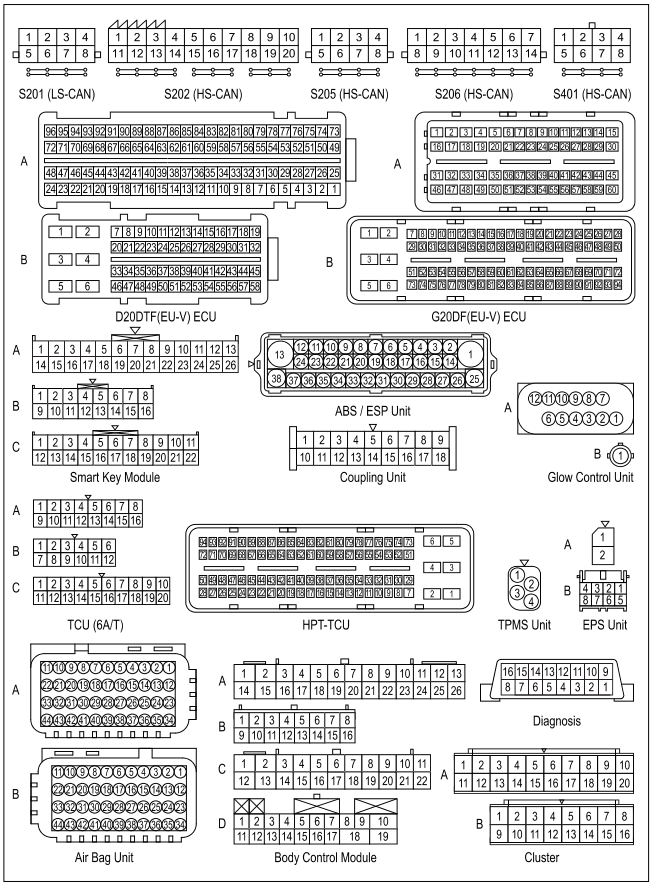
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(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C105	(8Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	GSL
	(16Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	DSL
C205 (56Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)		W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C208 (14Pin, White)		W/H Main - W/H Air Bag	Inside I.P (Upper Driver LegRoom)	
C214 (46Pin, Black)		W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
S101 (6Pin)		W/H Floor(LH)	Under Eng Room Fuse & Relay Box	HS-CAN
S102 (6Pin)		W/H Floor(RH)	Inside RH Fender	HS-CAN
S201 (8Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	LS-CAN
S202 (20Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S205 (8Pin)		W/H Main	Backside Audio(CTR Cowl Cross Member)	HS-CAN
S206 (14Pin)		W/H Floor(LH)	Under Driver Seat	HS-CAN
S401 (8Pin)		W/H Floor(LH)	Beside PAS Unit(Inside LH QTR Trim)	HS-CAN

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

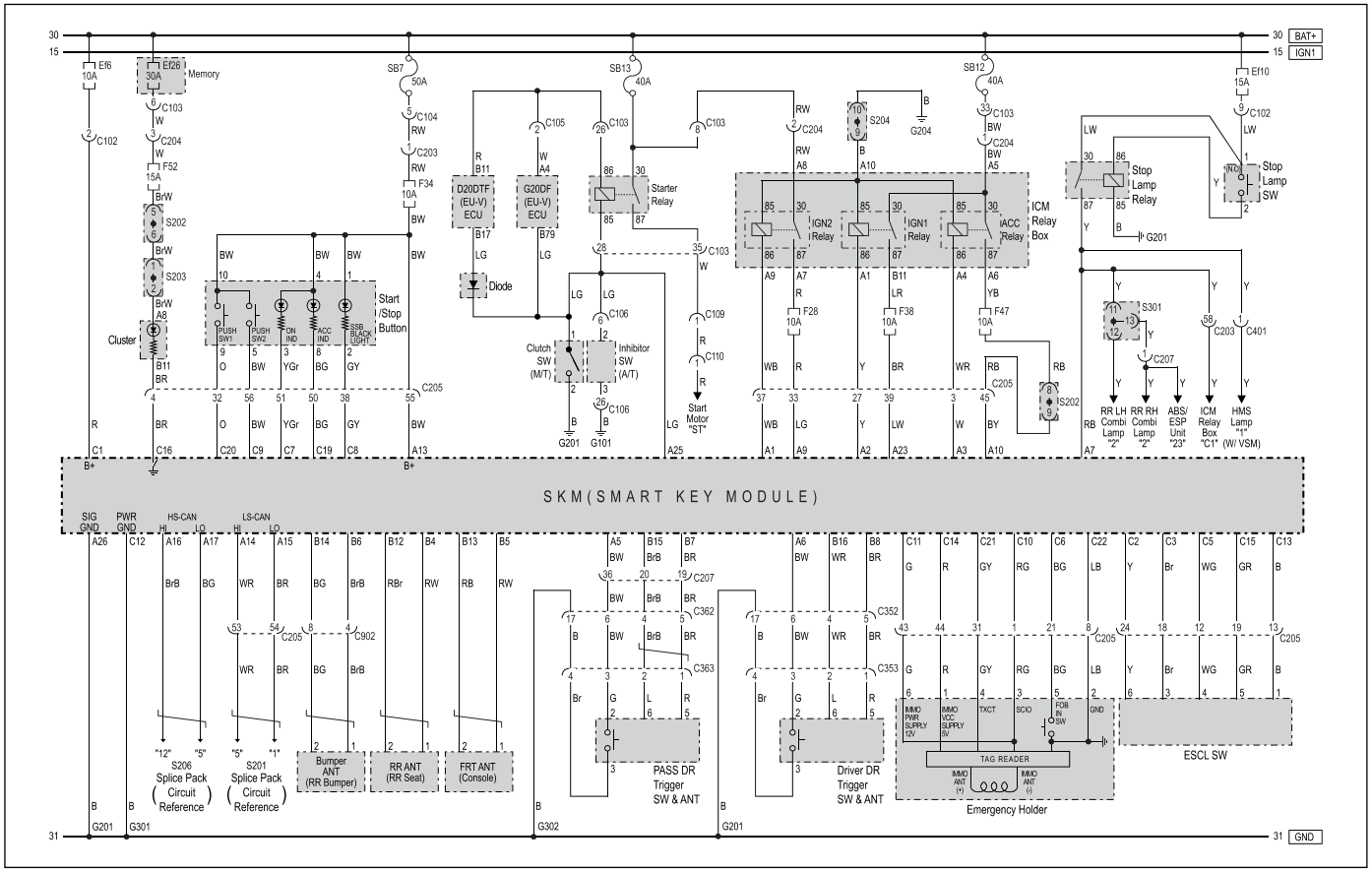




Modification basis	
Application basis	
Affected VIN	

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8712-03 SKM(SMART KEY MODULE)



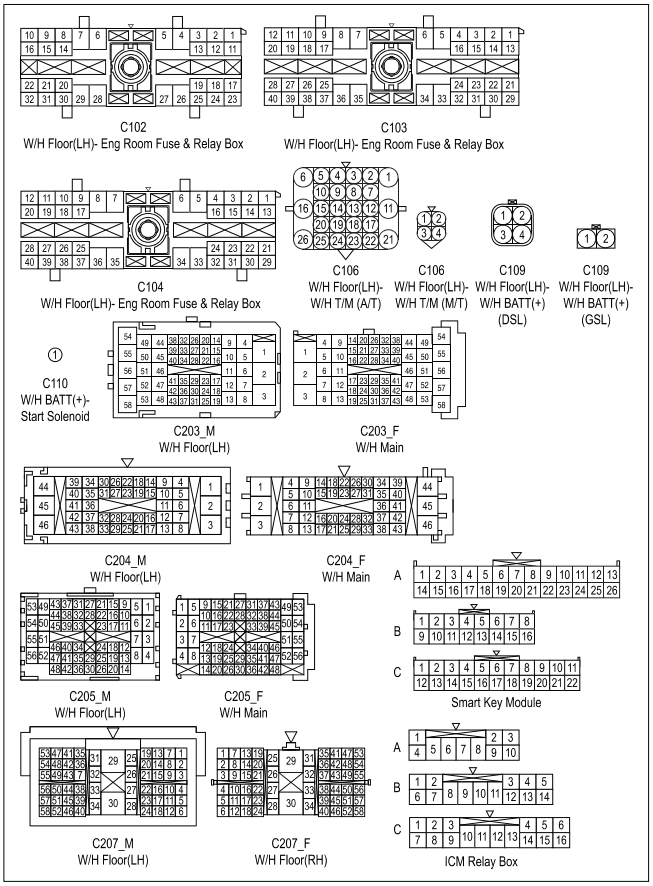
Modification basis	
Application basis	
Affected VIN	

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(1) CONNECTOR INFORMATION

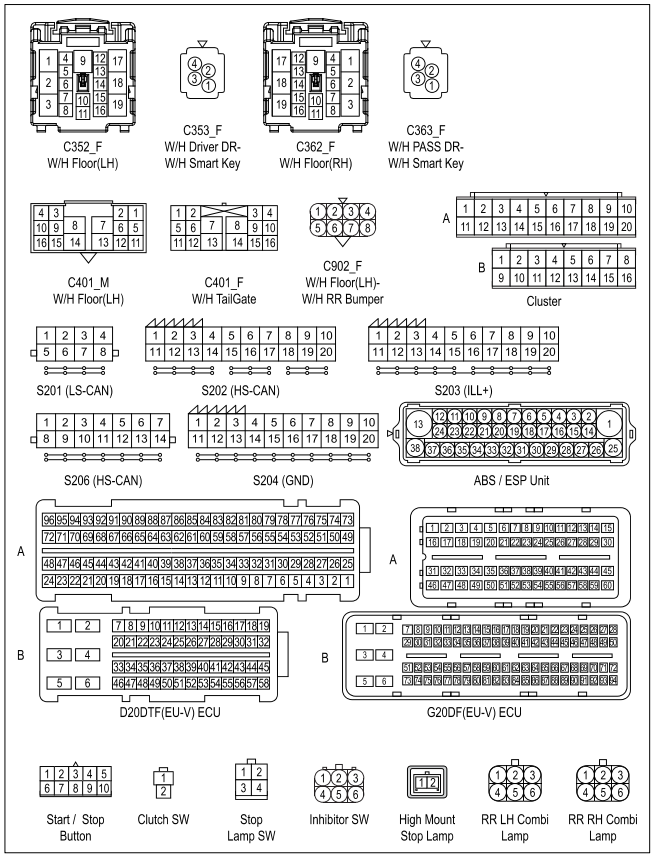
Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (40Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106	(26Pin, Black)	W/H Floor(LH) - W/H T/M	Upper T/M(Under BATT Tray)	A/T
	(4Pin, Black)	W/H Floor(LH) - W/H T/M	Upper T/M(Under BATT Tray)	M/T
C109	(2Pin, Gray)	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	GSL
	(4Pin, Black)	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	DSL
C110 (2Pin, Gray)		W/H BATT(+) - Start Solenoid	Beside Starter Motor	
C203 (58Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C205 (56Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)		W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C352 (19Pin, White)		W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C353 (4Pin, Black)		W/H Driver DR - W/H Smart Key	Inside Driver DR	
C362 (19Pin, Gray)		W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C363 (4Pin, Black)		W/H Passenger DR - W/H Smart Key	Inside Passenger DR	
C401 (16Pin, White)		W/H Floor(LH) - W/H Tail Gate	Upper Tail Gate LH	
C902 (8Pin, Black)		W/H Floor(LH) - W/H RR Bumper	Under RR LH Bumper	PAS
G101		W/H Floor(LH)	Behind LH Head Lamp	
G201		W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G204		W/H Main	Inside I.P(RH Glove Box)	
G301		W/H Floor(LH)	Under Driver Seat	
G302		W/H Floor(RH)	Under Passenger Seat	
S201 (8Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	LS-CAN
S202 (20Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S203 (20Pin)		W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204 (20Pin)		W/H Main	Backside Cluster(Upper ICM Relay Box)	GND
S206 (14Pin)		W/H Floor(LH)	Under Driver Seat	HS-CAN

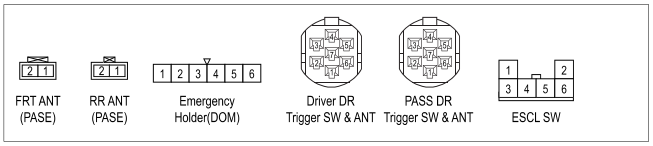
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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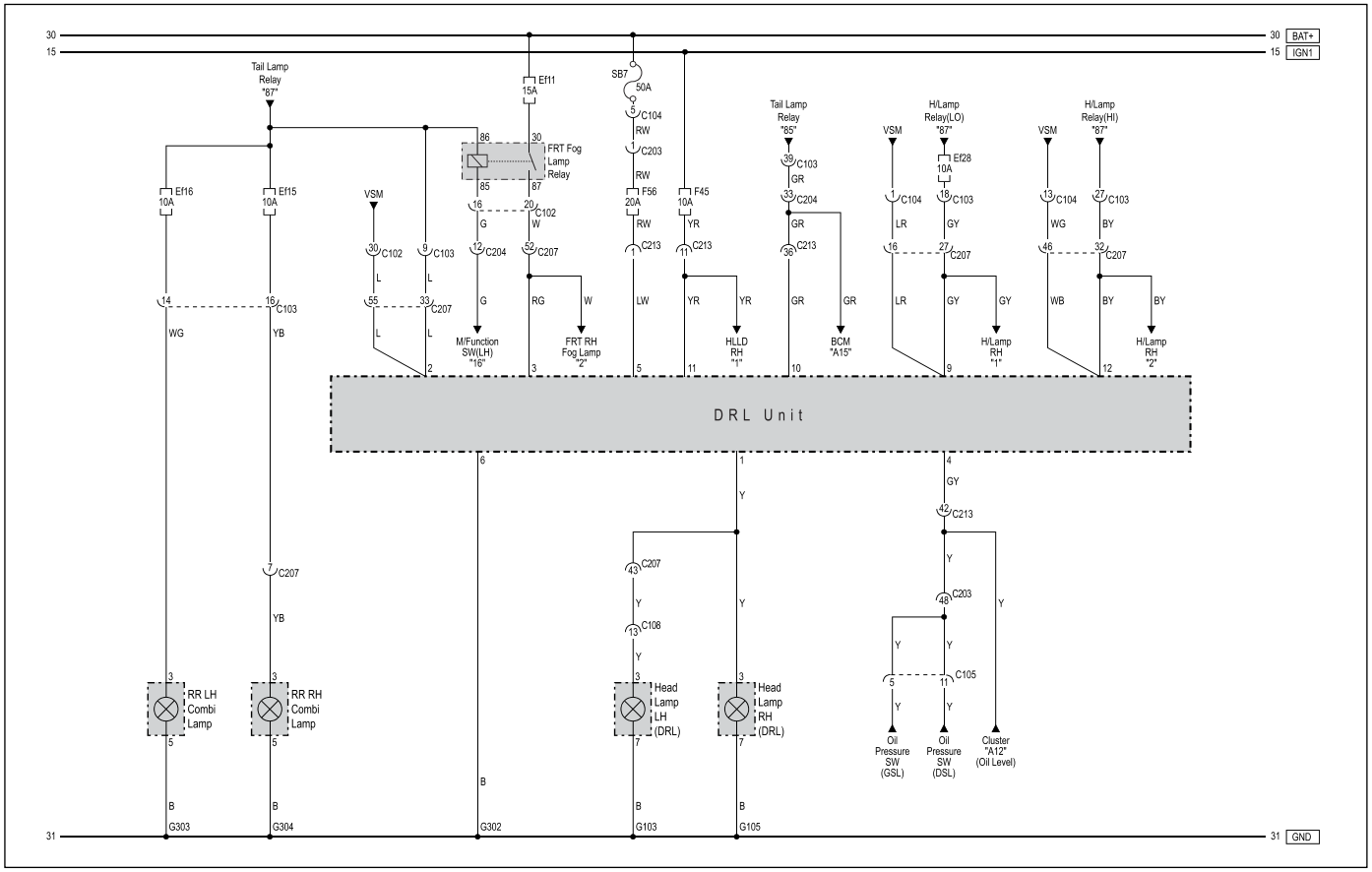




Modification basis	
Application basis	
Affected VIN	

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8610-16 DRL(DAY TIME RUNNING LIGHT) UNIT



CIRCUIT

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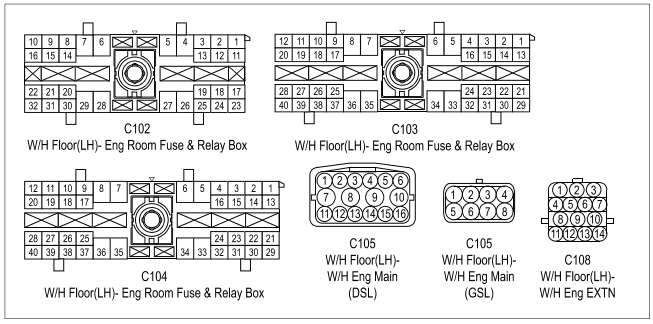
Modification basis	
Application basis	
Affected VIN	

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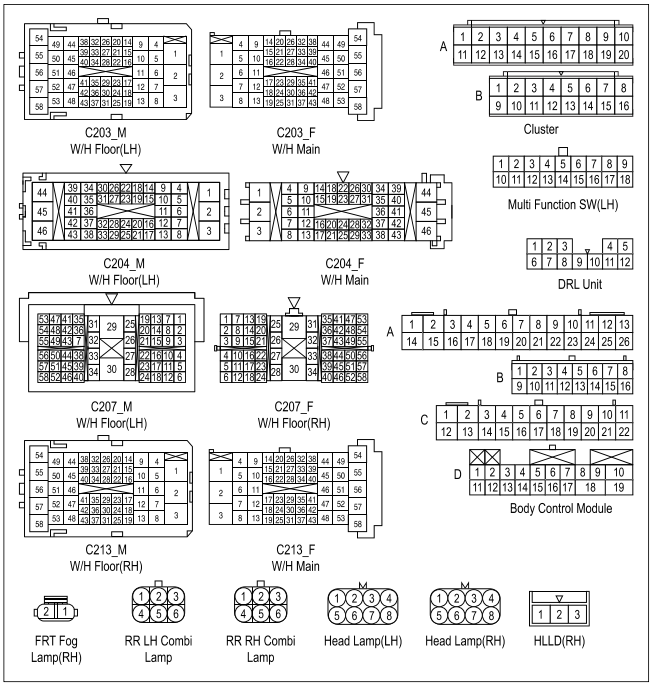
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C102 (32Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (40Pin, Gray)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (40Pin, Black)		W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105	(8Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	GSL
	(16Pin, Black)	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	DSL
C108 (14Pin, Black)		W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C203 (58Pin, White)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204 (46Pin, Black)		W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C207 (58Pin, Gray)		W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C213 (58Pin, White)		W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
G103		W/H Eng EXTN	Under BATT Tray	
G105		W/H Floor(RH)	Behind RH Head Lamp	
G302		W/H Floor(RH)	Under Passenger Seat	
G303		W/H Floor(LH)	Driver QTR PNL	
G304		W/H Floor(RH)	Passenger QTR PNL	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

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VEHICLE GENERAL 0000-00

GENERAL INFORMATION

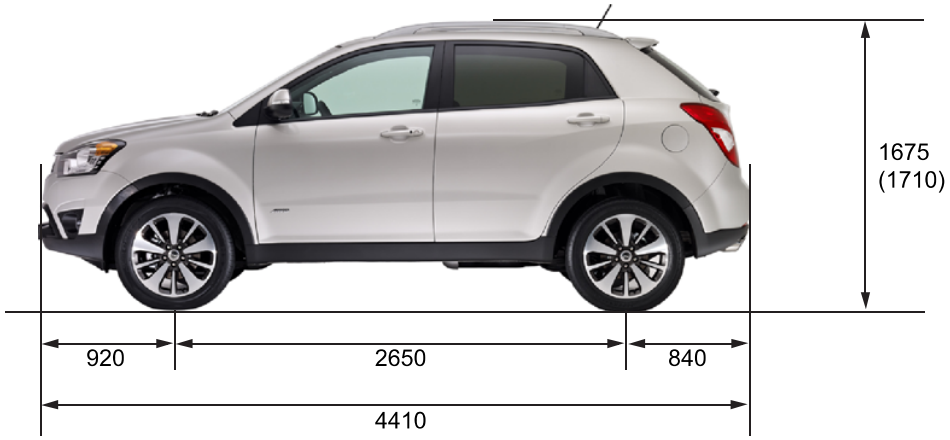
1. MAJOR DIMENSION

Unit: mm

Top view



Side view



Front side



Rear view



Modification basis	
Application basis	
Affected VIN	

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2. VEHICLE IDENTIFICATION

1) The engine number (671 950 0 2 5000001) is stamped on the lower area of cylinder block in exhaust manifold side.

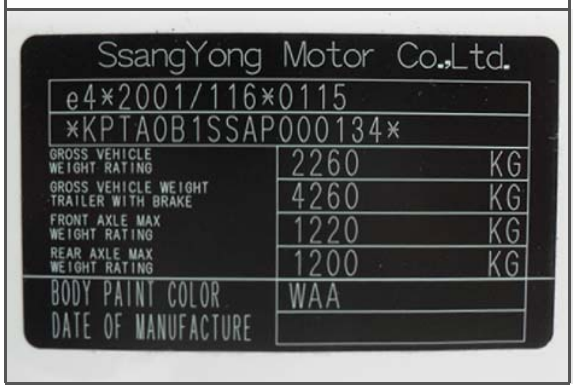


2) The chassis number (KPTA0B1SSAP012345) is stamped on the right side in the engine compartment (passenger side).





3) The certification label is affixed on the bottom of driver side B-pillar. (30 psi)



Modification basis	
Application basis	
Affected VIN	

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▶ VIN number

5) VIN NO.

K P T A O B 1 S S D P XXXXXX

- K: Manufactured in: K (Korea)
- P: Manufactured by: P (Ssangyong Motor Company)
- T: Vehicle type: T (Passenger Car)
- A: Line model: A (Korando C LHD)
- O: Body type: O (5 door)
- B: Trim level: A: STD, B: DLX, C: SUPER DLX
- 1: Others (Seat Belt): 1: 3 point, 2: 2 point
- S: Engine type (Displacement): S (1998 cc, D20DTF)
- S: Confirmation of identification: S (Mass production model)
- D: Year manufactured: D (2013)
- P: Manufactured at: P (Ssangyong Pyeongtaek Facility)
- XXXXX: Manufacture serial number: XXXXX

▶ Engine number

5) Engine no.

671 950 0 0 999 999

- 671: Engine model: 1. 664 - D20DT 4-cylinder, 2. 665 - D27DT 5-cylinder, 3. 671 - D20DTF 4-cylinder, 4. 667 - D32DT 6-cylinder
- 950: Engine version: 950 (C200)
- 0: Steering type: 1) 0 - LHD, RHD (Common), 2) 1 - LHD, 3) 2 - RHD
- 0: Transmission: 0 (Manual transmission), 1 (Auto transmission)
- 999 999: Manufactured sequence no.: Varies according to engine model, version, steering type, transmission type.

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3. SPECIFICATION

* ( ) Optional

Descriptions			Diesel 2.0 Engine	Gasoline 2.0 Engine
General	Overall length (mm)		4410	←
	Overall width (mm)		1830	←
	Overall height (mm)		1675 (1710: including roof rack)	←
	Gross vehicle weight (kg)		4WD: 2260, 2WD: 2180	4WD: 2170, 2WD: 2100
	Curb vehicle weight (kg)	A/T	4WD: 1747, 2WD: 1665	4WD: 1680, 2WD: 1599
		M/T	4WD: 1727, 2WD: 1645	4WD: 1673, 2WD: 1592
	Fuel		Diesel	Gasoline
	Fuel tank capacity (ℓ)		57	←
Engine	Engine		D20DTF	G20DF
	Number of cylinders/ Compression ratio		4 / 16.5:1	4 / 10.5:1
	Total displacement (cc)		1998	←
	Camshaft arrangement		DOHC	←
	Max. power	Normal power	175 ps / 4000 rpm	149 ps / 6000 rpm
		Low power	149 ps / 3000~4000 rpm (149 ps / 3400~4000 rpm)	-
	Max. torque	Normal power	360 Nm / 2000~3000 rpm	197 Nm / 4000 rpm
		Low power	360 Nm / 2000~2500 rpm (360 Nm / 1500~2800 rpm)	-
	Idle speed	A/T	780 ± 20 rpm	700 ± 50 rpm
		M/T	750 ± 20 rpm	700 ± 20 rpm
	Cooling system		Water-cooled / forced circulation	←
	Coolant capacity (ℓ)		8.5	←
	Lubrication type		Gear pump, forced circulation	←
	Max. oil capacity (ℓ) (when shipping)		6.0	4.5
	Turbocharger and cooling type		Turbocharger, water-cooled	-

Modification basis	
Application basis	
Affected VIN	

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* ( ) Optional

Descriptions			Diesel 2.0 Engine	Gasoline 2.0 Engine
Manual Transaxle	Operating type		Floor change type	←
	Gear ratio	1st	3.538 (3.385)	3.616
		2nd	1.909 (1.708)	1.957
		3rd	1.179 (1.033)	1.207
		4th	0.814 (0.786)	0.905
		5th	0.734 (0.730)	0.842
		6th	0.628 (0.595)	0.714
		Reverse	3.910 (3.747)	3.747
Automatic Transaxle	Model		Electronic 6-speed	←
	Operating type		Floor change type	←
	Gear ratio	1st	4.156	4.212
		2nd	2.375	2.637
		3rd	1.522	1.800
		4th	1.144	1.386
		5th	0.859	1.000
		6th	0.676	0.772
		Reverse	3.178	3.385
Transfer Case	Model		AWD	←
	Type		On demand type	←
Clutch (M/T)	Operating type		Hydraulic type	←
	Disc type		Dry single diaphragm type	←
Power Steering	Type		Rack and pinion (EPS, HPS)	←
	Steering angle	Inner	38.62°	←
		Outer	31.07°	←
Rear Axle	Drive shaft type	Independent suspension	Ball joint type	←
	Axle housing type		Build-up type	←

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* ( ) Optional

Descriptions			Diesel 2.0 Engine	Gasoline 2.0 Engine
Brake	Master cylinder type		Tandem type	←
	Booster type		Vacuum assisted booster type	←
	Brake type	Front wheel	Disc	←
		Rear wheel	Disc	←
	Parking brake		Mechanical type	←
Suspension	Front suspension		Macpherson + Coil spring	←
	Rear suspension		Multi link + Coil spring	←
Air Conditioner	Refrigerant (capacity)		R-134a (430 ± 30g)	←
Electrical	Battery type / Capacity (V-AH)		MF / 12 - 90	←
	Starter capacity (V-KW)		12 - 2.3	12 - 1.4
	Alternator capacity (V-A)		12V - 140A (EPS), 120A (HPS)	12V - 140A

Modification basis	
Application basis	
Affected VIN	

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4. RECOMMENDED FLUIDS AND LUBRICANTS

Descriptions			Capacity	Specifications
Engine Oil	Diesel Engine	D20DTF	≒ 6.0 ℓ	Quality class: Ssangyong genuine engine oil (Total Quartz INEO ECS 5W 30, SK ZIC SY 5W 30 or oil Approved by MB 229.51 SAE 5W30)
	Gasoline Engine	G20DF	≒ 4.5 ℓ	Quality class: Ssangyong genuine engine oil (Approved by MB 229.51 SAE 5W30)
Engine Coolant	Diesel Engine	D20DTF	≒ 8.5 ℓ	Ssangyong genuine coolant Anti-Freeze: SYC-1025 Anti-Freeze:Water = 50:50 ORGANIC ACID TYPE, COLOR:BLUE
	Gasoline Engine	G20DF	≒ 8.5 ℓ	
Automatic Transaxle Fluid		DSI 6A/T	≒ 7.5 ℓ	Ssangyong genuine oil (FUCHS TITAN ATF 3292)
		HPT 6A/T	≒ 7.1 ℓ	Ssangyong genuine oil (SK ATF SP-IV M)
Manual Transaxle Fluid			≒ 1.65 ℓ	Ssangyong genuine oil (HD MTF 75W/85 (SHELL) or HK MTF 75W/85 (SK))
Transfer Case (PTU) Fluid		AWD	≒ 0.58 ℓ	Ssangyong genuine oil (IDEMITSU LW 80W/90)
Rear Axle Oil		AWD	≒ 0.7 ℓ	Ssangyong genuine oil (SAE 80W/90, API GL-5)
Brake / Clutch Fluid			As required	Ssangyong genuine oil (DOT4)
Power Steering Fluid			≒ 1.0 ℓ	Ssangyong genuine oil (S-PSF-3) * TOTAL FLUIDE DA (Extreme cold condition only)

WARNING

- 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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5. SCHEDULED MAINTENANCE SERVICES

1) Diesel Engine(EU)

* Use only approved Ssangyong genuine parts.

Maintenance service and record retention are the owner's responsibility. You should retain evidence that proper maintenance has been performed on your vehicle in accordance with the scheduled maintenance service chart.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first								
	x1000 km	20	40	60	80	100	120	140	160
	x1000 miles	12.5	25	37.5	50	62.5	75	87.5	100
	Months	12	24	36	48	60	72	84	96
ENGINE CONTROL SYSTEM									
Drive belt		I	I	I	I	I	I	I	I
* Engine oil & filter *1 (1)* (3)* (4)*		R	R	R	R	R	R	R	R
		Shorten the service interval under severe conditions							
Cooling system hose & connections		I	I	I	I	I	I	I	I
Engine coolant (3)* (4)		Change every 200000 km or 5 years. And, inspect and replenish if necessary.							
Fuel filter (1)*			R		R		R		R
		Drain the water from fuel filter when the warning light comes on							
Fuel line & connections		I	I	I	I	I	I	I	I
Air cleaner (2)*		R	R	R	R	R	R	R	R
		Shorten the service interval under severe conditions							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

*1 Check the engine oil level and leak every 3000 km (2000 miles) or before starting a long trip.

R- Replace or change.

(1)* If vehicle is operated under severe condition:
Shorten the service interval.
- Frequent stop-and-go traffic, extended idling, short driving distance below 6 km, driving distance below 16 km when the outside temperature remains below freezing
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- High load driving such as trailer towing
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

(2)* If vehicle is operated under severe condition, driving in dusty condition or sandy condition, pollutant area or off-road driving, frequently inspect the air cleaner, if necessary, change the air cleaner.

(3)* More frequent maintenance is required if under dusty driving condition.

(4)* Refer to "Recommended fluids, coolant and lubricants".

Modification basis	
Application basis	
Affected VIN	

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* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first							
x1000 km	20	40	60	80	100	120	140	160
x1000 miles	12.5	25	37.5	50	62.5	75	87.5	100
Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY								
Exhaust pipes & mountings	I	I	I	I	I	I	I	I
Brake / Clutch fluid (3)*	Change every 2 years (inspect frequently)							
Parking brake / Brake pads (Front & Rear) (4)*	I	I	I	I	I	I	I	I
Brake line & connections (including booster)	I	I	I	I	I	I	I	I
Manual transaxle oil (5)*			I			I		
Clutch & brake pedal free play	I	I	I	I	I	I	I	I
Power transfer unit oil (6)*	I	I	I	I	I	I	I	I
	Severe driving condition: Change every 60000 km							
Rear axle oil	Inspect every 20000 km, change every 100000 km (Frequnt check of oil leak)							
Automatic transaxle fluid (6)*	I	I	I	I	I	I	I	I
	Change every 60000 km under severe condition							
Chassis & underbody bolts & nuts tight / Secure (6)*	Check frequently and adjust or replace if necessary							
Tire condition & inflation pressure	Check frequently and adjust or replace if necessary							
Wheel alignment (7)*	Inspect when abnormal condition is noted							
Steering wheel & linkage	I	I	I	I	I	I	I	I

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R- Replace or change.

(3)* Refer to “Recommended fluids and lubricants”.

(4)* More frequent maintenance is required if the vehicle is operated under any of the following conditions:

- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(5)* Inspect and replenish every 60000 km (or 3 years)
Normal driving condition: Fill for Life
(Severe driving condition: Change every 120000 km)

(6)* If vehicle is operated under severe condition: Shorten the service interval.

- Towing a trailer or off-road driving (Inspect the leak of fluid at any time, occasionlly)
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)
- Frequent stop-and-go traffic, extended idling, short driving distance
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- Driving frequently at high speed over 170 km/hour
- Driving frequently in area where heavy traffic under the ambient temperature above 32°C

(7)* If necessary, rotate and balance wheels.

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* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first								
	x1000 km	20	40	60	80	100	120	140	160
	x1000 miles	12.5	25	37.5	50	62.5	75	87.5	100
	Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY									
Power steering fluid & lines (3)*		I	I	I	I	I	I	I	I
Drive shaft boots (8)*		I	I	I	I	I	I	I	I
Seat belts, buckles & anchors		I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch		Check frequently and adjust or replace if necessary							
Wheel bearing grease		I	I	I	I	I	I	I	I
Propeller shaft grease - Front / Rear (9)*		I	I	I	I	I	I	I	I
Air conditioner filter (10)*		R	R	R	R	R	R	R	R
		Shorten the service interval under severe conditions							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R- Replace or change.

(3)* Refer to “Recommended fluids and lubricants”.

(8)* After completion of off-road operation, the drive shaft boots should be inspected.

(9)* Inspect propeller shaft grease every 5000 km or 3 months if the vehicle is mainly driven under severe condition.

- In off-road or dusty road, or
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain.

(10)* Severe Conditions in Air Conditioner Filter

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

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2) Diesel Engine(General)

* Use only approved Ssangyong genuine parts.

Maintenance service and record retention are the owner's responsibility. You should retain evidence that proper maintenance has been performed on your vehicle in accordance with the scheduled maintenance service chart.

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first							
x1000 km	15	30	45	60	75	90	105	120
x1000 miles	10	20	30	40	50	60	70	80
Months	12	24	36	48	60	72	84	96

ENGINE CONTROL SYSTEM

Drive belt	I	I	I	I	I	I	I	I
* Engine oil & filter *1 (1)* (3)* (4)*	R	R	R	R	R	R	R	R
	Shorten the service interval under severe conditions							
Cooling system hose & connections	I	I	I	I	I	I	I	I
Engine coolant (3)* (4)	Change every 200000 km or 5 years. And, inspect and replenish if necessary.							
Fuel filter (1)*			R			R		
	Drain the water from fuel filter when the warning light comes on							
Fuel line & connections	I	I	I	I	I	I	I	I
Air cleaner (2)*	R	R	R	R	R	R	R	R
	Shorten the service interval under severe conditions							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

*1 Check the engine oil level and leak every 3000 km (2000 miles) or before starting a long trip.

R- Replace or change.

(1)* If vehicle is operated under severe condition:
Shorten the service interval.
- Frequent stop-and-go traffic, extended idling, short driving distance below 6 km, driving distance below 16 km when the outside temperature remains below freezing
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- High load driving such as trailer towing
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

(2)* If vehicle is operated under severe condition, driving in dusty condition or sandy condition, pollutant area or off-road driving, frequently inspect the air cleaner, if necessary, change the air cleaner.

(3)* More frequent maintenance is required if under dusty driving condition.

(4)* Refer to "Recommended fluids, coolant and lubricants".

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MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first							
	x1000 km	15	30	45	60	75	90	105	120
	x1000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96

CHASSIS AND BODY

Exhaust pipes & mountings	I	I	I	I	I	I	I	I
Brake / Clutch fluid (3)*	Change every 2 years (inspect frequently)							
Parking brake / Brake pads (Front & Rear) (4)*	I	I	I	I	I	I	I	I
Brake line & connections (including booster)	I	I	I	I	I	I	I	I
Manual transaxle oil (5)*				I				I
Clutch & brake pedal free play	I	I	I	I	I	I	I	I
Power transfer unit oil (6)*	I	I	I	I	I	I	I	I
	Severe driving condition: Change every 60000 km							
Rear axle oil	Inspect every 15000 km, change every 100000 km (Frequnt check of oil leak)							
Automatic transaxle fluid (6)*	Inspect every 15000 km or 12 month (But change every 60000 km under severe condition)							
Chassis & underbody bolts & nuts tight / Secure (6)*	Check frequently and adjust or replace if necessary							
Tire condition & inflation pressure	Check frequently and adjust or replace if necessary							
Wheel alignment (7)*	Inspect when abnormal condition is noted							
Steering wheel & linkage	I	I	I	I	I	I	I	I

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R- Replace or change.

(3)* Refer to “Recommended fluids and lubricants”.

(4)* More frequent maintenance is required if the vehicle is operated under any of the following conditions:

- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(5)* Inspect and replenish every 60000 km (or 4 years)
Normal driving condition: Fill for Life
(Severe driving condition: Change every 120000 km)

(6)* If vehicle is operated under severe condition: Shorten the service interval.

- Towing a trailer or off-road driving (Inspect the leak of fluid at any time, occasionlly)
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)
- Frequent stop-and-go traffic, extended idling, short driving distance
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- Driving frequently at high speed over 170 km/hour
- Driving frequently in area where heavy traffic under the ambient temperature above 32°C

(7)* If necessary, rotate and balance wheels.

Modification basis	
Application basis	
Affected VIN	

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MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first							
	x1000 km	15	30	45	60	75	90	105	120
	x1000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY									
Power steering fluid & lines (3)*		I	I	I	I	I	I	I	I
Drive shaft boots (8)*		I	I	I	I	I	I	I	I
Seat belts, buckles & anchors		I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch		Check frequently and adjust or replace if necessary							
Wheel bearing grease		I	I	I	I	I	I	I	I
Propeller shaft grease - Front / Rear (9)*		I	I	I	I	I	I	I	I
Air conditioner filter (10)*		R	R	R	R	R	R	R	R
		Shorten the service interval under severe conditions							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R- Replace or change.

(3)*Refer to “Recommended fluids and lubricants”.

(8)*After completion of off-road operation, the drive shaft boots should be inspected.

(9)*Inspect propeller shaft grease every 5000 km or 3 months if the vehicle is mainly driven under severe condition.

- In off-road or dusty road, or
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain.

(10)*Severe Conditions in Air Conditioner Filter

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

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3) Gasoline Engine

* Use only approved Ssangyong genuine parts.

Maintenance service and record retention are the owner's responsibility. You should retain evidence that proper maintenance has been performed on your vehicle in accordance with the scheduled maintenance service chart.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first								
	x1000 km	15	30	45	60	75	90	105	120
	x1000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96
ENGINE CONTROL SYSTEM									
Drive belt		I	I	I	I	I	I	I	I
Engine oil & engine oil filter (1)* (3)* (Initial change: 10,000 km)		R**	R	R	R	R	R	R	R
		Shorten the service interval under severe conditions							
Cooling system hose & connections		I	I	I	I	I	I	I	I
Engine coolant (3)*		Change every 200000 km or 5 years. And, inspect replenish if necessary.							
Fuel filter (2)*		Replace every 100000 km (if using poor quality of fuel, replace every 30000 km)							
Fuel line & connections		I	I	I	I	I	I	I	I
Air cleaner (2)*		R	R	R	R	R	R	R	R
		Shorten the service interval under severe conditions							
Ignition timing		I	I	I	I	I	I	I	I
Spark plugs (G20DF)		Change every 160000 km or 5 years.							
Charcoal canister & vapor lines		-	-	I	-	-	I	-	-

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R - Replace or change.

** - In order to secure engine long life and effective break-in, first oil (factory filled) would be recommended to drain with in 10,000 km.

(1)* If vehicle is operated under severe condition:
Shorten the service interval.
- Frequent stop-and-go traffic, extended idling, short driving distance below 6 km, driving distance below 16 km when the outside temperature remains below freezing
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- High load driving such as trailer towing
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

(2)* If vehicle is operated under severe condition, pollutant area or off-road driving, driving in dusty condition or sandy condition, frequently inspect the air cleaner, if necessary, change the air cleaner.

(3)* Refer to "Recommended fluids and lubricants".

Modification basis	
Application basis	
Affected VIN	

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MAINTENANCE INTERVAL / MAINTENANCE ITEM		Kilometers (miles) or time in months, whichever comes first							
	x1000 km	15	30	45	60	75	90	105	120
	x1000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY									
Exhaust pipes & mountings		I	I	I	I	I	I	I	I
Brake / Clutch fluid (3)*		Change every 2 years (inspect frequently)							
Parking brake / Brake pads (Front & Rear) (4)*		I	I	I	I	I	I	I	I
Brake line & connections (including booster)		I	I	I	I	I	I	I	I
Manual transaxle oil (5)*					I				I
Clutch & brake pedal free play		I	I	I	I	I	I	I	I
Power transfer unit oil (6)*		I	I	I	I	I	I	I	I
		Severe driving condition: Change every 60000 km							
Rear axle oil		Inspect every 15000 km, change every 100000 km (Frequnt check of oil leak)							
Automatic transaxle fluid (6)*	General	Change every 100000 km under severe condition							
	EU	Change every 90000 km under severe condition							
Chassis & underbody bolts & nuts tight / Secure (6)*		Check frequently and adjust or replace if necessary							
Tire condition & inflation pressure		Check frequently and adjust or replace if necessary							
Wheel alignment (7)*		Inspect when abnormal condition is noted							
Steering wheel & linkage		I	I	I	I	I	I	I	I

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R- Replace or change.

(3)* Refer to “Recommended fluids and lubricants”.

(4)* More frequent maintenance is required if the vehicle is operated under any of the following conditions:
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(5)* Inspect and replenish every 60000 km (or 4 years)
Normal driving condition: Fill for Life
(Severe driving condition: Change every 120000 km)

(6)* If vehicle is operated under severe condition: Shorten the service interval.
- Towing a trailer or off-road driving (Inspect the leak of fluid at any time, occasionlly)
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)
- Frequent stop-and-go traffic, extended idling, short driving distance
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- Driving frequently at high speed over 170 km/hour
- Driving frequently in area where heavy traffic under the ambient temperature above 32°C

(7)* If necessary, rotate and balance wheels.

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* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first							
	x1000 km	15	30	45	60	75	90	105	120
	x1000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY									
Power steering fluid & lines (3)*		I	I	I	I	I	I	I	I
Drive shaft boots (8)*		I	I	I	I	I	I	I	I
Seat belts, buckles & anchors		I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch		Check frequently and adjust or replace if necessary							
Wheel bearing grease		I	I	I	I	I	I	I	I
Propeller shaft grease - Front / Rear (9)*		I	I	I	I	I	I	I	I
Air conditioner filter (10)*		R	R	R	R	R	R	R	R
		Shorten the service interval under severe conditions							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R- Replace or change.

(3)*Refer to “Recommended fluids and lubricants”.

(8)*After completion of off-road operation, the drive shaft boots should be inspected.

(9)*Inspect propeller shaft grease every 5000 km or 3 months if the vehicle is mainly driven under severe condition.

- In off-road or dusty road, or
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain.

(10)*Severe Conditions in Air Conditioner Filter

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

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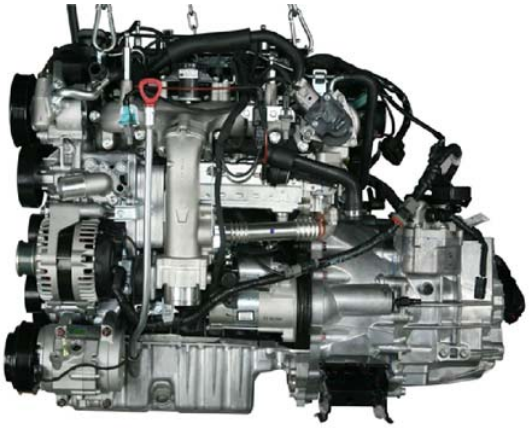
ENGINE GENERAL

0000-00

GENERAL INFORMATION

1. LAYOUT

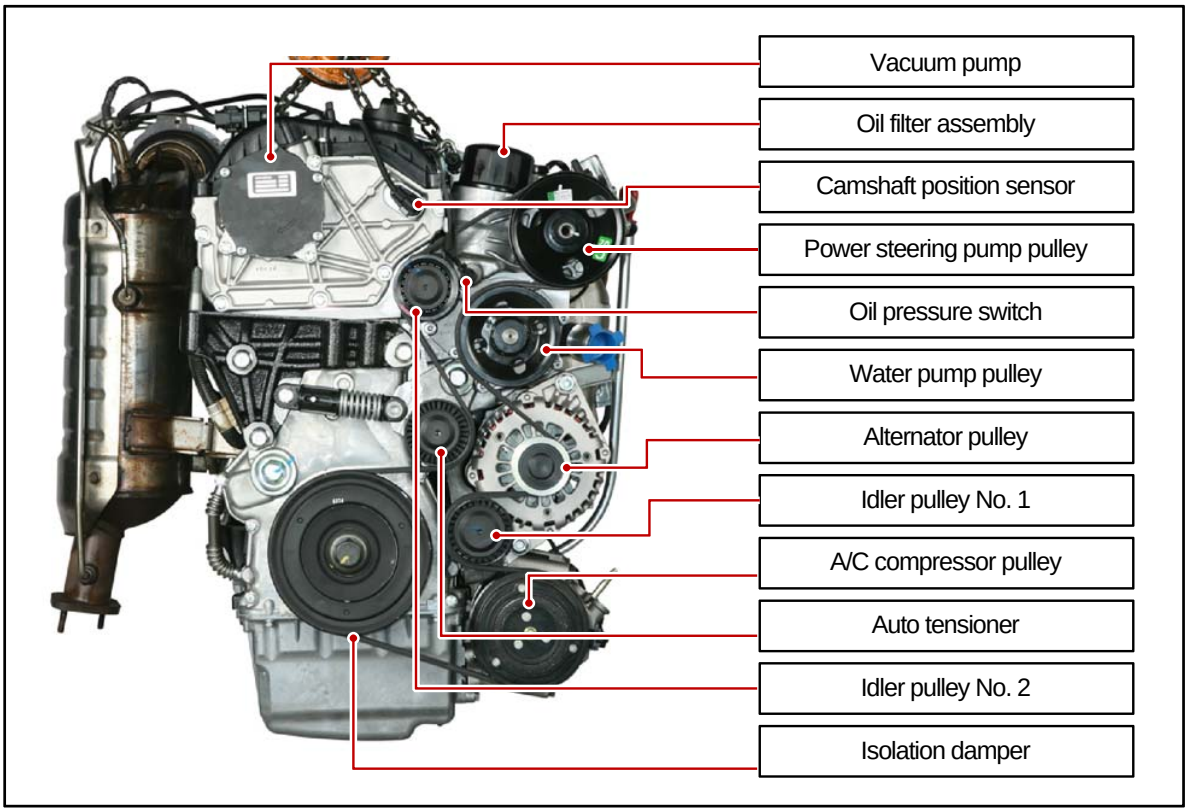
Front view	Rear view
	

Right side view	Left side view
	

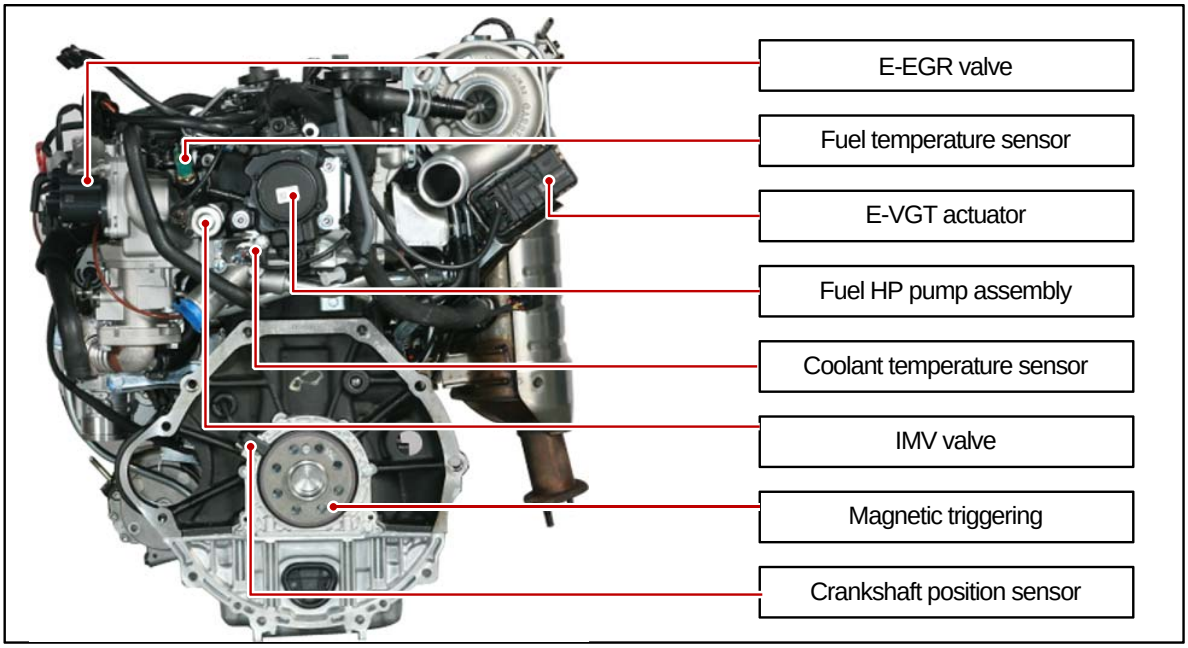
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2. MAJOR COMPONENTS

▶ **Front View**



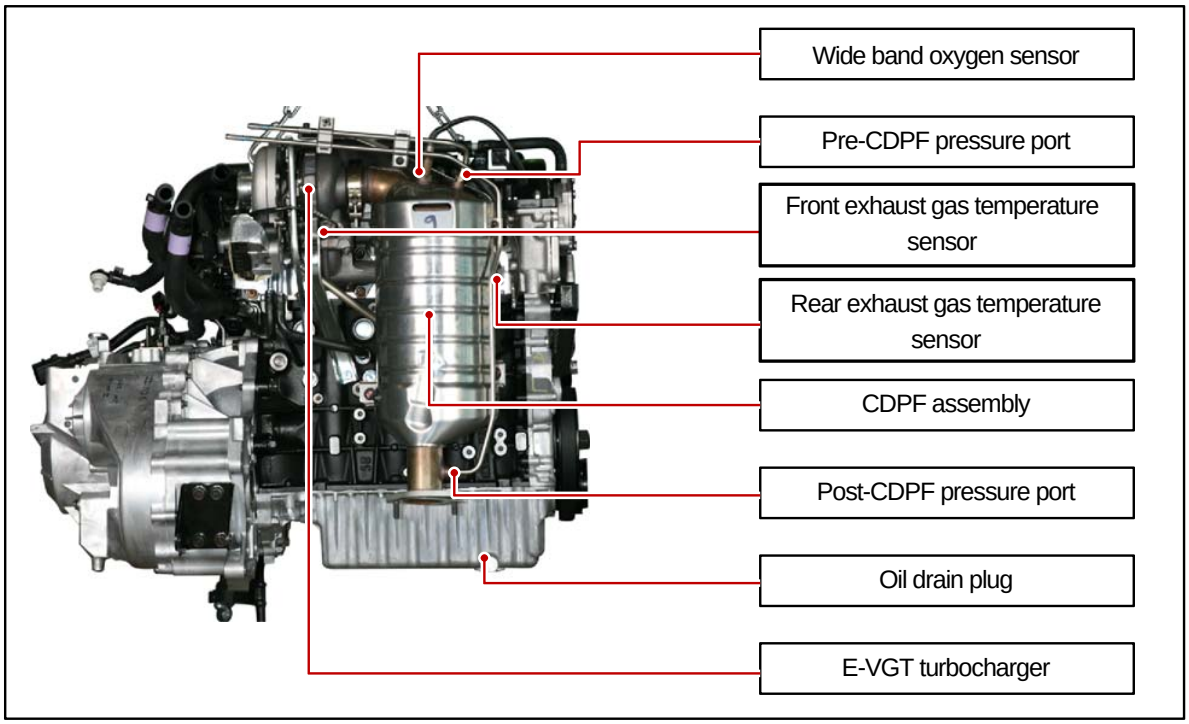
▶ **Rear View**



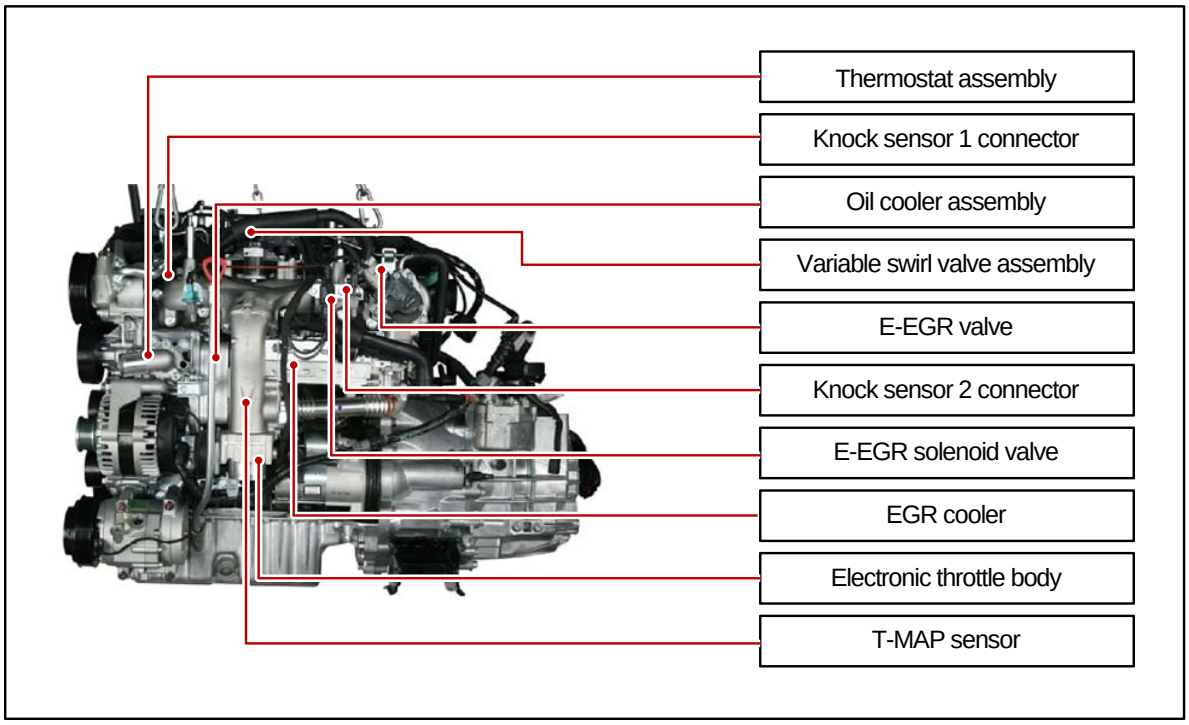
Modification basis	
Application basis	
Affected VIN	

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▶ Right side View



▶ Left side View



Modification basis	
Application basis	
Affected VIN	

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GENERAL INSTRUCTIONS

1. GUIDELINES FOR SERVICE WORKS

1) For Safety

To perform the service works easily ans safely, the service technicians must keep the proper working procedures and rules.
This manual provides the useful instructions to the service technicians so that they can perform the servive works with standard working process, skills, tips in time.
Please read this manual and follow the instructions carefully.

Signal words such as "CAUTION" and "NOTE" have special meanings.

NOTE
indicates information to assist maintenance and instructions.

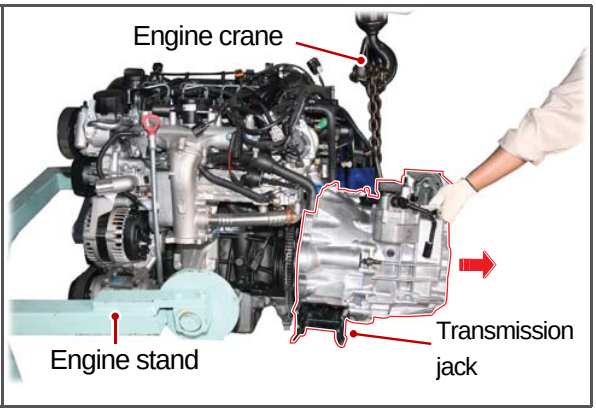
CAUTION
indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damage.

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

2) Equipment

- Korando is FF (Front Engine Front Drive) type vehicle, and engine and powertrain system are integrated into a module. Therefore, 2-post lift and general equipment are necessary when working
- on the engine and transmission.
  Major equipment: Engine and transmission jack, Engine stand, Engine crane, Transmission jack, Engine hanger





Modification basis	
Application basis	
Affected VIN	

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Remove the engine and transaxle as a set.

- Korando is FF (Front Engine Front Drive) type vehicle, and engine and powertrain system are integrated into a module. Therefore, 2-post lift and general equipment are necessary when working on the engine and transmission.
- Major equipment: Engine and transmission jack, Engine stand, Engine crane, Transmission jack, Engine hanger

3) General Instructions

(1) Before lifting up the vehicle with a lift, correctly support the lifting points.
(2) When using a jack, park the vehicle on a level ground and place the wheel chocks under the tires. Position the jack under the frame and lift up the vehicle and then support with chassis stand before service work.
(3) Make sure to disconnect the negative (-) cable from the battery to prevent any damage to electric systems.
(4) If you have to work on vehicle, cover the seats and floor with protection covers to avoid any damage and contamination.
(5) Brake fluid and anti-freeze can damage the painted surface of body. So carefully handle them during service work.
(6) To improve the efficiency of service work, use only recommended and specified tools.
Use only Ssangyong genuine spare parts.
(7) Never reuse the cotter pin, gasket, O-ring, oil seal, lock washer and self-locking nut. Replace them
(8) with new ones. If reused, normal functions cannot be maintained.
(9) Store the disassembled parts as a set based on disassembly order and unit.
(10) Pay particular attention not to miss or mix the fasteners.
(11) If necessary, especially for inspection, clean the removed parts completely.
(12) Apply the oil or grease on the running and sliding surfeces before installation. Use the specified
(13) sealant and gasket to prevent leakage if necessary.
(14) Tighten the fasteners with the specified tightening torque.
(15) As a final stage of service work, check if the serviced system is working properly and the problem has been eliminated clearly.

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4) Basic Inspection

(1) Horn operation

- Listen for the horn sound when pressing the horn pad on the steering wheel.

(2) Brake operation

- Check if there is any abnormal noise, unusually long braking distance, or uneven braking force. If the brake warning lamp does not go out even after starting the engien or are flashing during driving, have the brake system checked immediately.
- Check the brake pipes and hoses for connection, oil leak, crack or interference after changing the position of tires. When replacing the tires, check the brake disc for surface condition and wear. Check the parking brake cable and brake operation. Shorten the checking interval if the parking
- brake is used frequently.

(3) Exhaust system

- Be aware to any changes in sound or smell from the exhaust system. These may be caused by leak or overheat. Have the exhaust system checked and repaired immediately.
- Inspect the exhaust system including catalytic converter. Inspect all the components and body frame near the exhaust system.

(4) Tires

- Unusual vibration of the steering wheel and seats or pulling to one side on the straight and level roads may indicates the uneven tire inflation pressure or poor wheel balance.

(5) Steering and suspension system

- Inspect the front and rear suspension and the steering system for damage, looseness or missing parts, signs of wear or lack of lubrication. Inspect the power steering line and the hoses for connection, leak, crack and chafing. Inspect the drive axle boot and seals for damage, tear or leak. Replace or repair the system if necessary.

(6) Engine oil

- Check the oil level when the engine is still warm and add the specified engine oil if necessary.

(7) Coolant

- Check the coolant level in the coolant reservoir, coolant conditions (contamination, foreign material), and hoses for damage and leak. Replace or add the Ssangyong genuine coolant, if needed.

(8) Engine drive belt

- Check all drive belts on the engine for wear, crack and looseness. Retighten or replace the belt, if needed.

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5) Guidelines on Engine Service

To prevent the personal injuries and vehicle damages that can be caused by mistakes during service and to provide the optimized performance and safety after service works, the service technicials must keep the basic cautions and service guidelines below. These could be easily forgotten during service works.

(1) Cautions before service works

- Make sure to disconnect the negative (-) cable from the battery to prevent any damage to electric systems.
- Make sure to clean the working area and to prepare the necessary tools before service works. Always place the ignition switch to OFF position if not required. Otherwise, there could be
- unexpected damage to electric devices or personal injuries due to short-circuit.
  To prevent the foreign material from entering into the fuel injection system, completely seal the inlets
- of HP pump, fuel hoses and high pressure pipes.
  To remoev the engine, use the dedicated equipments such as engine jack, transmission jack, engine
- stand and engine crane.

(2) Engine and accessories

Engine has a lot of precise components. The specified tightening torque and correct procedures should be kept during service works. And, the working area is always clean and well prepared.

- When disassembling the engine, related parts (bolts, gaskets, etc.) should be stored as a set.
- Clean the components completely with engine oil before assembling if needed.
- Fully drain the engine oil, coolant and fuel from the vehicle and seal the inlets with the plugs before removing the engine.
- All the interference should be eliminated before removing the engine.

(3) Electric devices

Extraordinary care should be taken when servicing the electric systems. Currently, the engine uses a lot of electric devices. Short circuit and poor contact may cause the low engine performance, incomplete combustion and other abnormalities.

- To prevent any damage to electric systems, make sure to disconnect the negative (-) cable from the battery and place the ignition switch to OFF position before servicing.
- Use only the specified parts with same ratings when replacing the electric devices. Check the grounds and connections for looseness.

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(4) Fuel and lubrication system

- When working with the fuel or oil systems in enclosed area, always keep the working area well-ventilated and never allow anybody to smoke.
- Gaskets and seals on the fuel and oil systems should be replaced with new ones. All bolts and nuts should be tightened as specified.
- Make sure to check the connections for leak after installation.

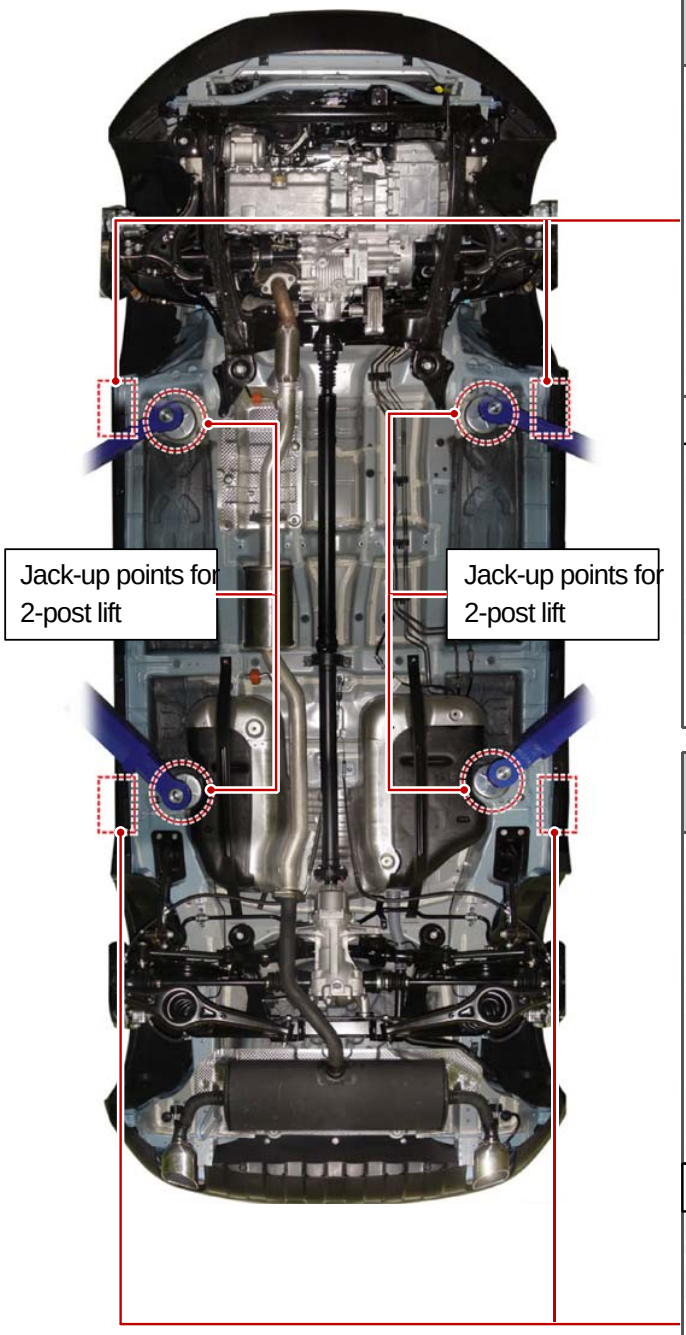
NOTE

1. If fine dust or foreign material enters into DI engine's fuel system, there can be serious damages between HP pump and injectors. So, be sure to cover removed fuel system components with cap and protect removed parts not to be contaminated with dirt. (Refer to cleanness in this manual while working on DI engine fuel system)
2. When working on the fuel line between priming pump and injector (including return line), always plug the openings with caps to prevent foreign materials or dust from entering to the openings and connections.
3. The HP fuel supply pipe (HP pump to fuel rail) and HP fuel pipe (Fuel rail to injector) should be replaced with new ones when removed.

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2. JACK-UP POINTS

▶ **Stand jack-up points and installation status (front side)**



Jack-up points and setup (front side)



Supporting



Jack-up points and setup (rear side)



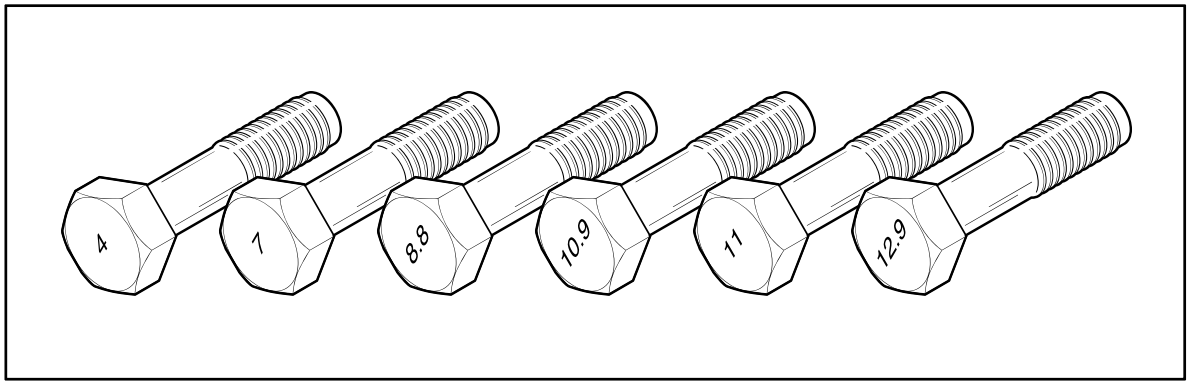
Supporting



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3. STANDARD BOLTS SPECIFICATIONS

Bolt	Pitch	Tightening torque(kgf.cm)					
		Standard			Limit		
		4T	7T	9T	4T	7T	9T
M3	0.5	5	9	13	7	12	17
M4	0.7	12	20	30	16	27	40
M5	0.8	24	40	57	32	53	77
M6	1.0	41	68	99	55	91	130
M8	1.25	88	160	230	130	210	310
M10	1.25	190	330	470	260	430	620
	1.5	190	310	450	250	420	600
M12	1.25	350	580	840	460	770	1,100
	1.75	330	550	790	440	730	1,000
M14	1.5	550	910	1,300	730	1,200	1,900
M16	1.5	830	1,100	2,000	1,100	1,900	2,700
M18	1.5	1,200	2,000	2,900	1,600	2,700	3,800
M20	1.5	1,700	2,800	4,000	2,200	3,700	5,300
M22	1.5	2,300	3,800	5,400	3,000	5,000	7,200
M24	1.5	2,900	4,900	7,000	3,900	6,500	9,400
	2.0	2,800	4,700	6,800	3,800	6,300	9,100



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

- Aluminum alloy: Tighten to 80 % of above torque table.
- Plastics: Tighten to 20 % of above torque table.

Modification basis	
Application basis	
Affected VIN	

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4. CODING

1) Engine Variant Coding

Description	Selection	Coding
Additional heater	NO	PTC auxiliary heater is the standard equipment in this vehicle. Select "YES".
	YES	
Gear box	5-speed M/T	M/T : 6-speed M/T A/T : 6-speed A/T (DSI 6AT)
	6-speed M/T	
	5-speed A/T (DC 5 AT)	
	7-speed A/T (DC 7 AT)	
	6-speed A/T (DC 6 AT)	
Immobilizer	NO	Immobilizer is the standard equipment in this behicle. Select "YES".
	YES	
FAN	2 relays	Select "2 relays".
	FAN	
	Not defind	
Engine level control	NO	Engine level control system is not available in this vehicle. Select "NO".
	YES	
SKM key	NO	with Smart key : Select "YES".
	YES	
Glow plug	Relay (K-Line)	AQGS is the standard equipment in this vehicle. Select "AQGS".
	AQGS (CAN)	
A/C	NO	Select the appropriate system.
	YES	
	Not defind	
Vehicle speed sensor	CAN	with ABS or ESP : Select "CAN".
	WIRE	
Cruise control	NO	with cruise control system : Select "YES".
	YES	
G-sensor	NO	with 2WD ABS and non-ABS : Select "NO" with 4WD ABS and ESP : Select "YES"
	YES	

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2) Chassis Variant Coding

Description	Selection	Coding
Domestic/Export	EU export	Select the appropriate system
	General export	
EPB application	NO	Select the appropriate system
	YES	
Shift lever type	Not defined	A/T : DURA lever M/T : M/T
	DC lever	
	DURA lever	
	M/T	
Electric power steering(EPS)	YES	Select the appropriate system
	NO	
Transfer case	2WD	Select the appropriate system
	AWD(E-coupling)	
	Not defined	
Sedan/Limousine	Sedan(RV)	Select : Sadan(RV)
	Limousine	
Vehicle code (Engine)	D32DT	Select : D20DTF
	D27DT	
	D27DTP	
	D20DTF	
EAS	NO	Select : NO
	ECS	
	2 corner EAS	
	4 corner EAS	
Telematics	NO	Select : NO
	YES	
Brake	NO	Select the appropriate system
	ABS	
	TCS	
	ESP	

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Description	Selection	Coding
TPMS application	NO	Select the appropriate system
	YES	
Transmission type	M/T	Select the appropriate system
	DC AT	
	DSI AT	
Vehicle code (platform)	STAVIC	Select : KORANDO
	REXTON	
	KORANDO	
	KYRON	
	ACTYON SPORT	
	Not defined	
ECU coding status	ECU not coded	Select : ECU coded
	ECU coded	
	Signal not valid	
	Not defined	

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D20DTF ENGINE ASSEMBLY

0000-00

GENERAL INFORMATION

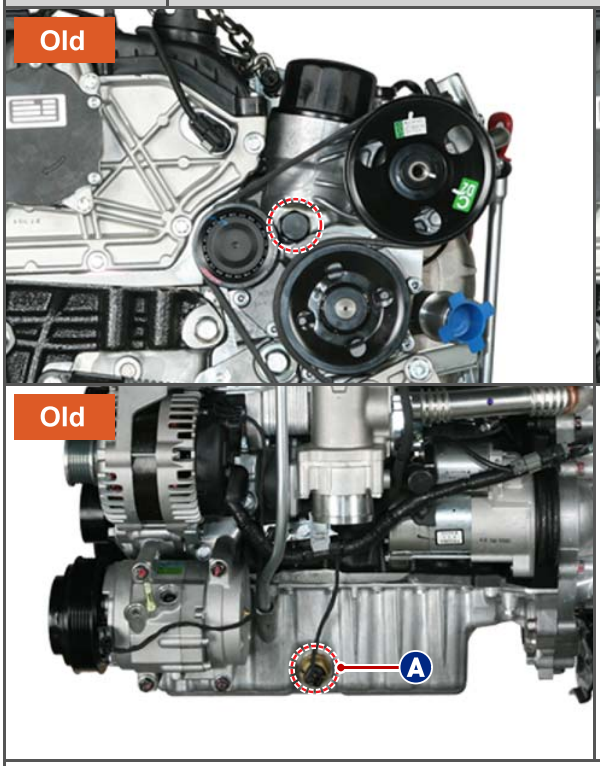
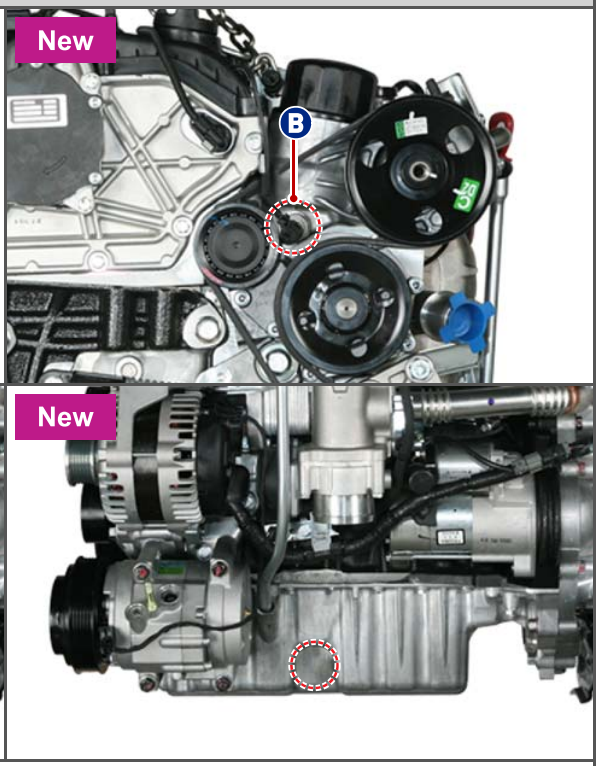
1. SPECIFICATION

Unit	Description		Specification	Remark
Cylinder head	Height		131.9 to 132.1mm	
	Flatness		below 0.1mm	
	Flatness on manifold side	Intake manifold	0.1/150mm	
		Exhaust manifold	0.15mm	
Mass balance shaft (MBU)	Backlash		0.05 to 0.15mm	
Connecting rod	End play		0.05 to 0.31mm	
Camshaft	Axial end play	Intake	0.1 to 0.35mm	
		Exhaust	0.1 to 0.35mm	
Camshaft position sensor	Distance between Camshaft position sensor and sprocket		0.20 to 1.80mm	
Valve	Clearance between valve and piston	Intake	Approx. 0.7mm	
		Exhaust	Approx. 0.8mm	
	Valve recess	Intake	0.6 to 1.0mm	
		Exhaust	0.6 to 1.0mm	
Cylinder block	Piston protrusion		0.475 to 0.745mm	
Piston ring	TOP ring end gap		0.20 to 0.35mm	
	2nd ring end gap		0.35 to 0.50mm	
	3rd ring end gap		0.2 to 0.40mm	
	Offset		0.3mm	
Head gasket	Piston protrusion	0.475~0.540	1.2t	
		0.541~0.649	1.3t	
		0.650~0.745	1.4t	

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2. MAJOR CHANGES

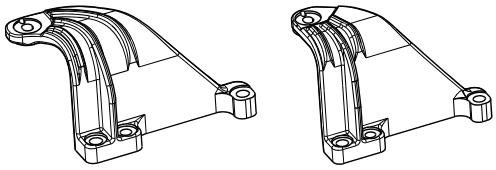
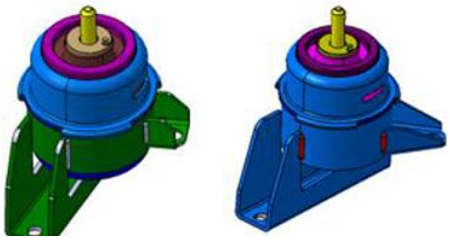
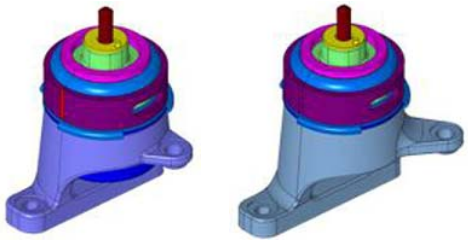
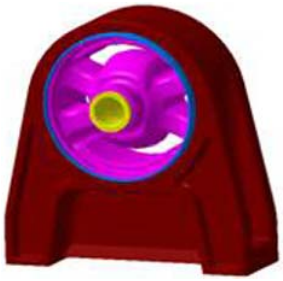
▶ **Oil pressure switch**

0000-00	Oil pressure switch
	
- Newly added oil pressure switch (B) instead of oil level switch (A)	

Modification basis	
Application basis	
Affected VIN	

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▶ Engine Mount

1900-00	Mounting Assembly RH
Old 2/4WD 	New 2WD 4WD 
Old 2WD 4WD 	New 2WD 4WD 
1900-00	**Front Mounting Assembly**
Old 	New 
1900-00	**Rear Mounting Assembly**
Old 	New 

- Changed appearance of right-hand mounting assembly and its rubber for enhanced NVH performance
- Changed appearance and material of front/rear mounting assemblies' rubbers for enhanced NVH performance
  * The mounting appearance has been changed, but work procedure is same as the old one.

Modification basis	
Application basis	
Affected VIN	

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3. TIGHTENING TORQUE

Component	Size	Quantity	Tightening torque (Nm)	Remark (Total torque)
Main bearing cap	M12×82	10	55 ± 5Nm, 180°	Not re-usable
Connecting rod cap	M9×52	8	40 ± 5Nm, 90° ± 10°	50~80Nm
Crankshaft rear cover	M6×20	6	10 ± 1Nm	-
Oil pump	M8×35	3	25 ± 2.5Nm	-
Flywheel	M10×22	8	45 ± 5Nm, 90° ± 10°	Not re-usable
Isolation damper center bolt	M18×50	1	200 ± 20Nm, 180° ± 20°	660~720Nm Not re-usable
Oil pan	M6×20	18	10 ± 1Nm	-
	M6×35	2	10 ± 1Nm	-
	M6×85	2	10 ± 1Nm	-
	M6×120	2	10 ± 1Nm	-
	M8×40	2	25 ± 2.5Nm	-
HP pump main nut	M14×1.5-8-1	1	650 ± 5Nm	-
HP pump mounting bolt	M8×55	3	25 ± 2.5Nm	-
Cylinder head	M13×150	12	85Nm 270° ± 10°	-
Camshaft cap	M6×30	16	10 ± 1Nm	-
	M8×60	4	25 ± 2.5Nm	-
Exhaust stud bolt		10	15 ± 1.5Nm	-
Exhaust sprocket bolt	M8×13.5	1	25 ± 2.5Nm	-
Coolant temperature sensor		1	20 ± 2.0Nm	-
Belt auto tensioner	M8×30(LOW)	1	25 ± 2.5Nm	-
	M10×75(Upper)	1	55 ± 5.5Nm	-
Coolant pump	M6×50	7	10 ± 1.0Nm	-

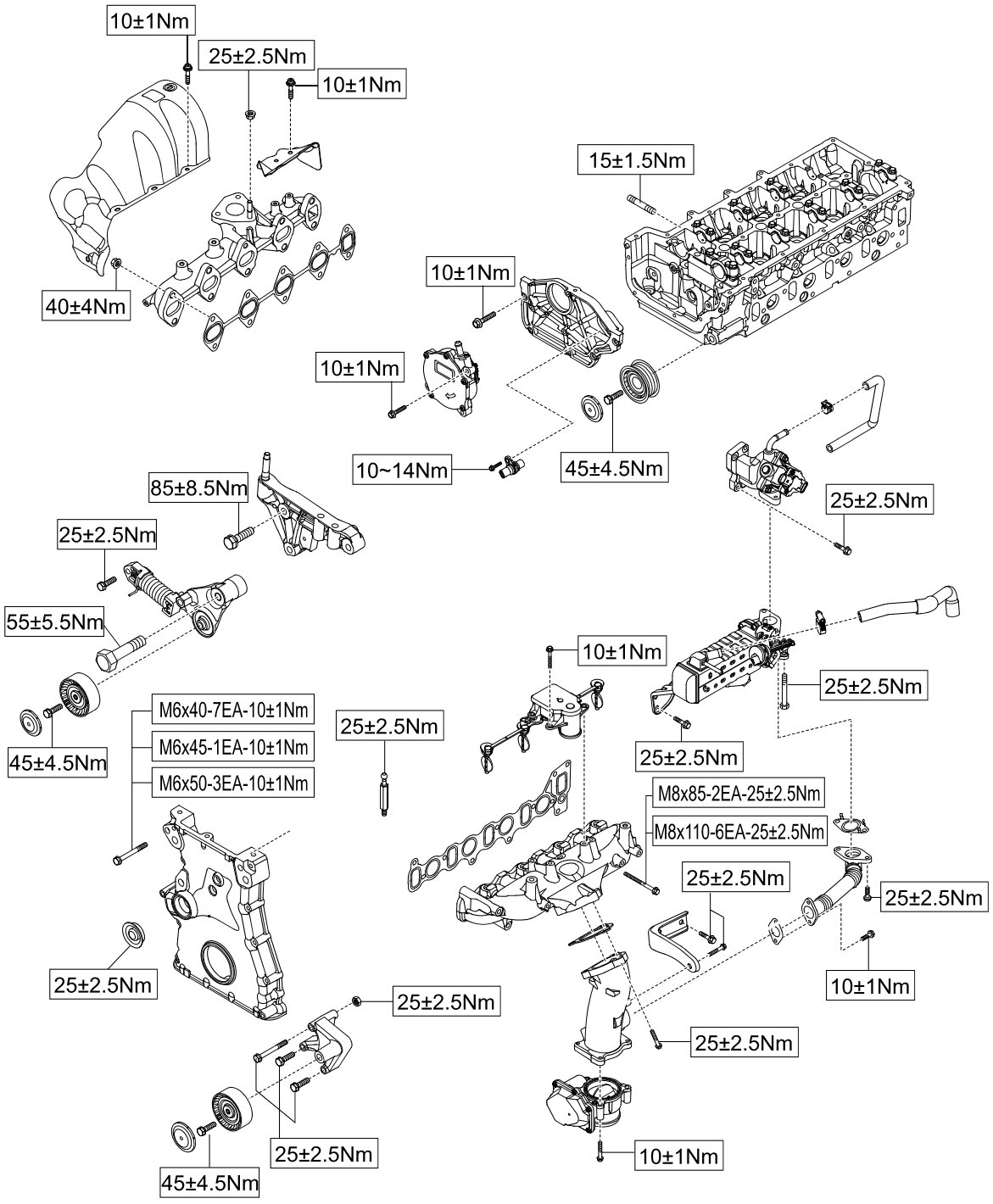
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Component	Size	Quantity	Tightening torque (Nm)	Remark (Total torque)
Hot water inlet pipe	M6×12	2	10 ± 1Nm	-
Alternator	M10×90	1	25 ± 2.5Nm	Lower
	M10×116	1	46 ± 4.6Nm	Upper
A/C compressor	M8×85	4	25 ± 2.5Nm	-
A/C bracket	M6×25	4	10 ± 1Nm	-
Intake manifold	M8×35	2	25 ± 2.5Nm	-
	M8×110	6	25 ± 2.5Nm	-
Oil filter module	M8×40	6	25 ± 2.5Nm	-
	M8×20	1	25 ± 2.5Nm	-
	M8×140	2	25 ± 2.5Nm	-
Knock sensor	M8×28	2	20±5Nm	-
Cam position sensor	M8×14	1	10~14Nm	-
T-MAP pressure sensor	M6×20	1	10±1Nm	-
Exhaust manifold	M8	10	40±4Nm	-
Turbocharger	M8	3	25±2.5Nm	-
T/C support bracket bolt		1	25±2.5Nm	-
T/C support bracket bolt	M8	1	25±2.5Nm	-
T/C oil supply pipe	M6(block side)	1	10±1.0Nm	-
	M6(turbo side)	1	17±2.0Nm	-
T/C oil return pipe	M6×16 (turbo side)	2	10±1Nm	-
	M6×16 (block side)	2	10±1Nm	-
EGR valve	M8×22	3	25±2.5Nm	-
EGR pipe bolt (Intake side)	M6×16	2	10±1Nm	-
EGR pipe bolt (EGR cooler side)	M8×25	2	25±2.5Nm	-
Oil pressure sensor	M24	1	Max. 50Nm	-

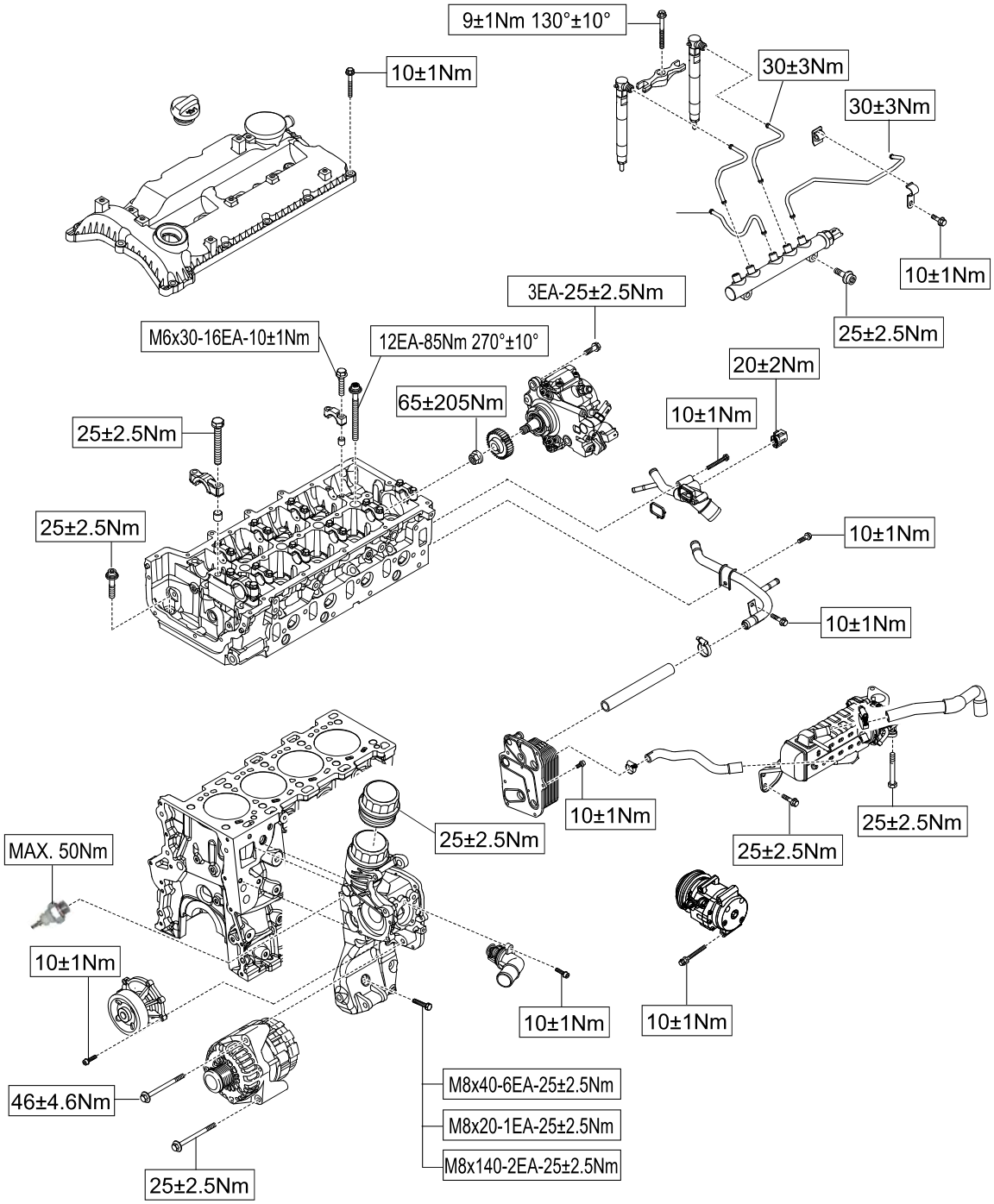
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Component	Size	Quantity	Tightening torque (Nm)	Remark (Total torque)
Idle pulley/Tensioner pulley		1	45 ± 4.5Nm	-
Glow plug	M5	4	20 ± 2Nm	-
Vacuum pump	M6×25	3	10 ± 1Nm	-
Timing gear case cover	M6×40	7	10 ± 1Nm	-
	M6×45	1	10 ± 1Nm	-
	M6×50	3	10 ± 1Nm	-
Cylinder head cover	M6×35	21	10 ± 1Nm	-
Oil gauge tube	M6×16	1	10 ± 1Nm	-
Oil filter cap		1	25 ± 2.5Nm	-
Fuel rail	M8×35	2	25 ± 2.5Nm	-
Injector clamp bolt	M6×60	2	9 ± 1.0Nm 130° + 10°	-
High pressure pipe (between HP pump and fuel rail)	M17	1	30 ± 3Nm	-
High pressure pipe (between fuel rail and injector)	M17	4	30 ± 3Nm	-
Crank position sensor	M5×14	1	8 ± 0.4Nm	-
Main wiring	M6×16	5	10 ± 1Nm	-
Intake duct	M8x25	3	25 ± 2.5Nm	-
Power steering pump	M8×100	3	25 ± 2.5Nm	-
Mass balance shaft (MBU)	M8×45	6	30 ± 3Nm	-
Cylinder head front cover	M6×10	5	10 ± 1Nm	-

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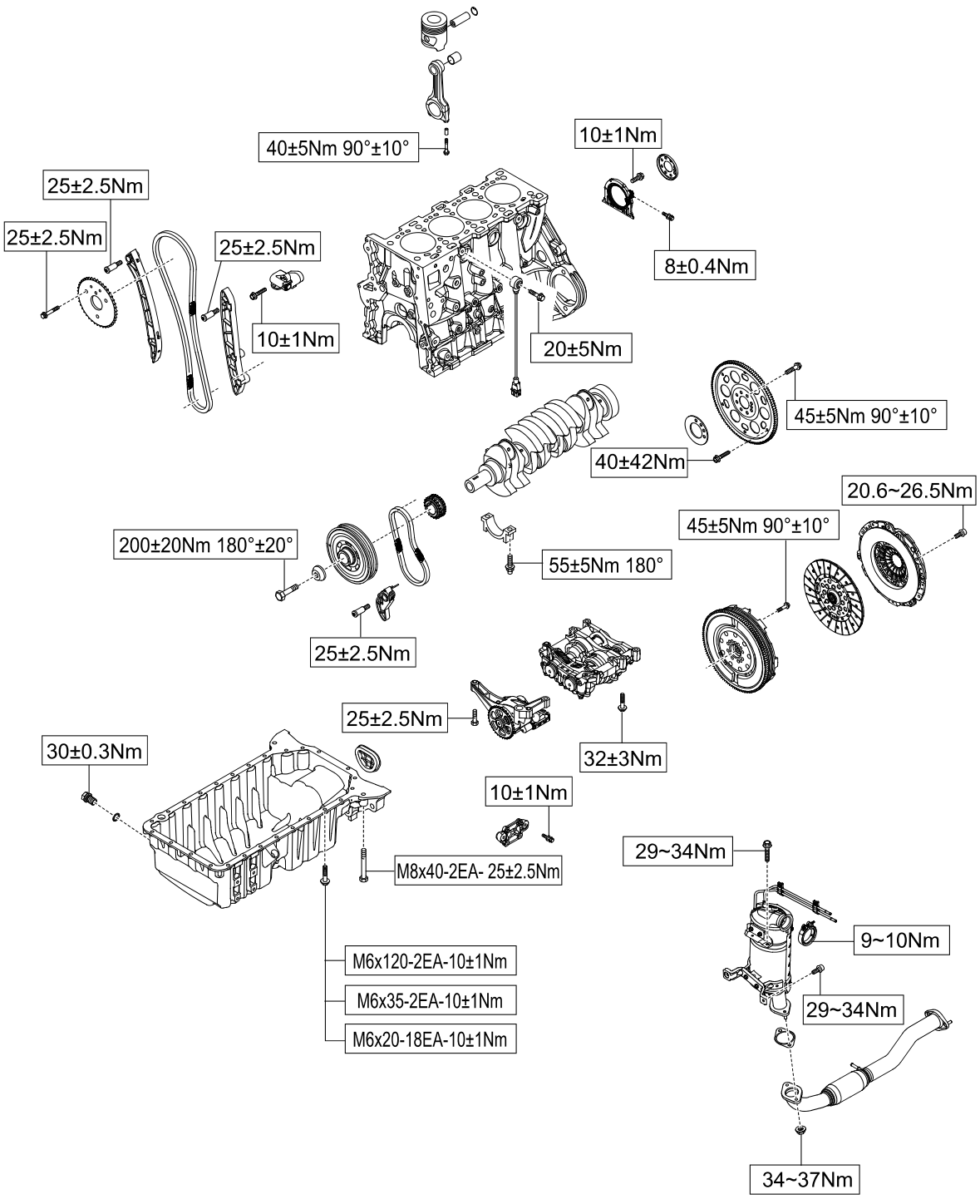


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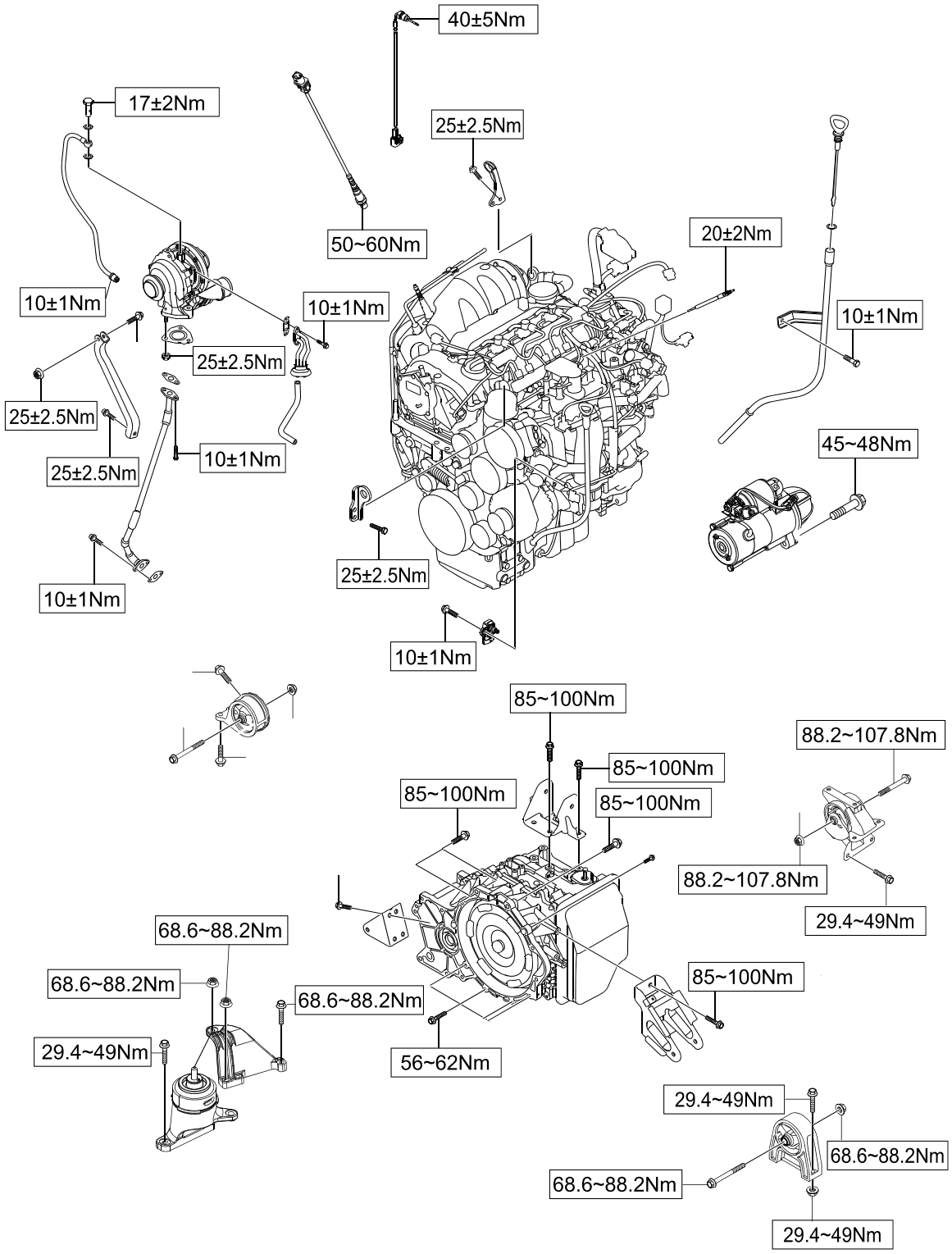
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4. CHECK AND INSPECTION

1) Cylinder

(1) Compression pressure test

▶ **Specified value**

Compression ratio		16.5 : 1
Test condition		at normal operating temperature (80°C)
Compression pressure	**Standard**	32 bar
	Minimum	18 bar
Differential limit between cylinders		Maximum 3 bar

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

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

(2) Cylinder pressure leakage test

▶ **Specified value**

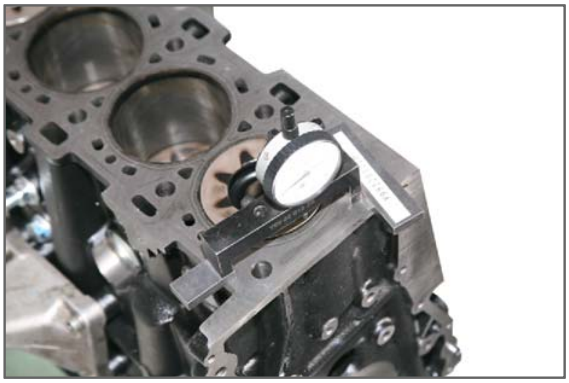
Test condition: normal engine operating temperature (80°C)	Specified value
Whole engine	below 25%
at valve and cylinder head gasket	below 10%
at piston ring	below 20%

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

CAUTION
- Perform this test in the sequence of firing order.
- Do not test the cylinder pressure leakage with wet type test procedure. (do not inject the engine oil into the combustion chamber)

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(3) Piston protrusion check



Measure how the piston is protruded from the upper side of the cylinder block.

Specified value	0.475 to 0.745mm

CAUTION

- Measure it at both end positions in the axial direction of the crankshaft.

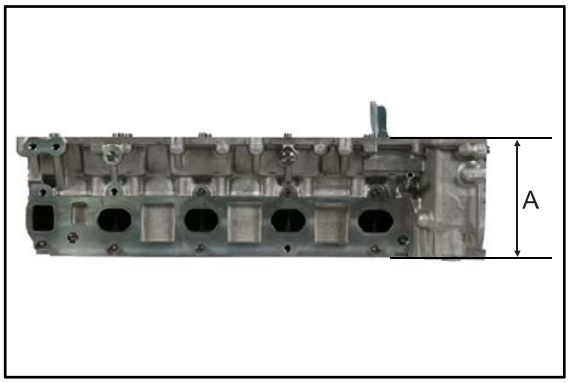
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2) Cylinder Head

(1) Cylinder head mating surface check

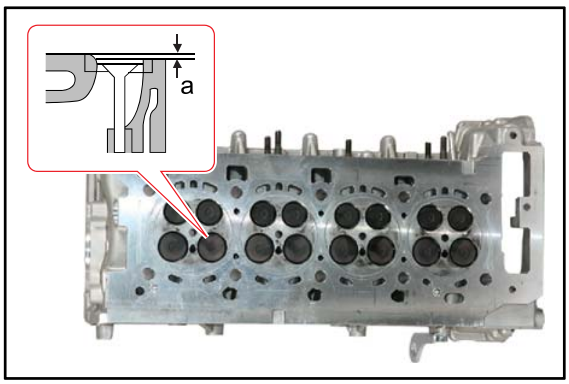
▶ **Specified value**

Total height "A"		131.9 to 132.1 mm
Minimum height after machining		131.9mm
Flatness	**Longitudinal direction**	0.1 / 150
	Transverse direction	0.15
Parallel deviation of cylinder head		below 0.1 mm
Peak-to valley of surface		Rmax7 Rz6.3
valve recess "a"	**Intake valve**	0.6 to 1.0 mm
	Exhaust valve	



1. Measure the cylinder head height "A".

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



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

Valve recess "a"	0.6 to 1.0 mm

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

(2) Cylinder head pressure Leak test

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

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5. GUIDELINES ON ENGINE SERVICE

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

▶ **Cautions before service works**

- For safe and correct works, you must observe the working procedures and instructions in this manual. And, use the designated tools as follow:
  Engine stand / Heavy duty engine jack
- To prevent the engine from starting abruptly, do not allow anybody to get in the vehicle while servicing in engine compartment.
- Before work on engine and each electrical equipment, be sure to disconnect battery negative (-) terminal.
- Before service works, be sure to prepare the works by cleaning and aligning work areas.
- Do not allow the foreign material get into the fuel injection system.
- When removing the engine, use only the safety hook on engine and engine hanger. Do not support the bottom of oil pan with a jack.

▶ **Engine and accessories**

Engine has a lot of precise portions so tightening torque should be correct during disassembly/assembly and removal/installation and service work should be done in clean ways during disassembly/assembly. Maintaining working area clean and cautious service administration is essential element of service works while working on the engine and each section of the vehicle. So the mechanics should well aware of it.

- Completely drain the engine oil, coolant and fuel from engine before removal.
- Before disassembling/assembling the engine components, carefully read the working procedures in this manual.
- Make sure to keep the specified tightening torques during installation.
- Clean and properly lubricate the parts before reassembly.
- Carefully check that there are not any interference while servicing.

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▶ Fuel and lubrication system

- Do not allow the fluid and engine oil to make contact with the body paintwork and hoses.
- If work on the fluid system such as fuel and oil, working area should be well ventilated and smoking should be prohibited.
- Gasket or seal on the fuel/lubrication system should be replaced with new ones and bolts and nuts should be tightened as specified.
- After removal/installation works, be sure to check whether there is leak on the connecting section.

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

▶ Electrical equipment

Electric devices should be handled more carefully.
Currently, the engine has a lot of electric devices. there could be poor engine performance, incomplete combustion and other abnormal symptoms due to short circuit or poor contact.

- Before work on engine and each electrical equipment, be sure to disconnect battery negative (-) terminal.
- When replacing the electric device, use only genuine part and check the conditions of connections and grounds. Loosened connection or ground make cause a fire and personal injury.

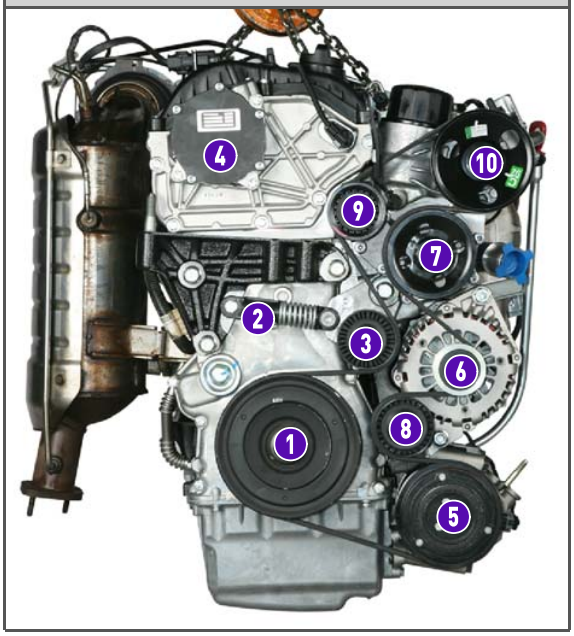
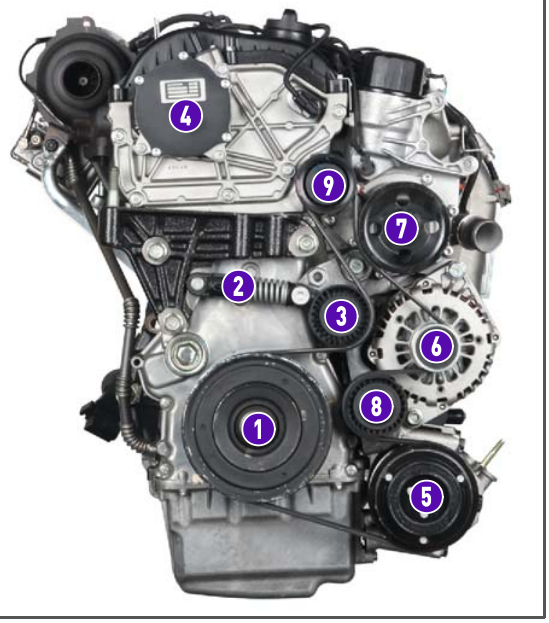
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OVERVIEW AND OPERATING PROCESS

1. BELT SYSTEM

The belt system is a single belt drive system which uses single belt and has components on the oil filter housing as FEAD (Front End Accessories Drive) type.

▶ **Components**

with HPS (hydraulic power steering)	with EPS (electric power steering)
	

	HPS	EPS
1	Crankshaft pulley (DDU)	←
2	Auto tensioner	←
3	Tensioner pulley	←
4	Vacuum pulley	←
5	A/C compressor pulley	←
6	Alternator pulley	←
7	Water pump pulley	←
8	NO. 1 idler pulley	←
9	NO. 2 idler pulley	←
10	Power steering pump	-

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2. VACUUM PUMP

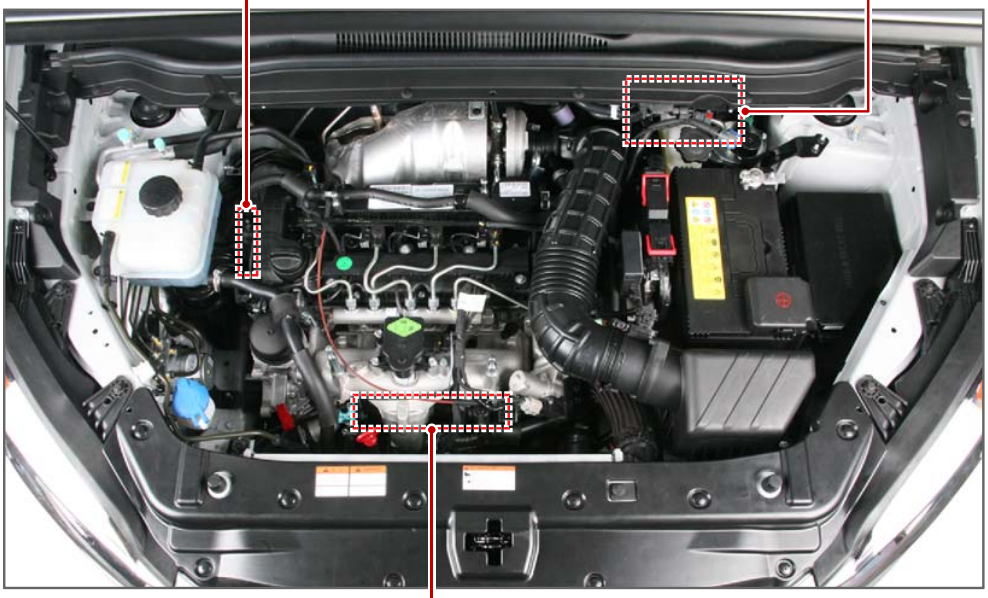
Vacuum pump generates the vacuum pressure and supplies it to EGR cooler bypass solenoid. This pump is single vane type and displacement is 210 cc/rev. The lubrication oil is supplied through the hole in hollow shaft.

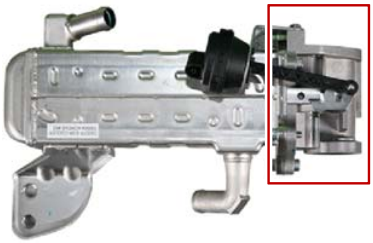
▶ **Components**

Vacuum pump	
	Pump capacity: 210 cc/rev Speed: 375 to 3,000 rpm Lubrication temperature: −40 to 155°C Oil: 5W30 Drive type: Driven by exhaust Camshaft solt

Brake booster





EGR cooler bypass valve	
	Exhaust gas goes to combustion chamber without through EGR cooler in engine cooled, and the valve is closed by vacuum pressure.

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3. ENGINE MOUNTINGS

D20DTF engine mounting is 4-point mounting type and supports the engine and transaxle.
Front and rear mountings are rubber type and support the torque reaction. Left and right mountings support the power train rods and torque reaction. Additionally, right mounting is hydraulic type and supports the engine vibration.

▶ **Components**

Right mounting assembly
Location: Engine block side and body side member



Right MTG-2WD



Right MTG-4WD



BRKT-Right MTG-2WD



BRKT-Right MTG-4WD



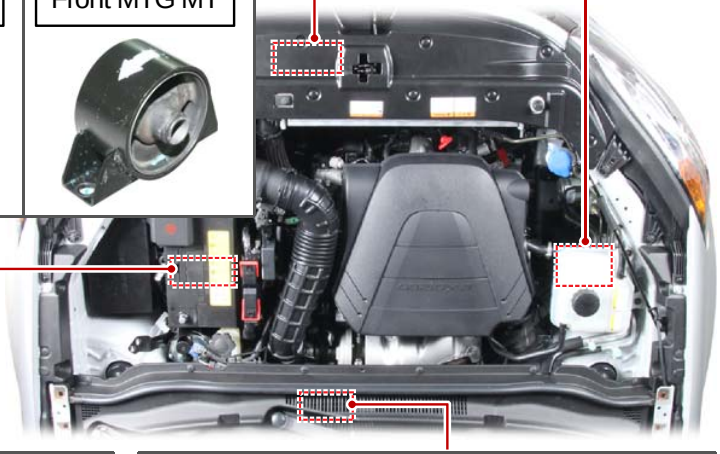
Front mounting assembly
Location: Front side of transfer axle housing and front side of sub frame



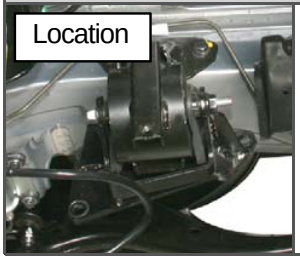
Front MTG AT



Front MTG MT



Left mounting assembly
Location: Upper side of transfer axle housing and body side member



Front mounting



Rear mounting assembly
Location: Rear side of transfer axle housing and front side of sub frame



Front mounting



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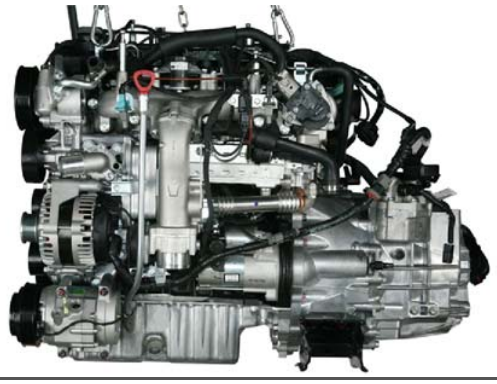
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4. INTAKE/EXHAUST SYSTEM

1) Intake Manifold

Intake manifold is installed on the cylinder head with 8 bolts. The variable swirl valve is introduced to improve the EGR gas mixture and turbulence in combustion chamber and to decrease the exhaust gas.

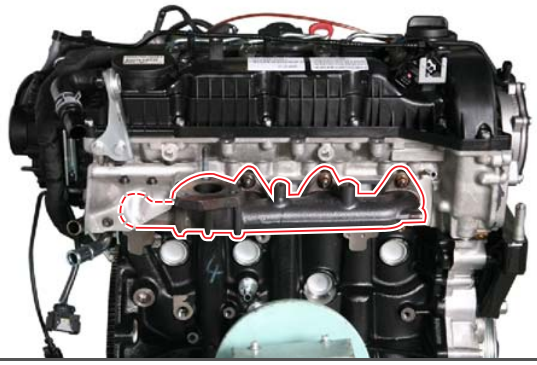
▶ **Components**

Intake manifold	
	

2) Exhaust Manifold

Exhaust manifold is installed on the cylinder head with 10 stud bolts and nuts. EGR port is integrated in cylinder head.

▶ **Components**

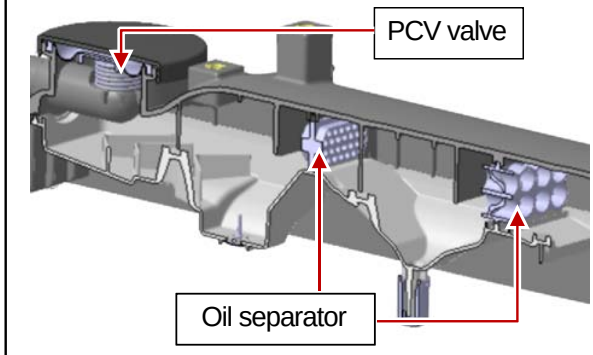
Exhaust manifold	
	

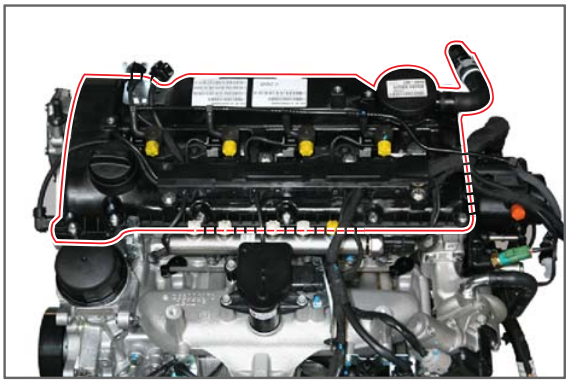
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5. CYLINDER HEAD COVER AND OIL SEPARATOR

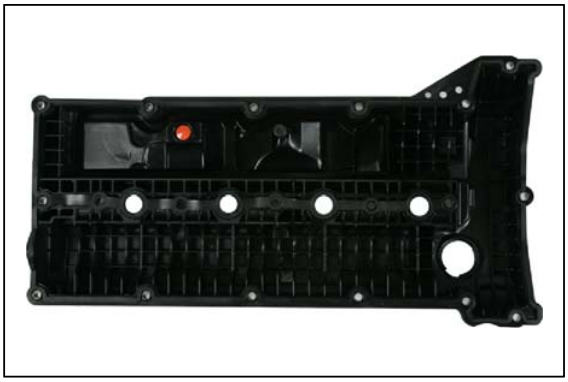
The cylinder head cover is made by high strength plastic to reduce the weight. The multi twist type oil separator improves the oil consumption.

▶ **Components**









Modification basis	
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6. CYLINDER HEAD

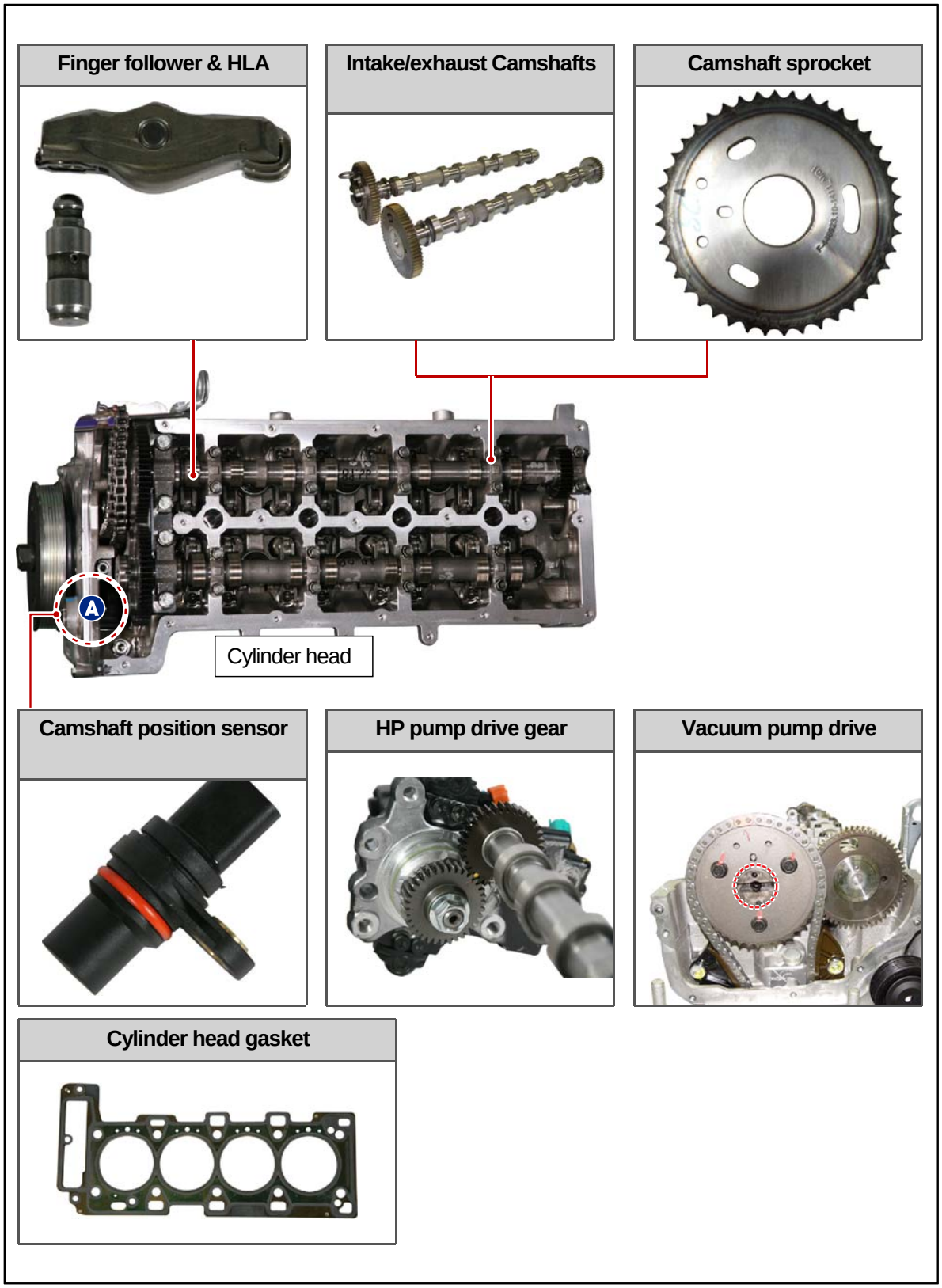
Cylinder head contains cam position sensor, vacuum pump, intake manifold, exhaust manifold and valve assembly. Vacuum pump and the high pressure (HP) pump are driven by Camshaft and valves are install in vertical direction. This enables the compact layout in cylinder head assembly.





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▶ Components



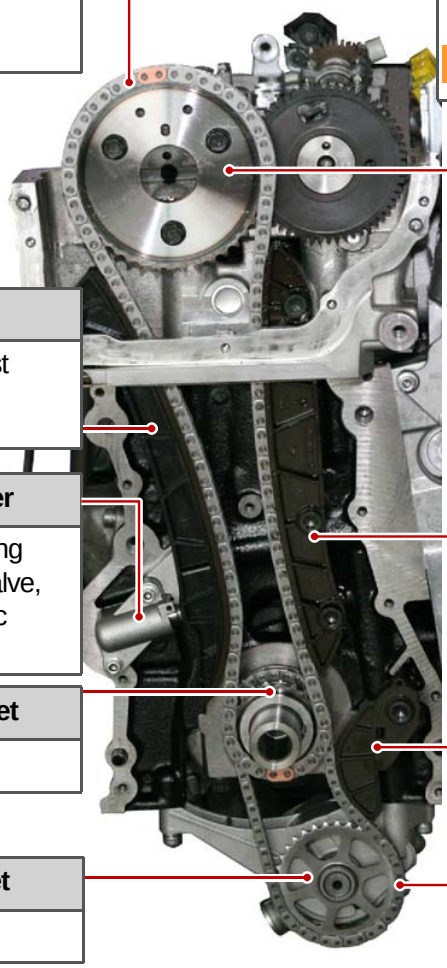
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7. CHAIN AND GEAR DRIVE SYSTEM

D20DTF engine uses single stage chain drive system. Timing chain drives the exhaust side and gear drive the intake side. Timing chain is single bush type. Upper chain drives HP pump connected to intake Camshaft by driving exhaust cam shift sprocke, and lower chain drives oil pump to lubricate the engine. And, MBU (Mass Balance shaft Unit) drive gear drives MBU.

▶ **Components**



Chain upper bush
Chain type: single bush
Chains: 112 EA

Exhaust Camshaft sprocket
Teeth: 42 EA
Tightening torque 25 ± 2.5Nm

Tensioner rail
Installed between exhaust Camshaft sprocket and crankshaft sprocket

Clamping rail
Installed between exhaust Camshaft sprocket and crankshaft sprocket

Hydraulic tensioner
Contains tensioner housing plug, spring and check valve, and operated by hydraulic pressure

Mechanical type tensioner
Operated by internal spring

Crankshaft sprocket
Teeth: 21 EA

Oil pump sprocket
Teeth: 30 EA

Chain lower bush
Chain type: single bush
Chains: 60 EA

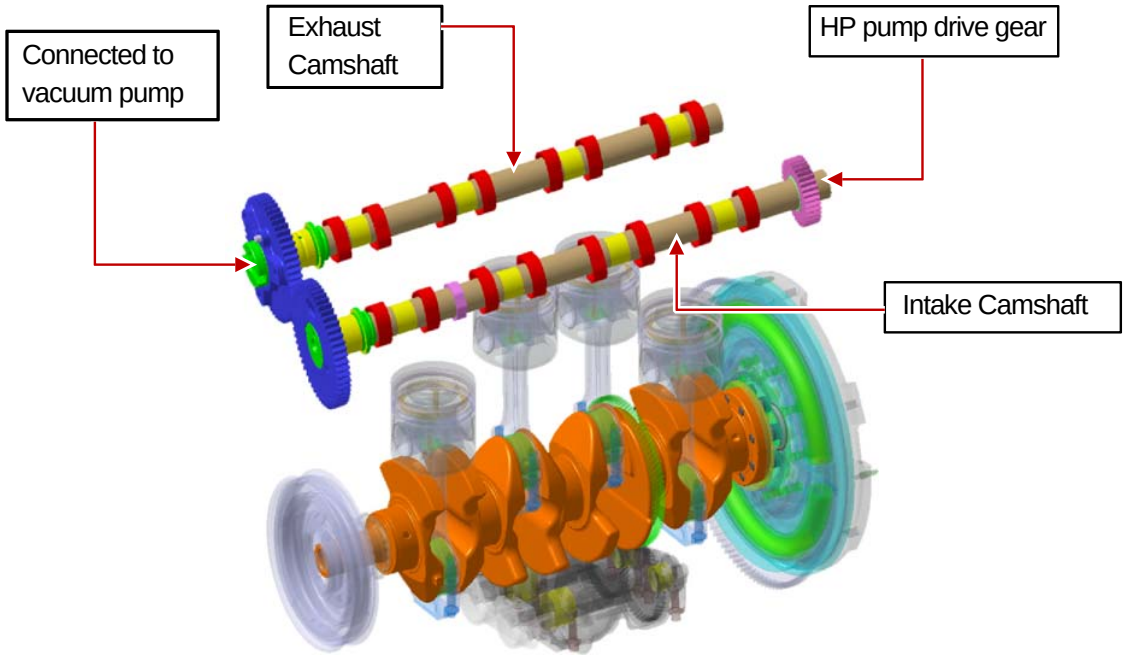
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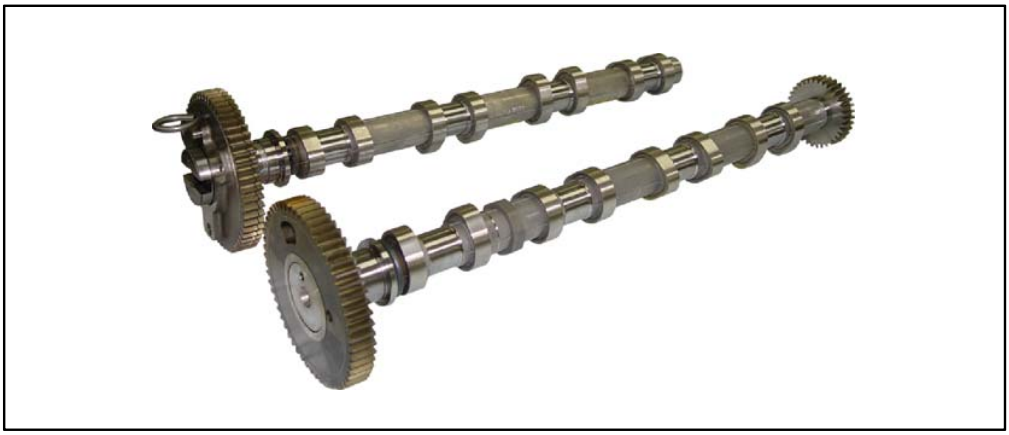
The timing links (gold color) on the timing chain are aligned with the timing marks on the crankshaft sprocket and the camshaft sprocket whenever the crankshaft rotates 8 turns.

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▶ Components

Intake/exhaust Camshaft assembly





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Timing gear cover case (TGCC)



TGCC



Oil seal



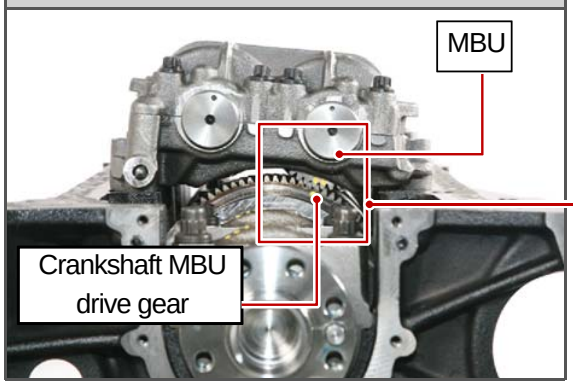
Screw plug

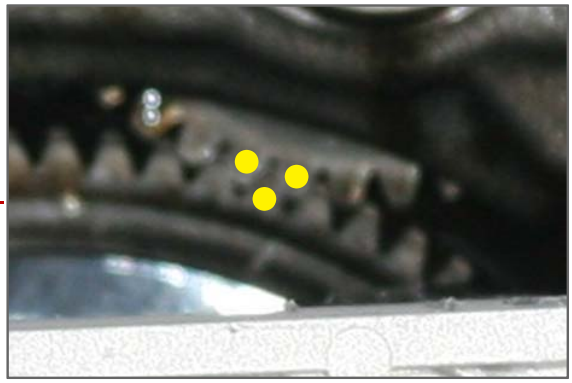


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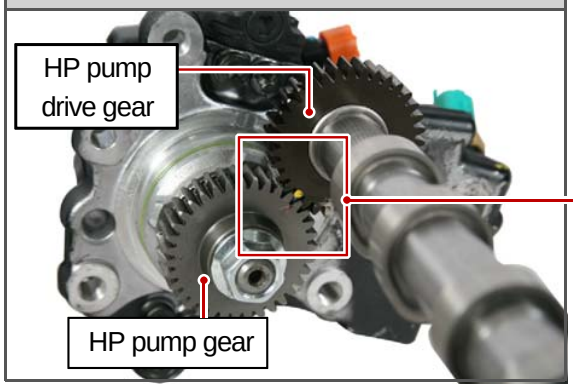
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Mass Balance Unit (MBU)





Fuel HP pump





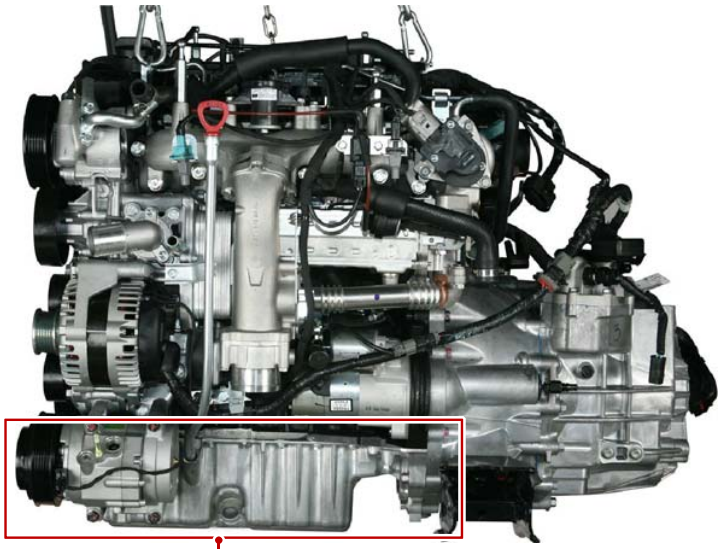
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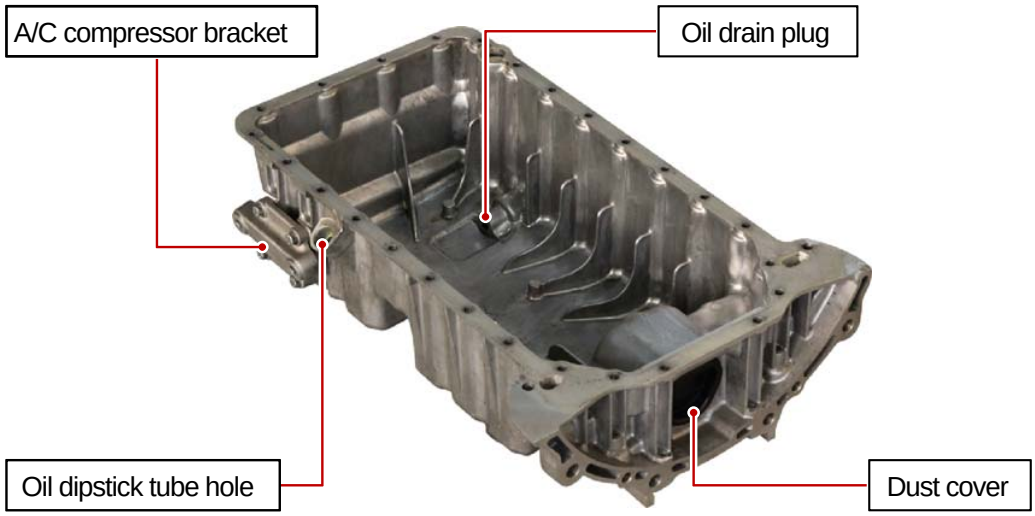
8. OIL PAN

The oil pan in D20DTF engine improves the noise and vibration. Especially, the oil drainage is very easier than before. And, A/C compressor bracket and the oil dipstick tube are mounted on the oil pan.

▶ Components



Oil pan assembly

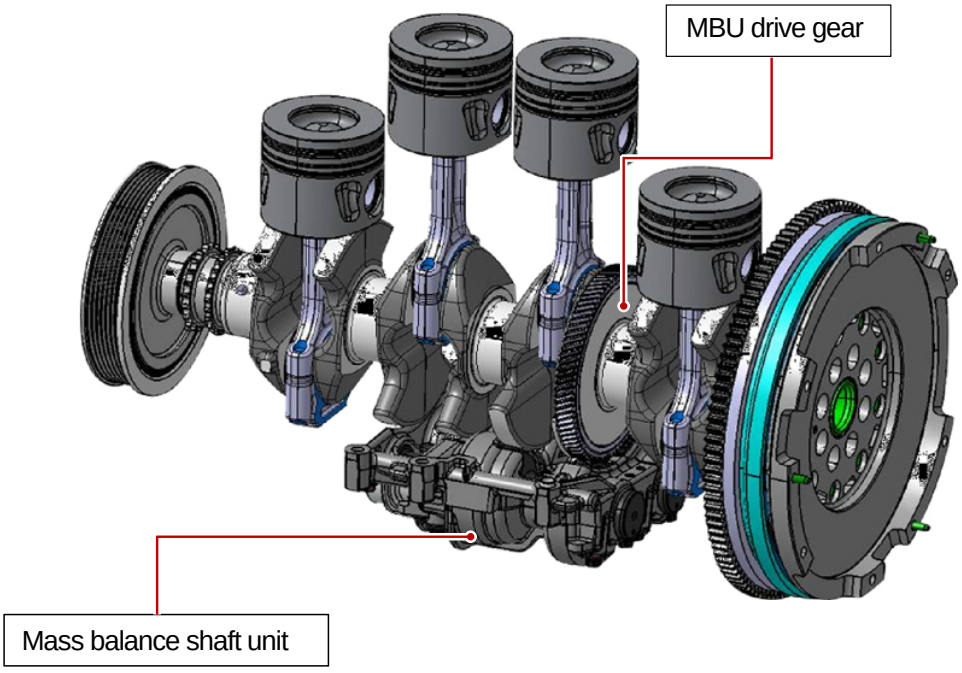


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9. MASS BALANCE SHAFT UNIT (MBU)

The balance shaft in MBU (Mass Balance shaft Unit) improves the NVH performance by decreasing the unbalanced force.

▶ **Components**



Mass balance shaft unit





Modification basis	
Application basis	
Affected VIN	

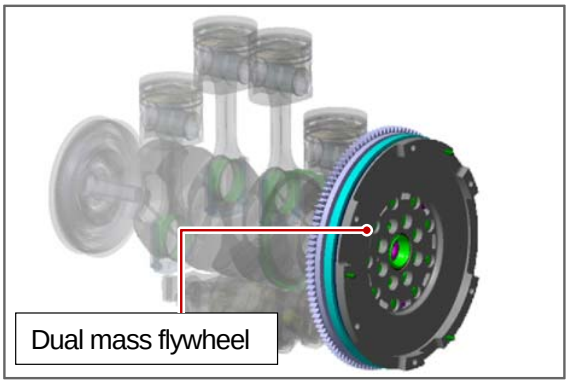
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10. FLYWHEEL AND DRIVE PLATE

1) DMF (Dual Mass Flywheel)

The dual mass flywheel, or DMF, eliminates excessive transmission gear rattle, reduces gear change/shift effort, and increases fuel economy. There is a friction ring located between the inner and outer flywheel that allows the inner and outer flywheel to slip. This feature is designed to alleviate any damage to the transmission when torque loads exceed the vehicle rating of the transmission. The friction ring is the weak spot in the system and can wear out if excessive engine torque loads are applied through it. The system also has a center support bearing that carries the load between the inner and outer flywheel, and is fitted with damper springs to absorb shocks.

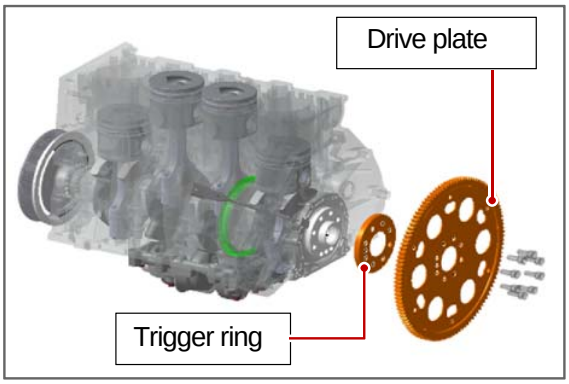
▶ **Components**



2) Drive Plate

Drive plate receives the power from the start motor when starting the engine. With this, the drive plate initially drives the power train system. And, it is connected to the torque converter to transfer the engine torque to the power train system.

▶ **Components**

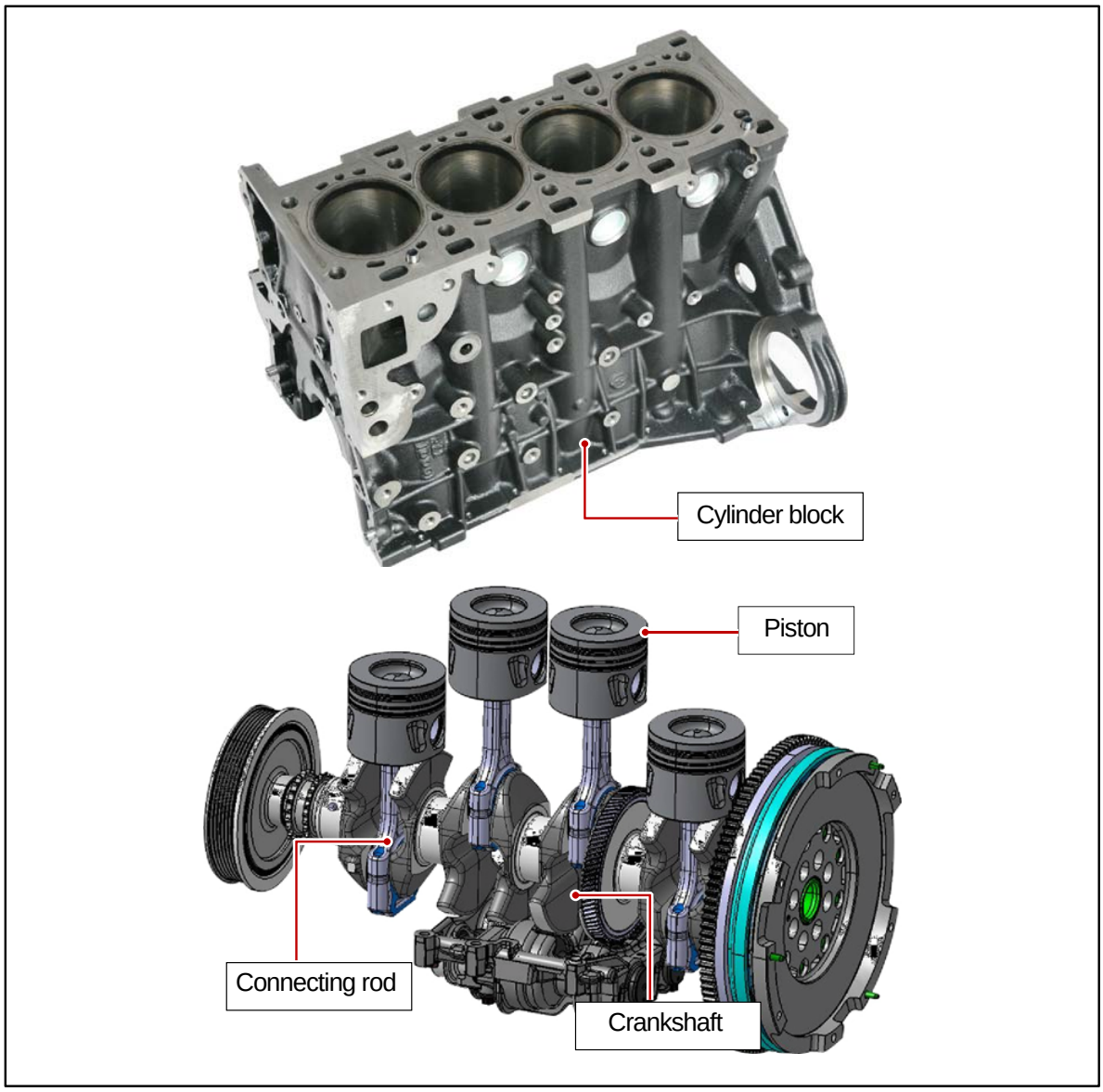


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11. PISTON/CRANKSHAFT/CYLINDER BLOCK

This vehicle is FF driving type and the engine is installed in lateral direction. The crankshaft and the cylinder block convert the compression pressure to the rotating energy.

▶ **Components**



Modification basis	
Application basis	
Affected VIN	

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ENGINE FUEL SYSTEM

0000-00

GENERAL INFORMATION

1. SPECIFICATION

Description			Specification
Fuel			Diesel
Fuel filter	Type		Fuel heater + priming pump + water separator integrated type
	Filter type		Changeable filter element type
	Change interval	EU	every 40,000 km
		GEN	every 45,000 km
	Water accumulating capacity		200 cc
	Heater capacity		250W 13.5V
Injector	System pressure		1800 bar
High pressure fuel pump	Type		Eccentric cam/Plunger type
	Operating type		Gear driven type
	Normal operating temperature		−40 ~ 125℃
	Operating pressure		1800 bar
	Operating temperature		−30℃ ~ 120℃
Low pressure fuel pump	Type		Vane type
	Gear ratio (pump/engine)		0.5 : 1
	Pressure		6 bar
Fuel tank	Capacity		57 L
	Material		Plastic
	Fuel sender		Dual sender type

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2. MAJOR CHANGES

▶ **Filter**

Part SGN NO.	Sub Sender Filter
Old 	New 
- Suction port introduced replacing sub sender pre-filter	

Modification basis	
Application basis	
Affected VIN	

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3. MAINTENANCE AND INSPECTION

1) Maintenance Procedures for DI Engine Fuel System

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

NOTE

Follow the below procedures before starting service works for fuel system.

Carefully listen the symptoms and problems from customer.

↓

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

↓

Perform the diagnosis proceee with SCAN tool

↓

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

↓

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

CAUTION

Clean the engine compartment before starting service works.

Tool kit for high pressure line	Took kit for low pressure line
	

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

Disconnect the negative battery cable.

↓

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

Once disconnected, the fuel pipes between HP pump and fuel rail and between fuel rail and each injector should be replaced with new ones. The pipes should be tightened tospecified tightening torques during installation. Over or under torques out of specified range may cause damages and leaks at connections. Once installed, the pipes have been deformed according to the force during installation, therefore they are not reusable. The copper washer on injector should be replaced with new one. The injector holder bolt should be tightened to specified tightening torque as well. If not, the injection point may be deviated from correct position, and it may cause engine disorder.

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

6. Plug the removed components with clean and undamaged sealing caps and store it into the box to keep the conditions when it was installed.

Fuel filter assembly



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

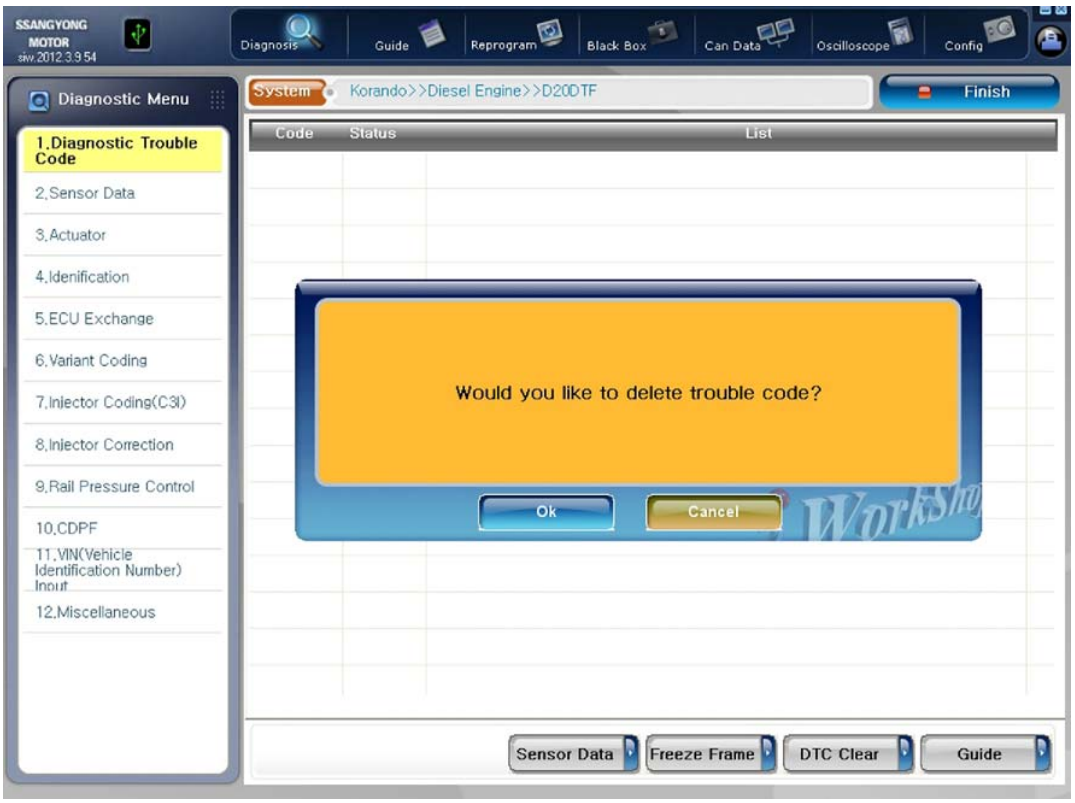
Priming pump cap



Modification basis	
Application basis	
Affected VIN	

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8. Check the installed components again and connect the negative battery cable. Start the engine and check the operating status.
9. With Scan Tool, check if there are current faults and erase the history faults.



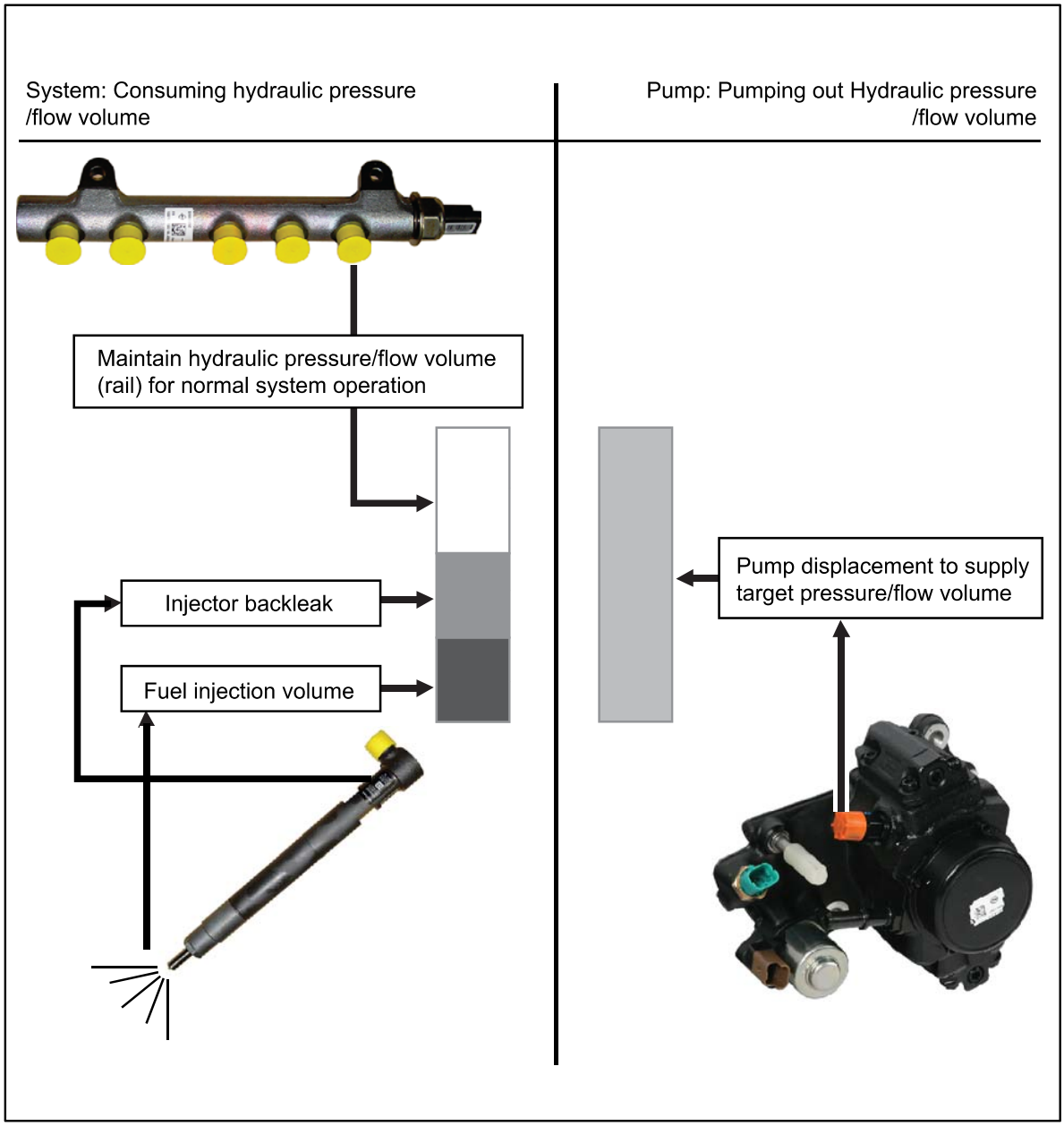
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2) Diagnostic Test for Engine Fuel System

(1) Overview

If a DTC is displayed on the diagnostic device, check the low pressure- and high pressure fuel systems before removing the components.
To run the system properly, the electric system must be intact but for the DI engine, the fuel pressure should be measured also when there is a malfunction even after the diagnostic test with a diagnostic device.

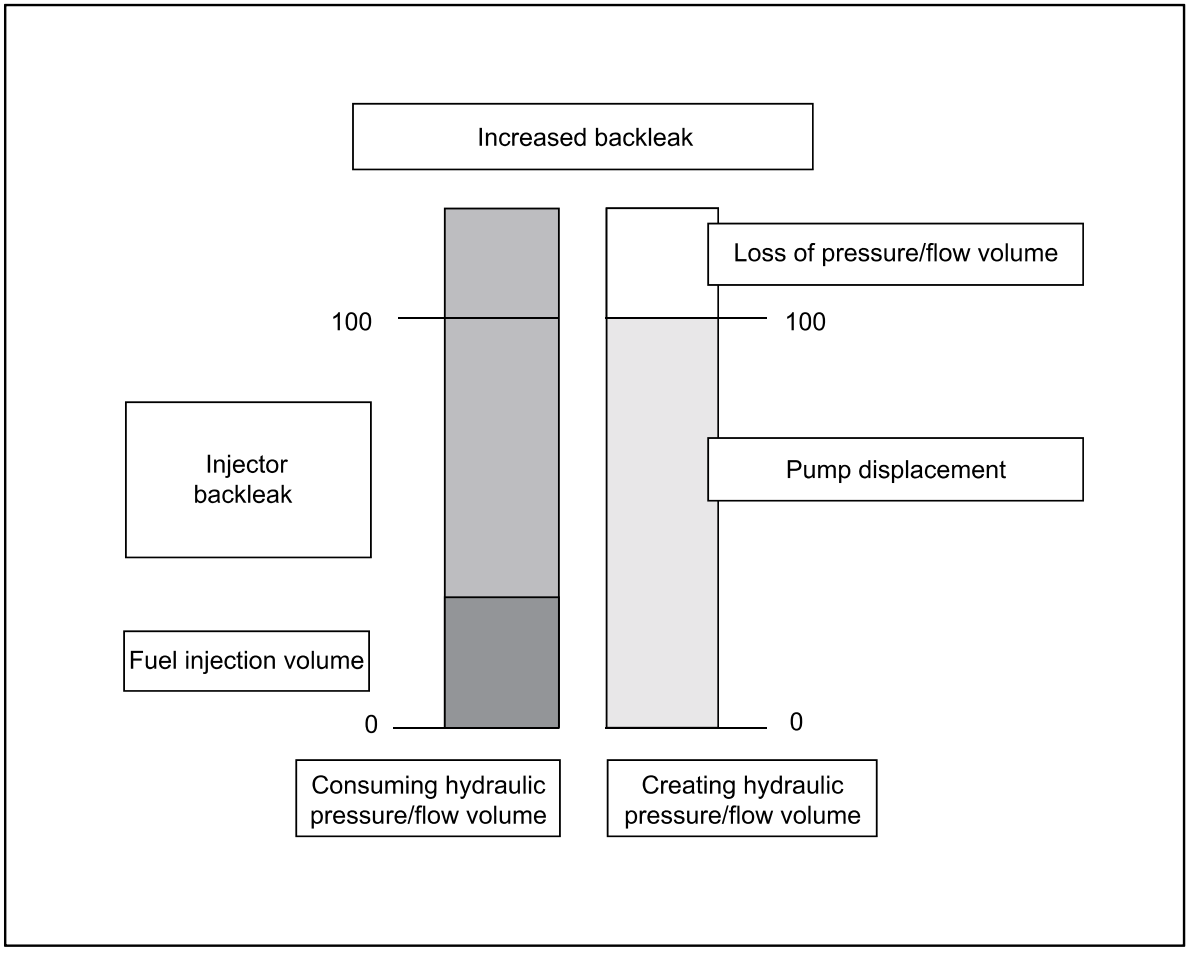
(2) Hydraulic system



Modification basis	
Application basis	
Affected VIN	

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(3) Excessive backleak of injector



▶ **Excessive injector backleak**

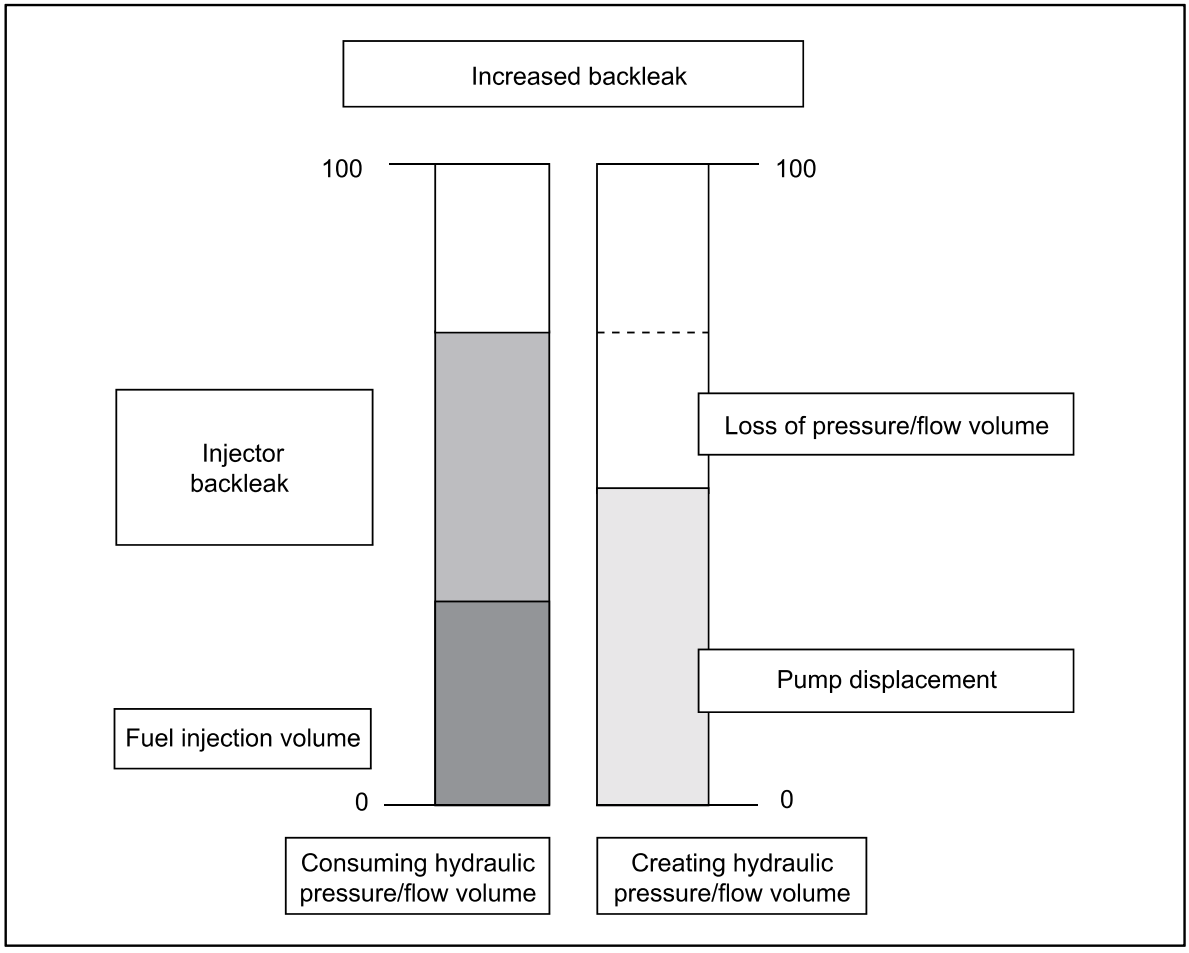
Occurs when the injector control valve is not sealed due to the entry of the foreign materials.

▶ **Example:**

- Entry of foreign materials
- Burned out and worn HP pump
- Mechanical damage inside the injector

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(4) Loss of pump pressure/flow



▶ Loss of HP pump pressure/flow

Faulty fuel supply line, or damaged or worn pump causes the lack of flow pressure and flow volume

▶ Example:

- Air in fuel supply line
- Excessive load on fuel supply line (←400 mBar)
- Burned out and mechanical worn pump
- High temperature of fuel supply (> 85℃)

Modification basis	
Application basis	
Affected VIN	

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3) Pressure Test for Fuel System in DI Engine

(1) Test device (Tool kit)

Tool kit for high pressure line

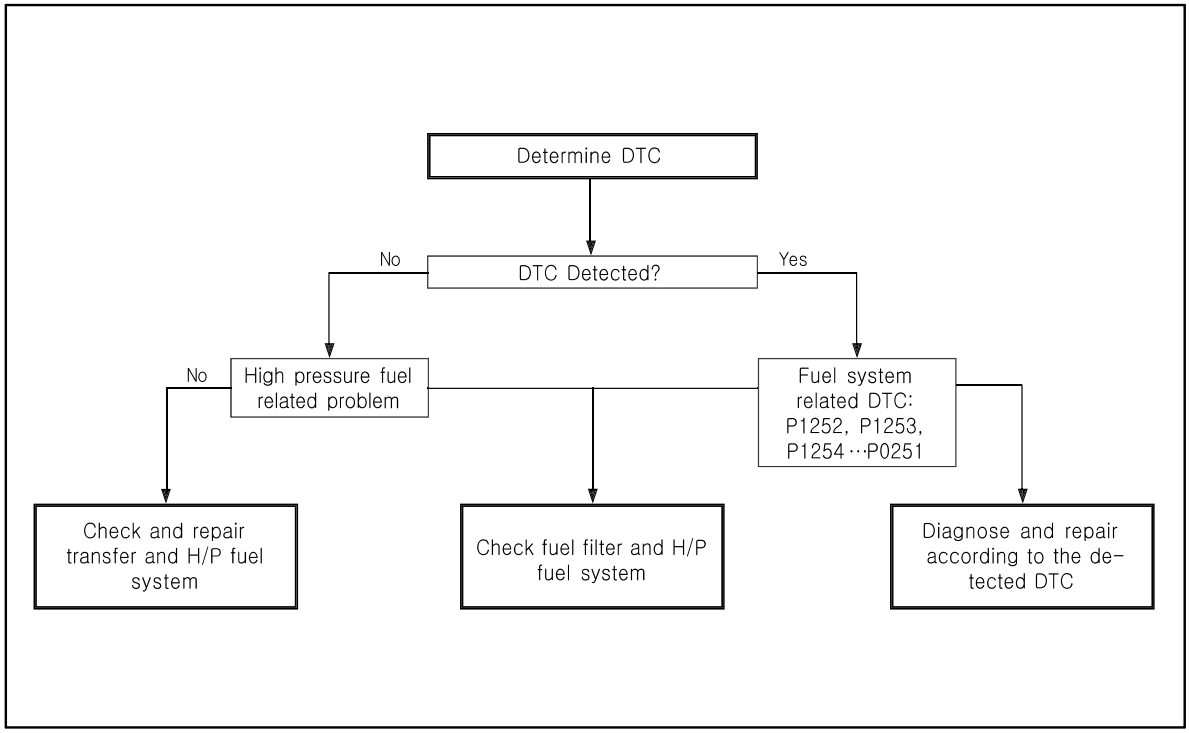
Tool kit for low pressure line


(2) Pre-inspection

- Connections in fuel supply line
- Fuel level in fuel tank
- Air in fuel supply line (air bubbles in fuel supply line or fuel)
- Fuel leaks from fuel supply line (low/high pressure line)
- Used the specified
- Fuel filter contamination

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(3) DTC Check



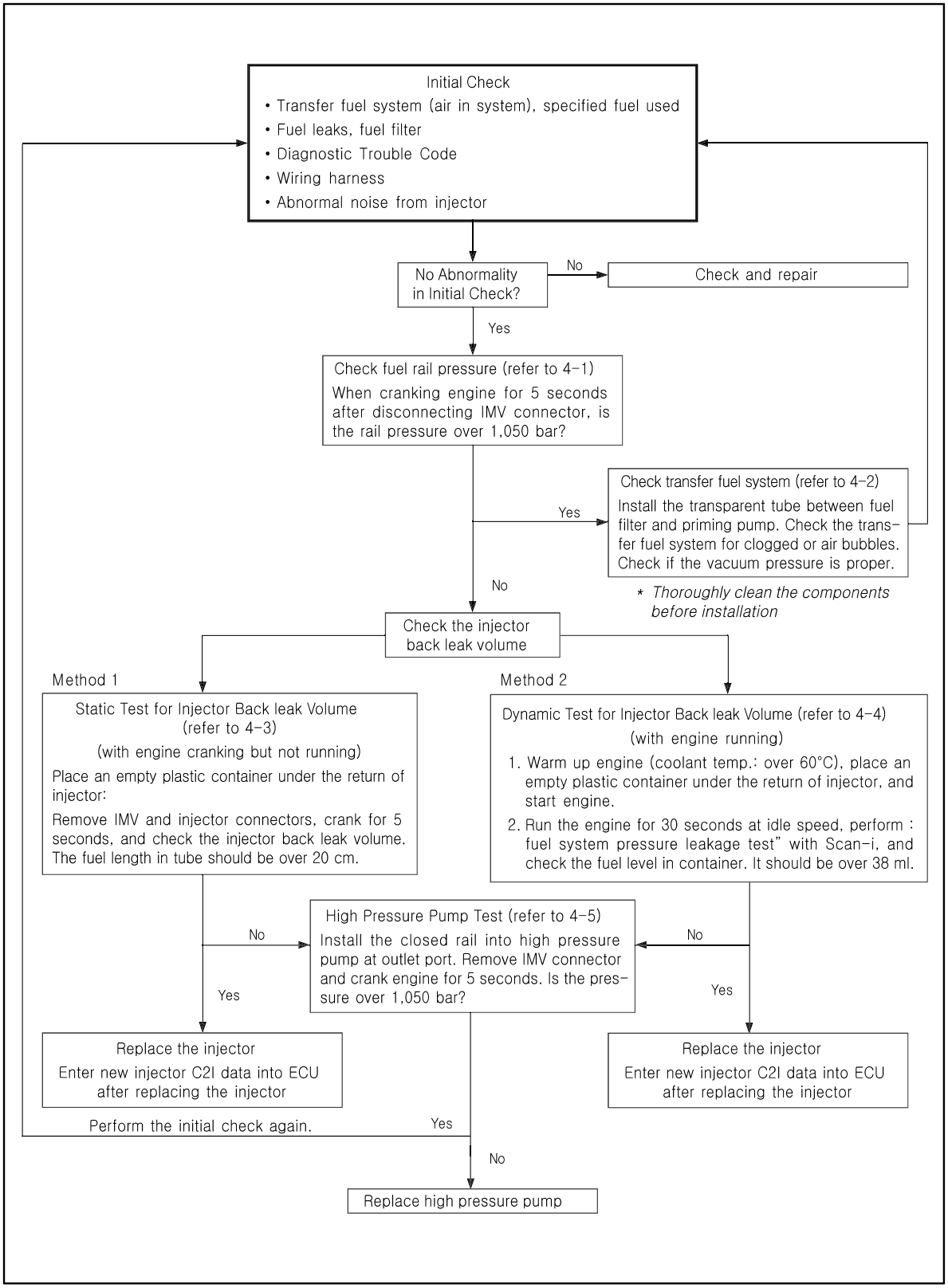
CAUTION

If several DTCs are output simultaneously, check the electric wiring for open or short circuit.
Check the low pressure fuel system and fuel filter and confirm that there are no abnormalities. Carry out the high pressure fuel system check.

Modification basis	
Application basis	
Affected VIN	

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(4) Fuel System Check Procedure

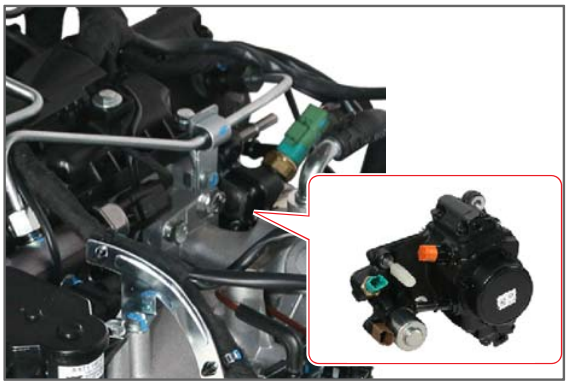


Modification basis	
Application basis	
Affected VIN	

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(5) High Pressure System Pressure Test

▶ **Fuel rail pressure test**



1. Disconnect the fuel rail pressure sensor connector and then IMV connector.



2. Connect the pressure tester to the fuel rail pressure sensor connector.



3. Crank the engine 2 times for 5 seconds.
   - Read the highest pressure value displayed on the tester display.
   - If the highest pressure value is 1,050 bar or less, refer to the section "Fuel System Check Process".

Modification basis	
Application basis	
Affected VIN	

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▶ How To Use Pressure Tester



1. Press the "TEST" button on the tester to check if the message "TEST?" is displayed. If the button is pressed again at 4 seconds
2. after starting engine cranking, the highest pressure is displayed on the tester.

NOTE

The fuel rail pressure value can be checked using a diagnostic device.

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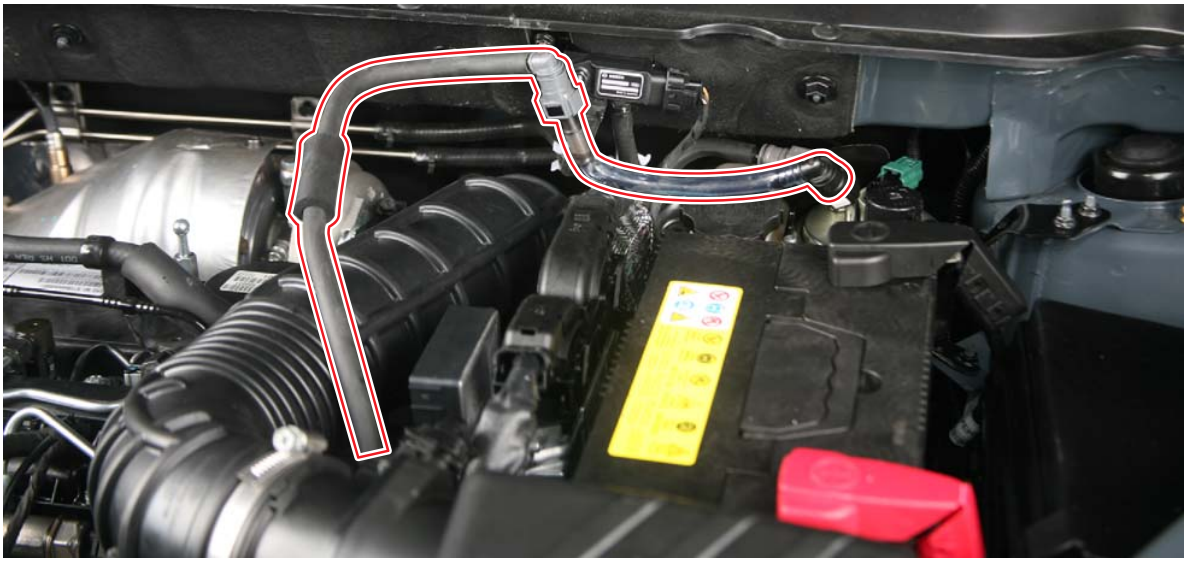
(6) Low Pressure System Pressure Test

▶ **Inspection procedure**



1. All wirings/connectors and fuel lines should be connected and the engine should work properly.
2. Prepare a special tool for low pressure test and clean it thoroughly to prevent foreign materials from entering.

3. Disconnect the key connector for fuel filter connection, and connect both connectors to the fuel filter and hose.

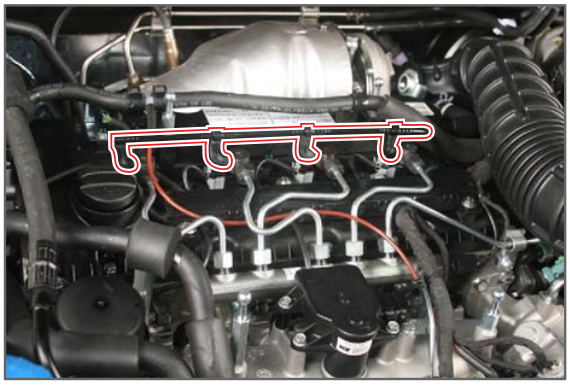


4. Start the engine and check visually for clogged low pressure fuel system, excessive air or air entry. If the fuel flow is not sufficient or air is in the fuel, repair the leak area.
5.

Modification basis	
Application basis	
Affected VIN	

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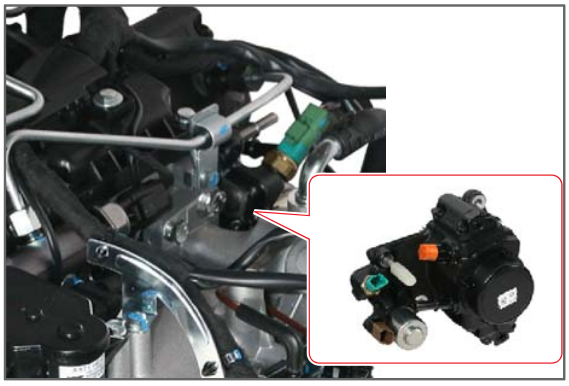
▶ Static test for backleak of injector



1. Disconnect the injector return hose and cover the openings with caps shaped screw (included in the special tool).



2. Connect the hose of the container for measuring backleak to the return nipple of the injector.
(prevent air entry to the low pressure line)



3. Disconnect the IMV connector of the high pressure pump and then fuel pressure sensor connector.

CAUTION
The connector of the injector can be easily contaminated. Always keep it clean.



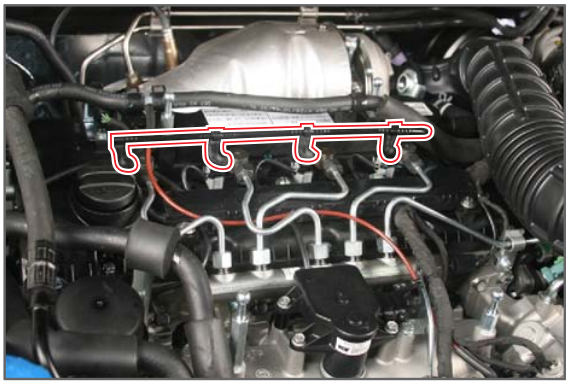
4. Crank the engine for 5 seconds.
5. Check the flow volume of injector backleak.

Flow volume of injector backleak	below 20 cm

NOTE
If the value is out of the specified range, replace the injector.

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▶ Dynamic test for backleak of injector



1. Warm up the engine so that the engine coolant temperature be over 80℃ and star
2. the engine again.
   Disconnect the injector return hose and cover the openings with caps shaped screw (included in the special tool).



3. Connect the hose of the container for measuring backleak to the return nipple of
4. the injector.
   Start the engine again and let the engine
5. idle for 30 seconds.
   Perform backleak test of fuel system with a diagnostic device after 30 seconds.

This test consists of 4 cycles, and the engine rpm reaches 3,500 rpm for 18 seconds in each cycle.



6. Check the amount of backleak collected into the container and confirm that it is within the specified range.

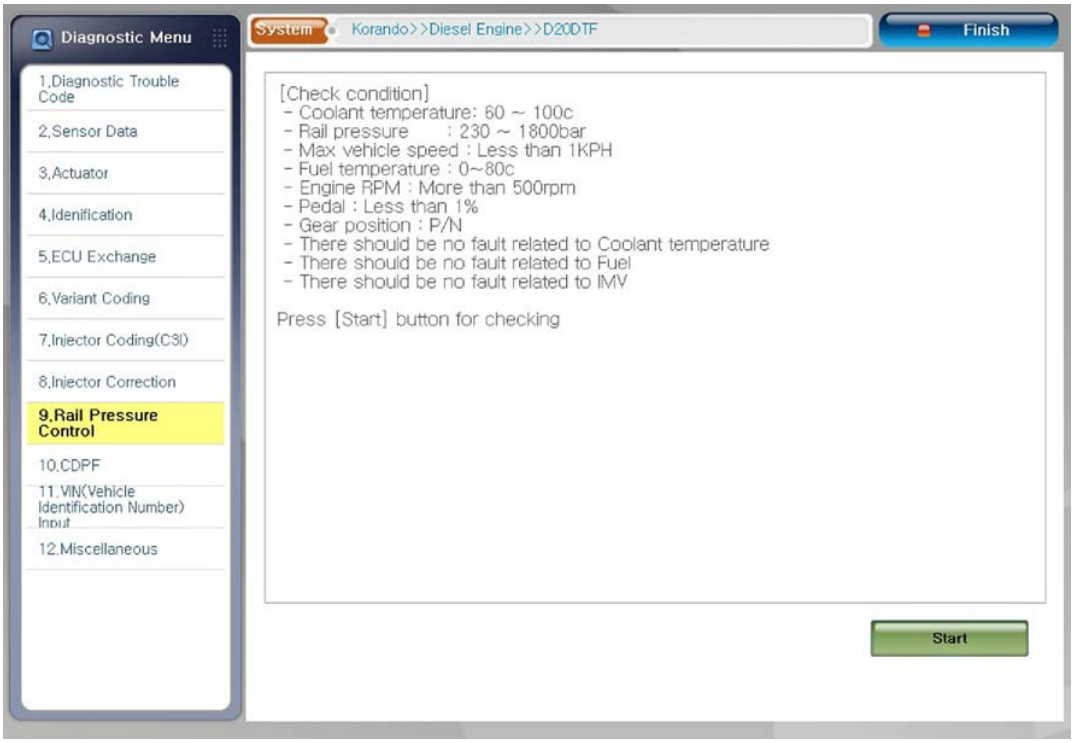
Specification	38 ml or less



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▶ Pressure leak test in fuel system with scan tool

1. When the dynamic test for injector backleak is performed, this test should be done together with it. However, you can check the pressure leak from the fuel system only with this test.
2. To do this test, the coolant temperature should be over 60°C. Check the conditions of sensors and components in fuel system with scan tool.
3. Perform the diagnostic test as follows:
   - Select the "Vehicle Model" and go to "Diagnosis Mode".
   - Select "Pressure Leak Test in Fuel System" in "Diagnosis Menu".
   - If the conditions are OK, press "Start".



NOTE

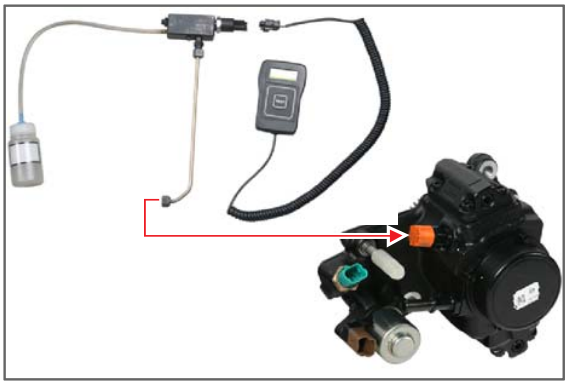
The pressure leak test procedure is performed in 4 cycles. The engine speed goes up to 3,500 rpm and down again four times for 18 seconds. If the system is OK, the "System OK" message will be displayed.

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▶ HP pump pressure test



1. Prepare a special tool for high pressure test and clean it thoroughly to prevent foreign materials from entering.



2. Disconnect the high pressure fuel supply pipe on the HP pump and install the close rail in the tool kit.

Tightening torque 30Nm

3. Connect the other end of the close rail to the fuel rail for test

Tightening torque 30Nm

4. Disconnect the return hose for HP pump and connect the clear hose and connect its the other end to the return port of the fuel rail for test.
5. Connect the digital tester connector to the sensor connector of the fuel rail for test.
6. Crank the engine 2 times for 5 seconds after removing the IMV connector and fuel rail pressure sensor connector.
7. Read the pressure value displayed on the tester display is within the specified range.



Specification	1,050 bar or more

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4. CAUTIONS FOR DI ENGINE

1) Cautions for DI Engine

This chapter describes the cautions for DI engine equipped vehicle. This includes the water separation from engine, warning lights, symptoms when engine malfunctioning, causes and actions.

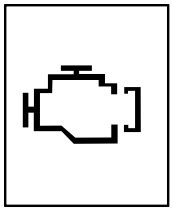
1. DI Engine

Comparatively conventional diesel engines, DI engine controls the fuel injection and timing electrically, delivers high power and reduces less emission.

2. System Safety Mode

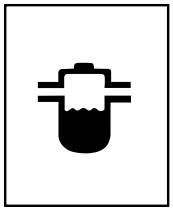
When a severe failure has been occurred in a vehicle, the system safety mode is activated to protect the system. It reduces the driving force, restricts the engine speed (rpm) and stops engine operation. Refer to "Diagnosis" section in this manual.

3. Engine CHECK Warning Lamp



The Engine CHECK warning lamp on the instrument cluster comes on when the fuel or major electronic systems of the engine are not working properly. As a result, the engine's power output may decrease or the engine may stall.

4. Water Separator Warning Lamp



When the water level inside water separator in fuel filter exceeds a certain level (approx. 45 cc), this warning light comes on and buzzer sounds.
Also, the driving force of the vehicle decreases (torque reduction). If these conditions occur, immediately drain the water from fuel filter.

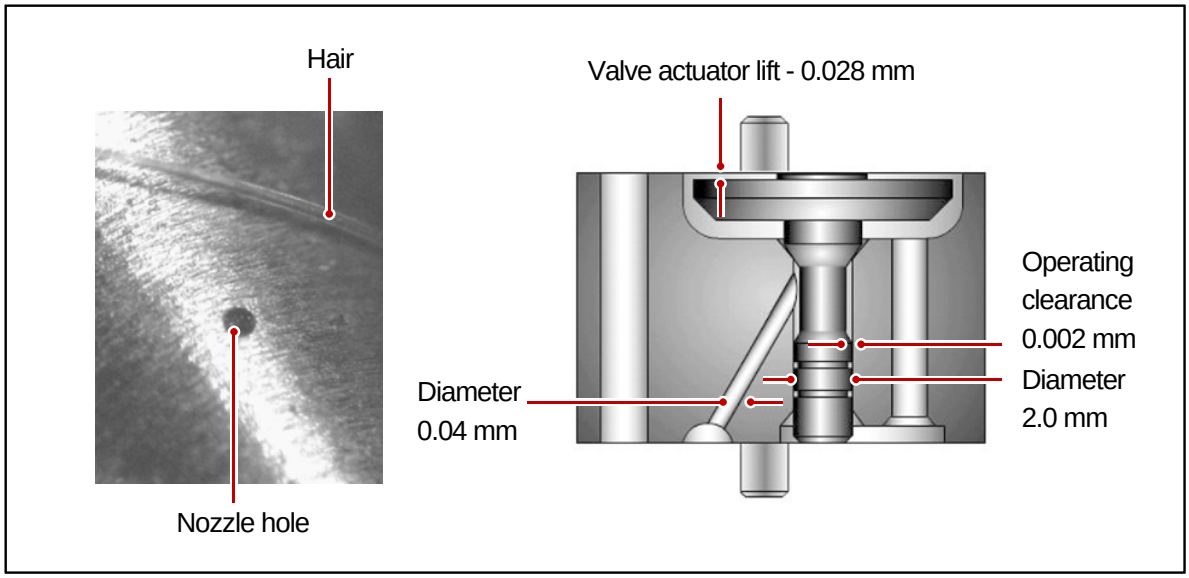
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2) Cleanness

(1) Cleanness of DI engine fuel system

▶ Cleanness of DI engine fuel system and service procedures

The fuel system for DI engine consists of transfer (low pressure) line and high pressure line.
Its highest pressure reaches over 1,600 bar.
Some components in injector and HP pump are machined at the micrometer 100 μm of preciseness.
The pressure regulation and injector operation are done by electric source from engine ECU.
Accordingly, if the internal valve is stuck due to foreign materials, injector remains open.
Even in this case, the HP pump still operates to supply high pressurized fuel. This increases the pressure to combustion chamber (over 250 bar) and may cause fatal damage to engine.
You can compare the thickness of injector nozzle hole and hair as shown in below figure (left side). The below figure shows the clearance between internal operating elements.



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

Modification basis	
Application basis	
Affected VIN	

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(2) Di engine and its expected problems and remedies can be caused by water in fuel

▶ System supplement against paraffin separation

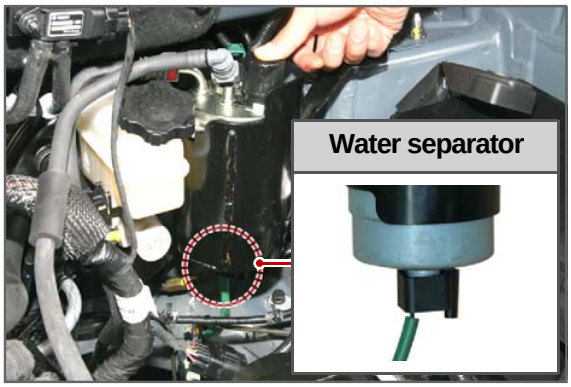
In case of Diesel fuel, paraffin, one of the elements, can be separated from fuel during winter and then can stick on the fuel filter blocking fuel flow and causing difficult starting finally. Oil companies supply summer fuel and winter fuel by differentiating mixing ratio of kerosene and other elements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

▶ System supplement and remedy against water in fuel

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

▶ Water drain from water separator

If water in the separator on the fuel filter exceeds a certain level, it will be supplied to HP pump with fuel, so the engine ECU turns on warning lamp on the meter cluster and buzzer if water level is higher than a certain level.
Due to engine layout, a customer cannot easily drain water from fuel filter directly, so if a customer checks in to change engine oil, be sure to perform water drain from fuel filter.

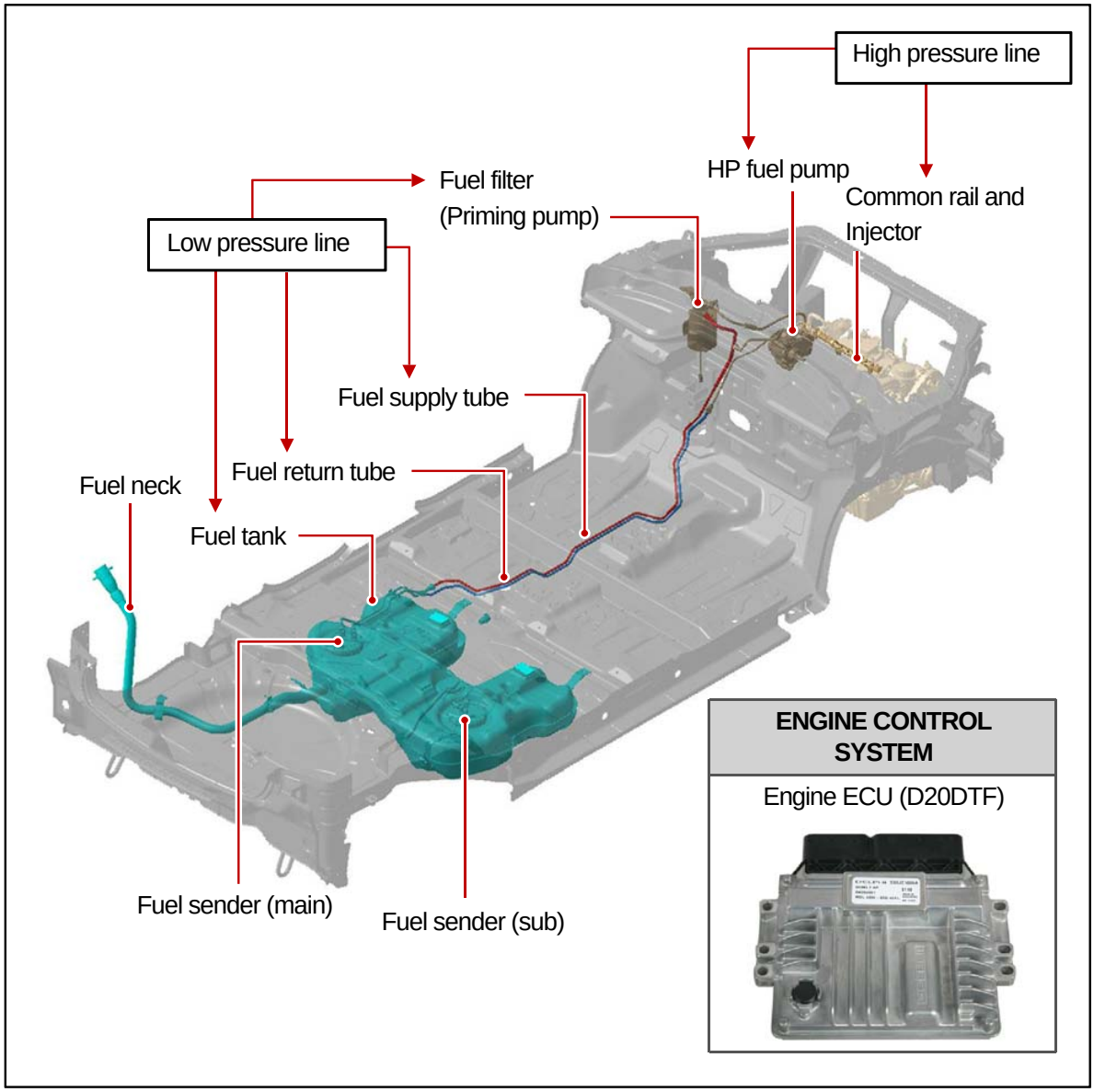


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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The components in the fuel system supply fuel and generate high pressure to inject fuel to each injector. They are controlled by the engine ECU.
The common rail fuel injection system consists of fuel tank, fuel line, low pressure line which supplies low pressure fuel to the low pressure pump (includes high pressure pump), high pressure line which connected to the injector and the engine control unit (ECU) which calculates the accelerator pedal position and controls the overall performance of vehicle based on the input signals from various sensors.



Modification basis	
Application basis	
Affected VIN	

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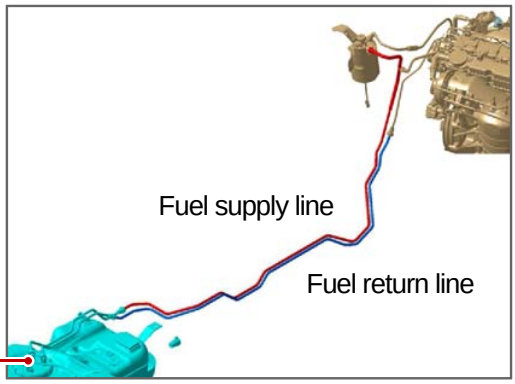
Memo

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2. SYSTEM LAYOUT AND OPERATION

1) Layout

NOTE
For sensor and actuator control logic, refer to Chapter "ENGINE CONTROL".



Fuel tank

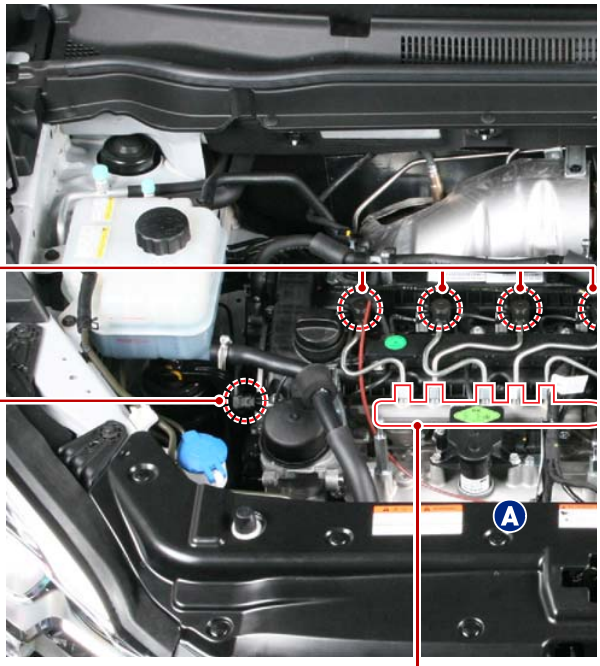


Fuel metering by dual sender. Supply the fuel in main fuel tank and sub fuel tank through fuel inlet tube

Injector (C3I)



Pre-injection, main injection, after-injection by signals from ECU



Camshaft position sensor



Determines the injection order.

Fuel rail assembly



Relieves the pulsation.
Measures the fuel pressure.
Distributes the fuel to injectors.

Modification basis	
Application basis	
Affected VIN	

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High pressure pump

Plunger type HP pump (1,800 bar)



Vane type transfer pump (6bar)

Generates the high pressurized fuel and supply it.

Accelerator pedal position sensor

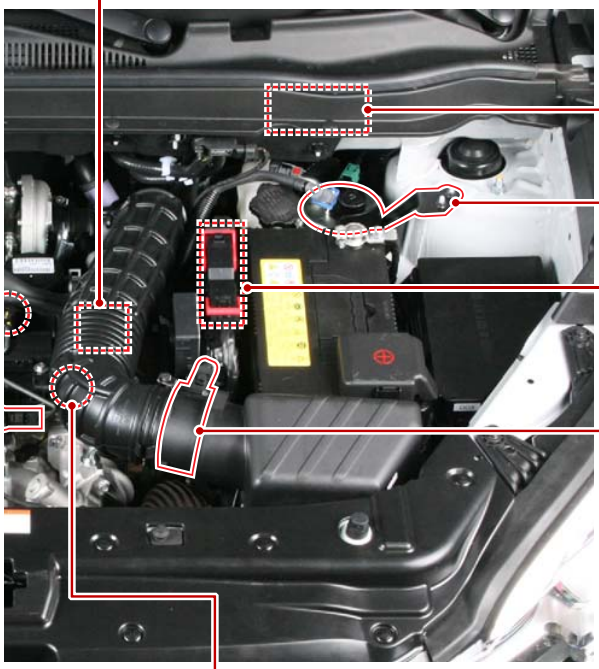


Detects driver's intention for speed up/down

Fuel filter assembly



Supply clean fuel/fuel heating/water separation by priming pump



Engine ECU (D20DTF)



Engine control by various signals

Crankshaft position sensor



Measuring engine rpm

T-MAP sensor



Measuring booster pressure and temperature

HFM

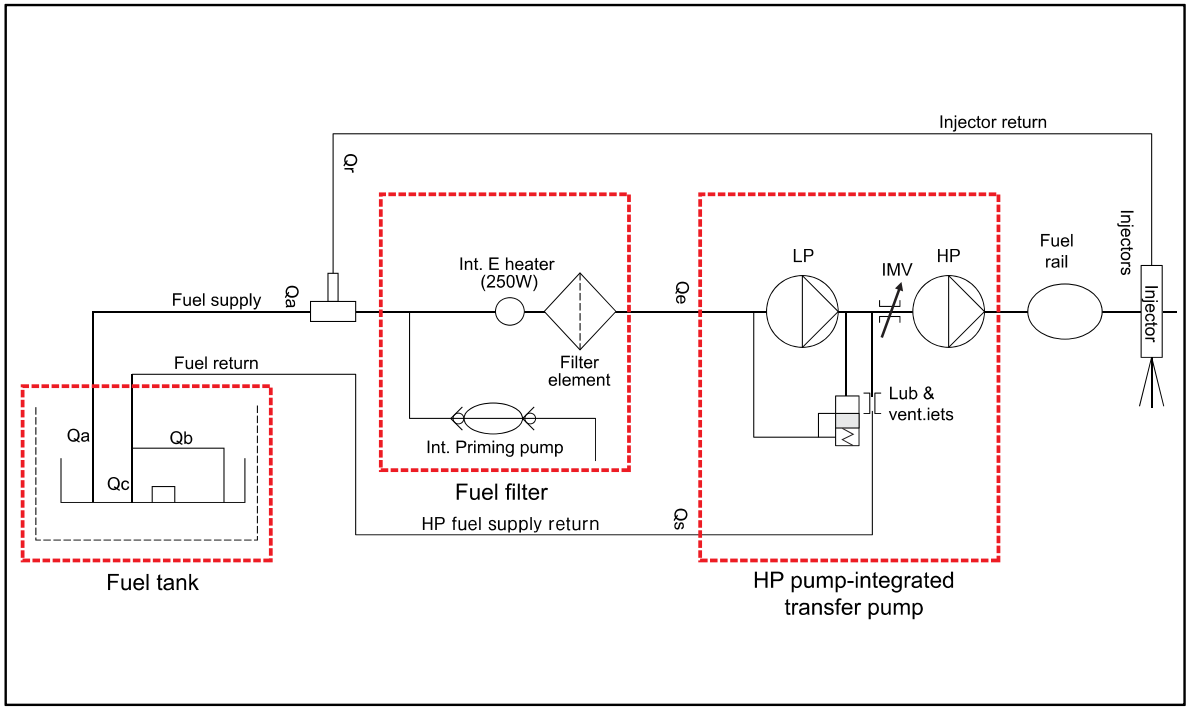


Measuring intake air mass and temperature

Modification basis	
Application basis	
Affected VIN	

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2) Fuel System Flow Diagram

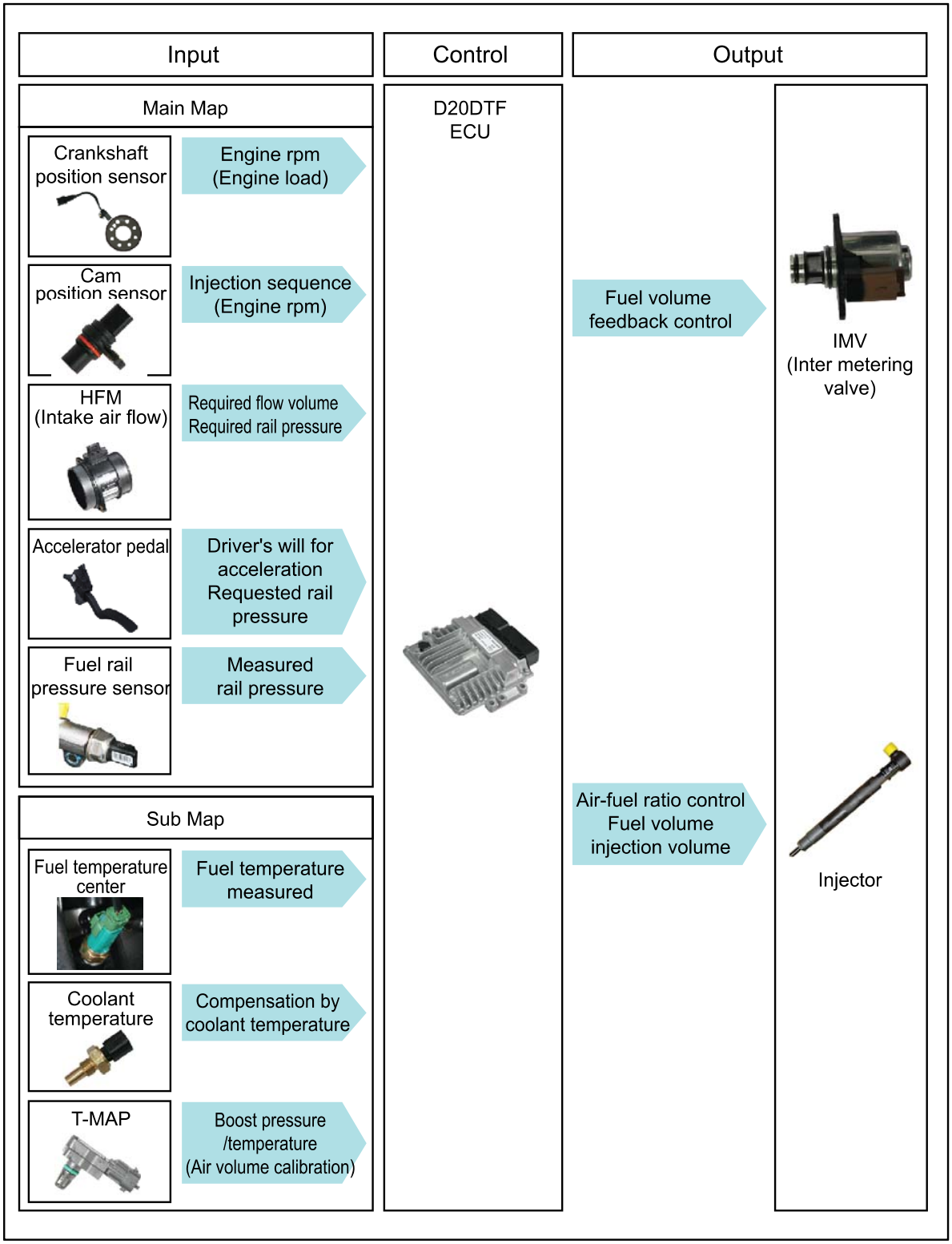


The fuel from the fuel tank is supplied to the fuel heater of fuel filter/priming pump and then low pressure generated by the low pressure pump (built into HP pump) is transmitted to the HP pump.
The fuel pressure at the HP pump is controlled by the IMV valve, and the maximum allowed pressure is 1,800 bar. The compressed fuel at the fuel pump is delivered to the rail, and injected by the injectors according to the injection signals. The injection method is the same with the conventional method; Fuel return by backleak which operates the needle valve.
The major difference is that the fuel return line is connected to the fuel filter inlet port, not the HP pump venturi.
The pressure from the high pressure pump is increased to 1,800 bar from 1,600 bar, and the pump is now installed to the cylinder head (cylinder block for previous model). The fuel pressure is generated by the operation of intake camshaft and gears. The specifications for the IMV valve and the fuel temperature sensor are not changed.

Modification basis	
Application basis	
Affected VIN	

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3) Input/Output devices



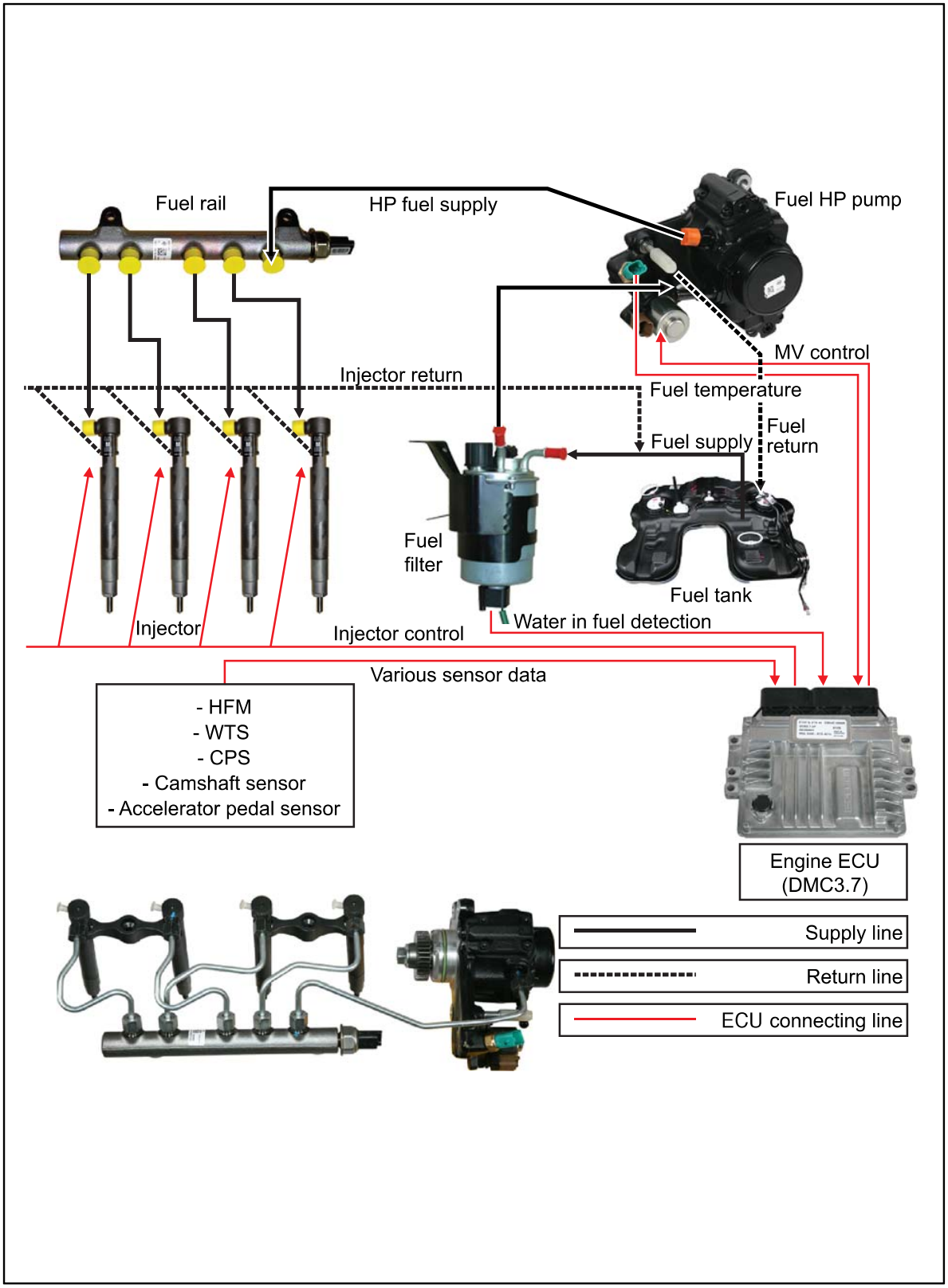
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The engine ECU calculates the accelerator pedal based on the input signals from various sensors, and controls the overall operation of the vehicle.
The ECU receives the signals from various sensor through data line, and performs effective air-fuel ratio control based on these signals.
The crankshaft speed (position) sensor measures the engine speed, and the camshaft speed (position) sensor determines the order of injections, and the ECU detects the amount of the accelerator pedal depressed (driver's will) by receiving the electrical signals from the accelerator pedal sensor.
The mass air flow sensor detects the volume of intake air and sends the value to the ECU.
The major function of the ECU is controlling air-fuel ratio to reduce the emission level (EGR valve control) by detecting instantaneous air flow change with the signals from the mass air flow sensor.
Also, the ECU uses the signals from the coolant temperature & air temperature sensors, booster pressure sensor, atmospheric pressure sensor to: a) determine injection starting point and set value for pilot injection, and b) deal with various operations and variable conditions.

Modification basis	
Application basis	
Affected VIN	

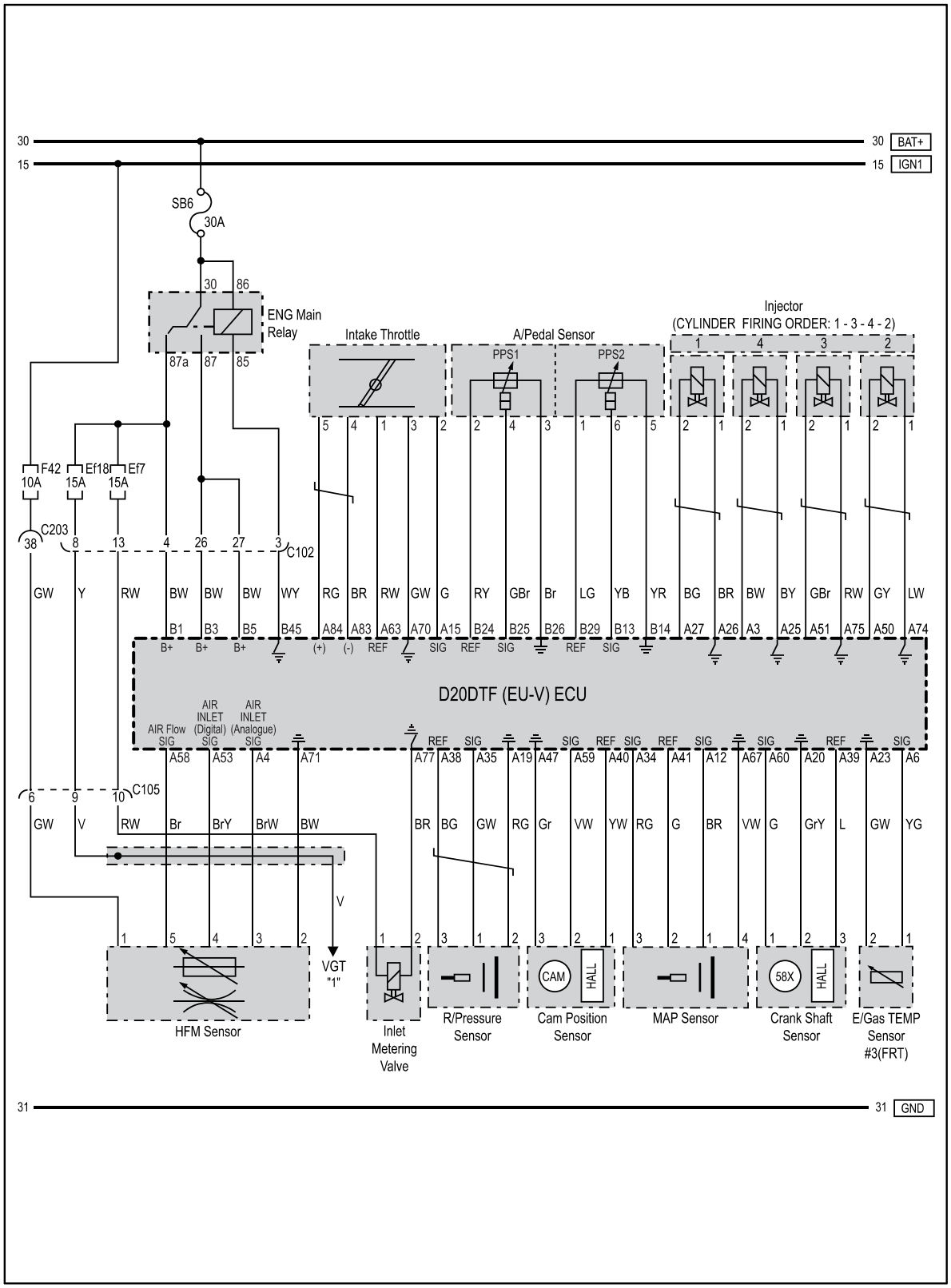
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4) Flow Diagram of Fuel Supply System



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5) Circuit Diagram



Modification basis	
Application basis	
Affected VIN	

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INTAKE SYSTEM

0000-00

GENERAL INFORMATION

1. SPECIFICATION

Component	Item	Specification
Air cleaner element	Filter type	Dry, filter element
	Filter area	0.208 m²
	Service interval	EU: Change every 20,000 km (But, shorten the service interval under severe conditions)
		GEN: Change every 15,000 km (But, shorten the service interval under severe conditions)
Air cleaner assembly	Weight	1.13 kg
	Operating temperature	−30 ~ 100℃
	Capacity	6.5 L
Intercooler	Core material	Aluminum
	Size	510 x 110 x 70 (W x H x T)
	Core size	510 x 110 x 63 (W x H x T)
	Tank material	Plastic (Molding)
	Efficiency	80%

* Shorten the service interval under severe conditions such as driving on a dusty road or off-road.

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2. INSPECTION

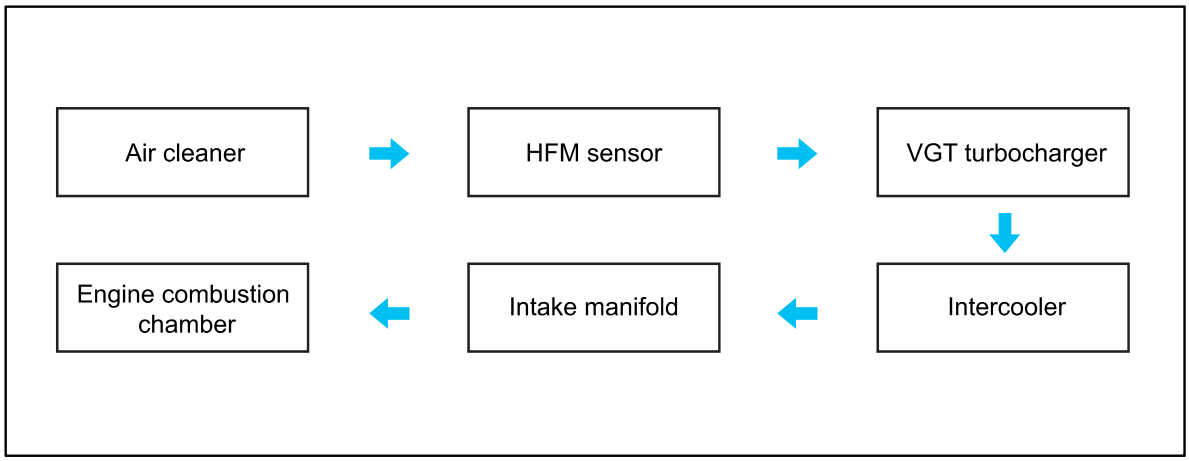
1) Troubleshooting

▶ **When Abnormal Noises are Heard from the Engine Room**

CAUTION

For the vehicle equipped with DI engine, if a learning noise occurs in each range or other noises occur, the major cause of it is a faulty turbocharger assembly. But an interference issue, poor tightness or loose in the intake and exhaust system also can cause those noises. This is mainly because the operator didn't follow the instruction exactly when reconnecting the intake hoses and pipes which were disconnected to check the system or replace the air cleaner. If the intake system is free of any faults, check the EGR and PCV oil separator connected to the intake system.
The figure may be different from the actual engine. Therefore, read thoroughly below before replacing the parts.

2) Abnormal Noise Caused by Poor Tightness of Intake System



When the DI engine is running, the air entered into the engine flows in the sequence as shown above. If high intake pressure is applied to the loose or damaged part, a whistling noise may occur, the intake air volume is measured incorrectly or the engine power is derated.

Modification basis	
Application basis	
Affected VIN	

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3) Troubleshooting Sequence

The basic checks for intake system are as follows:

▶ Basic Checks for Intake System

Check if any abnormal noise occurs in each range while the vehicle is driven.

↓

Check if the engine warning lamp is illuminated or any DTC is displayed on the diagnostic device.

↓

Check the hoses for loose connections, or the clamps for deformation.

↓

Check tightness of the air cleaner housing by shaking it.

↓

Check the turbocharger and the intake/exhaust system for interferences in each range.

↓

Check the vacuum system and the hoses connected.

Make sure to replace or clean the air cleaner element periodically. Otherwise, engine will be derated or work abnormally because of low intake air volume.
Unlike the fuel system, which is a closed circuit, the intake system is an open circuit system. Therefore any malfunction may occur due to dust and dirt.
Most of the connections consist of hoses so the system cannot withstand high temperature and pressure. Also it can be deformed or loosened easily because it is a clamp mounting system. Thus, when checking the engine, basic inspections, such as tightened status check and visual inspection for hose, etc., should be carried out in advance.

▶ Other Checks for Intake System

Check the EGR system (vacuum circuit, electrical circuit of modulator, mechanical movements of EGR valve).

↓

Check the PCV oil separator.

If the intake system is free of any faults, check for EGR and PCV oil separator.

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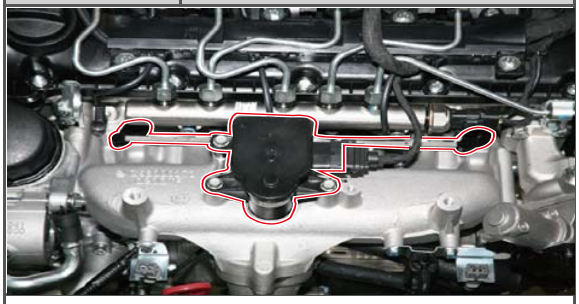
OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The intake system for D20DTF engine is equipped with an electric throttle body which includes a flap. This flap is controlled by an electrical signal to cut off the intake air entering to the engine when the ignition switch is turned off. To be sure to get the optimized swirl in intake manifold, the swirl valve and dual type port have been adopted. And, the improved HFM sensor has been adopted to control the intake air volume more precisely.

2. COMPONENTS

1719-02	Swirl control valve



Operates variably in accordance with the engine load and rpm.
* For more information, refer to Chapter "Engine Control".

1719-01	Intake manifold

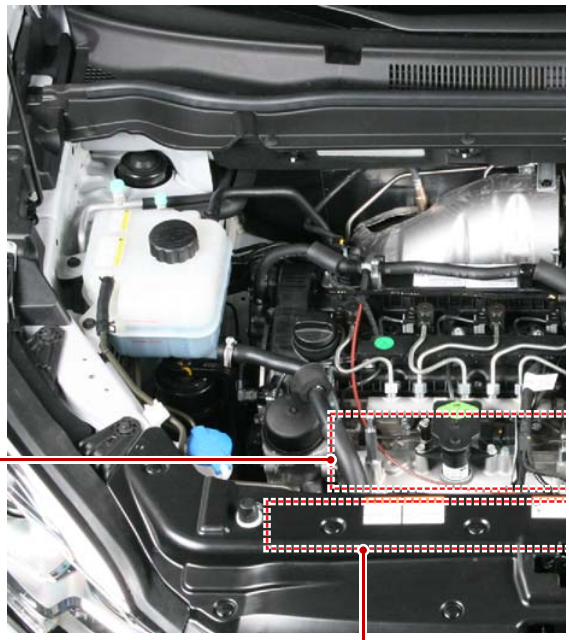


Passage for intake air during the operation of variable swirl valve

1719-16	Electric throttle body



* For more information, refer to Chapter "Engine Control".

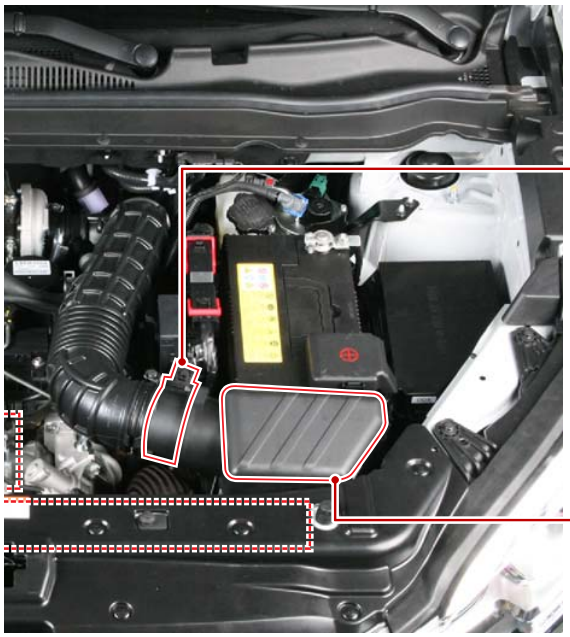


2330-01	Intercooler assembly



Modification basis	
Application basis	
Affected VIN	

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2313-15	HFM (Hot Film Air-Mass) sensor



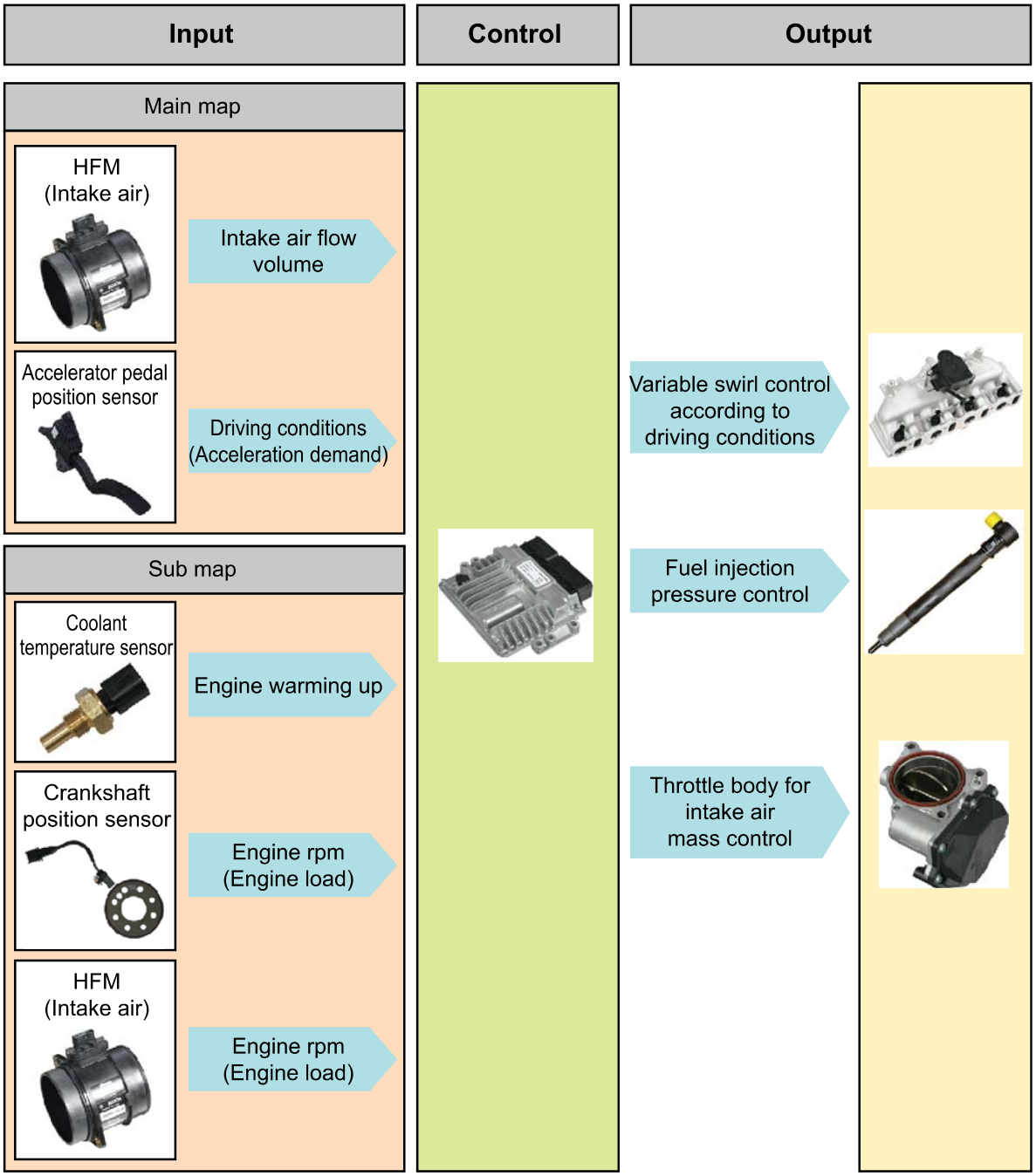
HFM sensor, version 6
* For more information, refer to Chapter "Engine Control".

2313-01	Air cleaner assembly and resonator



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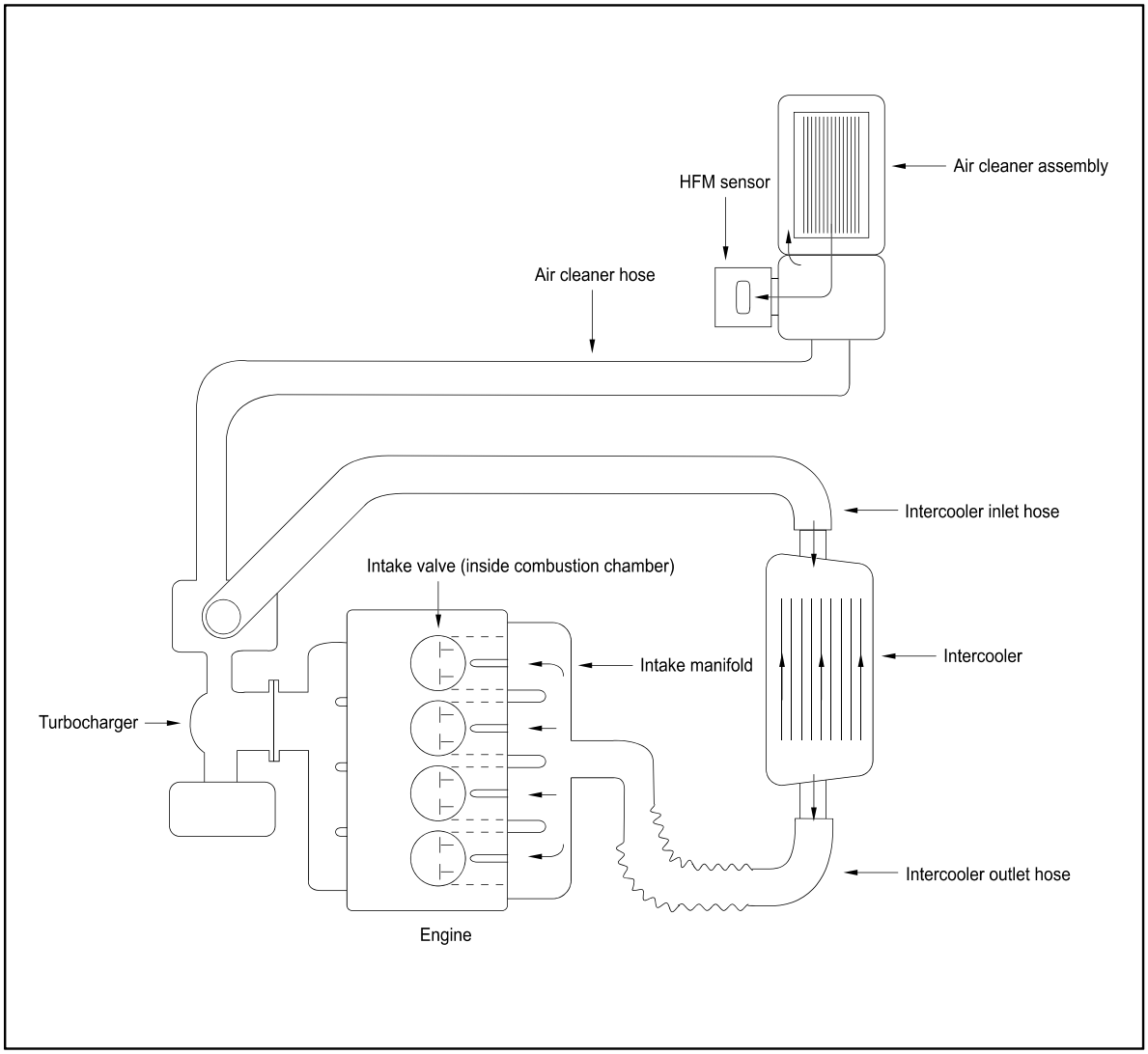
3. INPUT/OUTPUT OF INTAKE SYSTEM



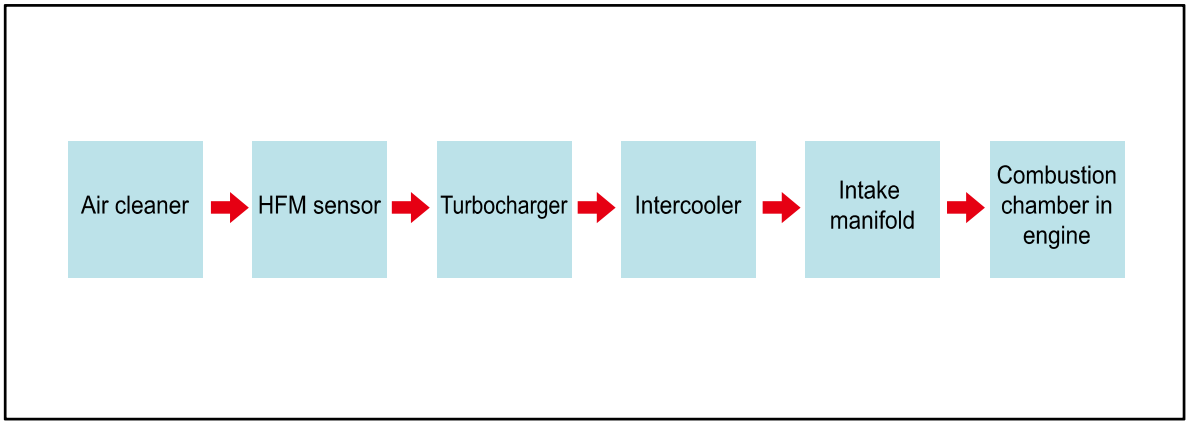
Modification basis	
Application basis	
Affected VIN	

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4. OPERATING PROCESS

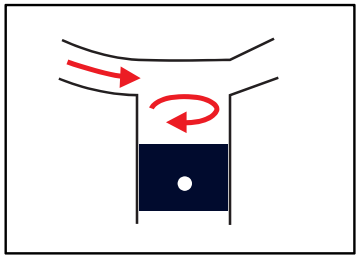


▶ Work Flow

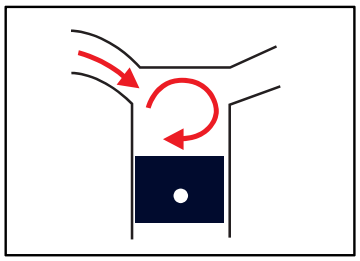


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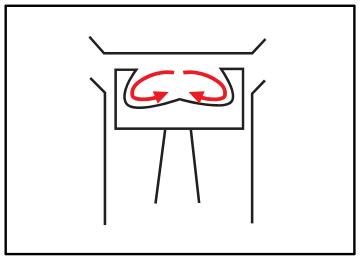
1) Types of swirl



Swirl: One cylinder has two intake air ports, one is set horizontally and the other one is set vertically. Swirl is the horizontal air flows in cylinder due to the horizontal intake air ports.



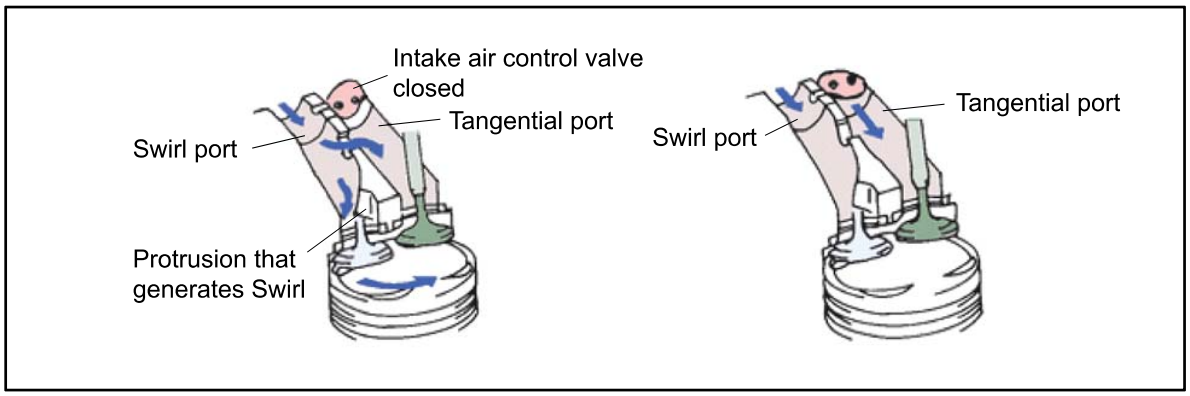
Tumble: Tumble is the vertical air flows in cylinder due to the vertical intake air port



Squish: Squish is the air flows due to the piston head. Normally, this is appears at the final process of compression. In CRDi engine, the piston head creates the bowl type squish.

2) Swirl control

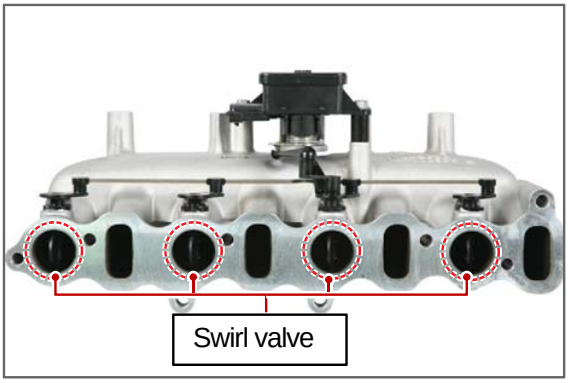
In DI type diesel engine, the liquefied fuel is injected into the cylinder directly. If the fuel is evenly distributed in short period, the combustion efficiency could be improved. To get this, there should be good air flow in cylinder. In general, there are two intake ports, swirl port and tangential port, in each cylinder. The swirl port generates the horizontal flow and the tangential port generates the longitudinal flow. In low/mid load range, the tabgential port is closed to increase the horizontal flow. Fast flow decreases the PM during combustion and increases the EGR ratio by better combustion efficiency.



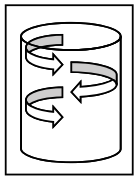
Modification basis	
Application basis	
Affected VIN	

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Load	Engine speed	Swirl valve	Amount of swirl	Remarks
Low speed, Low load	below 3,000 rpm	Closed	Heavy	Increased EGR ratio, better air-fuel mixture (reduce exhaust gas)
High speed, High load	over 3,000 rpm	Open	Light	Increase charge efficiency, higher engine power



The variable swirl valve actuator operates when turning the ignition switch ON/OFF position to open/close the swirl valve. In this period, the soot will be removed and the learning for swirl valve position is performed.



NOTE

Swirl: This is the twisted (radial) air flow along the cylinder wall during the intake stroke. This stabilizes the combustion even in lean air-fuel mixture condition.

3) Features

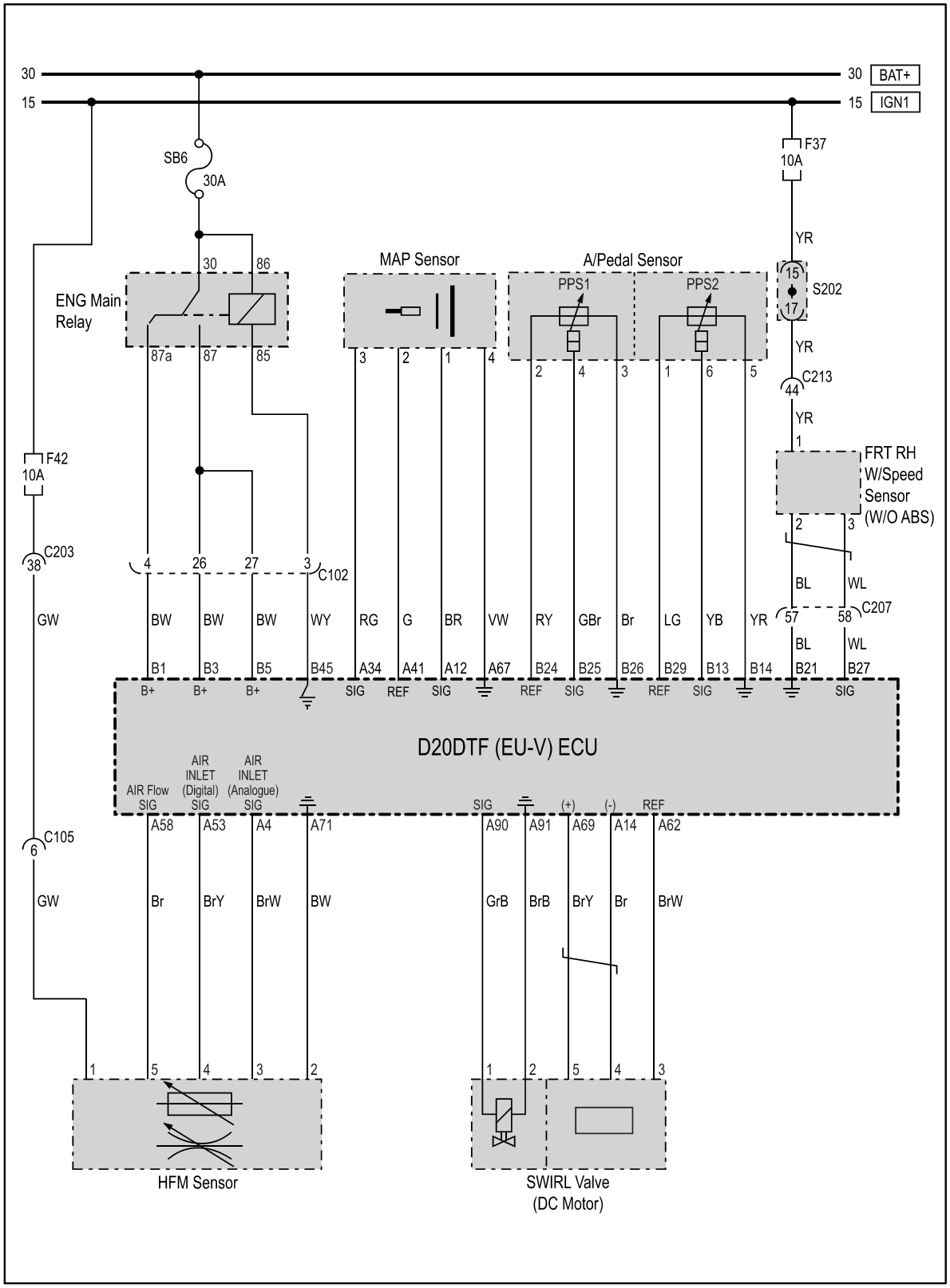
- Swirl and air intake efficiency
  To generate the swirl, the intake port should be serpentine design. This makes the resistance in air flow. The resistance in air flow in engine high speed decreases the intake efficiency. Eventually, the engine power is also decreased, Thus, the swirl operation is deactivated in high speed range to increase the intake efficiency.
- Relationship between swirl and EGR
  To reduce Nox, it is essential to increase EGR ratio. However, if EGR ratio is too high, the PM also could be very higher. And, the exhaust gas should be evenly mixed with newly aspired air. Otherwise, PM and CO are dramatically increased in highly concentrated exhaust gas range and EGR ratio could not be increased beyond a certain limit. If the swirl valve operates in this moment, the limit of EGR ratio will be higher.

4) Relationship between swirl and fuel injection pressure

The injector for DI engine uses the multi hole design. For this vehicle, there are 8 holes in injector. If the swirl is too strong, the injection angles might be overlapped and may cause the increased PM and insufficient engine power. Also, if the injection pressure is too high during strong swirl, the injection angles might be overlapped. Therefore, the system may decreases the fuel injection pressure when the swirl is too strong.

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5. CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

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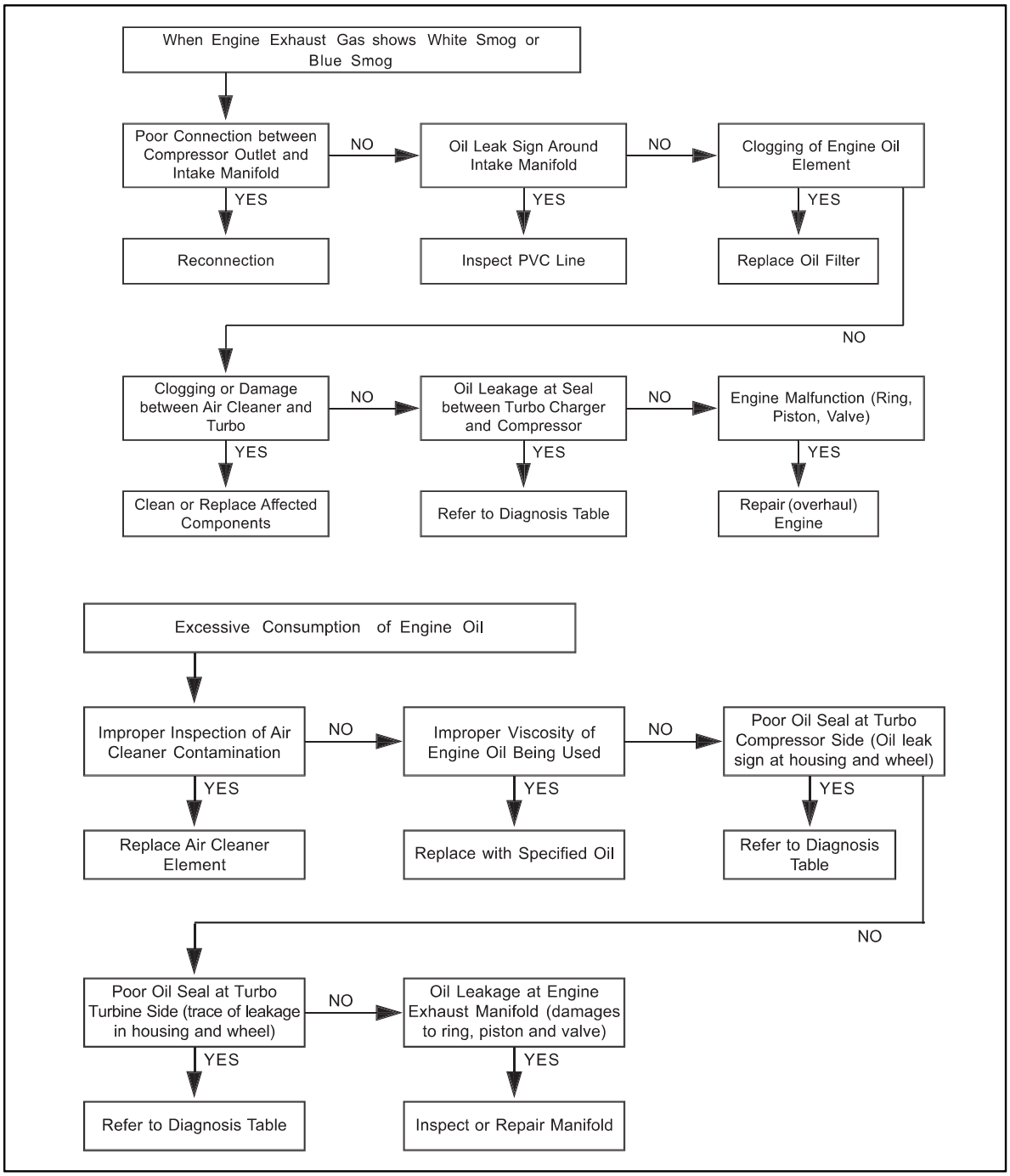
EXHAUST SYSTEM

0000-00

GENERAL INFORMATION

1. TROUBLESHOOTING

1) Work Flow



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2. CAUTIONS

- Do not park the vehicle on flammable materials, such as grass, leaves and carpet.
- Do not touch the catalyst or the exhaust gas ignition system when the engine is running.
- If a misfire occurs in the combustion chamber or the emission of pollutant exceeds the specified level, the catalyst can be damaged.
- When servicing or replacing components of the exhaust system, makes sure that the components are positioned at regular intervals from all other parts of the under body.
- Be careful not to damage the exhaust system when lifting the vehicle from its side.
- All components and body parts of the engine exhaust system should be inspected for crack, damage, air hole, part loss and incorrect mounting location. Also check for any deformation which can result in exhaust gas drawn into the vehicle.
- Make sure that the exhaust pipe is cooled down sufficiently before working on it because it is still hot right after the engine is stopped.
- Wear protective gloves when removing the exhaust pipe.

Modification basis	
Application basis	
Affected VIN	

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

This system purifies the exhaust gas generated by the combustion in the engine to reduce the pollutants and noise during that arise during combustion.

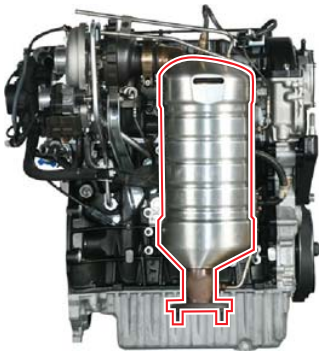
2. COMPONENT

Exhaust manifold

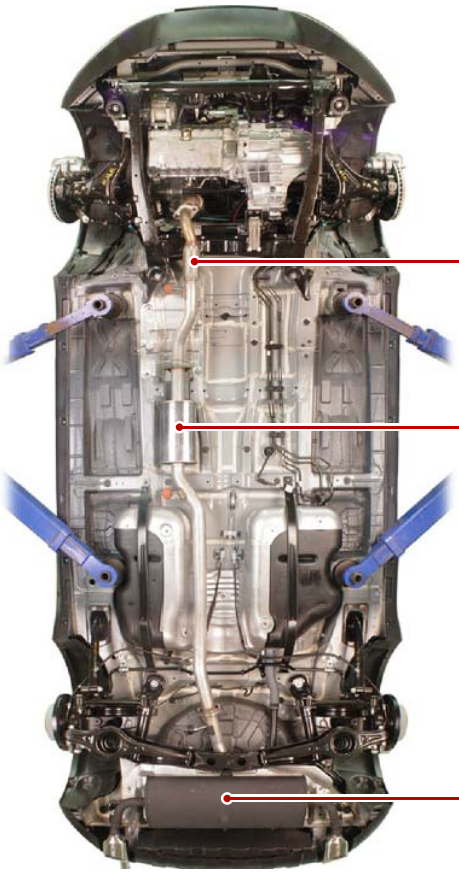




CDPF assembly



Fore details about the CDPF assembly, refer to Chapter "CDPF System".



No. 1 exhaust pipe



No. 2 exhaust pipe



No.3 muffler pipe

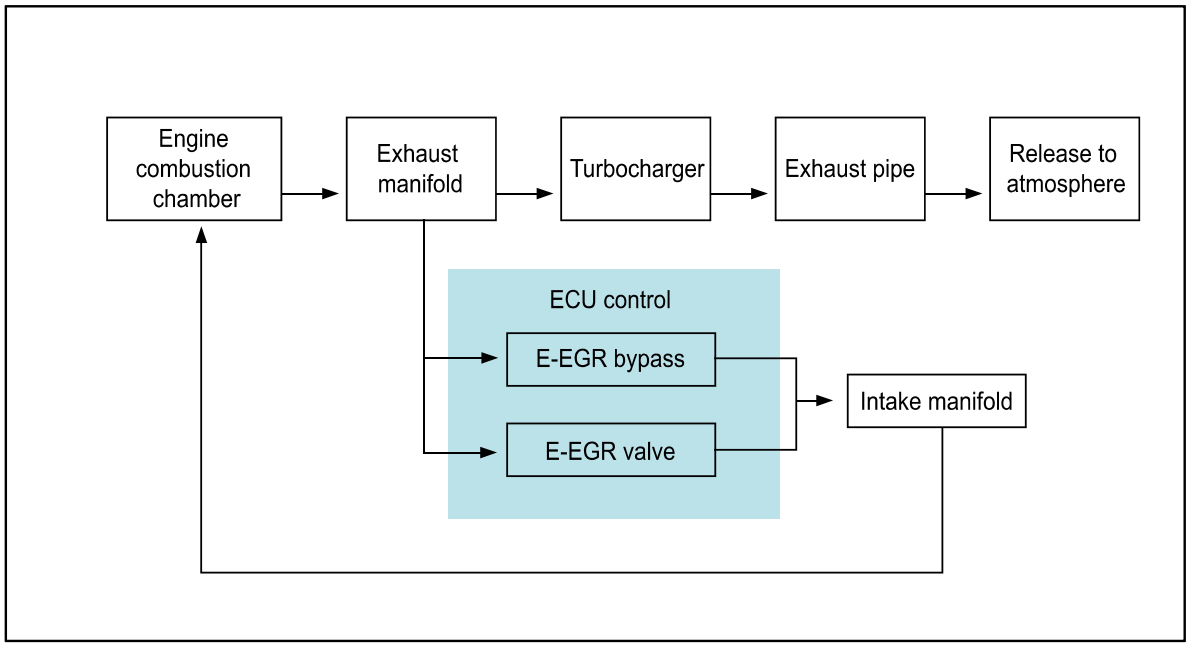


Modification basis	
Application basis	
Affected VIN	

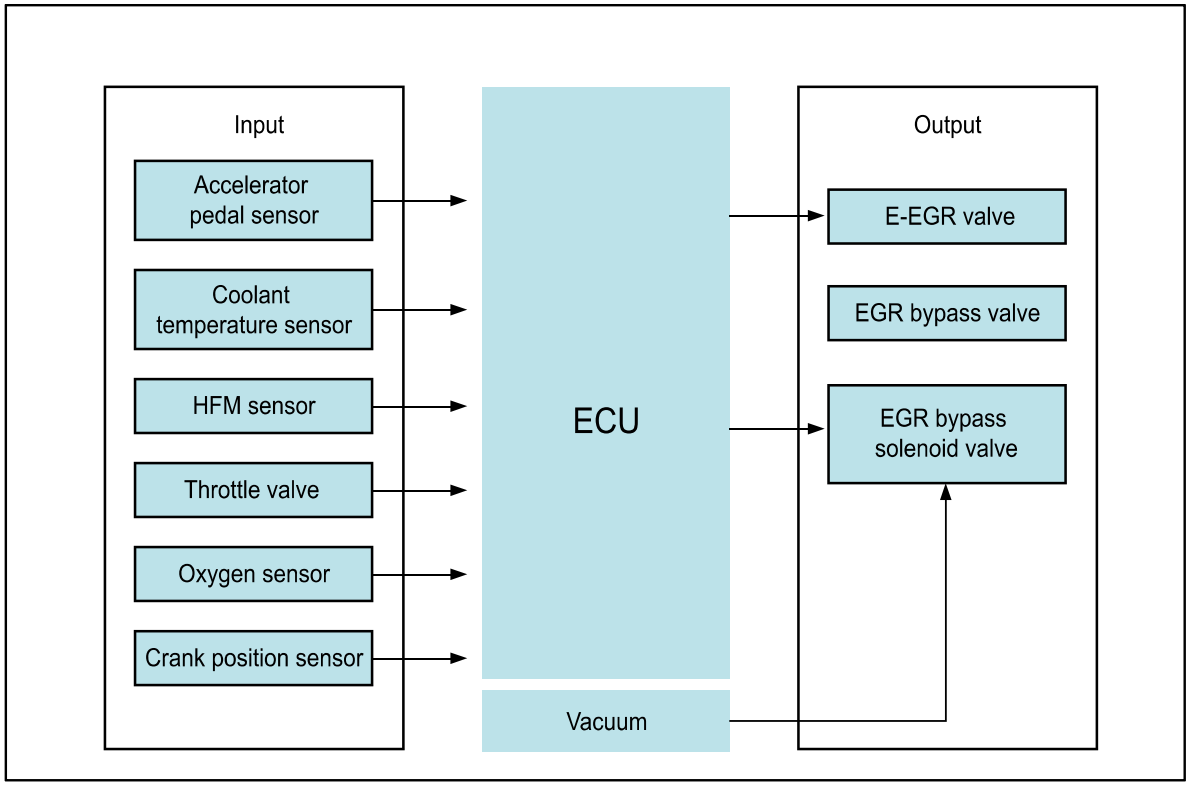
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3. OPERATING PROCESS

1) Exhaust Gas Flow



2) Input & Output Devices



Modification basis	
Application basis	
Affected VIN	

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TURBO SYSTEM

0000-00

GENERAL INFORMATION

1. SPECIFICATION

Component	Item	Specification
Turbocharger	Max. expansion coefficient	5.0
	Max. turbine speed	215,000 rpm
	Max. temperature of turbine housing	800 ℃
	Weight	7.2 kg
E-Actuator	Operation duty cycle	300 Hz

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2. INSPECTION

1) Cautions During Driving

The following lists cautions to take during test drive and on the turbocharger vehicle, which must be considered during the operation.

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

CAUTION

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

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2) Inspection of Turbocharger

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

1. On-board Inspection
   - Check the bolts and nuts foe looseness or missing
   - Check the intake and exhaust manifold for looseness or damage
   - Check the oil supply pipe and drain pipe for damages
   - Check the housing for crack and deterioration
2. Inspection of turbine

Remove the exhaust pipe at the opening of the turbine and check, with a lamp, the existence of interference of housing and wheel, oil leakage and contamination (at blade edge) of foreign materials.

- Interference: In case where the oil leak sign exists, even the small traces of interferences on the turbine wheel mean, most of times, that abrasion has occurred on the journal bearing. Must
- inspect after overhauling the turbocharger.
  Oil Leakage: Followings are the reasons for oil leakage condition

* Problems in engine: In case where the oil is smeared on inner wall section of the exhaust gas
* opening.
Problems in turbocharger: In case where the oil is smeared on only at the exhaust gas outlet section.

CAUTION

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

- Oil Drain Pipe Defect
  In case where oil flow from the turbocharger sensor housing to the crank case is not smooth would become the reason for leakage as oil builds up within the center housing. Also, oil thickens (sludge) at high temperature and becomes the indirect reason of wheel hub section. In such case, clogging and damage of the oil drain pipe and the pressure of blow-by gas within the crank case must be inspected.
  Damages due to Foreign Materials
- When the foreign materials get into the system, it could induce inner damage as rotating balance of the turbocharger gets out of alignment.

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3) Inspection of Turbine

Thoroughly check the followings.

CAUTION

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

- Interference: In case where is trace of interference or smallest damage on the compressor wheel means, most of times, that abrasion has occurred on the journal bearing. Must inspect after the overhaul.
- Oil Leakage: The reason for oil leakage at the compressor section is the air cleaner, clogged by substances such as dust, causes the compressor inlet negative pressure.

a. Rotating in high speed at no-load for extended period of time can cause oil leakage to the compressor section as oil pressure within the center housing gets higher than pressure within the compressor housing.
Overuse of engine break (especially in low gear) in down hill makes significantly low exhaust gas
b. energy compared to the time where great amount of air is required during idling conditions of the engine. Therefore, amount of air in the compressor inlet increases but the turbocharge pressure is not high, which makes negative pressure at the compressor section causing the oilleakage within the center housing.

CAUTION

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

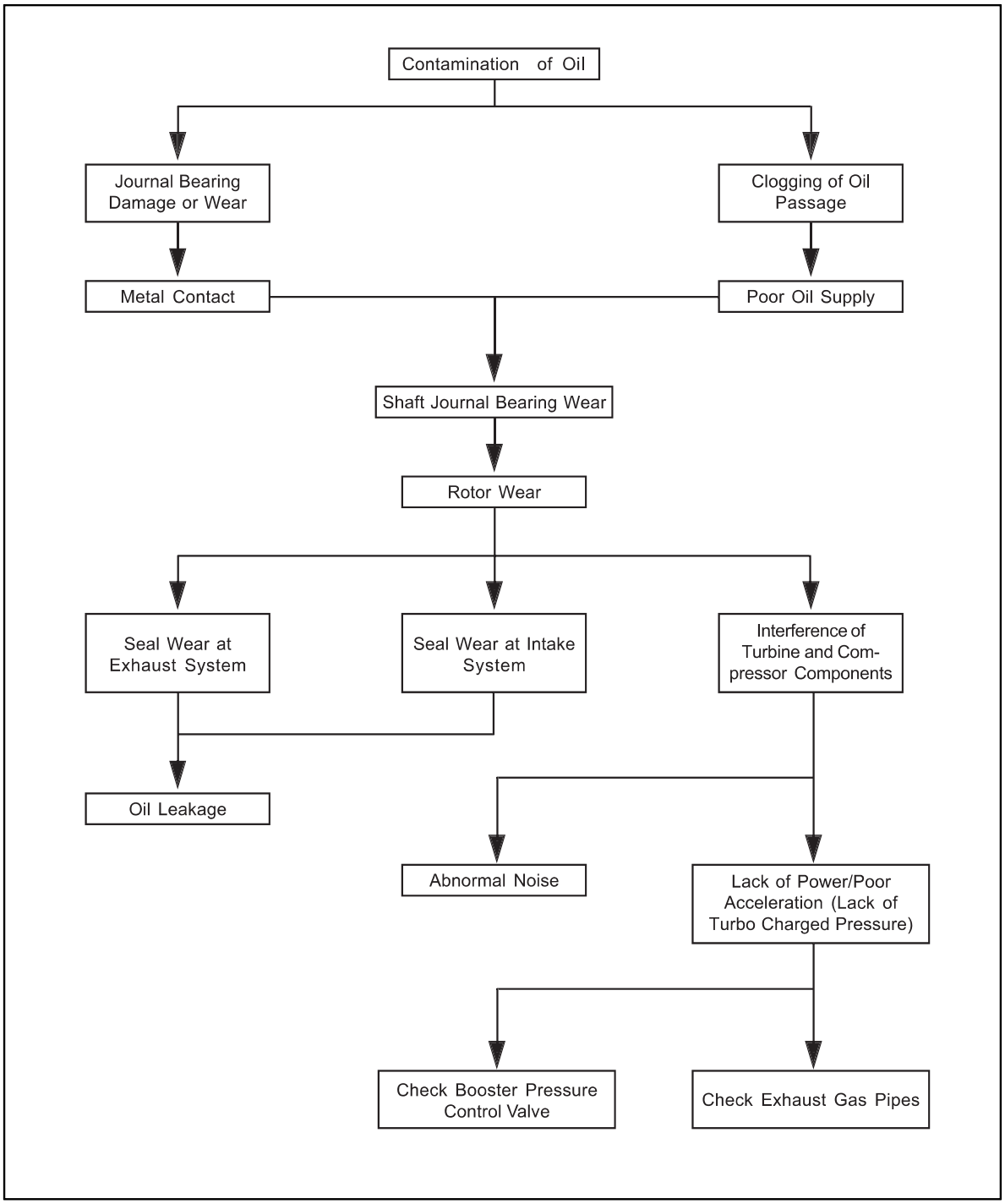
Damages by foreign materials: In case where the compressor wheel is damaged by foreign materials requires having an overhaul. At this time, it's necessary to check whether the foreign materials have contaminated intake/exhaust manifold or inside of engine.

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4) Possible Causes of Defect

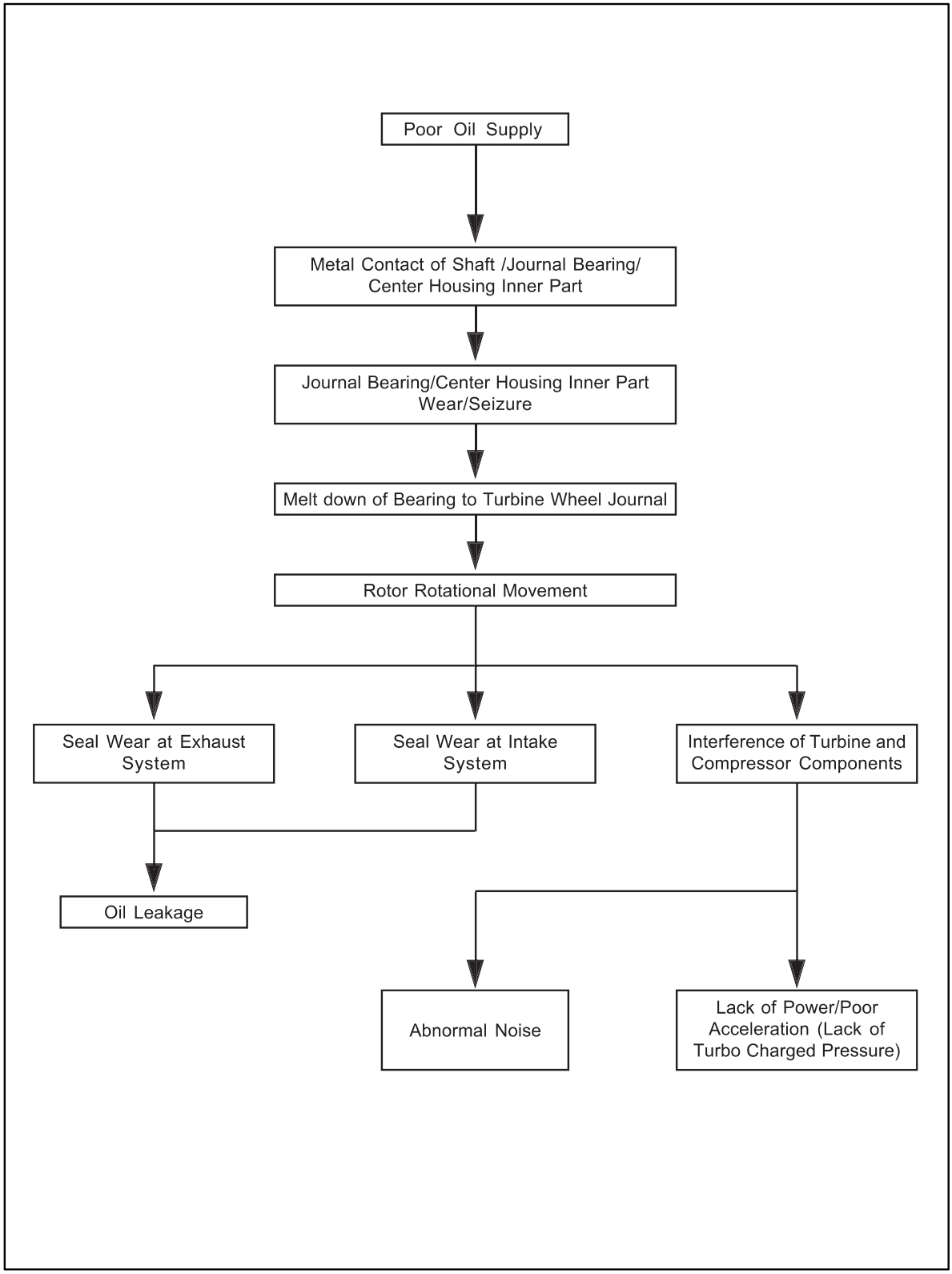
The following tries to understand the defects that can occur with vehicle installed with the turbocharger and to manage the reasons of such defects.

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



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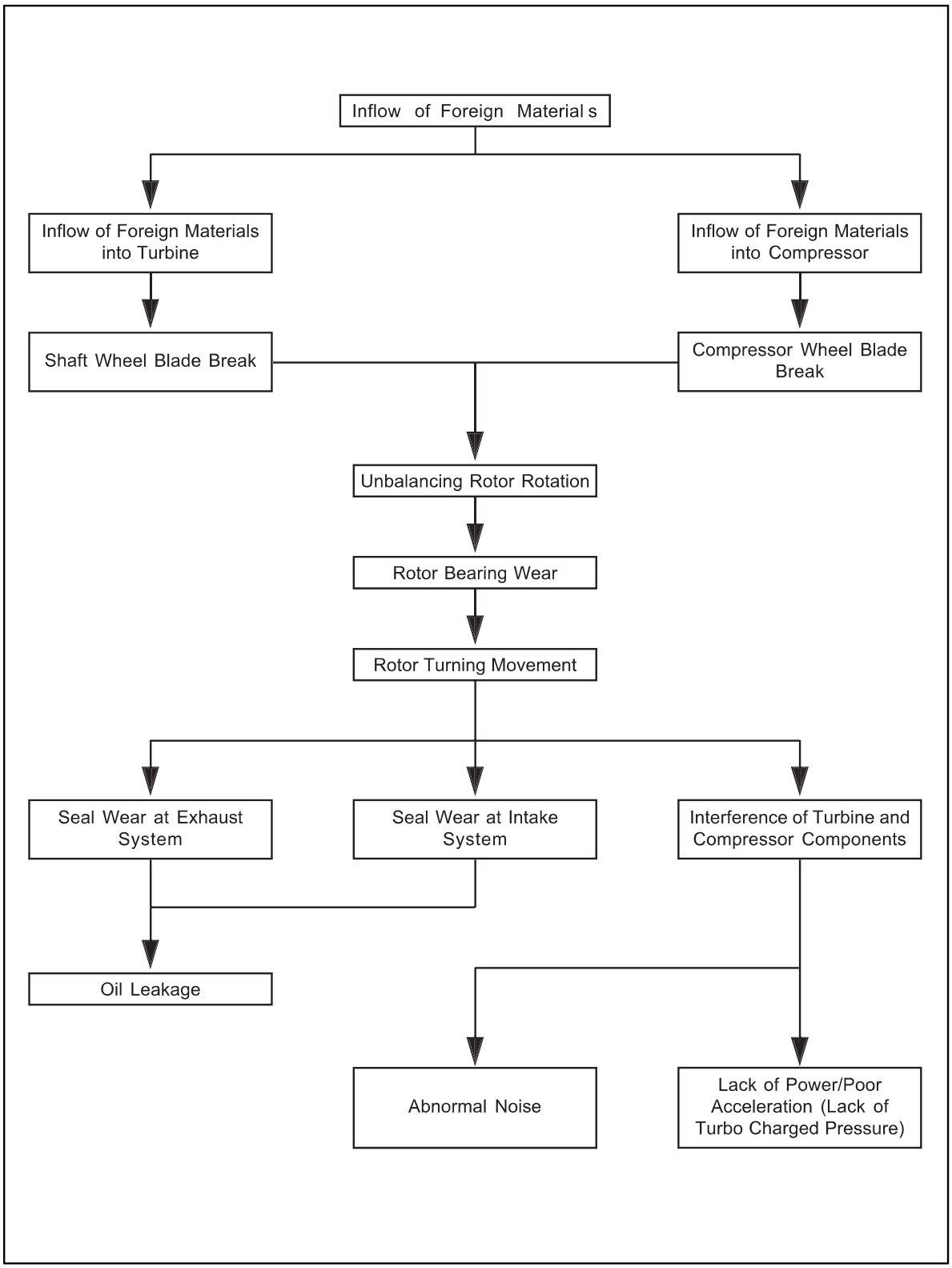
2. Oil Pump Defect: Rapid over-loaded driving after replacing oil filter and oil and clogging of oil line.



Modification basis	
Application basis	
Affected VIN	

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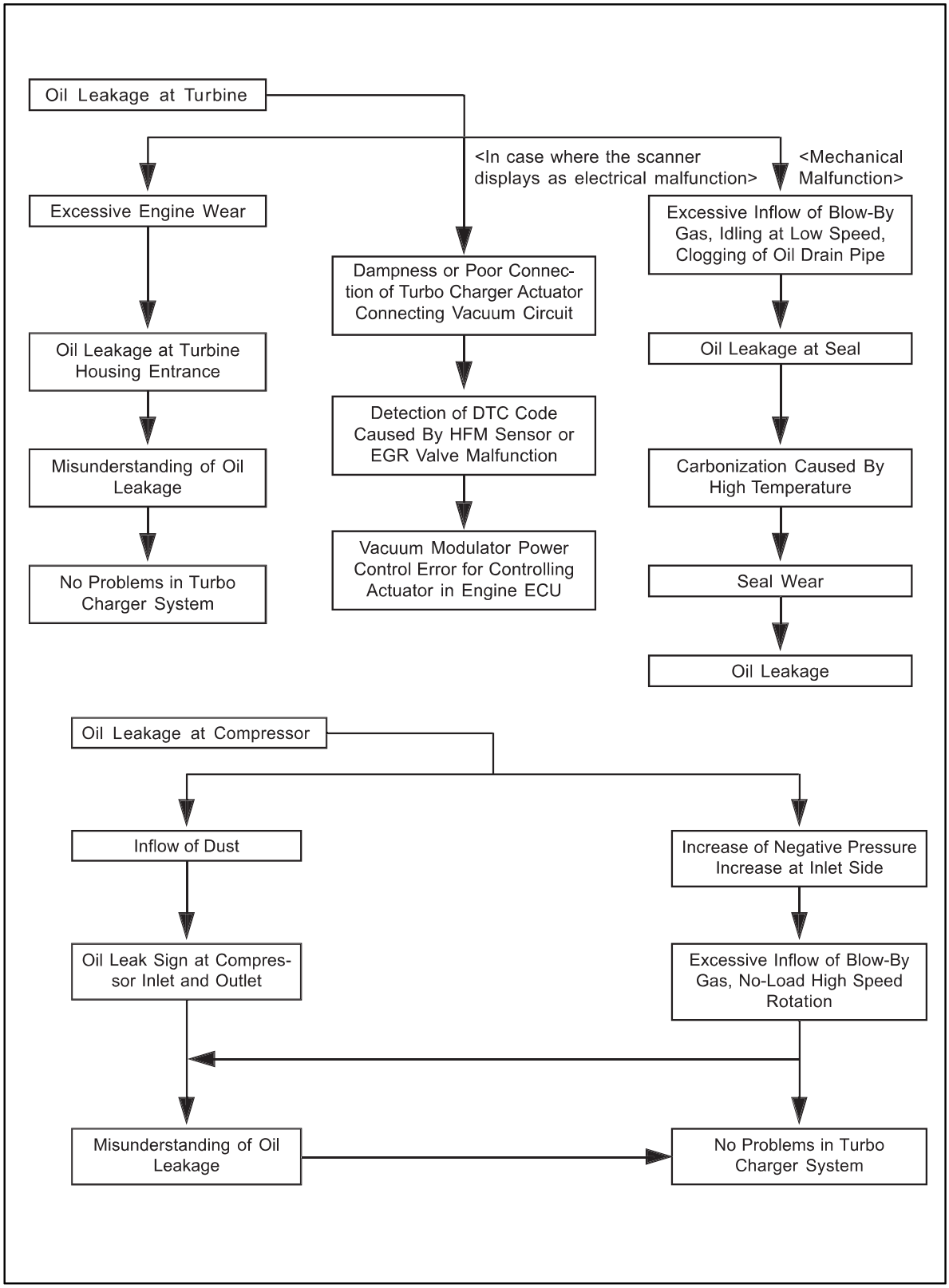
3. Turbine Side: Inflow of foreign materials from engine
   Compressor Side: such as air filter, muffler and nut



Modification basis	
Application basis	
Affected VIN	

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4. Defects caused by reasons other than that of the turbocharger.



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3. TROUBLESHOOTING

The followings are cautions to take in handling defects of turbocharger, which must be fully aware of.

1) Cautions

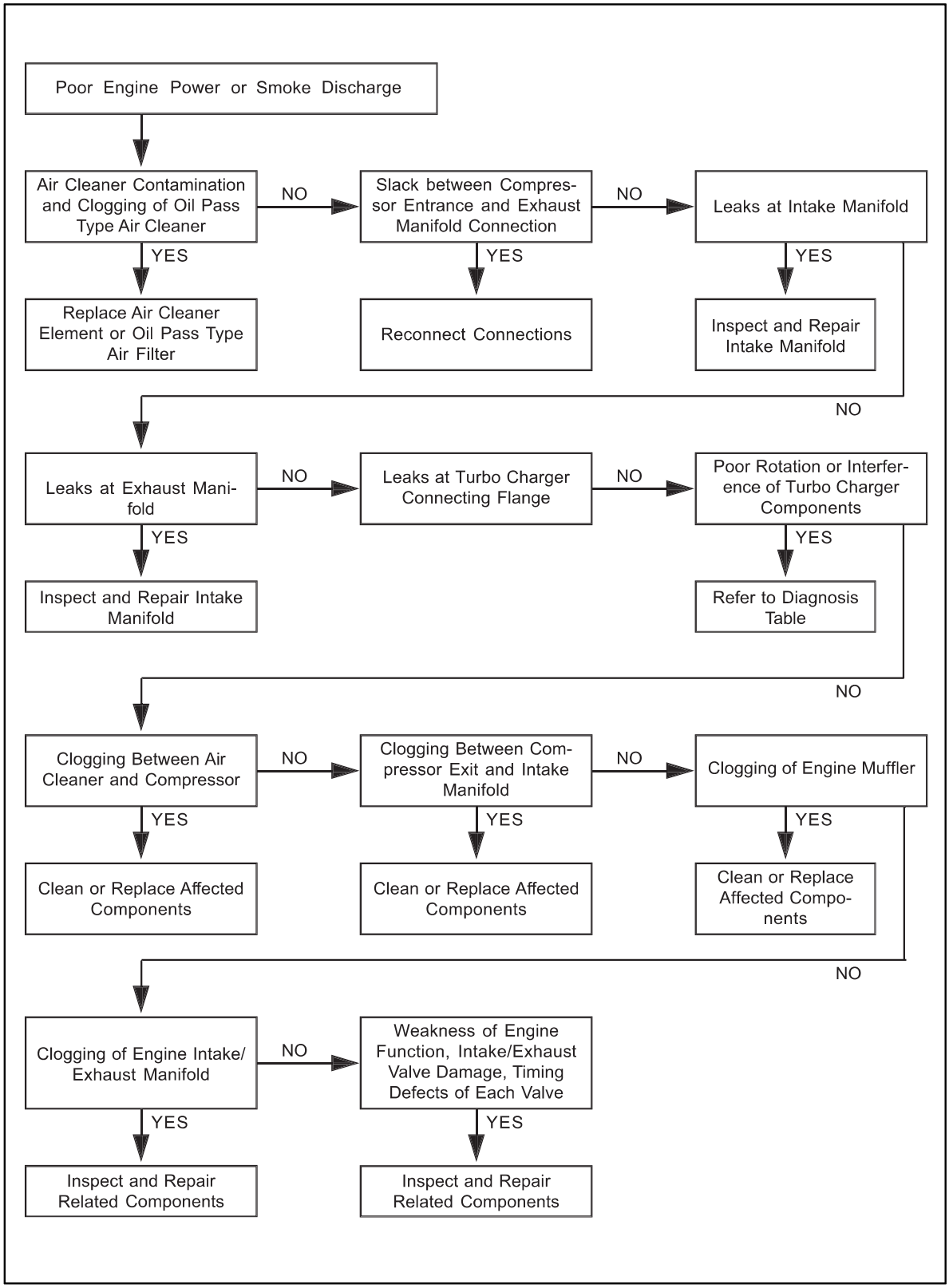
1. After stopping the engine, check whether the bolts on pipe connecting section are loose as well as the connecting condition of vacuum port and modulator, which is connected to the actuator.
2. During idling of the engine, check for leakage in the connecting section of pipe (hoses and pipes, duct connections,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

CAUTION

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

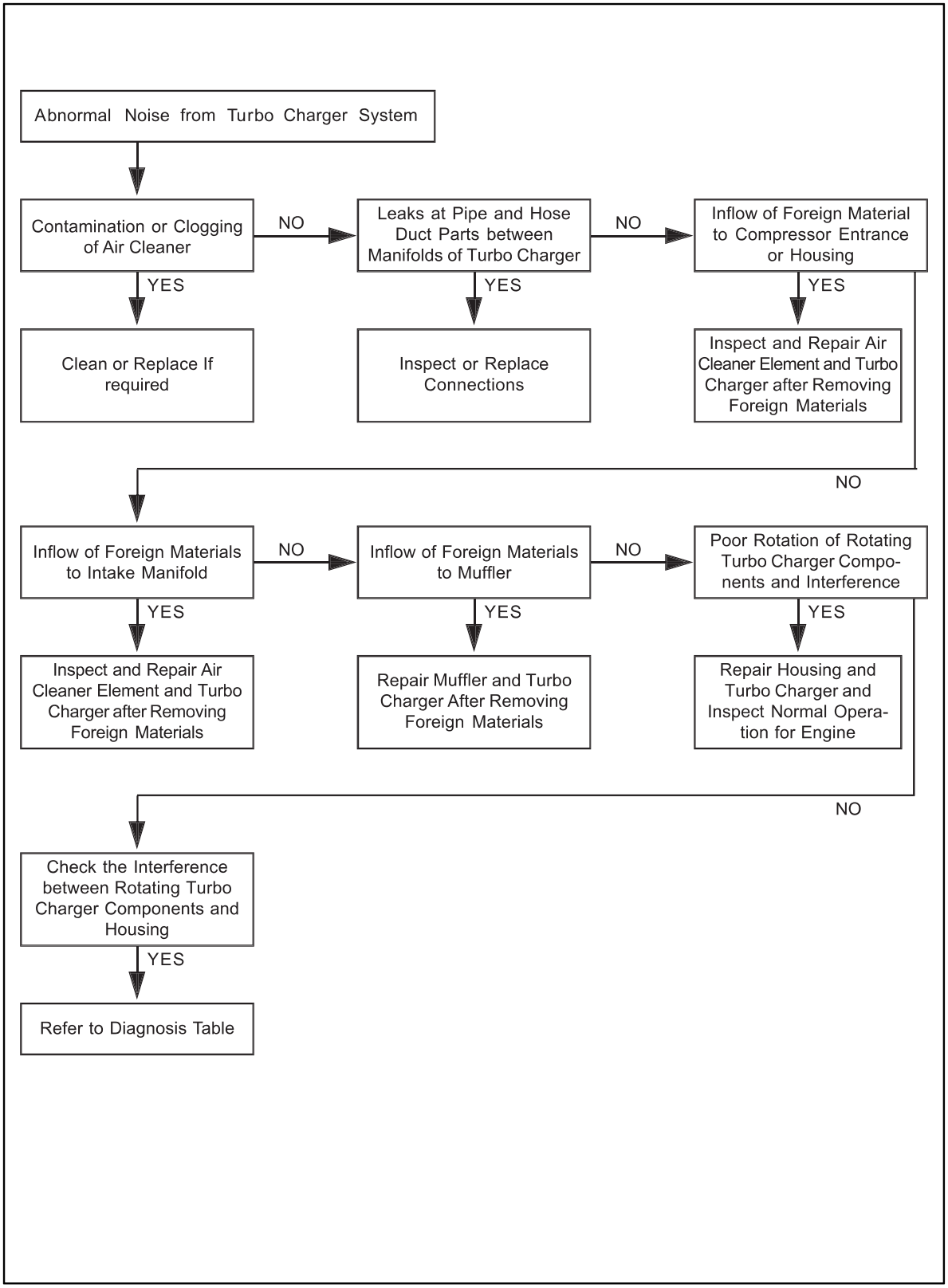
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2) Work Flow for Troubleshooting



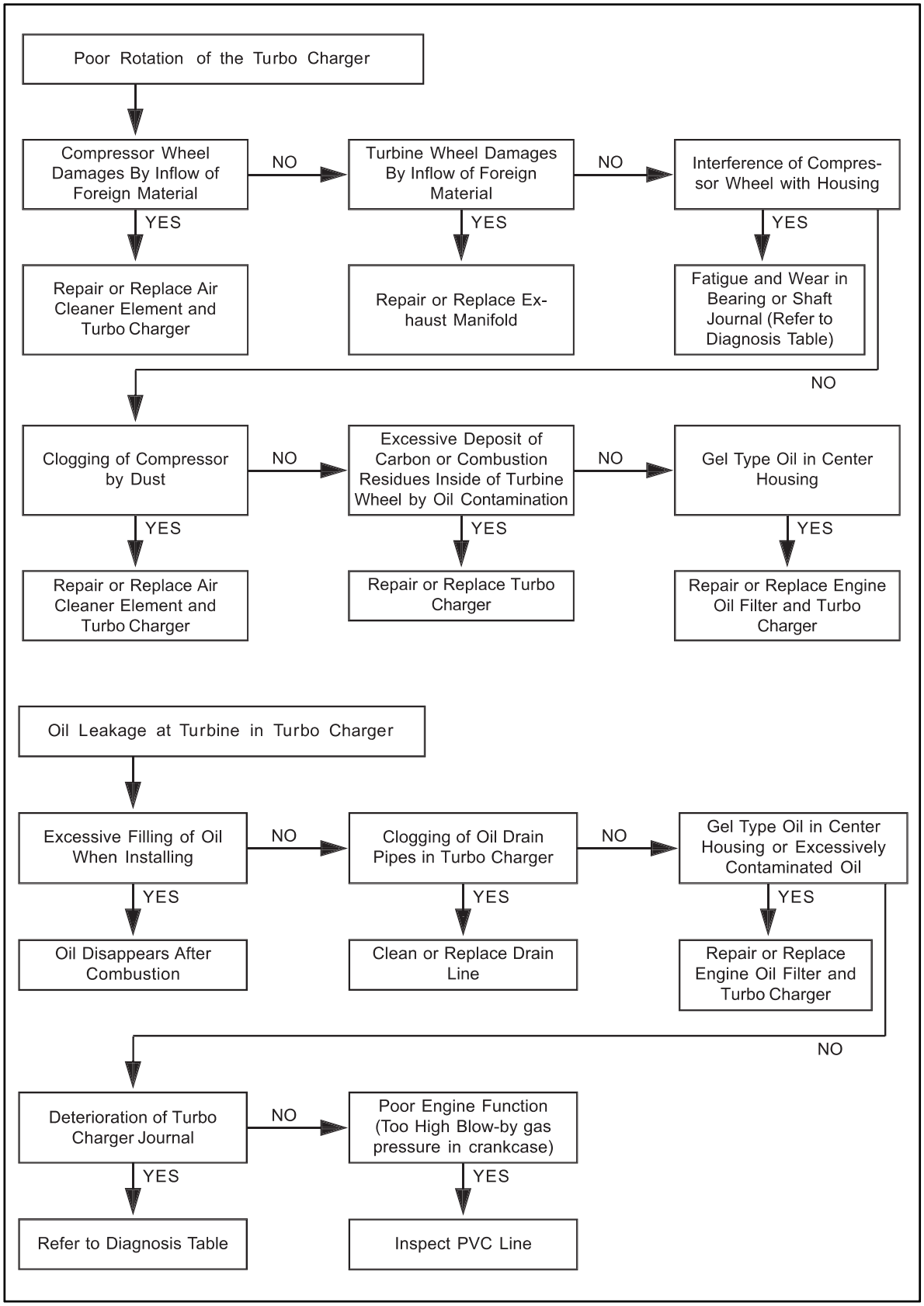
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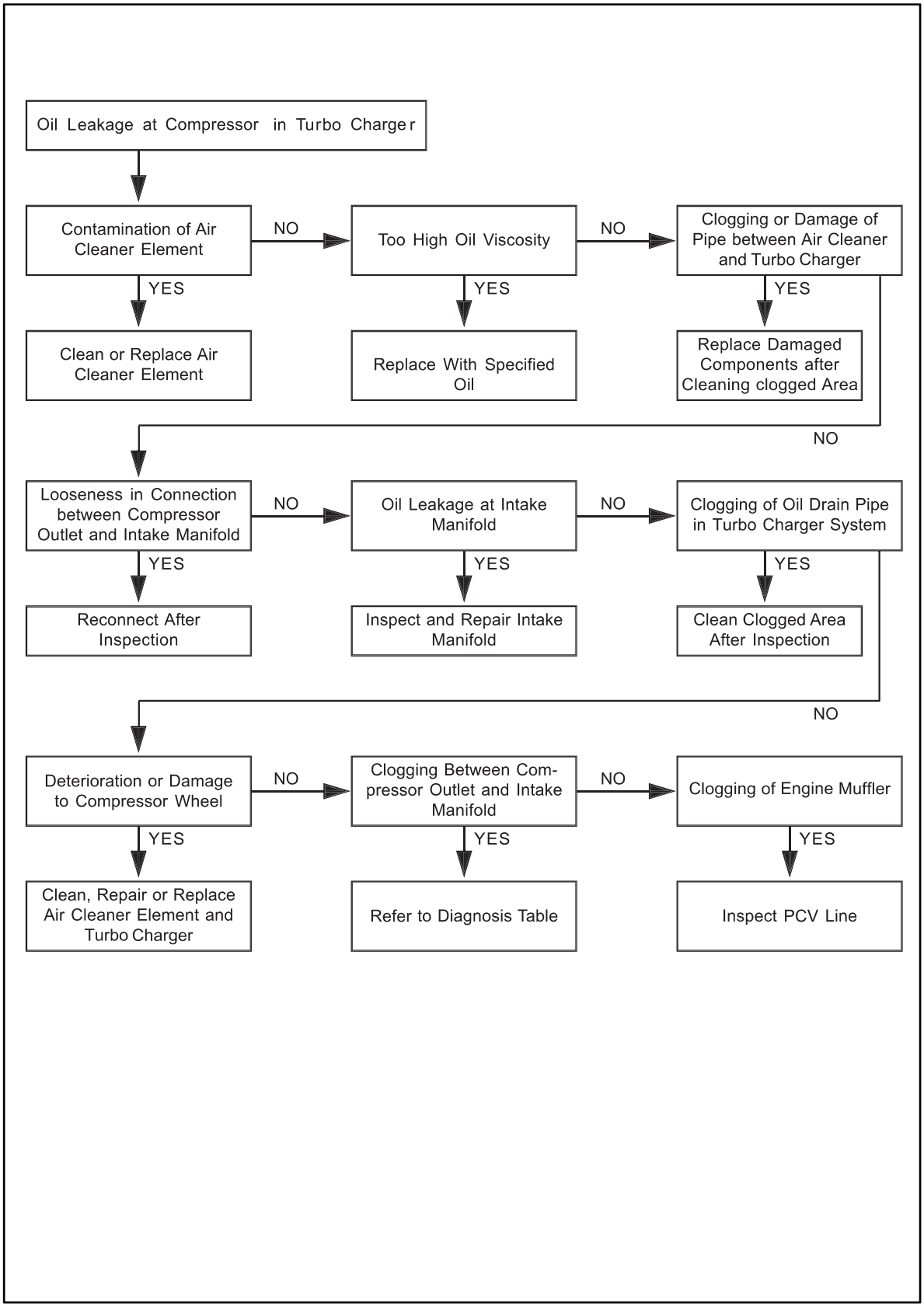
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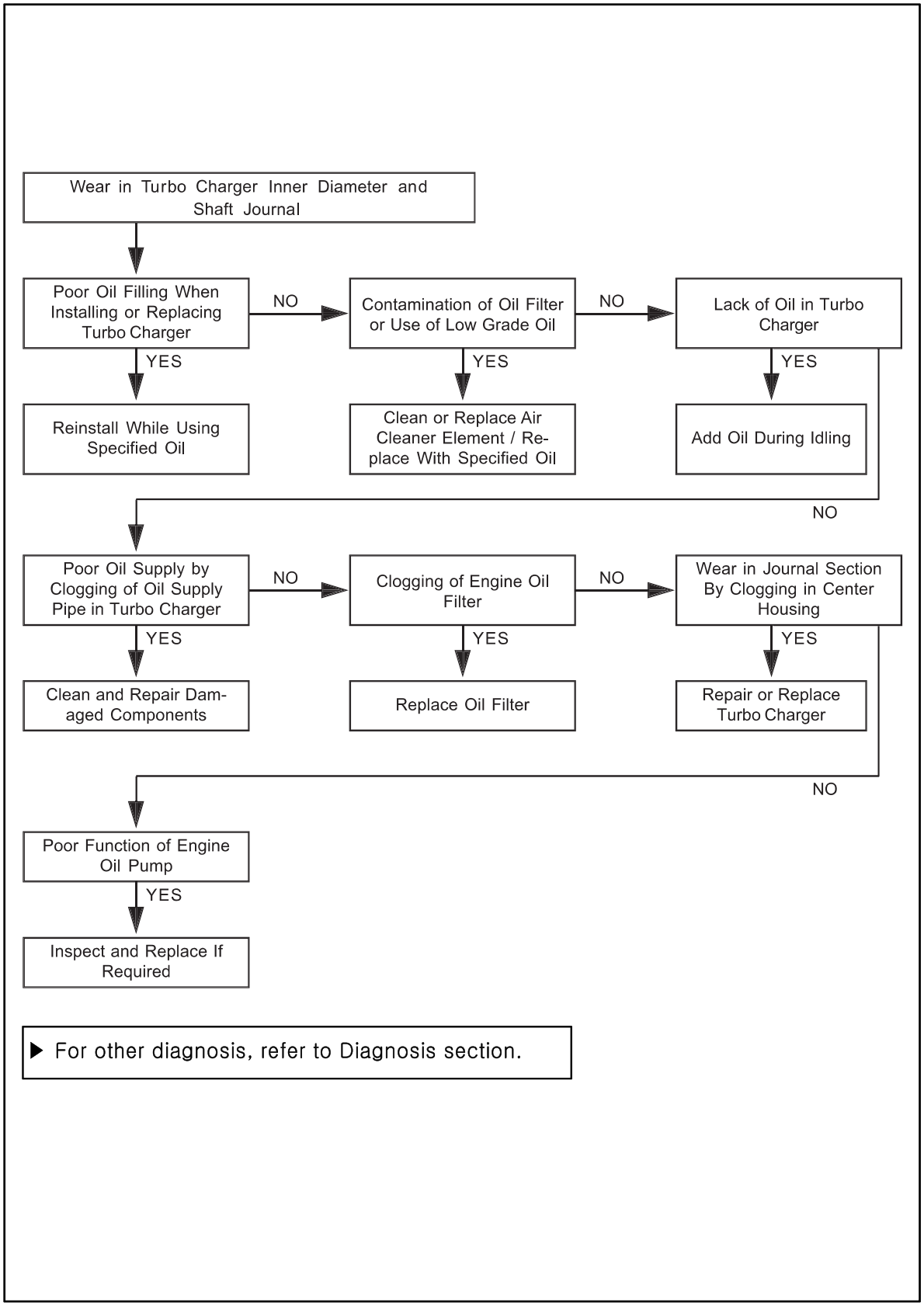


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OVERVIEW AND OPERATING PROCESS

1. SYSTEM DESCRIPTION OF E-VGT (Electric-Variable Geometry Turbine)

A turbocharger is a centrifugal compressor powered by a high speed turbine that is driven by an engine's exhaust gases. Its benefit lies with the compressor increasing the mass of air entering the engine (forced induction), thereby resulting in greater performance (for either, or both, power and efficiency). As the turbine, at exhaust end, is rotated by exhaust gas pressure the impeller, at intake end, gets rotated to send air around center of the impeller, being circumferentially accelerated by the centrifugal force, into the diffuser. The air, which has been introduced to the diffuser having a passage with big surface, transforms its speed energy into the pressure energy while being supplied to the cylinder improving the volume efficiency. Also, the exhaust efficiency improves as the exhaust turbine rotates. The turbocharger is often referred to as the exhaust turbine turbocharger.

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

The E-VGT system installed to the D20DTF engine variably controls the passages of the turbine housing to regulate the flow rate of the exhaust gas. The actuator of E-VGT is a DC motor actuator (E-Actuator) which controls more quickly and precisely than the previous vacuum type actuator.
The engine ECU controls the E-Actuator electronically as follows:

- At low speed: Narrows the flow passage for the exhaust gas, resulting in increasing the flow speed of the exhaust gas and running the turbine quickly and powerfully.
- At high speed: Expands the flow passage for the exhaust gas, resulting in increasing the mass flow of the exhaust gas and running the turbine more powerfully.

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1) Features

(1) Performance (for EURO V)

1. Enhanced emission control: By temperature control with CDPF system

- Target temperature and airflow control

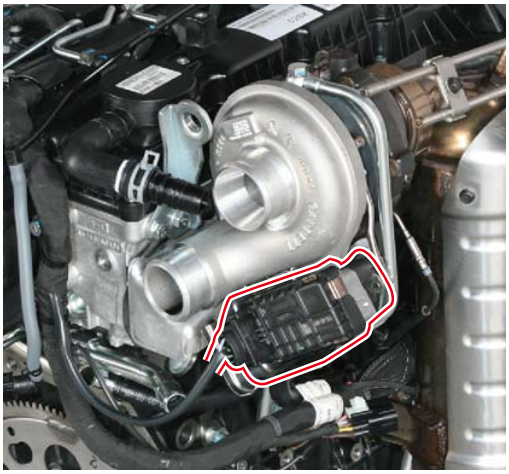
(2) E-Actuator (Electric-Actuator, Rotary type)

1. Optimizes the exhaust gas flow rate by controlling the vanes inside the turbine housing with the E-Actuator.

- Maximizes the intake air charging efficiency (Approx. 15%)

2. Has a faster response time than the conventional vacuum actuator

- Improved low speed torque, high speed power and fuel economy.
- Improved acceleration performance with rapid response time of vane



Features

- Folding and unfolding of the vane is controlled electrically
- Easy to get low speed air volume Rapid response time
- Electric control
-

Benefits

- Improved low speed torque Improved low speed torque and power
- Reduced exhaust gas
- Improved fuel consumption
- Improved acceleration performance

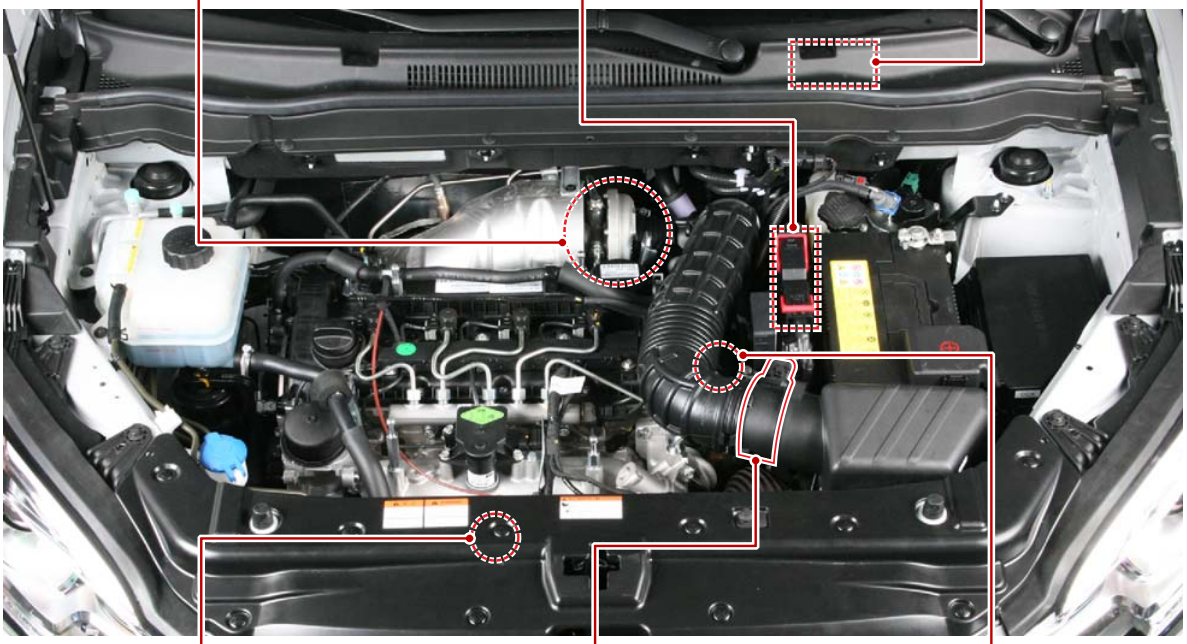
Modification basis	
Application basis	
Affected VIN	

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2. COMPONENTS

For more information about control logic, refer to Chapter "Engine Control".

E-VGT turbocharger	Engine ECU (D20DTF)	Accelerator pedal position sensor
	 Atmospheric pressure, RPM signal	
Improves engine power	E-VGT duty control	Transfers accelerating demand to ECU

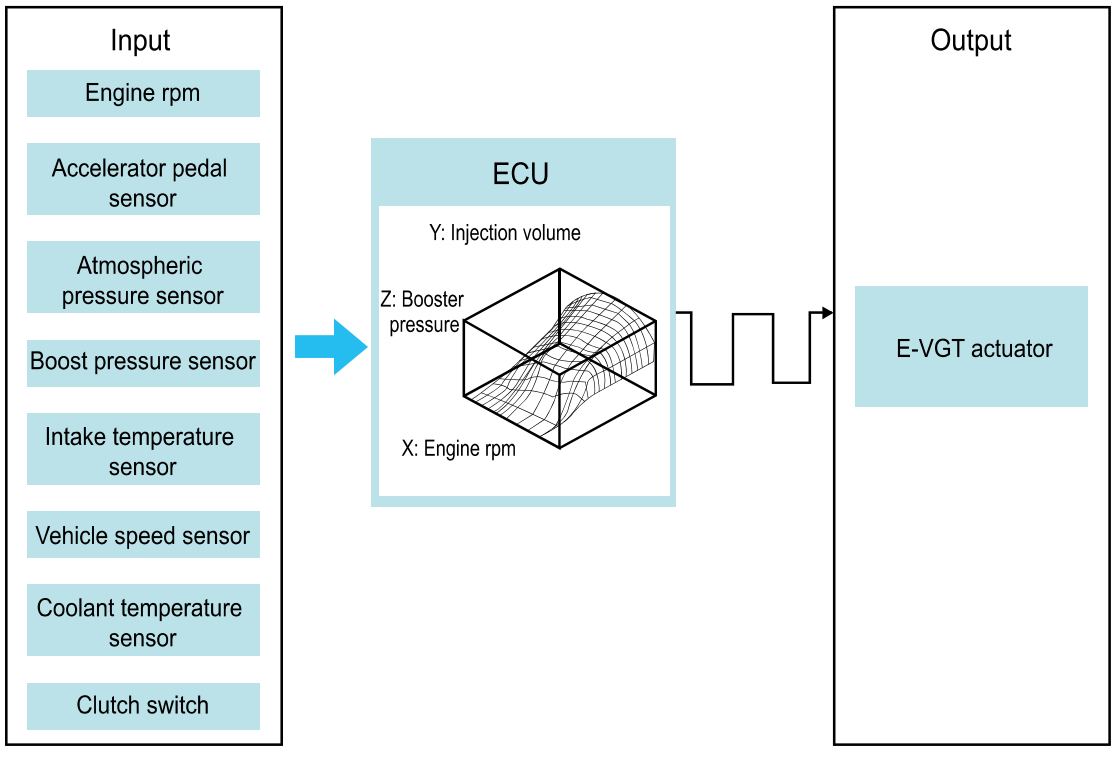


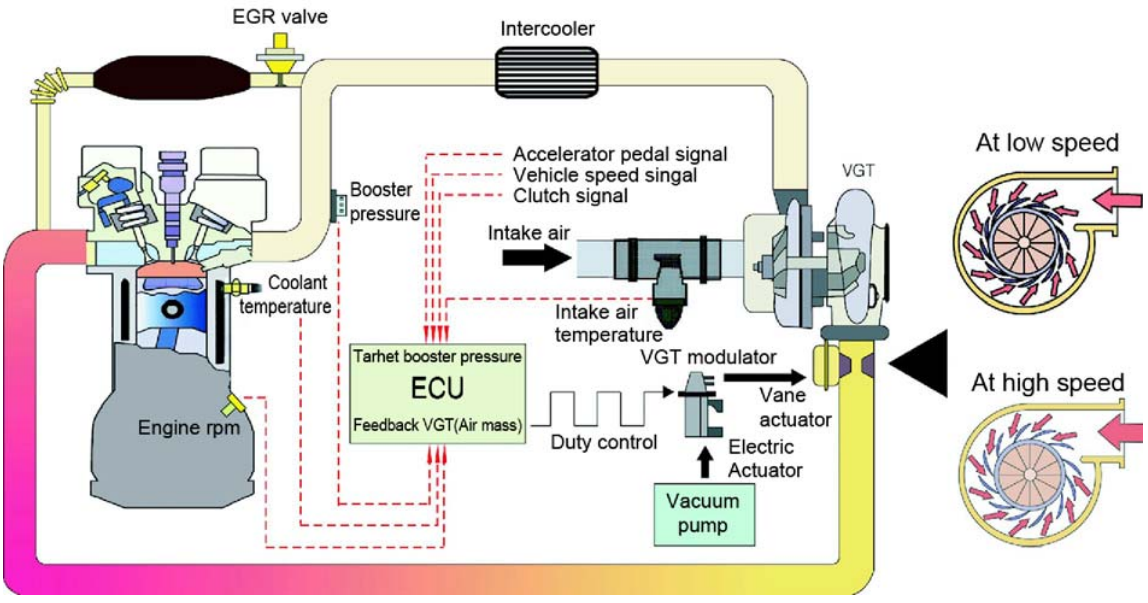
T-MAP sensor	HFM sensor	Coolant temperature sensor
		
Boost pressure and temperature	Improves the engine power	Operates the VGT according to engine warm-up

Modification basis	
Application basis	
Affected VIN	

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3. INPUT/OUTPUT DEVICES





Modification basis	
Application basis	
Affected VIN	

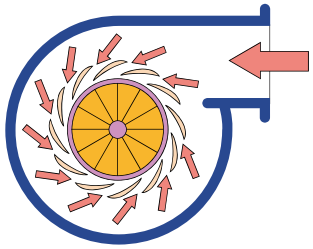
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4. OPERATING PRINCIPLES

The E-VGT is designed to get more improved engine power in all ranges by controlling the turbine as follows:

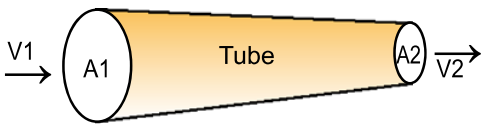
1) How it Works at Low Speed

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

Control range	Turbocharger driving mechanism	Control method	Effect	Improved performance
At low speed		Narrows the flow passage for the exhaust gas by folding the vanes	The flow rate is increased as the exhaust gas passes the narrow passage → Increased turbine & impeller speed, Increased compressive force	Improved low speed torque

※ **Basic principle at low speed**

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



V1 x A1 = V2 x A2 = Constant

NOTE

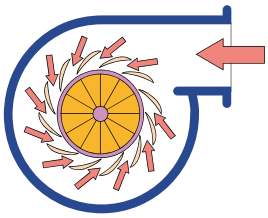
Turbocharger lag

The turbocharger is at idle speed when there is no load or it is in the normal driving condition. During this period, the amount of exhaust gas passing through the turbine is not enough to turn the compressor wheel (impeller) fast. Therefore, the intake air is not compressed as needed. Because of this, it takes time for turbocharger to supply the additional power after the accelerator pedal is depressed. This is called "turbocharger lag".

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2) How it Works at High Speed

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

Control range	Turbocharger driving mechanism	Control method	Effect	Improved performance
At high speed		Expands the flow passage for the exhaust gas by unfolding the vanes	The flow rate is increased due to the expanded passage→ Increased turbine & impeller speed, Increased compressive force	Improved maximum power

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LUBRICATION SYSTEM

0000-00

GENERAL INFORMATION

1. SPECIFICATION

Unit	Description	Specification	
Oil pump	Lubrication system	Gear pump, forced circulation	
	Type	Internal gear	
	Capacity	74 L at 4,000 rpm, 3 bar	
	Relief pressure	6.3 bar ± 0.3 bar	
Oil filter	Type	Fulle flow/Paper element	
Engine oil	Specified oil	Quality class: Ssangyong genuine engine oil (Total Quartz INEO ECS 5W 30, SK ZIC SY 5W 30 or oil Approved by MB 229. 51) SAE 5W30	
	Capacity	Min.: 4.5 L / Max.: 6.0 L	
	Service interval	EU	Change every 20000 km or 12 months (But, shorten the service interval under severe condition)
		General	Change every 15000 km or 12months (But, shorten the service interval under severe condition)
Oil injection nozzle	Type	Piston	
	Operating pressure	1.5 bar	
	Closing pressure	1.0 bar	
	Oil flow	4L/min	

CAUTION

The engine oil filter element should be changed at the same time with the engine oil.

- Regularly check the engine oil level and add the engine oil if necessary.
- Remember to check the engine oil level and shorten the cycle to replace the engine oil under severe driving conditions.

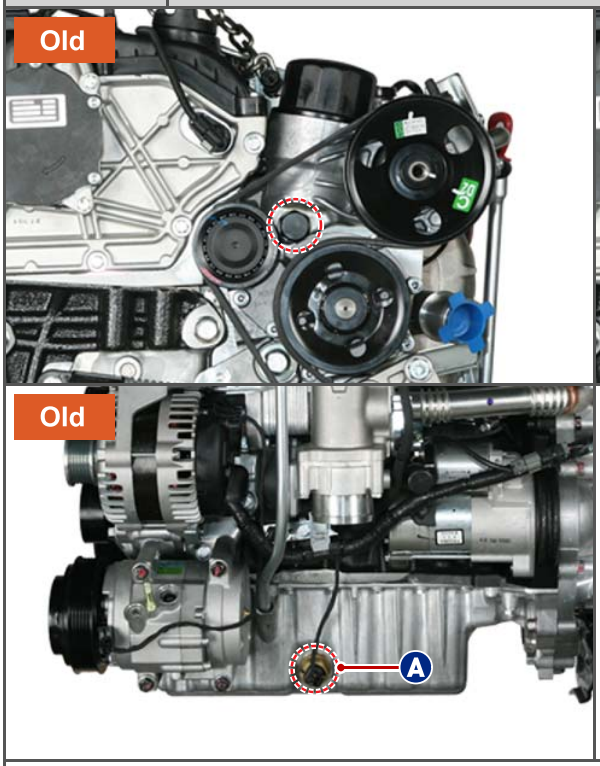
Severe Driving Condition

- Frequent stop-and-go traffic, extended idling, short driving distance below 6 km, driving distance below 16 km when the outside temperature remains below freezing
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- High load driving such as trailer towing
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

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2. MAJOR CHANGES

▶ **Oil pressure switch**

0000-00	Oil pressure switch
	
- Newly added oil pressure switch (B) instead of oil level switch (A)	

Modification basis	
Application basis	
Affected VIN	

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3. MAINTENANCE

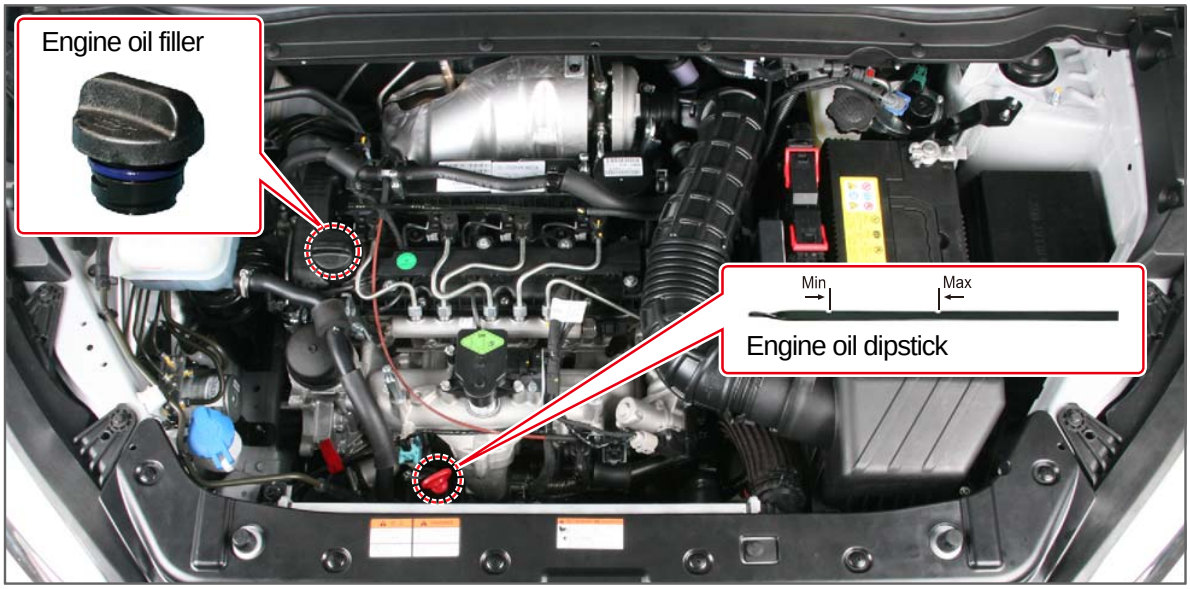
1) Level Check

Park the vehicle on a level ground and apply the parking brake. Stop the engine and wait more than 5 minutes.

- Pull out the dipstick and wipe it with a clean cloth. Reinsert it all the way.
- Pull out it again and check the oil level.
- The oil level should be between the maximum (Max) mark and minimum (Min) mark on the oil dipstick. Oil should be replenished before the level goes below the minimum mark.

WARNING

Operating vehicle with insufficient amount of oil can damage the engine. Make sure the engine oil level is correct and add oil if necessary.



2) Replenishment

If the level gets to the lower point, open the filler cap on top of the cylinder block and add the genuine oil without exceeding the level of the upper mark.
Recheck the oil level after 5 minutes.

CAUTION

- Regularly check the engine oil level and add Ssangyong genuine engine oil if necessary.
- Clean the dipstick with clean cloth so that any foreign materials cannot get into the engine.
- The oil should not go above the upper mark on the dipstick.
- The engine oil may be consumed more if the engine is new.

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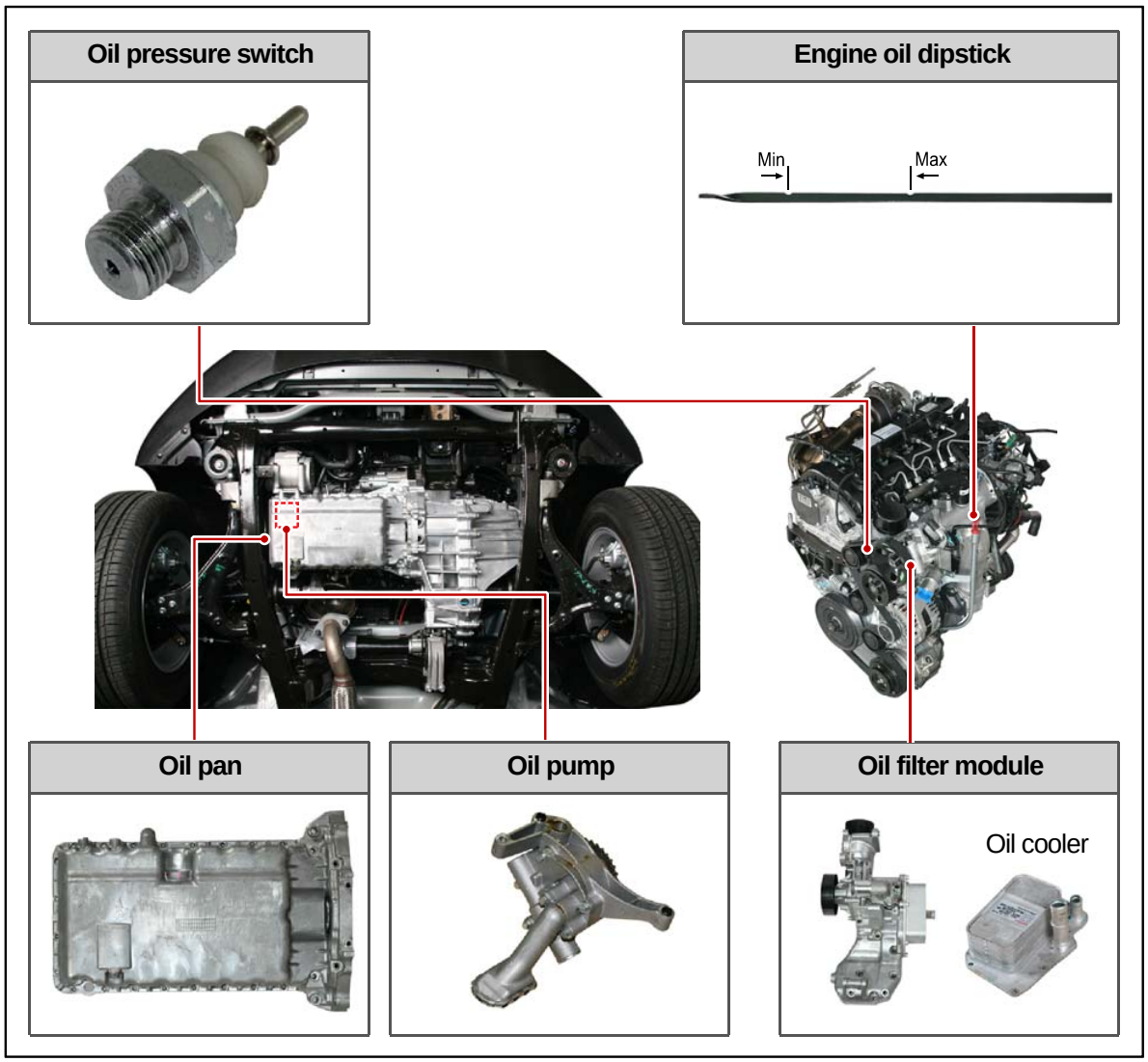
OVERVIEW AND OPERATING PROCESS

1. SYSTEM DESCRIPTION

1) Overview

The lubrication system supplies oil to each lubrication section to prevent friction and wear and to remove heat from the friction part. As the engine runs, frictional heat is generated on each lubrication section. If this condition persists, the bearing can be burned and stuck.
In other words, it creates an oil film on each sliding surface to convert solid friction to liquid friction in order to minimize wear and prevent temperature increasing on the friction part.

2) Component



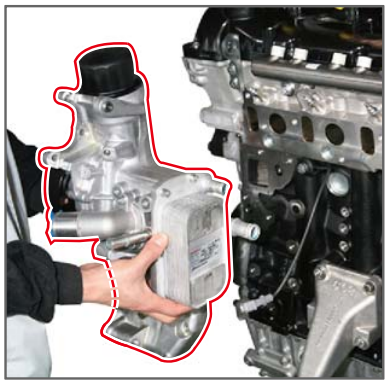
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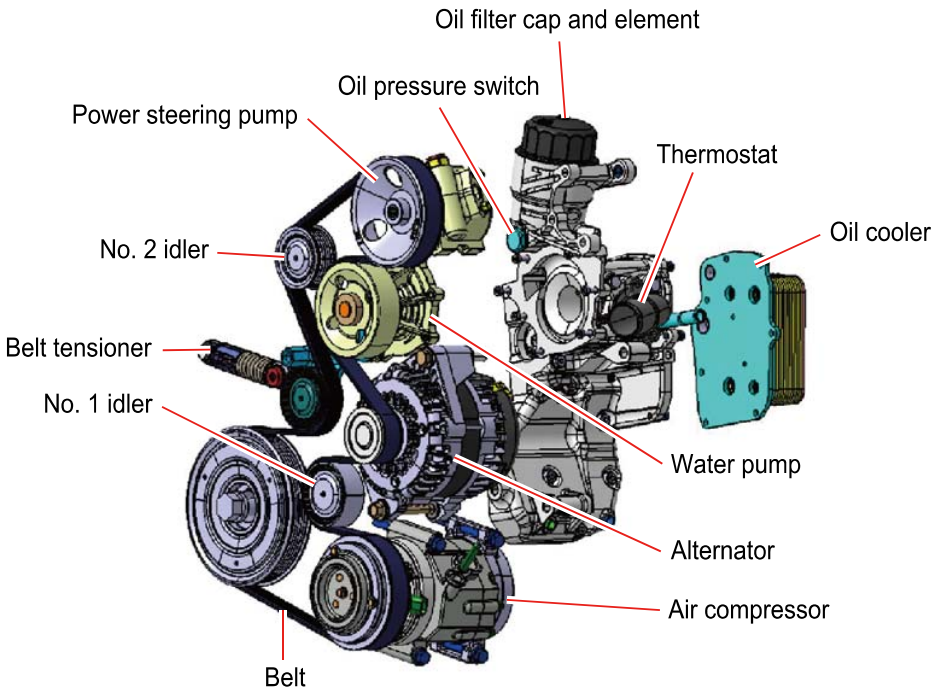
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3) Oil Filter Module

The oil filter module consists of lubrication system, cooling system and some mechanical devices as below.

System	Components
Supplementary devices	Power steering pump (HPS), Alternator, A/C compressor
Belt drive	Belt tensioner, Idle pulley
Cooling	Water pump, Thermostat, Cooler housing and Pipes
Lubrication	Oil filter, Oil cooler (except coolant pipes)

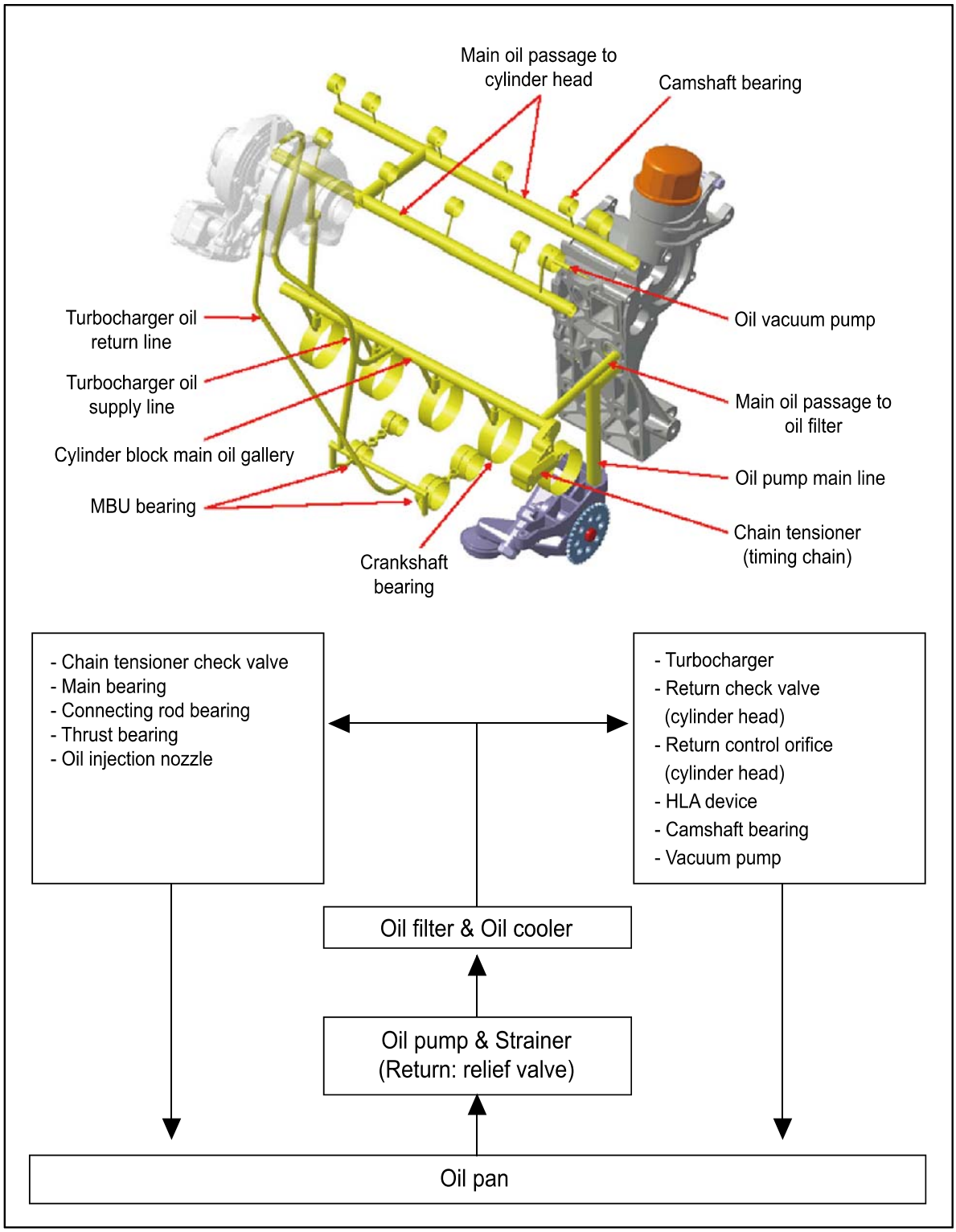




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2. OPERATING PROCESS

1) Operation Flow



Modification basis	
Application basis	
Affected VIN	

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3. LUBRICATION

1)Anti-friction

The oil makes a thin film on the surface of sliding components to reduce the wear due to friction.

2)Cooling

The friction makes the heat on the components. The oil absorbs the heat and radiates it or cools it down.

3) Sealing

The piston ring on the piston seals the cylinder. The oil gets into the clearance in piston ring to secure the sealing for compression pressure and combustion gas.

4) Anti-corrosion

The oil generates the thin film on the surface of components to prevent the material from contacting with air, water and corrosive gas.

5) Cleaning

The oil transfers the residue of material due to friction, oxidized substance, and carbonized substance while circulating in the engine by oil pump.

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COOLING SYSTEM

0000-00

GENERAL INFORMATION

1. SPECIFICATION

Description			Specification
Cooling system	Type		Water cooling, forced circulation
Coolant	Capacity		Approx. 8.5 liter
Radiator	Core size		740W X 380H X 27t (over 281,200㎟)
	Flow type		Cross flow
	Min. cooling capacity		over 68,000kcal/h
Antifreeze	Type		Long life coolant (SYC 1025)
	Mixing ratio (water:antifreeze)		50 : 50
Cooling fan module	Type		Electric
	Capacity	M/T	180W (Ø360) + 120W (Ø360)
		A/T	220W (Ø360) + 150W (Ø360)
	Control type		Series: low speed, Parallel: high speed
Coolant reservoir	Capacity		over 2.2L
	Circulation		Closed roof type
	Pressure cap		Screw type, 1.4bar
	Vacuum valve		Screw type, 1.4bar
Thermostat	Type		Wax pallet type
	Opening temperature		90℃
	Fully open temperature		100℃
	Valve lift		8mm

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2. INSPECTION

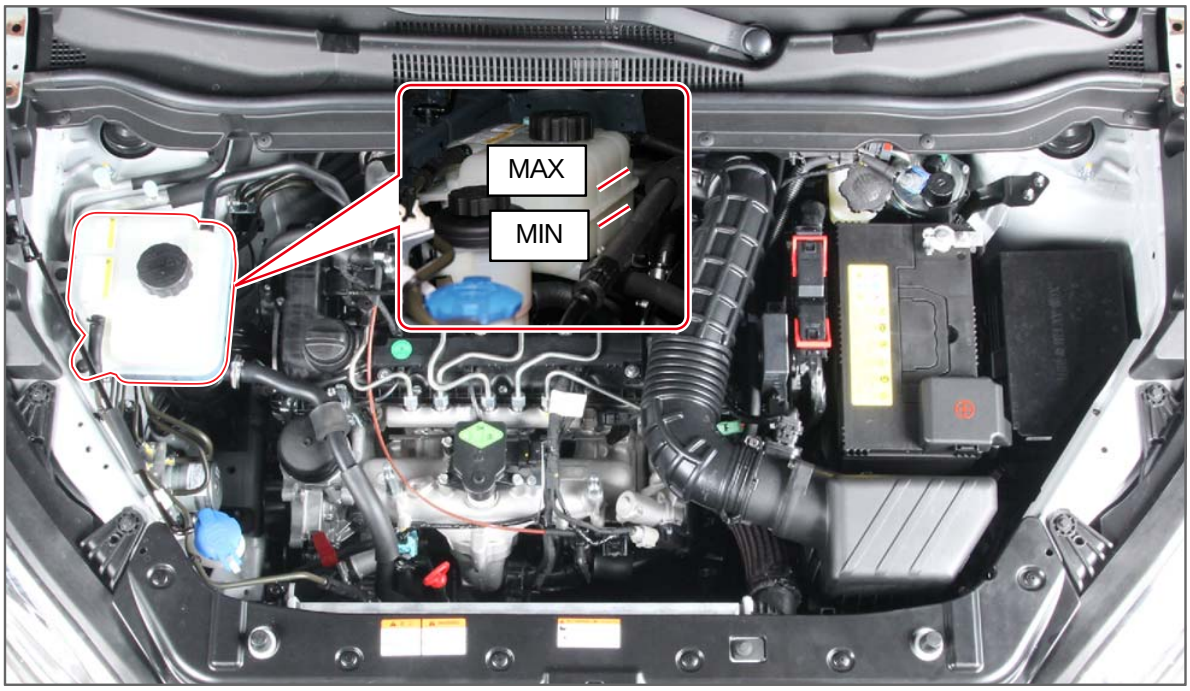
Possible Cause		Action
Coolant level is too low	- Leak from the radiator - Leak from the auxiliary reservoir - Leak from the heater core	- Replace the radiator - Replace the auxiliary reservoir - Replace the heater
	- Leak from the coolant hose connections - Damaged coolant hose	- Reconnect the hose or replace the clamp - Replace the hose
	- Leak from the water pump gasket - Leak from the water pump internal seal	- Replace the gasket - Replace the water pump
	- Leak from the water inlet cap - Leak from the thermostat housing	- Replace the water inlet cap gasket - Replace the thermostat sealing
	- Incorrect tightening torque of the cylinder head bolts - Damaged cylinder head gasket	- Tighten the bolts to the specified torque - Replace the cylinder head gasket
Coolant temperature is too high	- Coolant leakage (Coolant level is low) - Improper coolant mixture ratio - Kinked coolant hose	- Add coolant - Check the coolant concentration (Anti-freeze) - Repair or replace the hose
	- Defective thermostat - Defective water pump - Defective radiator - Defective auxiliary reservoir or tank cap	- Replace the thermostat - Replace the water pump - Replace the radiator - Replace the auxiliary reservoir or tank cap
	- Cracks on the cylinder block or cylinder head - Clogged coolant passages in the cylinder block or cylinder head	- Replace cylinder block or cylinder head - Clean the coolant passage
	- Clogged radiator core	- Clean the radiator core
	- Improper operation of cooling fan	- Replace the cooling fan or repair the related circuit
	- Defective temperature sensor or faulty wiring	- Replace the sensor or repair the related wiring
Coolant temperature is too low	- Thermostat is stuck open	- Replace the thermostat
	- Improper operation of cooling fan	- Replace the cooling fan or repair the related circuit
	- Defective temperature sensor or faulty wiring	- Replace the sensor or repair the related wiring

Modification basis	
Application basis	
Affected VIN	

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1) Coolant Level Check

1. Park the vehicle on level ground and apply the parking brake. Stop the engine and wait until it is cooled down.
2. The coolant level should be between the MAX and MIN mark on the coolant reservoir.
   Check the coolant level. If the level is below the "MIN" mark, immediately add coolant.



CAUTION

- Scalding hot coolant and steam could be blown out under pressure, which could cause serious injury. Never remove the coolant reservoir cap when the engine and radiator are hot.
- Avoid any direct contact of the coolant to the painted body of the vehicle.

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2) Leak Test



1. Release the pressure in the system by loosening the pressure cap of the coolant reservoir slightly. Then, remove the pressure cap completely.

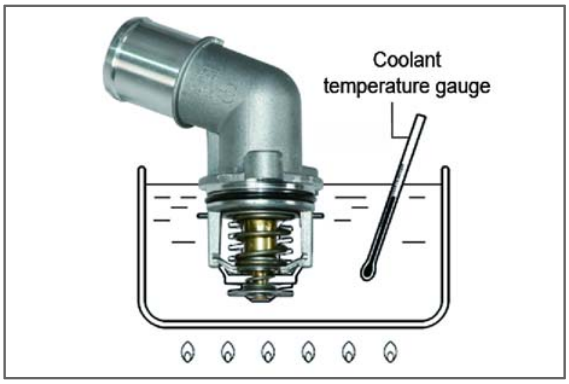
CAUTION

Never open the cap until the coolant temperature becomes under 90℃ to prevent any burn.



2. Add the coolant so that the coolant level is between MAX and MIN mark on the coolant auxiliary tank.
3. Connect the tester to the tank filler and apply pressure (1.4 bar).
4. Check all the coolant hoses, pipes and connections for leaks when the pressure of the tester drops, and replace or tighten, if necessary.

3) Thermostat



Immerse the thermostat into the water. Heat the water and check the valve opening temperature.

Valve opening temperature	90±2℃

Modification basis	
Application basis	
Affected VIN	

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3. CAUTIONS

CAUTION

- If 100% of anti-freeze is added, the water pump vane can be damaged and thermal conductivity can be decreased resulting in poor circulation in the cooling system which leads to overheated engine.
- Use of non-recommended coolant could cause damage to the cooling system and overheating of the engine.
- Opening the coolant reservoir cap while the engine is running or hot can cause burns by hot steam or water.
- To open the coolant reservoir cap, wrap the cap with a wet towel or thick cloth after the engine is cooled down sufficiently.
- If cool water is added to the heated engine, the engine or radiator can be deformed.
- The anti-freeze in the coolant can damage the painted surface, so avoid the contact of the coolant to the painted body.
- The anti-freeze and water should be mixed in proper mixture ratio. Never add only water when adding coolant.
- If the anti-freeze content is too low, the coolant can be frozen while the engine can be overheated if anti-freeze content is too high.

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OVERVIEW AND OPERATING PROCESS

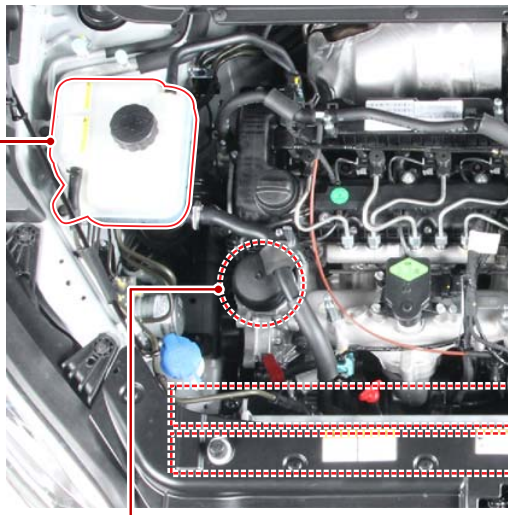
1. SYSTEM DESCRIPTION

1) Overview

Coolant reservoir



Long life coolant is used.



Water pump

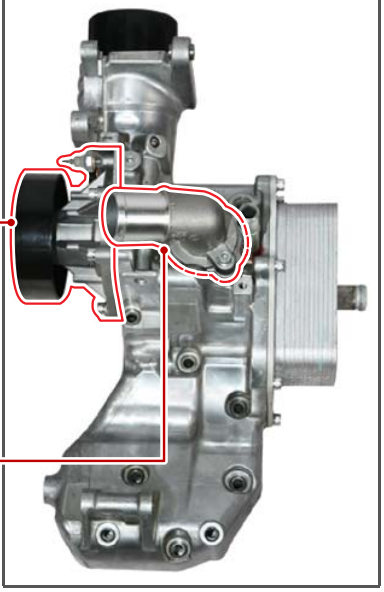


Water pump pulley



The water pump is driven by the engine drive belt and supplies the coolant to each area of the engine.

Oil filter module



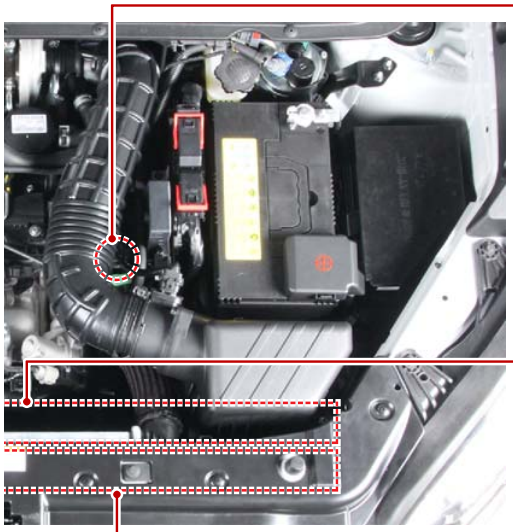
Thermostat



When the engine coolant reaches 90℃, the thermostat starts to open (fully open at 100℃) and lets the coolant flow to the radiator to maintain the engine temperature.

Modification basis	
Application basis	
Affected VIN	

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Coolant temperature sensor



Measures the coolant temperature and sends the result to the engine ECU.

Electric fan



Circulates the fresh air forcibly to exchange heat with the radiator core fin.

Radiator

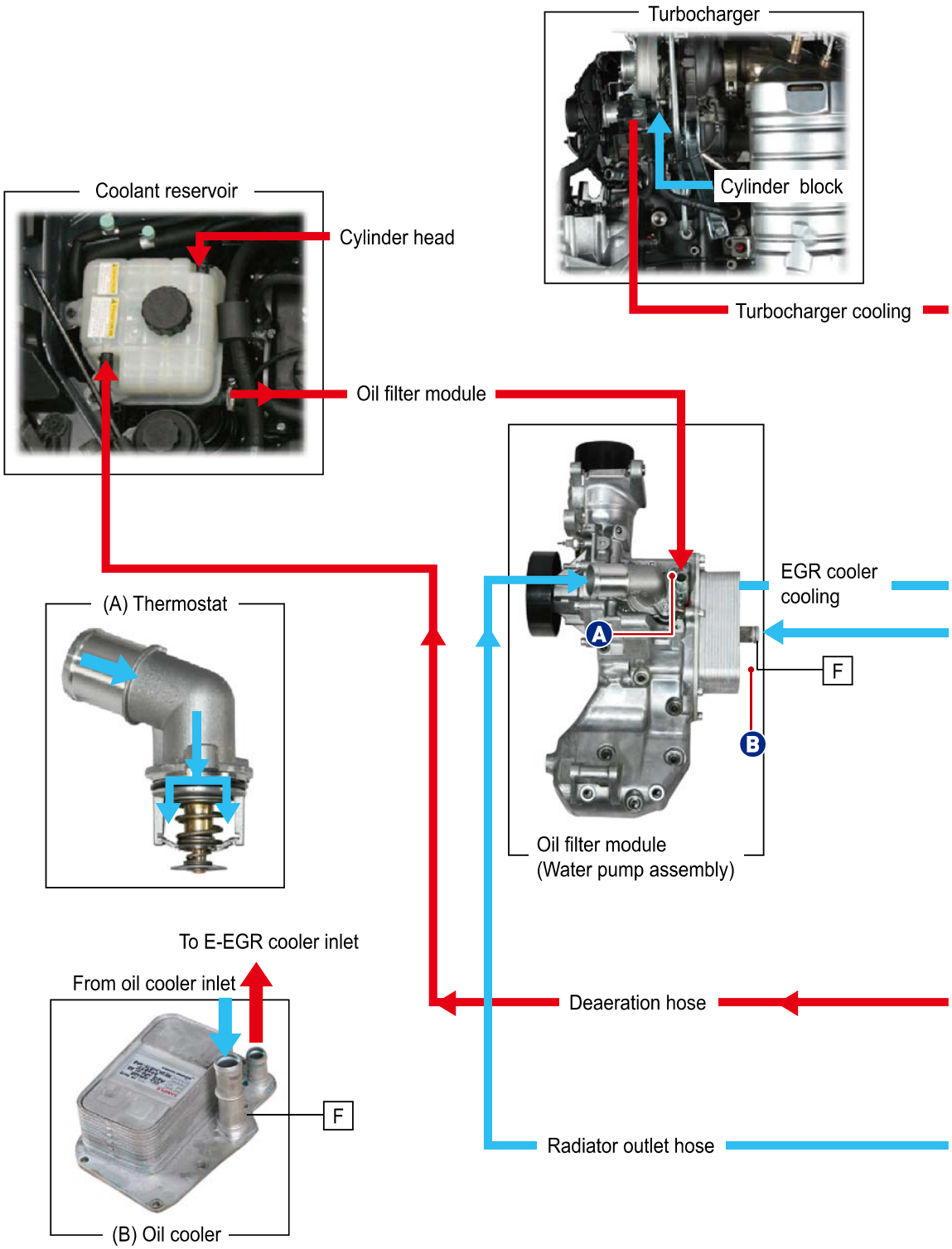


Releases heat through fins and cools down the hot coolant as the coolant passes through the tube of the radiator core.

Modification basis	
Application basis	
Affected VIN	

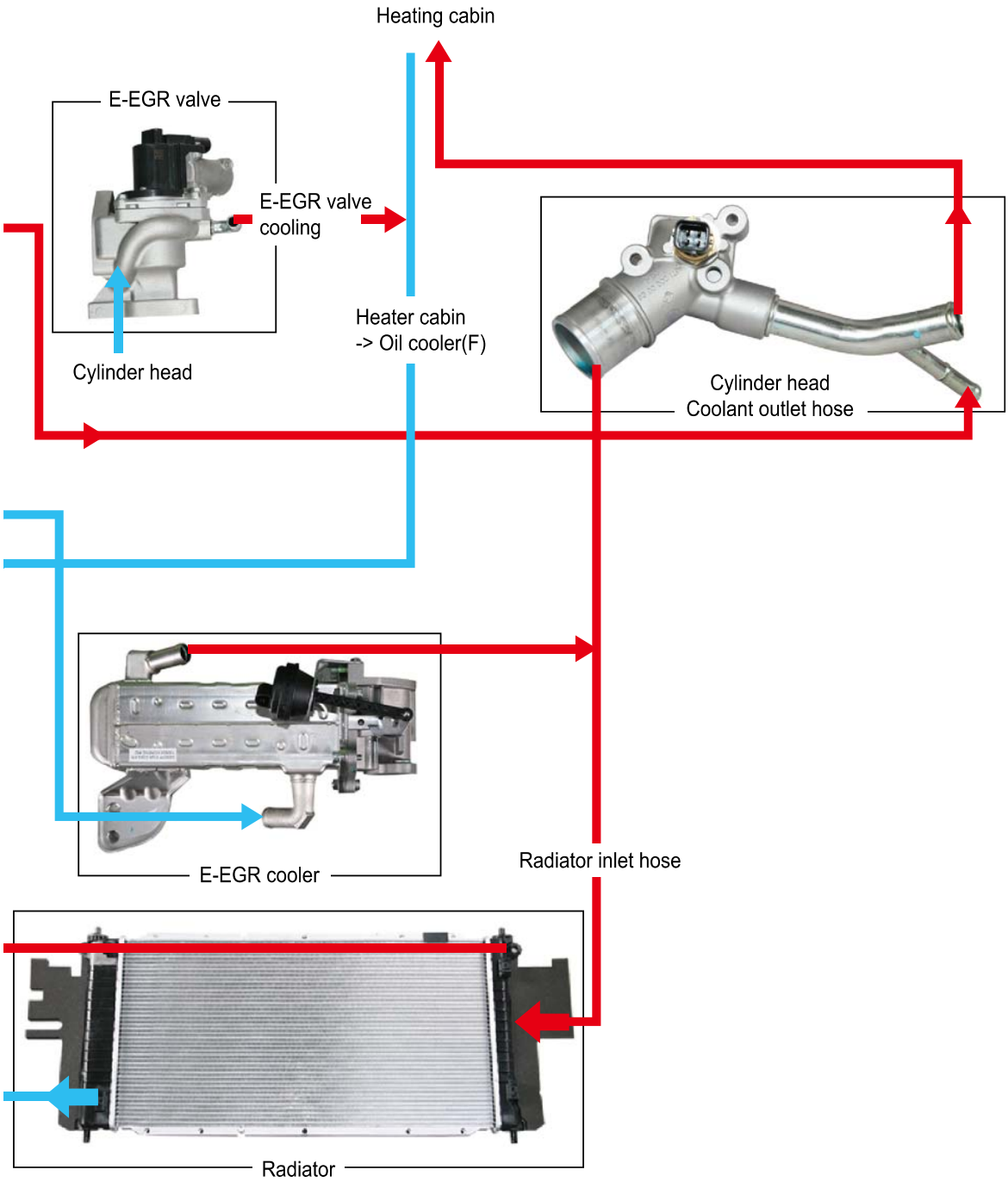
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3) System Layout



Modification basis	
Application basis	
Affected VIN	

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CHARGING SYSTEM

0000-00

GENERAL INFORMATION

1. SPECIFICATION

Specification			HPS	EPS
Alternator	Crankshaft pulley : Alternator Pulley		1 : 2.94	
	Normal output (idling/2200 rpm)		70/120 A	70/140A
	Regulator voltage		14.6 V	←
	Brush	Length	12.5 mm	←
		Wear limit	7 mm	←
Battery	Type		MF	←
	Capacity		90AH	←

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2. INSPECTION

1) Alternator Output Test

Item	How to check	DTC set value / Action
Output current	1. Disconnect the cable connected to the B terminal on the alternator. Connect one end of the ammeter to the B terminal and the other end to the cable connected to the B terminal. 2. Measure the maximum output value. (Maintain the engine speed between 2,500 and 3,000 rpm.) (Turn the headlamp and all the electrical switches on.)	- Pass: If the measured current is 45 A or higher. - Fail: If the measured current is less than 45 A. - Check the current of the B terminal.
B terminal current	1. Move the gear selector lever to the neutral position. 2. Maintain the engine speed at 2,500 rpm with the vehicle unloaded. (Turn all the electrical switches off.)	- Open circuit: If the measured current is 5 A or higher.
Rotor coil resistance	1. Disconnect the negative cable from the battery. 2. Remove the B terminal and turn off the ignition switch. 3. Measure the resistance between the L and F terminals with an ohmmeter.	- Pass: If the measured resistance is between 3 and 6 Ω. - Faulty rotor coil or slip ring: If the measured resistance is less than 3 Ω or greater than 6 Ω.
L terminal voltage	1. Connect the B terminal wiring. 2. Measure the voltage with the engine running.	- Specification: 12.5 V to 14.5 V - Faulty IC regulator or field coil: If the measured voltage is 14.5 V or higher.

CAUTION

- Disconnect the negative battery cable.
- Connect the negative cable again after connecting the ammeter.

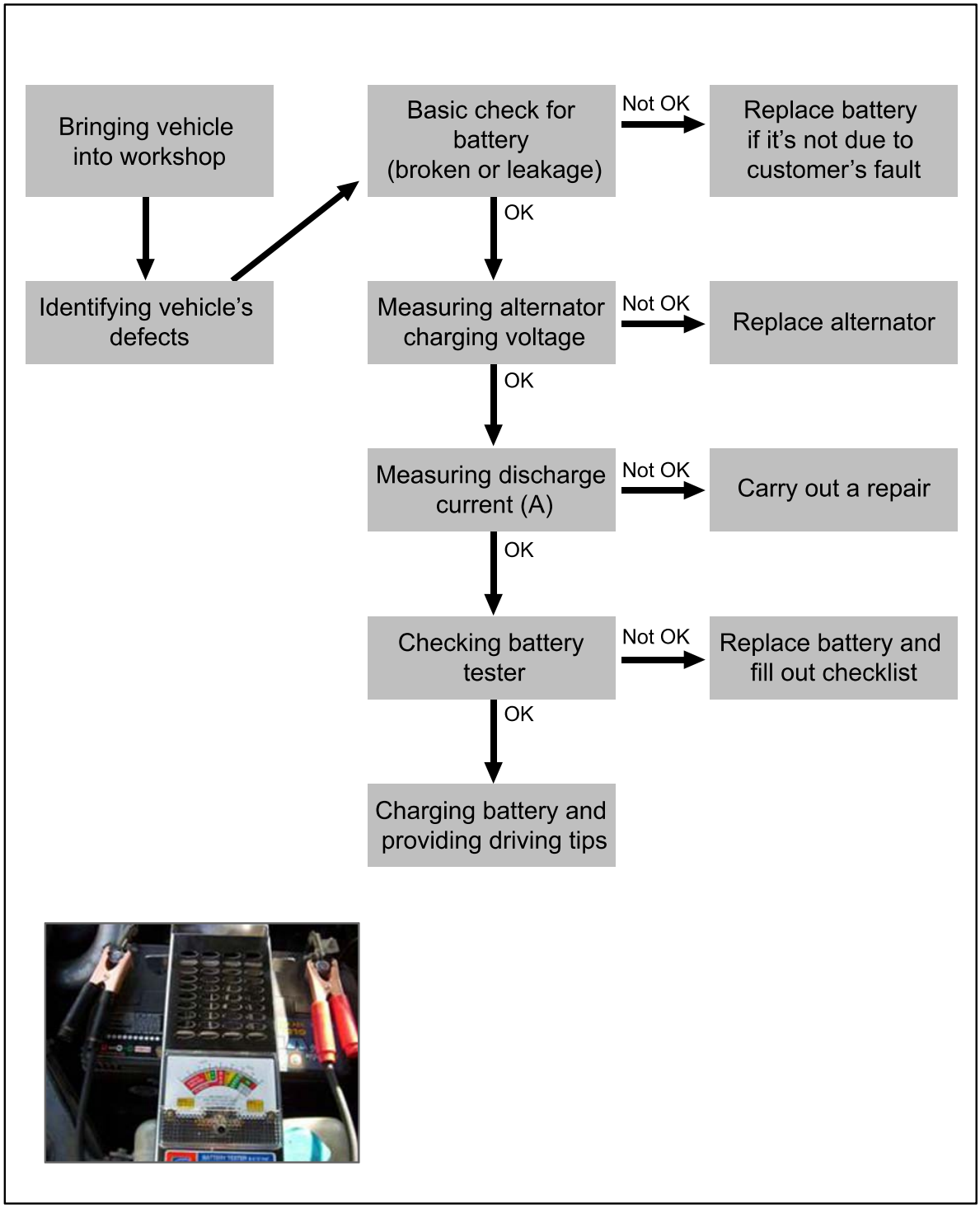
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2) Troubleshooting for Alternator

Item	Cause	Action
Overcharged battery	Defective alternator voltage regulator	Replace
	defective alternator detection wiring	Repair or replace
Discharged battery	Loose alternator drive belt	Adjust the belt tension or replace
	Poor connection of related circuit or open circuit	Retighten the loose connection or repair open circuit
	Defective alternator voltage regulator	Replace
	Terminated battery	Replace
	Defective ground	Repair
Charge warning lamp does not come on when turning on ignition switch with engine stopped	Defective alternator voltage regulator	Replace
	Open circuit in charge warning lamp, fuse or wiring	Replace or repair the charge warning lamp or fuse
	Defective ignition switch	Replace
	Defective ground of alternator circuit	Repair
Charge warning lamp does not go off after starting engine	Defective alternator voltage regulator	Replace
	Corroded or worn battery cable	Repair or replace
	Loose alternator drive belt	Adjust the belt tension or replace the belt
	Defective wiring harness	Repair or replace

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3) Checking Battery



Modification basis	
Application basis	
Affected VIN	

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(1) Checking

▶ **Using battery tester**

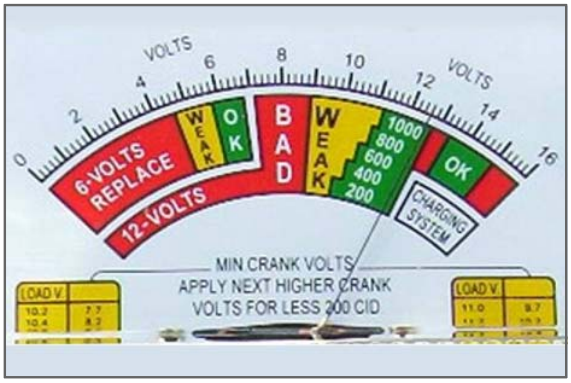
- PASS (11.0 V or more): Explain to the customer that the battery is reusable.
- Need to be charged (9.0 to 11.0 V): Charge the battery with a charger and reinstall it. Explain it to the customer.
- Need to be replaced (9.0 V or more): The battery should be replaced due to overdischarging.

(2) How to use battery tester



▶ **How it works and How to use it**

- Determine battery capacity by fixing current (load capacity) and time and varying voltage. Determine battery capacity based on the
- amount of voltage drop when discharging a fixed load capacity (120 A) for 5 seconds. Connect the tester to the battery and read the
- display while applying a load for 5 seconds.



▶ **How to read display**

- Red area (①): overdischarge or faulty battery
- Yellow area (②): Need to be charged (using a vehicle alternator and a battery charger)
- Green area (③): Normal
- Red area on the left-hand side of OK (④): Impossible to charge with an alternator
- Green area with OK (⑤): Normally charged
- Red area on the right-hand side of OK (⑥ Overcharged by an alternator

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(3) Starting with jumper cable

If the battery is weak or terminated, the battery from another vehicle can be used with jumper cables to start the engine.

▶ Connecting order

1. The positive (+) terminal of the discharged battery
2. The positive (+) terminal of the booster battery
3. The negative (-) terminal of the booster battery
4. Connect one end of the other jumper cable to the body of the discharged vehicle, such as the engine block or a front towing hook.

▶ Starting

1. Prepare a set of jumper cables.
2. Place another vehicle that has the same 12 V of power near to the discharged vehicle.
3. Switch off all electrical accessories for the discharged vehicle.
4. Apply the parking brake and shift the transaxle to the P position (automatic transaxle) or neutral (N) position (manual transaxle).
5. Connect the jumper cables.
6. Try to start the discharged vehicle while accelerating the engine rpm in the booster vehicle.
7. Attempt to start the engine with the discharged battery.
8. After starting the engine, carefully disconnect the jumper cables in the reverse sequence of connection.

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(4) Maintenance

If the charge warning lamp ( ) on the instrument cluster comes on while driving, there is a malfunction in the charge system including the battery. Therefore, carrying out the system check is needed.



- Make sure that the battery cables are firmly connected.
- If the terminals are corroded, clean them with a wire brush or sandpapers.
- Always disconnect the battery cables with the ignition key removed. When disconnecting the battery cables with the ignition key turned to ON or ACC position, several electric units can be damaged due to sudden voltage change.
- Check the battery for crack, damage or fluid leaks. Replace it if necessary.
- Wipe out the battery fluid on the battery surface using a rubber glove and a clean cloth wetted with soapy water.

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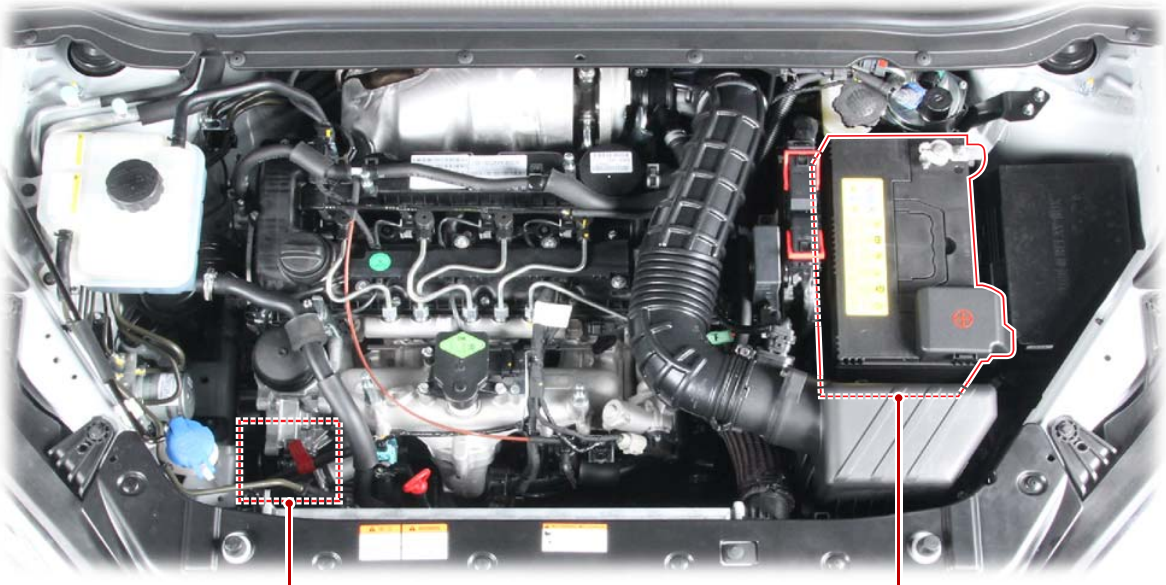
OVERVIEW AND OPERATING PROCESS

1. SYSTEM DESCRIPTION

1) Overview

The charge system is designed to supply electrical energy to the vehicle while driving, and supplies a constant direct current voltage by converting mechanical rotational movement to electrical energy.
The voltage regulator on the back of the alternator controls the generated voltage in all rotating ranges and adjusts the system voltage according to the electric load and ambient temperature change.

2) System Layout (Locations)



Alternator	Battery
	
The alternator charges the battery and supplies power to each electric unit by converting the mechanical energy to the electrical energy.	It converts the chemical energy to the electrical energy and supplies power to the corresponding electric units when starting the engine.

Modification basis	
Application basis	
Affected VIN	

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3) Charging

The alternator uses a new regulator which has three diodes. It consists of the delta stator, rectifier bridge, slip ring and brush.

▶ **Charging time according to vehicle conditions and environment**

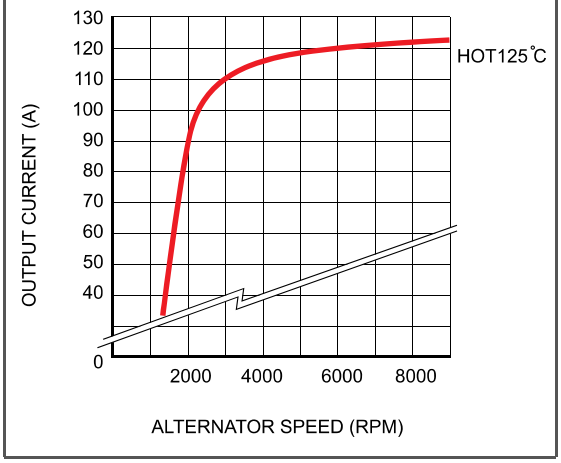


Specification: Charging a fully depleted high-capacity battery takes twice or more as long as charging a fully depleted battery for small vehicles.
Temperature: The lower the temperature is, the longer the time taken to charge the battery. When connecting the battery charger to the cold battery, the amount of current the battery can accept initially is very small. As the battery gets warmer, it can accept more current.

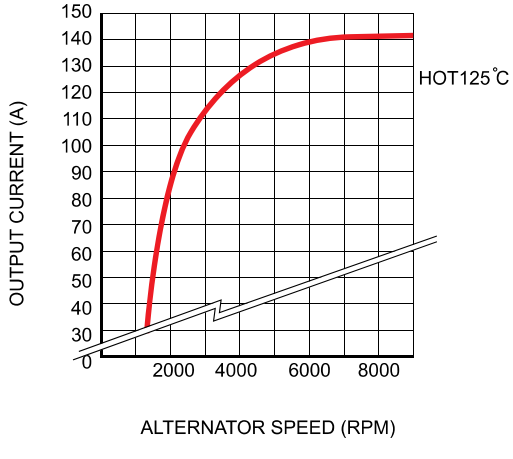
Charging capacity: Charging a battery with a low-capacity charger takes longer time than charging with a high-capacity charger.
Charging status: Charging a fully depleted battery takes twice or more as long as charging a half-depleted battery. Since the electrolyte in a fully depleted battery consists of nearly pure water and conductor, only a very small amount of current can be accepted by the battery initially. The charging current increases as the amount of acids in the electrolyte is increased by the charging current.

