SECTION DI0A

GENERAL INFORMATION

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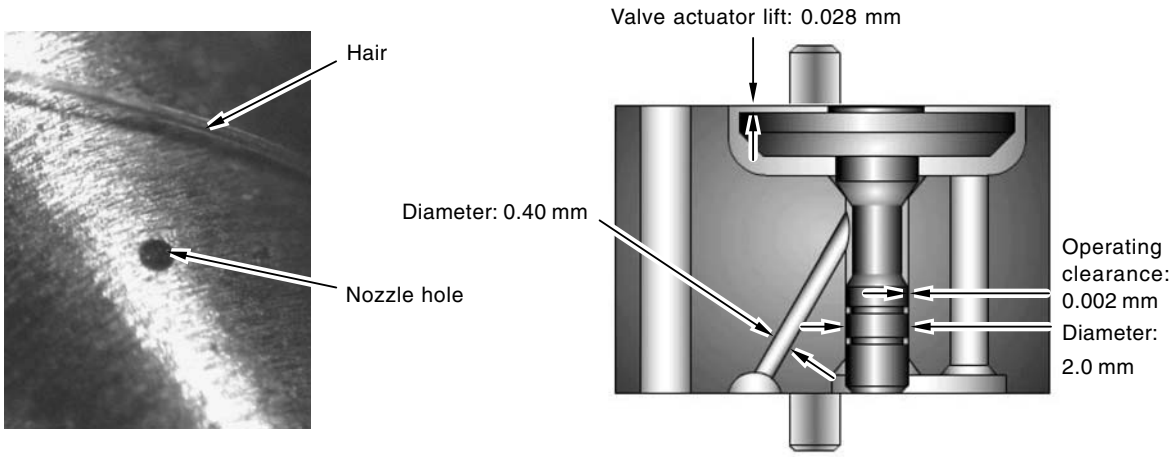
CLEANNESS

Cleanness of DI Engine Fuel System and Service Procedures

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

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



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

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Job procedures

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

Carefully listen the symptoms and problems from customer.

↓

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

↓

Perform the diagnosis proceee with Scan-i
(refer to “DIAGNOSIS” section in this manual).

↓

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

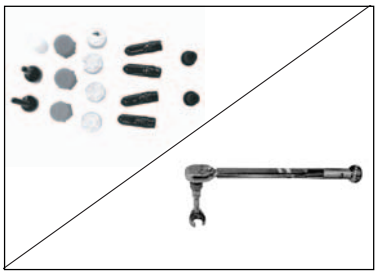
5. If the problem is from HP pump, fuel supply line or injector, prepare the clean special tools and sealing caps to perform the diagnosis for DI engine fuel system in “DIAGNOSIS” section in this manual. At this point, thoroughly clean the related area in engine compartment.

Notice

Clean the engine compartment before starting service works.

Tool kit for high pressure line

Took kit for low pressure line



Removal tool box and cap kits

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

Disconnect the negative battery cable.

↓

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

↓

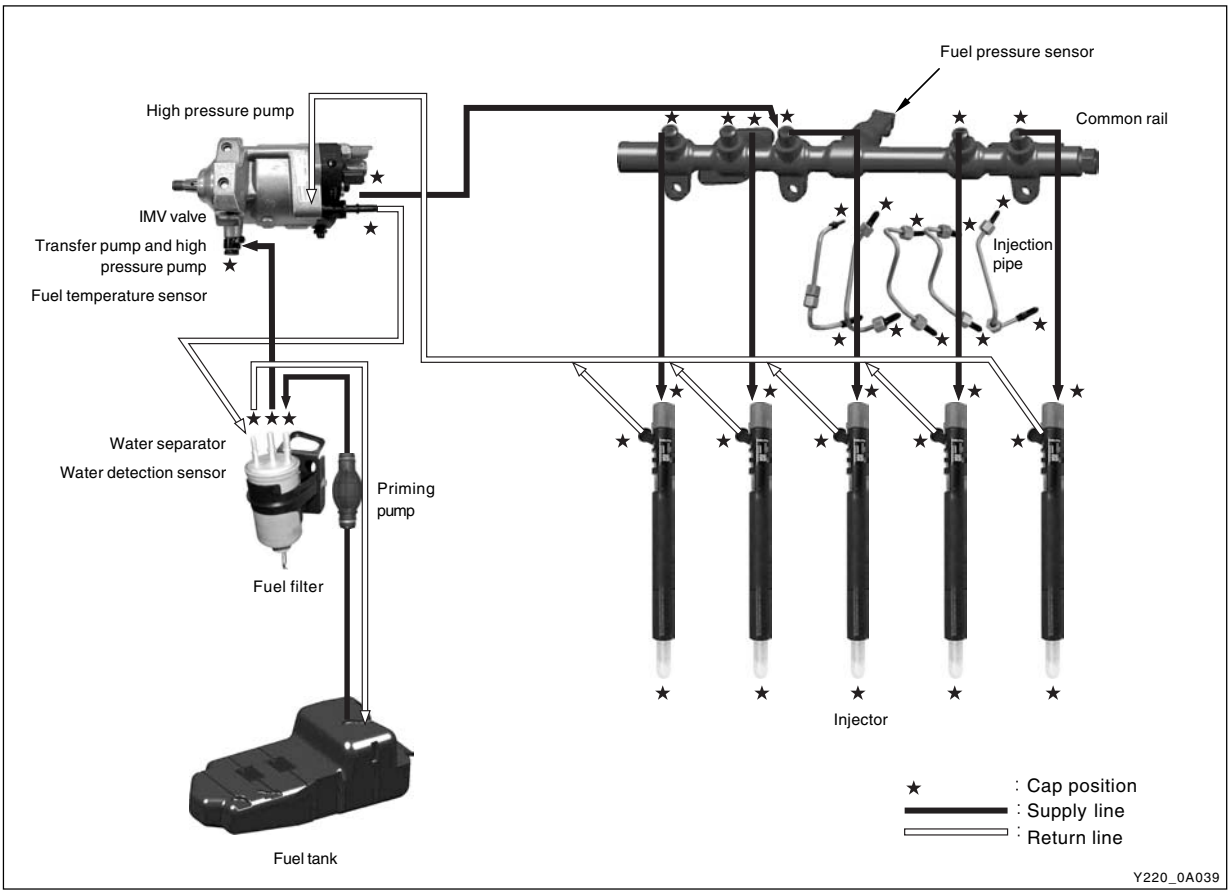
Use special tools and torque wrench to perform the correct works.

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

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

↓

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



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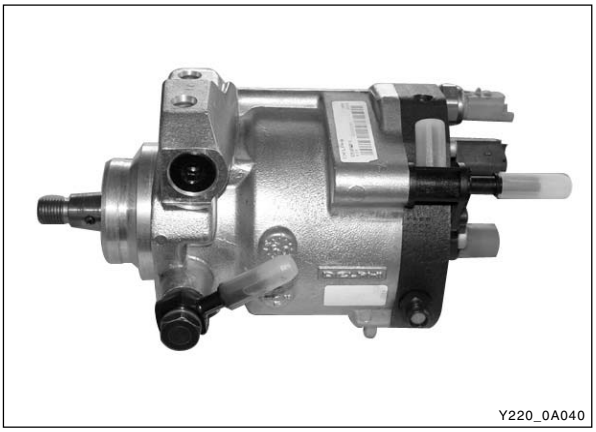
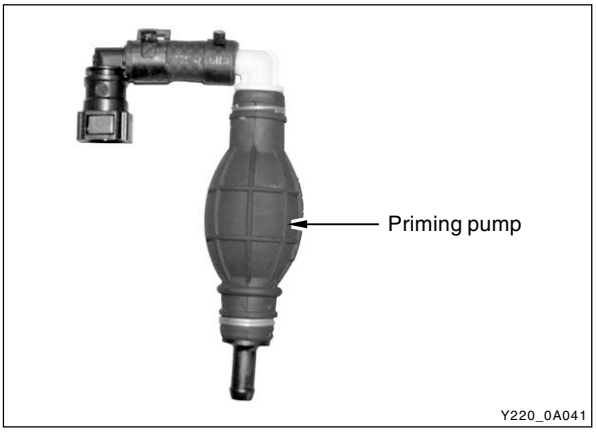

Y220_0A040

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



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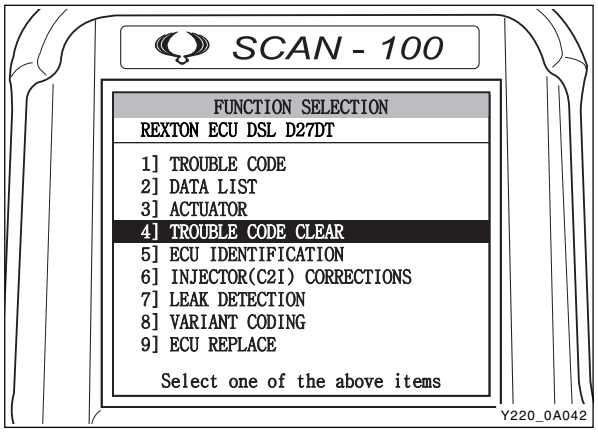
9. To supply the fuel to transfer line of HP pump press the priming pump until it becomes hard.

Warning

Do not crank engine before having filled pump.



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

Note

For details, refer to "DI10 Diagnosis teable".

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.


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

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

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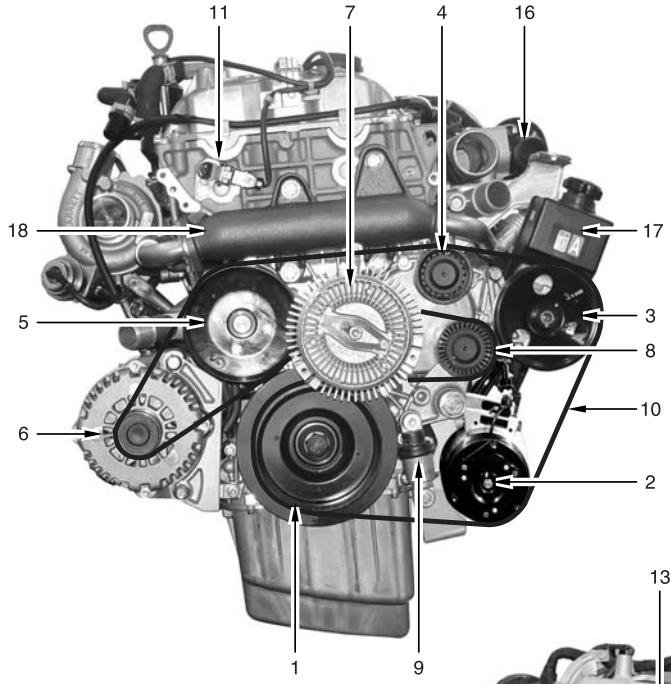
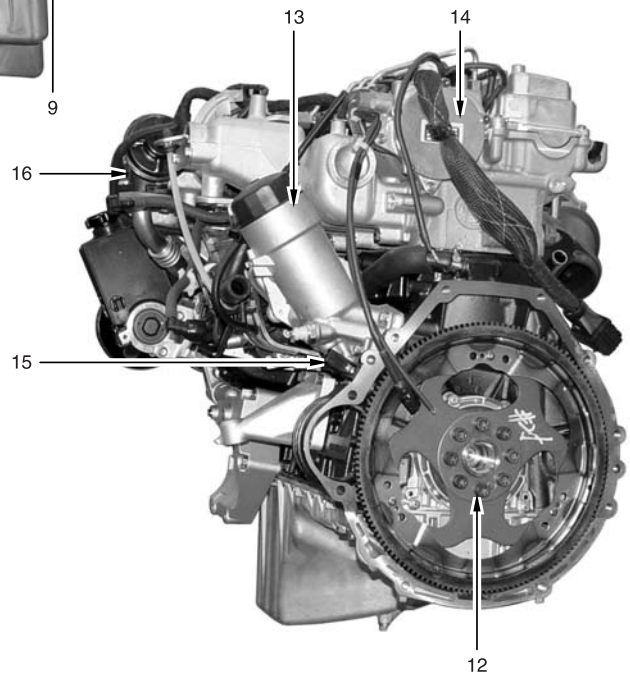
STRUCTURE

Front view



Rear view



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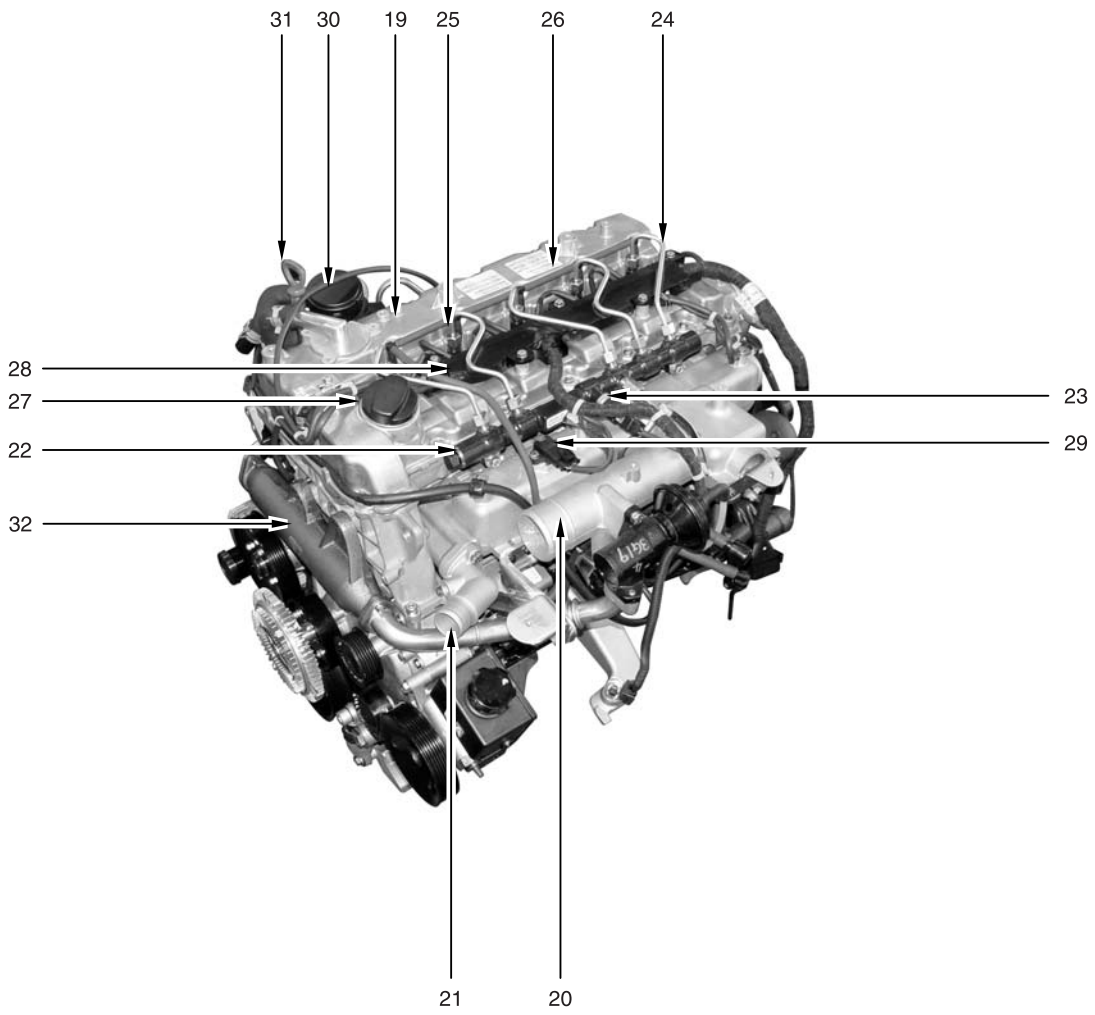
1. TVD (Torsional Vibration Damper)
2. Air conditioner compressor
3. Power steering pump pulley
4. Idle pulley
5. Water pump pulley
6. Alternator
7. Cooling fan pulley & viscos clutch
8. Aut tensioner pulley
9. Auto tensioner
10. Poly-groove belt
11. Cam position sensor
12. Drive plate (M/T: DMF)
13. Oil filter housing
14. Vacuum pump
15. Crank position sensor
16. EGR valve
17. Power steering pump
18. EGR center pipe

Top view



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19. Cylinder head cover
20. Intake manifold
21. Water outlet port
22. Common rail
23. Fuel pressure sensor
24. Fuel pipe
25. Injector
26. Fuel return line
27. Oil filler cap
28. Glow plug
29. Booster pressure sensor
30. Oil separator
31. Oil dipstic
32. EGR center pipe

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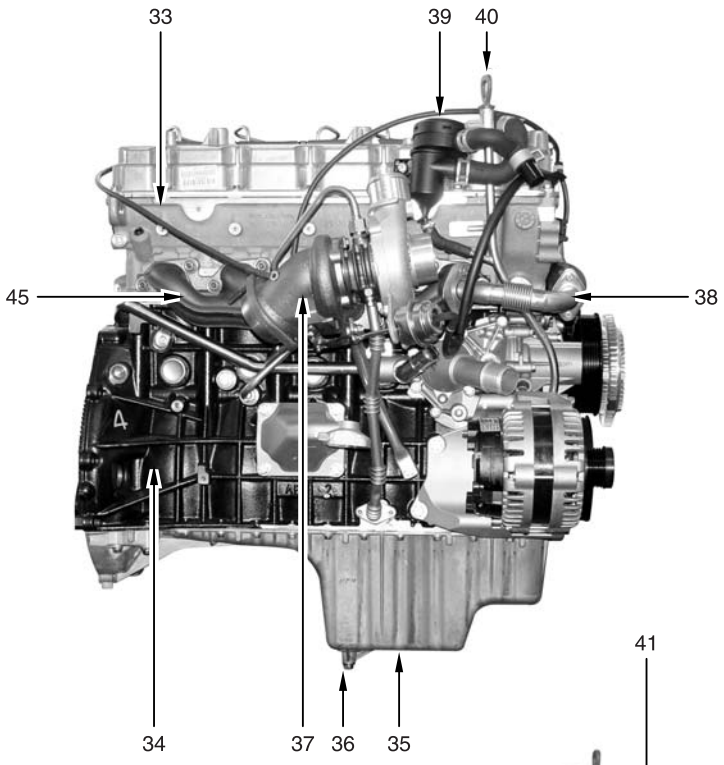
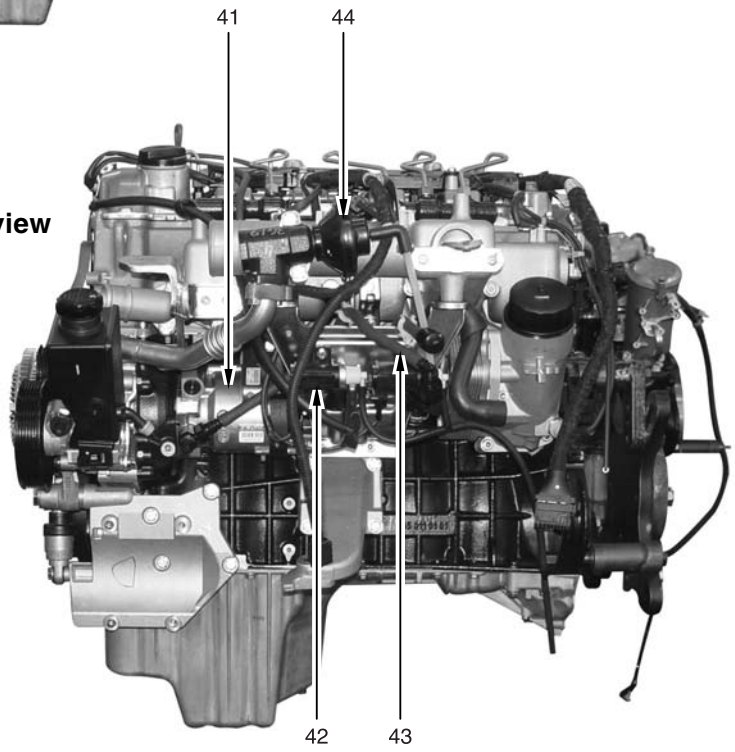
Left side view



Right side view



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33. Cylinder head
34. Cylinder block
35. Oil pan
36. Drain plug
37. Turbocharger
38. EGR - RH pipe
39. Oil separator
40. Oil dipstic
41. HP pump
42. Turbocharger vacuum modulator
43. EGR valve vacuum modulator
44. EGR valve
45. Exhaust manifold

ENGINE CONTROLS

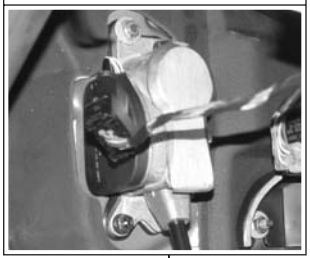
ECU RELATED COMPONENTS

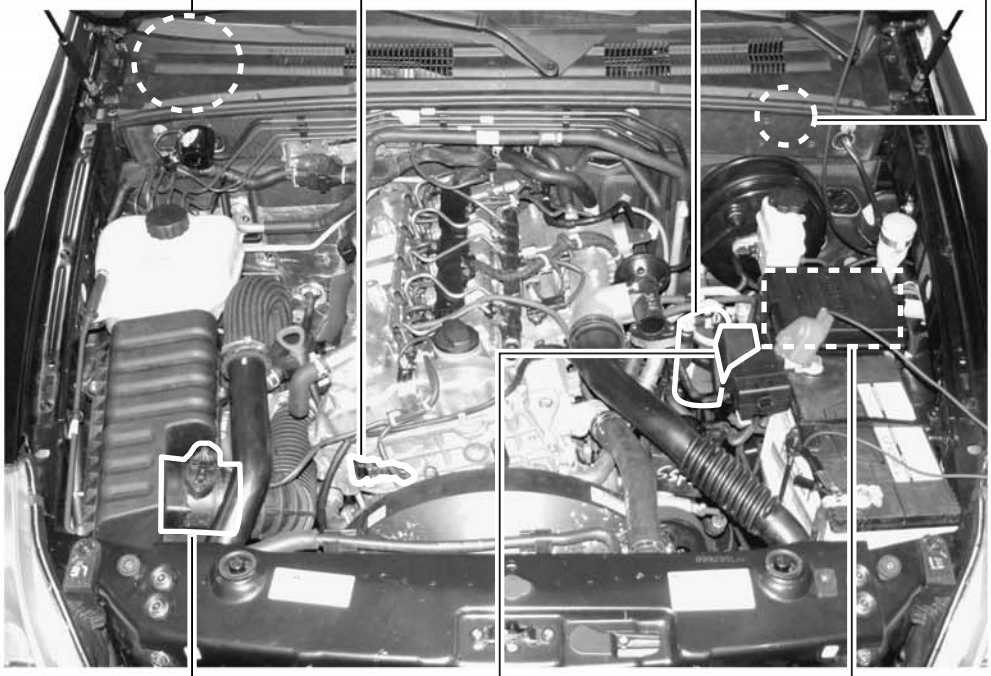
ECU/barometric sensor

Cam position sensor

Fuel filter (water detection sensor)

Accelerator pedal sensor

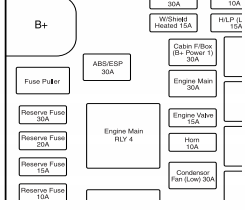




HFM sensor/intake air temperature sensor

Pre heating time relay

Main relay



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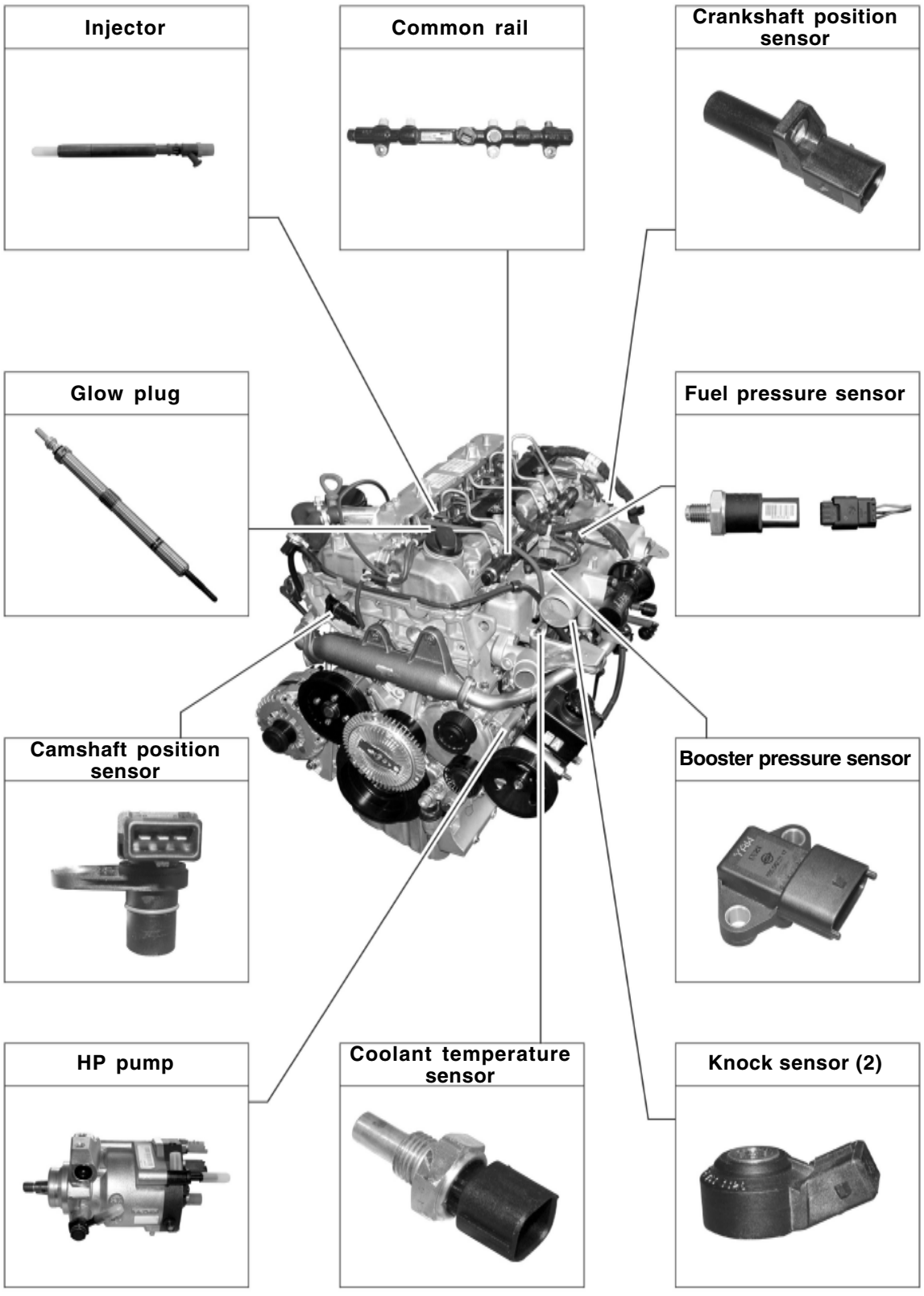
ENGINE AND SENSORS



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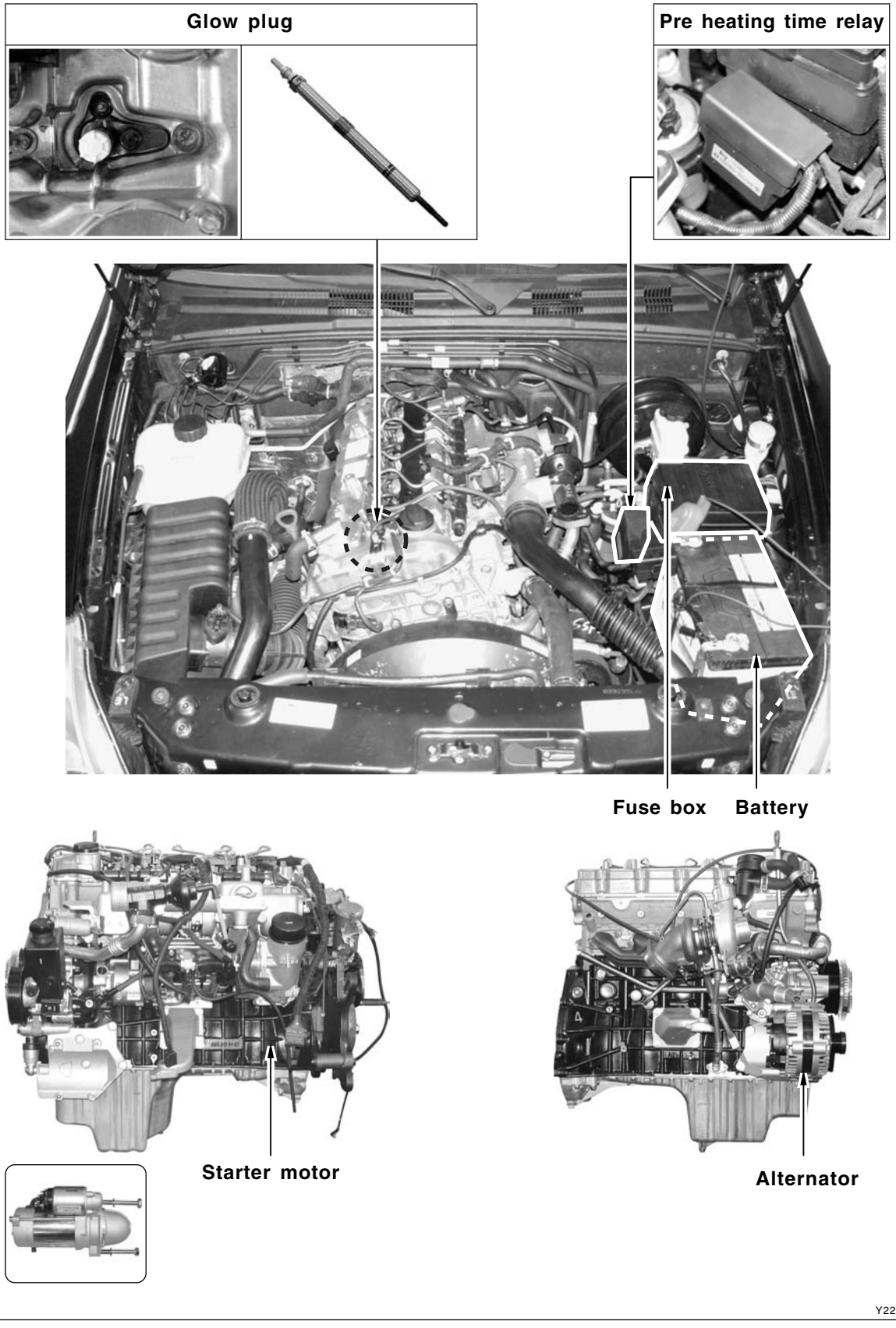
ELECTRICAL COMPONENTS AND PRE HEATING SYSTEM



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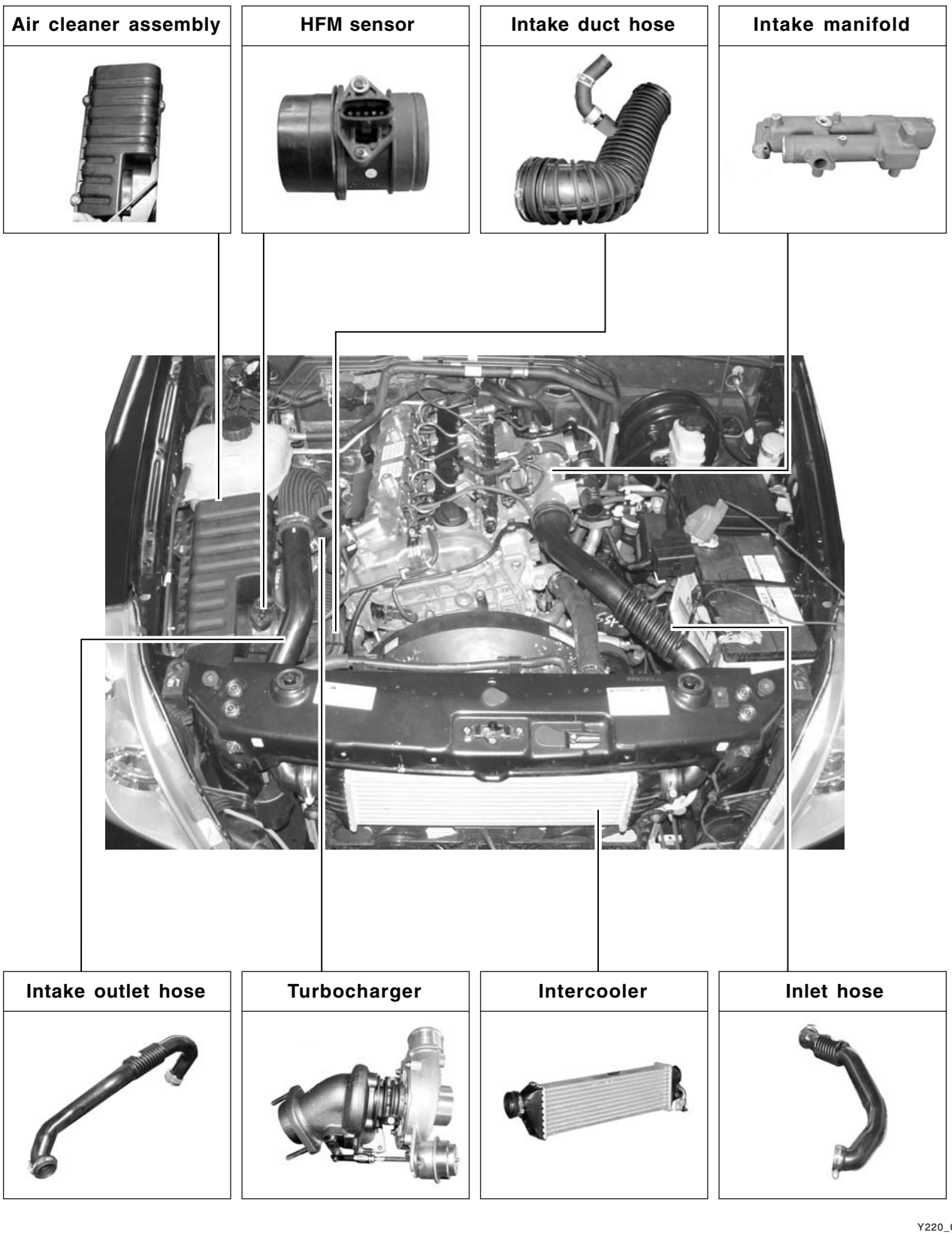
INTAKE SYSTEM



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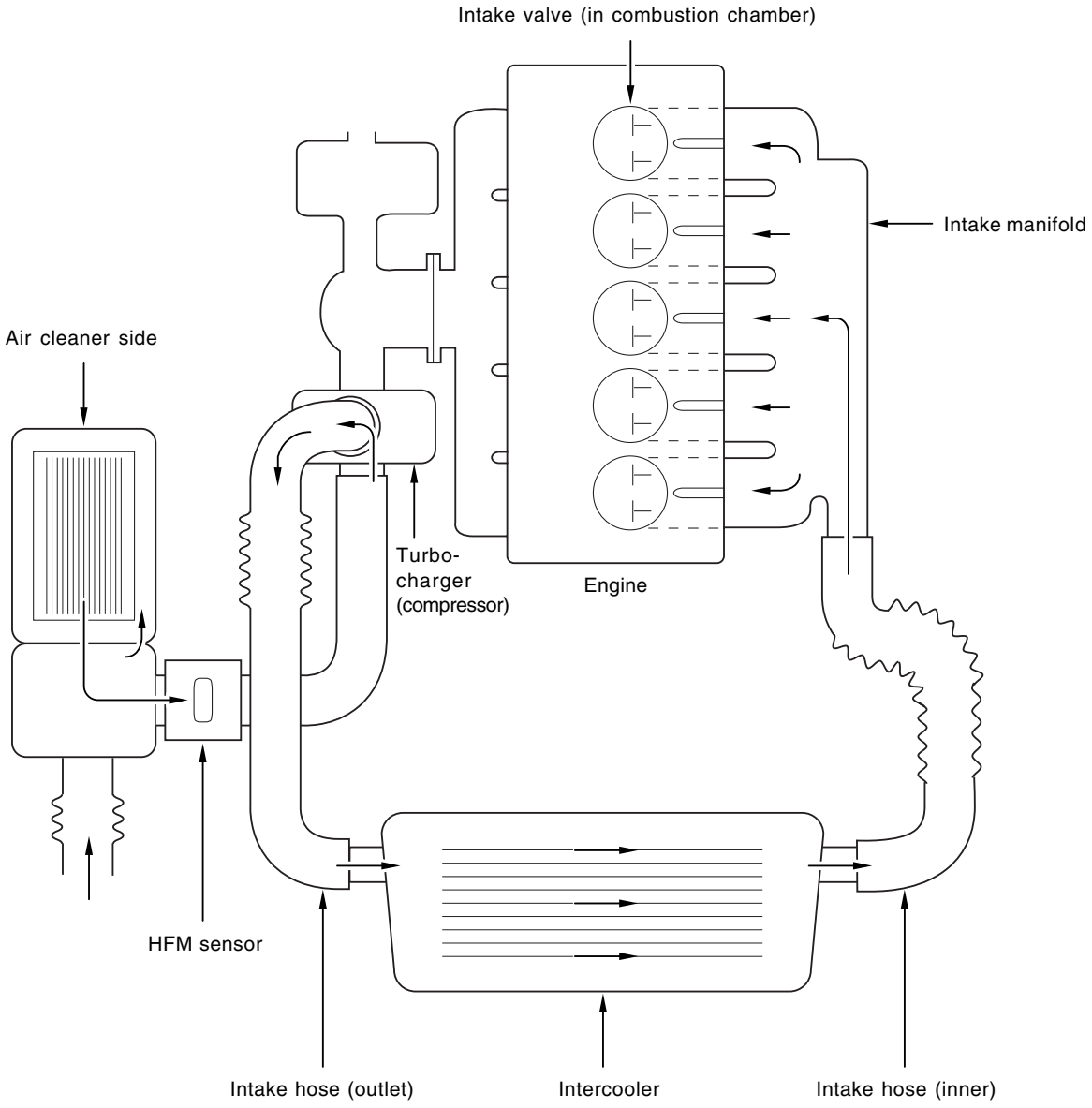
INTAKE AIR FLOW CHART



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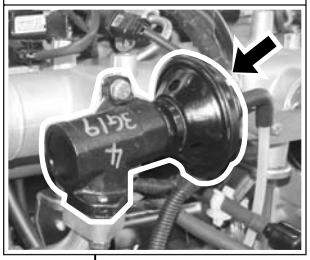
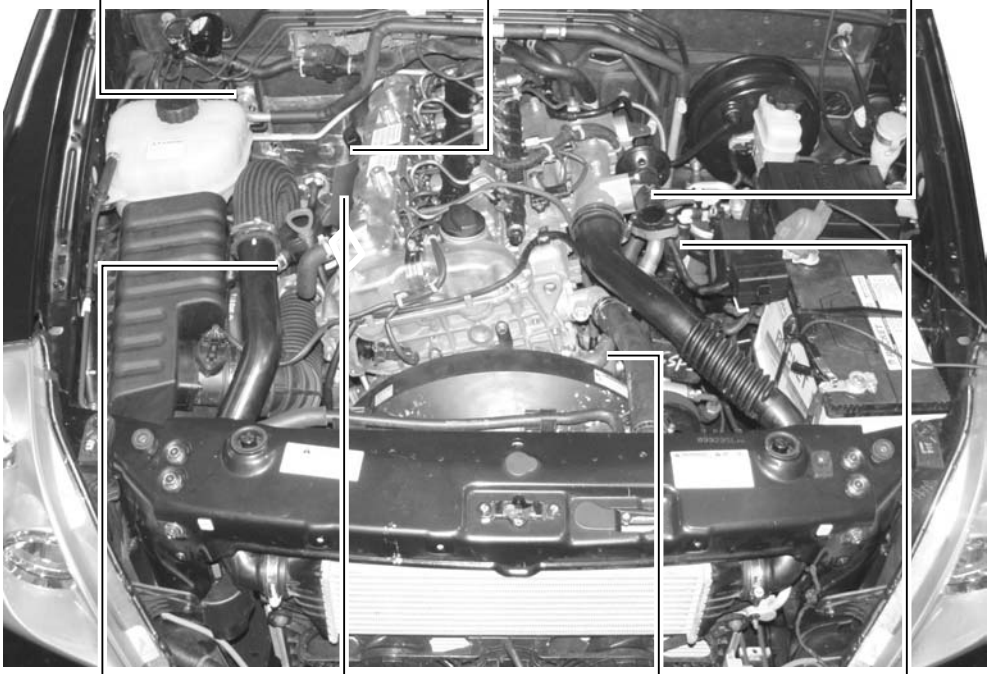
INTAKE SYSTEM

Muffler

Exhaust manifold

EGR valve

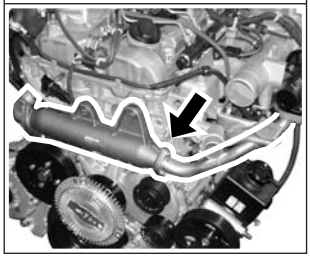




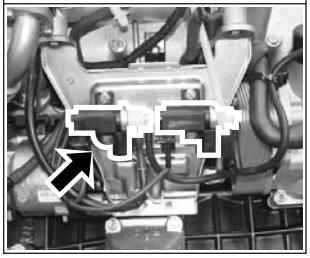
Turbocharger

Catalytic converter

EGR pipe



Vacuum modulator



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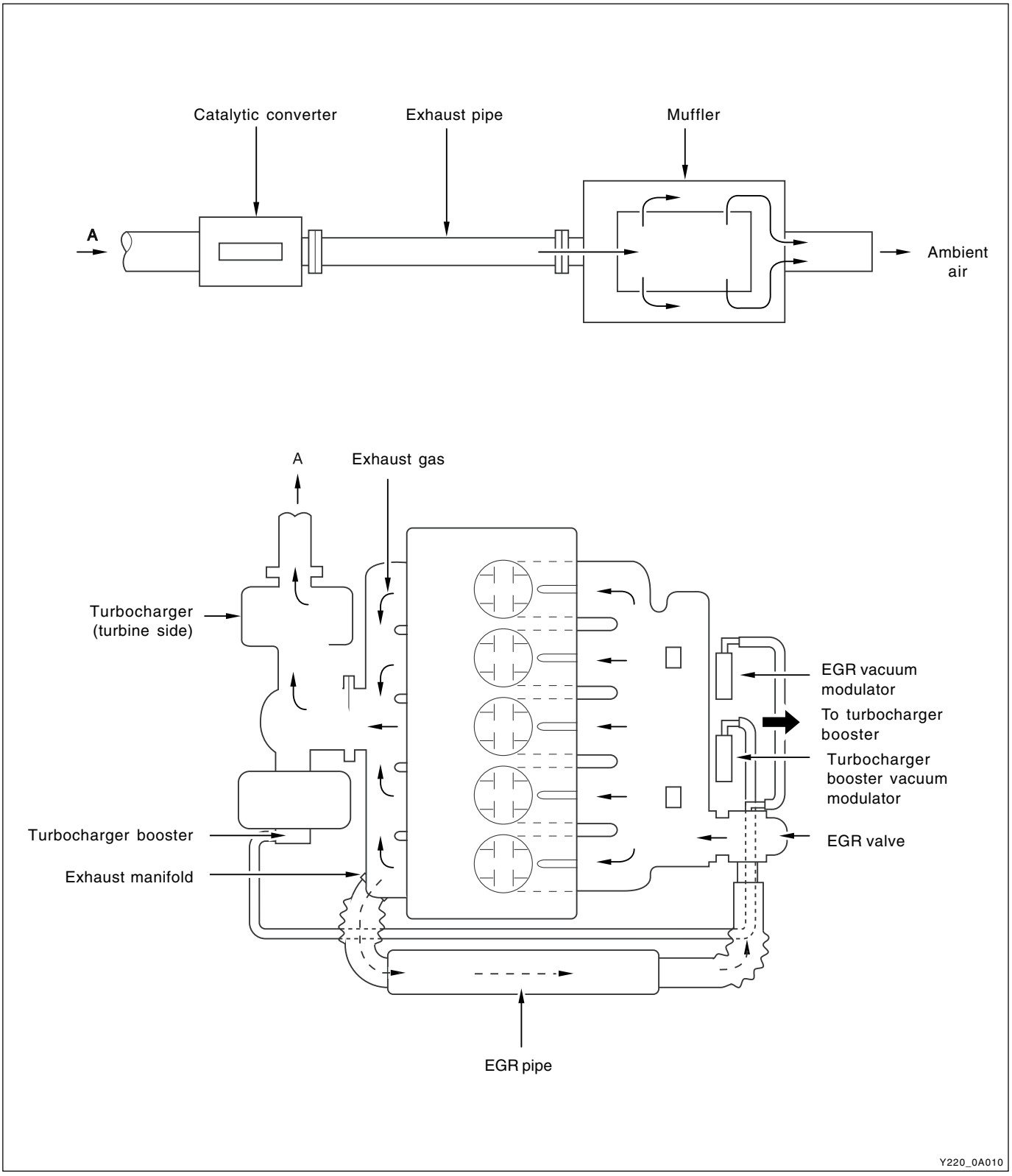
EXHAUST AIR FLOW CHART



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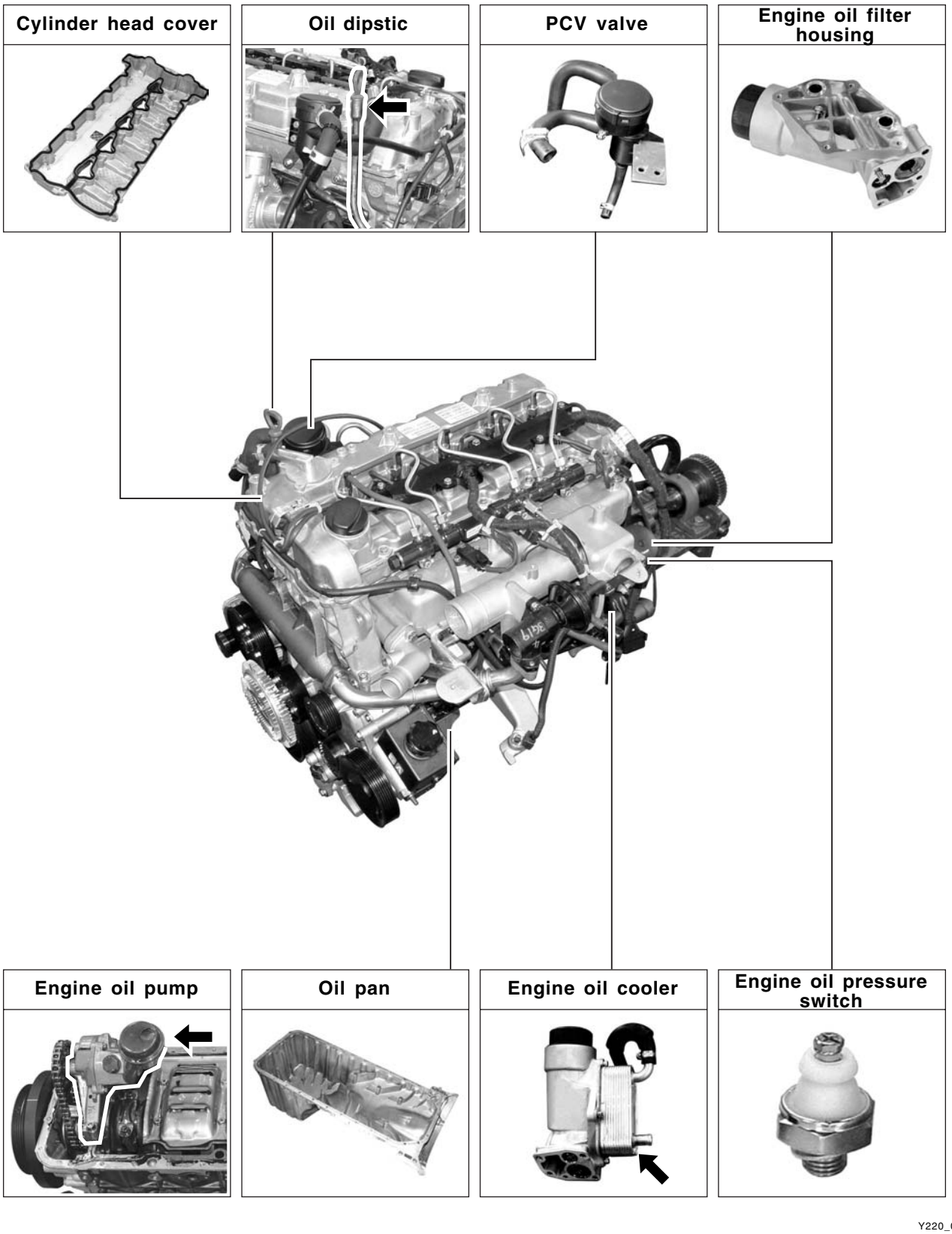
LUBRICATION SYSTEM



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COOLING SYSTEM

Coolant reservoir

Water pump

Radiator assembly

Cooling fan and fan clutch

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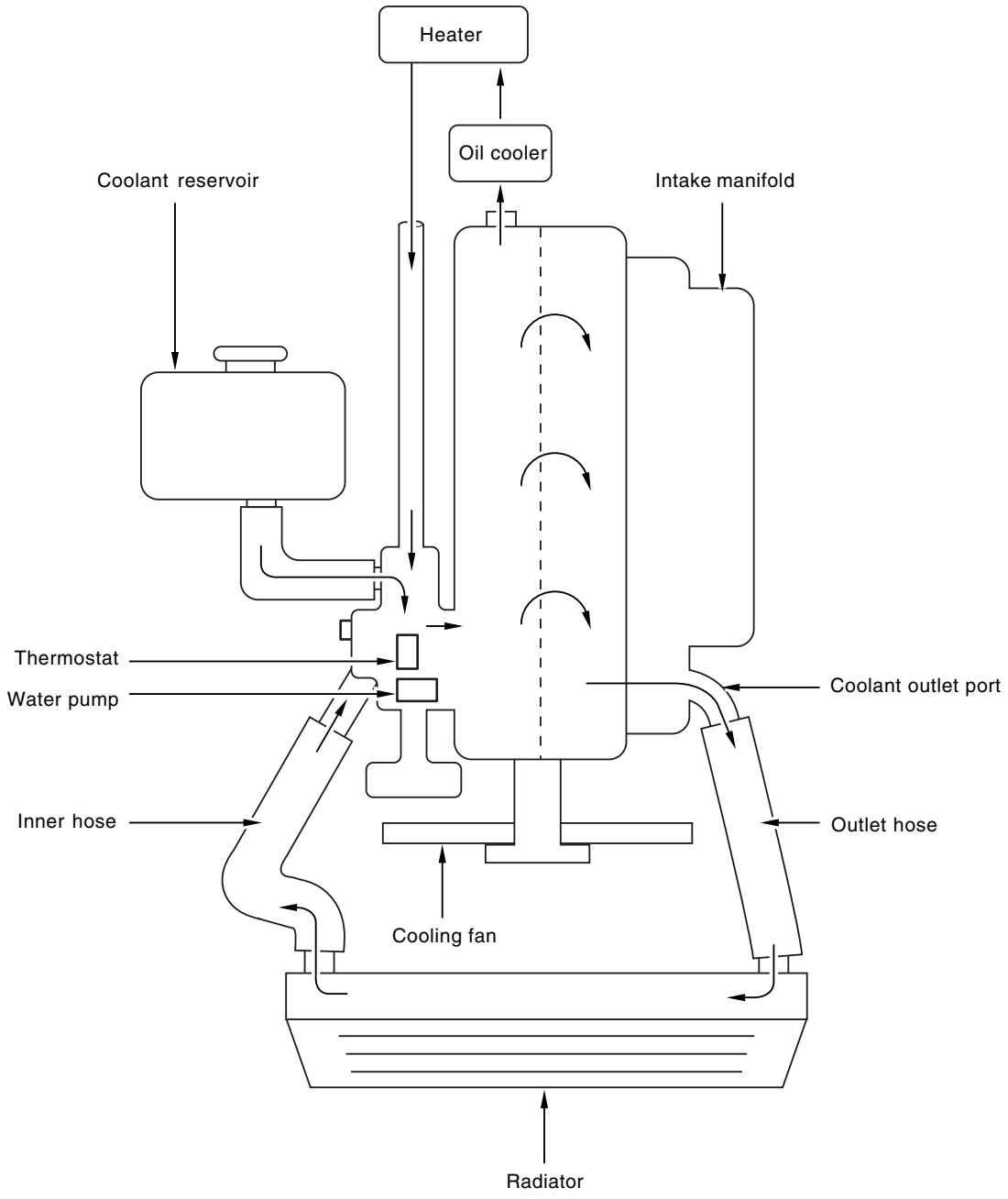
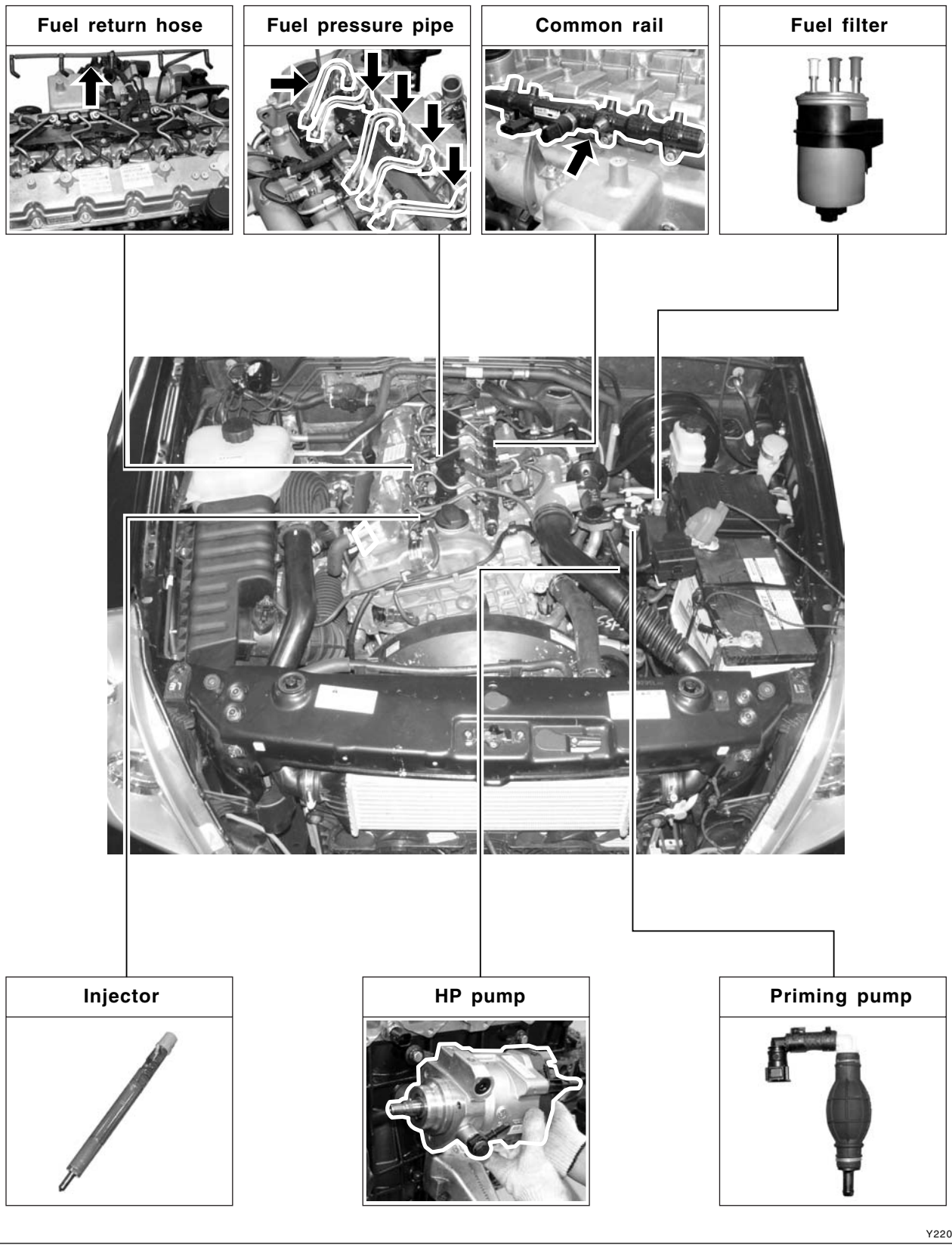
COOLANT FLOW CHART



FUEL SYSTEM



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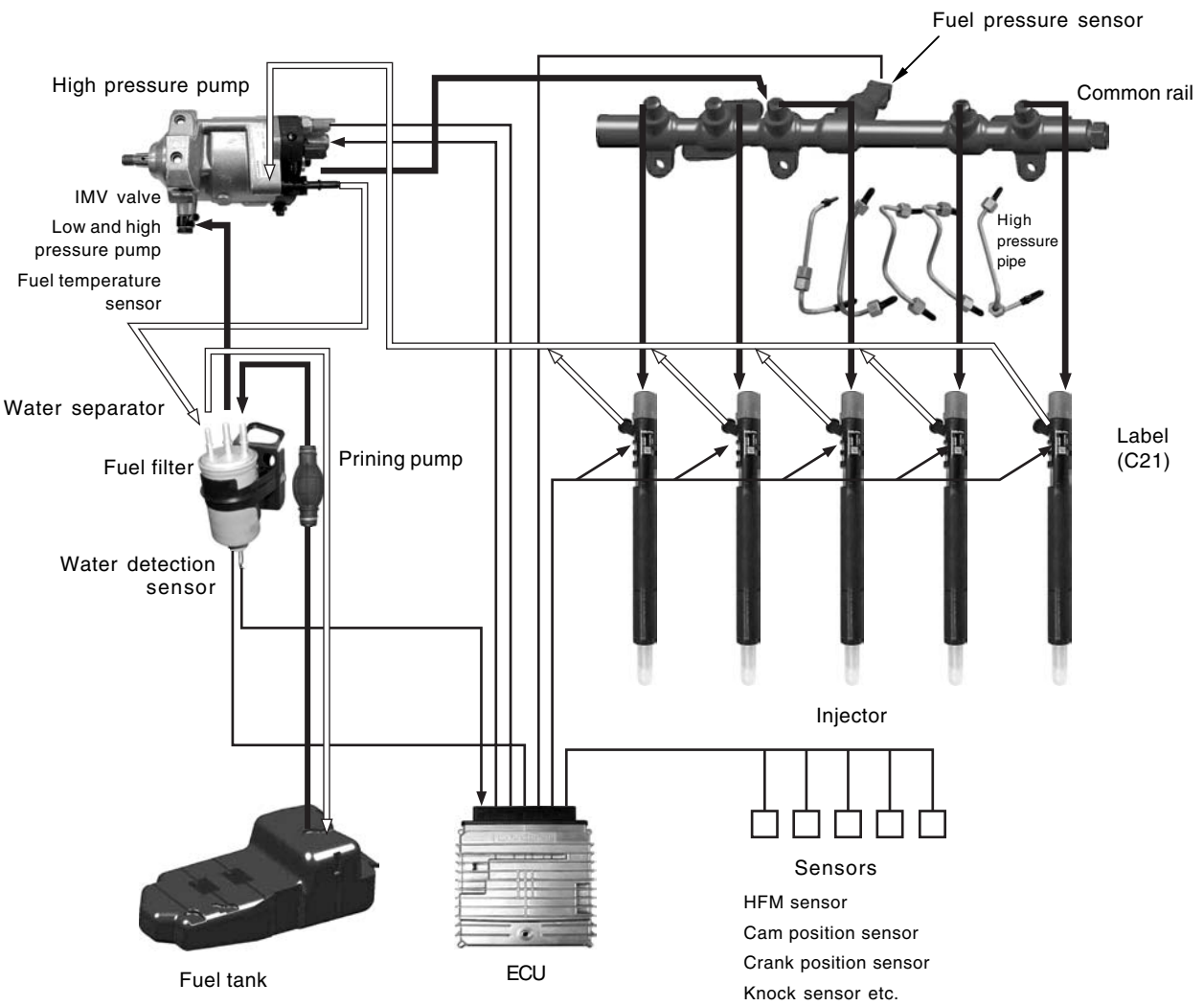
FUEL SUPPLY SYSTEM



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

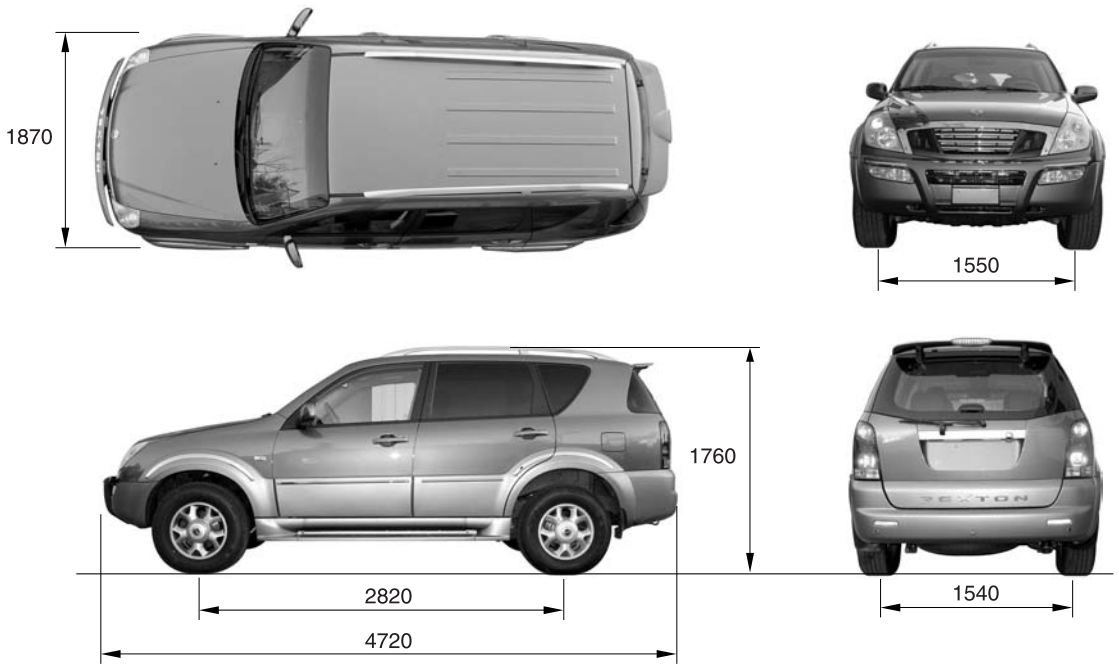
ECU receives signals from sensors via data line and then performs effective engine air-fuel ratio controls based on those signals. Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's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

GENERAL SPECIFICATIONS

VEHICLE SPECIFICATIONS

▶ Vehicle Dimension

(mm)



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▶ Specifications

Systems	Items		Diesel				Remark
General	Overall length (mm)		4,720 (4,785)				( ): optional item
	Overall width (mm)		1,870				
	Overall height (mm)		1,760 (1,830)				
	Gross vehicle weight (kg)		AT: 2450 (2510), MT: 2405 (2465)				
	Curb weight (kg)		AT: 1995 (2055), MT: 1950 (2010)				
	Min. turning radius (m)		5.6				
	Ground clearance (mm)		200				
	Fuel		Diesel				
	Fuel tank capacity		80 ℓ				
Engine	Model		D27DT				
	No. of cyl./Compression ratio		5/18:1				
	Total displacement		2,696 cc				
	Camshaft arrangement		DOHC				
	Max. power		170 ps/4,000 rpm				
	Max. torque		34.7 kg•m/1,800 rpm				
	Injection timing		ATDC 4° ± 1°(at idle)				
	Idle speed		760 ± 50 rpm				
	Cooling system		Water-cooled/forced circulation				
	Coolant capacity		Approx. 11.5 ℓ				
	Lubrication		Gear pump, forced circulation				
	Max. oil capacity		9.3 ℓ				
	Turbo charger and cooling type		Turbo charger, air-cooled				
Manual transmission	Type		Remote control, floor change type				
		1st	IDI Engine	4.007	DI Engine	4.315	
		2nd		2.367		2.475	
		3rd		1.473		1.536	
		4th		1.000		1.000	
		5th		0.872		0.807	
		Rev.		3.700		3.591	
Automatic transmission	Model		Electronic				
	Type		Floor change type				
		1st	2.742		3.595	2.742	
		2nd	1.508		2.186	1.508	
		3rd	1.000		1.405	1.000	
		4th	0.708		1.000	0.708	
		5th	-		0.831	-	
		Rev. 1st	2.429		3.162	2.429	
		Rev. 2nd	-		1.926	-	

▶ Specifications (Cont'd)

Systems	Items		Diesel		Remark
Transfercase	Model		Part-time		( ): optional item
	Type		Planetary gear type		
	Gear ratio	High	1.000 : 1		
		Low	2.483 : 1		
Clutch	Type		Hydraulic [A/T: Torque converter]		
	Disc type		Dry single diaphragm type [A/T: 3 elements 1 stage 2 phases]		
Power steering	Type		Rack and pinion		
	Steering angle	Inner	36° 17′		
		Outer	32° 40′		
Front axle	Drive shaft type		Ball joint type		
	Axle housing type		Build-up type		
Rear axle	Drive shaft type		Semi-floating type		
	Axle housing type		Build-up type		
Brake	Master cylinder type		Tandem type		
	Booster type		Vacuum booster		
	Type	Inner	Disc		
		Outer	Drum (Disc)		
	Parking brake		Cable type (internal expansion)		
Suspension	Front		Wishbone + Coil spring		
	Rear		5-link + Coil spring		
Air conditioner	Refrigerant		R134a		
	Compressor type		Vane type		
Electrical	Battery type/Capacity (V-AH)		MF / 12 - 90		
	Starter capacity (V-kW)		Diesel : 12 - 2.2, Gasoline : 12 - 1.8		
	Alternator capacity (V-A)		IDI	12 - 75 (12 - 90)	
			DI	12 - 140 (12 - 115)	
			Gasoline	12 - 115	

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MAINTENANCE

▶ Major Components and Service Interval

* Use only Ssangyong Genuine Parts.

Components		Daily	Weekly	Service Interval	Remarks
Engine oil and oil filter	Gasoline engine	O	-	Initial change: 10,000 km Replace at every 15,000 km	More frequent maintenance is required if the vehicle is operated under severe condition. **Severe conditions?** - Frequent low-speed operation as in stop-and-go traffic - When most trips are less than 6 km (in winter, less than 16 km) - Driving in sandy, dusty, and salty road - Driving in mountainous areas - Extensive idling or high load operation such as towing a trailer
	DI diesel engine	O	-	Initial change: 5,000 km Replace at every 10,000 km or 12 months	
	IDI diesel engine	O	-		
Coolant		O	-	Replace at every 60,000 km or 3 years	
Brake pipe and hose		-	-	Initial inspection: 1,000 km Inspect at every 20,000 km, replace if necessary	
Brake pad, shoe and disc		-	-	Inspect at every 10,000 km, check or adjust if necessary	
Air cleaner element	Gasoline engine	-	O	Clean at every 15,000 km, Replace at every 60,000 km	If vehicle is operated under dusty or sandy area, frequently clean and inspect the air cleaner system. If necessary, replace the air cleaner element.
	DI diesel engine	-	O	Initial clean: 5,000 km, Clean at every 10,000 km, replace if necessary, Replace at every 30,000 km	
	IDI diesel engine	-	O		
Fuel filter	Gasoline engine	-	-	Replace at every 60,000 km	
	DI diesel engine	-	-	Replace at every 30,000 km (Drain the water from fuel filter at every 10,000 km)	
	IDI diesel engine	-	-	Replace at every 40,000 km	
Auto-matic transmis-sion oil	4-speed	-	-	Inspect at every 30,000 km or 1 year, replace if necessary (replace at every 60,000 km if the vehicle is operated under severe conditions)	More frequent maintenance is required if the vehicle is operated under severe condition. - Driving in unpaved road - Towing a trailer
	5-speed	-	-		
Manual transmission oil		-	-	Inspect at every 10,000 km, Replace at every 60,000 km	
Transfer case oil		-	-	Inspect at every 10,000 km, Replace at every 60,000 km (but, frequently chexk the leaks)	
Axle oil		-	-	Replace at every 30,000 km	
Air conditioner air filter		-	-	Replace at every 10,000 km	More frequent maintenance is required if the vehicle is operated under severe condition. - Driving in sandy, dusty, and unpaved road - Excessive operation of air conditioner or heater
Spark plug (gasoline engine)		-	-	Replace at every 60,000 km	

▶ Lubrication Chart

Lubricant		Capacity		Classification	
Engine oil	Diesel	IDI Engine	6.0 ~ 8.0 L	Quality class**	API : CG grade or above, ACEA : B2, B3 or B4 MB sheet : 229.1/3 (preferable)
		DI Engine	6.8 ~ 8.3 L		
				Viscosity	MB sheet No. 224.1
	Gasoline	G23D	5.5 ~ 7.5 L	Quality class**	API : SJ grade or above, ACEA : A2 or A3 MB sheet : 229.1/3 (preferable)
		G32D/G28D	7.0 ~ 9.0 L		
				Viscosity	MB sheet No. 224.1
Engine coolant (Antifreeze and soft water mixed)		IDI Engine	10.5 ~ 11.0 L	MB sheet 325.0	
		DI Engine	11.0 ~ 12.0 L		
		G23D	10.0 ~ 10.5 L	BASF GLYSANTIN G05-11,	
		G32D/G28D	11.3 ~ 11.5 L	HOECHST GENANTIN SUPER 8023/14	
Manual transmission oil		4WD: 3.6 L, 2WD: 3.4 L		ATF DEXRON® II, III, ATF S-2, S-3, S-4, TOTAL FLUID ATX	
Brake/Clutch fluid (Level must be maintained between MAX & MIN level)		Properly		SAE J 1703, DOT 3 or DOT 4	
Power steering fluid		1.1 L		ATF DEXRON® II, III	
Automatic transmission fluid		4-speed: 9.5 L		CASTROL TQ 95	
		5-speed: 8.0 L		SHELL or FUCHS ATF 3353	
Transfer case fluid	IDI Engine	Part time	1.2 ~ 1.4 L	ATF DEXRON® II, III,	
	DI Engine	Part time	1.4 ~ 1.5 L		
		Full time(TOD)	1.4 ~ 1.5 L	ATF S-4, TOTAL FLUID ATX	
	Gasoline	Full time(TOD)	1.4 ~ 1.5 L		
Axle fluid	Front	1.4 ~ 1.5 L		SAE 80W/90, API GL-5	
	Rear	2.2 L			
Wheel bearing grease		Properly		SHELL Retinax “A” grade	
Propeller shaft grease - Front/Rear		Properly		ALVANIA EP#2	

* Please contact Ssangyong Dealer for approved alternative fluid.

** In only case not available MB 229.1 or 229.3, API or ACEA oil may be accepted, however it would rather recommend to shorten the change interval around 30%.