4) Output Characteristics

Alternator (120 A)



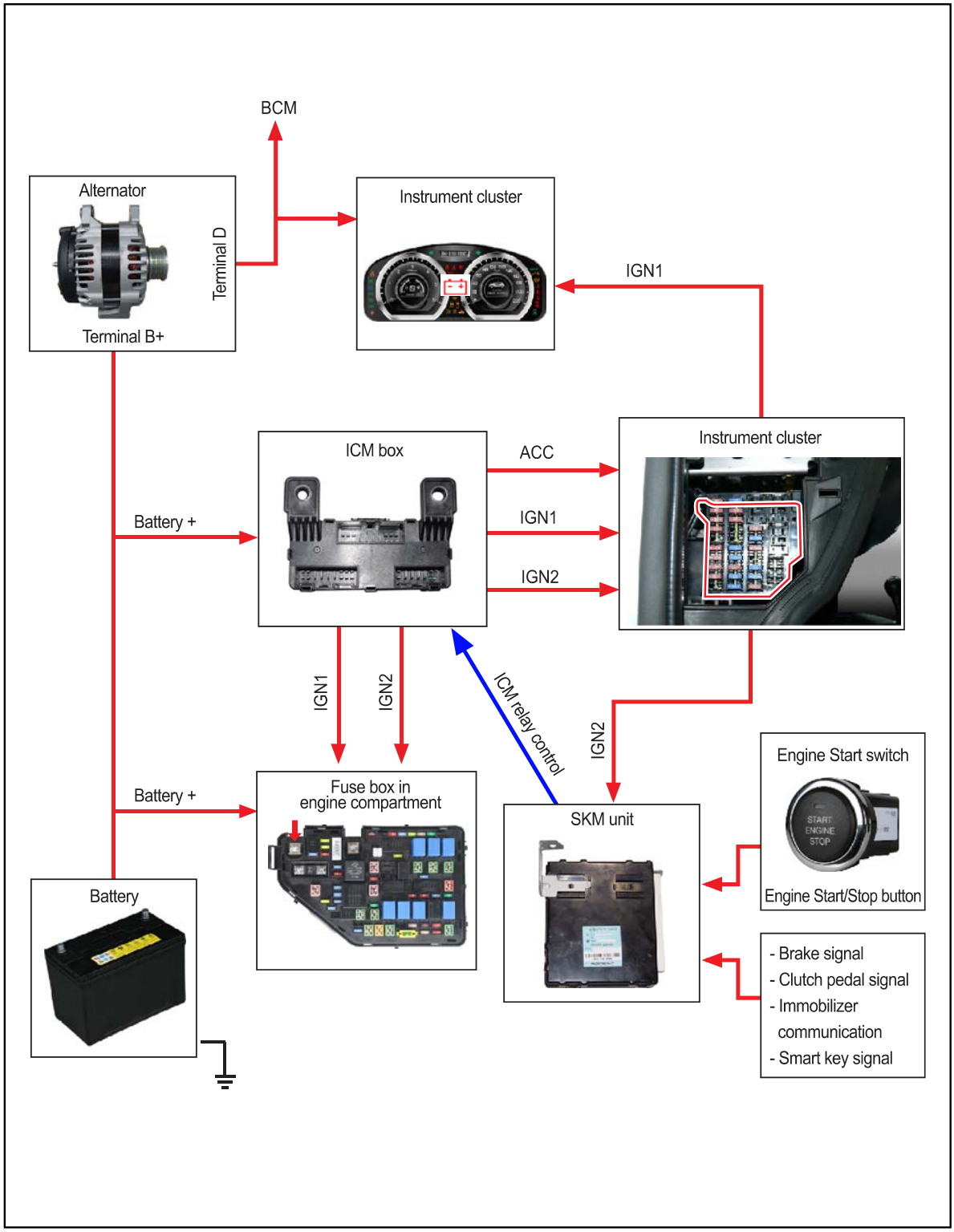
Alternator (140 A)



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2. CHARGING OPERATION

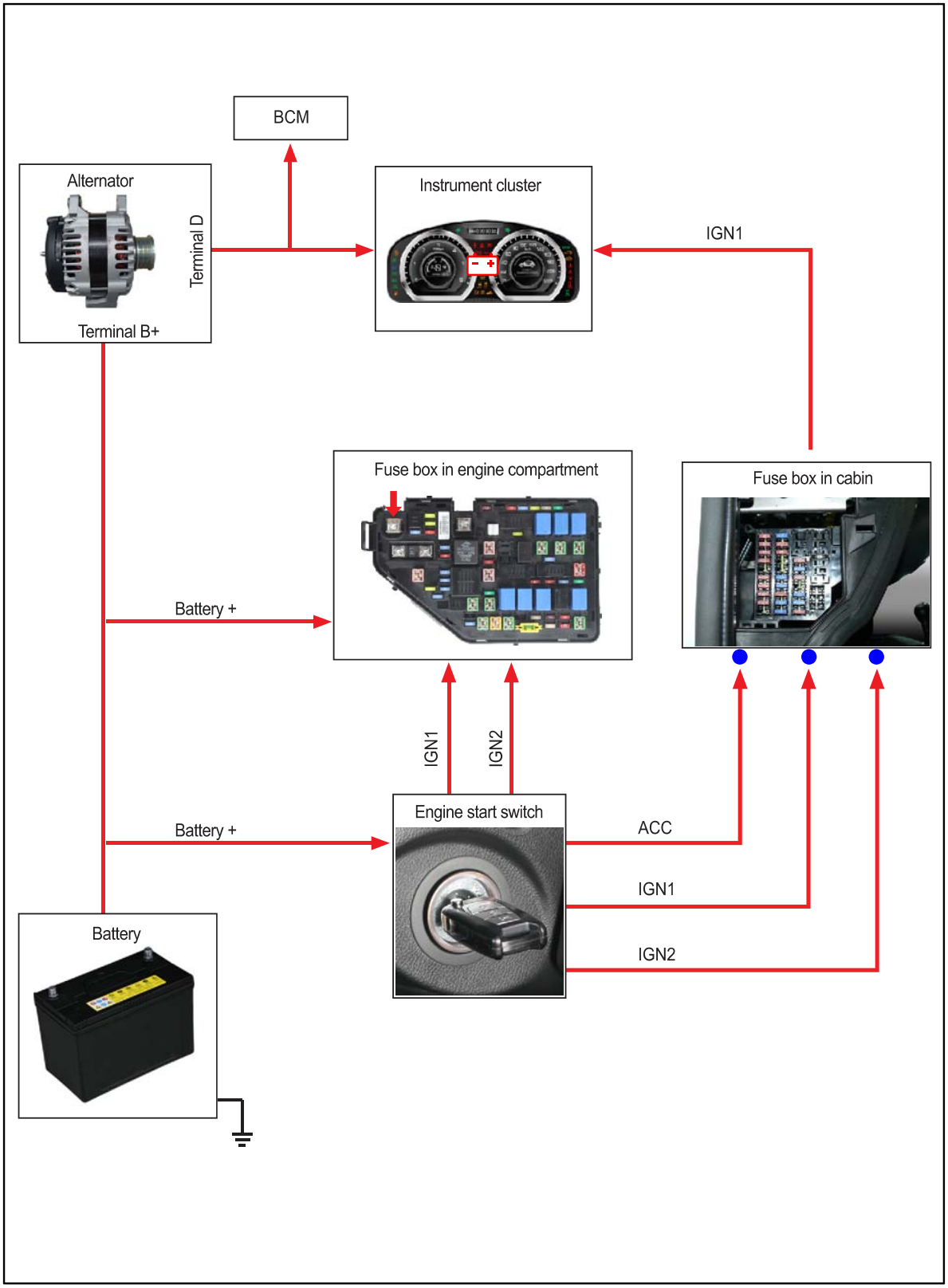
1) With Smart Key System



Modification basis	
Application basis	
Affected VIN	

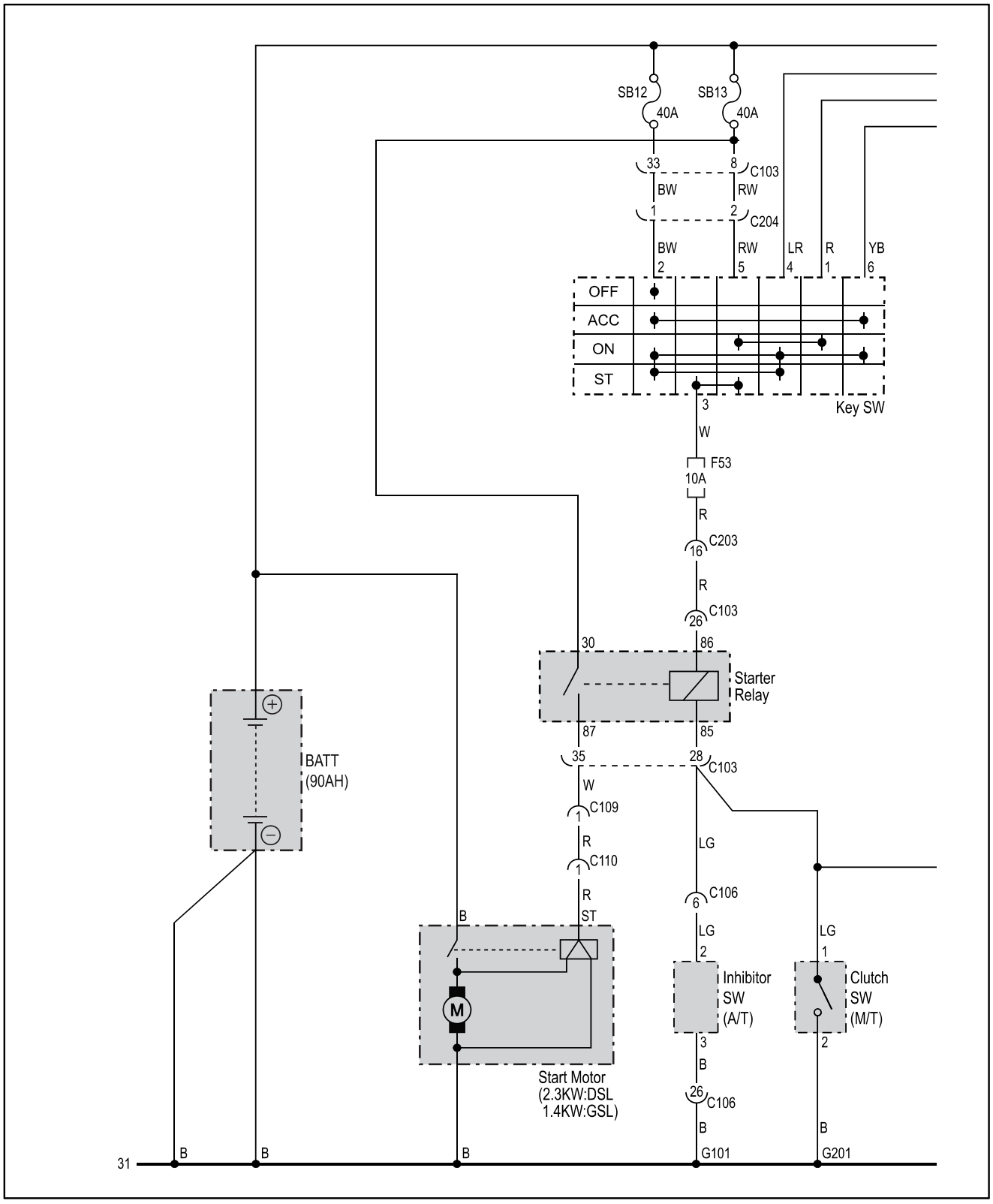
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2) Without SMART Key System



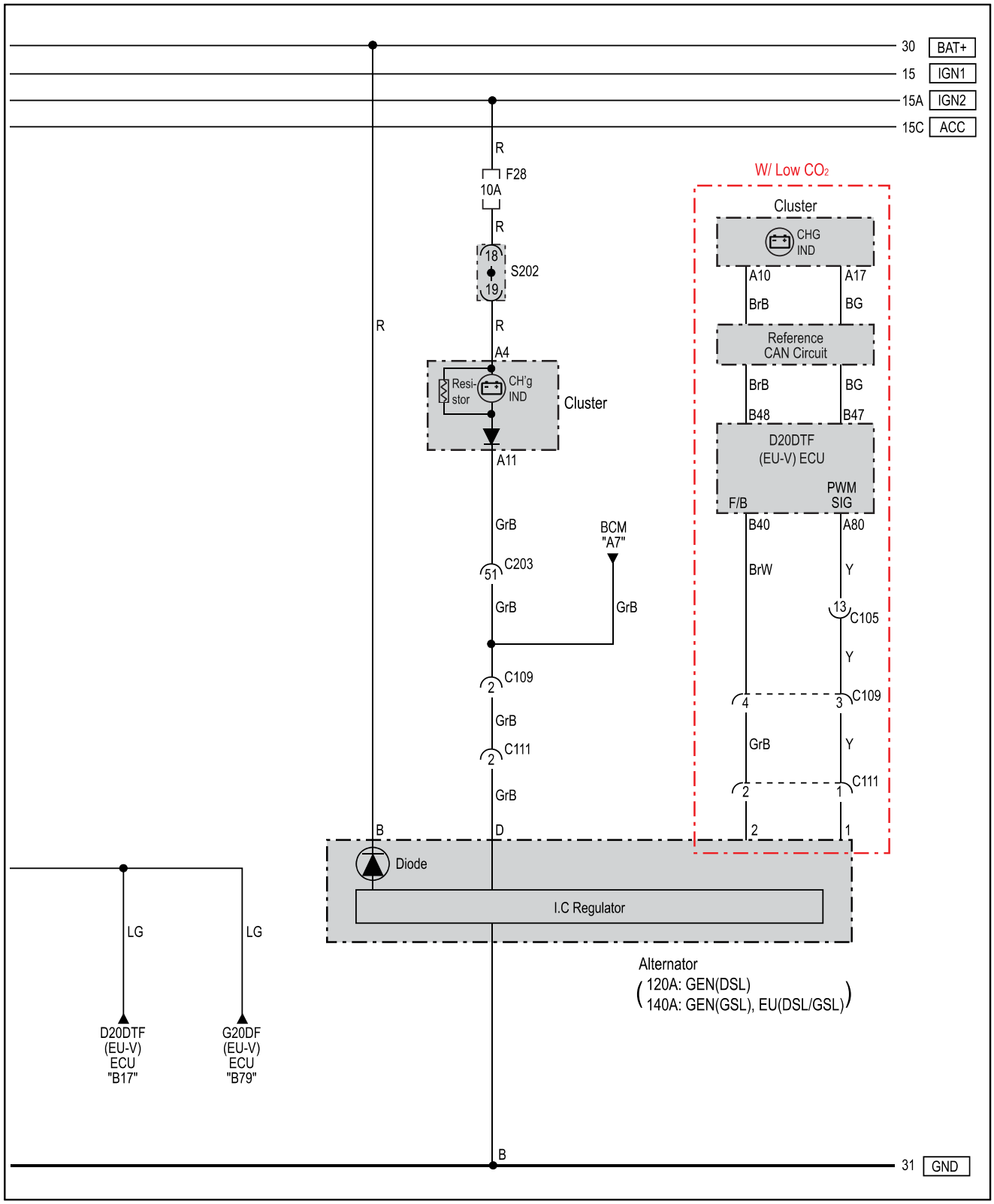
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3. CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
Affected VIN	

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D20DTF PRE-HEATING 1413-00

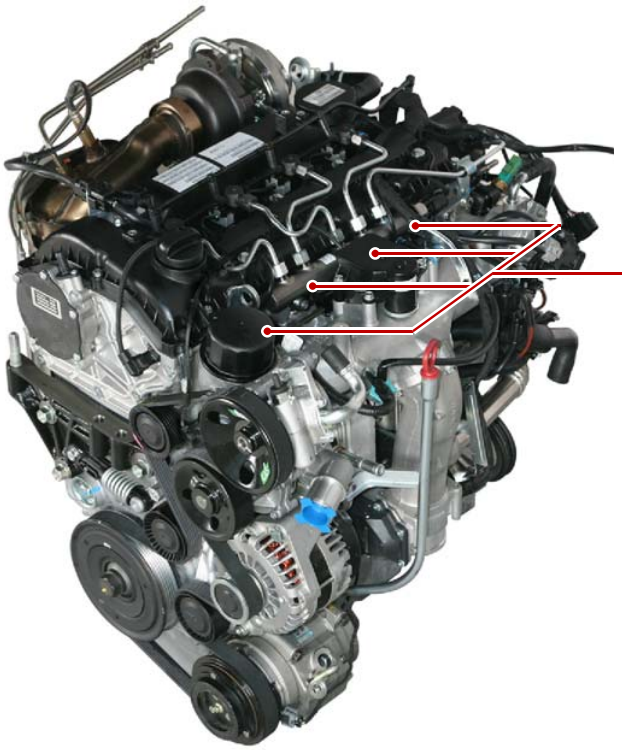
GENERAL INFORMATION

1. SPECIFICATION

Description		Specification
Glow plug	Rated voltage	4.4 V
	Maximum temperature	1100°C
	Operating temperature	1080 to 1100°C
Glow plug control unit	EMS operating voltage	6 to 16 V
	Operating temperature	−40°C to 110°C
	Dark current	Max. 1 mA

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2. TIGHTENING TORQUE



Glow plug





GCU (Glow plug Control Unit)



No.	Name	Tightening torque	
1	Glow plug	15 ± 1.5 Nm	
2	Glow plug control unit bolt	10 ± 1.0 Nm	

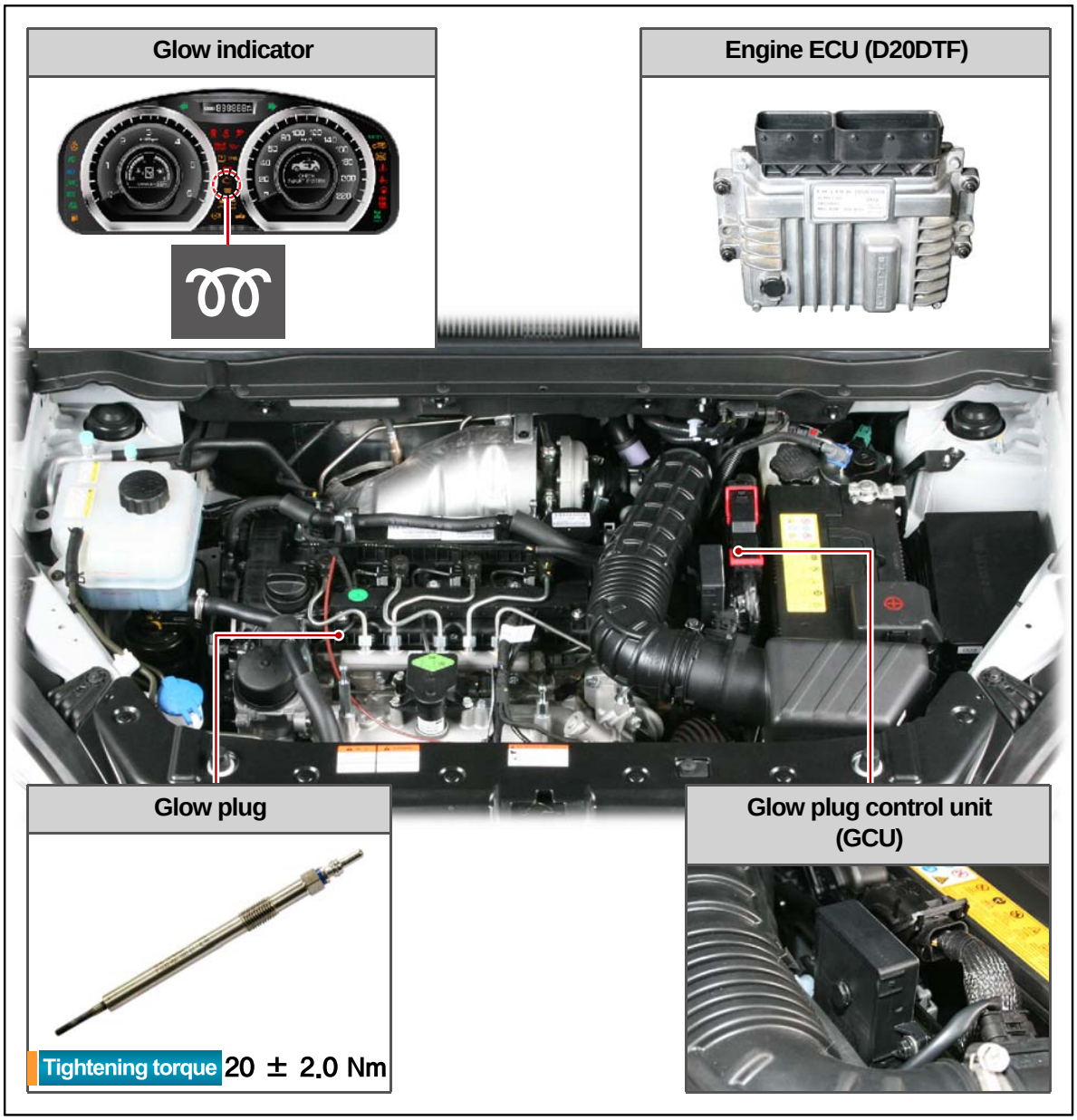
Modification basis	
Application basis	
Affected VIN	

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The pre-heating system for D20DTF engine has the glow plug to the cylinder head (combustion chamber), and improves the cold start performance and reduces the emission level.
The pre-heating resistor (air heater) is used to heat the intake air.
This enables the diesel fuel to be ignited in low temperature condition.
The ECU receives the information such as, engine rpm, coolant temperature, engine torque, etc., through CAN communication during pre-heating process; and the pre-heating control unit controls the pre-heating, heating during cranking and post-heating by the PWM control.

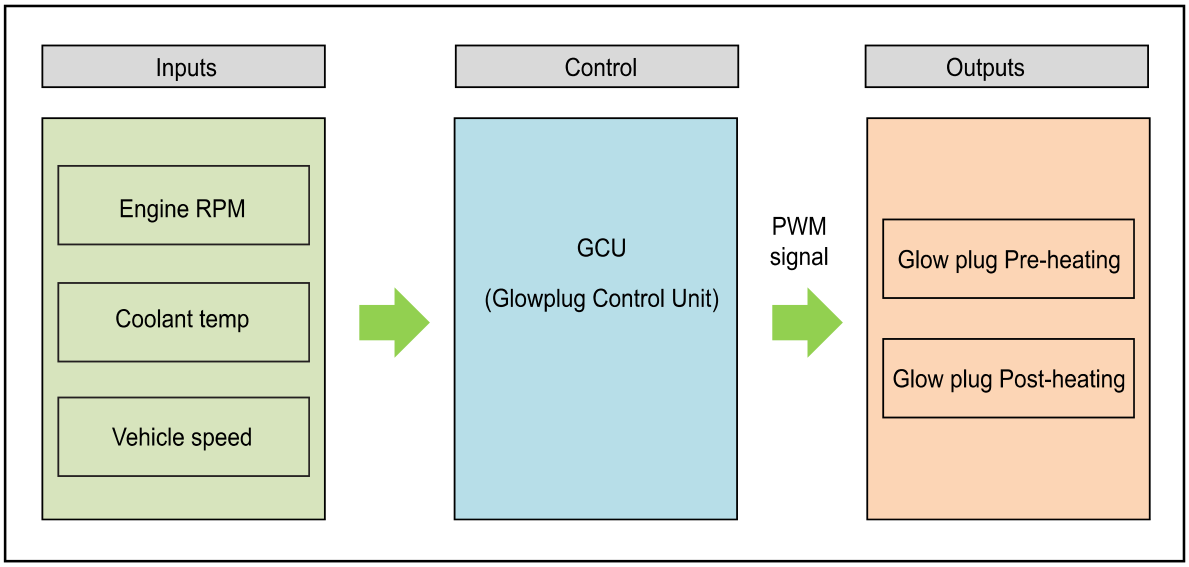


Modification basis	
Application basis	
Affected VIN	

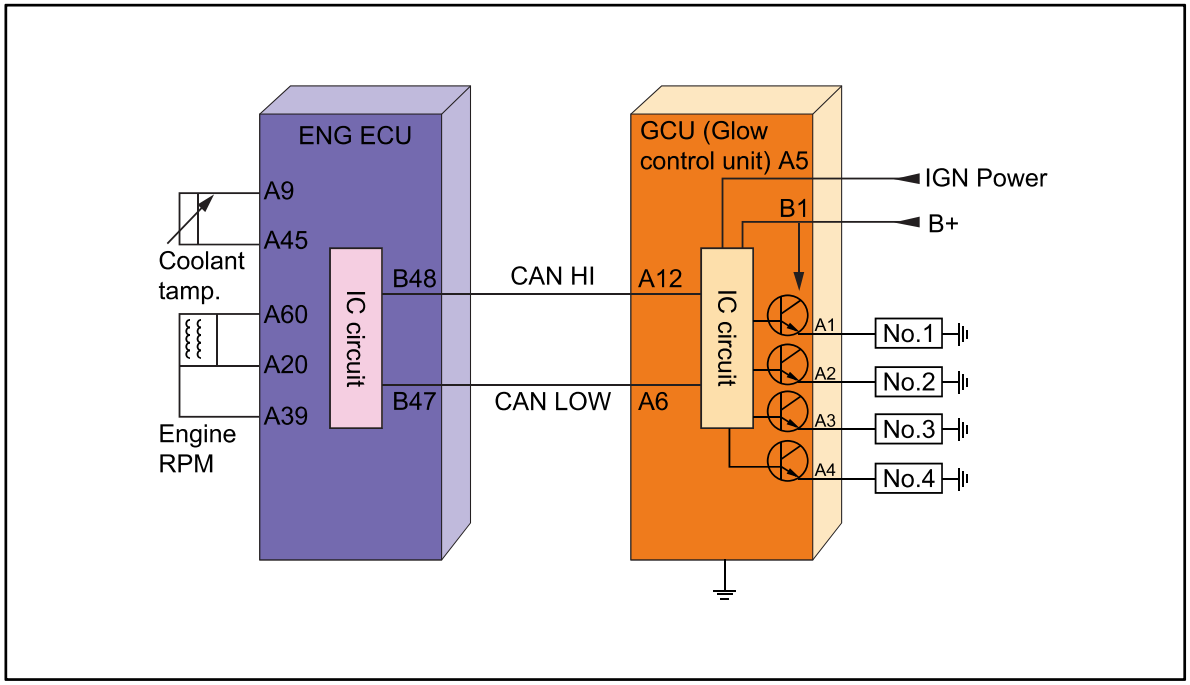
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2. SYSTEM OPERATION

1) Input/Output Diagram of Glow Plug Control Unit



2) System Diagram



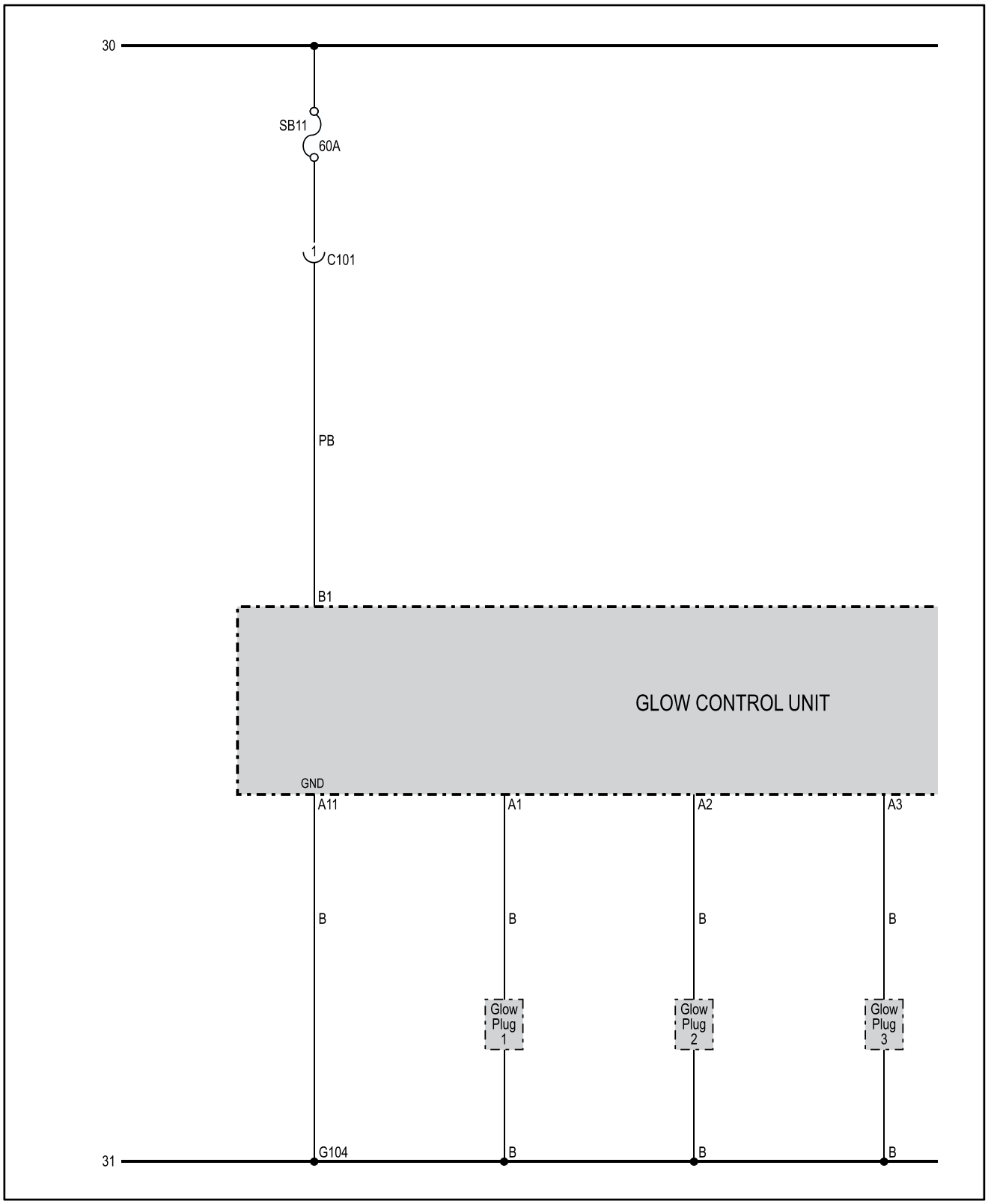
Modification basis	
Application basis	
Affected VIN	

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Memo

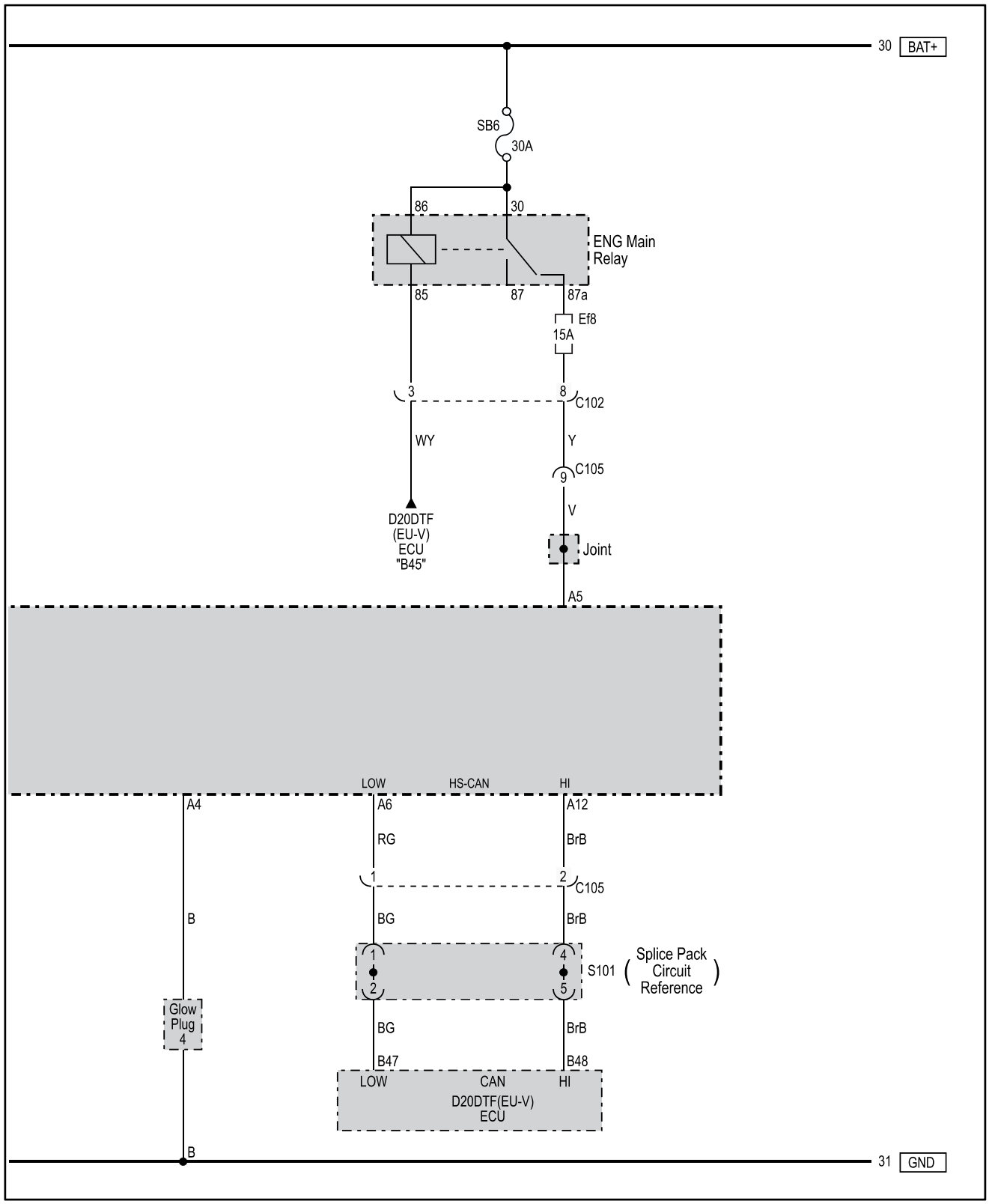
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3) Circuit Diagram



Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
Affected VIN	

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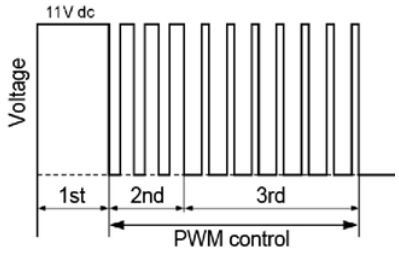
4) System Operation

Glow plug is installed in the cylinder head. It enhances the cold starting performance and reduces the exhaust gas during cold starting.
ECU receives the various signals such as engine rpm, coolant temperature and vehicle speed through CAN communication lines. GCU controls the pre-heating, cranking and post-heating operations and monitors the glow plug. If GCU detects a problem, it sends the result to ECU.

(1) Characteristics of temperature and current in AQGS

1. AQGS unit increases the glow plug temperature very rapidly (1,000˚C in 2 seconds).
2. FET (similar to transistor) for each cylinder in AQGS unit pre-heats the glow plug.
3. If the glow plug temperature reaches to target temperature, the temperature is controlled by duty ratio.

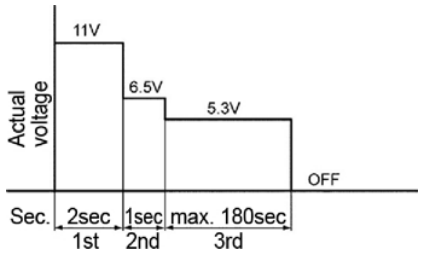
AQGS PWM Control



Frequency: 20~33Hz
PWM Control duty ratio
- 1st step: 100%
- 2nd step: 35%
- 3rd step: 23%

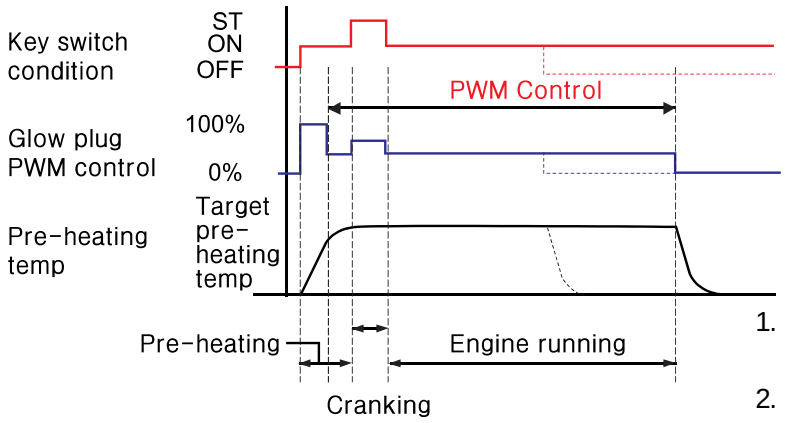
AQGS unit supplies the power to glow plug.

Actual voltage pattern



This shows the voltage and time supplied by AQGS by steps. As shown on the graph, the supplied voltage is decreased as the steps are continued. The 3rd step is to keep the temperature, not to raise it.

(2) Operation of AQGS

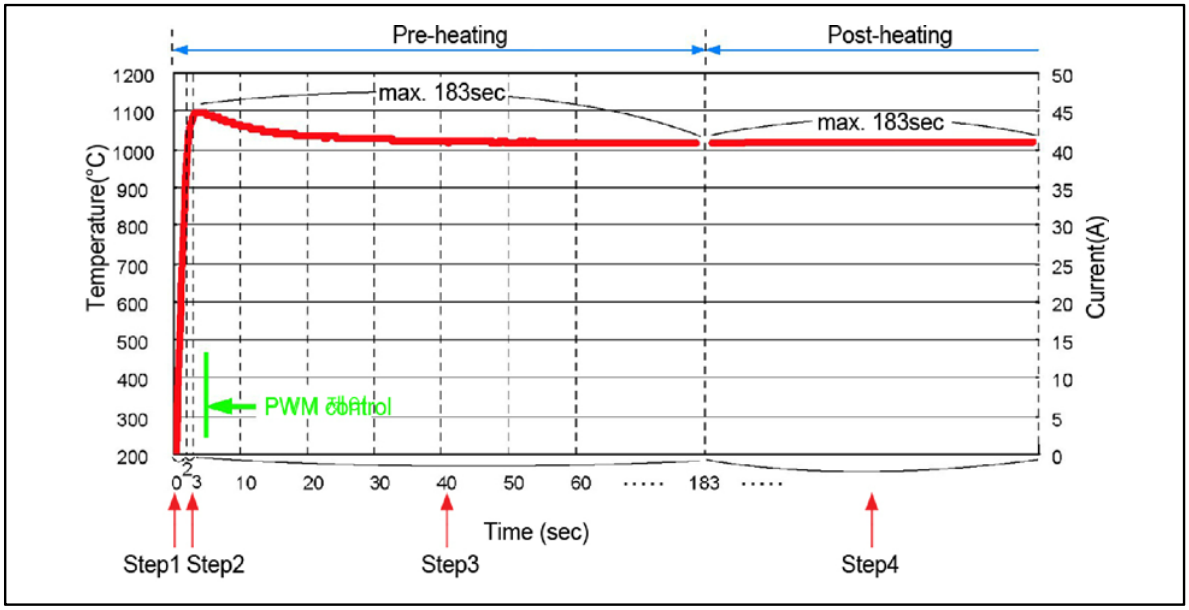


1. Duty control area:
   Between 5 and 100%
2. Frequency: 20 Hz
3. Duty ratio = $\frac{(\text{RMS voltage})^2}{(\text{Battery voltage})^2}$

Modification basis	
Application basis	
Affected VIN	

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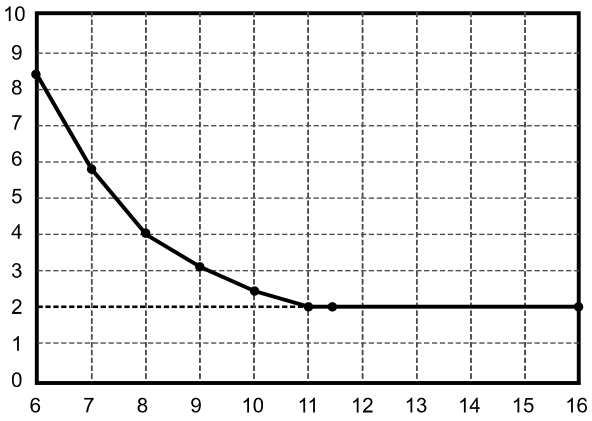
(3) Operating Steps



▶ Pre-Glow: Step 1

If normal communication with the ECU is established 2 seconds after the power is supplied to the IGN terminal from the battery, the GCU supplies the battery power to raise the temperature of the glow plug to 1000℃ by the preheating request from the engine ECU before starting.

- The time for pre-heating is controlled by the ECU.



Input voltage VB (V)	Pre-heating time T1 (sec)
6	8.27
7	5.8
8	4.1
9	3.15
10	2.4
11	1.95
≥ 11.5	1.9

- If the input voltage (VB) is 11.5 V or less, GCU supplies the battery voltage for preheating time (T1). If the input voltage (VB) is greater than 11.5 V, GCU supplies the voltage of 11.5 V for preheating time
- (T1).

NOTE
The preheating time may vary according to the conditions.

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▶ **During cranking: Step 2 and step 3**

1. Step 2: If the ECU receives the cranking signal after pre-heating (step 1), the GCU supplies the voltage of 6.8 V for 1 sec to raise the temperature to 1,100℃.
2. Step 3: The GCU supplies the voltage of 5.1 V to keep the temperature at 1,000°C.
   * Under fixed temperature: The AQGS unit supplies power for 30 seconds (Step 1 + Step 3) if no cranking signal is received after the step 1.
   * During cranking: The step 3 is started after the step 2.

▶ **Post-glow: Step 4:**

The post-heating is for reducing HC/CO after the engine is started. If the time for post-heating exceeds 180 sec., the GCU unit cuts off the power to each glow plug even if there is preheating request from the engine ECU.

▶ **Emergency glow**

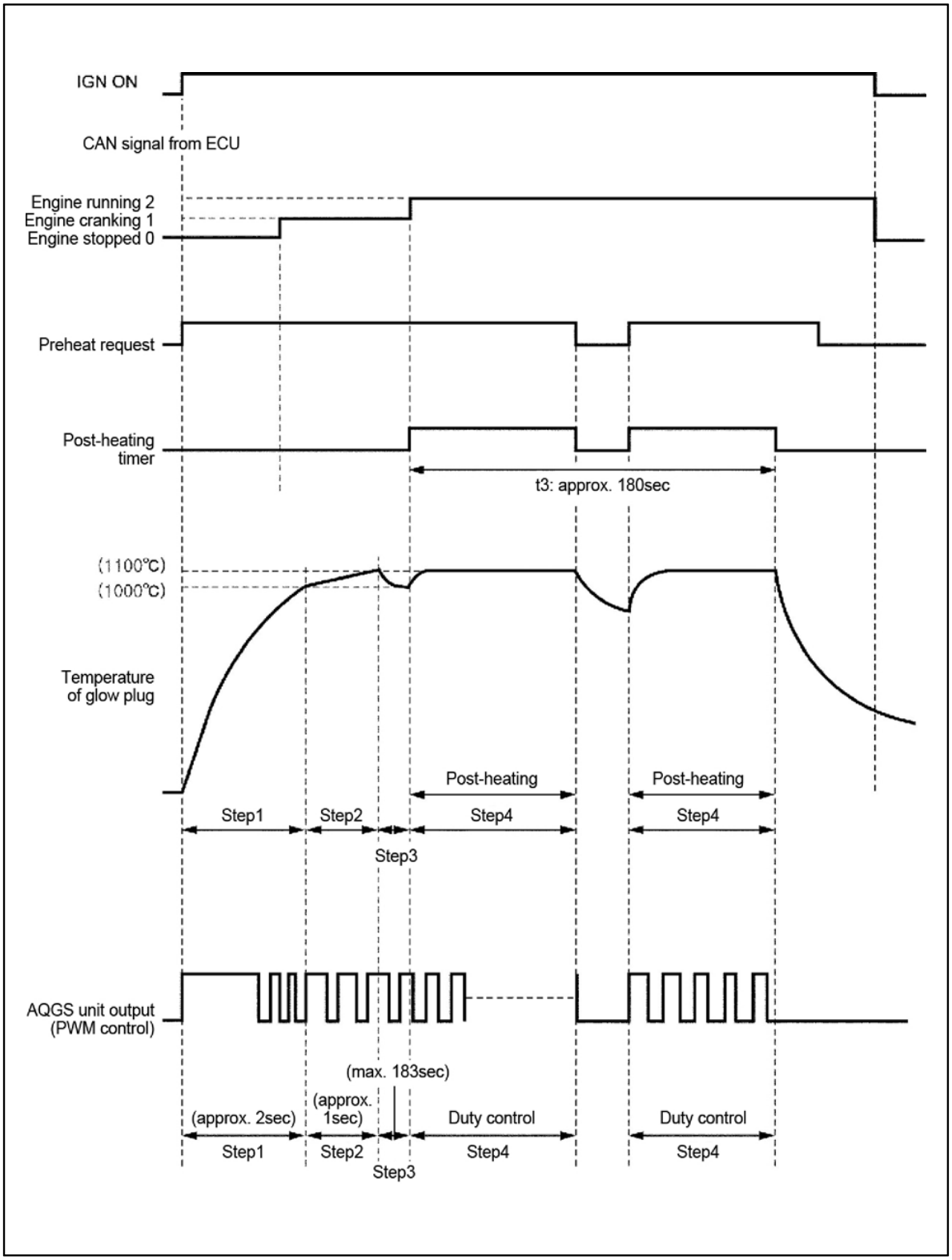
If no CAN signal is received for 4 seconds from the engine ECU after the IGN ON signal is input, the GCU performs emergency preheating (Step 3) for 30 seconds.

Modification basis	
Application basis	
Affected VIN	

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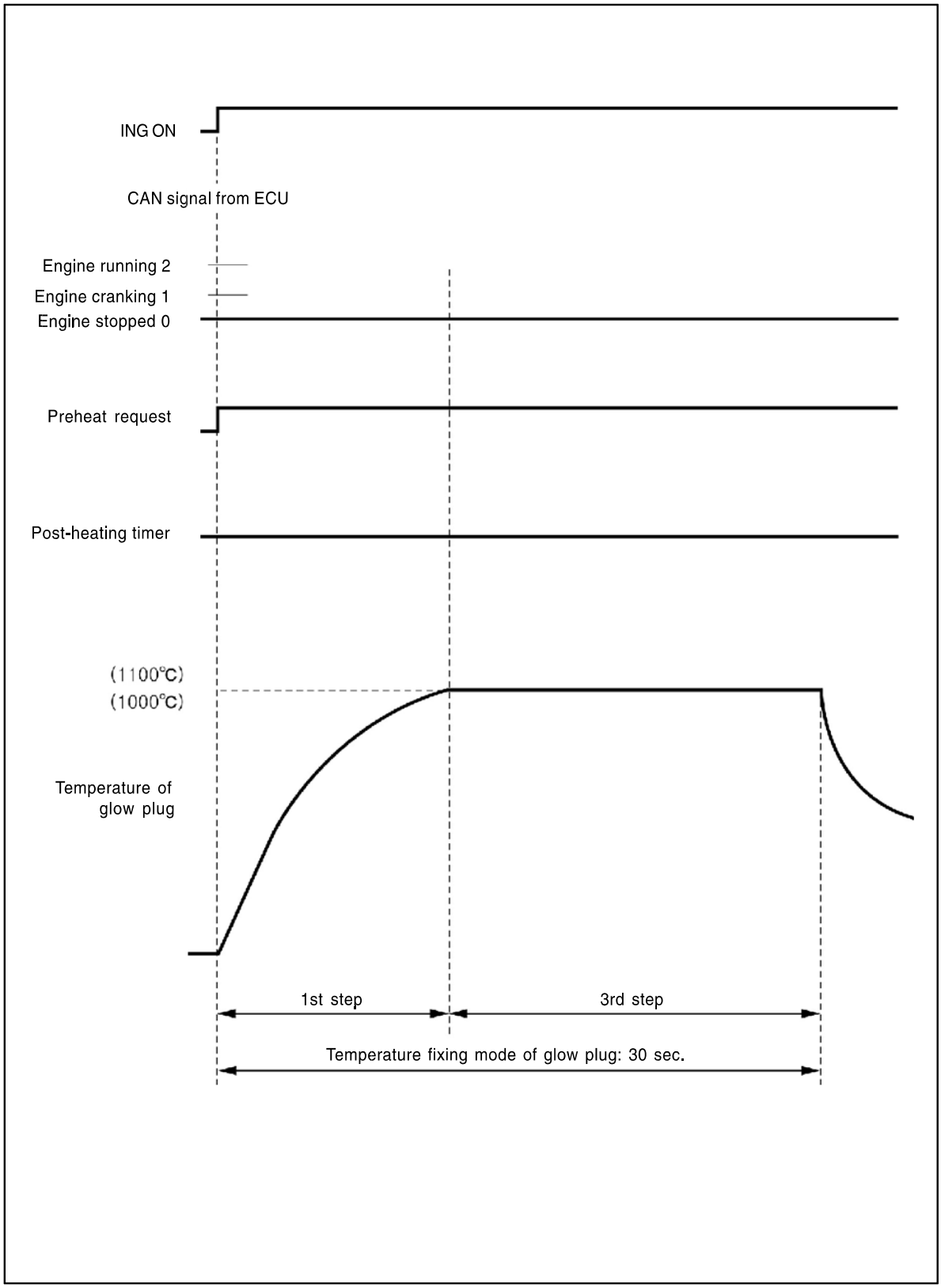
▶ Normal operating mode

This shows the components of preheating system in the pre-heating and the post-heating steps.



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▶ When there is no engine cranking signal after turning the ignition key ON



Modification basis	
Application basis	
Affected VIN	

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STARTING SYSTEM

0000-00

GENERAL INFORMATION

1. SPECIFICATION

Capacity	12V 2.3kW
Engagement	Meshed type
Rotating direction	Clockwise
Pinion gear manufacturing	Cooled forging
Solenoid operating voltage	Max. 8 V
Weight	2.5 kg
Bracket manufacturing	Aluminum die casting

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2. TROUBLESHOOTING

Problem	Possible Cause	Action
Engine will not crank	Low battery voltage	Charge or replace
	Loose, corroded or damaged battery cable	Repair or replace
	Faulty starter or open circuit	
	Faulty ignition switch or blown fuse	Repair or replace
	Poor engine ground	Repair
Engine cranks too slow	Low battery voltage	Charge or replace
	Loose, corroded or damaged battery cable	Repair or replace
	Faulty starter	
Starter does not stop	Faulty starter	
	Faulty ignition switch	Replace
Engine cranks normally, but does not start	Broken pinion gear or faulty starter	Replace the starter
	Broken flywheel ring gear	Replace
	Open circuit	Repair

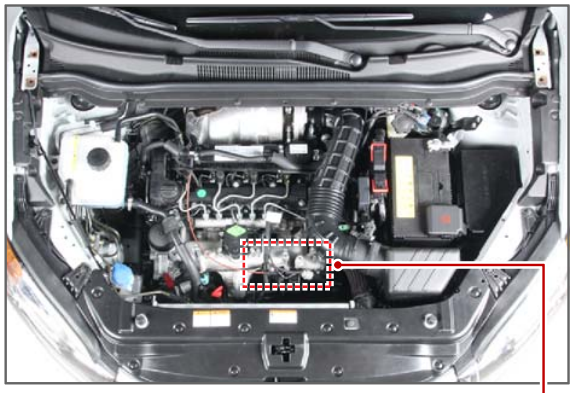
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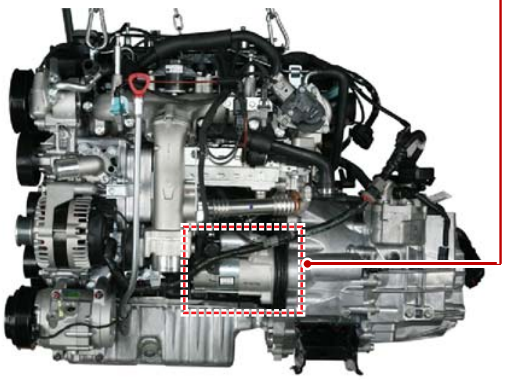
OVERVIEW AND OPERATING PROCESS

1. SYSTEM DESCRIPTION

The starter (start motor) starts the engine with rotational power by converting the electric energy to the mechanical energy.
When the engine is cranking, the pinion gear meshes with the ring gear. If the ring gear overruns, the pinion gear clutch overruns to protect the pinion gear.

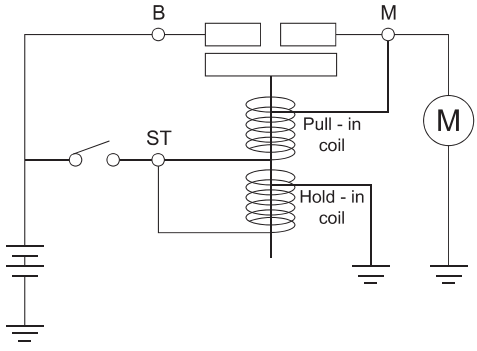
▶ System Configuration





Start motor assembly





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2. OPERATING PROCESS

1) System Layout

(1) Engine start

1. SKM performs the authentication process for the SMART key and sends the engine start request to EMS if there is a normally coded SMART key when pressing the Engine Start/Stop button with the brake pedal depressed and gear shift lever in "P" or "N" position.
2. SKM sends the start request signal to PCAN network and the cranking request to BCAN network by "SMART key location" signal when receiving the engine start signal by Engine Start/Stop button.
3. SKM turns off the IGN2/ACC relay during cranking to shut down the electric loads.
4. SKM receives the starting status signal from EMS throug PCAN.
5. After cranking, SKM turns on the ACC/IGN2 relay and sends the power status signal of "IGN after started" through BCAN.
6. EMS starts to crank the engine after checking the pre-heating condition if it receives the engine cranking request 1 when pressing the Engine Start/Stop button. EMS starts to crank the engine immediately if it receives the engine cranking request 2 when pressing the Engine Start/Stop button.

   - Engine cranking request 1: when pressing the Engine Start/Stop button shortly in normal conditions
   - Engine cranking request 2: when pressing the Engine Start/Stop button again after first press or when pressing the Engine Start/Stp button for more than 3 seconds

7. Engine start during driving
   - When pressing the Engine Start/Stop button with IGN ON, the engine start is requested if the vehicle speed is less than 10 km/h or no signal, the gear shift lever is in 'N" position and the brake switch is ON (no need authentication for 30 seconds).
   - When pressing the Engine Start/Stop button with IGN ON, the engine start is requested regardless of brake signal if the vehicle speed is over 10 km/h and the gear shift lever is in ' position (no need authentication for 30 seconds).

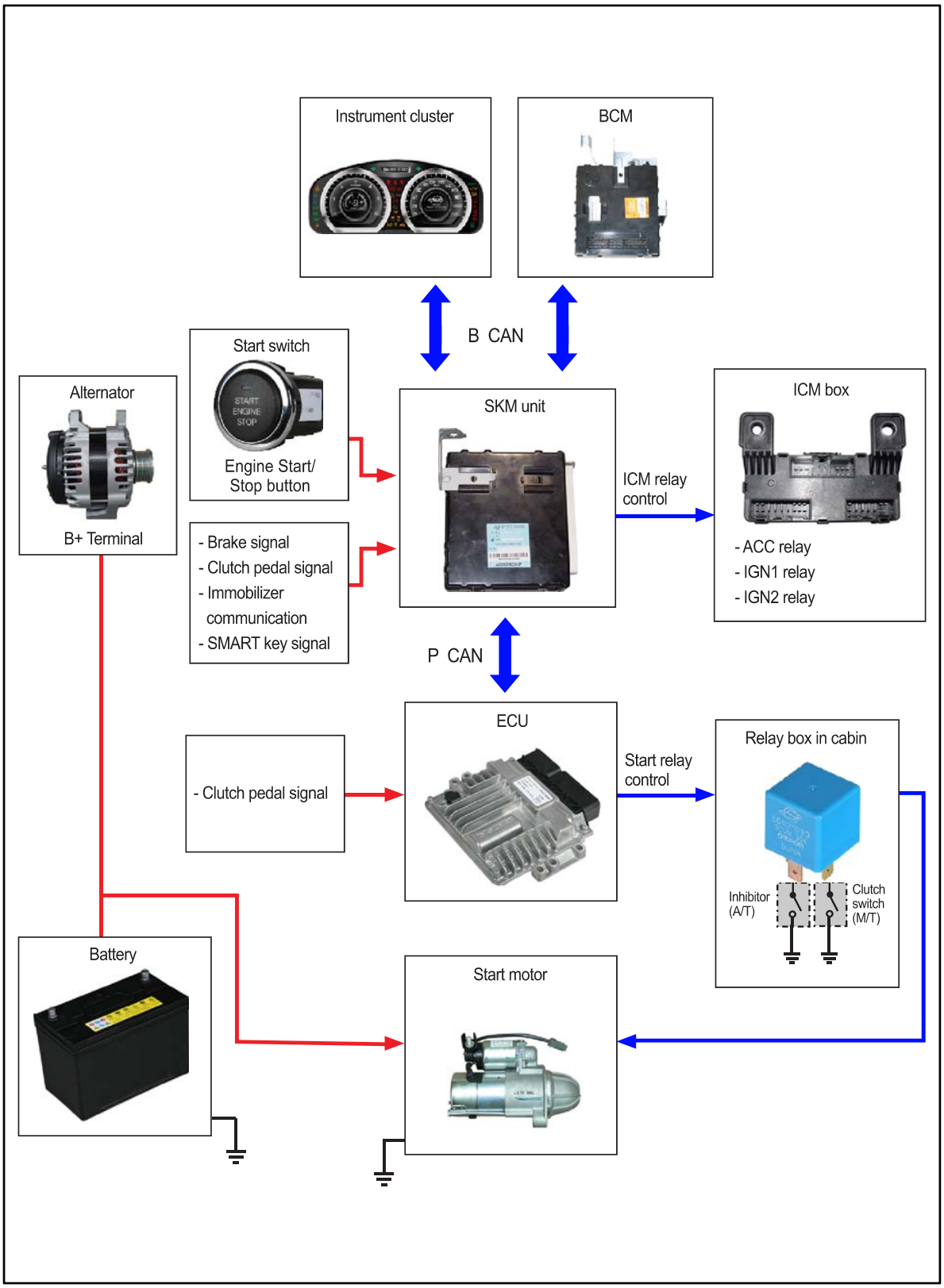
   * Except input of brake switch signal

   - In vehicle equipped with A/T, when pressing the Engine Start/Stop button for more than 10 seconds with ACC ON, the engine start is requested regardless of brake signal if the gear shift lever is in "P" or 'N" position in IGN ON.

Modification basis	
Application basis	
Affected VIN	

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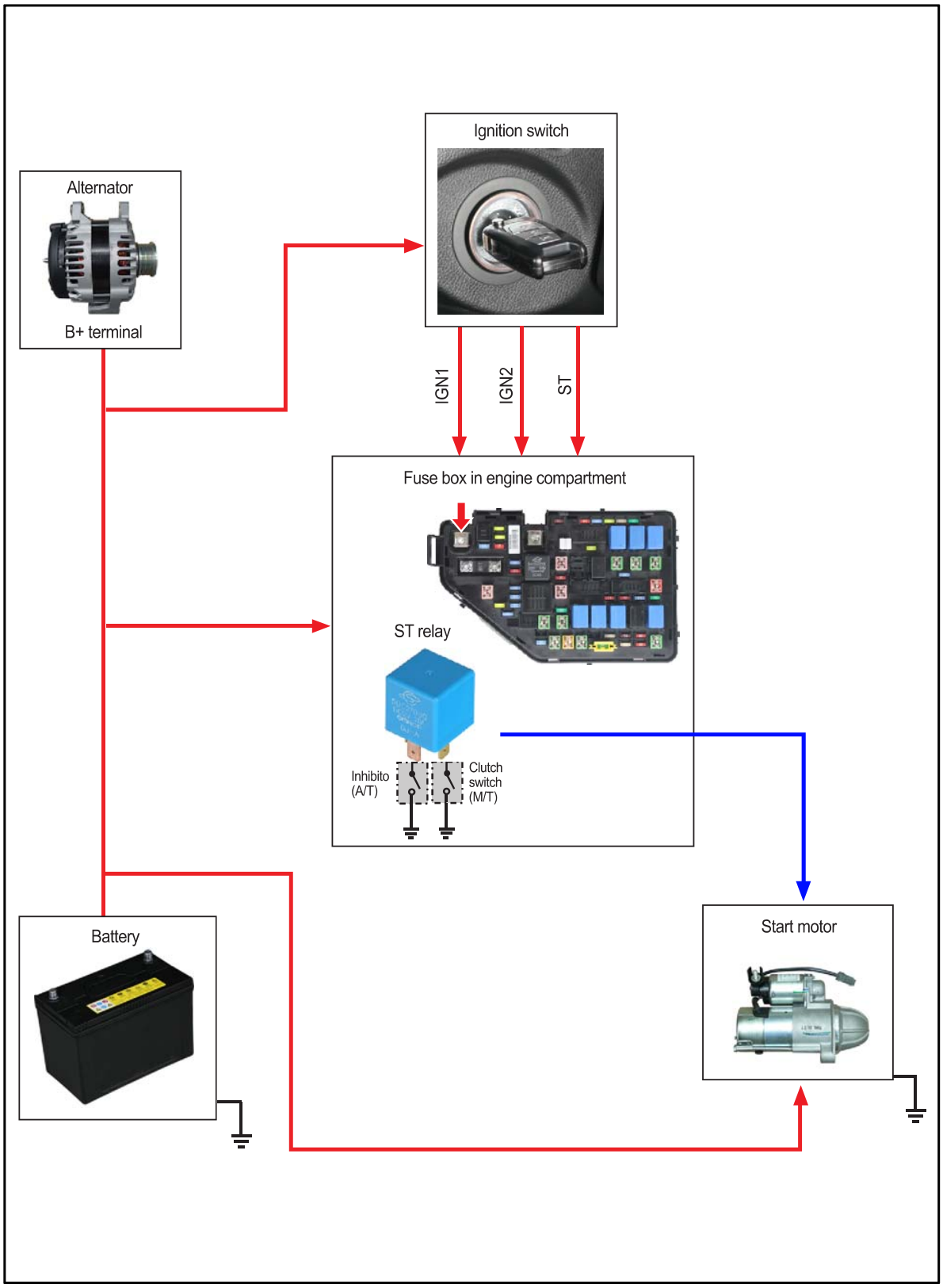
(2) With SMART key system



Modification basis	
Application basis	
Affected VIN	

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(3) Without SMART key system



Modification basis	
Application basis	
Affected VIN	

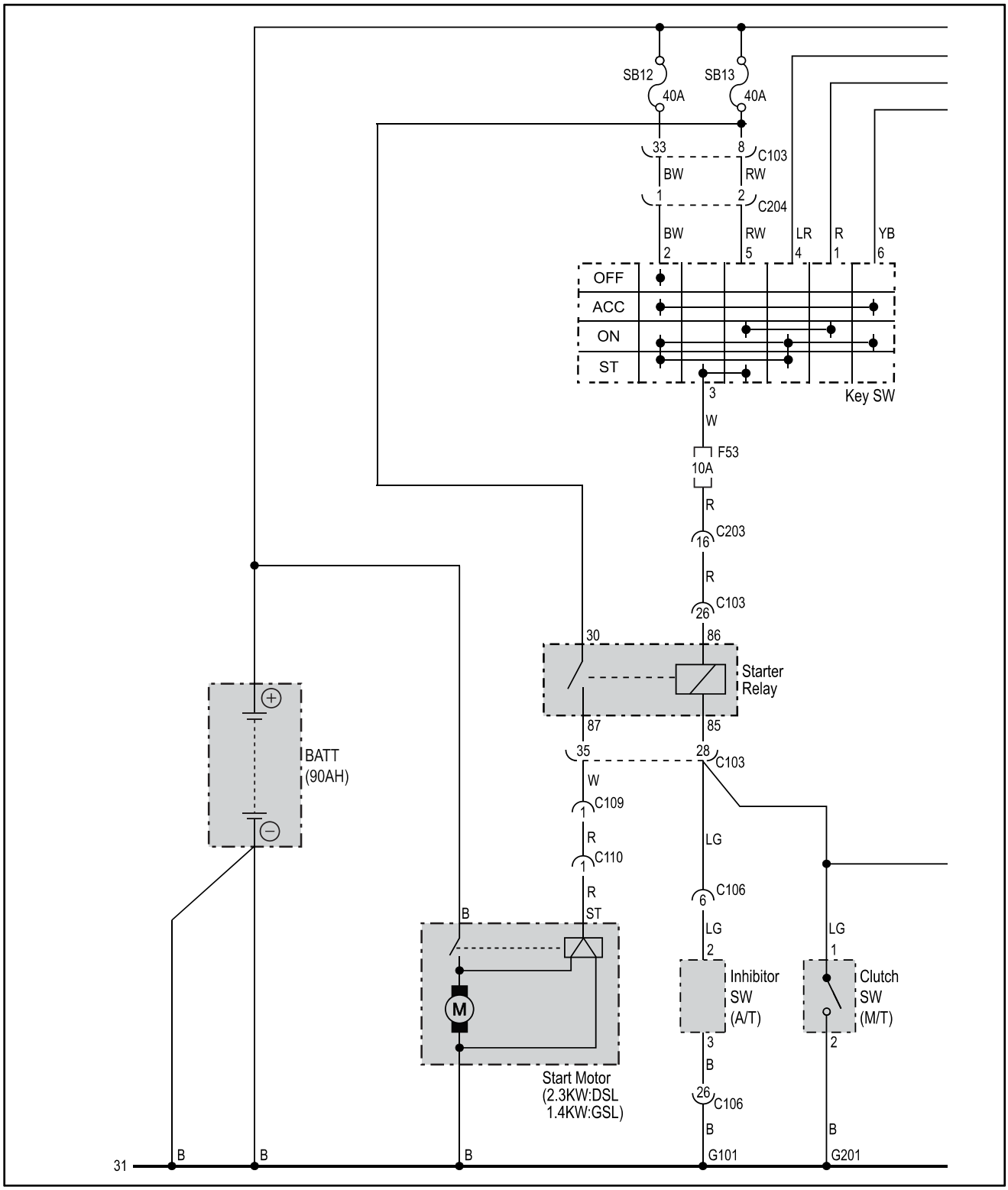
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Memo

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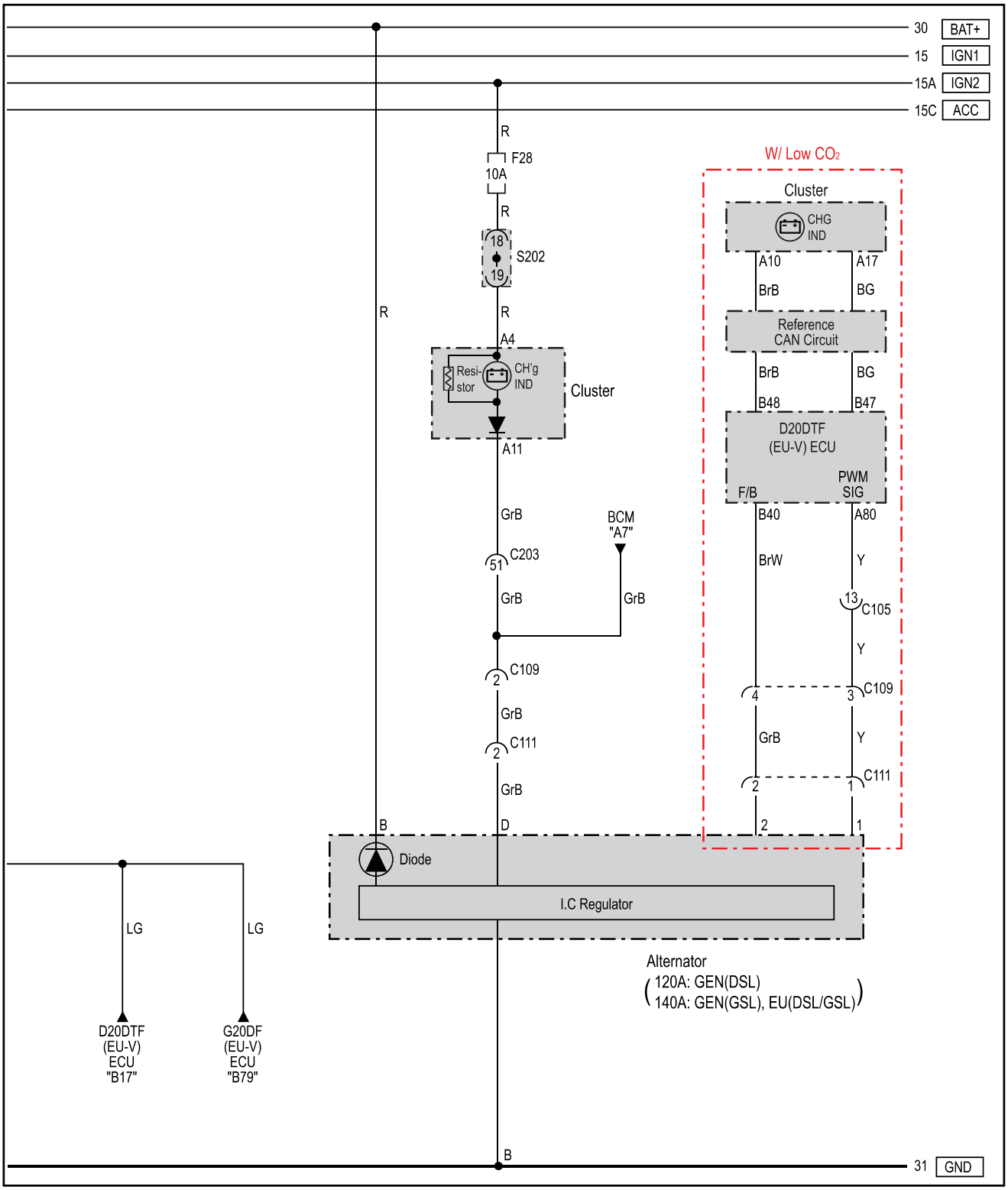
2) Circuit Diagram

(1) With SMART key system



Modification basis	
Application basis	
Affected VIN	

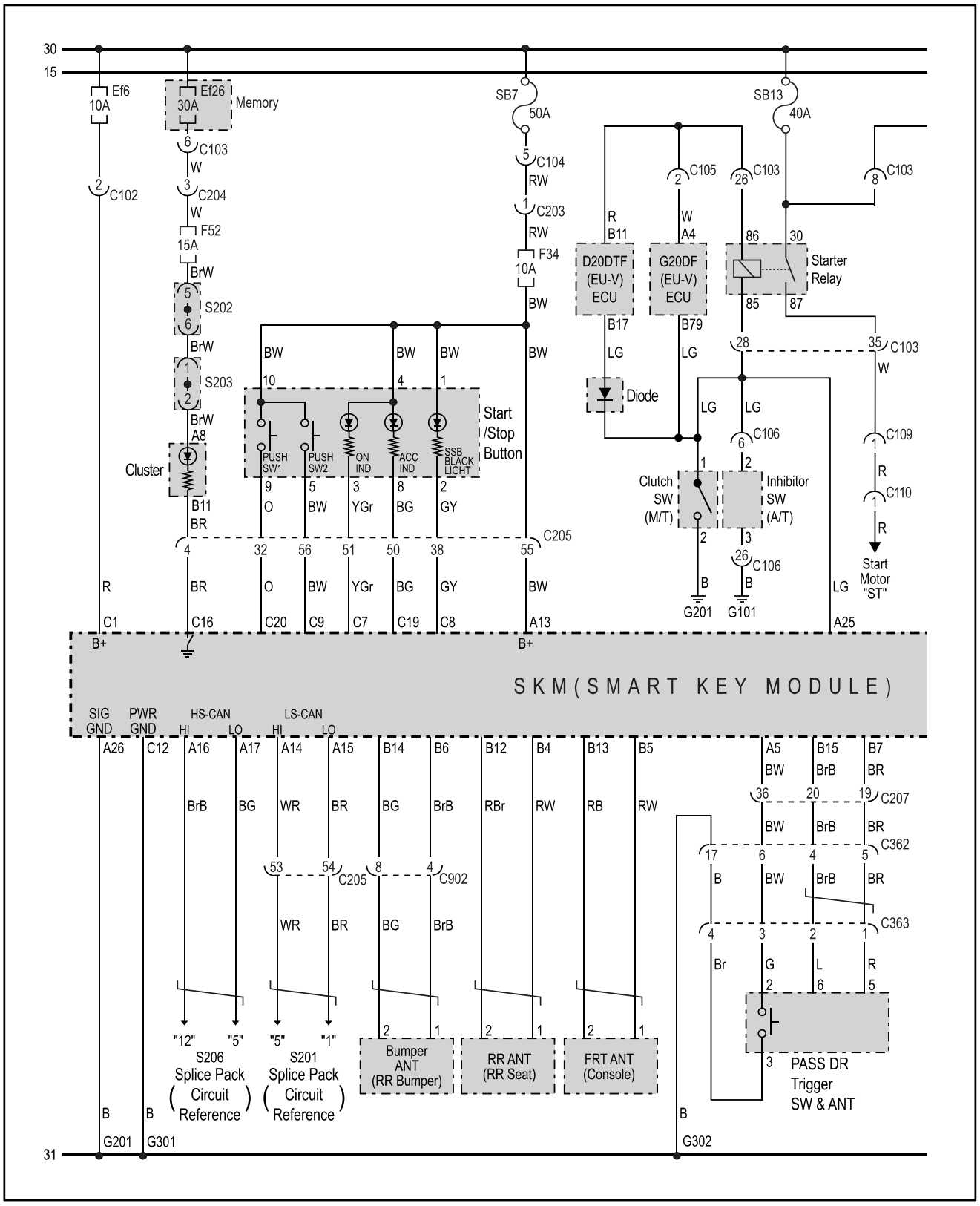
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Modification basis	
Application basis	
Affected VIN	

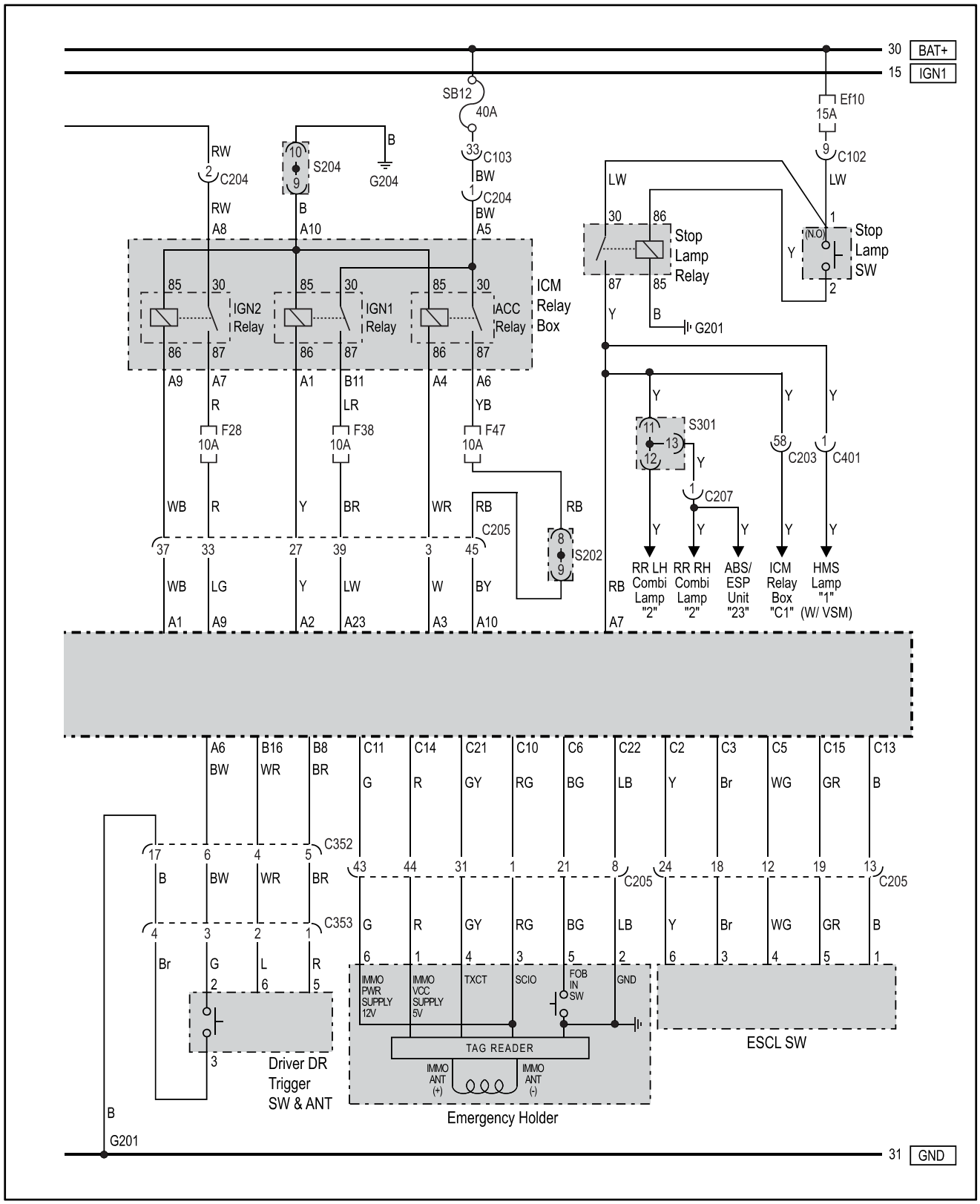
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(2) Without SMART key system



Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
Affected VIN	

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CRUISE CONTROL

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

1) System Description



The cruise control is an automatic speed control system that maintains a desired driving speed without using the accelerator pedal. The cruise control switch is under the right side of steering wheel and 'ECO" indicator or "AUTO CRUISE" indicator comes on according to the working conditions. The vehicle speed must be greater than 38 km/h to engage the cruise control. This feature is especially useful for motorway driving.

CAUTION

The cruise control system is a supplementary system, which helps the driver to drive the vehicle at a desired speed without using the accelerator pedal under the traffic condition where the vehicle-to-vehicle distance meets the legal requirement.

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2) Traffic Conditions for Using Cruise Control

Use the cruise control system only when the traffic is not jammed, driving on motorways or highways where there is no sudden change in the driving condition due to traffic lights, pedestrian, etc.

WARNING

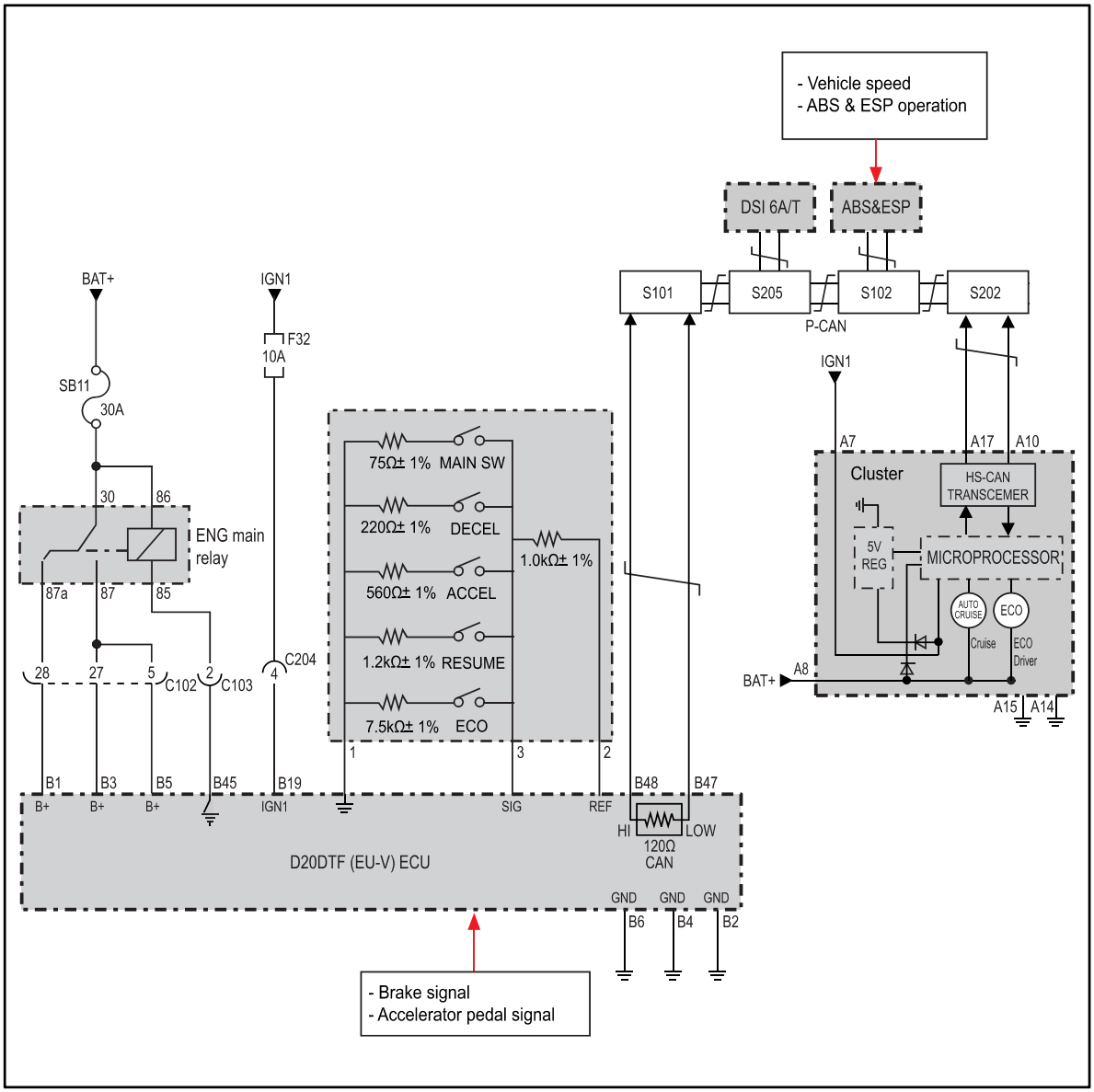
Improper use of the cruise control could be dangerous.

- Do not use on winding roadsyy .
- Do not use in heavy traffic.
- Do not use on slippery, wet roads.
  This could result in a loss of control, collision, and/or personal injuries.

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2. CONFIGURATION

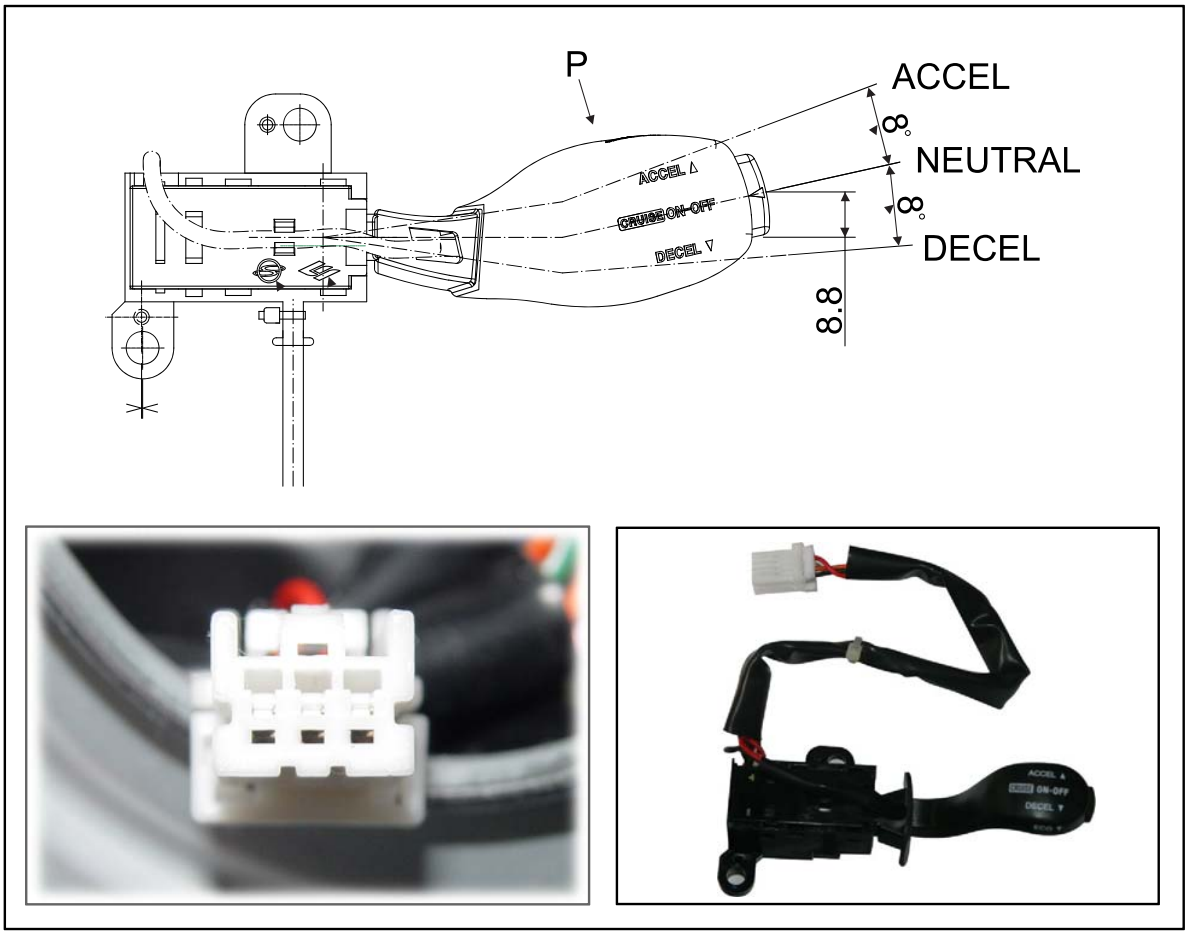
1) Circuit Diagram



The engine ECU detects the operating conditions of cruise control system, and monitors the braking performance, vehicle speed, road conditions and ESP system operation. If the engine ECU determines that there are not any problem to drive in cruise control mode, the vehicle can be operated by cruise switch signals (decelerating, accelerating, cruising).

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2) Components



Test voltage(VCC 5V)

FUNCTION	KEY VOLUE	REMARK
MAIN	0.15 ~ 0.55V	-
DECEL	0.7 ~ 1.1V	-
ACCEL	1.6 ~ 2.0V	-
RESUME	2.52 ~ 2.92V	-
ECO	4.22 ~ 4.82V	-

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3. OPERATION

1) Setting a Desired Speed



1. To operate the cruise control, accelerate to the desired speed, which must be more than 38 km/h (24 MPH) and less than 150 km/h (90 MPH). In the vehicle equipped with manual transaxle, the gear shift lever should be in 3rd (GSL: 2nd) or higher gear position.
2. Diesel engine equipped vehicle: When the desired speed is reached, press CRUISE ON (3) switch of cruise control lever.
   Gasoline engine equipped vehicle: When the desired speed is reached, press CRUISE ON (3) switch of cruise control lever. The system is readyreadyreadyready to activate the cruise control function. To activate the cruise control function, push up (1) the ACCEL switch of the cruise control lever.
   Now, the vehicle is cruised by this system with the set speed.
3. And you can set to other vehicle speeds again with above steps after an accelerator pedal
4. intervention during the cruise control running.

CAUTION

Never use the cruise control system until you get used to it.
Improper use or not fully aware of this function could result in collision and/or personal injuries.

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2) Accelerating with the Cruise Control System



(1) While the cruise control system is running

1. Push up the ACCEL switch of the cruise control lever and hold it until the desired speed is reached without an accelerator pedal intervention.
2. When the desired speed is reached, release the lever.

(2) While the cruise control system is not running

1. Accelerate using the accelerator pedal over 38 km/h.
2. Push up the ACCEL switch of the cruise control lever and hold it.
3. And then release the accelerator pedal slowly.
4. When the desired speed is reached, release the lever.

(3) Tap-up while the cruise control system is running

1. Push up the ACCEL switch of the cruise control lever less than 0.5 second per one switching while the cruise control system is running. This is a tap-up switching.
2. When you operate a tap-up switching, the vehicle is accelerated by 1.0 km/h over the previous set speed.
3. If you want to accelerate to 10 km/h, operate the tap-up switching ten times without accelerating with the cruise control system.

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3) Decelerating with the Cruise Control System



(1) While the cruise control system is running

1. Push down the DECEL switch of the cruise control lever and hold it until the desired speed is reached without a brake pedal intervention. But the cruise control system cannot maintain the cruise function at less than 38 km/h.
2. When the desired speed is reached, release the lever.

(2) When the cruise control system is not running

1. Push down the DECEL switch of the cruise control lever and hold it.
2. And then release the accelerator pedal slowly.
3. When the desired speed is reached, release the lever. But the cruise control system cannot maintain the cruise function at less than 38 km/h.
4. When you push down the cruise control switch, "RESUME" function starts (GSL only).

(3) Tap-down while the cruise control system is running

1. Push down the DECEL switch of the cruise control lever less than 0.5 second per one switching while the cruise control system is running. This is a tap-down switching.
2. When you operate a tap-down switching, the vehicle is decelerated by 1 km/h below the previous set speed.
3. If you want to decelerate to 10 km/h, operate the tap-down switching ten times without the brake pedal intervention.

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4) Recovery of Set Speed (RESUME)



Even if the cruise control is cancelled, the previous set cruise speed can be recovered by pulling up the cruise control lever when the current vehicle speed is over 38 km/h without an acceleration intervention. But if you turn off the ignition switch, the memorized set speed is cleared and you cannot recover the previous set speed.

CAUTION

The resume position should only be used if the driver is fully aware of this speed and wishes to resume this particular speed.

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5) ECO Cruise Control



ECO cruise is ready and ECO cruise indicator on the instrument cluster comes on when pushing down the cruise control lever. To activate the ECO cruise mode, push down the cruise control lever again. To cancel the ECO cruise mode while in operation, push down the cruise control lever again. The ECO cruise mode is canceled and the indicator goes out.

What is ECO Cruise mode?

In this mode, the smooth acceleration to the set cruise speed can be achieved by optimized fuel consumption.

Control lever	ECO indicator	
	ON	Blinking
Push down the lever	O	
Push down it again		O

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6) Normal Cancellation of the Cruise Control



The cruise control system will be canceled when one or more items of the following conditions are applied;

1. When the brake pedal is depressed.
2. When the cruising speed is decreased less than 38 km/h.
3. When pushing the ON-OFF switch of the cruise control lever.
4. When ESP is activated.
5. When applying the parking brake while driving.
6. When using the clutch in order to shift (M/T only).
7. To cancel the cruise control function, pull the cruise switch toward you. (GSL only).

And the cruise control system can be operated again in driving state.

CAUTION

Keep the main cruise control switch in the neutral position when not using the cruise control.

Modification basis	
Application basis	
Affected VIN	

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(1) Abnormal Cancellation of the Cruise Control

1. When the rapid deceleration is applied without braking.
2. When the rapid acceleration is applied without acceleration pedal intervention (DSL only).
3. When the cruise control lever is failed (DSL only).
4. When the brake switch and the brake light switch input signal are implausible.

And the cruise control system cannot be operated again in driving state. In this case, you should stop the vehicle, and turn off the ignition switch and then turn it on again. After you do that, you can use the cruise control system again. But if the cruise control system isn't recovered, you should contact a Ssangyong Dealer for diagnosis of the cruise control system.

CAUTION

1. Abnormal changes of the gear selector lever can damage the yyengine. Do not move the gear shift lever to Neutral while driving at the set speed. Automatic transaxle damage may result.
   The speed that has been set may not be maintained on uphill or yydownhill slopes.
2. The speed may drop to less than the set speed on a steep uphill yygrade. The accelerator must be
3. used if you want to maintain that speed.
   The speed may increase to more than the set speed on a steep yydownhill grade. When the speed
4. increases too much, turn off the cruise control.

(2) Using the Cruise Control on Hills

How well the cruise control works on hills depends on the speed, load, and the steepness of the hill. When going up steep hills, you may have to depress the accelerator pedal to maintain your speed. When going downhill, you may have to brake or shift to a lower gear to keep your speed down. Applying the brake takes you out of the cruise control.

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E-EGR SYSTEM

0000-00

GENERAL INFORMATION

1. SPECIFICATION

Item			
E-EGR valve	Motor	EGR response time	50 mS
		Driven by	DC motor
	Valve	EGR gas flow rate	120 Kg/h
	Position sensor	Sensing type	Hall sensor
		Supply voltage	5V ± 10%
		Signal range	5% ~ 95%
		Max. current consumption	< 15mA
E-EGR cooler		Cooling capacity	8.3 kW or more
		Coolin fin type	Wavy fin
		Coller type	U-shaped
E-EGR bypass valve	Solenoid valve	Drivien by	Vacuum (Solenoid valve)

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OVERVIEW AND OPERATING PROCESS

1. SYSTEM DESCRIPTION

1) Overview

The EGR (Electric-Exhaust Gas Recirculation) valve reduces the NOx emission level by recirculating some of the exhaust gas to the intake system.
To meet Euro-V regulation, the capacity and response rate of E-EGR valve in D20DTF engine have been greatly improved. The EGR cooler with high capacity reduces the Nox, and the bypass valve reduces the CO and HC due to EGR gas before warming up.
Also, the engine ECU adjusts the E-EGR opening by using the air mass signal through HFM sensor. If the exhaust gas gets into the intake manifold when the EGR valve is open, the amount of fresh air through HFM sensor should be decreased.

▶ **Benefits of E-EGR valve**

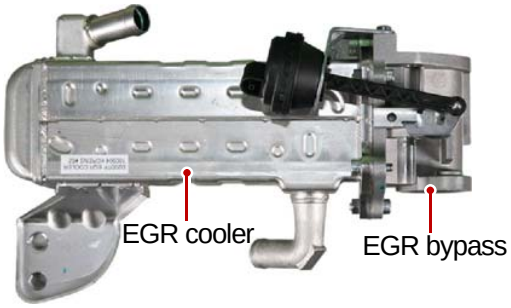
- Improved accuracy and response through electric control
- Feedback function (Potentiometer)
- Preventing chattering of EGR valve and improved durability
- Self-cleaning function

Modification basis	
Application basis	
Affected VIN	

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2) Location and Components

E-EGR cooler and bypass valve

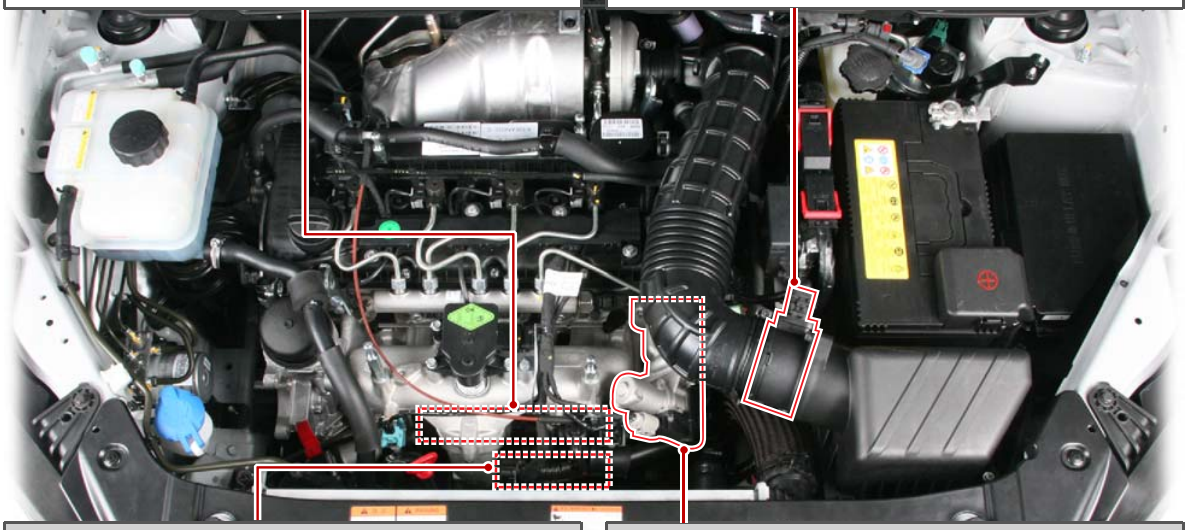


The cooler lowers the high temperature of the exhaust gas and the bypass valve directly supplies the exhaust gas to the intake duct without passing through the EGR cooler to reduce the emission of exhaust gas before warming up the engine.

HFM sensor



Used as a main map value to control the EGR. The coolant temperature, engine rpm, engine load, intake air temperature (HFM: decreased at 60˚C or more), atmospheric pressure (atmospheric pressure sensor: altitude compensation) are used as auxiliary map values.



EGR pipe



Transports the exhaust gas from the EGR cooler and EGR bypass valve to the intake duct.

E-EGR valve

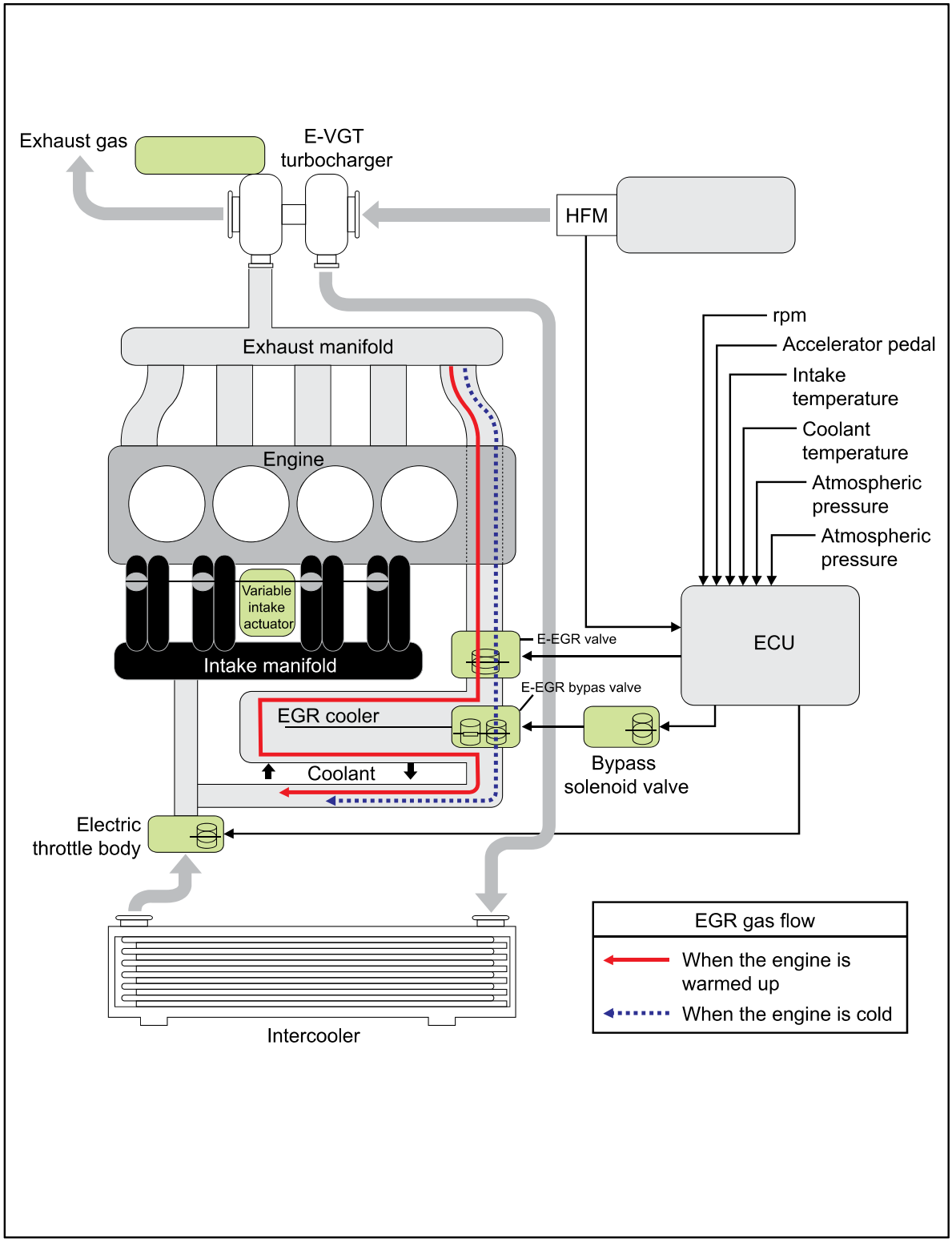


Receives the electric signal from the ECU to control the valve.

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2. OPERATING PROCESS

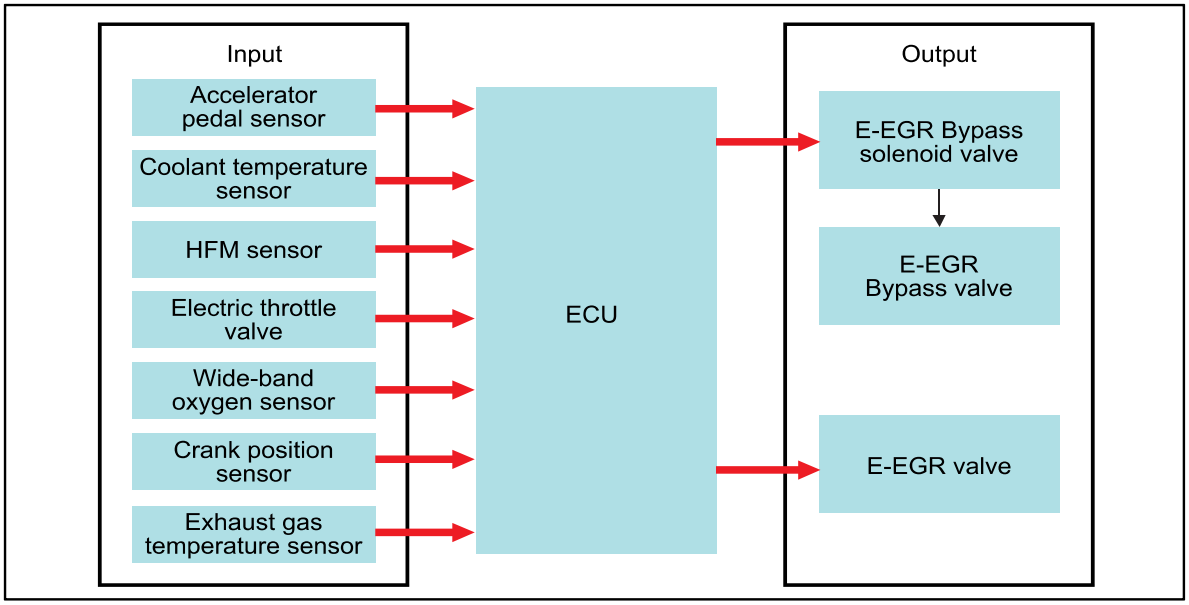
1) Schematic Diagram



Modification basis	
Application basis	
Affected VIN	

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2) Input/Output Devices



3) Control Logic

The EGR system controls the EGR amount based on the map values shown below:

※ Main map value: Intake air volume
※ Auxiliary map value:
- Compensation by the coolant temperature
- Compensation by the atmospheric pressure: Altitude compensation
- Compensation by the boost pressure deviation (the difference between the requested value and the measured value of boost pressure)
- Compensation by the engine load: During sudden acceleration
- Compensation by the intake air temperature

The engine ECU calculates the EGR amount by adding main map value (intake air volume) and auxiliary map value and directly drives the solenoid valve in the E-EGR to regulate the opening extent of the EGR valve and sends the feedback to the potentiometer.

(1) Operating conditions

- Intake air temperature: between −10 and 50℃
- Atmospheric pressure: 0.92 bar or more
- Engine coolant temperature: between 0 and 100°C
- When there is no fault code related to EGR

(2) Shut off conditions

- Abrupt acceleration: with engine speed of 2600 rpm or more
- When the engine is idling for more than 1 minute
- Vehicle speed: 100 km/h or more
- Engine torque: 380 Nm or more

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CDPF SYSTEM

0000-00

GENERAL INFORMATION

1. SPECIFICATION

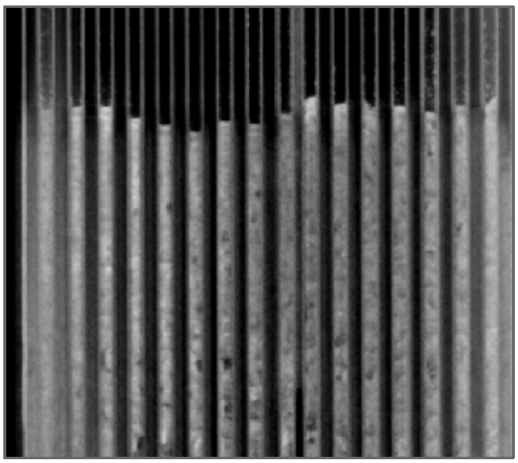
Emission Regulation		Euro-V
Front Area		182.41cm
Size	DOC	124 X 158 X 78L
	DPF	124 X 158 X 194L
CDPF Canister	Shell	SUS430J1L X 1.5t
	End Cone	SUS430J1L X 2.0t (Single)
CDPF	Catalyst Capacity	4.2L
	Material of Filter	AT (Aluminum-Titanium Alloy)

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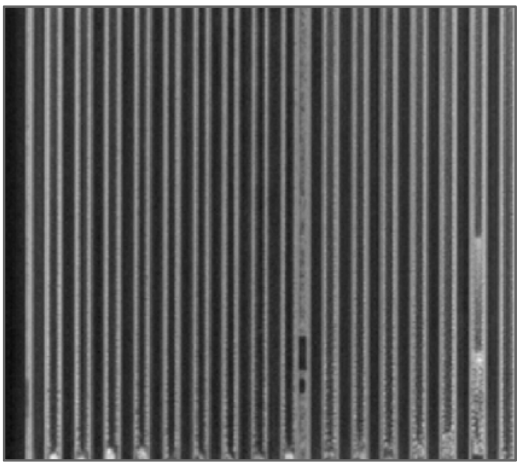
2. CAUTIONS

▶ **Standard pattern of soot accumulation**

(1) Abnormal Soot Accumulation



(2) Normal Soot Combustion



▶ **Cautions to protect the catalyst filter**

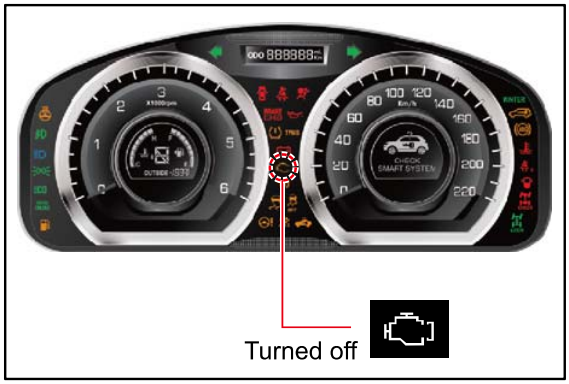
- Use the designated fuel only.
- Observe the recommended service intervals of engine oil.
- Check the engine oil level frequently and add if necessary.
- Do not idle the vehicle unnecessarily.
- Do not turn off the engine while the vehicle is running.
- Do not shift the gear selector lever to neutral when going downhill.
- Do not use improper engine oil or fuel additives.
- Do not drive for a long time when the warning lamp is illuminated.
- Make sure no flammable material, such as dry grass or tissue paper, contacts with the catalyst filter while the vehicle is parked.
- For the vehicles used in urban traffic, driving on the expressways for more than 1 hour at least once per week is needed so that the PM inside CDPF isn't collected to one side only.

Modification basis	
Application basis	
Affected VIN	

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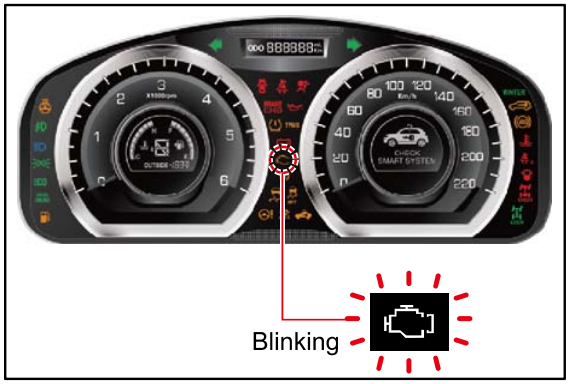
(3) Warning Lamp Related to CDPF

▶ CDPF regeneration process (warning lamp NOT illuminated)



The CDPF system enters the regeneration mode when the driving distance becomes approx. 600 to 1,200 km (may differ by the driving condition and driving style). Then, the engine ECU performs the CDPF regeneration operation. However, the driver is not informed with this operation by any engine warning lamp or vehicle signal, so he/she may not detect this operation. The control logic at the post-injection dur-ing the regeneration process is to increase the fuel injection volume and control the intake air volume (by the throttle body) in order to increase the temperature of the exhaust gas. The driver may not feel any particular difference from the vehicle.

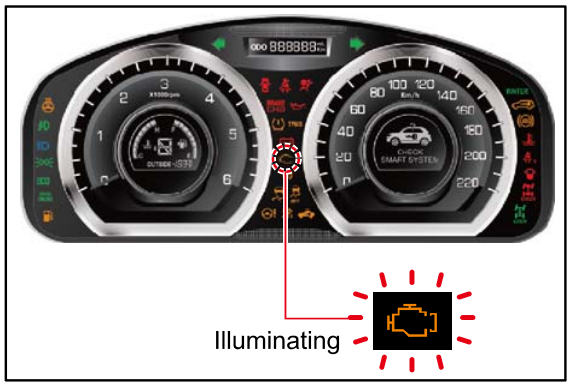
▶ Overload of CDPF (warning lamp blinking)



1. If the CDPF cannot reach the regeneration temperature due to low speed driving or other reason during the regeneration process, the soot is continuously accumulated in the CDPF. When this condition continues and the CDPF is overloaded with soot, the engine warning lamp blinks to inform this situation to the driver.
   In order to solve this problem, drive the
2. vehicle at a speed of approx. 80 km/h for 15 to 20 minutes to perform the CDPF regeneration process.
   If the engine warning lamp on the instrument
3. cluster blinks, the CDPF is overloaded. In this case, perform the step 2.

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▶ Excessive overload of CDPF (warning lamp illuminated)



1. If the vehicle is driven at a speed of 5 to 10 km/h for an extended period of time, the soot accumulated in the CDPF cannot be burned as the CDPF cannot reach the regeneration temperature. Then, an excessive amount of soot can be accumulated in the CDPF.
   This case is much worse than the simple over-
2. load of the CDPF. To inform this to the driver, the engine warning lamp comes on and the engine power is decreased to protect the system.
   To solve this problem, blow soot between the
3. engine and exhaust system several times and erase the related DTC. Then, check if the same DTC is regenerated again. If so, check the DTC related to the differential pressure sensor.

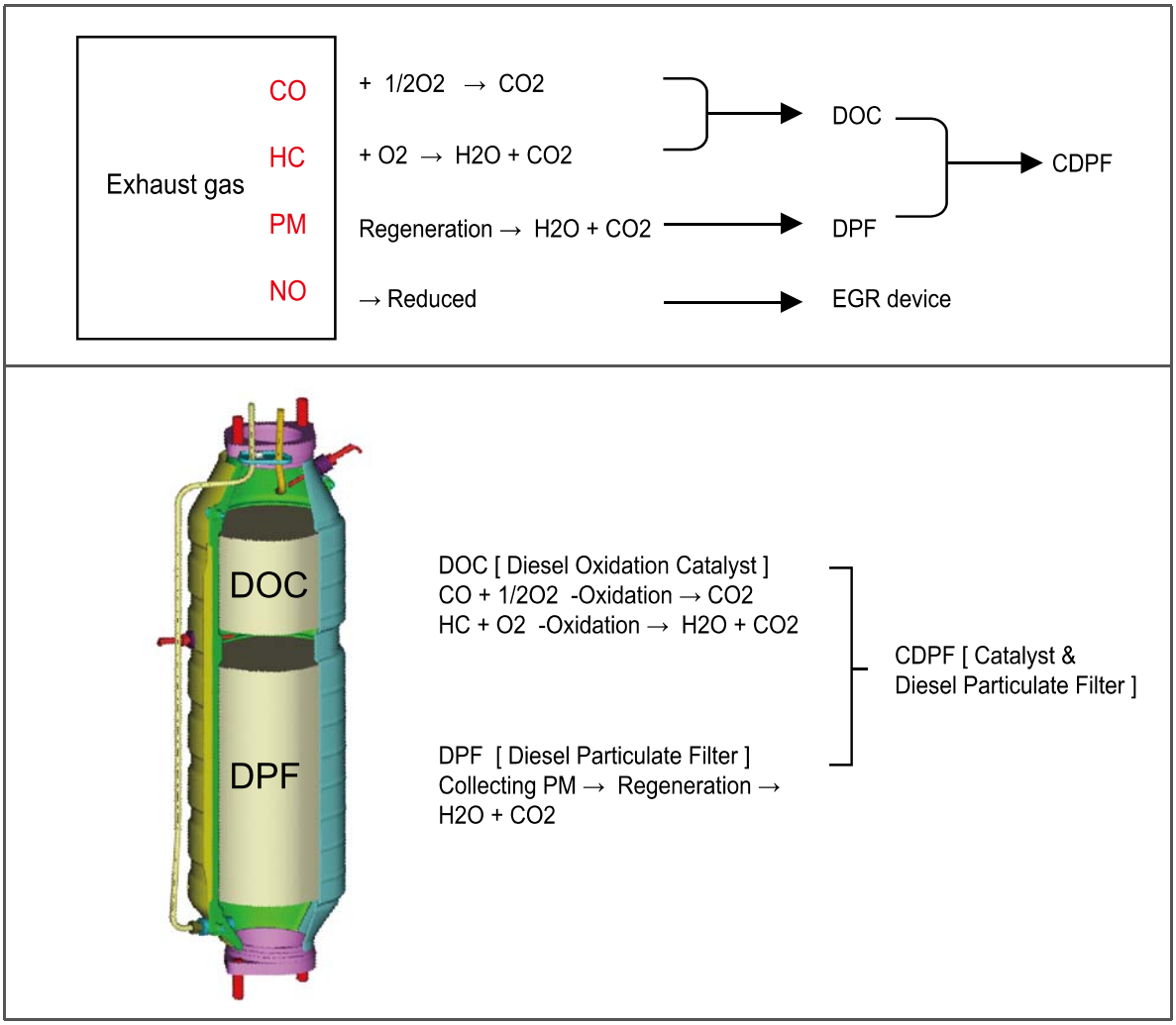
Modification basis	
Application basis	
Affected VIN	

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The DOC (Diesel Oxidation Catalyst) generates CO2 and H2O which are harmless through the oxidation process of CO and HC. And the DPF (Diesel Particulate Filter) collects PM (Particle Matter) and is regenerated to reduce the quantity of particulates, HC and CO. But there is a limitation in reducing the emission of exhaust gas for each system, so the CDPF which combines these two system is applied.



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2. COMPONENT

Rear temperature sensor



Measures the temperature of fuel combustion.

CDPF (DOC + DPF)



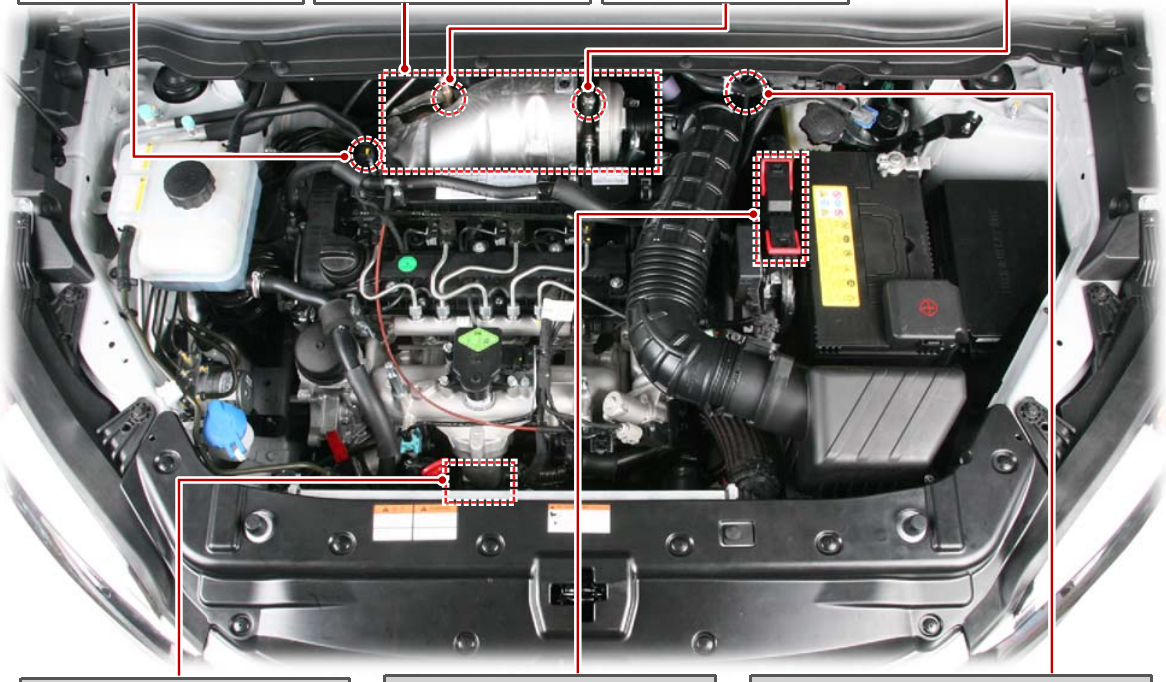
Oxygen sensor



Front temperature sensor



Protects the turbocharger.



Electric throttle body



Regulates the rate of air intake.

Engine ECU (D20DTF)



Post-injection

Differential pressure sensor

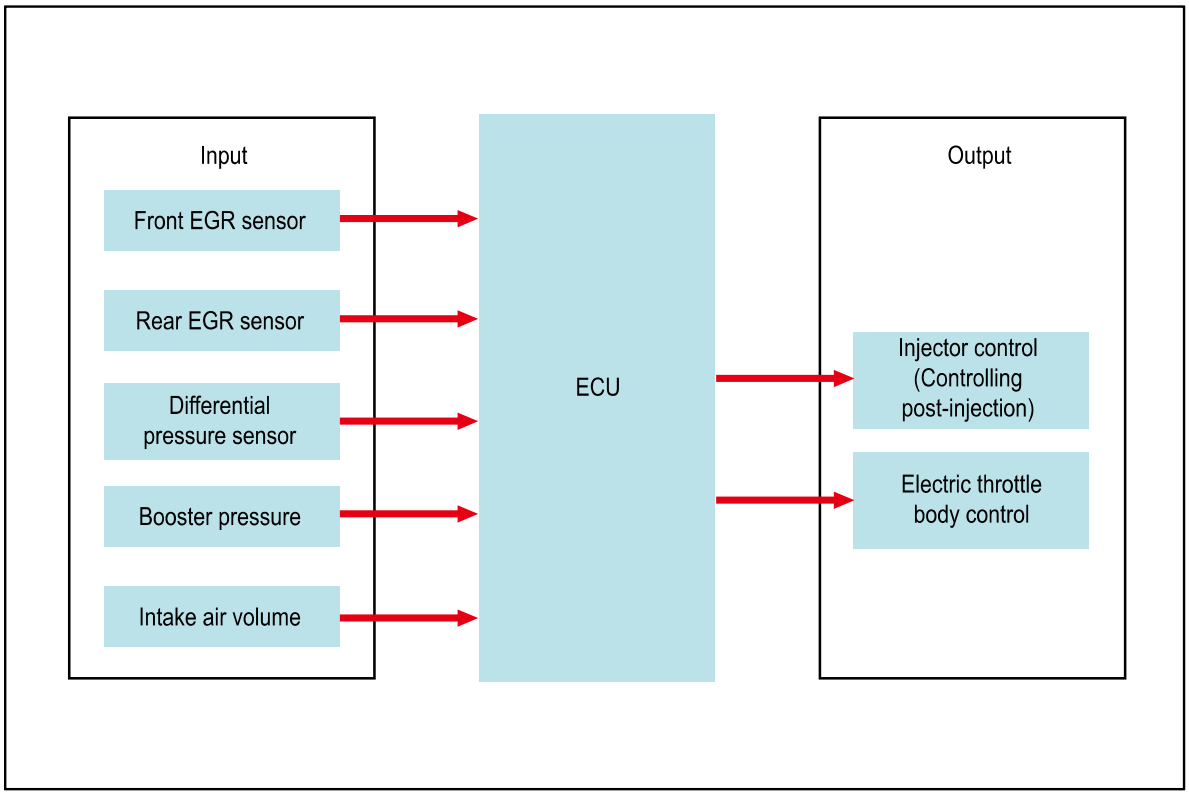


Calculates the amount of PM collected by reading the pressure difference between before and after the CDPF.

Modification basis	
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3. INPUT/OUTPUT DEVICES



1. Front temperature sensor: This sensor is installed at the inlet of DOC and detects whether the DOC can burn (oxidize) the post-injected fuel or not.
2. Rear temperature sensor: This sensor is installed at the inlet of DPF and monitors that the temperature of the exhaust gas is kept at 600℃.

- If the temperature exceeds 600℃, the life of CDPF can be reduced. So the amount of fuel post-injection is decreased.
- If the temperature drops under 600℃, the rate of regeneration can be decreased. So the amount of fuel post-injection is increased.

3. Differential pressure sensor: This sensor checks the amount of PM collected by calculating the pressure difference between before and after the CDPF.
4. Electric throttle valve: This valve reduces the intake air flow to raise the temperature of the exhaust gas when the CDPF is operating during idling.

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4. POST-INJECTION AND AIR MASS CONTROL

A DPS (Differential Pressure Sensor) measures the pressure difference between before and after the CDPF and detects whether the soot is collected in the CDPF or not. If PM is collected in the CDPF (In this case the pressure difference between before and after the CDPF exceeds the specified value. Normally, the system sends the signal when the driving distance becomes approx. 600 to 1,200 km), the temperature of exhaust gas is increased and the post-injection is started for regeneration. The amount of fuel post-injection is controlled by the exhaust gas temperature measured by the rear temperature sensor. If the temperature is less than 600℃, the amount of post-injection is increased to increase the regeneration temperature. Otherwise, the fuel injection amount is decreased or the fuel is not injected.

When the engine is running with low load, the intake air amount is also controlled as well as fuel injection amount. This function is used to increaser the combustion temperature by increasing the amount of fuel post-injection with the lowest air amount within the specified control logic.

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Front EGT sensor



Measures the temperature of DOC.

The DOC performs the redox reaction at between 300 and 500℃ and the front EGT sensor monitors the temperature of DOC.

HFM sensor

Intake air volume

Rear EGT sensor



Measures the temperature of DPF.

The DPF burns the soot with hot exhaust gases (regeneration) at around 600℃ and the rear EGT sensor monitors the temperature of DPF.

ECU (DCM 3.7)



Differential pressure sensor



Measures the pressure values of before and after the CDPF.

The pressure difference between before and after the CDPF is measured by the differential pressure sensor (If PM is collected in the CDPF, the pressure difference between before and after the CDPF exceeds the specified value).

Detecting excess of PM amount limit

Injector (C3I)



Controls the post-injection.

Boost pressure/ temperature

Electric throttle body



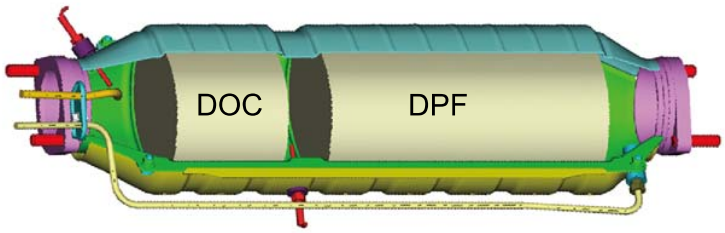
Controls the intake air volume.

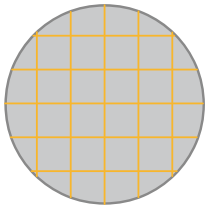
T-MAP sensor

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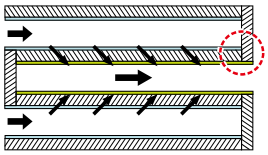
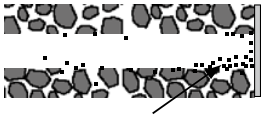
5. OPERATING PROCESS

[Configuration and principle of operation]





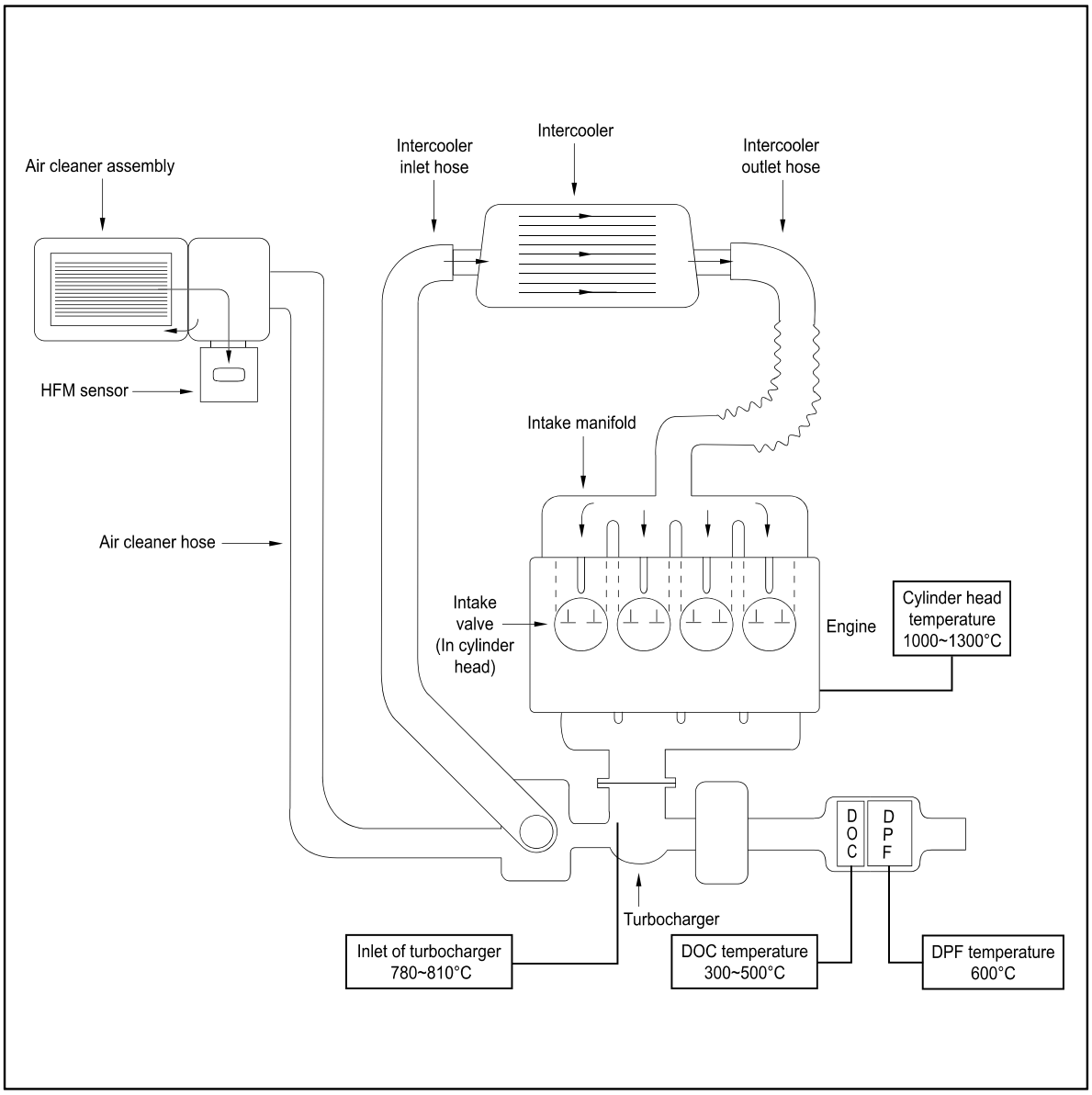
The exhaust gas passed through the exhaust manifold enters into the CDPF assembly (at approx 250℃).

Oxidation (DOC)	Collecting PM → Regeneration
	
When the exhaust gas enters into the CDPF assembly, its CO, HC and PM are reduced by the redox reaction of the DOC. The remaining PM is filtered and collected in CDPF, and the temperature of the exhaust gas is increased to between 450 and 500°C.	The engine ECU detects the amount of PM collected by the information from the temperature sensors and differential pressure sensor. When the soot is accumulated, the engine ECU performs post-injection to increase the exhaust gas temperature and burns the collected PM at approx. 600°C.

Modification basis	
Application basis	
Affected VIN	

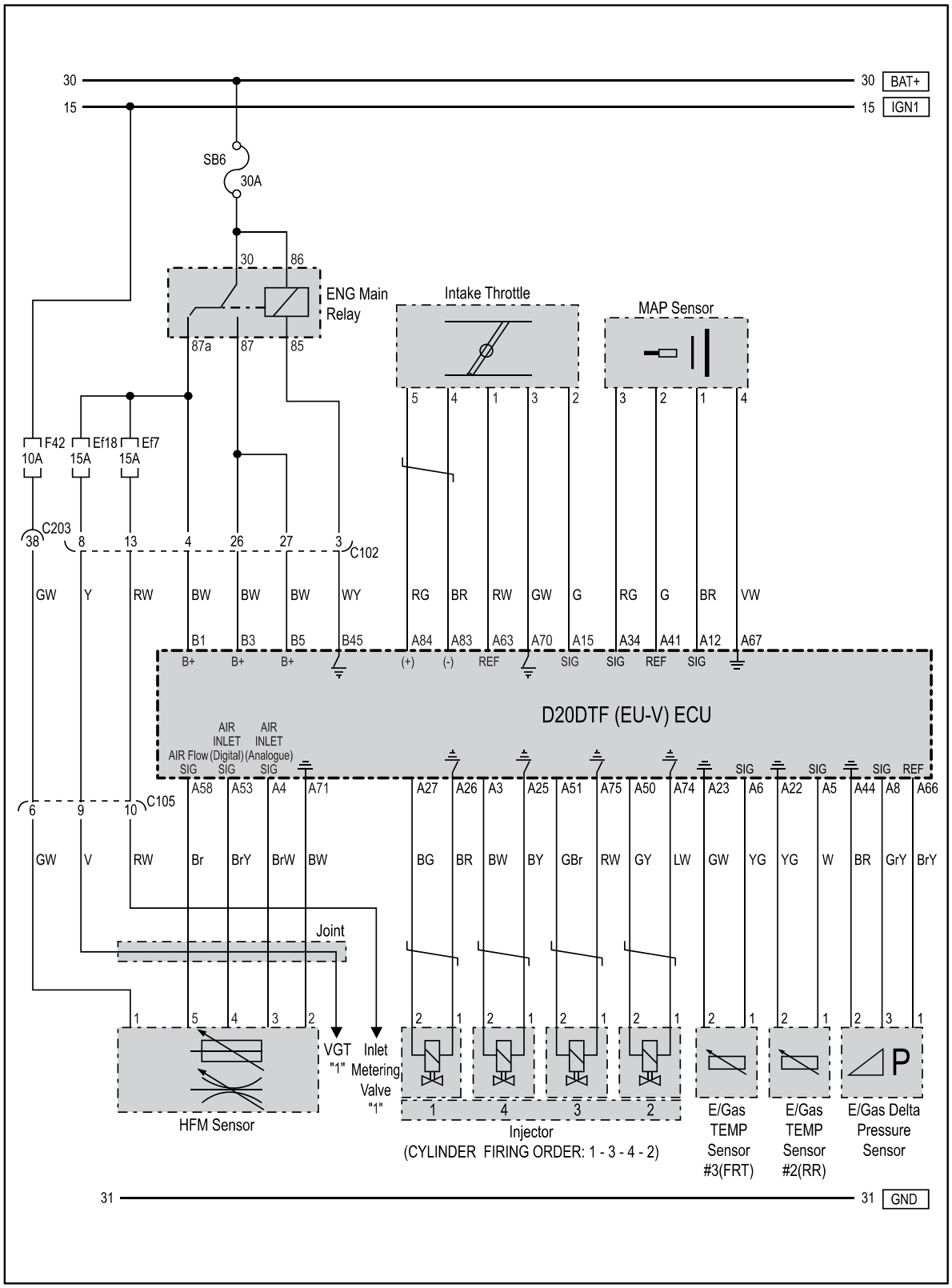
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6. OPERATING TEMPERATURE



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7. ELECTRIC CIRCUIT DIAGRAM



Modification basis	
Application basis	
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8. CAUTIONS

1) Designated Engine Oil for CDPF (Low Ash Oil)

1. Need to use the designated engine oil for CDPF
   - The smoke from the vehicle may generate the particle material in the ambient air. CDPF is the device to reduce the smoke by collecting and recycling it. To ensure the performance of CDPF, the designated engine oil should be used.
   - The smoke including combusted sulfur in fuel cannot be recycled in CDPF. This smoke generates the ash, resulting in clogging the filter.
2. Advantages when using the designated engine oil for CDPF
   - Reduces the amount of ash
   - Improves the fuel economy and reduces the CO2
   - Increases the life span of engine oil
   - Available for all engines (diesel and gasoline)
3. Problems when using non-designated engine oil for CDPF
   - Decreases the life span of engine oil due to accumulated ash in DPF (around 30%)
   - Decreases the fuel economy due to friction resistance, exhaust gas resistance and frequent recycling process of DPF

> **CAUTION**
> The fule containing high sulfur may cause the same problems.

2) Do Not Use the Fuel Containing High Sulfur

1. Producing white smoke during recycling
   - The sulfur in exhaust gas is changed to sulfate gas during exhaust process. This sulfate gas is shown as white smoke.
2. Producing odor during recycling
   - The sulfur after oxidation may produce the odor.
3. Accumulation of ash
   - The sulfur accumulated in DPF cannot be recycled. It reduces the life span of DPF.

3) White Smoke

The white smoke can be generated when the exhaust gas is recycled in DPF. There are two reasons as below.

1. Saturated vapor
2. Sulfate

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9. DESCRIPTION ON CDPF REGENERATION

No.	Sensor item	Data	Unit	Description
1	Driven distance from last CDPF regeneration	0	km	Driven distance from last generation up to now
2	CDPF regeneration history (distance/time) Index	0	-	Display regeneration history (distance/time) stored until now in figure, Index ([0] ~ [4])
3	Driven distance between CDPF regenerations[0]	0	km	The regeneration distance/time is stored up to the last 5 events in sequence and the oldest one will be deleted if the number of events is exceeded 5 times. The currently displayed index value indicates where the regeneration information will be stored in the future and the just previous value shows the last regeneration information. Ex) Index value: 3 (last regeneration information stored at 2) 
4	Driven distance between CDPF regenerations[1]	0	km	
5	Driven distance between CDPF regenerations[2]	0	km	
6	Driven distance between CDPF regenerations[3]	0	km	
7	Driven distance between CDPF regenerations[4]	0	km	
8	CDPF regeneration time[0]	0.0	S	
9	CDPF regeneration time[2]	0.0	S	
10	CDPF regeneration time[2]	0.0	S	
11	CDPF regeneration time[3]	0.0	S	
12	CDPF regeneration time[4]	0.0	S	
13	CDPF regeneration history (OK/Fail) Index	0	-	Display regeneration history (OK/Fail) stored until now in figure, Index ([0]~[4])
14	CDPF regeneration history[0]	OK	OK/Fail	The regeneration distance/time is stored up to the last 5 events in sequence and the oldest one will be deleted if the number of events is exceeded 5 times. The currently displayed index value indicates where the regeneration information will be stored in the future and the just previous value shows the last regeneration information. Ex) Index value: 3 (last regeneration information stored at 2) 
15	CDPF regeneration history[1]	OK	OK/Fail	
16	CDPF regeneration history[2]	OK	OK/Fail	
17	CDPF regeneration history[3]	OK	OK/Fail	
18	CDPF regeneration history[4]	OK	OK/Fail	
19	Times of CDPF regeneration start (differential pressure)	0	-	Times which regeneration is requested using differential pressure sensor signal

Modification basis	
Application basis	
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No.	Sensor item	Data	Unit	Unit
20	Times of CDPF regeneration start (soot mass from engine)	0	-	The ECU calculates the soot mass from engine in consideration of the engine RPM, based on the ECU base MAP. The ECU regenerates the CDPF automatically when it determines that the accumulated soot is about 36 g or greater. (The more city driving, the greater value is) The times of regeneration is displayed cumulatively.
21	Times of CDPF regeneration start (collected soot mass)	0	-	The ECU calculates the soot mass from engine in consideration of the engine RPM, based on the ECU base MAP. The ECU regenerates the CDPF automatically when it determines that the accumulated soot is about 24 g or greater. (The more city driving, the greater value is) The times of regeneration is displayed cumulatively.
22	Times of CDPF regeneration start (driven distance)	0	-	The ECU regenerates the CDPF automatically when the driving distance reaches about 1,000 km or longer. (The more high-speed driving, the greater value is) The times of regeneration is displayed cumulatively.
23	Times which CDPF re-regeneration start is requested	0	-	When the regeneration should be stopped and started again according to the exhaust gas temperature, start condition and vehicle speed during CDPF regeneration, the times of re-regeneration is displayed cumulatively.
24	Times which SIW forced CDPF regeneration is requested	0	-	The times which the technician carried out the forced regeneration using the SIW program is displayed cumulatively.
25	Times of ECU replacement	1	-	The times of ECU initialization is displayed cumulatively.

NOTE

A. The ECU calculates the data of 4 items from No. 19 to No. 22 (map value calculated by the ECU) to carry out the CDPF regeneration and the regeneration event map values of 4 items between No. 19 to No. 22 will be reset. (times of regeneration start is stored normally)

B. In the event of ECU initialization, the data of items from No. 1 to No. 24 will be reset.

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ENGINE CONTROL

0000-00

GENERAL INFORMATION

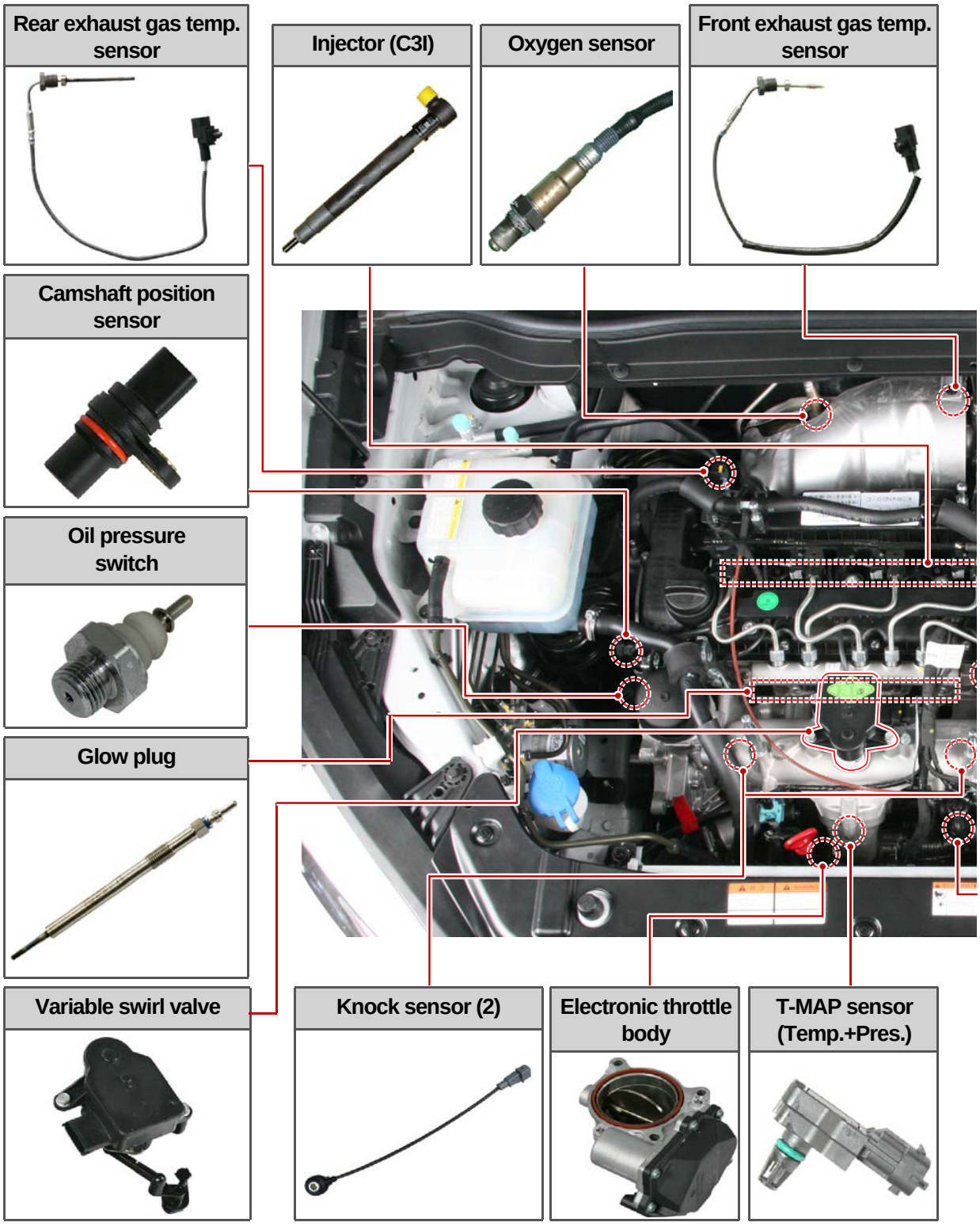
1. ENGINE DATA LIST

Data	Unit		Value
Coolant temperature	℃		0.436 V (130℃) to 4.896 V (−40℃)
Intake air temperature	℃		−40 to 130℃ (varies by ambient air temperature or engine mode)
Idle speed	rpm	A/T	780 ± 20
		M/T	750 ± 20
Engine load	%		18~25%
Mass air flow	kg/h		16 to 25 kg/h
Throttle position angle	°TA		0° (Full Open) to 78° (Close)
Engine torque	Nm		varies by engine conditions
Injection time	ms		3 to 5ms
Battery voltage	V		13.5 V to 14.1 V
Accelerator pedal position 1	V		04. to 4.8V
Accelerator pedal position 2	V		0.2 to 2.4 V
Throttle position 1	V		0.3 to 4.6 V
Throttle position 2	V		0.3 to 4.6 V
Oxygen sensor	mV		0 to 5 V
A/C compressor switch	1=ON / 0=OFF		-
Full load	1=ON / 0=OFF		-
Gear selection (A/T)	1=ON / 0=OFF		-
Knocking control	1=ON / 0=OFF		-
Brake switch	1=ON / 0=OFF		-
Cruise control	1=ON / 0=OFF		-

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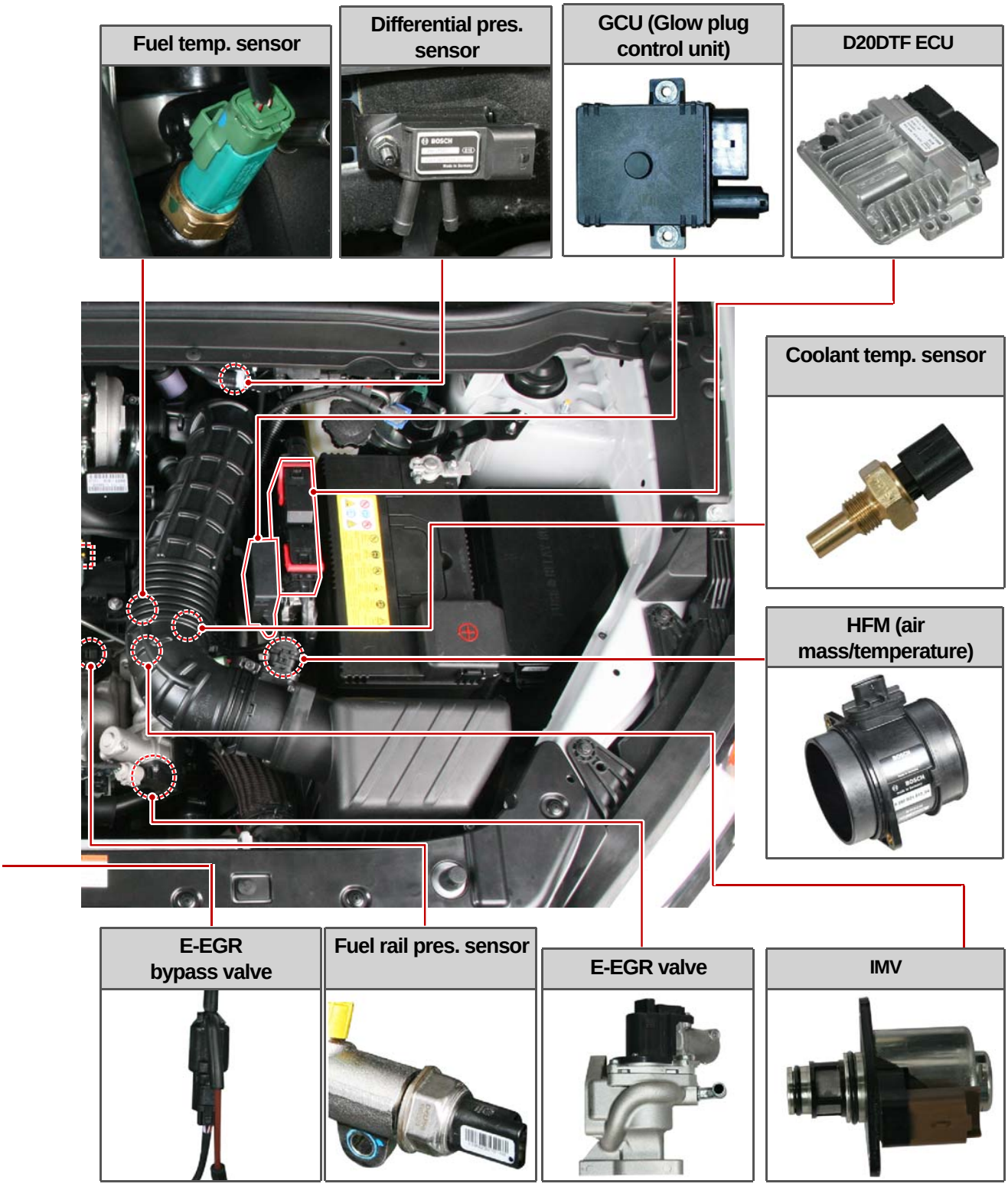
OVERVIEW AND OPERATING PROCESS

1. MAJOR COMPONENT



Modification basis	
Application basis	
Affected VIN	

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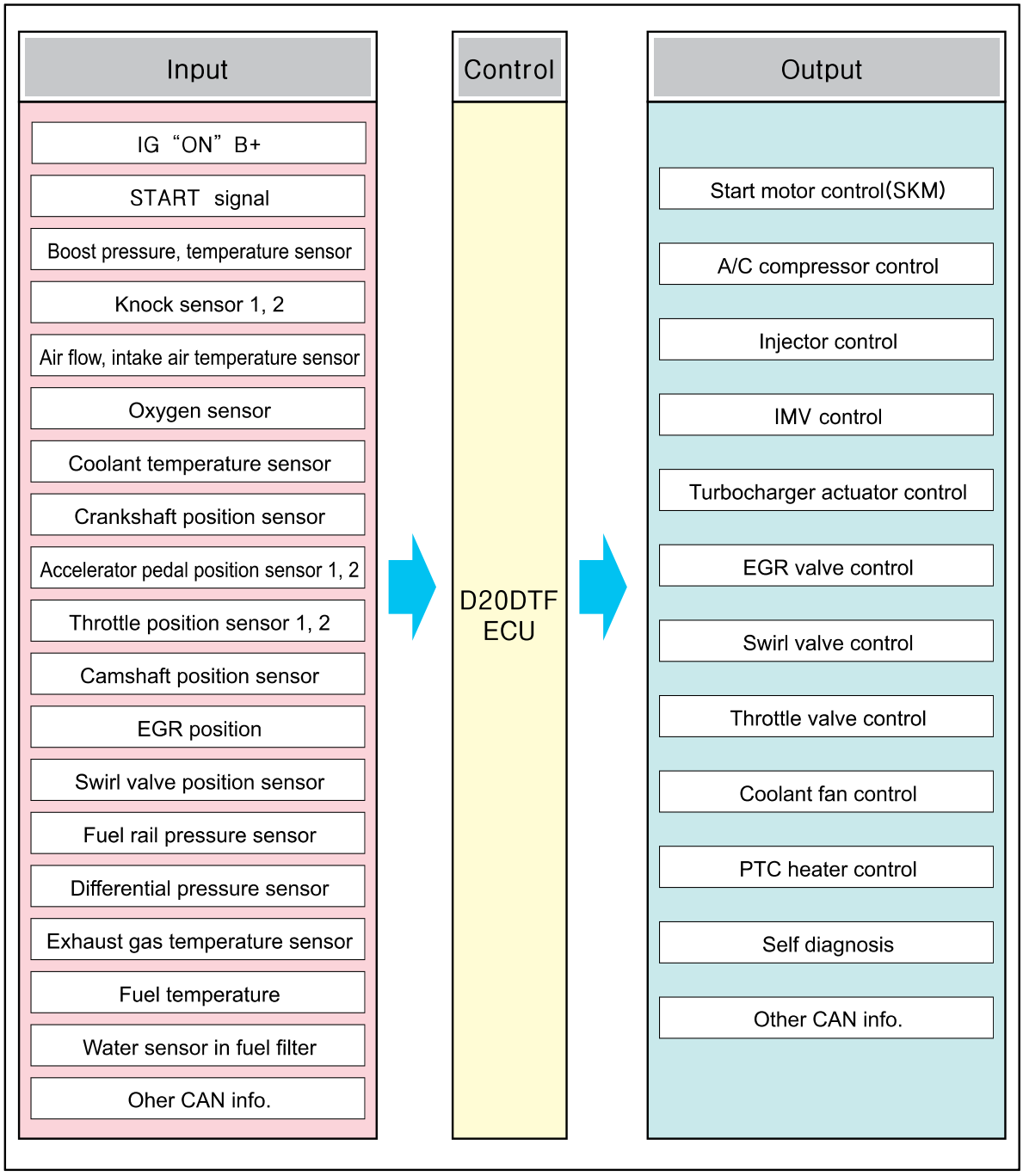
Modification basis	
Application basis	
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2. SYSTEM OPERATION

1) Input/Output of ECU

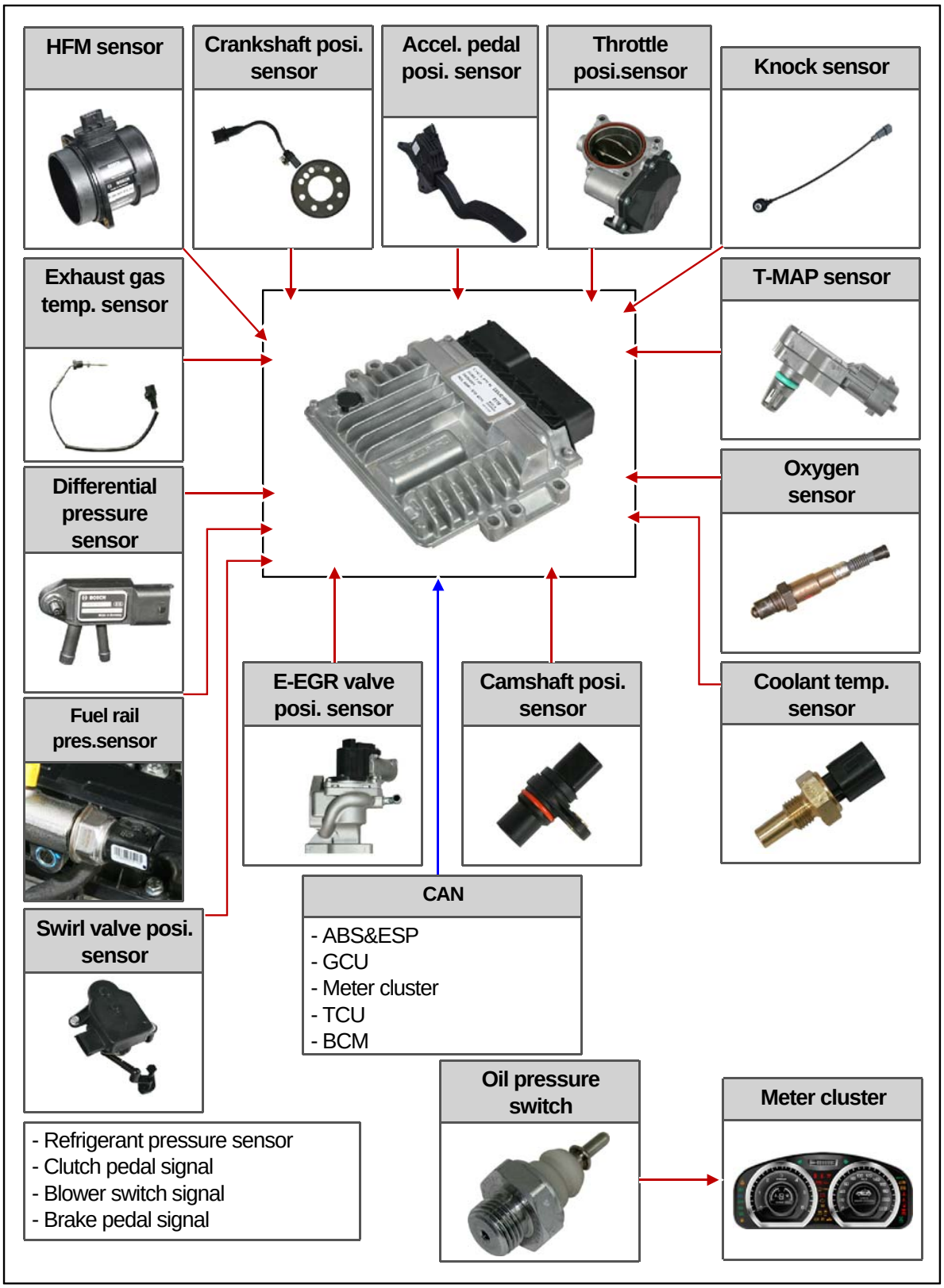
(1) ECU Block diagram



Modification basis	
Application basis	
Affected VIN	

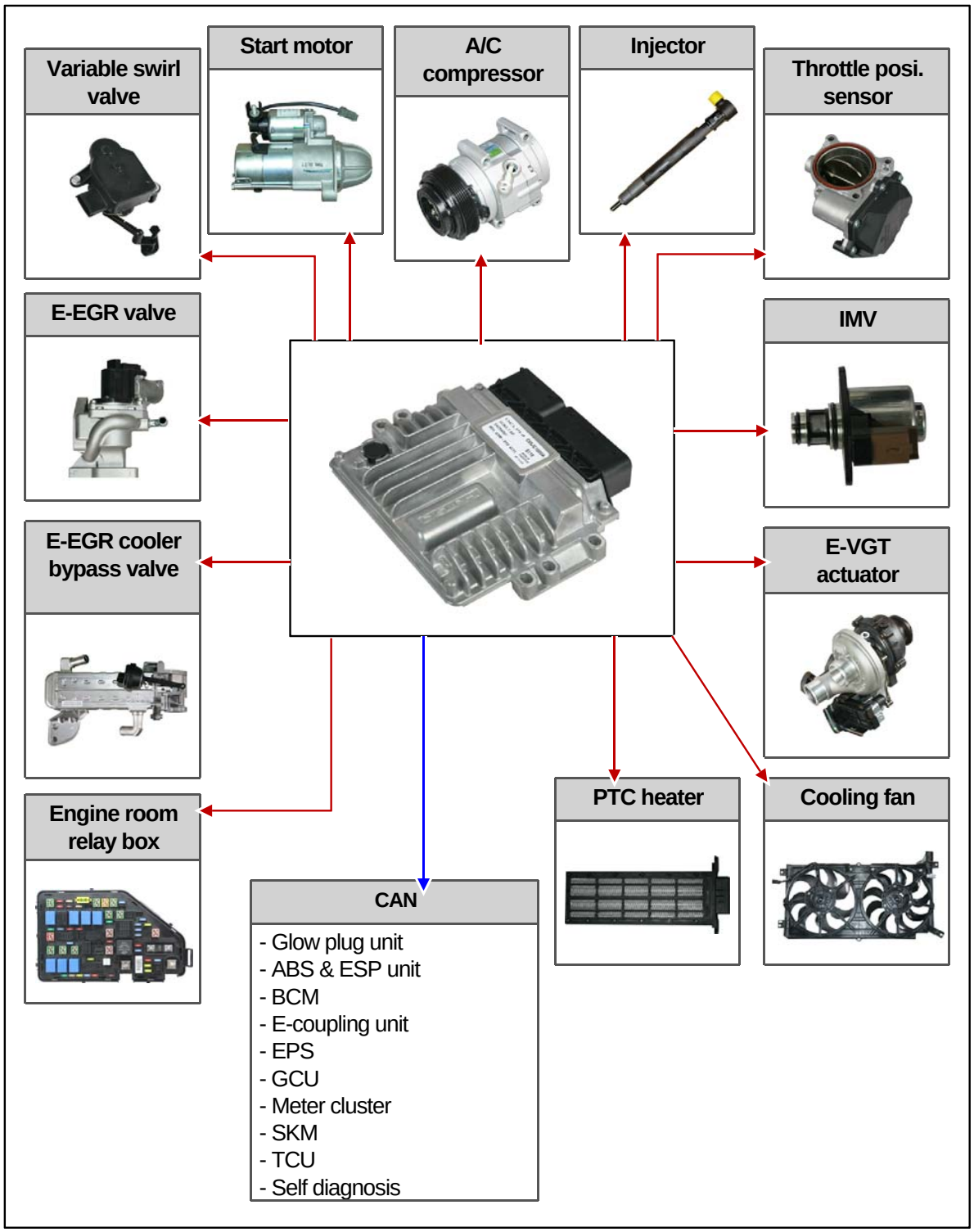
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(2) Components for ECU Input



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(3) Components for ECU Input



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2) ECU Control

(1) Function

a. ECU Function

ECU receives and analyzes signals from various sensors and then modifies those signals into permissible voltage levels and analyzes to control respective actuators.
ECU microprocessor calculates injection period and injection timing proper for engine piston speed and crankshaft angle based on input data and stored specific map to control the engine power and emission gas.
Output signal of the ECU microprocessor drives pressure control valve to control the rail pressure and activates injector solenoid valve to control the fuel injection period and injection timing; so controls various actuators in response to engine changes. Auxiliary function of ECU has adopted to reduce emission gas, improve fuel economy and enhance safety, comforts and conveniences. For example, there are EGR, booster pressure control, autocruise (export only) and immobilizer and adopted CAN communication to exchange data among electrical systems (automatic T/M and brake system) in the vehicle fluently. And Scanner can be used to diagnose vehicle status and defectives.
Operating temperature range of ECU is normally −40 to +85°C and protected from factors like oil, water and electromagnetism and there should be no mechanical shocks.
To control the fuel volume precisely under repeated injections, high current should be applied instantly so there is injector drive circuit in the ECU to generate necessary current during injector drive stages. Current control circuit divides current applying time (injection time) into full-in-current-phase and hold-current-phase and then the injectors should work very correctly under every working condition.

b. Control Function

- Controls by operating stages
  To make optimum combustion under every operating stage, ECU should calculate proper injection volume in each stage by considering various factors.
- Starting injection volume control
  During initial starting, injecting fuel volume will be calculated by function of temperature and engine cranking speed. Starting injection continues from when the ignition switch is turned to ignition position to till the engine reaches to allowable minimum speed.
- Driving mode control
  If the vehicle runs normally, fuel injection volume will be calculated by accelerator pedal travel and engine rpm and the drive map will be used to match the drivers inputs with optimum engine power.

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(2) Fuel Control

a. Fuel Pressure Control Elements

Pressure control consists of 2 principles.

- Determines rail pressure according to engine operating conditions.
- Controls IMV to make the rail pressure to reach to the required value.

Pressure in the fuel rail is determined according to engine speed and load on the engine.

- When engine speed and load are high
  The degree of turbulence is very great and the fuel can be injected at very high pressure in order to optimize combustion.
- When engine speed and load are low
  The degree of turbulence is low. If injection pressure is too high, the nozzle's penetration will be excessive and part of the fuel will be sprayed directly onto the sides of the cylinder, causing incomplete combustion. So there occurs smoke and damages engine durability.

Fuel pressure is corrected according to air temperature, coolant temperature and atmospheric pressure and to take account of the added ignition time caused by cold running or by high altitude driving. A special pressure demand is necessary in order to obtain the additional flow required during starts. This demand is determined according to injected fuel and coolant temperature.

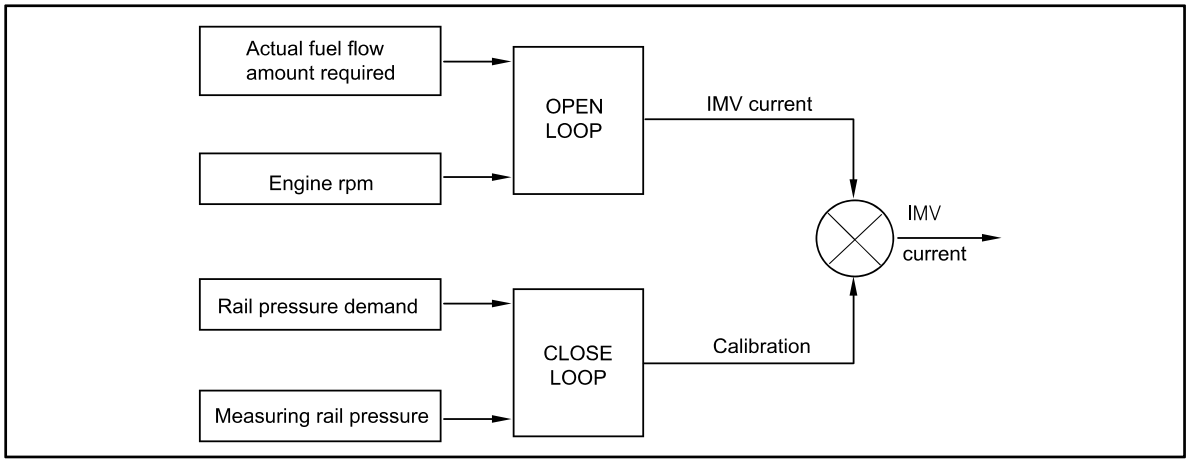
b. Fuel Pressure Control

Rail pressure is controlled by closed loop regulation of IMV.

▶ Open loop determines the current which needs to be sent to the actuator in order to obtain the flow demanded by the ECU.

▶ Closed loop will correct the current value depending on the difference between the pressure demand and the pressure measured.

- If the pressure is lower than the demand, current is reduced so that the fuel sent to the high pressure pump is increased.
- If the pressure is higher than the demand, current is increased so that the fuel sent to the high pressure pump is reduced.



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c. Fuel Injection Control

Injection control is used in order to determine the characteristics of the pulse which is sent to the injectors.
Injection control consists as below.

- Injection timing
- Injection volume
- Translating fuel injection timing and injection volume into values which can be interpreted by the injector driver.

▶ Main injection timing control

The pulse necessary for the main injection is determined as a function of the engine speed and of the injected flow.
The elements are:

- A first correction is made according to the air and coolant temperatures.
  This correction makes it possible to adapt the timing to the operating temperature of the engine. When the engine is warm, the timing can be retarded to reduce the combustion temperature and polluting emissions (NOx). When the engine is cold, the timing advance must be sufficient to allow the combustion to begin correctly.
- A second correction is made according to the atmospheric pressure.
  This correction is used to adapt the timing advance as a function of the atmospheric pressure and therefore the altitude.
- A third correction is made according to the coolant temperature and the time which has passed since starting.
  This correction allows the injection timing advance to be increased while the engine is warming up (initial 30 seconds). The purpose of this correction is to reduce the misfiring and instabilities which are liable to occur after a cold start.
- A fourth correction is made according to the pressure error.
  This correction is used to reduce the injection timing advance when the pressure in the rail is higher than the pressure demand.
- A fifth correction is made according to the rate of EGR.
  This correction is used to correct the injection timing advance as a function of the rate of exhaust gas recirculation.
  When the EGR rate increases, the injection timing advance must in fact be increased in order to compensate for the fall in termperature in the cylinder.

During starting, the injection timing must be retarded in order to position the start of combustion close to the TDC. To do this, special mapping is used to determine the injection timing advance as a function of the engine speed and of the water temperature.

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▶ **Pilot injection timing control**

The pilot injection timing is determined as a function of the engine speed and of the total flow.
The elements are:

- A first correction is made according to the air and coolant temperatures. This correction allows the pilot injection timing to be adapted to the operating temperature of the engine.
- A second correction is made according to the atmospheric pressure. This correction is used to adapt the pilot injection timing as a function of the atmospheric pressure and therefore the altitude.

d. Fuel Control

1. Main Flow Control

The main flow represents the amount of fuel injected into the cylinder during the main injection. The pilot flow represents the amount of fuel injected during the pilot injection.

The total fuel injected during 1 cycle (main flow + pilot flow) is determined in the following manner.

▶ When the driver depress the pedal, it is his demand which is taken into account by the system in order
▶ to determine the fuel injected.
When the driver release the pedal, the idle speed controller takes over to determine the minimum fuel which must be injected into the cylinder to prevent the enigne from stalling.

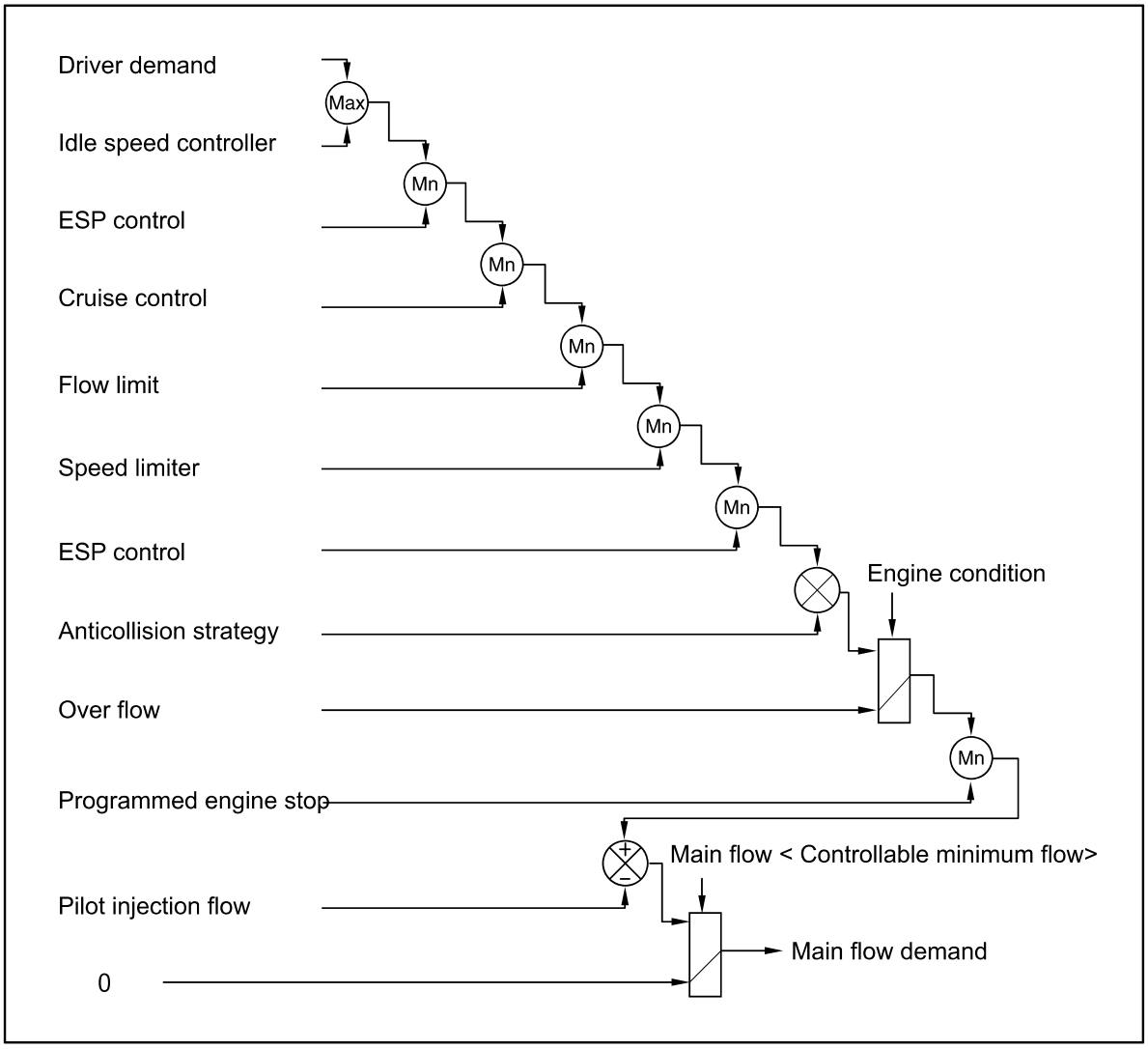
It is therefore the greater of these 2 values which is retained by the system. This value is then compared with the lower flow limit determined by the ESP system.
As soon as the injected fuel becomes lower than the flow limit determined by the ESP system, the antagonistic torque (engine brake) transmitted to the drive wheels exceeds the adherence capacity of the vehicle and there is therefore a risk of the drive wheels locking.
The system thus chooses the greater of these 2 values (main flow & pilot flow) in order to prevent any loss of control of the vehicle during a sharp deceleration.
As soon as the injected fuel becomes higher than the fuel limit determined by the ASR trajectory control system, the engine torque transmitted to the wheels exceeds the adhesion capacity of the vehicle and there is a risk of the drive wheels skidding. The system therefore chooses the smaller of the two values in order to avoid any loss of control of the vehicle during accelerations.
The anti-oscillation strategy makes it possible to compensate for fluctuations in engine speed during transient conditions. This strategy leads to a fuel correction which is added to the total fuel of each cylinder.

A switch makes it possible to change over from the supercharge fuel to the total fuel according to the state of the engine.

- Until the stating phase has finished, the system uses the supercharged fuel.
- Once the engine changes to normal operation, the system uses the total fuel.

The main fuel is obtained by subtracting the pilot injection fuel from the total fuel.
A mapping determines the minimum fuel which can control an injector as a function of the rail pressure.
As soon as the main fuel falls below this value, the fuel demand changes to 0 because in any case the injector is not capable of injecting the quantity demand.

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2. Driver Demand

The driver demand is the translation of the pedal position into the fuel demand. It is calculated as a function of the pedal position and of the engine speed. The driver demand is filtered in order to limit the hesitations caused by rapid changes of the pedal position. A mapping determines the maximum fuel which can be injected as a function of the driver demand and the rail pressure. Since the flow is proportional to the injection time and to the square root of the injection pressure, it is necessary to limit the flow according to the pressure in order to avoid extending the injection for too long into the engine cycle. The system compares the driver demand with this limit and chooses the smaller of the 2 values. The driver demand is then corrected according to the coolant temperature. This correction is added to the driver demand.

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3. Idle Speed Controller

The idle speed controller consists of 2 principal modules:

- The first module determines the required idle speed according to:
  * The operating conditions of the engine (coolant temperature, gear engaged)
  * Any activation of the electrical consumers (power steering, air conditioning, others)
  * The battery voltage
  * The presence of any faults liable to interface with the rail pressure control or the injection control. In this case, increase the idle speed to prevent the engine from stalling.
- The second module is responsible for providing closed loop control of the engine's idle speed by adapting the minimum fuel according to the difference between the required idle speed and the engine speed.

4. Flow Limitation

The flow limitation strategy is based on the following strategies:

- The flow limitation depending on the filling of the engine with air is determined according to the engine speed and the air flow. This limitation allows smoke emissions to be reduced during stabilized running.
- The flow limitation depending on the atmospheric pressure is determined according to the engine speed and the atmospheric pressure. It allows smoke emissions to be reduced when driving at altitude.
- The full load flow curve is determined according to the gear engaged and the engine speed. It allows the maximum torque delivered by the engine to be limited.
- A performance limitation is introduced if faults liable to upset the rail pressure control or the injection control are detected by the system. In this case, and depending on the gravity of the fault, the system activates:

Reduced fuel logic 1: Guarantees 75 % of the performance without limiting the engine speed.
Reduced fuel logic 2: Guarantees 50 % of the performance with the engine speed limited to 3,000 rpm.
Reduce fuel logic 3: Limits the engine speed to 2,000 rpm.

The system chooses the lowest of all values.
A correction depending on the coolant temperature is added to the flow limitation. This correction makes it possible to reduce the mechanical stresses while the engine is warming up. The correction is determined according to the coolant temperature, the engine speed and the time which has passed since starting.

Superchager Flow Demand

The supercharge flow is calculated according to the engine speed and the coolant temperature. A correction depending on the air temperature and the atmospheric pressure is made in order to increase the supercharge flow during cold starts. It is possible to alter the supercharge flow value by adding a flow offset with the aid of the diagnostic tool.

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5. Pilot Flow Control

The pilot flow represents the amount of fuel injected into the cylinder during the pilot injection. This amount is determined according to the engine speed and the total flow.

- A first correction is made according to the air and water temperature.
  This correction allows the pilot flow to be adapted to the operating temperature of the engine. When the engine is warm, the ignition time decreases because the end-of-compression temperature is higher. The pilot flow can therefore be reduced because there is obviously less combustion noise when the engine is warm.
- A second correction is made according to the atmospheric pressure.

During starting, the pilot flow is determined on the basis of the engine speed and the coolant temperature.

6. Cylinder Balancing Strategy

▶ Balancing of the point to point flows

The pulse of each injector is corrected according to the difference in instantaneous speed measured between 2 successive injectors.

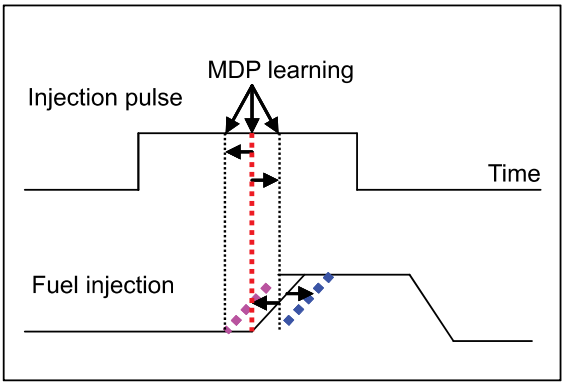
The instantaneous speeds on two successive injections are first calculated.
The difference between these two instantaneous speeds is then calculated.
Finally, the time to be added to the main injection pulse for the different injectors is determined. For each injector, this time is calculated according to the initial offset of the injector and the instantaneous speed difference.

▶ Detection of an injector which has stuck closed

The cylinder balancing strategy also allows the detection of an injector which has stuck closed. The difference in instantaneous speed between 2 successive injections then exceeds a predefined threshold. In this case, a fault is signaled by the system.

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e. MDP Learning Control



MDP (Minimum Drive Pulse) refers to the minimum power supply pulse for injection which the injector can perform. It is possible to control the fuel volume for each injector accurately through correct learning for the MDP value. The basic process of MDP learning is that the pulse slightly higher than MDP is supplied and then (b) the vibration generated from the cylinder is detected. The knock sensor detects the vibration from the engine after a small volume of fuel is injected. And the time interval between the points of injection and vibration is measured so that MDP can be learned. MDP learning is helpful to prevent engine vibration, high emission and power reduction through performing calibration for the old injectors. During MDP learning, a little vibration and noise can be occur for a while. This is because the fuel pressure is increased instantaneously and the exact injection value is not input, so that the exact engine vibration timing can be detected.

Modification basis	
Application basis	
Affected VIN	

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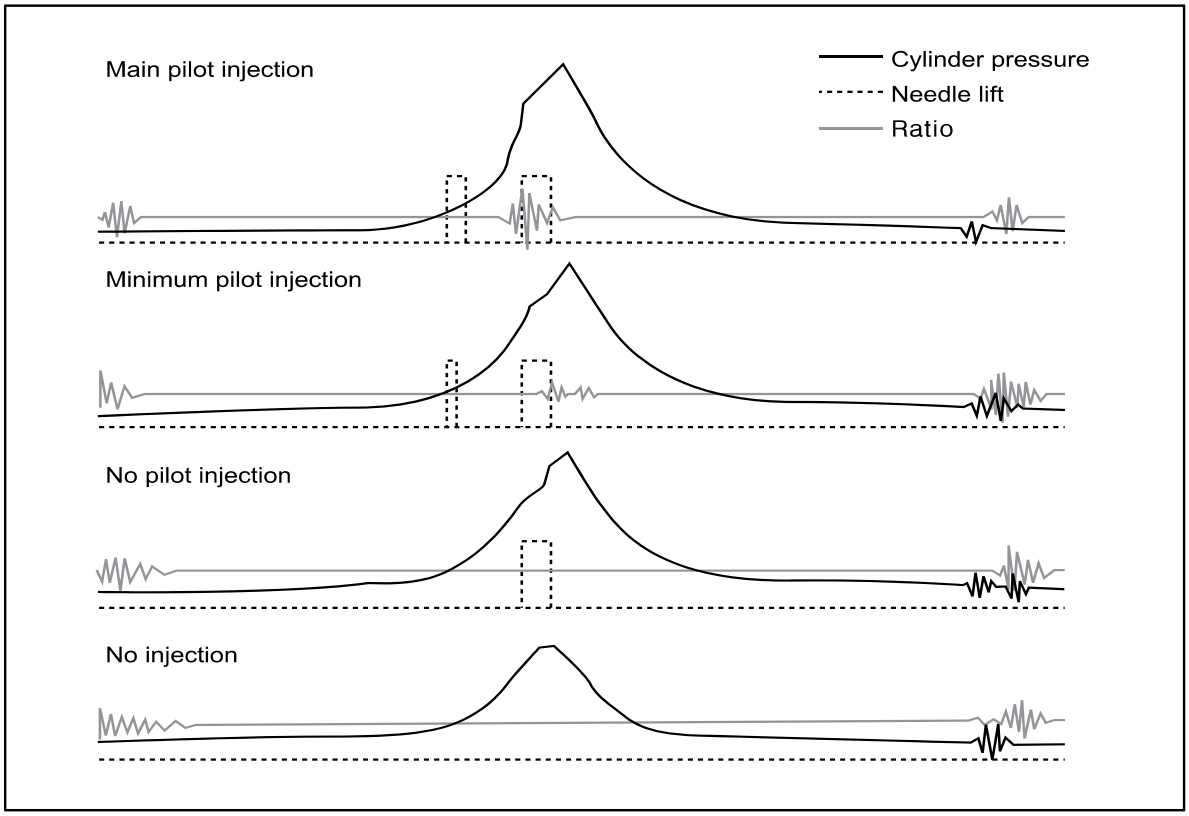
(3) Accelerometer Control

a. Resetting the pilot injection

The accelerometer is used to reset the pilot injection flow in closed loop for each injector. This method allows the correction of any injector deviations over a period of time. The principle of use of the accelerometer is based on the detection of the combustion noises.
The sensor is positioned in such a way as to receive the maximum signal for all the cylinders. The raw signals from the accelerometer are processed to obtain a variable which quantifies the intensity of the combustion. This variable, known as the ratio, consists of the ratio between the intensity of the background noise and the combustion noise.

1. A first window is used to establish the background noise level of the accelerometer signal for each cylinder. This window must therefore be positioned at a moment when there cannot be any combustion.
2. The second window is used to measure the intensity of the pilot combustion. Its position is such that only the combustion noises produced by the pilot injection are measured . It is therefore placed just before the main injection.

The accelerometer does not allow any evaluation of the quantity injected. However, the pulse value will be measured when the injector starts injection and this pulse value is called the MDP (Minimum Drive Pulse). On the basis of this information, it is possible to efficiently correct the pilot flows. The pilot injection resetting principle therefore consists of determining the MDP, in other words the pulse corresponding to the start of the increase in value of the ratio (increase of vibration due to fuel combustion).



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This is done periodically under certain operating conditions. When the resetting is finished, the new minimum pulse value replaces the value obtained during the previous resetting. The first MDP value is provided by the C3I. Each resetting then allows the closed loop of the MDP to be updated according to the deviation of the injector.

b. Detection of leaks in the cylinders

The accelerometer is also used to detect any injector which may have stuck open. The detection principle is based on monitoring the ratio. If there is a leak in the cylinder, the accumulated fuel self-ignites as soon as the temperature and pressure conditions are favorable (high engine speed, high load and small leak).
This combustion is set off at about 20 degrees before TDC and before main injection.
The ratio therefore increases considerably in the detection window. It is this increase which allows the leaks to be detected. The threshold beyond which a fault is signaled is a percentage of the maximum possible value of the ratio.
Because of the severity of the recovery process (engine shut-down), the etection must be extremely robust.
An increase in the ratio can be the consequence of various causes:

- Pilot injection too much
- Main combustion offset
- Fuel leak in the cylinder

If the ratio becomes too high, the strategy initially restricts the pilot injection flow and retards the main injection. If the ratio remains high despite these interventions, this shows that a real leak is present, a fault is signaled and the engine is shut down.

c. Detection of an accelerometer fault

This strategy permits the detection of a fault in the sensor or in the wiring loom connecting the sensor to the ECU.
It is based on detection of the combustion. When the engine is idling, the detection window is set too low for the combustion caused by the main injection. If the ratio increases, this shows that the accelerometer is working properly, but otherwise a fault is signaled to indicate a sensor failure. The recovery modes associated with this fault consist of inhibition of the pilot injection and discharge through the injectors.

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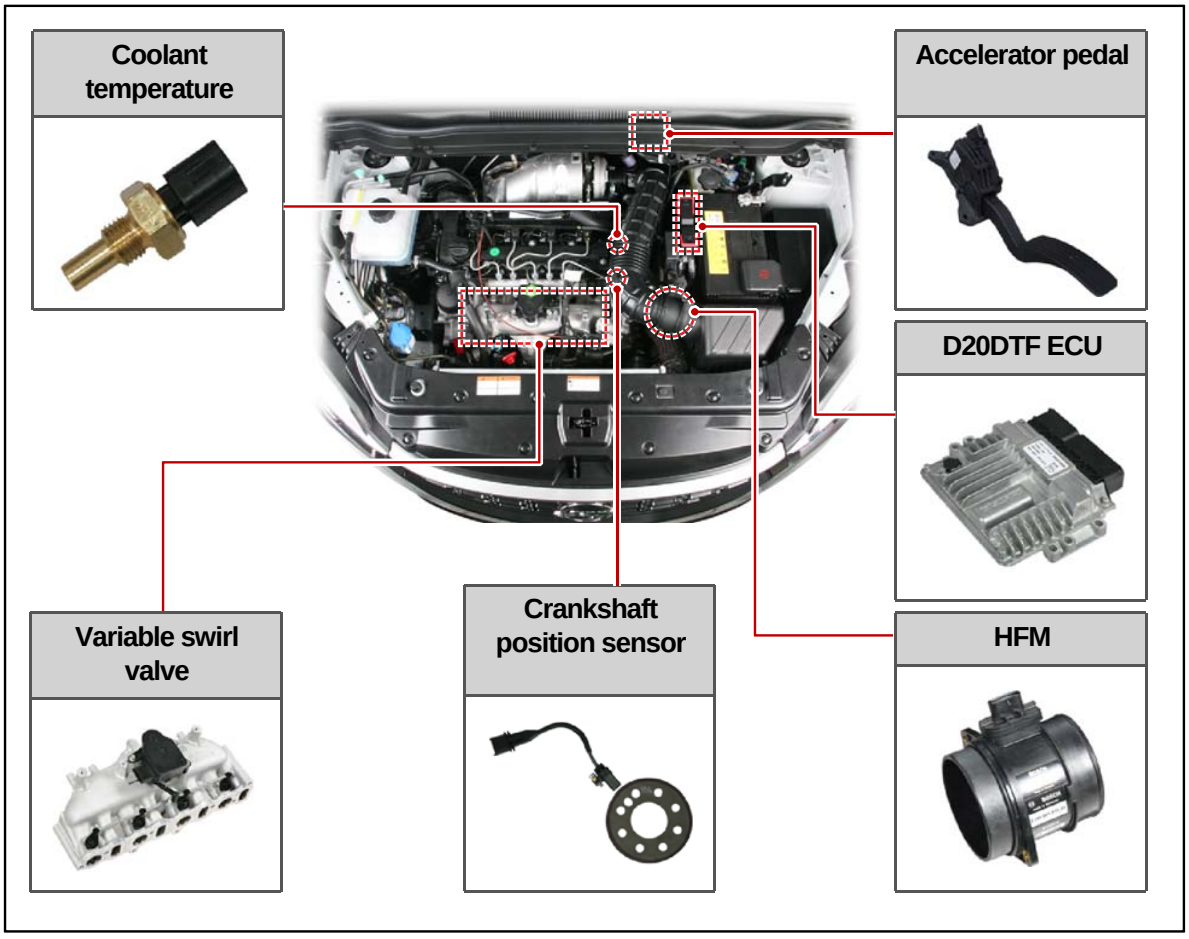
(4) Swirl control

a. Overview

- Variable swirl valve

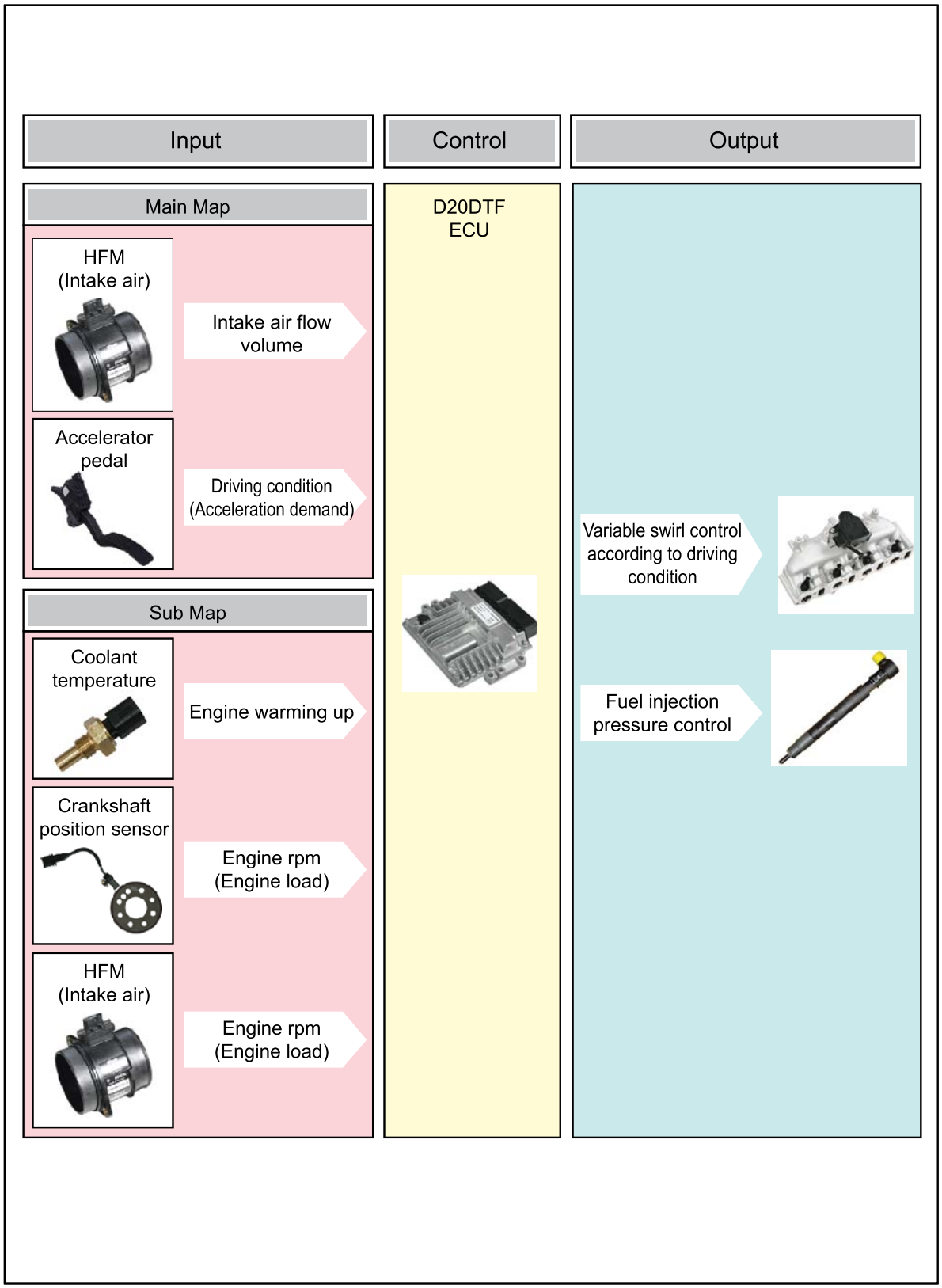
The strong swirl caused by intake air is important element for anti-locking function in diesel engine. The swirl control valve partially closes the intake port to generate the swirl according to the engine conditions. When the engine load is in low or medium range, the swirl could not be generated because the air flow is slow. To generate strong swirl, there are two passages in intake manifold, and one of them has the valve to open and close the passage. When the valve closes the passage, the air flow through the another passage will be faster, and the strong swirl will be generated by the internal structure of the passage. This swirl makes the better mixture of air and fuel, eventually the combustion efficiency in combustion chamber could be improved. This provides the enhanced fuel consumption, power and EGR ratio.

- Components



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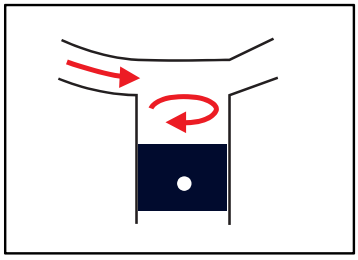
b. Input/Output for variable swirl valve



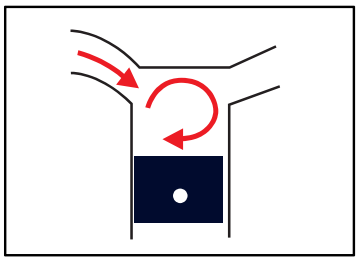
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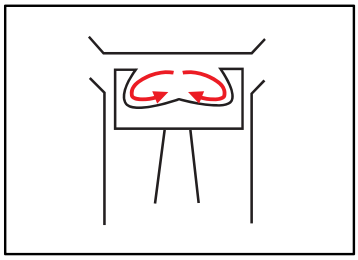
c. Types of swirl



Swirl: One cylinder has two intake air ports, one is set horizontally and the other one is set vertically. Swirl is the horizontal air flows in cylinder due to the horizontal intake air ports.



Tumble: Tumble is the vertical air flows in cylinder due to the vertical intake air port

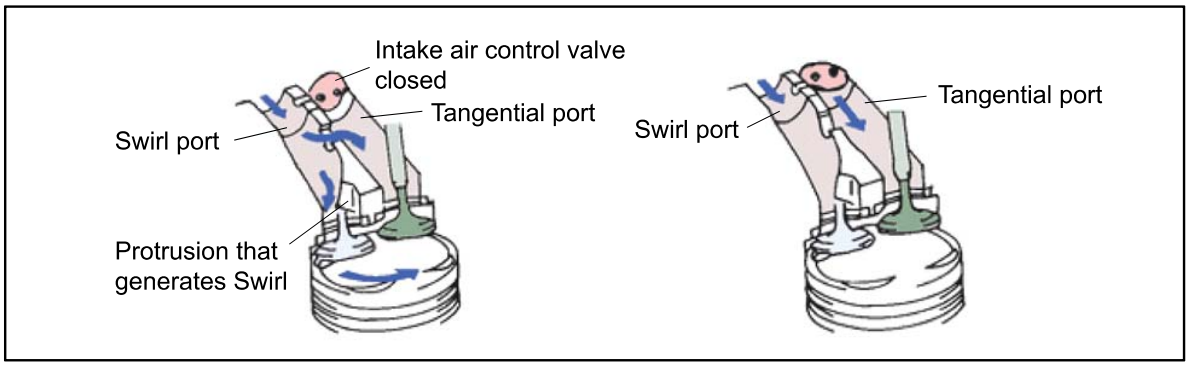


Squish: Squish is the air flows due to the piston head. Normally, this is appears at the final process of compression. In CRDi engine, the piston head creates the bowl type squish.

d. Swirl control

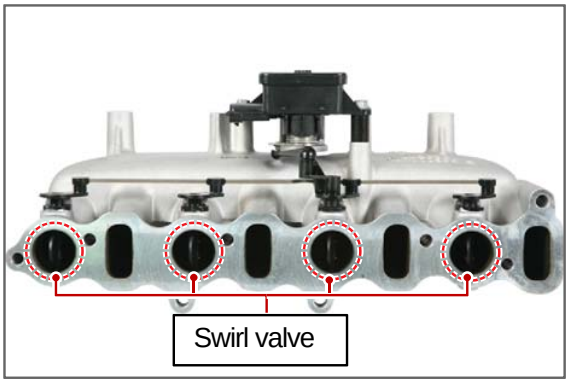
In DI type diesel engine, the liquefied fuel is injected into the cylinder directly. If the fuel is evenly distributed in short period, the combustion efficiency could be improved. To get this, there should be good air flow in cylinder. In general, there are two intake ports, swirl port and tangential port, in each cylinder. The swirl port generates the horizontal flow and the tangential port generates the longitudinal flow.

In low/mid load range, the tabgential port is closed to increase the horizontal flow. Fast flow decreases the PM during combustion and increases the EGR ratio by better combustion efficiency.

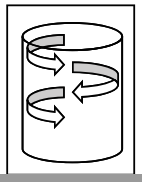


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Load	Engine speed	Swirl valve	Amount of swirl	Remarks
Low speed, Low load	below 3,000 rpm	Closed	Heavy	Increased EGR ratio, better air-fuel mixture (reduce exhaust gas)
High speed, High load	over 3,000 rpm	Open	Light	Increase charge efficiency, higher engine power



The variable swirl valve actuator operates when turning the ignition switch ON/OFF position to open/close the swirl valve. In this period, the soot will be removed and the learning for swirl valve position is performed.



NOTE

Swirl: This is the twisted (radial) air flow along the cylinder wall during the intake stroke. This stabilizes the combustion even in lean air-fuel mixture condition.

e. Features

- Swirl and air intake efficiency
  To generate the swirl, the intake port should be serpentine design. This makes the resistance in air flow. The resistance in air flow in engine high speed decreases the intake efficiency. Eventually, the engine power is also decreased, Thus, the swirl operation is deactivated in high speed range to increase the intake efficiency.
- Relationship between swirl and fuel injection pressure
  The injector for DI engine uses the multi hole design. For this vehicle, there are 8 holes in injector. If the swirl is too strong, the injection angles might be overlapped and may cause the increased PM and insufficient engine power. Also, if the injection pressure is too high during strong swirl, the injection angles might be overlapped. Therefore, the system may decreases the fuel injection pressure when the swirl is too strong.

Modification basis	
Application basis	
Affected VIN	

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f. Relationship between swirl and fuel injection pressure

- The injector for DI engine uses the multi hole design. For this vehicle, there are 8 holes in injector. If the swirl is too strong, the injection angles might be overlapped and may cause the increased PM and insufficient engine power. Also, if the injection pressure is too high during strong swirl, the injection angles might be overlapped. Therefore, the system may decreases the fuel injection pressure when the swirl is too strong.

NOTE

* Anti-knock methods:
- Shorten the ignition timing by pilot injection, lessen the fuel injection volume during ignition delay period.
- Increase engine speed.
- Maintain intake sir temperature with intercooler or glow plug device.
- Increase intake air pressure with turbocharger.
- Warm up engine to keep the normal operating temperature.
- Increase compression ratio.
- Use the fuel with high cetane.

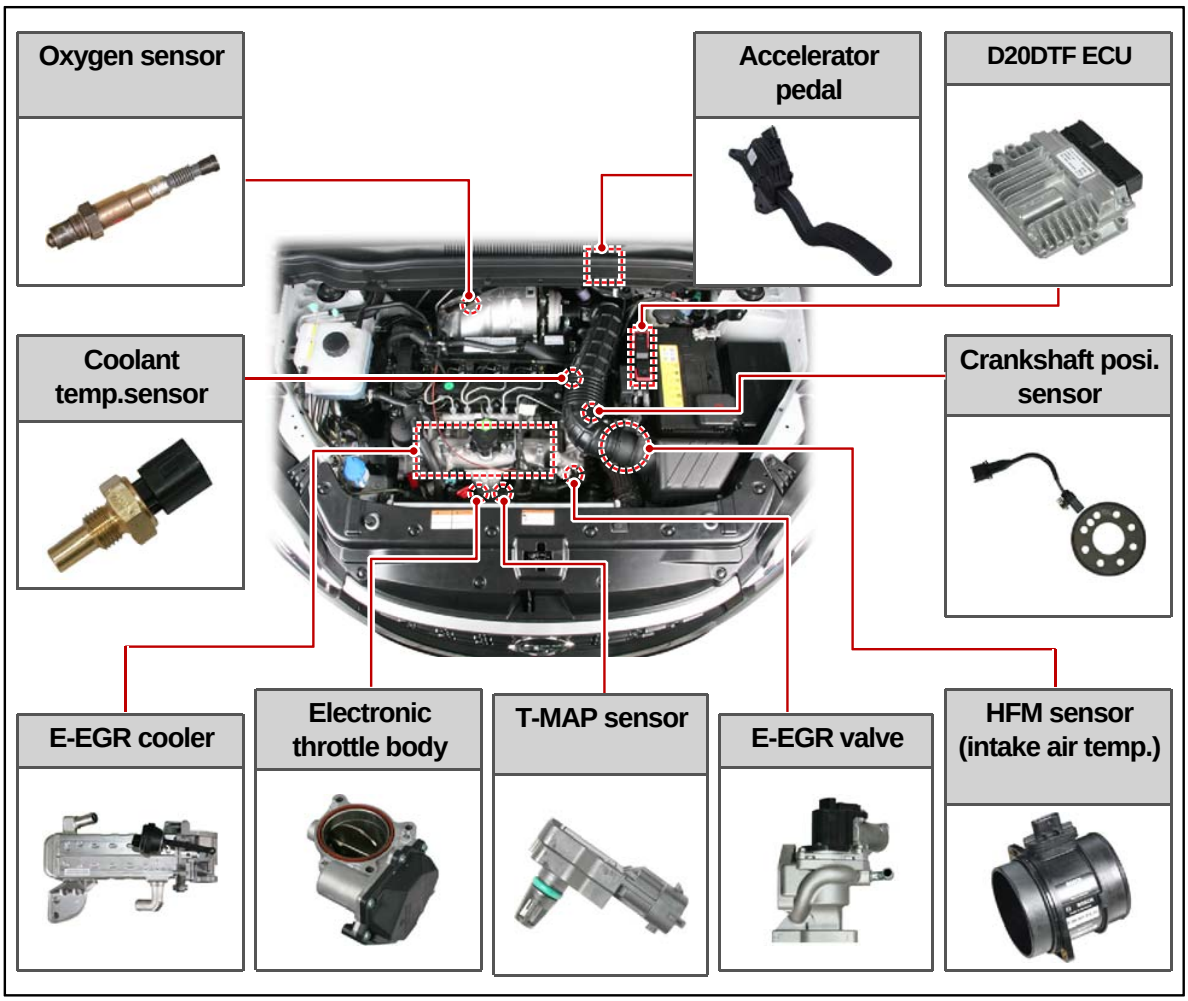
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(5) EGR control

a. Overview

The EGR (Electric-Exhaust Gas Recirculation) valve reduces the NOx emission level by recirculating some of the exhaust gas to the intake system.
The major difference with the previous EURO 4 type, is that the DC motor with improved response rate according to the EURO 5 regulation. The solenoid type actuator is used in the conventional model, but in this new model, the DC motor type actuator with improved response rate is adopted. Also the hall sensor which provides a more stabilized signal than the potentiometer, and the EGR bypass flap which improves engine warming up efficiency are also used. The HFM sensor and the position sensor are used to feedback the amount of EGR for both EURO 4 and EURO 5.

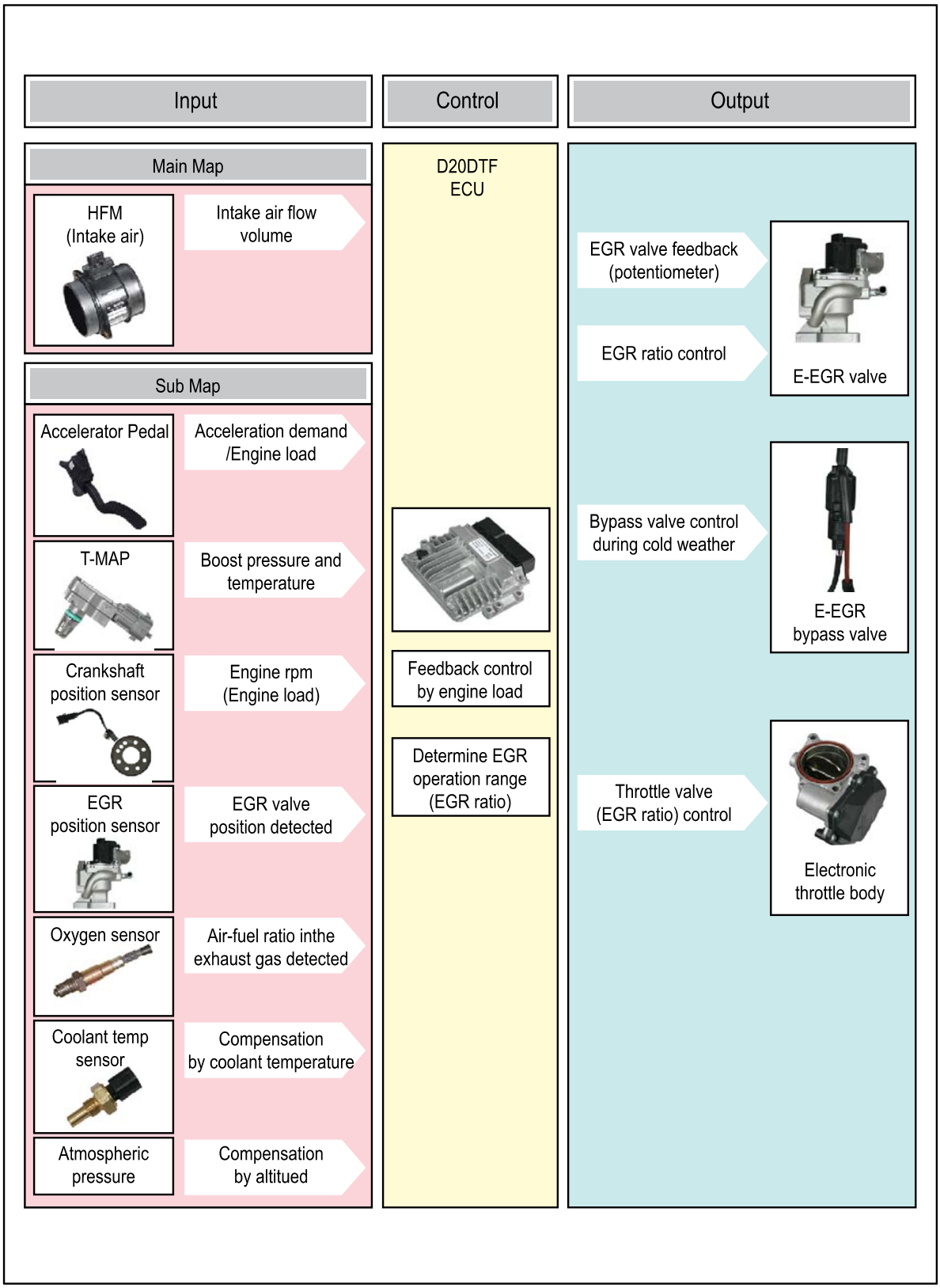
b. Components



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Application basis	
Affected VIN	

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c. Input/Output of E-EGR system



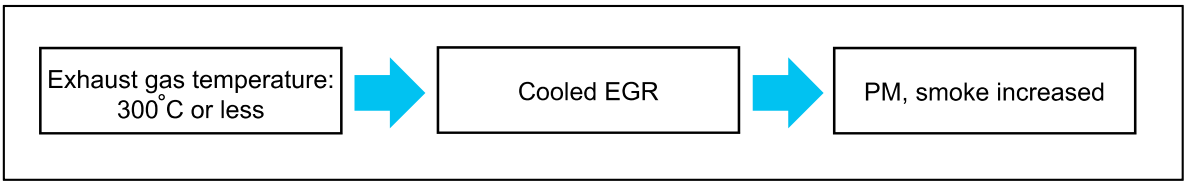
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d. Bypass control for EGR cooler

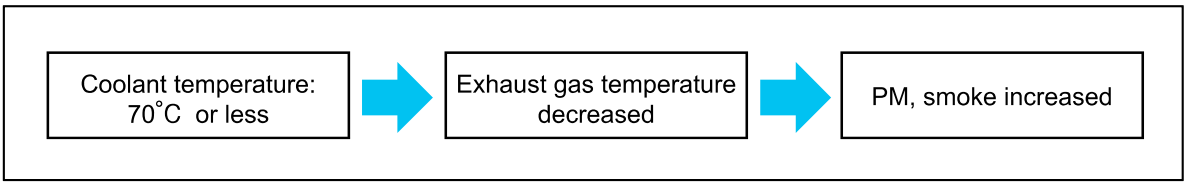
1. Cooler temperature

When the coolant temperature is below 70℃, the exhaust gas is bypassed the EGR cooler.



2. Exhaust gas temperature

When the exhaust gas temperature is below 300℃, the exhaust gas is bypassed the EGR cooler. Otherwise, PM could be increased due to too low exhaust gas temperature.



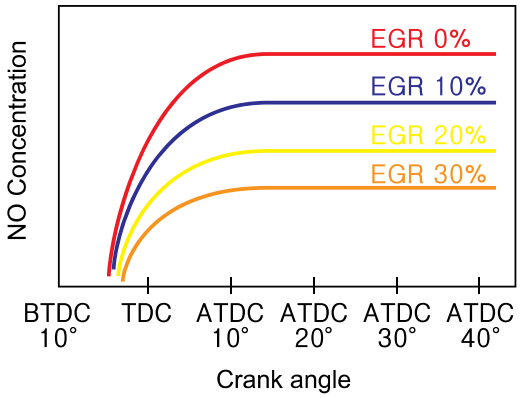
e. Control elements for EGR system

- Accelerator pedal (engine load) - Indicates the driver's intention and engine load. If the load goes up, the EGR ratio is decreased.
- T-MAP (boost pressure map stored in ECU) - Compensates the difference in boost pressure by adjusting EGR ratio.
- Engine rpm - Used as the signal for determining EGR operating range.
- Coolant temperature - When the coolant temperature is low, NOx is decreased but PM could be increased. So, to reduce PM, decrease EGR ratio when the coolant temperature is low.
- Intake air mass and temperature - HFM sensor measures the intake air mass to calculate the actual EGR volume. If the air mass is larger than programmed value in map, EGR ratio will be higher.
- EGR position sensor - Detects the actual opening angle of EGR valve and performs feedback function according to PWM control by ECU.
- Wide band oxygen sensor - Detects the oxygen volume in exhaust gas to check if the EGR ratio is proper.
- Electronic throttle body - Keeps EGR ratio to optimized level by controlling the throttle body in EGR operating range (decreasing pressure in intake manifold).

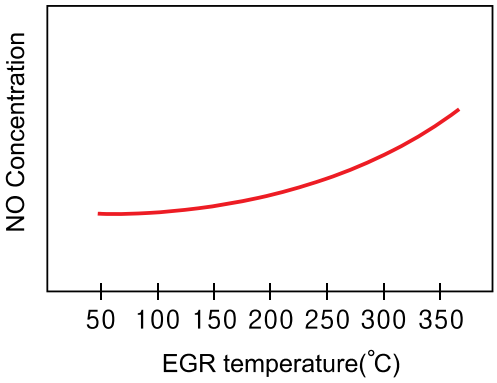
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f. Features



As EGR ratio goes up, smoke volume will be higher. But, this lowers the combustion chamber temperature and accordingly the concentration of NOx is decreased. The point with highest NOx is immediately after TDC.



As EGR temperature goes up, the concentration of NOx will be higher. Thus, it is necessary to cool down the exhaust gas. However, during engine cooled, it may cause large amount of PM. To prevent this, the exhaust gas is bypassed the EGR cooler.

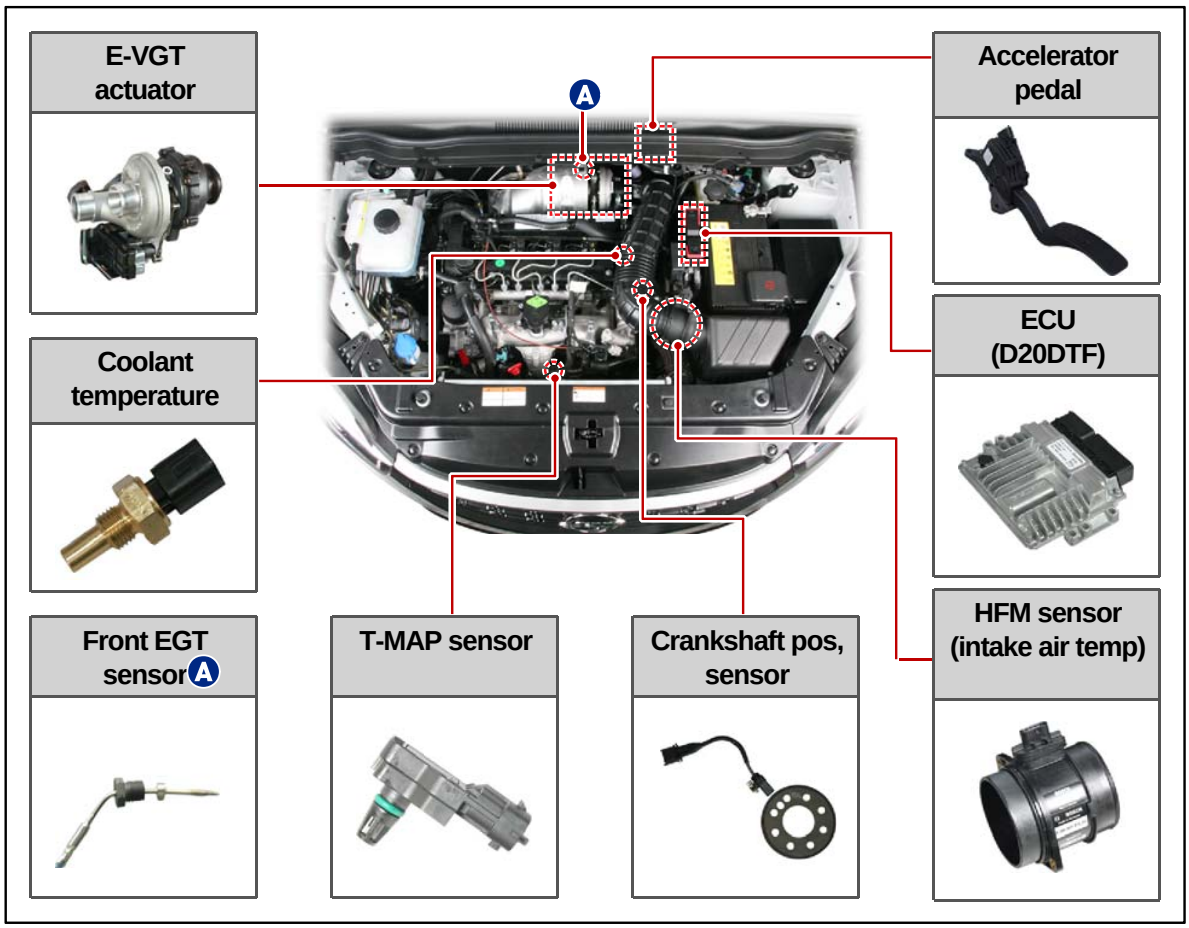
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(6) E-VGT control

a. Overview

E-VGT (Electric-Variable Geometry Turbine) turbocharger system in D20DTF engine uses the venturi effect that controls the flow rate of exhaust gas by adjusting the passage in turbine housing. The newly adopted DC motor actuator (E-actuator) controls the E-VGT system more precisely and faster. To get the high operating power from turbine, the ECU reduces the exhaust gas passage In low speed range and increases it in high speed range.

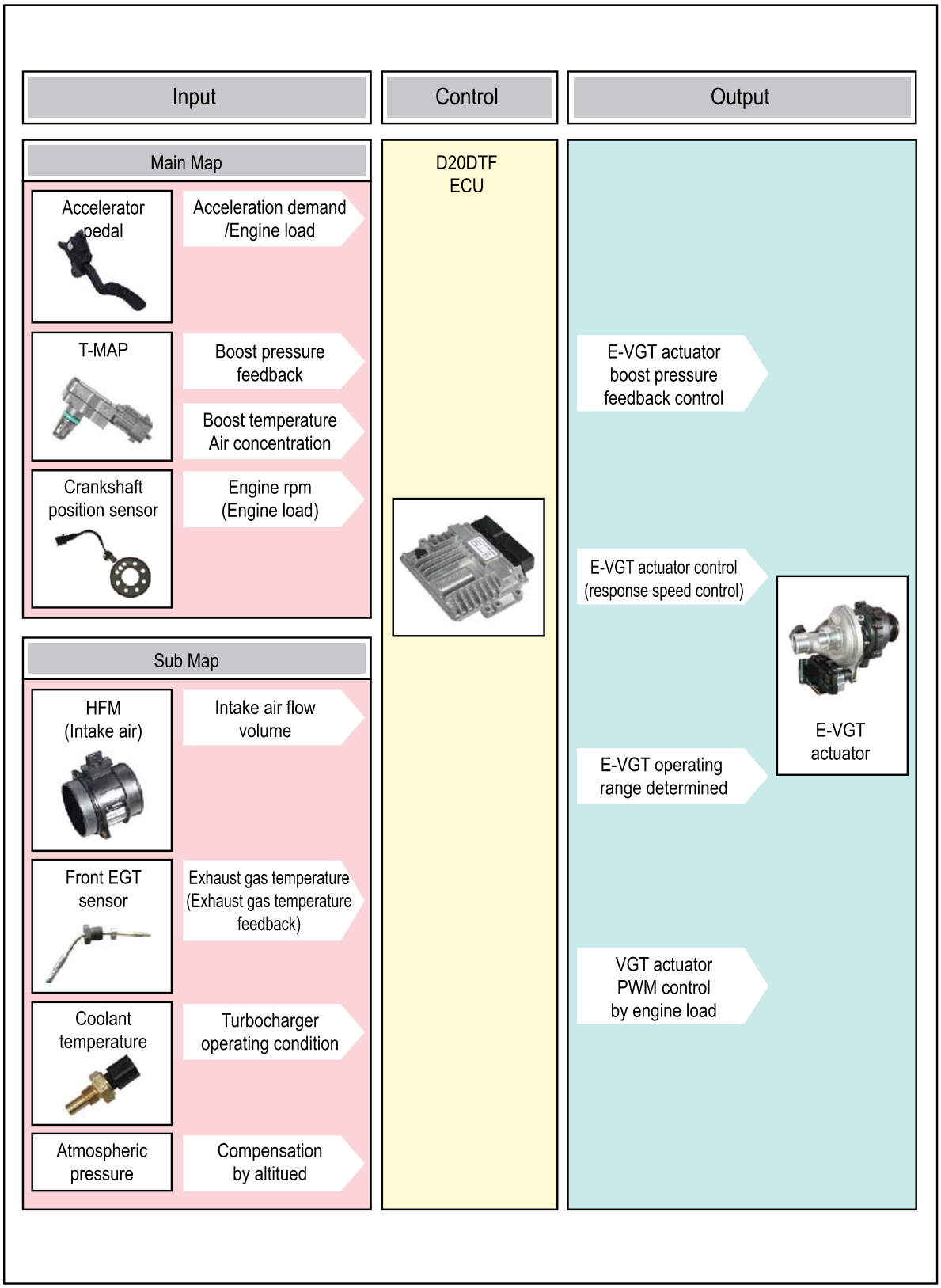
b. Components



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c. Input/Output for E-VGT system

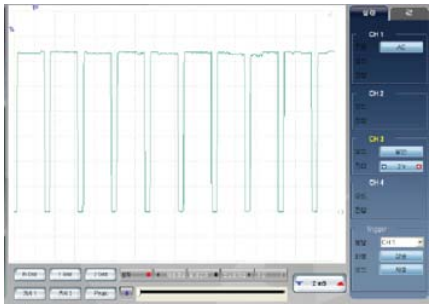
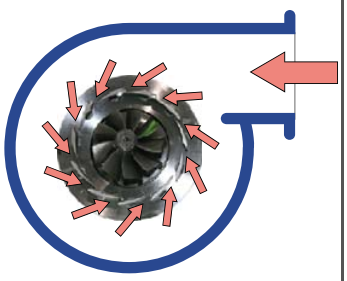
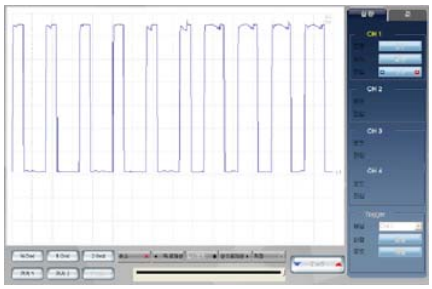
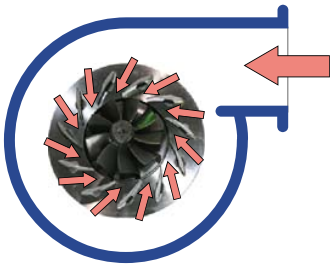


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d. E-VGT system control

Turbocharger system operates the E-VGT actuator according to the signals for engine epm, accelerator pedal position, atmospheric pressure, T-MAP, coolant temperature and intake air temperature.
Turbocharger actuator is performed PWM control by ECU.
In general, the boost pressure feedbacks the turbocharger operation and the boost temperature is used for calculating the precise density.
E-VGT provides higher engine power with faster reaction speed compared to conventional VGT.

	Operating wave	Vane	Control
Low speed range			In low speed range: retract the vane to increase boost pressure. The vane has low (-) duty, and the unison ring moves to retract the vane in weak PWM signal.
High speed range			The unison ring moves to extend the vane in strong PWM signal. Maximum pressure is 3 bar and the system controls it according to the input signals.

Modification basis	
Application basis	
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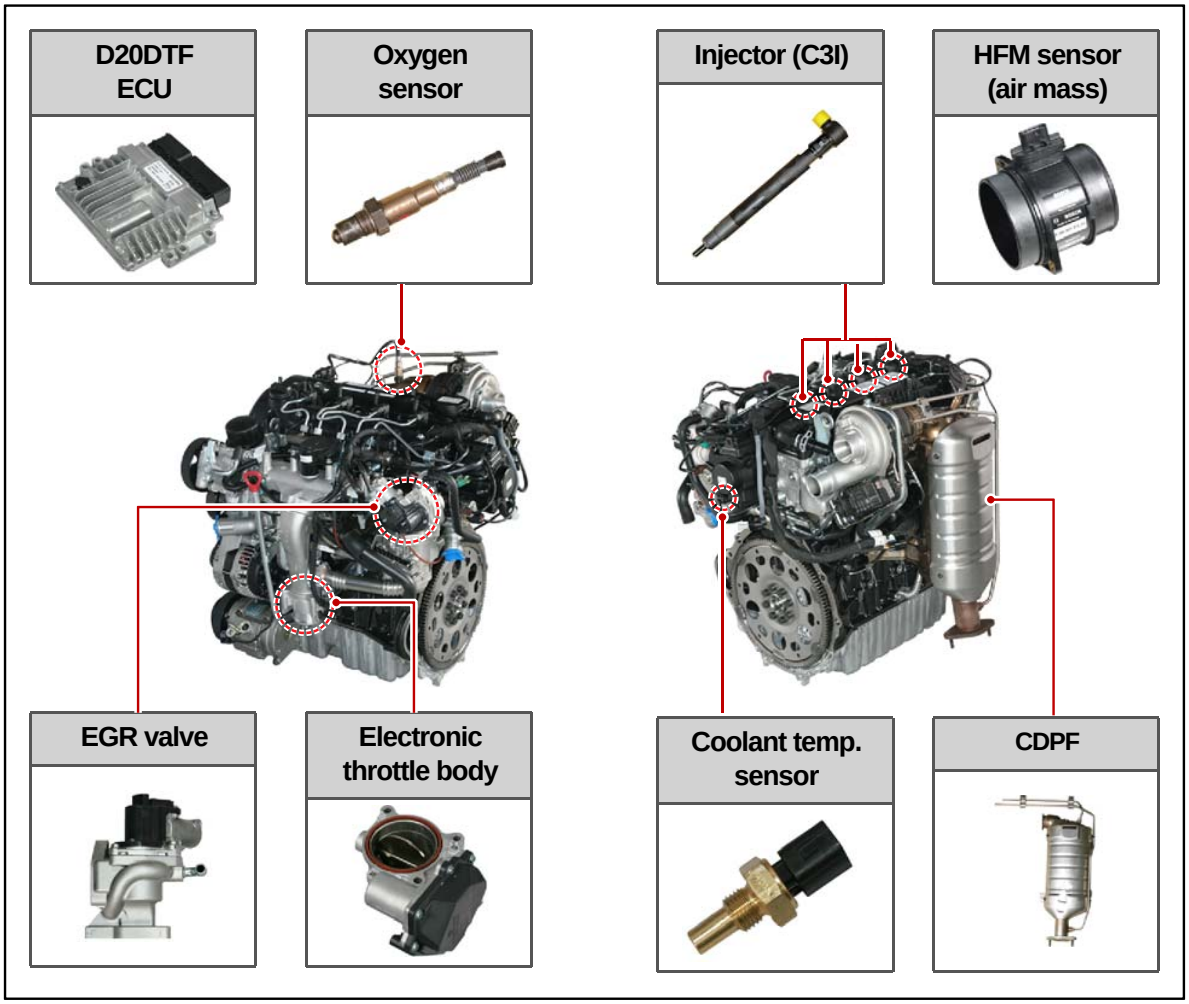
(7) Wide band oxygen sensor

a. Overview

For diesel engine, combustion is not performed at the optimum (theoretically correct) air-fuel ratio and the oxygen concentration is thin in most cases. So the wide-band oxygen sensor is used for this kind of engine, and this sensor is a little different from the one that used for gasoline engine. The combustion in diesel engine is controlled by fuel injection volume. Therefore, the wide band oxygen sensor should be used in diesel engine. This sensor measures the air-fuel ratio in very wide range, and is also called full range oxygen sensor.

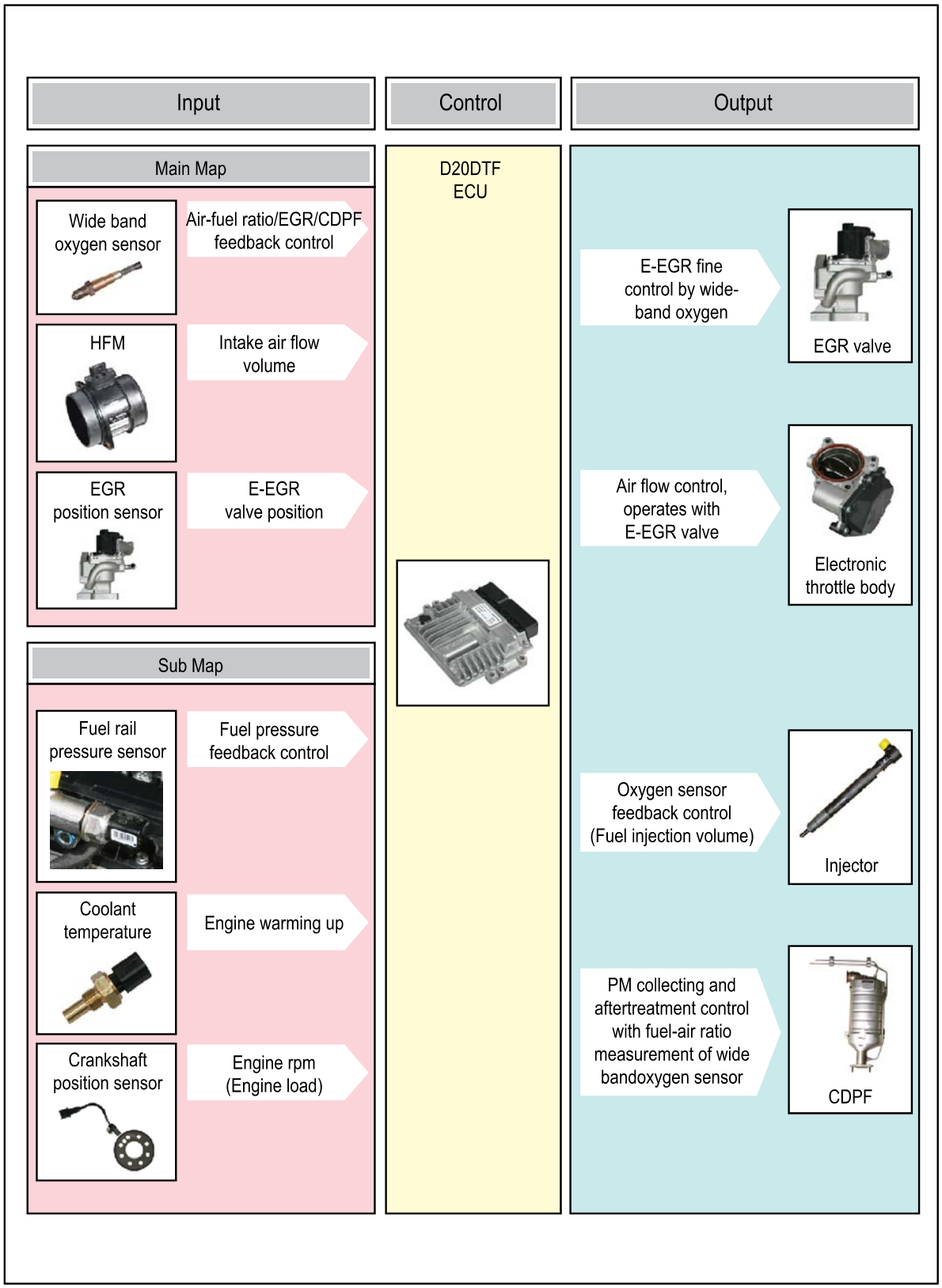
- The wide band oxygen sensor measures the oxygen density in exhaust gas and sends it to ECU to control the EGR more precisely.

b. Components



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c. Input/Output for oxygen sensor

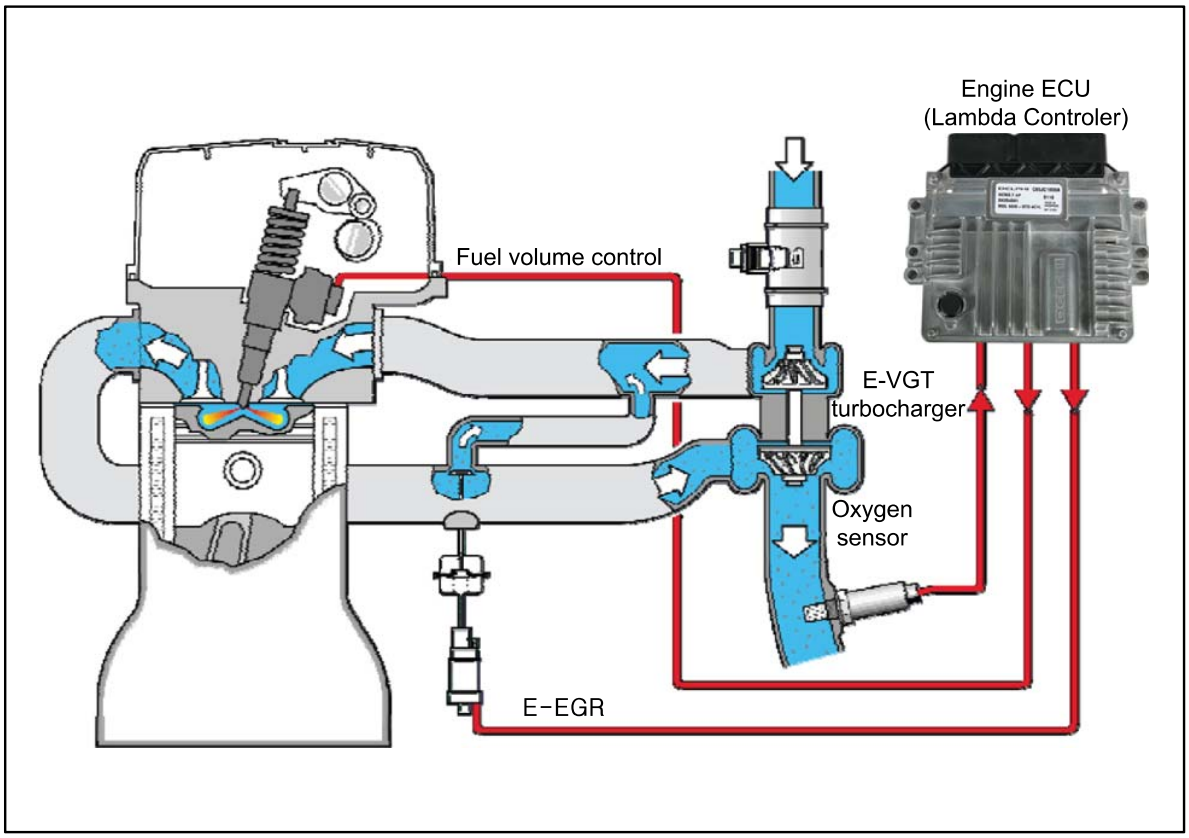


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d. Oxygen sensor control

The wide band oxygen sensor uses ZnO2. It produces the voltage by movement of oxygen ions when there is oxygen concentration difference between exhaust gas and atmosphere.
If a certain voltage is applied to the sensor, the movement of oxygen ions occurs regardless of the oxygen density. The current generated through this flow of ions, is called pumping current (IP), and the oxygen sensor measures this value.



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(8) Cooling fan control

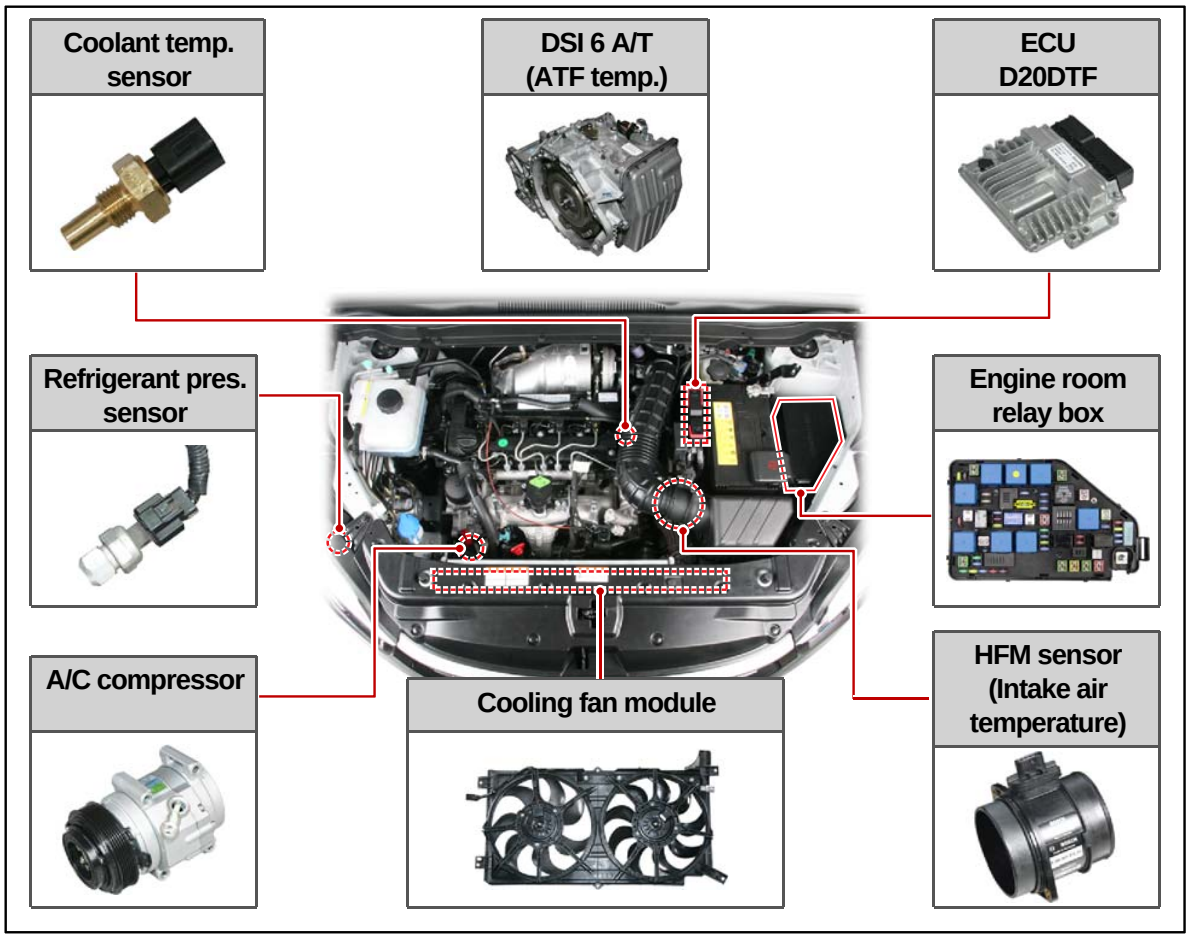
a. Overview of cooling fan and A/C compressor

The cooling system maintains the engine temperature at an efficient level during all engine operating conditions. The water pump draws the coolant from the radiator. The coolant then circulates through water jackets in the engine block, the intake manifold, and the cylinder head. When the coolant reaches the operating temperature of the thermostat, the thermostat opens. The coolant then goes back to the radiator where it cools. The heat from automatic transaxle is also cooled down through the radiator by circulating the oil through the oil pump.
There are two cooling fans (200W+150W) in D20DTF engine. ECU controls the electric cooling fans with three cooling fan relays to improve the engine torque and air conditioning performance.

NOTE

For details about A/C compressor and refrigerant pressure sensor, refer to Chapter "Air Conditioning System" in "Body" section.

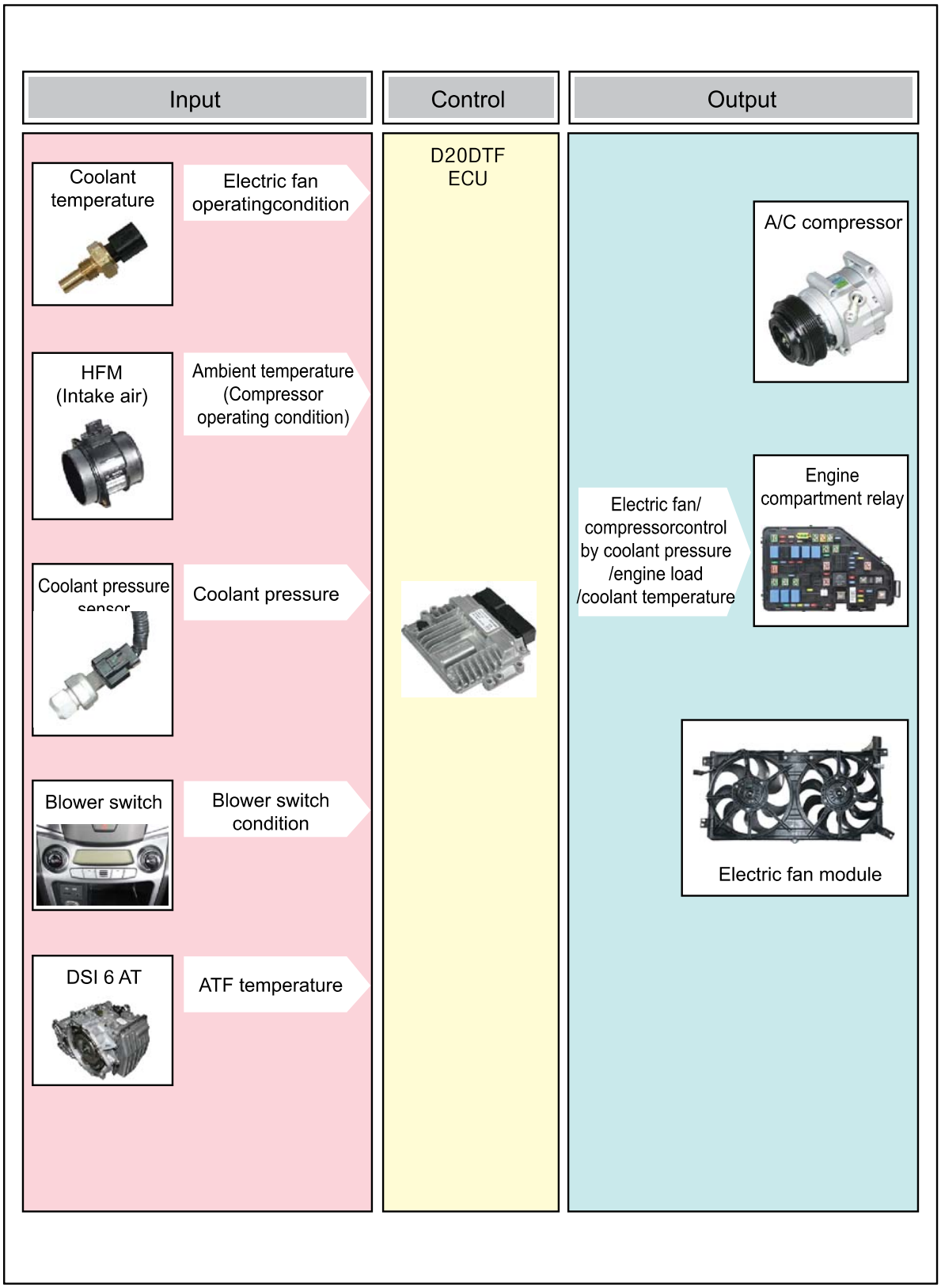
b. Components



Modification basis	
Application basis	
Affected VIN	

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c. Input/Output for cooling fan and A/C compressor



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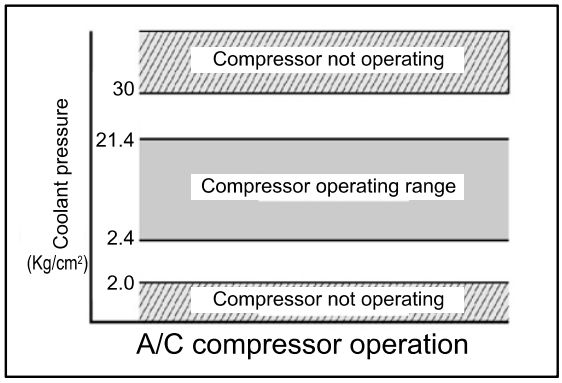
d. Cooling fan and A/C compressor control

▶ Conditions for cooling fan

The cooling fan module controls the cooling fan relay, high speed relay and low speed relay. The cooling fan is controlled by the series and parallel circuits.

A/C switch	Cooling fan	Coolant temperature	Refrigerant pressure	A/C compressor
OFF	OFF	Coolant temp. < 90℃	-	
	LO	90℃ ≤ Coolant temp. < 105℃	-	
	HI	105℃ ≤ Coolant temp	-	
ON	LO	Coolant temp. < 105℃	Refrigerant pressure < 18 bar	ON
	HI		18 bar ≤ Refrigerant pressure	
	HI	105℃ ≤ Coolant temp. < 115℃	-	
	HI	115℃ ≤ Coolant temp.	-	OFF (cut)

▶ A/C compressor OFF conditions



A/C compressor operation

- Coolant temperature: below −20℃ or over 115℃
- Approx. 4 seconds after starting the engine
- Engine rpm: below 650 rpm or over 4500 rpm
- When abrupt acceleration
- Refrigerant pressure:
  * OFF below 2.0 kg/㎠, then ON over 2.4 kg/㎠
  * OFF over 30 kg/㎠, then ON below 21.4 kg/㎠

▶ Output voltage according to refrigerant pressure

The output voltage from refrigerant pressure sensor is 1.7 V to 3.5 V when the refrigerant pressure is 10 to 24 kgf/㎠ with A/C "ON".

▶ Cooling fan control according to ATF temperature

ATF temperature	Cooling fan	Remark
Over 100˚C	High speed	-

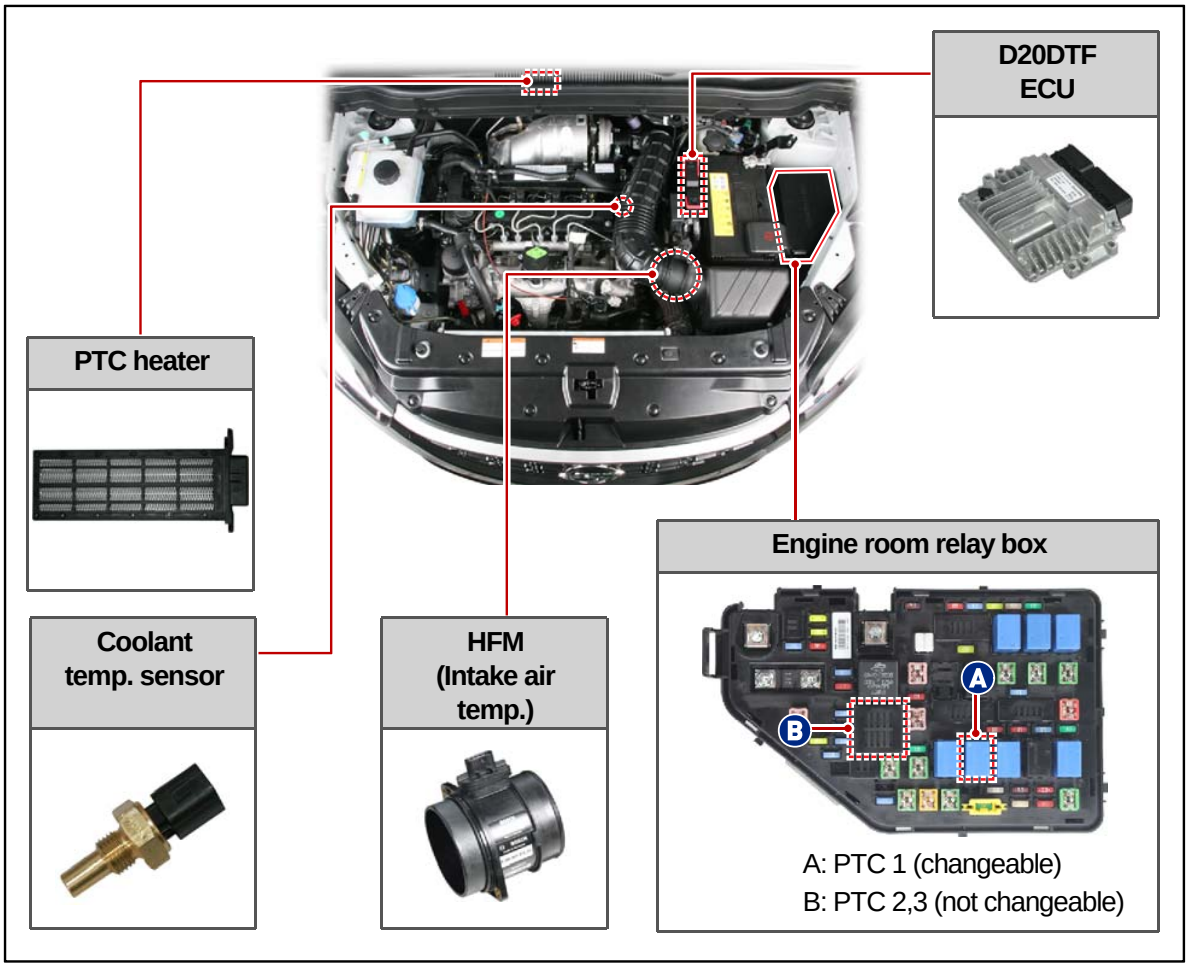
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(9) PTC heater control

a. 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. PTC does not operate during engine cranking, while the battery voltage is lower than 11 V or during preheating process of glow plugs.

b. Components

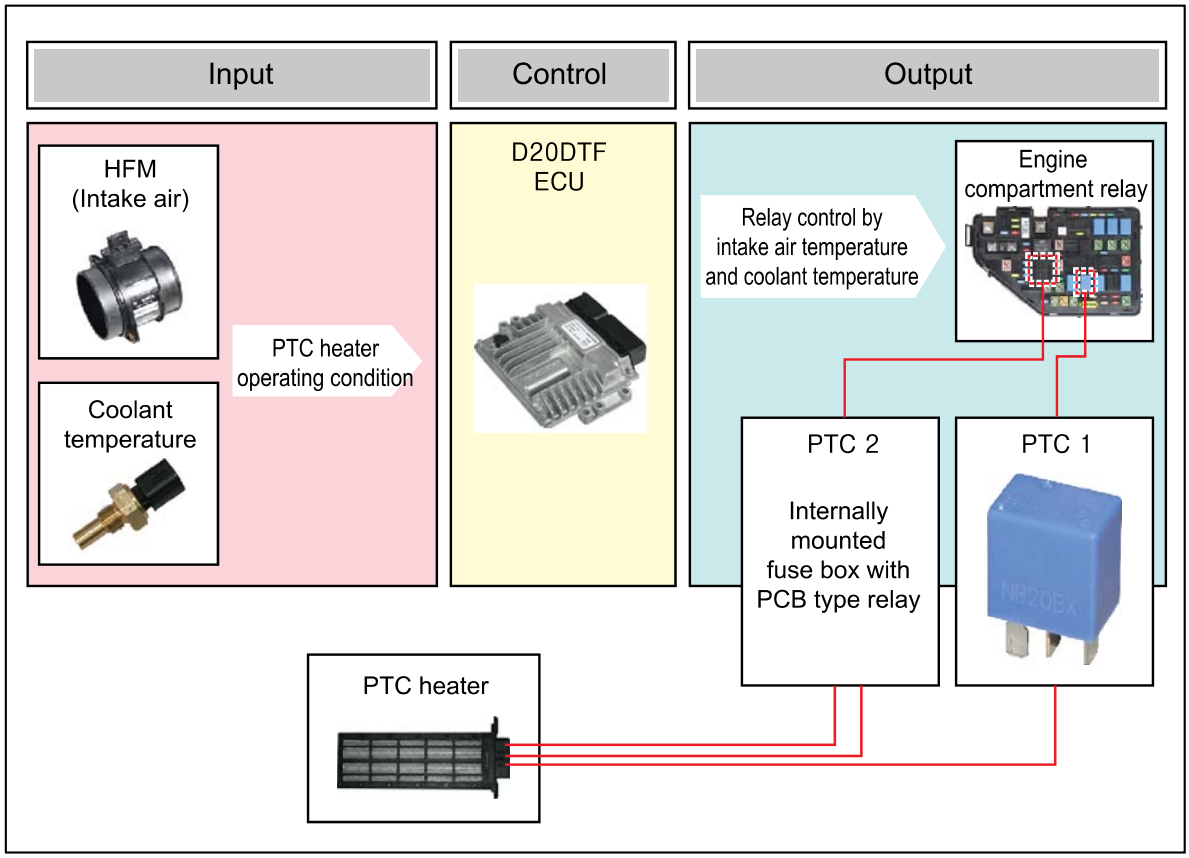


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c. Operation process

The ceramic PTC has a feature that the resistance goes up very high at a certain temperature. There are three circuits in PTC heater. Only one circuit is connected when PTC1 relay is ON, and two circuits are connected when PTC2 relay is ON.

Operation process: reaches at a certain temperature→high resistance→low current→less heat radiation→temperature down→high resistance→high current→temperature up



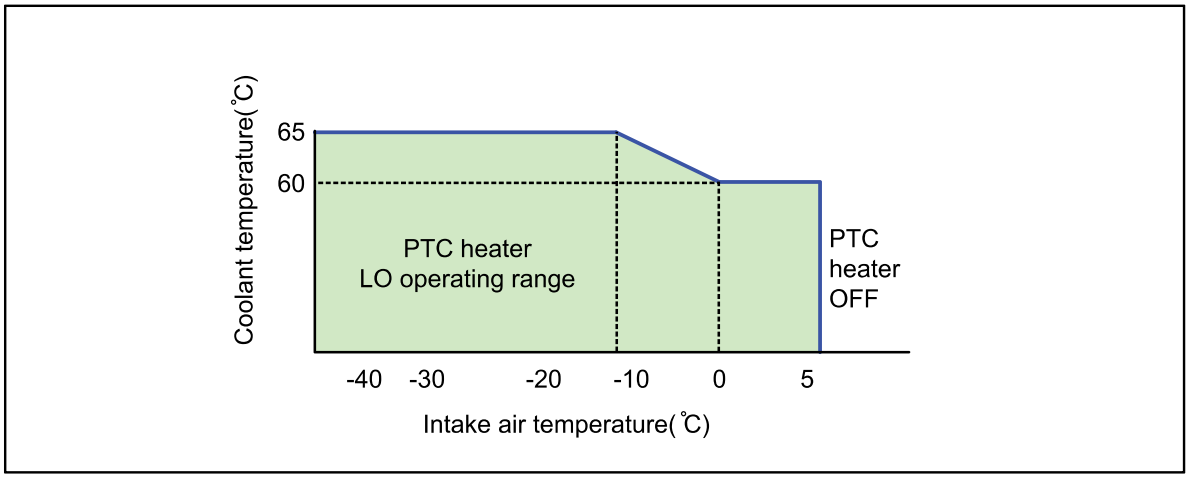
Modification basis	
Application basis	
Affected VIN	

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d. Control conditions

Operation	Operating condition	PTC Heater
HI (PTC2)	- Coolant temperature < 15℃	PTC HI ON
LO (PTC1)	- Coolant temperature 15℃ ≤ 65℃, intake air temperature ≤ −10℃ - Coolant temperature 15℃ < 65 to 60℃, intake air temperature <−10℃ to 0℃ - Coolant temperature 15℃ ≤ 60℃, intake air temperature ≤ 0℃ to 5℃	PTC LO ON
Stop	- A/C blower switch OFF - Defective ambient air temperature sensor (including open or short circuit) - Engine cranking - Low battery voltage (below 11V) - During pre-glow process (glow indicator ON)	

▶ **Operation diagram for PTC heater LO (step 2)**



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(10) Immobilizer control

a. Overview

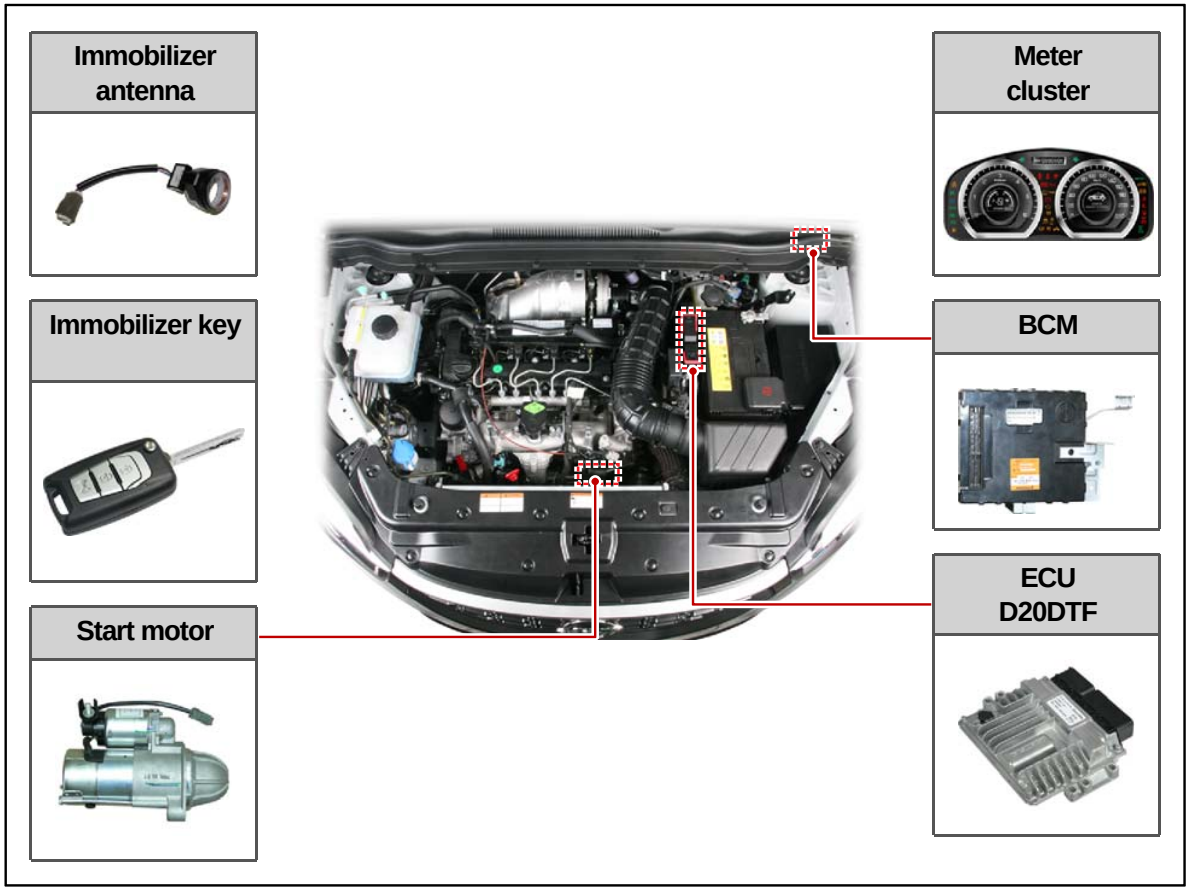
The Immobilizer System provides an additional theft deterrent to the vehicle in which it is installed and prevents it from being started by unauthorized persons. The transponder integrated in the key and the engine control unit have the same code. When the ignition key with the integrated transponder is turned to the ON position, the ECU (Engine Control Unit) checks the crypto code of the key and, if correct, allows the vehicle to start the engine.

NOTE

For details, refer to Chapter "BCM".

b. Components

▶ **Basic components (ignition key system)**

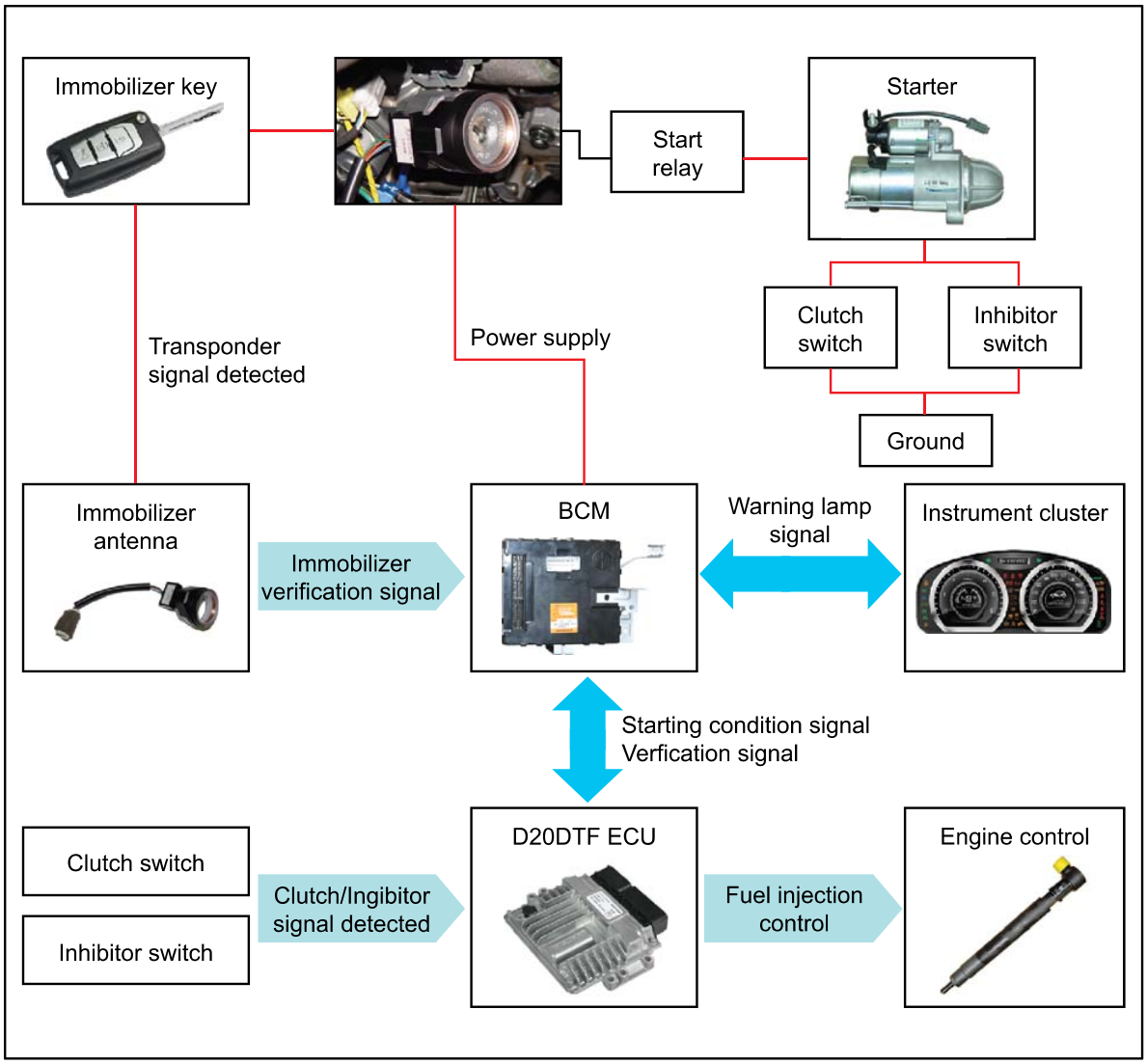


Modification basis	
Application basis	
Affected VIN	

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▶ Key approval process

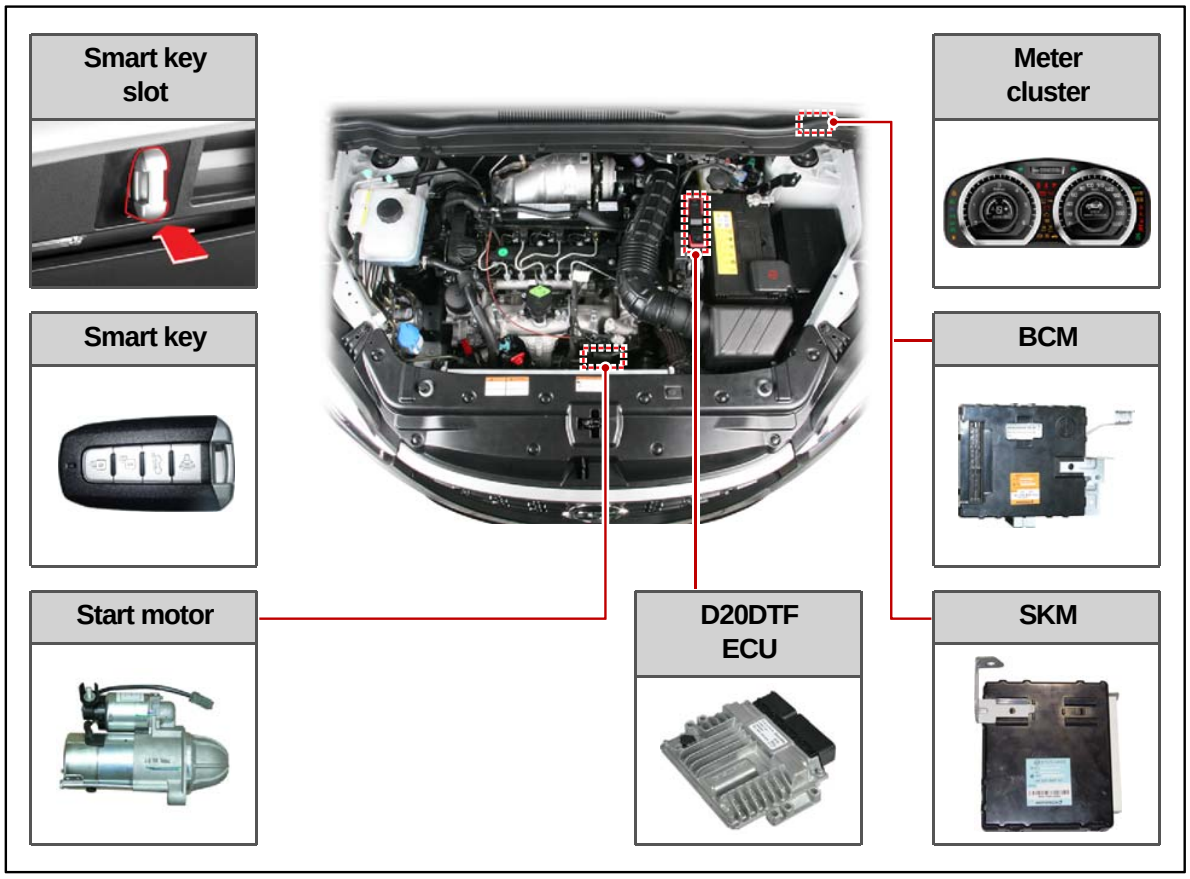
When turning the ignition switch to ON position, the power is supplied to BCM and ECU. ECU communicate with the immobilizer key to check if it is valid crypto code. If it is valid, ECU start to control the engine when turning the ignition switch to START position.
The system has 10 seconds of valid time-out period. If the engine does not start in this period, the key approval process should be done again.



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c. Components for immobilizer with Smart key system

▶ Components (For antenna, refer to Chapter "SKM")

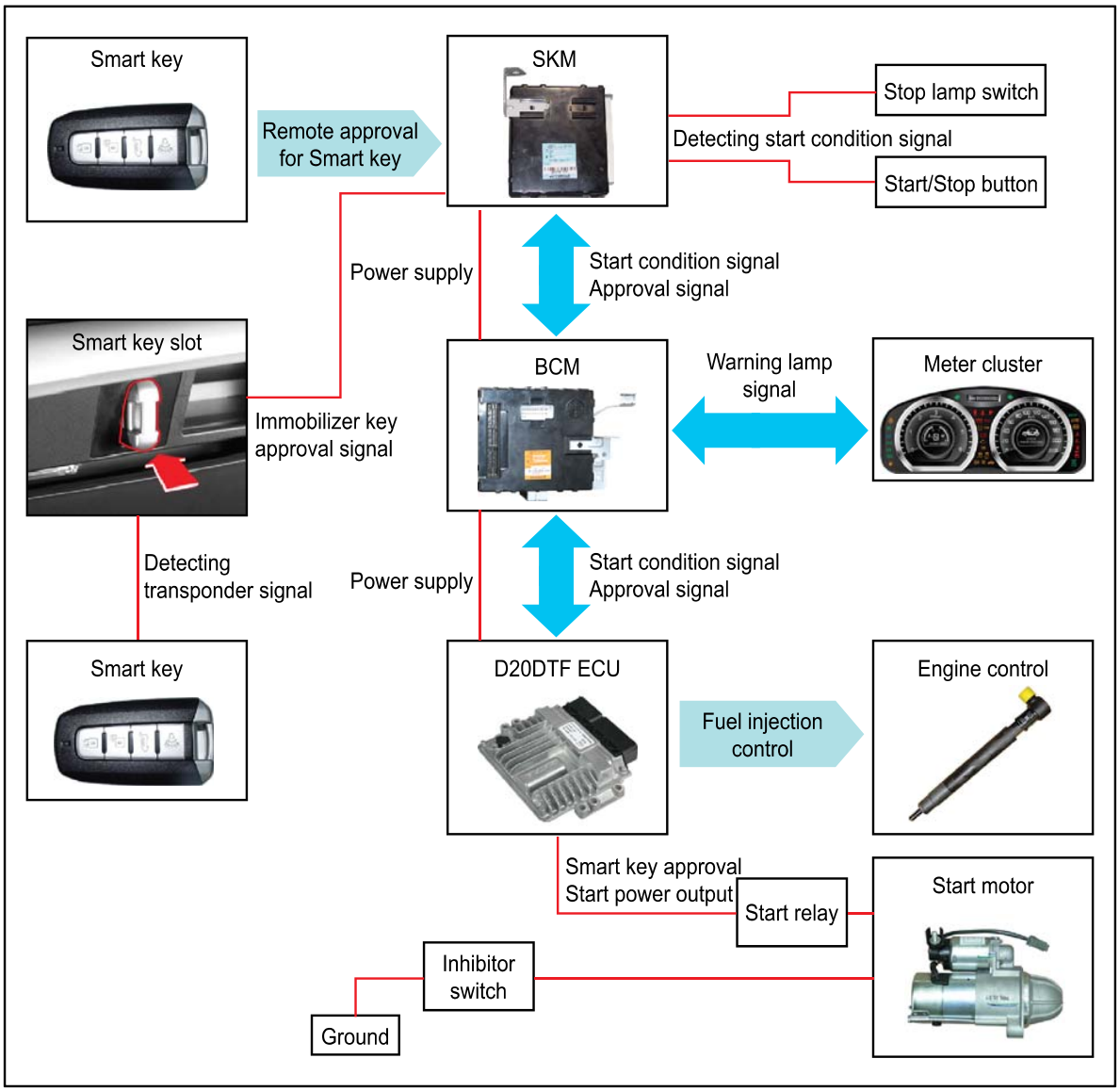


Modification basis	
Application basis	
Affected VIN	

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▶ **Key approval process in Smart key system equipped vehicle**
The key approval consists of two processes; immobilizer key approval and Smart key approval.

Immobilizer key approval: When inserting the Smart key into Smart key slot, the power is supplied to the key slot. SKM communicate with the Smart key in key slot to check if it has valid crypto code. If it is valid, ECU start to control the engine when pressing the Engine Start/Stop button. The system has 10 seconds of valid time-out period. If the engine does not start in this period, the key approval process should be done again.
Smart key approval: When pressing the Engine Start/Stop button or depressing the brake pedal without Smart key inserted into the key slot, SKM communicate with the Smart key to check if it has valid crypto code. If it is valid, the engine can be started.



Modification basis	
Application basis	
Affected VIN	

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(11) CDPF control

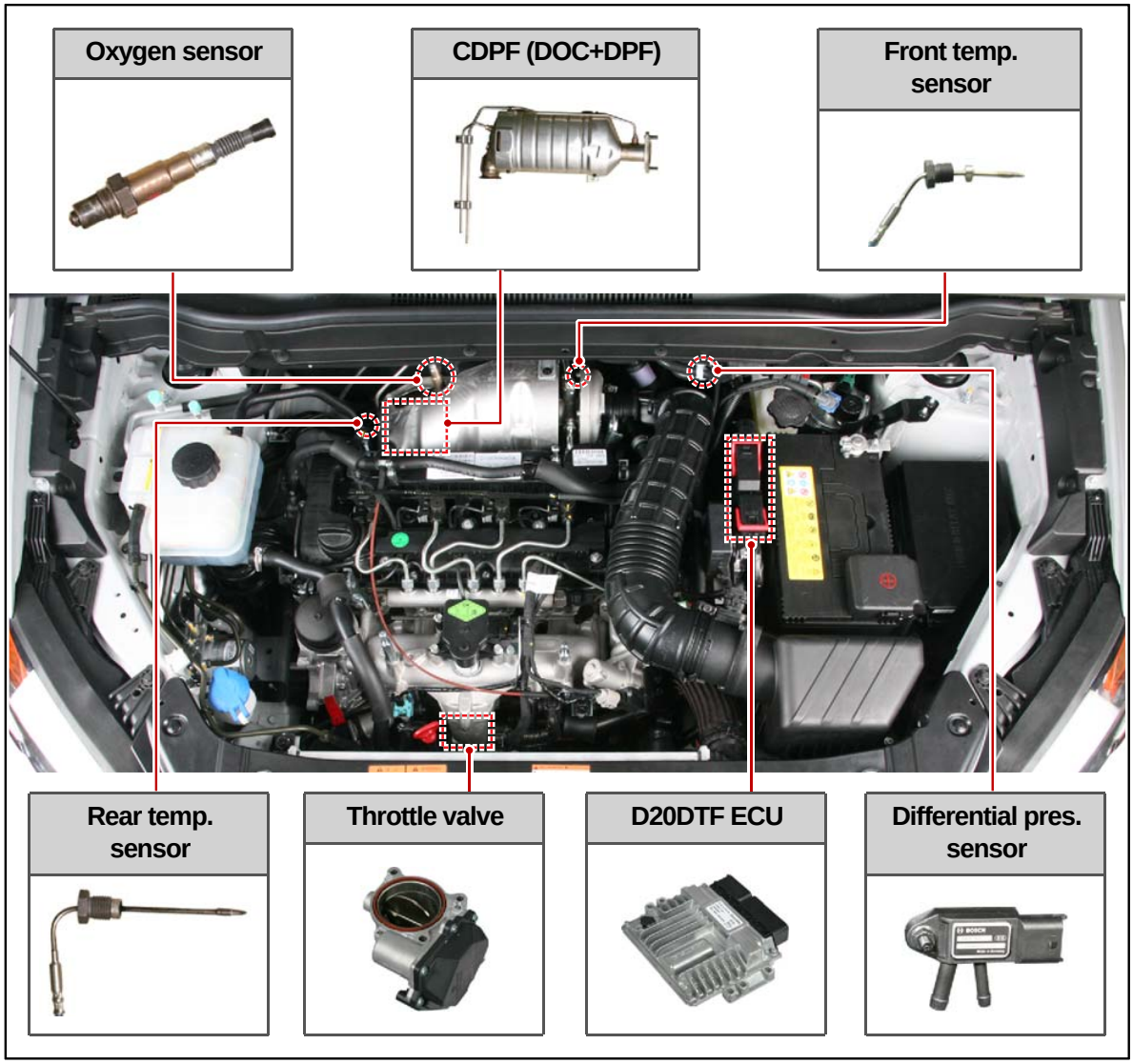
a. Overview

As the solution for environmental regulations and PM Particle Material) of diesel engine, the low emission vehicle is getting popular. This vehicle is equipped with an extra filter to collect the soot and burn it again so that the amount of PM in the exhaust gas passed through the DOC (Diesel Oxidation Catalyst) is reduced. The CDPF (Catalyst & Diesel Particulate Filter) is an integrated filter including DOC (Diesel Oxidation Catalyst) and DPF (Diesel Particulate Filter).

NOTE

For details, refer to Chapter "CDPF".

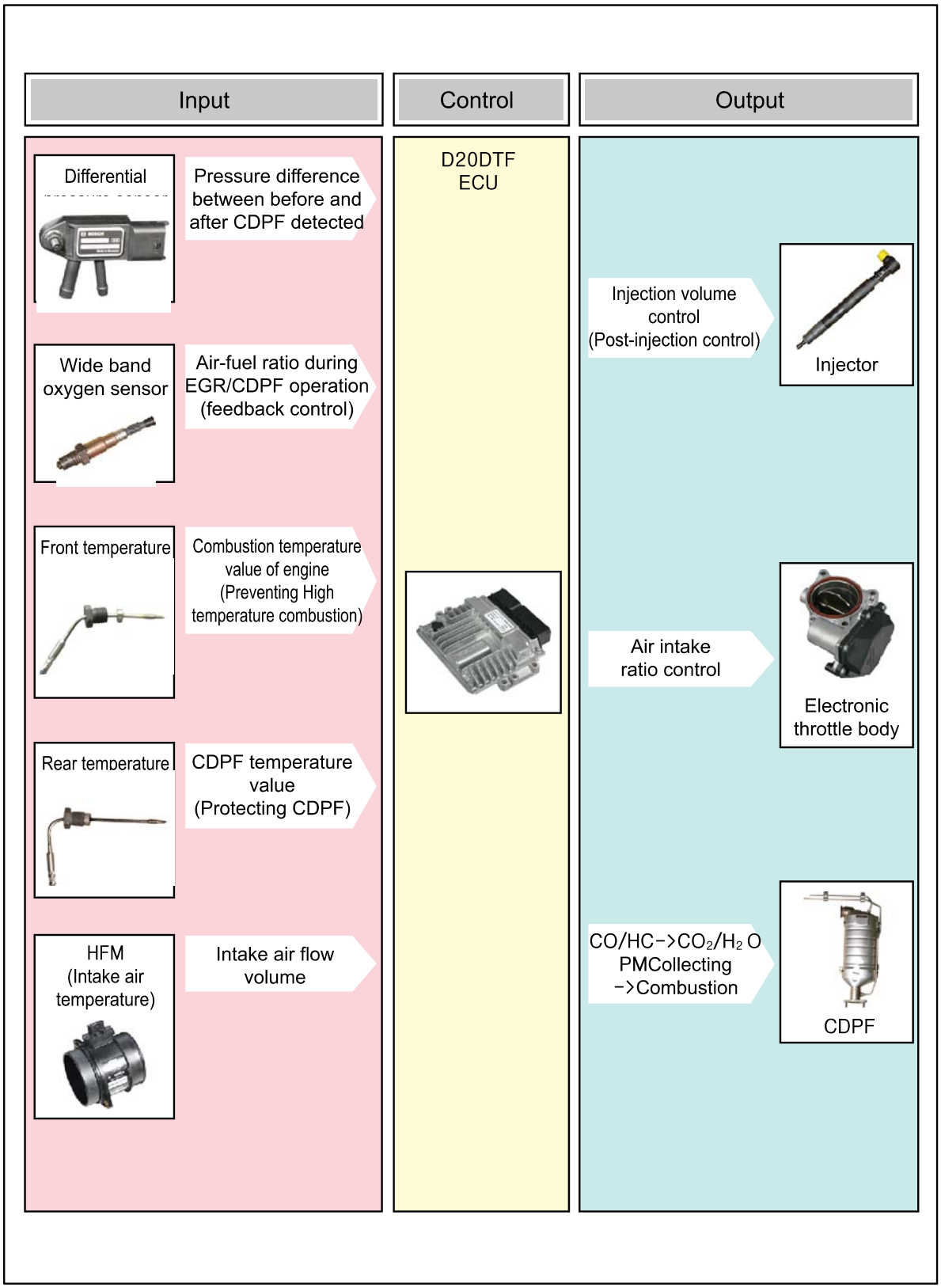
b. Components



Modification basis	
Application basis	
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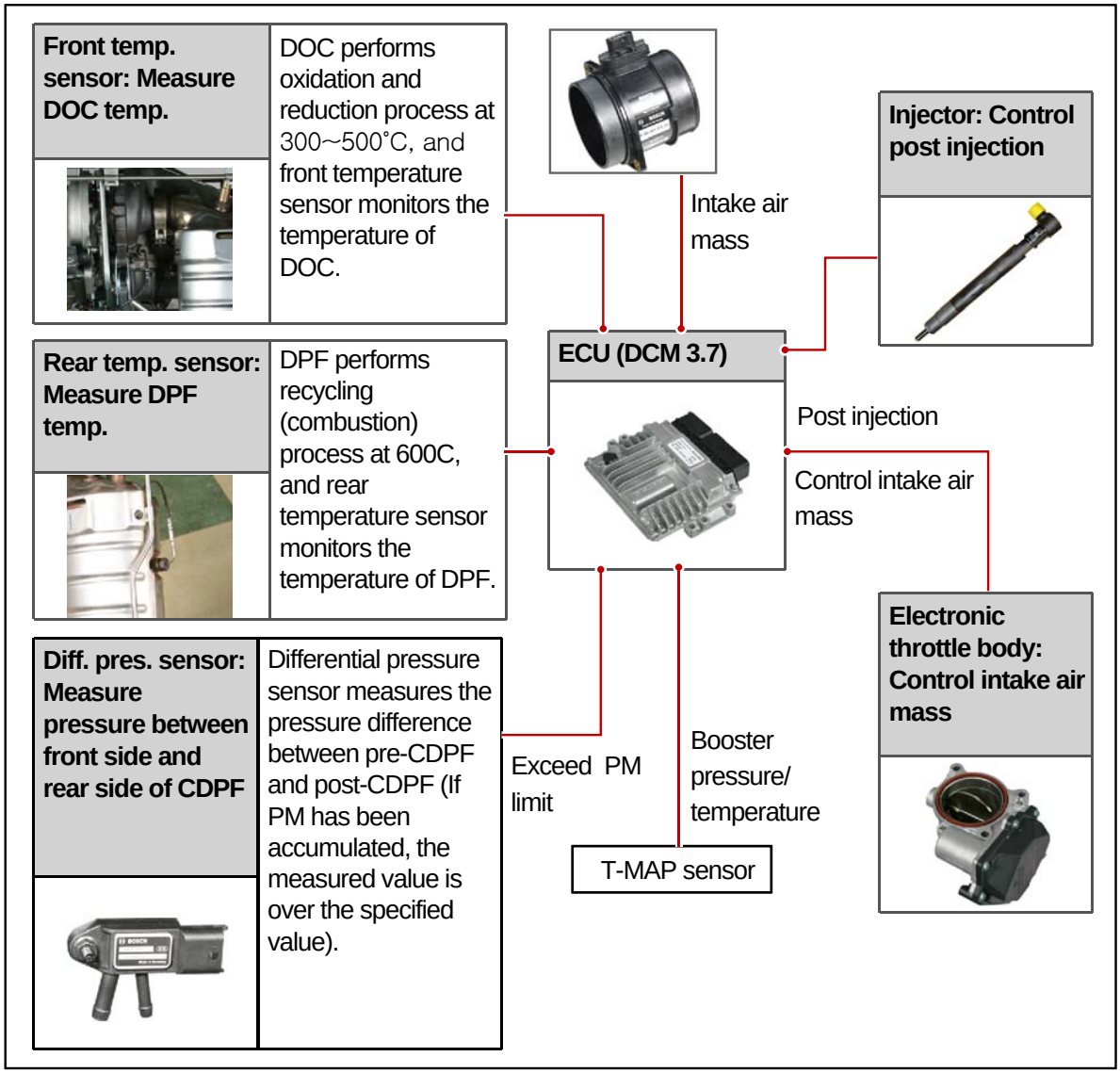
c. Input/Output for CDPF control



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d. Operation process

When the differential pressure sensor detects the pressure difference between the front and the rear side of CDPF, the sensor sends signal indicating the soot is accumulated and the post injection is performed to raise the temperature of exhaust gas. The amount of fuel injected is determined according to the temperature of exhaust gas detected by the rear temperature sensor. If the temperature is below 600°C, the amount of fuel injected is increased to raise the temperature. If the temperature is over 600°C, the amount of fuel injected is decreased or not controlled. When the engine is running in low load range, the amount of post injection and the amount of intake air are controlled. It is to raise the temperature by increasing the amount of fuel while decreasing the amount of intake air.



Modification basis	
Application basis	
Affected VIN	

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e. Cautions

- Use only specified Engine Oil (approved by MB Sheet 229.51) for CDPF.

1. Use only specified engine oil (Low Ash Oil)

- The vehicle equipped with CDPF should use specific engine oil to improve the engine performance and fuel economy, and ensure the service life of CDPF.

2. Issue with normal engine oil

- Sulfur, one of the contents of engine oil is burned and generates soot that is not regenerated by the DPF. This remains on the filter as ashes and keeps accumulating. Eventually, this ashes will block the filter.

3. Benefit for specified engine oil

- Minimized the sulfur content of engine oil which reduces the service life.
- Improved fuel economy and emission level of CO2 with high performance and low viscosity.
- Increased service life of engine oil with high resistance to temperature.

4. Problems when using unspecified engine oil

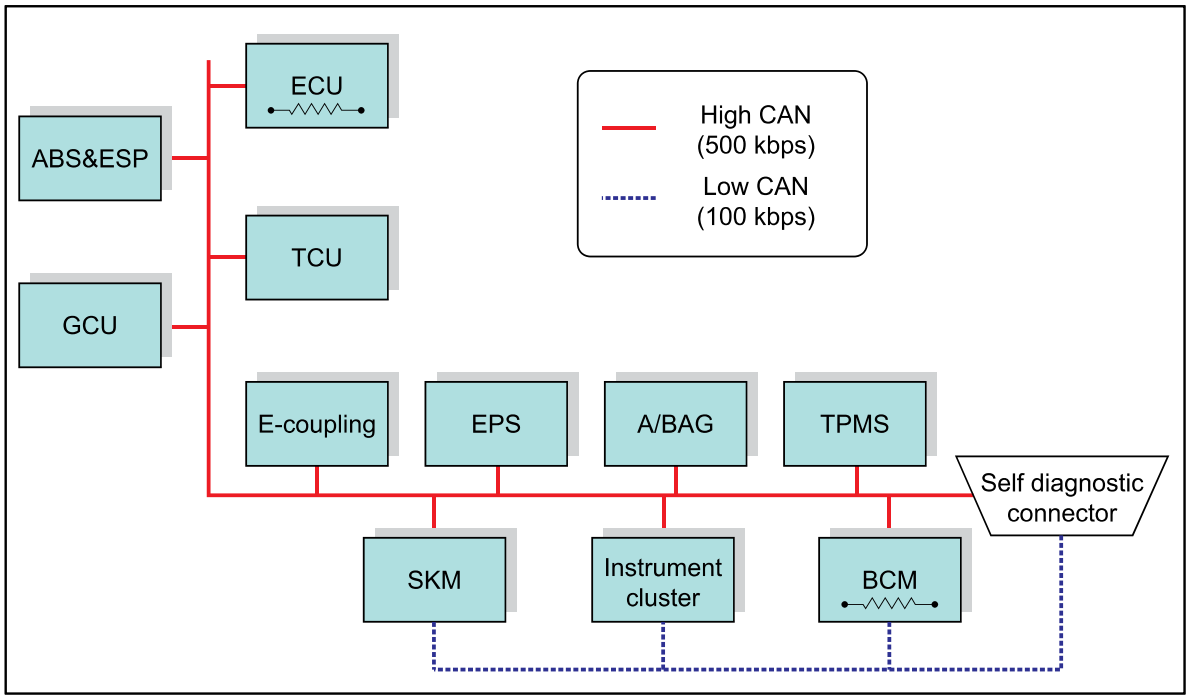
- The service life of filter may be reduced by 30% or more by the ashes accumulated on the filter. The fuel economy may be reduced because of engine rolling resistance, frequent regeneration of
- DPF.

* These problems are also caused by oil with high sulfur content, such as tax exemption oil and heating oil, etc.

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3) Input/Output for CAN communication

(1) Configuration of CAN (P-CAN/B-CAN)



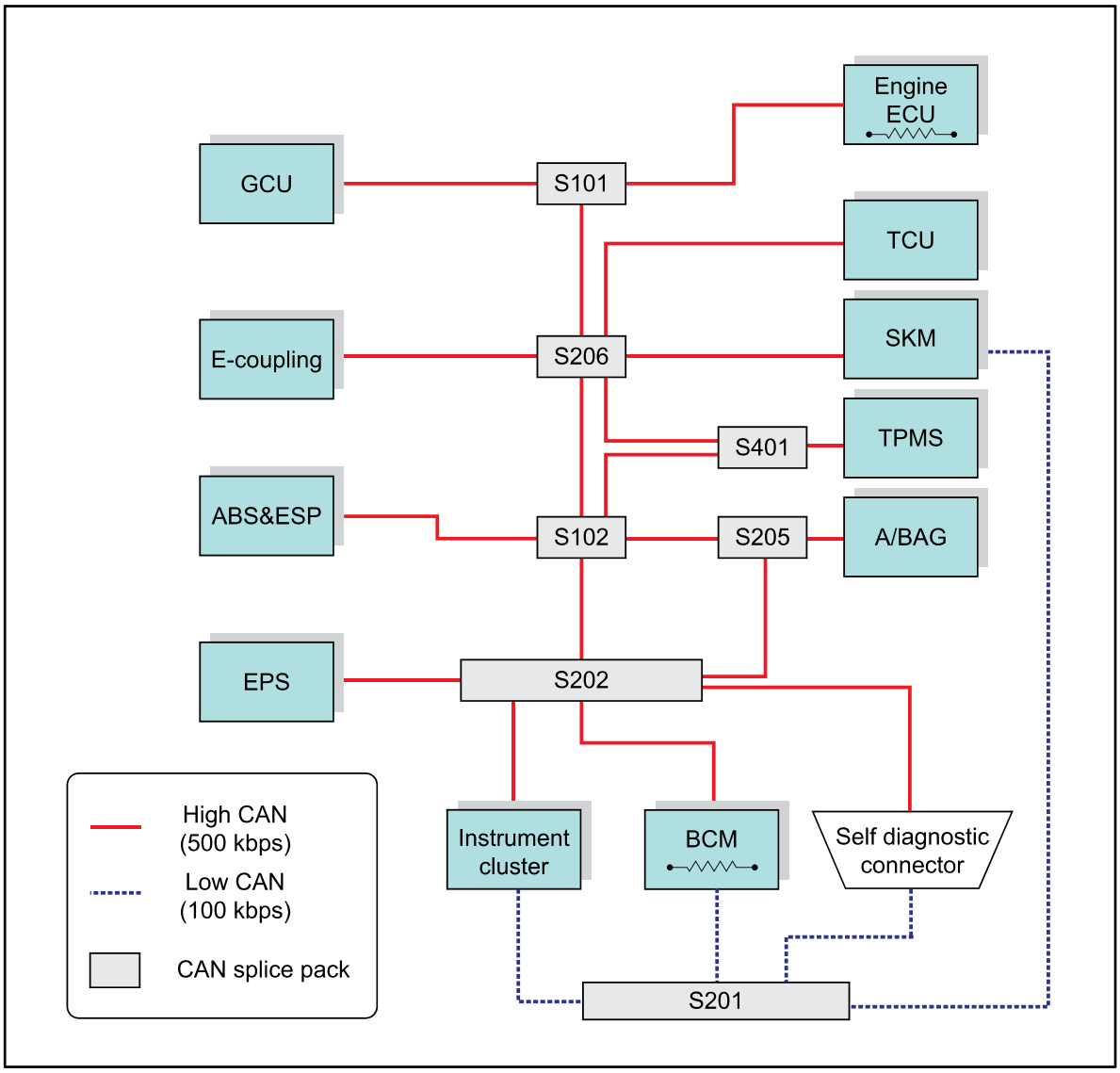
Abbreviation	Function
GCU	Glow Control Unit
EPS	Electronic Power Steering Unit
BCM	Body Control Module
SKM	Smart Key Module
TPMS	Tire Pressure Monitering System

CAN Topology communicate with system units. There are two types (P-CAN and B-CAN) of communication according to the communication speed. Instrument cluster, BCM and diagnostic connector use both types of communication. And, ECU, ABS & ESP, TCU, GCU, E-coupling and EPS unit use P-CAN communication because it is faster than B-CAN. The terminal resistances are installed in ECU and BCM.

Modification basis	
Application basis	
Affected VIN	

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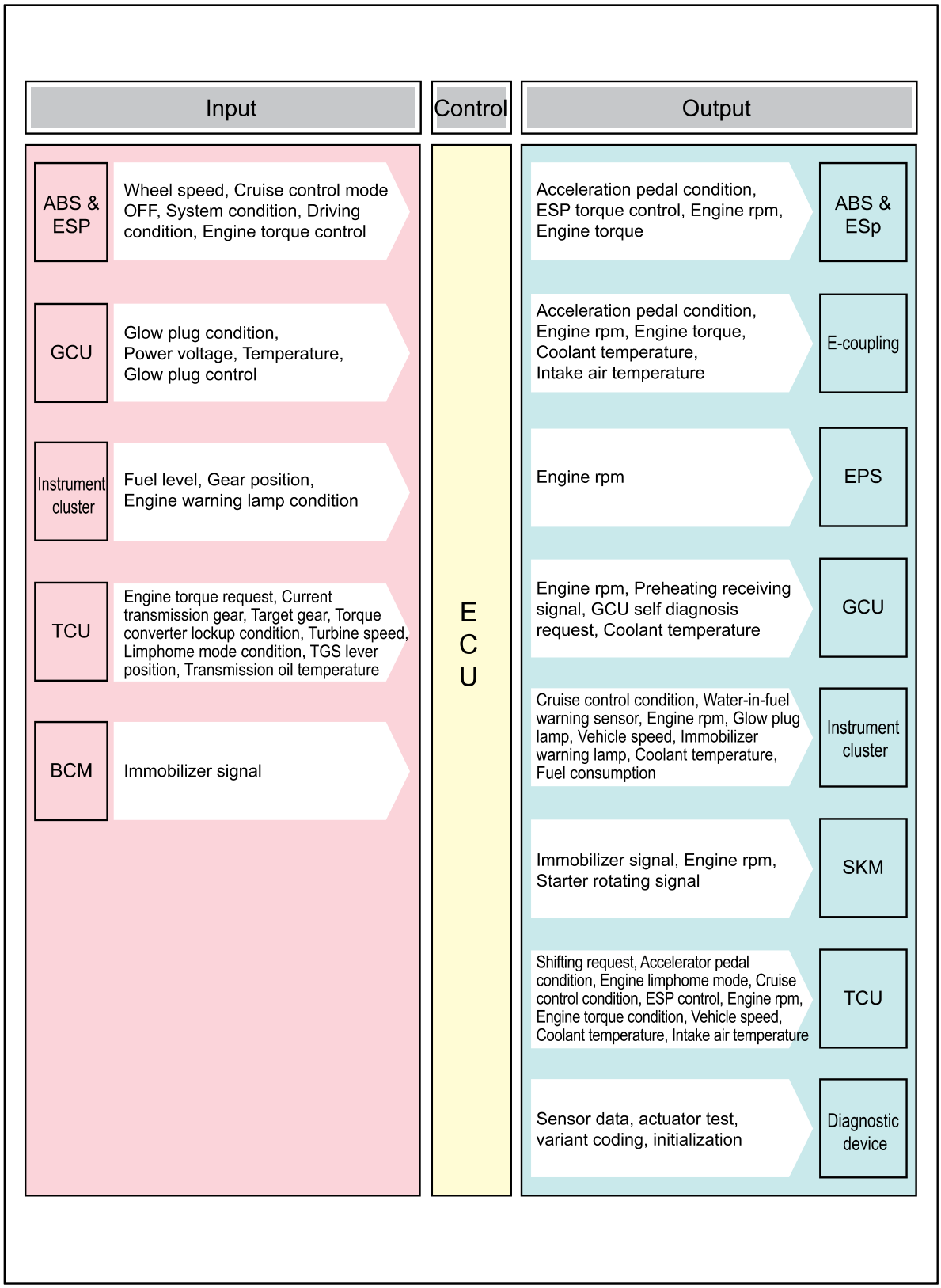
(2) CAN communication flow chart



Splice pack	Wiring harness	Location
S101	W/H Floor(LH)	Glow Control Unit
S102	W/H Floor(RH)	Inside RH Fender
S202	Main wiring	Backside Cluster(LH Cowl Cross Member)
S204	Main wiring	Backside Cluster(Upper ICM Relay Box)
S205	W/H Main	Backside Audio(CTR Cowl Cross Member)
S206	W/H Floor(LH)	Under Driver Seat
S401	W/H Floor(LH)	Beside PAS Unit(Inside LH QTR Trim)

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(3) Input/Output for CAN communication



Modification basis	
Application basis	
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ENGINE GENERAL

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GENERAL INFORMATION

1. LAYOUT

Front view	Rear view
	

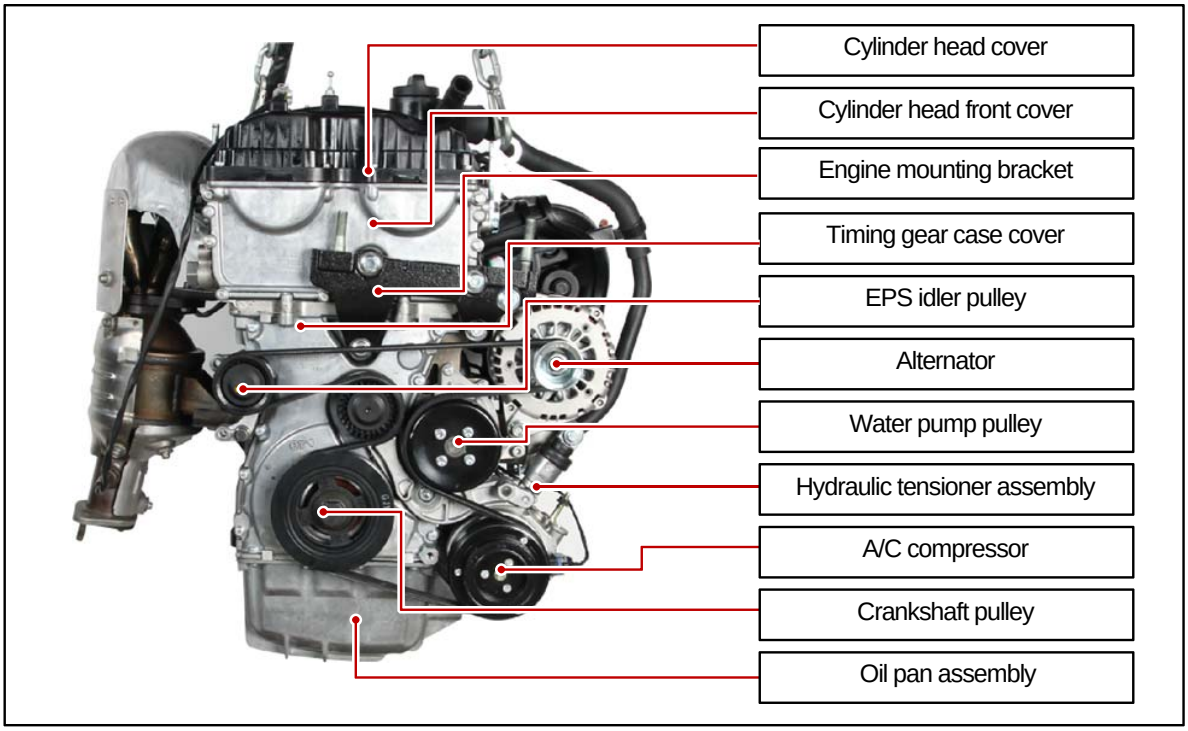
Right side view	Left side view
	

Modification basis	
Application basis	
Affected VIN	

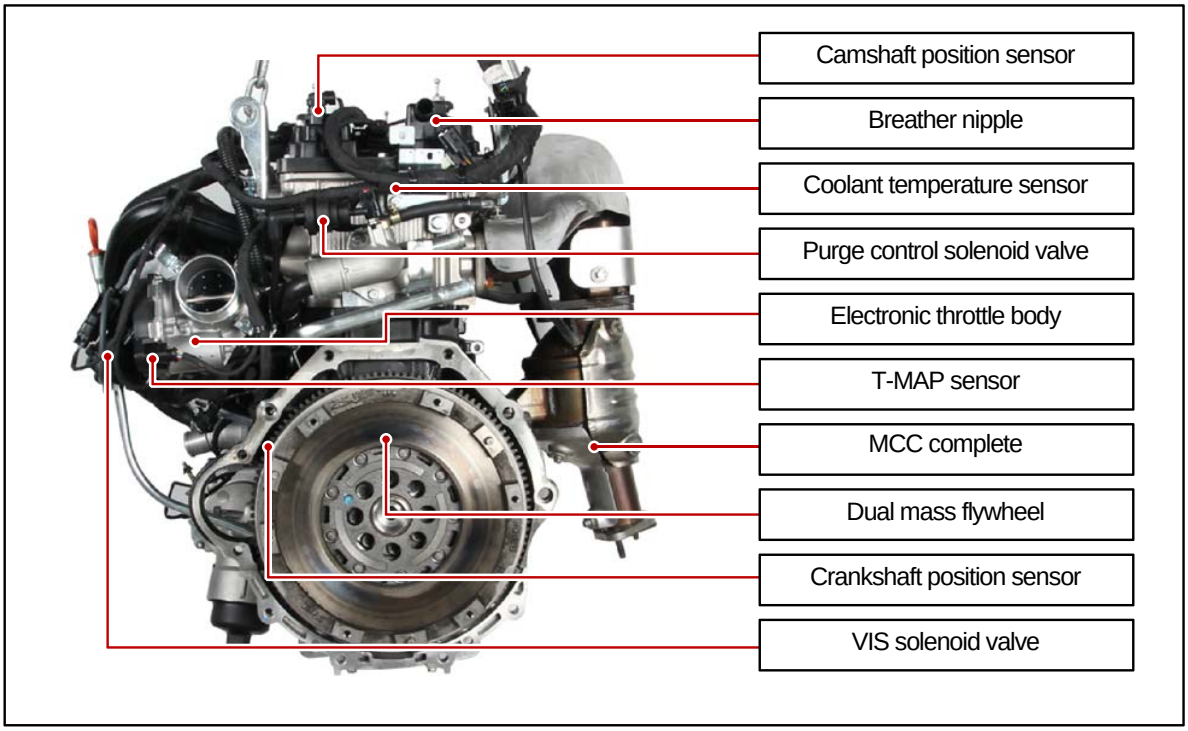
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2. MAJOR COMPONENTS

▶ **Front View**



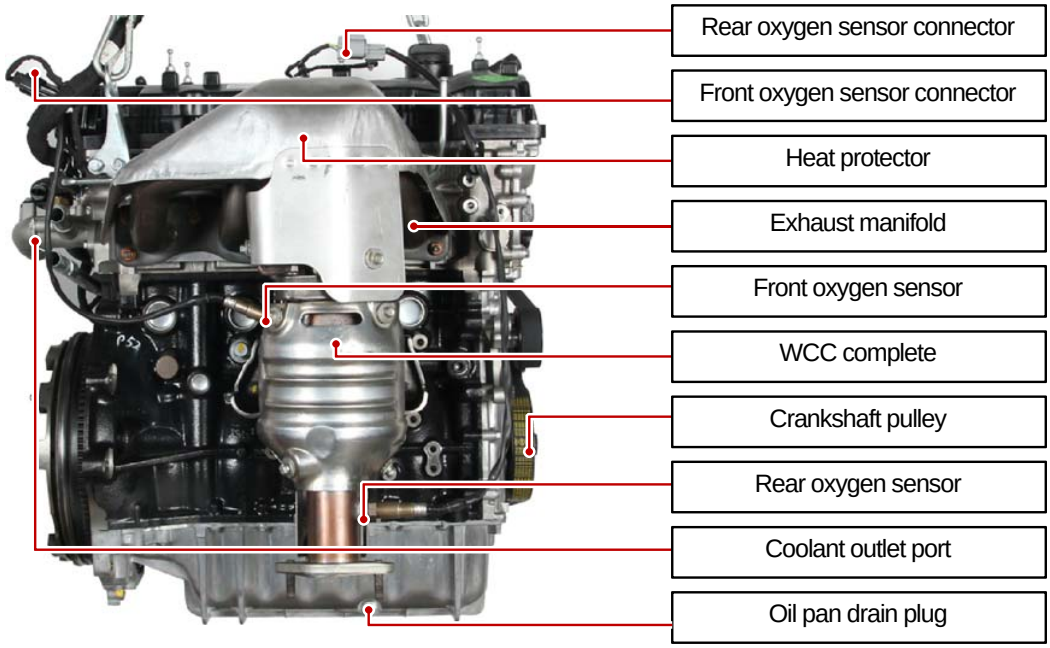
▶ **Rear View**



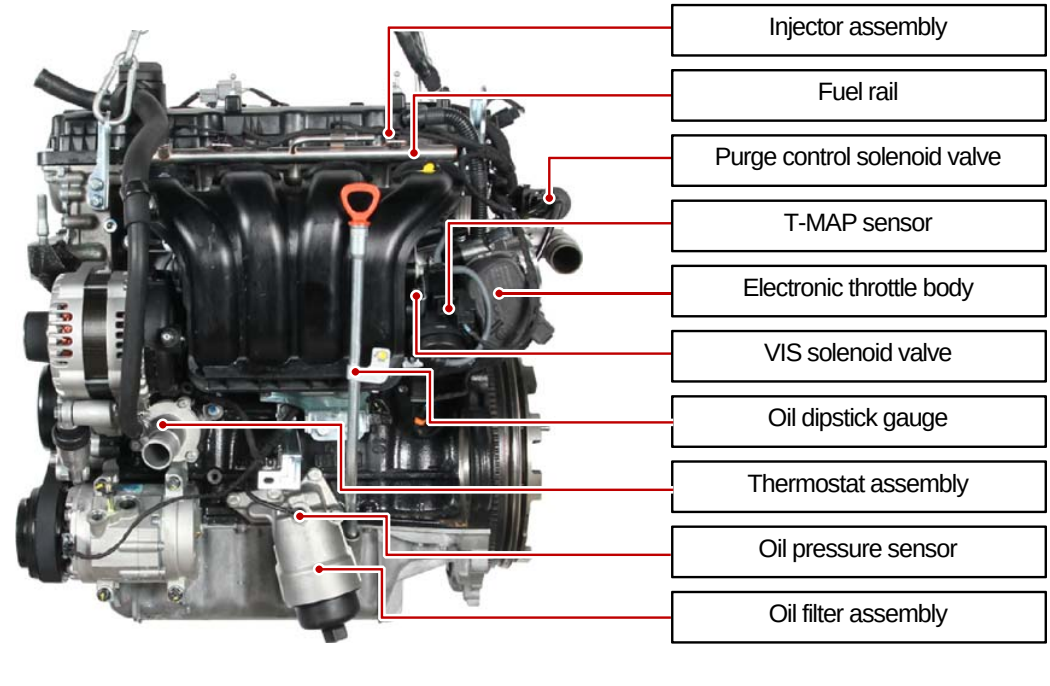
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▶ Right side view



▶ Left side view



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GENERAL INSTRUCTIONS

1. GUIDELINES FOR SERVICE WORKS

1) For Safety

To perform the service works easily ans safely, the service technicians must keep the proper working procedures and rules.
This manual provides the useful instructions to the service technicians so that they can perform the servive works with standard working process, skills, tips in time.
Please read this manual and follow the instructions carefully.

Signal words such as "WARNING", "CAUTION" and "NOTE" have special meanings.

NOTE
indicates information to assist maintenance and instructions.

CAUTION
indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damage.

WARNING
indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

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

Modification basis	
Application basis	
Affected VIN	

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2) Equipment

- Korando is FF (Front Engine Front Drive) type vehicle, and engine and powertrain system are integrated into a module. Therefore, 2-post lift and general equipment are necessary when working on the engine and transmission.
- Major equipment: Engine and transmission jack, Engine stand, Engine crane, Transmission jack, Engine hanger





Remove the engine and transaxle as a set.

- Manual transaxle: Transaxle can be separated after removing the front module (sub frame, engine and transaxle).
- Automatic transaxle: Transaxle can be separated after removing the sub frame.

3) General Instructions

(1) Before lifting up the vehicle with a lift, correctly support the lifting points.
(2) When using a jack, park the vehicle on a level ground and place the wheel chocks under the tires. Position the jack under the frame and lift up the vehicle and then support with chassis stand before service work.
(3) Make sure to disconnect the negative (-) cable from the battery to prevent any damage to electric systems.
(4) If you have to work on vehicle, cover the seats and floor with protection covers to avoid any damage and contamination.
(5) Brake fluid and anti-freeze can damage the painted surface of body. So carefully handle them during service work.
(6) To improve the efficiency of service work, use only recommended and specified tools.
(7) Use only Ssangyong genuine spare parts.
(8) Never reuse the cotter pin, gasket, O-ring, oil seal, lock washer and self-locking nut. Replace them with new ones. If reused, normal functions cannot be maintained.
(9) Store the disassembled parts as a set based on disassembly order and unit.
(10) Pay particular attention not to miss or mix the fasteners.
(11) If necessary, especially for inspection, clean the removed parts completely.
(12) Apply the oil or grease on the running and sliding surfeces before installation. Use the specified sealant and gasket to prevent leakage if necessary.
(13) Tighten the fasteners to the specified tightening torque.
(14) As a final stage of service work, check if the serviced system is working properly and the problem has been eliminated clearly.

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4) Basic Inspection

(1) Horn operation

- Listen for the horn sound when pressing the horn pad on the steering wheel.

(2) Brake operation

- Check if there is any abnormal noise, unusually long braking distance, or uneven braking force. If the brake warning lamp does not go out even after starting the engien or are flashing during driving, have the brake system checked immediately.
- Check the brake pipes and hoses for connection, oil leak, crack or interference after changing the position of tires. When replacing the tires, check the brake disc for surface condition and wear. Check the parking brake cable and brake operation. Shorten the checking interval if the parking
- brake is used frequently.

(3) Exhaust system

- Be aware to any changes in sound or smell from the exhaust system. These may be caused by leak or overheat. Have the exhaust system checked and repaired immediately.
- Inspect the exhaust system including catalytic converter. Inspect all the components and body frame near the exhaust system.

(4) Tires

- Unusual vibration of the steering wheel and seats or pulling to one side on the straight and level roads may indicates the uneven tire inflation pressure or poor wheel balance.

(5) Steering and suspension system

- Inspect the front and rear suspension and the steering system for damage, looseness or missing parts, signs of wear or lack of lubrication. Inspect the power steering line and the hoses for connection, leak, crack and chafing. Inspect the drive axle boot and seals for damage, tear or leak. Replace or repair the system if necessary.

(6) Engine oil

- Check the oil level when the engine is still warm and add the specified engine oil if necessary.

(7) Coolant

- Check the coolant level in the coolant reservoir, coolant conditions (contamination, foreign material), and hoses for damage and leak. Replace or add the Ssangyong genuine coolant, if needed.

(8) Engine drive belt

- Check all drive belts on the engine for wear, crack and looseness. Retighten or replace the belt, if needed.

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5) Guidelines on Engine Service

To prevent the personal injuries and vehicle damages that can be caused by mistakes during service and to provide the optimized performance and safety after service works, the service technicials must keep the basic cautions and service guidelines below. These could be easily forgotten during service works.

(1) Cautions before service works

- Make sure to disconnect the negative (-) cable from the battery to prevent any damage to electric systems.
- Make sure to clean the working area and to prepare the necessary tools before service works.
  Always place the ignition switch to OFF position if not required. Otherwise, there could be unexpected
- damage to electric devices or personal injuries due to short-circuit.
  To prevent the foreign material from entering into the fuel injection system, completely seal the inlets of
- HP pump, fuel hoses and high pressure pipes.
  To remoev the engine, use the dedicated equipments such as engine jack, transmission jack, engine
- stand and engine crane.

(2) Engine and accessories

Engine has a lot of precise components. The specified tightening torque and correct procedures should be kept during service works. And, the working area is always clean and well prepared.

- When disassembling the engine, related parts (bolts, gaskets, etc.) should be stored as a set.
- Clean the components completely with engine oil before assembling if needed.
- Fully drain the engine oil, coolant and fuel from the vehicle and seal the inlets with the plugs before removing the engine.
- All the interference should be eliminated before removing the engine.

(3) Electric devices

Extraordinary care should be taken when servicing the electric systems. Currently, the engine uses a lot of electric devices. Short circuit and poor contact may cause the low engine performance, incomplete combustion and other abnormalities.

- To prevent any damage to electric systems, make sure to disconnect the negative (-) cable from the battery and place the ignition switch to OFF position before servicing.
- Use only the specified parts with same ratings when replacing the electric devices. Check the grounds and connections for looseness.

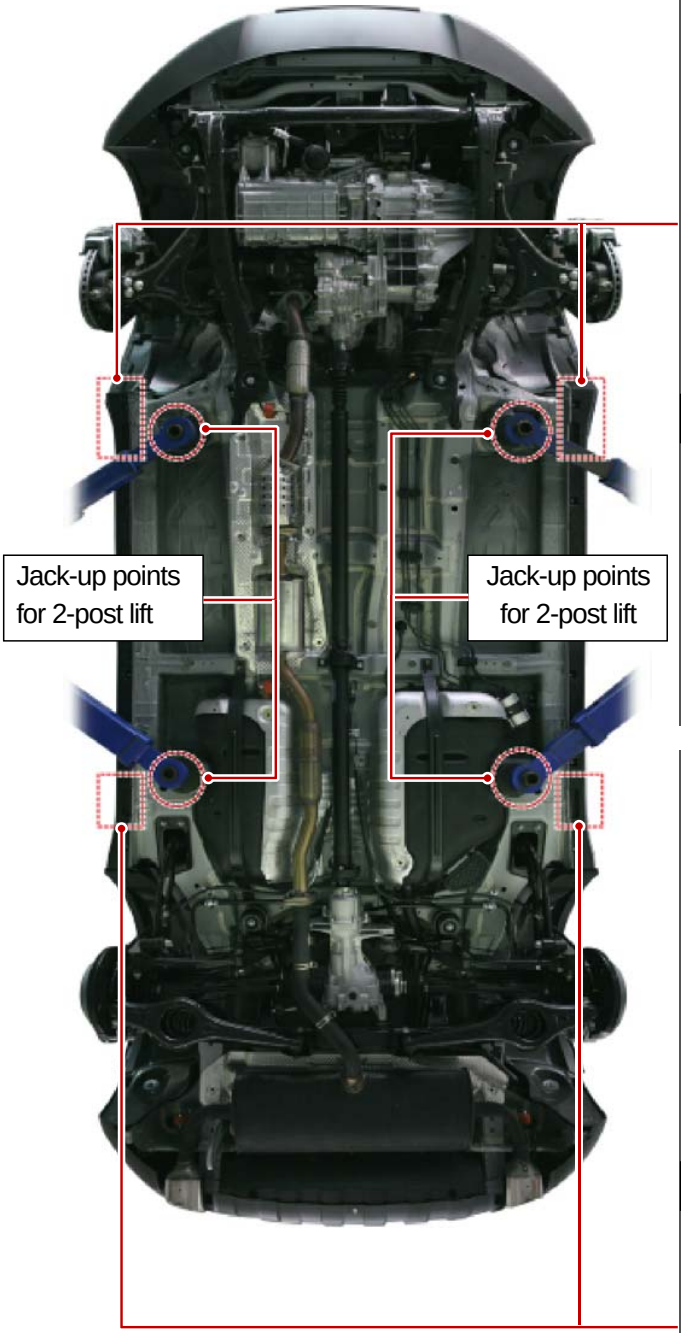
(4) Fuel and lubrication system

- When working with the fuel or oil systems in enclosed area, always keep the working area well-ventilated and never allow anybody to smoke.
- Gaskets and seals on the fuel and oil systems should be replaced with new ones. All bolts and nuts should be tightened as specified.
- Make sure to check the connections for leak after installation.

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2. JACK-UP POINTS

▶ **Stand jack-up points and installation status (front side)**



Jack-up points and setup (front side)



Supporting



Jack-up points and setup (rear side)



Supporting

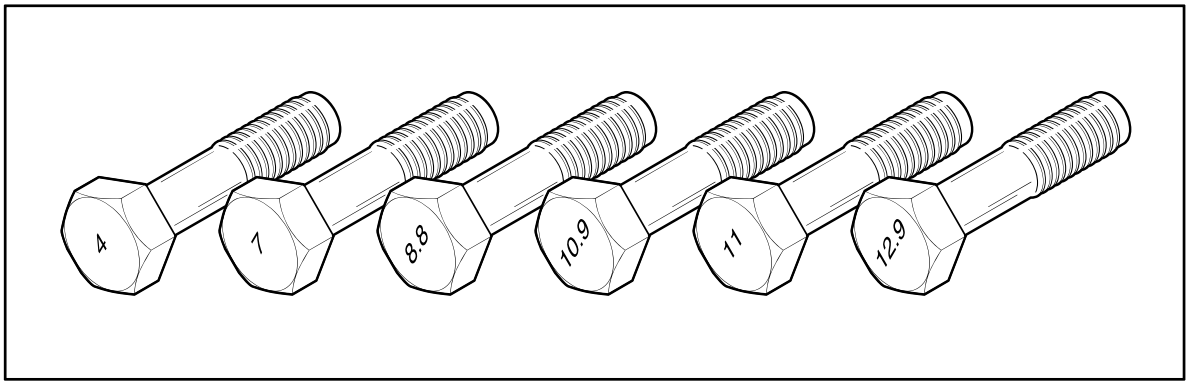


Modification basis	
Application basis	
Affected VIN	

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3. STANDARD BOLTS SPECIFICATIONS

Bolt	Pitch	Tightening torque(kgf.cm)					
		Standard			Limit		
		4T	7T	9T	4T	7T	9T
M3	0.5	5	9	13	7	12	17
M4	0.7	12	20	30	16	27	40
M5	0.8	24	40	57	32	53	77
M6	1.0	41	68	99	55	91	130
M8	1.25	88	160	230	130	210	310
M10	1.25	190	330	470	260	430	620
	1.5	190	310	450	250	420	600
M12	1.25	350	580	840	460	770	1,100
	1.75	330	550	790	440	730	1,000
M14	1.5	550	910	1,300	730	1,200	1,900
M16	1.5	830	1,100	2,000	1,100	1,900	2,700
M18	1.5	1,200	2,000	2,900	1,600	2,700	3,800
M20	1.5	1,700	2,800	4,000	2,200	3,700	5,300
M22	1.5	2,300	3,800	5,400	3,000	5,000	7,200
M24	1.5	2,900	4,900	7,000	3,900	6,500	9,400
	2.0	2,800	4,700	6,800	3,800	6,300	9,100



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

- Aluminum alloy: Tighten to 80 % of above torque table.
- Plastics: Tighten to 20 % of above torque table.

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4. CODING

1) Variant Coding

Description	Selection	Coding
Unleaded/leaded	Unleaded	Select the appropriate system
	Leaded	
Cruise control	No system	Select the appropriate system
	Cruise control	
	ACC	
	Undefined	
Vehicle speed Max	180kph	Selec : 190kph
	190kph	
	200kph	
	210kph	
Tire size	215/65R 16	Select the appropriate system
	225/60R 17	
	225/55R 18	
	undefined	
Air-Conditionation	Not equipped	Select the appropriate system
	Equipped	
OBD Information	No MIL OBD - I	Select the appropriate system
	MIL treatment OBD - I	
	MIL treatment OBD - II	
	MIL treatment E - OBD	
	MIL treatment KOBD	
Engine	E20	Select : E20
	E23	
	E28	
	E32	
	E36	
Body	Sedan	Select : Sedan
	Limousine	

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Description	Selection	Coding
Transfer case	2WD	2WD : 2WD 4WD : AWD
	TOD	
	P/T 4WD	
	AWD	
EPS	Not equipped	Select the appropriate system
	Equipped	
Select lever	BTRA lever	M/T : M/T lever A/T : DURA lever
	DC lever	
	DURA lever	
	M/T lever	
EPB	Not equipped	Select : Not equipped
	Equipped	
Enable RON conection	RON 89	Select : RON 95
	RON 91	
	RON 93	
	RON 95	
	RON 97	
	RON 98	
	RON 100	
	Not defined	
MIL	MIL - not illuminate	Select : MIL - illuminate
	MIL - illuminate	
Engine fan	Relay	Select : Relay
	PWM	
Coding is completed	NO	Select : YES
	YES	

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Description	Selection	Coding
Immobilizer & Key	Non - IMMO	Select the appropriate system
	BCM(IMMO)	
	SKM	
Vehicle variant message	Not defined	Select : Yes
	No	
	Yes	
Vehicle	Chairman	Select : KORANDO C
	W200	
	REXTON	
	Musso	
	Kyron	
	KORANDO C	
	KORANDO (old)	
	Actyon Sport	
Vehicle code, transmission	M/T	M/T : M/T A/T : NAGI/HPT
	NAGI/HPT	
	BTRA A/T	
	ION 6 speed A/T	
	NAG2 A/T	
TPMS	Not equipped	Select the appropriate system
	Equipped	
EBS(ABS/ESP)	Not equipped	Select the appropriate system
	ABS	
	TCS	
	ESP	
Telematics	Not equipped	Select : Not equipped
	Equipped	

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Description	Selection	Coding
EAS	Not equipped	Select : Not equipped
	ECS	
	2 Corner EAS	
	4 Corner EAS	
Domestic/Export	Domestic	Select the appropriate system
	General export	
	EU export	

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2) Parameter Coding

Parameter	Range	Remark
Fuel characteristic	1 ~ 6	
Idle RPM(P)	-50 ~ 127	
Idle RPM(D)	-50 ~ 127	
CO correction	-6.945 ~ 6.8907	
Pedal progress coding	1 ~ 3	
Idle RPM(P) - cold condition	-50 ~ 127	
Idle RPM(D) - cold condition	-50 ~ 127	

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ENGINE ASSEMBLY 1116-01

GENERAL INFORMATION

1. SPECIFICATION

Unit	Description		Specification
Cylinder head	Height		142.5 mm
	Weight		15.6 kg
	Flatness		Below 0.05 mm
	Spark plug offset		2.5 mm
	Thickness of cylinder head gasket (when compressed)		0.7 mm
Camshaft	Axial end play	Intake	0.1~0.35 mm
		Exhaust	0.1~0.35mm
	Valve timing	Intake valve open	BTDC 35/-10
		Intake valve close	ABDC 14/62
		Exhaust valve open	BBDC 40/40
		Exhaust valve close	ATDC 12/12
	Journal bearing	Diameter	24mm
		Width	17 mm
		Oil clearance	0.037~0.074 mm
Intake/exhaust valve	Lift of intake valve		Max. 9.0 mm
	Lift of exhaust valve		Max. 8.0 mm
	Length of intake valve		115.0mm
	Length of exhaust valve		114.0mm
Connecting rod	End play		0.5~1.5mm

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2. TIGHTENING TORQUE

Name	Size	Quantity	Tightening torque
Heater core screw bolt	-	1	70 ± 7 Nm
Ladder frame bolt	M8 X 1.25 X 20	7	25 ± 2.5 Nm
TGCC	M6 X 1.0 X 25	10	10 ± 1.0 Nm
Oil drain plug	-	1	30 ± 3.0 Nm
Oil pan bolt	M6 X 1.0 X 20	16	10 ± 1.0 Nm
Oil pan bolt	M6 X 1.0 X 35	4	10 ± 1.0 Nm
Oil pan bolt	M6 X 1.0 X 85	2	10 ± 1.0 Nm
Oil dipstick gauge bolt	M6 X 1.0 X 16	1	10 ± 1.0 Nm
Main gallery screw bolt	-	1	55 ± 5.5 Nm
Main bearing cap bolt	-	10	55 Nm + 90°
Cylinder head bolt	M12X1.75X102	10	55 Nm + 180°
Cylinder head TGCC side bolt	M8 X 1.25 X 30	4	25 ± 2.5 Nm
Cylinder head front cover bolt	M6 X 1.0 X 25	8	10 ± 1.0 Nm
Cylinder head cover bolt	M6 X 1.0 X 30	20	10 ± 1.0 Nm
Crankshaft center bolt	M18 X 1.5 X 50	1	200 ± 20 Nm
			90 ° + 10 °
Flywheel bolt	M10 X 1.0 X 22	8	45 ± 5 Nm
			90 ° + 10 °
Connecting rod bolt	M9 X 1.0 X 52	8	40 + 5 Nm
			90 ° + 10 °
Cam Cap bolt (#1)	M6 X 1.0 X 35	4	10 ± 1.0 Nm
Cam Cap bolt (#2~5)	M6 X 1.0 X 30	16	10 ± 1.0 Nm
Solenoid valve bolt	M5 X 0.8 X 22	1	8 ± 1 Nm
Intake manifold bolt	M8 X 1.25 X 32	5	25 ± 2.5 Nm

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Name	Size	Quantity	Tightening torque
Intake manifold lower bracket bolt	M8 X 1.25 X 16	4	25 ± 2.5 Nm
Exhaust manifold nut	-	7	40 ± 5 Nm
Heat protector bolt	M6 X 1.0 X 25	7	10 ± 1 Nm
Oil jet bolt	-	4	10 ± 1 Nm
Oil pump bolt	M8 X 1.25 X35	3	25 ± 2.5 Nm
Oil filter assembly assembly bolt	M8 X 1.25 X30	3	25 ± 2.5 Nm
Oil filter assembly assembly bolt	M8 X 1.25 X65	1	25 ± 2.5 Nm
Water pump bolt	M6 X 1.0 X22	1	10 ± 1 Nm
Belt tensioner upper bolt	M8 X 1.25 X30	1	25 ± 2.5 Nm
Belt tensioner lower bolt	M10 X 1.5 X55	1	65 ± 5 Nm
Water pump pulley bolt	M6 X 1.0 X12	4	10 ± 1 Nm
Thermostat bolt	M6 X 1.0 X22	3	10 ± 1 Nm
Coolant outlet port bolt	M6 X 1.0 X22	3	10 ± 1 Nm
Coolant pipe mounting bolt	M6 X 1.0 X14	3	10 ± 1 Nm
Bypass hose clamp	M24	2	3 ± 0.5 Nm
EPS idler pulley	-	1	25 ± 2.5 Nm
Engine mountinf stud bolt	-	2	50 ± 5.0 Nm
Engine front mounting bolt	M10 X 45	3	60 ± 6.0 Nm
Engine front mounting bolt	M10 X 77	1	60 ± 6.0 Nm
Engine front hanger bracket	M8 X 1.25 X 20	2	25 ± 2.5 Nm
Engine rear hanger bracket	M8 X 1.25 X 20	4	25 ± 2.5 Nm
A/C compressor bolt	-	4	25 ± 2.5 Nm
Alternator bolt	M10	4	45 ± 4.5 Nm
Start motor bolt	M10	4	Max. 48Nm
Power steering braket bolt	M8 X 1.25 X 50		30 ± 3.0 Nm

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3. GUIDELINES ON ENGINE SERVICE

G20DF engine is for FF (Front Engine Front Drive) type vehicle. Therefore, there are some deferent maintenance and repair works compared to the engine for FR (Front Engine Rear Drive) type vehicle. For safe and correct works, you must observe the working procedures and instructions in this manual. And, use the designated tools as follow:
: Power train mounting stand / Engine hanger / Engine stand / Heavy duty engine jack.

▶ Cautions before service works

- G20DF engine is FF (Front Engine Front Drive) type engine, and the engine and transmission are integrated in a same module. Remember that there are many differences compared to conventional engine in FR (Front Engine Rear Drive) type SUV vehicle.
  To remove the engine, use the dedicated equipments such as engine jack, transmission jack, engine stand and engine crane (1 ton).
- To prevent the engine from abruptly starting during service in engine compartment, never allow anybody to stay in the vehicle.
- Make sure to disconnect the negative (-) cable from the battery to prevent any damage to electric systems.
- Make sure to clean the working area and to prepare the necessary tools before service works. Always place the ignition switch to OFF position if not required. Otherwise, there could be
- unexpected damage to electric devices or personal injuries due to short-circuit..
  To prevent the foreign material from entering into the fuel injection system, completely seal the
- inlets of HP pump, fuel hoses and high pressure pipes.
  Do not remove the engine while supporting the oil pan with a jack.
-

▶ Lifting up the vehicle

- Before lifting up the vehicle with a lift, correctly support the lifting points.
- To prevent the vehicle from rolling down, put the chocks under the tires (when using a 4-post lift). Make sure to support the correct lifting points (when using a 2-post lift).
-

Modification basis	
Application basis	
Affected VIN	

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▶ Engine and accessories

Engine has a lot of precise components. The specified tightening torque and correct procedures should be kept during service works. And, the working area is always clean and well prepared.
When disassembling the engine, related parts (bolts, gaskets, etc.) should be stored as a set.

- Carefully read the disassembly and reassembly procedures in this manual before starting the works.
- Clean the components completely with engine oil before assembling if needed.
- Fully drain the engine oil, coolant and fuel from the vehicle and seal the inlets with the plugs before removing the engine.
- All the interference should be eliminated before removing the engine.

▶ Exhaust system

- Wear the protective gloves before removing the exhaust pipe.
- The exhaust pipe is very hot immediately after stopping th engine. Check if the exhaust pipe is fully cooled down before servicing the exhaust system.

▶ Cooling system

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

▶ Tightening the fastener

When reassembling the parts to G20DF, use the angle tightening as a final step.
1. Clean the mating surfaces before tightening.
2. Place the marks with paint to tighten by angle if the angle wrench is not available.

NOTE

The position and direction of the componets is based on the rear view.
Do not tighten the fasteners with excessive force. Especially, the threads of cylinder block could be damaged.
The self screw bolt makes the thread itself when tightening it. Do not apply excessive force.
Do not reuse the bolt that has been tightened with angle tightening method.

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▶ Fuel and engine oil system

The engine oil and fuel damages the painted surfaces and rubber material of the vehicle.

- Disconnect the negative cable from the battery before servicing the fuel system, and prepare the service plug grip.
- When working with the fuel or oil systems in enclosed area, always keep the working area well-ventilated and never allow anybody to smoke.
- Do not allow the gasoline to contact to rubber or leather parts.
- Carefully separate the pipe between high pressure fuel pump and fuel injector so that any fuel can be spilled out.
- Fully release the pressure from the fuel system before removing any parts of fuel system.
- To release the fuel pressure in high pressure line, let the engine fully cool down.
- Gaskets and seals on the fuel and oil systems should be replaced with new ones. All bolts and nuts should be tightened as specified.
- Prolonged exposure to the engine oil make cause a skin cancer or an irritation.
- Used engine cotains the hazardous material that may cause the skin cancer. Do not allow the used engine to make contact with your skin.
- Make sure to wear the protection gloves and goggle when handling the engine oil. If contact happens, rinse affected areas immediately with plenty of water. Do not wash it with gasoline or solvent. If irritation persists, consult a doctor.
- Improperly disposed engine oil can pollute the environment. Dispose the used engine oil and oil filter in accordance with local environmental regulations.
- Make sure to check the connections for leak after installation.

▶ Electric devices

Extraordinary care should be taken when servicing the electric systems. Currently, the engine uses a lot of electric devices. Short circuit and poor contact may cause the low engine performance, incomplete combustion and other abnormalities.

- To prevent any damage to electric systems, make sure to disconnect the negative (-) cable from the battery and place the ignition switch to OFF position before servicing.
- Use only the specified parts with same ratings when replacing the electric devices. Check the grounds and connections for looseness.

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OVERVIEW AND OPERATING PROCESS

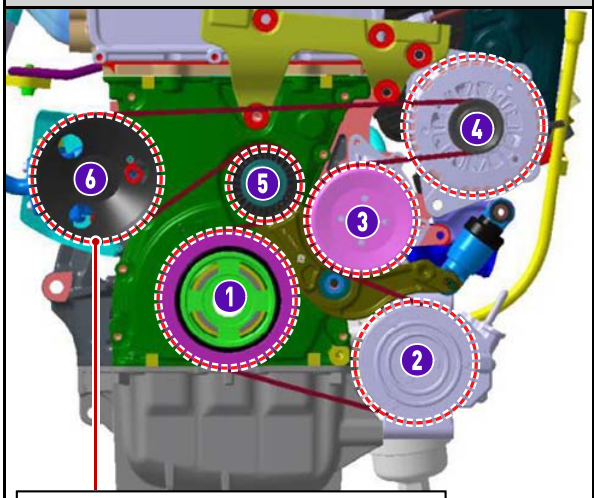
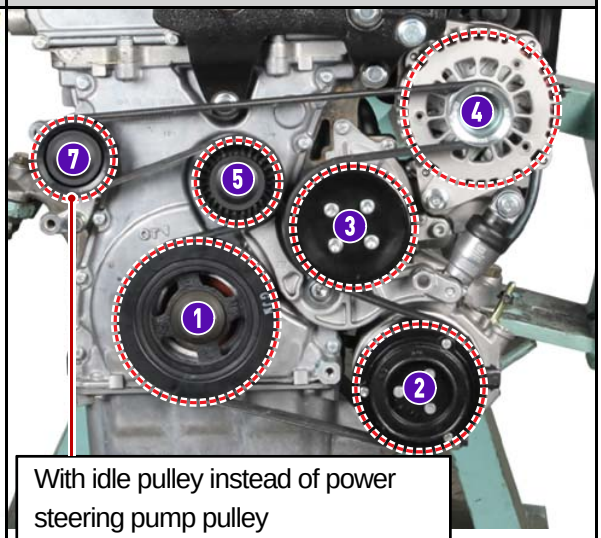
S.G.N. 1337-04 BELT SYSTEM

1) Drive Belt

▶ Overview

There are two types of belt system; EPS (Electric Power Steering) and HPS (Hydraulic Power Steering). In the vehicle with ESP, instead of power steering pulley, the idle pulley is installed on the engine. The belt system is a single belt drive system which uses single V-belt with 6 grooves. This design provides the long life span and minimizes the belt slip and noise.

▶ Components

With HPS (Hydraulic Power Steering)	With ESP (Electric Power Steering)
 With power steering pump pulley	 With idle pulley instead of power steering pump pulley
Length of belt : 1913mm	Length of belt : 1740mm

1. Crankshaft pulley
2. Air conditioner compressor
3. Water pump
4. Alternator
5. Tension pulley
6. Power steering pump pulley
7. Idler pulley

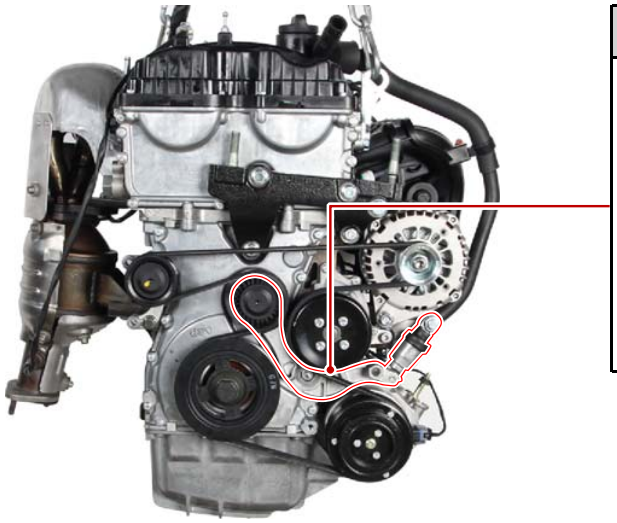
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2) Hydraulic Tensioner Assembly

▶ Overview

The hydraulic tensioner maintains the belt tension to minimize the slip and vibration and provides long life span of the belt. Hydraulic tensioner consists of hydraulic tension spring, hydraulic damper, lever arm and tension pulley.
To transfer the tension to the belt from the hydraulic tensioner in small working space in G20DF engine, the belt system uses the longer lever arm.

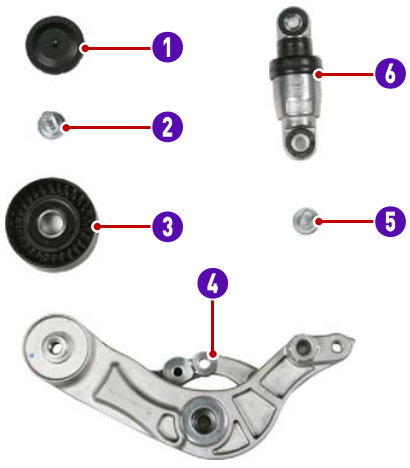
▶ Location and Components



Hydraulic tensioner assembly



Components



No	Name
1	Tensioner pulley cap
2	Tensioner pulley mounting bolt
3	Tensioner pulley
4	Lever arm
5	Hydraulic tensioner bolt
6	Hydraulic tensioner

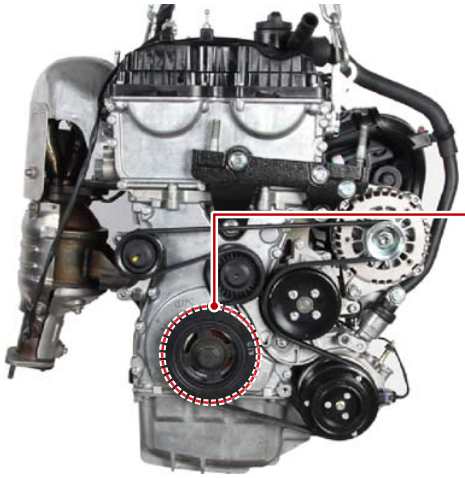
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3) Crankshaft Pulley (CRS)

▶ Overview

The strut type tensioner automatically adjusts the belt tension to provide the reliability and durability for the system. And, the belt tension is decreased to minimize the friction loss and improve the belt operating noise.

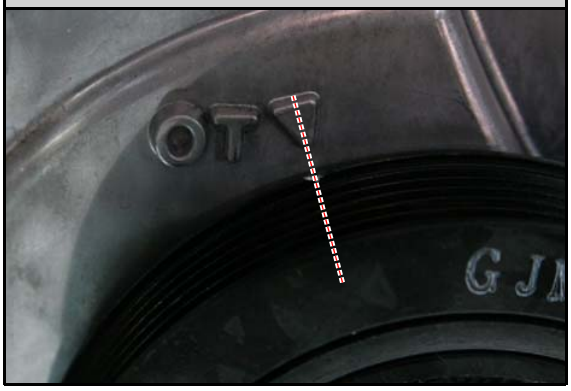
▶ Location



Crankshaft pulley (CRS)



Timing mark



Modification basis	
Application basis	
Affected VIN	

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S.G.N.
1990-01

ENGINE MOUNTING

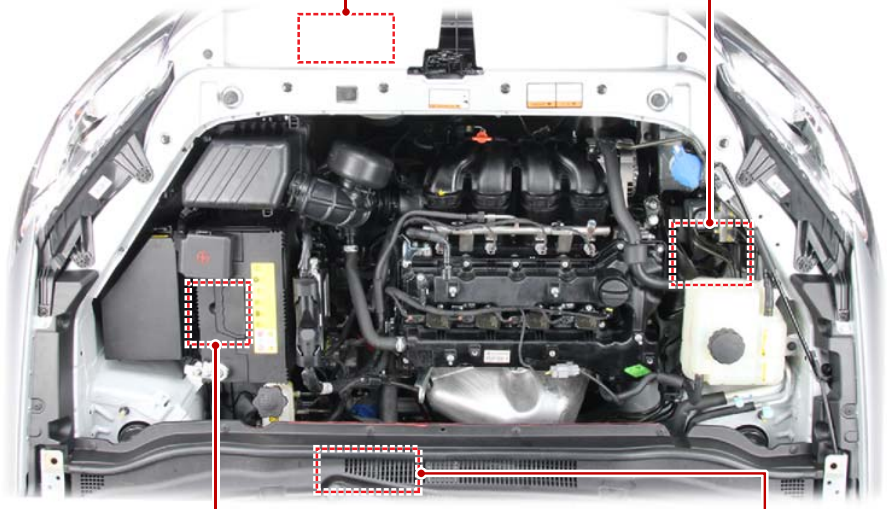
▶ Location

Front mounting assembly
Location: Front side of transaxle housing and front side of sub frame

Location	Front mounting
	

Right mounting assembly
Location: Engine block side and body side member

Location	Right mounting
	



Left mounting assembly
Location: Upper side of transaxle housing and body side member

Location	Left mounting
	

Rear mounting assembly
Location: Rear side of transaxle housing and front side of sub frame

Location	Rear mounting
	

Modification basis	
Application basis	
Affected VIN	

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▶ Function

Appearance	Type and function
Front mounting: Bracket + Insulator 	Type: Rubber type mounting Function: support torque reaction
Rear mounting: Bracket + Insulator 	Type: Rubber type mounting Function: support torque reaction
Left mounting: Bracket + Insulator 	Type: Rubber type mounting Function: - support power train rod - support torque reaction
Rear mounting: Bracket + Insulator and D-damper 	Type: Hydraulic type mounting Function: - support power train rod - power train bounce vibration absorber - support torque reaction

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S.G.N.
1211-01 CYLINDER HEAD ASSEMBLY

1) Cylinder Head

▶ Overview

The cylinder head assembly is located on the cylinder block.
This contains the combustion chamber, intake and exhaust ports, valve running housing, and oil gallery.
And, this also contains the water jacket to dissipate the heat from the combustion chamber

▶ Location

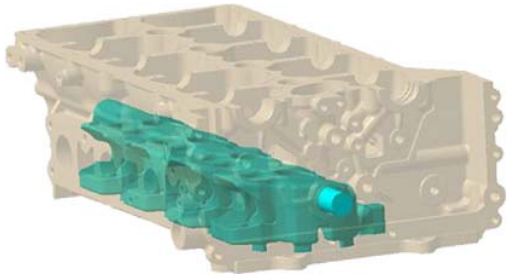
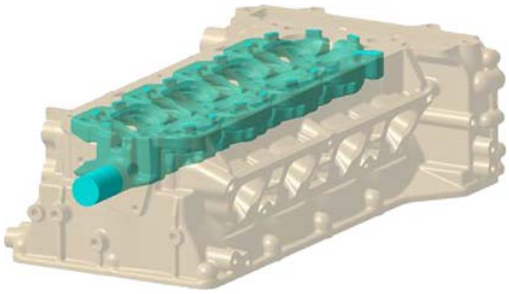


Top of cylinder head	Bottom of cylinder head
	
Intake side	**Exhaust side**
	

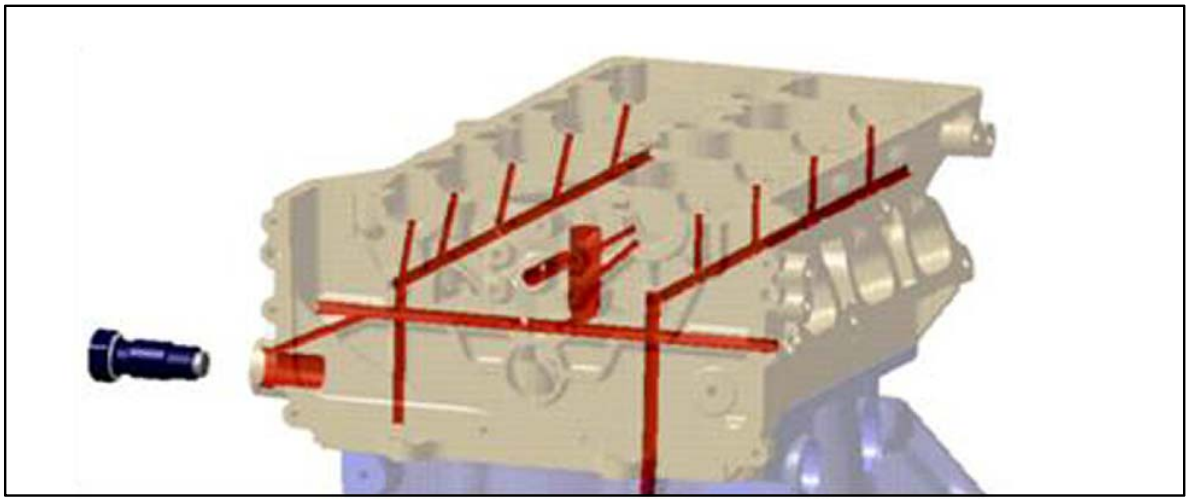
Modification basis	
Application basis	
Affected VIN	

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▶ **Closed-roof water jacket (improving coolimg efficiency)**

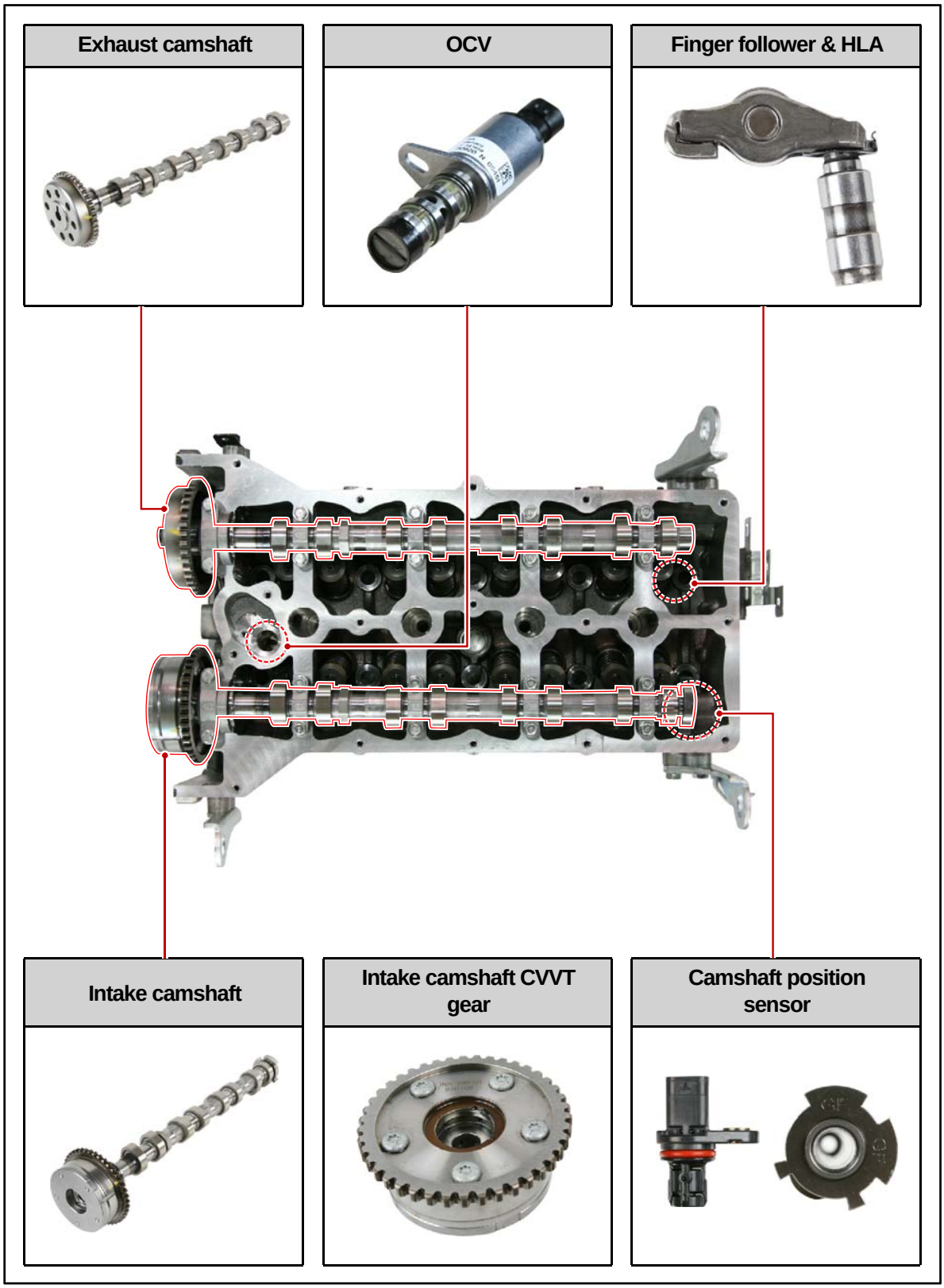
Intake side	Exhaust side
	

▶ **Cylinder head oil gallery**



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▶ Components



Modification basis	
Application basis	
Affected VIN	

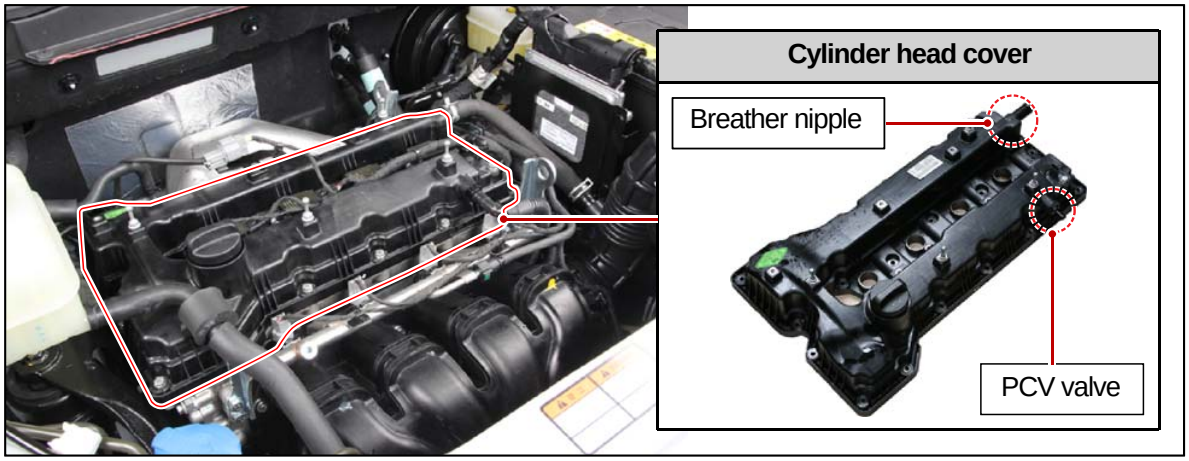
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2) Cylinder Head Cover

▶ Overview

The cylinder head cover protects the valve system. It contains the breathing system with PCV valve for recirculation of blow-by gas. The blow-by gas is induced into the intake manifold through the breather nipple and PCV Valve. To improve the sealing performance, new bolt pattern is introduced. And, to prevent the freezing, the PCV valve is tilted with 9° to the below direction.

▶ Location



Modification basis	
Application basis	
Affected VIN	

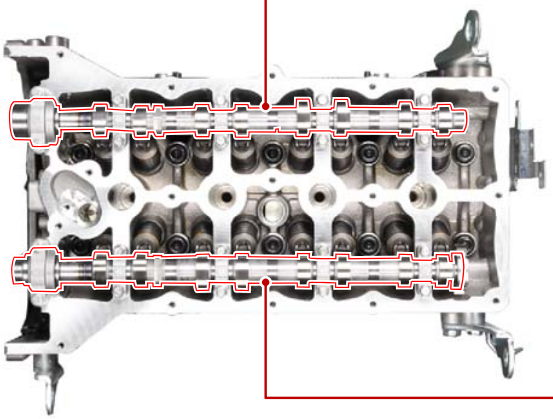
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3) Camshaft Assembly

▶ Overview

The camshaft is hollow type, and contains the cam, octagon cam, OCV gallery, cam position rotor. The camshaft operates the intake and exhaust valves.

▶ Location



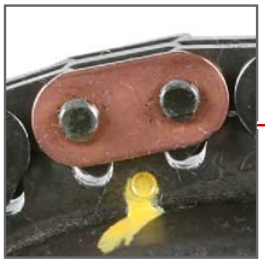
Exhaust camshaft

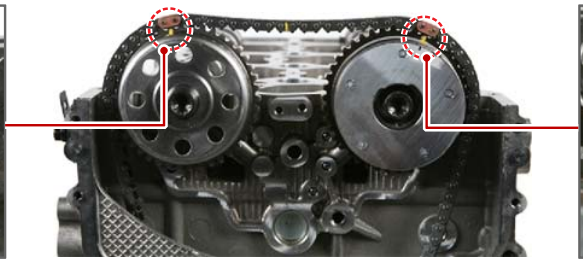


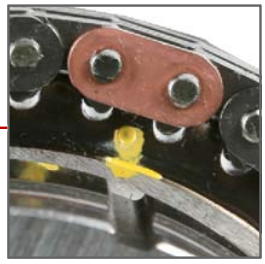
Intake camshaft

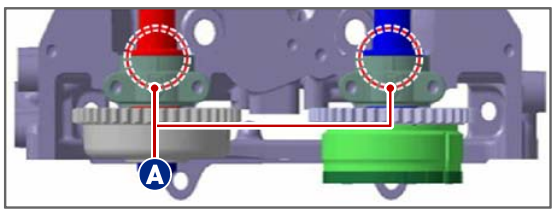


Timing marks









Align the timing marks (A) on the camshaft flange and camshaft cap when installing the intake/exhaust camshaft.

Modification basis	
Application basis	
Affected VIN	

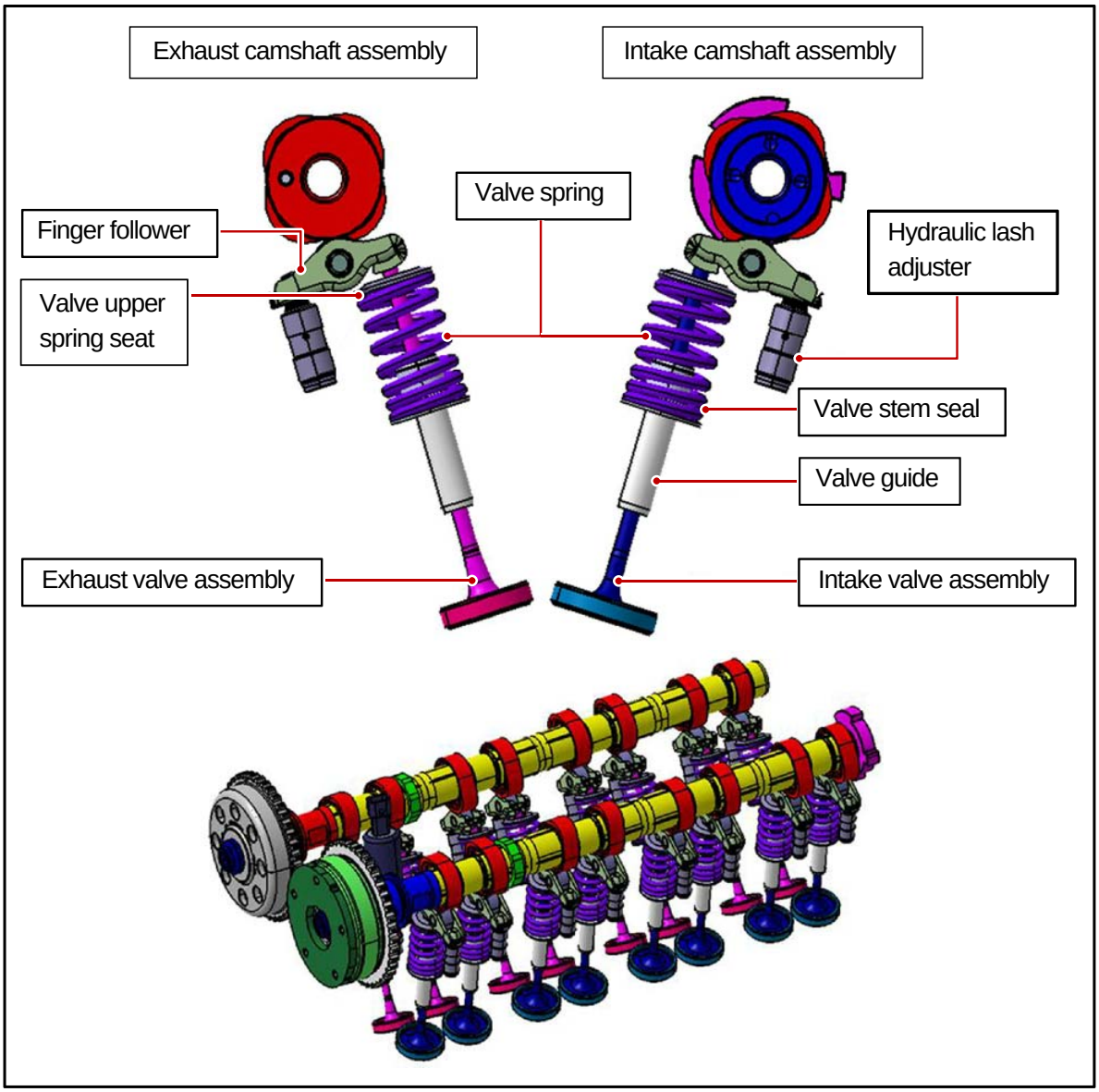
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4) Intake/Exhaust Valve Assembly (Installed on Cylinder Head)

(1) Features

- Automatic adustment of valve clearance by hydraulic pressure system (Maintenance Free)_Hydraulic lash
- Decreased valve operating noise
- Decreased friction loss by introducing the roller type finger follower
- Valave installation angle: 17°
- Decreased running amount by compact design (increased valve following movement in high speed and improved fuel economy by decreased friction loss)

(2) Layout and components



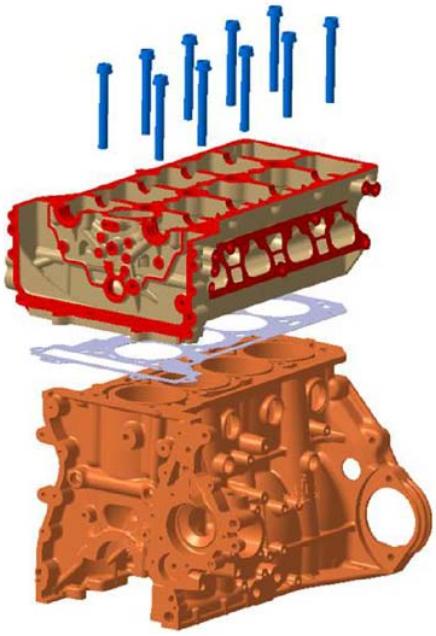
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5) Cylinder Head Gasket

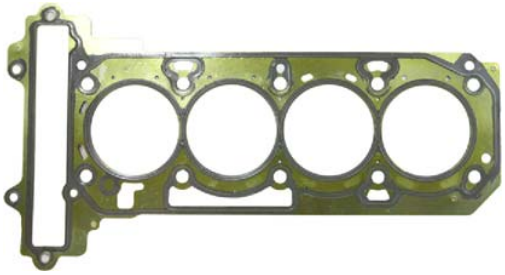
▶ Overview

The cylinder head gasket is installed between cylinder block and cylinder head to seal the combustion gas from the combustion chamber, engine oil and coolant.

▶ Location



Cylinder head gasket



- 3 Layer MLS Gasket
- Thickness : 0.7 mm (Compressed)
- PFP: Max. 85 bar

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S.G.N.
1311-01 CHAIN DRIVE SYSTEM

▶ Overview

The drive chain is single chain drive system with simple design and variable performance, and it utilizes the hydraulic tensioner to reduce the wave impact generated by the chain. The silent chain provides the silence during the operation. To improve NVH, the shoulder bolt has been introduced.

▶ Layout and Components

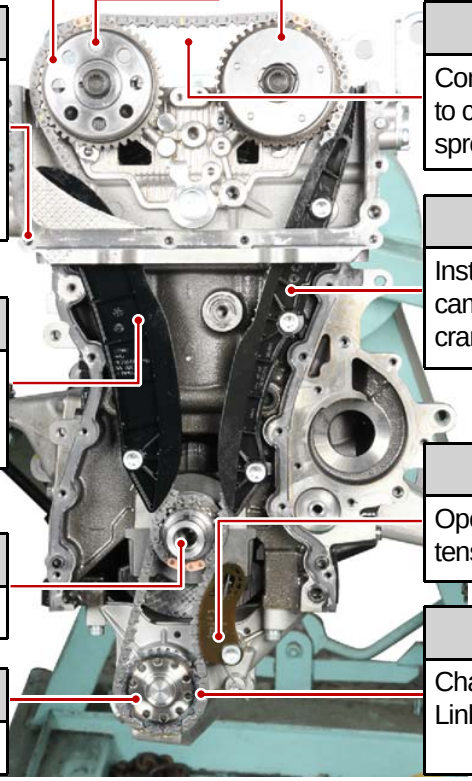
Timing chain
Chain type: Silent chain type
Links: 146 ea

Exhaust camshaft sprocket
Teeth:42 ea

Intake camshaft sprocket
CVVT
Teeth: 42 ea

Hydraulic tensioner
Consists of tensioner housing plug, spring, check valve, and operated by hydraulic pressure and spring in tensioner

OCV
Controls the hydraulic circuit to control the intake cam sprocket variably



Clamping rail
Installed between intake camshaft sprocket and crankshaft sprocket

Tensioner rail
Installed between exjaust camshaft sprocket and crankshaft sprocket

Mechanical tensioner
Operated by spring in tensioner

Crankshaft sprocket
Teeth: 21 ea

Oil pump chain
Chain type: Silent chain type
Links: 58 ea

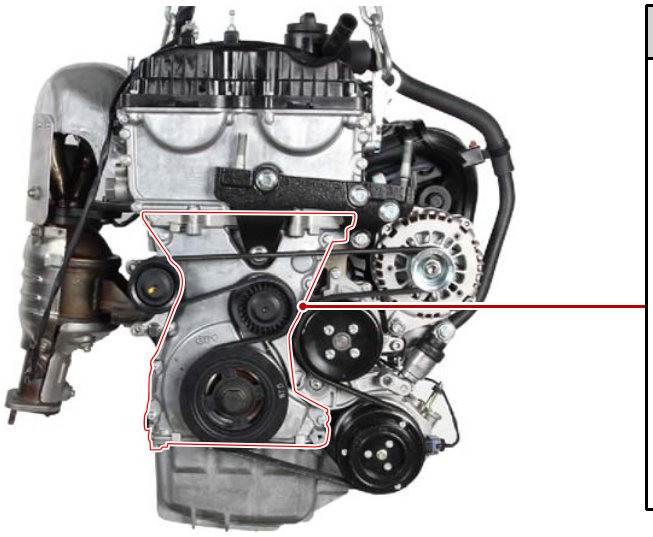
Oil pump sprocket
Teeth: 28 ea

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1) Timing Gear Case Cover

▶ **Features**

- Major function: Protecting the chain drive system, minor function: Shielding the chain noise
- Timing gear case cover prevents the oil from leaking.
- The crankshaft front seal and the engine mounting bracket are installed on the timing gear case cover.



Timing gear case cover



CAUTION

- Do not touch the inner lip of crankshaft front seal installed on the timing gear case cover.

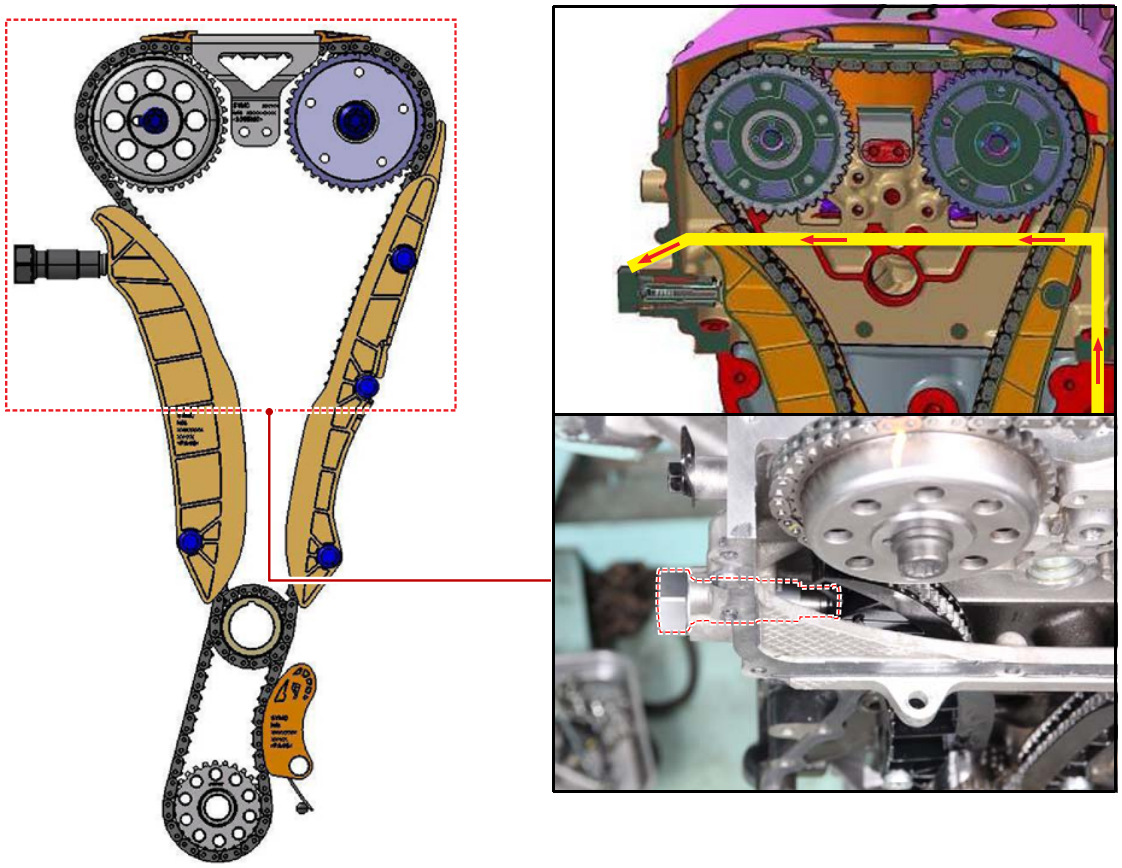
Modification basis	
Application basis	
Affected VIN	

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2) Hydraulic Auto Tensioner

In G20DF engine, the hydraulic auto tensioner is used to keep the tension for chain drive system of engine. The auto tensioner is operated by the spring in tensioner and the hydraulic pressure.

Layout and Location



Hydraulic chain tensioner

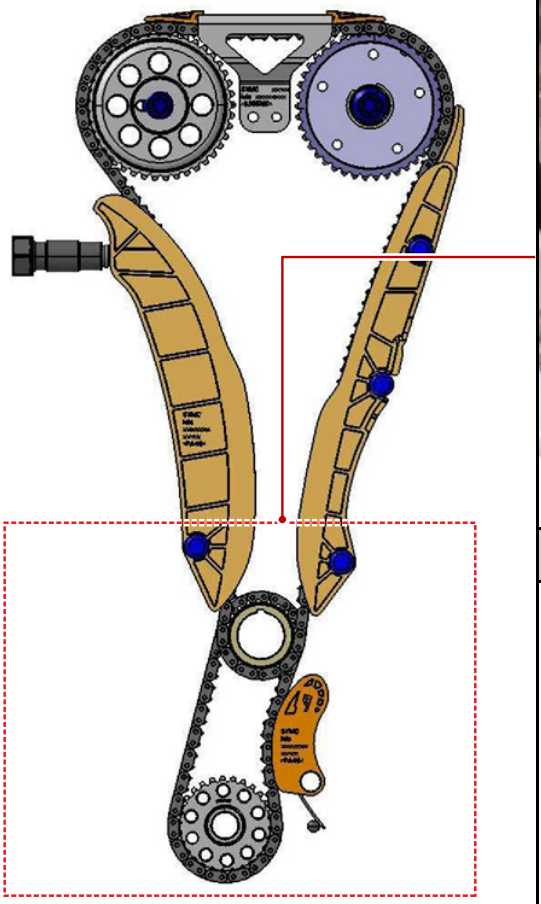


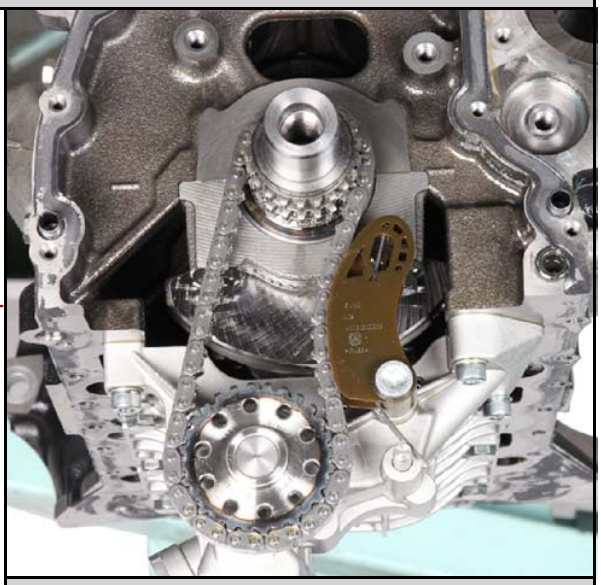
Modification basis	
Application basis	
Affected VIN	

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3) Oil Pump Chain Tensioner

Layout and Location





Oil pump chain tensioner



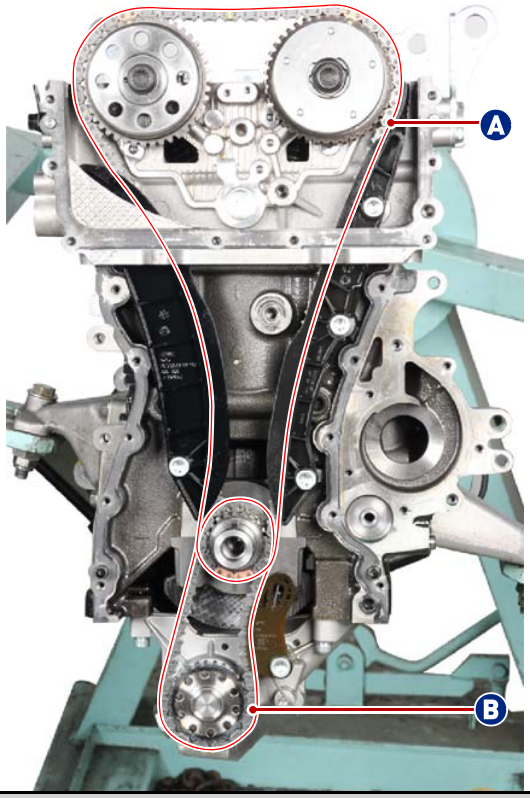
- Operated by spring in tensioner
- Tensioner type: Compensating and absorbing the impact
- Static and dynamic force: spring

Modification basis	
Application basis	
Affected VIN	

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4) Timing Chain and Gear

▶ Timing chain



A. Timing chain

Teeth: 146 ea



B. Oil pump chain

Teeth: 58 ea

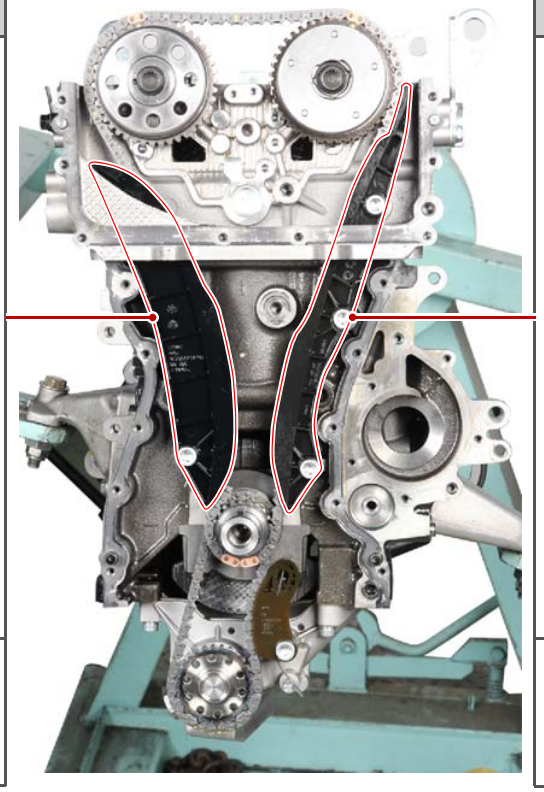


- Simple layout provides the optimized timing.
- Decreased chain vibration and noise
- Single stage layout: minimized chain load

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5) Chain Rails

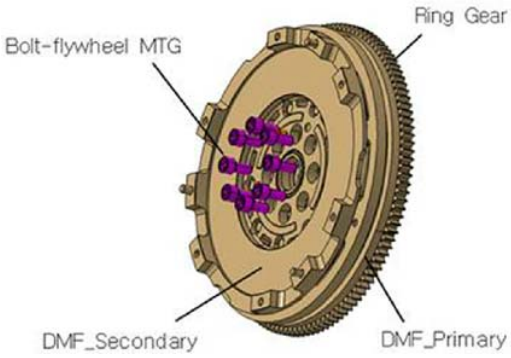
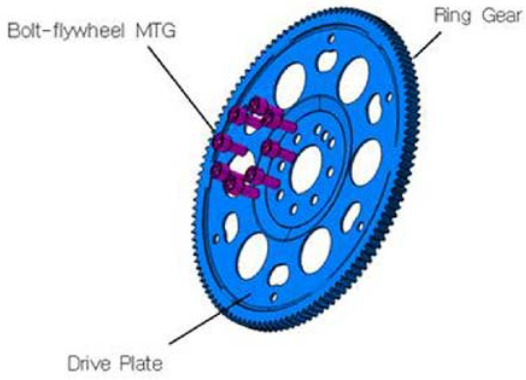
The chain rails are used for optimizing the movement of chain drive system. And they also prevent the chain from contacting each other when the chain is loose, and reduces the chain wear. The chain rail is normally made of PA (Polyamide nylon), and PA66 and PA46 are used for the chain rails in G20DF engine. For the tensioner rail, PA46 is used to provide high anti-wear function and high strength since the load to the rail is huge. Ther is an open area for shoulder bolt hole in the clamping rail. The chain rails are installed by shoulder bolts.

Tensioner rail		Clamping rail
		
Installed between exhaust camshaft sprocket and crankshaft sprocket		Installed between intake camshaft sprocket and crankshaft sprocket

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S.G.N.
1130-13 FLYWHEEL

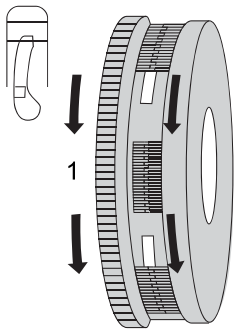
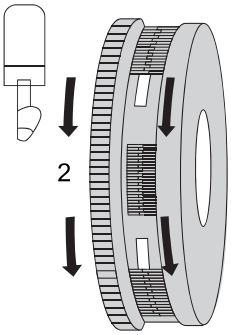
1) Overview

Dual mass flywheel (DMF) - Manual transaxle	Drive plate - Automatic transaxle
 	 
Dual mass flywheel reduces the unbalanced rotation of crankshaft in manual transaxle equipped vehicle. The flywheel is installed on the crankshaft and is engaged to the clutch disc to transfer the driving torque from the engine to the powertrain system. Additionally, DMF decreases the rattling noise in transaxle and the vehicle vibration by reducing the differences of torque and rotational speed due to the combustion in engine.	The drive plate initially drives the powertrain system by using the power from the start motor when starting the engine. The drive plate is installed on the crankshaft and is engaged to the torque converter of automatic transaxle to transfer the driving torque from the engine to the powertrain system.

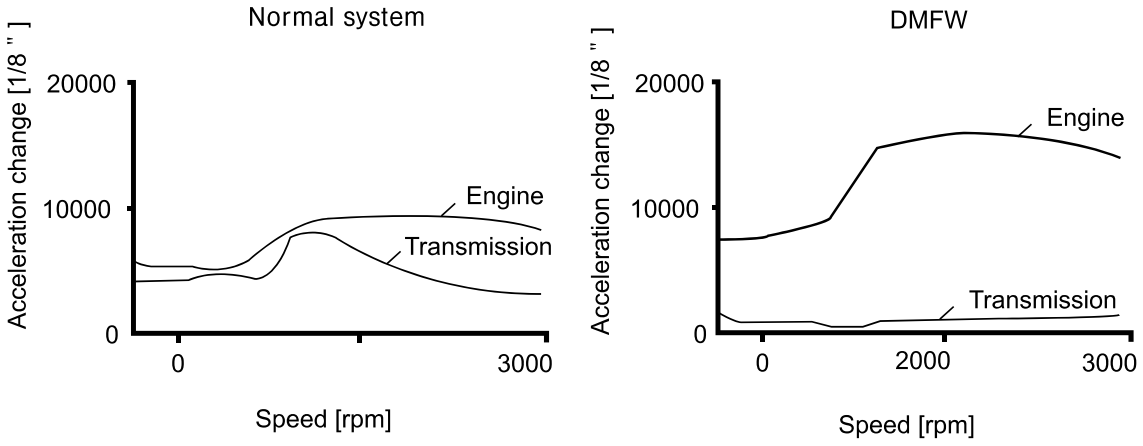
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2) Operation of DMF

- Compensating the irregular operation of engine: The secondary flywheel operates almost evenly so does not cause gear noises
- The mass of the primary flywheel is less than conventional flywheel so the engine irregularity increases more (less pulsation absorbing effect).
- Transaxle protection function: Reduces the torsional vibration to powertrain (transaxle) by reducing the irregularity of engine.

Compression stroke	Combustion stroke
	
Small changes from engine (k): Damper increases the torque changes to clutch	**Large changes from engine (j):** Damper decreases the torque changes to transaxle by absorbing the impact

Torque change curve of engine and drive shaft



Modification basis	
Application basis	
Affected VIN	

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3) Features of DMF

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

4) Advantages of DMF

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

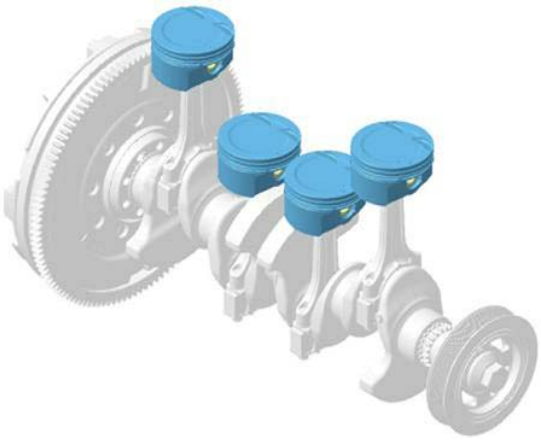
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S.G.N.
1130-33 PISTON ASSEMBLY

▶ Overview

Piston assembly contains piston, #1 ring, #2 ring, oil ring, piston pin and snap ring. The expansion energy from engine is transferred to the crankshaft through connecting rod to convert the linear movement to rotating energy.

▶ Layout and Components



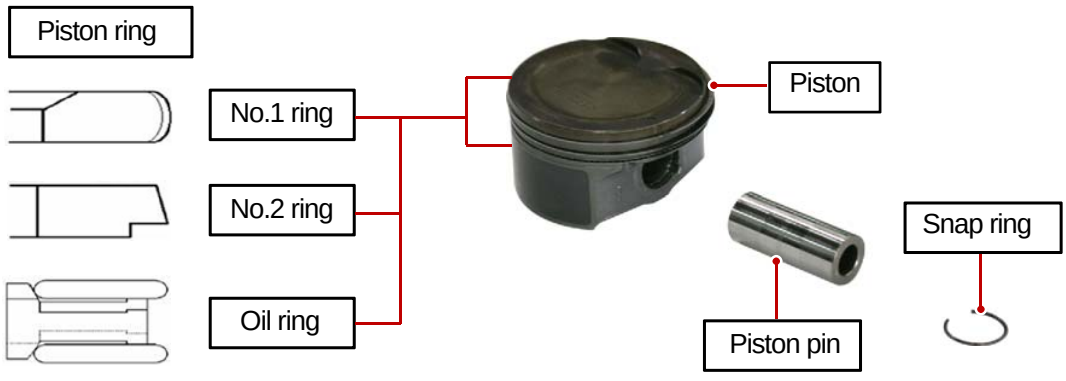
Top



Bottom



Components



Modification basis	
Application basis	
Affected VIN	

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▶ Functions

Piston transfers the combustion energy from engine to connecting rod.

A. Piston ring

- #1 ring (Top ring) : Prevents the high pressurized combustion gas from leaking into crank chamber, and prevents the engine oil getting into combustion chamber.
- #2 ring: Scrapes the engine oil on the cylinder bore, and prevents the leaked combustion gas from #1 ring from leaking into the crank chamber.
- Oil ring: Scrapes the engine oil on the cylinder bore.

B. Piston pin

- Connects the piston the connecting rod, and transfers the linear movement of piston to connecting rod to convert it to rotating energy.

C. Snap ring

- Locks the piston pin.

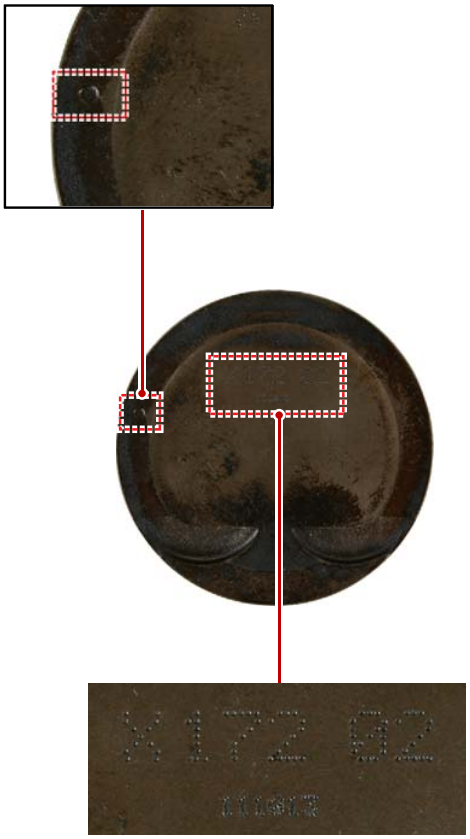
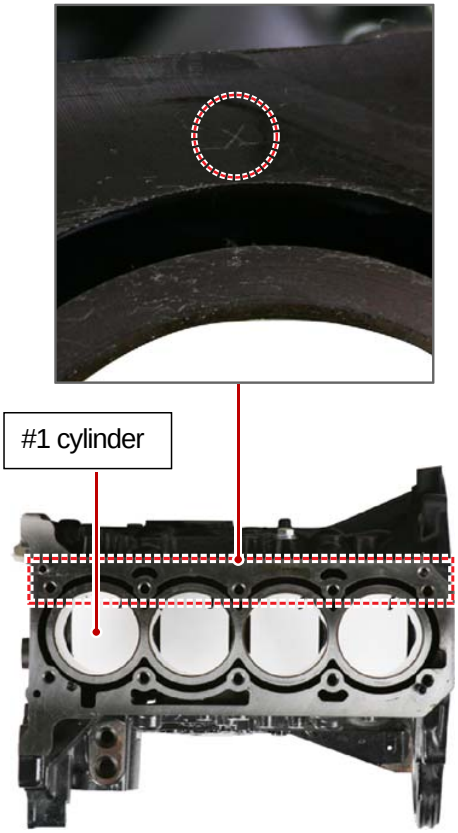
▶ Piston ring

	
Piston ring end gap (mm) #1 end gap: 0.170 ~ 0.320 #2 end gap: 0.300 ~ 0.450	**Piston ring side clearance (mm)** #1 groove: 0.040 ~ 0.080 #2 groove: 0.040 ~ 0.080

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▶ Assembling the piston

- Install the piston rings with the "X" mark on the ring facing upwards.
- Position the end gap of #1 ring at 180˚ away from the end gap of #2 ring.
- Position the end gap of oil ring at 180˚ away from the end gap of coil spring, and position the end gap of oil ring at 90˚ away from the end gap of #2 ring.

Assembly mark	
Top surface of piston	**Top surface of cylinder block**
	

Modification basis	
Application basis	
Affected VIN	

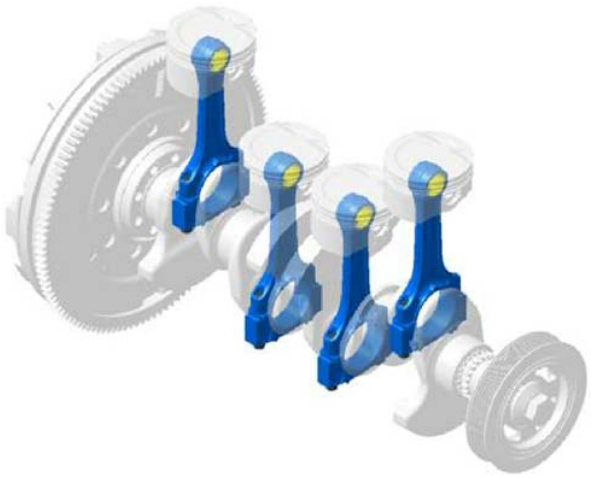
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S.G.N.
1130-25 CONNECTING ROD

▶ Overview

Connecting rod converts the reciprocating movement of piston to the rotating movement of crankshaft. The big end is connected to connecting rod bearing and the crank pin journal, and the small end is connected to the piston pin.

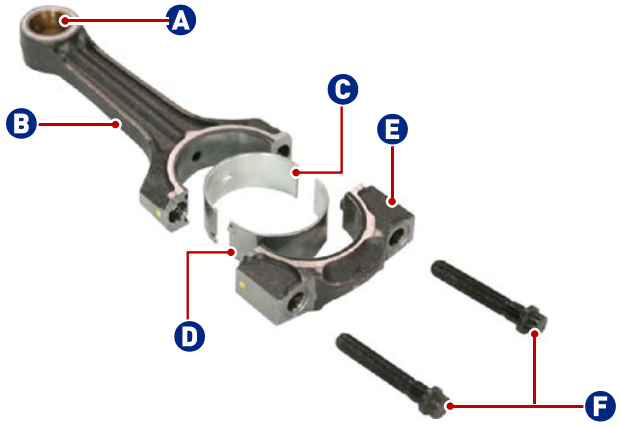
▶ Components



Connecting rod



Components



A. Piston pin bush
B. Connecting rod
C. Connecting rod upper bearing
D. Connecting rod lower bearing
E. Connecting rod cap
F. Connecting rod cap bolt

Modification basis	
Application basis	
Affected VIN	

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▶ Selection of connecting rod bearing

Select the bearing shell combination according to the table below:

Conrod_UPR Grade	Conrod_LWR Grade	Clearance
Red	Blue	0.005 ~ 0.050
Yellow	Yellow	0.005 ~ 0.050
Blue	Red	0.005 ~ 0.050

Modification basis	
Application basis	
Affected VIN	

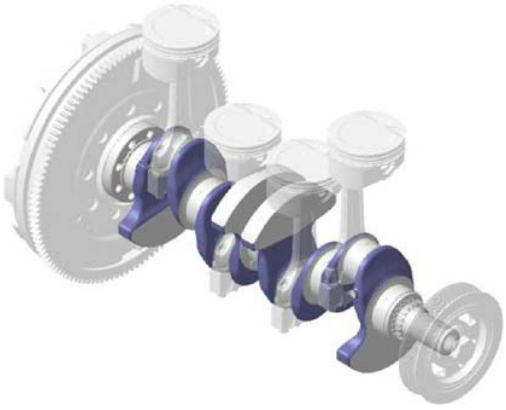
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S.G.N.
1130-01 CRANKSHAFT

▶ Overview

Crankshaft is installed on the cylinder block. The crankshaft converts the reciprocative movement of piston to the rotatinal movement.

▶ Layout and Components



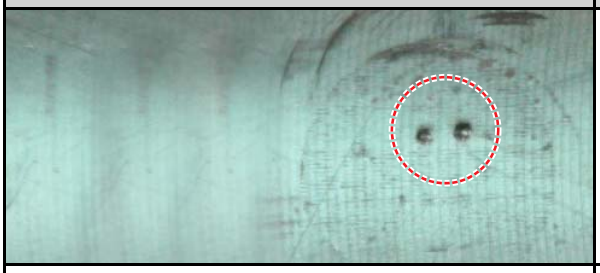
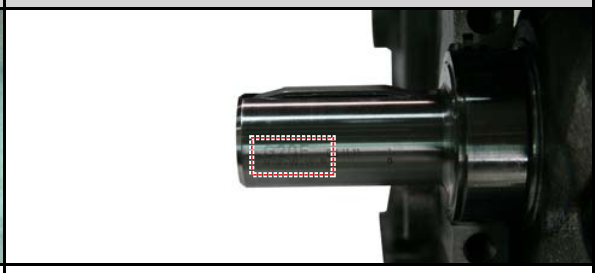
Crankshaft



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▶ Selection of crankshaft main bearing



Bottom of cylinder block	Crankshaft sprocket installing surface
	

Engine name	G	2	0	D	F
Main journal bearing	R	R	W	W	R
	#1	#2	#3	#4	#5

Pin punch mark	Color	Diameter of crankshaft main journal in cylinder block (mm)
*	Blue	62.500 ~ 62.506
**	Yellow	62.506 ~ 62.513
***	Red	62.513 ~ 62.519

Mark	Color	Diameter of crankshaft main journal (mm)
B	Blue	57.960 ~ 57.965
Y	Yellow	57.955 ~ 57.960
R	Red	57.950 ~ 57.955
W	White	57.945 ~ 57.950
V	Violet	57.940 ~ 57.945

Crankshaft lower bearing	Crankshaft lower bearing
	

Modification basis	
Application basis	
Affected VIN	

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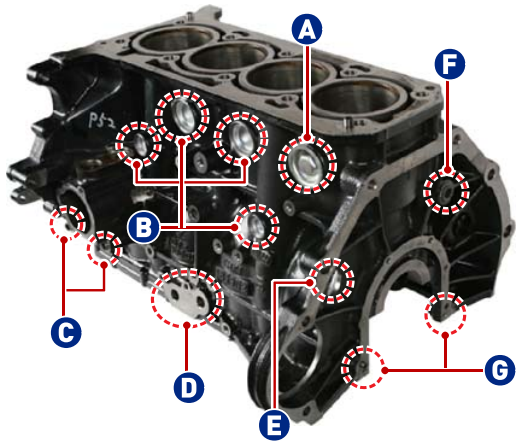
S.G.N.
1128-01 CYLINDER BLOCK

▶ Overview

The cylinder block is made of special cast iron, and contains the major components such as cylinder head, crankshaft and piston assembly. There are oil and coolant galleries to lubricate and cool the engine.

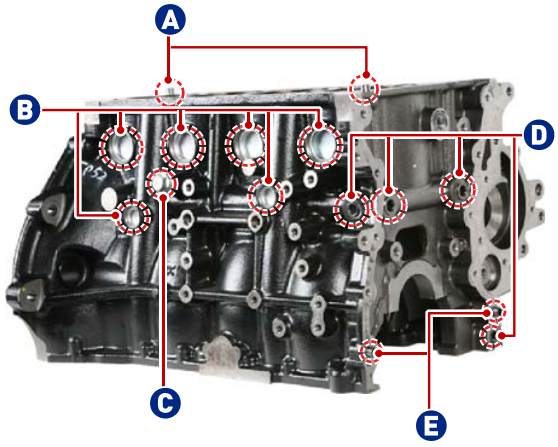
▶ Components

Front view



A. Plug screw (water jacket plug) (70Nm)
B. Expansion plug (intake: 4)
C. Spring pin (A/C mounting)
D. Oil gallery (oil filter assembly)
E. Ctankshaft position sensor mounting
F. Plug screw (oil gallery plug)
G. Spring pin (RR seal mounting)

Rear view

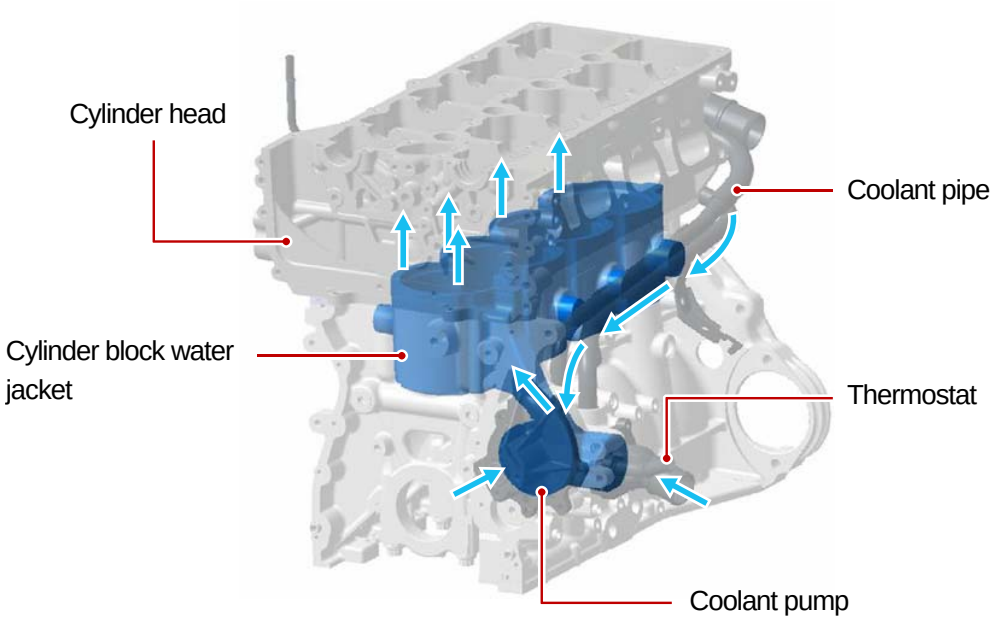


A. Spring pin (cylinder head mounting)
B. Expansion plug (exhaust: 6)
C. Screw plug (water jacket plug) (30Nm)
D. Screw plug (oil gallery plug)
E. Spring pin (T.G.C.C)

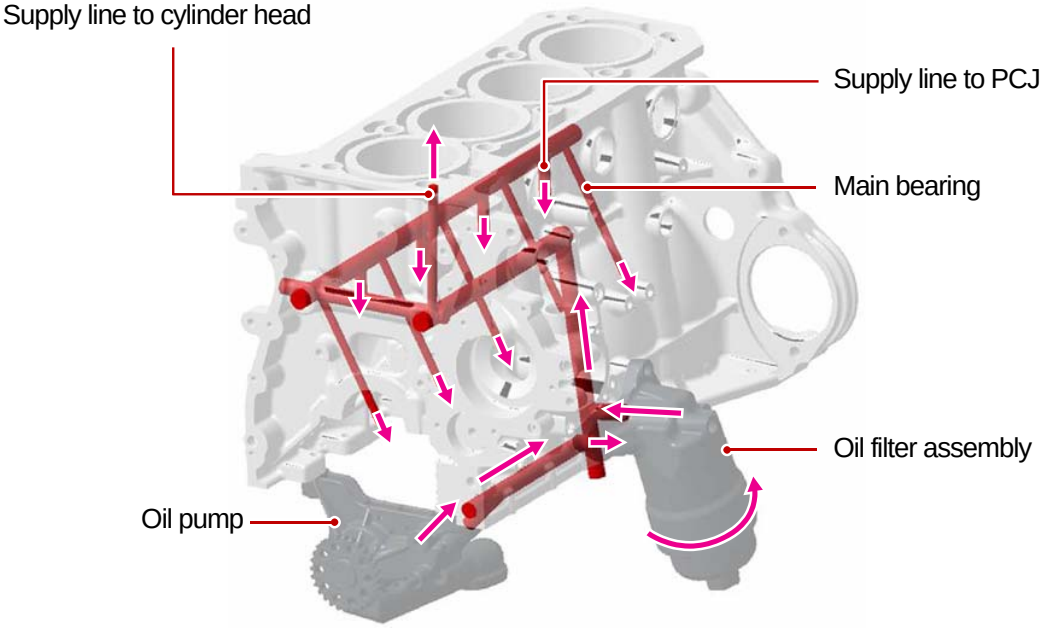
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▶ Coolant and oil flows

Coolant



Engine oil



Modification basis	
Application basis	
Affected VIN	

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INTAKE SYSTEM 1740-01

GENERAL INFORMATION

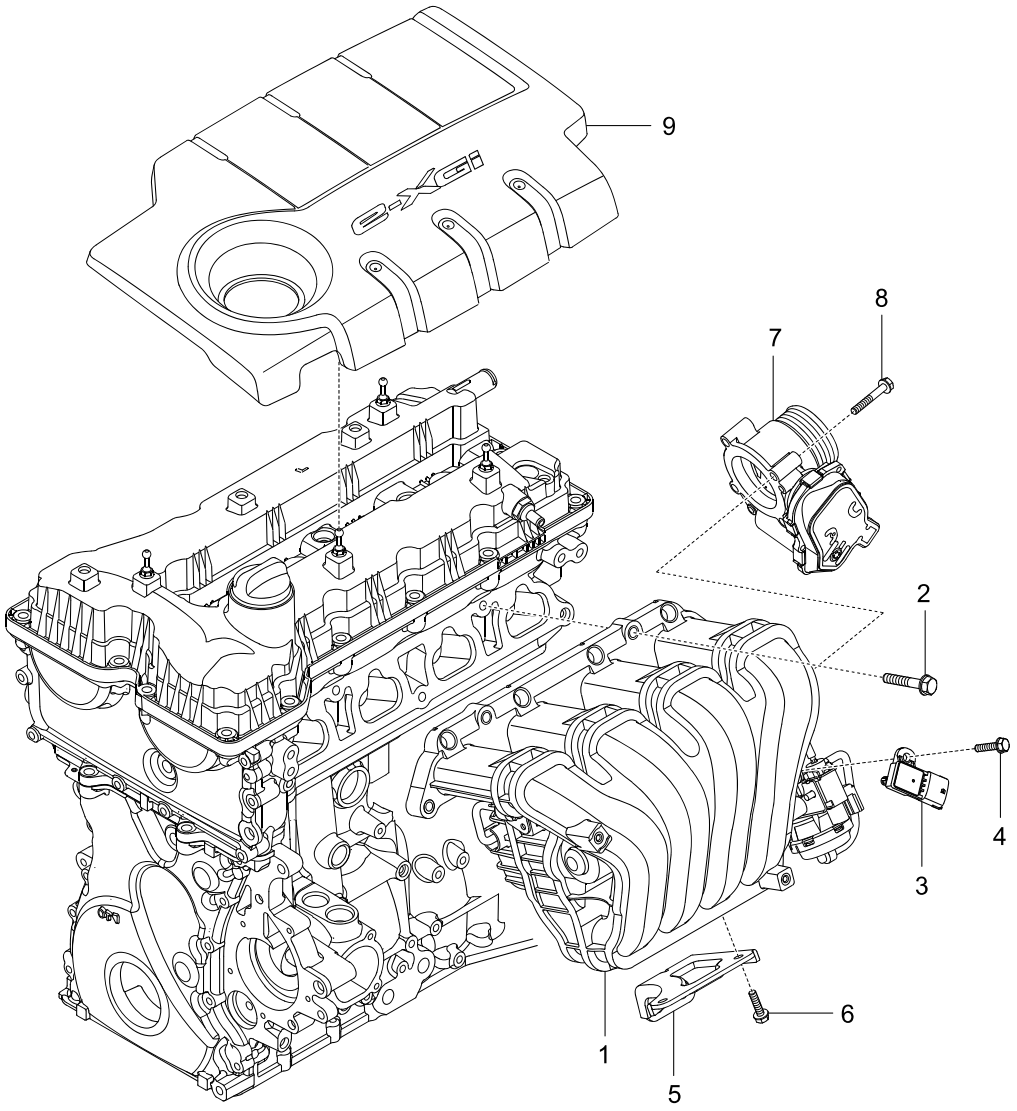
1. SPECIFICATION

Unit	Description	Specification
Air cleaner element	Filter type	Dry, filter element
	Filtering area	0.225 m²
	Service interval	Clean every 7,500 km
		Change every 15,000 km
Air cleaner assembly	Weight	1.45 kg
	Operating temperature	25℃
	Capacity	7L

* Shorten the service interval under severe conditions such as driving on a dusty road or offroad.

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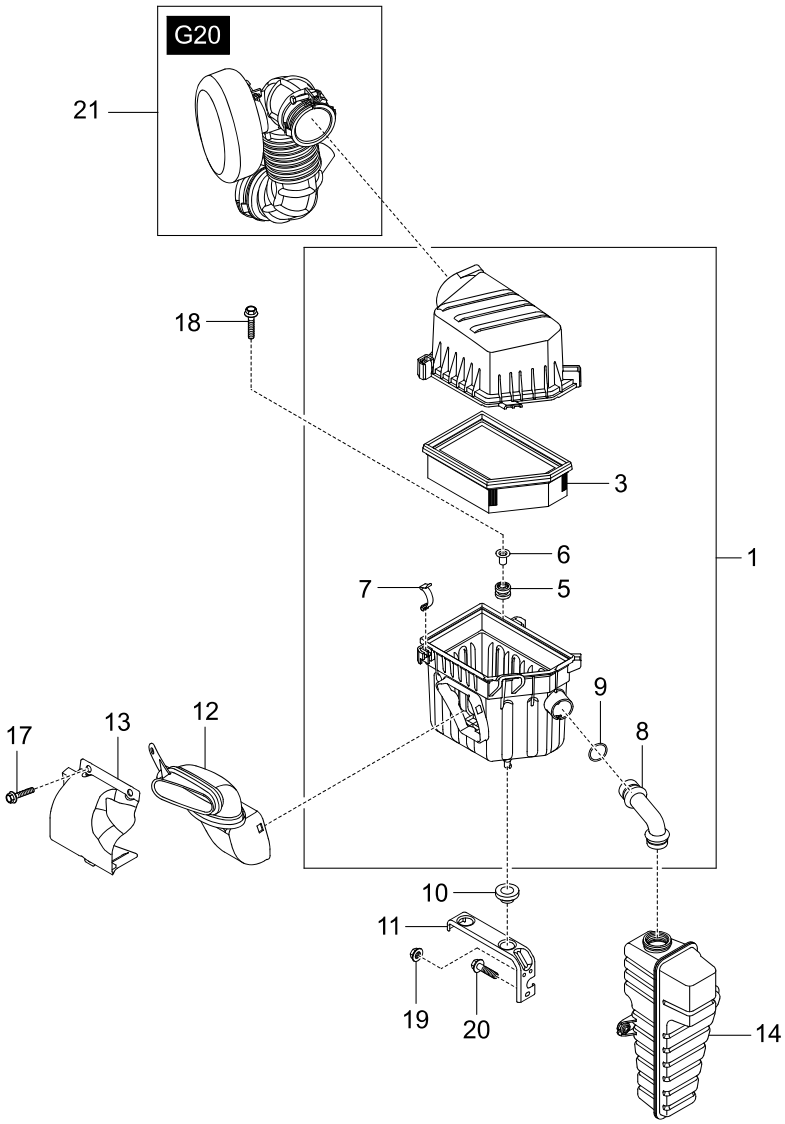
2. LAYOUT



1. Intake Manifold Assy
2. Bolt
3. T-MAP sensor
4. Bolt
5. Intake Manifold Brkt
6. Bolt
7. Electric Throttle Body
8. Bolt
9. Acoustic Cover

Modification basis	
Application basis	
Affected VIN	

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1. Air Cleaner Assy
3. Element Assy
5. Air Cleaner MTG NO.2
6. Insulator Collar
7. Spring Clamp
8. Resonance Duct
9. Resonance O-Ring
10. Air Cleaner MTG NO.1
11. Air Cleaner MTG Bolt
12. Snorkel Assy
13. Water Portector
14. Resonator Assy
17. RR Fascia MTG Screw Rivet
18. Bolt
19. Nut
20. Screw
21. Air Cleaner to Engine Hose Assy

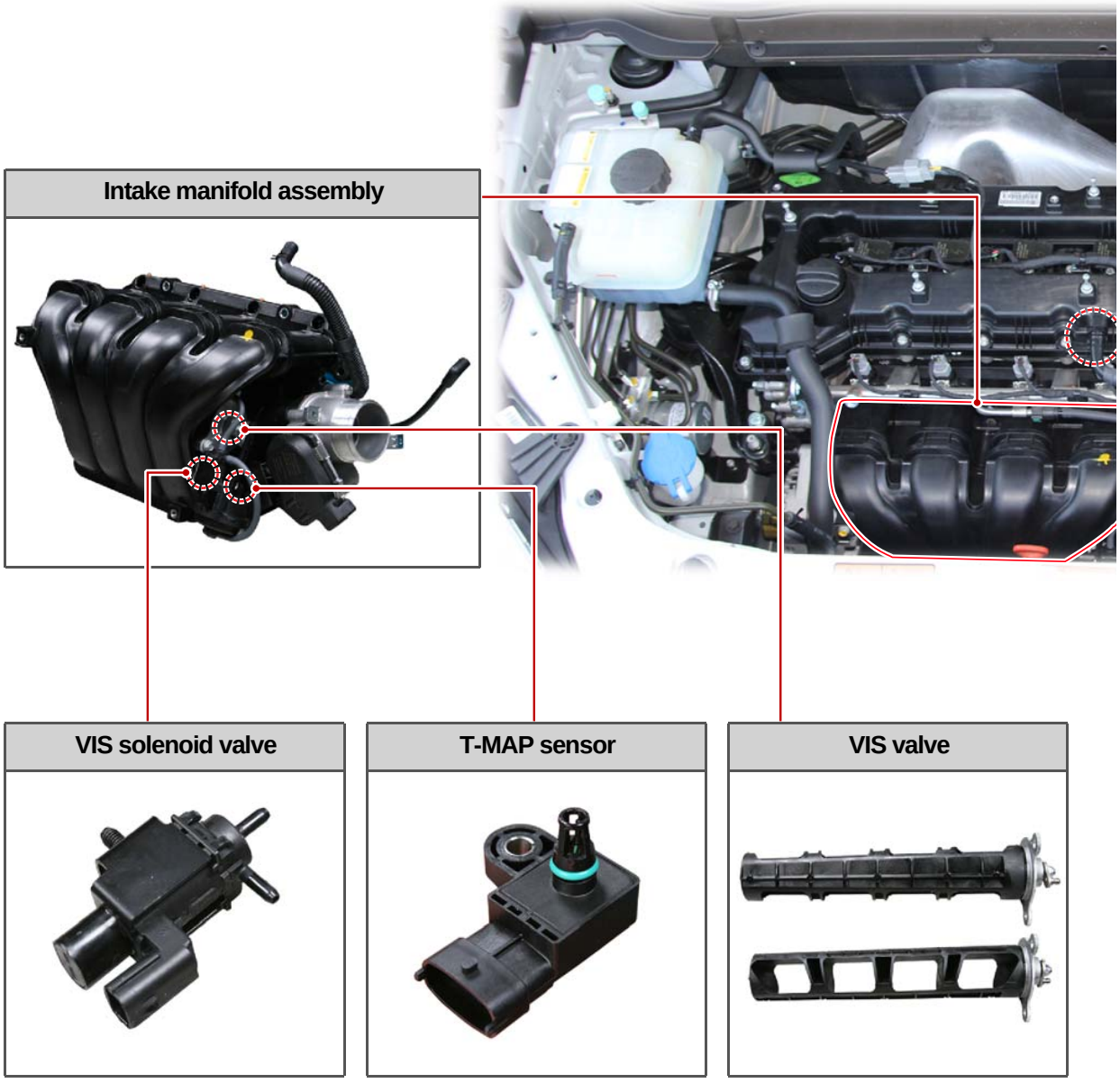
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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

To improve the engine performance, the VIS system has been introduced in the intake manifold. It provides the "Long Runner" in low speed and the "Short Runner" in high speed.
And, to reduce the internal pulsation in the intake manifold, the Runner # 1 and #2 are located in symmetry position with Runner #3 and #4. To reduce the air resistance, the throttle body is tilted b

2. COMPONENTS



Modification basis	
Application basis	
Affected VIN	

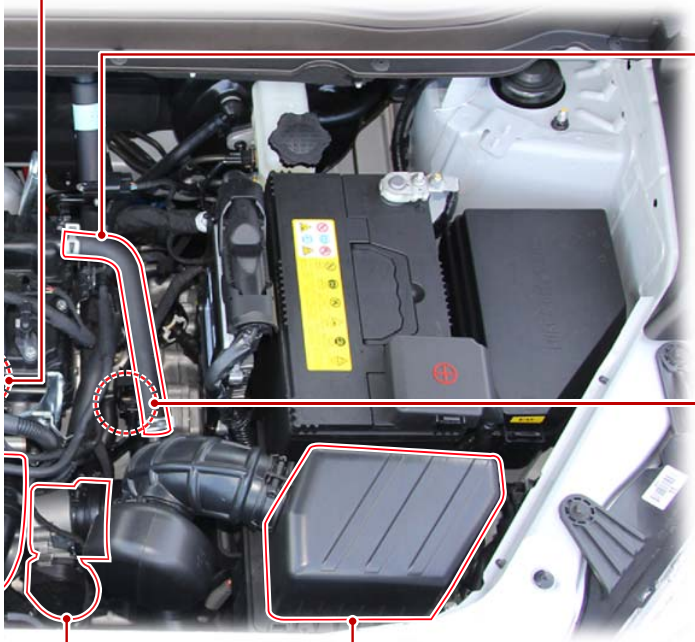
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PCV valve



Blow-by hose





Purge control solenoid valve



Electronic throttle body



Air cleaner element

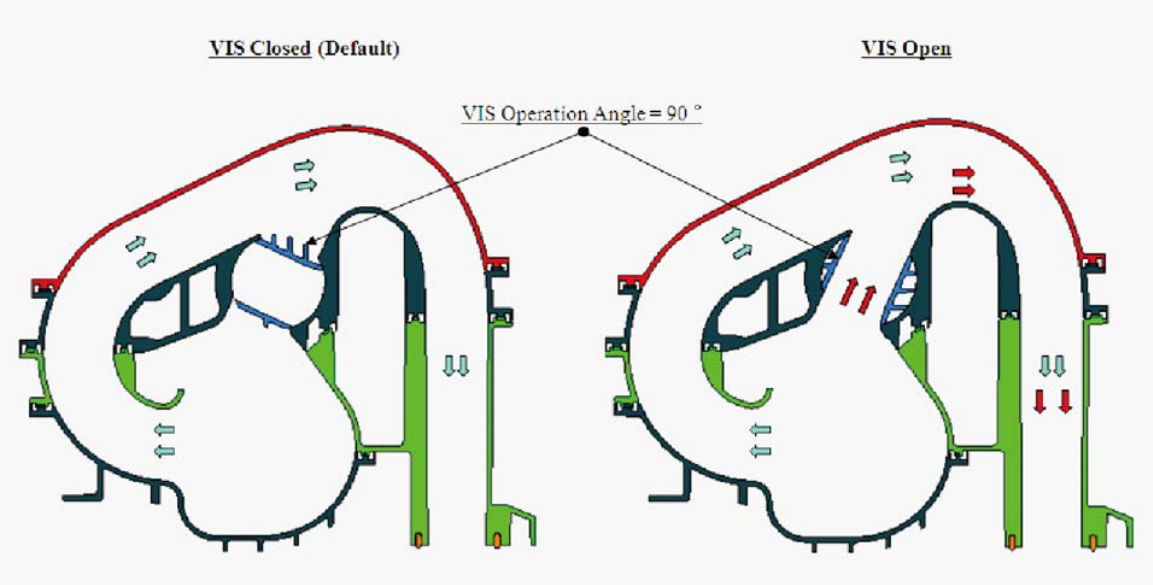


Modification basis	
Application basis	
Affected VIN	

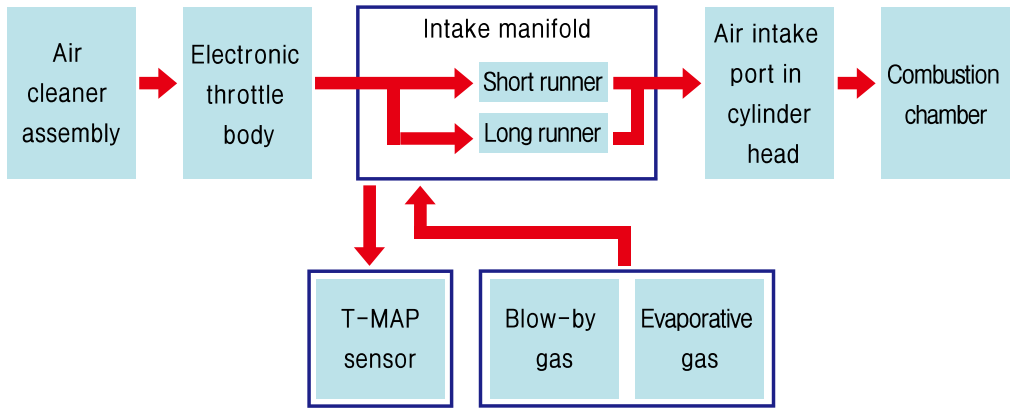
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3. OPERATING PROCESS

When Long Runner is operating	When Short Runner is operating



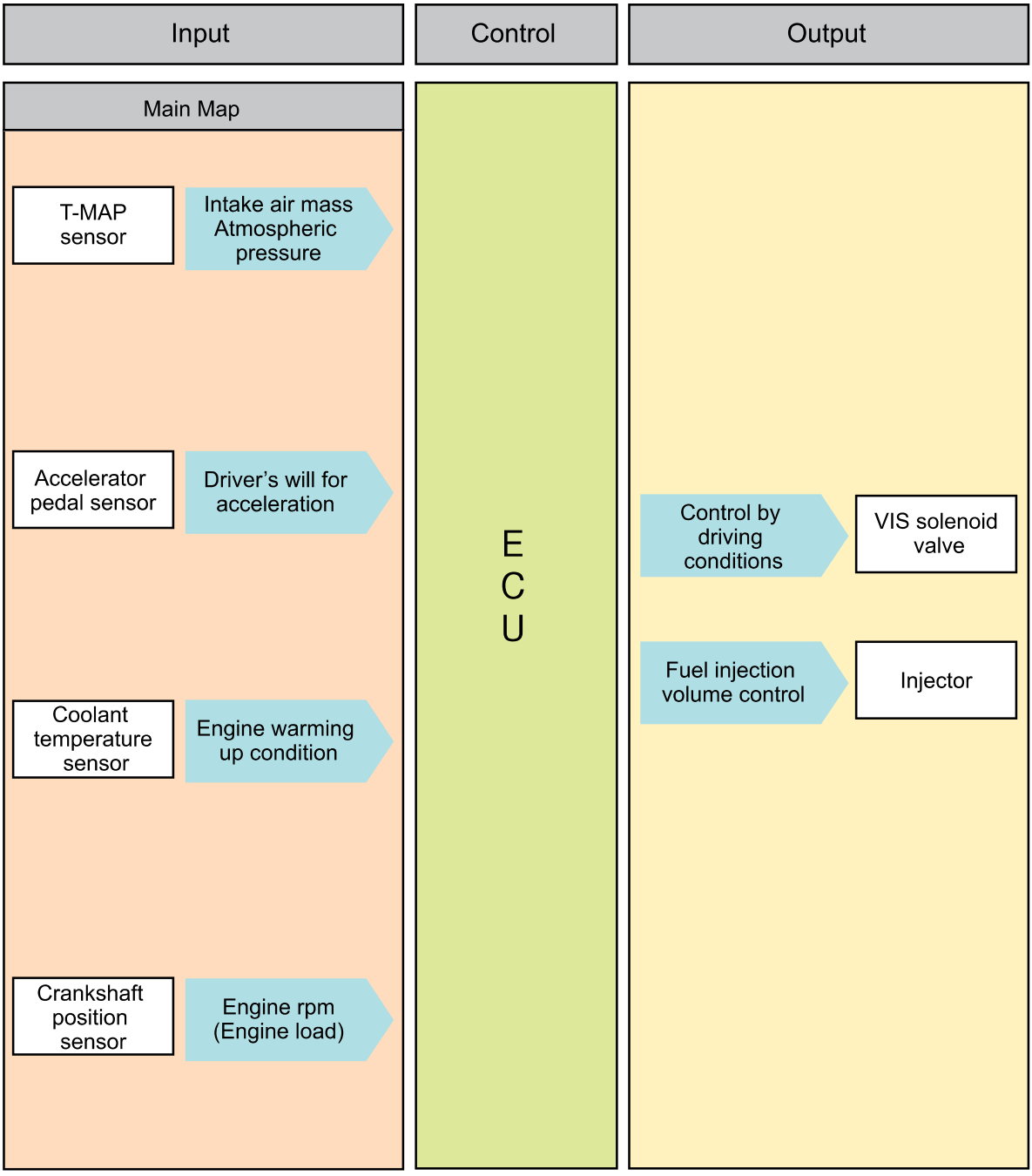
Intake air flows



Modification basis	
Application basis	
Affected VIN	

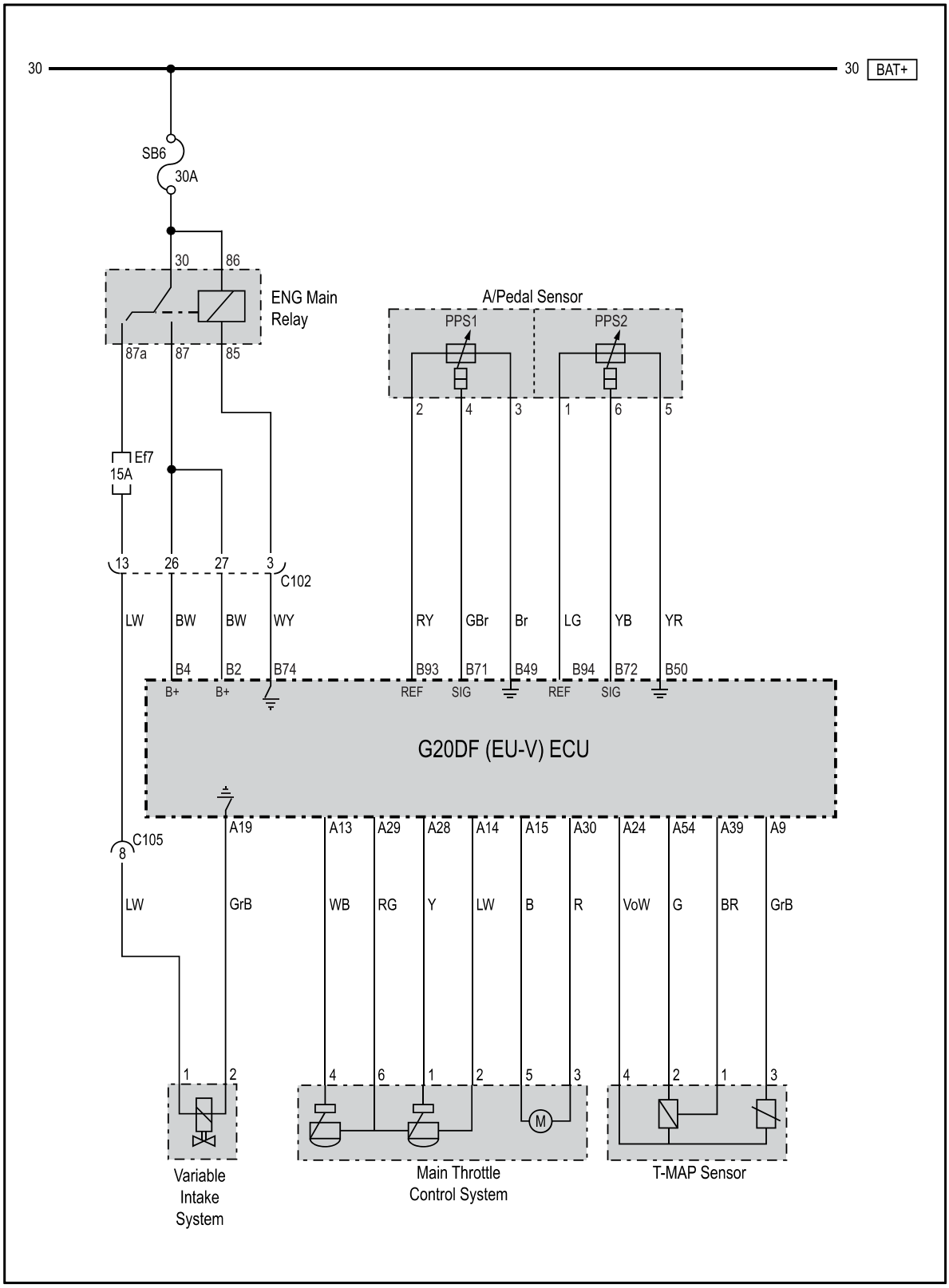
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4. INPUT/OUTPUT DEVICES



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5. CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

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FUEL SYSTEM 2221-01

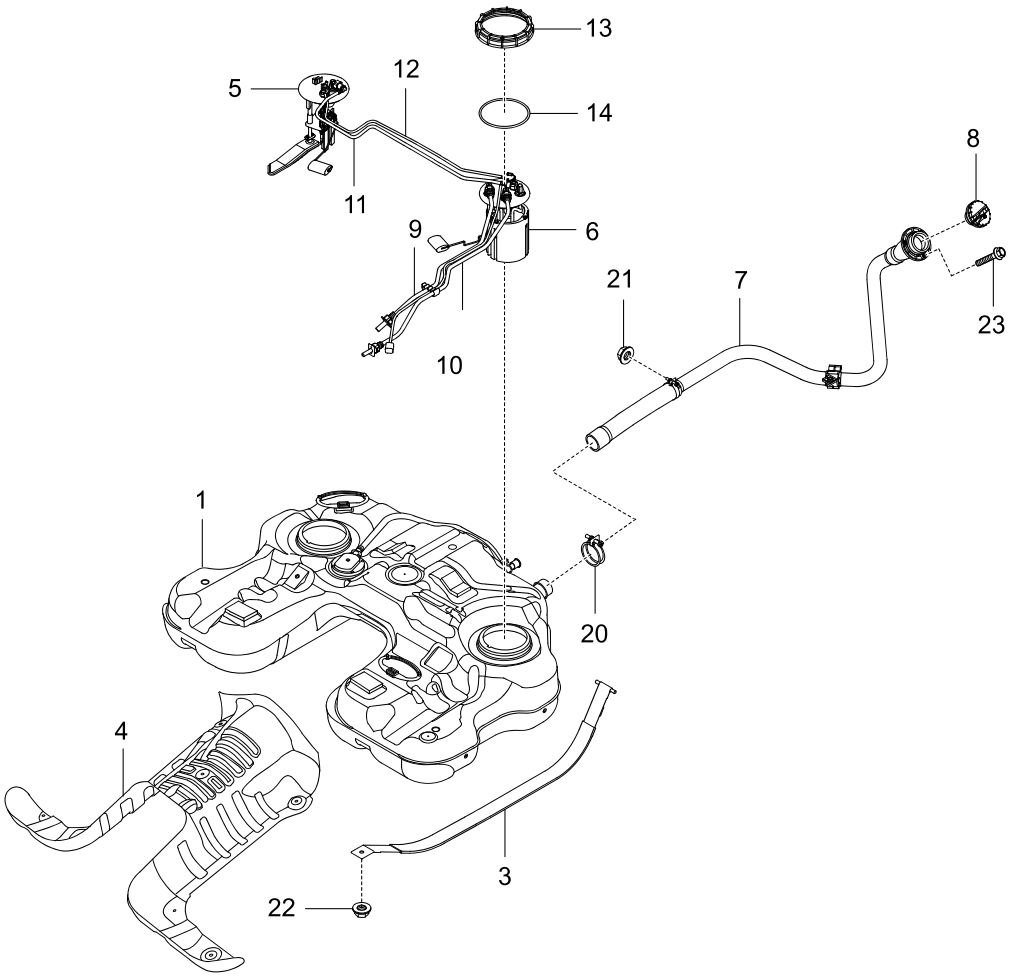
GENERAL INFORMATION

1. SPECIFICATION

Unit		Specification
Fuel system	Fuel	Unleaded gasoline
	Fuel injection	MPI (Muilt Point Injecter) type
	Fuel supply	Returnless Fuel System
Fuel tank	Capacity	57 L
	Material	Plastic
	Fuel sender	Dual sender type
Fuel filter	Service interval	Change every 100,000 km
Fuel pump	Pressure	3.8 bar
Injector	Color	Black
	Capacity	187.2 g/min

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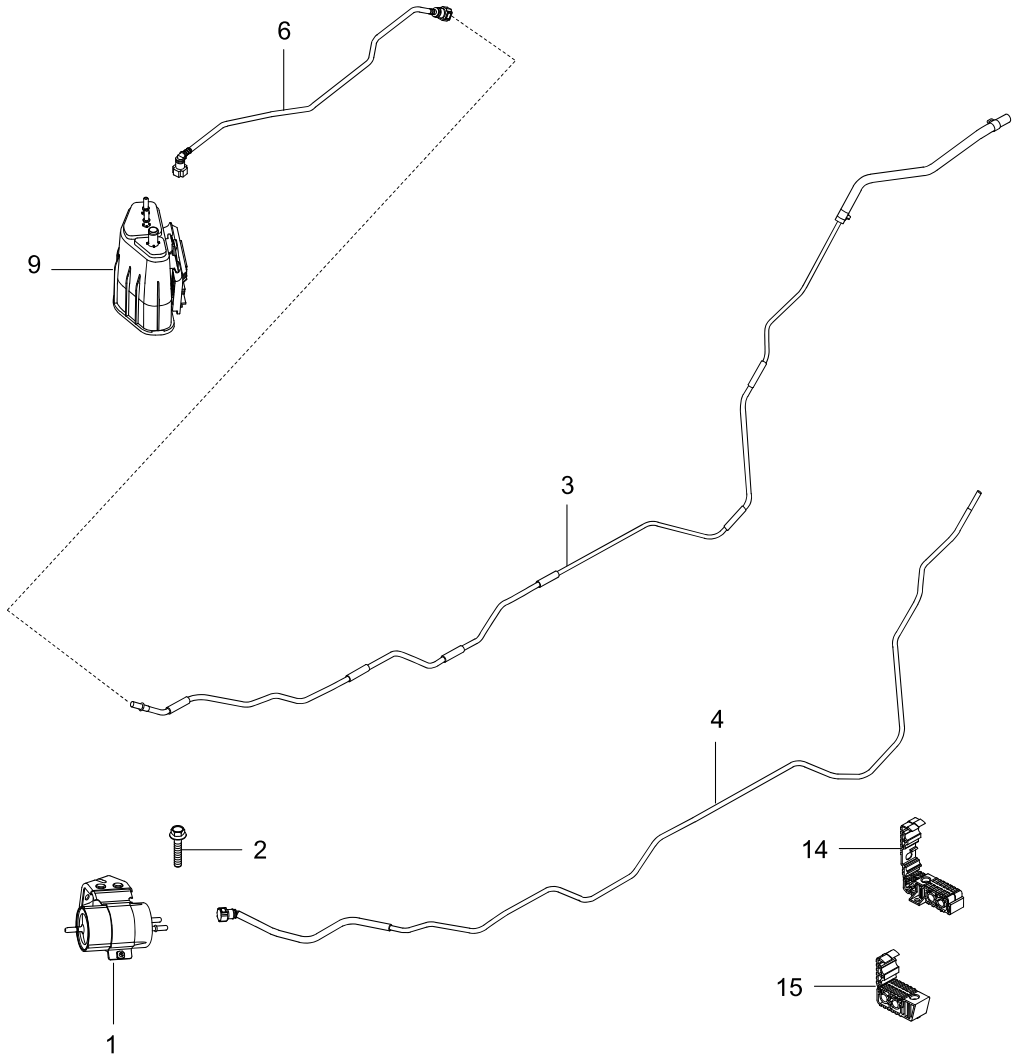
2. SYSTEM LAYOUT



1. Fuel tank assy
3. Fuel tank strap assy
4. Heat shield assy
5. Sub sender assy
6. Main fuel pump assy
7. Fuel filler assy
8. Fuel filler cap assy
9. Feed tube assy
10. Return tube assy
11. Suction tube assy
12. Harness wiring assy
13. Fuel pump plate cover
14. O-ring
20. clamp
21. Nut
22. Nut
23. Screw

Modification basis	
Application basis	
Affected VIN	

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1. Fuel Filter Assy
2. Bolt
3. Fuel Return Pipe
4. Fuel Supply pipe
6. Fuel Vapor Pipe Assy
9. Canister Compl
14. Fuel line Holder
15. Fuel line Holder

Modification basis	
Application basis	
Affected VIN	

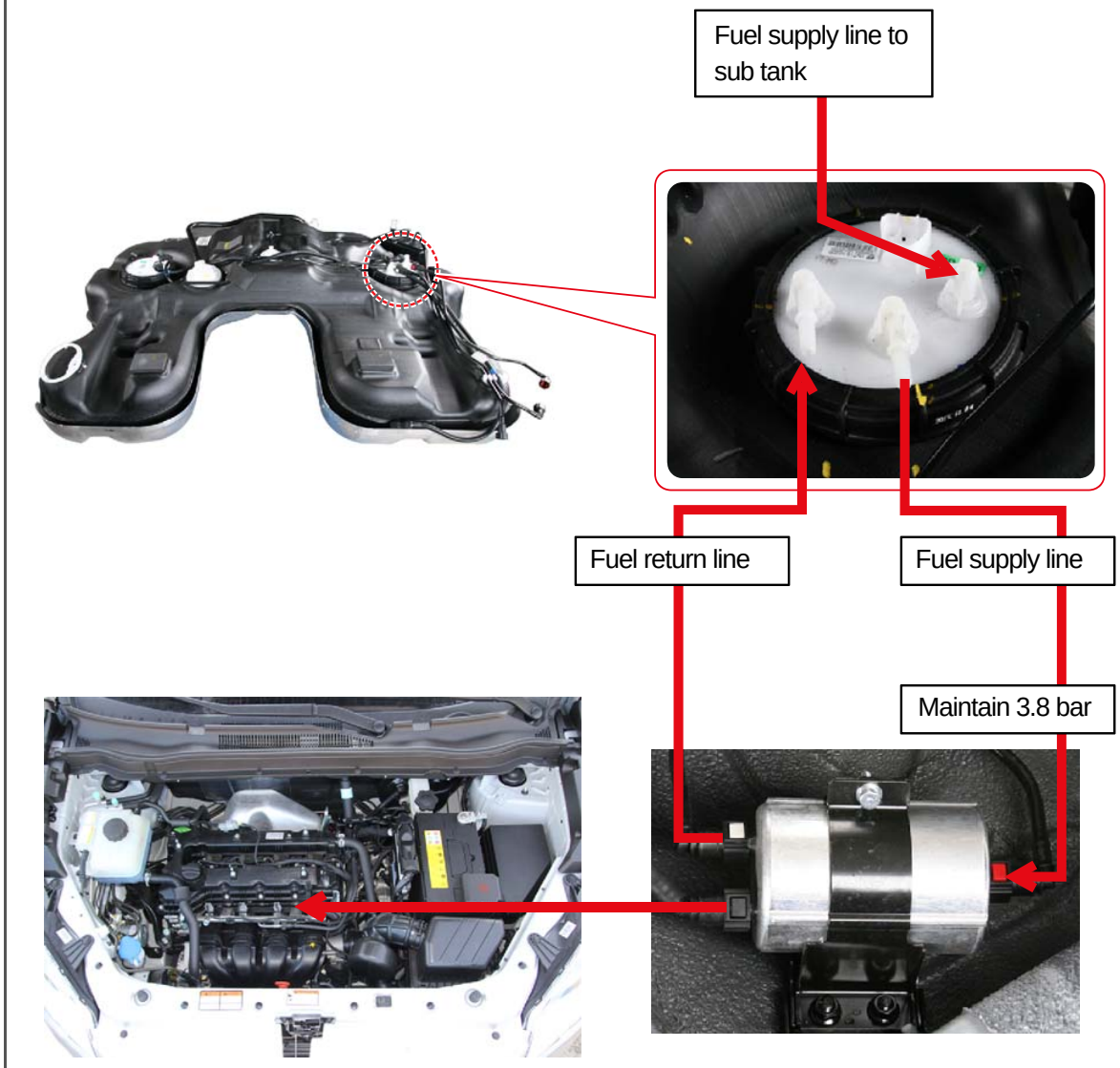
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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The fuel system is a returnless type that the fuel pressure regulator is mounted inside the fuel tank.
The engine ECU controls the fuel injection in each injector electronically.
According to the engine loads, the engine ECU draws or cuts off the evaporated gas in canister into the combustion chamber. The fuel system consists of fuel tank, fuel lines, fuel pump and fuel pressure regulator.

Returnless Type



Modification basis	
Application basis	
Affected VIN	

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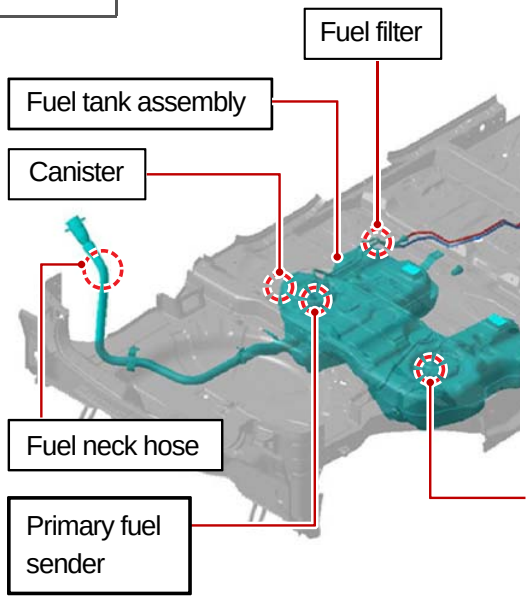
Memo

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2. COMPONENTS

Canister	Fuel filter
	

Fuel pump and fuel sender assembly

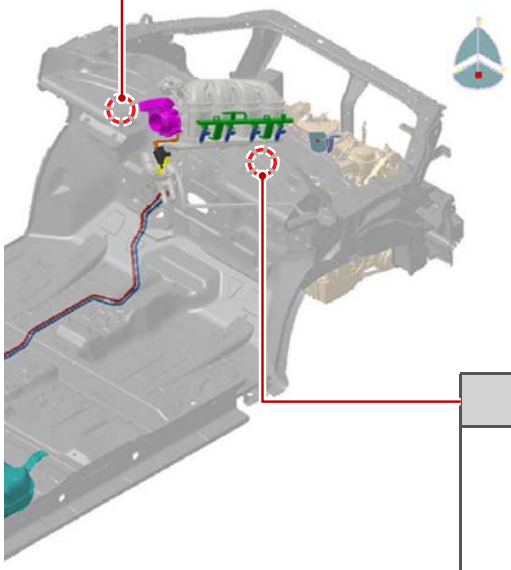
Fuel tank assembly


Modification basis	
Application basis	
Affected VIN	

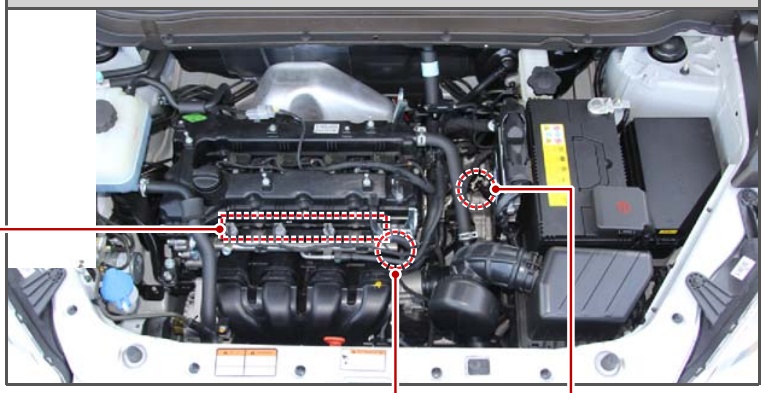
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Engine ECU





Engine compartment



Secondary fuel sender

Injector



Fuel rail

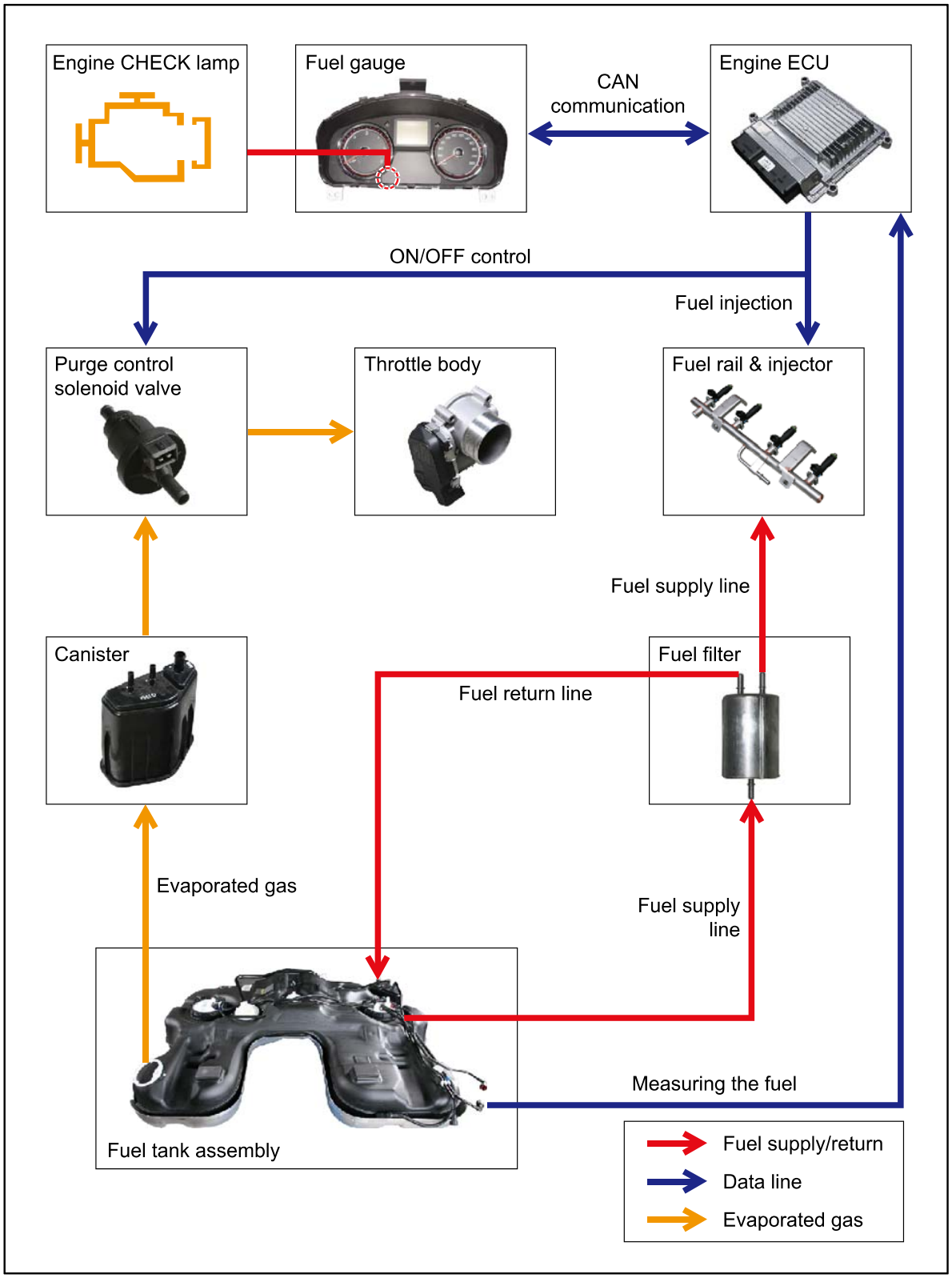


Purge control solenoid valve



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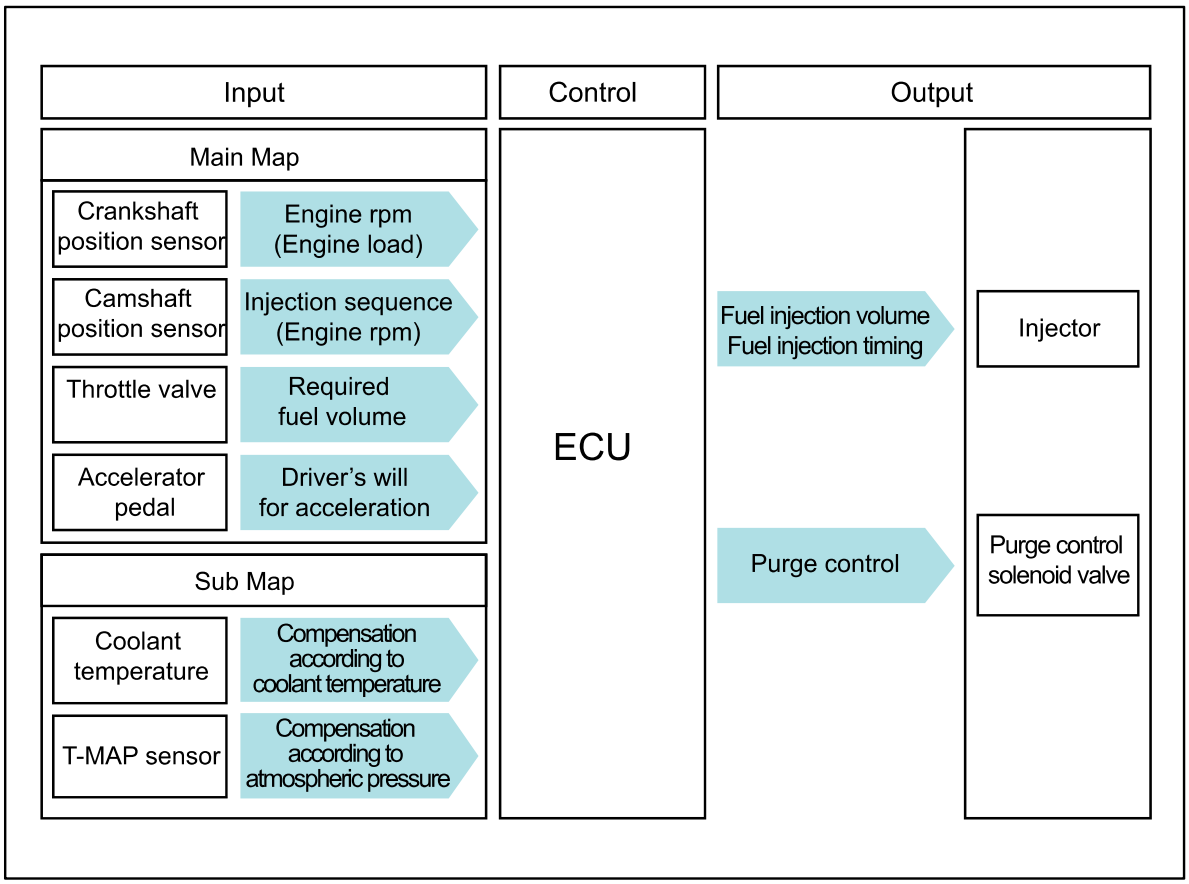
3. SCHEMATIC DIAGRAM OF FUEL FLOWS



Modification basis	
Application basis	
Affected VIN	

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4. INPUT/OUTPUT DEVICES



The engine ECU calculates the accelerator pedal based on the input signals from various sensors, and controls the overall operation of the vehicle.
The ECU receives the signals from various sensor through data line, and performs effective airfuel ratio control based on these signals.

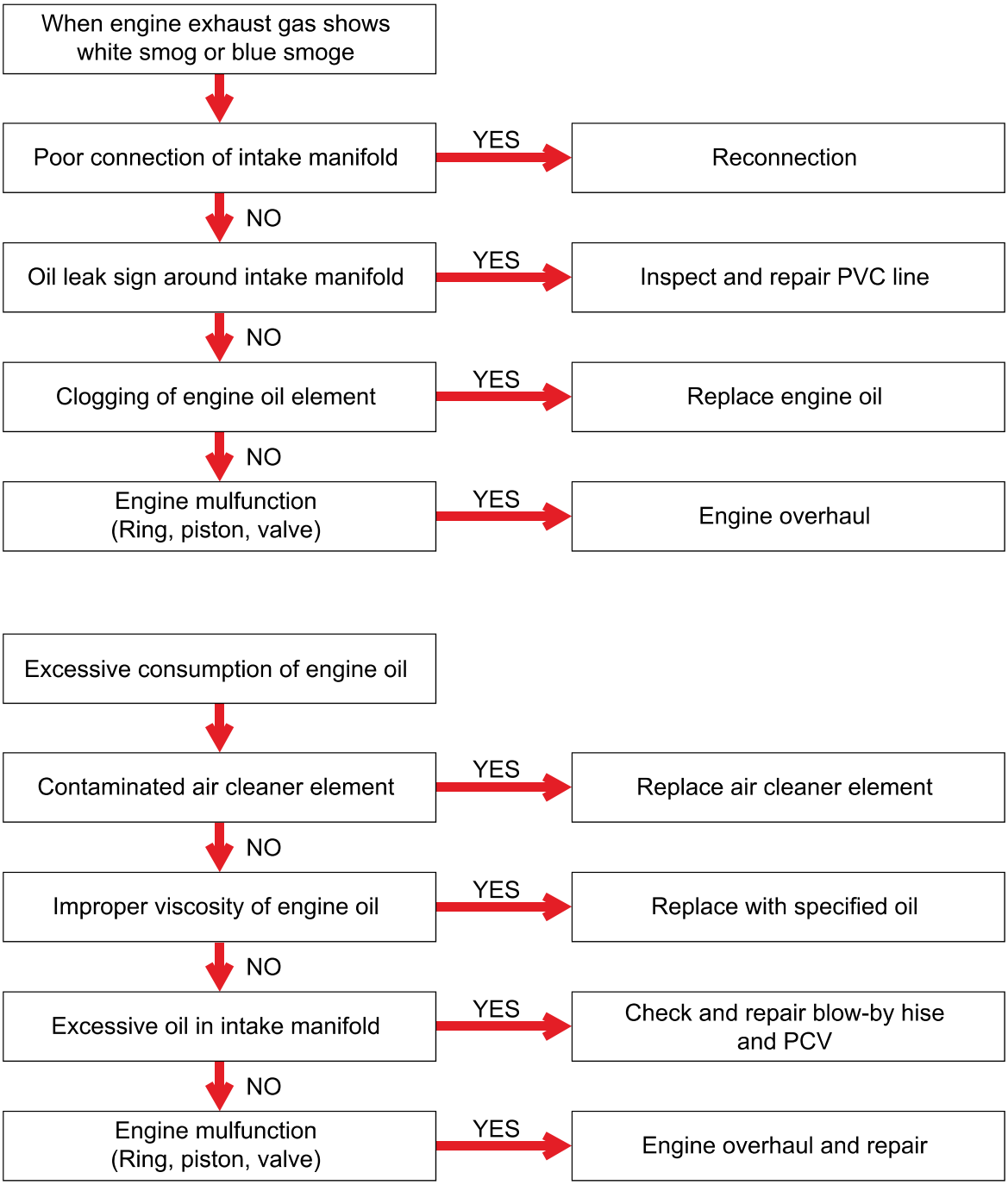
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EXHAUST SYSTEM

1745-01

GENERAL INFORMATION

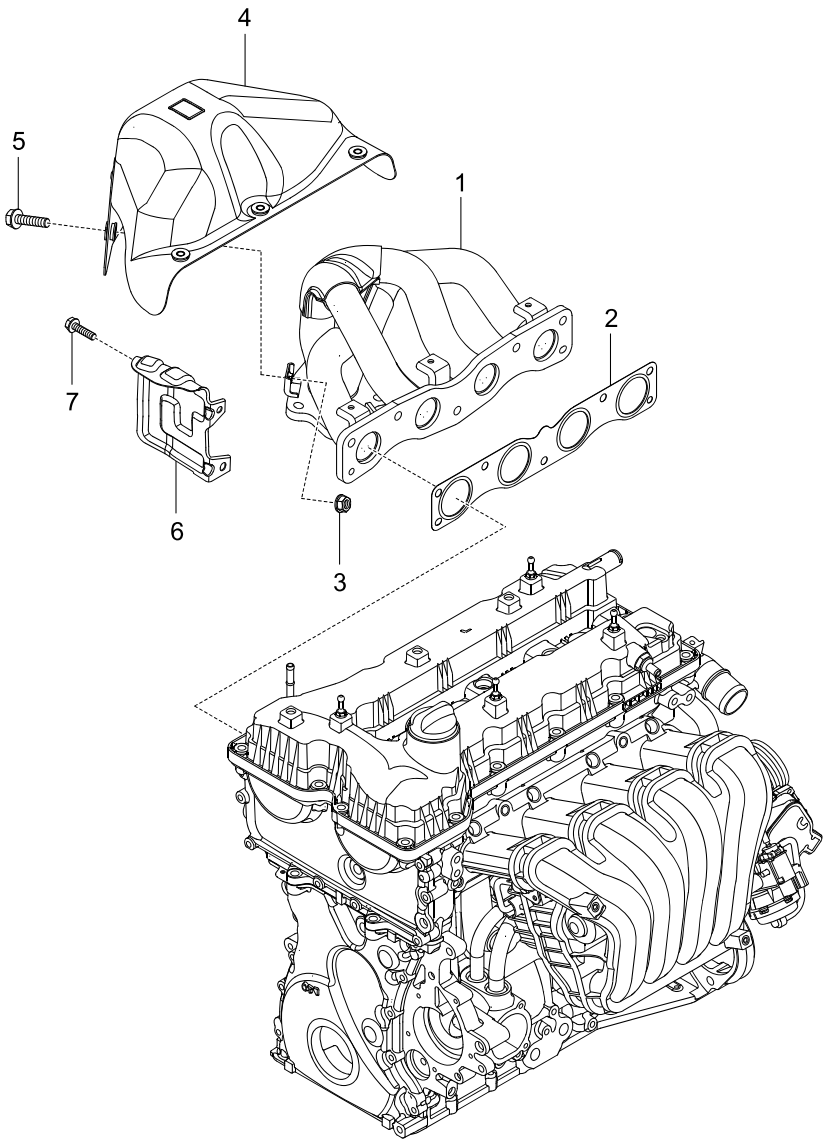
1. TROUBLESHOOTING



Modification basis	
Application basis	
Affected VIN	

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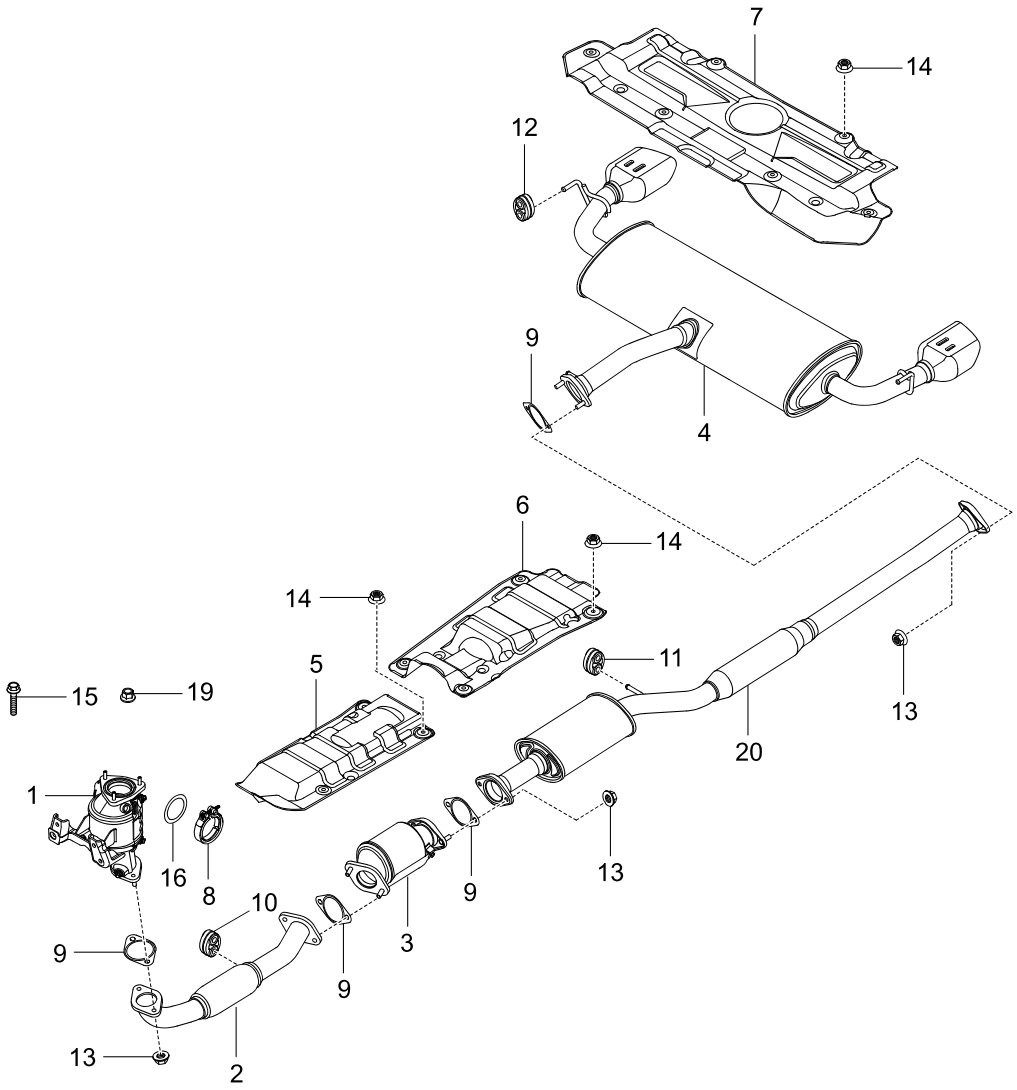
2. LAYOUT



1. Exhaust Manifold Assy
2. Exhaust Manifold Gasket
3. Hex Flange Nut
4. Heat Protector Assy
5. Hex Bolt (M6 X 1 X 25)
6. Heat Protector Assy
7. Hex Bolt (M8 X 1.25 X 16)

Modification basis	
Application basis	
Affected VIN	

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1. WCC Compl
2. Exhaust FRT Pipe Assy
3. UCC Compl
4. Muffler Complete ?RR
5. Exhaust FRT Heat Protector
6. CTR Muffler Heat Protector
7. RR Muffler Heat Protector
8. Clamp
9. Gasket
10. Hanger
11. Hanger
12. Hanger
13. Nut
14. Nut
15. Bolt
16. Gasket Ring
19. Nut
20. CTR Muffler Complete

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3. CAUTIONS

- Do not park the vehicle on flammable materials, such as grass, leaves and carpet.
- Do not touch the catalyst or the exhaust gas ignition system when the engine is running.
- If a misfire occurs in the combustion chamber or the emission of pollutant exceeds the specified level, the catalyst can be damaged.
- When servicing or replacing components of the exhaust system, makes sure that the components are positioned at regular intervals from all other parts of the under body.
- Be careful not to damage the exhaust system when lifting the vehicle from its side.
- All components and body parts of the engine exhaust system should be inspected for crack, damage, air hole, part loss and incorrect mounting location. Also check for any deformation which can result in exhaust gas drawn into the vehicle.
- Make sure that the exhaust pipe is cooled down sufficiently before working on it because it is still hot right after the engine is stopped.
- Wear protective gloves when removing the exhaust pipe.

Modification basis	
Application basis	
Affected VIN	

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

This system purifies the exhaust gas generated by the combustion in the engine to reduce the pollutants and noise during that arise during combustion.
Harmful materials produced in the combustion process is treated and reduced in the exhaust system.
Harmful materials discharged from the crankcase and fuel tank is drawn into the intake system again to reduce discharge amount of harmful materials.

▶ Emission aftertreatment system

- Catalytic Converter & O2 Sensor
  The catalytic converter is a monolith type purification system composed of cordierite which purifies exhaust gas through the small holes of active monolith catalyst from the exhaust manifold. As exhaust gas passes through the small holes in the layer in the middle, its CO and HC are reduced by oxidization reaction and its NOx is reduced by reduction reaction to Pt, Ph and Pd. The oxygen sensor sends signals for feedback and determination of catalyst condition. For detailed description, see the corresponding section.

▶ Purge Canister Control

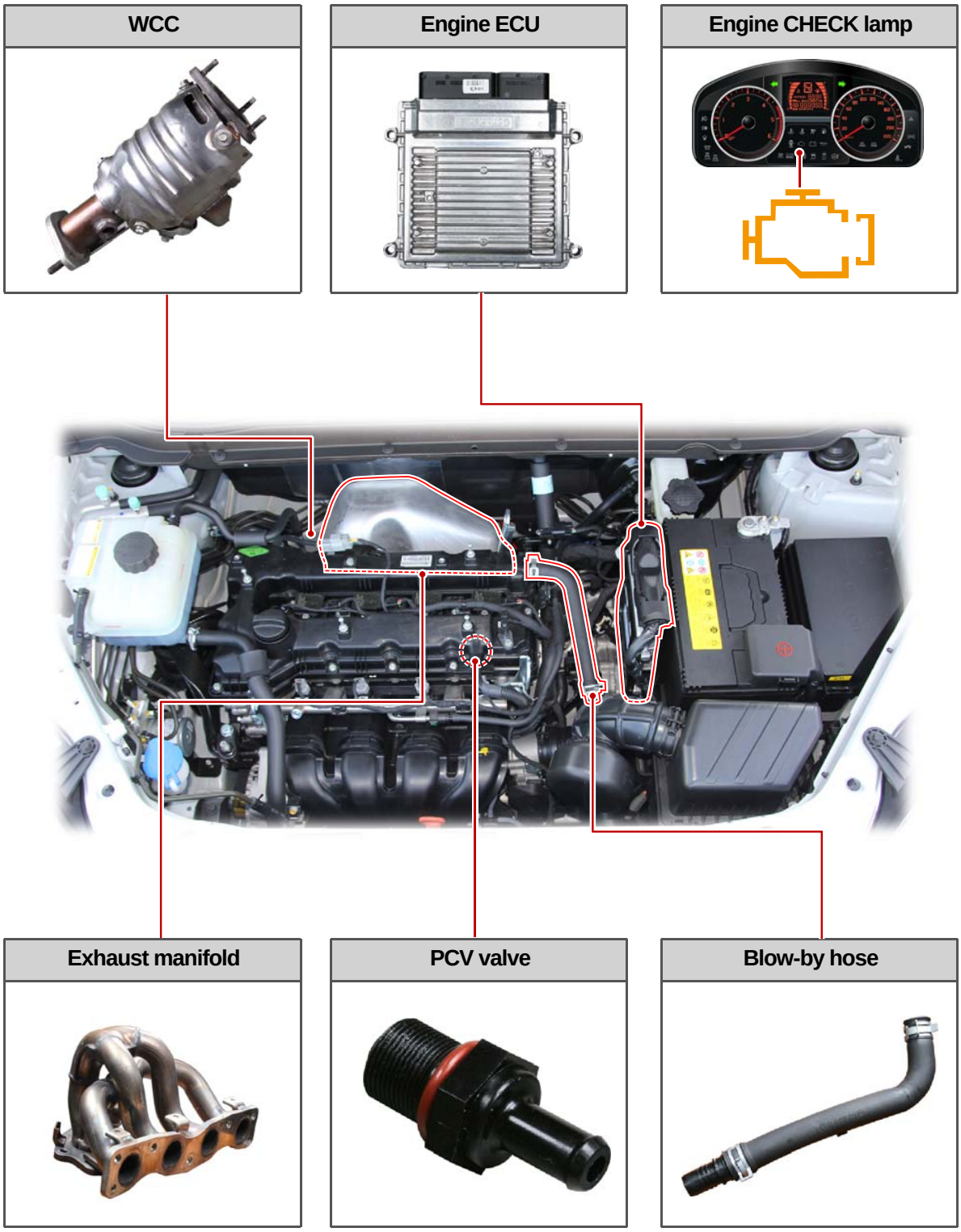
The fuel evaporative gas is a gas evaporated to the atmosphere in the section between the fuel tank and fuel line, and its main component is hydrocarbon (HC). The fuel evaporative gas is temporarily stored in the canister, and it is drawn to the engine through the throttle body when the purge control solenoid valve is open according to the engine operating condition.

▶ Blow-by gas control system (crankcase ventilation system)

Gas in the combustion chamber is sealed by the piston. However, gas is leaked through the gap between the cylinder and piston and drawn into the crankcase during the compression and explosion strokes. This gas is blow-by gas and its main components are hydrocarbon and carbon monoxide. If this gas is drawn into the crankcase, the system can be corroded and oil can be deteriorated. Also, if this gas is discharged into the air, it can pollute the environment. To prevent these, the blow-by gas reduction system (also called as crankcase ventilation system) draws the blow-by gas from the crankcase to the combustion chamber for combustion.

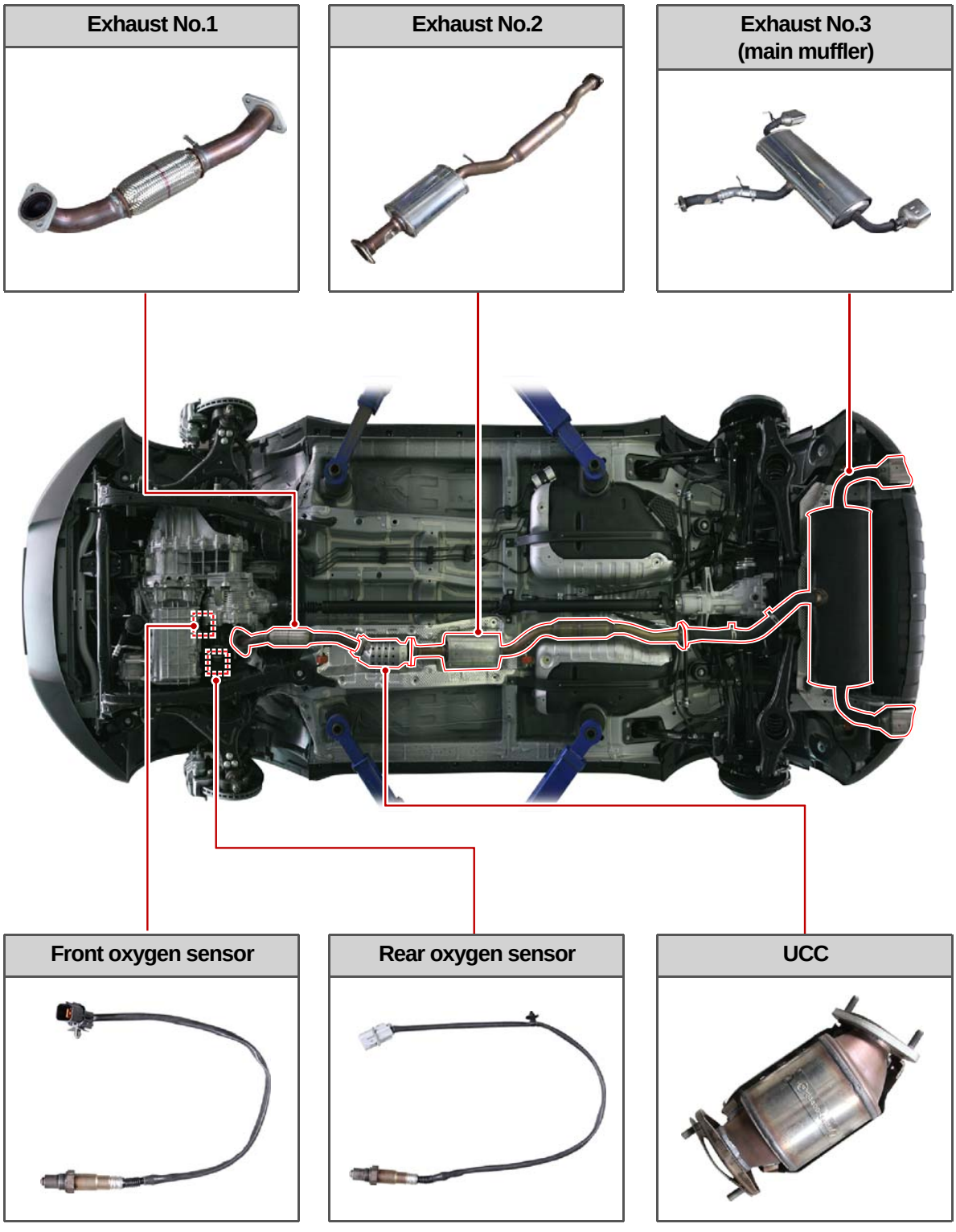
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2. COMPONENTS



Modification basis	
Application basis	
Affected VIN	

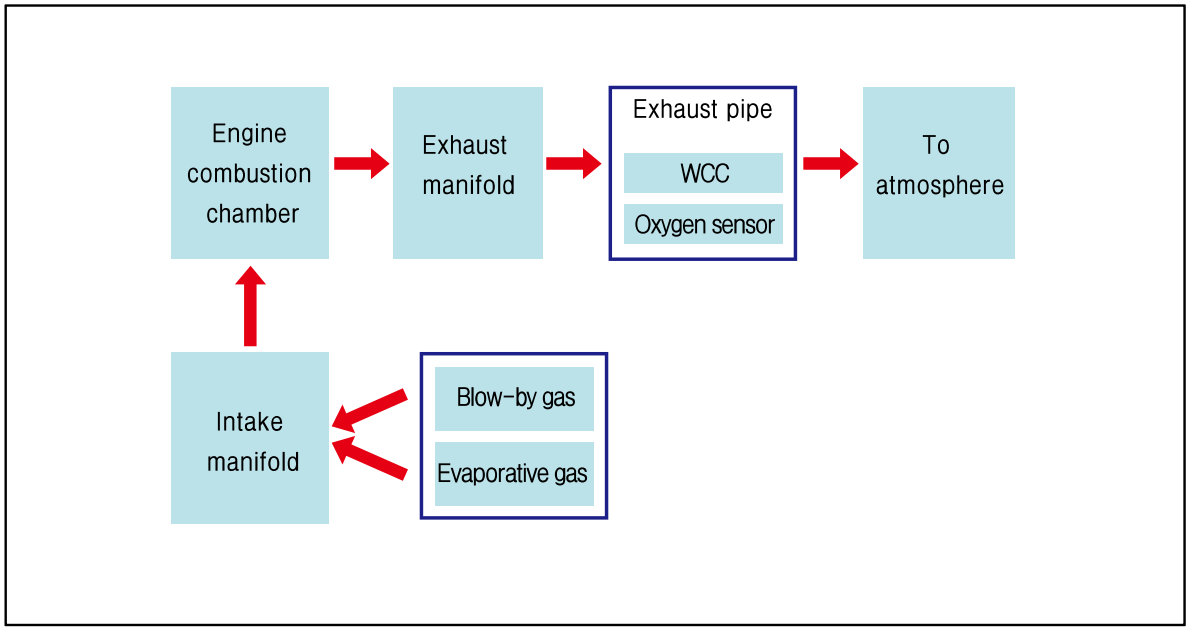
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Modification basis	
Application basis	
Affected VIN	

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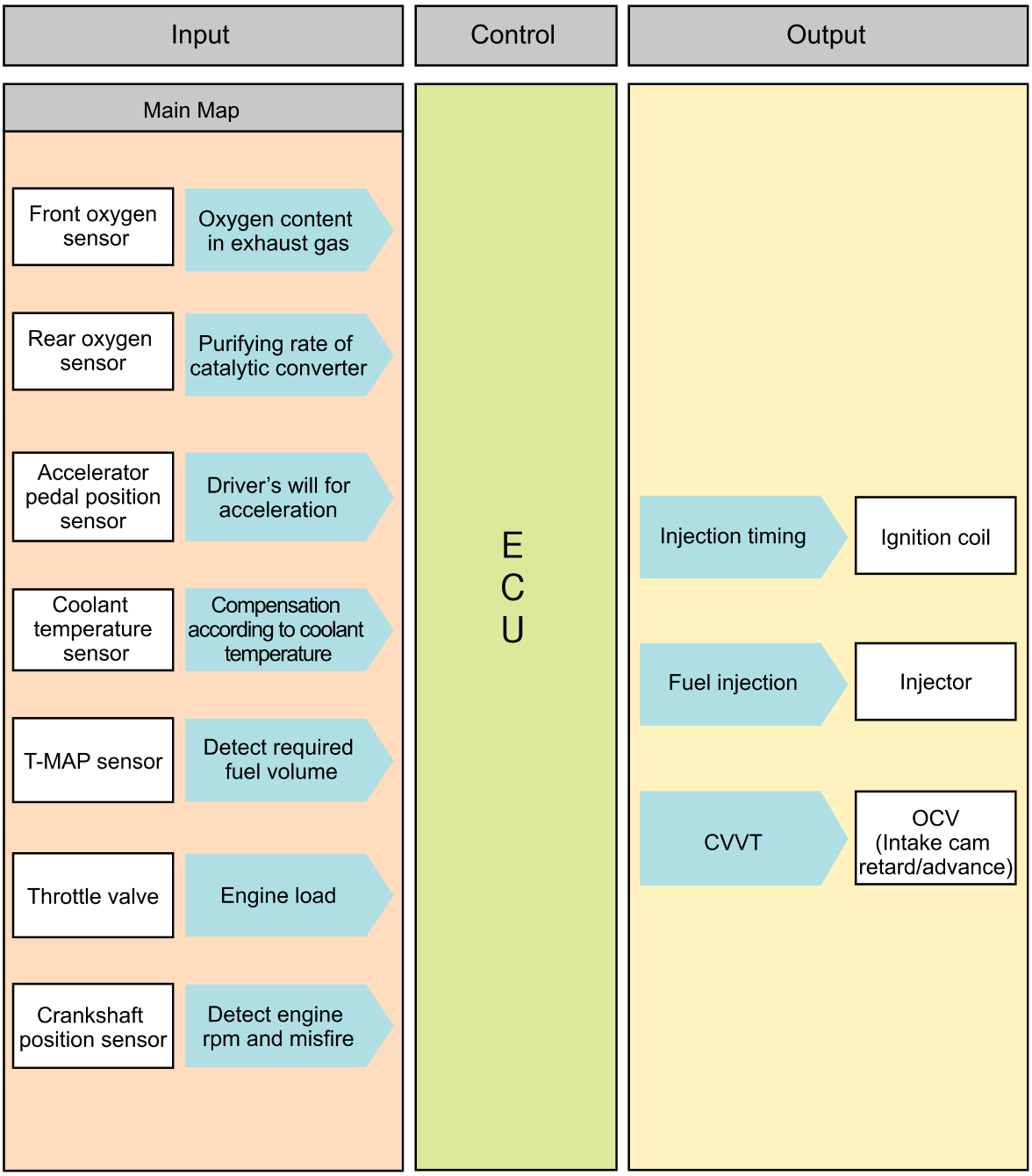
3. WORK FLOW IN EXHAUST SYSTEM



Modification basis	
Application basis	
Affected VIN	

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4. INPUT/OUTPUT DEVICES



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IGNITION SYSTEM

1443-01

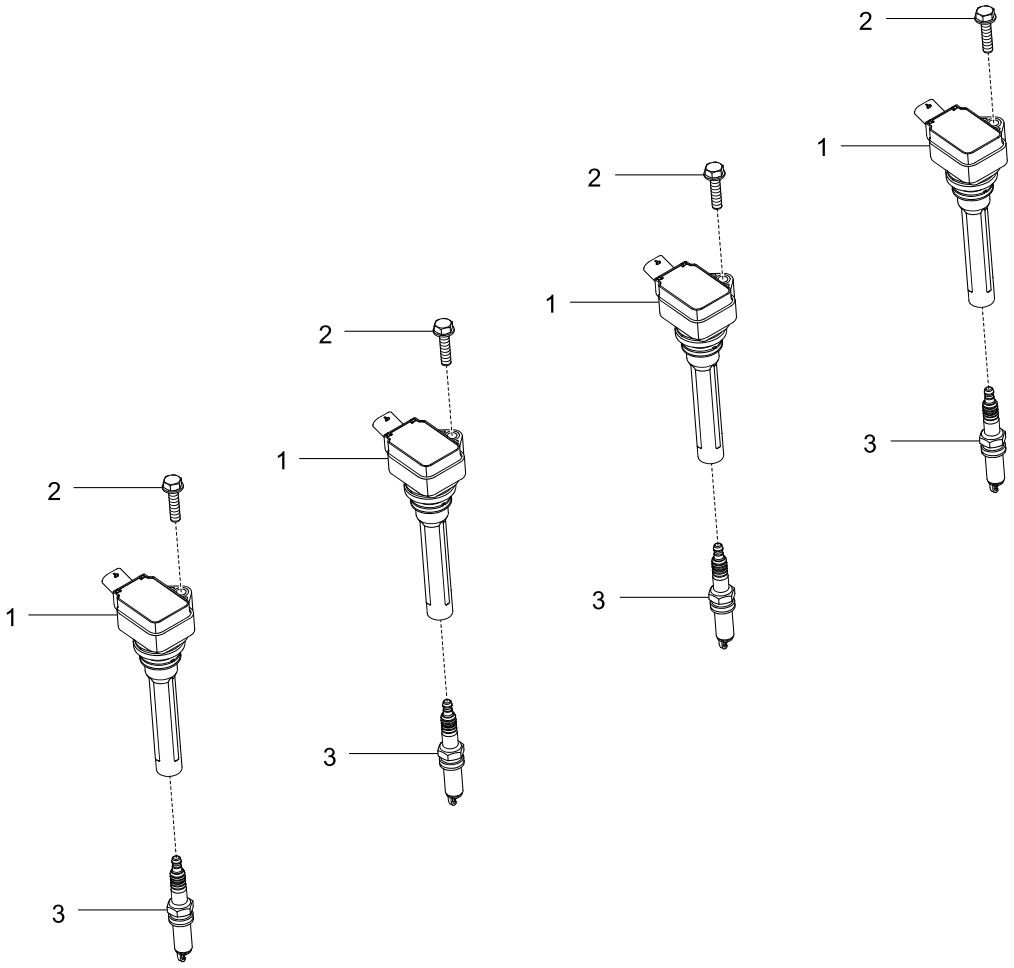
GENERAL INFORMATION

1. SPECIFICATION

Description		Specification
Spark plug	Internal resistance	3 ~ 7 kΩ
	Center electrode	Iridium alloy
	Ground electrode	Platinum alloy
	Electrode clearance	1.1 mm
	Change interval	160,000 km
Ignition coil	Primary operating current	7 ± 0.5A
	Generated voltage (primary/secondary)	Max. 400 V / 5~20 kV
	Ignition type	Independent ignition type
	Ignition sequence	1-3-4-2

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2. LAYOUT



1. Ignition Coil
2. Bolt
3. Spark Plug

Modification basis	
Application basis	
Affected VIN	

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The ignition system is to supply high voltage generated from the ignition coil to the spark plug. The G20DF engine is equipped with the independent type direct ignition system that the ignition coil is installed in each cylinder.
The basic ignition timing in each cylinder is determined by the signals from camshaft position sensor and crankshaft position sensor.
This ignition system controls the electronic ignition timing received from the engine ECU. To control the ignition timing precisely, the ECU use the information below:

- Engine load
- Coolant temperature
- Intake air temperature
- Engine rpm
- Camshaft position sensor (CPS)
- Crankshaft position sensor (CKS)

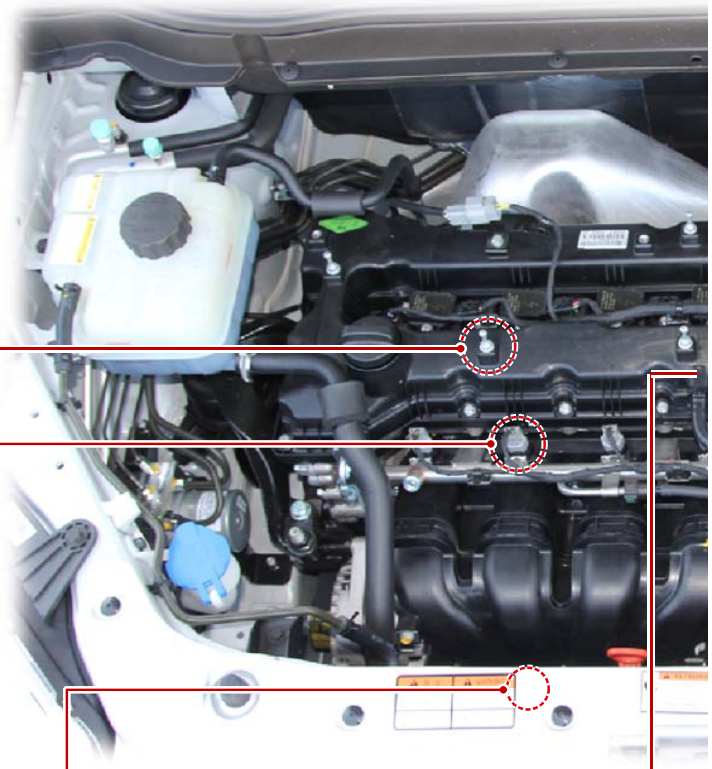
If the signal from the camshaft position sensor is not delivered to the engine ECU, the ignition coil and fuel system cannot be operated.

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2. COMPONENTS

Ignition coil





Spark plug



Injector



Knock sensor

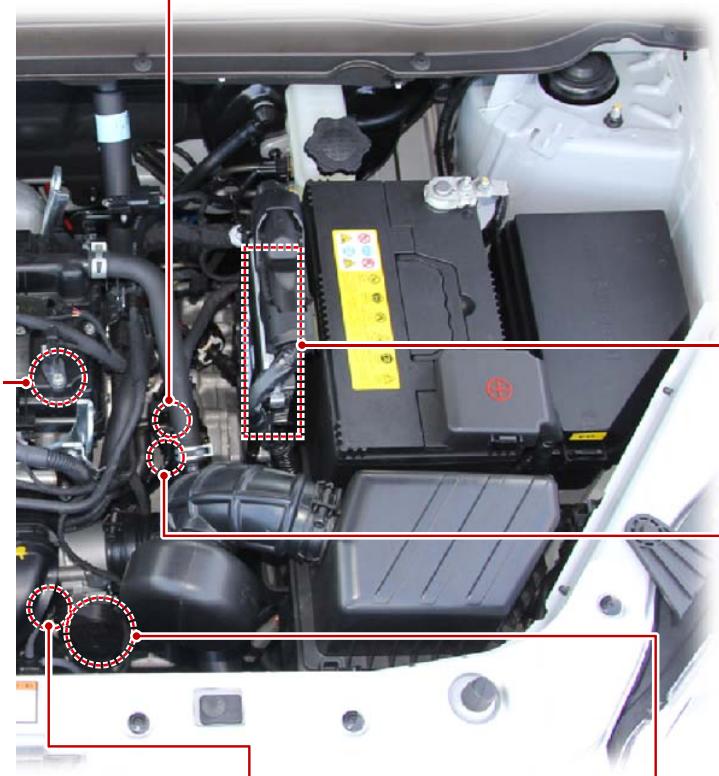


Camshaft position sensor



Modification basis	
Application basis	
Affected VIN	

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Crankshaft position sensor



Engine ECU



Coolant temperature sensor



T-MAP sensor



Electric throttle valve



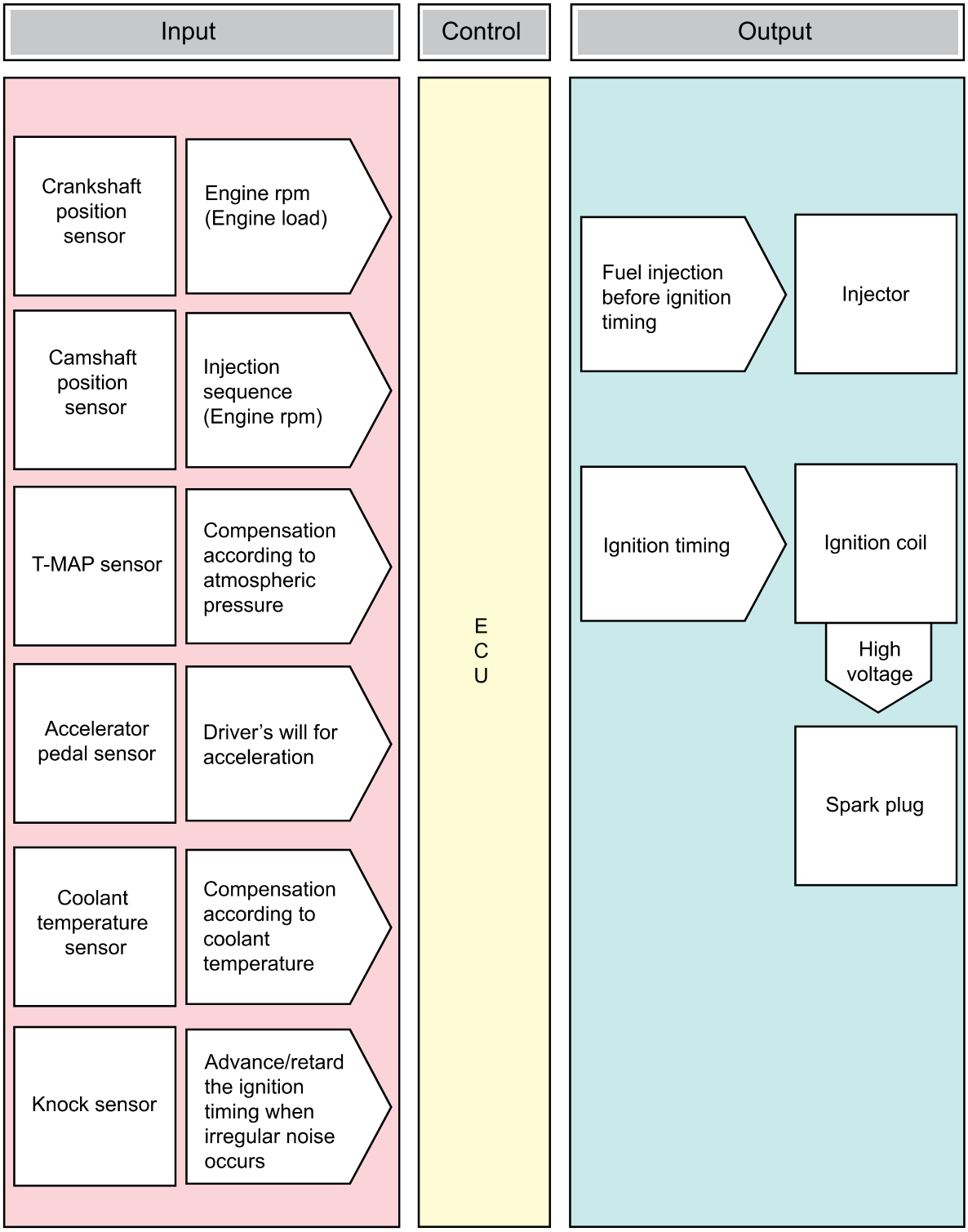
Accelerator pedal position sensor



Modification basis	
Application basis	
Affected VIN	

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3. INPUT/OUTPUT DEVICES



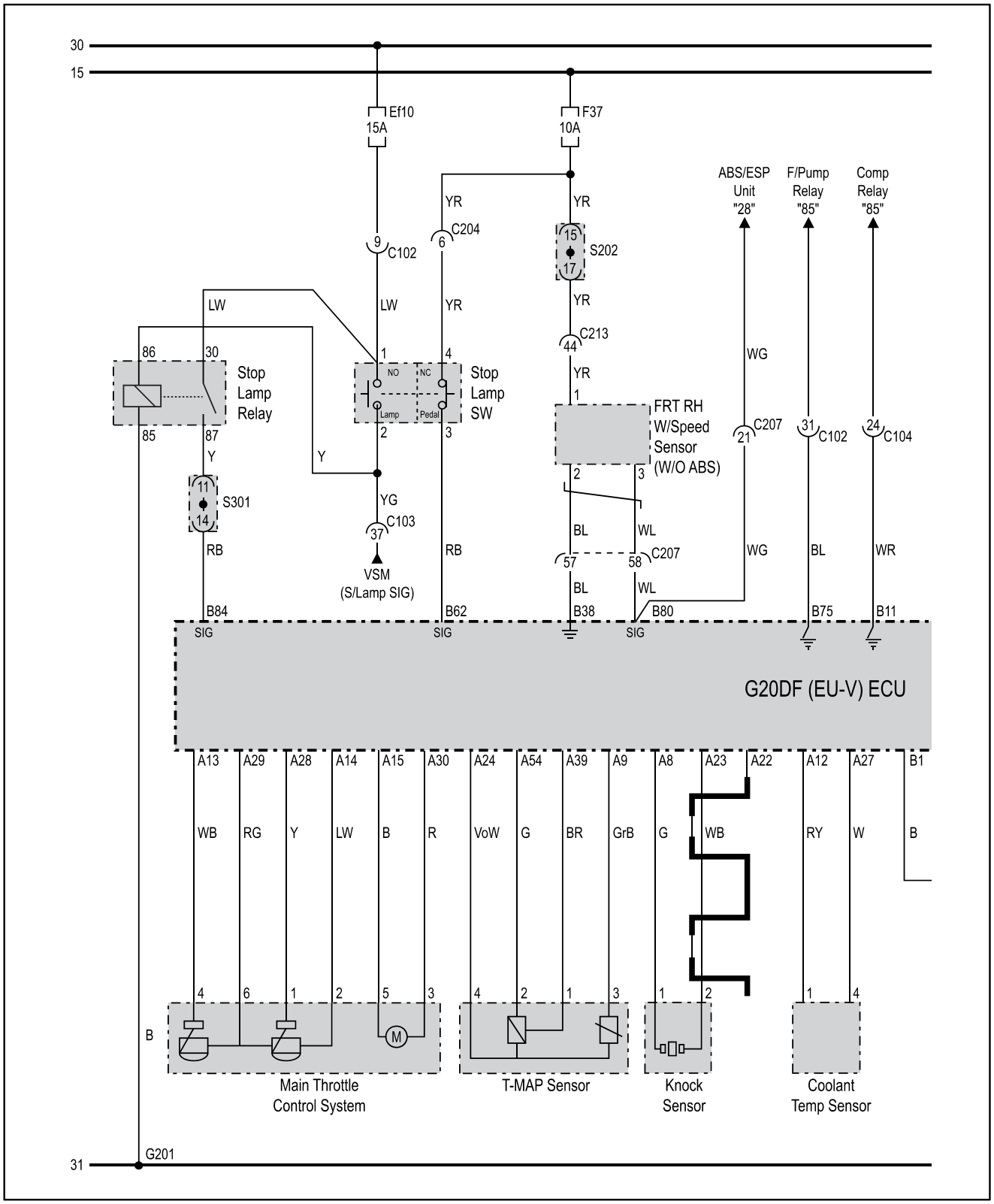
Modification basis	
Application basis	
Affected VIN	

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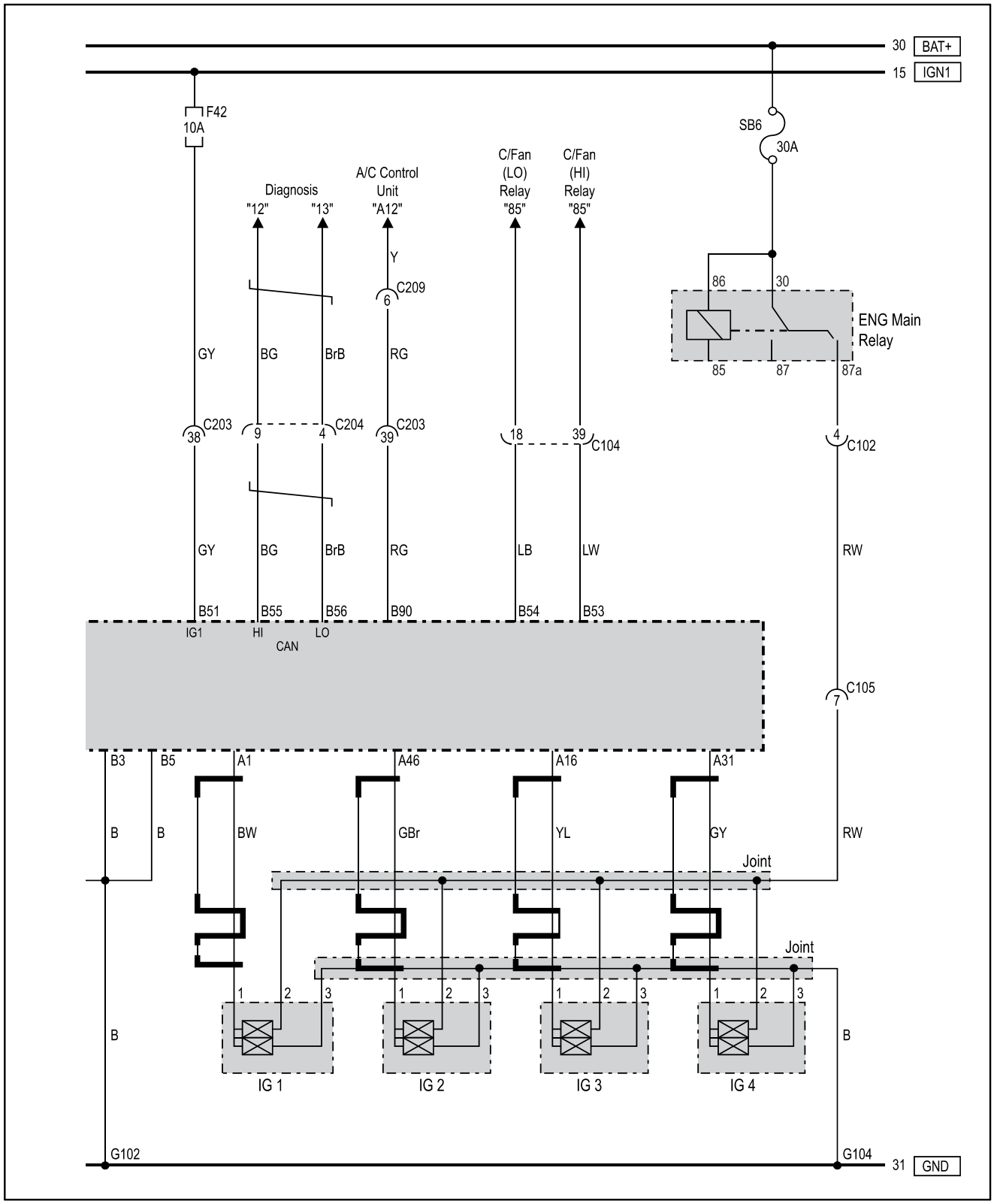
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4. CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
Affected VIN	

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LUBRCATION SYSTEM 1535-01

GENERAL INFORMATION

1. SPECIFICATION

Description		Specification
Oil pump	Lubrication type	Gear pump, forced circulation
	Type	Internal gear
Oil filter	Type	Full flow/Paper element
Engine oil	Oil	Quality class: Ssangyong genuine engine oil (Approved by MB 229.51 SAE 5W30)
	Capacity	4.5 L
Oil injection nozzle	Type	Flange and bolt type

CAUTION

The engine oil filter element should be changed at the same time with the engine oil.

- Regularly check the engine oil level and add the engine oil if necessary.
- Remember to check the engine oil level and shorten the cycle to replace the engine oil under severe driving conditions.

Severe Driving Condition?

- Frequent stop-and-go traffic, extended idling, short driving distance below 6 km, driving distance below 16 km when the outside temperature remains below freezing
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- High load driving such as trailer towing
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

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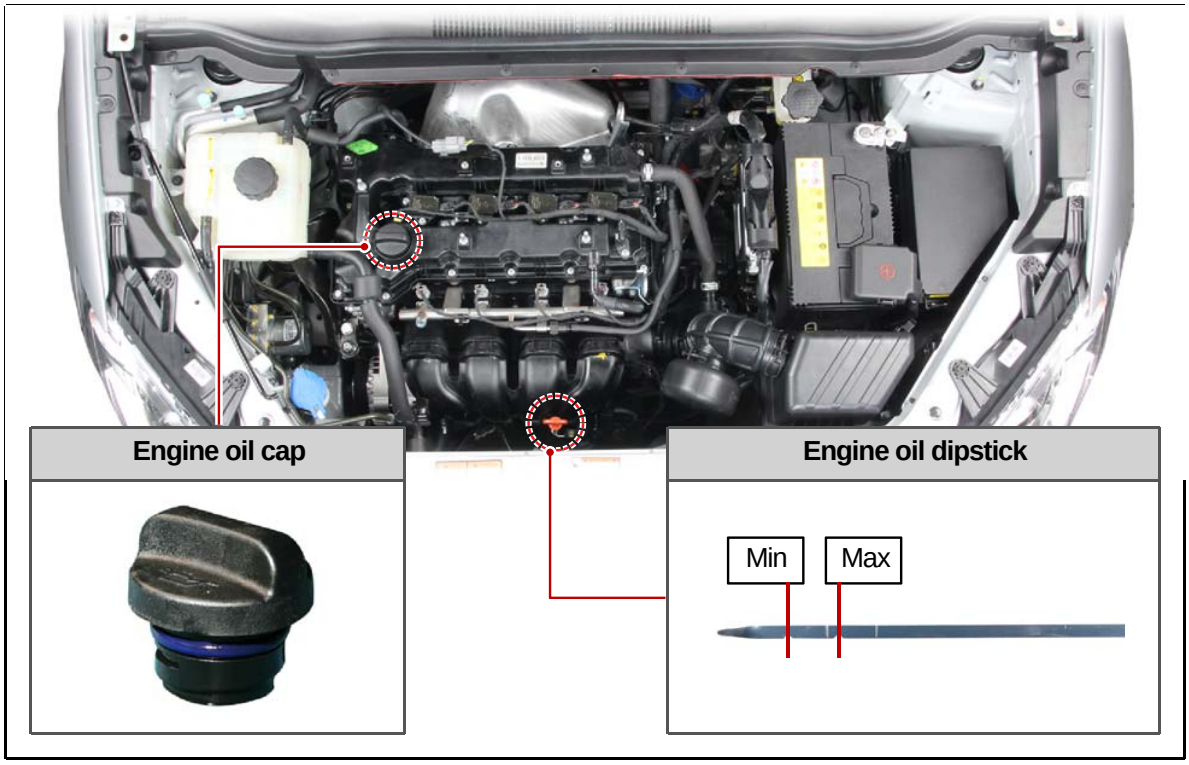
2. MAINTENANCE

Park the vehicle on a level ground and apply the parking brake. Stop the engine and wait more than 5 minutes.

- Pull out the dipstick and wipe it with a clean cloth. Reinsert it all the way.
- Pull out it again and check the oil level.
- The oil level should be between the maximum (Max) mark and minimum (Min) mark on the oil dipstick. Oil should be replenished before the level goes below the minimum mark.

WARNING

Operating vehicle with insufficient amount of oil can damage the engine. Make sure the engine oil level is correct and add oil if necessary.



▶ **Replenishment**

If the level gets to the lower point, open the filler cap on top of the cylinder block and add the genuine oil without exceeding the level of the upper mark.
Recheck the oil level after 5 minutes.

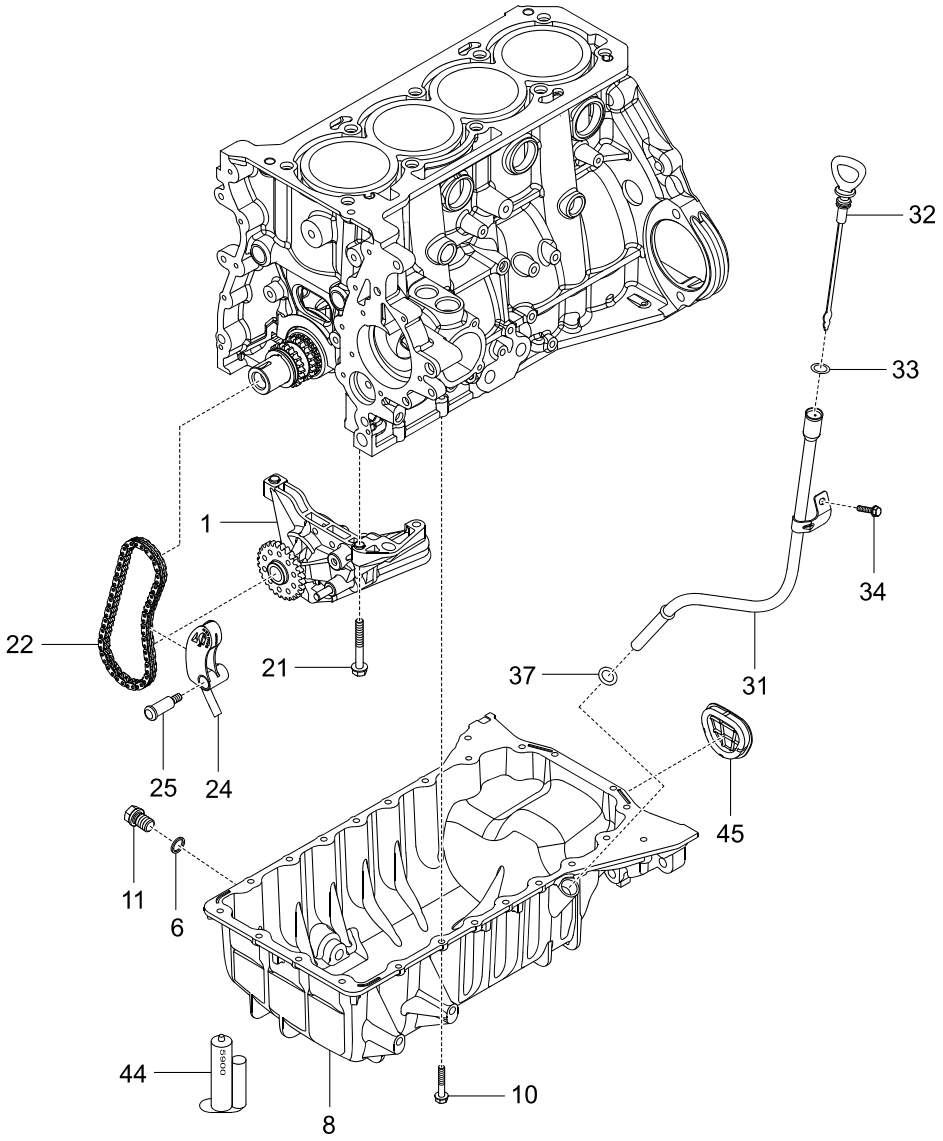
CAUTION

- Regularly check the engine oil level and add Ssangyong genuine engine oil if necessary.
- Clean the dipstick with clean cloth so that any foreign materials cannot get into the engine.
- The oil should not go above the upper mark on the dipstick.
- The engine oil may be consumed more if the engine is new.

Modification basis	
Application basis	
Affected VIN	

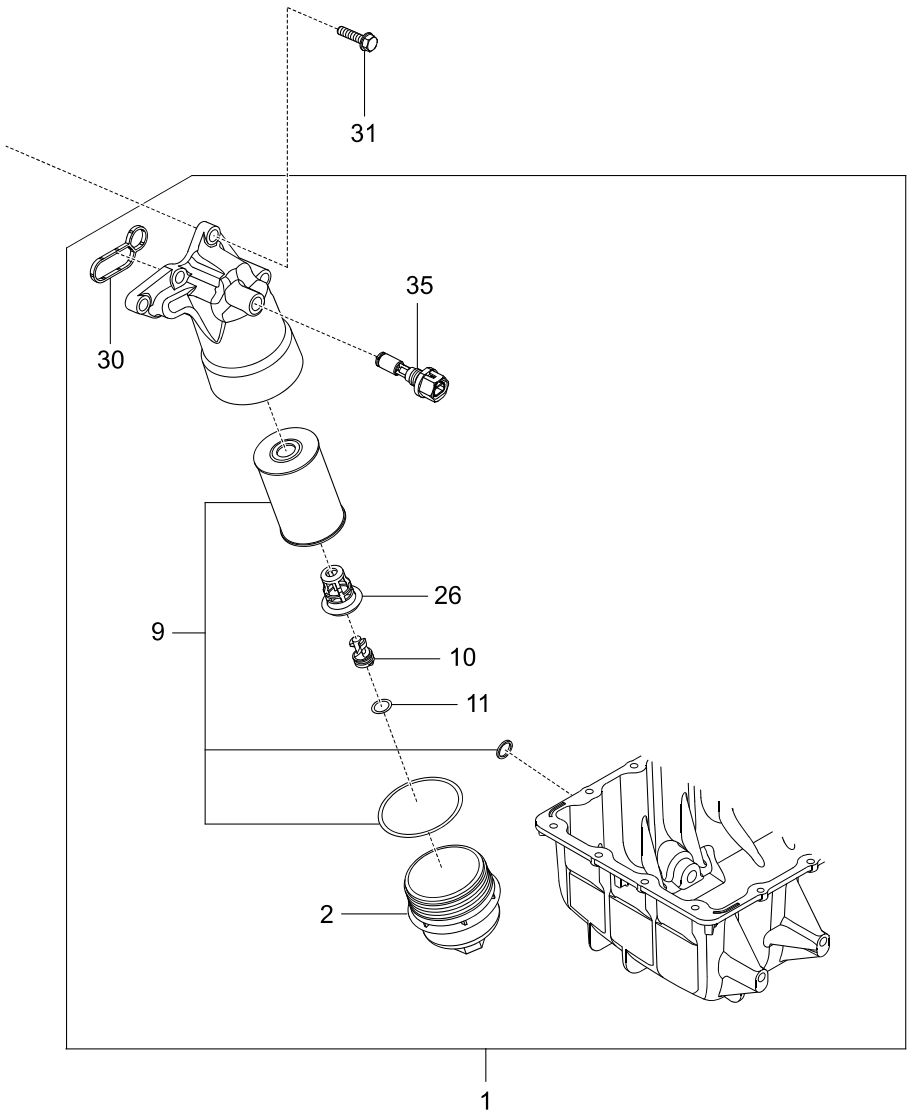
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3. LAYOUT



1. Oil Pump Assy
6. Seal Ring
8. Oil Pan
10.Bolt
11.Drain Plug
21.Bolt
22.Oil Pump Chain
24.Oil Pump Chain Tensioner Assy
25.Bolt
31.Oil Dipstick Tube Assy
32.Oil Dipstick Gauge Assy
33.O-Ring
34.Bolt
37.O-Ring
44.Sealant
45.Dust Cover

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1. Oil Filter Assy
2. Oil Filter Cover
9. Oil Filter Element Kit
10. Drain Plug
11. O-Ring
26. Oil Filter Bypass Valve Assy
30. Oil Filter Housing Gasket
31. Bolt
35. Oil pressure switch

Modification basis	
Application basis	
Affected VIN	

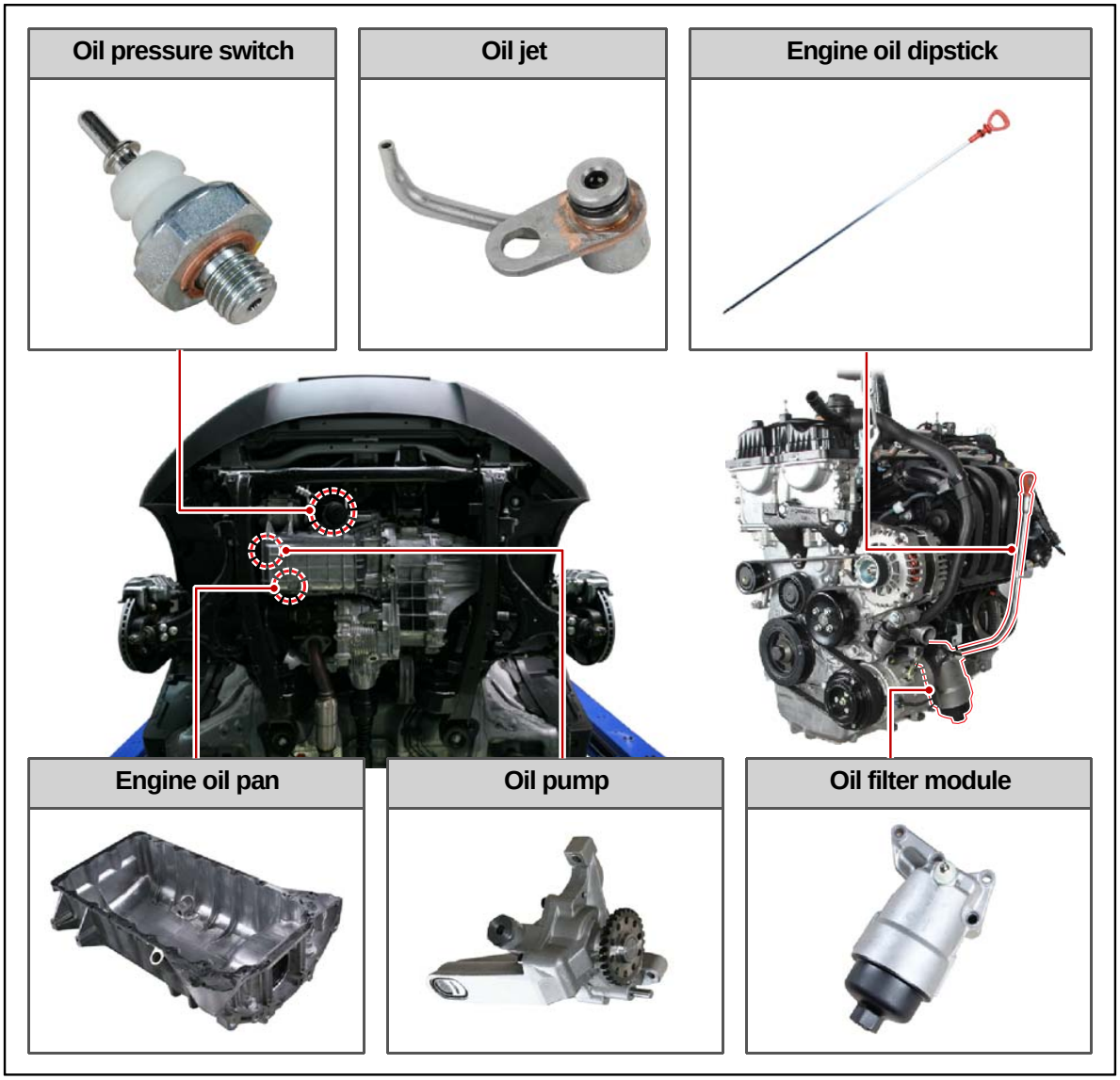
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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The lubrication system supplies oil to each lubrication section to prevent friction and wear and to remove heat from the friction part. As the engine runs, frictional heat is generated on each lubrication section. If this condition persists, the bearing can be burned and stuck.
In other words, it creates an oil film on each sliding surface to convert solid friction to liquid friction in order to minimize wear and prevent temperature increasing on the friction part.

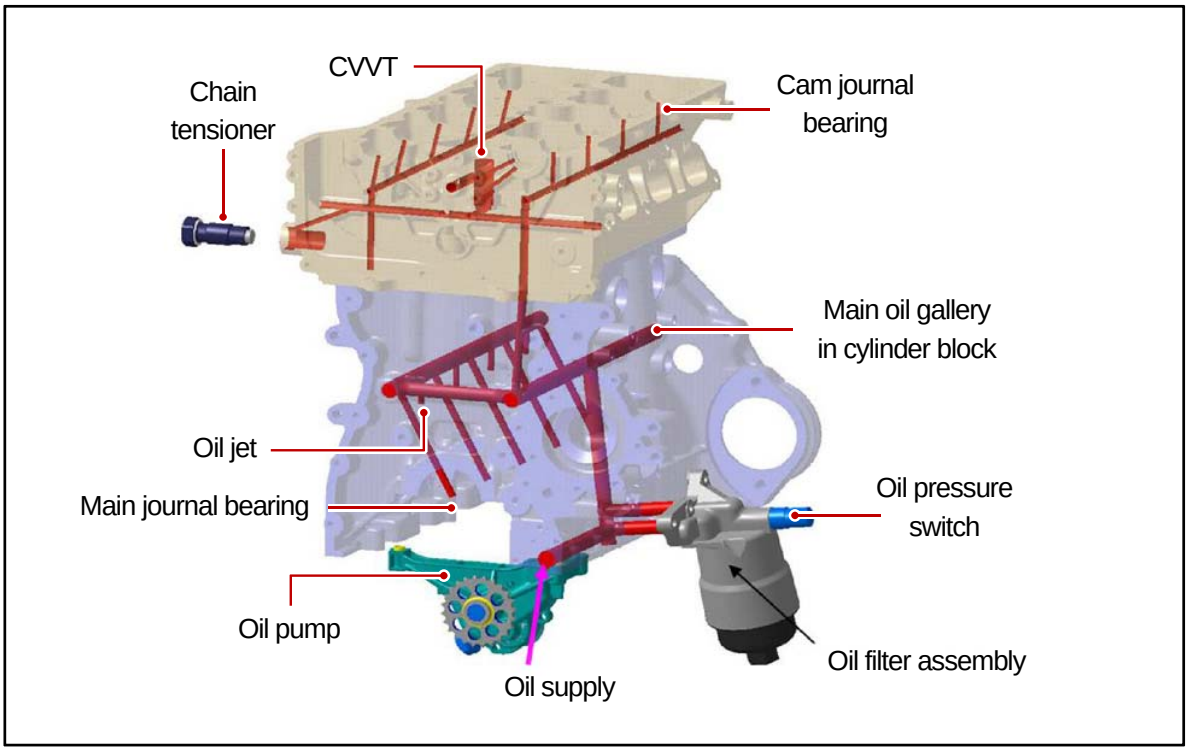
2. COMPONENTS

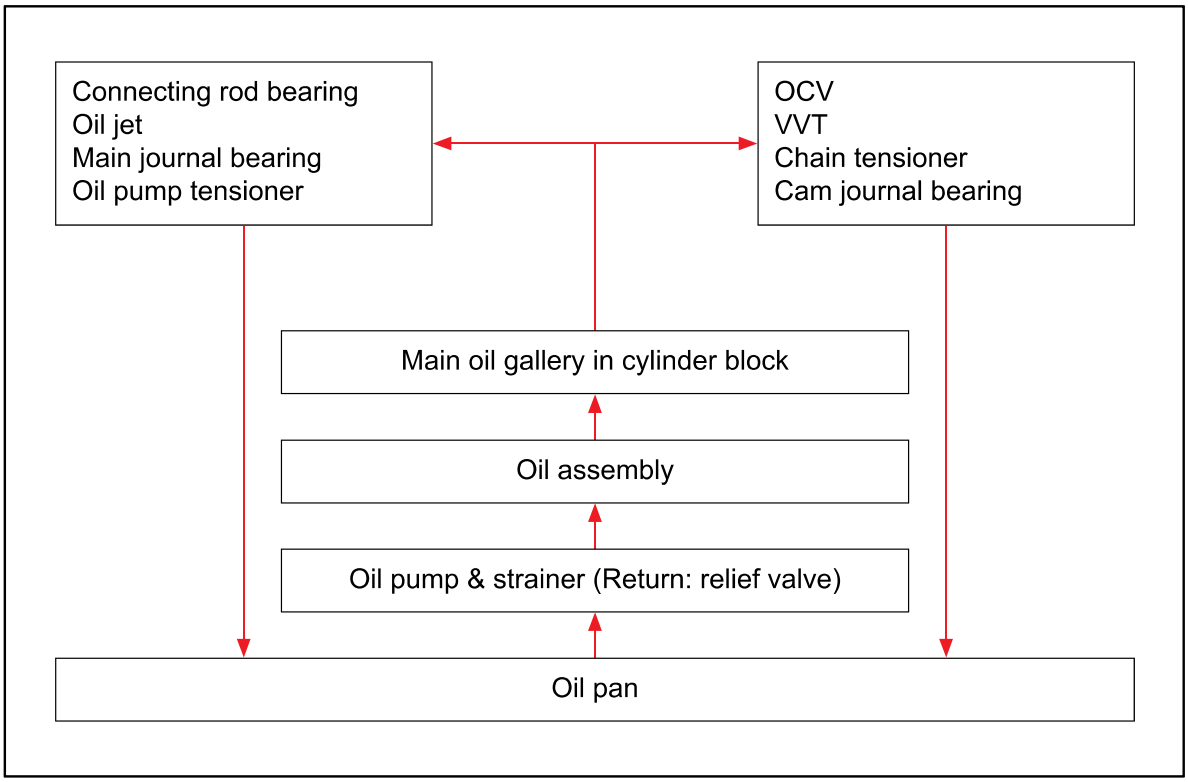


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3. OPERATING PROCESS

1) Operation Flow





Modification basis	
Application basis	
Affected VIN	

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COOLING SYSTEM 2112-01

GENERAL INFORMATION

1. SPECIFICATION

Description		Specification
Cooling system	Type	Water cooling, forced circulation
Coolant	Capacity	Approx. 8.0 ~ 8.5 L
Radiator	Core size	740W X 378.9H X 27T
	Flow type	Cross flow
Antifreeze	Type	SYC 1025 (LLC)
	Mixing ratio	50:50 (water:antifreeze)
Cooling fan module	Type	Electric
	Capacity	180 W + 120 W
	Control type	Series: low speed, Parallel: high speed
Coolant reservoir	Min. capacity	1.6 L
	Circulation	Closed roof type
	Pressure cap	Screw type, 1.4 bar
Thermostat	Type	Wax pallet type
	Opening temperature	90℃
	Fully open temperature	100℃
	Valve lift	8mm

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2. INSPECTION

Problem	Possible Cause	Action
Coolant level is too low	- Leak from the radiator - Leak from the coolant auxiliary tank - Leak from the heater core	- Change the radiator - Change the coolant auxiliary tank - Change the heater
	- Leak from the coolant hose connections Damaged coolant hose -	- Reconnect the hose or replace the clamp - Change the hose
	- Leak from the water pump gasket - Leak from the water pump internal seal	- Change the gasket - Change the water pump
	- Leak from the water inlet cap - Leak from the thermostat housing	- Change the water inlet cap gasket Change the thermostat sealing -
	- Incorrect tightening torque of the cylinder head bolts - Damaged cylinder head gasket	- Tighten the bolts to the specified torque - Change the cylinder head gasket
Coolant temperature is too high	- Coolant leakage (Coolant level is low) Improper coolant mixture ratio - Kinked coolant hose -	- Add coolant - Check the coolant concentration (Anti-freeze) - Repair or replace the hose
	- Defective thermostat - Defective water pump - Defective radiator - Defective coolant auxiliary tank or tank cap	- Change the thermostat - Change the water pump - Change the radiator - Change the coolant auxiliary tank or tank cap
	- Cracks on the cylinder block or cylinder head - Clogged coolant passages in the cylinder block or cylinder head	- Change cylinder block or cylinder head - Clean the coolant passage
	- Clogged radiator core	- Clean the radiator core
	- Improper operation of cooling fan	- Replace the cooling fan or repair the related circuit
	- Defective temperature sensor or faulty wiring	- Replace the sensor or repair the related wiring

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Problem	Possible Cause	Action
Coolant temperature is too low	- Thermostat is stuck open	- Change the thermostat
	- Improper operation of cooling fan	- Replace the cooling fan or repair the related circuit
	- Defective temperature sensor or faulty wiring	- Replace the sensor or repair the related wiring

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1) Coolant Level Check

A. Park the vehicle on level ground and apply the parking brake. Stop the engine and wait until it is cooled down. The coolant level should be between the MAX and MIN mark on the coolant reservoir. If the coolant level is below the "MIN" mark, immediately add coolant.

B.



CAUTION

- Scalding hot coolant and steam could be blown out under pressure, which could cause serious injury. Never remove the coolant reservoir cap when the engine and radiator are hot.
- Avoid any direct contact of the coolant to the painted body of the vehicle.

Modification basis	
Application basis	
Affected VIN	

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2) Leak Test



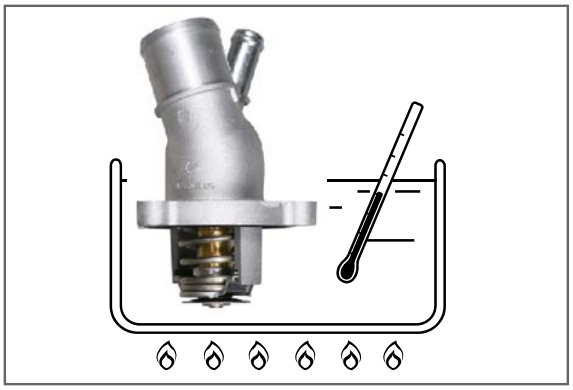
A. Release the pressure in the system by loosening the pressure cap of the coolant reservoir slightly. Then, remove the pressure cap completely.

CAUTION
Never open the cap until the coolant temperature becomes under 90℃ to prevent any burn.



B. Add the coolant so that the coolant level is between MAX and MIN mark on the coolant auxiliary tank.
C. Connect the tester to the tank filler and apply pressure (1.4 bar).
D. Check all the coolant hoses, pipes and connections for leaks when the pressure of the tester drops, and replace or tighten, if necessary.

3) Thermostat



Immerse the thermostat into the water. Heat the water and check the valve opening temperature.

Valve opening temperature	90±2℃

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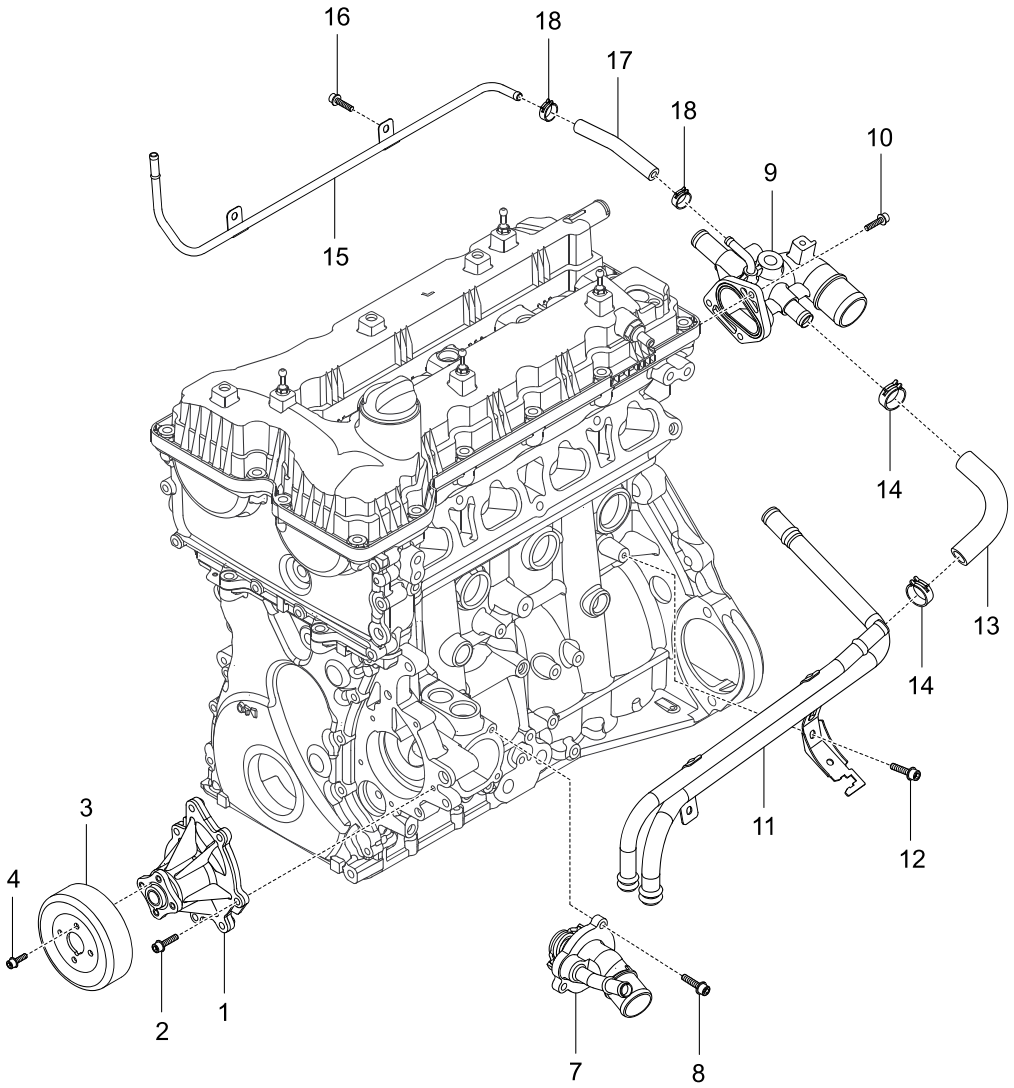
3. CAUTIONS

CAUTION

- If 100% of anti-freeze is added, the water pump vane can be damaged and thermal conductivity can be decreased resulting in poor circulation in the cooling system which leads to overheated engine.
- Use of non-recommended coolant could cause damage to the cooling system and overheating of the engine.
- Opening the coolant reservoir cap while the engine is running or hot can cause burns by hot steam or water.
- To open the coolant reservoir cap, wrap the cap with a wet towel or thick cloth after the engine is cooled down sufficiently.
- If cool water is added to the heated engine, the engine or radiator can be deformed.
- The anti-freeze in the coolant can damage the painted surface, so avoid the contact of the coolant to the painted body.
- The anti-freeze and water should be mixed in proper mixture ratio. Never add only water when adding coolant.
- If the anti-freeze content is too low, the coolant can be frozen while the engine can be overheated if anti-freeze content is too high.

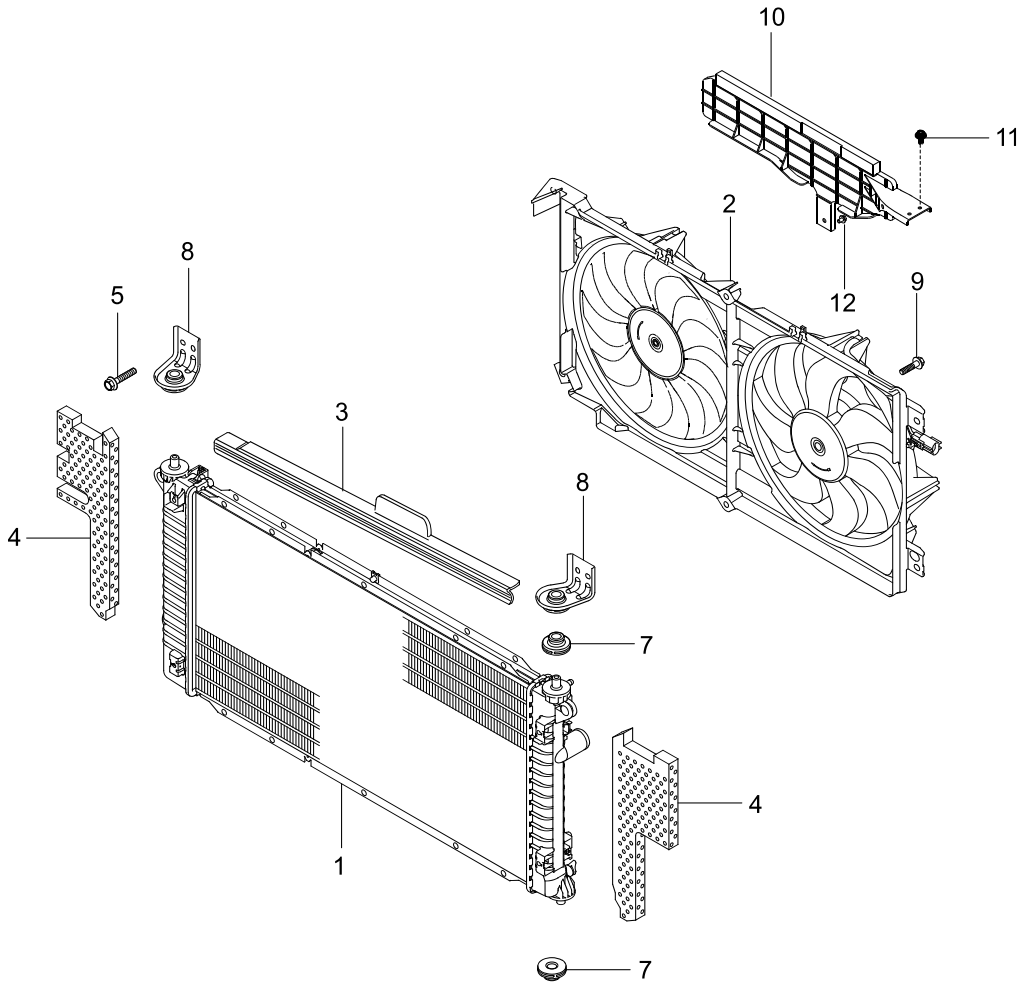
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4. LAYOUT



1. Water Pump Assy
2. Bolt
3. Water Pump Pulley
4. Bolt
7. Thermostat Assy
8. Bolt
9. Coolant Outlet Port Assy
10. Bolt
11. Coolant Pipe Assy
12. Bolt
13. Bypass Hose
14. Clamp
15. Deaeration Pipe Assy
16. Bolt
17. Bolt Deaeration Hose
18. Clamp

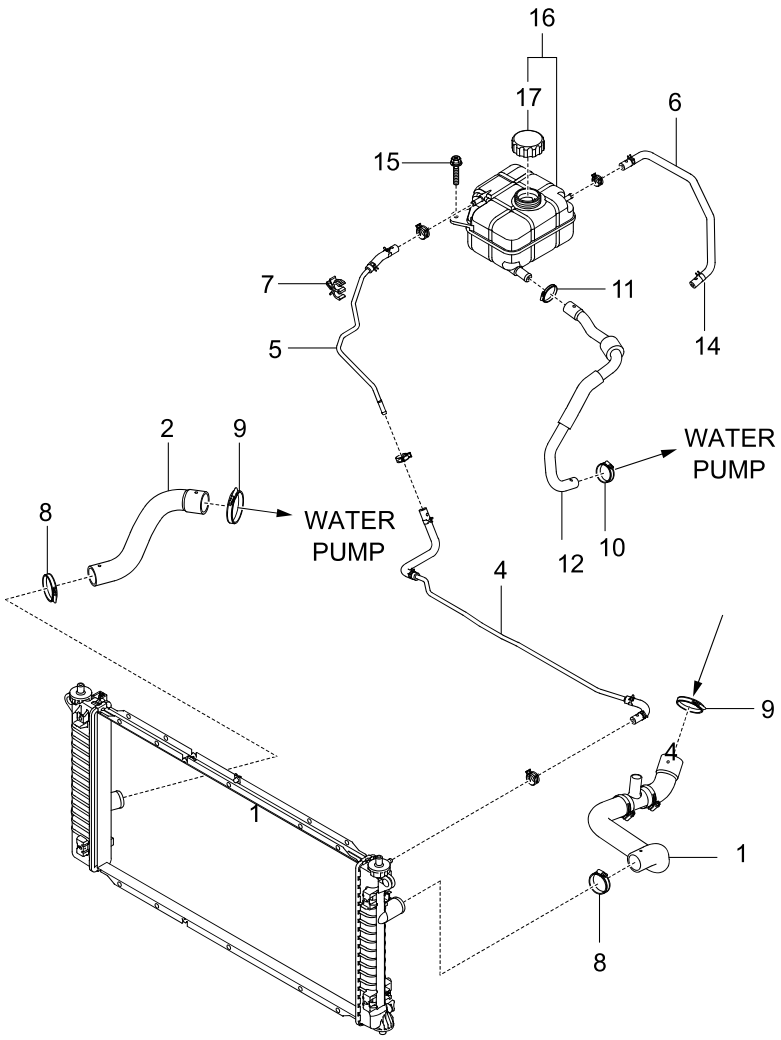
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1. Cooling Radiator Assy
2. Fan & Shroud Assy
3. Cover-Radiator
4. Seal Side
5. Screw
7. Insulator Module MTG LWR
8. Module MTG UPR Brkt Assy
9. Screw
10. Protector-Eroom Hot Air
11. Screw
12. Fastener

Modification basis	
Application basis	
Affected VIN	

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1. Hose-Rad Inlet
2. Hose-Rad Outlet
3. Hose-Make Up
4. Hose Assy-Deaeration Rad
5. Hose Assy-Deaeration Rsvr
6. Hose Assy-Deaeration Eng
7. Clip-Deaeration Tube mtg
8. WDT_Spring_Clamp_M45
9. WDT_Spring_Clamp_M50
10. WDT_Clamp_M24
11. WDT_Clamp_M30
12. Clip_Closed_CT_M25
13. Bolt-Tapping
14. Clamp_Spring_M14
15. Screw
16. Tank Assy-Reservoir
17. Cap-Reservoir Tank

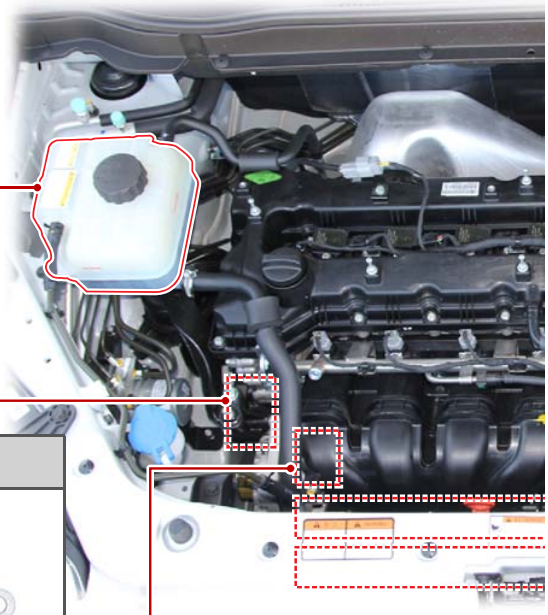
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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The coolant system is to keep the engine temperature stable.

2. COMPONENTS



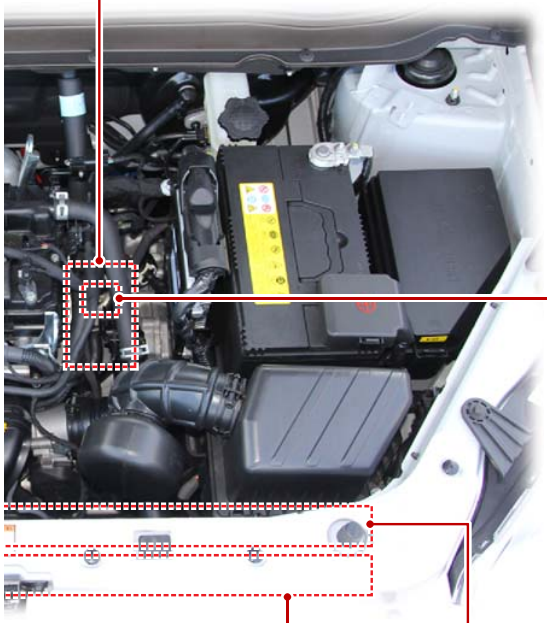
Coolant reservoir


Water pump	
	
The water pump is driven by the engine drive belt and supplies the coolant to each area of the engine.	

Thermostat	
	When the engine coolant reaches 90℃, the thermostat starts to open (fully open at 100℃) and lets the coolant flow to the radiator to maintain the engine temperature.

Modification basis	
Application basis	
Affected VIN	

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Coolant outlet port



Coolant temperature sensor



Measures the coolant temperature and sends the result to the engine ECU.

Radiator



Radiates the heat through fins and cools down the hot coolant as the coolant passes through the tube of the radiator core.

PWM fan

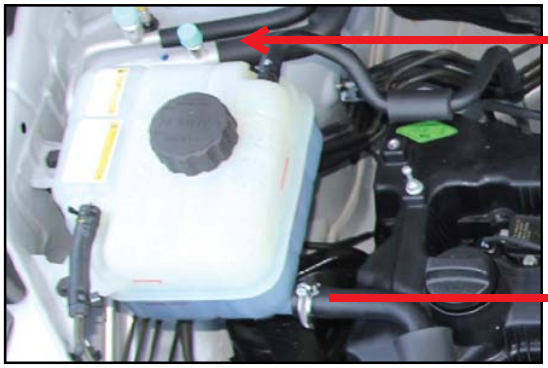


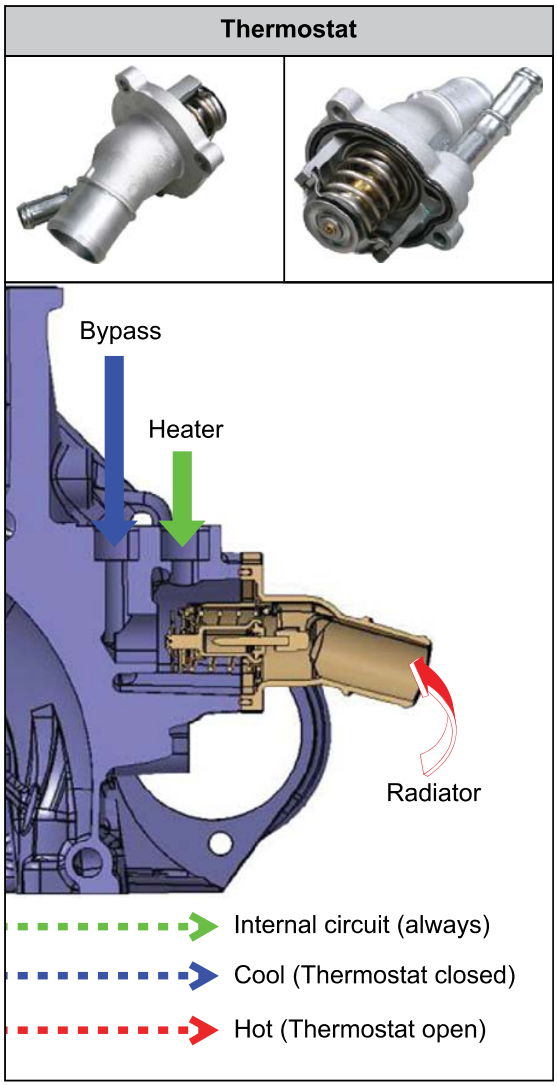
Circulates the fresh air forcibly to exchange heat with the radiator core fin.

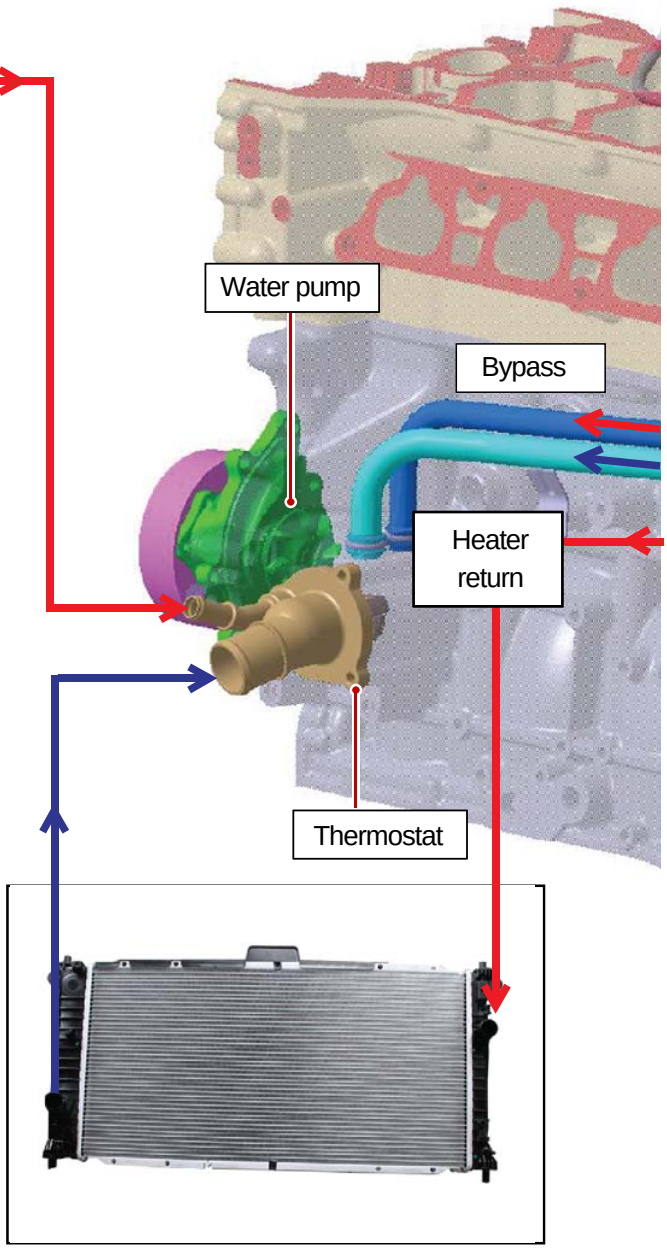
Modification basis	
Application basis	
Affected VIN	

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3. COOLANT FLOW DIAGRAM

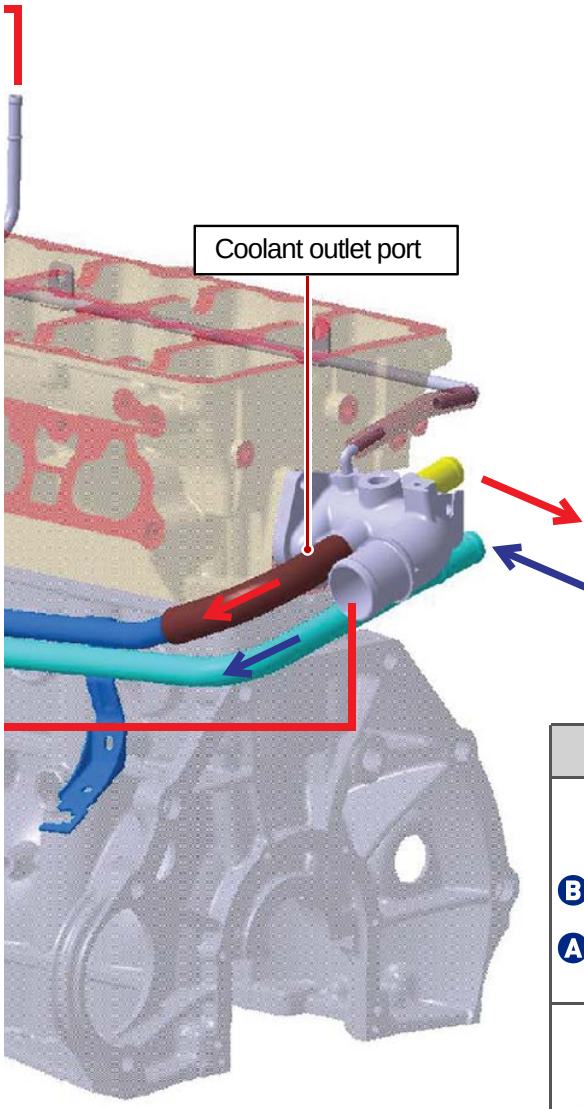




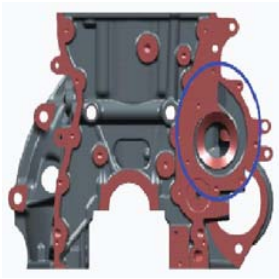


Modification basis	
Application basis	
Affected VIN	

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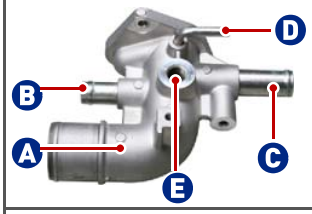


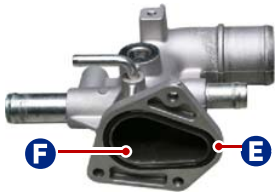
Water pump





Coolant outlet port





A: to radiator
B: to water pump (bypass) to cabin heater
C: to coolant reservoir
D: Coolant temperature
E: sensor mountinh boss from cylinder head
F: Gasket
G:

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CHARGE SYSTEM 1452-01

GENERAL INFORMATION

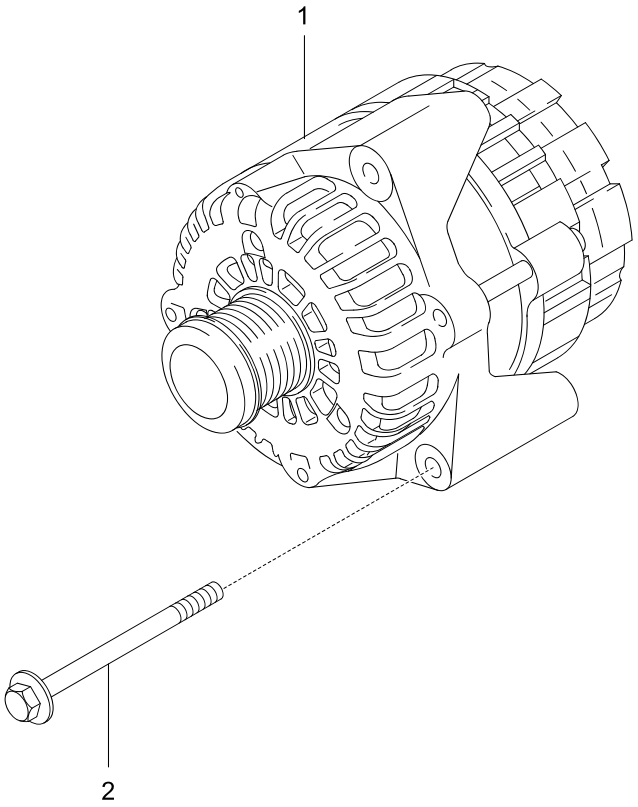
1. SPECIFICATION

Unit	Description		Specification	
Alternator	Type		HPS	EPS
	Crankshaft pulley : Alternator pulley		1 : 2.66	
	Normal output (idle/2200rpm)		70/140A	←
	Regulator voltage		12V	←
	Brush	Length	12.5mm	←
		Wear limit	7.0mm	←
Battery	Type		MF	←
	Capacity		90AH	←

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2. LAYOUT

1) Alternator

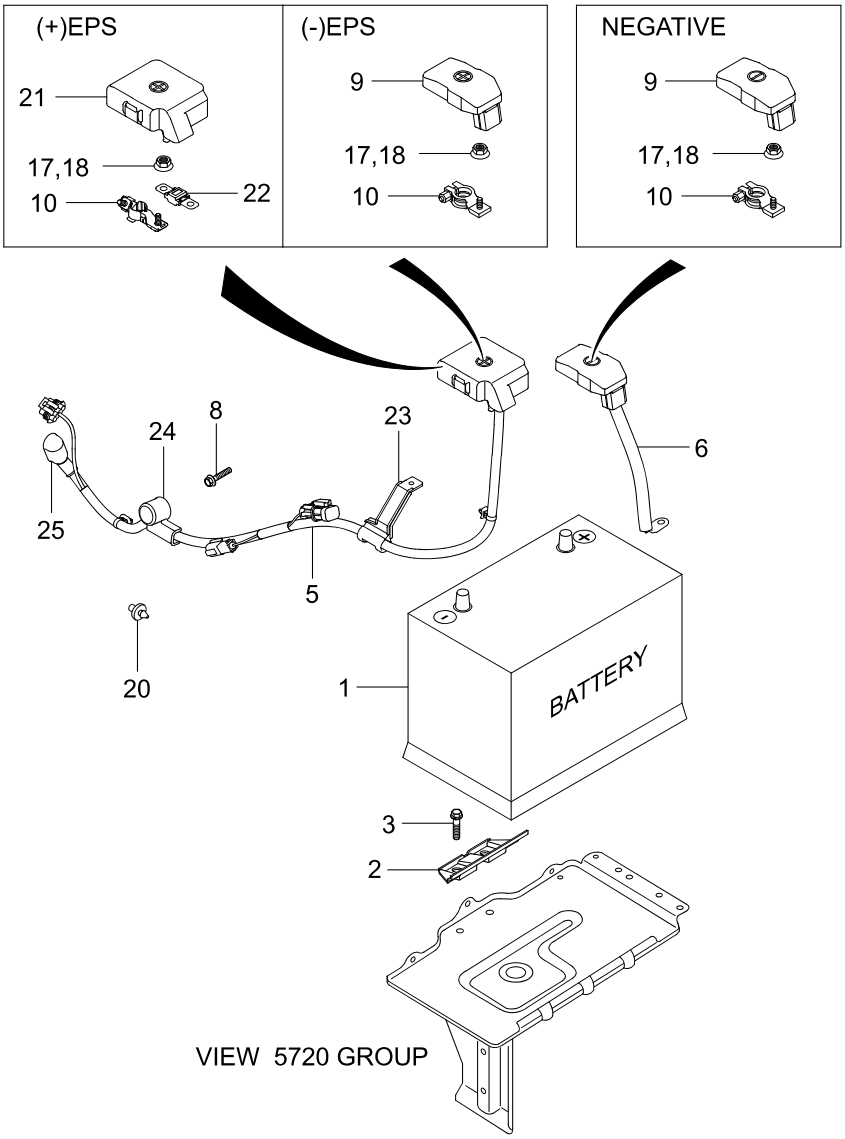


1. Alternator assembly
2. Bolt

Modification basis	
Application basis	
Affected VIN	

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2) Battery



1. Battery assembly
2. Clamp - Battery
3. Bolt
5. Cable assembly - Cable positive
6. Cable assembly - Battery ground
8. Bolt - Earth
9. Cap - Terminal
10. Connector - Battery
17. Nut
18. Nut
20. Cab - Earth
21. Box assembly - Battery sub
22. Fuse - MID 80A
23. Clamp - Battery cable
24. Grommet - Ring terminal
25. Grommet - Ring terminal

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3. INSPECTION

1) Alternator

▶ **Output Test**

Item	How to check	DTC set value / Action
Output current	1. Disconnect the cable connected to the B terminal on the alternator. Connect one end of the ammeter to the B terminal and the other end to the cable connected to the B terminal. 2. Measure the maximum output value. (Maintain the engine speed between 2,500 and 3,000 rpm.) (Turn the headlamp and all the electrical switches on.)	- Pass: If the measured current is 45 A or higher. - Fail: If the measured current is less than 45 A. - Check the current of the B terminal.
B terminal current	1. Move the gear selector lever to the neutral position. 2. Maintain the engine speed at 2,500 rpm with the vehicle unloaded. (Turn all the electrical switches off.)	- Open circuit: If the measured current is 5 A or higher.
Rotor coil resistance	1. Disconnect the negative cable from the battery. 2. Remove the B terminal and turn off the ignition switch. 3. Measure the resistance between the L and F terminals with an ohmmeter.	- Pass: If the measured resistance is between 3 and 6Ω. - Faulty rotor coil or slip ring: If the measured resistance is less than 3Ω or greater than 6Ω.
L terminal voltage	1. Connect the B terminal wiring. 2. Measure the voltage with the engine running.	- Specification: 12.5V to 14.5V Faulty IC regulator or field - coil: If the measured voltage is 14.5V or higher.

CAUTION
- Disconnect the negative cable from the battery.
- Connect the negative cable again after connecting the ammeter.

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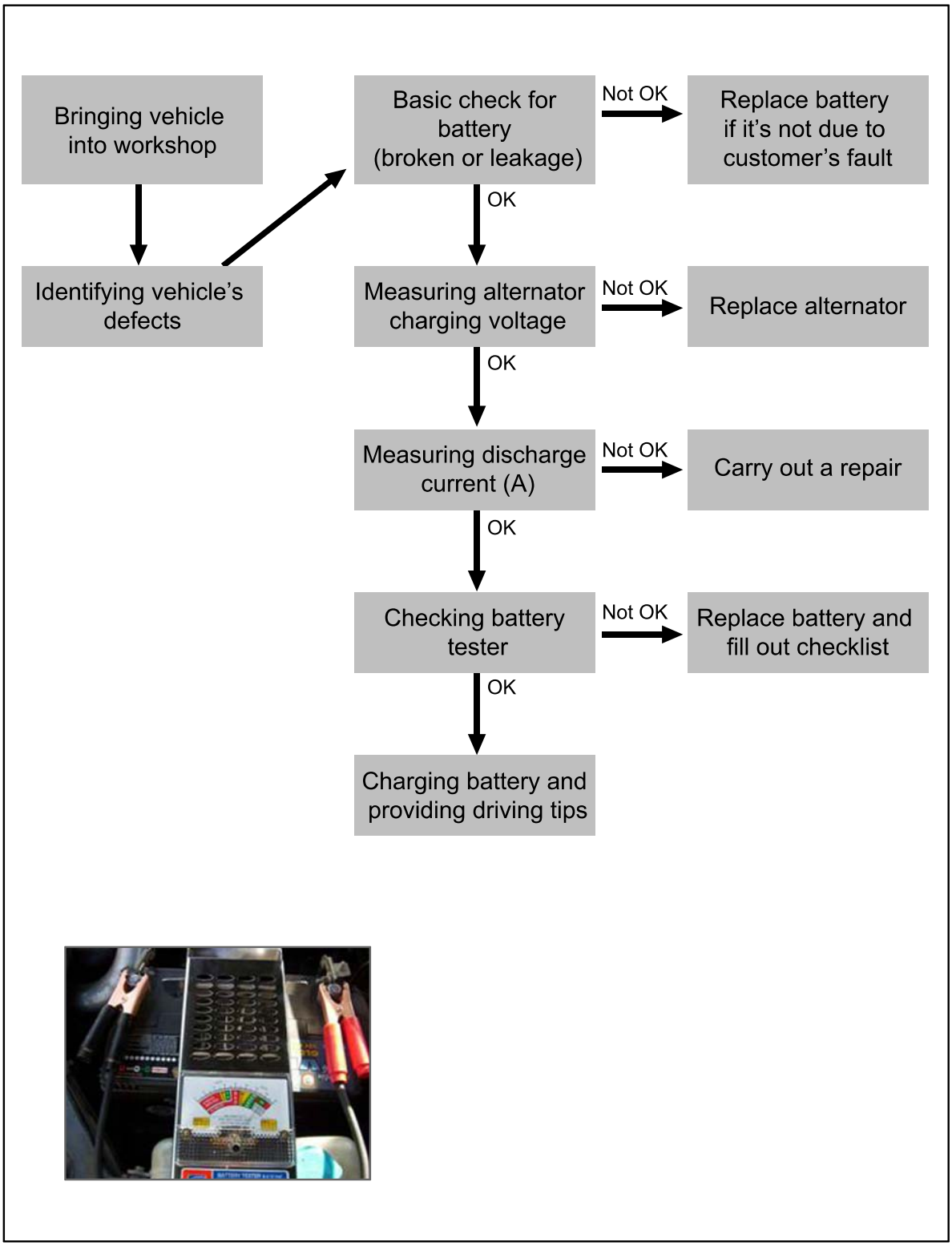
▶ **Troubleshooting**

Item	Cause	Action
Overcharged battery	Defective alternator voltage regulator	Replace
	Defective voltage detection wiring	Repair or replace
Discharged battery	Loose alternator drive belt	just the belt tension or replace
	Poor connection of related circuit or open circuit	Retighten the loose connection or repair open circuit
	Defective alternator voltage regulator	Replace
	Terminated battery	Replace
	Defective ground	Repair
Charge warning lamp does not come on when turning on ignition switch with engine stopped	Defective alternator voltage regulator	Replace
	Open circuit in charge warning lamp, fuse or wiring	Replace or repair the charge warning lamp or fuse
	Defective ignition switch	Replace
	Defective ground of alternator circuit	Repair
Charge warning lamp does not go off after starting engine	Defective alternator voltage regulator	Replace
	Corroded or worn battery cable	Repair or replace
	Loose alternator drive belt	Adjust the belt tension or replace the belt
	Defective wiring harness	Repair or replace

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2) Battery

▶ **Inspection**



Modification basis	
Application basis	
Affected VIN	

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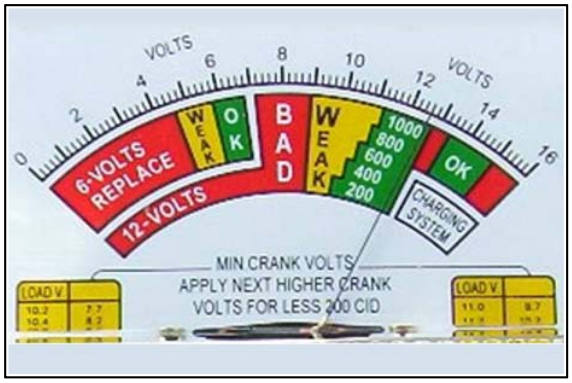
▶ Using battery tester

- PASS (11.0 V or more): Explain to the customer that the battery is reusable.
- Need to be charged (9.0 to 11.0 V): Charge the battery with a charger and reinstall it. Explain it to the customer.
- Need to be replaced (9.0 V or more): The battery should be replaced due to overdischarging.

▶ How to use battery tester



- Determine battery capacity by fixing current (load capacity) and time and varying voltage. Determine battery capacity based on the
- amount of voltage drop when discharging a fixed load capacity (120 A) for 5 seconds. Connect the tester to the battery and read the display while applying a load for 5 seconds.
-



- Red area (①): overdischarge or faulty battery
- Yellow area (②): Need to be charged (using a vehicle alternator and a battery charger)
- Green area (③): Normal
- Red area on the left-hand side of OK (④):
- Impossible to charge with an alternator
- Green area with OK (⑤): Normally charged Red area on the right-hand side of OK
- (⑥): Overcharged by an alternator

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▶ Jump start

If the battery is weak or terminated, the battery from another vehicle can be used with jumper cables to start the engine.

▶ Connecting order

1. The positive (+) terminal of the discharged battery
2. The positive (+) terminal of the booster battery
3. The negative (-) terminal of the booster battery
4. Connect one end of the other jumper cable to the body of the discharged vehicle, such as the engine block or a front towing hook.

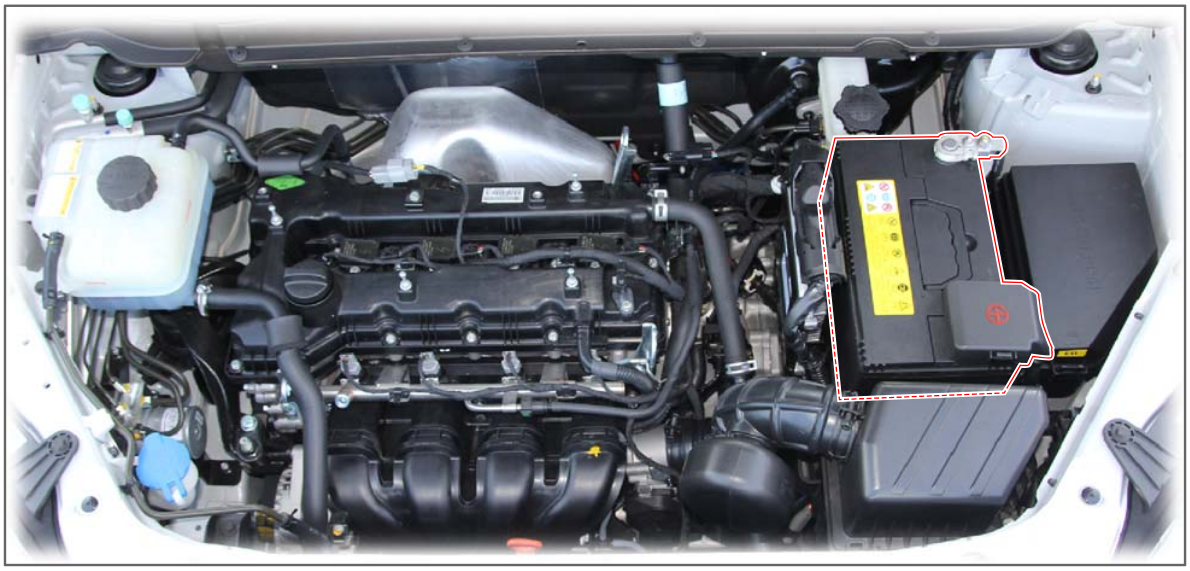
▶ Starting

1. Prepare a set of jumper cables.
2. Place another vehicle that has the same 12 V of power near to the discharged vehicle.
3. Switch off all electrical accessories for the discharged vehicle.
4. Apply the parking brake and shift the transaxle to the P position (automatic transaxle) or neutral (N) position (manual transaxle).
5. Connect the jumper cables.
6. Try to start the discharged vehicle while accelerating the engine rpm in the booster vehicle.
7. Attempt to start the engine with the discharged battery.
8. After starting the engine, carefully disconnect the jumper cables in the reverse sequence of connection.

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▶ Maintenance

If the charge warning lamp ( ) on the instrument cluster comes on while driving, there is a malfunction in the charge system including the battery. Therefore, carrying out the system check is needed.



- Make sure that the battery cables are firmly connected.
- If the terminals are corroded, clean them with a wire brush or sandpapers.
- Always disconnect the battery cables with the ignition key removed. When disconnecting the battery cables with the ignition key turned to ON or ACC position, several electric units can be damaged due to sudden voltage change.
- Check the battery for crack, damage or fluid leaks. Replace it if necessary.
- Wipe out the battery fluid on the battery surface using a rubber glove and a clean cloth wetted with soapy water.

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The charge system is designed to supply electrical energy to the vehicle while driving, and supplies a constant direct current voltage by converting mechanical rotational movement to electrical energy. The voltage regulator on the back of the alternator controls the generated voltage in all rotating ranges and adjusts the system voltage according to the electric load and ambient temperature change.

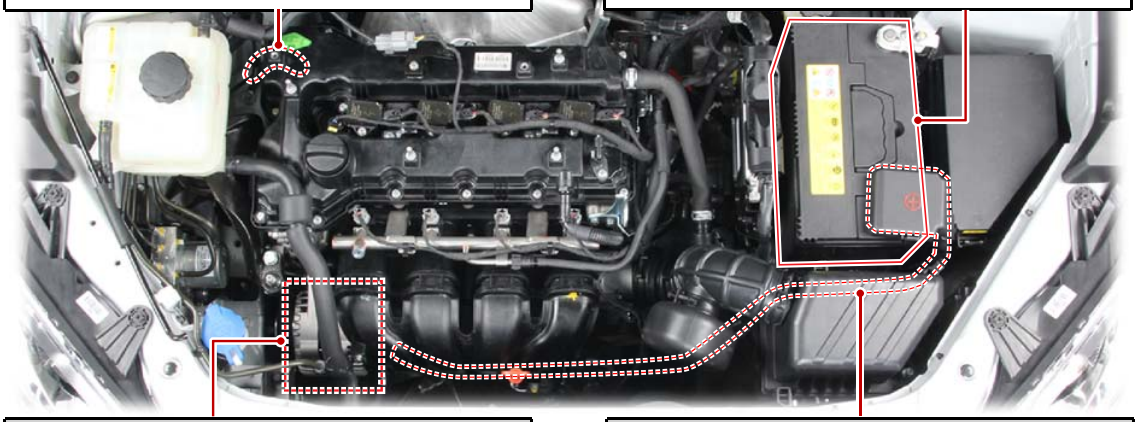
Body ground



Battery



It converts the chemical energy to the electrical energy and supplies power to the corresponding electric units when starting the engine.



Alternator



The alternator charges the battery and supplies power to each electric unit by converting the mechanical energy to the electrical energy.

B+ wiring

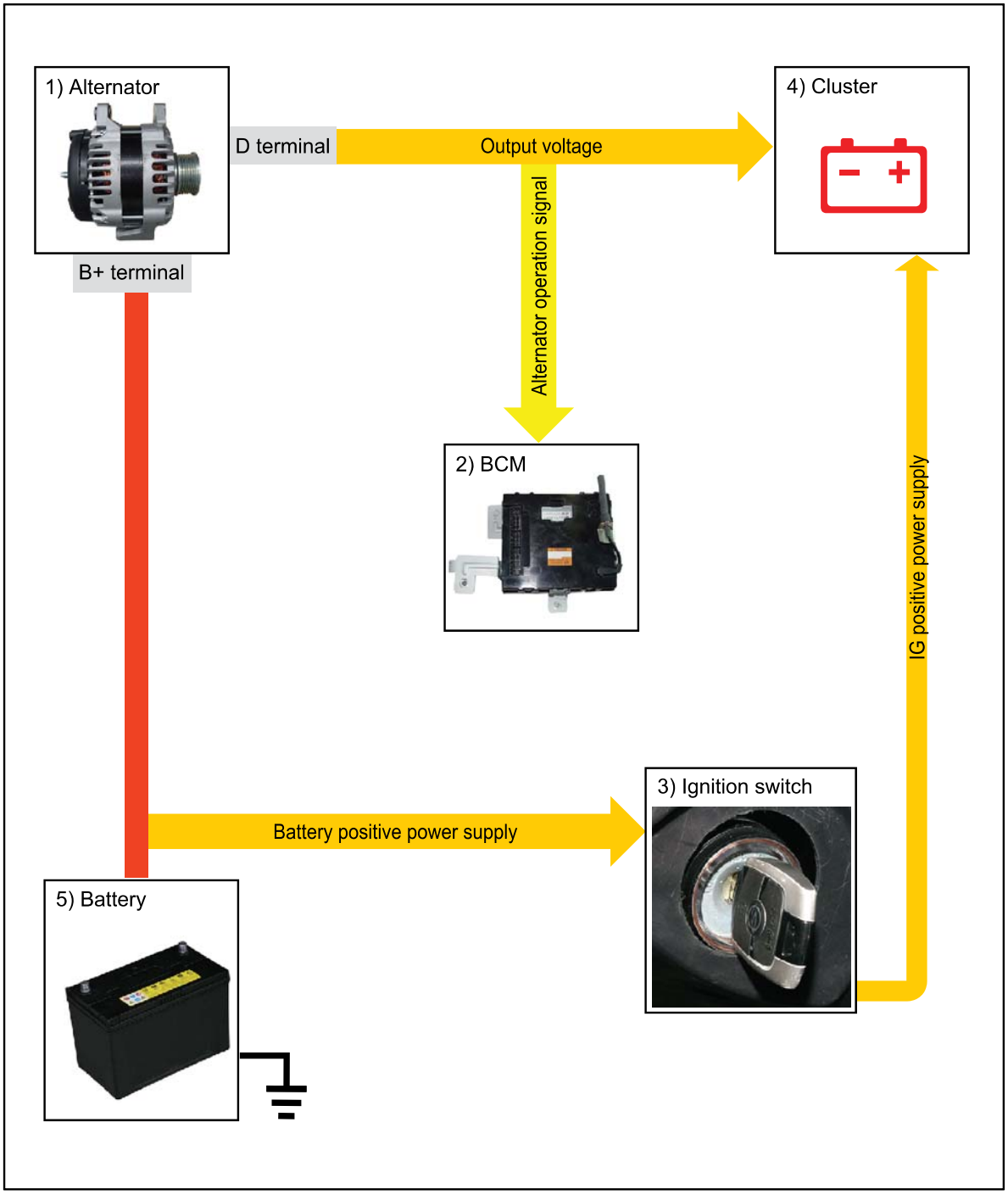


Modification basis	
Application basis	
Affected VIN	

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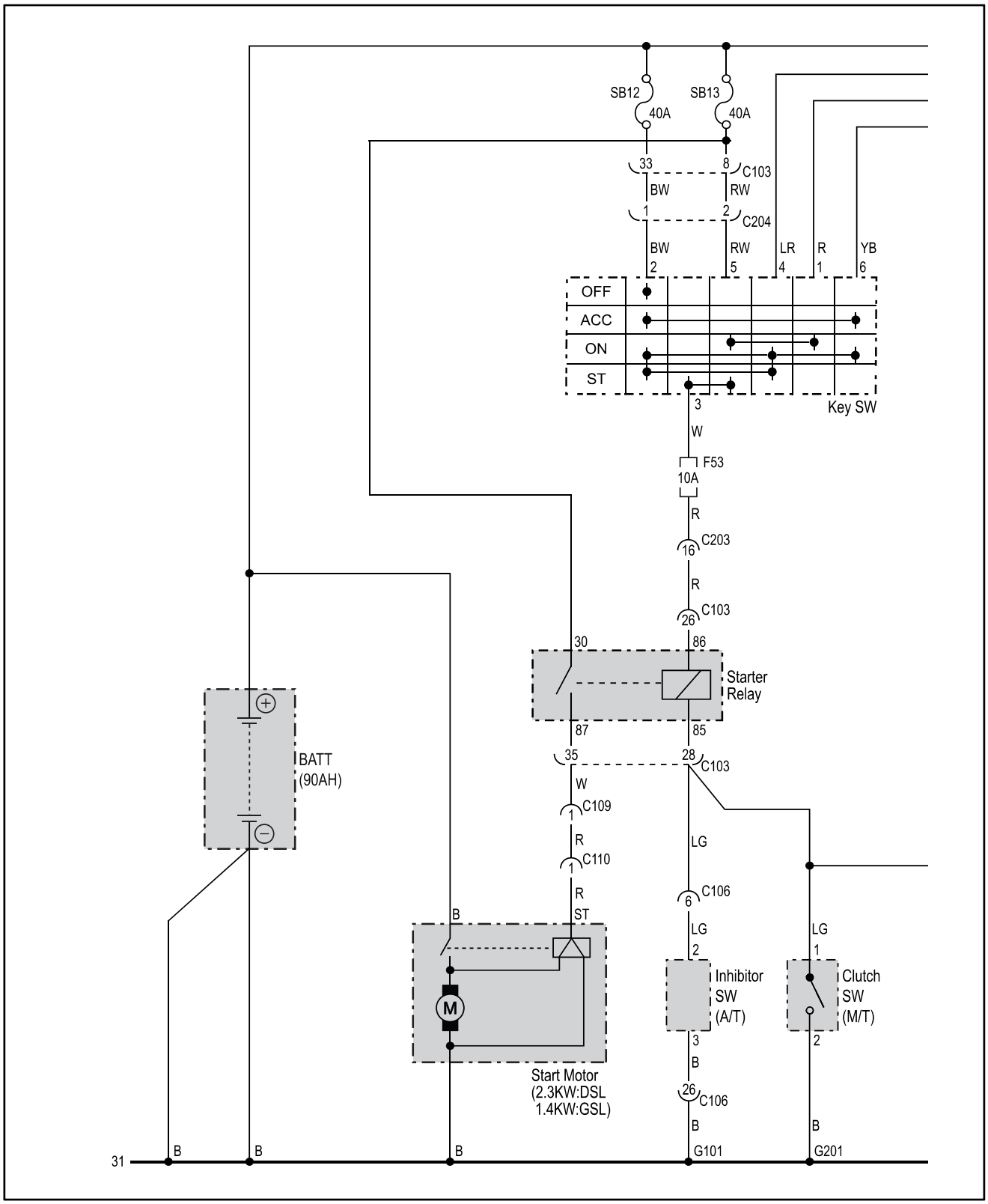
2. CHARGING OPERATION

1) Vehicle without Smart key system



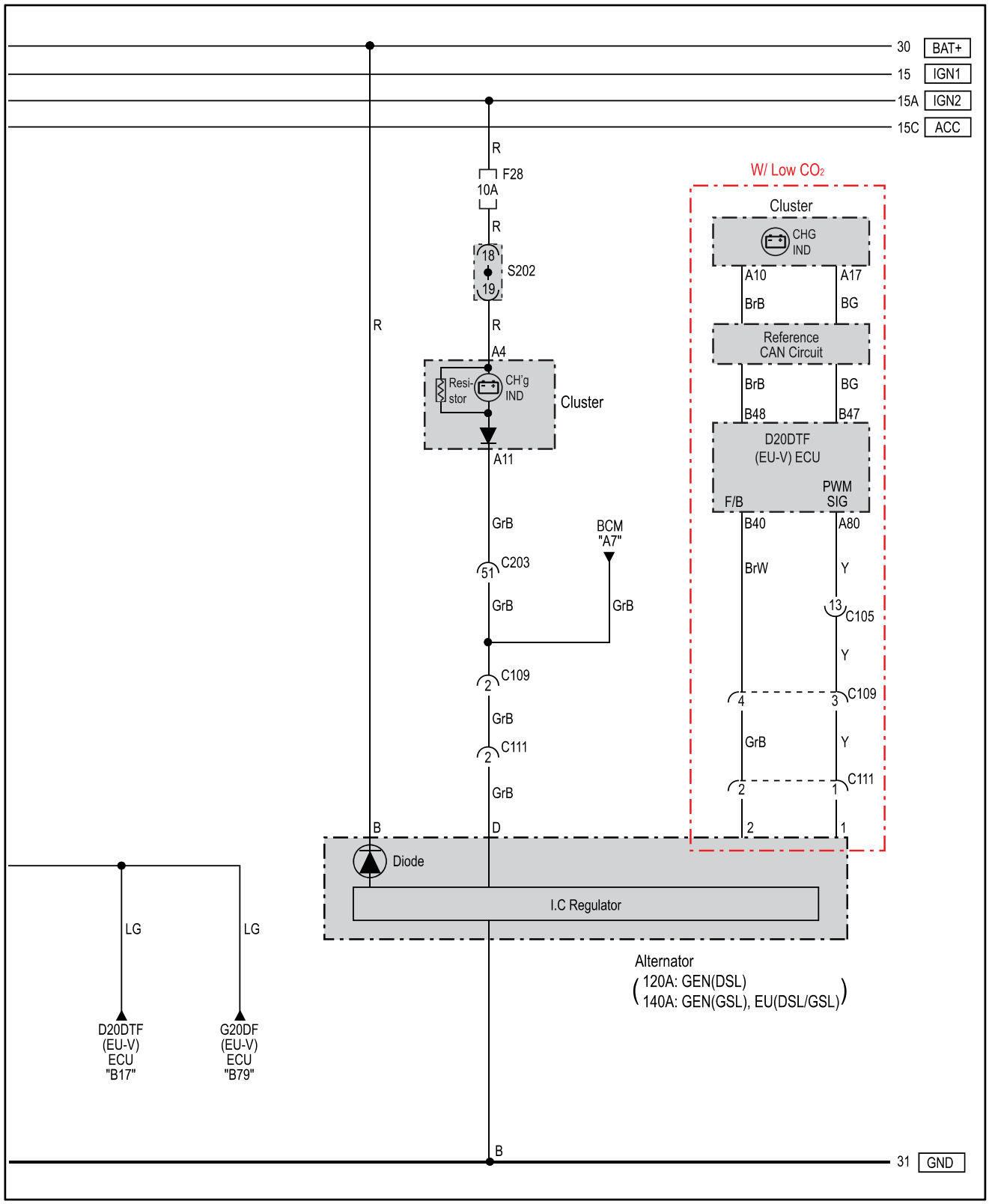
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2) Circuit Diagram



Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
Affected VIN	

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STARTING SYSTEM 1462-01

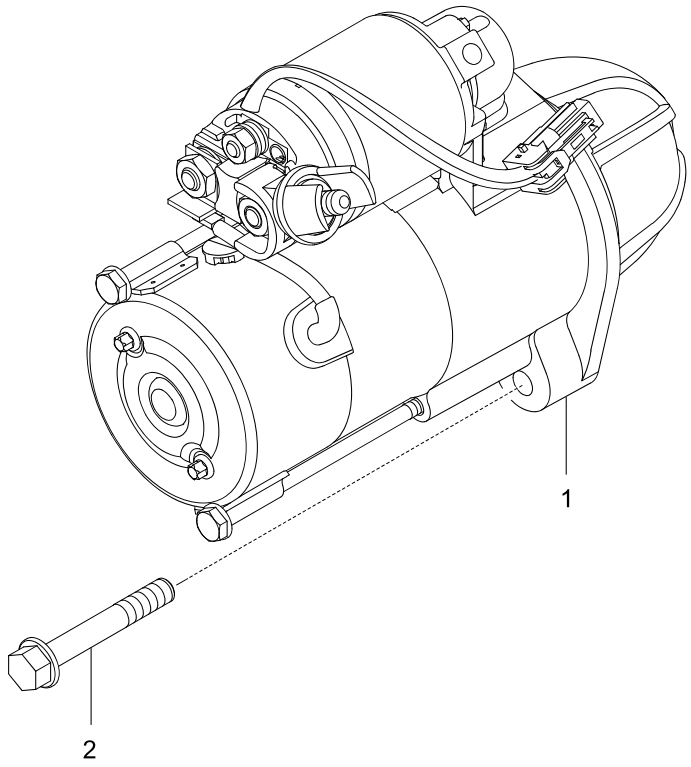
GENERAL INFORMATION

1. SPECIFICATION

Unit	Description	Specification
Start motor	Capacity	12V 1.4kw
	Engagement	Meshed type
	Rotating direction	Clockwise
	Solenoid operating voltage	Max. 8V
	Weight	2.5kg

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2. LAYOUT



1. Starter
2. Bolt

Modification basis	
Application basis	
Affected VIN	

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3. TROUBLESHOOTING

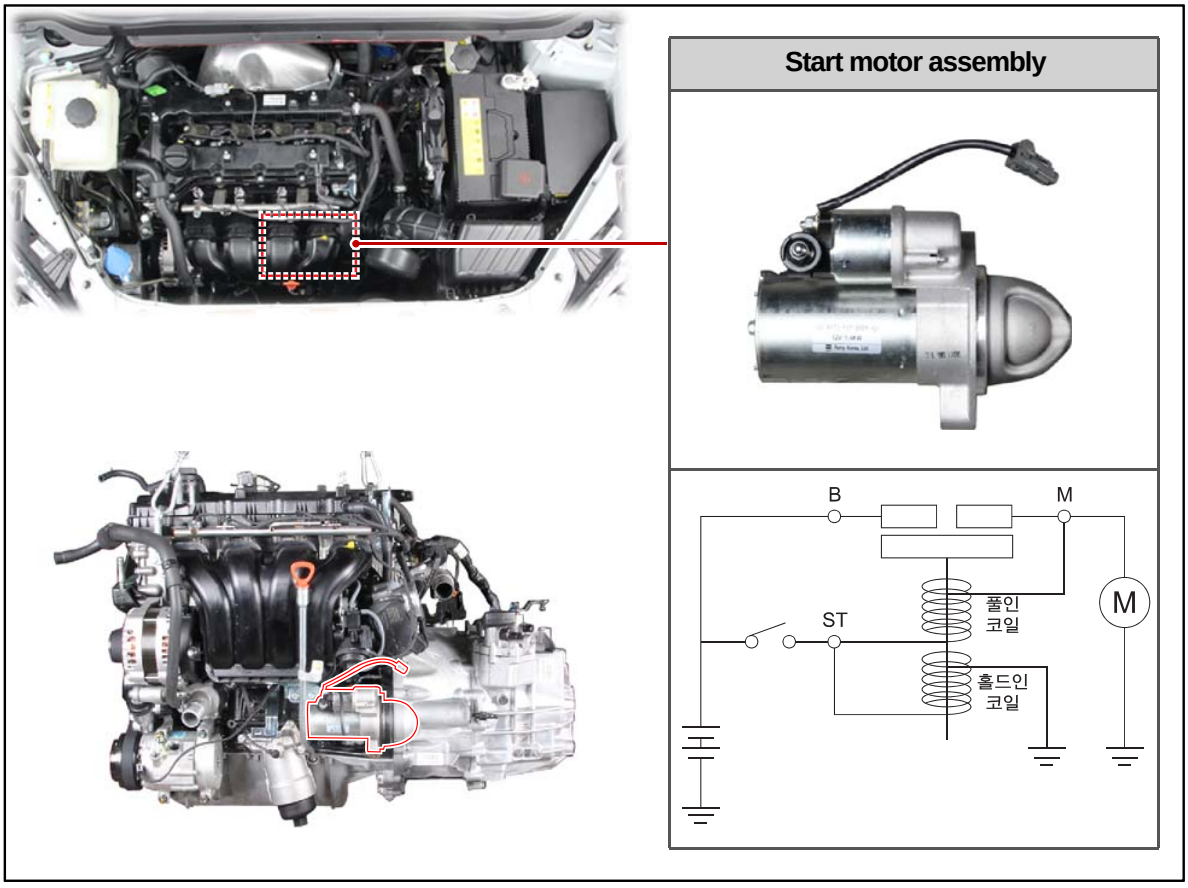
Problem	Possible Cause	Action
Engine will not crank	Low battery voltage	Charge or replace
	Loose, corroded or damaged battery cable	Repair or replace
	Faulty starter or open circuit	
	Faulty ignition switch or blown fuse	Repair or replace
	Poor engine ground	Repair
Engine cranks too slow	Low battery voltage	Charge or replace
	Loose, corroded or damaged battery cable	Repair or replace
	Faulty starter	
Starter does not stop	Faulty starter	Repair or replace
	Faulty ignition switch	Replace
Engine cranks normally, but does not start	Broken pinion gear or faulty starter	Replace the starter
	Broken flywheel ring gear	Replace
	Open circuit	Repair

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

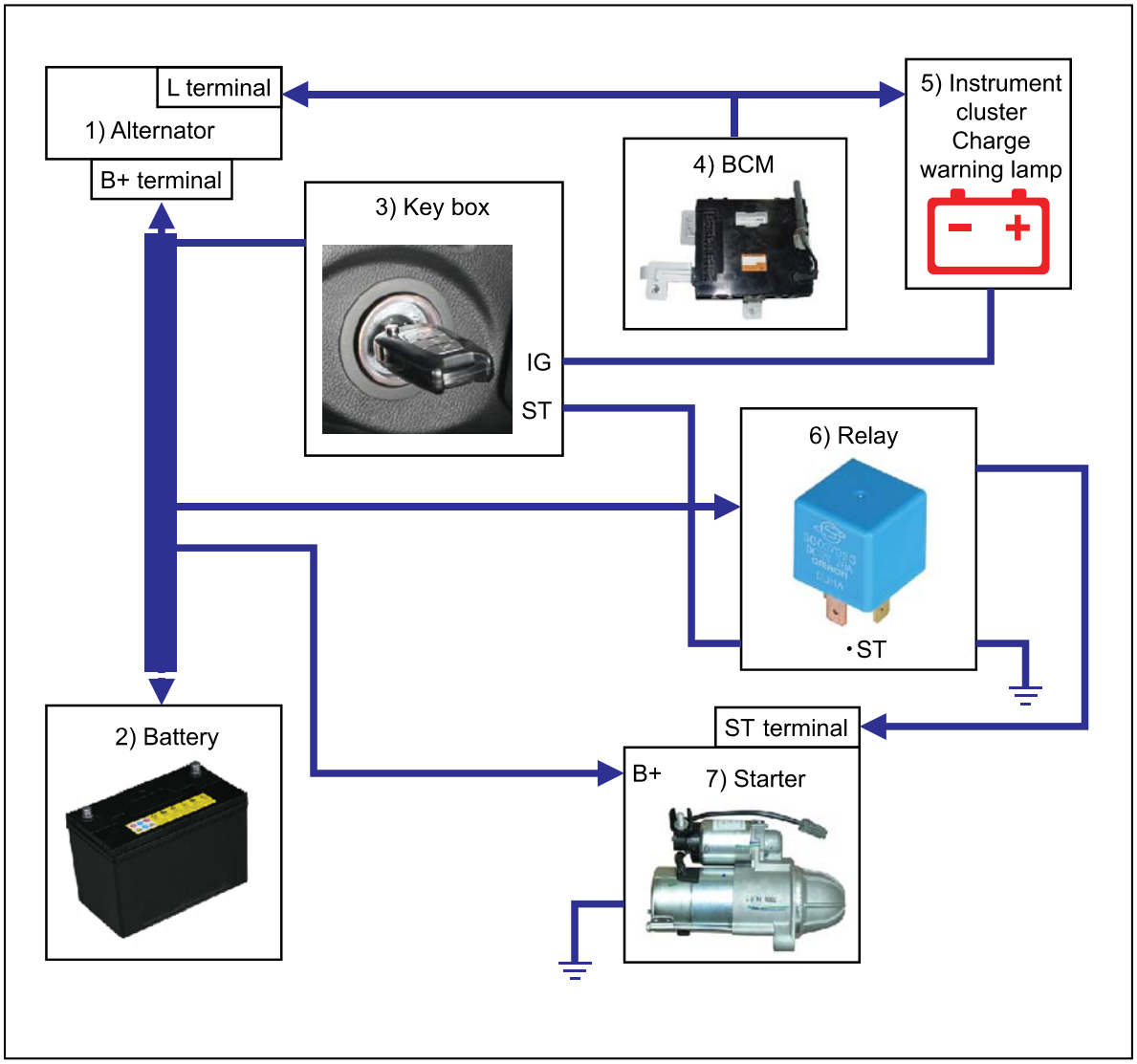
The starter (start motor) starts the engine with rotational power by converting the electric energy to the mechanical energy.
When the engine is cranking, the pinion gear meshes with the ring gear. If the ring gear overruns, the pinion gear clutch overruns to protect the pinion gear.



Modification basis	
Application basis	
Affected VIN	

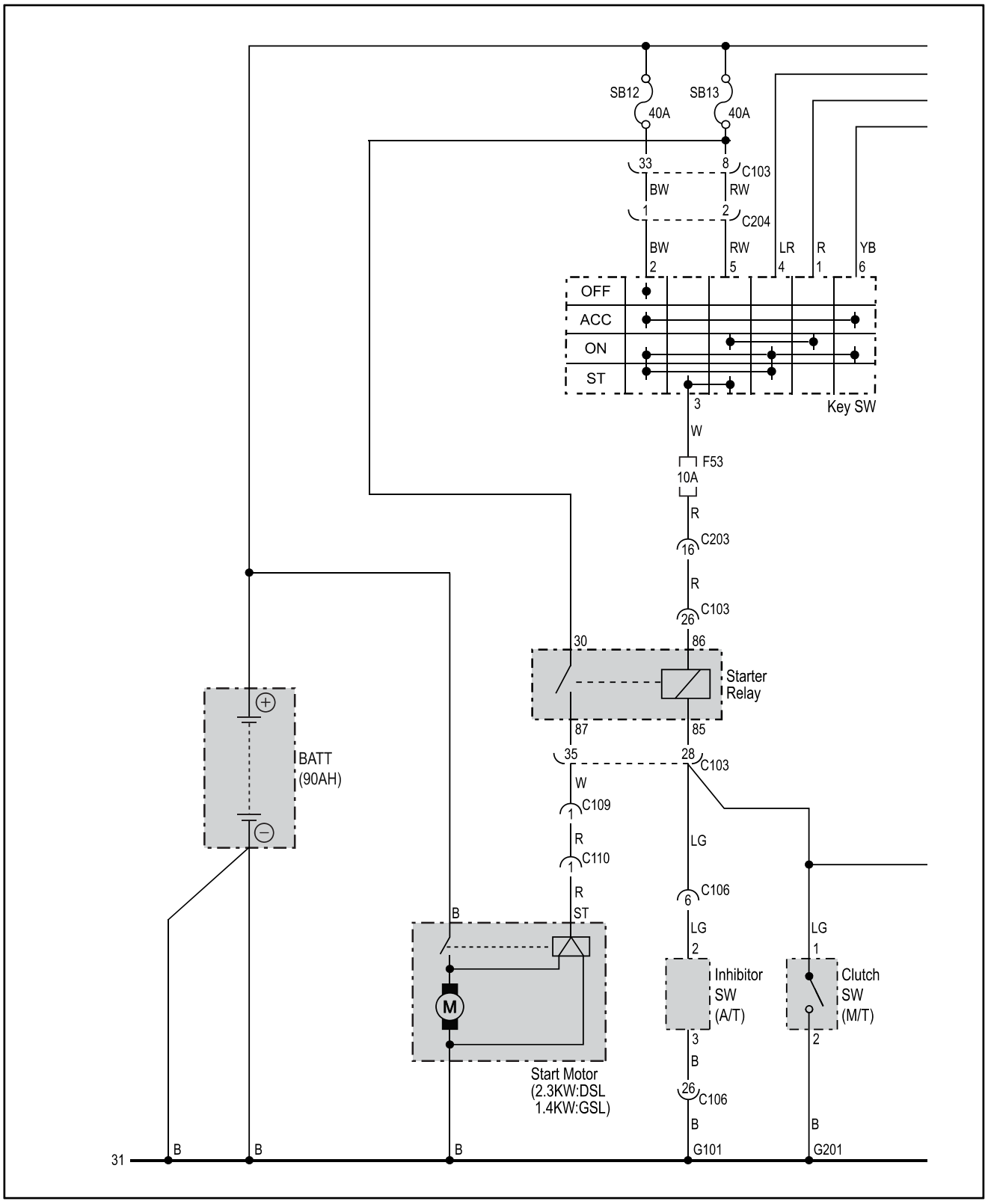
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2. OPERATING PROCESS



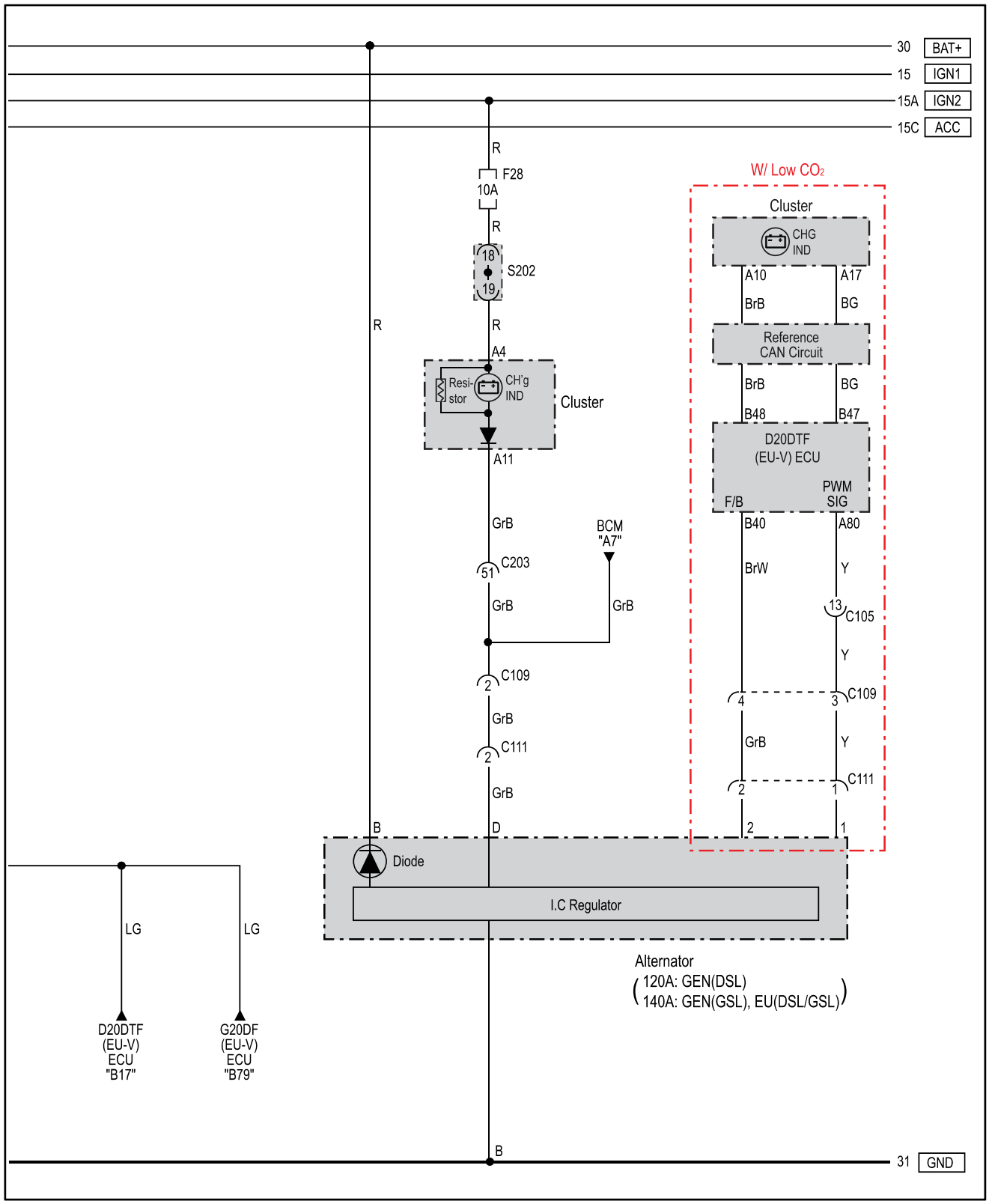
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3. CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
Affected VIN	

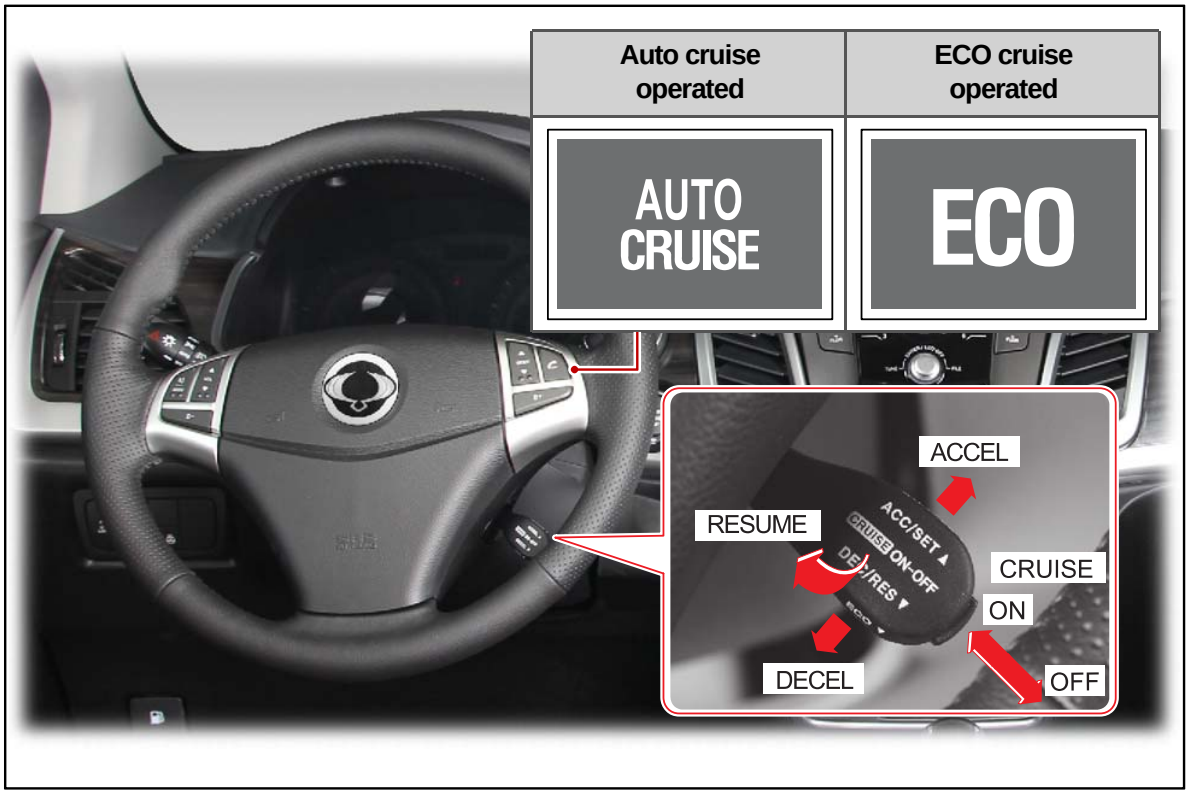
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CRUISE CONTROL 0000-00

OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

1) System Description



The cruise control is an automatic speed control system that maintains a desired driving speed without using the accelerator pedal. The cruise control switch is under the right side of steering wheel and 'ECO" indicator or "AUTO CRUISE" indicator comes on according to the working conditions. The vehicle speed must be greater than 38 km/h to engage the cruise control. This feature is especially useful for motorway driving.

CAUTION

The cruise control system is a supplementary system, which helps the driver to drive the vehicle at a desired speed without using the accelerator pedal under the traffic condition where the vehicle-to-vehicle distance meets the legal requirement.

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2) Traffic Conditions for Using Cruise Control

Use the cruise control system only when the traffic is not jammed, driving on motorways or highways where there is no sudden change in the driving condition due to traffic lights, pedestrian, etc.

WARNING

Improper use of the cruise control could be dangerous.

- Do not use on winding roads.yy
- Do not use in heavy traffic.yy
- Do not use on slippery, wet roads.

This could result in a loss of control, collision, and/or personal injuries.

NOTE

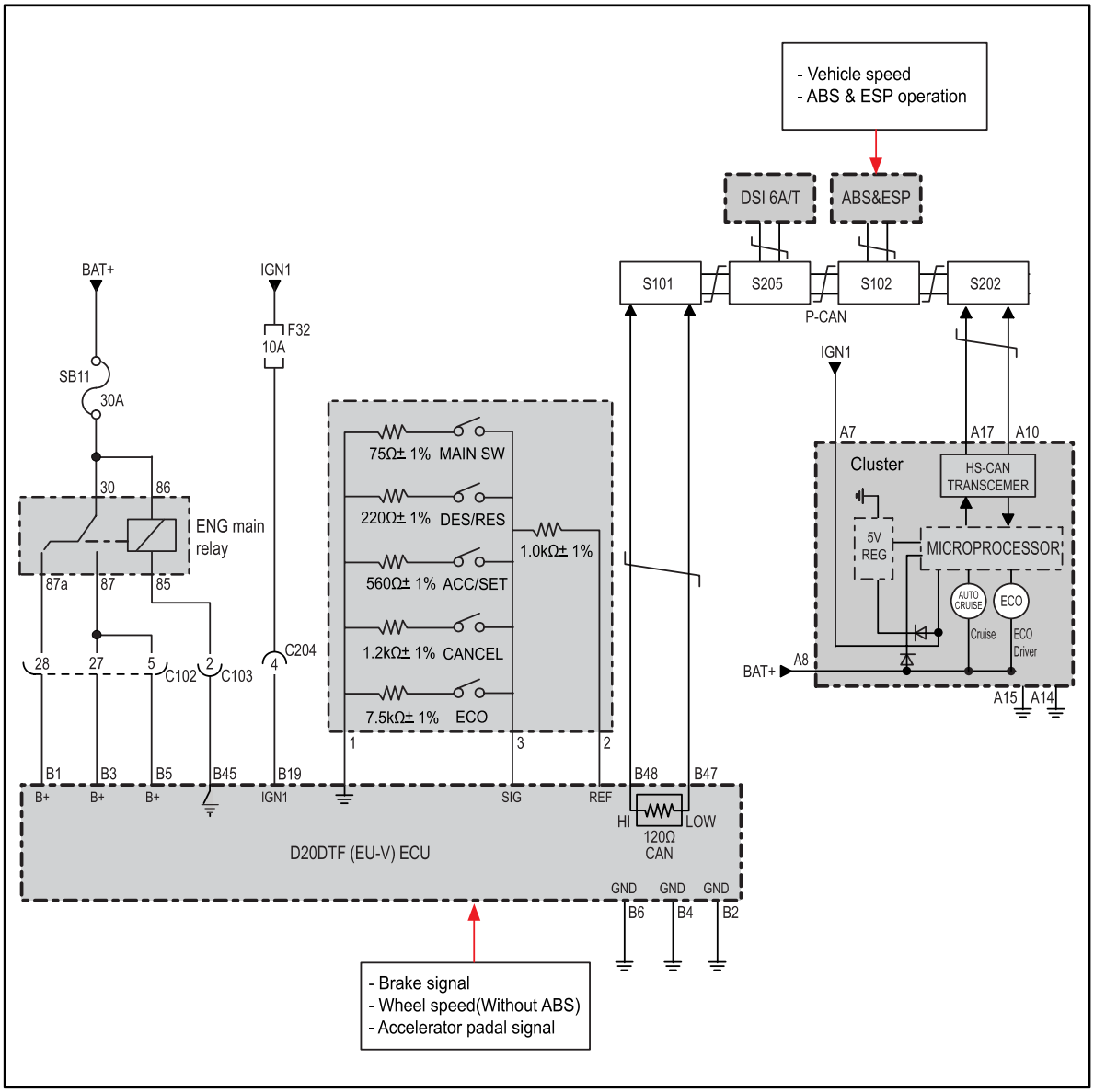
The described speed value may vary slightly depending on the road conditions.

Modification basis	
Application basis	
Affected VIN	

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2. CONFIGURATION

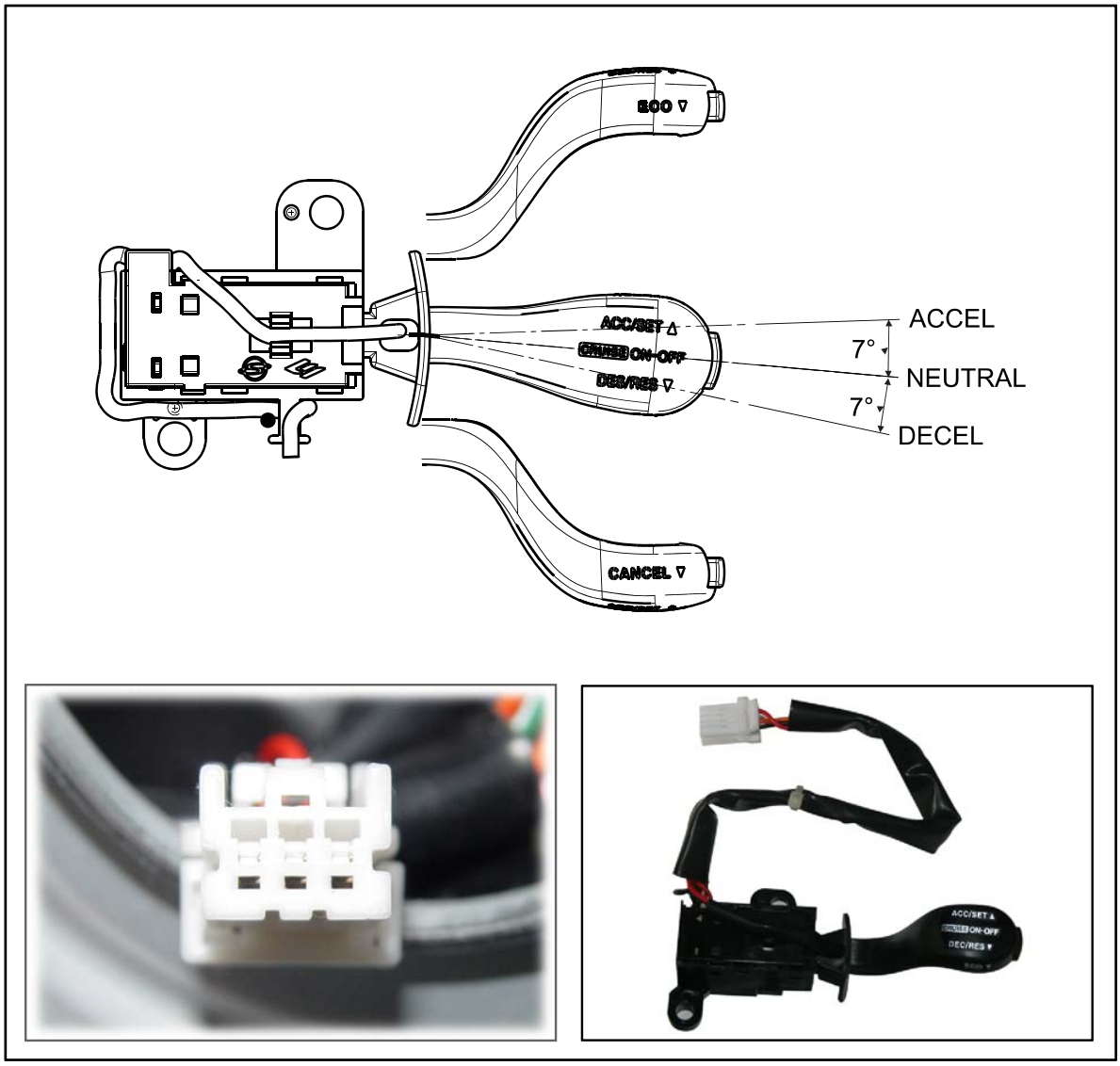
1) Circuit Diagram



The engine ECU detects the operating conditions of cruise control system, and monitors the braking performance, vehicle speed, road conditions and ESP system operation. If the engine ECU determines that there are not any problem to drive in cruise control mode, the vehicle can be operated by cruise switch signals (decelerating, accelerating, cruising).

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2) Components



Test voltage(VCC 5V)

FUNCTION	KEY VOLUE	REMARK
MAIN	0.15 ~ 0.55V	-
DES/RES	0.7 ~ 1.1V	-
ACC/SET	1.6 ~ 2.0V	-
CANCEL	2.52 ~ 2.92V	-
ECO	4.22 ~ 4.82V	-

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3. OPERATION

1) Setting a Desired Speed



1. To operate the cruise control, accelerate to the desired speed, which must be more than 38 km/h (24 MPH) and less than 150 km/h (90 MPH). In the vehicle equipped with manual transaxle, the gear shift lever should be in 3rd (GSL: 2nd) or higher gear position.
2. Diesel engine equipped vehicle: When the desired speed is reached, press CRUISE ON (3) switch of cruise control lever.
   Gasoline engine equipped vehicle: When the desired speed is reached, press CRUISE ON (3) switch of cruise control lever. The system is readyreadyreadyready to activate the cruise control function. To activate the cruise control function, push up (1) the ACCEL switch of the cruise control lever.
   Now, the vehicle is cruised by this system with the set speed.
3. And you can set to other vehicle speeds again with above steps after an accelerator pedal intervention
4. during the cruise control running.

⚠ CAUTION

Never use the cruise control system until you get used to it.
Improper use or not fully aware of this function could result in collision and/or personal injuries.

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2) Accelerating with the Cruise Control System



(1) While the cruise control system is running

1. Push up the ACCEL switch of the cruise control lever and hold it until the desired speed is reached without an accelerator pedal intervention.
2. When the desired speed is reached, release the lever.

(2) While the cruise control system is not running

1. Accelerate using the accelerator pedal over 38 km/h.
2. Push up the ACCEL switch of the cruise control lever and hold it.
3. And then release the accelerator pedal slowly.
4. When the desired speed is reached, release the lever.

(3) Tap-up while the cruise control system is running

1. Push up the ACCEL switch of the cruise control lever less than 0.5 second per one switching while the cruise control system is running. This is a tap-up switching.
2. When you operate a tap-up switching, the vehicle is accelerated by 1.0 km/h over the previous set speed.
3. If you want to accelerate to 10 km/h, operate the tap-up switching ten times without accelerating with the cruise control system.

Modification basis	
Application basis	
Affected VIN	

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3) Decelerating with the Cruise Control System



(1) While the cruise control system is running

1. Push down the DECEL switch of the cruise control lever and hold it until the desired speed is reached without a brake pedal intervention. But the cruise control system cannot maintain the cruise function at less than 38 km/h.
2. When the desired speed is reached, release the lever.

(2) When the cruise control system is not running

1. Push down the DECEL switch of the cruise control lever and hold it.
2. And then release the accelerator pedal slowly.
3. When the desired speed is reached, release the lever. But the cruise control system cannot maintain the cruise function at less than 38 km/h.
4. When you push down the cruise control switch, "RESUME" function starts (GSL only).

(3) Tap-down while the cruise control system is running

1. Push down the DECEL switch of the cruise control lever less than 0.5 second per one switching while the cruise control system is running. This is a tap-down switching.
2. When you operate a tap-down switching, the vehicle is decelerated by 1 km/h below the previous set speed.
3. If you want to decelerate to 10 km/h, operate the tap-down switching ten times without the brake pedal intervention.

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4) Recovery of Set Speed (RESUME)



To cancel the cruise control function, pull the cruise switch toward you.

CAUTION

The resume position should only be used if the driver is fully aware of this speed and wishes to resume this particular speed.

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5) ECO Cruise Control



ECO cruise is ready and ECO cruise indicator on the instrument cluster comes on when pushing down the cruise control lever. To activate the ECO cruise mode, push down the cruise control lever again. To cancel the ECO cruise mode while in operation, push down the cruise control lever again. The ECO cruise mode is canceled and the indicator goes out.

What is ECO Cruise mode?

In this mode, the smooth acceleration to the set cruise speed can be achieved by optimized fuel consumption.

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6) Normal Cancellation of the Cruise Control



The cruise control system will be canceled when one or more items of the following conditions are applied;

1. When the brake pedal is depressed.
2. When the cruising speed is decreased less than 38 km/h.
3. When pushing the ON-OFF switch of the cruise control lever.
4. When ESP is activated.
5. When applying the parking brake while driving.
6. When using the clutch in order to shift (M/T only).
7. To cancel the cruise control function, pull the cruise switch toward you. (GSL only).

And the cruise control system can be operated again in driving state.

CAUTION

Keep the main cruise control switch in the neutral position when not using the cruise control.

Modification basis	
Application basis	
Affected VIN	

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(1) Abnormal Cancellation of the Cruise Control

1. When the rapid deceleration is applied without braking.
2. When the rapid acceleration is applied without acceleration pedal intervention (DSL only).
3. When the cruise control lever is failed (DSL only).
4. When the brake switch and the brake light switch input signal are implausible.

And the cruise control system cannot be operated again in driving state. In this case, you should stop the vehicle, and turn off the ignition switch and then turn it on again. After you do that, you can use the cruise control system again. But if the cruise control system isn't recovered, you should contact a Ssangyong Dealer for diagnosis of the cruise control system.

CAUTION

1. Abnormal changes of the gear selector lever can damage the yyengine. Do not move the gear shift lever to Neutral while driving at the set speed. Automatic transaxle damage may result.
2. The speed that has been set may not be maintained on uphill or yydownhill slopes.
3. The speed may drop to less than the set speed on a steep uphill yygrade. The accelerator must be used if you want to maintain that speed.
4. The speed may increase to more than the set speed on a steep yydownhill grade. When the speed increases too much, turn off the cruise control.

(2) Using the Cruise Control on Hills

How well the cruise control works on hills depends on the speed, load, and the steepness of the hill. When going up steep hills, you may have to depress the accelerator pedal to maintain your speed. When going downhill, you may have to brake or shift to a lower gear to keep your speed down. Applying the brake takes you out of the cruise control.

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ENGINE CONTROL 1490-00

GENERAL INFORMATION

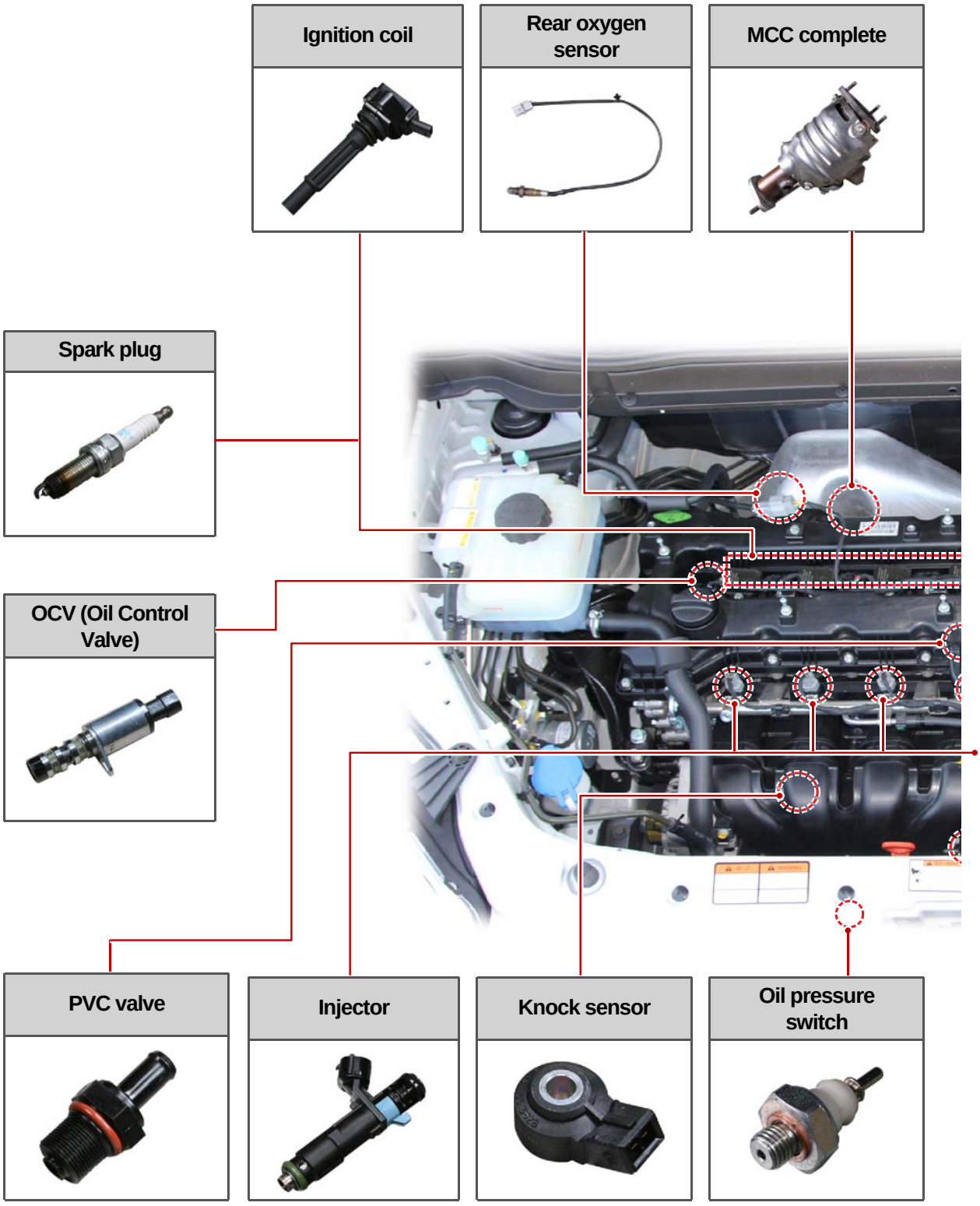
1. ENGINE DATA LIST

Data	Unit	Value
Coolant temperature	℃	0.436V (130℃) ~4.896V (-40℃)
Intake air temperature	℃	-40~130℃ (varies according to ambient air temperature or engine mode)
Idle speed	rpm	700±50(P/N), 600±(D)
Engine load	%	18~25%
Mass air flow	kg/h	16~25kg/h
Throttle position angle	°TA	0° (Full Open) ~ 78° (Close)
Engine torque	Nm	varies according to engine conditions
Injection time	Ms	-
Battery voltage	V	13.5V~14.1V
Accelerator pedal position 1	V	0.3~4.8 V
Accelerator pedal position 2	V	0.3~2.4 V
Oxygen sensor	mV	0~5 V
OCV (Oil Control Valve)	%	0~100%
VIS solenoid valve	1=ON / 0=OFF	-
A/C compressor switch	1=ON / 0=OFF	-
Full load	1=ON / 0=OFF	-
Knocking control	1=ON / 0=OFF	-
Brake switch	1=ON / 0=OFF	-
Cruise control	1=ON / 0=OFF	-

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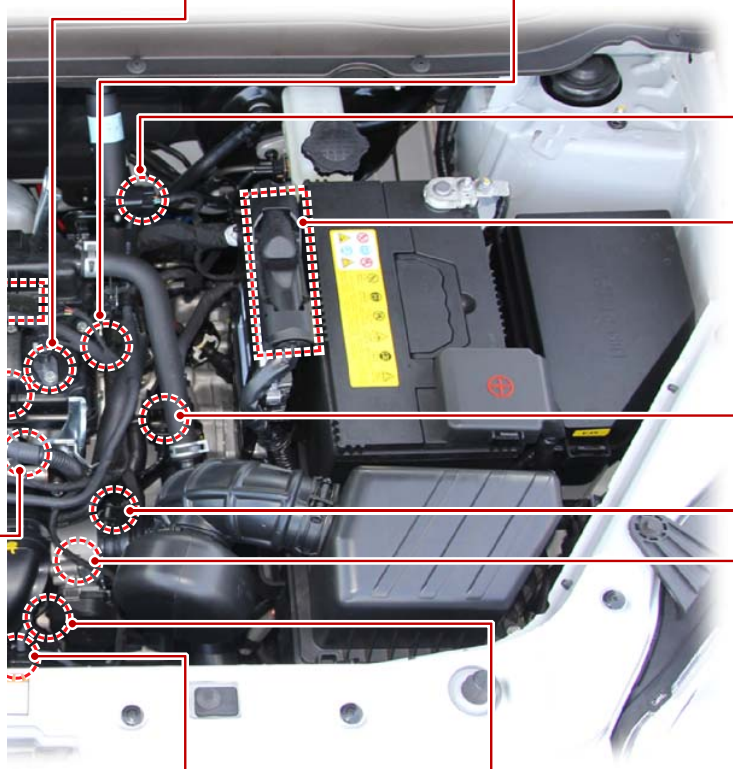
OVERVIEW AND OPERATING PTOCESS

1. MAJOR COMPONENTS



Modification basis	
Application basis	
Affected VIN	

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Camshaft position sensor



Coolant Temp sensor



Front oxygen sensor



G20DF engine ECU



Purge control solenoid valve



Crankshaft position sensor



VIS solenoid valve



T-MAP sensor



Electronic throttle body



Magnetic trigger ring

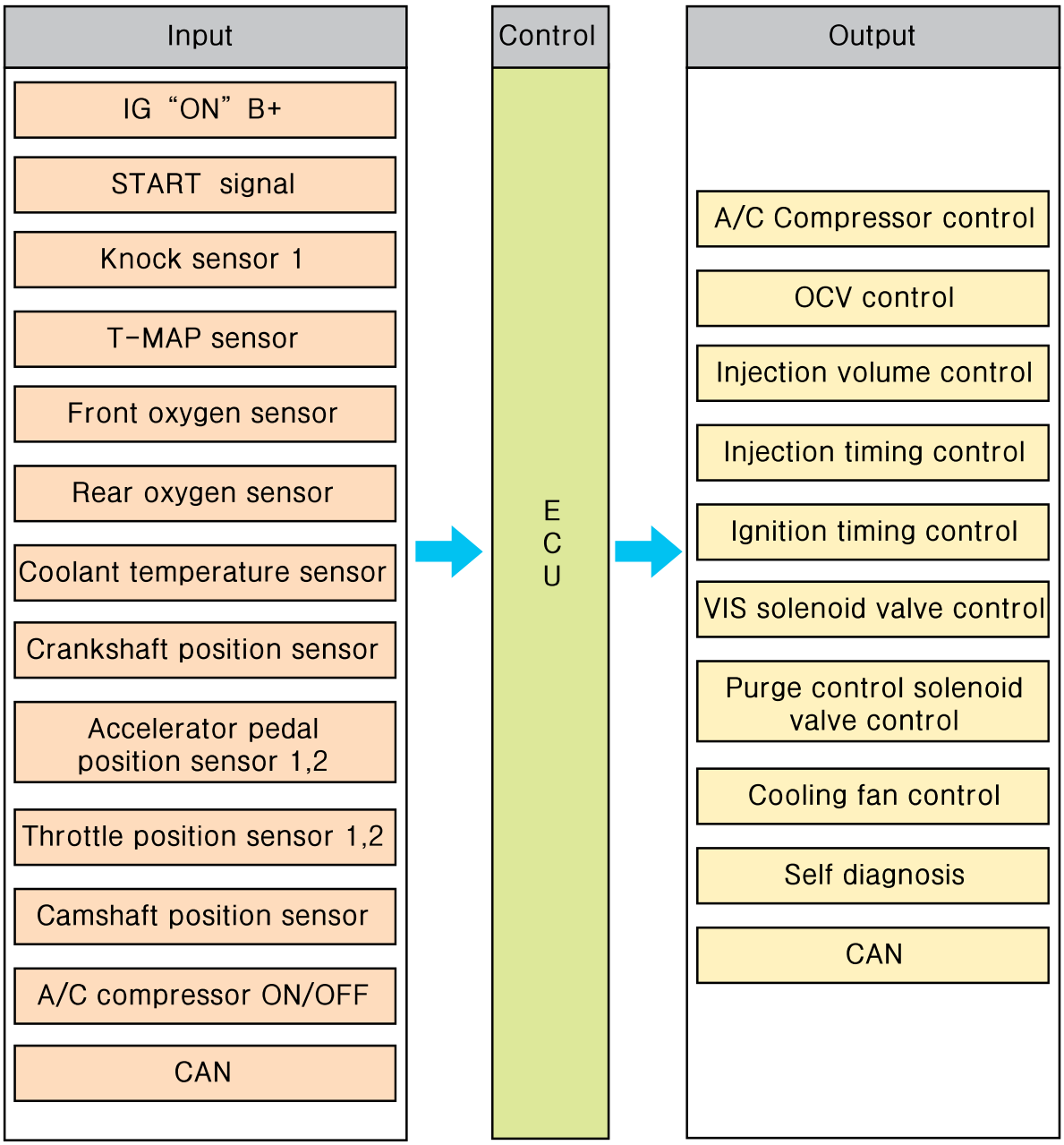


Modification basis	
Application basis	
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2. SYSTEM OPERATION

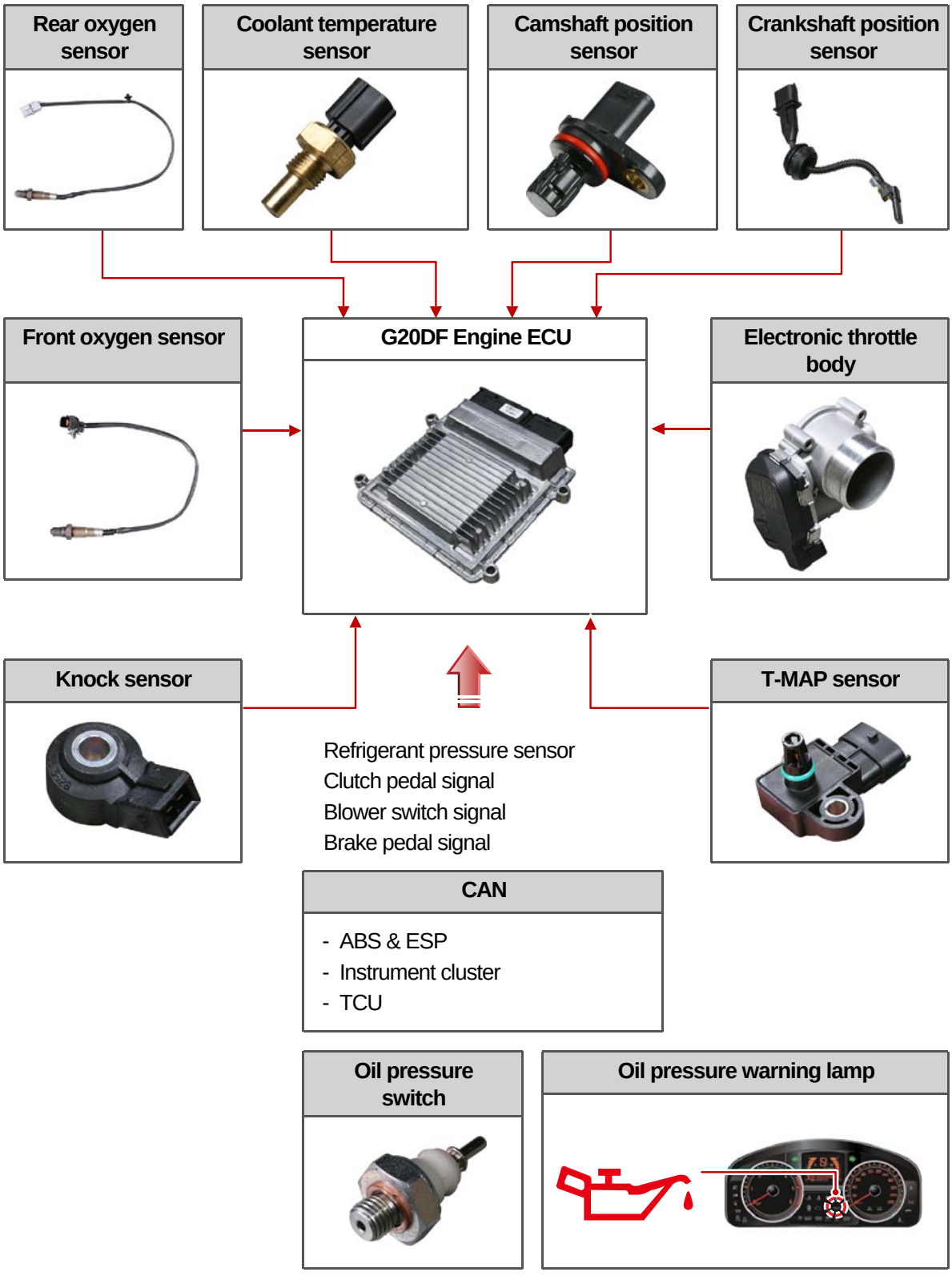
1) Input/Output of ECU



Modification basis	
Application basis	
Affected VIN	

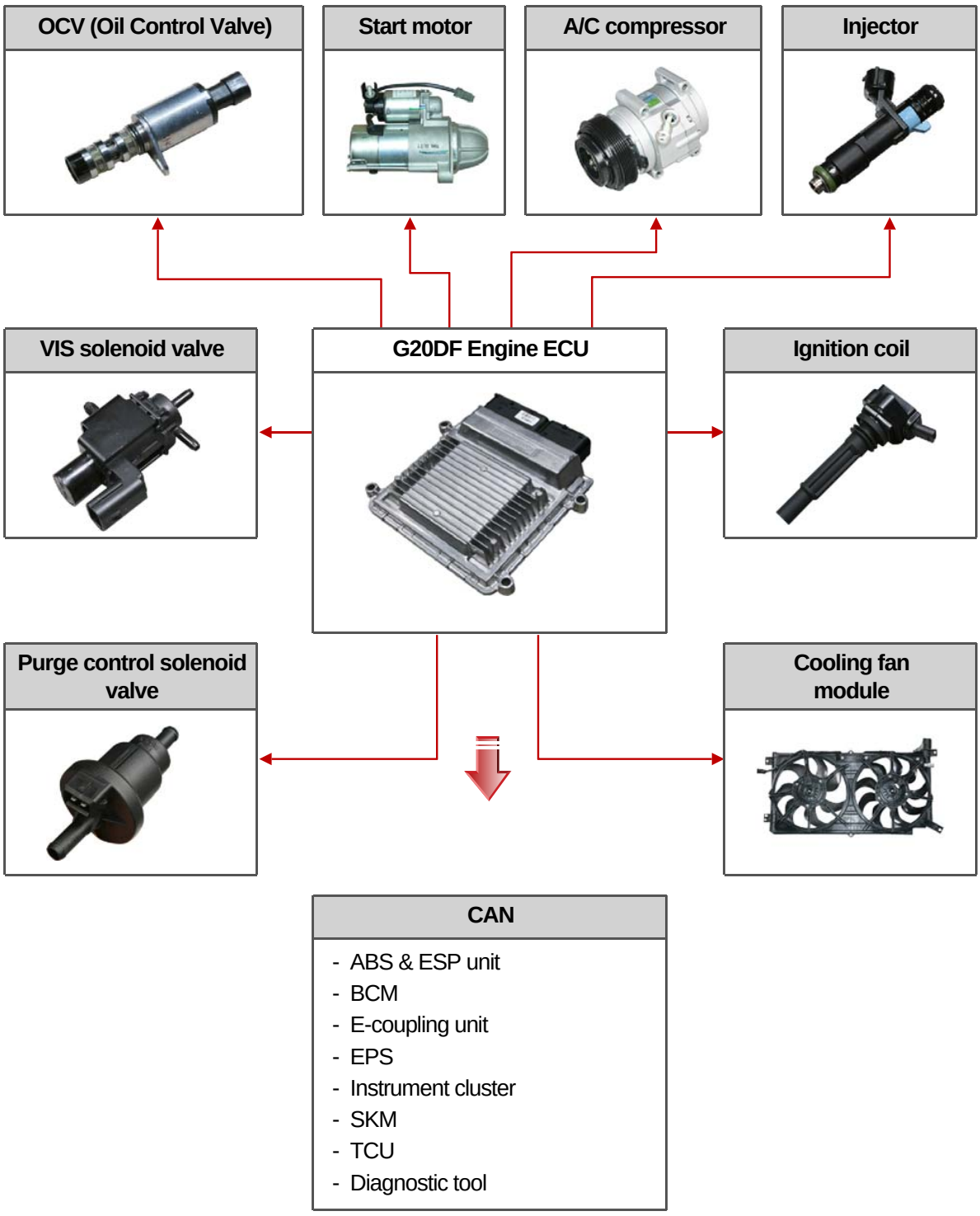
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2) Components for ECU Input



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3) Components for ECU Output



Modification basis	
Application basis	
Affected VIN	

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3. ECU CONTROL

1) Functions

ECU receives and analyzes signals from various sensors and then modifies those signals into permissible voltage levels and analyzes to control respective actuators.
ECU microprocessor calculates injection period and injection timing proper for engine piston speed and crankshaft angle based on input data and stored specific map to control the engine power and emission gas.
Output signal of the ECU microprocessor activates the injector solenoid valve to control the fuel injection period and injection timing; so controls various actuators in response to engine changes.
Auxiliary function of ECU has adopted to reduce emission gas, improve fuel economy and enhance safety, comforts and conveniences. For example, there are autocruise and immobilizer and adopted CAN communication to exchange data among electrical systems (automatic T/M and brake system) in the vehicle fluently. And the diagnostic tool can be used to diagnose vehicle status and defectives.
Operating temperature range of ECU is normally −40 to +85°C and protected from factors like oil, water and electromagnetism and there should be no mechanical shocks.

2) Control Functions

- Controls by operating stages:
  To make optimum combustion under every operating stage, ECU should calculate proper injection volume in each stage by considering various factors.

- Starting injection volume control:
  During initial starting, injecting fuel volume will be calculated by function of temperature and engine cranking speed. Starting injection continues from when the ignition switch is turned to ignition position to till the engine reaches to allowable minimum speed.

- Driving mode control:
  If the vehicle runs normally, fuel injection volume will be calculated by accelerator pedal travel and engine rpm and the drive map will be used to match the drivers inputs with optimum engine power.

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3) Injection Volume Control

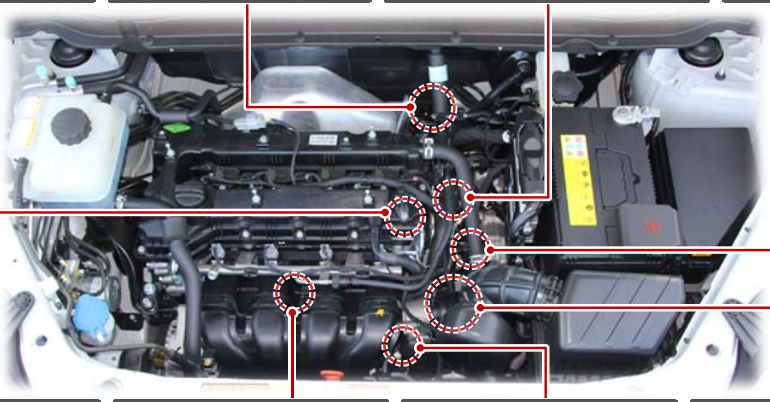
(1) Overview

To keep the best engine conditions and to reduce the emission gas, ECU determines the injection volume and timing.

(2) Components

▶ **Input Components**

Accelerator pedal position sensor	Front oxygen sensor	Coolant temperature sensor	Crankshaft position sensor
			



Camshaft position sensor	Knock sensor	T-MAP sensor	Electronic throttle body
			

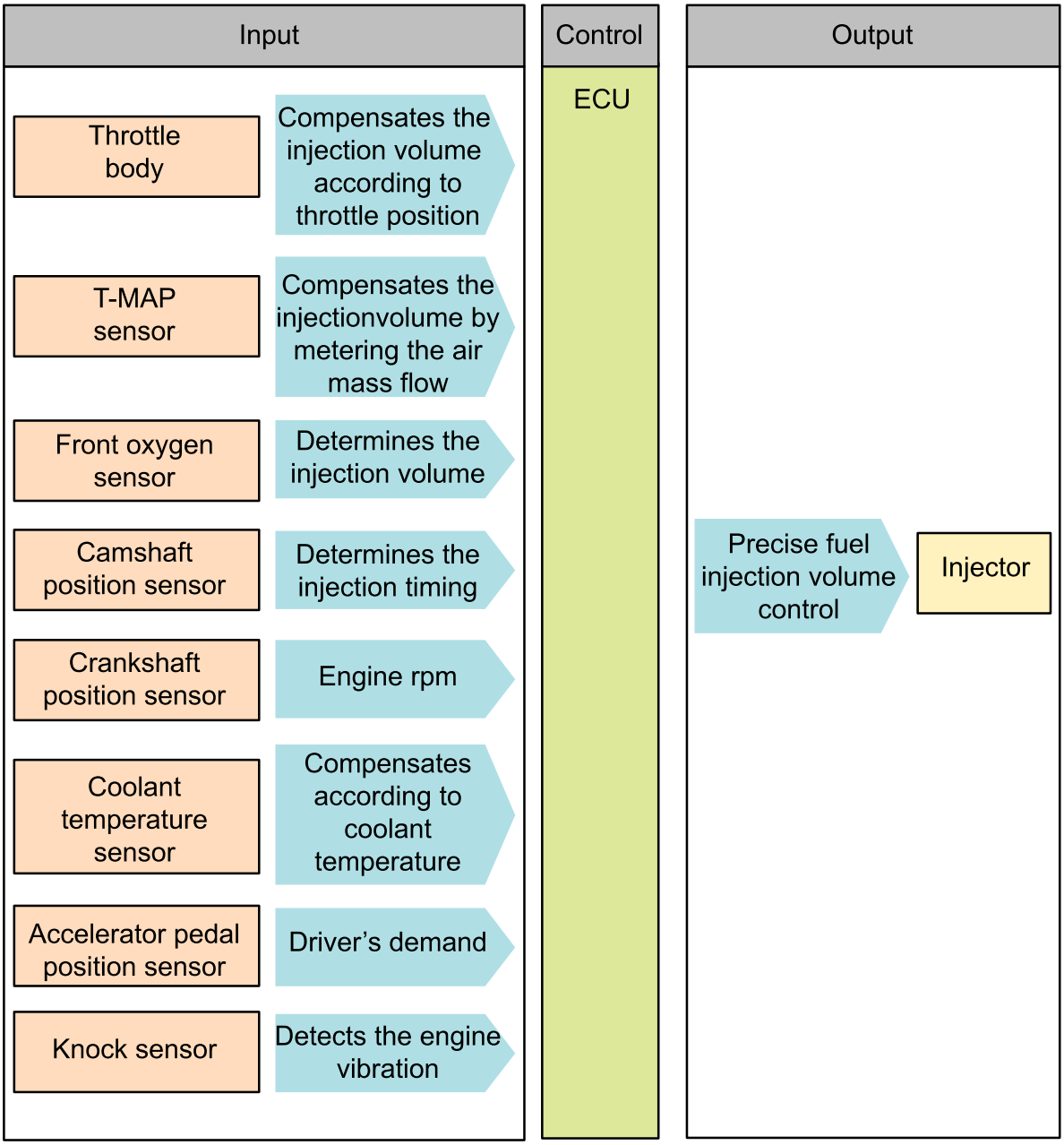
▶ **Output Components**

Various sensor data	→	Engine ECU	→	Injector
		 Determines the basic injection volume.		 Operates the injector by receiving the signal from ECU.

Modification basis	
Application basis	
Affected VIN	

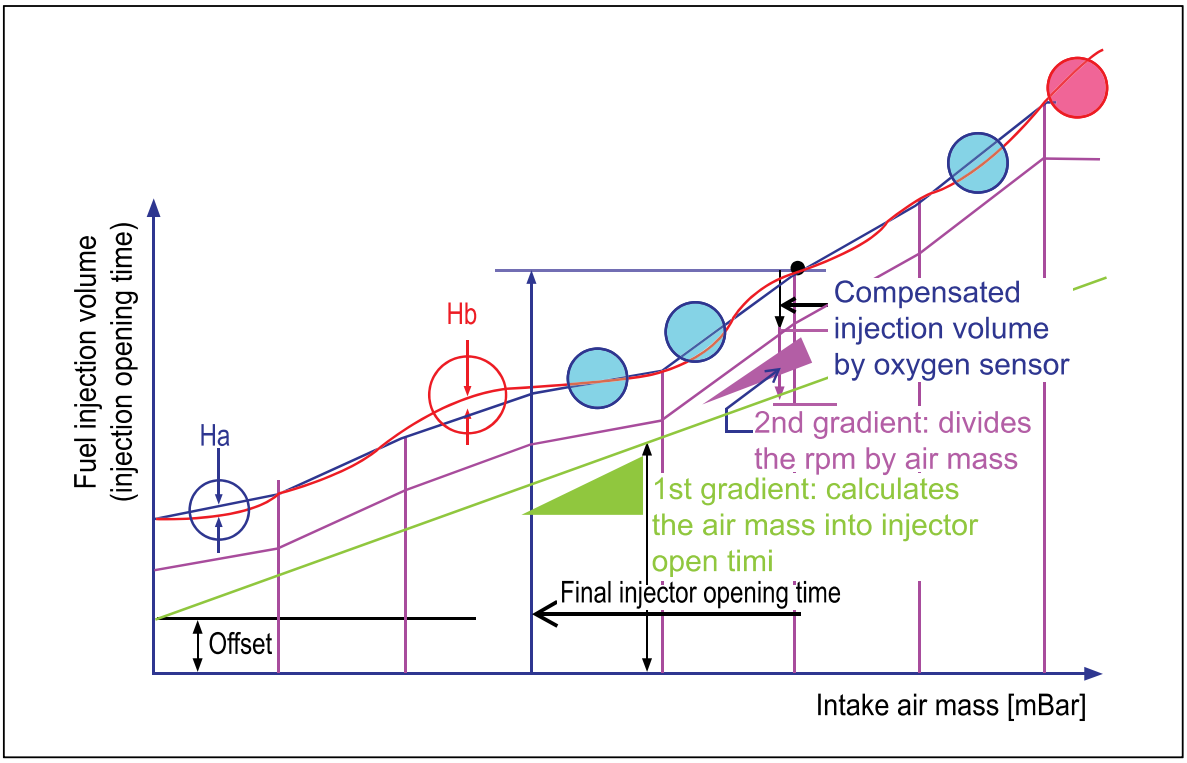
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(3) Input/Output for Injection Volume Control



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(4) Basic Injection Volume Map



Modification basis	
Application basis	
Affected VIN	

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4) Ignition System Control

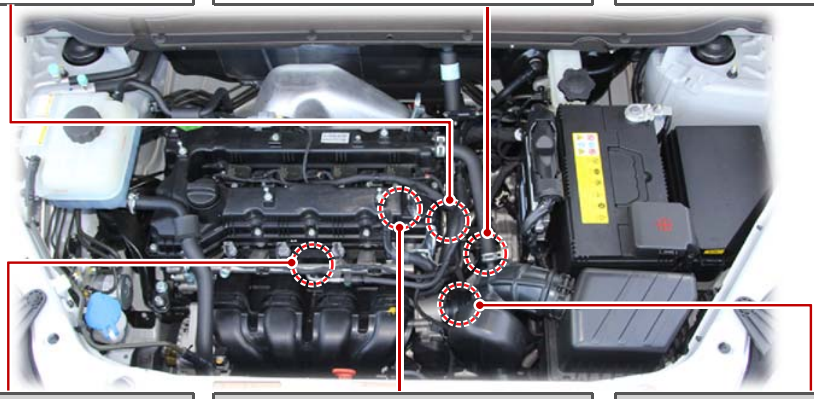
(1) Overview

G20DF engine is equipped with the single ignition system. Each spark plug is operated independently by the ECU and one ignition coil and spark plug are provided for each cylinder.

(2) Components

▶ **Input Components**

Coolant temperature sensor	Crankshaft position sensor	Accelerator pedal position sensor
		



Knock sensor	Camshaft position sensor	Electronic throttle body
		

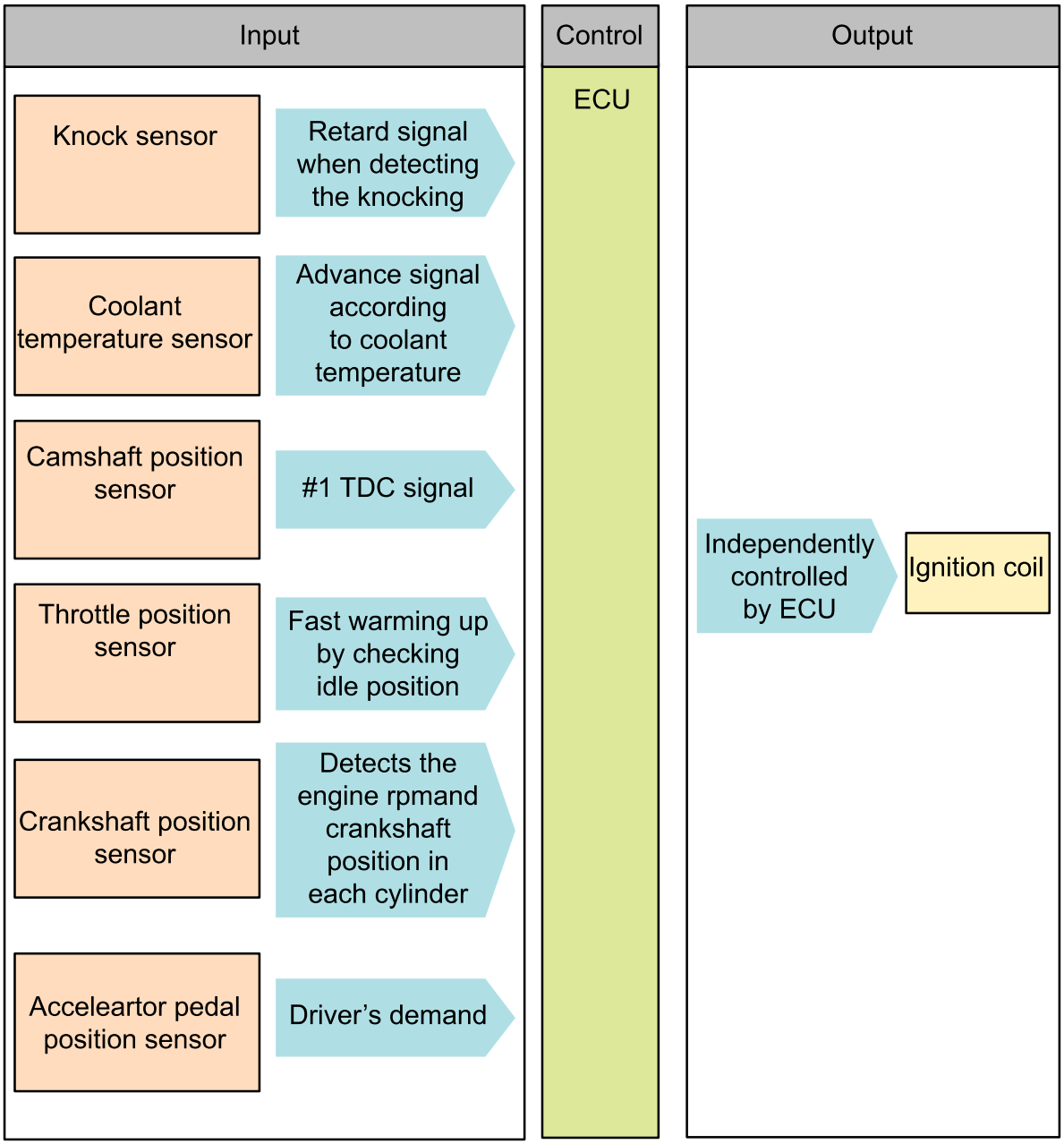
▶ **Output Components**



Modification basis	
Application basis	
Affected VIN	

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(3) Input/Output for Ignition System



Modification basis	
Application basis	
Affected VIN	

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(4) Features

1. Determines the ignition timing according to input signal
   The ECU always analyzes the following elements when determining the ignition timing.

   - Crankshaft position sensor
   - Camshaft position sensor
   - Coolant temperature sensor
   - Intake air temperature/air mass

2. Warm-up of catalytic converter
   The ignition timing is retarded for about 20 seconds to operate the catalytic converter according to the operating temperature under the following conditions:

   - The coolant temperature is 15°C ~ 40°C at starting.
   - The idle speed is increased by the idle speed control to help warming up of the catalytic converter

3. Idle speed control
   The ignition timing can be retarded up to 36° or advanced up to 20° to help idle speed control.
   The ignition timing control can be performed faster than the control through the throttle valve.

4. Fuel cut-off in deceleration
   The ignition timing is retarded temporarily to prevent abrupt increase of the torque when the combustion is restarted.

5. Intake air temperature/coolant temperature
   The ignition timing is retarded to prevent knocking if the intake air temperature or coolant temperature is high. The ignition timing is retarded in the following cases.

   - The intake air temperature is above 30°C.
   - The coolant temperature is above 105°C.

   The ignition timing retard for intake air temperature and for coolant temperature is added up for correction.

6. ESP/ASR control mode
   The ignition timing is retarded to reduce engine torque as fast as possible under the ESP/ASR control mode.

7. Knocking control
   If knocking occurs in the cylinder, the ignition angle of the corresponding cylinder is retarded. The coolant temperature is 15°C to 40°C when starting.

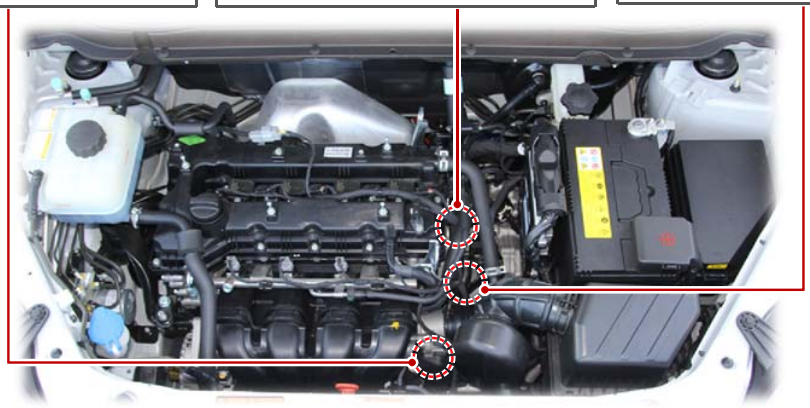
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5) Warm-Up of Catalytic Converter

(1) Components

▶ Input Components

T-MAP sensor	Coolant temperature sensor	Crankshaft position sensor
		



▶ Output Components

Various sensor data	Engine ECU	Injector	Ignition coil
			
	- Determines the fuel injection volume - Heats the oxygen sensor	Operates the injector by receiving the signal from ECU	Retards the ignition by receiving the signal from ECU

Oxygen sensor

Heats the oxygen sensor by receiving the signal from ECU

Modification basis	
Application basis	
Affected VIN	

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(2) Warm-up Control Function

▶ **Idle speed control**

The idle speed is controlled according to the fuel/air mixture when the engine load is changed, the power steering wheel is turned to its end, the selector lever is in the "D" position and the A/C compressor is in operation. It is also controlled according to the charge level during the purge control operation.

▶ **Ignition timing**

The idle speed is controlled according to the fuel/air mixture when the engine load is changed, The ignition angle can be retarded up to 36˚ or advanced up to 20˚ to help idle speed control.

▶ **Air conditioner compressor operation**

The air conditioner control unit sends the air conditioner operation signal to the ECU to increase the throttle valve opening amount in order to prevent reduction of the engine speed when the air conditioner compressor is in operation at idling.

▶ **Low voltage**

If low voltage is detected by the ECU, the idle speed increases up to 100 rpm selectively under the driving mode until the ignition switch is turned off.

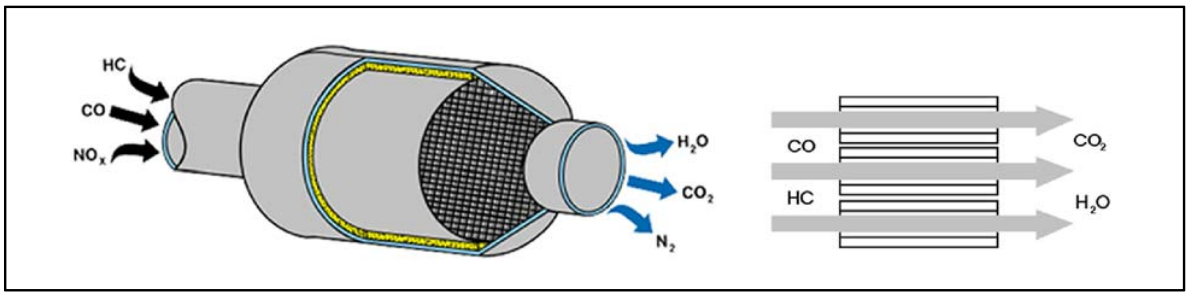
(3) Warm-up Control Operating Conditions

To make the catalytic converter reach a operating temperature, the ignition timing is retarded for about 20 seconds under the following conditions:

▶ The coolant temperature is 15°C ~ 40°C when the engine is started.
▶ **The selector lever is in the "P" or "N" position.**

Also, the idle speed increases to 1100 ~ 1500 rpm simultaneously by the idle speed control. However, as soon as the selector lever is shifted to the D position, warming up control of the catalytic converter will be inhibited. The information necessary to perform such control is as follows:

▶ **Coolant temperature**
▶ **Engine rpm**
▶ **Intake air mass**
▶ **Recognizing idling status**
▶ **Selector lever position**



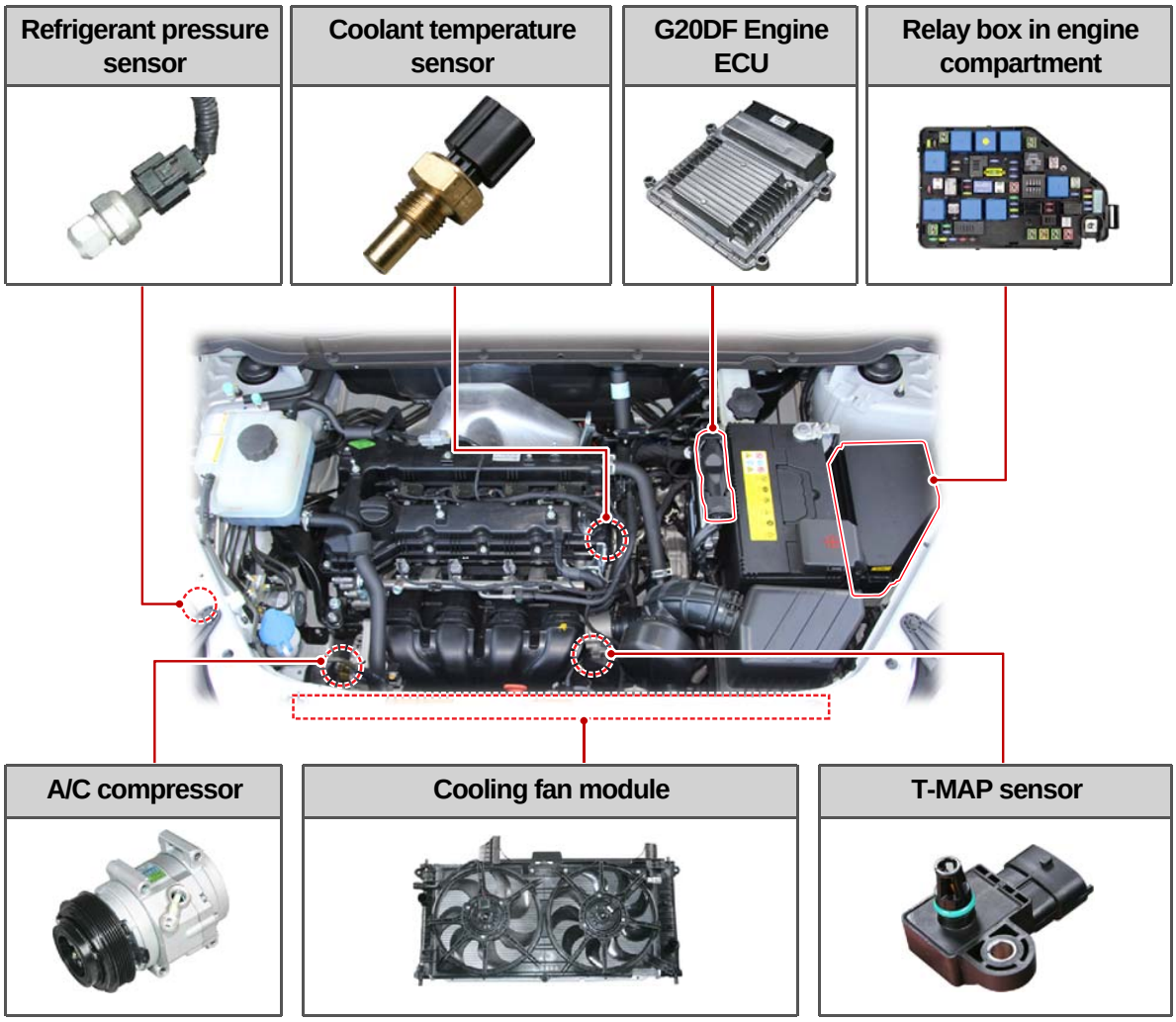
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6) Cooling Fan Control

(1) Overview of Cooling Fan and A/C Compressor

The cooling system maintains the engine temperature at an efficient level during all engine operating conditions. The water pump draws the coolant from the radiator. The coolant then circulates through water jackets in the engine block, the intake manifold, and the cylinder head. When the coolant reaches the operating temperature of the thermostat, the thermostat opens. The coolant then goes back to the radiator where it cools. The heat from automatic transaxle is also cooled down through the radiator by circulating the oil through the oil pump. There are two cooling fans (180W+120W) in G20DF engine. ECU controls the electric cooling fans with three cooling fan relays to improve the engine torque and air conditioning performance.

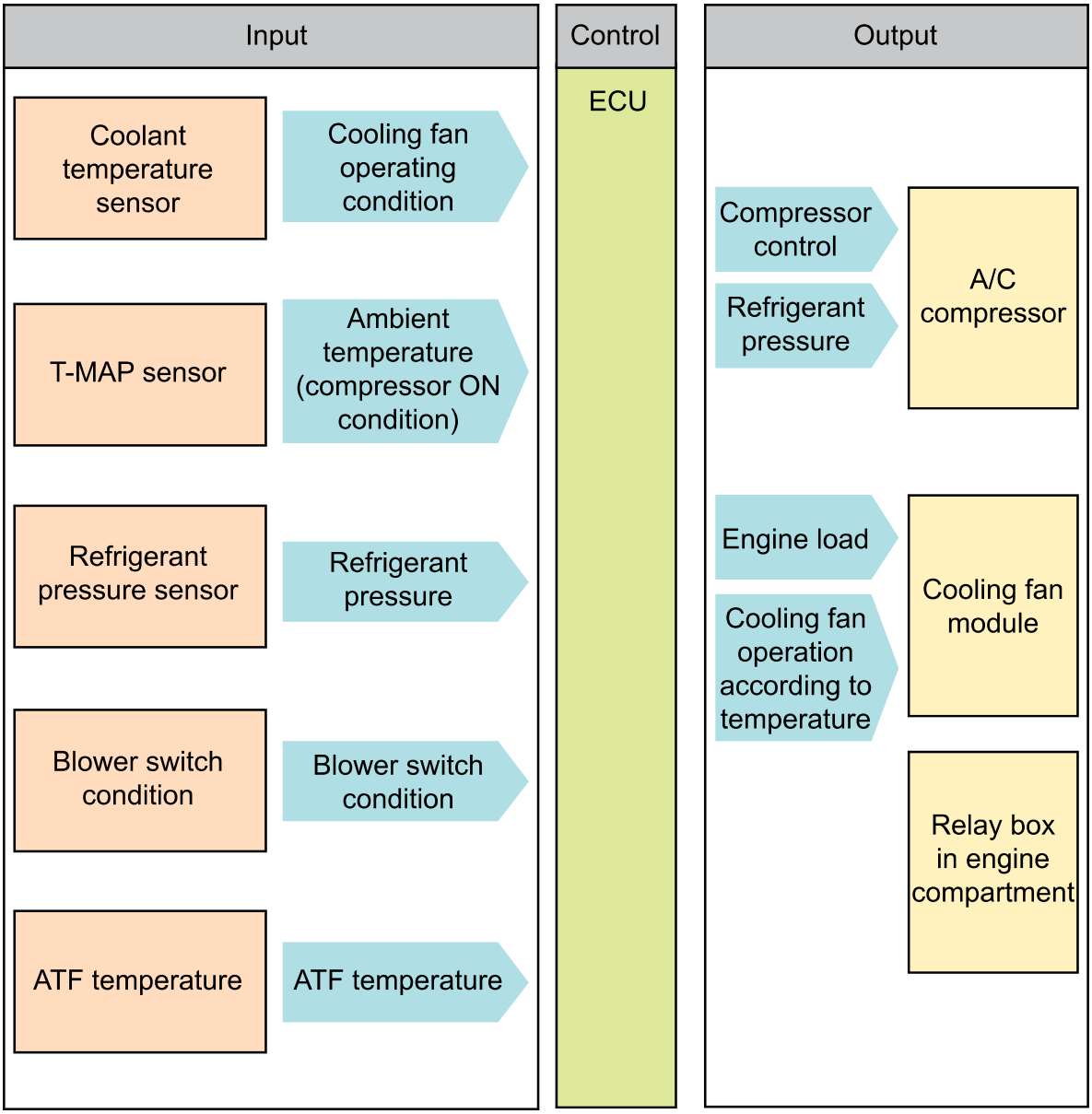
(2) Components



Modification basis	
Application basis	
Affected VIN	

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(3) Input/Output for Cooling Fan and A/C Compressor



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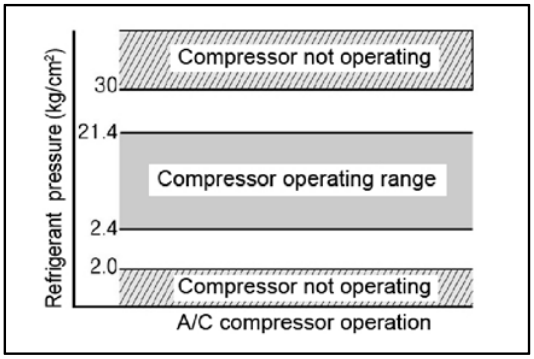
(4) Cooling Fan and A/C Compressor Control

▶ Conditions for cooling fan

The cooling fan module controls the cooling fan relay, high speed relay and low speed relay.
The cooling fan is controlled by the series and parallel circuits

A/C switch	Cooling fan	Coolant temperature	Refrigerant pressure	A/C compressor
OFF	OFF	Coolant temp.<90℃	-	
	LO	90℃≤Coolant temp.<105℃	-	
	HI	105℃≤Coolant temp.	-	
ON	LO	Coolant temp.<105℃	Refrigerant pressure<18 bar	ON
	HI		18 bar≤Refrigerant pressure	
	HI	105℃≤Coolant temp.<115℃	-	
	HI	115℃≤Coolant temp.	-	OFF (cut)

▶ A/C compressor OFF conditions



- Coolant temperature: over 118℃
- Approx. 4 seconds after starting the engine
- When abrupt acceleration
- Refrigerant pressure:
  * OFF below 2.0 kg/㎠, then ON over 2.4 kg/㎠
  * OFF over 32 kg/㎠, then ON below 26.0 kg/㎠

▶ Output voltage according to refrigerant pressure

The output voltage from refrigerant pressure sensor is 1.7 V to 3.5 V when the refrigerant pressure is 10 to 24 kgf/㎠ with A/C "ON".

▶ Cooling fan control by ATF temperature

ATF temperature	Cooling fan speed	Remark
Over 110°C	HI	-

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7) Immobilizer Control

(1) Overview

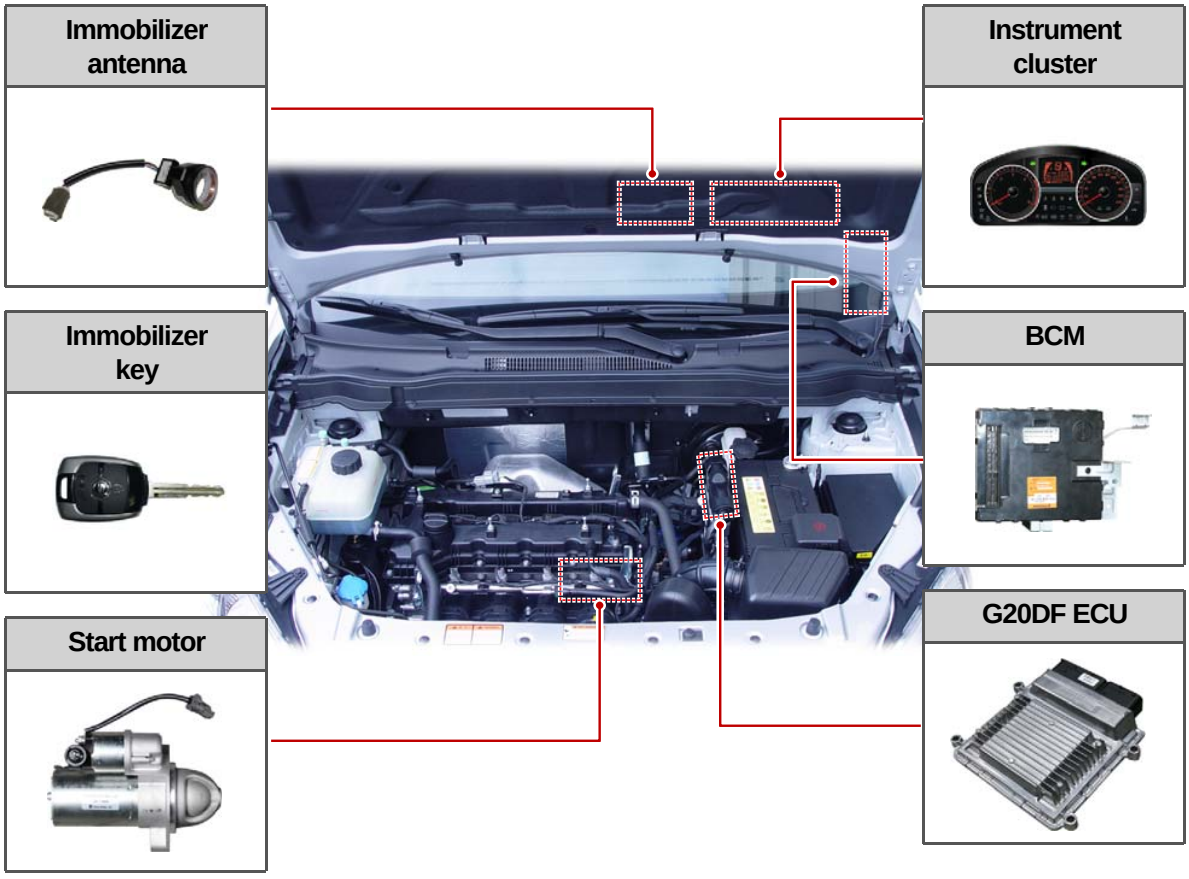
The Immobilizer System provides an additional theft deterrent to the vehicle in which it is installed and prevents it from being started by unauthorized persons. The transponder integrated in the key and the engine control unit have the same code. When the ignition key with the integrated transponder is turned to the ON position, the ECU (Engine Control Unit) checks the crypto code of the key and, if correct, allows the vehicle to start the engine.

NOTE

For details, refer to Chapter "BCM".

(2) Components

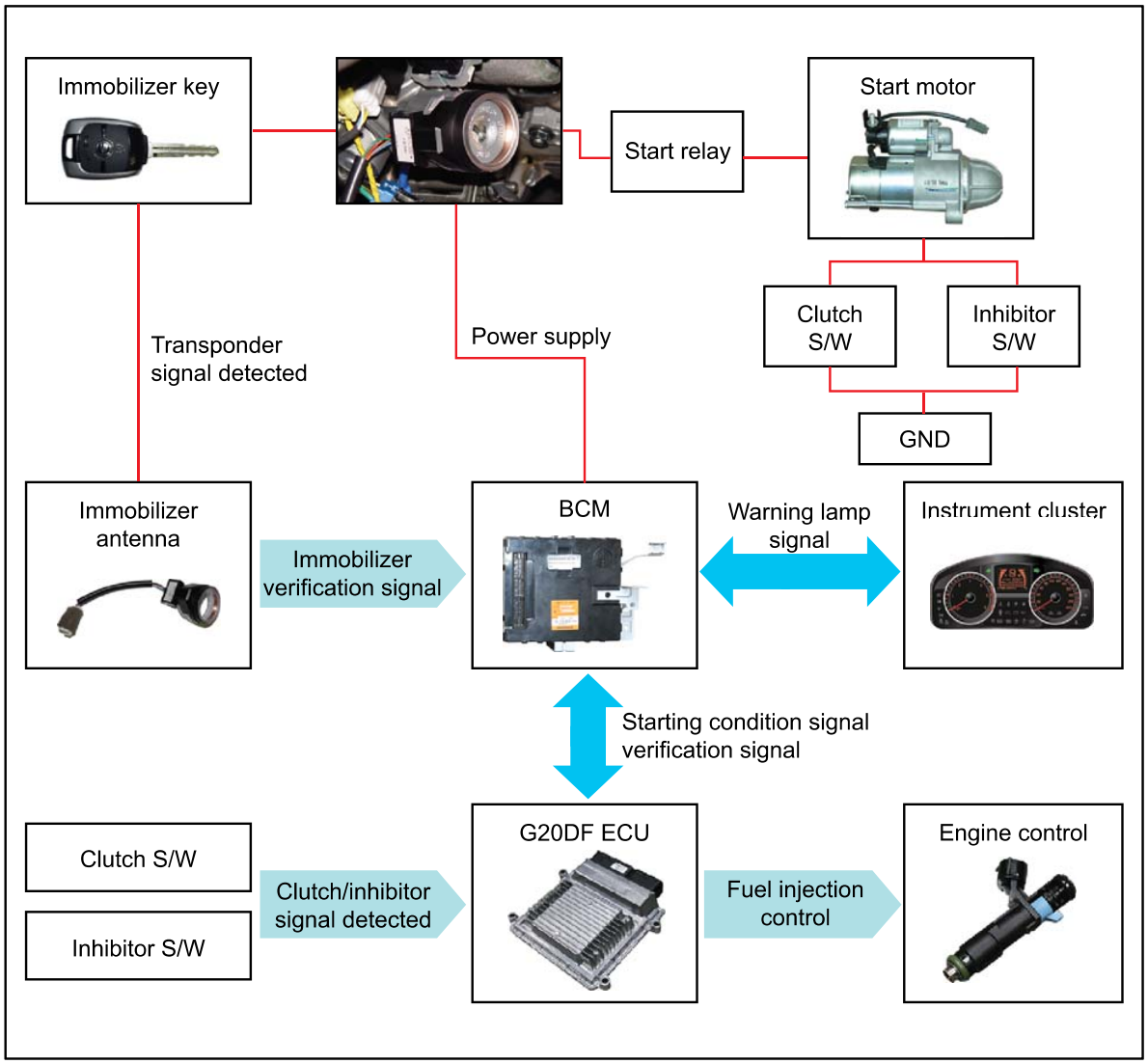
▶ **Conditions for cooling fan**



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▶ Key approval process

When turning the ignition switch to ON position, the power is supplied to BCM and ECU. ECU communicate with the immobilizer key to check if it is valid crypto code. If it is valid, ECU start to control the engine when turning the ignition switch to START position.
The system has 10 seconds of valid time-out period. If the engine does not start in this period, the key approval process should be done again.

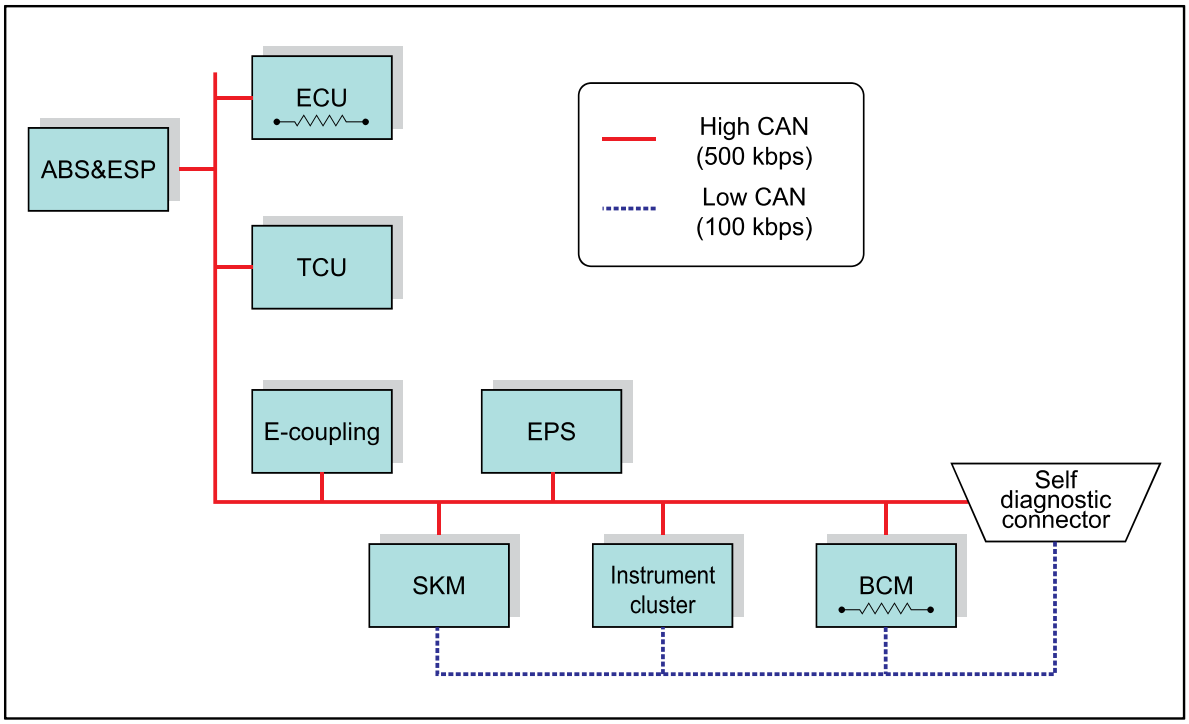


Modification basis	
Application basis	
Affected VIN	

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8) CAN Configuration (P-CAN/B-CAN)

(1) CAN Configuration (P-CAN/B-CAN)

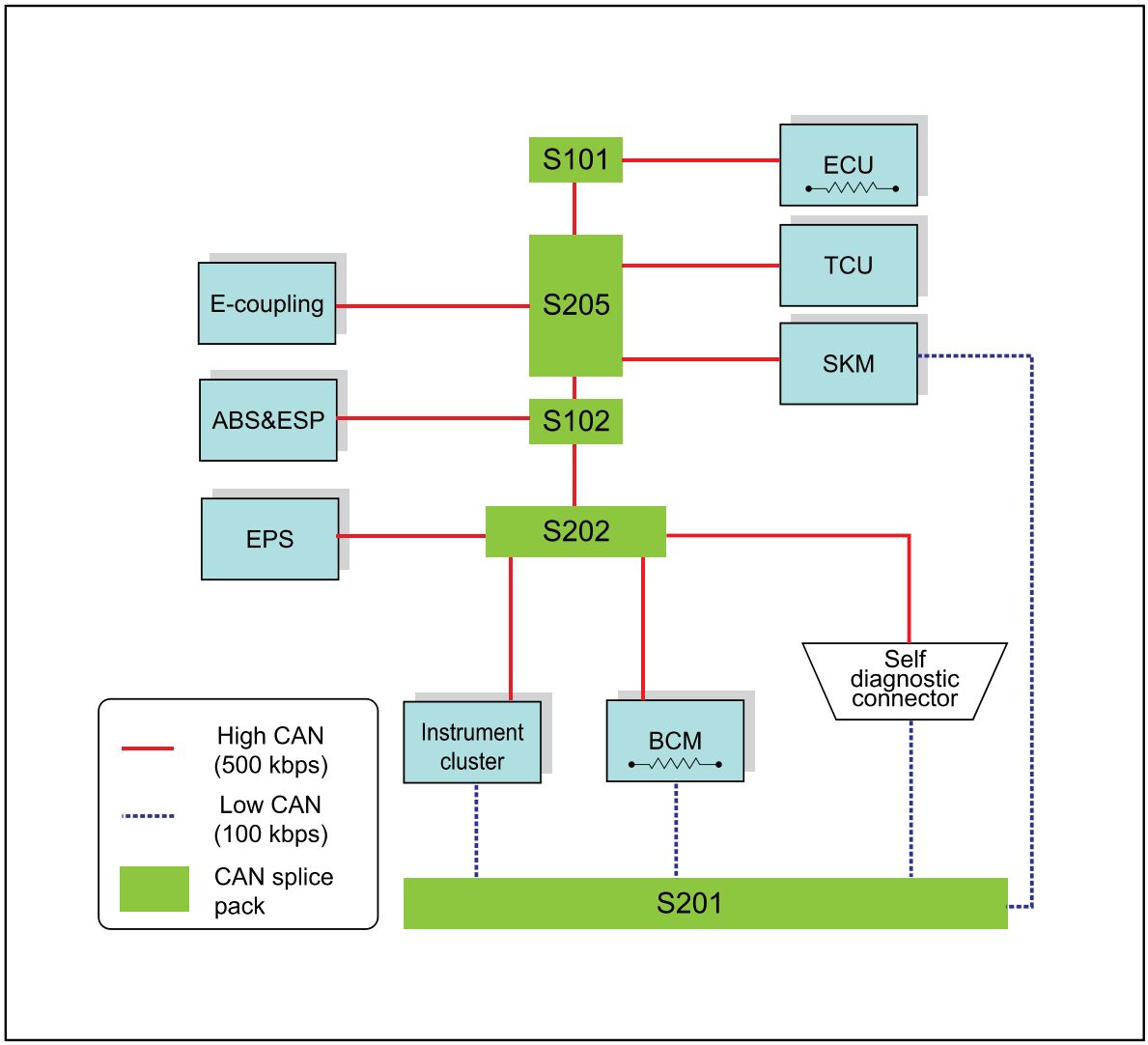


Name	Function
ECU	Electronic Control Unit
TCU	Transmission Control Unit
EPS	Electronic Power Steering Unit
BCM	Body Control Moudule
SKM	Smart Key Moudule

CAN system communicates with the system units in vehicle. It consists of P-CAN and B-CAN according to the communication speed.
P-CAN & B-CAN: SKM, Instrument cluster, BCM, Disgnostic connector
P-CAN: ECU, ABS & ESP, TCU, E-coupling, EPS unit
Terminal resistance: installed on ECU and BCM

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(2) Wiring Connection of CAN Communication

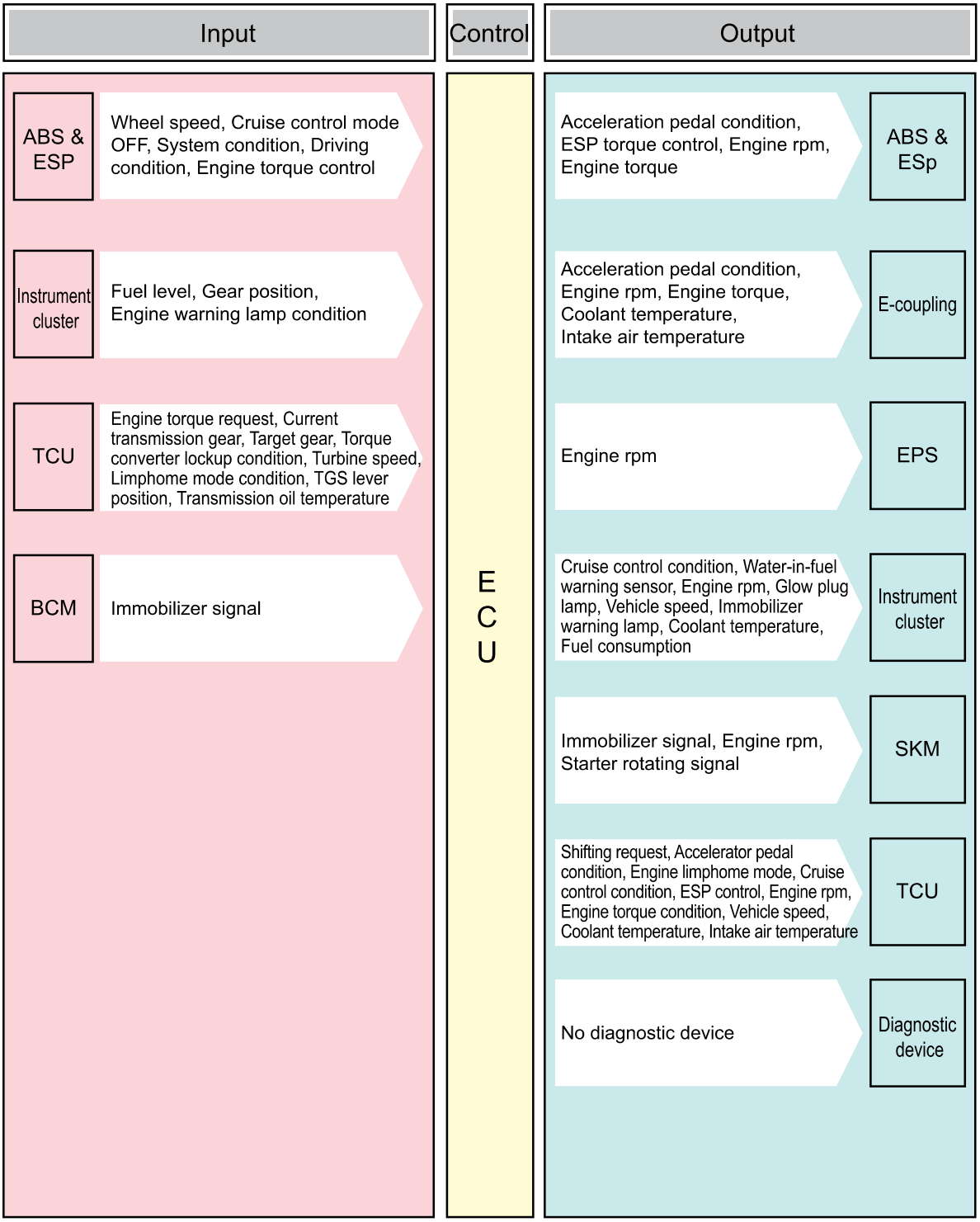


Splice pack	Wiring	Location
S101	Floor wiring (LH)	Under fuse & relay box in engine compartment
S102	Floor wiring (RH)	Inside of right fender
S201	Main wiring	Behind instrument cluster (cowl cross member)
S202	Main wiring	Behind instrument cluster (cowl cross member)
S205	Floor wiring (LH)	Under driver's door scuff

Modification basis	
Application basis	
Affected VIN	

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(3) Input/Output for CAN communication



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VEHICLE GENERAL 0000-00

GENERAL INFORMATION

1. SPECIFICATIONS

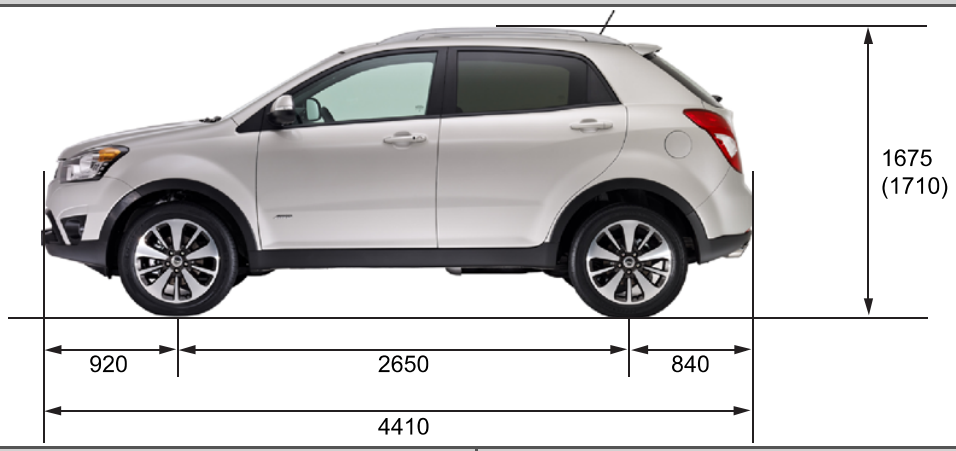
1) Dimensions

Unit: mm

Top view



Side view



Front side



Rear view



Modification basis	
Application basis	
Affected VIN	

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2) Identifications

1) The engine number (671 950 0 2 5000001) is stamped on the lower area of cylinder block in exhaust manifold side.

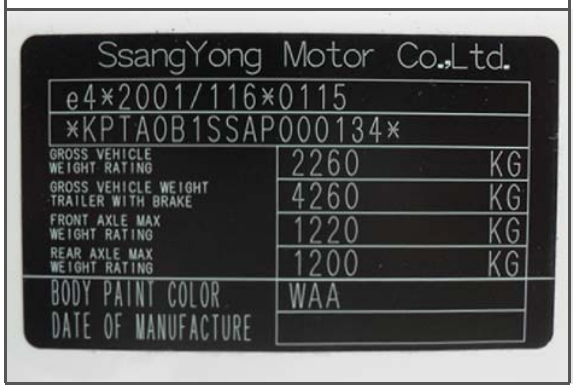


2) The chassis number (KPTA0B1SSAP012345) is stamped on the right side in the engine compartment (passenger side).





3) The certification label is affixed on the bottom of driver side B-pillar. (30 psi)

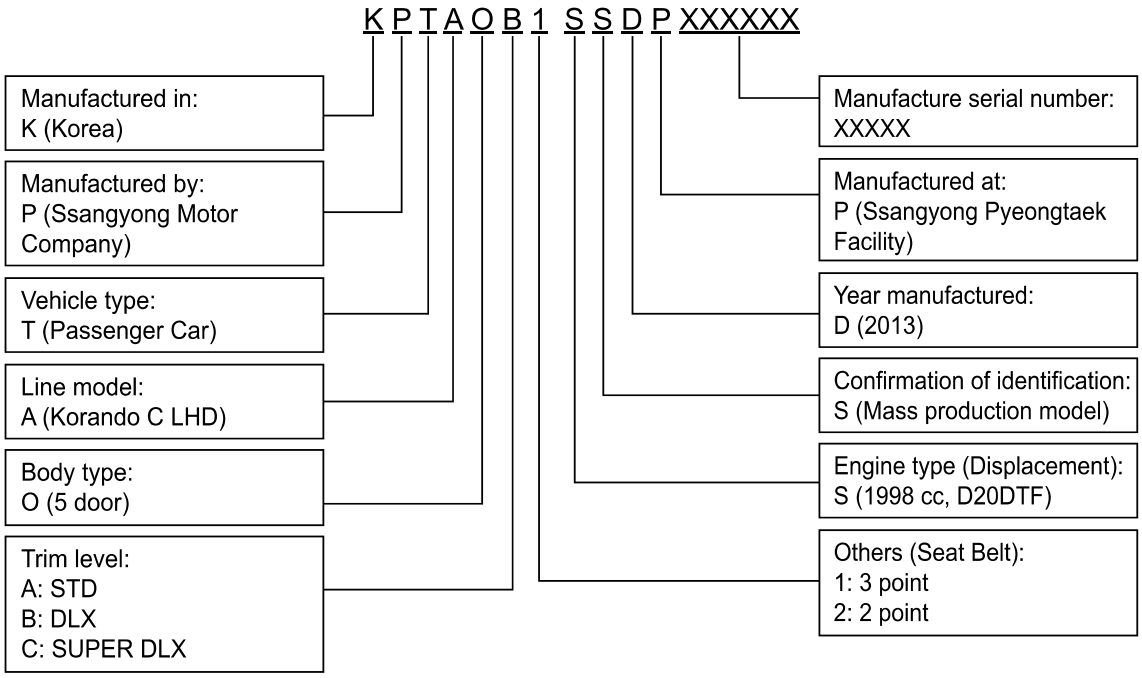


Modification basis	
Application basis	
Affected VIN	

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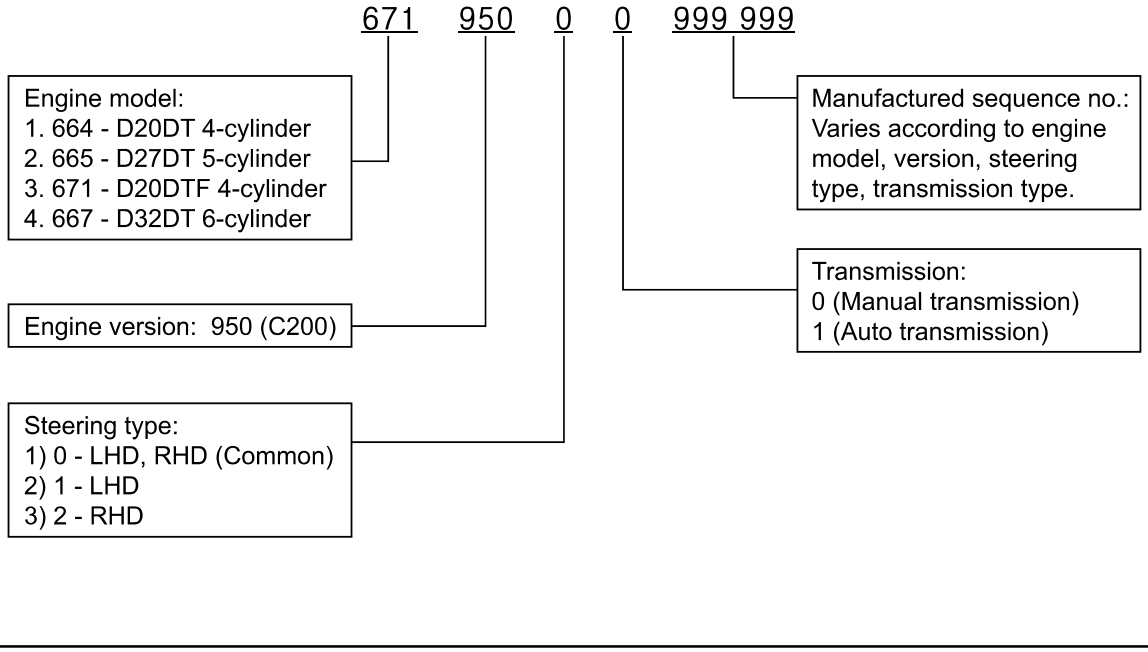
▶ VIN NO.

5) VIN NO.



▶ Engine NO.

5) Engine no.



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2. SPECIFICATION

* ( ) option

Descriptions			Diesel 2.0 Engine (D20DTF(Low CO2))
General	Overall length (mm)		4410 (4500: with trailer hitch)
	Overall width (mm)		1830
	Overall height (mm)		1675 (1710: including roof rack)
	Gross vehicle weight (kg)		4WD: 2260, 2WD: 2180
	Curb vehicle weight (kg)	M/T	4WD: 1727, 2WD: 1645
	Fuel		Diesel
	Fuel tank capacity (ℓ)		57
Engine	Engine		D20DTF
	Number of cylinders/ Compression ratio		4 / 16.5:1
	Total displacement (cc)		1998
	Camshaft arrangement		DOHC
	Max. power	Low power	149 ps / 3400~4000 rpm
	Max. torque	Low power	360 Nm / 1500~2800 rpm
	Idle speed	M/T	750 ± 20 rpm
	Cooling system		Water-cooled / forced circulation
	Coolant capacity (ℓ)		8.5
	Lubrication type		Gear pump, forced circulation
	Max. oil capacity (ℓ) (when shipping)		6.0
	Turbocharger and cooling type		Turbocharger, air-cooled
Manual Transaxle	Operating type		Floor change type
	Gear ratio	1st	3.385
		2nd	1.708
		3rd	1.033
		4th	0.786
		5th	0.730
		6th	0.595
		Reverse	3.747

Modification basis	
Application basis	
Affected VIN	

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Descriptions			Diesel 2.0 Engine (D20DTF(Low CO2))
Transfer Case	Model		AWD
	Type		On demand type
Clutch	Operating type		Hydraulic type
	Disc type		Dry single diaphragm type
Power Steering	Type		Rack and pinion (EPS, HPS)
	Steering angle	Inner	38.62°
		Outer	31.07°
Rear Axle	Drive shaft type	Rigid axle	2WD: Semi-floating type
		Independent suspension	4WD: Ball joint type
	Axle housing type		Build-up type
Brake	Master cylinder type		Tandem type
	Booster type		Vacuum assisted booster type
	Brake type	Front wheel	Disc
		Rear wheel	Disc
	Parking brake		Mechanical type
Suspension	Front suspension		Macpherson + Coil spring
	Rear suspension		Multi link + Coil spring
Air Conditioner	Refrigerant (capacity)		R-134a (430 ± 30g)
Electrical	Battery type / Capacity (V-AH)		MF / 12 - 90
	Starter capacity (V-KW)		12 - 2.3
	Alternator capacity (V-A)		12V - 140A (EPS), 120A (HPS)

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3. RECOMMENDED FLUIDS AND LUBRICANTS

Descriptions		Capacity	Specifications
Engine Oil		≒ 6.0 ℓ	Quality class: Ssangyong genuine engine oil (Total Quartz INEO ECS 5W 30, SK ZIC SY 5W 30 or oil Approved by MB 229.51 SAE 5W30)
Engine Coolant		≒ 8.5 ℓ	Ssangyong genuine coolant Anti-Freeze: SYC-1025 Anti-Freeze:Water = 50:50 ORGANIC ACID TYPE, COLOR:BLUE
Manual Transaxle Fluid		≒ 1.65 ℓ	Ssangyong genuine oil (HD MTF 75W/85 (SHELL) or HK MTF 75W/85 (SK))
Transfer Case (PTU) Fluid	AWD	≒ 0.58 ℓ	Ssangyong genuine oil (IDEMITSU LW 80W/90)
Rear Axle Oil	AWD	≒ 0.7 ℓ	Ssangyong genuine oil (SAE 80W/90, API GL-5)
Brake / Clutch Fluid		As required	Ssangyong genuine oil (DOT4)
Power Steering Fluid		≒ 1.0 ℓ	Ssangyong genuine oil (S-PSF-3) * TOTAL FLUIDE DA (Extreme cold condition only)

CAUTION

- Use only Ssangyong genuine fluids. Use of non-recommended products could cause damage to the unit
- Keep the specified capacity and service interval.

Modification basis	
Application basis	
Affected VIN	

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4. SCHEDULED MAINTENANCE SERVICES

* Use only approved Ssangyong genuine parts.

Maintenance service and record retention are the owner's responsibility. You should retain evidence that proper maintenance has been performed on your vehicle in accordance with the scheduled maintenance service chart.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first							
x1000 km	20	40	60	80	100	120	140	160
x1000 miles	12.5	25	37.5	50	62.5	75	87.5	100
Months	12	24	36	48	60	72	84	96

ENGINE CONTROL SYSTEM

Drive belt	I	I	I	I	I	I	I	I
* Engine oil & filter *1 (1)* (3)* (4)*	R	R	R	R	R	R	R	R
	Shorten the service interval under severe conditions							
Cooling system hose & connections	I	I	I	I	I	I	I	I
Engine coolant (3)* (4)	Change every 200000 km or 5 years. And, inspect and replenish if necessary.							
Fuel filter (1)*		R		R		R		R
	Drain the water from fuel filter when the warning light comes on							
Fuel line & connections	I	I	I	I	I	I	I	I
Air cleaner (2)*	R	R	R	R	R	R	R	R
	Shorten the service interval under severe conditions							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

*1 Check the engine oil level and leak every 3000 km (2000 miles) or before starting a long trip.

R- Replace or change.

(1)* If vehicle is operated under severe condition:
Shorten the service interval.
- Frequent stop-and-go traffic, extended idling, short driving distance below 6 km, driving distance below 16 km when the outside temperature remains below freezing
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- High load driving such as trailer towing
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

(2)* If vehicle is operated under severe condition, driving in dusty condition or sandy condition, pollutant area or off-road driving, frequently inspect the air cleaner, if necessary, change the air cleaner.

(3)* More frequent maintenance is required if under dusty driving condition.

(4)* Refer to "Recommended fluids, coolant and lubricants".

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* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first								
	x1000 km	20	40	60	80	100	120	140	160
	x1000 miles	12.5	25	37.5	50	62.5	75	87.5	100
	Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY									
Exhaust pipes & mountings		I	I	I	I	I	I	I	I
Brake / Clutch fluid (3)*		Change every 2 years (inspect frequently)							
Parking brake / Brake pads (Front & Rear) (4)*		I	I	I	I	I	I	I	I
Brake line & connections (including booster)		I	I	I	I	I	I	I	I
Manual transaxle oil (5)*				I			I		
Clutch & brake pedal free play		I	I	I	I	I	I	I	I
Power transfer unit oil (6)*		I	I	I	I	I	I	I	I
		Severe driving condition: Change every 60000 km							
Rear axle oil		Inspect every 20000 km, change every 100000 km (Frequnt check of oil leak)							
Automatic transaxle fluid (6)*		I	I	I	I	I	I	I	I
		Change every 60000 km under severe condition							
Chassis & underbody bolts & nuts tight / Secure (6)*		Check frequently and adjust or replace if necessary							
Tire condition & inflation pressure		Check frequently and adjust or replace if necessary							
Wheel alignment (7)*		Inspect when abnormal condition is noted							
Steering wheel & linkage		I	I	I	I	I	I	I	I

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R- Replace or change.

(3)* Refer to “Recommended fluids and lubricants”.

(4)* More frequent maintenance is required if the vehicle is operated under any of the following conditions:

- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(5)* Inspect and replenish every 60000 km (or 3 years)
Normal driving condition: Fill for Life
(Severe driving condition: Change every 120000 km)

(6)* If vehicle is operated under severe condition: Shorten the service interval.

- Towing a trailer or off-road driving (Inspect the leak of fluid at any time, occasionlly)
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)
- Frequent stop-and-go traffic, extended idling, short driving distance
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- Driving frequently at high speed over 170 km/hour
- Driving frequently in area where heavy traffic under the ambient temperature above 32°C

(7)* If necessary, rotate and balance wheels.

Modification basis	
Application basis	
Affected VIN	

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* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first							
x1000 km	20	40	60	80	100	120	140	160
x1000 miles	12.5	25	37.5	50	62.5	75	87.5	100
Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY								
Power steering fluid & lines (3)*	I	I	I	I	I	I	I	I
Drive shaft boots (8)*	I	I	I	I	I	I	I	I
Seat belts, buckles & anchors	I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch	Check frequently and adjust or replace if necessary							
Wheel bearing grease	I	I	I	I	I	I	I	I
Propeller shaft grease - Front / Rear (9)*	I	I	I	I	I	I	I	I
Air conditioner filter (10)*	R	R	R	R	R	R	R	R
	Shorten the service interval under severe conditions							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R- Replace or change.

(3)*Refer to “Recommended fluids and lubricants”.

(8)*After completion of off-road operation, the drive shaft boots should be inspected.

(9)*Inspect propeller shaft grease every 5000 km or 3 months if the vehicle is mainly driven under severe condition.

- In off-road or dusty road, or
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain.

(10)*Severe Conditions in Air Conditioner Filter

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

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Memo

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ENGINE

0000-00

GENERAL INFORMATION

1. SPECIFICATIONS

System	Unit	Description	Specification
Intake system	Air cleaner element	Filtering type	Dry, filter element
		Filtering area	0.208m²
		Service interval	EU: Change every 20,000 km (But, shorten the service interval under severe conditions) GEN: Clean every 7,500 km, change every 15,000 km (But, shorten the service interval under severe conditions)
	Air cleaner assembly	Weight	1.5kg
		Operating temperature	−30 ~ 100℃
		Capacity	8L
	Intercooler	Core material	Aluminum
		Size	510X122X67(WxHxT)
		Tank material	Plastic (Molding)
		Efficiency	80%
Exhaust system	Turbocharger assembly	Max. temperature of turbine housing	780 ℃
		Diameter of turbine housing	ø40.0
		Diameter of compressor housing	ø46.8
		Cooling type	Air cooled type

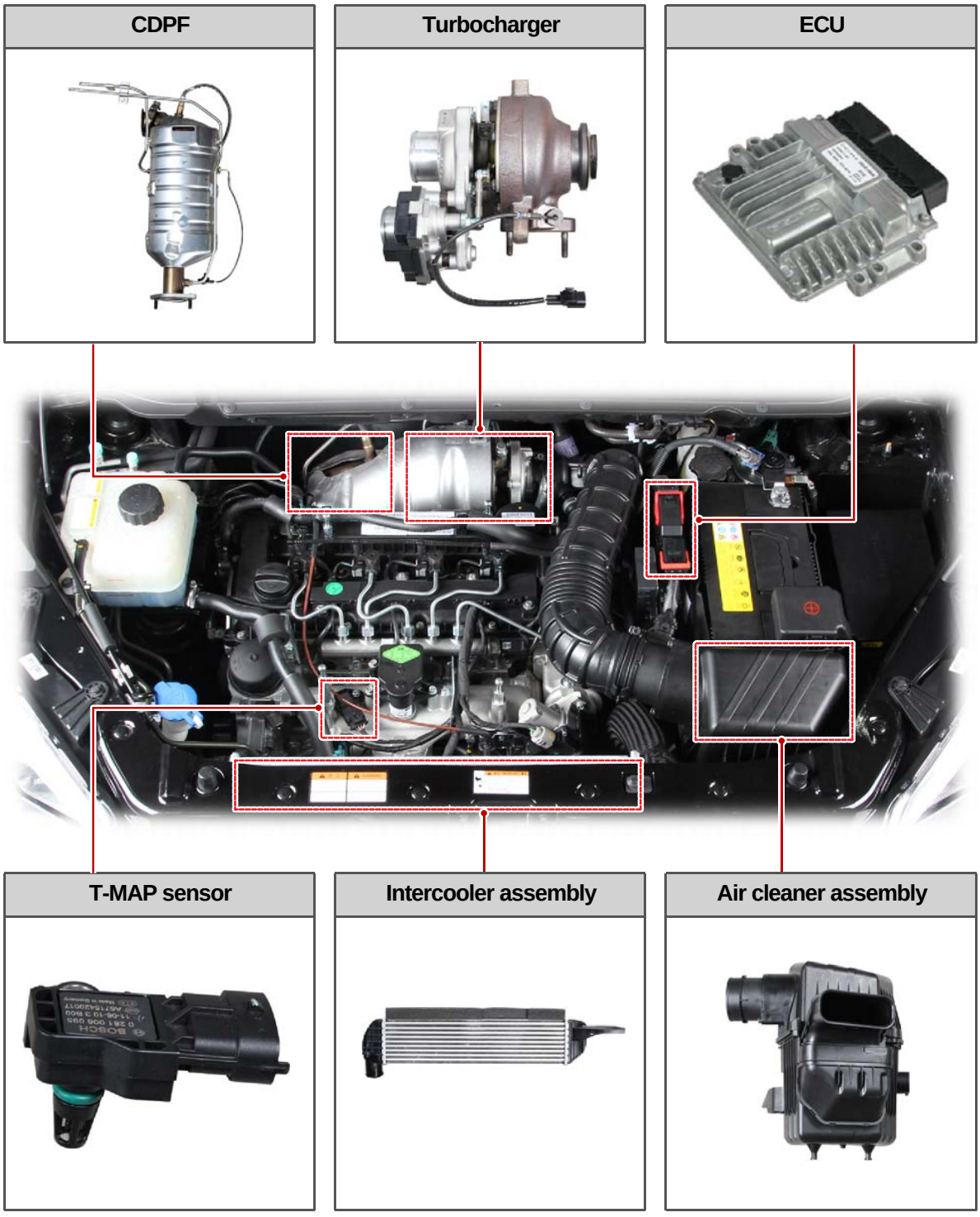
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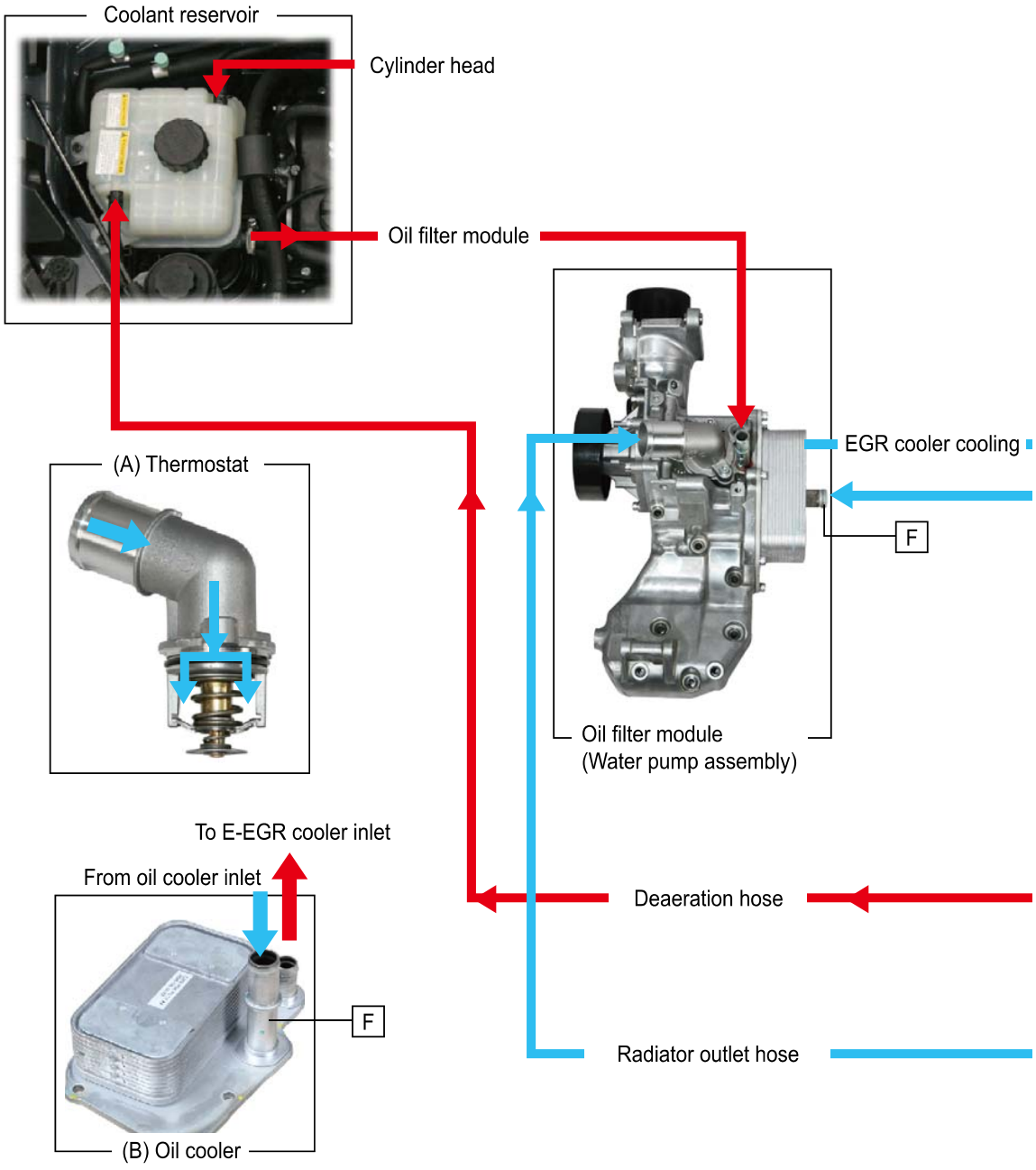
OVERVIEW AND OPERATING PROCESS

1. MAJOR COMPONENTS (D20DTF(Low CO2))



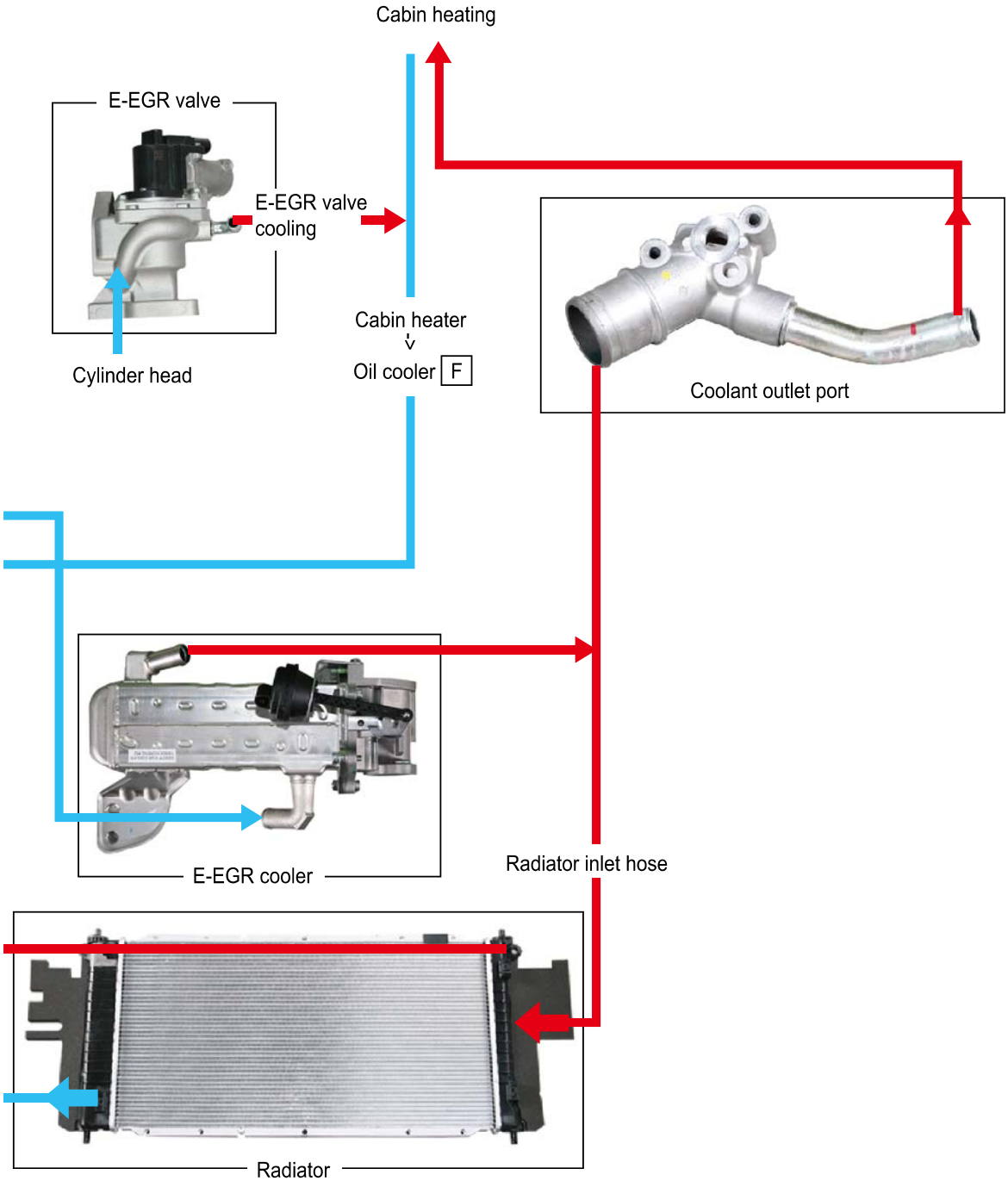
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2. COOLANT FLOWS IN COOLING SYSTEM



Modification basis	
Application basis	
Affected VIN	

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3. LAYOUT OF INTAKE SYSTEM

1) Overview

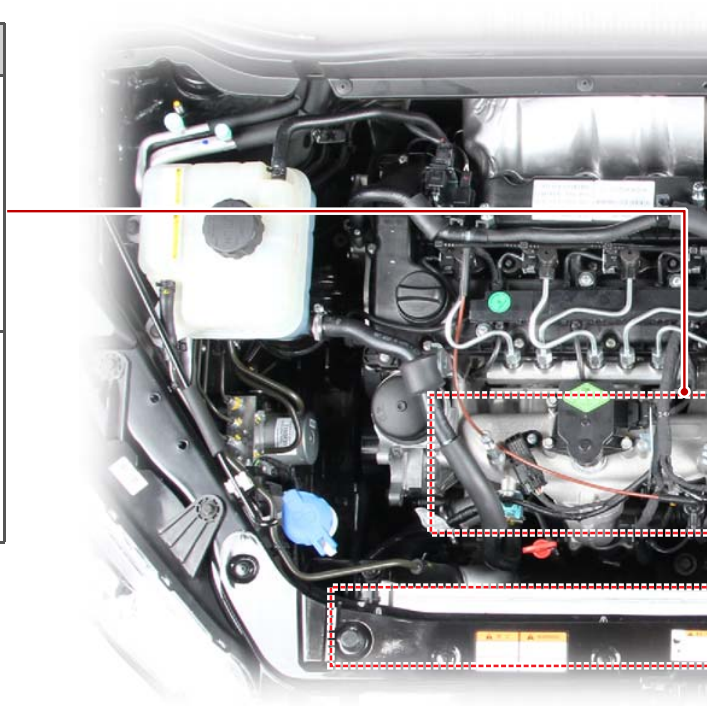
The intake system for D20DTF(Low CO2) engine is equipped with a throttle body which includes a flap. This flap is controlled by an electrical signal to cut off the intake air entering to the engine when the ignition switch is turned off. The intake manifold contains the swirl control valve and dual port system to make the optimum turbulence. The T-MAP sensor is located on the left top of the intake manifold and the HFM sensor for precise control is located at the rear side of air cleaner. To reduce the intake noise and to improve the intake efficiency, the volume of air cleaner has been increased.

2) Components

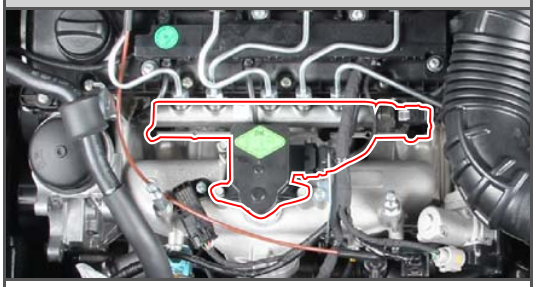
Intake manifold



It is the passage for intake air when the swirl vale is operating. The T-MAP sensor for measuring the pressure and temperature of pressurized air in turbocharger is installed on the left top of intake manifold.



Swirl control valve



It operates variably in accordance with the engine load and rpm.
Refer to Chapter “Engine Control”.

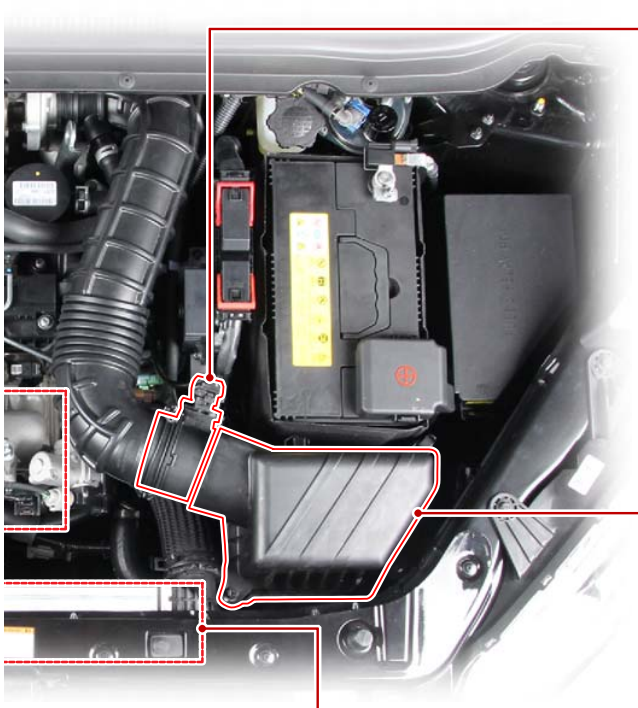
Electric throttle body



Refer to Chapter “Engine Control”.

Modification basis	
Application basis	
Affected VIN	

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HFM (Hot Film Air-Mass Sensor)



HFM sensor, version 6
Refer to Chapter "Engine Control".

Air cleaner assembly



Its volume is increased and air flowing efficiency is improved.

Intercooler assembly



Its volume is increased and cooling efficiency is improved.

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EEM (Energy Efficiency Management) 0000-00

GENERAL INFORMATION

1. SPECIFICATIONS

Unit	Description	Specification
Alternator	Rated output	140A (25℃, 6500rpm) 76A/1800rpm, 140A/6500rpm, 25℃, 13.5V
Battery	Capacity	90Ah(20hr)
	Reserve capacity	180 minutes
	Starting current (when engine cooed)	710A
	Weight	23kg
EBS (Electronic Battery Sensor)	Resolving power	1mA
	Operating voltage	7~18V
	Operating temperature	-40~105℃
	Communication	LIN 2.0

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2. COMPARISON

<table>
<tr><th rowspan="2">Item</th><th colspan="2">Description</th></tr>
<tr><th>D20DTF</th><th>D20DTF (Low CO2)</th></tr>
<tr><td>Applied engine</td><td colspan="2">D20DTF</td></tr>
<tr><td>Battery capacity</td><td colspan="2">12V 90Ah</td></tr>
<tr><td>Alternator capacity</td><td>Delphi 120A</td><td>Delphi 140A</td></tr>
<tr><td rowspan="4">Alternator</td><td colspan="2">Changed the diameter of belt pulley (Front view))</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Changed the regulator and control logic (Rear view)</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>EBS</td><td>None</td><td>Monitoring the battery conditions (voltage, current, temperature and SOC)</td></tr>
</table>

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3. BASIC INSPECTION

1) Battery Terminal



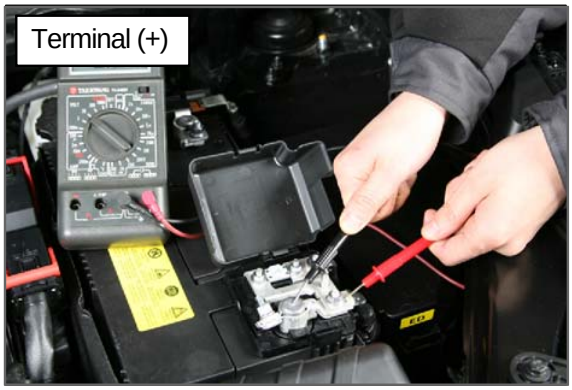
- Make sure the terminal connections are securely tightened. If the terminals are corroded, clean them or replace the battery.

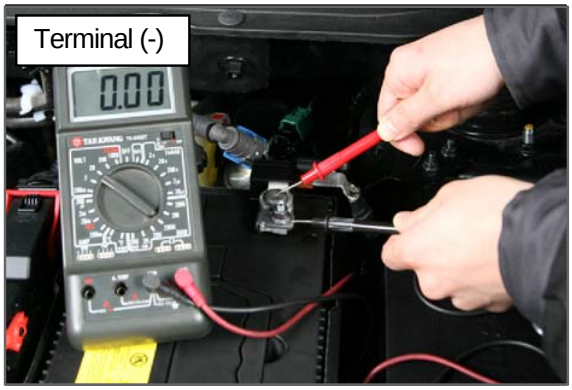
NOTE

* Cleaning
Remove the corrosion or dirt with a wire brush or sand paper, and then wash out with lukewarm soapy water.

2) Measuring the Voltage Drop

▶ **Measuring at battery terminal**





- Measure the voltage between battery terminal (+. -) and wiring clamp.

Specified value	below 0.3V

NOTE

If the terminals are corroded, clean and retightening them. If the specified tightening torque cannot be kept, replace the clamp.

Tightening torque **Terminal (+): 4 ~ 5 Nm**
Terminal (−): 6 ± 1Nm

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▶ Measuring at (-) wiring



- Measure the voltage between battery wiring and body ground.

Specified value	below 0.3V

NOTE

If the voltage is out of the specified value, check the wiring mounting bolt for corrosion and looseness. If there is a poor contact due to corrosion or paint, wipe out the contact area and retighten it.

Tightening torque **Wiring mounting bolt to body ground (-): 17 Nm**

▶ Measuring the battery voltage

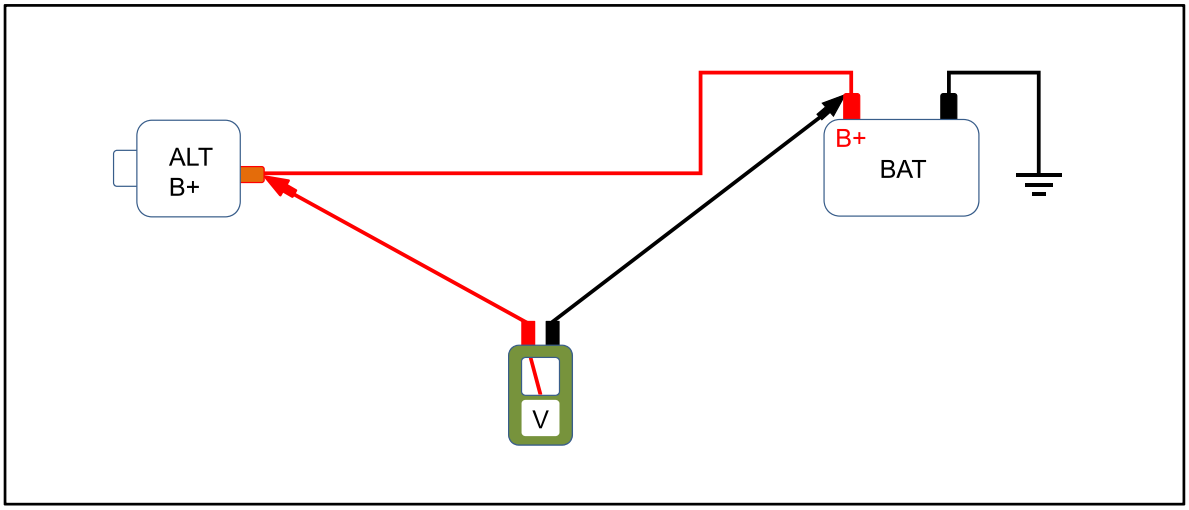


- Stop the engine and wait for 20 minutes. Measure the voltage between terminal (+) and terminal (-) with the ignition switch OFF and all electric devices OFF.

Specified value	over 12V

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▶ Measuring the voltage drop between lines



- Measure the voltage drop between alternator B+ and battery B+.

Specified value	below 0.3V

NOTE

If the value is out of the specified value, check the terminal and clamp for looseness.

▶ Checking the charge warning lamp

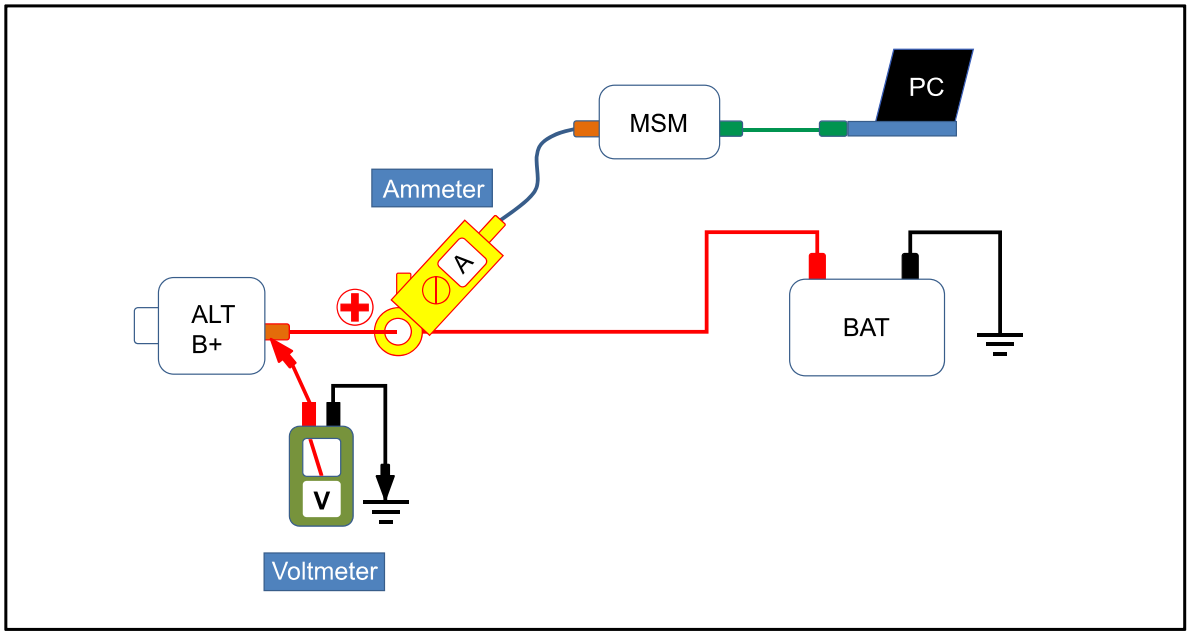
1. Turn off all electric devices and put the ignition switch "ON" (Pre-warning).
2. Check if the charge warning lamp goes out.
   - If the charge warning lamp does not go off, inspect the electric circuit.
3. Start the engine and check if the charge warning lamp keeps off.

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4. INSPECTION - CHARGING CURRENT

Preceding work - Perform the basic inspection.

▶ **Setting up the testers**



▶ **Preparation**



1. Set up the ammeter and voltmeter as shown in the figure.

CAUTION

Make sure to set up the tester while keeping its polarity.

Modification basis	
Application basis	
Affected VIN	

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▶ Inspection

1. Start the engine and turns on the headlamp, blower and heated wire at their full load. Then, measure the maximum output current (MSM measurement value) when racing the engine to 2,700 rpm.

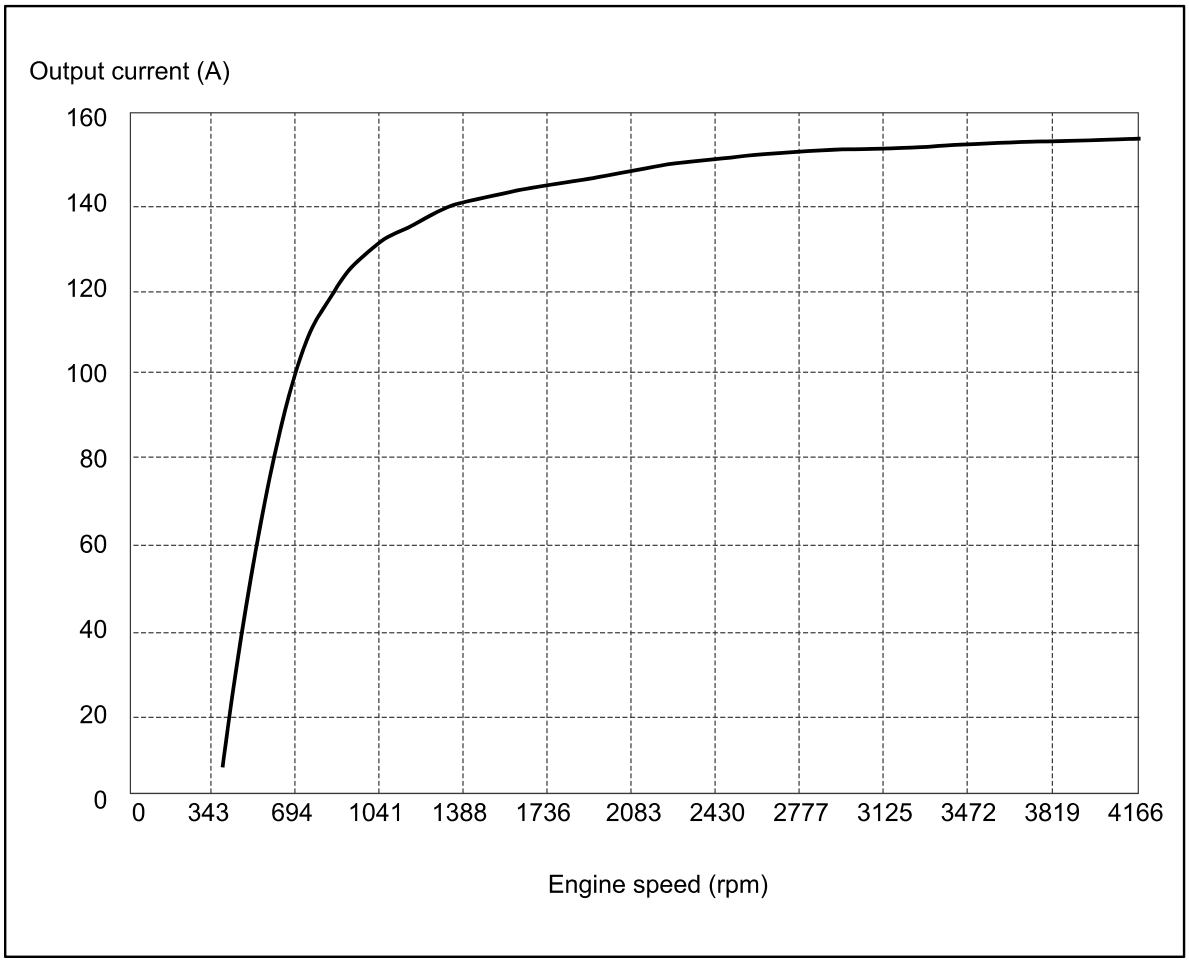
Specified value	60% of rated current (limit)

NOTE

The output current may not reach the limit value due to various parameters (high temperature or electric load etc.). Thus, do not perform the inspection with fully charged battery.

2. Turn the ignition OFF after inspection.
3. Disconnect the negative cable from the battery and remove the testers (ammeter and voltmeter).

▶ Characteristic curve (output from alternator)

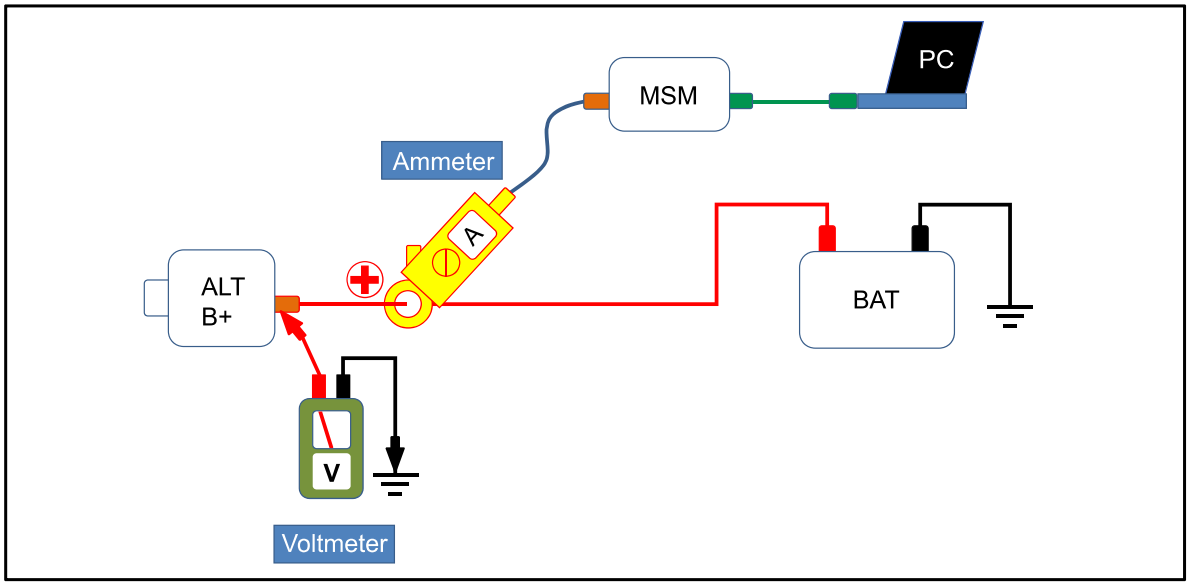


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5. INSPECTION - REGULATING VOLTAGE

Preceding work - Perform the basic inspection.