IDI: Indirect Injection

DI: Direct Injection

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VEHICLE IDENTIFICATION

1. Vehicle identification Number

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

[KPTPOA19S1P 122357]

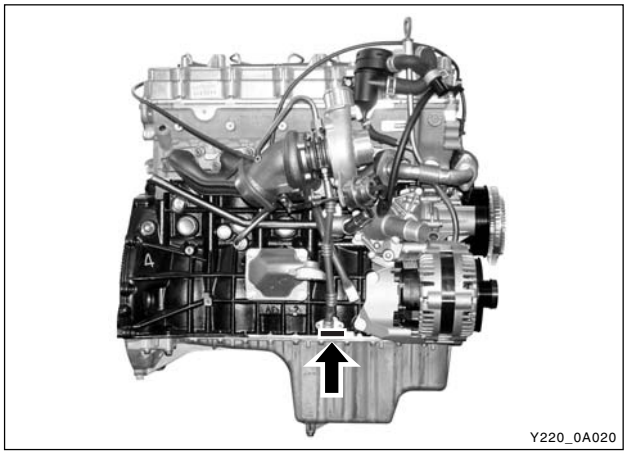
K .. Nation	(K: Korea)
P .. Maker Identification	(P: Ssangyong Motor Company)
T .. Vehicle Type	(T: Passenger car - 4WD)
P .. Line Models	(P: Rexton)
O . Body Type	(O: 5-door)
A .. Trim Level	(A: Standard, B: Deluxe, C: Super deluxe)
1 .. Restraint System	(0: No seatbelts, 1: 3-point seatbelts, 2: 2-point seatbelt)
9 .. Engine Type	(9: 3199cc, In-line 6 cylinders, Gasoline E32) (D: 2874cc, Il-line 5 cylinders, Diesel)
S .. Check Digit	(S: All area except North America)
1 .. Model Year	(1: 2001, 2: 2002, 3: 2003)
P .. Plant Code	(P: Pyungtaek plant)
122357	(Production serial number)

2. Certification Label

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

3. Engine Serial Number

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

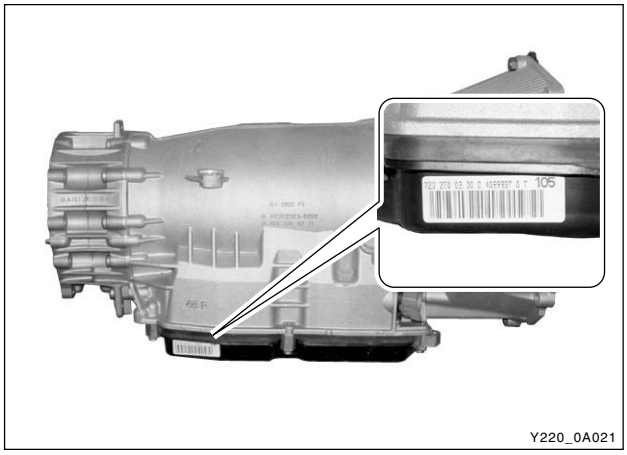


4. Manual Transmission Number

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

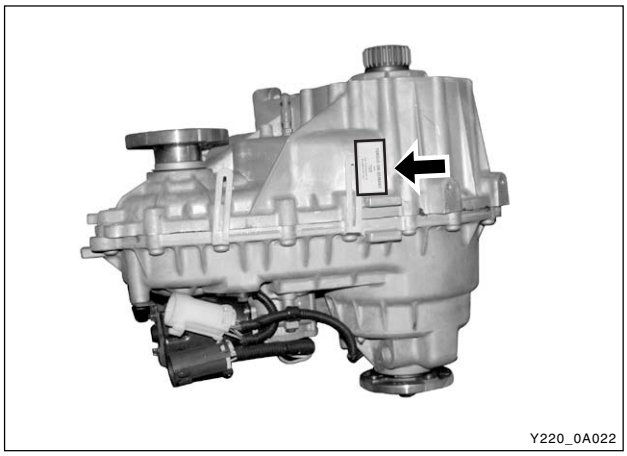
5. Automatic Transmission Number

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



6. Transfer Case Number

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



HOW TO USE AND MAINTAIN WORKSHOP MANUAL

CONSISTS OF WORKSHOP MANUAL

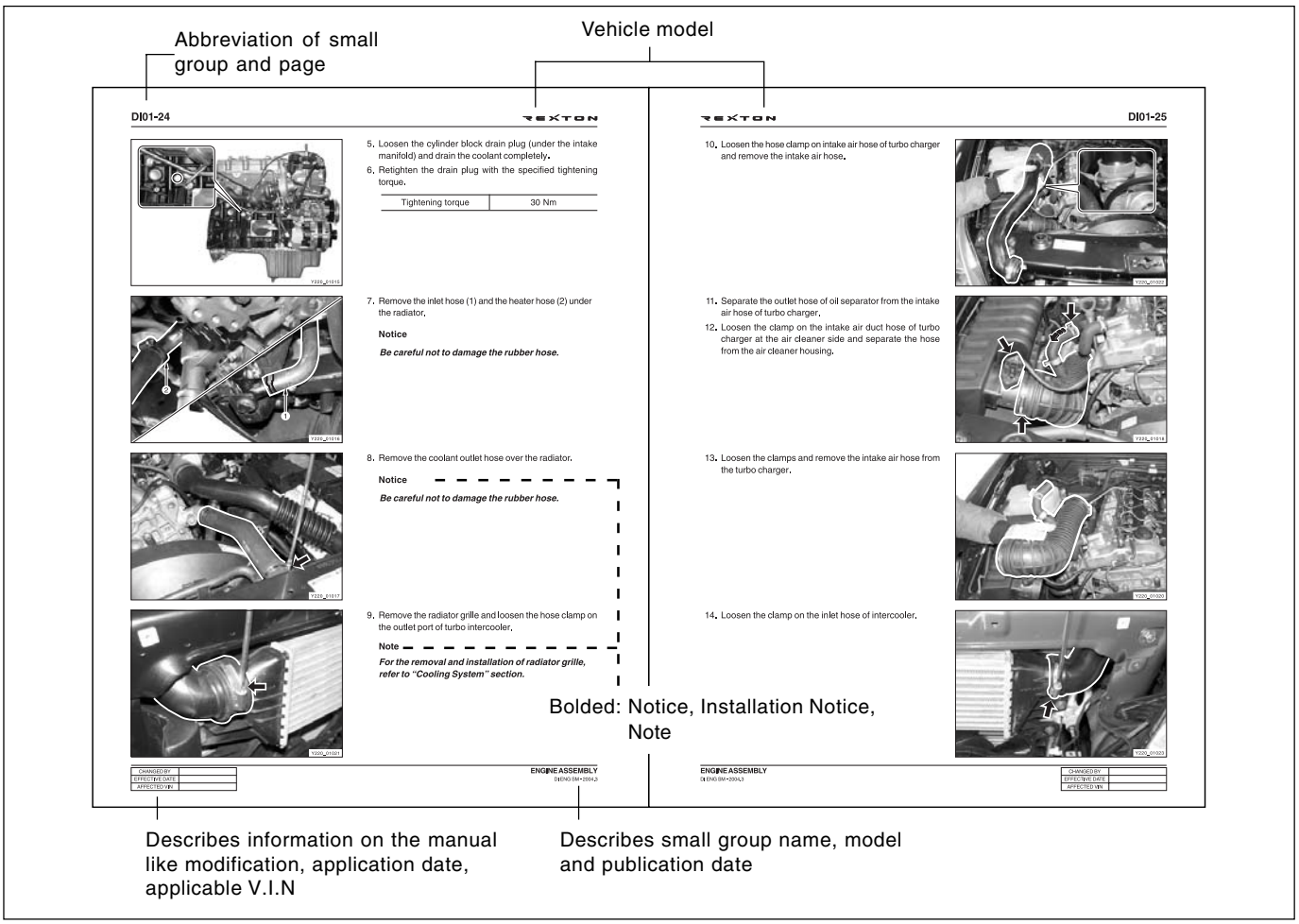
1. Group: The manual is divided in large group like engine, transmission, axle and others and this group is also divided in small group by vehicle state.
2. Small group: Each small group consists of general, vehicle service, unit repair and special tool usage.

MANUAL DESCRIPTION

- The contents of the manual consist of operational principle of system, specifications, diagnosis, removal/ installation on vehicle, inspections, disassembly/ assembly of removed assembly, special tool usage. Not providing simple removal/installation information but focused on to describe much more functions, roles and principles of system.
- Every automotive term like part name on the manual is the same in parts catalog, technical bulletin and drawings to avoid confusion among them.

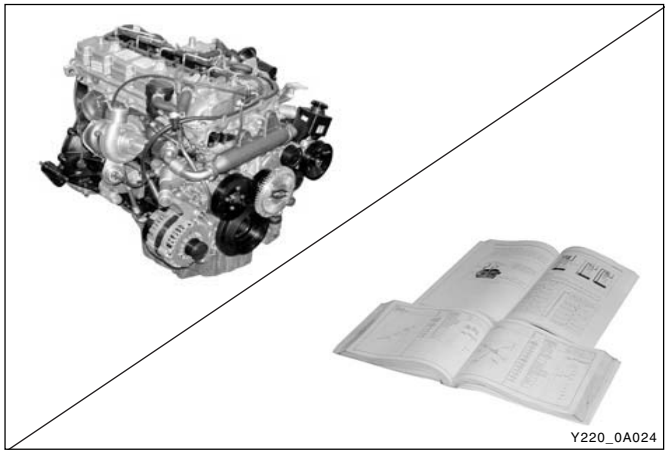
▶ Consists of Small Group

1. **Contents:** In small group, included subjects and detailed subjects are described in.
2. **General:** In the general, summary of the small group (assembly), function and operational principle, specifications, structure and components, diagnosis and circuit diagram are described in.
3. **Vehicle service:** Service works on the vehicle like replacement of parts and inspection repairs are described in the order of repair works with actual photos and illustrations. Also cautions in service works, references and inspection methods after completion of service are described in.
4. **Disassembly and assembly of unit assembly:** Detailed service works like disassembly, inspection, adjustment and assembly on removed component (assembly) are described in with systematic contents and photo illustration.



GUIDELINES FOR SERVICE WORK SAFETY

▶ General



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

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

Note, Notice

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

Note

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

Notice

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

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

▶ Cautions on Inspection/Service

Notice

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

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

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▶ 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

- 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.
- Always position the ignition switch to OFF if not required. If not, there can be electrical equipment damages or personal injuries due to short-circuit or ground by mistake.
- There should be no leak from fuel injection system (HP pump, fuel hose, high pressure pipe) of the D27DT engine. So they should be protected from foreign materials.
- While removing the engine, do not position the jack and others under the oil pan or engine. To secure the safety, use only safety hook on the engine.

Engine and accessories

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

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

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

Fuel and lubrication system

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

- If work on the fluid system such as fuel and oil, working area should be well ventilated and mechanic should not smoke.
- Gasket or seal on the fuel/lubrication system should be replaced with new 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 between HP pump and injectors. So, be sure to cover removed fuel system components with cap and protect removed parts not to be contaminated with dirt. (Refer to cleanness in this manual while working on DI engine fuel system)

Electrical equipment

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

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

During Service Work - Inspection

1. Before lifting up the vehicle with lift, correctly support the lifting points and lift up.
2. When using a jack, park the vehicle on the level ground and block front and rear wheels. Position the jack under the frame and lift up the vehicle and then support with chassis stand before service work.

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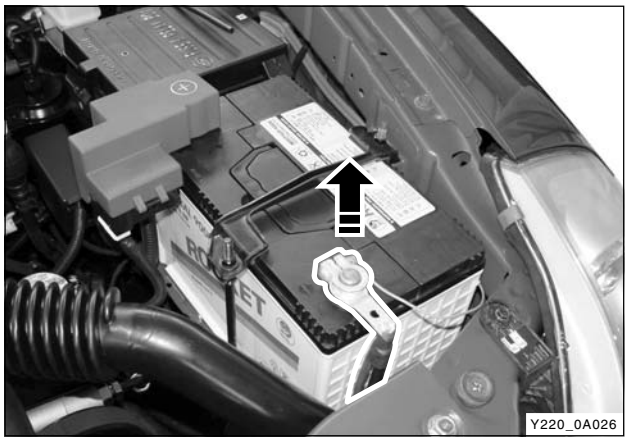
3. Before service work, be sure to disconnect battery negative (-) terminal to prevent damages by bad wire and short.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4. If service from interior of the vehicle, use protection cover to prevent damage and contamination of seat and floor.
5. Brake fluid and anti-freeze can damage painted surface of body. So carefully handle them during service work.


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

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

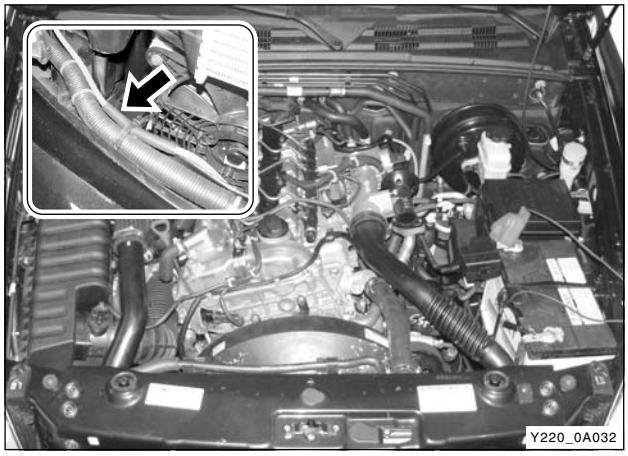
   If reused, normal functions cannot be maintained.
9. Align the disassembled parts in clean according to disassembling order and group for easy assembling.
10. According to installing positions, the bolts and nuts have different hardness and design. So be careful not to mix removed bolts and nuts each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

During Service Work for Electric Devices

Notice

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

1. Be sure to disconnect battery negative (-) terminal during every service work. Before disconnecting battery negative (-) terminal, turn off ignition key.
2. Replace with specified capacity of fuse if there is bad, blown or short circuited fuse. If use electrical wire or steel wire other than fuse, there can be damages on the various electrical systems. If replaced with over-capacity fuse, there can be damages on the related electrical device and fire.
3. Every wire on the vehicle should be fastened securely not to be loosened with fixing clip.
4. If wires go through edges, protect them with tape or other materials not to be damaged.



5. Carefully install the wires not to be damaged during installation/removal of parts due to interference.
6. Be careful not to throw or drop each sensor or relay.
7. Securely connect each connector until hear a “click” sound.

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LIFTING POINTS

▶ Lifting Positions

1. 4-post lift

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

Notice

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

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

Warning

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

2. Safety jack and safety stand

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

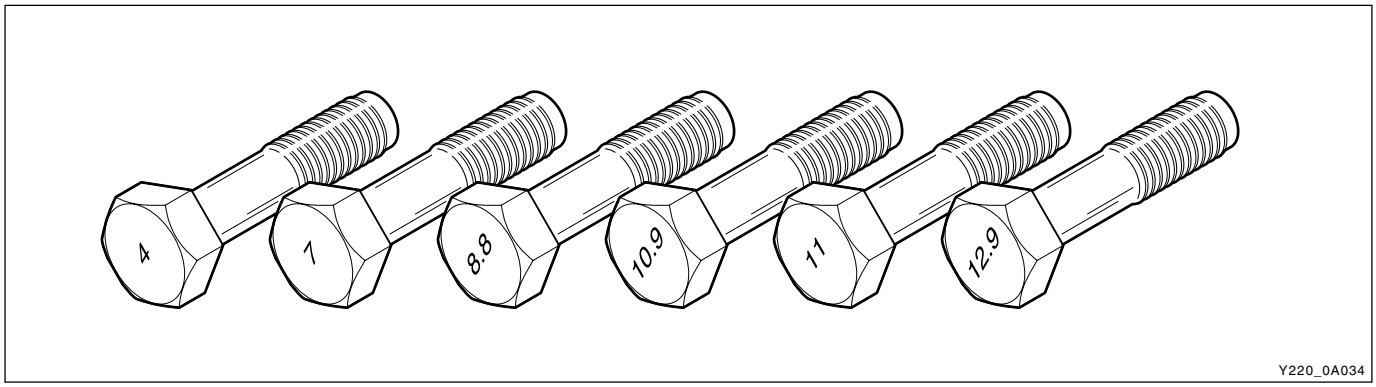
Warning

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

TIGHTENING TORQUE OF STANDARD BOLTS

▶Tightening Torque By Bolt Specification

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



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

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SECTION DI01

ENGINE ASSEMBLY

Table of Contents

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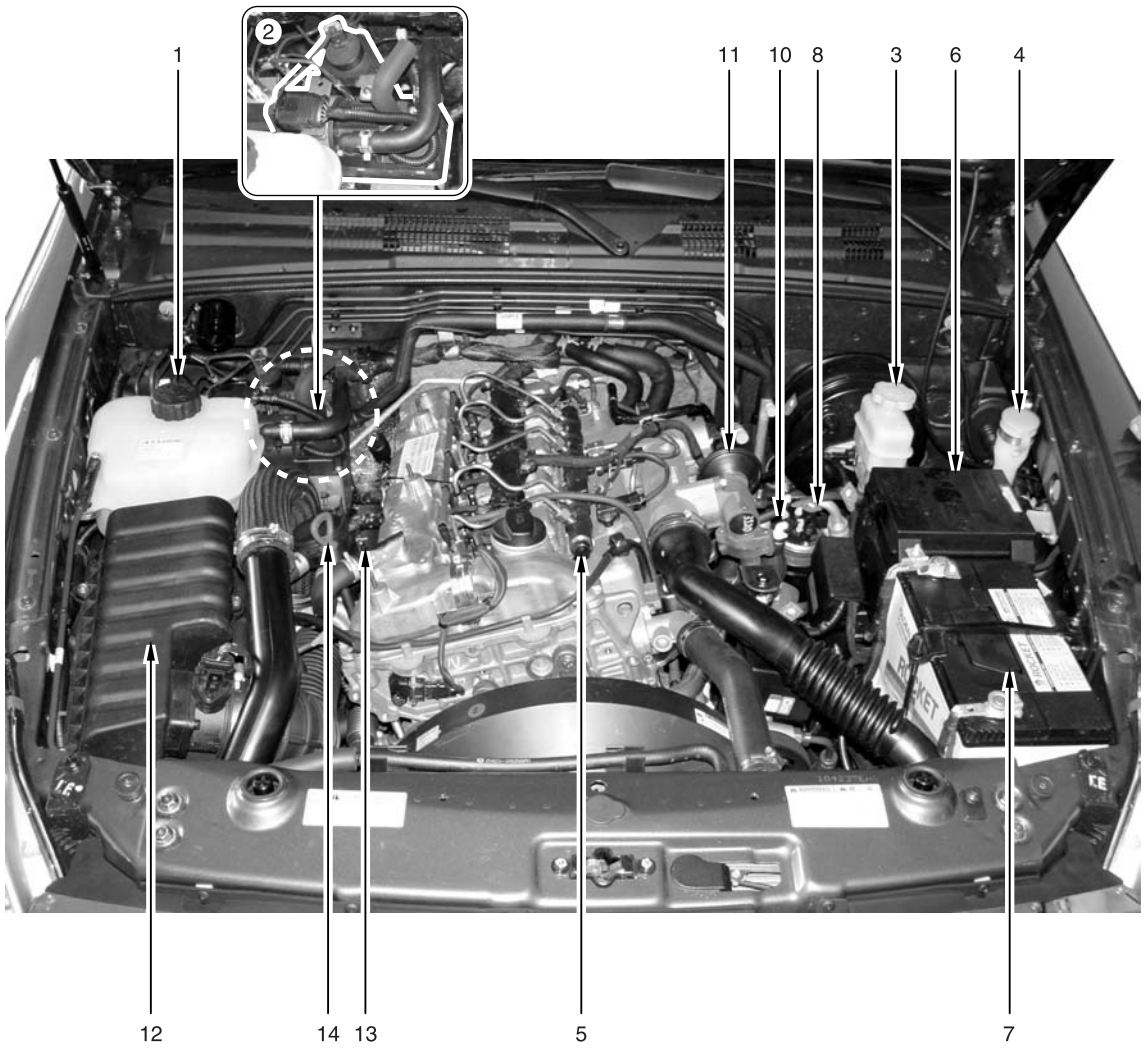
STRUCTURE AND FUNCTION DESCRIPTIONS

D27DT ENGINE

▶ Major Components in Engine and Engine Compartment

The advanced electronically controlled D27DT engine that has high pressure fuel system has been introduced to this vehicle. It satisfies the strict emission regulation and provides improved output and maximum torque.



1. Coolant reservoir
2. FFH device
3. Brake fluid reservoir
4. Washer fluid reservoir
5. Common rail
6. Fuse box
7. Battery
8. Fuel filter
9. Power steering pump
10. Priming pump
11. EGR valve
12. Air cleaner assembly
13. Turbo charger
14. Oil dipstick

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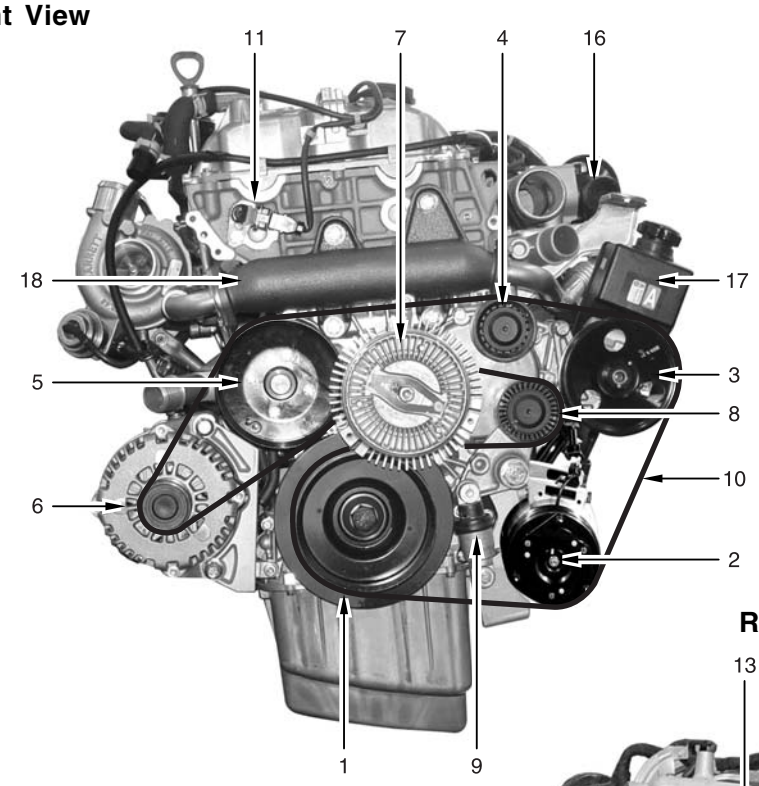
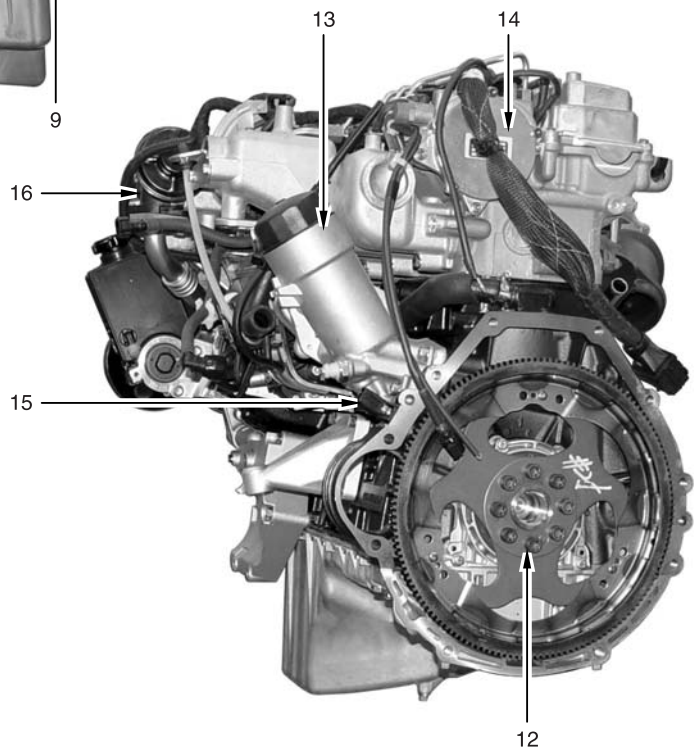
▶ Engine Structure

Front View



Rear View



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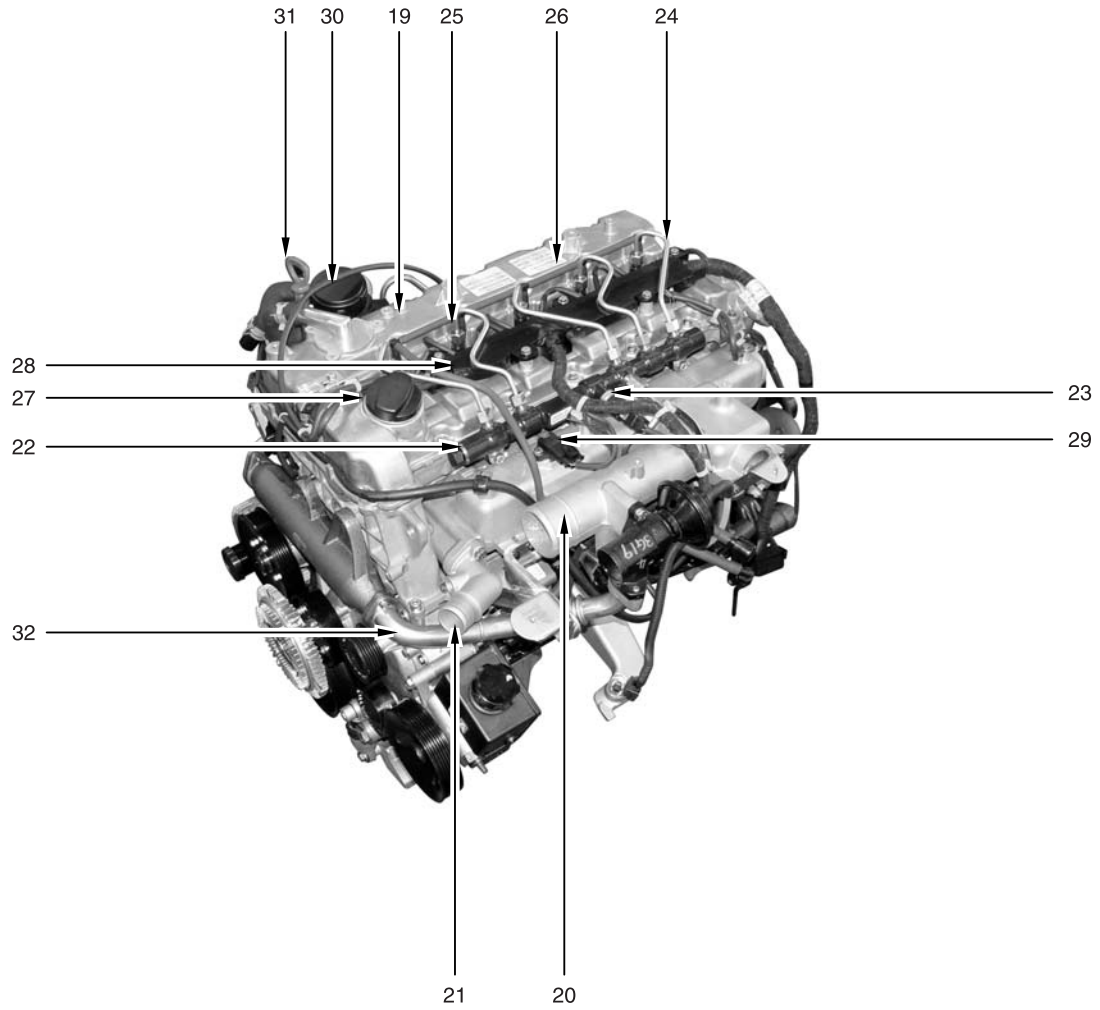
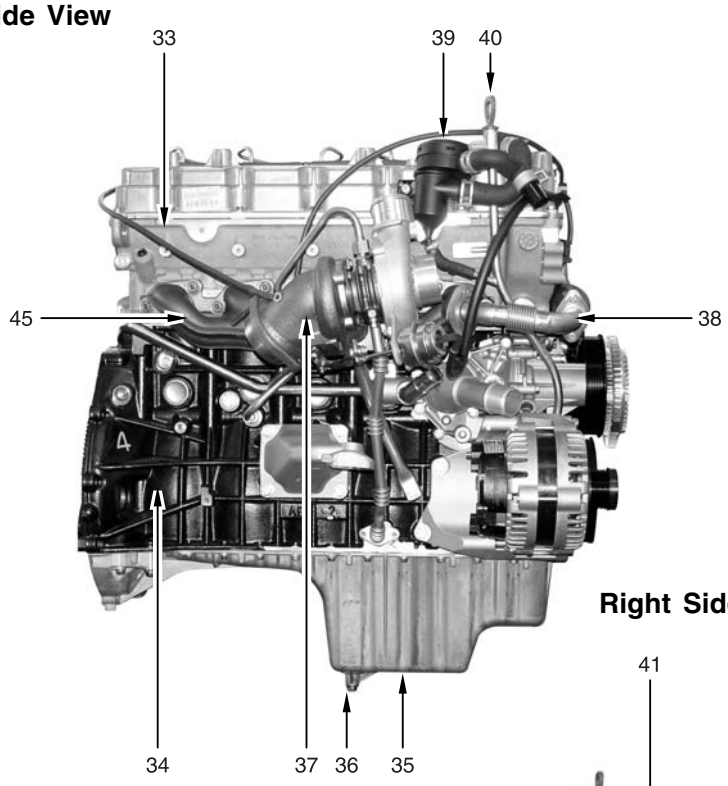
1. TVD (Torsional Vibration Damper)
2. Air conditioner compressor
3. Power steering pump pulley
4. Idle pulley
5. Coolant pump pulley
6. Alternator
7. Viscos fan clutch
8. Auto tensioner pulley
9. Auto tensioner
10. Poly-grooved belt
11. Cam position sensor
12. Drive plate (MT: DMF)
13. Oil filter
14. Vacuum pump
15. Crank position sensor
16. EGR valve
17. Power steering pump
18. EGR to center pipe

Top View

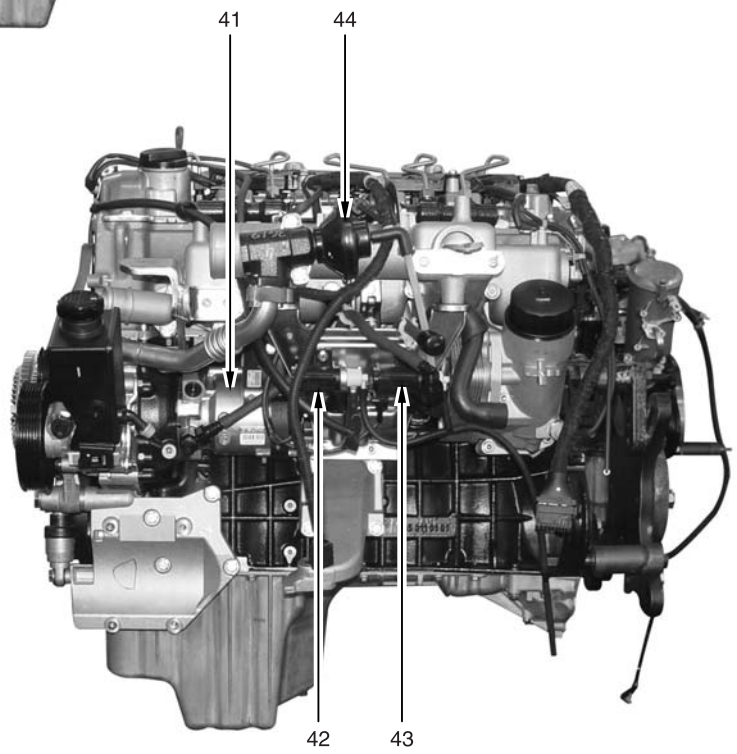


19. Cylinder head cover
20. Intake manifold
21. Water outlet port
22. Common rail
23. Fuel pressure sensor
24. Fuel pipe
25. Injector
26. Fuel return line
27. Oil filler cap
28. Glow plug
29. Booster pressure sensor
30. PCV valve and oil separator
31. Oil dipstick
32. EGR-LH pipe

Left Side View



Right Side View



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33. Cylinder head
34. Cylinder block
35. Oil pan
36. Drain plug
37. Turbo charger
38. EGR-RH pipe
39. PCV valve and oil separator
40. Oil dipstick
41. High pressure pump
42. Turbo charger booster vacuum modulator
43. EGR valve vacuum modulator
44. EGR valve
45. Exhaust manifold

▶ Specifications

Description			Specification
Engine	Type/Number of cylinders		D27DT/5-cylinder
Cylinder	Inner diameter (mm)		86.2
	Stroke (mm)		92.4
Displacement (cc)			2696
Compression ratio			18:1
Maximum output (ps/rpm)			170/4,000
Maximum torque (kg·m/rpm)			34.7/1,800
Idle speed	For Manual Transmission		750 ± 50 rpm
	For Automatic Transmission		750 ± 50 rpm
Valve	Intake	Opens (BTDC)	16°
		Closes (ABDC)	33°
	Exhaust	Opens (BBDC)	46°
		Closes (ATDC)	21°
Camshaft	Type		DOHC
Fuel system	Fuel type		Low sulfur diesel
	Fuel pump type		Vane pump in HP pump
	Fuel supply pressure		HP pump inlet port: max. 400 mbar HP pump outlet port (with IMV fully open): over 1,050 bar
	Water separation in fuel filter		at every 10,000 km
	Fuel tank capacity (ℓ)		80
Lubrication system	Oil specification		SAE 10W40, 5W40 (MB Sheet 229.1, 229.3 approved oil)
	Lubrication type		Forced delivery
	Oil filter type		Full flow, filter element type
	Oil capacity (ℓ)		6.8 ~ 8.3
Cooling system	Cooling type		Water cooling type
	Cooling fan operation type		Belt operated typr
	Thermostat: Fully Open: 100°C)	Opening temperature (°C)	85
		Type	WAX pellet type
	Coolant capacity (ℓ)		˙. 11.5

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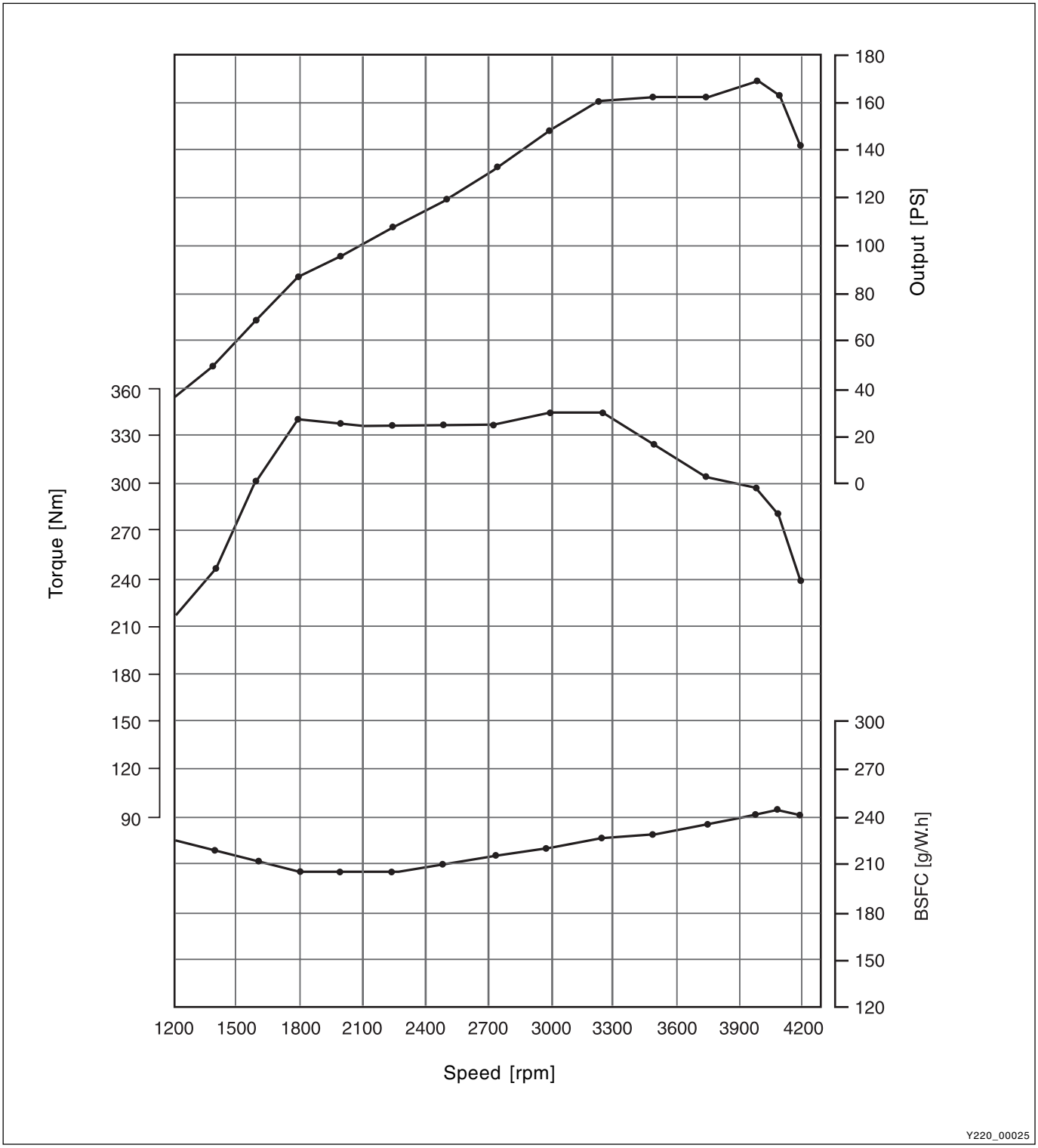
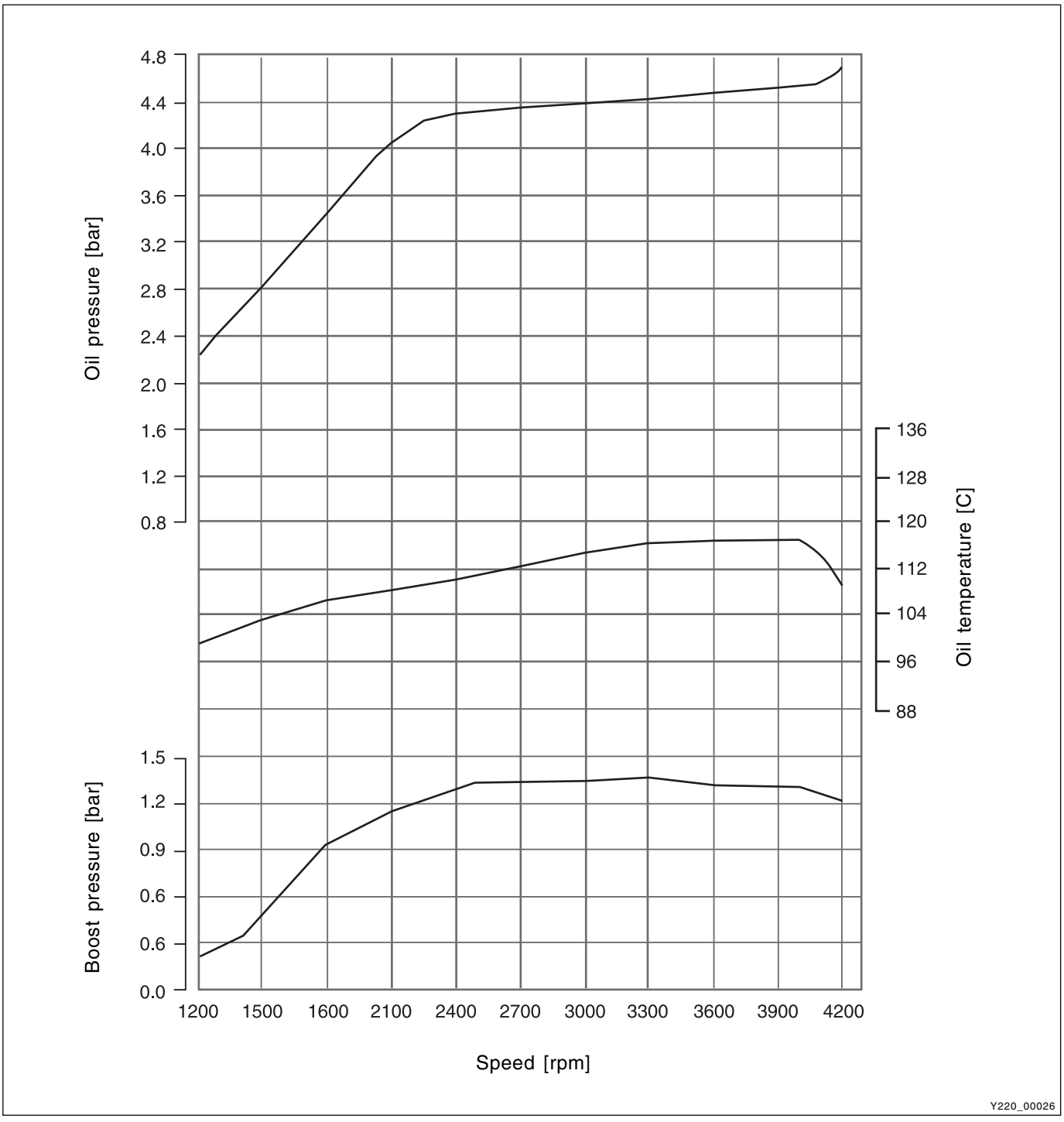
ENGINE PERFORMANCE CURVE

▶ Output and Torque



▶ Oil Temperature/Pressure and Boost Pressure



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GENERAL DIAGNOSIS

Condition		Probable Cause	Correction
Hard Starting (With normal cranking)	Malfunction of Ignition System	• Faulty fuse.	• Replace the fuse.
		• Faulty spark plug.	• Clean, adjust the plug gap or replace.
		• Electric leakage at the high tension cable.	• Replace the cable.
		• Poor connection of the high tension cable or lead wires.	• Replace the cable or wires.
		• Improper ignition timing.	• Adjust the ignition timing.
		• Faulty ignition coil.	• Replace the ignition coil.
	Malfunction of Fuel System	• Lock of fuel in the fuel tank.	• Feed the fuel.
		• Dirty or clogged fuel filter.	• Replace the filter.
		• Clogged fuel pipe.	• Clean the fuel pipe.
		• Malfunction of the fuel pump.	• Replace the fuel pump.
		• Malfunction of the fuel injector.	• Replace the injector.
		• The foreign material in the fuel tank.	• Clean the fuel tank.
	Decline of Compression Pressure	• Poor tightening spark plug.	• Tighten to the specified torque. Compression
		• Cracked cylinder head gasket.	• Replace the gasket.
		• Inadequate the valve clearance.	• Adjust the clearance.
		• Leakage of the valve clearance.	• Repair the valve.
		• Interference of the valve stem.	• Replace the valve or the valve guide.
		• Low elasticity or damage of the valve spring.	• Replace the valve spring.
		• Abnormal interference of pistons and cylinders.	• Replace the piston ring.
		• Excessive wear of pistons, rings, or cylinders.	• Replace the ring or the piston and boring or replace the cylinder.
	Others	• Broken timing belt.	• Replace the belt.
		• Loosening, damage or leakage of the vacuum hose.	• Connect the hose correctly or replace it.
		• Leakage of intake system.	• Replace intake system.
Lack of Engine Power	Decline of Compression Pressure	• Refer to above in this page.	• Refer to above in this page.
	Malfunction of Ignition System	• Improper ignition timing.	• Adjust the ignition timing.
		• Faulty spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.

GENERAL DIAGNOSIS (Cont'd)

Condition		Probable Cause	Correction
Lack of Engine Power	Malfunction of Fuel System	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
	Others	• Clogged exhaust system.	• Check and repair the system.
		• Clogged or contaminated air cleaner element.	• Clean or replace the air cleaner element.
		• Leak of the intake manifold gasket.	• Replace the gasket.
		• Dragging brakes.	• Repair or replace the brakes.
Rough Engine Idling	Decline of Compression Pressure	• Refer to "Compression Pressure Test".	• Refer to "Compression Pressure Test".
	Malfunction of Fuel System	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
		• Malfunction of the fuel pressure regulator.	• Replace the regulator.
	Malfunction of Ignition System	• Malfunction of the spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
		• Poor ignition timing.	• Adjust the ignition timing.
		• Malfunction of the ignition coil.	• Replace the ignition coil.
	Others	• Clogged or contaminated air cleaner element.	• Clean or replace the air cleaner element.
		• Leak of the intake manifold gasket.	• Replace the gasket.
		• Poor connection or damage or leakage of the vacuum hose.	• Connect the hose correctly or replace it.
Engine Hesitate (Upon pressing accelerating pedal, the engine makes delayed response This situation is remarkable when cruising or starting.)	Decline of Compression Pressure	• Refer to "Compression Pressure Test".	• Refer to "Compression Pressure Test".
	Malfunction of Ignition System	• Poor ignition timing.	• Adjust the ignition timing.
		• Poor spark plug or Poor adjustment of the plug gap.	• Replace the plug or adjust the gap.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
	Others	• Malfunction of the air cleaner system.	• Clean or replace the air cleaner system.
		• Leak of the intake manifold gasket.	• Replace the gasket.

GENERAL DIAGNOSIS (Cont'd)

Condition		Probable Cause	Correction
Engine Surging (Engine power makes fluctuation in a fixed speed and speed changes without operating the accelerating pedal.)	Decline of Compression Pressure	• Refer to "Compression Pressure Test".	• Refer to "Compression Pressure Test".
	Malfunction of Fuel System	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
		• Malfunction of the fuel pressure regulator.	• Replace the fuel pressure regulator.
	Malfunction of Ignition System	• Malfunction of the spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
		• Poor ignition timing.	• Adjust the ignition timing.
	Others	• Leak of the intake manifold gasket.	• Clean or replace the gasket.
		• Leakage of the vacuum hose.	• Connect the hose correctly or replace it.
Excessive Detonation (According to the opening range of Malfunction of metallic is made with abnormal explosion)	Overtheated Engine	• Refer to "Overheat" in this page.	• Refer to "Overheat" in this page.
	Malfunction of Fuel System	• Abnormal spark plug.	• Replace the spark plug.
		• Poor ignition timing.	• Adjust the ignition timing
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
	Malfunction of Ignition System	• Clogged or contaminated fuel filter and fuel pipe.	• Clean or replace the fuel filter and the fuel pipe.
	Others	• Leak of the intake manifold gasket.	• Replace the gasket.
		• Excessive carbon deposit due to abnormal combustion.	• Remove the carbon.
Overheat	Malfunction of Cooling System	• Lack of coolant.	• Refill coolant.
		• Malfunction of the thermostat.	• Replace the thermostat.
		• Malfunction of the cooling fan.	• Check or replace the cooling fan.
		• Poor water pump performance.	• Replace the pump.
		• Clogged or leaky radiator.	• Clean, repair or replace the radiator.
	Malfunction of Lubrication System	• Poor engine oil.	• Replace engine oil with the specified one.
		• Blocking oil filter or strainer.	• Clean or repair the oil filter or the strainer.
		• Lack of engine oil.	• Refill oil.
		• Poor oil pump performance.	• Replace or repair the pump.
	Other	• Leakage of oil	• Repair.
		• Damaged cylinder head gasket.	• Replace the gasket.

GENERAL DIAGNOSIS (Cont'd)

Condition		Probable Cause	Correction
Poor Fuel Consumption	Decline of Compression Pressure	• Refer to "Compression Pressure Test".	• Refer to "Compression Pressure Test".
	Malfunction of Fuel System	• Leakage of the fuel tank or the fuel pipe.	• Repair or replace the fuel tank or the fuel pipe
	Malfunction of Ignition System	• Improper ignition timing.	• Adjust the ignition timing.
		• Abnormal spark plug (Excessive carbon deposit, inadequate gap, burnt electrode).	• Replace the plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable normally or replace it.
	Malfunction of Cooling System	• Malfunction of the thermostat.	• Repair the thermostat.
	Others	• Improperly installed valve.	• Repair or replace the valve.
		• Low pressure of tires.	• Adjust the pressure of tires.
Excessive Consumption of Engine Oil	Leakage of Engine Oil	• Loosened oil drain plug.	• Tighten the plug.
		• Loosened oil pan bolt.	• Tighten the bolt. Engine Oil
		• Loosened oil filter.	• Tighten the filter.
		• Loosened oil pressure switch.	• Tighten the switch.
		• Leakage of camshaft front oil seal.	• Replace the seal.
		• Leakage of crankshaft front oil seal.	• Replace the seal.
		• Leakage at the cylinder head cover gasket.	• Replace the gasket.
		• Damage of the cylinder head gasket.	• Replace the gasket.
	Oil Mixing in Combustion Chamber	• Stuck piston ring.	• Remove carbon and replace the ring.
		• Worn piston or cylinder.	• Replace the piston or the cylinder.
		• Worn piston ring or ring groove.	• Replace the piston or ring.
		• Inadequate position of the piston ring cutting part.	• Adjust the position.
		• Abrasion or damage of the valve system.	• Replace the valve system.
Low Oil Pressure	Malfunction of Lubrication System	• Inadequate oil viscosity.	• Replace with the specified one.
		• Loosening of the oil pressure switch.	• Tighten the switch.
		• Lack of engine oil.	• Refill oil.
		• Blocking oil strainer.	• Clean the strainer.
		• Lowered function of the oil pump.	• Replace the pump.
		• Abrasion or damage of the oil pump relief valve.	• Replace the valve.

GENERAL DIAGNOSIS (Cont'd)

Condition		Probable Cause	Correction
Engine Noise	Valve Noise	• Inadequate valve clearance	• Adjust the valve clearance.
		• Abrasion of valve stem or guide.	• Replace the valve stem or the guide.
		• Weak valve spring.	• Replace the spring.
	Piston, Ring, Cylinder Noise	• Abrasion of the piston, the ring or the cylinder.	• Boring the cylinder or replace the piston, the ring or the cylinder.
	Connecting Rod Noise	• Abrasion of the connecting rod bearing.	• Replace the bearing.
		• Loosened the connecting rod nut.	• Tighten to the specified torque
	Crankshaft Noise	• Abrasion of the crankshaft bearing.	• Replace the bearing.
		• Abrasion of the crankshaft journal.	• Grind or replace the crankshaft journal.
		• Loosened bearing cap bolt.	• Tighten to the specified torque.
		• Excessive clearance of the crankshaft thrust bearing.	• Adjust or replace.
		• Low oil pressure.	• Refer to "Low Oil Pressure" in this section.

DIAGNOSTIC INFORMATION AND PROCEDURE

OIL LEAK DIAGNOSIS

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

▶ Finding the Leak

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

▶ Powder Method

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

▶ Black Light and Dye Method

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

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

▶ Repairing the Leak

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

▶ Gaskets

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

Seals

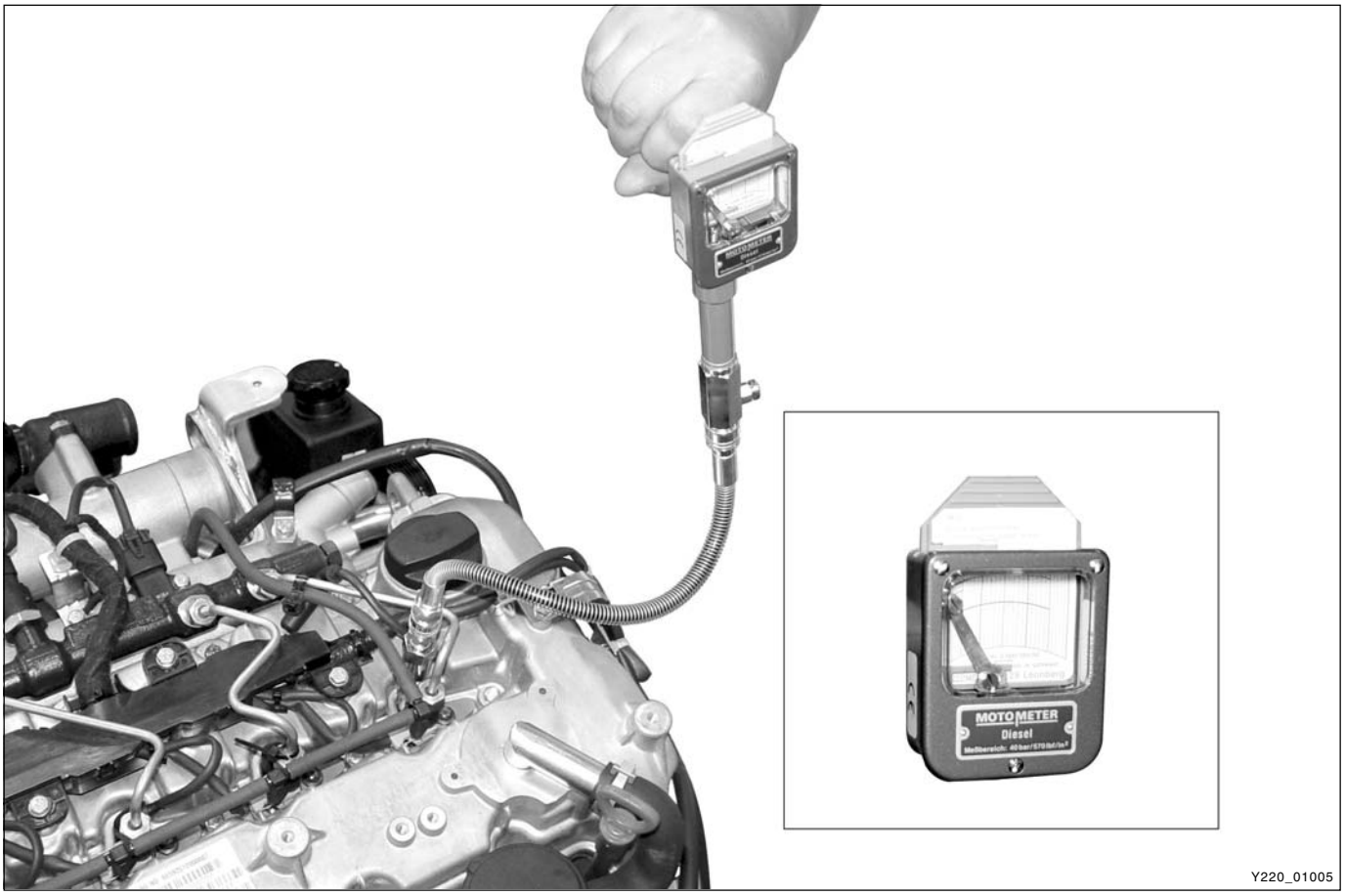
- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The seal bore is damaged (scratched, burred or nicked).
- The seal is damaged or worn.
- Improper installation is evident.
- There are cracks in the components.
- The shaft surface is scratched, nicked or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

COMPRESSION PRESSURE TEST

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

Notice

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



▶ Specifications

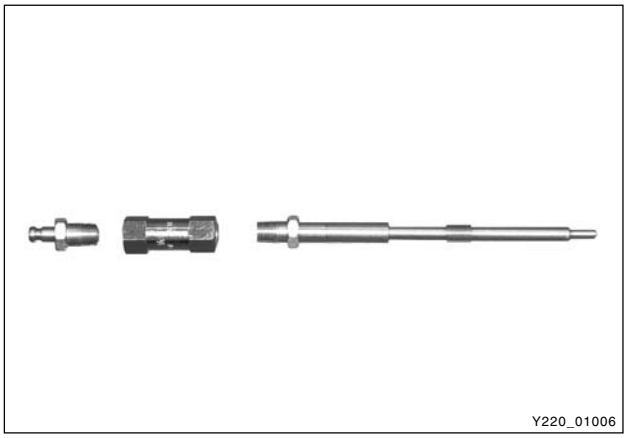
Compression ratio		18 : 1
Test temperature		at normal operating temperature (80°C)
Compression pressure	Normal value	32 bar
	Minimum value	18 bar
Permissible pressure difference between individual cylinders		Max. 3 bar

▶ Measuring Procedure

Notice

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

1. Warm the engine up to normal operating temperature (80°C).
2. Disconnect the fuel rail pressure sensor connector to cut off the fuel injection.
3. Place the diagram sheet to compression pressure tester.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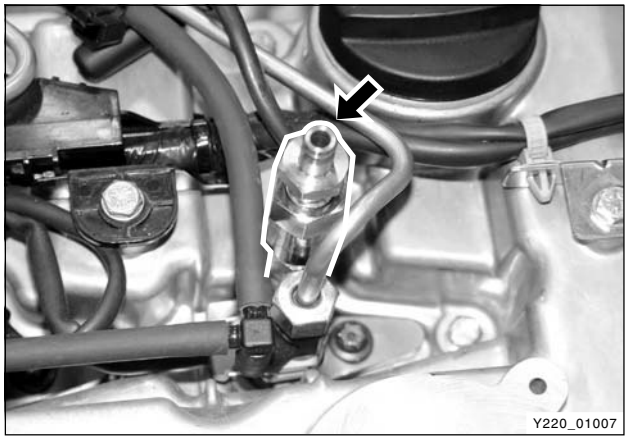
4. Remove the glow plugs and install the compression pressure tester into the plug hole.

Tightening torque (Tester)	15 Nm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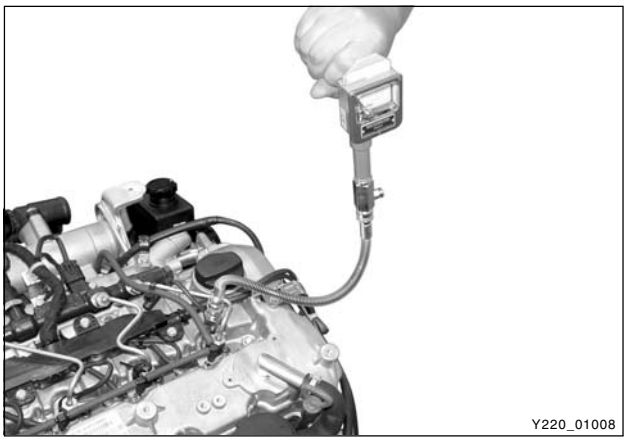
5. Crank the engine for approx. 10 seconds by using the start motor.
6. Record the test result and measure the compression pressure of other cylinders with same manner.
7. If the measured value is not within the specifications, perform the cylinder pressure leakage test.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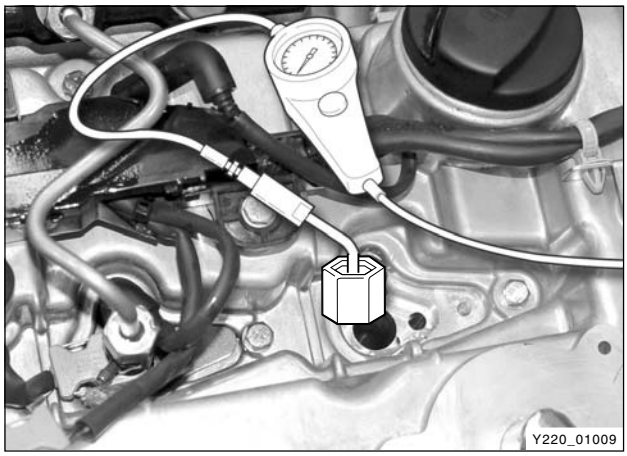
CYLINDER PRESSURE LEAKAGE TEST



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

▶ Permissible Pressure Leakage

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

Notice

- ***Perform the pressure in order: 1 - 2 - 3 - 4 - 5***
- ***Do not test the cylinder pressure leakage with wet type test procedure. (do not inject the engine oil into the combustion chamber)***

TIGHTENING TORQUE

NO.	Name	Size	Quantity	Tightening Torque
1	Oil nozzle	M6 x 22	5	10 ± 1
2	Main bearing cap	M11 x 62	12	55 ± 5
				90° ± 10°
3	Connecting rod cap	M9 x 52	5	40 ± 5
				90° ± 10°
4	Rear cover	M6 x 20	6	10 ± 1
5	Oil pump	M8 x 35SOC	3	25 ± 2.5
6	Oil baffle plate assembly	M6 x 20	10	10 ± 1
7	T.G.C.C	M6 x 16	1	10 ± 1
		M6 x 40	6	10 ± 1
		M6 x 60	3	10 ± 1
		M6 x 70	2	10 ± 1
		M8 x 80SOC	1	25 ± 2.5
8	Flywheel	M10 x 30	8	45 ± 5
				90° ± 10°
9	Crankshaft hub	M18 x 50	1	325 ± 33
				90° ± 10°
10	Oil pan	M6 x 20	24	10 ± 1
		M6 x 35	3	10 ± 1
		M6 x 38	3	10 ± 1
		M6 x 40	4	25 ± 2.5
11	High pressure pump assembly	M8 x 40	4	25 ± 2.5
12	High pressure pump sprocket assembly	M14 x 1.5-8-1	1	65 ± 5
13	High pressure pump bracket	M7 x 16	3	20 ± 2 x 90° + 10°
14	Cylinder head assembly	M8 x 25	2	25 ± 2.5
		M8 x 50	2	
		M12 x 177	11	Step1: 20 Nm ± 2 Nm Step2: 85 Nm ± 5 Nm
		M12 x 158	1	Step3: 3 x 90° + 10°
15	Camshaft cap	M8 x 60	24	25 ± 2.5
16	Stud bolt	M8	10	15 ± 1.5
17	Camshaft sprocket (Intake)	M11 x 52	1	25 ± 2.5
	Camshaft sprocket (Exhaust)		1	90° ± 10°
18	Chain tensioner	M22	1	65 ± 5
19	Coolant temperature sensor	M14	1	22 ± 2.2

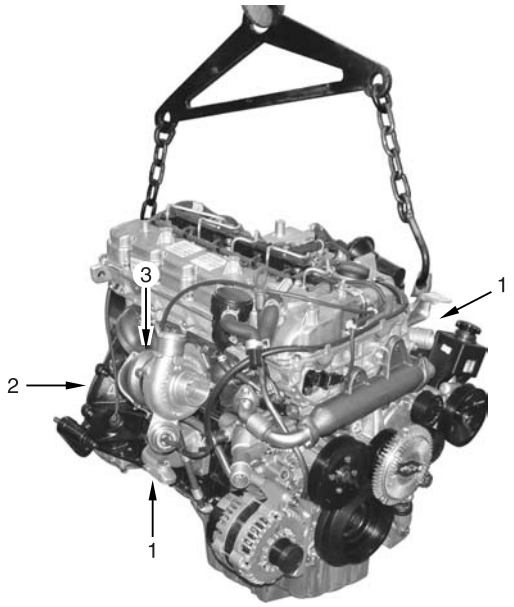
NO.	Name	Size	Quantity	Tightening Torque
20	Auto tensioner	M8 x 45(LOWER)	1	32 ± 3
		M12 x 90	1	82 ± 6
21	Water pump assembly	M6 x 50	7	10 ± 1
22	Water pump pulley	M6 x 12	4	10 ± 1
23	Hot water inlet pipe assembly	M6 x 12	2	10 ± 1
24	Alternator bracket	M8 x 32	4	25 ± 2.5
25	Alternator	M10 x 90	2	46 ± 4.6
26	Air conditioner compressor assembly	M8 x 95	4	46 ± 4.6
27	Air conditioner compressor bracket assembly	M8 x 25	1	25 ± 2.5
		M8 x 60	3	25 ± 2.5
28	Air conditioner compressor sub bracket assembly	M6 x 14	1	10 ± 1.0
		M8 x 16	1	25 ± 2.5
29	Intake manifold	M8 x 45	6	25 ± 2.5
		M8 x 130	6	25 ± 2.5
30	Bracket	M6 x 16	1	10 ± 1.0
31	Knock sensor	M8 x 28	2	20 ± 2.6
32	Camshaft position sensor	M8 x 16	1	12 ± 1.7
33	Booster pressure sensor	M6 x 16	2	10 ± 1.0
34	Exhauster manifold	M8	10	40 ± 4
35	Turbo charger assembly	M8	4	25 ± 2.5
36	Turbo charger adaptor piece		1	32 ± 3.2
37	Nut	M8	1	25 ± 2.5
38	Combination bolt	M8 x 22	1	25 ± 2.5
39	T/C oil supply pipe	M6 x 16 (Cylinder block side)	1	25 ± 2.5
		M16 (T/C side)	1	20 ± 2.0
40	T/C oil return pipe	M6 x 16 (T/C side)	2	10 ± 1.0
		M6 x 16 (Cylinder block side)	2	10 ± 1.0
41	EGR valve assembly	M8 x 22	2	25 ± 2.5
42	EGR-LH pipe bolt	M6 x 16	2	10 ± 1.0
		M8 x 22	2	35 ± 2.0
43	EGR combination bolt	M6 x 16	4	10 ± 1.0
		M8 x 16	4	25 ± 2.5
	EGR-RH pipe nut	M8	2	35 ± 2.0
44	Glow plug cable nut	M5	5	15 ± 3
45	Vacuum pump	M6 x 20	3	10 ± 1.0
46	Cooling fan bracket assembly	M6 x 25	5	10 ± 1.0
		M6 x 65	1	10 ± 1.0
		M6 x 85	3	10 ± 1.0
47	Cylinder head cover	M6 x 35	21	23 ± 2.3

NO.	Name	Size	Quantity	Tightening Torque
48	Vacuum modulator	M6 x 16SOC	4	10 ± 1.0
49	WDT combination bolt	M6 x 16	3	10 ± 1.0
50	Oil dipstick tube	M6 x 16	1	10 ± 1.0
51	Oil filter assembly	M8 x 35SOC	1	25 ± 2.5
		M8 x 50SOC	2	25 ± 2.5
		M8 x 55SOC	1	25 ± 2.5
52	Fuel rail assembly	M8 x 35SOC	3	25 ± 2.5
53	Injector clamp washer	M6 x 60	5	10 ± 1.0 180 + 20°
54	Fuel pipe clip (H-C)	M6 x 19	1	10 ± 1.0
55	Fuel pipe clip (C-I)	M6 x 16	5	10 ± 1.0
56	Crankshaft position sensor	M5 x 17	1	0.8 ± 0.4
57	Crankshaft position sensor	GAP		0.7 ~ 1.5
58	Fuel pressure sensor		1	
59	Wiring	M6 x 16	5	10 ± 1.0
60	Intake manifold bracket	M8 x 16	2	25 ± 2.5
		M8 x 40	2	25 ± 2.5
61	Power steering pump	M8 x 100	2	25 ± 2.5
		NUT	2	25 ± 2.5
62	Piston protrusion		5	0.765 ~ 1.055
63	Clearance between connecting rod and pin boss		5	0.05 ~ 0.31
64	End play of crankshaft	NEW: 0.100 ~ 0.245 mm // USED: 0.300 mm		

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

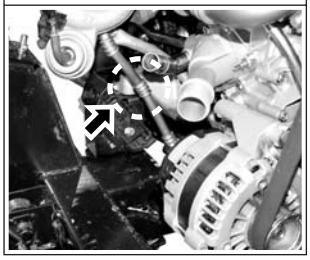
REMOVAL AND INSTALLATION

ENGINE MOUNTING



1. Side Mountings

Left



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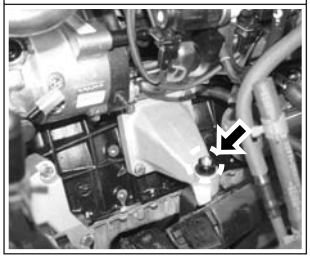
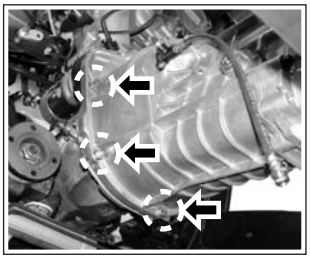
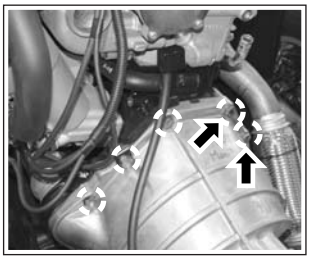
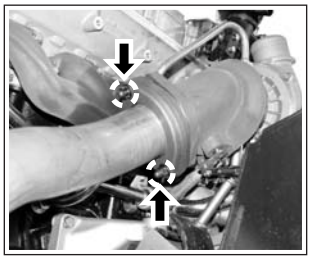


2. Transmission Mounting





3. Exhaust Manifold and Pipe



4. Cables and Connectors

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Notice

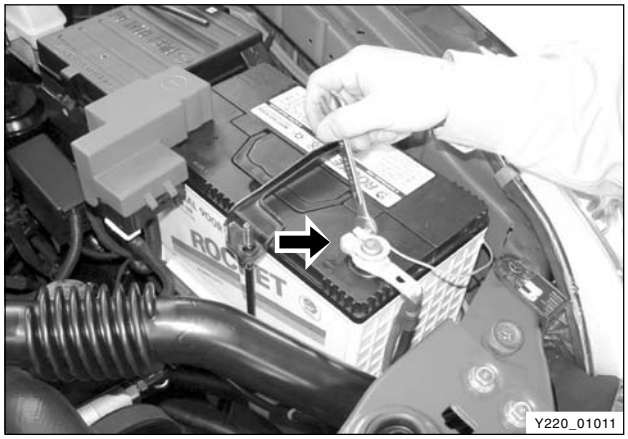
1. ***Disconnect the negative battery cable before removal.***
2. ***Drain the engine oil.***
3. ***Drain the engine coolant.***
4. ***Be careful not to splash the fuel to the vehicle body. It may cause a fire or vulcanization of rubber products. Make sure to block the fuel related hoses before removal.***

Engine Assembly - Removal

1. Disconnect the negative battery cable.

   Notice

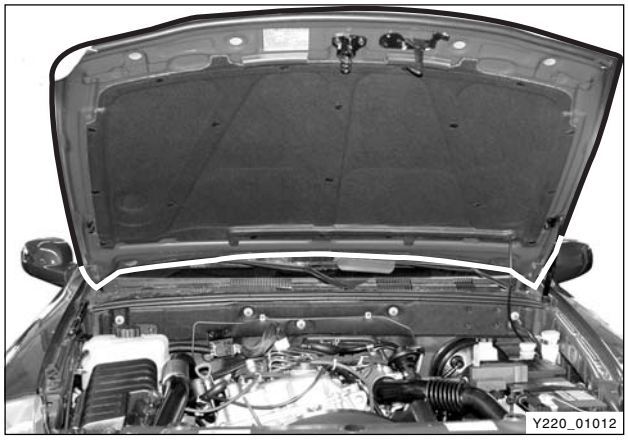
   If not necessary, place the ignition switch at "OFF" position.



2. Remove the engine hood assembly.

   Note

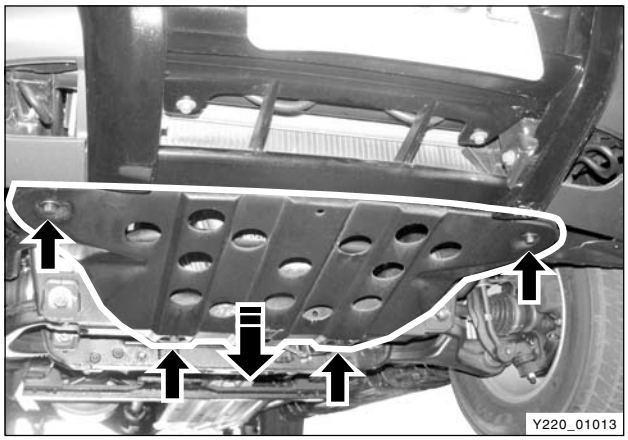
   Refer to "Body" section.



3. Remove the skid plate under the engine compartment.

   Installaiton Notice

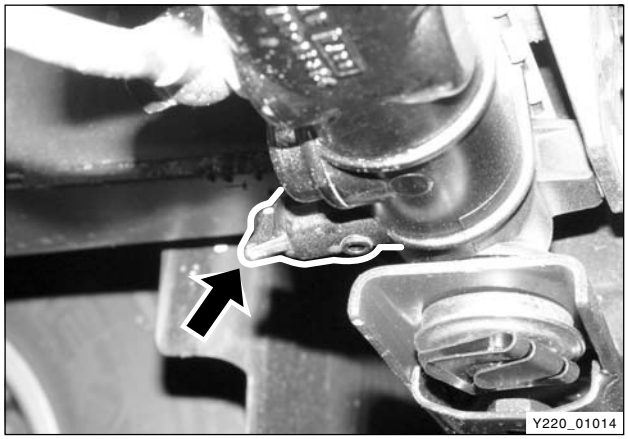
Tightening torque	12 ± 1.2 Nm



4. Loosen the radiator drain cock and drain the coolant.

   Notice

   1. ***Be careful not to contact with coolant. If contacted, wash with soap and water to ensure all coolant is removed.***
   2. ***Use only designated coolant.***
   3. ***Open the coolant reservoir cap to help the draining.***



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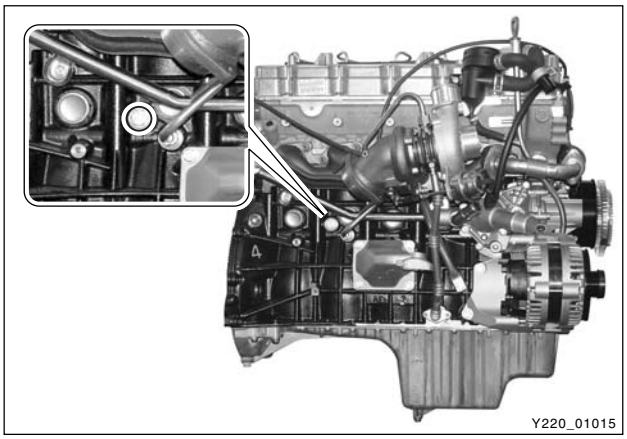
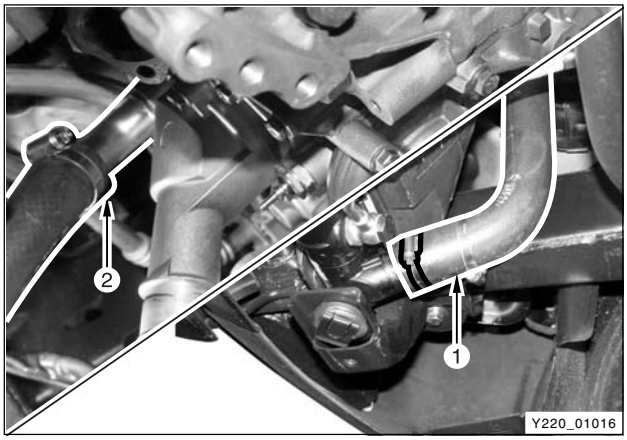


5. Loosen the cylinder block drain plug (under the intake manifold) and drain the coolant completely.
6. Retighten the drain plug with the specified tightening torque.