▶ **Setting up the testers**



▶ **Preparation**



1. Set up the ammeter and voltmeter as shown in the figure.

CAUTION

Make sure to set up the tester while keeping its polarity.

▶ **Inspection**

1. Turn the ignition ON and measure the voltage on the voltmeter.

Specified value	over 12V

2. Start the engine and turn all electric devices OFF.
3. Increase the engine speed to 2,700 rpm and maintain the speed. Measure the voltage when the output current from alternator decrease below 30A.

Specified value	11.5 ~ 15.5V

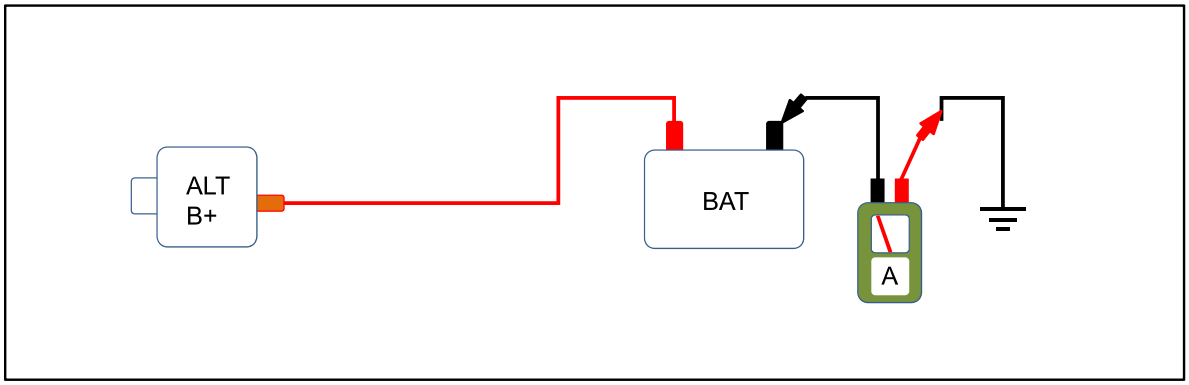
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6. INSPECTION - DARK CURRENT

Preceding work - Perform the basic inspection.

1) When Using Multi-tester

▶ Setting up the tester



▶ Preparation

1. Disconnect the negative cable from the battery.
2. Set up the ammeter as shown in the figure above.

CAUTION

Connect the "+" probe to ground wiring and "−"probe to "−"terminal of battery.

▶ Inspection

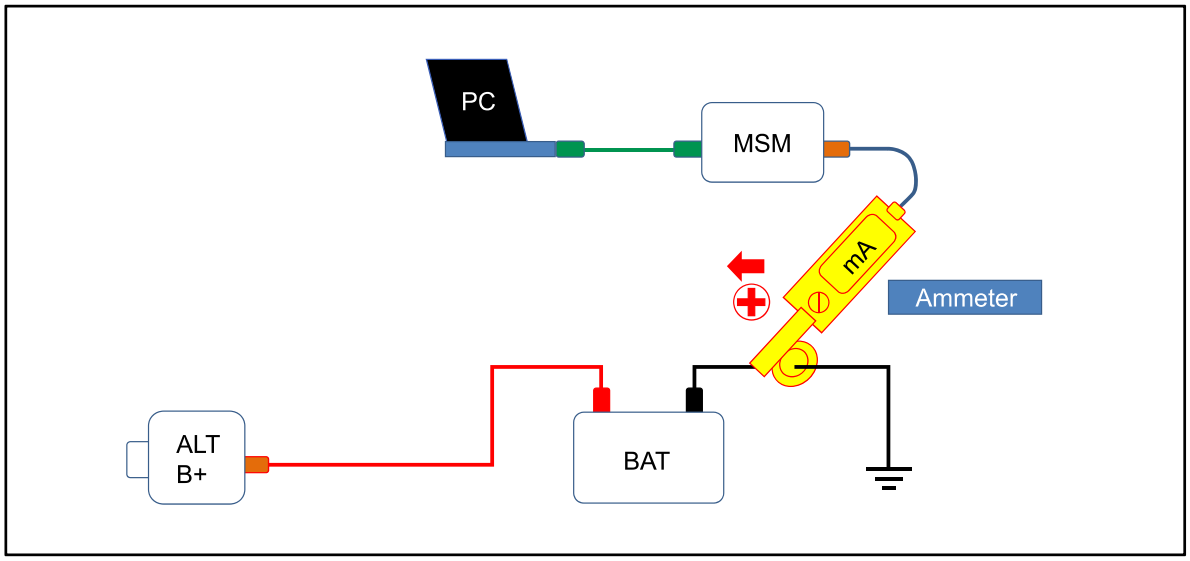
1. Measure the current while removing the fuses one by one. If the current drops sharply when a certain fuse is removed, inspect the affected circuit.

Specified value	below 0.05A

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2) When Using MSM

▶ Setting up the tester



▶ Preparation



1. Disconnect the negative cable from the battery.
2. Set up the ammeter and MSM as shown in the figure above.

CAUTION

Make sure to set up the tester while keeping its polarity.

3. Connect the negative cable to the battery.

Specified value	below 0.05A

NOTE

Measure the current while removing the fuses one by one. If the current drops sharply when a certain fuse is removed, inspect the affected circuit.

Modification basis	
Application basis	
Affected VIN	

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7. INSPECTION - BATTERY

Preceding work - Perform the basic inspection (all electric devices OFF).



Battery tester

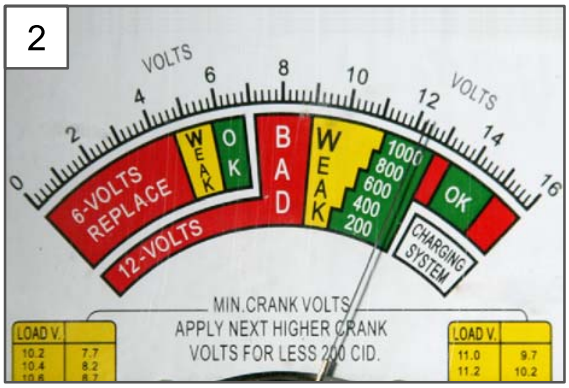
1) Voltage Check (without load)

1



1. Connect one measuring clamp to "+" terminal of battery first, then connect the other one to "−"terminal. (Disconnect the clamps in the reverse order).

2



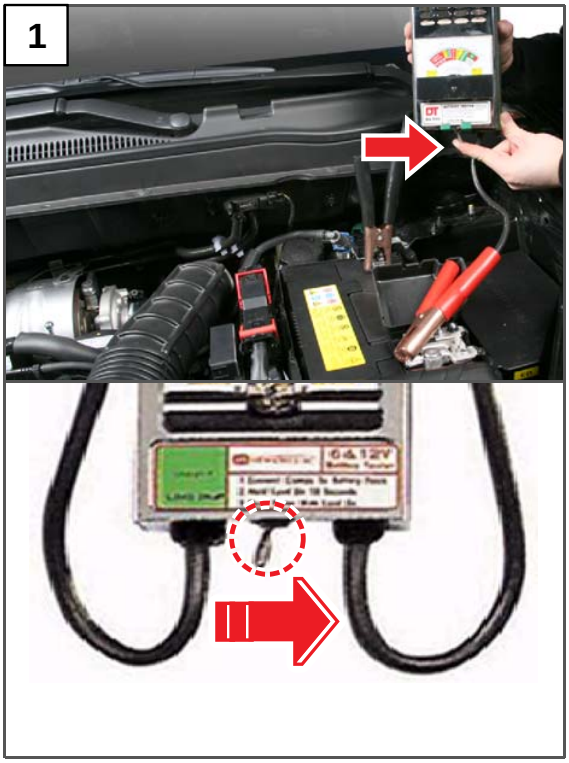
2. Read the measurement.

Specified value	over 11V: Normal 9 ~ 11V: Charging required below: 9V: Over discharged, battery replacement required

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2) Voltage Check (with load)

1

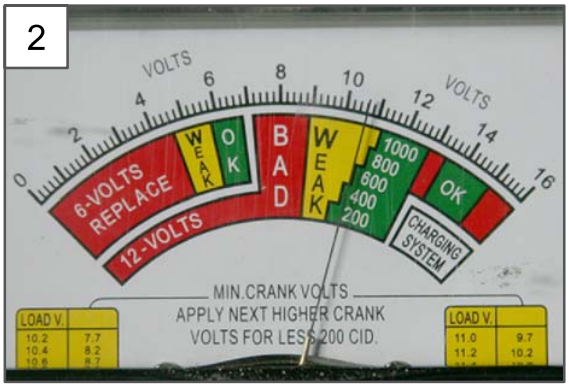


1. Push the load switch to ON (to arrow direction) direction for less than 5 seconds.

NOTE

To identify the battery capacity with the voltage drop (V) value, discharge the fixed load capacity (120A) for a certain period (5 seconds).

2



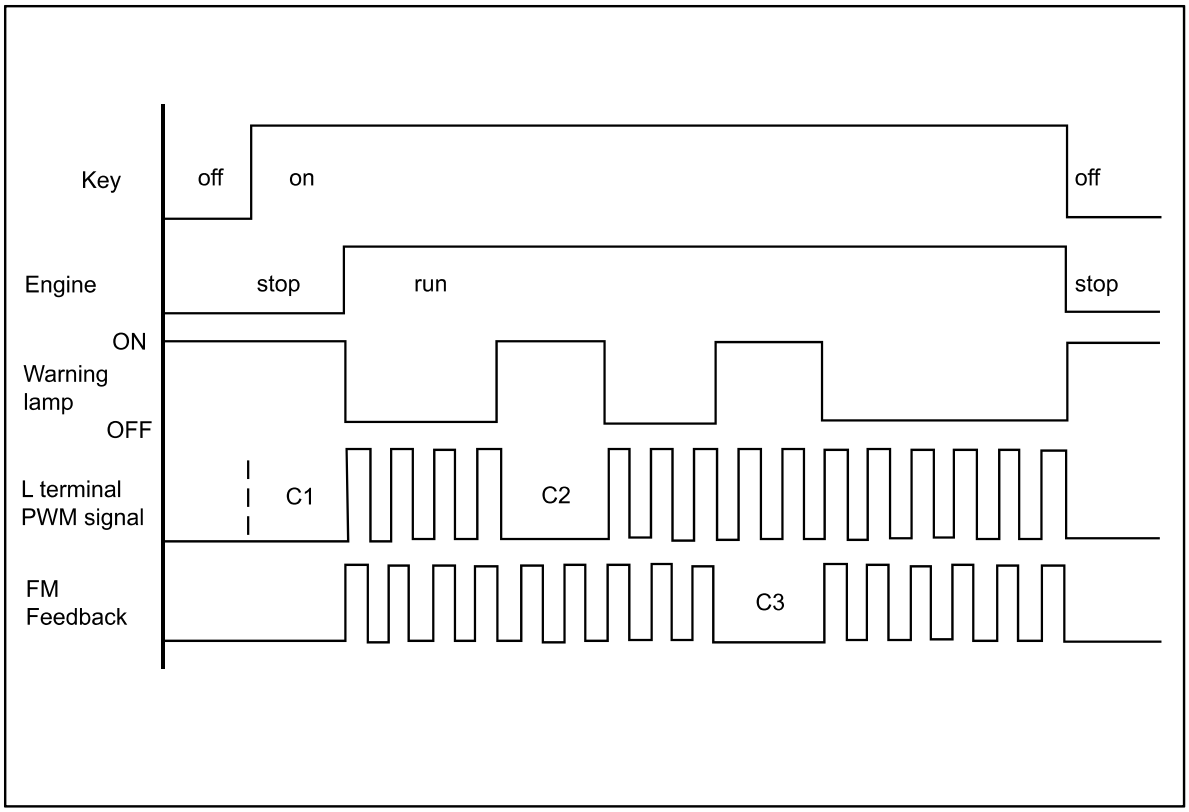
2. Read the measurement.

Specified value	7 ~ 9V (Red): Over discharged or faulty 9 ~ 11V (Yellow): Charging required 11 ~ 13V: Normal

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8. DTC SETTING CONDITIONS

▶ **Charge warning lamp ON condition**

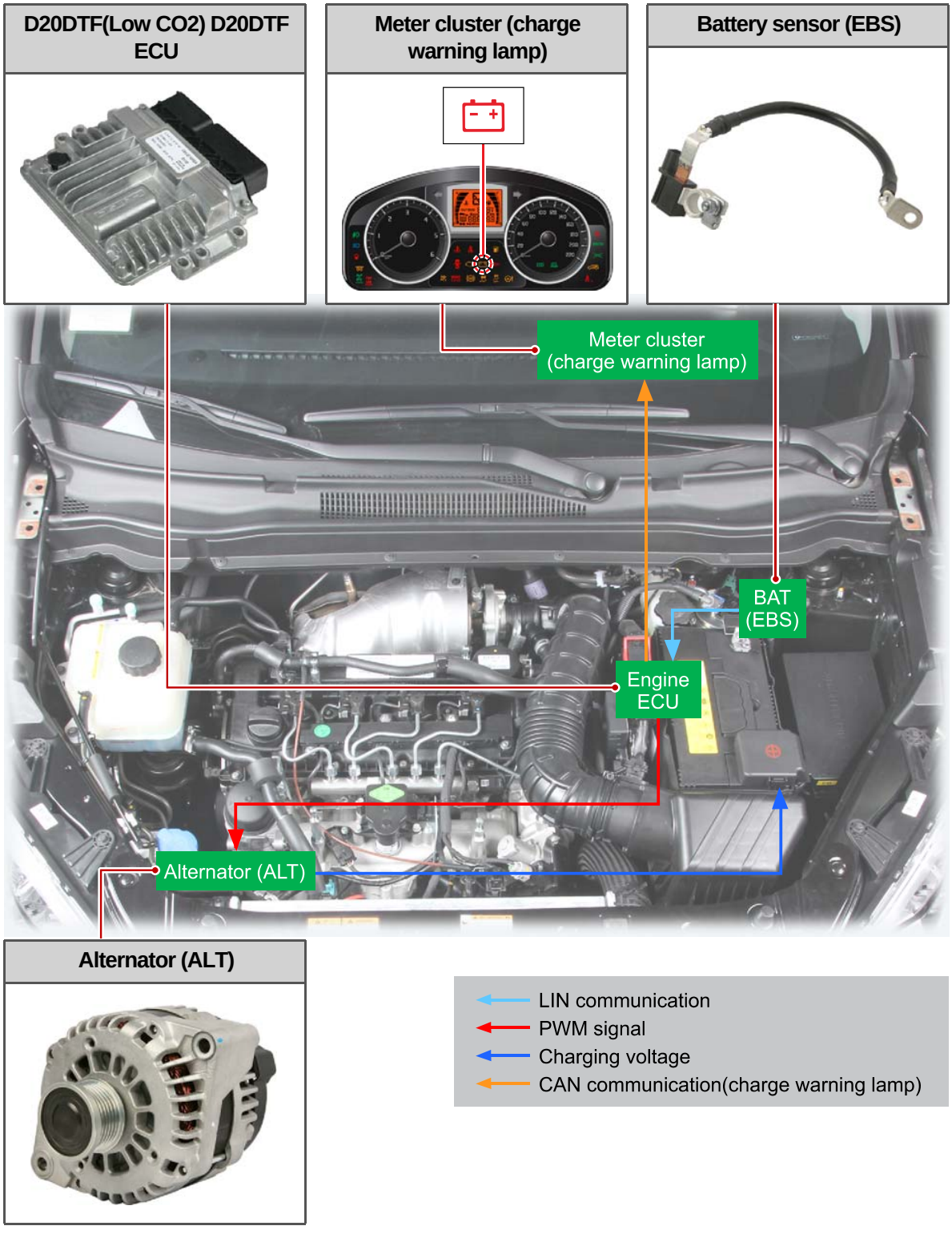


1. Turn the ignition ON (Engine stopped)
2. Open or short circuit of L terminal wiring, open or short internal circuit of alternator (fixed control of 13.8V)
3. Open or short circuit of F terminal wiring, no feedback output signal

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OVERVIEW AND OPERATING PROCESS

1. LAYOUT

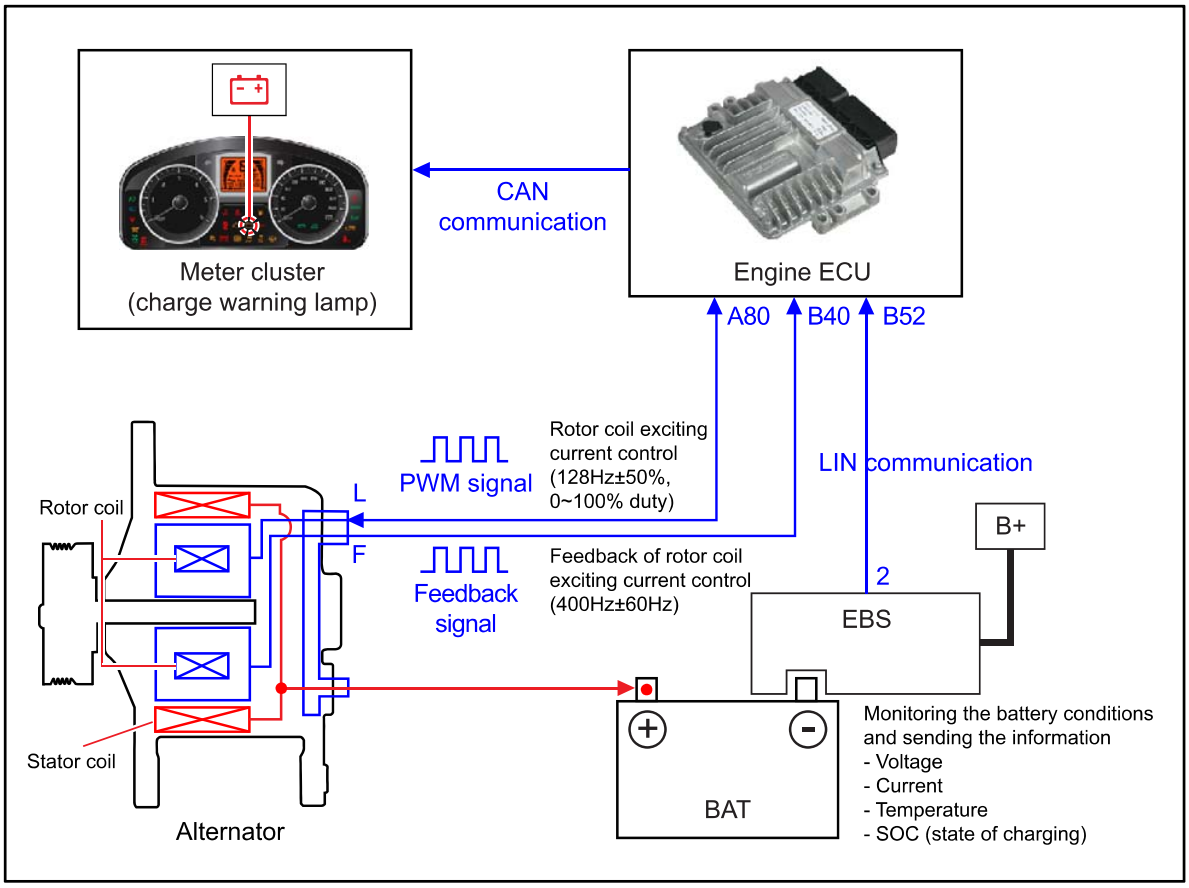


Modification basis	
Application basis	
Affected VIN	

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2. OPERATING PROCESS

▶ System diagram



▶ Operation

- EEM monitors the electric loads and battery conditions and controls the voltage to improve the fuel economy and battery charging efficiency.
- EBS on "−" terminal of battery sends the battery information (voltage, current, temperature and SOC) to engine ECU with LIN communication.
- Engine ECU outputs the information from EBS and regulating control signal (PWM) according to the engine load conditions to "L" terminal on alternator.
- Engine ECU controls the magnetic resistance between stator coil and rotor coil by controlling the current in rotor coil according to PWM duty value.
- The alternating voltage induced to stator coil is converted to direct voltage by rectifier. And, EBS outputs the charging voltage to "B" terminal on alternator.

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▶ Basic control logic according to the driving conditions

Engine ECU determines the engine loads according to the fuel injection volume and engine speed. It charges the battery by increasing the generating voltage during deceleration. To improve the fuel economy by reducing the alternator load during acceleration, engine ECU decreases the generating voltage and consumes the battery voltage.

▶ Operation of charge warning lamp

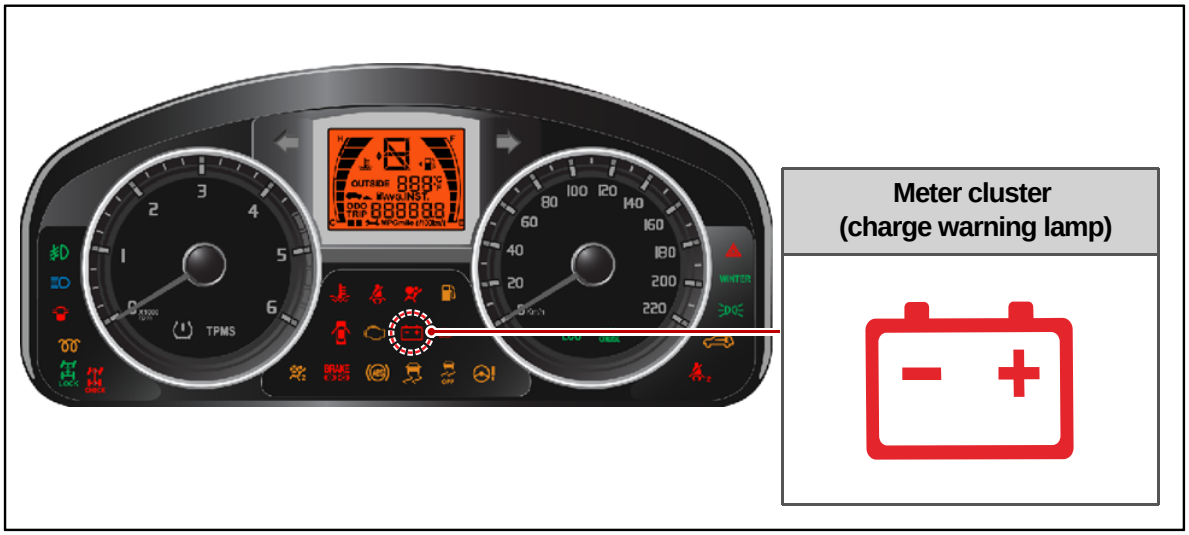
ECU checks the generating voltage from alternator and circuit conditions and sends the warning lamp ON signal to meter cluster through CAN line.

Modification basis	
Application basis	
Affected VIN	

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3. CAN COMMUNICATION (Charge Warning Lamp)

▶ Overview

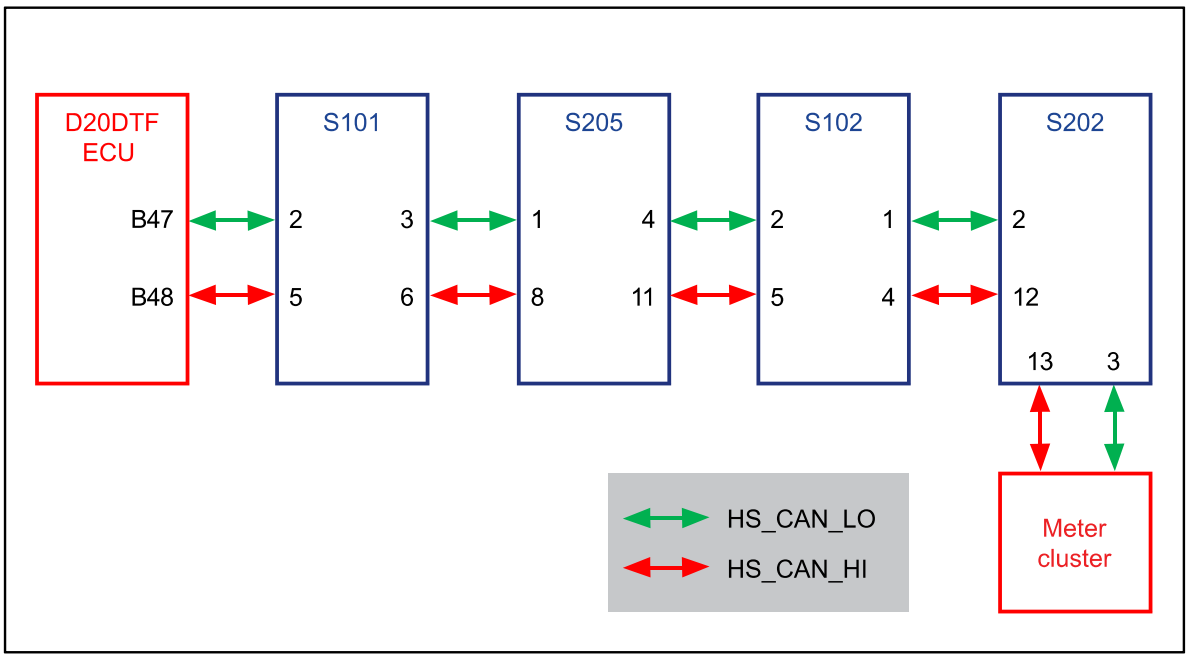


The meter cluster receives the charge warning lamp ON signal from ECU through CAN line.

Charge warning lamp ON conditions

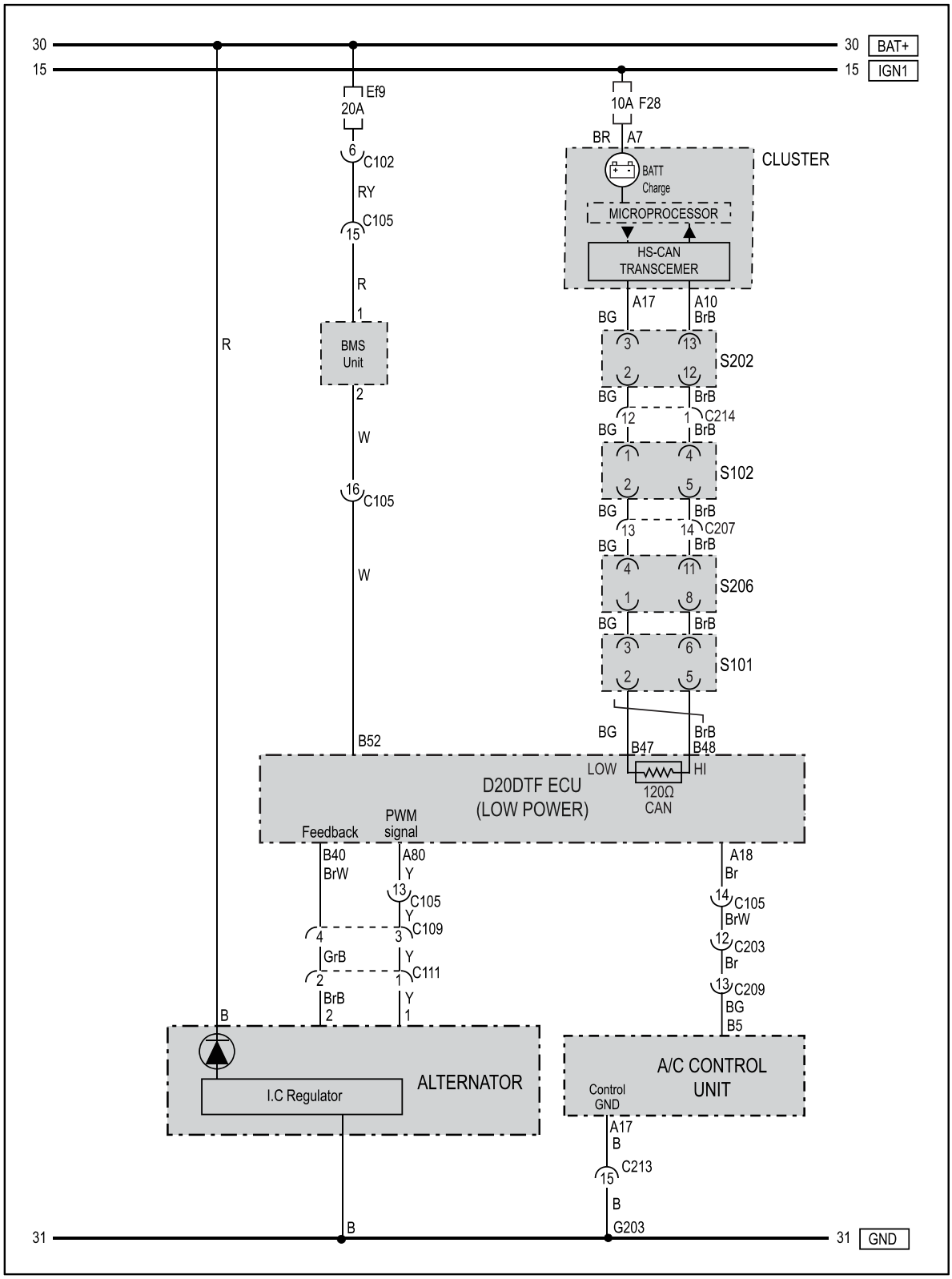
- Pre-warning
- When DTC related EEM set
- Open or short circuit in alternator

▶ Circuit diagram



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4. CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

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GENERAL INFORMATION

0000-00

GENERAL INFORMATION

1. EXTERIOR LAMP SYSTEM LAYOUT

Front view



- Side repeater lamp
- Puddle lamp
- Headlamp (Low beam)
- Turn signal lamp
- Tail lamp, DRL (EU)*
- Front fog light
- Headlamp (High beam)

Rear view

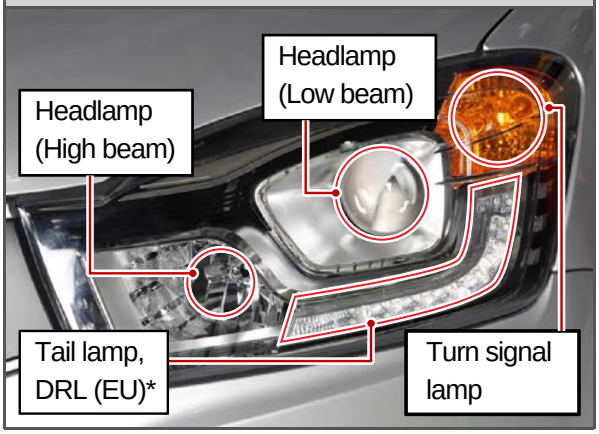


- High-mounted stop lamp
- Stop lamp
- Tail lamp
- Turn signal lamp
- Back-up lamp
- Stop lamp, Rear fog light (EU)
- License plate lamp
- Reflector

Modification basis	
Application basis	
Affected VIN	

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1 Headlamp





2 Front fog light



3 Puddle lamp



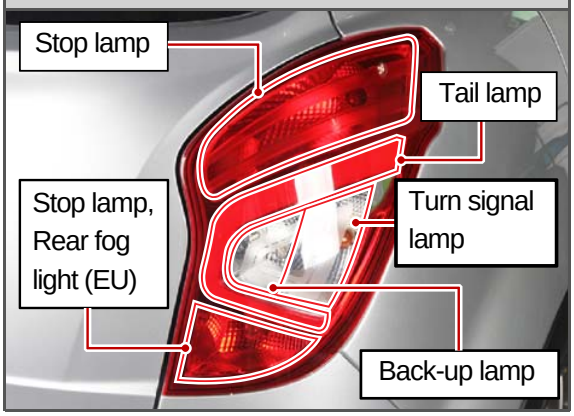
4 Side repeater



Modification basis	
Application basis	
Affected VIN	

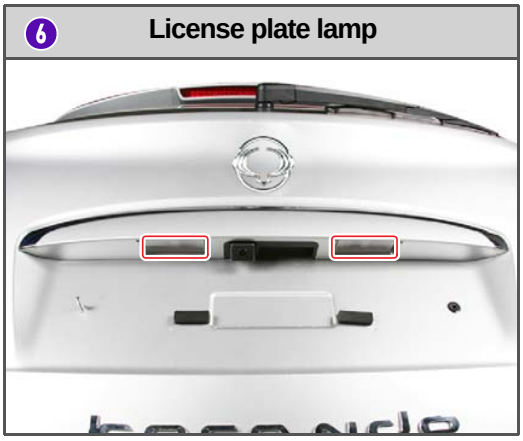
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5 Rear combination lamp

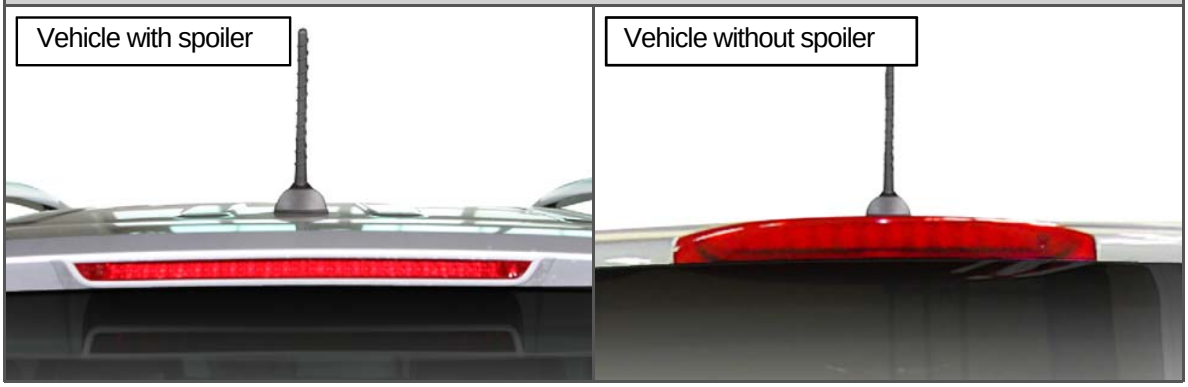




6 License plate lamp



7 High mounted stop lamp

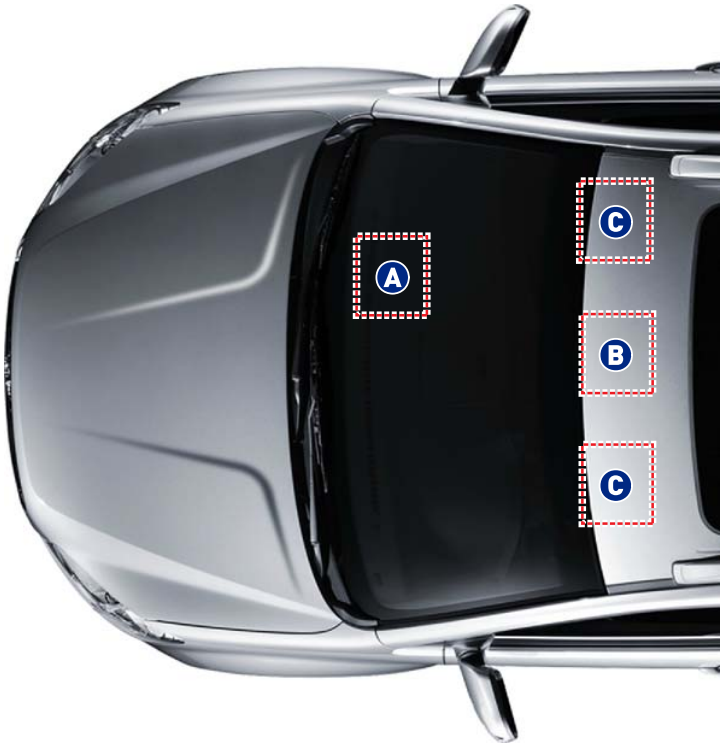


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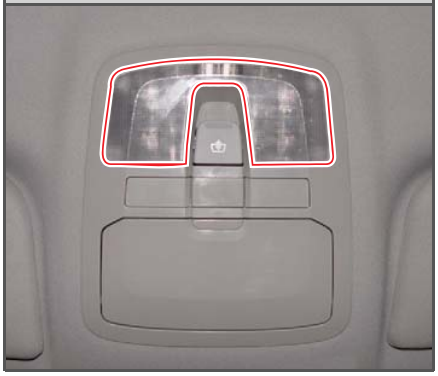
2. INTERIOR LAMP SYSTEM LAYOUT

A Glove box lamp





B Front room lamp



C Sun visor lamp



Modification basis	
Application basis	
Affected VIN	

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D Center room lamp





E Luggage lamp



F Door courtesy lamp



Modification basis	
Application basis	
Affected VIN	

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3. SWITCH SYSTEM LAYOUT

Steering wheel remote control switch

1



Start/stop switch

2



Passenger door switch

3



Cruise control switch

4





Multifunction switch

5



Lower main panel switch

6



FATC switch

7



Hazard warning switch bezel assembly

8



Drive door main switch & Outside rearview mirror switch

9



Modification basis	
Application basis	
Affected VIN	

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Front seat heating and ventilation switch

With heating and ventilation switch	With heating switch
10 	

Overhead console switch

11 



Center room lamp switch

12 

Luggage lamp switch

13 

Tailgate switch

14 

Driver power seat switch

17 

Rear door switch (RH)

16 

Rear door switch (LH)

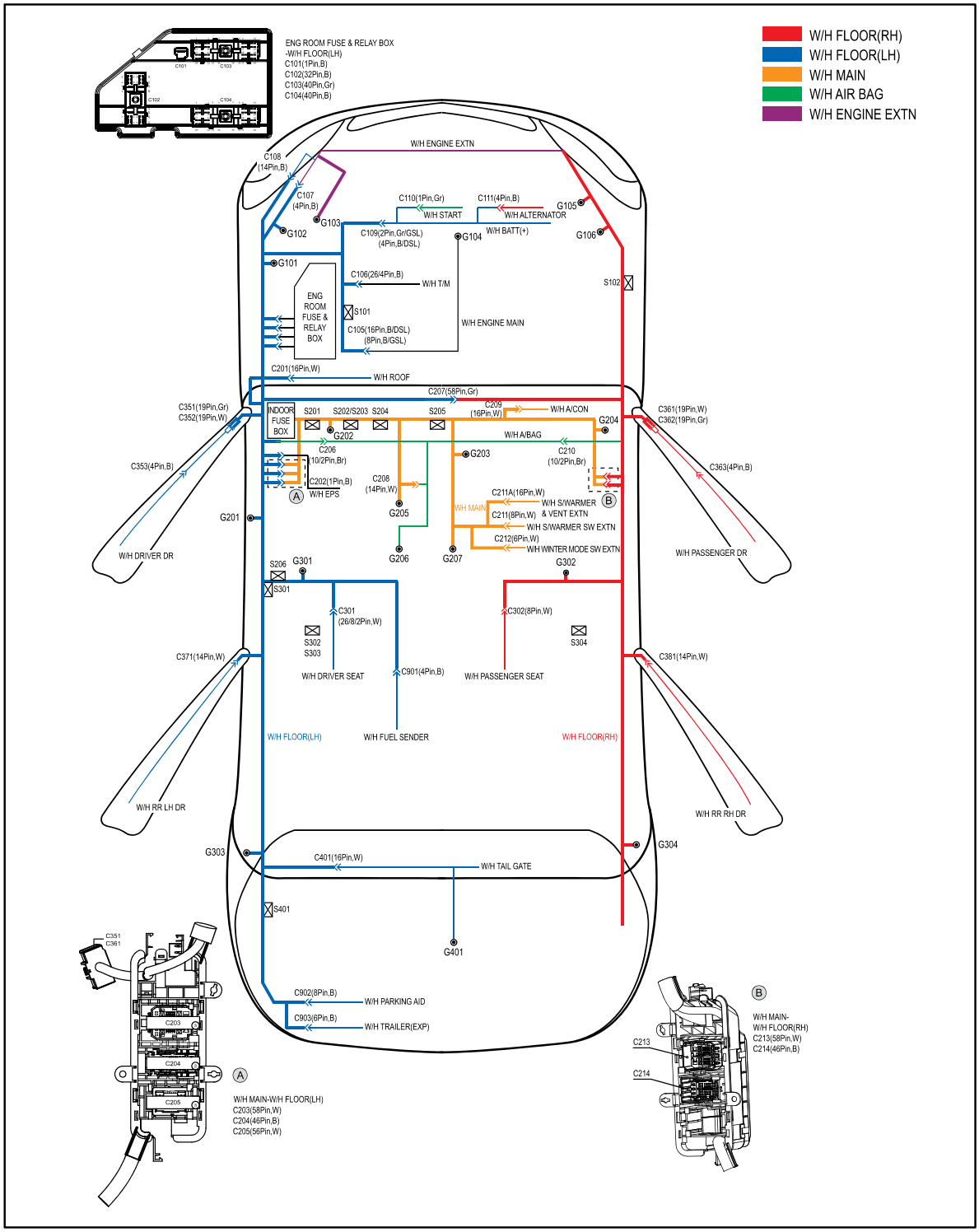
15 

Modification basis	
Application basis	
Affected VIN	

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4. SCHEMATIC DIAGRAM FOR WIRING AND ELECTRICAL DEVICES

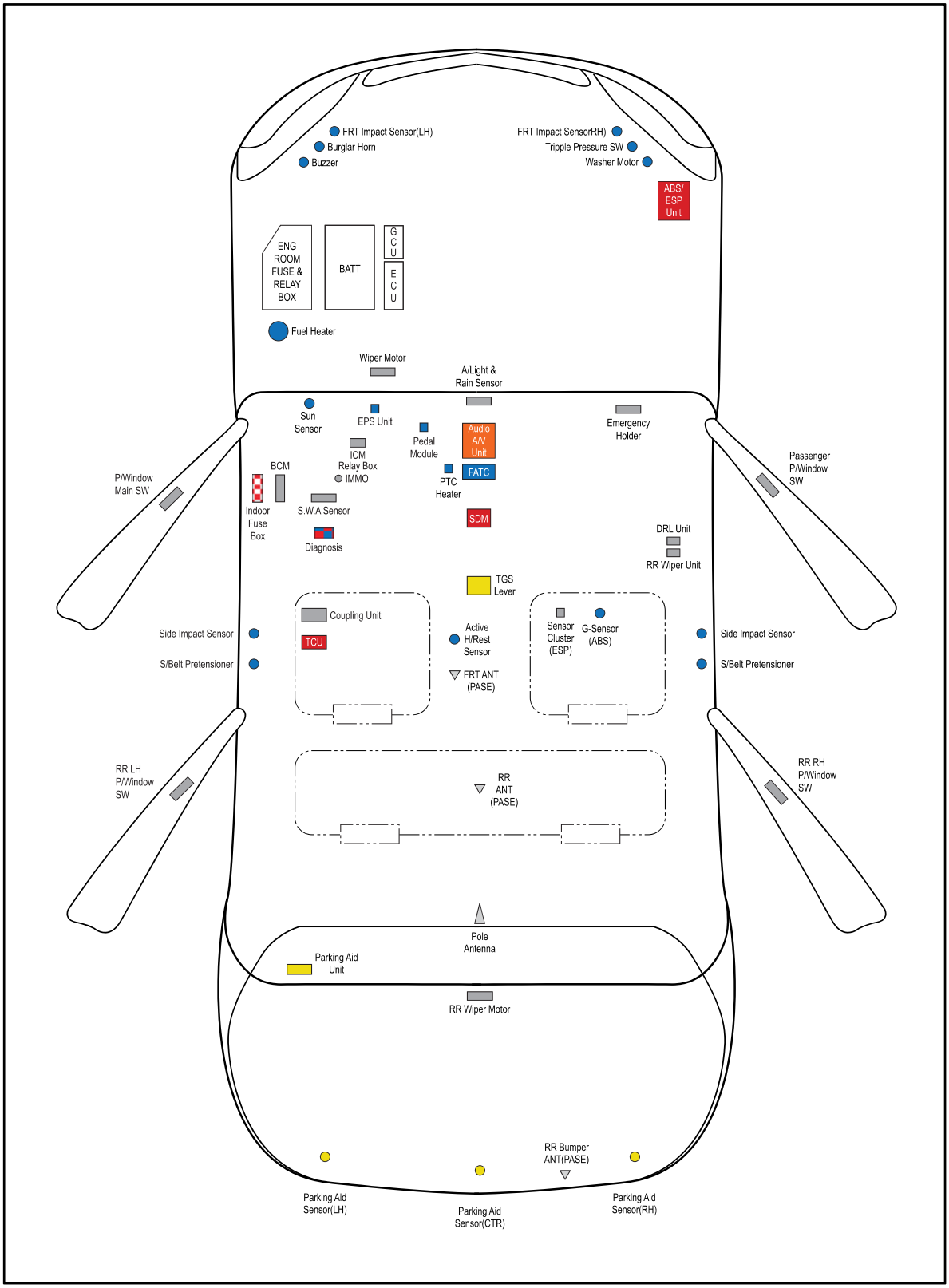
1) Wiring Harness Arrangement



Modification basis	
Application basis	
Affected VIN	

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2) Electrical Devices Mounting Locations



Modification basis	
Application basis	
Affected VIN	

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3) Connector, Ground And Splice Pack

▶ Connector

Connector Number (Pin Number/Color)			Connecting Wiring Harness	Connector Position	Remark
C101	1	Black	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102	32	Black	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103	40	Gray	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104	40	Black	W/H Floor(LH) - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105	8	Black	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	GSL
	16	Black	W/H Floor(LH) - W/H Eng	Upper BATT Tray(Beside Fuel Heater)	DSL
C106	26	Black	W/H Floor(LH) - W/H T/M	Upper T/M(Under BATT Tray)	A/T
	4	Black	W/H Floor(LH) - W/H T/M	Upper T/M(Under BATT Tray)	M/T
C107	4	Black	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C108	14	Black	W/H Floor(LH) - W/H Eng EXTN	Inside FRT Bumper(Behind LH Fog Lamp)	
C109	2	Gray	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	GSL
	4	Black	W/H Floor(LH) - W/H BATT(+)	Lower Air Cleaner Duct	DSL
C110	1	Gray	W/H BATT(+) - Start Solenoid	Beside Starter Motor	
C111	4	Black	W/H BATT(+) - Alternator	Beside Alternator	
	2	Black	W/H BATT(+) - Alternator	Beside Alternator	LOW CO_2
C201	16	White	W/H Floor(LH) - W/H Roof	Upper Driver Cowl Side Connector Holder	
C202	1	Black	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	EPS
C203	58	White	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C204	46	Black	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C205	56	White	W/H Main - W/H Floor(LH)	Driver Cowl Side Connector Holder	
C206	10	Brown	W/H Air Bag - W/H Air Bag EXTN	Driver Cowl Side Connector Holder	Curtain/Side A/Bag
	2	Brown	W/H Air Bag - W/H Air Bag EXTN	Driver Cowl Side Connector Holder	
C207	58	Gray	W/H Floor(LH) - W/H Floor(RH)	Upper CTR Dash PNL	
C208	14	White	W/H Main - W/H Air Bag	Inside I.P (Upper Driver LegRoom)	
C209	16	White	W/H Main - W/H Air Con	Inside I.P (Upper CTR Cowl Cross Member)	
C210	10	Brown	W/H Air Bag - W/H Air Bag EXTN	Passenger Cowl Side Connector Holder	Curtain/Side A/Bag
	2	Brown	W/H Air Bag - W/H Air Bag EXTN	Passenger Cowl Side Connector Holder	
C211	8	White	W/H Main - W/H Seat Warmer switch EXTN	Inside Console	A/T, M/T DLX
C211A	16	White	W/H Main - W/H Seat Warmer/VENT switch EXTN	Inside Console	VENT SW
C212	6	White	W/H Main - W/H Winter Mode switch EXTN	Inside Console	A/T, DSL
C213	58	White	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C214	46	Black	W/H Main - W/H Floor(RH)	Passenger Cowl Side Connector Holder	
C301	26	White	W/H Floor(LH) - W/H Driver Seat	Under Driver Seat	Vent & Power Seat
	8	White	W/H Floor(LH) - W/H Driver Seat	Under Driver Seat	S/Warmer, Active
	2	White	W/H Floor(LH) - W/H Driver Seat	Under Driver Seat	
C302	8	White	W/H Floor(RH) - W/H Passenger Seat	Under Passenger Seat	
C351	19	Gray	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C352	19	White	W/H Floor(LH) - W/H Driver DR	Under LH A Pillar	
C353	4	Black	W/H Driver DR - W/H Smart Key	Inside Driver DR	Smart Key
C361	19	White	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C362	19	Gray	W/H Floor(RH) - W/H Passenger DR	Under RH A Pillar	
C363	4	Black	W/H Passenger DR - W/H Smart Key	Inside Passenger DR	Smart Key
C371	14	White	W/H Floor(LH) - W/H RR LH DR	Under LH B Pillar	
C381	14	White	W/H Floor(RH) - W/H RR RH DR	Under RH B Pillar	
C401	16	White	W/H Floor(LH) - W/H Tail Gate	Upper Tail Gate LH	
C901	4	Black	W/H Floor(LH) - W/H Fuel Sender	FRT Fuel Tank	
C902	8	Black	W/H Floor(LH) - W/H RR Bumper	Under RR LH Bumper	PAS
C903	6	Black	W/H Floor(LH) - W/H Trailer	Under RR LH Bumper	

Modification basis	
Application basis	
Affected VIN	

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▶ Ground

Connector Number	Connecting Wiring Harness	Connector Position	Remark
G101	W/H Floor(LH)	Behind LH Head Lamp	
G102	W/H Floor(LH)	Under BATT Tray	ECU
G103	W/H Eng EXTN	Under BATT Tray	
G104	W/H Eng Main	FRT Intake Valve	
G105	W/H Floor(RH)	Behind RH Head Lamp	
G106	W/H Floor(RH)	Beside ABS/ESP Unit	ABS/ESP
G201	W/H Floor(LH)	Under Driver Cowl Side Connector Holder	
G202	W/H Main	Backside Cluster(LH Cowl Cross Member)	AUDIO
G203	W/H Main	Backside Audio(CTR Cowl Cross Member)	
G204	W/H Main	Inside I.P(RH Glove Box)	
G205	W/H Main	Left Side I.P(Beside CTR Support BRKT)	PTC
G206	W/H Main	Left Under TGS Lever	AIR BAG
G207	W/H Main	Right Under TGS Lever	EPS
G301	W/H Floor(LH)	Under Driver Seat	
G302	W/H Floor(RH)	Under Passenger Seat	
G303	W/H Floor(LH)	Driver QTR PNL	
G304	W/H Floor(RH)	Passenger QTR PNL	
G401	W/H Tail Gate	CTR Under Tail Gate	

▶ Splice pack

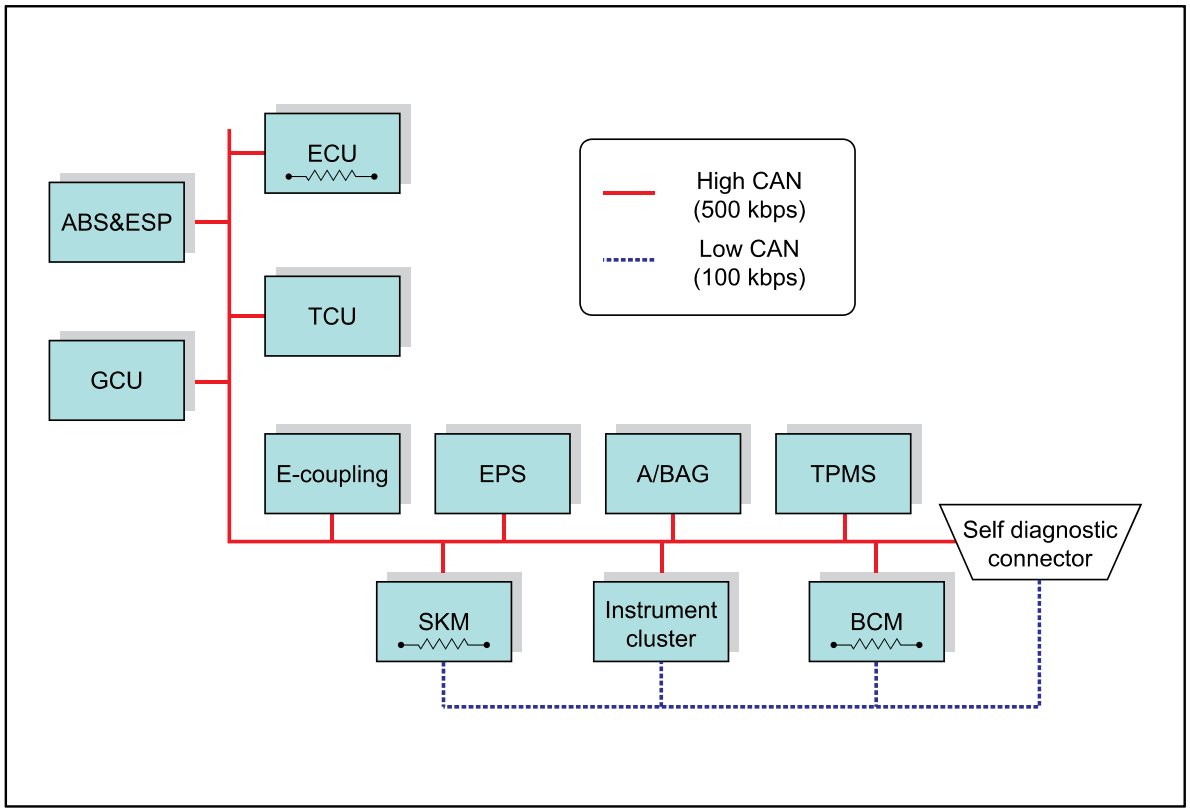
Connector Number (Pin Number/Color)		Connecting Wiring Harness	Connector Position	Remark
S101	**6**	W/H Floor(LH)	Under Eng Room Fuse & Relay Box	HS-CAN
S102	**6**	W/H Floor(RH)	Inside RH Fender	HS-CAN
S201	**8**	W/H Main	Backside Cluster(LH Cowl Cross Member)	LS-CAN
S202	**20**	W/H Main	Backside Cluster(LH Cowl Cross Member)	HS-CAN
S203	**20**	W/H Main	Backside Cluster(LH Cowl Cross Member)	ILL +
S204	**20**	W/H Main	Backside Cluster(Upper ICM Relay Box)	GND
S205	**8**	W/H Main	Backside Audio(CTR Cowl Cross Member)	HS-CAN
S206	**14**	W/H Floor(LH)	Under Driver Seat	HS-CAN
S301	**14**	W/H Floor(LH)	Under Driver Seat	
S302	**14**	W/H Driver Seat	Inside Driver Seat(Seat Frame)	Power Seat
S303	**14**	W/H Driver Seat	Inside Driver Seat(Seat Frame)	Manual Seat
S304	**8**	W/H Passenger Seat	Inside Passenger Seat(Seat Frame)	
S401	**8**	W/H Floor(LH)	Beside PAS Unit(Inside LH QTR Trim)	HS-CAN

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5. CAN COMMUNICATION CONFIGURATION

The CAN topology is linked with CAN communication system, which consists of P-CAN and B-CAN. The instrument cluster and BCM (Body Control Module) communicate through both P-CAN and B-CAN at the same time, and the SKM (SMART Key Module) communicates with the instrument cluster and BCM through B-CAN.

1) CAN Configurations (P-CAN/B-CAN)

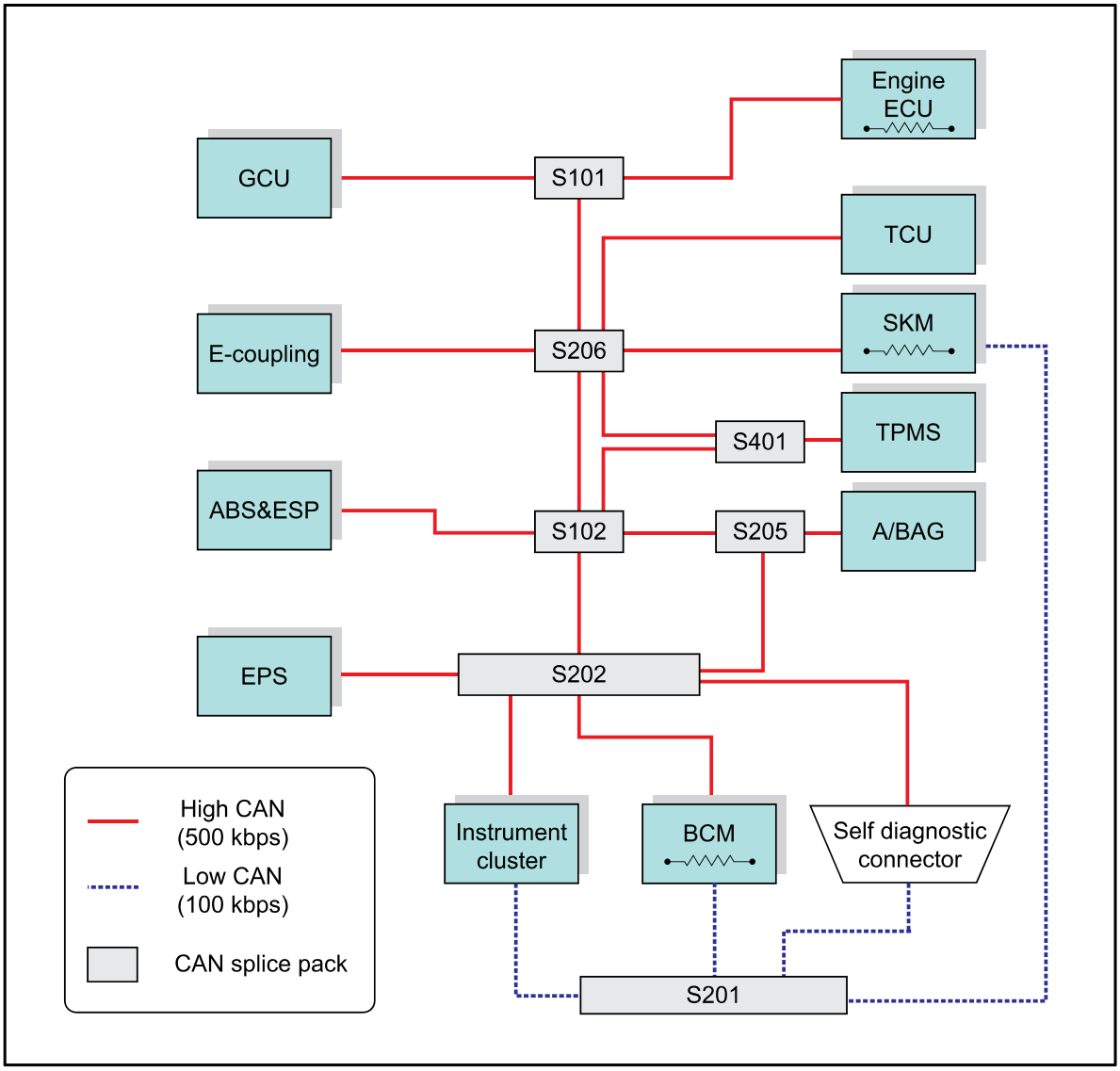


Abbreviations	Meaning	Function
GCU	Glow Control Unit	Glow Control Unit
EPS	Electronic Power Steering Unit	Electronic Power Steering Unit
BCM	Body Control Module	Body Control Module
SKM	Smart Key Module	Smart Key Module
TPMS	Tire Pressure Monitering System	Tire Pressure Monitering System

Modification basis	
Application basis	
Affected VIN	

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2) CAN Communication Wiring Diagram



Splice pack	Wiring	Location
S101	W/H Floor (LH)	Glow Control Unit
S102	W/H Floor (RH)	Inside RH Fender
S202	W/H Main	Backside Cluster (LH Cowl Cross Member)
S204	W/H Main	Backside Cluster (Under ICM Relay Box)
S205	W/H Main	Backside Audio (CTR Cowl Cross Member)
S206	W/H Floor (LH)	Under Driver Seat
S401	W/H Floor (LH)	Beside PAS Unit (inside LH QTR Trim)

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Memo

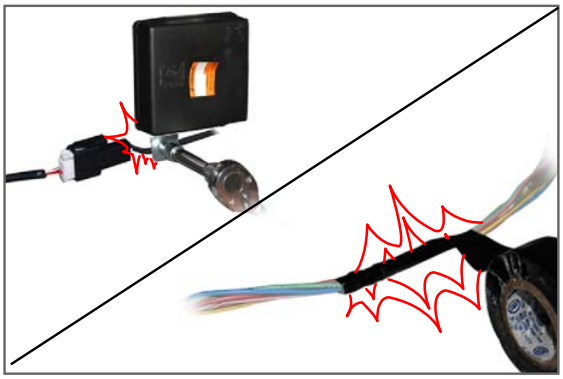
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Fuse and relay

8410-00

GENERAL INFORMATION

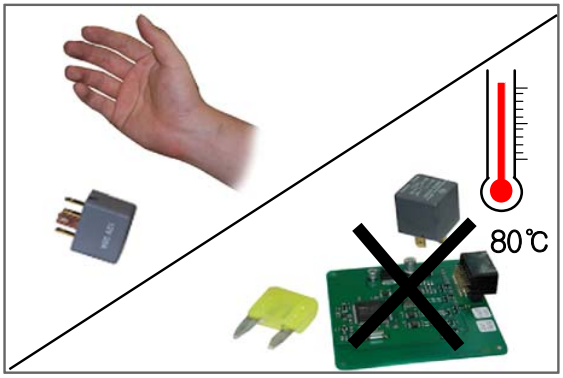
1. CAUTIONS WHEN WORKING ON ELECTRICAL UNITS



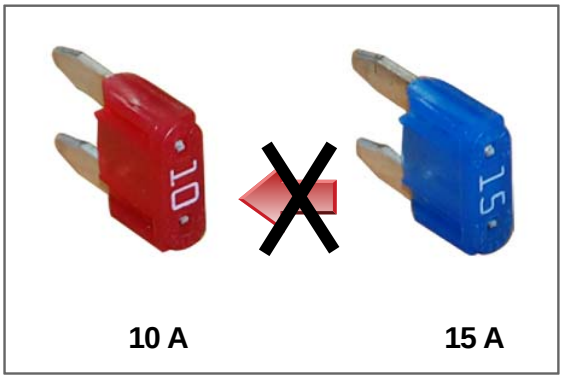
- Disconnect the negative cable from the battery in advance when working on electrical units.

CAUTION

Make sure to turn "OFF" the ignition switch and other lamp switches before disconnecting or connecting the negative battery cable. (Otherwise, semiconductor parts can be damaged.)

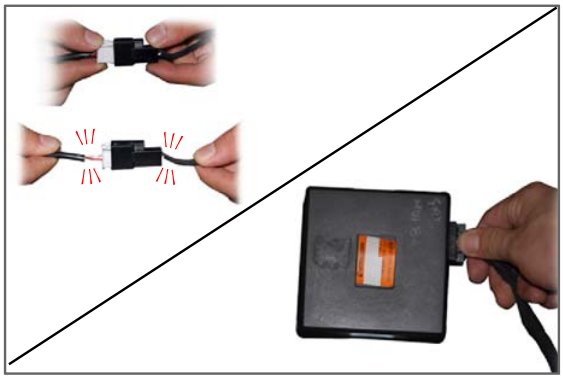


- Do not drop or appy excessive impact to sensors and relays.

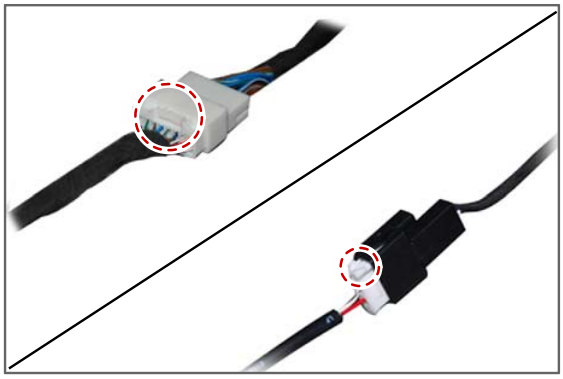


- If a fuse is blown, replace it with a fuse which has the correct amperage rating. If you use a fuse with higher capacity than the specification, the component can be damaged or catch fire.

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- Make sure a connector is connected securely. Loose connection results in malfunction.



- When disconnecting a connector equipped with a lock, press it down to the direction in the below figure.



- When checking voltage or continuity of the connector terminal with a circuit tester, connect the tester probe to the terminal at the harness side. For a sealed type connector, connect the probe to the terminal through the hole in the rubber cap of the wiring. Take care not to damage the insulation of the wires. Insert the probe until it contacts the terminal completely.

CAUTION

When inspecting the airbag system, make sure to use a diagnostic device, not a circuit tester.

Modification basis	
Application basis	
Affected VIN	

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2. CHECKING CABLES AND WIRES

- Check for loose connection or rust.
- Check terminals and wires for corrosion due to electrolyte leakage.
- Check terminals and wires for open circuit.
- Check the wire insulation and coat for damage, cracks or deterioration.
- Check if the conductive parts of the terminals do not contact with vehicle body or other metal parts. Check that the grounding part has continuity with mounting bolts and vehicle body.
- Check that wires are properly routed.
- Make sure that wires are securely fixed to avoid contact with sharp body parts and high-temperature
- parts, such as the exhaust manifold and exhaust pipes. The rotating parts, such as fan pulley and fan belt, perturbative parts and wiring should be secured
- tightly at regular intervals. Secure the wiring between the fixed parts, such as the vehicle body, and vibrating parts, such as the
- engine, after slackening it slightly to prevent it from being damaged.

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3. MAJOR CHANGES

▶ **Changes for engine compartment fuse box**

8410-02	Engine compartment fuse box
Old 	New 
- Changed layout	

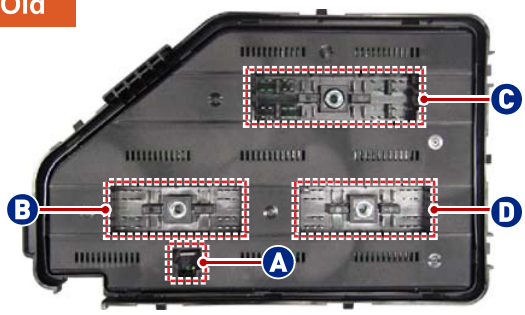
	Name	Changes made
A	ALT terminal and fuse (150A)	Newly adopted
B	A/C compressor relay	Changed to PCB type
C	Headlamp high beam	Changed to PCB type
D	Rear glass/heated mirror relay	Changed to PCB type
E	Cooling fan high-speed relay	Changed to Micro type
F	Blower motor relay	Changed to Micro type
G	Cooling fan low-speed relay	Changed to Micro type
H	Cooling fan relay	Changed to Micro type
I	Fuel heater relay	Changed to Micro type
J	PTC1 heater relay	Changed to Micro type
K	Power window relay	Changed to Micro type
L	Starting relay	Changed to Micro type

Modification basis	
Application basis	
Affected VIN	

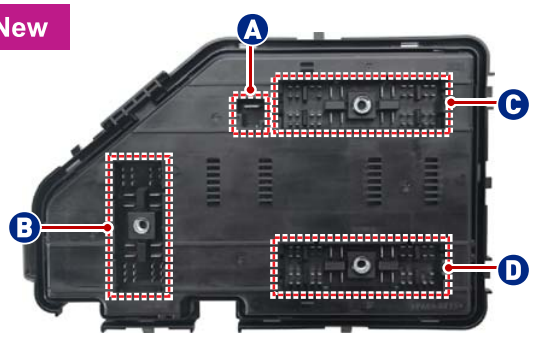
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8410-02	Changed connector position

Old



New



- Change position of connectors A, B and D

8410-02	Changed connector D

Old



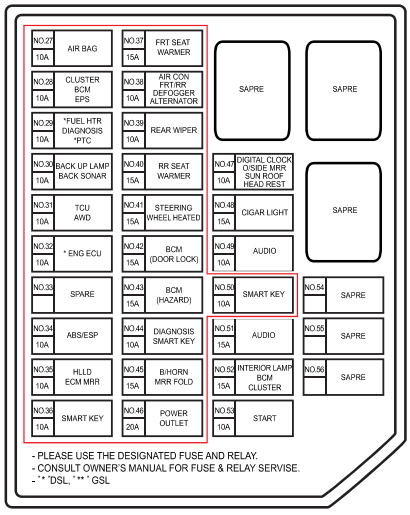
New



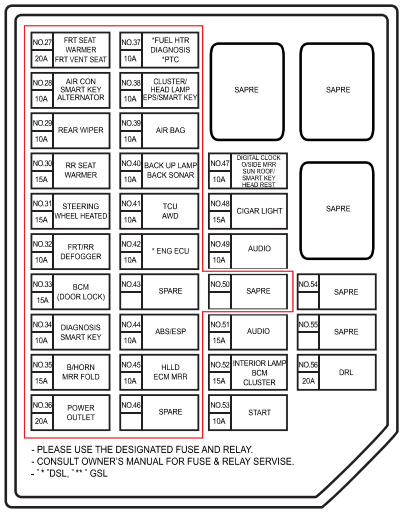
– Connector D changed (32 pin → 40 pin)

8410-02	Interior fuse box

Old



New



- Interior fuse box label changed

Modification basis	
Application basis	
Affected VIN	

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The fuse and relay boxes in this vehicle are mounted on the engine compartment, left side of the instrument panel and rear of the instrument cluster (3 off in total). The capacities and its names for each fuse and relay are marked on the each fuse and relay box cover.
The label attached on each fuse box indicates only major fuses and relays. For detailed information, see the power distribution circuit diagram.

2. SYSTEM LAYOUT



Modification basis	
Application basis	
Affected VIN	

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BCM (BODY CONTROL MODULE) 4170-34

GENERAL INFORMATION

1. SPECIFICATIONS

Item	Conditions	Description
Rated voltage	13.5 V	
Operating voltage	9.0 V to 16.0 V (CAN communication: 7.0 V to 18.0 V)	Should be operated normally within this range.
Operating temperature	−30℃ ~ +80℃	Should be operated normally within this range.
Storage temperature	−40℃ to +85℃	
Max. operating humidity	95%	
Dark current	BCM without SKM: 7.0 mA or less BCM with SKM: 4.0 mA or less	All switches turned OFF, Key removed, entering sleep mode after all doors are locked

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2. INPUT SIGNALS

NO	Input signal	Logic
1	IGN1	ON = Battery voltage (IGN ON or START)
2	IGN2	ON = Battery voltage (IGN ON)
3	Alternator	ON = Battery voltage (engine running)
4	Key reminder switch	IN = Battery voltage (key inserted)
5	Driver door LOCK detecting switch	LOCK = GND, UNLOCK = OPEN
6	Driver door UNLOCK detecting switch	LOCK = OPEN, UNLOCK = GND
7	Passenger door LOCK detecting switch	LOCK = GND, UNLOCK = OPEN
8	Passenger door UNLOCK detecting switch	LOCK = OPEN, UNLOCK = GND
9	Rear door LOCK detecting switch	LOCK = OPEN, UNLOCK = GND
10	Puddle lamp	ON = (-) OUTPUT
11	Driver door open switch	OPEN = GND, CLOSE = OPEN
12	Passenger door open switch	OPEN = GND, CLOSE = OPEN
13	Rear LH door open switch	OPEN = GND, CLOSE = OPEN
14	Rear RH door open switch	OPEN = GND, CLOSE = OPEN
15	Tailgate switch	OPEN = GND, CLOSE = OPEN
16	Hood switch	OPEN = GND, CLOSE = OPEN
17	Sunroof switch	OPEN = GND, CLOSE = OPEN
18	headlamp switch	ON = GND, OFF = OPEN
19	Folding/unfolding switch	ON = GND, OFF = OPEN
20	Crash door LOCK/UNLOCK switch	ON = GND, OFF = OPEN
21	Crash sensor (air bag)	ON = 200 ms Low signal, OFF = OPEN
22	Front defogger (heated wire) switch	ON = GND, OFF = OPEN
23	Rear defogger (heated wire) switch	ON = GND, OFF = OPEN
24	Wiper switch 1	ON = GND, OFF = OPEN
25	Wiper switch 2	ON = GND, OFF = OPEN
26	Driver seat belt switch	Unbuckled = GND, Fastened = OPEN
27	Passenger seat belt switch (only EU)	Unbuckled = GND, Fastened = OPEN
28	Rain & AUTO light sensor	LIN communication

Modification basis	
Application basis	
Affected VIN	

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NO	Input signal	Logic
29	Intermittent wiper speed control switch	0 Ω to 51 KΩ
30	Wiper motor parking signal	Stop = GND, Rotation = VCC (5 V)
31	AUTO washer switch	ON = IGN, OFF = OPEN
32	Windshield washer switch	ON = IGN, OFF = OPEN
33	Rear washer switch	ON = IGN, OFF = OPEN
34	AUTO light switch	OPEN = GND, CLOSE = OPEN
35	Tail lamp switch	ON = GND, OFF = OPEN
36	AUTO hazard warning lamp switch	ON = GND, OFF = OPEN
37	Left turn signal lamp switch	ON = GND, OFF = OPEN
38	Right turn signal lamp switch	ON = GND, OFF = OPEN
39	Hazard warning lamp switch	ON = GND, OFF = OPEN
40	DRL switch	ON = GND, OFF = OPEN
41	Rear fog lamp switch	ON = IGN, OFF = OPEN

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3. MAJOR FUNCTIONS

	Item	Function	w/o SKM	w/ SKM
1	WIPER CONTROL	Wiper MIST and washer coupled wiper	O	O
		AUTO washer coupled wiper operation	O	O
		Rain sensor coupled wiper (LIN)	O	O
		Speed sensitive intermittent wiper	O	O
		Wiper LO/HI control	O	O
2	Ignition key warning lamp	Ignition key reminder warning	O	X
		Ignition key reminder	O	X
		External buzzer control	X	O
		Door LOCK prevention function when a door is ajar	O	O
3	Tail lamp control	Tail lamp switch ON warning	O	O
		Tail lamp warning display	X	O
		Tail lamp AUTO switching off	O	O
4	Door ajar warning	Door ajar control	X	O
		Door ajar warning	O	O
5	Seat belt control	Seat belt warning	O	O
		Seat belt reminder	O	O
6	Sunroof warning	Sunroof warning	O	O
		Sunroof warning display	X	O
7	Room lamp control	Door coupled room lamp dim control	O	O
		Room lamp AUTO switching off	O	O
		Room lamp control display	X	O
8	Ignition key hole lamp	Ignition key hole lamp control	O	X
9	Defogger (heated wire) control	Front defogger (heated wire) control	O	O
		Rear defogger (heated wire) control	O	O

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	Item	Function	w/o SKM	w/ SKM
10	Ignition key remote control function	Transmitter function	O	X
		Remote control door LOCK	O	X
		Remote control door UNLOCK	O	X
		Remote control panic	O	X
		Remote control escort	O	X
		AUTO door LOCK after 30 seconds	O	X
11	Door LOCK/UNLOCK control	Door LOCK/UNLOCK control by door knob switch	O	O
		Door LOCK/UNLOCK control by center door LOCK switch	O	O
		Door LOCK/UNLOCK control by REKES key signal	O	X
		Door LOCK/UNLOCK control by smart key	X	O
		Door LOCK/UNLOCK control by door handle switch (passive entry)	X	O
		AUTO door LOCK control	O	O
		AUTO UNLOCK upon receiving air bag deployment signal	O	O
12	Panic alarm	Panic alarm control by REKES key signal	O	X
		Panic alarm control by smart key signal	X	O
13	Tailgate control	Tailgate open control (for vehicles without SKM)	O	X
		Tailgate open control (for vehicles with SKM)	X	O
14	Theft deterrent alarm control	Theft deterrent alarm control (for vehicles without SKM)	O	X
		Theft deterrent alarm control (for vehicles with SKM)	X	O
15	Time lag window control	Time lag power window control	O	O

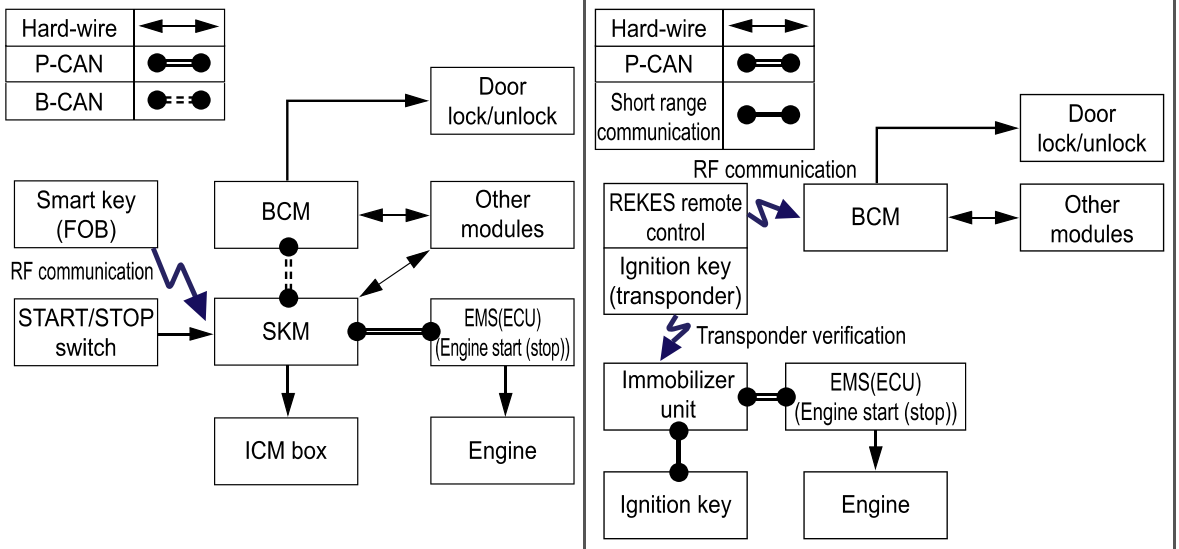
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	Item	Function	w/o SKM	w/ SKM
16	System power sleep mode	System power sleep mode control	O	O
17	Flasher unit control	Left turn signal lamp control	O	O
		Right turn signal lamp control	O	O
		Hazard warning lamp control	O	O
		AUTO hazard warning lamp control	O	O
		Emergency hazard warning flasher control	O	O
18	Fog lamp control	Fog lamp control	O	O
19	Immobilizer function	Key coding	O	X
		CHALLENGE	O	X
		CAN information	O	X
20	Folding/unfolding control	Folding/unfolding control	O	O
		AUTO folding/unfolding control	O	O
21	Approach lamp control	Approach lamp control (for vehicles without SKM)	O	X
		Approach lamp control (for vehicles with SKM)	X	O
22	SKM warning control	SKM buzzer control	X	O

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4. WITH SKM VS. WITHOUT SKM

BCM (BODY CONTROL MODULE)



BCM (Body Control Module) inputs/outputs data from various switches, sensors, and other modules through the hard wire and CAN communication, and controls the body and electronic system of the vehicle.
For the vehicles with SKM, the SKM unit communicates with BCM through B-CAN. It sends the door LOCK/UNLOCK signal by smart key, theft deterrent mode signal, and passive entry signal, etc. to the BCM to control each module. The signals for engine running and stopping controls are sent to the EMS (ECU) through the P-CAN.
For the vehicles without SKM, the BCM receives door LOCK/UNLOCK signal by smart key, theft deterrent mode signal, and passive entry signal, etc. directly from the modules to control them. The BCM controls the engine running and stopping by sending the corresponding signals to the EMS (ECU) after verifying the ignition key. The controls for other modules may vary depending on the vehicle specifications.

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5. MAJOR CHANGES



Outside rear view mirror folding/unfolding	
Old	**New**
AUTO folding/unfolding setting Pressing the manual folding switch for 3 seconds or more sets the AUTO folding/unfolding and operates the external buzzer once. **AUTO folding/unfolding unsetting** Pressing the manual folding switch for 3 seconds or more again unsets the AUTO folding/unfolding and operates the external buzzer twice.	**AUTO folding/unfolding setting** The manual folding switch is not pressed. **AUTO folding/unfolding unsetting** The manual folding switch is pressed.

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REKES key	
Old 	New  Folding key type
The design of REKES key has been changed.	

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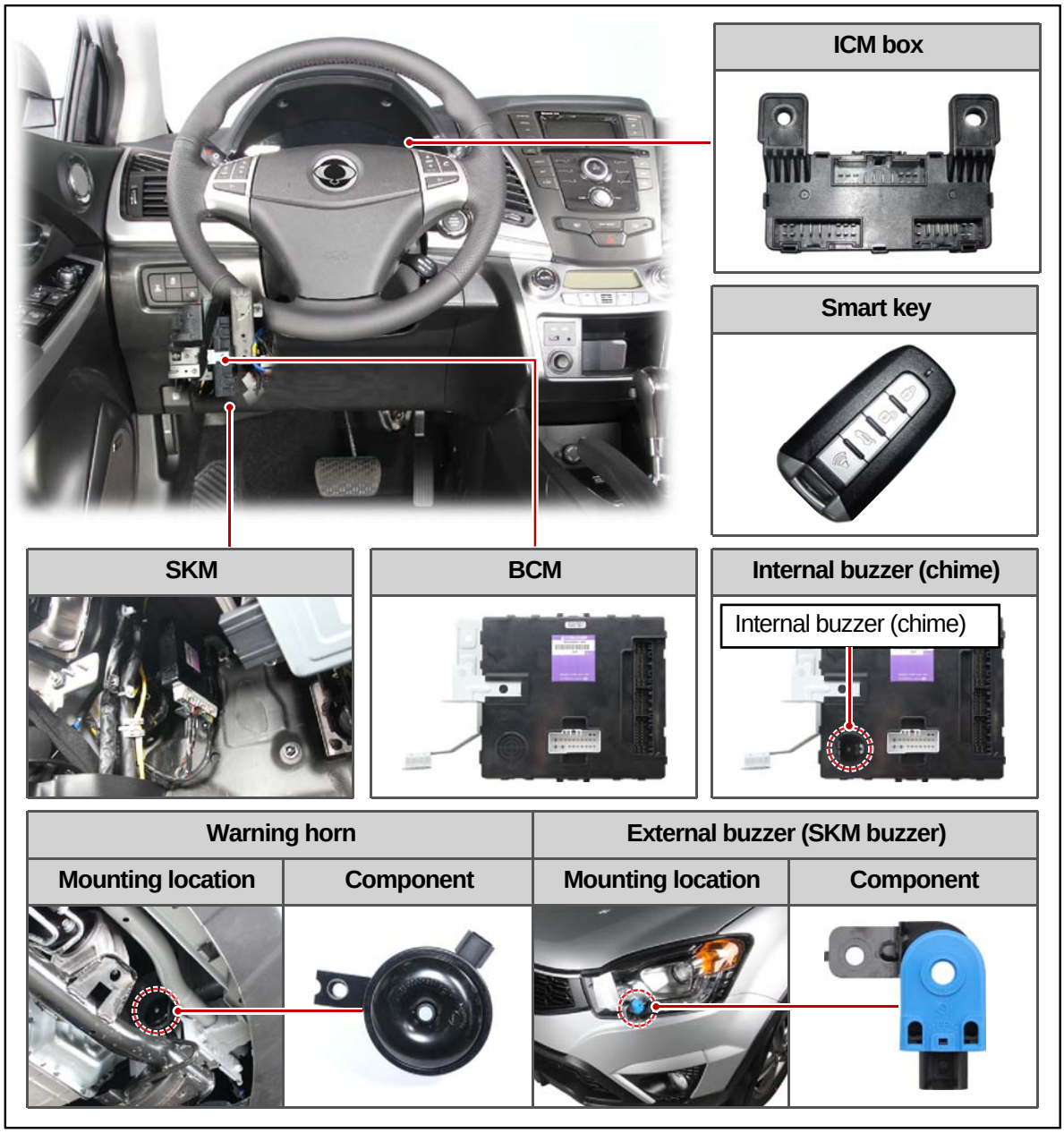
OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

BCM (Body Control Module) is a module that inputs/outputs data from various switches, sensors, and other modules through the hard wire and CAN communication, and controls the body, electronic system, and chassis of the vehicle.

2. SYSTEM CONFIGURATION

1) Vehicles With SKM



Modification basis	
Application basis	
Affected VIN	

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2) Without SKM



ICM box



Immobilizer



BCM



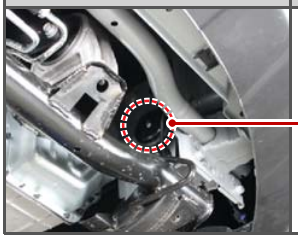
Internal buzzer (chime)



REKES key

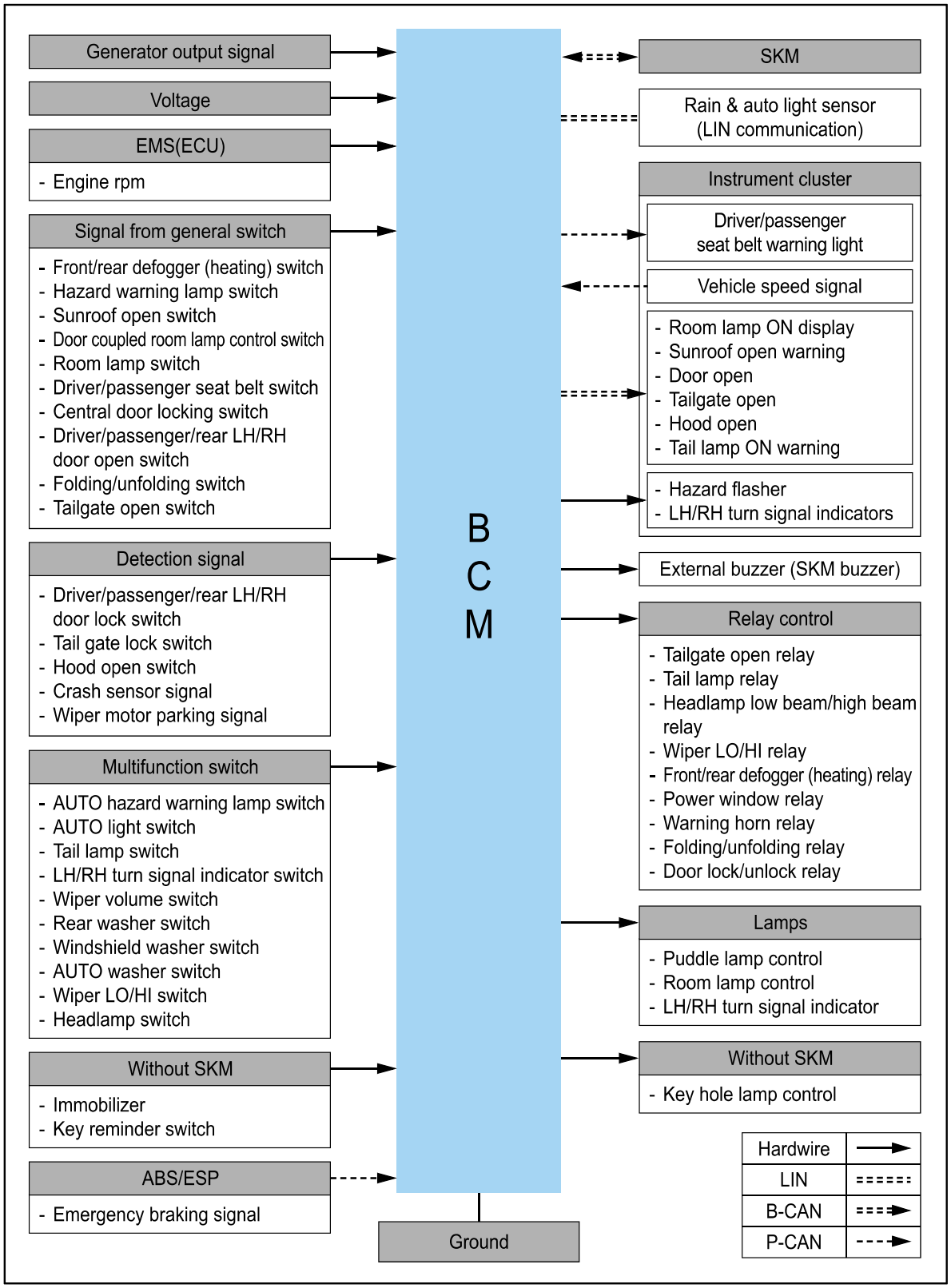


Warning horn

Mounting location	Component
	

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3. INPUTS AND OUTPUTS



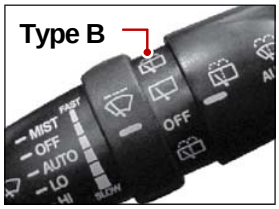
Modification basis	
Application basis	
Affected VIN	

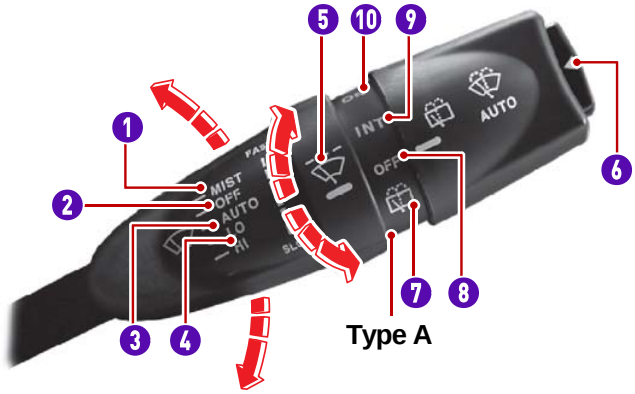
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4. WIPER CONTROL

The wiper system operates the wiper and washer using the signals from the multi-function switch, and receives rain sensing signal from the rain sensor unit.

▶ Windshield wiper and washer switch function





1. MIST

- When the wiper switch is pulled up and released, the wiper cycles once and then returns to the park position.

2. OFF

- Stops the windshield wiper operation.

3. AUTO

- When the wiper switch is set to the AUTO position, the wiper speed is adjusted automatically according to the amount of rain measured by the rain sensor mounted on the windshield.

4. LO/HI

- When the wiper switch is set to the LO position, the wiper speed is decreased. When the switch is set to the HI position, the wiper speed is increased.

5. Wiper speed control switch

- The wiper speed can be adjusted with this switch as follows when the wiper switch is in AUTO position.
  * FAST: increases wiper speed
  * SLOW: decreases wiper speed

6. AUTO washer switch

- When the AUTO washer switch is pressed, the washer fluid is sprayed once and the wiper is operate 4 times. Then, the fluid is sprayed once again with 3 wiping operations.

7.

- 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.

8. OFF

- Rear wiper is not in operation.

TYPE A

9. INT

- Rear wiper operation (Intermittent)

10. ON

- Rear wiper operation (Normal Speed)

TYPE B

9. Rear wiper operation

10. 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 Rear Wiper Operation mode and only the wiper will keep operating.

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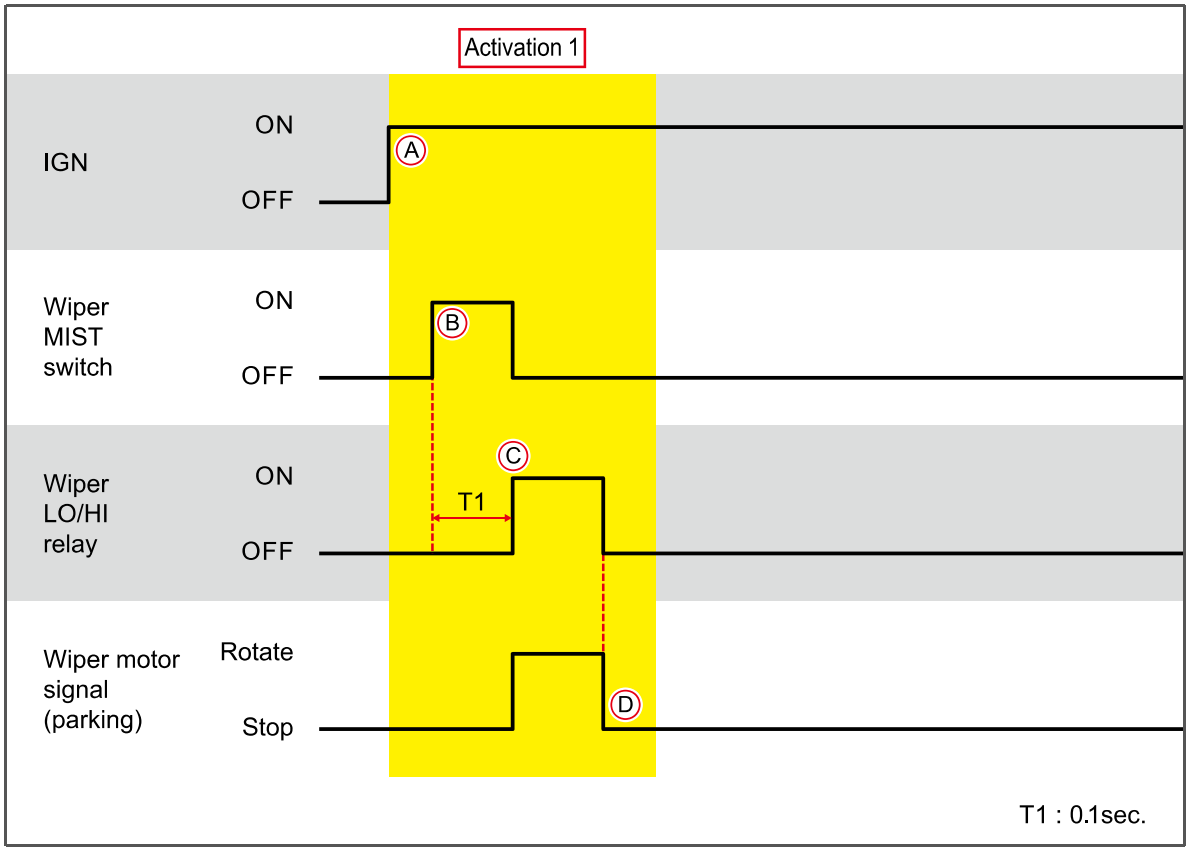
▶ Windshield wiper MIST operation

Operation 1.

A. The ignition is turned ON.
B. The MIST switch is turned ON for 0.1 seconds or more.
C. The wiper LO/HI relay is activated 0.1 seconds (T1) after the MIST switch is turned ON.
D. The wiper LO relay is deactivated when the MIST switch is turned OFF and the wiper motor parking signal is input.

NOTE

The wiper HI relay is activated when the MIST switch signal is input. If no signal from the MIST switch is input, the wiper LO relay is activated.

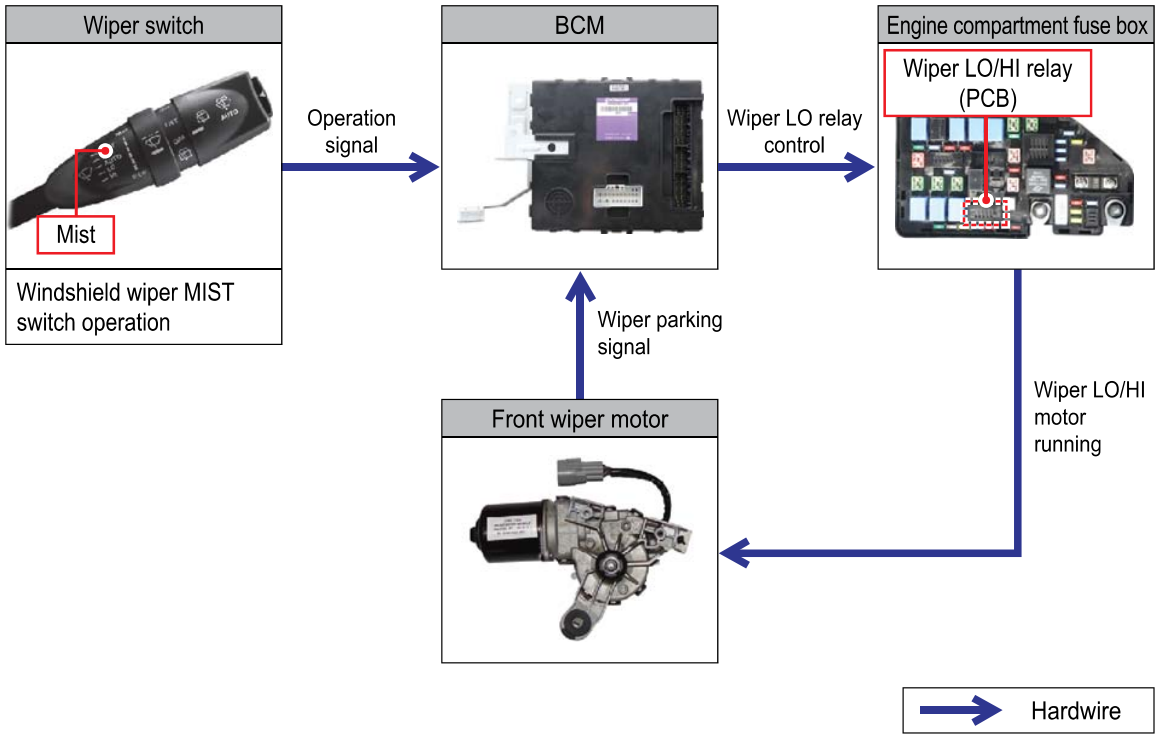


Modification basis	
Application basis	
Affected VIN	

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Operating process

- IGN ON

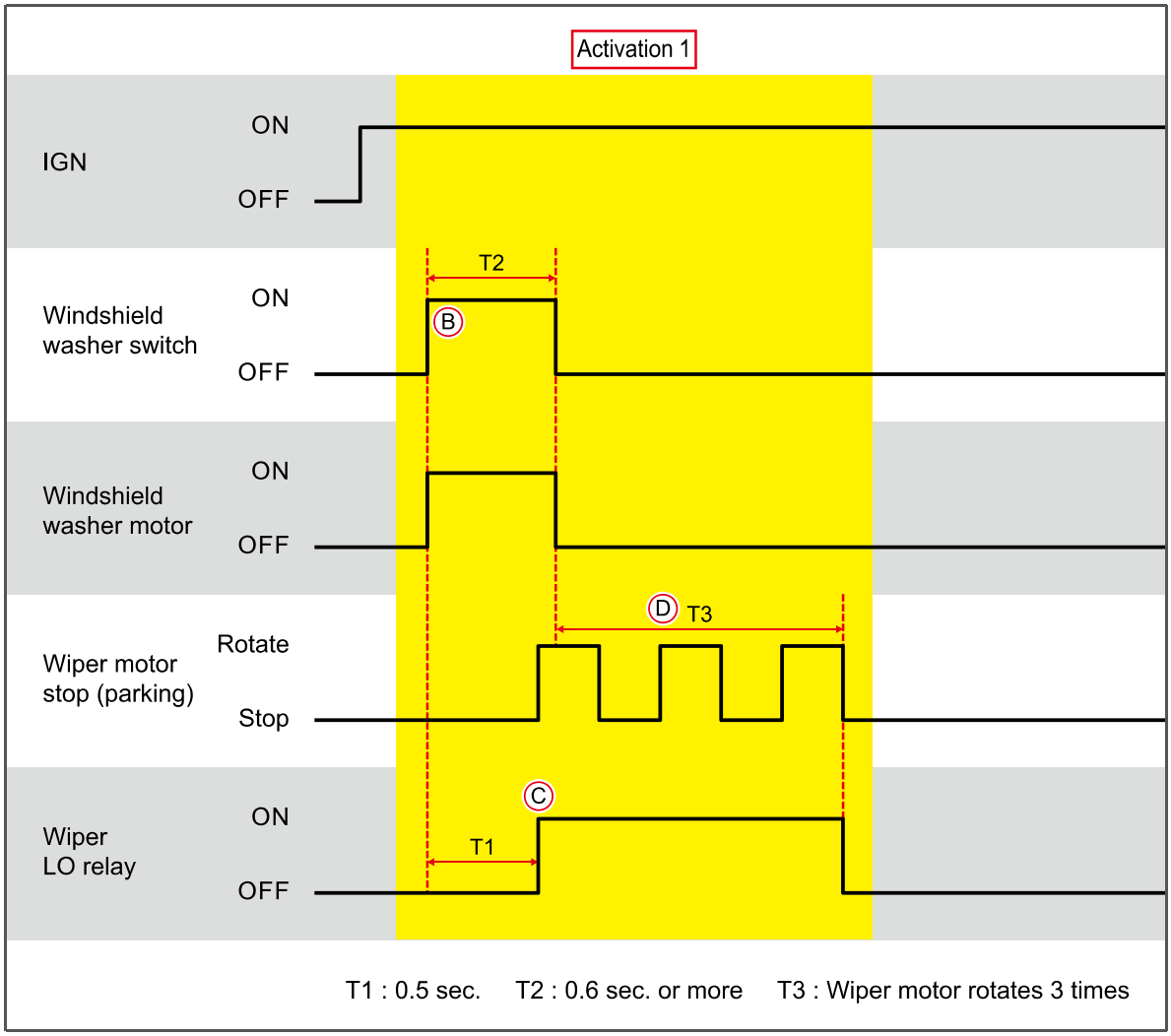


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▶ **Windshield washer switch coupled windshield wiper operation**

Operation 1. (washer switch pressed for 0.1 to 0.59 seconds)

A. The ignition is turned ON.
B. When the windshield washer switch is turned ON for 0.6 seconds or more (T2), the windshield washer motor is activated.
C. The windshield wiper LO relay is activated 0.5 seconds (T1) after the windshield washer switch is turned ON.
D. When the windshield washer switch is turned OFF, the windshield wiper LO relay is deactivated after the windshield wiper motor rotates 3 times (T3).



Modification basis	
Application basis	
Affected VIN	

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▶ Windshield washer switch coupled windshield wiper operation (during intermittent windshield wiper)

Operation 1. (windshield washer switch pressed for 0.1 to 0.59 seconds)

A. The ignition is turned ON with the wiper AUTO switch ON.

B. The windshield wiper LO relay is activated 0.5 seconds (T1) after the windshield washer switch is turned ON for less than 0.6 seconds (T2).

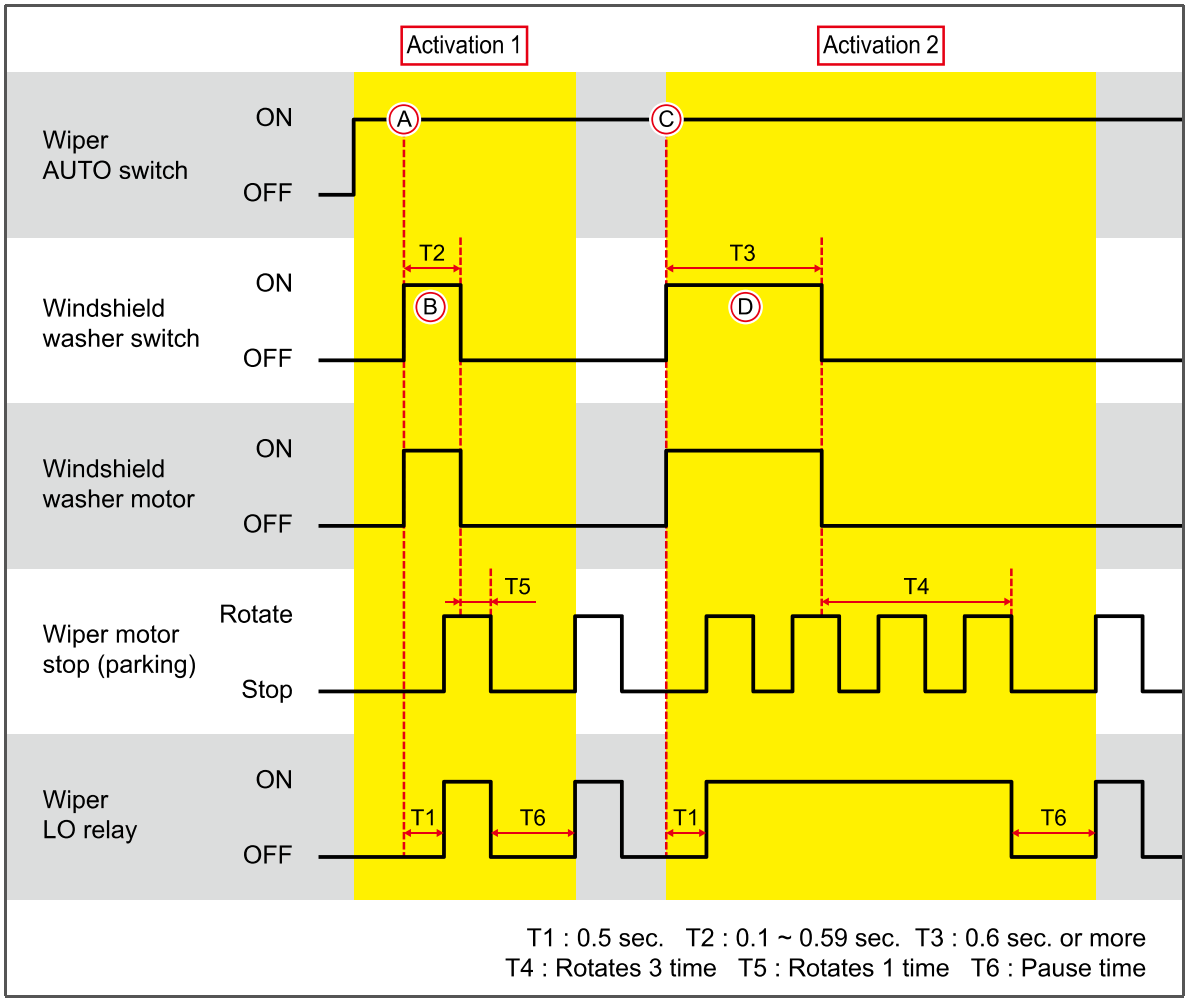
- When the windshield washer switch is turned OFF, the windshield wiper LO relay is deactivated after the windshield wiper motor rotates once (T5), and then the windshield wiper is operated intermittently after the rest time (T6).

Operation 2. (windshield washer switch pressed for 0.6 seconds or more)

C. The ignition is turned ON with the wiper AUTO switch ON.

D. The windshield wiper LO relay is activated 0.5 seconds (T1) after the windshield washer switch is turned ON for 0.6 seconds or more (T3).

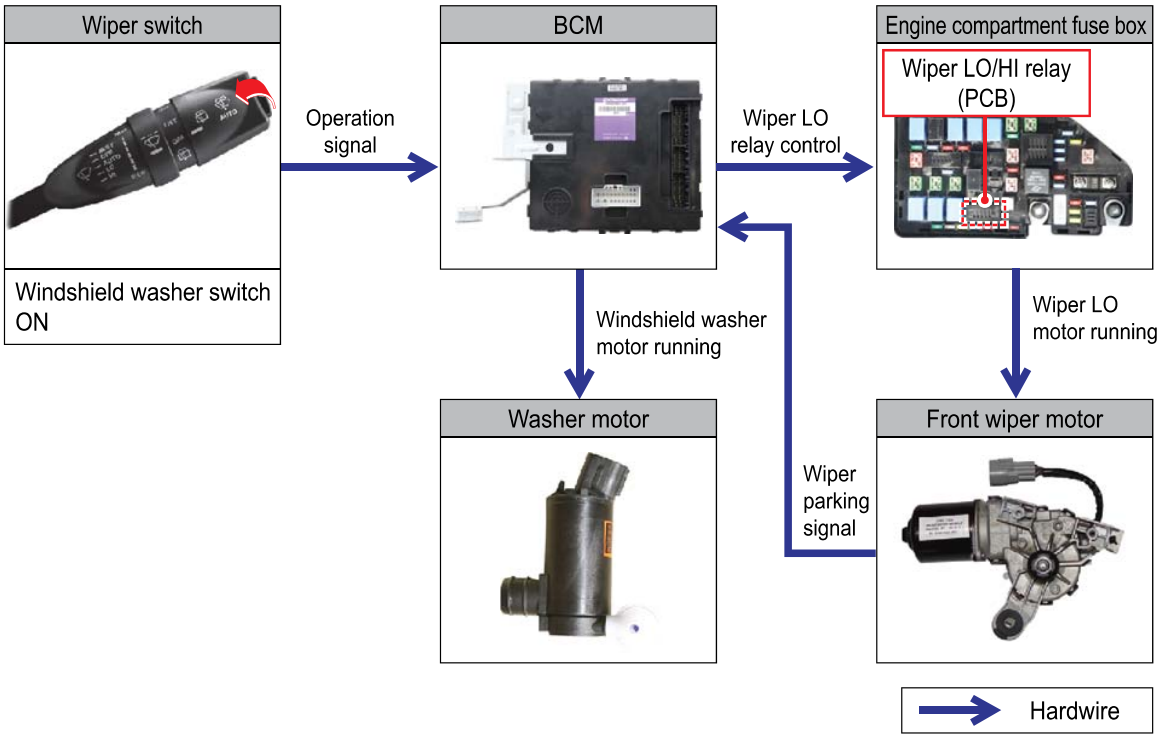
- When the windshield washer switch is turned OFF, the windshield wiper LO relay is deactivated after the windshield wiper motor rotates 3 times (T4), and then the windshield wiper is operated intermittently after the rest time (T6).



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Operating process

- IGN ON and wiper AUTO switch in ON position



NOTE

Priority of operation:

Windshield washer switch → Wiper AUTO switch

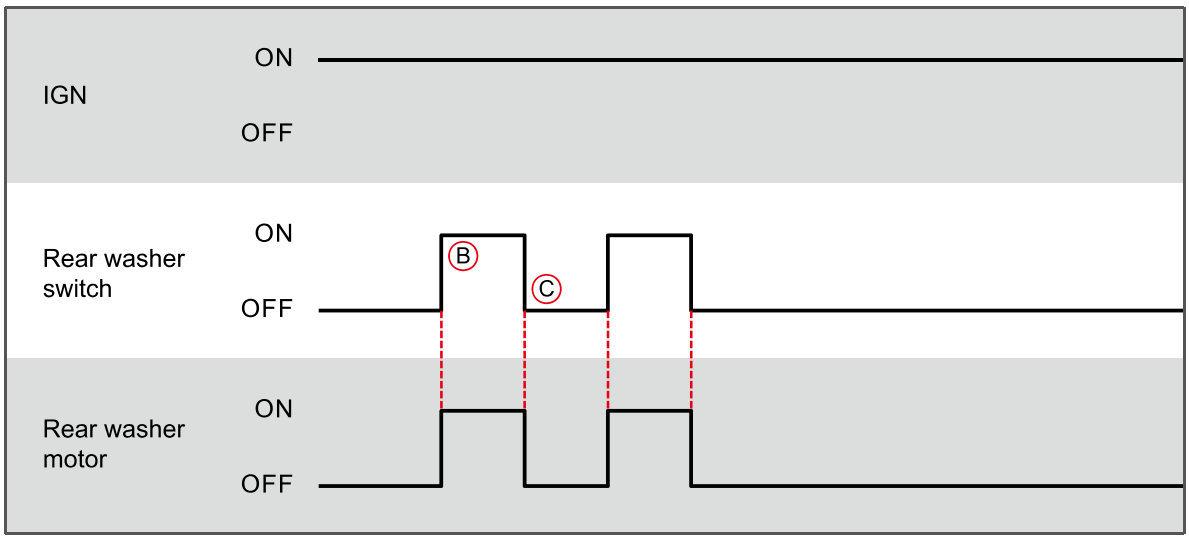
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▶ Rear washer motor control

Operation 1.

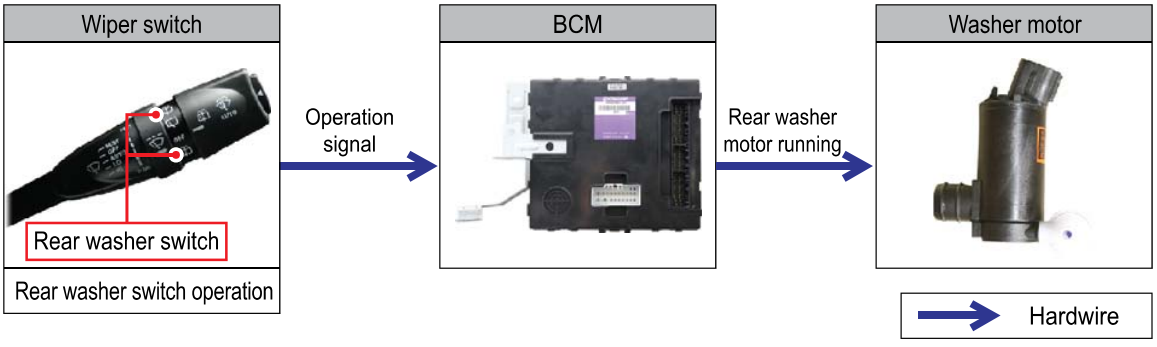
A. The ignition is turned ON.
B. The rear washer motor is activated when the rear washer switch is turned ON.
C. The rear washer motor is deactivated when the rear washer switch is turned OFF.

NOTE
Priority of operation: Windshield washer switch > Rear washer switch.



Operating process

- IGN ON



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▶ **AUTO washer switch coupled wiper operation**

Operation 1.

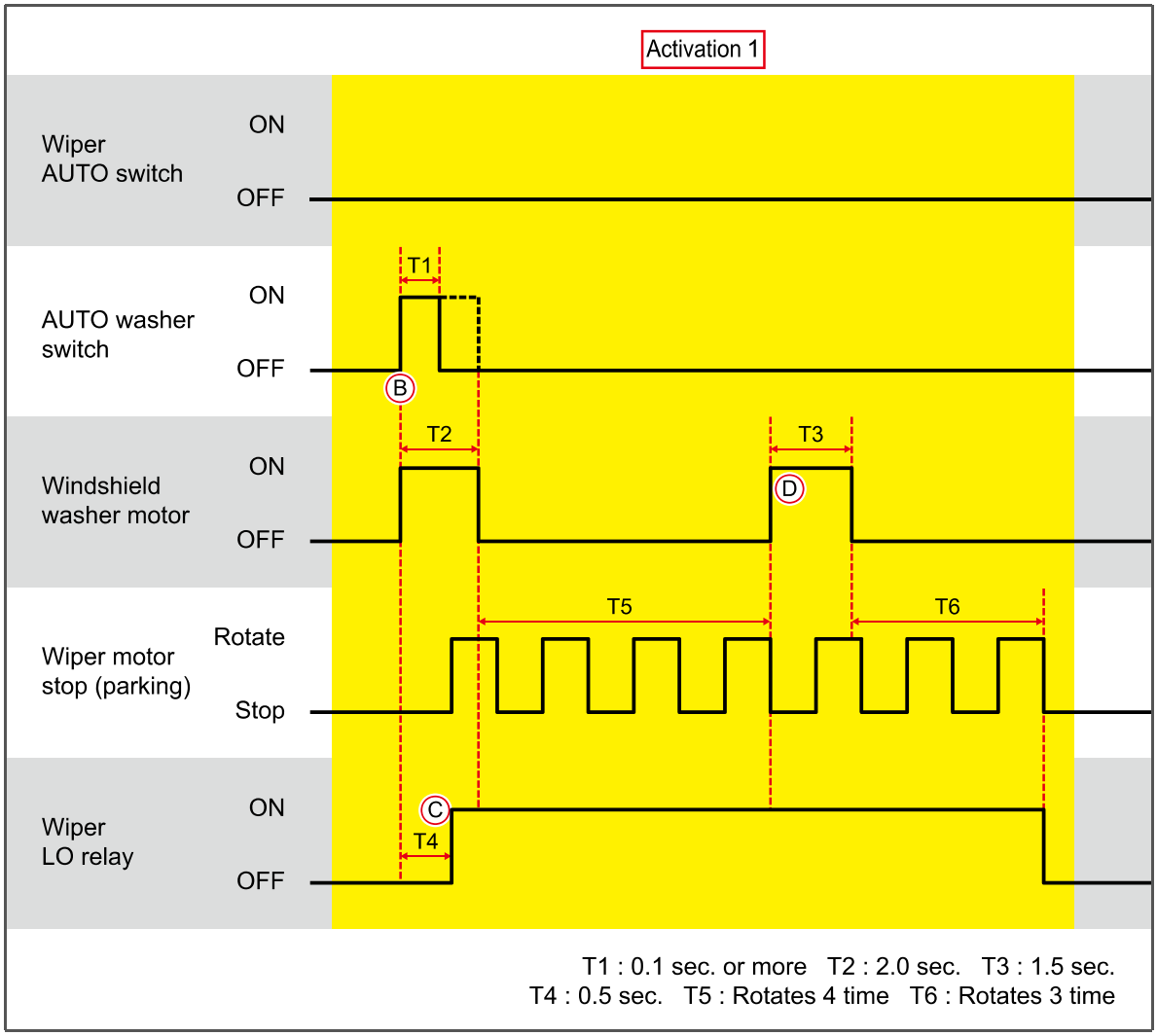
A. The wiper AUTO switch is in the OFF position with IGN ON
B. When the AUTO washer switch is turned ON for 0.1 seconds or more (T1), the windshield washer motor is activated for 2 seconds (T2).
C. The windshield wiper LO relay is operated 4 times (T5) 0.5 seconds (T4) after the windshield washer motor has been activated.
D. And then the windshield wiper LO relay is deactivated 3 times (T6) of operation while the windshield washer motor is activated for 1.5 seconds (T3).

NOTE

- The input from the AUTO washer switch during the washer coupled wiper operation is overridden.
- The input from the AUTO washer switch during the AUTO washer coupled wiper operation is ignored.
- The input from the AUTO washer switch during the speed sensitive intermittent wiper operation is ignored.
- When the signal from the intermittent wiper switch is received during the AUTO washer operation, the AUTO washer doesn't operate any longer and the intermittent wiper operation will be performed.
- The input from the washer switch during the AUTO washer operation is ignored.

-

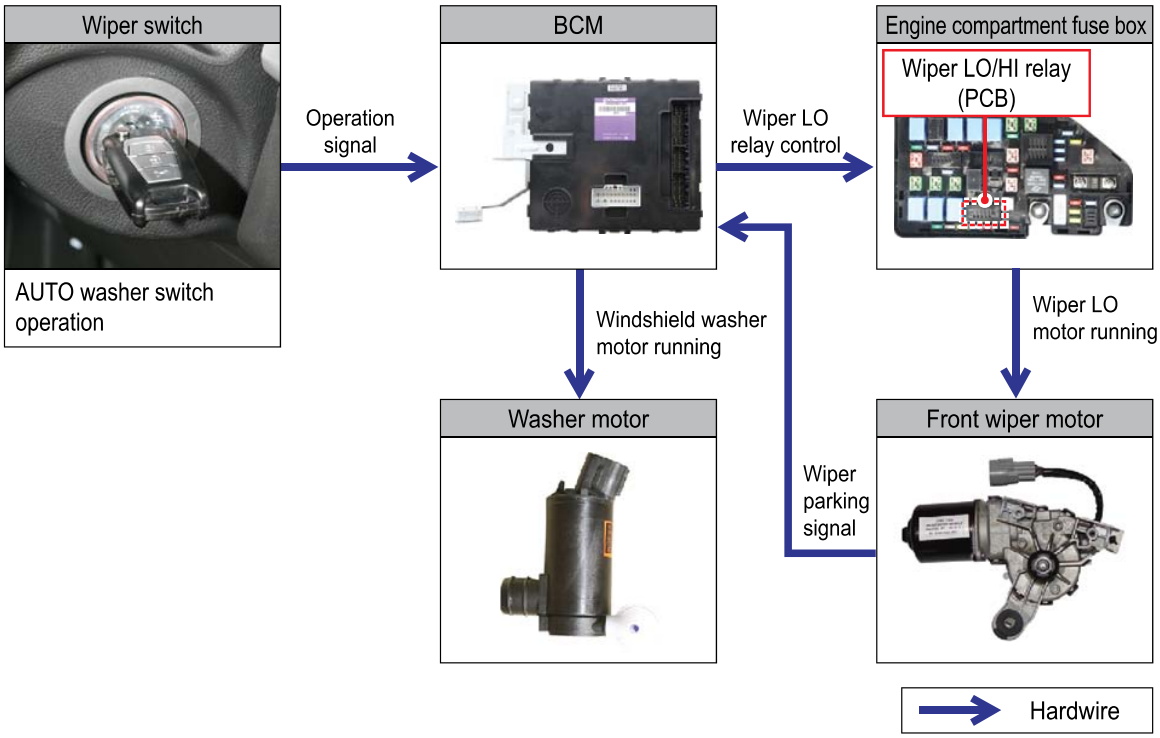
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Operating process

- IGN ON and wiper AUTO switch in OFF position

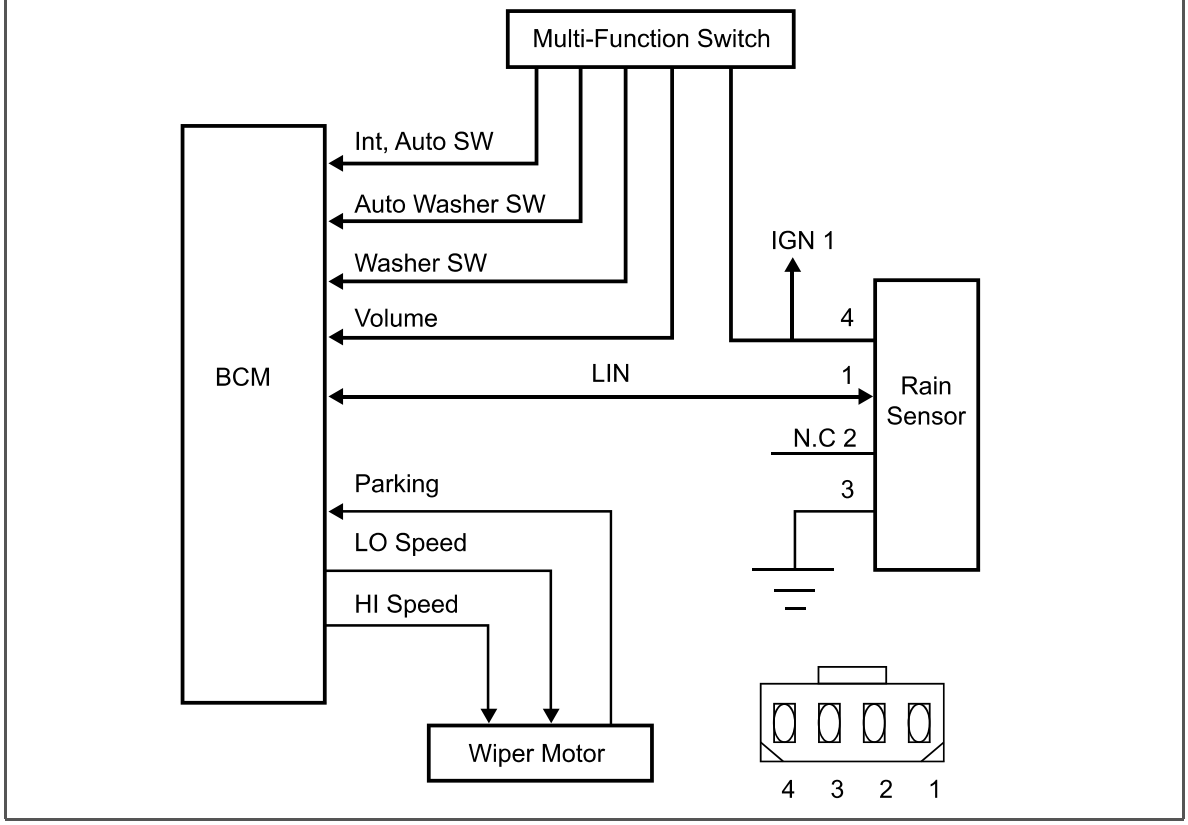


Modification basis	
Application basis	
Affected VIN	

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▶ **BCM and rain sensor system diagram**

Operating process



Data recognition time

The LIN communication is established when the ignition is turned ON, regardless of the wiper and light switch operation. Then the function for the LIN data is carried out with the wiper AUTO switch or AUTO light switch in the AUTO position.
The data from the rain sensor is recognized as 2 consecutive data.

Operation when data is recognized

Data OFF: Lo/HI relay output OFF
Low speed signal: LO relay output ON (ON for at least 1 revolution), HI relay output OFF
High speed signal: HI relay output ON (ON for at least 1 revolution), LO relay output ON
The washer input is overridden during continuous operation of wiper. (washer coupled wiper operation during intermittent operation)

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▶ **Power-up reminder wiper**

Operation 1.

A. The wiper AUTO switch is in the ON position.
B. The ignition is turned ON, and then OFF, and then ON again.
C. The windshield wiper LO relay is not operated.

Operation 2.

D. The position of the wiper AUTO switch is changed to the ON from the OFF position with IGN ON.
E. The wiper motor rotates once (T1) initially when the windshield wiper LO relay is activated, regardless of the rain sensor communication.

Operation 3.

(The rain sensor did not detect rain drops after Operation 2.)

F. The ignition is turned ON with the wiper AUTO switch in the ON position.
G. The windshield wiper LO relay is not operated.

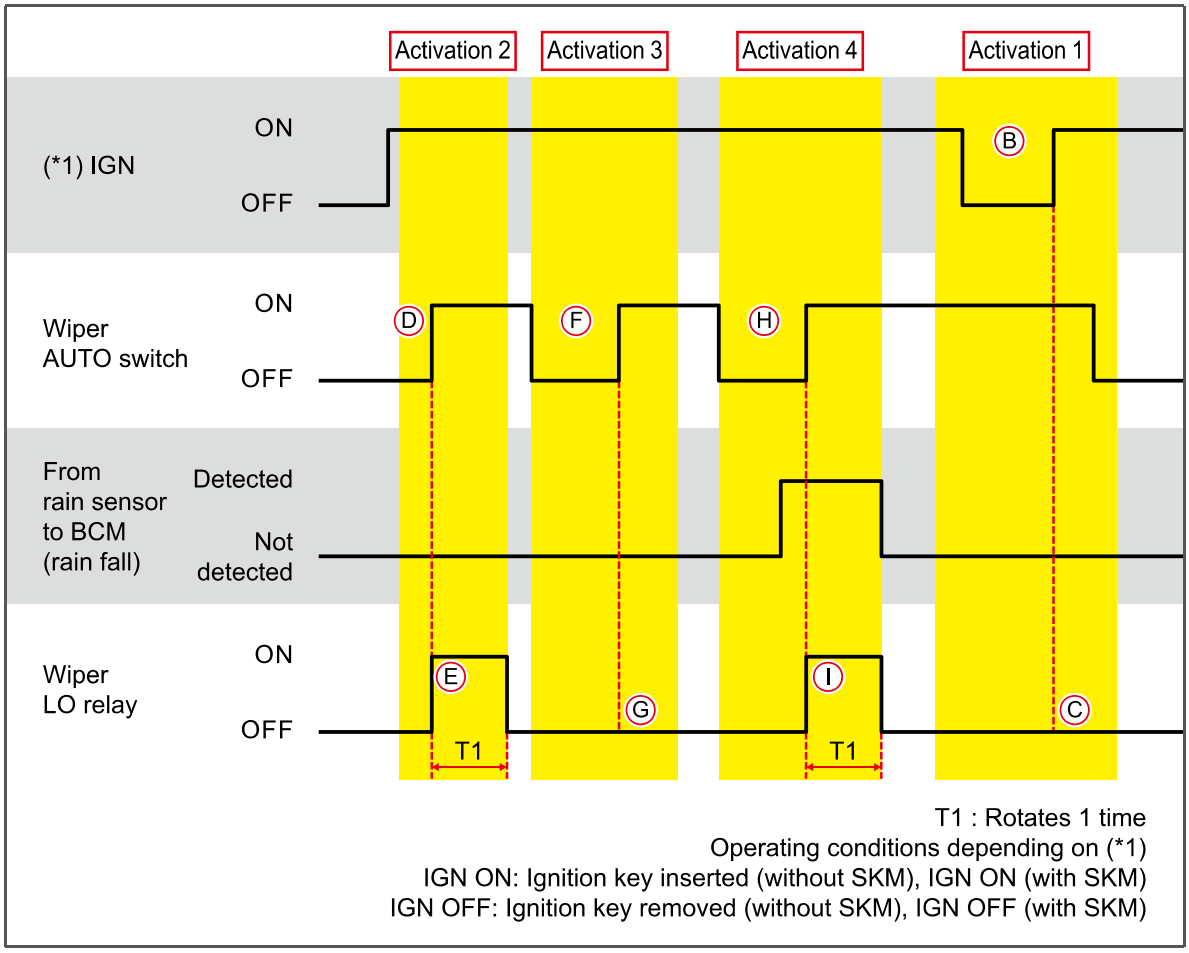
Operation 4.

(The rain sensor detects rain drops after Operation 2.)

H. The ignition is turned ON with the wiper AUTO switch in the ON position.
I. The windshield wiper LO relay is operated.

Modification basis	
Application basis	
Affected VIN	

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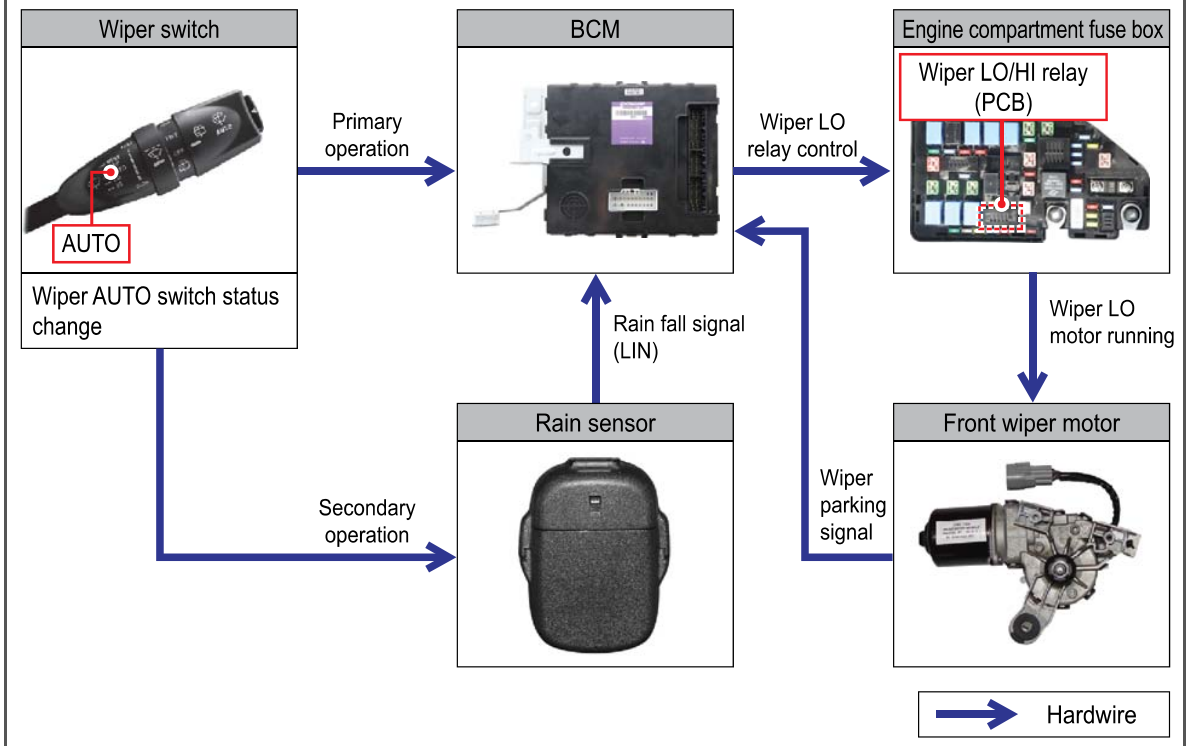
T1 : Rotates 1 time
Operating conditions depending on (*1)
IGN ON: Ignition key inserted (without SKM), IGN ON (with SKM)
IGN OFF: Ignition key removed (without SKM), IGN OFF (with SKM)

Modification basis	
Application basis	
Affected VIN	

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Operating process

- IGN ON



Modification basis	
Application basis	
Affected VIN	

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▶ Washer switch input during rain sensor coupled operation

Basic conditions	Intermittent operation with IGN ON and wiper AUTO switch in ON position

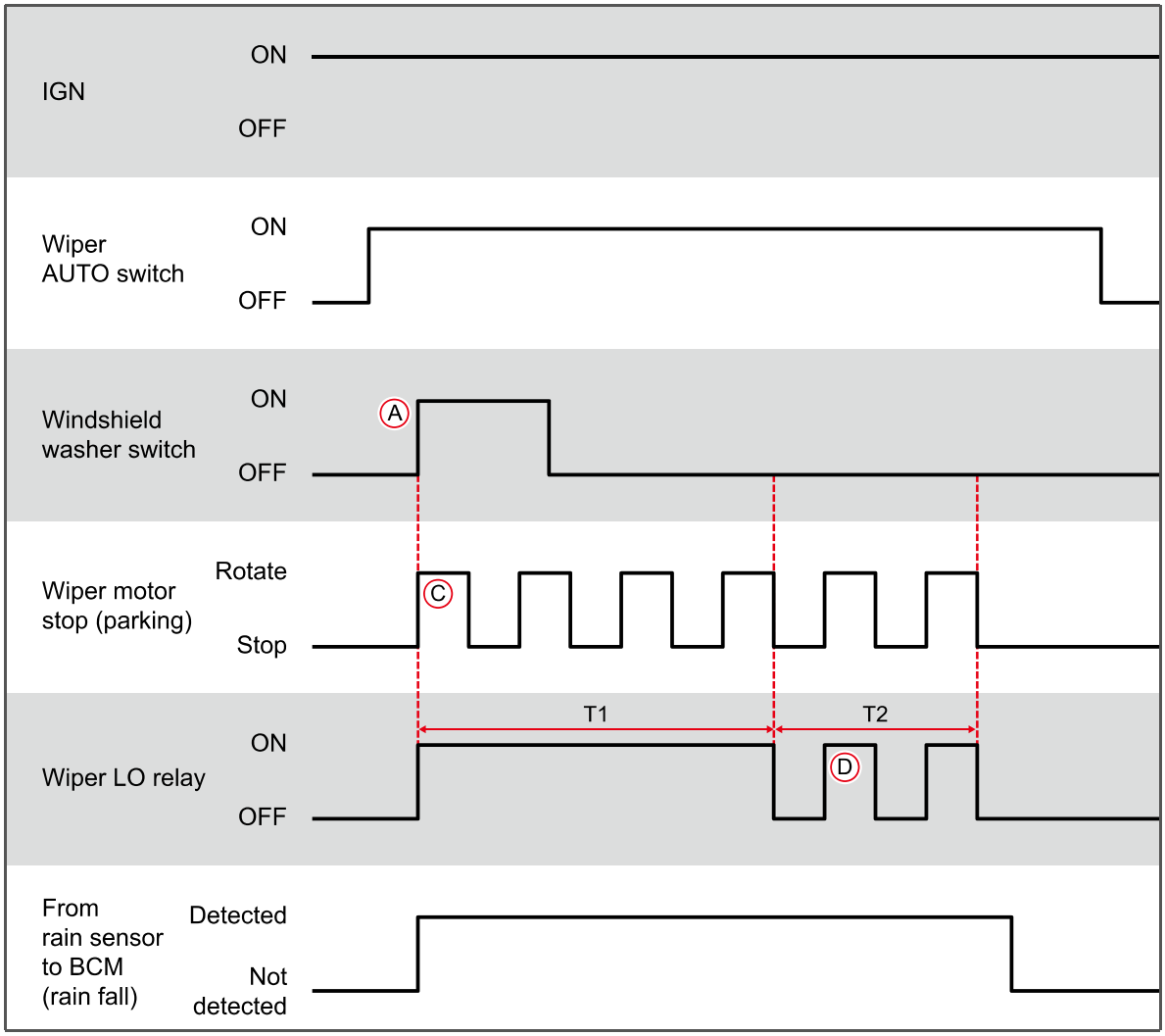
Operation 1.

- The rain sensor coupled data is not continuous wiper operation.

A. The windshield washer switch is in the ON position.
B. The communication with the rain sensor is ignored. (can misread washer fluid as rain drops)
C. The washer coupled wiper operation is activated (T1).
D. After that, the wiper is operated by rain sensor coupled operation (T2).
However, if the washer switch signal is received the washer relay is activated and wiper relay remains activated, when the data coupled with rain sensor indicates continuous wiper operation.

NOTE

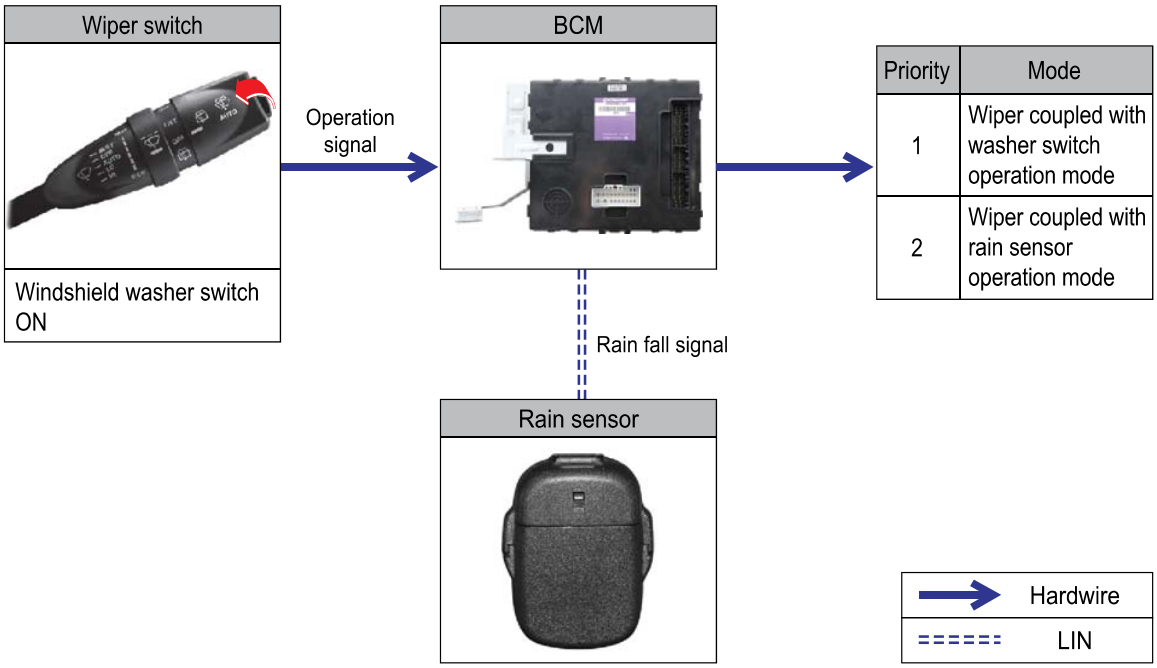
Even though the wiping system is in washer coupled wiper mode, the operating data are sent to rain sensor from the BCM.



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Operating process

- Intermittent operation with IGN ON and wiper AUTO switch in ON position



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▶ Wiper speed control

Basic conditions	IGN ON/Wiper AUTO switch ON/Wiper motor in parking position

Operation 1.

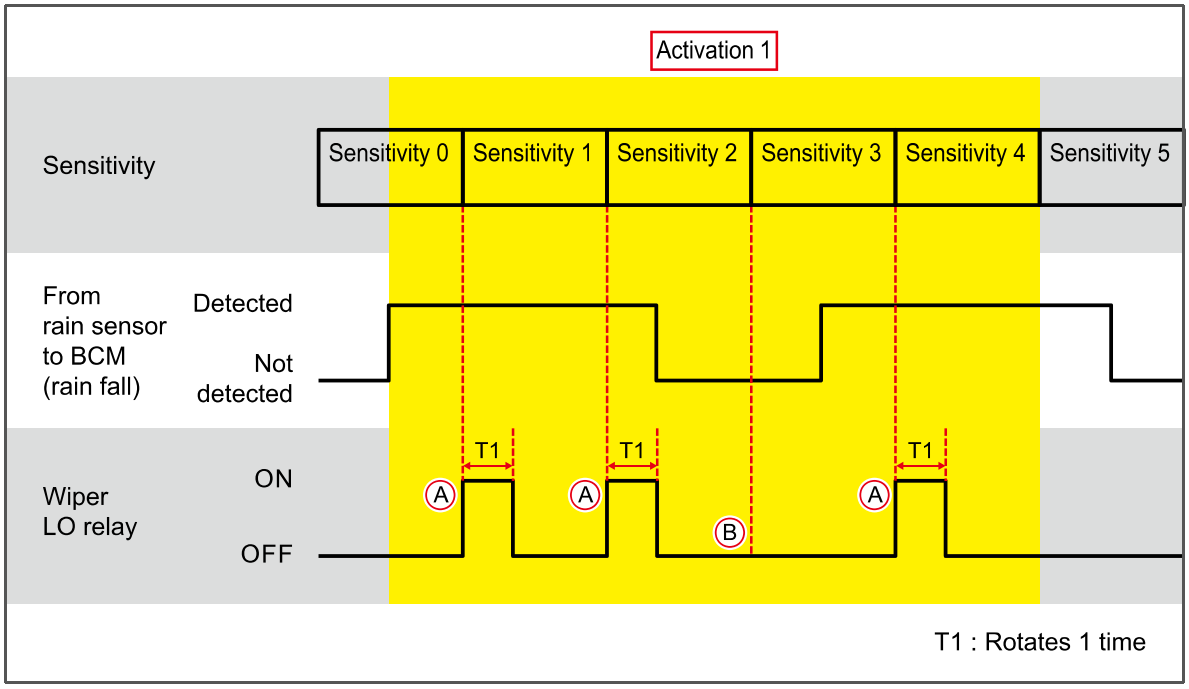
– Increasing the speed level (ex: speed level 0 → level 1)

A. The amount of rain is detected by the rain sensor.
The windshield wiper LO relay is operated once (T1).

B. The amount of rain is not detected by the rain sensor.
The windshield wiper LO relay is not operated.

NOTE

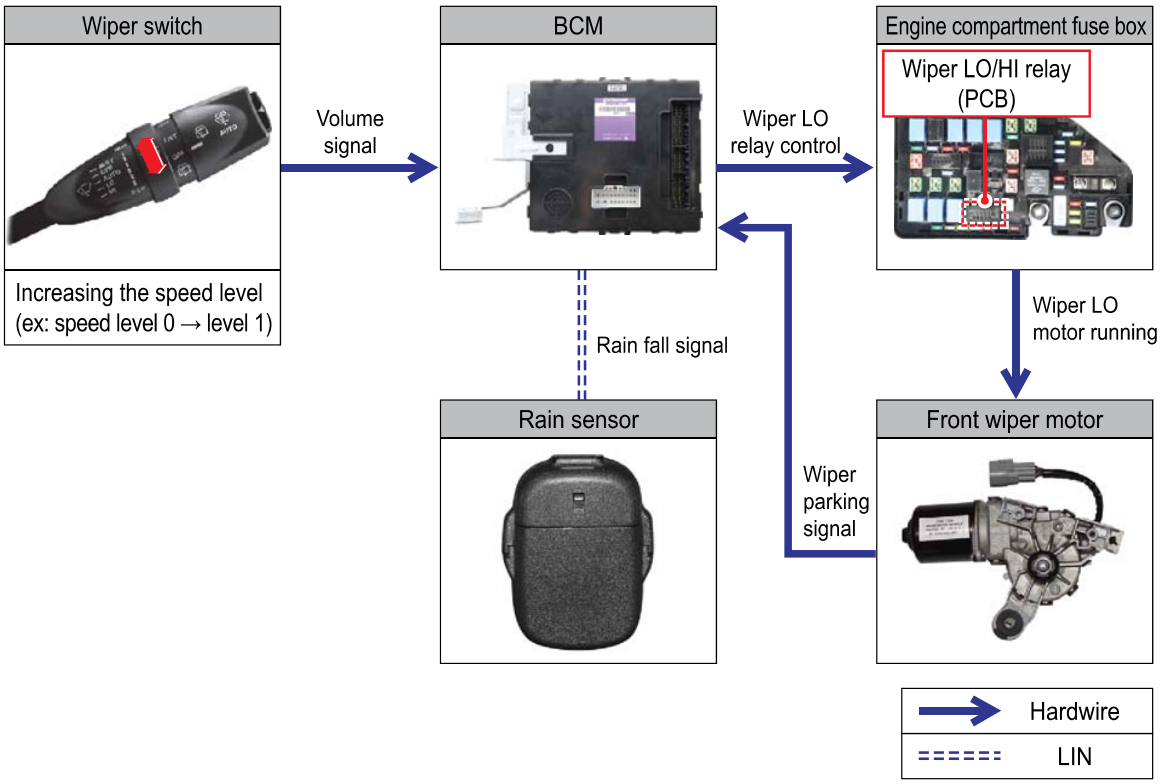
If the speed level is changed more than 1 stage within 2 seconds, the windshield wiper motor runs only one cycle.



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Operating process

- IGN ON/Wiper AUTO switch ON/Wiper motor in parking position



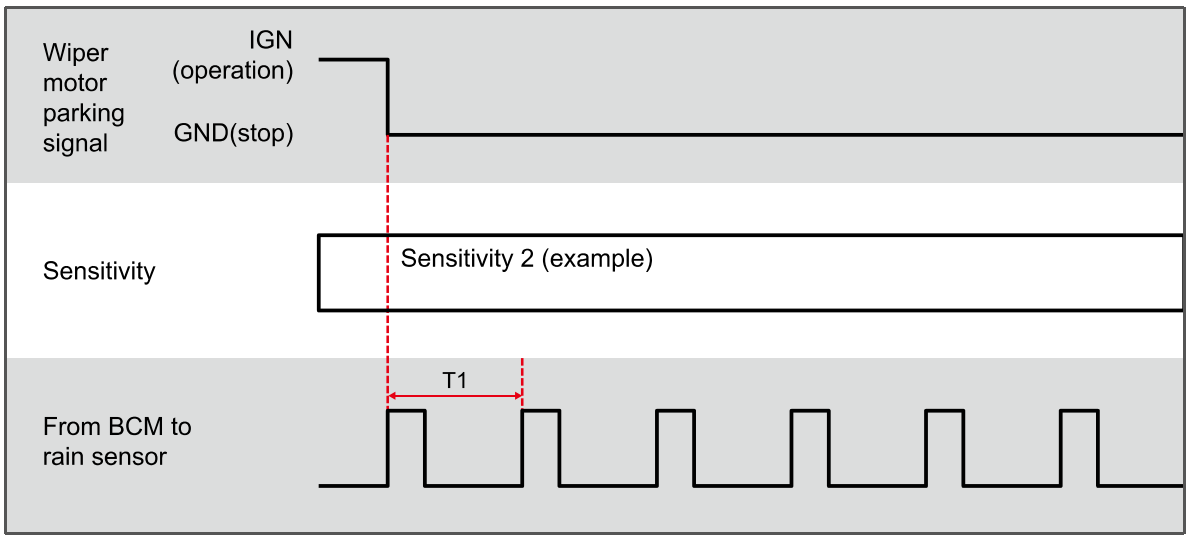
Modification basis	
Application basis	
Affected VIN	

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▶ Abnormal wiper parking signal stop (GND)

Operation 1. (When the wiper motor parking signal stopped at GND)

A. The wiper system sends the corresponding signal of current status with IGN ON and wiper AUTO switch ON. (The wiper motor is operated only when the request signal from the rain sensor is received.)

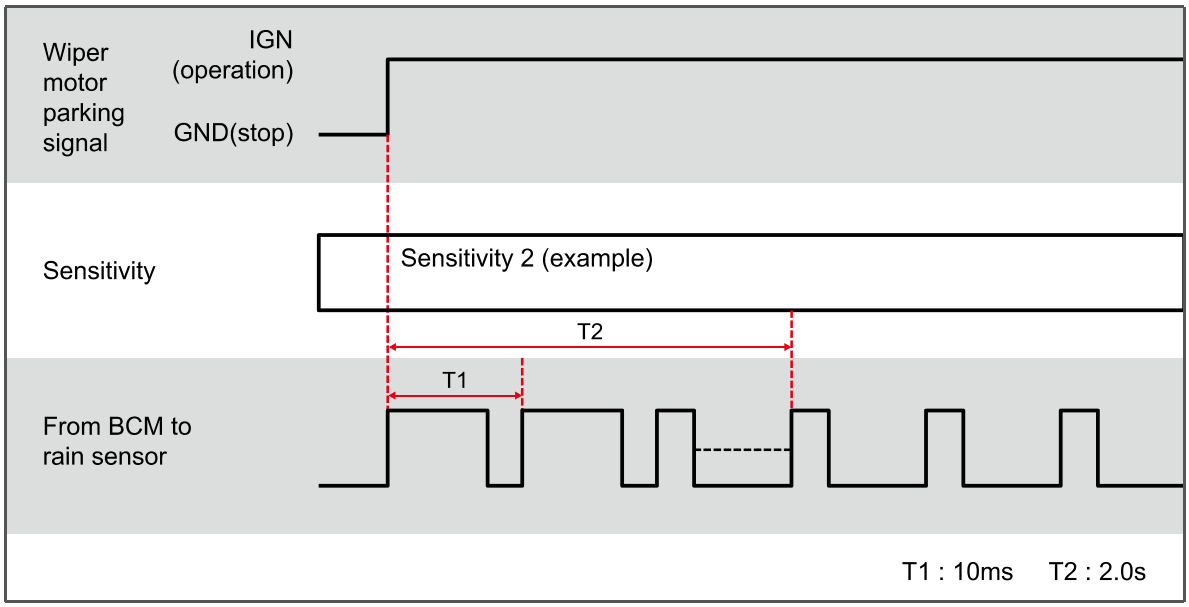


▶ Abnormal wiper parking signal stop (IGN)

Operation 1. (When the wiper motor parking signal stopped at ING)

A. The wiper system sends the corresponding signal of current status for 2 seconds (T2) with IGN ON and wiper AUTO switch ON.

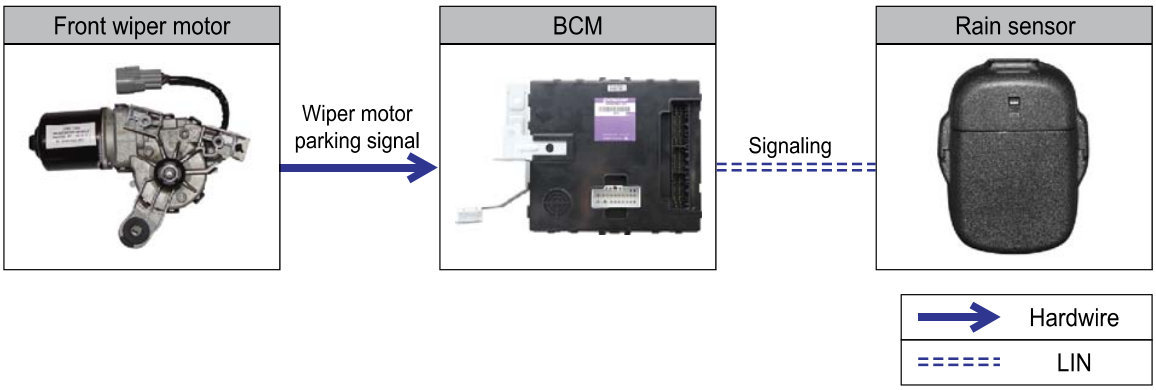
B. After the 2 seconds (T2), the system outputs the signal of the stopped status.
(The wiper motor is operated only when the request signal from the rain sensor is received.)



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Operating process

- IGN ON/Wiper AUTO switch ON/Wiper motor in parking position



Modification basis	
Application basis	
Affected VIN	

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▶ Rain sensor malfunction (rain sensor external malfunction)

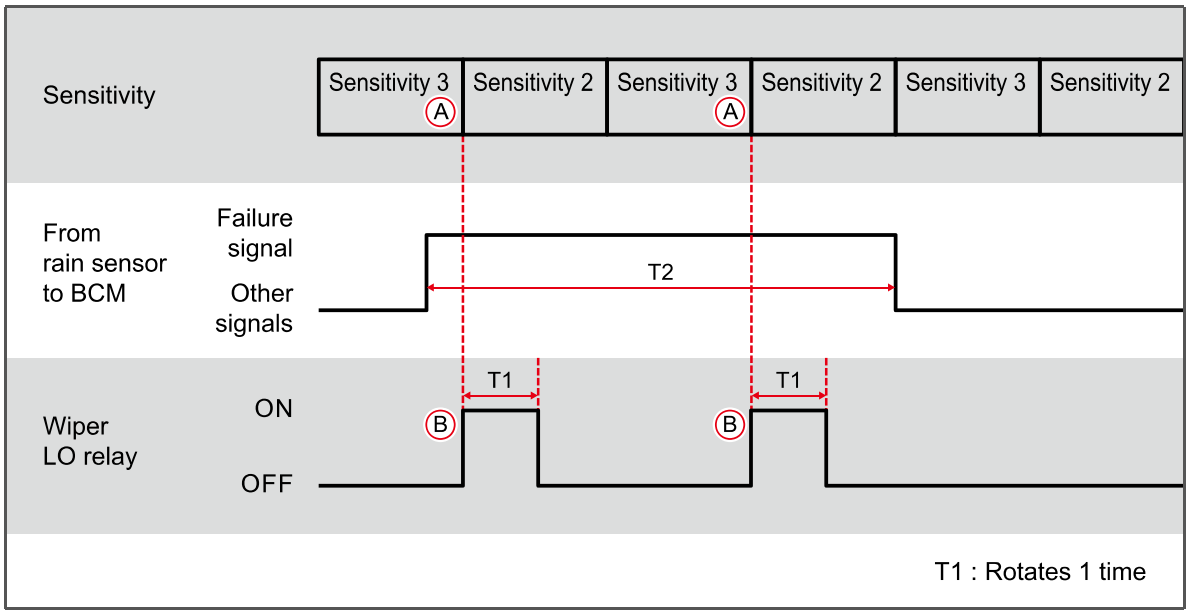
Basic conditions	IGN ON and wiper AUTO switch in ON position

Operation 1.

("rain sensor installed improperly" signal received from the rain sensor)

A. The wiper AUTO switch speed level is adjusted (speed level 3 → level 2)

B. The wiper LO relay is operated once (T1).



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▶ Rain sensor malfunction (no rain sensor signal)

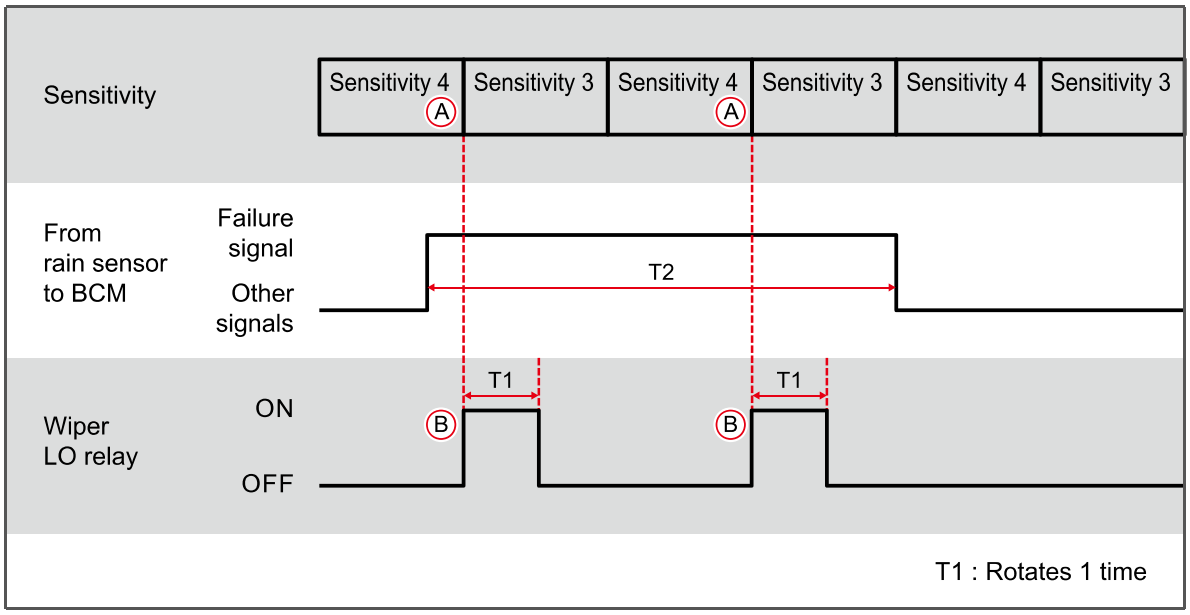
Basic conditions	IGN ON and AUTO switch ON

Operation 1.

("no signal detected" signal received from the rain sensor)

A. The AUTO switch speed level is adjusted (ex: speed level 4 → level 3)

B. The wiper LO relay is operated once (T1).

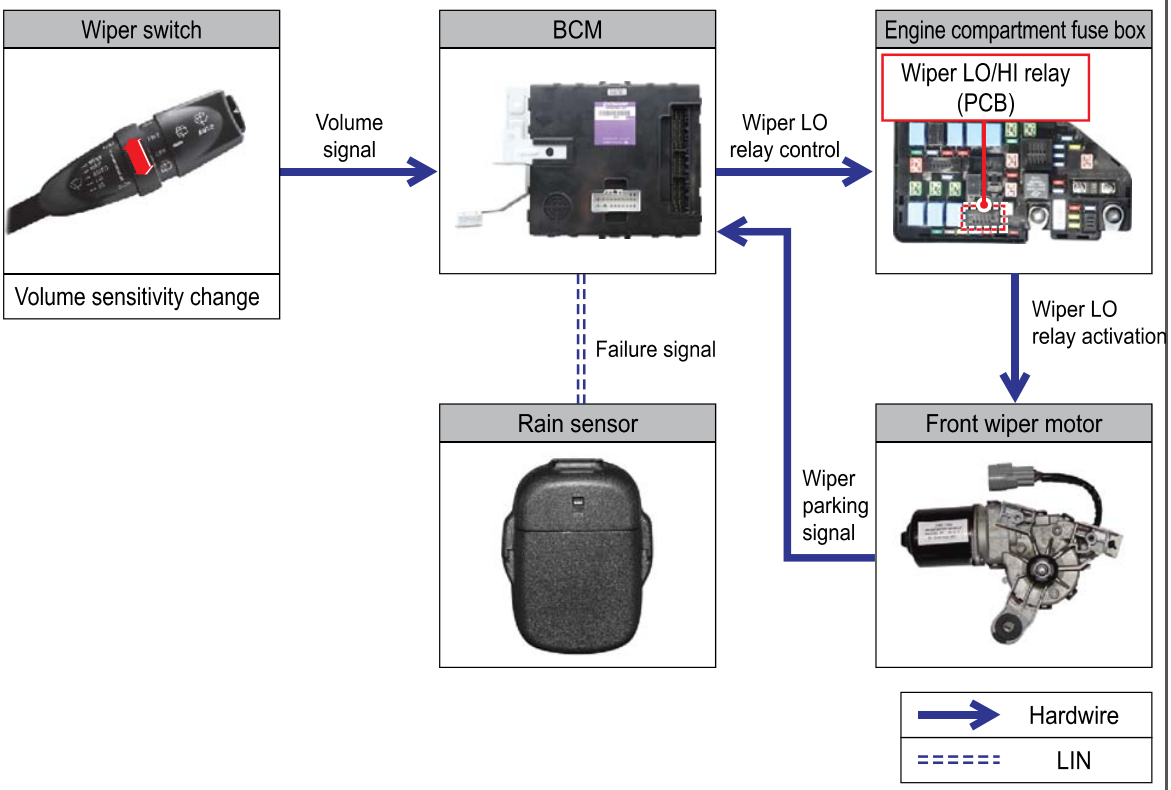


Modification basis	
Application basis	
Affected VIN	

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Operating process

- IGN ON/Wiper AUTO switch ON



Modification basis	
Application basis	
Affected VIN	

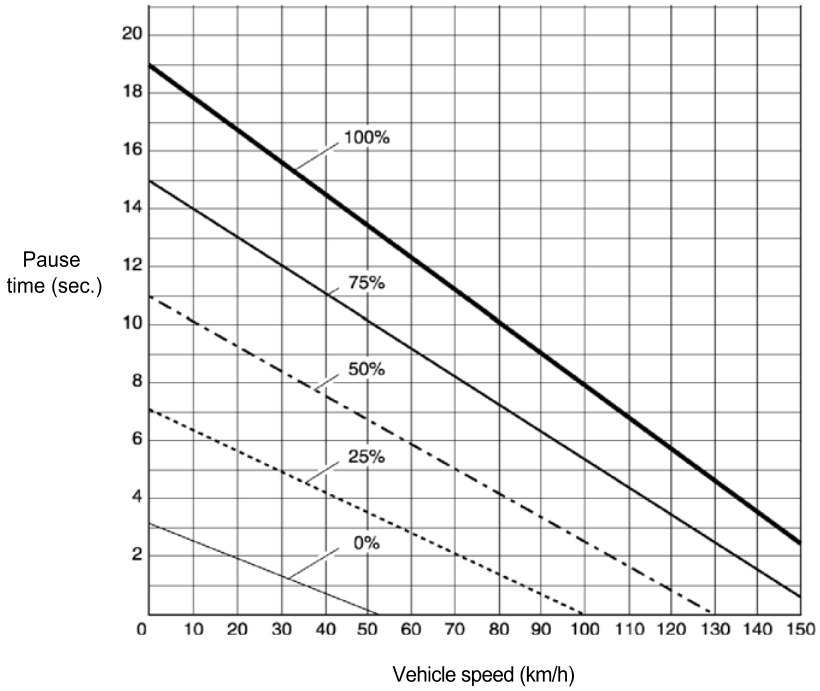
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▶ Speed sensitive AUTO wiper

The speed sensitive AUTO wiper is operated as follows for the vehicles without rain sensor or the vehicles without rain sensor coupled wiper operation because of faulty rain sensor.

- Intermittent wiper operation by the values from vehicle speed and speed level of the wiper speed control.

Speed sensitivity AUTO switch rest time



AUTO switch level		
Level	**Resistance**	**Remarks**
0%	3 kΩ or less	FAST
25%	8 kΩ to 13 KΩ	
50%	18 kΩ to 30 KΩ	
75%	35 kΩ to 43 KΩ	
100%	45 kΩ or more	SLOW

There are HYSTERISIS ranges between the levels.

NOTE

- The wiper remains activated for the time remaining when the AUTO switch is turned OFF during the speed sensitive wiper operation.
- The intermittent operation is reactivated when the AUTO switch is turned ON with IGN ON.
- The intermittent operation is reactivated when the AUTO switch is turned ON with IGN ON.

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▶ Wiper troubleshooting

Symptom 1. The wiper does not cycle one time when turning the multi-function wiper switch from OFF to AUTO position or when starting the engine with the multi-function wiper switch in AUTO position.

1. When starting the engine with the multi-function wiper switch in AUTO position, the wiper always cycles one time to remind the driver of system in AUTO mode.
2. This wiper operation is performed only for the first time when turning the multi-function wiper switch from OFF to AUTO position with IGN ON. If the switch is turned from OFF to AUTO again after that, the wiper is operated only when raining to prevent the wiper blade from wearing.

NOTE

The wiper also cycles one time when the multi-function wiper switch is turned from OFF to AUTO position during 5 minutes after the rain stops.

Symptom 2. It rains but the wiper does not work with the wiper switch in AUTO position.

1. Check if the multi-function wiper switch is in AUTO position.
2. Check the power to the rain sensor. That is, check the pin no. 3 (GND) and pin no. 4 (IGN).
3. Check that the wiper relay is intact.

Symptom 3. The wiper operates 3 or 4 times with high speed abruptly.

Check if the wiper speed control switch is set to the fast side.
The fast stage has the highest sensitivity and is very sensitive to the small change of amount of rain drops. Therefore, adjust the knob to lower the sensitivity level.

Symptom 4. The wiper continues work even if the windshield glass is dry.

1. Check the wiper blade for wear. If the wiper blade cannot wipe the glass uniformly and clearly, this problem could occur. In this case, replace the wiper blade with a new one.
2. Check if the wiper speed control switch is set to the fast side.

The fast stage has the highest sensitivity and is very sensitive to the small change of amount of rain drops. Therefore, adjust the knob to lower the sensitivity level.

Symptom 5. The overall wiper response is too fast or slow.

Check if the wiper speed control switch is set to the fast or slow side.
Notify that the user can select the sensitivity by selecting the variable resistance value. And, select a proper stage.

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▶ Wiper LO/HI control

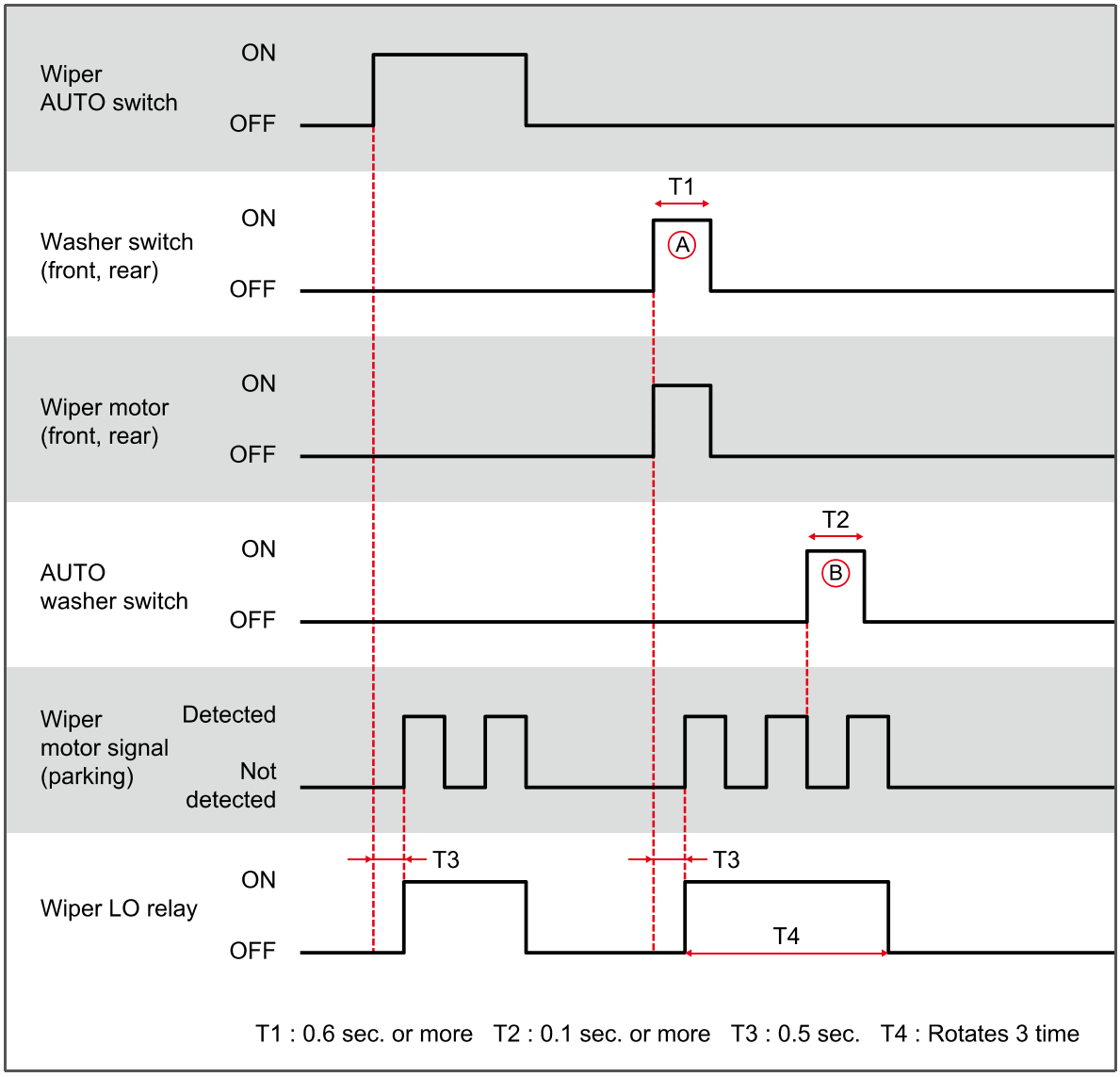
Operation 1.

A. When front or rear washer signal is input during the wiper LO/HI operation, the front or rear washer motor is activated.
B. The AUTO washer input is overridden during wiper LO/HI operation.

NOTE

- When the signal from the wiper LO/HI switch is received, the wiper LO/HI relay is turned ON/OFF. (The wiper LO relay is always activated when the HI relay is activated.)
- If the ignition turned OFF while the wiper is operated, the wiper stops operating when the wiper motor parking signal is input.
- If no wiper motor parking signal is input during the wiper LO/HI operation, the wiper relay continues working. (If no wiper parking signal is input for 3 seconds of wiper AUTO operation, wiper relay is deactivated after 5 seconds - failure notification)
- When the ignition is turned OFF during the wiper HI operation, the wiper is operated in LO mod and then returns to the parking position.

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5. IGNITION KEY REMINDER

▶ **Internal buzzer (chime) operation for ignition key reminder**

Operation 1.

A. When the driver door is opened with the ignition key inserted, the internal buzzer (chime) is operated for 10 seconds at intervals of 0.02 sec. ON/1.38 sec. OFF.

Operation 2.

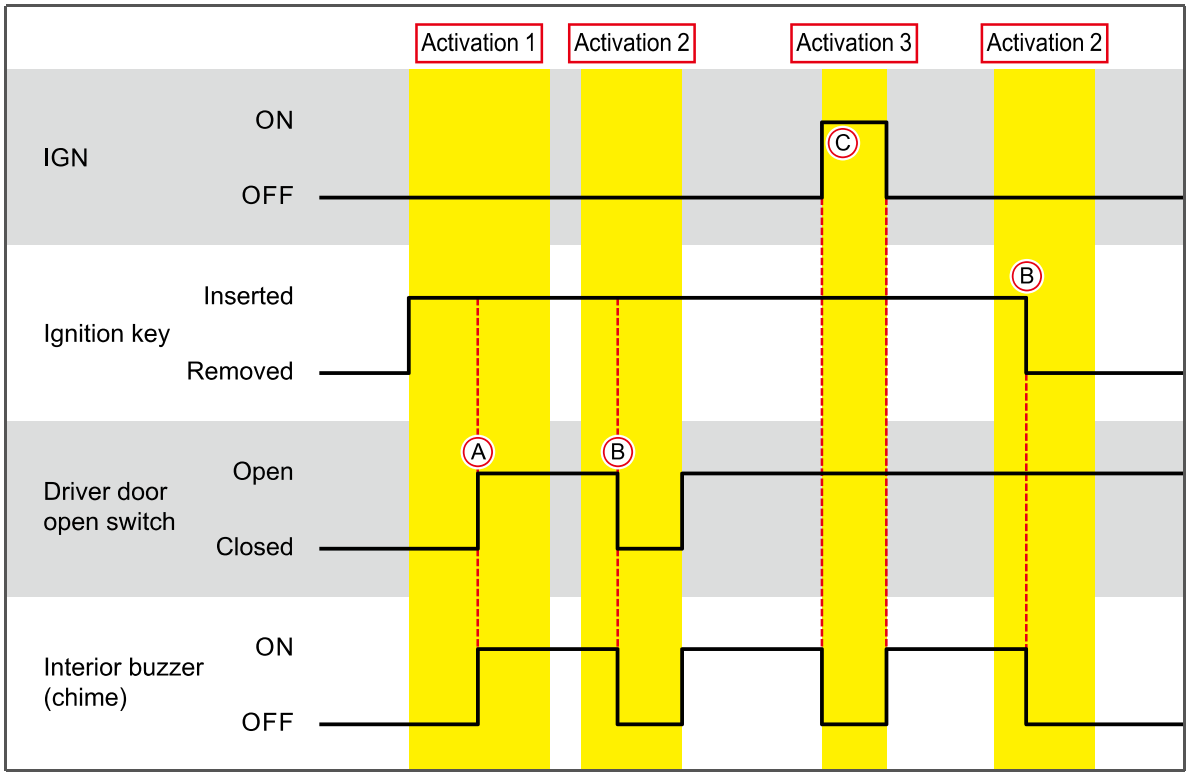
B. When the ignition key is removed or the driver door is closed while the internal buzzer (chime) is activated for up to 10 seconds, the buzzer is deactivated.

Operation 3.

C. The 2 operations stated above are not available after the ignition is turned ON.

NOTE

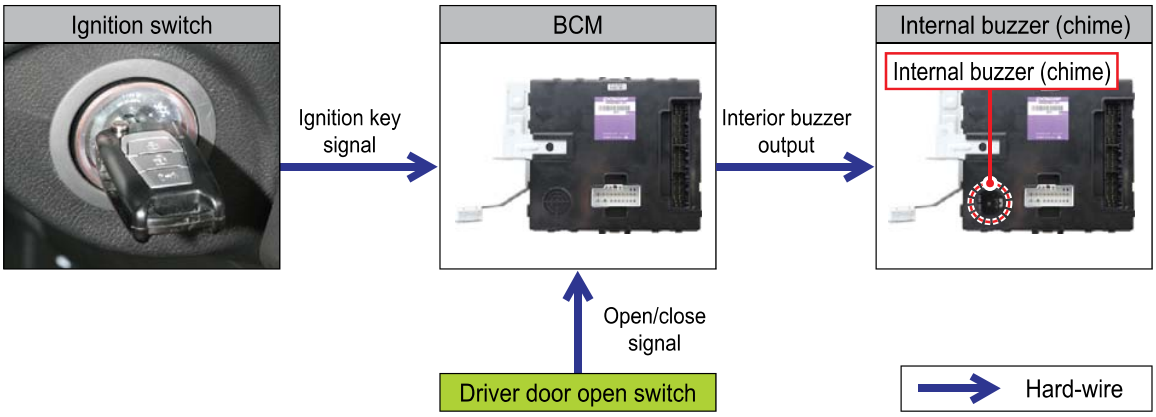
This function overrides the tail lamp switch warning function.



Modification basis	
Application basis	
Affected VIN	

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Operating process



Mounting location for internal buzzer (chime)



NOTE

The internal buzzer (chime) is fitted inside the BCM.

Modification basis	
Application basis	
Affected VIN	

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▶ **Ignition key reminder operation**

Operation 1.

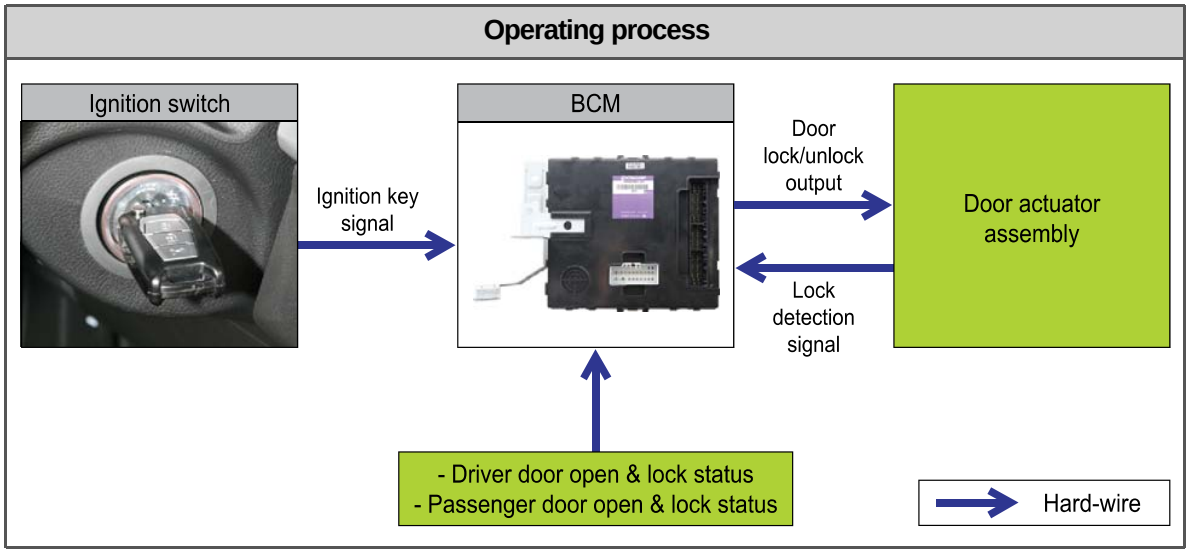
A. The door LOCK switch is in LOCK position after the driver door is opened with the ignition key inserted.
B. The UNLOCK signal is output for 0.5 seconds (T2) immediately after the LOCK signal output.

Operation 2.

C. The door LOCK switch is in LOCK position within 0.5 seconds (T1) after the door is closed with the ignition key inserted.
D. The UNLOCK signal is output for 0.5 seconds (T2) immediately after the LOCK signal output.

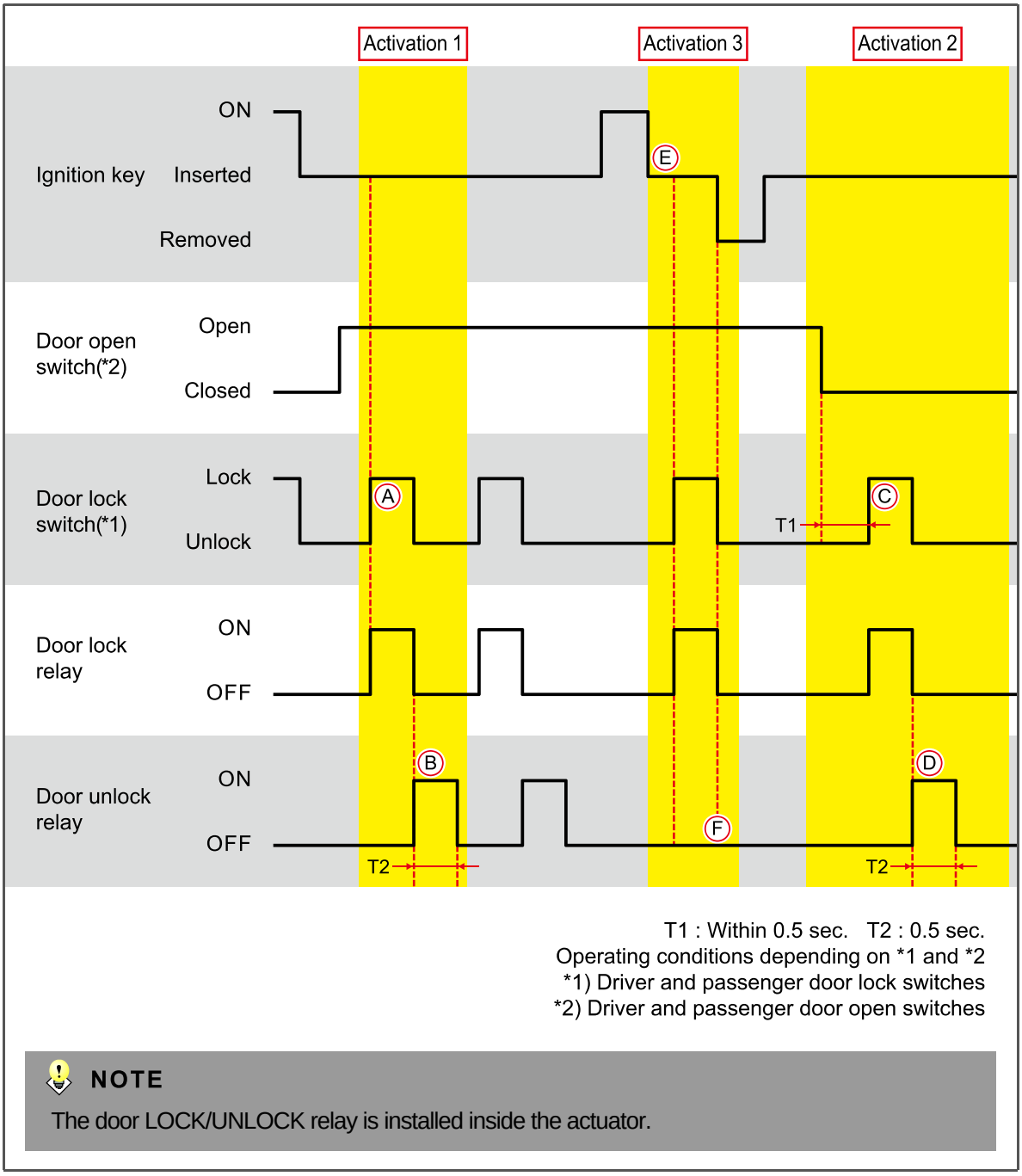
Operation 3.

E. The door LOCK switch is in LOCK position after the driver door is opened with the ignition key inserted.
F. The door UNLOCK signal is not output when the ignition key is removed during the door LOCK output.



Modification basis	
Application basis	
Affected VIN	

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T1 : Within 0.5 sec. T2 : 0.5 sec.
Operating conditions depending on *1 and *2
*1) Driver and passenger door lock switches
*2) Driver and passenger door open switches

NOTE

The door LOCK/UNLOCK relay is installed inside the actuator.

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▶ All doors LOCK prevention function

Operation 1.

A. When the LOCK signal is input with the doors (driver/passenger/rear) open and the ignition key removed or IGN ON).
B. The UNLOCK signal is output for 0.5 seconds (T1) immediately after the LOCK signal output.
- Except tailgate and hood

Operation 2.

C. All doors are closed during the UNLOCK output.
D. The UNLOCK output continues.

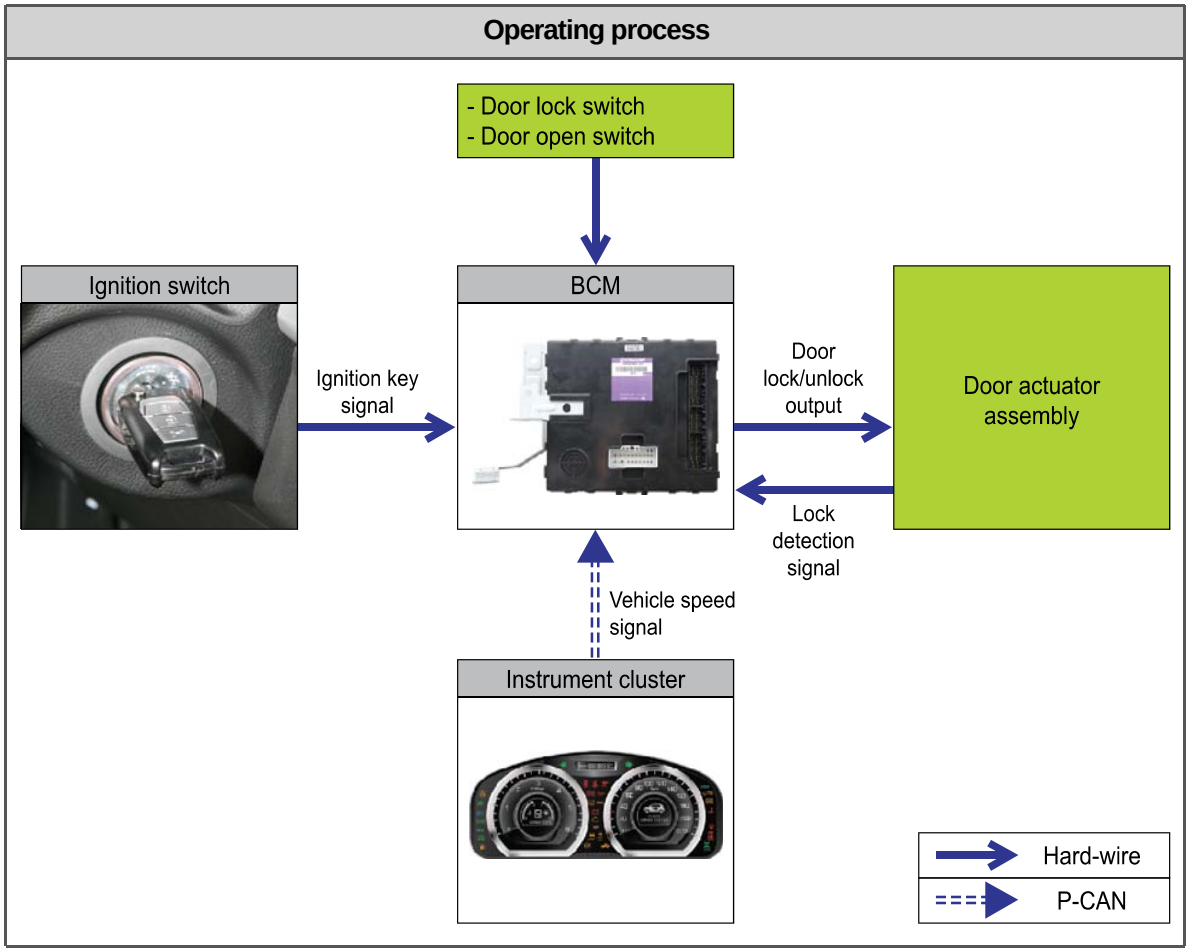
Operation 3.

E. When the ignition key is inserted, the ignition key reminder is operated.

NOTE

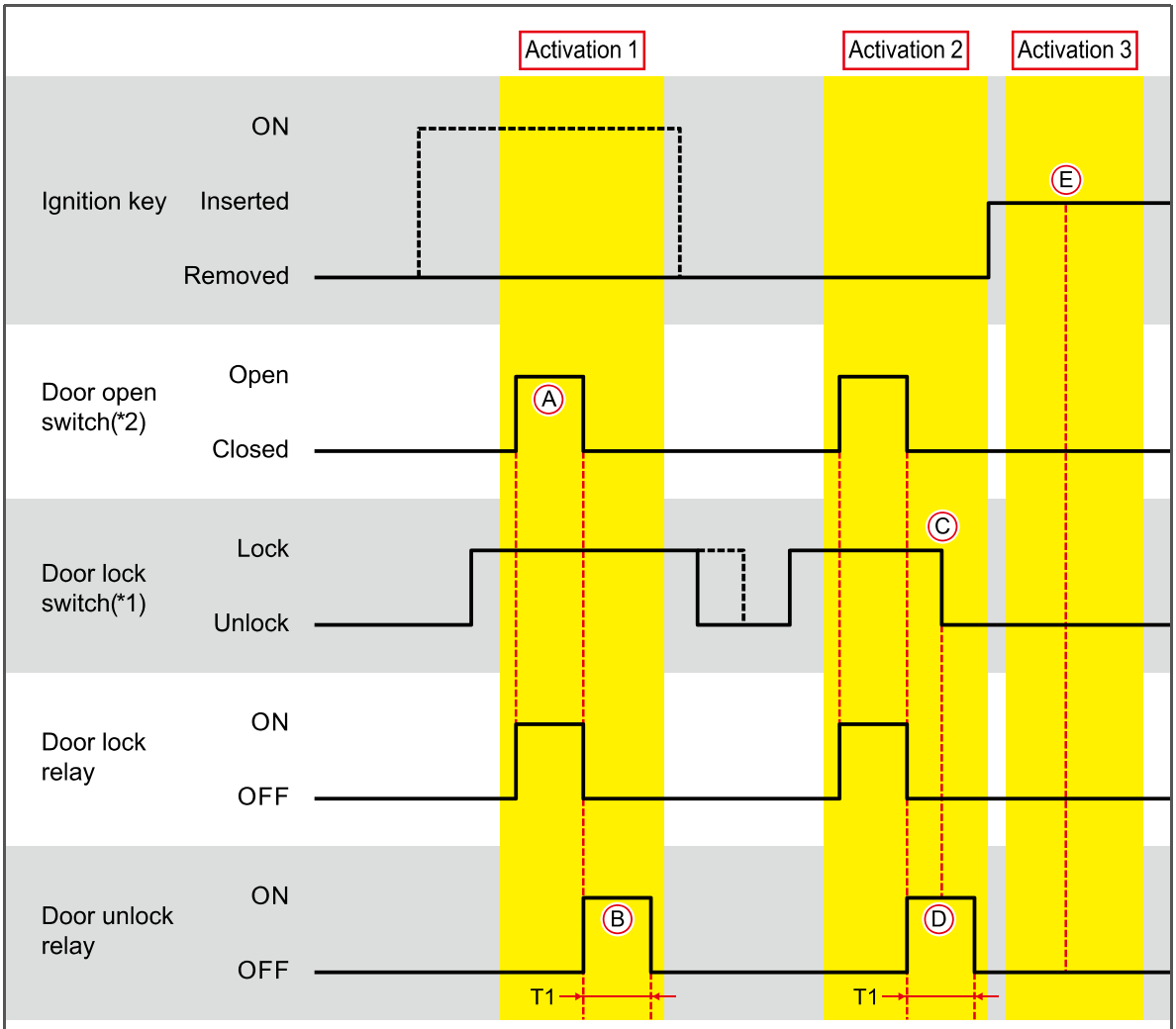
This function does not work if the vehicle speed is over 10 km/h.

Operating process



Modification basis	
Application basis	
Affected VIN	

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T1 : 0.5 sec.
Operating conditions depending on *1 and *2
*1) Driver/passenger/rear LH/RH door lock switch
*2) Driver/passenger/rear LH/RH door open switch

NOTE

The door LOCK/UNLOCK relay is installed inside the actuator.

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6. TAIL LAMP CONTROL

▶ **Tail lamp ON warning**

Operation 1.

A. The driver door is opened with the tail lamp ON and ACC or IGN OFF (ignition key removed).
B. The internal buzzer (chime) sounds for 10 seconds (T2) at intervals of 1.4 seconds (T1).

Operation 2.

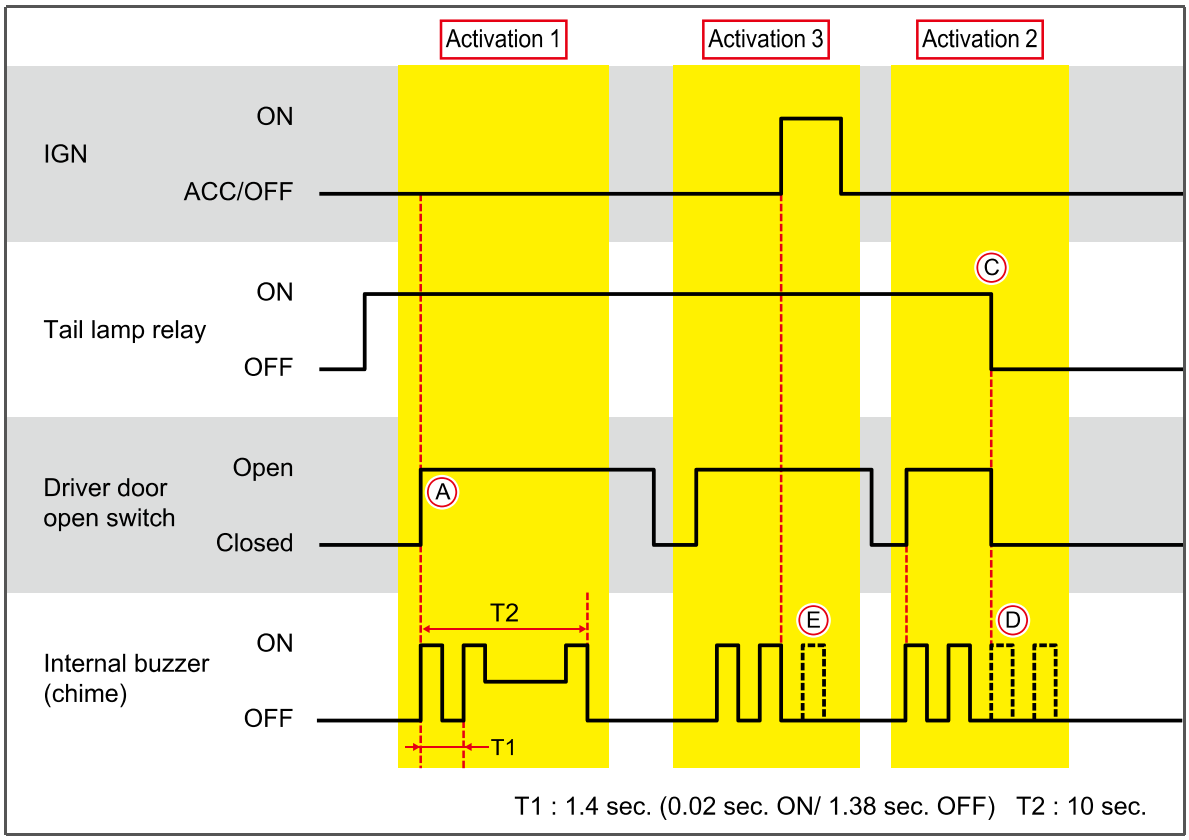
C. The tail lamp switch is turned OFF while the internal buzzer (chime) is activated, or the driver door is closed.
D. The internal buzzer (chime) is deactivated immediately.

Operation 3.

E. The 2 operations stated above are not available after the ignition is turned ON.

NOTE

- The sunroof and ignition key reminder warnings override this function.
- If the tail lamp switch is turned ON from OFF while the internal buzzer (chime) is activated, the buzzer sounds again.

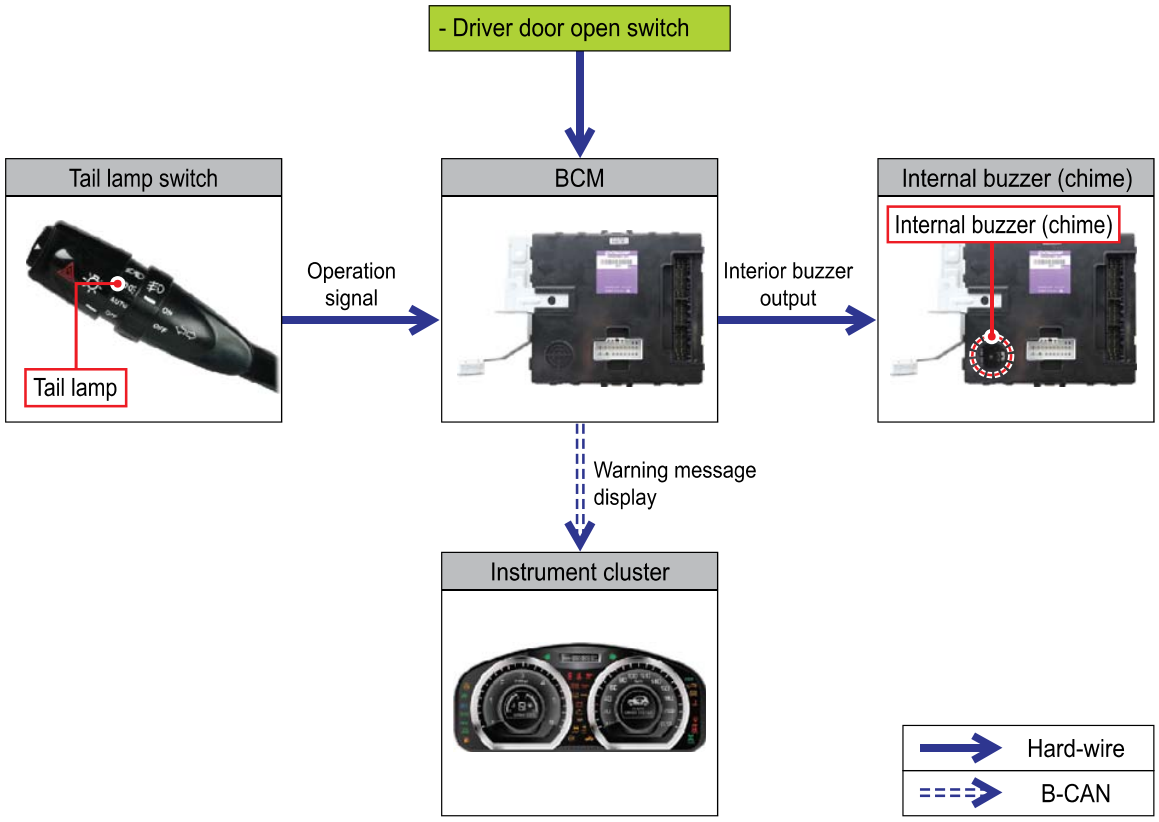


Modification basis	
Application basis	
Affected VIN	

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Operating process

- IGN OFF (ignition key removed)



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▶ Tail lamp AUTO switching off

Operation 1.

A. The tail lamp relay is turned ON or OFF according to the ON/OFF operation of the tail lamp switch.

Operation 2.

B. When the ignition is turned OFF or the ignition key is turned to the ACC ON position (ignition key removed) with the tail lamp switch ON.
C. After this, the tail lamp relay is turned OFF automatically when the driver door is opened and then closed. (with tail lamp switch ON)

Operation 3.

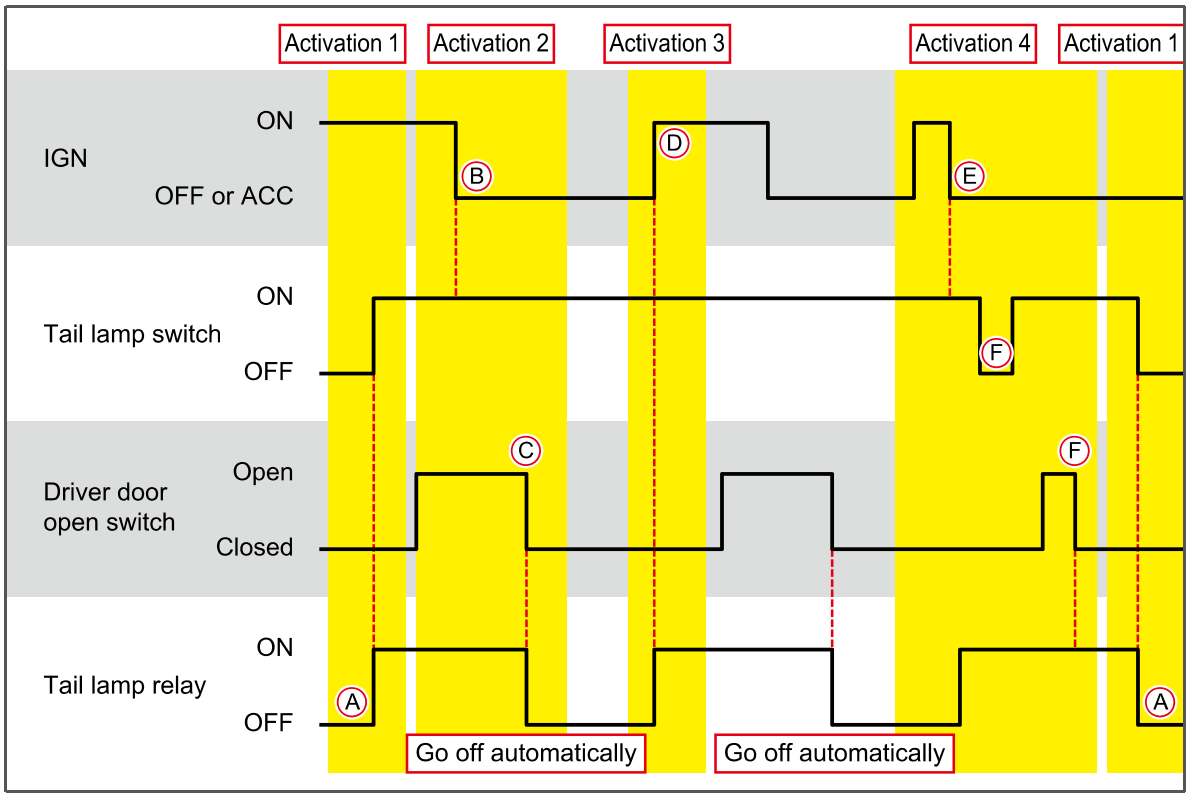
D. When the ignition is turned ON (ignition key inserted) after the operation 2, the tail lamp relay is turned ON.

Operation 4.

E. The ignition is turned OFF or the ACC is turned ON (ignition key removed).
F. After the tail lamp is turned ON, the lamp relay is not turned OFF automatically when the driver door is opened and then closed. (with tail lamp switch ON)

NOTE

To reset, turn the ignition ON (ignition key inserted)

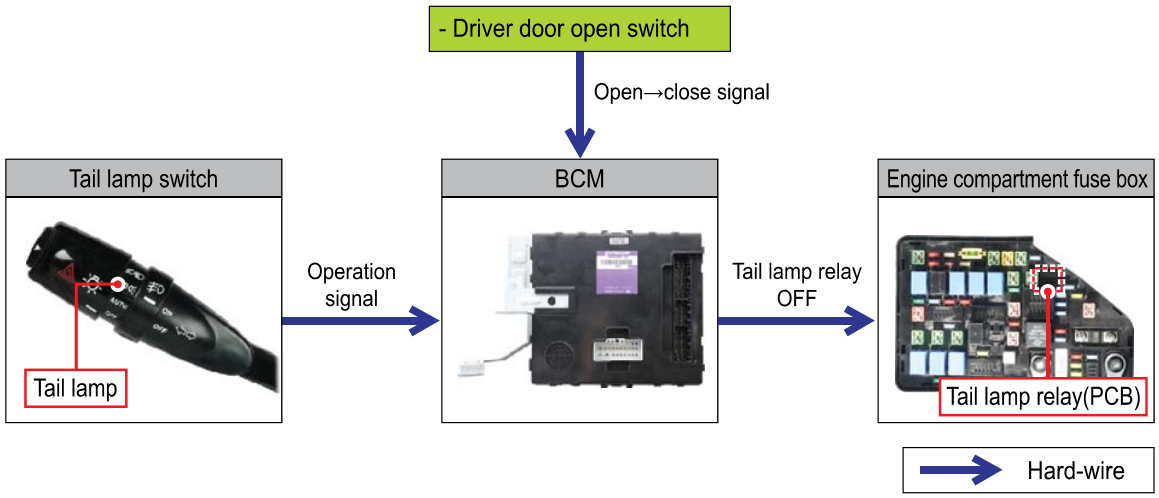


Modification basis	
Application basis	
Affected VIN	

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Operating process

- IGN OFF (ignition key removed)



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7. DOOR AJAR WARNING LAMP CONTROL

▶ **Door ajar warning lamp**

Operation 1.

A. When the door ajar signal is input while the vehicle is driven at 10 km/h or less (V2).
B. The door ajar warning lamp comes on.
- The door ajar warning lamp goes out when the open door is closed under the condition stated above.

Operation 2.

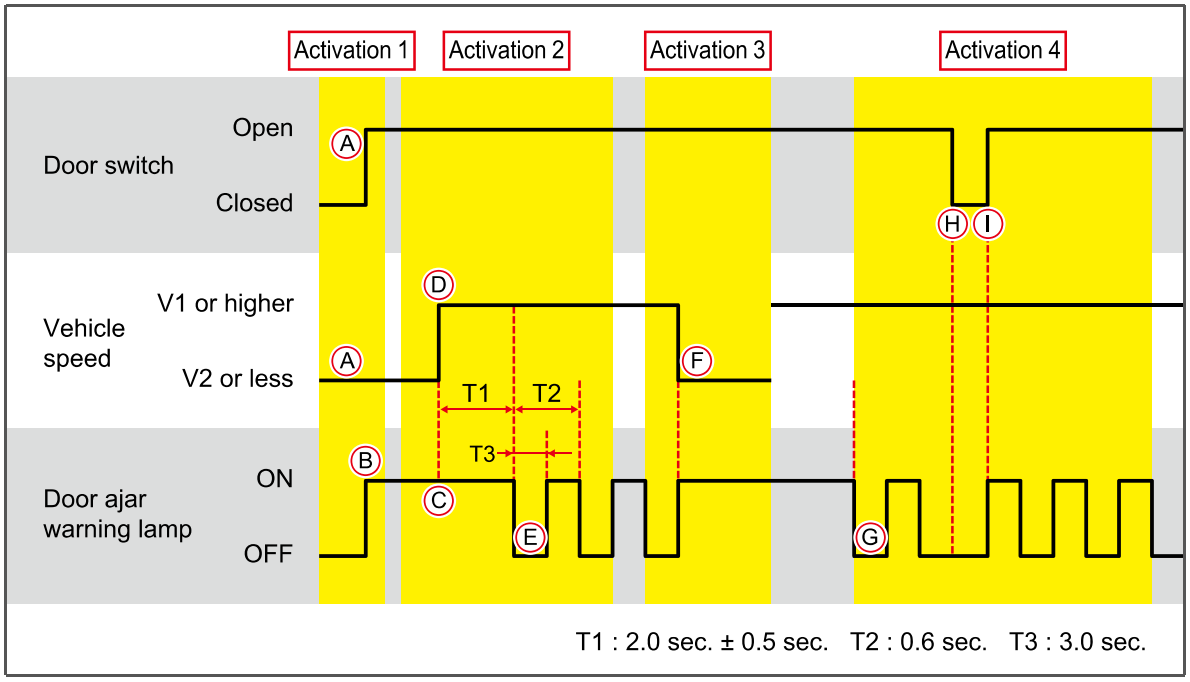
C. The door ajar warning lamp is ON.
D. The vehicle is driven at 10 km/h or more (V1) for 2 seconds or longer (T1).
E. The door ajar warning lamp starts to flash.

Operation 3.
(The warning lamp flashes under the condition of operation 2.)

F. The warning lamp remains on when the vehicle speed decreases to 10 km/h or less (V2).
- The door ajar warning lamp goes out when the open door is closed under the condition stated above.

Operation 4.

G. The door ajar warning lamp flashes.
H. The lamp goes out when the open door is closed.
I. The lamp flashes again whenever a door is opened.

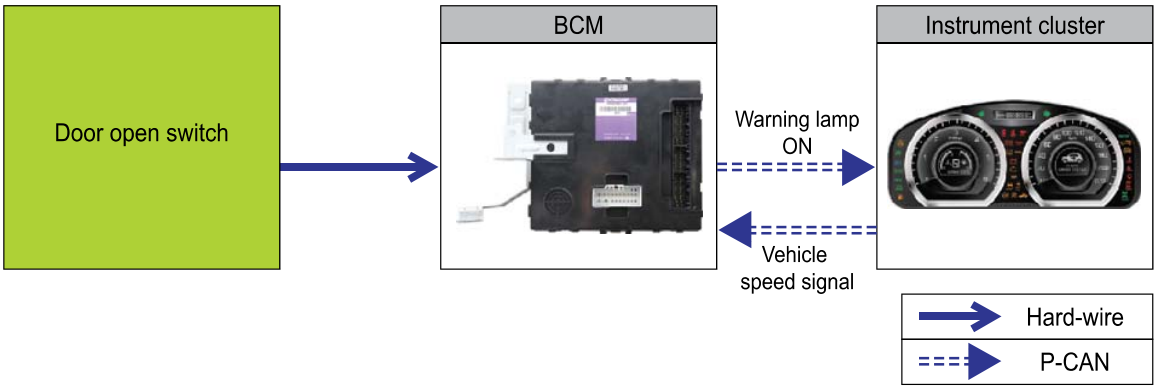


Modification basis	
Application basis	
Affected VIN	

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Operating process

- IGN ON



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8. SEAT BELT CONTROL

▶ **Seat belt internal buzzer (chime) and warning lamp**

Operation 1.

A. The ignition is turned ON from OFF with the driver and passenger seat belts unbuckled.
B. The internal buzzer (chime) sounds and the warning lamp comes on for 6 seconds (T2).
(internal buzzer controlled by BCM, warning lamp controlled by instrument cluster)

Operation 2.

C. The ignition is turned ON from OFF with the driver and passenger seat belts unbuckled.
D. The internal buzzer (chime) does not sound but the warning lamp comes on for 6 seconds (T2).
(The seat belt reminder is operated when the vehicle is driven at 10 km/h (for EU), 25 km/h (for GEN))

Operation 3.

E. When the fastened driver seat belt is unbuckled with IGN ON.
F. The internal buzzer (chime) sounds and the driver seat belt warning lamp comes on for T2 again.

Operation 4.

G. The ignition is turned OFF while the internal buzzer (chime) and seat belt warning lamp are activated.
The internal buzzer (chime) and seat belt warning lamp are deactivated.
H.

Operation 5.

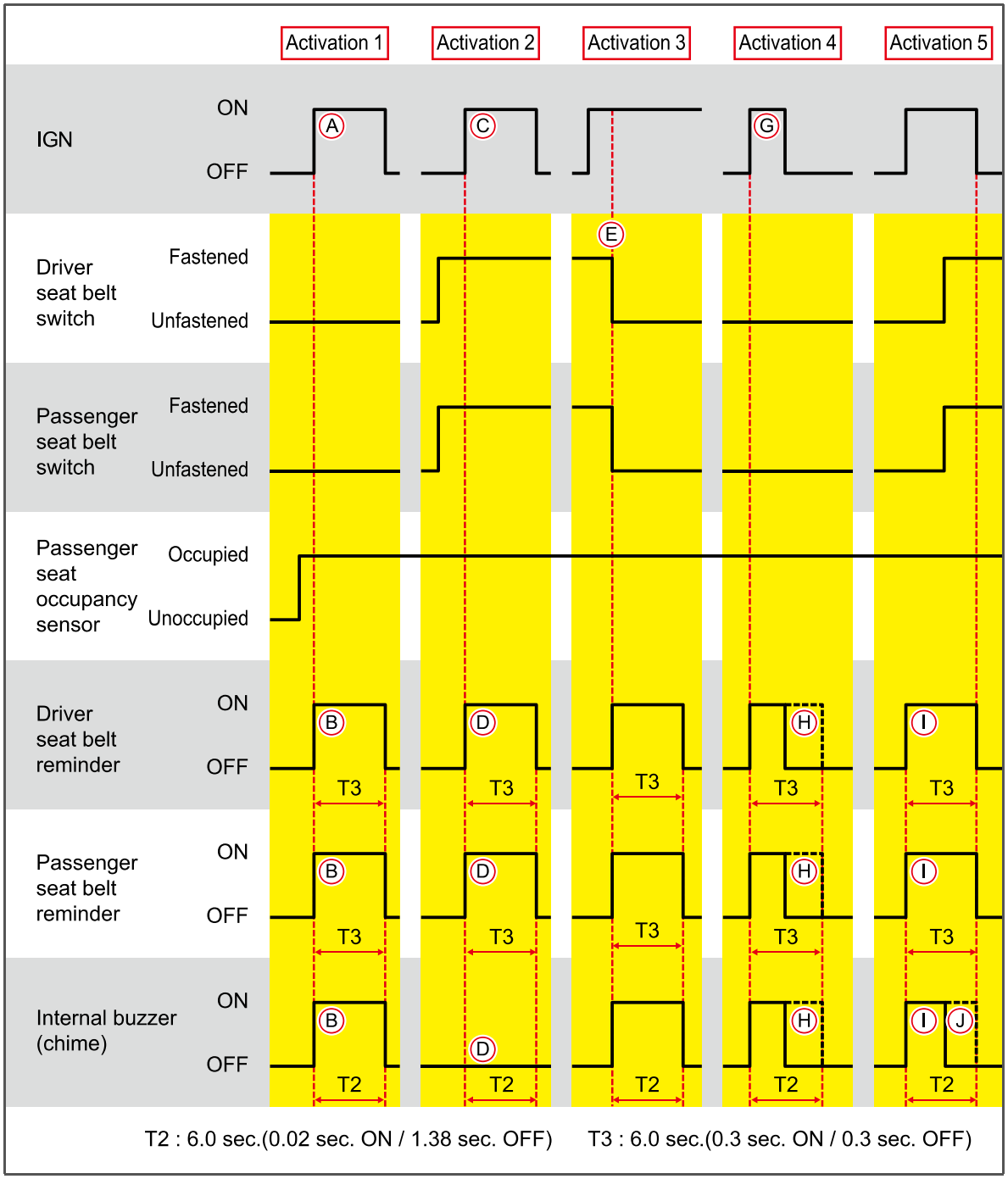
I. The driver seat belt is fastened while the internal buzzer (chime) and seat belt warning lamp are activated.
J. The internal buzzer (chime) does not sound but the warning lamp comes on for the time remaining.

NOTE

- When the seat belt reminder operation conditions are met during the warning, the seat belt reminder is operated after stopping the warning output.
- For the passenger seat, however, the system detects if the passenger seat is empty or occupied and operates the warning lamp only for the first time. After that, the only seat belt reminder detects if the passenger seat is occupied.

Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
Affected VIN	

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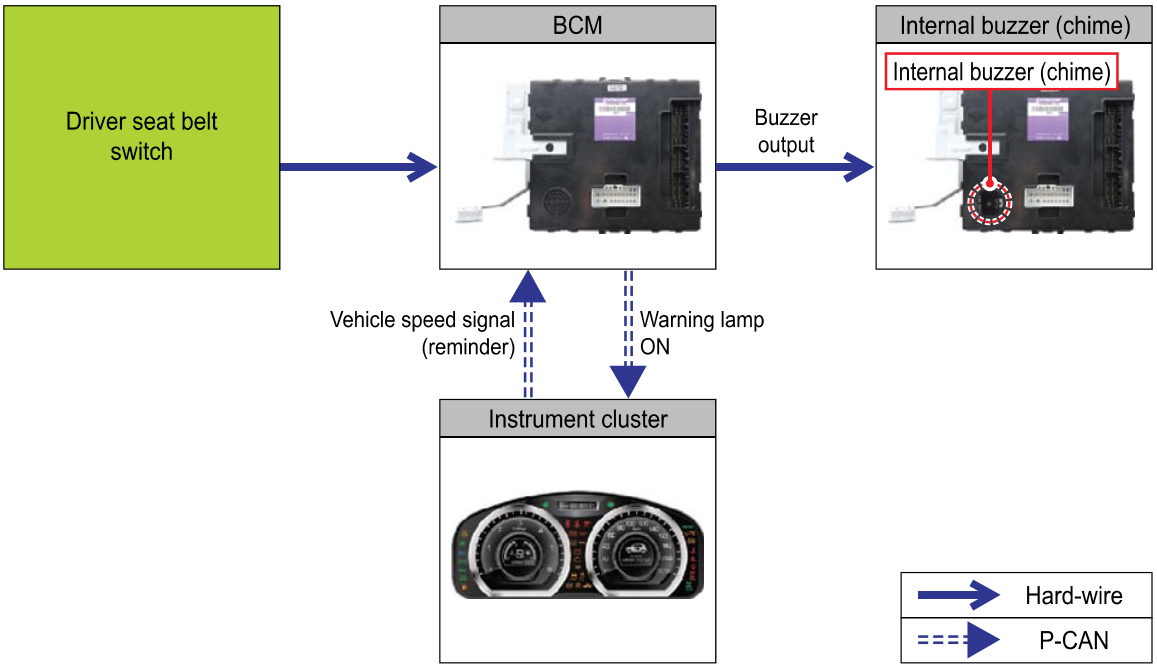
▶ **Seat belt reminder operation**

<table>
<tr><td>A</td><td>▶ Only EU
If the driver and passenger seat belts are not fastened with the ignition switch ON, engine running, vehicle speed above 10 km/h and any passenger occupied, the seat belt reminder is activated. In addition, even though the vehicle speed reduces to below 10 km/h after the reminder is activated at speed of 10 km/h or higher, it will remain activated.</td><td>▶ GEN
The seat belt reminder is operated when the vehicle is driven at 25 km/h or more with IGN ON and alternator in High status (engine running), and driver seat belt is not fastened. If the vehicle speed is decreased to less than 25 km/h within 5 minutes after the seat belt reminder is activated, the internal buzzer (chime) is turned off. If the vehicle speed is increased to 25 km/h or more, the buzzer signal is output for 5 minutes.</td></tr>
<tr><td>B</td><td colspan="2">If the seat belt is fastened after the seat belt reminder is activated, the output of the reminder is turned OFF immediately. The reminder will be operated again whenever the seat belt is unbuckled.</td></tr>
<tr><td>C</td><td colspan="2">When the seat belt reminder is activated initially with the seat belt unbuckled, the internal buzzer (chime) is turned ON for 0.02 seconds and then turned OFF for 1.18 seconds (this cycle continues for 5 minutes) and the driver seat belt warning lamp on the instrument cluster remains on.</td></tr>
<tr><td>D</td><td colspan="2">When the seat belt reminder is activated with the seat belt unbuckled, the internal buzzer (chime) is turned ON for 0.02 seconds and then turned OFF for 1.18 seconds (this cycle continues for 5 minutes) and the passenger seat belt warning lamp on the instrument cluster remains on, after detecting that the passenger seat is occupied through the input value of the passenger seat occupancy sensor.</td></tr>
<tr><td>E</td><td colspan="2">When the vehicle speed is changed while the seat belt reminder is turned on, the internal buzzer (chime) is operated as follows:
<table>
<tr><th rowspan="2">Vehicle speed</th><th colspan="2">Function</th><th rowspan="2">Remarks</th></tr>
<tr><th>Interior buzzer</th><th>Instrument cluster</th></tr>
<tr><td>25 Km/h to 49 Km/h (10km/h~49km/h)</td><td>0.02 sec. ON / 1.18 sec. OFF</td><td>Remains on</td><td>(Only EU)</td></tr>
<tr><td>50 Km/h to 99 Km/h</td><td>0.02 sec. ON / 0.98 sec. OFF</td><td>Remains on</td><td></td></tr>
<tr><td>100 km/h or more</td><td>0.02 sec. ON / 0.78 sec. OFF</td><td>Remains on</td><td></td></tr>
</table></td></tr>
<tr><td>F</td><td colspan="2">Priority of internal buzzer (chime) operation
(Seat belt reminder > ignition key reminder > sunroof warning > tail lamp warning > hazard warning flasher on > turn signal indicator)</td></tr>
</table>

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Operating process

- IGN ON



Modification basis	
Application basis	
Affected VIN	

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9. SUNROOF WARNING LAMP CONTROL

Operation 1.

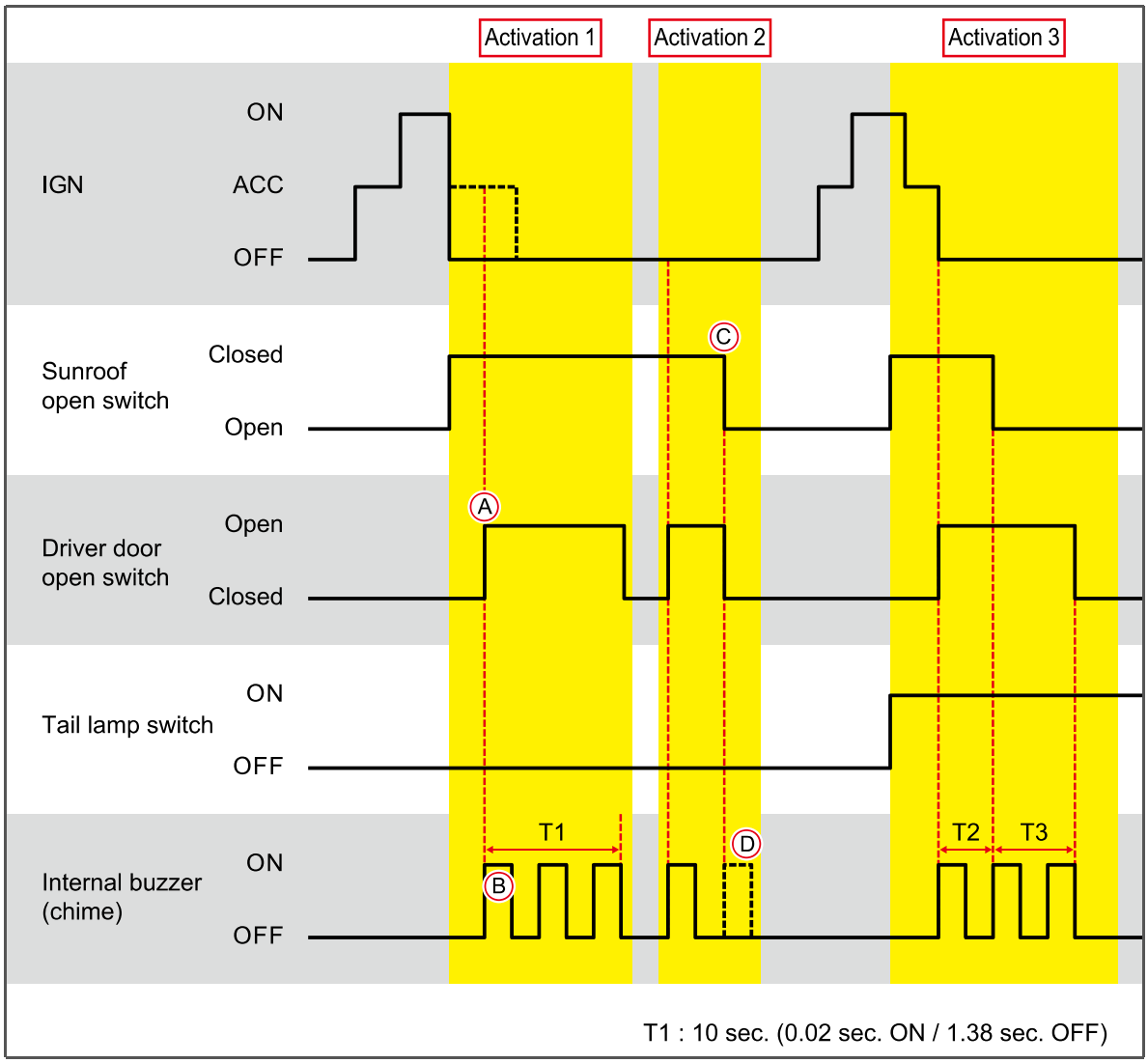
A. The driver door is opened with the sunroof open and IGN OFF and ACC ON (ignition key removed).
B. The internal buzzer (chime) sounds for 10 seconds (T1).

Operation 2.

C. The driver door and sunroof is closed while the internal buzzer (chime) is activated.
D. The internal buzzer (chime) is deactivated.
(The internal (chime) buzzer is not activated again after the operation 1, and it is activated again when the operation 1 is performed after the ignition is turned ON)

Operation 3.

E. The sunroof open warning (T2) overrides the tail lamp ON warning (T3).

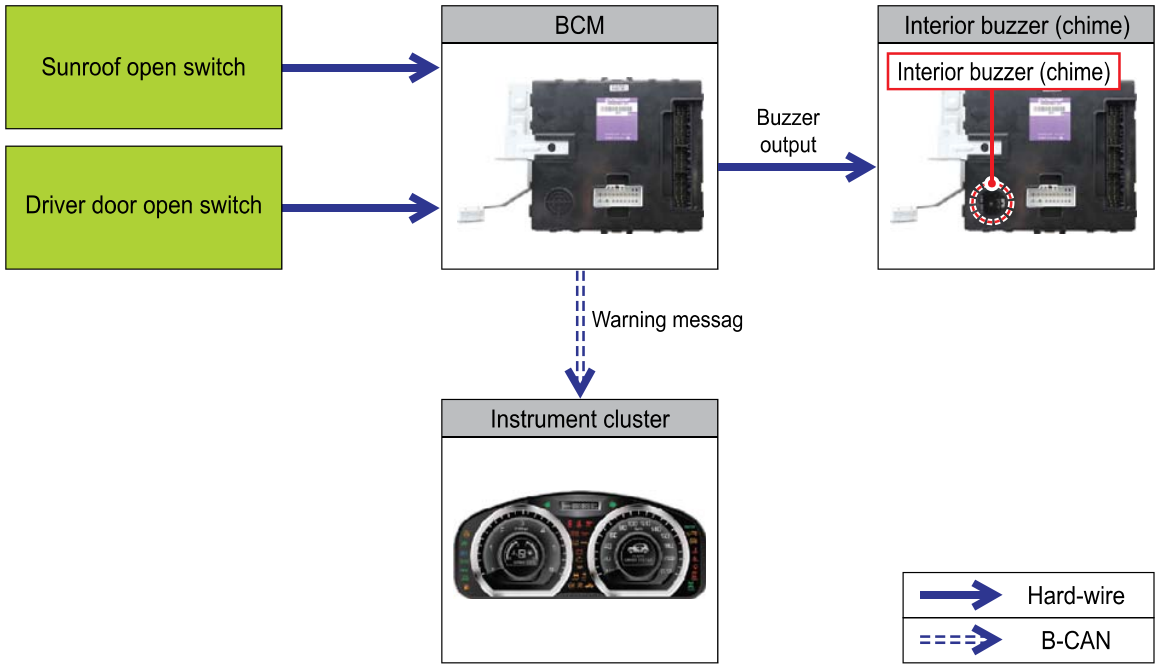


Modification basis	
Application basis	
Affected VIN	

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Operating process

- IGN OFF (ignition key removed)



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10. KEY HOLE LAMP CONTROL

Operation 1.

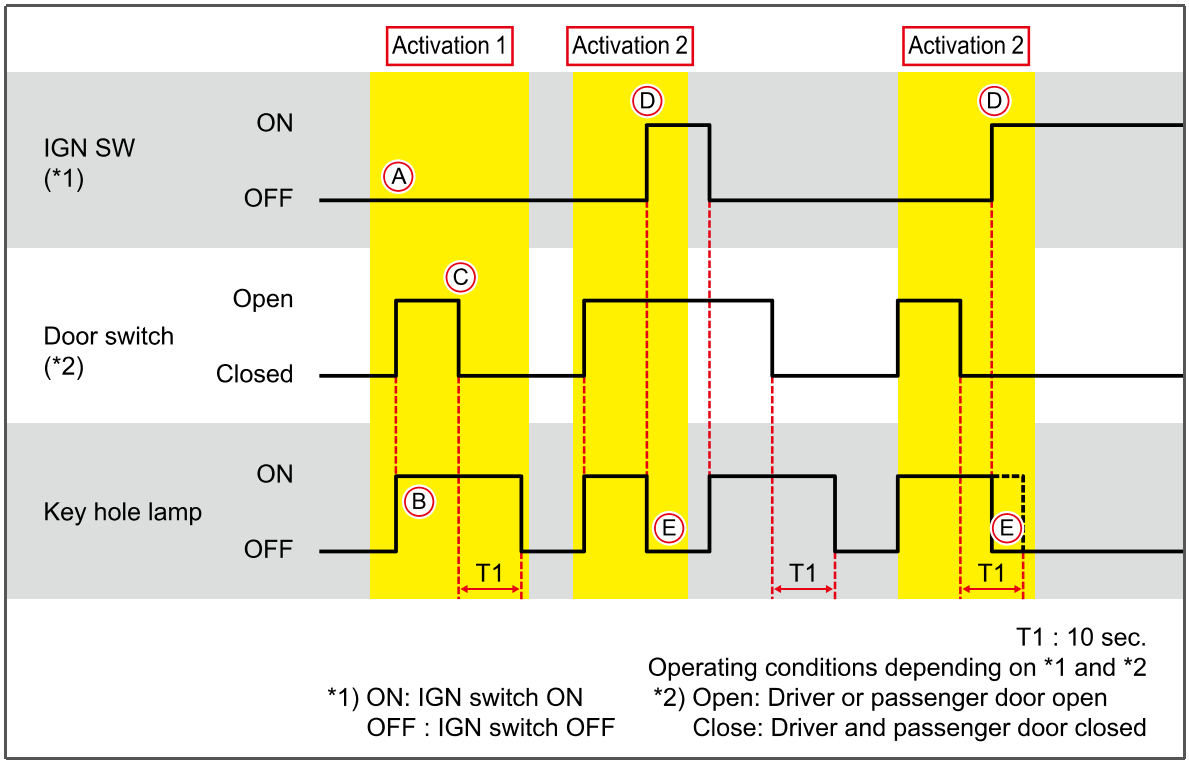
A. Door is opened with IGN OFF.
B. The key hole lamp comes on.
C. The key hole lamp comes on for 10 seconds (T1) when the door is closed.

Operation 2.

D. The ignition is turned ON with the key hole lamp ON.
E. The key hole lamp goes out.

NOTE

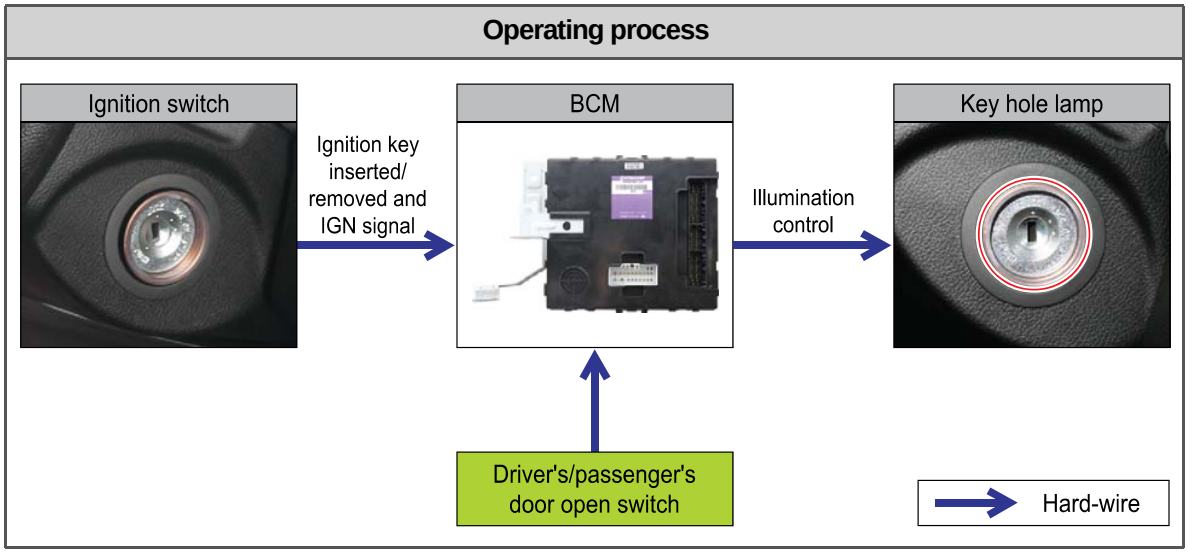
- The key hole lamp goes out when the REKES LOCK signal is received (in theft deterrent mode).
- When the key hole lamp and immobilizer signals are received simultaneously, the immobilizer signal overrides the key hole lamp signal.
- When the immobilizer confirmation is failed, regardless of the key hole lamp operation condition, it flashes for 11 seconds at intervals of 0.5 sec. ON/0.5 sec. OFF.
- When the ignition is turned ON in virgin status, the key hole lamp flashes for 8 seconds at intervals of 0.5 sec. ON/0.5 sec. OFF.



T1 : 10 sec.
Operating conditions depending on *1 and *2
*1) ON: IGN switch ON
OFF : IGN switch OFF
*2) Open: Driver or passenger door open
Close: Driver and passenger door closed

Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
Affected VIN	

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11. DEFOGGER (HEATED WIRE) TIMER CONTROL

▶ **Front defogger (heated wire) timer control**

Operation 1.

A. The front defogger (heated wire) switch is turned ON.
B. The front defogger (heated wire) is activated for 12 minutes (T1).

Operation 2.

C. Turning on the front defogger (heated wire) switch again when the defogger is activated turns off the fog lamp output.

Operation 3.

D. Within 10 minutes (T2) after the output of the front defogger (heated wire) for 12 minutes (T1).
E. When the front defogger (heated wire) switch is turned ON, the front defogger is activated for only 6 minutes (T3).
(This operation is not available when the front defogger is turned off by turning off engine, IGN OFF, or front defogger (heated wire) switch).

Operation 4.

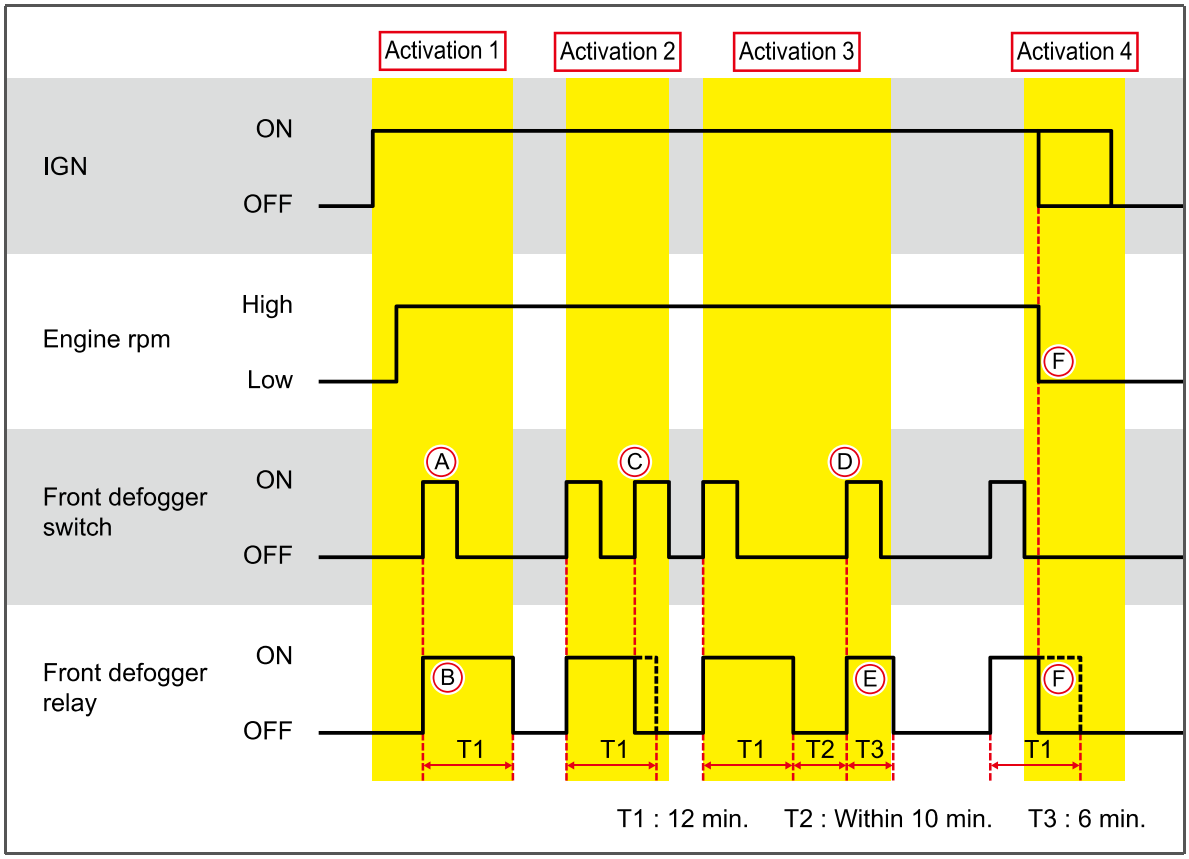
F. If the engine is running at low speed with IGN OFF or IGN ON, the front defogger (heated wire) is deactivated.

reference

The front defogger is turned OFF when the ignition is turned OFF or engine is not running.

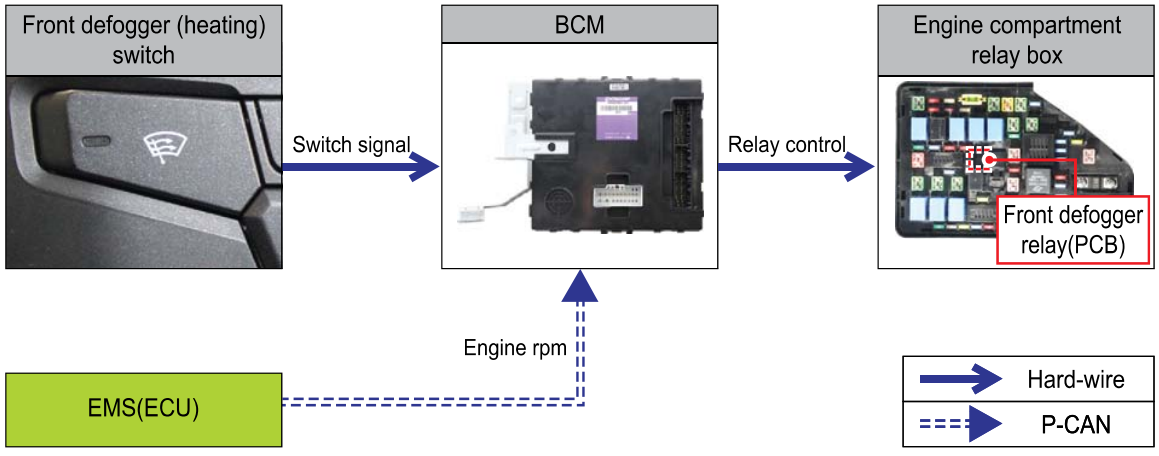
Modification basis	
Application basis	
Affected VIN	

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Operating process

- Engine running (Alternator: High)



Modification basis	
Application basis	
Affected VIN	

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Front defogger (heated wire) switch



Modification basis	
Application basis	
Affected VIN	

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▶ Rear defogger (heated wire) timer control

Operation 1.

A. The rear defogger (heated wire) switch is turned ON.
B. The rear defogger (heated wire) is activated for 12 minutes (T1).

Operation 2.

C. Turning on the rear defogger (heated wire) switch again when the defogger is activated turns off the fog lamp output.

Operation 3.

D. Within 10 minutes (T2) after the output of the rear defogger (heated wire) for 12 minutes (T1).
E. When the rear defogger (heated wire) switch is turned ON, the front defogger is activated for only 6 minutes (T3).
(This operation is not available when the rear defogger is turned off by turning off engine, IGN OFF, or front defogger (heated wire) switch)

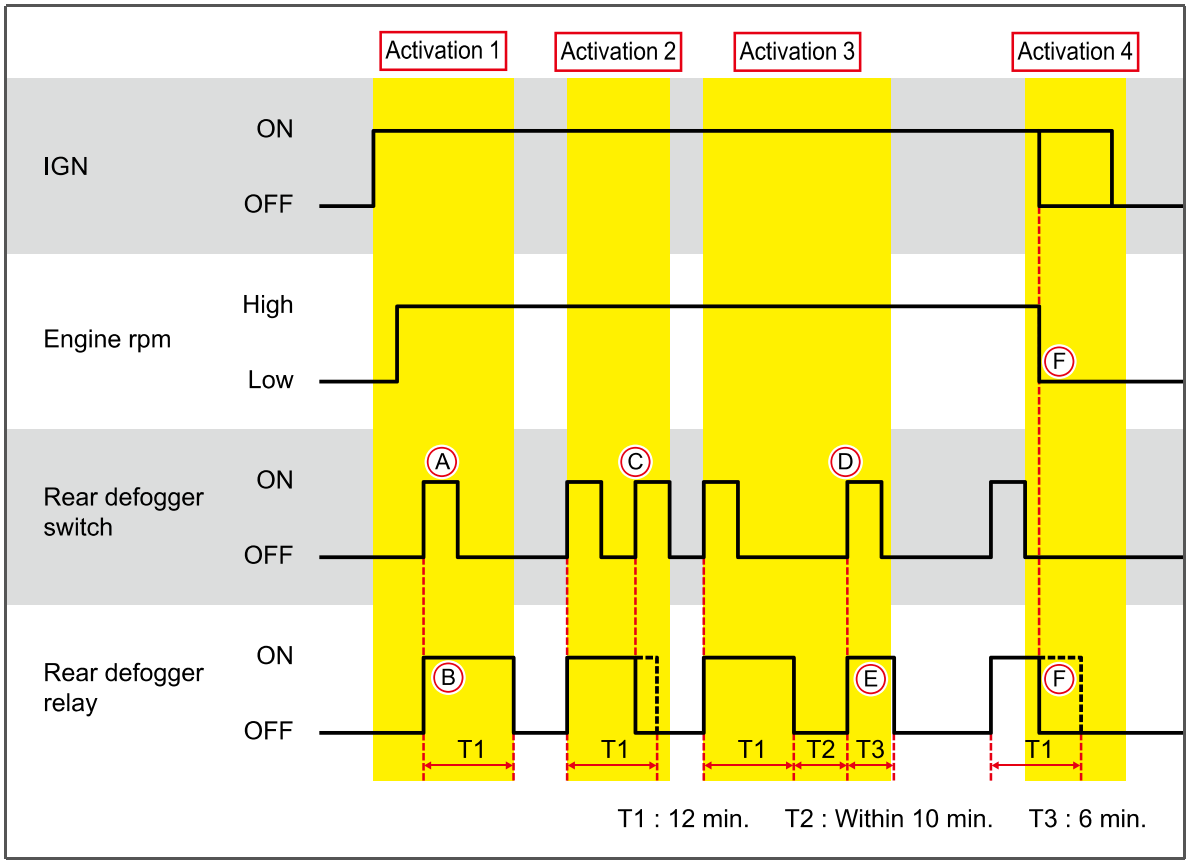
Operation 4.

F. If the engine is running at low speed with IGN OFF or IGN ON, the rear defogger (heated wire) is deactivated.

reference

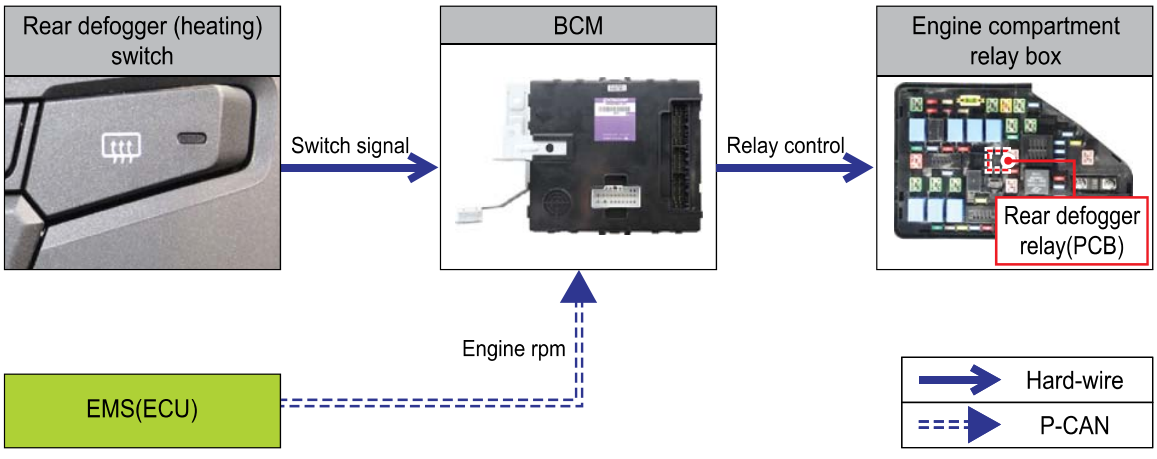
The rear defogger is turned OFF when the ignition is turned OFF or engine is not running.

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Operating process

- Engine running (Alternator: High)



Modification basis	
Application basis	
Affected VIN	

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Rear defogger (heated wire) switch



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12. ROOM LAMP CONTROL

- When the room lamp switch is in the door coupled position and the driver/passenger/rear door is opened, the room lamp comes on.
- The room lamp goes out automatically after 10 minutes of illumination when the ignition is turned OFF (ignition key is removed) and a door is open.
- The sleep mode is deactivated when the door status is changed or UNLOCK signal is received after automatic switching off.

▶ Door coupled room lamp control

Operation 1.

A. When all doors are closed with IGN ON, the room lamp goes out immediately.

Operation 2.

B. All doors are closed with IGN OFF.
C. The room lamp stays on for 2 seconds (T1) and then fades out over 3 seconds (T2) and goes off.
- When the ignition is turned ON while the room lamp is fading out, the lamp goes out immediately.

Operation 3.

D. When UNLOCK signal by the smart key (REKES key) is received with IGN OFF (ignition key removed) and all doors closed, the room lamp remains ON for 30 seconds (T3).
E. When UNLOCK signal is received again while the room lamp is ON, the lamp stays on for 30 seconds more. The room lamp lighting is extended when UNLOCK signal by the REKES key is received.

Operation 4.

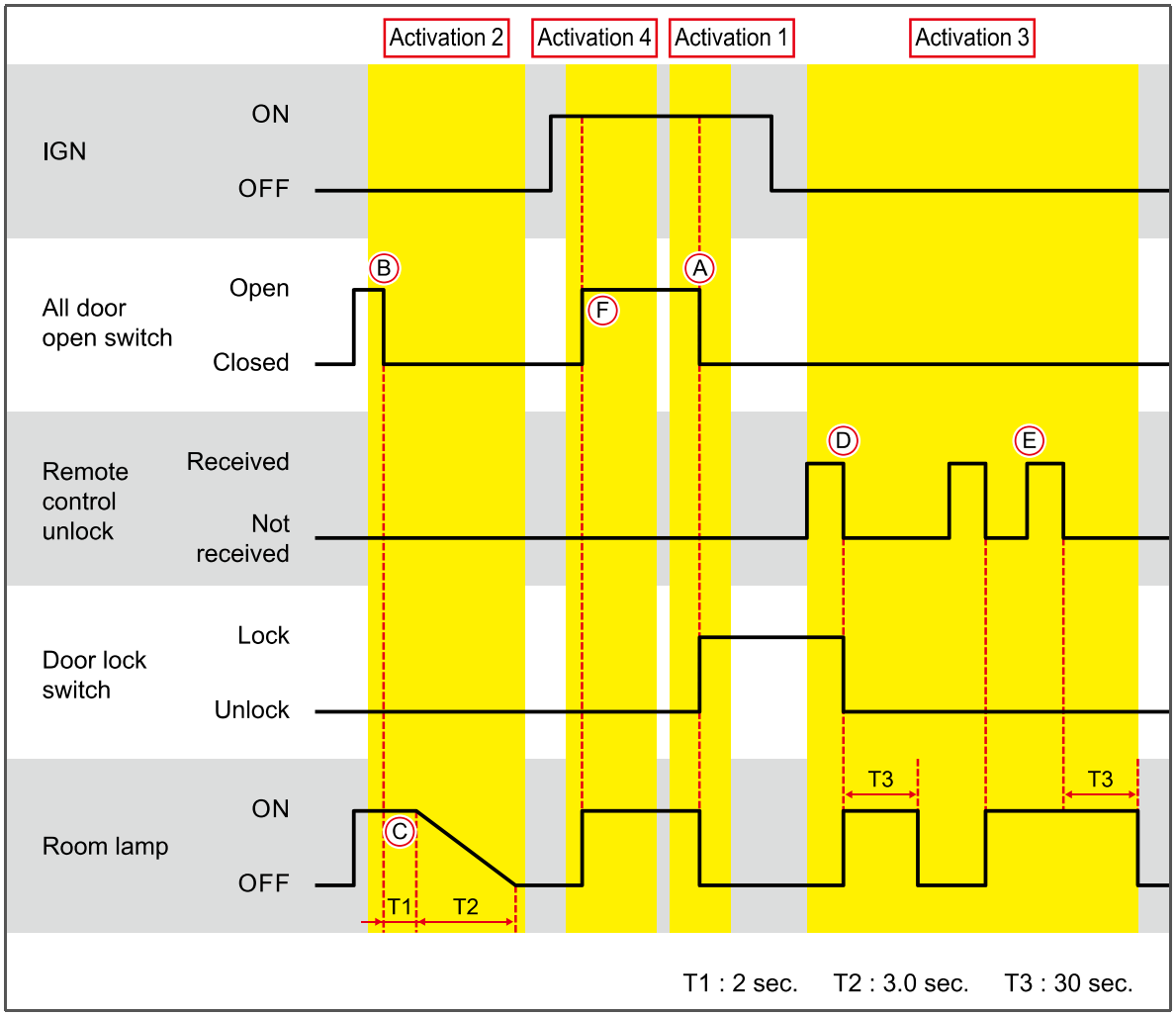
F. The room lamp stays on when a door is opened during fading out.
The lamp goes out or fades out when the door is closed.

NOTE

- When the open driver/passenger/rear door is closed, the room lamp fades out. When the system enters the theft deterrent mode, the room lamp goes out immediately.
- In puddle lamp coupled room lamp mode, the room lamp comes on when the puddle lamp operation signal is received.

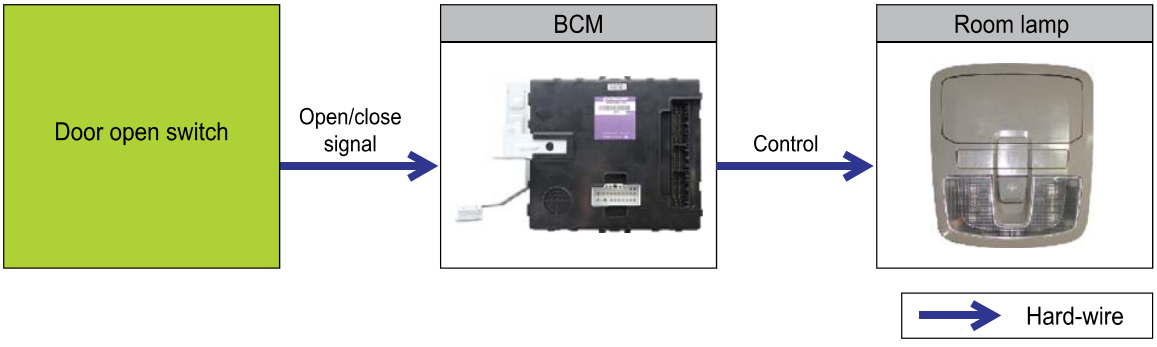
Modification basis	
Application basis	
Affected VIN	

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Operating process

- Door coupled front room lamp switch in ON position



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▶ Room lamp cut off control

Operation 1.

A. The lamp is turned off when entering sleep mode or in alarming status.

Operation 2. (preventing battery discharge)

B. When the ignition is turned OFF (ignition key removed) with the room lamp switch ON, the room lamp comes on for 10 minutes and then goes out automatically.

C. When the room lamp is turned off automatically, the room lamp automatic switching off signal is sent to the instrument cluster before entering sleep mode.

Operation 3.

D. When the ACC is turned ON or ignition is turned ON with the ignition key inserted, the room lamp is activated.

NOTE

- When the room lamp cut off operation is activated, the BCM sends cut off operation signal to the instrument cluster through B-CAN to prevent the battery discharge.

Modification basis	
Application basis	
Affected VIN	

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13. REMOTE KEYLESS ENTRY SYSTEM (REKES)

▶ REKES key (Transmitter)

When the user operates the switch of the REKES key, the vehicle control message formatted by the remote controller CPU is sent to the main part via radio transmission. The CPU of the main part controls the vehicle and the main part controls the vehicle operations.



▶ REKES key switch description

1. Door LOCK (locks the doors and tailgate when pressed briefly)
   - All doors and the tailgate are locked and the theft deterrent mode is activated.
   - When the theft deterrent mode is activated, the hazard warning lamp flashes twice. When this button is pressed once more within 4 seconds, the hazard warning lamp flashes twice and the buzzer sounds once.

NOTE

The escort function is activated with the headlamp ON for 20 seconds when the door LOCK button is pressed for 0.5 seconds or more in the theft deterrent mode. If the door LOCK button is pressed briefly or the ignition is turned ON during the escort operation, the escort is deactivated.

2. Door UNLOCK (unlocks the doors and tailgate when pressed briefly)
   - If this button is pressed briefly, all doors and the tailgate are unlocked and the theft deterrent mode is deactivated.
   - When the theft deterrent mode is deactivated, the hazard warning lamp flashes once.
   - In theft deterrent mode, if a door, tailgate or engine hood is not opened within 30 seconds after the door is unlocked by a remote controller, the doors are locked with the hazard warning lamp and buzzer activated (lamp flashes twice and buzzer sounds once, the theft deterrent mode is activated again).
3. Panic (Press and hold for 2 seconds or more)
   - If this button is pressed for 2 seconds or more, the hazard warning lamp flashes while the buzzer sounds for approx. 30 seconds.
   - If the door LOCK button or panic button is pressed, this function is deactivated.

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14. CENTRAL DOOR LOCKING SYSTEM CONTROL

- For BCM with SKM, sleep mode is deactivated by receiving the status signals from the driver door knob switch, passenger door knob switch, rear LH/RH door knob switch, and central door LOCK/UNLOCK switch through the wiring.
- If all doors are unlocked 5 times within 1 minute after door LOCK signal output, because of faulty door knob switch and door open switch, the doors are forced to lock and not allowed to unlock. However, the UNLOCK conditions are met, the UNKLOCK signal is input normally.

▶ Door LOCK/UNLOCK control by door knob switch

Operation 1.

A. The driver and passenger door LOCK knob switches are in the LOCK position from UNLOCK position.
B. The door LOCK relay is activated for 0.5 seconds (T1).

Operation 2.

C. The driver and passenger door LOCK knob switches are in the UNLOCK position from LOCK position.
D. The door UNLOCK relay is activated for 0.5 seconds (T2).
   - The door lock/unlock system does not work regardless of the door LOCK/UNLOCK switch position, when reconnecting the battery. (to reset, turn the ignition ON)

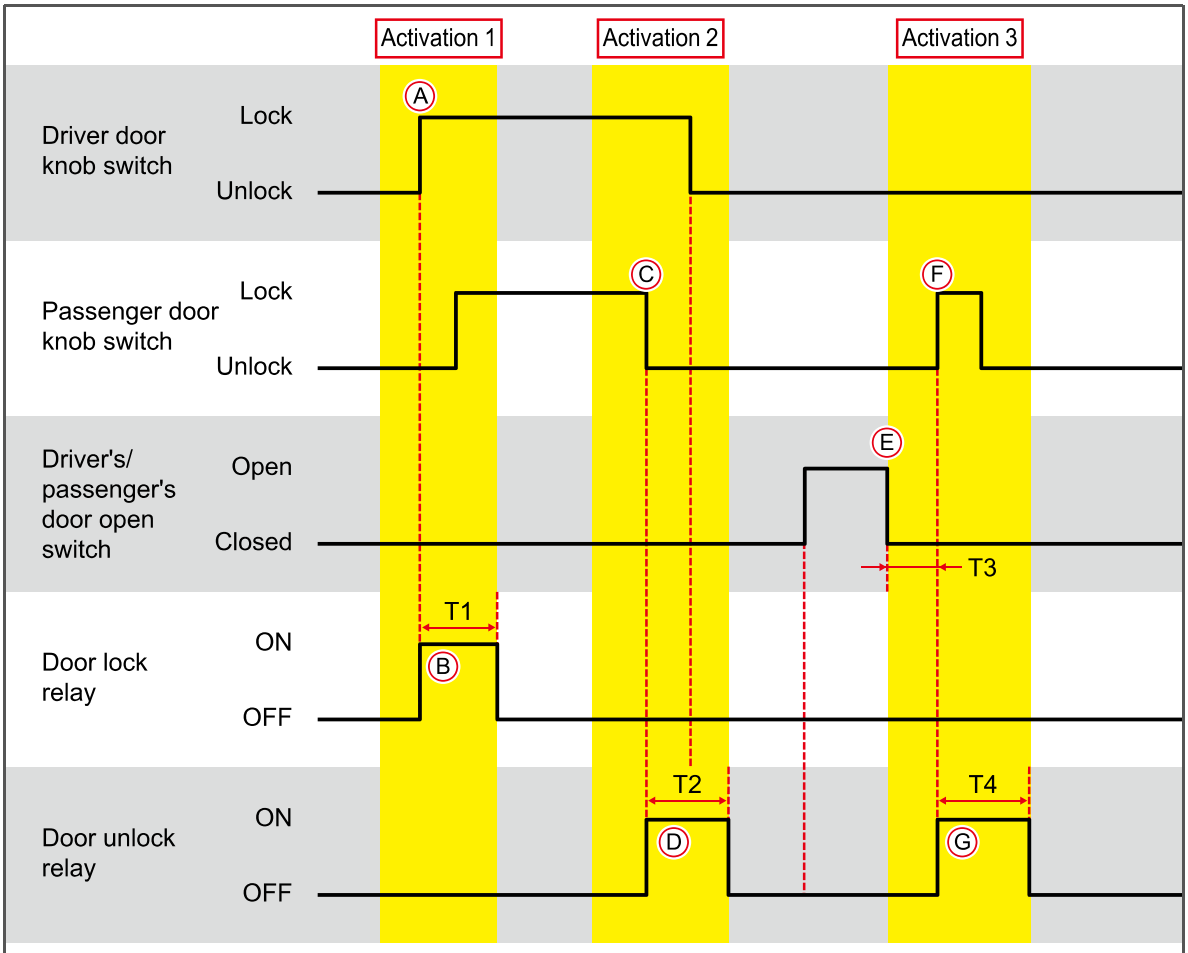
Operation 3.

E. All open doors are closed.
F. The LOCK signal is input within 0.5 seconds (T3).
G. The UNLOCK signal for all doors is output once for 0.5 seconds (T4).

NOTE

- The signal change from UNLOCK to LOCK is ignored during LOCK/UNLOCK output by the central door LOCK switch, REKES key, and door handle switch.
- If LOCK signal from the switch is input within 0.5 seconds after any door is closed, UNLOCK signal is output.

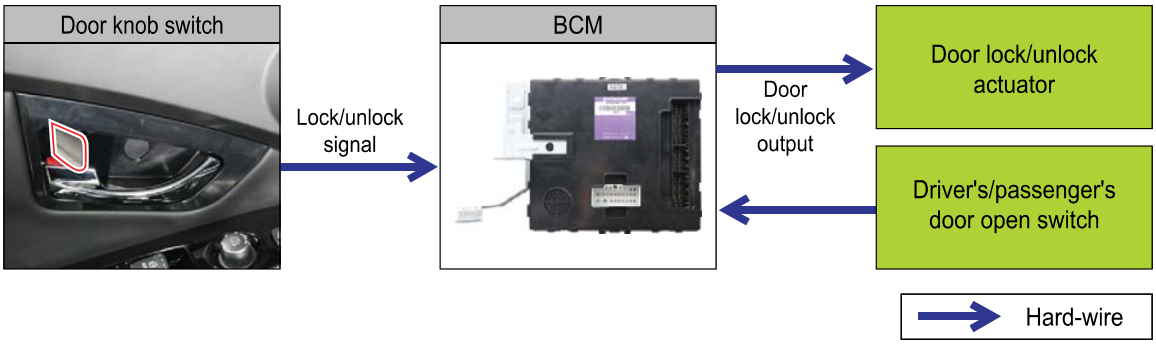
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NOTE

The door LOCK/UNLOCK relay is installed inside the actuator.

Operating process



Modification basis	
Application basis	
Affected VIN	

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▶ Door LOCK/UNLOCK control by central door LOCK switch

Operation 1.

A. The central door LOCK switch is turned ON.
B. The door LOCK/UNLOCK relay is activated for 0.5 seconds (T1, T2).

Operation 2.

C. The central door switch signal is ignored in the theft deterrent mode.

NOTE

- When one of the door LOCK detection switches* is in LOCK position with the ignition turned OFF, all doors are unlocked automatically.
- When the central door switch LOCK is operated with all doors unlocked and any door ajar, the door LOCK relay is activated followed by UNLOCK relay to prevent the door LOCK by misoperation.

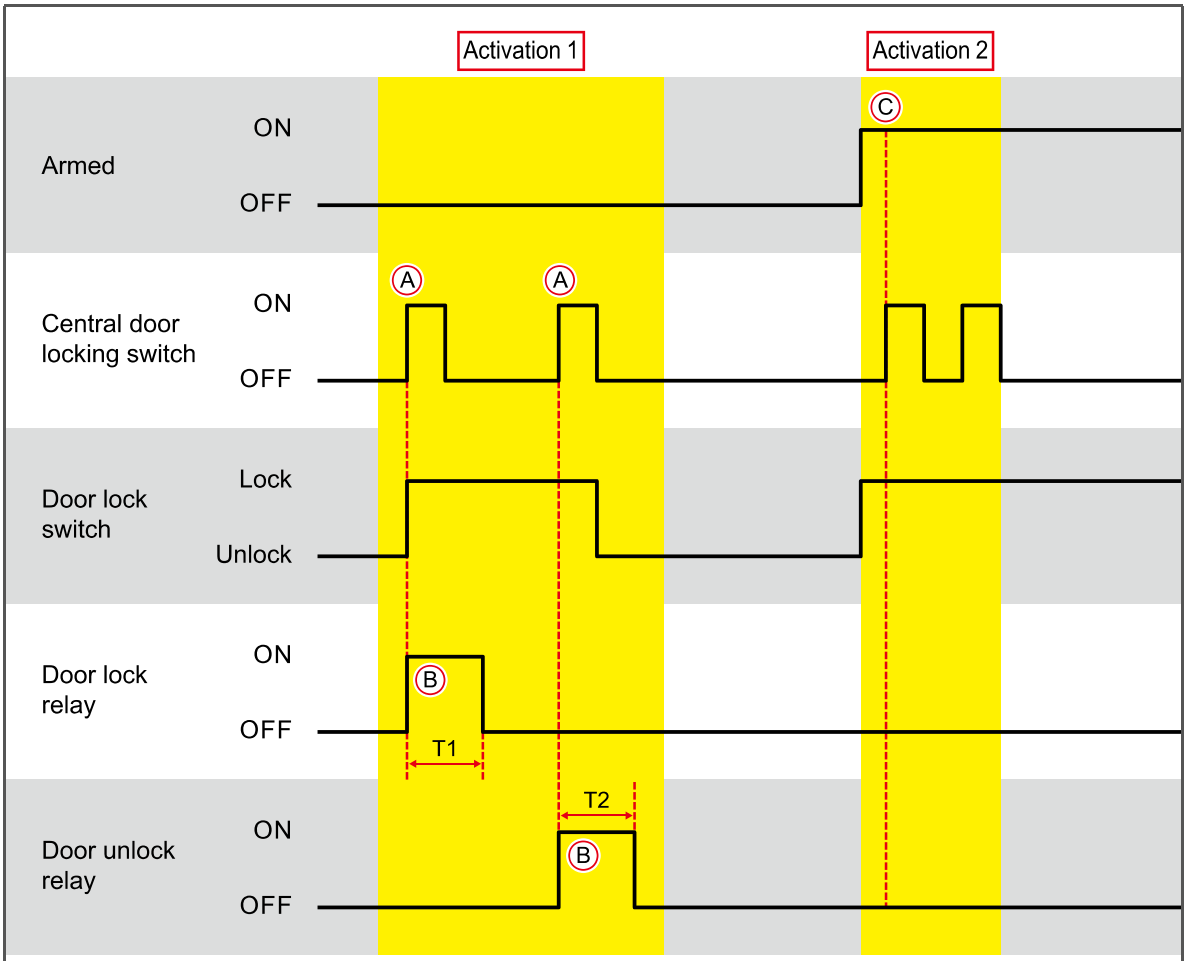
* Door LOCK detection switch: The switch is installed inside the door actuator and detects the door LOCK status.

Central door LOCK switch (driver door side)



Modification basis	
Application basis	
Affected VIN	

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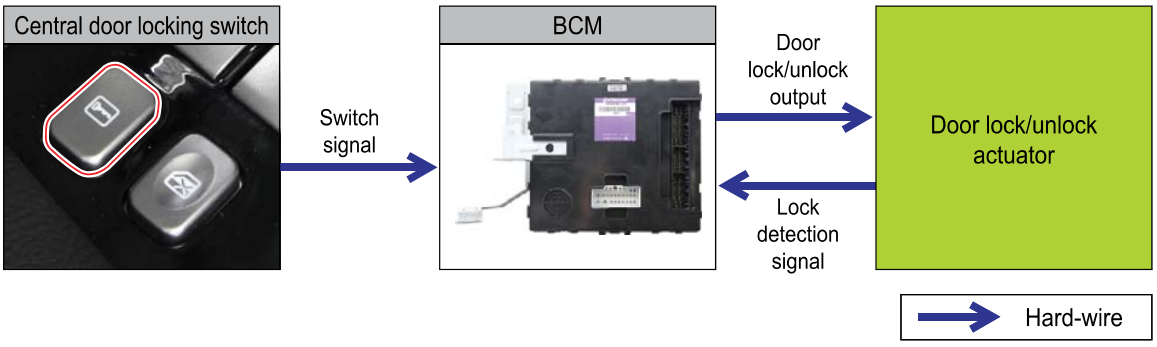


T1 : 0.5 sec. T2 : 0.5 sec.

NOTE

The door LOCK/UNLOCK relay is installed inside the actuator.

Operating process



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▶ Door LOCK/UNLOCK by REKES key

Operation 1.

A. When the REKES LOCK switch is pressed less than 0.5 seconds (T1), the door LOCK relay is activated for 0.5 seconds (T2).

B. All of following conditions are met within 0.2 seconds (T4) after the chattering time (T3):

- All doors closed
- Hood closed
- Tailgate closed
- Door LOCK detection switch in LOCK state

C. The turn signal lamp flashes 2 times at intervals of 0.5 sec. ON/0.5 sec. OFF.

Operation 2.

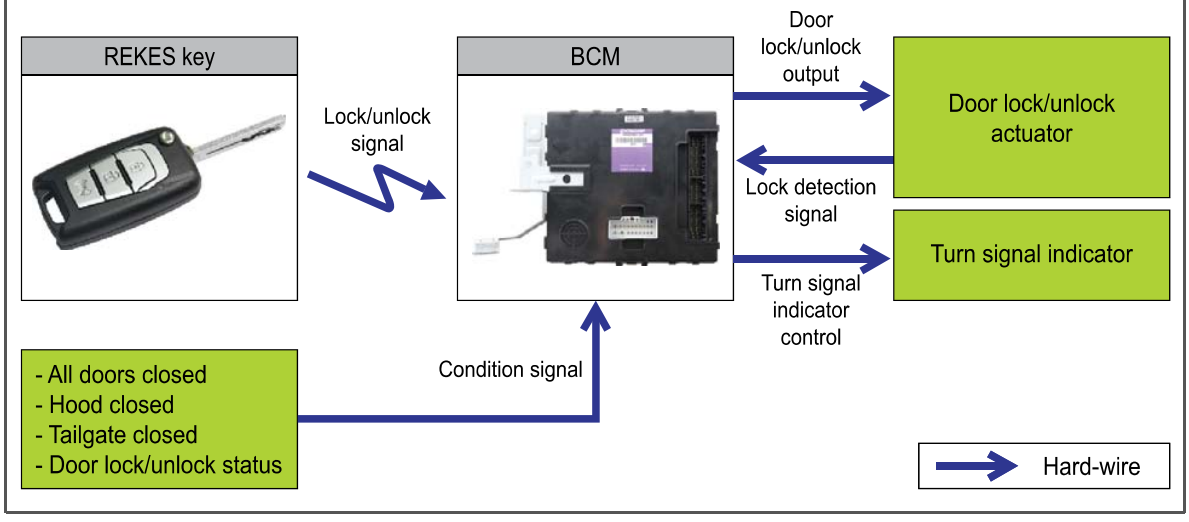
D. When the REKES UNLOCK switch is pressed less than 2 seconds (T5), the door UNLOCK relay is activated for 0.5 seconds (T2).

E. The door UNLOCK conditions are met, the turn signal lamp is operated once for 1 second.

NOTE

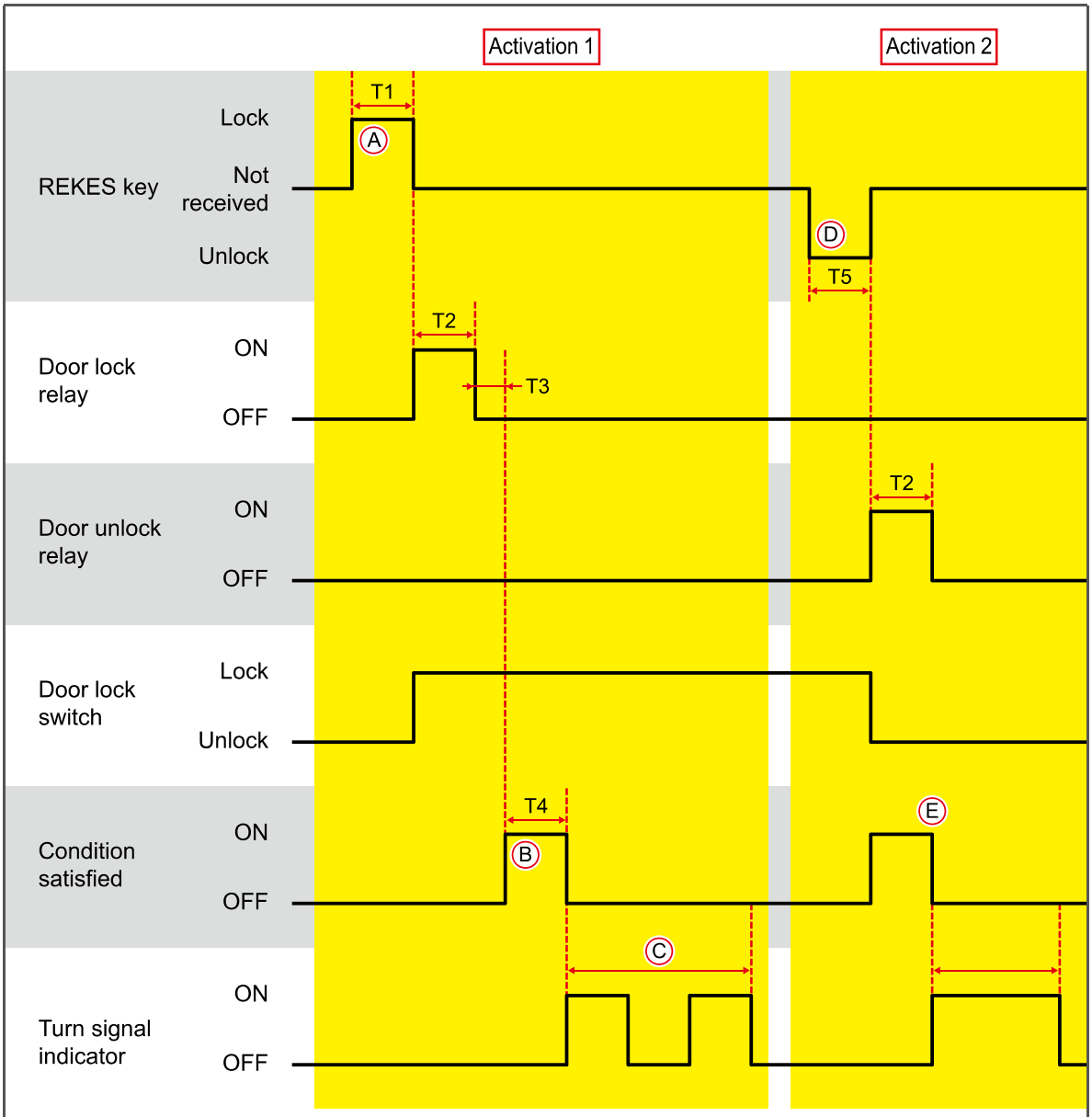
- Do not operate the REKES key with the ignition key inserted or for 1 second after the ignition key is removed. (to prevent the remote controller switch malfunction)
- When one of the LOCK switches is unlocked after the door LOCK, all doors will be unlocked.

Operating process (for vehicles without SKM)



Modification basis	
Application basis	
Affected VIN	

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T1 : 0.5 sec. T2 : 0.5 sec. T3 : Chattering time T4 : 0.2 sec. T5 : Below 2.0 sec.

NOTE

The door LOCK/UNLOCK relay is installed inside the actuator.

Modification basis	
Application basis	
Affected VIN	

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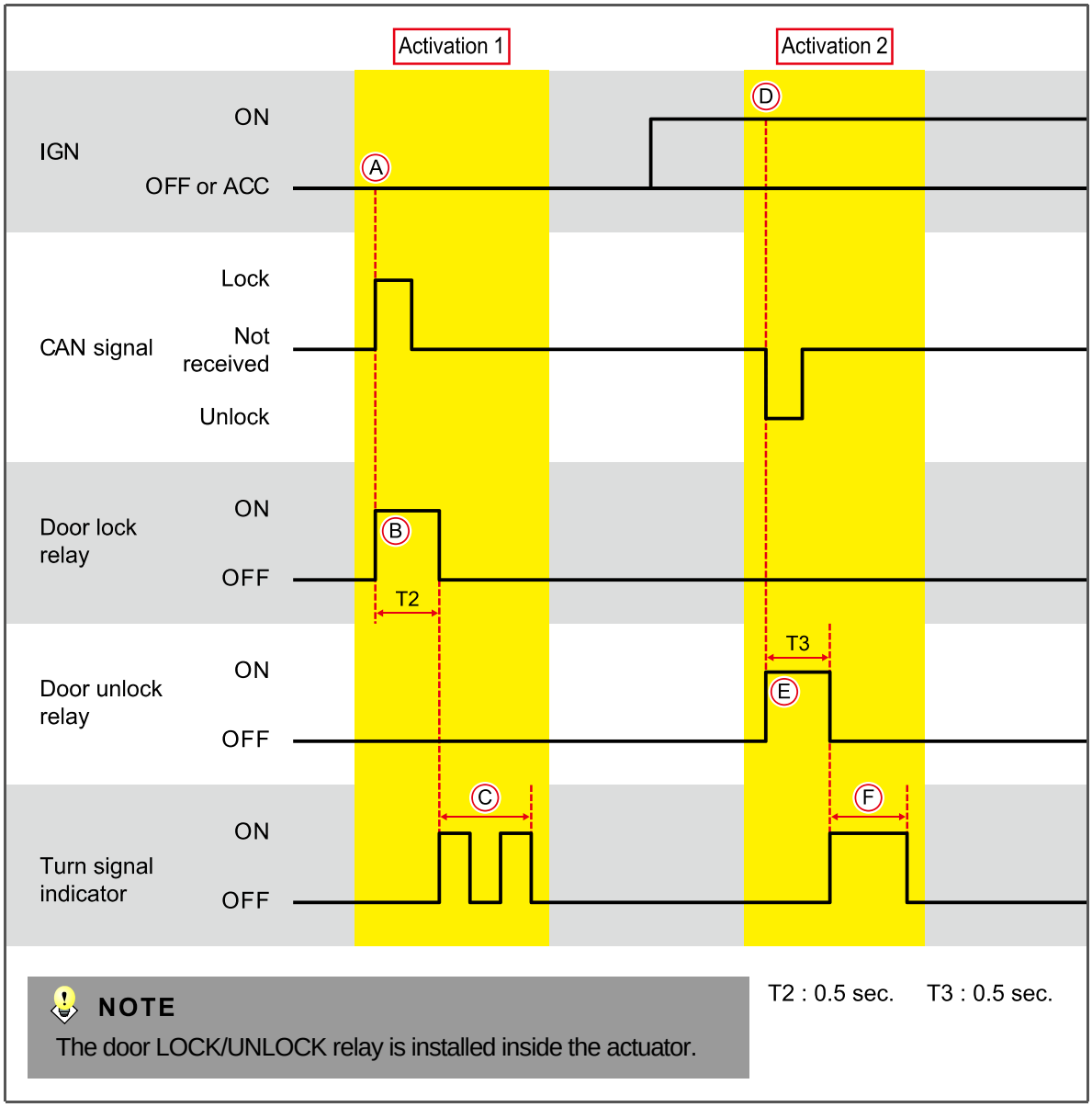
▶ Door LOCK/UNLOCK control by smart key

Operation 1.

A. The SKM receives LOCK signal through B-CAN with IGN OFF or ACC ON.
B. The BCM outputs LOCK relay signal for 0.5 seconds (T2).
C. The turn signal lamp is turned ON for 0.5 seconds and then turned OFF for 0.5 seconds, and this operation is repeated 2 times.

Operation 2.

D. SKM receives UNLOCK signal through B-CAN with IGN ON, IGN OFF, or ACC ON.
E. BCM outputs UNLOCK relay signal for 0.5 seconds (T3).
F. The turn signal lamp is operated once for 1 second.



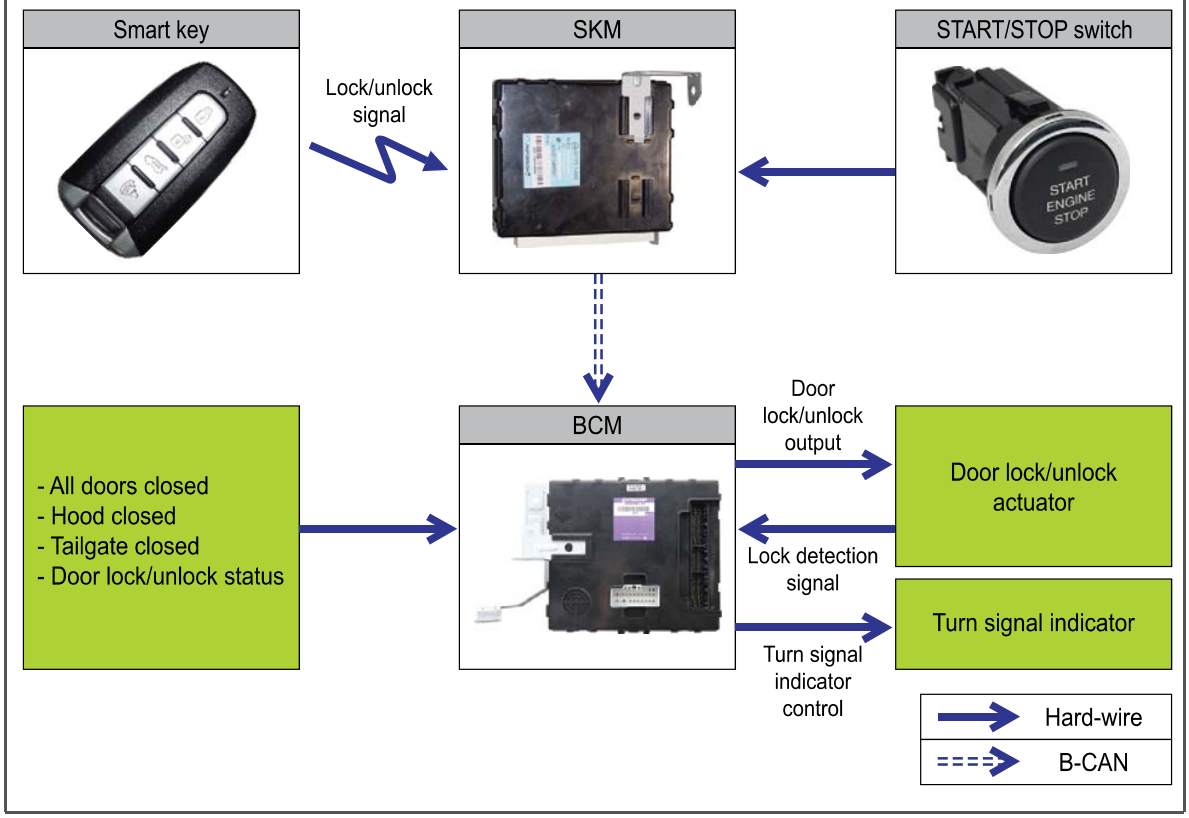
NOTE
The door LOCK/UNLOCK relay is installed inside the actuator.

T2 : 0.5 sec. T3 : 0.5 sec.

Modification basis	
Application basis	
Affected VIN	

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Operating process (for vehicles with SKM)



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▶ Door LOCK/UNLOCK control by door handle switch

Operation 1. (when driver door locked)

A. The ignition is turned ON or OFF, or the ACC is turned ON.
B. When the door handle switch is operated, the door LOCK/UNLOCK signal is sent to the BCM through B-CAN.
C. The SKM operates the turn signal lamp once for 1 second after 0.5 seconds (T3) of door UNLOCK relay operation.

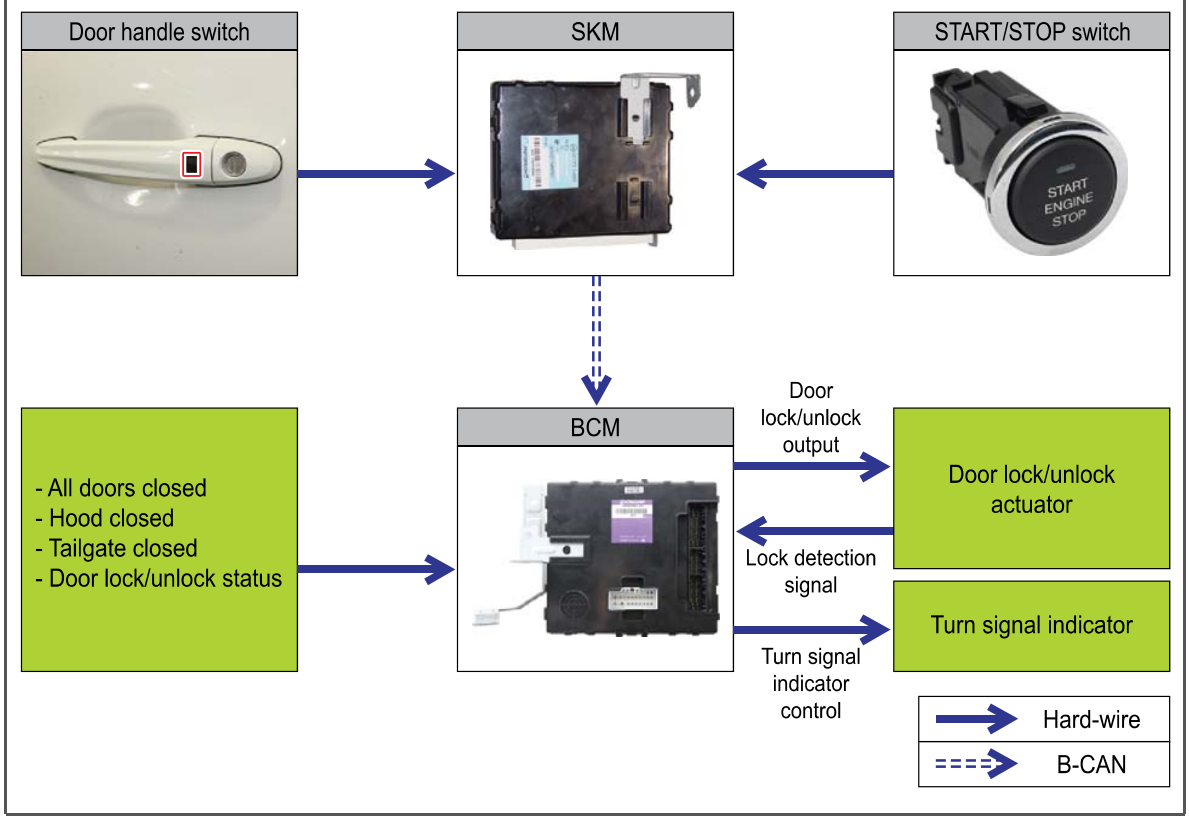
Operation 2. (when driver's door unlocked)

D. The ignition is turned OFF or ACC is turned ON.
E. When the door handle switch is operated, the door LOCK/UNLOCK signal is sent to the BCM through B-CAN.
F. The SKM operates the turn signal lamp twice at intervals of 0.5 sec. ON/0.5 sec. OFF after 0.5 seconds (T2) of door LOCK relay operation.

NOTE

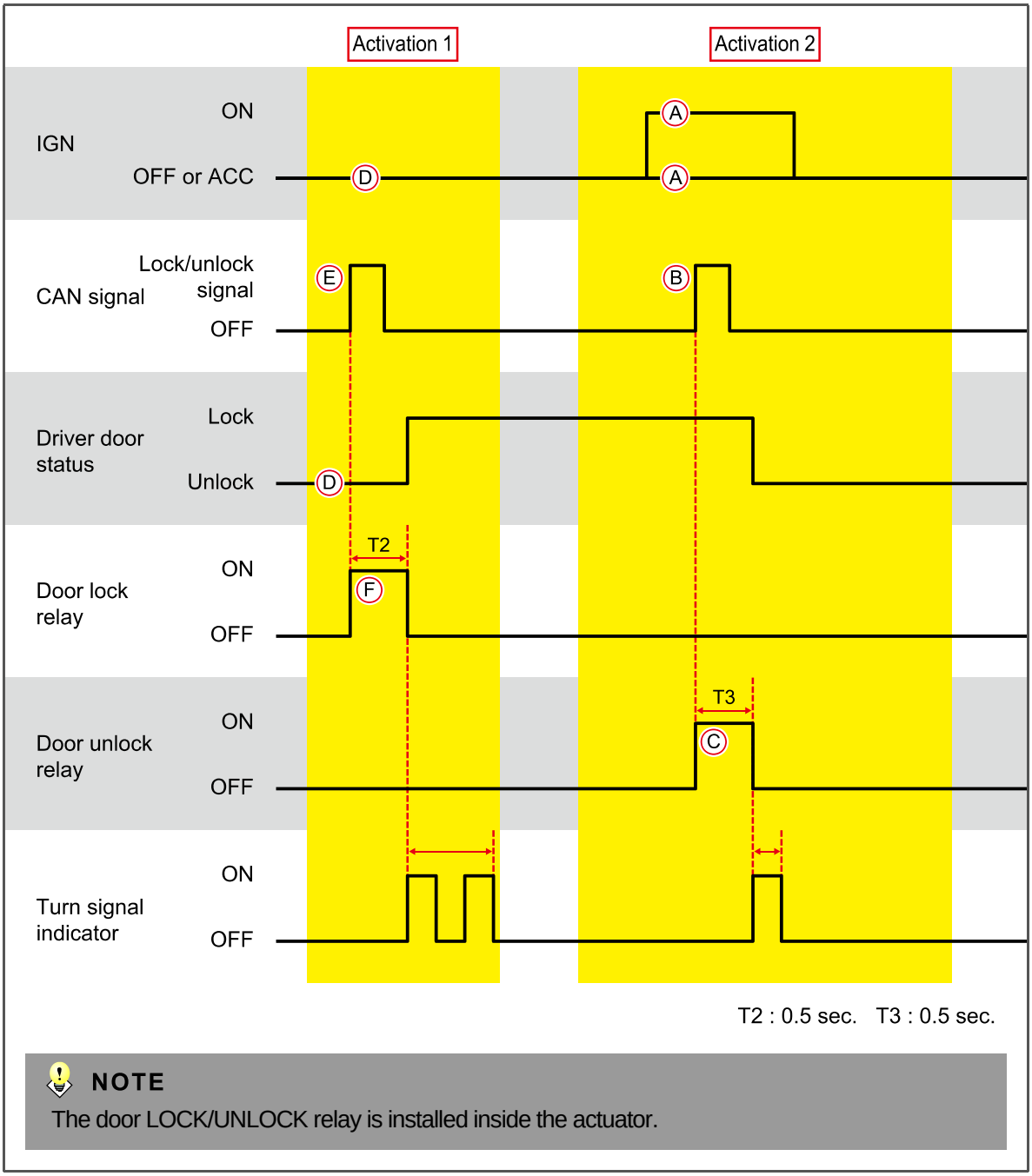
When the driver door is unlocked after passive UNLOCK signal is received with IGN ON, the door is not locked.

Operating process (for vehicles with SKM)



Modification basis	
Application basis	
Affected VIN	

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T2 : 0.5 sec. T3 : 0.5 sec.

NOTE

The door LOCK/UNLOCK relay is installed inside the actuator.

Modification basis	
Application basis	
Affected VIN	

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▶ AUTO door LOCK control

Operation 1.

A. REKES LOCK
B. The vehicle is driven at 30 km/h or more.
C. The door LOCK relay is activated for 0.5 seconds (T2).
The door LOCK relay is not activated when all doors (except tailgate) are locked or door malfunction signal is input.

Operation 2. (after operation 1)

D. A door is unlocked.
E. The door LOCK signal is output 5 times (T3) except the door LOCK carried out in operation 1.

NOTE

- If a door is unlocked after the 5 times of LOCK output, the door is regarded as malfunctioning.
- If there is a malfunctioning door, the AUTO door LOCK is not activated but the LOCK operation by the central door LOCK switch is available.
- If a malfunction occurs when the vehicle is driven at 30 km/h or more, the AUTO door LOCK will not be activated even when the vehicle speed decreases to 30 km/h or less and then increases to 30 km/h or more.
- The faulty door will be reset when the unlocked malfunctioning door is locked.

Operation 3. (during operation 2)

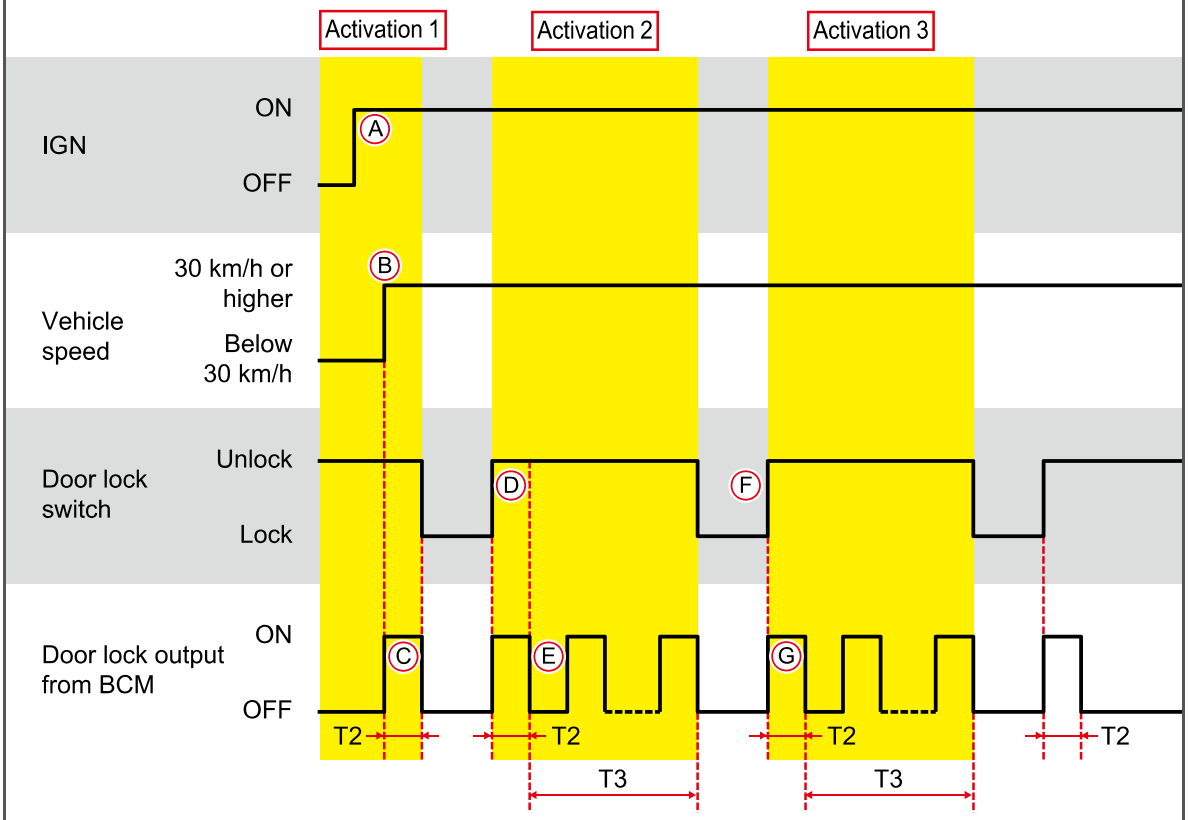
F. The UNLOCK signal by other switch is received.
G. The door LOCK signal is output 5 times for the switch.

- The door LOCK system outputs UNLOCK signal automatically when the LOCK output conditions are met by this function or the ignition is turned ON to OFF. (even when there is no LOCK output while the vehicle is driven at over 30 km/h under LOCK condition).

NOTE

- The faulty door will be reset when the ignition is turned OFF.
- When one of the door LOCK switches is in LOCK position with the ignition turned OFF, all doors are unlocked.

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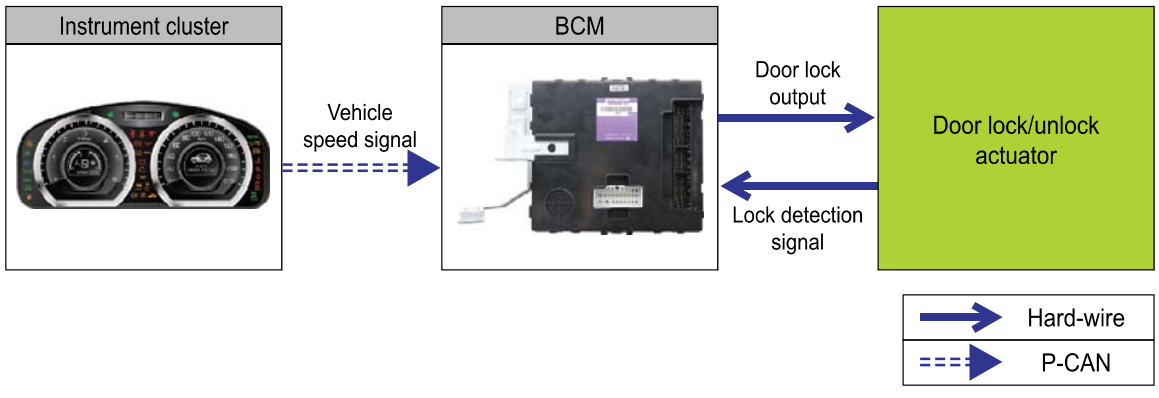
T1 : 0.5 sec. T2 : 0.3 sec. T3 : Outputs door lock 5 times

Lock: Driver, passenger, rear & tailgate door lock switch = LOCK
Unlock: Driver, passenger, rear & tailgate door lock switch = UNLOCK

NOTE

The door LOCK/UNLOCK relay is installed inside the actuator.

Operating process (for vehicles without SKM)



Modification basis	
Application basis	
Affected VIN	

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▶ AUTO UNLOCK upon receiving air bag deployment signal

Operation 1.

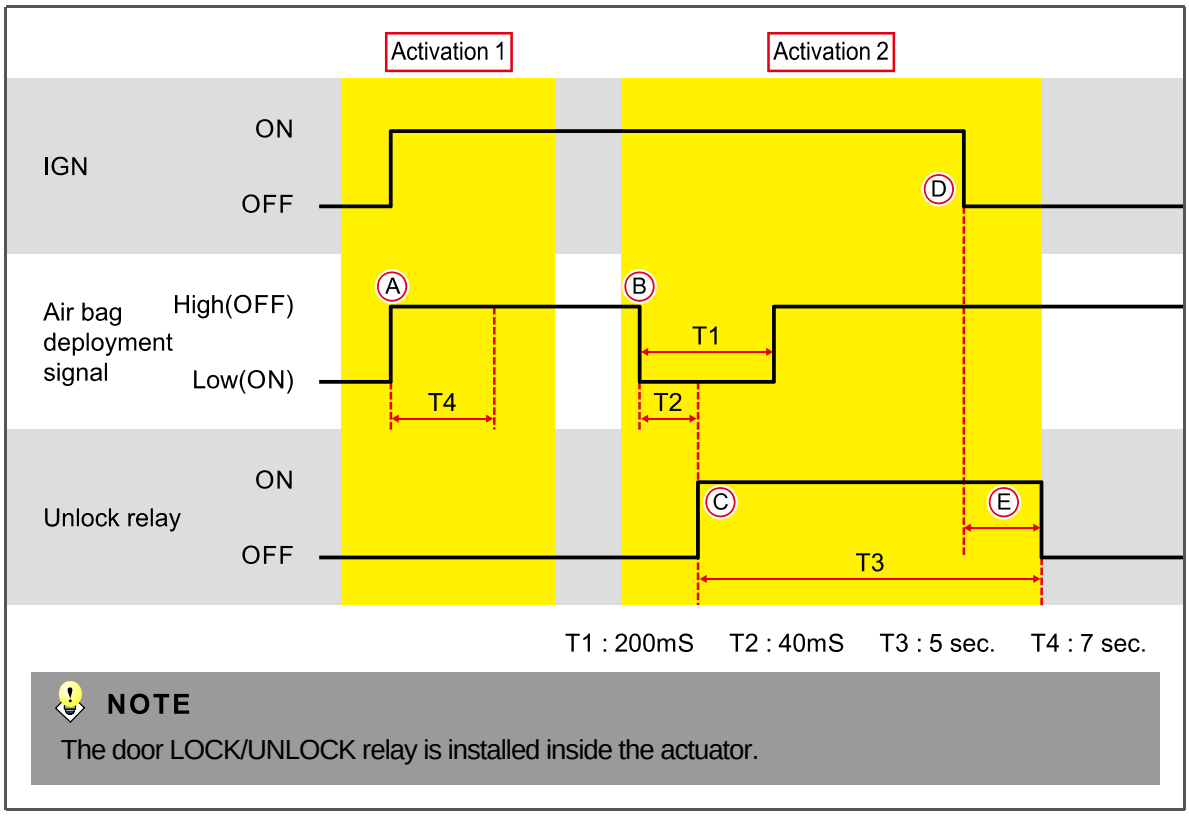
A. Air bag deployment signal is not input for initial 7 seconds (T4) after IGN ON

Operation 2.

B. When air bag deployment signal (OFF→ON) is input 7 seconds (T4) after IGN ON
C. Signal from unlock relay is output for 5 seconds (T3) after 40 ms (T2)
D. When turning IGN OFF during 5 seconds (T3) of unlock relay signal output
E. Signal from unlock relay is input for the rest of the time

NOTE

- The room lamp comes on when the air bag deployment signal is input except when the room lamp switch is turned off.
- The hazard warning lamp flashes when the air bag deployment signal is input.
- Resetting the auto door unlock function turns off the battery (cutting off BCM power).



NOTE

The door LOCK/UNLOCK relay is installed inside the actuator.

Modification basis	
Application basis	
Affected VIN	

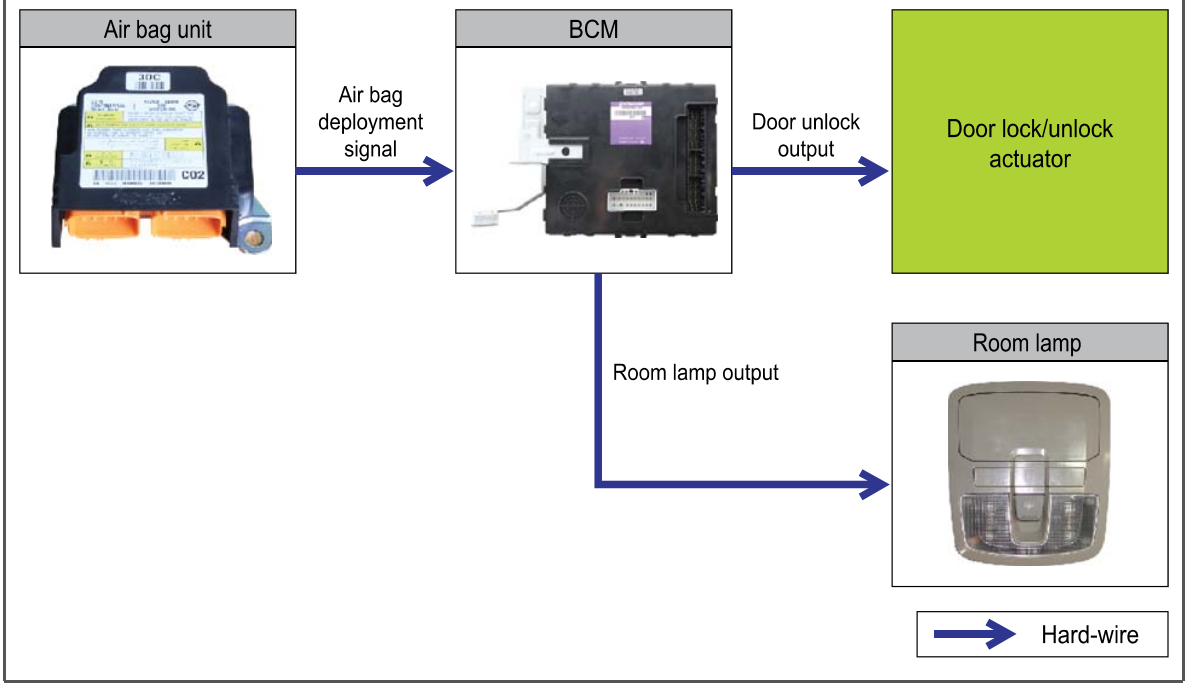
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CAUTION

1. The UNLOCK by the air bag deployment signal takes priority over the LOCK/UNLOCK control from other functions.
2. The LOCK/UNLOCK requests from other functions during or after the UNLOCK output by the air bag signal are ignored. However, the LOCK control is carried out when the ignition switch is turned to the "OFF" position.
3. The same request during the LOCK/UNLOCK output is ignored. However, the UNLOCK by the air bag deployment signal or operation by the smart key is carried out.
4. When LOCK and UNLOCK outputs occur at the same time, the LOCK output is carried out and UNLOCK is ignored.

Operating process

- IGN ON/Room lamp switch in any position other than OFF



Modification basis	
Application basis	
Affected VIN	

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15. PANIC ALARM CONTROL

▶ **REKES key panic alarm (for vehicles without SKM)**

Operation 1.

A. The REKES key panic signal is received.
B. The hazard warning lamp and warning horn are activated for 30 seconds (T1) at intervals of 0.5 sec. ON/0.5 sec. OFF.

Operation 2.

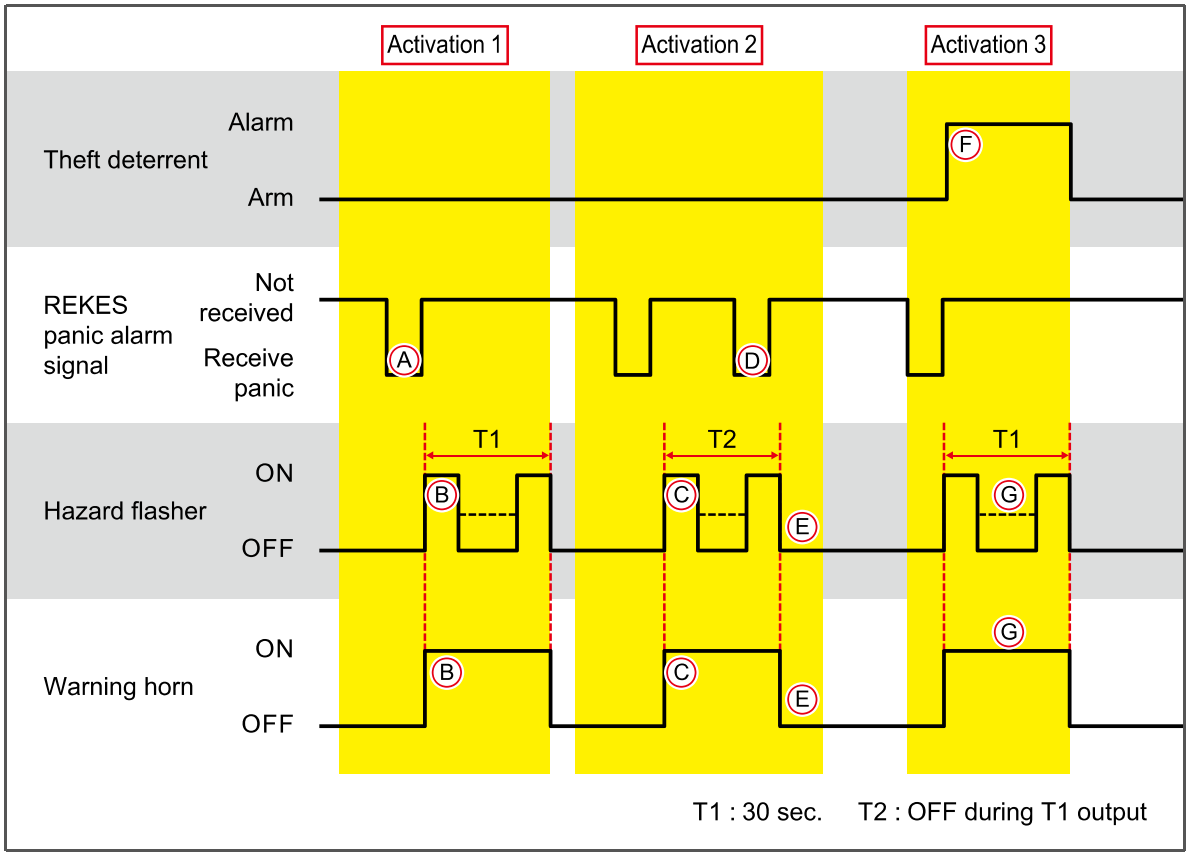
C. The hazard warning lamp and warning horn are activated by REKES panic function.
D. The REKES panic LOCK and panic signals are received.
E. The panic function is interrupted and other functions are activated by the corresponding command.

Operation 3. (during operation 1)

F. The theft deterrent alarm is activated.
G. The panic function is interrupted and theft deterrent alarm is set.

NOTE

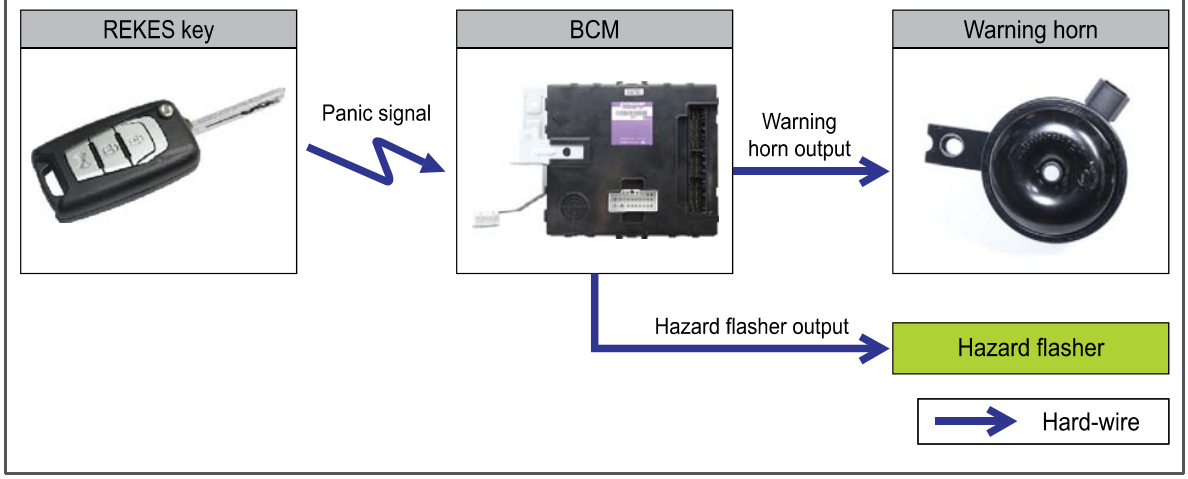
- The panic alarm functions regardless of the ignition status.



Modification basis	
Application basis	
Affected VIN	

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Operating process



Modification basis	
Application basis	
Affected VIN	

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▶ **Smart key panic alarm (for vehicles with SKM)**

Operation 1.

A. The ignition is turned ON or OFF, or the ACC is turned ON.
B. The smart key panic signal is received.
C. The hazard warning lamp and siren are activated for 30 seconds (T1) at intervals of 0.5 sec. ON/0.5 sec. OFF.

Operation 2.

D. The hazard warning lamp and warning horn are activated by smart key panic function (operation 1). The followings occur:
E.
- The panic button of the smart key is pressed.
- When other function signal is received, the command is executed while the panic function is kept.

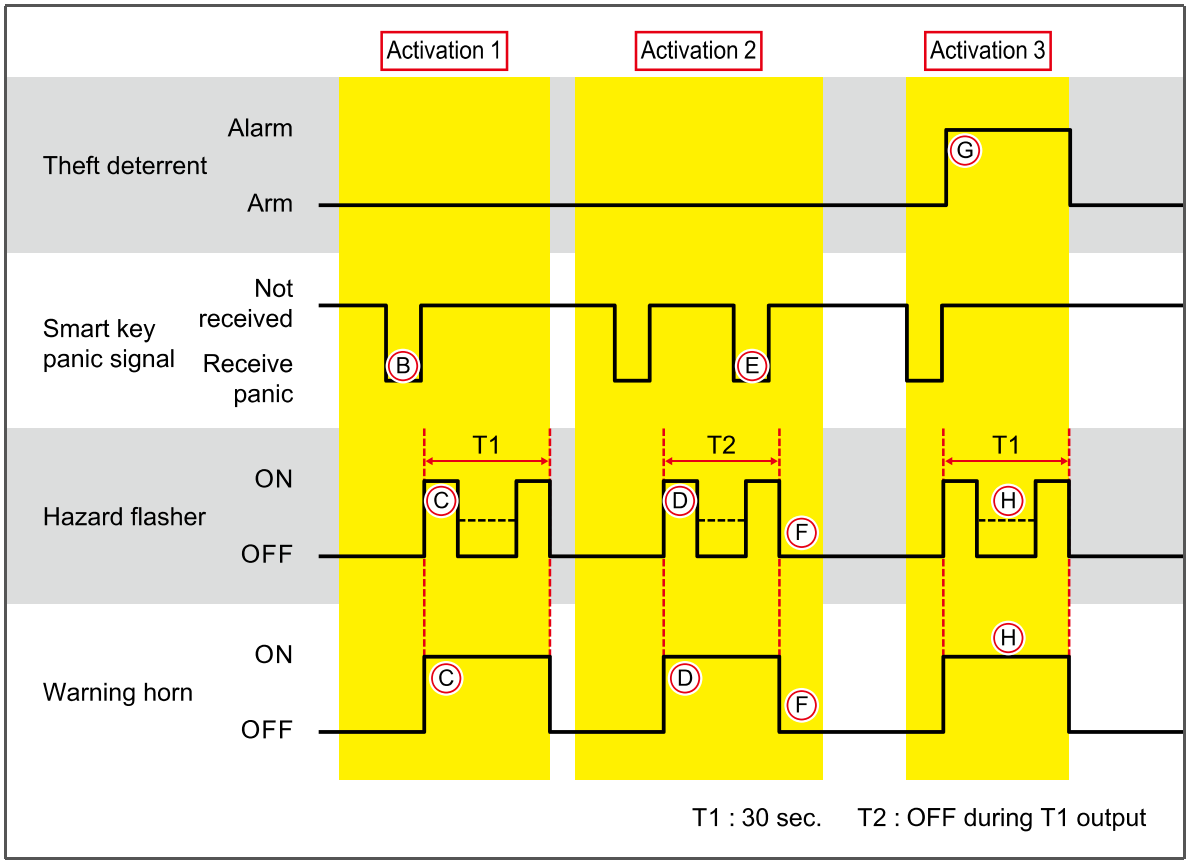
F. The panic function is interrupted and other functions are activated by the corresponding command.

Operation 3. (during operation 1)

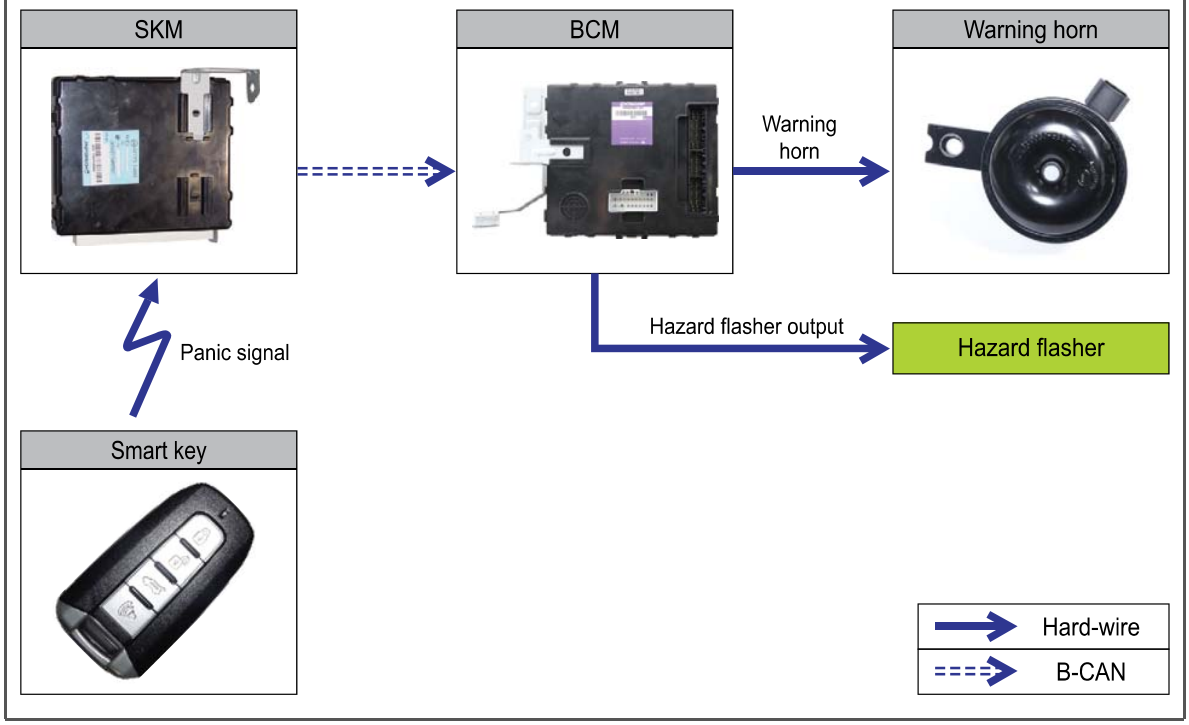
G. The theft deterrent alarm is activated.
H. The panic function is interrupted and theft deterrent alarm is set.

reference The panic function is activated by the signals from SKM.

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Operating process



Modification basis	
Application basis	
Affected VIN	

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16. TAILGATE OPEN CONTROL

▶ **Tailgate open control (for vehicles without SKM)**

Operation 1.

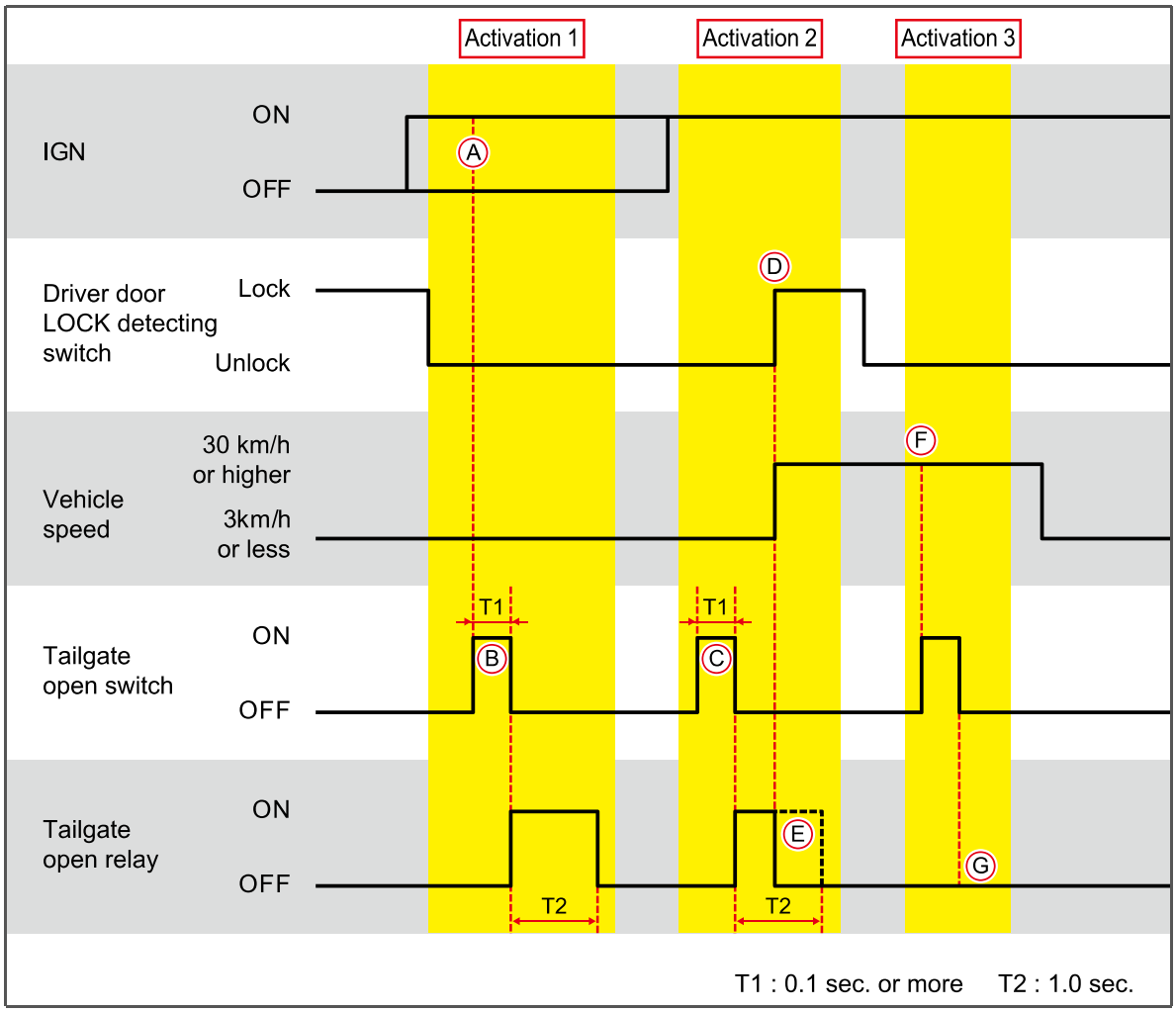
A. The ignition is turned OFF or ON, or ACC is turned ON with the driver door unlocked.
B. When the tailgate open switch is pressed for more than 0.1 seconds (T1), the tailgate open relay is activated for 1 second.

Operation 2.

C. The tailgate open relay is activated.
D. The vehicle is driven at 3 km/h or more with the driver door locked or IGN ON.
E. The tailgate open relay is deactivated immediately.

Operation 3.

F. The vehicle is driven at 3 km/h or more with IGN ON.
G. The tailgate open relay is not activated when the tailgate open switch is pressed.

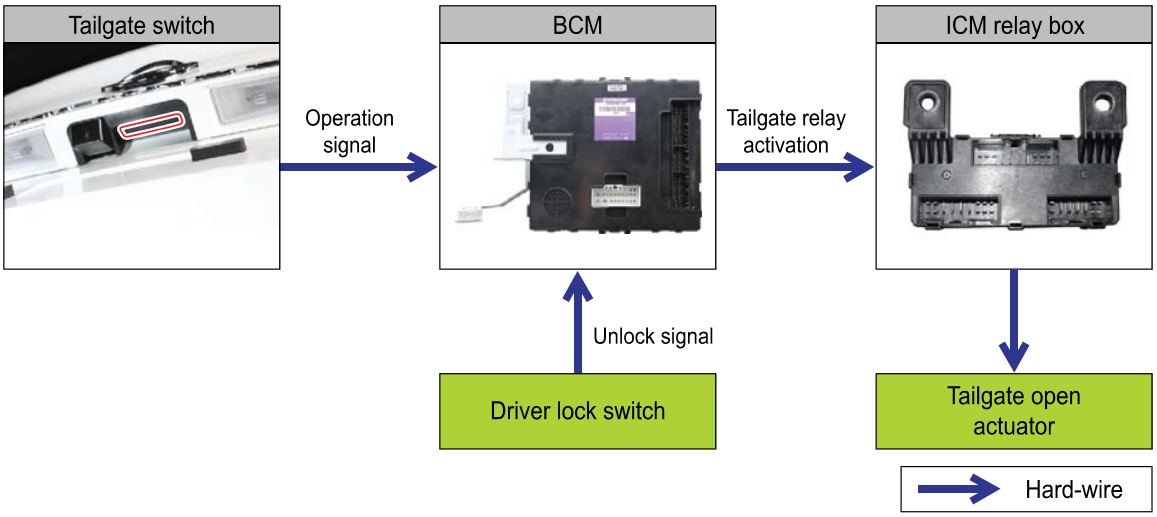


Modification basis	
Application basis	
Affected VIN	

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Operating process

- When the driver door is unlocked with the power OFF, ACC ON, or IGN ON.



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▶ **Tailgate open control (for vehicles with SKM)**

Operation 1.

A. The ignition is turned OFF or ON, or ACC is turned ON with the driver door unlocked.
B. When the tailgate open switch is pressed for more than 0.1 seconds (T1), the tailgate open relay is activated for 1 second. With the ignition turned ON, the tailgate open relay is activated only when the vehicle is driven at 3 km/h or less.

Operation 2.

C. The tailgate open relay is activated.
D. The vehicle is driven at 3 km/h or more with the driver door locked or IGN ON.
E. The tailgate open relay is deactivated immediately.

Operation 3.

F. The vehicle is driven at 3 km/h or more with IGN ON.
G. The tailgate open relay is not activated when the tailgate open switch is pressed.

Operation 4.

- The ignition is turned OFF or ON, or ACC is turned ON with the driver door and tailgate door locked. The tailgate open switch is pressed for 0.1 seconds or more.
- The BCM sends the verification request to the SKM through B-CAN. The SKM verifies the smart key
- and sends the signal to the BCM through B-CAN.
  The BCM activates the tailgate open relay after the valid smart key verification.
- (In theft deterrent mode, only the theft deterrent for tailgate is deactivated.)

Operation 5.

- The tailgate open signal is input by the smart key when the vehicle is not in stationary or the power is not turned OFF.
- The BCM keeps the tailgate open relay ready to operate for 30 seconds.
- If the signal from the tailgate open switch is input within this 30 seconds,
- The tailgate open relay is activated.
  If no signal is input within 30 seconds in theft deterrent mode, the mode remains on. The system enters the theft deterrent mode immediately when the LOCK signal from the smart key is input.

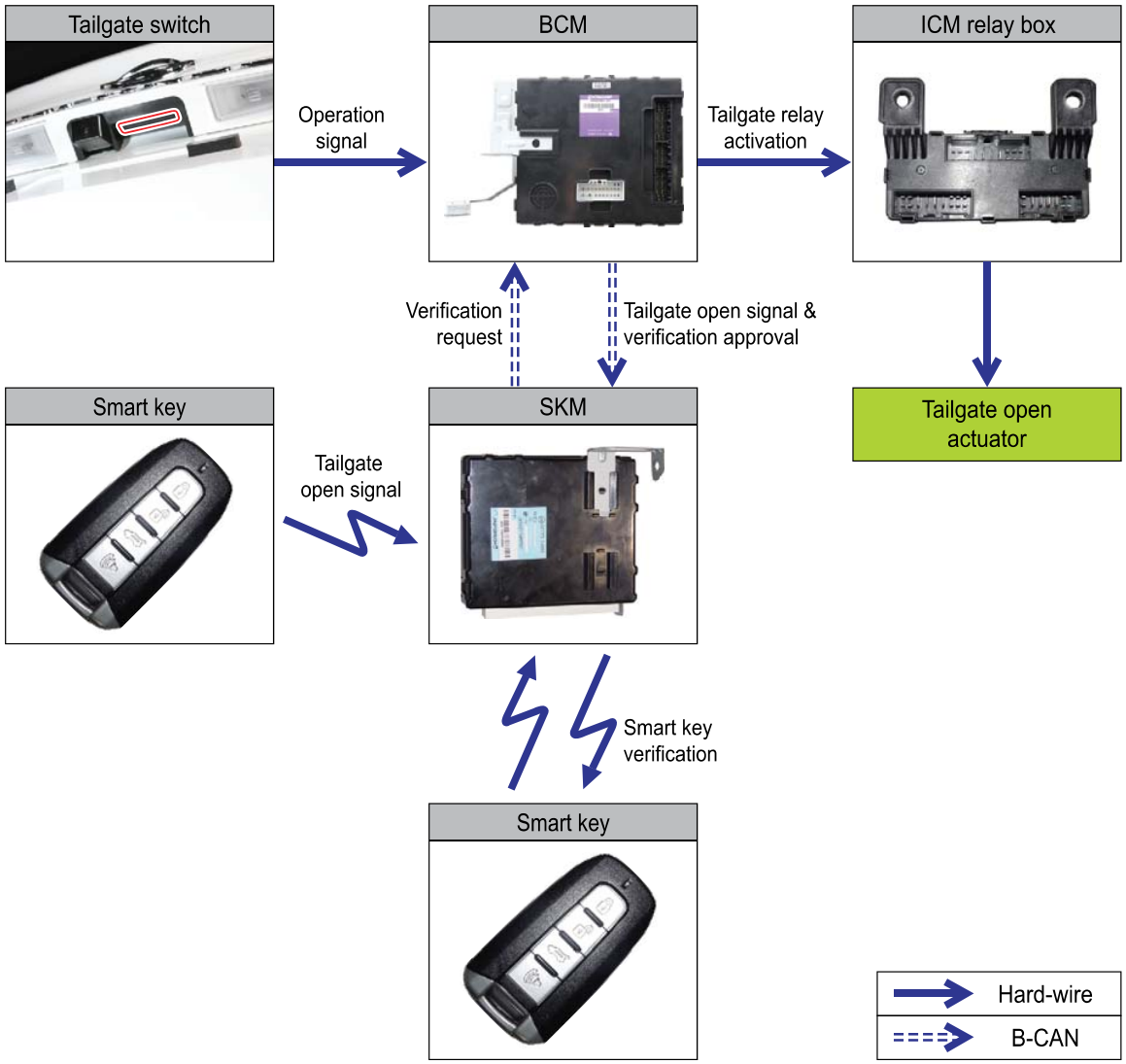
Operation 6.

- The tailgate closed signal is input in theft deterrent mode with power OFF.
- The BCM searches a verified smart key in the luggage compartment after 1 second.
- If a verified smart key is found in the luggage compartment, the BCM activates the external buzzer for 5 seconds.
- The driver presses the tailgate open switch to find the smart key.
- The BCM deactivates the tailgate LOCK function so that the tailgate can be opened even when the driver door is locked. (standby to operate without verification)

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Operating process

- in theft deterrent mode



Modification basis	
Application basis	
Affected VIN	

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17. THEFT DETTERENT FUNCTION

▶ **Theft deterrent mode entering by REKES key (for vehicles without SKM)**

Operation 1.

A. All doors (including hood and tailgate) are closed with the ignition key removed.
B. REKES LOCK signal is received.
C. The door LOCK relay is activated.
D. All doors (including hood and tailgate) are locked
E. The system enters the theft deterrent mode after operating the hazard warning lamp twice.

Operation 2.

F. REKES LOCK signal is received again within 4 seconds of theft deterrent mode activation.
G. The hazard warning lamp flashes twice and the warning horn is operated once in the theft deterrent mode.

Operation 3.

H. REKES LOCK signal is received with one or more doors open.
I. The LOCK relay is activated followed by activation of UNLOCK relay.

Operation 4.

J. REKES LOCK signal is received with the tailgate and hood open.
K. Only the LOCK relays of the closed doors except hood and tailgate are activated.
L. The system does not enter theft deterrent mode.
M. If the open tailgate and hood are closed.
N. The system enters the theft deterrent mode after operating the hazard warning lamp twice.

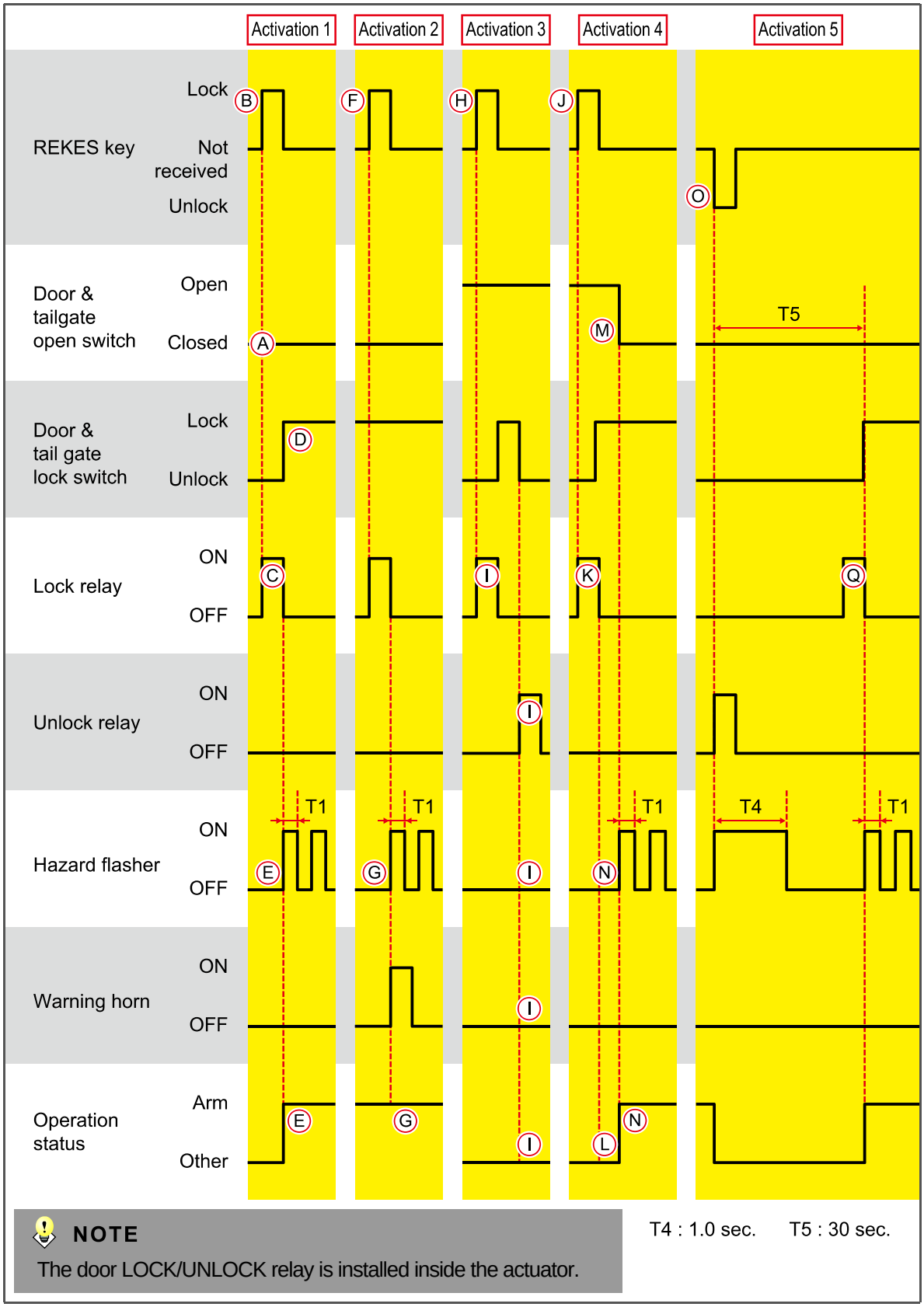
Operation 5.

O. All doors are opened or the ignition key is not inserted within 30 seconds (T5) after the REKES UNLOCK signal is received.
P. The LOCK relay is activated and the system enters the theft deterrent mode after operating the hazard warning lamp twice.

NOTE

- The theft deterrent mode will not be activated when the door is locked by the door key.

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NOTE

The door LOCK/UNLOCK relay is installed inside the actuator.

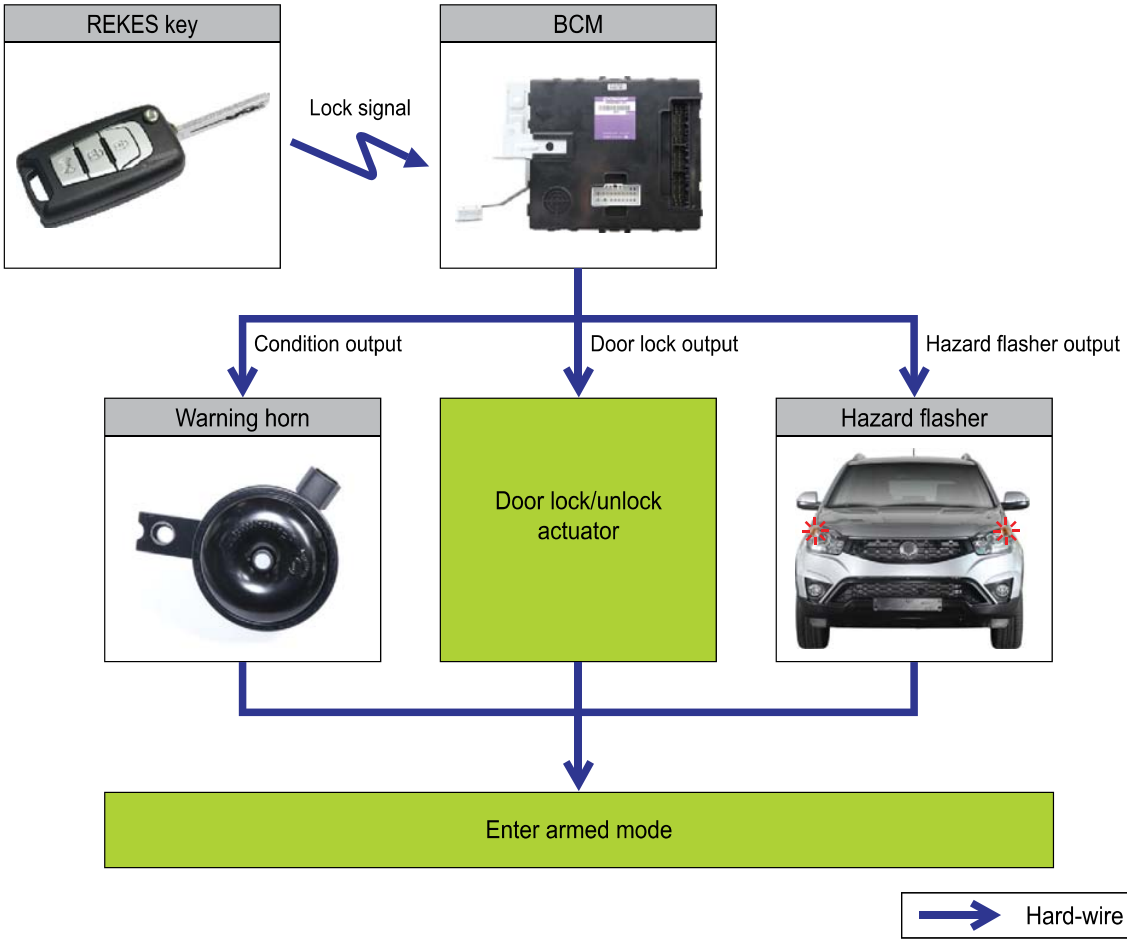
T4 : 1.0 sec. T5 : 30 sec.

Modification basis	
Application basis	
Affected VIN	

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Operating process

- IGN OFF/ACC ON
- All doors (including hood and tailgate) closed



Modification basis	
Application basis	
Affected VIN	

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▶ Theft deterrent mode deactivation conditions (for vehicles without SKM)

- The REKES UNLOCK signal is input with IGN ON.
- When the REKES UNLOCK signal is input in the theft deterrent mode or with the theft deterrent mode deactivated, the hazard warning lamp is operated once and the theft deterrent mode is deactivated (without warning horn output).

▶ Theft deterrent mode (for vehicles without SKM)

The BCM monitors the following conditions continuously in theft deterrent mode.

- Battery power
- Front/rear door open
- Tailgate open
- 4 doors LOCK/UNLOCK
- Hood open

▶ Theft deterrent alarm activation (for vehicles without SKM)

- Any door including hood and tailgate is opened in theft deterrent mode.
- The LOCK switch of any door including tailgate is set to UNLOCK in theft deterrent mode.
- Any door except tailgate and hood is closed and then opened after 30 seconds of alarming.
- The hazard warning lamp and warning horn are activated for 30 seconds at intervals of 0.5 sec. ON/0.5 sec. OFF.

▶ Theft deterrent alarm deactivation conditions (for vehicles without SKM)

- Any signal from the REKES (LOCK, UNLOCK, Panic, Escort) deactivates the theft deterrent alarm.
- The theft deterrent alarm remain on for up to 30 seconds.
- When the theft deterrent alarm is activated in theft deterrent mode, turning the ignition ON immediately deactivates the mode. The alarm is deactivated 30 seconds (time remaining) after that. (For vehicles with immobilizer system, the alarm is deactivated once the key is verified after the ignition is turned ON)

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▶ **Theft deterrent mode entering by smart key (for vehicles with SKM)**

Operation 1.

A. The ignition is turned OFF or ACC is turned ON with all doors (including hood and tailgate) closed.
B. The door LOCK signal is received through B-CAN.
C. The door LOCK relay is activated.
(If ACC ON, the relay is activated after the power is turned OFF.)
D. All doors (including hood and tailgate) are locked
E. The system enters the theft deterrent mode after operating the hazard warning lamp twice and external buzzer (SKM buzzer) once.

Operation 2.

F. The door LOCK signal is received through B-CAN when one or more doors are open with driver door unlocked.
G. The LOCK relay is activated followed by activation of UNLOCK relay.
H. The hazard warning lamp and external buzzer (SKM buzzer) are not operated and the system does not enter the theft deterrent mode.

Operation 3.

I. The tailgate and hood are open.
J. The door LOCK signal is received through B-CAN.
K. If all doors (including hood and tailgate) are closed, door LOCK relay is activated.
L. The system does not enter theft deterrent mode.
M. If the open tailgate and hood are closed.
N. The system enters the theft deterrent mode after operating the hazard warning lamp twice and external buzzer (SKM buzzer) once.

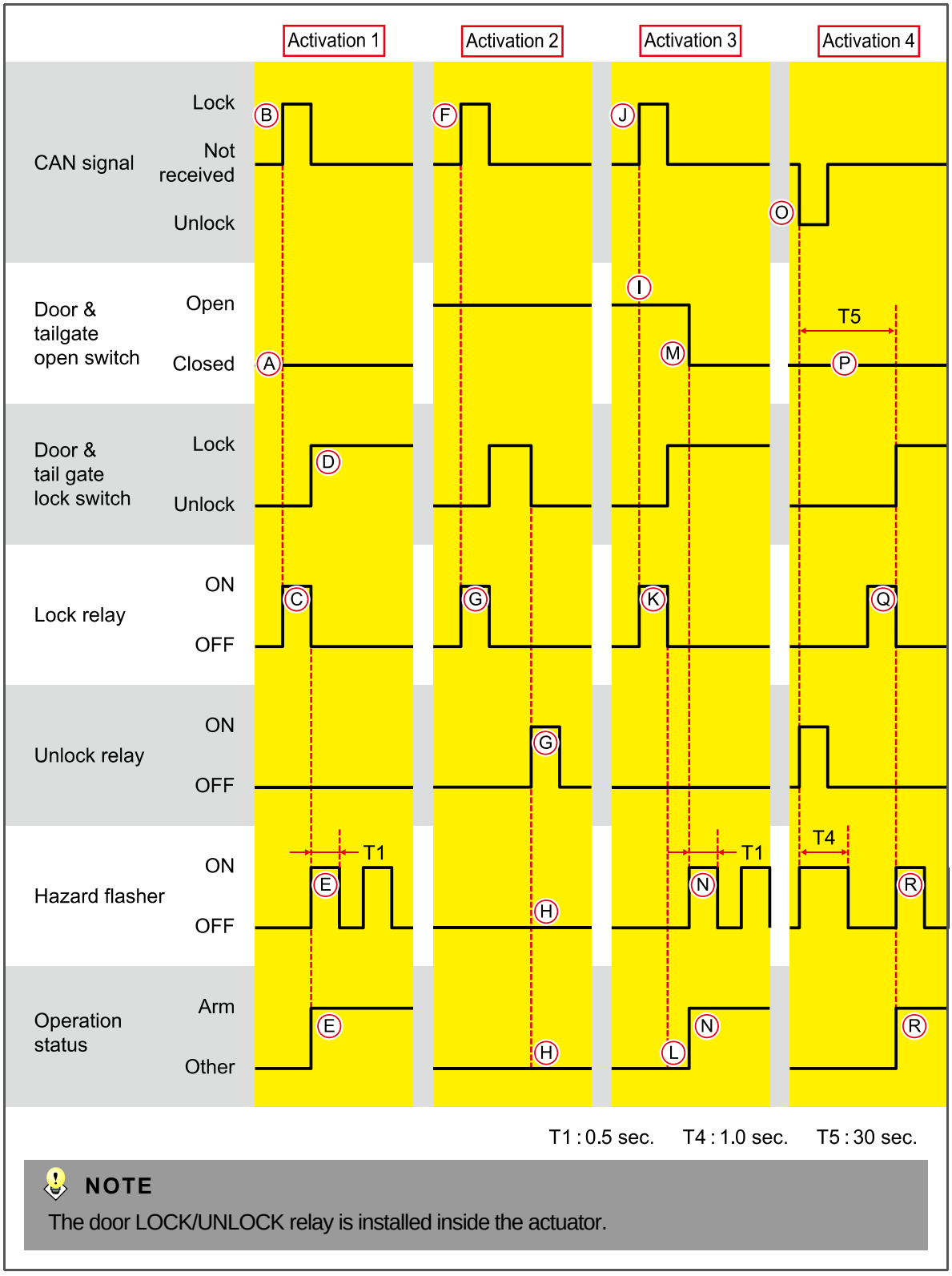
Operation 4.

O. The door UNLOCK signal is received through B-CAN.
P. All doors (including hood and tailgate) are not opened or the ignition is not turned ON within 30 seconds (T5).
Q. The door LOCK relay is activated.
R. The system enters the theft deterrent mode again after operating the hazard warning lamp twice and external buzzer (SKM buzzer) once.

NOTE

The procedure of entering theft deterrent mode by door handle switch LOCK is the same with the operation 3.
Ex) The theft deterrent mode will not be activated when the door is locked by the door key.

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T1 : 0.5 sec. T4 : 1.0 sec. T5 : 30 sec.

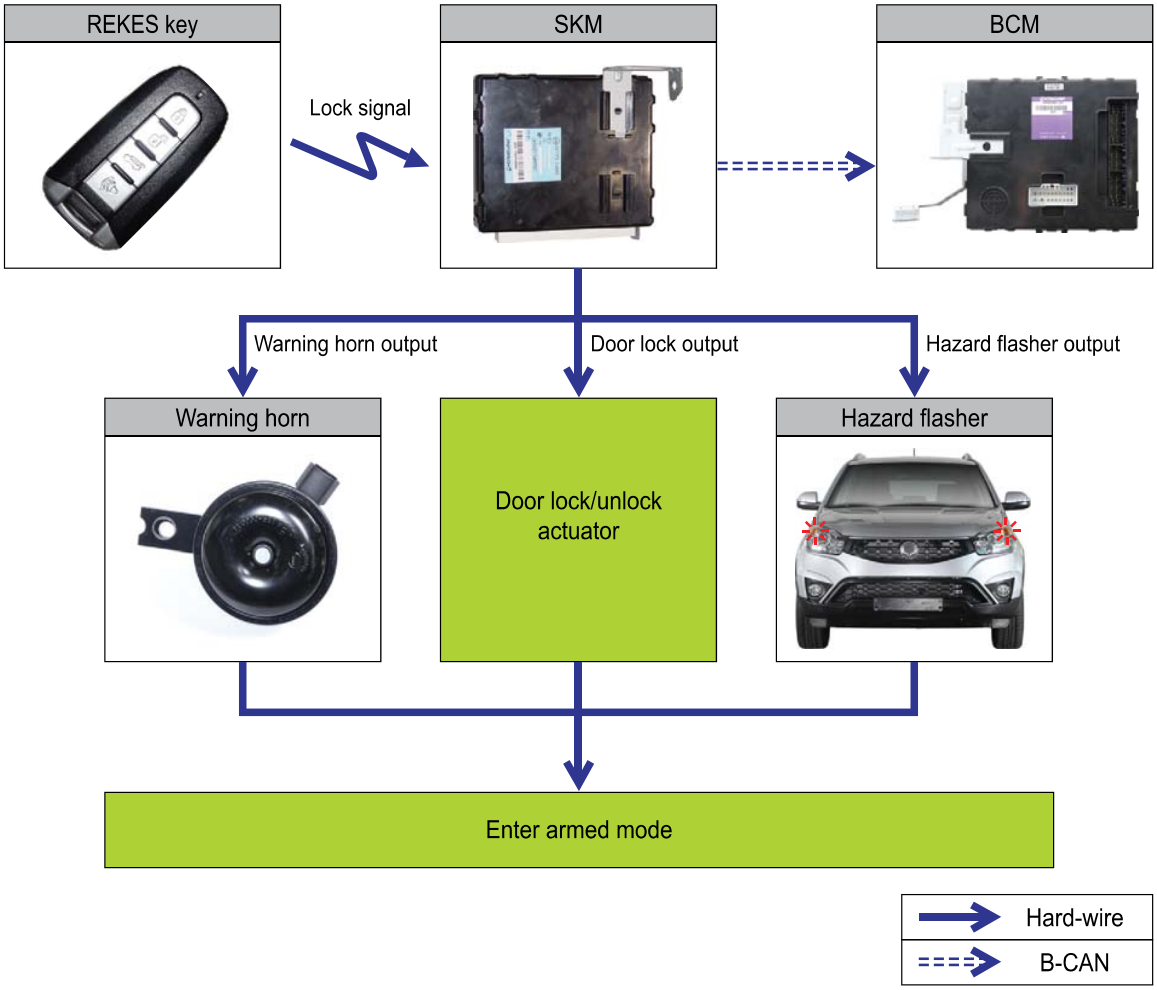
NOTE

The door LOCK/UNLOCK relay is installed inside the actuator.

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Operating process

- IGN OFF/ACC ON
- All doors (including hood and tailgate) closed



▶ **Theft deterrent mode deactivation conditions (for vehicles with SKM)**

- When UNLOCK signal by the smart key with IGN OFF or by the door handle switch with the door locked is received, the door UNLOCK signal is output and the theft deterrent mode is deactivated after the hazard warning lamp (once) and external buzzer (SKM buzzer) (twice) operations.
  If UNLOCK signal by the smart key is received after the deactivation of theft deterrent mode, the
- hazard warning lamp relay and external buzzer (SKM buzzer) are turned ON.
  When the tailgate open signal by the smart key or tailgate open switch is received, only the theft
- deterrent for tailgate is deactivated.
  The theft deterrent mode is deactivated when the ignition is turned ON.
-

Modification basis	
Application basis	
Affected VIN	

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▶ Theft deterrent mode (for vehicles with SKM)

The BCM monitors the following conditions continuously in theft deterrent mode.

- Battery power
- Front/rear door open
- Tailgate open
- 4 doors LOCK/UNLOCK
- Hood open

▶ Theft deterrent alarm activation (for vehicles with SKM)

- Any door including hood and tailgate is opened in theft deterrent mode.
- The LOCK switch of any door including tailgate is set to UNLOCK in theft deterrent mode.
- Any door including tailgate and hood is closed and then opened after 30 seconds of alarming.
- The hazard warning lamp and warning horn are activated for 30 seconds at intervals of 0.5 sec. ON/0.5 sec. OFF.

▶ Theft deterrent alarm deactivation conditions (for vehicles with SKM)

- The theft deterrent alarm is deactivated in the following conditions. The theft deterrent mode is kept ON.
  a. Door LOCK/UNLOCK signal by smart key is received.
  b. Tailgate open signal by smart key is received.
  c. UNLOCK signal by door switch is received.
  d. Tailgate open switch signal is received.
  e. IGN ON signal is received.
  f. Panic function is activated.
- When the ignition is turned ON while the theft deterrent alarm is activated, the alarm is deactivated immediately.
- When the theft deterrent alarm is activated in theft deterrent mode, turning the ignition ON immediately deactivates the mode. The alarm is deactivated 30 seconds (time remaining) after that. If no deactivation command is received, the system enter the theft deterrent mode after the 30
- seconds.

▶ Theft deterrent mode re-activation after tailgate open (for vehicles with SKM)

All doors except the tailgate are in theft deterrent mode, the system searches for the smart key inside the vehicle 1 second after the tailgate is closed. If no smart key is found, the system enters the theft deterrent mode again.
The hazard warning lamp and warning horn are activated when the system enters the mode.

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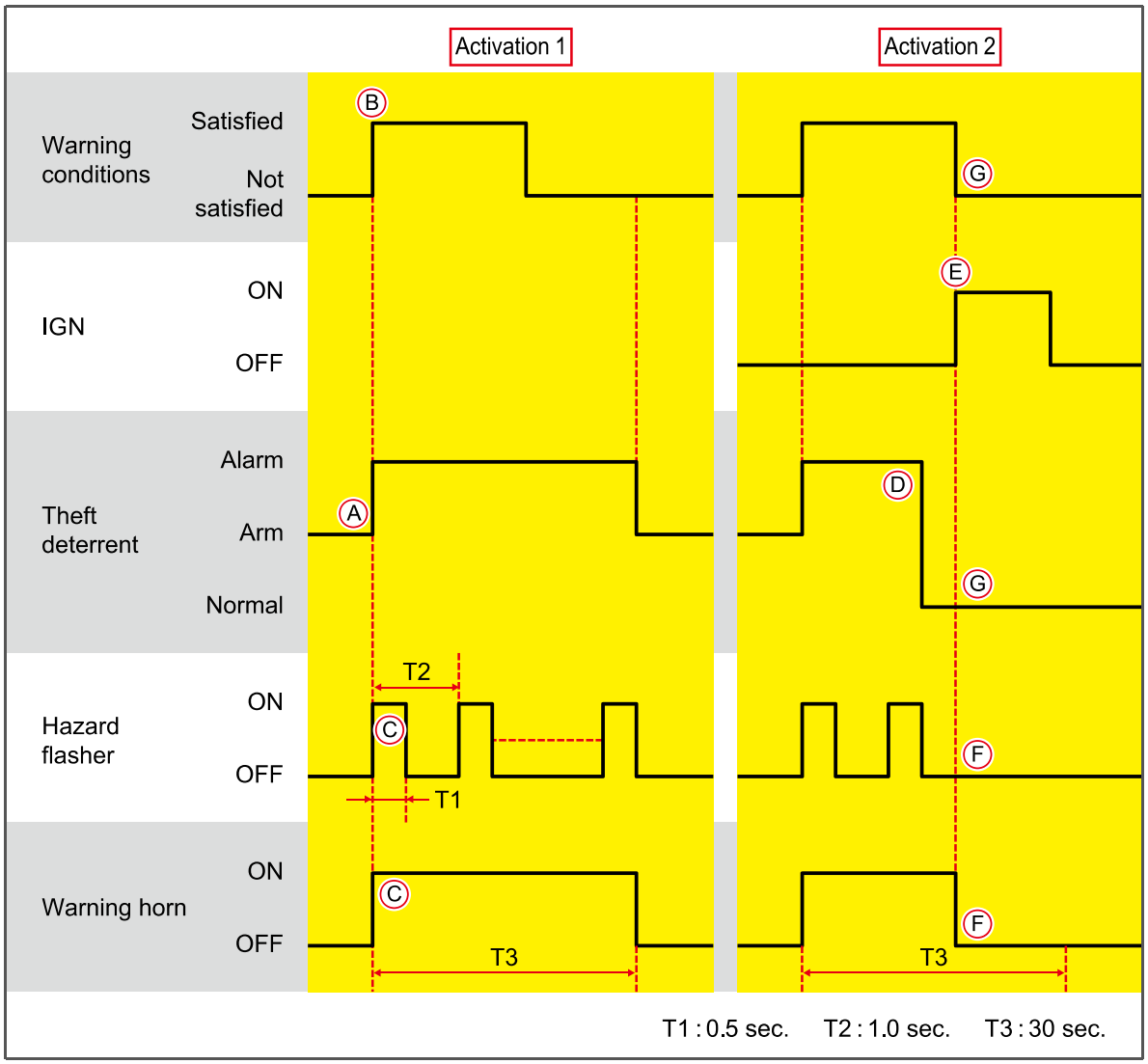
▶ Theft deterrent alarm deactivation (for vehicles with/without SKM)

Operation 1.

A. The system is in theft deterrent mode.
B. The conditions for theft deterrent alarm are met.
C. The hazard warning lamp flashes and the warning horn is activated.

Operation 2.

D. The theft deterrent alarm is activated.
E. The conditions for deactivation of theft deterrent alarm are met.
F. The hazard warning lamp and warning horn are deactivated.
G. The theft deterrent alarm is deactivated because the conditions are not met, and the system enters the theft deterrent mode.

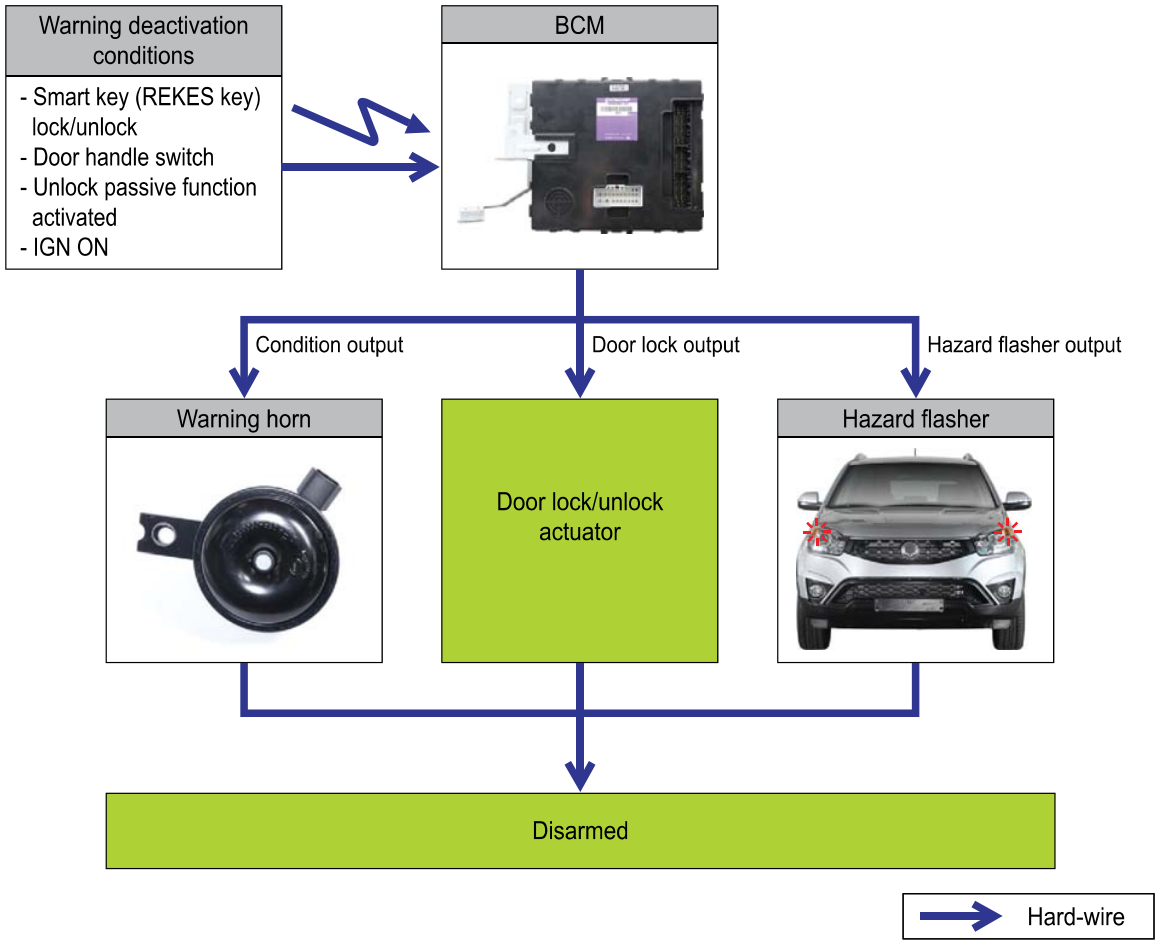


Modification basis	
Application basis	
Affected VIN	

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Operating process

- Theft deterrent alarm activated



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18. POWER WINDOW RELAY CONTROL

▶ **Time lag power window control**

Operation 1.

A. The ignition is turned ON.
B. The power window relay is activated.
C. The ignition is turned OFF.
D. The power window relay is turned ON for 30 seconds (T1).