Tightening torque	30 Nm



7. Remove the inlet hose (1) and the heater hose (2) under the radiator.

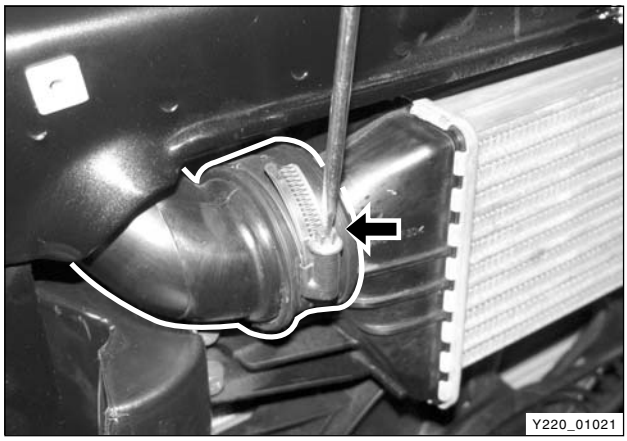
Notice

Be careful not to damage the rubber hose.

8. Remove the coolant outlet hose over the radiator.

Notice

Be careful not to damage the rubber hose.

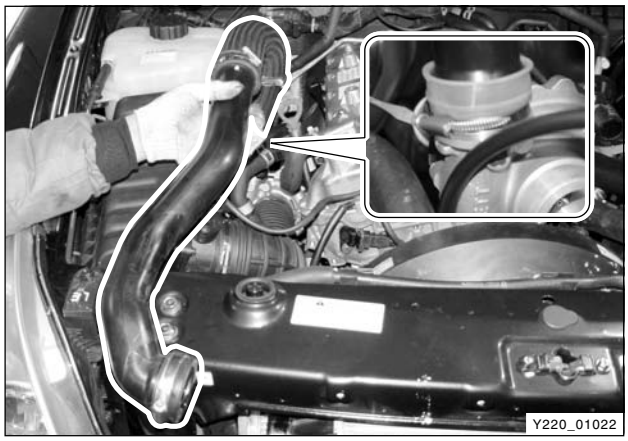


9. Remove the radiator grille and loosen the hose clamp on the outlet port of turbo intercooler.

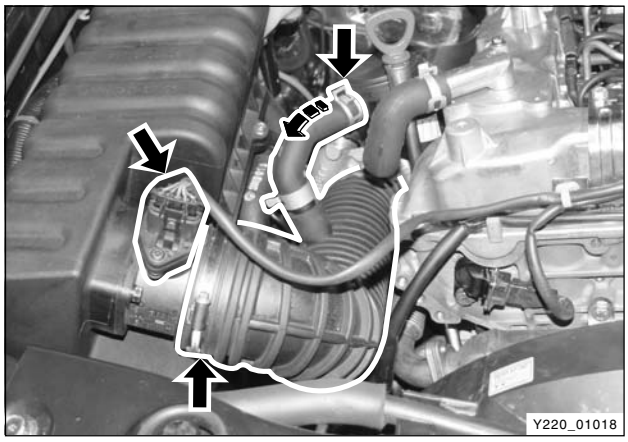
Note

For the removal and installation of radiator grille, refer to "Cooling System" section.

10. Loosen the hose clamp on intake air hose of turbo charger and remove the intake air hose.

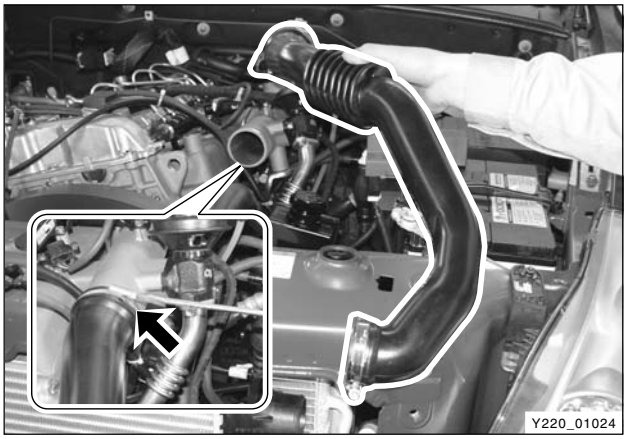


11. Separate the outlet hose of oil separator from the intake air hose of turbo charger.
12. Loosen the clamp on the intake air duct hose of turbo charger at the air cleaner side and separate the hose from the air cleaner housing.

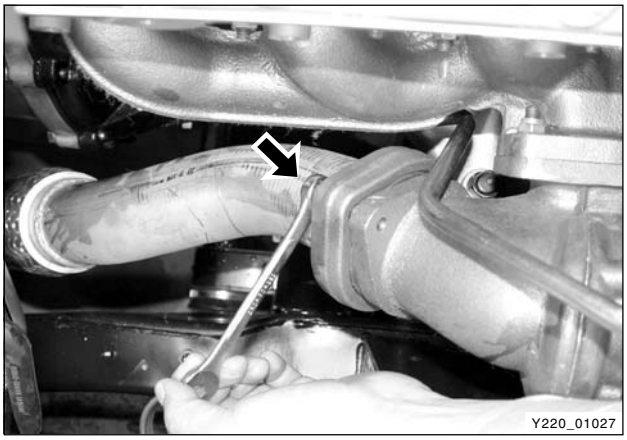


13. Loosen the clamps and remove the intake air hose from the turbo charger.

14. Loosen the clamp on the inlet hose of intercooler.



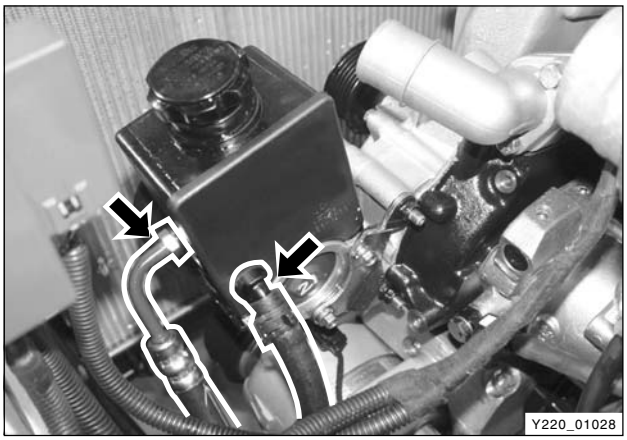
15. Loosen the clamp on the intake manifold and remove the intake air hose.



16. Remove the exhaust pipe mounting nuts from the turbo charger.

Installation Notice

Tightening torque	25 ± 2.5 Nm



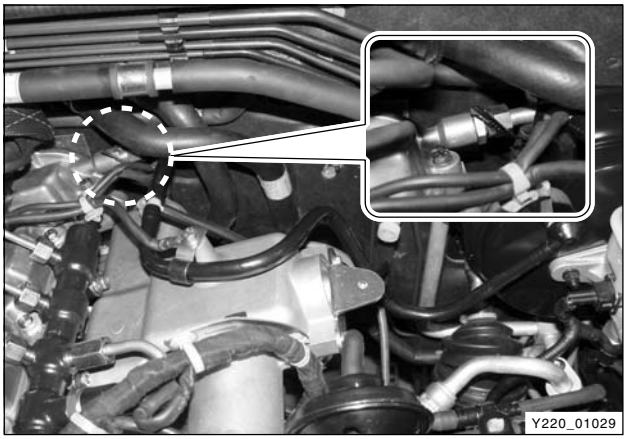
17. Remove the power steering inlet pipe and the outlet hose from the power steering pump.

Notice

Plug the openings of hoses and pump with caps not to flow out the oil.

Installation Notice

Inlet pipe union nut	25 ± 2.5 Nm

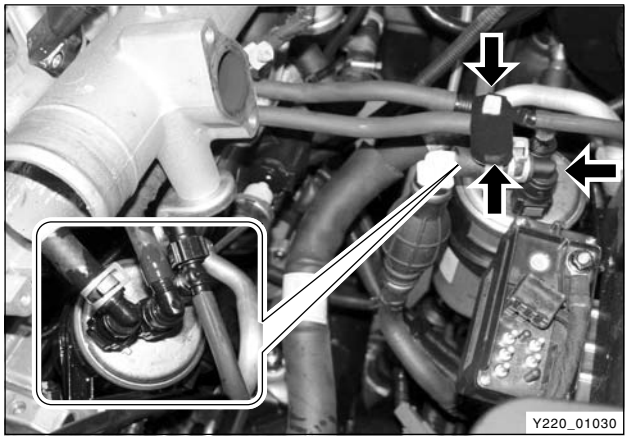


18. Remove the vacuum hose from the brake booster.

Installation Notice

Vacuum pipe union nut (at vacuum pump side)	10 Nm

19. Remove the supply inlet, supply outlet and return hose from the fuel filter.



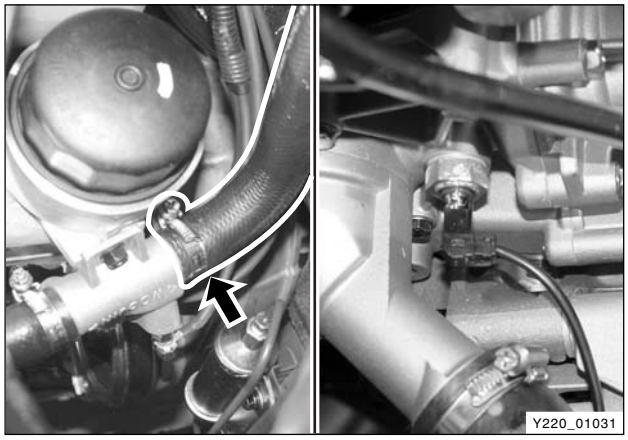
Notice

1. When separating the hoses from the fuel filter, plug the openings with caps so that the contaminants will not get into the fuel system.

2. Mark on all the hoses not to be mixed each other.

20. Remove the engine oil heater outlet hose.
21. Disconnect the cables from the cylinder block and other components.

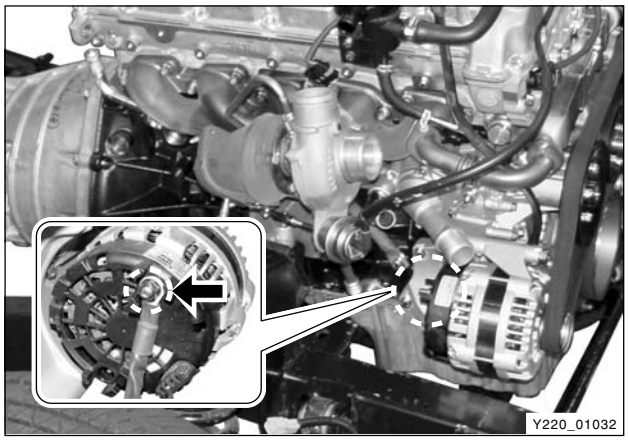
    (e.g., coolant temperature sensor cable and oil temperature switch)



22. Disconnect the engine ground cable and the alternator "+" terminal cable.

Notice

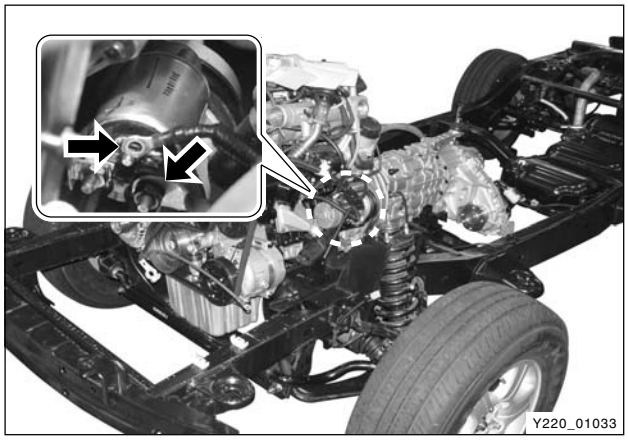
Make sure to properly tighten the cable nuts when installing. Otherwise, it may cause a poor ground or electric charging problem.



23. Disconnect the "ST" terminal and "+" terminal cables from the starter motor.

Notice

Make sure to properly tighten the cable nuts when installing. Otherwise, it may cause an engine starting problem.



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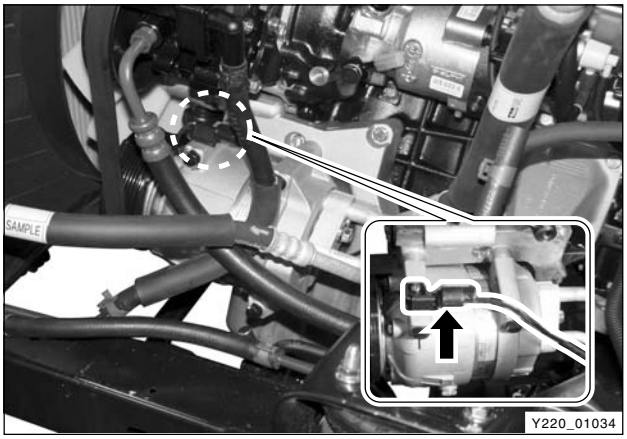
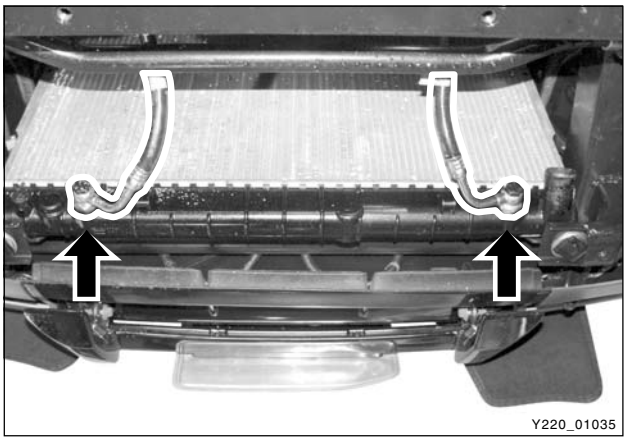
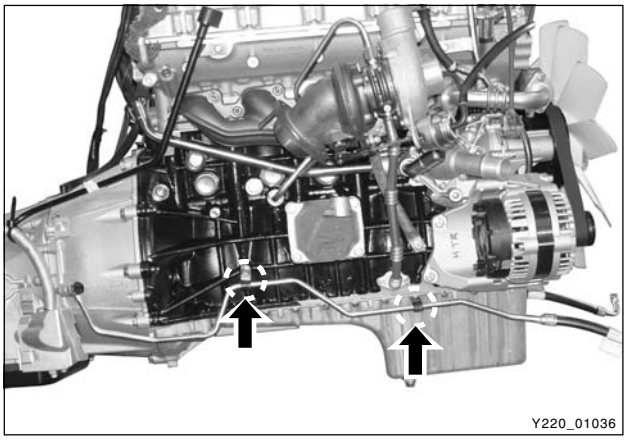


24. Disconnect the air conditioner compressor connector and remove the inlet and outlet pipes from the compressor.



25. For the automatic transmission equipped vehicle, remove the oil cooler pipes.

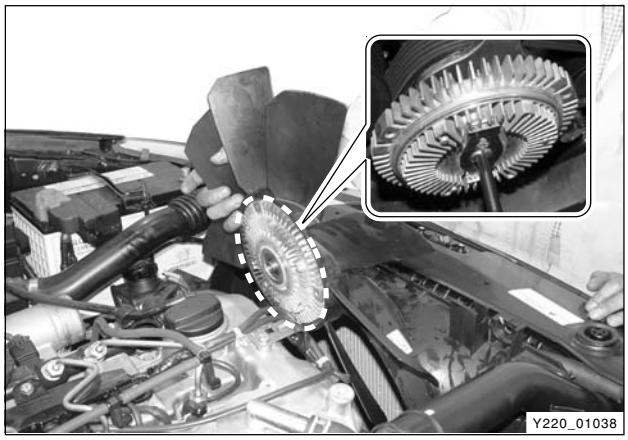


Note

The oil cooler pipes are connected to cylinder block at both sides and bottom area of oil with brackets.

Installation Notice

Pipe mounting bracket bolt	25 ± 2.5 Nm
Pipe hose (radiator side) union nut	25 ± 2.5 Nm

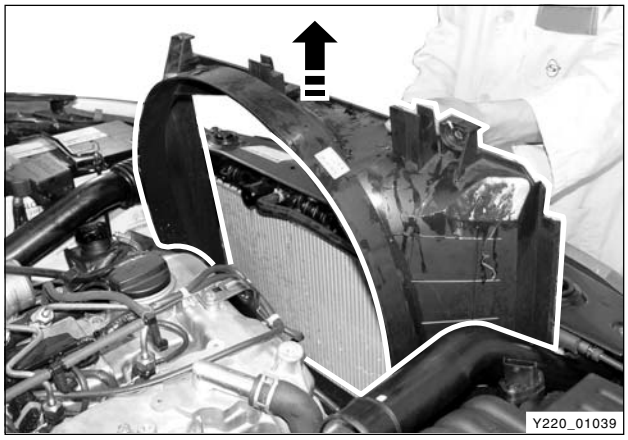


26. Set up the special to the cooling fan pulley and remove the cooling fan assembly. To make the removal easier, loosen the radiator shroud.

Installation Notice

Cooling fan pulley bolt	10 ± 1.0 Nm

27. Remove the radiator shroud.



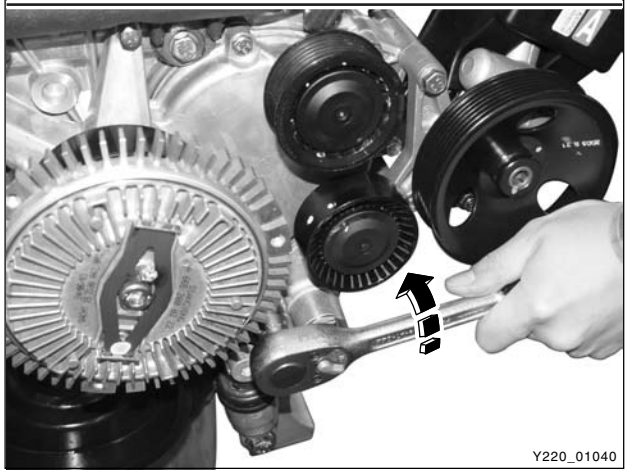
Installation Notice

Tightening torque	10 ± 1.0 Nm

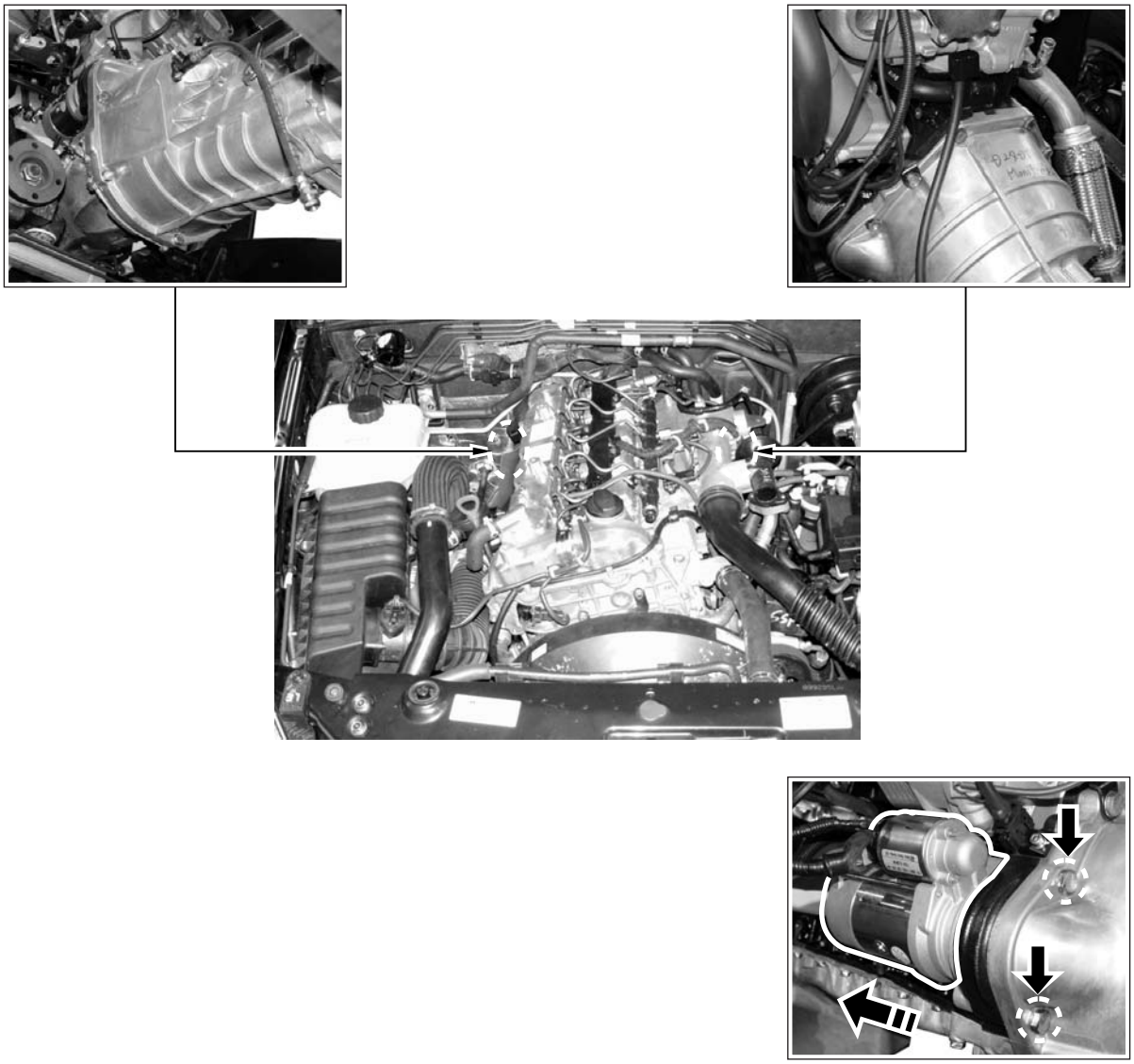
28. Take off the fan belt from the engine.

Note

1. ***Insert a tool into the belt tensioner and rotate it counterclockwise to take off the fan belt.***
2. ***After installation of the fan belt, pump the belt tensioner 3 to 4 times.***



29. Remove the transmission mounting bolts and separate the engine assembly from the transmission assembly.



Y220_01041

Note

1. Before unscrewing the transmission mounting bolts, remove the starter motor.

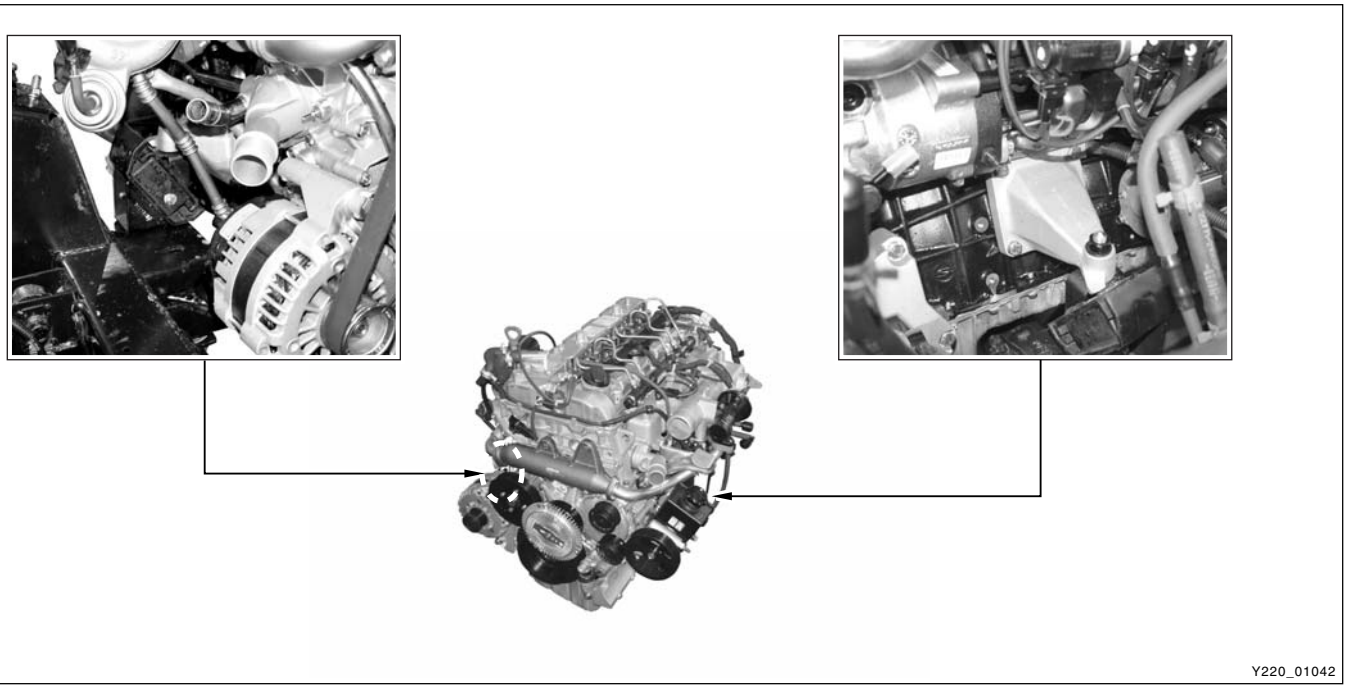
Installation Notice

Mounting bolt	55 ± 5 Nm

30. Remove the engine assembly mounting nuts at both sides.

Installation Notice

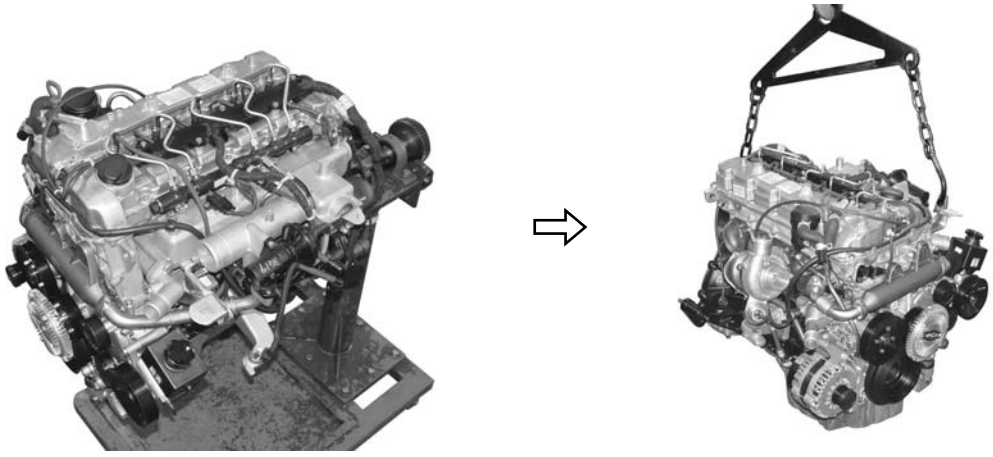
Mounting Nut	55 ± 5 Nm



Y220_01042

31. Hook the chain on the engine brackets and carefully pull out the engine assembly from the vehicle by using a hoist or crane.

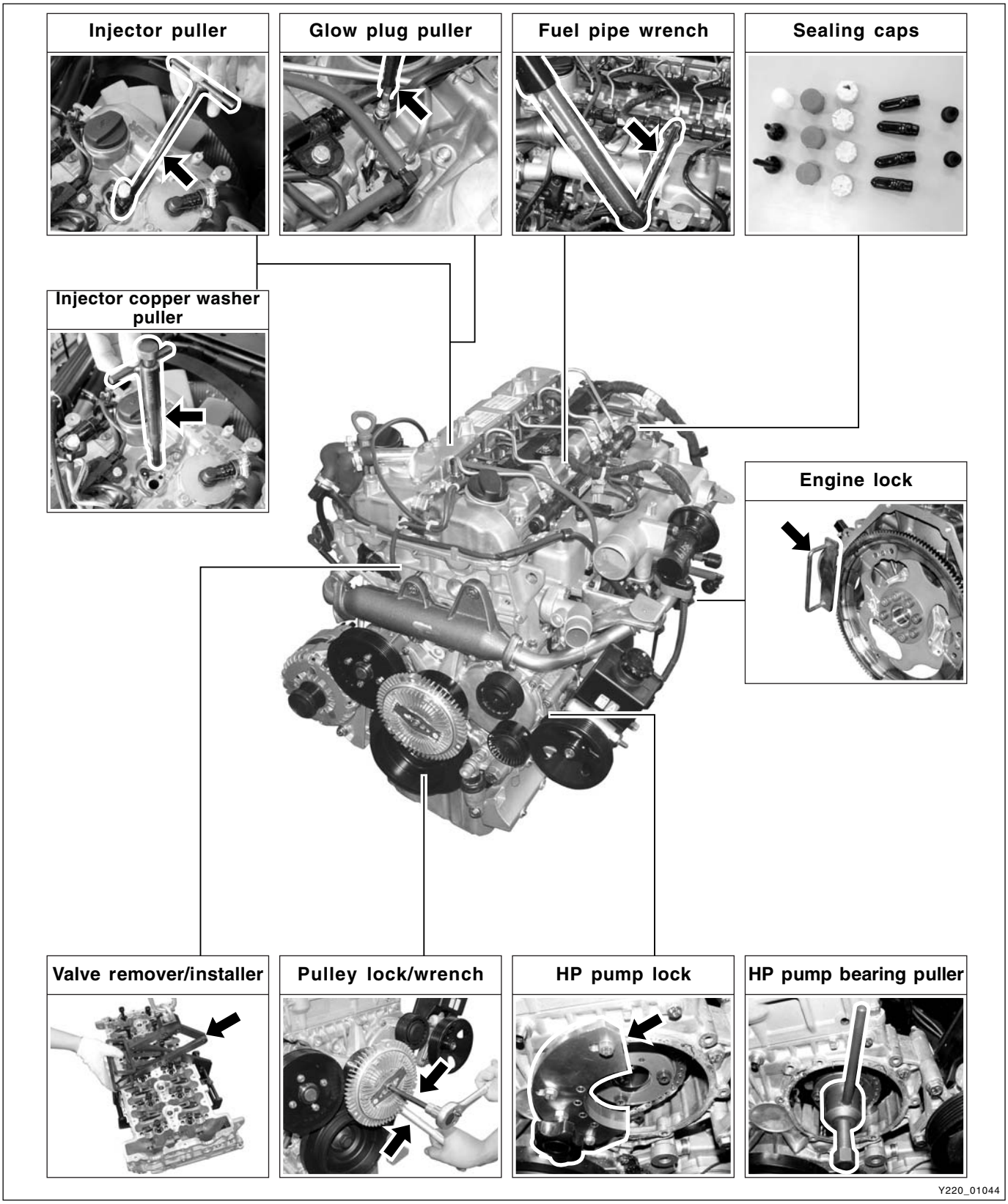
32. Put the removed engine assembly on the safety stand.



Y220_01043

DISASSEMBLY AND REASSEMBLY

COMPONENTS AND SPECIAL TOOLS



Inspection Before Disassembly and Reassembly

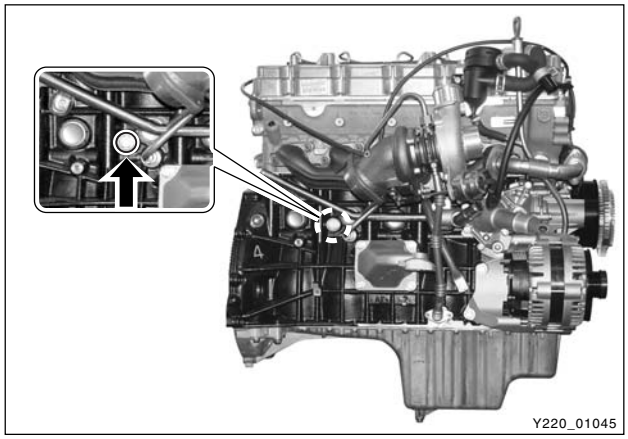
Preparations and Preceding Works

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

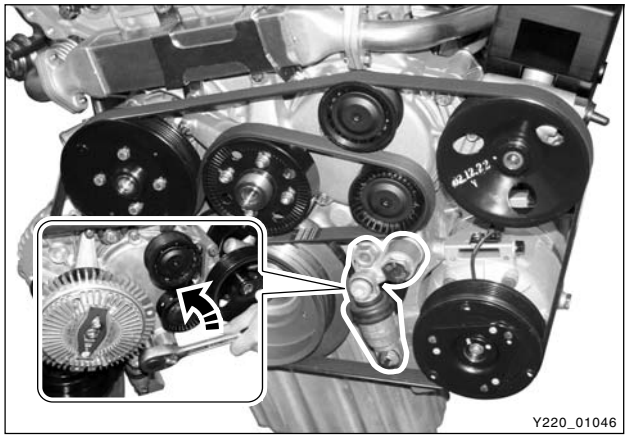
Tightening torque	30 Nm

Notice

Replace the seal with new one once removed.

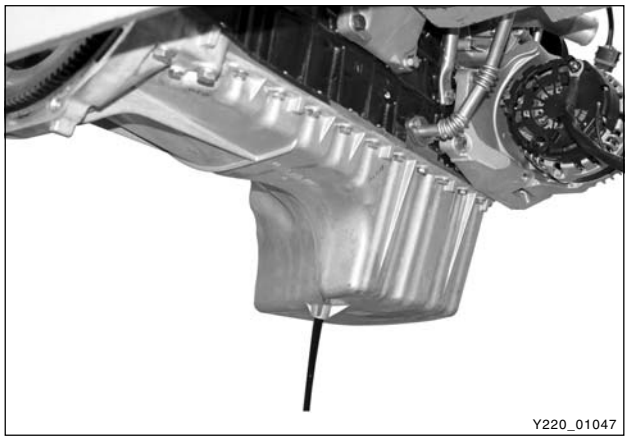


2. When the fan belt is installed, gently pump the belt shock absorber mounting bolt (M19) 3 times.
3. Take off the fan belt while pushing the mounting bolt (M19).



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

Drain plug	25 ± 2.5 Nm



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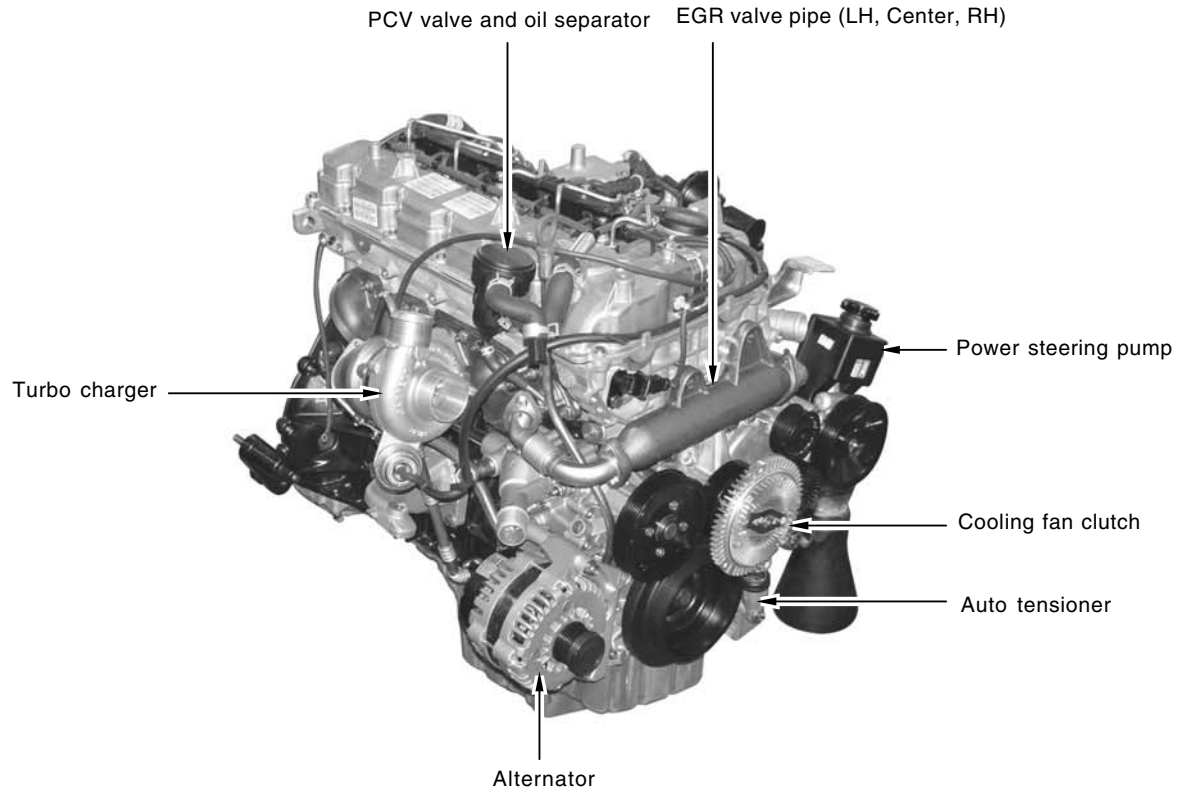
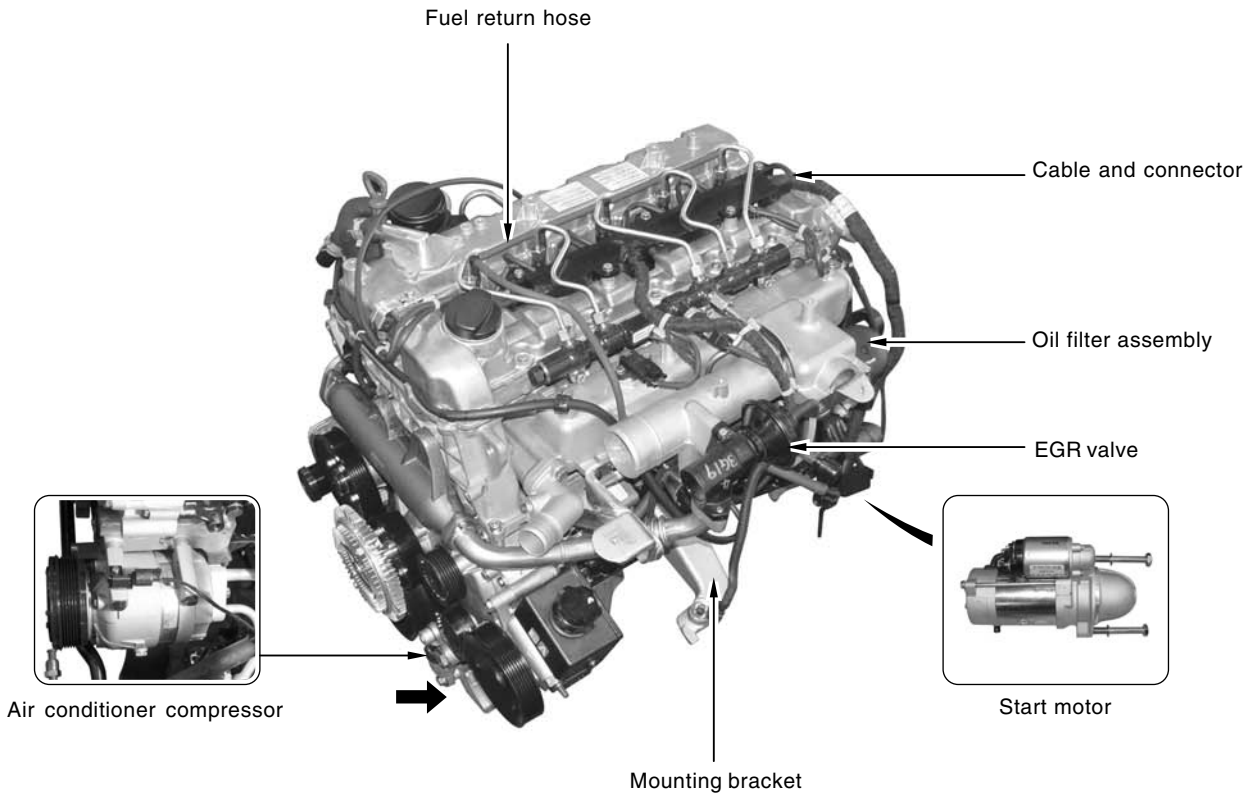
Accessories - Removal and Installation





Y220_01048

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

▶ Removal and Installation Order of Major Accessories

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

* Camshaft Position Sensor
* Crankshaft Position Sensor
* Injector Fuel Line Connector
* Glow Plug Connector
* Fuel Return Hose
* High/Low Pressure Hoses in HP Pump
* Ground Cables
* Fuel Pressure Sensor Connector
* Booster Pressure Sensor Connector
* Knock Sensor Connector
* Coolant Temperature Sensor Connector
* HP Pump: Fuel Temperature Sensor (Green)
  IMV (Brown)

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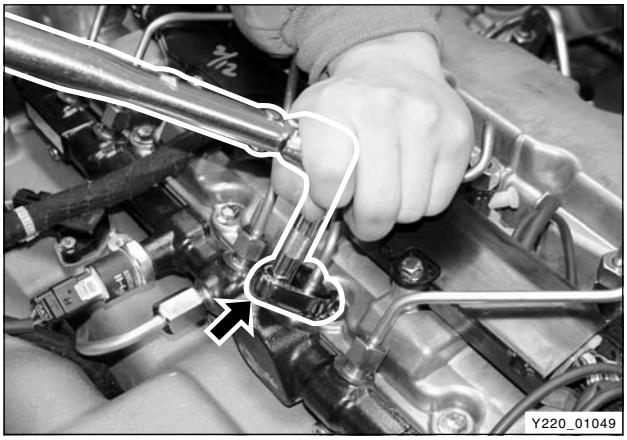
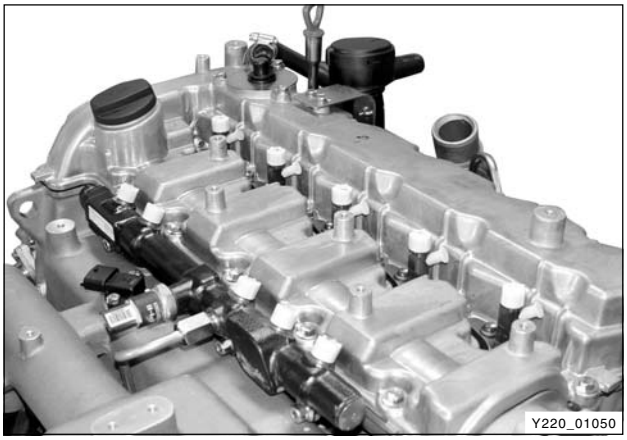


1. Remove the fuel pipes.
   A. Remove the fuel supply pipes between each cylinder and common rail with a special tool.

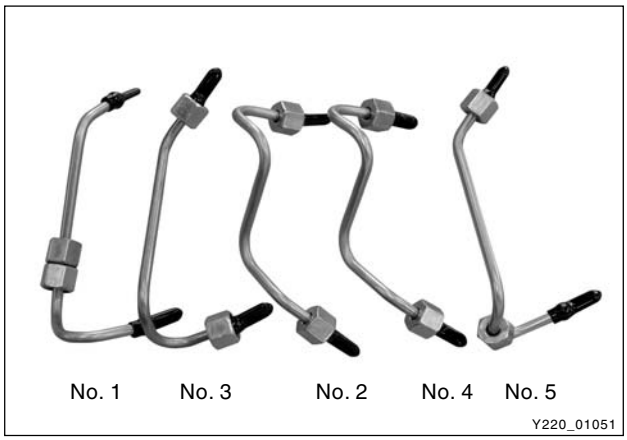
Installation Notice

Tightening torque	40 ± 4.0 Nm

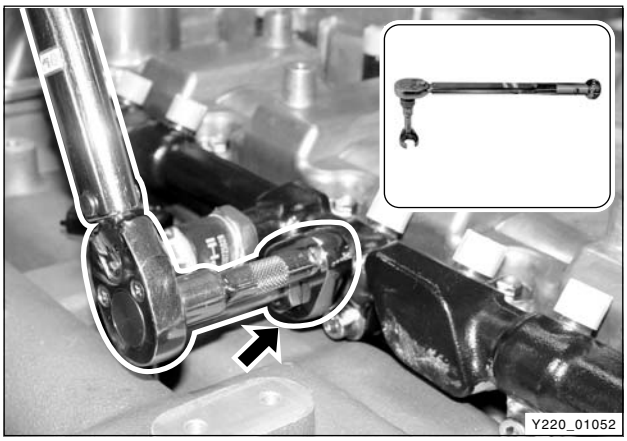


Notice

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



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



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

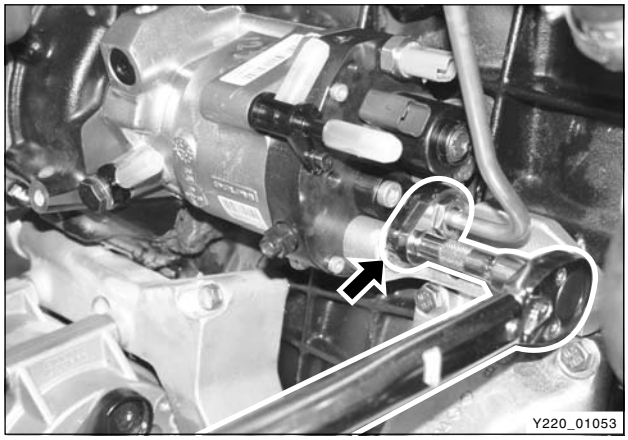
Installation Notice

Tightening torque	40 ± 4 Nm

C. High fuel pressure supply pipe at HP pump side

Installation Notice

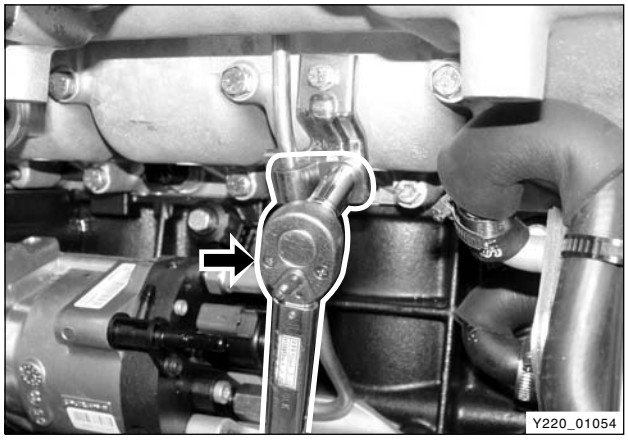
Tightening torque	40 ± 4.0 Nm



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

Note

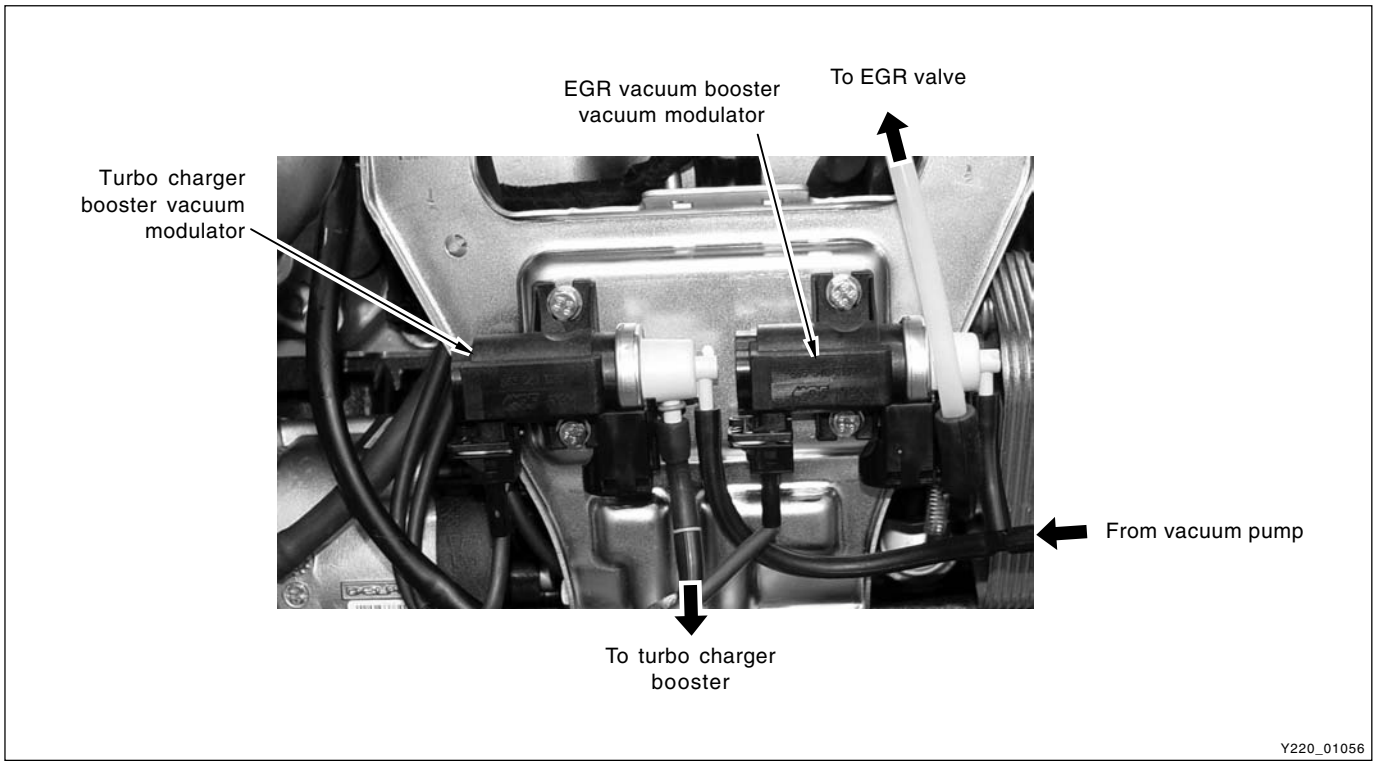
Special tool: Fuel pipe remover and installer

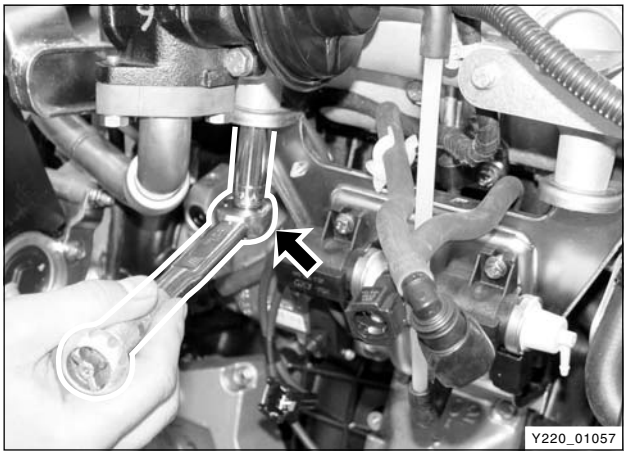


2. Disconnect the vacuum hoses and module cables from the vacuum modulator.

Notice

Put the installation marks on the modulator hoses and connectors.



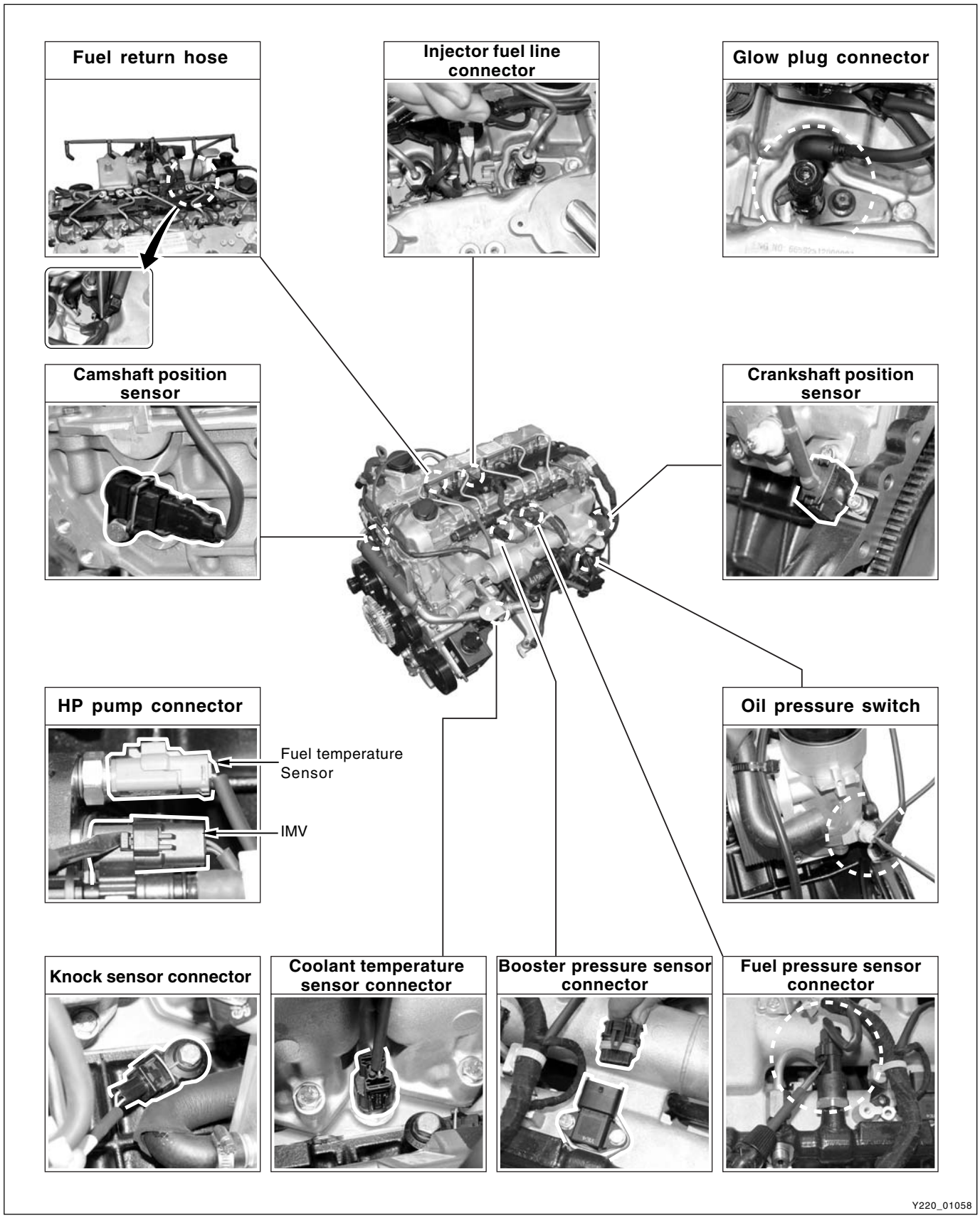


A. Remove the vacuum modulator bracket.
(Upper: 10 M x 2, Lower: 10M x 2)

Installation Notice

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

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



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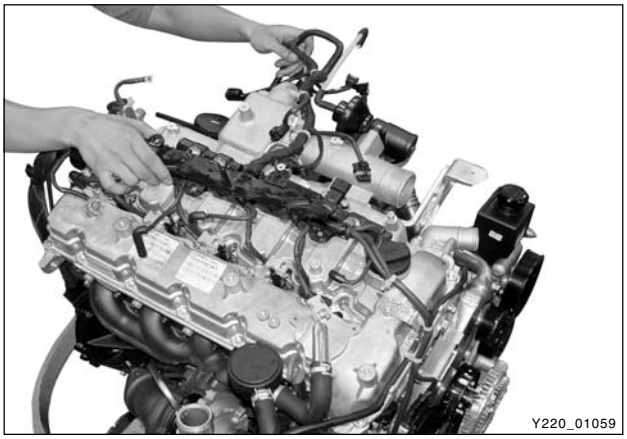
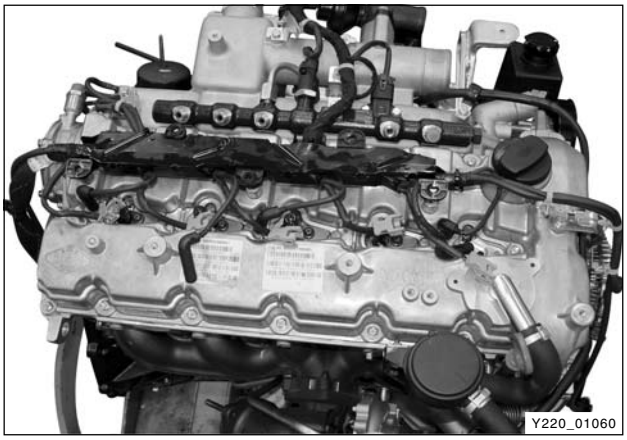


A. Remove the cable assembly from the engine.

Important

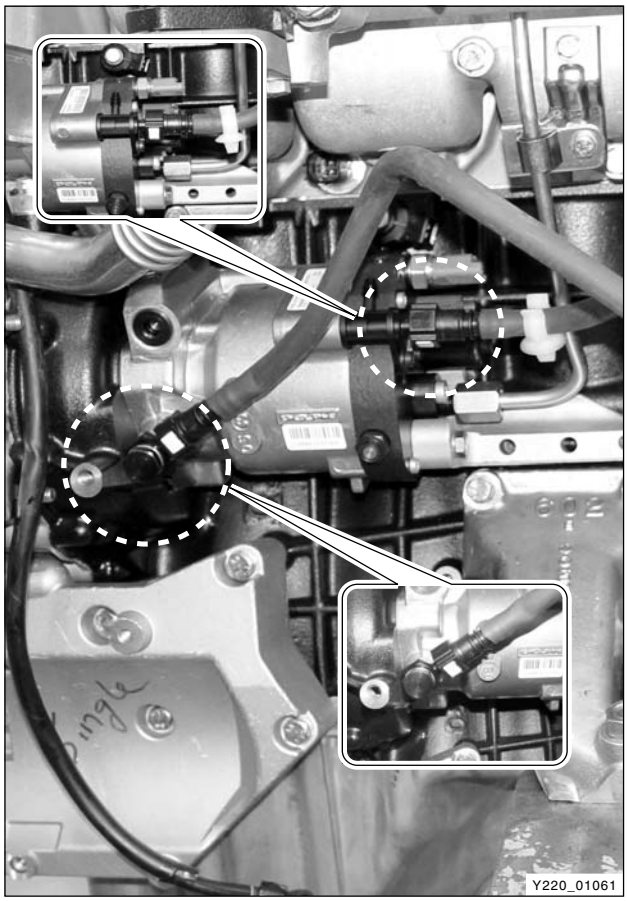
1. ***If possible, remove the cables after removing the fuel pipes. It make the operation easier and protect the cables and connectors.***



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

Notice

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



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

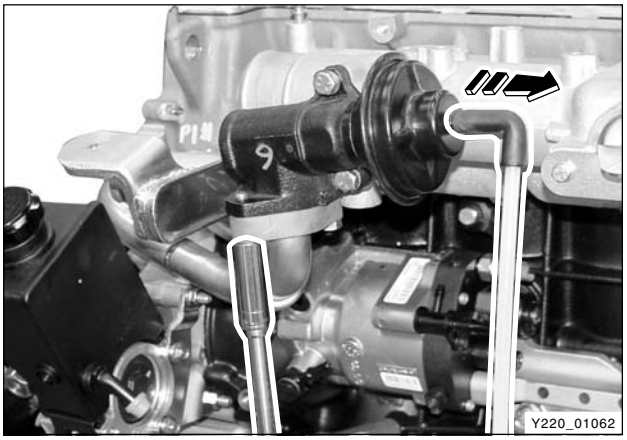
Notice

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

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

Installation Notice

EGR valve bolt	25 ± 2.5 Nm
EGR valve and center pipe bolt	25 ± 2.5 Nm



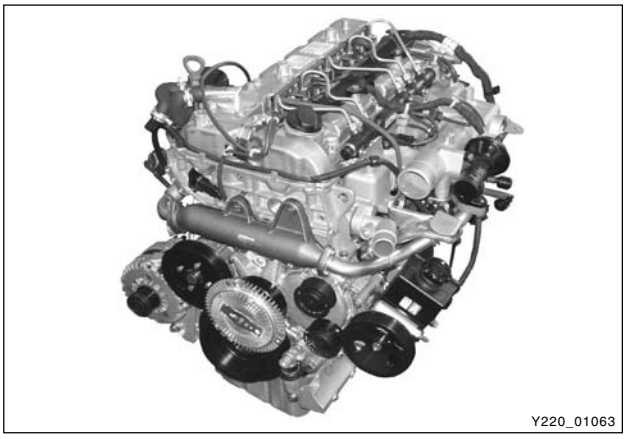
   C. Remove the EGR valve #1 pipe.

Installation Notice

Center pipe bolt	35 ± 3.5 Nm
Center pipe and #1 pipe bolt and nut	35 ± 3.5 Nm

Notice

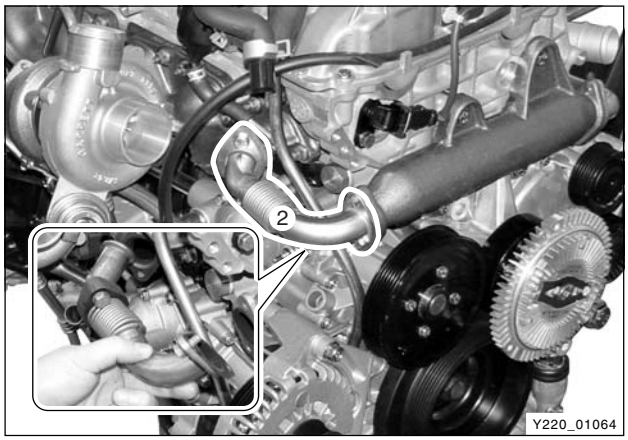
The EGR #2 pipe should be replaced with new one.



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

Installation Notice

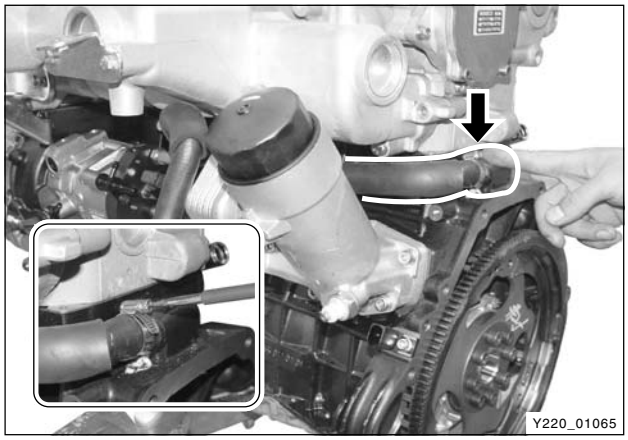
Tightening torque	35 ± 3.5 Nm

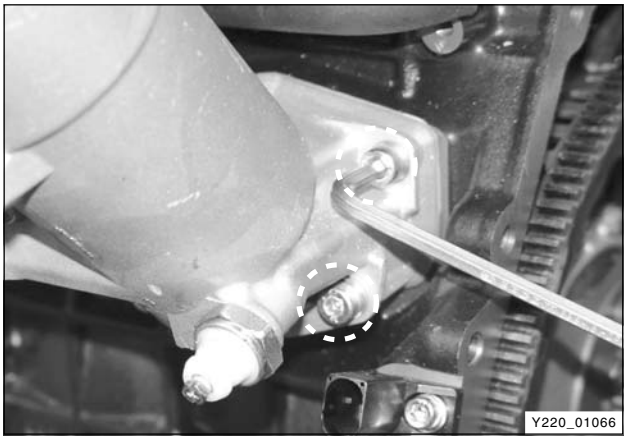


Notice

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

6. Remove the oil filter assembly.
   A. Remove the oil cooler hose.

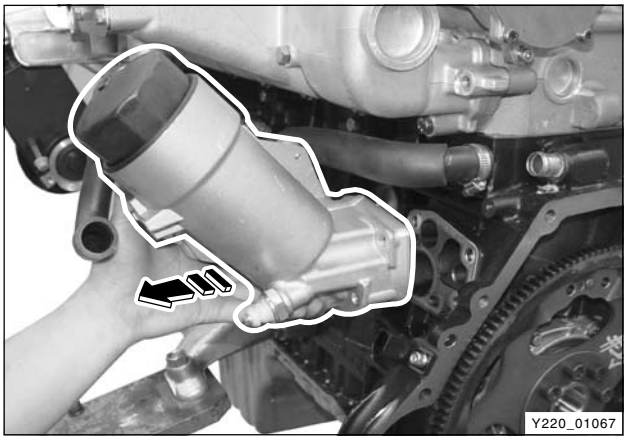




B. Remove the oil filter assembly mounting bolts.

Notice

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

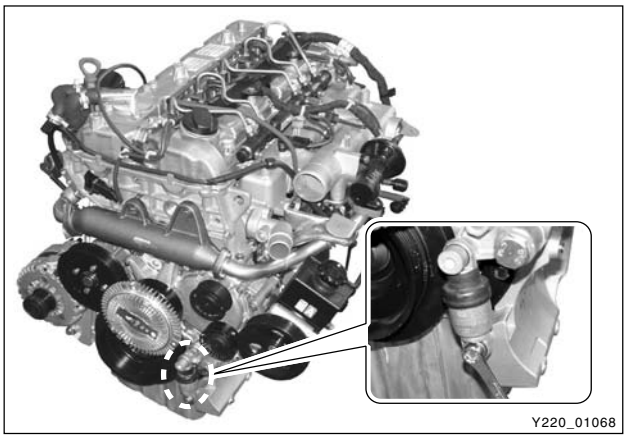


C. Remove the oil filter assembly from the cylinder block.

Installation Notice

- Replace the oil filter gasket with new one.

Tightening torque	25 ± 2.5 Nm

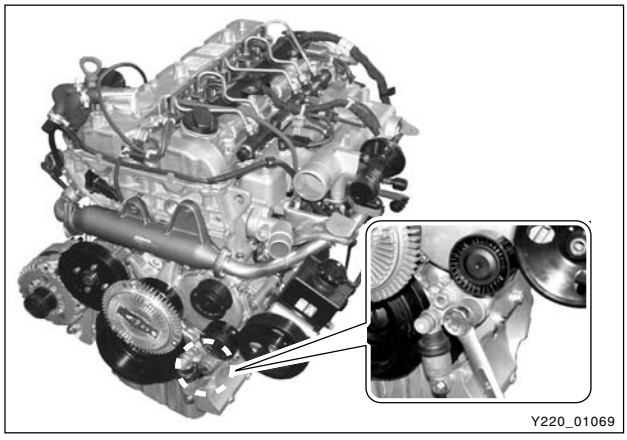


7. Remove the belt tensioning device.

A. Remove the shock absorber lower mounting bolt.

Installation Notice

Tightening torque	32 ± 3 Nm



B. Remove the shock absorber upper mounting bolt.

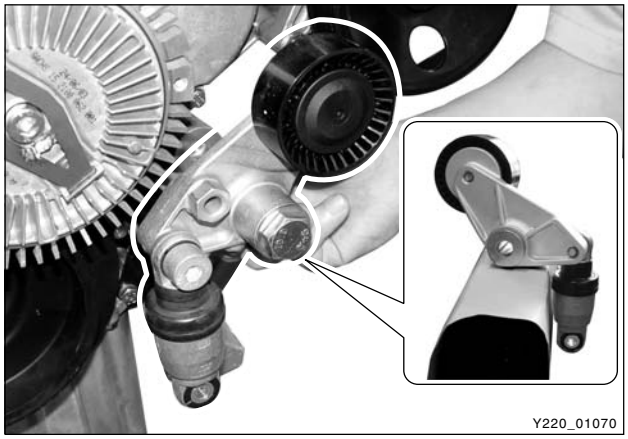
Installation Notice

Tightening torque	82 ± 6 Nm

C. Remove the belt tensioning device.

Notice

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


Y220_01070

7. Remove the power steering pump assembly.

A. Remove the power steering pump mounting bolts.

Installation Notice

Tightening torque	25 ± 2.5 Nm

Notice

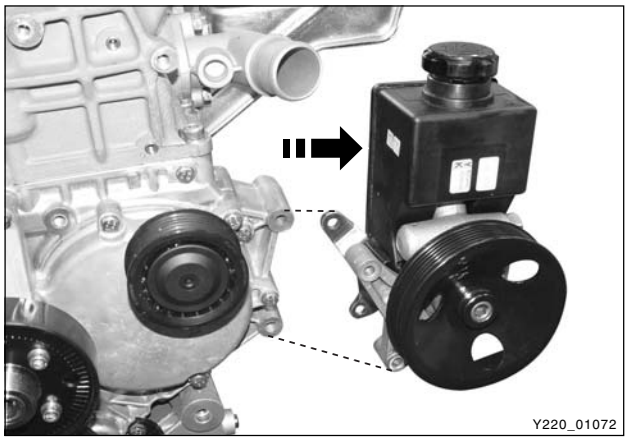
Be careful not to flow out the oil.


Y220_01071

B. Remove the power steering pump assembly from the engine.

Notice

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

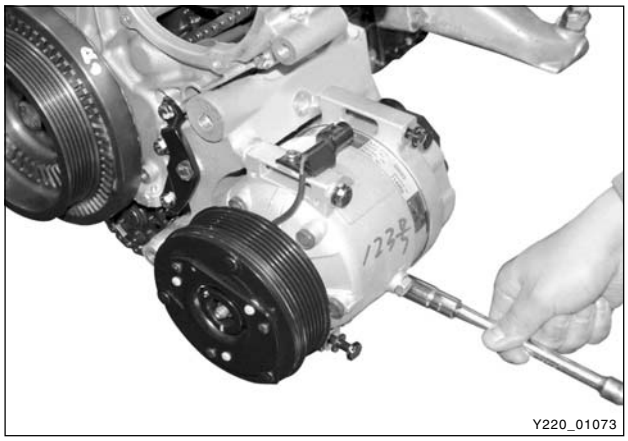

Y220_01072

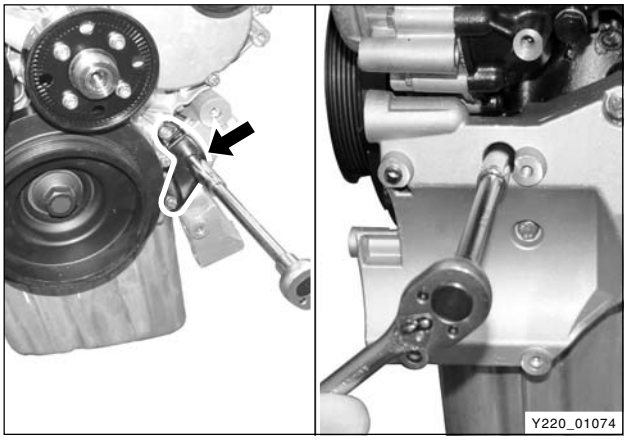
8. Remove the air conditioner compressor assembly.