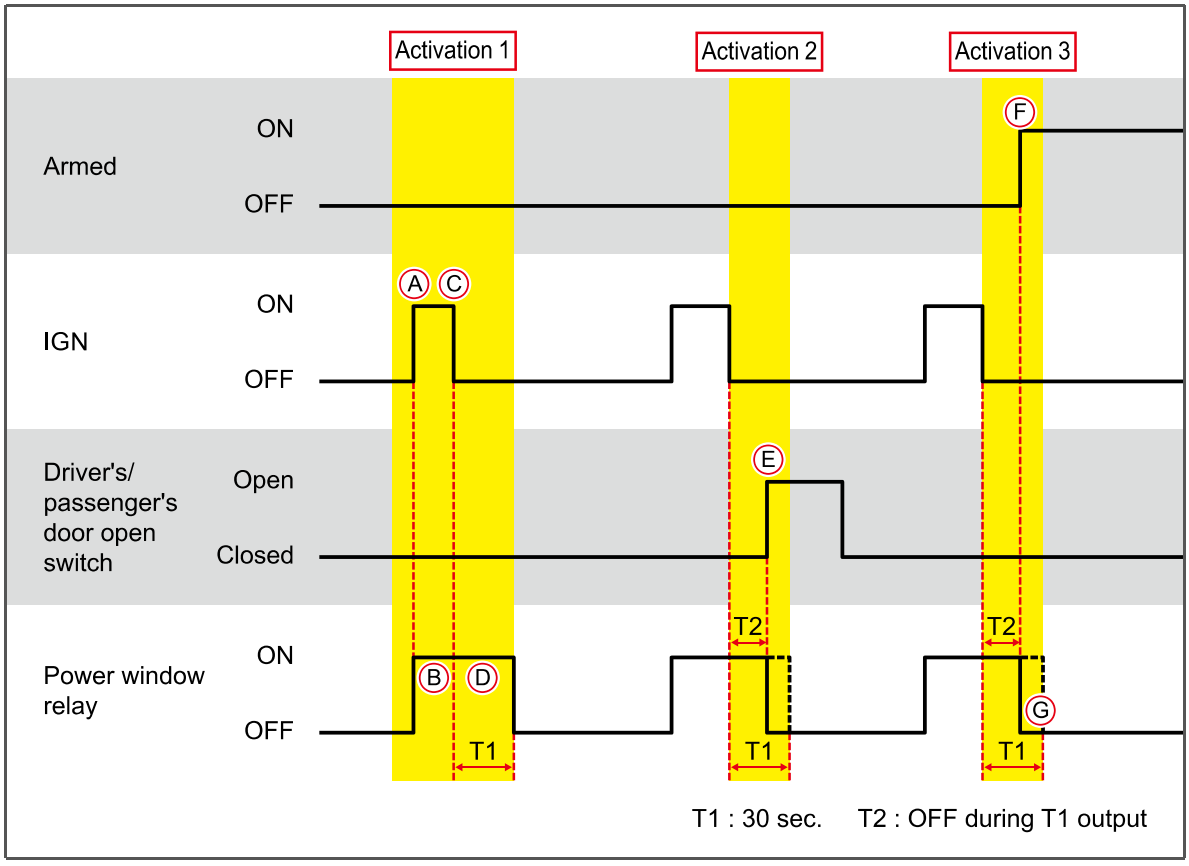
Operation 2.

(during 30 seconds (T1) of power window relay ON).

E. The power window relay is turned OFF immediately when the driver/passenger door is opened.

Operation 3.

F. The system enters theft deterrent mode.
G. The power window relay is turned OFF immediately.

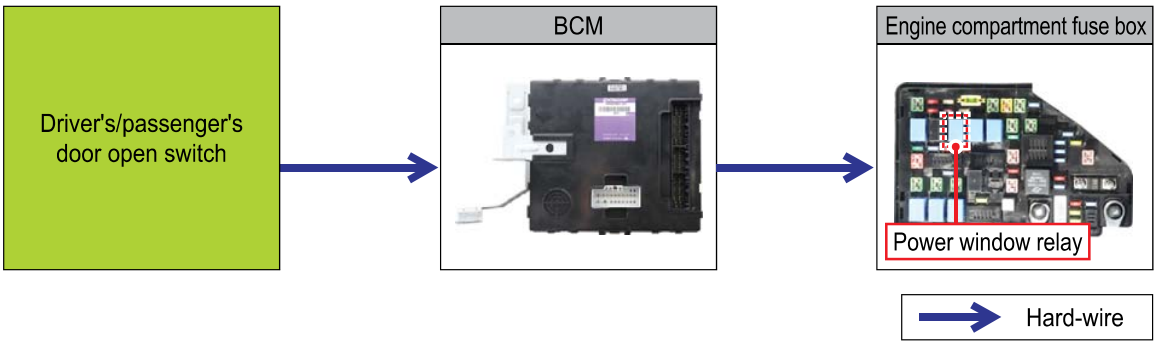


Modification basis	
Application basis	
Affected VIN	

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Operating process

- The ignition is turned OFF.



19. SLEEP MODE

1. If the state of the LOCK switches of driver/passenger/rear doors and tailgate is not changed for 6 seconds with the all doors including tailgate closed and IGN OFF (ignition key removed), even if the state is not LOCK, the system enters the sleep mode to power down.
2. If any condition of the (1) is not met, the system enters the wake up mode immediately.
3. When the room lamp, key hole lamp, tail lamp, or power window is already activated, or all doors are closed for continuous 30 seconds after the door UNLOCK under the conditions stated in (1), the system waits in normal mode. If the lamps or power window is deactivated and no change is detected for 6 seconds after all doors are closed, the system enters the sleep mode.
4. When the front room lamp is ON, the system turns of the room lamp in 10 minutes and enters the sleep mode after 6 seconds.
5. If the coming home light is ON, the system enters the sleep mode when the coming home light switching off conditions are met.
6. The sleep mode is deactivated when a door is opened or key is inserted.

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20. FLASHER FUNCTION

▶ **LH/RH turn signal lamp control**

Operation 1.

A. The LH/RH turn signal lamp switch is turned ON with IGN ON.
B. The LH/RH turn signal lamp flashes 75 times per minute (T1), and the internal buzzer sounds at intervals of 0.4 sec. ON/0.4 sec. OFF.
C. The LH/RH turn signal lamp and internal buzzer are deactivated when the LH/RH turn signal lamp switch is turned OFF.

Operation 2.

D. Abnormal current (less than 3 A or more than 7 A) detection signal is input while the lamp is ON. The LH/RH turn signal lamp flashes 100 times per minute (T2), and the internal buzzer sounds at
E. intervals of 0.3 sec. ON/0.3 sec. OFF.

Operation 3.

F. The LH/RH turn signal lamp is activated only with IGN ON.

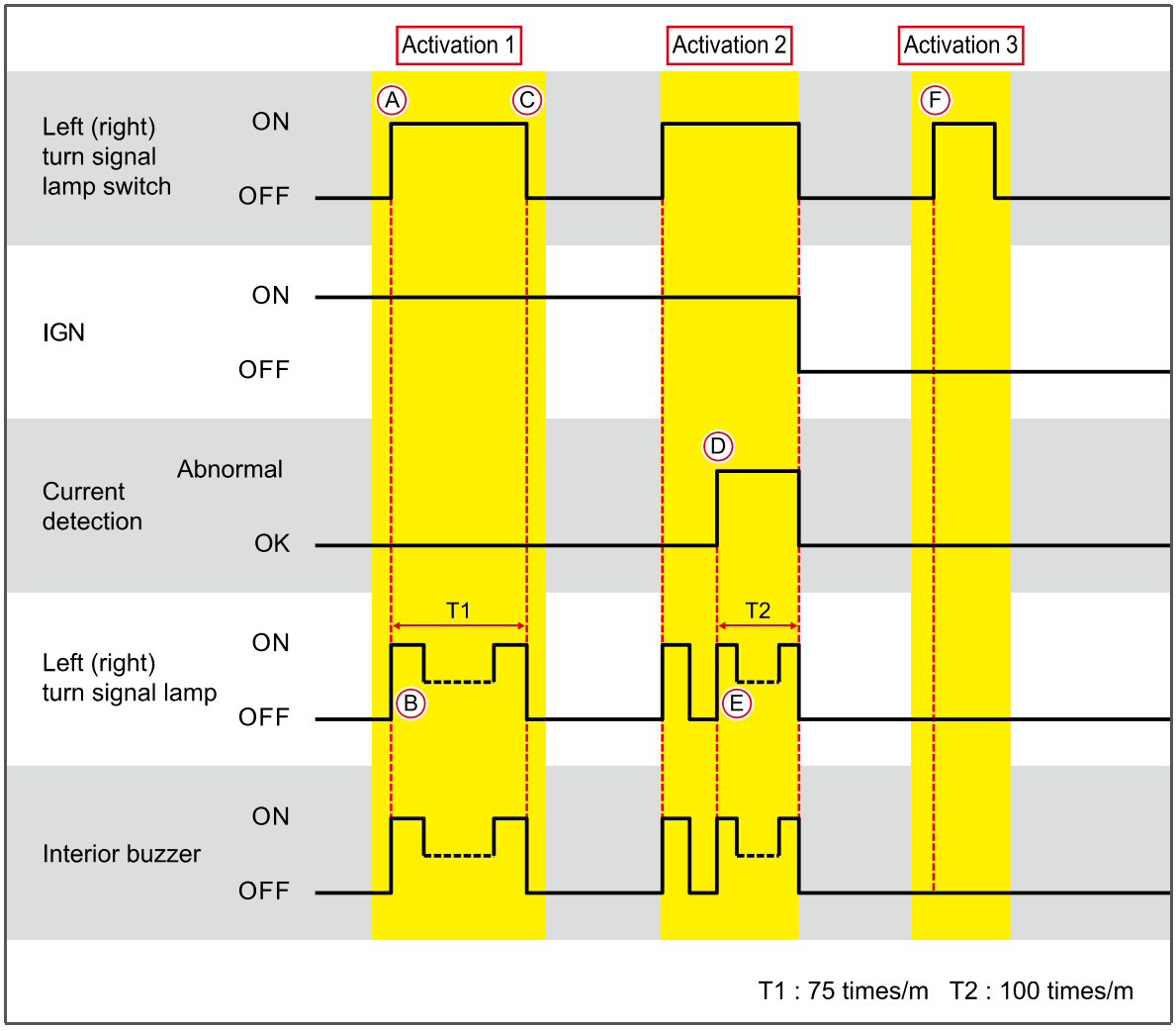
NOTE

The LH/RH turn signal lamp flashes 3 times once the corresponding lamp switch is turned ON.

- When the LH turn signal lamp switch is turned OFF during the 3 times flashing, the turn signal lamp goes out after the flashing operation.
- When the LH turn signal lamp switch is turned ON during the 3 times flashing, the turn signal lamp flashes 3 more times.
- When the RH turn signal lamp switch is turned ON during the 3 times flashing, the LH turn signal lamp goes out immediately and the RH turn signal lamp flashes 3 times before switching off.

Modification basis	
Application basis	
Affected VIN	

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▶ Hazard warning lamp switch control

Operation 1.

A. The hazard warning lamp switch is turned ON with IGN ON or OFF.
B. The hazard warning lamp flashes 75 times per minute (T1), and the internal buzzer sounds at intervals of 0.4 sec. ON/0.4 sec. OFF.
C. The hazard warning lamp and internal buzzer are deactivated when the hazard warning lamp switch is turned OFF.

Operation 2.

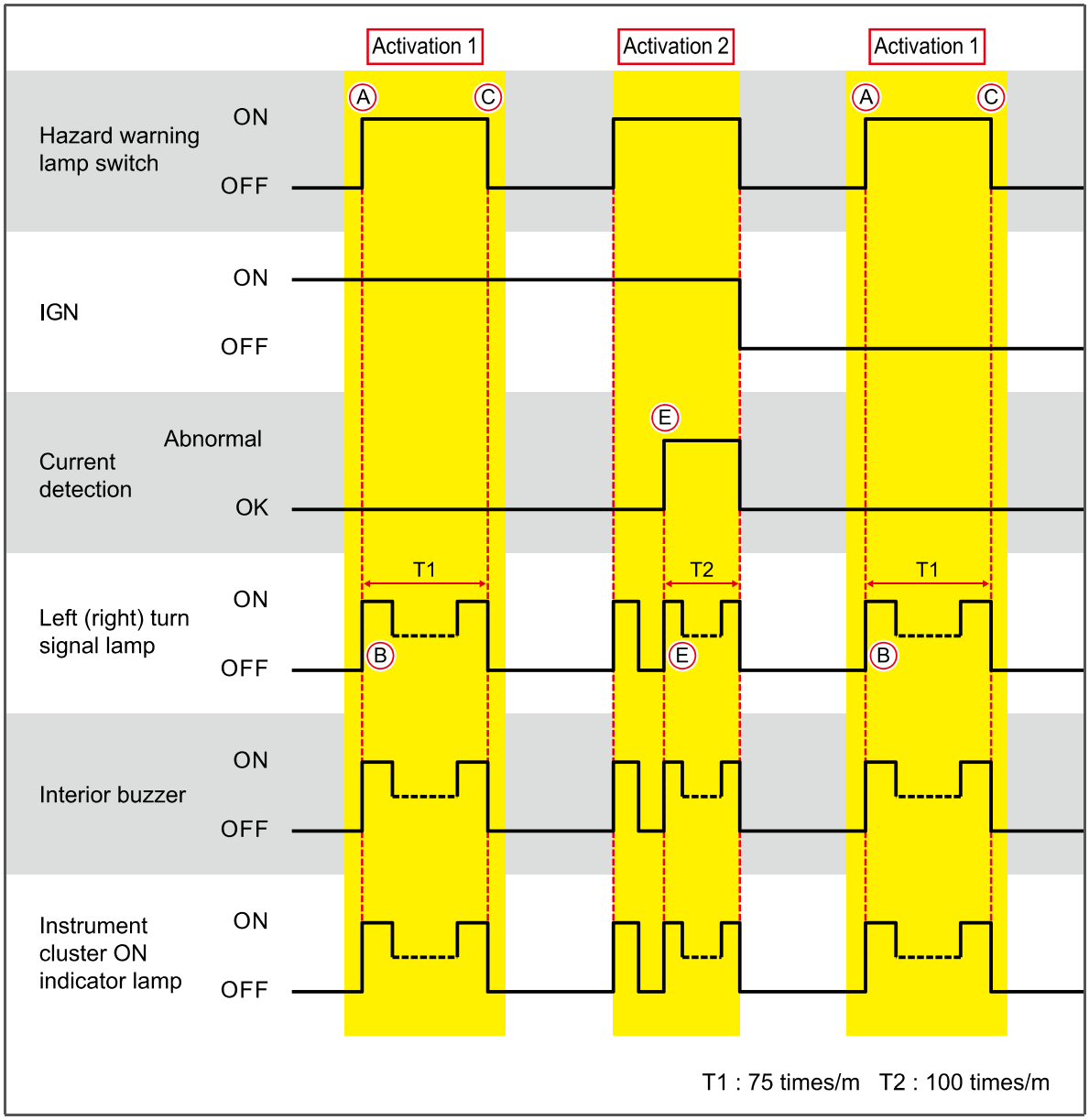
D. Operation 1. Abnormal current (less than 3 A or more than 7 A) detection signal is input while the lamp is ON.
E. The hazard warning lamp flashes 100 times per minute (T2), and the internal buzzer sounds at intervals of 0.3 sec. ON/0.3 sec. OFF.

NOTE

- Hazard warning lamp functions at B+ or more.
- The allowed time difference between the LH and RH turn signal lamp operations is within 0.1 seconds.
- The hazard warning lamp overrides the turn signal lamp.
- Priority of internal buzzer (chime) operation while the hazard warning lamp is ON
  (Seat belt reminder > Ignition key reminder > Sunroof open > Tail lamp ON > Hazard warning lamp > Turn signal lamp)

Modification basis	
Application basis	
Affected VIN	

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▶ AUTO hazard warning flasher control

Operation 1.

A. The hazard warning lamp comes on 3 times (T3) when the AUTO hazard warning lamp switch is pressed for less than 0.6 seconds (T1).

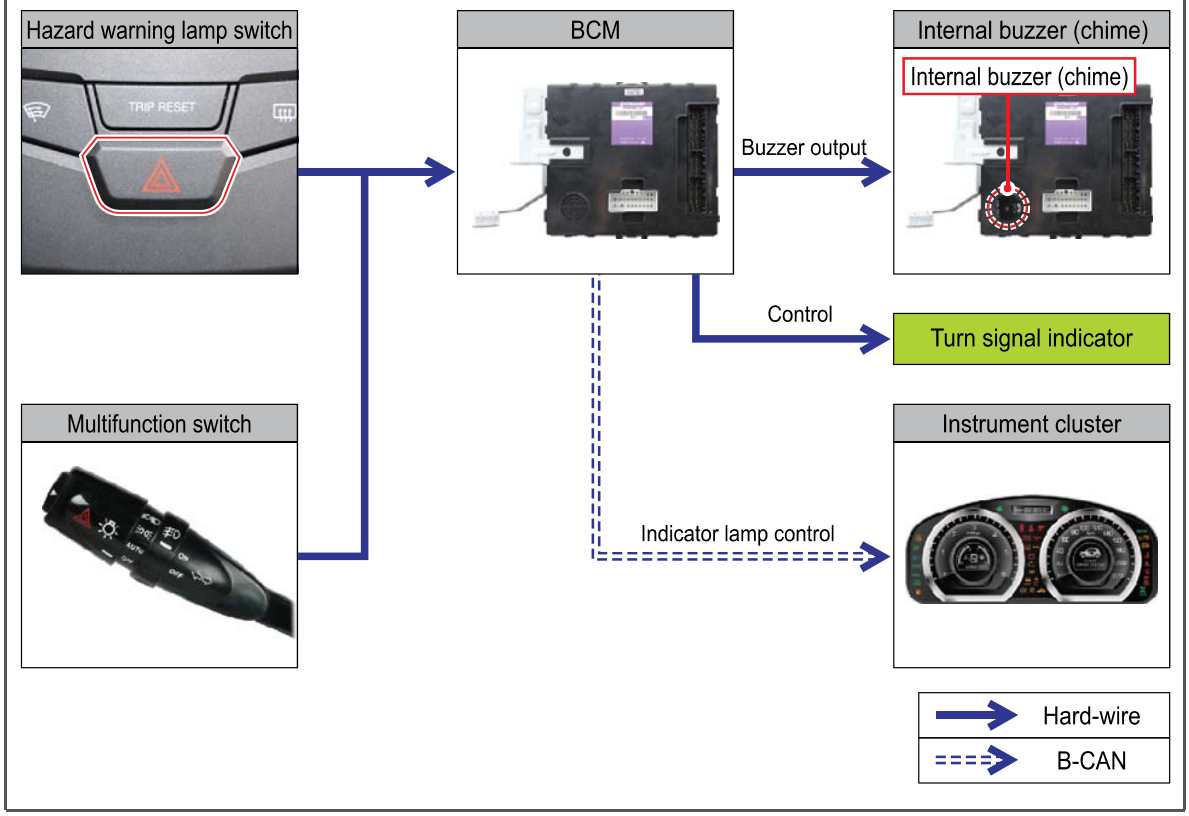
Operation 2.

B. The hazard warning lamp comes on 10 times (T4) when the AUTO hazard warning lamp switch is pressed for 0.6 seconds or more (T2).
C. The turn signal lamp switch is pressed during the AUTO hazard warning lamp operation.
D. The corresponding turn signal lamp is activated after this AUTO hazard warning lamp operation.

NOTE

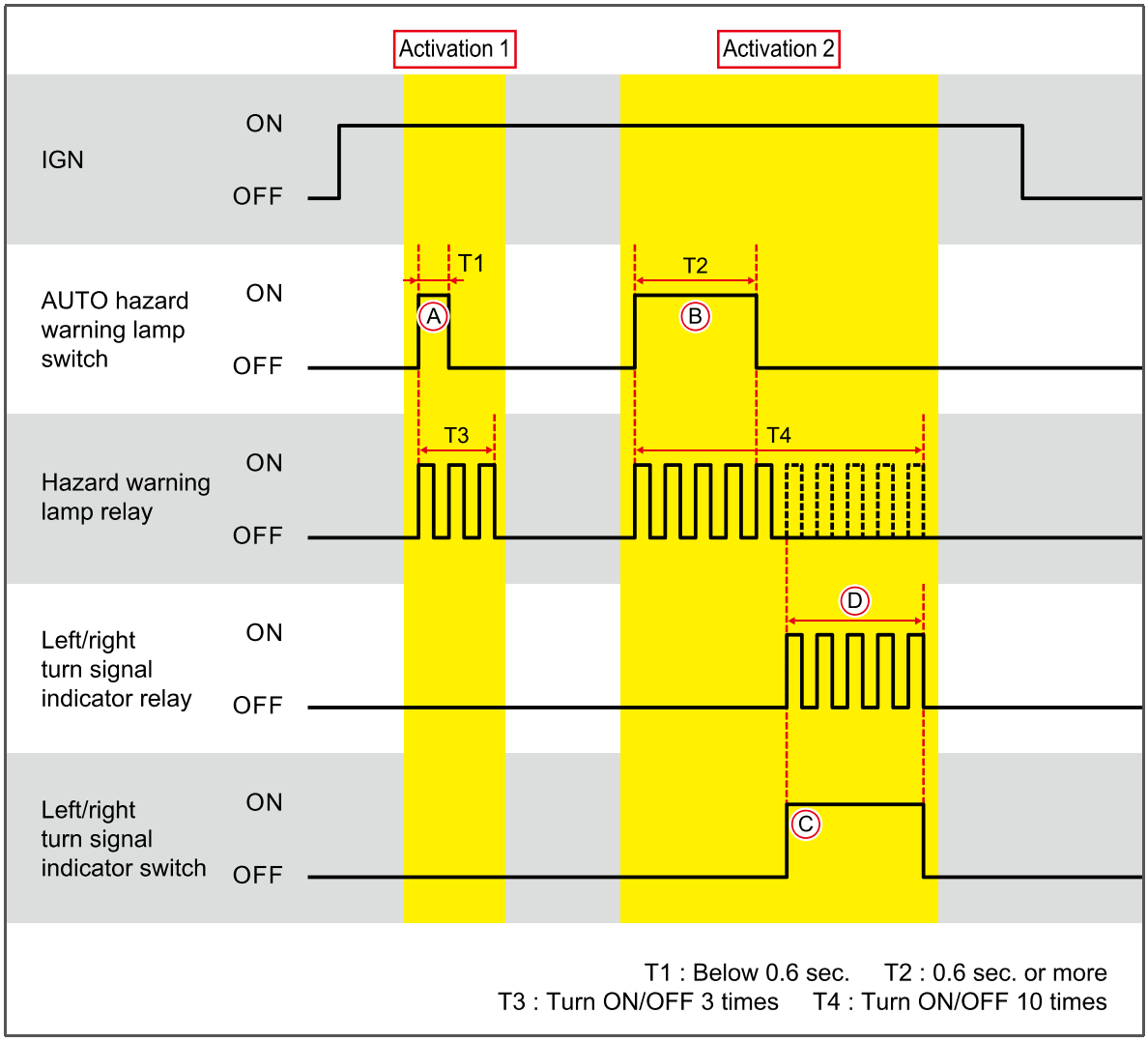
- The AUTO hazard warning lamp can be controlled only with IGN ON.
- The input from the AUTO hazard warning lamp switch is ignored during the turn signal lamp operation by the turn signal lamp switch.
- Priority of operation: (Hazard warning lamp switch > LH/RH turn signal lamp > AUTO hazard warning lamp switch)

Operating process



Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
Affected VIN	

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▶ **Emergency hazard warning lamp control (coupled with ABS)**

The BCM activates emergency hazard warning lamp operation when receiving emergency braking signal from the ESP/ABS.

- Priority of operation
  (Manual operation of hazard warning lamp > Emergency stop signal > Emergency AUTO hazard warning lamp > AUTO hazard warning lamp)

Operation 1. (emergency stop signal)

A. The emergency stop signal is input from the ABS/ESP module with the vehicle driven at 50 km/h or more.
B. The hazard warning lamp flashes at 4 Hz (T1) and internal buzzer (chime) sounds at 1.25 Hz.

Operation 2. (Emergency stop signal → Emergency AUTO hazard warning lamp)

C. During operation 1 (emergency stop signal activated)
D. The vehicle speed decreased to 50 km/h or less
E. The hazard warning lamp flashes for 10 seconds (T2) at 1.25 Hz and then goes out.

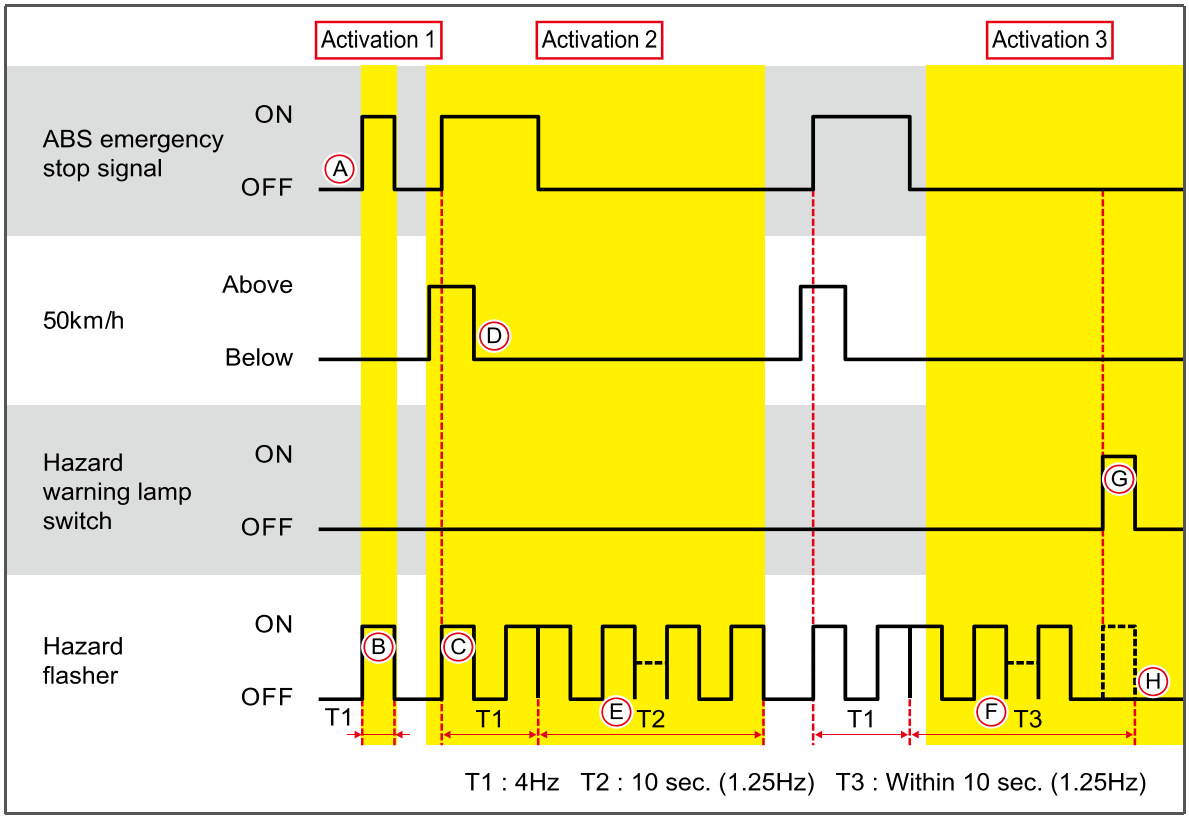
Operation 3. (Emergency AUTO hazard warning lamp → Manual operation of hazard warning lamp)

F. During operation 2 (emergency AUTO hazard warning lamp)
G. The hazard warning lamp switch is turned OFF.
H. The hazard warning lamp is turned OFF because the manual operation overrides the emergency AUTO operation.

NOTE

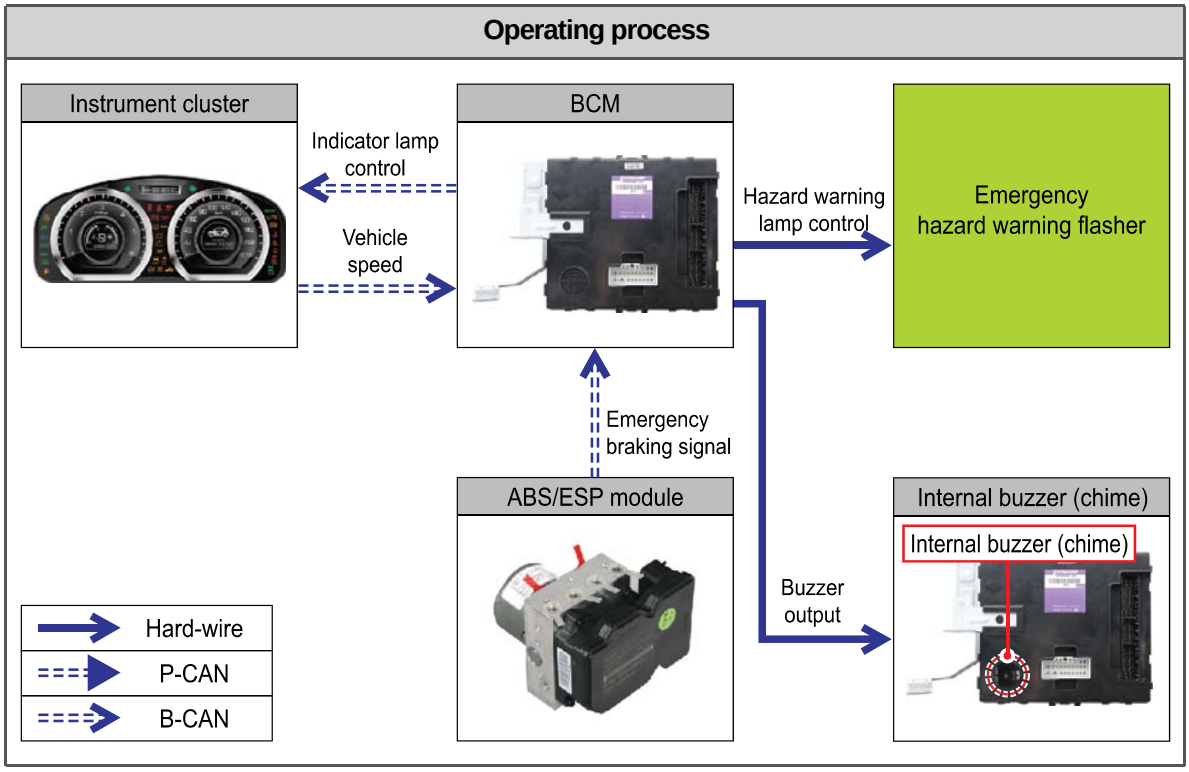
The emergency stop signal and emergency AUTO hazard warning lamp signal are switched off when the vehicle speed exceeds 10 km/h (if emergency stop signal is input).

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Modification basis	
Application basis	
Affected VIN	

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The BCM activates emergency hazard warning lamp operation when receiving emergency braking flasher ON signal from the ESP/ABS.
When the emergency stop signal is input through the P-CAN, the hazard warning lamp flashes with the frequency of 4 Hz and the internal buzzer sounds at 1.25 Hz.
P-CAN signal during operation: Emergency Stop=EBL_INFO=0*0=Hazard Warning Lamp unrequested

Modification basis	
Application basis	
Affected VIN	

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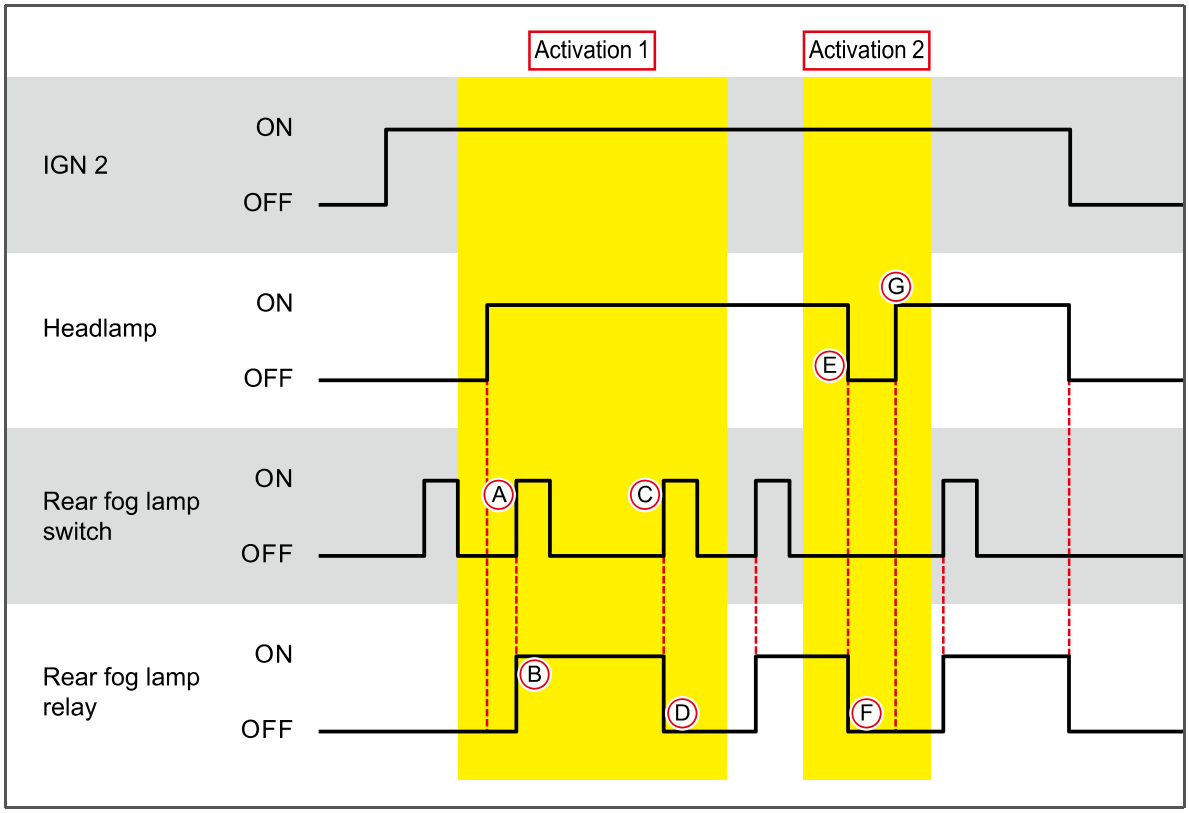
▶ Rear fog lamp control (only EU)

Operation 1.

A. When pressing the rear fog lamp switch with IGN2 ON (headlamp ON condition),
B. The rear fog lamps are turned on.
C. When pressing the rear fog lamp switch again during the operation,
D. The rear fog lamps are turned off.

Operation 2.

E. If the headlamp is turned off or IGN2 switch is turned to "OFF" position,
F. The rear fog lamps are turned off.
G. The rear fog lamps are not turned on automatically without operating the rear fog lamp switch.



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21. OUTSIDE REAR VIEW MIRROR FOLDING/UNFOLDING

▶ **Folding/unfolding control**

Operation 1.

A. The folding switch is turned ON.
B. The folding relay is activated for 16 seconds (T1).

Operation 2.

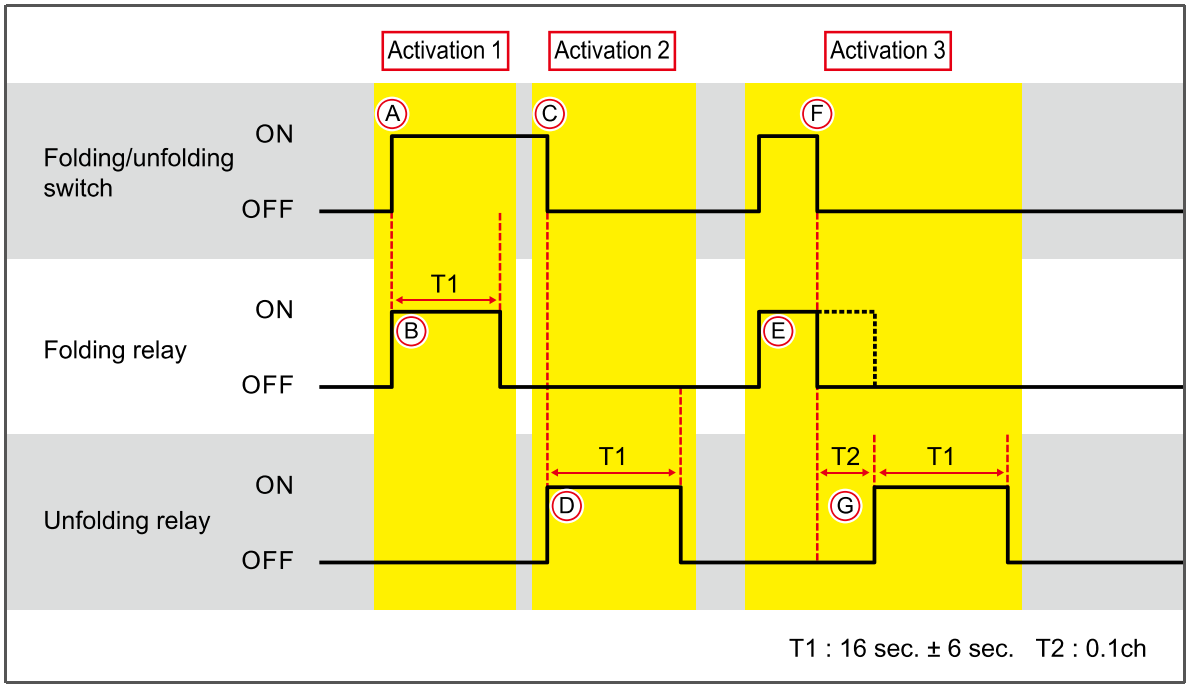
C. The folding switch is turned OFF.
D. The unfolding relay is activated for 16 seconds (T1).

Operation 3.

E. The folding relay is activated by the folding switch.
F. The folding switch is turned OFF.
G. The unfolding relay is activated after 0.1 seconds (T2).
- The control logic is the same for folding to unfolding operation and unfolding to folding operation.

NOTE

- The AUTO folding/unfolding function is not available when the folding switch is ON.
- The AUTO folding/unfolding function is available when the folding switch is OFF.



Modification basis	
Application basis	
Affected VIN	

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22. APPROACH (PUDDLE) LAMP

▶ Approach lamp control (for vehicles without SKM)

Operation 1. (Puddle lamp ON conditions)

A. The lamp is illuminated for 30 seconds when the REKES key UNLOCK signal is received in theft deterrent mode.
B. The lamp is illuminated when the driver door is opened after the ignition is turned OFF.

Operation 2. (Puddle lamp OFF conditions)

C. When the door LOCK signal is received with the lamp ON (the system enters the theft deterrent mode)
D. When the ignition is turned ON with the lamp ON.
E. Thirty seconds after the lamp ON

▶ Approach lamp control (for vehicles with SKM)

Operation 1. (Puddle lamp ON conditions)

A. The lamp is illuminated for 30 seconds when UNLOCK signal by the smart key or door handle switch is received in theft deterrent mode.
B. The lamp is illuminated when the driver door is opened after the ignition is turned OFF.

Operation 2. (Puddle lamp OFF conditions)

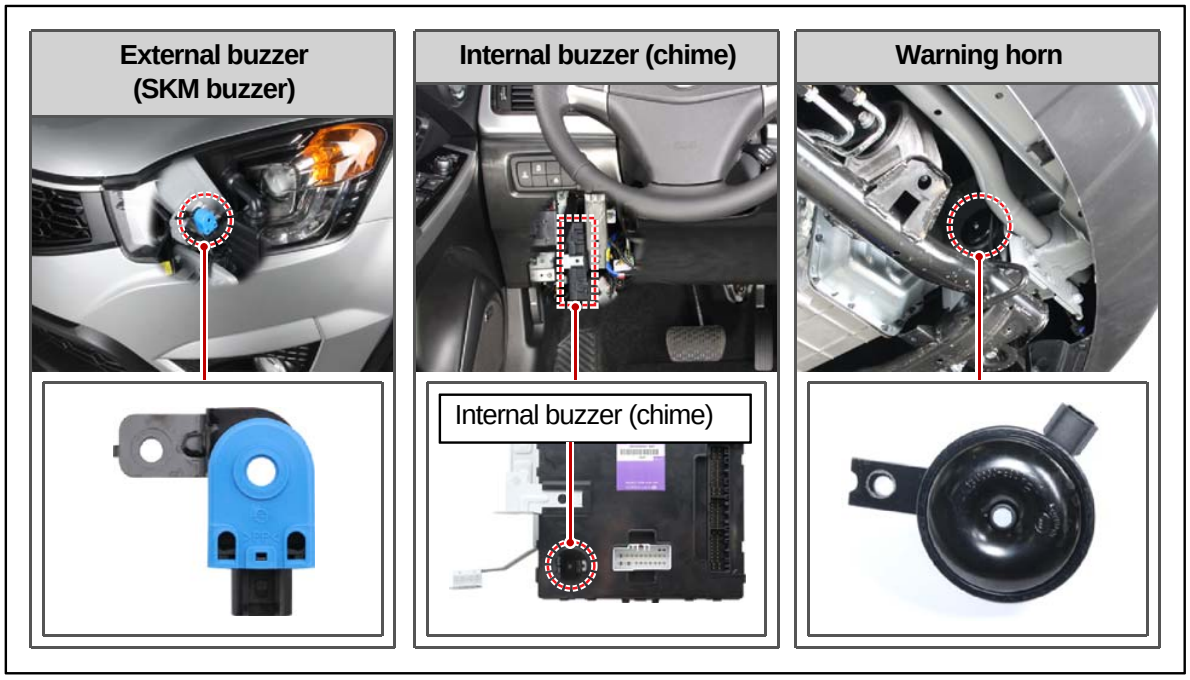
C. When the door LOCK signal is received with the lamp ON (the system enters the theft deterrent mode)
D. When the ignition is turned ON with the lamp ON.
E. Thirty seconds after the lamp ON

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23. BUZZER CONTROL

▶ **Priority of BCM buzzer control**

Buzzer Priority in BCM					Warning command from SKM			
			For BCM without SKM	For BCM with SKM				For BCM with SKM
1	REKES lock alarm	Exterior	Horn	1	1	Key-OFF alarm	Exterior	1
2	REKES unlock alarm	Exterior			2	Smart key reminder warning	Exterior	
3	Panic alarm	Horn	2	2	3	Smart key verification failure warning	Interior	5
4	Theft deterrent alarm	Horn	1	1	4	Transponder verification failure warning	Interior	
5	Seat belt reminder alarm	Interior	3	1	5	Smart key battery discharge warning	Interior	
6	SWR alarm	Interior	4		6	Gear position warning	Interior	
7	sun roof alarm	Interior	6	2	7	SKM error warning	Interior	
8	Tail lamp alarm	Interior	7		8	Brake warning	Interior	
9	Hazard flasher alarm	Interior	8	4	9	Clutch warning	Interior	
10	Turn signal lamp alarm	Interior	9		10	Smart key holder reminder warning	Interior	3
11	Auto folding setting	Interior	10	6				
12	Key reminder	Interior	5	-				



Modification basis	
Application basis	
Affected VIN	

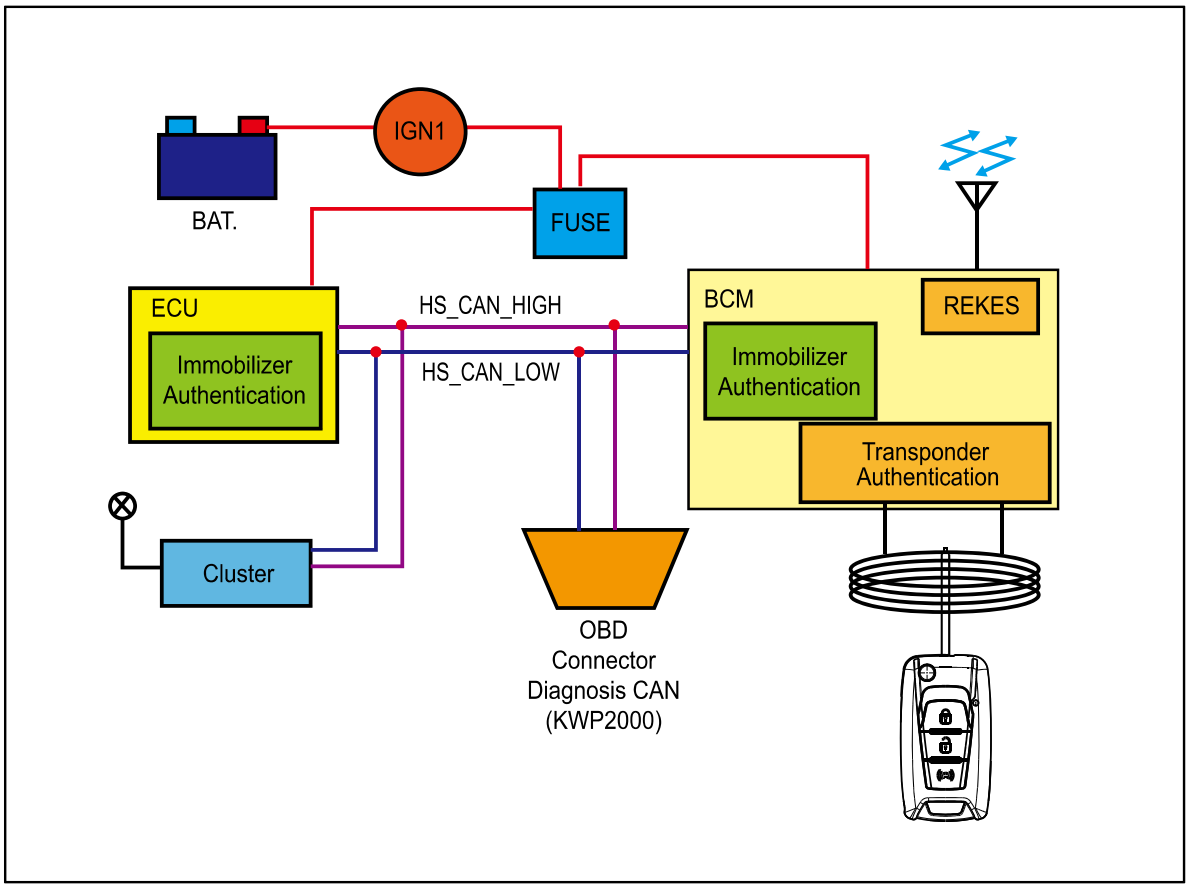
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24. IMMOBILIZER SYSTEM

1) System Description

The BCM without SKM communicates with the transponder in the REKES key and immobilizer unit in the key box through wireless communication. The immobilizer unit and BCM check the encrypted codes received through hard wire communication to start the engine.
Stays on: Communication failure between immobilizer and EMS (ECU)
Flashes: Immobilizer coding failure (once per second)

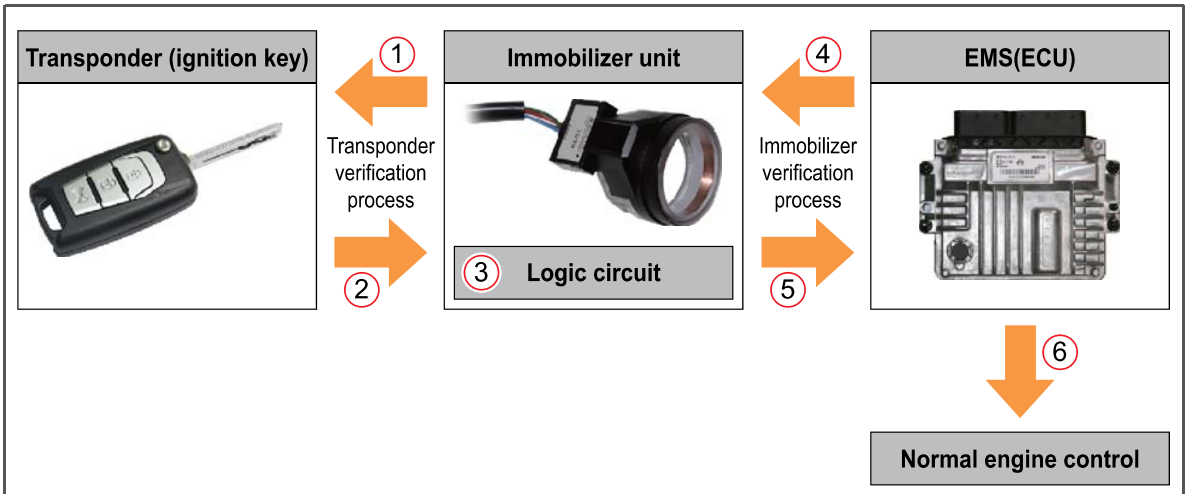
2) System Diagram



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3) Immobilizer Ignition Key Verification

When turning the ignition key to the ON position, the power is supplied to the immobilizer unit and EMS (ECU). The ECU communicates with the immobilizer unit to verify the key and transponder. If it is valid, the ECU starts to control the engine or immobilizer indicator (illumination or flashing) when the ignition key is turned to the START position.
Once the key is verified, valid key verification time is provided for 10 seconds and the engine can be started by turning the ignition key to the engine START position during this verification time. If the ignition key is turned to the START position again after the 10 seconds of verification time, the key verification should be reperformed.



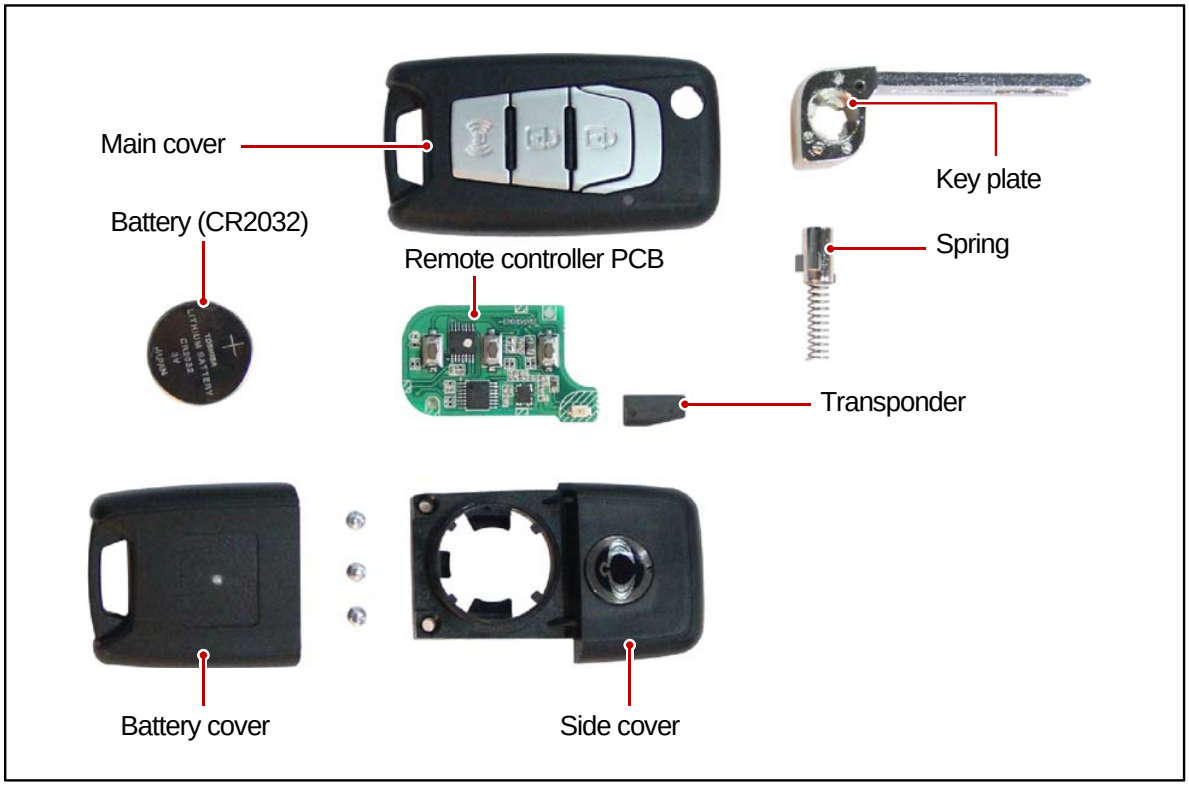
1. When the ignition key is inserted, the immobilizer unit requests the transponder verification through the antenna.
2. The transponder sends the encrypted message to the immobilizer control unit.
3. The immobilizer unit compares the encrypted message received from the transponder to the coded value through the logic circuit. If they are identical, it requests the transponder approval. When the ignition is turned ON, the EMS (ECU) requests immobilizer verification process through
4. the P-CAN.
   The immobilizer control unit sends the encrypted message to the EMS (ECU).
5. The EMS controls the engine normally when the coded value and the encrypted message sent
6. from the immobilizer are identical.

NOTE

When the immobilizer verification has failed, the verification signal is sent again 3 times for 2 seconds, and the verification procedure is carried out up to 3 times by turning the ignition ON within 10 seconds. If the three re-verifications fail, verification procedure is stopped and will be restarted after 10 seconds.

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4) REKES Key Configuration



▶ Battery replacement

Remove the battery cover with a flat-bladed screwdriver to replace the battery.

▶ Transponder replacement

- Remove the battery cover to remove the battery.
- Remove the key plate after removing the rubber cover and screws.
- Remove the side cover and main cover.
- Replace the transponder

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5) Cautions for immobilizer

CAUTION

1. When deleting the old code of the transponder registering an extra ignition key, please attend on the site and observe the process personally.
2. In any cases, the immobilizer system cannot 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.
3. The remote engine starter cannot be installed to the vehicle equipped with the immobilizer system. Do not drop the key or subject it to impact the key, as it may damage the transponder inside the
4. key.
   The engine cannot be started using a key with damaged transponder.
5. In the following cases, you may experience starting problem or a system error can occur.
6.
   - When two or more ignition keys come into contact with (each) other(s), or the key is close to any device that sends/receives electromagnetic fields or waves.
   - When the ignition key is close to any electromagnetic device, such as lighting equipment, security keys or security cards.
   - When the key is close to a magnetic, metal object, or battery.

Modification basis	
Application basis	
Affected VIN	

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SMART KEY MODULE

8712-03

GENERAL INFORMATION

1. SPECIFICATIONS

▶ **Smart key module**

Component	Item	Specifications
SKM unit (Electric)	Rated voltage	12.0 V
	Operating voltage	9.0 V to 16.0 V (CAN: 6.0 V to 18.0 V)
	Operation temperature	−30℃ to 80℃
	Max. operating humidity	95%
	Dark current	5.5 mA
	Voltage drop	1.0 V or less
SKM unit (wireless)	Receive frequency	433.920 MHz ± 0.015 kHz/PWM
	Frequency bandwidth	15 kHz ± 2 kHz or less
	Modulation type	FSK (Frequency Shift Keying)
	Receive distance	RF: 10 m or more (without obstacles) LF: 1.2 m (without obstacles)

▶ **Smart key**

Component	Item	Specifications	
Smart key (Electric)	Operating voltage	2.7 V to 3.3 V	
	Operation temperature	−20℃ to 60℃	
	Battery type	CR2032	
Smart key (wireless)		**RF (Radio Frequency) (transmission)**	**LF (Low Frequency) (receiving)**
	Sending/receiving frequency	433.92 ± 0.0125 MHz	133.3 kHz ± 0.2 kHz
	Modulation type	FSK (Frequency Shift Keying)	

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▶ **LF (Low Frequency) antenna**

Component	Item	Specifications
Smart key antenna	Frequency	134.2 ± 1.5 kHz
	Current consumption	Max. 1.2 A
	Operating temperature range	−30℃ to 80℃
Door handle switch	Rated voltage	5.0 V
	Voltage range	6.0 V to 16.0 V
	Rated current	5 to 20 mA
	Operating temperature range	−30℃ to 80℃

▶ **External buzzer (SKM buzzer)**

Component	Item	Specifications
External buzzer (SKM buzzer)	Operating voltage	7.5 V to 14.5 V
	Operation temperature	−30℃ to 80℃
	Sound pressure level	83 dB

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Memo

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The SKM (Smart Key Module) system is equipped to only the vehicles with smart key and is to prevent theft and enhance the driver experience. When the driver presses a door handle switch carrying a smart key, this system checks the smart key information and driver door status and locks/unlocks the doors (passive function). The vehicle can be started when the driver enters the vehicle and presses the START/STOP switch (passive start function).

2. COMPONENTS



External buzzer (SKM buzzer)



Sounds a warning related to SKM system

Smart key indicator



Smart key undetected warning/ verification fail indicator

SKM



Wireless communication with other modules through B-CAN, P-CAN, hard wire to control SKM system

BCM



Communicates with SKM through B-CAN to control the vehicle components

START/STOP switch



- Supplies power to the vehicle with a button (ACC, IGN1, IGN2)
- Indicates vehicle status with LED illumination and flashing

Emergency slot



For emergency use to start the engine when the smart key battery has been discharged.

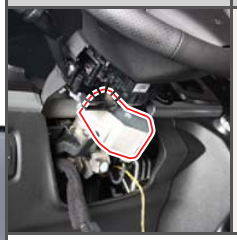
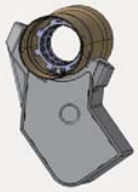
Smart key



Wireless communication with SKM system by receiving LF (Low frequency) and transmitting RF (Radio frequency)

Modification basis	
Application basis	
Affected VIN	

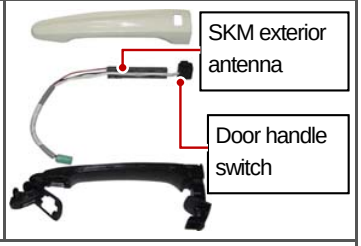
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ESCL	
Mounting location	Component
	
The ESCL (Electric Steering Column Lock) is a device which locks the steering handle with an electrical signal.	



Interior (center) antenna	
Mounting location	Component
	

Interior (rear) antenna	
Mounting location	Component
	
LF transmission for valid smart key searching inside vehicle (passive start and KEY IN/OUT)	

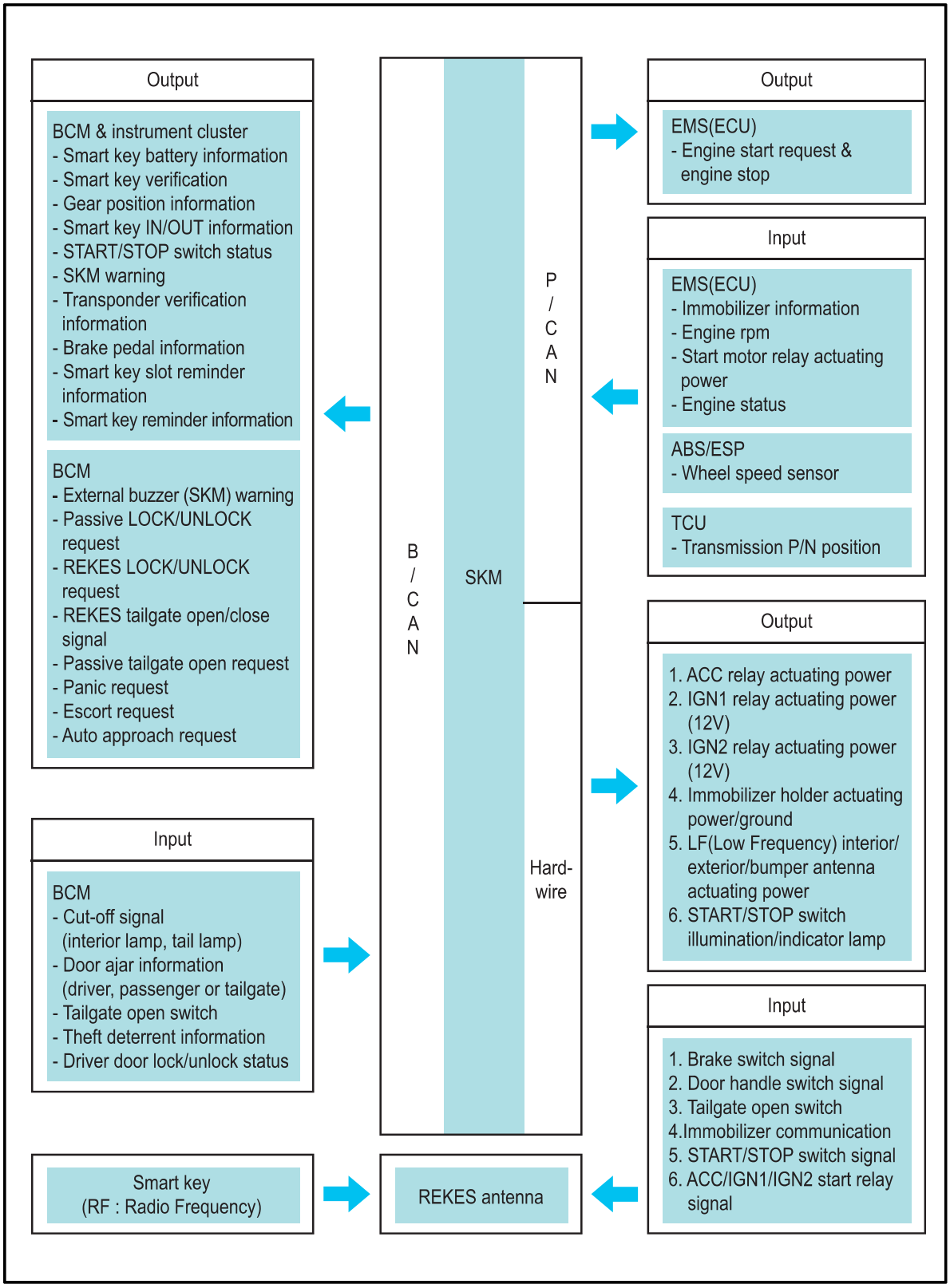
Door handle switch & antenna	
Mounting location	Component
	
LF transmission for valid smart key searching outside vehicle (passive entry and KEY IN/OUT)	

Exterior (bumper) antenna	
Mounting location	Component
	
LF transmission for valid smart key searching outside area of rear bumper when tailgate open switch signal input	

Modification basis	
Application basis	
Affected VIN	

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3. INPUT/OUTPUT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

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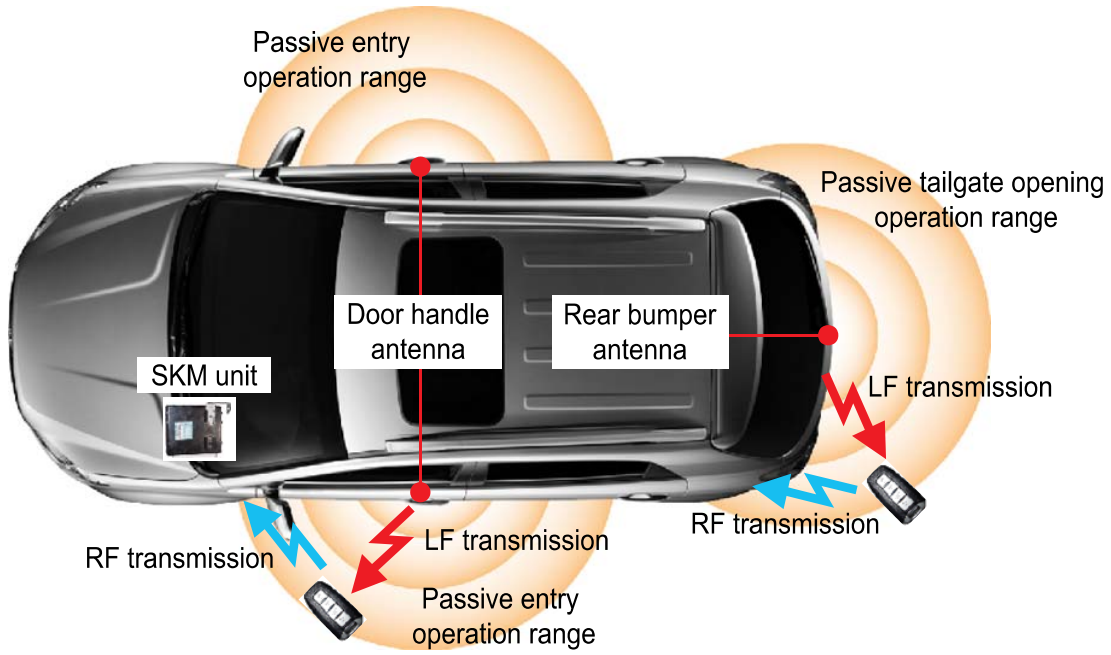
4. PASSIVE ENTRY MANAGEMENT

- Searching for a smart key signal from the outside the vehicle is prioritized in the theft deterrent mode when the passive entry signal is input. Searching for a smart key signal from the inside is prioritized when the theft deterrent mode is deactivated.
- The system searches a smart key only in the actuation area of a switch, which the signal is input (driver/passenger door handle switches and tailgate open switch).

1) Passive Function

(1) Passive entry actuation area

- The passive entry actuation area refers to the area where passive LOCK/UNLOCK can be performed by pressing the switch on the driver or passenger door handle with a smart key carried by the driver.
- The passive tailgate open actuation area refers to the area where the tailgate can be opened by pressing the tailgate switch with a smart key carried by the driver.



LF transmission: Verification request signal
RF transmission: Response signal

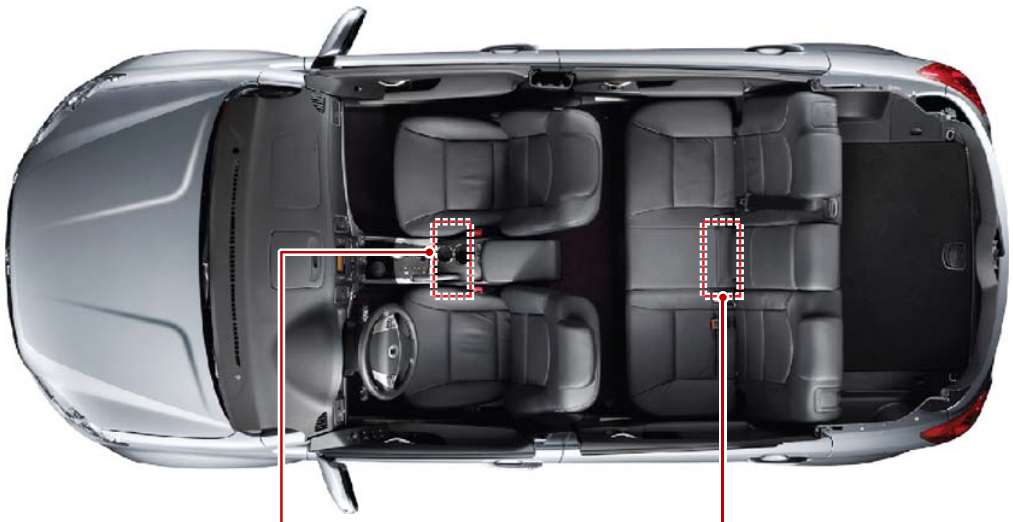
NOTE

- Passive entry function actuation area: Within 1.2 m from the door handle antenna
- Passive tailgate open actuation area: Within 1.2 m from the center of the bumper

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(2) Passive start actuation area

- Starting the engine by pressing the START/STOP switch with the gear selector lever in "P" or "N" position and the brake pedal depressed (START/STOP switch LED: green) after the driver has entered the vehicle carrying a smart key.



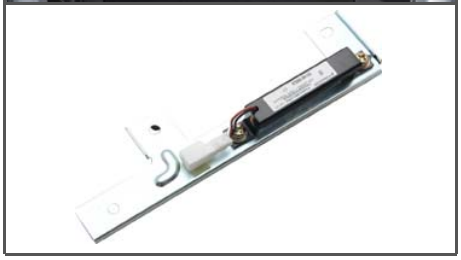
Interior (center) antenna





Interior (rear) antenna





- Passive start actuation area: Vehicle interior

CAUTION

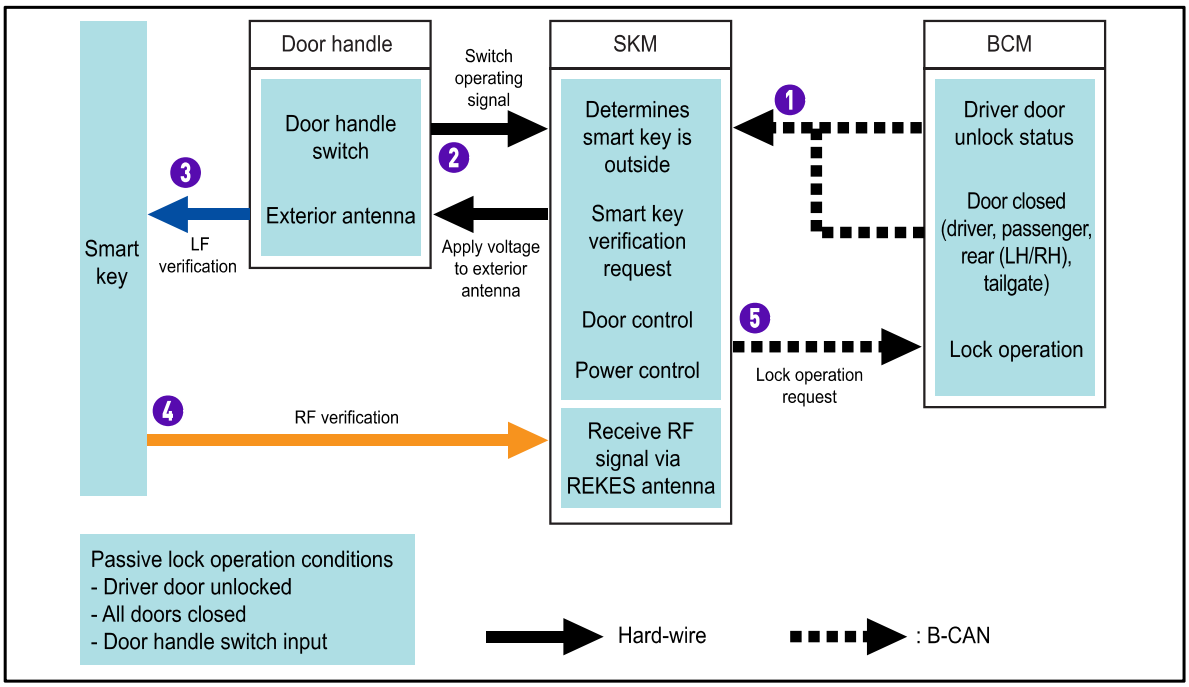
- The smart key verification many not possible in an area where the communication is poor, such as the seat cushion that the seat heated wire is operated, around the pedals and the on the floor. The smart key system malfunctions may occur when generating radio waves around the smart key
- or vehicle, or attaching a electronic device which generates radio waves on the smart key or vehicle.

Modification basis	
Application basis	
Affected VIN	

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(3) Passive LOCK

The passive LOCK (door LOCK) is activated by the door handle switch with a valid smart key present within the passive entry actuation area.



▶ Passive LOCK and verification by door handle switch

- The ignition is turned OFF or ACC is turned ON.

1. All doors are closed and the driver door is unlocked.
2. The door handle switch on the driver or passenger door is pressed briefly.
3. The SKM verifies if a smart key is outside the vehicle using the door handle antenna (LF verification) (The SKM searches the last smart key used first. Searching for a smart key signal from the outside the vehicle is followed by searching from the inside the vehicle).
4. The verification signal (RF verification) from the smart key is sent to the REKES antenna of the SKM. The SKM sends the Passive LOCK signal to the BCM through the B-CAN if the verified smart key is
5. found outside the vehicle.
   The BCM receives the signal from the SKM and controls the door LOCK actuator and turn signal
6. lamp. (The buzzer sounds once and hazard warning lamp flashes twice when the system enters the theft deterrent mode)

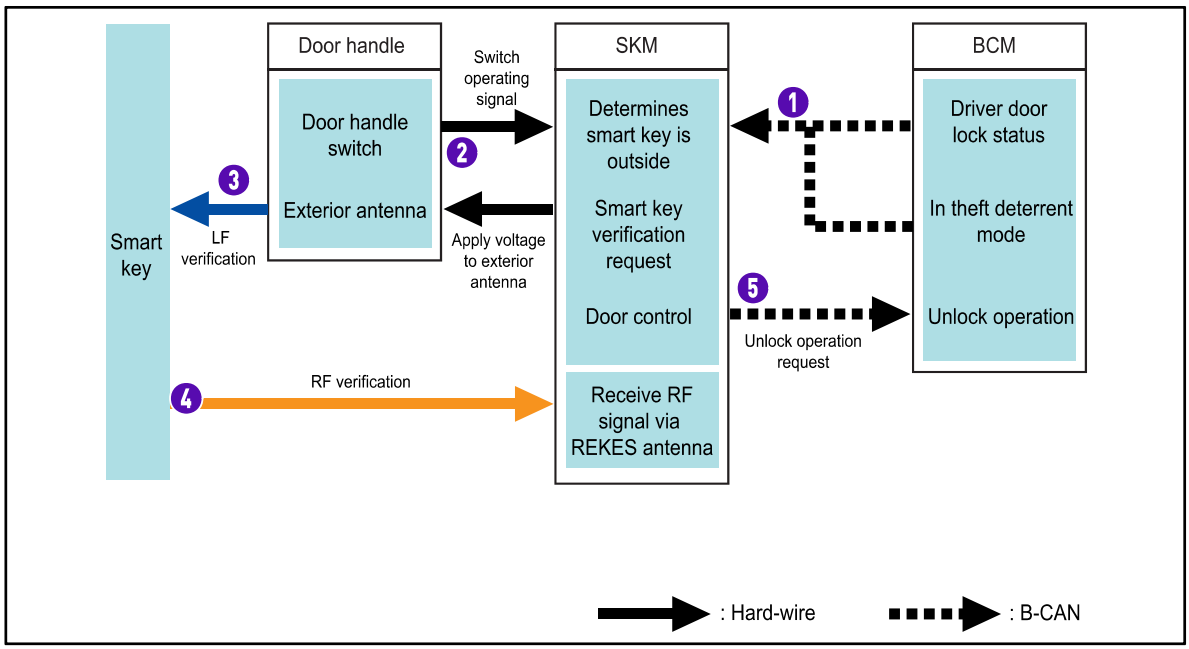
NOTE

- If no smart key is identified as being outside the vehicle, the passive LOCK process is stopped and restarted when the next signal is received from the door handle switch.
- When the door handle switch is pressed with ACC ON and driver door unlocked, the SKM changes the ignition status to OFF and sends the passive LOCK signal to the BCM through the B-CAN to lock the door. The BCM ignores the signal if the ignition is turned ON.

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(4) Passive UNLOCK

The passive UNLOCK (door UNLOCK) is activated by the door handle switch with a valid smart key present within the passive entry actuation area.



▶ Passive UNLOCK and verification by door handle switch

1. The driver door is locked and the system in the theft deterrent mode.
2. The door handle switch on the driver or passenger door is pressed briefly.
3. The SKM verifies if a smart key is outside the vehicle using the door handle antenna (LF verification) (The SKM searches the last smart key used first).
4. The verification signal (RF verification) from the smart key is sent to the REKES antenna of the SKM. The SKM sends the Passive UNLOCK signal to the BCM through the B-CAN if the verified smart key
5. is found outside the vehicle.
   The BCM receives the signal from the SKM and controls the door UNLOCK actuator and turn signal
6. lamp. (The buzzer sounds twice and hazard warning lamp flashes once when the theft deterrent mode is deactivated)

NOTE

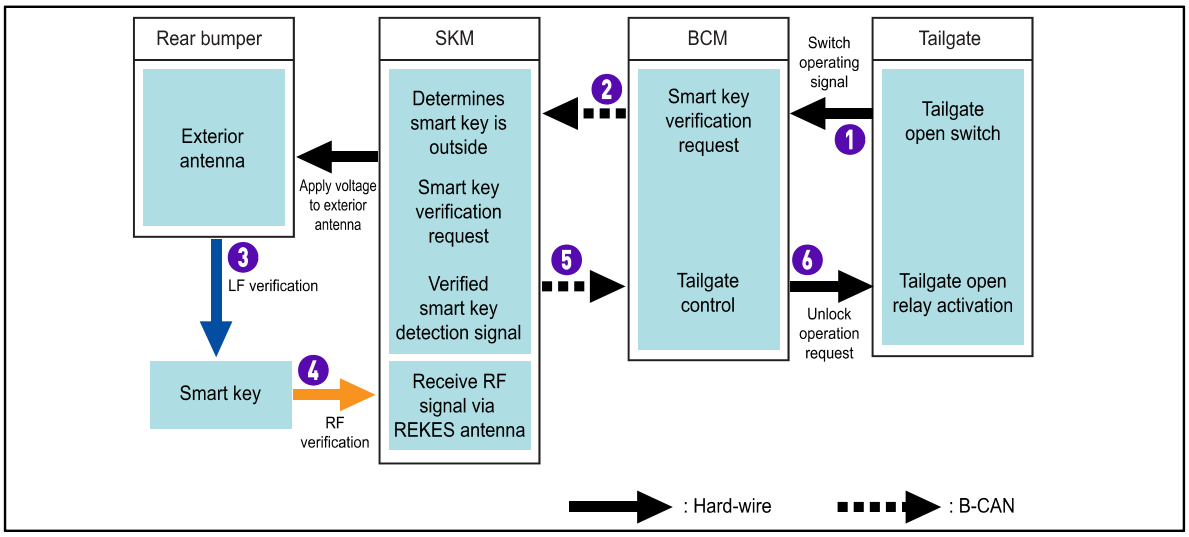
- If no smart key is identified as being outside the vehicle, the passive UNLOCK process is stopped and restarted when the next signal is received from the door handle switch.
- When the driver door is locked with ACC ON, the SKM sends the Passive UNLOCK signal to the BCM through the B-CAN to unlock the door without changing the ignition status to OFF. (The vehicle power is turned OFF when the door is opened.)
- Smart key searching
  * Theft deterrent mode: deactivated after searching the outside vehicle
  * Theft deterrent mode deactivated: outside searching after inside searching

Modification basis	
Application basis	
Affected VIN	

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(5) Passive tailgate open

The tailgate open control is activated by the tailgate open switch with a valid smart key present within the passive entry actuation area.



▶ Passive tailgate open by tailgate open switch

- The driver door is locked and the system in the theft deterrent mode.

1. The tailgate open switch signal is received.
2. The BCM sends the valid smart key verification request signal to the SKM.
3. The SKM verifies if a smart key is outside the vehicle using the corresponding rear bumper antenna (LF verification) (The SKM searches the last smart key used first. If a valid smart key searching is completed, searching for a key in the luggage compartment and inside the vehicle is started).
   The verification signal (RF verification) from the smart key is sent to the REKES antenna of the SKM.
4. The SKM sends the Passive tailgate open signal to the BCM through the B-CAN if the verified smart key is found outside the vehicle.
5. The BCM activates the tailgate open relay according to the signal received from the SKM.
   (Only the theft deterrent mode for tailgate is deactivated.)
6.

NOTE

- When the tailgate is closed with all doors closed, the system enters the theft deterrent mode after checking a valid smart key inside the vehicle. When a valid smart key is found inside the vehicle, the external buzzer and smart key detected warning indicator is operated for 10 seconds.
  If no smart key is identified as being outside the vehicle, the passive gate open process is stopped
- and restarted when the next signal is received from the tailgate open switch.
  Smart key searching
- * Theft deterrent mode: deactivated after searching the outside vehicle
  * Theft deterrent mode deactivated: outside searching after inside searching

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(6) Puddle (approach) lamp control

The SKM sends the AUTO approach (puddle) lamp ON signal and UNLOCK signal to the BCM through the B-CAN with AUTO approach (puddle) lamp ON, smart key UNLOCK and Passive entry UNLOCK.

▶ Operating conditions

- The SKM starts to search a smart key 30 seconds after the vehicle has entered the theft deterrent mode.
- When the driver approaches the vehicle in theft deterrent mode (within 1 m), the SKM sends the puddle lamp operation signal through the B-CAN if a smart key is identified.

▶ Continuous operation

- When a smart key is identified within 1 m from the vehicle in theft deterrent mode, the SKM sends the puddle lamp operation signal (10 minutes timer activated) through the B-CAN. If a smart key is continuously found within 10 minutes the SKM sends the puddle lamp signal again for continuous operation (up to 2 times within 10 minutes)
- The SKM starts to search a smart key 30 seconds after sending the 1st puddle lamp operation signal. If a smart key is found, the SKM sends the 2nd operation signal.

▶ Reset conditions

- 10 minutes timer terminated
- Re-entering theft deterrent mode after deactivation

▶ Standby mode operation

	Duration	Function	Time (sec)
1st	within 5 days	Normal monitoring time	1.25
2nd	within 5 to 14 days	Increasing monitoring time	1.5
3rd	14 days or more	Stop	

▶ Stop/Standby operation reset condition

Door LOCK/UNLOCK by a smart key or passive

▶ Approach (puddle) lamp ON by smart key UNLOCK and passive entry UNLOCK.

The SKM sends the smart key UNLOCK and passive UNLOCK signals to the BCM through the B-CAN in the theft deterrent mode to control the approach (puddle) lamp ON.

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5. REKES CONTROL FUNCTION

▶ REKES LOCK operation

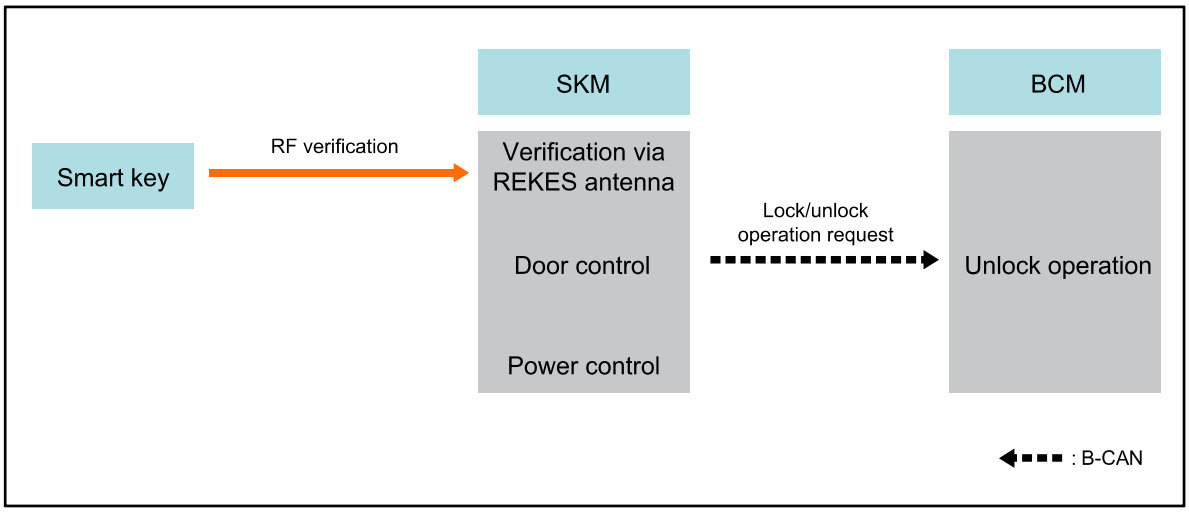
1. The REKES LOCK signal is sent when the LOCK button on the smart key is pressed briefly (0.1 sec. to 1.5 sec.).
2. The SKM receives the REKES LOCK signal and sends the REKES LOCK request signal to the BCM through B-CAN.
3. The BCM outputs the door LOCK signal according to the signal received from the SKM.

NOTE

When the REKES LOCK signal is received with the ACC ON, the ACC is turned OFF and the REKES LOCK signal is sent.

▶ REKES UNLOCK operation

1. The REKES UNLOCK signal is sent when the UNLOCK button on the smart key is pressed briefly (0.1 sec. or more).
2. The SKM receives the REKES UNLOCK signal and sends the REKES UNLOCK request signal to the BCM through B-CAN.
3. The BCM outputs the door UNLOCK signal according to the signal received from the SKM.



▶ Tailgate open operation

1. The ignition is turned OFF, ON, or ACC is turned ON.
2. The tailgate open signal is sent when the tailgate open button on the smart key is pressed 1 second or more.
3. The SKM receives the tailgate open signal and sends the tailgate open request signal to the BCM through B-CAN.
4. The BCM activates the tailgate open relay when the tailgate open switch is pressed.

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▶ REKES panic

1. The ignition is turned OFF, ON, or ACC is turned ON.
2. The panic signal is sent when the panic button on the smart key is pressed 1 second or more.
3. The SKM receives the panic signal and sends the panic request signal to the BCM through B-CAN. The BCM controls the panic alarm and hazard warning lamp.
4.

NOTE

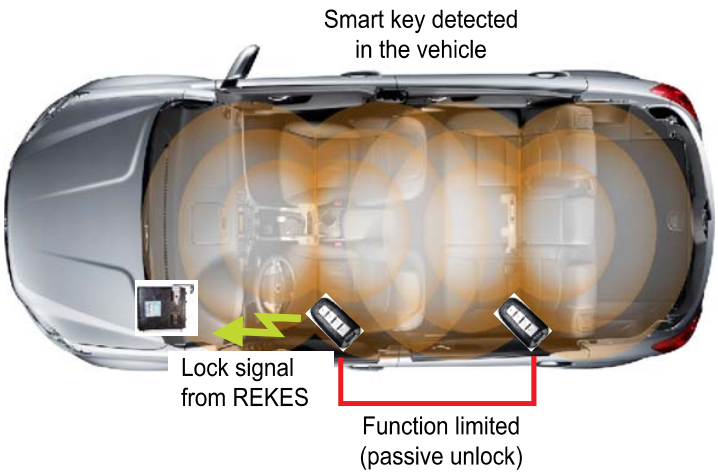
- When the panic button on the smart key is pressed again during the panic alarm operation, the SKM sends the panic operation command to the BCM to stop the panic alarm.
- When the theft deterrent activation command is received from the BCM, the panic alarm is stopped and the theft deterrent siren is activated.

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6. SMART KEY FUNCTION LIMITATION (SILENT) /DEACTIVATION

▶ **Silent smart key**

Limits the passive UNLOCK function when searching for the smart key which activated the REKES LOCK inside the vehicle (including external/internal antenna overlapping area), to prevent the break-in.



Silent activation conditions **- All doors closed (B-CAN)** **- Theft deterrent mode activated (B-CAN)** **- Smart key search**	Silent: The passive UNLOCK is unavailable when REKES LOCK is carried out with a smart key inside the vehicle.

- **Silent smart key activation**

1. The REKES LOCK (theft deterrent mode activation) request signal is sent by a smart key inside the vehicle.
2. The smart key activated REKES LOCK is found in the vehicle.
3. All smart keys in the vehicle including the one that output the REKES LOCK are memorized as silent smart keys, and the passive UNLOCK is not available with these keys.

- **Silent smart key function**

1. Passive UNLOCK not available
2. Passive start & power control available
3. REKES function available

- **Cancellation of silent smart key**

1. When the theft deterrent mode is deactivated, the silent smart key functions are available.

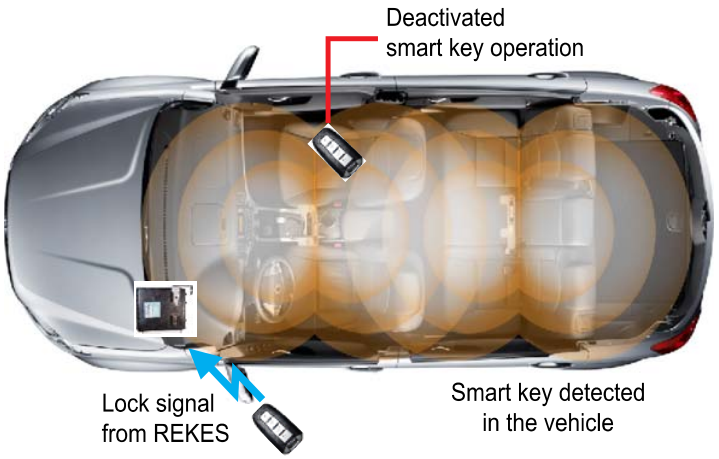
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▶ Smart key deactivation

This function prevents the operation by the smart key inside the vehicle even if the driver breaks in the vehicle in the theft deterrent mode.

NOTE

In theft deterrent mode, the smart key(s) inside the vehicle is deactivated to prevent theft.



Deactivation conditions **- All doors closed (B-CAN)** **- Theft deterrent mode activated (B-CAN)** **- Smart key search**	FOB deactivation: The smart key inside the vehicle is deactivated when the passive LOCK/REKES LOCK signal is input by a smart key from the outside.

- **Smart key deactivation**

1. The REKES LOCK/passive LOCK (theft deterrent mode activation) request signal is sent by a smart key outside the vehicle.
2. The smart key activated door LOCK is not found in the vehicle.
3. The system memorizes all smart keys found inside the vehicle as deactivated ones.

- **Smart key deactivation actuation area**

1. Passive entry not available
2. Passive starting & power control not available
3. REKES function not available

- **Cancellation of smart key deactivation**

1. When the theft deterrent mode is deactivated using a smart key outside the vehicle, the deactivated smart key functions returns to be available.

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7. SMART KEY VERIFICATION TIME CONTROL

The smart key verification time control consists of pre-verification timer and immobilizer verification timer, and no verification process is required for 30 seconds after the each verification process has been completed.

- Pre-verification timer: Time for performing start & power mode function that controls the vehicle power.
- Immobilizer verification timer: Time for which the start with a smart key is possible after the SKM and EMS (ECU) verify the immobilizer.

Item	Pre-verification timer	Immobilizer verification timer
Operating power	Power OFF, ACC, IGN ON	IGN ON after pre-verification (ACC)
Function	Time for which the power control can be carried out under the verified conditions (30 seconds after the verification)	Time for which the start request can be carried out without a smart key under the verified conditions (30 seconds after the verification)
Input conditions	1. All doors closed (including tailgate) 2. START/STOP switch input 3. Brake switch signal input 4. Smart key inserted into emergency slot 5. Smart key searching completed 6. Engine start ON to OFF	1. Brake switch signal input 2. START/STOP switch input
Verification conditions	Smart key searching completed after the following conditions are met: 1. Close signal input after any door opened 2. Brake switch signal input 3. START/STOP switch signal input 4. After emergency slot inserted 5. After IGN OFF	1. Power changed to IGN ON after valid pre-verification 2. Power changed to IGN ON by smart key verification after pre-verification timer completed 3. Smart key verification succeeded by brake switch input after immobilizer verification timer completed with IGN ON 4. Smart key verification succeeded after immobilizer verification timer completed with IGN ON, immobilizer verification and brake switch input

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Component	Pre-verification timer	Immobilizer verification timer
Deactivation conditions	1. 30 seconds has been passed after the pre-verification timer 2. Door handle switch ON 3. IGN ON 4. Theft deterrent mode activation/deactivation 5. Door status changed (open/closed)	1. 30 seconds has been passed after the immobilizer verification timer IGN1 OFF 2. No smart key is found inside the 3. vehicle with all doors closed after any door has been opened and then closed.
If any condition for pre-verification timer and immobilizer verification timer is met, no verification process is required for 30 seconds after the each verification process has been completed.		

NOTE

Operation before pre-verification timer

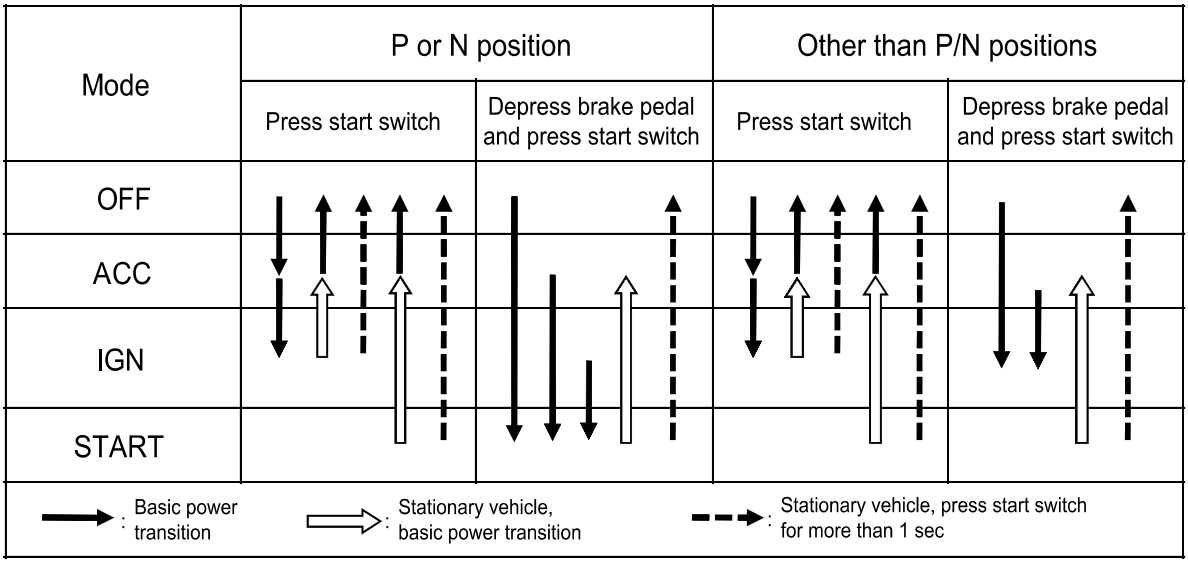
- Passive LOCK/UNLOCK
- REKES LOCK/UNLOCK

Ignition status after immobilizer verification

- The immobilizer verification has been completed when the engine starts.
- The immobilizer verification is not deactivated until the ignition is turned to ON, OFF or ACC ON.
- The immobilizer is not deactivated when the key out warning condition is met while the engine is running.

8. START & POWER MODE CONTROL

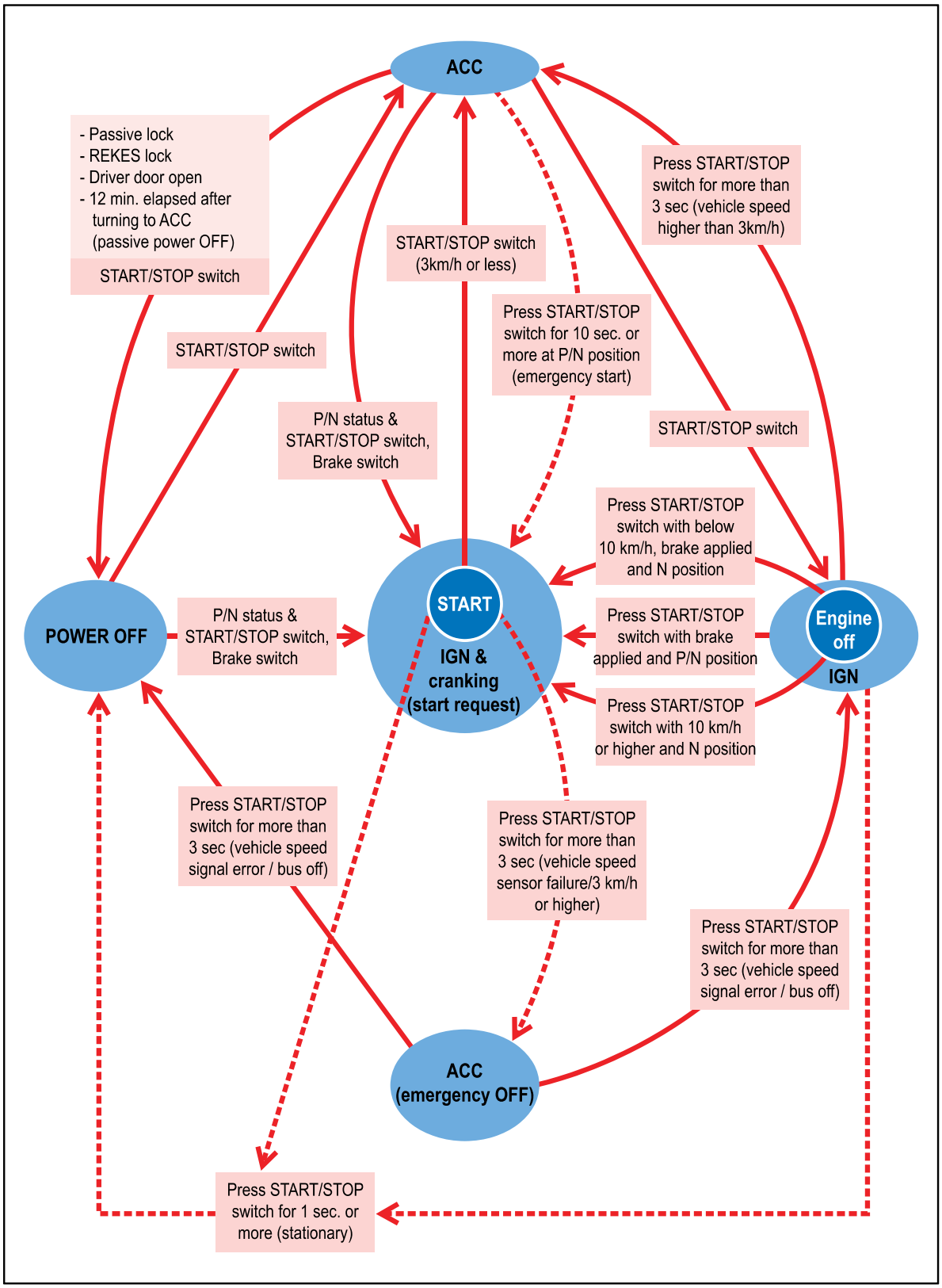
The ignition status is changed to OFF, ACC ON, IGN ON and engine cranking by one START/STOP switch.



Modification basis	
Application basis	
Affected VIN	

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▶ Power control and engine start diagram



Modification basis	
Application basis	
Affected VIN	

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▶ **Engine starting**

1. When the START/STOP button is pressed with the brake pedal applied and gear selector lever in P or N position, the SKM performs the immobilizer verification and sends the engine START request signal to the EMS if a normal coded smart key is found.
2. When the .engine start request signal from the START/STOP switch is received, the SKM sends the start request signal through the P-CAN and the vehicle power status signal to the BCM through the B-CAN.
3. The SKM cuts the power for IGN2 and ACC relays while the engine is cranking as cutting the electric load is necessary.
4. The SKM receives the engine start status signal from the EMS (ECU) through the P-CAN.

EMS (ECU)	Engine rpm, engine cranking/stop/running/loaded
TCU	Gear selector lever position: P, N
ABS/ESP	Vehicle speed signal (wheel speed sensor on each wheel)

5. The SKM turns on the ACC/IGN2 relays after the engine cranking and sends the signal for IGN after starting to the BCM through the B-CAN.
6. When the START/STOP button is pressed and engine cranking request1 signal is sent, the EMS (ECU) cranks the engine after checking the engine warming up. If the engine cranking request2 signal is sent, the EMS cranks the engine without checking the engine warming up.

Engine cranking request1 (engine start after warming up)	When the START/STOP button is pressed briefly under the start conditions, the vehicle starts to warming up and then the engine is started after a certain amount of time (warming up indicator ON to OFF). **NOTE** It can be delayed by several seconds according to the engine coolant temperature.
Engine cranking request2 (engine start without warming up)	When the START/STOP switch is pressed once again while the engine cranking request1 signal is sent, the engine is started (regardless of warming up indicator)

7. Starting engine while driving
   - The engine start request signal is sent when the START/STOP switch is pressed, provided that the vehicle speed is less than 10 Km/h or no vehicle speed signal is input, the gear selector lever is in N position and the brake switch is ON with IGN ON (30 sec. verification is not required).
   - The engine start request signal is sent regardless of the brake signal when the START/STOP switch is pressed, provided that the vehicle speed is 10 Km/h or more and the gear selector lever is in N position with IGN ON (30 sec. verification is not required).

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8. Condition for starting request transmission
   - ACC ON: Gear selector lever (P/N), Brake switch ON, START/STOP switch signal
   - IGN ON: Vehicle in stationary, Gear selector lever (P/N), Brake switch ON, START/STOP switch ON
9. Condition for canceling starting request
   - At engine starting completed

▶ No engine operation

1. When the START/STOP button is pressed at the vehicle speed of 3 km/h or less, the SKM turns off the IGN relay to stop the engine.
2. When the vehicle speed is 3 km/h or more or no speed signal is input, the SKM performs the following functions:

Vehicle status	Conditions
3 km/h or faster	- When the START/STOP switch is pressed for 3 seconds or more, the ignition status is changed from IGN to ACC. - If the engine START/STOP switch is pressed again, the ignition status is changed from ACC to IGN.
Abnormal vehicle speed (No or abnormal CAN signal)	- When the START/STOP switch is pressed for 3 seconds or more, the ignition status is changed from IGN to ACC. - If the engine START/STOP switch is pressed again, the ignition status is changed from ACC to Power OFF. (DTC set)

3. When the START/STOP button is pressed and held with IGN ON, the ignition status is changed to OFF. When the START/STOP button is pressed briefly, the ignition status is changed to ACC ON.

▶ ACC ON to Power OFF

The SKM changes the ignition status to OFF from ACC ON when:

1. the engine START/STOP button is pressed with the brake pedal released after the ignition status is changed from IGN ON to ACC ON.
2. the REKES LOCK or passive LOCK signal is input with ACC ON.
3. the driver door is opened with ACC ON.
   (Driver door open signal input through B-CAN)
4. 12 minutes have passed with ACC ON.

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9. ESCL CONTROL

- ESCL lock/unlock is not performed at ESCL virgin mode.
- The SKM does not carry out the ESCL LOCK control if the engine is running with IGN ON or the vehicle speed is 3 km/h or higher.
- All the ESCL functions including START/STOP switch is disabled during anti-scanning flag bit set.

1) ESCL LOCK Control

When the ESCL is unlocked and the followings are met at normal condition:

- If the driver door is open or closed with ignition key OFF, the electric steering motor performs the steering column lock.
- If the theft deterrent mode is activated by the LOCK signal from the passive or REKES key when turning the ignition key from "ON" position to "OFF" position, the ESCL LOCK is performed. The ESCL LOCK is performed after 60 seconds since the ignition key is turned to B+ from
- "ON" or "ACC" position.

2) ESCL UNLOCL Control

When the ESCL is locked and the followings are met at normal condition:

- If the smart key is pressed with power off, the electric steering motor performs the steering column unlock. In some cases, power transition is carried out to ACC or IGN ON.
- If the power transition and start is not possible after retry to LOCK or UNLOCK operation, the power transition and start is not still possible after automatic retry and the warning lamp comes on.

Modification basis	
Application basis	
Affected VIN	

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3) ESCL Retry Control

1. ESCL operation is not possible if Bolt is "Failure".
2. When the UNLOCK retry occurs after ESCL LOCK command, the ESCL LOCK is performed.
   - The UNLOCK retry is possible up to 2 times automatically. If the UNLOCK retry occurs 3 times in succession, the ESCL NOT LOCKED warning is triggered.
   - Reactivates when the ESCL LOCK conditions are met.
3. When the LOCK retry occurs after ESCL LOCK command, the command will be overridden without retry.
   - ESCL NOT LOCKED warning is triggered.
   - Reactivates when the UNLOCK conditions are met by pressing the START/STOP switch.
4. When the LOCK retry occurs after ESCL UNLOCK command, the ESCL UNLOCK is performed.
   - The LOCK retry is possible up to 2 times automatically. If the LOCK retry occurs 3 times in succession, the ESCL JAM warning is triggered.
   - Reactivates when the ESCL UNLOCK conditions are met by pressing the START/STOP switch.
5. When the UNLOCK retry occurs after ESCL UNLOCK command, the command will be overridden without retry.
   - After the command is overridden, the ESCL JAM warning is triggered.
   - Reactivates when the UNLOCK conditions are met by pressing the START/STOP switch after ESCL LOCK.

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10. START/STOP SWITCH CONTROL

1) Power Status

▶ **Ignition status indicator on START switch**

Status	Turning-ON conditions
OFF	IGN OFF, IGN ON & engine ON
Green	Engine can be started by START/STOP switch operation/Engine is cranking (IGN OFF & brake switch ON, ACC ON & brake switch ON, IGN ON & brake switch ON)
Amber	ACC ON
Red	IGN ON & engine OFF, error

▶ **START switch indicator output**

Powerstatus	Power OFF		ACC ON	IGN ON	Engine start status	Engine can be started	Error	Remarks
	Door closed	Door open						
Figure								
Indicator status	OFF	OFF	Amber	Red	OFF	Green	Red Flash	
Illumination control	OFF	TIME	Controlled by SKM					LED

- The indicator flashes 5 times at intervals of 0.5 sec. ON/0.5 sec. OFF when an error occurs.
- When all the doors are closed with B+, the indicator does not flash.

▶ **START/STOP switch indicator control**

START/STOP switch indicator	
ON	**OFF**
	

- **Door coupled function**

1) When the driver door is opened, the indicator comes on (the indicator remains on while the door is open). When the room lamp is turned off, the indicator goes
2) out immediately.
The indicator goes out 10 seconds after the driver door
3) is closed.
The indicator is reset when the driver door is opened.

4) **Tail lamp coupled function**

-

Modification basis	
Application basis	
Affected VIN	

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11. SKM WARNING CONTROL

(1) Smart Key Not Detected Warning

▶ With ACC ON

1. Any door except the driver door is opened and then closed.
2. The SKM starts to identify a smart key by using the interior antenna after confirming that all the doors are closed through CAN communication with the BCM.
3. When no smart key is found, the SKM sends the smart key not detected warning signal to the BCM and instrument cluster through B-CAN.
4. The BCM activates the buzzer for up to 10 seconds at intervals of 0.5 sec. ON/0.5 sec. OFF and turns on the smart key warning indicator on the instrument cluster.
5. If a smart key is found, no operation is performed.

NOTE

Smart key not detected warning deactivation conditions

- ACC OFF, IGN1 ON, Smart key detected

▶ IGN ON and engine running

1. Any door except the driver door is opened and then closed.
2. The smart key not detected warning is not activated.
   – Smart key searching using the interior antenna → No smart key found → The SKM sends the smart key not detected warning signal to the BCM and instrument cluster through B-CAN.
3. The smart key not detected warning is activated.
   - Smart key searching at intervals of 3 seconds using the interior antenna.

NOTE

Smart key not detected warning deactivation conditions

- IGN1 OFF, Smart key detected, Door open

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(2) Smart Key Detected Warning (Smart Key Found Inside Vehicle)

▶ **Smart key deactivation warning**

1. The ignition is turned OFF or ACC is turned ON.
2. A verified smart key found in the vehicle with all doors (including tailgate) closed.
3. The REKES LOCK or passive LOCK signal is input with a valid smart key from the outside the vehicle.
4. The SKM sends the theft deterrent mode signal to the BCM through B-CAN and the verified smart key is found inside the vehicle.
5. The SKM sends the smart key detected warning to the BCM and instrument cluster through B-CAN. The BCM activates the buzzer for up to 10 seconds at intervals of 0.5 sec. ON/0.5 sec. OFF and
6. turns on the smart key detected warning indicator on the instrument cluster.

NOTE

Smart key detected warning deactivation conditions

- The theft deterrent mode is deactivated.

▶ **Smart key inside vehicle warning**

1. The ignition is turned ON or OFF, or the ACC is turned ON.
2. A verified smart key found only in the vehicle (including emergency slot) with all doors (including tailgate) closed.
3. The passive LOCK signal is input without a valid smart key from the outside the vehicle.
4. The SKM sends the theft deterrent mode signal to the BCM through B-CAN and the verified smart key is found inside the vehicle.
5. The SKM sends the smart key detected warning to the BCM and instrument cluster through B-CAN. The BCM activates the buzzer for up to 10 seconds at intervals of 0.5 sec. ON/0.5 sec. OFF and
6. turns on the smart key detected warning indicator on the instrument cluster.

NOTE

Smart key detected warning deactivation conditions

- No smart key is found inside the vehicle when a door is opened and then closed.

Modification basis	
Application basis	
Affected VIN	

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(3) Smart key verification fail warning

When the verification is requested for ignition status change or engine starting and no verified smart key is in the vehicle, the SKM sends the "smart key verification status" signal, which indicates that the verification has failed, for up to 10 sec. until the verification fail conditions are deactivated. for up to 10 seconds. until the verification fail conditions are deactivated.

- Normally, the smart key verification warning is one of the smart key fail conditions.

▶ **Verification fail detection and transmission conditions**

- When the ignition status is changed after a smart key is verified by the START/STOP switch ON input, the SKM sends the verification status for 10 sec.

* Ignition status change
(OFF -> ACC) / (OFF -> IGN)/(ACC -> IGN) / (IGN -> engine ON)

- If above conditions are met again, the SKM re-verifies a smart key and sends the verification status for another 10 seconds.
- When the ignition status is changed by the transponder verification while the smart key status is sent through the B-CAN, the SKM sends the smart key verification signal and also sends the transponder verification signal for 10 seconds.

(4) Smart key battery discharge warning

If low smart key battery is detected during the verification process for ignition status change or engine start, the SKM sends the signal for "smart key battery low voltage warning" to the BCM and instrument cluster through the B-CAN for up to 10 sec. until the warning condition is deactivated.

▶ **Smart key battery discharge confirmation and deactivation**

- If the smart key battery low voltage is confirmed, the SKM sends the smart key battery low voltage warning signal.
- If the smart key battery is in normal condition, the SKM sends the smart key battery low voltage warning deactivation signal.

* The smart key is the last used key.

(5) Transponder verification fail warning

If a verified smart key is not found by the key verification process, the SKM sends the information that indicates the key is not verified to the instrument cluster through the B-CAN for up to 10 seconds until the warning condition is deactivated.

- The SKM sends the transponder verification warning when the verification has failed with the smart key inserted into the immobilizer holder.

▶ **Transponder verification fail detection and transmission conditions**

- When the ignition status is changed after the transponder is verified by the START/STOP switch ON input, the SKM sends the transponder verification status for 10 sec.

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* Ignition status change
(OFF → ACC) / (OFF → IGN)/(ACC → IGN) / (IGN → engine ON)

- If above conditions are met again, the SKM re-verifies the transponder and sends the verification status for another 10 sec.
- When the ignition status is changed by a smart key verification while the transponder verification is processed, the SKM sends the signal for [transponder verification fail], and sends the smart key verification status for 10 sec.

(6) Transmission position warning

When the gear selector lever is in a position other than P or N with IGN ON and engine started, the SKM sends the [gear position warning] signal to the instrument cluster through the BCAN for up to 10 sec. until the operating conditions are deactivated.

▶ **Transmission position warning deactivation**

- When re-attempting to start with IGN1 ON and transmission in P or N

(7) ESCL JAM warning

The SKM transmits the warning active command to the BCAN through the BCAN signals such as ESCL NOT LOCKED warning signal or ESCL JAM warning signal within 10 seconds or until the active command deactivation conditions will be met, if jam is occurred when the electric steering motor is locked/unlocked.

▶ **Failure Detecting Conditions**

1. When the UNLOCK retry occurs after ESCL LOCK command, the ESCL LOCK is performed.
   - The UNLOCK retry is possible up to 2 times automatically. If the UNLOCK retry occurs 3 times in succession, the ESCL NOT LOCKED warning is triggered.
   - Reactivates when the ESCL LOCK conditions are met.
2. When the LOCK retry occurs after ESCL LOCK command, the command will be overridden without retry.
   - After the command is overridden, the ESCL NOT LOCKED warning is triggered.
   - Reactivates when the LOCK conditions are met by pressing the START/STOP switch after ESCL UNLOCK.
3. When the LOCK retry occurs after ESCL UNLOCK command, the ESCL UNLOCK is performed.
   - The LOCK retry is possible up to 2 times automatically. If the LOCK retry occurs 3 times in succession, the ESCL JAM warning is triggered.
   - Reactivates when the ESCL UNLOCK conditions are met by pressing the START/STOP switch.
4. When the UNLOCK retry occurs after ESCL UNLOCK command, the command will be overridden without retry.
   - After the command is overridden, the ESCL JAM warning is triggered.
   - Reactivates when the UNLOCK conditions are met by pressing the START/STOP switch after ESCL LOCK.

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▶ **ESCL JAM Warning Deactivation**

The ESCL JAM FAILURE warning will be deactivated as soon as the signal "ESCL UNIT STATUS OK" is received by the ESCL restart when the ESCL UNLOCK (or LOCK) activation conditions are met again by pressing the START/STOP switch to change the ignition status within 10 seconds or after 10 seconds triggering the warning.

(8) ESCL FAIL warning

The SKM monitors the ESCL and transmits the warning active command to the BCAN for 10 seconds through the BCAN signal "ESCLFailWarnCmd" if there is an error with operation.

▶ **Failure Transmitting Conditions**

1. ESCL bolt status failure
   - Bolt status "FAILURE" signal received once through LIN communication
2. ESCL no response error
   - No response or incorrect response from ESCL 3 times in succession
3. Status mismatch
   - Mismatch between ESCL bolt status and micro switch status
4. ESCL anti-scanning error
   - Verification fails 2 times in succession

(9) SKM error alert

The SKM sends the SKM error alert signal to the instrument cluster through the B-CAN for up to 10 sec. when an in ignition status related error or passive entry system error occurs.

▶ **SKM error transmission conditions**

When any of the following errors is detected and a DTC is set, the SKM sends the error alert signal for 10 sec.

1. B+ (power) low voltage
2. B+ (logic) low voltage
3. ACC ON fail
4. ACC OFF fail
5. IGN1 ON fail
6. IGN1 OFF fail
7. IGN2 ON fail
8. IGN2 OFF fail
9. START/STOP switch short circuit

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(10) Brake not working alert

The SKM sends the brake not working alert signal for 10 sec. every time the ignition status is changed after the 1st cycle (OFF-ACC-IGN-ACC-OFF)
while the brake is not operated.

▶ **Warning deactivation conditions**

- when the brake pedal is depressed, the system is reset and alert deactivation signal is sent.
- when the 10 min. timer is terminated

(11) Smart key slot detection alert

▶ **Warning transmission conditions**

- The SKM sends the smart key slot detection alert signal for 10 sec. when a smart key inserted into the slot is detected with IGN OFF and the driver's door open.

▶ **Warning deactivation conditions**

- when the smart key is removed, the alert deactivation signal is sent.
- when the 10 min. timer is terminated

(12) SKM alert priority

1	Smart key out alarm	Outside	1
2	Smart key reminder alarm	Outside	
3	Smart key verification failure alarm	Inside	2
4	Transponder verification fail alert	Inside	
5	Smart key battery low voltage alert	Inside	
6	Transmission position alert	Inside	
7	SKM error alert	Inside	
8	Brake alert	Inside	
9	Clutch alert	Inside	
10	Smart key slot reminder alarm	Inside	1

Modification basis	
Application basis	
Affected VIN	

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12. SKM IMMOBILIZER SYSTEM

1) System Description

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 SKM (immobilizer slot) and EMS (ECU) through P-CAN communication, and the system permits the engine to start after confirming the encrypted coding.
When the START/STOP switch is pressed with the smart key inserted into the immobilizer slot because of the smart key battery discharge, the SKM communicates with the EMS (ECU) through P-CAN, and the ECU starts to control the engine only the signal is valid.
A valid key verification time is provided for 10 seconds and the engine can be started during this time. If pressing the START/STOP switch again after this 10 seconds, the key verification process is performed again.

2) Configuration



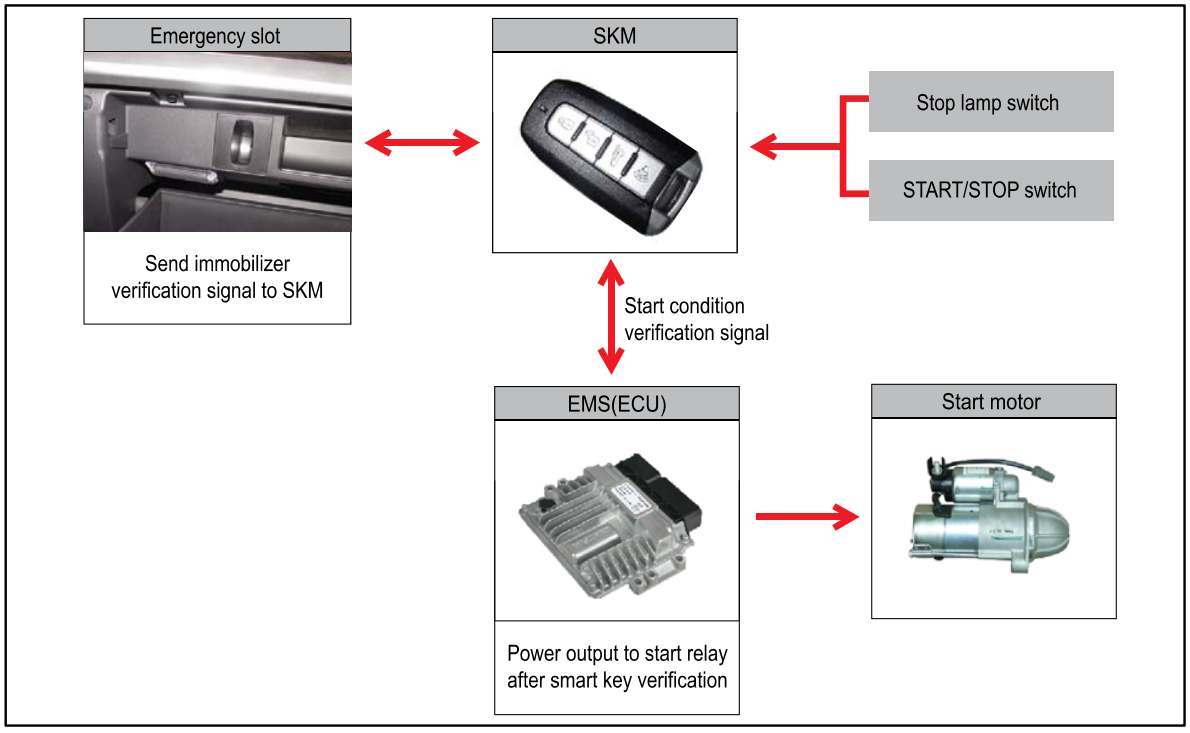
Modification basis	
Application basis	
Affected VIN	

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3) Operating Process

Key verification can be divided into two types, immobilizer key verification and smart key verification. The immobilizer verification is applied for the SKM system, and verifies the transponder built in the smart key. When the smart key is inserted into the slot, the verification is carried out, overriding the RF signal from the smart key.
The power is supplied to the slot when the START/STOP switch is pressed with the smart key inserted into the slot, and the smart key transponder verification is carried out by the transponder communication. Once the key is verified, a valid key verification time is provided for 10 seconds and the engine can be started by pressing the START/STOP switch during this time. If pressing the START/STOP switch after this 10 seconds, the key verification process is performed again.

1. When the ignition is turned ON, the EMS (ECU) sends the challenge message to the SKM through the P-CAN. (This is to verify whether the transponder of the smart key is valid. If the verification fails, it transmits the re-verification signals 3 times for 2 seconds. If 3rd re-verification fails, the verification is deactivated for 10 seconds and re-activated after that.)
2. The immobilizer slot of the SKM system sends the encrypted cod to the transponder, and the transponder re-sends the encrypted code to the immobilizer slot.
3. The encrypted sent to the immobilizer slot is re-sent to the SKM.
4. The SKM compares this code with the encrypted code randomly transmitted by the internal logic. (System compares the signal from transponder and encrypted signal from the immobilizer control unit)
5. Only when the two signals are identical, it recognizes the key as the verified one and transmits the positive message to the ECU.
6. The ECU enables the engine to be started.



Modification basis	
Application basis	
Affected VIN	

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INSTRUMENT CLUSTER 8010-01

GENERAL INFORMATION

1. SPECIFICATION

Pin No.	Specification
Rated voltage	DC 12.0 V
Operating voltage	DC 9 V ~ 16 V
CAN operating voltage	DC 7 V ~ 18 V
Inspection voltage	DC 13.5 V
Operating temperature	−30℃ ~ +80℃
Storage temperature	−40℃ ~ +85℃
Dark current	IGN OFF: 1 mA, 12 V Measurement condition (at 25℃): 60 seconds after that ignition is turned off and stabilized data get IGN ON: Max. 2 A, 12 V Measurement condition (at 25℃): during DTC check mode

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2. MAJOR CHANGES

1) TPMS/Global Warning Lamp Added

<table>
<tr><th>Status</th><th>Standard type</th><th>Supervision type</th></tr>
<tr><td rowspan="3">TPMS/global warning lamp added</td><td>  </td><td>  </td></tr>
<tr><td colspan="2"><table>
<tr><th>TPMS warning lamp</th><th>Global warning</th></tr>
<tr><td>TPMS</td><td>  </td></tr>
<tr><td>Comes on when there is a malfunction in TPMS.</td><td>Comes on when the tire pressure is not normal.</td></tr>
</table></td></tr>
<tr><td>TPMS/Global warning lamp added</td><td>TPMS/Global warning lamp added</td></tr>
<tr><td>Warning message added to LCD display related to TPMS</td><td> 
</td><td> 
</td></tr>
<tr><td></td><td>If the driver press the TRIP switch to change to the tire pressure display mode, the tire pressure is displayed in following order: front wheels and rear wheels. If there is any fault, “--” is displayed without other messages.</td><td>If the driver press the TRIP switch to change to the tire pressure display mode, the tire pressure is displayed. If the tire pressure is normal, “Tire Pressure OK” is displayed. If the tire pressure is abnormal, the tire in question blinks then comes on depending on how the abnormality is severe on the display screen.</td></tr>
</table>

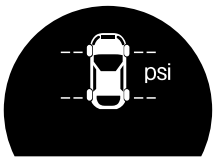
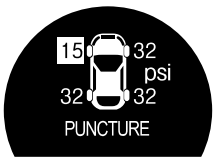
Modification basis	
Application basis	
Affected VIN	

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2) TPMS Mode

(1) Supervision type LCD instrument cluster display

- It monitors the tire and warns the driver if there is any abnormality.
- The driver can see the current tire pressure by pressing the TRIP switch.

Status	Message	Operating condition
Impossible to determine tire pressure		Pressure of the tire displayed as "--" when not possible to determine tire pressure correctly * At initial start, the tire pressure can be displayed after 10 minutes of driving at speed of 20 km/h or higher
Correct tire pressure		The specified tire pressure is based on a cold tire with the vehicle unloaded (no occupant); 32 psi at 20℃.
Lower than minimum tire pressure		Corresponding status lamp comes on if tire pressure is 24 psi or less
Excessive tire pressure		Corresponding status lamp blinks with shading reverse at interval of 0.4 seconds if tire pressure is 50 psi or higher
Low tire pressure		Corresponding status lamp comes on if tire pressure is 24 psi or less
Sudden tire pressure loss		Corresponding status lamp blinks with shading reverse at interval of 0.4 seconds if tire pressure changes more than 3 psi per 1 minute at speed of 0 km/h or above.
Imbalance between left and right tire pressure		Corresponding status lamps blink alternately at interval of 1.0 second if tire pressure differs by more than 4 psi in the left and right tires while driving for more than 10 minutes

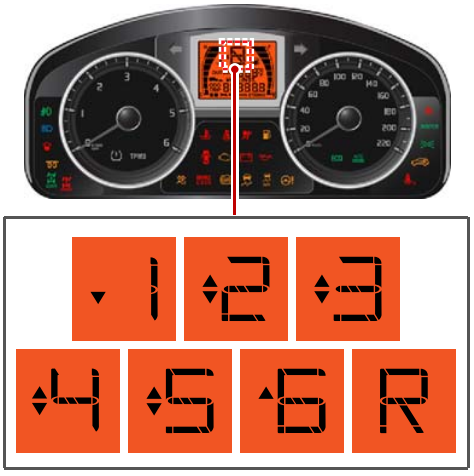
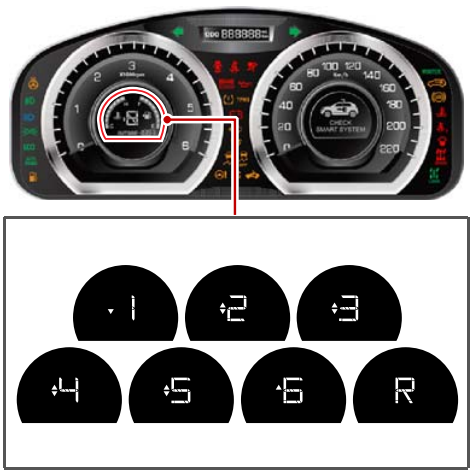
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(2) Standard type LCD instrument cluster display

- The standard type instrument cluster shows only tire pressure and "--".



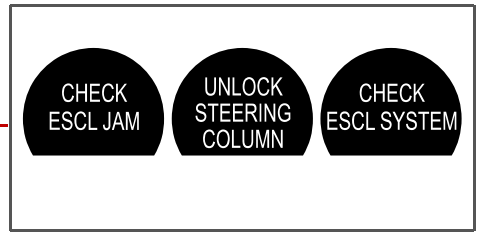
3) GSI(Gear Shift Indication)

Status	Standard type	Supervision type
Display gear stage for manual transmission		
Informs appropriate shift time for manual transmission ▲3 : This means that you should shift up to 3rd gear. (2nd gear or lower currently) ▼3 : This means that you should shift down to 3rd gear. (4th gear or higher currently) The system operates normally when the indicator lamp looks not being gone out completely.		

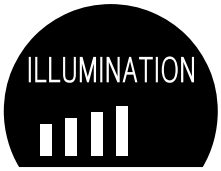
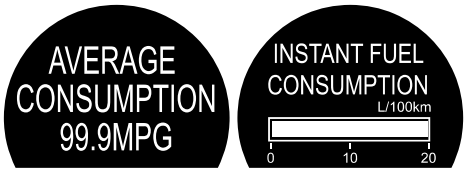
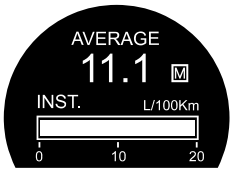
Modification basis	
Application basis	
Affected VIN	

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4) ESCL

Status	Supervision type
LCD display	 
	The ESCL (Electric Steering Column Lock) is a device to lock the steering handle using an electric signal, not a mechanical type and shows the messages above if the relevant systems are faulty.

5) LCD display

Status	Old	New
LCD display		
	Bar graph border maintained when adjusting illumination brightness	
		
	Average fuel economy and instant fuel economy displayed simultaneously	
	-	
	Auto cruise indicator and supervision cluster DOT LCD graphic added for gasoline engine ? newly adopted ?	
		-
	DOT LCD winter mode deleted	

Modification basis	
Application basis	
Affected VIN	

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6) TPMS/Global Warning Lamp Added

<table>
<tr><th>Status</th><th>Standard type</th><th>Supervision type</th></tr>
<tr><td>ECO indicator</td><td colspan="2"> 
<table>
<tr><th>Diesel</th><th>Gasoline</th></tr>
<tr><td>ECO</td><td>READY</td></tr>
</table></td></tr>
<tr><td>Warming up indicator</td><td colspan="2"> 
<table>
<tr><th>Diesel</th><th>Gasoline</th></tr>
<tr><td>  </td><td>ECO</td></tr>
</table></td></tr>
</table>

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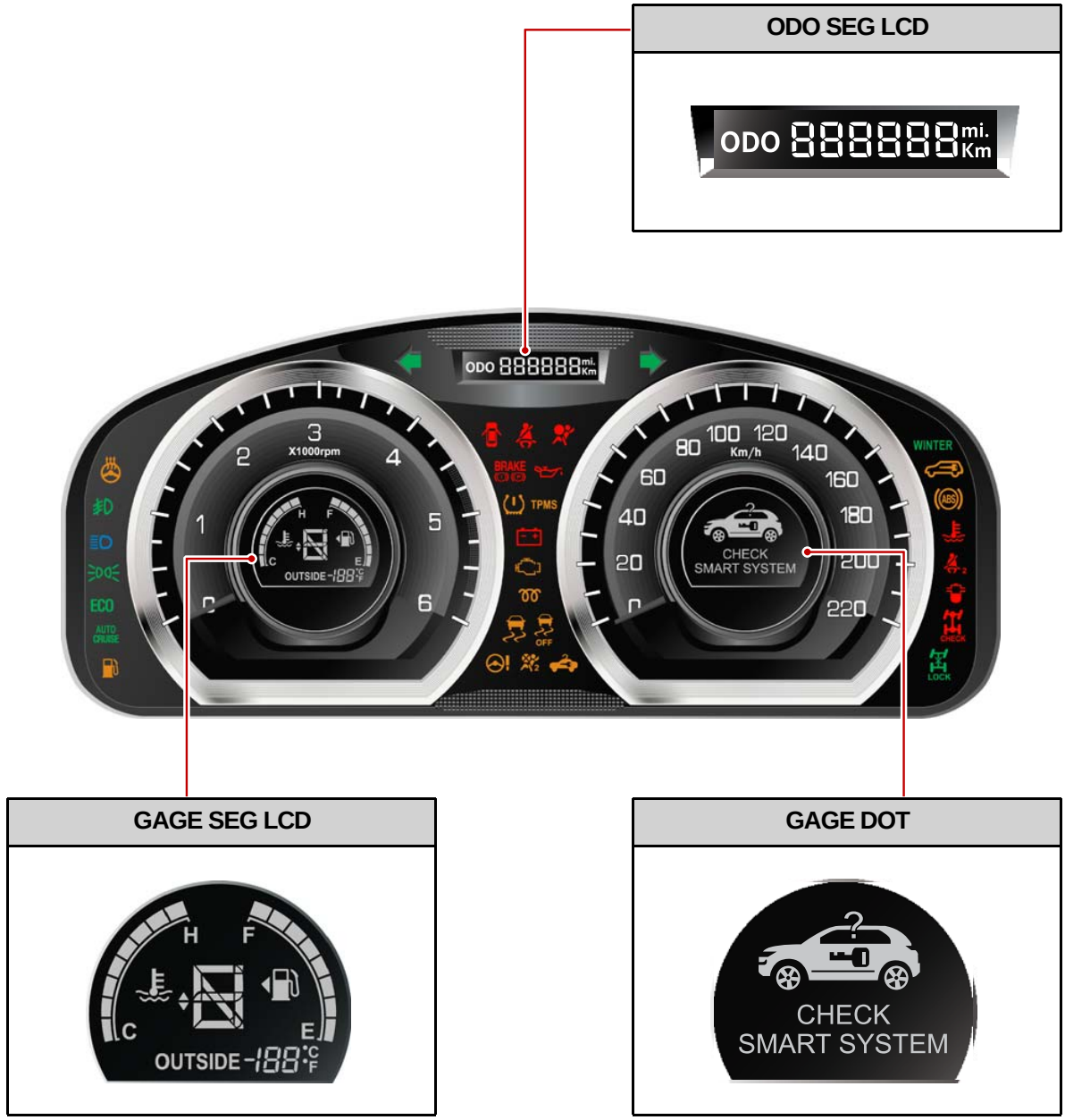
OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

There are two types in the instrument cluster used for KORANDO C: SVC (super vision) and STD (standard). While the SVC type has three LCD screens - <DOT LCD>, <GAGE SEG LCD> and <ODO SEG LCD>, the STD type has one LCD screen.

2. LAYOUT

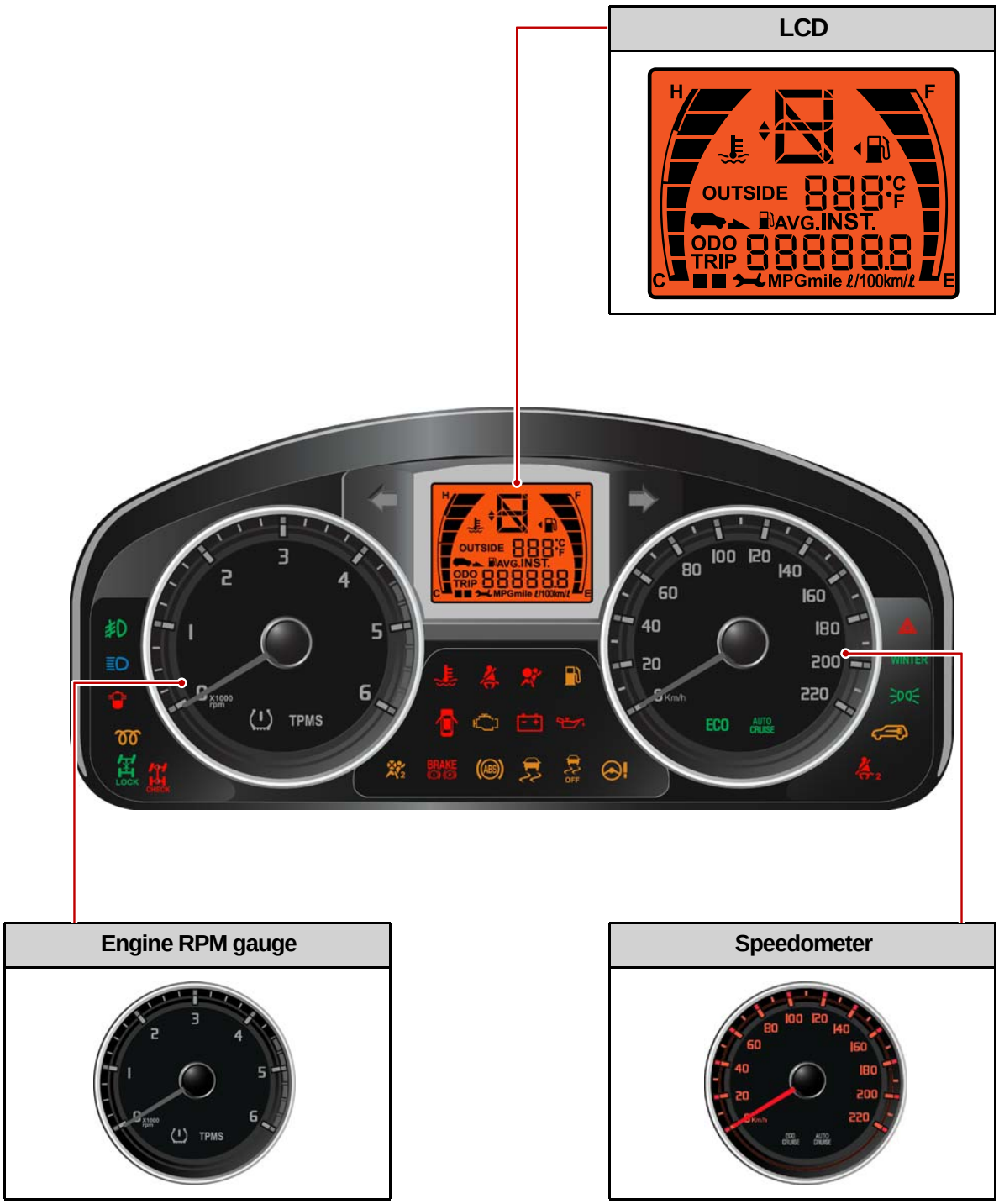
▶ **SVC**



Modification basis	
Application basis	
Affected VIN	

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▶ **STD**

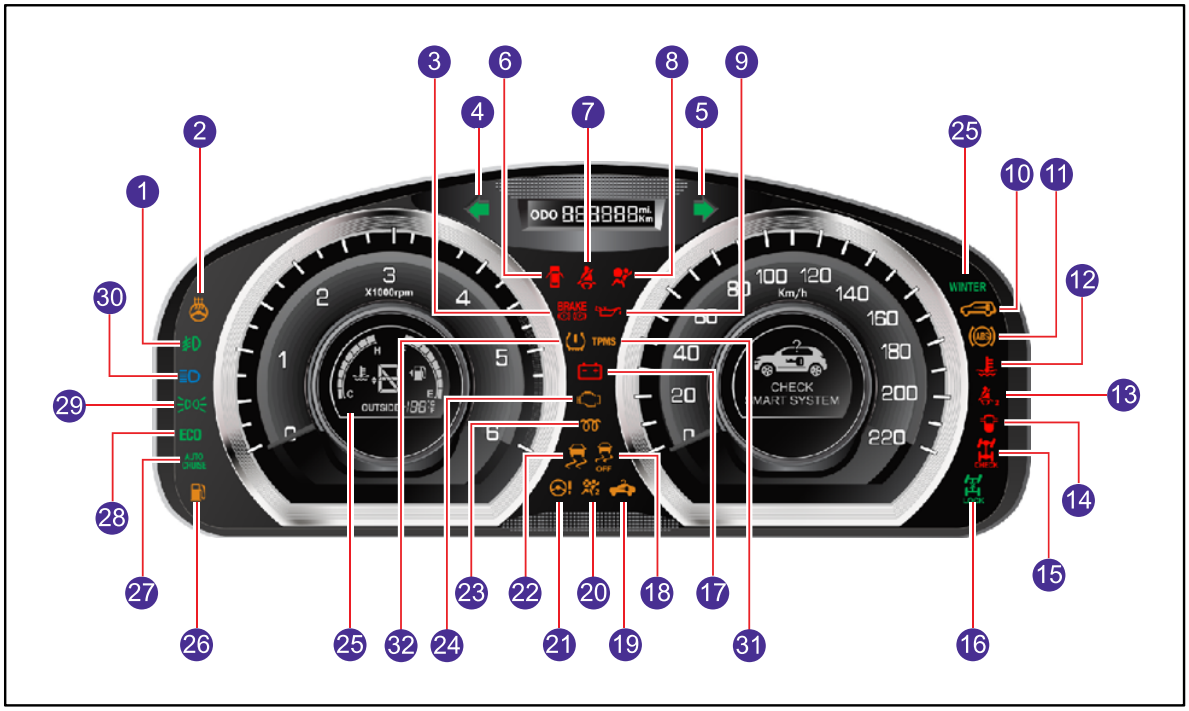


Modification basis	
Application basis	
Affected VIN	

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3. DESCRIPTION OF WARNING LAMPS & INDICATORS

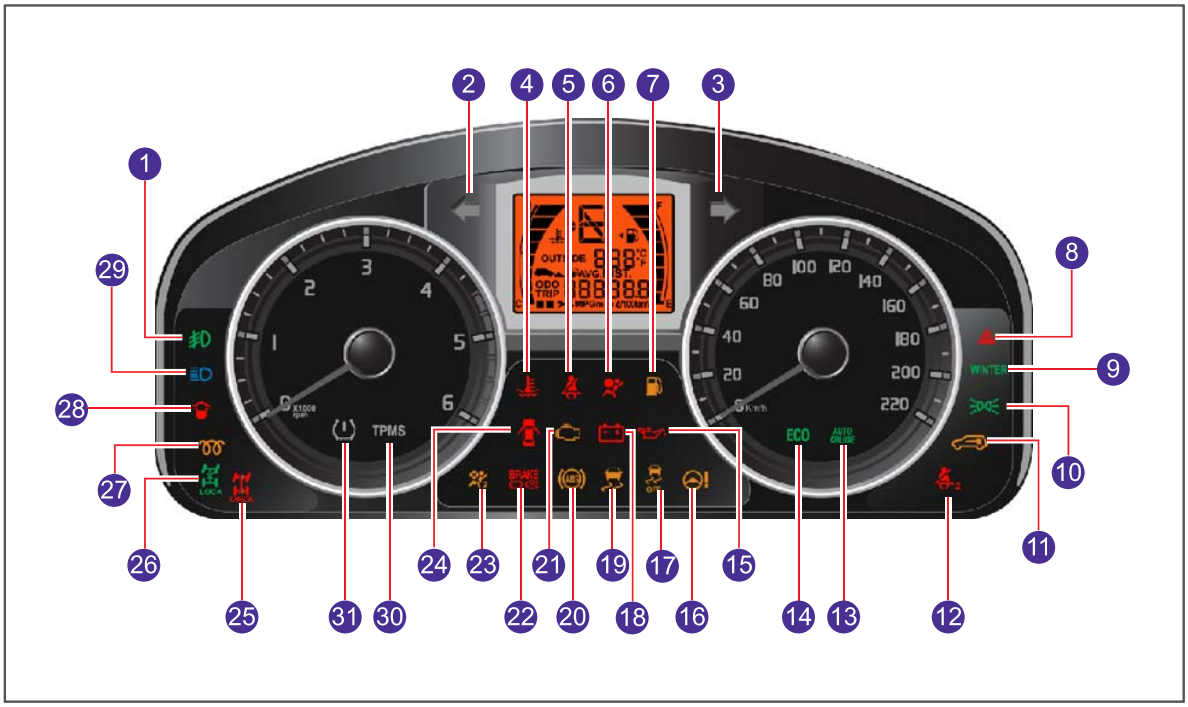
1) SVC



NO.	Symbol	Description	NO.	Symbol	Description	NO.	Symbol	Description
1		FRT FOG	12		TEMP HIGH	23		GLOW(DSL), ECO(GSL)
2		STEERING WHEEL HEATING INDICATOR	13		PASSENGER SEAT BELT	24		ENGINE CHECK
3	BRAKE	PARKING BRAKE (BRAKE FLUIDE)	14		FUEL FILTER	25	WINTER	WINTER MODE
4		TURN-L	15	CHECK	4WD CHECK	26		LOW FUEL WARNING
5		TURN-R	16	LOCK	4WD LOCK	27	AUTO CRUISE	AUTO CRUISE
6		DOOR OPEN	17		CHARGE	28	ECO	ECO(DSL), READY(GSL)
7		DRIVER SEAT BELT	18	OFF	ESP OFF	29		SIDE LIGHT
8		AIR BAG	19		SMART KEY	30		HIGH BEAM
9		OIL PRESSUR	20		PASSENGER AIR BAG DISABLE INDICATOR	31	TPMS	TPMS WARNING
10		IMMOBILIZER	21		EPS	32		GLOBAL WARNING
11	ABS	ABS	22		ESP			

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2) STD



NO.	Symbol	Description	NO.	Symbol	Description	NO.	Symbol	Description
1		FRT FOG	12		PASSENGER SEAT BELT	23		PASSENGER AIR BAG DISABLE INDICATOR
2		TURN-L	13	AUTO CRUISE	AUTO CRUISE	24		DOOR OPEN
3		TURN-R	14	ECO	ECO(DSL), READY(GSL)	25	CHECK	4WD CHECK
4		TEMP HIGH	15		OIL PRESSUR	26	LOCK	4WD LOCK
5		DRIVER SEAT BELT	16		EPS	27		GLOW(DSL), ECO(GSL)
6		AIR BAG	17	OFF	ESP OFF	28		FUEL FILTER
7		LOW FUEL WARNING	18		CHARGE	29		HIGH BEAM
8		HAZARD	19		ESP	31	TPMS	TPMS WARNING
9	WINTER	WINTER MODE	20	ABS	ABS	32		GLOBAL WARNING
10		SIDE LIGHT	21		ENGINE CHECK			
11		IMMOBILIZER	22	BRAKE	PARKING BRAKE (BRAKE FLUIDE)			

Modification basis	
Application basis	
Affected VIN	

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3) Details of Warning Lamps and Indicators

▶ Headlamp high beam indicator

Indicator (blue)	
	This lamp comes on when the headlamp high beam is operated.

▶ Front fog lamp indicator

Indicator (green)	
	This indicator comes on when the fog lamp switch is operated after the tail lamps comes on.

▶ Side light indicator

Indicator (green)	
	This indicator comes on when the tail lamp is switched on.

▶ Glow indicator(DSL only)

Indicator (amber)	
	This indicator comes on when the ignition switch is turned to the "ON" position and will go off when the glow plugs are sufficiently heated.

▶ Fuel filter indicator(DSL only)

Indicator (red)	
	This indicator comes on when the water level in the fuel filter exceeds a certain level.

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▶ Low fuel level warning lamp

Warning lamp (amber)	
	This lamp comes on if the fuel level is approx. 10 ℓ or below. However, the fuel level may change slight depending on vehicle condition, inclination of the road, etc. Also, it blinks if there is a short or open circuit between the fuel level sensor and cluster.

▶ Engine overheat warning lamp

Warning lamp (red)	
	When the coolant temperature is 120°C or higher, this lamp blinks at an interval of 1 second, a message is displayed, the warning sounds once through the speaker and the buzzer sounds at an interval of 0.5 seconds.

▶ Door ajar

Warning lamp (red)	
	This lamp comes on when any door is open or not closed completely. (both STD and SVC class)

▶ Seat belt reminder

Warning lamp (red)	
	This lamp comes on when the ignition switch is pressed ON. It keeps coming on if the driver's seat belt is not fastened.

▶ Air bag

Warning lamp (red)	
	This lamp comes on when the ignition switch is pressed to the ON mode. Then, it goes off if the system is normal. If this lamp stays on while driving, it means that the air bag system is faulty.

Modification basis	
Application basis	
Affected VIN	

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▶ ESP

Indicator (amber)	This indicator comes on when the ESP system is faulty.
	

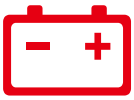
▶ ESP OFF indicator

Indicator (amber)	This indicator comes on when pressing the ESP OFF switch.
	

▶ Engine check warning lamp

Indicator (amber)	This lamp comes on if any sensor or device related to the engine control is defective.
	

▶ Battery charge warning lamp

Indicator (red)	This lamp comes on when the start switch is ON or when the battery level is low. (For EEM, warning lamp is controlled according to CAN signal)
	

▶ Engine oil level warning lamp

Indicator (red)	- This lamp comes on when the ignition switch is turned to "ON" position, and then goes off if the engine oil level is normal. - If the engine oil level warning lamp comes on while driving, check the engine oil level and oil leakage.
	

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▶ Brake warning lamp (brake fluid)

Indicator (red)	
	- This lamp comes on when the parking brake is applied or the brake fluid is insufficient. - If this lamp doesn't go off after the parking brake is released, check the brake fluid level first and then fluid leakage.

▶ ABS warning lamp

Indicator (amber)	
	- This warning light comes on when the ignition switch is turned to ON and should go out if the system is normal

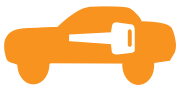
▶ Passenger air bag disable indicator

Indicator (amber)	
	This indicator comes on when the passenger air bag OFF switch is operated.

▶ EPS

Indicator (red)	
	This indicator comes on when the EPS system is faulty.

▶ Immobilizer indicator

Indicator (amber)	
	This indicator comes on the immobilizer (transponder) is not certified.

Modification basis	
Application basis	
Affected VIN	

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▶ Hazard indicator

Indicator (red)	This indicator comes on when the hazard warning flashers are switched on. (applies to STD class)
	

▶ ECO indicator

Indicator (green)	This indicator comes on when the ECO cruise system is activated. This indicator goes off when the brake pedal is depressed. (ECO deactivated)
ECO	

▶ Cruise control indicator

Indicator (green)	This indicator comes on when the cruise control system is activated. This indicator goes off when the brake pedal is depressed. (auto cruise deactivated)
AUTO CRUISE	

▶ 4WD LOCK indicator

Indicator (green)	This warning lamp comes on when the 4WD LOCK switch is pressed. This indicator goes off when pressing the switch again.
	

▶ 4WD check warning lamp

Indicator (red)	This warning lamp comes on when the 4WD system is defective.
	

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▶ Passenger seat belt reminder

Indicator (red)	This indicator comes on when the ignition switch is turned to the "ON" position and goes off when the passenger's seat belt is fastened.
	

▶ Left turn signal indicator

Indicator (green)	The left turn signal indicator blinks if the light switch is pushed down to the left, and both turn signal indicators blink if the hazard warning flasher switch is pressed.
	

▶ Right turn signal indicator

Indicator (green)	The right turn signal indicator blinks if the light switch is pushed up to the right, and both turn signal indicators blink if the hazard warning flasher switch is pressed.
	

▶ Winter mode indicator(DSL only)

Indicator (green)	When the mode switch is pressed, the winter mode is selected and the winter mode indicator comes on on the instrument cluster. The winter mode is used to start off on a slippery road with the 2nd gear. If the switch is pressed again, the winter mode is deactivated and system returns to standard mode.
WINTER	

▶ Smart key warning lamp

Indicator (amber)	This lamp comes on when the uncertified transponder or smart key is detected, SKM system is defective or there is no smart key in the vehicle.
	

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▶ Steering wheel heating indicator

Indicator (amber)	
	This indicator comes on when the steering wheel heating switch is operated with the ignition switch turned on and the engine running. (applies to SVC class)

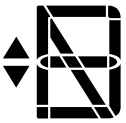
▶ TPMS WARNING LIGHT

Indicator (amber)	
TPMS	This warning light comes on when the ignition switch is turned to "ON" and should go off in a few seconds. If the TPMS is defective, this warning light comes on.

▶ GLOBAL WARNING LIGHT

Indicator (amber)	
	This warning light comes on when the ignition switch is turned to "ON" and should go off in a few seconds. If the tire pressure is too low, this warning light blinks for 70 seconds and then ON.

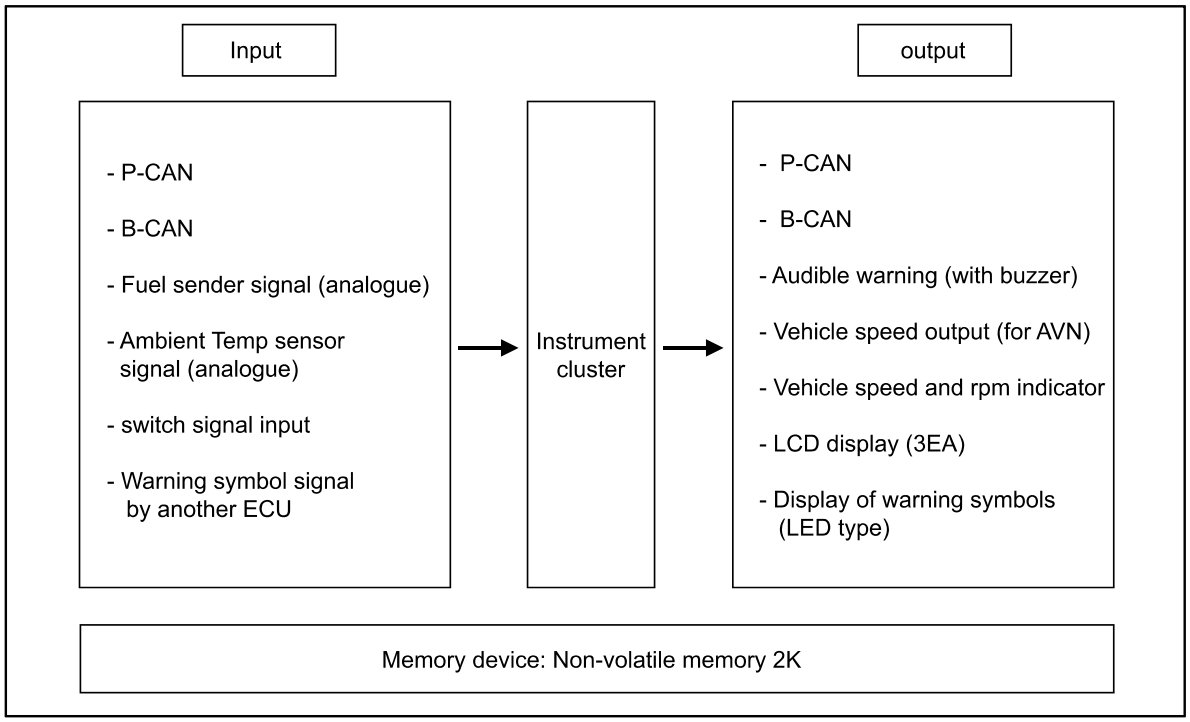
▶ GSI (GEAR SHIFT INDICATOR)

	This indicator indicates the proper gear shifting time. Ex)  Shift-up to 3rd gear (currently 2nd gear or lower)  Shift-down to 3rd gear (currently 4th gear or higher) If the system is properly working, this indicator is invisible.

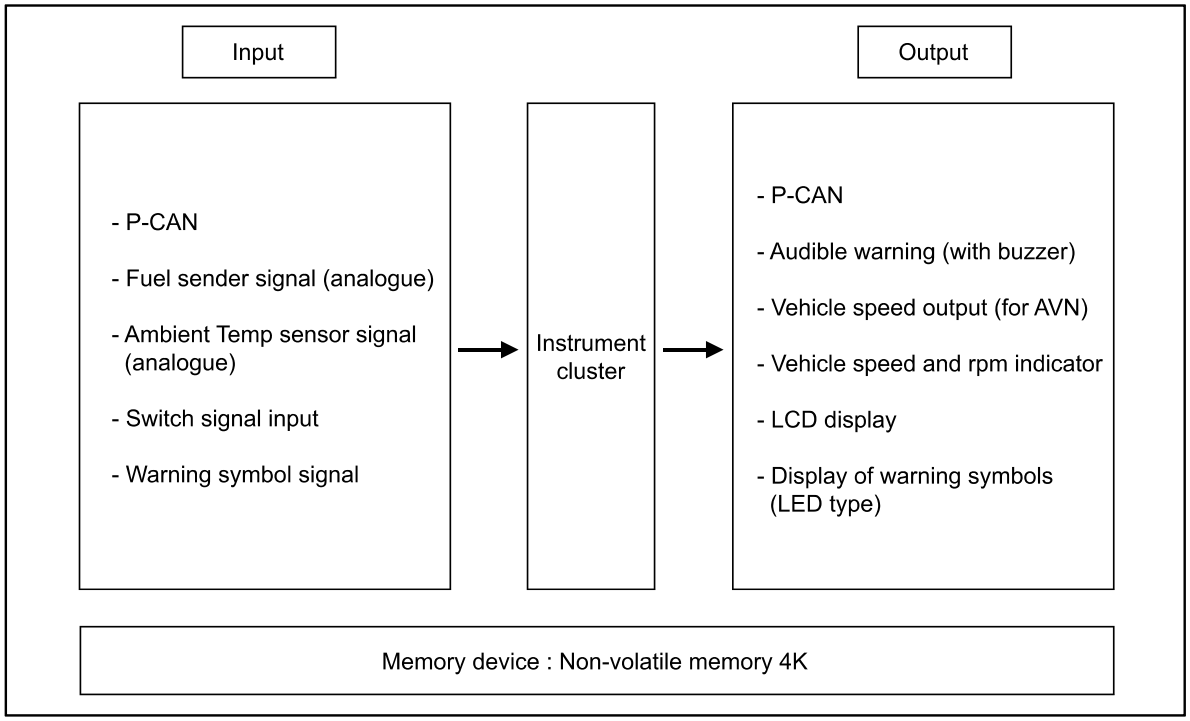
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4. OPERATING PROCESS

1) SVC



2) STD

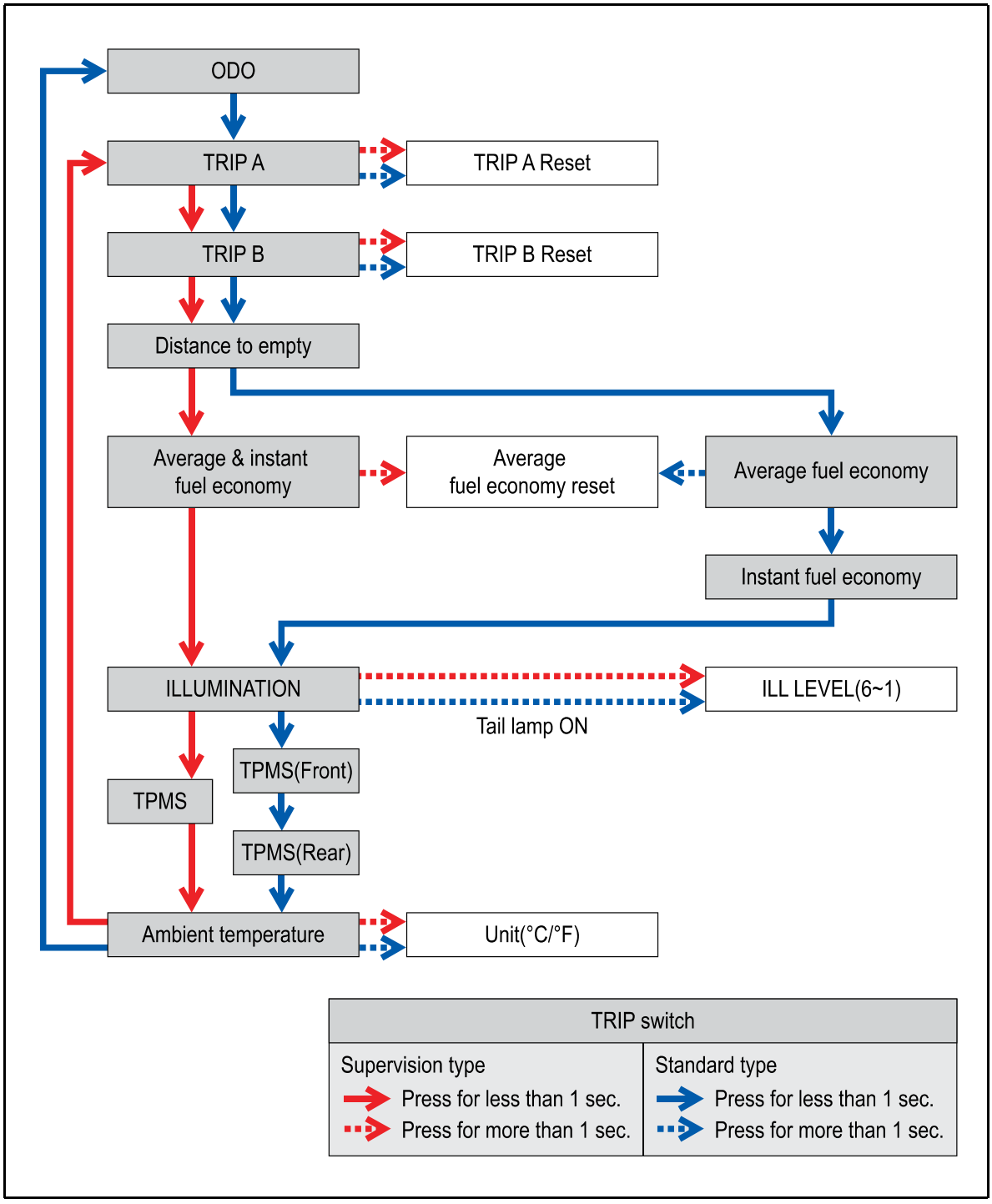


Modification basis	
Application basis	
Affected VIN	

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3) Display Sequence

▶ **Display sequence for STD main LCD & SVC DOT LCD**



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Operating time of Trip switch	Function	
Below 1 second (60 to 980 ms)	STD	Mode change (ODO → TRIP A → TRIP B → DTE → AFC → IFC → ILLUMINATION → TPMS(FRONT WHEEL) → TPMS(REAR WHEEL) → OUT TEMP)
	SVC	Mode change (TRIP A → TRIP B → DTE → AFC & IFC → ILLUMINATION → TPMS → OUT TEMP)
Over 1 seconds	Reset function (Trip A, B, AFC) (Illumination (6 to 1 level), unit of outside temperature (℃ ↔ ℉))	
Over 3 seconds - Ready	Mode change (Illumination → OUT TEMP → ODO)	

* If the Trip/Reset switch is not pressed within 3 seconds after getting into the illumination mode and the ambient air temperature mode, the LCD changes to next mode.
* The factory-setting mode is DTE (Distance To Empty) mode.

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4) Illumination & Brightness

(1) Operations for Power Supply

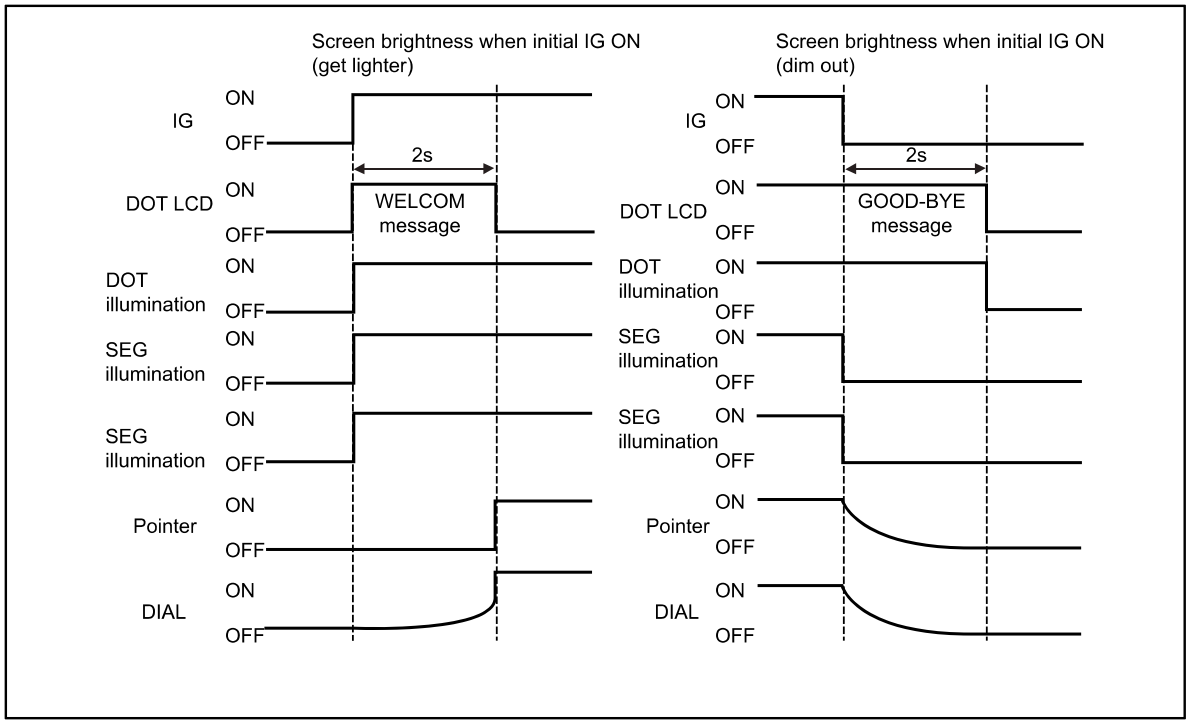
▶ Operations for power supply in SVC

CLUSTER ACC / IGN ON SEQUENCE		Time elapsed (sec)											
		1	2	3	4	5	6	7	8	9	10	11	12
LCD DISPLAY	LCD ON	→	→	→	→	→	→	→	→	→	→	→	→
	WELCOME	→	→										
	SEAT BELT WARNING			→	→	→							
	Priority step 1, 2 3 activated					→	→	→	→	→	→	→	→
ILL	POINTER illumination			→	→	→	→	→	→	→	→	→	→
	Dial illumination (lights up gradually for 2 sec. from 0% to USER%)	→	→	→	→	→	→	→	→	→	→	→	→
SYMBOL	ON and then OFF	→	→	→	→								
GAUGE SEG,LCD DISPLAY	LCD ON	→	→	→	→	→	→	→	→	→	→	→	→

1. When the ignition switch is turned to ON position, the message "WELCOME" is displayed for 2 seconds on the DOT LCD and the seat belt reminder comes on for 4 seconds. However, if a signal with higher priority is received, the seat belt reminder comes on only for 2 seconds to display it.
2. The pre-warning (system check) indicator comes on for 4 seconds and goes off 0.4 seconds after that the ignition is switched on.
3. All input signals can be input 4 seconds after the pre-warning (system check) indicator starts illuminating.
4. Only the symbol and DOT LCD are illuminated initially, if the SKM (Smart Key Module) or door (B-CAN) signal is received
   while B+ power is supplied.
   If the ignition is switched on with the LCD illuminated, the DOT LCD and the symbol follow the side fascia panel.
5. When the step 1, 2 and 3 are performed after 4 seconds, the seat belt warning lamp is deactivated in advance.
6. Dial light ON condition: Lights up gradually for 2 seconds when the ignition is switched on.

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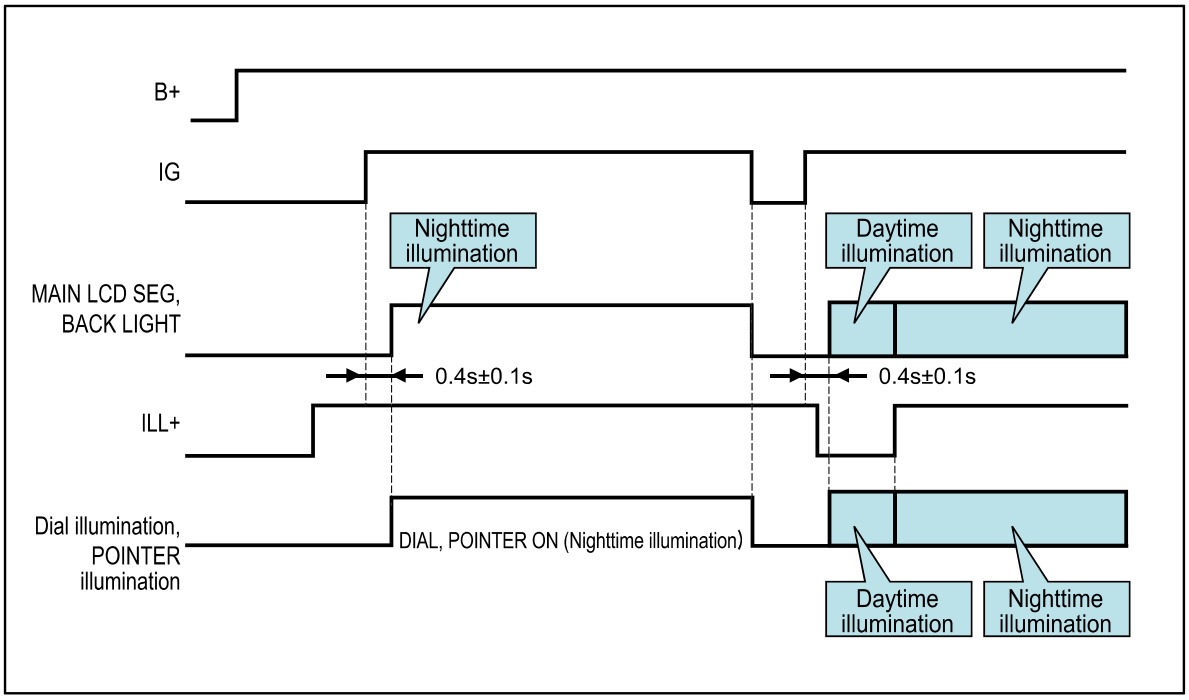
7. When the ignition is switched off, the message "GOOD-BYE" is displayed for 2 seconds and disappears.
   The other LCDs go off as soon as the ignition is switched off.
   The dial and pointer dim down for 2 seconds and go off at the same time when the DOT LCD goes off.



Modification basis	
Application basis	
Affected VIN	

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▶ Operations for power supply in STD



- The operation input before the LCD backlight is illuminated, right after the ignition is turned OFF or ON, is ignored.
- The LCD backlight and other lamps are illuminated 0.4 ±0.1 second after the ignition ON is detected.
- The LCD display, LCD backlight, dial lamp and indicator lamp are turned on or off by the ignition switch ON/OFF operation.

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(2) Illumination Level

▶ **Brightness in SVC**

Operating power		Illumination level	DOT LCD		ODO, gauge LCD, dial pointer	
			Day	Night	Day	Night
B+(B-CAN Wake UP)	Initial time	-	Level 6	Level 6	OFF (however, level 6 for initial operation with B+ & IGN1 ON)	
	After initial time		Maintain previous level	Maintain previous level	OFF (however, maintains previous level for initial operation with B+ & IGN1 ON)	
IGN 1		Level 1	25%	5%	25%	5%
		Level 2	40%	12%	40%	12%
		Level 3	55%	19%	55%	19%
		Level 4	70%	26%	70%	26%
		Level 5	85%	33%	85%	33%
		Level 6	100%	40%	100%	40%

▶ **Brightness in STD**

Operating power	Illumination level	Main LCD, dial point	
		Day	Night
B+ (B-CAN Wake UP)	-	OFF	OFF
IGN 1	Level 1	100%	20%
	Level 2	100%	30%
	Level 3	100%	40%
	Level 4	100%	50%
	Level 5	100%	60%
	Level 6	100%	70%

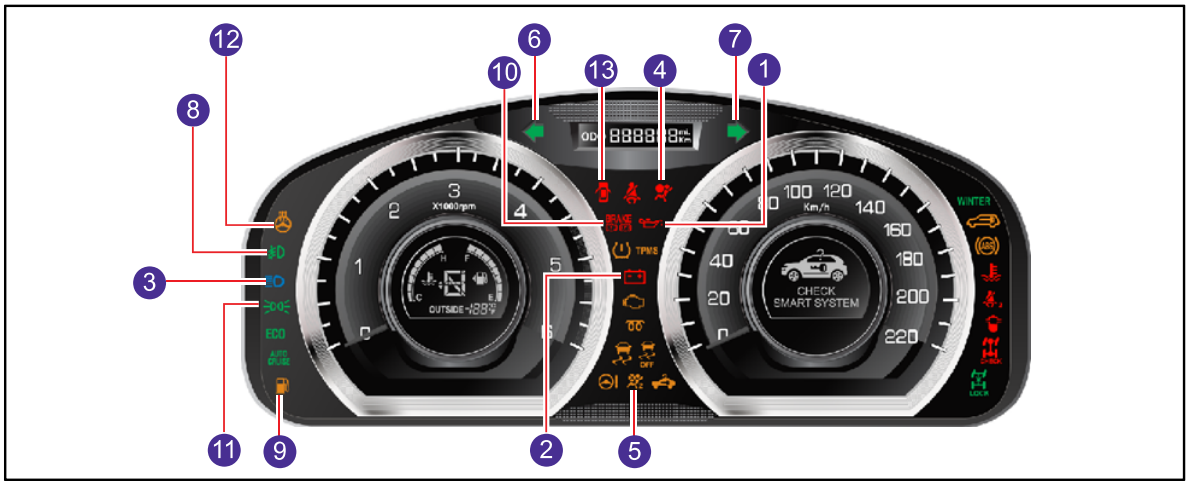
Modification basis	
Application basis	
Affected VIN	

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5) System Analysis

(1) SVC

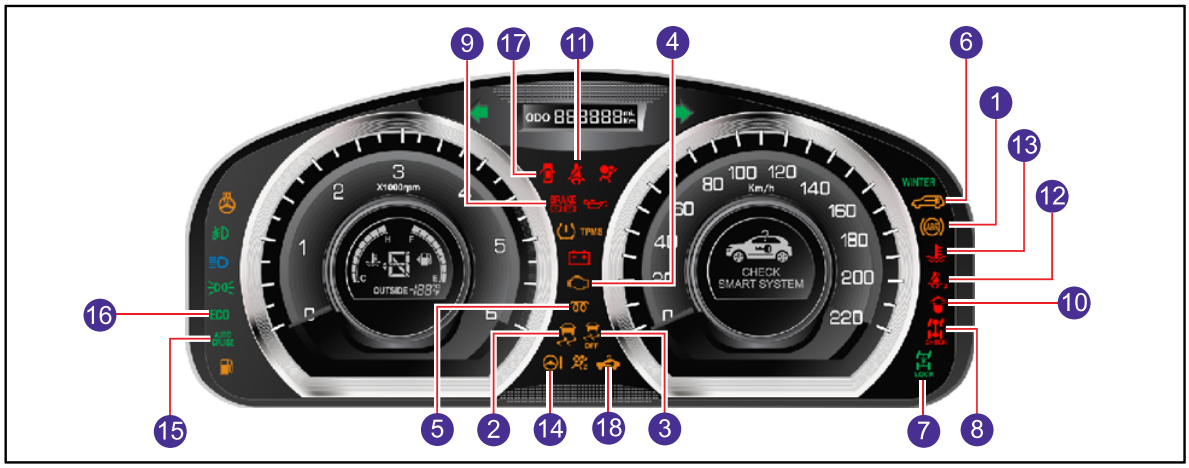
▶ Symbols in SVC



NO	NAME / Pre-Warning	SYMBOL	COLOR	CTRL	SIGNAL SOURCE	Signal Value	Operation STATE
1	OIL PRESSURE		RED	By micom	Oil Pressure Switch	GROUND	IGN ON
2	CHARGE		RED	By micom	Alternator	GROUND	IGN ON
3	HIGH BEAM		BLUE	By wire	High-beam Switch	H/B(+) : HIGH	IGN ON
4	AIR BAG		RED	By wire	SDM	GROUND	IGN ON
5	PADL		AMBER	By wire	SDM	GROUND	IGN ON
6	TURN-L		GREEN	By wire	BCM	HIGH	B+/IGN ON
7	TURN-R		GREEN	By wire	BCM	HIGH	B+/IGN ON
8	FRT FOG		GREEN	By wire	Front Fog Switch	HIGH	B+/IGN ON
9	LOW FUEL WARNING		AMBER	By micom	FUEL SENDER	Analogue signal	IGN ON
10	PARKING BRAKE (BRAKE FLUIDE) (4s±0.2s)	BRAKE	RED	By micom	P/BRAKE SW	GROUND (Circuit input signal takes priority over CAN signal.)	IGN ON
11	SIDE LIGHT		GREEN	By micom	ILL	HIGH	IGN ON
12	STEERING WHEEL HEATING(SVC)		AMBER	By micom	Steering wheel heating	HIGH	IGN ON
13	DOOR OPEN (ALL SVC)		RED	By micom	Door switch	GROUND	B+/IGN ON

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▶ Symbols in SVC (via CAN)



NO	NAME / Pre-Warning	SYMBOL	COLOR	CTRL	TIMEOUT (3.5Times)
1	ABS (4s±0.2s)	ABS	AMBER	By micom	ON
2	ESP (4s±0.2s)		AMBER	By micom	ON
3	ESP OFF (4s±0.2s)	OFF	AMBER	By micom	OFF
4	EINGINE CHECK (4s±0.2s)		AMBER	By micom	HOLD
5	GLOW(DSL) ECO(GSL)		AMBER	By micom	OFF
		ECO	GREEN		
6	IMMOBILIZER		AMBER	By micom	OFF
7	4WD LOCK (4s±0.2s)	LOCK	GREEN	By micom	OFF
8	4WD CHECK (4s±0.2s)	CHECK	RED	By micom	HOLD
9	EBD	BRAKE	RED	By micom	ON
		ABS	AMBER		
10	FUEL FILTER (4s±0.2s)		RED	By micom	OFF
11	DRIVER SEAT BELT		RED	By micom	OFF

Modification basis	
Application basis	
Affected VIN	

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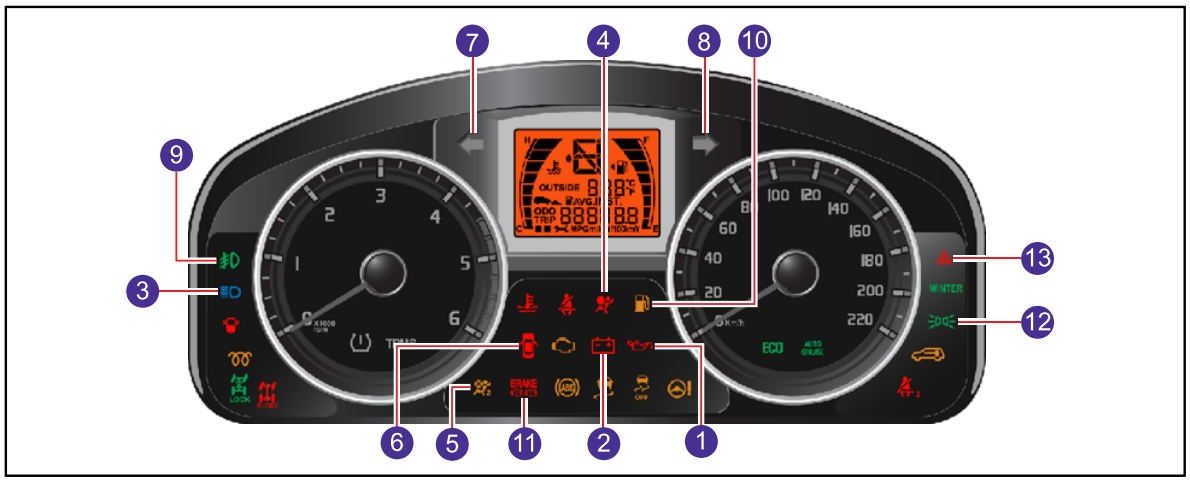
NO	NAME / Pre-Warning	SYMBOL	COLOR	CTRL	TIMEOUT (3.5Times)
12	PASSENGER SEAT BELT		RED	By micom	OFF
13	TEMP HIGH (Pre-warning removed)		RED	By micom	OFF
14	EPS (4s±0.2s)		RED	By micom	ON
15	AUTO CRUISE	AUTO CRUISE	GREEN	By micom	OFF
16	ECO(DSL) READY(GSL)	ECO READY	GREEN	By micom	OFF
17	DOOR OPEN (Operates regardless of interior lamp ON signal)		RED	By micom	HOLD
18	SMART KEY		AMBER	By micom	ON
19	CHARGE		RED	By micom	ON
20	TPMS	TPMS	AMBER	By micom	ON
21	GLOBAL		AMBER	By micom	Blinks and comes on

The pre-warning is performed for 4 seconds after turning the ignition switch to ON position. BCM checks that the warning lamps (ABS, ESP, ESP OFF, 4WD CHECK, 4WD LOCK) are matched with CAN signals.
The pre-warning is performed by the variant code.

- The pre-warning of the MICOM control warning is performed 400 ms after turning the ignition switch to ON position.
- IGN ON detecting time: 40~80 ms after turning ignition switch to ON position

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(2) STD



▶ Symbols in STD

NO	NAME / Pre-Warning	SYMBOL	COLOR	CTRL	SIGNAL SOURCE	Signal Value	Operation STATE
1	OIL PRESSURE		RED	By micom	Oil Pressure Switch	GROUND	IGN ON
2	CHARGE		RED	By micom	Alternator	GROUND(Other than EEM)	IGN ON
3	HIGH BEAM		BLUE	By wire	High-beam Switch	H/B(+) : HIGH	IGN ON
4	AIR BAG		RED	By wire	SDM	GROUND	IGN ON
5	PADL		AMBER	By wire	SDM	GROUND	IGN ON
6	DOOR OPEN (STD ALL)		RED	By micom	Door switch	GROUND	B+/IGN ON
7	TURN-L		GREEN	By wire	BCM	HIGH	B+/IGN ON
8	TURN-R		GREEN	By wire	BCM	HIGH	B+/IGN ON

Modification basis	
Application basis	
Affected VIN	

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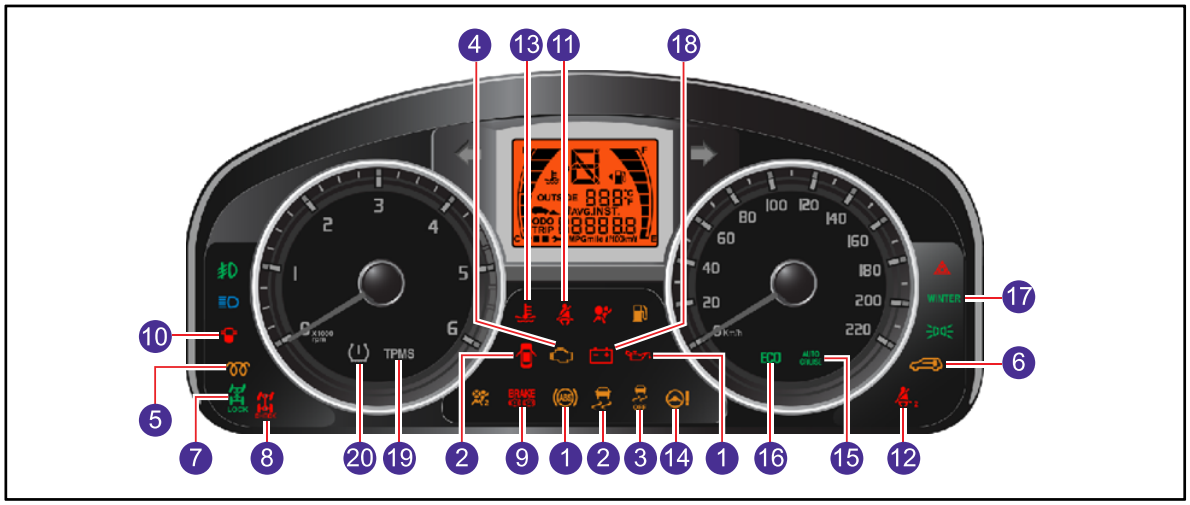
NO	NAME / Pre-Warning	SYMBOL	COLOR	CTRL	SIGNAL SOURCE	Signal Value	Operation STATE
9	FRT FOG		GREEN	By wire	Front Fog Switch	HIGH	B+/IGN ON
10	LOW FUEL WARNING		AMBER	By micom	FUEL SENDER	Analogue signal	IGN ON
11	PARKING BRAKE (BRAKE FLUIDE) (4s±0.2s)	BRAKE	RED	By micom	P/BRAKE SW & BRAKE OIL LEVEL SENSOR	GROUND (Circuit input signal takes priority over CAN signal.)	IGN ON
12	SIDE LIGHT		GREEN	By micom	ILL	HIGH	IGN ON
13	HAZARD		RED	By wire	BCM	HIGH	B+/IGN ON

The pre-warning is performed for 4 seconds after turning the ignition switch to ON position. BCM checks that the warning lamps (ABS, ESP, ESP OFF, 4WD CHECK, 4WD LOCK) are matched with CAN signals.
The pre-warning is performed by the variant code.

- The pre-warning of the MICOM control warning is performed 400 ms after turning the ignition switch to ON position.
- IGN ON detecting time: 40~80 ms after turning ignition switch to ON position

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▶ Symbols in STD (via CAN)



NO	NAME / Pre-Warning	SYMBOL	COLOR	CTRL	TIMEOUT (3, 5Times)
1	ABS (4s±0.2s)	ABS	AMBER	By micom	ON
2	ESP (4s±0.2s)		AMBER	By micom	ON
3	ESP OFF	OFF	AMBER	By micom	OFF
4	EINGINE CHECK (4s±0.2s)		AMBER	By micom	HOLD
5	GLOW(DSL) ECO(GSL)		AMBER	By micom	OFF
		ECO	GREEN		
6	IMMOBILIZER		AMBER	By micom	OFF
7	4WD LOCK	LOCK	GREEN	By micom	OFF

Modification basis	
Application basis	
Affected VIN	

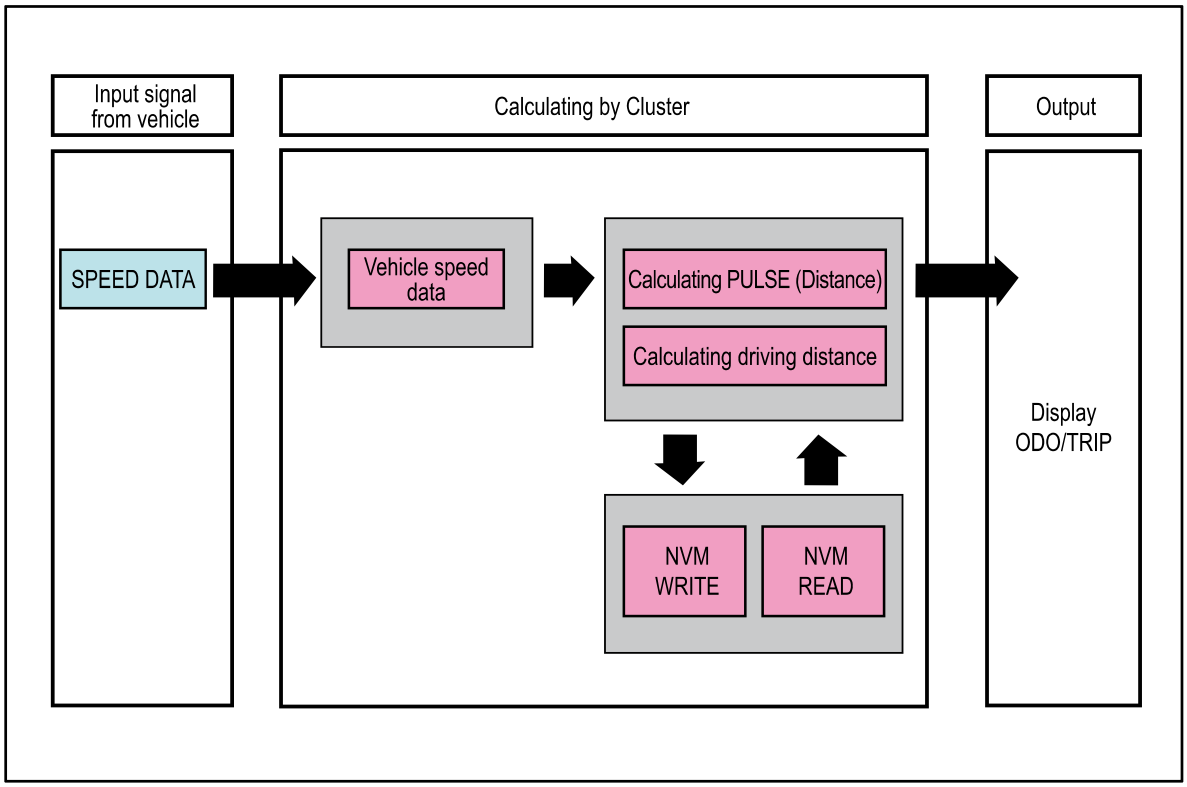
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NO	NAME / Pre-Warning	SYMBOL	COLOR	CTRL	TIMEOUT (3, 5Times)
8	4WD CHECK (4s±0.2s)	CHECK	RED	By micom	HOLD
					HOLD
9	EBD	BRAKE (!) (P)	RED	By micom	ON
		(ABS)	AMBER	By micom	ON
10	FUEL FILTER (4s±0.2s)		RED	By micom	OFF
11	DRIVER SEAT BELT		RED	By micom	OFF
12	PASSENGER SEAT BELT	2	RED	By micom	OFF
13	TEMP HIGH (Pre-warning removed)		RED	By micom	OFF
14	EPS (4s±0.2s)		AMBER	By micom	ON
15	AUTO CRUISE	AUTO CRUISE	GREEN	By micom	OFF
16	ECO(DSL) READY(GSL)	ECO	GREEN	By micom	OFF
		READY			
17	WINTER	WINTER	GREEN	By micom	OFF
18	CHARGE		RED	By micom	ON
19	TPMS	TPMS	AMBER	By micom	ON
20	GLOBAL		AMBER	By micom	Blinks and comes on

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6) Odometer (ODO) and Trip Meter (TRIP)

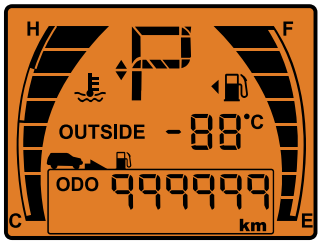
The total driving distance (0 to 999,999 km or 0 to 999,999 miles) and the trip distance (0.0 to 999.9 km or 0.0 to 9,999.9 miles) are calculated by using the value of pulse per 1 km which is programmed in the EEPROM.
Applicable maximum driving speed is 300 km/h. If the vehicle speed goes over the limit, ODO and Trip meter does not operate any more and the pointer indicates the maximum km/h (MPH). The pulse count information is sent from the speed module according to the speed CAN data that matches the speed frequency.



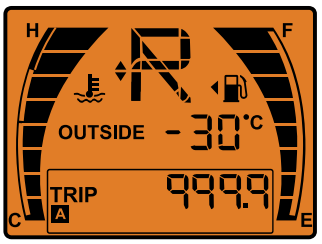
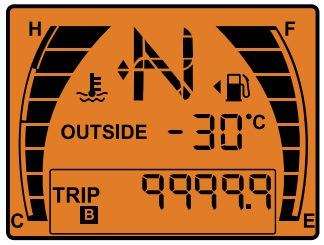
Modification basis	
Application basis	
Affected VIN	

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▶ STD Class Odometer Display & Data Storage

Function	Signal	Remark	
Input data	Speed signal		
Display type	6 digits LCD		
Display range	0~999999 km(mile) Hold		
Resolution	1 km (mile)		
Maximum Odo value	If the signal indicating actual vehicle speed above 300 km/h is received, the data is not accumulated.	<STD>	<SVC>

▶ STD Class Tripmeter Display

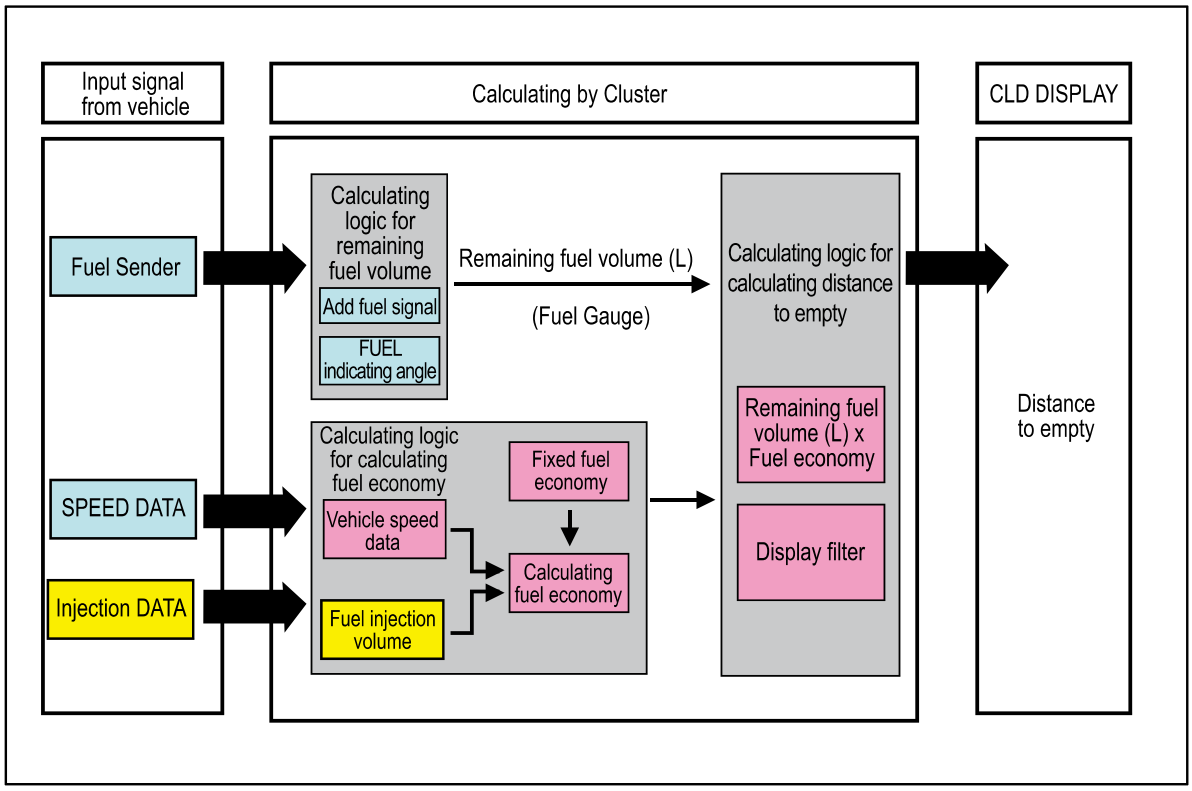
Function	Signal	Remark	
Input data	Speed signal	 	 
Display type	4 digits LCD		
Display range	A: 0.0 ~ 999.9 km (mile) B: 0.0 ~ 9999.9 km (mile)		
Resolution	0.1 km (mile)		
Maximum Odo value	A: 0.0 → 999.9 → 0.0 km B: 0.0 → 9999.9 → 0.0 km	<STD>	<SVC>
IGN OFF	Memorize and maintain previous trip distance		
Data clear	Supply B+ voltage for the first time Press and hold mode switch for more than 1 sec.		
Maximum Odo value	If the signal indicating actual vehicle speed above 300 km/h is received, the data is not accumulated.		

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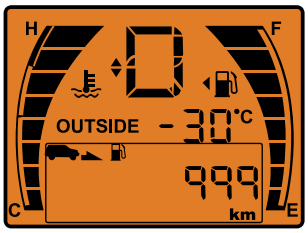
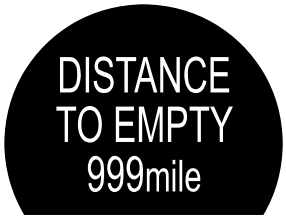
7) Display Mode

(1) DTE (Distance To Empty) Mode

The DTE (distance to empty) function is an estimation on how much further the vehicle can be driven with the fuel remaining in the tank, based on the previous driving pattern (fuel economy).



▶ **STD Class Odometer Display & Data Storage**

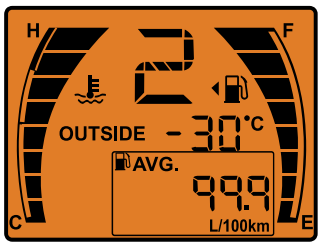
Function	Signal	Remark	
Display type	3 digits LCD		
Display range	50 km ~ 999 km (30 miles ~ 999 miles)		
Resolution	1 km (mile)		
Display interval	every 1 seconds	**<STD>**	**<SVC>**

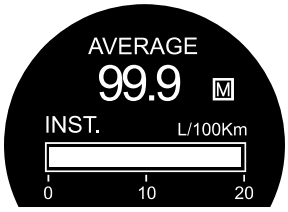
Modification basis	
Application basis	
Affected VIN	

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(2) Average Fuel Consumption Mode

The LCD display indicates average fuel consumption calculated based on total driving distance and total fuel consumption since B+ power supply or data reset.

<table>
<tr><th>Function</th><th>Signal</th><th colspan="2">Remark</th></tr>
<tr><td>Display type</td><td>3 digits LCD</td><td rowspan="5"> 

<STD></td><td rowspan="5"> 

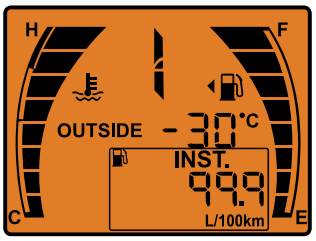
<SVC></td></tr>
<tr><td>Display range</td><td>0.0 km ~ 99.9 km
(0 miles~99.9 miles)</td></tr>
<tr><td>Resolution</td><td>0.1 km (mile)</td></tr>
<tr><td>Display interval</td><td>every 10 seconds</td></tr>
<tr><td>Data clear</td><td>- Disconnect B+ voltage
- Press and hold Reset switch for more than 1 sec.
- Reset automatically when refilling</td></tr>
<tr><td></td><td colspan="2">Standard type
- Drives at speed of 1 km/h or higher after refueling
- Press TRIP switch for more than 1 sec.

Supervision type
- To set reset ON/OFF when driving at speed of 1 km/h or higher after refueling
A) For auto reset
- Drive at speed of 1 km/h or higher after refueling
- Menu is not reset when pressing TRIP switch for more than 1 sec.
- Changed to manual setting when pressing TRIP switch for more than 5 sec.
B) For manual reset
- Menu is not reset when driving at speed or 1 km/h or higher after refueling
Menu is reset when pressing TRIP switch for more than 1 sec.
- Changed to automatic setting when pressing TRIP switch for more than 5 sec.</td></tr>
</table>

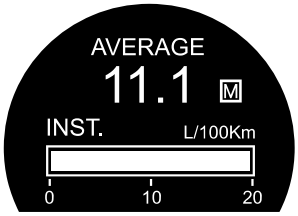
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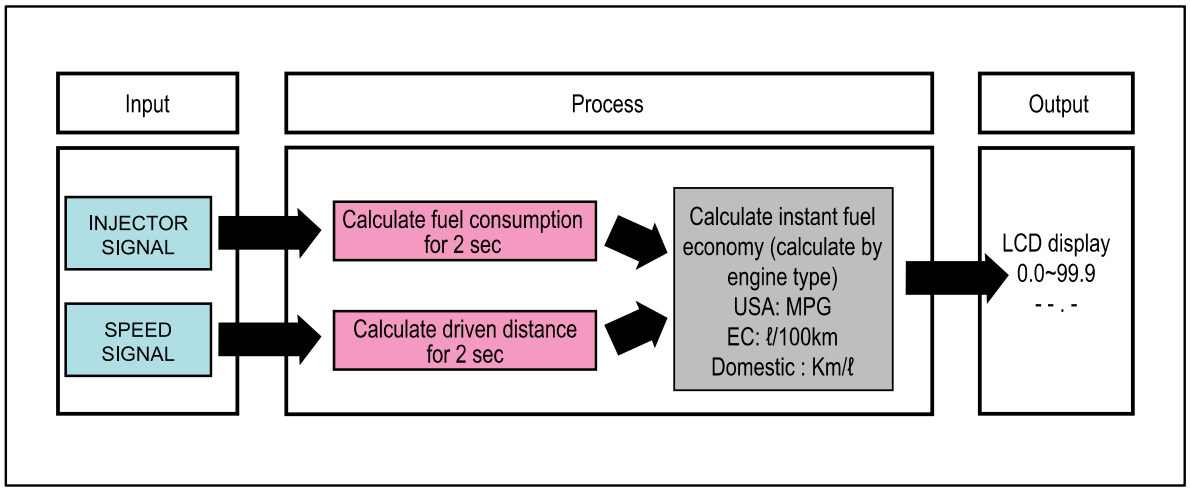
(3) Instant Fuel Consumption Mode

The LCD display indicates the instant fuel consumption (for 2 seconds) calculated based on driving distance and fuel consumption for last 2 seconds.

Function	Signal	Remark
Display type	3 digits LCD	 <STD>
Display range	0.0 ~ 99.9 (MPG, ℓ/100 km, km/ℓ)	
Resolution	0.1 km (mile)	
Display interval	every 2 seconds	

- When the ignition is switched on and the vehicle is drived more than 10 km, average fuel consumption is displayed at every 200 ms, based on the fuel consumption and driving distance for 600 ms.

Function	Signal	Remark
Display type	DOT BAR TYPE(92DOT)	 <SVC>
Display range	0.0 ~ 20(ℓ/100km, km/ℓ)/ 0.0 ~ 50(MPG)	
Resolution (DOT)	0.2174(ℓ/100km, km/ℓ per Bar), 0.5435(MPG per Bar)	
Display interval	every 200ms(25℃)	



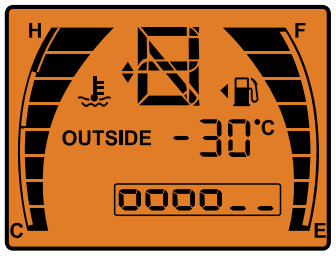
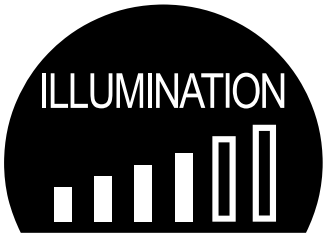
Modification basis	
Application basis	
Affected VIN	

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(4) Illumination Mode

▶ **TRIP/RESET switch**

- Press for less than 1 second: change to next mode
- Press for more than 1 second:
  : Enter into illumination level mode
  → Level changes by 1 step up and down when pressing the switch for more than 1 second on consecutively illumination mode
  (e.g. Level 4 → 5 → 6 → 5 → 4 → 3 → 2 → 1)
- If the Trip/Reset switch is not pressed within 3 seconds after getting into the illumination mode, the LCD changes to next mode.

SVC class instrument cluster	STD class instrument cluster
 <STD>	 <SVC>

(5) TPMS mode

- The TPMS (Tire Pressure Monitoring System) monitors each tire's status and warns a driver for dangerous situations.
- At initial start (more than 20 minutes have elapsed after ignition off), the tire pressure is not determined. It can be displayed after 10 minutes of driving at speed of 20 km/h or higher.

▶ **Standard type**

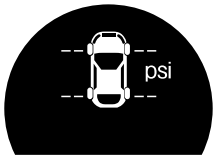
Pressing the TRIP switch at the illumination brightness mode shows the items in the following order: TPMS (front)->TPMS (rear).

Status	Operating conditions	Display
Tire pressure display	At initial start (more than 20 minutes have elapsed after ignition off), the tire pressure is not determined. It can be displayed after 10 minutes of driving at speed of 20 km/h or higher.	F32 32 A32 32
FR - display RR - display	If the tire pressure is abnormal when it is not detected, '--' is displayed. The standard type instrument cluster shows only tire pressure and '--'.	F32 -- A32 --

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▶ **Supervision type**

- Pressing the TRIP switch at the illumination brightness mode changes the screen to the tire pressure display mode.
- If the tire pressure is normal, "Tire Pressure OK" is displayed. If the tire pressure is abnormal, the tire in question blinks then comes on depending on how the abnormality is severe on the display screen.

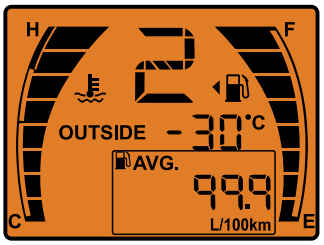
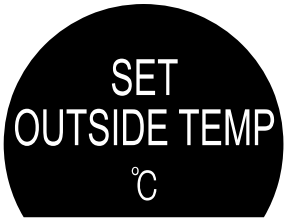
Status	Message	Operating condition
Impossible to determine tire pressure		Pressure of the tire displayed as "--" when not possible to determine tire pressure correctly * At initial start, the tire pressure can be displayed after 10 minutes of driving at speed of 20 km/h or higher
Correct tire pressure		The specified tire pressure is based on a cold tire with the vehicle unloaded (no occupant); 32 psi at 20℃.
Lower than minimum tire pressure		Corresponding status lamp comes on if tire pressure is 24 psi or less
Excessive tire pressure		Corresponding status lamp blinks with shading reverse at interval of 0.4 seconds if tire pressure is 50 psi or higher
Low tire pressure		Corresponding status lamp comes on if tire pressure is 24 psi or less
Sudden tire pressure loss		Corresponding status lamp blinks with shading reverse at interval of 0.4 seconds if tire pressure changes more than 3 psi per 1 minute at speed of 0 km/h or above.
Imbalance between left and right tire pressure		Corresponding status lamps blink alternately at interval of 1.0 second if tire pressure differs by more than 4 psi in the left and right tires while driving for more than 10 minutes

Modification basis	
Application basis	
Affected VIN	

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(6) Ambient Air Temperature Mode

- The ambient air temperature is calculated and displayed.
- This is displayed on both STD and SVC class, regardless of FATC type (automatic or manual).
- For SVC class, the driver set only the unit between ℃ and ˚F on the DOT LCD, the ambient temperature is displayed on the SEG LCD.

Function	Signal	Remark	
Display type	3 digits LCD	 <STD>	 <SVC>
Display range	- −30℃ ~ 90℃ (−22˚F~ 194˚F) - −31℃ ~ −33℃ : maintain 30℃ - 91℃~93℃ : maintain 90℃		
Resolution	1℃(1˚F)		

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8) Buzzer

▶ **Specifications**

Function	Signal
Part name	PKM17EPP-2002-B0 (MURATA, Piezoelectric Sound Components)
Permitted input voltage	25 VP-P or less
Operating temperature	−20˚C to +70˚C
Storage temperature	−30˚C to +80˚C
Sound pressure level	70 dB/min (3 Vp-p, 2 kHz, square wave, 10 cm)
Capacitance	19.0 nF ±30% (120 Hz)

▶ **Priority of instrument cluster buzzer output**

Priority	Item	Buzzer output time		Operating condition
		ON	OFF	
1	PAS			See PAS
2	ESP	0.1sec	0.1sec	Instrument cluster buzzer output signal is received from ABS/ESP
3	Engine overheat warning lamp	0.5sec	0.5sec	Engine overheats (120℃ or higher)
4	Water separator warning light	0.5sec	0.5sec	Water separator warning light ON with IGN ON
5	Parking brake	2.8sec	1.5sec	Parking brake applied depending on vehicle speed

NOTE

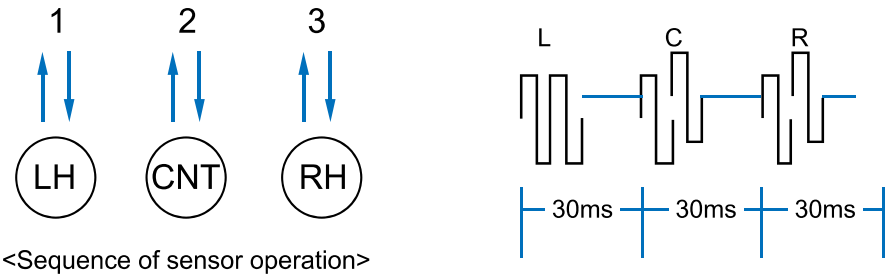
If there are multiple signals at a time, the operation should be completed by the priority.

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9) PAS (Parking Aid System)

(1) Sensor Operating Process

The ultrasonic sensors transmit ultrasonic waves and receive the reflected waves from an obstacle to detect it in the following order: L → C → R.



<Sequence of sensor operation>

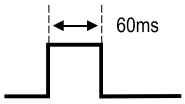
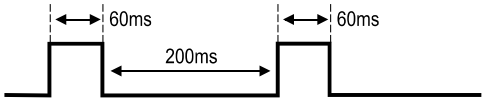
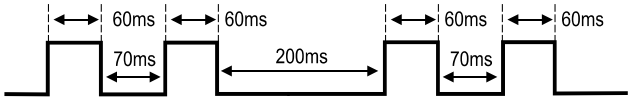
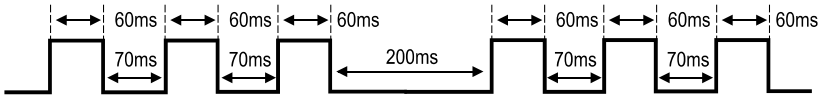
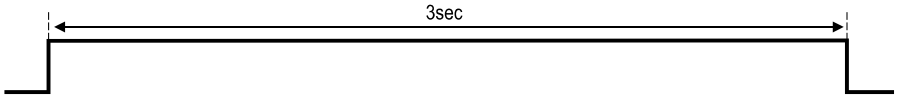
(2) Self Diagnosis Mode

▶ Operating conditions

Self diagnosis is performed once when the ignition is switched on (gear shift lever in "R" position). If the system is defective (Fail) due to open sensor or communication problem, the information for the failed sensor is sent to the instrument cluster.

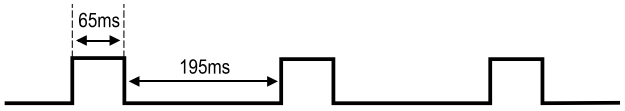
- Fail condition (However, no obstacle should be within 30 cm)
  1. The signal wire is open
  2. The power wire (+ and -)is open

▶ Buzzer interval during self diagnosis

MODE	Alarm interval (msec)
Normal	
LEFT	
CENTER	
RIGHT	
2 or more sensors	

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▶ **Buzzer interval when measuring distance**

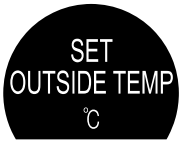
Step	L / R	CENTER	Alarm Interval (msec)
Step 1	80~100 (cm)	80~120 (cm)	
Step 2	50~80 (cm)		
Step 3	25~50 (cm)		
Tolerance	±10 (cm)		±10 (cm)

- Exception/error handling

1. Timeout processing time for buzzer interval after measuring distance/self diagnosis: 600 ms
   - If timeout is reached, the PAS returns to undetected condition.
2. Process while re-inputting
   After timeout, the process is performed normally if the signal required for display is received from beginning to end.
   (not detectable if the signal is received in the midst of process)

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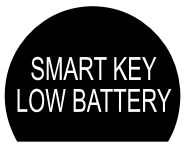
▶ **DOT LCD message display**

Pin No.	Message	Operating condition
Ambient temperature: indicates air temperature outside control		TRIP switch
Trip A		Reset: Press and hold the Trip switch for more than 1 second
Trip B		Reset: Press and hold the Trip switch for more than 1 second
Distance to empty: indicates a distance can be driven with the fuel remaining control		Factory-setting mode
Average fuel consumption: indicates average fuel control		Reset: Press and hold the Trip switch for more than 1 second
Instant fuel consumption: indicates fuel consumption for a short periods		TRIP switch
Illumination brightness: indicates tail lamp brightness control		Brightness control: Press and hold the Trip switch for more than 1 second
Start-up screen		LCD display shows this message for 2 seconds after ignition ON.
Driver's seat belt reminder		LCD display shows this message for 4 seconds after "WELCOME" message.

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Pin No.	Message	Operating condition
Smart key warning		This message comes on the LCD display, if the smart key is not in the vehicle when the door is open and closed in the ignition ON or ACC mode.
		This message comes on the LCD display for approx. 10 seconds, if the ignition switch is pressed when the smart key is not in the vehicle.
		This message comes on the LCD display for approx. 10 seconds, if the smart key verification fails after inserting the smart key into the key holder.
		LCD display shows this message and Smart key reminder sounds for 10 seconds when you open the driver's door with engine OFF and Smart key inserted in the Smart key holder.
		This message informs the driver that the brake pedal should be depressed and the ignition switch be pressed in order to start the engine, if the ignition is switched to ACC mode for more than one time when the driver keeps pressing the ignition switch without depressing the brake pedal.
		LCD display shows this message when you press the ignition switch without depressing the clutch pedal.
		This message comes on for approx. 10 seconds to inform the driver that the ignition switch should be pressed with the shift lever in P in order to start the engine.
		When a Smart key is inside the vehicle and all doors are closed, LCD display shows this message if you press the Lock button on the other Smart key.

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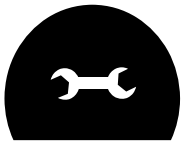
Pin No.	Message	Operating condition
Smart key warning		LCD display shows this message for 10 seconds when the ignition switch or Smart key system is defective.
		This message comes on for approx. 10 seconds if the low smart key battery is detected when the ignition switch is pressed or the engine is started.
Door/PAS		LCD display shows this message when the door, engine hood or tailgate is open.
		
Tailgate		If the tailgate is open, open status messages are displayed in 4-step graphics.
Parking aid system		If any obstacle is detected in the rear of the vehicle when the shift lever is moved to "R" position with IGN ON, each sensor shows its position and distance.
		If any error is detected during initial diagnosis, it is displayed as "?". Other than that is operated in the same way as the PAS distance measurement mode.
Cruise control		This message comes on when the cruise control system is activated.
		This message comes on when the cruise control system is deactivated.
		This message comes on when the cruise switch is moved to the ECO position.

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Pin No.	Message	Operating condition
Auto cruise		LCD display shows this message when turning on the cruise control switch with ignition ON or engine running. This message disappears when activating the cruise control by operating "ACCEL" switch on the cruise control lever.
Cruise control		This message comes on when the ECO cruise mode is deactivated.
EMS		This message comes on when the engine is faulty.
Lamp		This message comes on when the tail lamps are ON with the ignition in the "OFF" or "ACC" position.
SUNROOF SYSTEM		For the vehicle with SKM, this message comes on when the sunroof is open with the ignition in the "OFF" or "ACC" position. For the vehicle without SKM, this comes on when the sunroof is open with the ignition in the "OFF" position and the key removed.
Low fuel level		This message comes on when the remaining fuel is insufficient.
ESP check		This message comes on when the ESP system is faulty.
ABS check		This message comes on when the ABS system is faulty.
Engine oil level check		LCD display shows this message when the engine oil level is low. Have the system checked at Ssangyong Authorized Service Center.

Modification basis	
Application basis	
Affected VIN	

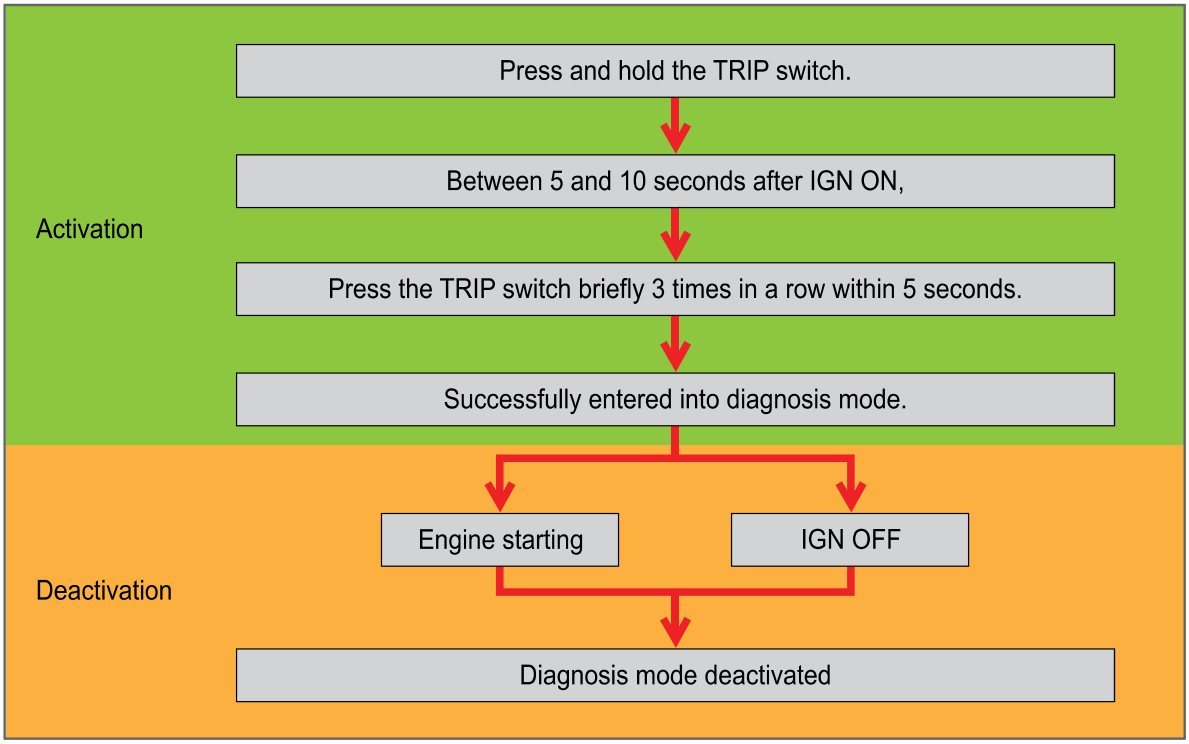
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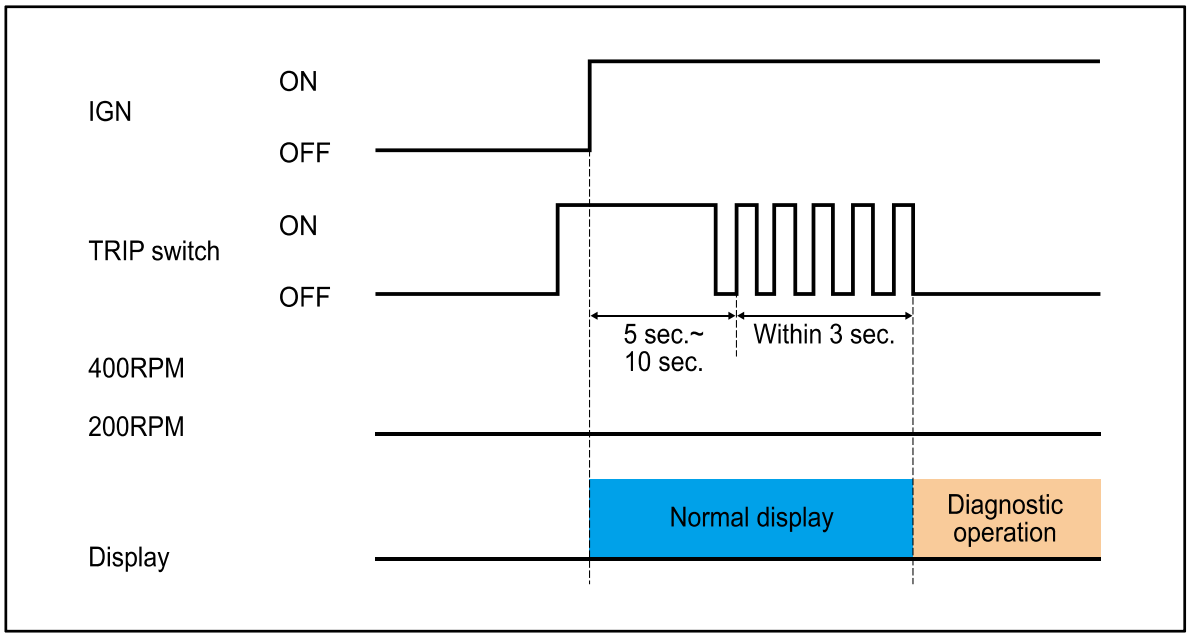
Pin No.	Message	Operating condition
Tire alignment (applies to vehicle with EPS)	<Level 0>  <Level 1>  <Level 2>  <Level 3>  <Level 4>  <Level 5> 	- This message helps the driver to predict the driving direction since the tire alignment is displayed on the instrument cluster. - The images on the left show that the tires are aligned to the left. When the tires are aligned to the right, the image is symmetrical vertically. - Tire alignment is displayed between level 0 and level 5 depending on the alignment degree when the ignition switch is turned to "ON" position from "OFF" position with the shift lever in "P" or "N" position. While the images up to level 2 comes on for 5 seconds, the images from level 3 stay on. These messages are not displayed when the EPS - check message is displayed.
CAN scan		(This message goes off when all the CAN signal inputs are normal)
ESCL	  	LCD display shows this message when ESCL (Electric Steering Column Lock) system is defective. There is no specific ESCL warning light on the instrument cluster. This problem could be temporary. Turn the ignition off and then on again to check if this message will be disappeared.

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5. SELF DIAGNOSIS PROCESS

1) Self Diagnosis Process Mode





Modification basis	
Application basis	
Affected VIN	

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2) What Is Shown On Instrument Cluster

▶ **Supervision type**



▶ **Standard type**



(1) Self diagnosis for gauge

- Speedometer/tachometer (RPM): Oscillates between lower mark and upper mark repeatedly.

(2) Self diagnosis for warning lamp and indicator lamp

- All the warning lamps and indicator lamps come on by MICOM control (CAN communication) and they blink if faulty.
  (However, the wired type symbols such as air bag, LH/RH turn signal indicators, hazard warning flasher, high beam, front fog lamp do not come on.)

(3) Miscellaneous

- When entering into the self diagnosis mode, the instrument cluster illumination output will be 100%. All the segments are ON.
-

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SWITCH 8510-00

GENERAL INFORMATION

1. SPECIFICATIONS

▶ **Multifunction switch**

Unit				Specification
Multifunction switch	Rated voltage			DC 12 V
	Rated load	Multifunction turn light switch	Light switch	ON: 1 A (relay load)
			Dimmer & passing switch	High beam: 0.3 A (relay load) Low beam: 0.3 A (relay load) Passing: 0.3 A (relay load)
			Turn signal lamp switch	0.1 A (relay load)
			AUTO hazard warning flasher switch	0.1 A (relay load)
		Multifunction wiper switch	Wiper switch	LO: 0.1 A (relay load) HI: 0.1 A (relay load) AUTO: 0.22±0.05 A (relay load) Fixed: Max. 0.1 A (relay load)
			AUTO washer switch	0.1 A (relay load)
			Washer switch	0.1 A (relay load)
			Wiping speed control switch	Max. 25 mA
			Mist switch	0.1 A (relay load)
			Rear wiper & washer switch	Rear wiper: 0.1 A (relay load)

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▶ **Lower main switch**

Item		Specification
Lower main switch	4WD LOCK switch	DC 12V - 0.1A
	ESP OFF switch	DC 12V - 0.1A
	Steering wheel heating switch	DC 12V - 0.1A

▶ **Center fascia switch**

Item		Specification
Center fascia switch	Hazard warning flasher switch	DC 12V - 0.1A (max. 30 mA)
	TRIP/RESET switch	DC 12V - 0.1A (max. 30 mA)
	Windshield heating switch	DC 12V - 0.1A (max. 30 mA)
	Rear glass and outside rearview mirror heating switch	DC 12V - 0.1A (max. 30 mA)

▶ **Power window main switch**

Item			Specification
Power window main switch	Rated voltage		DC 12 V
	Operating voltage		DC 9 to 16 V
	Rated load	AUTO switch	0.7 A (motor load)
		AUTO/MANUAL switch	10 A (motor load)
		Window lock switch	10 A (motor load)
		Door unlock switch	0.4 A (motor load)

▶ **Power window sub switch**

Item			Specification
Power window sub switch	Rated voltage		DC 12 V
	Operating voltage		DC 9 to 16 V
	Rated load	Manual switch	10 A (motor load)

Modification basis	
Application basis	
Affected VIN	

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▶ Audio remote control switch

Item		Resistance	Output voltage
Audio remote control switch	VOL -	0 Ω ± 5%	0 to 0.3 V
	VOL +	3.3 KΩ ± 5%	0.4 to 1.0 V
	MODE	6 KΩ ± 5%	1.1 to 1.4 V
	MUTE	9.9 KΩ ± 5%	1.5 to 1.8 V
	SEEK UP	16.7 KΩ ± 5%	1.9 to 2.25 V
	SEEK DOWN	31.3 KΩ ± 5%	2.26 to 2.64 V
	TIP -	670 Ω ± 5%	-
	TIP +	1.08 KΩ ± 5%	-
	Bluetooth (hands-free)	64.7 KΩ ± 5%	2.66 to 3.0 V

▶ Cruise control switch

Item		Specification
Cruise control switch	ON/OFF	DC 5V - 10mA
	DECEL	DC 5V - 10mA
	ACCEL	DC 5V - 10mA
	RESUME	DC 5V - 10mA

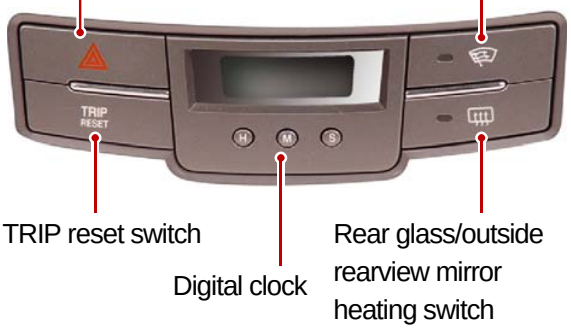
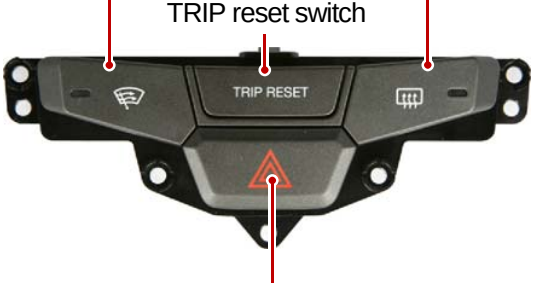
▶ Front seat heating and ventilation switch

Item		Specification
Front seat heating and ventilation switch	Driver seat heating switch	12V - 0.1A (max. 30 mA)
	Driver seat ventilation switch	12V - 0.1A (max. 30 mA)
	Passenger seat heating switch	12V - 0.1A (max. 30 mA)

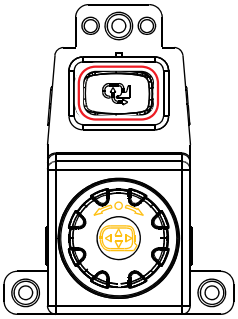
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2. MAJOR CHANGES

▶ **Center fascia switch**

Center fascia switch	
Old  	**New** 
- Center fascia switch design and layout changed - Digital clock switch deleted	

▶ **Outside rearview mirror switch**

Outside mirror switch	
Old 	**New** 
- Changed from self-return type to push-lock type	

Modification basis	
Application basis	
Affected VIN	

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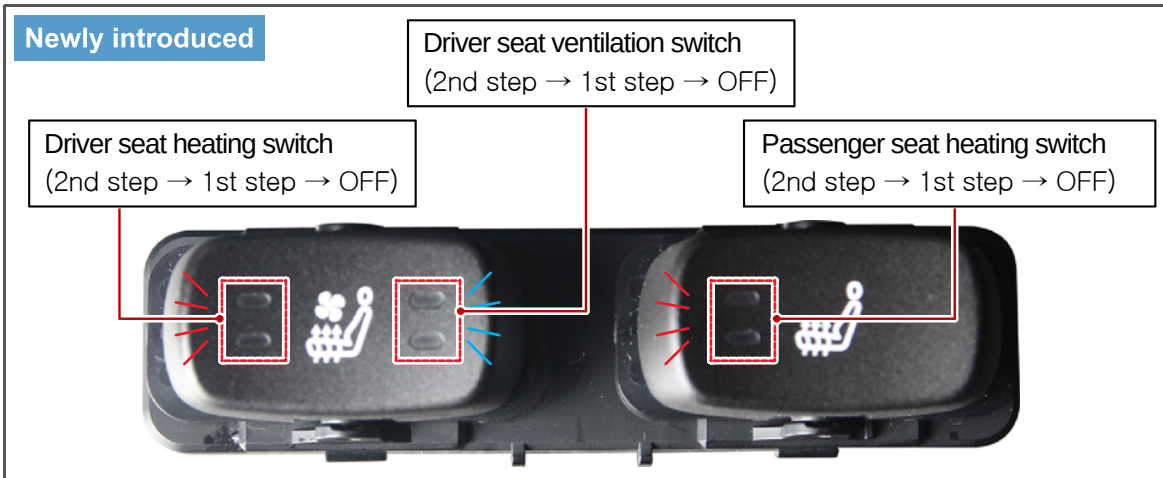
▶ Seat heating and ventilation unit & switch application

●: New, ○: Already used, -: N/A

Item	Heating and ventilation specification	Heating specification
Heating and ventilation unit	●	-
Heating and ventilation switch	●	-
Heating switch	-	○
How to operate	Driver: heating and ventilation (two-step) Passenger: heating (two-step)	Driver: heating (LO↔HI) Passenger: heating (LO↔HI)

▶ Front seat heating & ventilation switch (2-level of driver seat heating and ventilation, 2-level of passenger seat heating)

Newly introduced



- Addition of driver seat ventilation switch and staged operation of switch
- Front seat heating & ventilation switches classified according to specifications
  Switch with heating & ventilation: 2nd step → 1st step → OFF
  Switch with heating: LO ↔ HI (same as conventional switch)

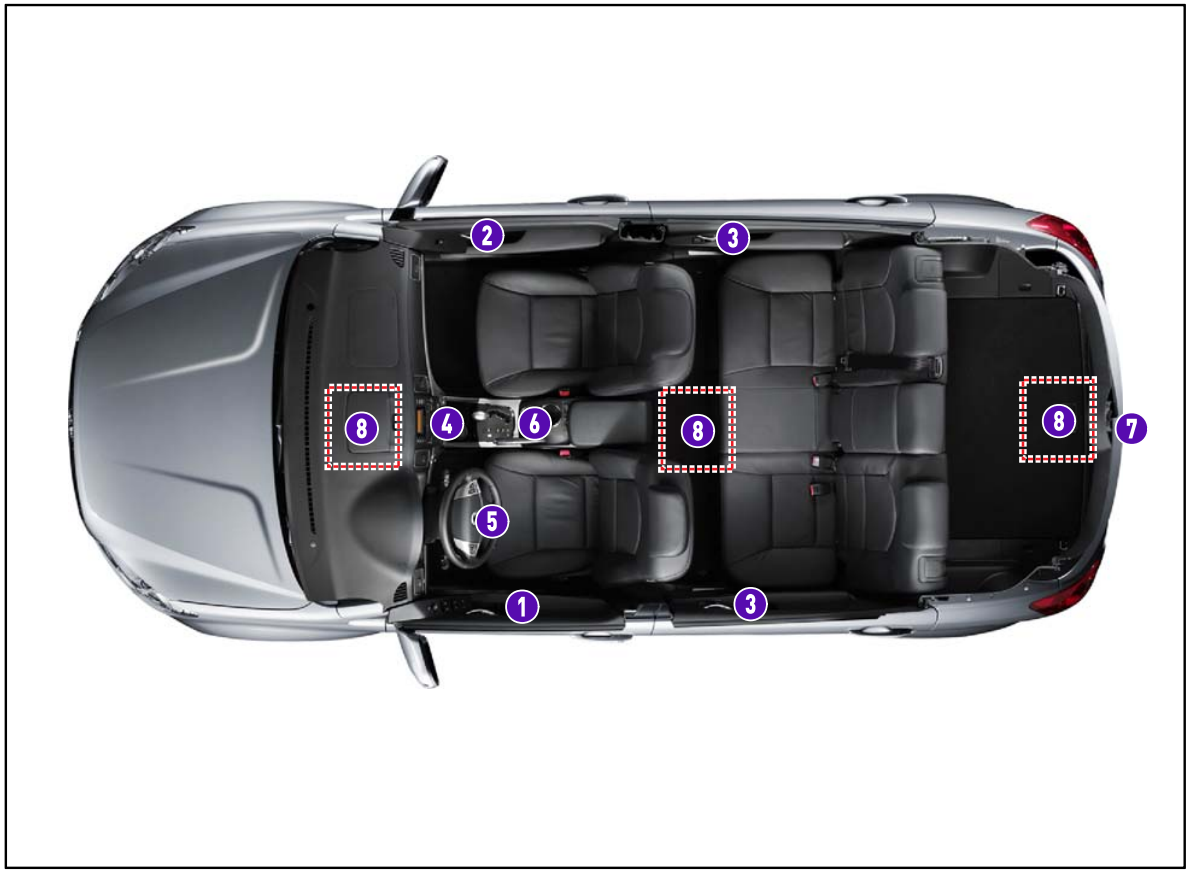
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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

This helps to enable the driver to drive the vehicle safely and comfortably by operating the switch for the driving situation.

1) Mounting Locations



1. Door panel switch (driver)
2. Door panel switch (passenger)
3. Door panel switch (rear)
4. IP panel switch
5. Steering wheel switch
6. Front console switch
7. Trunk switch
8. Headlining switch

Modification basis	
Application basis	
Affected VIN	

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Memo

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▶ Switch layout

Steering wheel remote control switch

1



Start/stop switch

2



Passenger door switch



Cruise control switch

4





Multifunction switch

5



Lower main panel switch

6



Heater and A/C control switch (auto)

7



Center fascia switch

8



Drive door main switch & outside mirror switch

9



Modification basis	
Application basis	
Affected VIN	

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Front seat heating and ventilation switch

With heating and ventilation switch	With heating switch
10 	

Overhead console switch

11 



Center room lamp switch

12 

Luggage lamp switch

13 

Tailgate switch

14 

Driver power seat switch

17 

Rear door switch and heating switch (RH)

16 

Rear door switch and heating switch (LH)

15 

Modification basis	
Application basis	
Affected VIN	

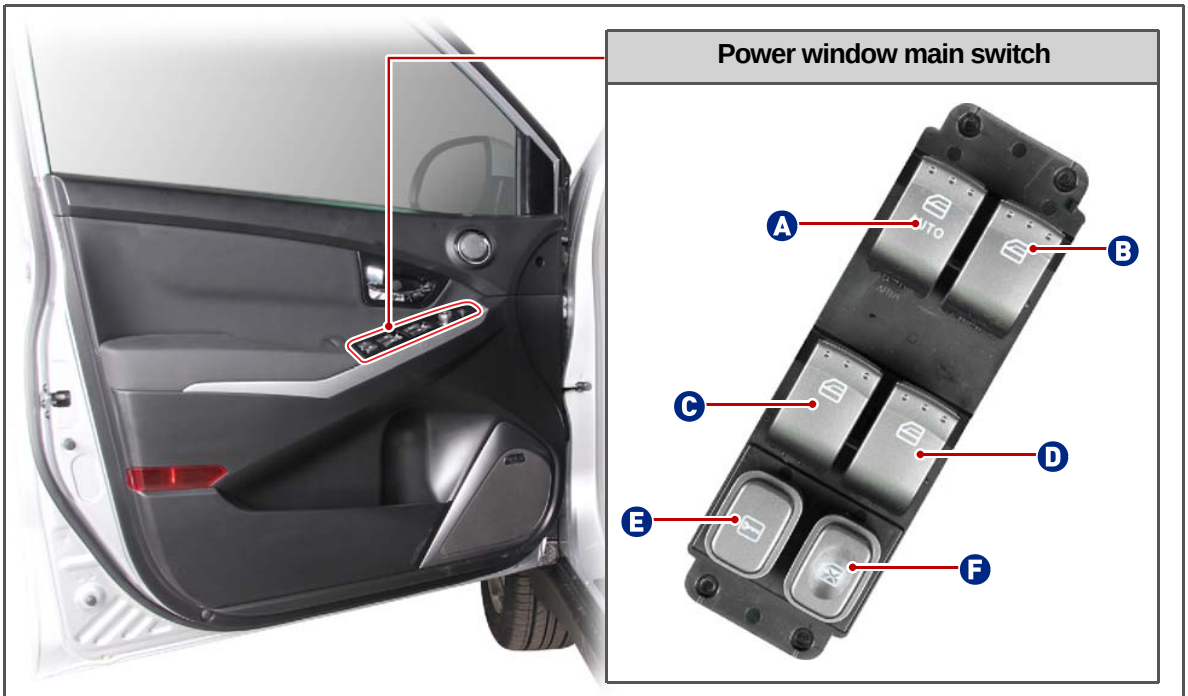
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2. SWITCH CLUSTER ON DOOR TRIM

1) Driver Door Switches

(1) Power window main switch

It is mounted to the door trim and can open or close the 4 windows. It has the switches which can lock or unlock all the doors and windows. The window main switch has the auto open and close function (only for driver), anti-trap system and driver window safety function.



A. Driver door window switch
B. Passenger door window switch
C. Rear LH window switch
D. Rear RH window switch
E. Door lock/unlock switch
F. Window lock switch

▶ **Driver window safety function**

The anti-trap system enables the driver's window to automatically reverse when something is caught in the window as it is closing. When the sensor detects an obstacle, the window will be lowered immediately. The anti-trap safety system is available only for the driver's window equipped with the automatic rolling up (Auto-up) function. The anti-trap safety system does not operate when the window is about to touch its window frame.

Modification basis	
Application basis	
Affected VIN	

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Driver door window switch

The driver's door window switch has Auto down/Auto up function. The window can be controlled within 30 seconds by activating the power window relay 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).
There are two variants of this: only auto down and anti-trap (auto down and auto up).

Rear LH window switch

The window moves upwards or downwards while this switch is operated.

Passenger door switch

The window moves upwards or downwards while this switch is operated.



Rear RH window switch

The window moves upwards or downwards while this switch is operated.

Door lock/unlock switch

When the door lock/unlock switch is pressed while all doors including the tailgate are locked, all doors will be unlocked. When the switch is pressed again, all doors will be locked.

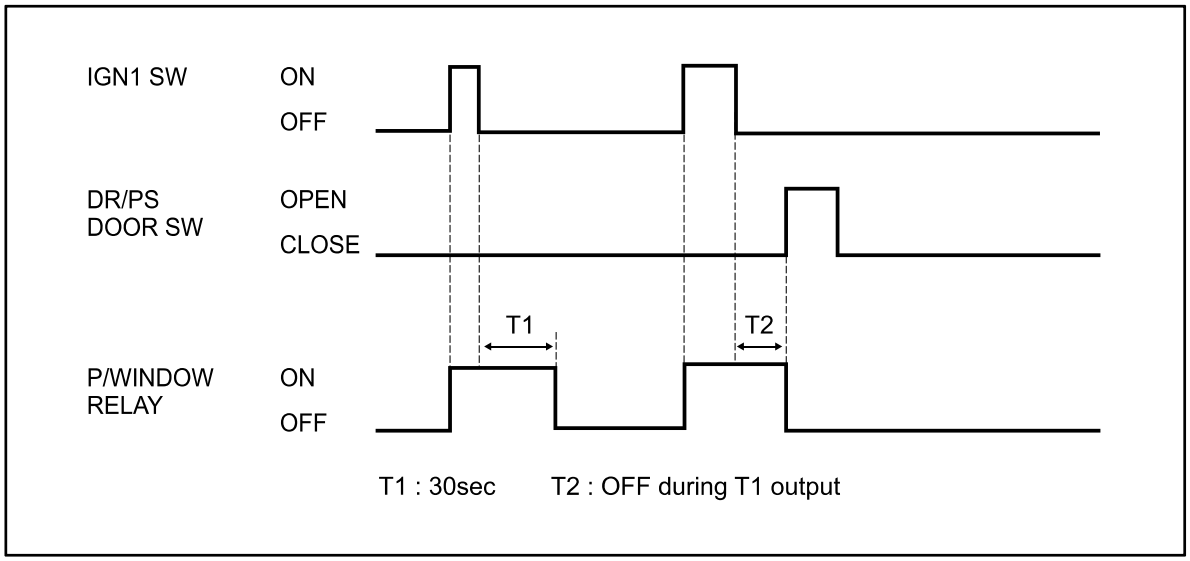
Window lock switch

If the window lock switch is pressed down, only driver window is operative. Passenger and rear windows cannot be operated by their switches.

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▶ Time lag power window control

1. When turning the ignition switch to ON position, the power window relay is turned ON.
2. The power window relay keeps ON for 30 seconds even when stopping the engine.
   However, the power window relay is turned OFF when opening a front door.
3. When locking the door (activation of theft deterrent mode), the power window relay is immediately turned OFF.



Modification basis	
Application basis	
Affected VIN	

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▶ Function of door lock/unlock switch

There are 5 actuators in door lock/unlock system (including tailgate). All of them can control the corresponding door lock and unlock separately. But, the driver door lock switch can control all door locks. The BCM controls the lock/unlock switch using the door lock/unlock relay. This is a same control type with Auto door lock function that locks the doors when the vehicle speed exceeds 30 km/h. (see circuit diagram)

Door lock/unlock switch



A Door lock/unlock switch

When the door lock/unlock switch is pressed while all doors including the tailgate are locked, all doors will be unlocked. When the switch is pressed again, all doors will be locked.

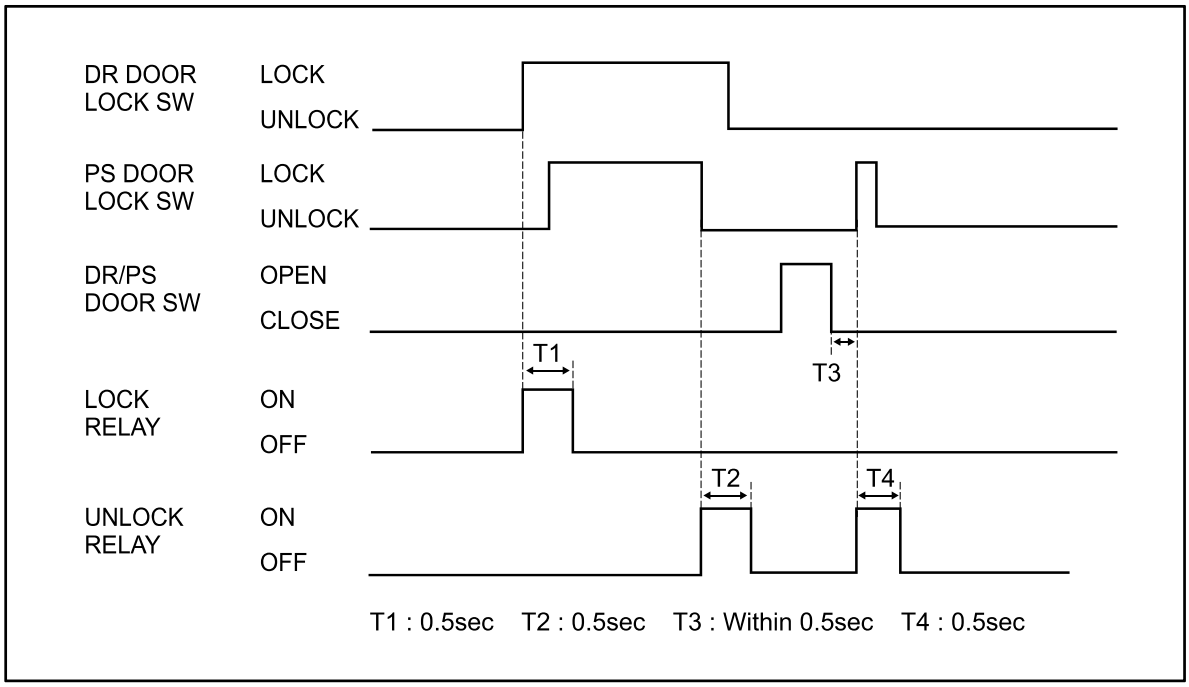
▶ Door lock/unlock relay (integrated in BCM)



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▶ Door lock/unlock control by door LOCK switch

1. When moving the driver or passenger door lock (knob) switch to LOCK from UNLOCK position, BCM sends the LOCK signal for 0.5 seconds.
2. When moving the driver or passenger door lock (knob) switch to UNLOCK from LOCK position, BCM sends the UNLOCK signal for 0.5 seconds.
3. The LOCK (UNLOCK) operation by the door lock (knob) switch is not available when sending the LOCK (UNLOCK) signal by any other method such as remote control key.
4. When reconnecting the battery, the door lock (knob) switch is not operational regardless of the door lock switch positions.
5. All doors stay unlocked when receiving the door lock signal in 0.5 seconds after closing the doors.

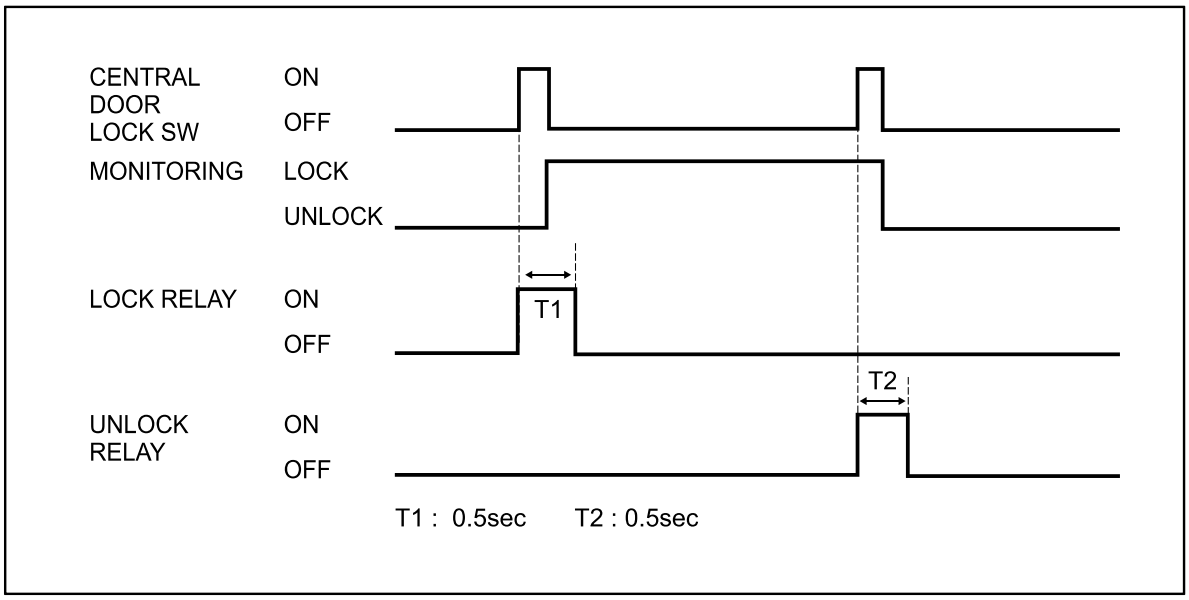


Modification basis	
Application basis	
Affected VIN	

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▶ Door lock/unlock control by central door lock switch

1. When pressing the central door lock/unlock switch, BCM sends the LOCK or UNLOCK signal according to the previous condition of driver door lock switch for 0.5 seconds.
2. The central door dock switch is not available when the system is in theft deterrent mode.
3. When turning the ignition off, all doors are automatically unlocked if any of the door lock (knob) switches is in LOCK position.
4. When pressing the central door lock switch with any door open, the system unlocks the doors immediately after locking them.



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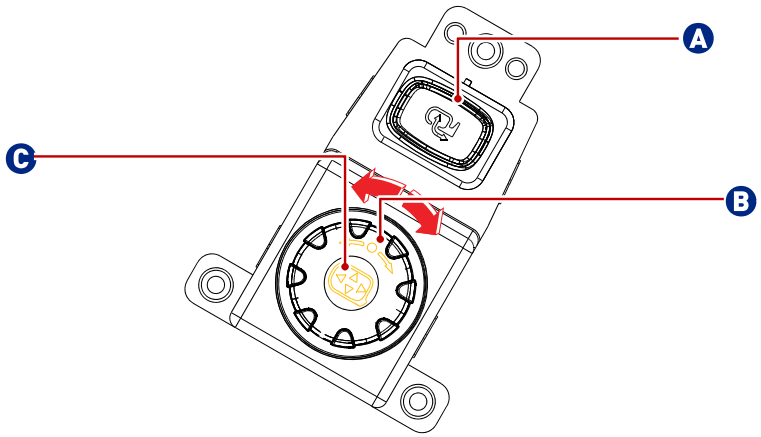
2) Outside Mirror Switch

(1) Overview

It is mounted to the door trim and can be adjusted to up, down, left or right so that the driver can obtain a clear view of the rear of the vehicle depending on the driver's physical condition. The driver can fold the outside rearview mirror when passing by the narrow road or parking the vehicle. Do not fold or unfold the outside rearview mirrors manually since the outside rearview mirror folding switch is a push-lock type switch. This may cause a malfunction of the relevant devices.



Outside rearview mirror switch



A. **Outside mirror folding/unfolding switch**
The outside mirrors are folded/unfolded whenever pressing this switch.

B. **Mirror selection switch**
LH: Driver side mirror
RH: Passenger side mirror

C. **Mirror aiming switch**
Adjust the selected mirror up, down, left, or right by pressing the corresponding edges of the switch to get a desired view.

Modification basis	
Application basis	
Affected VIN	

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▶ Folding/unfolding control

1. When you turn the folding switch to the "ON" position, the folding relay is activated for 16 seconds.
2. When you turn the folding switch to the "OFF" position, the unfolding relay is activated for 16 seconds.
3. When you turn the folding switch to the "OFF" position with the folding relay activated, the unfolding relay is activated for 0.1 second.
   - The control logic is the same for folding to unfolding operation and unfolding to folding operation.

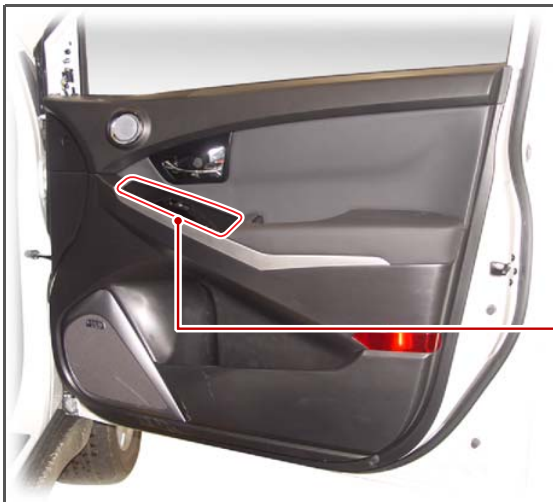
NOTE

- The AUTO folding/unfolding function is not available when the folding switch is ON.
- The AUTO folding/unfolding function is available when the folding switch is OFF.

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3) Power Window Sub Switch (Passenger)

It is mounted to the door trim and can open or close only the window at the door.



Power window sub switch (passenger)

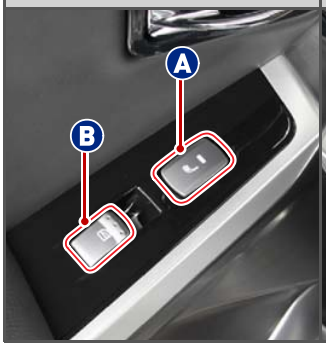


A. **Power window sub switch (passenger)**
The window is operated only when the switch is operated.

4) Rear Door Power Window Sub Switch

It is mounted to the door trim and can open or close only the window at the door.



Rear door power window sub switch (LH)	Rear door power window sub switch (RH)
	

A. **Rear seat heating switch**
When you press the switch, the heating is operated and indicator lamp comes on.
B. **Power window switch**
The window is operated only when the switch is operated.

Modification basis	
Application basis	
Affected VIN	

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3. INTEGRATED INSTRUMENT PANEL SWITCH

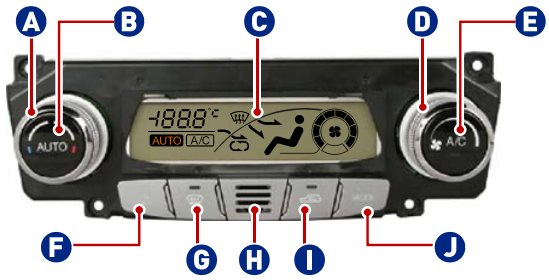
1) Overview

It is mounted to the instrument panel and combined with the cooler; which provides cooling and dehumidification by repeating the cycles of compression -> condensation -> expansion -> evaporation, and heater; which controls the heating systemically in the course of circulating the coolant heated by the engine heat to the heater. This allows the driver to maintain the indoor comfortable conditions throughout the year.



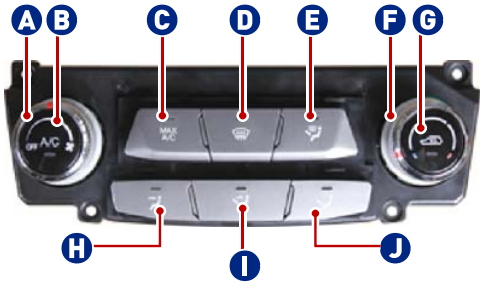
Heater and A/C control switch

Automatic



A. Temperature control dial
B. AUTO switch
C. LCD display
D. Fan speed dial
E. A/C switch
F. ON/OFF switch
G. Defroster mode switch
H. Indoor temperature sensing part
I. Air source selection switch Air distribution switch
J.

Manual



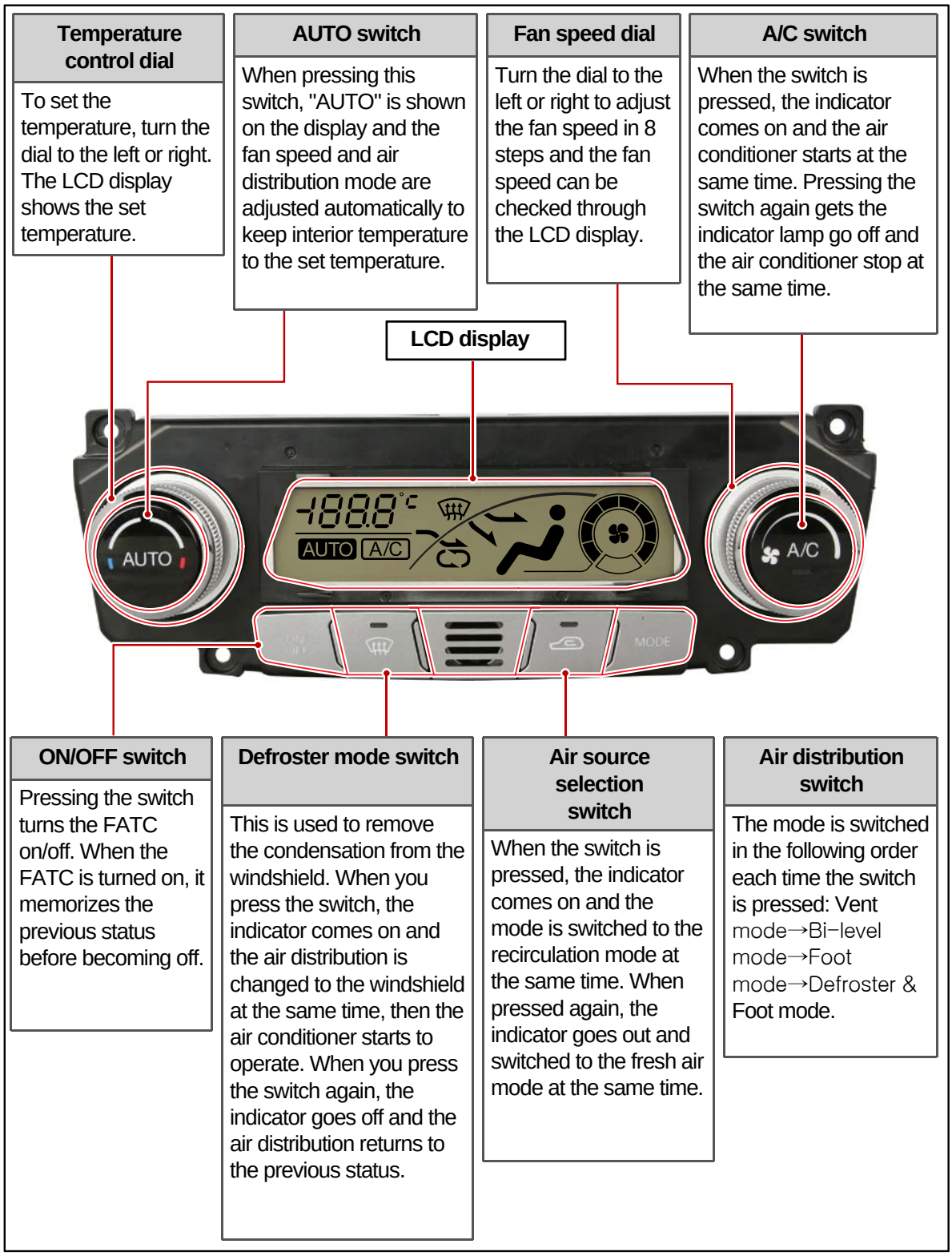
A. Fan speed dial
B. A/C switch
C. MAX A/C switch
D. Defroster mode switch
E. Defroster & foot mode switch
F. Temperature control dial
G. Air source selection switch Vent mode switch
H. Bi-level mode switch
I. Foot mode switch
J.

Modification basis	
Application basis	
Affected VIN	

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▶ Description

a. Automatic



Modification basis	
Application basis	
Affected VIN	

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b. Manual

Fan speed dial

Turn the dial to the left or right to adjust the fan speed in 7 steps. At this time, the indicator lamp comes on.

MAX A/C switch

This is designed for increasing driver comfort. When the switch is pressed, the indicator comes on and the air conditioner starts at the same time and vent and recirculation modes are selected automatically.

Defroster & foot mode switch

If the switch is pressed, the indicator comes on while the air flows to the footwell and the windshield.

A/C switch

When the switch is pressed, the indicator comes on and the air conditioner starts at the same time. Pressing the switch again gets the indicator lamp go off and the air conditioner stop at the same time.

Defroster mode switch

This is used to remove the condensation from the windshield. When you press the switch, the indicator comes on and the air distribution is changed to the windshield at the same time, then the air conditioner starts to operate.

Temperature control dial

Turn the dial to the left or right to adjust the set temperature.



Vent mode switch

If the switch is pressed, the indicator comes on while the air flows to the upper part of the body.

Bi-level mode switch

If the switch is pressed, the indicator comes on while the air flows to the footwell and the upper part of the body.

Foot mode switch

If the switch is pressed, the indicator comes on while the air flows to the footwell and the upper part of the body.

Air source selection switch

When the switch is pressed, the indicator comes on and the mode is switched to the recirculation mode at the same time. When pressed again, the indicator goes out and switched to the fresh air mode at the same time.

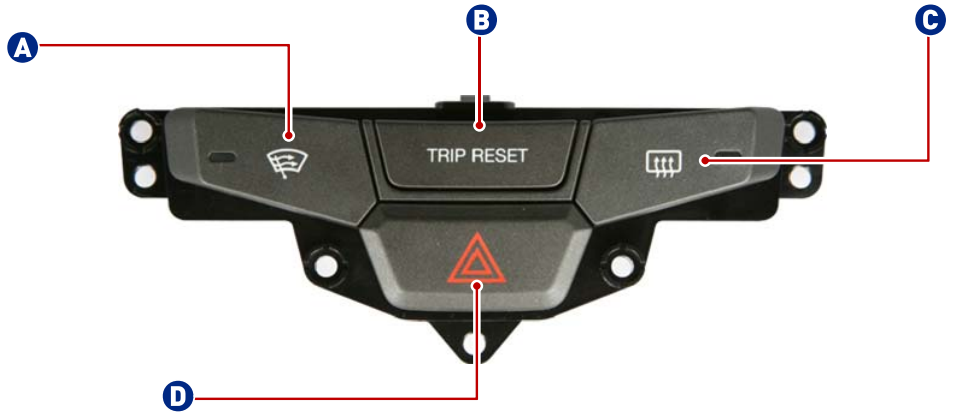
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2) Center Fascia Switch

This helps the driver to drive the vehicle comfortably by operating the switch for the driving situation. It consists of the windshield heating switch, TRIP/RESET switch, rear glass/outside rearview mirror heating switch and hazard warning flasher switch.



Center fascia switch



A. Windshield heating switch
B. TRIP/RESET switch
C. Rear glass/outside rearview mirror heating switch
D. Hazard warning flasher switch

Modification basis	
Application basis	
Affected VIN	

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▶ Description

Windshield heating switch

Press this switch to operate the windshield heating system for 12 minutes. Press the switch again to stop the system. 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. The indicator lamp for the switch comes on when the heating is on.

NOTE

The switch is operable only when the engine is started.

TRIP/RESET switch

Whenever pressing this button, the information is displayed in the following order: Odometer, Trip A, Trip B, Distance to empty, Average fuel economy, Instant fuel economy, Illumination level, Tire pressure (with TPMS), Ambient air temperature (for STD); Trip A, Trip B, Distance to empty, Average fuel economy/Instant fuel economy, Illumination level, Tire pressure (with TPMS), Ambient air temperature (for SVC). Press and hold this button to initialize (reset) Trip A/Trip B and average fuel consumption, adjust illumination level or change the unit of temperature.



Hazard warning flasher switch

When the driver presses the switch, all the turn signal lamps flash regardless of the ignition switch status. Pressing the switch again turns off the turn signal lamps. The turn signal lamp does not operate while the hazard warning flasher operates.

NOTE

The hazard warning flasher blinks during emergency hazard warning lamp control and air bag deployment signal activation.

Rear glass/outside rearview mirror heating switch

Press this switch to operate the rear glass and outside rearview mirror heating system for 12 minutes. Press the switch again to stop the system. 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. The indicator lamp for the switch comes on when the heating is on.

NOTE

The switch is operable only when the engine is started.

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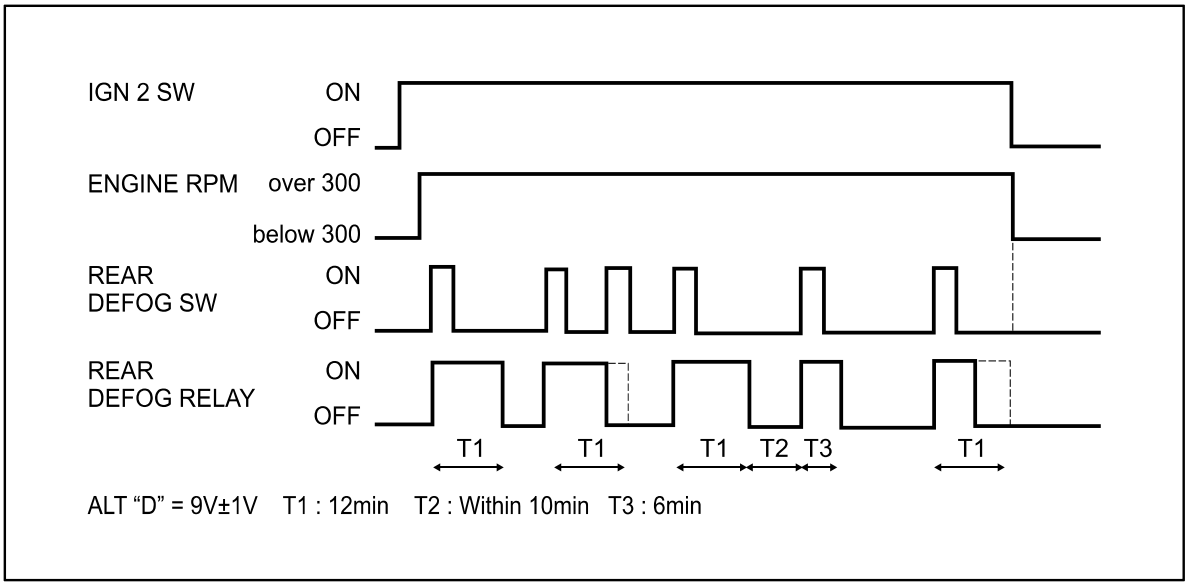
(1) Rear glass/outside mirror heating switch

▶ Overview

The rear glass/outside mirror heating is operated by BCM.
The heating operates for about 12 minutes when the switch is pressed with the engine started.
Press the switch again to stop the operation.
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.
This function is available only when the engine is running.



▶ Operation curve



Modification basis	
Application basis	
Affected VIN	

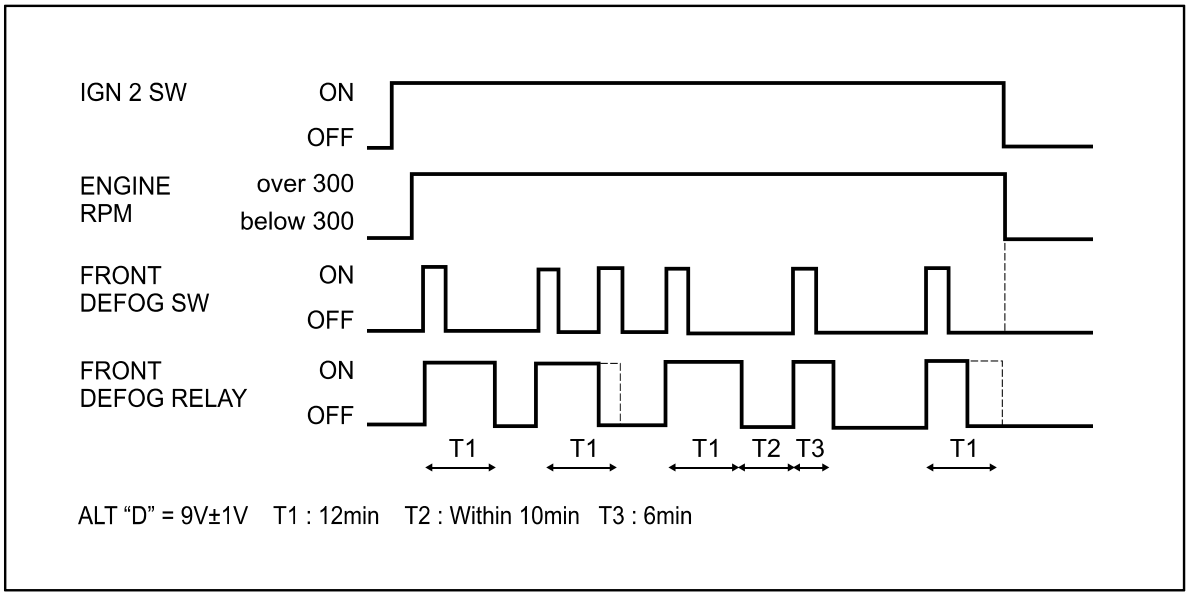
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(2) Windshield heating switch

The windshield glass/outside mirror heating is operated by BCM.
The heating operates for about 12 minutes when the switch is pressed with the engine started.
Press the switch again to stop the operation.
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.
This function is available only when the engine is running.



▶ Operation curve



ALT “D” = 9V±1V T1 : 12min T2 : Within 10min T3 : 6min

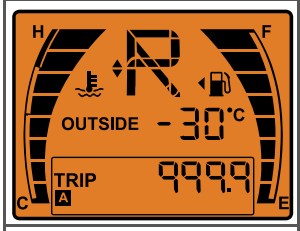
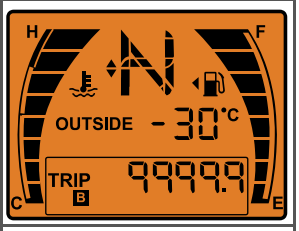
Modification basis	
Application basis	
Affected VIN	

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(3) Trip switch

Whenever pressing this button, the information is displayed in the following order: Odometer, Trip A, Trip B, Distance to empty, Average fuel consumption, Instant fuel consumption, Illumination level, Ambient air temperature (for STD); Trip A, Trip B, Distance to empty, Average fuel consumption, Instant fuel consumption, Illumination level, Ambient air temperature (for SVC). Press and hold (for more than 1 sec) this button to initialize (reset) Trip A/Trip B and average fuel consumption, adjust illumination level or change the unit of temperature.

Display

STD class instrument cluster		SVC class instrument cluster	
			
TRIP A	**TRIP B**	**TRIP A**	**TRIP B**

▶ **Description**



Mode Switch	Detecting time	Function	
Briefly and hold	Below 1 second (60 to 980 ms)	STD	- Mode change (Odo→Trip A→Trip B→DTE →Average fuel consumption→Instant fuel consumption →Illumination level→Ambient air temperature)
		SVC	- Mode change (Trip A→Trip B→DTE→Average fuel consumption →Instant fuel consumption→Illumination level →Ambient air temperature)
Press and hold	Over 1 seconds	- Reset (Trip A, B, average fuel consumption) - Change (Illumination level (6 to 1), temperature unit (℃↔°F))	
Not press	Over 3 seconds	- Mode change (Illumination level→Ambient air temperature→Odo)	

※ The factory setting is DTE mode.

Modification basis	
Application basis	
Affected VIN	

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(4) Hazard warning flasher switch

▶ Operation process

When the driver presses the switch, all the turn signal lamps flash regardless of the ignition switch status. Pressing the switch again turns off the turn signal lamps. The turn signal lamp does not operate while the hazard warning flasher operates.

NOTE

The hazard warning flasher blinks during emergency hazard warning lamp control and air bag deployment signal activation.



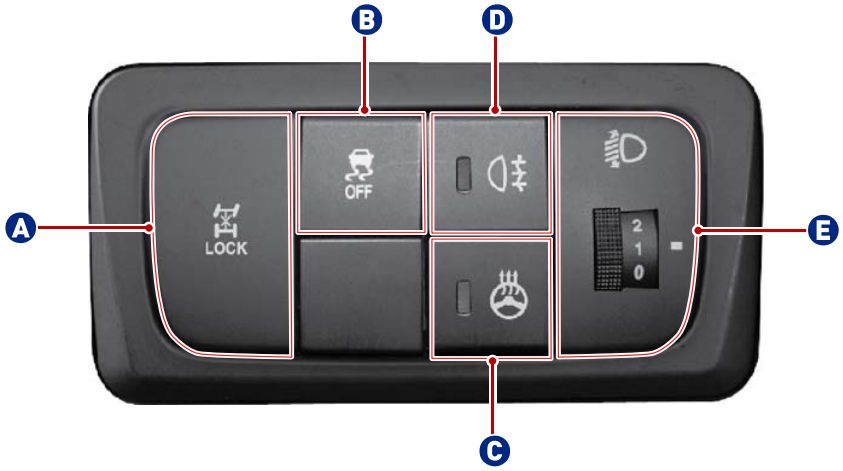
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3) Lower Main Panel Switch

This helps the driver to drive the vehicle comfortably by operating the switch for the driving situation.



Lower main panel switch



A 4WD LOCK switch	**D Rear fog lamp switch (EU ONLY)**
B ESP OFF switch	**E HLLD (Headlamp Leveling Device)**
C Steering wheel heating switch	

Modification basis	
Application basis	
Affected VIN	

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4WD LOCK switch

This switch is of push lock type, which enables to increase/decrease the torque to the rear wheels in AWD mode.

Rear fog lamp switch (EU ONLY)

This switch is of push return type, which sends ON/OFF signal to the BCM so that the BCM can switch on the lamps by activating the rear fog lamp relay.



ESP OFF switch

The ESP OFF switch is of push return type, which is used to stop or resume the ESP function.

HLLD (Headlamp Leveling Device)

The headlamp aiming can be adjusted by using this dial-type switch.

Steering wheel heating switch

This switch is of push return type, which is used to activate or deactivate the steering wheel heating function.

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(1) 4WD LOCK switch

▶ How to operate 4WD LOCK switch

When the switch is pressed, 4WD LOCK mode is activated (4WD LOCK indicator lamp comes on). If you press the switch again, the system enters 4WD AUTO mode (indicator lamp goes off).



▶ 4WD AUTO mode (normal)

This provides a slip control for the rear wheels depending on the driving conditions such as stationary, straight-line motion or cornering motion.

▶ 4WD LOCK mode (4WD LOCK switch pressed)

- In 4WD LOCK mode, the 4WD LOCK control works in the same way as the AUTO mode, but it increases the driving force to the rear wheels more than in AUTO mode.
- If the rear wheel speed is over 40 km/h, the vehicle enters into the 4WD AUTO mode automatically. If it is below 35 km/h, the vehicle returns to the 4WD LOCK mode.

▶ 4WD mode operation table

4WD LOCK switch	Vehicle speed	Drive mode
Deactivated (4WD AUTO)	Unlimited	4WD AUTO
Activated (4WD LOCK)	40 km/h or higher	4WD AUTO
Activated (4WD LOCK)	Below 35 km/h	4WD LOCK

NOTE

4WD: 4WD stands for Four Wheel Drive and drives all the wheels to maximize the vehicle's driving force on the unpaved road, rough road, steep hills, sandy or muddy road for enhanced driving performance.
Electric AWD (All Wheel Drive): 4-wheel drive is an electric drive system in which the vehicle is usually driving in 2WD mode but, if the vehicle determines that 4WD is needed because of the differences in slip and cornering between front and rear wheels, road gradient and etc., it is switched to 4WD automatically by the E-coupling control unit.

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(2) ESP OFF switch

▶ Overview

The ESP OFF switch is located to the driver's lower panel. When the driver press the ESP OFF switch, the ESP OFF indicator lamp comes on in the instrument cluster and the ESP becomes disabled. However, the ABS still works as it should.



▶ ESP ON/OFF switch (only for vehicle with ESP)

- The ESP function turns ON and OFF each time the driver presses the ESP ON/OFF switch. This switch is a constant-open type instant contact switch and grounded to IGN1. The default setting is ESP ON and it is turned on and off each time the switch is pressed.
- If the driving wheels are slipping on snowy or icy roads, the engine rpm may not increase even when you depress the accelerator pedal, and accordingly, you may not be able to move your vehicle. In this case, stop the ESP function by pressing the ESP OFF switch. When the ESP OFF switch is pressed, the ESP function stops and the vehicle is driven independently from the sensor outputs.

▶ ESP OFF indicator lamp module (only for vehicle with ESP)

▷ CAN Cluster Type

The ESP OFF lamp shows how the ESP function works.

The ESP OFF lamp comes on when:

- ESP function is deactivated by switch input

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▶ ESP warning lamp module

The ESP warning lamp shows self-diagnosis result of ESP function and whether there is a fault. The ESP warning lamp comes on when:

- Initialization mode after IGN ON, ESP disabled due to failure, during ESP operation (blink), under diagnostic mode, indicator lamp ON in instrument cluster, impossible to communicate with CAN module.

Mode	Warning Lamp			
	 EBD warning lamp	 ABS warning lamp	 ESP OFF Lamp	 ESP warning lamp
EBD Error	ON	ON	OFF	ON
ABS Error	OFF	ON	OFF	ON
ESP Error	OFF	OFF	OFF	ON

Modification basis	
Application basis	
Affected VIN	

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(3) Operation process

▶ Steering wheel heating switch

The steering wheel heating switch is mounted to the lower main panel. In that, signal voltage from the steering wheel heating controller, which is installed in the steering wheel, is grounded. This is used as an operation signal for the steering wheel heating system. The indicator in the switch comes on when it is operated.



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4) Power Seat Switch Assembly

(1) Power seat switch (Driver side)



Power seat switch

A. Seat sliding B. Seatback reclining C. Seat height adjustment

Seat sliding	Seatback reclining	Seat height adjustment
		

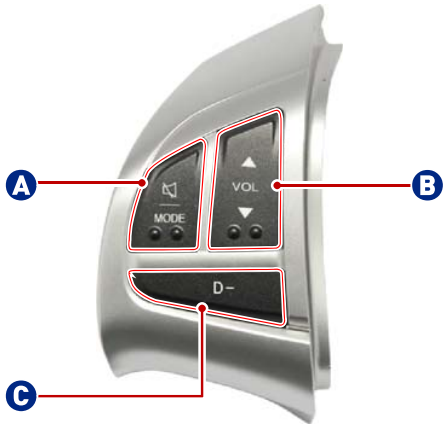
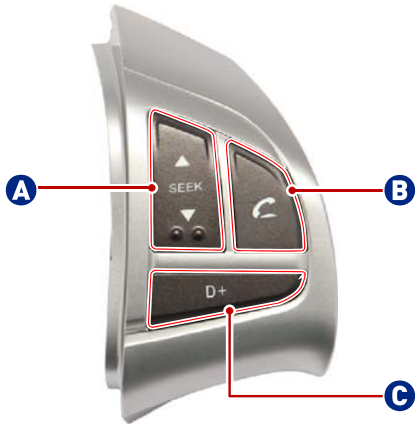
Modification basis	
Application basis	
Affected VIN	

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4. STEERING WHEEL SWITCH

1) Audio Remote Control Switch



Audio remote control switch (LH)	Audio remote control switch (RH)
	
A MUTE & MODE switch B Volume UP/DOWN switch C Tip switch (D-)	A SEEK UP/DOWN switch B Handsfree switch C Tip switch (D+)

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MUTE & MODE switch

To eliminate the sound (MUTE), briefly press this switch. To change the audio mode (Radio-CD-USB-AUX-Radio), press and hold this switch.

SEEK UP/DOWN switch

- CD mode
  Select next/previous track and FF/REW
- Radio mode
  Change frequency UP or DOWN
  Press and hold to auto search



Volume UP/DOWN switch

Increases/decreases volume

Handsfree switch

To make/receive/end a call, press and hold this switch.

Tip switch (D-)

Gear change switch
-Change down

Tip switch (D-)

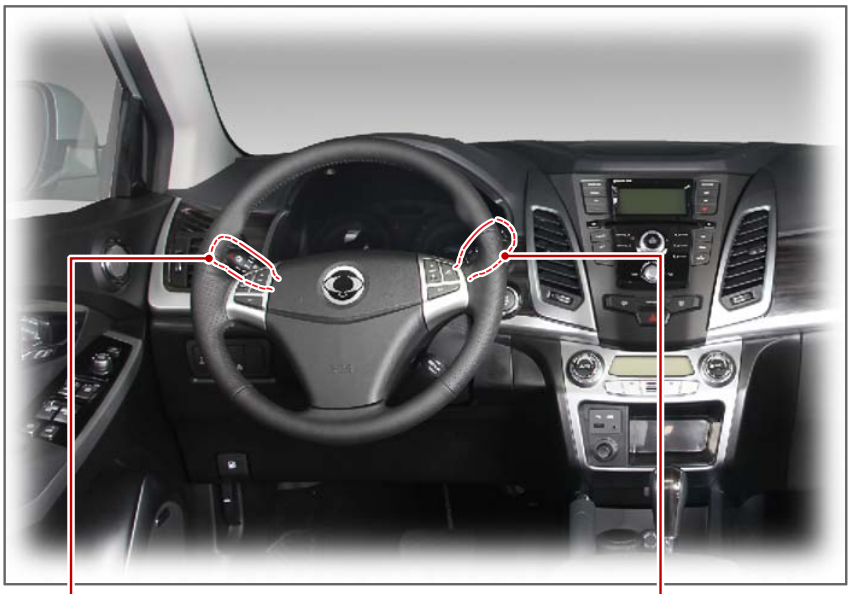
Gear change switch
-Change up

Modification basis	
Application basis	
Affected VIN	

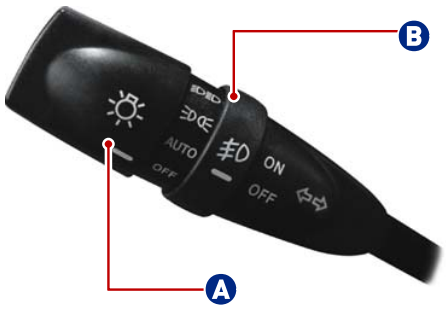
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2) Multifunction Switch

The multifunction switch contains the auto washer and wiper switch, front fog lamp switch and auto hazard warning flasher switch. For the vehicle with air bag, since the contact coil is fitted to the upper part of the multifunction switch and ESP steering wheel angle sensor is fitted to upper part of the contact coil, pay attention to when removing and fitting or checking the wiring.



Multifunction light switches



- **A** Light switch
- **B** Front fog lamp switch

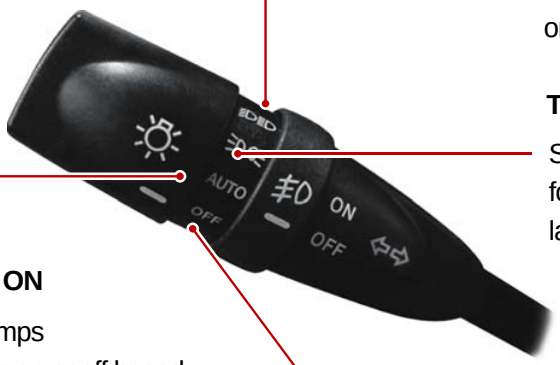
Multifunction wiper switches



- **A** Front wiper switch
- **B** Wiper speed dial
- **C** Rear wiper switch
- **D** Front auto washer switch

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▶ Light switch



Headlamps ON

Headlamp, side-marker, tail, license plate, fog, and instrument cluster lamps come on.

Tail lamp ON

Side-marker, tail, license plate, fog, and instrument cluster lamps come on.

Automatic light ON

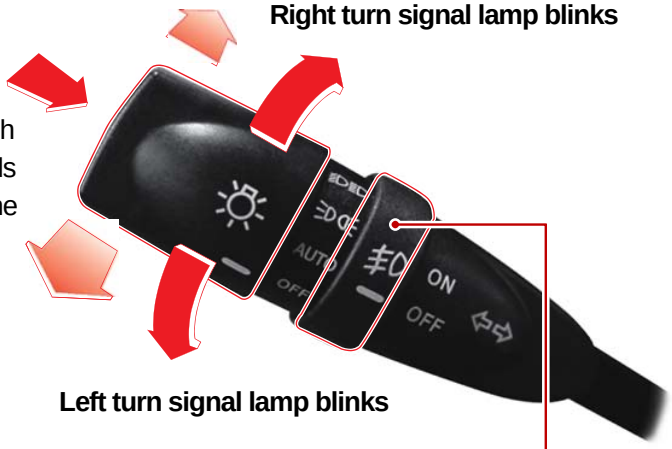
Head- and tail lamps automatically turn on or off based upon the intensity of the sunlight analyzed by the automatic light sensor.

Lights OFF

Right turn signal lamp blinks

High beam ON

To turn on the headlamp high beam, push the lever towards the instrument cluster with the headlamp low beam on.



Left turn signal lamp blinks

Passing

Regardless of the position of the light switch, when holding the lever toward the steering wheel, the headlights are on high beam during the hold.

Front fog lamp switch

To turn on the fog lights, turn this switch while the tail lamps or headlamps are turned on.

Modification basis	
Application basis	
Affected VIN	

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▶ Wiper switch

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 once more and the wiper operates 3 times.

MIST

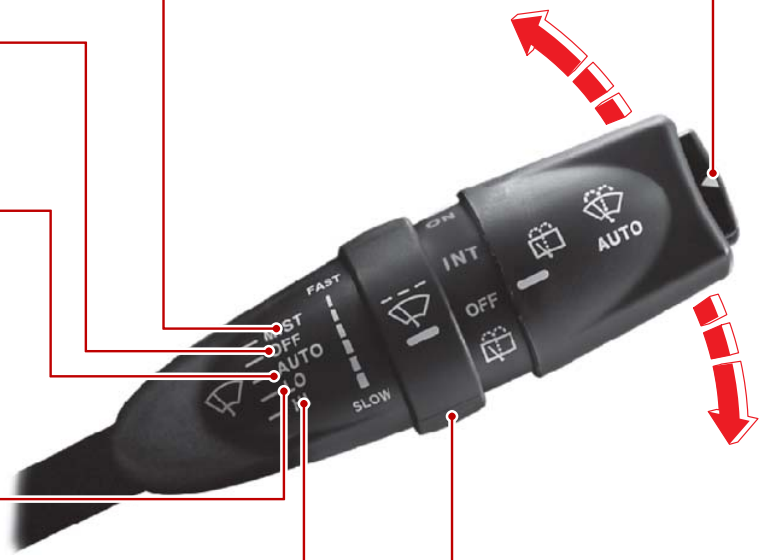
If you move the wiper switch to “MIST” position and release it, the windshield wipers operate one wiping cycle. The wipers will operate continuously if the switch is held in this position.

OFF

Wipers are not in operation.

AUTO

Operates automatically according to the vehicle speed and amount of rainfall.



LO

Continuous wipe, slow operation

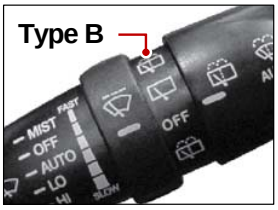
HI

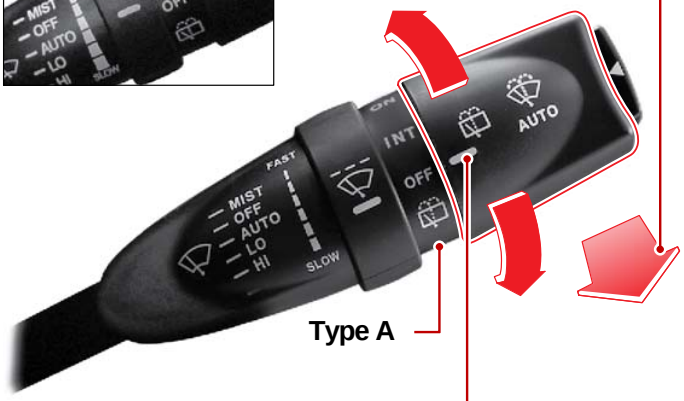
Continuous wipe, fast operation

Front automatic wiping speed control switch

The interval of wiping speed can be adjusted by turning the control knob upward or downward when the windshield wiper switch is in AUTO position.
Fast: Fast interval
Slow: Slow interval

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Windshield Washer Operation

In the "OFF" position, pull the lever toward you to spray washer fluid on the windshield and to operate the wipers 1~3 cycles.

Pull the lever briefly (for less than 0.6 seconds): One wiping cycle with washer spray

Pull and hold the lever for more than 0.6 seconds: Three wiping cycles with washer spray

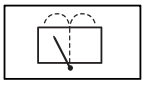
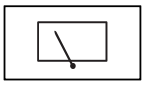
The spray and wiper operation will continue until you release the lever.

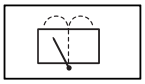
Rear wiper switch

TYPE A

ON	Rear wiper operation (Normal Speed)
INT	Rear wiper operation (Intermittent)

TYPE B

	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 Rear Wiper Operation mode and only the wiper will keep operating.
	Rear wiper operation

OFF	Rear wiper is not in operation.
	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.

Modification basis	
Application basis	
Affected VIN	

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3) Cruise Control Switch

The cruise control is an automatic speed control system that maintains a desired driving speed without using the accelerator pedal. The cruise control switch is fitted to the bottom right section of the steering wheel. When this switch is operated, the AUTO CRUISE or ECO lamp on the instrument cluster comes on.

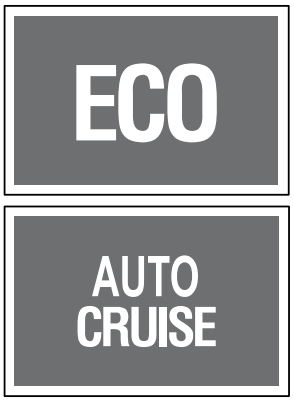
The cruise control switch has a fivefold switch in it. The engine ECU can determine the current driving condition since the resistance varies depending on the operation of the switch.

The cruise control system is operated at vehicle speed of between 38 km/h and 150 km/h. The manual transmission is operated in the range of 3rd gear or higher.

This function can be used at the following traffic condition. (It is important to be careful for using this function)



Cruise control switch





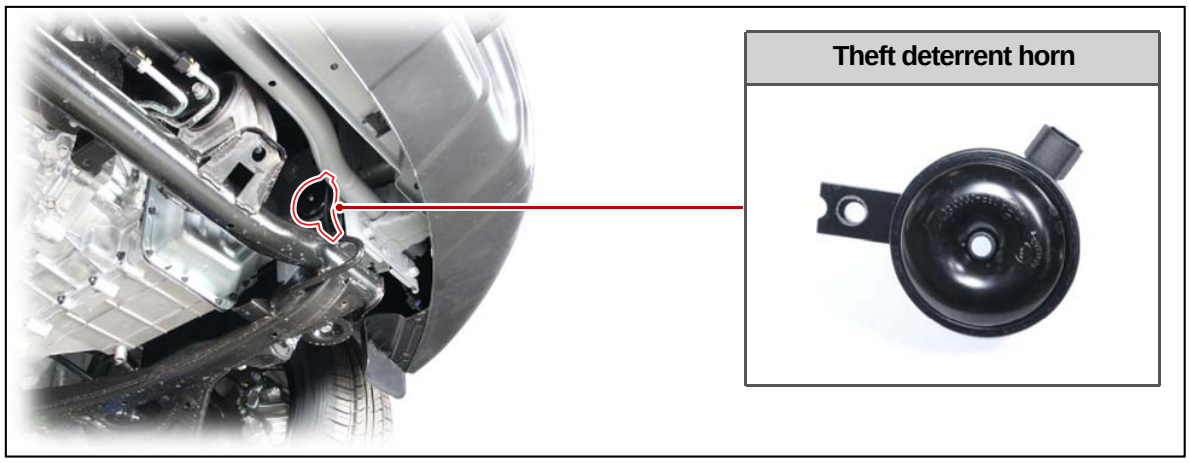
- A Cruise control (ON)
- B Cruise control (OFF)
- C Cruise control (Acceleration)
- D Cruise control (Deceleration)
- E Cruise control (Reset)

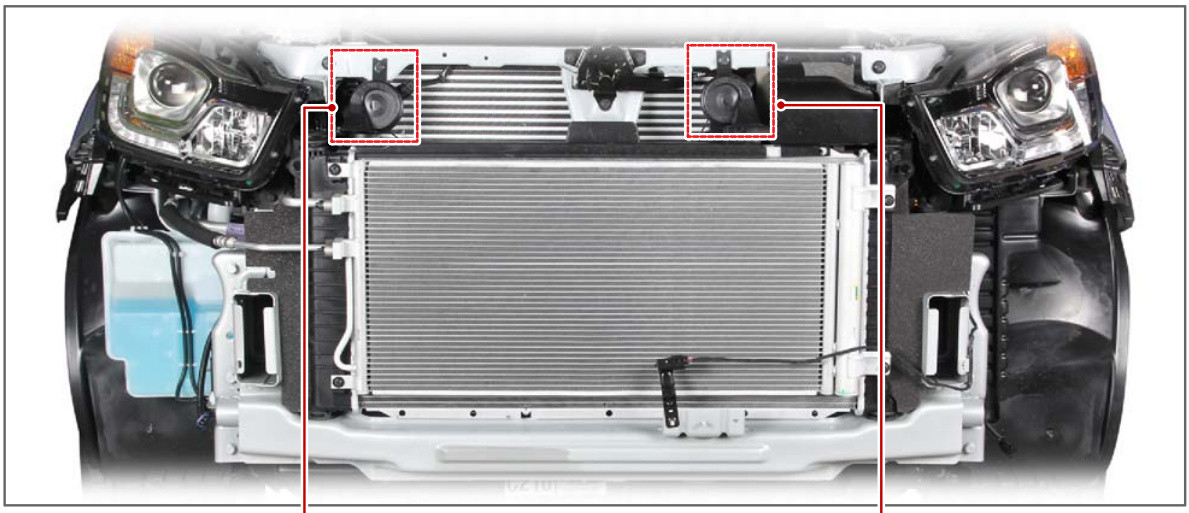
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4) Horn Switch

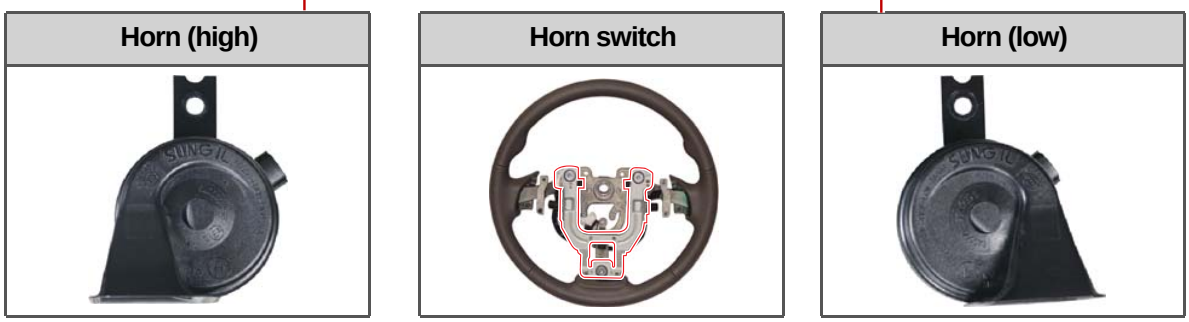
Two horns are installed in the radiator grille at the bottom of both sides (one on each side). There is another horn installed at the bottom of the battery tray side in the engine compartment for theft alarm. Operating the horn switch on the steering wheel applies the power to the horn relay to operate both horns (Dual horn). The theft deterrent horn is controlled by the BCM in armed mode regardless of the horn relay operation.

▶ **Theft deterrent horn**





▶ **Horn (dual horn)**



Modification basis	
Application basis	
Affected VIN	

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5. SEAT HEATING AND VENTILATION SWITCH

- Front seat heating & ventilation switch (2-level of driver seat heating and ventilation, 2-level of passenger seat heating)
- Front seat & rear seat heating (Driver and passenger seats: LO↔HI, rear seats: ON↔OFF)

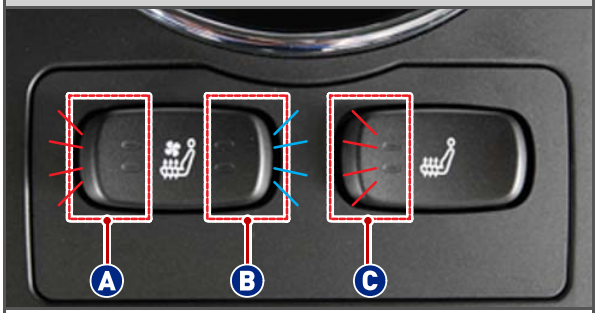
▶ **Seat heating and ventilation unit & switch application**

●: New, ○: Already used, -: N/A

Item	Heating and ventilation specification	Heating specification
Heating and ventilation unit	●	-
Heating and ventilation switch	●	-
Heating switch	-	○
How to operate	Driver: heating and ventilation (two-step) Passenger: heating (two-step)	Driver: heating (LO↔HI) Passenger: heating (LO↔HI)

1) Front Seat Heating and Ventilation Switch Overview (2-level of Driver Seat Heating and Ventilation, 2-level of Passenger Seat Heating)

Front seat heating and ventilation switch (2-level of driver seat heating and ventilation, 2-level of passenger seat heating)



A. Driver seat heating switch
B. Driver seat ventilation switch
C. Passenger seat heating switch

The temperature of the seat can be adjusted in 3 levels (Level 2 → Level 1 → OFF) with the seat heated wire and ventilation switch. Every time the seat heating and ventilation switch is pressed, the temperature level goes down by one level. Pressing the switch a third time will turn off the operation. Pressing the desired side of the switch heats the seat cushion and seatback or activates the seat ventilation function. The temperature of the seat is kept uniform by cutting off or connecting power through thermistor fitted in the seat. The seat heating and ventilation unit controls the rpm of the motor using PWM control to operate the seat ventilation.

NOTE

- The front seat heating and ventilation functions cannot be operated at the same time.
- The front seat heating and ventilation switch functions only when the engine is started.

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2) Front Seat & Rear Seat Heating Switch Overview
(Driver and Passenger Seats: LO↔HI, Rear Seats: ON↔OFF)

Front seat heating switch
(Driver: LO↔HI, Passenger: LO↔HI)



A. Driver seat heating switch
B. Passenger seat heating switch

The front seat heating switch can be operated to the desired temperature (LO/HI) by pressing the front seat heating switch. Press the "HI (High temperature)" or "LO (Low temperature)" on the seat heating switch to heat the seat and seatback. When the temperature reaches 40 ±5℃, the thermistor integrated in seat connects and cuts the power to keep the temperature stable. There is no separate seat warmer unit to control the temperature of the seat heating system.

Rear seat heating switch



A. Rear LH seat heating switch



A. Rear RH seat heating switch

NOTE
- The front seat and rear seat heating switches operates with IGN ON.
- The seat heating and ventilation unit is not fitted in a vehicle without seat ventilation function.

Modification basis	
Application basis	
Affected VIN	

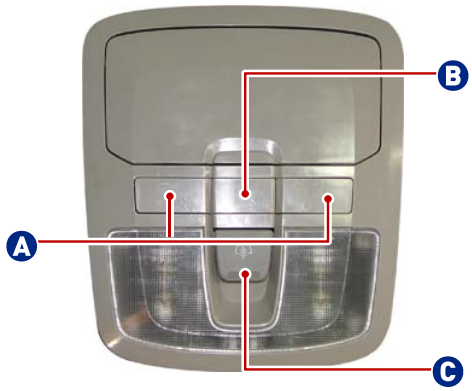
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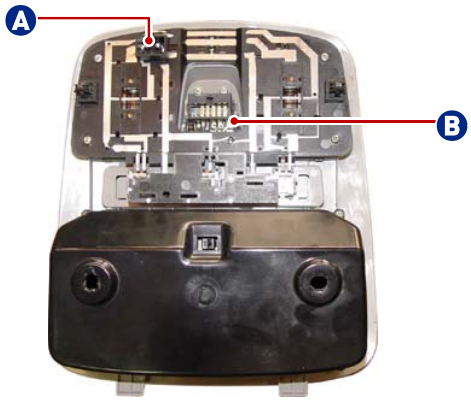
6. OVERHEAD CONSOLE SWITCH

- The front room lamp is controlled by the BCM.
- The front room lamp comes on when opening the driver or passenger door. (door coupled operation switch ON)
- When closing the driver or passenger door, the front room lamp comes on for 2 seconds and then dims down for 3 seconds. (door coupled operation switch ON)
- The front room lamp turns on/off depending on the operation of the front room lamp ON/OFF switch (spot switch).



Overhead console switch



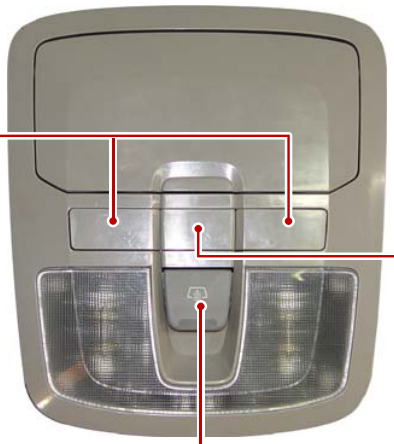


A Front room lamp switch B Door coupled operation switch C Sunroof switch	A Front room lamp connector B Sunroof connector

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Front room lamp switch
The driver/passenger room lamps turns on when pressing in these switches.

Door coupled operation switch
The front room lamp and center room lamp come on when opening a door with this switch pressed in.



Sunroof switch

▶ **Push up the switch briefly: 2-step auto sliding open**

When pushing up the switch briefly, the sunroof is automatically opened. Opening is carried out in 2 steps. In first step, the area 5 cm behind the sunroof is not opened. Push up the switch once again in order to open the sunroof completely. The sunroof operation stops if you operate the switch during its operation.

▶ **Push up and hold the switch: manual sliding open**

The sunroof is opened as long as pushing up the switch.

▶ **Pull down the switch briefly: auto sliding close**

When pulling down the switch briefly, the sunroof is automatically closed. To stop the closing sunroof, operate the switch to either direction.

▶ **Pull down and hold the switch: manual sliding close**

The sunroof is closed as long as pulling down the switch.

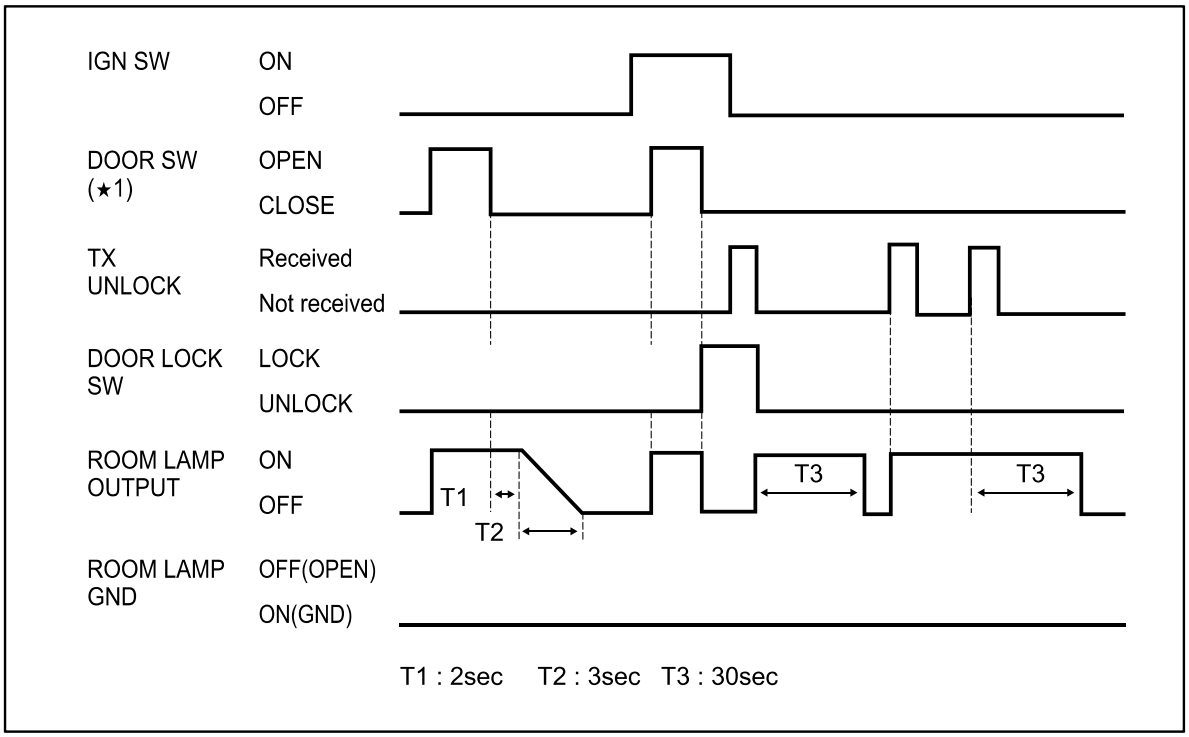
Modification basis	
Application basis	
Affected VIN	

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▶ Door coupled room lamp operation and dimming control

When opening any of doors while the room lamp switch in overhead console is pressed in ("Door" coupled position), the front and center room lamps come on. If the key is removed and door stays open, the room lamps automatically goes off after 10 minutes. The sleep mode will be deactivated when the door is locked or closed with the lamp OFF automatically.

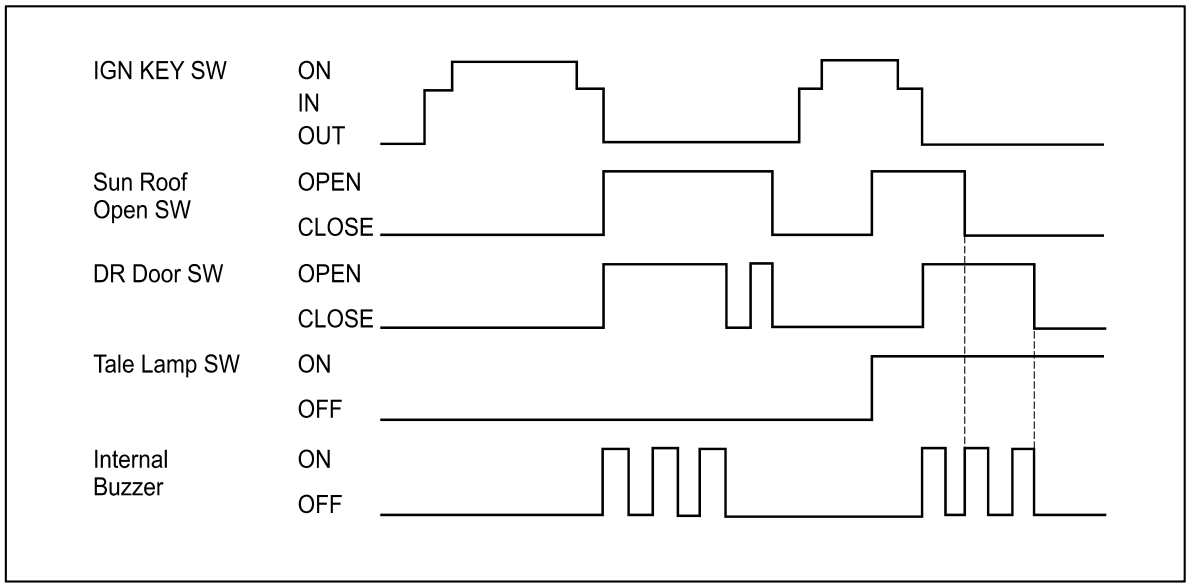
1. When closing the door with IGN ON, the room lamps go off immediately.
2. When closing the door with IGN OFF, the room lamps stay on for 2 seconds more and are dimmed out the side fascia panel.
3. When turning the ignition switch to ON position during dimming out operation, the room lamps go off immediately.
4. When receiving the door unlock signal with IGN OFF, key removed and door closed, the overhead console room lamp/center room lamp come on for 30 seconds.
   For specification with the SKM, the lamps come on by the REKES unlock or passive unlock signal.
5. When receiving the door unlock signal again while the lamps stay on by the REKES or passive unlock signal, the overhead console/center room lamps stays on for 30 seconds more. (the lamps stay on when receiving door unlock signal)
6. When opening a door during the coupled operation and dimming operation, the room lamps stays ON. When closing it again, the lamps stay on for 2 seconds more and are dimmed out for 3 seconds. While the room lamps dim out when the driver/passenger/rear doors are open and closed, they go off
7. immediately when entering into the theft deterrent mode.
   The room lamps come on when AUTO approach signal is received.
8.



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▶ Sunroof warning control

1. When removing the ignition key with the sunroof open (without SKM) or when opening the driver door with IGN OFF or ACC and sunroof open (with SKM), the indoor buzzer sounds for 10 seconds with the interval of 0.02s ON/1.58s OFF.
2. When opening and closing the driver door or closing the sunroof during indoor buzzer operation, the buzzer stops its operation immediately.
3. When closing the driver door or sunroof and opening again during warning operation, the sunroof warning does not work. If the condition is met after the ignition switch is turned to "ON" position again, the indoor buzzer sounds for 10 seconds with the interval of 0.02s ON/1.58s OFF.
   The sunroof warning has a priority over the tail lamp ON warning.
4.



Modification basis	
Application basis	
Affected VIN	

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7. TAILGATE SWITCH



Tailgate open switch

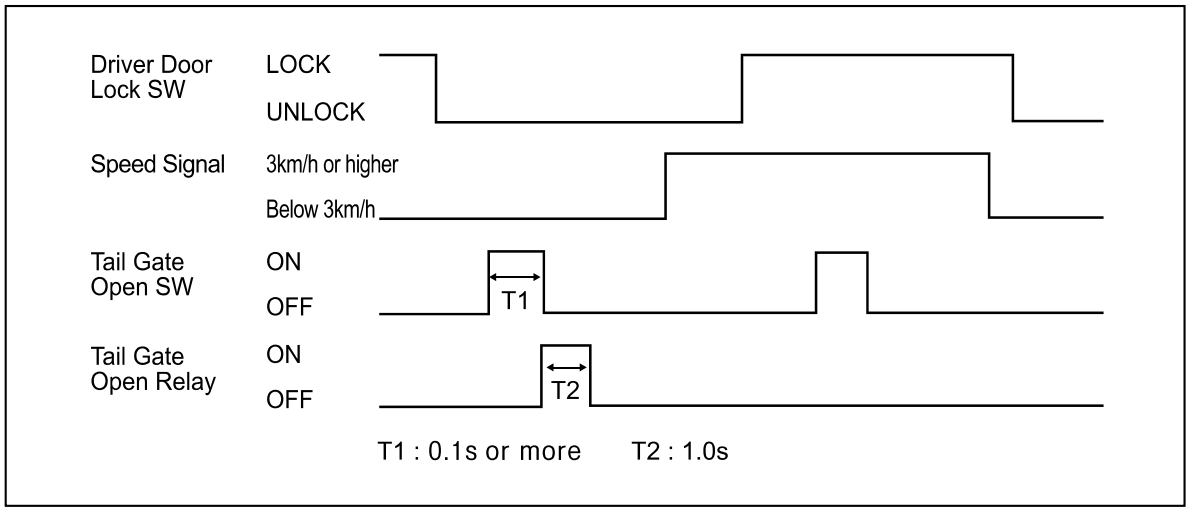


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▶ **Tailgate open**

Without SKM

1. When pressing the tailgate switch for more than 0.1 second with driver door unlocked and vehicle speed below 3 (±0.1) km/h, the tailgate open relay is turned ON for about 1 second, with power OFF, ACC ON or IGN ON. However, it is turned ON when the vehicle speed is below 3 (±0.1) km/h, with IGN ON.
2. The tailgate open relay is turned OFF immediately after the driver door is locked or the vehicle speed goes over 3 km/h with IGN ON during its operation. However, the BCM does not operate if the tailgate open switch is pressed when the vehicle speed is above 3 km/h.



- Tailgate open: REKES unlock (disarmed deterrent mode) → Tailgate open signal → Tailgate open

With SKM

1. When pressing the tailgate switch for more than 0.1 second with driver door unlocked and vehicle speed below 3 (±0.1) km/h, the tailgate open relay is turned ON for about 1 second.
2. The tailgate open relay is turned OFF immediately after the driver door is locked or the vehicle speed goes over 3 km/h during its operation.
3. When the tailgate switch on smart key is pressed in theft deterrent mode or with the smart key detected by the exterior antenna, the SKM verifies the smart key and disarms the tailgate only. When the tailgate is open and closed, the system enters into the theft deterrent mode again. If the tailgate switch is not operated for 30 seconds, the system also does so.
4. The BCM checks that the verified smart key is in the luggage room 1 second after when the closed tailgate is detected by the tailgate open switch with power OFF.
   If there is a verified smart key in the luggage room when the tailgate is open and closed in theft deterrent mode, the external buzzer sounds for 5 seconds.
   When the driver press the tailgate open switch in order to look for the smart key, the BCM deactivates lock so that the tailgate can be opened even though the driver door is locked. (maintains standby for opening without verification)

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LAMP

8310-00

GENERAL INFORMATION

1. LAMP SPECIFICATIONS

1) Exterior Lamps

Description		Numbers	Specification
Headlamp	High beam	2	H1-55W
	Low beam	2	H7-55W
	Turn signal lamp	2	P21W
	Position lamp	-	LED
Front fog light		2	H16-19W
Rear fog light		2	21W
Side repeater		-	LED
Rear combination lamp	Tail lamp	-	LED
	Turn signal lamp	2	PY21W
	Back-up lamp	2	W16W
	Stop lamp	2	P21W
License plate lamp		2	W5W
High mounted stop lamp		-	LED
Puddle lamp		2	LED

2) Interior Lamps

Description	Numbers	Specification
Front room lamp	2	10W
Glove box lamp	1	5W
Center room lamp	1	10W
Luggage lamp	1	10W
Door courtesy lamp	2	5W

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2. AUTOMATIC LIGHT SENSOR SPECIFICATIONS

Pin No.	Specification
Operating voltage	9 V to 16 V
Load	Max. 200 mA (relay load)
Operating temperature	−30℃ to 85℃
Storage temperature	−40℃ to ±120℃
Mounting location	Top center of inner side of windshield glass

NOTE

▶ LED

- The LED stands for "Light Emitting Diode" or "Luminescent Diode." LED is a semiconductor diode that emits incoherent narrow-spectrum light when electrically biased in the forward direction of the p-n junction, as in the common LED circuit. In short, it is an element that converts electric signals into light signals. Yellow, blue, red and white LEDs are currently available.
  The followings are the advantages of LED.
- It is not glaring and doesn't have short circuit unlike the conventional lamps.
  It is semi-permanent and doesn't generate heat.
  Its power consumption is much lower than those of conventional bulbs.

▶ **Luminous Intensity**

- Luminous intensity is a measure for the amount of light which passes through the unit area per time unit. The SI unit of luminous intensity is the candela (cd), an SI base unit.

▶ **Luminance**

- Luminance describes the amount of light that passes through or is emitted from a particular area, and falls within a given solid angle. It is measured in sb or nt.

▶ **Intensity of illumination**

- This indicates the amount of light reaching a given area. Measuring unit is lux (lx) and it is not directly proportional to the brightness of the area as the reflection rate is not included.

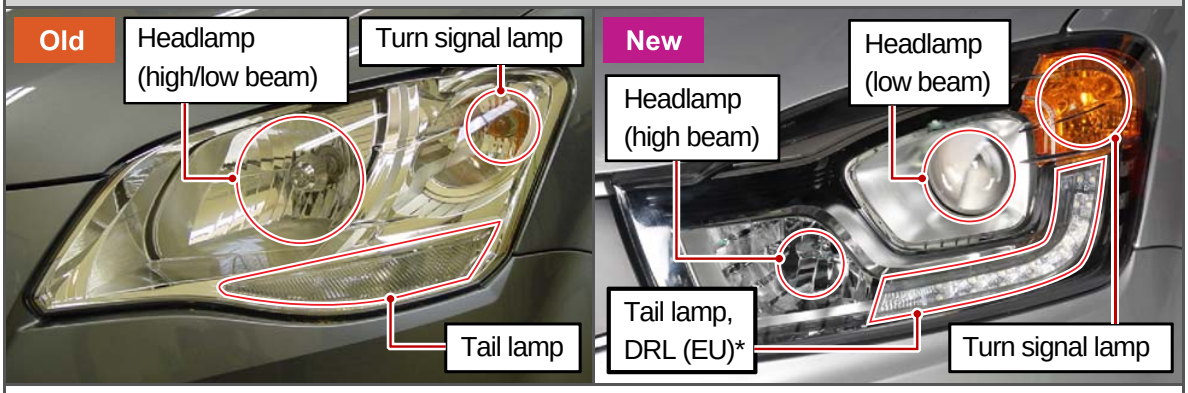
Modification basis	
Application basis	
Affected VIN	

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3. MAJOR CHANGES

▶ **Front side**

Headlamp



– Headlamp design and its function changed (2 lamp system → 4 lamp system)
- Headlamp (high/low beam) dualized and tail lamp changed to LED type



Fog lamp



- Fog lamp design changed

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▶ Rear side



Rear combination lamp



- Rear combination lamp design and its function changed
- Tail lamp (stop lamp) changed to LED type

Modification basis	
Application basis	
Affected VIN	

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▶ Indoor

Front door courtesy lamp

- Door courtesy lamp design changed due to modified front door trim

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Application basis	
Affected VIN	

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OVERVIEW AND OPERATING PROCESS

1. EXTERIOR LAMP

1) Overview

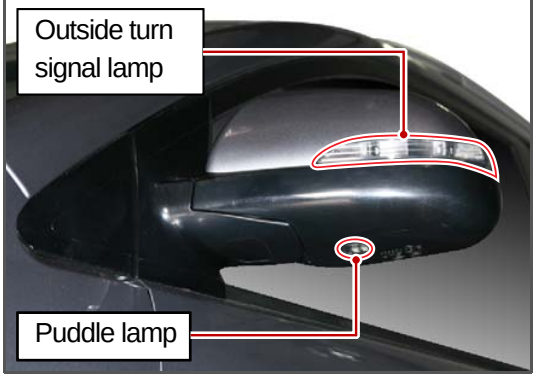
Exterior lamps can be divided into front, rear and side lamps as follows.

- Front lamp: headlamp and fog lamp
- Rear lamp: combination lamp, license lamp, high mounted stop lamp and reflex reflector lamp
- Side lamp: outside turn signal lamp and puddle (approach) lamp

2) Layout

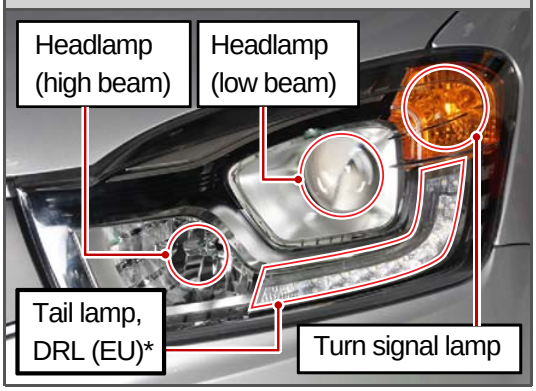
▶ **Front side**

Outside turn signal lamp and puddle lamp





Headlamp



Fog lamp

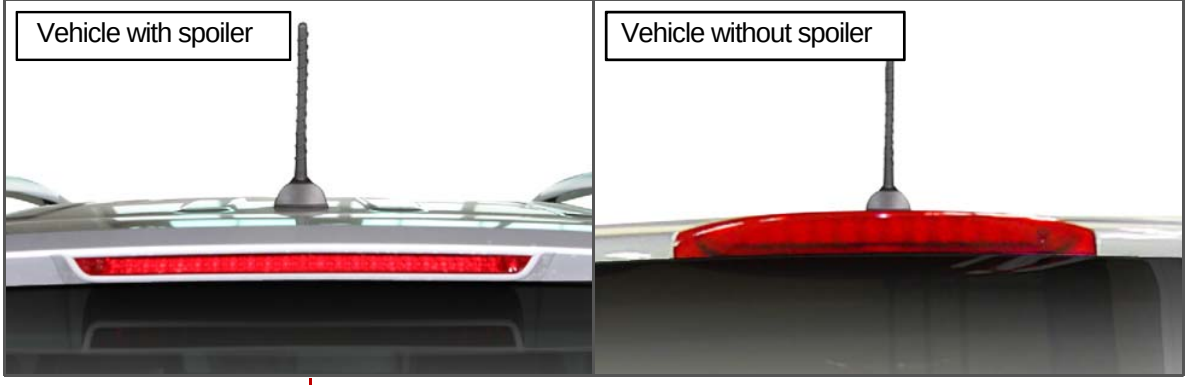


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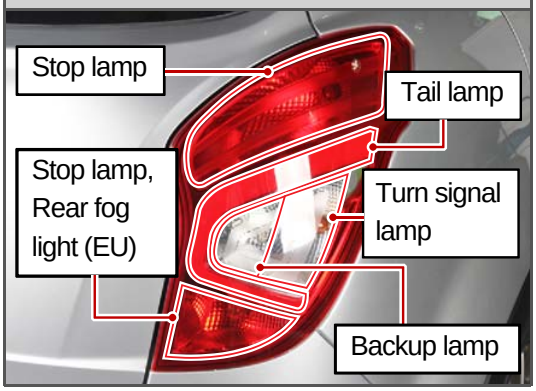
▶ Rear side

High mounted stop lamp





Rear combination lamp



License plate lamp



Reflex reflector lamp



Modification basis	
Application basis	
Affected VIN	

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3) Operating Process

(1) Headlamp (high/low beam) operation process

The headlamp is usually operated by the multifunction switch or by the REKES or smart key through the BCM.
The BCM controls the headlamp and tail lamp according to the signal from the AUTO light sensor through LIN communication when the multifunction switch is in "AUTO" position.



NOTE

▶ **DRL (Day Time Running Light)**

DRL is the function to turn on the high beam and tail lamp without any intervention from the light switch. DRL turns off the lamps when turning off the light switch. This is an additional safety device to prevent the accident.

Modification basis	
Application basis	
Affected VIN	

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(2) Tail lamp

▶ **Front**



▶ **Rear**



The tail lamp is operated by the BCM when the BCM receives a signal from the multifunction switch.

▶ **Tail lamp warning**

1. The buzzer sounds for 10 seconds with the interval of 0.02 s ON and 1.38 s OFF when opening the driver door with the key removed (without SKM)/with IGN OFF or ACC (with SKM) and tail lamp ON. The buzzer stops its operation when turning off the tail lamp or closing the driver door during buzzer
2. operation. The buzzer stays ON when turning the tail lamp on again after turning it off during buzzer operation.

▶ **Tail lamp auto turn-off**

- When opening and closing the driver door after turning off the ignition with the tail lamp ON, the tail lamps go off automatically.
- The tail lamps come on again when inserting the ignition key (without SKM) and turning on the ignition (with SKM) after tail lamp auto OFF.
- The tail lamp should not go off when turning on the tail lamp switch with the ignition key removed (without SKM) and with power off or ACC ON (with SKM).

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(3) Auto light (LIN)

Auto light switch	Automatic light sensor unit
	

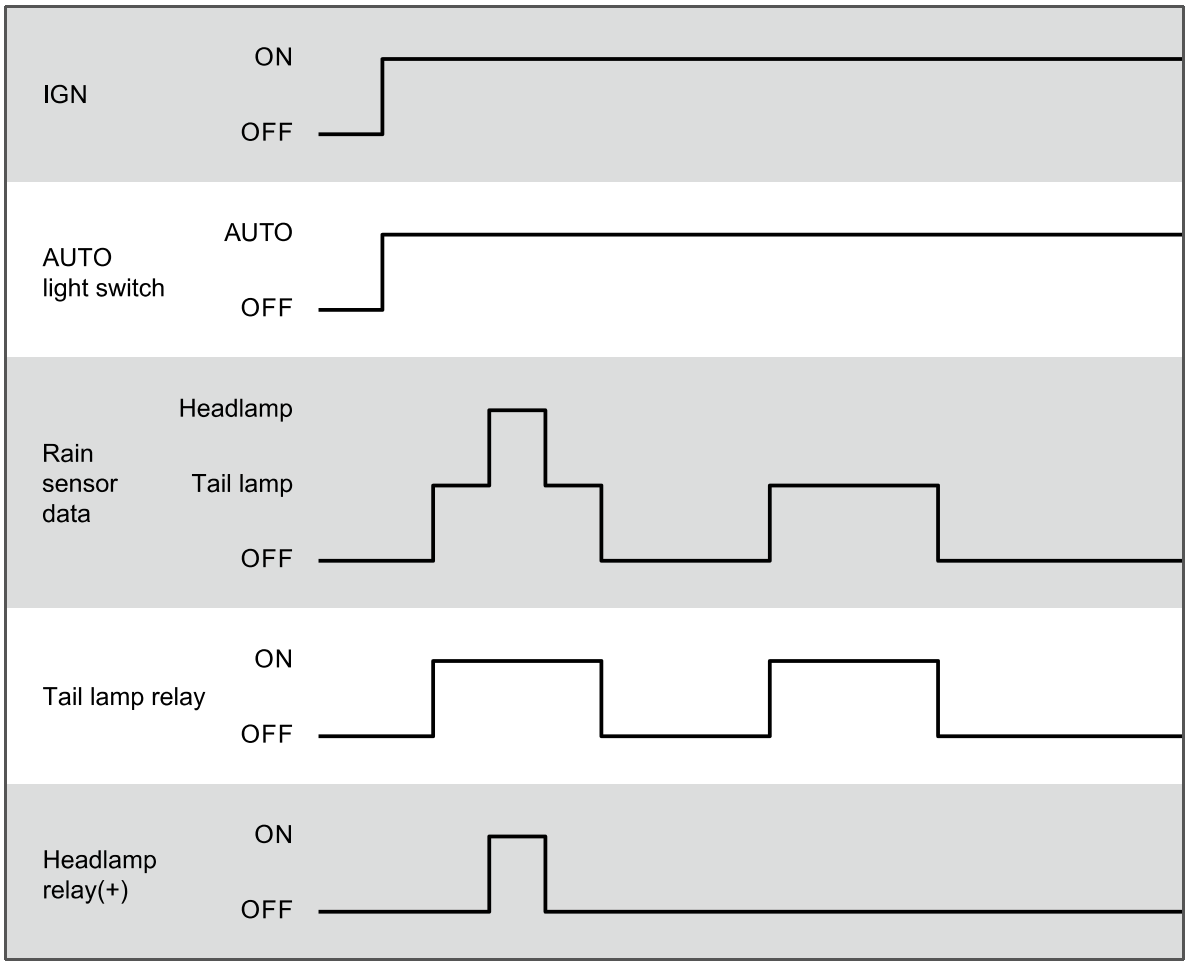
The auto light sensor unit is installed to the back side of the ECM mirror located upper center of the windshield, and detects the illuminance change. The BCM communicates with the auto light sensor when the ignition is turned on, and turns on or off the tail lamp and headlamp automatically according to the signals from the sensor when the multifunction switch is set to AUTO light.
The BCM communicates with the rain sensor even if the multifunction switch is in tail lamp.

Modification basis	
Application basis	
Affected VIN	

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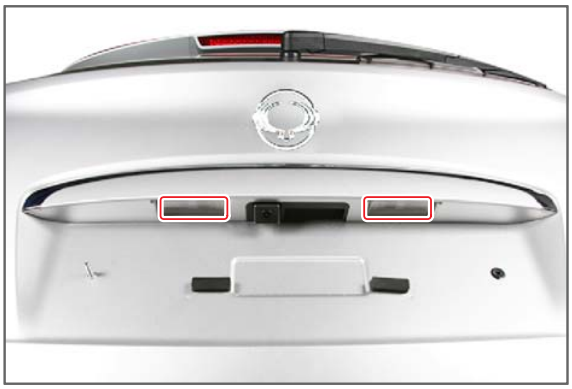
▶ Control by BCM

The rain sensor & AUTO light module communicates with BCM with IGN ON. When the AUTO light switch is in the AUTO position, the BCM controls the tail lamp and headlamp according to the LIN communication data.



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(4) License lamp operation process



When the corresponding lamp comes on and goes off by operating the tail lamp, AUTO light, high beam and low beam on the multifunction switch, the license lamp also does.

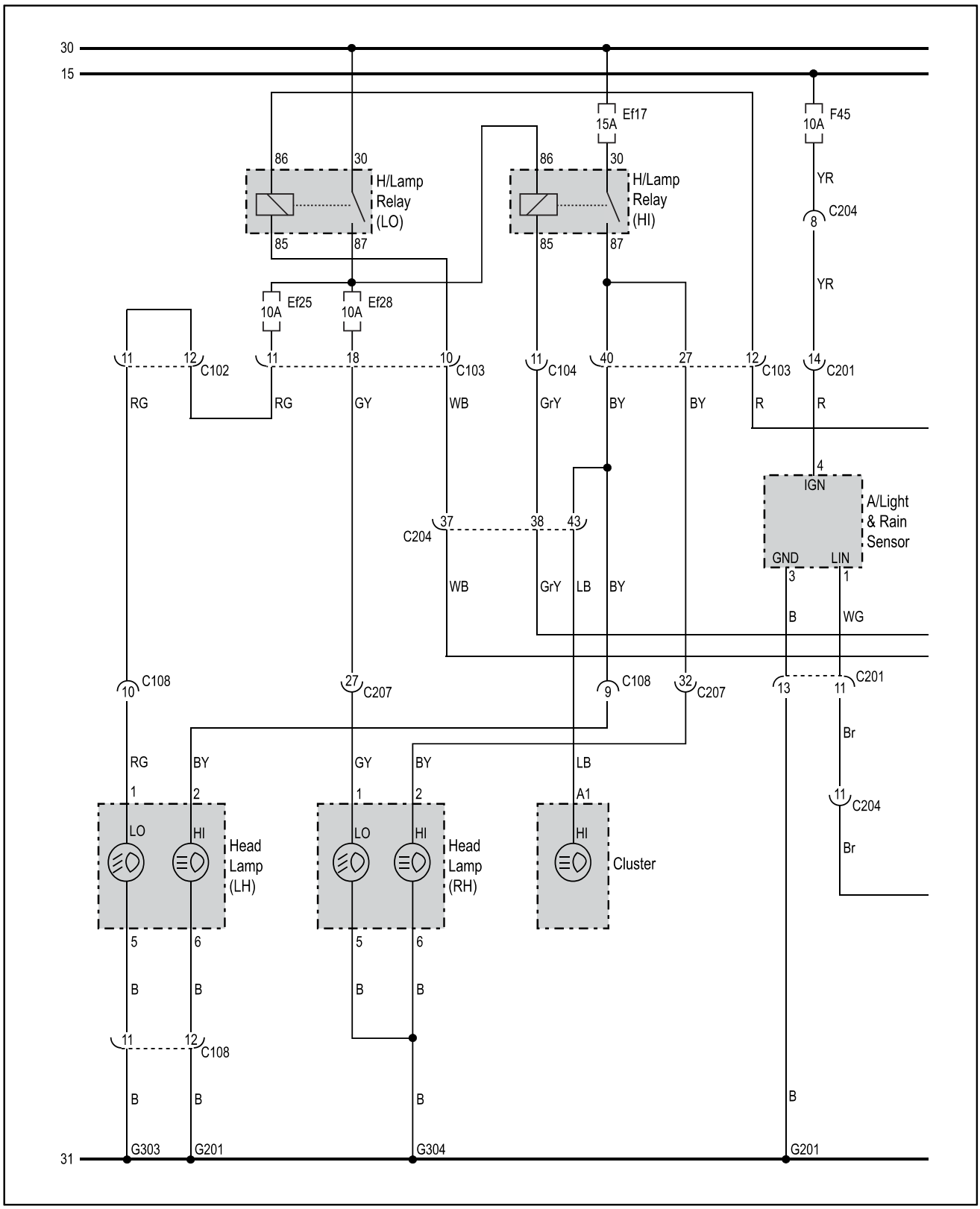
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Memo

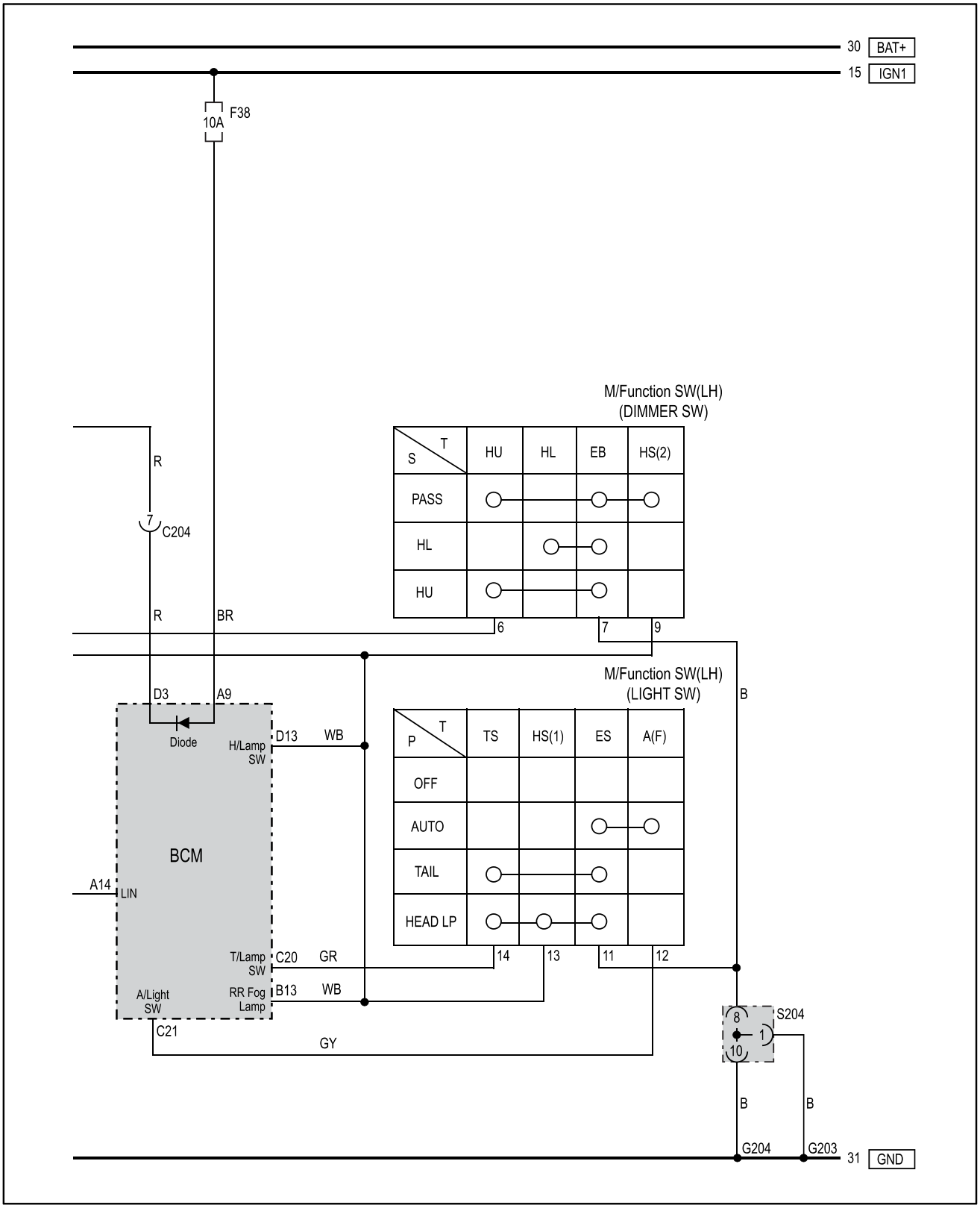
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▶ Headlamp



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Application basis	
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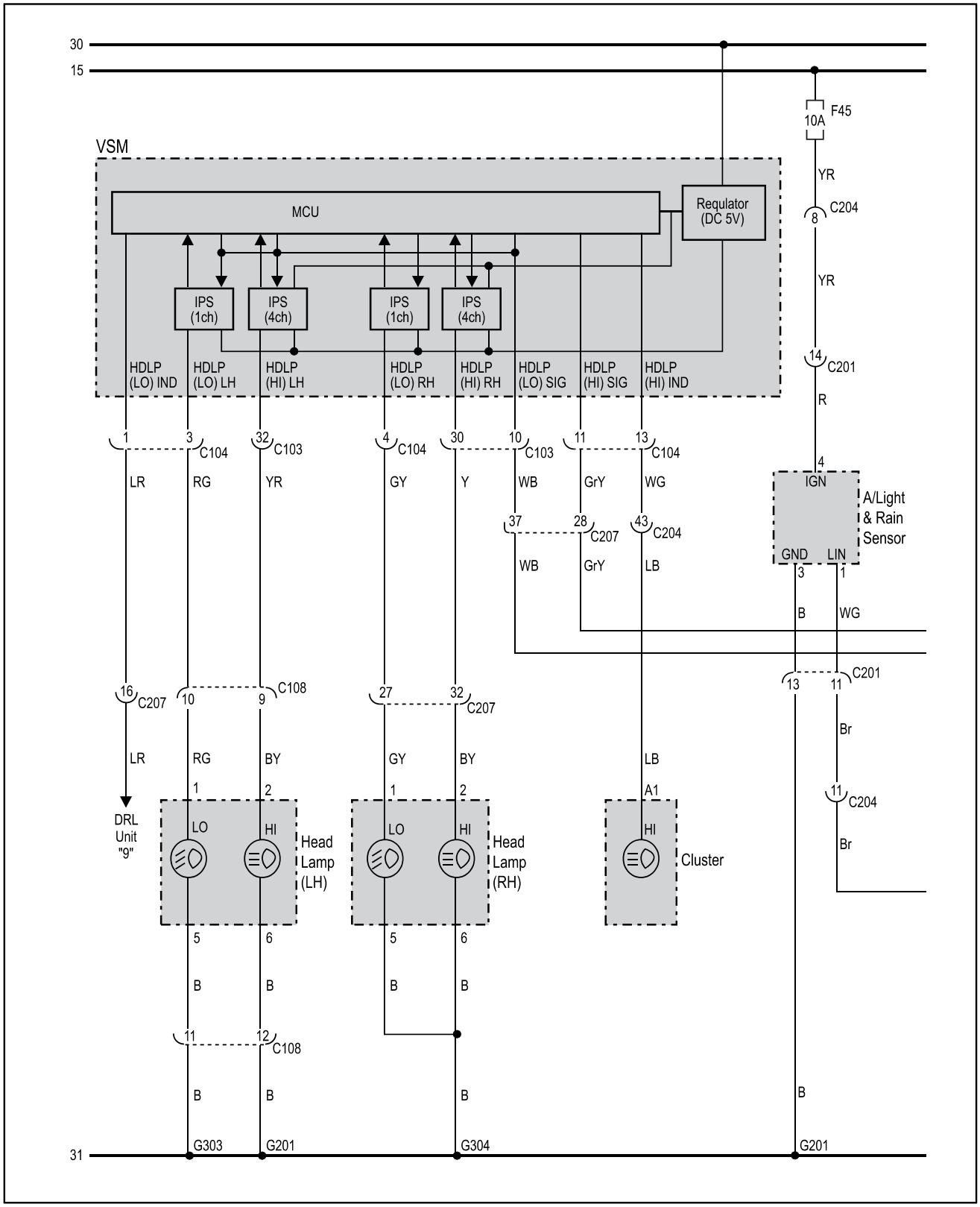
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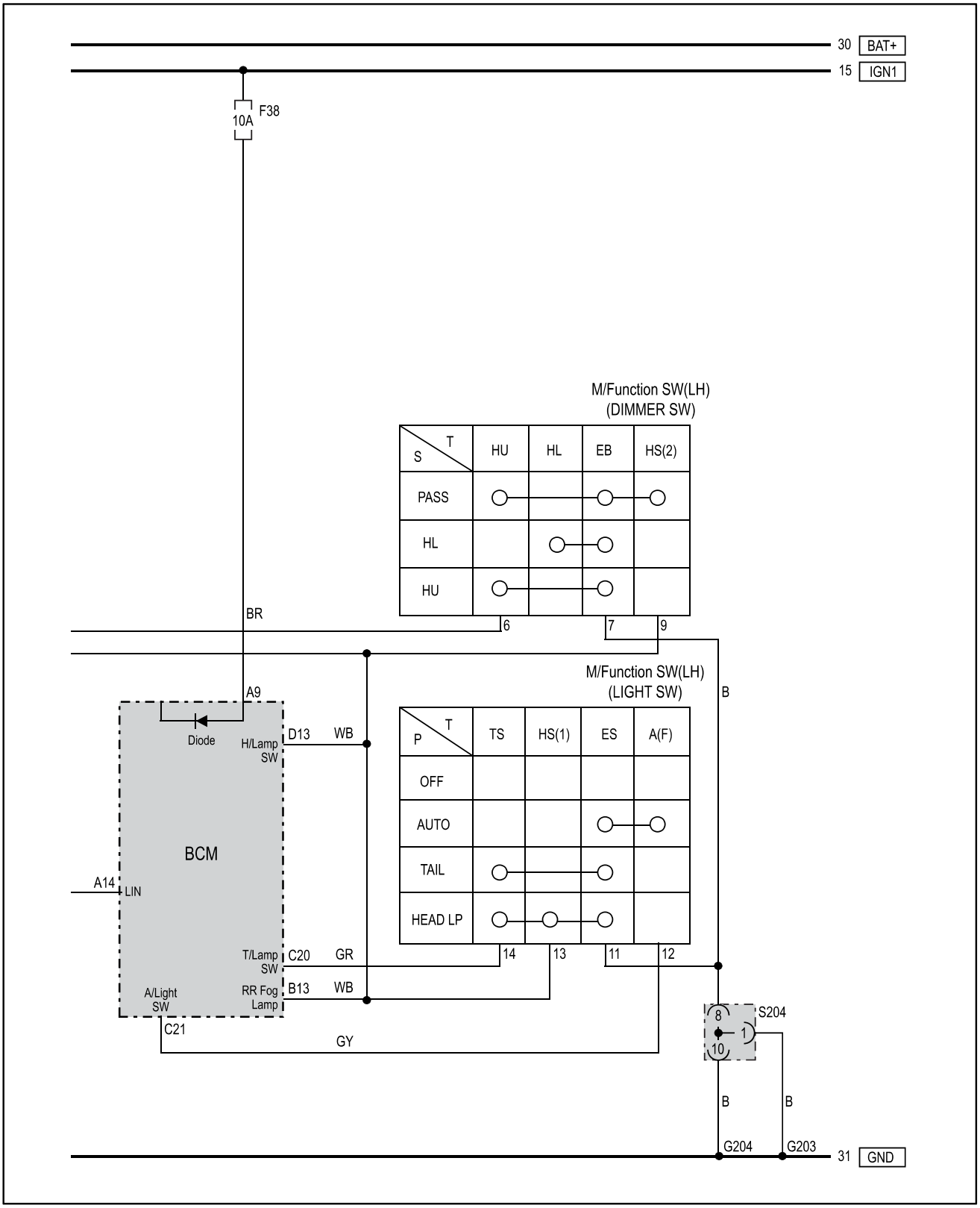
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▶ Headlamp(W/ VSM)



Modification basis	
Application basis	
Affected VIN	

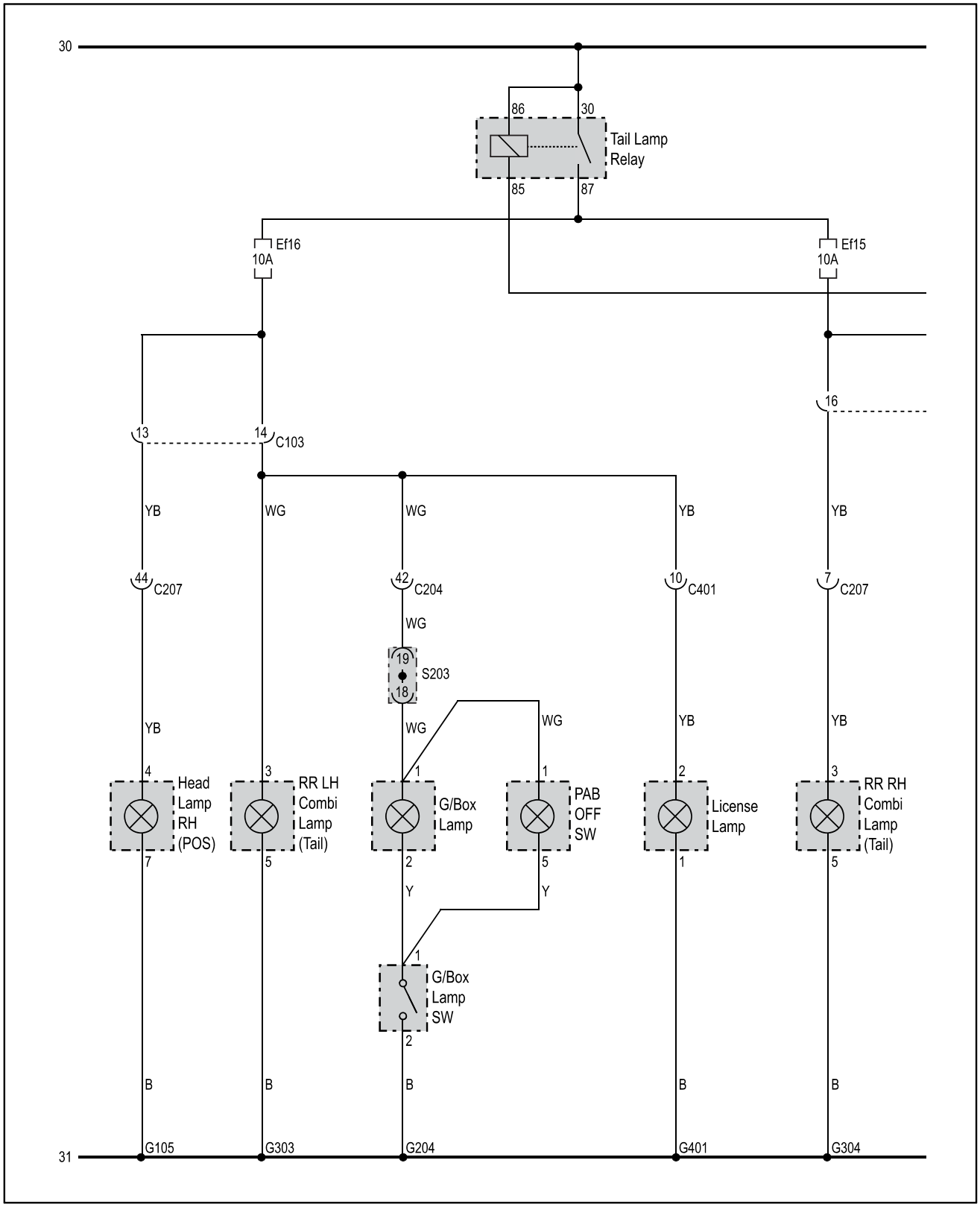
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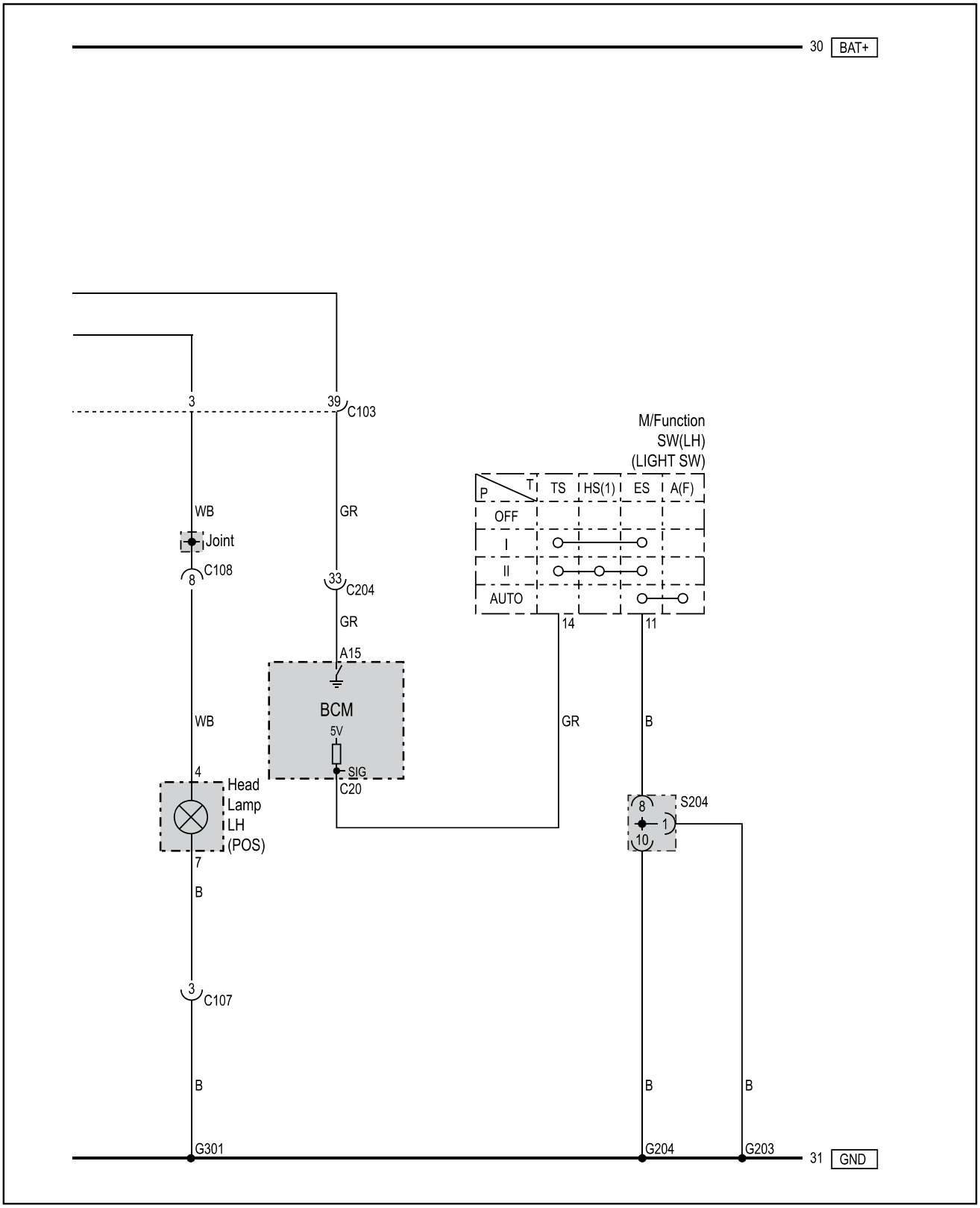
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▶ Tail lamp circuit diagram



Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
Affected VIN	

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(5) Fog lamp

The fog lamp is operated by the fog lamp switch only when the headlamp (tail lamp) is operating.
The front and rear fog lamps go off when turning the ignition switch or headlamp (tail lamp) switch to the "OFF" position.

▶ **Front**



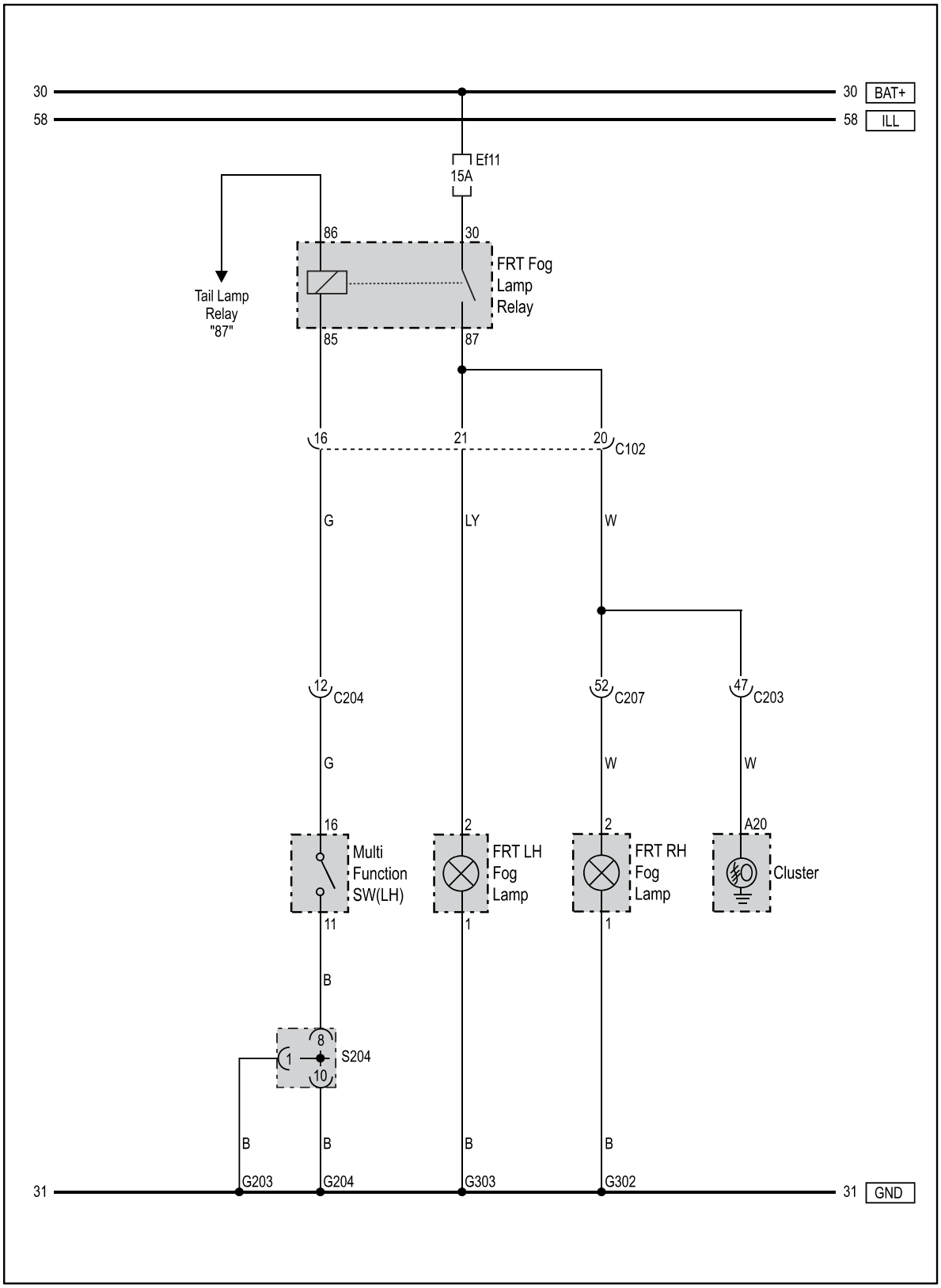
▶ **Rear (EU only)**



Modification basis	
Application basis	
Affected VIN	

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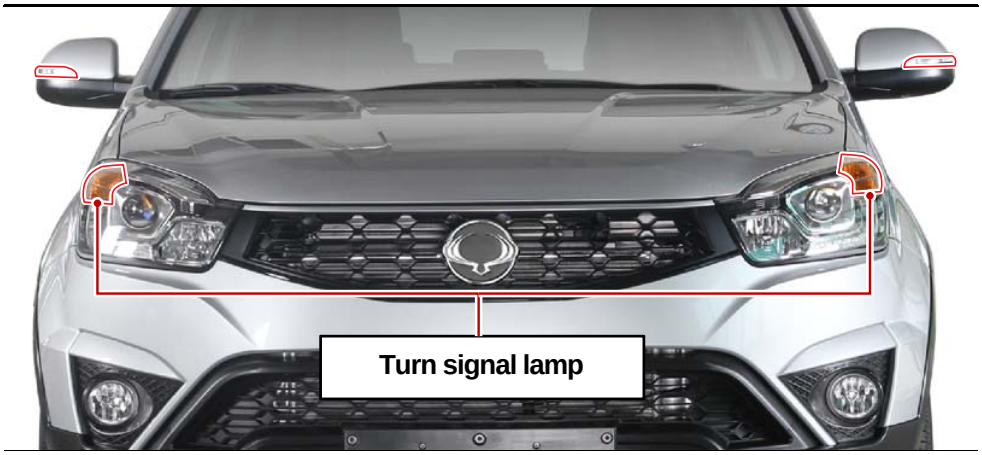
▶ Fog lamp circuit diagram



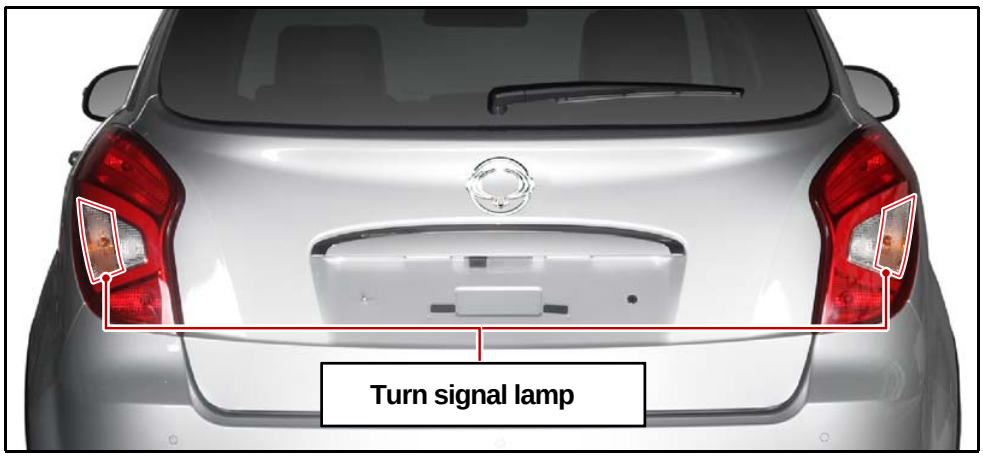
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(6) Turn signal lamp / Side repeater lamp

▶ **Front**



▶ **Rear**



The turn signal lamp is operated by the BCM when the BCM receives a signal from the multifunction switch. The BCM cycles the turn signal lamp and buzzer (ON/OFF) 75 times per minute.
The turn signal lamps are operational only when IGN1 is ON.
If the turn signal lamp fails while it is illuminated, the BCM cycles the lamp and buzzer 100 times per minute.
The BCM determines that there is an open circuit if the load is 3.0 A or less, and there is a short circuit if the load is 7.0 A or more.
When turning ON the turn signal switch, the lamp blinks 3 times by the BCM. When turning OFF the switch during the operation, the turn signal lamp blinks 3 times and goes off.
When turning OFF and then immediately ON the turn signal switch during auto blinking operation of 3 times, the turn signal lamp blinks additional 3 times.
If one of the turn signal lamp is flashing and the other lamp switch is turned on, the lamp for the activated switch flashes.

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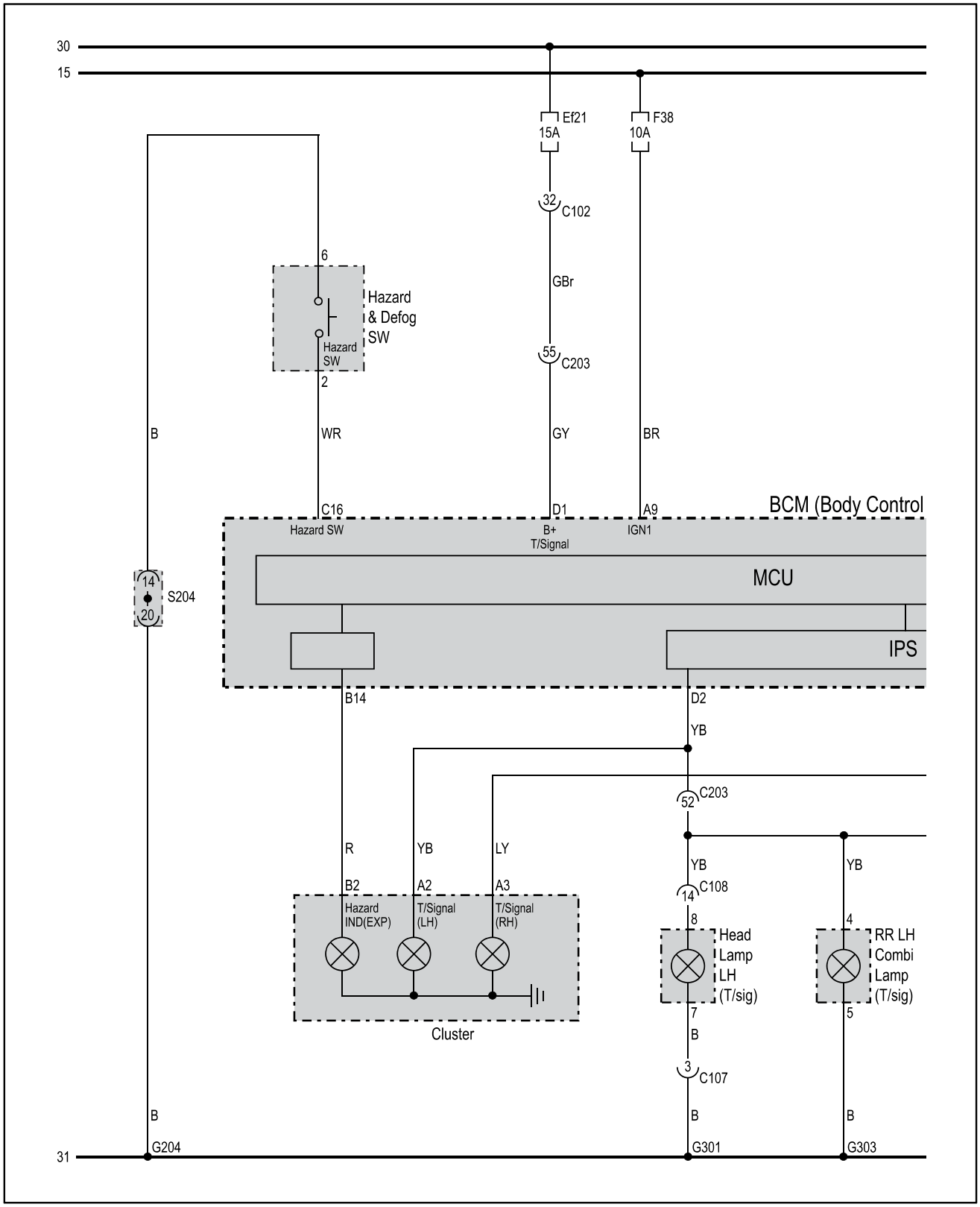
(7) Side repeater lamp

Side repeater lamp	
	

The side repeater lamp is operated by the BCM when the BCM receives a signal from the multifunction switch.
The BCM cycles the side repeater lamp and buzzer (ON/OFF) 75 times per minute.
The side repeater lamp operates only when IGN1 is ON.
If the side repeater lamp fails while it is illuminated, the BCM cycles the lamp and buzzer 100 times per minute.
The lamp automatically flashes 3 times when the multifunction switch is turned on. If the switch is turned off
during this operation, the lamp flashes 3 times and then goes off.
If the switch is turned off and then on during the 3 times of automatic flashing, the lamp flashes 3 more times.

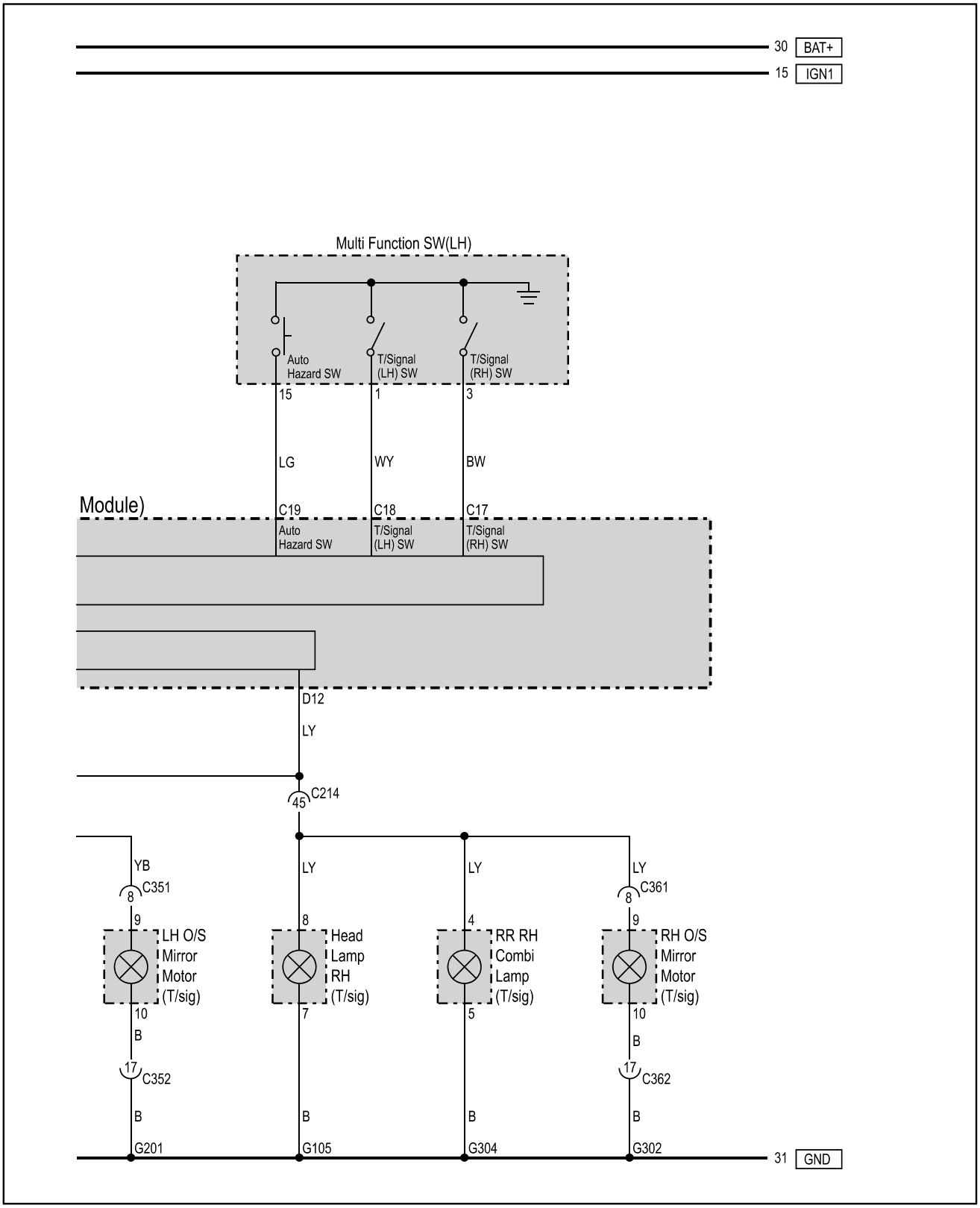
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▶ Turn signal lamp circuit diagram



Modification basis	
Application basis	
Affected VIN	

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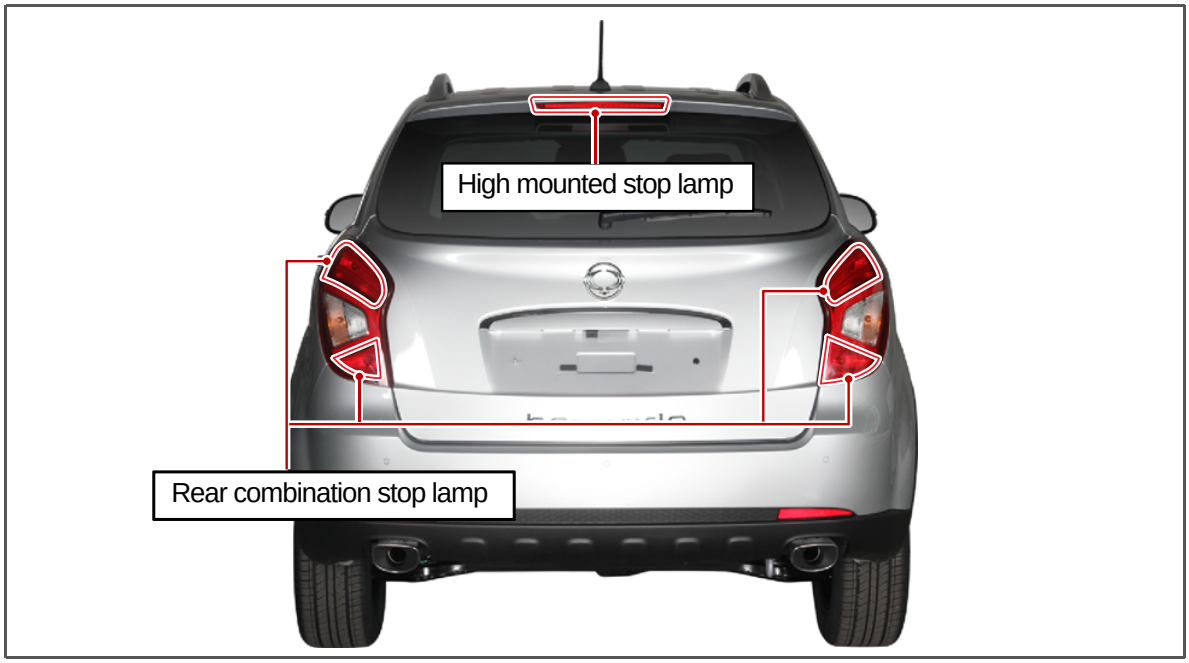


Modification basis	
Application basis	
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(8) Stop lamp operation process

Depressing the brake pedal lights on the stop lamps by a signal from the stop lamp switch fitted to the brake pedal and releasing the brake pedal turns off it.



(9) Backup lamp operation process

When shifting the TGS lever into the "R" position with the ignition switch "ON", the backup lamps come on. If the lever is placed in other positions, the lamps go off.



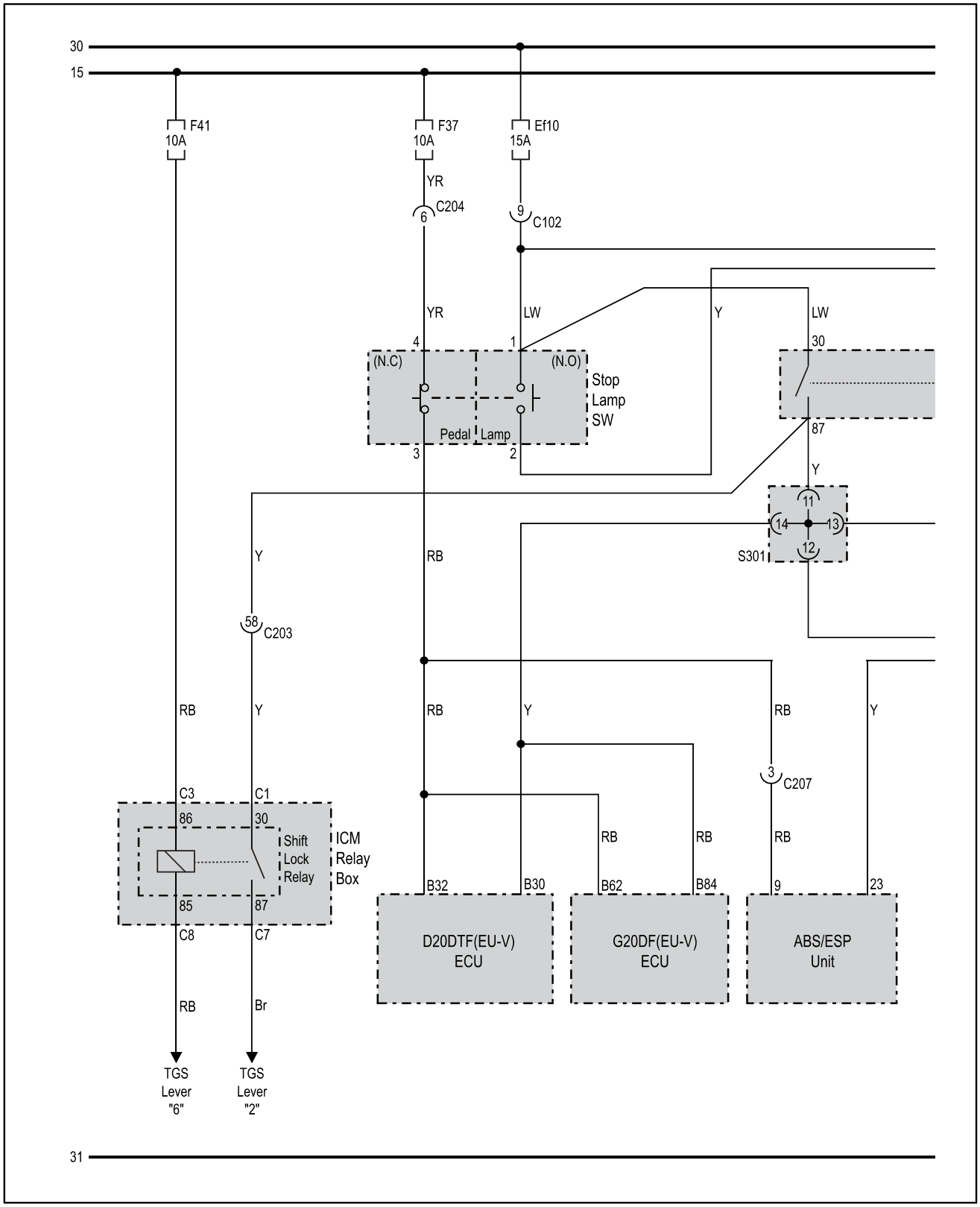
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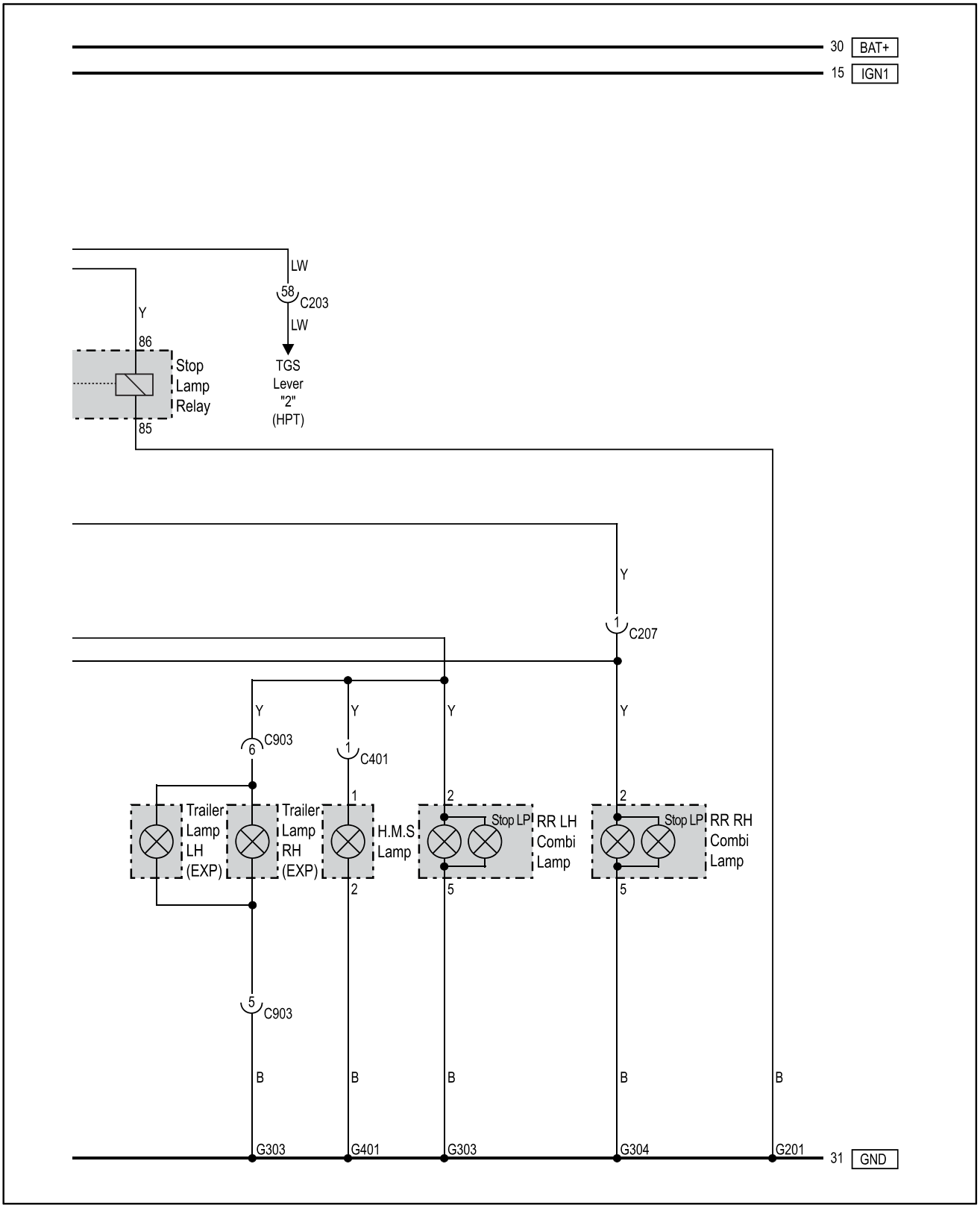
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▶ Stop lamp circuit diagram



Modification basis	
Application basis	
Affected VIN	

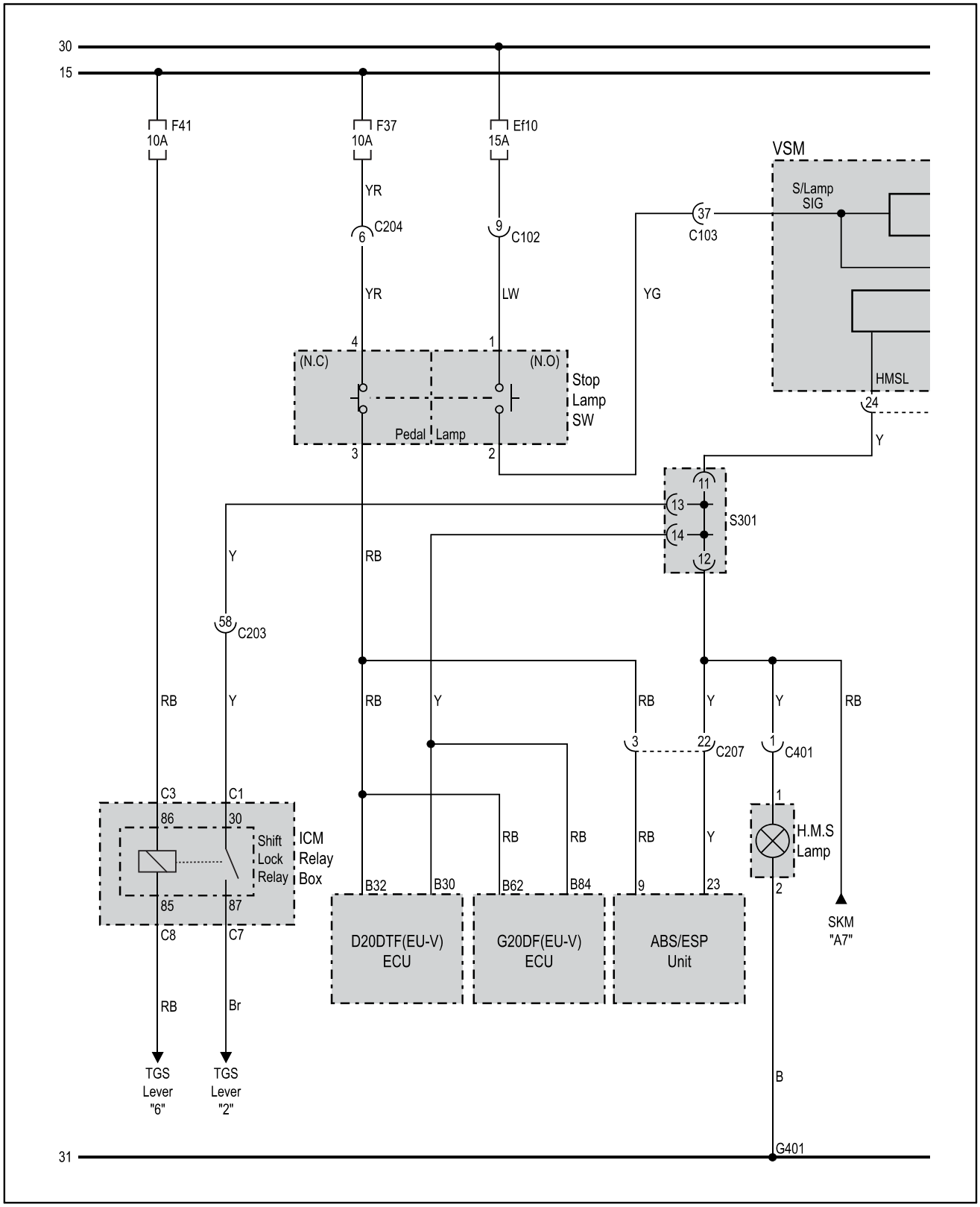
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Modification basis	
Application basis	
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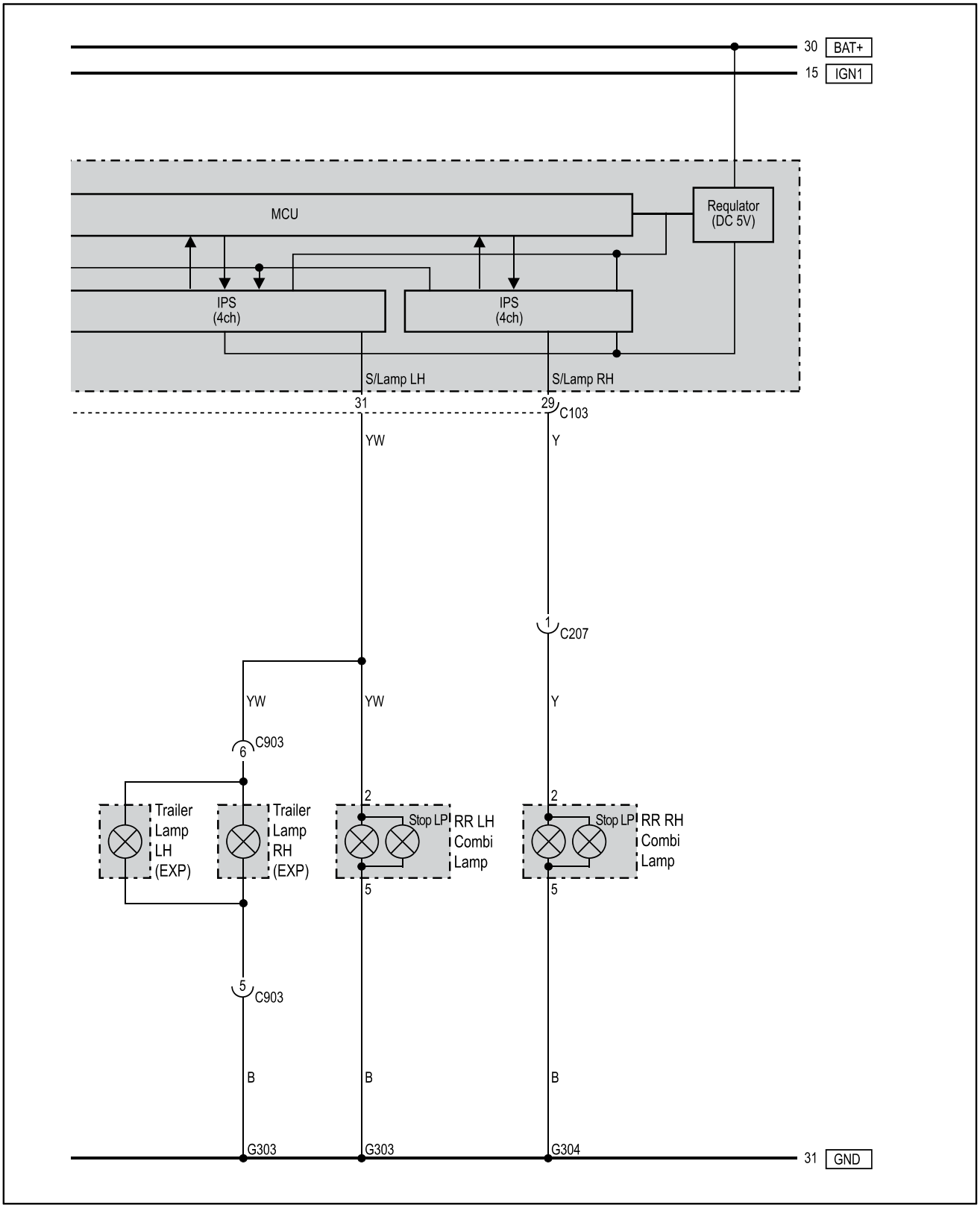
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▶ Stop lamp (W/ VSM) circuit diagram



Modification basis	
Application basis	
Affected VIN	

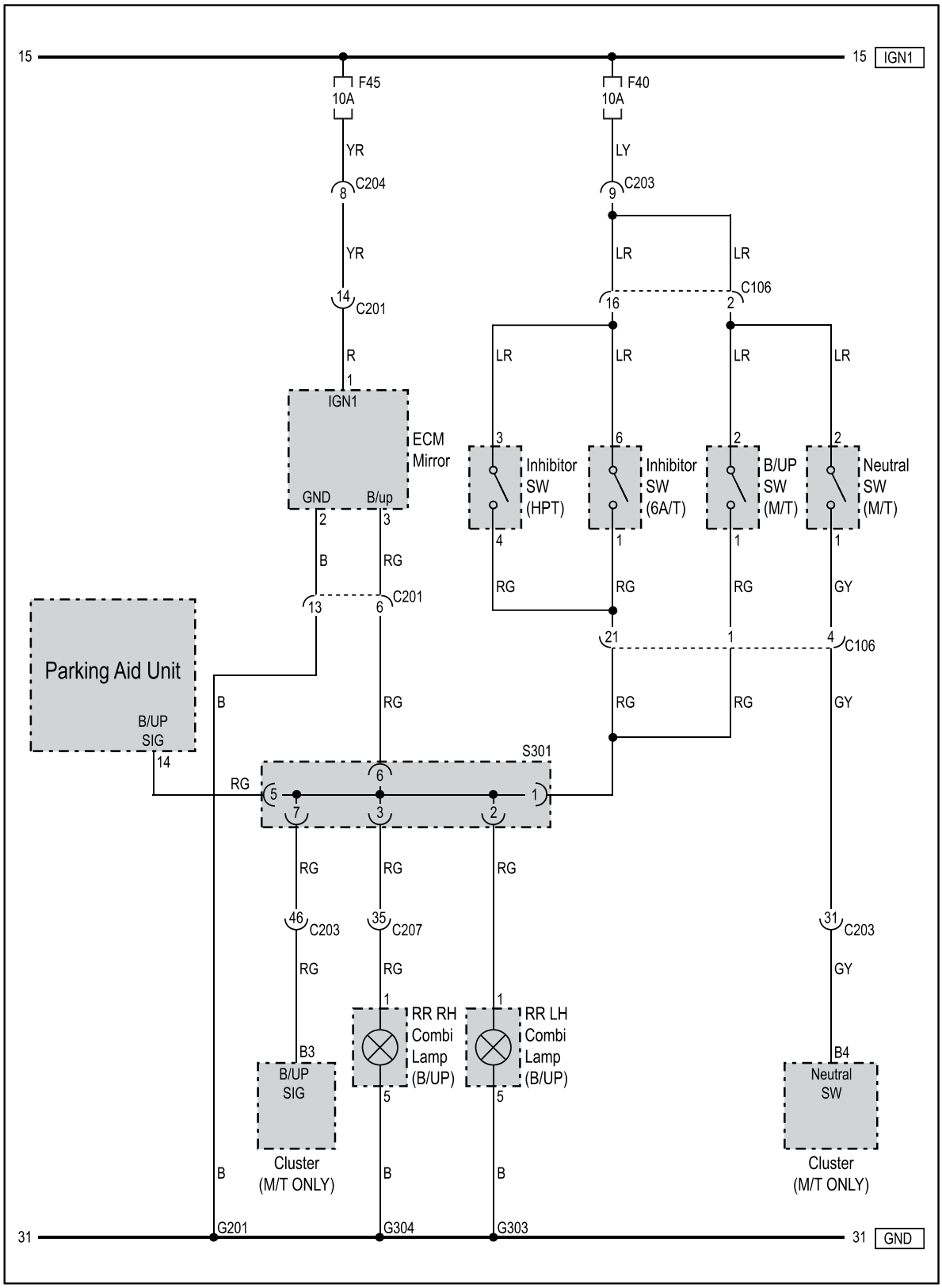
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Modification basis	
Application basis	
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▶ Backup lamp circuit diagram



Modification basis	
Application basis	
Affected VIN	

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(10) Puddle (approach) lamp

Approach (puddle) lamp	
	

▶ Lamp control for models without SKM

1. Approach lamp ON
   - When receiving the UNLOCK signal in the theft deterrent mode, the approach lamps come ON for 30 seconds.
   - When turning the ignition switch to OFF from ON position and opening the driver door, the approach lamps come ON.
2. Approach lamp OFF
   - When receiving the door lock signal with the approach lamps ON, the lamps go OFF (reactivation of theft deterrent mode).
   - When turning the ignition switch to ON position with the approach lamps ON, the lamps go OFF. The approach lamps go OFF after 30 seconds.
   -

▶ Lamp control for models with SKM

1. Approach lamp ON
   - When turning the ignition switch to OFF from ON position and opening the driver door, the approach lamps come ON.
   - When receiving the UNLOCK signal from the smart key remote control or outside door handle switch signal in the theft deterrent mode, the approach lamps come ON for 30 seconds.
     When receiving the AUTO approach signal in the theft deterrent mode, the approach lamps come
   - ON for 30 seconds.

2. Approach lamp OFF
   - When receiving the door lock signal from the smart key remote control or outside door handle switch signal with the approach lamps ON, the lamps go OFF (reactivation of theft deterrent mode).
   - When turning the ignition switch to ON position with the approach lamps ON, the lamps go OFF. The approach lamps go OFF after 30 seconds.
   -

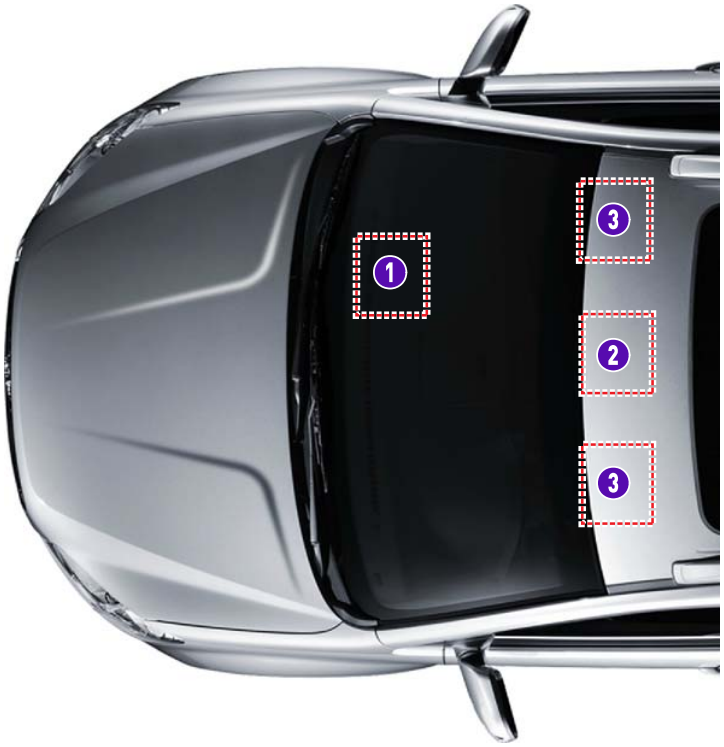
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2. INTERIOR LAMPS

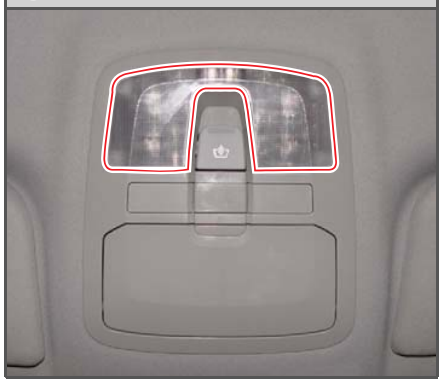
1) Layout

1 Glove box lamp





2 Front room lamp

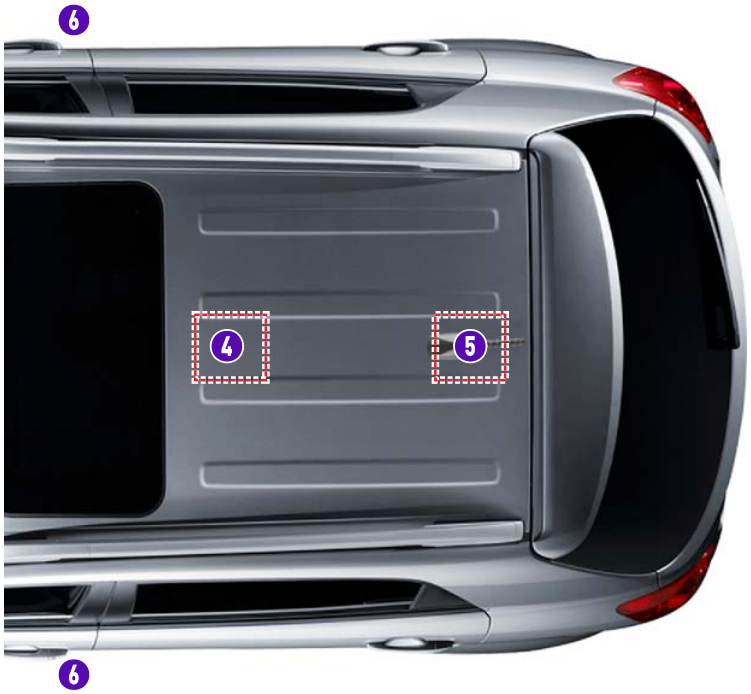


3 Sun visor lamp



Modification basis	
Application basis	
Affected VIN	

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4 Center room lamp



5 Luggage lamp



6 Door courtesy lamp

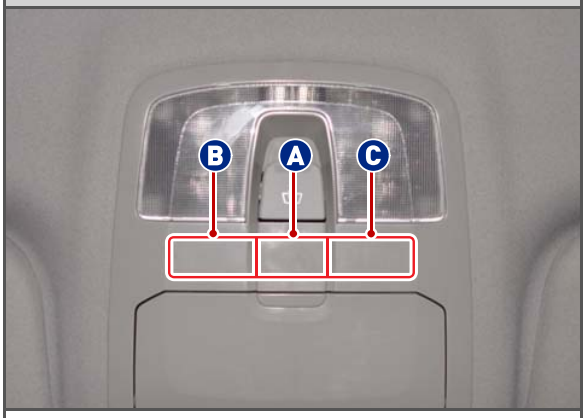


Modification basis	
Application basis	
Affected VIN	

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2) Operation

(1) Front room lamp/Center room lamp

Front room lamp	Center room lamp
	
A. Door coupled operation switch: Comes on when opening door and goes off when closing with switch pressed B. Driver spot lamp switch: Driver front room lamp comes on when pressing switch C. Passenger spot lamp switch: Passenger front room lamp comes on when pressing switch	Press switch to turn on center room lamp and press again to turn off it. It comes on when opening the door with door coupled operation switch in the front room lamp pressed even though the switch is in "OFF" position.

Operating the front room lamp and center room lamp switches illuminates the driver/passenger side lamps and center room lamp.

▶ **Room lamp control by door coupled room lamp operation**

1. If a door except the tailgate is opened after the ignition is turned off, provided that door coupled front room lamp switch is pressed, the front room lamp and center room lamp are illuminated for 2 sec. and then fade out for 3 sec.
   If a door except the tailgate is opened and then closed while the room lamp is fading out, the room lamp is illuminated for 2 sec. and then fades out for 3 sec. If the ignition is turned on, the room lamp goes off immediately.
2. The front room lamp and center room lamp are illuminated for 30 sec. when the door is unlocked by the REKES or passive door UNLOCK function with IGN OFF and the ignition key removed. If the REKES or passive door UNLOCK signal is received again, the room lamps are illuminated for another 30 sec.
3. The room lamp goes off immediately when the REKES or passive door LOCK signal is received or the ignition switch is turned to ON position.
4. If the room lamp is turned on after the ignition key is removed (door open or room lamp switch is pressed), it is turned off after 10 minutes by the BCM.
5. When the door open state is changed or the ignition is turned on after the room lamp has been turned off automatically, the battery saver feature is reset.

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(2) Luggage lamp

Luggage lamp



The luggage lamp is turned on when the tailgate is opened with the switch operated.
This lamp is not controlled by the BCM, unlike the front/center room lamp.

▶ **Luggage lamp control by coupled operation switch when opening/closing tailgate**

1. The luggage lamp comes on when the tailgate is open.
2. The luggage lamp goes off as soon as the tailgate is closed.

(3) Glove box lamp

Glove box lamp



The glove box lamp comes on when the glove box is opened after the tail lamp is illuminated.

(4) Sun visor lamp

Sun visor lamp



The sun visor lamp comes on when the sun visor vanity mirror cover is opened.

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(5) Courtesy lamp

Courtesy lamp


The door courtesy lamp comes on when the driver's door or passenger's door is opened.

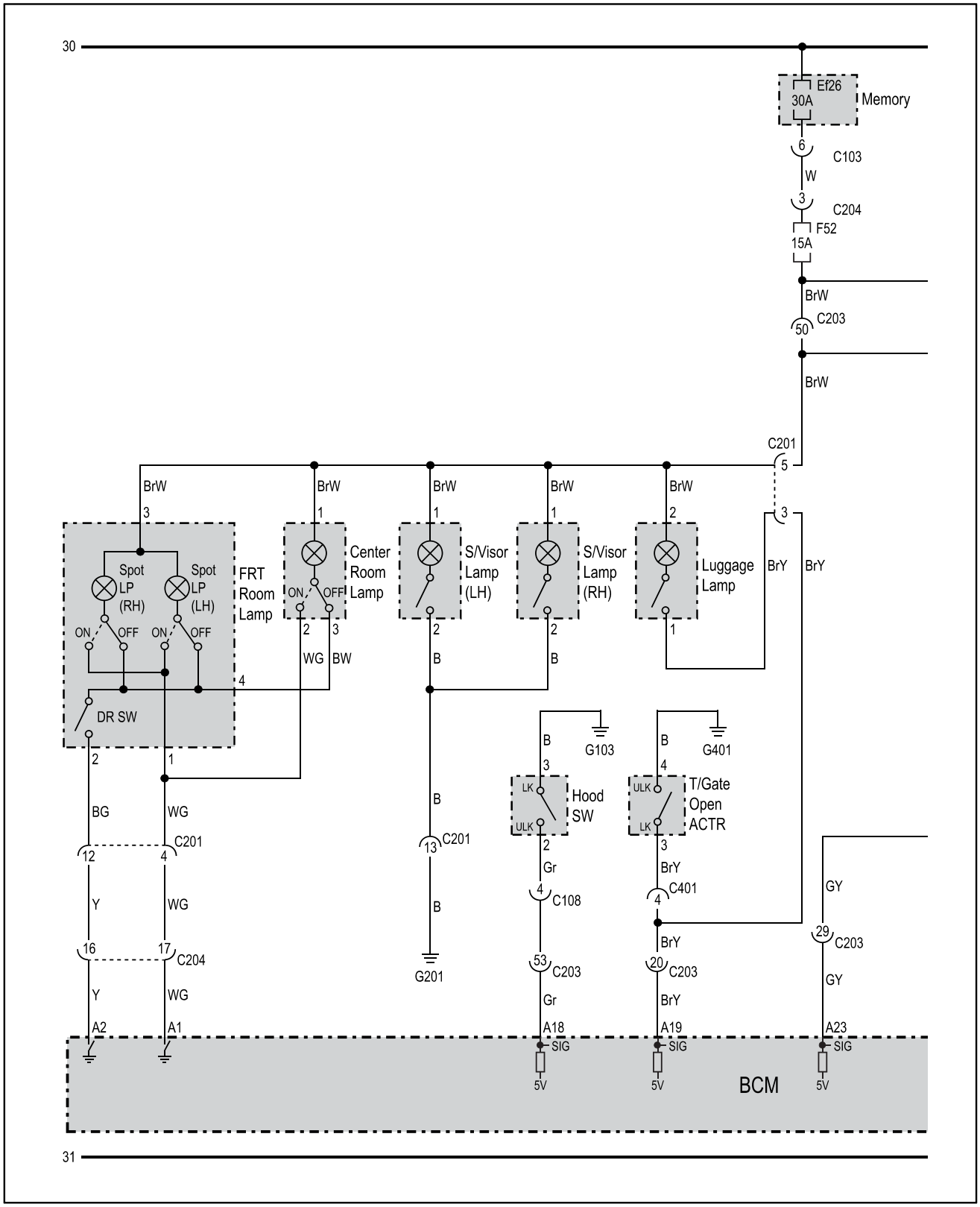
Modification basis	
Application basis	
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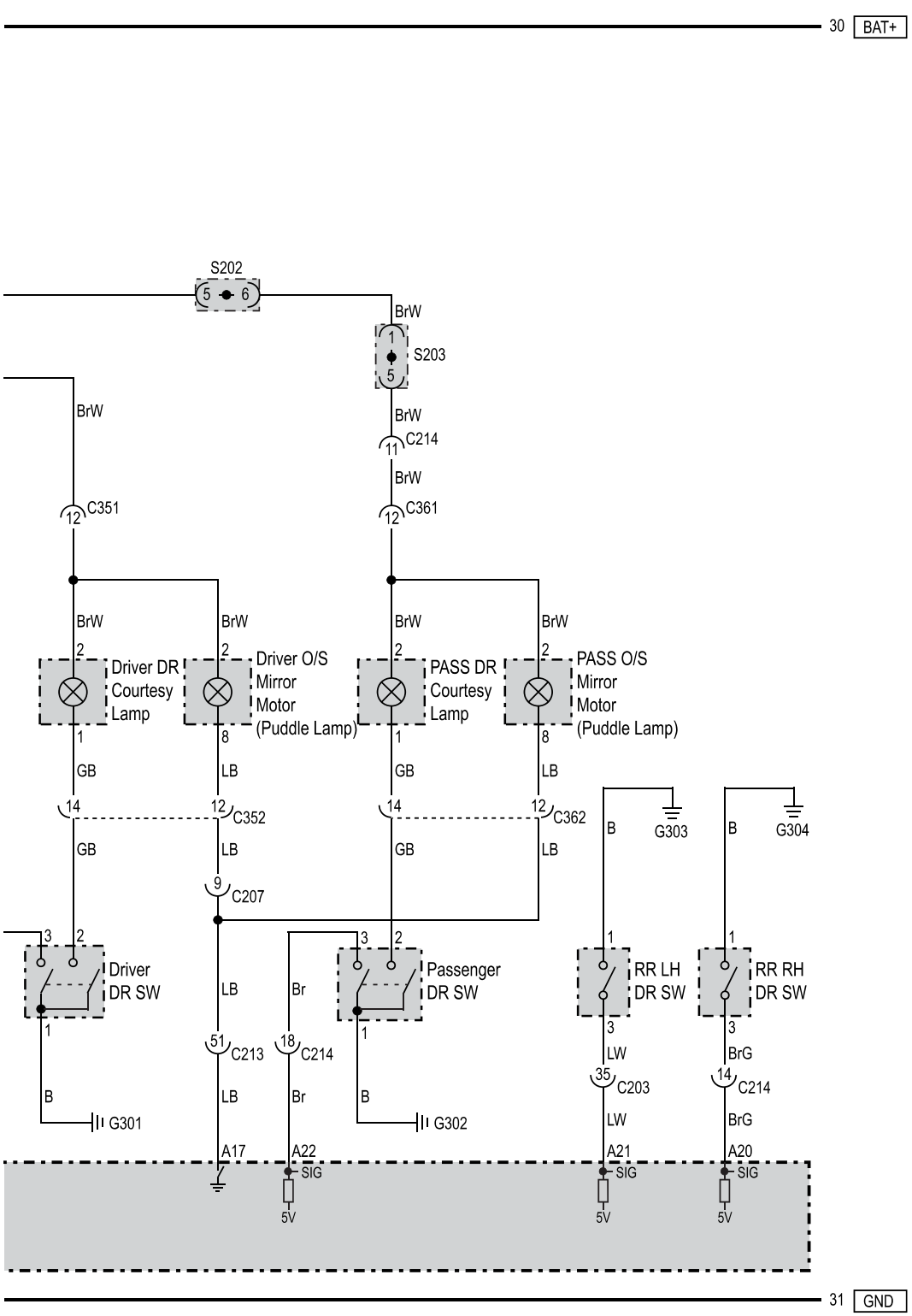
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▶ Room lamp circuit diagram



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WIPER AND WASHER SYSTEM 7810-00

GENERAL INFORMATION

1. WIPER CONTROL

- ▶ **Wiper mist & washer coupled wiper**
- ▶ **Auto washer coupled wiper**
- ▶ **Rain sensor coupled wiper operation (LIN)**
- ▶ **Speed sensitive intermittent wiper**
- ▶ **Wiper low/high control**

2. CAUTIONS ON RAIN SENSOR

- When the wiper switch is in the AUTO position, the wiper will operate for 1 cycle if the initial engine start is made. This may cause the wiper blades to wear prematurely. Therefore, other than rainy days, set the switch to the OFF position. Especially during the winter time, check if the wiper blades are not frozen to the windshield.
  Operating the wiper with the blades frozen can damage the wiper motor.
- If you operate the wipers when the windshield is dry without spraying washer fluid, the windshield can be scratched and the wiper blades can wear prematurely. Use the wiper with the washer fluid when the windshield is dry.
- When it does not rain, turn the wiper switch to the OFF position.
- Turn the wiper switch to the OFF position before any car wash to avoid unwanted operation of the wipers.

WARNING

When cleaning the windshield over the sensor with damp clothes, the wiper may operate suddenly. It could cause serious injury. Make sure to place the wiper switch to the OFF position and ignition switch OFF when not in use.

▶ **Irregular operation (abrupt operation)**

- Check if the sensor is off the position.
- Check if the rain sensor cover is securely installed.
- Check if the customer is familiar to how to control the wiper sensitivity.
  Check if the wiper sensitivity control is set to the FAST side (step 5).
- Check the wiper blade for wear.
- If the wiper blade cannot wipe the glass uniformly and clearly, it may cause the rain sensor to work irregularly. Therefore, in this case, replace the wiper blade with a new one.

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OVERVIEW AND OPERATING PROCESS

1. WIPER AND WASHER SYSTEM

1) AUTO Washer Coupled Wiper Function



If you press the AUTO washer switch briefly with the ignition key ON and INT-AUTO switch "OFF", the washer motor is operated for about 2 seconds to spray washer fluid once after the switch is turned ON and the wiper relay is turned ON for 4 cycles. After that, the washer motor is operated for about 2 seconds to spray the washer fluid again and the relay is turned ON for 3 cycles and then the relay is turned OFF.

2) Rear Washer Fluid Supply System

The front washer fluid reservoir supplies the rear washer fluid without additional washer fluid reservoir.



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Application basis	
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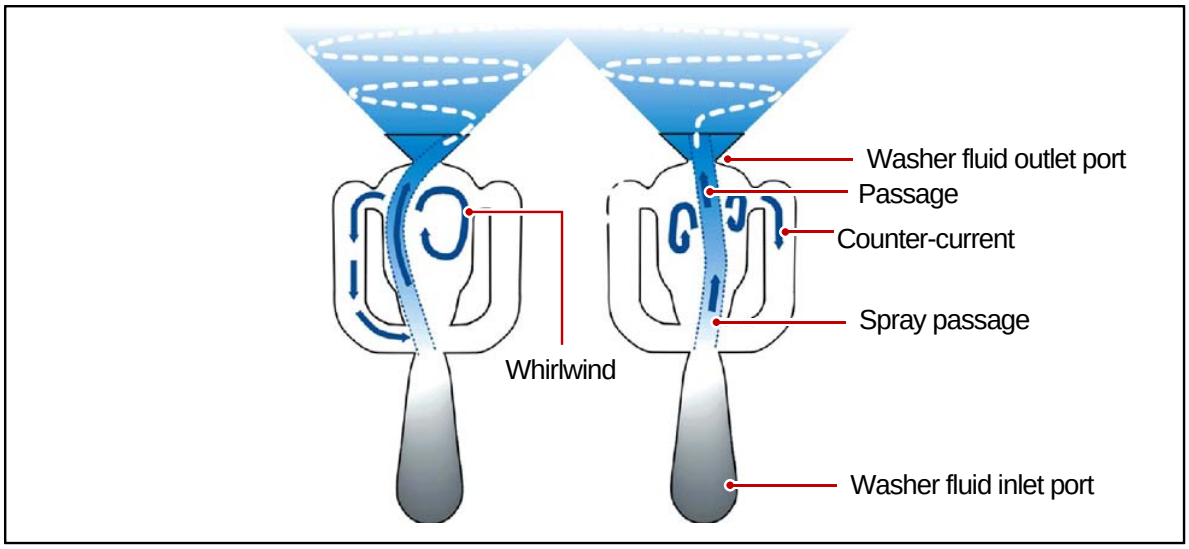
3) Fluidic Washer Nozzle

This vehicle has the fluidic washer nozzle, which is designed to use fluid movement occurring in the washer fluid spraying process.



* When installing the washer nozzle, make sure that the mounting surface is clean and free of dirt or debris, since the water may come into the engine compartment in accordance with a seamless contact condition between the mounting surface of the nozzle and the curved surface of the engine hood.

The inside of the nozzle is designed in a fan shape to change the spray direction continuously based on the time the fluid is sprayed. Refer to the figure below.



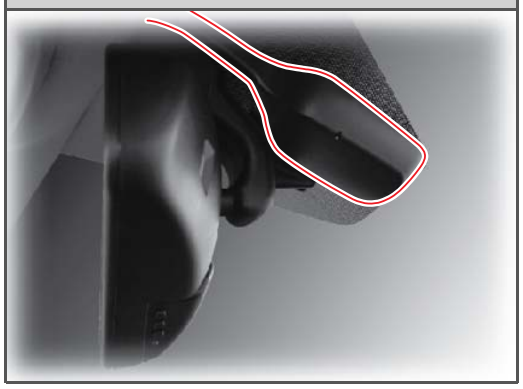
The spray direction is changed by means of the whirlwind and back flow generated while the washer fluid is passing through the nozzle.

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2. RAIN SENSING SYSTEM

In the rain sensing wiper operation system, the rain sensing unit only sends the information about the amount of rain drops to the BCM, and it does not operate the wiper directly. The wiper and washer are controlled by the BCM according to the driver's choice.

Rain sensing unit



This sensor emits infrared rays through LED and then detects the amount of rain drops by receiving the rays reflected off the sensing section (rain sensor mounting section on the windshield) with photodiode.

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 the sensitivity for the amount of rains on the windshield and transmit the wiping request signal accordingly.





Rain sensor emitter lens

Auto light sensor sensing portion

Modification basis	
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▶ BCM

The rain sensor detects the amount of rain drops and sends the operating request signal to the BCM, which drives the wiper directly. At this moment, the BCM also sends the information on whether the wiper is in operation mode or whether the multifunction wiper switch is in AUTO position to the rain sensor.

BCM	Underhood Fuse Box
	

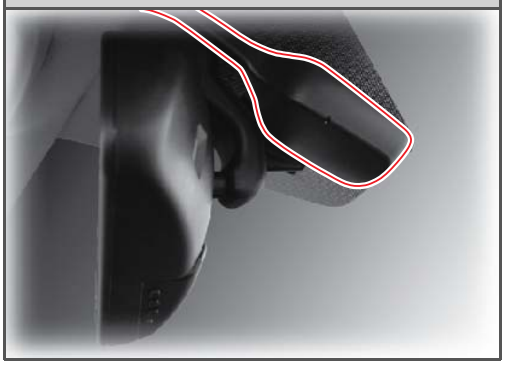
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3. SYSTEM LAYOUT (INCLUDING RAIN SENSOR)

Wiper and washer switch



Rain sensor unit



Wiper

Front wiper



Rear wiper





Rear washer hose and nozzle

For vehicles with rear spoiler



For vehicles without rear spoiler



Modification basis	
Application basis	
Affected VIN	

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BCM







Front nozzle assembly



Washer fluid reservoir assembly



Washer motor



Modification basis	
Application basis	
Affected VIN	

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4. WIPER AND WASHER OPERATION

1) Windshield Wiper Control Function

MIST

If you move the wiper switch to "MIST" position and release it, the windshield wipers operate one wiping cycle. The wipers will operate continuously if the switch is held in this position.

OFF

Wipers are not in operation.

AUTO

Operates automatically according to the vehicle speed and amount of rainfall.

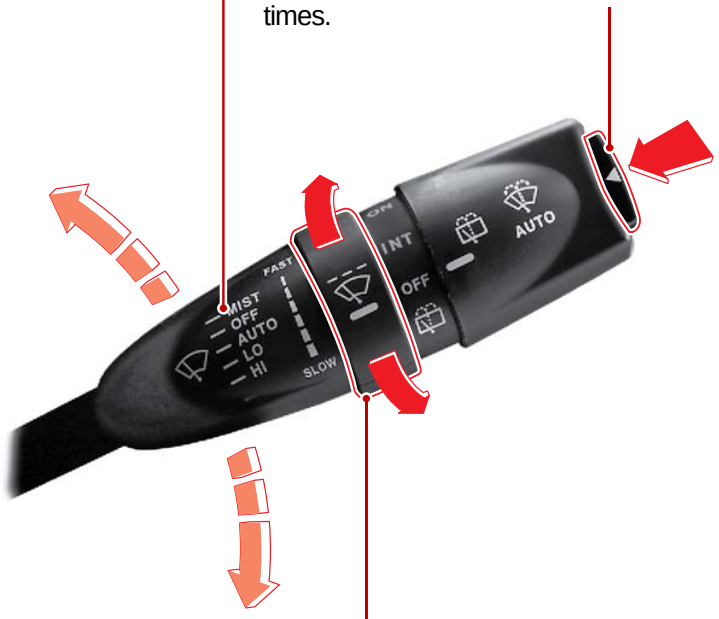
LO

Continuous wipe, slow operation

HI

Continuous wipe, fast operation

Front auto washer switch
When you press this switch with the front wiper switch in "OFF" position, 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.



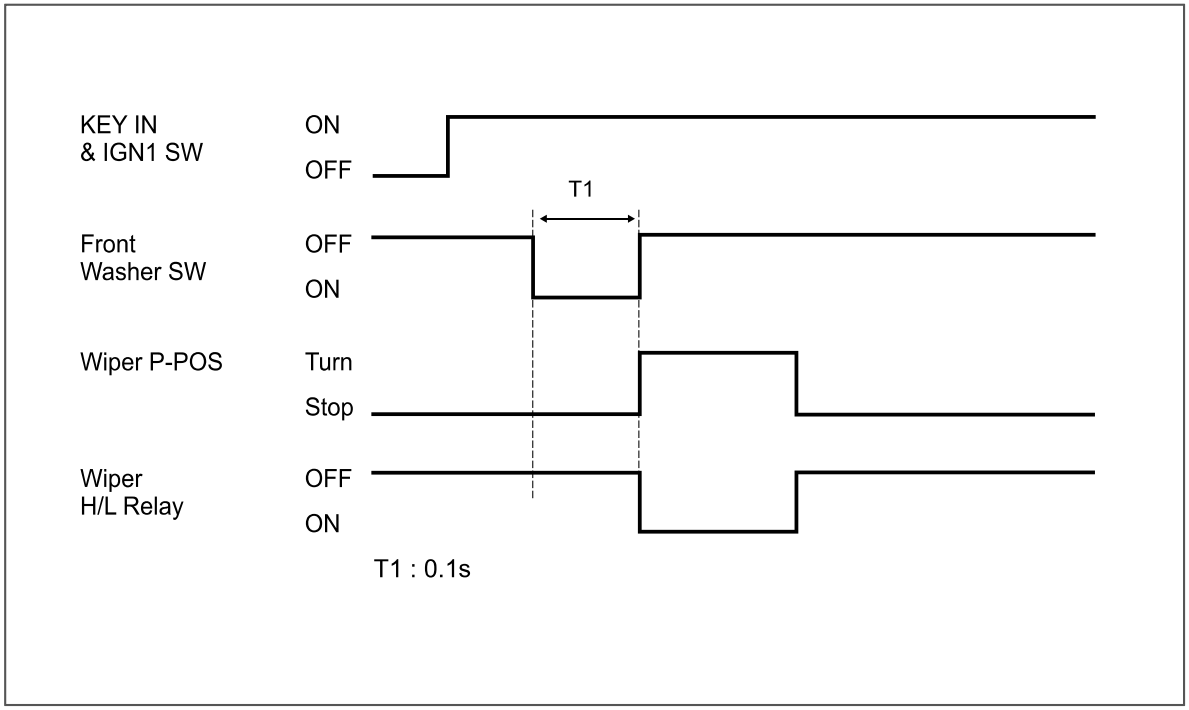
Front automatic wiping speed control switch
turning the control knob upward or downward when the windshield wiper switch is in AUTO position.
Fast: Fast interval
Slow: Slow interval

Modification basis	
Application basis	
Affected VIN	

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(1) Wiper mist

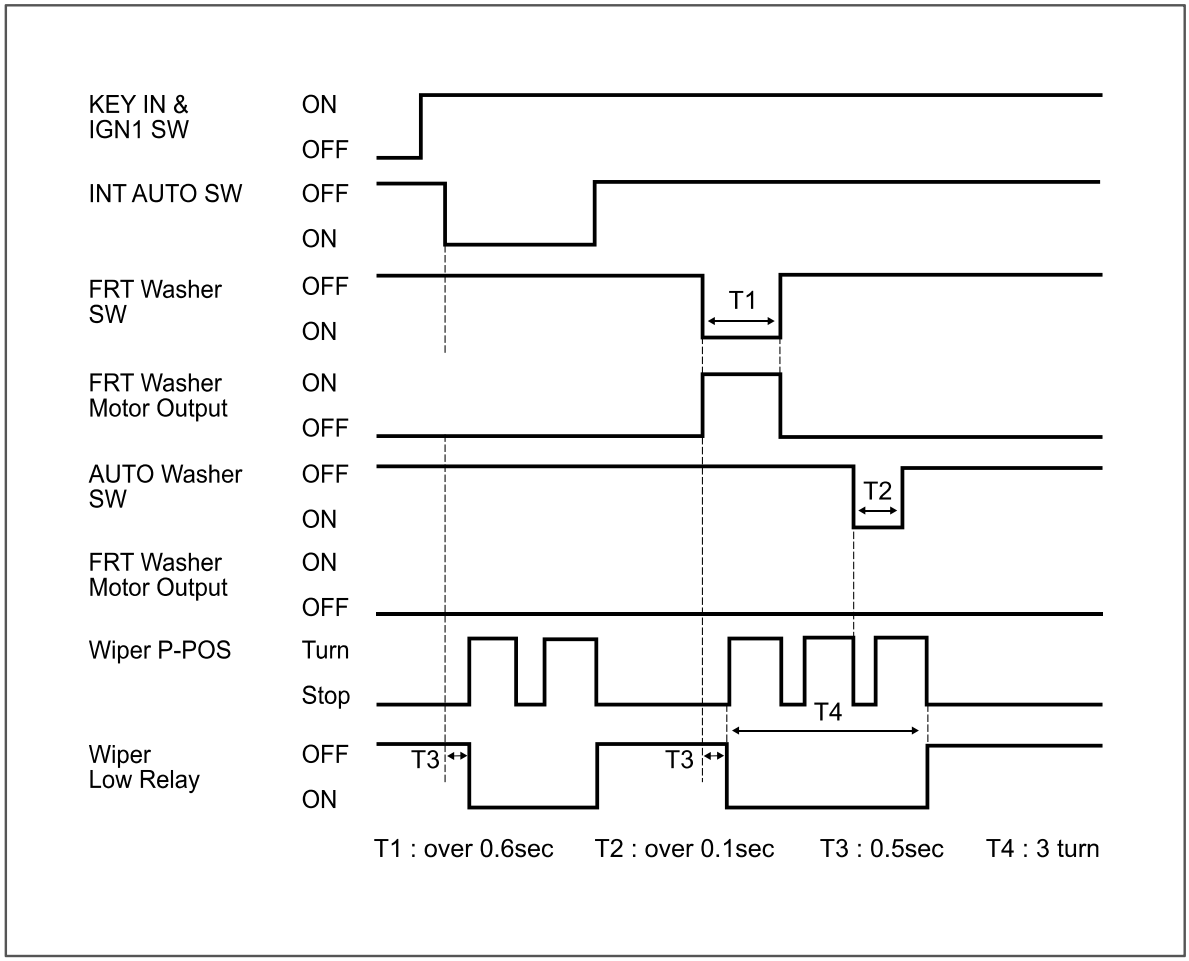
1. When the multifunction switch is pushed to the MIST position for 0.1 sec. or more with the IGN1 ON, the wiper relay is turned on after 0.1 sec. has passed. When the wiper returns to the park position, the wiper relay is turned off.
2. When the MIST switch signal is input the wiper is operated at high speed. When the switch is release from the MIST position, the wiper is operated at low speed.



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(2) Wiper LO/HI control

1. The wiper LOW relay is turned on when the multifunction wiper switch is at the LO position. The wiper HIGH relay is turned on when the wiper switch is at the HI position. When the wiper switch is at the HI position, both the LOW relay (constant operation) and HIGH relay are operated.
2. The wiper motor returns to parking position and stops, even when turning off the ignition switch during wiper operation.
3. The wiper relay should stay ON in low/high wiper operation mode even if the parking signal for the wiper motor is not received. In INT/AUTO wiper operation mode, the wiper relay should be turned OFF after 5 seconds if there is no parking signal for the wiper for 3 seconds and informs the driver of parking position signal abnormality.
4. While the wiper operates at low/high speed, the front/rear washer switch can be operated but the auto washer switch cannot.
5. The wiper motor returns to parking position and stops when turning off the ignition switch during wiper operation in high mode.



Modification basis	
Application basis	
Affected VIN	

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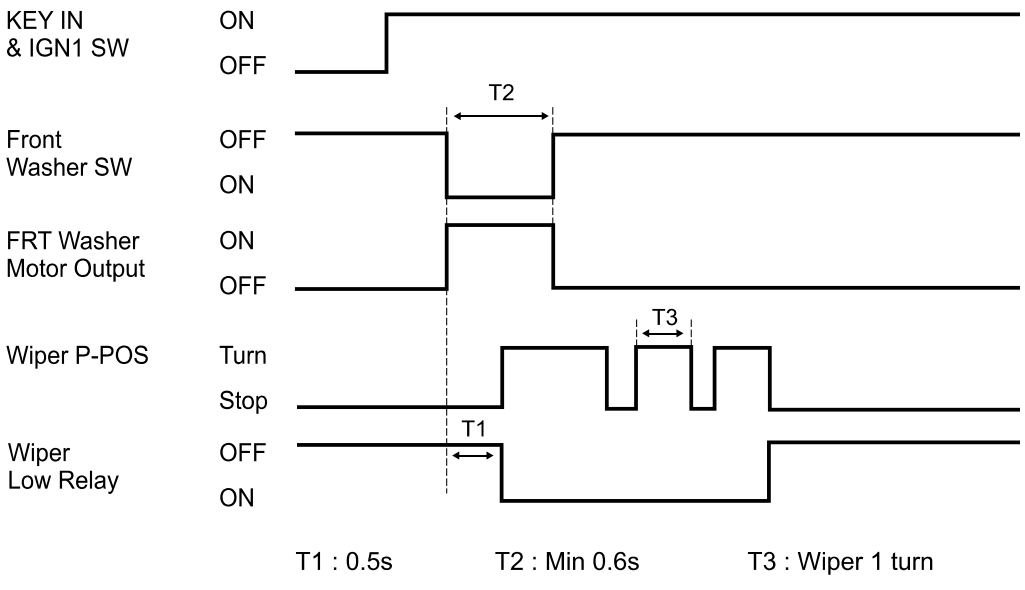
2) Windshield Washer Control Function

(1) Windshield washer coupled wiper



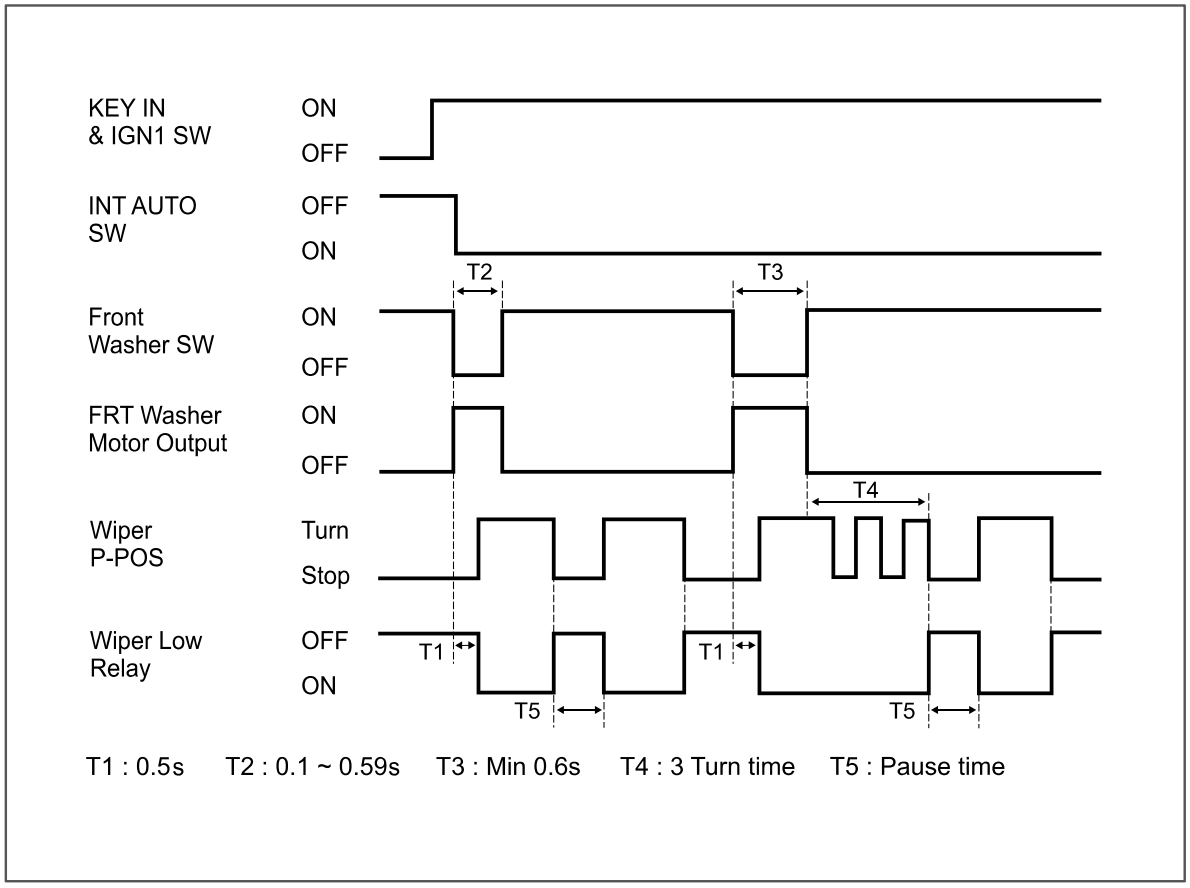
Wiper and Washer Coupled Operation
Pull the switch briefly (for less than 0.6 sec.)
: One wiping cycle
Pull and hold the switch for more than 0.6 sec.
: Three wiping cycles with washer fluid spray

1. When holding the front washer switch at ON position for more than 0.6 seconds with IGN ON, the wiper relay is activated 0.5 seconds after. The wiper stops after three more wipes since that the washer switch is turned to "OFF" position.



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2. When holding the front washer switch at ON position for 0.1 to 0.59 seconds during the wiper operation by the intermittent/automatic wiper switch, the wiper will operate only once. When holding the washer switch for more than 0.6 seconds, the wiper relay is activated 0.5 seconds after. The wiper stops after three more wipes since that the washer switch is turned to "OFF" position.



Modification basis	
Application basis	
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(2) AUTO washer coupled wiper

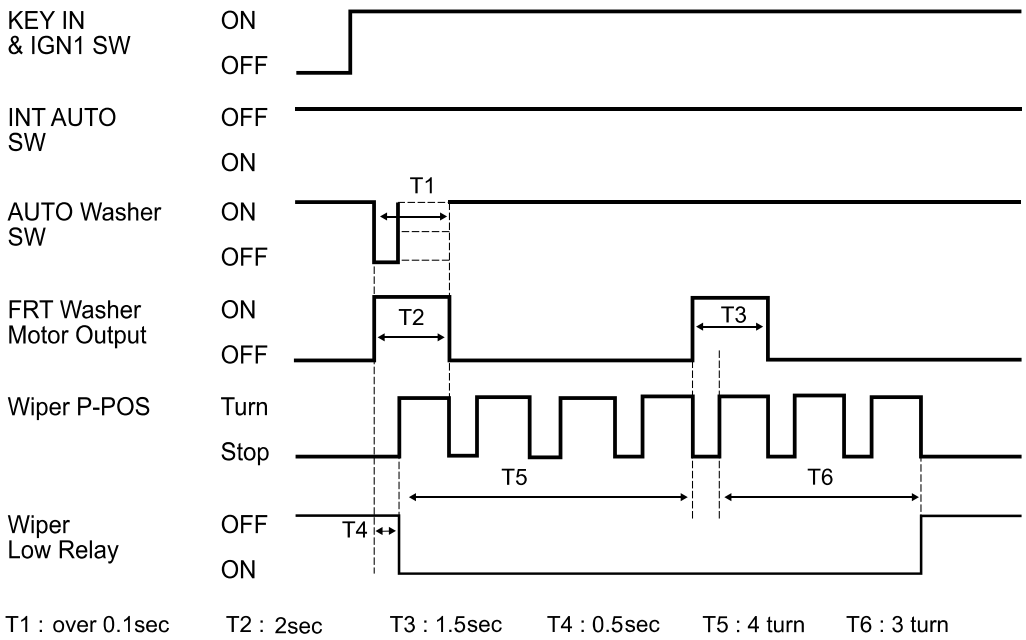


Auto washer switch

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 once more and the wiper operates 3 times.

1. When the AUTO washer switch is operated with IGN ON and the INT/AUTO switch OFF, the washer motor is operated for 2 sec. and the wiper continues to cycle 4 times. And then the washer motor is operated for 2 sec. and the wiper continues to cycle 3 times before returning to park position.
2. The auto washer switch signal is overridden during speed sensitive intermittent wiper, washer coupled wiper or auto washer coupled wiper operation.
3. When turning the wiper switch to AUTO position during the operation of auto washer, the auto washer stops its operation and the intermittent/automatic wiping mode will be started.
4. The front and rear washer switch signal are overridden during the operation of auto washer. The input from the switch during the AUTO washer coupled wiper operation also is ignored.
5.

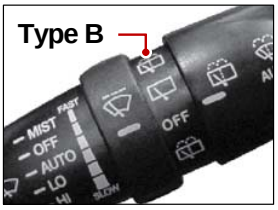


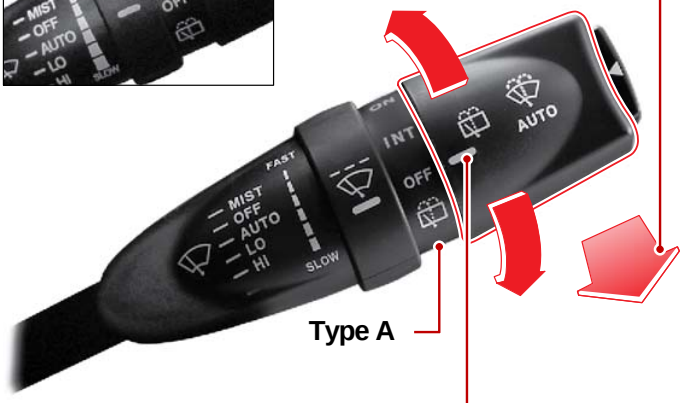
T1 : over 0.1sec T2 : 2sec T3 : 1.5sec T4 : 0.5sec T5 : 4 turn T6 : 3 turn

Modification basis	
Application basis	
Affected VIN	

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3) Rear Wiper Control Function





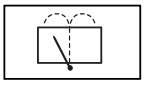
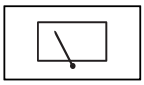
Windshield Washer Operation
In the "OFF" position, pull the lever toward you to spray washer fluid on the windshield and to operate the wipers 1~3 cycles.
Pull the lever briefly (for less than 0.6 seconds): One wiping cycle with washer spray
Pull and hold the lever for more than 0.6 seconds: Three wiping cycles with washer spray
The spray and wiper operation will continue until you release the lever.

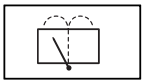
Rear wiper switch

TYPE A

ON	Rear wiper operation (Normal Speed)
INT	Rear wiper operation (Intermittent)

TYPE B

	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 Rear Wiper Operation mode and only the wiper will keep operating.
	Rear wiper operation

OFF	Rear wiper is not in operation.
	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.

Modification basis	
Application basis	
Affected VIN	

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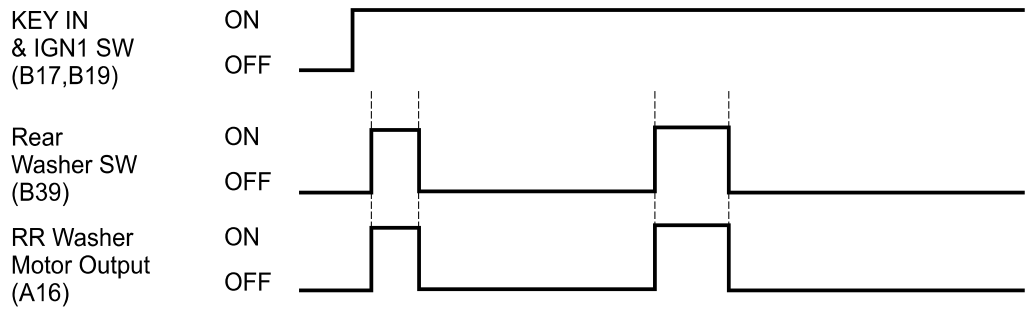
4) Rear Washer Control Function



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.

▶ Rear washer motor control

1. The rear washer motor is operated only when the rear washer switch is activated with the ignition key ON.
2. If the front washer or automatic washer switch signal is received during the rear washer switch operation, the washer motor stops and the front washer or automatic washer motor begins to operate.



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5) Rain Sensor Coupled Wiper Control Function

AUTO operation and sensitivity control



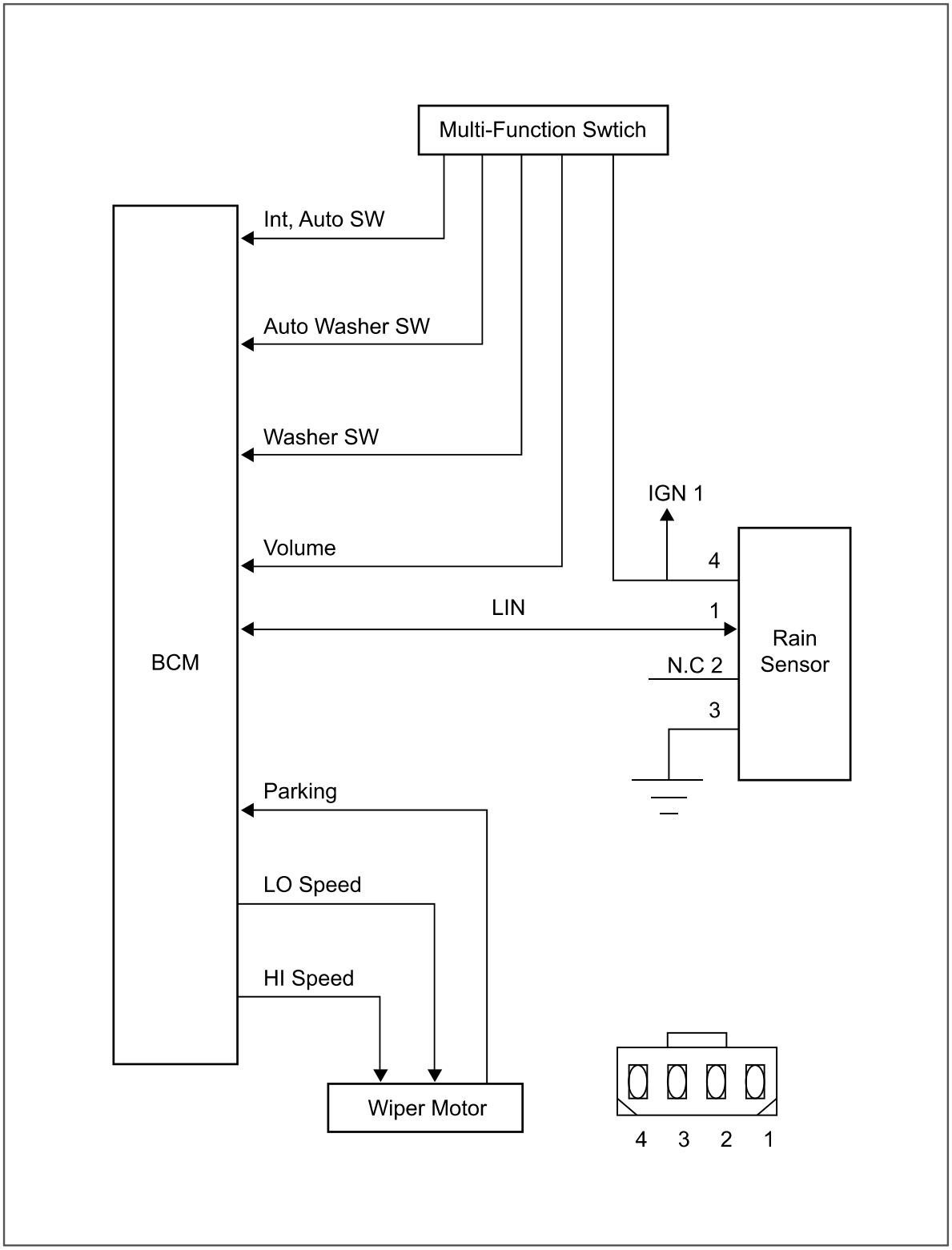
AUTO: Wiper operates automatically by rain sensor
FAST <----> Auto delay/auto speed control
A position that can control sensitivity against rains on the windshield and transmits wiping demand signal accordingly.

Modification basis	
Application basis	
Affected VIN	

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(1) Rain sensor coupled wiper operation (LIN)

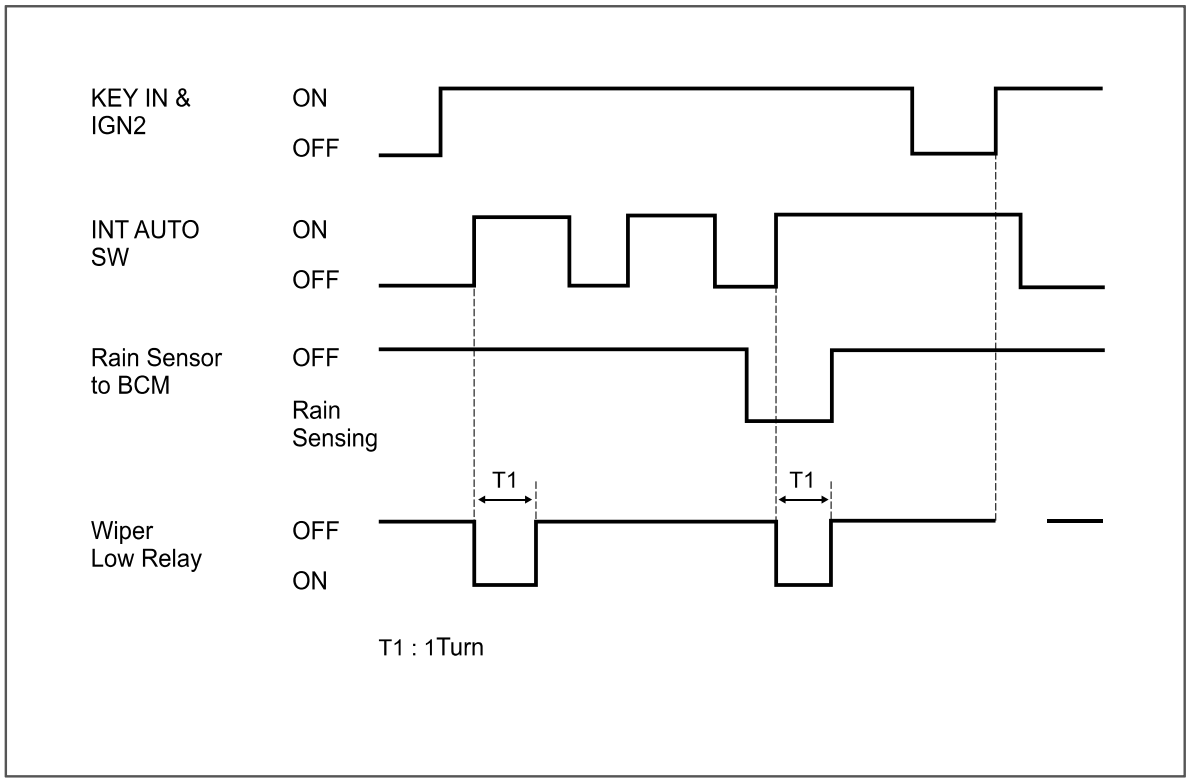
▶ **System layout**



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(2) Power-up reminder wiper

1. If the intermittent/automatic wiper switch is in "ON" position, the wiper motor does not operate even when turning the ignition switch to ON from OFF position.
2. When the INT/AUTO wiper switch is turned on from off with the ignition switch ON, the wiper is operated at low speed for the 1st cycle regardless of the rain sensor signals. After that, if the INT/AUTO wiper switch is turned on from off, the wiper cycles one time at low speed only when the rain sensor detects the presence of rain.

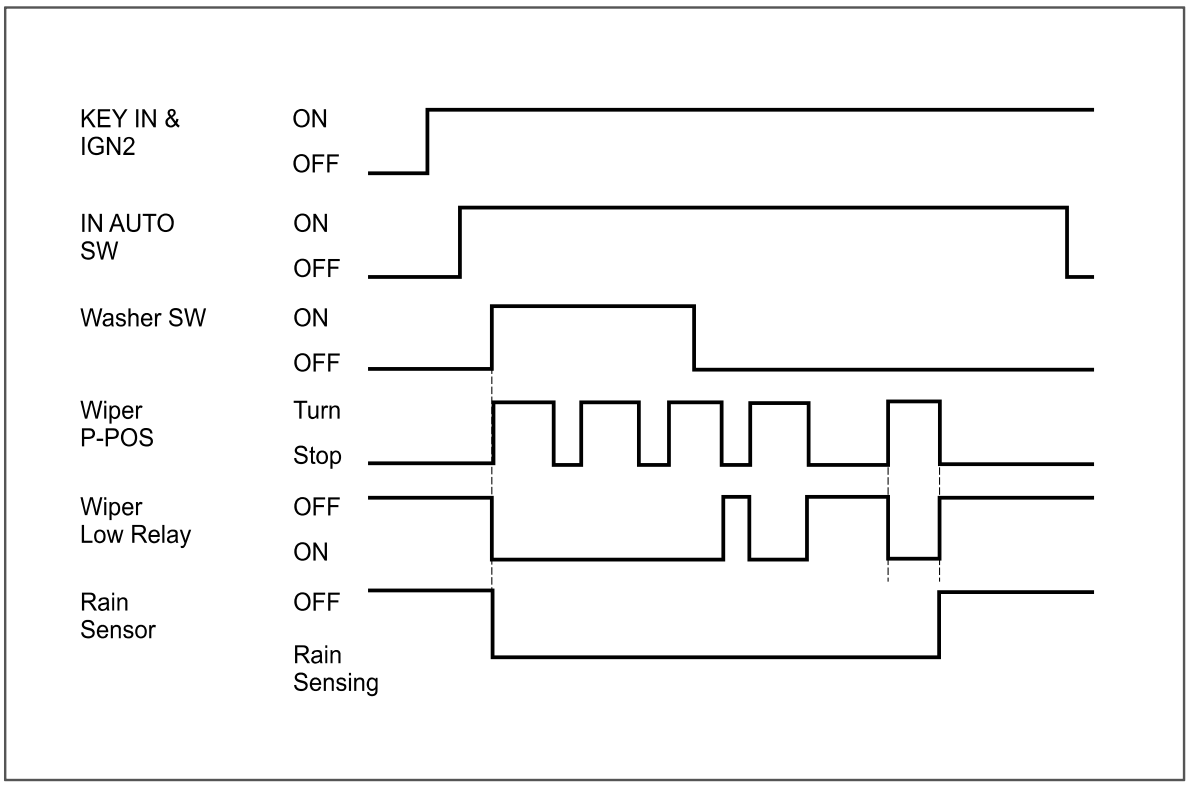


Modification basis	
Application basis	
Affected VIN	

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(3) Washer coupled wiper operation during rain sensor coupled operation

1. When the washer switch signal is received during intermittent operation coupled with rain sensor with IGN ON and intermittent/automatic
   washer switch operation, the wipers operate in washer coupled mode regardless of the communication with the rain sensor. However, if the washer switch
   signal is received the washer relay is activated and wiper relay remains activated,
   when the data coupled with rain sensor indicates continuous wiper operation.
2. Even though the wiping system is in washer coupled wiper mode, the operating data are sent to rain sensor.

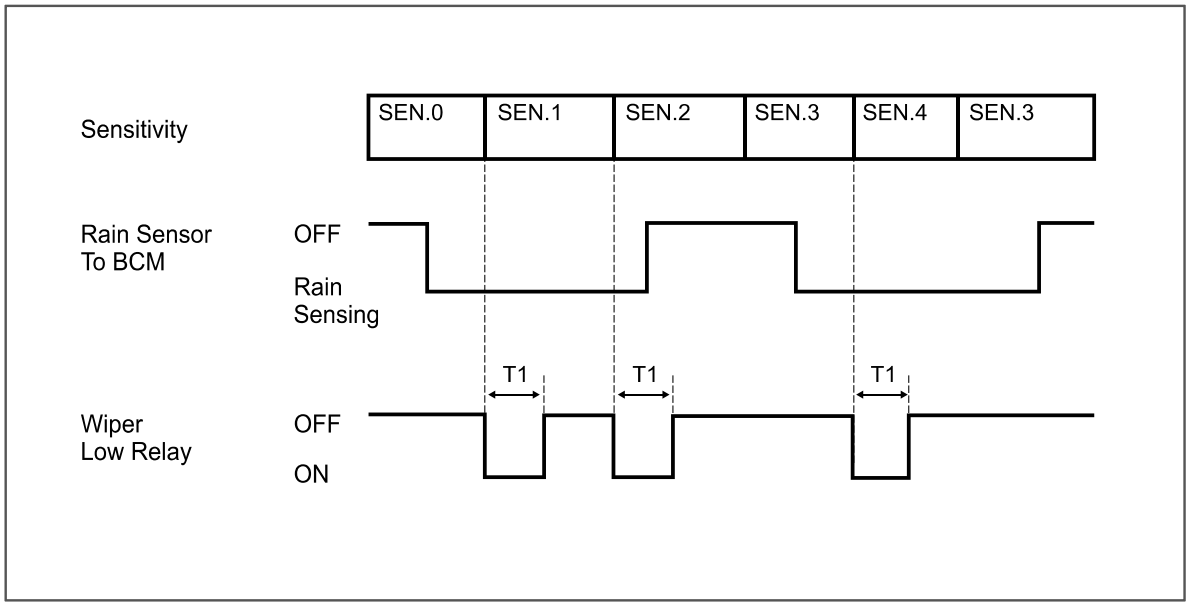


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(4) Sensitivity control (instant wiping)

1. When the wiping speed control switch is turned to "FAST" with IGN2 ON, intermittent/automatic wiper switch in "ON" position and wiper motor stop (parking position), the wiper motor operates one cycle at low speed.
   (only when the rain sensor detects raindrops)

* If the wiping speed control switch is changed more than 2 stages within 2 seconds, the wiper motor operates only one cycle.

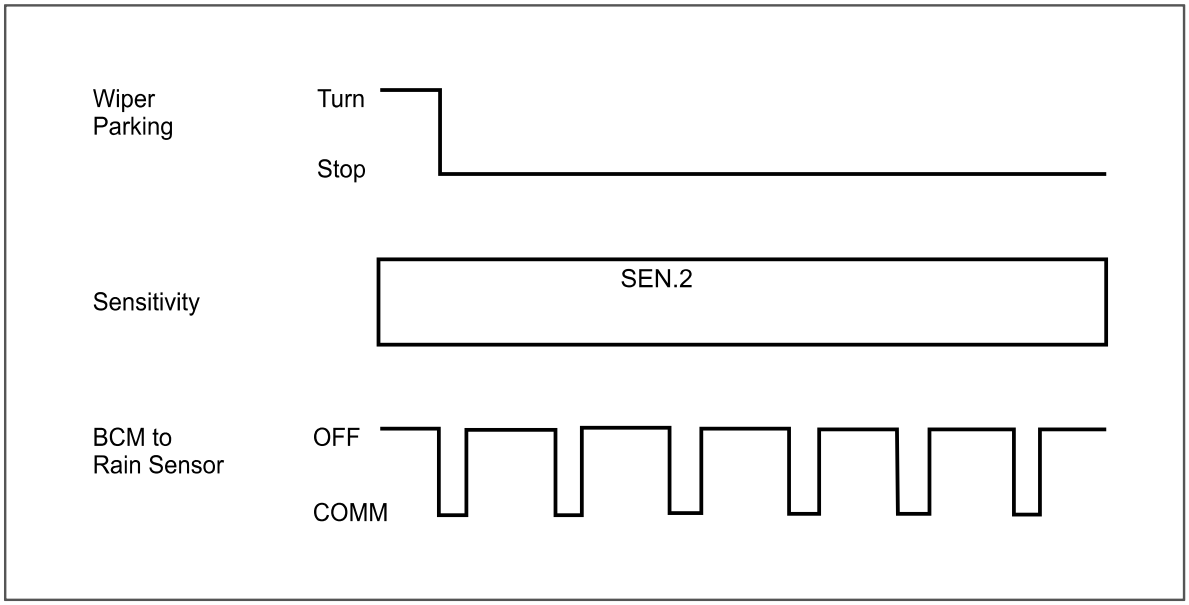


Modification basis	
Application basis	
Affected VIN	

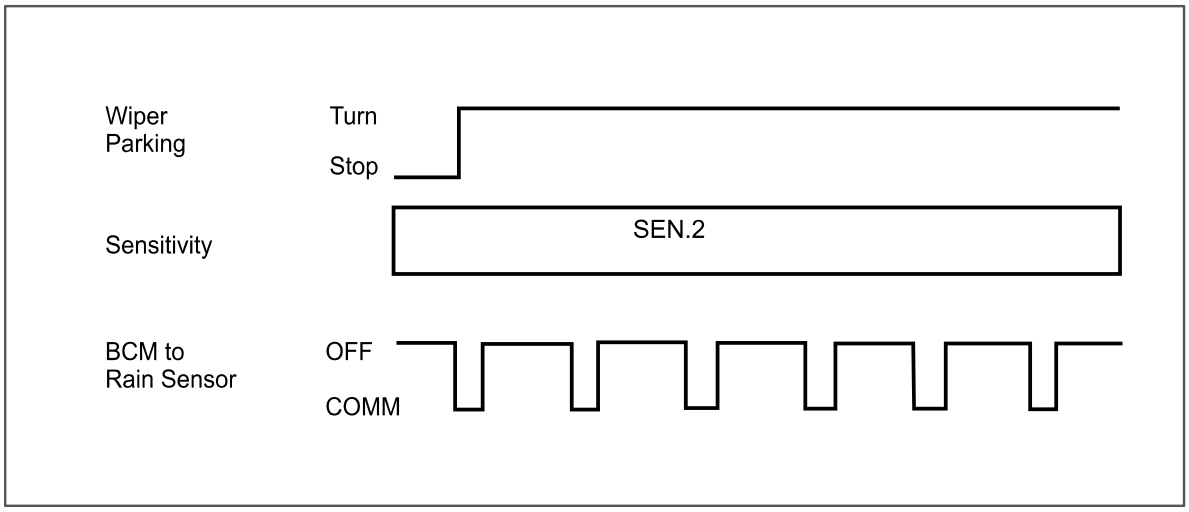
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(5) For abnormal wiper parking signal

1. The wiper system sends continuously the signal for current status when the wiper parking terminal is shorted to ground with IGN2 ON and intermittent wiper switch in "ON" position.
   * The wiper motor is operated only when there is a request from the rain sensor.



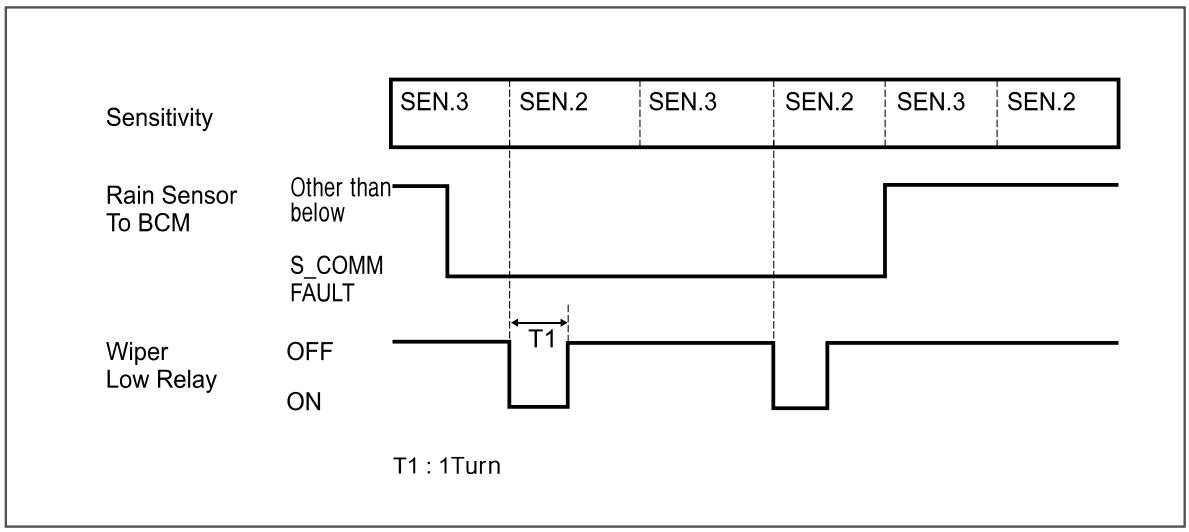
2. When the parking terminal is shorted to power with IGN2 ON and intermittent wiper switch in "ON" position, the wiper system sends the signal for current wiping status for 2 seconds. After that, it sends the current signal for parking status continuously.
   * The wiper motor is operated only when there is a request from the rain sensor.



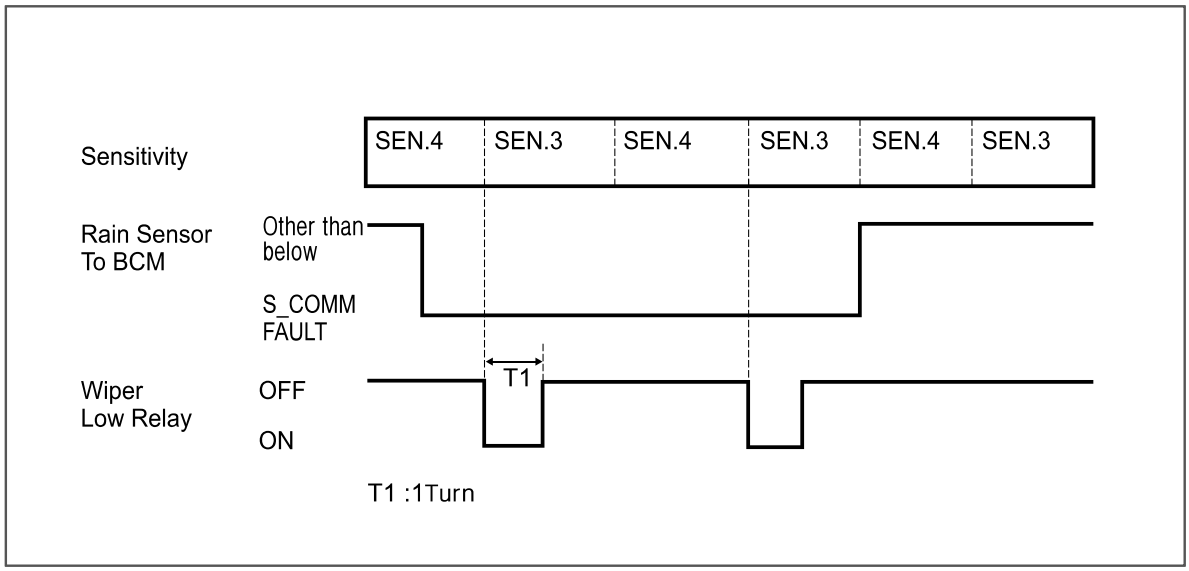
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(6) For faulty rain sensor

1. When the wiper speed control switch is turned to step 2 from step 3 the wiper motor cycles one time at low speed, provided that the BCM receives a faulty sensor signal from the rain sensor unit with IGN ON and the INT/AUTO switch ON.



2. When the wiper speed control switch is turned to step 3 from step 4 the wiper motor cycles one time at low speed, provided that the BCM receives a communication error signal from the rain sensor unit with IGN ON and the INT/AUTO switch ON.



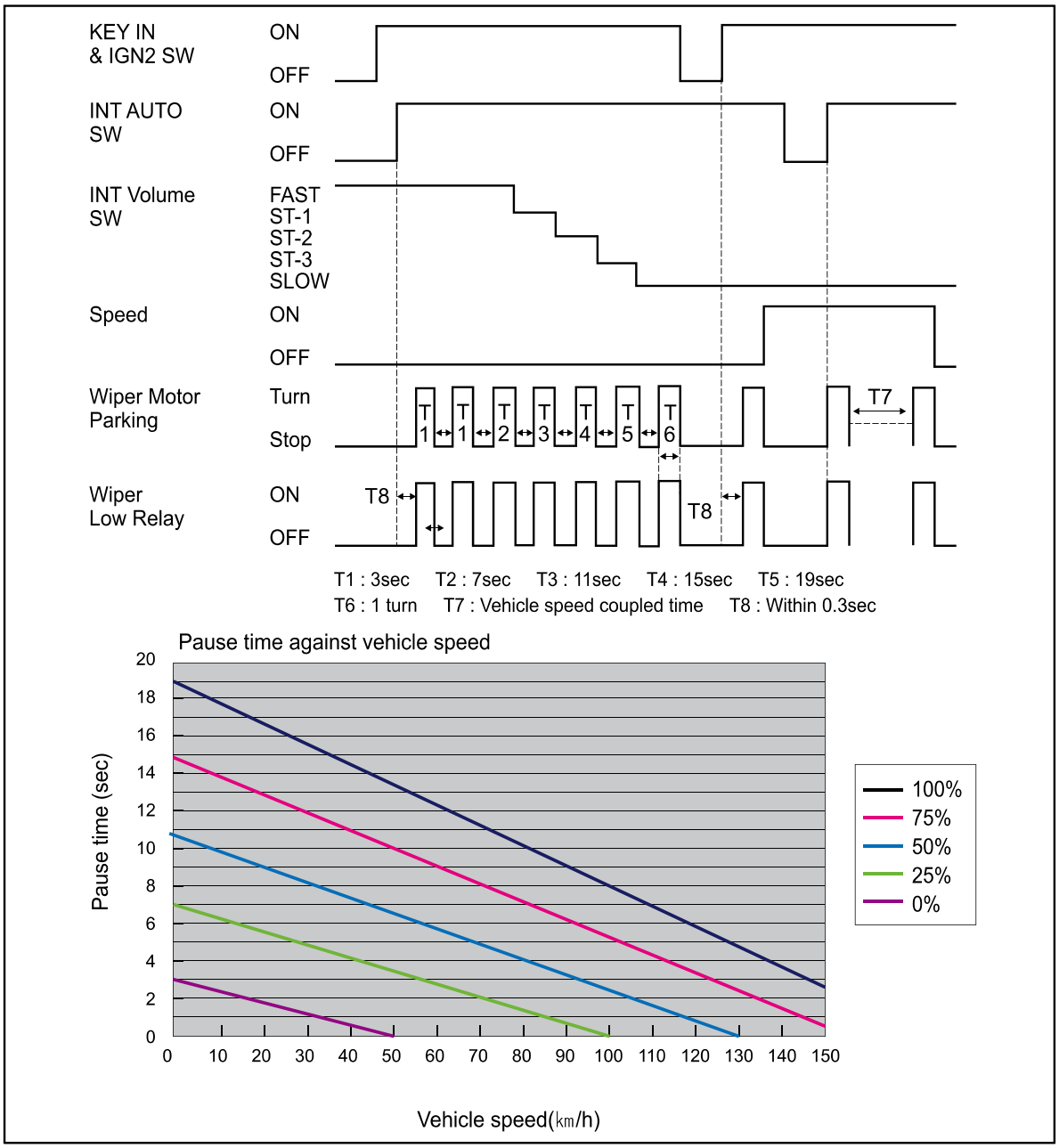
Modification basis	
Application basis	
Affected VIN	

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(7) Speed sensitive intermittent wiper

For the vehicles without rain sensor, the BCM operates the wiper as follows:

1. When turning the ignition switch to ON from OFF position with the intermittent wiper switch in "ON" position, the wipers do not operate.
2. When turning the wiper switch to ON from OFF position after turning the ignition switch to ON position, the wipers operate one cycle.
3. The wiper's operation cycle depends on the vehicle speed (CAN communication with instrument cluster) and wiping speed the side fascia panel.
   - Wiping cycle: 3 ± 0.5 sec. (FAST) to 19 ± 2 sec. (SLOW)



Modification basis	
Application basis	
Affected VIN	

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▶ Speed sensitive intermittent wiper interval

SPEED / VIR	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

Modification basis	
Application basis	
Affected VIN	

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PAS

8790-00

GENERAL INFORMATION

1. SPECIFICATION

Pin No.	Specification	Pin No.	Specification
Rated voltage	DC 12.0 V	Insulating resistance	No heat & fire due to current leak
Operating voltage	DC 9.0 V ~ 16.0 V	Max. permissible current	Unit: 100 mA or less
Operating temperature	−30℃ ~ +80℃		Sensor: 20 mA or less
Storage temperature	−40℃ ~ +85℃	Weight	Unit: 75.7 g±5 g
Maximum humidity	95%		Sensor: 38.7 g±5 g

2. CAUTIONS

▶ **Sensor Cannot Detect**

- When the sensor is frozen (operate normally when it's thawed)
- When the sensor is covered with foreign materials such as snow or condensation (if the foreign materials are removed, the sensor operates normally.)

▶ **Not defective but improperly working**

- When the sensing portion is frozen (operates normally after thawed)
- When reversing on rough roads, gravel roads, hills, or grass.
- When receiving other ultrasonic signals (metal sounds or air braking noises from heavy commercial vehicles).
- When there is heavy rainfall or water drops.
- When the sensor is covered with snow.

▶ **Certain obstacles that sensors cannot detect**

- Thin and narrow objects, such as wires, ropes, or chains
- Cotton, sponge, clothes, snow that absorb ultrasonic waves.

▶ **Weak Sensing Scopes**

- When the ambient temperature is too high or too low.
- When a 1 m or less long small object with a diagmeter of 100 mm or less is detected.

Modification basis	
Application basis	
Affected VIN	

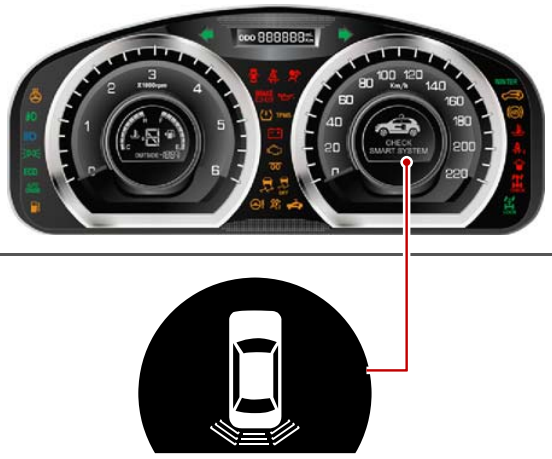
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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

When the gear selector lever is shifted into "R", the parking aid system is activated and three sensors in the rear bumper detect the distance to any obstacle. The PAS detects the returning signals reflected to the obstacles at regular intervals when the vehicle is parked to indicate the display and alarm for the distance between the obstacles by phase so as to allow the driver easy parking by securing safe distance.

① IP display (SVC only)





② Buzzer for PAS



Buzzer sounds using instrument cluster buzzer

③ Rearview camera



④ Shift lever



Modification basis	
Application basis	
Affected VIN	

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2. CONFIGURATION



Installation of PAS sensor





5 Parking aid unit



6 PAS sensor



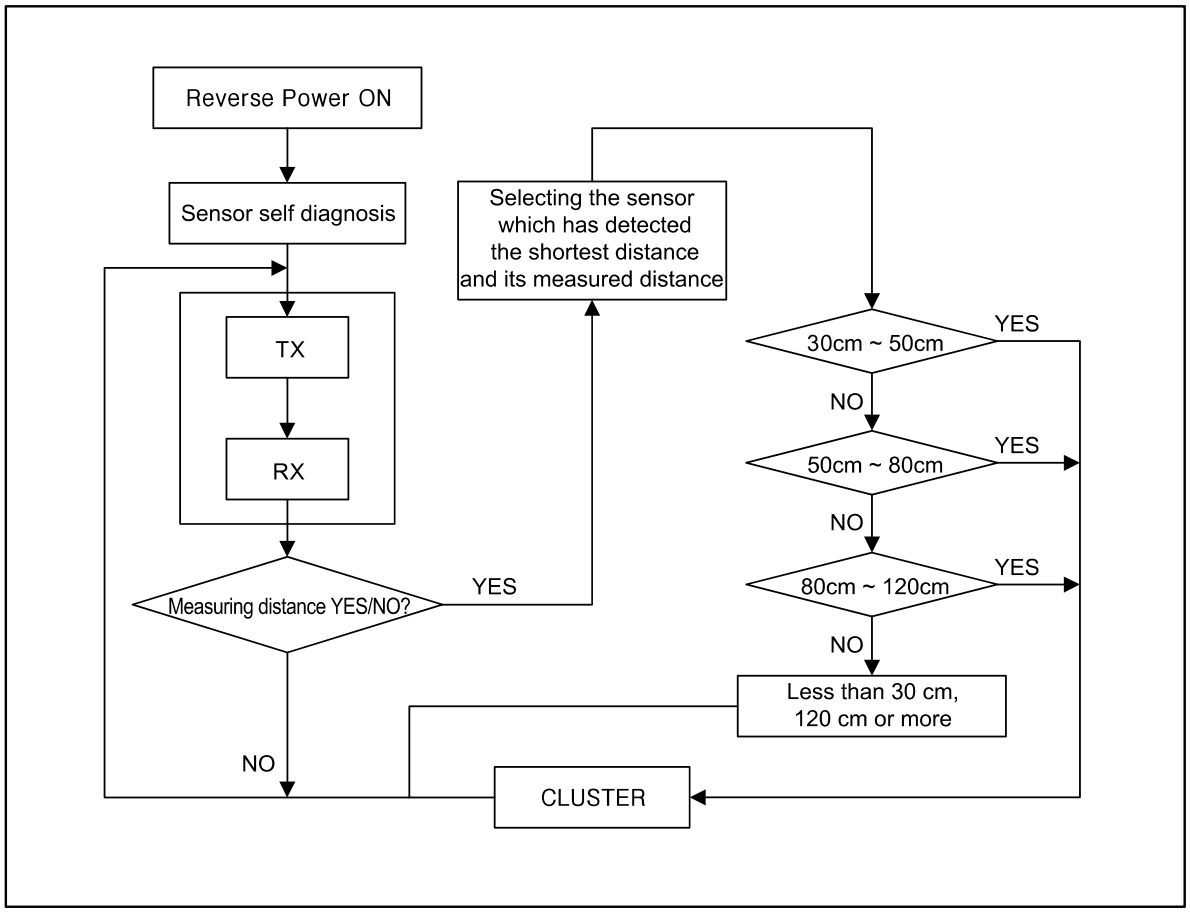
Modification basis	
Application basis	
Affected VIN	

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3. OPERATING PROCESS

When PAS receives "R" signal, it starts to detect the obstacles behind vehicle after self diagnosis.
If the system detects the obstacle, the buzzer sounds according to the distance. If there is no obstacle, starts to detect the obstacles after self diagnosis again.

1) Block Diagram



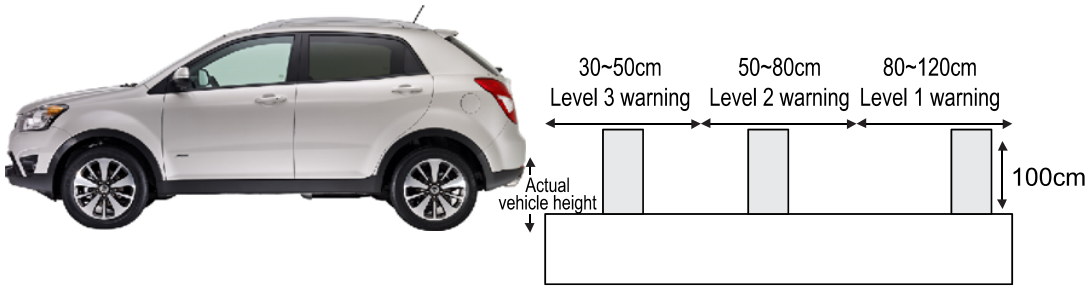
Modification basis	
Application basis	
Affected VIN	

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2) Rear PAS Sensor

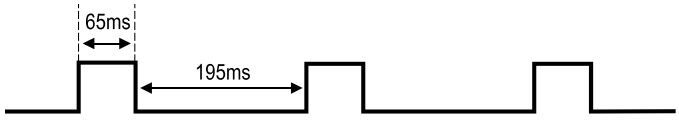
While reversing, if obstacles are within stage 1, the warning beep sounds with long intervals. If within stage 2, the warning beep sounds with short intervals and if within stage 3, the warning beep sounds continuously.

Sensor detection range



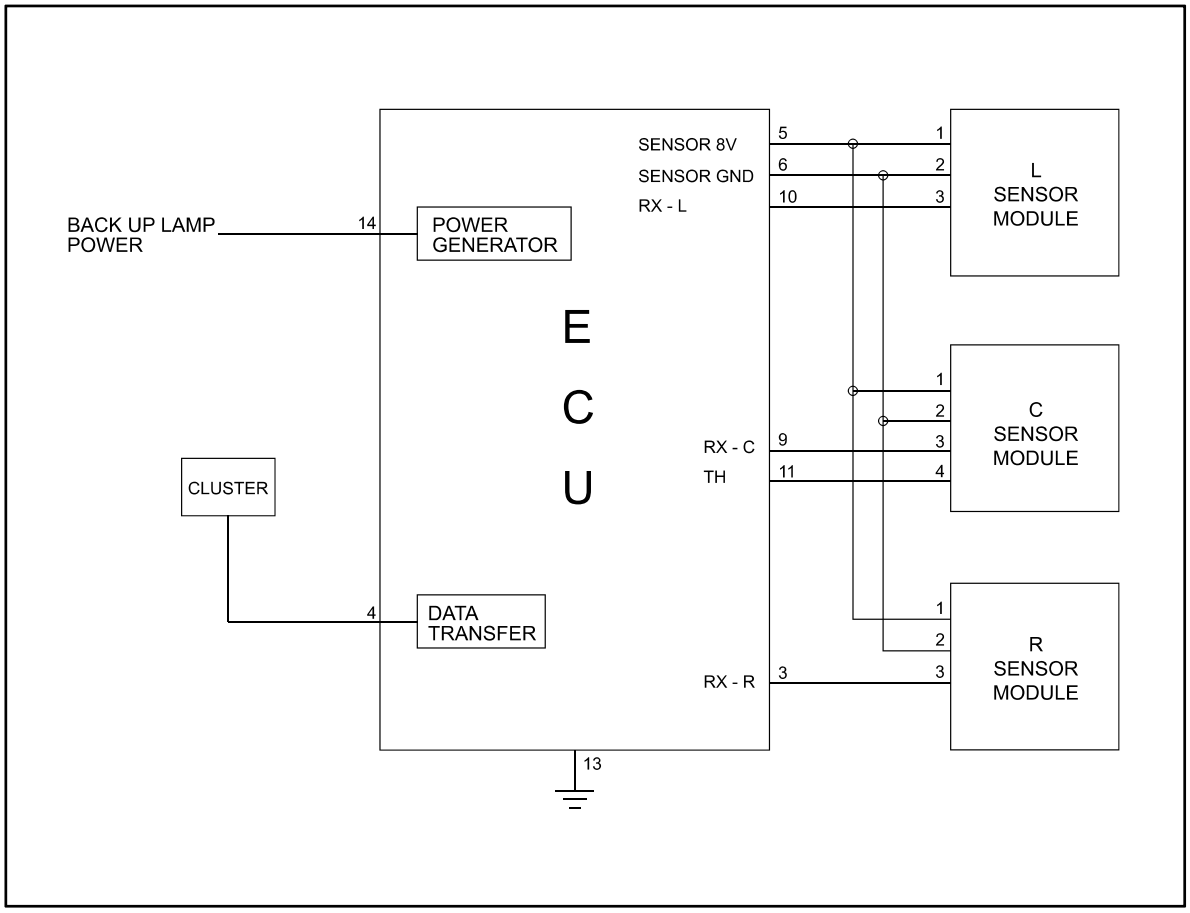
Within 20 cm from the ground
(Objects may not be detected in this range.)

▶ **Buzzer interval when measuring distance**

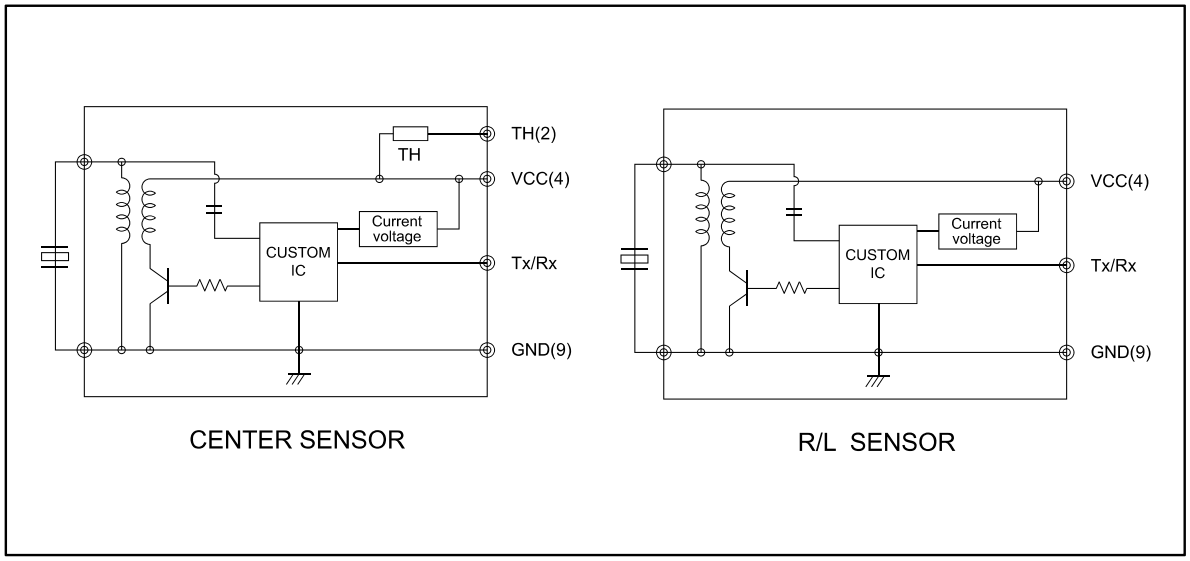
Level	L / R	CENTER	Alarm interval (msec)
Level 1	80~100 (cm)	80~120 (cm)	
Level 2	50~80 (cm)		
Level 3	30~50 (cm)		
Tolerance	±10 (cm)		±10 (cm)

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▶ Circuit diagram of ECU



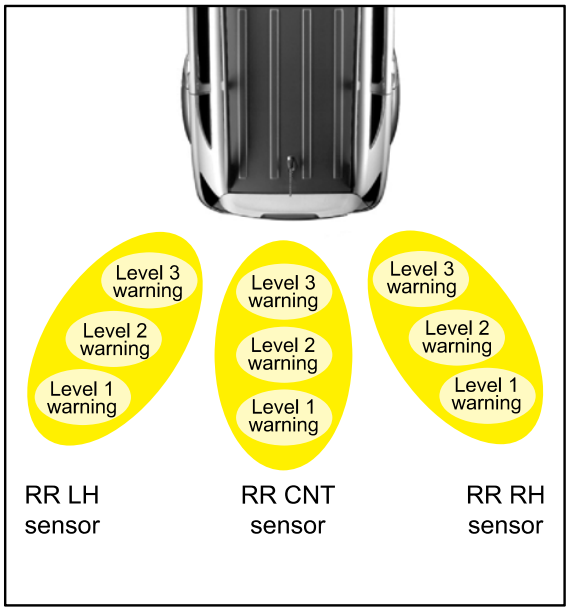
▶ Internal circuit diagram of sensors



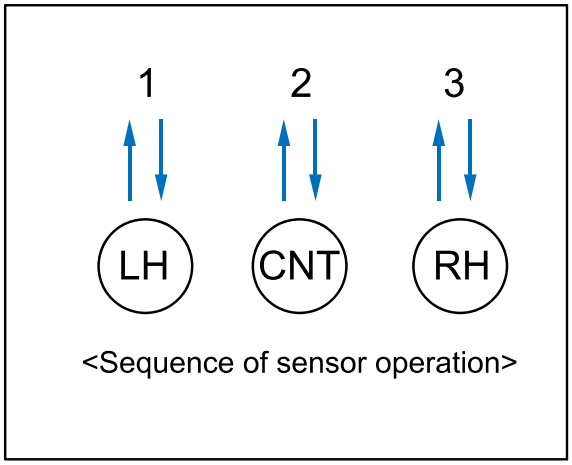
Modification basis	
Application basis	
Affected VIN	

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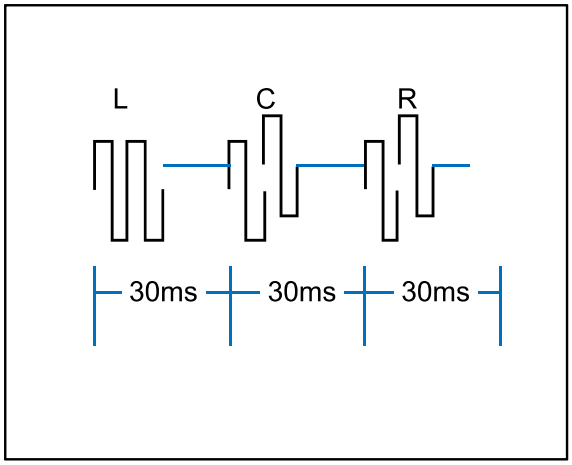
▶ Sensor operating sequence



The ultrasonic sensors transmit ultrasonic waves and receive the reflected waves from an obstacle to detect it in the following order: L → C → R.



<Sequence of sensor operation>



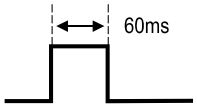
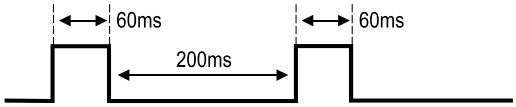
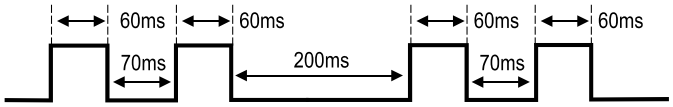
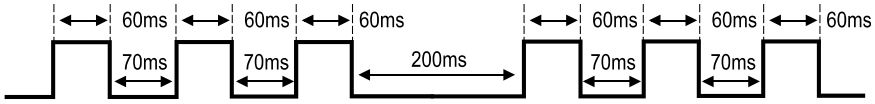
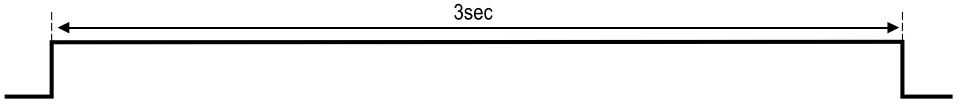
Modification basis	
Application basis	
Affected VIN	

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4. OUTPUT SPECIFICATIONS FOR SENSOR SELF-DIAGNOSIS BUZZER SOUND

▶ Buzzer interval during self diagnosis

Self diagnosis is performed once when the ignition is switched on (gear shift lever in "R" position). If the system is defective (Fail) due to open sensor or communication problem, the information for the failed sensor is displayed as buzzer sound.
If it is normal, the warning buzzer sounds for 60 ms.

MODE	Alarm interval (msec)
Normal	
LEFT	
CENTER	
RIGHT	
2 or more sensors	

▶ Conditions to "FAIL" in sensor diagnosis

- Fail condition (However, no obstacle should be within 30 cm)
  1. The signal wire is open
  2. The power wire (+ and -)is open

▶ Exception/error handling

1. Timeout processing time for buzzer interval after measuring distance/self diagnosis: 600 ms
   - If timeout is reached, the PAS returns to undetected condition.
2. Process while re-inputting
   - After timeout, the process is performed normally if the signal required for display is received from beginning to end. (not detectable if the signal is received in the midst of process)

Modification basis	
Application basis	
Affected VIN	

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AUDIO SYSTEM 8910-05

GENERAL INFORMATION

1. SPECIFICATION

Unit	Item	Specification
Audio	Voltage	DC 14.4 V
	Speaker impedance	4 Ω
	Max. power	45 watts x 4 ch
	Weight	2,244 g
	Size	310.4 mm (W) x 275.7 mm (H) x 209 mm (D)
Radio	Frequency	FM: 87.5 MHz ~ 108.0 MHz AM: 531 kHz ~ 1,602 kHz
	Sensitivity	FM: 18 dBu AM: 35 dBu
	S/N ratio (Signal/noise ratio)	FM: 45 db AM: 40 db
	Stereo channel separation	FM: 20 db
MP3 [WMA]/USB	Frequency response	20 Hz ~ 20 kHz
	S/N ratio (Signal/noise ratio)	60 dB
	Channel response	54 dB
MP3 [WMA]/CD	Frequency response	20 Hz ~ 20 kHz (±3 db)
	S/N ratio (Signal/noise ratio)	50 dB
	Channel response	35 dB
Bluetooth	Frequency	2,402 ~ 2,480 MHz
	Specification	Supports headset, hands-free, A2DP and AVRCP profile formats (Headset, hands-free: profile for calling) (A2DP, AVRCP: profile for listening music)

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Unit	Item		Specification
Micro pole antenna	Audio specification	Operating current	Max. 150 mA
		Operating voltage	DC 10.5 V to 16 V
		Operating temperature	−30℃ ~ +60℃
		Storage temperature	−40℃ ~ +80℃
		I/O impedance	75 Ω (FM)

Modification basis	
Application basis	
Affected VIN	

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2. CAUTIONS AND WARNING FOR SAFETY

CAUTION

- This mark indicates potentially hazardous situation which, if not observed, may result in serious injury and material damage.
- Ssangyong is not liable for any personal injury and material damage, caused by violation of traffic regulations or neglect of observing actual traffic and driving situations.
- Colors on display figures in this manual may differ from actual display due to publication concerns.

WARNING

- This mark indicates situation which, if not observed, may result in an accident or system malfunction.
- Do not disassemble or modify this system.
  If doing so, it may cause an accident, fire or electric shock.
- Do not use the system if it is malfunctioning (sound or video output problem).
  Doing so may lead to an accident or electric shock.
  Please contact a Ssangyong service dealer immediately.
- The system should be used only when the engine is started.
  Using the system for an extended period of the with the engine off may discharge the battery.
  Do not leave beverages or foreign materials around the system.
- If they enter the system, they may cause a fire.
  The system may break down if a disc not supported by this system is inserted.
- Do not apply impact to or drop this system.
- It might cause malfunction.
  Never leave the system in a hot or cold place for an extended period of time. Therefore, do not
- park the vehicle in a hot or cold place. The ambient temperature should be −30℃ ~ +80℃ for proper operation.

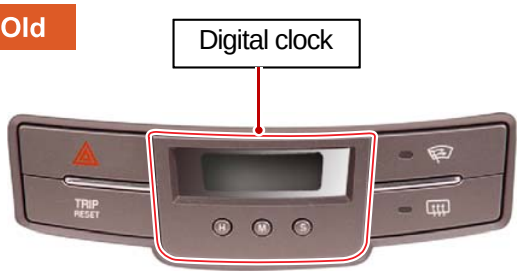
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3. MAJOR CHANGES

▶ **Audio head unit**

Audio head unit	
Old 	New 
- Audio head unit design changed	

LCD resolution	
Old 	New 
- LCD display resolution increased	

LCD display digital clock	
Old 	New 
– LCD display digital clock adopted (center fascia switch → audio LCD display)	

Modification basis	
Application basis	
Affected VIN	

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▶ USB & AUX jack

USB & AUX jack	
Old 	New 
- USB & AUX jack switch arrangement changed – USB insertion (reverse direction → normal direction) - iPod support function added to USB terminal	

▶ USB cable

- USB cable length changed due to new instrument panel

▶ Front & rear feeder cables

- Front and rear feeder cables length changed due to new instrument panel

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▶ **Front tweeter speaker**

Front tweeter speaker	
Old 	New 
- Design changed	



▶ **Front door speaker**

Front door speaker	
Old 	New 
- Design changed	

Modification basis	
Application basis	
Affected VIN	

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▶ Rear door speaker

Rear door speaker

- Design changed

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The audio head unit is fitted with the Bluetooth handsfree for convenience. It has a micro pole antenna and its own integrated amplifier to improve the radio frequency reception rate and to provide the high-quality sound. The iPod function also has been added to the USB terminal.

2. LAYOUT

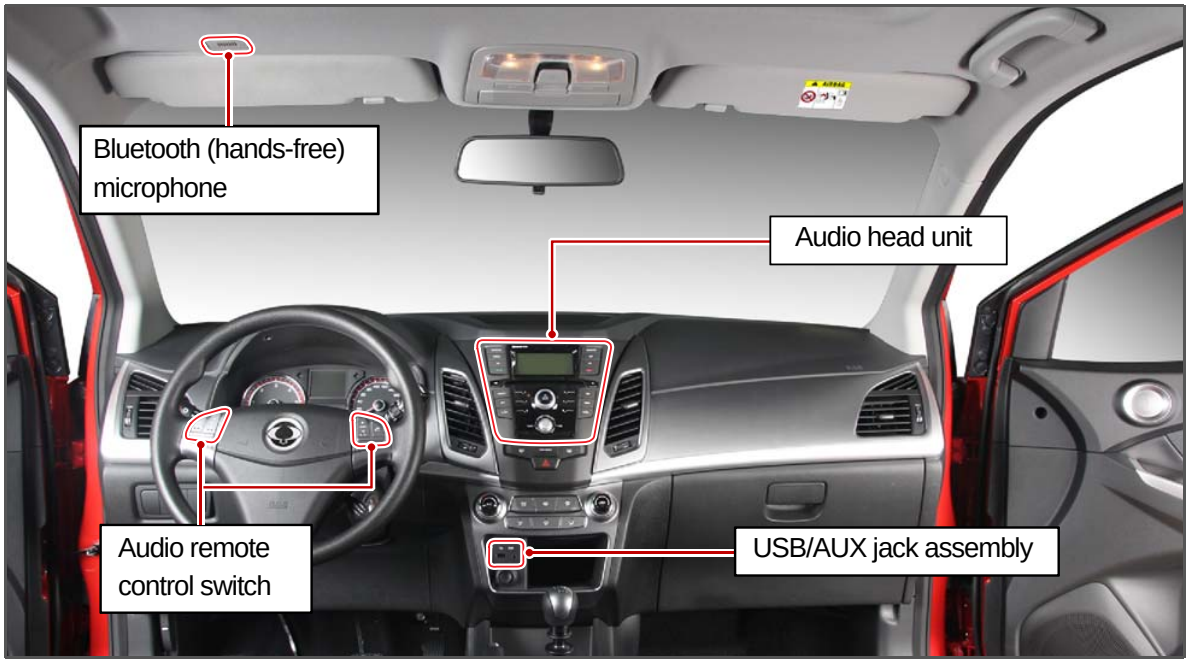
1 Audio head unit	2 USB & AUX jack assembly	3 Bluetooth (hands -free)microphone
		



4 Audio remote control switch	5 Front door tweeter speaker	6 Front door speaker
		

Modification basis	
Application basis	
Affected VIN	

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7 Rear door speaker	8 Micro pole antenna
	

Modification basis	
Application basis	
Affected VIN	

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3. OPERATION PROCESS

Audio remote control switch



Outputs the signal when power, mode, volume up/down, handsfree, seek up/down, mute switch is operated.

Bluetooth (hands-free) microphone



It sends the transmission tone signal to the head unit and outputs the receiving tone and navigation guidance sound to the driver's door speaker during hands-free calling.

USB/AUX jack assembly



Sends USB signal, AUX (stereo) and iPod output signals.

Audio head unit



The audio system plays a various types of music such as radio, MP3, CD, USB and iPod. It has a built-in high output amplifier, allowing to provide the high-quality sound.

Micro pole antenna



Micro pole radio antenna is fitted to ensure the high sensitivity.

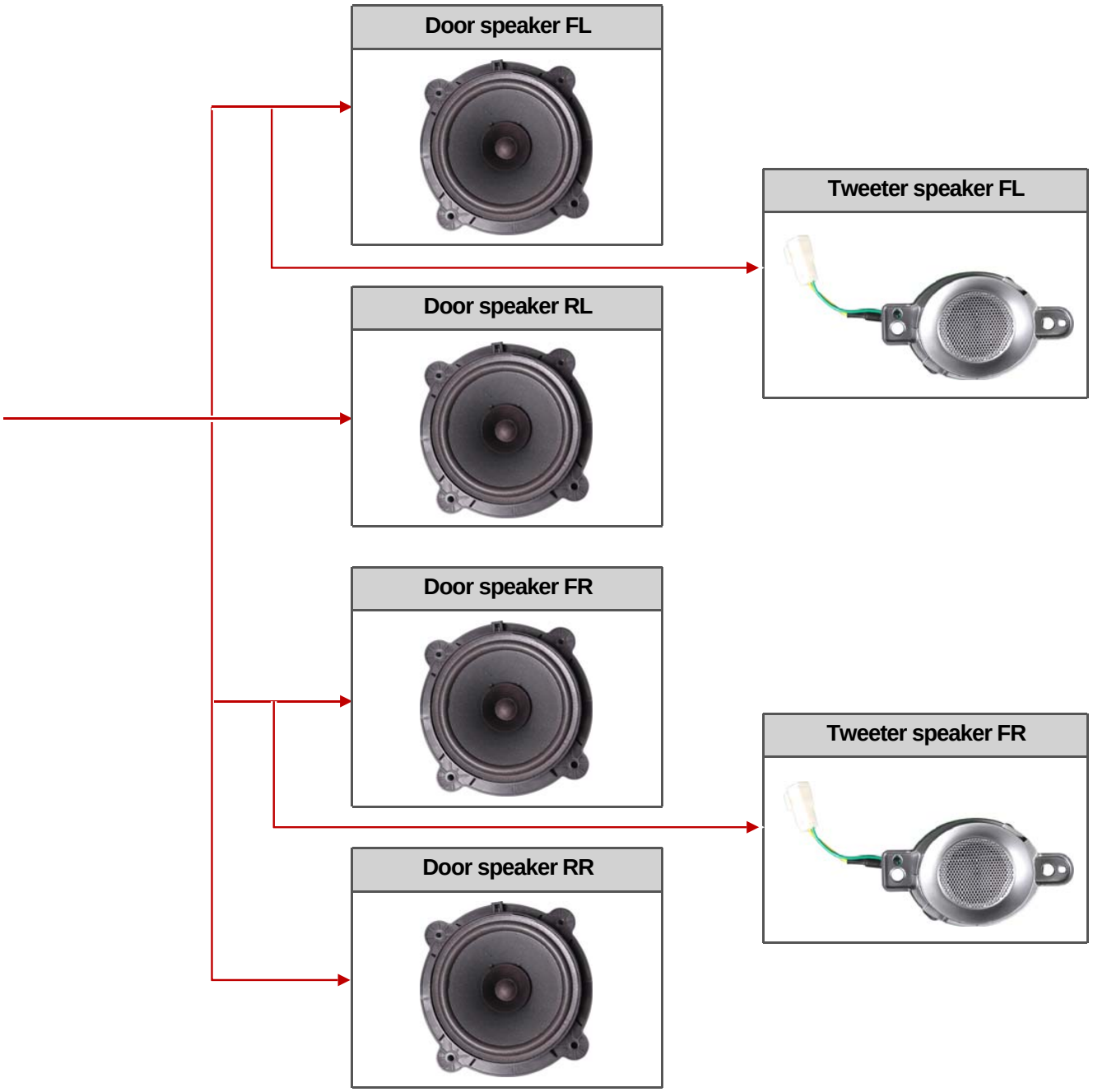
Bluetooth (hands-free)



Once the pairing is complete, after searching for the Bluetooth phone, you can use a various functions and contents in the phone via Bluetooth.

Modification basis	
Application basis	
Affected VIN	

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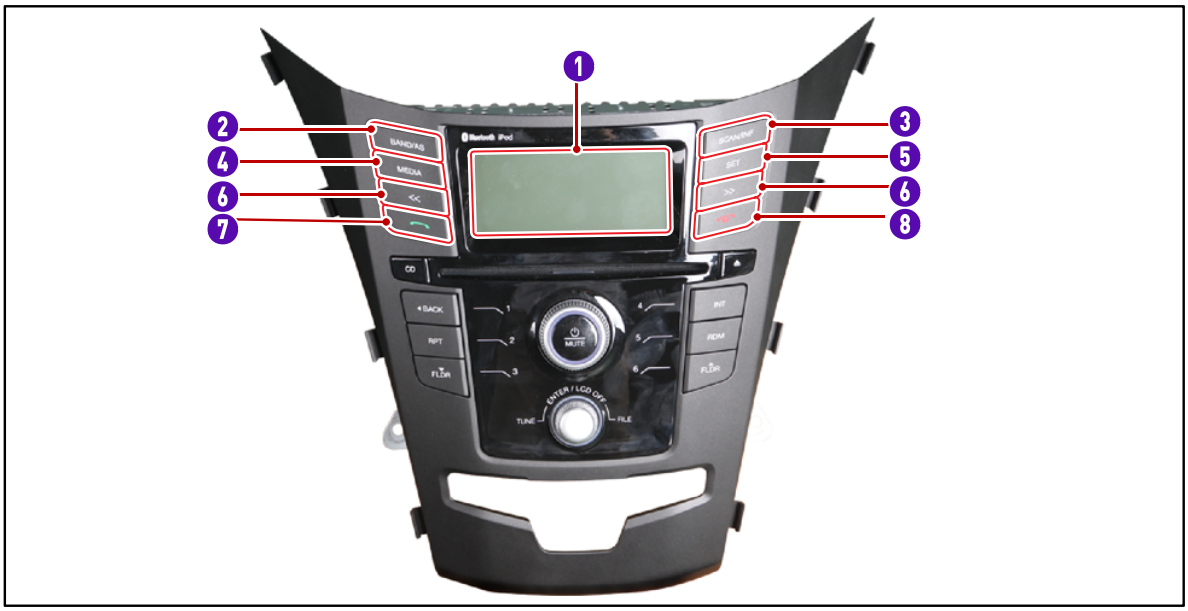


Modification basis	
Application basis	
Affected VIN	

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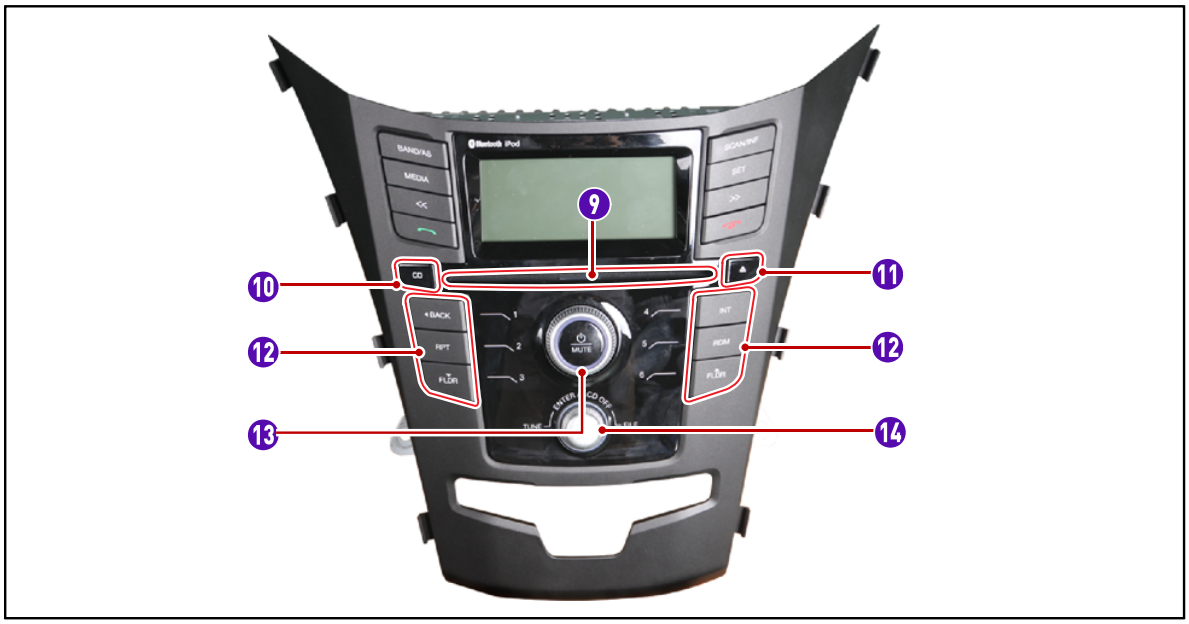
4. SWITCH OPERATION AND FUNCTION

1) Audio Head Unit



No.	Name	Description
1	Display window	Displays operation status and various information
2	[BAND/AS] button	Briefly press: Switching between AM and FM radio Press and hold: Registering and storing station with good reception automatically
3	[SCAN/INF] button	Briefly press: Scanning receivable stations or displaying other information of music currently playing Press and hold: Displaying data table of music currently playing
4	[MEDIA] button	Playing connected external device such as USB/iPod/Bluetooth/AUX
5	[SET] button	Enter into setting mode
6	Adjustment button	- Radio mode Briefly press: Search broadcasting frequency Press and hold: Search receivable frequency - MP3/CD/USB/iPod mode Briefly press: Move to previous/next song Press and hold: Fast forwarding/rewarding
7	Dial button	Briefly press: Receive a phone call Press and hold: Connect to Bluetooth phone
8	End button	Briefly press: End a call Press and hold: Disconnect Bluetooth phone

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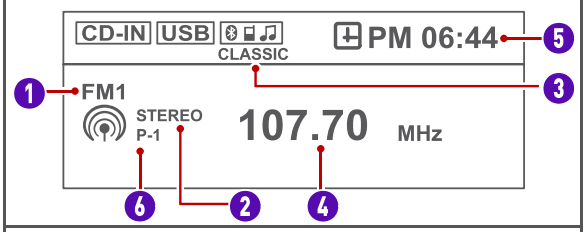


No.	Name	Description
9	Disc slot	Insert or eject a disc to play
10	CD button	Select CD/MP3 disc play function
11	Disc eject button	Eject a disc
12	Station memory button [1~6]	- Radio mode Briefly press: Select a stored station directly Press and hold: Store the listening broadcasting frequency MP3/CD mode - Press [3FLDR▼] / [6FLDR▲] button to move other folder
13	Power/mute button with volume dial	Briefly press: Switch the system on, activate/deactivate mute Pause ON/OFF Press and hold: Switch the system off Turn dial: adjust volume
14	[ENTER] button, [TUNE]/[FILE] dial	Turn dial: change frequency, song or menu Press dial: Change or select item or setting value Press and hold dial: Turn off display window backlight (comes on if any of buttons is pressed)

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2) Display Window

Radio



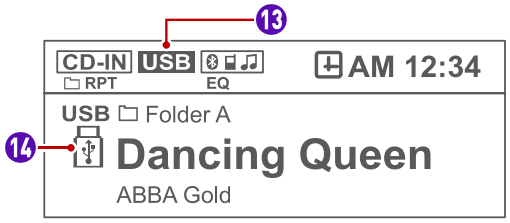
1. Radio station band: FM1/FM2/AM
2. FM stereo reception display
3. EQ: POP/ROCK/COUNTRY/VOICE/JAZZ/ CLASSIC
4. Receiving broadcasting frequency
5. Digital clock
6. Specified station number: P1~P6

CD/MP3



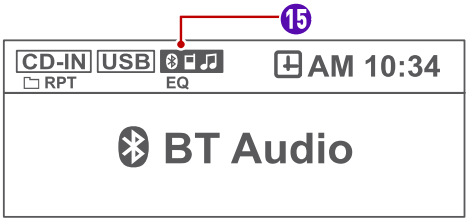
7. Disc insertion display
8. Play mode display
   RDM (Random): Play folder in random order RPT (Repeat): Play folder repeatedly INT (Intro): Play folder intro
9. Current folder name
10. Play disc
11. Current playing song name
12. Other information of current playing song: Play time/album/artist/genre

USB



13. USB connection
14. USB play

BT AUDIO



15. Bluetooth connection

Modification basis	
Application basis	
Affected VIN	

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5. SETTINGS

▶ Tone setup

Set the Bass/Middle/Treble, Balance and EQ (sound effect) for the sound of the output speaker.

1. When pressing the SET button, "Setup List" is displayed.
   - "Setup List" screen is displayed only for 5 seconds.
2. Turn the [TUNE] dial to select a desired "Tone Setup" and press the [ENTER] button.
   - Press the [1BACK◀] button in order to go back to the previous screen.
3. Turn the [TUNE] dial to select a desired setup item and press the [ENTER] button.
   - Select one of the following: Bass ↔ Middle ↔ Treble ↔ Balance ↔Fader ↔ EQ (sound effect).
4. Turn the [TUNE] dial or press the [ENTER] button to select the desired setting value.
   - Bass: setting the bass level (-7 ~ +7)
   - Middle: setting the middle level (-7 ~ +7)
   - Balance: setting LH/RH speaker balance (LEFT 15 ~ RIGHT 15)
   - EQ (Equalizer): select EQ (sound effect) style.
     (EQ OFF ↔ POP ↔ ROCK ↔ COUNTRY ↔ VOICE ↔ JAZZ ↔ CLASSIC)
   - Default: initialize all the settings.

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6. CURRENT TIME/DATE SETTING

▶ Turn the power off and set the displayed current time and date.

1. When pressing the SET button, "Setup List" is displayed.
   - "Setup List" screen is displayed only for 5 seconds.
2. Turn the [TUNE] dial to select a desired "Time & Date" and press the [ENTER] button.
   - Press the [1BACK◀] button in order to go back to the previous screen.
3. Turn the [TUNE] dial to select a desired setup item and press the [ENTER] button.
   - Select one of the followings: Set Time ↔ Set Time Format ↔ Set Date ↔ Display Digital Clock On/Off
4. Turn the [TUNE] dial or press the [ENTER] button to select the desired setting value. Repeat these steps if several items need to be set. (e.g. YY/MMDD in date setting)
   - Set Time: Set the current time.
   - Set Time Format: Set the time format to 12-hour or 24-hour system.
   - Set Date: Set the date.
   - Display Digital Clock On/Off: Set whether the digital clock is displayed or not.

Modification basis	
Application basis	
Affected VIN	

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7. RADIO SETTINGS

▶ Listening radio station

1. Press the [BAND] button repeatedly to select the desired broadcasting band.
   - Select one of FM1, FM2 or AM.
   - Broadcasting is received from the broadcasting frequency which has been listening previously.

▷ Searching for broadcasting manually

2. Turn the [TUNE] dial or press the <<ADJ>> button repeatedly to select the desired broadcasting frequency.

▷ Searching for broadcasting automatically

3. Press the <<ADJ>> button more than 2 seconds and release it so that the system searches for one broadcasting frequency with good reception and receives it automatically.

▷ Selecting broadcasting with automatic search

4. When pressing the [SCAN] button, the system searches for the broadcasting with good reception one by one within the receiving frequency range and gives a hearing about for 5 seconds. If you hear the desired broadcasting, press the [SCAN] button briefly to keep listening it.

▶ Registering broadcasting frequency manually

1. Select the broadcasting frequency to register.
2. When the [1BACK◀] ~ [6FLDR▲] buttons to register is pressed for more than 2 seconds, the beep sounds to indicate the registration is completed.

▶ Registering broadcasting frequency automatically

1. Press the [BAND] button repeatedly to select the desired broadcasting band.
   - Select one of FM1, FM2 or AM.
   - The system shows the selected frequency previously in the selected broadcasting band and receives it.
2. Press the [AS] button for more than 2 seconds.
   - "AST Scanning" is displayed, and the system searches for 6 stations with good reception one by one to register them to each [1BACK◀] ~ [6FLDR▲] button.

▶ Listening registered station

1. Press the [BAND] button repeatedly to select the desired broadcasting band.
   - Select one of FM1, FM2 or AM.
   - The system shows the selected frequency previously in the selected broadcasting band and receives it.
2. Press the desired button between [1BACK◀] and [6FLDR▲] to listen the broadcasting.

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8. MP3 [WMA]/CD PLAYER

▶ To change play mode

1. Press the [2RPT] button repeatedly to select the repeat mode.
   - 🗀RPT: Repeat all the songs in the current folder in order (applies only to MP3/WMA disc)
   - RPT: Repeat the playing song consecutively
   - OFF: Deactivates repeat mode

2. Press the [4INT] button repeatedly to select the intro play mode.
   - 🗀INT: Play the intro of all the songs in the current folder in order for about 10 seconds (applies only to MP3/WMA disc)
   - INT: Play the intro of all the song in the disc in order for about 10 seconds
   - OFF: Deactivates playing intro

3. Press the [5RDM] button repeatedly to select the random play mode.
   - 🗀RDM: Play all the songs in the current folder in random order (applies only to MP3/WMA disc)
   - RDM: Play all the song in the disc in random order
   - OFF: Deactivates random play mode

▶ Search for song and play it

1. When [MENU] button is pressed after turning the [TUNE] dial to select the song number or name to play, the system begins playing the song.

▶ MP3[WMA] song information view

1. If you press the [INF] button briefly and repeatedly when a song is playing, other information (artist/album/genre/play time) for the song is displayed for 3 seconds.
2. If you press and hold the [INF] button when a song is playing, the data table for the song is displayed for 5 seconds.

▶ To set scroll function

1. When pressing the [SET] button, "Setup List" is displayed.
2. Turn the [TUNE] dial to select the desired "Scroll On/Off" and press the [ENTER] button to select ON or OFF.

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9. BLUETOOTH

▶ To register Bluetooth device

1. Press the [Call] button for more than 3 seconds.
   - "PAIRING" is displayed and followed by "KEY 00xx" to indicate stand-by mode.
2. Activate the Bluetooth device to register to carry out Bluetooth setting/device search and connect it to the audio system.
   - If the searched device selection item is displayed, carry out selecting/connecting "SSANGYONG".
   - If the device search fails for 60 seconds, "NO device paired" is displayed. If this is the case, carry out steps 1~2 above again.
3. Enter the pairing key, "00xx", displayed on the audio system screen to the *pin code input item of the Bluetooth device to connect and register it.
   - When the registration is completed normally, the audio system screen displays "BT CONNECT" and displays cellular phone model name or "BT MOBILE" together with the Bluetooth icon.
   - The Bluetooth device can be registered just once. Although several devices can be registered, you can select only 1 device to connect the system. If the registered Bluetooth device is set to connect to other device, disable the previous connection under Connect Bluetooth device and select "Car audio" or "Audio device" to connect the device to the system.
4. Check whether the Bluetooth connection is completed.

▶ To set Bluetooth mode

1. When pressing the [SET] button, "Setup List" is displayed.
   - The setting screen is displayed for 5 seconds.
2. Turn the [TUNE] dial to select a desired "Bluetooth Setup" and press the [ENTER] button.
3. Turn the [TUNE] dial to select a desired Bluetooth setup item and press the [ENTER] button.
   - Turn the dial to select one of the followings: Pair Device ↔ Select Device ↔ Delete Device ↔ Priority Device.

   For "Pair Device", see the steps 2~4 in "To register Bluetooth device".
4. Turn the [TUNE] dial to select the device list and press the [ENTER] button.
   - Select Device: Select the connected device.
   - Delete Device: Delete the registered device.
   - Priority Device: Set the connection priority for Bluetooth devices.

▶ Making phone call using recent call list

1. When you [Call] button for more than 3 seconds, the system displays "REDIAL" and makes a phone call to the recent calling party.

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▶ Answering an incoming call

- When the call is incoming, the bell rings and "CALL IN" and sender's telephone number are displayed.

1. To make a call, press the [Call] button.
   - "BT TEL" is displayed during a call and you can converse through the microphone and speaker connected to this system. If you don't want to receive a call, press the [End] button to reject it.
   - After "CALL REJECT" is displayed, the system returns to the previous screen.

▶ Hang-up call

1. To hang-up the call, press the [END] button.
   - The call is ended and system returns to the previous screen.
   - However, the connection between the audio system and the phone remains "connected".

▶ To adjust volume

1. Turn the [VOL] dial to adjust the volume.
   - The adjustable range is between BT VOL 06 to 32.

▶ Mute function

1. Press the [MUTE] button on the audio remote control to activate the mute function.
   - "MIC MUTE" is displayed and the other party can't hear your voice.
   - Press the [MUTE] button again to resume your conversation.

▶ Private mode

- You can change to private call using a cellular phone during hands-free call. (The other party's voice is coming through only the cellular phone, not speaker.)

1. When you press the [Call] button during hands-free call, "PRIVATE" is displayed and hands-free call is changed to cellular phone call. When you press the [Call] button during cellular phone call, "BT TEL" is displayed and cellular phone call is changed to hands-free call.
   - This function may not be available on some phone models.

▶ To disconnect

1. Press and hold the [End] button to disconnect the connection with Bluetooth device and press and hold it once again to turn off the Bluetooth function.
   - At this time, "BT DISCONNECT" is displayed and the Bluetooth icon disappears.

▶ Playing music stored in cellular phone

1. Press the [MEDIA] button repeatedly to select "BT AUDIO".
2. After playing the music using a music-playback function in the cellular phone, turn the [VOL] dial to adjust the volume.
3. To exit the function, press the [End] button or press the [BAND/AS], [MEDIA] or CD button to select other function.

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10. EXTERNAL DEVICE (USB/AUX & I-POD)

▶ To playback USB/iPod

1. Press and hold the power button to turn the audio off.
2. Insert the linking cable of the USB or iPod in which MP3/WMA file to play is stored to the USB terminal.
3. Press the [MEDIA] button repeatedly to select the USB or iPod function.
   - "USB" or "I-POD" is displayed and the music files which has been played previously are played automatically.

▶ To use AUX jack

1. Turn off the external device's power supply and connect its sound output to the [AUX] jack.
2. Press the [MEDIA] button repeatedly and select the [AUX IN] function.
3. Turn the [VOL] dial to adjust the sound volume.

▶ Layout with USB/iPod



USB 2.0 cable



- Playing music file in USB memory
- Playing external audio device through AUX jack
- Supports iPod function

* Connect iPod to USB terminal



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CAUTION

Cautions for using USB memory/iPod

- Ensure that the connection or disconnection between the audio system and the USB memory/iPod is carried out only when the engine is switched off. If the engine is switched on or off while the USB memory is connected or disconnected, the USB memory may be damaged or not operate normally.
- The audio system may not recognize some USB memory depending on the comparability or condition. Check whether the USB memory operates normally in the vehicle before using it.
- Take great care to ensure that the USB connection does not come in contact with the human body or any object and the USB linking cable does not disturb a safe driving.
- When you connect and disconnect the USB memory to the audio system several times in a short periods, it may cause the USB memory to corrupt. If you particularly disconnect USB memory during playback, it may be broken or operate incorrectly.
- When you use the USB device for charging or heating by using the USB terminal on the audio system, it may cause the system to deteriorate or fail.
- iPod is a registered trademark of Apple Inc.
- This audio system supports only the following iPod products: iPod Nano /iPod/iPod Touch/ iPhone.
- This audio system may not support some iPod/iPhone products.
- Always use the linking cable included with the iPod product when connecting it to the audio system.
- The other cables may not be compatible and cause the audio system to fail.
- In some cases, the iPod product may be damaged or not operate normally when the engine is switched on while it is connected to the audio system. When not in use, always disconnect the iPod product with the engine switched off.
- When you use the iPod by connecting it to the audio system, the playback function and information display may differ from original.
- The iPod product can't be recharged using a iPod linking cable.

-

Modification basis	
Application basis	
Affected VIN	

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CHASSIS GENERAL 0000-00

CHASSIS

1. MAJOR CHANGES

▶ **Wheel assembly changed**

Wheel Assembly		
Old		
16-inch Silver	17-inch Silver	18-inch Hyper silver
PN: 41730-34000	PN: 41730-34100	PN: 41730-34220
		
New		
16-inch Silver	17-inch Silver	18-inch Diamond cutting
PN: 41730-34200	PN: 41730-34300	PN: 41730-34400
		

- 16, 17 and 18-inch wheel assembly design changed
  (For 17-inch: existing 18-inch design used)
  (For 18-inch: Hyper silver type → Diamond cutting type)
- Wheel offset and tire size same as before

Modification basis	
Application basis	
Affected VIN	

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▶ **Newly added TPMS (Tire Pressure Monitoring System)**

DOT LCD display window (supervision type)

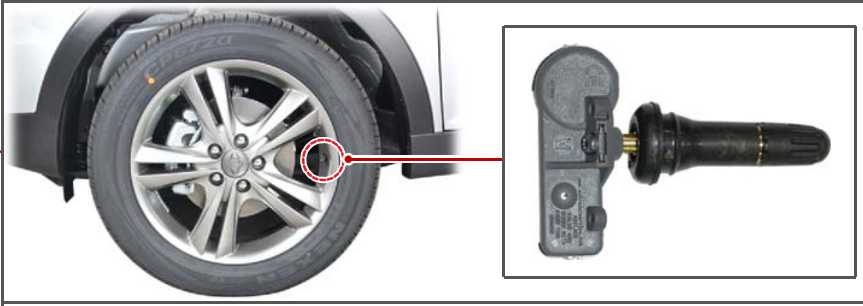
Displays current tire pressure and abnormality.



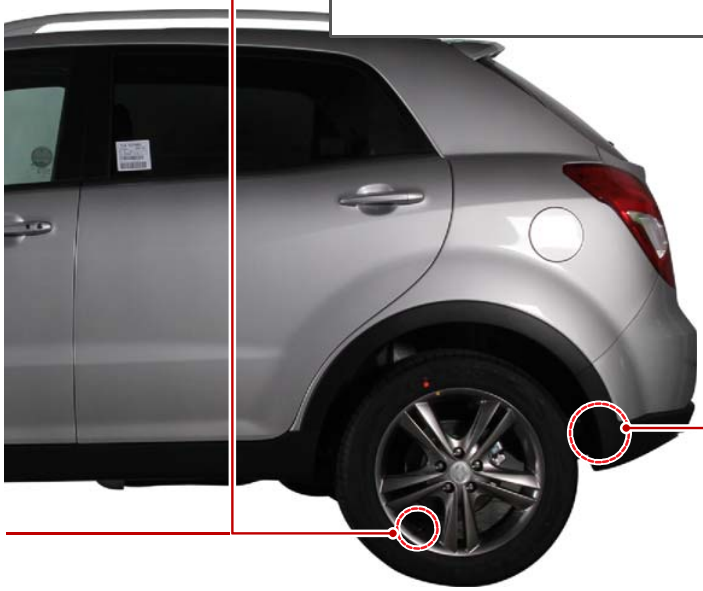
TPMS related warning lamp	
TPMS warning lamp	Global warning lamp
	
- TPMS warning lamp: Comes on if an error occurs in any component related to the TPMS regardless of tire inflation pressure. - Global warning lamp: Comes on when the tire pressure is low.	

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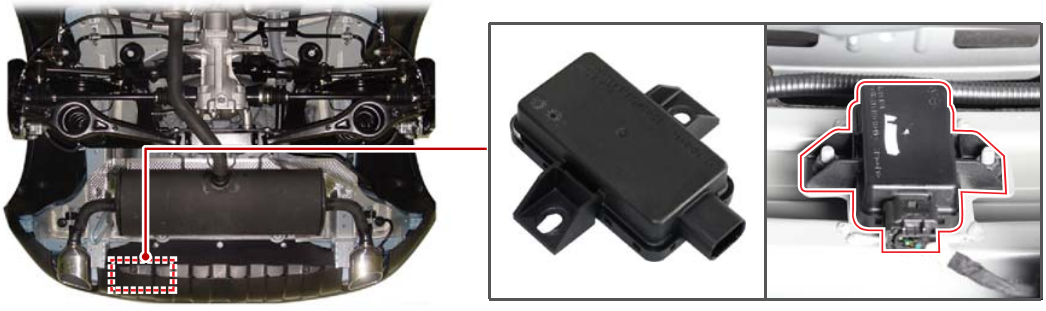
Wheel module



The wheel modules are mounted to each wheel rim and hole. They transmit the signal of the pressure and temperature in tire, rotating direction and wheel module ID code, etc. using the radio frequency to the TPMS ECU.



TPMS ECU



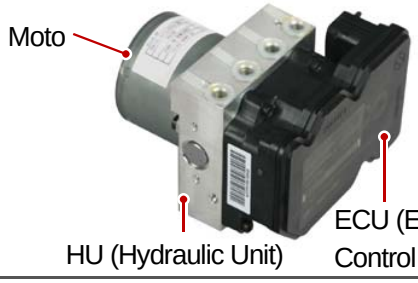
The TPMS ECU is located to the rear bumper rail under the vehicle. It outputs the tire pressure and each wheel's condition to the instrument cluster, based on the wheel module information and CAN data.

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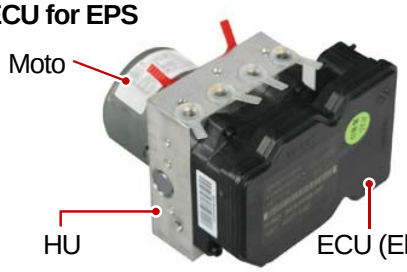
2. MOUNTING LOCATIONS (CHASSIS)

HECU (Hydraulic & Electronic Control Unit)

HECU for ABS

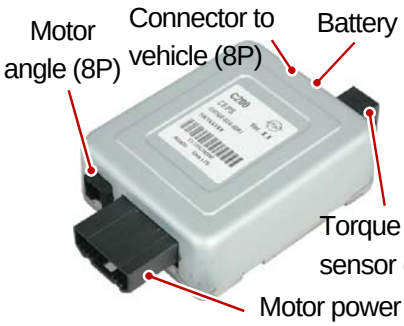


HECU for EPS

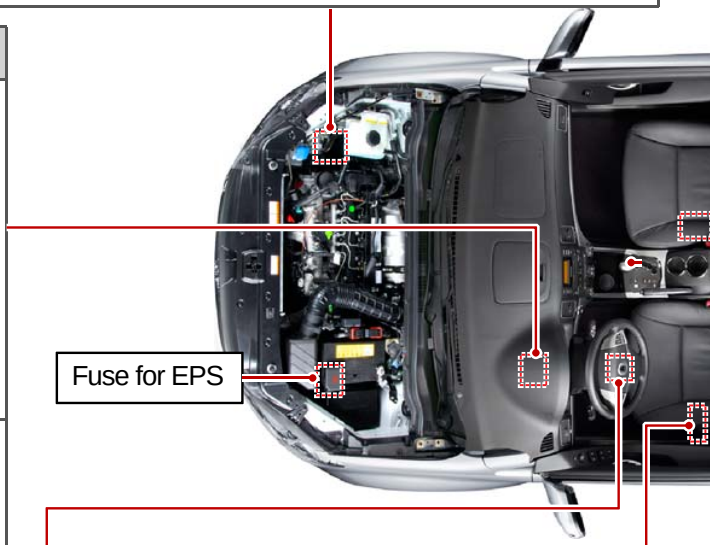


The HECU (Hydraulic & Electronic Control Unit) determines the slip conditions of vehicle wheels by calculating each wheel's speed and the increment/decrement of speed based on the information detected by the sensors, and controls the pumping and boosting/reducing/keeping pressure by operating the valve and motor of HECU.

EPS unit



The ECU controls the electric power steering system depending on the driving conditions, based on the signals from the torque and angle sensor.



Steering wheel angle sensor (SWAS)



The steering wheel angle sensor is mounted between the steering column and the steering column shaft. It is commonly used by the ESP (Electronic Stability Program) system. And it receives signals of the steering wheel angle sensor from the ESP HECU (Hydraulic & Electronic Control Unit).

E-coupling unit



The E-coupling unit is a control unit which determines the magnetic force by considering CAN signals (wheel speed, engine torque, pedal opening, ABS/ESP CAN signals, etc.) from other ECUs.

Modification basis	
Application basis	
Affected VIN	

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Sensor cluster

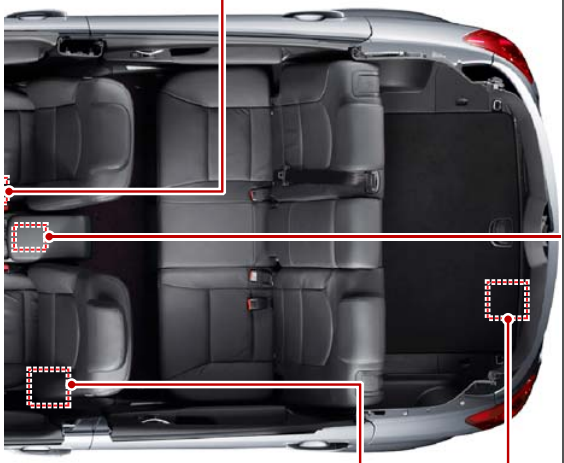


The sensor cluster is linked to the sensors on the unit board and CAN interface. And they are housed in one case and mounted to the body.

TGS Lever assembly



The TGS communicates with TCU (Transmission Control Unit), ECU, ESP HECU and instrument cluster to let the driver select the desired transmission gear and to maintain the desired driving condition. Also, the tip switch is installed on the lever knob and the steering wheel so that the driver select the gear manually when the shift lever is in "M".



G-sensor(4WD, ABS)



For the vehicle with the ABS, a speed difference between the wheels is not noticeable as all the wheels are slipping during abrupt braking. Therefore, the vehicle needs the speed information from other sensors other than the wheel speed sensor. The longitudinal acceleration sensor (G-sensor) is used for this case. It controls the ABS by using the signals from the sensor during abrupt braking and acceleration.

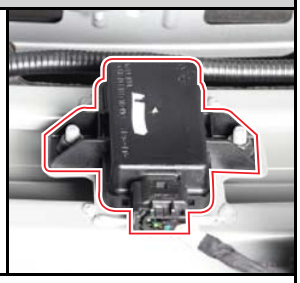
TCU unit



The transmission control unit (TCU) is installed under the driver seat, and controls the transmission. The TCU is operated by the ignition power supply and receives and processes the following information from the inner sensors through CAN buses.

TPMS ECU





The TPMS ECU is located to the rear bumper rail under the vehicle. It outputs the tire pressure and each wheel's condition to the instrument cluster, based on the wheel module information and CAN data.

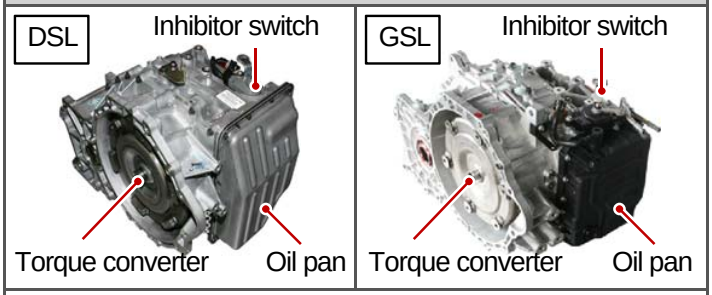
Modification basis	
Application basis	
Affected VIN	

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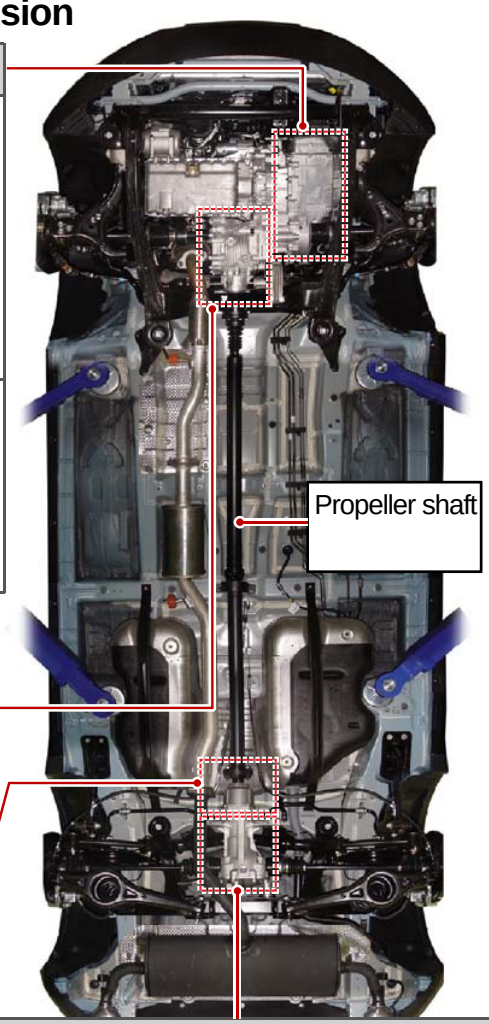
3. CHASSIS COMPONENT LAYOUT

1) 4WD Vehicle With Automatic Transmission

A/T assembly



Automatic transmission is available as 4WD- and 2WD-type, and provides 6 speeds for forward travel and 1 reverse travel. It is also equipped with the torque converter with inner lock-up clutch and electronically controlled solenoid which controls all hydraulic functions.



PTU (Power Transfer Unit)



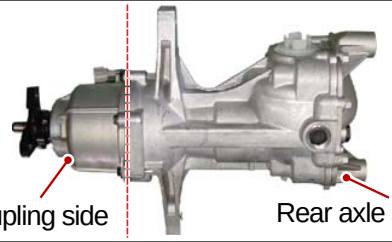
The PTU is a device that transfers the power generated from the engine to the rear axle through propeller shaft and E-coupling by changing the power flow direction by 90° in the front wheel drive type 4WD vehicle.

E-coupling control unit (E-Coupling ECU)



The E-coupling unit is a control unit which determines the magnetic force by considering CAN signals (wheel speed, engine torque, pedal opening, ABS/ESP CAN signals, etc.) from other ECUs.

Rear axle assembly



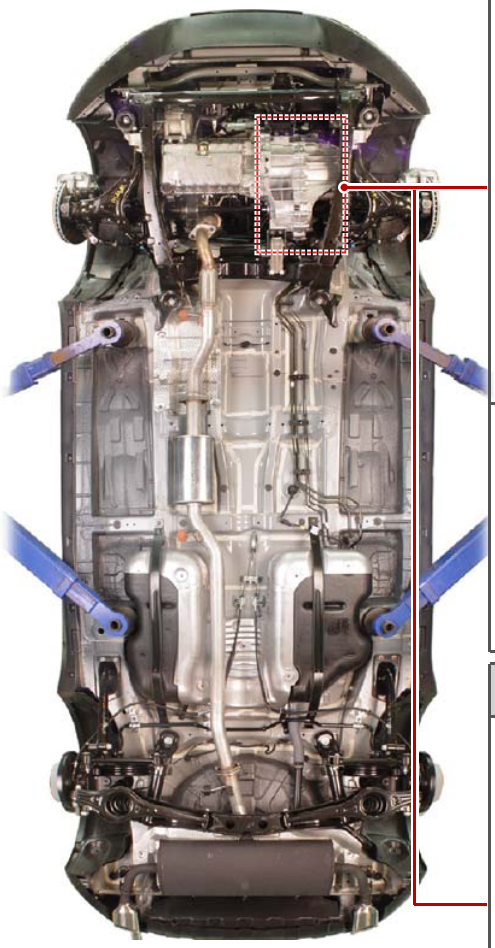
The rear axle installed in this car is a removable axle, called IRDA (Independent Rear Differential Axle). The rear differential carrier is installed directly on the sub frame, and there is an independent suspension that allows each wheel on the same axle to move vertically independently of each other with the universal joint and the slip joint.

Modification basis	
Application basis	
Affected VIN	

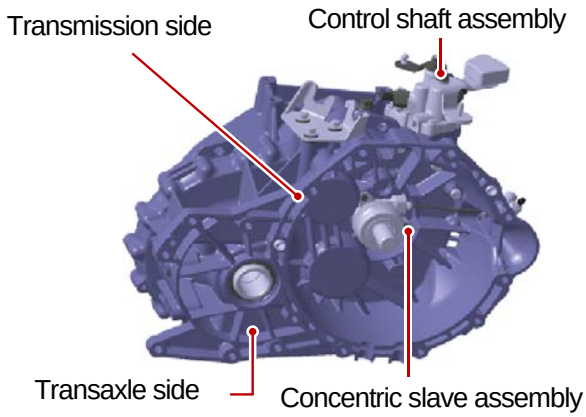
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2) 2WD Vehicle With Manual Transmission

The 2WD vehicle with manual transmission is a front wheel drive type vehicle that doesn't have PTU, propeller shaft, E-coupling and rear axle which are applied to 4WD vehicle. Its under structure is very simple.

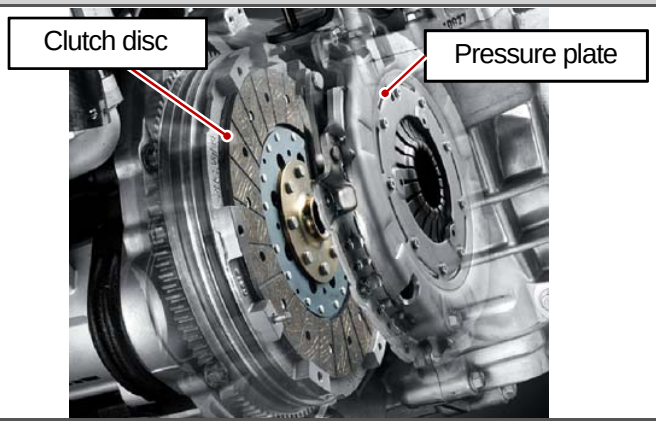


M6LF1 manual transmission



M6LF1 manual transmission is a model modified from the one that used in other vehicle so that it can be applied to FF (Front engine-Front wheel driving) type vehicle, and has an axle in one piece. The engine torque and gear ratio of this transmission have been optimized to maximize driving performance. It provides 6 speeds for forward travel and 1 reverse travel.

Clutch assembly



M6LF1 manual transmission is a model modified from the one that used in other vehicle so that it can be applied to FF (Front engine-Front wheel driving) type vehicle, and has an axle in one piece. The engine torque and gear ratio of this transmission have been optimized to maximize driving performance. It provides 6 speeds for forward travel and 1 reverse travel.

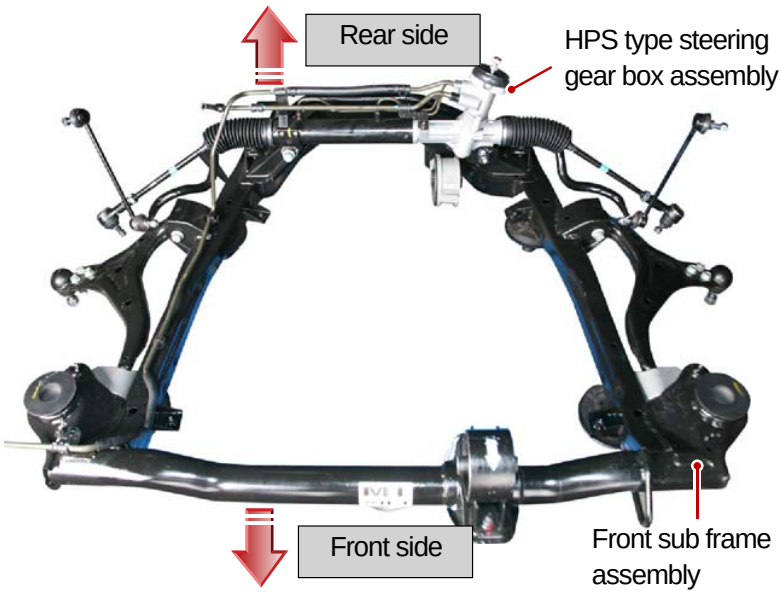
Manual gear selector lever



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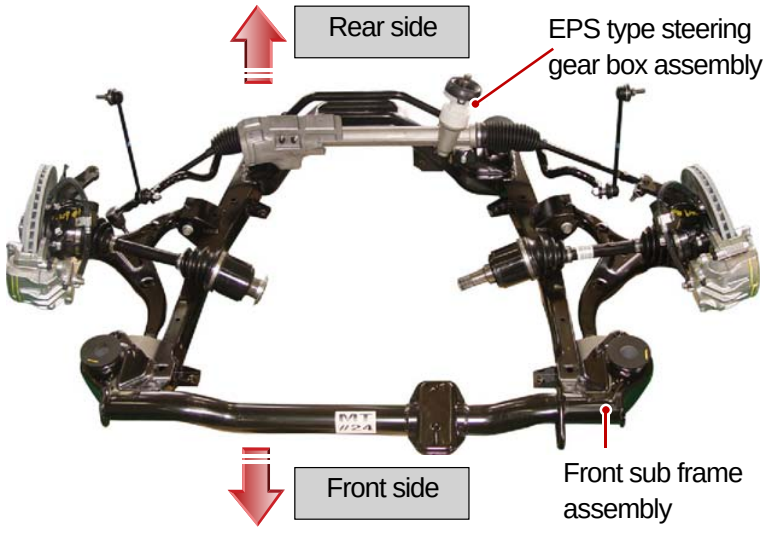
4. SUB FRAME AND STEERING GEAR BOX LAYOUT

Front sub frame with HPS type steering gear box assembly

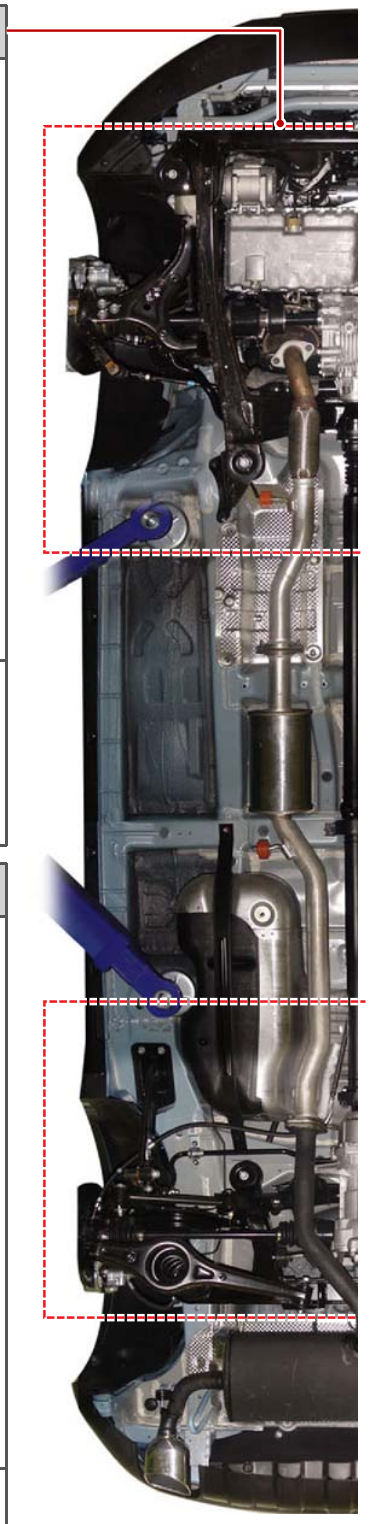


The front sub frame consists of 4 body bush mountings and 2 transmission bush mountings which reduce the vibration from the powertrain and road, and also control the torque. And the frame is equipped with hydraulic pressure pipe of the HPS type steering gear box.

Front sub frame with EPS type steering gear box assembly

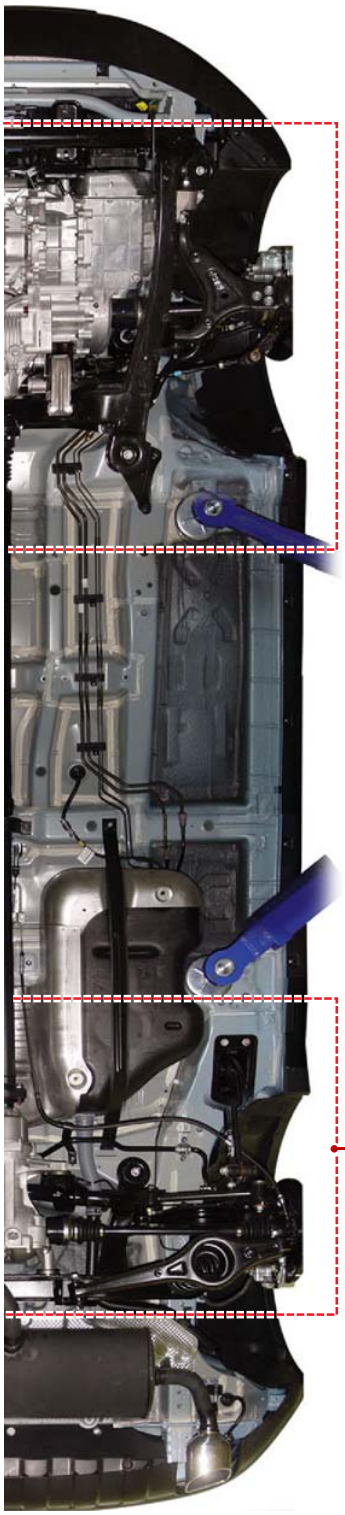


This kind of front sub frame system has the same mounting structure with the frame with HPS. But the EPS type steering gear box has no hydraulic pressure pipe since it is driven by the electric motor.

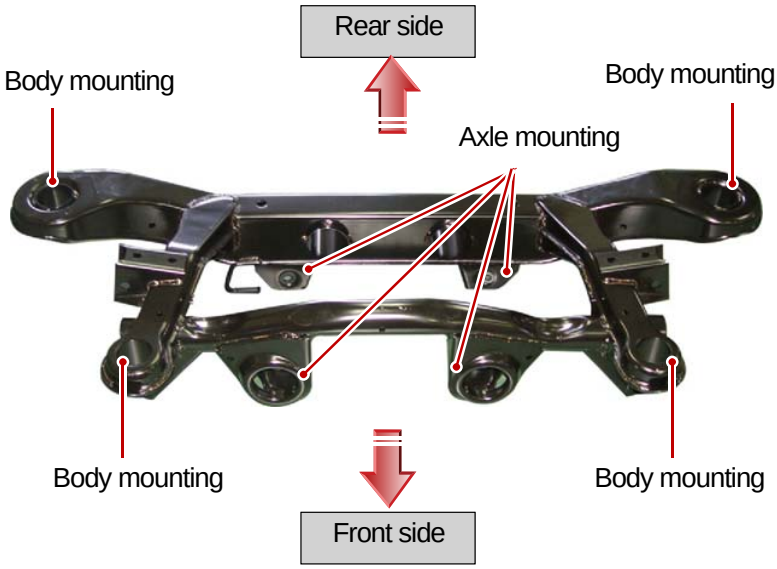


Modification basis	
Application basis	
Affected VIN	

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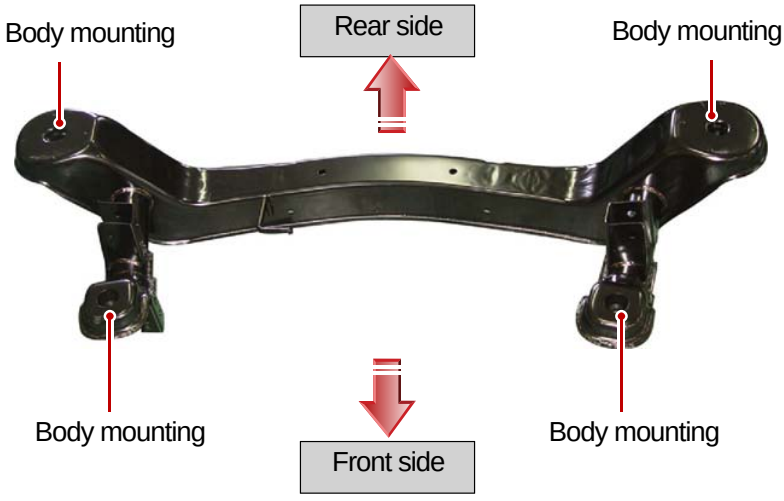


Rear sub frame assembly for 4WD



The rear sub frame for 4WD vehicle consists of 4 body (bush) mountings and 2 axle (direct) mountings which reduce the vibration from the powertrain and road, and also control the torque.

Rear sub frame assembly for 2WD



The rear sub frame for 2WD vehicle functions in the same way as the one for 4WD vehicle, but the structure is different from the one for 4WD. It consists of 4 body (bush) mountings.

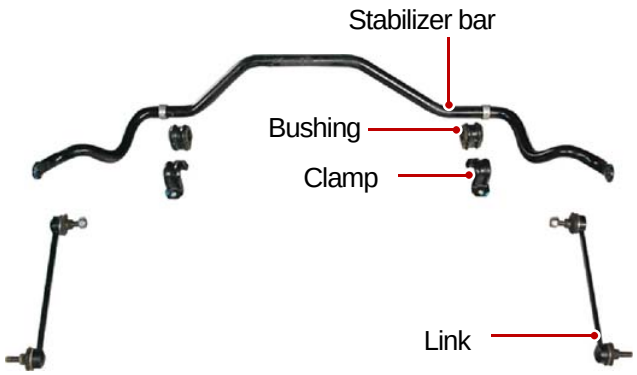
Modification basis	
Application basis	
Affected VIN	

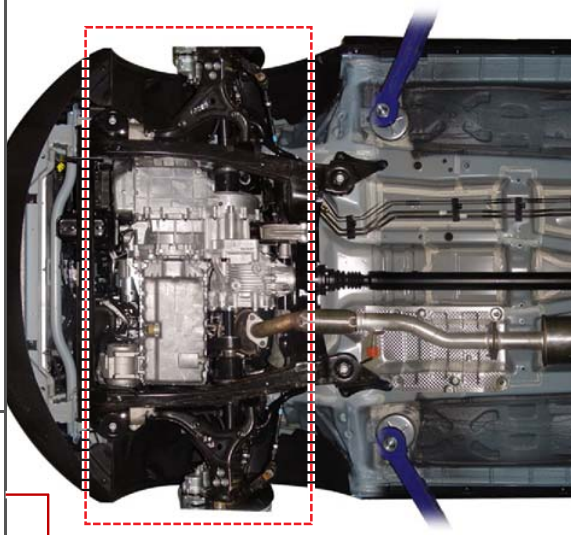
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5. FRONT SUSPENSION COMPONENT LAYOUT

Front suspension supports the vehicle weight and absorber the vibration from tires. And, in this type of suspension, the steering linkage tie rod is mounted on the knuckle. The Macpherson Strut suspension is an independent suspension which has a spring on the strut with a built-in shock absorber. The lower arm is installed on sub frame and large strut damper is installed on the knuckle to support the tire.

Stabilizer bar assembly

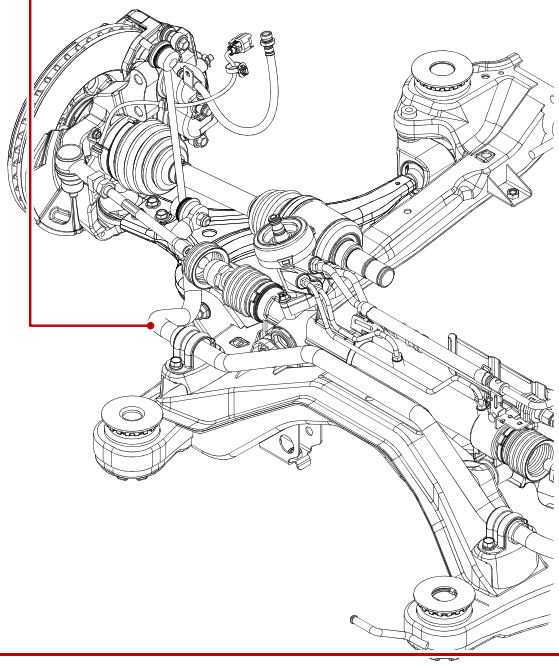




The stabilizer bar assembly is not activated if the left/right wheels move up/down simultaneously, but if both wheels move up/down differently it is activated with frame to minimize the tilting of the body.

Lower arm assembly

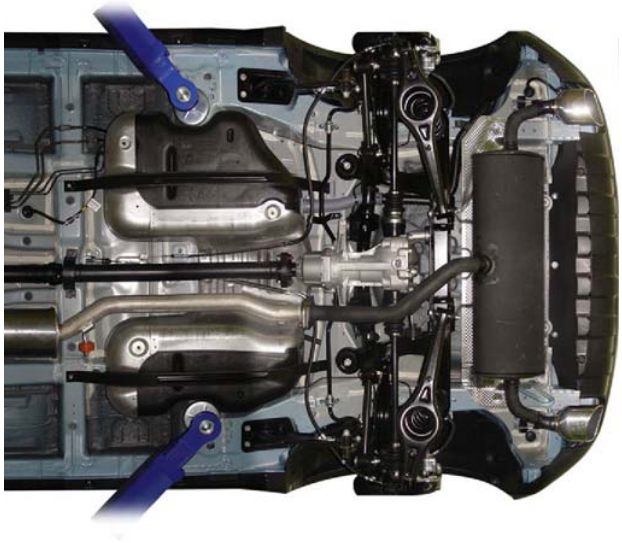


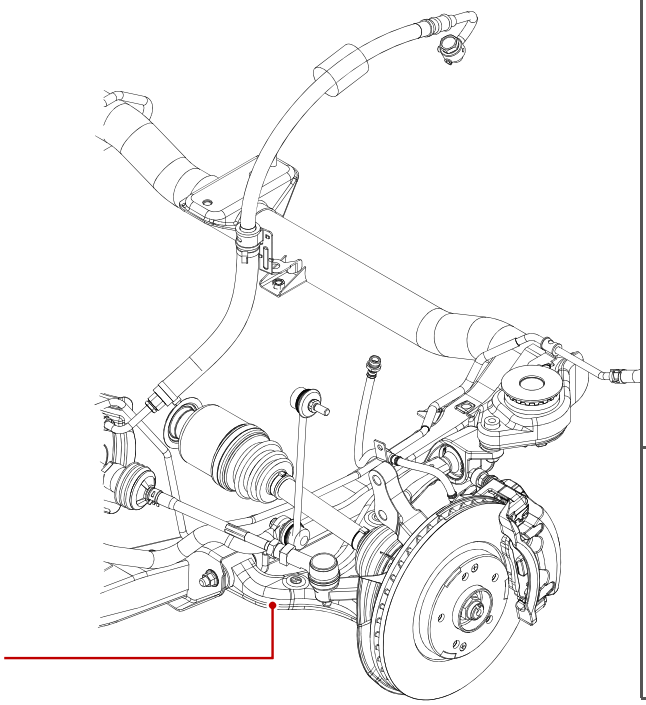


The lower arm assembly connects the frame and knuckle. It supports the load transferred to the tire knuckle, relieves the impact from the vehicle and ground conditions, and ensures driving stability.

Modification basis	
Application basis	
Affected VIN	

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Front coil spring assembly



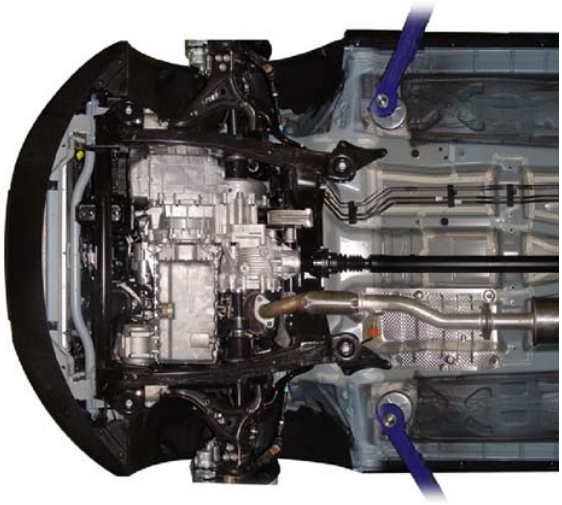
The coil spring is made by winding solid steel rod to form the coil shape. Its energy absorption rate per weight is higher than that of the leaf spring and it allows to absorb small vibration properly resulted in keeping the ride comforts. Therefore, it's difficult to make an effect on vibration damping because there is not any friction between coils.

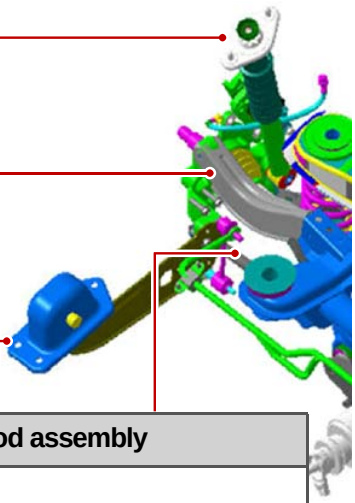
Modification basis	
Application basis	
Affected VIN	

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6. REAR SUSPENSION COMPONENT LAYOUT

Multi-link type suspension is the independent suspension. It provides good ride comfort and drivability by reducing the coil spring weight. Also, it increases the space for passenger compartment by lowering the floor.
This type of suspension consists of multiple links such as trailing arm, upper arm, lower arm and track rod.





Shock absorber assembly

This vehicle uses the gas 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 assembly



Upper arm is installed between knuckle and sub frame and controls the lateral load and vehicle height.

Trailing arm assembly



Trailing arm is installed between knuckle and vehicle body and controls the front and rear load.

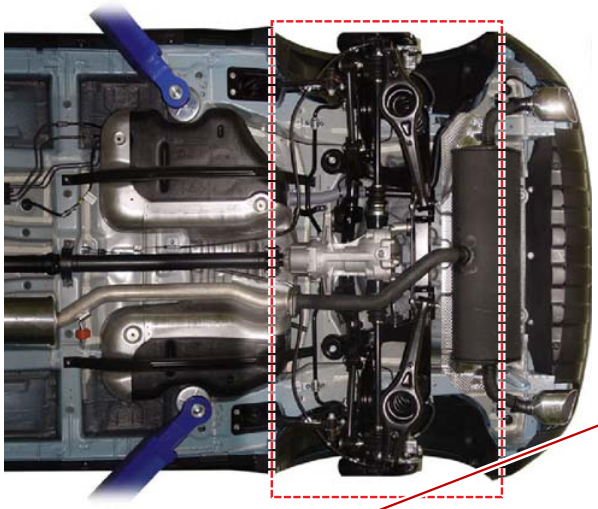
Track rod assembly

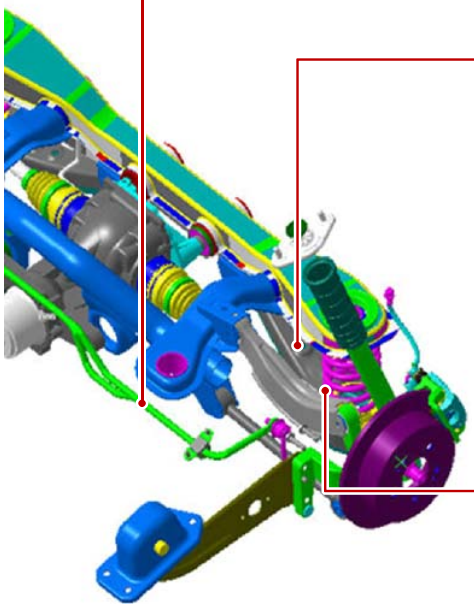


Track rod is installed between knuckle and rear sub frame and controls and compensates the lateral load.

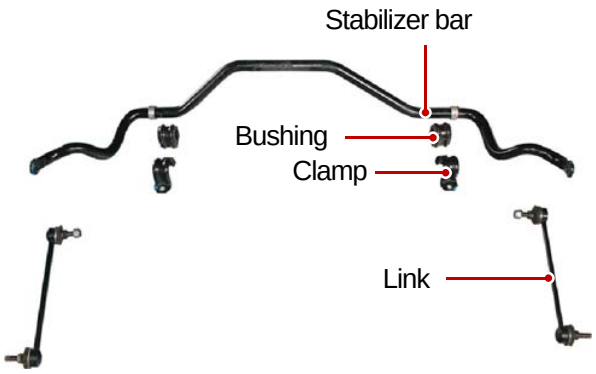
Modification basis	
Application basis	
Affected VIN	

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Stabilizer bar assembly



The stabilizer bar assembly is not activated if the left/right wheels move up/down simultaneously, but if both wheels move up/down differently it is activated with frame to minimize the tilting of the body.

Coil spring

Coil spring is installed between the coil spring link and body frame. It relieves the vibrations and impacts from wheels to vehicle body.



Lower arm assembly

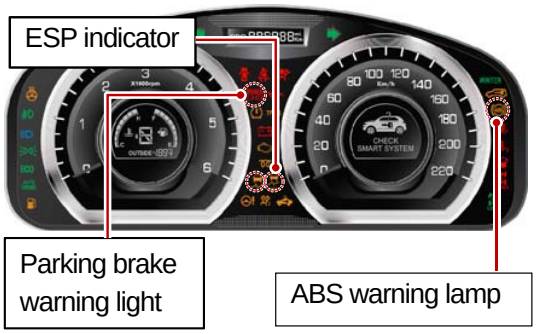


The lower arm is installed between knuckle and rear sub frame and relieves the load to coil spring from wheel. In other word, it controls the longitudinal load.

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7. BRAKE SYSTEM AND ESP SYSTEM LAYOUT

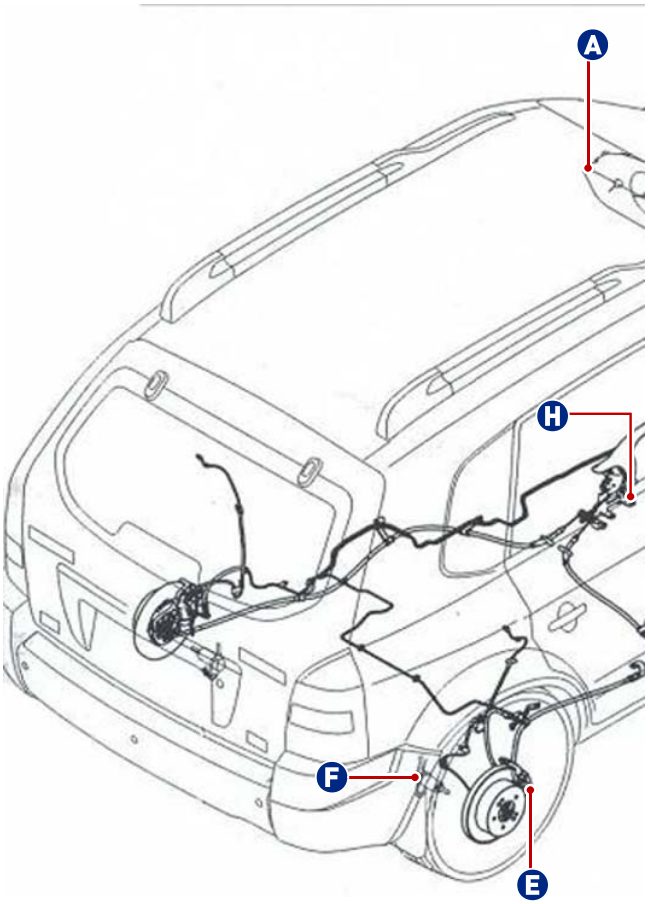
A. Indicators on instrument cluster



B. Master cylinder assembly



Description for master cylinder in this chapter is based on ABS/ESP equipped vehicle. For CBS, there is an extra pressure valve mounted to the master cylinder.

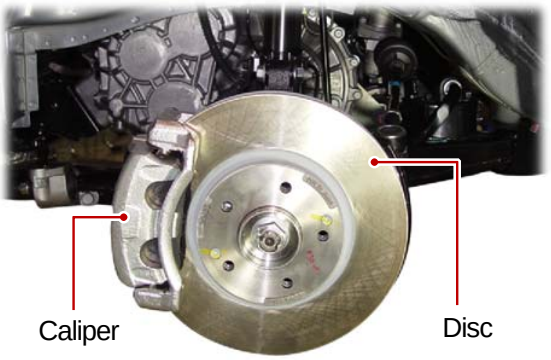


C. HECU assembly



The HECU assemblies for ABS and ESP have similar appearance but they have different inner structure and connector connections from each other.

D. Front brake assembly

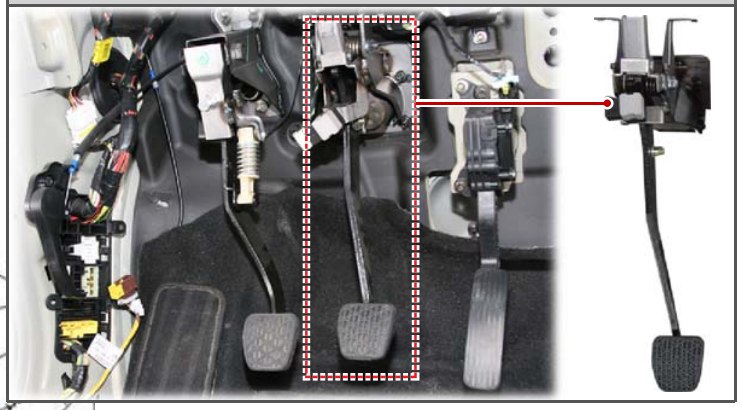


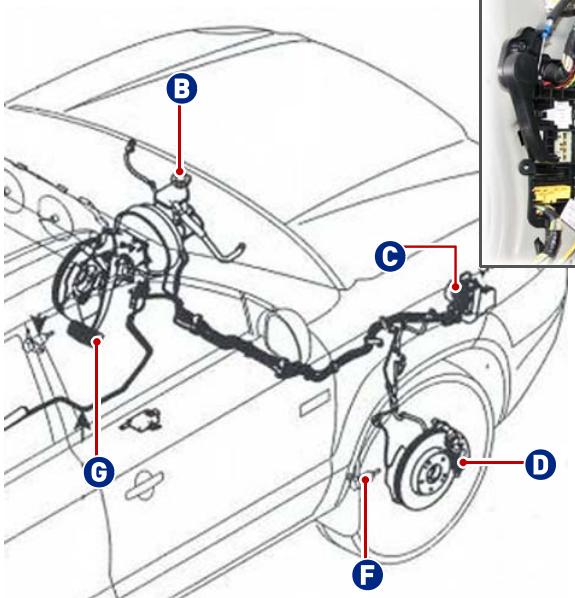
The disc brake for 4WD vehicle is the same with the one for 2WD vehicle.

Modification basis	
Application basis	
Affected VIN	

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G. Brake pedal



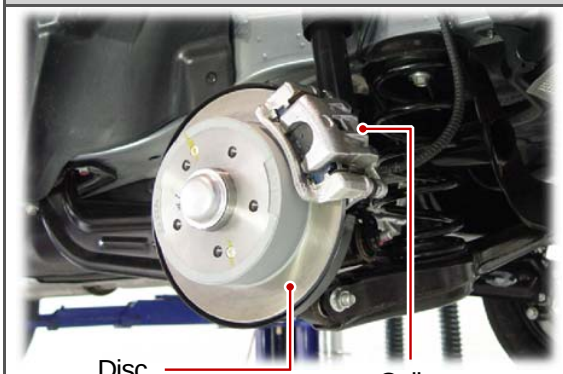


F. Parking brake

4WD and 2WD Front side	2WD Rear side
	

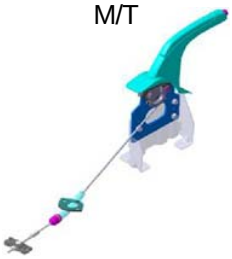
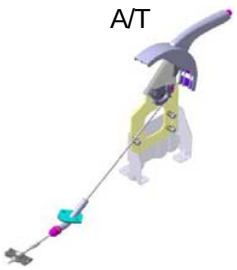
The wheel speed sensor for 4WD has the same structure and mounting location with the one for 2WD vehicle. But the rear side wheel speed sensor for 2WD vehicle has different sensor appearance and mounting status because the knuckle shape is different from the 4WD vehicle.

E. Rear brake assembly



The disc brake for 4WD vehicle has the same structure with the one for 2WD vehicle, but the appearance and knuckle shape is different from each other.

H. Parking brake

M/T	A/T
	

The parking brake is the mechanical device to hold the vehicle. When pulling up the lever, the parking brake cable between the lever and the rear drum brake trailing shoe pulls the parking brake lining to contact to drum.

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8. STEERING SYSTEM LAYOUT

1) HPS (Hydraulic Power Steering)

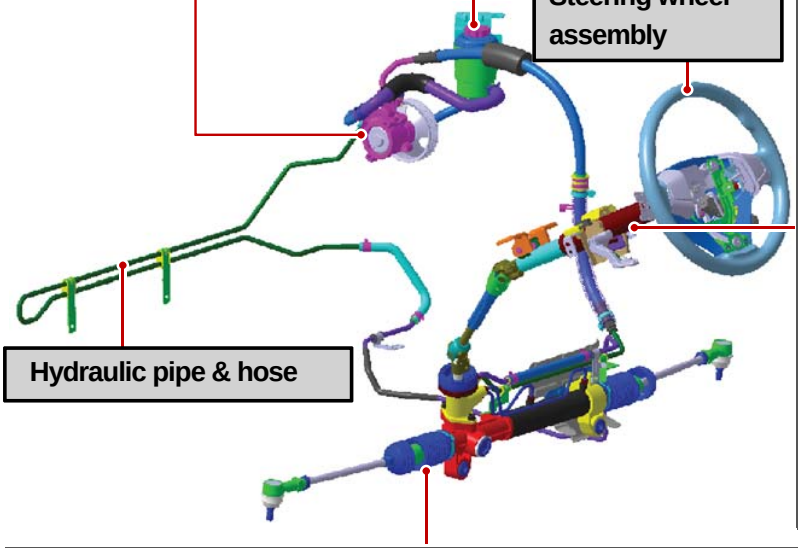
The hydraulic pump is a vane type pump and consists of the flow control valve and pressure relief valve.



The oil reservoir sends the oil to the power steering pump and receives the oil from the power steering gear.



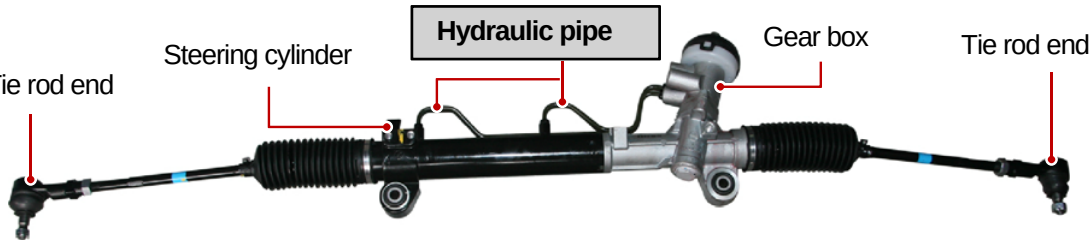
There is a shock absorber which is folded in the axial direction when the vehicle is crashed and a ignition switch assembly on the column shaft.





The lower shaft minimizes the torque change using a CV joint which has constant angular speed.

Steering gear box assembly



The steering gear box assembly consists of power cylinder and control valve. The power cylinder has a cylinder, piston and piston rod. The control valve directs the oil to one end face of the piston to enhance the steering force. There is a safety check valve which lets the driver steer manually when there is a malfunction in the hydraulic circuit.

Modification basis	
Application basis	
Affected VIN	

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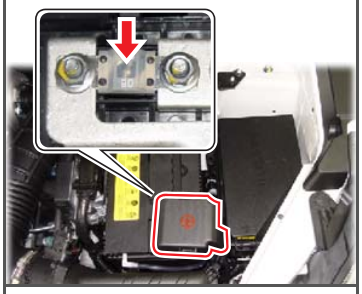
2) EPS (Electric Power Steering)

ECU



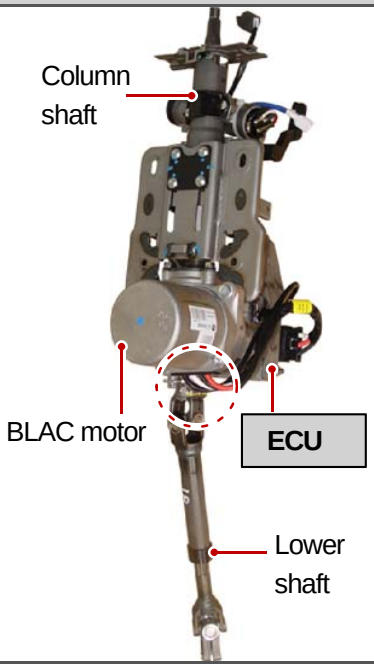
The ECU controls the electric power steering system depending on the driving conditions, based on the signals from the torque and angle sensor.

Fuse

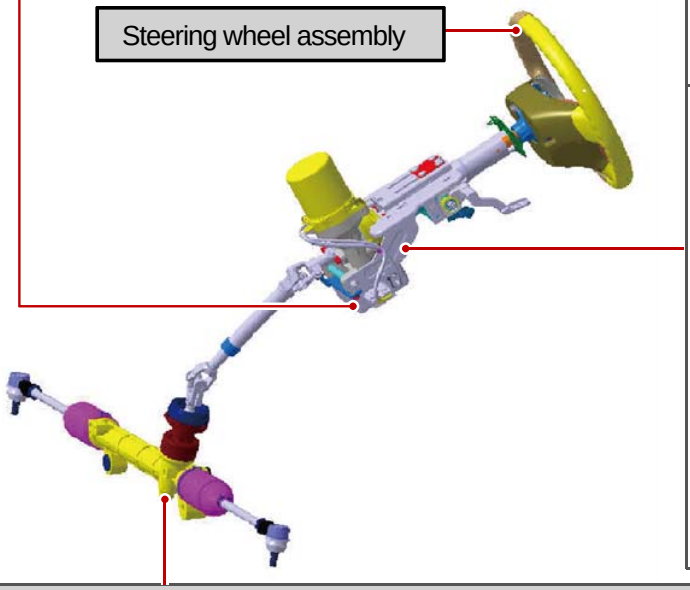


The vehicle with EPS has EPS fuse (80A) mounted to the positive (+) terminal of the battery, and this fuse supplies power to the EPS unit directly..

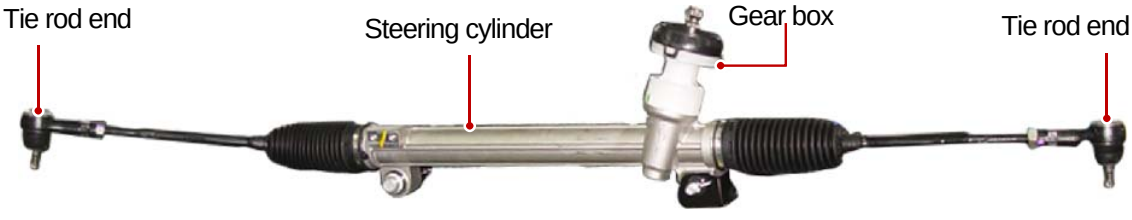
Colum shaft assembly



The column shaft assembly consists of BLAC motor, ECU, torque and angle sensors. The electric power steering (EPS) system uses the electric motor to assist the steering force. It functions independently regardless of whether the engine is running or not, unlike the existing hydraulic power steering.
The lower shafts functions in the same way as the hydraulic type.



Steering gear box assembly



When the driver turns the steering wheel, a torque is generated and the torque sensor and the steering angle sensor in the EPS system detect the rotation of the steering column to run the electric motor. At this time, the worm gear connected to the motor drives the helical gear mounted to the steering column to generate the assist torque for the steering column. This allows the driver to operate the steering wheel easier.

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GENERAL INSTRUCTIONS

1. GUIDELINES FOR SERVICE WORKS

1) For Safety

To perform the service works easily ans safely, the service technicians must keep the proper working procedures and rules.
This manual provides the useful instructions to the service technicians so that they can perform the servive works with standard working process, skills, tips in time.
Please read this manual and follow the instructions carefully.

Signal words such as "WARNING", "CAUTION" and "NOTE" have special meanings.

NOTE
indicates information to assist maintenance and instructions.

CAUTION
indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damage.

WARNING
indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

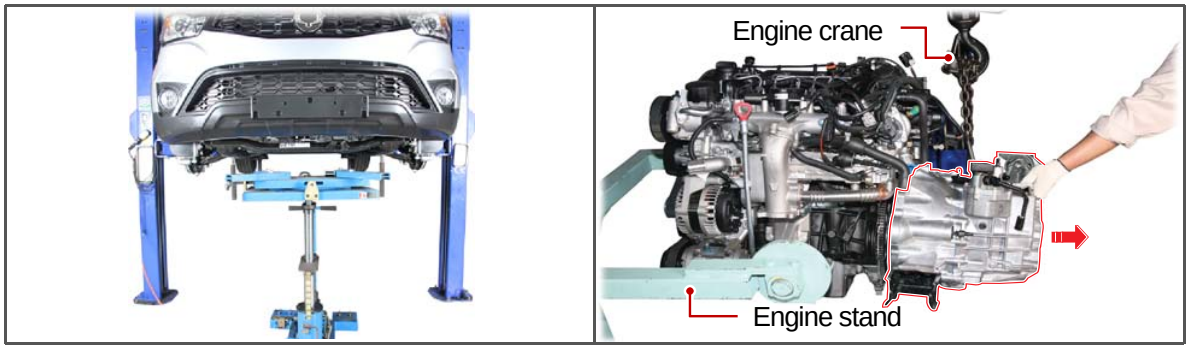
However, above references and cautions cannot be inclusive measures, so should have habits of paying attentions and cautions based on common senses.

Modification basis	
Application basis	
Affected VIN	

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2) Equipment

- Korando is FF (Front Engine Front Drive) type vehicle, and engine and powertrain system are integrated into a module. Therefore, 2-post lift and general equipment are necessary when working on the engine and transmission.
- Major equipment: Engine and transmission jack, Engine stand, Engine crane, Transmission jack, Engine hanger



Remove the engine and transaxle as a set.

- Manual transaxle: Transaxle can be separated after removing the front module (sub frame, engine and transaxle).
- Automatic transaxle: Transaxle can be separated after removing the sub frame.

3) General Instructions

(1) Before lifting up the vehicle with a lift, correctly support the lifting points.
(2) When using a jack, park the vehicle on a level ground and place the wheel chocks under the tires. Position the jack under the frame and lift up the vehicle and then support with chassis stand before service work.
(3) Make sure to disconnect the negative (-) cable from the battery to prevent any damage to electric systems.
(4) If you have to work on vehicle, cover the seats and floor with protection covers to avoid any damage and contamination.
(5) Brake fluid and anti-freeze can damage the painted surface of body. So carefully handle them during service work.
(6) To improve the efficiency of service work, use only recommended and specified tools.
(7) Use only Ssangyong genuine spare parts.
(8) Never reuse the cotter pin, gasket, O-ring, oil seal, lock washer and self-locking nut. Replace them with new ones. If reused, normal functions cannot be maintained.
(9) Store the disassembled parts as a set based on disassembly order and unit.
(10) Pay particular attention not to miss or mix the fasteners.
(11) If necessary, especially for inspection, clean the removed parts completely.
(12) Apply the oil or grease on the running and sliding surfeces before installation. Use the specified sealant and gasket to prevent leakage if necessary.
(13) Tighten the fasteners to the specified tightening torque.
(14) As a final stage of service work, check if the serviced system is working properly and the problem has been eliminated clearly.

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4) Basic Inspection

(1) Horn operation

- Listen for the horn sound when pressing the horn pad on the steering wheel.

(2) Brake operation

- Check if there is any abnormal noise, unusually long braking distance, or uneven braking force. If the brake warning lamp does not go out even after starting the engien or are flashing during driving, have the brake system checked immediately.
- Check the brake pipes and hoses for connection, oil leak, crack or interference after changing the position of tires. When replacing the tires, check the brake disc for surface condition and wear. Check the parking brake cable and brake operation. Shorten the checking interval if the parking
- brake is used frequently.

(3) Exhaust system

- Be aware to any changes in sound or smell from the exhaust system. These may be caused by leak or overheat. Have the exhaust system checked and repaired immediately.
- Inspect the exhaust system including catalytic converter. Inspect all the components and body frame near the exhaust system.

(4) Tires

- Unusual vibration of the steering wheel and seats or pulling to one side on the straight and level roads may indicates the uneven tire inflation pressure or poor wheel balance.

(5) Steering and suspension system

- Inspect the front and rear suspension and the steering system for damage, looseness or missing parts, signs of wear or lack of lubrication. Inspect the power steering line and the hoses for connection, leak, crack and chafing. Inspect the drive axle boot and seals for damage, tear or leak. Replace or repair the system if necessary.

(6) Engine oil

- Check the oil level when the engine is still warm and add the specified engine oil if necessary.

(7) Coolant

- Check the coolant level in the coolant reservoir, coolant conditions (contamination, foreign material), and hoses for damage and leak. Replace or add the Ssangyong genuine coolant, if needed.

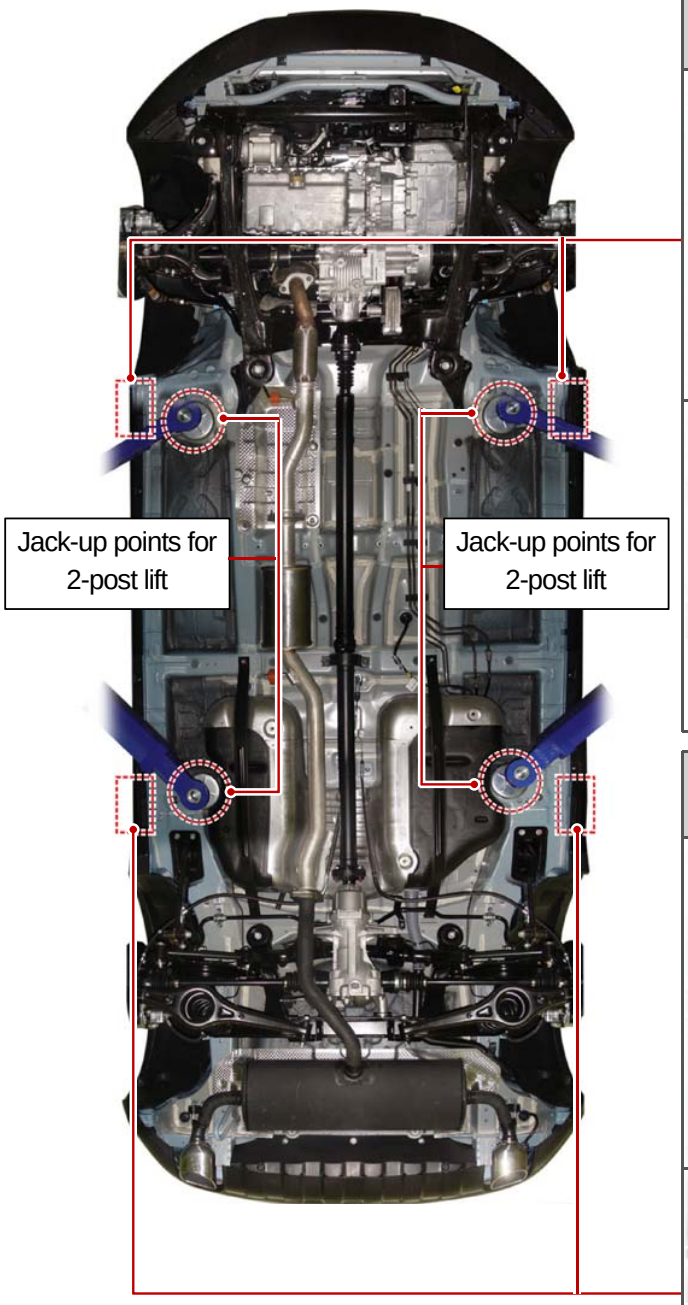
(8) Engine drive belt

- Check all drive belts on the engine for wear, crack and looseness. Retighten or replace the belt, if needed.

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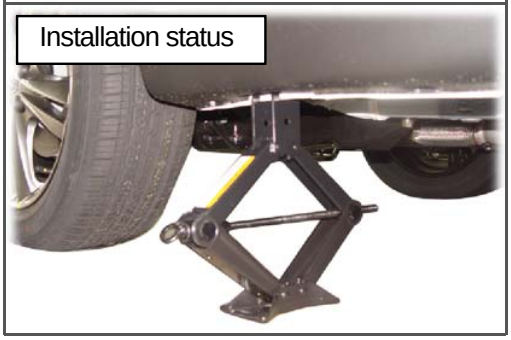
2. JACK-UP POINTS

▶ **Stand jack-up points and installation status (front side)**



Stand jack-up points and installation status (front side)





Stand jack-up points and installation status (rear side)

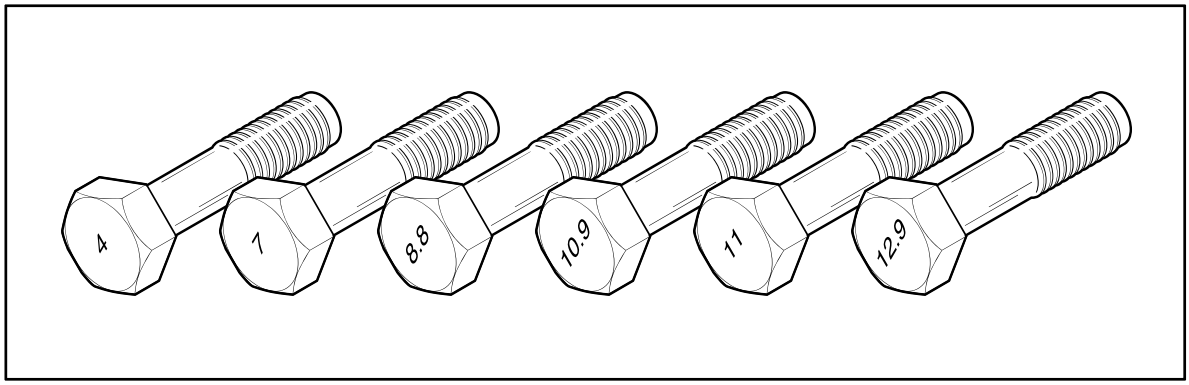




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3. STANDARD BOLTS SPECIFICATIONS

Bolt	Pitch	Tightening torque(kgf.cm)					
		Standard			Limit		
		4T	7T	9T	4T	7T	9T
M3	0.5	5	9	13	7	12	17
M4	0.7	12	20	30	16	27	40
M5	0.8	24	40	57	32	53	77
M6	1.0	41	68	99	55	91	130
M8	1.25	88	160	230	130	210	310
M10	1.25	190	330	470	260	430	620
	1.5	190	310	450	250	420	600
M12	1.25	350	580	840	460	770	1,100
	1.75	330	550	790	440	730	1,000
M14	1.5	550	910	1,300	730	1,200	1,900
M16	1.5	830	1,100	2,000	1,100	1,900	2,700
M18	1.5	1,200	2,000	2,900	1,600	2,700	3,800
M20	1.5	1,700	2,800	4,000	2,200	3,700	5,300
M22	1.5	2,300	3,800	5,400	3,000	5,000	7,200
M24	1.5	2,900	4,900	7,000	3,900	6,500	9,400
	2.0	2,800	4,700	6,800	3,800	6,300	9,100



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

Modification basis	
Application basis	
Affected VIN	

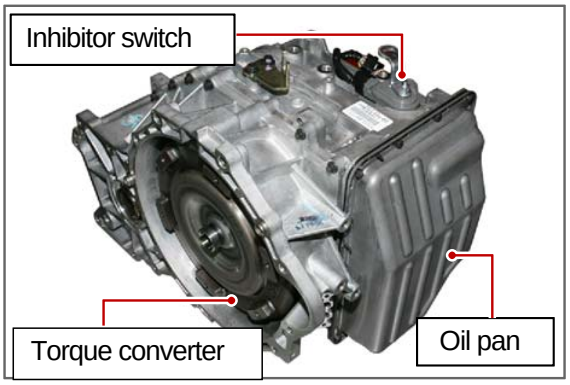
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DSI 6 SPEED AUTO TRANSAXLE

0000-00

GENERAL INFORMATION

1. GENERAL INFORMATION

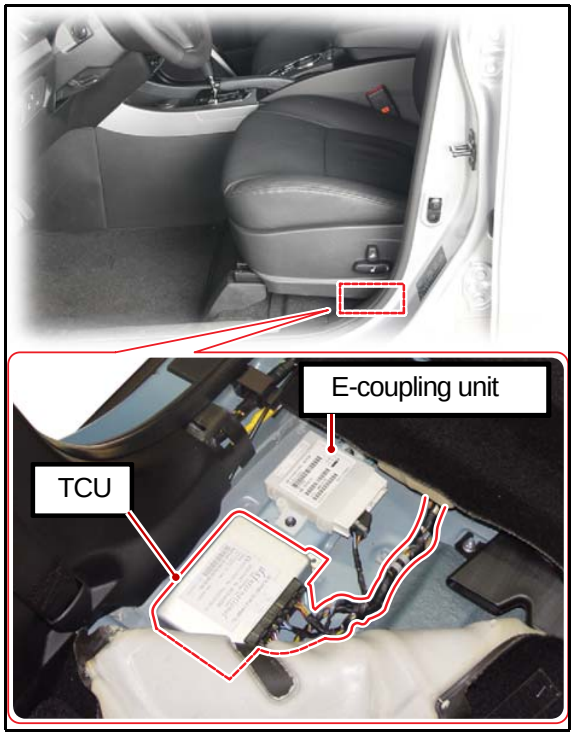


▶ **Automatic transaxle (M11)**

The Model 11 six speed automatic transaxle is available in two variants: four wheel drive and two wheel drive.

- Six forward speeds
- One reverse gear
- A toruqe converter with an integral converter lock-up clutch with slip control capabilities Electronic shift and pressure controls
- A single planetary gear-set
- A double planetary gear-set
- One hydraulically controlled brake bands
- Three multi-plate clutches
- One multi plate brake
- All hydraulic functions are directed by electronic
- solenoids to control:

1) Engagement feel
2) Shift feel
3) Shift scheduling
4) Modulated torque converter clutch applications



▶ **TCU (located under driver's seat)**

TCU is located under the driver's seat and controls the transaxle operations.
TCU is activated and deactivated by the ignition voltage, and connected to the transaxle through pin 26 in connector.
TCU receives and uses the signals from sensors and switches through CAN bus with analog and digital types.

Modification basis	
Application basis	
Affected VIN	

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▶ Tip switches on steering wheel

The shiftable gear can be adjusted by pressing the "UP (D+)" or "DOWN(D-)" switch when the gear selector lever is in "M" position.



▶ Meter cluster

This indicator shows the current position of the gear.





▶ Gear selector lever

Shift lock release button

If the selector lever cannot be moved from "P" or "N" position, try to move the lever while pushing down this button with finger. For safety, turn off the engine and depress the brake pedal before the attempt.

Lever positions

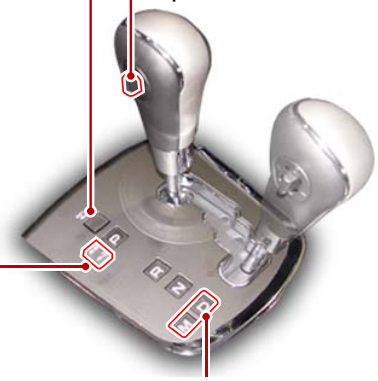
P : Park
R : reverse
N : Neutral
D : Drive

Mode switch

W: Winter mode (pressed "OUT")
S: Standard mode (pressed "IN")
Toggle the mode between winter mode and standard mode by pressing this switch.

Tip switch (manual shift switch)

The shiftable gear can be adjusted by moving this switch to forward and rearward when the gear selector lever is in "M" position.



Selection of Manual/Automatic Shift Function

D: Automatic shift according to the driving condition
M: Manual shift

Modification basis	
Application basis	
Affected VIN	

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2. SPECIFICATIONS

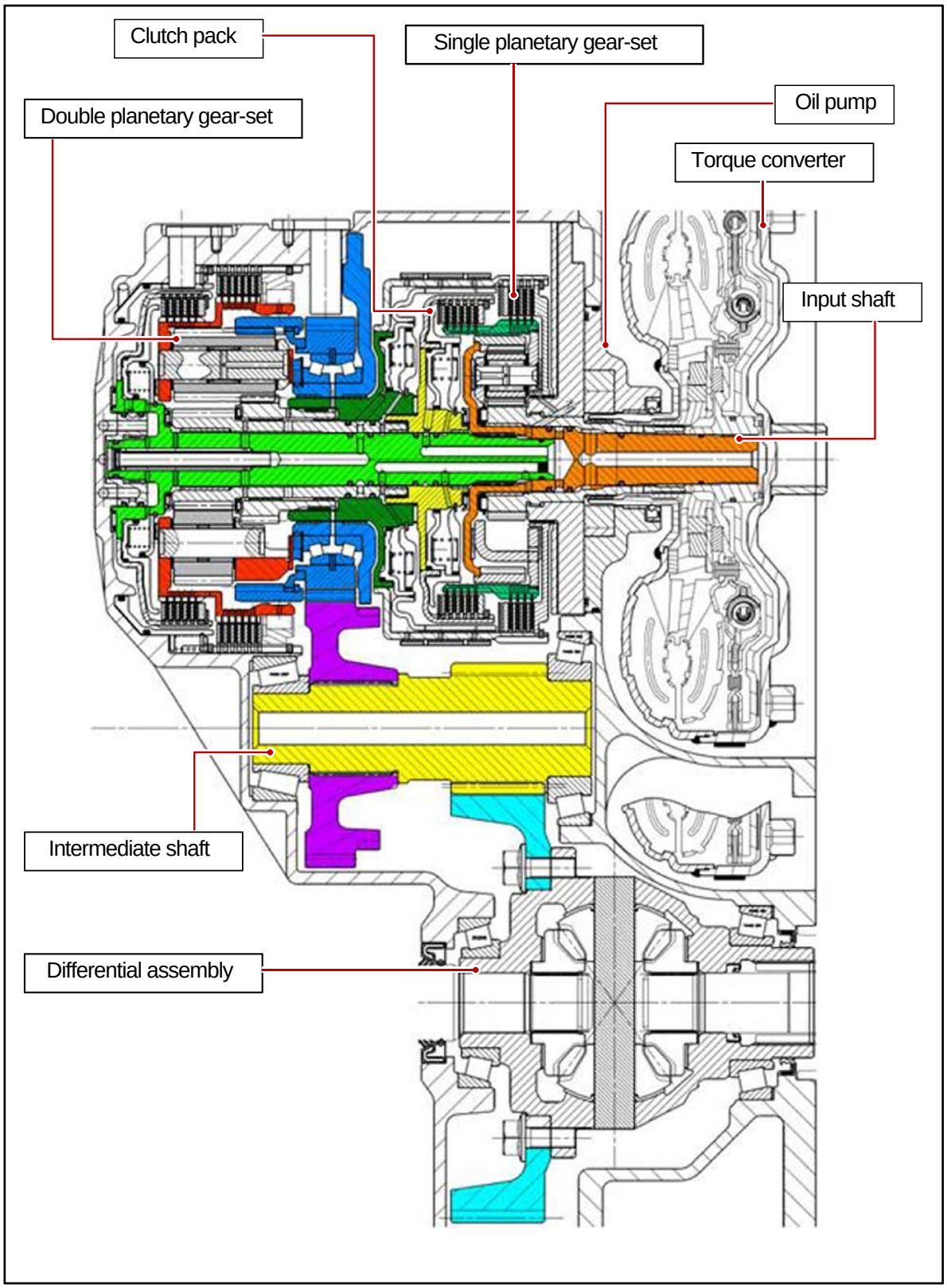
1) Specifications

Descriptions		Specification
Gear ratio	1st gear	4.156
	2nd gear	2.375
	3rd gear	1.522
	4th gear	1.144
	5th gear	0.859
	6th gear	0.676
	Reverse gear	3.178
Oil	Type	Fuchs TITAN ATF 3292
	Capacity	approx. 7.5 L
	Change interval	EU: Inspect every 20,000 km or 12 months (But, change every 60,000 km under severe condition) General: Inspect every 15,000 km or 12 months (But, change every 60,000 km under severe condition)
Resistance of oil temperature sensor	-20	430.7 to 533.9 kΩ
	0	146.8 to 175.7 kΩ
	20	56.74 to 65.86 kΩ
	100	3.201 to 3.399 kΩ
Inhibitor switch	D	2.686 kΩ ±8%
	N	5.036 kΩ ±8%
	P	8.953 kΩ ±8%
	R	16.786 kΩ ±8%

Type/Weight	M11 6-speed automatic transaxle / approx. 102 kg (including ATF)
TORQUE	400 Nm
Overall length / Center length	367 mm / 205 mm

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2) Sectional Diagram



Modification basis	
Application basis	
Affected VIN	

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3. TIGHTENING TORQUE

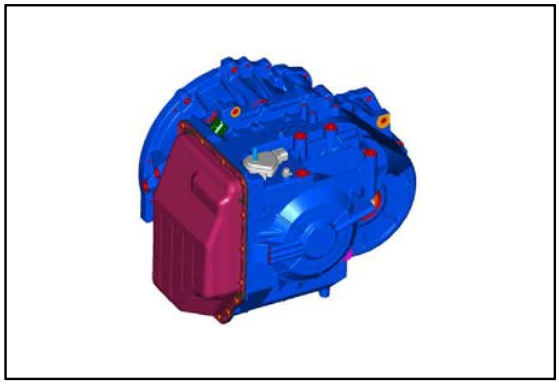
Descriptions		Size x Numbers	Tightening torque (Nm)
Automatic transaxle	Engine side mounting bolt	17 mm X 4	85.0 to 100
	Oil pan and engine side mounting bolt	14 mm X 4	56.0 to 62.0
	Oil filler plug	16 mm	25.0 to 30.0
	Oil drain plug	Hexagon 5 mm	25.0 to 30.0
Valve body	Assembly mounting screw	T30 mm X 9	16.0
	Oil pan bolt	10 mm X 15	7.0 to 8.0
	VBS screw	T30 mm	4.0
	Valve body screw	T30 mm X 25	16.0
Torque converter	Mounting bolt	13 mm X 6	40.0 to 42.0
Cable	Link nut (switch side)	13 mm X 1	13.7 to 19.6
	Link nut (cable side)	12 mm X 1	14.7 to 22.5
	Mounting nut (floor side)	12 mm X 1	17.6 to 21.6
	Mounting nut (dash panel side)	12 mm X 2	17.6 to 21.6
TGS lever	Mounting nut	12 mm X 4	17.6 to 21.6
TCU	Mounting nut	8 mm X 2	5.0 to 6.0
Inhibitor switch	Mounting nut	12 mm X 2	3.9 to 7.8
Transaxle bracket	Left bracket	17 mm X 3	85.0 to 100
	Right bracket	17 mm X 4	85.0 to 100
	Upper bracket	17 mm X 4	85.0 to 100
Oil cooler pipe	Mounting bolt	10 mm X 2	Max.: 13.0
	Bracket mounting bolt	10 mm X 1	13.0

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW





Engine power reaches the transaxle via a torque converter with integral converter lock-up clutch. The six forward gears and one reverse gear are obtained from a single planetary set, followed by a double planetary set. This type of gear-set arrangement is commonly known as Lepelletier type gear-set.
The Model M11 6 speed automatic transaxle is electronically controlled. The control system is comprised of the following components:

- External transaxle control unit (TCU)
- Internal embedded memory module (EMM)
- Input and output speed sensors
- Valve body unit comprised of four ON/OFF solenoid valves and six variable bleed solenoids (VBS) Torque converter
-

TCU controls the oil pressure for various internal clutches and bands to select the gear. It also controls the electronic elements, shift pressure and torque converter slip. If the system is defective, TCU provides FMEC (Failure Mode Effect Control) to maintain the functionality of transaxle. This keeps the basic function of transaxle (gear selection) even when there are failure in controls and power supply.

There are selector shaft position sensor (inhibitor switch) and oil temperature sensor in transaxle. In manual mode, TCU receives the information from TGS (Transmission Gear Selector) through PCB (Printed Circuit Board) when driver selects the manual shift mode. TCU communicates with other electric control modules through CAN. In order to ensure a safe driving state and to prevent damage to the automatic transmission, TCU switches to Limp-Home mode in the event of critical faults.

Modification basis	
Application basis	
Affected VIN	

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2. FEATURES

1) Advantages

▶ Early Downshift with Hard Braking and Skip Shifts

When heavy braking is detected, the transaxle downshifts early and skips gears to provide increased engine braking to provide gear selection for tip-in.

▶ Gear Hold going Uphill/Downhill

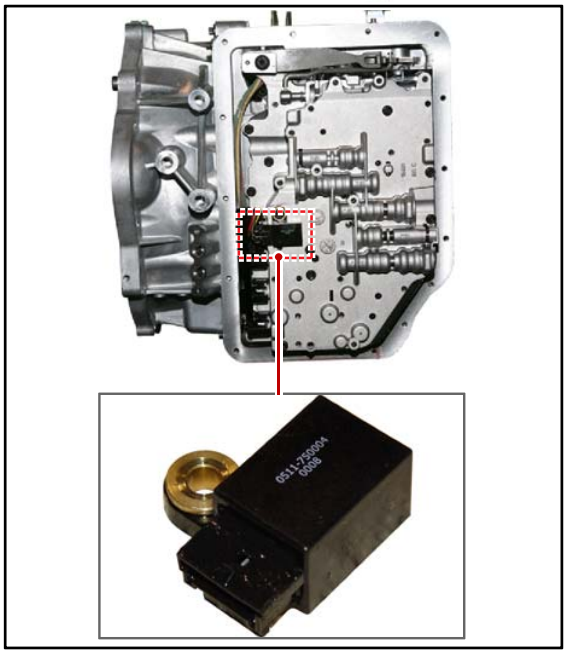
If the accelerator pedal is released when traveling uphill, upshifts are prevented to reduce busyness on grades. If the accelerator pedal is released when traveling downhill, upshifts are prevented to enhance engine braking.

▶ Drive and Reverse Engagement

A soft engagement feature avoids harsh take up of drive when selecting Drive or Reverse. This is achieved by limiting engine speed and engine torque which results in a rapid, but progressive engagement of either Drive or Reverse when moving from the Park or Neutral positions. Drive and Reverse engagements from either Park or Neutral are performed in less than 2.2 seconds. There is no drive engagement prevention strategy implemented on the transaxle system as there is sufficient engine strategy to protect the system. However, reverse engagement is prevented until engine speed is less than 1,400 rpm and the accelerator pedal position is less than 12% and vehicle speed is less than 10 km/h.

▶ Converter Clutch Lock-Up In All Gears

The transaxle features converter clutch lock-up in all gears. This feature provides improved fuel economy and vehicle performance. It also improves transaxle cooling efficiency when towing heavy loads at low speeds, e.g. in city driving or hill terrain.



▶ Embedded Memory Module (EMM)

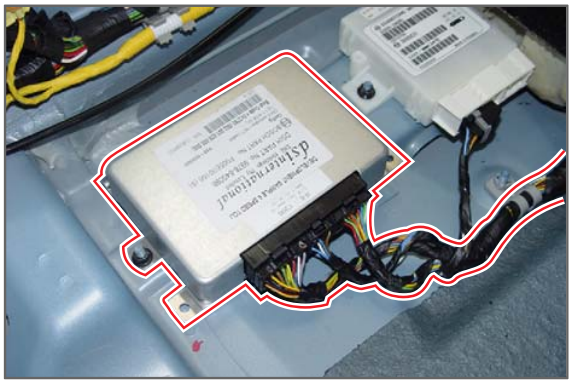
The embedded memory module (EMM) is matched to the transaxle's valve bodies during transaxle assembly to ensure refined shift quality. The EMM is used to store data such as valve body calibration data and valve body serial number. Upon installation, the TCU will download the data from the EMM and utilize this data in the operation of the transaxle.

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2) Transaxle Cooling

The transaxle cooling system ensures rapid warm-up and constant operating temperature resulting in reduced fuel consumption and refined shift quality.
It also includes a cooler by-pass within the hydraulic system to allow sufficient lubrication to the transaxle drivetrain in the event of a blockage in the transaxle cooler.

3) Shift Strategy



▶ **Gear Change**

Transaxle gear change is controlled by the TCU. The TCU receives inputs from various engine and vehicle sensors to select shift schedules and to control the shift feel and torque converter clutch (TCC) operation at each gear change.

▶ **Coast down**

Coast down down shifts occur at 0% pedal when the vehicle is coasting down to a stop.

▶ **Torque Demand**

Torque demand down shifts occur (automatically) when the driver demand for torque is greater than the engine can provide at that gear ratio. If applied, the transaxle will disengage the TCC to provide added acceleration.

Modification basis	
Application basis	
Affected VIN	

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3. MODES AND FUNCTIONS

1) Mode Switch



▶ **W: Winter mode (pressed "OUT")**

To select the winter mode, press the mode switch. The winter mode indicator (W) in the instrument cluster comes on. To return to standard mode, press the switch again. The indicator goes out. Use this mode to drive off smoothly on an icy and slippery road.

▶ **S: Standard mode (pressed "IN")**

Use the standard mode in normal driving condition.

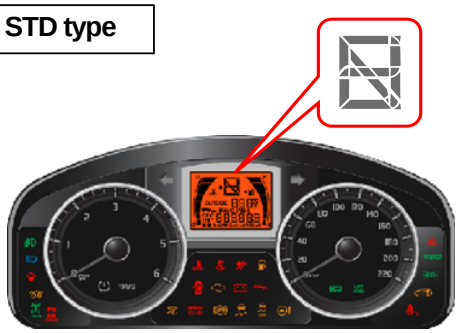
2) M Mode (Manual Mode)



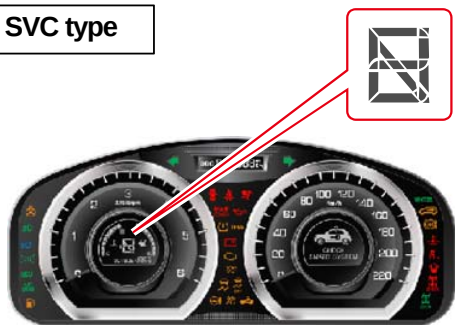
This allows the driver to define the highest possible gear by selecting "+" or "−" on the gear selector when the lever is in the "M" position. When the lever is first moved to the manual "M" position the transaxle will select the lowest possible gear.

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STD type



SVC type



▶ 1st Gear State

- The 1st gear state will display on the instrument cluster. Unlike the normal 1st gear, engine braking will be available in this manual 1st state.

▶ 2nd Gear State

- The 2nd gear state will display on the instrument cluster. 2-1 automatic kick-down shifts are available. 2nd gear has engine braking available.

▶ 3rd Gear State

- The 3rd gear state will display on the instrument cluster. 3-2 and 3-1 automatic kick-down shifts are available. 3rd gear has engine braking available.

▶ 4th Gear State

- The 4th gear state will display on the instrument cluster. 4-3 and 4-2 automatic kick-down shifts are available. 4th gear has engine braking available.

▶ 5th Gear State

- The 5th gear state will display on the instrument cluster. 5-4 and 5-3 automatic kick-down shift is available. 5th gear has engine braking available.

▶ 6th Gear State

- The 6th gear state will display on the instrument cluster. 6-5 and 6-4 automatic kick-down shifts are available. 6th gear has engine braking available.

Modification basis	
Application basis	
Affected VIN	

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4. LIMP HOME MODE

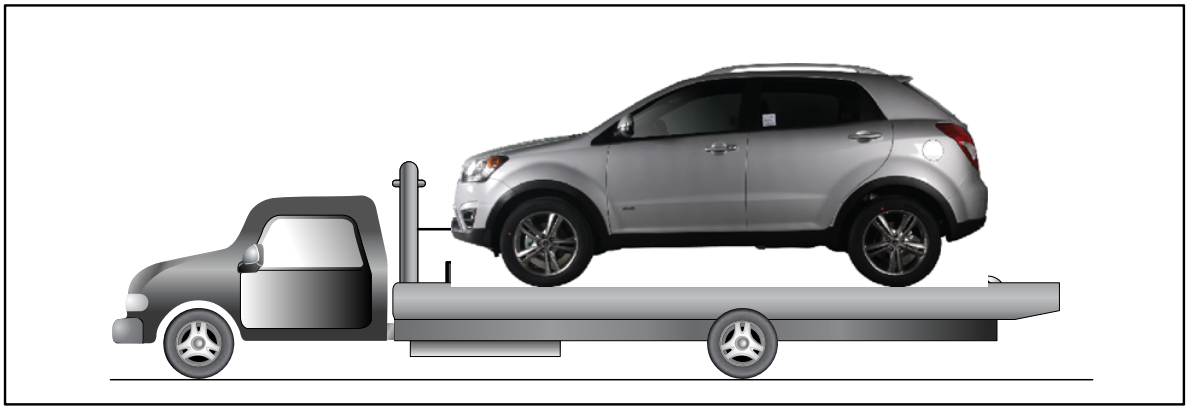
▶ When the transaxle is defective

1. In the event of a system fault, the TCU also provides for failure mode effect control (FMEC) to maintain maximum functional operation of the transaxle.
2. In the event of a total loss of control or electrical power, the basic transaxle functions (Park, Reverse, Neutral and Drive) are retained. The 4th and reverse gear ratios with the torque converter clutch in the unlocked state are the retained gear states the hydraulic system supports without any electrical assistance.
3. The TCU communicates with other vehicle electronic control modules by the controller area network (CAN). If a major fault develops, the transaxle may automatically operate in a "limp home" (failure) mode to enable the vehicle to be driven to an authorized dealer for repair.
4. The TCU also provides for transaxle diagnostics, which meet the requirements of OBD II legislation, monitoring all components which may effect vehicle emissions.

▶ When the transaxle overheats

1. Limp home mode may also be engaged if the battery charge falls below 8V.
2. If the transaxle overheats, the shift patterns will automatically change to enable improved transaxle cooling.
3. During transaxle overheat, the instrument cluster transaxle selector position display and the over temperature condition is indicated by flashing the "W(Winter)" indicator on the instrument cluster until normal transaxle operating temperature is reached.

▶ Towing the automatic transaxle equipped vehicle



CAUTION

- Flat-bed equipment is the best method of moving a disabled vehicle to avoid any damages.
- For AWD vehicle: The vehicle must be towed with a wheel lift and dollies or flatbed equipment with all the wheels off the ground.
  For 2WD vehicles: It is acceptable to tow the vehicle with the rear wheels on the ground without dollies and the front wheels off the ground. When being towed by a commercial towtruck and wheel dollies are not available, the front of the vehicle should be lifted, not the rear.

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5. TRANSAXLE ELECTRONIC CONTROL SYSTEM

1) General Information

The transmission control unit (TCU) and its input/output network control the following transmission operations:

- Shift timing
- Line pressure
- Clutch pressure (shift feel)
- Torque converter clutch

also uses these signals when determining transaxle operating strategy. Using all of these input signals, the TCU can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch. It will also determine the pressure needed to optimise shift feel. To accomplish this, the TCU operates six variable bleed control solenoids and four on/off solenoids to control transaxle operation.

2) TCU (Transmission Control Unit)



The transaxle control unit (TCU) is mounted under the driver's seat and controls the operation of the transaxle.
The TCU is activated and deactivated by the ignition power supply and is connected to the transaxle link harness by a 26 pin connector. The TCU processes information received from internal sensors and signals received across the CAN bus in analogue and digital forms such as:

- Transaxle input speed
- Transaxle output speed
- Accelerator pedal position
- Gear selector position
- Engine torque
- Engine speed
- Transaxle fluid temperature
- Brake pedal status
- Engine oil temperature
- Engine coolant temperature
- Ambient air temperature
- Barometric pressure

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This information is used by the TCU to decide which shift pattern to select and for shift energy management. Electro-hydraulic solenoid valves and variable bleed solenoids control the transaxle gear changes.
Six variable bleed solenoids and four on/off solenoids are used to direct transaxle fluid flow to control the fluid pressure within the three clutches and two bands. Separate pressure regulators are used exclusively for torque converter clutch control and main transaxle line pressure.
The TCU monitors all TCU inputs and outputs to confirm correct system operation. If a fault occurs the TCU is able to perform default action and inform the driver of the problem through the instrument cluster warning lights. Detailed information is available via trouble codes which can be read with the service tool.

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3) Shift Map Selection

The driver can manually select between normal (S) and winter modes (W) via the mode switch. Depending on the transaxle temperature, uphill and downhill grades and altitude, shift maps will be selected by the TCU to suit the driving conditions. The following maps are available.

▶ Standard (Normal) Mode

Normal Mode is selected when the lever is in the D position with the mode switch in the normal (S) position and the transaxle is within normal temperature ranges. Shift schedule points are optimised for fuel efficiency and general driving conditions.

▶ Uphill and Downhill Mode

In this mode, depending on the load of the vehicle, adaptive shift maps are selected to progressively adjust the shift points and torque converter lock points.

▶ Altitude Mode

Shift points are automatically adjusted at higher altitudes to compensate for changes in engine torque where the torque produced by the engine is greatly reduced by the effects of reduced barometric pressure and temperature.

▶ Winter (W) Mode

When winter mode is selected, starting in second gear is facilitated and the WINTER mode indicator light is switched ON. To prevent wheel spin on slippery surfaces, the transmission will not allow first gear unless manually overridden.

▶ Warm up Schedule

Used typically when transaxle fluid temperature is below 20°C.
The torque converter will not lock-up below 20°C to assist in transaxle warm-up.

▶ Hot Mode

The hot mode is progressively applied between temperatures of 110° ~ 200°C. The torque converter lock-up is increased to prevent heat generation by the torque converter.

Above 110℃	the electrical radiator fans are switch ON
Above 130℃	the engine torque will be reduced and the W light on the instrument cluster will flash
Above 200℃	the transaxle will neutralise until the fluid temperature falls below 200°C as a final protection.

Activation of the hot mode inhibits other transmission performance features including uphill and downhill compensation and altitude compensation. Some degradation in shift feel may be experienced as the torque converter is not unlocked during shifting.

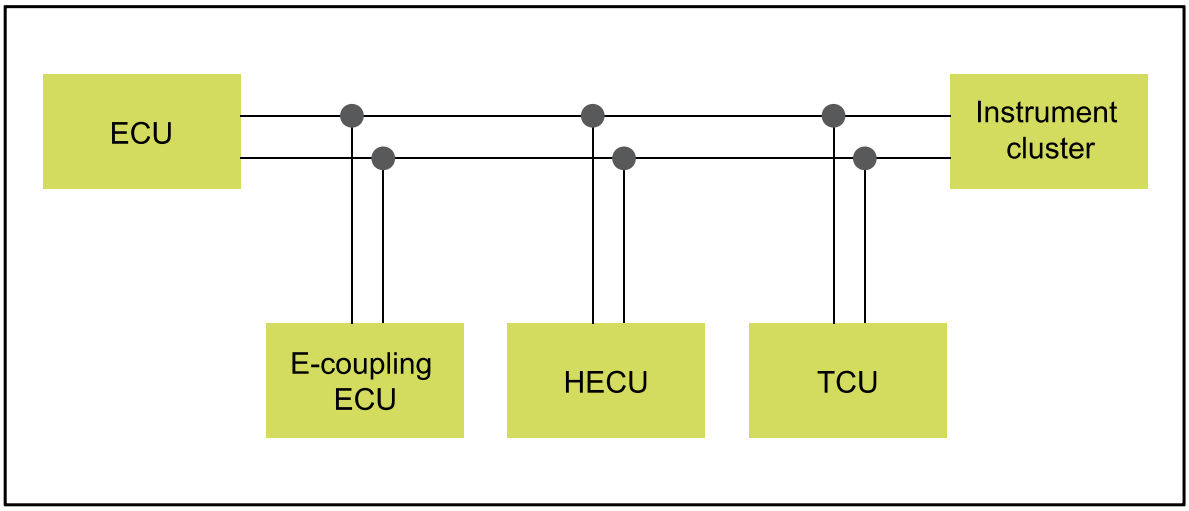
▶ Cruise Control Mode

When cruise control is activated the engine ECU may request the transaxle to downshift under trailing throttle conditions to increase engine braking.

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6. CAN NETWORK

▶ **Schematic Diagram of Network Communication**



The TCU sends signals to be used by other vehicle systems via the CAN bus, such as:

- Selector lever position
- Selected gear state
- Manual mode activation
- Output torque
- Transaxle fluid temperature
- Engine torque reduction requests

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7. POWER TRANSFER

Power transfer modes are as follow:

- Manual: 1st gear (position M)
- Drive: 1st gear
- Drive: 2nd gear
- Drive: 3rd gear
- Drive: 4th gear - limp home mode
- Drive: 5th gear
- Drive: 6th gear

1) Gear Selection and Engagement Element

Gear	Gear ratio	Engagement element (clutch/band)					
		C1	C2	C3	B1	B2	1-2 OWC
M1	4.156		ON			ON	
1st	4.156		ON				ON
2nd	2.375		ON		ON		
3rd	1.522		ON	ON			
4th	1.144	ON	ON				
5th	0.859	ON		ON			
6th	0.676	ON			ON		
Reverse	3.178			ON		ON	

Gear	ON/OFF solenoid valve				Variable bleed solenoid valve (VBS)					
	S1	S2	S3	S4	S5(A)	S6(A)	S7(A)	S8(A)	S9(A)	S10(A)
M1	ON				1	0	1			
1st	ON				1	0			0-1	
2nd	ON			ON	1	0		1	0-1	
3rd	ON		ON		1	0	1		0-1	
4th					0	0			0-1	
5th		ON			0	1	1		0-1	
6th		ON		ON	0	1		1	0-1	
Rev.	ON	ON	ON		1	1	1		0-1	

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2) Power Flowing Sequence

Engine



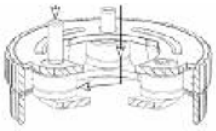
Torque converter

This is a fluid clutch. Transfers the power from engine to transaxle and amplifies the torque.



Input shaft

Transfers the power from torque converter to front planetary gear.



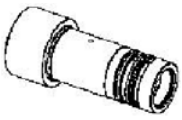
Front planetary gear

Generates the gear ratio and transfers the power.



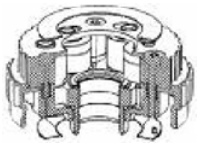
C2 clutch

Engaged by hydraulic pressure and transfers the power to C1 clutch.



Forwarding sun gear

Transfers the power from torque converter to rear planetary gear.



Rear planetary gear

Generates the gear ratio and transfers the power.



C1 clutch

Engaged by hydraulic pressure and transfers the power to C1 clutch.



Center support

Transfers the power from input shaft to intermediate shaft.



Intermediate shaft assembly

Changes the rotating direction and generates the final reduction rear ratio.



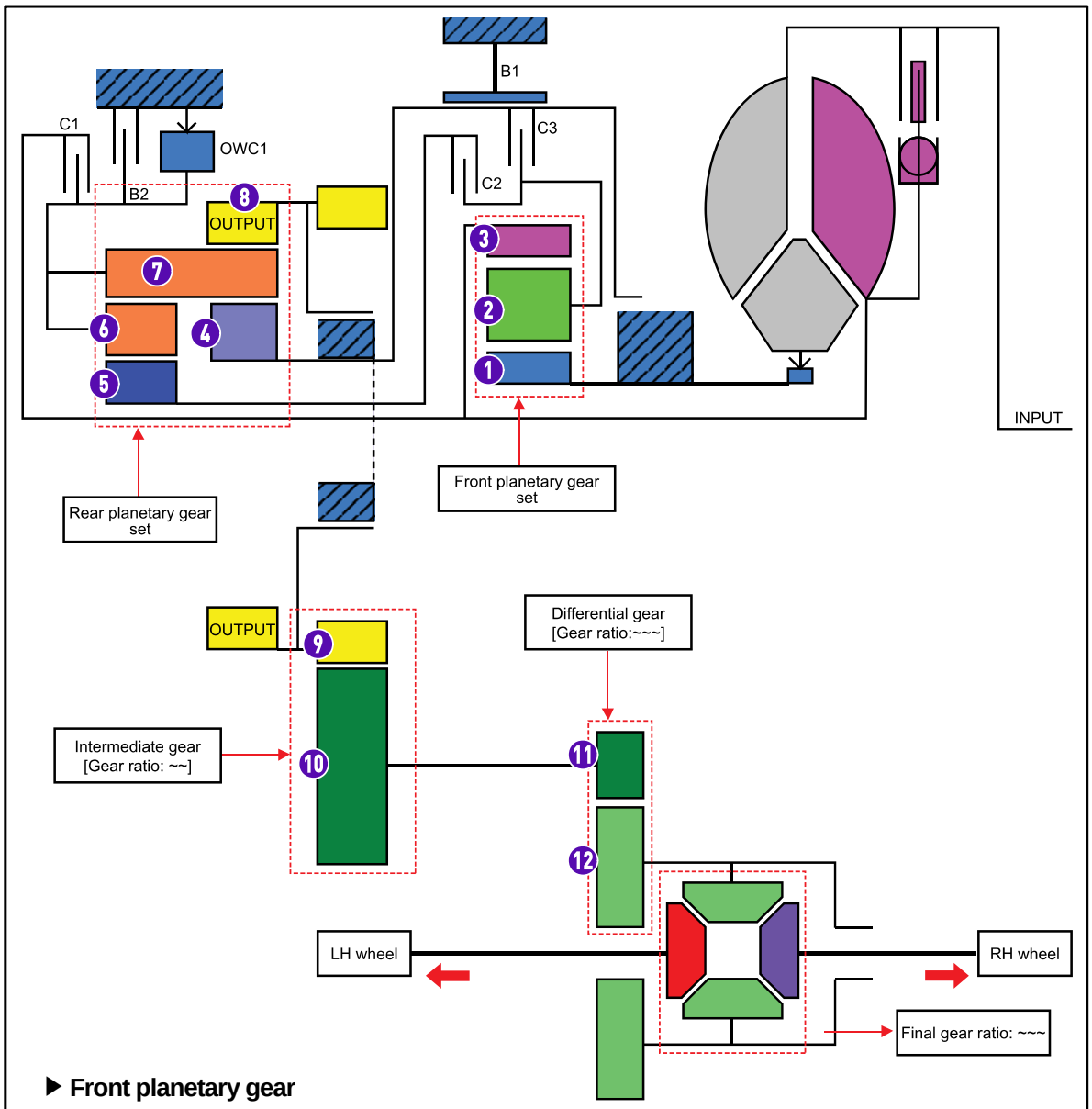
inal reduction and differential gear

Generates the final reduction gear ratio and performs the differential function.
Transfers the power to constant velocity shaft.

Universal joint

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3) Power Flow



▶ **Front planetary gear**

1. Front sun gear (FSG)
2. Planetary hear pinion (PP)
3. Ring gear (Internal)

▶ **Rear planetary gear**

4. Forward sun gear (FSG)
5. Reverse sun gear (RSG)
6. Short pinion (SPP)
7. Long oinion (LPP)
8. Ring gear (RG)

▶ **Intermediate gear**

9. Drive gear
10. Driven gear

▶ **Differential gear**

11. Pinion
12. Differential

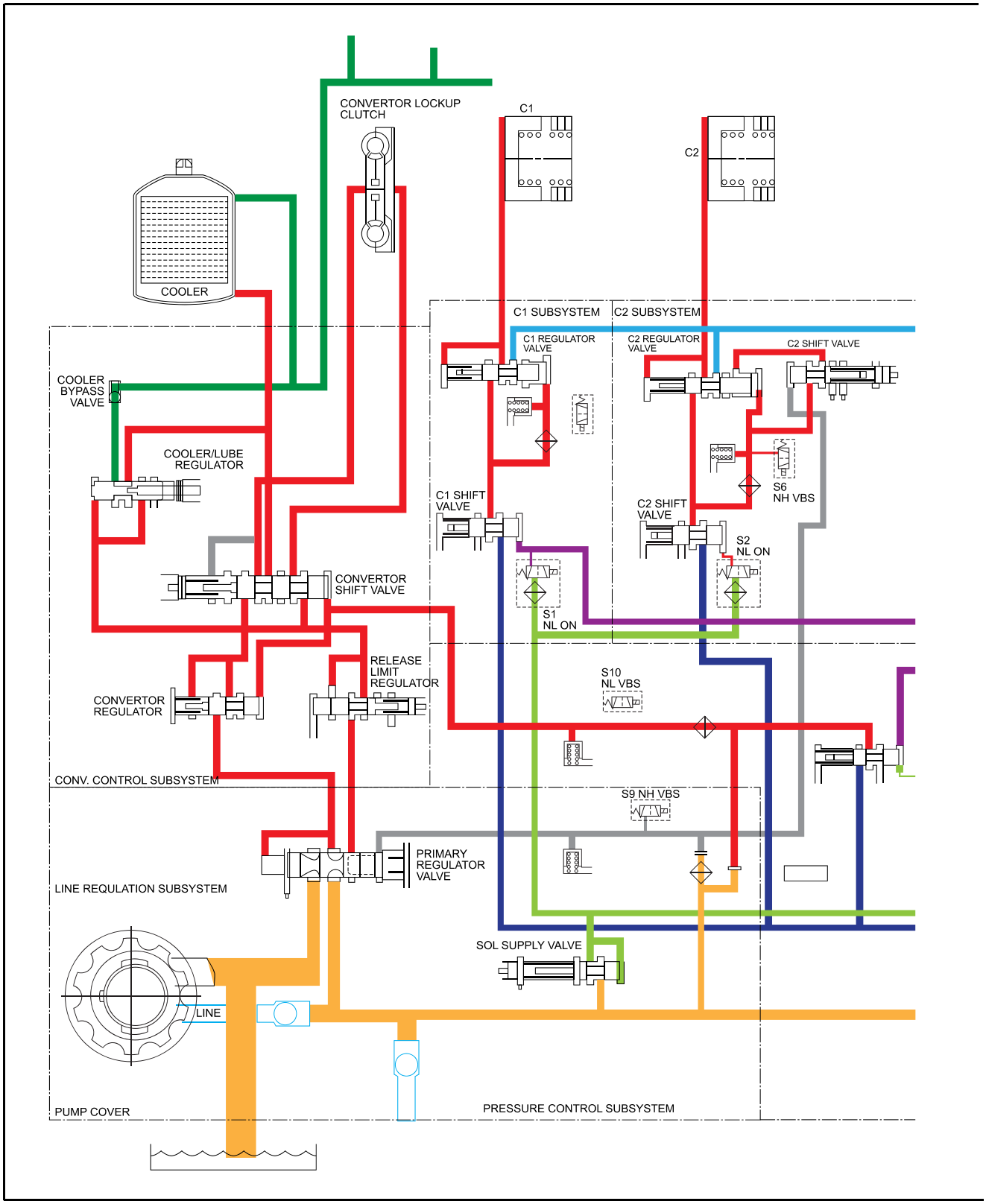
Modification basis	
Application basis	
Affected VIN	

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Memo

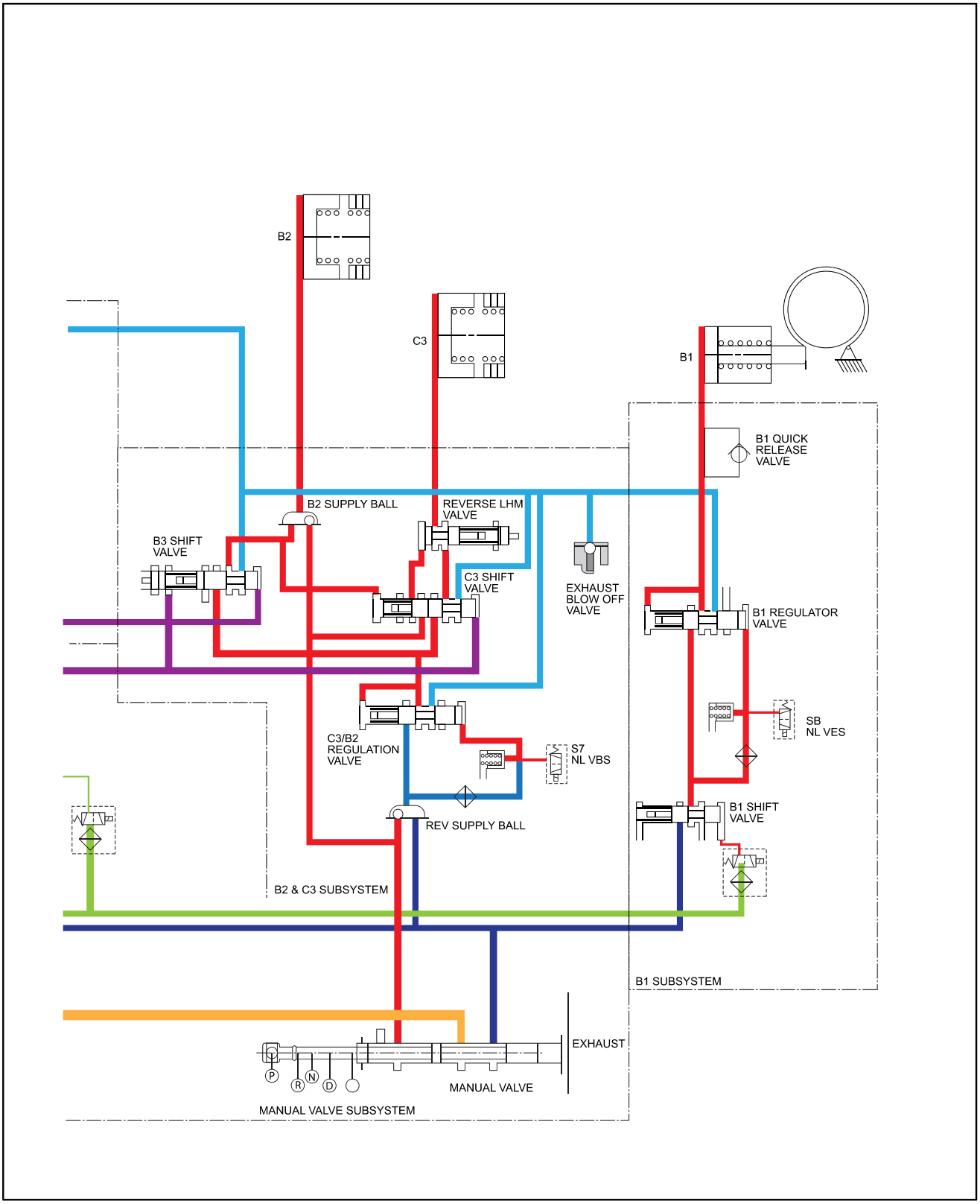
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3) Hydraulic Circuit Diagram



Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
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DSI 6 SPEED AUTO TRANSAXLE

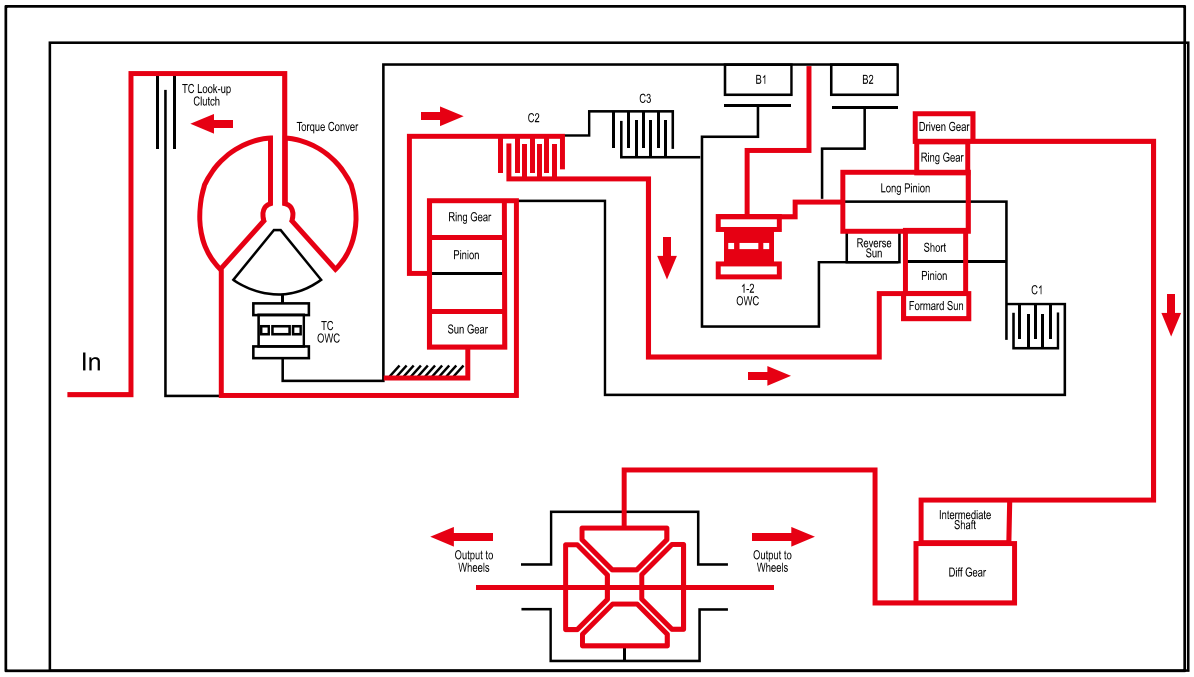
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4) Power Transfer in Each Gear

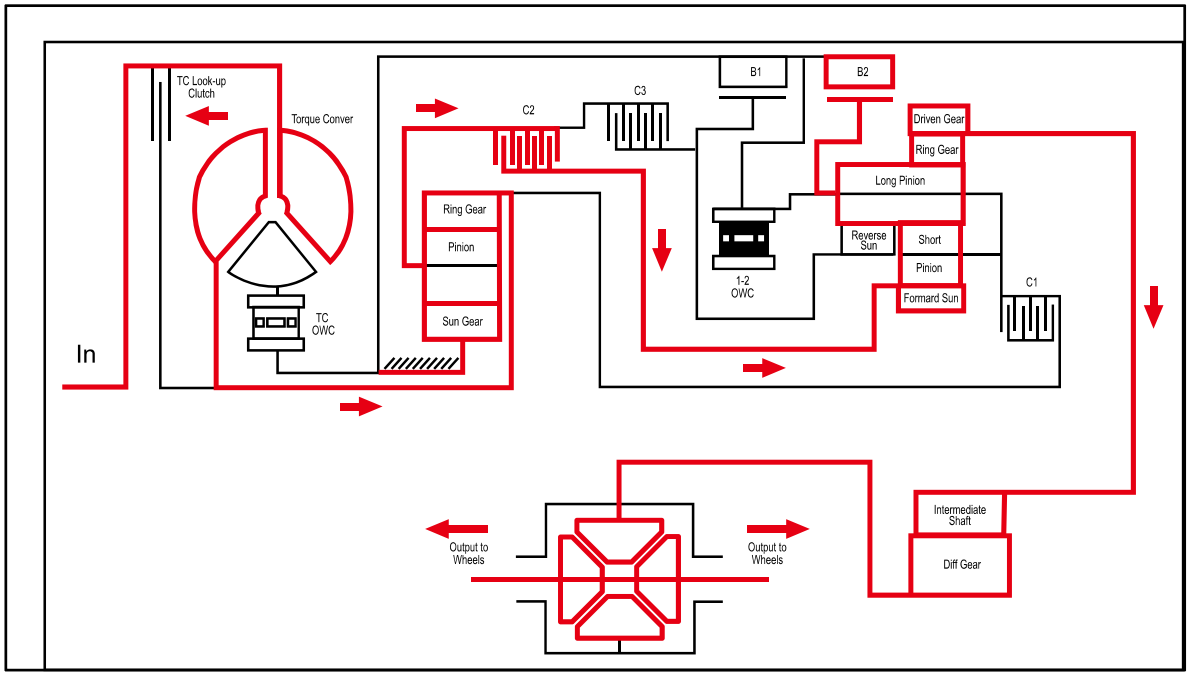
(1) Manual (position M) - 4.156 : 1

▶ **Power flow**



(2) Drive 1st Gear (1st Auto) - 4.156 : 1

▶ **Power flow**

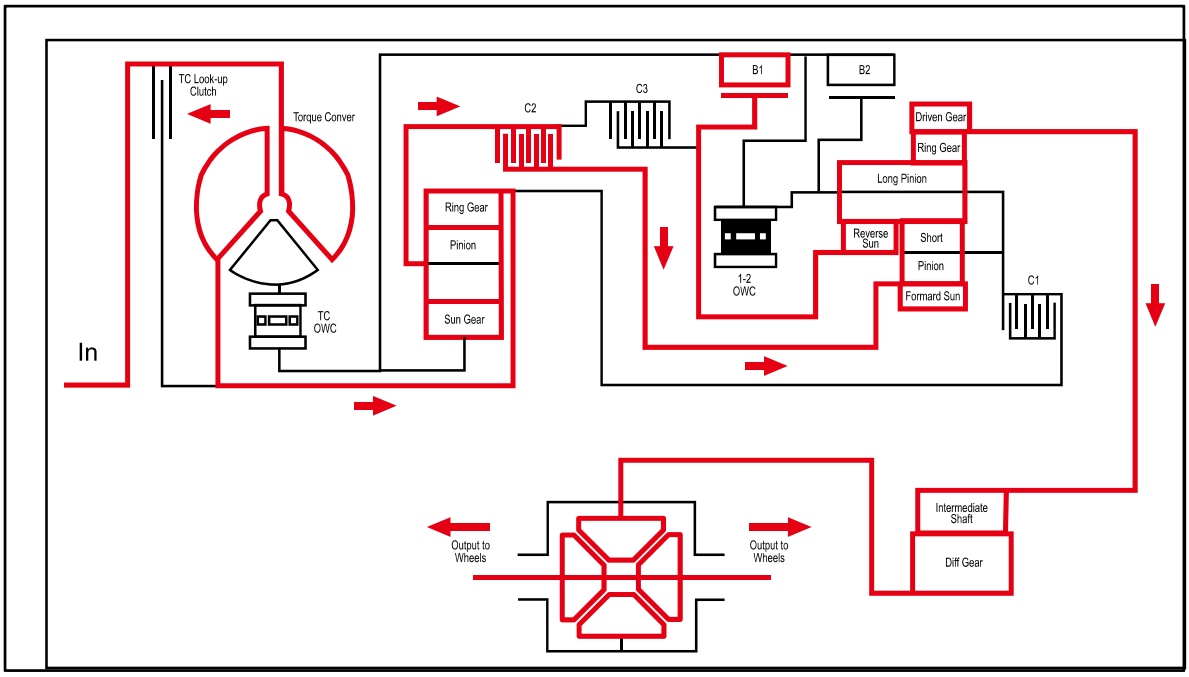


Modification basis	
Application basis	
Affected VIN	

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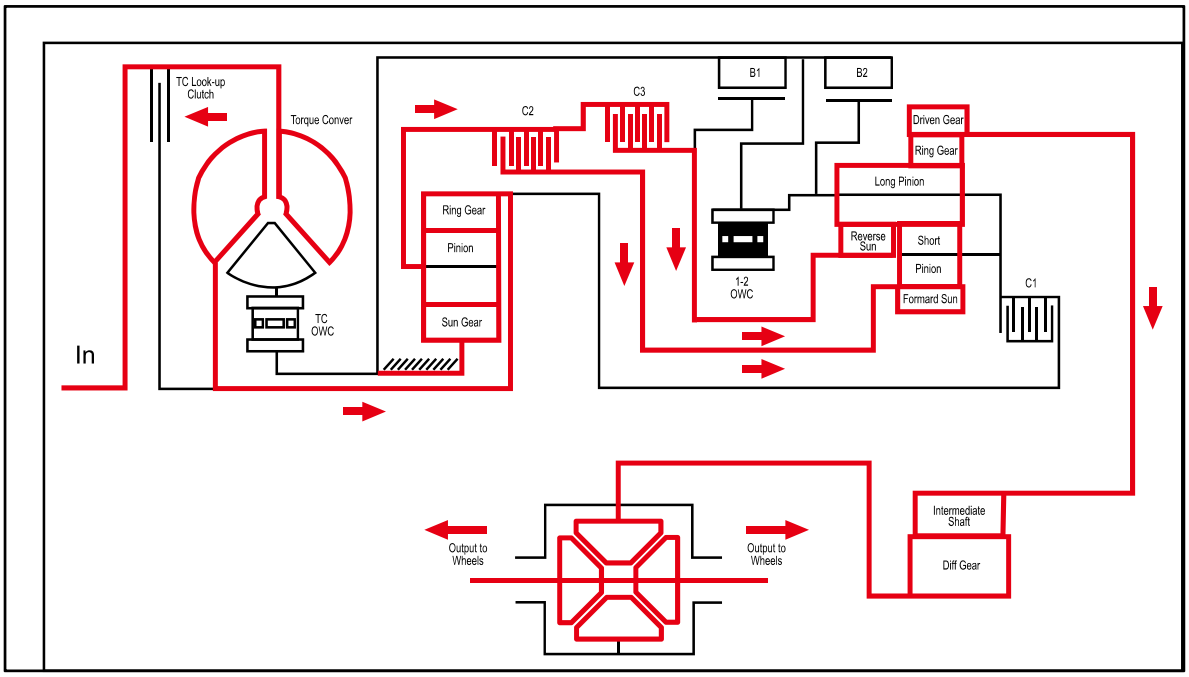
(3) Drive 2nd (2nd Auto) - 2.375 : 1

▶ **Power flow**



(4) Drive 3rd (3rd Auto) - 1.522 : 1

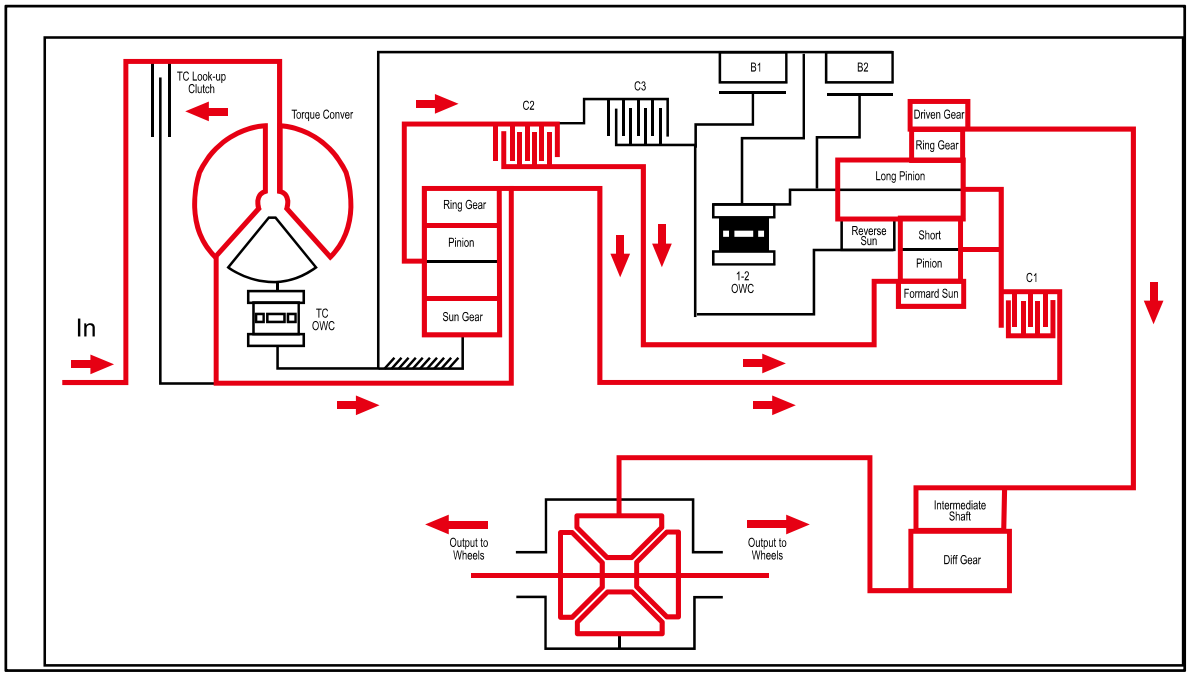
▶ **Power flow**



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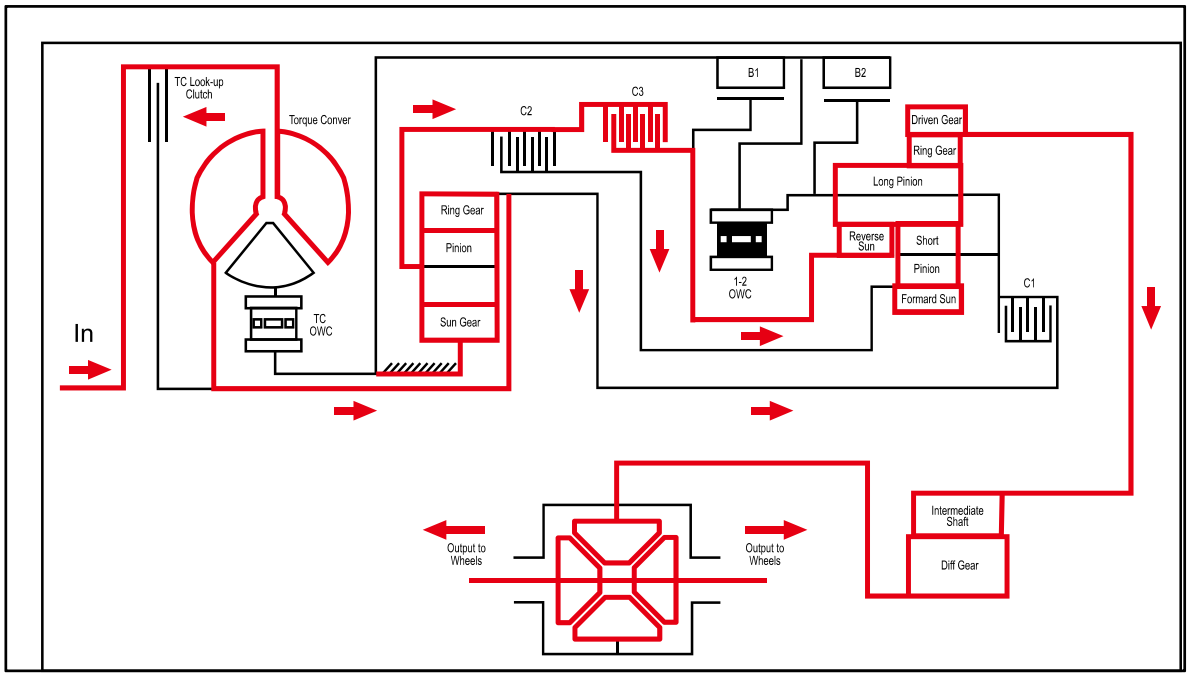
(5) Drive 4th (4th Auto) - 1.144 : 1

▶ **Power flow**



(6) Drive 5th (5th Auto) - 0.859 : 1

▶ **Power flow**

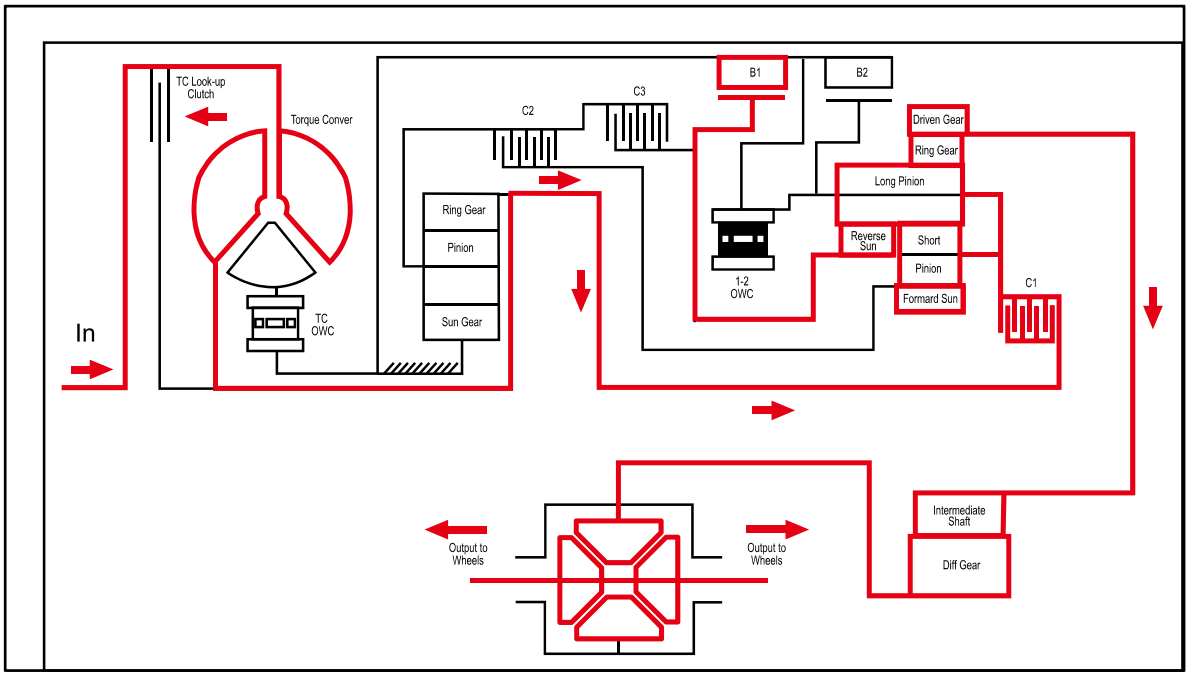


Modification basis	
Application basis	
Affected VIN	

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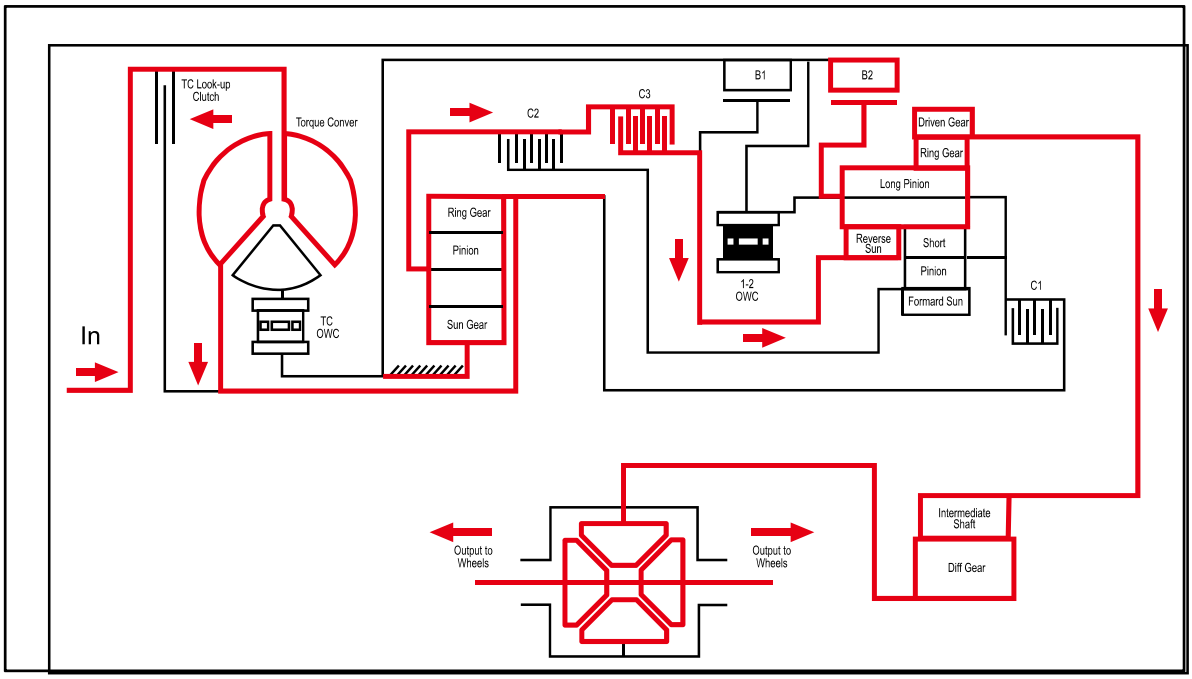
(7) Drive 6th (6th Auto) - 0.676 : 1

▶ **Power flow**



(8) Reverse - 3.178 : 1

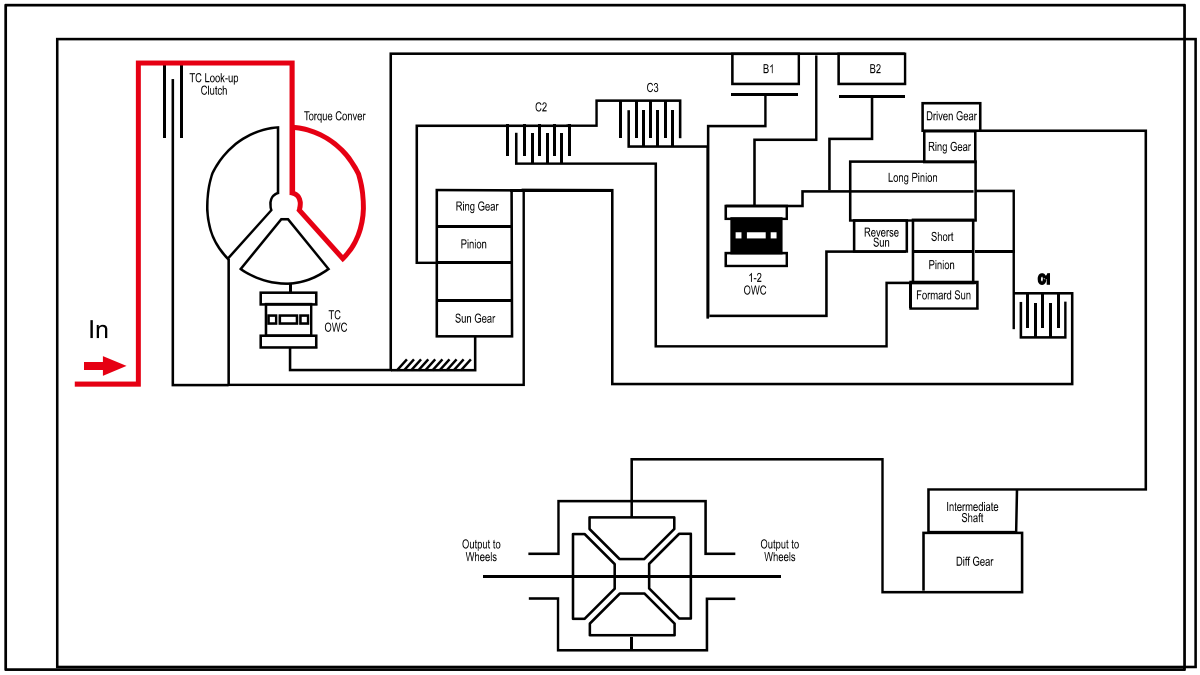
▶ **Power flow**



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(9) Neutral / Park

▶ Power flow



Modification basis	
Application basis	
Affected VIN	

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HPT 6 SPEED AUTO TRANSAXLE 3660-01

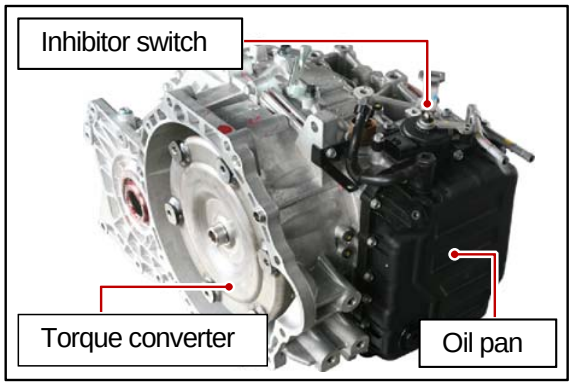
GENERAL INFRMATION

1. ABBREVIATION

No	Abbreviation	Name
1	DTC	Diagnostic trouble code
2	TCU	Transmission control unit
3	ATF	Automatic transmission fluid
4	DC	Damper clutch
5	PCSV	Pressure control solenoid valve
6	UD	Under drive
7	OD	Over drive
8	LR	Low reverse
9	LP	Line pressure
10	SOL	Solenoid
11	VFS	Variable force solenoid
12	PG-A	Input speed sensor
13	PG-B	Output speed sensor

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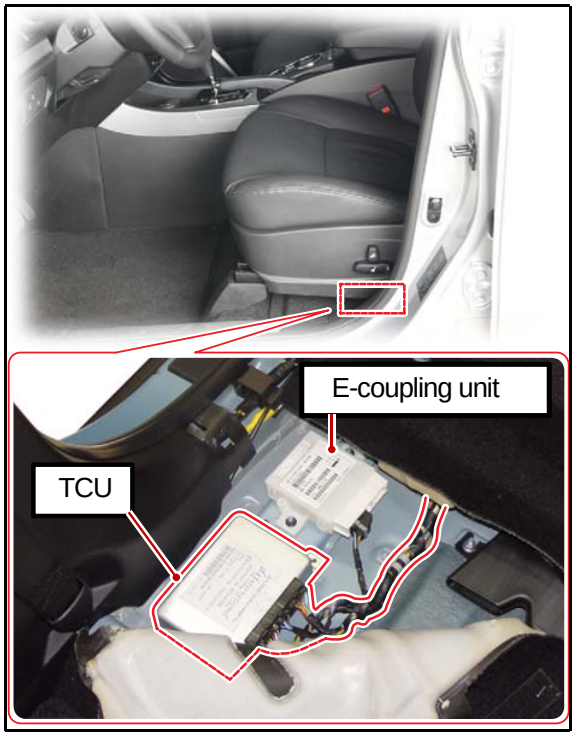
2. GENERAL INFORMATION



▶ Automatic transaxle (6F24)

The Model 6F24 six speed automatic transaxle is available in two variants: four wheel drive and two wheel drive.

- Six forward speeds
- One reverse gear
- A toruqe converter with an integral converter lock-up clutch with slip control capabilities
- Planetary gear-set (3EA)
- Clutches (2EA)
- Brake (3EA)
- O.W.C (1EA)
- All hydraulic functions are directed by electronic solenoids to control:
  1) Engagement feel
  2) Shift feel
  3) Shift scheduling
  4) Modulated torque converter clutch applications



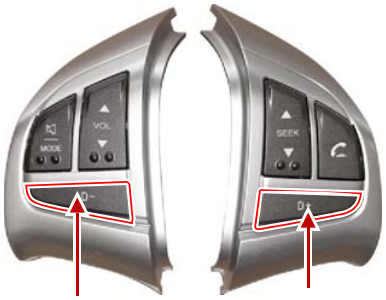
▶ TCU (located under driver's seat)

TCU is located under the driver's seat and controls the transaxle operations.
TCU receives and uses the signals from sensors and switches through CAN bus with analog and digital types.

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▶ Tip switches on steering wheel

The shiftable gear can be adjusted by pressing the "UP (D+)" or "DOWN(D-)" switch when the gear selector lever is in "M" position.



▶ Meter cluster

This indicator shows the current position of the gear.





▶ Gear selector lever

Shift lock release button

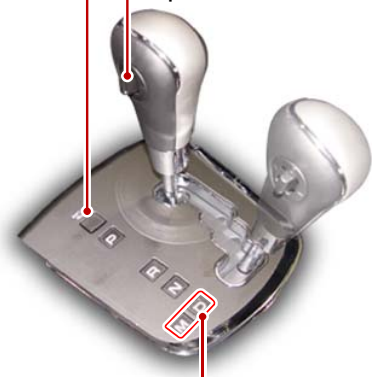
If the selector lever cannot be moved from "P" or "N" position, try to move the lever while pushing down this button with finger. For safety, turn off the engine and depress the brake pedal before the attempt.

Lever positions

P : Park
R : reverse
N : Neutral
D : Drive

Tip switch (manual shift switch)

The shiftable gear can be adjusted by moving this switch to forward and rearward when the gear selector lever is in "M" position.



Selection of Manual/Automatic Shift Function

D: Automatic shift according to the driving condition
M: Manual shift

Modification basis	
Application basis	
Affected VIN	

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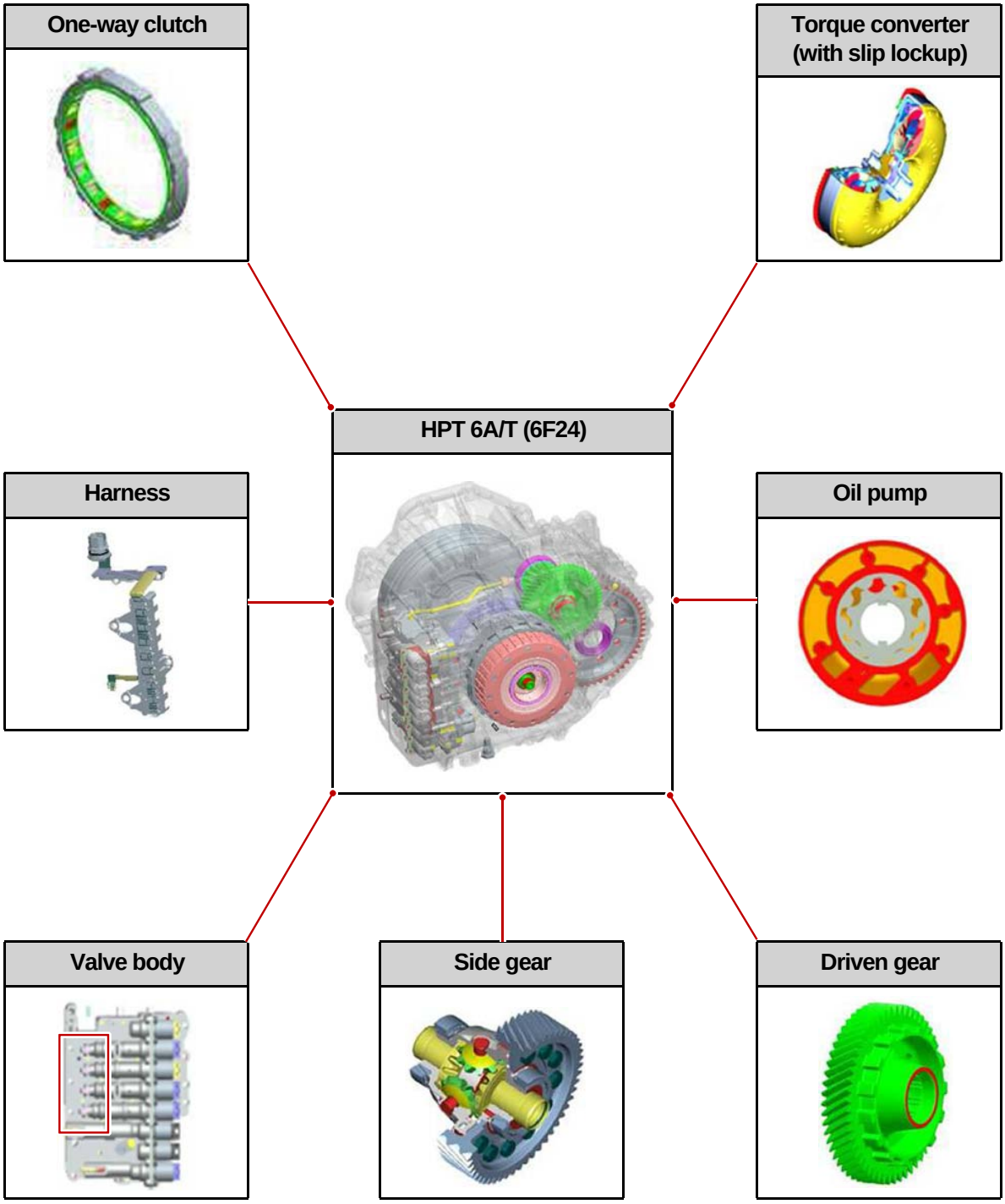
3. SPECIFICATIONS

1) Specifications

Descriptions		Specification
Gear ratio	1st gear	4.212
	2nd gear	2.637
	3rd gear	1.800
	4th gear	1.386
	5th gear	1.000
	6th gear	0.772
	Reverse gear	3.385
Shift pattern		Variable
Shift range		4 Range (P-R-N-D) + Manual mode
Shift range valve		VFS : 6EA
Planetary gear		3EA (Front, Middle, Rear)
Clutch		2EA
Brake		3EA
O.W.C		1EA
Oil	Type	ATF SP-IV M
	Capacity	approx. 7.1 L
	Change interval	Maintenance free. However, under the severe conditions or commercially used, change the oil at every 100,000 km (EU: 90,000 km).
Resistance of oil temperature sensor	-20	Approx 15.6kΩ
	0	Approx 5.88kΩ
	20	Approx 2.51kΩ
	100	Approx 0.18kΩ
Type/Weight		6F24 6-speed automatic transaxle / approx. 86 kg (including ATF)
TORQUE		230 Nm
Overall length / Center length		373.1 mm / 204 mm
Weight	2WD	87.5kg
	4WD	88.5kg

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4. COMPONENTS



Modification basis	
Application basis	
Affected VIN	

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5. TIGHTENING TORQUE

Descriptions		Size x Numbers	Tightening torque (Nm)
TGS lever	Nut	12 mm X 4	17.6 ~ 21.6Nm
	Nut (manual control lever)	13 mm X 1	14.0 ~ 20.0Nm
TGS cable	Nut (floor)	12 mm X 1	17.6 ~ 21.6Nm
	Nut (dash panel)	12 mm X 2	17.6 ~ 21.6Nm
A/T bracket	Bolt (left bracket)	17 mm X 3	88.2 ~ 107.8Nm
	Bolt (right bracket)	17 mm X 4	88.2 ~ 107.8Nm
	Bolt (upper bracket)	17 mm X 4	88.2 ~ 107.8Nm
Automatic transaxle	Bolt (engine)	17 mm X 4 14 mm X 1	85.0 ~ 100.0Nm
	Bolt (start motor)	14 mm X 2	48.0 ~ 58.8Nm
	Bolt (oil pan)	14 mm X 4	56.0 ~ 62.0Nm
	Bolt (torque converter)	17 mm X 6	45.0 ~ 52.0Nm
	Eye bolt	22 mm X 1	3.0 ~ 5.0Nm
	Drain plug	24 mm X 1	34.0 ~ 44.0Nm
	Nut (range select lever)	14 mm X 1	17.6 ~ 24.5Nm
	Bolt (inhibitor switch)	10 mm X 2	9.8 ~ 11.7Nm
	Bolt (oil pan)	10 mm X 19	12.0 ~ 14.0Nm
	Bolt (solenoid harness)	10 mm X 6	9.8 ~ 11.7Nm
	Bolt (oil temperature sensor)	10 mm X 1	9.8 ~ 11.7Nm
	Bolt (input & output sensor)	10 mm X 2	9.8 ~ 11.7Nm
	Bolt (detent spring)	12 mm X 1	12.0 ~ 16.0Nm
	Bolt (valve body)	10 mm X 8	9.8 ~ 11.7Nm
	Bolt (V/B solenoid bracket)	H5 mm X 9	9.8 ~ 11.7Nm
	Bolt (torque converter housing)	12 mm X 20	28.0 ~ 35.0Nm
	Bolt (oil guide A)	10 mm X 3	9.8 ~ 11.7Nm
	Bolt (oil guide B)	10 mm X 1	5.0 ~ 7.0Nm
	Bolt (oil filter)	H5 mm X 2	9.8 ~ 11.7Nm

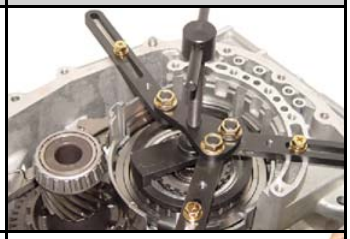
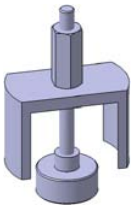
Modification basis	
Application basis	
Affected VIN	

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Descriptions		Size x Numbers	Tightening torque (Nm)
Automatic transaxle	Bolt (oil lubrication pipe)	10 mm X 1	9.8 ~ 11.7Nm
	Bolt (oil pump)	12 mm X 7	20.0 ~ 26.0Nm
	Bolt (parking rod guide)	10 mm X 2	9.8 ~ 11.7Nm
	Bolt (U/D brake retainer)	T40 X 6	31.0 ~ 36.0Nm
	Bolt (U/D brake chamber)	T30 X 2	4.9 ~ 9.8Nm
	Bolt (rear cover)	12 mm X 13	28.0 ~ 35.0Nm

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6. SPECIAL SERVICE TOLLS

Part number	Name	Tool	How to use
00104-001(UD)	Remover & Installer - U/D brake return sprin		
00104-002(OD)	Remover& Installer - O/D clutch return spring		
00104-003(LR) (use with 00104-001)	Remover& Installer - L/R brake return spring		

* Special service tool Supplier: Tool & Tech

Modification basis	
Application basis	
Affected VIN	

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

2WD



4WD



The Model 6F24 6 speed automatic transaxle is electronically controlled. The control system is comprised of the following components:

- External transaxle control unit (TCU)
- Input and output speed sensors
- Six variable force solenoids(VFS) and two on/off solenoids
- Torque converter
- ATF temperature sensor

TCU controls the oil pressure for various internal clutches and brakes to select the gear. It also controls the electronic elements, shift pressure and torque converter slip. If the system is defective, TCU provides FMEC (Failure Mode Effect Control) to maintain the functionality of transaxle. This keeps the basic function of transaxle (gear selection) even when there are failure in controls and power supply.

There are selector shaft position sensor (inhibitor switch) and oil temperature sensor in transaxle. In manual mode, TCU receives the information from TGS (Transmission Gear Selector) through PCB (Printed Circuit Board) when driver selects the manual shift mode. TCU communicates with other electric control modules through CAN. In order to ensure a safe driving state and to prevent damage to the automatic transmission, TCU switches to Limp-Home mode in the event of critical faults.

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2. FEATURES

1) Advantages

▶ **Early Downshift with Hard Braking and Skip Shifts**

When heavy braking is detected, the transaxle downshifts early and skips gears to provide increased engine braking to provide gear selection for tip-in.

▶ **Gear Hold going Uphill/Downhill**

If the accelerator pedal is released when traveling uphill, upshifts are prevented to reduce busyness on grades. If the accelerator pedal is released when traveling downhill, upshifts are prevented to enhance engine braking.

▶ **Drive and Reverse Engagement**

A soft engagement feature avoids harsh take up of drive when selecting Drive or Reverse. This is achieved by limiting engine speed and engine torque which results in a rapid, but progressive engagement of either Drive or Reverse when moving from the Park or Neutral positions. Drive and Reverse engagements from either Park or Neutral are performed in less than 2.2 seconds. There is no drive engagement prevention strategy implemented on the transaxle system as there is sufficient engine strategy to protect the system. However, reverse engagement is prevented until vehicle speed is less than 7 km/h.

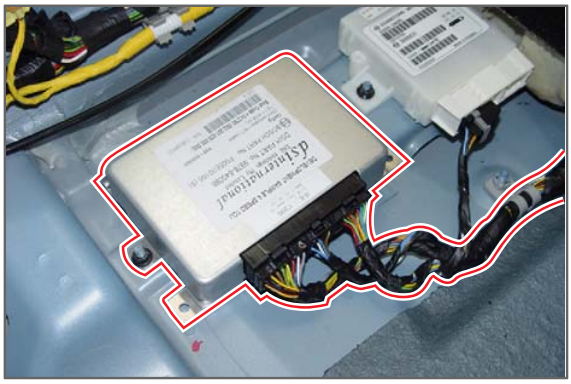
Modification basis	
Application basis	
Affected VIN	

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2) Transaxle Cooling

The transaxle cooling system ensures rapid warm-up and constant operating temperature resulting in reduced fuel consumption and refined shift quality.
It also includes a cooler by-pass within the hydraulic system to allow sufficient lubrication to the transaxle drivetrain in the event of a blockage in the transaxle cooler.

3) Shift Strategy



▶ Gear Change

Transaxle gear change is controlled by the TCU. The TCU receives inputs from various engine and vehicle sensors to select shift schedules and to control the shift feel and torque converter clutch (TCC) operation at each gear change.

▶ Coast down

Coast down down shifts occur at 0% pedal when the vehicle is coasting down to a stop.

▶ Torque Demand

Torque demand down shifts occur (automatically) when the driver demand for torque is greater than the engine can provide at that gear ratio. If applied, the transaxle will disengage the TCC to provide added acceleration.

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3. MODES AND FUNCTIONS



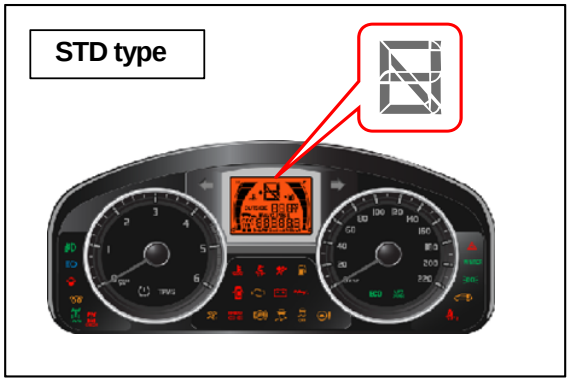
This allows the driver to define the highest possible gear by selecting "+" or "−" on the gear selector when the lever is in the "M" position. When the lever is first moved to the manual "M" position the transaxle will select one lower gear than current gear.

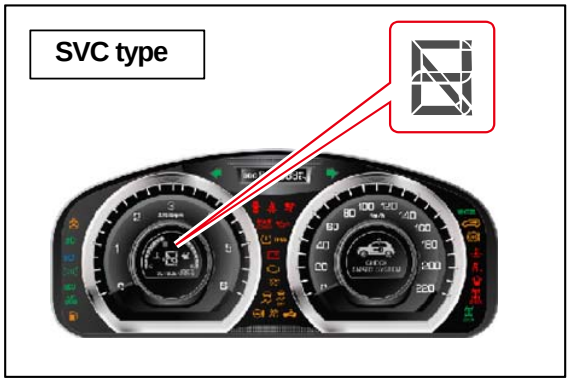
NOTE

When driving on a slippery road, push the tip switch forward into the "+" position in "M" position. This causes the transaxle to shift into the 2nd gear which is better for smooth driving on a slippery road.

Modification basis	
Application basis	
Affected VIN	

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▶ 1st Gear State

- The 1st gear state will display on the instrument cluster. Unlike the normal 1st gear, engine braking will be available in this manual 1st state.

▶ 2nd Gear State

- The 2nd gear state will display on the instrument cluster. 2nd gear has engine braking available.

▶ 3rd Gear State

- The 3rd gear state will display on the instrument cluster. 3rd gear has engine braking available.

▶ 4th Gear State

- The 4th gear state will display on the instrument cluster. 4th gear has engine braking available.

▶ 5th Gear State

- The 5th gear state will display on the instrument cluster. 5th gear has engine braking available.

▶ 6th Gear State

- The 6th gear state will display on the instrument cluster. 6th gear has engine braking available.

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4. LIMP HOME MODE

▶ When the transaxle is defective

1. In the event of a system fault, the TCU also provides for failure mode effect control (FMEC) to maintain maximum functional operation of the transaxle. (There are 3 FMEC modes, mechanical limp-home mode, electrical limp-home mode, limp-home mode C.)
2. In the event of a total loss of control or electrical power, the basic transaxle functions (Park, Reverse, Neutral and Drive) are retained. The 4th and reverse gear ratios with the torque converter clutch in the unlocked state are the retained gear states the hydraulic system supports without any electrical assistance. (Mechanical limp-home)
3. If the speed sensor circuit is failed, the gear is fixed to 4th gear, but manual shifting (2nd↔3rd↔4th) is available.(Electrical limp home mode)
4. If the inhibitor switch signals are invalid, shifting to1st and 2nd gear is forbidden. (Limp-home C)
5. The TCU communicates with other vehicle electronic control modules by the controller area network (CAN). If a major fault is developed, the transaxle may not accomplish the intelligent shift control. The TCU controls the transaxle with preset values.
6. The TCU also provides for transaxle diagnostics, which meet the requirements of OBD II regulation, monitoring all components which may effect vehicle emissions.

▶ Towing the automatic transaxle equipped vehicle



CAUTION

- Flat-bed equipment is the best method of moving a disabled vehicle to avoid any damages.
- For AWD vehicle: The vehicle must be towed with a wheel lift and dollies or flatbed equipment with all the wheels off the ground.
  For 2WD vehicles: It is acceptable to tow the vehicle with the rear wheels on the ground without dollies and the front wheels off the ground. When being towed by a commercial towtruck and wheel dollies are not available, the front of the vehicle should be lifted, not the rear.

Modification basis	
Application basis	
Affected VIN	

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5. TRANSAXLE ELECTRONIC CONTROL SYSTEM

1) General Information

The transmission control unit (TCU) and its input/output network control the following transmission operations:

- Shift timing
- Line pressure
- Clutch pressure (shift feel)
- Torque converter clutch

also uses these signals when determining transaxle operating strategy. Using all of these input signals, the TCU can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch. It will also determine the pressure needed to optimise shift feel.

2) TCU (Transmission Control Unit)



The transaxle control unit (TCU) is mounted under the driver's seat and controls the operation of the transaxle.
Internal sensors and signals received across the CAN bus in analogue and digital forms such as:

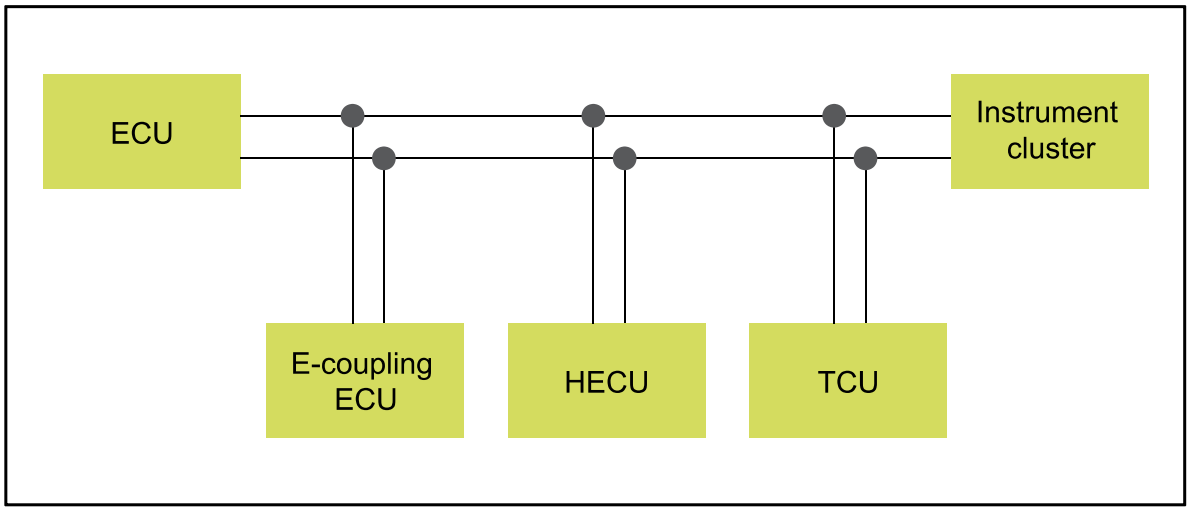
- Transaxle input speed
- Transaxle output speed
- Accelerator pedal position
- Gear selector position
- Engine torque
- Engine speed
- Transaxle fluid temperature
- Brake pedal status
- Engine oil temperature
- Engine coolant temperature
- Ambient air temperature
- Barometric pressure

The TCU monitors all TCU inputs and outputs to confirm correct system operation. If a fault occurs the TCU is able to perform default action and inform the driver of the problem through the instrument cluster warning lights. Detailed information is available via trouble codes which can be read with the service tool.

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6. CAN NETWORK

▶ **Schematic Diagram of Network Communication**



The TCU sends signals to be used by other vehicle systems via the CAN bus, such as:

- Selector lever position
- Selected gear state
- Manual mode activation
- Transaxle fluid temperature
- Engine torque reduction requests

Modification basis	
Application basis	
Affected VIN	

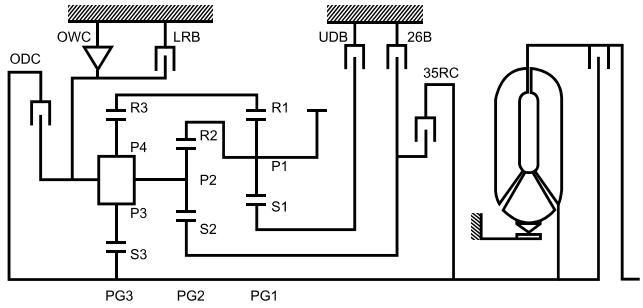
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7. POWER TRANSFER

Power transfer modes are as follow:

- Manual: 1st gear (position M)
- Drive: 1st gear
- Drive: 2nd gear
- Drive: 3rd gear
- Drive: 4th gear - limp home mode
- Drive: 5th gear
- Drive: 6th gear

1) Overview



Name	Component
C1	OVER DRIVE CLUTCH
C2	35R CLUTCH
B1	LOW & REVERSE BRAKE
B2	2/6 BRAKE
B3	UNDER DRIVE BRAKE
1F	1-2 ONE WAY CLUTCH

(1) Gear Selection and Engagement Element

GEAR	CLUTCH		BRAKE			OWC	Gear Ratio
	OD	35R	26	LR	UD		
1ST				△*	O	O	4.212
2ND			O		O		2.637
3RD		O			O		1.800
4TH	O				O		1.386
5TH	O	O					1.000
6TH	O		O				0.772
REV		O		O			3.385
N.P				O			

* Operation when vehicle speed under 5kph

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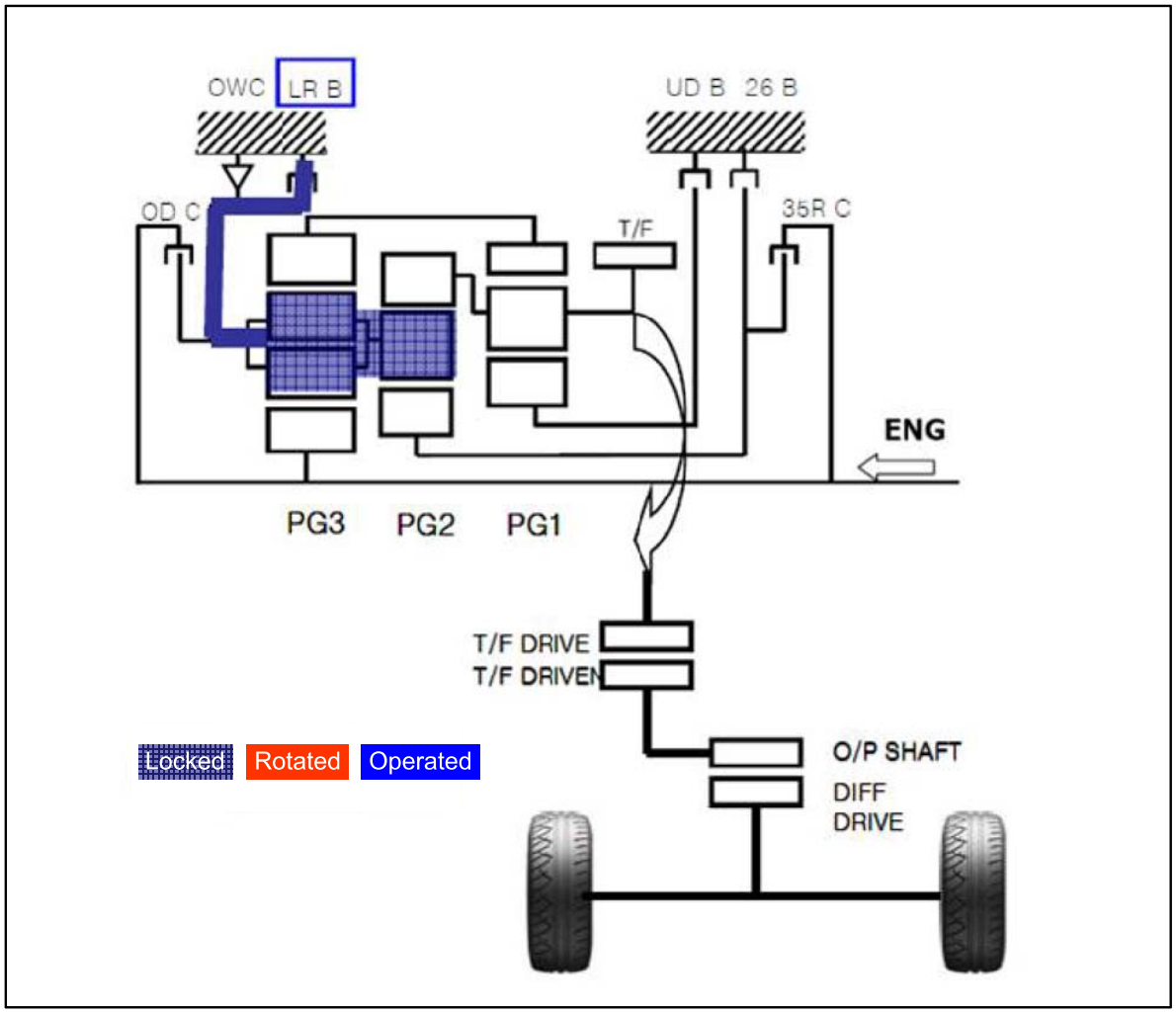
2) Operation in Each Gear Position

(1) Neutral/Park

- Lower & reverse brake (LR/B) operated → Overdrive (O/D) hub locked → Middle & rear (MID & REAR) P/C locked
- Input shaft rotated → Rear sun gear rotated → Rear inner pinion reverse rotated → Rear outer pinion rotated → Rear annulus gear rotated → Front annulus gear rotated → Front pinion rotated → Front sun gear reverse rotated → Underdrive (U/D) hub reverse rotated
- Input shaft rotated → Overdrive clutch (OD/C) retainer rotated
- Input shaft rotated → 35R clutch rotated

▶ **Power flow**

Description	35R C	OD C	26 B	UD B	LR B	O.W.C
P.N					●	



Modification basis	
Application basis	
Affected VIN	

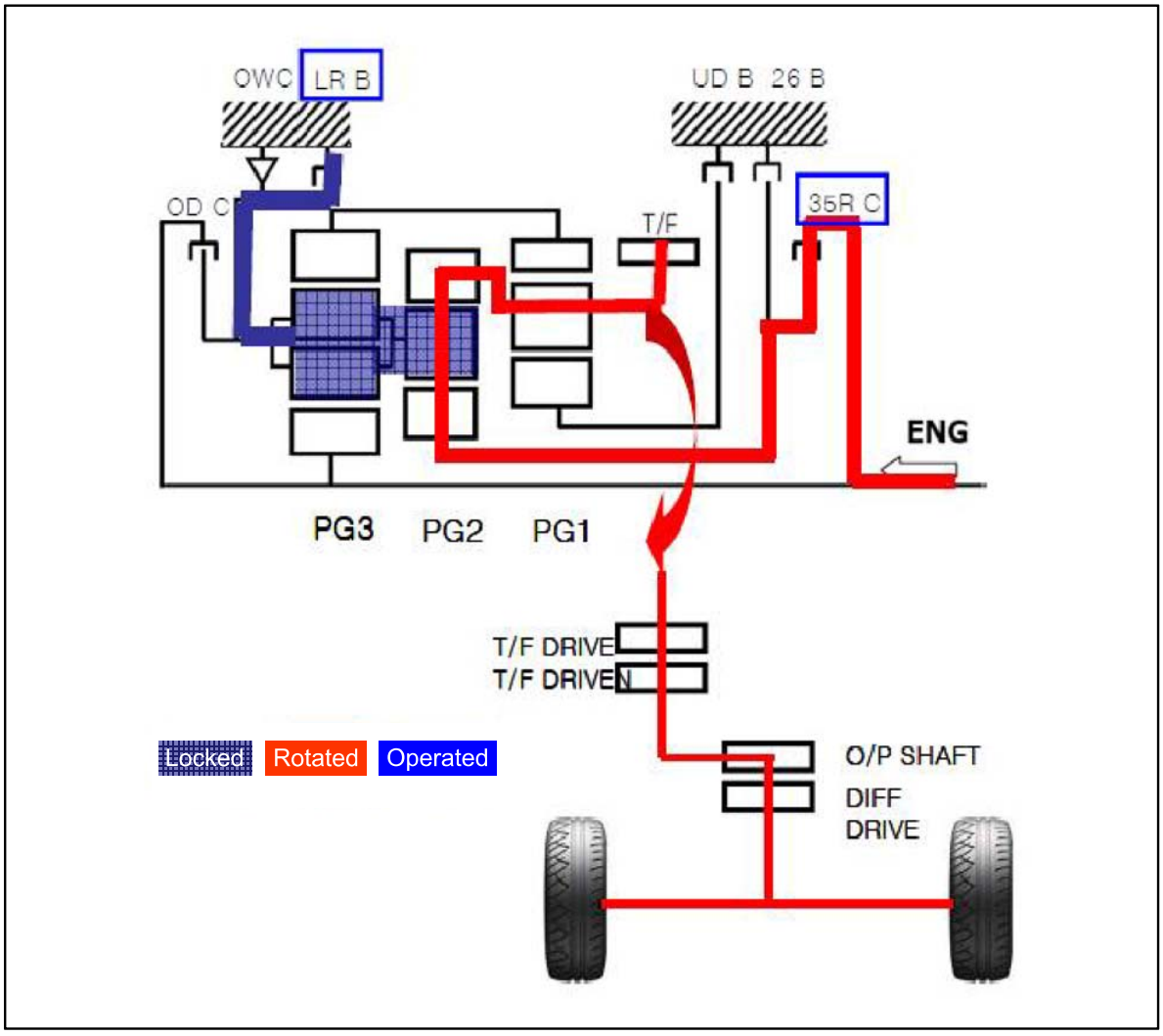
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(2) Reverse (3.385)

- Middle planetary gear locked, middle sun gear rotated
- When the sun gear rotates with the planetary gear locked in middle planetary gear set, the annulus gear (front planetary gear) rotates in reverse direction with decreased speed and the power flows through the front planetary gear.
- The rear planetary gear set reduces the rotating speed of rear & front annulus gears and the front planetary gear set rotates the front sun gear in reverse direction without load.

▶ Power flow

Description	35R C	OD C	26 B	UD B	LR B	O.W.C
R	●				●	



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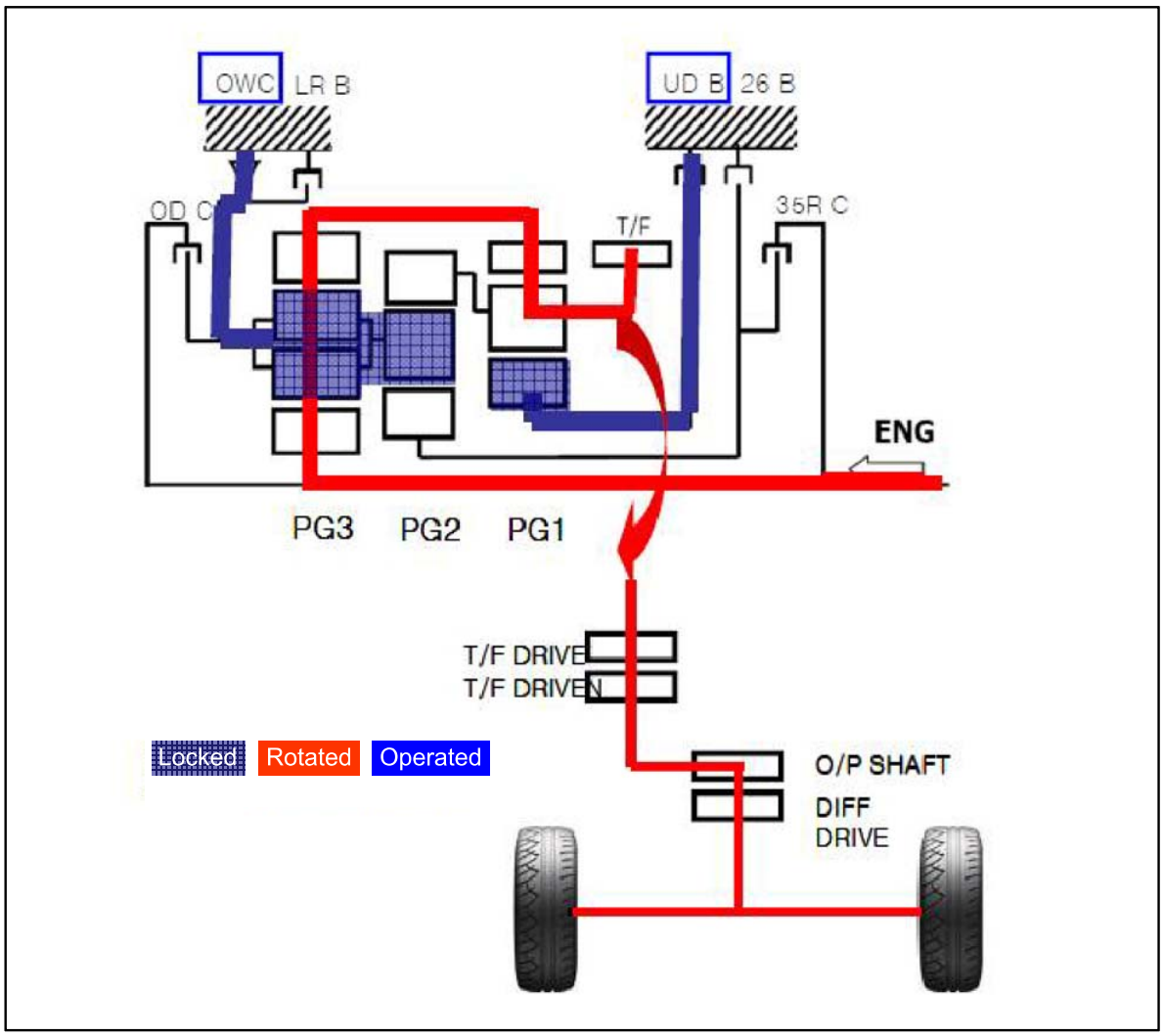
(3) 1st Drive Gear (4.212)

- Front sun gear and middle & rear planetary gears locked, and rear sun gear always rotated
- When the rear sun gear rotates, the rear planetary gear set reduces the speed at first, and then the reduced power is transferred to rear & front annulus gear. The power is secondarily reduced at front planetary gear locked with sun gear and flows to front planetary gear.
  At this moment, the middle sun gear rotates in reverse direction without load (idling) by the rotation of
- middle annulus gear integrated with front planetary gear.

▶ Power flow

Description	35R C	OD C	26 B	UD B	LR B	O.W.C
1ST				●	○	●

O :Operated below 5 km/h of vehicle speed



Modification basis	
Application basis	
Affected VIN	

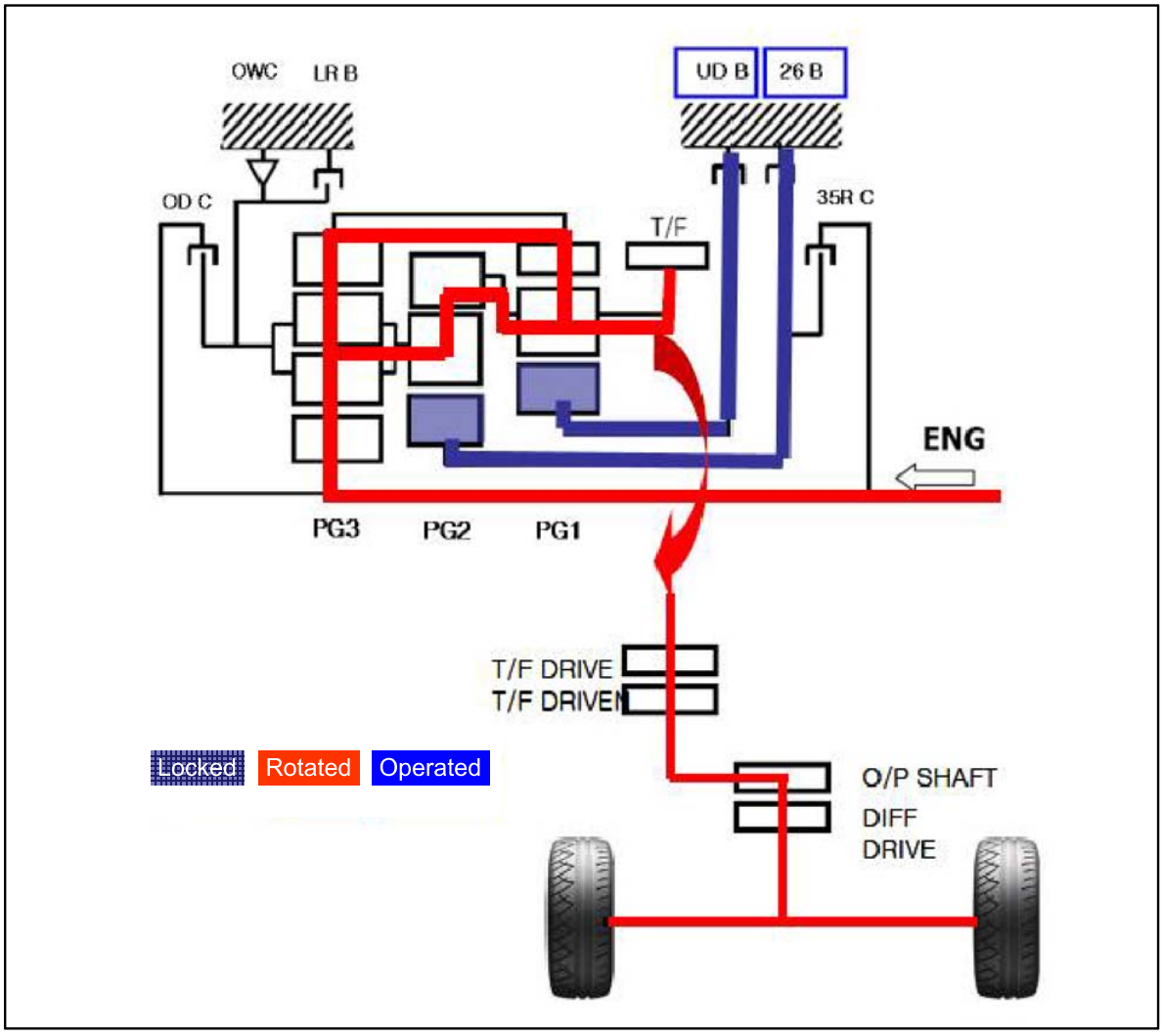
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(4) 2nd Drive Gear (2.637)

- Front sun gear and middle sun gear locked, rear sun gear always rotated
- When the sun gear rotates, the power is transferred to the rear & front annulus gears, and then the reaction power from the front planetary gear and middle annulus gear locked with sun gear is transferred to middle & rear planetary gear to circulate the power. Accordingly, the power flows through the front planetary gear while keeping the balance.

▶ Power flow

Description	35R C	OD C	26 B	UD B	LR B	O.W.C
2nd			●	●		



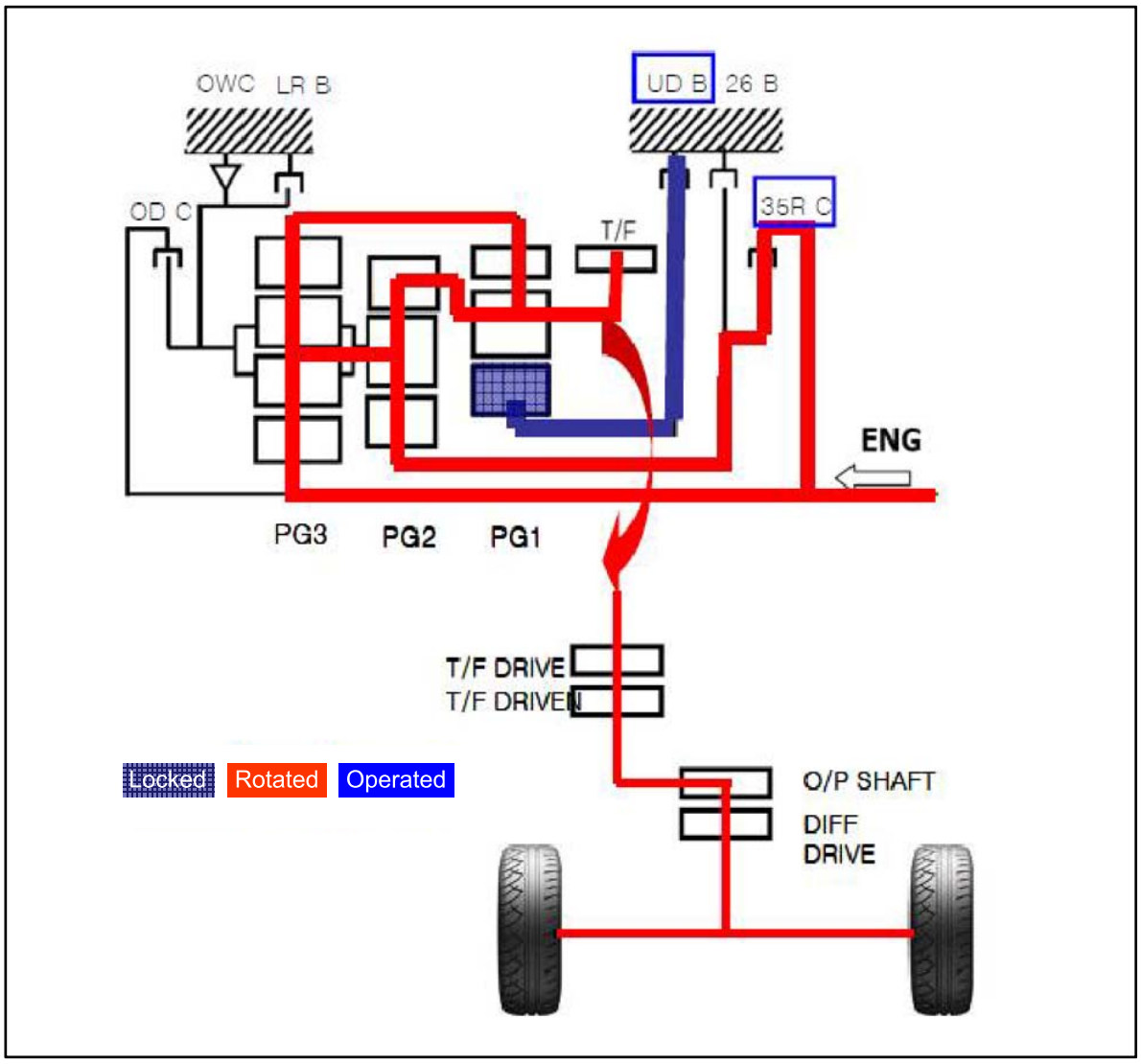
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(5) 3rd Drive Gear (1.800)

- Front sun gear locked, middle & rear sun gear rotated
- When the middle sun gear and rear sun gear rotate, the power is transferred to the rear & front annulus gears, and then the reaction power from the front planetary gear and middle annulus gear locked with sun gear is transferred to middle & rear planetary gear to circulate the power. Accordingly, the power flows through the front planetary gear while keeping the balance.

▶ Power flow

Description	35R C	OD C	26 B	UD B	LR B	O.W.C
3rd	●			●		



Modification basis	
Application basis	
Affected VIN	

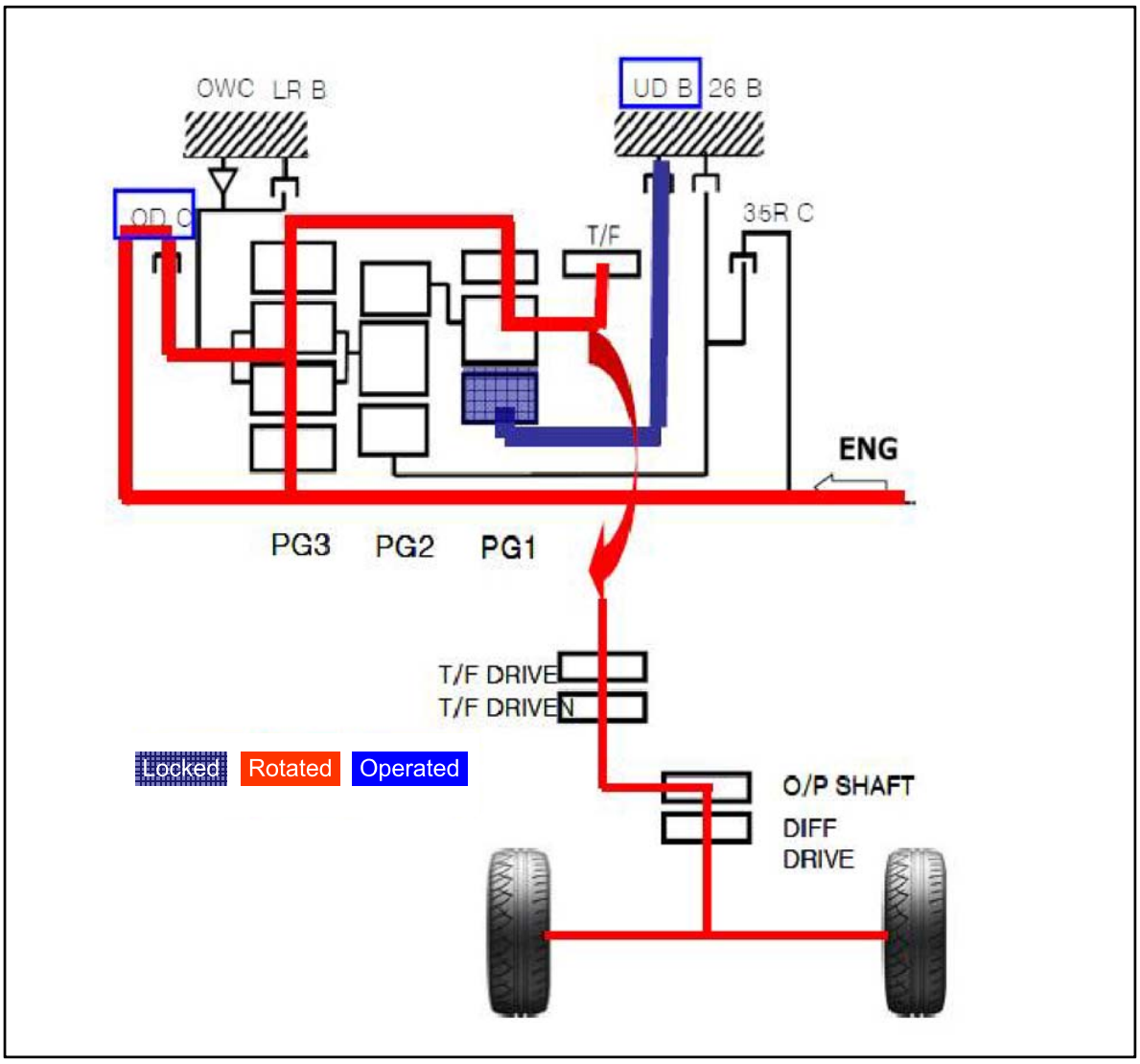
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(6) 4th Drive Gear (1.386)

- Front sun gear locked, rear planetary gear and rear sun gear rotated
- When the overdrive clutch (OD/C) operates, the carrier is engaged with sun gear in rear planetary gear set and the power with 1:1 ratio flows to the front planetary gear locked with sun gear after passing through the rear & front annulus gears.
- At this moment, by operation of speed-reduced annulus gears and carrier in 1:1 ratio, the middle sun gear in middle planetary gear set increases its speed without load (idling).

▶ Power flow

Description	35R C	OD C	26 B	UD B	LR B	O.W.C
4th		●		●		



Modification basis	
Application basis	
Affected VIN	

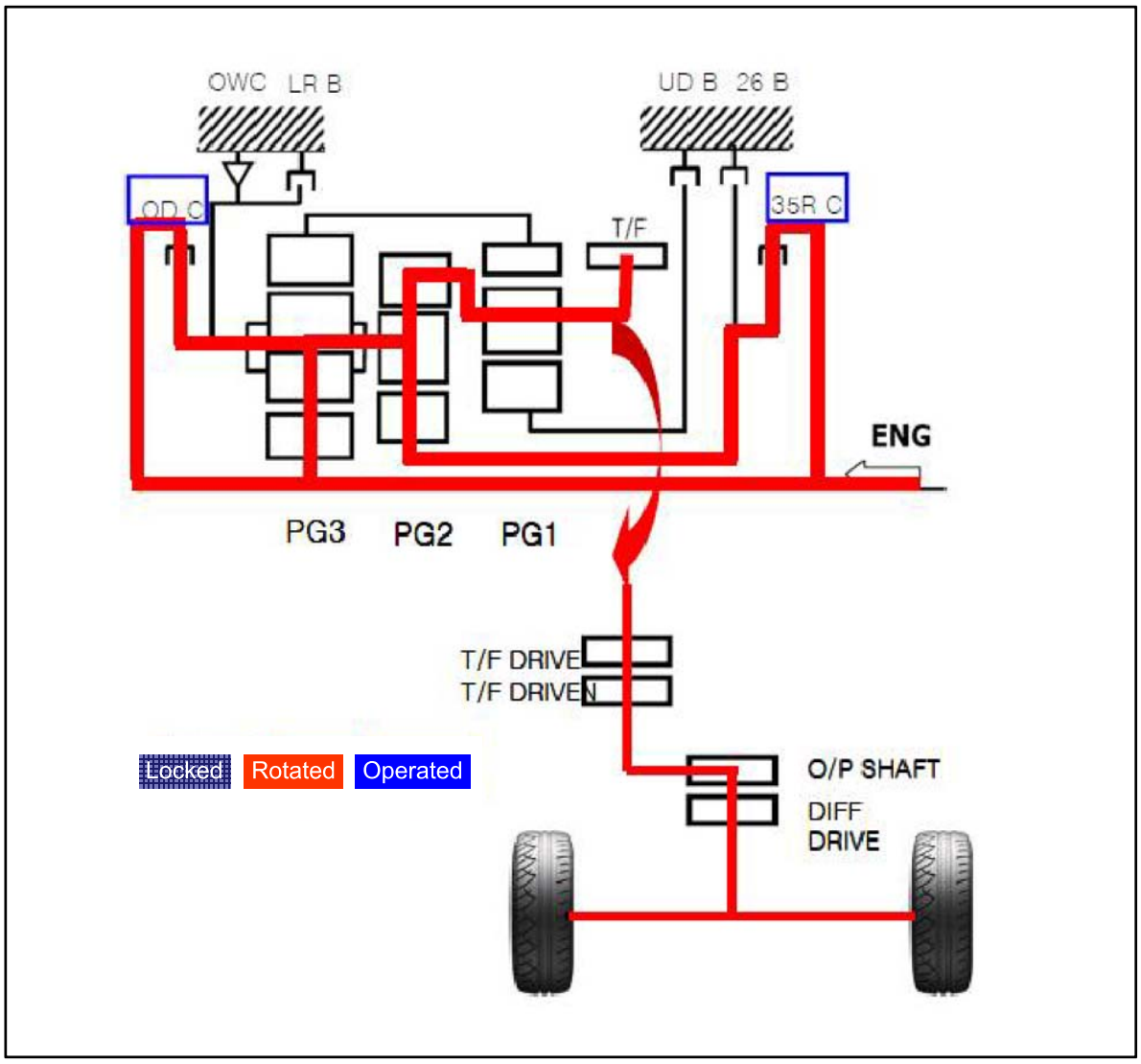
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(7) 5th Drive Gear (1.000)

- Middle & rear planetary gears, middle sun gear and rear sun gear rotated
- The rotating ratio of 1;1 is transferred to middle annulus gear (front planetary gear) because the middle planetary gear and sun gear in middle planetary gear set rotate simultaneously.
- At this moment, the rear planetary gear set rotates in 1:1 ratio (same in 4th gear). However, the front planetary gear set is not related to that, and the front sun gear rotates without load (idling) in 1:1 ratio.

▶ Power flow

Description	35R C	OD C	26 B	UD B	LR B	O.W.C
5th	●	●				



Modification basis	
Application basis	
Affected VIN	

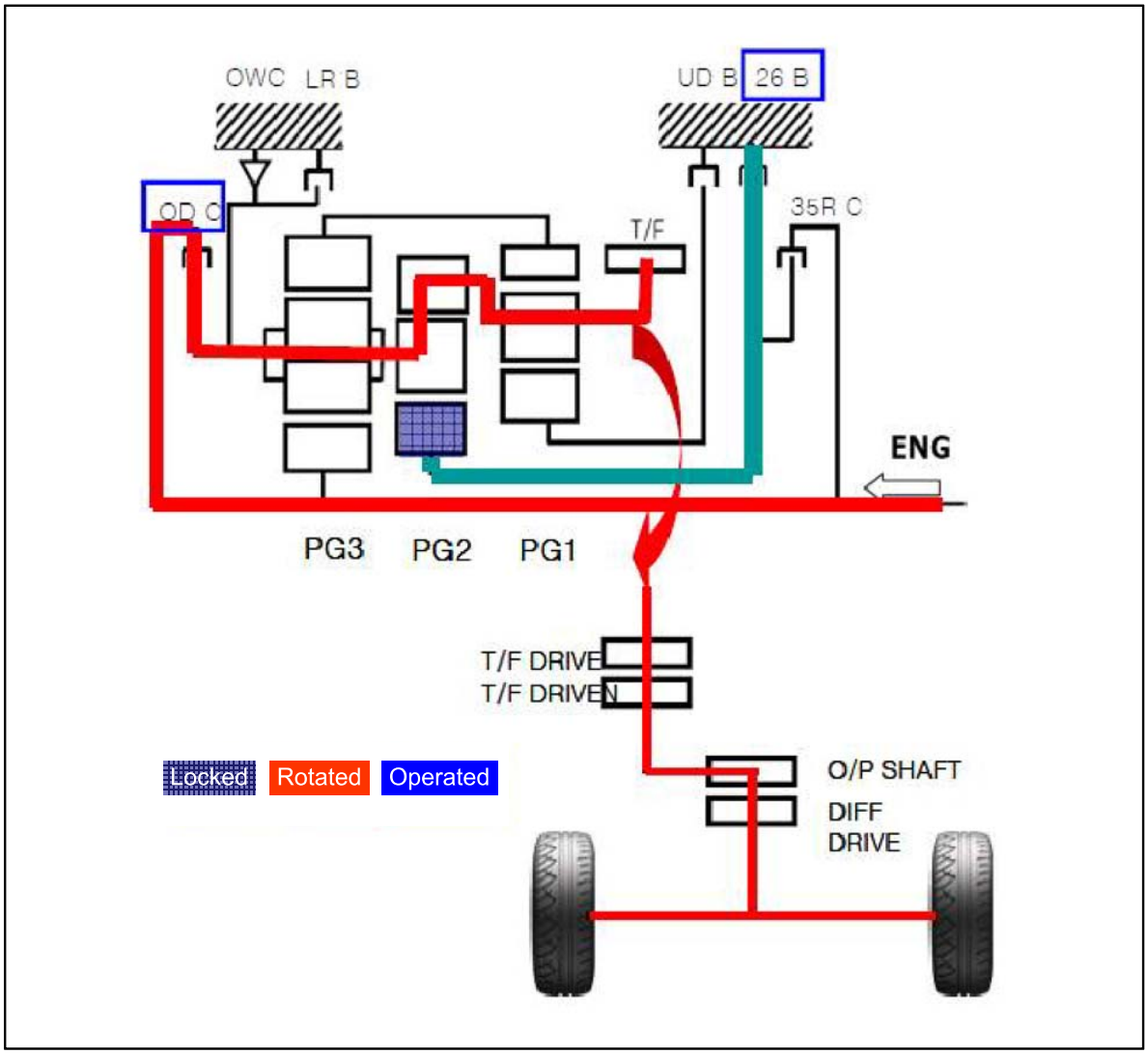
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(8) 6th Drive Gear (0.722)

- Middle planetary gear rotated, middle sun gear locked
- When the sun gear is locked in middle planetary gear set and the planetary gear rotates, the middle annulus gear increases the speed and the power is transferred to front planetary gear. The rear planetary gear set rotates in 1;1 ratio (same in 4th & 5th gears). However, the front
- planetary gear set is not related to that, and the front sun gear increases its speed without load (idling).

▶ Power flow

Description	35R C	OD C	26 B	UD B	LR B	O.W.C
6th		●	●			



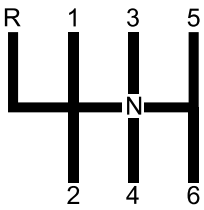
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6-SPEED M/T

0000-00

GENERAL INFORMATION

1. SPECIFICATION

Item		Specification			Remark
		D20DTF	D20DTF + Low CO_2	G20DF	
Model name		WM6F1			
Overall length		370 mm			
Distance between shafts		205 mm / 70 mm			
Weight (except transmission fluid)		62 kgf (2WD) / 63 kgf (4WD)			
Gear ratio	1st	3.538	3.385	3.616	
	2nd	1.909	1.708	1.957	
	3rd	1.179	1.033	1.207	
	4th	0.814	0.786	0.905	
	5th	0.734	0.730	0.842	
	6th	0.628	0.595	0.714	
	Reverse	3.910	3.747	3.747	
Synchronizer ring type	1st	T: Triple-cone			
	2nd	T: Triple-cone			
	3rd	T: Triple-cone			
	4th	D: Double-cone			
	5th	D: Double-cone			
	6th	S: Single-cone			
	Reverse	T: Triple-cone			
Shifting	Type	Remote (Cable type)			
	Gear selector lever position				Reversing: Reverse ring pull type

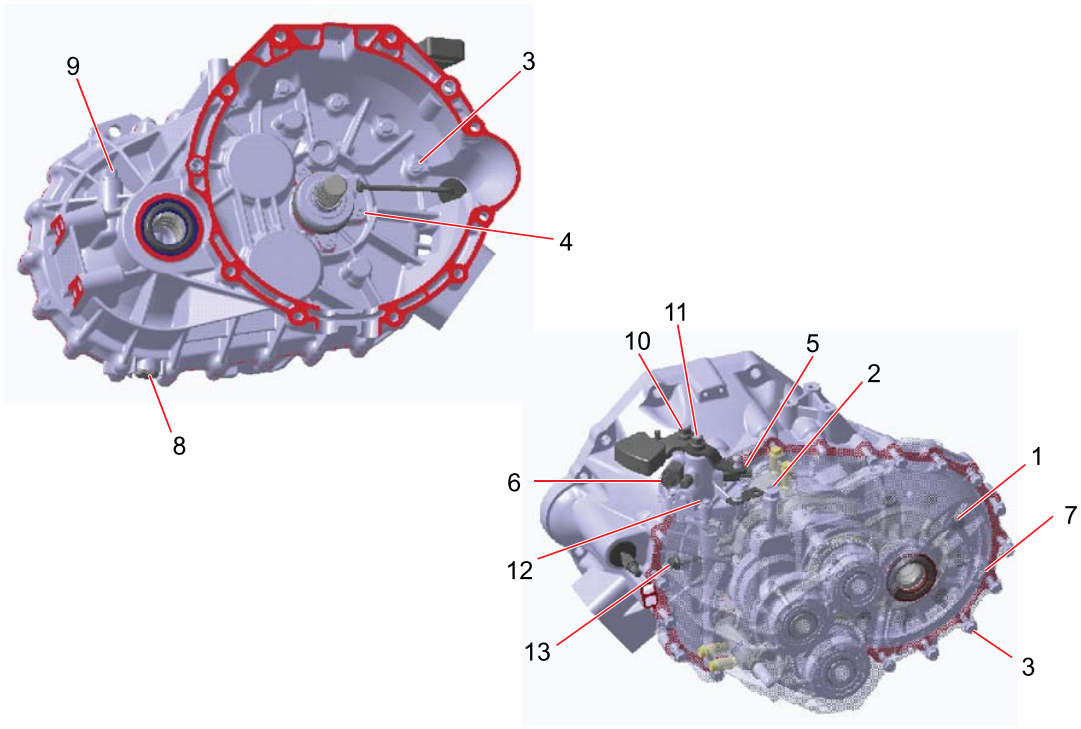
Modification basis	
Application basis	
Affected VIN	

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Item				Specification	Remark
Transmission fluid	Transmission fluid			SAE 75W / 85, API GL-4	
	Capacity			1.65 L	
	Replacement interval	DSL	EU	Inspect and replenish every 60000 km (or 3 years) Normal driving condition: Fill for Life (Severe driving condition: Change every 120000 km)	
			GEN	Inspect and replenish every 60000 km (or 4 years) Normal driving condition: Fill for Life (Severe driving condition: Change every 120000 km)	
		GSL		Inspect and replenish every 60000 km (or 4 years) Normal driving condition: Fill for Life (Severe driving condition: Change every 120000 km)	

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2. TIGHTENING TORQUE



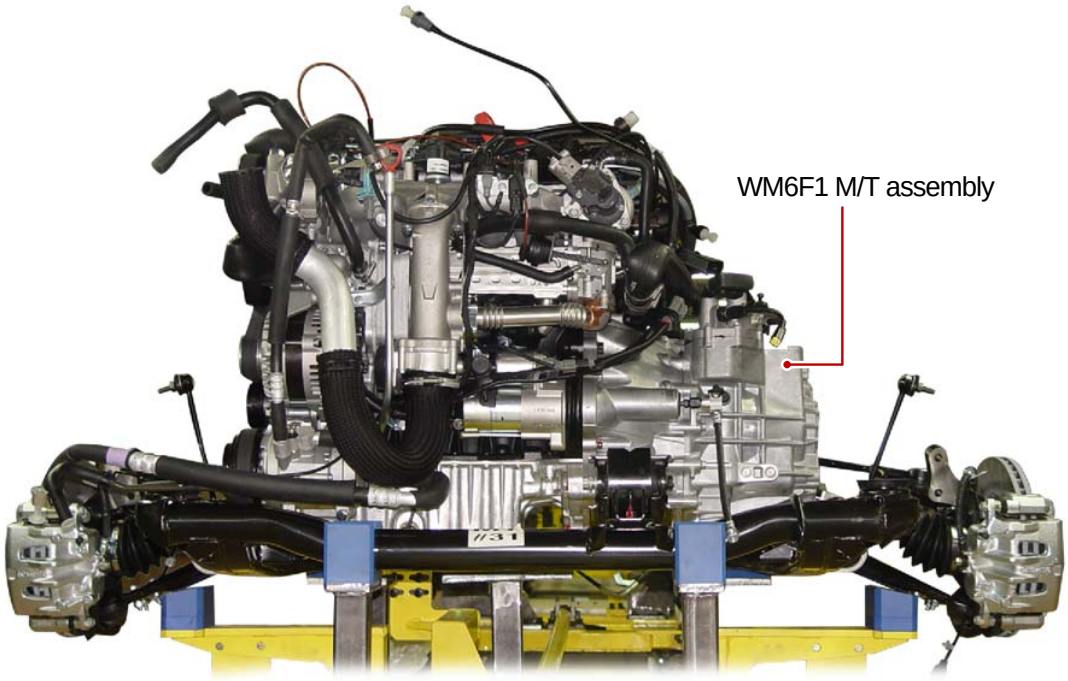
Part name	Tightening torque	Remark
1. Drive gear mounting bolt of differential carrier	166.6 to 176.4 Nm	10 EA
2. Reverse shaft mounting bolt	74.5 to 89.2 Nm	
3. Transmission case mounting bolt	19.6 to 26.5 Nm	22 EA
4. Concentric slave cylinder mounting bolt	11.8 to 14.7 Nm	3 EA
5. Backup lamp switch	29.4 to 34.3 Nm	
6. Neutral switch	29.4 to 34.3 Nm	
7. Oil filler plug	58.8 to 78.4 Nm	
8. Oil drain plug	58.8 to 78.4 Nm	
9. Oil plug	58.8 to 78.4 Nm	
10. Shift lever mounting nut	42.2 to 53.9 Nm	
11. Selector lever mounting nut	42.2 to 53.9 Nm	
12. Control shaft assembly mounting bolt	9.8 to 11.8 Nm	7 EA
13. Guide bolt	42.2 to 53.9 Nm	

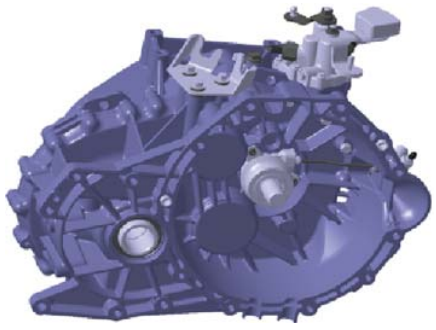
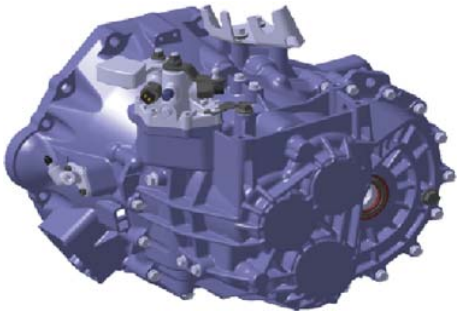
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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

This vehicle is equipped with WM6F1 M/T (Manual Transmission). This transmission is integrated with an axle and designed to maximize the driving performance by optimizing the gear ratio according to the engine torque.