A. Unscrew the bolts and remove the air conditioner compressor assembly.

Installation Notice

Tightening torque	25 ± 2.5 Nm

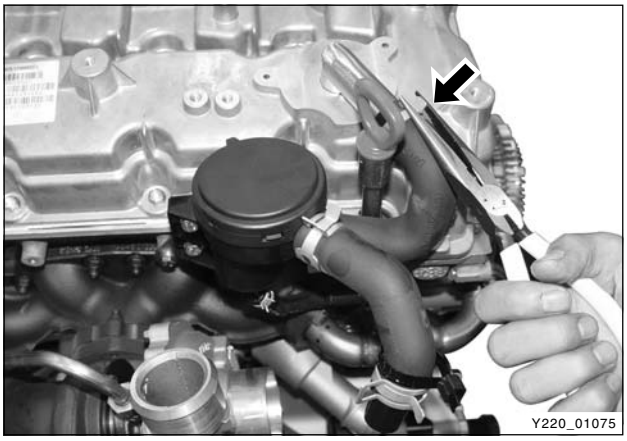

Y220_01073



B. Unscrew the bolts and remove the air conditioner mounting bracket.

Installation Notice

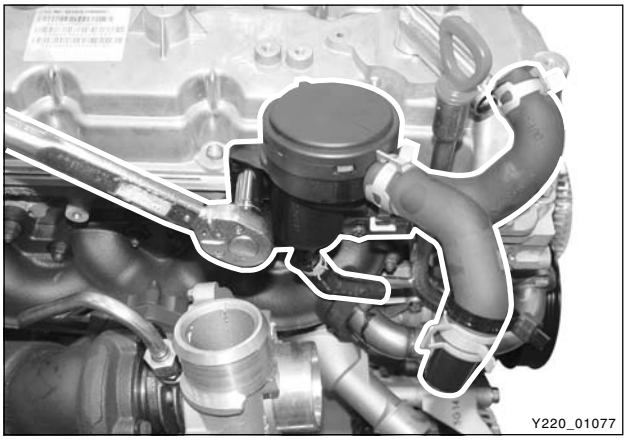
Front bolt	25 ± 2.5 Nm
Side bolt	25 ± 2.5 Nm



9. Remove the PCV valve assembly.

A. Remove the PCV valve hose.

B. Remove the PCV valve hose connected to the engine oil hose.



C. Unscrew the PCV valve mounting bolts and remove the PCV valve assembly.

Installation Notice

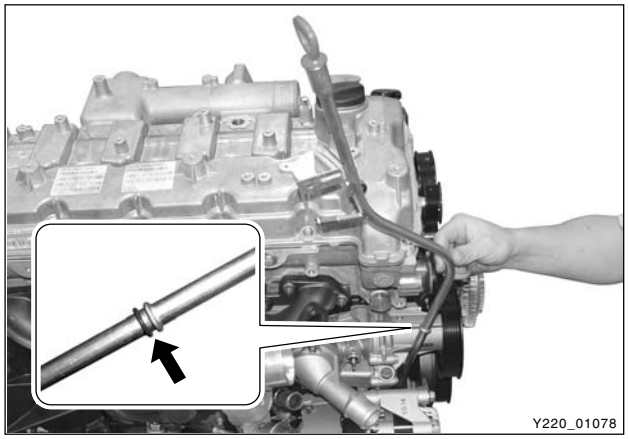
Tightening torque	10 ± 1.0 Nm

10. Remove the oil dipstick tube assembly.

    Unscrew the bracket bolts and remove the dipstick tube with O-ring.

    Installation Notice

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



Installation Notice

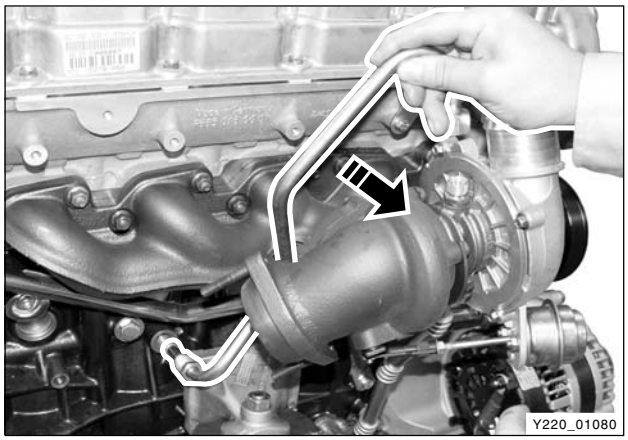
Tightening torque	10 ± 1.0 Nm

11. Remove the turbo charger assembly.

    A. Unscrew the bolts and remove the oil supply pipe.

Installation Notice

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

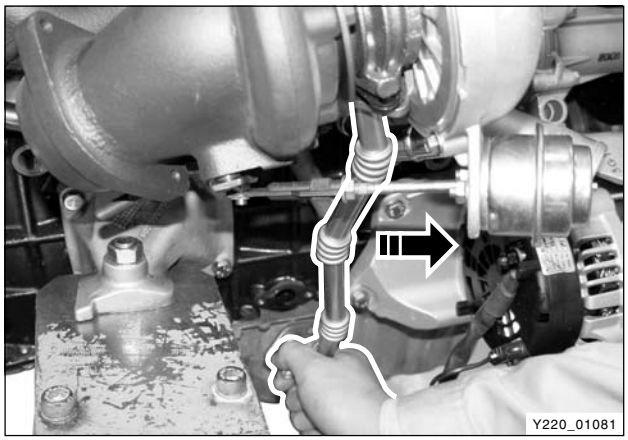


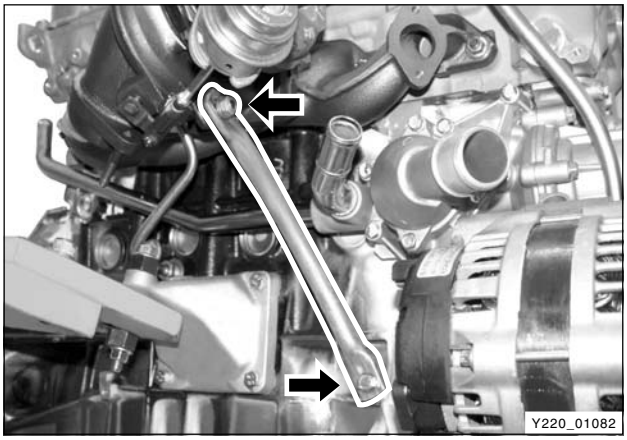
    B. Unscrew the bolts and remove the oil return pipe.

Installation Notice

- Make sure to install the gasket with correct direction.

Tightening torque	10 ± 1.0 Nm

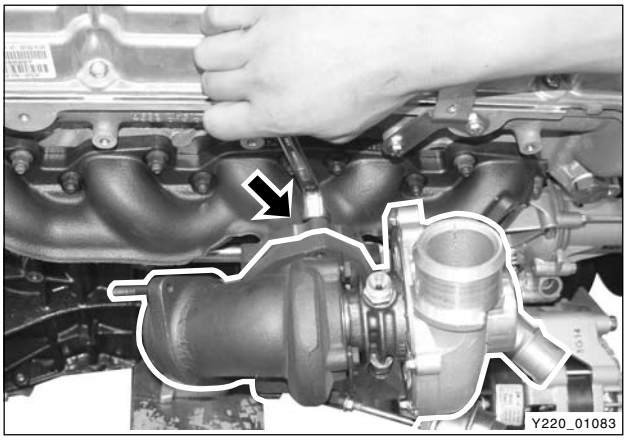




C. Unscrew the turbo charger mounting bracket bolts.

Installation Notice

Tightening torque	25 ± 2.5 Nm



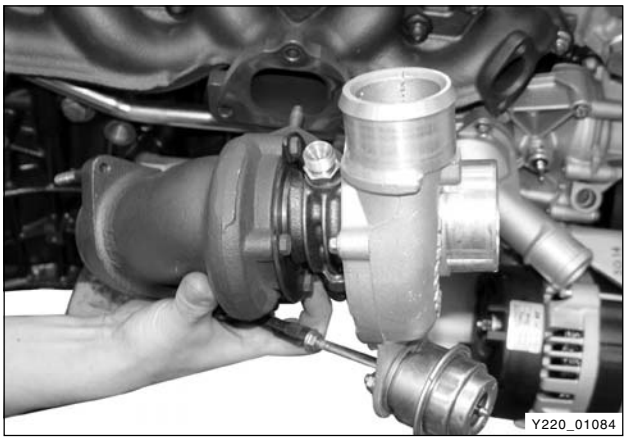
D. Unscrew the turbo charger mounting bolts to exhaust manifold.

Notice

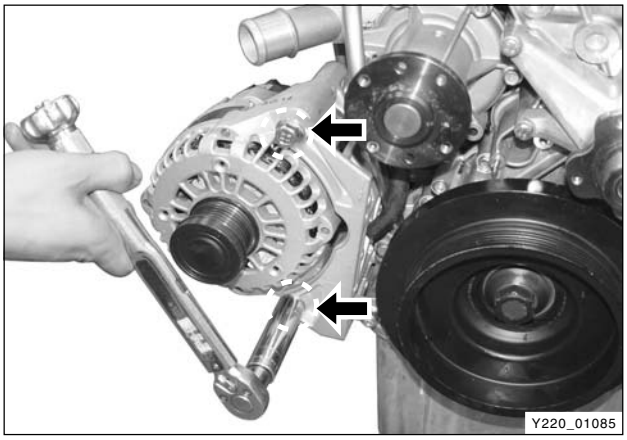
Use only 12 1/2 wrench.

Installation Notice

Tightening torque	25 ± 2.5 Nm



E. Remove the turbo charger assembly.



12. Remove the alternator assembly.
    A. Unscrew the bolts and remove the alternator.

Note

Alternator Capacity: 140 A

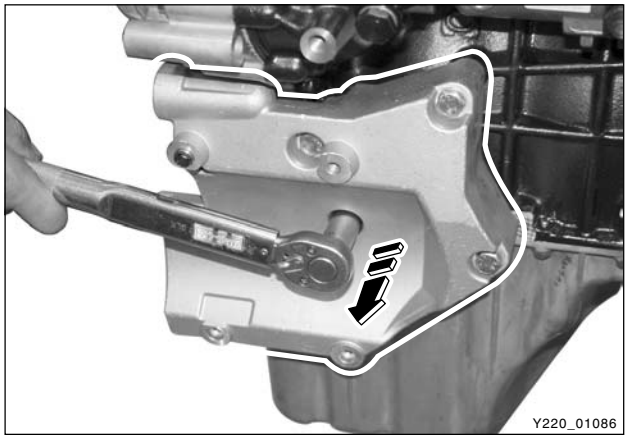
Installation Notice

Tightening torque	46 ± 4.6 Nm

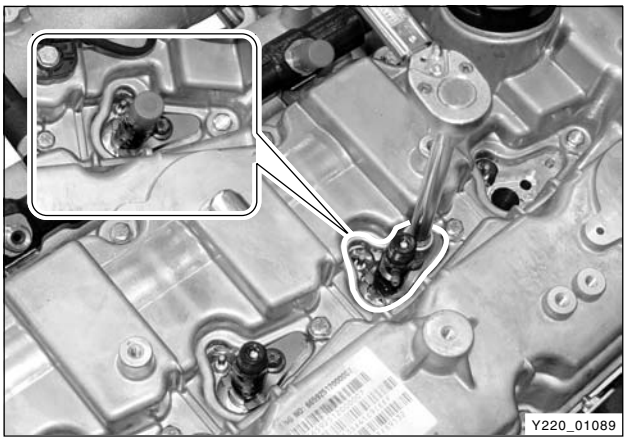
B. Remove the alternator mounting bracket.

Installation Notice

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



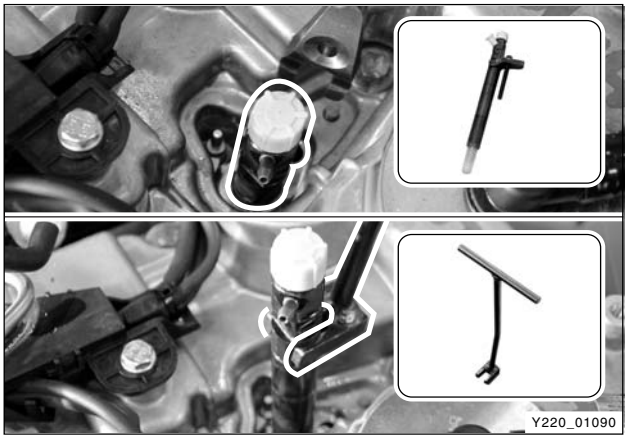
Engine - Disassembly and Reassembly



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

   Installation Notice

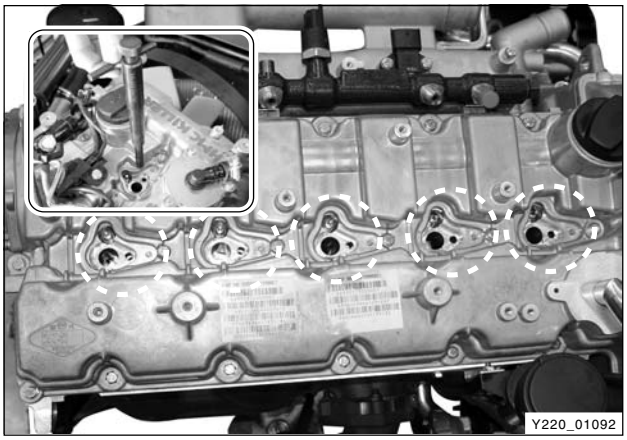
Tightening torque	9 ± 1.0 Nm, 190° + 10°



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

   Notice

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

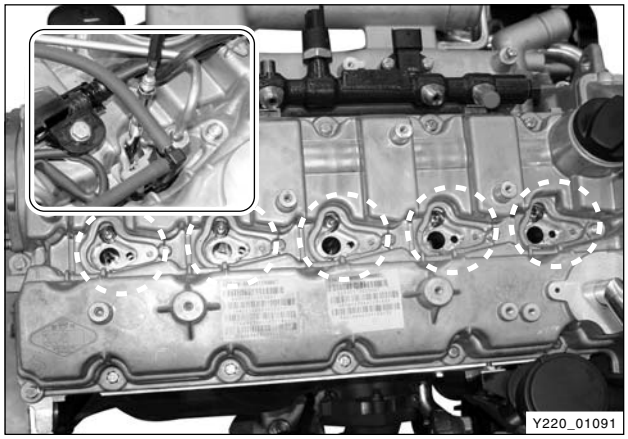


3. If the copper washer is in injector hole, remove it with a special tool as shown in the figure.

4. Remove the glow plugs with a special tool.

Installation Notice

Tightening torque	15 ± 3 Nm



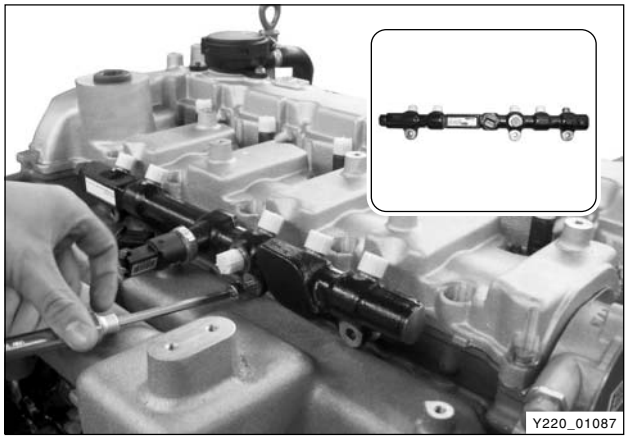
5. Unscrew the Torx bolts and remove the common rail from the engine.

Installation Notice

Tightening torque	25 ± 2.5 Nm

Notice

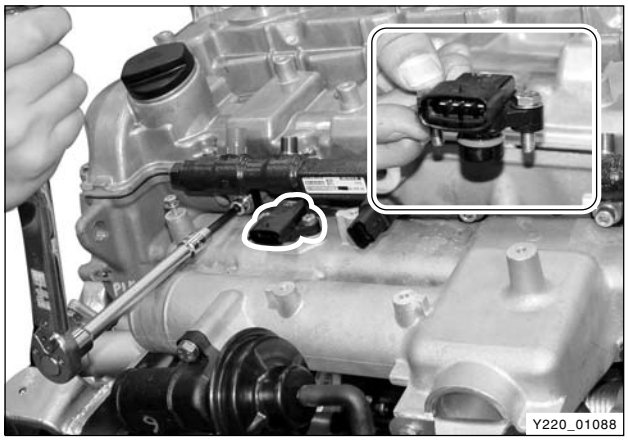
Plug the openings with sealing cap.



6. Remove the booster sensor from the engine.

Installation Notice

Tightening torque	10 ± 1.0 Nm

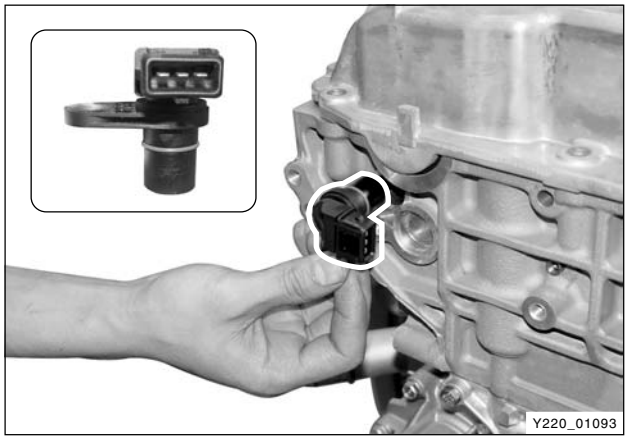


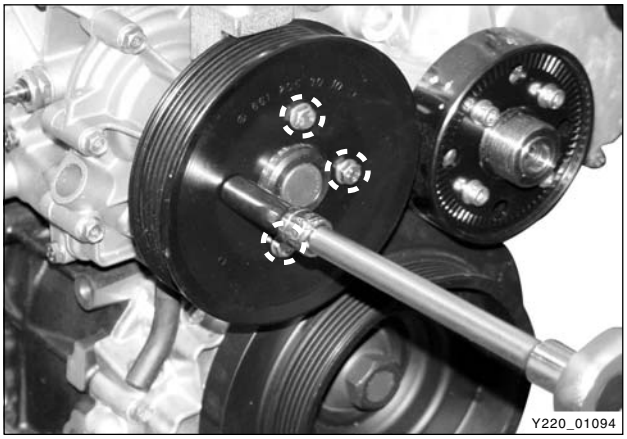
7. Unscrew the bolt and remove the camshaft position sensor.

Installation Notice

Tightening torque	12 ± 1.7 Nm

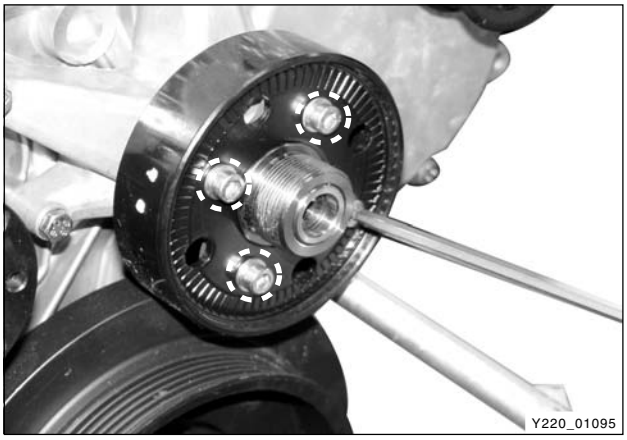
- Apply Loctite on the thread before installation.





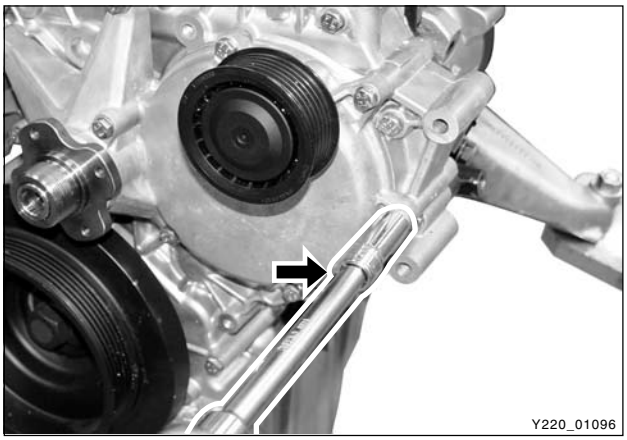
8. Unscrew the bolts and remove the cooling fan pulley while holding it with a special tool.

Tightening torque	10 ± 1.0 Nm



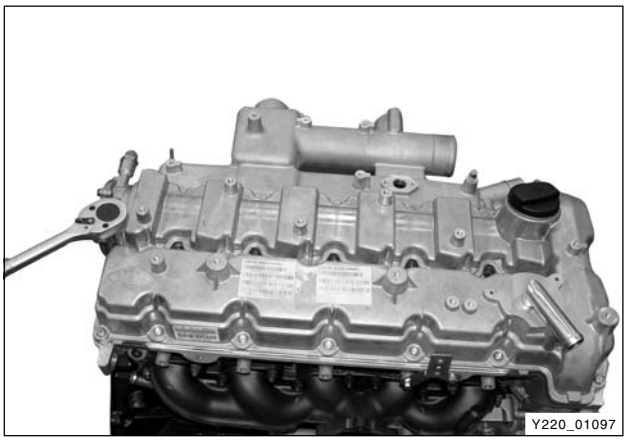
9. Remove the cooling fan belt idle pulley while holding it with a special tool.

Tightening torque	10 ± 1.0 Nm



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

Tightening torque	10 ± 1.0 Nm



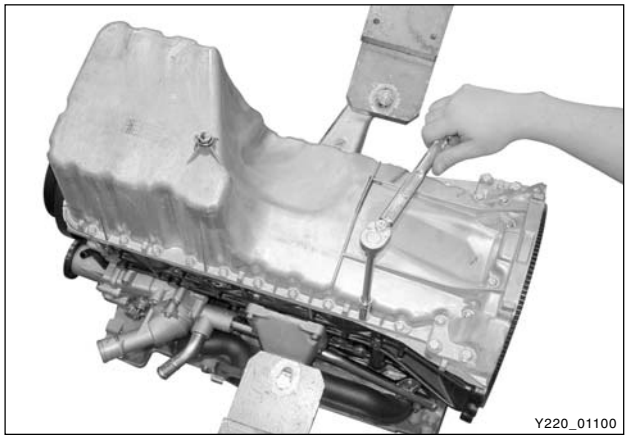
11. Unscrew the bolts and remove the cylinder head cover.

Tightening torque	10 ± 1.0 Nm

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

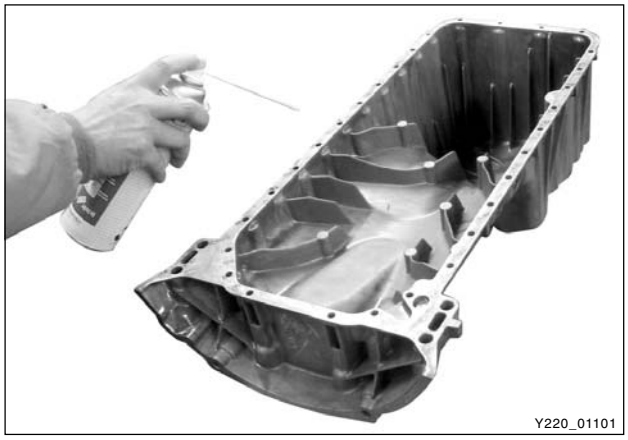
Installation Notice

Tightening torque	Nm
M6 x 20: 24 EA	10 ± 1.0
M6 x 35: 2 EA	10 ± 1.0
M6 x 85: 2 EA	10 ± 1.0
M8 x 40: 4 EA	25 ± 2.5



Installation Notice

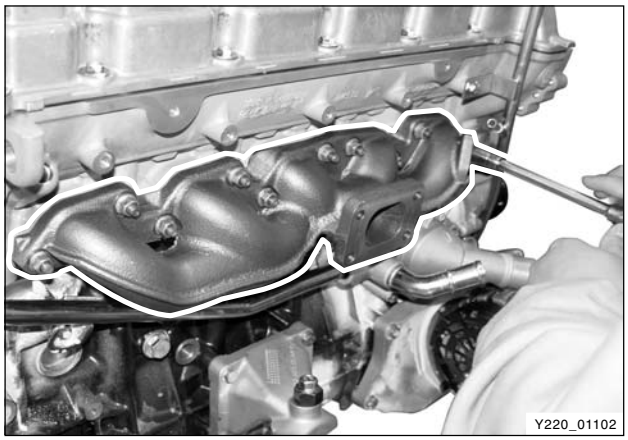
Remove the oil seal residues from the oil pan and apply the liquid gasket on the parting surface.



13. Unscrew the nuts and remove the exhaust manifold.

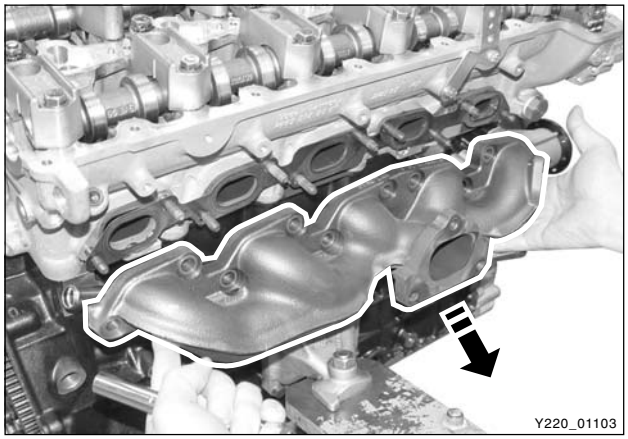
Installation Notice

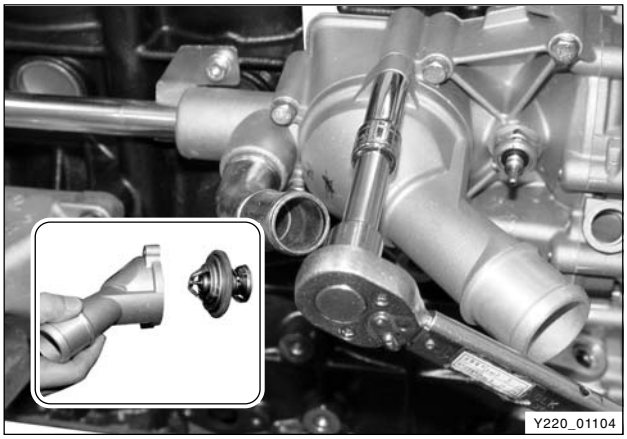
Tightening torque	40 ± 4.0 Nm



Notice

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





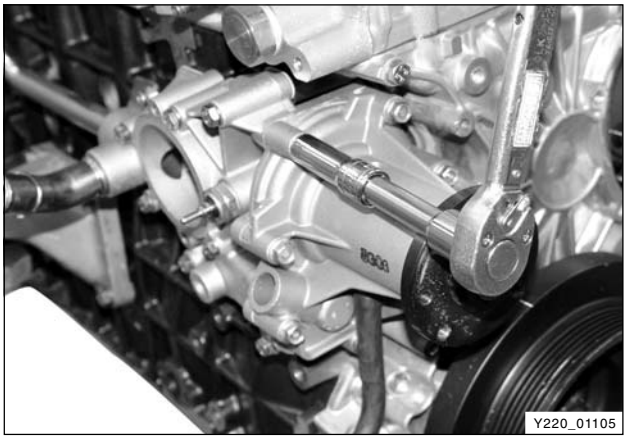
14. Unscrew the bolts and remove the thermostat.

Installation Notice

Tightening torque	10 ± 1.0 Nm

Notice

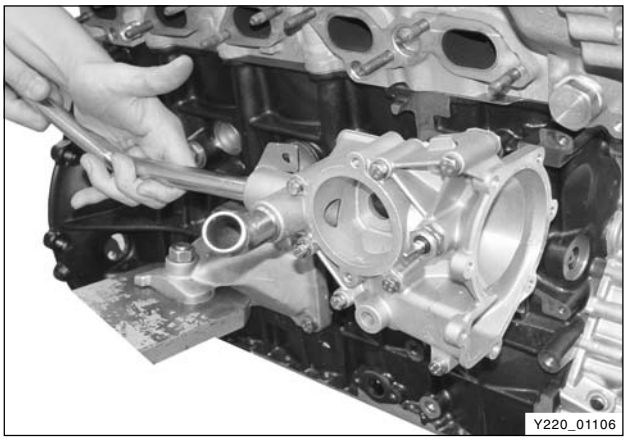
Be careful not to flow out the residual coolant.



15. Unscrew the bolts and remove the water pump.

Installation Notice

Tightening torque	10 ± 1.0 Nm



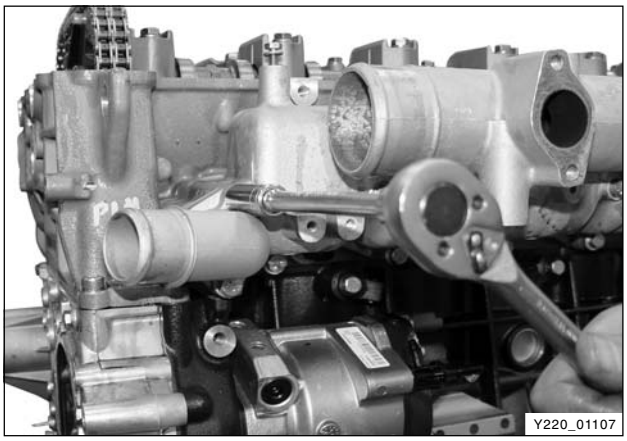
16. Unscrew the bolts and remove the water pump housing.

Installation Notice

Tightening torque	10 ± 1.0 Nm

Notice

Be careful not to flow out the residual coolant.



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

Installation Notice

Tightening torque	25 ± 2.5 Nm

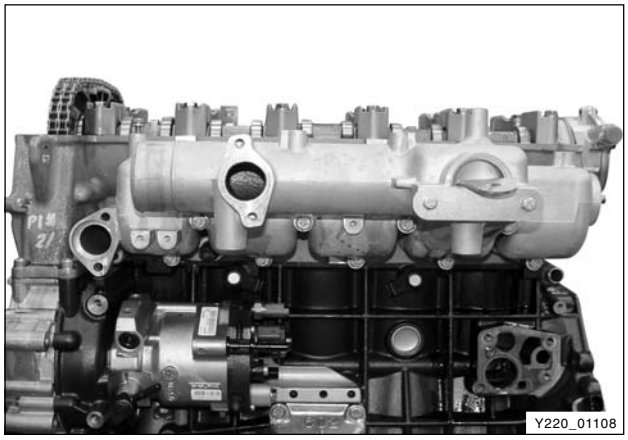
Notice

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

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

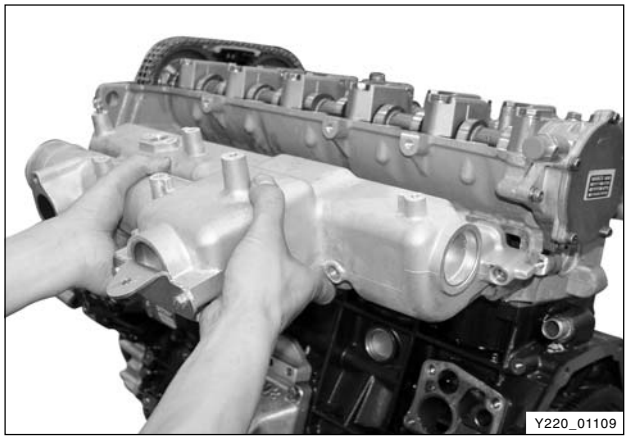
Installation Notice

Tightening torque	25 ± 2.5 Nm


Y220_01108

Notice

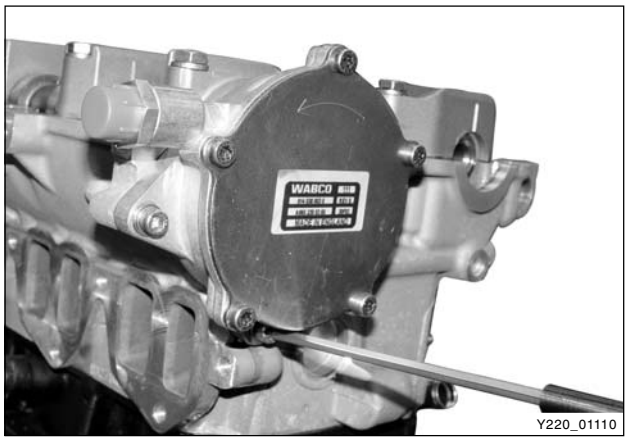
Replace the gasket with new one once removed.


Y220_01109

19. Remove the vacuum pump from the cylinder head.

Installation Notice

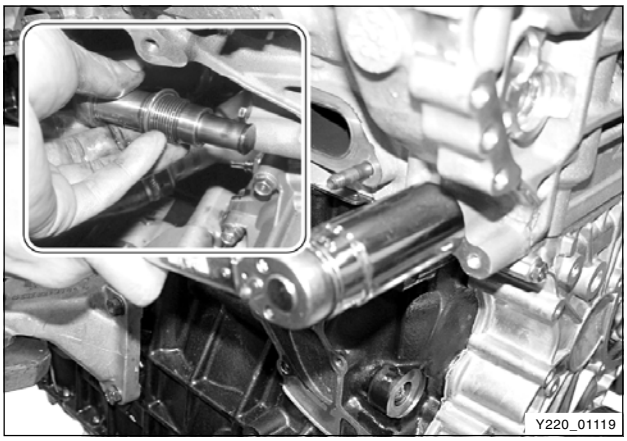
Tightening torque	10 ± 1.0 Nm



Y220_01110

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

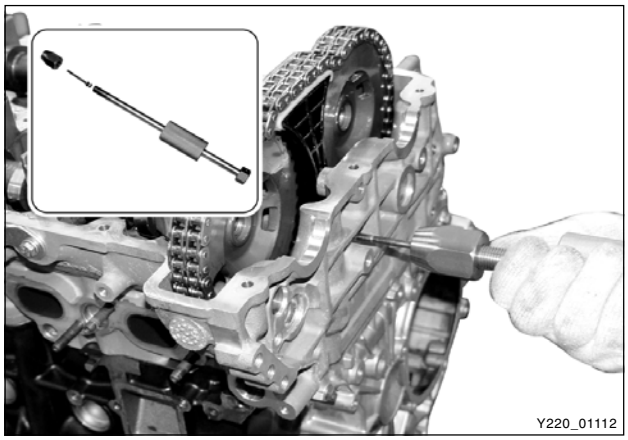

Y220_01111



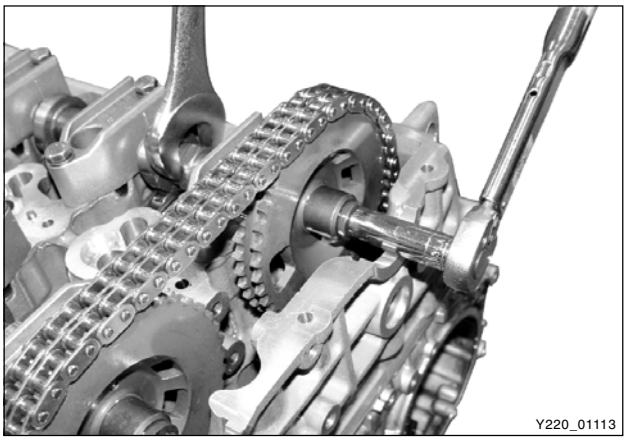
21. Remove the chain tensioner.

※ Preceding works: removal of EGR pipe and oil dipstick tube

Tightening torque	65 ± 5.0 Nm



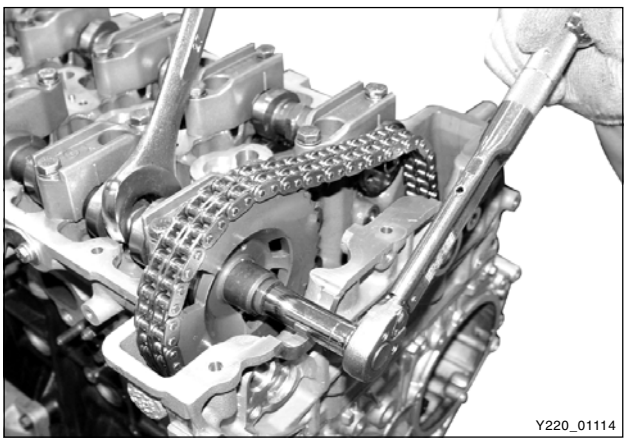
22. Pull out the lock pin and remove the upper chain guide bracket.



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

Installation Notice

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



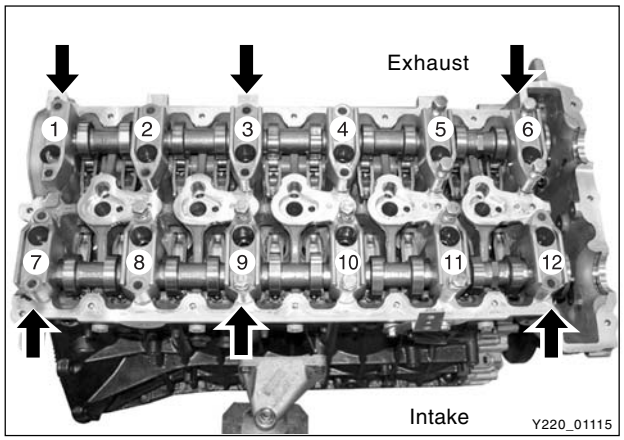
24. Unscrew the bolt and remove the exhaust camshaft sprocket.

Installation Notice

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

25. Remove the camshaft bearing cap bolts so that the tightening force can be relieved evenly.
    - Intake: #1, #3, #6
    - Exhaust: #7, #9, #12

    * However, there is no specific removal sequence.

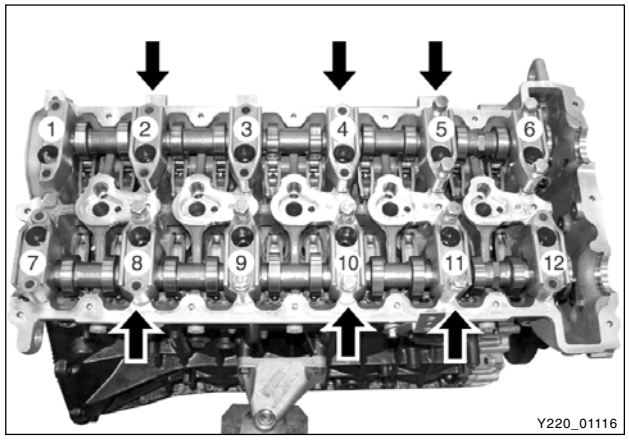


    - Intake: #2, #4, #5
    - Exhaust: #8, #10, #11

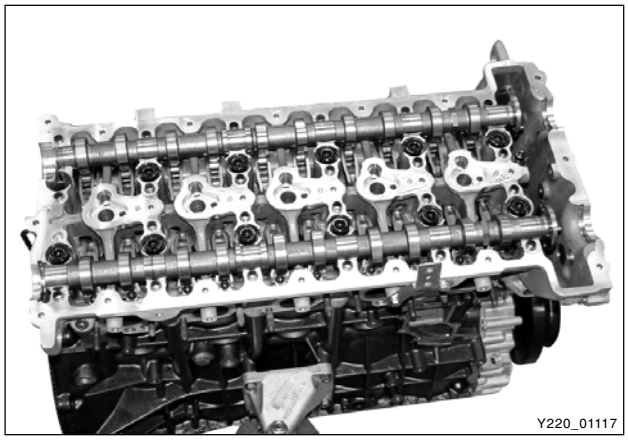
    * Do not remove the bolts at a time completely. Remove them step by step evenly or camshaft can be seriously damaged.

    Installation Notice

Tightening torque	25 ± 2.5 Nm



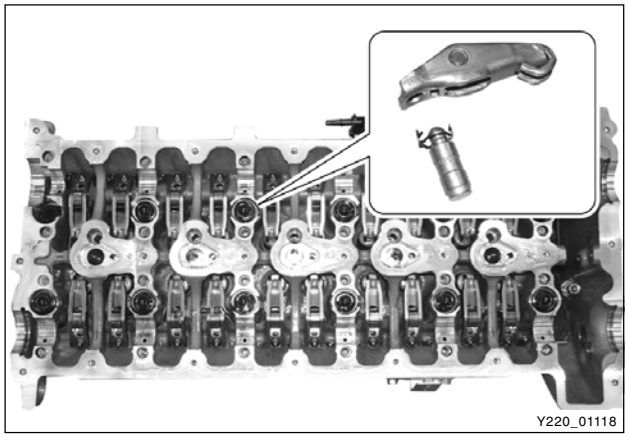
26. Remove the intake and exhaust camshafts from the cylinder head.

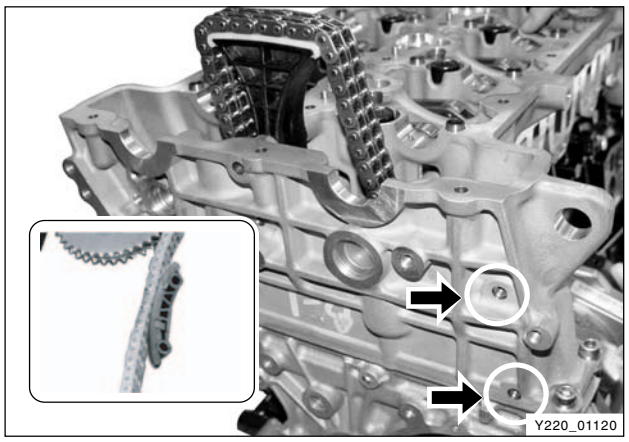


27. Remove the finger follower and the HLA device.

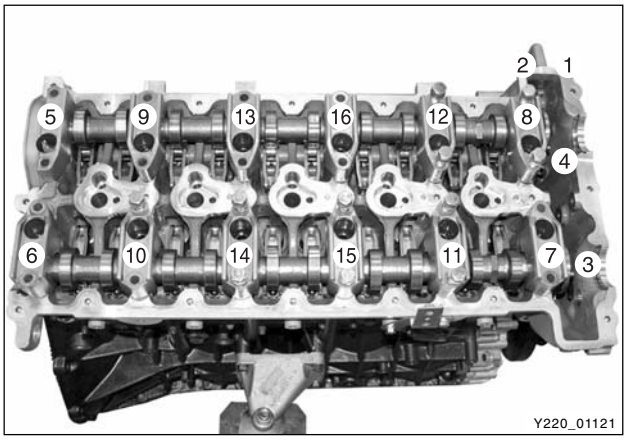
    Notice

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





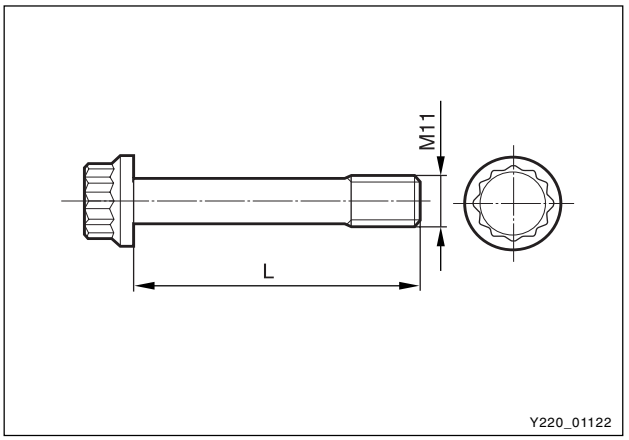
28. Pull out the pin and remove the timing chain guide from the engine.



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

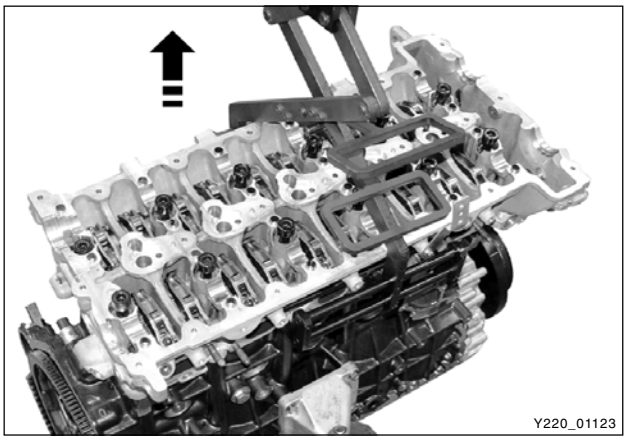
Installation Notice

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



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

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

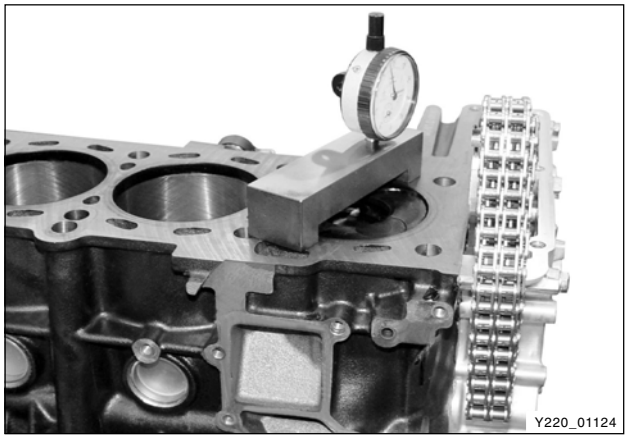


31. Remove the cylinder head.

Notice

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

32. Measure the piston protrusion from the parting surface.
    - Specified Value: 0.765 ~ 1.055 mm

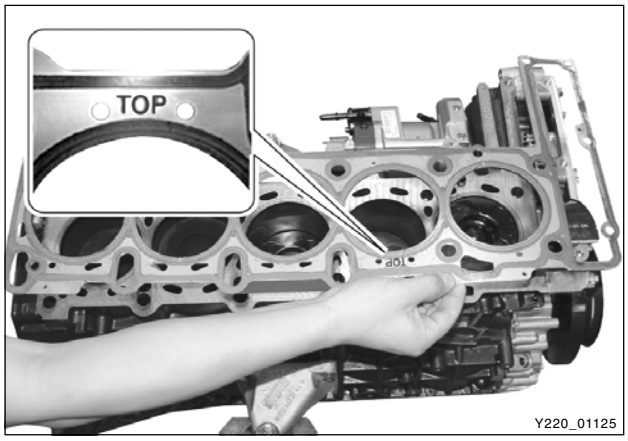


33. Remove the cylinder head gasket.

Installation Notice

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

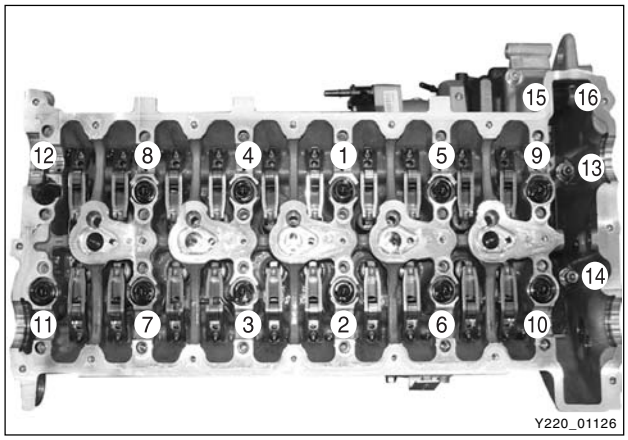
1. ***Put the steel gasket on the cylinder block and position the cylinder head.***



2. ***Tighten the cylinder head bolts to specified torque and torque angle.***

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

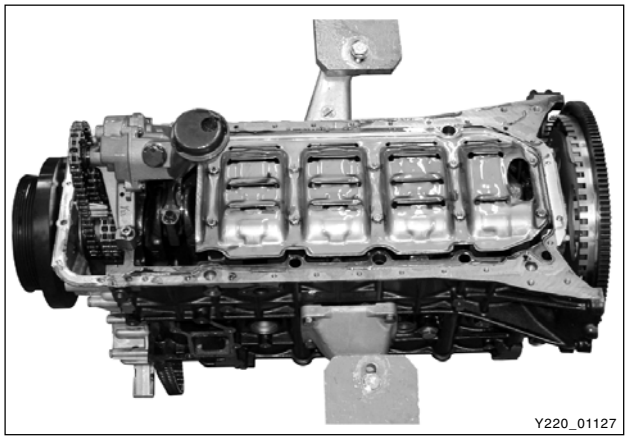
- ***Apply the oil on the bolt thread when installing.***
- ***Always insert new washer first.***
- ***The bolts (12) at vacuum pump side are shorter than others.***

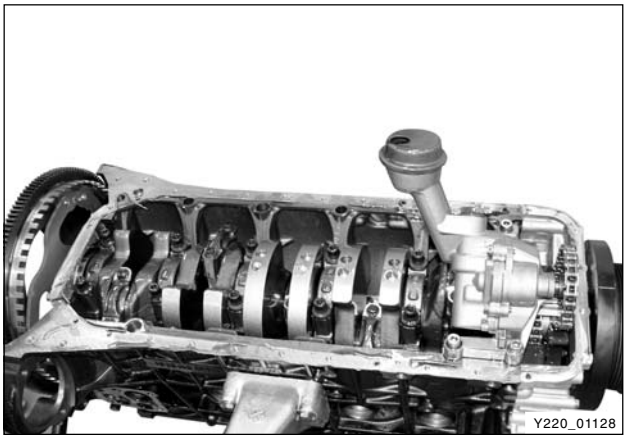


34. Turn over the engine and remove the baffle plate.

Installation Notice

Tightening torque	10 ± 1.0 Nm

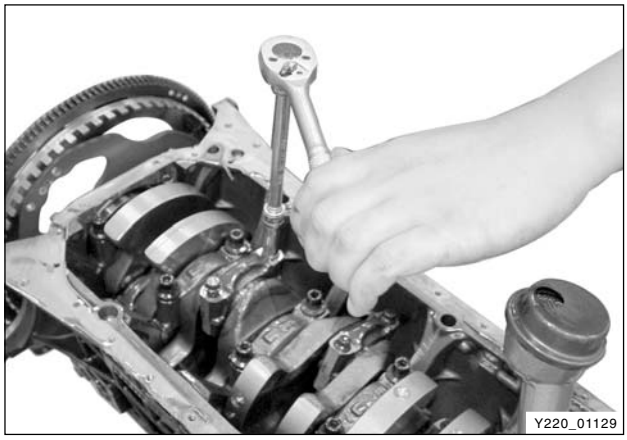




35. Unscrew the bolts and remove the oil strainer assembly.

Installation Notice

Tightening torque	25 ± 2.5 Nm



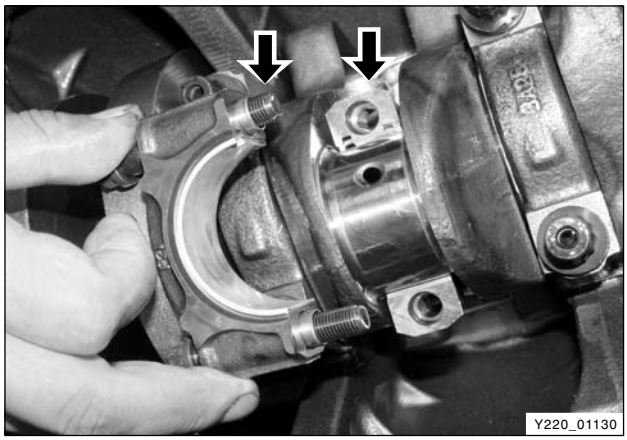
36. Remove the piston assembly from the cylinder block.

A. Unscrew the bearing cap bolts.

Installation Notice

Step 1	55 ± 5.0 Nm
Step 2	90° + 10°

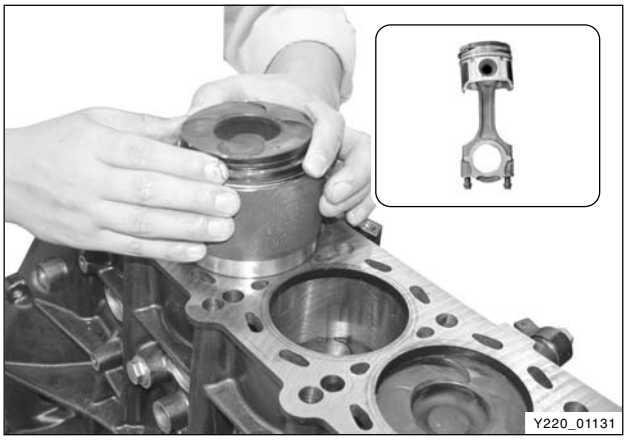
* Tighten the bolts from #1 cap.



Installation Notice

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

B. Remove the bearing caps and lower bearing shells.



C. Remove the piston assembly through the cylinder.

Notice

Do not mix up upper and lower crankshaft bearing shells.

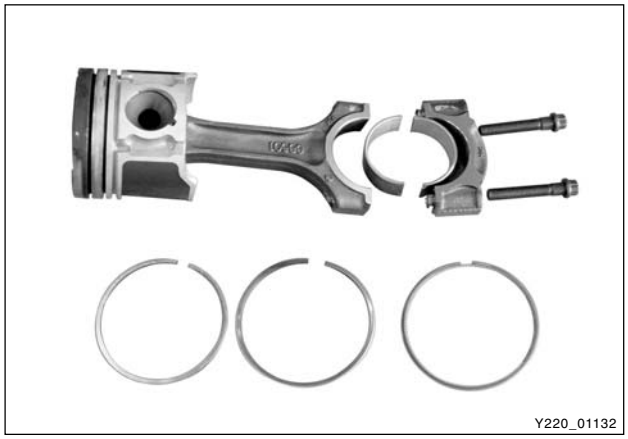
D. Remove the snap ring piston pin from the piston.

E. Disassemble the piston and connecting rod.

F. Remove the piston rings from the piston.

Installation Notice

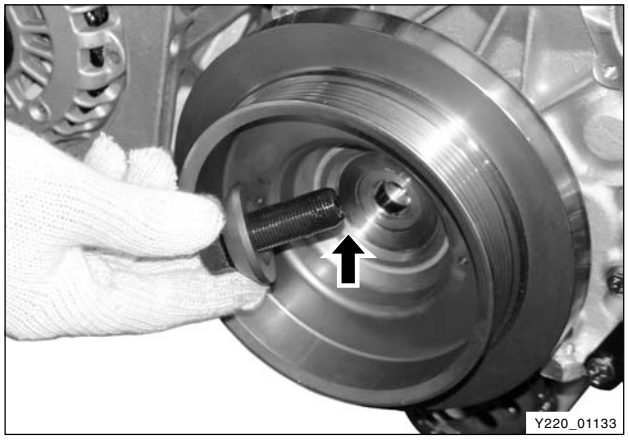
Replace the piston ring, bearing and snap ring with new ones.



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

Installation Notice

Tightening torque	325 ± 33 Nm, 90° + 10°

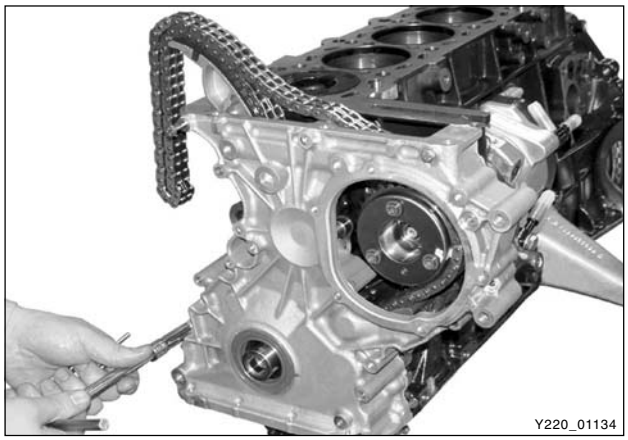


38. Remove the timing chain cover assembly.

A. Remove the cover bolts.

Installation Notice

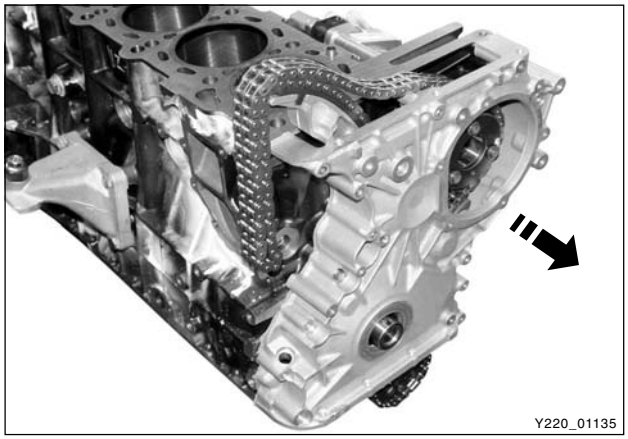
Tightening torque	10 ± 1.0 Nm

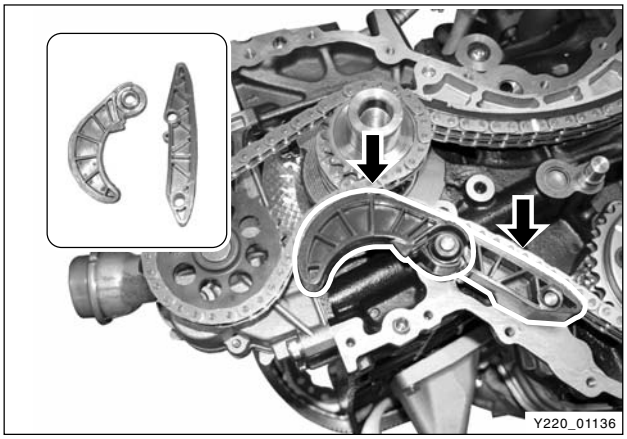


B. Hold the timing chain and remove the timing chain cover by tapping it with a rubber hammer and a screwdriver.

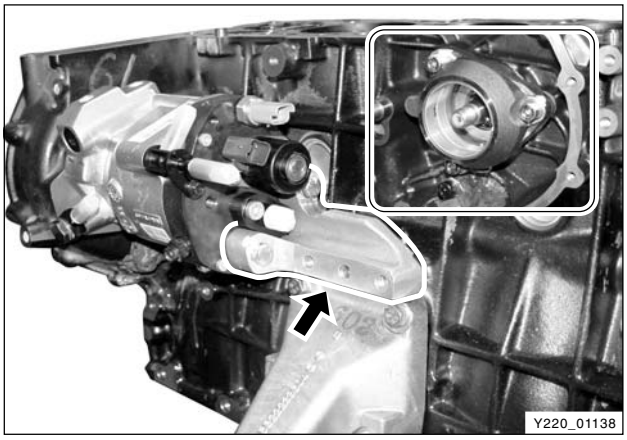
Installation Notice

Apply the sealant on the parting surface.

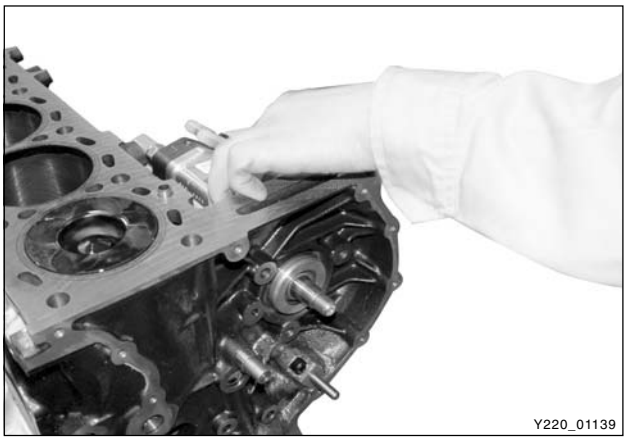




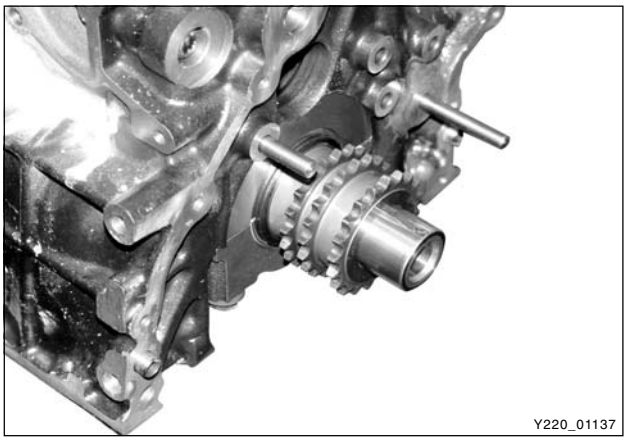
39. Remove the timing chain guide rail and timing chain.



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



- Remove the HP pump assembly.



41. Remove the crankshaft sprocket with a special tool.

42. Remove the flywheel and the crankshaft strainer.

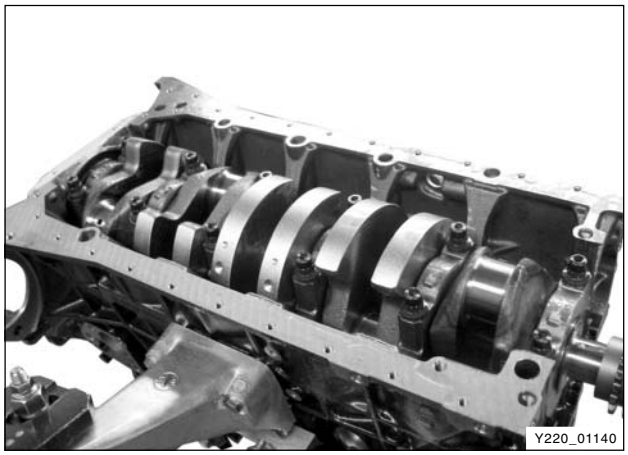
Installation Notice

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

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

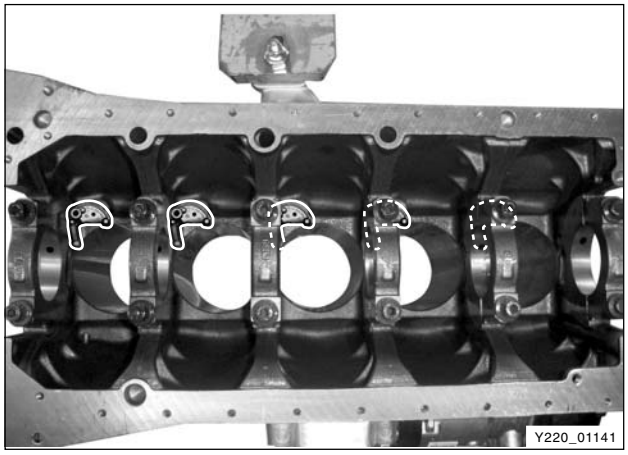
Installation Notice

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



Notice

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



Note

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

SECTION DI02

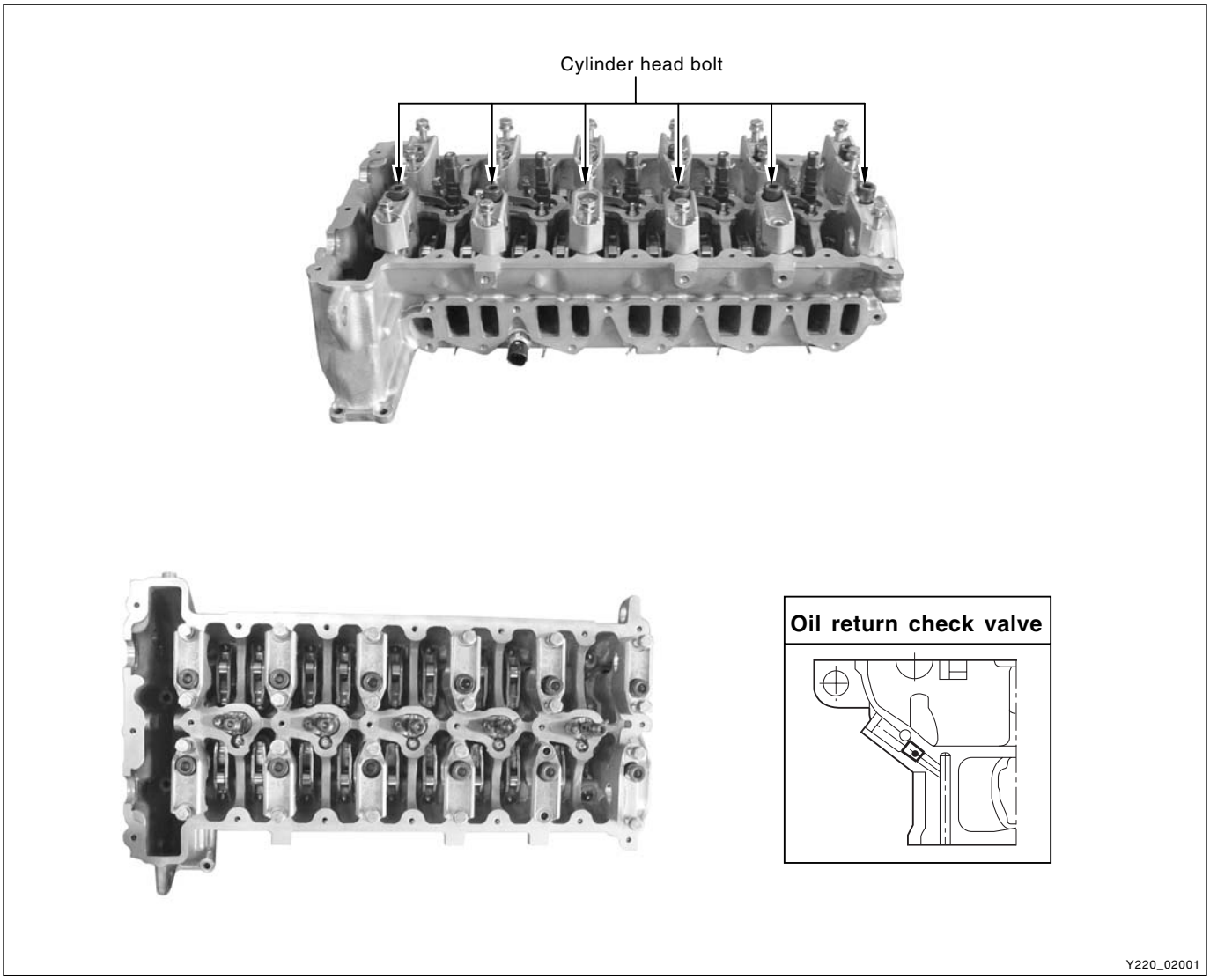
ENGINE HOUSING

Table of Contents

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

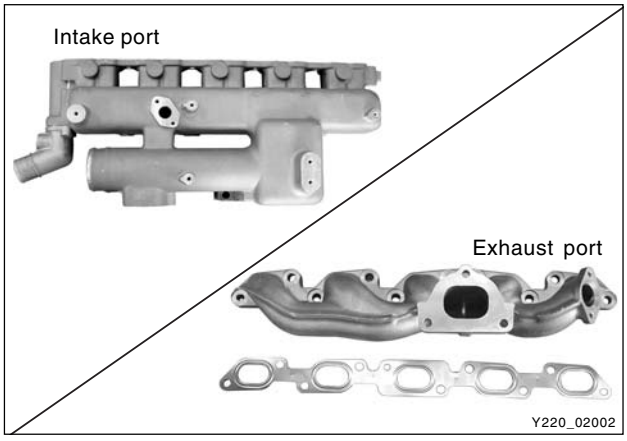
CYLINDER HEAD/CYLINDER BLOCK

CYLINDER HEAD



▶ System Characteristics

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

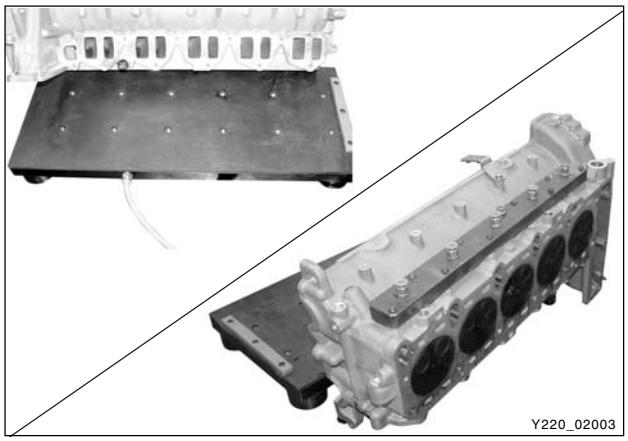


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Cylinder Head Pressure Leakage Test

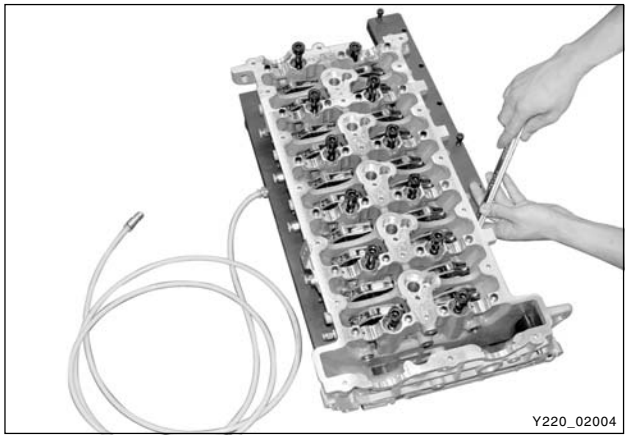
※ Preceding Works:

- Removal of cylinders
- Removal of intake and exhaust manifold
- Removal of valves



Test Procedures

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



2. Install the cylinder head on the pressure plate.

Tightening torque	60 Nm

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

Notice

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

▶ Cylinder Head Parting Surface Check

Specifications

Height “A” (cylinder head parting surface - cylinder head cover parting surface)		142.9 ~ 143.1 mm
Minimum height after machining		142.4 mm
Permissible unevenness of parting surface	in longitudinal direction	0.08 mm
	in transverse direction	0.0 mm
Permissible variation of parallelism of top parting surface to bottom in longitudinal direction		within 0.1 mm
Peak-to-valley height		0.004 mm
Valve recess “a”	Intake valve	0.1 ~ 0.7 mm
	Exhaust valve	0.1 ~ 0.7 mm

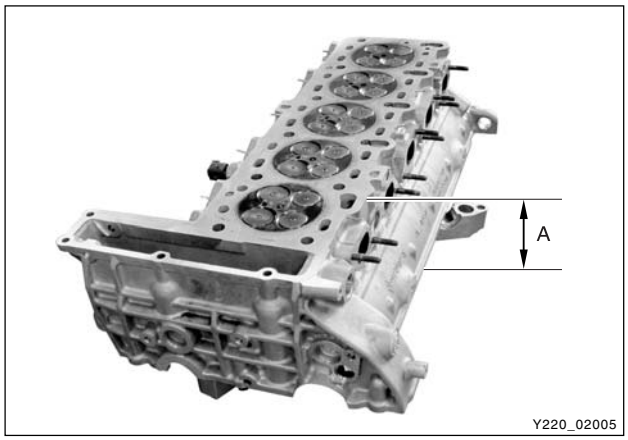
Measurement

1. Measure the cylinder head height “A”.

Limit	Over 142.4 mm

Notice

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

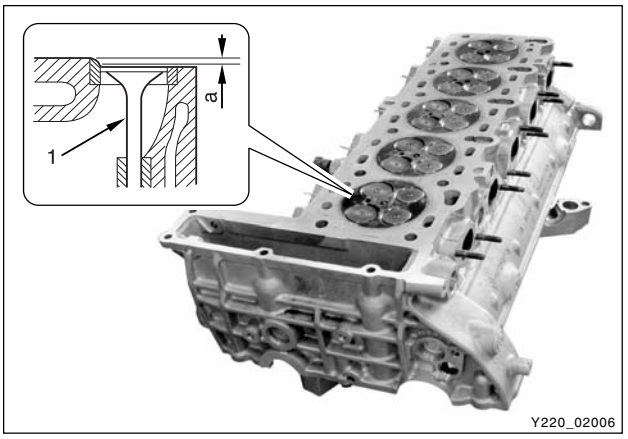


2. Insert the valves into the valve guides and measure the recesses.

Valve recess “a”	0.1 ~ 0.7 mm

Notice

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



CHANGED BY	
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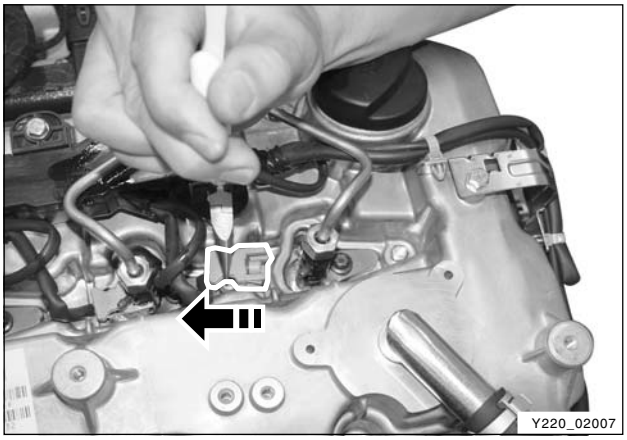
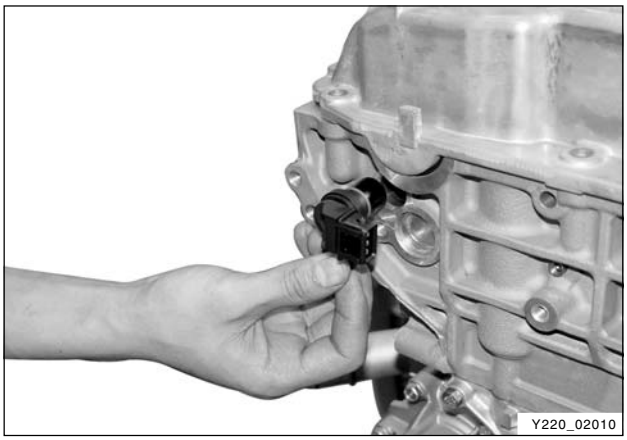
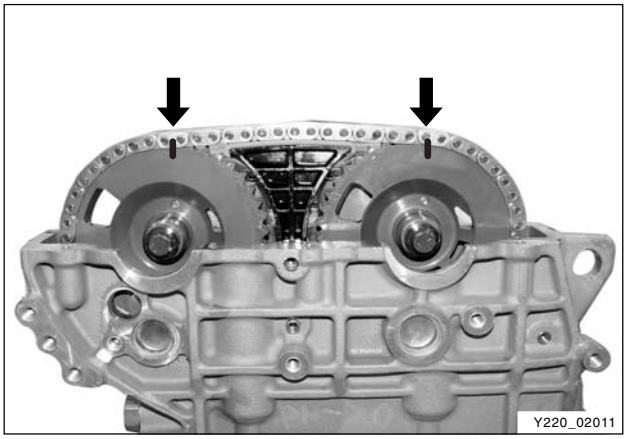






Cylinder Head - Disassembly and Reassembly

▶ Disassembly

※ Preceding Works:
- Removal of fan belt
- Removal of fuel supply and return lines
- Removal of EGR related pipes
- Removal of intake manifold mounting bracket
- Removal of injector fuel line and connector, and glow plug connector

Notice

- ***Plug the openings of injector holes and common rail with the protective caps.***

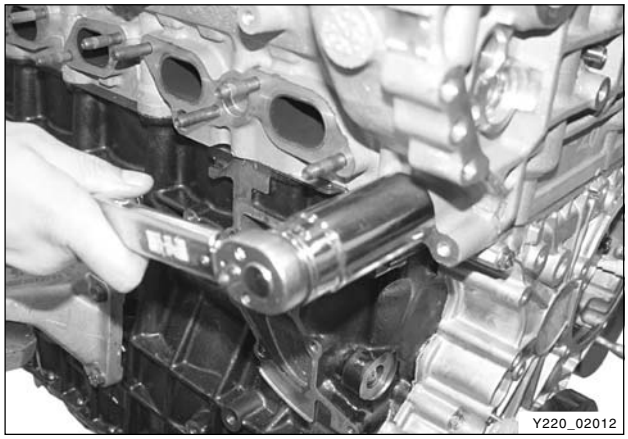
1. Remove the cylinder head cover.