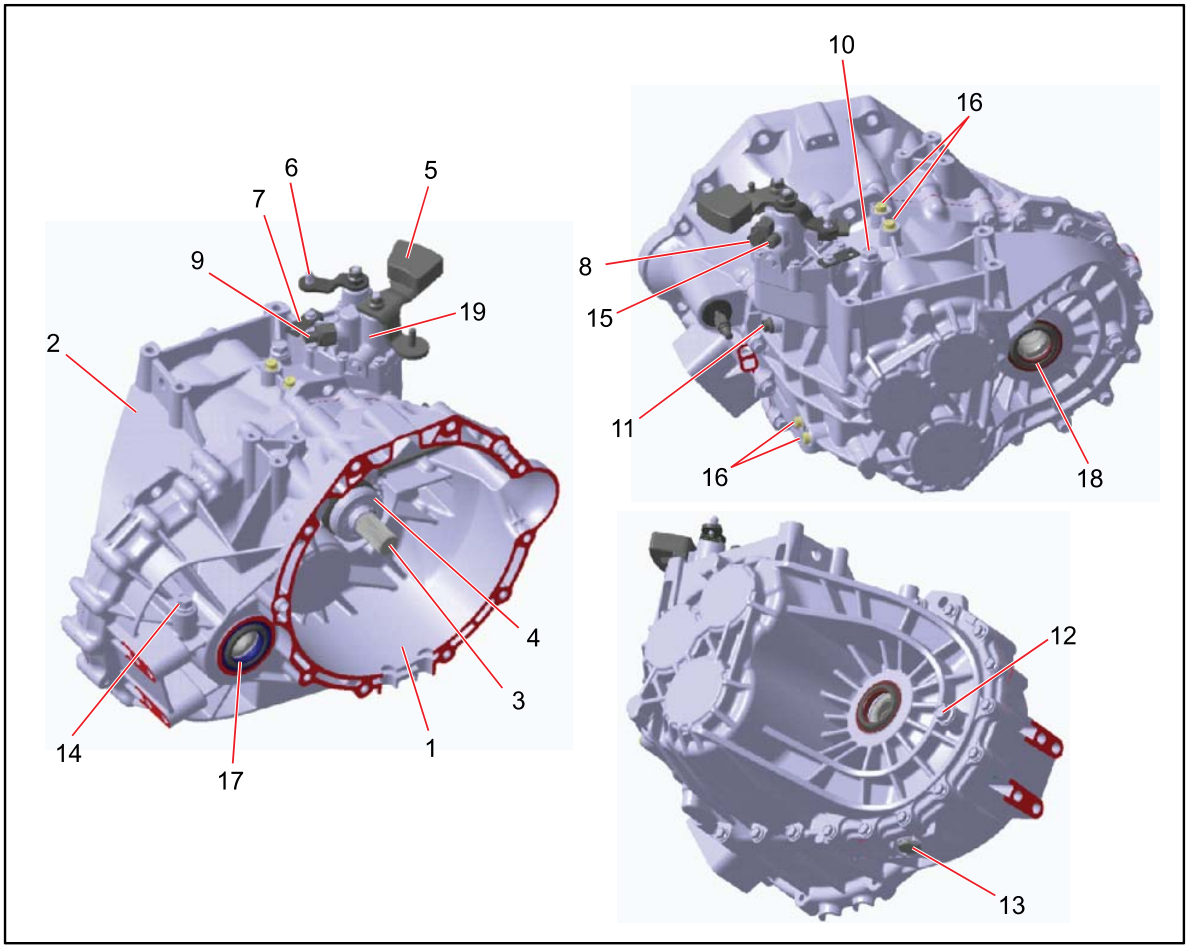
Front view	Rear view
	

Modification basis	
Application basis	
Affected VIN	

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1) Characteristics of WM6F1 M/T

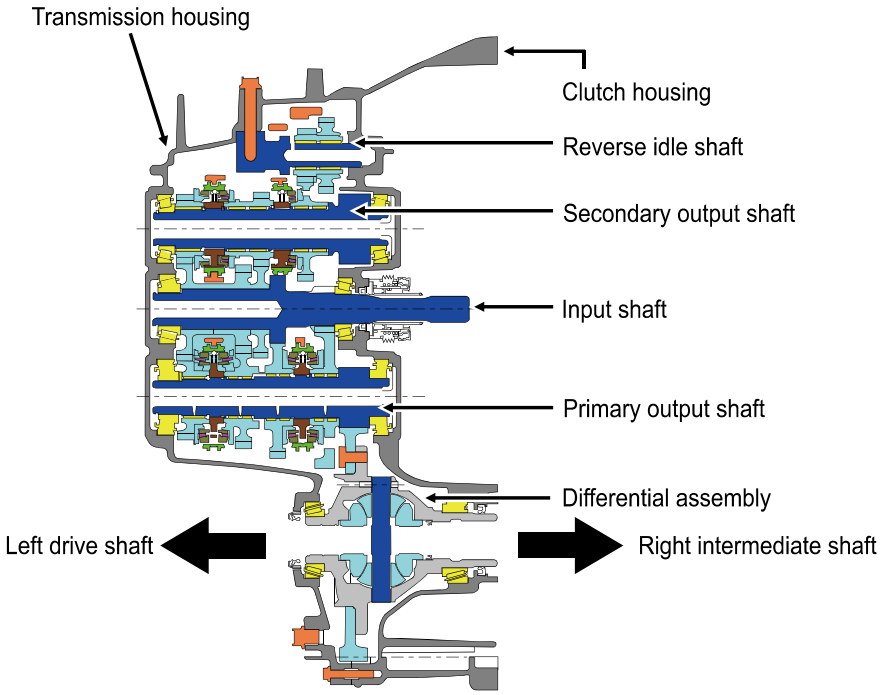
- Both Forward and Reverse gears use the helical gear and are made of high-strength material.
- Drives the clutch with a concentric slave cylinder mounting bolt.
- Shifting the transmission gears is performed through the remote control cable.
- A pull type clutch is used for Reverse gear shifting.
- Features triple/double/single synchronization.

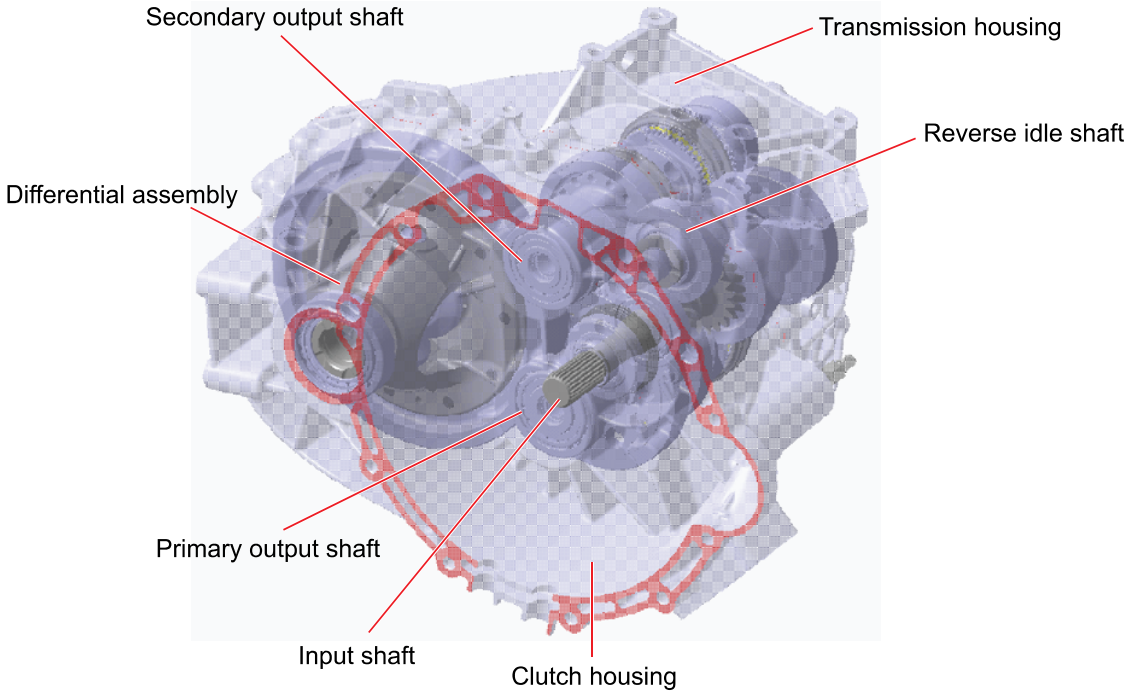


1. Clutch housing
2. Transmission case
3. Input shaft
4. Concentric slave cylinder
5. Shift lever
6. Selector lever
7. Wiring bracket
8. Neutral switch
9. Backup lamp switch
10. Reverse idle shaft mounting bolt
11. Control guide bolt
12. Oil filler plug (for servicing)
13. Oil drain plug
14. Oil filler plug (for manufacturing)
15. Air breather
16. Detent pin (for securing shift fork)
17. Oil seal (RH)
18. Oil seal (LH)
19. Control housing

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2) Internal Configuration

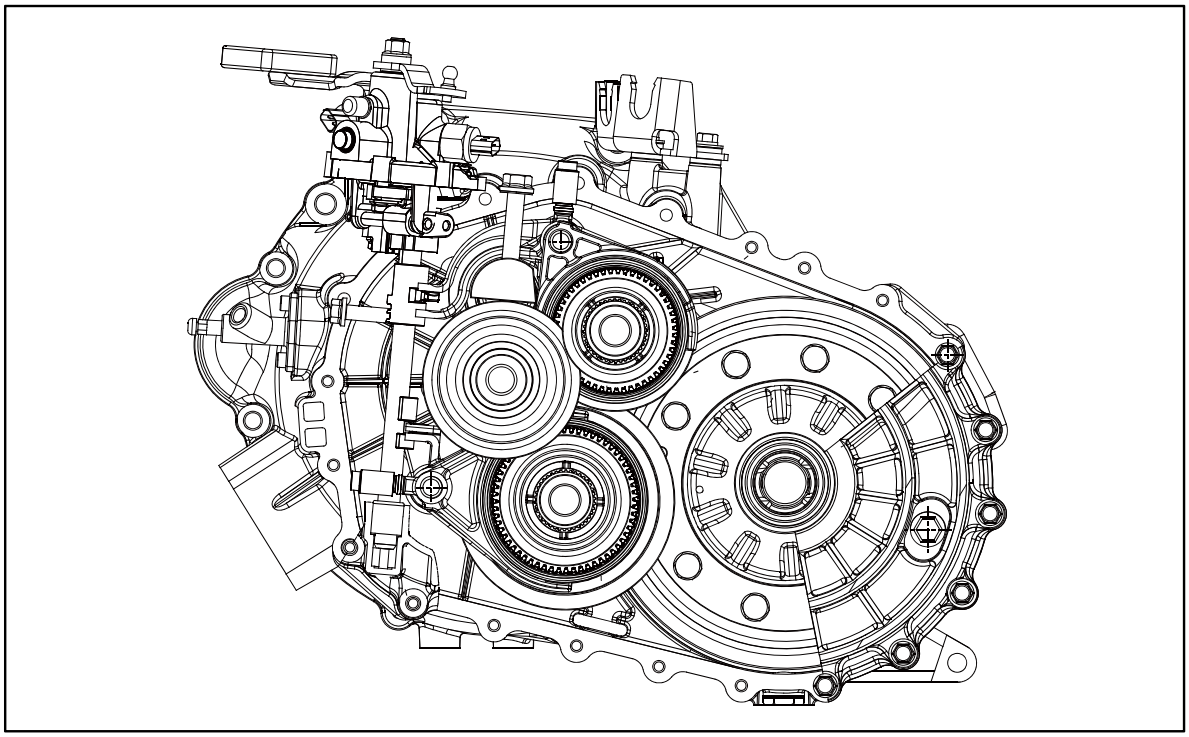




Modification basis	
Application basis	
Affected VIN	

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3) Schematic Diagram



4) Gear Ratio

Item	Speed gear			Final gear			Total gear ratio
	Number of teeth		Gear ratio	Number of teeth		Gear ratio	
	Input	Output		Input	Output		
1st	13	46	3.538	13	59	4.538	16.059
2nd	22	42	1.909				8.664
3rd	28	33	1.179				5.349
4th	43	35	0.814				3.694
5th	38	28	0.737	15	59	3.933	2.898
6th	43	27	0.628				2.47
Reverse	13	17	3.91				15.377
	24	36					

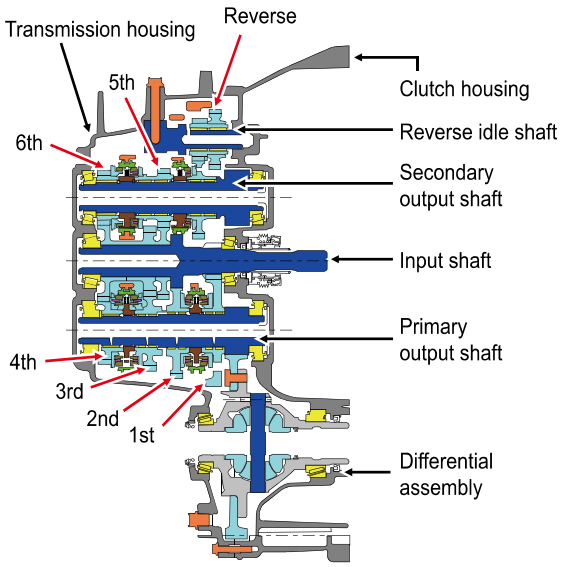
NOTE

- One input gear is used for 1st forward driving and back-up driving.
- One input gear is used for 4th and 6th forward driving.

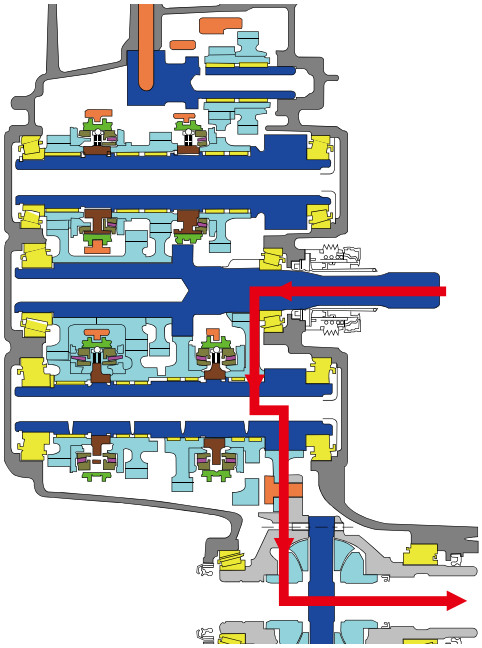
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2. POWER FLOWS

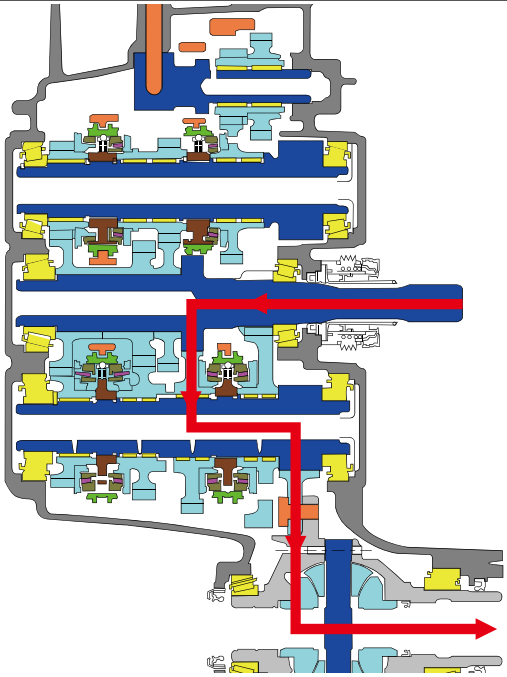
Sectional view of WM6F1 M/T



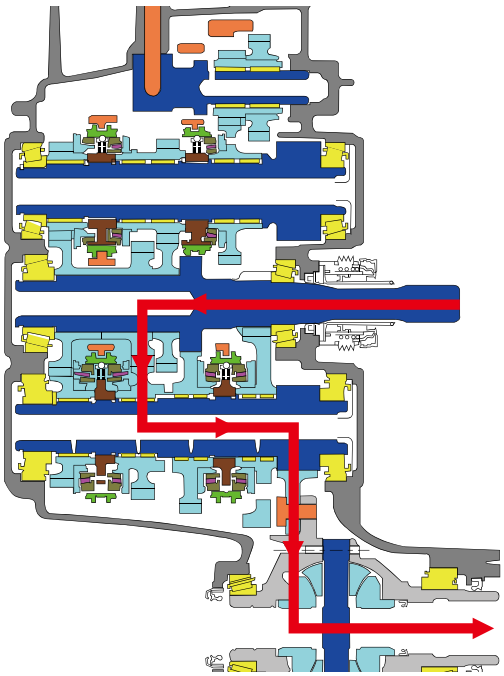
1st speed gear



2nd speed gear



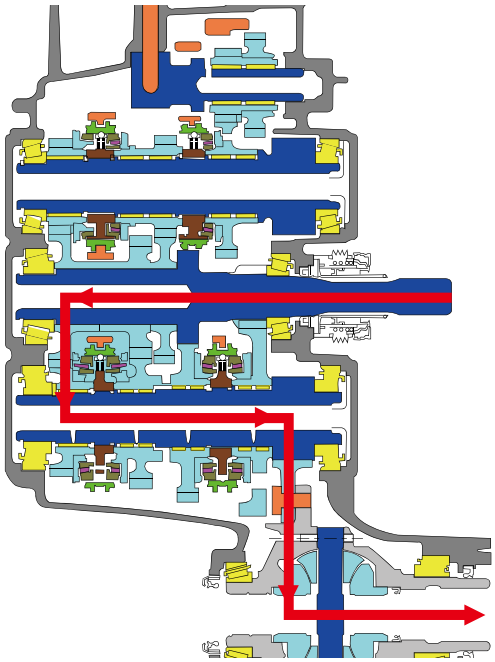
3rd speed gear



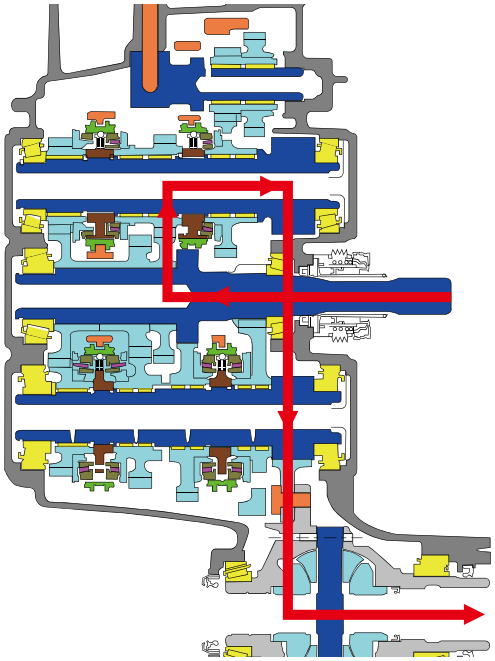
Modification basis	
Application basis	
Affected VIN	

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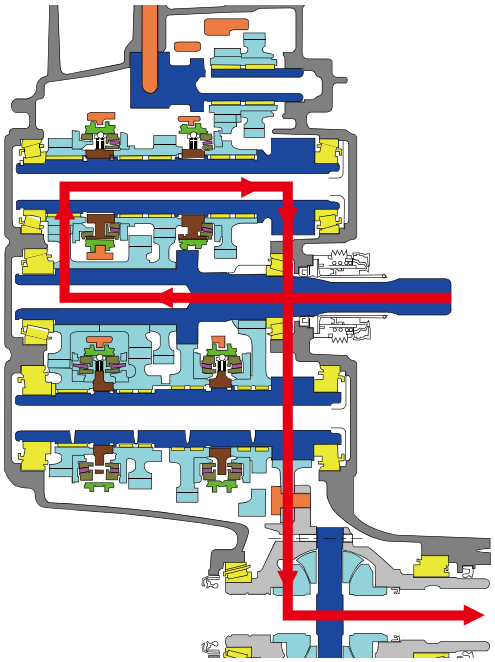
4th speed gear



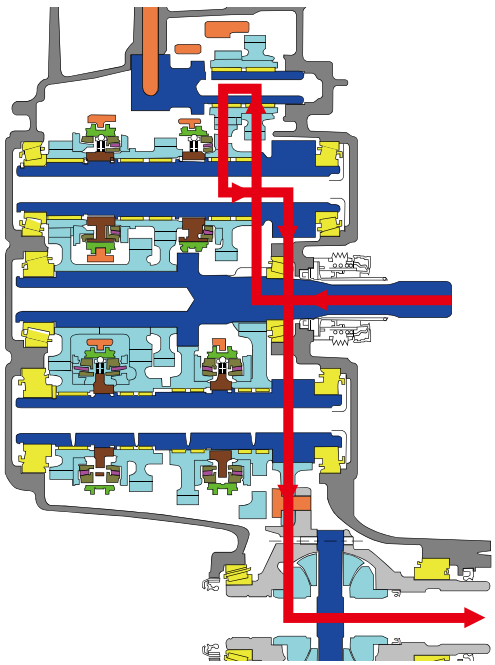
5th speed gear



6th speed gear

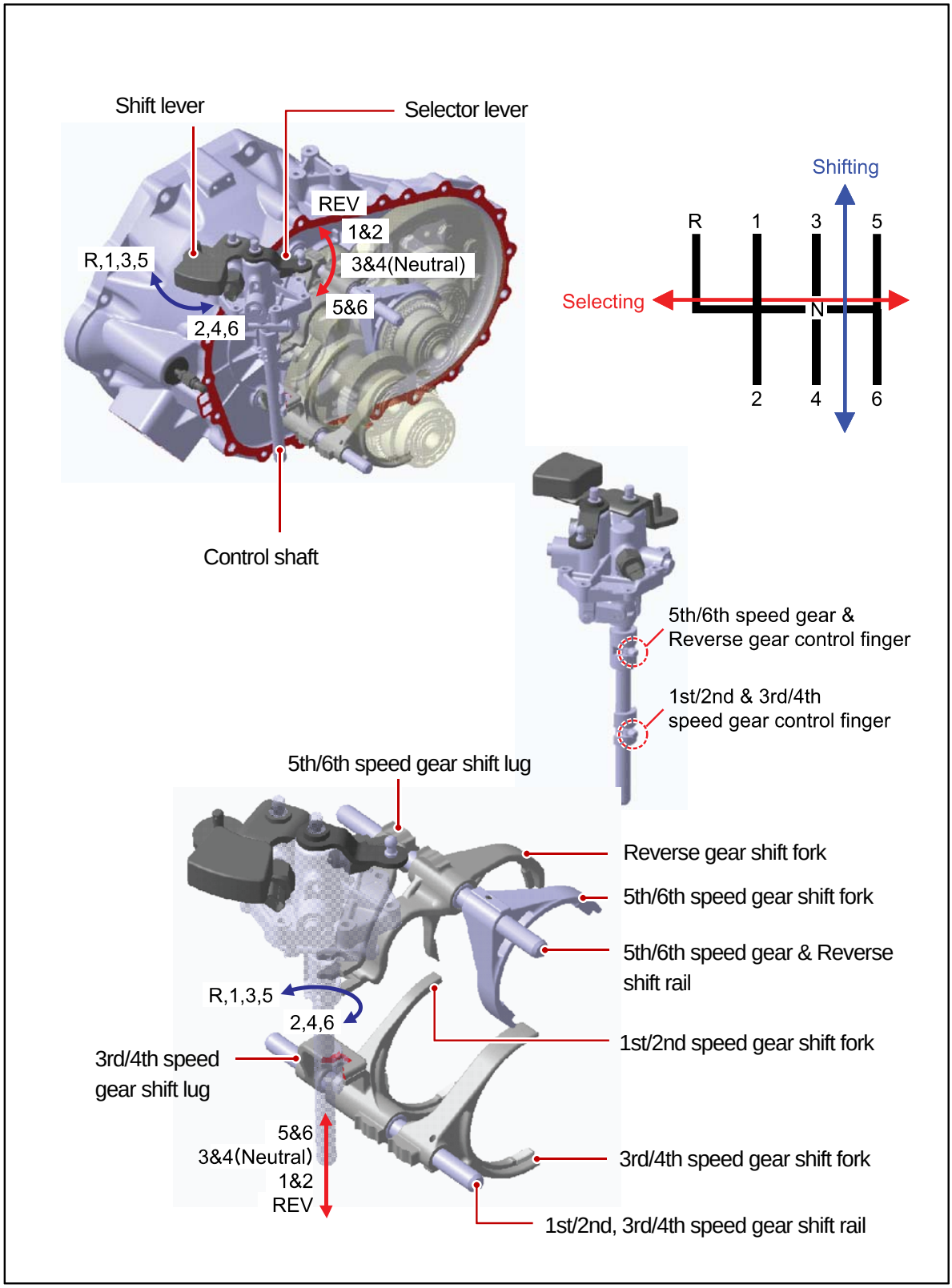


Reverse gear



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3. SHIFTING MECHANISM



Modification basis	
Application basis	
Affected VIN	

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GENERAL INFORMATION

1. SPECIFICATION

Description		Specification
Operating type		Hydraulic type
Clutch cover	Type	Diaphragm spring strap
	Adjusting type	SATIC (Self Adjusting Technology with Integrated Cassette) type
Clutch pedal	Type	Suspended type
	Max. operating travel	135 ± 3 mm
	Pedal free play (Longitudinal)	7.1 ± 3 mm
	Pedal free play (Transverse)	3 mm
Clutch disc	Type	Dry type single diaphragm (Rigid type)
	Diameter of facing	Outer: 250 ± 1 mm Inner:160 ± 0.8 mm
	Thickness of disc	Free: 8.7 ± 0.3 mm
		When loaded: 8.0 ± 0.2 (at 7,800 N)
	Numbers of disc	2
	Weight	1.18 kg
	Flywheel type	DMF (Dual Mass Flywheel)
Setting load of clutch cover assembly		At least 7,800 N
Clutch master cylinder	Operating travel	30 mm
	Inner diameter	17.46 mm
Concentric slave cylinder	Maximum operating travel	12.55 mm
	Operating pressure	Maximum 50 bar
Clutch oil	Standard	DOT 3 or DOT 4
	Capacity	As required

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2. TIGHTENING TORQUE

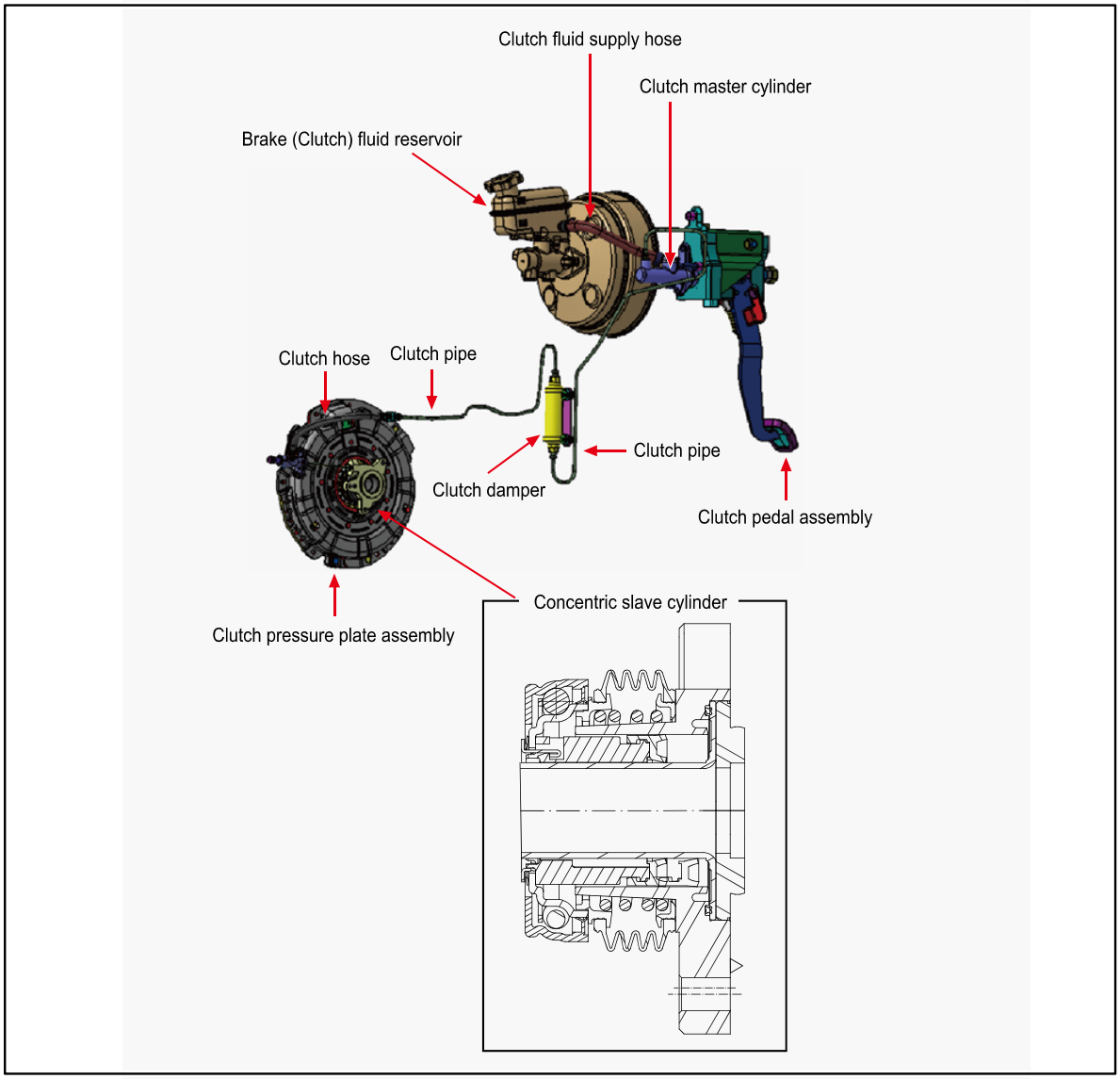
Description		Tightening torque	Amount
Clutch housing bolt	Upper (17 mm)	85.0 to 100 Nm	2
	Front (14 mm)	54.0 Nm + 20°	1
	Rear (14 mm)	51.3 to 56.7 Nm	2
	Lower (14 mm)	56.0 to 62.0 Nm	4
Pressure plate assembly bolt (Hexagon 6 mm)		21.0 to 27.0 Nm	6
Concentric slave cylinder bolt (Hexagon 5 mm)		10 to 16 Nm	3
Concentric slave cylinder oil pipe nut		24.5 to 28.4 Nm	Remove the nut if it is necessary. (Once removed, apply the Loctite on the thread before installation.)
Master cylinder nut (12 mm)		7.8 to 17.6 Nm	
Master cylinder oil pipe nut (10 mm)		14.7 to 17.6 Nm	
Master cylinder push rod lock nut		8.8 to 13.7 Nm	
Clutch oil chamber screw and bolt (10 mm)		3.9 to 7.8 Nm	
Oil pipe nut (10 mm)		14.7 to 17.6 Nm	
Clutch pedal mounting nut (12 mm)		7.8 to 17.6 Nm	
Stopper bolt		16 to 22 Nm	

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The hydraulic clutch transmits the force required to operate the clutch pedal to the concentric slave cylinder fitted to the clutch housing as a hydraulic pressure.
(The hydraulic pressure is transmitted in the following order: Clutch pedal - Clutch master cylinder - Clutch pipe - Clutch damper - Clutch pipe and hose - Concentric slave cylinder - Pressure plate - Flywheel.)
If a driver depress the clutch pedal, the hydraulic pressure is generated in the master cylinder. It is transmitted to the concentric slave cylinder through the pipe, resulting in the cylinder being forced out. At this time, the clutch disc is forced against the cylinder by pushing the cover. This, in turn, remove the flywheel from the pressure plate. As a consequence, the power from the engine will be cut off and the gear change can be carried out.



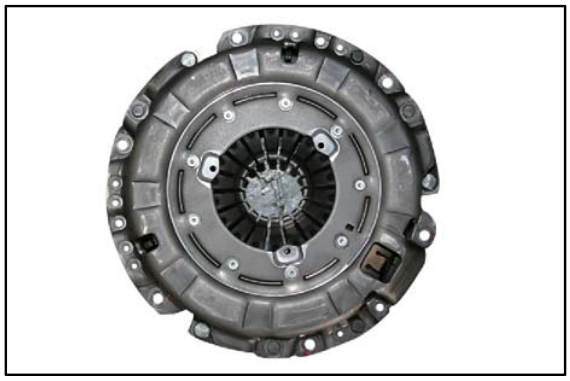
Modification basis	
Application basis	
Affected VIN	

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2. SATIC (SELF ADJUSTING TECHNOLOGY WITH INTEGRATED CASSETTE)

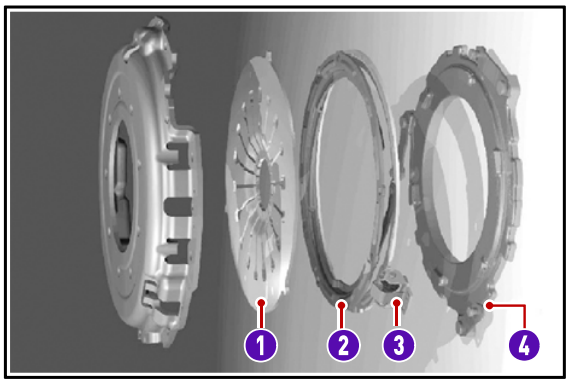
1) System Description

▶ Function

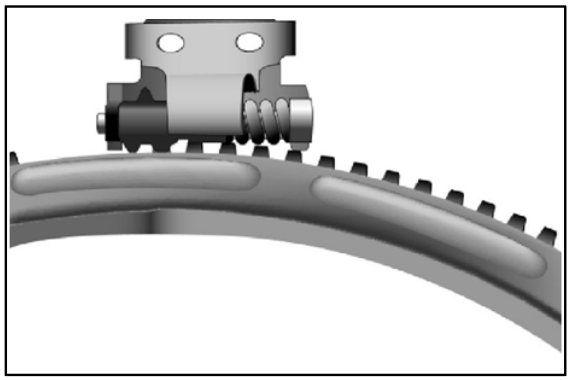


On the conventional clutch, the pedal force tends to increase in proportion to the degree of disc run-out. However, the SATIC clutch has the adjusting function which activates the cassette system inserted to the clutch cover to maintain a constant pedal force and clearance when the disc runs out. (Unlike SAT type, SATIC type does not need SST for clutch cover removal.)

▶ Operation



Diaphragm spring rotates the adjusting equipment as clutch disc is wearing and so, pressure plate is pushed to clutch disc side at the amount of wear.
Disc wear (Free play) → Diaphragm spring (1) → Adjusting equipment (2, 3) → Pressure plate (4)



Modification basis	
Application basis	
Affected VIN	

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2) Overview

▶ 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.

▶ 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.

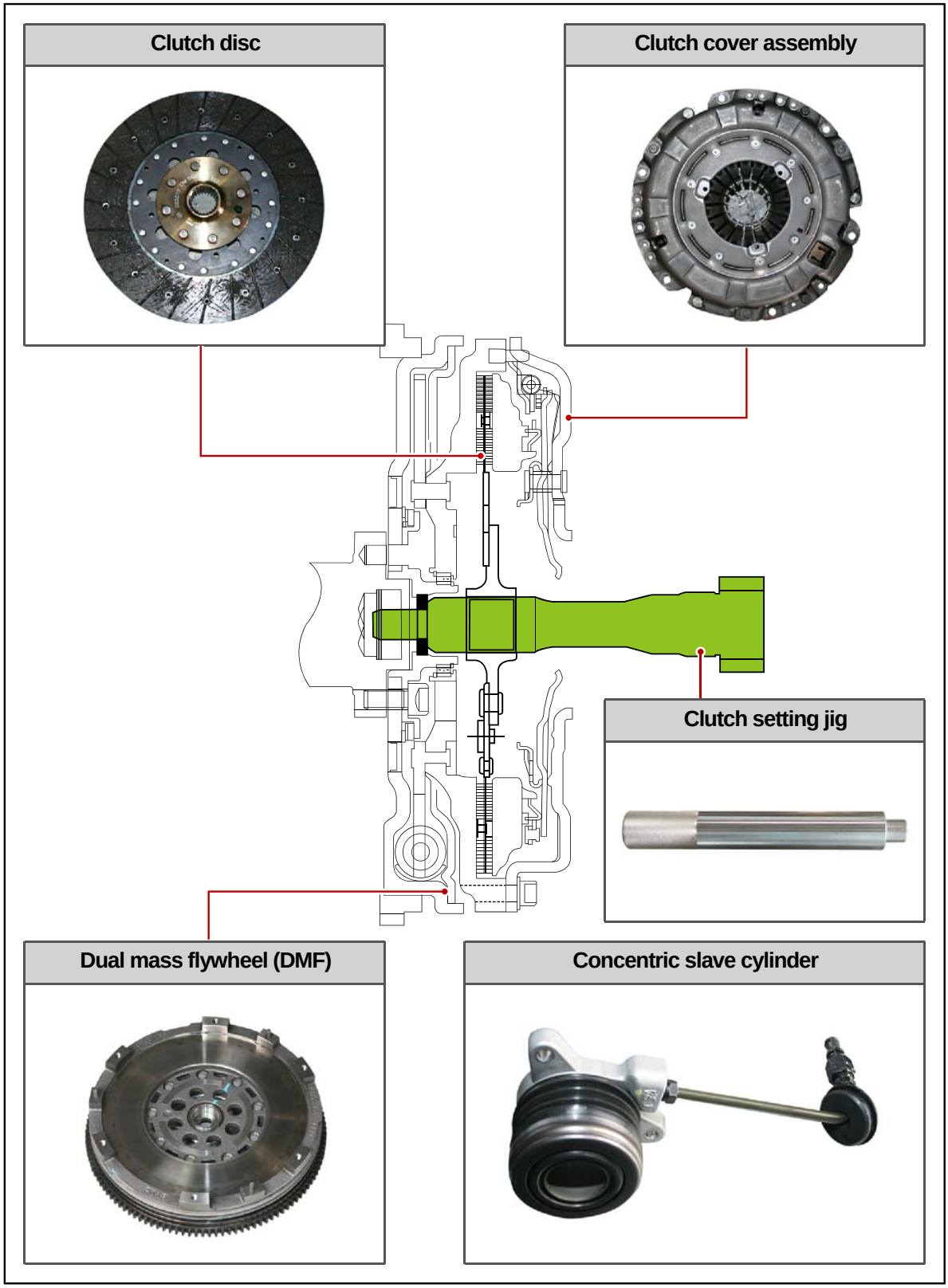
▶ Operating Elements

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

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

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3) Layout



Modification basis	
Application basis	
Affected VIN	

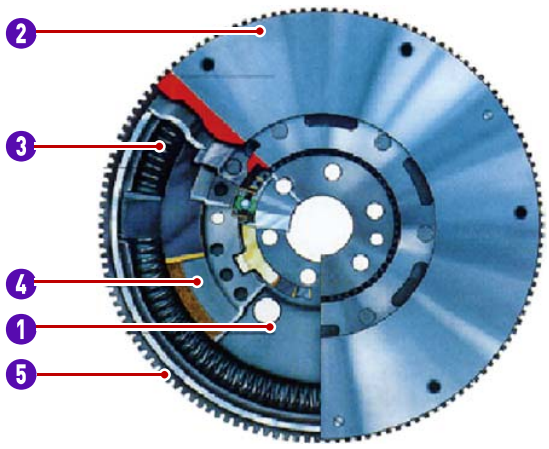
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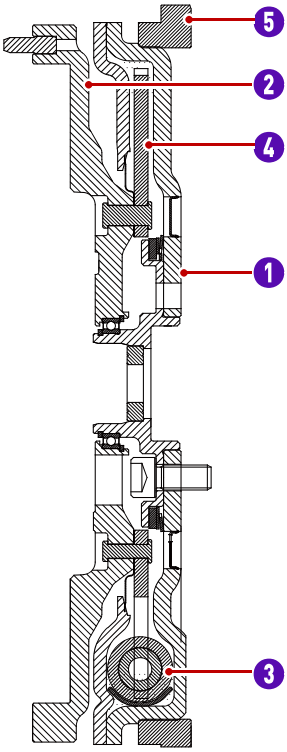
3. DUAL MASS FLYWHEEL (DMF)

The dual mass flywheel (DMF) is of having a mass divided into two halves.
While one mass is connected to the engine crankshaft, which is affected by the mass moment of inertia of the engine, the other mass is affected by one of the transmission.
The divided dual masses are connected to the coil spring and damping system internally.

▶ **The DMF has the following benefits:**

- Reducing fuel consumption by lowering engine speed
- Reducing rattling noise and vehicle vibration in all driving ranges
- Reducing synchronization wear
- Facilitating gear change
- Protecting power train parts by preventing excessive load from being delivered





1. Primary flywheel
2. Secondary flywheel
3. Arc damper spring
4. Torque limiter
5. Ring gear

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PROPELLER SHAFT (4WD ONLY) 3310-01

GENERAL INFORMATION

1. SPECIFICATION

Description		Specification
Structure		2-piece type with CV joint, spider, and rubber coupling
Weight		below 12.0 kg
Joint type		CV joint, spider, rubber coupling
Spider	Numbers	one (installed on center bearing side)
	External diameter	Ø24 mm
	Overall size	Ø62.5 mm
Dimension (Length x Dia.)	No.1 shaft (TM to spider)	1,069 x Ø60 mm
	No. 2 shaft (spider to axle)	847.5 x Ø60 mm
Runout of tube (after installation)		0.3 mm
Unbalance		80g.mm @ 3,000rpm (second measurement: 120 g.mm)
U-joint	Starting torque	0.3 to 0.7 Nm
	Minimum starting angle	18°
Amount of grease in CV joint		210+-10g

2. TIGHTENING TORQUE

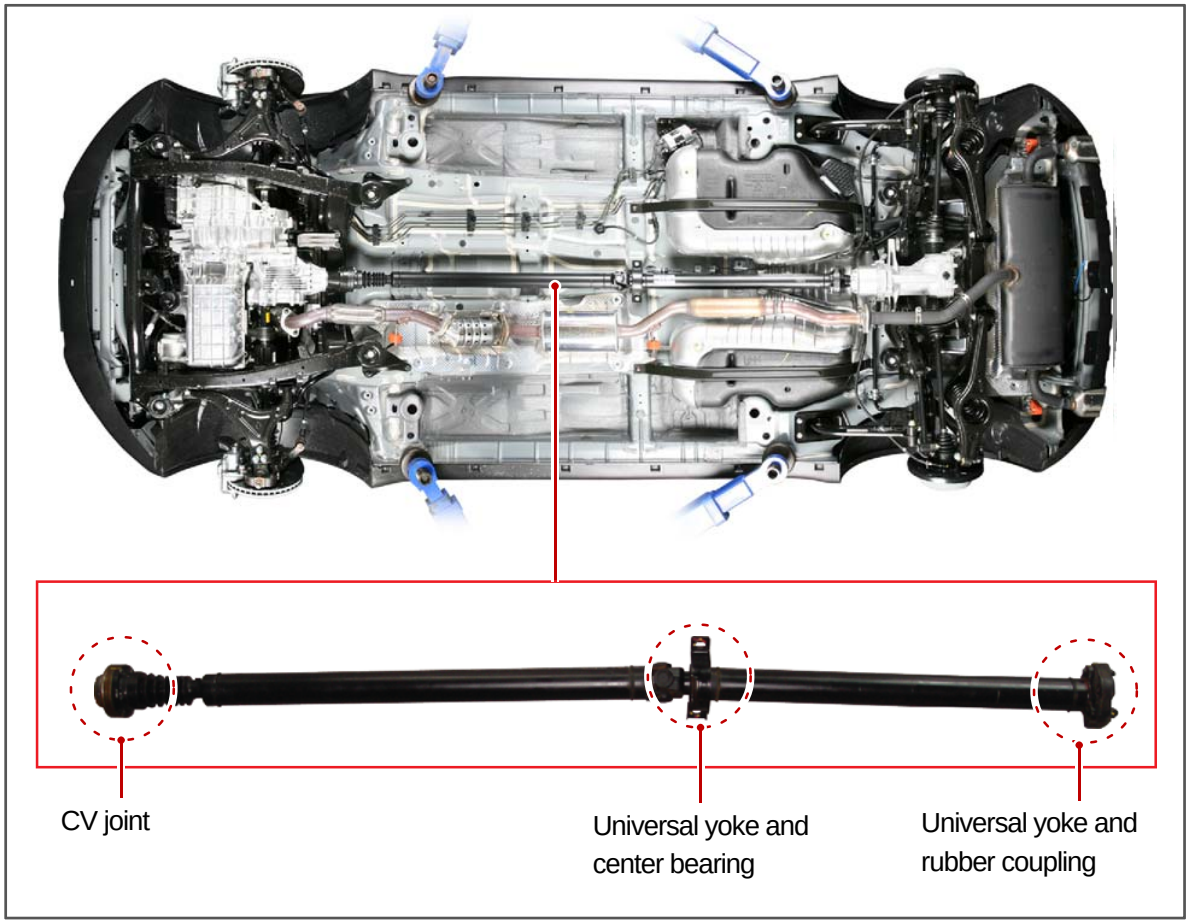
Fastener	Tightening torque
Bolt/nut for rubber coupling (rear axle side)	39.2 to 49.0 Nm
Bolt/nut for CV joint (transaxle side)	29.4 to 39.2 Nm
Mounting bolt for center bearing	58.8 to 68.6 Nm

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The propeller shaft is a thin steel pipe which transfers the power from the transmission to the E-coupling, and has high resistance to torsion and bending.
The propeller shaft has the universal joint (cross axle) mounted on the center of the shaft and splines for the slip joint on the E-coupling side to accommodate the height and length changes which occur as the shaft rotates at high speed.
And the rubber bushing for center bearing in the center of the propeller shaft keeps the balance of the shaft and absorbs its vibration.



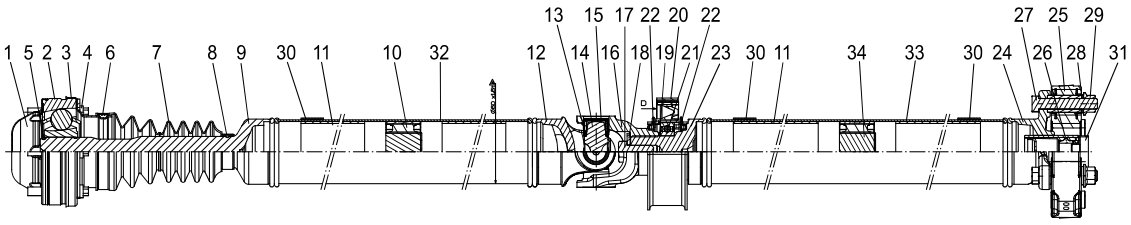
▶ **Function of propeller shaft**

- Transmits driving torque.
- Accommodates the angle change (universal joint / CV joint).
- Accommodates the axial length change (splines for the slip joint).

Modification basis	
Application basis	
Affected VIN	

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2. COMPONENT



1	End cap	18	Plain washer
2	VL joint assembly	19	AL washer
3	Washer	20	Center bearing assembly
4	Bolt	21	Ball bearing
5	Circlip	22	Dust shield
6	Clamp (big)	23	Intermediate shaft
7	Boot	24	Fork yoke
8	Clamp (small)	25	Rubber coupling
9	Stub shaft	26	Alignment support
10	Bending absorber	27	Bolt
11	Paper damper	28	Washer
12	Tube yoke	29	Lock nut
13	Oil seal	30	Balance weight
14	Spider	31	Protecter
15	Bearing cap	32	Tube
16	Intermediate yoke	33	Tube
17	Bolt	34	Bending absorber

CAUTION

Do not remove the rubber coupling since the vibration balance could be improper once removed it.

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DRIVE SHAFT AND AXLE

4110-01

GENERAL INFORMATION

1. SPECIFICATION

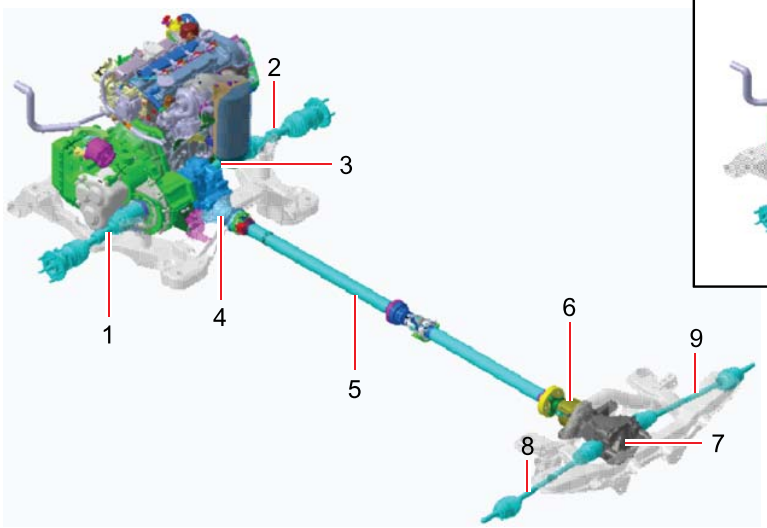
Component		Item	Specifications
2WD, 4WD	Front drive shaft	Joint type	Inside: Tripod joint Outside: Ball joint
		Max. allowed angle	Inside: 23° Outside: 46°
		To compensate the bending angle	Installation of equivalent length shaft
4WD only	Rear drive shaft	Joint type	Inside: Cross groove joint Outside: Ball joint
		Max. allowed angle	Inside: 23° Outside: 23°
	Rear differential carrier	Type	Independent Rear Drive Axle (IRDA)
		Reduction gear type	Hypoid gear
		Gear reduction ratio	2.93
		Diameter of gear	Ø152 mm
		Oil type	Hypoid gear oil (SAE 75W/90)
		Final drive gear backlash	0.10 to 0.15 mm
		Differential gear backlash	0 to 0.076 mm
	Propeller shaft	Joint type	PTU side: CV joint Rear axle side: Rubber coupling
		Sliding distance	±25 mm or more
		Unbalance	80 g.mm or less at 3,000 rpm
		Total runout	0.3 mm or less

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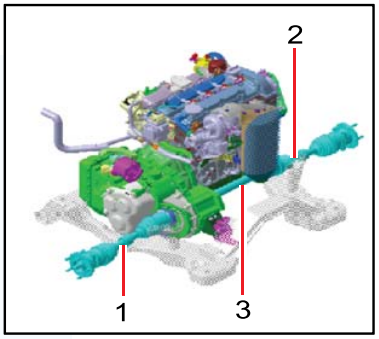
OVERVIEW AND OPERATING PROCESS

1. COMPONENT

For AWD vehicle



For 2WD vehicle



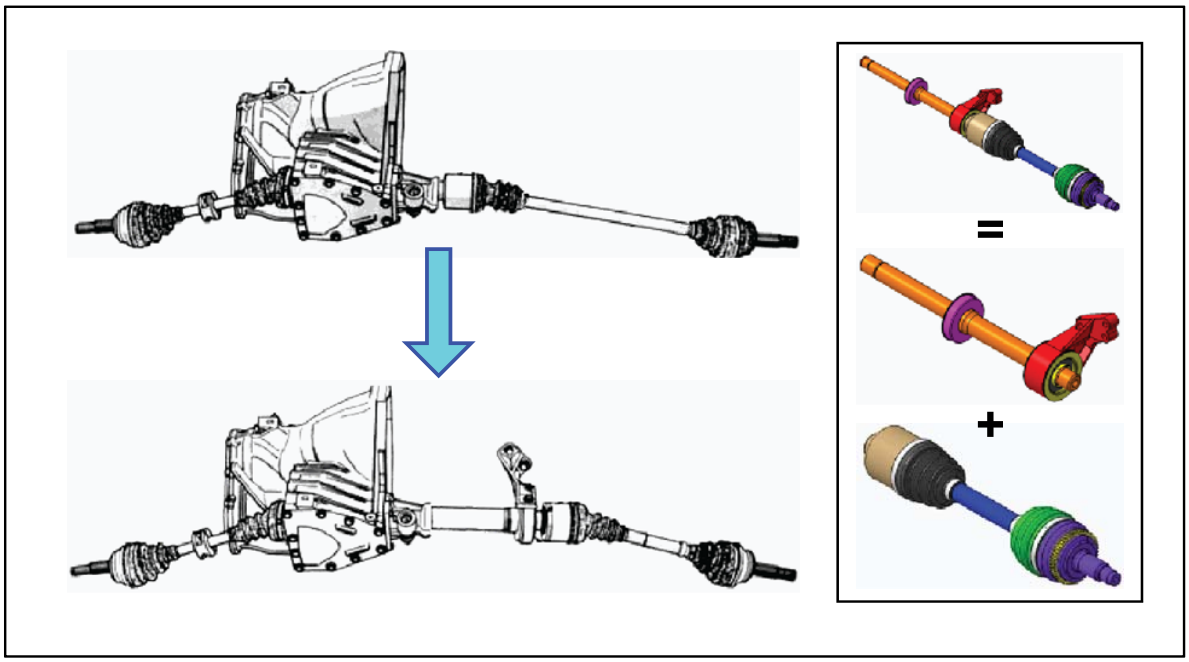
1. Front drive shaft (LH)
2. Front drive shaft (RH)
3. Intermediate shaft
4. Power transfer unit(PTU) - 4WD
5. Propeller shaft - 4WD
6. E-coupling - 4WD
7. Rear differential carrier - 4WD
8. Rear drive shaft (LH) - 4WD
9. Rear drive shaft (RH) - 4WD

Modification basis	
Application basis	
Affected VIN	

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2. TORQUE STEER

Torque steer is a condition in which a vehicle pulls to either side because of an inequality of traction between the left and right driving wheels when a large torque is applied to the front wheel of a FWD or 4WD.
Especially for a FWD vehicle, this mechanical condition can cause the steering effect because of the output torque (rotational force) produced by the gyroscope.
This rotational force is due to the difference in distance between the left/right front wheels and the transaxle which leads to the change of the shaft bending angle.
To prevent this, the intermediate shaft, called Intermediate shaft, is employed on each side so that the bending angle and the length are kept constant.



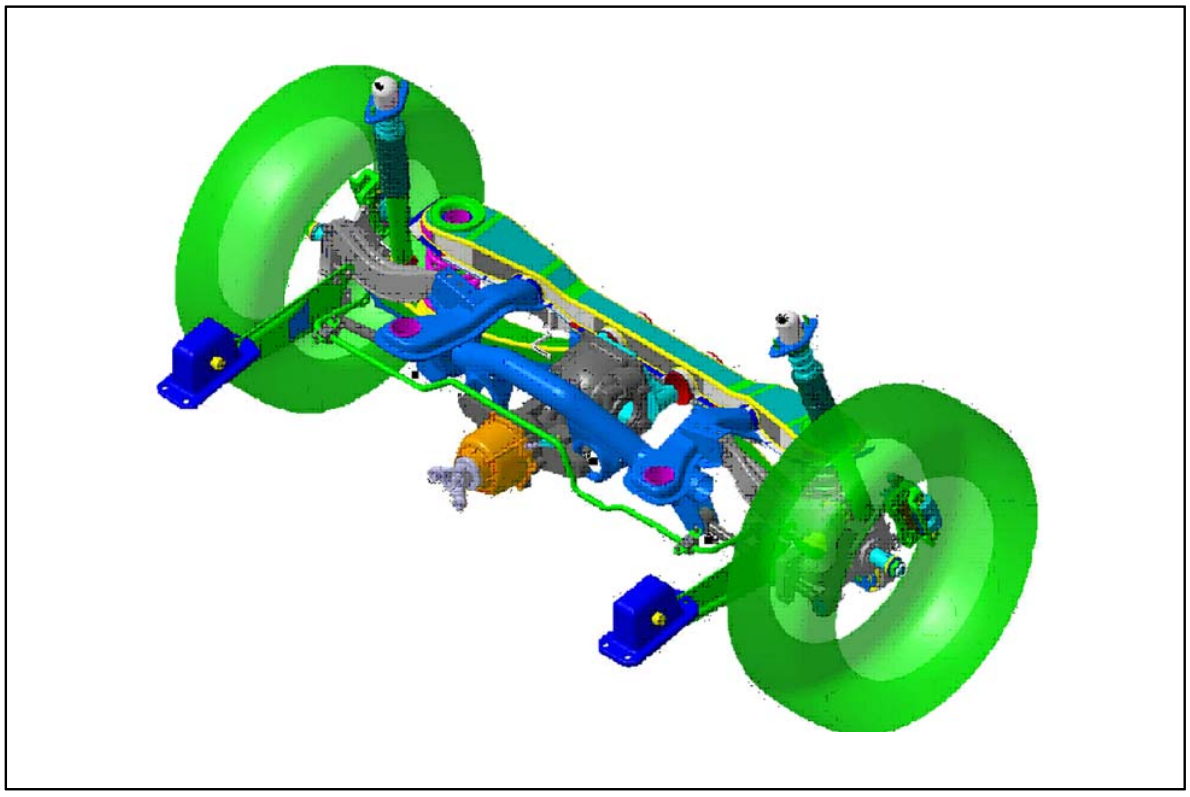
CAUTION

A gyroscope is a device for measuring or maintaining orientation, based on the principles of angular momentum. In essence, a mechanical gyroscope is a spinning wheel or disk whose axle is free to take any orientation. Although this orientation does not remain fixed, it changes in response to an external torque much less and in a different direction than it would without the large angular momentum associated with the disk's high rate of spin and moment of inertia. Since external torque is minimized by mounting the device in gimbals, its orientation remains nearly fixed, regardless of any motion of the platform on which it is mounted.

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3. REAR AXLE

The rear axle installed in this car is a removable axle, called IRDA (Independent Rear Differential Axle).
The rear differential carrier is installed directly on the sub frame,
and there is an independent suspension that allows each wheel on the same axle to move vertically and independently of each other with the universal joint and the slip joint.

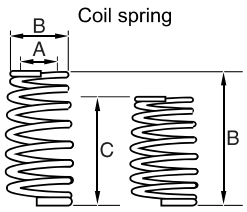
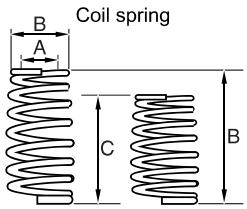


Modification basis	
Application basis	
Affected VIN	

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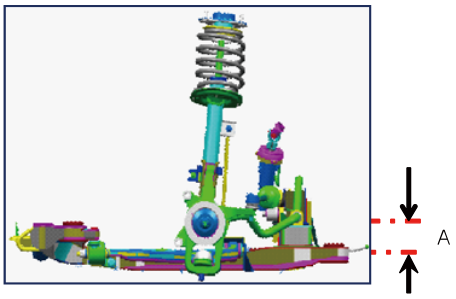
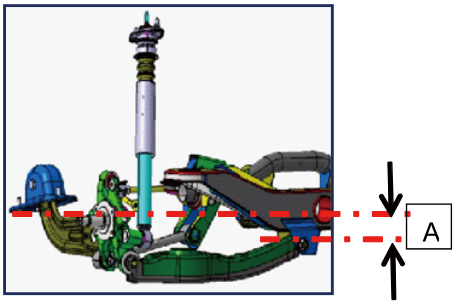
GENERAL INFORMATION

1. SPECIFICATION

System	Description		Specification	
Front suspension	Suspension type		Macperson strut type	
	Spring type		Coil spring	
	Stabilizer type		Torsion bar type	
	Shock absorber 	Type	Cylindrical reciprocation type	
		Max. length (extended)	564 mm	
		Min. length (compressed)	372 mm	
	Min. length (compressed) 	Inner diameter (A)	Upper: 84.0 mm Lower: 100.0 mm	
		Outer diameter (B)	163.1 mm	
		Free length (C)	356.1 mm	
		Installed length (D)	276.0 mm	
		Coil windings	5.32 turns	
		Winding direction	Right direction	
Rear suspension	Driving type		AWD	2WD
	Suspension type (trailing, upper, lower & track rod)		Multi-link type	←
	Spring type		Coil spring	←
	Stabilizer type		Torsion bar type	←
	Shock absorber	Type	Cylindrical reciprocation type	←
		Max. length (extended)	551 mm	←
		Min. length (compressed)	361 mm	←
	Coil spring	Diameter (A)	12.8 mm	12.6 mm
		Free length (B)	287.1 mm	291.7 mm
		Coil windings	6.64 turns	6.32
		Winding direction	Right direction	←

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1) Wheel Alignment

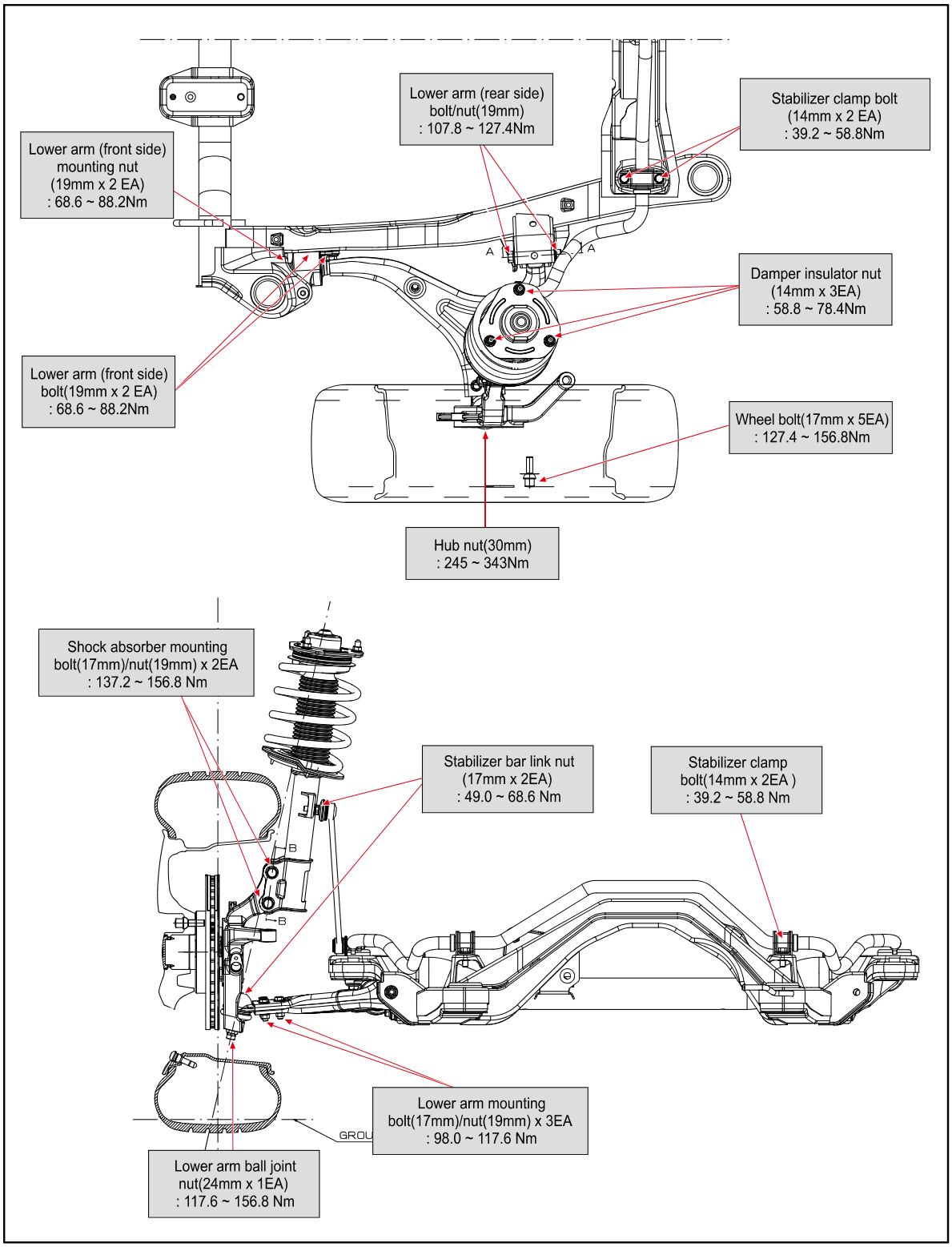
System	Description	Specification	
Front	Ground clearance (A)	76.8 ± 5 mm	
	Trim height : wheel center ↔ Wheel house	433 mm	
	Camber (maintenance free)	−0.5 ± 0.5˚	
	Caster (maintenance free)	4.8 ± 0.5˚	
	Total toe-in	0.0 ± 0.1˚ (adjust by tie rod)	
	King pin angle	12.85˚	
Rear	Ground clearance (A)	63.3 ± 5 mm	
	Trim height : wheel center ↔ Wheel house	437 mm	
	Camber (maintenance free)	−0.5 ± 0.5˚ [adjust by cam bolt on upper arm]	
	Total toe-in	0.0 ± 0.1˚ [adjust by cam bolt on track rod]	

Modification basis	
Application basis	
Affected VIN	

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2. TIGHTENING TORQUE

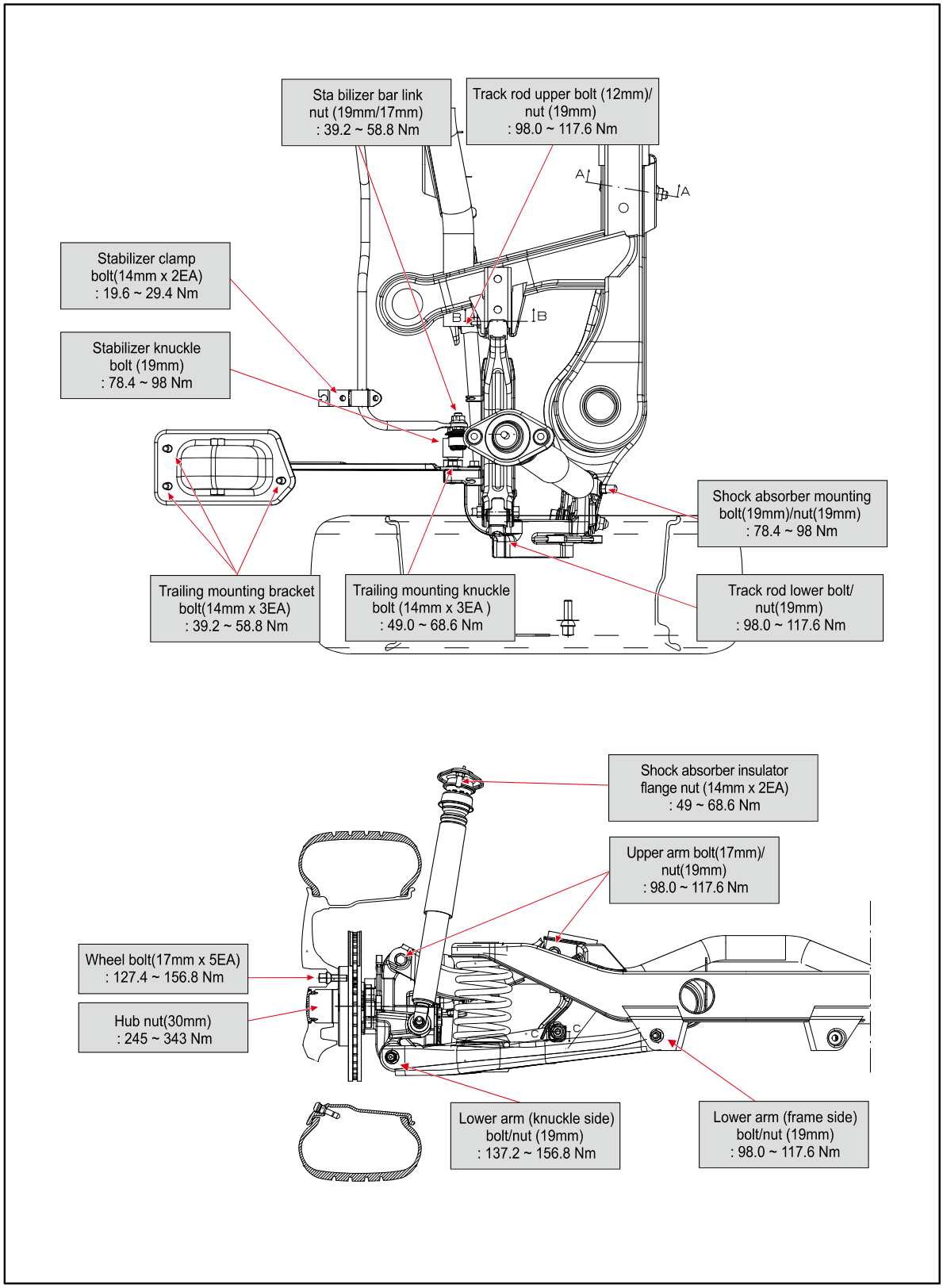
▶ Front suspension assembly



Modification basis	
Application basis	
Affected VIN	

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▶ Rear suspension assembly



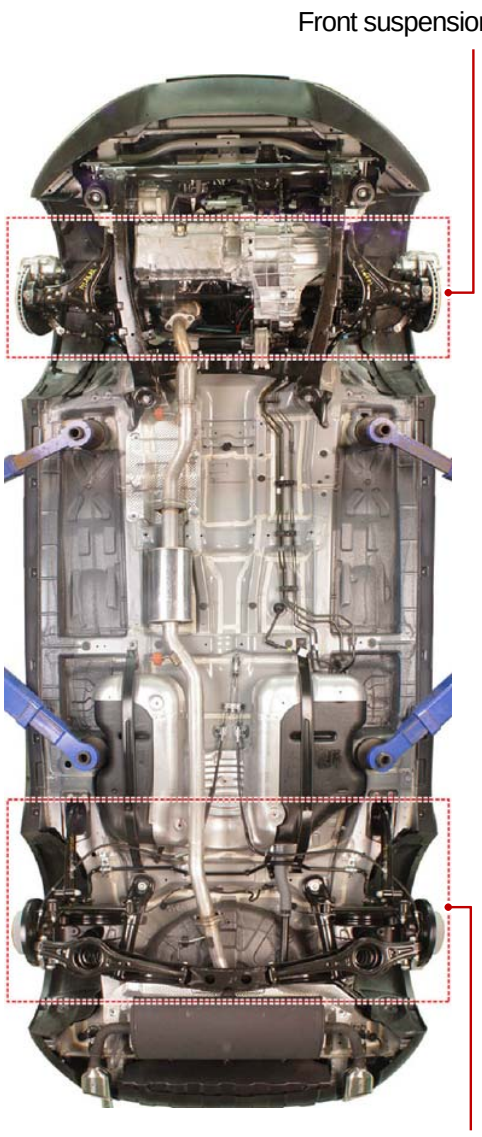
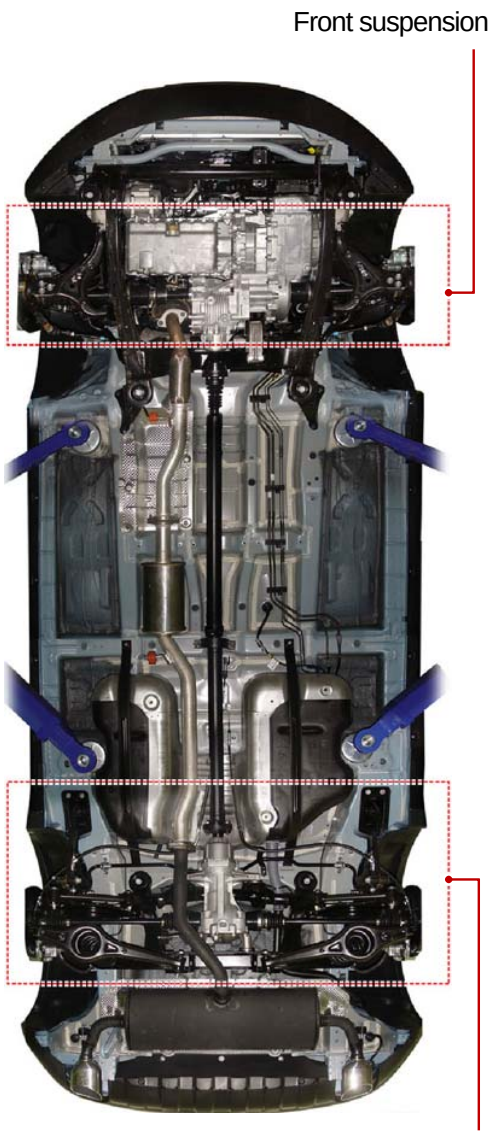
Modification basis	
Application basis	
Affected VIN	

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The suspension is the device to connect the axle and vehicle. It absorbs the vibrations and impacts from road surface, which enhances the comforts, driving force, braking force and drivability.

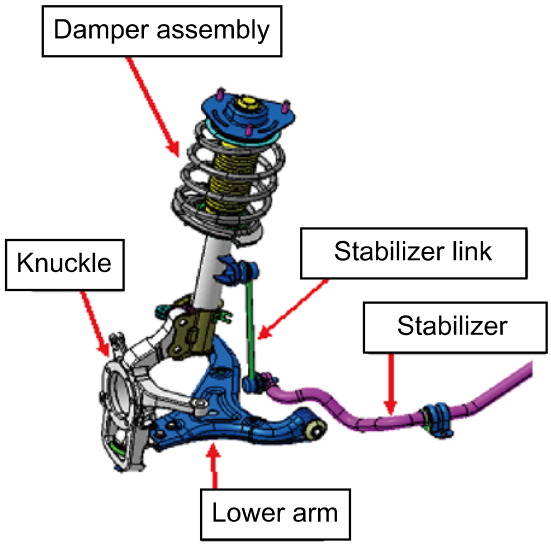
Underview of vehicle with 2WD, 6M/T	Underview of vehicle with 4WD, 6A/T
	

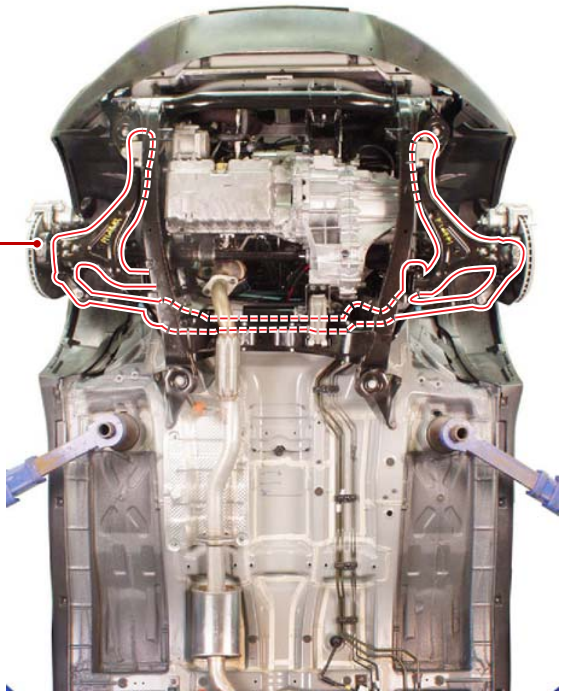
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1) Front Suspension (Macperson Strut Type)

Front suspension supports the vehicle weight and absorber the vibration from tires. And, in this type of suspension, the steering linkage tie rod is mounted on the knuckle.

Macperson strut type suspension





Macperson strut type suspension is the independent suspension which has the spring on the strut integrated with shock absorber. The lower arm is installed on sub frame and large strut damper is installed on the knuckle to support the tire. This type of suspension is normally applied to the vehicle with monocoque body, especially on the front wheel drive type. The upper part with spring is mounted at body mount and the strut with shock absorber is linked on the steering knuckle.

▶ Advantages

1. Compact and simple design
2. Stable wheel alignment
3. Good load distribution and easy installation
4. Less effect from tire up/down movement

▶ Disadvantages

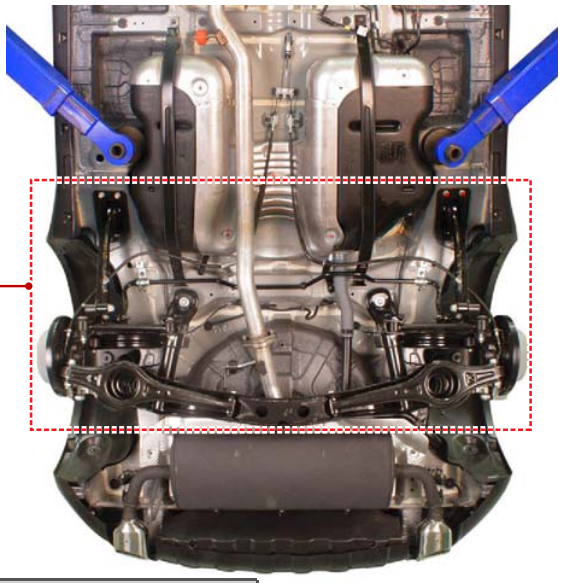
1. Comparatively weak to the impact from road surface and lateral shock due to long strut and single swing arm

Modification basis	
Application basis	
Affected VIN	

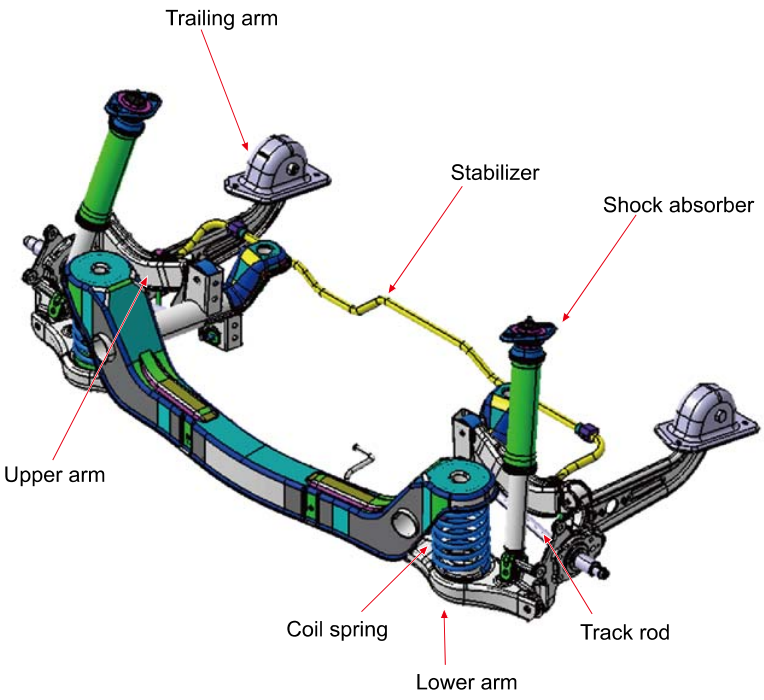
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2) Rear Suspension (Multi-link Type)

Multi-link type suspension is the independent suspension. It provides good ride comfort and drivability by reducing the coil spring weight. Also, it increases the space for passenger compartment by lowering the floor.
This type of suspension consists of multiple links such as trailing arm, upper arm, lower arm and track rod.



Layout



Modification basis	
Application basis	
Affected VIN	

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GENERAL INFORMATION

1. SPECIFICATION

Unit	Description	Specification
PTU (Power Transfer Unit)	Gear ratio	2.929
	Numbers of helical gear	22/39
	Numbers of hypoid gear	23/38
	Oil	IDEMITSU LW 80W/90
	Oil capacity	≒ 0.58 L
	Operating temperature	−40 to 150°C
E-coupling	Maximum torque	1,000 Nm
	Operating temperature	−40 to 120°C
	Numbers of main clutch	Outer: 11, Inner: 11
	Numbers of pilot clutch	Outer: 4, Inner: 3
	Coil windings	240 turns
	Weight	8 kg
	Oil	ECF107 (ATF based EMCD special oil)
	Oil capacity	0.145 L (145 ml)

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The AWD system in this vehicle is the electronic 4WD system and controls the traction to rear wheels according to the driving conditions.

1) Driving Mode

(1) AUTO mode (Normal driving mode)

Normally the vehicle is in 2WD mode.
Automatically change to this mode when the vehicle needs higher traction.

(2) LOCK mode (when pressing 4WD LOCK switch)

- This mode provides the highest traction. Use this mode when driving on unpaved, rugged, steep, sandy, wet or slippery roads.
- In 4WD LOCK mode, if the rear wheel speed exceeds 40 km/h, 4WD LOCK mode is canceled and 4WD AUTO mode is activated (Indicator OFF). If the speed is decreased below 35 km/h, 4WD LOCK mode is resumed (Indicator ON again).



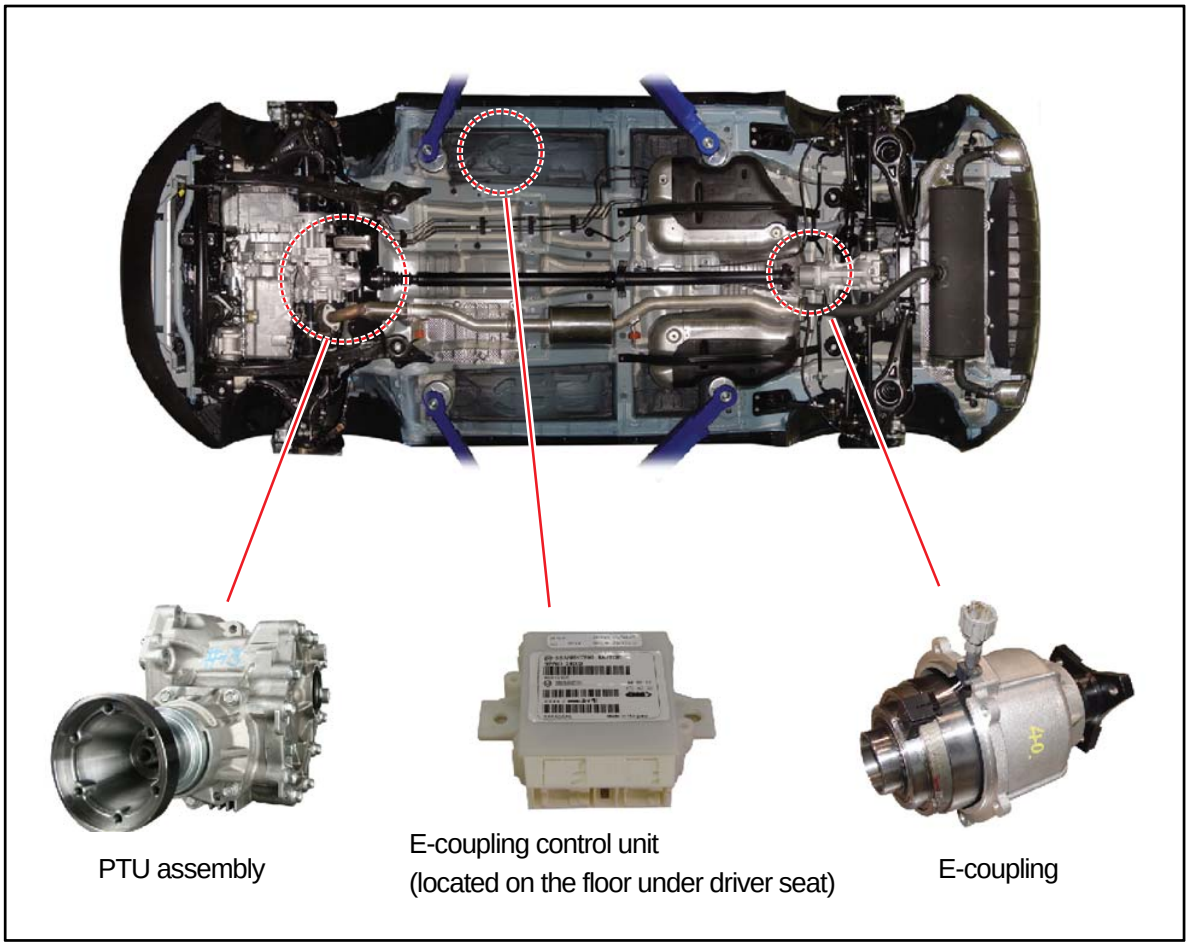
▶ **Mode table**

4WD LOCK switch	Vehicle speed	Driving mode
Not pressed (4WD AUTO)	No conditions	4WD AUTO
Pressed (4WD LOCK)	over 40 km/h	4WD AUTO
Pressed (4WD LOCK)	below 35 km/h	4WD LOCK

Modification basis	
Application basis	
Affected VIN	

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2. SYSTEM LAYOUT



1) Components

(1) PTU (Power Transfer Unit)

The power transfer unit in the front wheel drive model changes the angle of engine torque to 90° and transfer it to E-coupling to distribute the torque to rear wheels.

(2) E-Coupling (Electronic Coupling)

E-Coupling transfer the engine torque from PTU to rear axle and controls to distribute it between front wheels and rear wheels.

(3) E-Coupling Control Unit (ECU)

E-Coupling controls the current (clutch engagement force) of EMCD in E-Coupling according to CAN signals (wheel speed, engine torque, pedal position, ABS/ESP signals).
* EMCD: Electro-Magnetic Control Device

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GENERAL INFORMATION

1. SYSTEM OVERVIEW

1) Terms and Definition

- CBS: Conventional Brake System
- ABS: Anti-Lock Brake System
- EBD: Electronic brake-Force Distribution
- ESP: Electronic Stability Program
- ABD: Automatic Braking Differential
- ASR: Acceleration Slip Regulation
- AYC: Active Yaw Control (Understeer and Oversteer Control)
- HBA: Hydraulic Brake Assistant
- ARP: Active Rollover Protection
- HSA: Hill Start Assistant

2) Functions

<table>
<tr><th>Function</th><th>Vehicle with CBS</th><th>Vehicle with ABS/EBD</th><th>Vehicle with ESP</th></tr>
<tr><td>ABS</td><td rowspan="8">Not applied</td><td>Applied</td><td rowspan="8">Applied</td></tr>
<tr><td>EBD</td><td>Applied</td></tr>
<tr><td>ABD</td><td rowspan="7">Not applied</td></tr>
<tr><td>ASR</td></tr>
<tr><td>AYC</td></tr>
<tr><td>HBA</td></tr>
<tr><td>ARP</td></tr>
<tr><td>HSA</td></tr>
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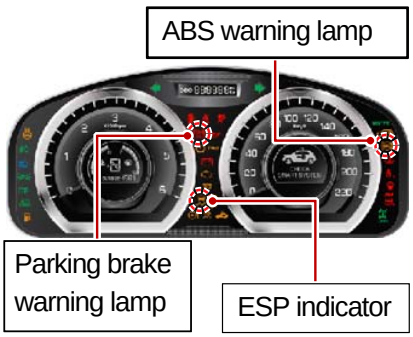
3) Parts Arrangement

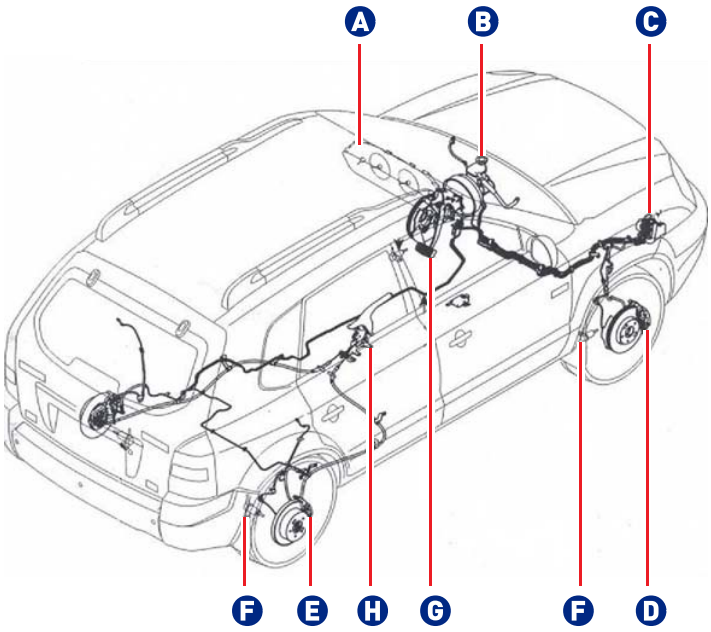
Part name	Vehicle with CBS	Vehicle with ABS/EBD	Vehicle with ESP
HECU	Not applied	Applied	Applied
Front wheel speed sensor			
Rear wheel speed sensor			
ABS warning lamp			
EBD indicator			
Longitudinal G sensor		2WD: N/A, 4WD: Applied	Not applied
Sensor cluster (Yaw rate sensor, lateral/longitudinal G sensor)		Not applied	Applied
ESP indicator			
ESP OFF switch and warning lamp			
Steering wheel angle sensor			

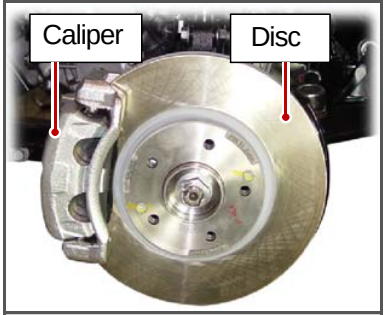
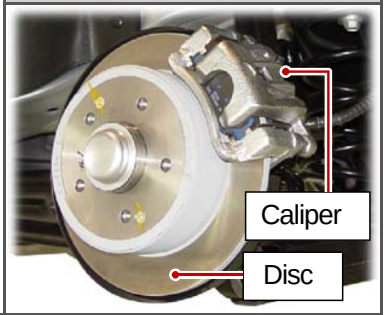
Modification basis	
Application basis	
Affected VIN	

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4) Component

A. Meter cluster-ABS, EBD, ESP indicator/warning lamp	B. Master cylinder and booster	C. HECU
		



D. Front brake assembly	E. Rear brake assembly
	

F. Front/rear wheel speed sensor		G. Brake pedal	H. Parking brake
Front/rear-4WD	Rear-2WD		
			

Modification basis	
Application basis	
Affected VIN	

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2. SPECIFICATION (DSL ONLY)

Unit	Description	Specification
Front brake	Type	Ventilated disc
	Outer diameter of disc	Ø298 mm
	Inner diameter of caliper cylinder	Ø43.0 x 2 mm
	Thickness of disc	26 mm (wear limit: 24 mm)
	Thickness of brake pad	10.5 mm (wear limit: 2 mm)
	Pad wear indicator	Mechanical type
Rear brake	Type	Solid disc
	Outer diameter of disc	2WD: Ø262 mm, 4WD: Ø284 mm
	Thickness of disc	10 mm (wear limit: 8.4 mm)
	Thickness of brake pad	10 mm (wear limit: 2 mm)
	Pad wear indicator	Mechanical type
Brake booster	Type	Vacuum assist type
	Size	8" + 9" (Tandem)
Master cylinder	Type	Tandem (level sensor installed)
	Inner diameter of cylinder	Ø25.4 mm
Brake pedal	Maximum operating stroke	140 ± 3 mm
	Pedal ratio	3.8 : 1
	Free play	3 to 10 mm
Parking brake	Type	Mechanically expanded rear lining
	Operating type	Hand operated type
	Inner diameter of drum	2WD: Ø168 mm, 4WD: Ø190 mm
Brake oil	Specification	DOT 4
	Capacity	0.7 to 0.8 liters

NOTE

Service interval for brake fluid: Change every other year.

Modification basis	
Application basis	
Affected VIN	

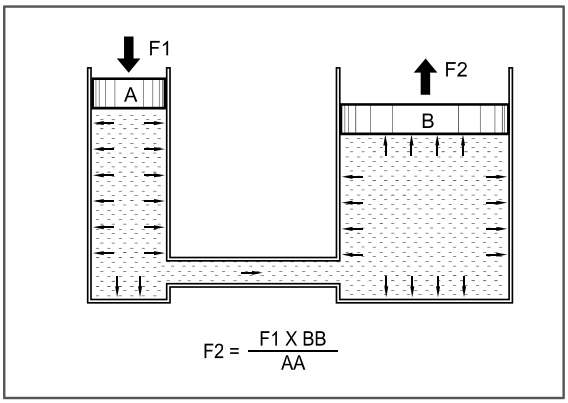
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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

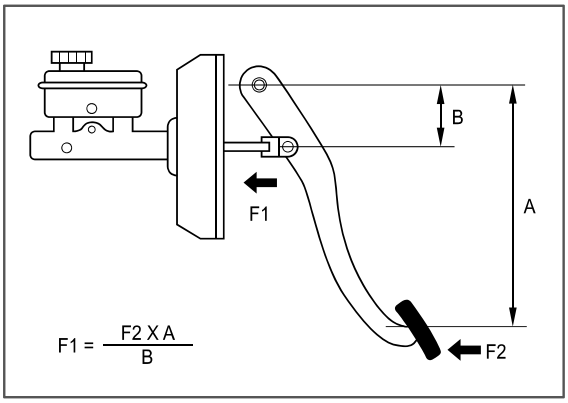
Even though a driver cuts off the power, while driving, the vehicle continues to move due to the law of inertia. Therefore, a braking device is needed to stop the vehicle. The brake system normally uses the frictional discs that converts the kinetic energy to the thermal energy by frictional operation. The brake system consists of the brake disc (front wheel), brake disc or drum (rear wheel), parking brake (mechanical type), master cylinder, booster, pedal and supply lines (pipes and hoses).

▶ Hydraulic brake



This system uses the leverage effect and Pascal's principle. When depressing the brake pedal, the pedal pressure is increased by booster and is delivered to master cylinder to generate hydraulic pressure. The hydraulic pressure generated by the master cylinder is delivered to the brake caliper through the brake pipes or hoses. This hydraulic pressure pushes the brake calipers, accordingly the caliper pads are contacted to brake disc to generate the braking force.

▶ Brake pedal

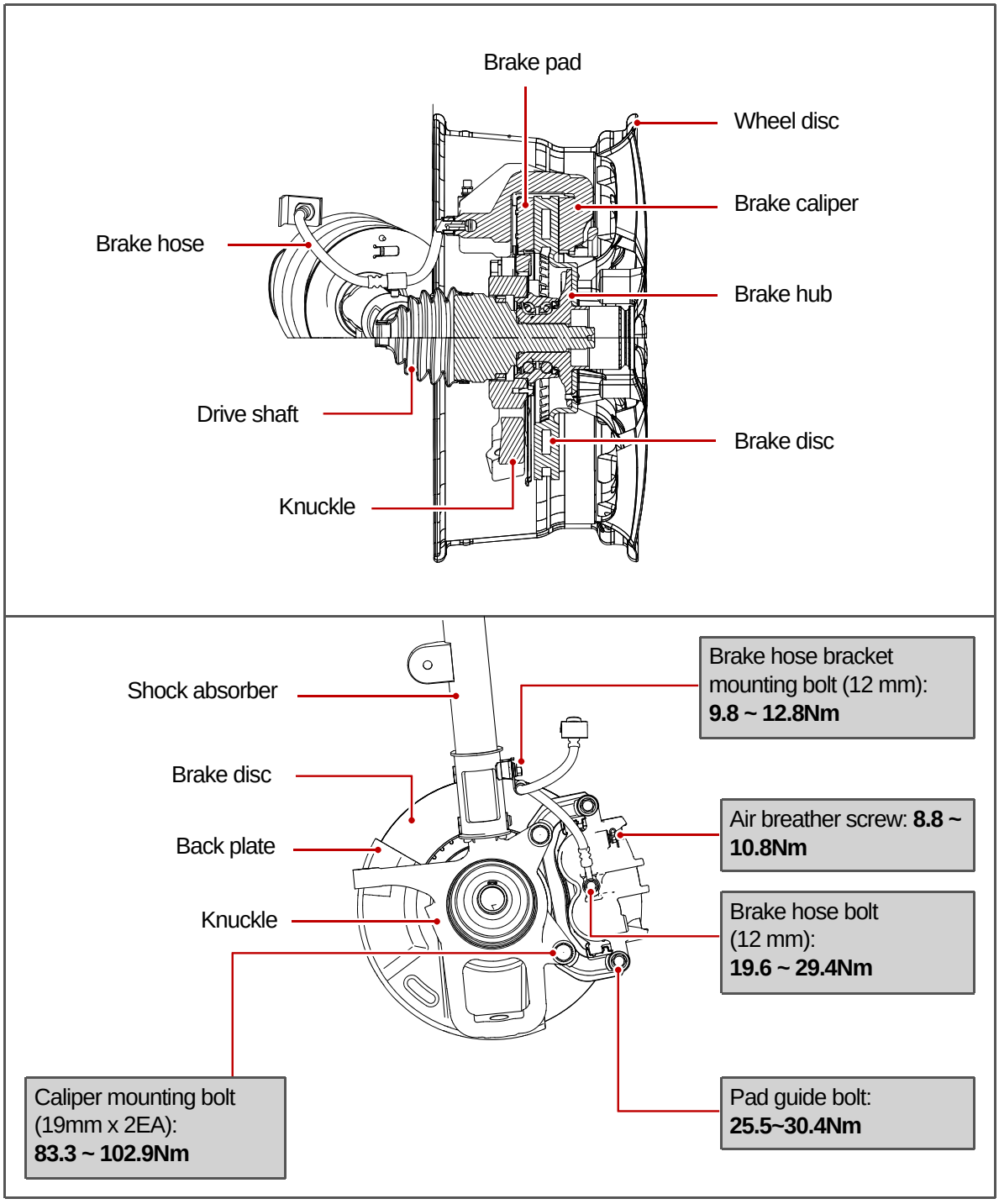


Brake pedal uses the leverage effect to apply bigger force to the brake master cylinder.

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2. SECTIONAL DIAGRAM

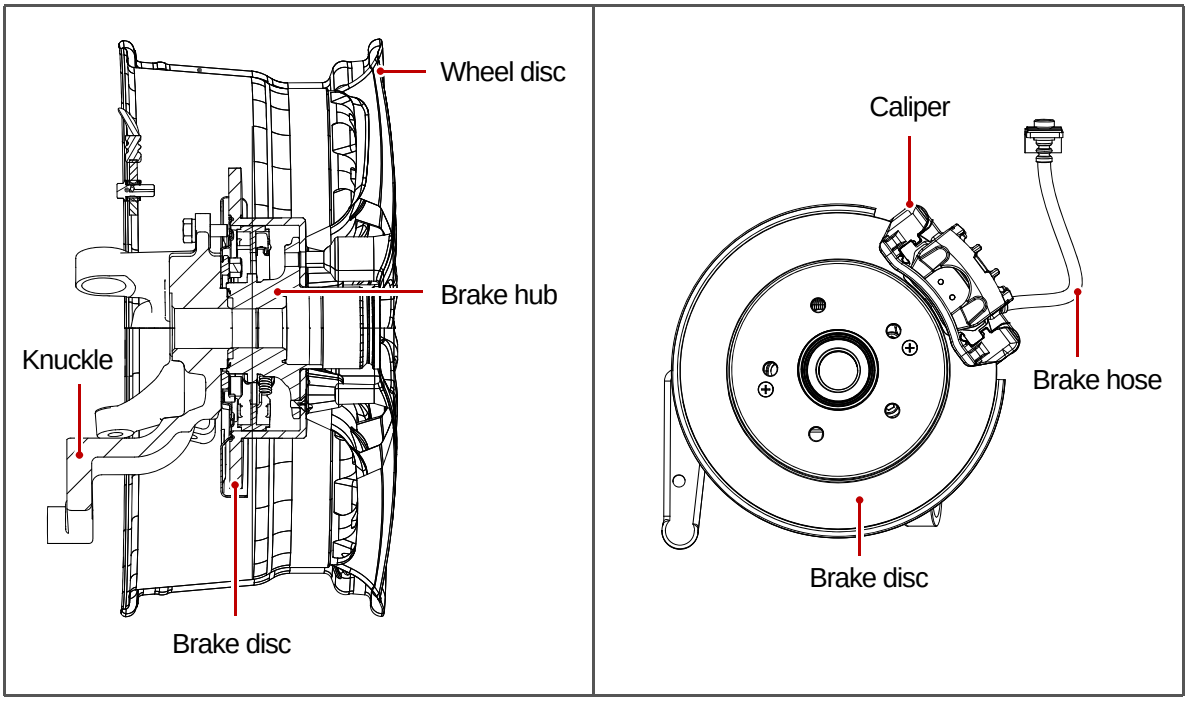
▶ **Front disc brake**



Modification basis	
Application basis	
Affected VIN	

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▶ **Rear disc brake**



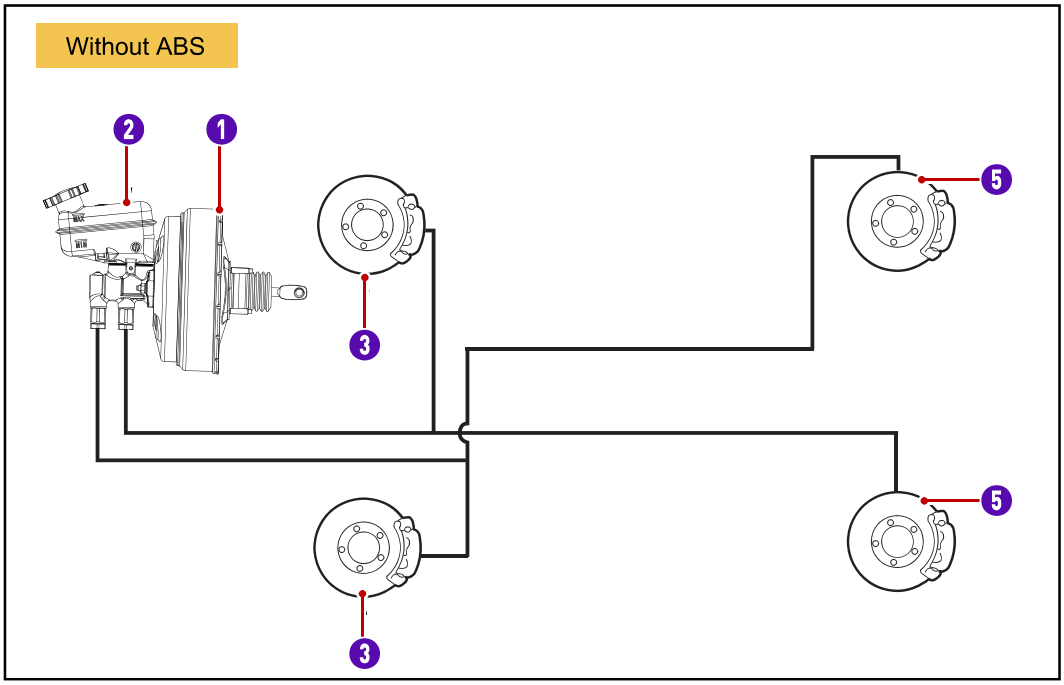
1) Tightening torque

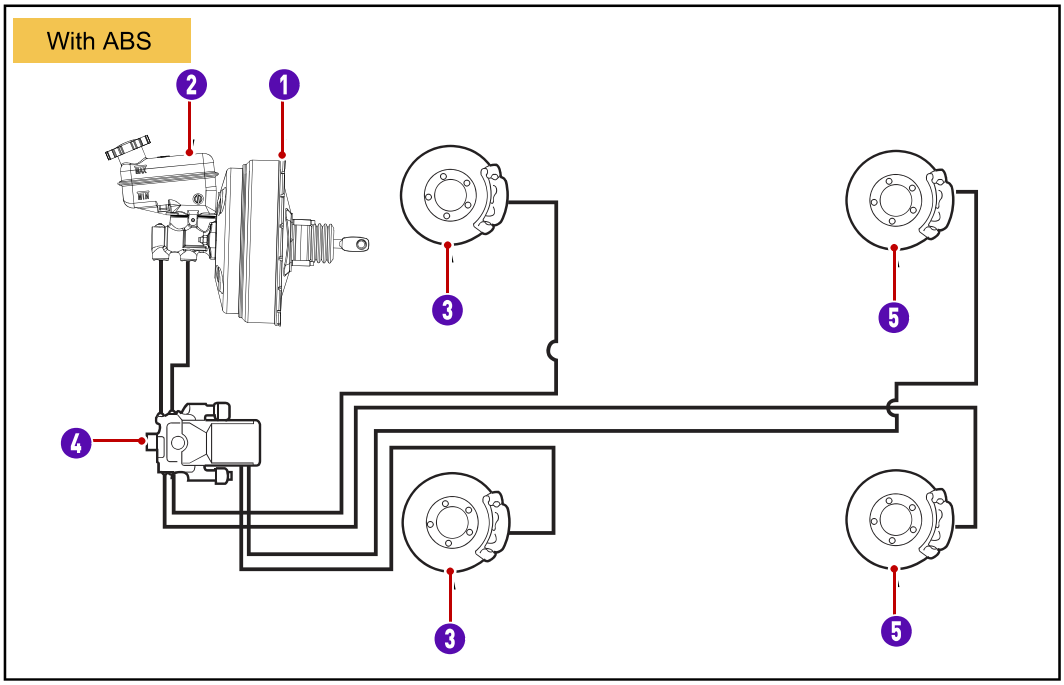
Fastener	Tightening torque	Remark
Brake pad guide bolt	25.5 ~ 30.4Nm	14 mm x 2EA
Brake caliper mounting bolt	52.9 ~ 63.7Nm	17 mm x 2EA
Brake hose bolt	19.6 ~ 29.4Nm	12mm
Brake hose bracket mounting bolt	9.8 ~ 12.8Nm	12mm
Air breather screw	8.8 ~ 10.8Nm	-

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3. SYSTEM LAYOUT

▶ **Hydraulic line**





1. Brake booster
2. Brake reservoir and master cylinder
3. Front disc brake and caliper
4. HECU (Hydraulic & Electric Control Unit)
5. Rear disc brake and caliper

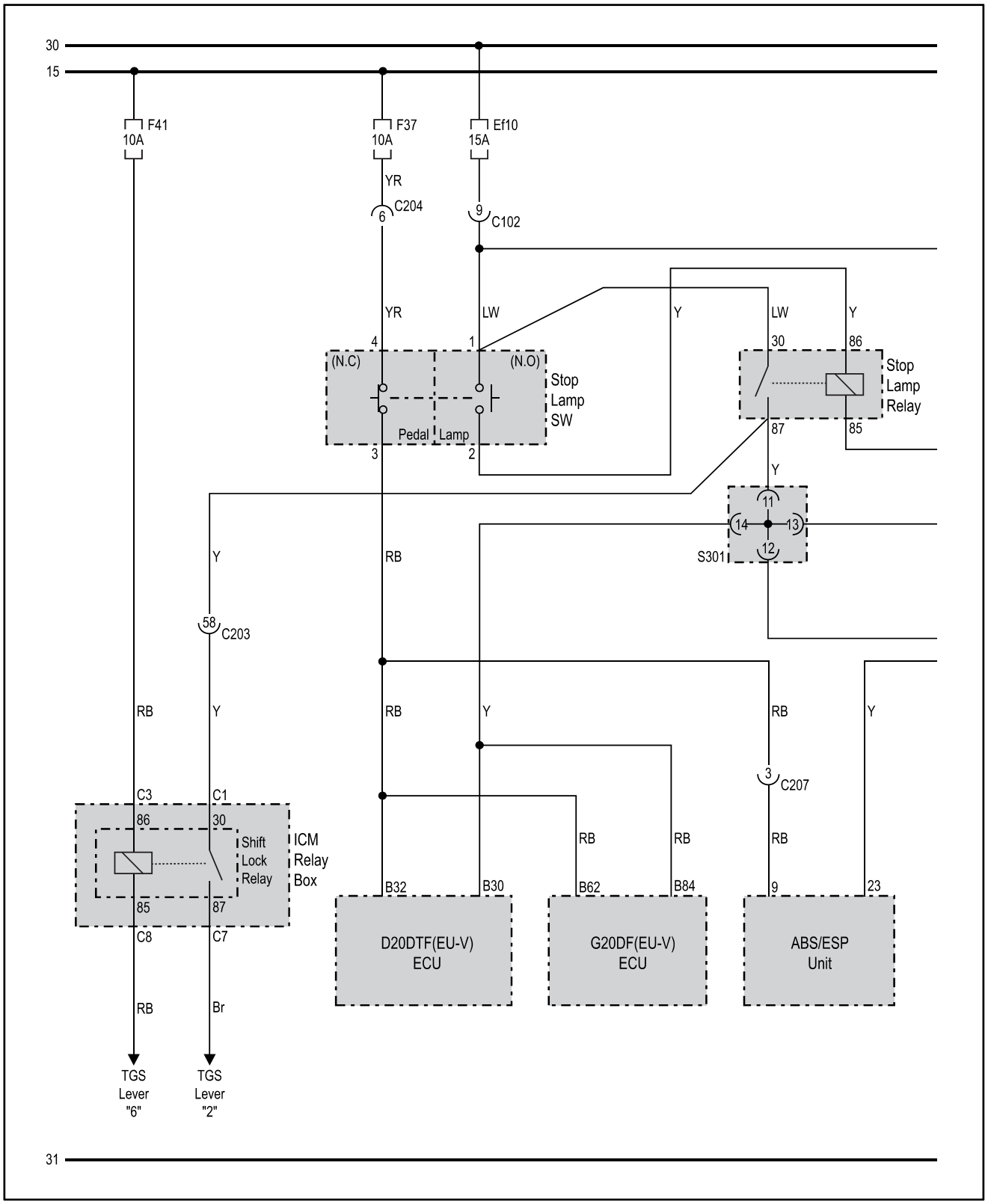
Modification basis	
Application basis	
Affected VIN	

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Memo

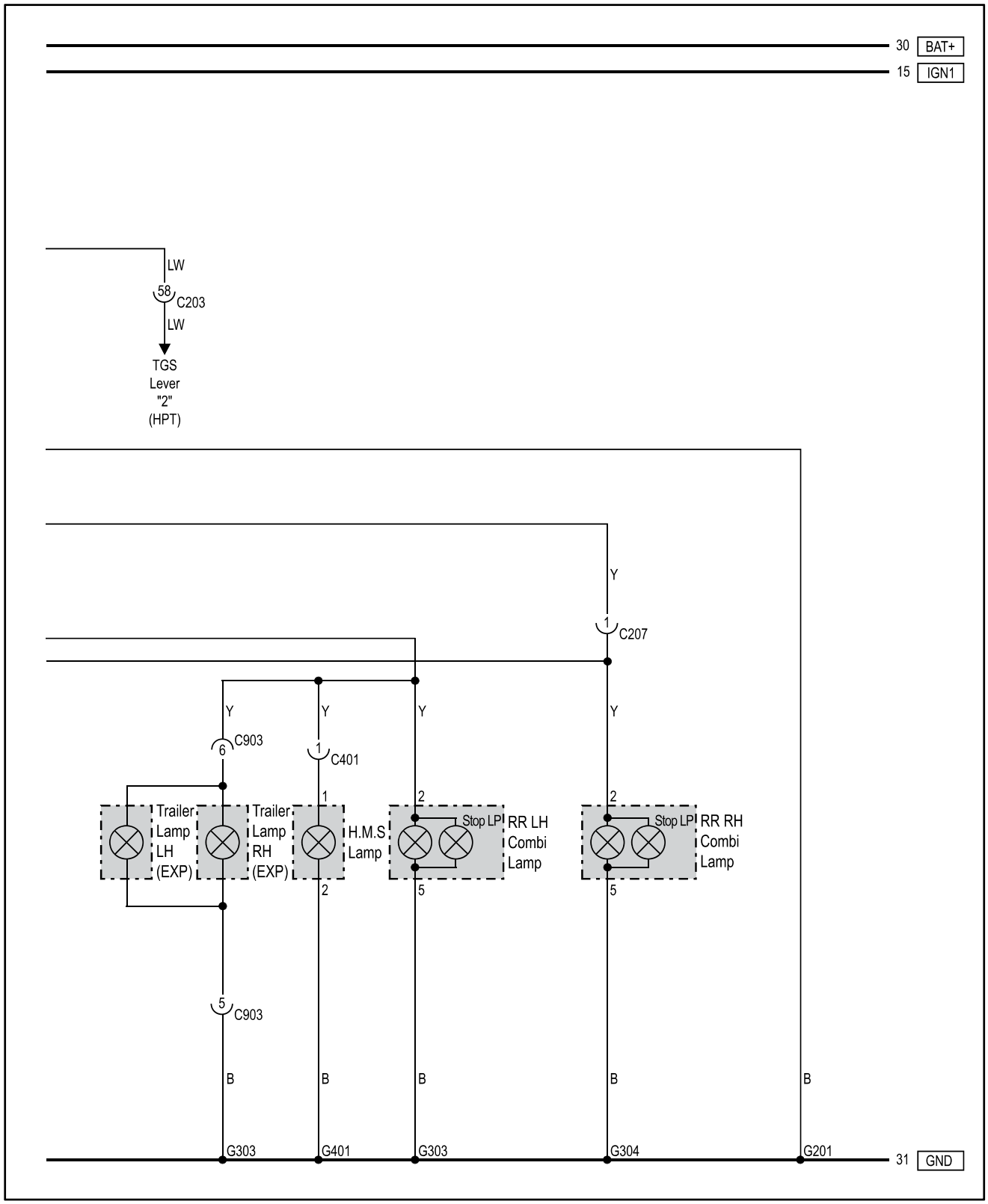
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4. CIRCUIT DIAGRAM OF STOP LAMP



Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
Affected VIN	

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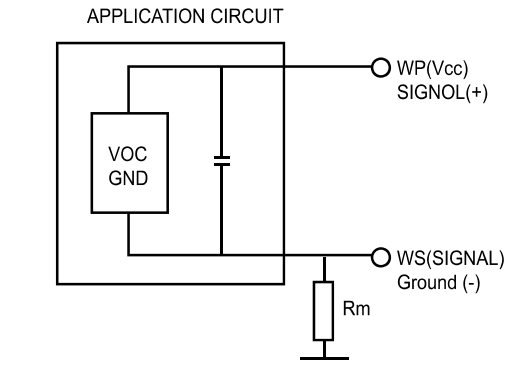
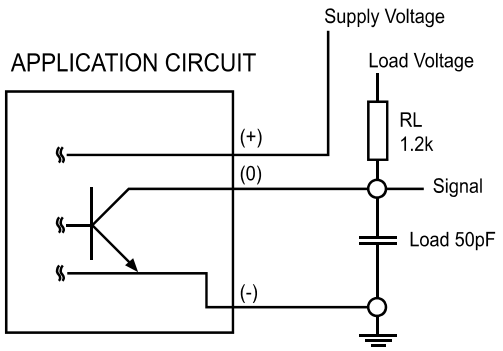
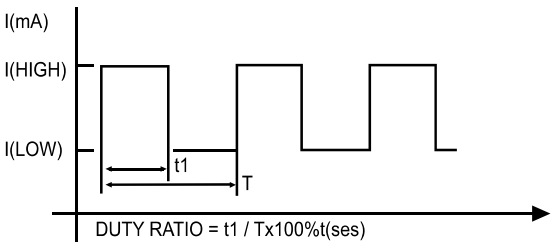
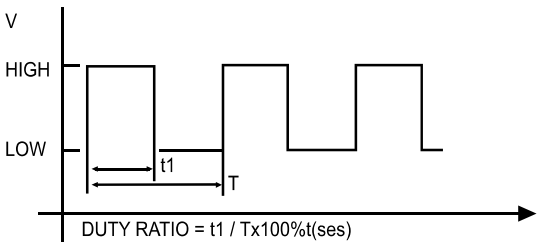
GENERAL INFORMATION

1. SPECIFICATION

Unit	Description	Specification	
		ABS	**ESP**
HECU	Clock frequency	32 MHz	50 MHz
	Memory	128 KB	512 KB
	Switch	Orifice	Orifice
Wheel speed sensor		**ABS / ESP**	**CBS**
	Operating temperature	− 40°C to 150°C	− 40°C to 150°C
		− 40°C to 115°C	− 40°C to 115°C
	Operating frequency	1 to 2,500 Hz	1 to 8,000 Hz
	Operating voltage	4.5 to 16 V	3.3 to 18 V
G-sensor		**ABS**	**CBS / ESP**
	Operating voltage	4.75 to 5.25 V	N/A
	Operating temperature	− 30°C to 85°C	
	Operating range	-1.5 to 1.5 g	
	Output voltage	0.5 to 4.5 V	

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▶ Circuit diagram of wheel speed sensor

ABS / ESP	CBS
	
	

Modification basis	
Application basis	
Affected VIN	

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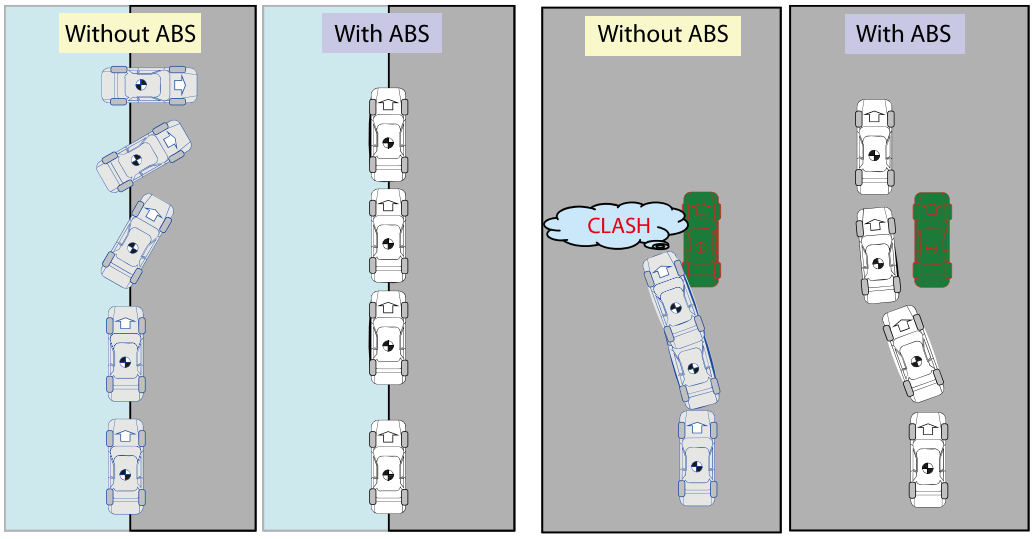
OVERVIEW AND OPERATING PROCESS

1. SYSTEM OVERVIEW

1) What is ABS?

When braking suddenly or braking on slippery roads, the vehicle keeps moving forward but the wheels are locking and not rotating. If these happen, the vehicle may lose stability or rotate resulting in an accident. ABS helps to maintain directional stability and control of the vehicle. ABS is designed to secure more safety and increase the control of steering wheel during emergency braking situation. But, ABS does not guarantee perfect safety beyond its physical limit. ABS in this vehicle contains EBD function. In normal driving conditions, the brake system operates without ABS function.

▶ **ABS effect according to braking conditions**



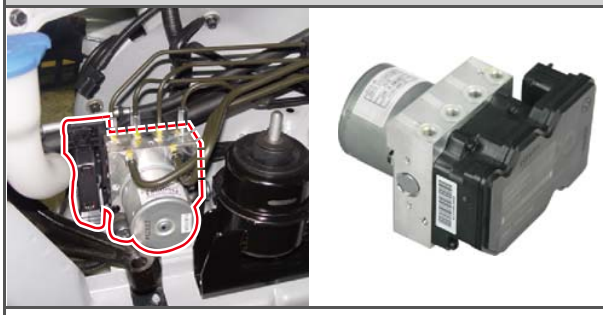
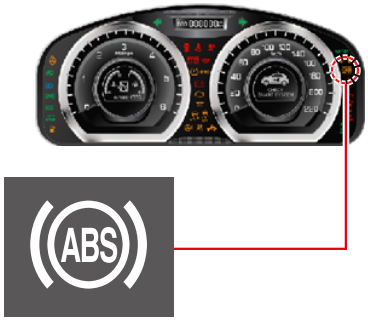
Braking on split road **Maneuvering while braking**

2) What is EBD (Electronic Brake-force Distribution)?

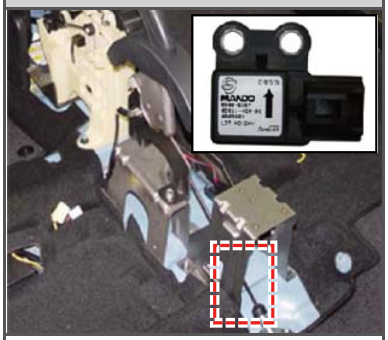
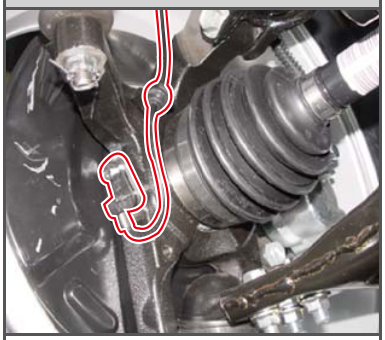
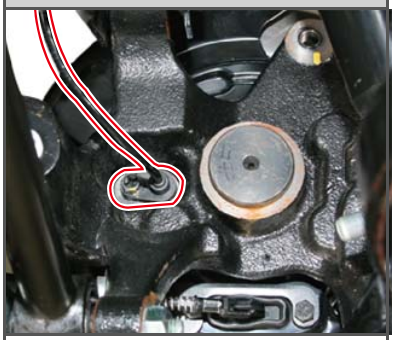
EBD is an automobile brake technology that automatically varies the amount of force applied to each of a vehicle's brakes, based on road conditions, speed, loading, etc. Always coupled with anti-lock braking systems, EBD can apply more or less braking pressure to each wheel in order to maximize stopping power whilst maintaining vehicular control. EBD does not operate when ABS is working.

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2. COMPONENT

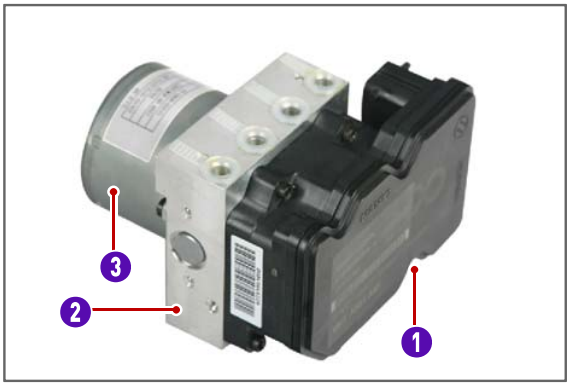
1. ABS hydraulic device and control unit	2. ABS warning lamp
 Located under the power steering fluid reservoir and contains the pressure sensor.	 EBD warning lamp (ABS warning lamp + Brake warning lamp)



3. G-sensor (for 4WD)	4. Wheel speed sensor (for 4WD)	4. Rear wheel speed sensor (for 2WD)
 Located on the floor under parking brake bracket in center console.	 Located on knuckle. The appearance of front sensor is same with rear sensor.	 Located on knuckle. The appearance is different from that for 4WD.

Modification basis	
Application basis	
Affected VIN	

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▶ HECU

1. ECU (Electronic Control Unit)

ECU calculates the wheel speed, acceleration and deceleration with the information from wheel speed sensor, and determines the wheel slip to control the valve and motor.

2. HU (Hydraulic Unit)

The hydraulic circuit contains the primary circuit and secondary circuit for ABS operation. This unit controls the hydraulic pressure to each wheel. If the system needs ABS operation, the valves in the unit operate to control HOLD, RISE and DUMP according to ECU control logic.

3. Motor

The motor is operated when ABS is activated. The cam-shaped output shaft of the motor enables the brake system to receive and supply the brake fluid during the motor operation.

4WD - Front/Rear wheel speed sensor
2WD - Front wheel speed sensor



2WD - Rear wheel speed sensor



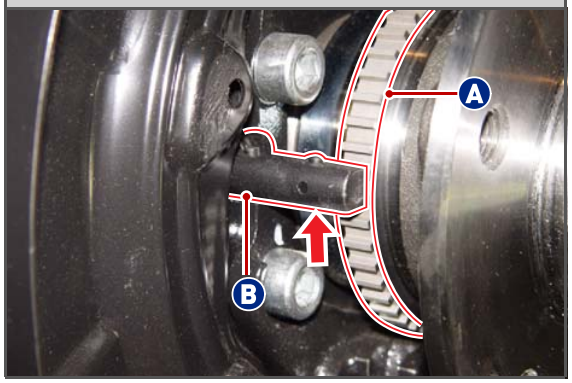
▶ Wheel speed sensor

Wheel speed sensor sends the data detected by tone wheel to HECU.

NOTE

Rear wheel speed sensor in 2WD vehicle is different from that in 4WD vehicle.

Location of rear tone wheel (A) and wheel sensor (B) in 2WD vehicle



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G-sensor



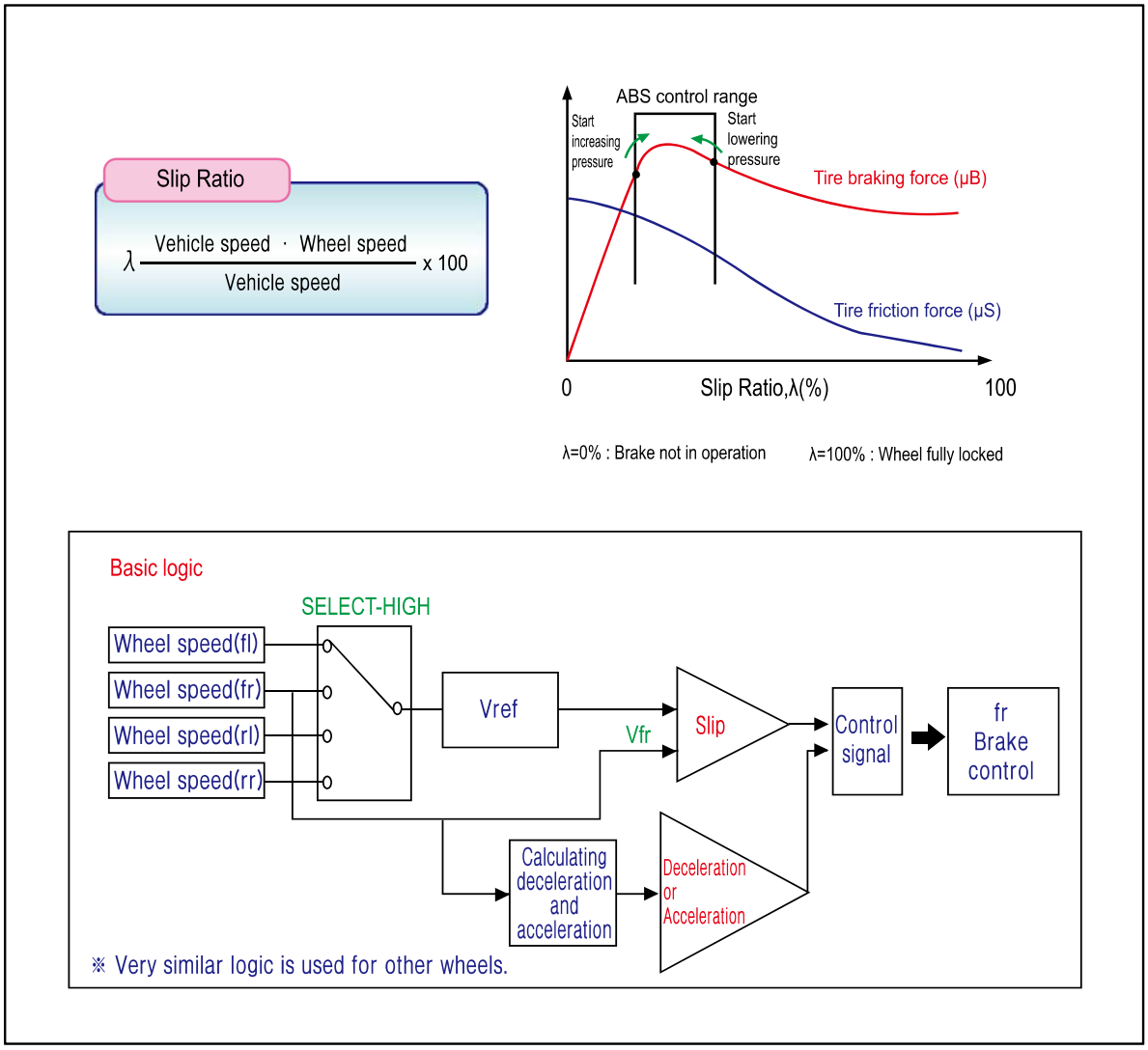
▶ G-sensor (only for 4WD)

For the vehicle with the ABS, a speed difference between the wheels is not noticeable as all the wheels are slipping during abrupt braking. Therefore, the vehicle needs the speed information from other sensors other than the wheel speed sensor. On the 2WD vehicle, there is not large difference between the vehicle speed reduction and actual wheel speed reduction in the event of braking since the driving wheels are in the front. So, the ABS HECU can control the vehicle, based on a calculation value. But, on the 4WD vehicle, if a speed reduction occurs in the front or rear of the vehicle, it affects the other side wheel. In other words, braking the rear wheels induces also a large speed reduction in the front wheels. The longitudinal acceleration sensor is used for this case. It controls the ABS by using the signals from the sensor during abrupt braking and acceleration.

Modification basis	
Application basis	
Affected VIN	

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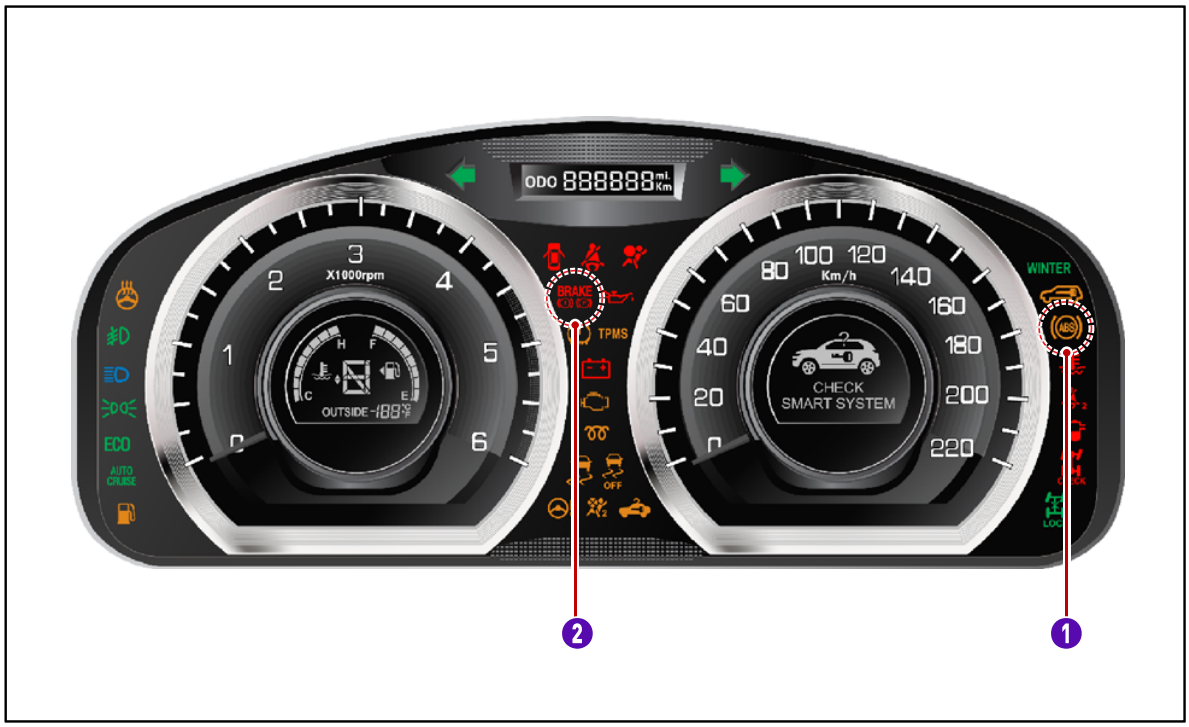
3. ABS CONTROL LOGIC



The principal ABS control logic is the determination of the reference speed by choosing one wheel meeting a certain condition, while sensing the speed information from 4 wheel speed sensors when the vehicle is being driven.
For example, when the comparison of the reference speed with front right wheel speed shows a slip, the control signal is determined according to whether it's deceleration or acceleration. If the control conditions are met, the brake for the front right wheel will be got under control.

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4. WARNING LAMPS



1. ABS warning lamp
2. Brake warning lamp
   (EBD warning lamp: ABS warning lamp + Brake warning lamp)

1) ABS Warning Lamp

ABS warning lamp module indicates the self diagnosis and malfunction.
ABS warning lamp ON:

1. When turning the ignition switch to ON position, ABS warning lamp comes on for 3 seconds for self-diagnosis and goes off if the system is OK (initialization mode).
2. When the system is defective, the warning lamp comes on.
3. When the self-diagnosis is performing, the warning lamp comes on.
4. When the HECU connector is disconnected, the warning lamp comes on.
5. ABS is not available during lamp ON. In this condition, Only normal brake system without ABS function is available.
6. When the communication between warning lamp CAN module in meter cluster, the warning lamp comes on.

Modification basis	
Application basis	
Affected VIN	

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2) EBD (Electronic Brake-force Distribution) Warning Lamp (Brake Warning Lamp)

EBD warning lamp when the system performs the self diagnosis and when it detects the malfunction of EBD system. However, the brake warning lamp comes on regardless of EBD when the parking brake is applied.

EBD warning lamp ON:

1. When turning the ignition switch to ON position, ABS warning lamp and the brake warning lamp comes on for 3 seconds for self diagnosis and goes off if the system is OK (initialization mode). When applying the parking brake, the brake warning lamp comes on.
2. When the brake fluid is not sufficient, the brake warning lamp comes on.
3. When the self-diagnosis is performing, the warning lamp comes on.
4. When the HECU connector is disconnected, the warning lamp comes on.
5. When the system is defective, ABS warning lamp and the brake warning lamp come on
6. simultaneously.

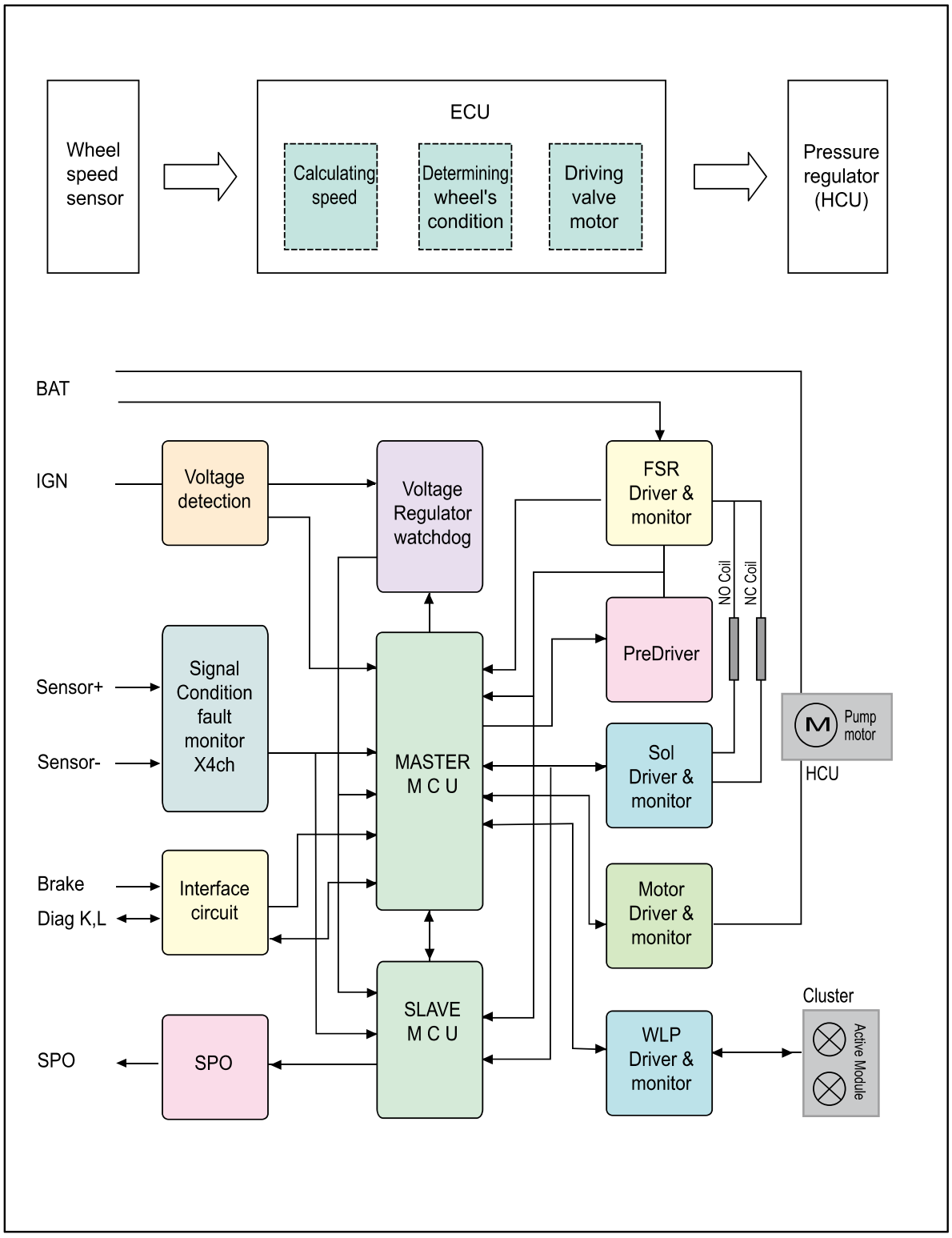
    a. When the solenoid valve is defective
    b. When one or more wheel sensors are defective
    c. When ABS HECU is defective
    d. When the voltage is abnormal
    e. When valve relay is defective

7. When the communication between warning lamp CAN module in meter cluster, the warning lamp comes on.

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5. SYSTEM OPERATION

1) Block Diagram of ABS HECU



Modification basis	
Application basis	
Affected VIN	

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2) Basic Theory of ABS Function

To give you a better understanding of the tasks and functions of ABS, we will first look at the physics principles.

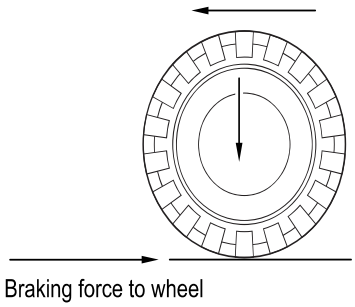
(1) Stopping distance

The stopping distance depends on the vehicle weight and initial speed when braking starts. This also applies for vehicle with ABS, where ABS always tries to set an optimum brake force on each wheel. As great forces are exerted between the tires and the carriageway when braking, even with ABS the wheels may scream and rubber is left on the road. With an ABS skid mark one may be able to clearly recognize the tire profile. The skid mark of an ABS vehicle does not however leave any hint of the speed of the vehicle in the case of an accident, as it can only be clearly drawn at the start of braking.

(2) Brake force on a wheel

The maximum possible brake force on a wheel depends on the wheel load and the adhesion coefficient between tire and carriageway. With a low adhesion coefficient the brake force, which can be obtained is very low. You are bound to know the result already from driving on winter roads. With a high adhesion coefficient on a dry road, the brake force, which can be obtained, is considerably higher. The brake force, which can be obtained, can be calculated from below formula:

▶ **Maximum brake force**



Braking force to wheel

FBmax = wheel load FR x coefficient of frictionMh

The braking process cannot be described sufficiently accurately with the brake forces calculated. The values calculated only apply if the wheel is not locked. In the case of a locking wheel, the static friction turns into lower sliding friction, with the result that the stopping distance is increased. This loss of friction is termed "slip" in specialist literature.

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▶ Slip

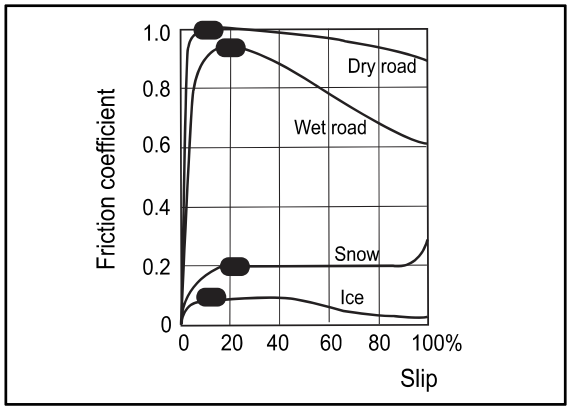
The brake slip is the difference between the vehicle speed and the wheel circumference speed. If the wheel locks, the slip is greatest, that is 100 %. If the wheel is running freely and un-braked, the slip is the lowest, equal to 0 %. Slip can be calculated from the vehicle speed Vveh and the wheel speed Vw. The equation for this is:

Vveh = 100 km/h, Vw = 70 km/h

$$\text{Slip ratio (S)} = \frac{\text{Vveh - Vw}}{\text{Vveh}} \text{ X } 100\%$$

S = 30%

▶ Typical Slip Curves

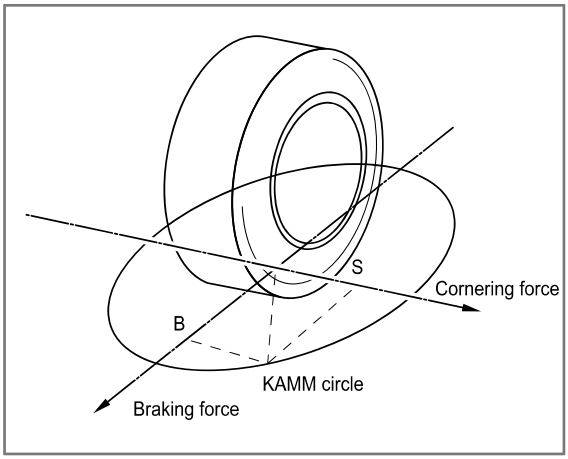


For the various road conditions, the friction coefficients were plotted. The typical course of the curves is always the same. The only special feature is shown by the curve for freshly fallen snow, for this curve increases at 100 % slip. In a vehicle without ABS, the wheel locks on braking and therefore pushes a wedge before it. This wedge of loose surface or freshly fallen snow means and increased resistance and as a result the stopping distance is shorter. This reduction in stopping distance is not possible with a vehicle with ABS, as the wheel does not lock. On these surfaces the stopping distance with ABS is longer than without ABS. The reason for this is based in physics and not in the Anti-Lock System.
However, as mentioned before, ABS is not about the stopping distance, but maneuverability and driving stability, for the vehicle with locking wheels without ABS cannot be steered.

Modification basis	
Application basis	
Affected VIN	

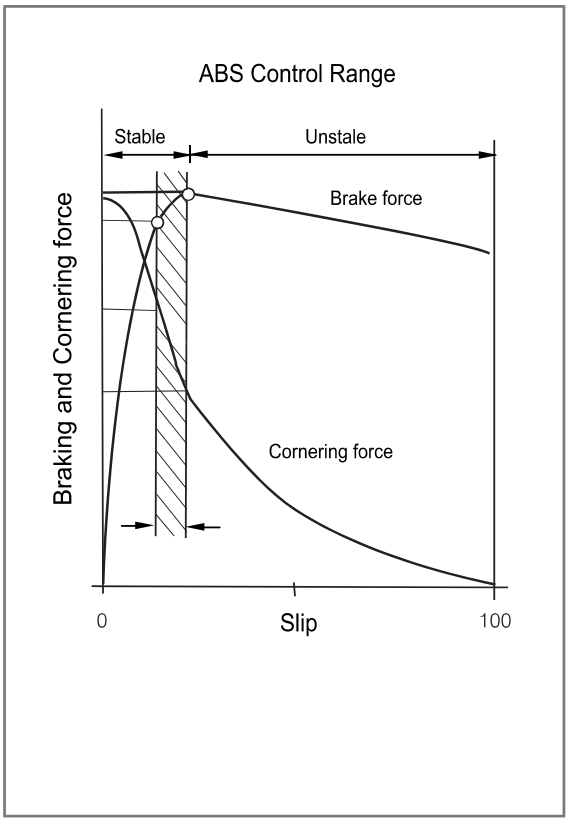
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▶ KAMM circle



Before we go into the Kamm circle, you should know that a tire offers a maximum of 100 % transmissibility. It is all the same for the tire whether we require 100 % in the direction of braking or in the direction of the acting lateral force, e.g. when driving round curves. If we drive into a curve too fast and the tire requires 100 % transmissibility as cornering force, the tire cannot transmit any additional brake force. In spite of the ABS the car is carried out of the curve. The relationship between brake force B and cornering force S is shown very clearly in the Kamm circle. If we put a vehicle wheel in this circle, the relationship becomes even clearer. In this relationship: as long as the acting forces and the resulting force remain within the circle, the vehicle is stable to drive. If a force exceeds the circle, the vehicle leaves the road.

▶ Brake and cornering force

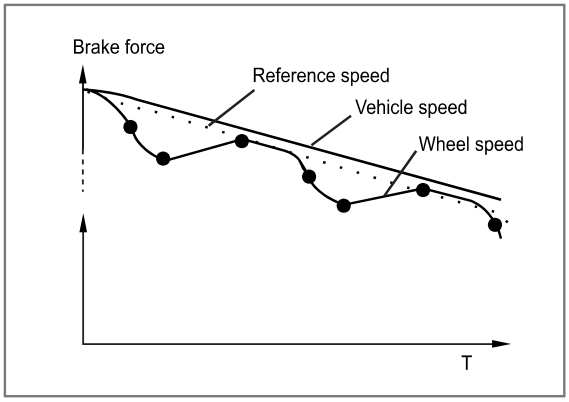


- Brake force
  When depressing the brake pedal the brake force increases to the maximum, then the brake force decreases until the wheel locks.
- Cornering force
  The cornering force is a maximum when the wheel is turning freely with zero slip. When braking the cornering force falls to zero if the wheel locks (slip 100 %).
- ABS operating range
  The operating range starts just before the maximum brake force and ends in maximum, for the unstable range then begins, in which no further modulation is possible. The ABS controls the regulation of the brake pressure so that the brake force only becomes great enough for a sufficient proportion of cornering force to remain. With ABS we remain in the Kamm circle as long as the car is driving sensibly. We will leave driving physics with these statements and turn to the braking systems with and without ABS.

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3) Basic ABS Control

▶ Operation of ABS control unit



Applications of the ABS control unit The signals produced by the wheel sensors are evaluated in the electronic control unit. From the information received, the control unit must first compute the following variables:

- Wheel speed
- Reference speed
- Deceleration
- Slip

▶ Reference speed

The reference speed is the mean, I.e. average speed of all wheel speeds determined by simple approximation.

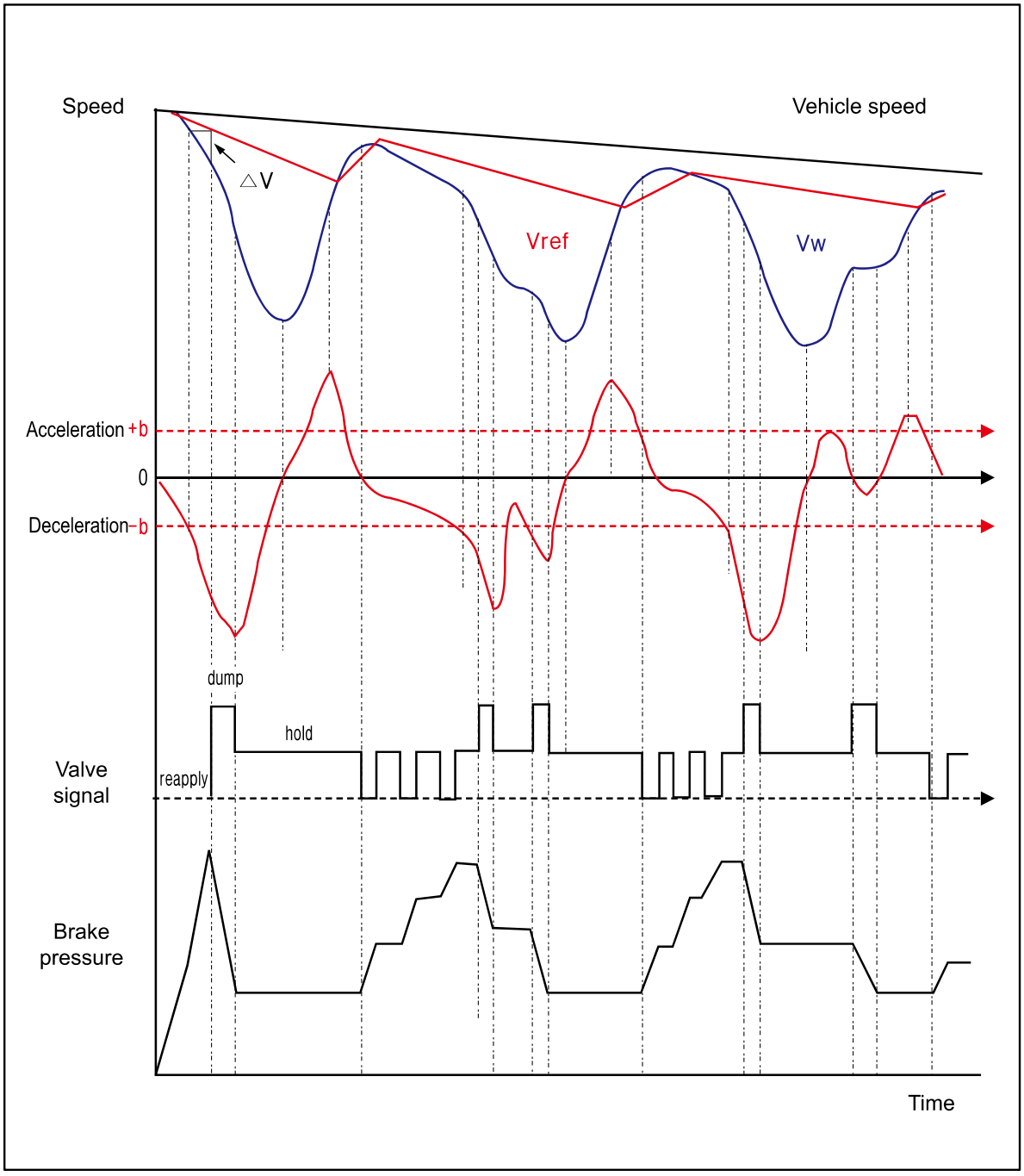
▶ Simplified ABS control

If, during braking, one wheel speed deviates from the reference speed, the ABS control unit attempts to correct that wheel speed by modulating the brake pressure until it again matches the reference speed. When all four wheels tend to lock, all four wheels speeds suddenly deviate from the previously determined reference speed. In that case, the control cycle is initiated again in order to again correct the wheel speed by modulating the brake pressure.

Modification basis	
Application basis	
Affected VIN	

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4) ABS Control Pattern



The ABS control is performed by comparing the reference speed with each wheel speed. Firstly, it is determined whether the vehicle is in the deceleration or acceleration state using the wheel speed change ratio. Then, a signal is transmitted to the valve.
Finally, the brake pressure is adjusted via the signal.

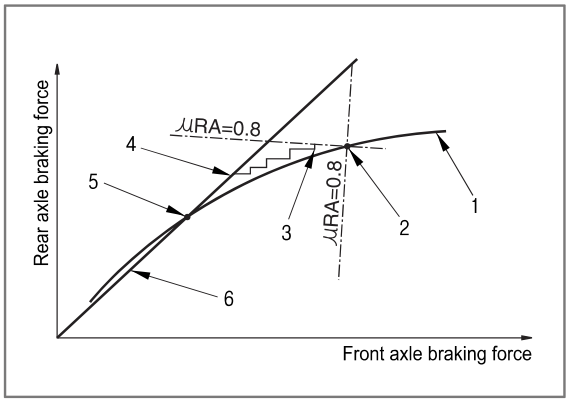
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5) EBD (Electronic Brake Force Distribution) System

▶ System description

As an add-on logic to the ABS base algorithm, EBD works in a range in which the intervention thresholds for ABS control are not reached yet.
EBD ensures that the rear wheels are sensitively monitored for slip with respect to the front axle. If slip is detected, the inlet valves for the rear wheels are switched to pressure hold to prevent a further increase in pressure at the rear-wheel breaks, thus electronically reproducing
a pressure-reduction function at the rear-wheel brakes.
ABS features an enhanced algorithm which includes control of the brake force distribution between the front and rear axles. This is called Electronic Brake Distribution. In an unloading car condition the brake efficiency is comparable to the conventional system but for a fully loaded vehicle the efficiency of the EBD system is higher due to the better use of rear axle braking capability.

▶ Advantages



- Elimination of conventional proportioning valve
  EBD utilizes the existing rear axle wheel speed sensor to monitor rear wheel slip.
  Based on many variables in algorithm a
- pressure hold, increase and/or decrease pulsetrain may be triggered at the rear wheels insuring vehicle stability.
  Vehicle approaches the ideal brake force
- distribution (front to rear).
  Constant brake force distribution during vehicle
- lifetime.
  EBD function is monitored via ABS safety logic
- (conventional proportioning valves are not monitorable).

Modification basis	
Application basis	
Affected VIN	

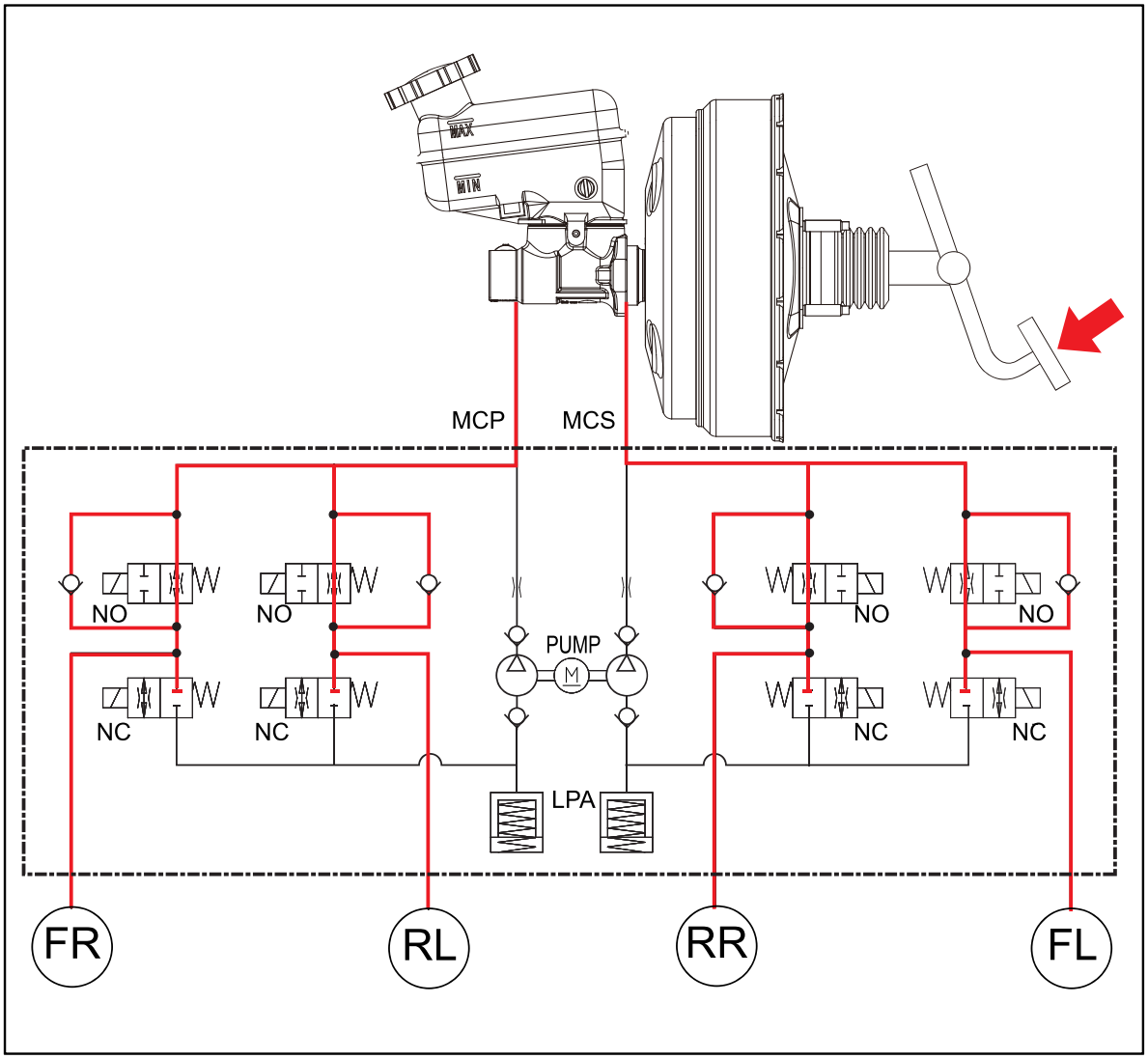
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6. HYDRAULIC CIRCUIT OF ABS

1) Normal Brake Operation (ABS is not working) Mode

If the driver depress the brake pedal so that the ABS does not operate, 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.

Solenoid valve	Valve Open/Close	Pump motor
Inlet valve - Normal open (NO) valve	Open	OFF
Outlet valve - Normal close (NC) valve	Close	

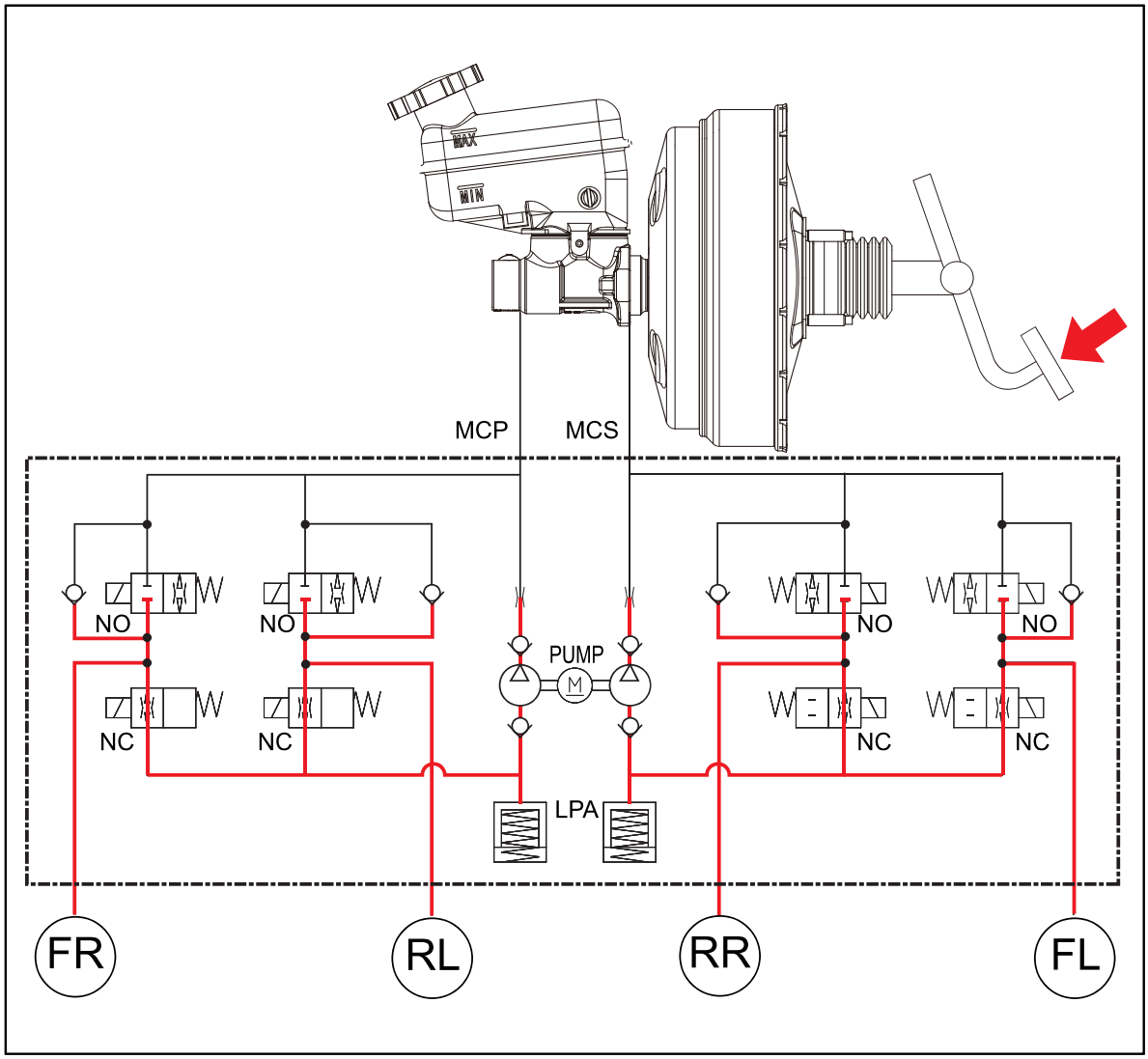


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2) DUMP (ABS is working) Mode

Even when the hydraulic pressure on each circuit is constant, the wheel can be locked as the wheel speed decreases. This is when the ABS HECU detects the wheel speed and the vehicle speed and gives the optimized braking without locking the wheels. In order to prevent the hydraulic pressure from increasing, the inlet valve will be closed, the outlet valve will be opened and the oil will flow into the low pressure chamber. In addition, the ABS HECU 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.

Solenoid valve	Valve Open/Close	Pump motor
Inlet valve - Normal open (NO) valve	Close	ON
Outlet valve - Normal close (NC) valve	Open	



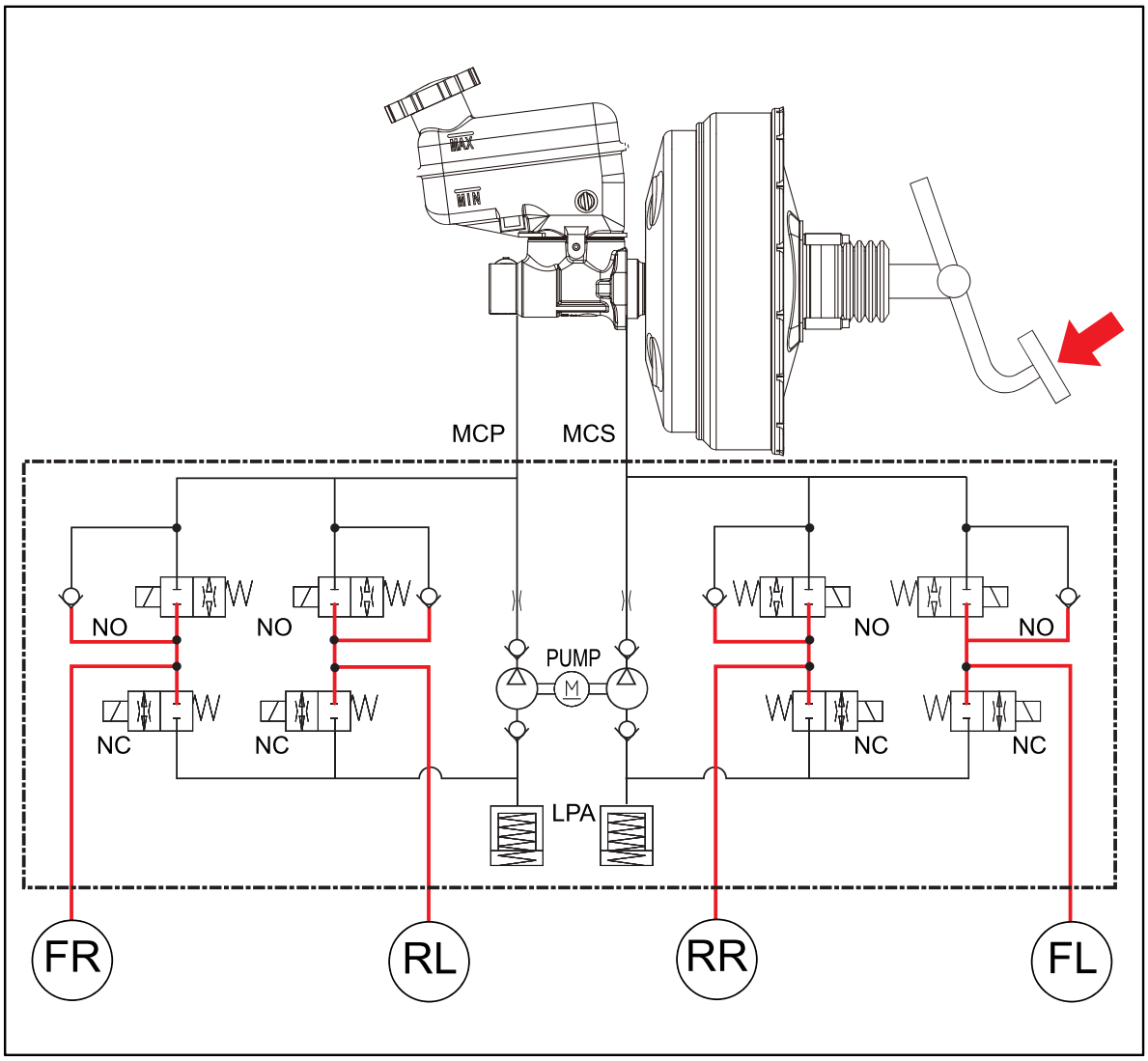
Modification basis	
Application basis	
Affected VIN	

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3) HOLD (ABS is working) Mode

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 stop increasing the hydraulic pressure by closing the inlet valve. At this moment, the outlet valve is closed. This procedure helps the wheel to maintain a constant hydraulic pressure.

Solenoid valve	Valve Open/Close	Pump motor
Inlet valve - Normal open (NO) valve	Close	OFF
Outlet valve - Normal close (NC) valve	Close	

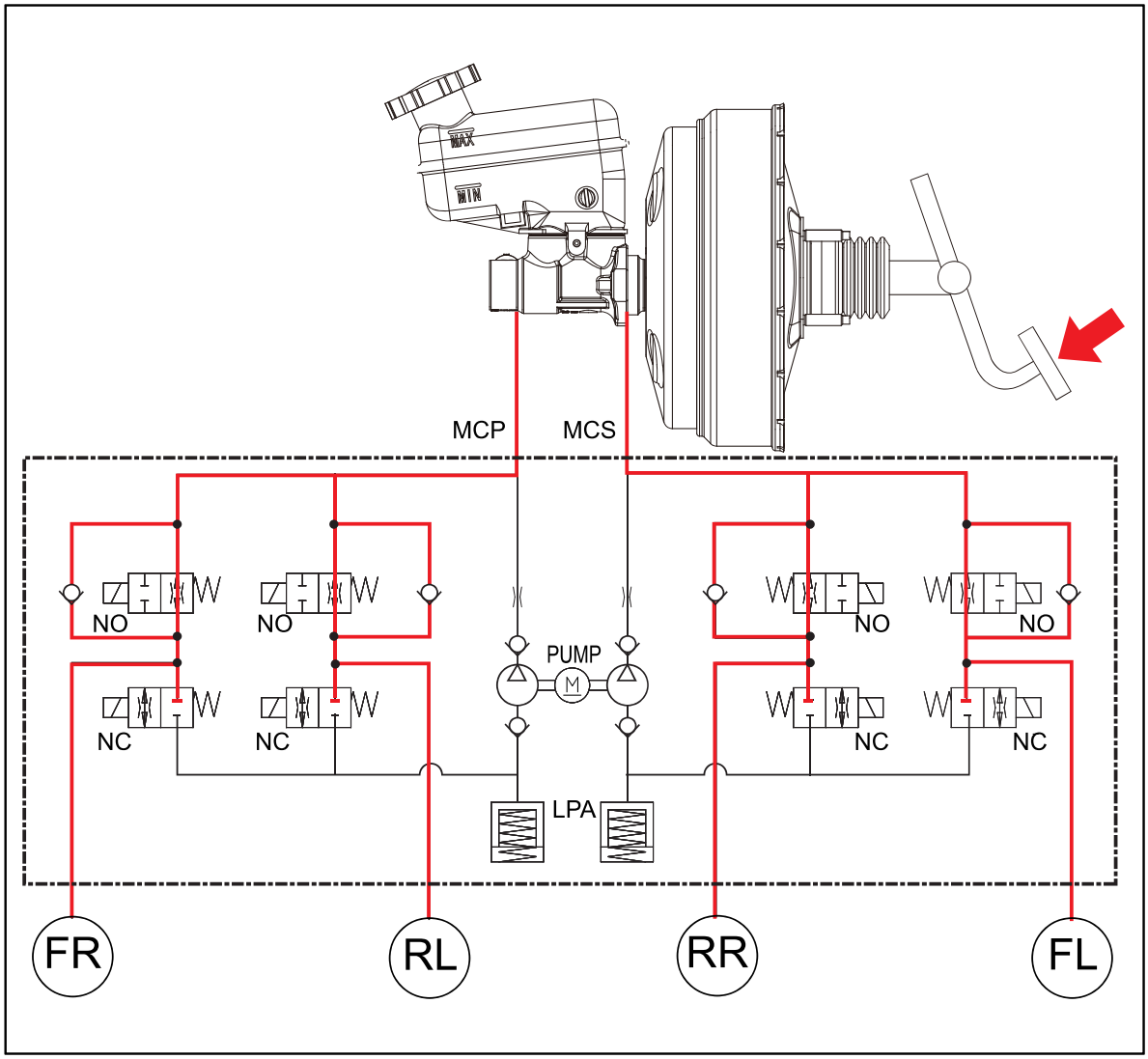


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4) RISE (ABS is working) Mode

As the wheel speed increases, the inlet valve opens and the wheel's pressure increases due to the master cylinder pressure. In addition, the pump circulates the oil in the low pressure chamber to the wheel. As the hydraulic pressure to the wheel increases, the wheel speed will reduce. This operation continues repetitively until there are no signs that the ABS HECU tends to lock the wheels. Since the ABS hydraulic pressure control process takes place repeatedly for a short time, there may be some vibration and noises at the brake pedal.

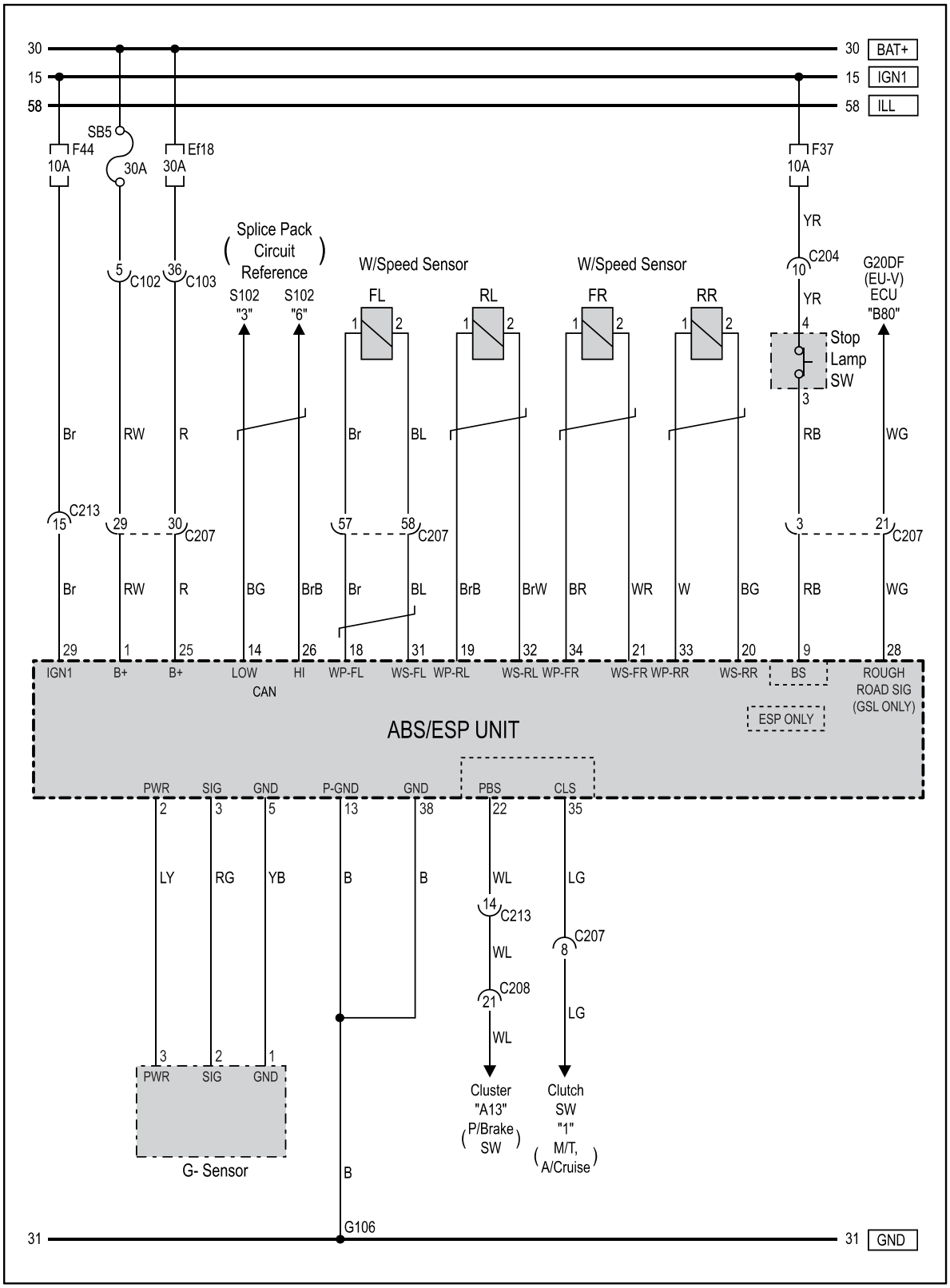
Solenoid valve	Valve Open/Close	Pump motor
Inlet valve - Normal open (NO) valve	Open	ON
Outlet valve - Normal close (NC) valve	Close	



Modification basis	
Application basis	
Affected VIN	

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7. CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

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GENERAL INFORMATION

1. SPECIFICATION

Unit	Description	
	ABS	ESP
HECU	Clock frequency: 32 MHz	Clock frequency: 50 MHz
	Memory: 128 KB	Memory: 512 KB
	Switch orifice	Switch orifice
Wheel speed sensor	Active type	Active type
Steering wheel angle sensor	None	Max. detection angle speed: 1500 °/Sec
		Operating voltage: 9 to 12 V
Sensor cluster	None	Yaw rate sensor + lateral G sensor + longitudinal G sensor (4WD)
Longitudinal G sensor	4WD only	None
Pressure sensor	None	HECU integrated

1) Specification of Active Wheel Sensor

Description	Specification
Supplying voltage	DC 12 V
Output current (at 2.75 km/h of vehicle speed)	7 mA (Lo) ~ 14 mA (Hi) +20%/-16%
Tightening torque	Front: 7.8 to 11.8 Nm
	Rear: 7.8 to 11.8 Nm
Operating temperature	−40 ~ 150 ℃
Operating frequency	1 ~ 2,500 Hz

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2) Specification of Steering Wheel Angle Sensor

Description	Specification
Operating voltage	9 to 16 V
Maximum output current	10 mA
Maximum detection angle speed	±100°/Sec
Operating temperature	−30 to 75 ℃
Supplying voltage	9 to 16 V (battery voltage)
Output voltage (HI)	approx. 3.50 V (3.0 to 4.1 V)
Output voltage (LO)	approx. 1.50 V (1.3 to 2.0 V)
Pulses/rev	45 pulses/rev

3) Specification of Sensor Cluster

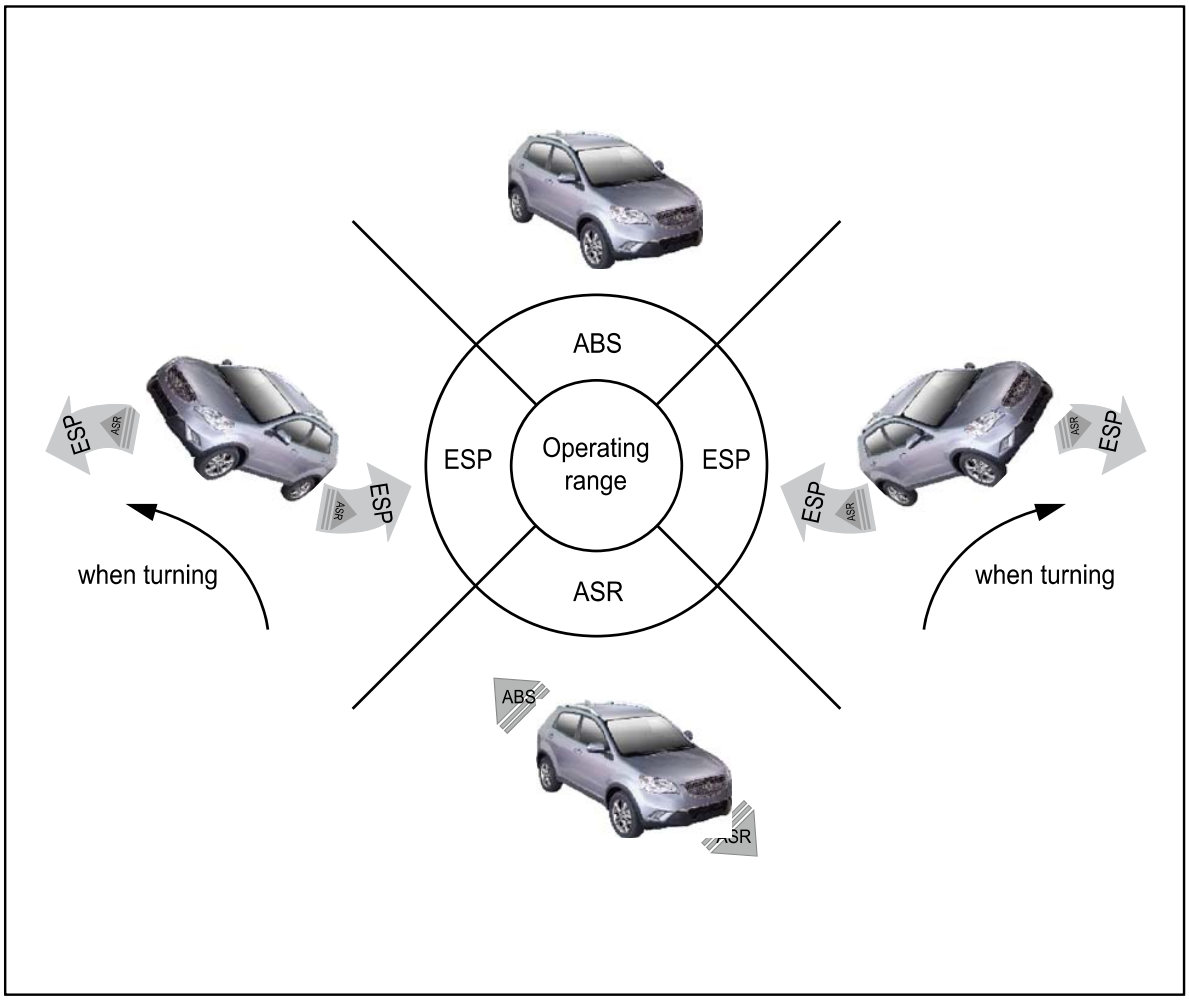
Description	Specification	
Supplying voltage	approx. 12 V (8 to 16 V)	
Current consumption	below 250 mA	-
Operating range	Yaw rate sensor	± 75 °/Sec
	Lateral/longitudinal sensor	± 14.7m/Sec²

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OVERVIEW AND OPERATING PROCESS

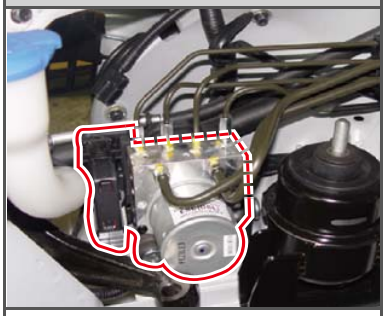
1. OVERVIEW

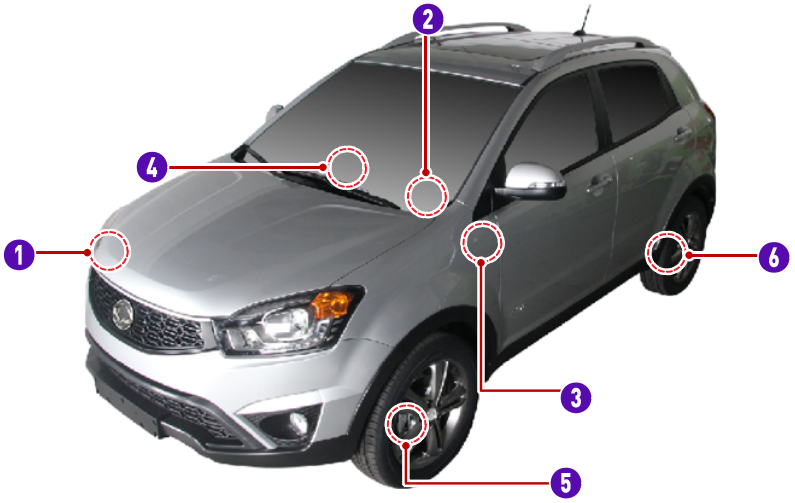
The ESP (Electronic Stability Program) has been developed to help a driver avoid danger of losing control of the vehicle stability due to understeer or oversteer during cornering. The yaw rate sensor, lateral sensor and longitudinal sensor in the sensor cluster and the steering wheel angle sensor under the steering column detect the vehicle conditions when the inner or outer wheels are spinning during oversteer, understeer or cornering. The ESP ECU controls against oversteer or understeer during cornering by controlling the vehicle stability using input values from these sensors and applying the braking force to the corresponding wheels independently. The system also controls the engine power right before the wheel spin synchronized to decelerate the vehicle automatically in order to maintain the vehicle stable during cornering.

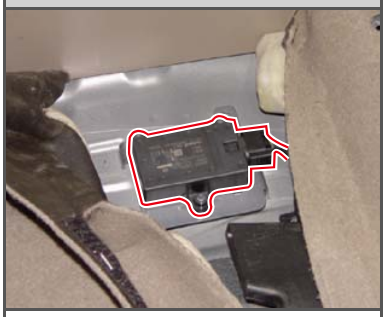
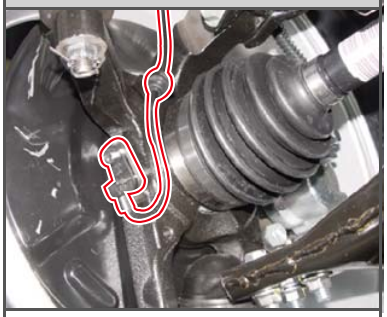


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2. COMPONENTS

1. HECU assembly	2. Steering wheel angle sensor	3. ESP OFF switch
		
Located under the power steering fluid reservoir and contains the pressure sensor.	Located on column shaft with contact coil.	Located on the left side of instrument panel.



4. Sensor cluster	5. Wheel speed sensor (4WD/2WD-front)	6. Rear wheel speed sensor (2WD)
		
Located on the floor under front passenger seat.	Located on knuckle. the appearance of front sensor is same with rear sensor.	Located on knuckle. The appearance is different from that for 4WD.

Modification basis	
Application basis	
Affected VIN	

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3. PRECAUTIONS

CAUTION

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 second. The ESP system is only a supplementary device for comfortable driving. When the vehicle exceeds its physical limits, it cannot be controlled.
Do not rely on the system. Keep on the safe driving.

Feeling when ESP is working

When the ESP system activates, the feeling can be different depending on vehicle driving conditions. For example, you will feel differently when the ESP system is activated during the ABS is operating with the brakes applied and when the brakes are not applied on a curve.
If the ESP system operates when the brake is applied, the brake pressure will be increased on the corresponding wheel which already has braking pressure for the ESP controls.

ARP Operation

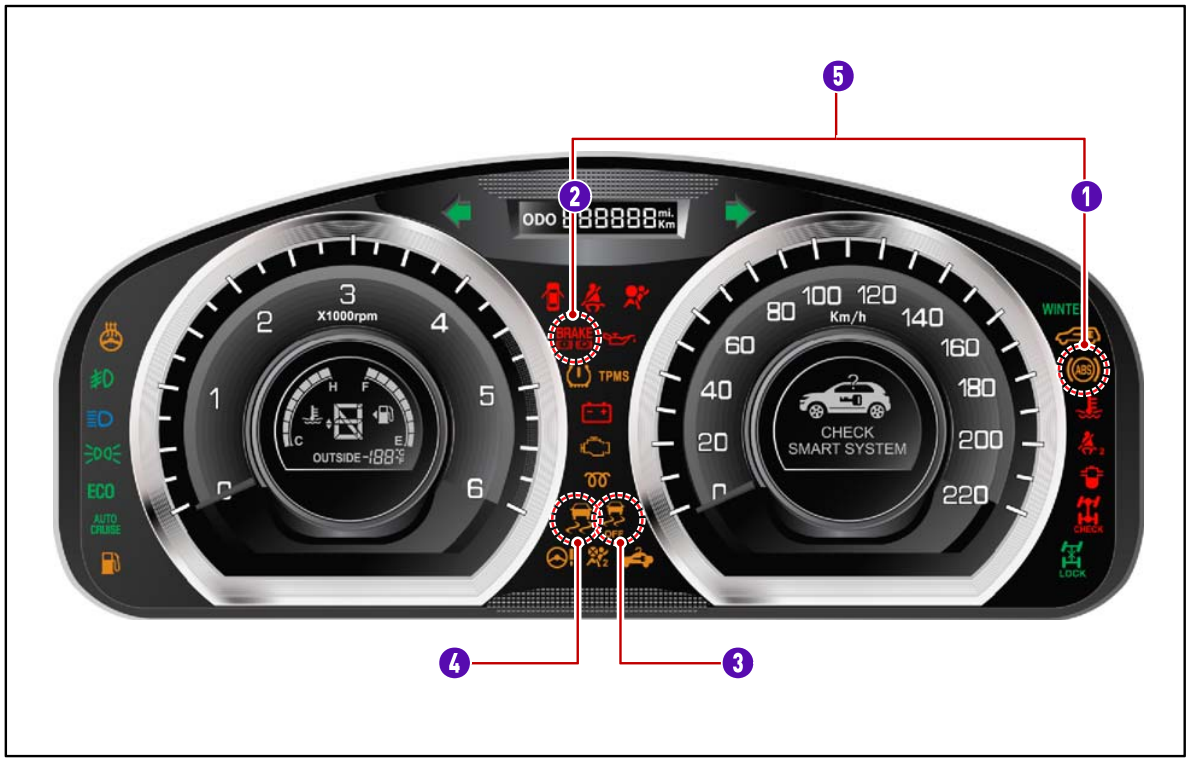
During the ARP operation, vehicle safety (rollover prevention) takes the first priority and thus, stronger engine control is in effect. Consequently, the vehicle speed decreases rapidly, so the driver must take caution for the vehicle may drift away from the lane.

Noise and vibration that driver feels when ESP system is operating

The ESP system may transfer noise and vibration to the driver due to the pressure changes caused by the motor and valve operations in a very short period of time. And, keep in mind that the output and vehicle speed could be decreased without rpm increase due to the ASR function that controls the engine power.

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4. WARNING LAMPS



1. ABS warning lamp
2. Brake warning lamp
3. ESP OFF indicator
4. ESP warning lamp/indicator
5. EBD warning lamp

1) ABS

ABS warning lamp module indicates the self-diagnosis and malfunction.
ABS warning lamp ON: Warning Lamp

1. When turning the ignition switch to ON position, ABS warning lamp comes on for 3 seconds for self-diagnosis and goes off if the system is OK (initialization mode).
2. When the system is defective, the warning lamp comes on.
3. When the self-diagnosis is performing, the warning lamp comes on.
4. When the HECU connector is disconnected, the warning lamp comes on.
5. ABS is not available during lamp ON. In this condition, Only normal brake system without ABS function is available.
6. When the communication between warning lamp CAN module in meter cluster, the warning lamp comes on.

Modification basis	
Application basis	
Affected VIN	

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2) EBD (Electronic Brake-force Distribution) Warning Lamp (Brake Warning Lamp)

EBD warning lamp when the system perform the self diagnosis and when it detects the malfunction of EBD system. However, the brake warning lamp comes on regardless of EBD when the parking brake is applied.

EBD warning lamp ON:

1. When turning the ignition switch to ON position, ABS warning lamp and the brake warning lamp comes on for 3 seconds for self diagnosis and goes off if the system is OK (initialization mode). When applying the parking brake, the brake warning lamp comes on.
2. When the brake fluid is not sufficient, the brake warning lamp comes on.
3. When the self-diagnosis is performing, the warning lamp comes on.
4. When the HECU connector is disconnected, the warning lamp comes on.
5. When the system is defective, ABS warning lamp and the brake warning lamp come on
6. simultaneously.

   a. When the solenoid valve is defective
   b. When one or more wheel sensors are defective
   c. When ABS HECU is defective
   d. When the voltage is abnormal
   e. When valve relay is defective

7. When the communication between warning lamp CAN module in meter cluster, the warning lamp comes on.

3) ESP OFF Indicator

ESP OFF indicator ON:

1. When turning the ignition switch to ON position, ESP warning lamp comes on for 3 seconds for self diagnosis and goes off if the system is OK (initialization mode).
2. When the ESP OFF switch is pressed to turn off ESP function, ESP OFF indicator comes on.

4) ESP Warning Lamp

1. ESP warning lamp ON:
2. When turning the ignition switch to ON position, ESP warning lamp comes on for 3 seconds for self diagnosis and goes off if the system is OK (initialization mode).
3. When the system is defective, the warning lamp comes on.
4. When the ESP function is activated, ESP warning lamp blinks with the interval of 2 Hz.
5. When the communication between warning lamp CAN module in meter cluster, the warning lamp comes on.

5) ESP OFF Switch

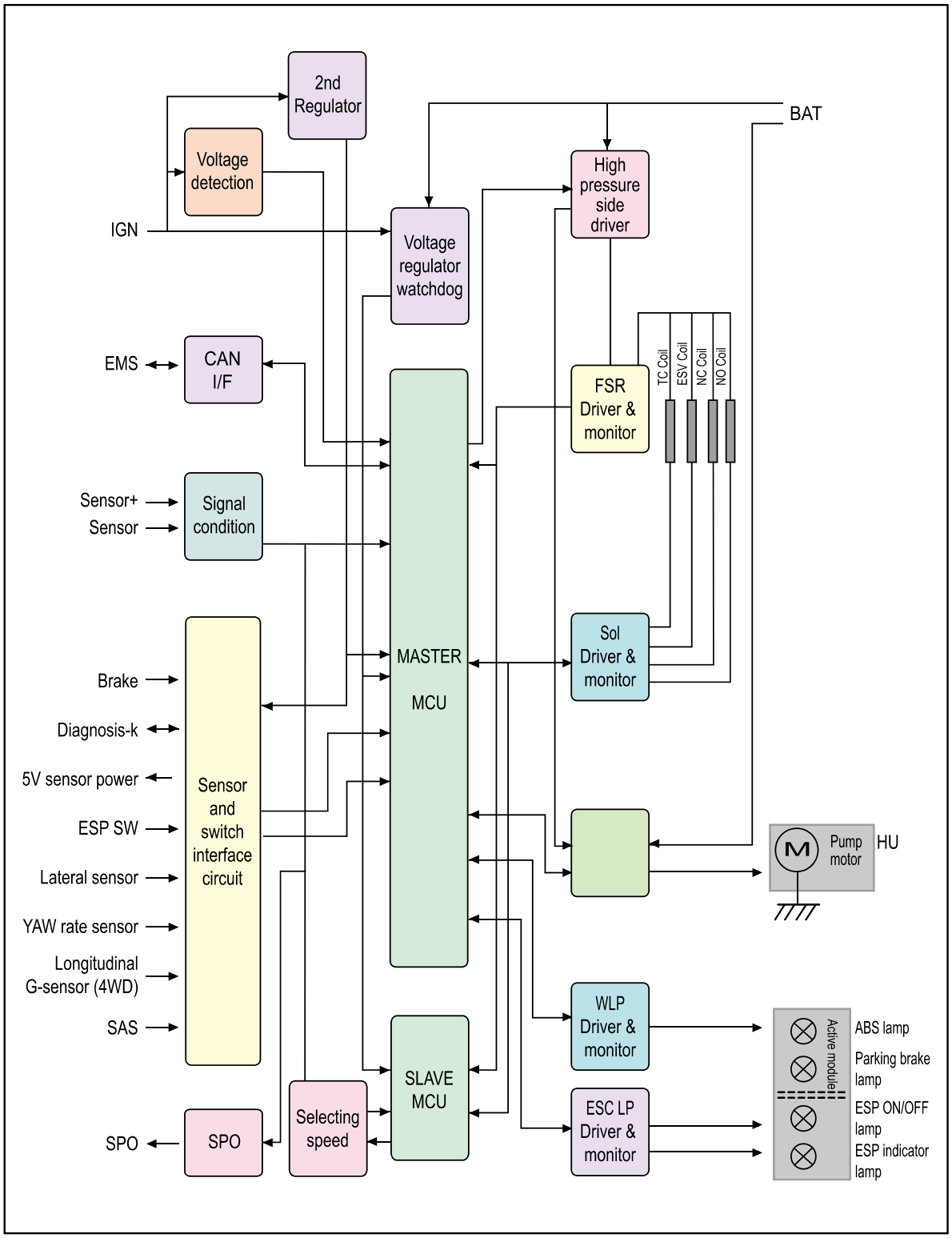
If ESP OFF switch is pressed, ESP function is deactivated and the ESP OFF indicator in the instrument cluster comes on.

To resume the ESP function, press the switch again. At this time, ESP OFF indicator goes out.

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5. SYSTEM DESCRIPTION

1) Block Diagram of ESP HECU



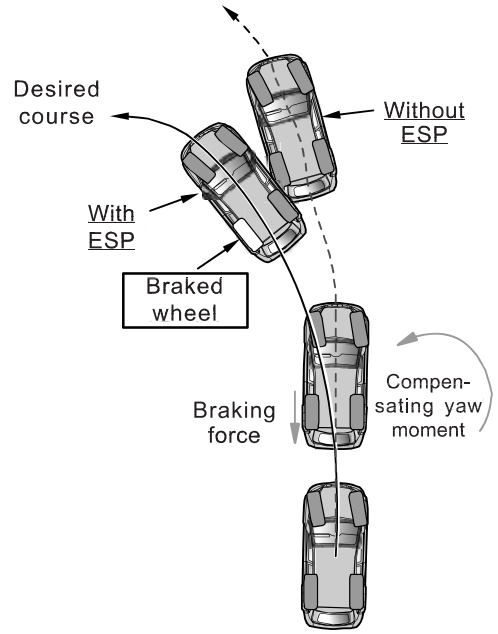
Modification basis	
Application basis	
Affected VIN	

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2) Operation of ESP System

The ESP (Electronic Stability Program) has been developed to help a driver avoid danger of losing control of the vehicle stability due to understeer or oversteer 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 vehicle conditions when the inner or outer wheels are spinning during oversteer, understeer or cornering. The ESP ECU controls against oversteer or understeer during cornering by controlling the vehicle stability using input values from these sensors and applying the braking force to the corresponding wheels independently. The system also controls the engine power right before the wheel spin synchronized with the ASR function to decelerate the vehicle automatically in order to maintain the vehicle stable during cornering.

(1) Under steering



▶ **What is understeering?**

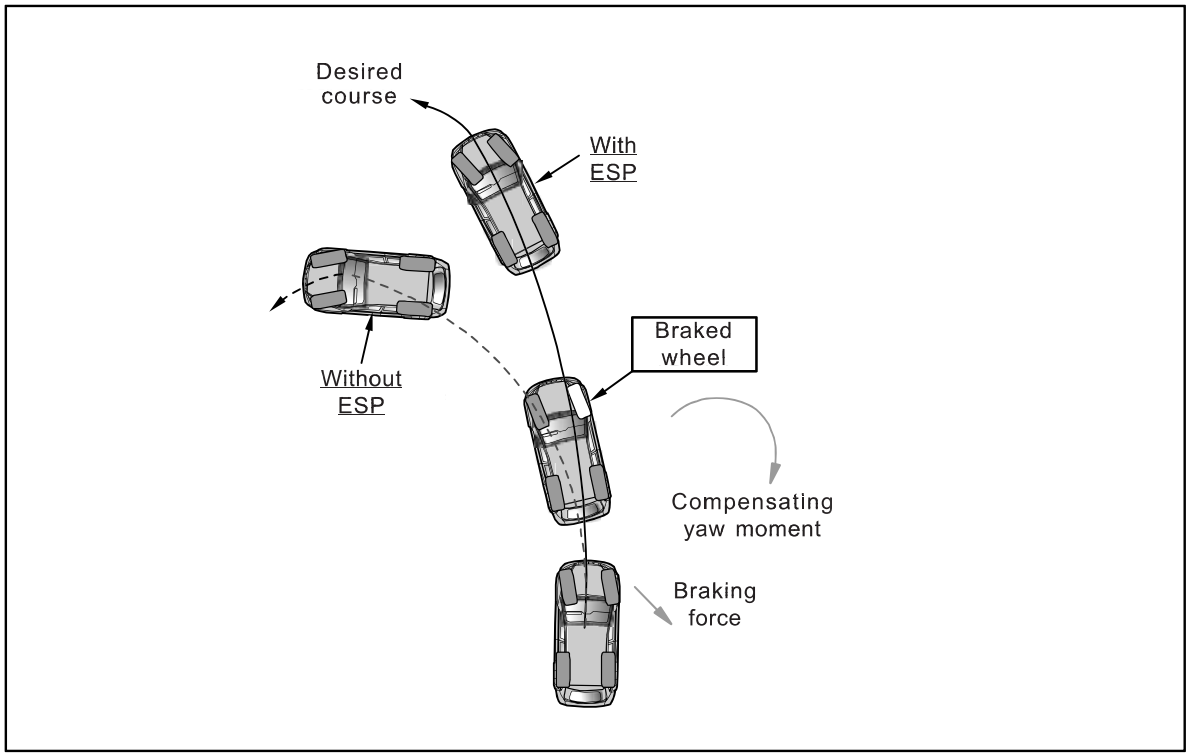
Understeer is a term for a condition in which the steering wheel is steered to a certain angle during driving and the front tires slip toward the reverse direction of the desired direction. Generally, vehicles are designed to have understeer. It is because that the vehicle can return back to inside of cornering line when the steering wheel is steered toward the inside even when the front wheels are 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.

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▶ **ESP controls during understeer**

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 understeer with the yaw rate sensor and lateral sensor. Then, the ESP system applies the braking force to 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 intended.

(2) Over steering



▶ **What is oversteering?**

Oversteer is a term of a condition in which the steering wheel is steered to a certain angle during driving and the rear tires slip outward losing traction.
Compared to understeering vehicles, it is hard to control the vehicle during cornering and the vehicle can spin due to rear wheel moment when the rear tires lose traction and the vehicle speed increases.

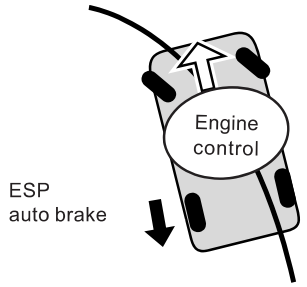
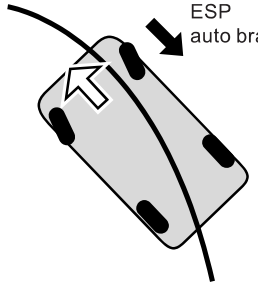
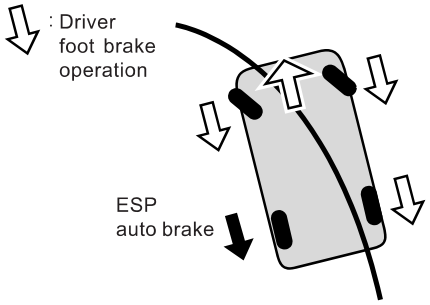
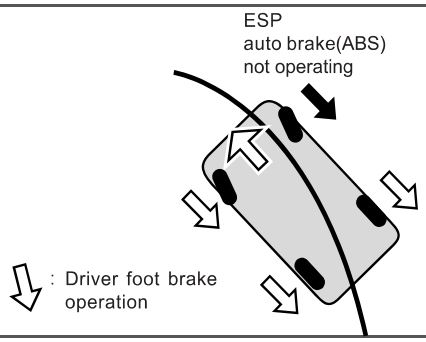
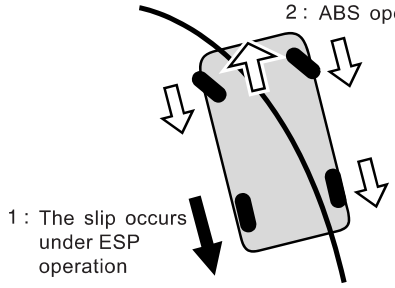
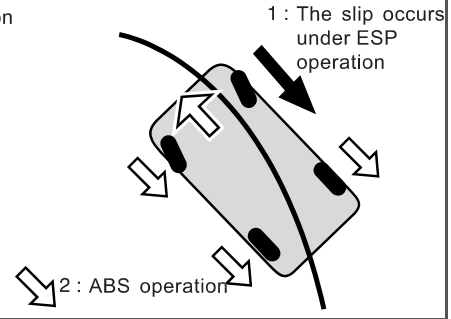
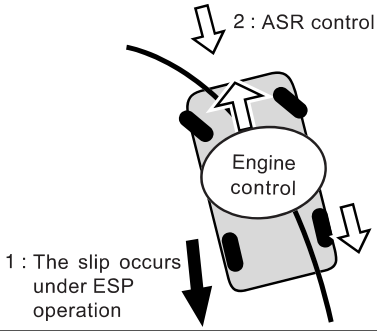
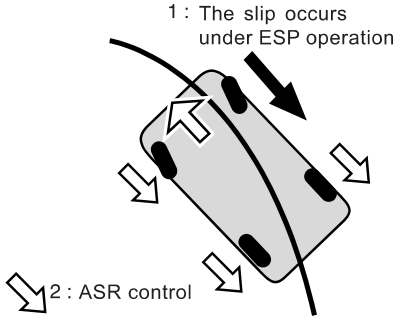
▶ **ESP controls during oversteer**

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 oversteer with the yaw rate sensor and lateral sensor. Then the ESP system applies the braking force to 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 intended.

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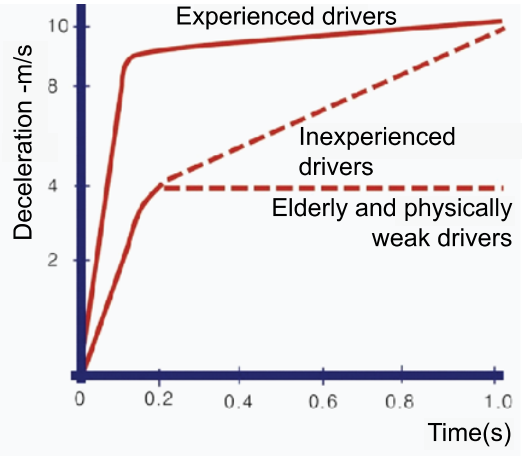
3) Vehicle Control During Cornering

The figure below shows the vehicle controls by the ESP system under various situations such as when the brake pedal is depressed or not depressed during cornering, when the ABS is operating and when braking without the ABS. It also includes the vehicle conditions when the TCS, a part of the ESP system, is operating.

Condition	Understeer control	Oversteer control
Only ESP in operation No braking by driver		
ESP + Normal braking (no ABS operation)		
ESP + ABS brake		
ESP + ASR		

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4) HBA (Hydraulic Brake Assist System)



(1) Purpose

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.

(2) Operation

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 depress the brake pedal slowly, the pressure change is not high. In this case, only the conventional brake system with booster is activated.

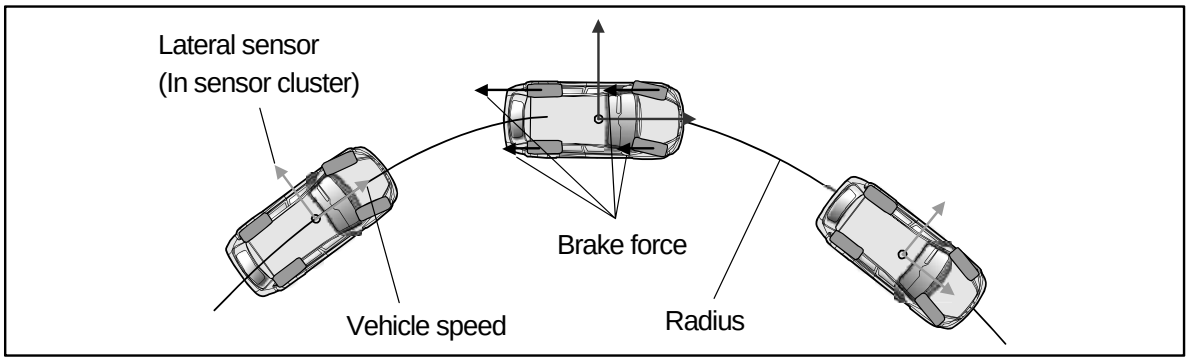
(3) Operating conditions

- Sensor pressure: over 40 bar
- Pressure changes: over 850 bar/sec
- Vehicle speed: over 30 km/h

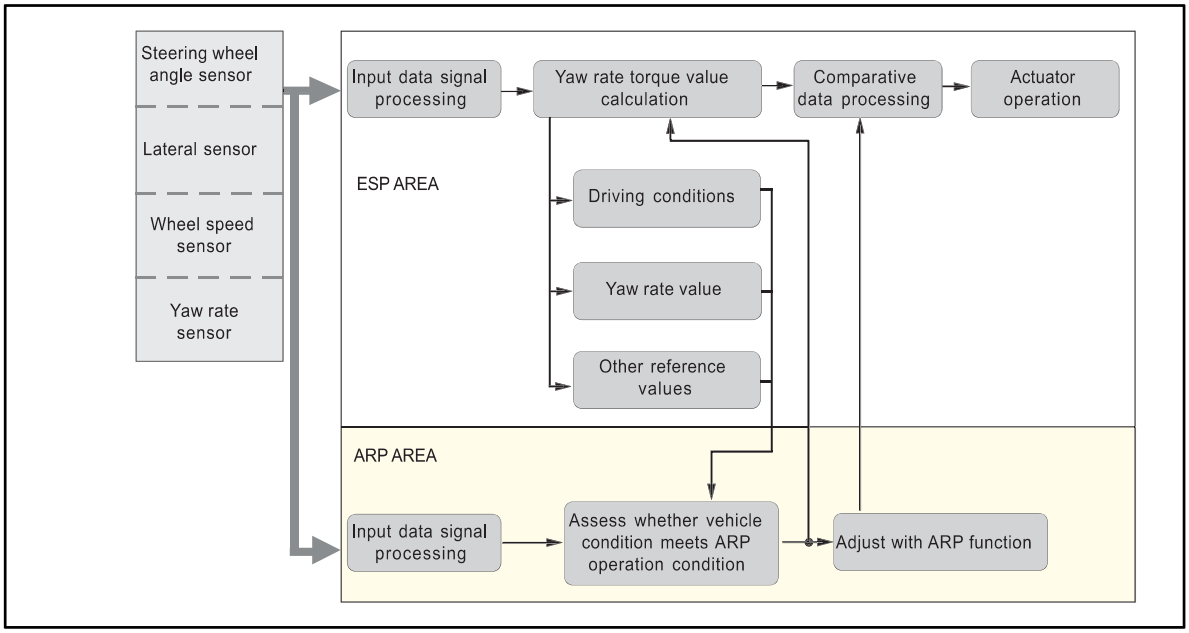
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5) ARP (Active Roll-Over Protection)

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.



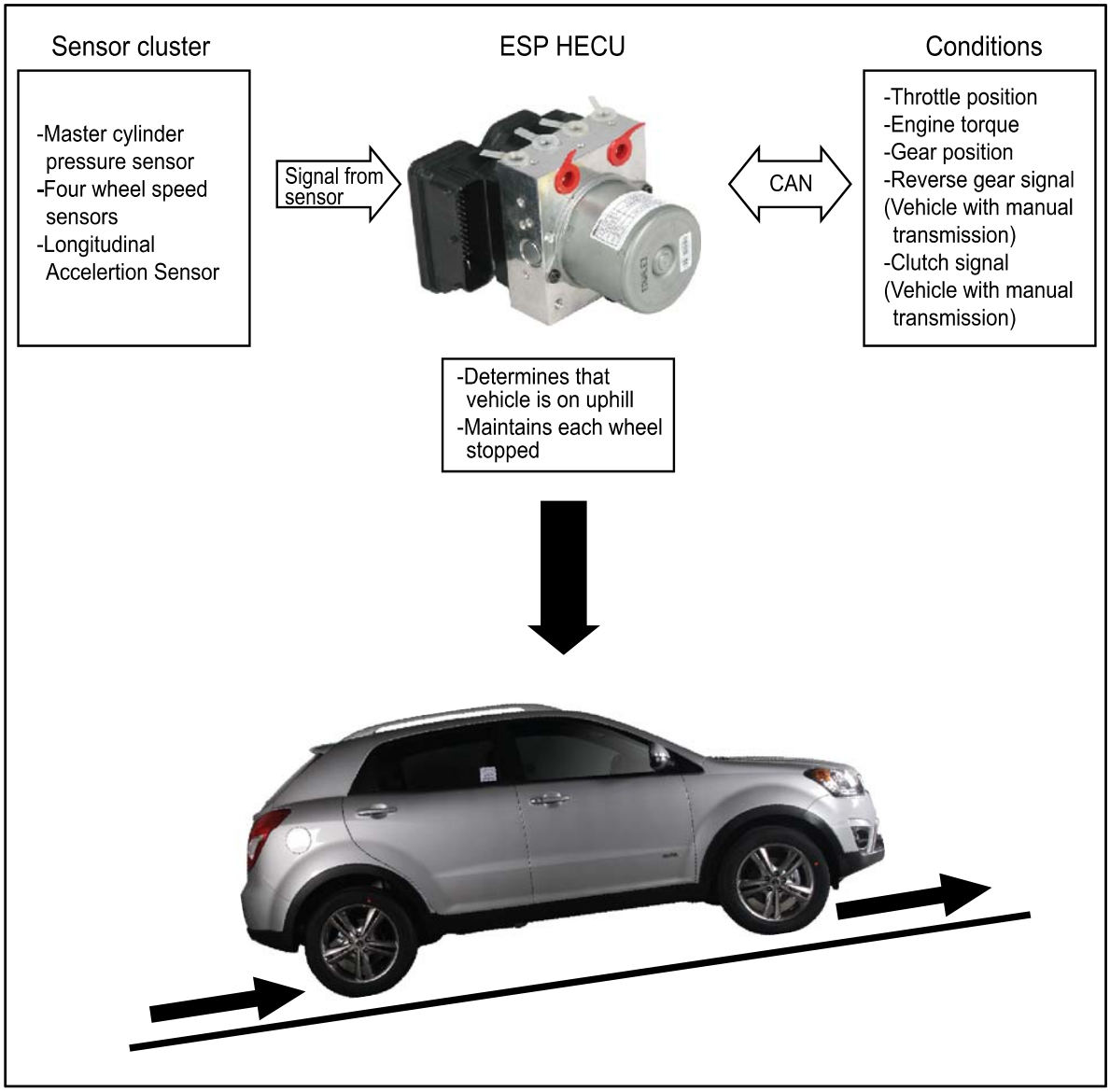
CAUTION

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) HSA (Hill Start Assist)

The HSA (Hill Start Assist) prevents the vehicle from rolling backward by supplying the hydraulic pressure to the wheels by the HECU after the brake pedal is released when starting off on uphill.

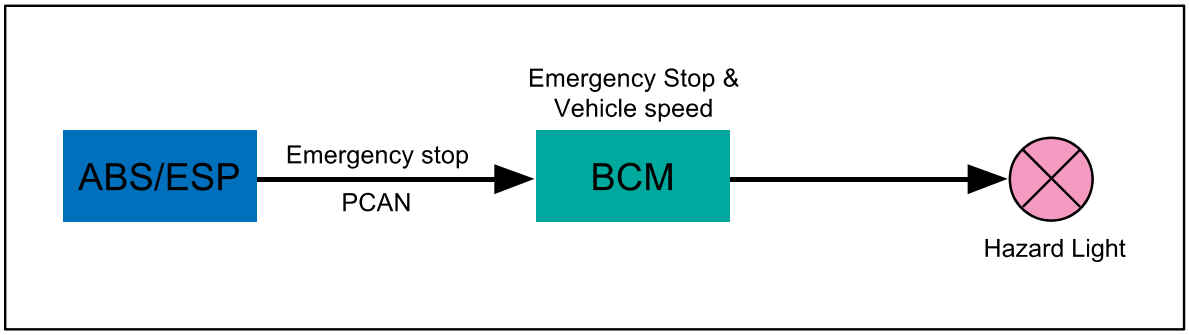


Modification basis	
Application basis	
Affected VIN	

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7) Emergency Hazard Flasher Control (Coupled with ABS)

(1) System layout



(2) Emergency stop signal function

When ABS system is operating (or sudden braking), the hazard warning flashers will blink for 10 seconds to inform the emergency situation to the vehicles behind.

(3) Operating process

When receiving the emergency stop signal through PCAN communication it blinks with the interval of 4 Hz and when receiving the emergency stop OFF signal through PCAN communication it blinks with the interval of 1.25 Hz, normal operating speed.
However, the manual operation of the switch has a priority over this function.

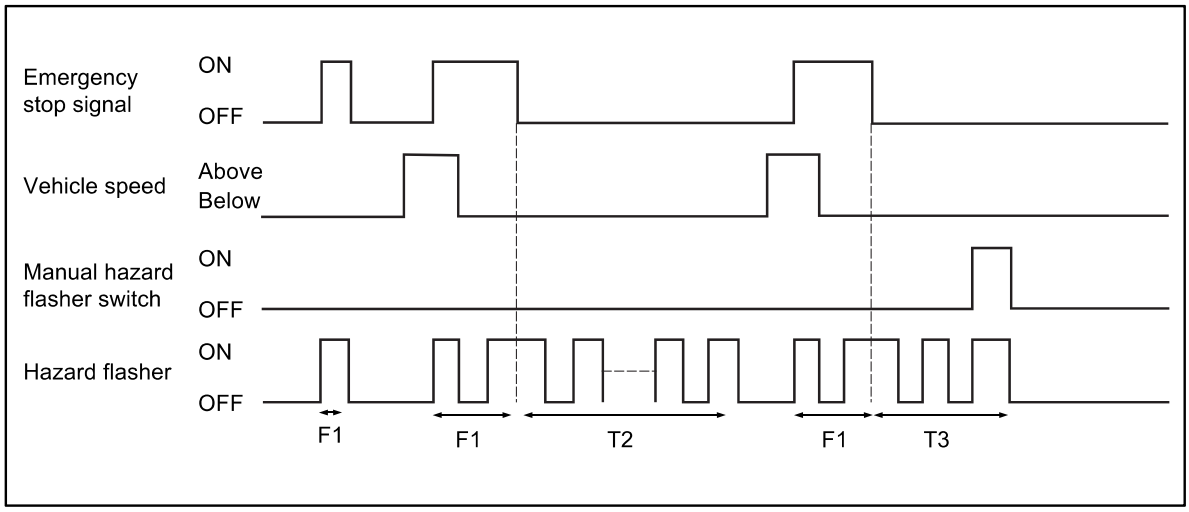
NOTE

Priority: Manual operation > Emergency stop signal > Emergency hazard flasher > Auto hazard flasher

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The BCM flashes the emergency auto hazard flasher with interval of 1.25 times/sec.:

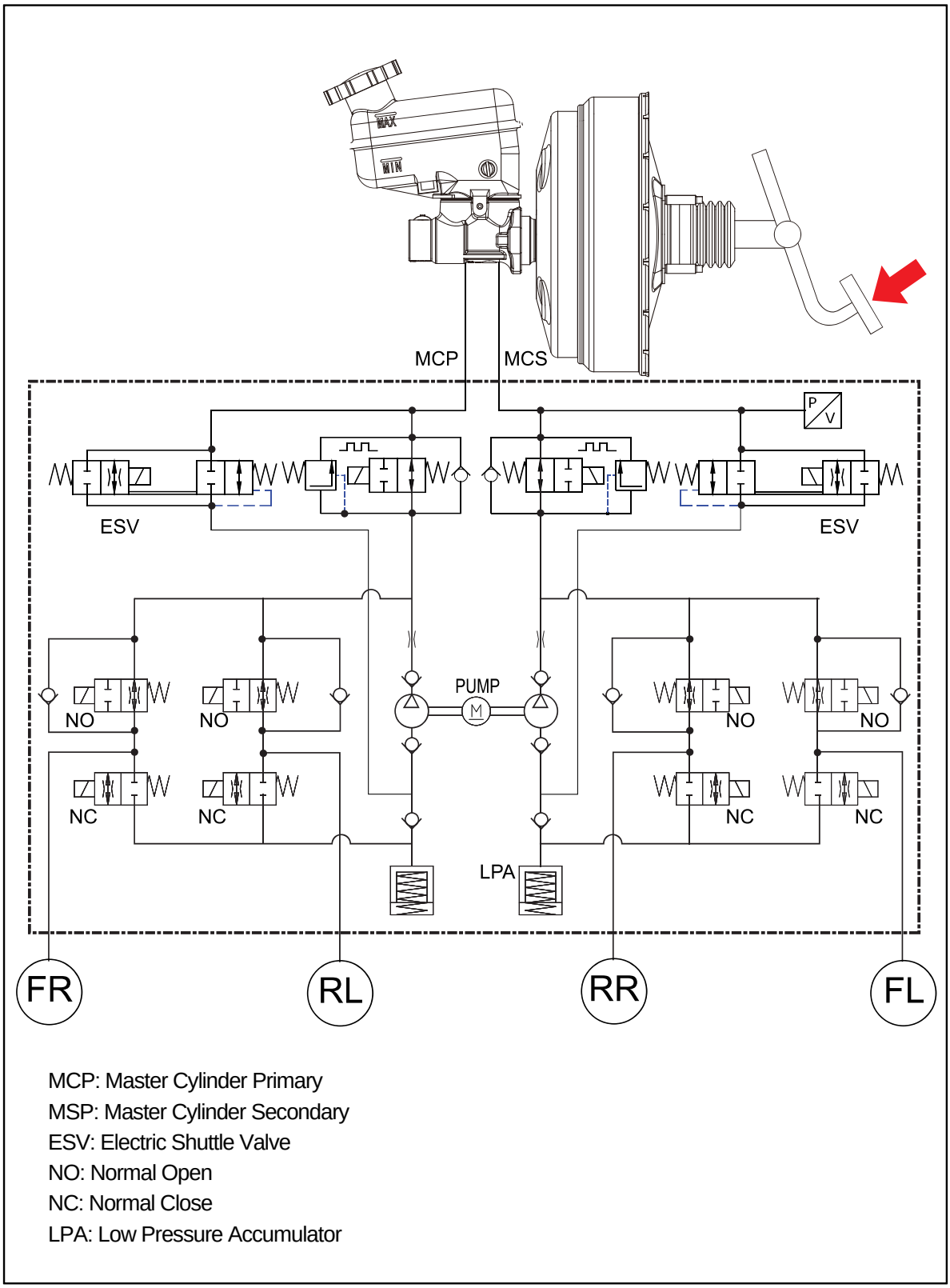
- The emergency hazard flasher does not operate if the vehicle speed is over 50 km/h when the emergency stop signal is received.
- The emergency hazard flasher operates if the vehicle speed is 50 km/h or lower when the emergency stop signal is received.
- When vehicle speed increases more than 10 km/h above the speed when the signal is received during operation by emergency braking signal, the emergency hazard flasher stops operation.
  When turning emergency hazard flasher switch OFF during operation by emergency braking signal,
- it stops operation.
  It is deactivated automatically 10 seconds after if items 2) and 3) above are not met during operation
- by emergency braking signal.
  If multi-function automatic hazard flasher signal is received during operation by emergency braking
- signal, it will be overridden.



Modification basis	
Application basis	
Affected VIN	

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6. HYDRAULIC CIRCUIT OF ESP



MCP: Master Cylinder Primary
MSP: Master Cylinder Secondary
ESV: Electric Shuttle Valve
NO: Normal Open
NC: Normal Close
LPA: Low Pressure Accumulator

Modification basis	
Application basis	
Affected VIN	

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▶ Circuit description

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 RISE, HOLD or DUMP conditions.

▶ Flashing warning lamp and warning sound during ESP operation

When the ESP operates while the vehicle is moving, the ESP warning lamp on the instrument panel flickers and the buzzer sounds at every 0.1 second. The ESP lamp operation is to inform a driver that the vehicle is extremely unstable.
The ESP system is just a supplementary system for the vehicle and it cannot control the vehicle over the physical limit. Do not solely rely on the system but be advised to drive the vehicle safely.

▶ Drive feeling during ESP operation

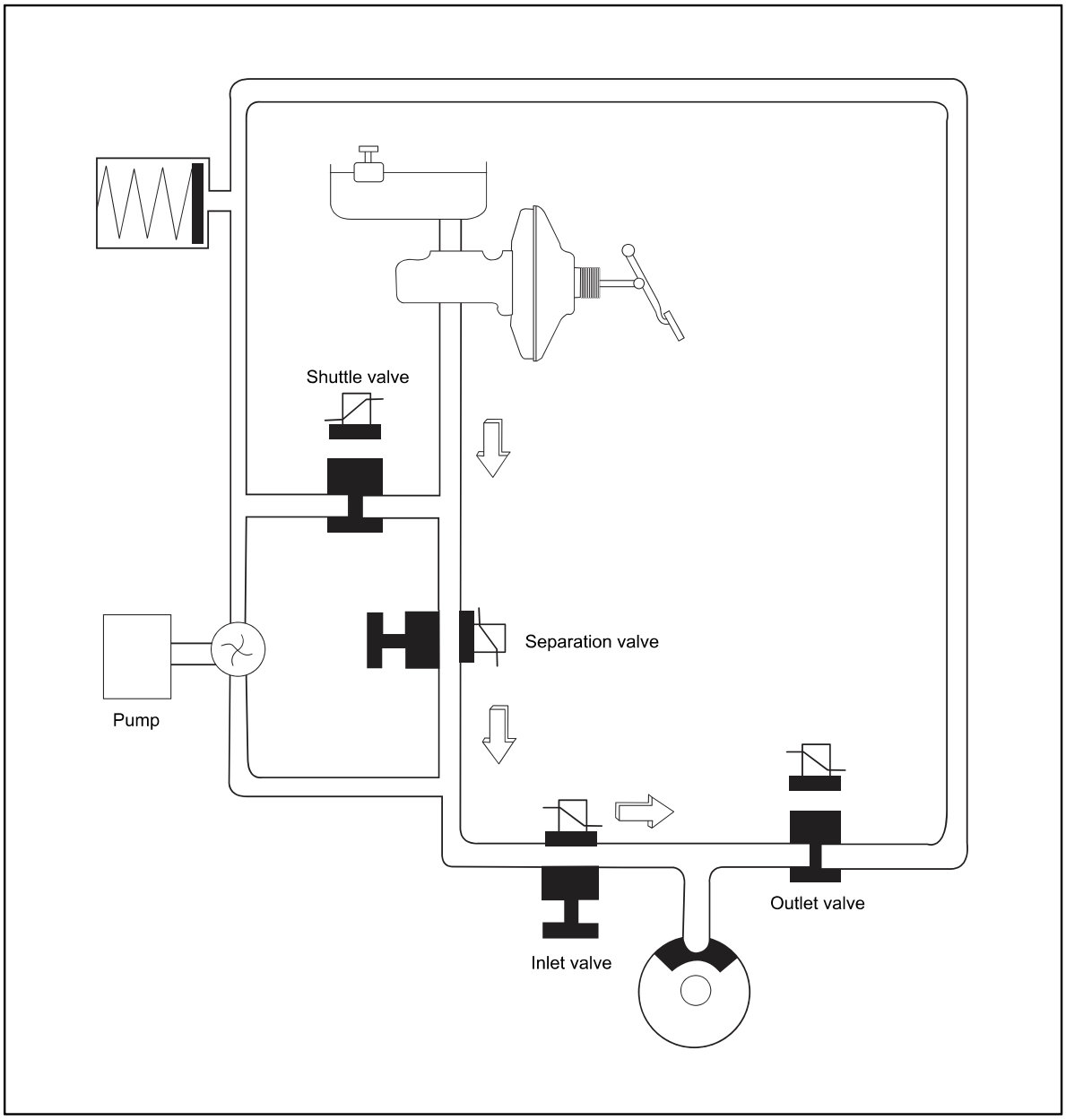
When the ESP system activates, the driving feeling can be different depending on vehicle driving conditions. For example, it will feel different when the ESP system is activated while the ABS is operated by depressing the brake pedal and when the ESP system is in control without the brake pedal depressed on the same curve.
If the ESP system operates with the brake applied, the brake pressure will be increased on the corresponding wheel which already has braking pressure for the ESP controls. In other words, the ESP system would make the driver feel more abruptly braked compared to the situation that the braking pressure is applied to wheel which had no braking force.

▶ Noise and vibration that driver senses during ESP operation

The ESP system may transfer noise and vibration to a driver due to the pressure changes caused by the motor and valve operations in a very short period of time.
Extreme cornering will trigger the ESP operation and this will make the driver sense noise and vibration due to sudden brake application.
Also, the ESP system controls the engine power. Therefore, the driver may notice the engine power decreases even when the accelerator pedal is depressed.

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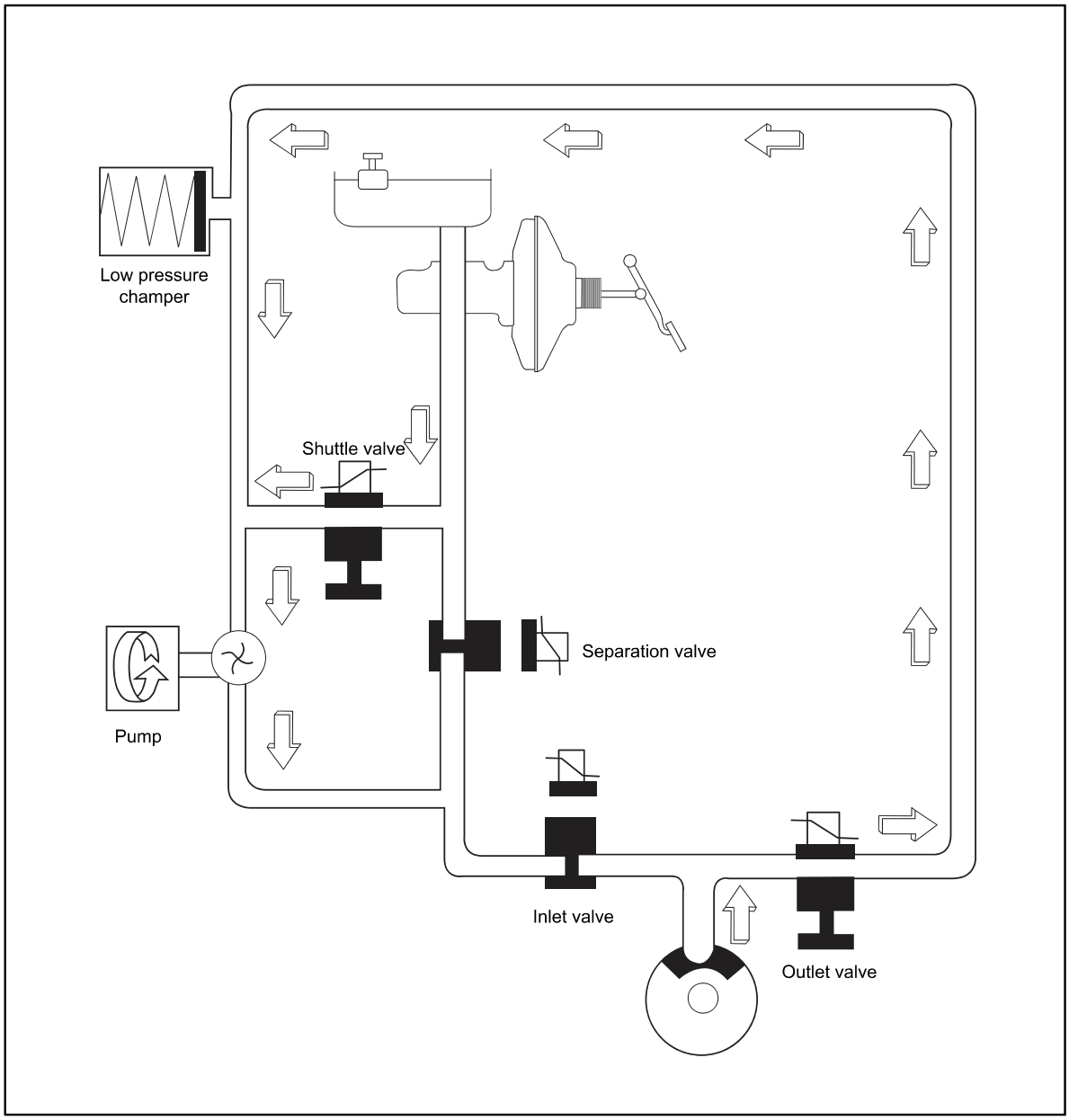
1) Idling and Normal Braking Condition



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.

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2) DUMP (ESP is working) Mode

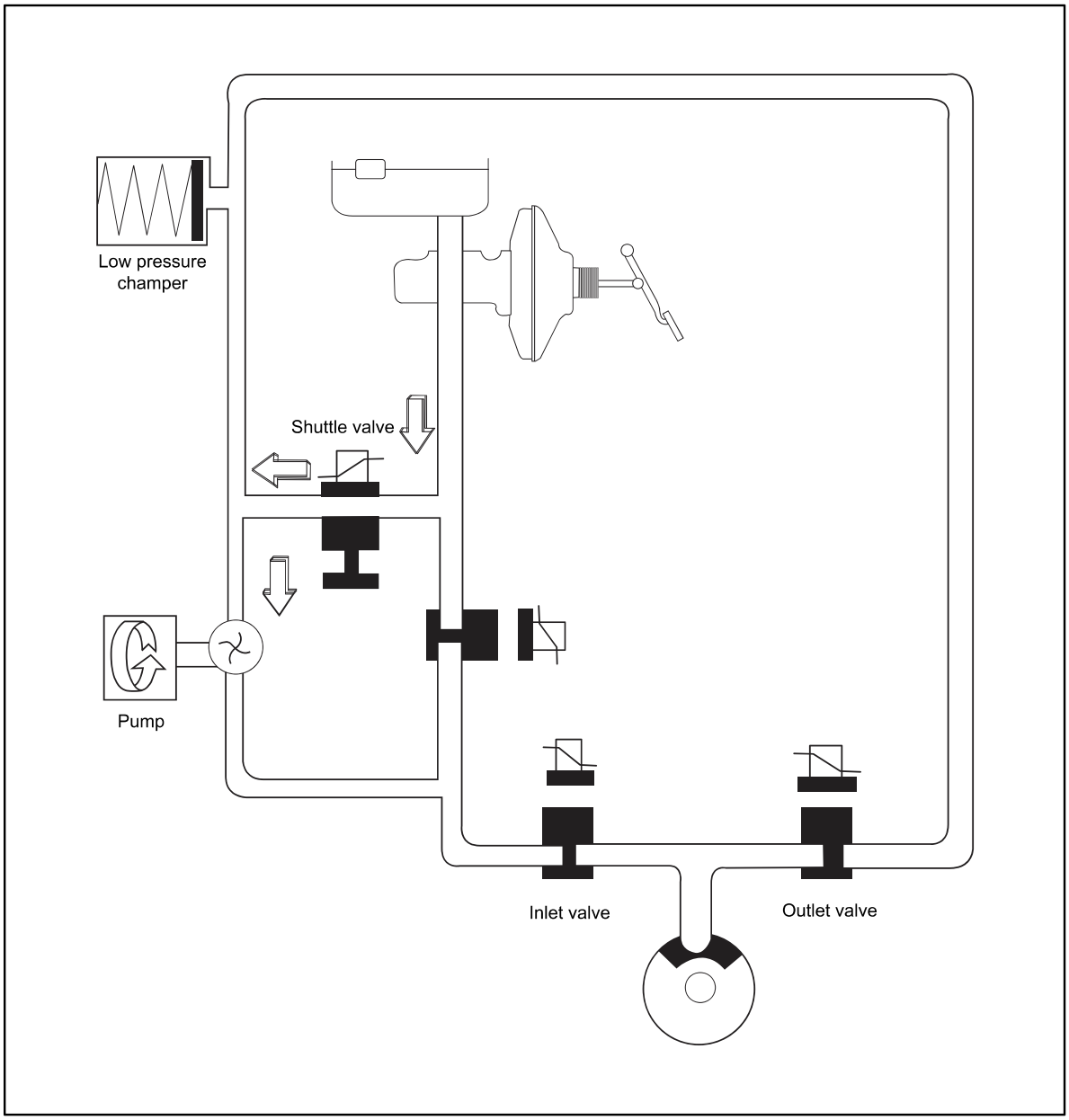


The pressure decreases just before the wheel speed drops and the wheels are locked.
The inlet valve closes and the outlet valve opens as in the ABS HECU and the oil is gathered at the low pressure chamber while no additional oil is being supplied. Then the pump operates to allow fast oil drainage. The shuttle valve and the separation valve do not operate while decompression.

Modification basis	
Application basis	
Affected VIN	

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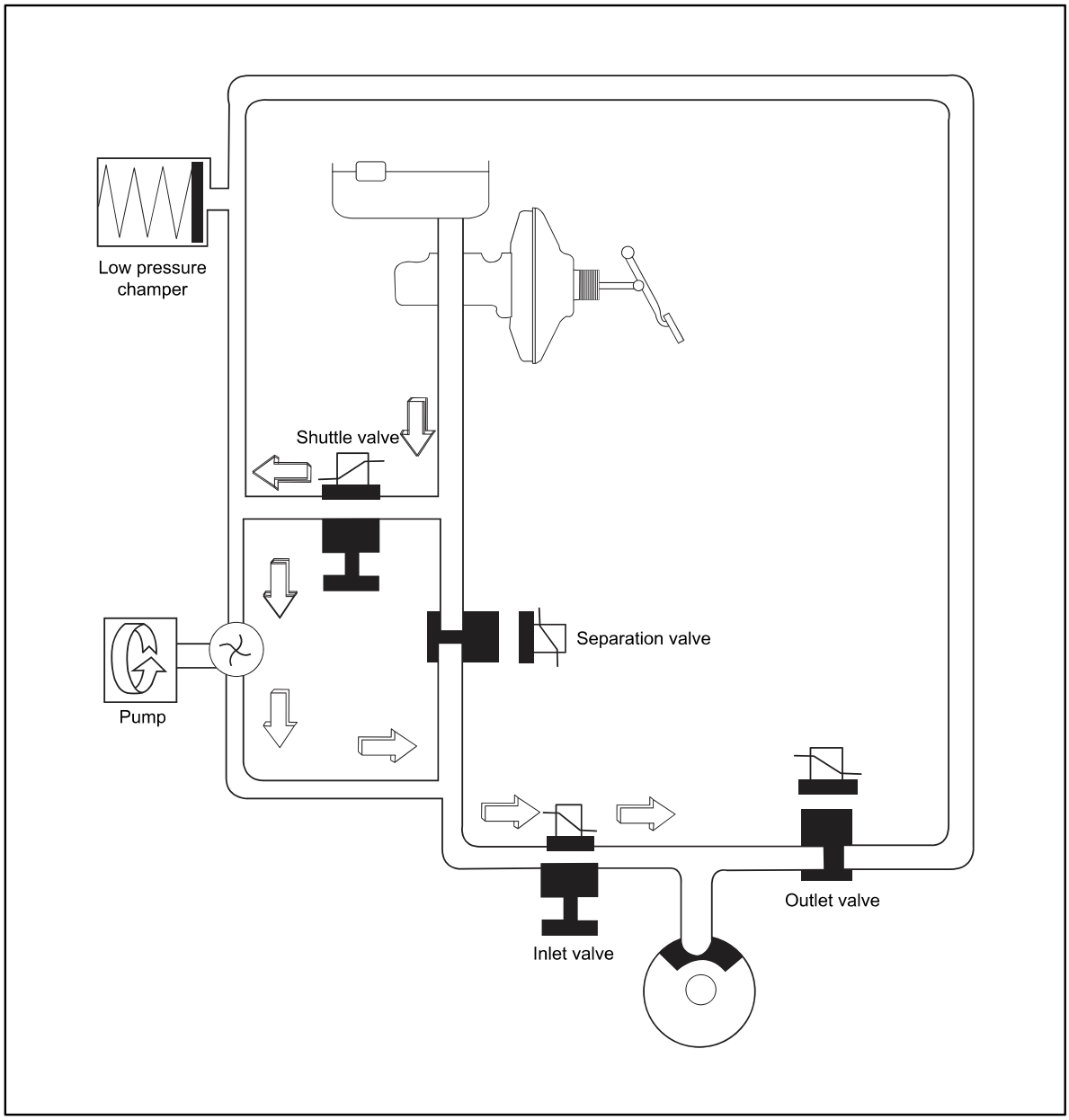
3) HOLD (ESP is working) Mode



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.

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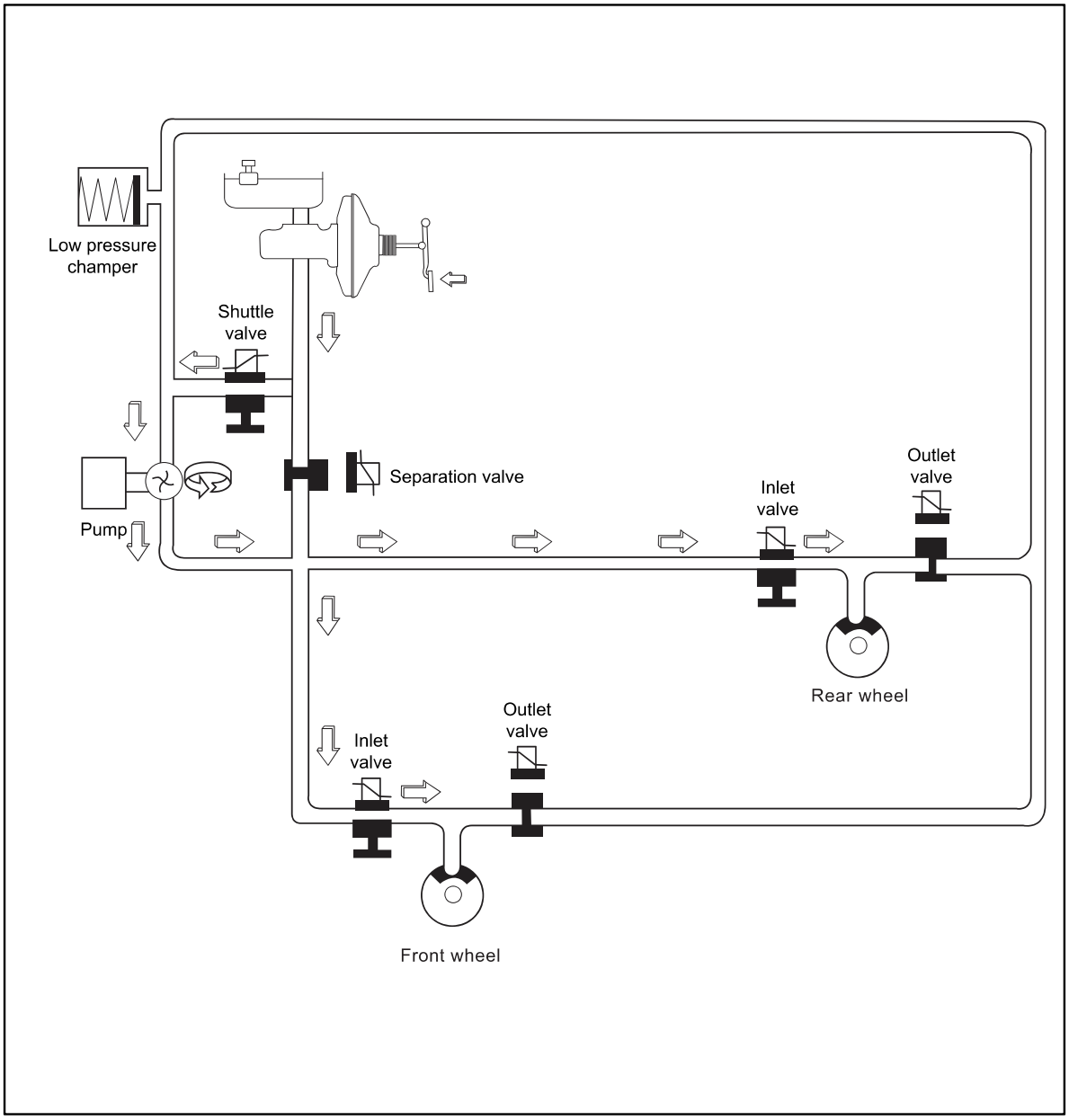
4) RISE (ESP is working) Mode



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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5) Hydraulic Circuit of HBA

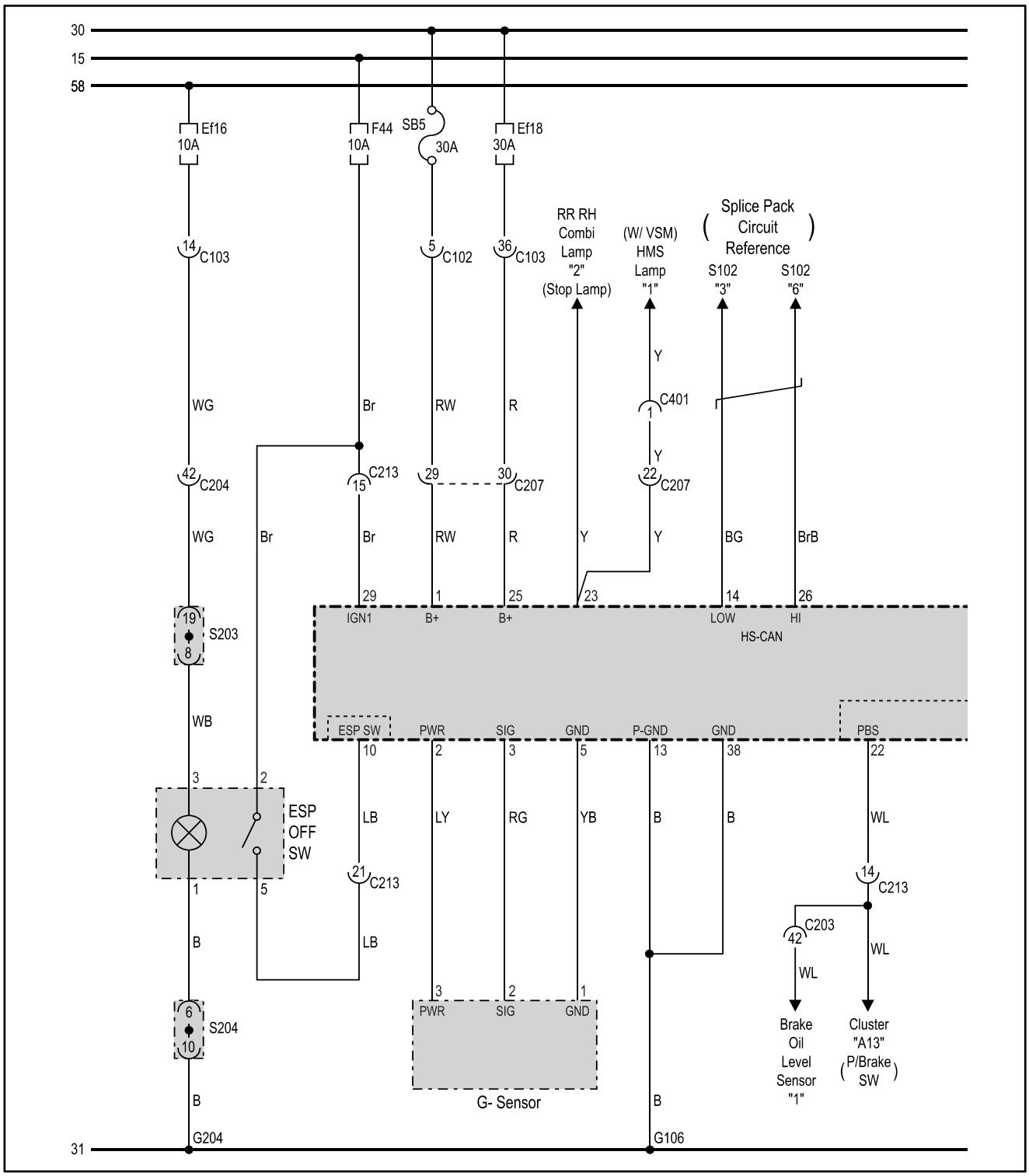


The above figure shows one front and one rear wheel and the same hydraulic circuit forms as in the ESP operation. When HECU recognizes that it is an emergency and it is required for hard braking, depending on the pressure value of the brake pressure sensor and pressure changes caused by the pressure sensor timing, it operates the pump immediately to apply the brake pressure at the wheels. Then, the pressure in the pump increases until just before the corresponding wheel gets locked. The motor still keeps rotating and the outlet valve and the separation valve will stay closed. When the wheel starts to lock, the HBA function cancels and switches to ABS operation.

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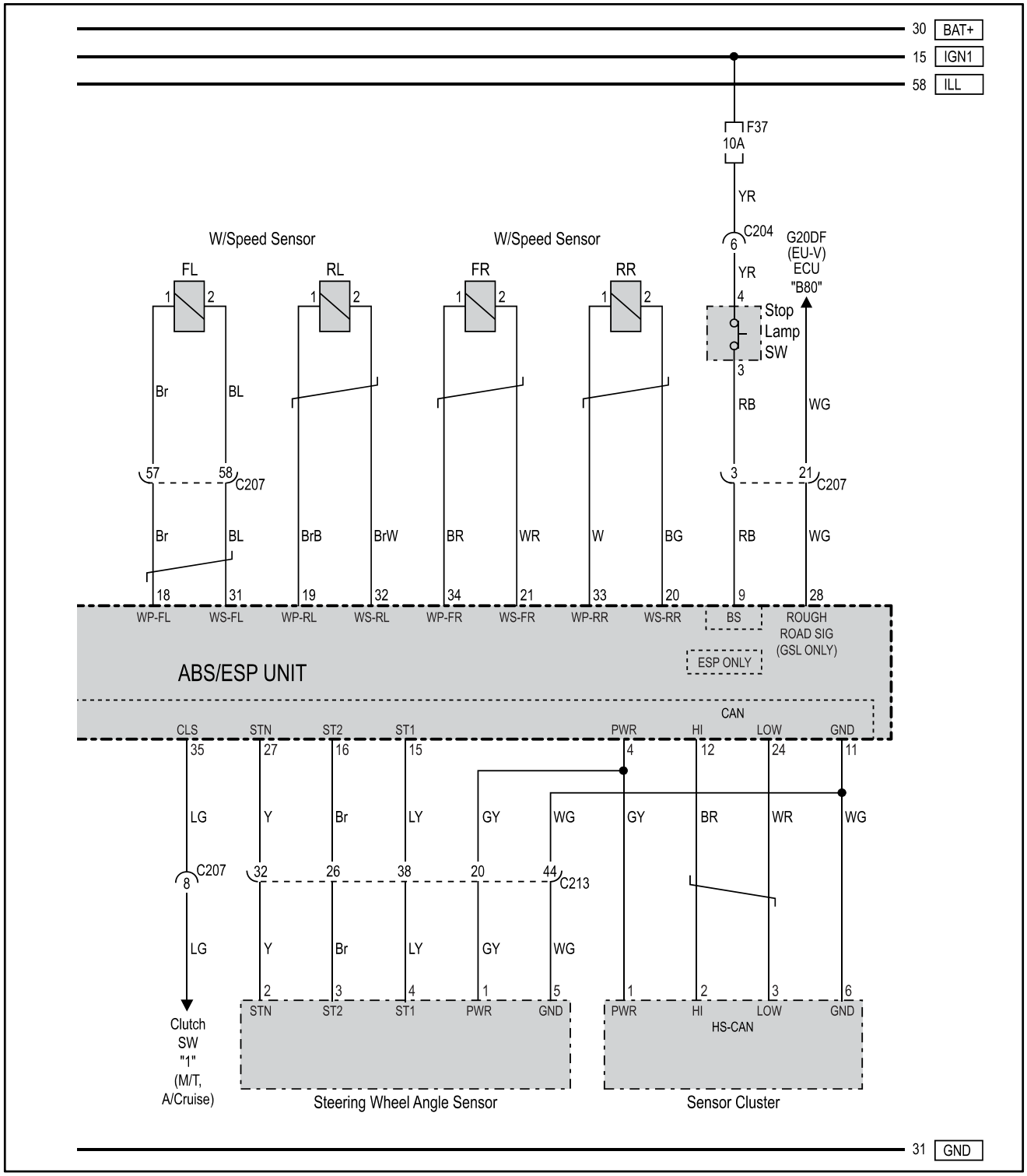
7. CIRCUIT DIAGRAM

▶ **Wheel speed sensor, Stop lamp switch, Self diagnostic connector, Warning lamp (ABS/ESP)**



Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
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ELECTRONIC STABILITY PROGRAM

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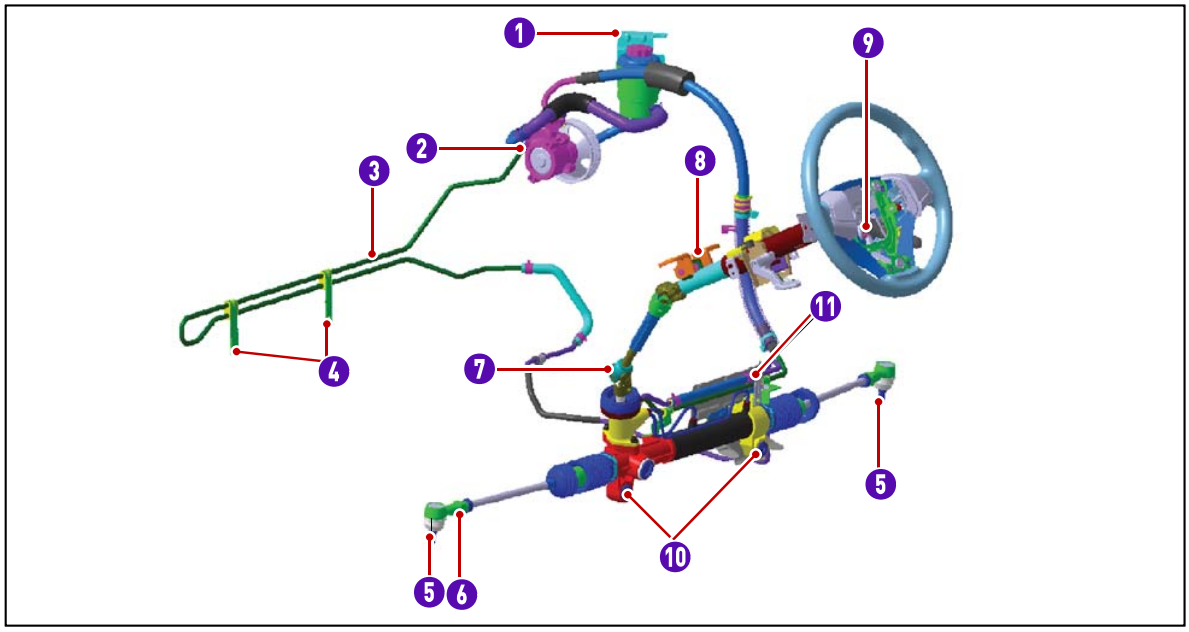
GENERAL INFORMATION

1. SPECIFICATION (HPS)

Component	Item		Specification
Steering wheel	Type		3-spoke
	Outside diameter		Φ 380 mm
	Number of revolutions		3.09 rotations
	Heated wire		Simple ON/OFF
Gear box	Type		Rack and pinion
	Gear ratio		46.94
	Rack stroke		± 72.5 mm
Steering angle	Inner		38.62°
	Outer		31.07°
Wheel alignment	Toe-in		2 ± 2 mm
Oil pump	Type		Vane (removable pump and reservoir)
	Maximum pressure		100 ± 3 bar
	Displacement		6.0 to 9.75 ℓ/min
	Pulley diameter		Φ 115 mm
Steering column	Tilting angle	Up	+ 2.0 deg
		Down	- 3.0 deg
Lower shaft	Type		Ball slip
Steering oil	Oil type		S-PSF 3
	Oil reservoir capacity		about 1 ℓ
	Change interval		EU (Diesel): Check and add at every 20,000 km GEN (Diesel, Gasoline): Check and add at every 15,000 km
Turning capability	Min. turning radius		5.35 m

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2. TIGHTENING TORQUE

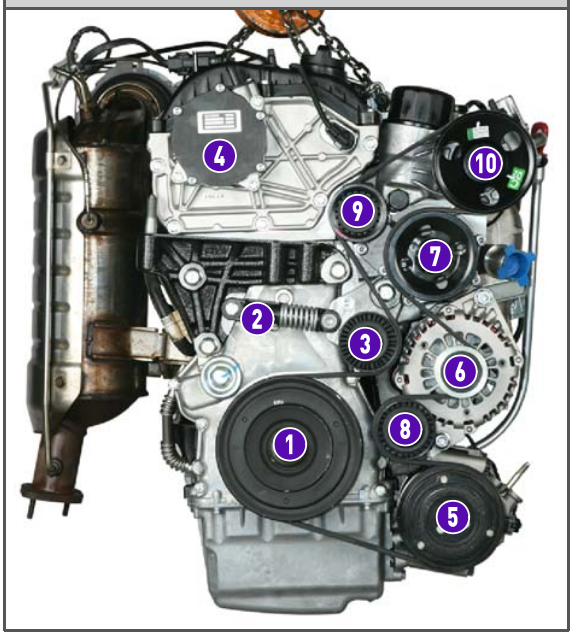
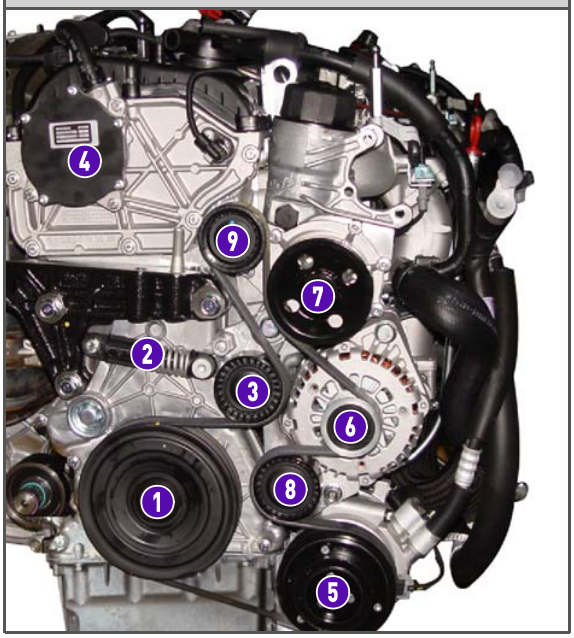


Item		Tightening torque	Remark
1. Power steering reservoir mounting bolt		8.8 to 13.7 Nm	12 mm x 2 EA
2. Power steering pump	Upper mounting bolt/nut	25 ± 2.5 Nm	13 mm x 1 EA
	Lower mounting bolt	25 ± 2.5 Nm	12 mm x 2 EA
3. Oil pipe	Eye bolt (pump side)	53.9 to 63.7 Nm	22 mm
	Steering gear box side nut	31.4 to 37.2 Nm	17 mm
4. Oil pipe bracket mounting nut		6.8 to 10.8 Nm	10 mm
5. Tie rod end lock nut		44.1 to 53.9 Nm	17 mm
6. Tie rod nut		63.7 to 78.4 Nm	22 mm
7. Lower shaft	Lower mounting bolt (gear box side)	17.6 to 24.5 Nm	12 mm
	Upper mounting bolt (column side)	17.6 to 24.5 Nm	12 mm
8. Column shaft	Lower mounting bolt	19.6 to 24.5 Nm	12 mm
	Upper mounting nut	19.6 to 24.5 Nm	12 mm
9. Steering wheel nut		39.2 to 49.1 Nm	22 mm
10. Loosened gear box mounting bolt/nut		Left: 98.0 to 127.4 Nm	17 mm
		Right: 88.3 to 107.9 Nm	17 mm
11. Heat shield mounting bolt		8.8 to 13.7 Nm	12 mm x 2 EA

Modification basis	
Application basis	
Affected VIN	

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3. DIFFERENCES BETWEEN HPS AND EPS

HPS (Hydraulic Power Steering)	EPS (Electric Power Steering)
	

	HPS	EPS
1	Crankshaft pulley (DDU)	←
2	Auto tensioner	←
3	Tensioner pulley	←
4	Vacuum pump	←
5	A/C compressor pulley	←
6	Alternator pulley	←
7	Water pump pulley	←
8	No.1 idle pulley	←
9	No.2 idle pulley	←
10	Power steering pump	-

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OVERVIEW AND OPERATING PROCESS

1. SYSTEM DESCRIPTION

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.

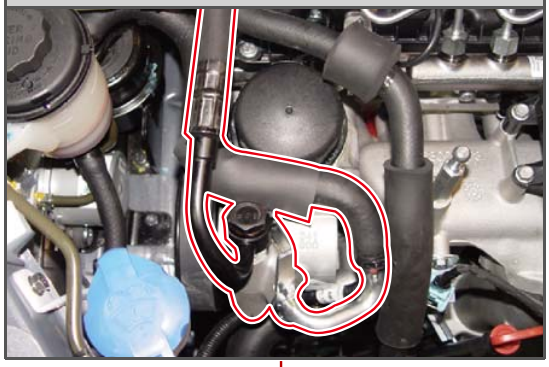
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2. SYSTEM LAYOUT

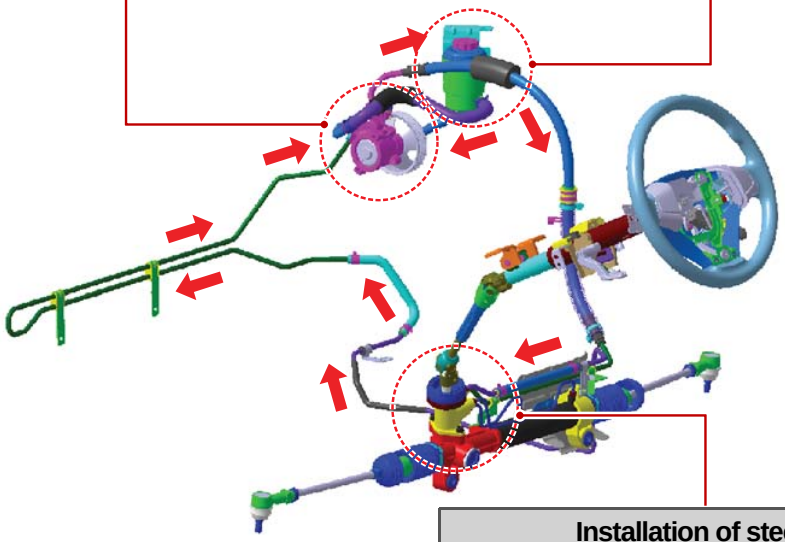
The steering pump is driven by the engine power through a belt. This pump circulates the power steering oil from the reservoir -> steering pump -> oil supply pipe -> steering gear box -> oil return pipe -> reservoir to perform steering operations.

Installation of power steering pump and pipe

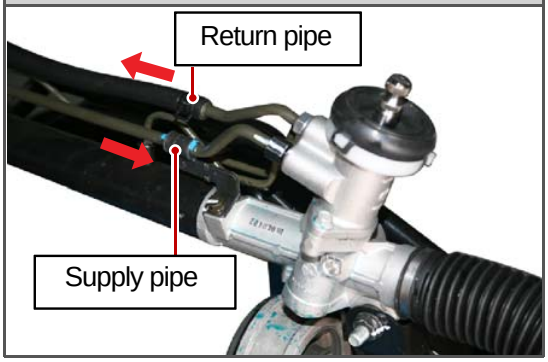


Installation of reservoir and hose





Installation of steering gear box and pipe



Modification basis	
Application basis	
Affected VIN	

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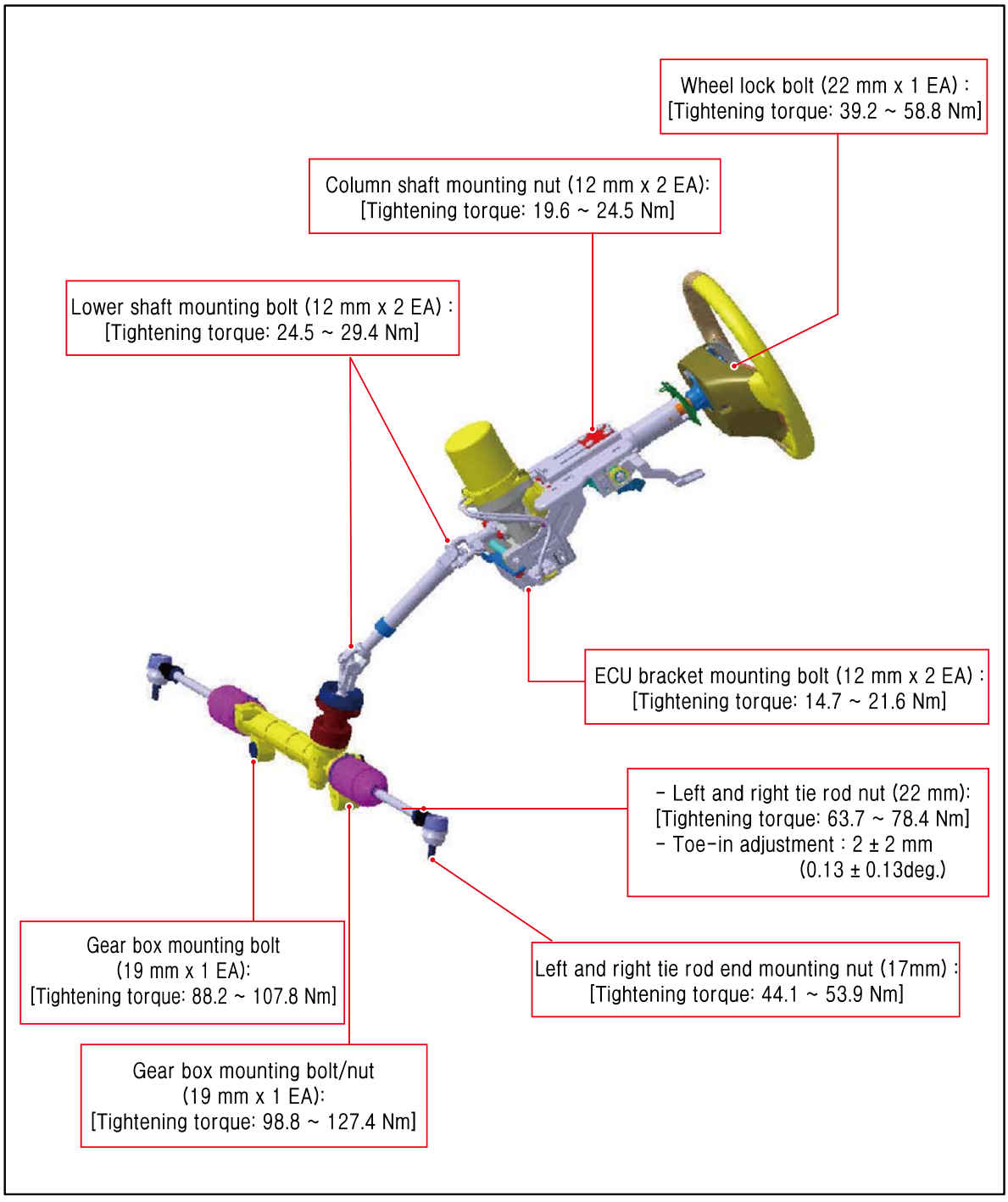
GENERAL INFORMATION

1. SPECIFICATION

Unit	Description	Specification
System operation	Operating type	Motor driven power steering system
	Operating temperature	− 40°C to 80°C
	Rated voltage	12 V
	Rated current	85 A
Operating voltage	Network	8 to 16 V
	C-EPS ECU	8 to 16 V
	Full Performance	10 to 16 V
Motor	Type	3-Phase BLAC (Brushless AC)
	Rated current/voltage	85 A / 12 V (at idle 0.5 A)
	Position sensor type	Hall sensor type
Torque & angle sensor	Type	Non-contact type
Steering column	Operating type	Manual tilting & telescoping
Lower shaft	Type	Sliding (Ball slip) type
Steering gear	Gear ratio	50.7 mm/rev
	Rack stroke	145 mm
Maximum steering angle	Inner wheel	38.62°
	Outer wheel	31.07°

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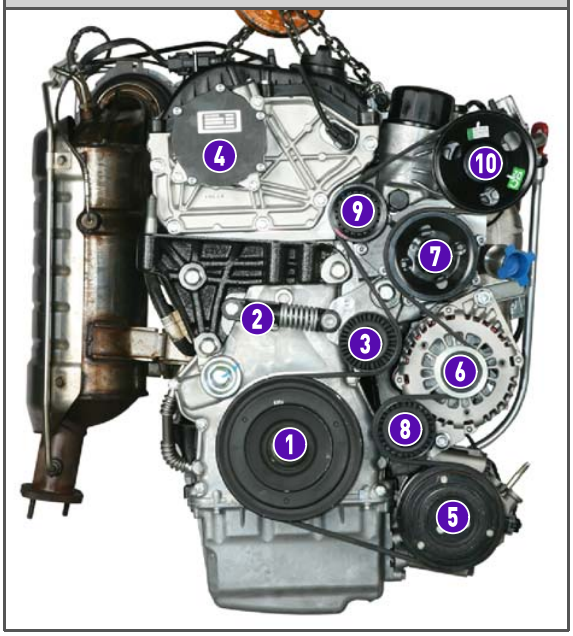
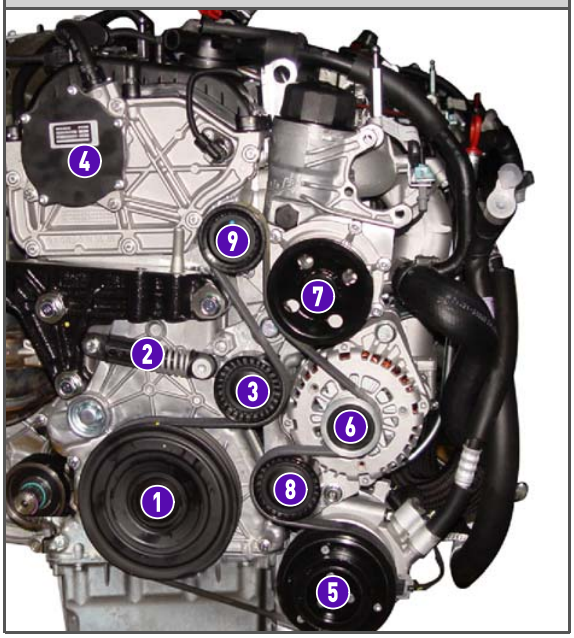
2. TIGHTENING TORQUE



Modification basis	
Application basis	
Affected VIN	

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3. DIFFERENCES BETWEEN HPS AND EPS

HPS (Hydraulic Power Steering)	EPS (Electric Power Steering)
	

	HPS	EPS
1	Crankshaft pulley (DDU)	←
2	Auto tensioner	←
3	Tensioner pulley	←
4	Vacuum pump	←
5	A/C compressor pulley	←
6	Alternator pulley	←
7	Water pump pulley	←
8	No.1 idle pulley	←
9	No.2 idle pulley	←
10	Power steering pump	-

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

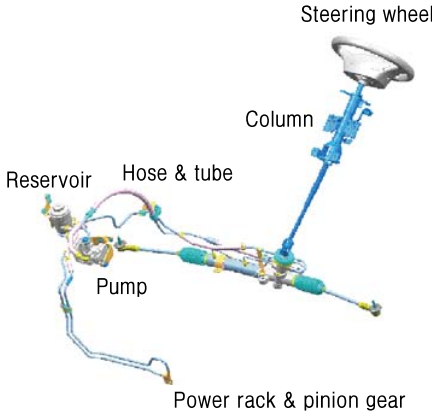
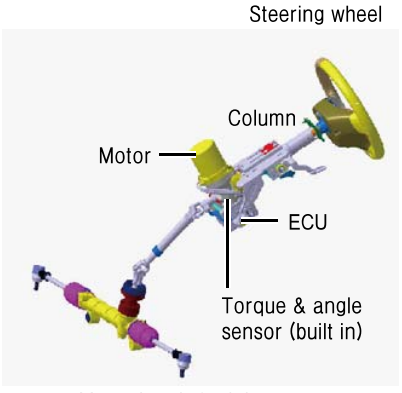
The electric power steering, EPS, does not have any belt-driven steering pump constantly running, so it is lightweight and the motor consumes energy only when the steering wheel is turned by the driver, and this leads to improvement in fuel efficiency. Also, the elimination of a belt-driven pump and its accessories greatly simplifies manufacturing and maintenance. While offering these benefits, as it does not contain any steering oil, the environment is not polluted both when the steering system is produced and discarded.
In other words, the electric power steering (EPS) system uses the electric motor to assist the steering force. It functions independently regardless of whether the engine is running or not, unlike the existing hydraulic power steering.
The EPS system generates an assist steering force variably depending on the driving conditions by controlling the motor's operation, based on the input signals from the sensors such as torque sensor and angle sensor. In turn, the EPS receives the torque signal by the driver's movements of the steering wheel, as well as the vehicle speed, and uses the motor to determine the assist torque. The EPS controls the motor for this. Another features of EPS are fail-safe function, diagnosis function, communication function between units and interface function for external diagnostic device.
The EPS system components such as the torque sensor, steering angle sensor, fail-safe relay, etc. are located in the steering column and EPS unit assembly.

▶ **Advantages:**

(1) Assurance of improved steering
- Provides optimal steering force according to the vehicle speed
- Enhanced steering stability while driving at high speed

(2) Reduced fuel consumption
- Consumes energy only when steering wheel is turned (improved by 3 to 5%)
- Energy saving (reduced by 85% compared with hydraulic power steering)
- Reduced number of parts: Elimination of steering pump, hydraulic hose, pump pulley, oil reservoir, belt, bracket, etc.

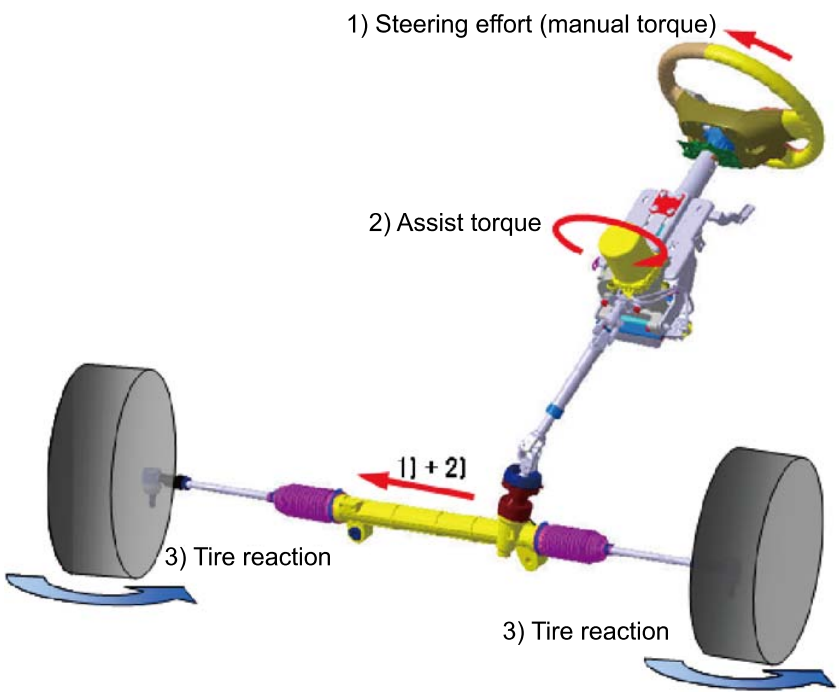
▶ **Comparison between hydraulic power steering and electric power steering (EPS)**

Hydraulic power steering	Electric power steering
	

Modification basis	
Application basis	
Affected VIN	

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2. OPERATION



Output torque = 1) Steering force (manual torque) + 2) Assist torque

When the driver turns the steering wheel, a torque is generated and the torque sensor and the steering angle sensor in the EPS system detect the rotation of the steering column to run the electric motor. At this time, the worm gear connected to the motor drives the helical gear mounted to the steering column to generate the assist torque for the steering column. This allows the driver to operate the steering wheel easier.

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GENERAL INFORMATION

1. SPECIFICATION

Description		Specification	Remark
Tire	16 inch	215 / 65R 16	Standard
	17 inch	225 / 60R 17	Optional
	18 inch	225 / 55R 18	Optional
Tire inflation pressure		32psi	-
Wheel	16 inch	6.5 J X 16	Standard
	17 inch	6.5 J X 17	Optional
	18 inch	6.5 J X 18	Optional
Balance weight		Inner: Clip-on type Outer: Adhesive type	- -
Tightening torquse of wheel bolt		127.4 ~ 156.8 Nm	17mm X 5 (Length:56.5 mm)

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2. MAJOR CHANGES

▶ **Wheel assembly changed**

Wheel Assembly		
Old		
16-inch Silver	**17-inch Silver**	**18-inch Hyper silver**
PN: 41730-34000	**PN: 41730-34100**	**PN: 41730-34220**
		
New		
16-inch Silver	**17-inch Silver**	**18-inch Diamond cutting**
PN: 41730-34200	**PN: 41730-34300**	**PN: 41730-34400**
		
- 16, 17 and 18-inch wheel assembly design changed (For 17-inch: existing 18-inch design used) (For 18-inch: Hyper silver type → Diamond cutting type) - Wheel offset and tire size same as before		

Modification basis	
Application basis	
Affected VIN	

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▶ **Repair kit changed**

Repair kit	
Old 	New 
Repair kit casing design changed (open cover type → integrated type)	

▶ **Newly added TPMS (Tire Pressure Monitoring System)**

Wheel module	
Newly introduced 	
The wheel modules are mounted to each wheel rim and hole. They transmit the signal of the pressure and temperature in tire, rotating direction and wheel module ID code, etc. using the radio frequency to the TPMS ECU.	

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

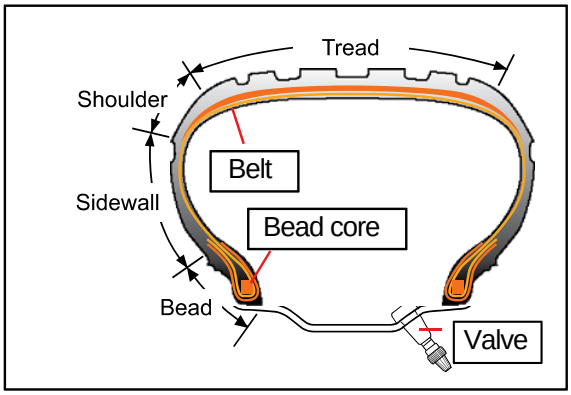
A radial tire uses a cord angle of 90 degrees. That is, the cord material runs in a radial or direct line from one bead to the other across the tread. In addition, a radial tire has a belt overwrap under the tread surface to provide greater structural stability. The belt overwrap of a radial tire distortion while the radial structure enables high speed driving.
Tire supports the weight of the vehicle, reduces the impact from the road and at the same time, transmits the power to propel, brake and steer on the road. It also functions to maintain a vehicle's movement. In order to complete such tasks, a tire must be structured to be a resilient vessel of air.
There is wear limit mark on the tire, which protrudes as a strip shape located approximately 1.6 mm from the groove bottom. This wear limit mark is not seen from the outside so there is additional "▲" mark on the shoulder to let the driver find the wear mark easily. To measure the tire groove depth, measure at any point other than the point which has a wear limit mark.
The tire is worn unevenly according to the driver's driving habit, improper servicing, low tire inflation pressure, changed tire location, etc.

1) Structure of Tire

Tread
This thick layer of rubber provides the interface between the tire and the road. Wear-resistant rubber is used to protect the carcass and belt against fractures and impacts and to deliver a long driving life.

Shoulder
Located between the tread and sidewall, the shoulder rubber is the thickest so that the design must allow for the easy diffusion of heat generated within the tire while driving.

Sidewall
The part between the shoulder and bead, the flexible sidewall protects the carcass and enhances the ride. A tire's type, size, structure, pattern, manufacturing company, product name and various characters are indicated here.



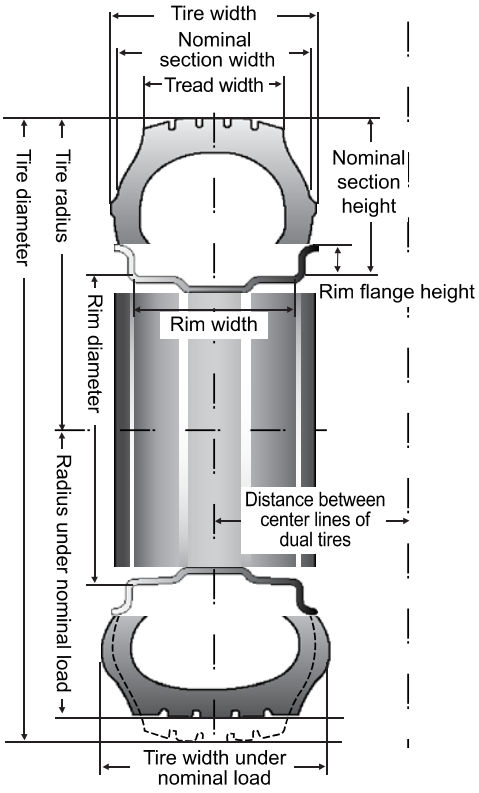
Bead
The bead attaches the tire to the rim and wraps the end of the cord fabric. Comprised of the bead wire, core, flipper and other parts, the bead is generally designed to be slightly tight around the rim so that in the case of a sudden drop in inflation pressure, the tire will not fall off the rim.

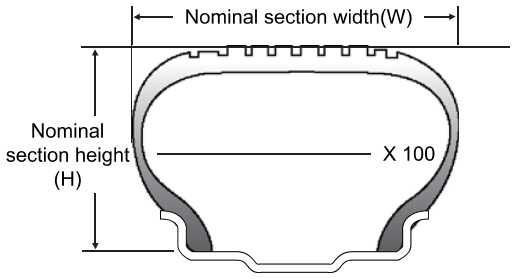
Carcass
As the most important framework of a tire, the entire inner layer of cord fabric is called the carcass. The carcass acts to support air pressure, vertical load and absorb shocks.

Modification basis	
Application basis	
Affected VIN	

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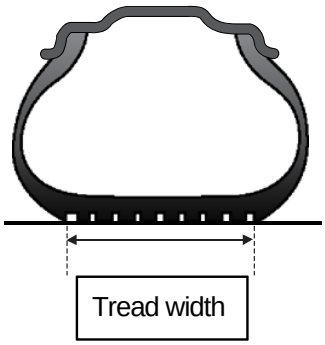
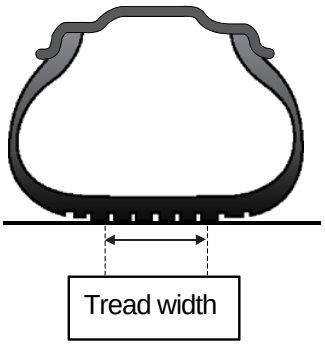
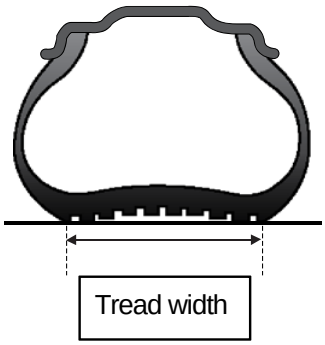
2) Tire Unit Indication





Aspect ratio (%)
= Nominal section height (H) / Nominal section width (W)
X 100

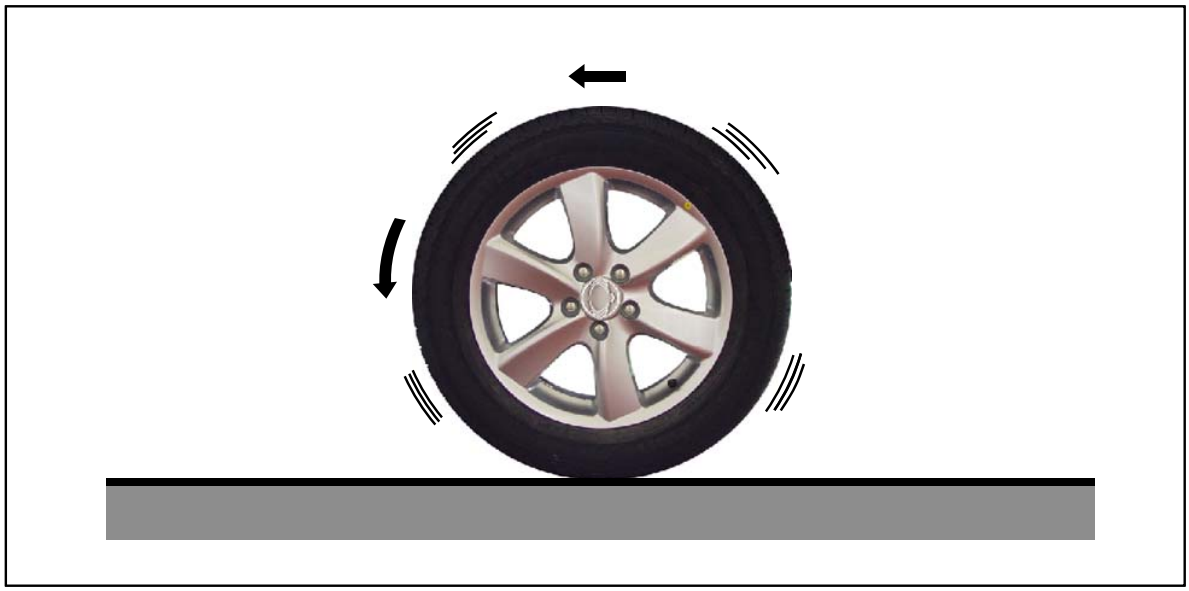
3) Tire Inflation Pressure (32 psi)

Proper inflation pressure	Excessive inflation pressure	Low inflation pressure
		
Tread width	Tread width	Tread width
The contact area between the ground and tire faces the tread layer completely. Thus the driving force and the braking force are optimized, and the tire is worn out evenly resulting in increased life.	The contact area between the ground and tire is not enough, so the tire is worn out unevenly and the tire is vulnerability to outside influence.	The contact area between the ground and tire is excessive, so a lot of heat is generated and the tire is worn out unevenly and abnormally.

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2. ABNORMAL TIRE SYMPTOM

1) Standing Wave

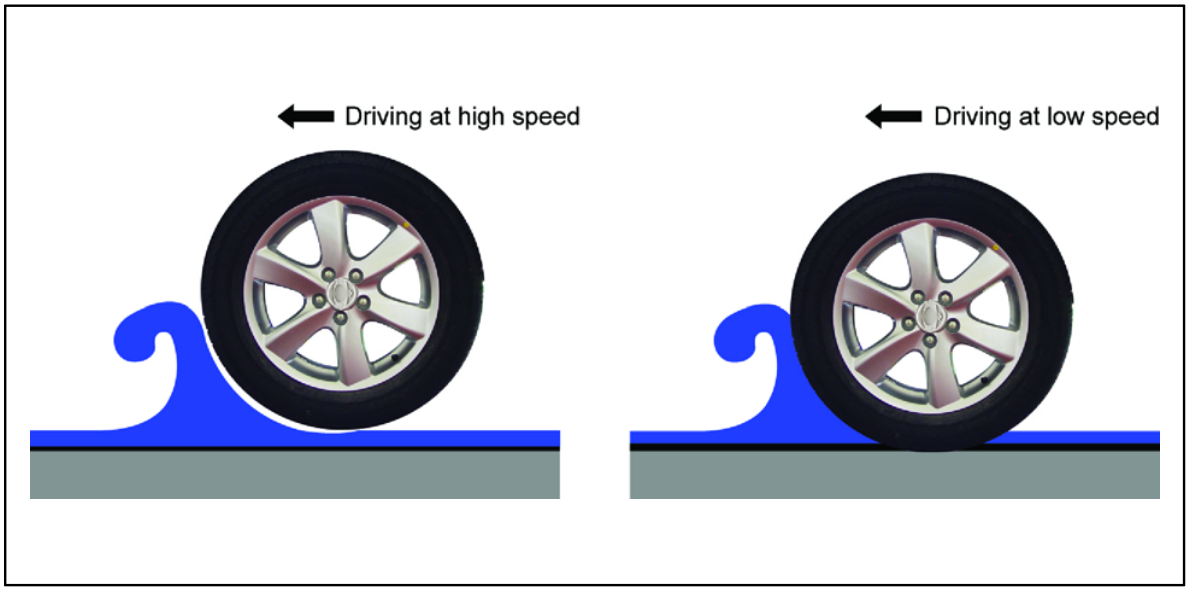


Specified tire inflation pressure	32psi

During driving, the rotating tire repeats deformation and restoring movement in is tread. This happens when the tire pressure is low in high speed driving.
However, when the wheel rotating speed is fast, the tire is deformed even before it is restored to its original shape and the trembling wave appears on the tread portion. If this symptom lasts for an extended period of time, the tire can be blown out in a short period of time.
If the standing wave symptom occurs on the tire, rubber on the tread comes off and eventually the tire can be blown out which is very dangerous. When driving at high speed, the inflation pressure should be increased to decrease heat generation due to extension and contraction motion, to decrease hydroplaning and to prevent standing wave.
To prevent this symptom, it is recommended to increase the tire pressure 10 ~ 30 % higher than the specified pressure value in high speed driving.

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2) Hydro Planing



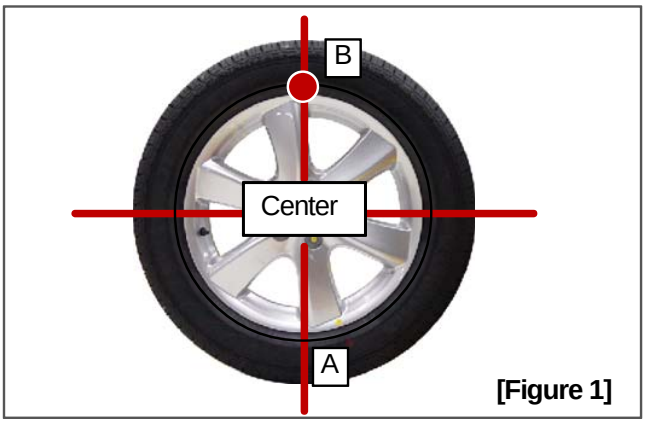
When the vehicle is driven on a road surface covered with water at high speed, tires do not contact with the road surface but rotate floating on a thin film of water.
It causes brake failure, lower traction force and losing the steering performance.
To prevent this, increase the tire inflation pressure, use tires with leaf shape tread which is not worn. However, it is a best measure to drive slowly.

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3. WHEEL BALANCE

If weight is not equally distributed around the wheel, unbalance centrifugal force by the wheel rotation produces vibration. As the centrifugal force is produced proportional to the square of the rotating speed, the wheel weight should be balanced even at high speed. There are two types of the tire and wheel balancing: static and dynamic. Abnormal vibration may also occur due to unbalanced rigidity or size of tires.

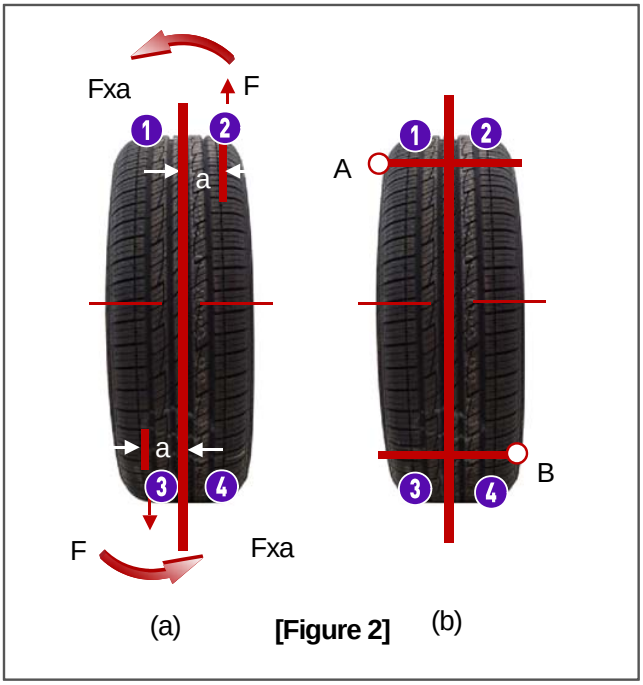
1) Static Balance



[Figure 1]

When the free rotation of the wheel is allowed, the heavier part is stopped on the bottom if the wheel weight is unbalanced and this is called "Static Unbalance". Also, the state at which tire's stop position is not same is called "Static Balance" when the wheel is rotated again. If the part A is heavier as shown in the figure 1, add the balance weight of a weight corresponding to unbalanced weight from B to A to maintain the static balance. If the static balance is not maintained, tramping, up and down vibration of the wheels, occurs.

2) Dynamic Balance



[Figure 2]

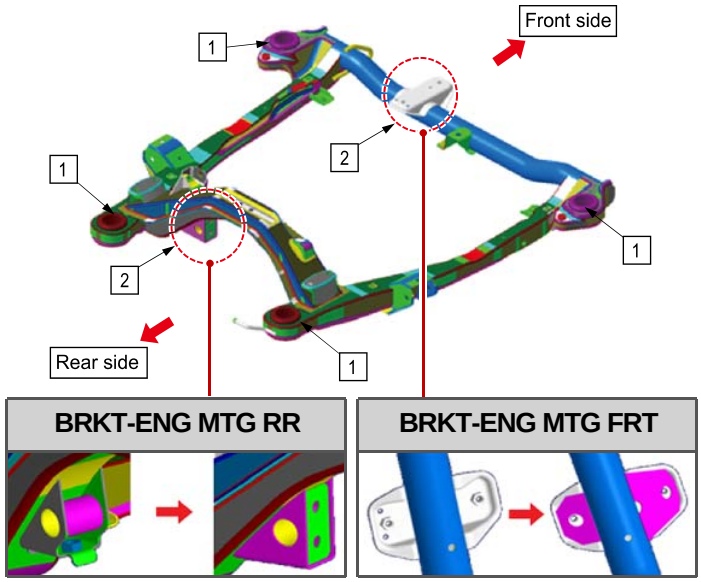
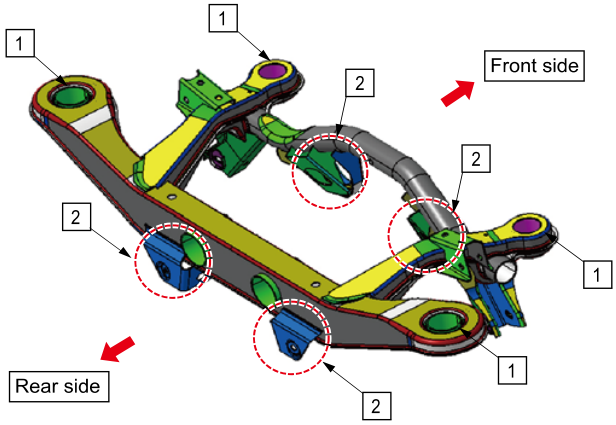
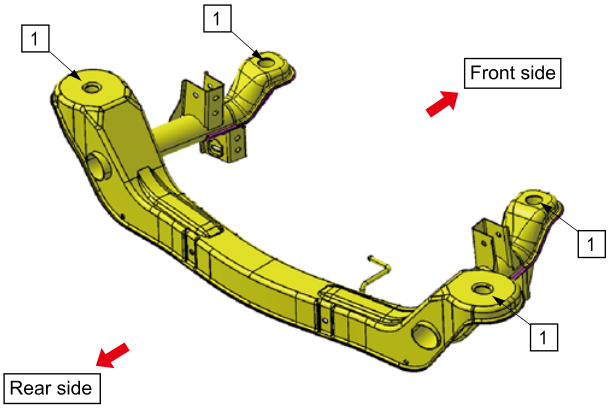
The static unbalance of the wheel creates the vibration in the vertical direction, but the dynamic unbalance creates the vibration in the lateral direction. As shown in the figure 2 (a), if two parts, (2) and (3), are heavier when the wheels are under the static balance condition, dynamic unbalance is created, resulting in shimmy, left and right vibration of the wheels, and the torque Fxa is applied in the axial direction. To correct the dynamic unbalance, add the balance weight of a same weight for two points of the circumference of the rim, A and B, as shown in the figure 2 (b), and apply the torque in the opposite direction to the torque Fxa to offset in order to ensure smooth rotation of the wheel.

Modification basis	
Application basis	
Affected VIN	

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GENERAL INFORMATION

1. SPECIFICATION

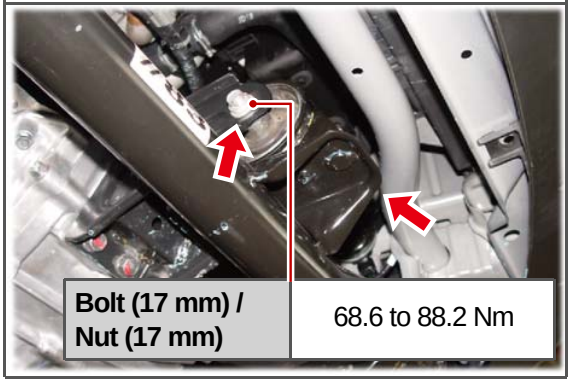
Unit	Construction	
Front sub frame	1. Body mounting: 4-points bush 2. Transaxle mounting: 2-points bush 3. Weight: 22.37 kg	
Rear sub frame (4WD)	1. Body mounting: 4-points bush 2. Axle mounting: 4-points bush 3. Weight: 16.61 kg	
Rear sub frame (2WD)	1. Body mounting: 40 points direct mounting 2. Spring link: Direct mounting without bracket on rear cross member 3. Weight: 12.74 kg	

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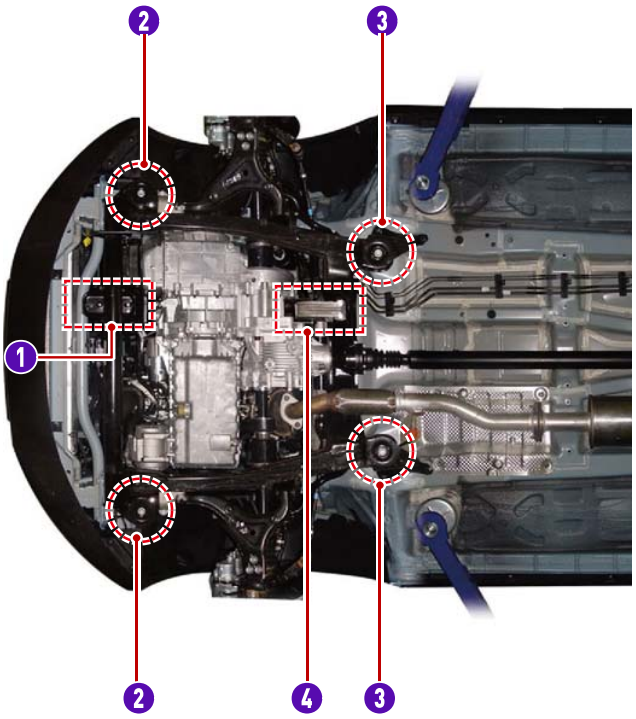
2. TIGHTENING TORQUE

▶ **Front sub frame - based on 4WD**

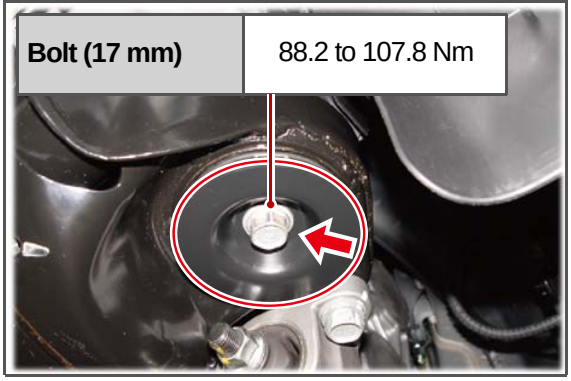
1. Transaxle mounting (Front)



Bolt (17 mm) / Nut (17 mm)	68.6 to 88.2 Nm



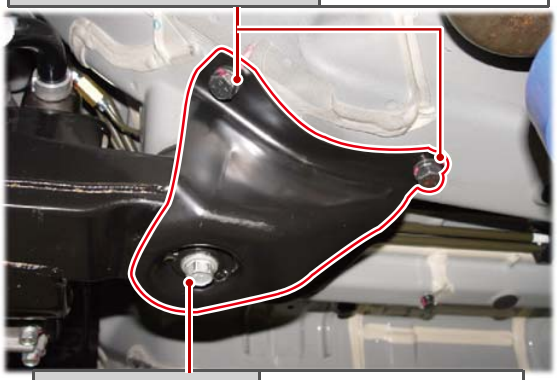
2. Front mounting (LH & RH)



Bolt (17 mm)	88.2 to 107.8 Nm

3. Rear mounting (LH & RH)

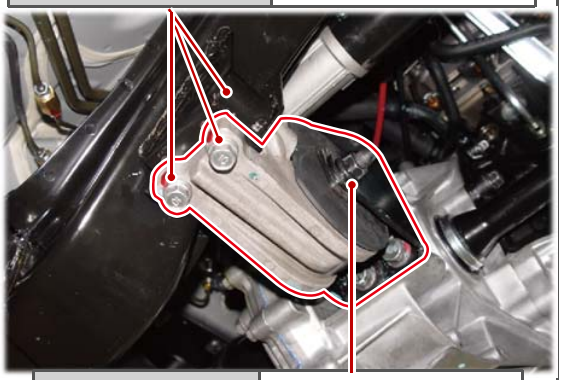
2 Bracket mounting bolts (17 mm)	88.2 to 107.8 Nm



Bolt (17 mm)	88.2 to 107.8 Nm

4. Transaxle mounting (Rear)

3 Bolts (14 mm)	29.4 to 49.0 Nm

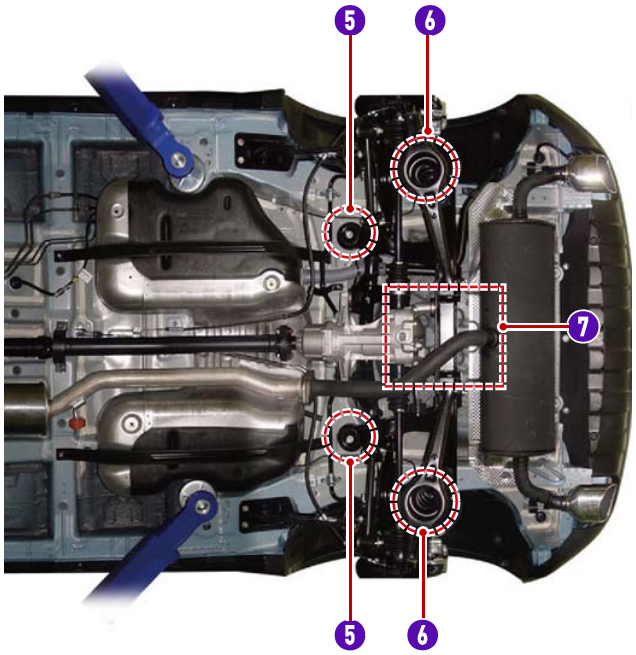


Bolt (14 mm) / Nut (14 mm)	68.6 to 88.2 Nm

Modification basis	
Application basis	
Affected VIN	

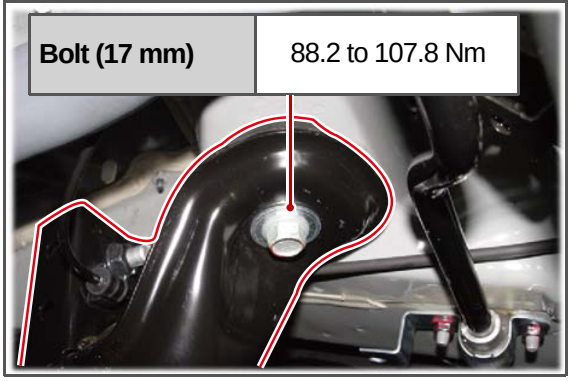
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▶ Rear sub frame - based on 4WD



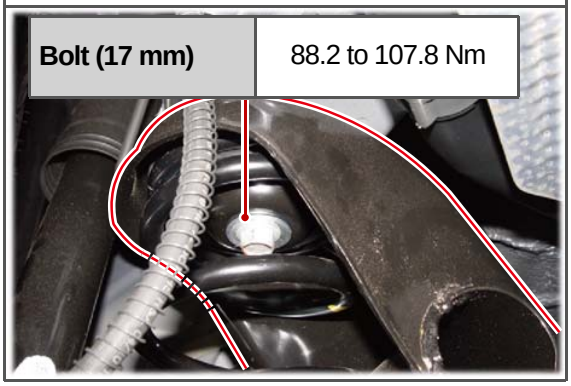
5. Front mounting (LH & RH)

Bolt (17 mm)	88.2 to 107.8 Nm



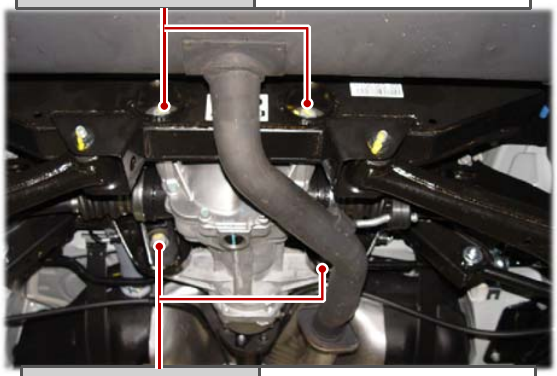
6. Rear mounting (LH & RH)

Bolt (17 mm)	88.2 to 107.8 Nm



7. Rear axle mounting

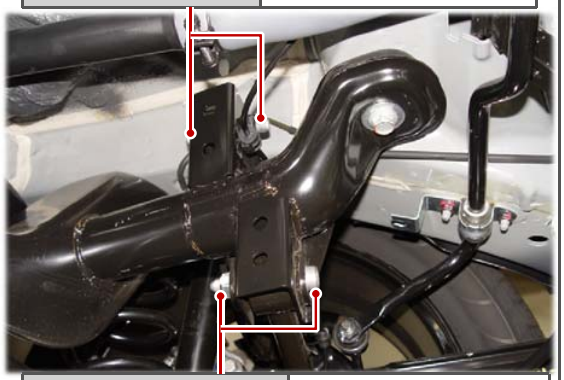
Rear mounting bolt (17 mm)	107.8 to 127.4 Nm



Rear mounting bolt (14 mm)	68.6 to 88.2 Nm

8. Other connections for rear sub frame (LH & RH)

Upper arm bolt (17 mm) / Nut (19 mm)	98.0 to 117.6 Nm

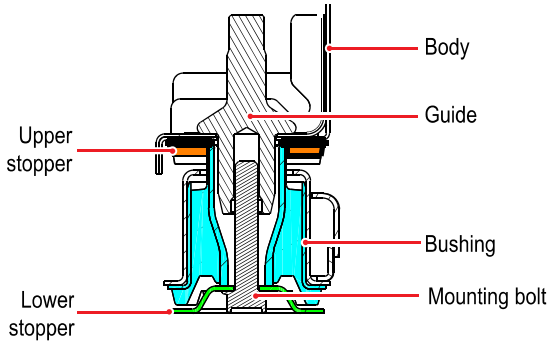
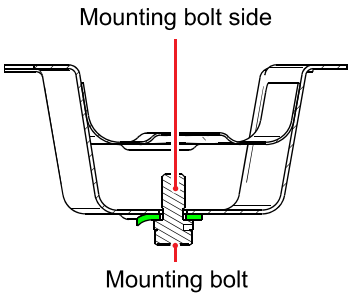
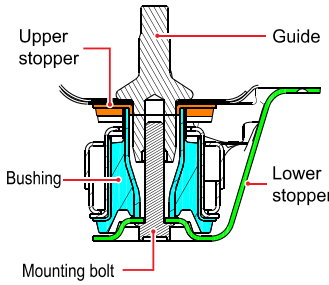
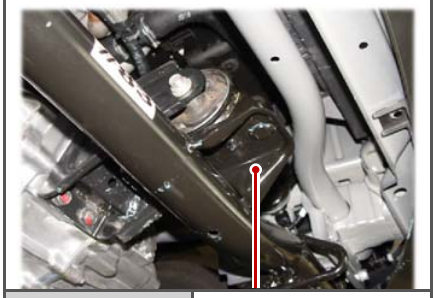
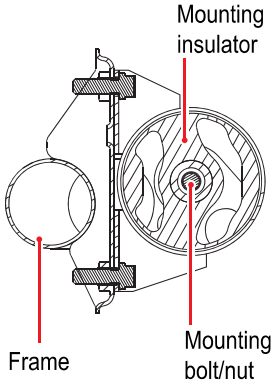
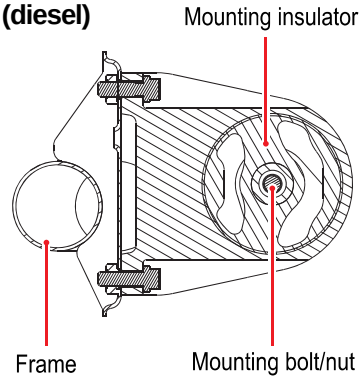
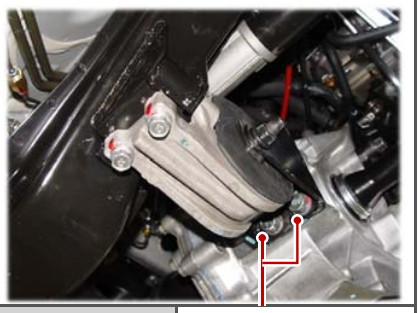
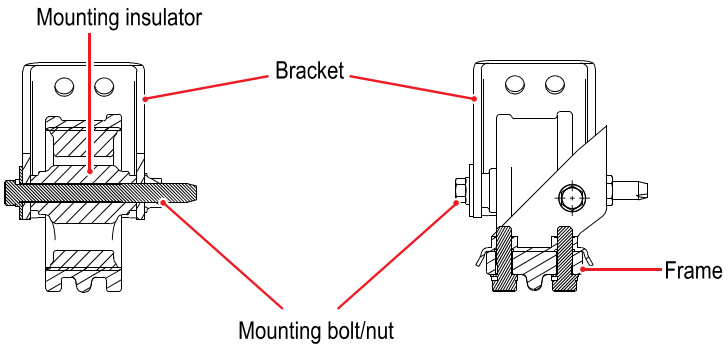


Lower arm nut/Bolt (19 mm)	98.0 to 117.6 Nm

Modification basis	
Application basis	
Affected VIN	

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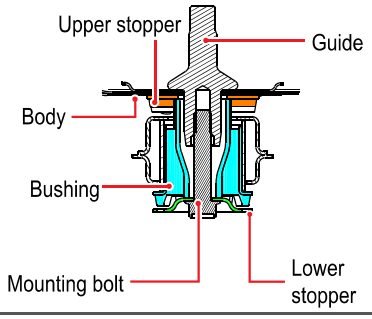
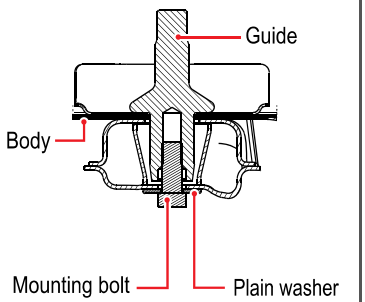
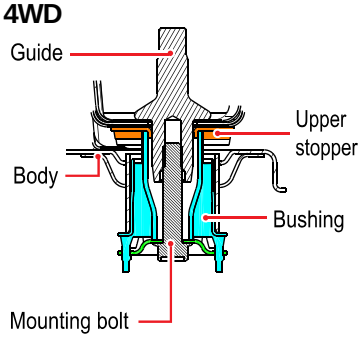
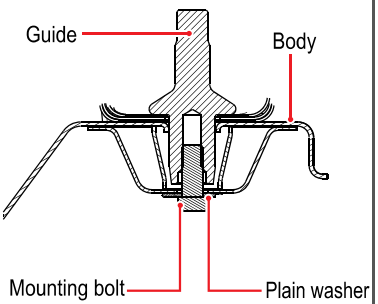
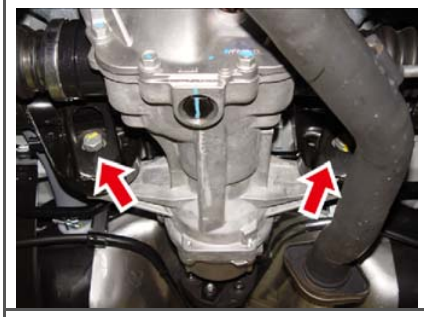
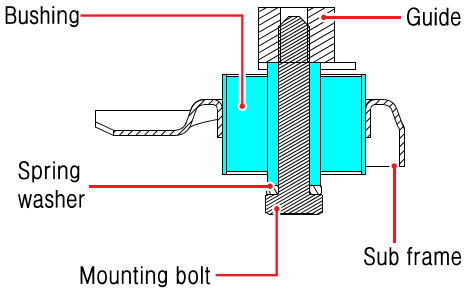
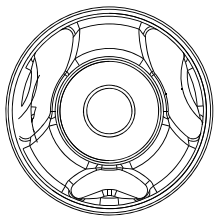
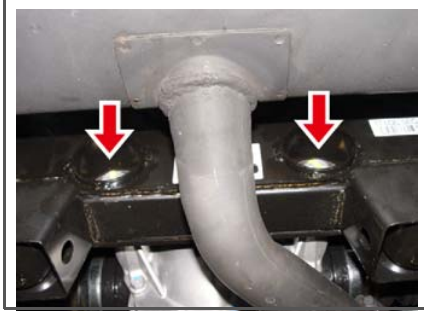
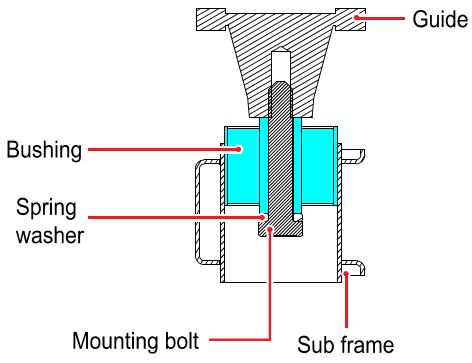
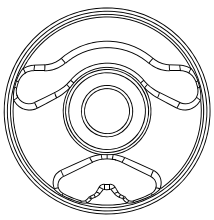
1) Sectional Diagram and Bolts for Front Sub Frame

Installation	Sectional diagram
1. Front 	
2. Rear 	**Mounting bracket**  **Mounting bolt** 
3. Transaxle mounting (Front)  **Mounting nut** 29.4 to 39.2 Nm	**For manual transaxle**  **For automatic transaxle (diesel)** 
4. Transaxle mounting (Rear)  **Bolt** 9.4 to 39.2 Nm	

Modification basis	
Application basis	
Affected VIN	

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2) Sectional Diagram and Bolts for Rear Sub Frame

Installation	Sectional structure	
1. Front 	**4WD** 	**2WD** 
2. Rear 	**4WD** 	**2WD** 
3. Rear axle - Front (4WD) 		
4. Rear axle - rear (4WD) 		

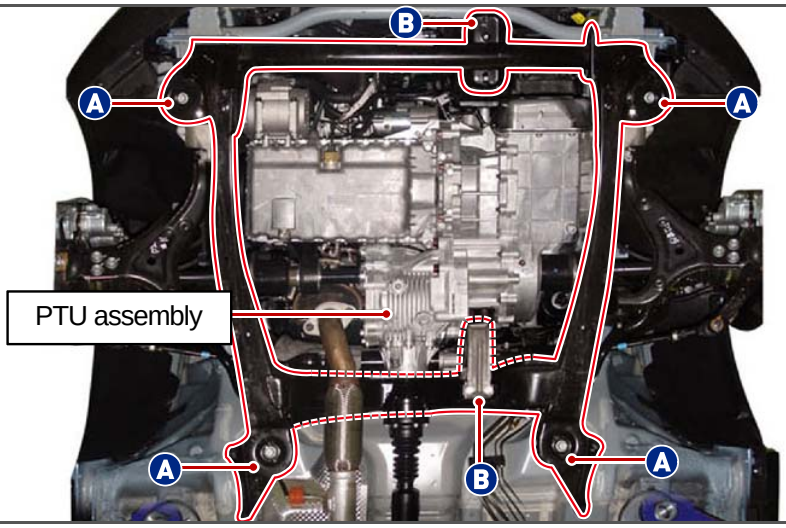
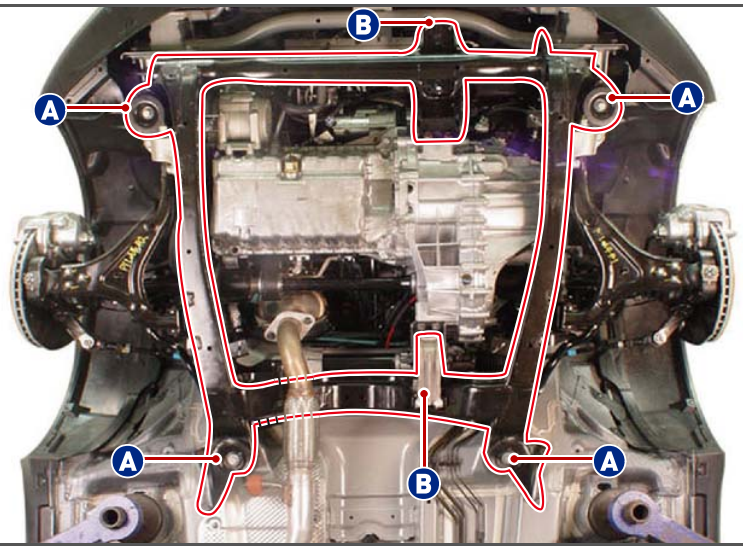
Modification basis	
Application basis	
Affected VIN	

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OVERVIEW AND OPERATING PROCESS

S.G.N. 4012-01 OVERVIEW OF FRONT SUB FRAME

The front sub frame consists of 4 body bush mountings(A) and 2 engine bush mountings(B) which reduce the vibration from the powertrain and road, and also control the torque. And the two engine bush mountings consist of an engine mounting which supports the engine powertrain and a transmission mounting.
The engine side and transmission side mountings are rubber mountings with brackets and insulators while the body mounting is a rubber bush mounting which is fitted to the frame.

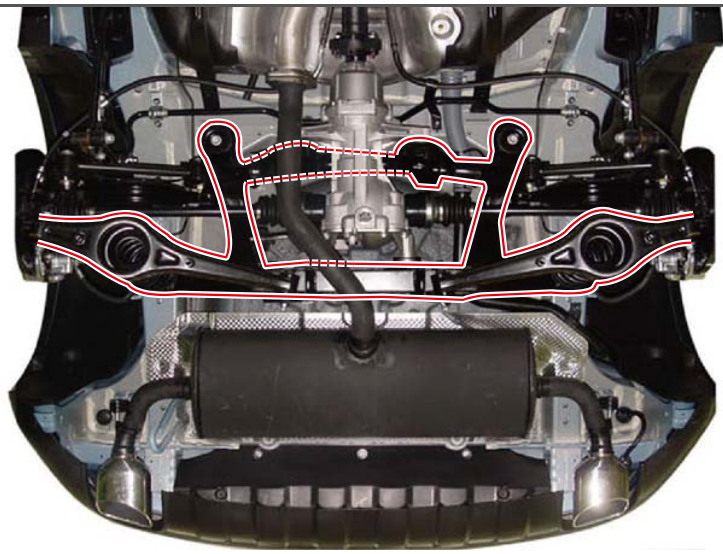
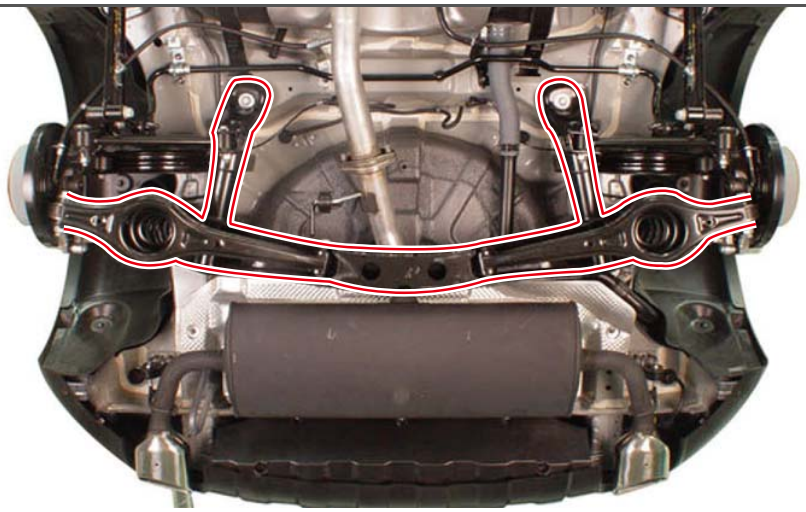
Installation of front sub frame (4WD)	The installation of the front sub frame is the same for both automatic transmission and manual transmission. For 4WD, the PTU and the propeller shaft are installed.
	
Installation of front sub frame (2WD)	The installation of the front sub frame is the same for both automatic transmission and manual transmission.
	

Modification basis	
Application basis	
Affected VIN	

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S.G.N.
4015-01 OVERVIEW OF REAR SUB FRAME

The rear sub frame system consists of body bush mountings and direct mountings which reduce the vibration transmitted from the powertrain and road to the vehicle body.
For 4WD, it consists of 4 body mountings (bush mountings) and 2 axle mountings (bush mountings) and for 2WD, it consists of 4 body mountings (direct mountings).

Installation of rear sub frame (4WD)	The installation of the rear sub frame is the same for both automatic transmission and manual transmission. For 4WD, the E-coupling, propeller shaft and rear axle are installed.
	
Installation of rear sub frame (2WD)	The installation of the rear sub frame is the same for both automatic transmission and manual transmission.
	

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TPMS

4190-00

GENERAL INFORMATION

1. SPECIFICATIONS

Unit	Item	Specification	Remarks
TPMS ECU	Voltage range	9 ~ 16 V	-
	Active mode	50 mA	-
	Coast mode	30 mA	-
	Sleep mode	100 uA	-
	Bit rate	500 Kbps	-
	Modulation type	Amplitude modulation (AM)	-
	Frequency	433.92 Mhz	-
Wheel module	Pressure measuring range	0 ~ 6.375 bar (0~92.43 psi)	1 bar = about 14.5 psi
	Tolerance range of measured pressure	±5% (−40℃ ~ −10℃) ±2% (−10℃ ~ 70℃) ±5% (70℃ ~ 100℃)	-
	Tolerance range of measured temperature	±5% (−40℃ ~ −10℃) ±2% (−10℃ ~ 70℃) ±5% (70℃ ~ 100℃)	-
	Temperature measuring range	−50℃ ~ 205℃	-
	Battery life	Lithium battery (about 3.0~3.2 V), 160,000 km or 10 years	It can be shortened depending on use condition.
Tire	Inflation pressure	32 psi	-

Modification basis	
Application basis	
Affected VIN	

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2. SPECIAL TOOL FOR TPMS SYSTEM

The following torque wrench and connecting adapter should be prepared when installing the TPMS wheel module.

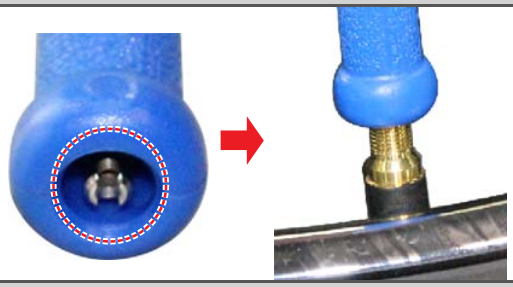
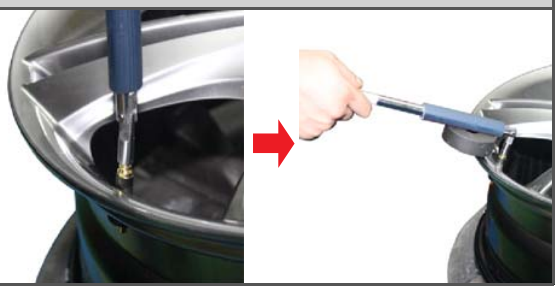
CAUTION

When fitting the wheel module, tighten the mounting bolt to the specified tightening torque (1.4 Nm) to prevent the wheel module from being damaged due to excessive tightening.







How to use	
Torque wrench	**To remove and install valve insert**
	
	To remove and install valve body
	

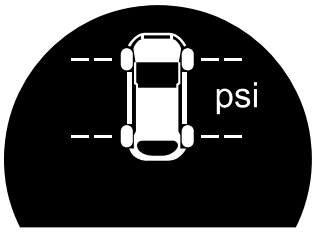
Modification basis	
Application basis	
Affected VIN	

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3. CAUTIONS

CAUTION

- The tire pressure values displayed on the instrument cluster are sent from the wheel modules after the vehicle is driven for a period of time. Therefore, they are not displayed at initial start (more than 20 minutes have elapsed after ignition off). It can be displayed after 10 minutes of driving at speed of 20 km/h or higher.

At initial start	Display pressure value after detecting position automatically
Standard type	
F-- --	F32 32
R-- --	R32 32
Supervision type	
	

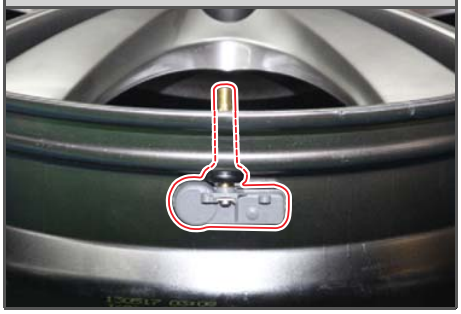
- The TPMS uses a radio frequency and a high frequency band between the wheel module and the TPMS ECU for communication.
  Therefore, if the vehicle is equipped with the electronic equipment such as mobile camera monitor or the vehicle is passing through the area with a strong electromagnetic field, the system may not operate normally.
- For the vehicle equipped with the TPMS, the TPMS warning lamp on the instrument cluster comes on and pressure values on the EL display is displayed as bars (--) after driving for a certain period of time if a newly installed tire is not equipped with the wheel module.

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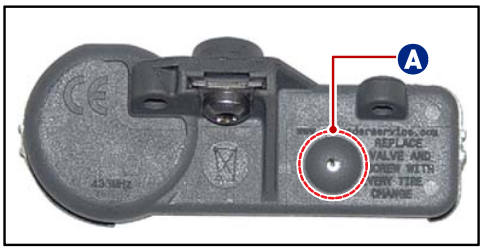
CAUTION

- If the vehicle is equipped with the TPMS, all wheels are equipped with the wheel modules. In this case, the wheel module may be interfered with the wheel rim depending on the mounting surface type of the rim. Therefore, always use the SYMC genuine wheel and wheel module for the vehicle.

Mounted view



- Clean the wheel mounting surface and inner side of the wheel thoroughly when replacing the tires. However, never inject the commercial anti-flat fluid or similar substance. It may cause a critical error to the wheel module.



Modification basis	
Application basis	
Affected VIN	

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Memo

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The TPMS is used to reduce the accident rate, enhance driving stability and avoid an unnecessary fuel consumption and tire wear by monitoring the tire pressure and temperature to inform the driver of tire pressure information and its status through the instrument cluster. The wheel module fitted in the tire transmits the internal data for the tire to the TPMS ECU periodically through the wireless transmission. The TPMS ECU can detect the positions of the wheel modules fitted to each wheel automatically and sends the signal on tire condition through the CAN line to the instrument cluster so that the driver can identify the wheel module in question.

2. LAYOUT



Instrument cluster display related to TPMS (with standard)		
DOT LCD display	**TPMS warning lamp**	**Global warning lamp**
F32 32 R32 32	TPMS	
Instrument cluster display related to TPMS (with supervision)		
DOT LCD display	**TPMS warning lamp**	**Global warning lamp**
32 32 psi 32 32 TIRE PRESSURES OK	TPMS	

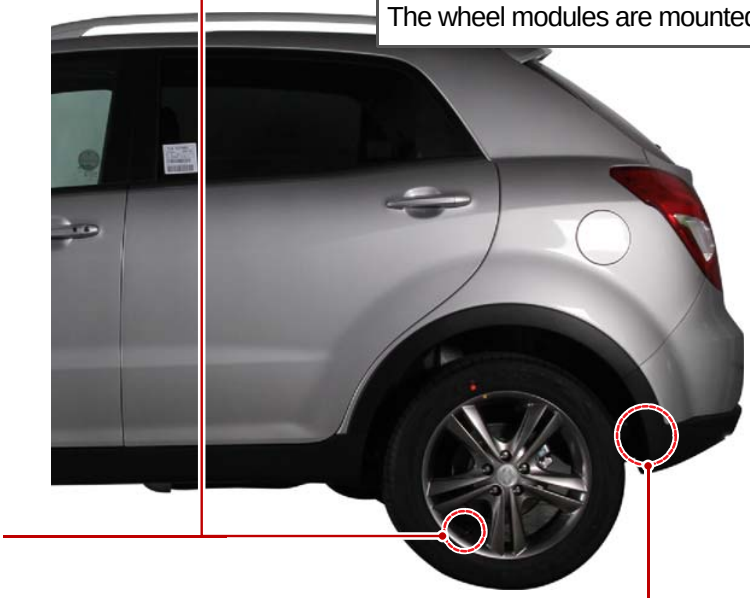
Modification basis	
Application basis	
Affected VIN	

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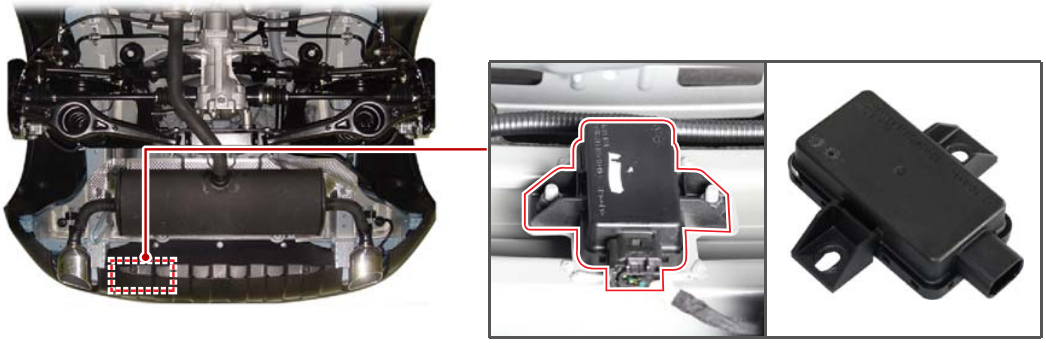
Wheel module



The wheel modules are mounted to each wheel rim and hole.



TPMS ECU

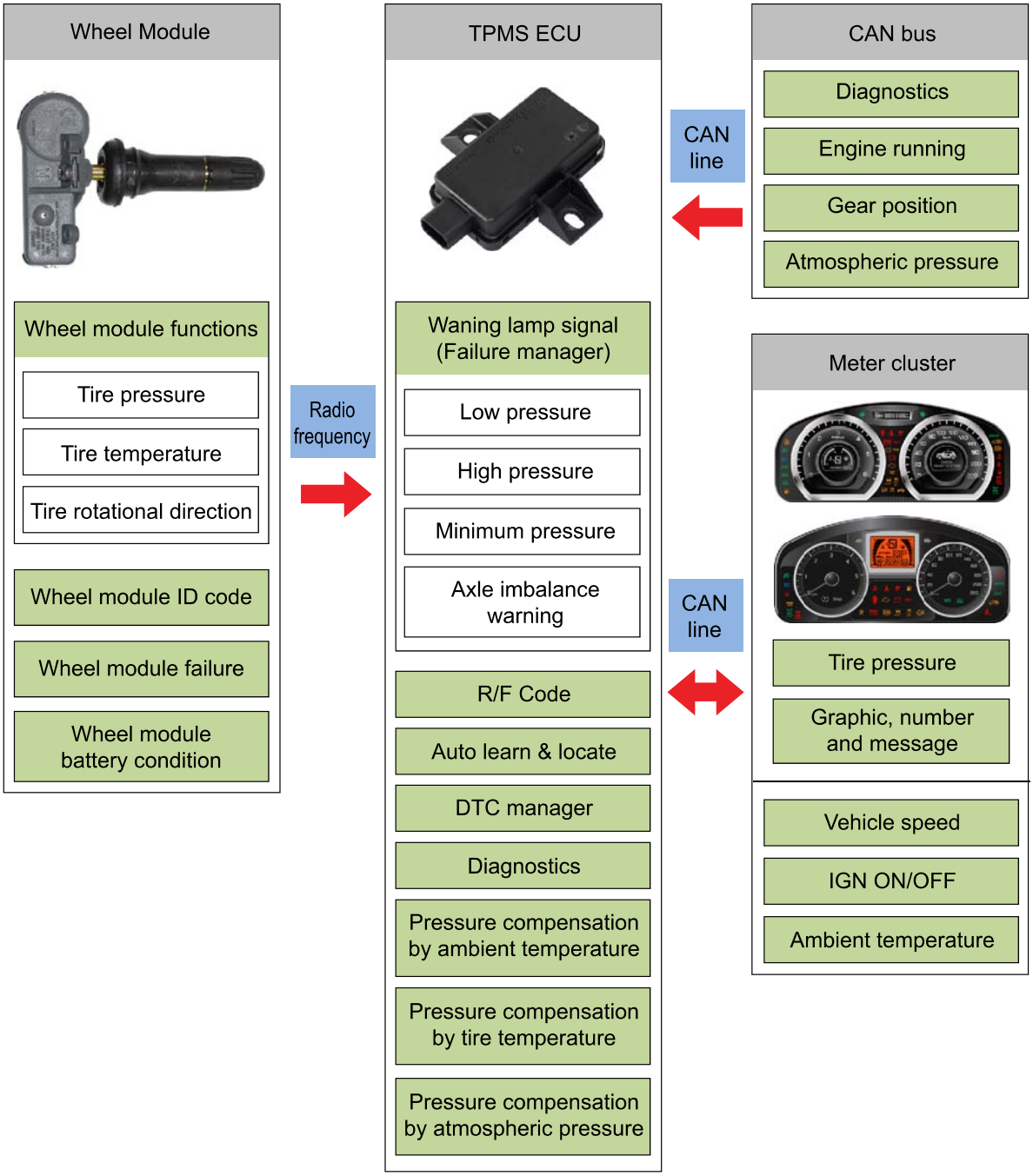


The TPMS ECU is mounted to the rear bumper beam.

Modification basis	
Application basis	
Affected VIN	

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3. TPMS ECU I/O DIAGRAM

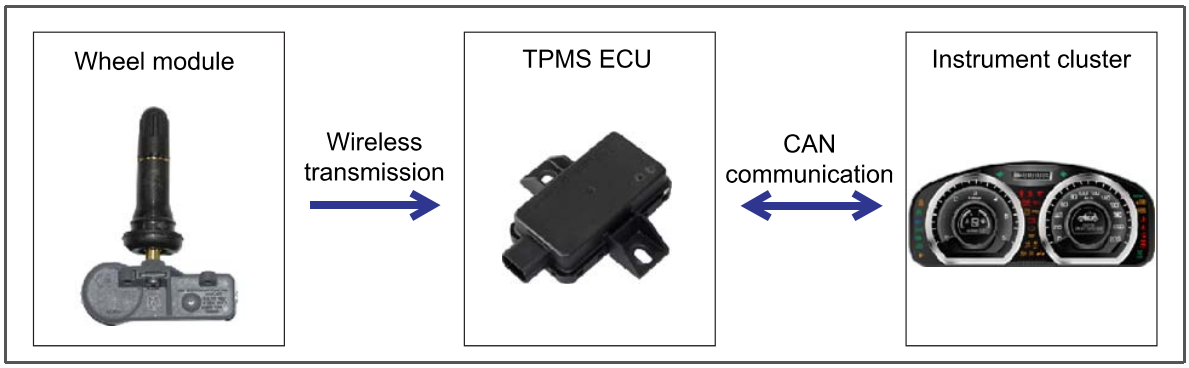


Modification basis	
Application basis	
Affected VIN	

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4. TPMS PRESSURE VALUE DISPLAYING PROCESS

The TPMS ECU receives the tire pressure value from the wheel module through the wireless transmission once every about 30 seconds and displays the pressure value on the instrument cluster through CAN line.



NOTE

Under normal circumstances, it transmits the tire pressure value and temperature value together with its ID (Identification) once every about 30 seconds to reduce the load on the wheel module's battery. But, in the event of emergency or situation which should give a warning to the driver, it transmits the data once every about 1 second. Since the battery consumption will be increased rapidly until the data transmission interval will be returned to normal after certain length of time, adjust the tire pressure to the specified one after rectifying the cause.

▶ **The tire pressure is displayed through the following sequences, which occur at the same time.**

Wheel module detection (Auto learning)	This is a step which receives an ID signal from the wheel module fitted to the vehicle. When the wheel module sends the signal about twice every 1 minute, each wheel module will be identified.
Wheel module mounting location detection (Auto location)	The TPMS ECU check which wheel module is installed to which tire.

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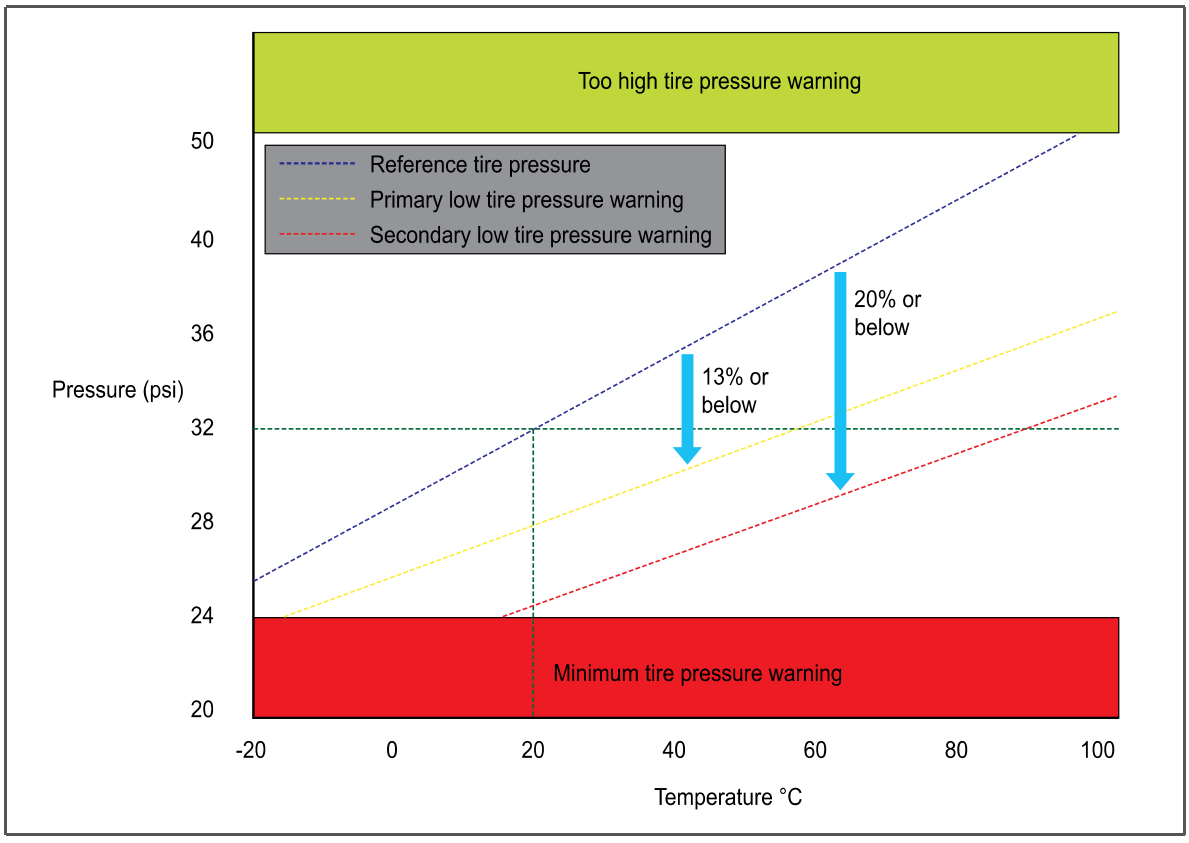
5. LOW TIRE PRESSURE WARNING

If the tire pressure is less than 13% of the proper value calculated by the TPMS ECU depending on the ambient temperature for more than 8 minutes, the 1st low tire pressure warning is given. And, if the tire pressure is less than 20% for more than 4 minutes, the 2nd warning is given. At this time, the "Check tire" message is displayed on the DOT LCD display and the global warning lamp comes on.

NOTE

While the proper tire pressure in this vehicle is 32 psi at room temperature of 20℃, the TPMS ECU receives the ambient temperature signal from the instrument cluster through CAN communication and calculates the proper tire pressure to correct it since the tire pressure changes depending on the ambient temperature.

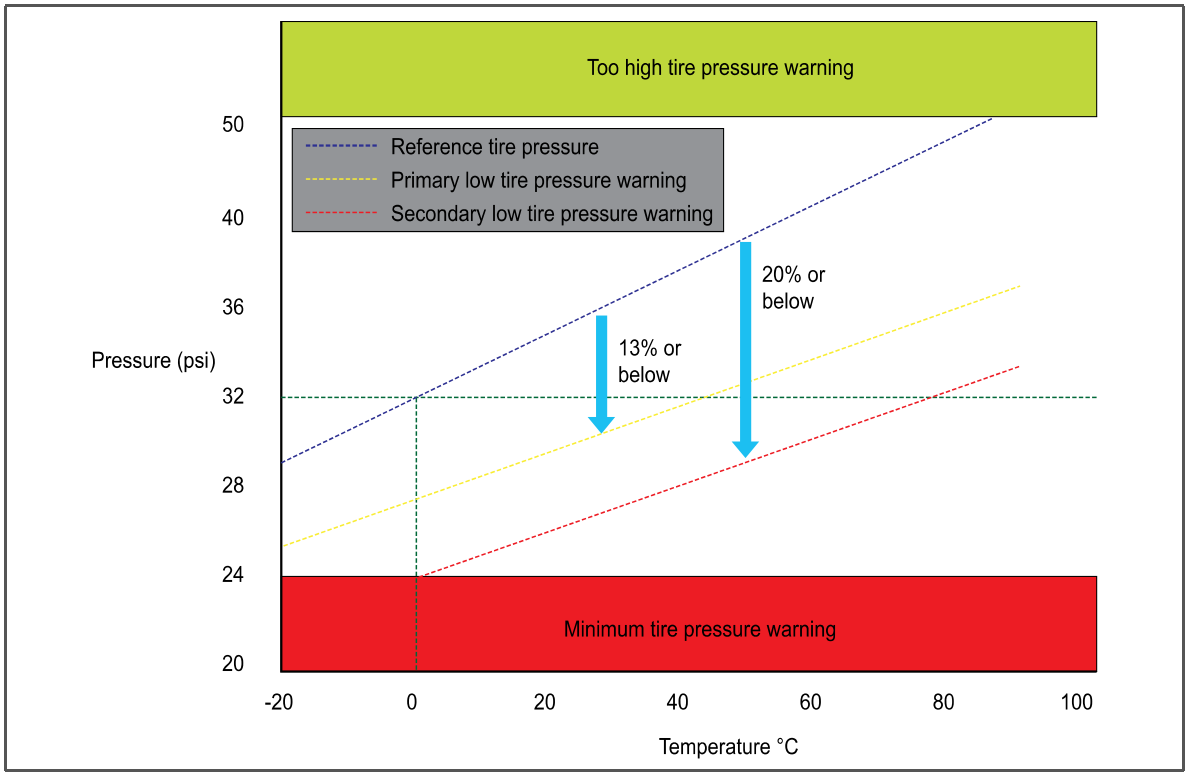
▶ At room temperature of 20°C



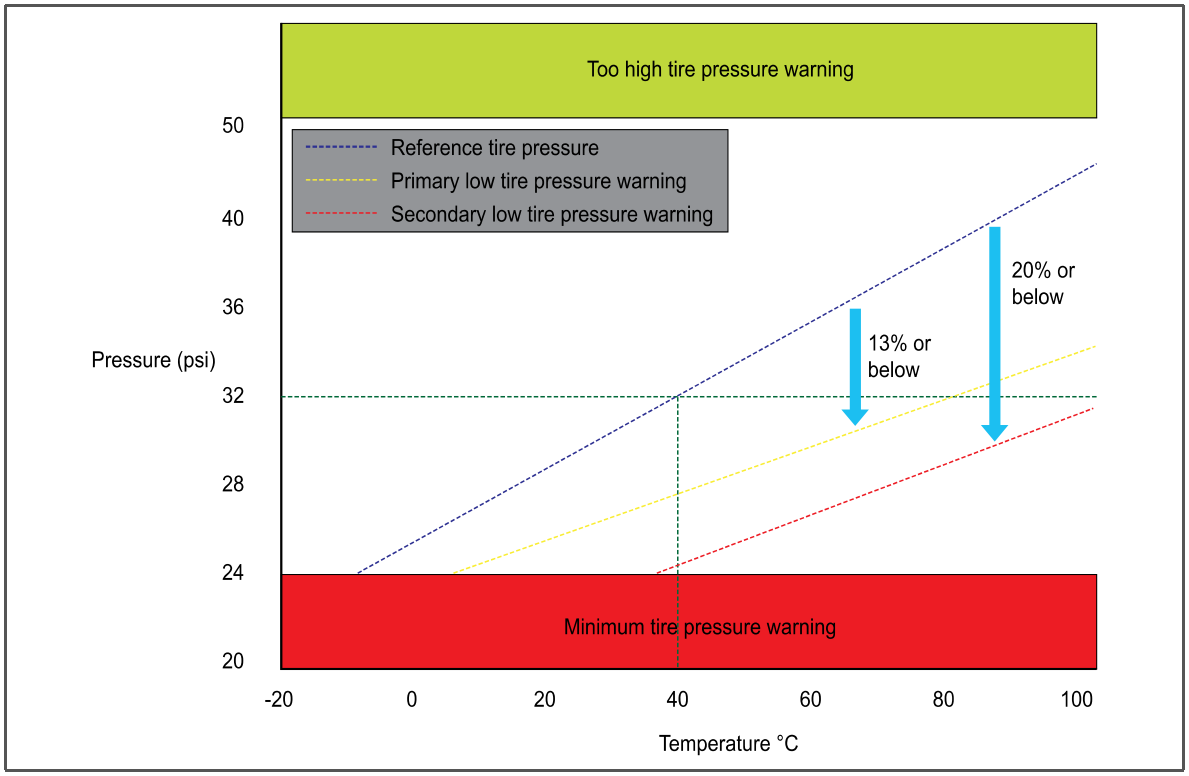
Modification basis	
Application basis	
Affected VIN	

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▶ At room temperature of 0°C



▶ At room temperature of 40°C



Modification basis	
Application basis	
Affected VIN	

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6. DISPLAY AND WARNING LAMPS RELATED TO TPMS

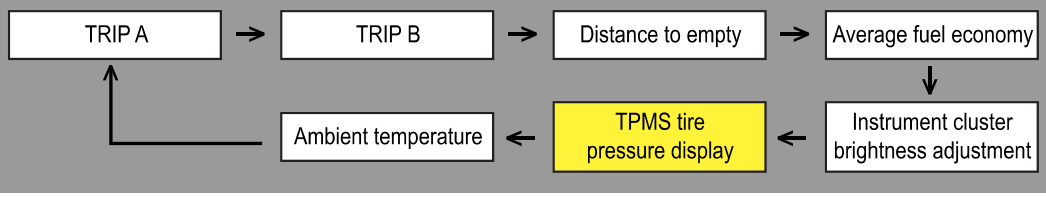
Supervision type



Display on cluster	
TPMS warning lamp TPMS	- This lamp comes on when the engine is initially started or the ignition switch is pressed ON (for about 4.0 seconds). Then, it goes off if the system is normal. - It comes on if an error occurs in any component related to the TPMS regardless of tire inflation pressure.
Global warning lamp	- This lamp comes on when the engine is initially started or the ignition switch is pressed ON (for about 4.0 seconds). Then, it goes off if the system is normal. - In the event of TPMS system (including sensor) failure, it flashes for 70 seconds at interval of 0.4 seconds and comes on. - Comes on when the tire pressure is low.
DOT LCD display 32 32 psi 32 32 TIRE PRESSURES OK	- It informs the driver of current tire pressure and abnormalities such as loss or over inflation by displaying them on the display. - The driver can see the current tire pressure by pressing the TRIP switch (press for 80 ms~1 sec.).

NOTE

DOT LCD display presentation sequence



Modification basis	
Application basis	
Affected VIN	

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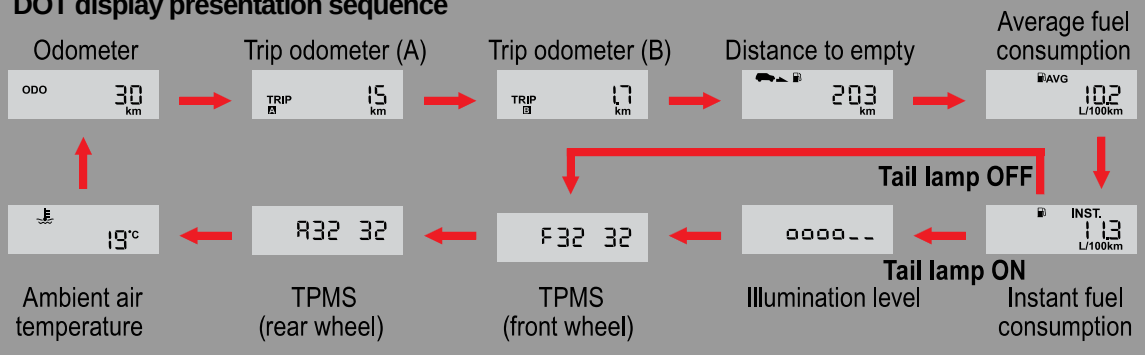
Standard type



Display on cluster	
TPMS warning lamp TPMS	- This lamp comes on when the engine is initially started or the ignition switch is pressed ON (for about 4.0 seconds). Then, it goes off if the system is normal. - It comes on if an error occurs in any component related to the TPMS regardless of tire inflation pressure.
Global warning lamp	- This lamp comes on when the engine is initially started or the ignition switch is pressed ON (for about 4.0 seconds). Then, it goes off if the system is normal. - In the event of TPMS system (including sensor) failure, it flashes for 70 seconds at interval of 0.4 seconds and comes on. - Comes on when the tire pressure is low.
DOT display F32 32 R32 32	- The tire pressure for front wheels is displayed on the LCD display. The tire pressure for rear wheels is displayed when pressing the Trip switch.

NOTE

DOT display presentation sequence

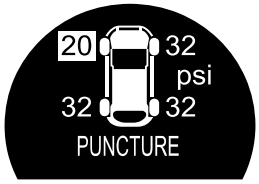
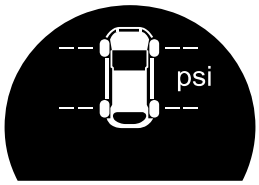


Modification basis	
Application basis	
Affected VIN	

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1) DOT LCD Display Related to TPMS

▶ **Supervision type**

Status	DOT LCD display	Condition & illumination method
Correct tire pressure		The specified tire pressure is based on a cold tire with the vehicle unloaded (no occupant); 32 psi at 20℃.
Excessive tire pressure		Corresponding status lamp blinks with reverse shading at interval of 0.4 seconds if tire pressure is 50 psi or higher
Low tire pressure		When tire pressure is less than 13~20% of specified value for a period of time, corresponding status lamp blinks with reverse shading for 70 seconds at interval of 0.4 seconds
Lower than minimum tire pressure		Corresponding status lamp comes on if tire pressure is 24 psi or less
Sudden tire pressure loss		Corresponding status lamp blinks with shading reverse at interval of 0.4 seconds if tire pressure changes more than 3 psi per 1 minute at speed of 0 km/h or above.
Imbalance between left and right tire pressure		Corresponding status lamps blink alternately at interval of 1.0 second if tire pressure differs by more than 4 psi in the left and right tires while driving for more than 10 minutes
Impossible to determine tire pressure		Pressure of the tire displayed as "--" when not possible to determine tire pressure correctly * At initial start, the tire pressure can be displayed after 10 minutes of driving at speed of 20 km/h or higher

Modification basis	
Application basis	
Affected VIN	

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▶ **Standard type**

Status	Operating conditions	Display
Tire pressure display	At initial start (more than 20 minutes have elapsed after ignition off), the tire pressure is not determined. It can be displayed after 10 minutes of driving at speed of 20 km/h or higher.	F32 32 A32 32
FR - display RR - display	If the tire pressure is abnormal when it is not detected, '--' is displayed. The standard type instrument cluster shows only tire pressure and '--'.	F32 -- A32 --

NOTE

Low tire pressure warning

If the tire pressure is less than 13% of the proper value for more than 8 minutes, the 1st low tire pressure warning is given. And, if the tire pressure is less than 20% for more than 4 minutes, the 2nd warning is given. The message "Check tire" is displayed on the instrument cluster DOT LCD display.
(see "LOW TIRE PRESSURE WARNING in this section)

Priority of TPMS warnings

The situation can occur in which two warning messages are displayed depending on the vehicle condition. If this happen, the warning messages are displayed according to the priority below.

Puncture Detected > Minimum & Low Pressure > High Pressure > Imbalance

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7. TIRE INFLATION PROCEDURE FOR VEHICLE WITH TPMS

1) Overview

For the vehicle with TPMS, the tire should be inflated in a method different from the conventional method since the tire pressure values displayed on the tire pressure gauge and instrument cluster are different after inflation.
The tire pressure displayed on the instrument cluster should be checked after a certain time delay (wireless transmission time for wheel module).
The displayed value can be changed after driving even if it was set to the specified value.

2) Tire Inflation Procedure

A. Park the vehicle on a flat ground and let everyone get off the vehicle.



CAUTION

- If there is another vehicle equipped with the TPMS, keep the distance from this vehicle for at least 5 mm to prevent interference of wheel module transmission.
- Unload cargoes if they are usually not loaded during driving.
- The instrument cluster does not display every pressure change while the air is injected or discharged to/from the tire. This is because the wheel module sends the pressure value to the TPMS ECU every minute.
  In addition, if there are other vehicles with the TPMS nearby, it might take several minutes to display the pressure values due to radio jamming and weather condition.

NOTE

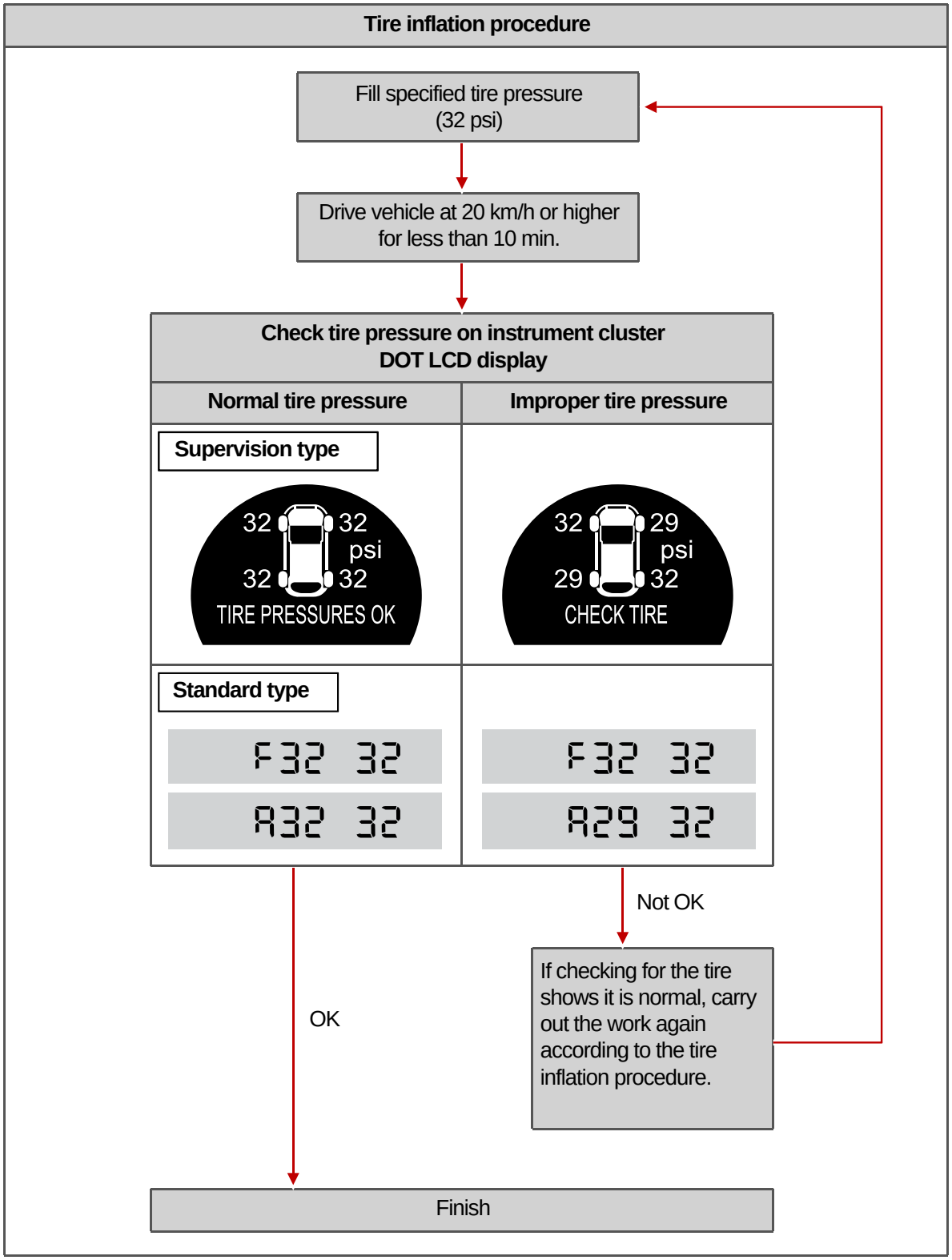
This symptom is occurred as the inflation pressure displayed on the instrument cluster becomes different by tires as different load is applied to each tire due to driving condition, number of occupants, irregular temperature change in tire and load condition.

Modification basis	
Application basis	
Affected VIN	

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B. Tire inflation & judgment

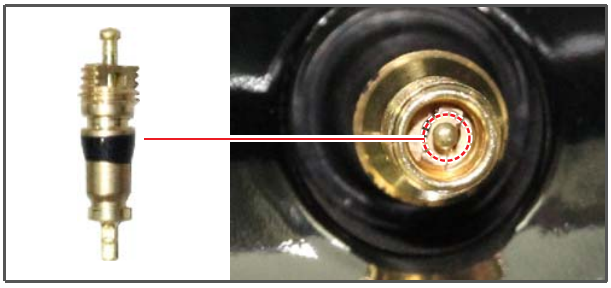
- Fill the tire pressure (air) according to the tire inflation procedure.



Modification basis	
Application basis	
Affected VIN	

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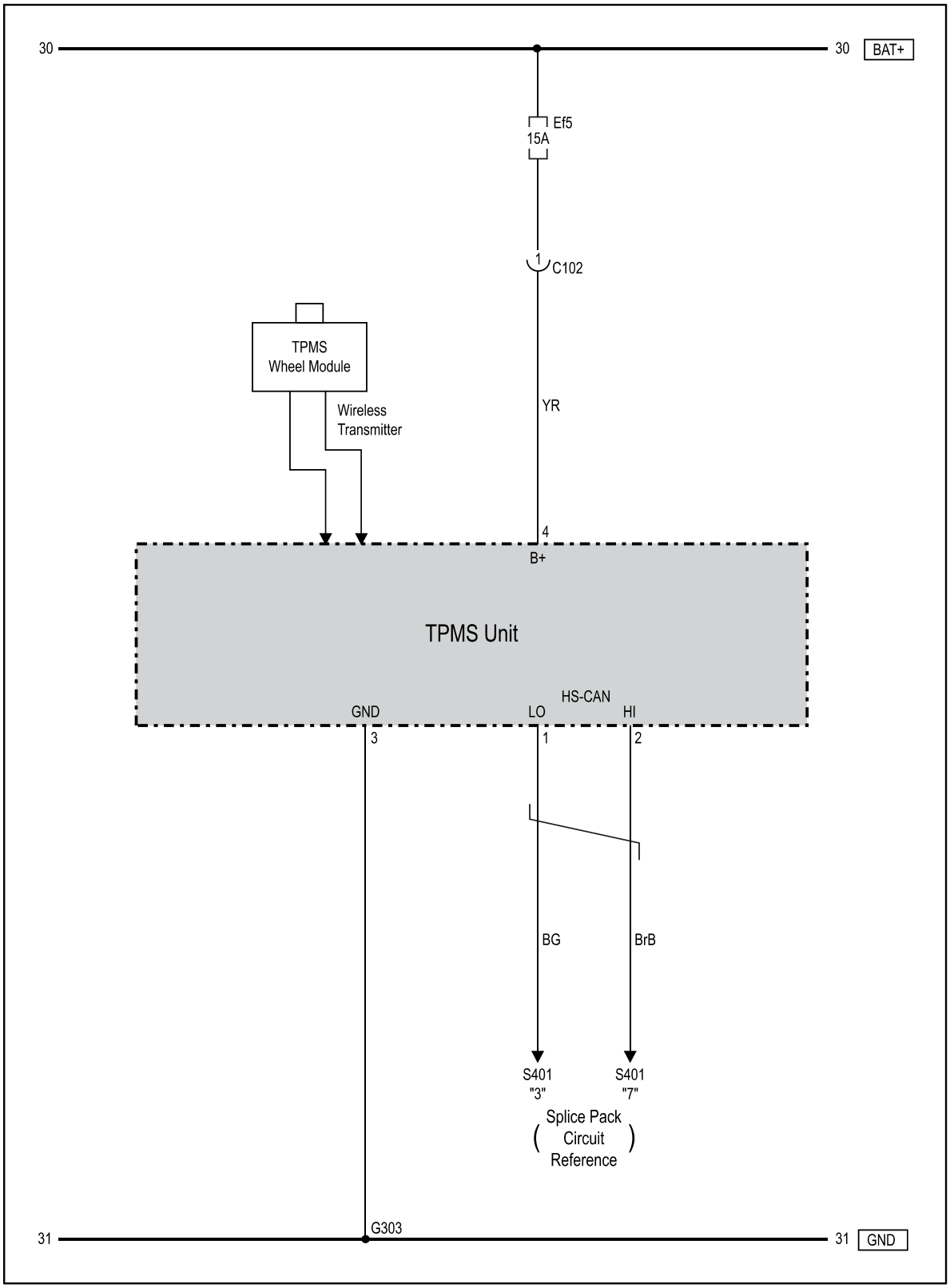
Cautions for TPMS tire inflation



- If the tire pressure is 10 psi lower than the specification (32 psi), replace the valve insert on the wheel module valve body with a new one and inject air into the tire.

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8. CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

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AIR CONDITIONER SYSTEM 6810-00

GENERAL INFORMATION

1. SPECIFICATIONS

Unit	Item		Specification
Heater	Core size (㎜)		200 x 168.5 x 23.5
	Capacity (kcal/h)		4,800
Evaporator	Core size (㎜)		254.8 x 196.7 x 60
	Capacity (kcal/h)		4,700
Blower motor	Supply power (W)		240 + 10% Max (at 12 V)
	Fan speed (rpm)		2900±200 Max (Rec. Mode: 420㎥/h)
PTC	Supply power		1 kW
Condenser	Core size (㎜)		588 x 455 x 16 (2,625)
	Capacity (kcal/h)		12,000
	Capacity of receiver drier		250 cc
Compressor	Volume		170 cc/rev
	Diameter of pulley		Ø120
	Max. continuous speed		8,000 rpm
	Voltage		DC 12 V
	Current consumption		2.2 A
Heater & A/C control assembly (FATC)	Rated voltage		DC 13.5 V
	Operating voltage		DC 9 V to 16 V
	Operating temperature		−30 ~ 80℃
	Max. current consumption		2.5 A
	Dark current		1.1 mA
	Button switch	Type	Push type (self-return)
		Operating force	2.54±0.5N
	Temperature & air distribution switch	Type	Dial type
		Rotation angle	360˚

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Item	Component		Specification
Heater & A/C control assembly (MTC)	Rated voltage		DC 13.5 V
	Operating voltage		DC 9 V to 16 V
	Operating temperature		−30 ~ 80℃
	Max. current consumption		2.5 A
	Dark current		1.1 mA
	Button switch	Type	Push type (self-return)
		Operating force	2.54±0.5N
	Temperature switch	Type	Dial type
		Rotation angle	220˚
	Fan speed switch	Type	Dial type
		Rotation angle	180˚
Refrigerant	Type		R134a
	Volume		430 ± 30 g

Modification basis	
Application basis	
Affected VIN	

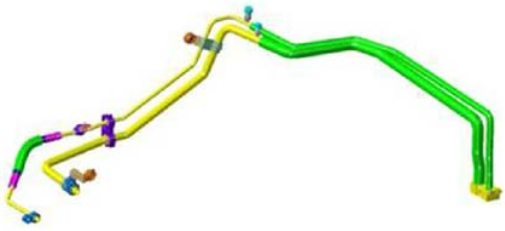
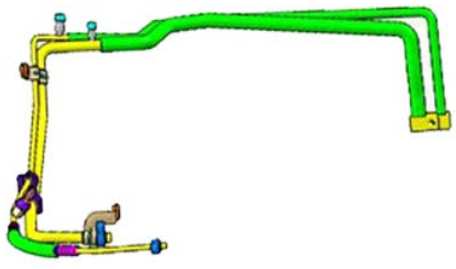
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2. MAJOR CHANGES

▶ **Changes in heater and control assembly**

Heater & A/C control assembly	
Old	**New**
With FATC 	With FATC 
With MTC 	With MTC 
Heater and A/C control assembly design and switch arrangement changed - Digital display (LCD display) with FATC used - Push button type switch used (self-return type)	

▶ **Change of air conditioner pipe**

Liquid and suction pipe	
	
Liquid and suction pipe route changed due to change of headlamp mounting bracket	

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OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The climate system in the vehicle is an air regulating system which keeps the indoor air pleasant through the heating, ventilation and air conditioning systems. The air conditioning systems fall in to two categories; FATC (Full Automatic Temperature Control), which is a temperature control device which receives signals from various sensors (ambient temperature sensor, water temperature sensor, sun-load sensor, AMP sensor) and control switches to control the blower motor and all kinds of actuator (mode door actuator, mix door actuator, air source door actuator) through MICOM in the FATC, therefore, the interior temperature of the vehicle is kept to the temperature which is set by a driver and MTC (Manual Temperature Control), which controls all the actuator and blower motor by the driver.

Modification basis	
Application basis	
Affected VIN	

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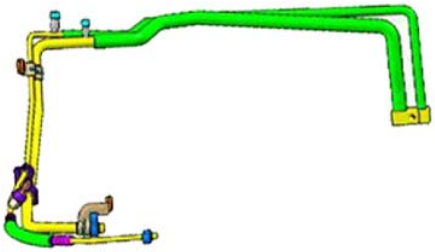
Memo

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2. LAYOUT

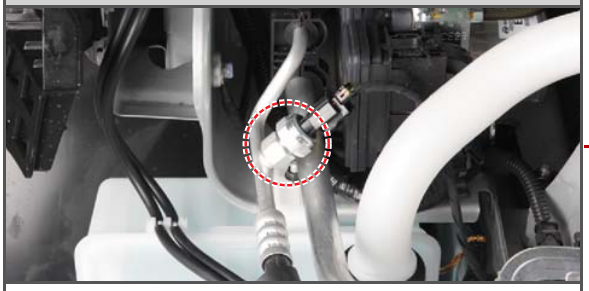
1) Exterior Layout

Liquid and suction pipe

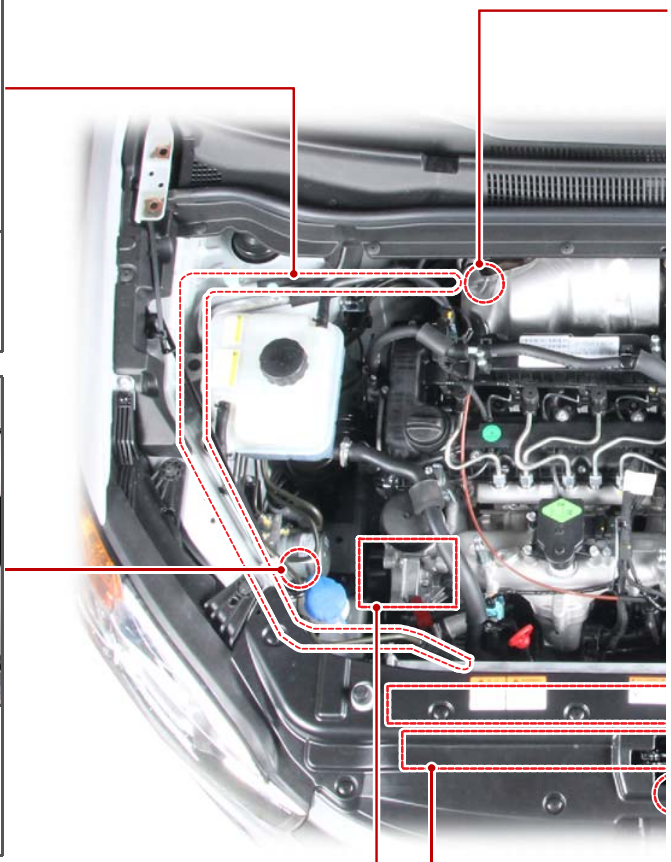


The high/low-pressure A/C refrigerant flows through this pipe. It is fitted with the refrigerant pressure sensor.

Refrigerant pressure sensor



It is mounted to the latter part of the right headlamp. It converts the A/C refrigerant pressure to voltage value and sends it to the engine ECU.



A/C compressor



It is installed to the left side of the engine assembly, compresses the low-temperature and low-pressure coolant and converts it to the high-temperature and high-pressure coolant. Then, it sends the coolant to the A/C condenser.

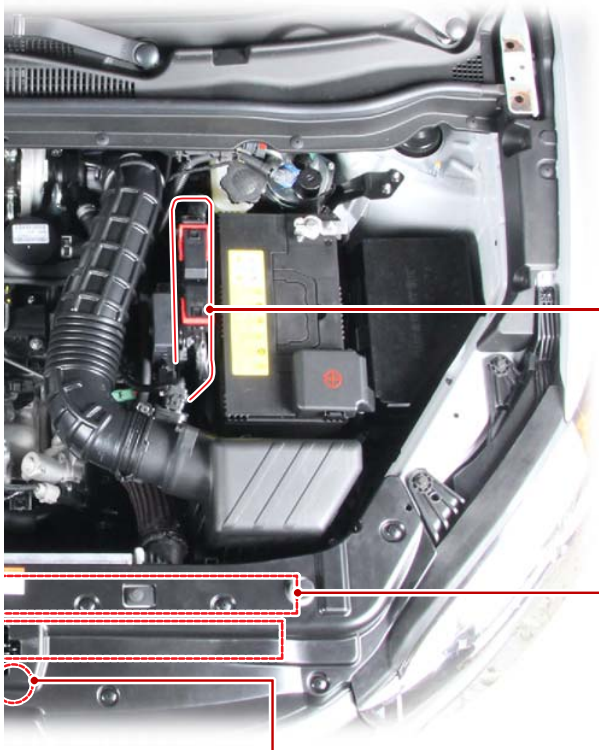
Electric fan



It cools down the A/C condenser to speed up the compression for the refrigerant in the condenser.

Modification basis	
Application basis	
Affected VIN	

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Expansion valve



It is mounted to the inlet of the evaporator core and supplies the appropriate quantity of refrigerant to the evaporator.

Engine ECU



It controls the A/C compressor, electric fan and PTC heater according to the signal from the A/C control panel.

Ambient temperature sensor



It is mounted to the front section of the vehicle and detects the ambient temperature to send the voltage value according to the resistance change to the heater and A/C control assembly.

A/C condenser & receiver drier



Integrated receiver drier

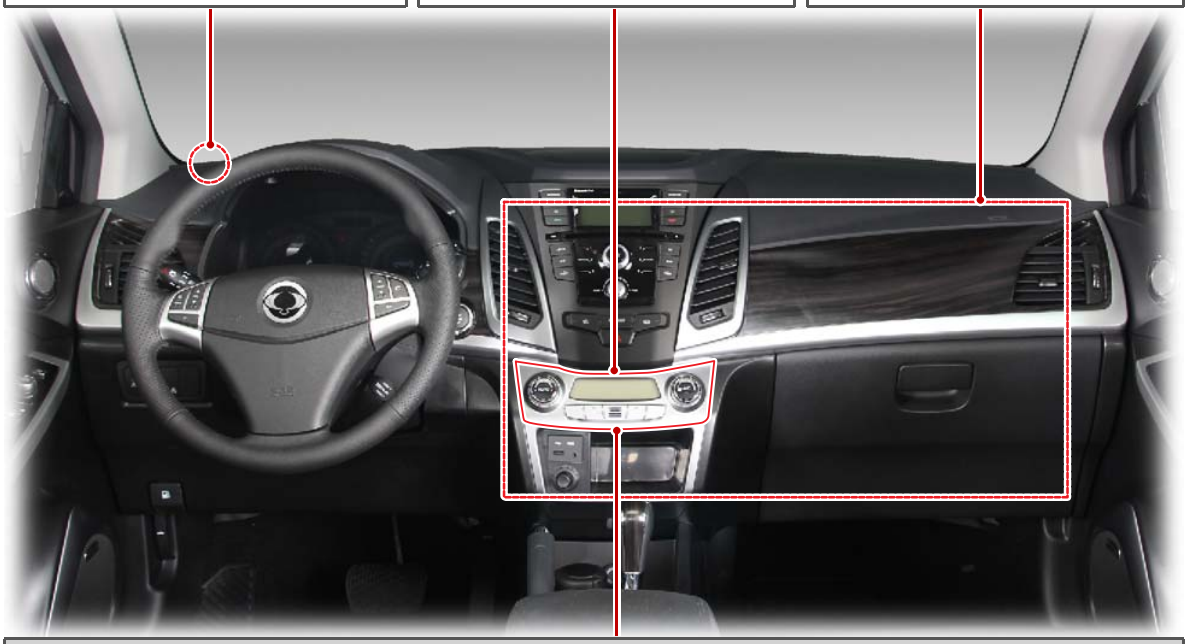
It is installed in front of vehicle and condenses vapor refrigerant into low temperature and high pressure liquid refrigerant. The receiver drier is built in it.

Modification basis	
Application basis	
Affected VIN	

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2) Interior Layout

Sun load sensor	Incar sensor	Air conditioner module
		
It is mounted to the upper left-hand of the instrument panel and detects the sun-load enters to the interior through the windshield with a photo diode.	It is mounted to the rear of the heater and A/C control panel (with FATC) and detects the interior air temperature drawn through the senor inlet.	It is mounted to inside of the instrument panel and has the evaporator core, heater core, PTC heater and corresponding actuator and different sensors.



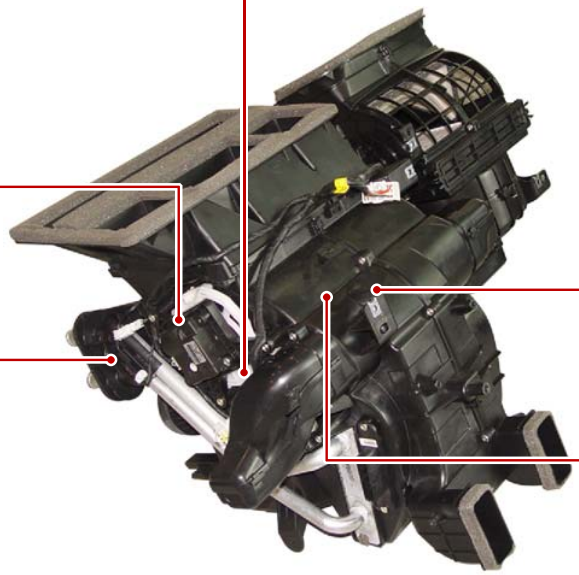
Heater & A/C control assembly	
With FATC	With MTC
	
It falls in to two categories; FATC (Full Automatic Temperature Control) and MTC (Manual Temperature Control), which controls the air conditioning system's operation.	

Modification basis	
Application basis	
Affected VIN	

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3) Air Conditioner Module Layout

Mode actuator	Temp actuator	Evaporator core
		
It controls the air outlet damper to the five directions according to the control command from the heater and A/C control assembly.	It changes the air mix door opening according to the control command from the heater and A/C control assembly.	It cools the surrounding air by passing through the low-temperature and low-pressure refrigerant sprayed from the expansion valve.

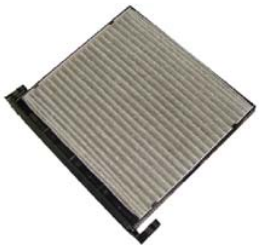


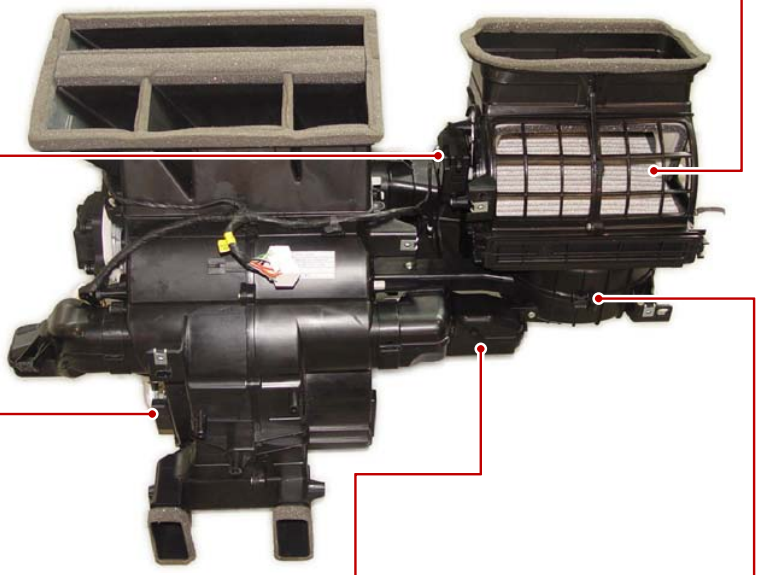
Water temperature sensor	Heater core	Intake sensor
		
It is mounted to the heater pipe part and detects the coolant temperature.	It is mounted to the left-hand of the air conditioner module and heats the indoor using the heat of the engine coolant.	It is mounted to the side of evaporator core and detects the temperature of the evaporator core.

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Intake actuator

It changes the air source selection mode according to the control command from the heater and A/C control assembly.

A/C filter

It is mounted to the top of the blower motor and filters the air before it is discharged through the duct.



PTC heater

It is mounted to the heater air outlet in the heater module and warms the air from the heater to the air vent.

MOS module

It controls the rotation speed of the blower motor by receiving the fan speed control signal from the heater and A/C control assembly.

Blower motor

It is mounted to the bottom of the blower box and sends the air inside of the vehicle.

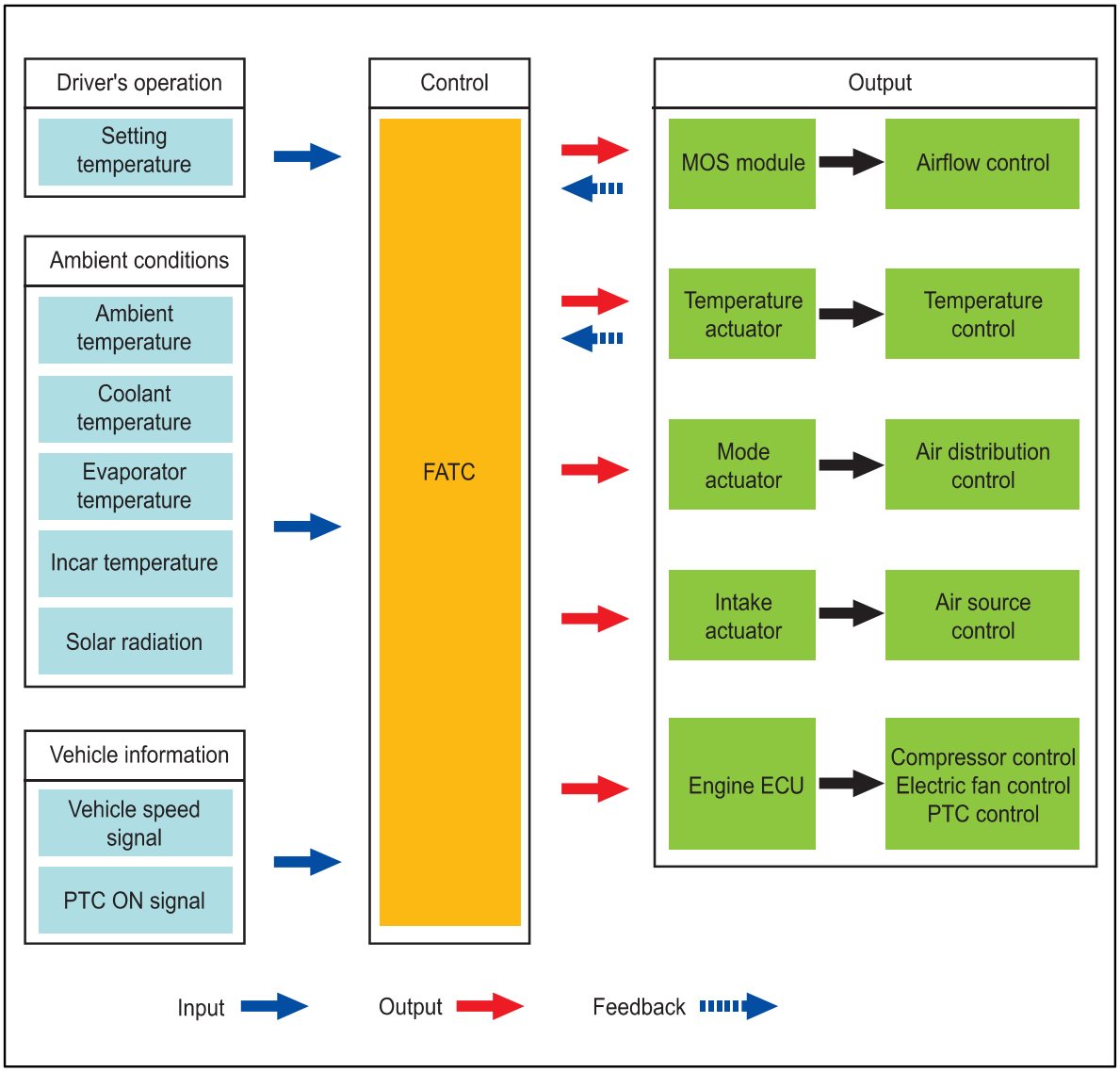
Modification basis	
Application basis	
Affected VIN	

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3. FATC SYSTEM OPERATION PROCESS

1) Input/Output Factors

FATC (Full Automatic Temperature Control) is a temperature control device which receives signals from various sensors (interior temperature sensor, ambient temperature sensor, water temperature sensor, sun-load sensor) and control switches to control the blower motor and all kinds of actuator (mode door actuator, mix door actuator, air source door actuator) through MICOM in the FATC, therefore, the interior temperature of the vehicle is kept to the temperature which is set by a driver. The driver can check the status of A/C through the LCD display of the A/C control assembly. The fan speed and the temperature are adjusted automatically by the input values from different sensors to keep indoor air fresh. If the FATC system has any defect, the self-diagnosis is used for the system to make it easier to detect the fault.

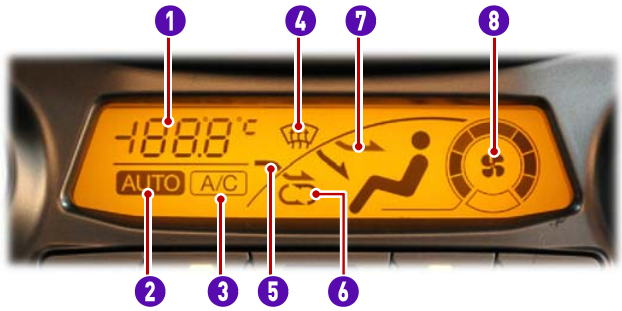


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2) Function

(1) Function of heater and A/C control assembly with FATC

LCD display



1. Indoor set temperature indicator
2. AUTO mode operation indicator
3. A/C operation indicator
4. Defrost mode indicator
5. Fresh air mode indicator
6. Air recirculation mode indicator
7. Vent & foot mode indicator
8. Fan speed indicator

Temperature control dial

To set the temperature, turn the dial to the left or right. The LCD display shows the set temperature.

AUTO switch

When pressing this switch, "AUTO" is shown on the display and the fan speed and air distribution mode are adjusted automatically to keep interior temperature to the set temperature.



ON/OFF switch

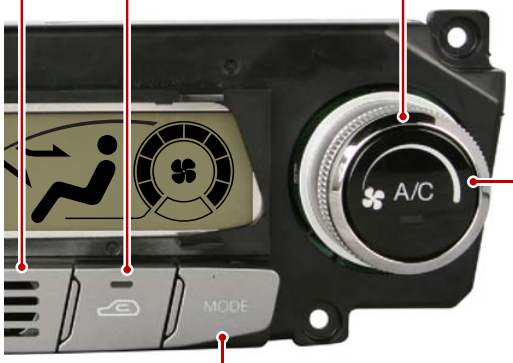
Pressing the switch turns the FATC on/off. When the FATC is turned on, it memorizes the previous status before becoming off.

Defroster mode switch

This is used to remove the condensation from the windshield. When you press the switch, the indicator comes on and the air distribution is changed to the windshield at the same time, then the air conditioner starts to operate. When you press the switch again, the indicator goes off and the air distribution returns to the previous status.

Modification basis	
Application basis	
Affected VIN	

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Indoor temperature sensing part

The incar sensor is mounted to the rear of the FATC and detects the interior air temperature drawn through the air inlet.

Air source selection switch

When the switch is pressed, the indicator comes on and the mode is switched to the recirculation mode at the same time. When pressed again, the indicator goes out and switched to the fresh air mode at the same time.

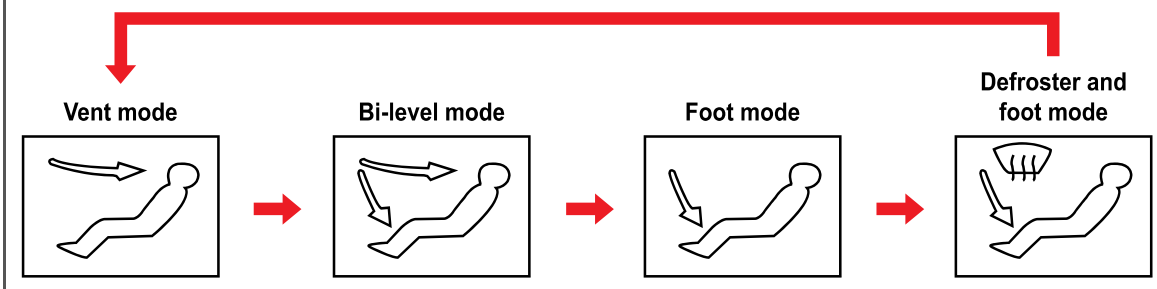
Fan speed dial

Turn the dial to the left or right to adjust the fan speed in 8 steps and the fan speed can be checked through the LCD display.

A/C switch

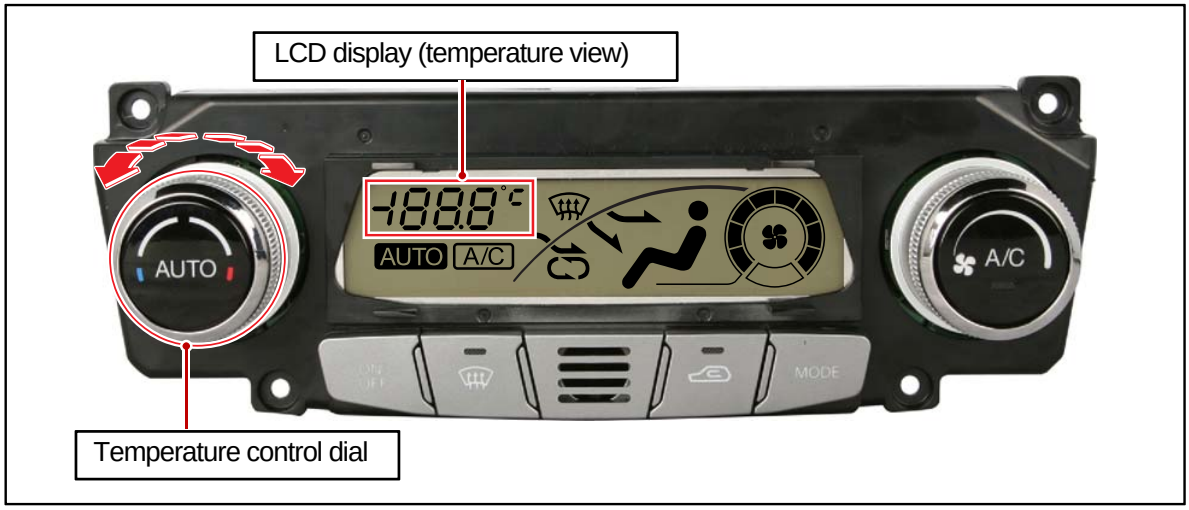
When the switch is pressed, the indicator comes on and the air conditioner starts at the same time. Pressing the switch again goes out the indicator and stops the air conditioner at the same time.

Air distribution switch (switches in order)



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(2) Temperature control



The blowing air temperature is controlled by the temp actuator and the set temperature can be checked via the LCD display.

▶ Manual control

The discharge air temperature is controlled by the temperature control dial. The driver can select one of the 31 levels.

▶ Auto control

When pressing the AUTO switch, "AUTO" is shown on the display and the fan speed and air distribution mode are adjusted automatically to keep interior temperature to the set temperature. In full AUTO mode, the FATC receives various signals such as the indoor temperature, ambient temperature, engine coolant temperature, sunlight, from different sensors to control the A/C compressor, mode actuator, intake actuator, temp actuator, blower motors, etc. to keep indoor environments fresh.

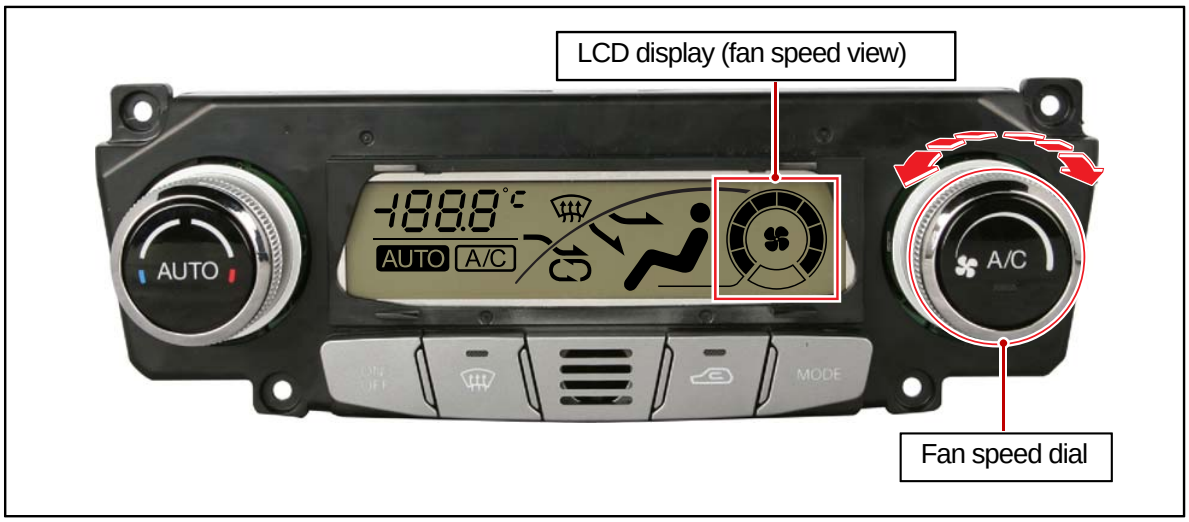
▶ Max. cooling/heating control (AUTO mode)

If the temperature is set to the lowest level (Lo) or highest level (Hi), the system will go into the maximum cooling or maximum heating mode regardless of the sensor signals.

Set temp.	A/C compressor	Air outlet (mode)	Air inlet	Blower voltage	Temp actuator
LO	ON	Vent	Recirculation	10.5 V	Max. cooling position
HI	OFF	Footwell	Fresh air	10.5 V	Max. heating position

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(3) Blower control



In AUTO mode, the blower motor is controlled automatically according to the set temperature and the blower motor speed can also be controlled manually. The fan speed can be checked via the LCD display.

▶ Manual control

Blower step	Blower motor voltage (V)
1	4.0
2	5.0
3	6.0
4	7.0
5	8.0
6	9.0
7	10.5
8	VIGN

Turn the fan speed dial to control the blower motor manually. The fan speed increments by 1 level per revolution of the dial. (allowance: ±0.5 V)

▶ Auto control

In AUTO mode, the fan speed is automatically controlled depending on the set temperature and surrounding environment and the blower motor operates steplessly.

▶ Control for defrosting

When the defrost mode is selected with the blower dial in AUTO position, the blower motor voltage is increased by 1.5 V compared to the AUTO control voltage for a certain amount of time.

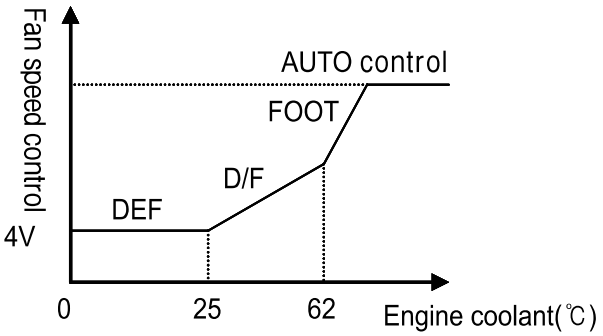
▶ Sun load compensation control

The system increases the fan speed by adding up 2.5 V of voltage in direct sunlight.

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▶ **Initial fan speed control for cooling/heating**

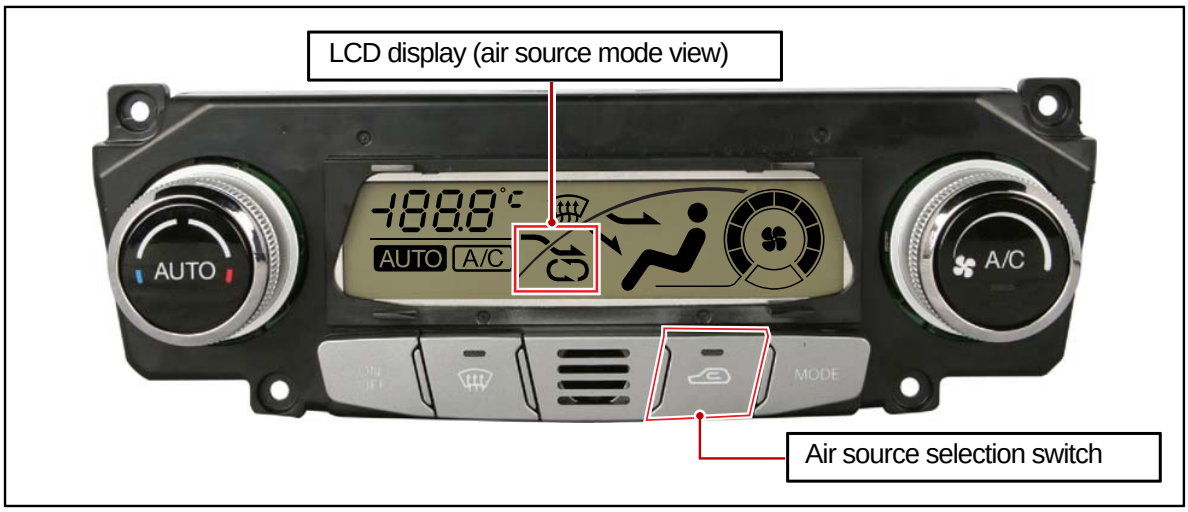
- Cooling start control
  When the intake temperature sensor indicates over 35°C, the driver might feel uncomfortable by the air flow from the vent. Therefore, at the initial operation stage, the hot air is discharged to the windshield (DEF mode) for about 5 seconds.
- Heating start control
  When the engine coolant temperature is low or the wind temperature is not warmed up sufficiently, the driver might feel uncomfortable by the air flow from the vent. Therefore, the fan speed is set to the 1st stage and the cool air is sent to the windshield until the coolant temperature increases to the proper level (DEF mode). As the engine coolant temperature goes up, the mode is changed to Defrost & Foot mode or AUTO mode to increase the speed of blower motor. This control is cancelled when the output value of the water temperature sensor is approximately 62℃. However, the control time must not exceed 10 minutes.



Modification basis	
Application basis	
Affected VIN	

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(4) Air source control



The air source selection is made by the intake actuator. The driver can see the air source mode through the switch's indicator and the LCD display.

▶ Manual control

Press the air source selection switch to control the air source selection door manually. The air source mode is switched
between the fresh air and recirculation alternatively each time the switch is pressed.

▶ Auto control

In auto mode, the basic setting for the air source is fresh air. When the ambient temperature is high during cooling,
the air source is changed from fresh air to recirculation to lower the temperature.

▶ Control by vehicle speed (heating)

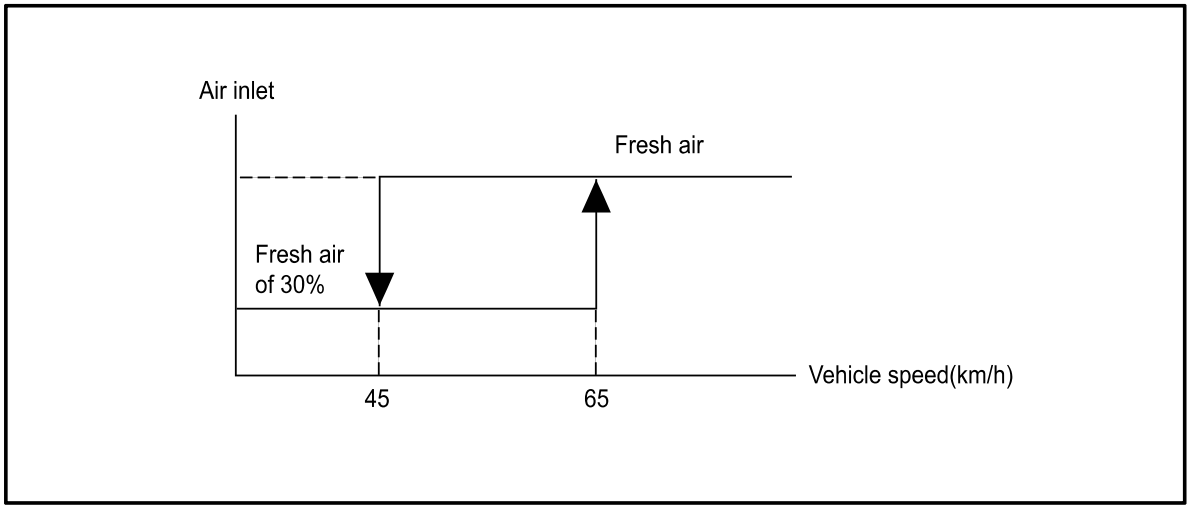
The air source selection is controlled in accordance with the vehicle speed while driving. Operating conditions and control process are as follows:

- AUTO mode
- When the vehicle speed is 45 km/h or lower in fresh air mode, the air source door is open 30% of its maximum opening. If the vehicle speed is 65 km/h or more, then
  the air source door is completely open.

NOTE

However, the ambient temperature should be 0°C or less, coolant temperature 62°C or less and the electric fan 7.5V or higher.

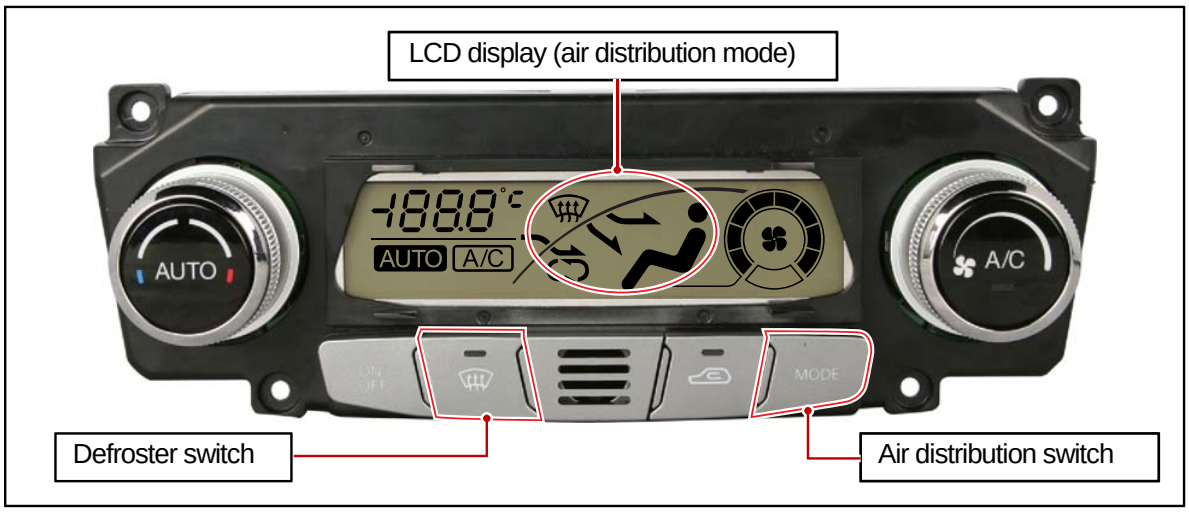
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Modification basis	
Application basis	
Affected VIN	

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(5) Air distribution control



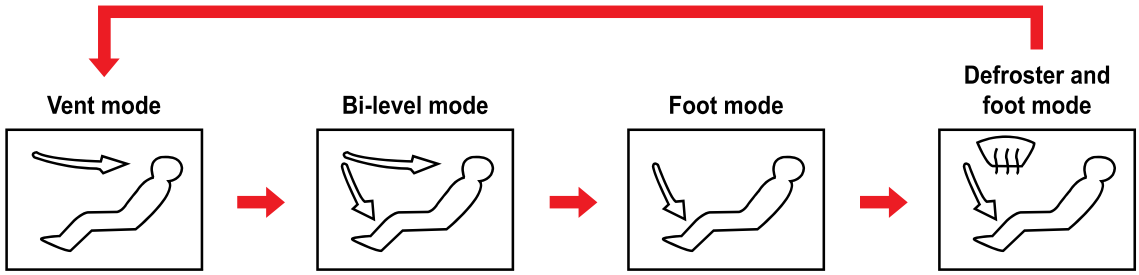
The air distribution is changed by the mode actuator and the LCD display and the indicator of the defroster switch shows which air distribution modes is selected.

▶ Manual control

The driver can select one of 5 air distribution mode using the air distribution switch and defroster switch.

- Defroster switch: When this switch is pressed, the defroster mode (A/C ON, fresh air mode, fan speed of 1 level or above) is activated. Pressing the switch again returns the unit to the previous status.
- Air distribution switch: The mode is switched in the following order each time the switch is pressed: Vent mode→Bi-level mode→Foot mode→Defroster & Foot mode.

Air distribution switch (switches in order)



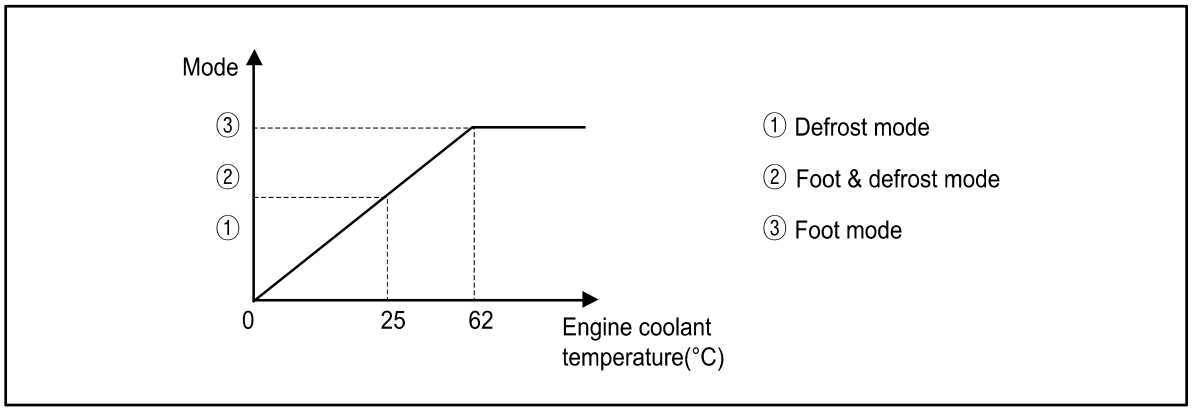
NOTE

When the defroster switch is pressed with the fan speed 0, the fan speed will be set to level 2 automatically.

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▶ Auto control

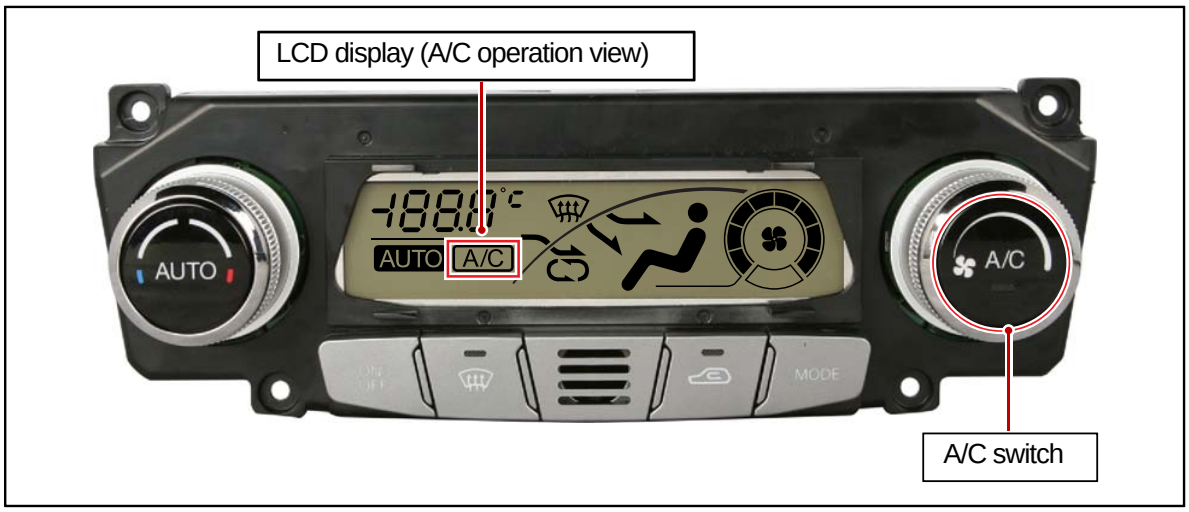
The air flow mode is controlled automatically in accordance with the vehicle indoor conditions.
But it is controlled as described below during initial driving (after overnight parking) in cold weather:



Modification basis	
Application basis	
Affected VIN	

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(6) A/C control



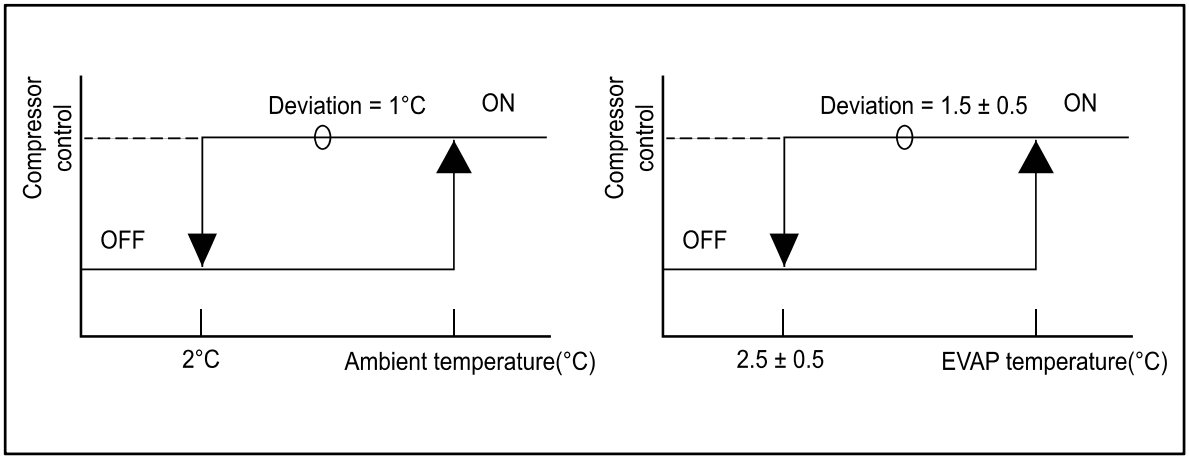
The air conditioner is controlled by the A/C compressor of the engine ECU according to the signal from the heater and A/C control assembly. The driver can see the air conditioner operation through the LCD display and the indicator of the A/C switch.

▶ Manual control

Pressing the A/C switch or selecting defrost mode turns on the A/C.

▶ Auto control

The A/C is controlled in accordance with the indoor temperature and ambient temperature.
If the intake sensor detects the freezing of the evaporator or the ambient temperature is low (2℃ or below) in winter, the compressor is turned off to protect the A/C compressor.



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(7) Self-diagnosis

The FATC has a self-diagnosis function that can diagnose the system by itself. If this system is defective, the LCD display shows the diagnostic trouble code (DTC) to inform a driver of defects on the device such as a sensor or actuator. The driver can see the each sensor data on the air conditioning system after entering self-diagnosis mode. Before checking each component, be sure to check the default code by using self diagnosis function.

▶ **Diagnostic trouble code**



Code	Defective part
00	Normal
21	Ambient temperature sensor
22	Incar sensor
23	Water temperature sensor
24	Intake sensor
26	Temp door (control)
31	Mode door (vent)
32	Mode door (bi-level)
33	Temp door (cool)
34	Mode door (foot)
35	Mode door (defroster & foot)
36	Mode door (defroster)
37	Intake door (fresh air)
38	Intake door (1/3)
39	Intake door (recirculation)

Diagnostic trouble code
Open circuit in sensor  Diagnostic trouble code

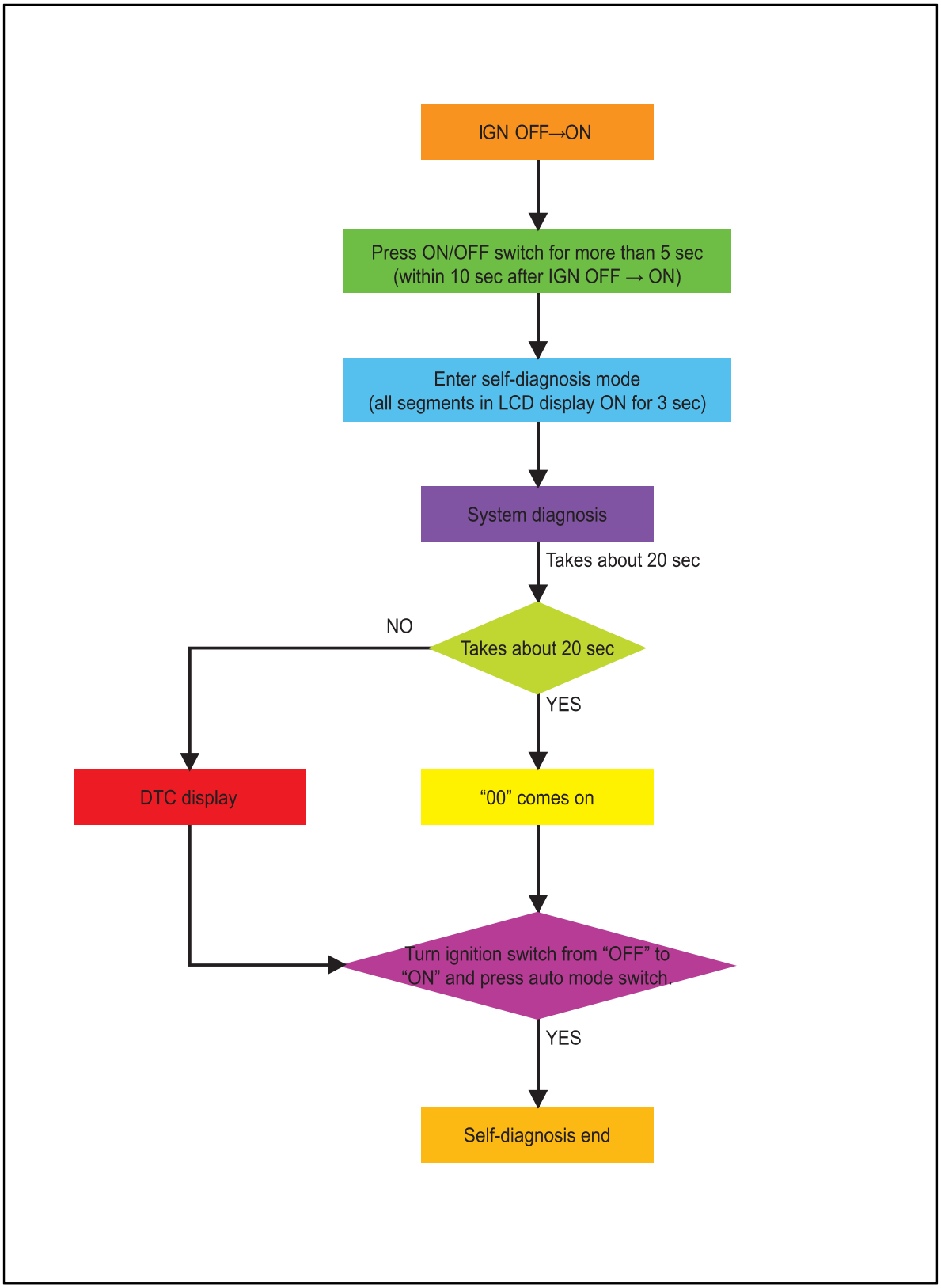
NOTE

The diagnostic trouble code (DTC) flashes twice and is displayed repeatedly in order as long as a separate operation is not performed.

Modification basis	
Application basis	
Affected VIN	

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▶ How to enter self-diagnosis



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1. If the ON/OFF switch of the FATC is pressed for more than 5 seconds within 10 seconds after turning the ignition key from the "OFF" position to the "ON" position, all the segments in LCD display comes on for 3 seconds.



2. The LCD display shows "2" and starts to check the sensor and actuator in the air conditioning system automatically.



3. After about 20 seconds, the LCD display shows whether there is fault. ("00" for normal)



4. The self diagnosis ends when turning the ignition key from the "OFF" position to the "ON" position or pressing the AUTO mode switch.

Modification basis	
Application basis	
Affected VIN	

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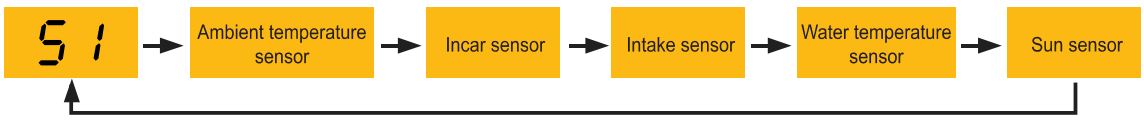
▶ Sensor data check

1. This mode can be entered when the temperature control dial is turned clockwise (1 click or more) at any time after entering self-diagnosis mode, and the LCD display shows "51".



2. The values for each sensor are shown in sequence on the LCD display each time the defroster switch is pressed.





NOTE

The value of the sun load sensor is displayed after being converted to one tenth.

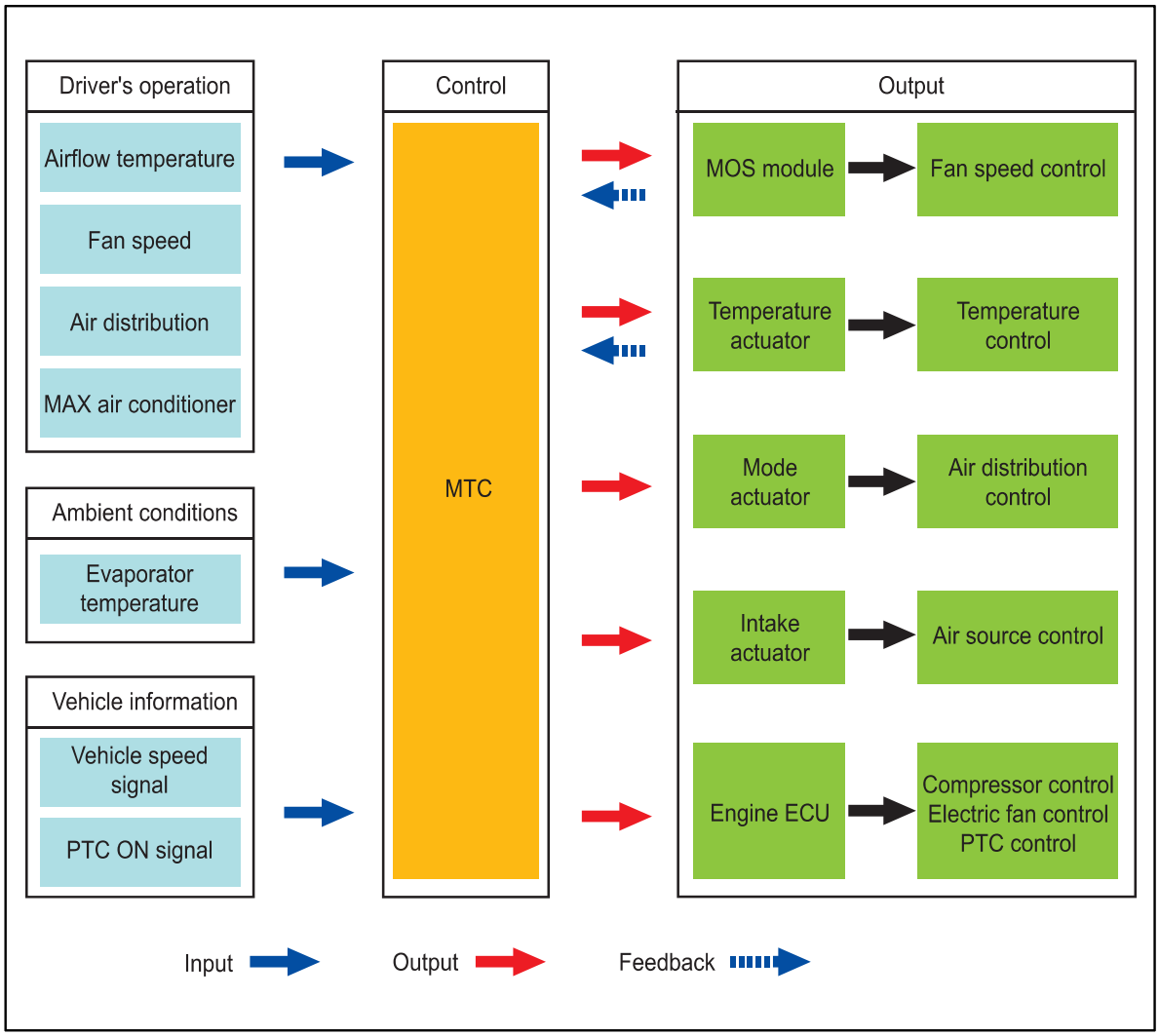
3. When the temperature control dial is turned anti-clockwise, the menu returns to status when entering self-diagnosis mode.

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4. MTC SYSTEM OPERATION PROCESS

1) Input/Output Factors

The MTC (Manual Temperature Control) system controls all the actuator and blower motor by the driver. The heater and A/C control assembly with MTC has the dials and switches with the indicators so that the driver can know the air conditioning system's operation.



Modification basis	
Application basis	
Affected VIN	

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2) Function

(1) Function of heater and A/C control assembly with MTC

MAX A/C control switch

This is designed for increasing driver comfort. When the switch is pressed, the indicator comes on and the air conditioner starts at the same time and vent and recirculation modes are selected automatically.

Defroster mode switch

This is used to remove the condensation from the windshield. When you press the switch, the indicator comes on and the air distribution is changed to the windshield at the same time, then the air conditioner starts to operate.

Defroster & foot mode switch

If the switch is pressed, the indicator comes on while the air flows to the footwell and the windshield.

Fan speed dial

Turn the dial to the left or right to adjust the fan speed in 7 steps.

Temperature control dial

Turn the dial to the left or right to adjust the set temperature.



A/C switch

When the switch is pressed, the indicator comes on and the air conditioner starts at the same time. Pressing the switch again goes out the indicator and stops the air conditioner at the same time.

Air source selection switch

When the switch is pressed, the indicator comes on and the mode is switched to the recirculation mode at the same time. When pressed again, the indicator goes out and switched to the fresh air mode at the same time.

Vent mode switch

If the switch is pressed, the indicator comes on while the air flows to the upper part of the body.

Bi-level mode switch

If the switch is pressed, the indicator comes on while the air flows to the footwell and the upper part of the body.

Foot mode switch

If the switch is pressed, the indicator comes on while the air flows to the footwell.

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(2) Temperature control



The temp actuator controls the temperature of air discharged depending on the temperature control dial operation by the driver. The driver can select one of the 17 levels.

(3) Blower control



Blower step	Blower motor voltage (V)
1	4.0
2	5.0
3	6.0
4	7.5
5	9.0
6	10.5
7	VIGN

The fan speed increments by 1 level per revolution of the fan speed dial. (allowance: ±0.5 V)

Modification basis	
Application basis	
Affected VIN	

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(4) Air source control



When pressing the air source selection switch, the air source mode is changed via the intake actuator's operation. The air source mode is switched between the fresh air and recirculation alternatively each time the switch is pressed. You can see the air source mode through the switch's indicator. (the indicator comes on at recirculation mode)

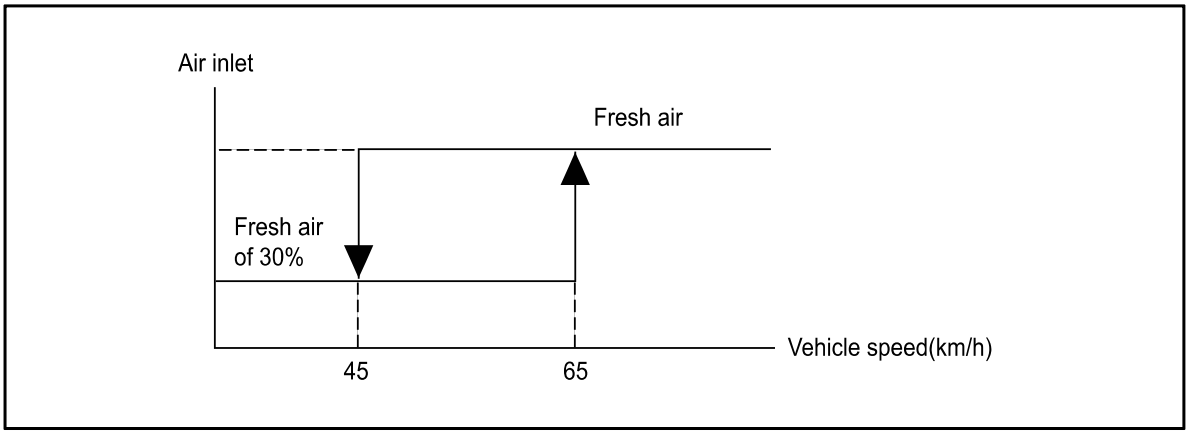
▶ Control by vehicle speed

The air source selection is controlled in accordance with the vehicle speed while driving. Operating conditions and control process are as follows:

- When the PTC heater operates at fresh air mode in winter
- When the vehicle speed is 45 km/h or lower in fresh air mode, the air source door is open 30% of its maximum opening. If the vehicle speed is 65 km/h or more, then the air source door is completely open.

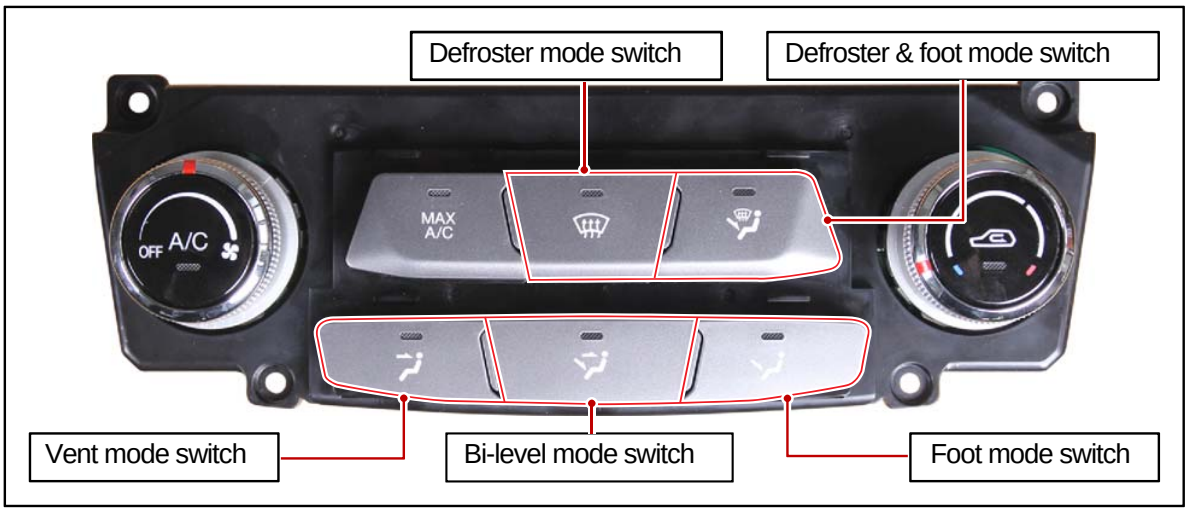
NOTE

However, the electronic fan should be more than 7.5 V.



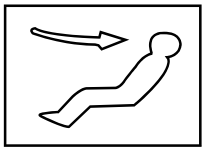
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(5) Air distribution control



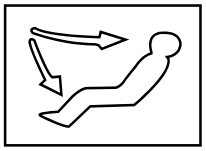
The driver can select one of 5 air distribution modes using the 5 air distribution switches in the center of the MTC The selected air distribution mode is changed by the mode actuator and acknowledged by the indicator for each switch coming on

▶ Vent mode



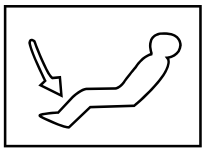
If the vent mode switch is pressed, the indicator comes on while the air flows to the upper part of the body.

▶ Bi-level mode



If the bi-level mode switch is pressed, the indicator comes on while the air flows to the footwell and upper part of the body.

▶ Foot mode



If the foot mode switch is pressed, the indicator comes on while the air flows to the footwell.

Modification basis	
Application basis	
Affected VIN	

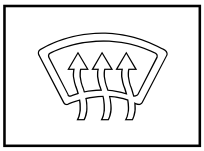
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▶ Defroster & foot mode



If the defroster & foot mode switch is pressed, the indicator comes on while the air flows to the footwell and the windshield.

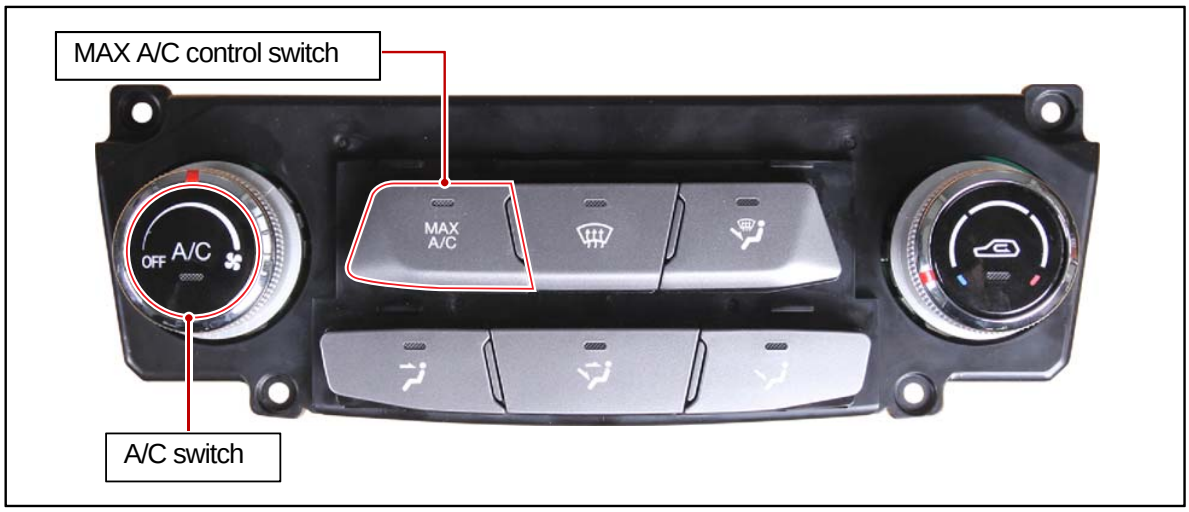
▶ Defroster mode



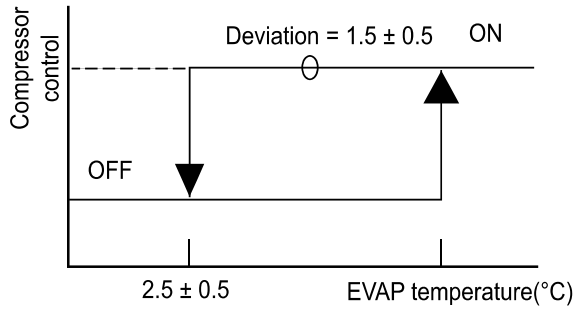
This is used to remove the condensation from the windshield. When you press the switch, the indicator comes on and the air distribution is changed to the windshield at the same time, then the air conditioner starts to operate.

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(6) A/C control



The air conditioner is operated at the defroster mode and MAX air conditioner mode and when the A/C switch is turned to "ON" position. It is controlled by the A/C compressor of the engine ECU according to the signal from the heater and A/C control assembly. The driver can see that the A/C has been activated when an indicator lamps at the A/C switch and MAX A/C switch comes on. If the intake sensor detects the freezing of the evaporator core, it stops the air conditioner by turning off the compressor.



▶ MAX A/C control

This is designed for increasing driver comfort. When the switch is pressed, the air conditioner is operated and vent and recirculation modes are selected automatically. The discharge temperature and fan speed are regulated depending on the driver's choice.

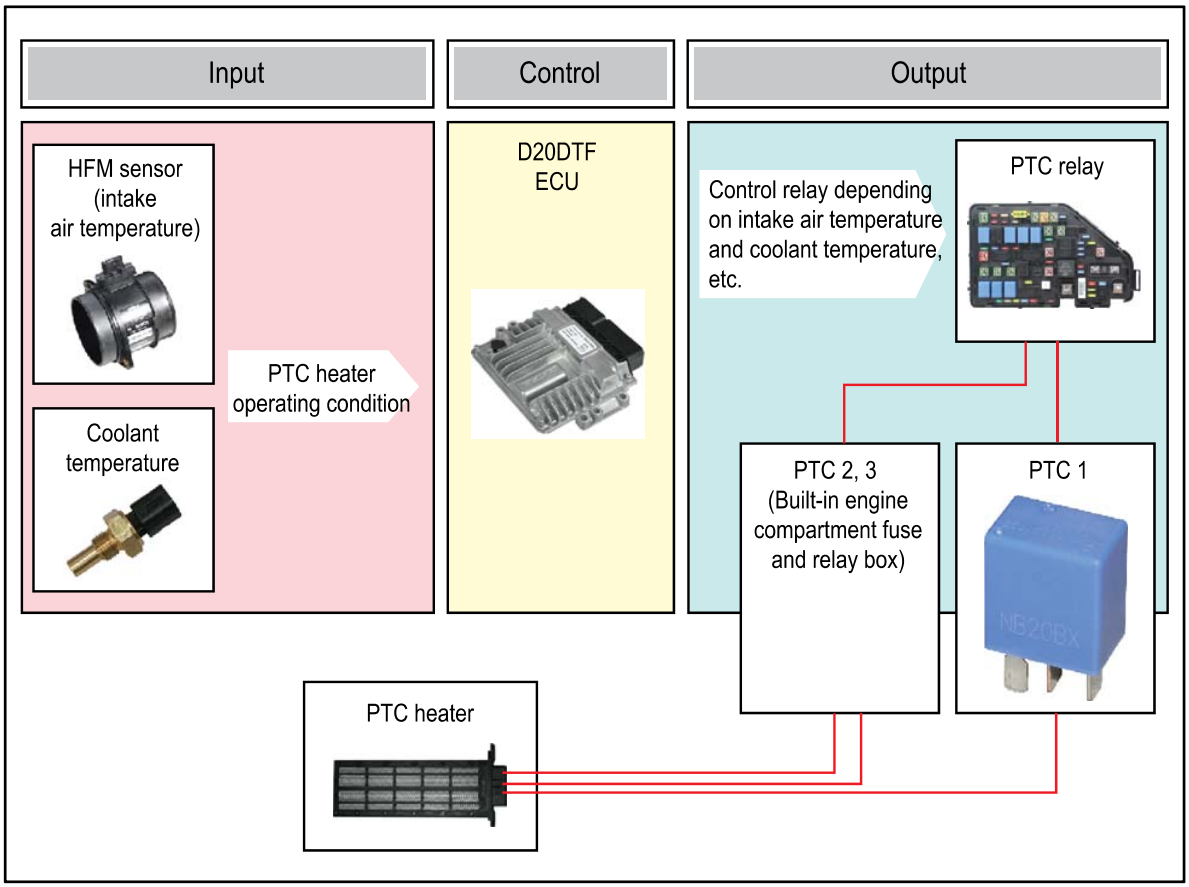
Modification basis	
Application basis	
Affected VIN	

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5. PTC HEATER OPERATION PROCESS

The engine ECU controls the PTC (Positive Temperature Coefficient) heater system by adjusting the power supplied to the PTC system according to the two measured temperature values from the engine coolant temperature sensor and HFM sensor. This system is mounted to the heater air outlet in the air condition system module and heats the air which flows to the passenger room. Since the PTC system is heated by the electrical power, the electric load and alternator capacity is greater than the conventional one. The PTC is not operated when a) the engine is cranking, b) the battery voltage is below 11 V, c) the glow plug is being preheated.

1) PTC Heater Input/Output Factors



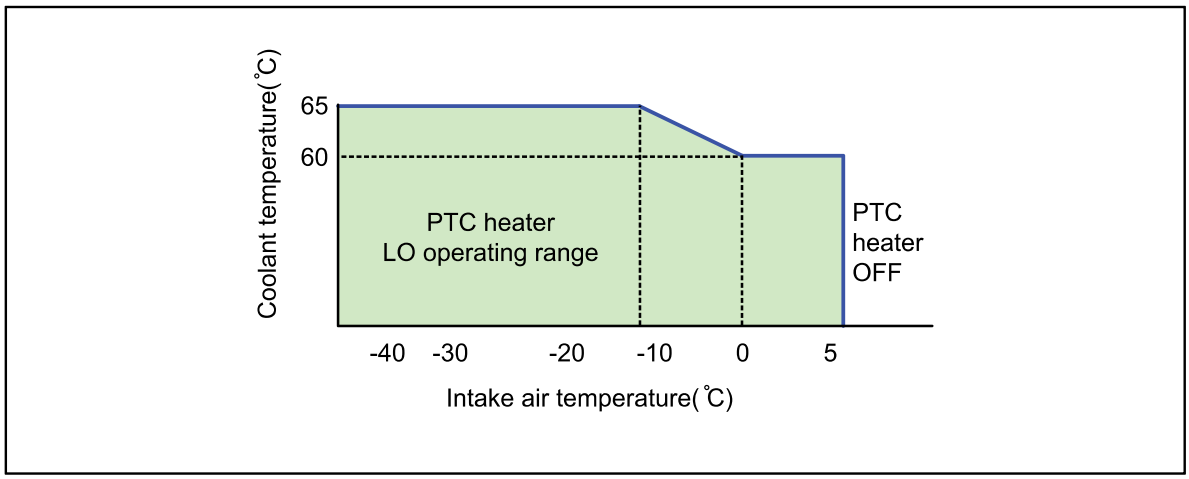
The ceramic PTC features that the resistance rises quickly in a certain temperature range. The PTC heater has 3 circuits with power of 330 W. While only 1 circuit in the PTC heater is connected during PTC1 operation, 2 circuits are connected during PTC2 or PTC3 operation.
The PTC heater operates as follows: temperature rises above specified level→resistance increases→current decreases→calorific value decreases→temperature drops→resistance increases→current increases→temperature rises.

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2) Control Condition For PTC Heater

Operation	Operating condition	PTC heater status
HI mode operation (PTC2, 3)	- Coolant temperature < 15℃	PTC heater operates in "HIGH" mode if operating conditions are met
LO mode operation (PTC1)	- Coolant temperature 15℃ ≤ 65℃ and intake temperature ≤ −10℃ - Coolant temperature 15℃ < 65 ~ 60℃ and intake temperature < −10℃ ~ 0℃ - Coolant temperature 15℃ ≤ 65℃ and intake temperature ≤ 0℃ ~ 5℃	PTC heater operates in "LOW" mode if operating conditions are met
Conditions for deactivating	- Air conditioner blower switch OFF - When the ambient temperature sensor is faulty (short or open circuit in the wiring) - Engine is cranking - Battery voltage is 11 V or less - Glow plug is being preheated (Glow indicator comes on)	

▶ **Conditions for PTC heater "LOW" operation mode (2nd step)**



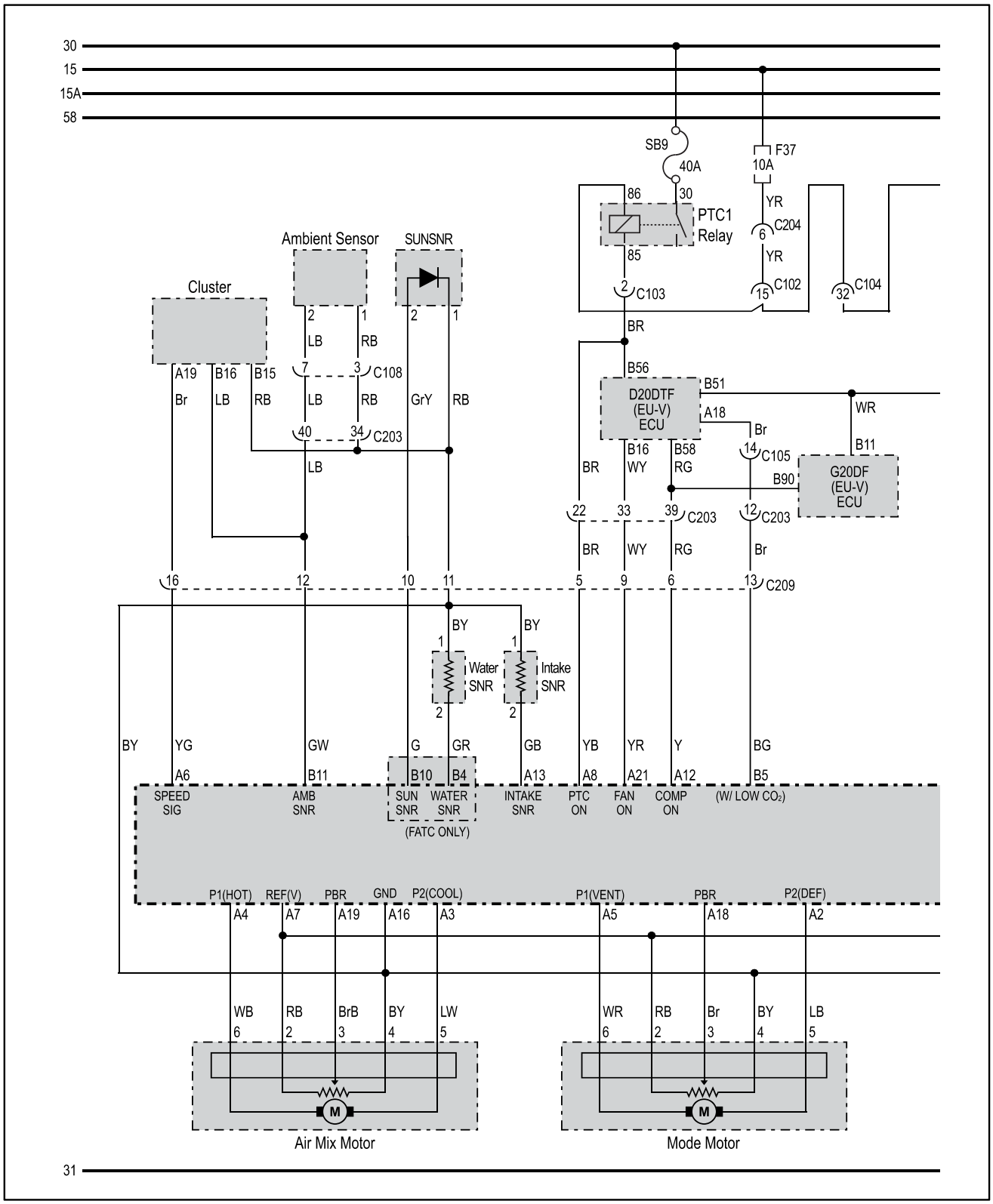
Modification basis	
Application basis	
Affected VIN	

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Memo

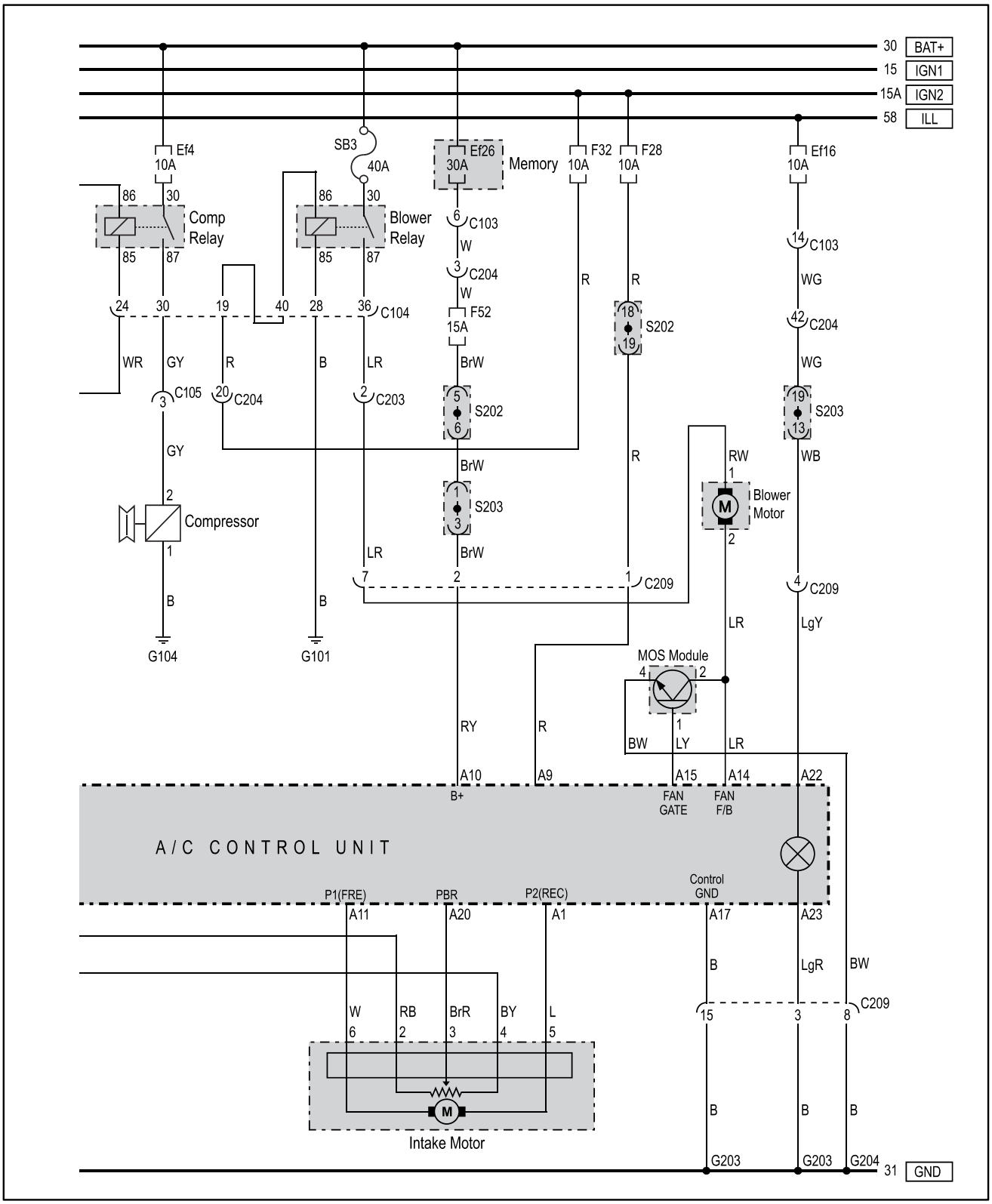
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6. CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
Affected VIN	

AIR CONDITIONING SYSTEM
KORANDO 2013.08

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AIR BAG

8810-00

GENERAL INFORMATION

1. SPECIFICATIONS

Item	Item	Specification
Air bag unit (SDM)	Voltage range	8.0 V to 16.0 V
	Voltage for system diagnosis and SDM self diagnosis	8.0 V to 16.0 V
	Voltage for communication between front and side impact sensors	7.0 V to 16.0 V
	Storage temperature	−40°C to +90°C
	Operating temperature	−40°C to +85°C
Air bag module and seat belt pretensioner	Resistance at −30 to +85°C	2.0 ± 0.3 Ω
	Non-ignition current at +85°C	0.4 A for 10 seconds
	All-ignition current at −35°C	1.2 A for 2 ms
Front and side impact sensors	Operating temperature	−40°C to +125°C
	Power voltage	5.0 to 11.0 V
	Measurement range	5.0 to 11.0 V
Contact Coil	Rated voltage	12.0 V
	Voltage range	9.0 V to 16.0 V
	Air bag circuit resistance	0.23 to 1.0 Ω
	Current capacity	5.0 A
	Rotation	2.1 rotations for each (LH/RH) direction
Replacement interval		Change at every 10 years

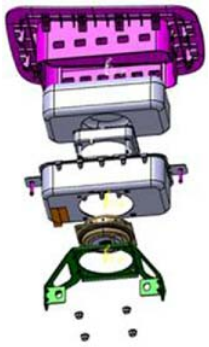
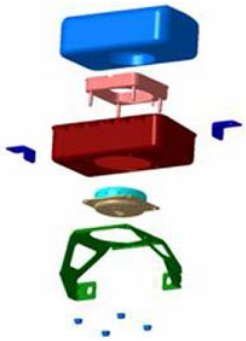
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2. MAJOR CHANGES

▶ **Air bag unit (SDM)**

Air bag unit (SDM)	
Old 	New 
− The appearance and connector (1 EA → 2 EA) of SDM have been changed - The logic for the air bag warning lamp operation has been changed. - Event data recorder (EDR) function has been added.	

▶ **Passenger air bag module**

Passenger air bag module	
Old 	New 
The air bag module type has been changed to "Invisible".	

Modification basis	
Application basis	
Affected VIN	

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▶ Impact sensor

Front impact sensor	
Old 	New 
The appearance of the front impact sensor has been changed.	

Side impact sensor	
Old 	New 
The appearance of the side impact sensor has been changed.	

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3. CAUTIONS FOR AIR BAG SYSTEM

▶ **Cautions for air bag maintenance**

1. Whenever installing or removing the devices related to the air bag system, disconnect the negative battery cable and wait for at least 30 seconds.
2. Do not connect a tester probe to the inflator to measure the resistance of the component of the air bag system. The detonator of the inflator may explode due to a sudden extra power supplied by the tester.
3. Note that the used components related to the air bag system, especially the air bag unit, should be packed in an air tight container and prevent it from any impact or damage.
4. When there is any deployed air bag (including curtain air bag and seat belt pretensioner), the entire system including the air bag unit should be replaced. The deployed air bag unit should not be reused since it has status data when it is deployed, and the data cannot be cleared with a diagnostic device. The air bag and seat belt pretensioner systems contain explosive charges, so handle carefully when
5. disposing or replacing them.

▶ **Cautions for air bag maintenance**

1. Do not modify, change or apply impact on any air bag component. The air bag may be deployed abruptly, causing serious injuries.
2. Children and infants should ride in a rear seat. Seating in the passenger seat with carrying a child or infant is strictly prohibited. An infant or a child could be severely injured by the air bag deployment.
3. A child restraint system must not be installed on the front seat. An infant or a child could be severely injured by the air bag deployment when it is fitted to the passenger seat.
4. Do not place any objects on the air bag inflation location. You may get injured by those objects during deployment.
5. Never put your arms around the front seat from behind, lean on the front seatback, or put your arms out of the window. You can severely injured when the side air bag deploys.
6. Never lean on the door since it becomes very dangerous when the side air bag deploys. The side air bag deploys when there is a severe side collision.
7. Do not slam the front door to close it. The side air bag may deploy unexpectedly.
8. When an occupant fastens the seat belt in an unstable or inclined posture, the air bag system cannot protect the occupant properly. Moreover, the occupant can be injured by the air bag.
9. Do not move your seat too close to the steering wheel or dashboard. Being too close to the steering wheel or instrument panel during the air bag deployment could cause serious injury, including death
10. Hold only the outer rim of the steering so that the air bag can inflate without any hindrance.
11. Do not incline toward the steering wheel. Never allow the passenger to put hands or feet on the dash board. The air bag cannot work properly Do not hold and operate the steering wheel by crossing your arms You could get seriously injured when the air bag deploys.

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12. A large quantity of non-toxic gas (nitrogen gas) is generated with a loud noise when the air bag or seat belt pretensioner deploys. If these airborne particles irritate your skin, eyes, nose, or throat, rinse the area with cool water. If the irritation continues, see your doctor.
13. The windshield glass may be broken when the passenger air bag deploys.
14. The air bag is a unit to save an occupant's life from a sudden accident and it inflates at a very fast speed by gas with high temperature, which might cause injury, such as an abrasion, bruise and burn depending on the accident conditions.
15. The air bag components will be very hot after deployment. Do not touch them.
16. The deployed air bag/seat belt pretensioner cannot deploy again. It will work when an additional impact is applied. Once the air bag system is triggered, the triggered air bag assembly should be removed from the vehicle and replaced with a new one.
17. The air bag warning lamp is illuminated for 3 to 7 seconds after the engine is started to check the system. If this warning lamp remains ON, then the system may be defective. Have the air bag system checked immediately by Ssangyong Dealer or Ssangyong Authorized Service Operation.
18. Incorrect inspection can result in serious injuries or malfunctions in the air bag and seat belt pretensioner system.

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Memo

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OVERVIEW AND OPERATING PROCESS

1. AIR BAG SYSTEM OVERVIEW

The air bag system is divided into front air bag system and side air bag system. The system protects the occupant's body by deploying the air bags in the event of a collision. The system consists of 8 inflators including the inflators of the seat belt pretensioners, air bag unit (SDM), and 4 impact sensors on the front side and both sides of the vehicle. The air bag unit (SDM) determines the operation of each air bag module and seat belt pretensioners using the crash signals from the front and side impact sensors in the event of a collision. The front and side air bag systems are operated independently, and the body control module (BCM) activates the auto door unlock function and various lamps including hazard warning lamp and room lamps, when the crash signal from the SDM is received to notify others of emergency situation and let the occupant escape easily. The SDM is equipped with self diagnosis function, and it performs the diagnosis on the internal/external devices of the air bag system for a certain period of time after IGN ON. And it monitors the air bag system regularly and turns on the air bag warning lamp on the instrument cluster when a fault is found in the system, to notify the driver. The SDM has event data recorder (EDR) function that stores the driving information data transmitted through CAN communication from various units (vehicle speeds, engine rpm, brake application, etc.) in a crash or near crash event, when the acceleration sensor in the air bag unit detects a sharp acceleration change, regardless of the air bag deployment

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2. AIR BAG SYSTEM LAYOUT

A Driver air bag



The air bag is installed at the center of the steering wheel. The inflator of this air bag is ignited momentarily in the event of a collision and deploys the air bag cushion.

B Passenger air bag



This air bag is installed in the upper side of the instrument panel on the passenger side. It activates in the same way of the driver air bag.

D Front impact sensor



The front impact sensors are fitted at the bottom of both LH and RH headlamp inside the front bumper, and output signals that activates the front air bag system.

E Air bag unit (SDM)



The air bag unit is installed in the front side of the front console, and it monitors the air bag system and determines the air bag deployment in the event of a collision.



K Passenger Air Bag ON/OFF Switch



The front passenger air bag is disabled (not inflatable) when placing the passenger air bag ON/OFF switch to “OFF” position. This switch is located on the right side of the instrument panel, and you can see it when opening the front passenger door. Press and turn this switch to operate.
“OFF” position: disabled (not inflatable)
“ON” position: enabled (inflatable)

C Air bag warning lamp



This lamp notifies the driver about the result of the diagnosis and faults.

Modification basis	
Application basis	
Affected VIN	

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F Seat belt pretensioner

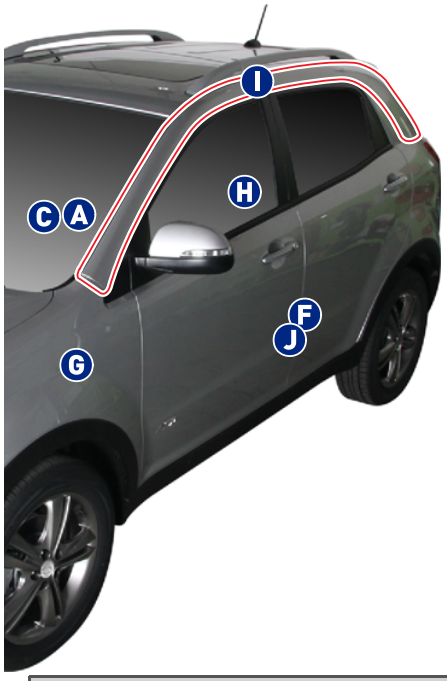


The seat belt pretensioners of all seats are operated at the same time, in the event of a collision. They pull the seat belt and holds the occupants in the seat to minimize the impact.

G BCM (Crash signal)



The BCM activates the auto door UNLOCK, hazard warning lamp, and room lamps when a crash signal of the air bag unit (SDM) is input.



H Side air bag



The side air bags are installed in the outer sides of the driver (LH) and passenger (RH) seats to minimize occupants' side injuries in case of a side impact. This air bag is operated based on the collision signal from the side impact sensor.

I Curtain air bag



The curtain air bags are installed to the upper end of both doors. The air bag provides head protection for the front and rear outboard occupants in a side collision.

J Side impact sensor



The side impact sensors are fitted at the bottom of both LH and RH B-pillars, and output signals that activates the side air bag system.

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3. AIR BAG SYSTEM OPERATING PROCESS

1) Air Bag System Input/Output

The air bag unit (SDM) performs the internal/external diagnosis on the air bag system for about 6 seconds after IGN ON. The air bag unit is ready to deploy air bag after this diagnosis, and when a certain level of collision occurs, it determines the deployment of the air bag using the signals from the impact sensors, deploys the corresponding air bag, and stores the collision data and EDR data. The body control module (BCM) activates the auto door unlock function and various lamps including hazard warning lamp and room lamps, when the crash signal from the SDM is received to notify others of emergency situation and let the occupant escape easily.

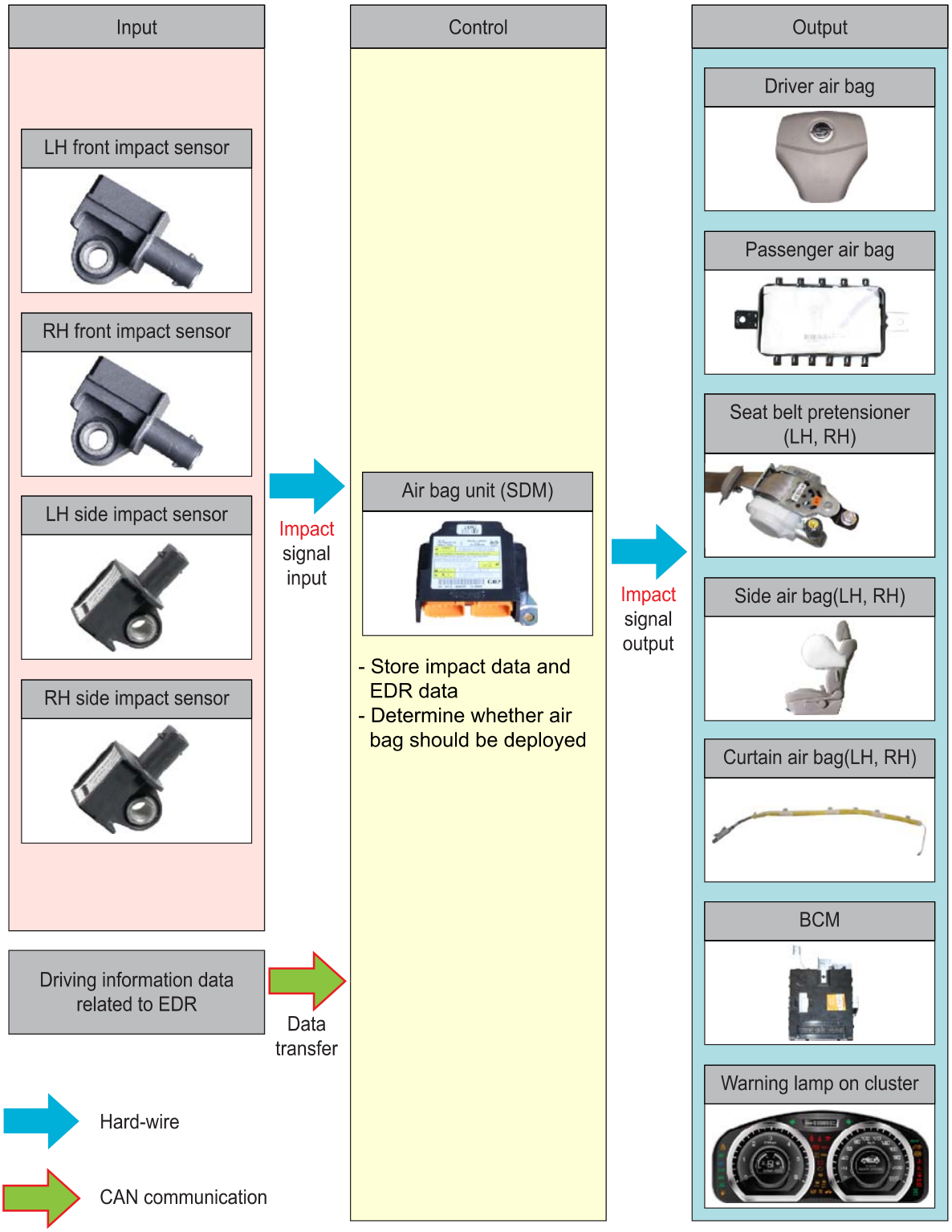
NOTE

Major functions

- Detects frontal and side collision (Rear-end collision only with EDR trigger)
- Activates the front air bag, side air bag, curtain air bag and belt pretensioners
- Indicates system readiness and faults to the driver by means of a fault warning lamp
- Facilitates servicing capability via a serial diagnostic communication interfaces
- Records crash data and DTCs
- Keeps power for deployment of air bag even when the power to the air bag unit is cut off due to the collision
- Event data recorder (EDR)

Modification basis	
Application basis	
Affected VIN	

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CAUTION

The front air bags and side air bags are activated independently according to the area and amount of an impact.

Modification basis	
Application basis	
Affected VIN	

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2) Front Air Bag System Operating Process

(1) Front air bag system deployment conditions

▶ **The air bag will be deployed when:**

- the impact or type of a frontal collision is too much for the seat belt to protect the occupant.

▶ **The air bag can be deployed when:**

- there is underbody impact from the road surface, impact against the curb at a very high speed, or dropping impact onto the road surface with a large angle.

▶ **The air bag will not be deployed when:**

- the vehicle rolls over or tips over sideward, or a side/rear collision occurs.
- the impact of the collision is low enough for the seat belt to protect the occupant properly.

▶ **The air bag will be hardly deployed when:**

- a collision to diagonal direction (not a frontal collision) occurs or the vehicle tips over.
- a minor collision which the air bag sensor cannot detect occurs (impact is lower than that of operating condition).
- a collision against narrow objects, such as a telegraph pole or a tree, occurs.
- the vehicle goes into a drainage or a puddle.
- the vehicle wedges under a truck or a trailer or collides with the underbody of a heavy-duty vehicle.
- the hood is hit by falling stones.
- the air bag warning lamp is on.

(2) Front air bag system deployment

When a collision occurs the air bag unit receives the signal from the front impact sensor and ignites the front air bag to deploy the driver and passenger air bags and seat belt pretensioner.

Item	Impact to (front)
Driver air bag	Ignite
Passenger air bag	Ignite
Seat belt pretensioner - Driver side	Ignite
Seat belt pretensioner - Passenger side	Ignite

(3) Component change after deployment

Air bag unit and its wirings (including connectors), seat belt pretensioner and its wirings (including connectors), all front air bags, instrument panel, front impact sensor and other damaged components

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3) Side Air bag System Operating Process

(1) Side air bag system deployment conditions

▶ **The air bag will be deployed when:**

- a severe oblique collision occurs with a specific severity, angle, speed, and position.

▶ **The air bag can be deployed when:**

- the vehicle rolls over or tips over sideward with a severe impact.
- the vehicle is stationary or a frontal collision occurs at low speed.
- a rear collision occurs.
- the impact of the collision is low enough for the seat belt to protect the occupant properly.

▶ **The air bag will not be deployed when:**

- the vehicle is stationary or a frontal collision occurs at low speed.
- a rear collision occurs.
- the impact of the collision is low enough for the seat belt to protect the occupant properly.

▶ **The air bag will be hardly deployed when:**

- a collision with oblique impact to the front seat direction or a frontal collision to the diagonal direction occurs.
- a frontal or rear collision occurs.
- the vehicle rolls over or tips over sideward with a minor impact.
- the air bag warning lamp is on.

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(2) Side air bag system deployment

The side air bag system is activated in the event of a left side or right side collision. The seat side air bags are installed to the driver and passenger seat (one on each seat) and the curtain air bags are installed in the end of the roof located on the upper sides of both doors. The side air bags and the curtain air bags are operated by the same signal. The air bags of the driver seat and passenger seat are operated separately according to the impact position (left side, right side).

Item	Impact to (side)	
	LH	RH
Side air bag - Driver side	Ignite	Not ignite
Side air bag - Passenger side	Not ignite	Ignite
Curtain air bag - Driver side	Ignite	Not ignite
Curtain air bag - Passenger side	Not ignite	Ignite
Seat belt pretensioner - Driver side	Not ignite	Not ignite
Seat belt pretensioner - Passenger side	Not ignite	Not ignite

(3) Component change after deployment

▶ **Side air bag deployed**
Deployed side air bag, air bag unit and its wirings (including connectors), side impact sensor, other damaged trim, seat components

▶ **Curtain air bag deployed**
Deployed curtain air bag, air bag unit and its wirings (including connectors), side impact sensor, damaged trim, seat and roof headlining

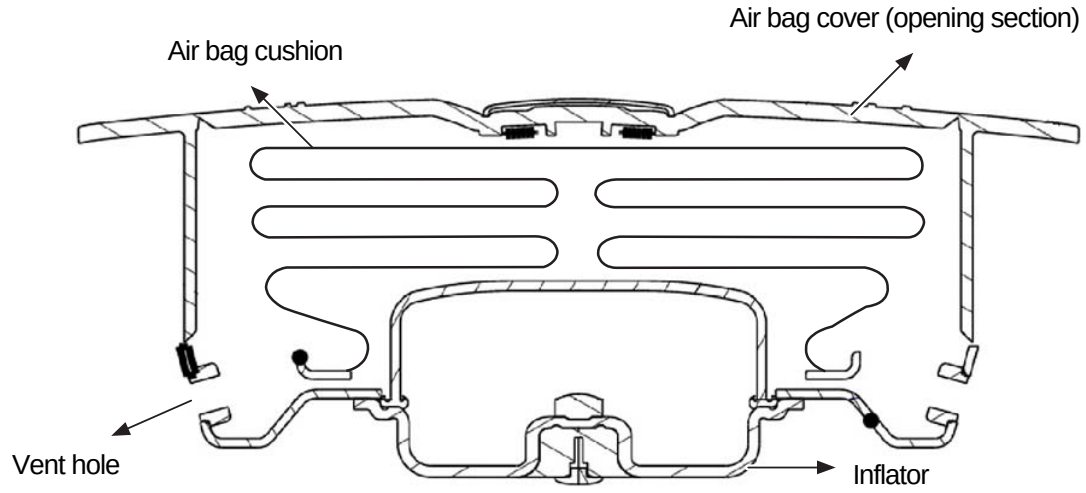
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3) Deployment Procedure

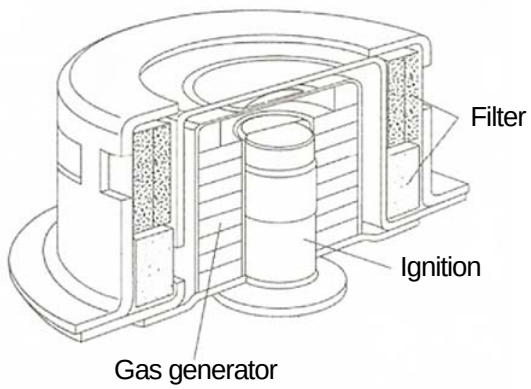
▶ **General deployment of air bag**

In general, the air bag unit transmits the ignition current to the ignition device of the corresponding air bag inflator when a collision signal from the impact sensor is sent to the air bag unit
When the ignition device of the inflator is ignited, the gas generator generates nitrogen gas by being burned, and this gas inflates the air bag cushion through the filter. The nitrogen gas used to inflate the air bag exhausts through the vent hole immediately.

Cross section of driver air bag

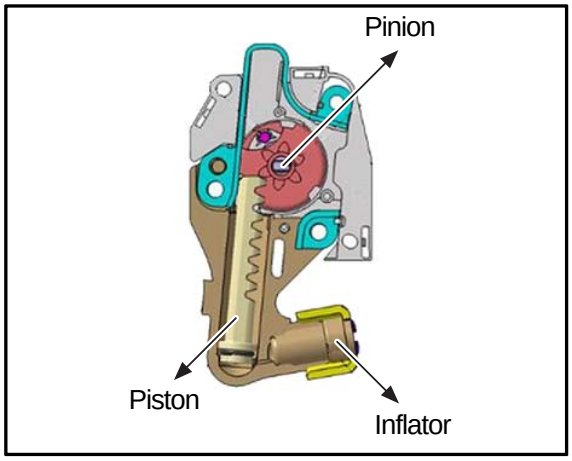


Cross section of inflator



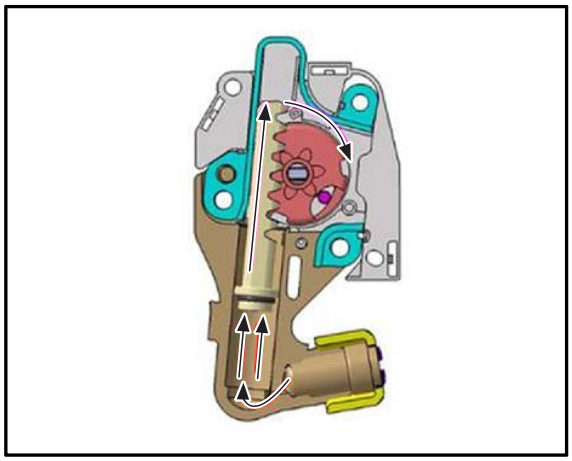
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▶ **Seat belt pretensioner deployment**



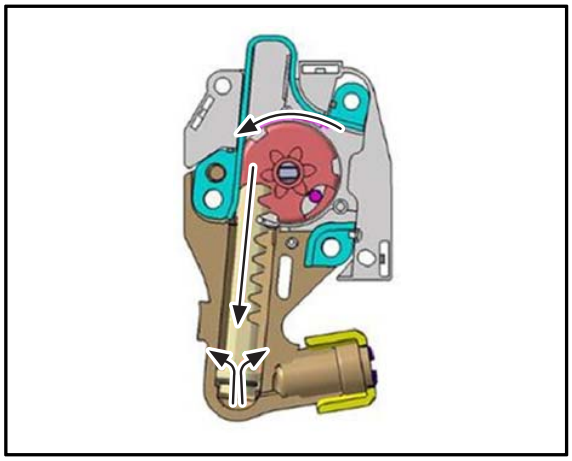
1. **Original status**

The piston and pinion in the seat belt pretensioner are disengaged and the tension of the return spring in it holds the occupant.



2. **Pretensioner operating**

When the ignition current is transmitted from the air bag unit to the ignition device of the seat belt pretensioner, gas is generated from the inflator and this pushes up the piston.
When the piston gear engages with the pinion gear, the clutch is integrated and winds the seat belt.



3. **Load limiter operating**

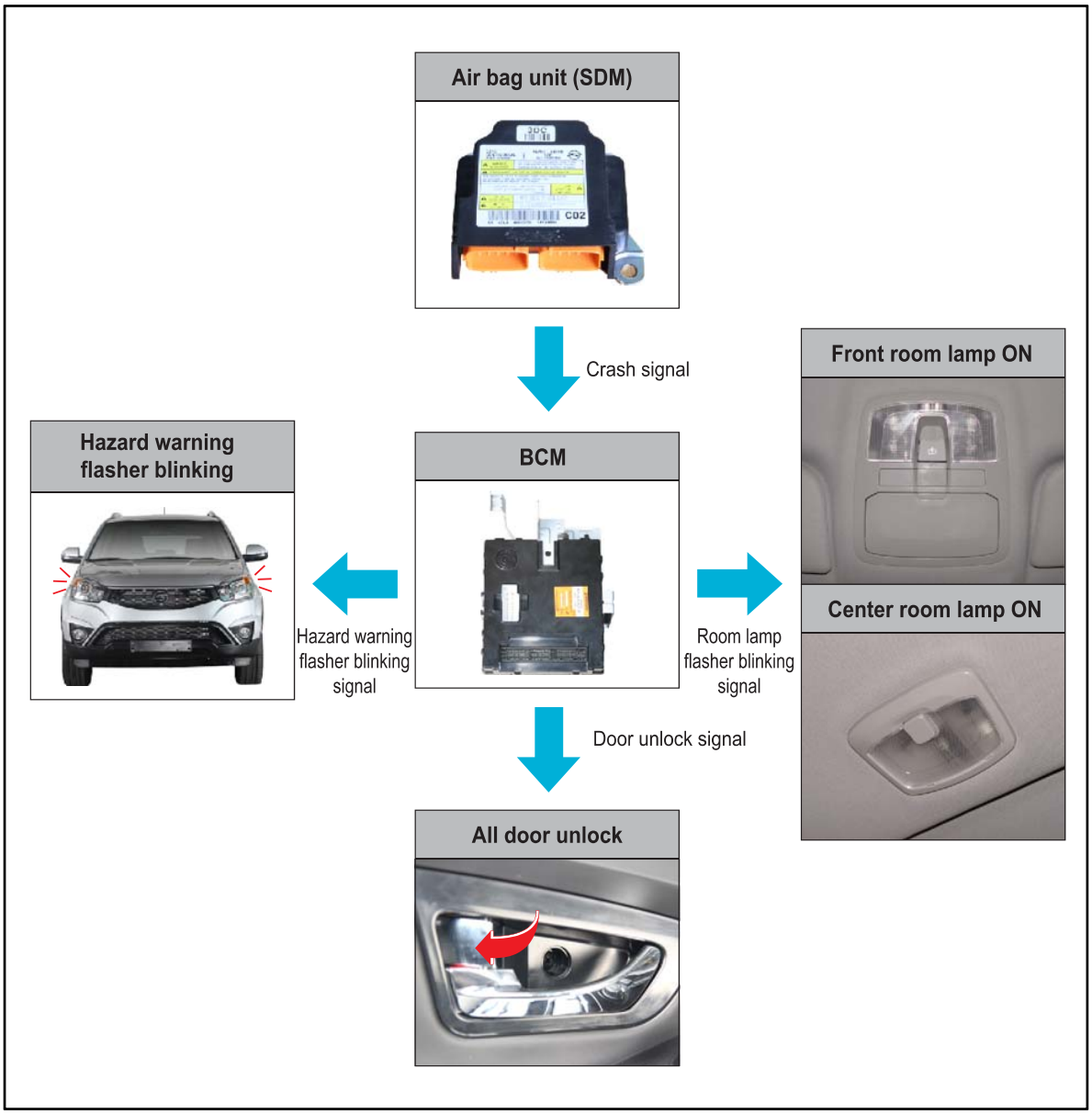
When the load on the seat belt increases and the inner device stars being deformed, the pinion rotates in reverse direction and the piston moves downward. The residual pressure is released through the vent hole of the piston when the piston moves down. The gears of pinion and piston are disengaged when the piston is located at the lowest position.

Modification basis	
Application basis	
Affected VIN	

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4) Air Bag Deployment Signal to BCM

The air bag deployment signal from the air bag unit is sent to the BCM. This signal triggers the flash of the hazard warning lamp to notify others of emergency situation, and is used as a signal that turns on the room lamps and activates auto door unlock function for the occupants.



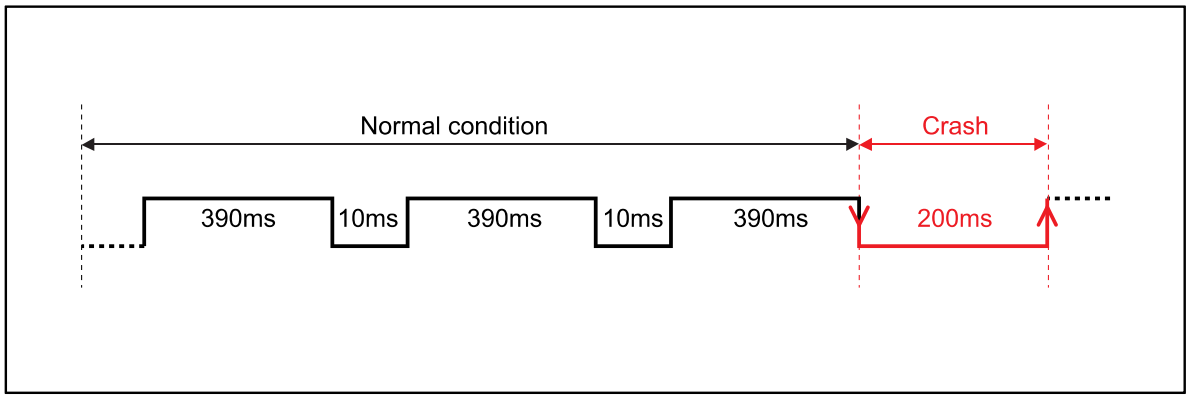
NOTE

The air bag unit of a vehicle without side air bag system can also send the crash signal to the BCM according to the value of the acceleration sensor to activate the auto door unlock and various lamps including hazard warning lamp and room lamps.

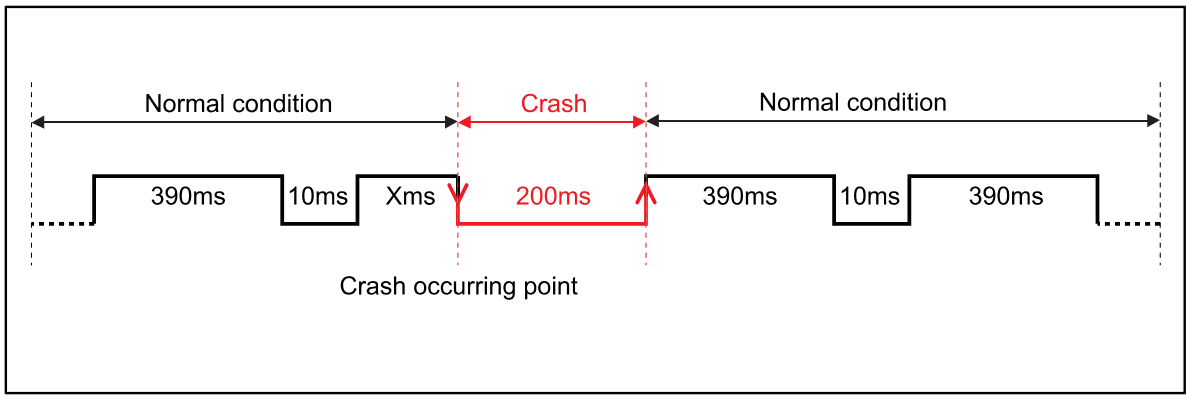
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(1) Air bag deployment signal output (crash out)

When a situation which requires an air bag deployment occurs, they system outputs the air bag deployment signal (crash out). If another air bag-required situation occurs while the deployment signal is sent, the second crash out will be delayed until the current 200 ms crash out is completed. (The tolerance at the time of signaling is ±5%)



The signal repeats increasing for 390 msec. and decreasing for 10 msec. before crash. At the time of crash, the air bag deployment signal is output to the BCM for 200 ms immediately.



Modification basis	
Application basis	
Affected VIN	

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(2) BCM control when air bag deployment signal is input

Operation 1.

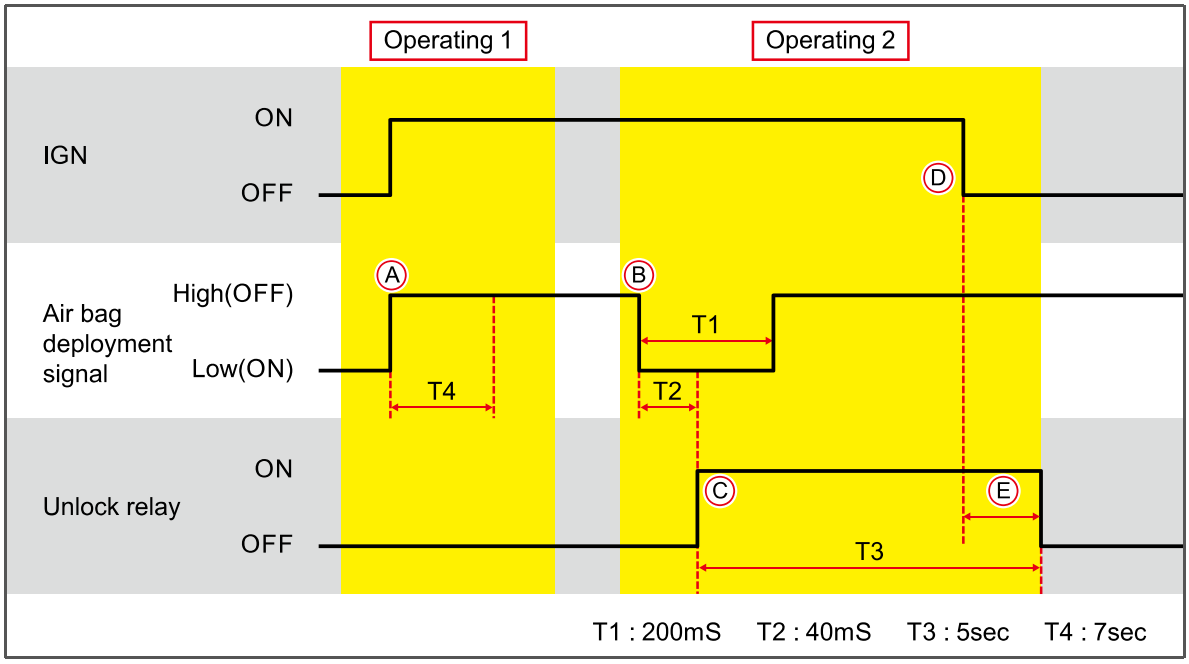
A. Air bag deployment signal is not input for initial 7 seconds (T4) after IGN ON

Operation 2.

B. When air bag deployment signal (OFF→ON) is input 7 seconds (T4) after IGN ON
C. Signal from unlock relay is output for 5 seconds (T3) after 40 ms (T2)
D. When turning IGN OFF during 5 seconds (T3) of unlock relay signal output
E. Signal from unlock relay is input for the rest of the time

NOTE

- The room lamp comes on when the air bag deployment signal is input except when the room lamp switch is turned off.
- The hazard warning lamp flashes when the air bag deployment signal is input.
- Resetting the auto door unlock function turns off the battery (cutting off BCM power).



CAUTION

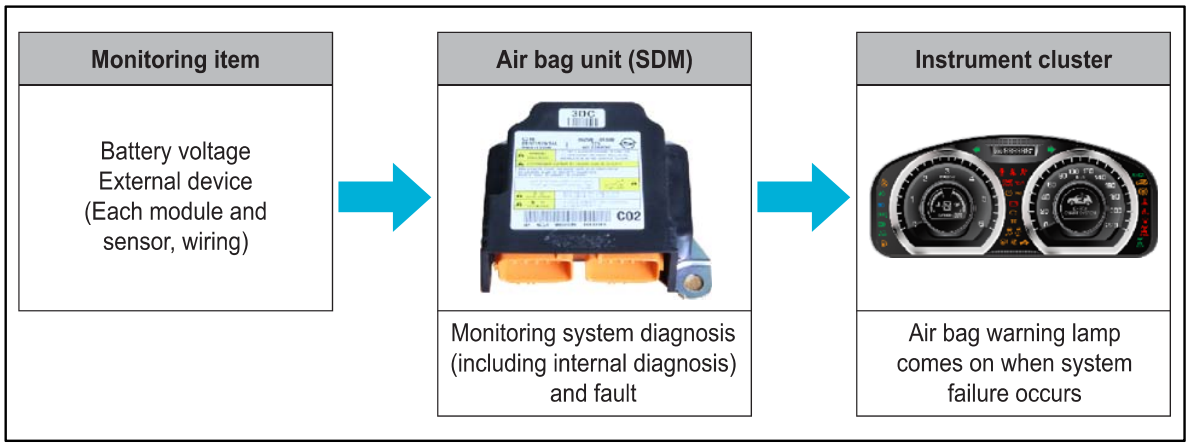
1. The UNLOCK by the air bag deployment signal takes priority over the LOCK/UNLOCK control from other functions.
2. The LOCK/UNLOCK requests from other functions during or after the UNLOCK output by the air bag signal are ignored. However, the LOCK control is carried out when the ignition switch is turned to the "OFF" position.
3. The same request during the LOCK/UNLOCK output is ignored. However, the UNLOCK by the air bag deployment signal or operation by the smart key is carried out.
4. When LOCK and UNLOCK outputs occur at the same time, the LOCK output is carried out and UNLOCK is ignored.

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4. AIR BAG SYSTEM SELF DIAGNOSIS

1) Air Bag Unit (SDM) Self Diagnosis

The air bag unit monitors the internal/external devices of the air bag system including battery voltage, limits certain functions of the air bag, and turns on the air bag warning lamp on the instrument cluster according to the conditions.



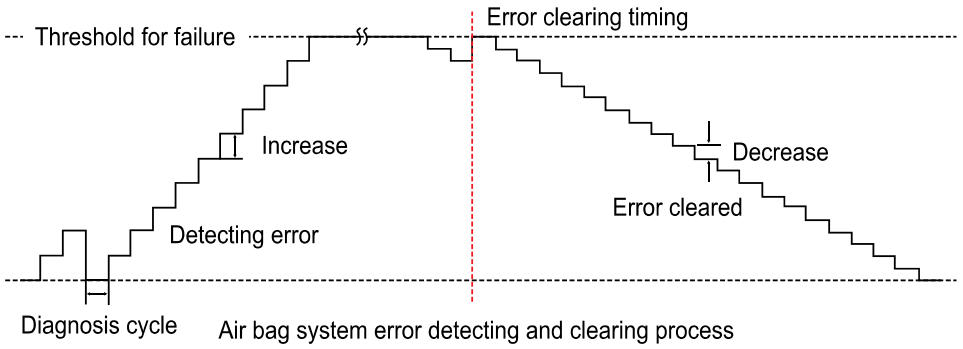
▶ **Conditions for detecting and clearing faults**

The time for detecting errors and clearing the errors is as follows:

Monitoring system	Diagnosis cycle	Time for detecting	Time for clearing	Clearing fault
Inflator circuit	400 ms	4 seconds	8 seconds	with a diagnostic device
warning lamp circuit	100 ms	4 seconds	8 seconds	with a diagnostic device
Battery voltage	10 ms	4 seconds	4 seconds	with a diagnostic device
Impact sensor	IGN ON	1 seconds	2 to 4 seconds (next Ign)	with a diagnostic device
Impact record (air bag deployed)	-	Immediately	-	by replacing SDM (cannot be cleared with a diagnostic device)
SDM internal fault	-		-	by replacing SDM (cannot be cleared with a diagnostic device)

Modification basis	
Application basis	
Affected VIN	

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Air bag system error detecting and clearing process

2) Air Bag Warning Lamp

The air bag unit turns on the air bag warning lamp on the instrument cluster for 6 seconds after IGN ON while performing self diagnosis for the air bag system. If no fault is found in the system, it turns off the warning lamp. After this, the unit monitors the system regularly, and notifies the driver by turning on the air bag warning lamp when a fault is found in the system.

Air bag warning lamp

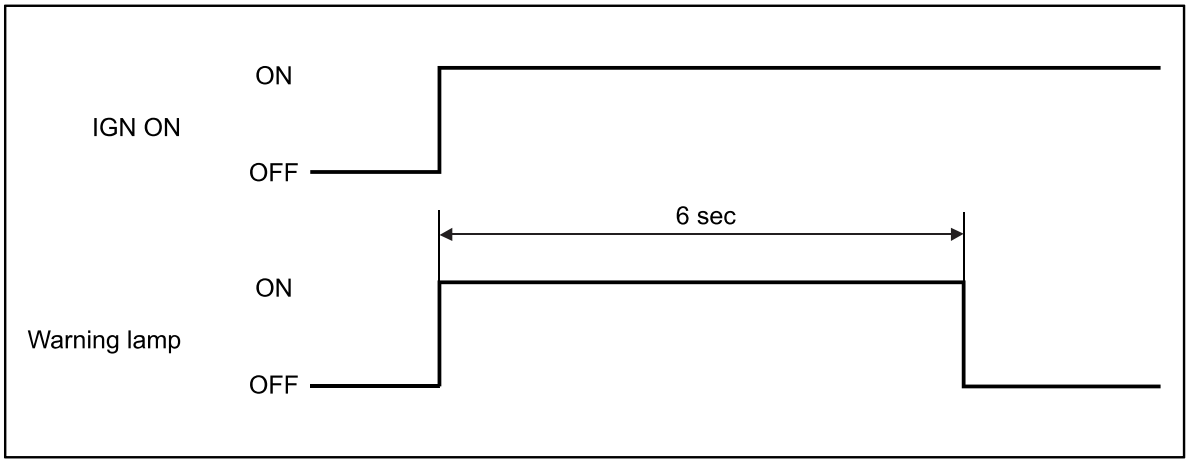

* The air bag warning lamp comes on when:

- diagnosis is performed for the inside/external devices of the system when the ignition is turned on
- the air bag system is malfunctioning
- the air bag unit and a diagnostic equipment communicate each other

(1) Air bag warning lamp ON at initial IGN ON

▶ **System normal**

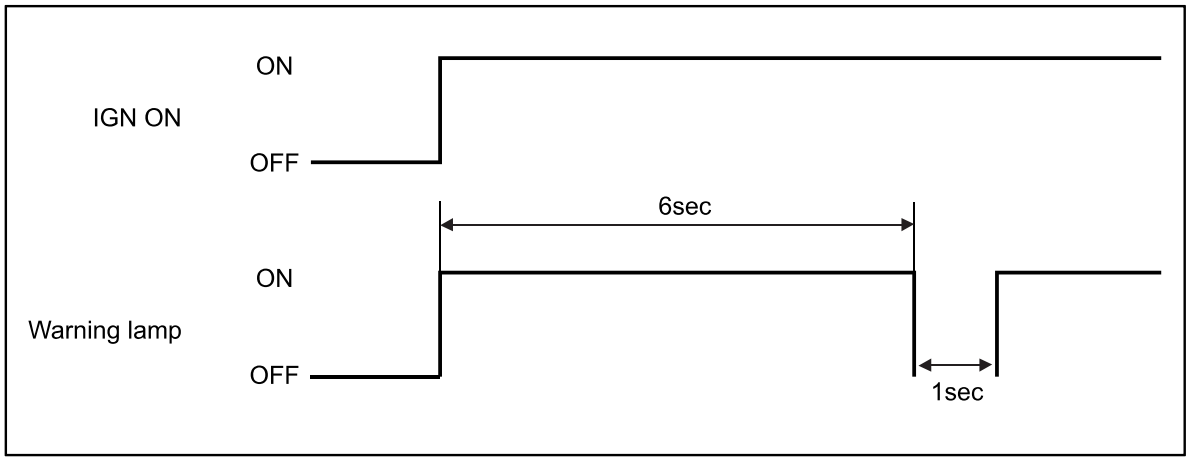
Comes on for 6 seconds after IGN ON and then goes out.



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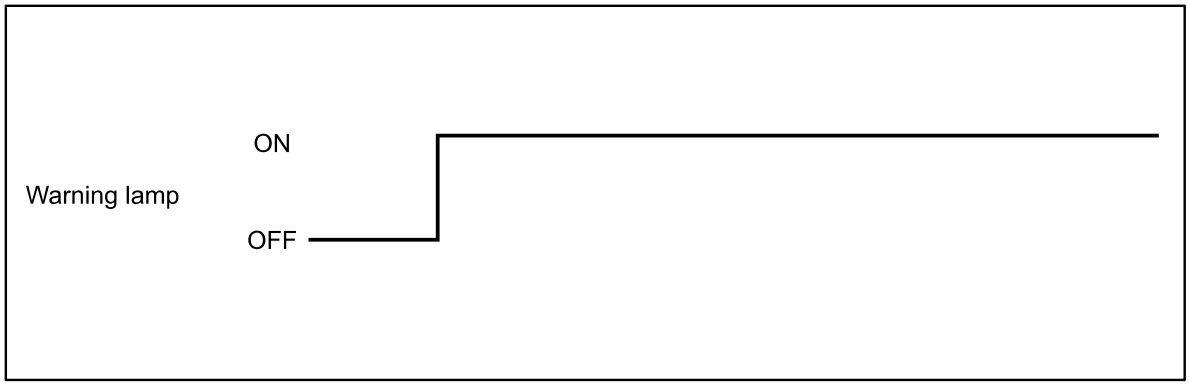
▶ **System malfunctioning**

Comes on for 6 seconds after IGN ON and goes out for 1 second, and then remains on.



(2) Air bag warning lamp operation during driving

The air bag warning lamp comes on when the air bag unit (SDM) detects a system malfunction. The warning lamp goes out when the malfunction disappears.

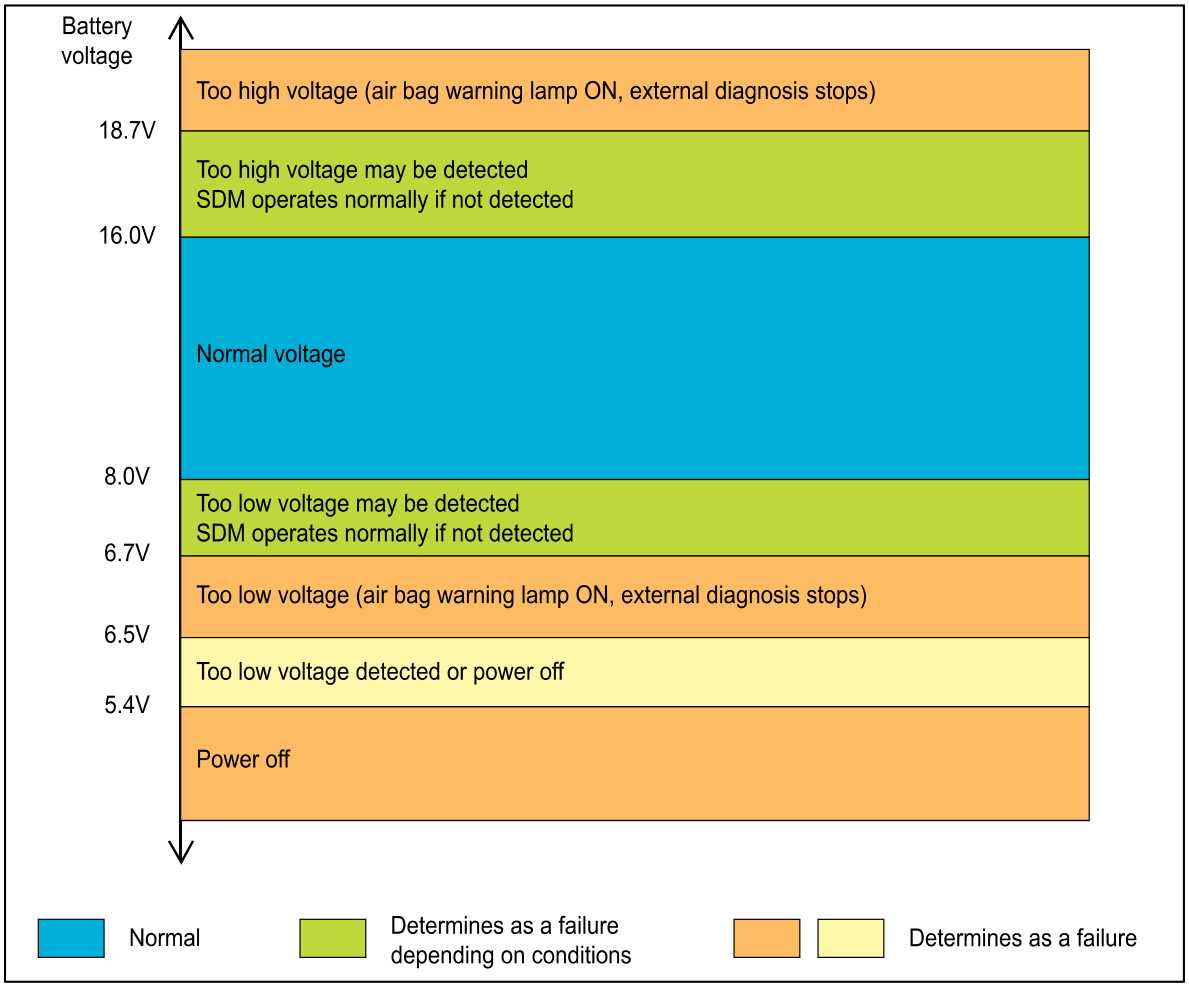


Modification basis	
Application basis	
Affected VIN	

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3) Supply Voltage Monitoring

The air bag unit monitors the battery voltage continuously while the ignition is turned on.. It limits certain functions of the air bag system and outputs DTC and air bag warning lamp signal according to the result of the monitoring.



CAUTION

Abnormal voltage of the air bag unit (too high/too low) is determined to be fault only when the signal is detected for continuous 4 seconds.

NOTE

Emergency power function

The SDM has an emergency power function that ensures the internal operation of the central unit and buffering firing circuits for a minimum of 150 ms after loss of battery power. Full emergency power capability is available after the minimum specified operating voltage has been applied to the SDM power line for 10 seconds, and from this point, air bag deployment and EDR are enabled.

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4) Internal monitoring

The air bag unit checks the status of the air bag system and monitors the system for internal errors. If an error is detected by self diagnosis, this unit disables part of the air bag system functions and outputs a diagnostic trouble code (DTC) and air bag warning lamp signal.

- **Watchdog**
  The micro controller is monitored periodically. And if a fault is found, micro controller is reset, inflator ignition function is limited, and the air bag warning lamp comes on.
- **Internal acceleration sensor test**
  The air bag unit checks internal acceleration sensor when the ignition is turned on. The air bag unit determines the deployment of the air bag for the collision signal input after the diagnosis.
- **Non-volatile memory (NVM) test**
  The air bag unit checks the values stored in the memory. If the values are not correct, the air bag unit sets a diagnostic trouble code (DTC) and turns on the air bag warning lamp.

▶ **Air bag operations for errors**

Internal errors	Air bag operation	
	Front air bag system	Side air bag system
X-axis acceleration sensor error	Disabled	Disabled
Y-axis acceleration sensor error		Disabled
Z-axis acceleration sensor error		available
ROM checksum error		Disabled
RAM checksum error		Disabled
NVM checksum error		Disabled

Modification basis	
Application basis	
Affected VIN	

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5) External monitoring

The air bag unit supplies a certain level of test current and monitors the resistance of the inflator circuit within a specified range to deploy the air bag. It limits certain functions of the air bag, sets a DTC and turns on the air bag warning lamp according to the conditions.

Item \ Unit	Driver/passenger air bag	Side air bag	Curtain air bag	Seat belt pretensioner
Resistance at -30 to +85°C	2.0 ± 0.3 Ω			
Non-ignition current at +85°C	0.4 A for 10 seconds			
All-ignition current at -35°C	1.2 A for 2 ms			
Periodical test current	160 mA	100 mA	100 mA	40 mA

▶ **Inflator circuit resistance monitoring**

Item \ Unit	Driver/passenger air bag	Side air bag	Curtain air bag	Seat belt pretensioner
Below 1.0 Ω	Low resistance detected			
1.0 Ω ~ 1.5 Ω	Not clearly detected low resistance			
1.5 Ω ~ 6.0 Ω	Normal resistance			
6.0 Ω ~ 7.0 Ω	Not clearly detected high resistance			
7.0 Ω or above	Not clearly detected high resistance			

Normal | Determines as a failure depending on conditions | Determines as a failure

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▶ **Impact sensor monitoring**

The air bag unit supplies a certain level of test current to monitor the front and side impact sensors. If the wiring is open/short circuited or no signal is input, or communication is malfunctioning, it sets a DTC and turns on the air bag warning lamp.

Faults	Detection		Time for clearing
	Fault condition	Time for detecting	
Normal errors	Incorrect ID after IGN ON	Approx. 1 seconds.	Approx. 2 seconds. (next Ign)
	Faulty sensor after IGN ON		
	Communication error		
Incorrect ID	Inconsistent ID after IGN ON		
Communication error	Communication data error		Approx. 2 seconds.
	Open/Short circuit (B+)		
Short Circuit to Ground	Short Circuit to Ground		approx. 2 to 4 seconds

6) DTC and Air Bag Deployment Data Storing

▶ **DTC storing**

All DTCs of air bag system are stored in the air bag unit. Maximum number of DTCs that can be stored is 16. If a new DTC is set after 16 DTCs are stored, the oldest stored code is erased first.

▶ **Airbag deployment data storing**

The air bag deployment data is stored in the air bat unit. Maximum number of data that can be stored is 7.

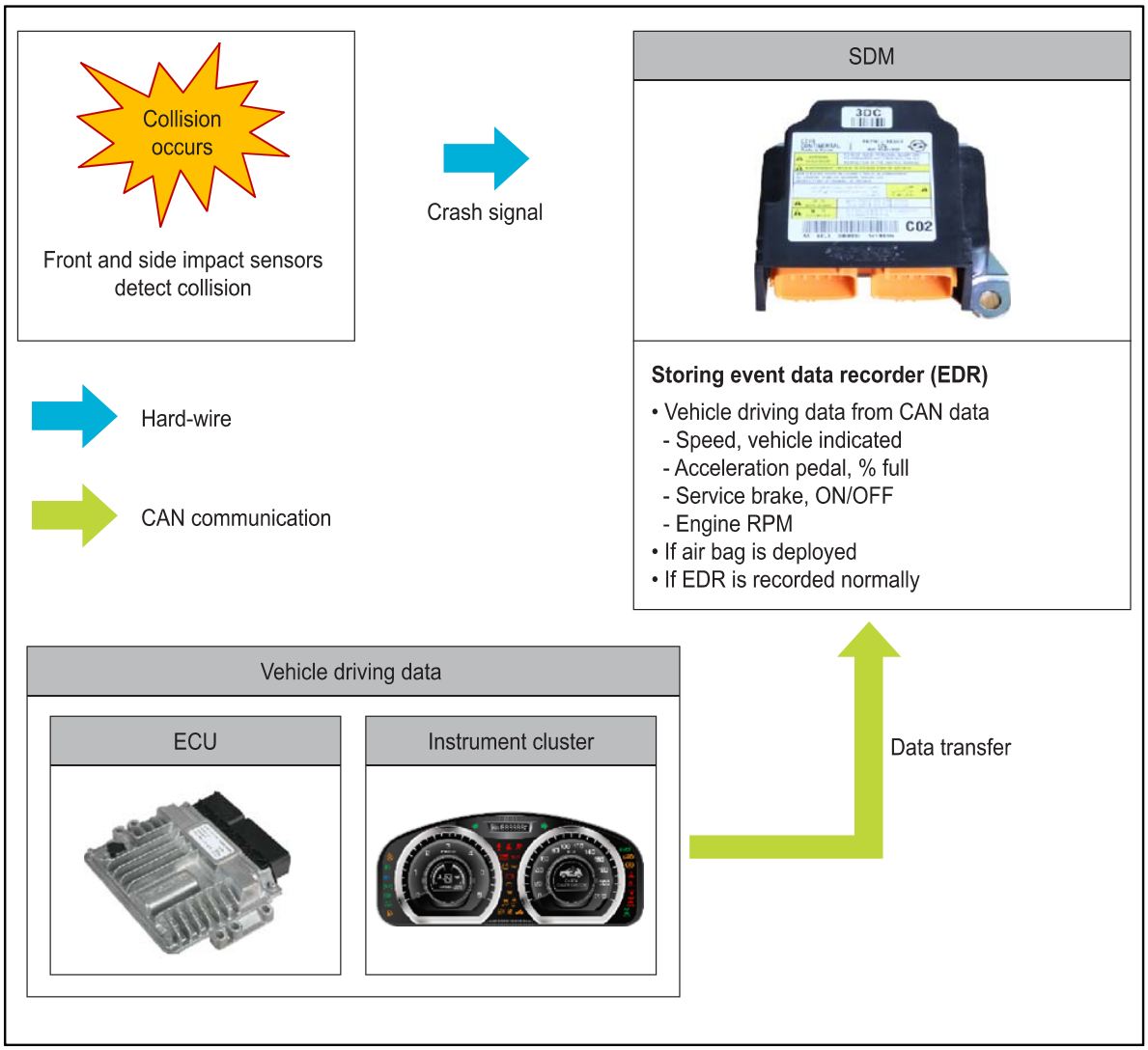
NOTE

- The DTCs realated to “low battery voltage" are not accumulated.
- The air bag deployment data due to a collision cannot be cleared. The air bag unit should be replaced.

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5. EVENT DATA RECORDER (EDR)

The event data recorder (EDR) stores the driving information data in a crash or near crash event, when the acceleration sensor in the air bag unit detects a sharp acceleration change which meets the EDR operating conditions, regardless of the air bag deployment The air bag unit always stores the driving information data and updates the data with new one periodically. If a collision is detected by front and side impact sensors, the acceleration sensor in the SDM detects the change in acceleration. The air bag unit stores the information on internal acceleration sensor, driving status and air bag deployment at this time.

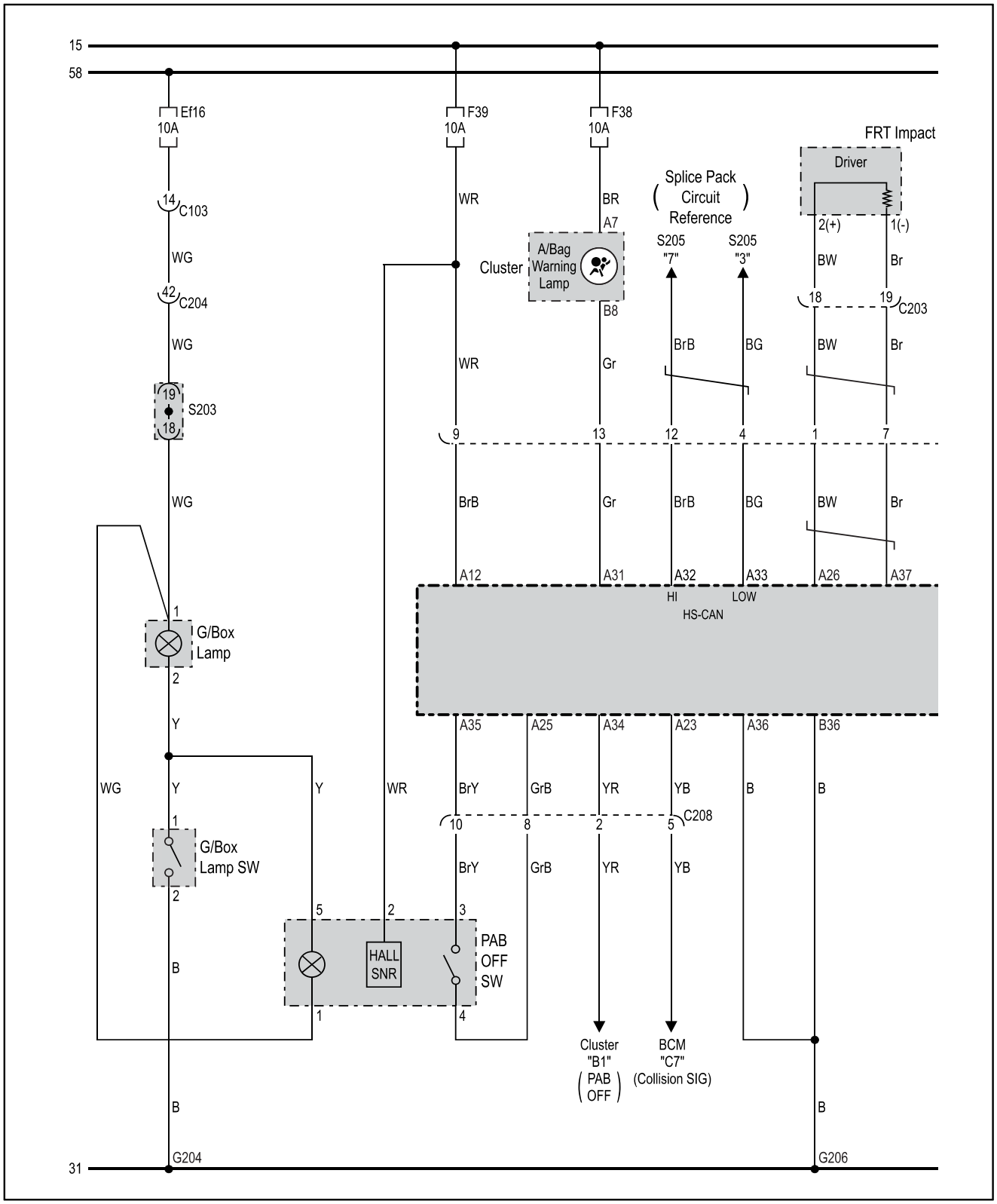


NOTE

The EDR stores the driving information also when the acceleration sensor in the air bag unit detects a sharp acceleration change in the event of a rear-end collision or side collision for a vehicle without an air bag

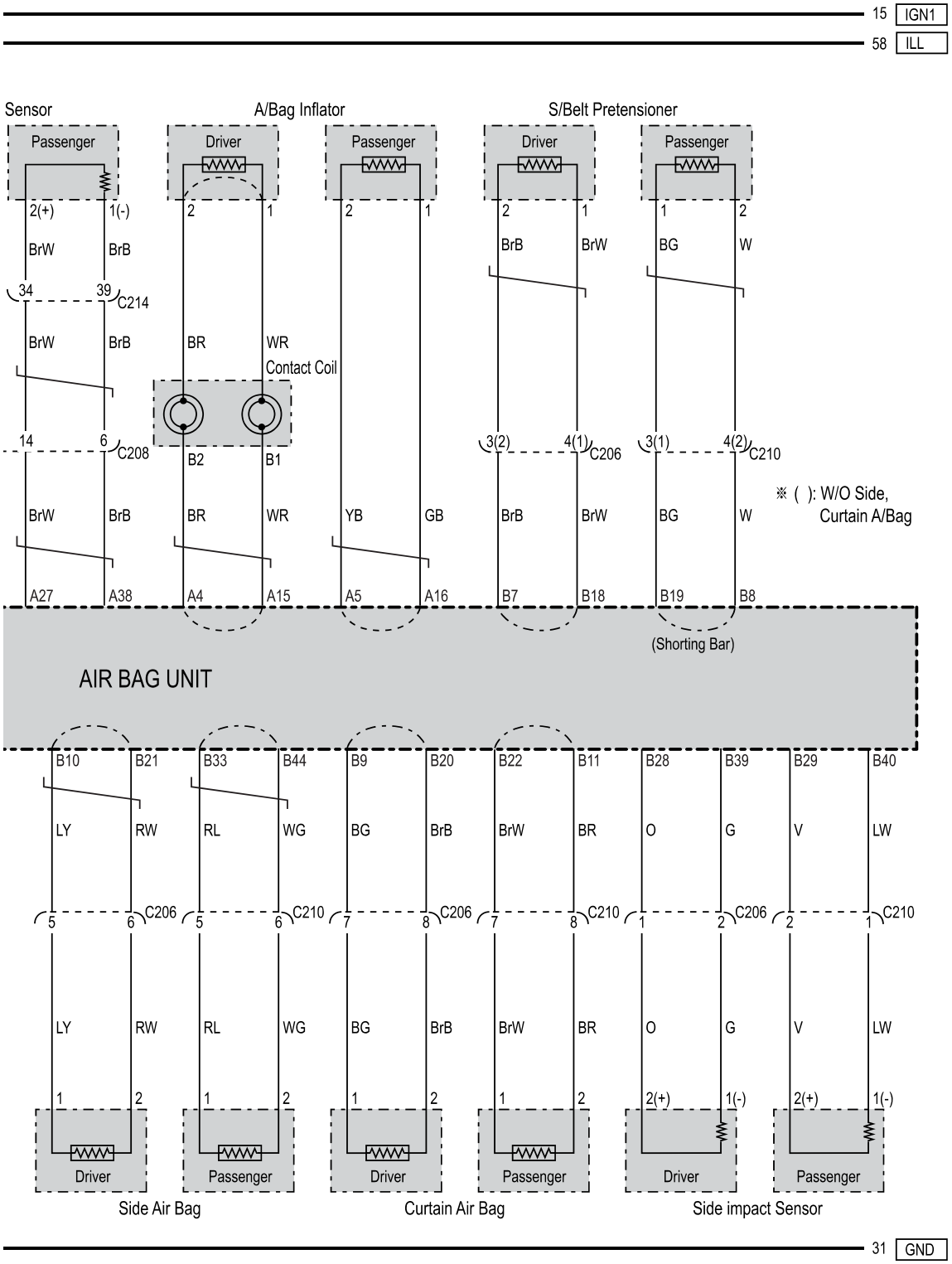
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6. CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

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Modification basis	
Application basis	
Affected VIN	

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Memo

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SEAT 7410-00

GENERAL INFORMATION

1. SPECIFICATION

1) Specifications

Item				Front seat (driver)	Front seat (passenger)	Rear seat
Type				Manual 6-way	Manual 4-way	4:6 split type
				Automatic (power) 6-way	-	-
Height adjuster	Manual			±25mm(Pump type)	-	-
	Automatic			±25mm	-	-
Sliding				240mm (Front 190 mm + rear 50 mm)	←	-
Recliner				66˚ (Front 20˚ + rear 46˚)	←	17.5˚(Front 7˚ + rear 10.5˚)
Lumbar support				Manual(2-level adjustment)	←	-
Seat heating and ventilation	Rated voltage			12V	←	←
	Operating voltage			10V ~ 16V	←	←
	Heating temperature	Heating level	LOW	25±4˚C ~ 35±4˚C	←	35±4˚C ~ 45±3˚C (ON → OFF)
			HI	33±4˚C ~ 43±3˚C	←	
		Heating and ventilation	1STEP	35±3˚C	←	35±4˚C ~ 45±3˚C (ON → OFF)
			2STEP	45±3˚C	←	
Head restraint	Conventional	Up/down		90mm (15mm x 6 steps)	90mm (15mm x 6 steps)	45mm (15mm x 3 steps)
		Sliding		24mm (8mm x 3 steps)	24mm (8mm x 3 steps)	-
	Electronic active type			15° tilting	15° tilting	-
Seat				3-point, ELR, PT, L/L	3-point, ELR, PT, L/L	LH/RH and center: 3-point, ELR
Back pocket				Mesh/leather type	Mesh/leather type	-

Modification basis	
Application basis	
Affected VIN	

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2) Seat Heated Wire and Ventilation Unit

Item			Specifications	
Seat heated wire and ventilation unit	Rated voltage		DC 12 V	
	Operating voltage		DC 9 V to 16 V	
	Operating temperature		−30˚C to + 80˚C	
	Rated load	Heated wire (driver & passenger seats)	DC 12 V − 5 A ± 10%	
		Ventilation (driver seat)	DC 12 V - max. 0.9 A	
	Cut off over-current	Heated wire (driver & passenger seats)	DC 12 V − 0.75 A ± 10%	
		Ventilation (driver seat)	DC 12 V − 8.5 A ± 10%	
	Ventilation motor	Operating current	Level 1	DC 12 V − 0.5 A ± 10%
			Level 2	DC 12 V − 0.6 A ± 10%
		Ventilation motor revolutions (rpm)	Seat cushion	Level 1 (2,400 RPM ± 10%)
				Level 2 (2,750 RPM ± 10%)
			Seat back	Level 1 (3,160 RPM ± 10%)
				Level 2 (3,660 RPM ± 10%)

Modification basis	
Application basis	
Affected VIN	

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2. WARNINGS FOR POWER SEAT

▷ Adjust the driver seat before driving.
▷ Make sure that the seat is firmly secured after adjusting.
▷ Never drive the vehicle with the head restraint removed or lowered excessively. Otherwise, your neck, spine or other parts of the body can be severely injured in the event of an accident.
If you recline the seatback excessively, you could slide under the seat belt and be injured severely
▷ in a collision.
Do not put any object that could damage the seat on the seat.
▷ The front and rear seats are equipped with the heated wire (seat warmer) system. Using the seat
▷ warmer system excessively may cause minor burns. The following occupants should exercise special care when using the heated wire seat.

- Infants, children, old or handicapped persons
- Persons with sensitive skin
- Exhausted persons
- Persons who is drunk or took medicine which causes drowsiness such as sleeping pills, cold tablets, etc.

▷ Do not place anything on the seat that insulates against the heat, such as a blanket or cushion.
Make sure that the head restraints are in place and secured properly. Never drive the vehicle with
▷ the head restraint removed.
To minimize the injuries in a collision or an abrupt stop, make sure the seatback is in the upright
▷ position before driving. If the seatback is reclined too much, the occupant could slide under the seat belt in a collision or an abrupt stop and cannot be protected properly by the air bag system.

3. CAUTIONS FOR POWER SEAT

▷ You can operate the power seat with the ignition switch OFF. However, frequent operation of the seat switch with the engine stopped can result in battery becoming discharged.
▷ Operating more than one seat adjustment switch at the same time can cause damage to the seat motor. Therefore, operate the seat switch only one at a time.
▷ Do not use organic solvents such as benzene, thinner, alcohol or gasoline to prevent the seat cover from being damaged while cleaning.
▷ Do not operate the seat position adjustment switch forcefully when the seat does not move or it contacts an object.
▷ If the power seat is not operated, check and correct the problem before driving off.

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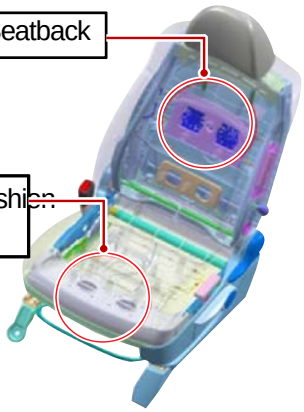
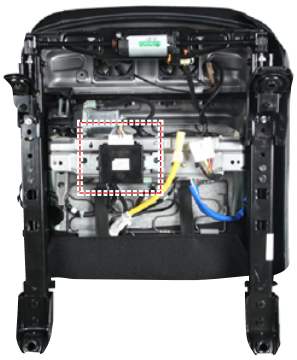
4. MAJOR CHANGES

▶ **Seat heated wire and ventilation unit & switch application**

●: New, ○: Already used, -: N/A

Item	Heating and ventilation specification	Heating specification
Heating and ventilation unit	●	-
Heating and ventilation switch	●	-
Heating switch	-	○
How to operate	Driver: heating and ventilation (two-step) Passenger: heating (two-step)	Driver: heating (LO↔HI) Passenger: heating (LO↔HI)

▶ **Front seat heated wire and ventilation unit**

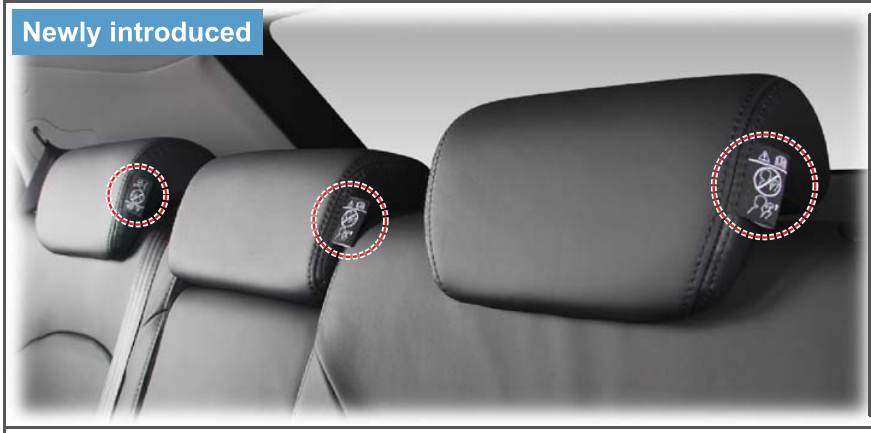
Front seat heated wire and ventilation unit		
Newly introduced	Mounting location for ventilation motor	Heated wire and ventilation unit mounting location
		

The front seat heated wire and ventilation unit has been added.
- Driver seat (heated wire and ventilation), passenger seat (heated wire)
- The heated wire and ventilation unit is not applied to a vehicle with heated wire only.

Modification basis	
Application basis	
Affected VIN	

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▶ Rear seat head restraint

Rear seat head restraint
Newly introduced  Head restraint warning label 
- Head restraint warning label has been attached to the side of rear seat head restraint.

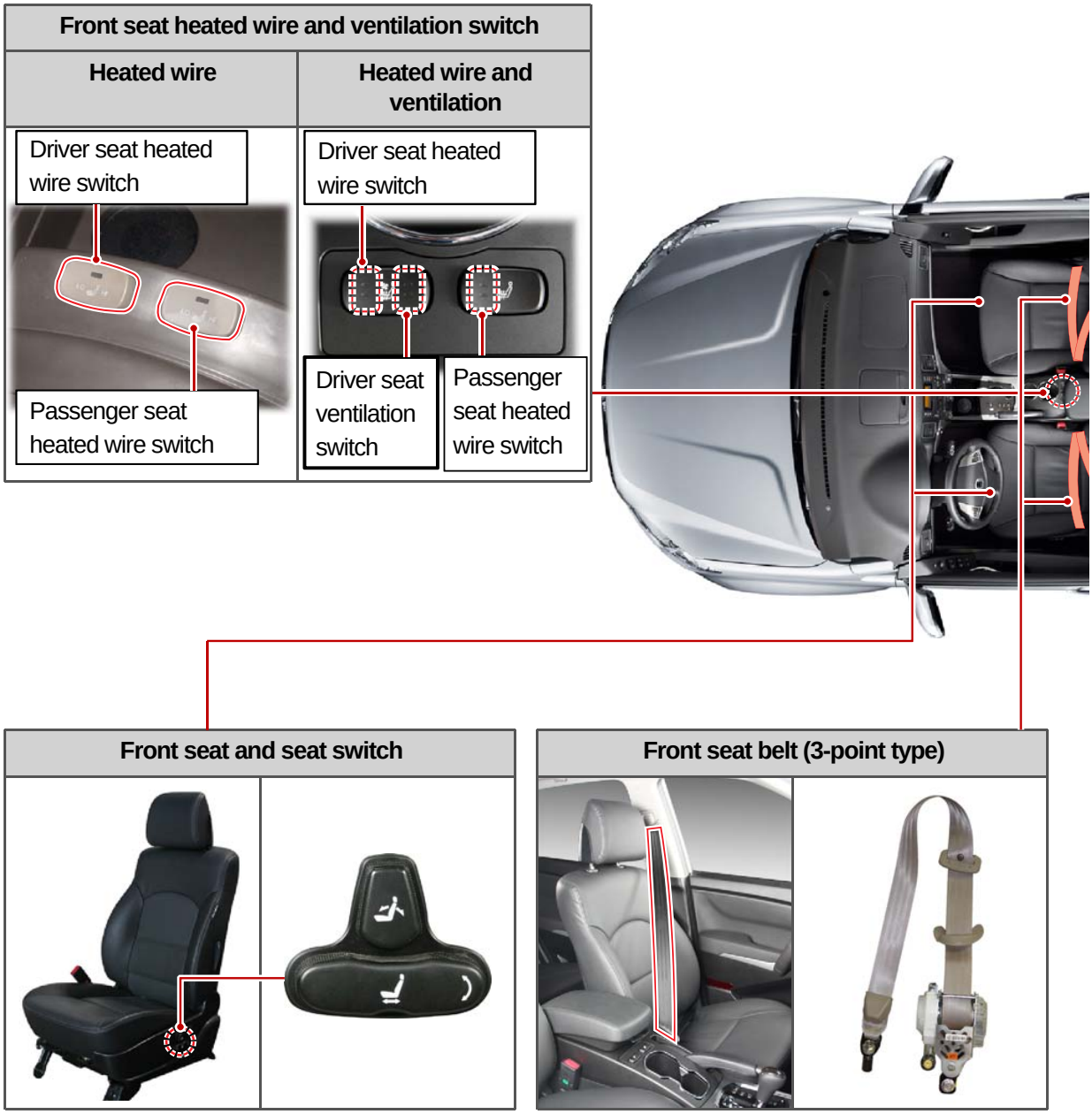
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OVERVIEW AND OPERATING PROCESS

1. SEAT/SEAT BELT OVERVIEW

The seat is divided into front seat (driver & passenger) and rear seat.
The front seat has the heated wire in the seat cushion and seatback and the rear seat has it in the seat cushion. The ventilation function is only applied to the driver seat. The seat belts of all seats are 3-point type.

2. SEAT/SEAT BELT LAYOUT

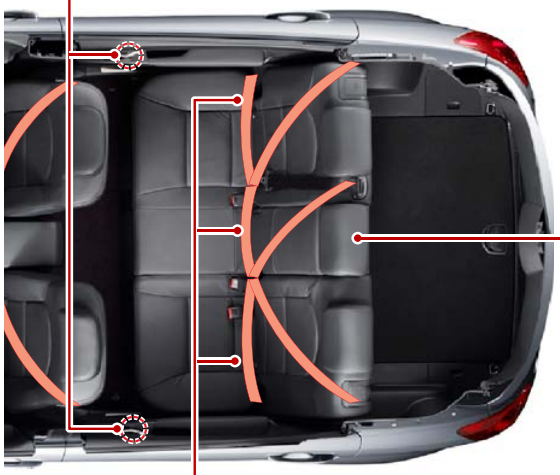


Modification basis	
Application basis	
Affected VIN	

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Rear seat heated wire switch

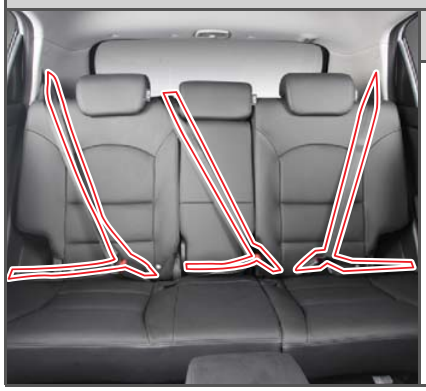




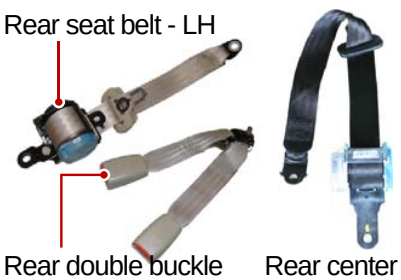
Rear seat



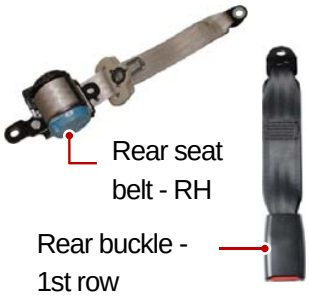
Rear seat belt (3-point type)



Rear LH, center



Rear RH



Modification basis	
Application basis	
Affected VIN	

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3. SEAT ADJUSTMENT AND OPERATION

1) Front Seat

There are 2 types of front seats: a) power seat that uses electric motor to move the seat and adjust the seatback and seat cushion; b) manual seat that a user has to operate the lever manually to adjust the seat.
However the head restraint and driver seat lumber support should be adjusted manually for both types of seats. Heated wire is installed in the seatback and seat cushion, and ventilation function may be added to driver seat depending on vehicle specifications. The switch for the front seat heated wire and ventilation is located on the TGS lever side.
The front part of the active head restraint is separated and moved forward to protect the occupant's neck in the event of a rear-end collision. The active head restraints may be installed to both driver and passenger seats depending on the vehicle specifications.

▶ **Head restraint adjustment**



Head restraint adjustment (Height)



To raise the head restraint, pull upward on the head restraint. To lower the head restraint, push downward on the head restraint with the head restraint sleeve (A) pressed.

Head restraint adjustment (Tilting)



The head restraint can be moved forward/backward.

Modification basis	
Application basis	
Affected VIN	

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(1) Driver seat operation

▶ Seat slide adjustment (forward/rearward)

Power seat	Manual seat
	
Moving the slide knob forward/backward moves the seat forward/backward by activating the slide motor.	To move the seat forward or backward, pull up and hold the seat slide lever and move the seat to the desired position.

▶ Seatback reclining adjustment

Power seat	Manual seat
	
Moving the upper part of the recliner knob forward/backward adjusts the seatback angle by activating the recliner motor.	Pull the recliner knob upward and adjust the seatback angle with the seatback lock released. Then release the recliner knob at the desired angle to lock the seatback.

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▶ Seat adjustment (height)

Power seat	Manual seat
	
Moving the slide switch upward/downward moves the seat cushion upward/downward as the front & rear up/down motors rotate the rail.	Pulling the recliner knob upward/downward moves the seat upward/downward.

▶ Driver seat lumbar support adjustment

Power seat	Manual seat
	
Lowering the lumbar support lever moves the lumbar support to the forward position, and raising the lever moves the lumbar support to the backward position.	Lowering the lumbar support lever moves the lumbar support to the forward position, and raising the lever moves the lumbar support to the backward position.

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(2) Driver seat heated wire and ventilation functions

Driver seat heated wire



Driver seat heated wire switch (vehicle with heated wire function only)



Seat back board



Driver seat ventilation

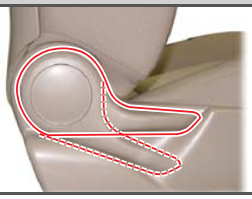


Driver seat heated wire and ventilation switch (vehicle with heated wire and ventilation functions)



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(3) Passenger seat operation

Passenger seat	Seatback reclining adjustment
	
	Pull the recliner knob upward and adjust the seatback angle with the seatback lock released. Then release the recliner knob at the desired angle to lock the seatback.
	Seat slide adjustment (forward/rearward)
	
	To move the seat forward or backward, pull up and hold the seat slide lever and move the seat to the desired position.

(4) Passenger seat heated wire and functions

Passenger seat heated wire	Passenger seat heated wire switch	
	Heated wire and ventilation	Heated wire
		
	Seat back board	
		

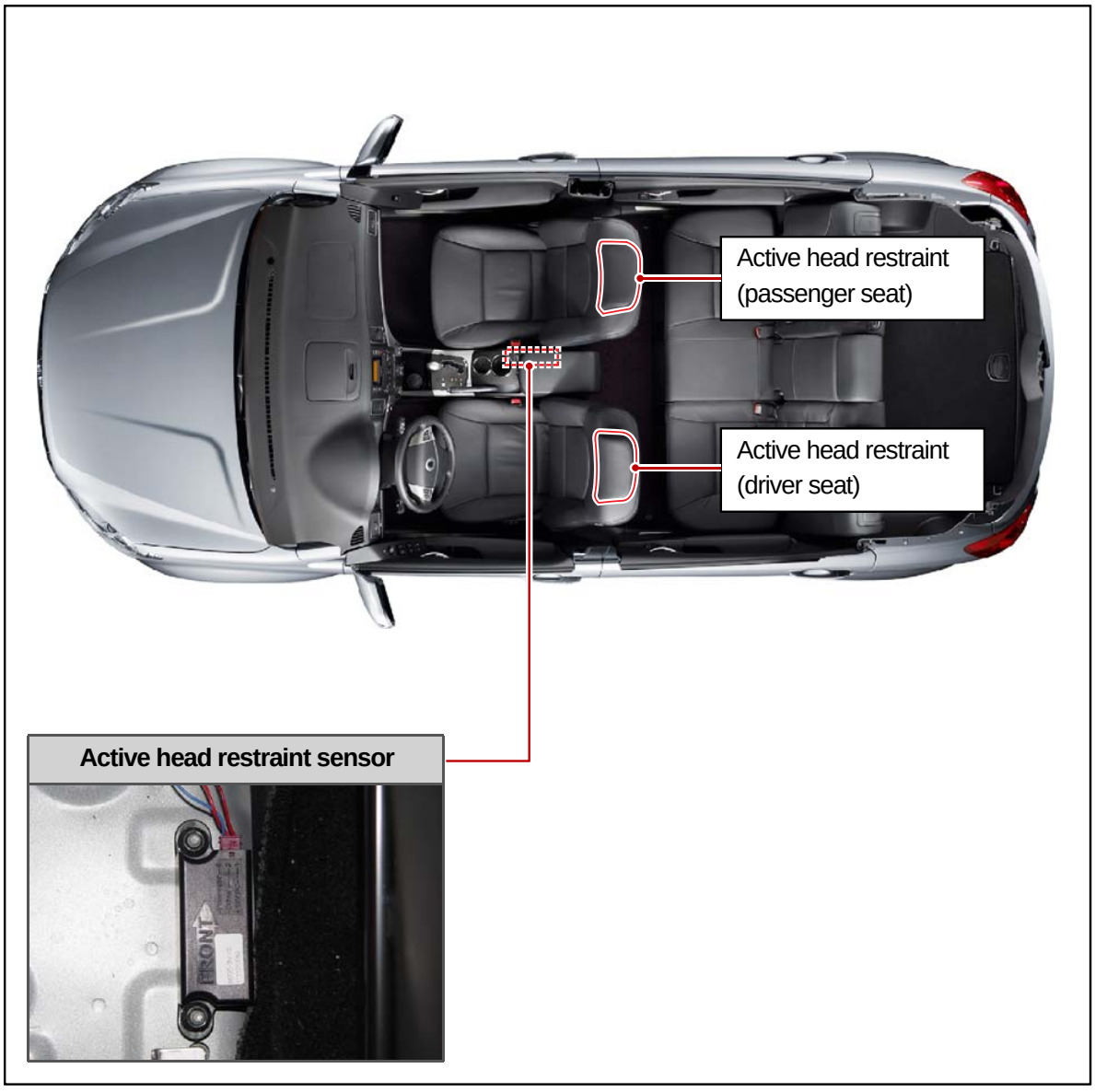
Modification basis	
Application basis	
Affected VIN	

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2) Active Head Restraint

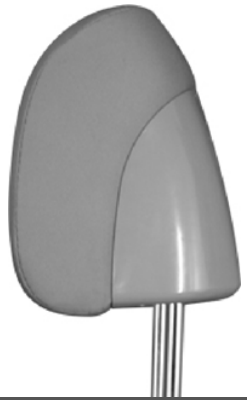
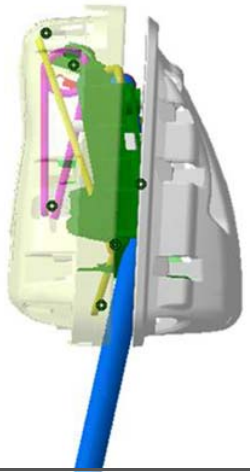
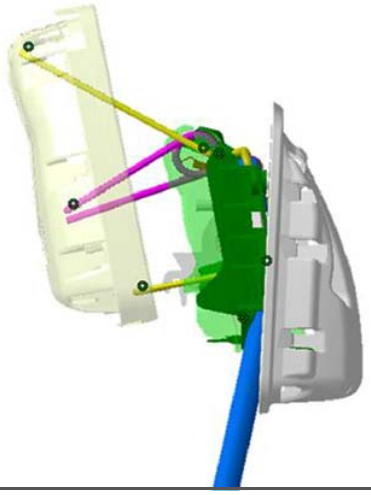
The front part of the active head restraint is separated and moved forward to protect the occupant's neck in the event of a rear-end collision.
The active head restraints may be installed to both driver and passenger seats depending on the vehicle specifications.

(1) System configuration



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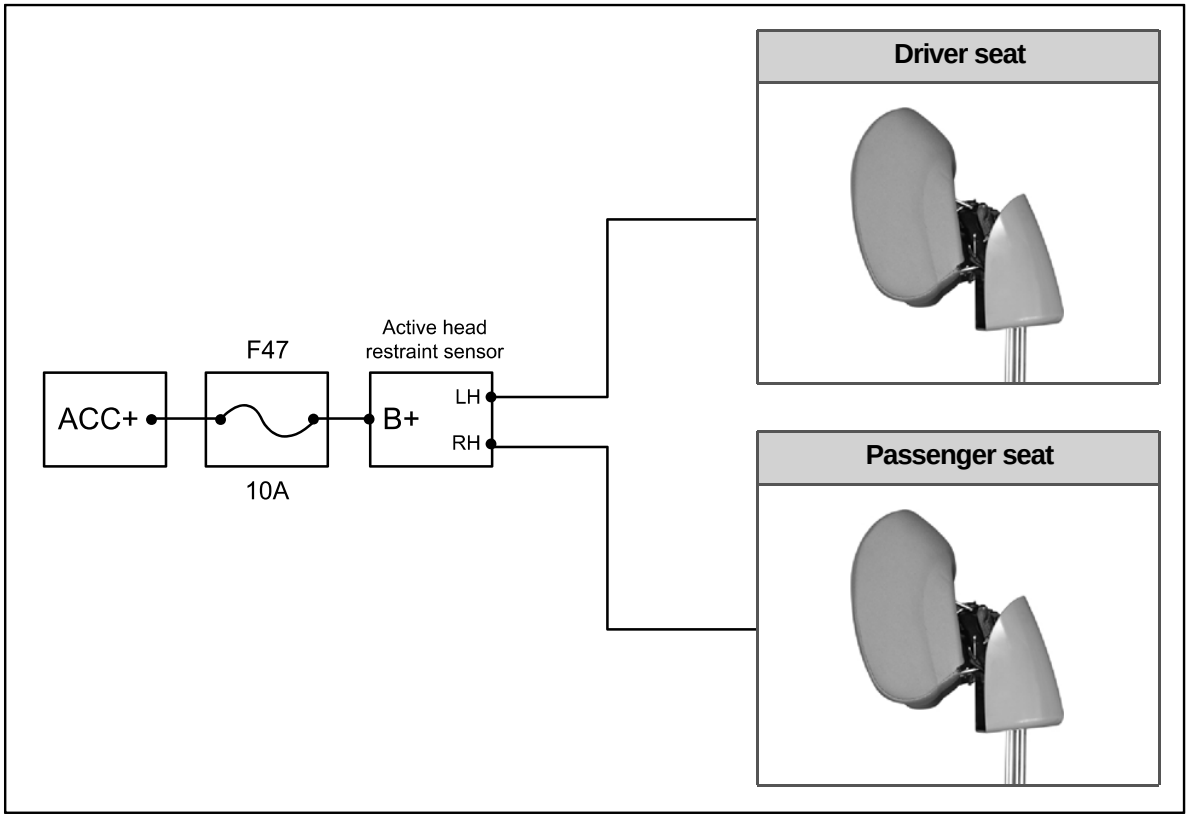
(2) Active head restraint deployment

No in operation	In operation
	
	

Modification basis	
Application basis	
Affected VIN	

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(3) Operating process



For a vehicle with an active head restraint system, an active head restraint sensor is installed and its G sensor is operated in the event of a rear-end collision. As the G sensor in the active head restraint sensor is operated, the power is supplied to the driver's or passenger's active head restraint. Then, the lock in the head restraint is disengaged and the front part of the head restraint is separated and moved toward the neck of an occupant.

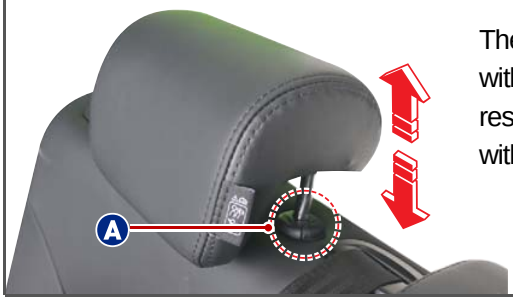
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3) Rear Seat

The rear seat is a 6:4 split seat and a manual seat that the angle of the head restraint and seatback of the seat can be adjusted. And the heated wires in the rear seat cushion and seatback can be operated with rear seat heated wire switches located on the LH/RH rear door trim.

(1) Rear seat operation

Head restraint adjustment (Height)



The head restraint can be raised without pressing the head restraint sleeve (A) or lowered with the sleeve (A) pressed.



Seatback reclining adjustment



To adjust the seatback angle, pull the lock release lever on the upper part of the seat to release the lock.

Modification basis	
Application basis	
Affected VIN	

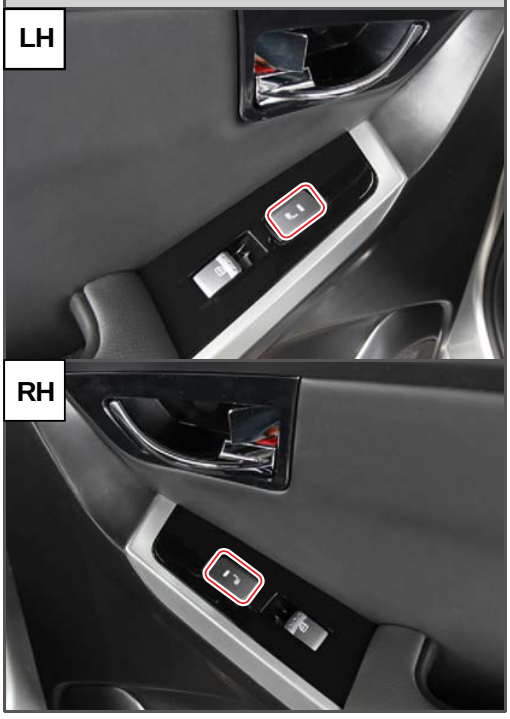
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(2) Rear seat heated wire functions

Rear seat heated wire



Rear seat heated wire switch



Seatback folding



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4) Front Seat Heated Wire and Ventilation Unit

(1) Front seat heated wire and ventilation unit operation

The seat heated wire and ventilation unit is mounted at the bottom of the driver seat. The temperature of the seat can be adjusted in 3 levels (Level 2 → Level 1 → OFF) with the seat heated wire and ventilation switch. Every time the seat heated wire and ventilation switch is pressed, the temperature level goes down by one level. Pressing the switch a third time will turn off the operation. Pressing the desired side of the switch heats the seat cushion and seatback or activates the seat ventilation function. The temperature of the seat is kept uniform by cutting off or connecting power through thermistor fitted in the seat. The seat heated wire and ventilation unit controls the rpm of the motor using PWM control to operate the seat ventilation.

	Mounting location	Seat heated wire and ventilation unit
		

NOTE

▶ **Seat heated wire and ventilation unit & switch application**

●: New, ○: Already used, -: N/A

Item	Heating and ventilation specification	Heating specification
Heating and ventilation unit	●	-
Heating and ventilation switch	●	-
Heating switch	-	○
How to operate	Driver: heating and ventilation (two-step) Passenger: heating (two-step)	Driver: heating (LO↔HI) Passenger: heating (LO↔HI)

- The seat heated wire and ventilation unit is not fitted in a vehicle without seat ventilation function.

Modification basis	
Application basis	
Affected VIN	

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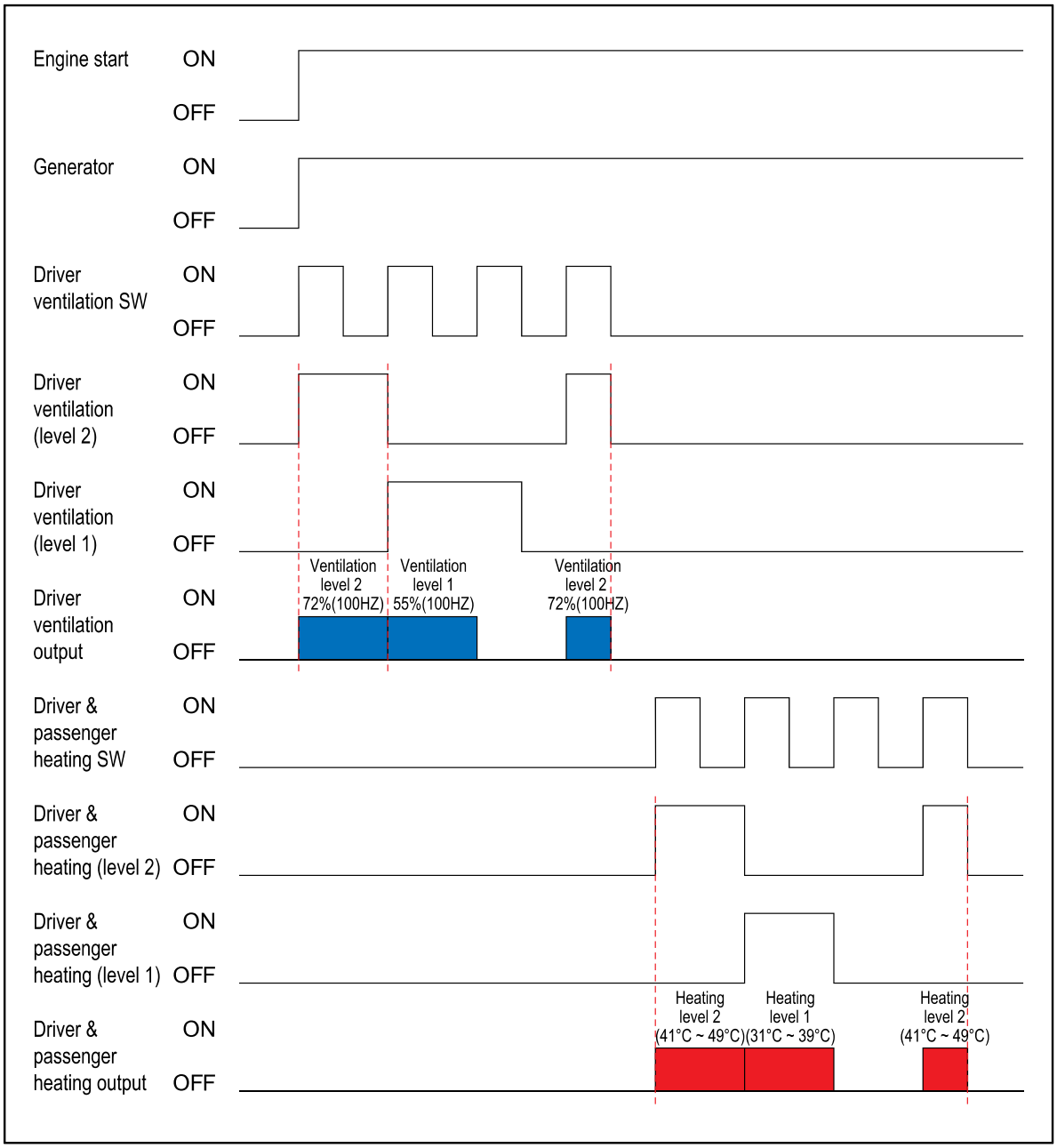
(2) Front seat heated wire and ventilation unit diagram

▶ **Condition: Engine running**

The temperature of the seat can be adjusted in 3 levels (Level 2 → Level 1 → OFF) with the front seat heated wire and ventilation switch. Every time the switch is pressed, the temperature level goes down by one level. Pressing the switch a third time will turn off the operation.

NOTE

The front seat heated wire and ventilation functions cannot be operated at the same time.

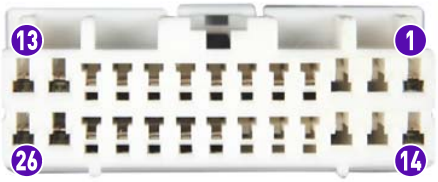


Modification basis	
Application basis	
Affected VIN	

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(3) Connector pin description

Seat heated wire and ventilation unit side

Seat heated wire and ventilation unit wiring side


Pin No.	Function
1	IGN2
2	-
3	-
4	Ventilation switch
5	Heater switch (LH)
6	Heater switch (RH)
7	Heater level 1 (LH)
8	Heater level 1 (RH)
9	Ventilation level 1 (LH)
10	Heater back (LH) NTC -
11	Heater back (RH) NTC +
12	Cushion ventilation power (+)
13	Heater back (LH) HTR
14	ALT
15	-
16	-
17	-
18	-
19	-
20	Heater level 2 (LH)
21	Heater level 2 (RH)
22	Ventilation level 2 (LH)
23	Heater back (LH) NTC +
24	Heater back (RH) NTC -
25	Heater back (RH) HTR
26	Ground

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5) Front Seat Heated Wire and Ventilation Operation

(1) Heated wire and ventilation functions for front seat (driver seat heated wire and ventilation - 2 levels, passenger seat heated wire - 2 levels)

▶ **Operating conditions**

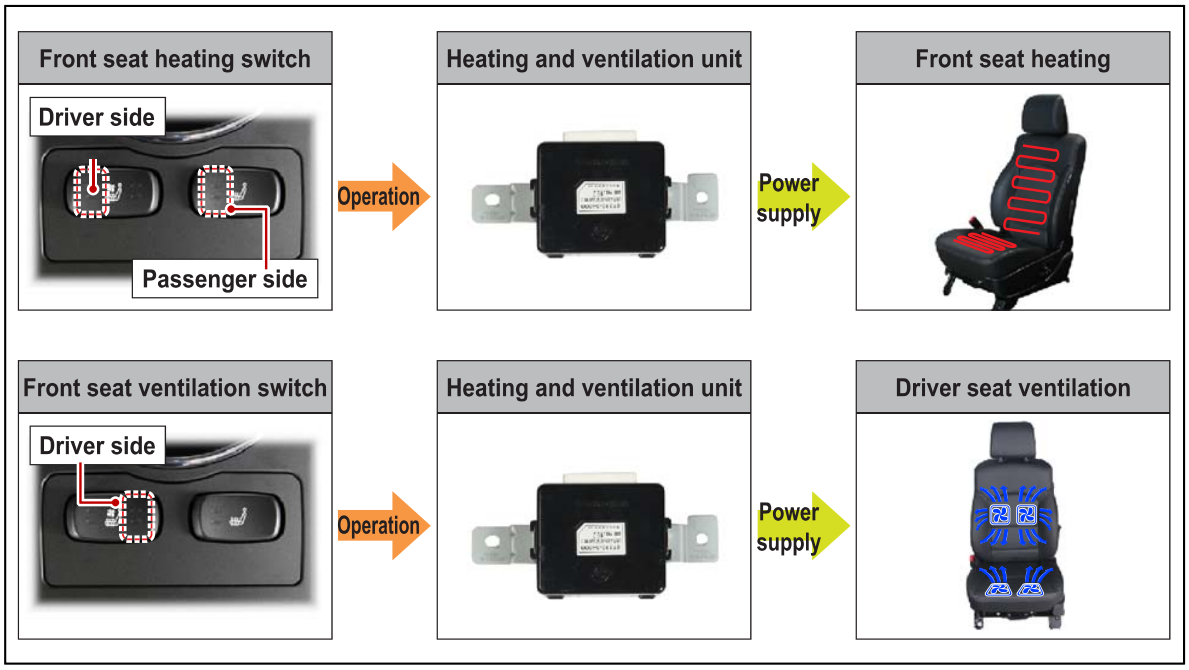
- Engine running
- If the engine starts to crank during the seat heated wire and ventilation signal output, the seat heated wire will not be operated until the cranking stops.

▶ **Operation description**

- After the ignition is turned on, the temperature of the seat can be adjusted in 3 levels (Level 2 → Level 1 → OFF) with each seat heated wire and ventilation switch. Every time the switch is pressed, the temperature level goes down by one level. Pressing the switch a third time will turn off the operation.

▶ **Operating process**

- When the front seat heated wire and ventilation switch is pressed, the front seat heated wire and ventilation unit supplies the power to the corresponding seat for heated wire and ventilation operation through the switch.



NOTE

The heated wire and ventilation functions cannot be operated at the same time.

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(2) Heated wire function for front and rear seats (driver and passenger seats LO↔HI, rear seats ON↔OFF)

▶ Operating conditions

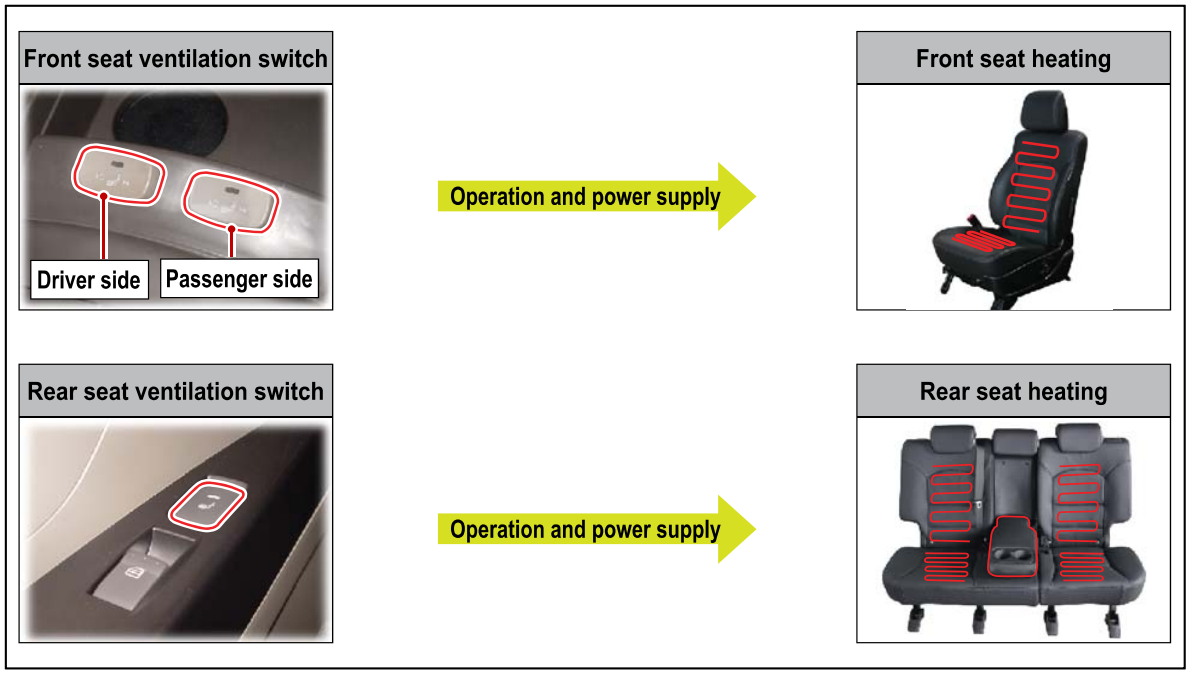
- IGN ON
- If the engine starts to crank during the seat heated wire signal output, the seat heated wire will not be operated until the cranking stops.

▶ Operation description

- After the ignition is turned on, the heated wire of the front seat can be operated to the desired temperature (LO/HI) by pressing the front seat heated wire switch.
- After the ignition is turned on, pressing a rear seat heated wire switch activates the heated wire of the corresponding seat and pressing the switch again turns off the heated wire operation.

▶ Operating process

- When the front or rear seat heated wire switch is pressed, the power is supplied to the corresponding front or rear seat heated wire through the switch.



NOTE

The seat heated wire and ventilation unit is not fitted in a vehicle without seat ventilation function.

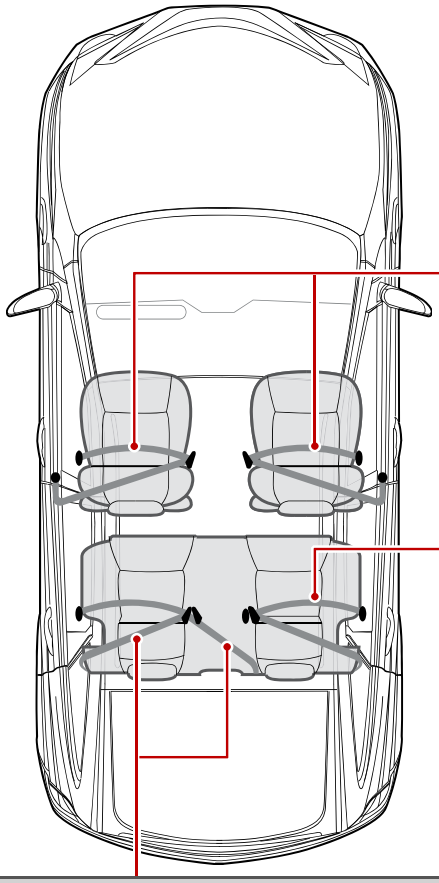
Modification basis	
Application basis	
Affected VIN	

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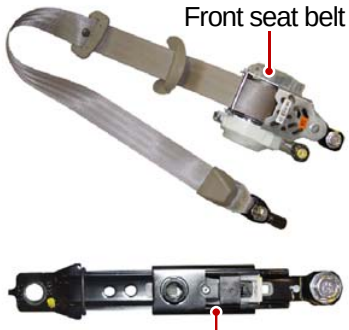
6) Seat Heated Wire and Ventilation

(1) Seat belt configuration

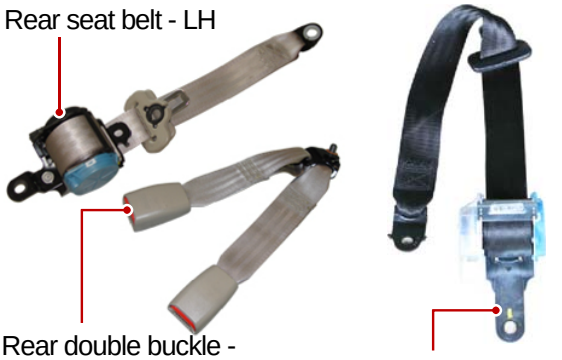
The 3-point type seat belts are mounted on the driver seat, passenger seat and rear seats (LH, RH, Center). The seat belts on the front seats (driver's/passenger's) include pretensioner feature which rewinds the seat belt immediately to protect the occupant's face and chest when a strong frontal collision occurs.



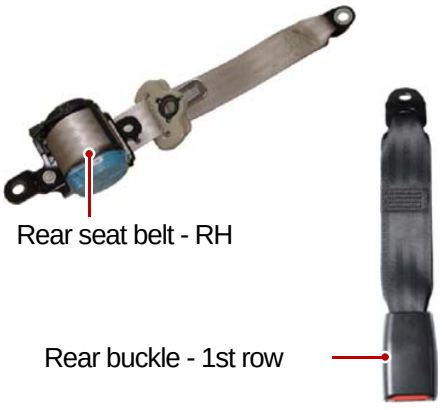
Front 3-point type seat belt (Driver & Passenger seats)



3-point type seat belt (RR center, LH)



Rear 3-point type seat belt (RH)



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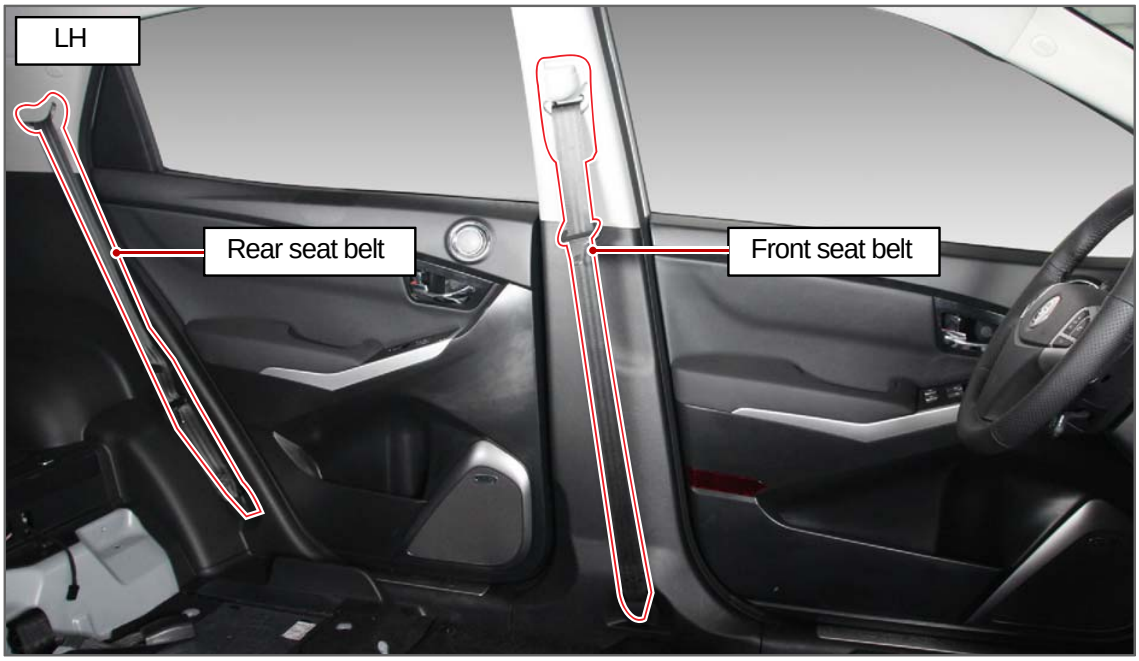
(2) Mounting location for seat belt

Driver seat Belt (3-point type)

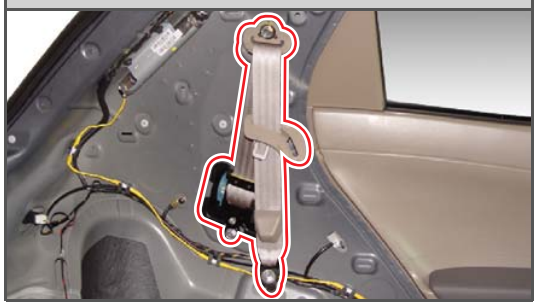


Passenger seat Belt (3-point type)

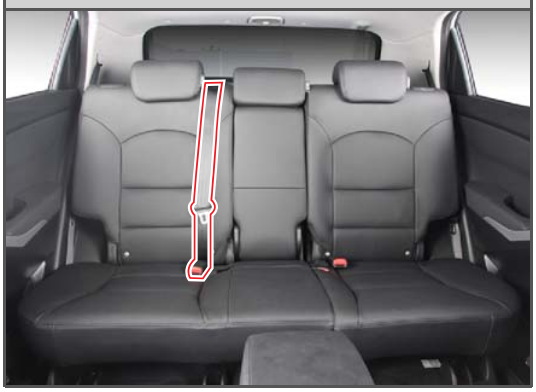




Rear seat belt - LH/RH (3-point type)



Rear center seat belt (3-point type)

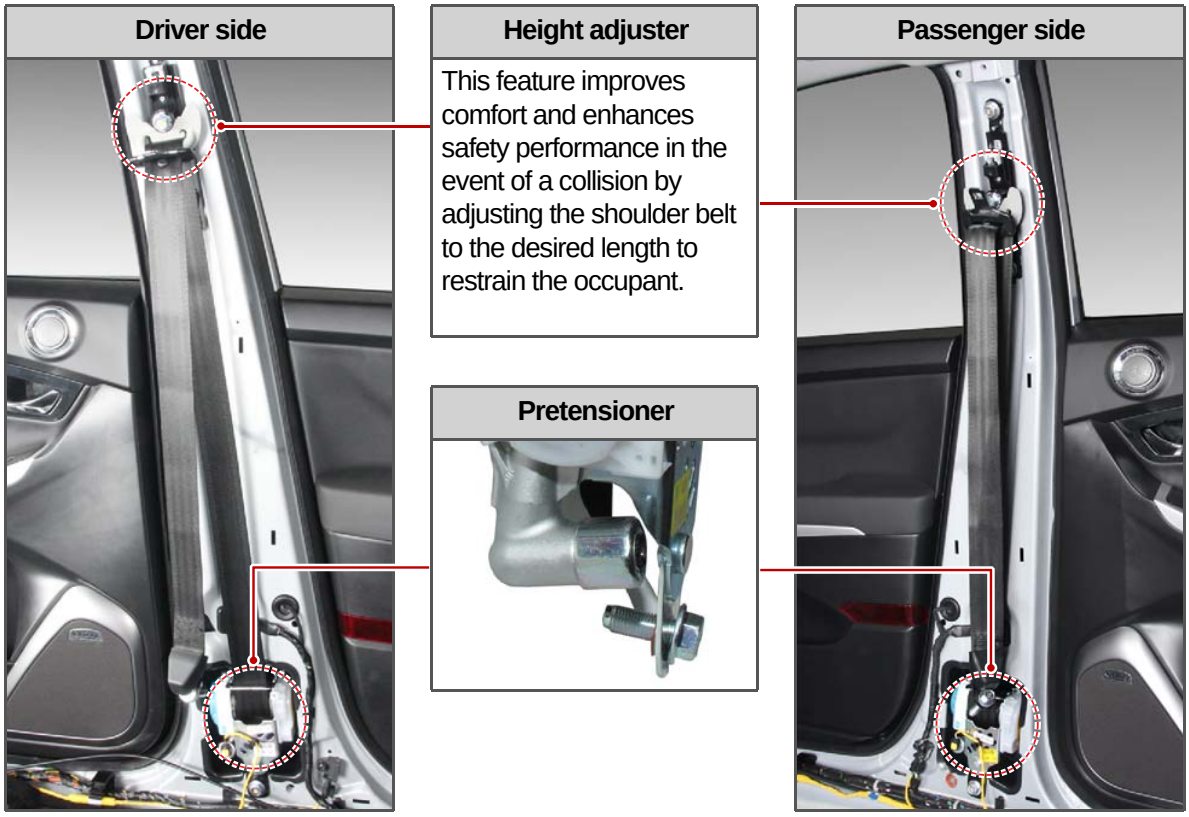


Modification basis	
Application basis	
Affected VIN	

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7) Mounting Location for Pretensioner

The seat belt pretensioner retracts the seat belt instantly by igniting the inflator in the pretensioner when the front air bag system is activated. It also improves the safety effect of the seat belt by preventing the front seat occupants from moving forward and keeping occupants in a stable posture.
The load limiter is also installed to reduce the chest impact to a front seat occupant by loosening the seat belt while maintaining the force applied by the seat belt uniformly when the pretensioner retracts the seat belt instantly. The seat belt pretensioner is operated first, and then the load limiter is activated.



Modification basis	
Application basis	
Affected VIN	

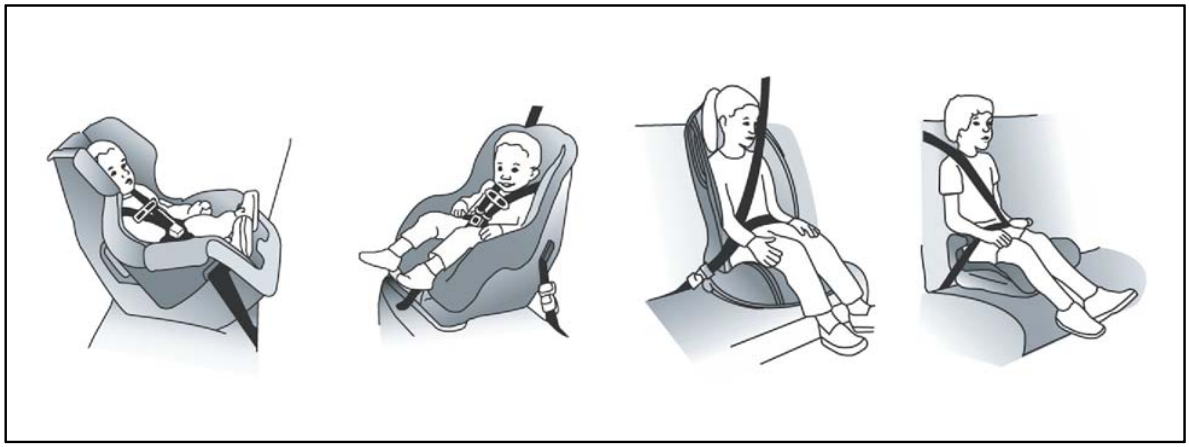
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4. CHILD RESTRAINT SYSTEM (ISO FIX)

1) Child Restraint System Type

There are 2 types in the child restraint system.
- Fixing using seat belt
- Fixing using ISOFIX (for the vehicle with ISOFIX system)

2) Child Restraint System Fixing Type



Item	Weight	Age	Fixing method	Rear LH/RH seat	Passenger seat/ Rear center seat
Reversed seat	< 10kg	6 to 9 months	Seat belt	U/SU	X
	< 13kg	12 to 15 months	Seat belt	U/SU	X
Front face seat	9~18kg	9 to 48 months	Seat belt / ISOFIX seat	U/UF/SU	X
Booster seat	15~25kg	4 to 6 years	Seat belt	U	X
Booster cushion	22~36kg	6 to 11 years	Seat belt	U	X

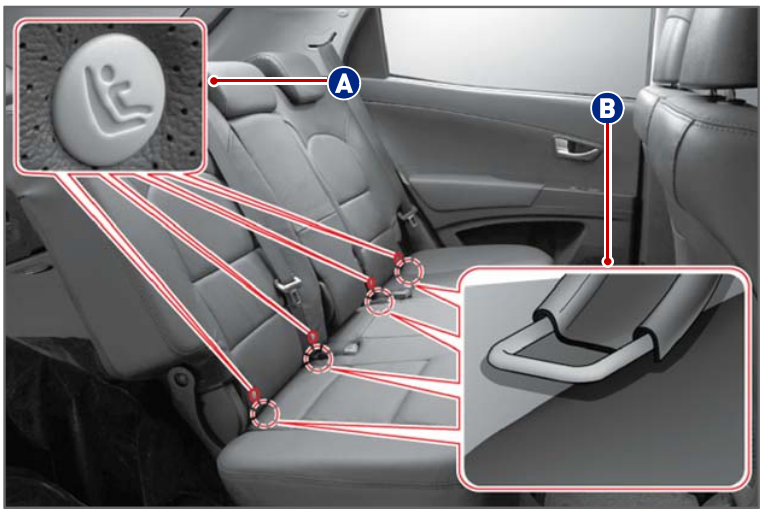
- U: General child restraint system which should be fixed with the seat belt approved by official institute.
  UF/SU: General child restraint system which should be fixed with the ISOFIX system approved by
- official/semiofficial institute.
  X: Seat which is not allowed to use child restraint system.
-

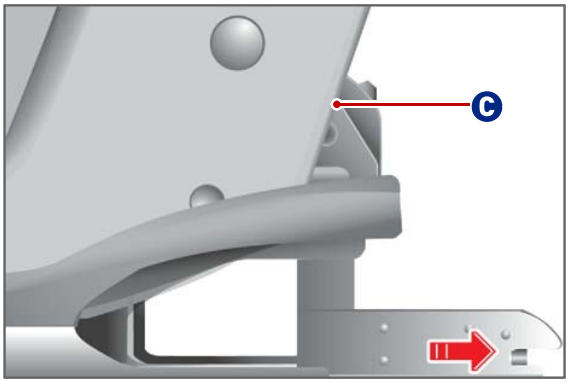
Modification basis	
Application basis	
Affected VIN	

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3) ISO FIX

▶ **Installation using lower latch**





- There are marks (A), which indicate that the ISOFIX for child restraint system can be fixed, at the bottom of the rear seatback as shown in the figure.
- Attach the ISOFIX child restraint system (C) to the two latches (B) located at the bottom of the rear seat.
- If a ISOFIX child restraint system is used, the seat belt is not needed.
- No lower anchor is installed to the rear center seat.
- The approved ISOFIX child restraint system can be mounted to the vehicle with ISOFIX system (2 lower latches and one rear seatback anchor).

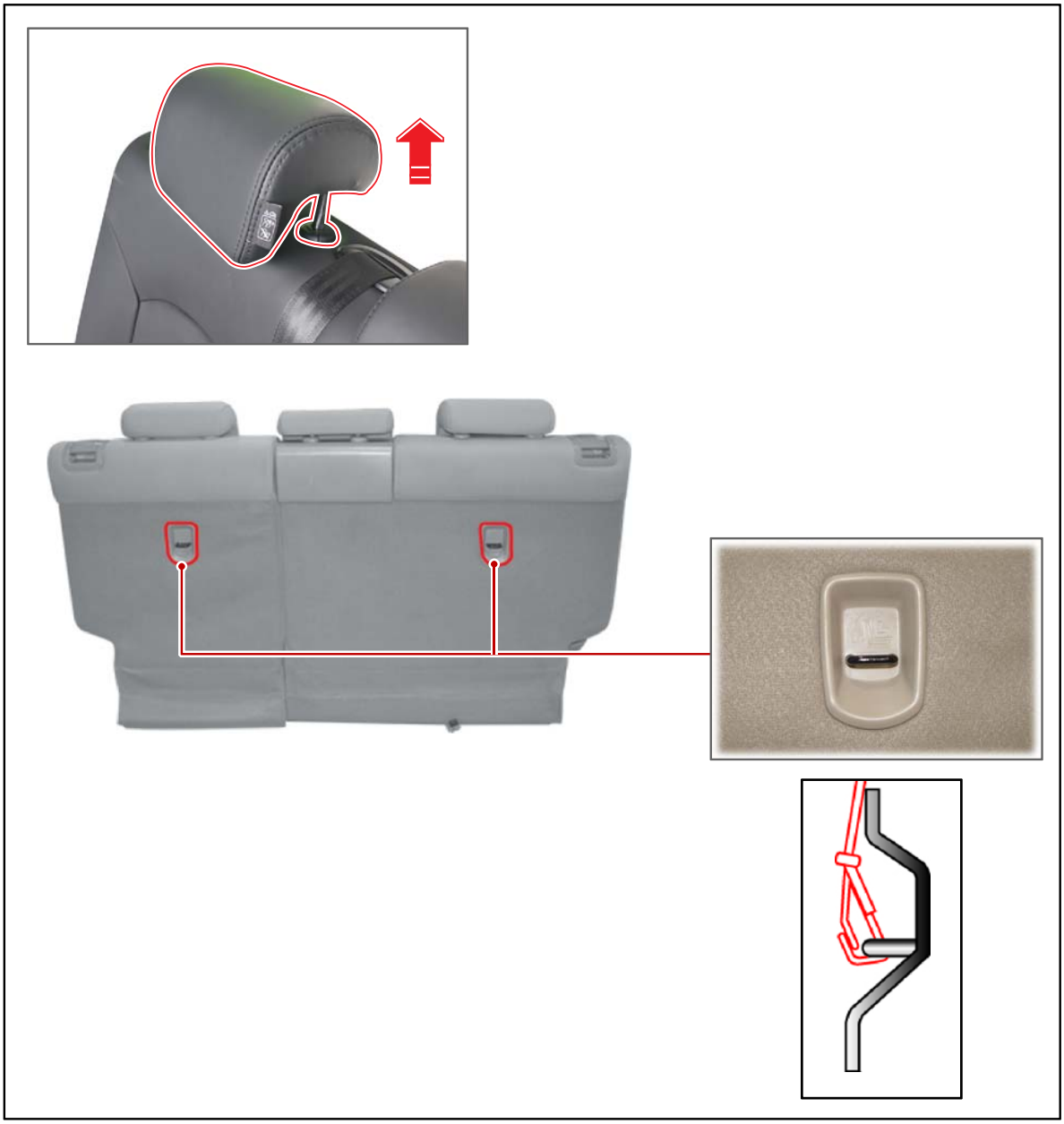
WARNING

- When installing ISOFIX child restraint system to the vehicle, all the seat belts in the rear seat should be buckled.
- The mounting latches and anchors for the ISOFIX system are only for the child restraint system, so DO NOT install any restraint system other than ISOFIX specifications, seat belt or other device to these latches or anchors.

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▶ Installation using rear seatback anchor

- There are anchors (for hook mounting) for fixing child restraint system, on the back side of the rear seatback as shown in the figure.



- Route the belt of the child restraint system over the seatback of the rear seat.
- Attach the hook of the child restraint system belt to the anchor firmly, and securely tighten the child restraint to the seat.

Modification basis	
Application basis	
Affected VIN	

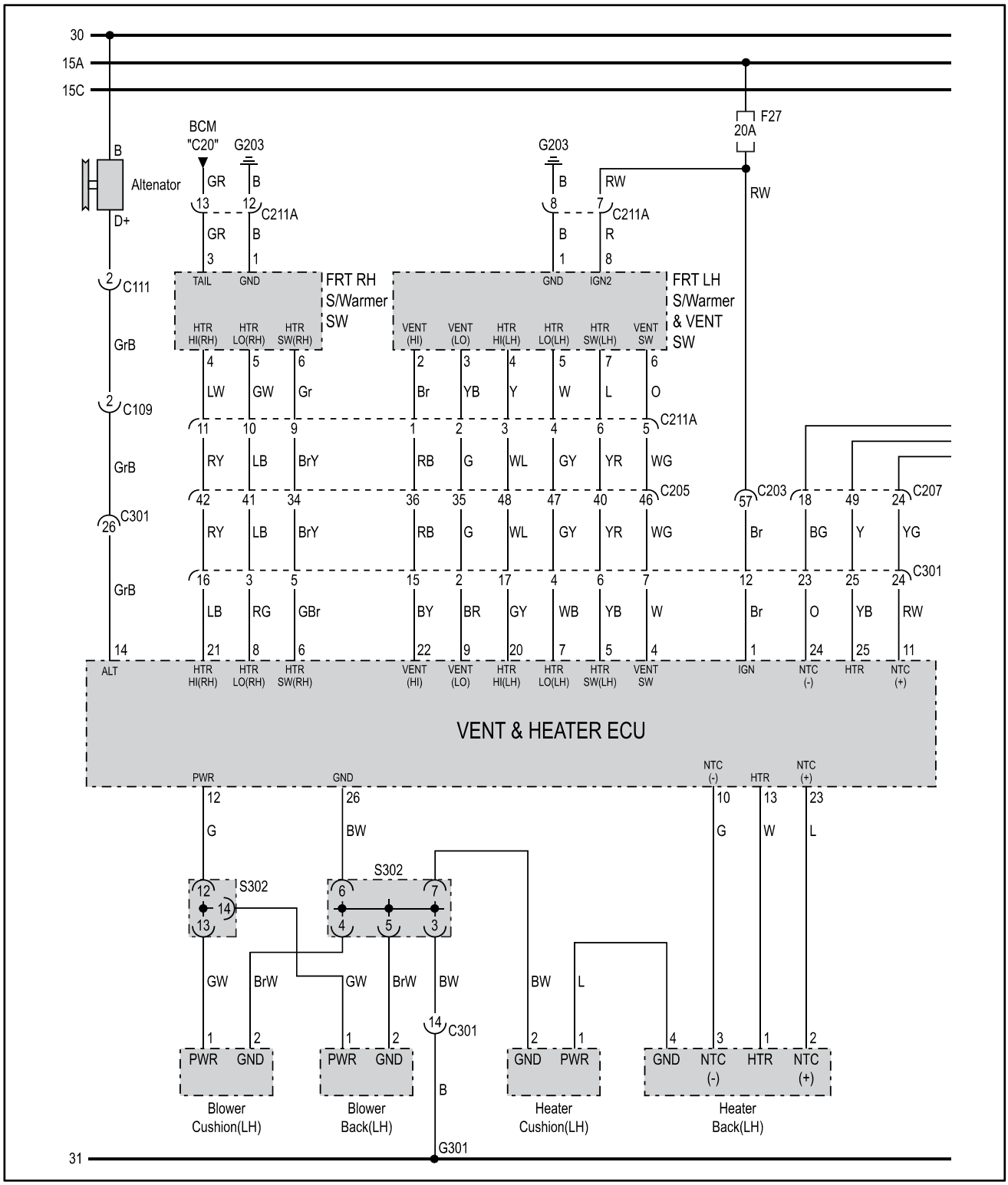
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Memo

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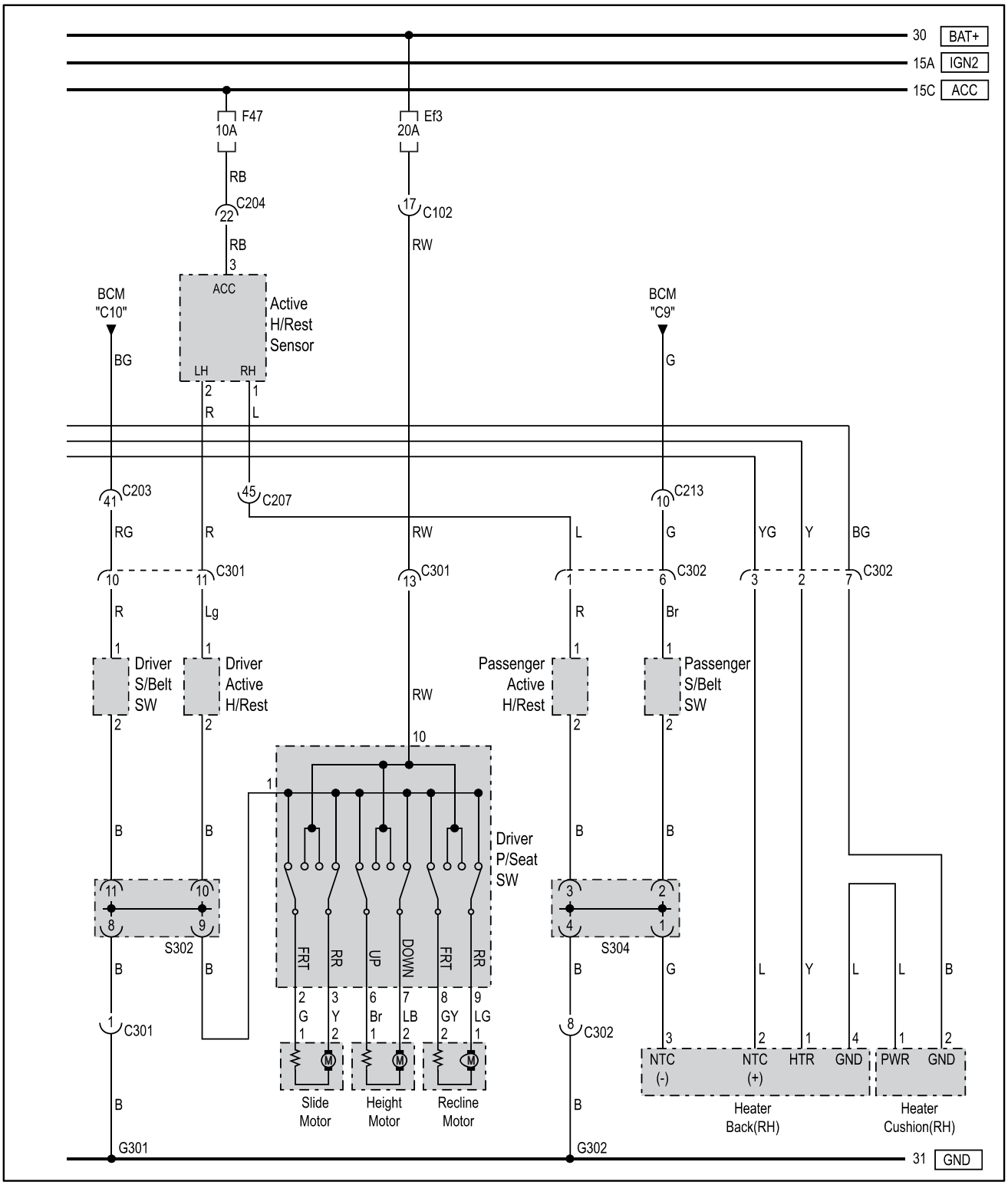
5. CIRCUIT DIAGRAM

1) Front Power Seat (Heated wire & Ventilation)



Modification basis	
Application basis	
Affected VIN	

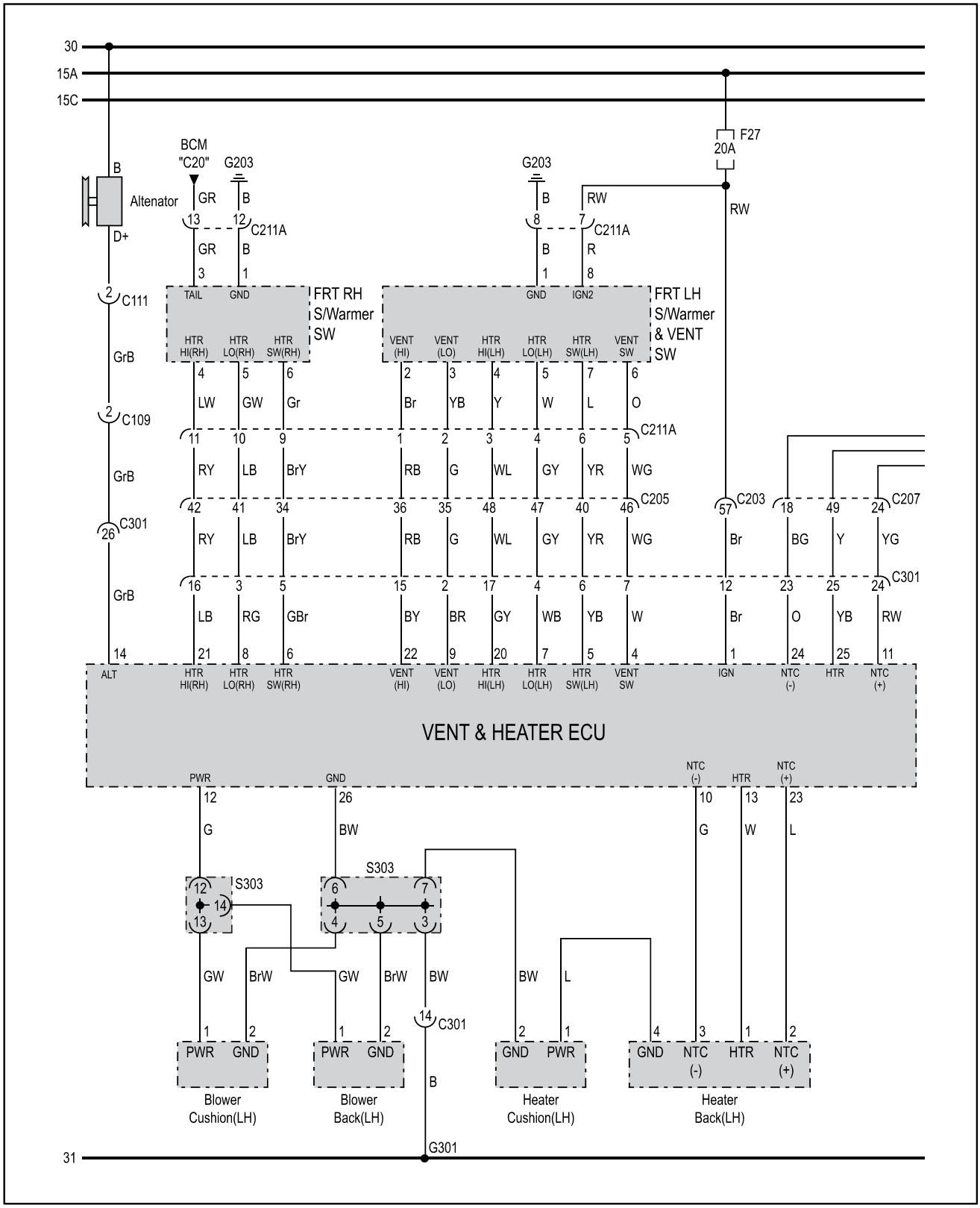
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Modification basis	
Application basis	
Affected VIN	

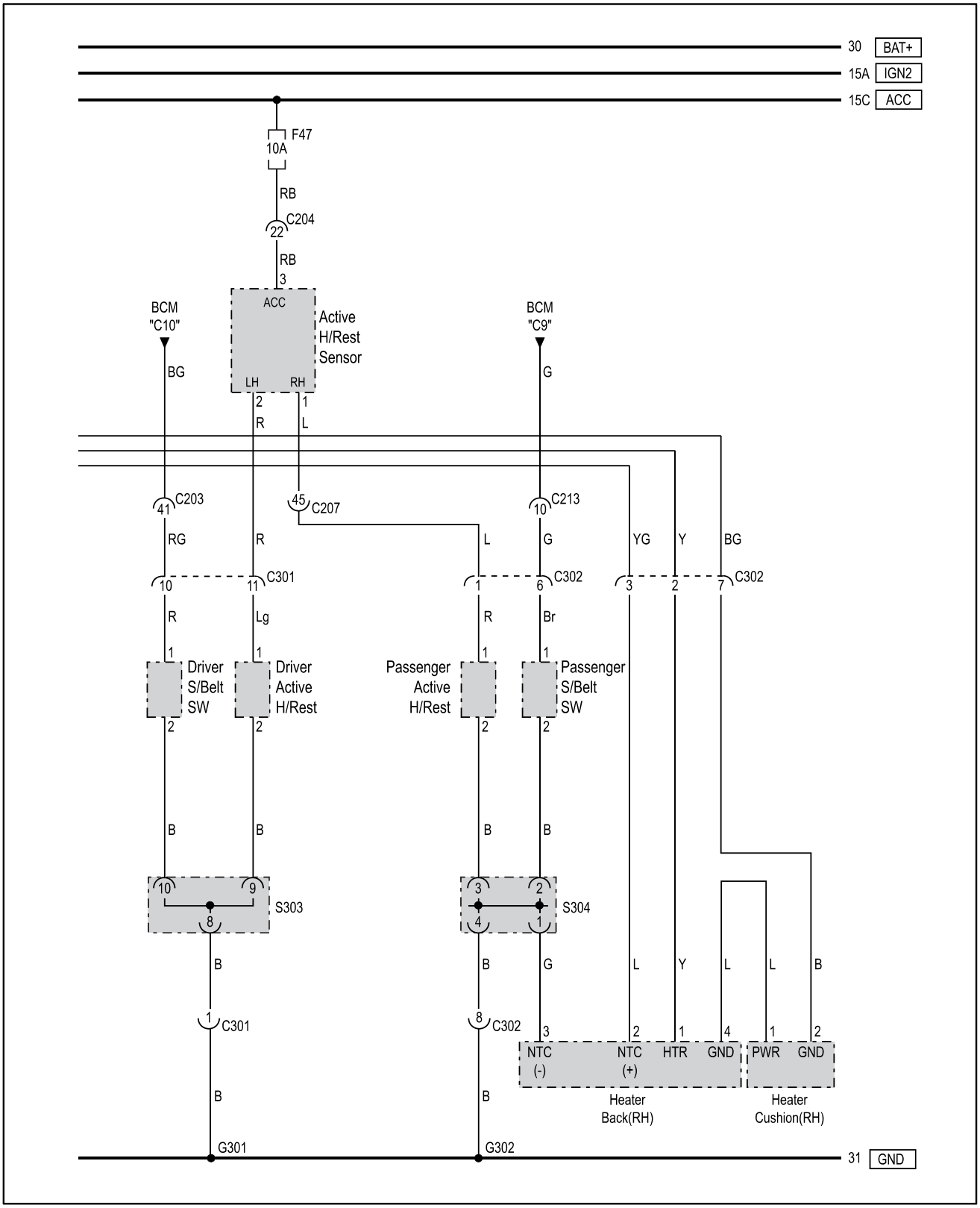
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2) Front Manual Seat (Heated Wire)



Modification basis	
Application basis	
Affected VIN	

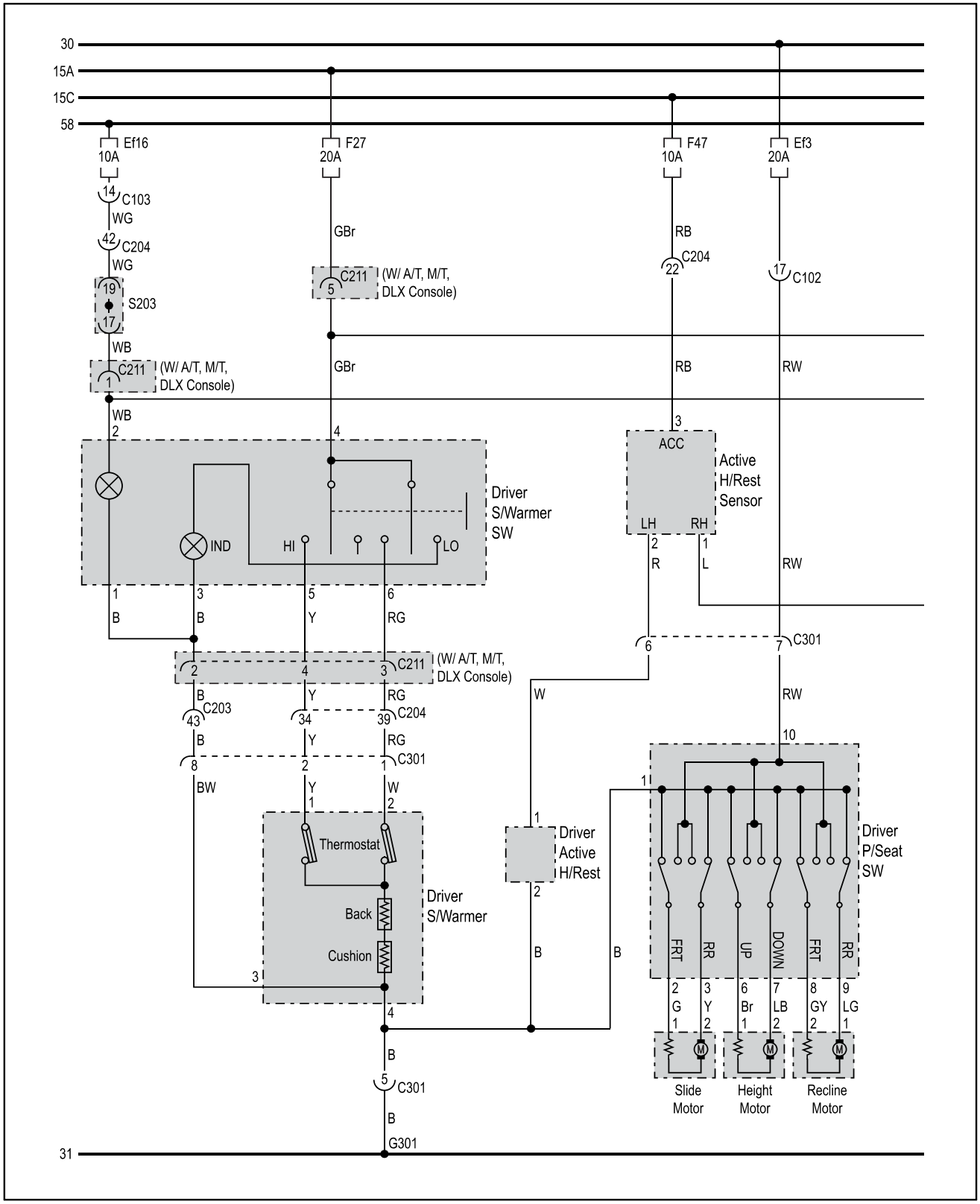
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Modification basis	
Application basis	
Affected VIN	

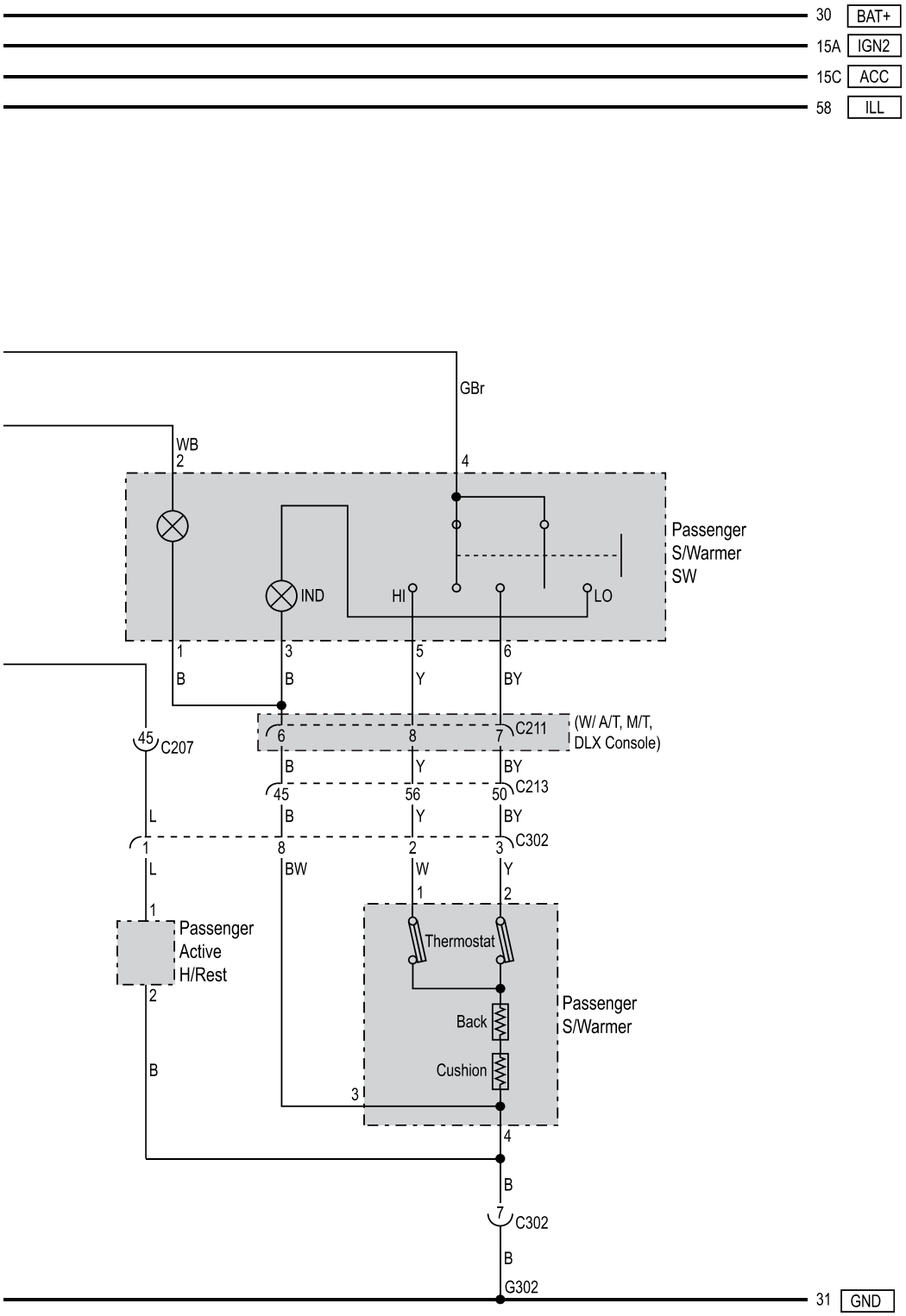
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3) Front Power Seat (Heated Wire)



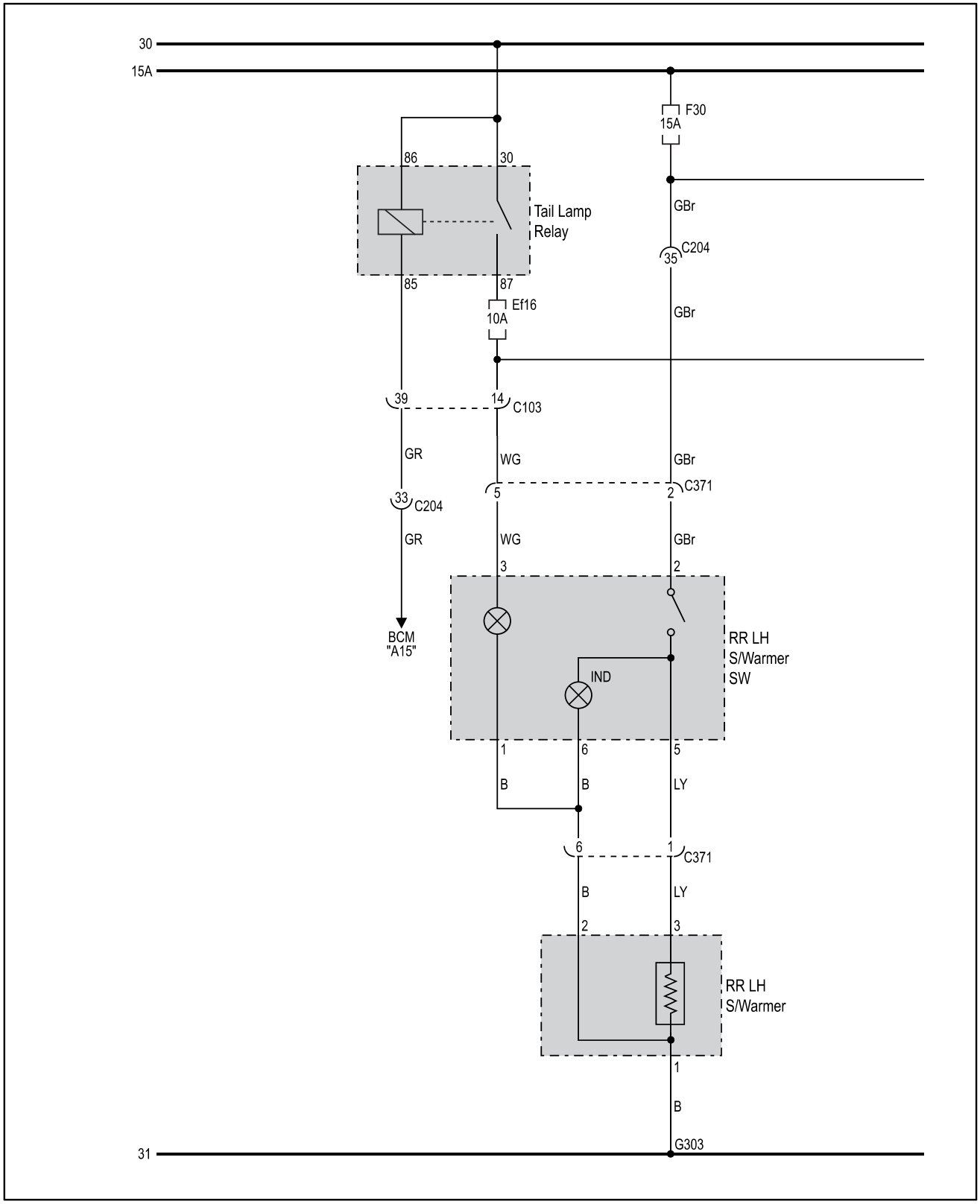
Modification basis	
Application basis	
Affected VIN	

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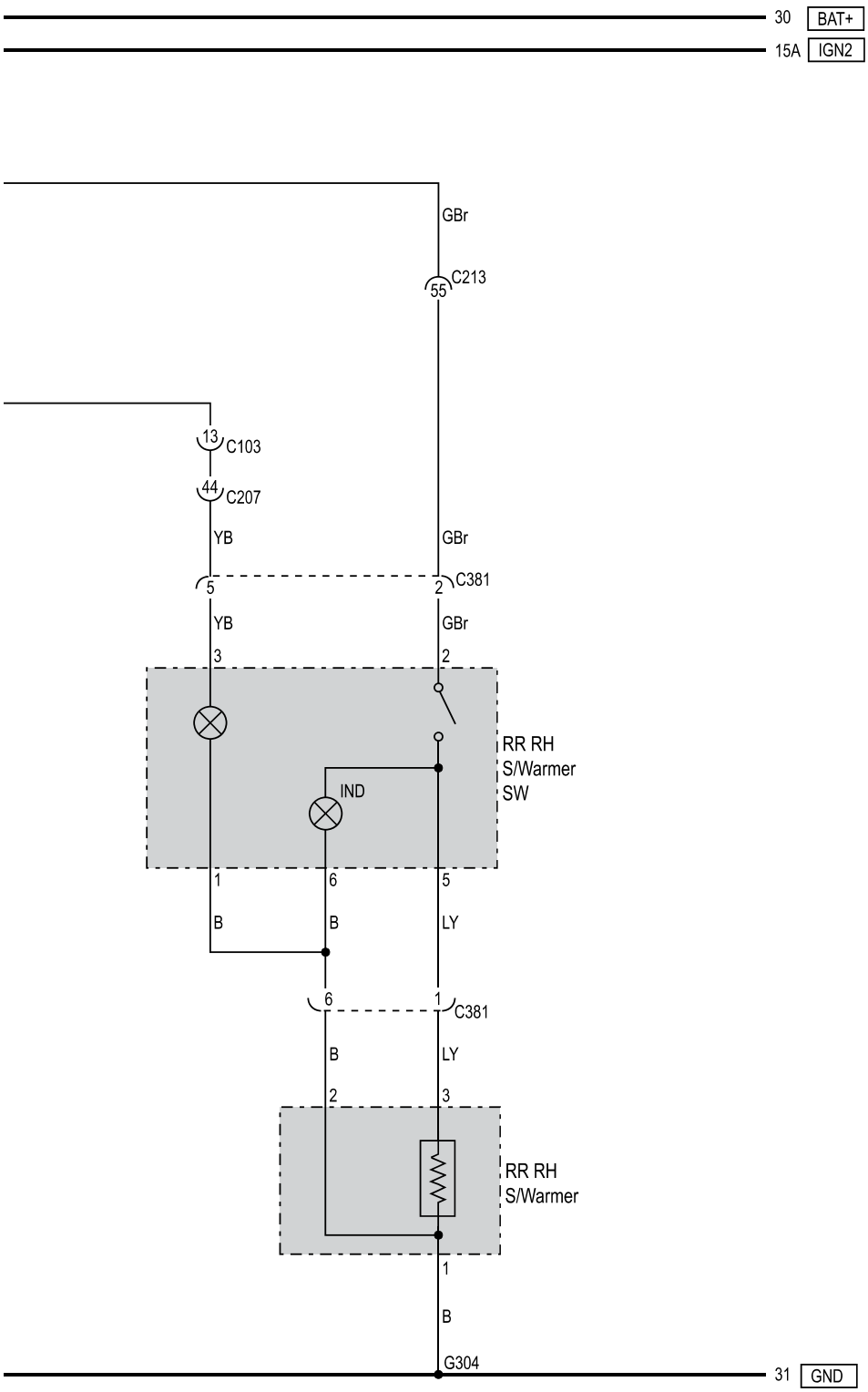
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4) Rear Seat Heated Wire



Modification basis	
Application basis	
Affected VIN	

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SUNROOF SYSTEM 7340-00

GENERAL INFORMATION

1. SPECIFICATIONS

Operating voltage	9 ~ 16V
Operating current (open & close)	Max. 6 A
At no load	Approx. 3 A
Leakage current	Max. 1 mA or less
Roof motor operating speed (at opening and closing)	1.4 ± 0.5 sec./100 mm
Motor overload stop conditions	Current for 25 A or higher and torque (load) for 7.5 Nm or above
2-step opening amount	1st step sliding open: 370 ± 5 mm
	2nd step sliding open: 450 ± 5 mm
Vertical/horizontal tolerance for sunroof glass panel	± 2mm

2. CAUTIONS

▶ **Cautions during work**

CAUTION

- Wear a clean work clothes and gloves.
- Any unauthorized modification or operational test is not allowed since the sunroof motor and control unit are preset at the factory.
- Take care not to drop or stack vertically when removing the sunroof. This may cause the moving parts to be damaged.

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OVERVIEW AND OPERATING PROCESS

1. SYSTEM LAYOUT

OPEN	TILT
	



Sunroof switch	Sunroof assembly	Sunroof motor & control unit
1 	2 	3 

Modification basis	
Application basis	
Affected VIN	

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2. OPERATING PROCESS

1) Sunroof Switch

▶ Sunroof switch

The sunroof switches are included in the overhead console switches and consists of the TILT, CLOSE and OPEN switches.



▷ **TILT**

Opens only rear section of the sunroof.

▷ **CLOSE**

Closes the sunroof.

▷ **OPEN**

Opens the sunroof.



▶ Sunroof glass

The sunroof glass can be open in two steps and can be tilted by the switch operation.

▶ Sun shade panel

This can be closed or open manually to block sunlight when the sunroof function is not in use.

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2) Sunroof Sliding Opening/Closing

Open: 2-step open





- Push up the switch

- **Push up the switch briefly: 2-step auto sliding open**
  When pushing up the switch briefly, the sunroof is automatically opened. Opening is carried out in 2 steps. In first step, the area 5 cm behind the sunroof is not opened. Push up the switch once again in order to open the sunroof completely. The sunroof operation stops if you operate the switch during its operation.
- **Push up and hold the switch: manual sliding open**
  The sunroof is opened as long as pushing up the switch.

Closing sunroof (Sliding close)





- Pull down the switch

- **Pull down the switch briefly: auto sliding close**
  When pulling down the switch briefly, the sunroof is automatically closed. To stop the closing sunroof, operate the switch to either direction.
- **Pull down and hold the switch: manual sliding close**
  The sunroof is closed as long as pulling down the switch.

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3) Sunroof Tilt Up/Down

This function is to raise or lower the rear section of the sunroof.

Tilt Up





- Pull down the switch

- The rear side of the sunroof is tilted up when pulling down the sunroof switch with the sunroof closed.

Tilt Down





- Push up the switch

- The rear side of the sunroof is tilted down when pushing up the sunroof switch with the sunroof tilted up.

CAUTION

When leaving the vehicle, make sure the sunroof is completely closed. The sunroof may look closed but it might be tilted up.

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4) Sunroof Safety Function

To prevent any body parts from being trapped by the sliding sunroof, an Anti-Pinch Function automatically opens the sunroof when an object is trapped.

CAUTION

The anti-pinch function is deactivated just before the sunroof closes.
The sunroof safety function is just a safety supplementary system which cannot replace driver's care and caution. Moreover, it may not be able to operate due to electric part or other conditions.

▶ Wind buffeting

- When you drive this vehicle with the window or sunroof open at a certain position, you may feel some pressure upon your ears or hear some noises similar to those from a helicopter. This happens because of an influx in air through the window or sunroof and its resonance effect. If this happens, adjust by opening the window or sunroof.

Modification basis	
Application basis	
Affected VIN	

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3. SUNROOF OPEN WARNING

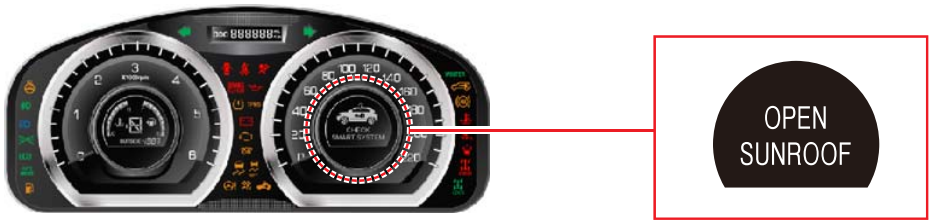
1) Warning Sound

When removing the key and then opening the door with the sunroof open, the warning sound is heard. Closing the door stops the warning sound.

2) Message on Instrument Cluster

The following message is displayed on the screen in the instrument cluster.

Supervision type



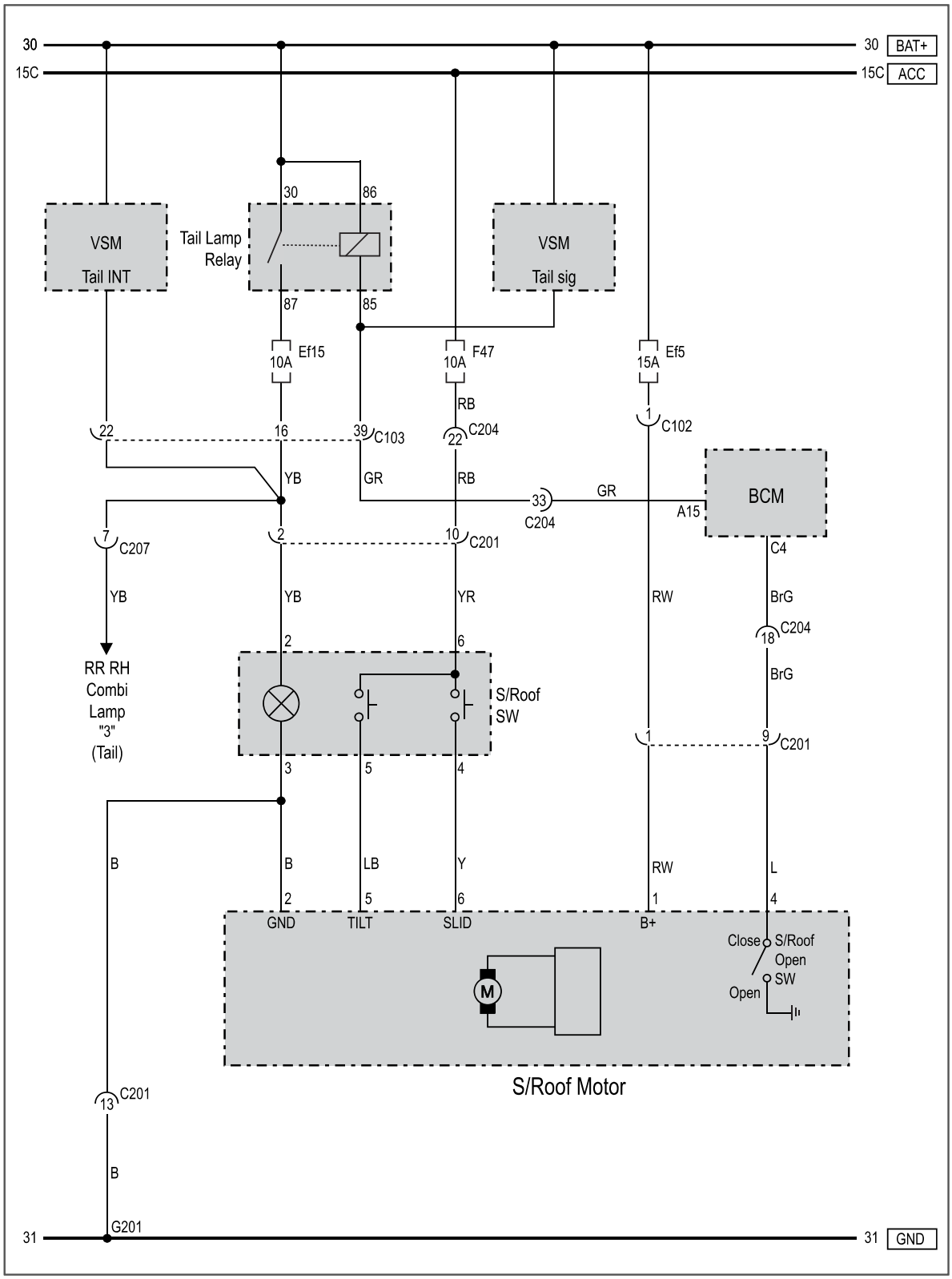
CAUTION

General precaution for sunroof

- Even though the sunroof can be operated when the engine is not running, operating the sunroof repeatedly with the engine turned off will run down the battery. Operate the sunroof while the engine is running.
- When the sunroof operation is completed, release the switch. Keeping pressing the switch can result in malfunction.
  Especially in winter, never operate the sunroof if operation areas are iced. Wait until melted.
  Make sure that the sunroof is completely closed when leaving the vehicle. Leaving the vehicle with
- the sunroof open result in a theft. In addition, rain or snow can get into the vehicle through the open sunroof.
  When the sunroof is fully open, wind buffeting symptom can be worse. In this case, try to adjust
- the sunroof position manually or open the sunroof into 1st first step until the wind buffeting is disappeared.
  Parts of the body can be trapped in the sunroof and can be struck by passing objects. Do not stick
- hands, head or anything else out of the openings.
  Remove any dirt and foreign material stuck on the edge of the sunroof glass periodically.
- Noise can occur due to friction when operating the sunroof.

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4. CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

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BODY INTERIOR 5110-01

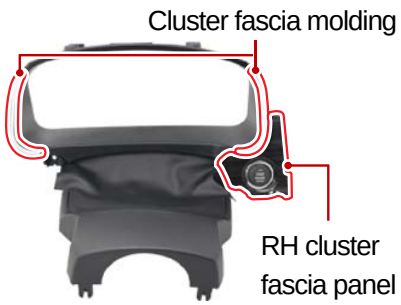
GENERAL INFORMATION

1. MAJOR CHANGES

▶ **Instrument Panel**

Instrument panel	LH side fascia panel & molding
Old  **New**  - The design and material of IP have been changed. - An invisible type passenger air bag module has been applied.	**Old**  **New**  The design of LH side fascia panel & molding has been changed.

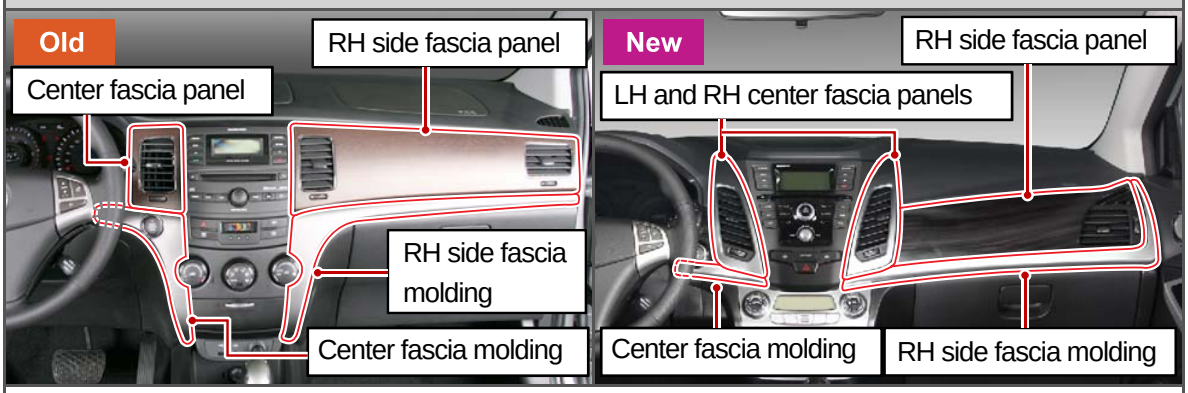


Cluster fascia panel	
Old 	**New** 
RH cluster fascia panel and molding have been newly applied.	

Modification basis	
Application basis	
Affected VIN	

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Center fascia panel & molding, RH side fascia panel & molding



- The design of center fascia panel & molding has been changed.
- The design of RH side fascia panel & molding has been changed.
- RH center fascia panel has been newly applied.



Crash pad upper cover



The name of crash pad upper tray has been changed to "crash pad upper cover" and its design also has been changed.

Center fascia lower panel



The design of center fascia lower panel has been changed (lower tray, heater and A/C control assembly).

RH glove box housing extension

Newly introduced



RH glove box housing extension panel has been newly added on the right side of glove box housing.

Modification basis	
Application basis	
Affected VIN	

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▶ Front Console

Front console

The appearance of the front console cup holder housing has been changed.

▶ Door Trim

Front door trim

The design of front door trim has been changed.

Rear door trim

- The design of rear door trim has been changed. – 2 Mounting points → 3 Mounting points

Modification basis	
Application basis	
Affected VIN	

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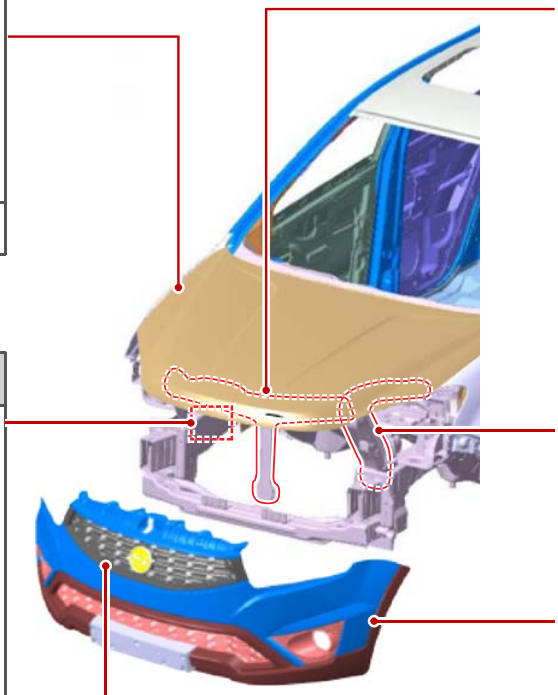
BODY EXTERIOR 0000-00

GENERAL INFORMATION

1. MAJOR CHANGES

Hood panel	
Old 	New 
The appearance of the hood panel has been changed.	

Hood latch	
Old 	New 
The appearance of the hood latch safety hook has been changed.	



Radiator grille	
Old 	New 
- The appearance of the radiator grille has been changed. - The emblem on the radiator grille has been changed.	

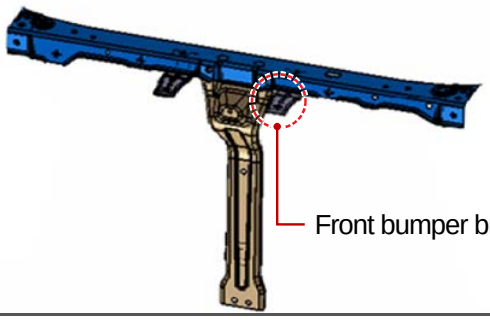
Modification basis	
Application basis	
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Front end upper member

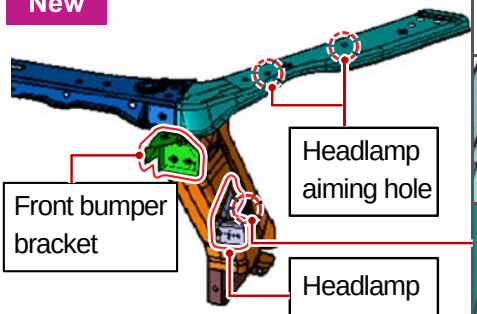
New



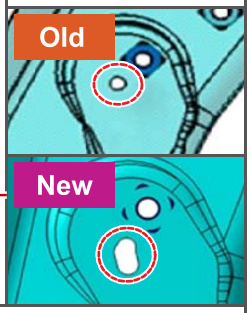
The front bumper bracket has been newly applied.

Headlamp member

New



Front impact sensor mounting



- Aiming hole has been added because of the changed headlamp
- The install location of front impact sensor has been changed.
- The appearances of the front bumper bracket and headlamp bracket have been changed.

Front bumper

Old



New



- The appearance of the front bumper has been changed.
- The front end upper panel has been newly applied.

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Rear quarter panel	
	
The outline of the rear combination lamp mounting has been changed.	

Modification basis	
Application basis	
Affected VIN	

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BODY REPAIR

5110-01

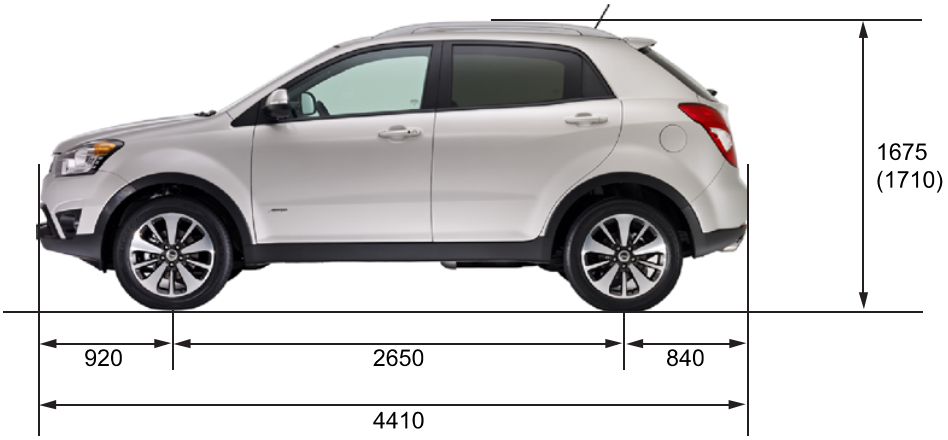
GENERAL INFORMATION

1. MAJOR DIMENSION

Top view



Side view



Front side



Rear view

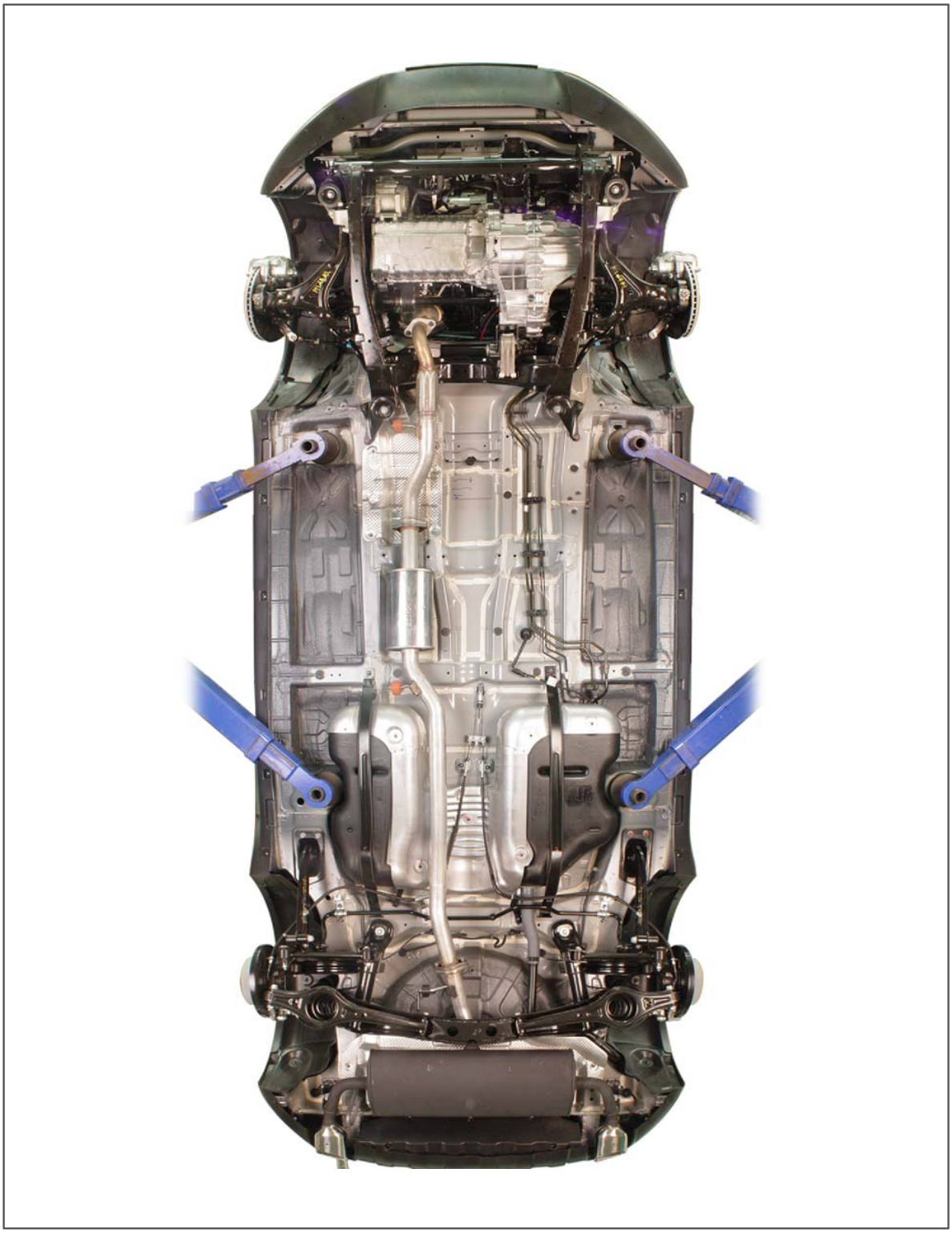


Modification basis	
Application basis	
Affected VIN	

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2. JACK POINTS

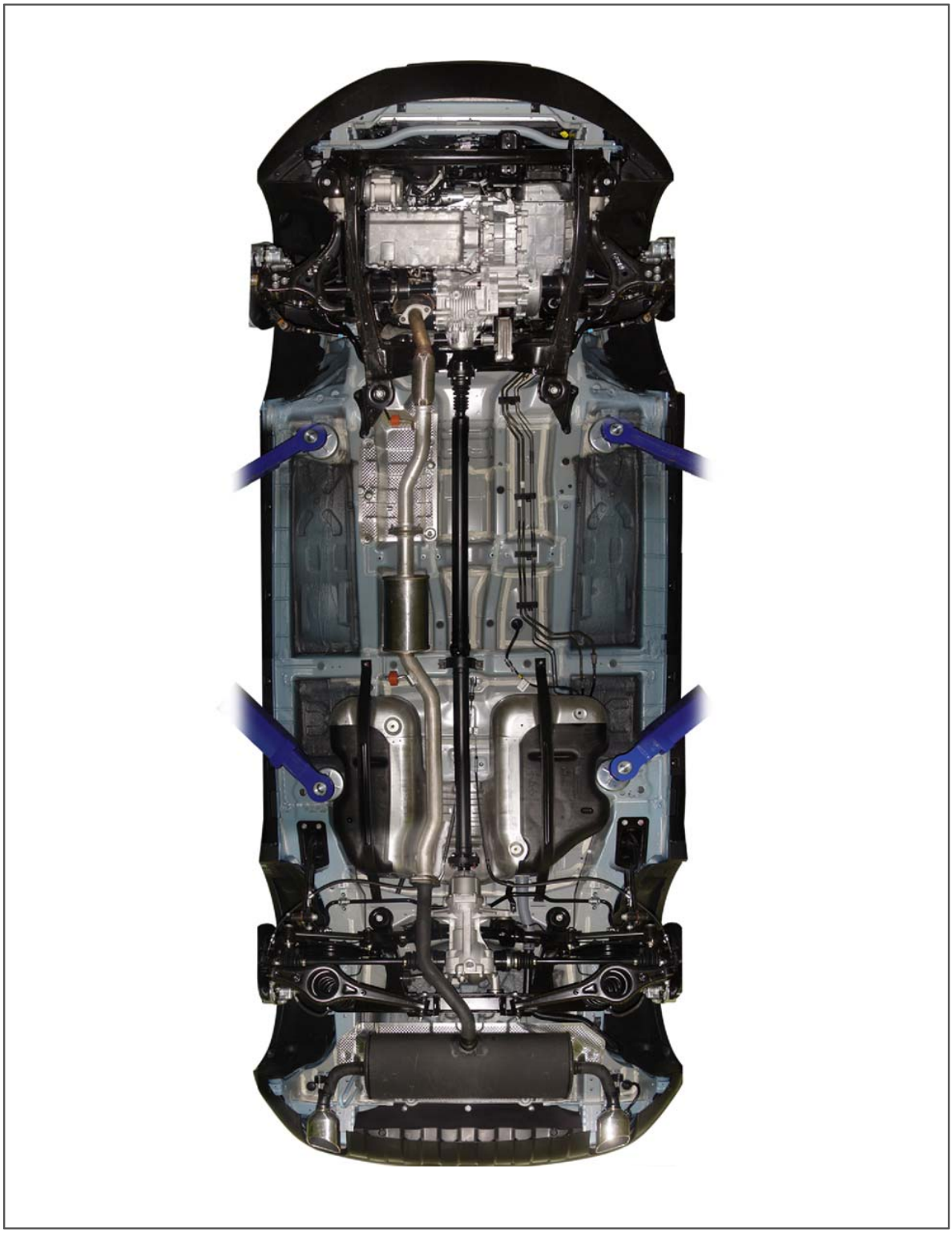
1) 2WD



Modification basis	
Application basis	
Affected VIN	

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2) 4WD

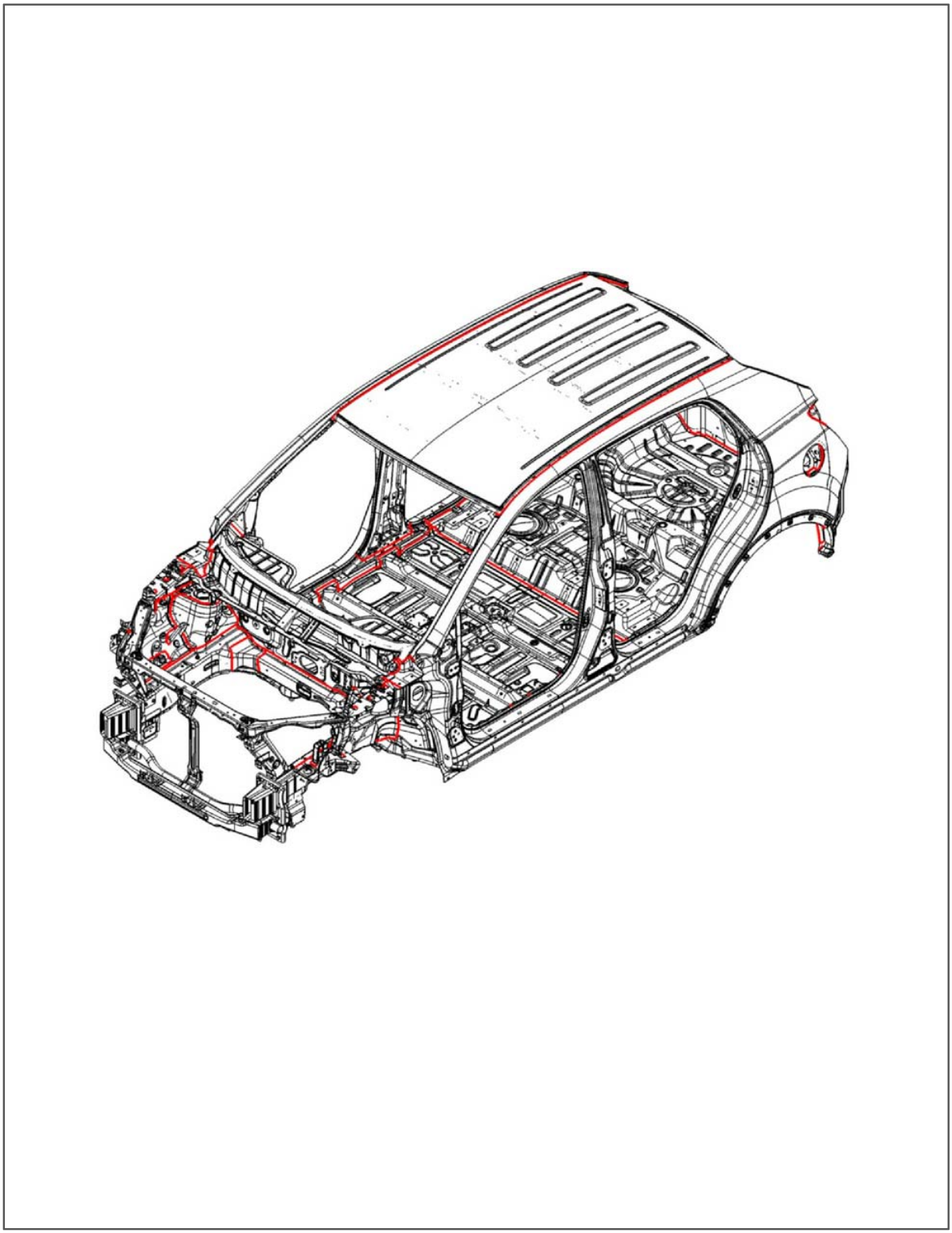


Modification basis	
Application basis	
Affected VIN	

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3. SEALING APPLICATION POINTS

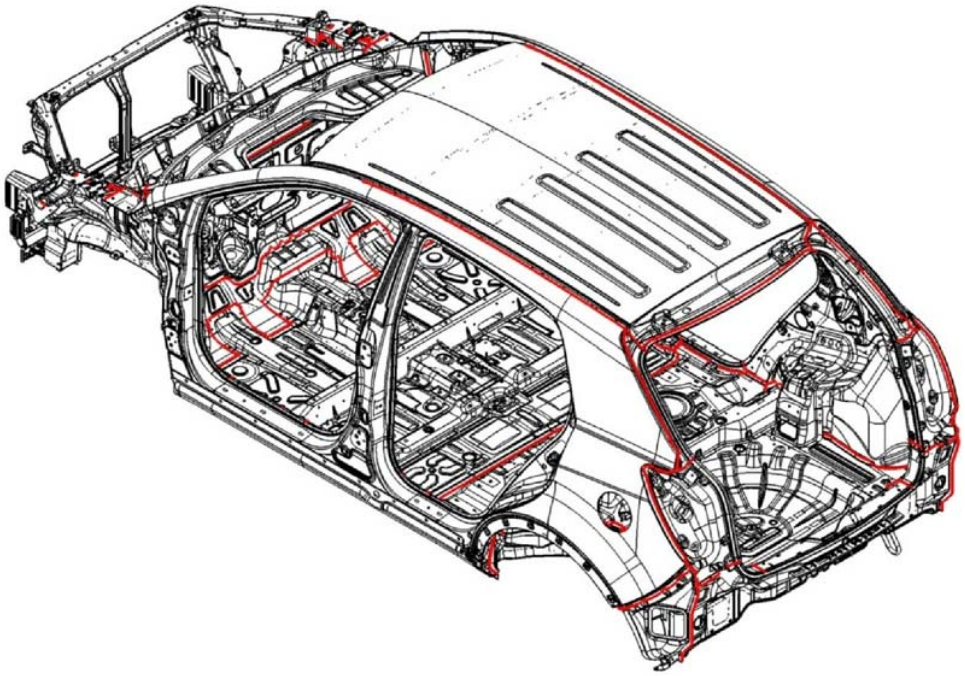
1) Dash Panel, Engine Tunnel, Floor, Etc.



Modification basis	
Application basis	
Affected VIN	

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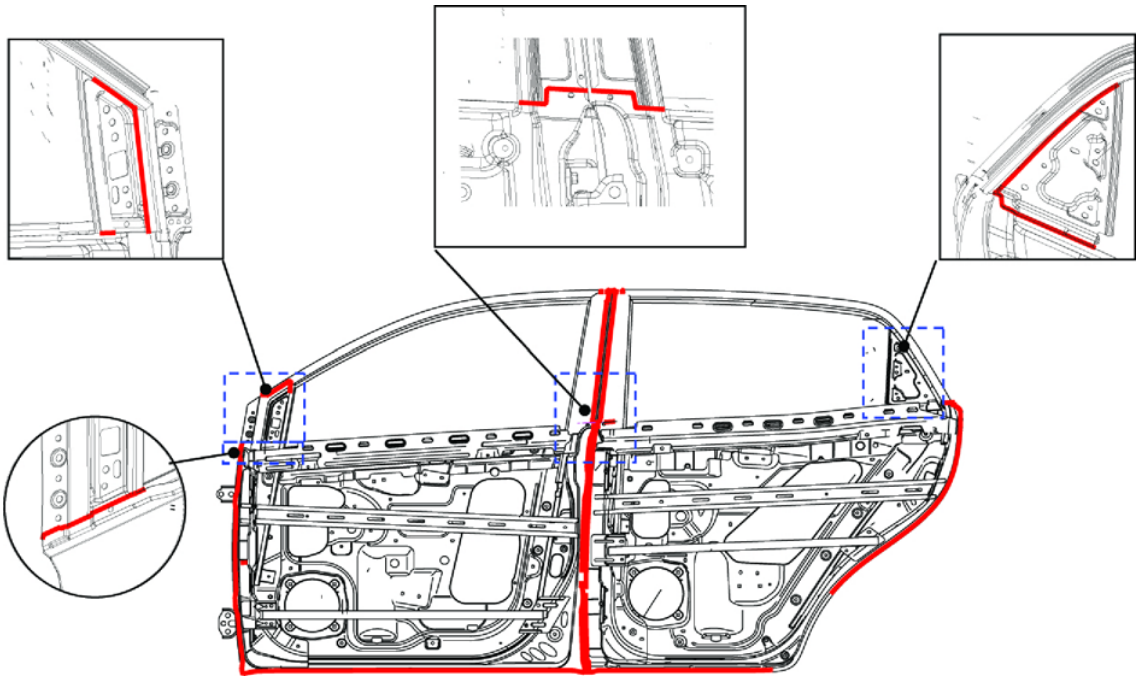
2) White Body



Modification basis	
Application basis	
Affected VIN	

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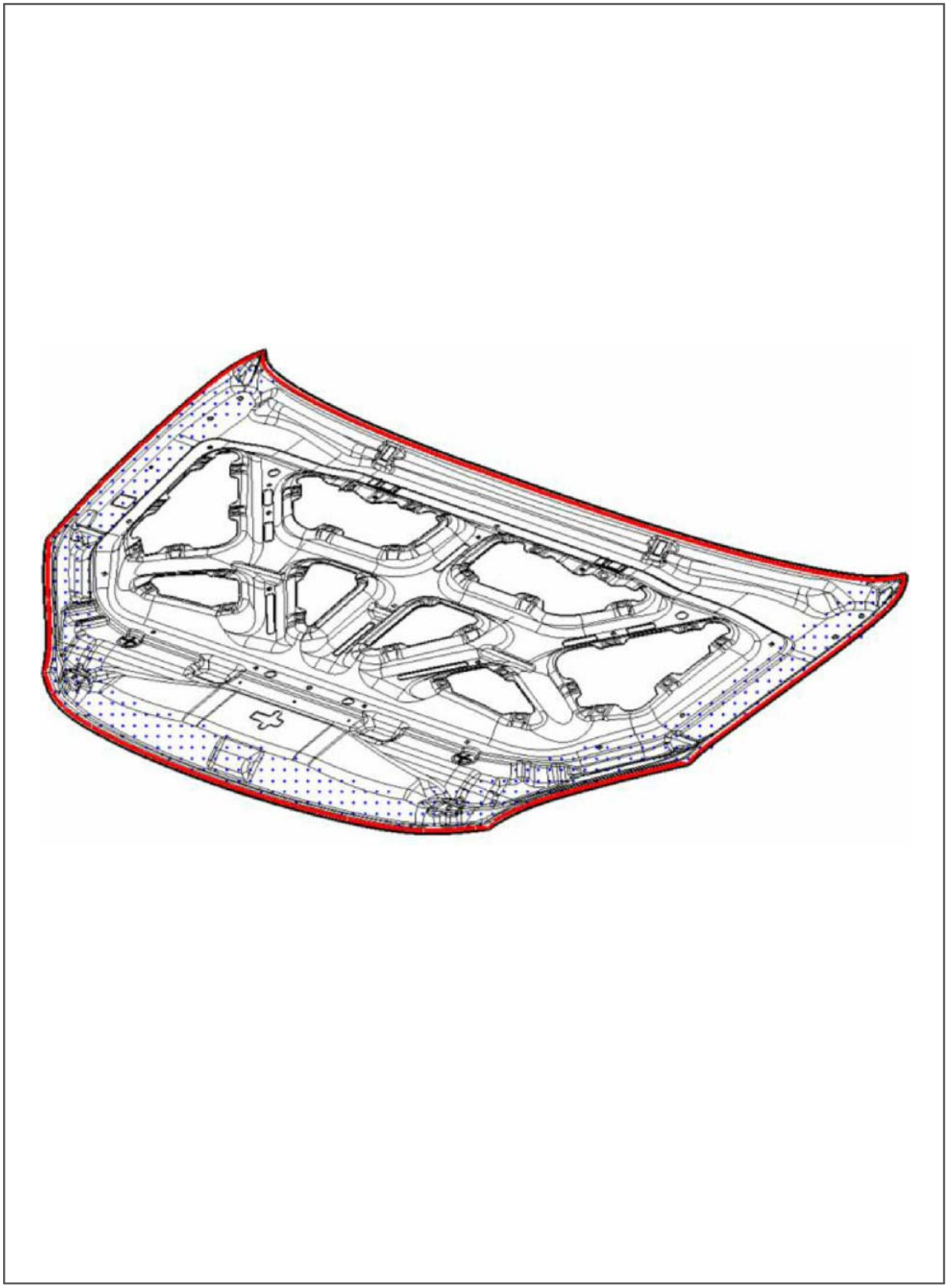
3) Front & Rear Door Panel



Modification basis	
Application basis	
Affected VIN	

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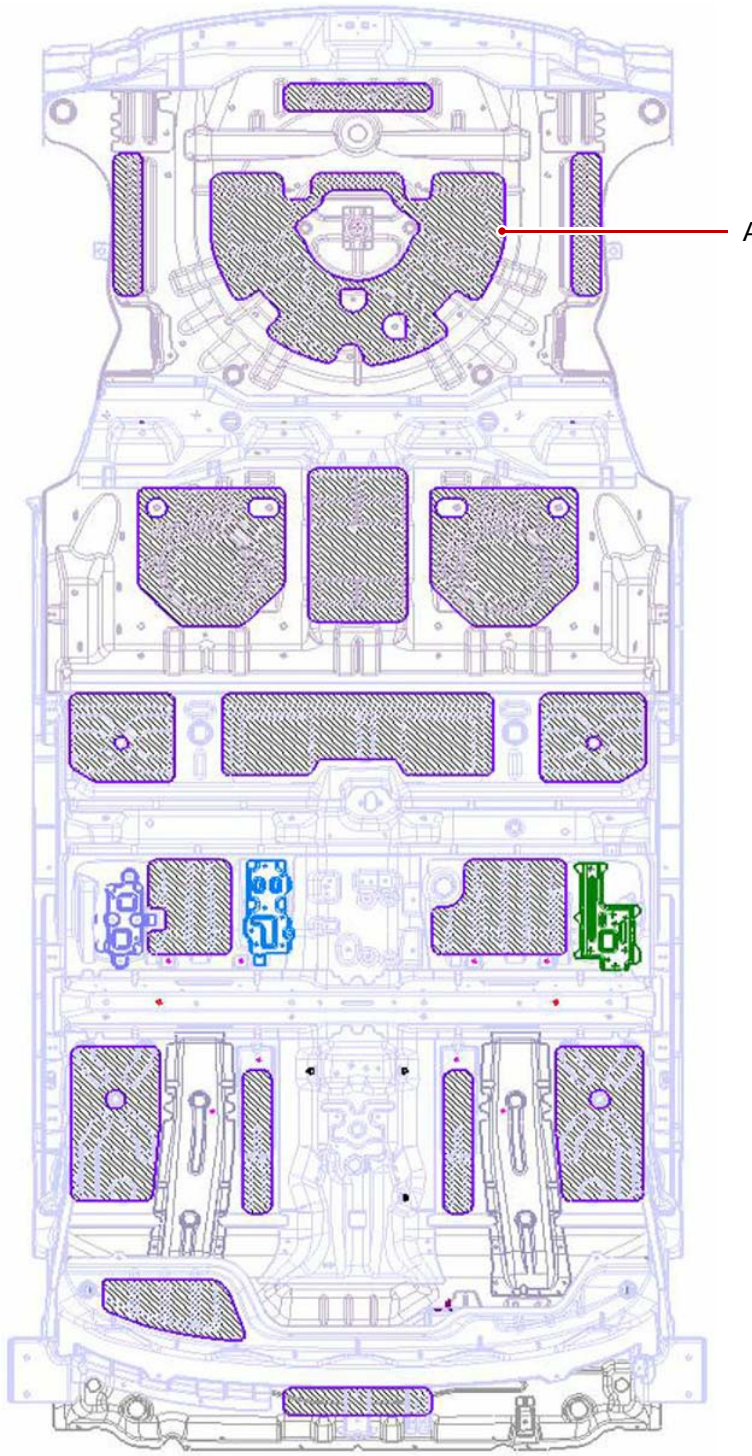
4) Engine Hood Panel



Modification basis	
Application basis	
Affected VIN	

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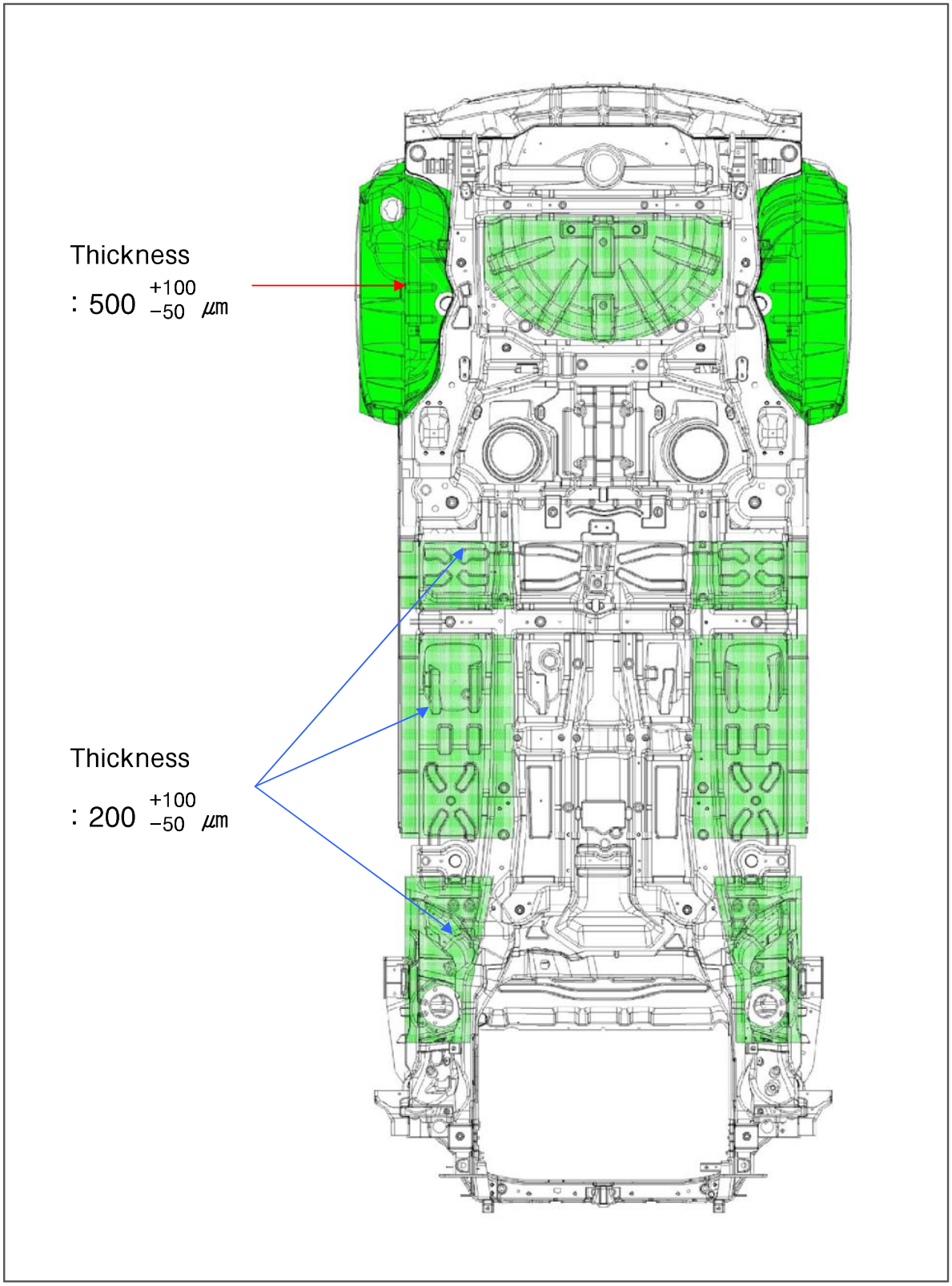
4. DEADENER APPLICATION POINTS



Modification basis	
Application basis	
Affected VIN	

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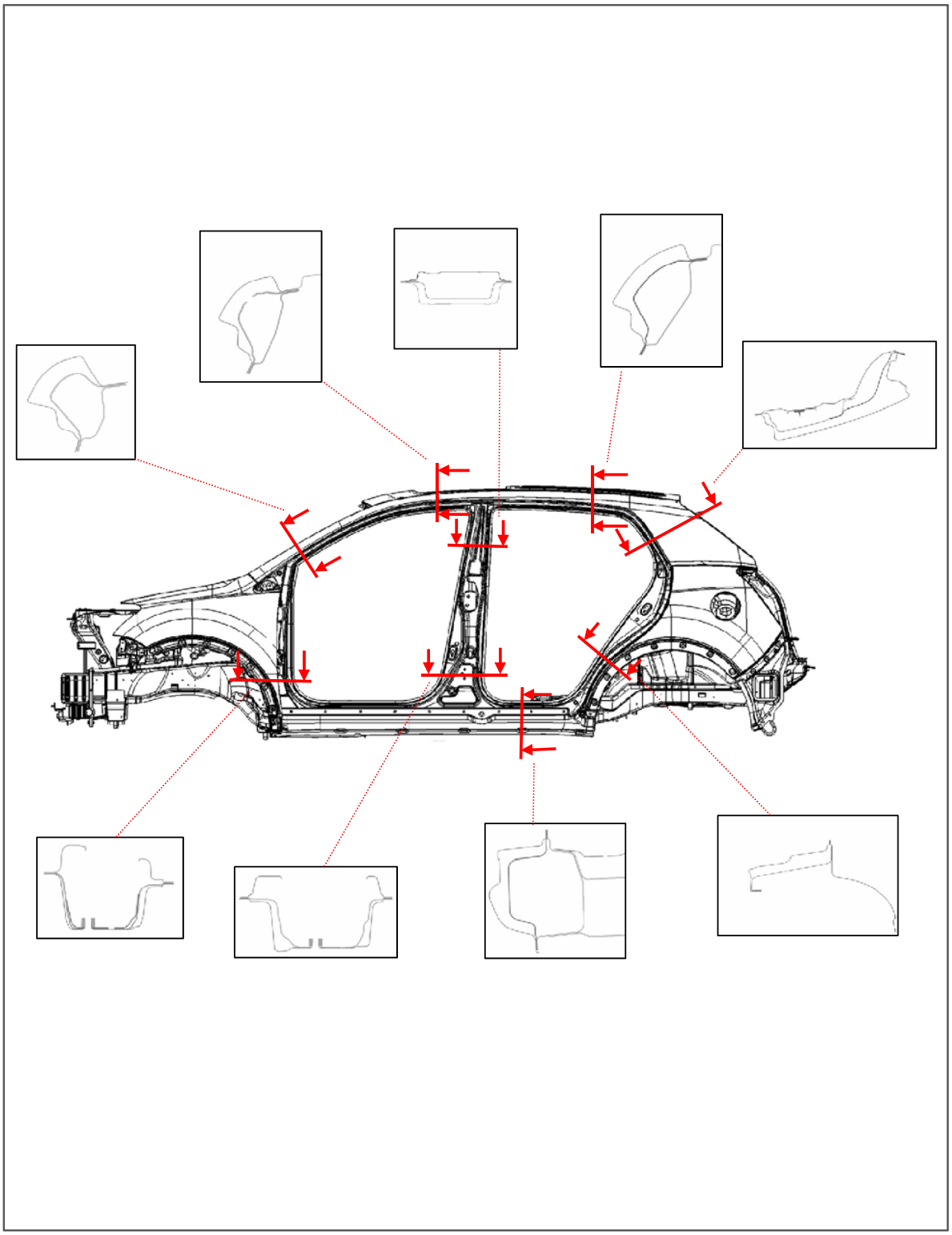
5. UNDER COATING



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6. MAJOR WELDING POINTS

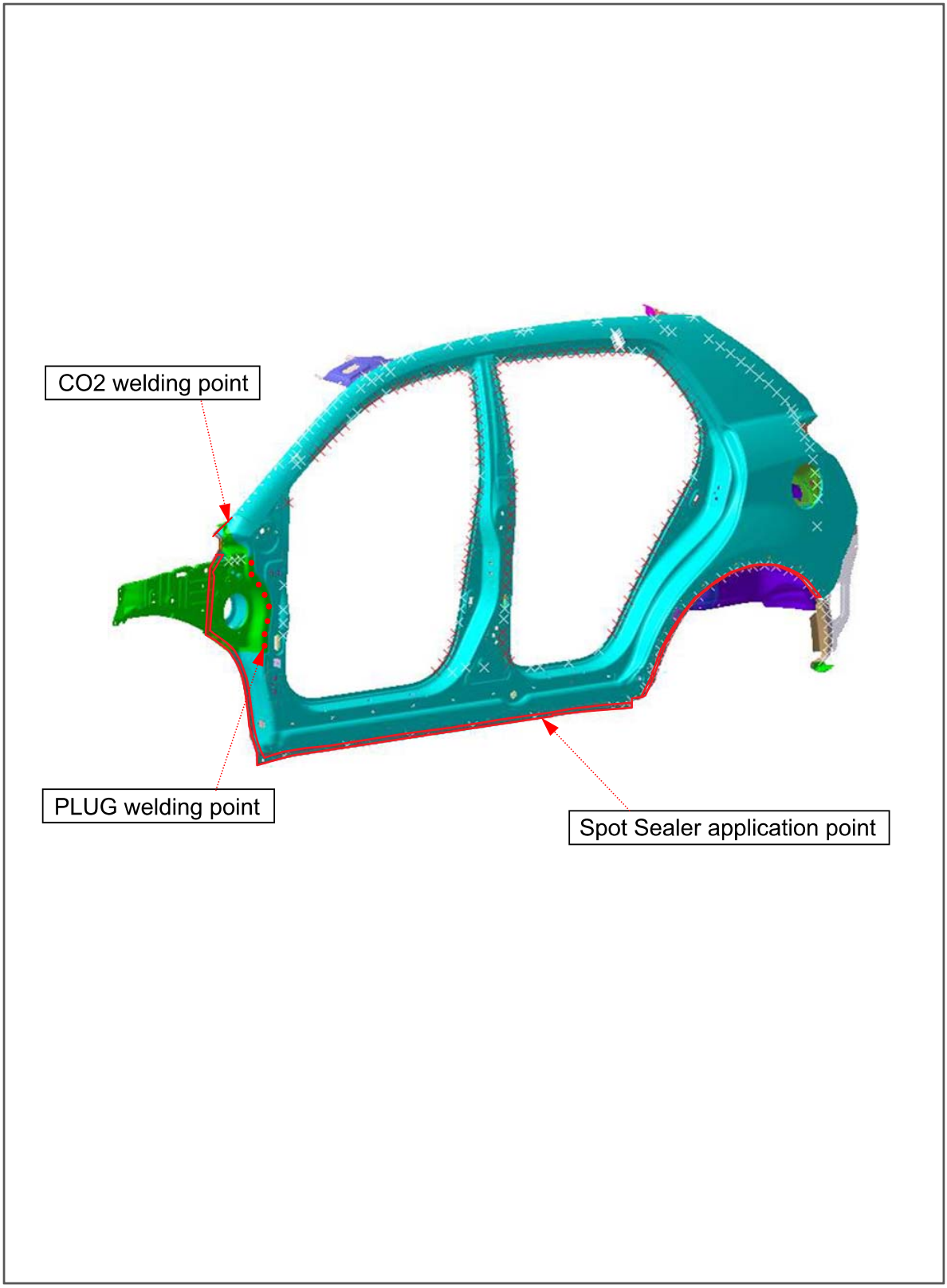
1) Cross Sectional View of Major Panels



Modification basis	
Application basis	
Affected VIN	

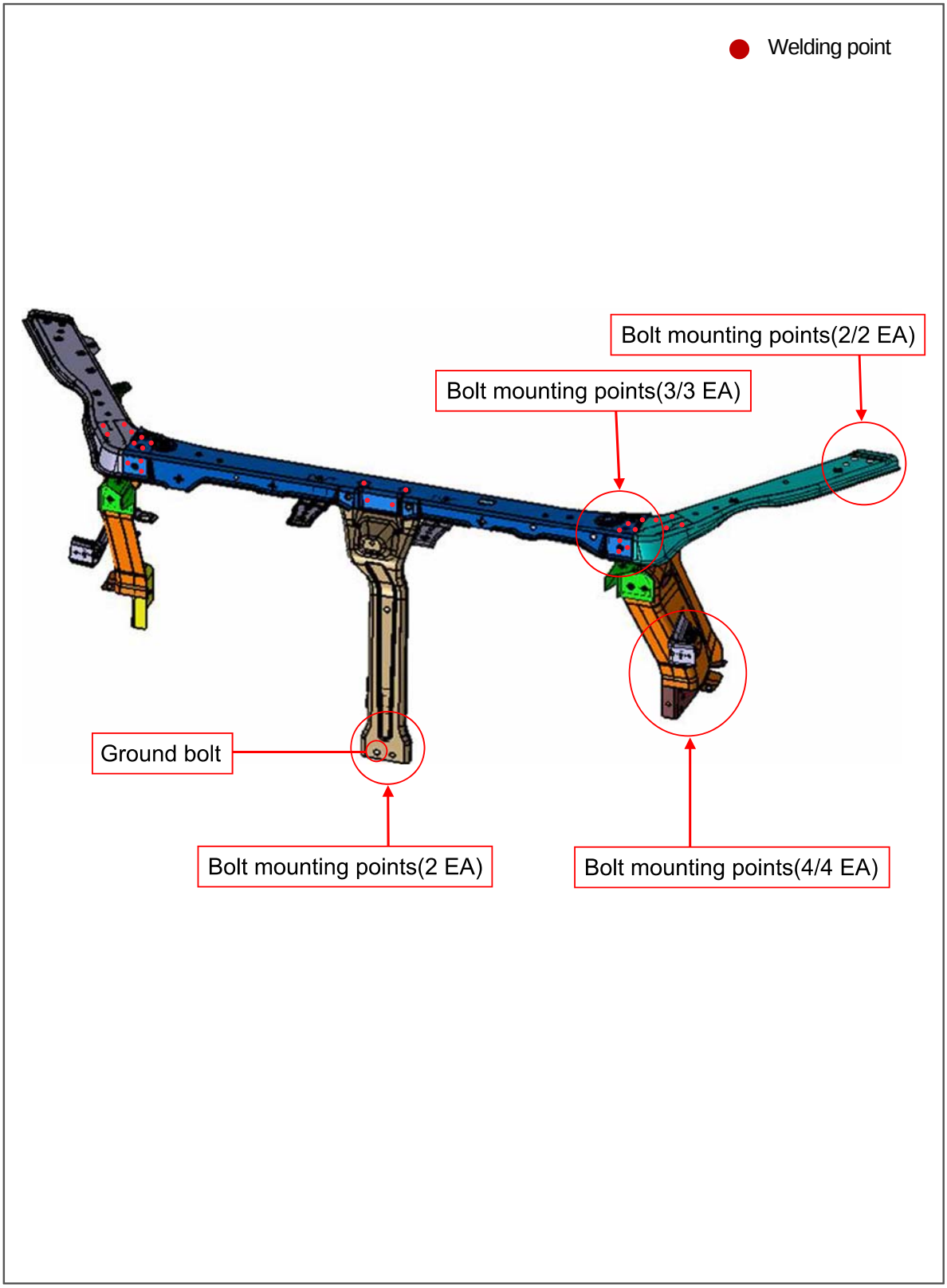
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2) Side Panel



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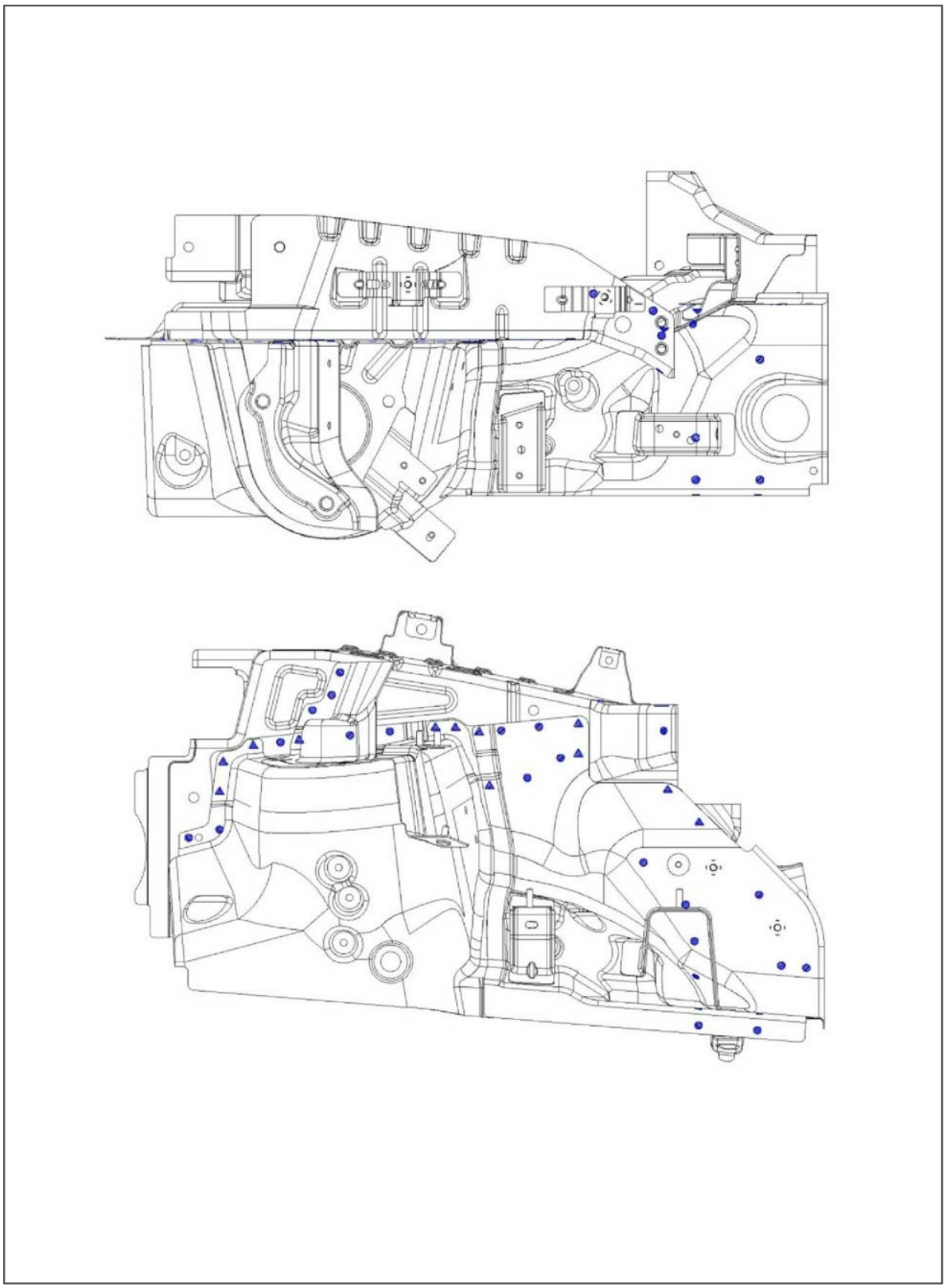
3) Front Panel



Modification basis	
Application basis	
Affected VIN	

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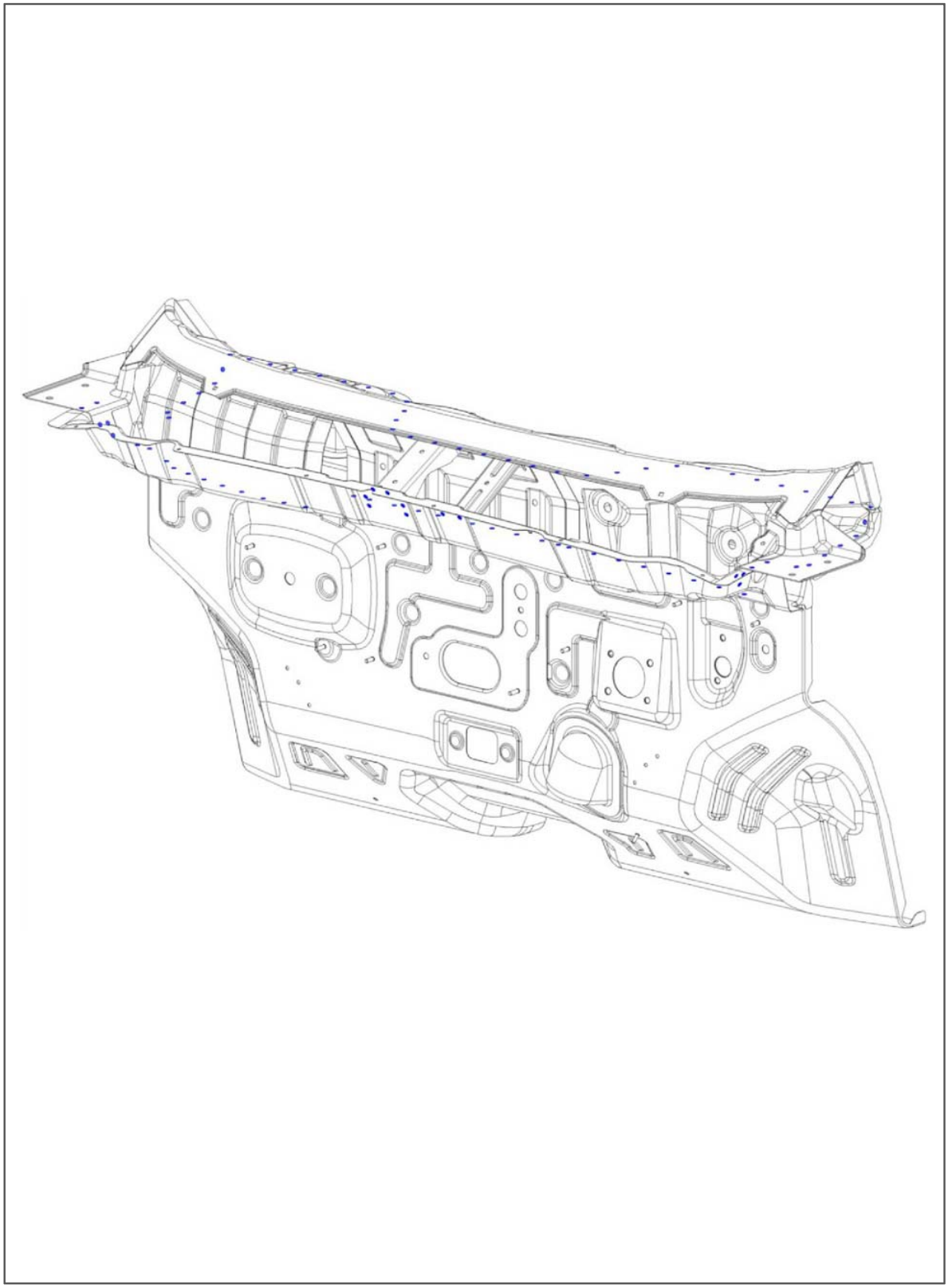
4) Apron Panel



Modification basis	
Application basis	
Affected VIN	

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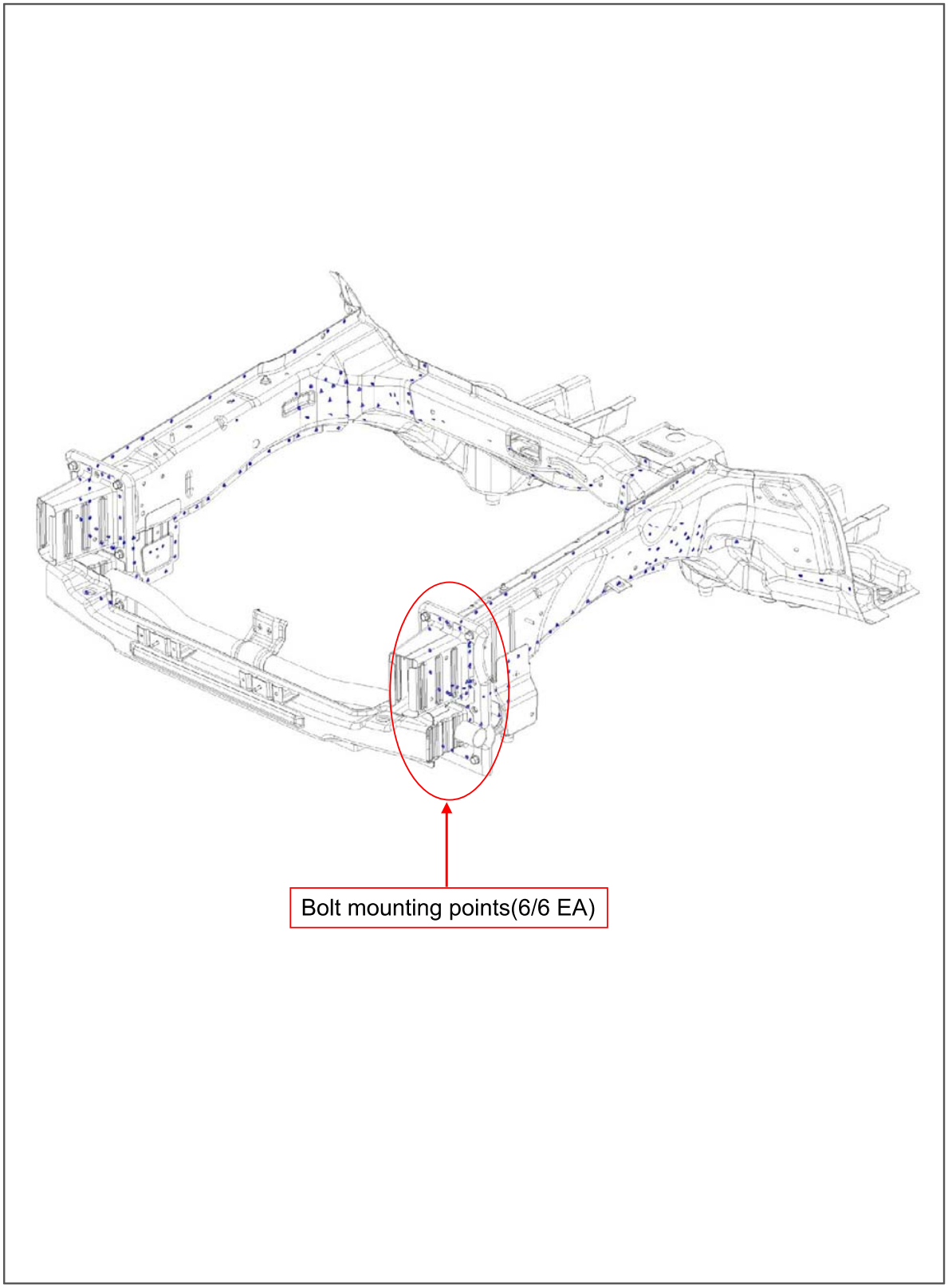
5) Dash & Cowl Panels



Modification basis	
Application basis	
Affected VIN	

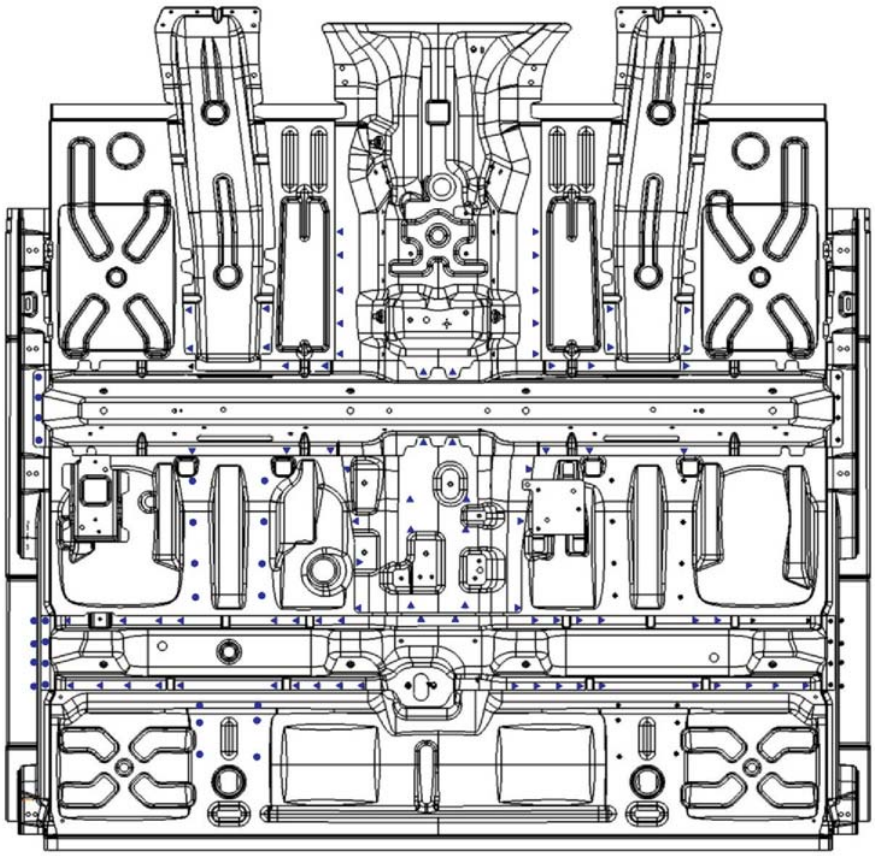
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6) Front H-Frame Panel



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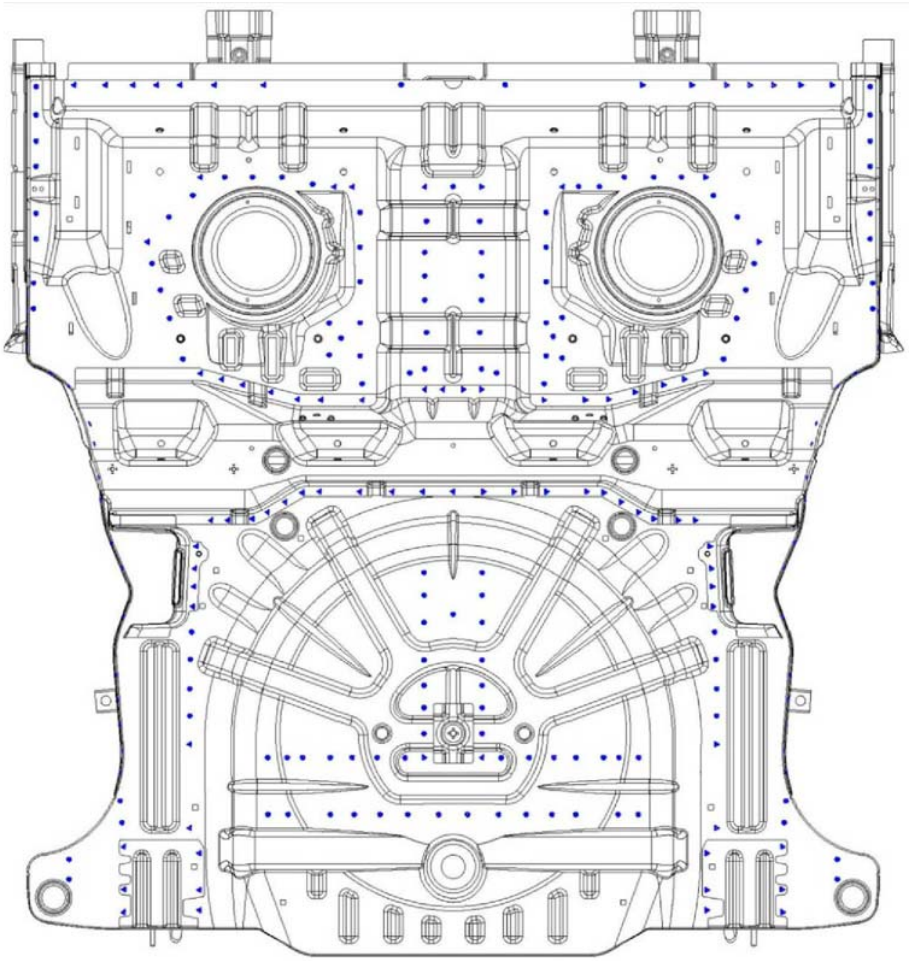
7) Front Floor Panel



Modification basis	
Application basis	
Affected VIN	

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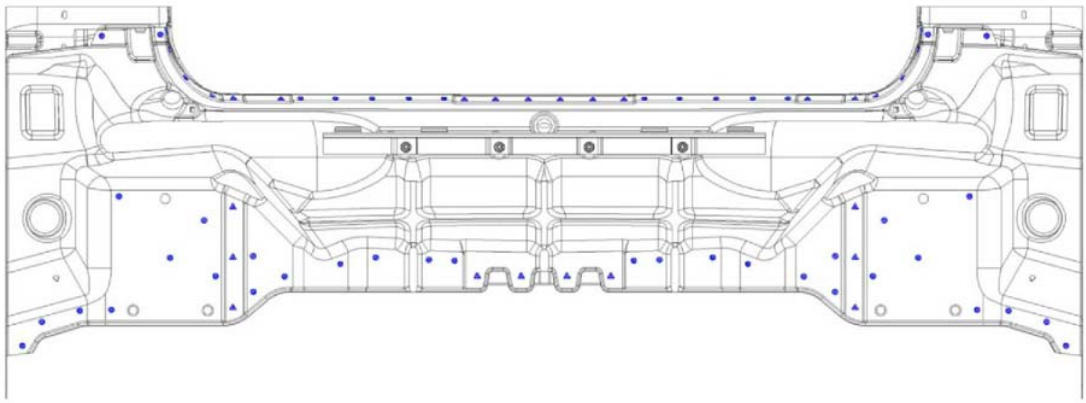
8) Rear Floor Panel



Modification basis	
Application basis	
Affected VIN	

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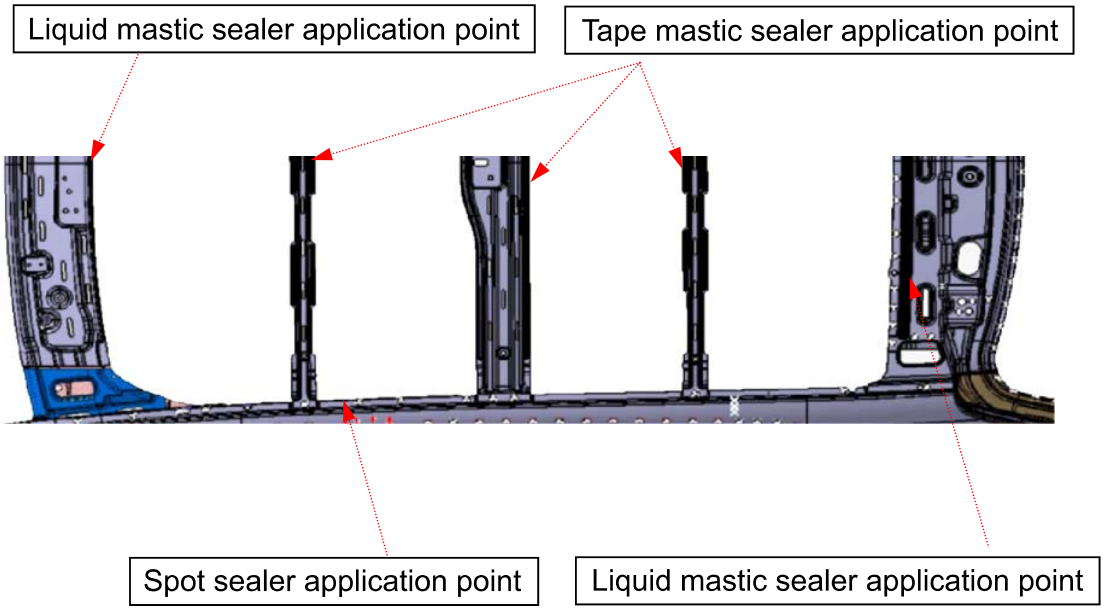
9) Rear End Panel



Modification basis	
Application basis	
Affected VIN	

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10) Roof Panel

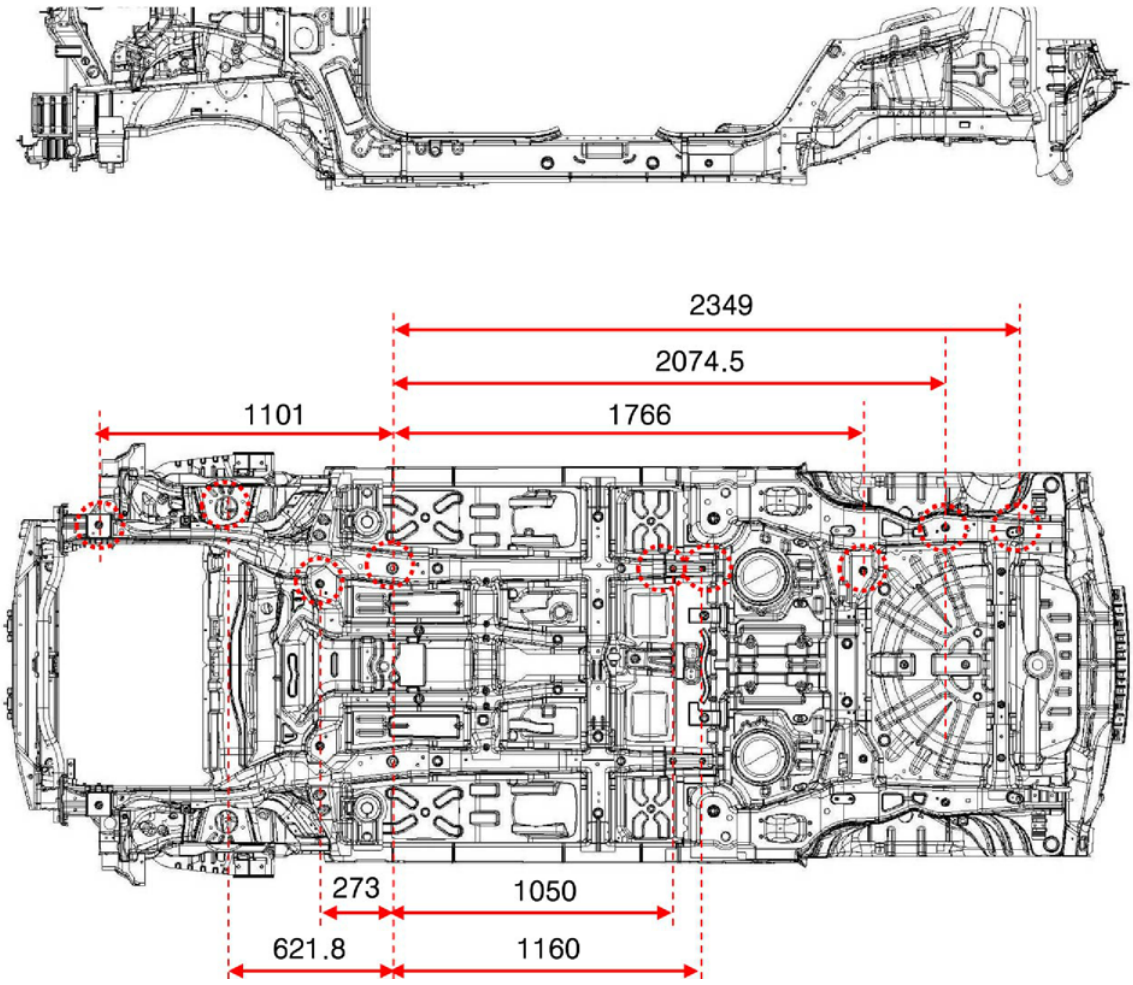


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7. MAJOR BODY DIMENSIONS

1) Under Body

Unit: mm

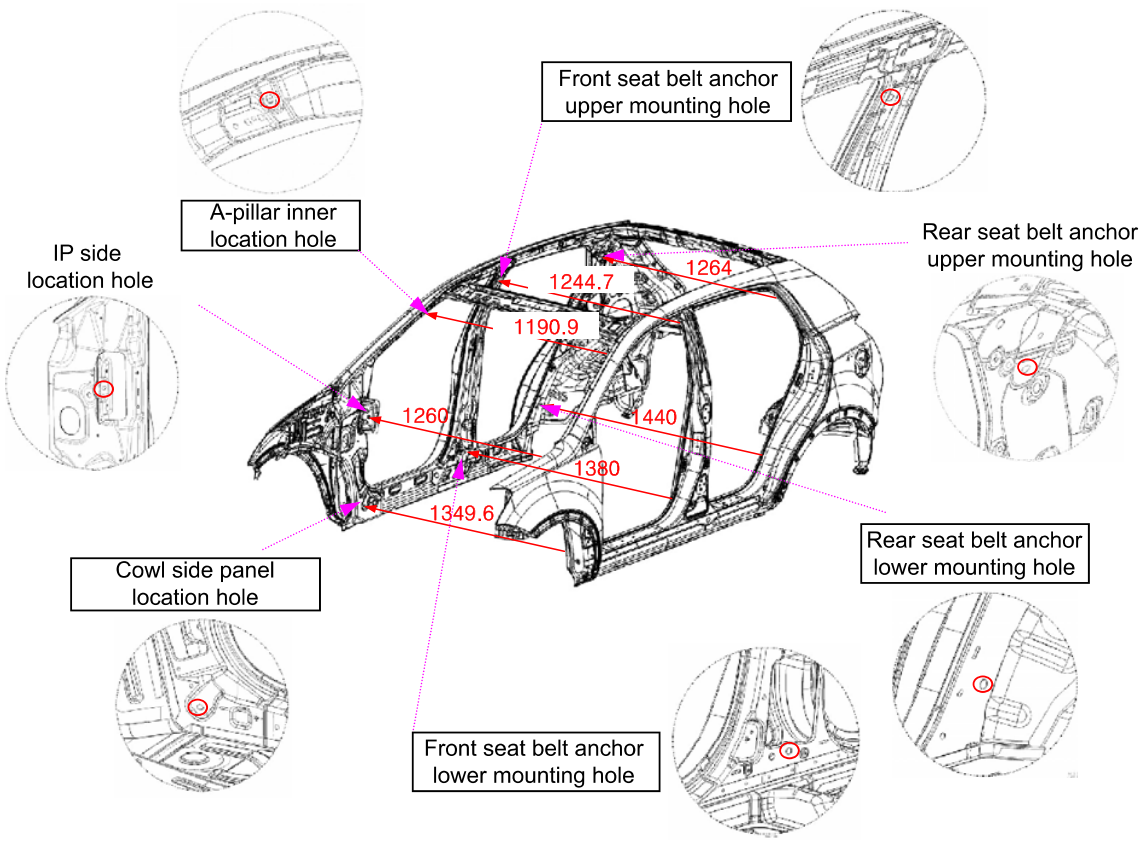


Modification basis	
Application basis	
Affected VIN	

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2) Vehicle Structure

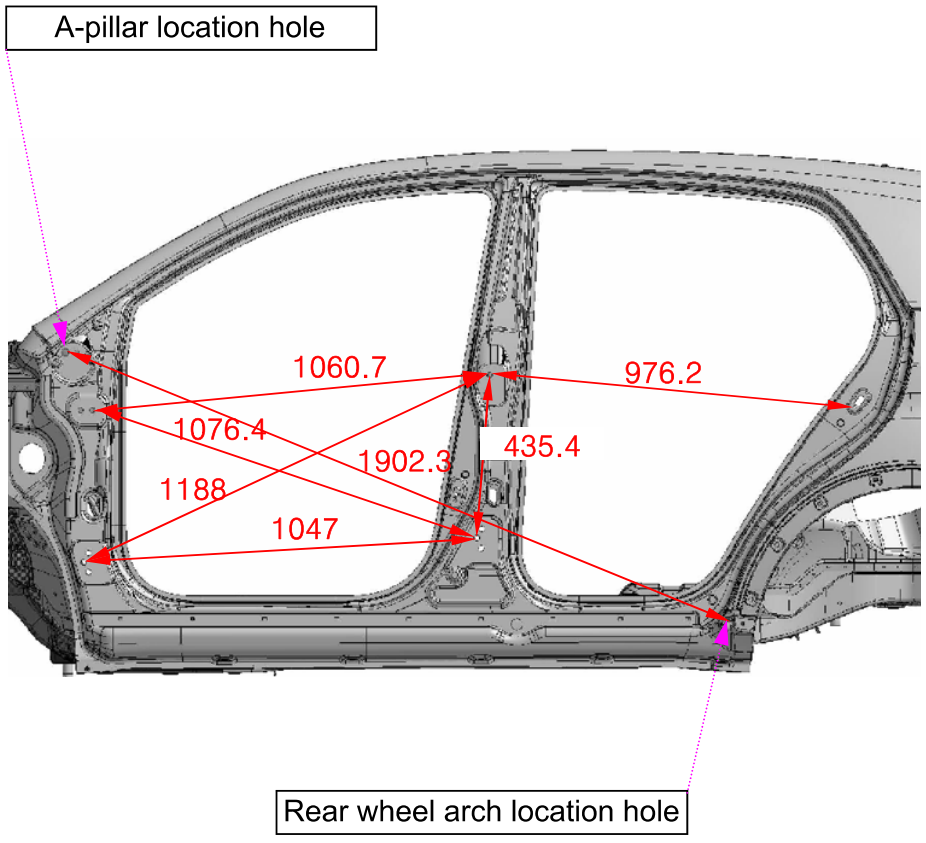
Unit: mm



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3) Side Structure

Unit: mm

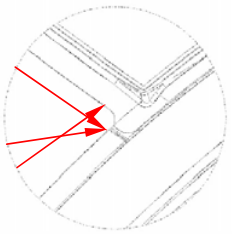


Modification basis	
Application basis	
Affected VIN	

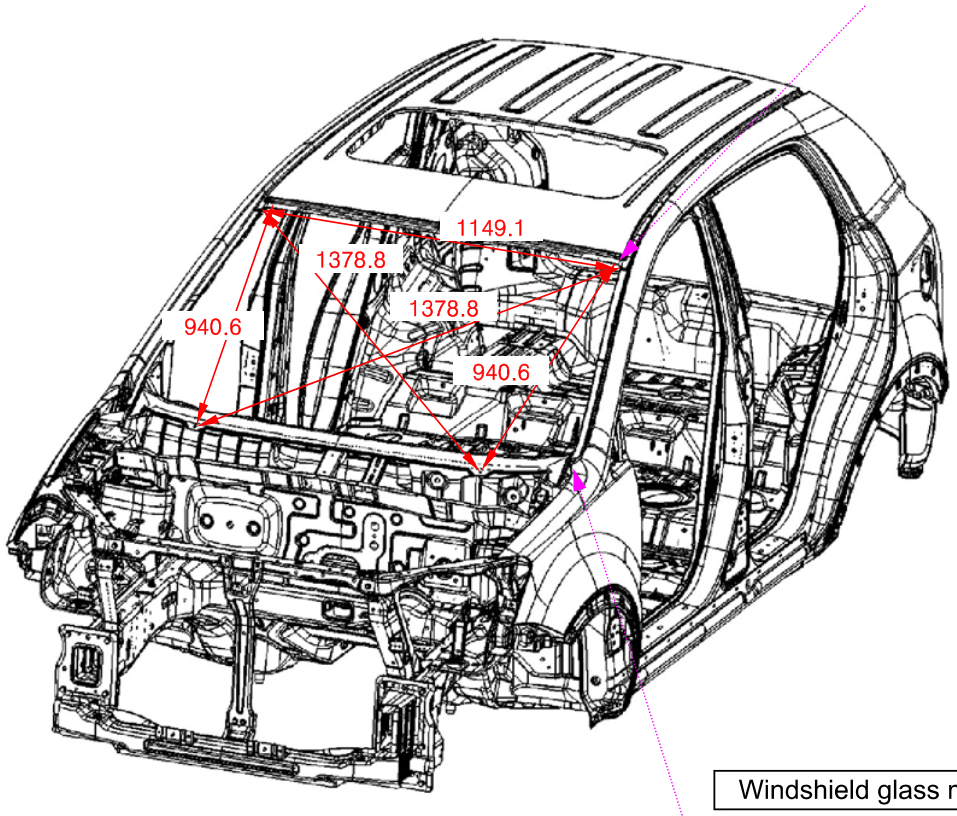
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4) Windshield Glass Area

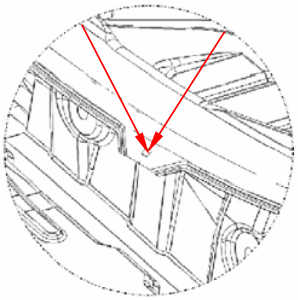
Unit: mm



Roof panel, side outer panel edge



Windshield glass mounting

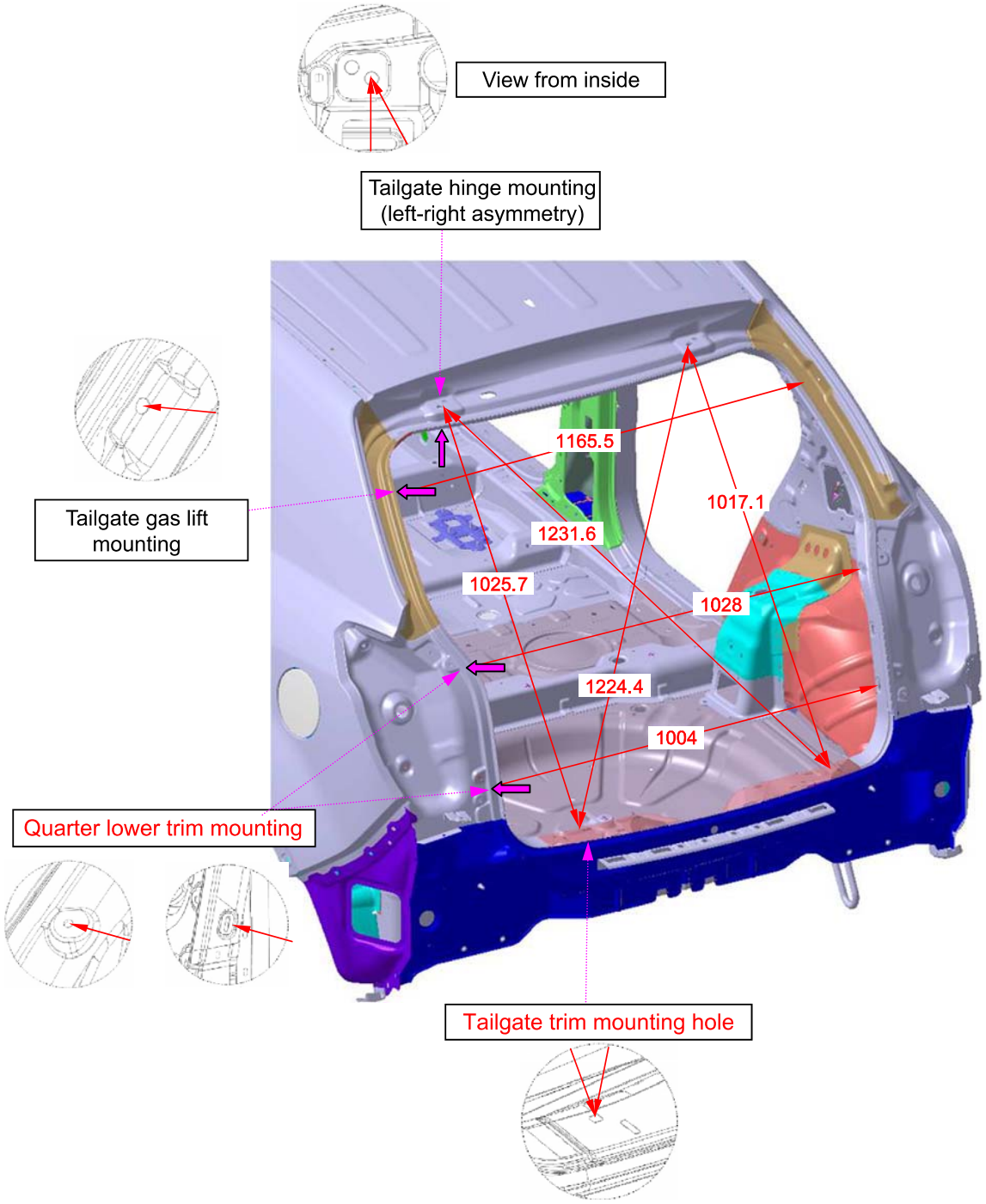


Modification basis	
Application basis	
Affected VIN	

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5) Tail Gate Area

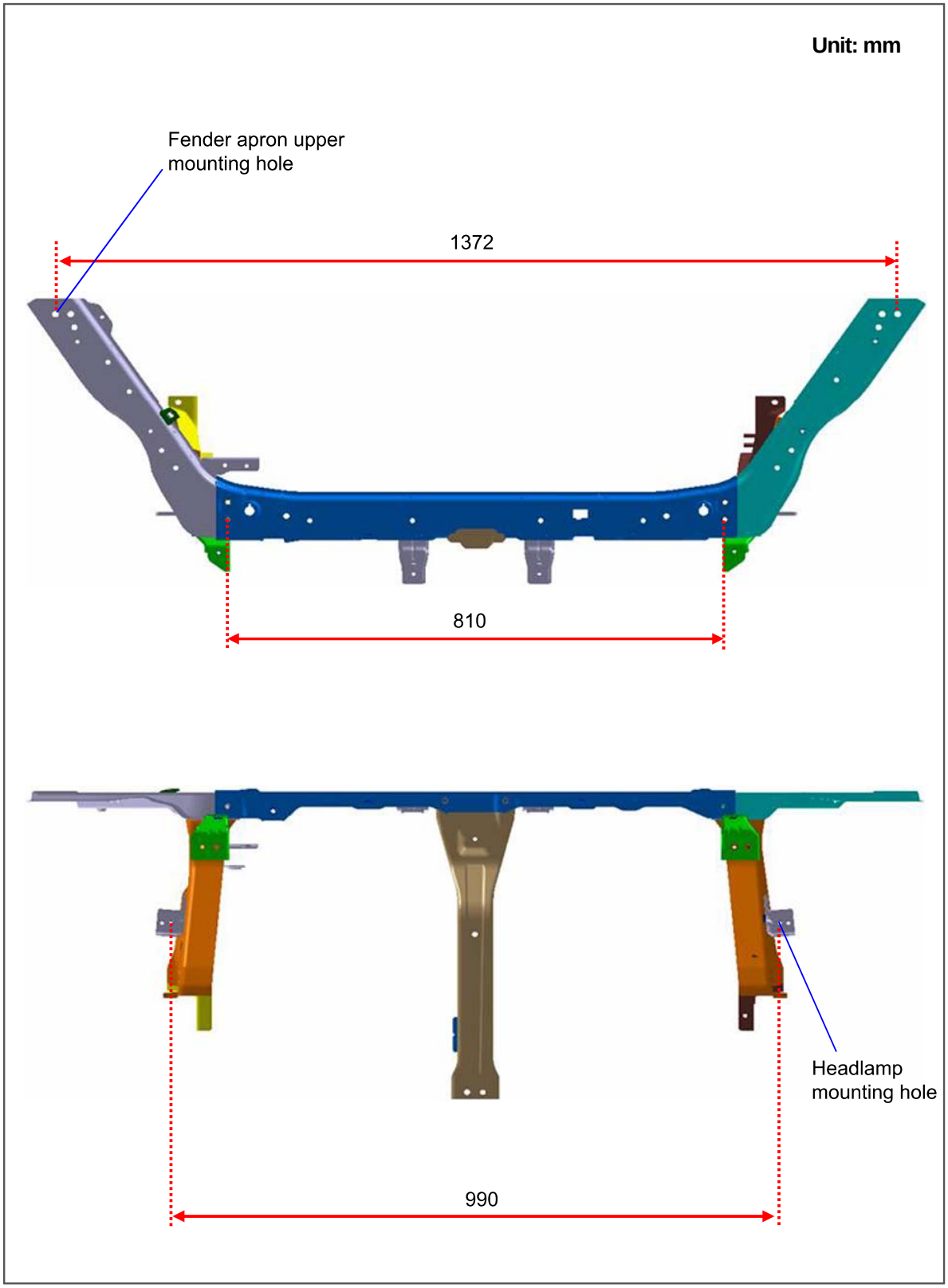
Unit: mm



Modification basis	
Application basis	
Affected VIN	

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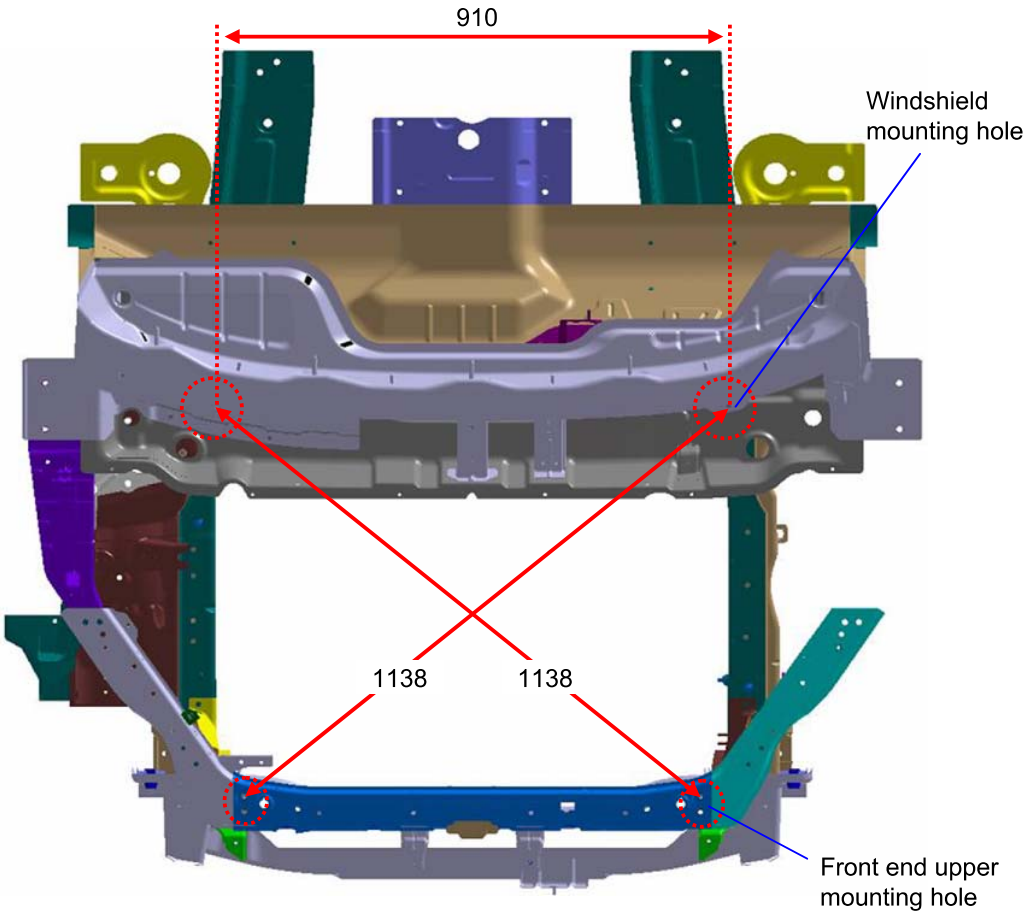
6) Front End



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7) Engine Room

Unit: mm

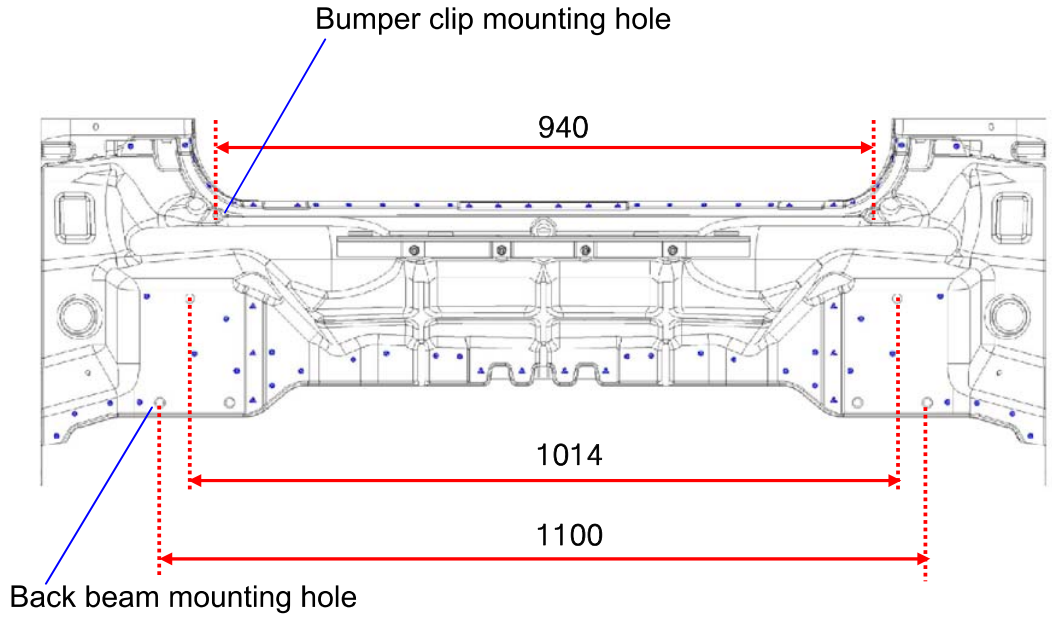


Modification basis	
Application basis	
Affected VIN	

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8) Back Panel

Unit: mm

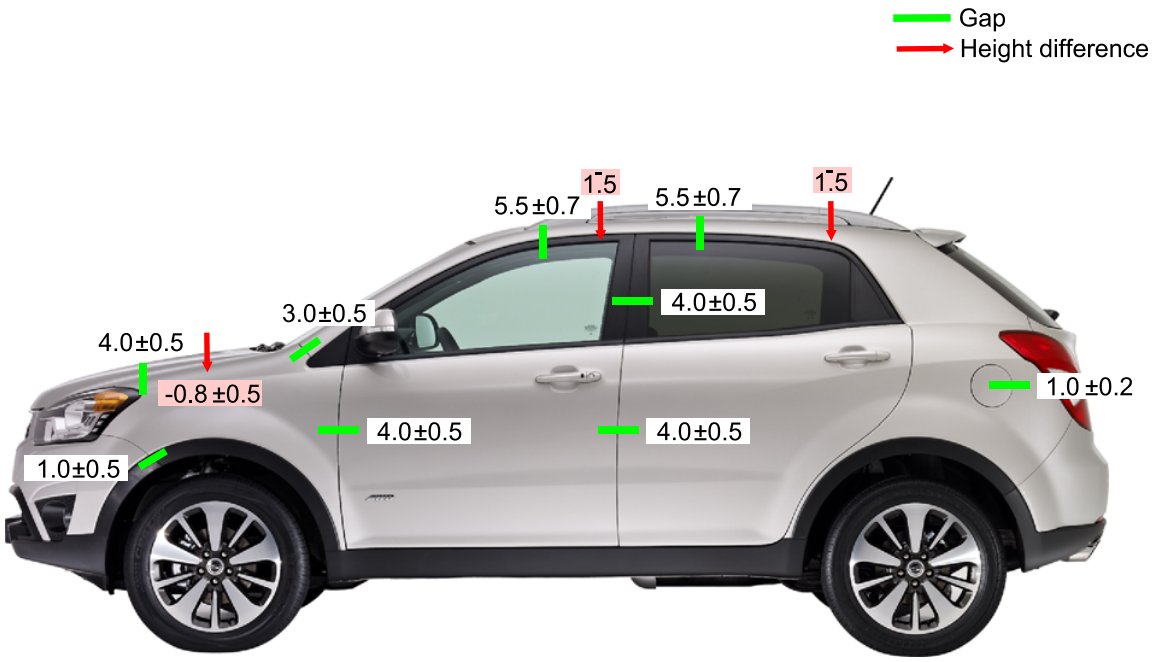


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8. GAP CHART

1) Side Body

Unit: mm

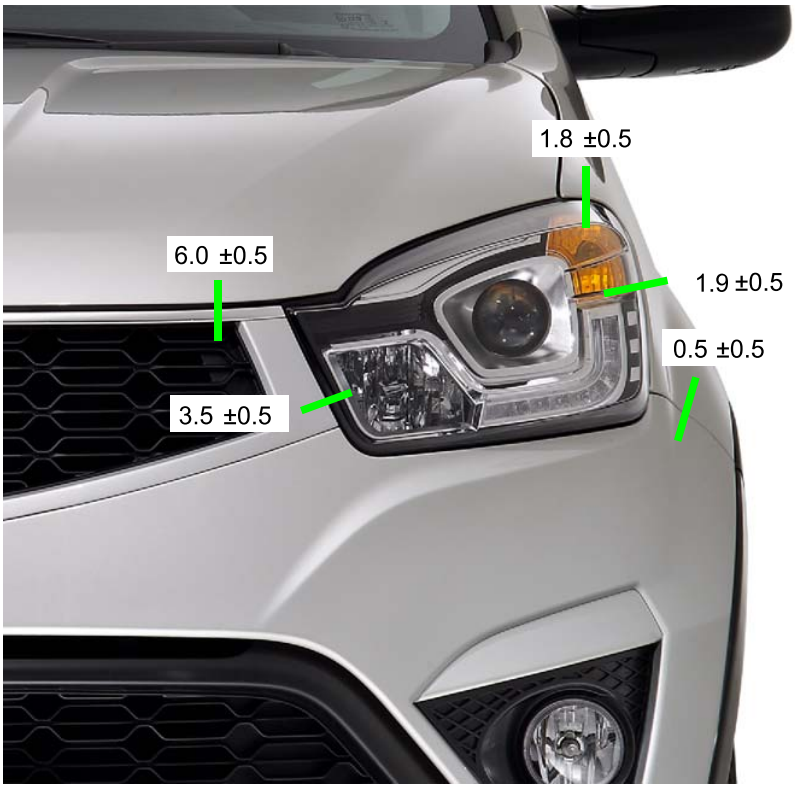


Modification basis	
Application basis	
Affected VIN	

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2) Front

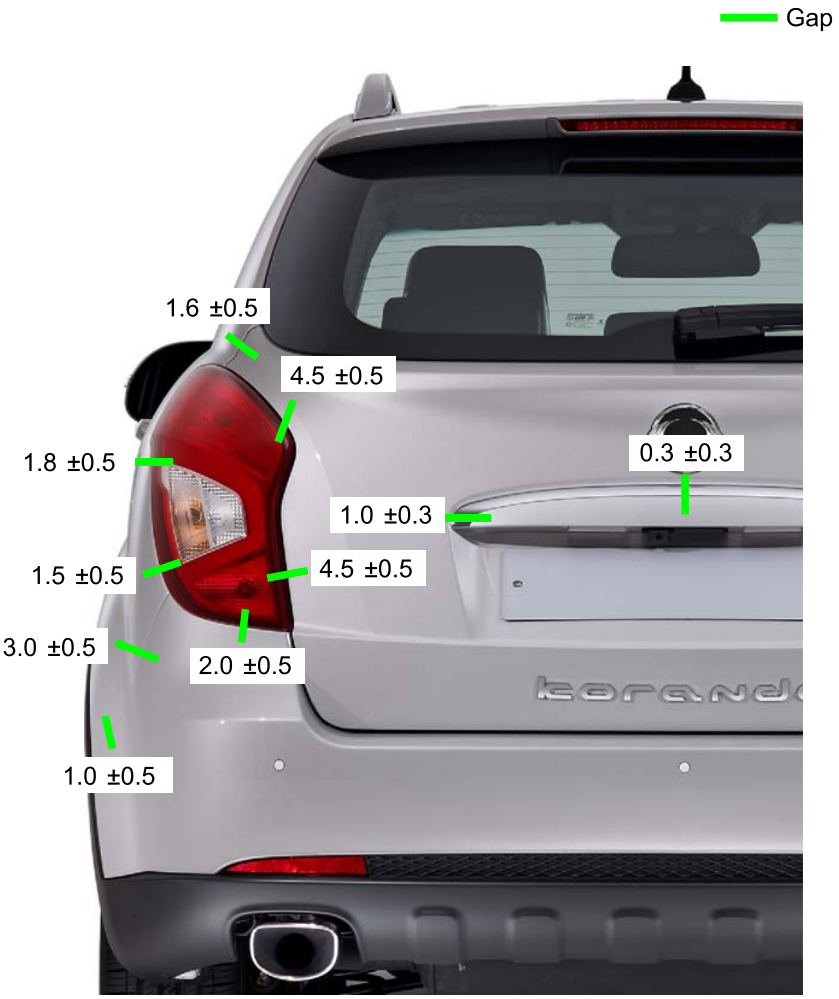
Unit: mm



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3) Rear

Unit: mm



Modification basis	
Application basis	
Affected VIN	

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