2. Remove the camshaft position sensor.
   - The intake manifold can be interfered by the sensor when installing.

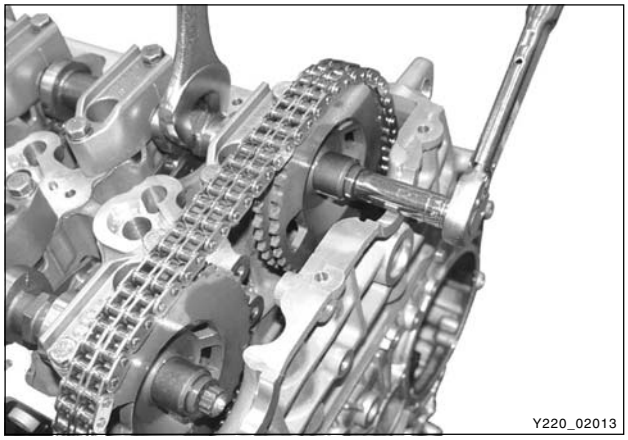
3. Mark on the intake camshaft sprocket and exhaust camshaft sprocket for timing setting during installation.

4. Remove the chain tensioner.

※ Preceding work: removal of EGR pipe and oil dipstick tube


Y220_02012

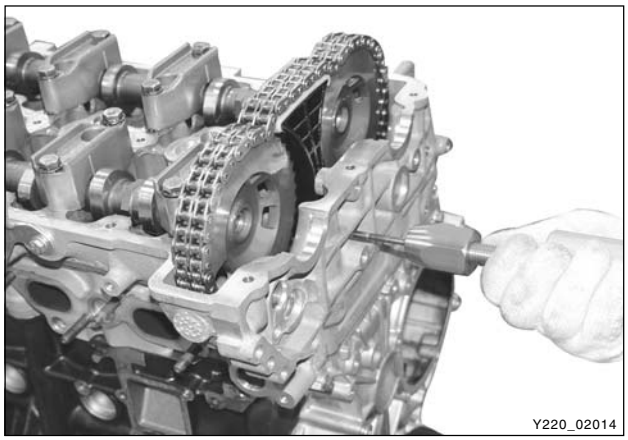
5. Hold the camshafts and remove the intake camshaft sprocket and exhaust camshaft sprocket.


Y220_02013

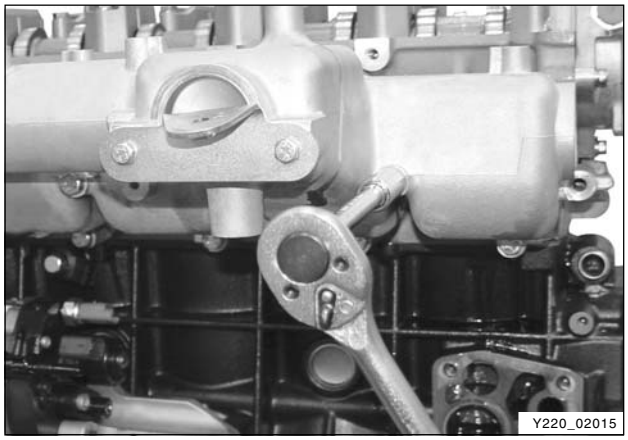
6. Pull out the lock pins with a sliding hammer and remove the upper guide rail.

Notice

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


Y220_02014

7. Remove the oil cooler, then remove the intake manifold.
   - The intake manifold can be interfered by the cylinder head bolt (M8 x 50).


Y220_02015

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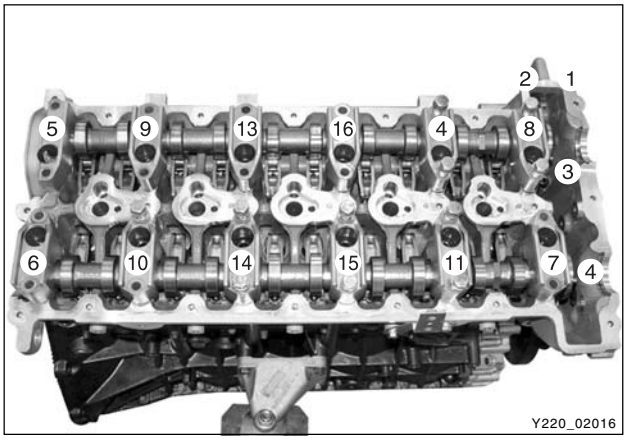
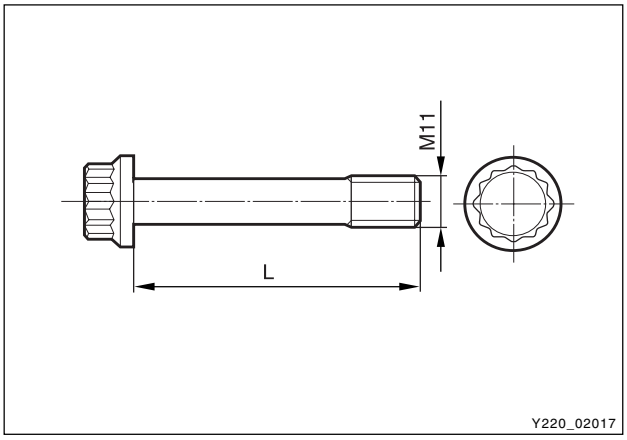
EFFECTIVE DATE	
AFFECTED VIN	



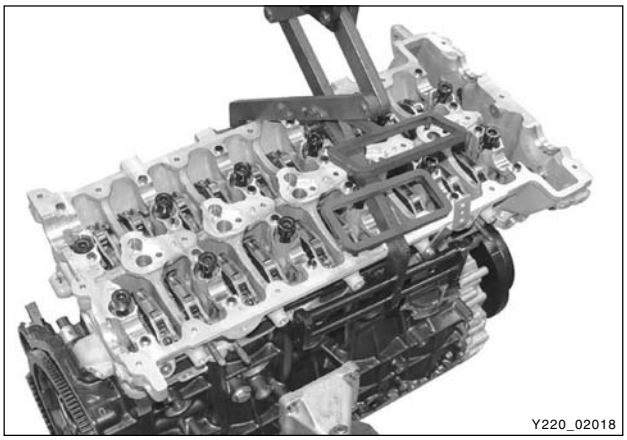
8. Remove the cylinder head bolts according to the numerical sequence.

   M8 x 25 : 2 EA
   M8 x 50 : 2 EA
   M12 x 177 : 11 EA
   M12 x 158 : 1 EA (Vacuum pump side)



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

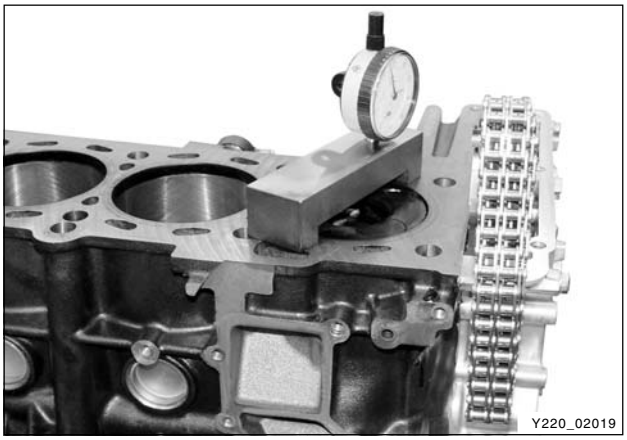
Length when new	Maximum Limit
177 mm	179 mm
158 mm	160 mm



10. Remove the cylinder head.

Notice

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



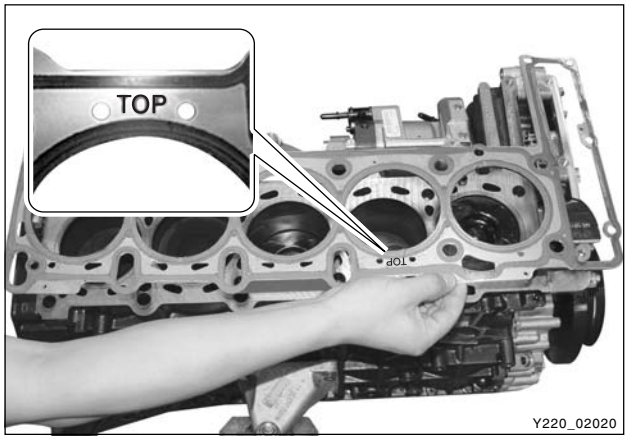
11. Measure the piston protrusion from the parting surface.
    - Specified Value: 0.765 ~ 1.055 mm

▶ Reassembly

1. Install the cylinder head with the steel gasket.

Notice

Make sure to place the "TOP" mark upward.

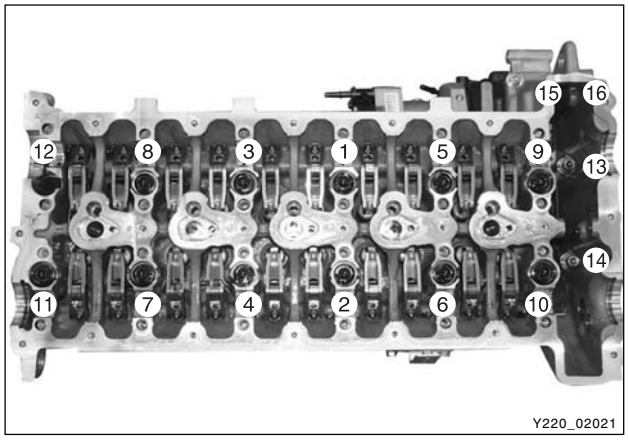


2. Tighten the cylinder head bolts to specified torque and torque angle.

Tightening torque	Step 1	20 ± 2.0 Nm
	Step 2	85 ± 5.0 Nm
	Step 3	270° (90° x 3) + 10°

Notice

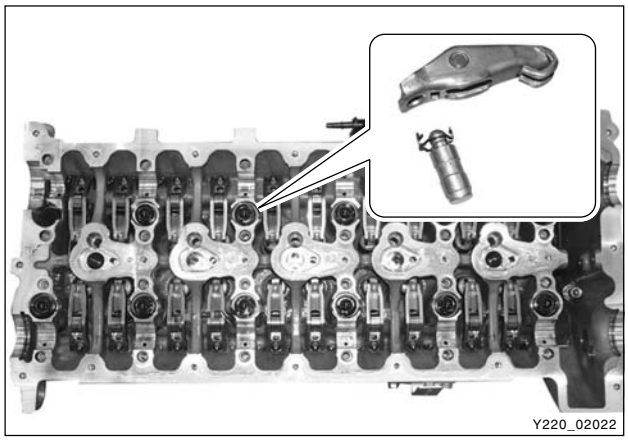
- ***Apply the oil on the bolt thread when installing.***
- ***Always insert new washer first.***
- ***The bolts (12) at vacuum pump side are shorter than others.***



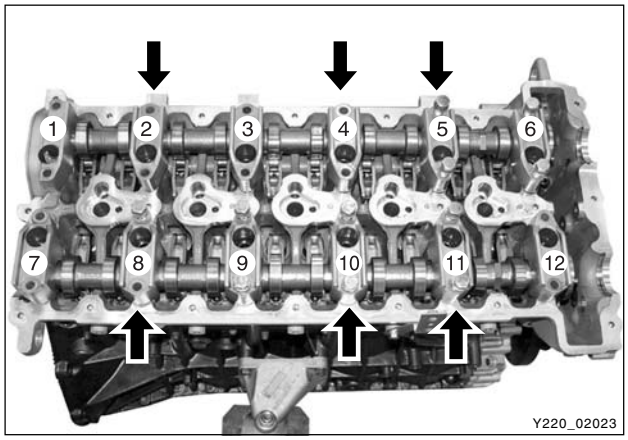
3. Install the HLA device and finger follower. Check the HLA device with the diagnosis procedures before installation.

Notice

- ***Put the cylinder head on the locating pins.***



4. Tighten the camshaft bearing cap bolts.
   - Intake: #2, #4, #5
   - Exhaust: #8, #10, #11



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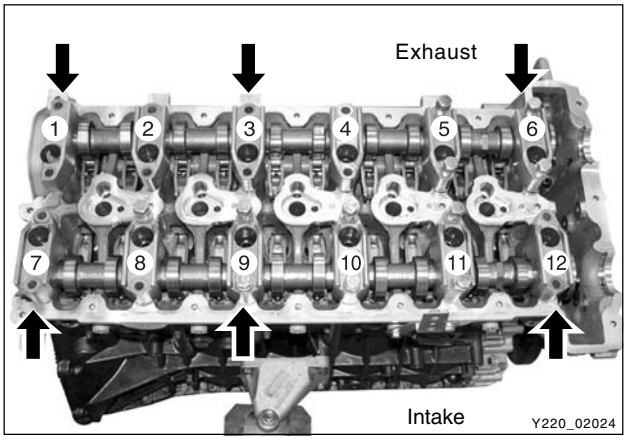
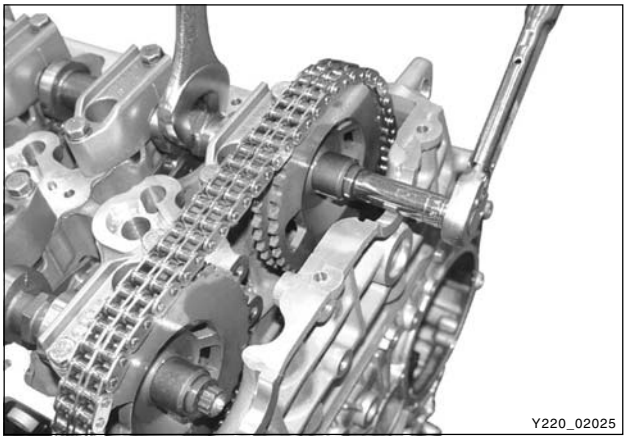


- Exhaust: #1, #3, #6
- Intake: #7, #9, #12

Tightening torque	25 Nm

Notice

Check the finger follower positions and align if needed.

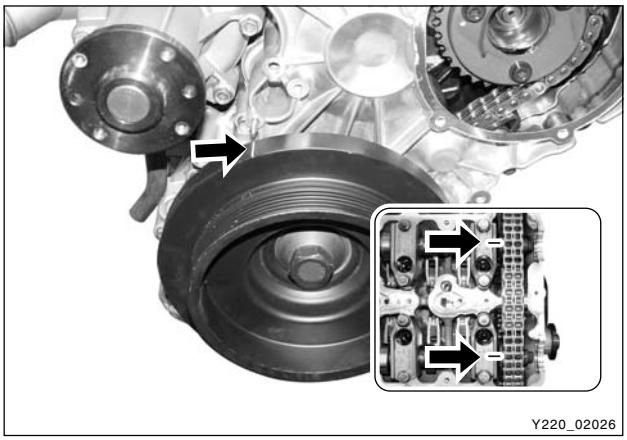


5. Install the intake and exhaust camshaft sprockets and the timing chain.

Tightening torque	25 Nm + 90°

Notice

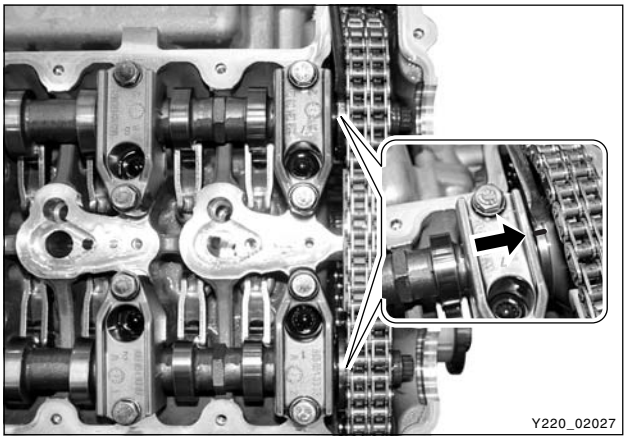
- ***If the sprocket bolt is stretched over 0.9 mm, replace it with new one.***
- ***Always install the intake camshaft sprocket first.***
- ***Ensure that the markings on camshaft sprocket and timing chain are aligned.***
- ***Make sure that the timing chain is securely seated on the guide rail.***



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

Notice

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



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

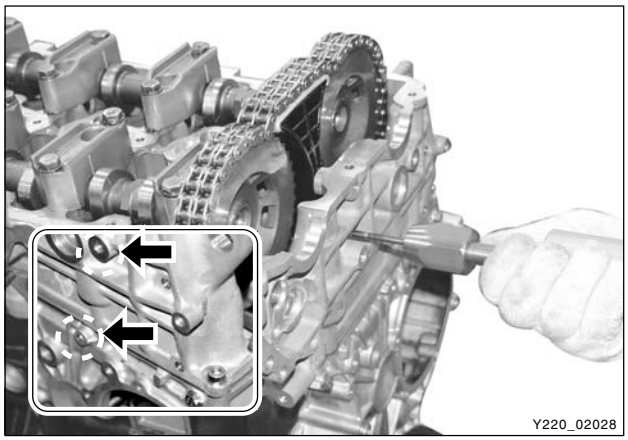
Notice

- ***Apply the sealant on the cap (#12) for the vacuum pump when installing.***
- ***Apply the oil on the bearing journals before installation.***

8. Fit the timing chain onto the camshaft sprockets and install the upper guide rail.
   - Install the clamping guide rail pin.

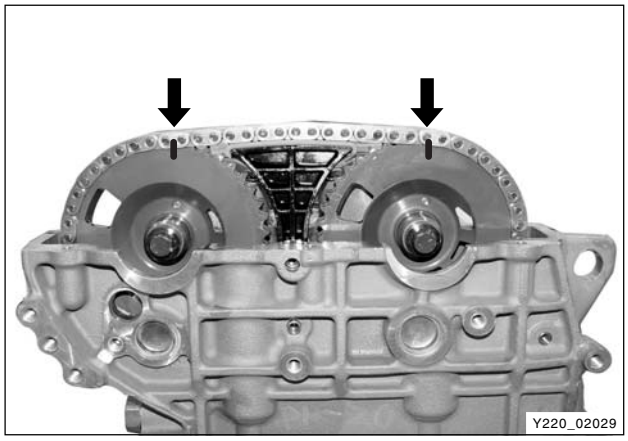
Notice

- ***Install the guide rail with slanted side facing forward.***
- ***Be careful not to change the timing of HP pump when fitting the timing chain.***



9. Tighten the intake and exhaust camshaft sprocket bolts.

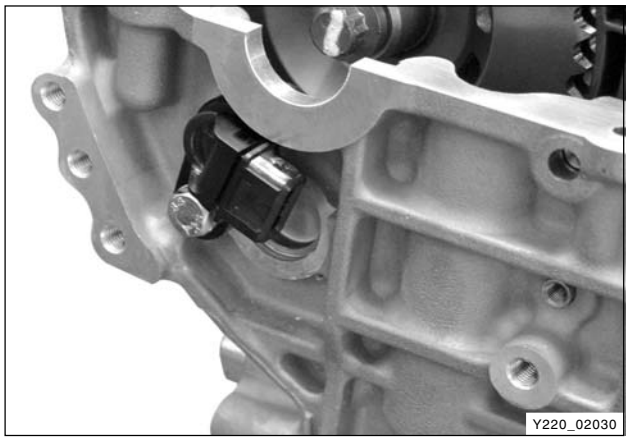
Tightening torque	25 ± 2.5 Nm, 90° + 10°



10. Install the camshaft position sensor.
11. Apply the Loctite to the bolt and tighten it.

Tightening torque	10 Nm

12. Check the intake camshaft before installing the vacuum pump.

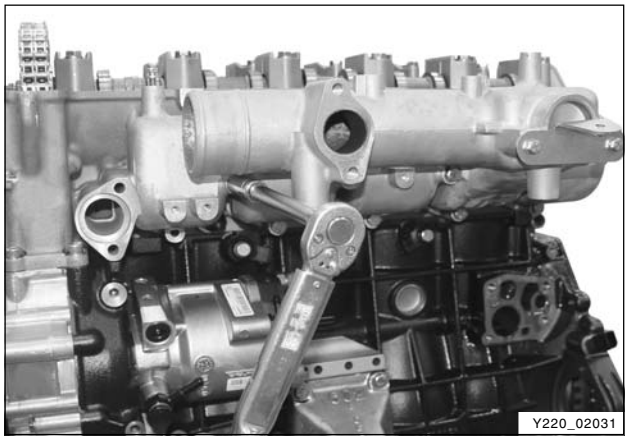


13. Install the intake manifold. Install the oil cooler with new gasket.

Tightening torque	25 Nm

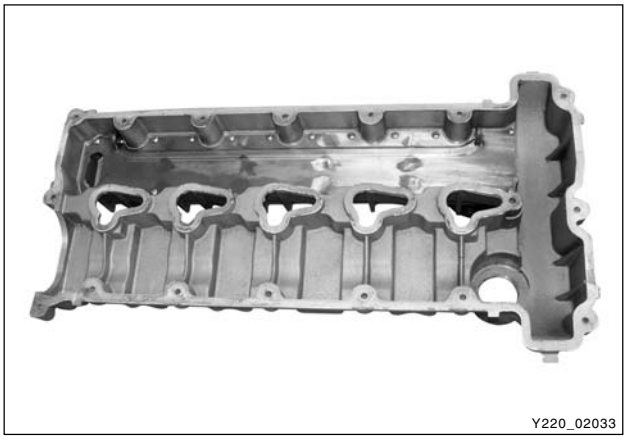
Notice

Ensure that there is no leaks around the coolant line for #1 cylinder



14. Install the chain tensioner.

Tightening torque	80 ± 8.0 Nm



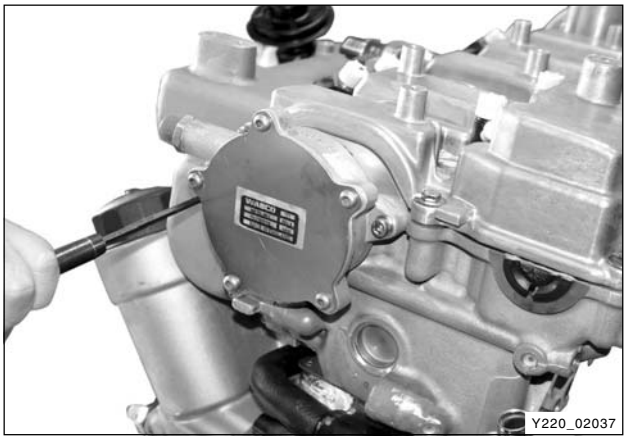
15. Install the cylinder head cover assembly.
16. Install the rubber gasket.

17. Tighten the cylinder head cover bolts.

Notice

- ***Apply the sealant to the bolts for the vacuum pump and the timing chain cover.***

Tightening torque	10 ± 1.0 Nm

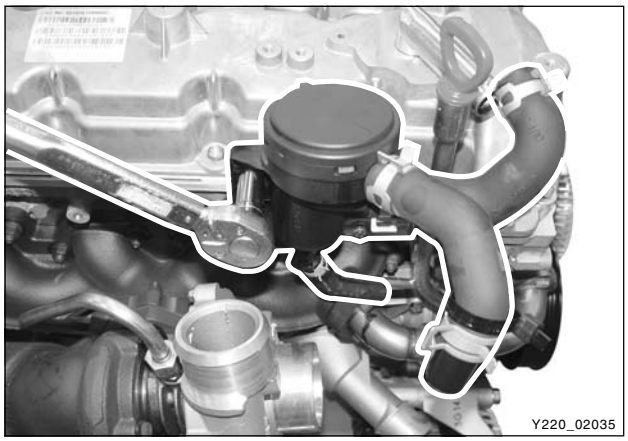


18. Check the parting surface of the #12 bearing cap and the cylinder head for contacting.
19. Check if the O-ring is installed in the vacuum pump.
20. Install the vacuum pump with the key groove aligned.
21. Tighten the vacuum pump mounting bolts.

Tightening torque	10 ± 1.0 Nm

22. Install the PCV valve assembly on the cylinder head.

Tightening torque	10 ± 1.0 Nm

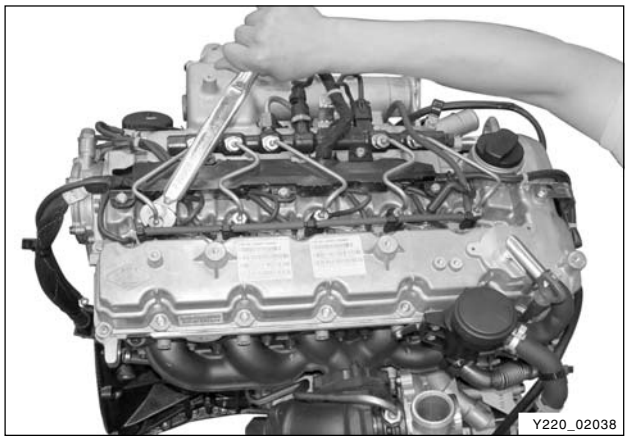


23. Engage the engine oil hose and the PCV valve hose.

24. Remove the protective caps and install the new fuel supply pipes.

Notice

- ***To keep the cleanness and protect the components, the fuel pipes should be replaced with new ones.***
- ***Be careful not to be mixed the fuel pipes because the pipe appearance of #1 and #3 cylinders and #2 and #4 are same each other.***



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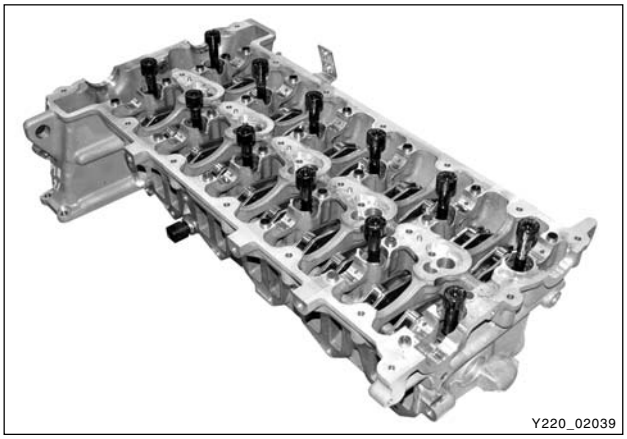
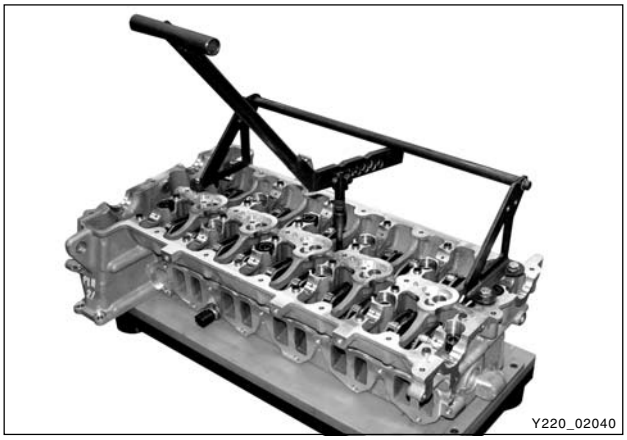
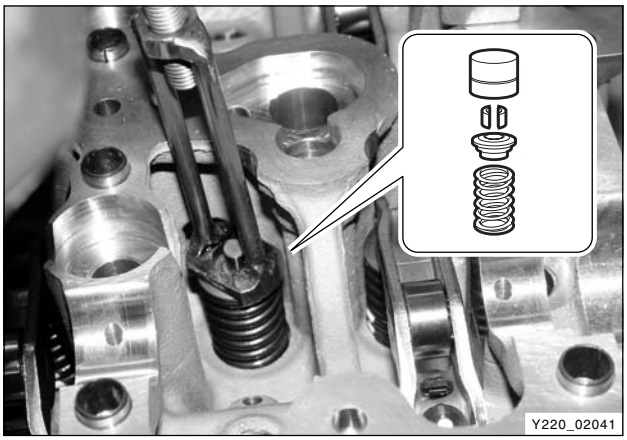


Intake/Exhaust - Removal/Installation

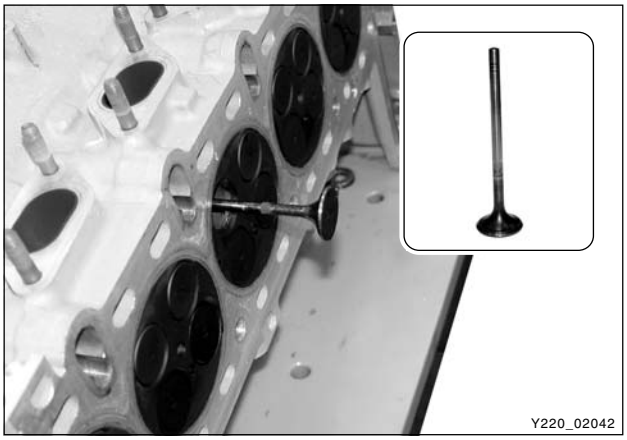
1. Remove the cylinder head assembly.



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

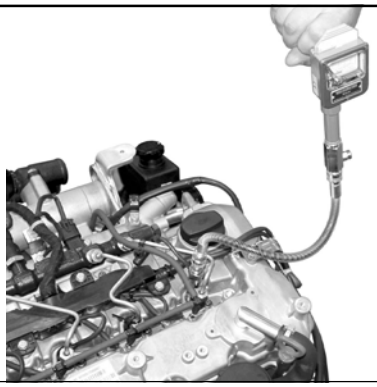
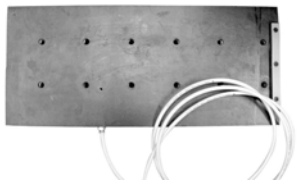
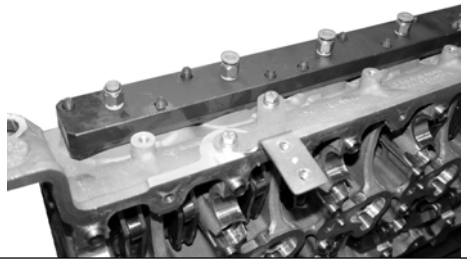
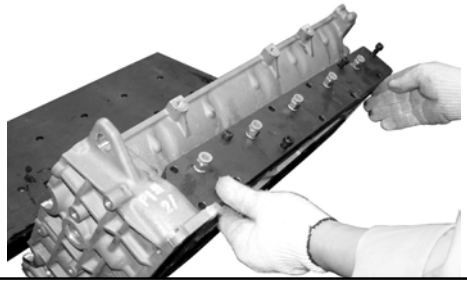


3. Push the valve spring seat down with the lever and remove the valve cotter, valve seat and valve spring.



4. Remove the valves from the cylinder head.

▶ Special Tools and Equipment

Name and Part Number	Application
Compression pressure measuring adapter and gauge  Y220_02043	 Y220_02044
Pressure plate (cylinder head pressure leakage test)  Y220_02045	 Y220_02046
Pressure plate (intake camshaft pressure leakage test  Y220_02047	 Y220_02048
Pressure plate (exhaust camshaft pressure leakage test)  Y220_02049	 Y220_02050

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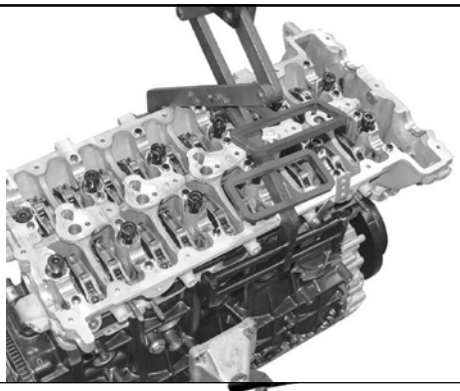
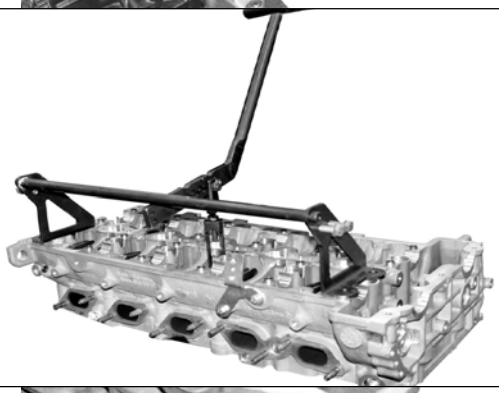
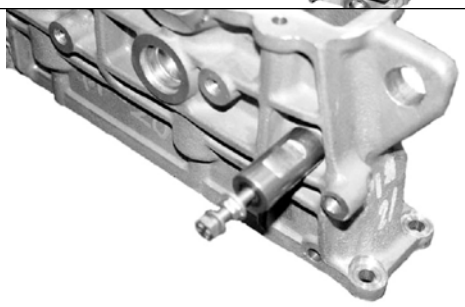
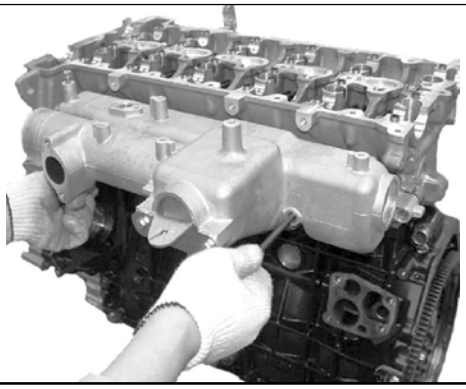
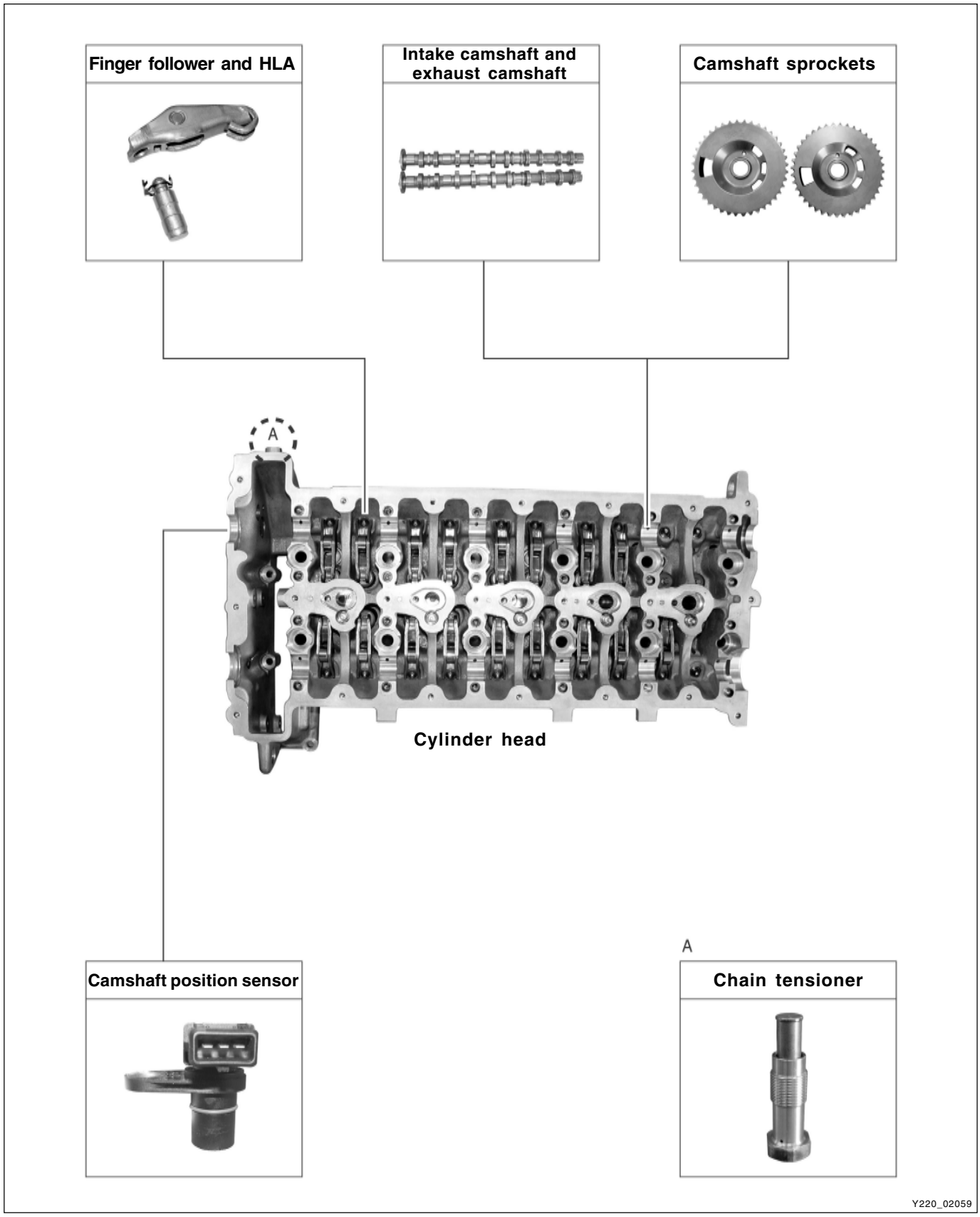
Name and Part Number	Application
Cylinder head hanger  Y220_02051	 Y220_02052
Supporting bar and lever  Y220_02053	 Y220_02054
Guide pin extractor  Y220_02055	 Y220_02056
Intake manifold guide pin  Y220_02057	 Y220_02058

CAMSHAFT ASSEMBLY

※ Preceding Work: Removal of cylinder head cover



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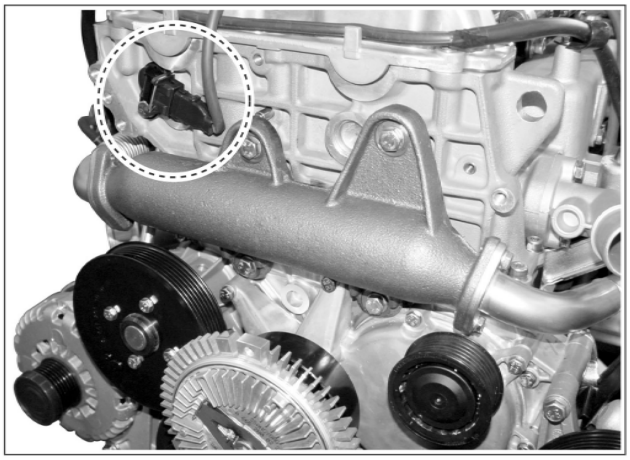
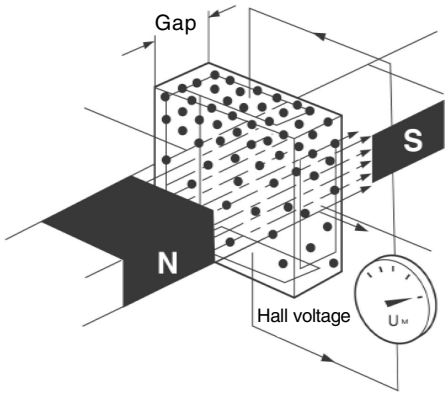
▶ Camshaft Position Sensor



<Location of camshaft position sensor>



<Operation principle of hall sensor>

Y220_02060

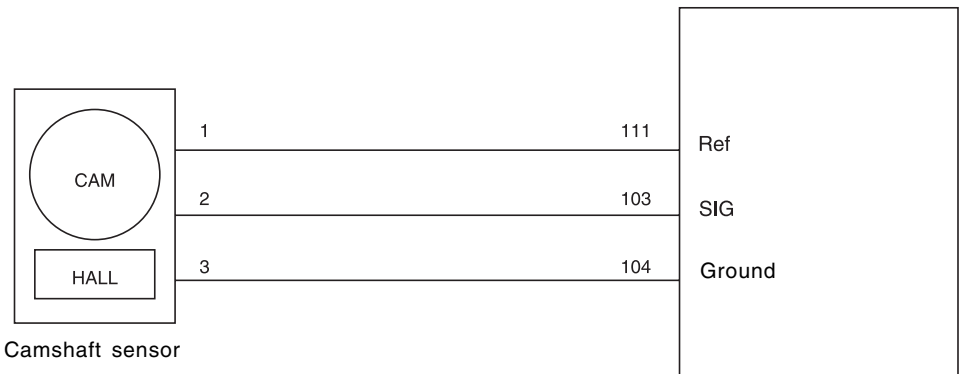
The camshaft position sensor uses hall-effect to set the camshaft position and metallic-magnetic-material sensor end is attached on the camshaft and then rotates with it. If sensor protrusion passes camshaft position sensor's semi-conductor wafer, magnetic field changes direction of electron on the semi-conductor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

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

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

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

Pulse generation	Cam angle ± 6°
Sensor air gap	0.2 ~ 1.8 mm
Tightening torque	10 ~ 14 Nm
Operating temperature	- 40 ~ 130°C



<Circuit diagram of camshaft position sensor>

Y220_02061

Removal

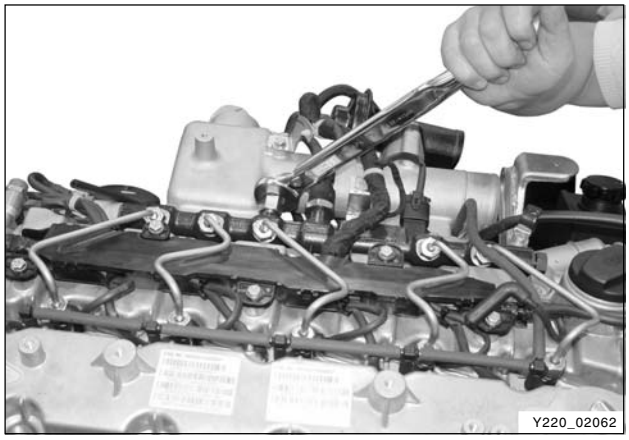
※ Preceding Works:

- Removal of fan belt
- Removal of fuel supply and return lines
- Removal of intake manifold mounting bracket

1. Remove the injector fuel line and connector, and glow plug connector

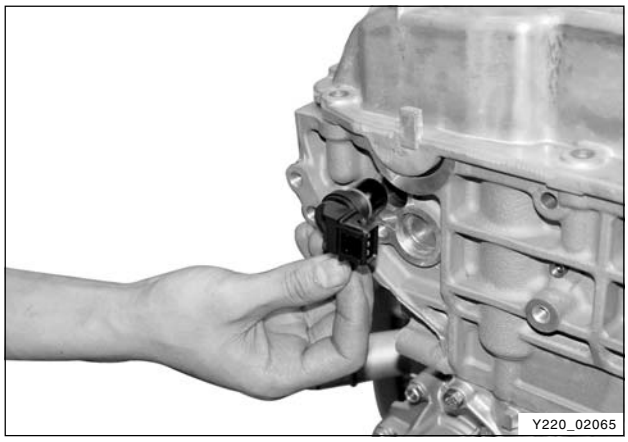
   Notice

   Plug the openings of injector holes and common rail with the protective caps.



2. Remove the cylinder head cover.

3. Remove the camshaft position sensor.



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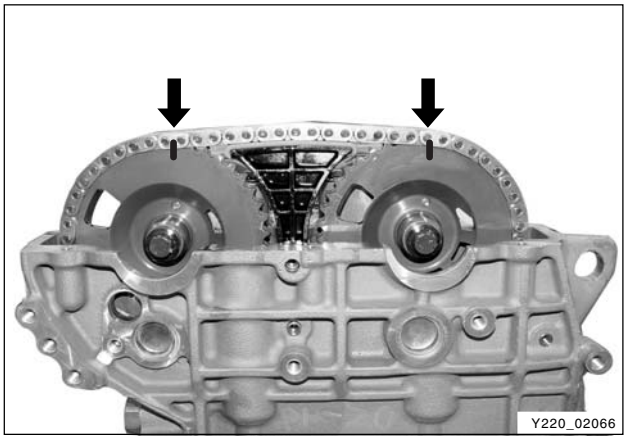
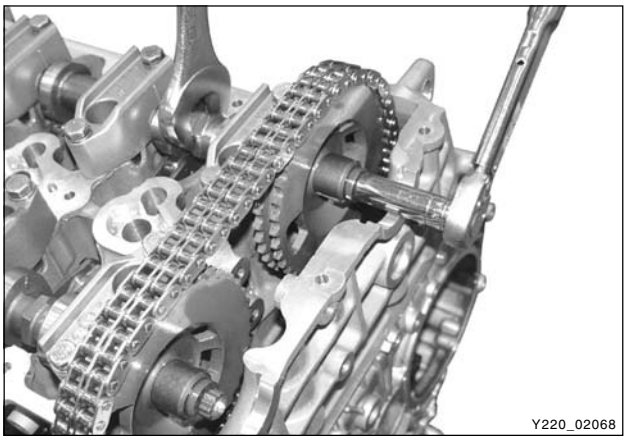


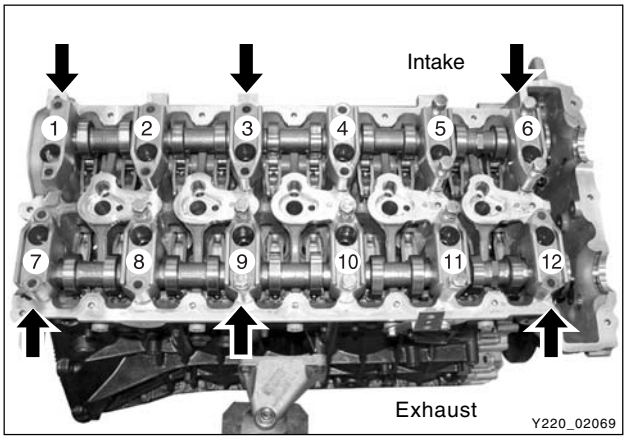
4. Mark on the intake camshaft sprocket and exhaust camshaft sprocket for timing setting during installation.

5. Remove the chain tensioner.

※ Preceding work: removal of EGR pipe and oil dipstick tube



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



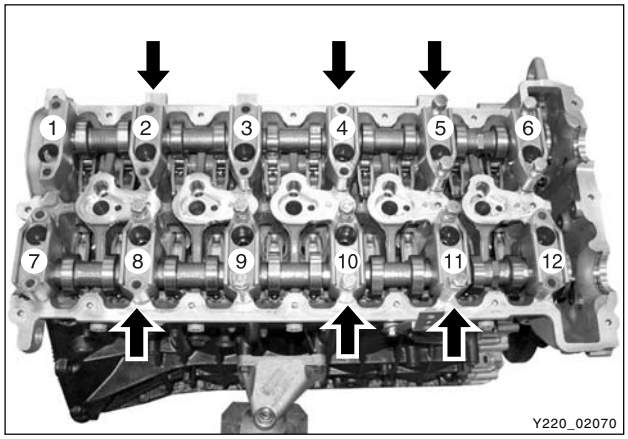
7. Remove the camshaft bearing cap bolts so that the tightening force can be relieved evenly.
   - Intake: #1, #3, #6
   - Exhaust: #7, #9, #12

* However, there is no specific removal sequence.

- Intake: #2, #4, #5
- Exhaust: #8, #10, #11

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

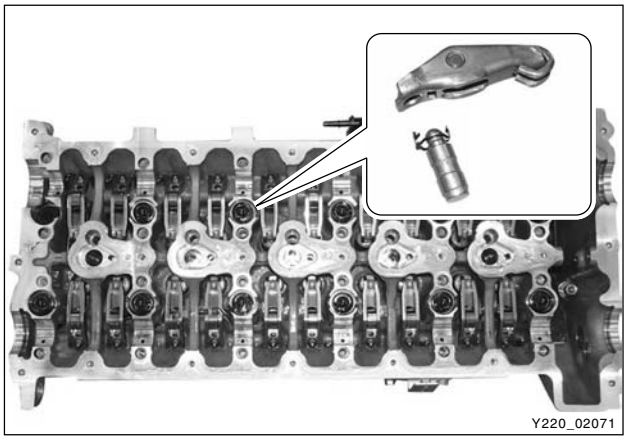
8. Remove the intake and exhaust camshafts from the cylinder head.

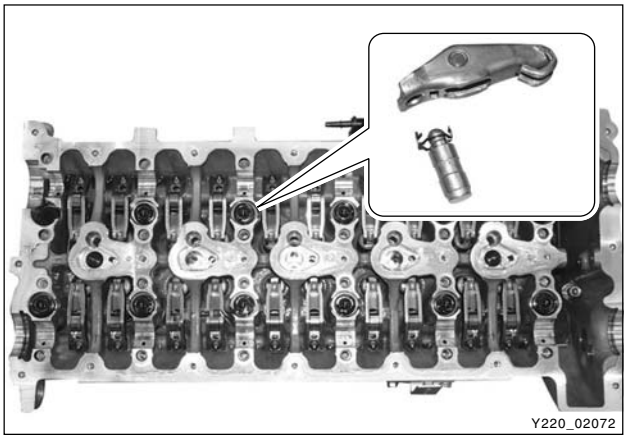


9. Remove the finger follower and the HLA device.

Notice

Avoid contact with hot metal parts when removing the HLA device immediately after stopping the engine.



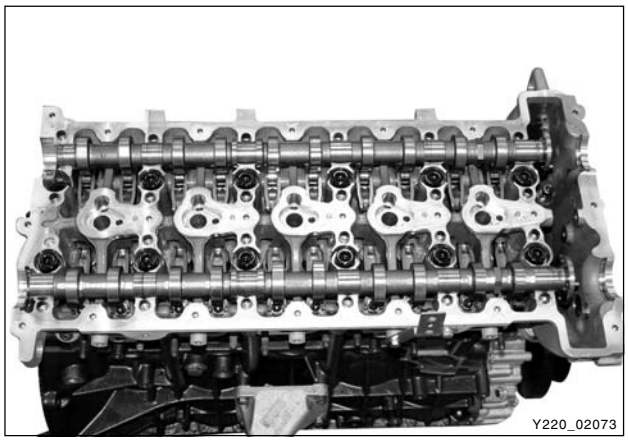


Installation

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

Notice

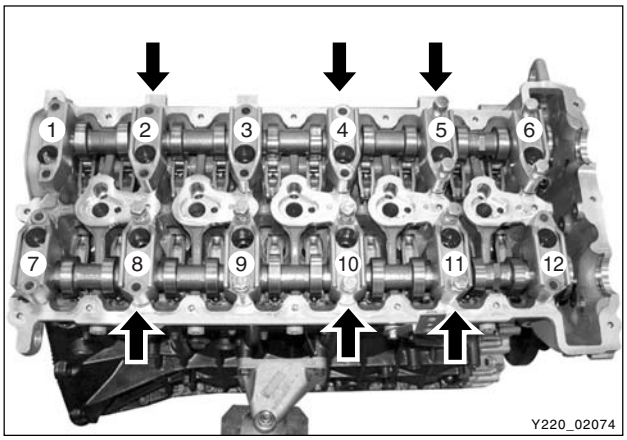
- ***Put the cylinder head on the locating pins.***



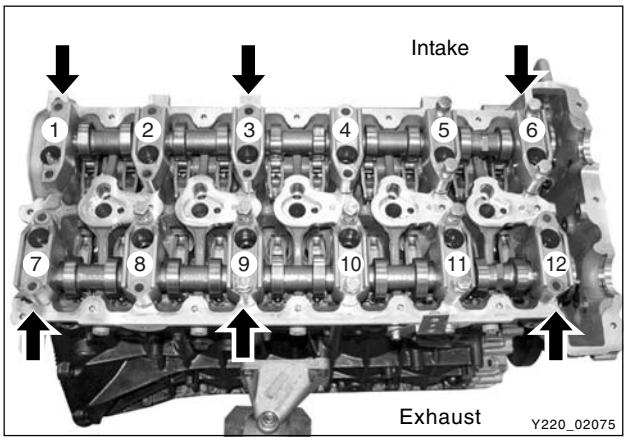
2. Place the bearing cap with the OT marks on both camshafts facing upward.

Notice

- ***Apply the sealant on the cap (#12) for the vacuum pump when installing.***
- ***Apply the oil on the bearing journals before installation.***



3. Tighten the camshaft bearing cap bolts.
   - Intake: #2, #4, #5
   - Exhaust: #8, #10, #11



   - Intake: #1, #3, #6
   - Exhaust: #7, #9, #12

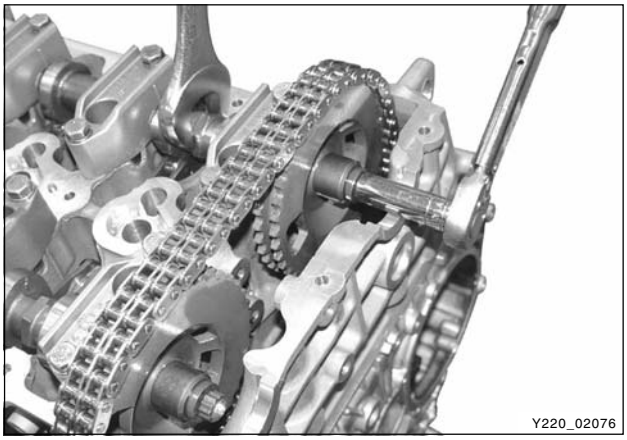
Tightening torque	25 Nm

Notice

Check the finger follower positions and align if needed.

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

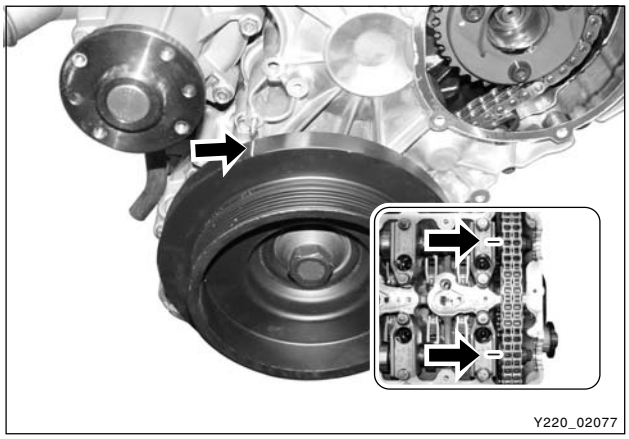
Tightening torque	25 Nm + 90° + 10°


Y220_02076

Notice

- ***If the sprocket bolt is stretched over 0.9 mm, replace it with new one.***
- ***Always install the intake camshaft sprocket first.***
- ***Ensure that the markings on camshaft sprocket and timing chain are aligned.***
- ***Make sure that the timing chain is securely seated on the guide rail.***

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

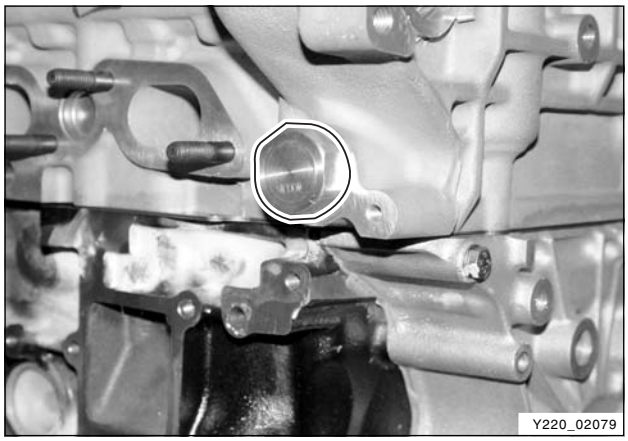

Y220_02077

Notice

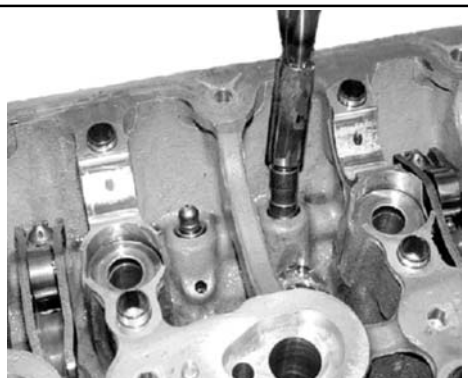
If the markings are not aligned, reinstall the cylinder head.

6. Install the chain tensioner.

Tightening torque	80 ± 8.0 Nm


Y220_02079

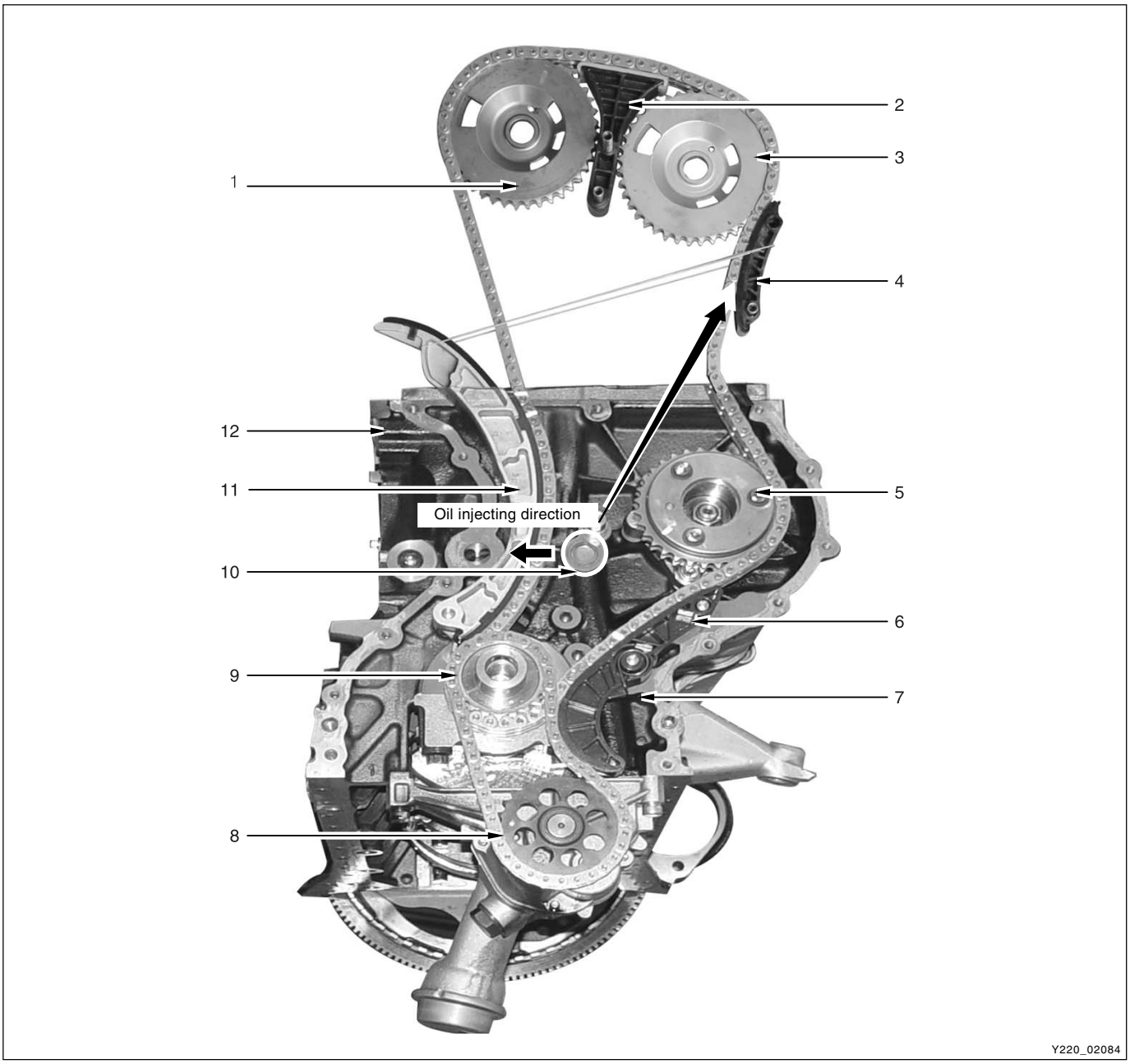
▶ Special Tools and Equipment

Name and Part Number	Application
HLA remover  Y220_02080	 Y220_02081
Stem seal drift  Y220_02082	 Y220_02083

TIMING CHAIN ASSEMBLY

▶ Chain Drive System

System Layout



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

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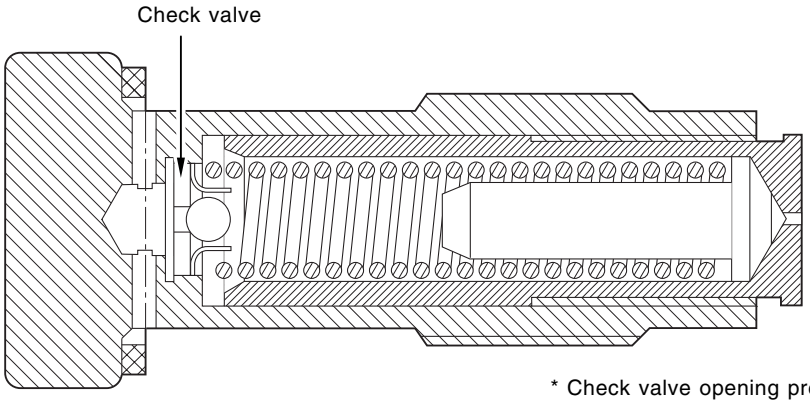
Chain

- Chain type: Double Bush
- Pitch: 9.525 mm
- Load limits: 19,000 N
- No. of links: 144 EA
- Overall length: 1371.6 mm
- Replace when the chain is extended by 0.5 % from overall length (Replace if extended by over 6.858 mm)

Chain tensioner



* Check valve opening pressure: 0.2 ~ 0.5 bar

Y220_02085

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

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

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

Guide rail

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

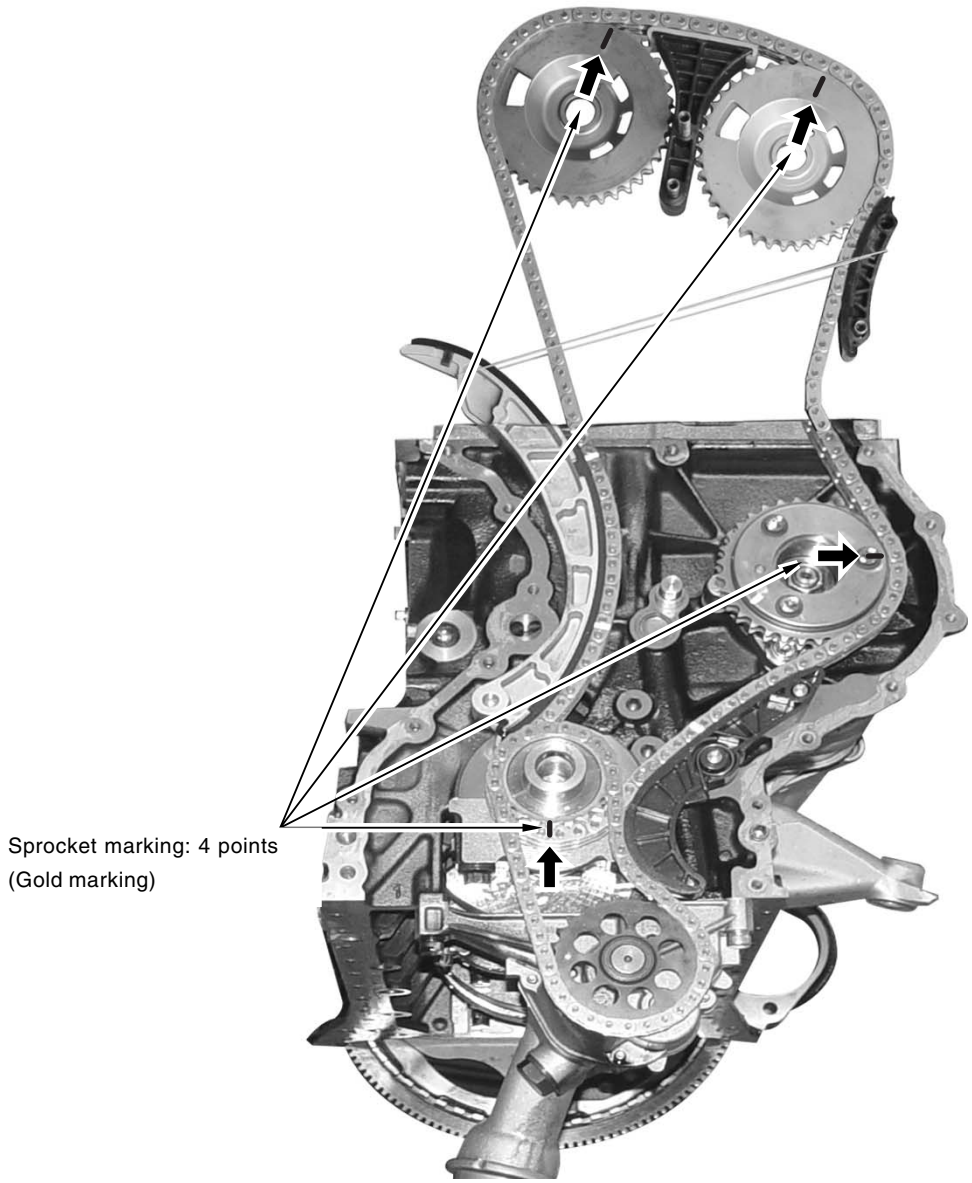
Guide rail can prevent chain slap when chain is extended and reduce chain wears.

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

The material is plastic.

- Location of guide rail
  - Tensioner guide rail: Between crankshaft sprocket and exhaust camshaft sprocket
  - Upper guide rail: Between exhaust camshaft sprocket and intake camshaft sprocket
  - Clamping guide rail: Between intake camshaft sprocket and HP pump sprocket
  - Lower guide rail: Between HP pump sprocket and crankshaft sprocket

Timing setting



<Timing marking points on chain>

Y220_02086

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

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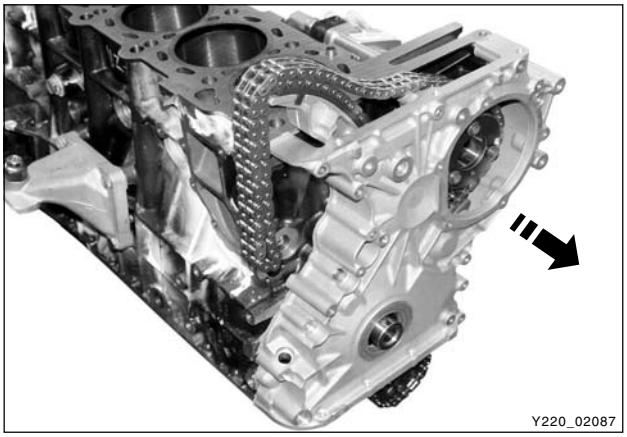
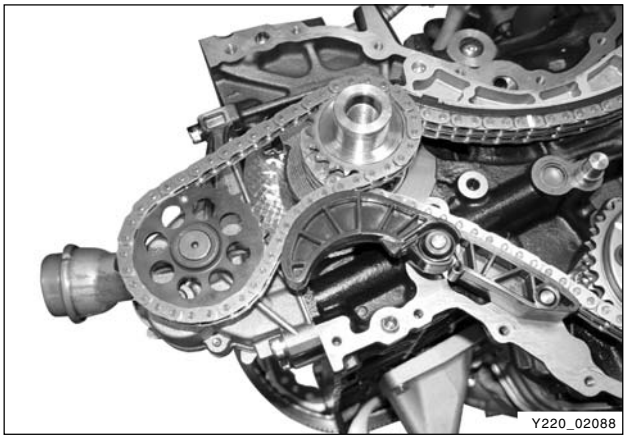
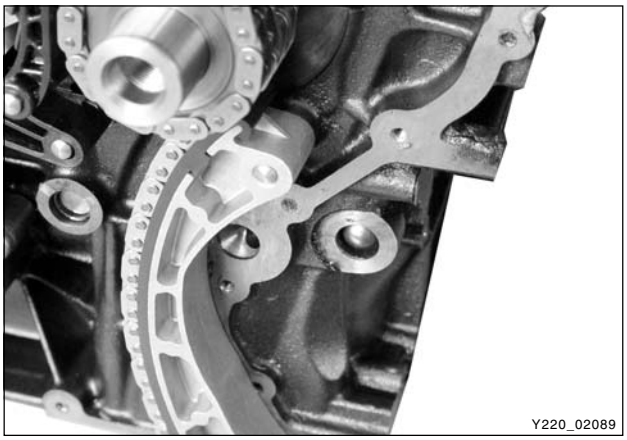


Removal and Installation

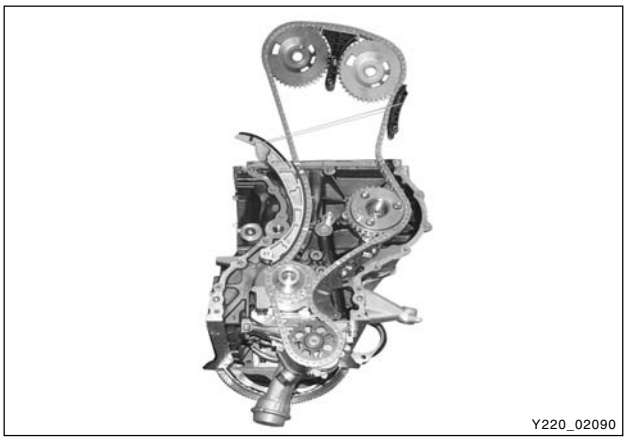
1. Remove the cylinder head assembly.
2. Remove the oil pan.
3. Remove the chain guide rail with a sliding hammer.
4. Remove the chain cover.



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



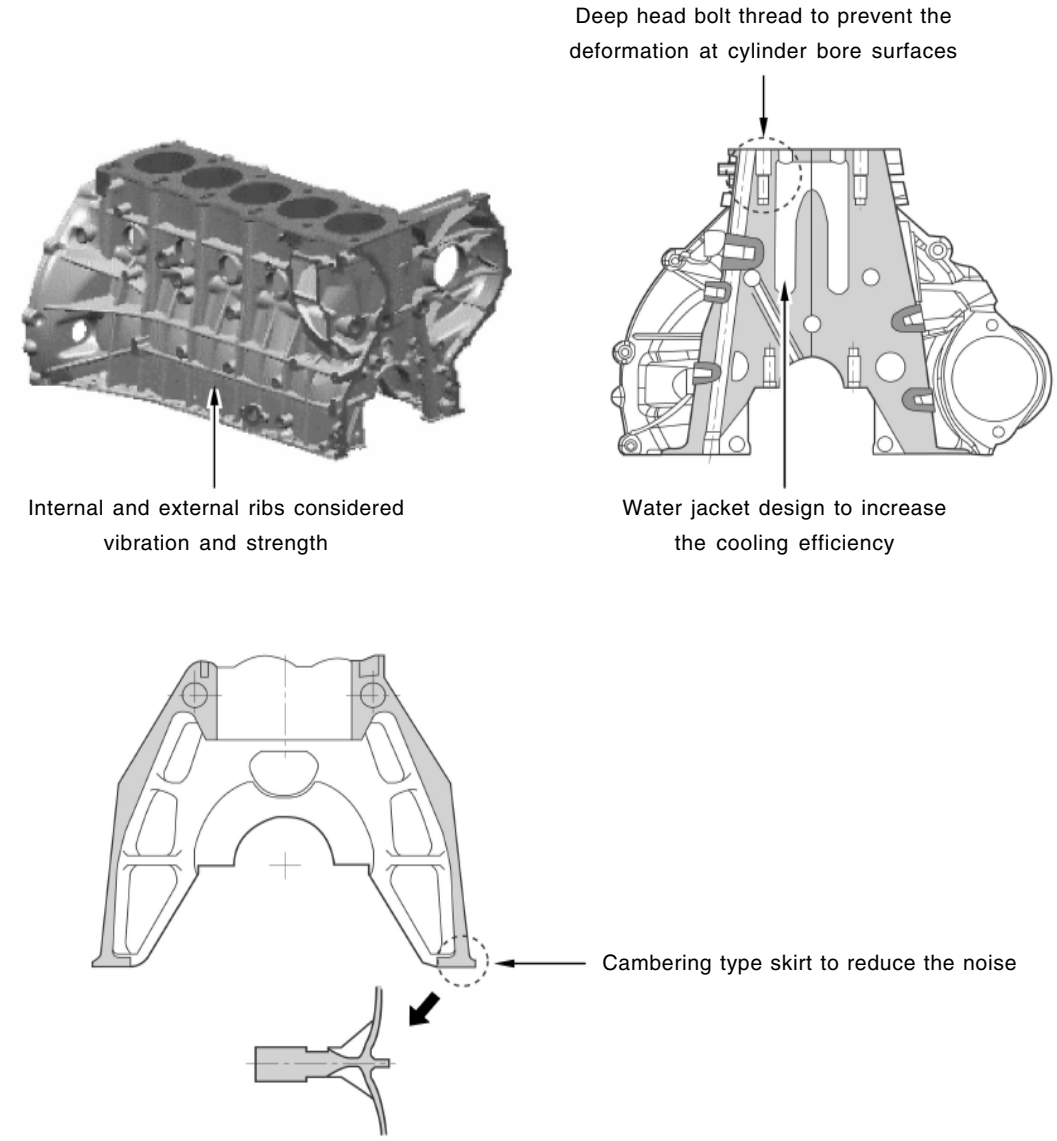
9. Remove the tensioning guide rail.



10. Remove the timing chain.
11. Install in the reverse order of removal.

* Thoroughly clean the removed components before installing.

CYLINDER BLOCK



▶ System Characteristics

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

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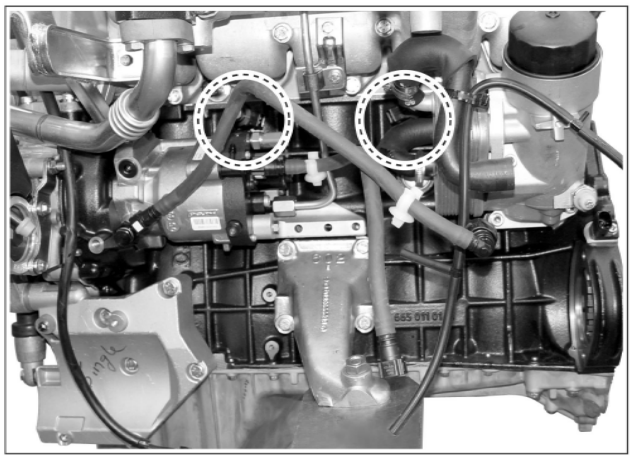
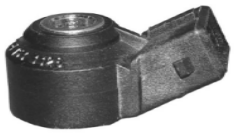
▶ Knock Sensor

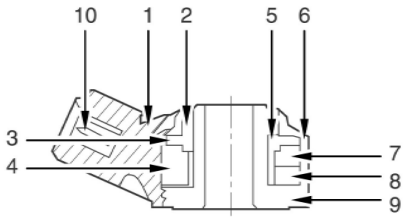
Two knock sensors are located on the cylinder block (intake manifold side).
To detect engine vibration under abnormal combustion, knock sensor has piezoelectric element fixed on the vibration plate and this vibration plate is fixed on the base. If happens knocking, pistons or connecting rods vibrate and occurs heavy sounds that hit metal. Knock sensor is used to detect those knockings caused by abnormal combustions. It controls idling stabilities and turns on the engine warning light when detects injector damages. And also controls pilot injection very precisely during MAP learning.
When knock sensor is defective, engine ECU corrects injection timing based on MAP values like engine speed, intake air volume and coolant temperature.

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

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







<Location of knock sensor>

Y220_02092

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

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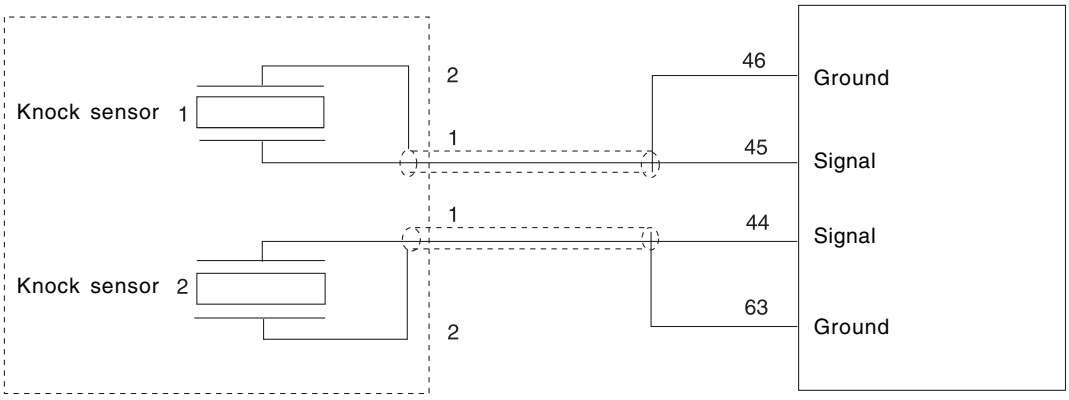
Notice

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



<Circuit diagram of knock sensor>

Y220_02093

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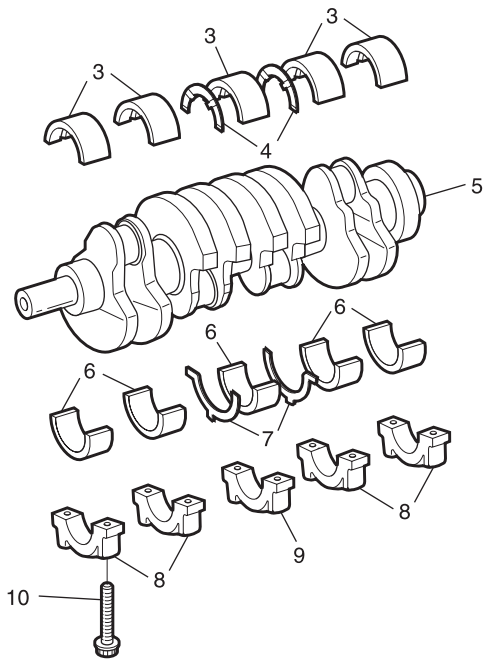
CRANKSHAFT

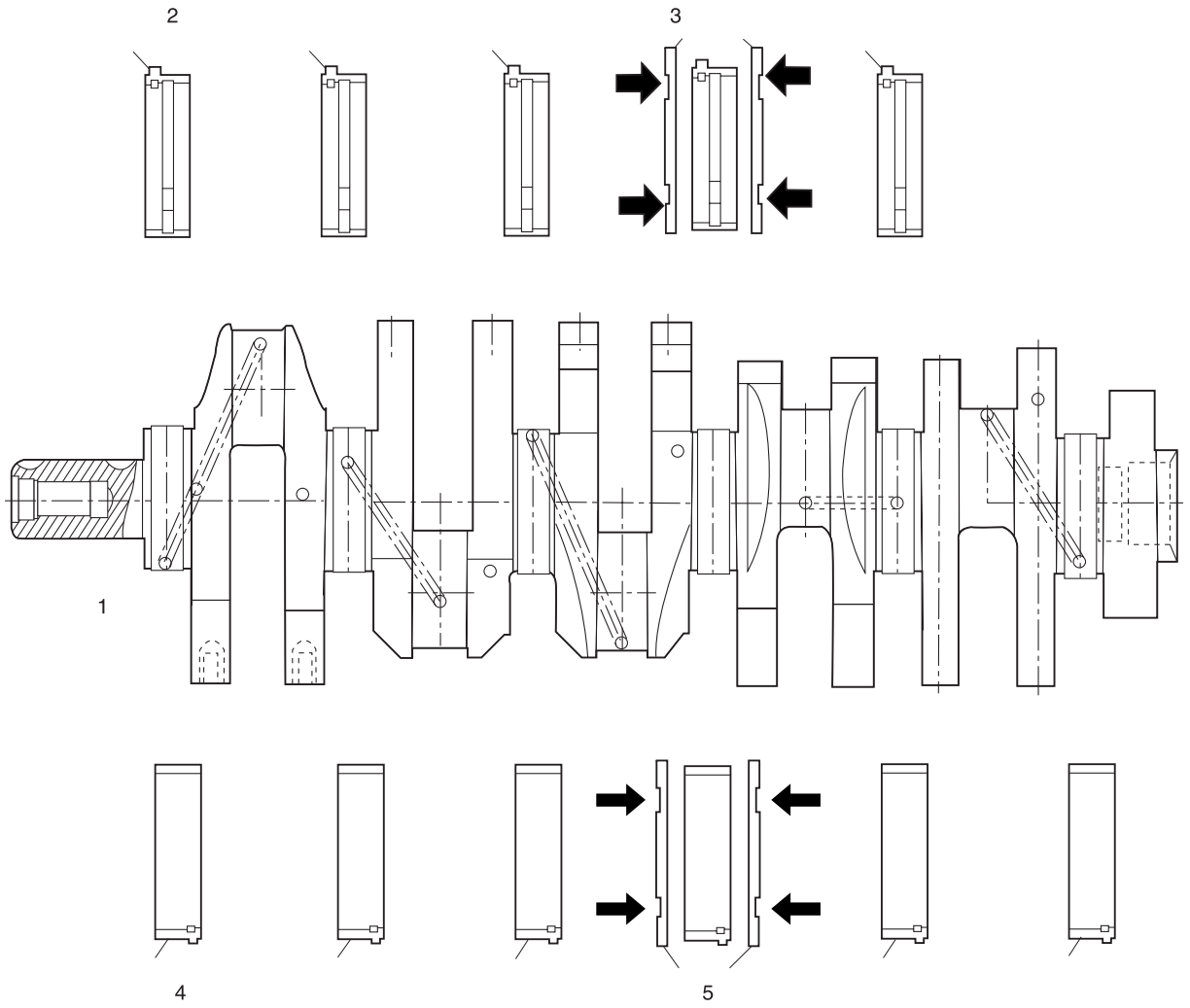
※ Preceding Works: Removal of end cover
Removal of pistons
Removal of crankshaft sprocket



Y220_02094

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

ARRANGEMENT OF THRUST WASHERS AND BEARINGS



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

Notice

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

▶ Dimensions of Crankshaft Main Bearing

(mm)

Color	Crankshaft Journal	Upper Main Bearing	Lower Main Bearing
Blue	57.965 ~ 57.960	2.260 ~ 2.255	2.260 ~ 2.255
Yellow	57.960 ~ 57.955	2.265 ~ 2.260	2.265 ~ 2.260
Red	57.955 ~ 57.950	2.270 ~ 2.265	2.270 ~ 2.265
White	57.950 ~ 57.945	-	2.275 ~ 2.270
Violet	57.945 ~ 57.940	-	2.280 ~ 2.275

▶ Bearing Clearance

(mm)

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

▶ Matching the Fit Bearing Journal Width to Thrust Washers

(mm)

Fit bearing Journal Width	Thrust Washer Thickness
24.500 ~ 24.533	2.15
24.600 ~ 24.633	2.20
24.70 ~ 24.733	2.25
24.900 ~ 24.933	2.35
25.000 ~ 25.033	2.40

Notice

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

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

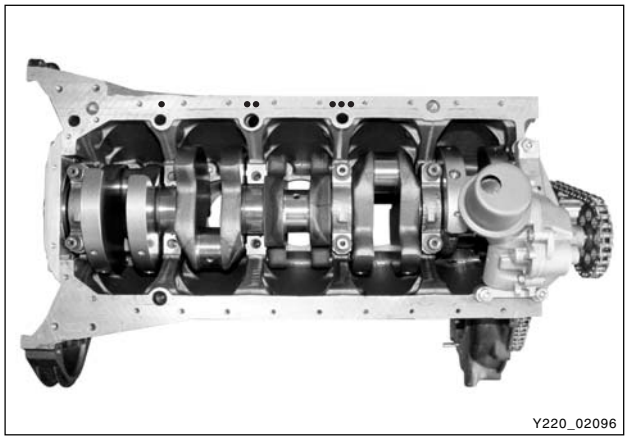
Marking of Basic Bearing Bore in Lower Parting Surface	Relevant Crankshaft Bearing Shell With Color Coding
1 punch mark or blue	blue or white - blue
2 punch marks or yellow	yellow or white - yellow
3 punch marks or red	red or white - red

▶ Matching Crankshaft Bearing Shells to Basic Bearing Journal of Crankshaft

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

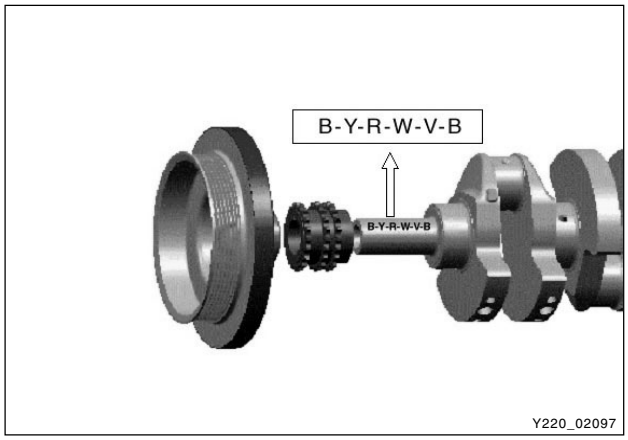
▶ Selection of Upper Main Bearing Shell

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


Y220_02096

▶ Selection of Lower Main Bearing Shell

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



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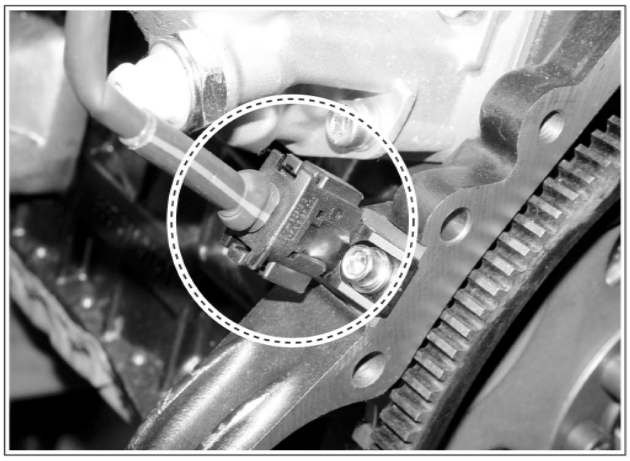
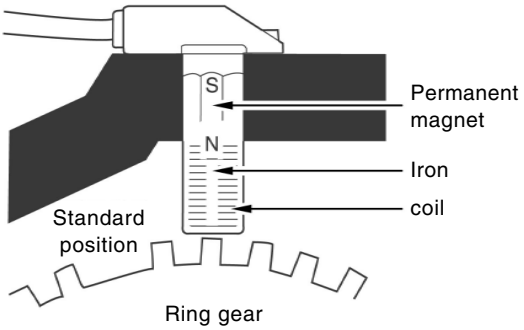
▶ Crankshaft Position Sensor



<Location of crankshaft position sensor>



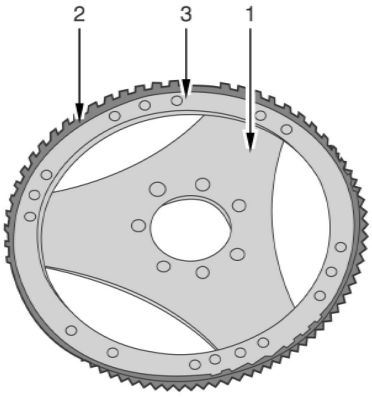
<Structure of crankshaft position sensor>

Y220_02098

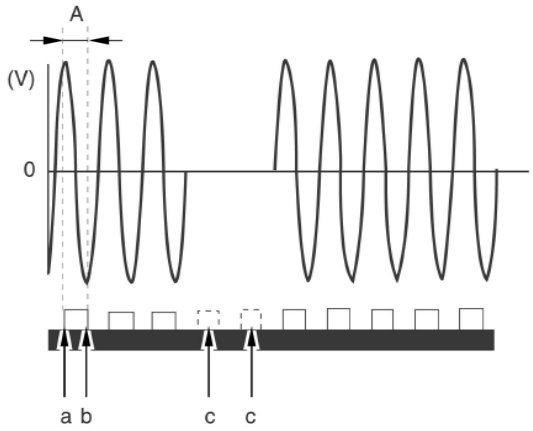
The crankshaft position sensor is located near to flywheel on the rear of cylinder block. It generates AC voltage between increment type driven plate that fixed on flywheel inside. The sensor consists of soft iron core that winded copper wire on permanent magnet and generates sign wave AC voltage when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

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

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



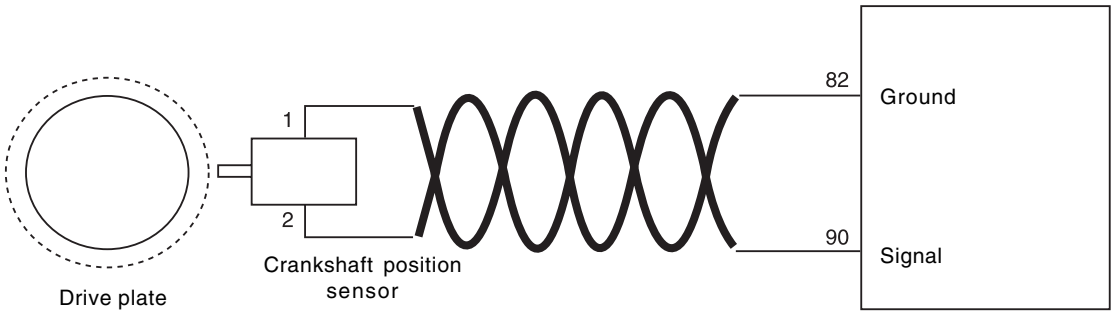
<Drive plate>



Y220_02099

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

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

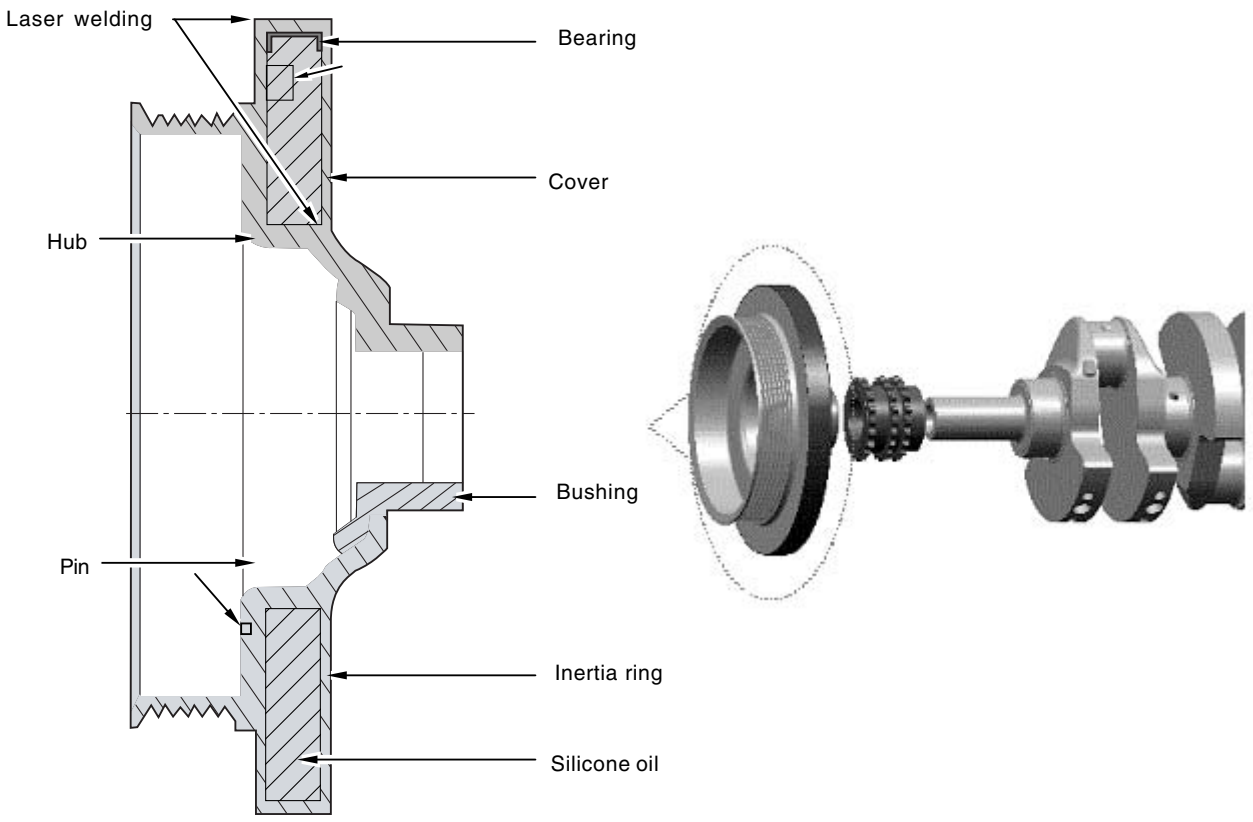


<Circuit diagram of crankshaft position sensor>

Y220_02100

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

TORSIONAL VIBRATION DAMPER



▶ System Description

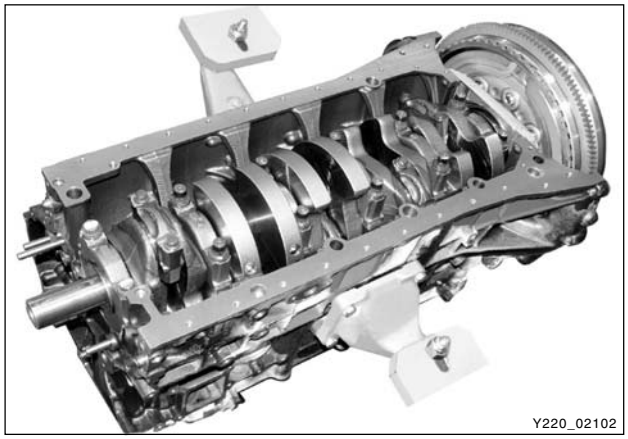
- Components: Hub, inertia mass, cover, bearing, bushing, silicon oil
- Functions: The crankshaft pulley optimizes the drive system by reducing the amount of torsional vibration in crankshaft. Conventional rubber damper is limited in changing materials (rubbers) to absorb vibration, but this crankshaft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

Crankshaft - Disassembly

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

Notice

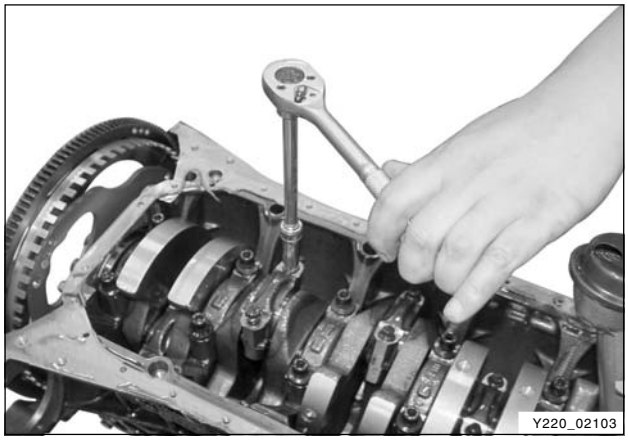
Position the #1 piston at TDC and remove the piston connecting rod journal bearing caps.



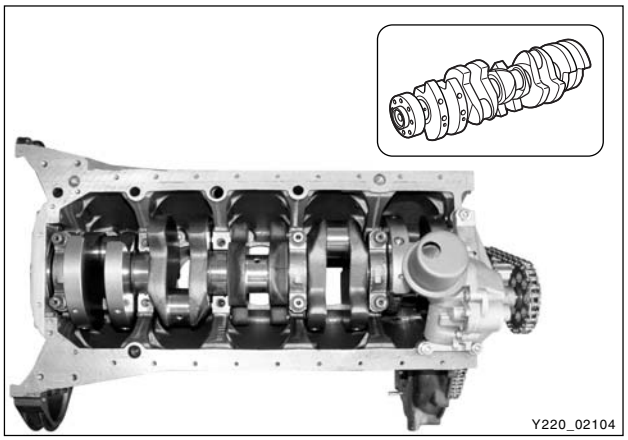
2. Remove the bearing cap bolts.
3. Remove the bearing caps.

Notice

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



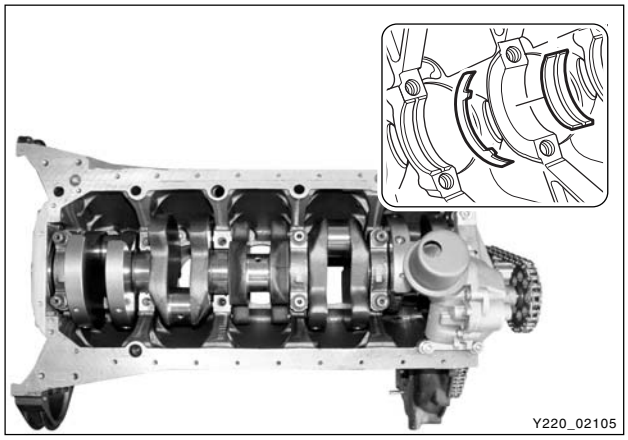
4. Remove the bearing caps and lower thrust bearing.
5. Separate the lower bearing shells from the bearing caps.
6. Remove the crankshaft.



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

Notice

Do not mix up the bearing shells.



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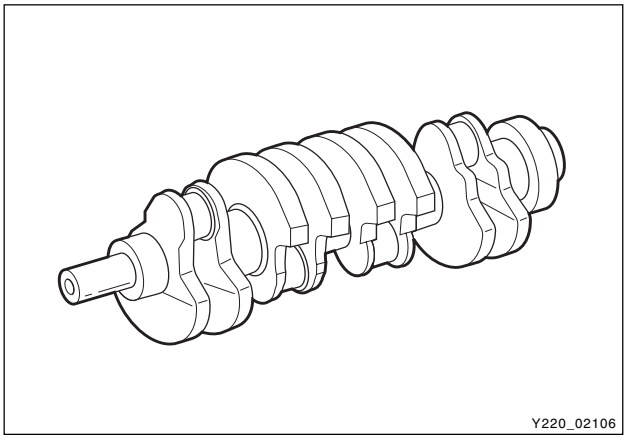
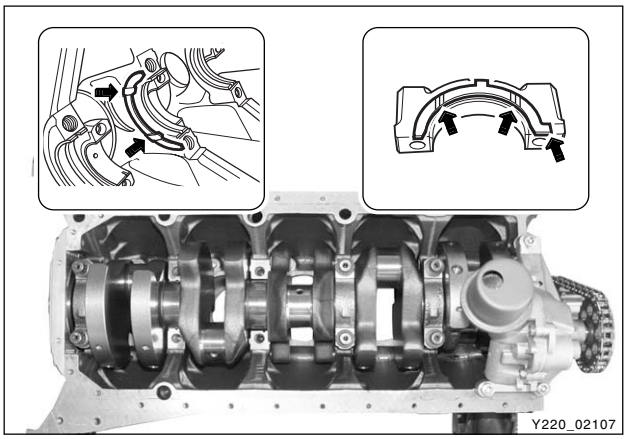


Crankshaft - Reassembly

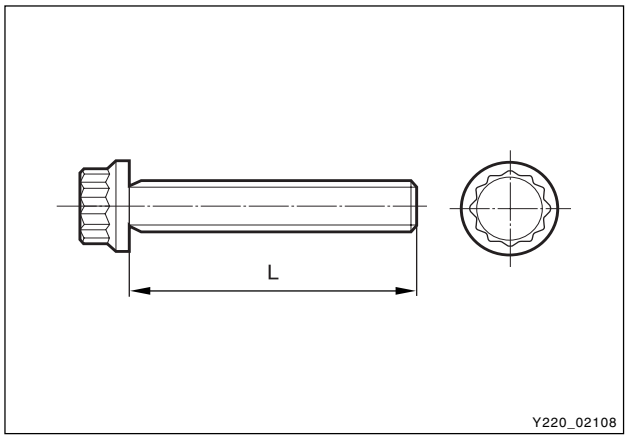
1. Thoroughly clean the oil galleries and check the journal section and bearings. Replace if necessary.



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

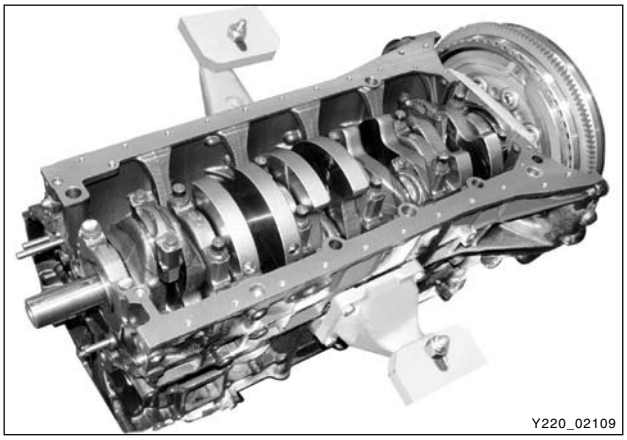
Notice

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



Notice

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



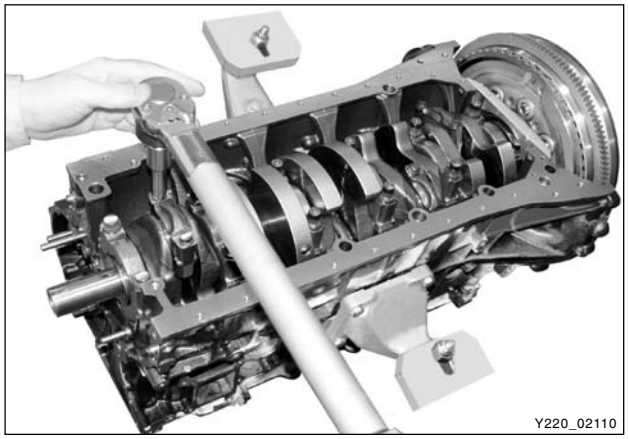
4. Coat the new crankshaft with engine oil and place it on the crankcase.
5. Install the crankshaft bearing caps according to the markings and tighten the bolts.

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

Notice

Install from #1 cap.

6. Position the #1 piston at TDC and install the crankshaft.
7. Install the piston connecting rod journal to the crankshaft journal and tighten the bolts.
8. Measure the crankshaft bearing axial clearance.
   - When new: 0.100 ~ 0.245 mm
   - When used: 0.300 mm
9. Rotate the crankshaft by hand and check whether it rotates smoothly.



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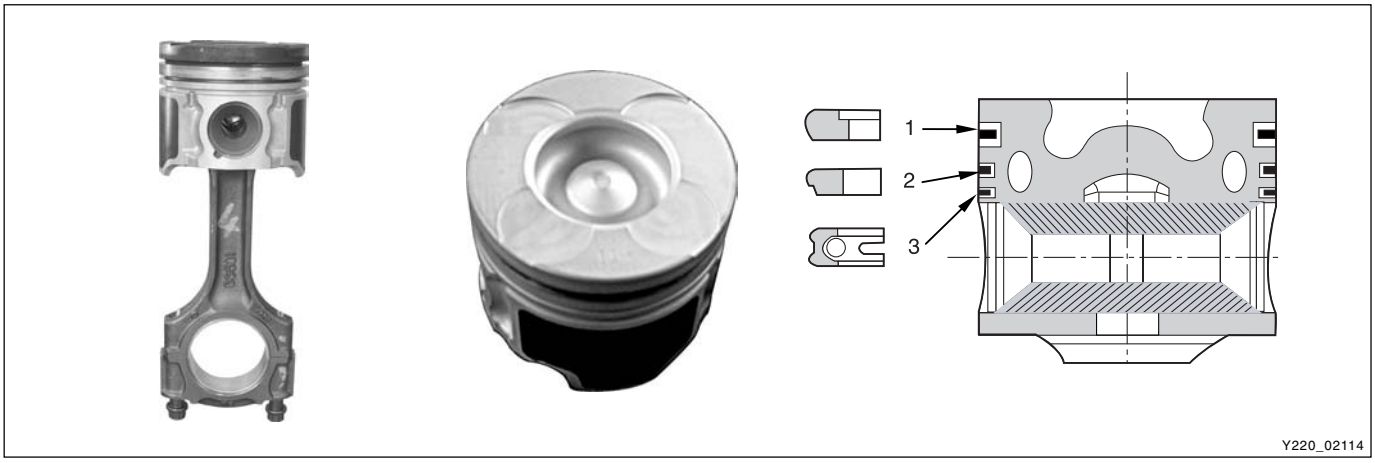
PISTON AND CONNECTING ROD

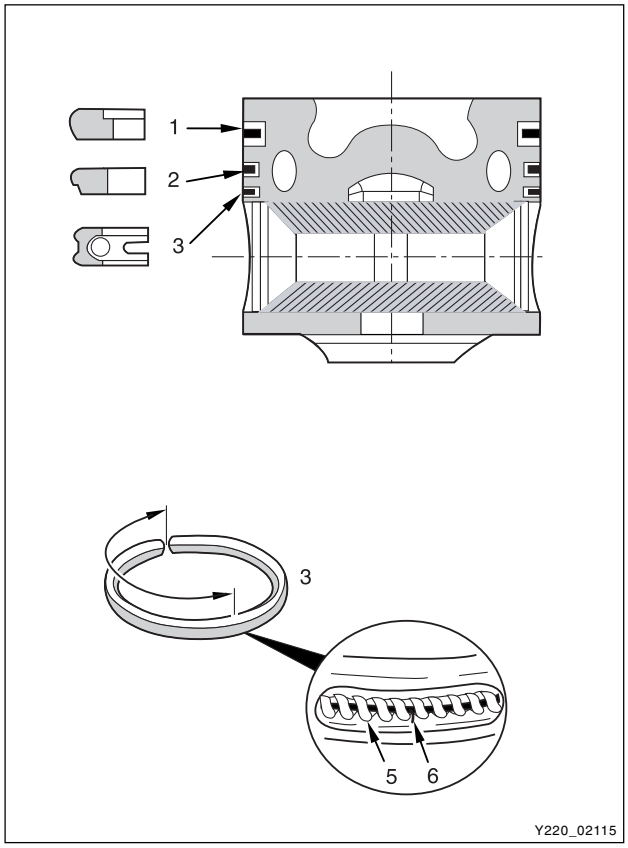


1. Piston
2. No.1 compression ring
3. No.2 compression ring
4. Oil ring
5. Piston pin
6. Snap ring

Description	D27 DT ENG
Cylinder bore diameter	ϕ 86.2 $_{(0\sim0.018)}$ mm
Piston outer diameter (D1)	ϕ 86.133 $_{(\pm0.009)}$ mm
Clearance between bore and piston	74 ㎛
Piston cooling gallery	Applied
Pin offset	N/A
Compression ratio	18 : 1
Length of piston pin	71.2 mm
Material of top ring / coating	Steel / Gas nitride
Tightening torque of connecting rod bolt	40 ± 5.0 Nm, 90° + 10°
Permissible weight difference of connecting rod	4 g
Thickness of connecting rod bearing (Red)	1.806 ~ 1.809 mm
Thickness of connecting rod bearing (Yellow)	1.809 ~ 1.812 mm
Thickness of connecting rod bearing (Blue)	1.812 ~ 1.815 mm

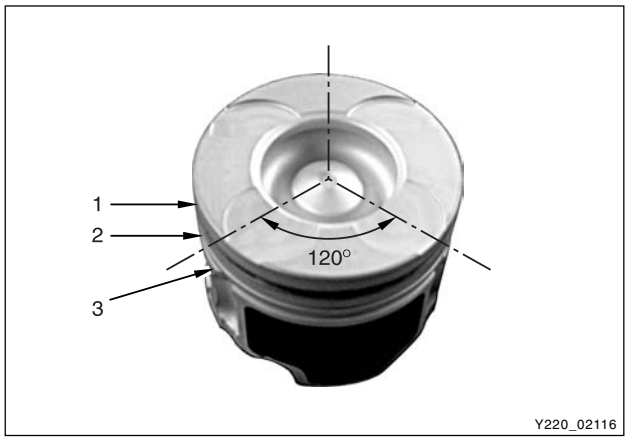
PISTON RING

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



▶ Replacement of Piston Ring

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



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

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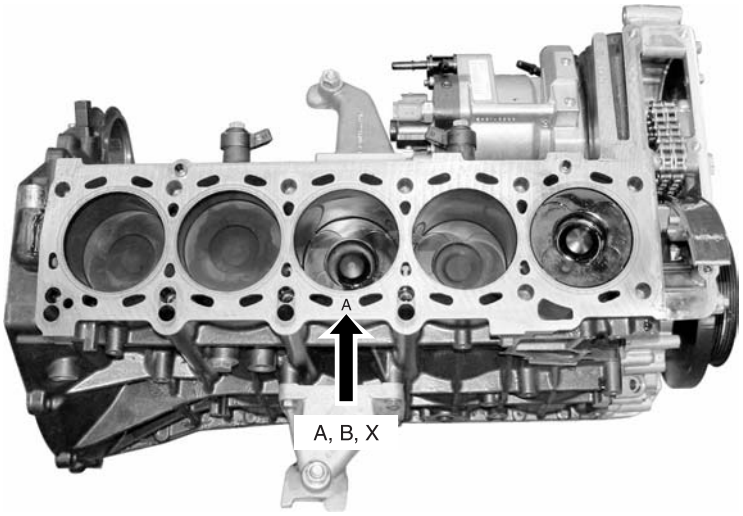
CYLINDER INNER DIAMETER AND PISTON SIZE



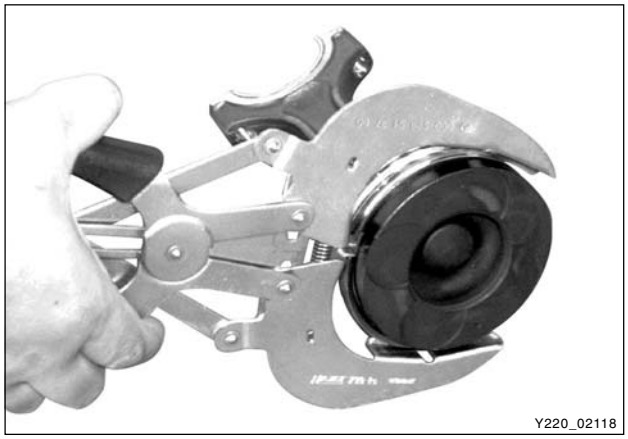
Y220_02117

(Unit : mm)

Engine	Code	Used piston	Cylinder Diameter	Piston Diameter
D27DT	A	A or X	86.200 ~ 86.206	86.124 ~ 86.130
	X	A, B or X	86.206 ~ 86.212	86.129 ~ 86.137
	B	B or X	86.212 ~ 86.218	86.136 ~ 86.142
	+ 5	+ 5	86.250 ~ 86.260	86.167 ~ 86.181
	+ 10	+ 10	86.300 ~ 86.310	86.217 ~ 86.231

Piston - Reassembly

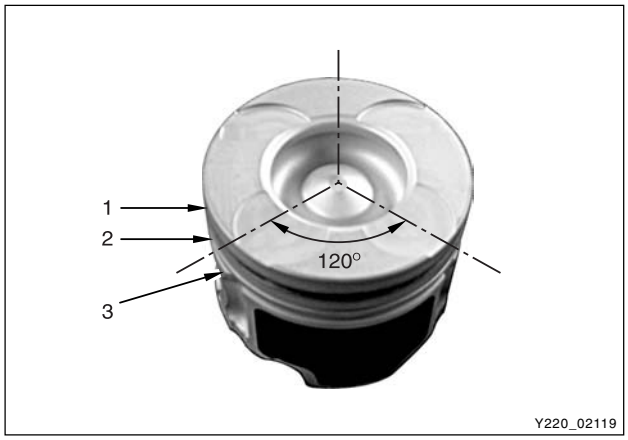
1. Install the compression ring and oil ring on the piston with a special tool.



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

Notice

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



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

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

* Piston ring end play (mm)

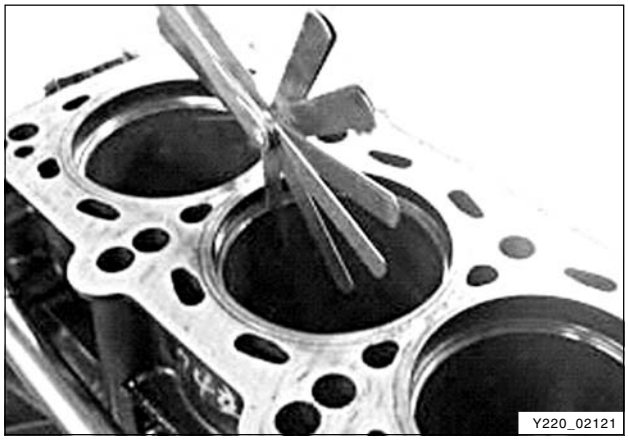
1st groove: 11.0 mm

2nd groove: 10.5 mm

3rd groove: 7.0 mm

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

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



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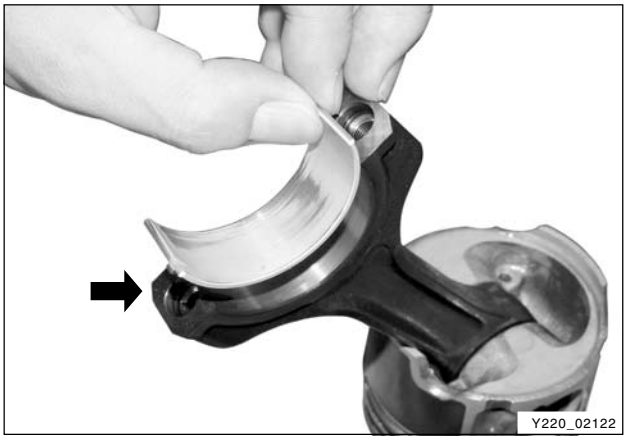


4. Fit the piston onto connecting rod so that the marking on piston crown and locking slot are facing to straight ahead direction.

Notice

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

5. Lubricate piston pin and push in by hand.

Notice

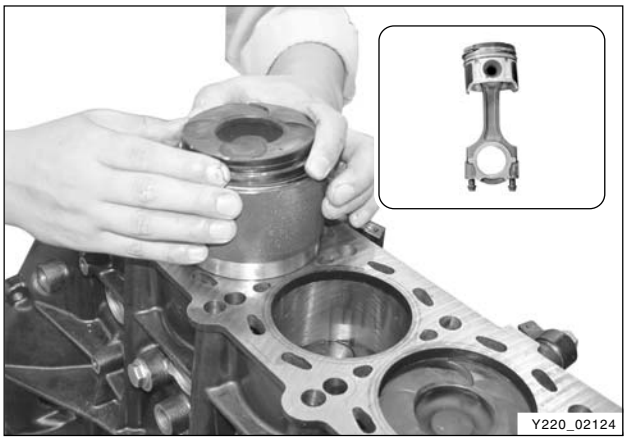
Do not heat up the piston.

6. Place new snap rings into the grooves.

Notice

The snap rings should be replaced with new one.

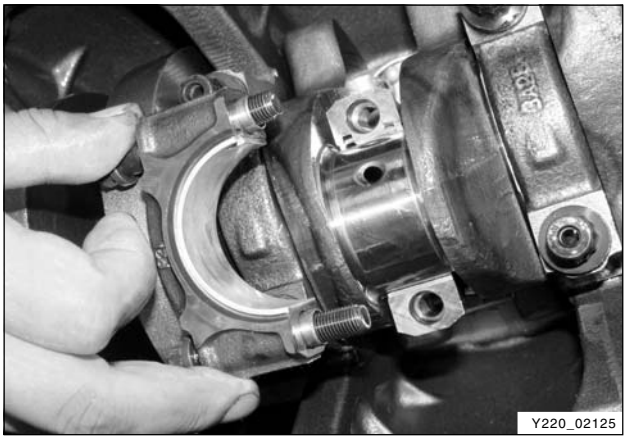
7. Lubricate the cylinder bore, connecting rod bearing journals, connecting rod bearing shells and pistons.



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

Notice

The marking on the piston crown must be facing to straight ahead direction.



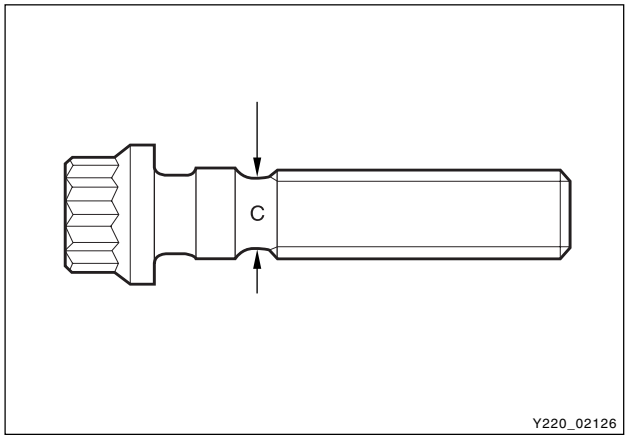
9. Insert connecting rod bearing shells.

Notice

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

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

Limit “C”	7.1 mm

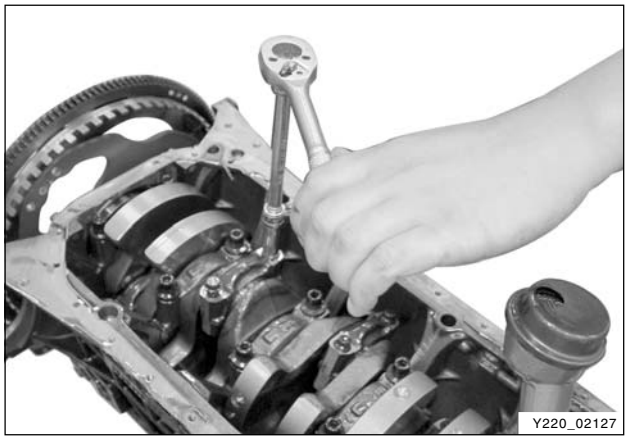


11. Lubricate the new connecting rod bolts and tighten.

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

- End play of connecting rod cap

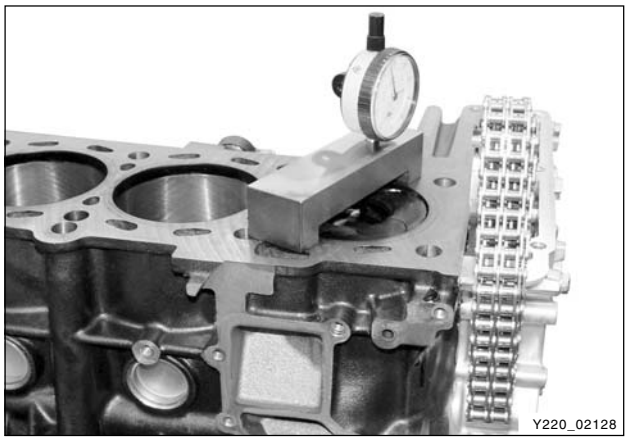
Specified value	0.5 ~ 1.5 mm



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

Permissible piston protrusion	0.765 ~ 1.055 mm

- Measure at both ends of axial direction.



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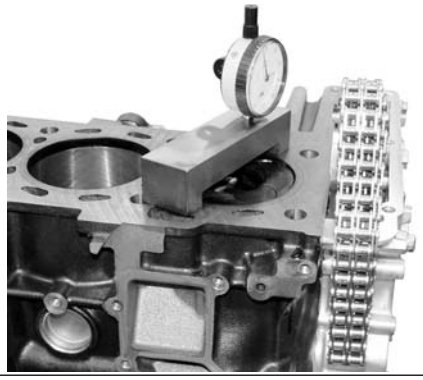
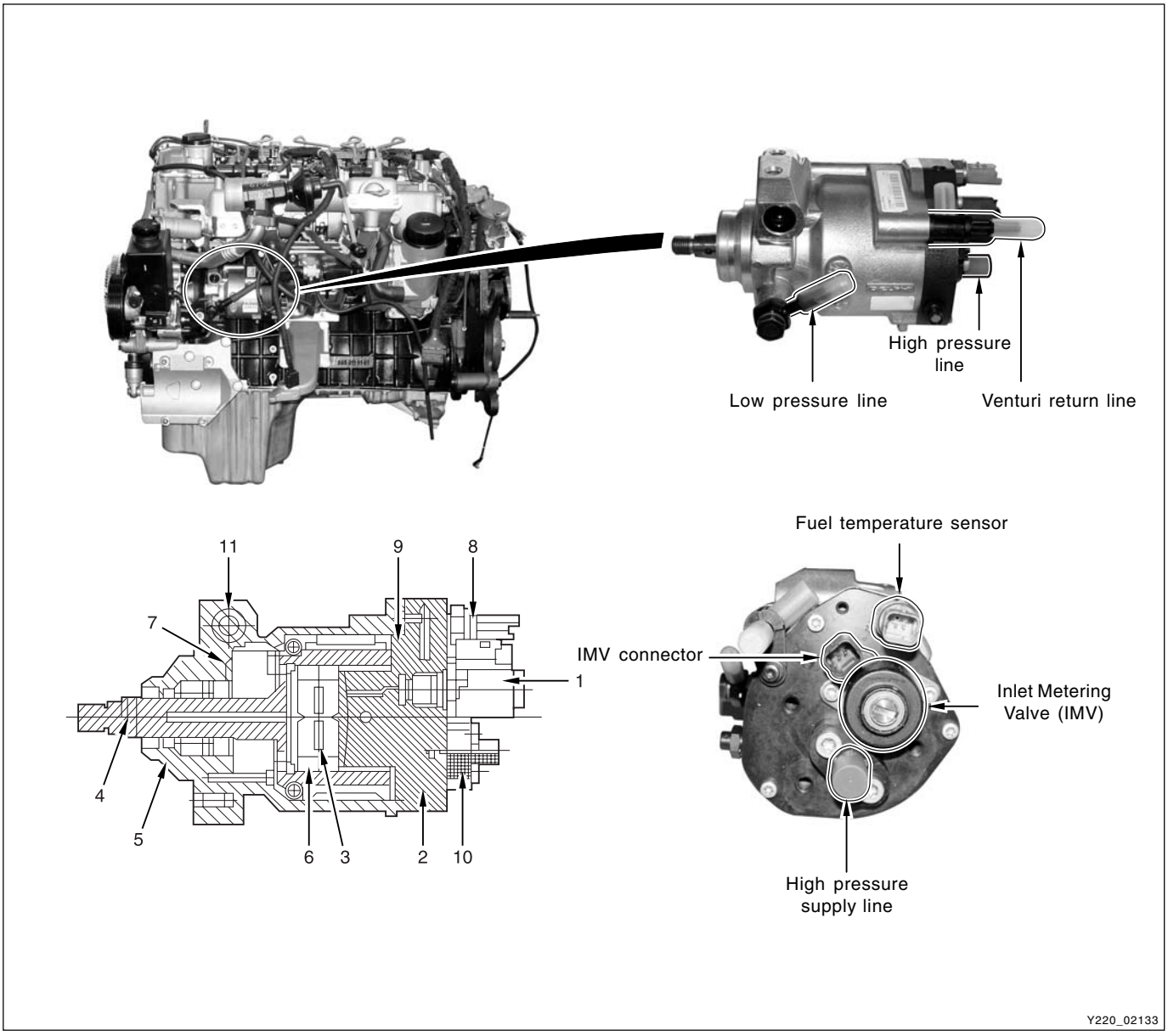
▶ Special Tools and Equipment

Name and Part Number	Application
Piston protrusion measuring jig  Y220_02129	 Y220_02130
Piston insertion jig  Y220_02131	 Y220_02132

HIGH PRESSURE PUMP (HPP)

COMPONENTS LOCATOR



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

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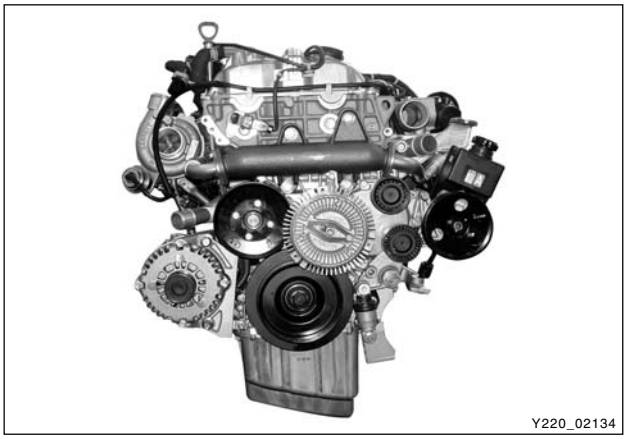

Y220_02134

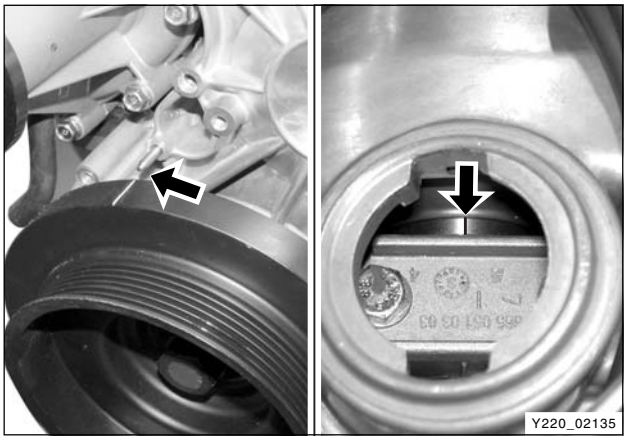
HP Pump - Disassembly and Reassembly

※ Preceding works:

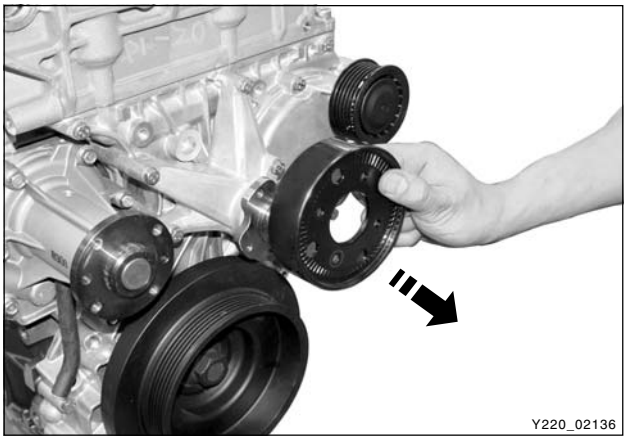
- Removal of fan belt (including cooling fan and fan clutch) and fan shroud
- Removal of intake manifold assembly
- Removal of water pump pulley
- Removal of auto tensioner
- Removal of EGR pipe
- Removal of oil dipstic gauge

Notice

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


Y220_02135

1. Set crankshaft pulley to OT point. Open the oil filler cap and check if the cam shaft notch marking is aligned to OT point.

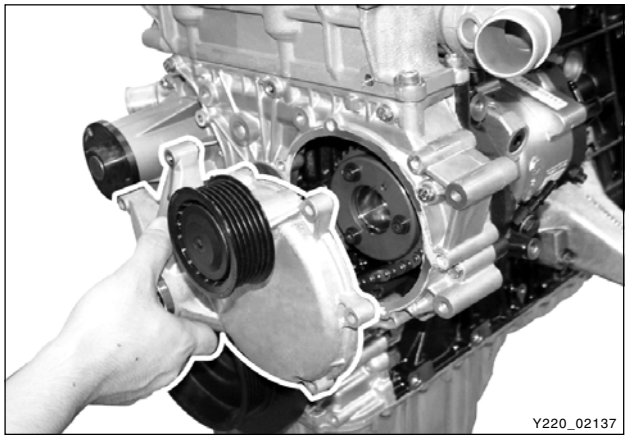

Y220_02136

2. Remove the cooling fan idle pulley with a pulley holder (special tool).

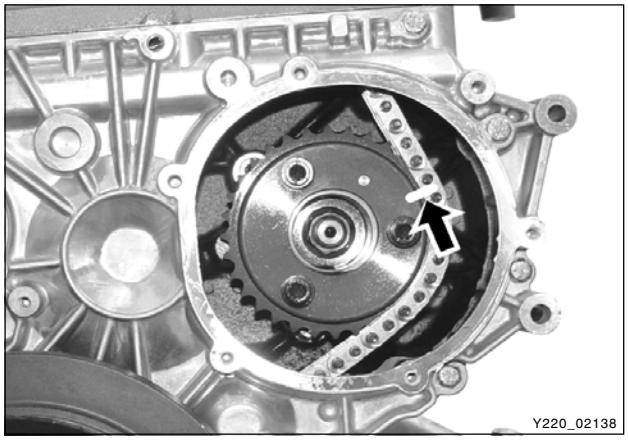
3. Remove the cooling fan bracket assembly.

Notice

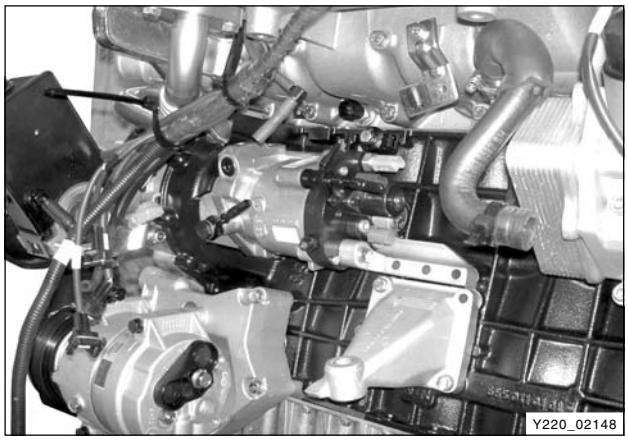
Be careful not to get the sealant or foreign materials into the engine.



4. Place the marks on the chain and HP pump sprocket for installation.



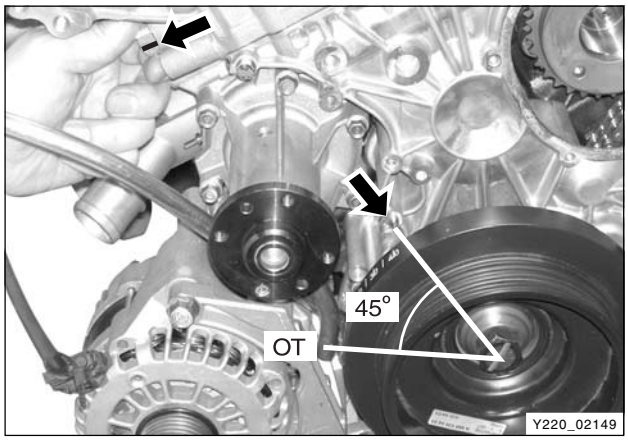
5. Remove the vacuum modulator bracket.
6. Remvoe the fuel pipes and wiring connectors which connected to fuel pump.



7. Turn the crankshaft pulley to the counter clockwise direction to ATDC 45° then remove the chain tensioner.

Installation Notice

Tightening torque	80 ± 8Nm



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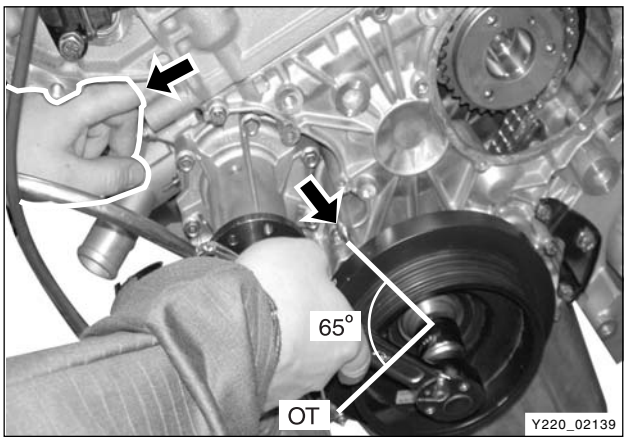
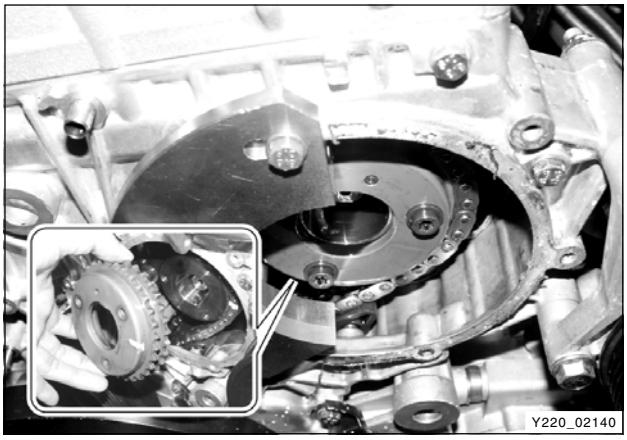
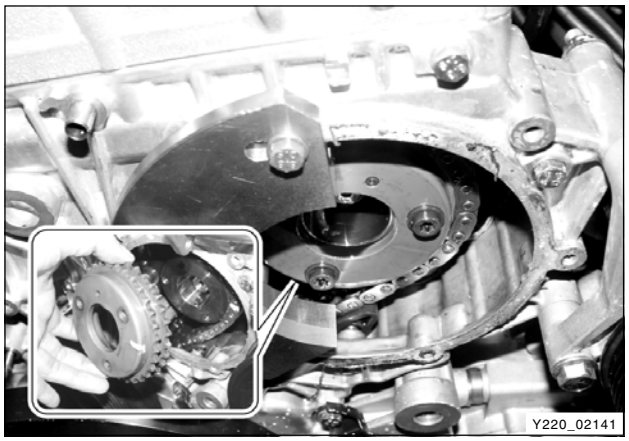


8. While insert finger and push the chain guide backward direction and turn the crankshaft pulley to ATDC 65° by counter clockwise direction until feel the chain guide inclined backward.



9. Install a special tool into the cooling fan bracket hole to hold the sprocket.



10. Remove the sprocket bolts and center nut and after slightly lifted up the chain, remove the pump sprocket.

Installation Notice

Tightening torque	Nm
Sprocket bolt	20 Nm + 90°
Center nut	65 ± 5 Nm

11. Remove the HP pump bearing with HP pump bearing puller (special tool).

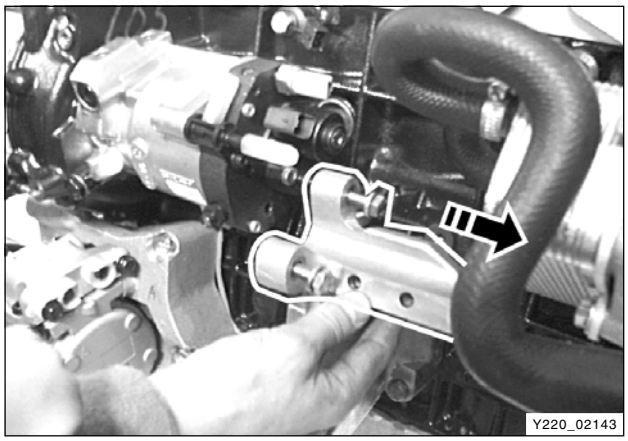
Notice

Do not apply excessive force. The timing chain may deviates.

12. Remove the HP pump mounting bracket.

Installation Notice

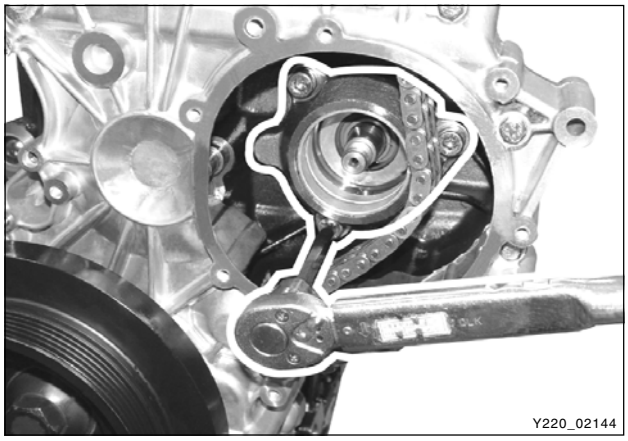
Tightening torque	24 ± 2.4 Nm



13. Unscrew the external bolts and remove the HP pump while rocking and tapping it with a rubber hammer.

Notice

- ***To prevent HP pump shaft damaging, do not apply excessive impact.***
- ***Do not apply excessive force. The timing chain may deviates.***



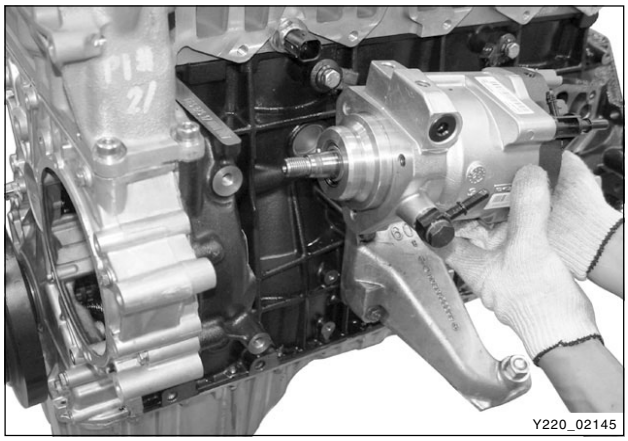
14. Remove the HP pump.

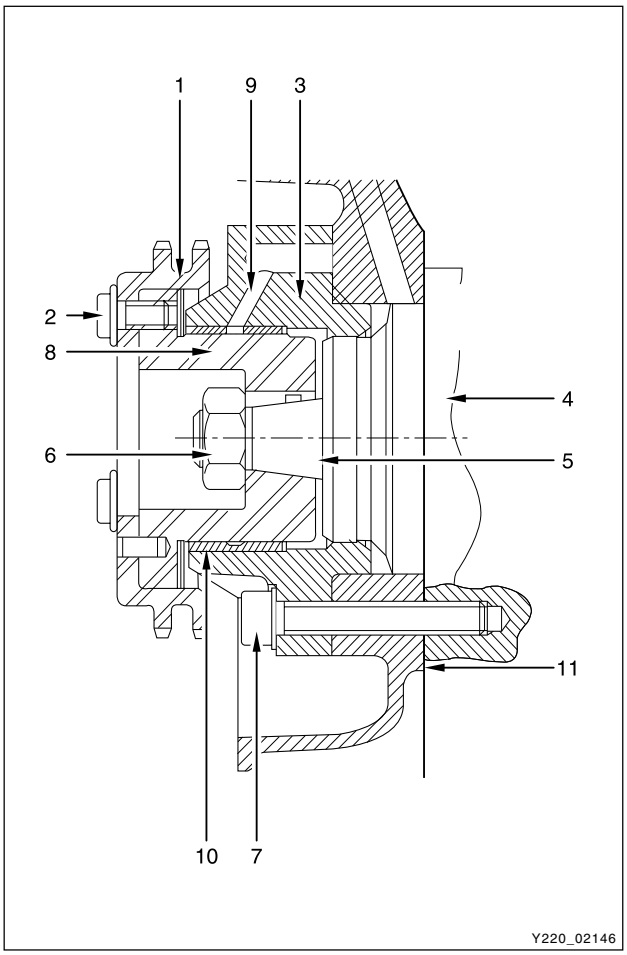
15. Install the new HP pump with sealing caps.

Notice

Remove the sealing caps only when connecting the pipes and hoses.

16. When replaced the HP pump, initialize the fuel pressure by using SCAN-100. Refer to “Trouble Diagnosis” section in this manual.





Notice

If the initialization of fuel pressure has not been performed, the engine ECU controls new HP pump with the stored offset value. This may cause the poor engine output.

Install in the reverse order of removal and tighten the fasteners with the specified tightening torque.

1. HP pump sprocket
2. 12-sided sprocket mounting bolt
3. HP pump bearing housing
4. HP pump (High Pressure Pump)
5. HP pump shaft
6. HP pump center nut
7. HP pump outer bolt
8. HP pump bearing shaft
9. Oil gallery
10. Bearing bushing
11. Gasket

* Tightening torque

Center nut (M14 x 1.5 - 1EA)	65 ± 5.0 Nm
Outer bolt (M8 x 55 - 3EA)	24 ± 2.4 Nm
Sprocket bolt (M7 x 13 - 3EA)	20 Nm ± 90°

SECTION DI03

INTAKE SYSTEM

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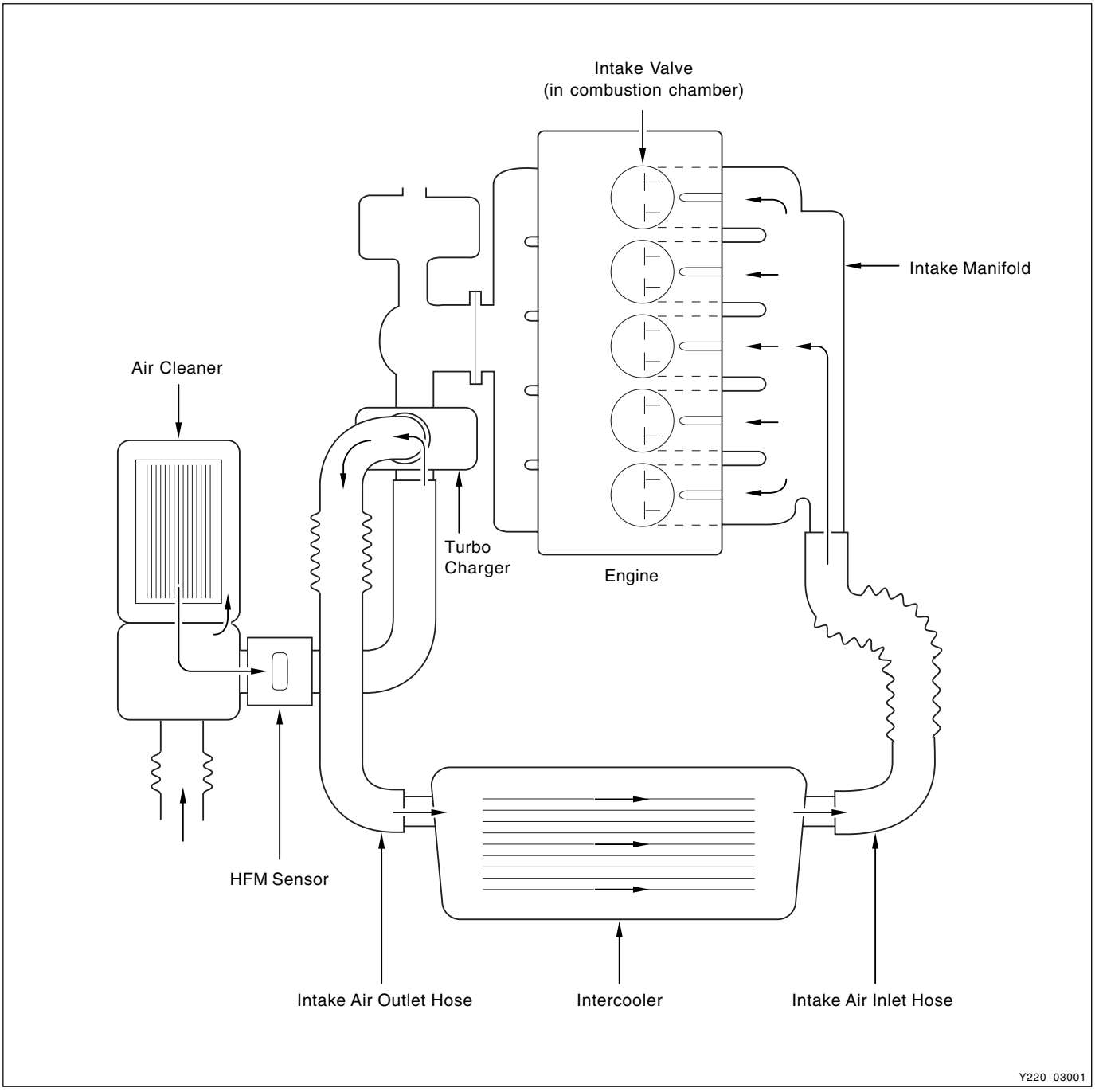
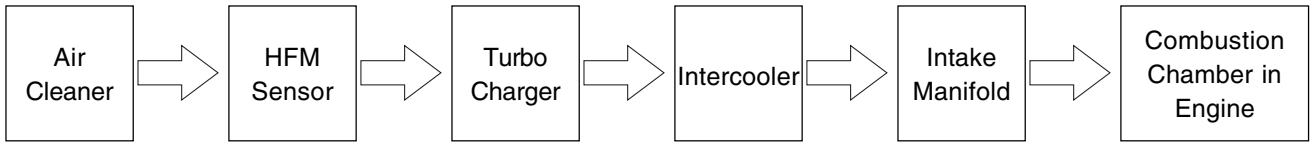
AIR FLOWS



▶ Work Flow of Intake System



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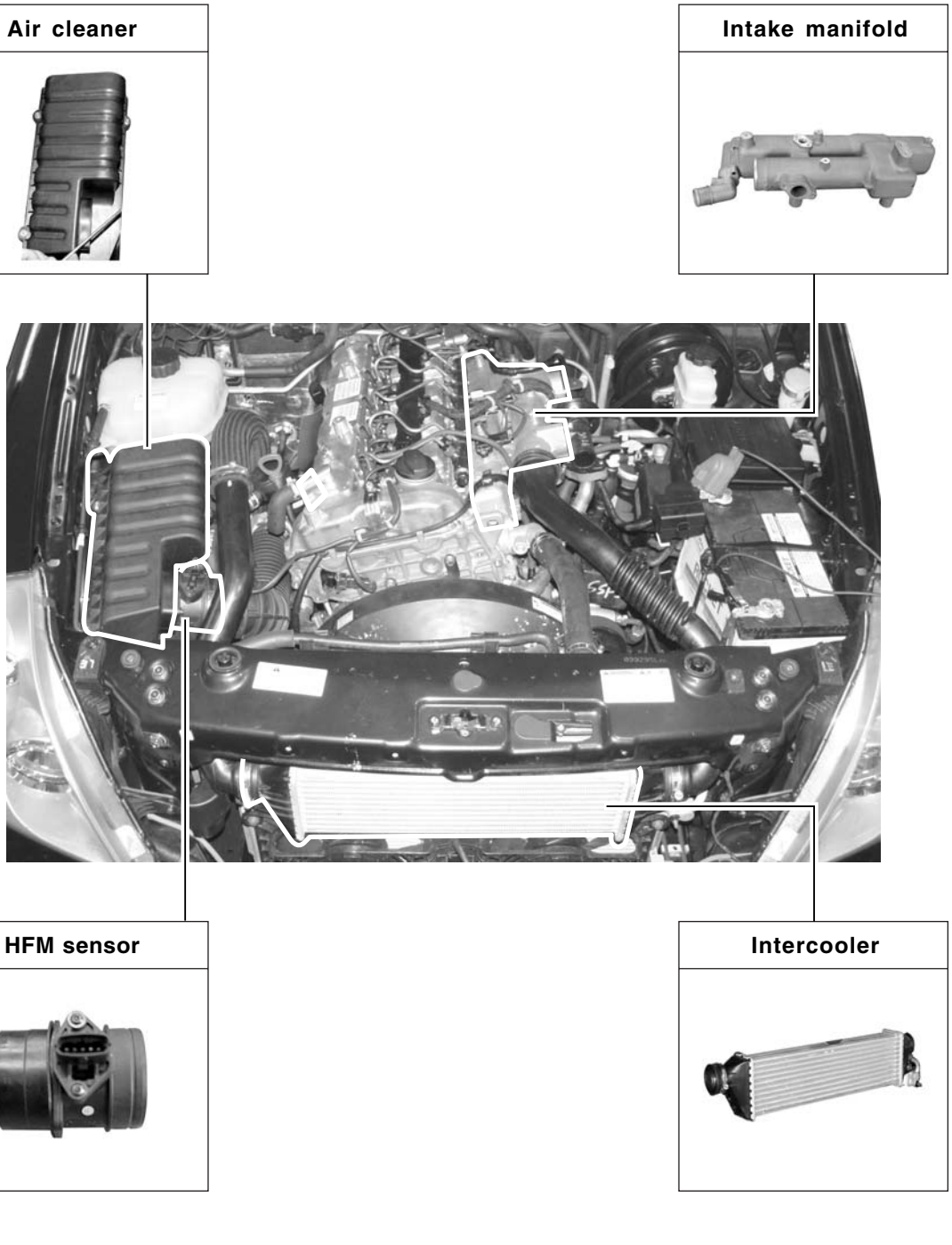
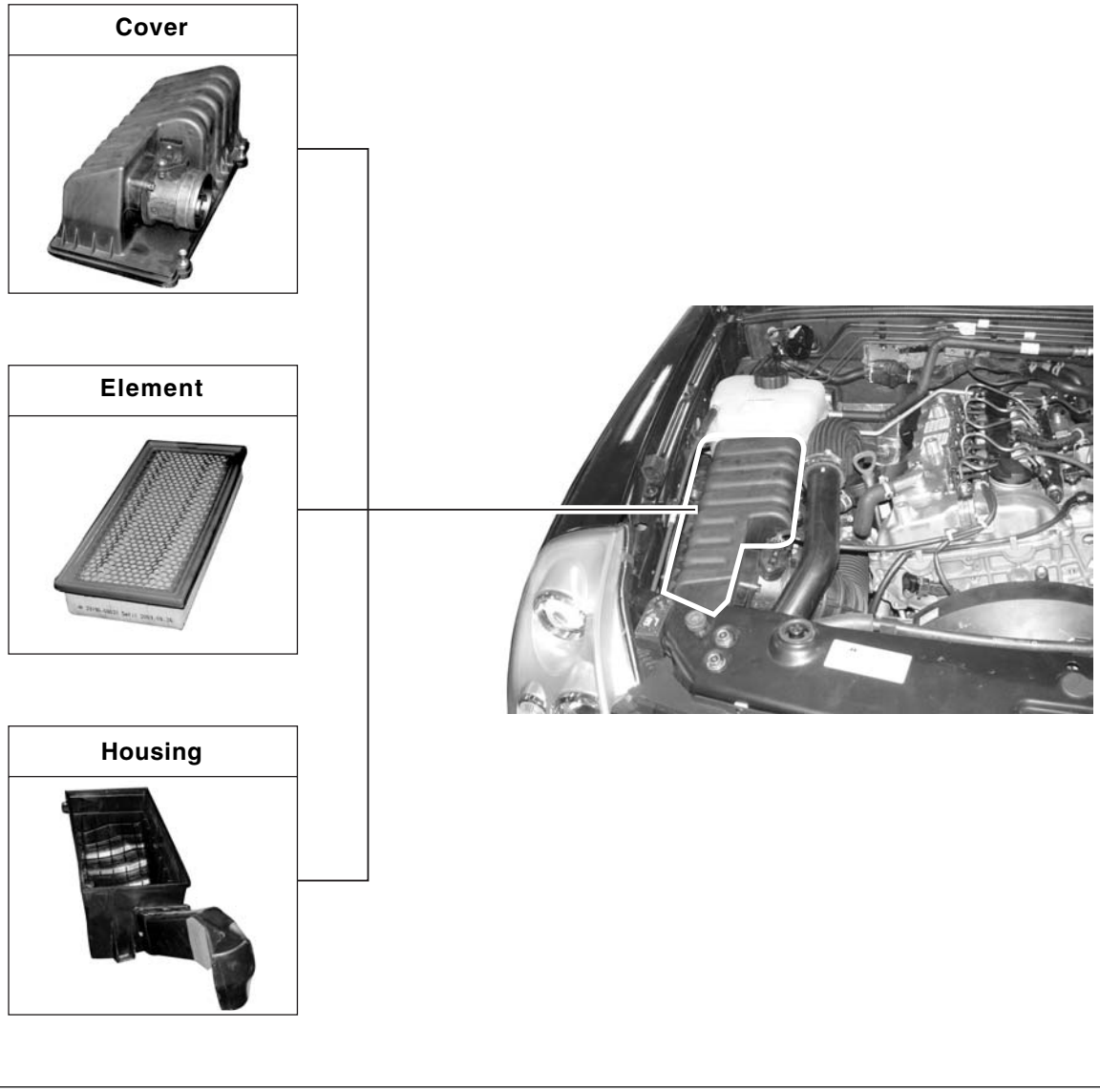
INTAKE SYSTEM LAYOUT

COMPONENTS LOCATOR



AIR CLEANER



▶ Specifications

Element Type	Dry-Element Type
Service Interval	* Initial cleaning: 5,000 km, Clean or change every 10,000 km as required. However, change every 30,000 km. * If the vehicle is operated under severe condition (short distance driving, extensive idling or driving in dusty condition): More frequent maintenance is required.

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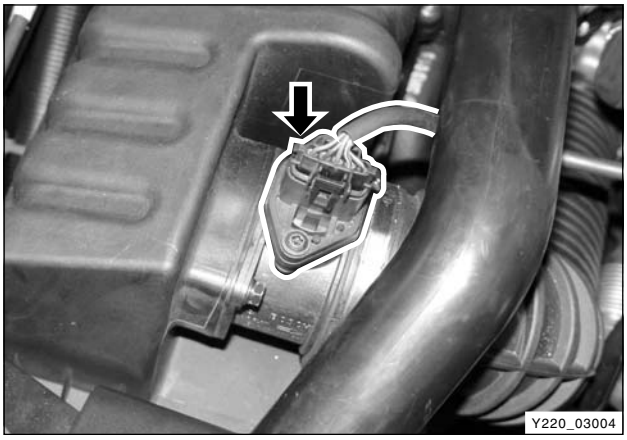
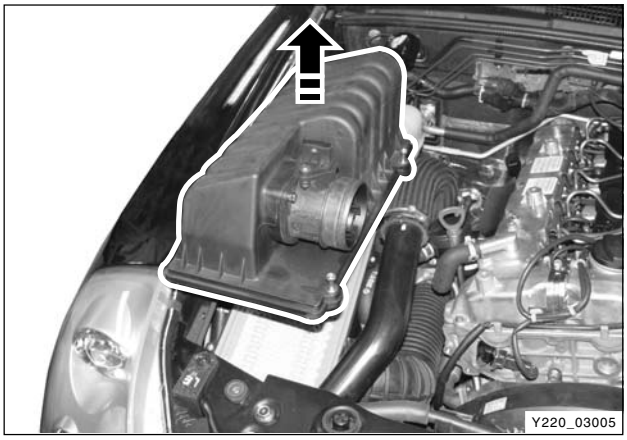


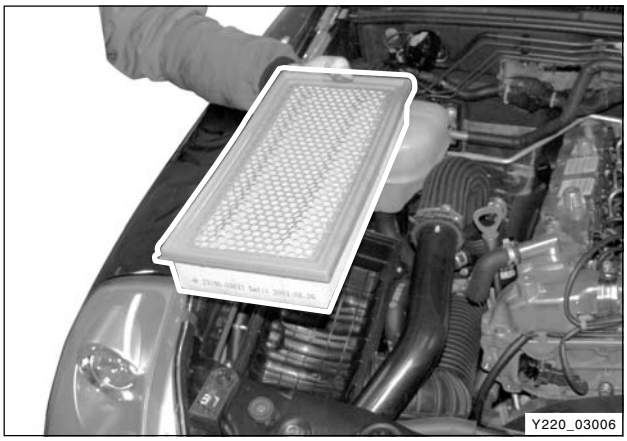
Air Cleaner Element - Replacement

※ Preceding Work: Disconnection of negative battery cable

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



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

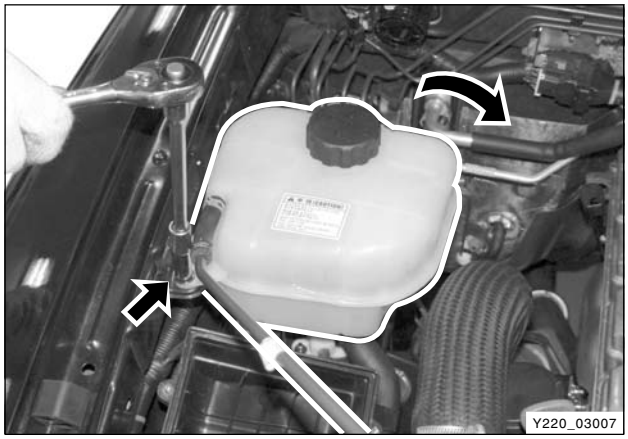


4. Remove the air cleaner element. Clean or replace the element as required.

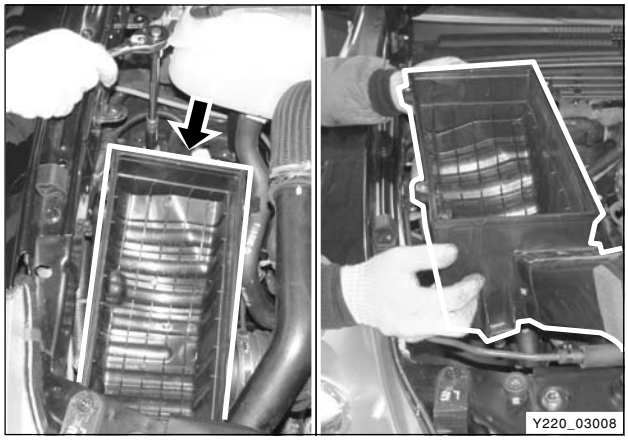
Air Cleaner Housing - Removal and Installation

※ Preceding Work: Removal of air cleaner cover

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

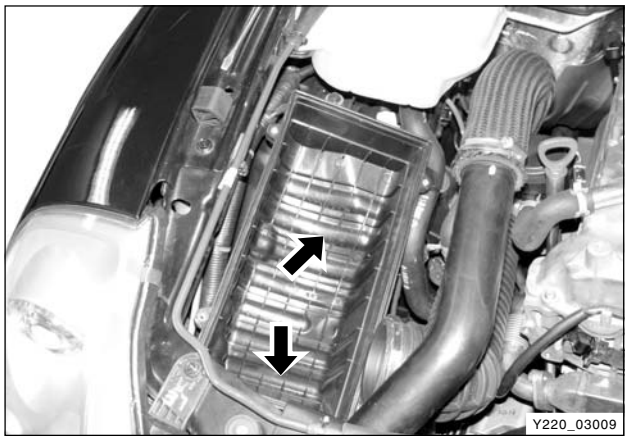


2. Remove the air cleaner housing bolts.
3. Install in the reverse order of removal.



Air Cleaner Housing/Element - Check

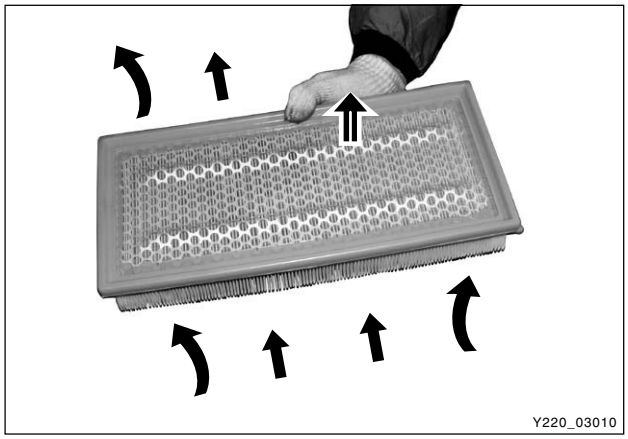
1. Check the air cleaner body, cover and packing for deformation, corrosion and damage.
2. Check the air duct for damage.



3. Check the air cleaner element for clogging, contamination and damage. If the element is partially clogged, remove the dust or foreign materials with the compressed air. If the contamination is severe, replace it with new one. Also, be careful not to contaminate during the replacement.
4. Check the air cleaner housing for clogging, contamination and damage.
5. If the inside of housing is contaminated, remove the contaminants.

Notice

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



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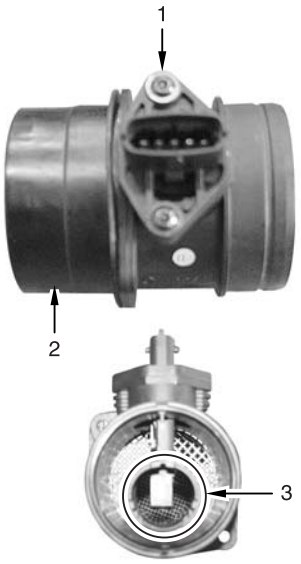
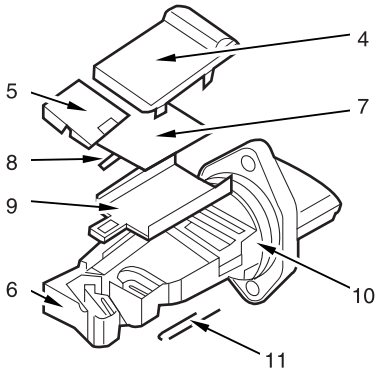
AIR FLOW SENSOR (HOT FILM AIR MASS SENSOR)





<CI type HFM sensor structure>

Y220_03011

▶ **Change history**

inner tube added + grid (No.3) added + sensing chip changed + sensing section design changed

▶ **Results**

Durability has enhanced 60 times (lab test results)

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

Air flow sensor is locating on the air intake passage between air cleaner and intake manifold and measures air volume flows to engine combustion chamber and intake air temperature.

And intake temperature sensor built-in the sensor detects intake temperature.

Internal circuit of the air flow sensor is being used to control the voltage value to control the temperature to maintain the heating resistance (Rh) to 160°C that is higher temperature than intake air temperature that is measured by resistance (RI).

Temperature sensor of the heating resistance (Rh) is measured by resistance (Rs).

If temperature changes occur due to increasing/decreasing intake air volume, voltage of the heating resistance changes to maintain the intake air temperature changes to set value (160°C).

Control unit computes intake air volume based on voltage changes of heating resistance.

Intake air temperature is measured by NTC integrated in the sensor.

Intake air temperature sensor is a part of HFM sensor and a thermister and resister and detects air temperature changes that flow into the engine. There occurs high resistance when temperature is low and low resistance when high (NTC type).

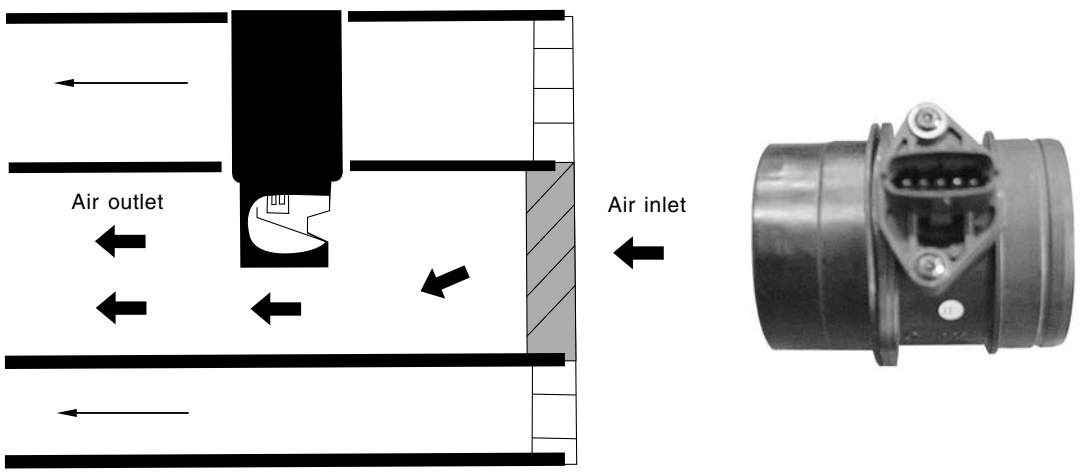
ECU supplies 5 V to intake air temperature sensor and then measures voltage changes to determine the intake air temperature. When air in the intake manifold is cold, the voltage is high and air is hot, the voltage is low.

The reason for using HFM sensor is that this sensor is most proper in controlling accurate air-fuel ratio to meet the legal emission regulations. This sensor measures actual intake air mass into engine very accurately during specific instant acceleration and deceleration, and determines engine loads and detects intake air pulsation and air flows.

Main functions of HFM sensor are:

- Using for EGR feedback control
- Using for turbocharger booster pressure control valve control
- Using for fuel injecting compensation

CI type HFM sensor: The air flowing the sensor does not directs toward sensing section but flows along with lower wall after passing protection grid to enhance durability of the sensor. Oil, water and dust less damage the sensor.



<Structure of CI type HFM sensor>

Y220_03012

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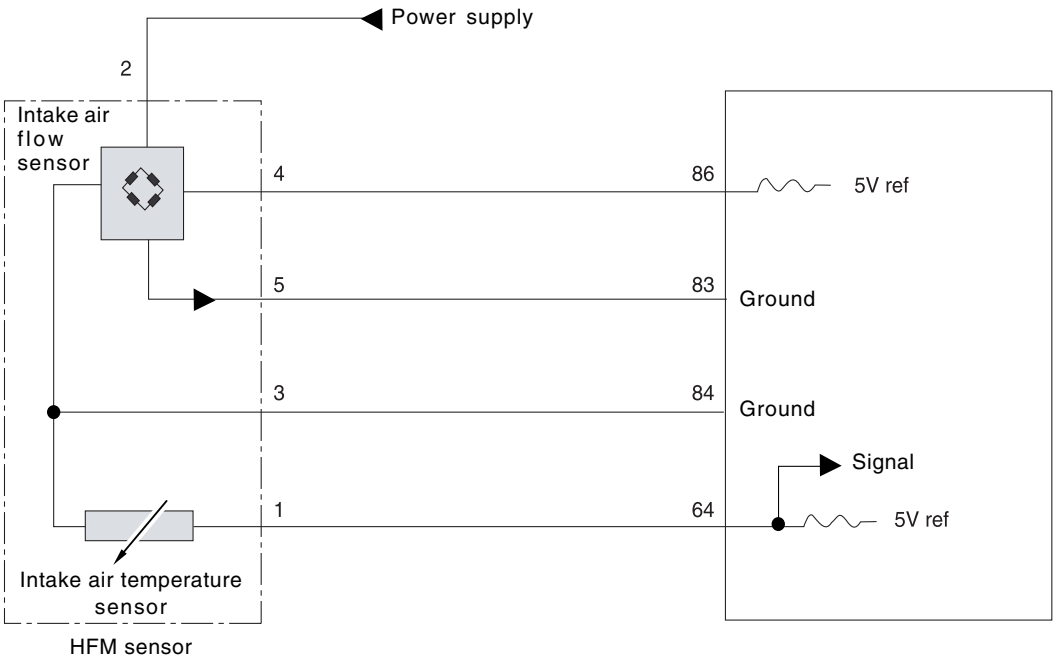
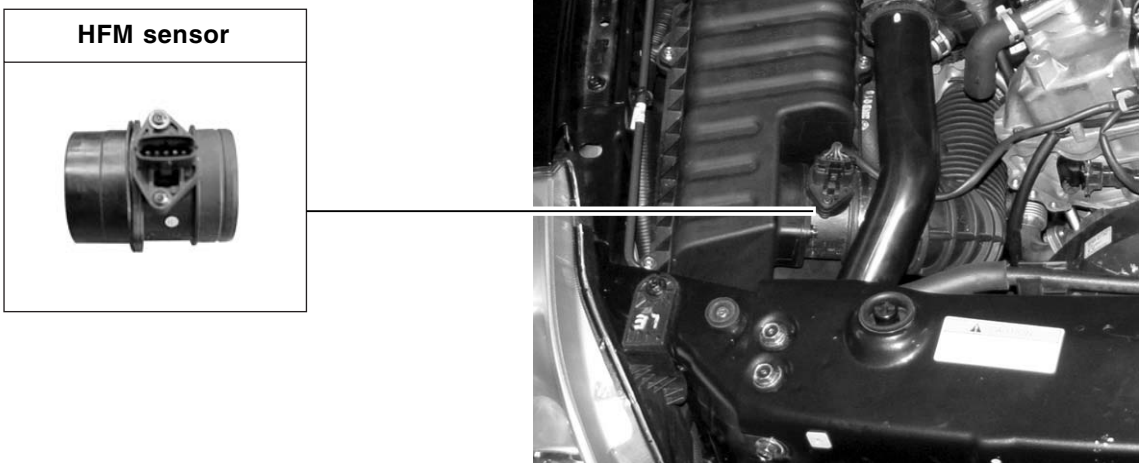


<Circuit diagram of HFM sensor>

Y220_03013

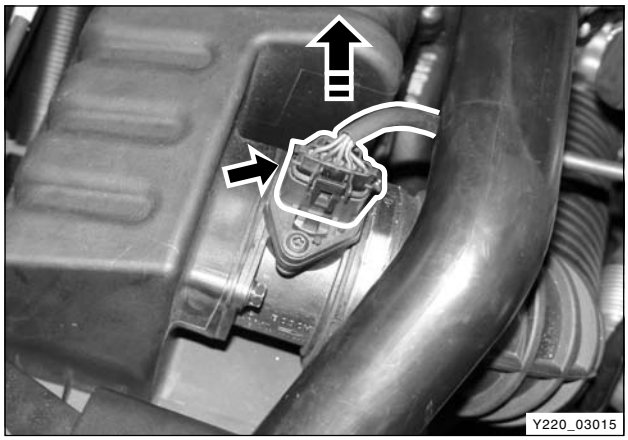
HFM Sensor - Removal and Installation



Y220_03014

※ Preceding Work: Disconnection of negative battery cable

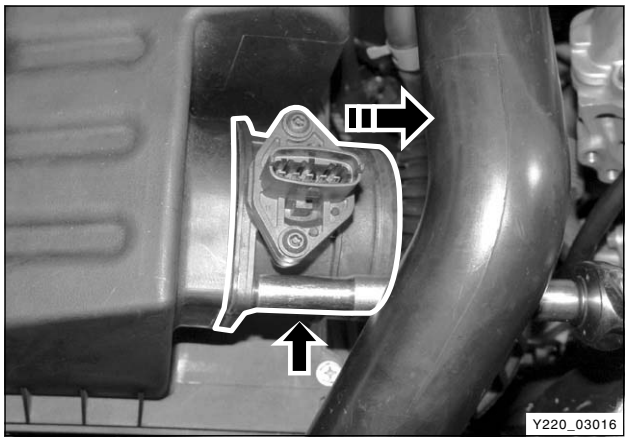
1. Disconnect the negative battery cable.
2. Loosen the clamps on the air cleaner and the turbo charger and remove the duct.



Y220_03015

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

Tightening torque	10 ± 1.0 Nm



Y220_03016

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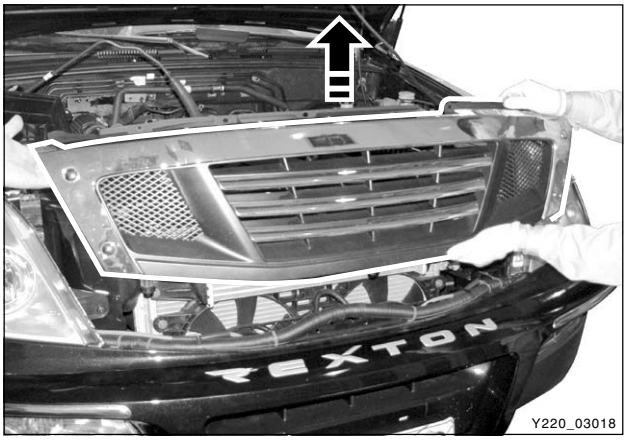
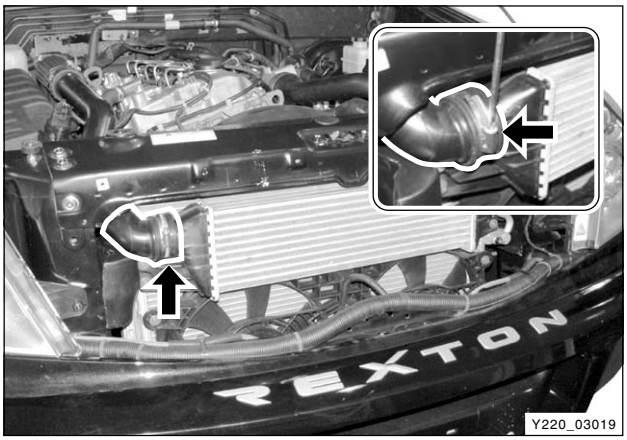
4. Install in the reverse order of removal.



Intake Air Outlet Hose (Turbo Charger) - Removal and Installation

1. Remove the radiator grille.



2. Loosen the clamp at both sides and remove the outlet hose.

3. Loosen the clamp on the intake air hose and remove the intake air hose.

Installation Notice

Tightening torque	6 ~ 7 Nm

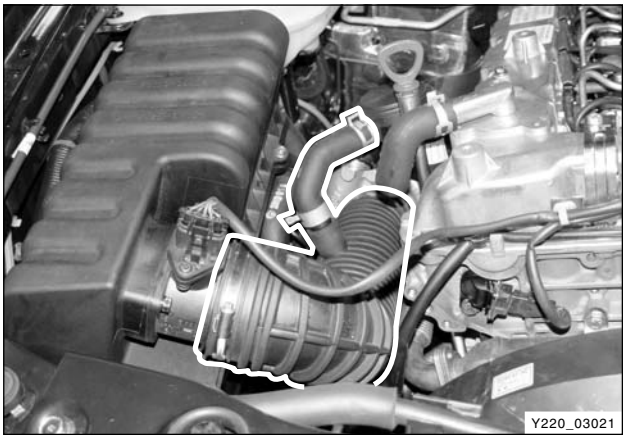
4. Install in the reverse order of removal.

Notice

Securely fasten the clamps on the pipes and hoses.

Intake Air Inlet Duct (Air Cleaner) - Removal and Installation

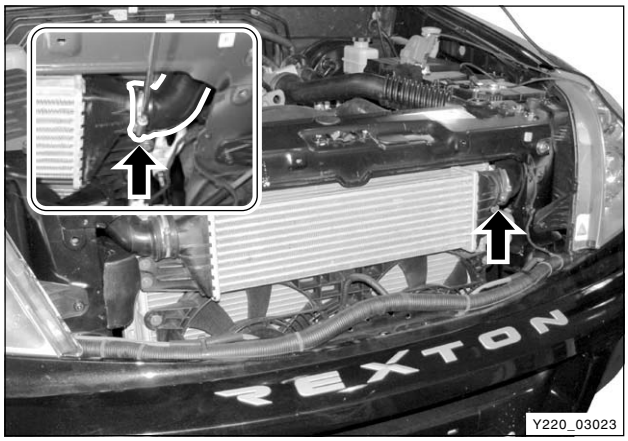
1. Loosen the clamp at intercooler side.
2. Loosen the clamp at turbo charger side.



3. Separate the hose from the oil separator and remove the intake duct.
4. Install in the reverse order of removal.

Intake Air Inlet Duct (Intake Manifold) - Removal and Installation

1. Loosen the clamp on the inlet hose in intercooler.

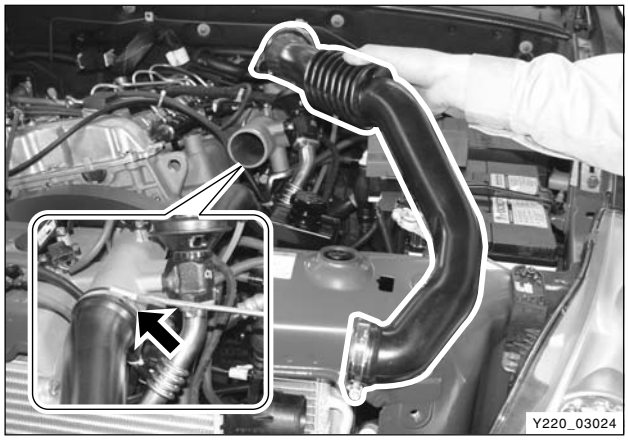


2. Loosen the clamp at the intake manifold and remove the inlet hose.

Installation Notice

Tightening torque	6 ~ 7 Nm

3. Install in the reverse order of removal.



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INTERCOOLER

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

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

1. Intercooler

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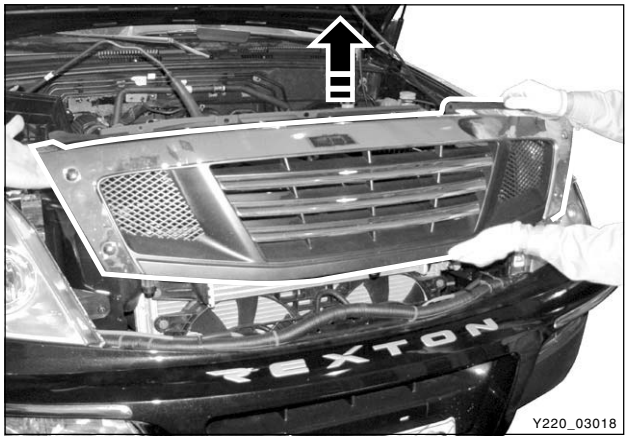
Intercooler - Removal and Installation

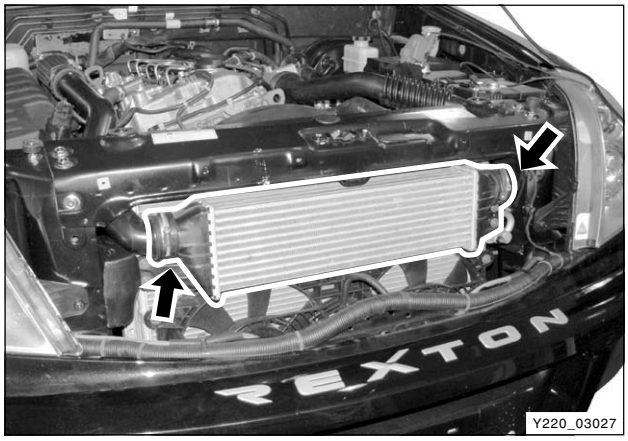
1. Remove the radiator grille.



2. Loosen the clamp at both sides (inlet and outlet) of the intercooler.

Installation Notice

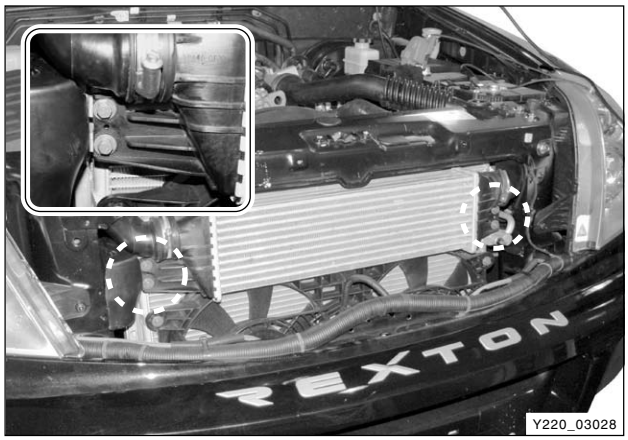
Tightening torque	6 ~ 7 Nm



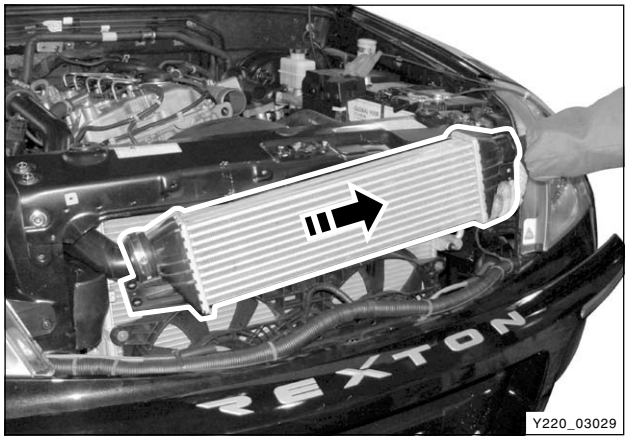
3. Remove the intercooler mounting bolts.

Installation Notice

Tightening torque	10 ± 1.0 Nm



4. Remove the air duct in intake manifold and the intercooler assembly.



5. Install in the reverse order of removal.

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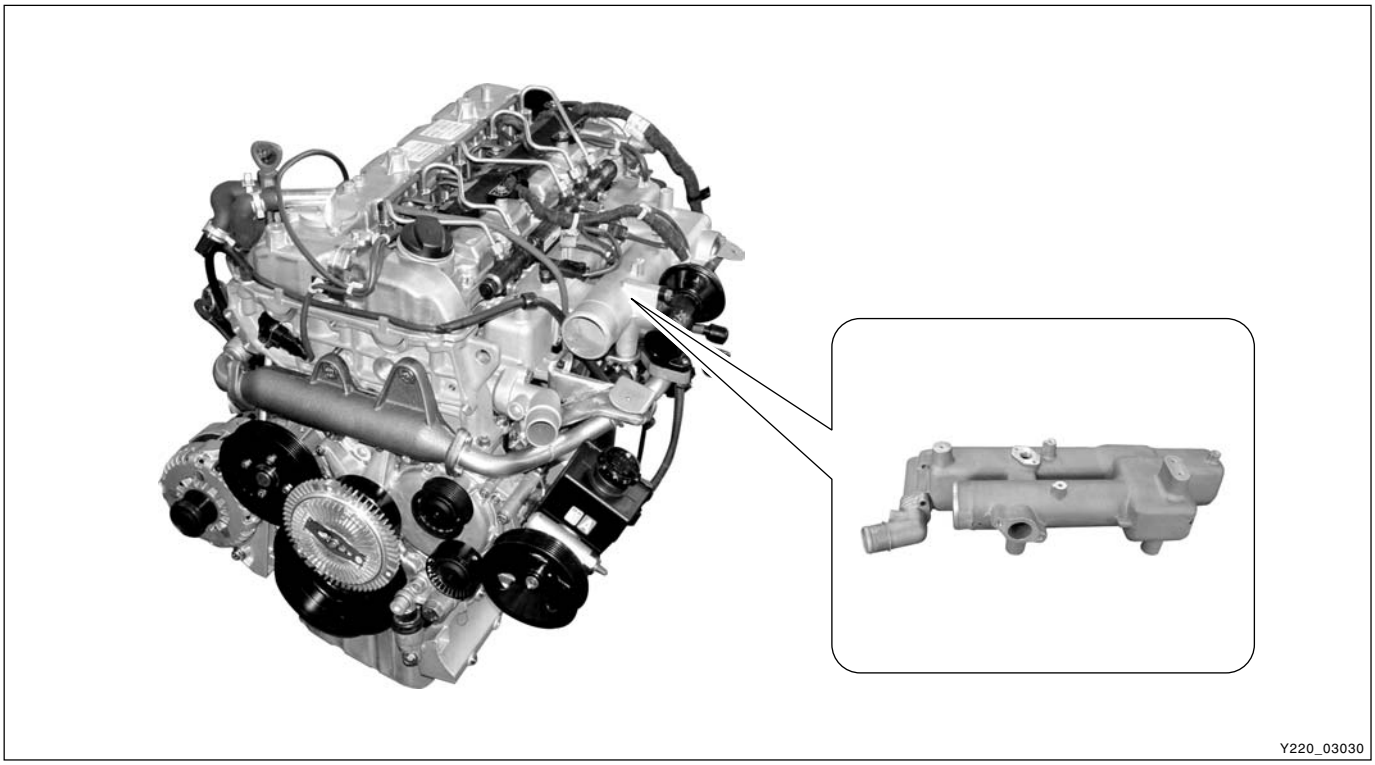
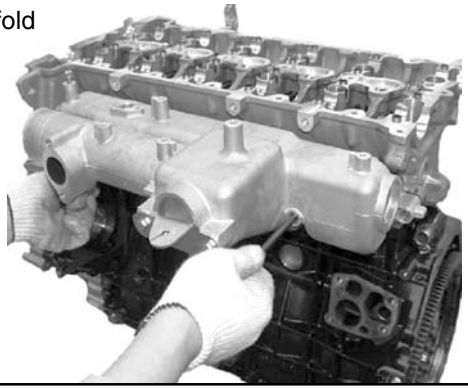
INTAKE MANIFOLD ASSEMBLY

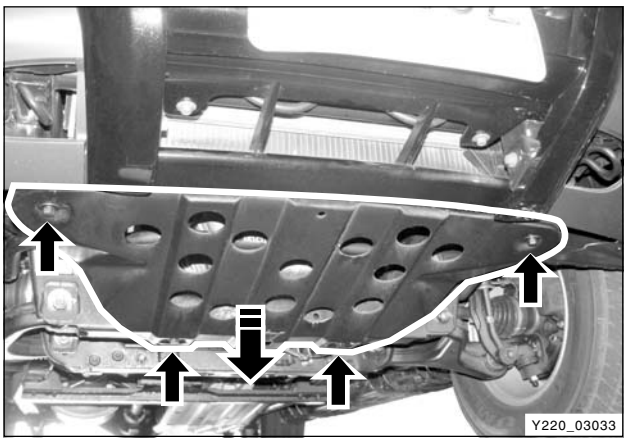


▶ System Characteristics

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

SPECIAL TOOLS AND EQUIPMENT

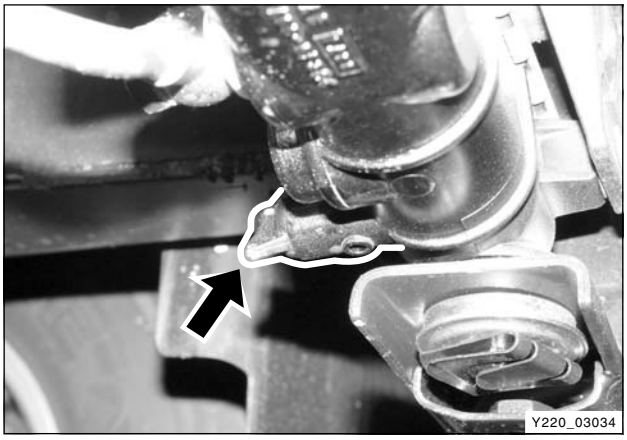
Name and Part Number	Application
Intake manifold locking guide pin  Y220_03031	Installation of intake manifold  Y220_03032



Intake Manifold - Removal/Installation

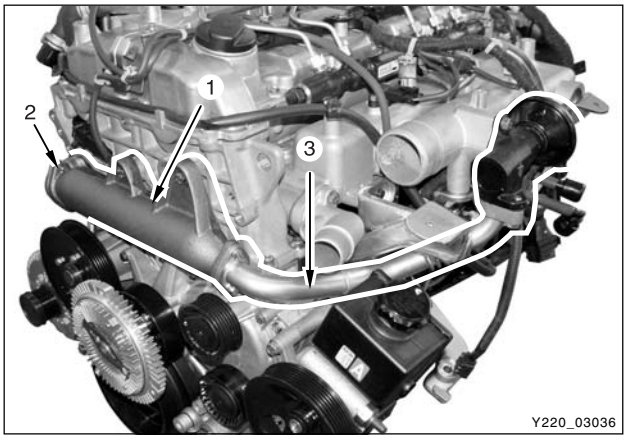
※ Preceding Work: Disconnection of negative battery cable

1. Lift up the vehicle and remove the skid plate.



2. Open the coolant reservoir cap and remove loosen the drain cock to drain the coolant.

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



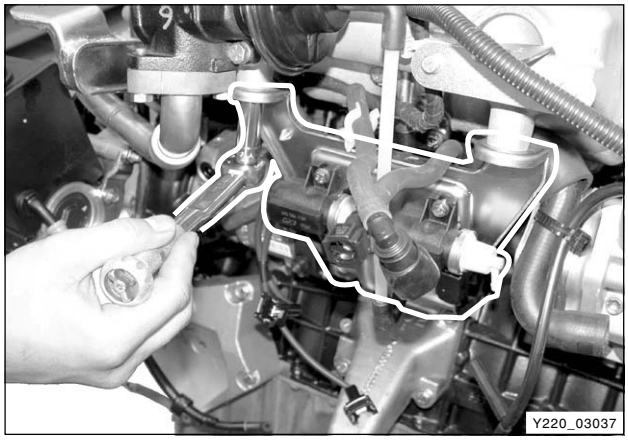
5. Remove the coolant inlet port housing.
6. Remove the vacuum hose from EGR valve.
7. Remove the EGR valve mounting bolts and gasket. Remove the EGR exhaust pipe (primary) mounting bolts and gasket.

Notice

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

8. Remove the brackets and connectors from top section of the engine.
   - Vacuum hose bracket in turbo charger
   - Booster pressure sensor
   - Main wiring bracket
   - Ground cable bracket
   - Fuel pressure sensor connector
9. Unscrew the bolts and remove the vacuum modulator bracket.

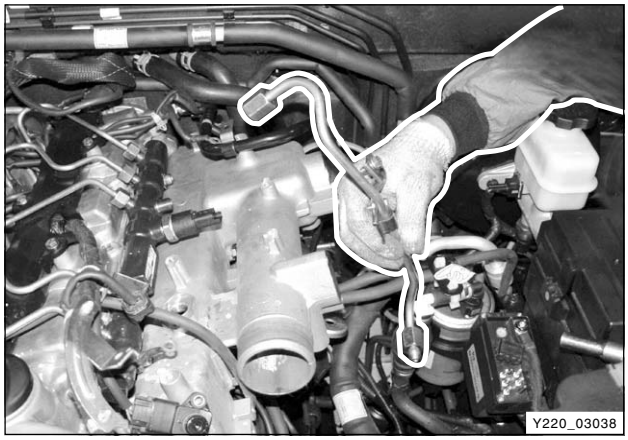
Tightening torque	9.0 Nm



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

Notice

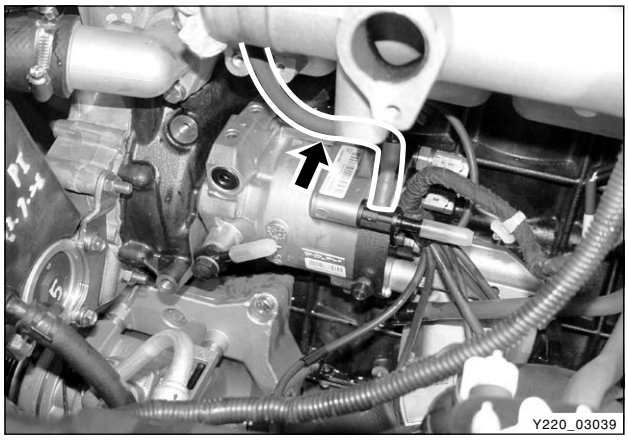
- ***Plug the openings of pipes and ports with sealing caps to keep the cleanness of the fuel system.***
- ***Replace the pipes with new one once removed.***

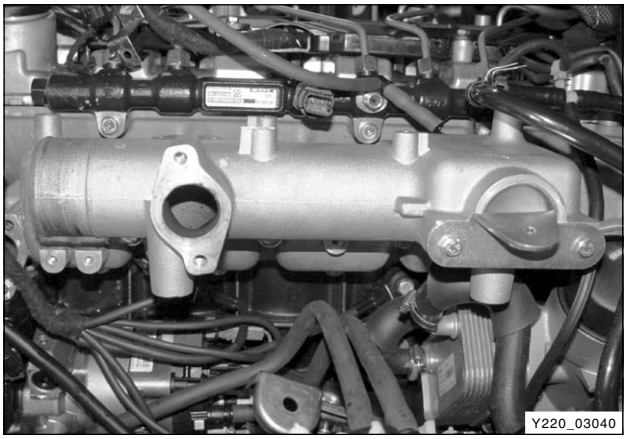


13. Remove the injector return line at HP pump.

Notice

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



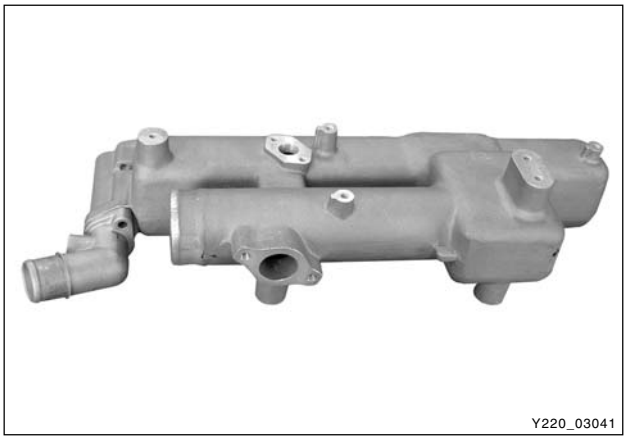

Y220_03040

14. Remove the intake manifold mounting bolts.

Notice

1. ***Check the length of the bolts before installation.***
   M8 x 45: 6EA
   M8 x 130: 6EA

Tightening torque	25 ± 2.5 Nm


Y220_03041

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

Notice

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

17. Install in the reverse order of removal.

Notice

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

SECTION DI04

EXHAUST SYSTEM

Table of Contents

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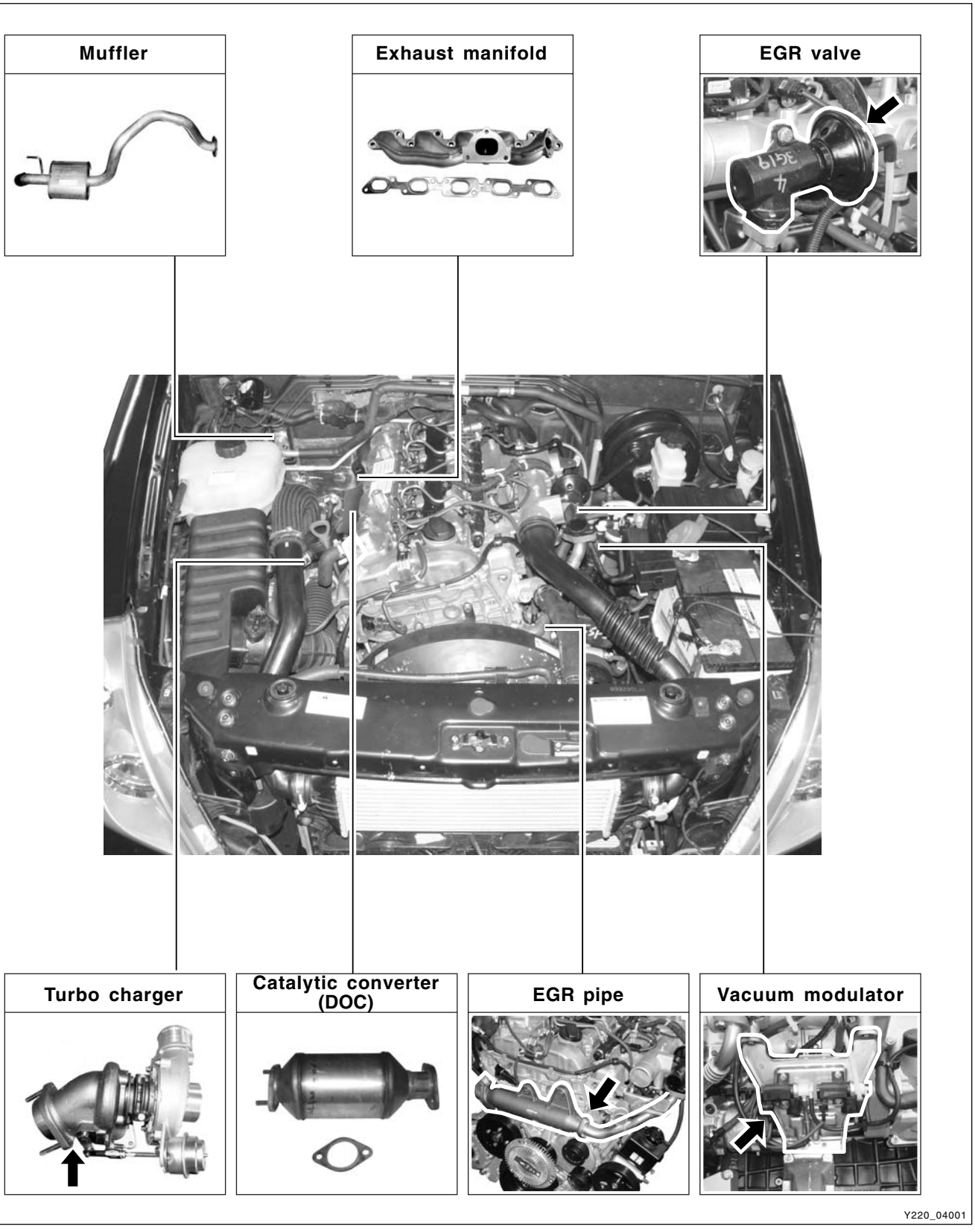
EXHAUST SYSTEM LAYOUT

COMPONENTS LOCATOR



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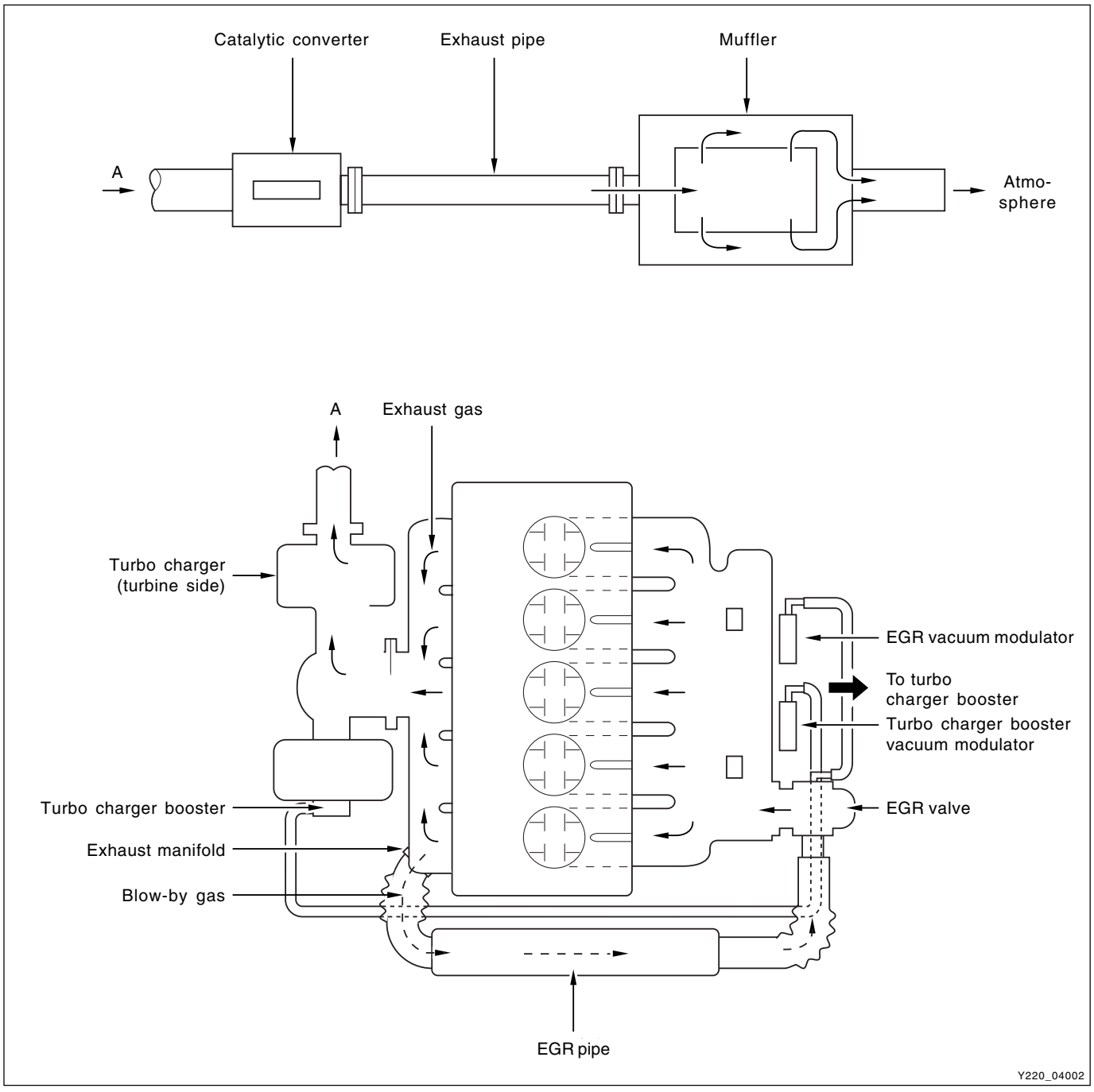
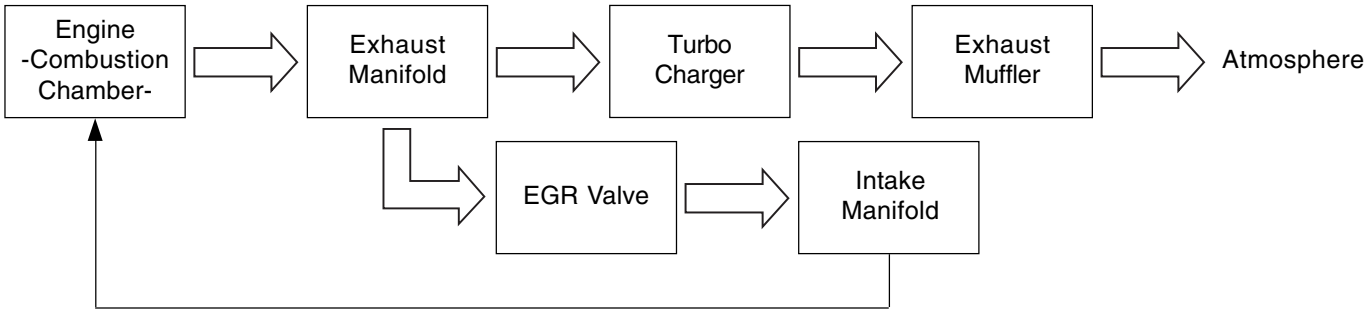
EXHAUST GAS FLOWS





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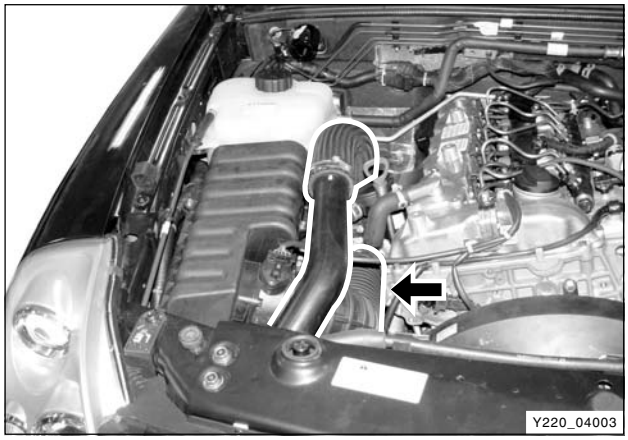
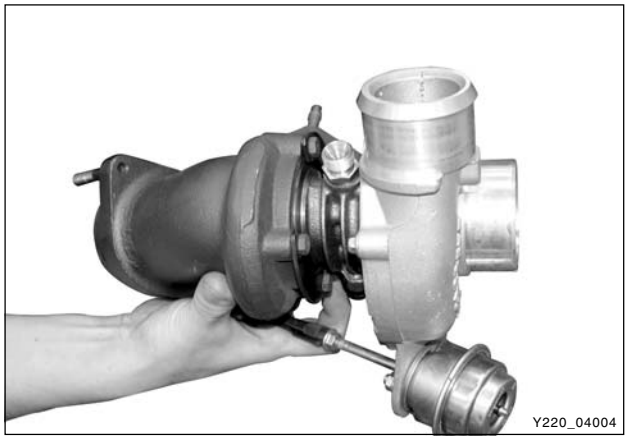
Exhaust Manifold - Removal and Installation

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



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

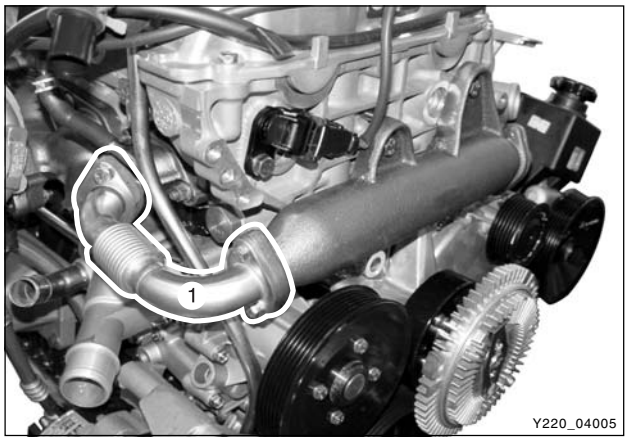


3. Remove the #3 pipe of EGR valve from the exhaust manifold.

Notice

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

Tightening torque	35 ± 3.5 Nm



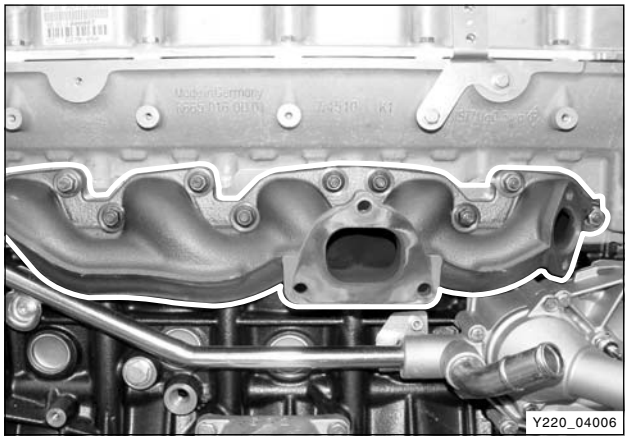
4. Unscrew the nuts and remove the exhaust manifold and gasket.

Tightening torque	40 ± 4.0 Nm

Notice

Replace the gasket with new one.

5. Install in the reverse order of removal.



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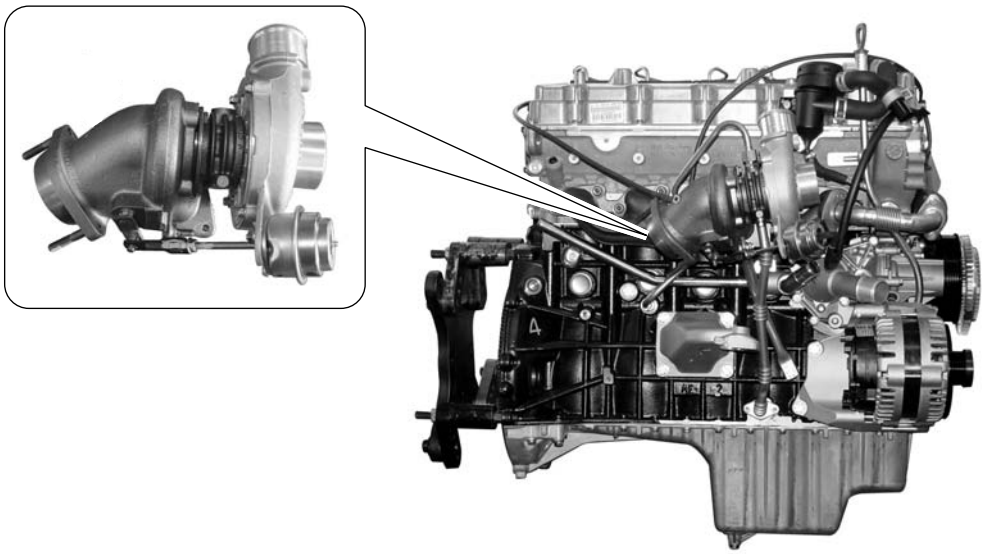
TURBO CHARGER ASSEMBLY

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

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



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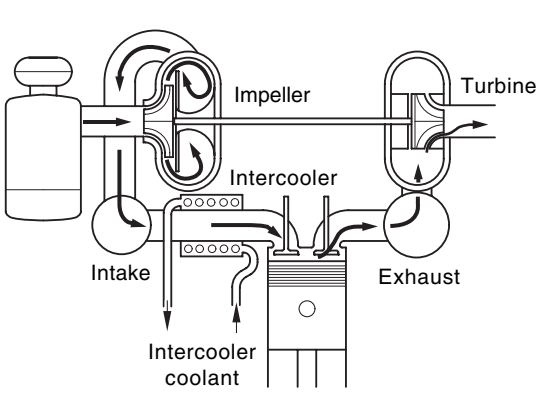


Y220_04008

▶ Operating Principle of Turbo Charger

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

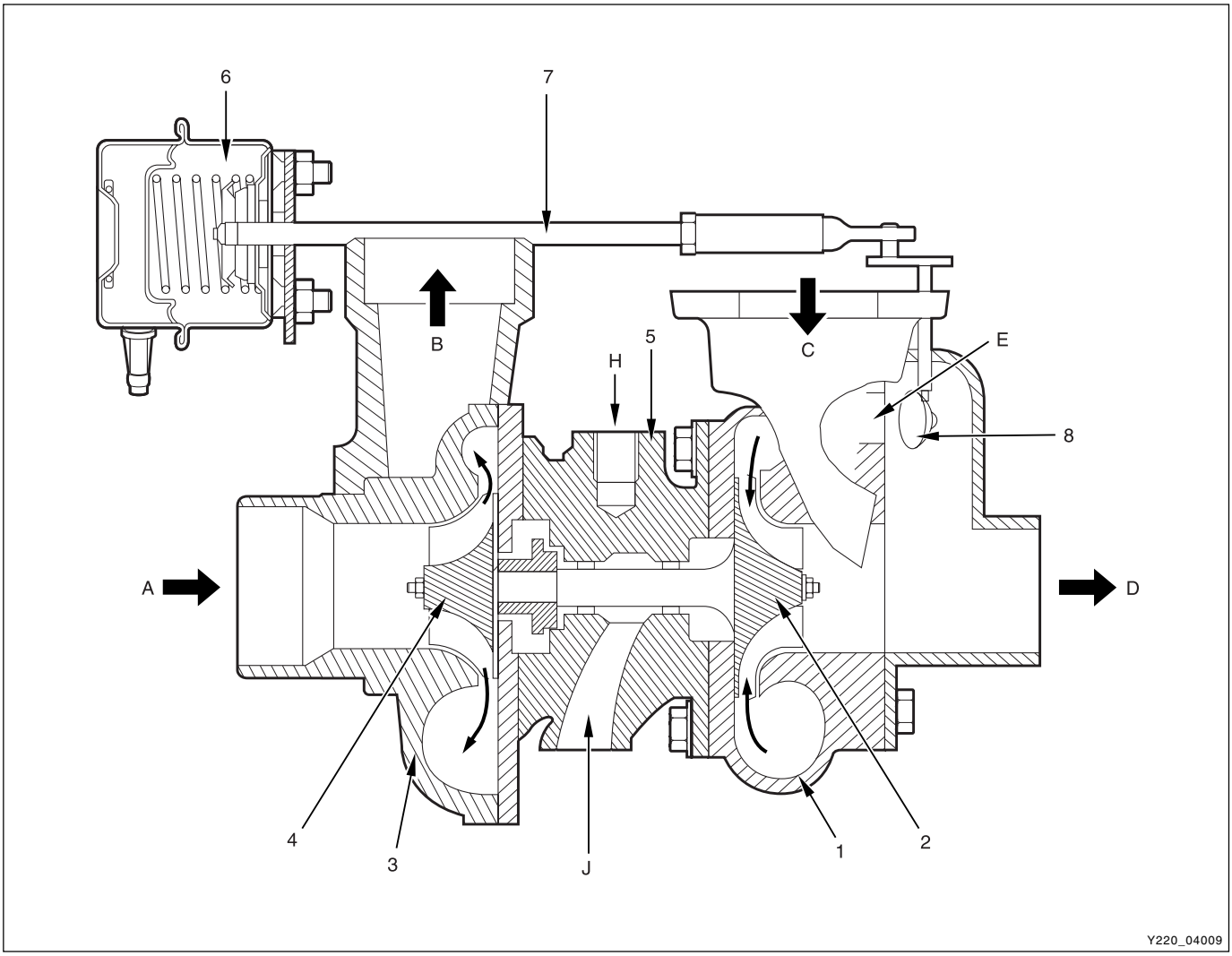
The air, which has been introduced to the diffuser having a passage with big surface, transforms its speed energy into the pressure energy while being supplied to the cylinder improving the volume efficiency. Also, the exhaust efficiency improves as the exhaust turbine rotates. The turbo charger is often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

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

▶ Construction of Turbo Charger

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

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



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

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

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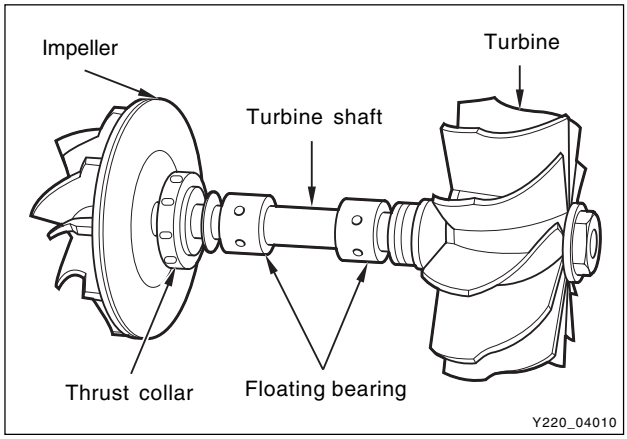
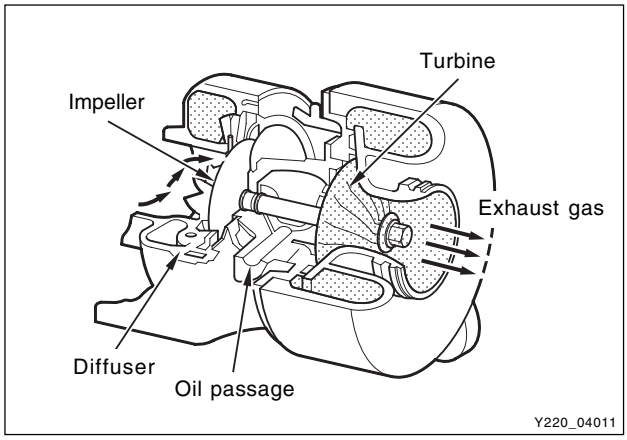


▶ Impeller

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



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

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

▶ Turbine

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

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

▶ Floating Bearing

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

Notice

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

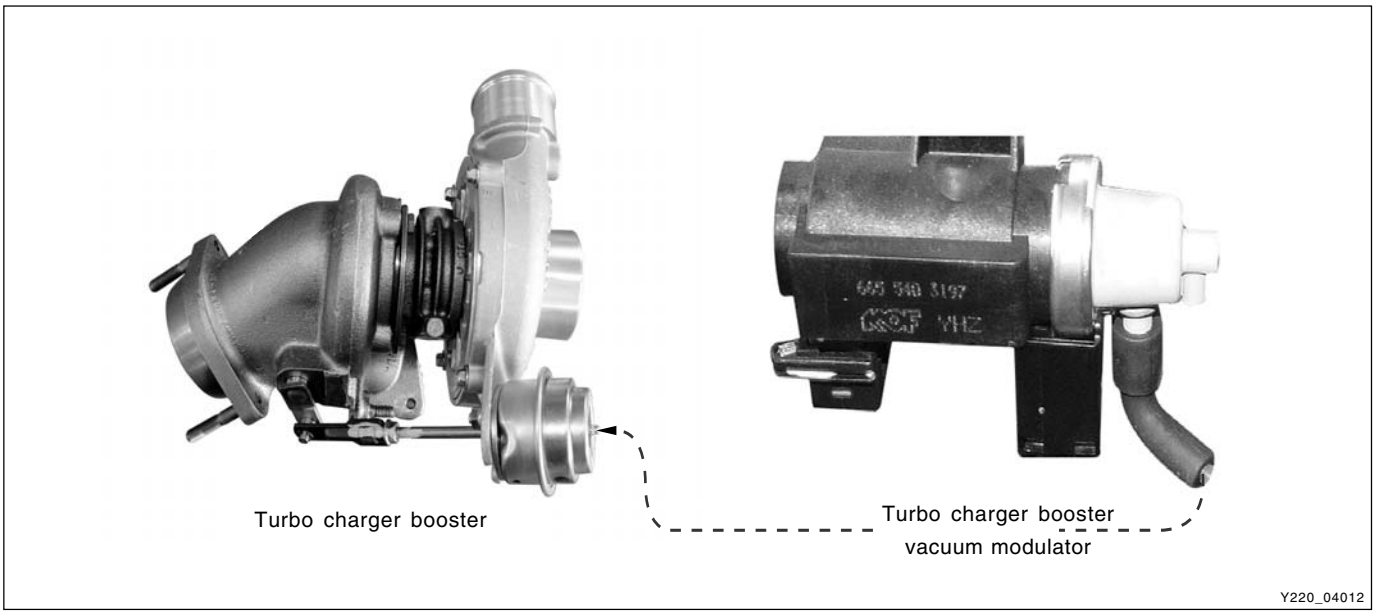
▶ Booster Pressure Control Valve Unit (Turbo Charger Actuator)

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

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

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

Booster pressure control valve unit and vacuum modulator



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▶ Diagnosis and Maintenance for Turbo Charger System

Cautions During Driving

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

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

Notice

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

Inspection of Turbo Charger

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

1. Inspection when installed
   - 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 in turbo charger

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

Notice

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

- Oil Drain Pipe Defect

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

- Damages from Foreign Materials

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

Inspection of Turbine

Thoroughly check the followings.

Notice

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

- 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.
  B. Overuse of engine break (especially in low gear) in down hill makes significantly low exhaust gas energy compared to the time where great amount of air is required during idling conditions of the engine. Therefore, amount of air in the compressor inlet increases but the turbo charge pressure is not high, which makes negative pressure at the compressor section causing the oil leakage within the center housing.

Notice

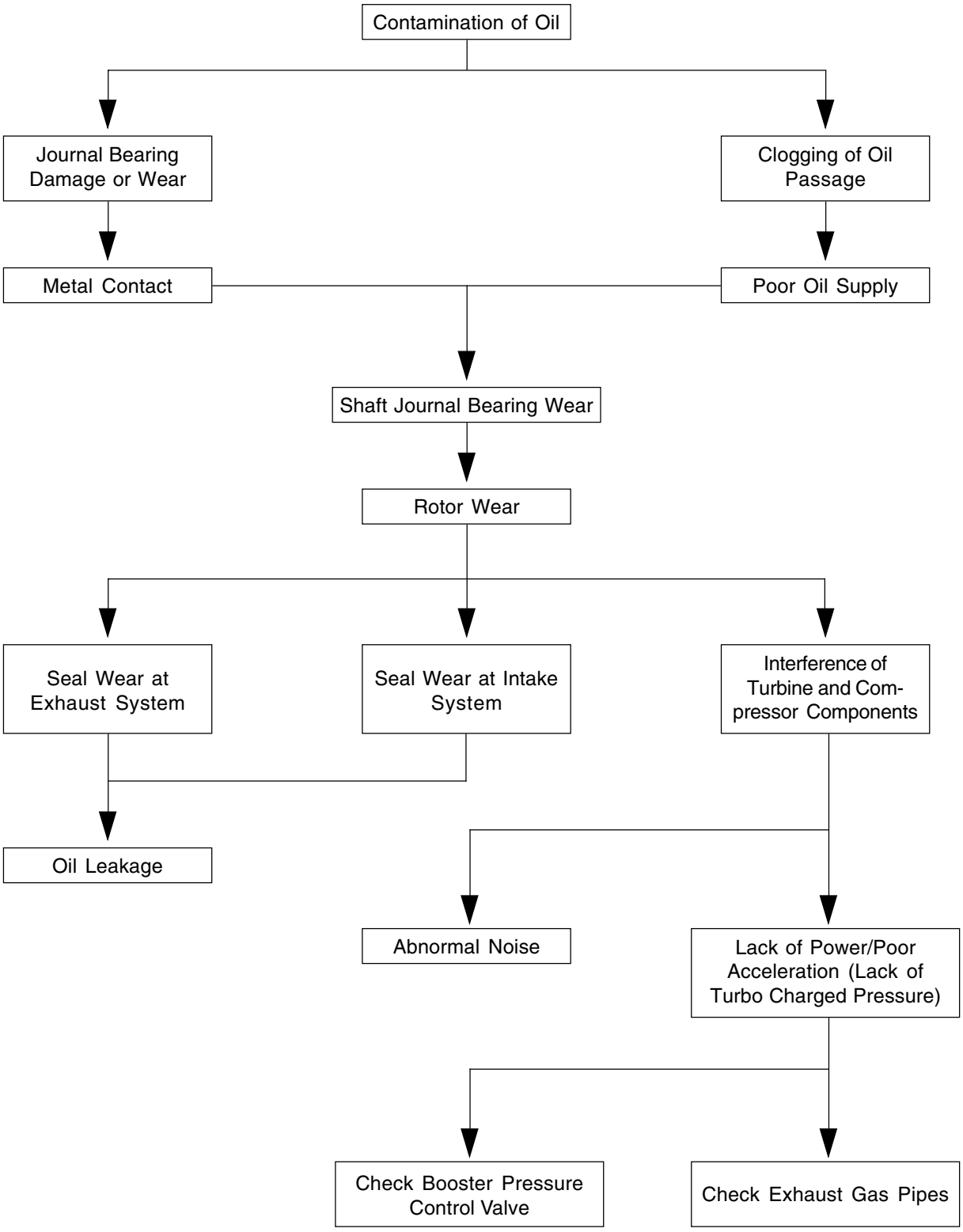
No problem will occur with the turbo charger if above conditions are found in early stage but oil leaked over long period of time will solidify at each section causing to breakout secondary defects.

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

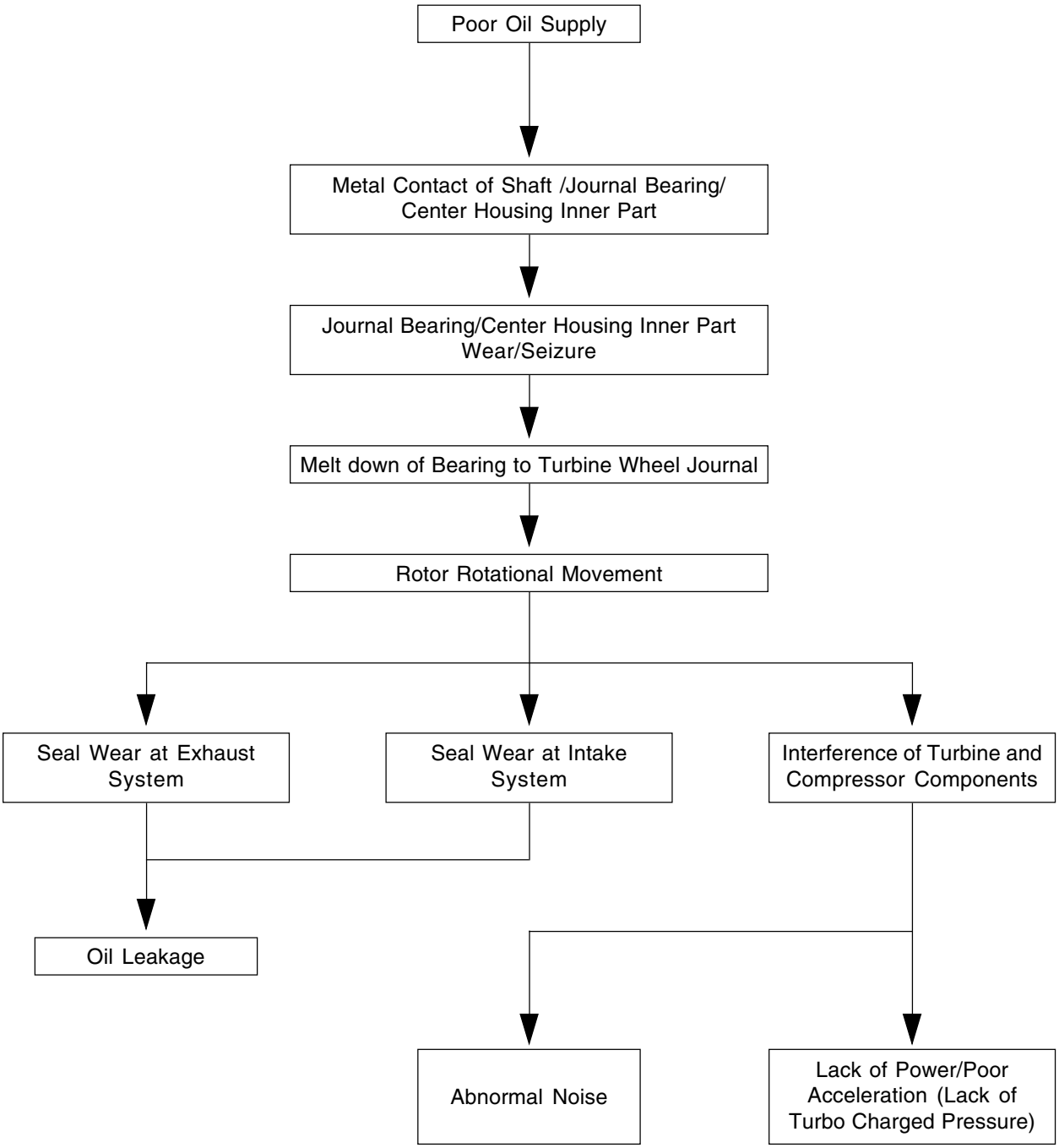
Path of Turbo Charger Defect

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

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



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



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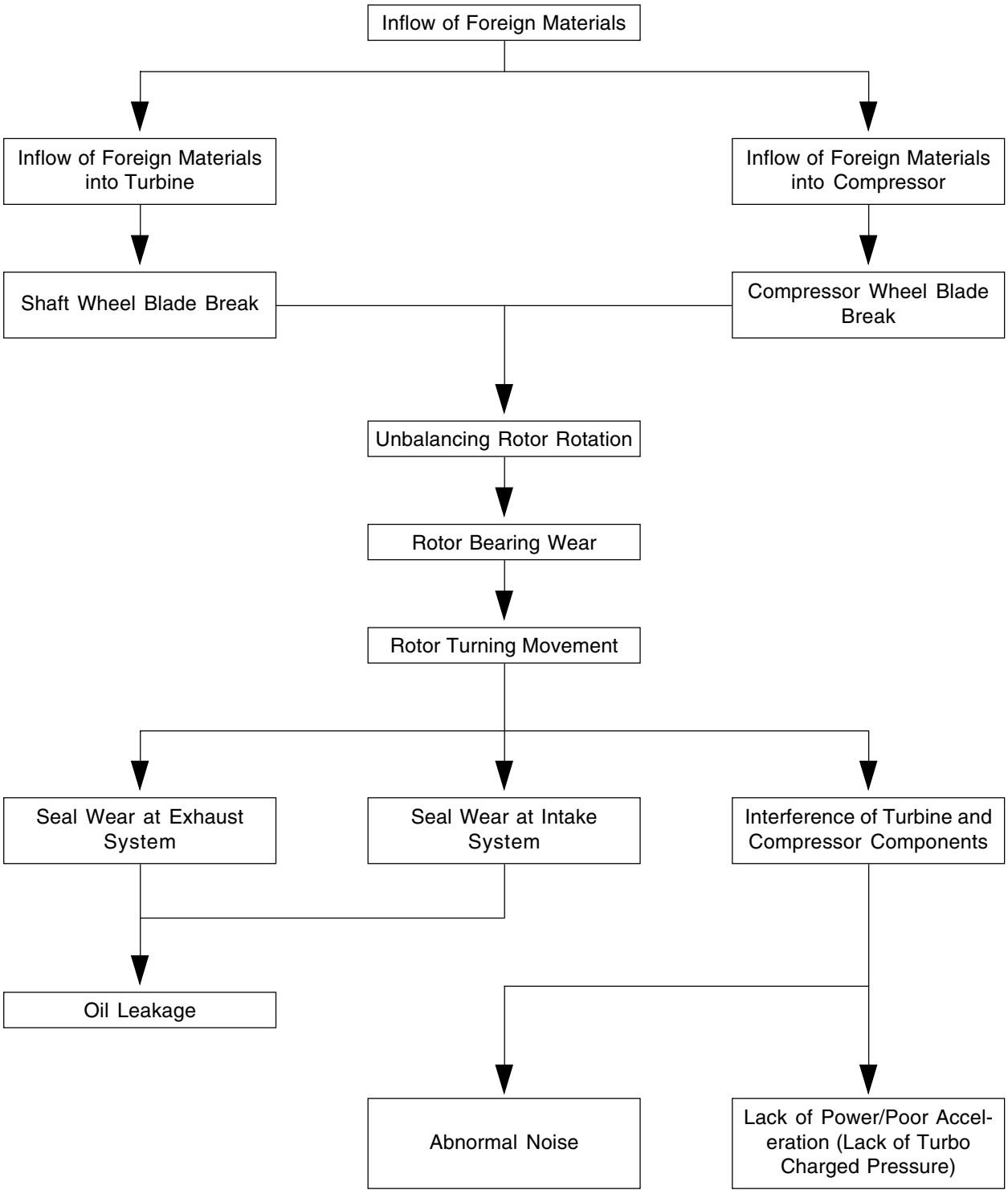
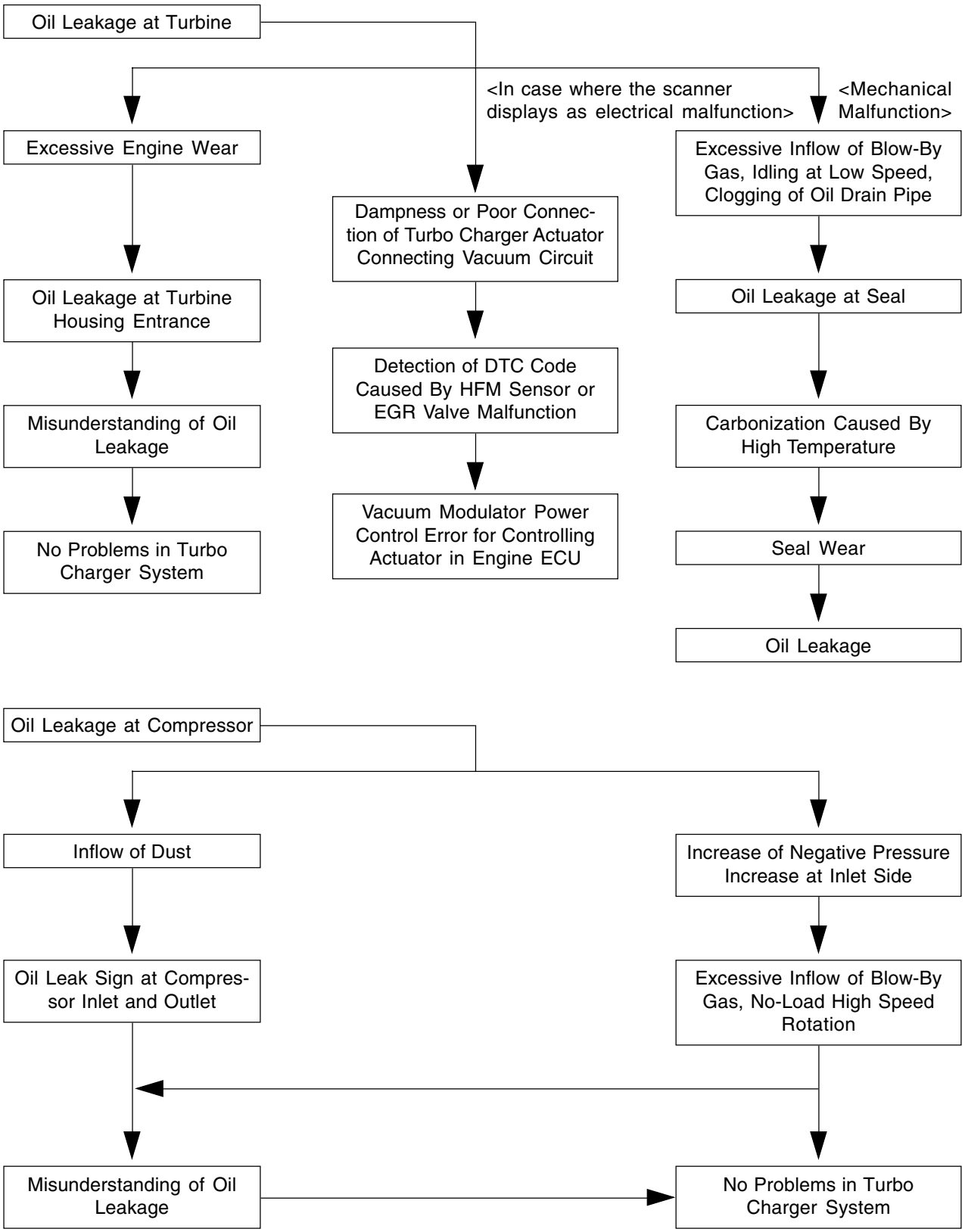
3. Turbine Side: Inflow of foreign materials from engine
Compressor Side: such as air filter, muffler and nut



4. Defects caused by reasons other than that of the Turbo Charger.



How to Diagnose

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

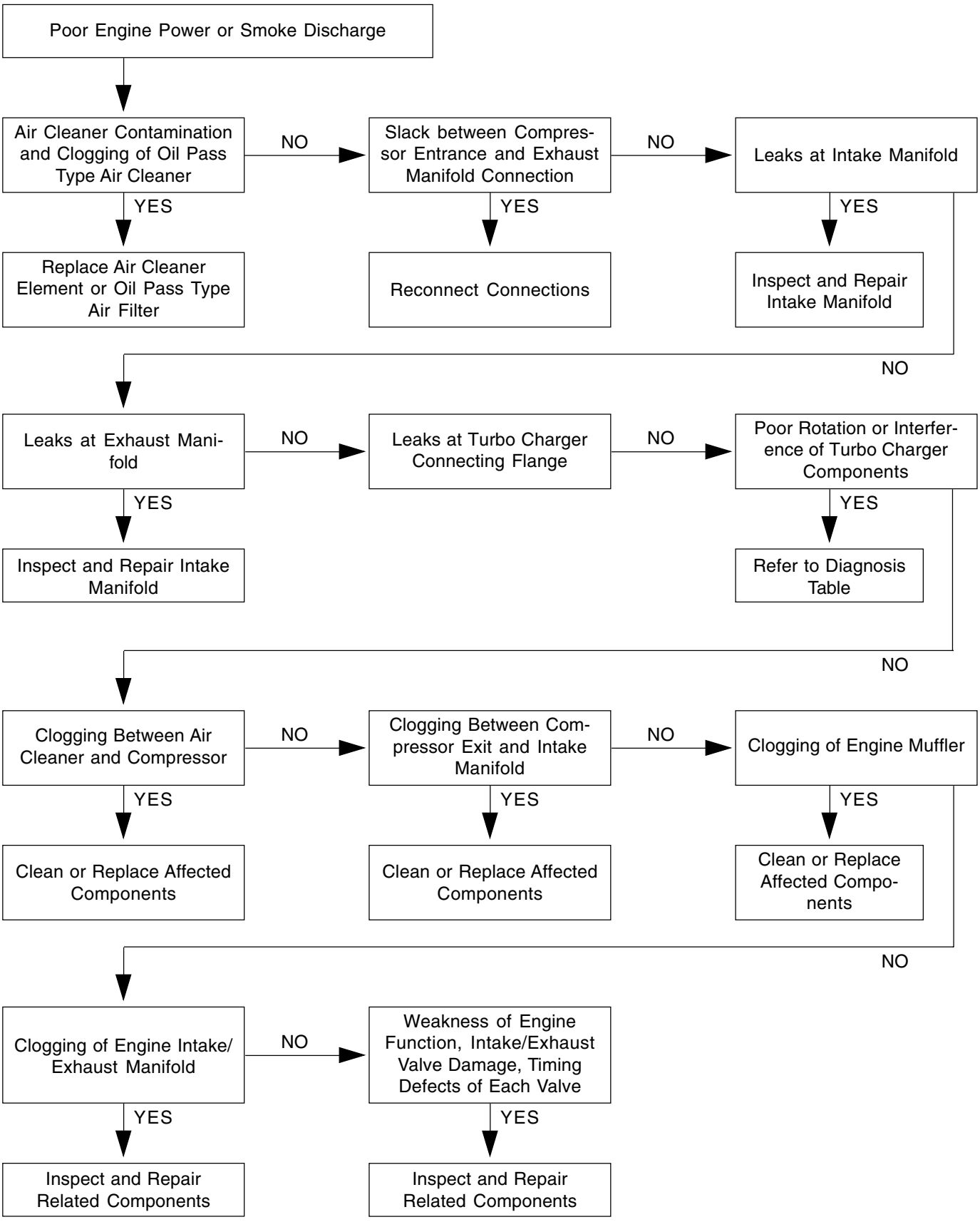
▶ Cautions When Examining the Defects:

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

Notice

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

▶ Diagnosis and Measure



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Before Diagnosis

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

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

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

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

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

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

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

EGR System for DI Engine

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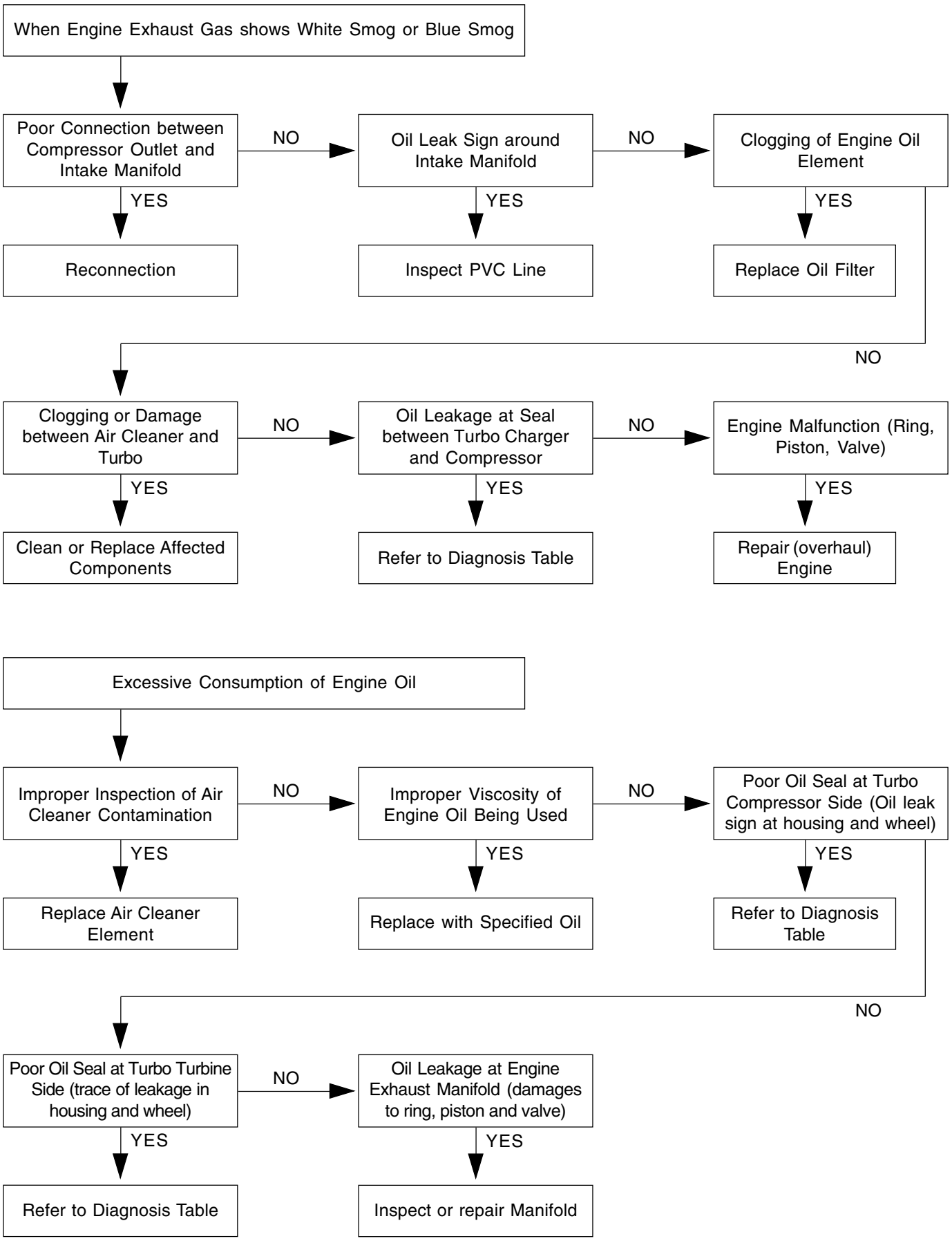
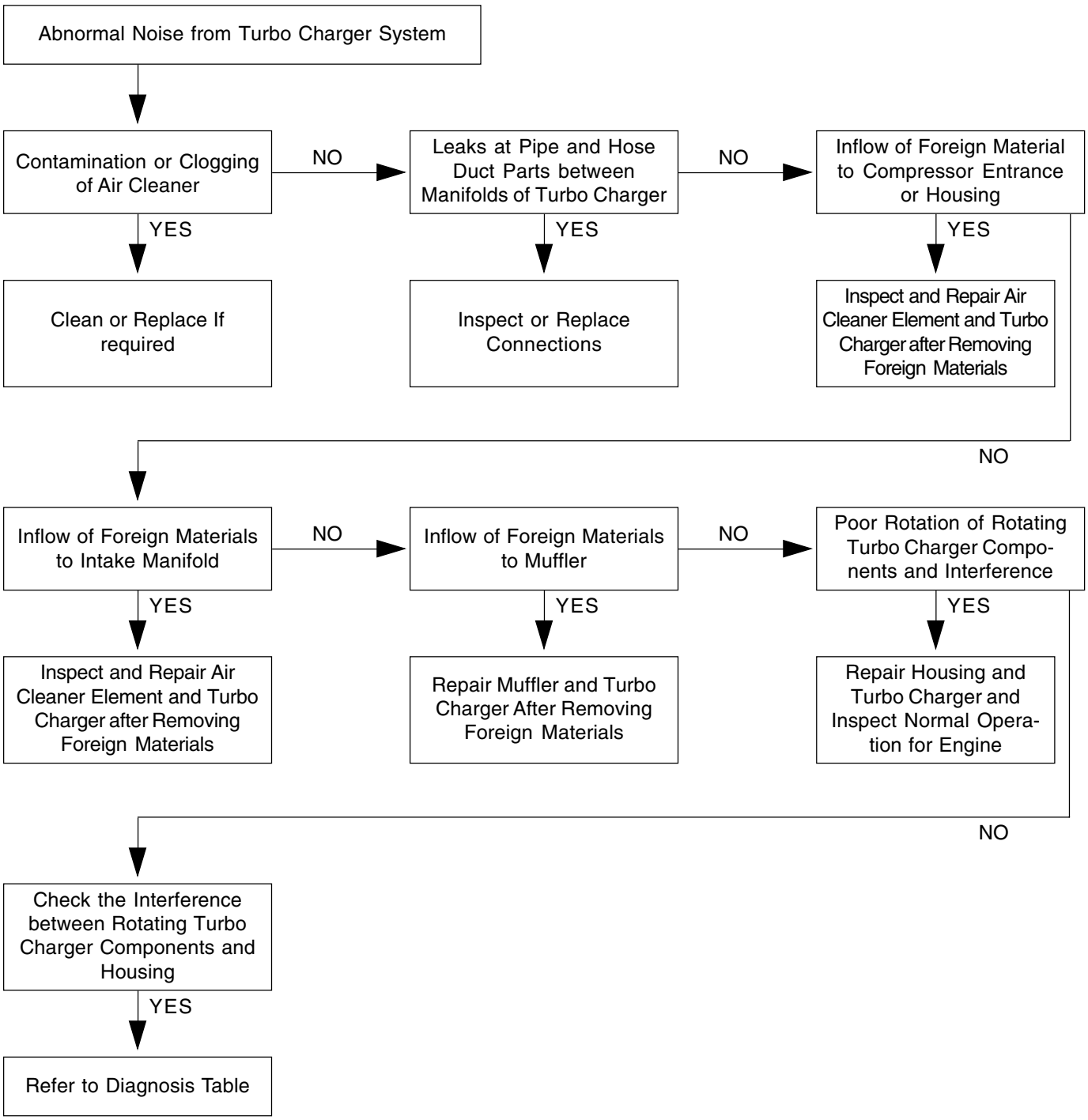
The other big difference between the Hoover EGR and EGR controller for DI engine is that from two vacuum modulator, one is same as being the modulator for EGR valve whereas the Hoover EGR system's the other modulator controls ALDA of injection pump and the DI engine's the other modulator controls waist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

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

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


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



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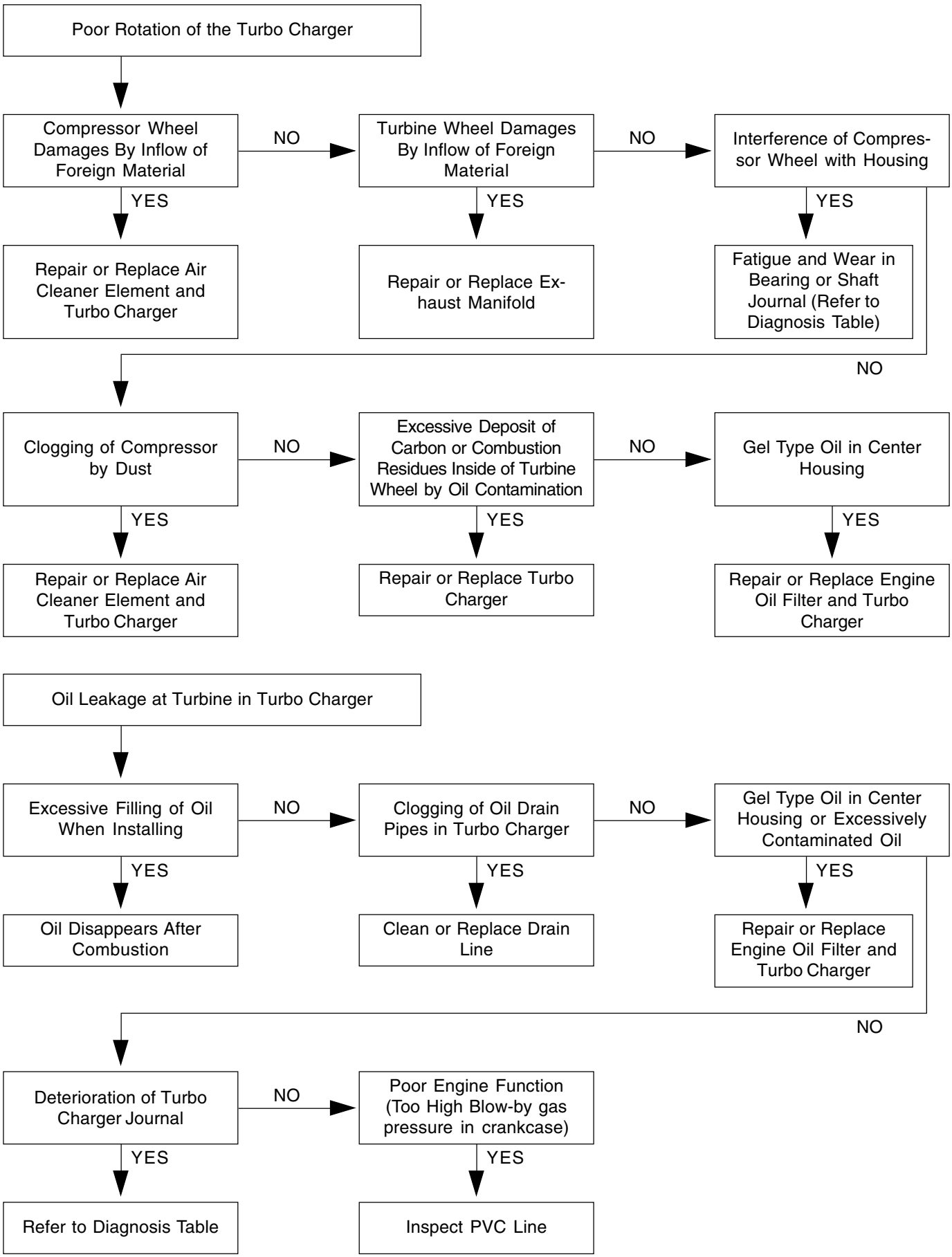
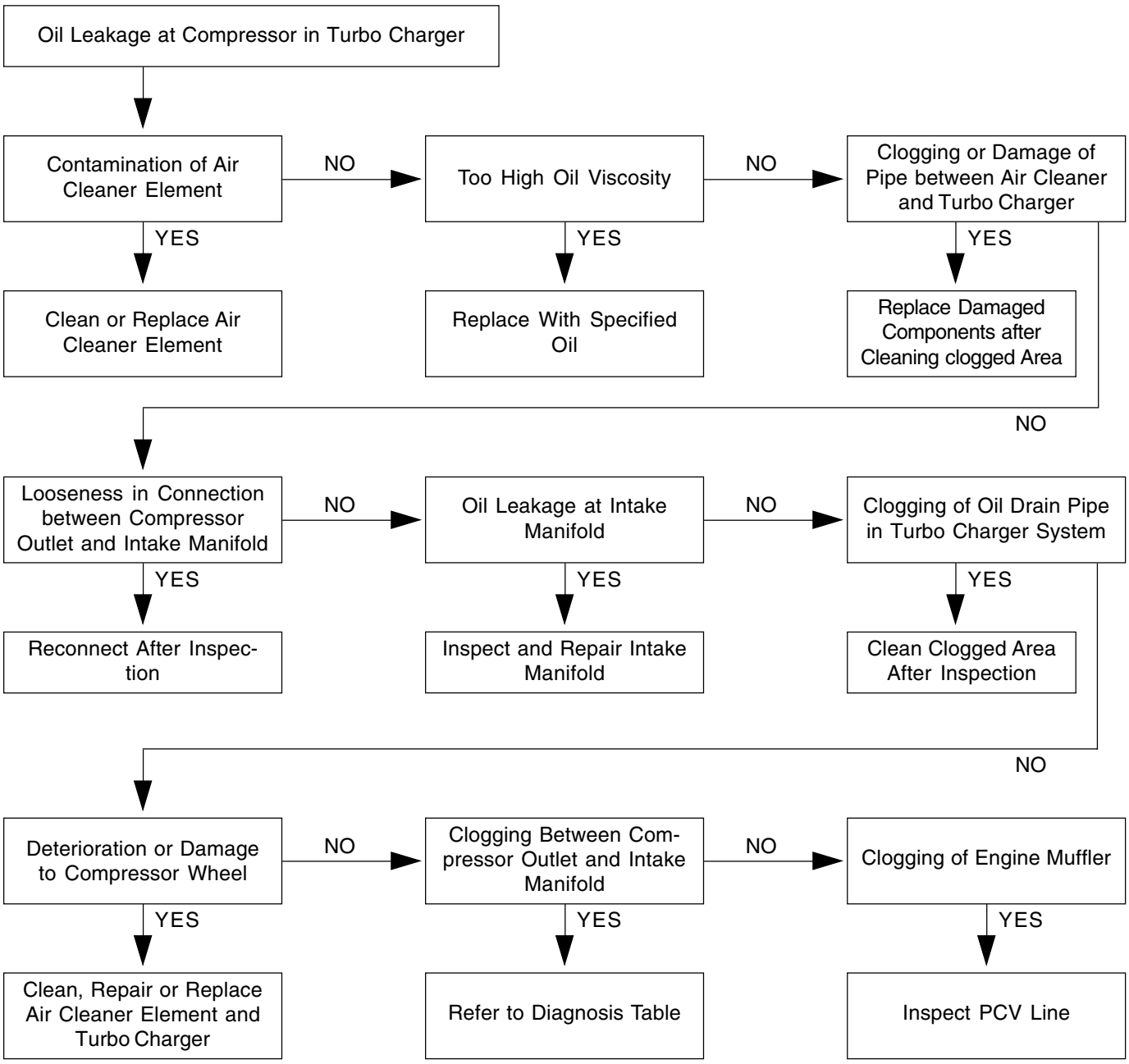

Poor Rotation of the Turbo Charger
Compressor Wheel Damages By Inflow of Foreign Material
NO
Turbine Wheel Damages By Inflow of Foreign Material
NO
Interference of Compressor Wheel with Housing
YES
YES
YES
Repair or Replace Air Cleaner Element and Turbo Charger
Repair or Replace Exhaust Manifold
Fatigue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



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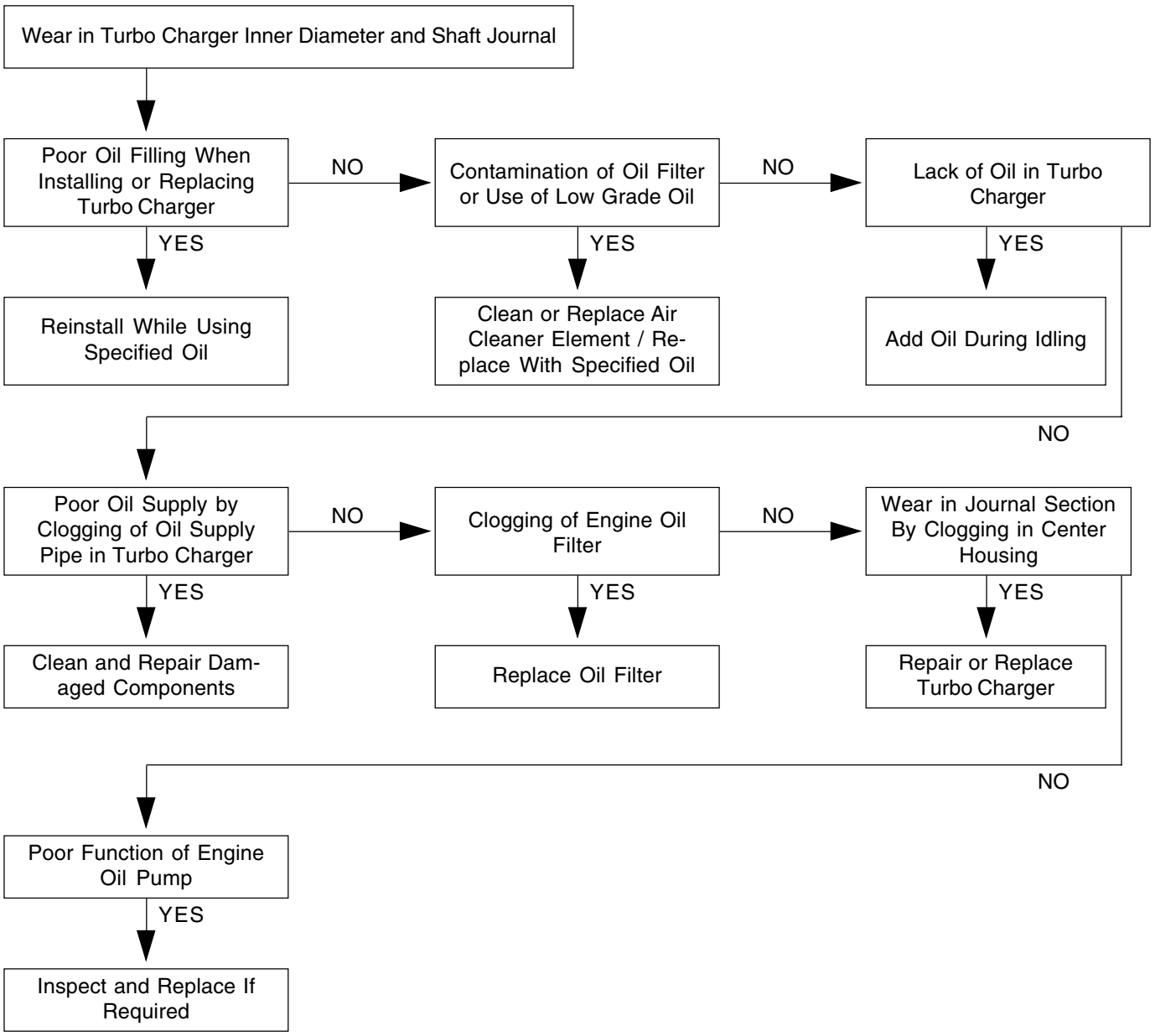


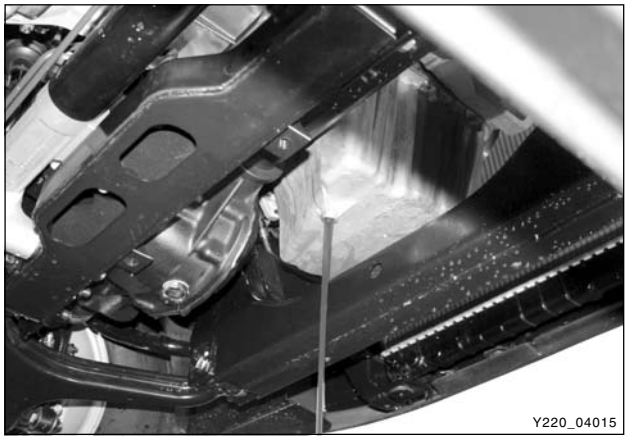
※ For other diagnosis, refer to Diagnosis section.

Turbo Charger Assembly - Removal and Installation

1. Remove the drain plug and drain the engine oil from the oil pan.

   Installation Notice

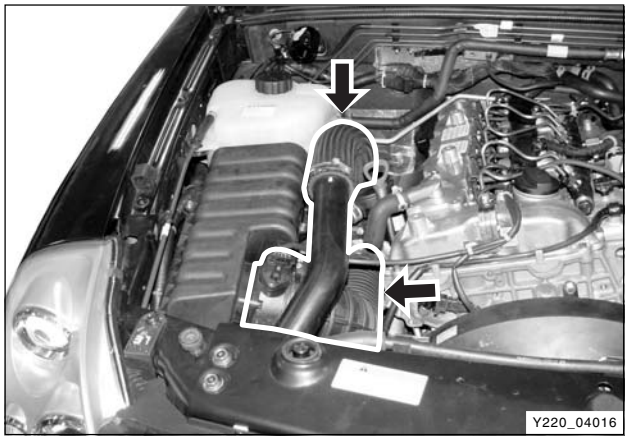
Tightening torque	25 ± 2.5 Nm



2. Remove the vacuum hose and inlet hose from the turbo charger.

   Installation Notice

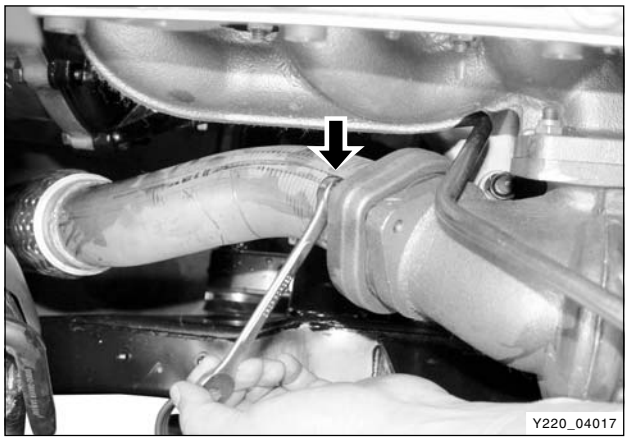
Tightening torque	6 ~ 7 Nm



3. Remove the bolts and nuts at the exhaust manifold in turbo charger.

   Installation Notice

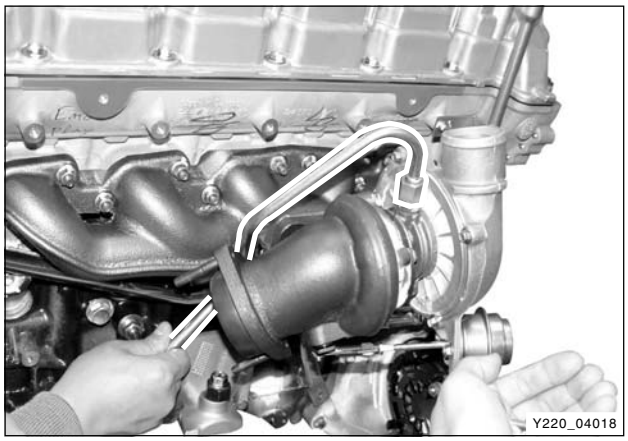
Tightening torque	25 ± 2.5 Nm



4. Remove the lower and upper bolts at turbo charger oil supply pipe.

   Installation Notice

Tightening torque	23 ± 2.3 Nm



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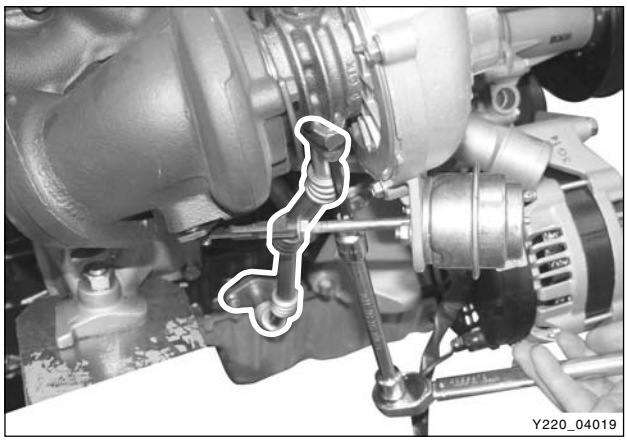


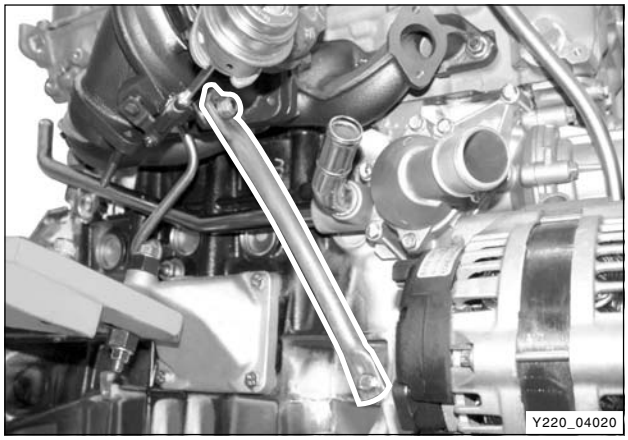
5. Remove the lower bolts at turbo charger oil return pipe.

Notice

Replace the steel gasket with new one.

Installation Notice

Tightening torque	25 ± 2.5 Nm



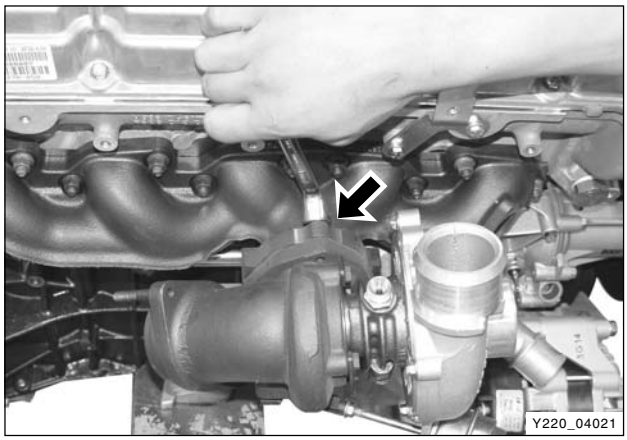
6. Remove the lower bolt at turbo charger bracket.
7. Remove the turbo charger bracket bolts.

Installation Notice

Tightening torque	32 ± 3.2 Nm

Notice

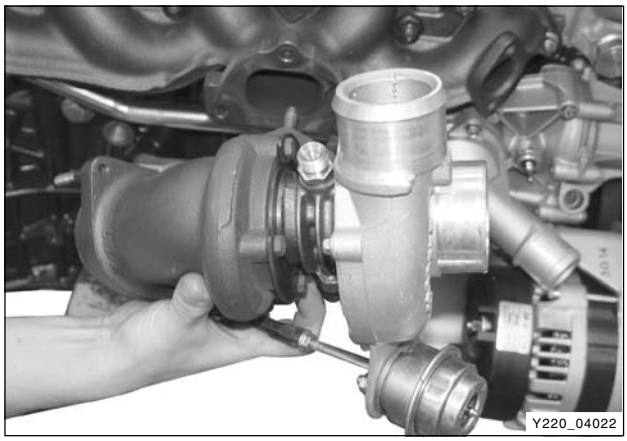
Use only 12 1/2" wrench.



8. Remove the bolts and nuts at the turbo charger and the exhaust manifold.

Installation Notice

Tightening torque	25 ± 2.5 Nm



9. Remove the turbo charger assembly.
10. Install in the reverse order of removal.

Notice

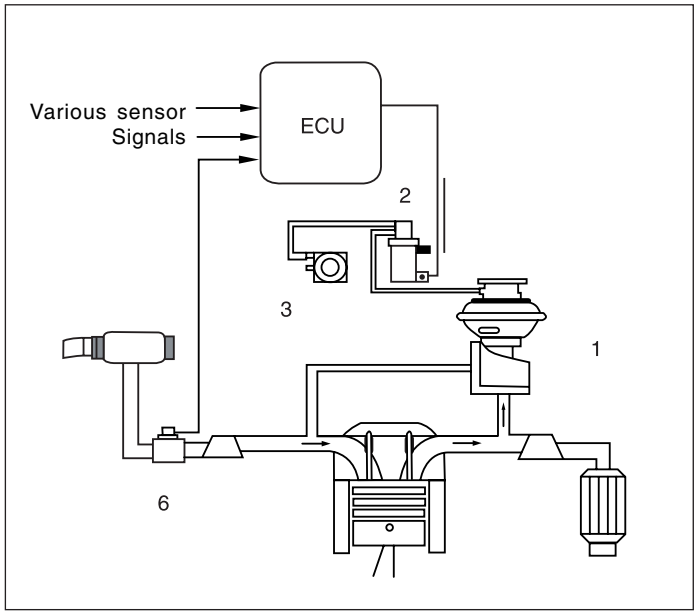
- ***Replace the steel gasket with new one.***
- ***To prevent gas leaks, tighten the fasteners with the specified tightening torques.***

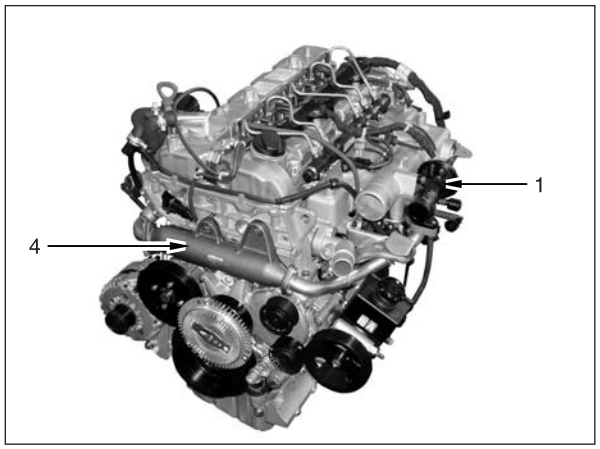
EGR VALVE AND VACUUM MODULATOR

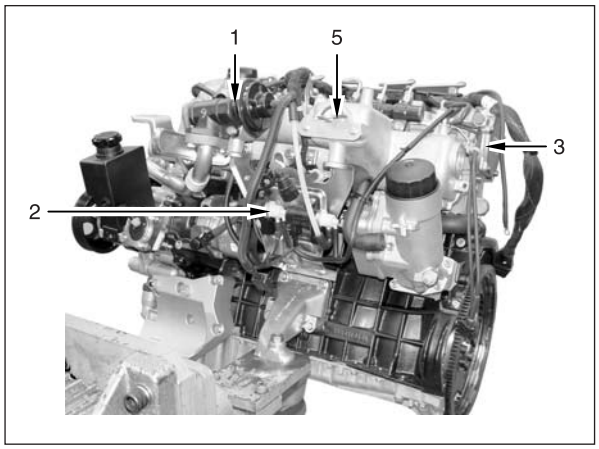
EGR SYSTEM

▶ General Information

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







Y220_04023

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

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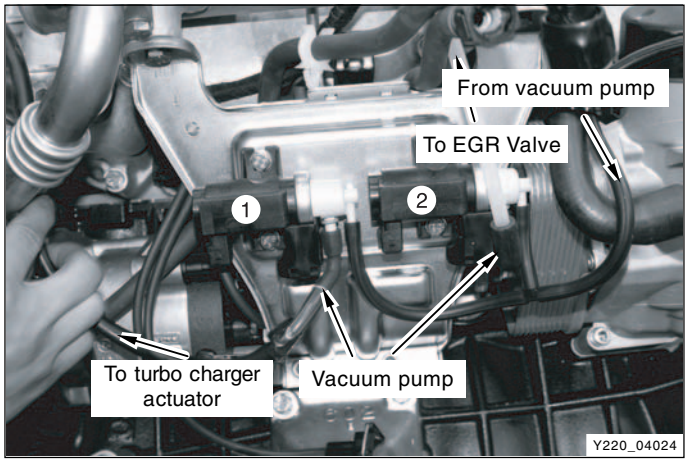
EGR VALVE AND TURBO CHARGER ACTUATOR CONTROL VACUUM CIRCUIT

▶ Vacuum Modulator

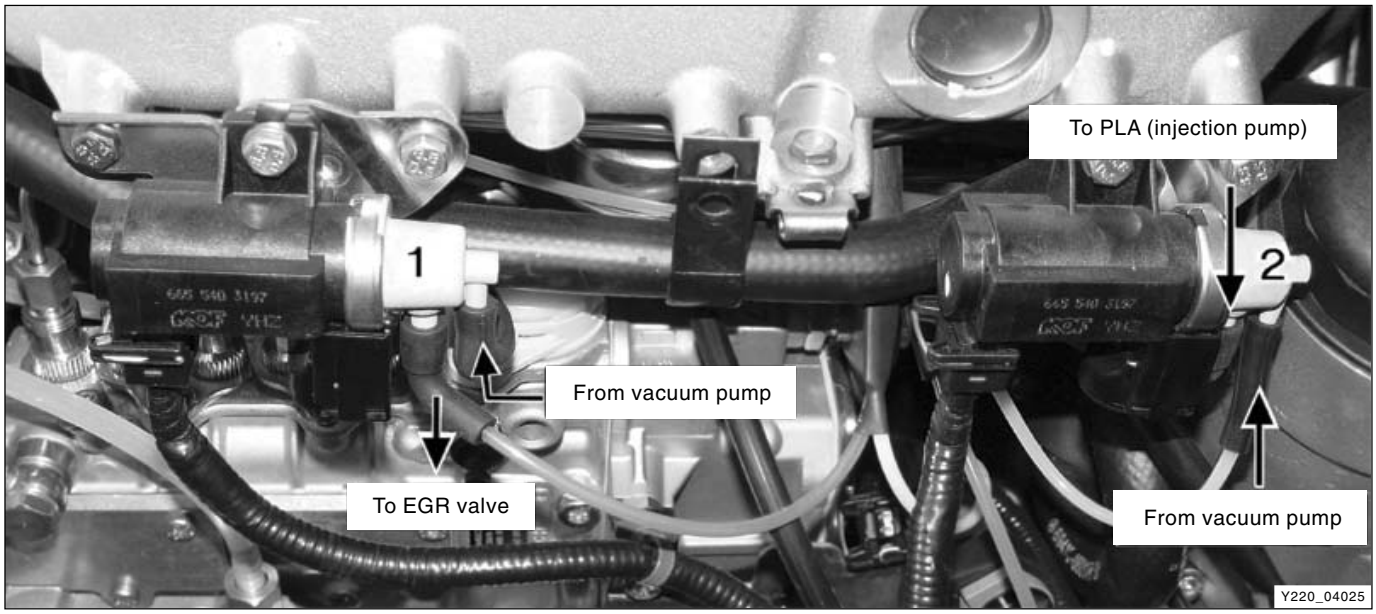
The biggest difference between the vacuum circuit and layout of the Hoover EGR system after K2004 has been introduced is the location of the vacuum modulator for EGR valve control and the function of the other modulator. In case of EGR equipped vehicle (IDI Engine), it performs the role of controlling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

DI engine vacuum modulator



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

IDI engine vacuum modulator (hoover EGR system - K2004)

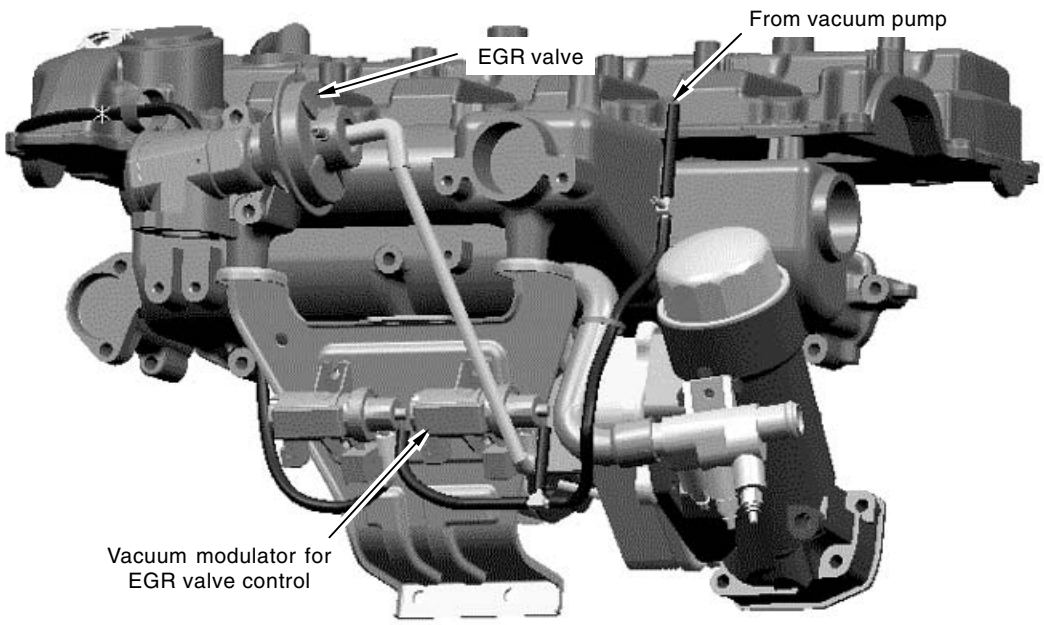


1. Vacuum modulator for EGR valve control
2. Vacuum modulator for injection pump PLA control

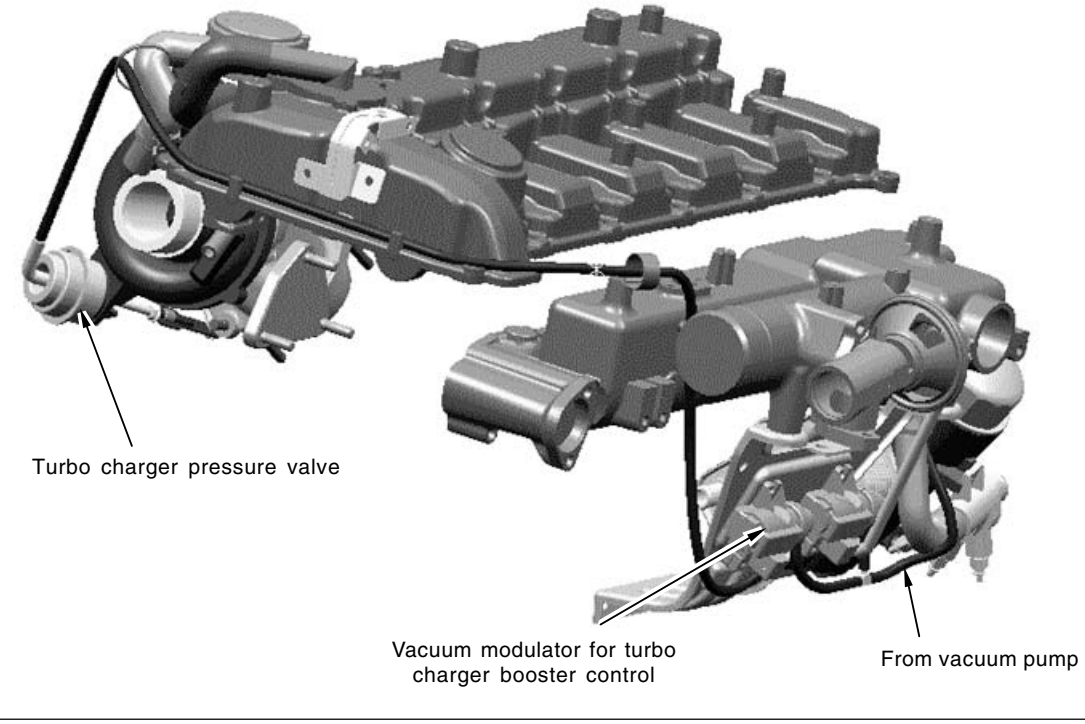
▶ Vacuum Modulator and Vacuum Hose

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

Related with EGR valve



Related with turbo charger actuator



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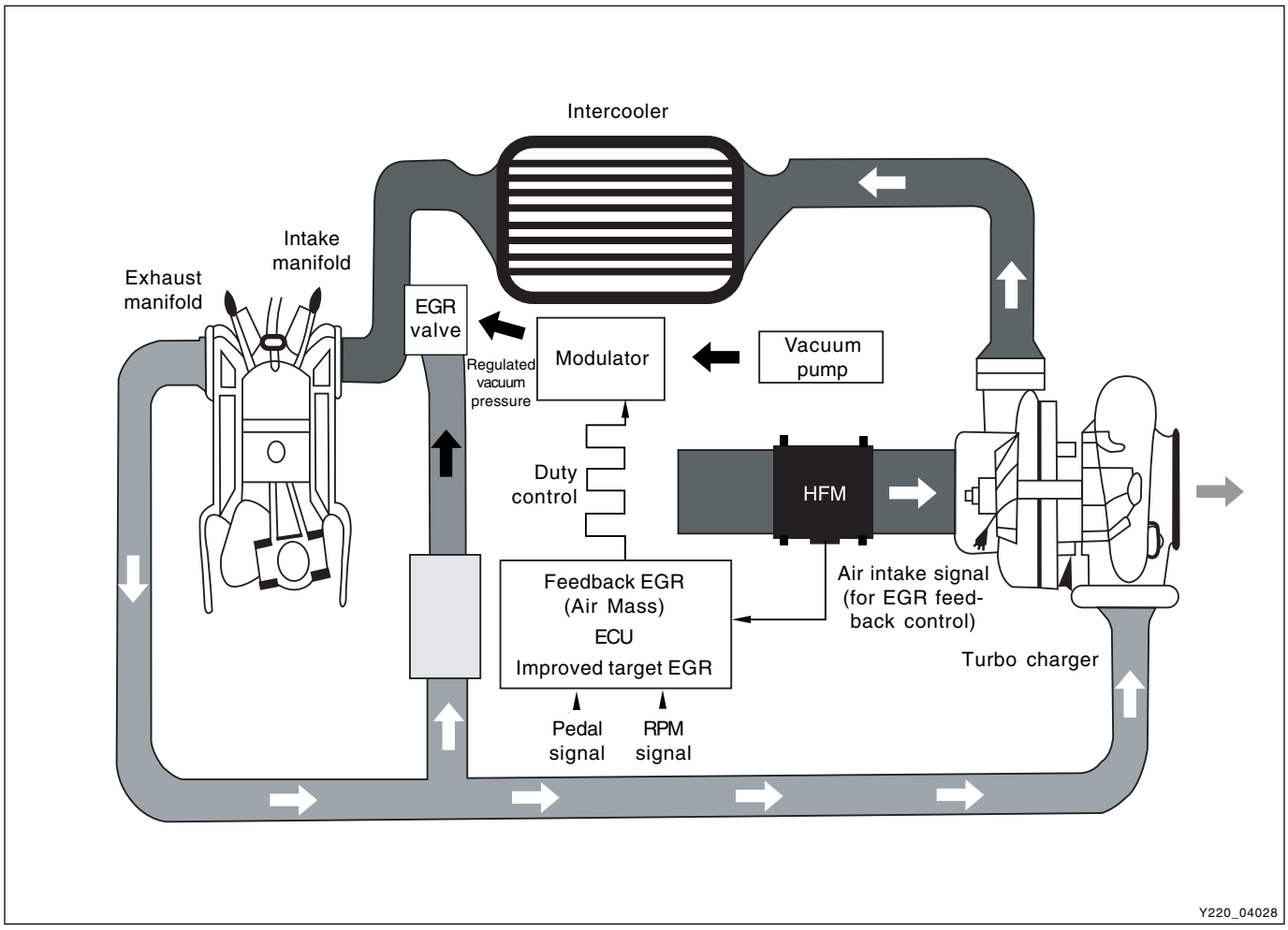
▶ EGR System Diagram



EGR Valve

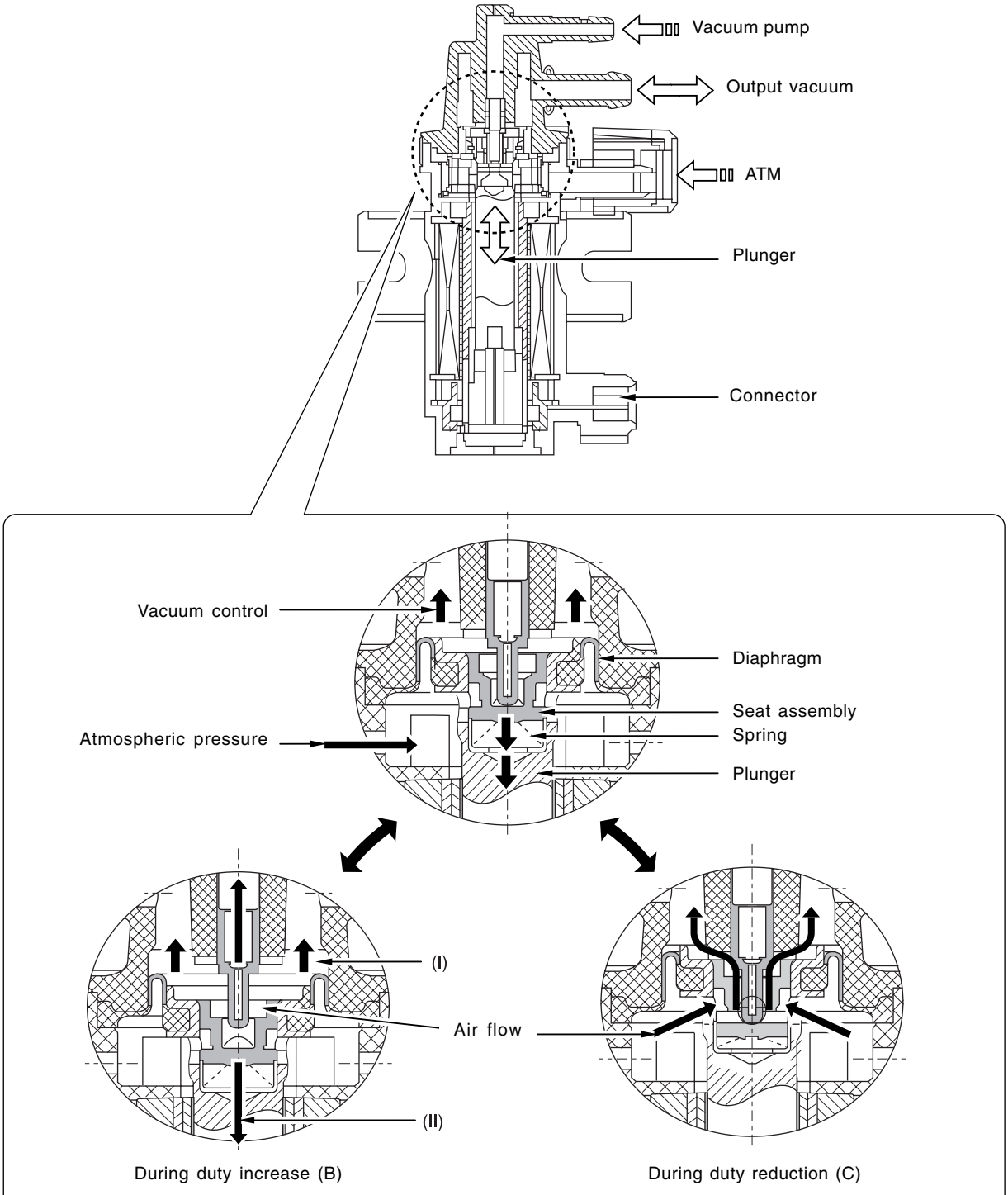
EGR valve recirculates some of exhaust gases to intake system to reduce toxic NOx from engine according to ECU signals.

- EGR valve opening point : -270 mmHg

EGR Modulator

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

▶ Operation Principle of Vacuum Modulator



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

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

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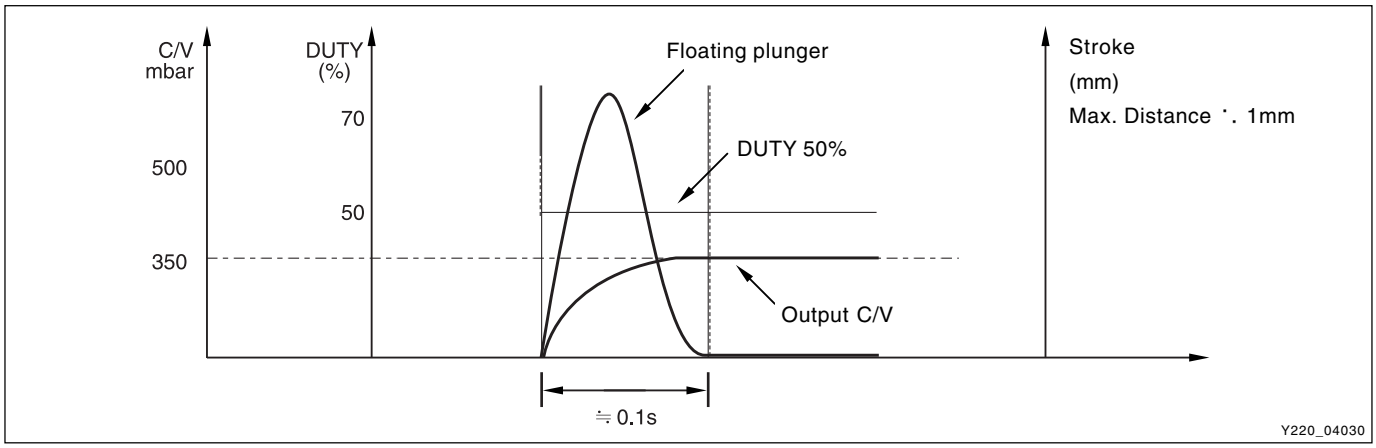
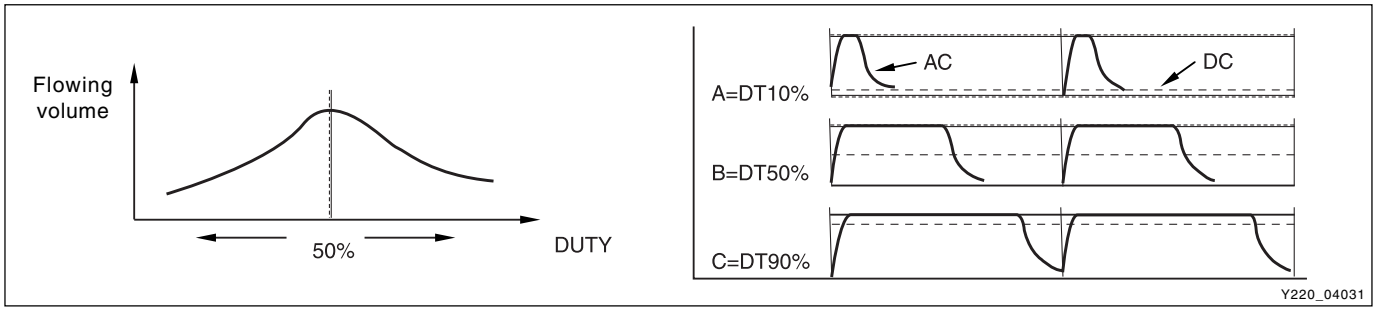
Operating principle: Balance between original vacuum pressure and magnetic force (see above figure)

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

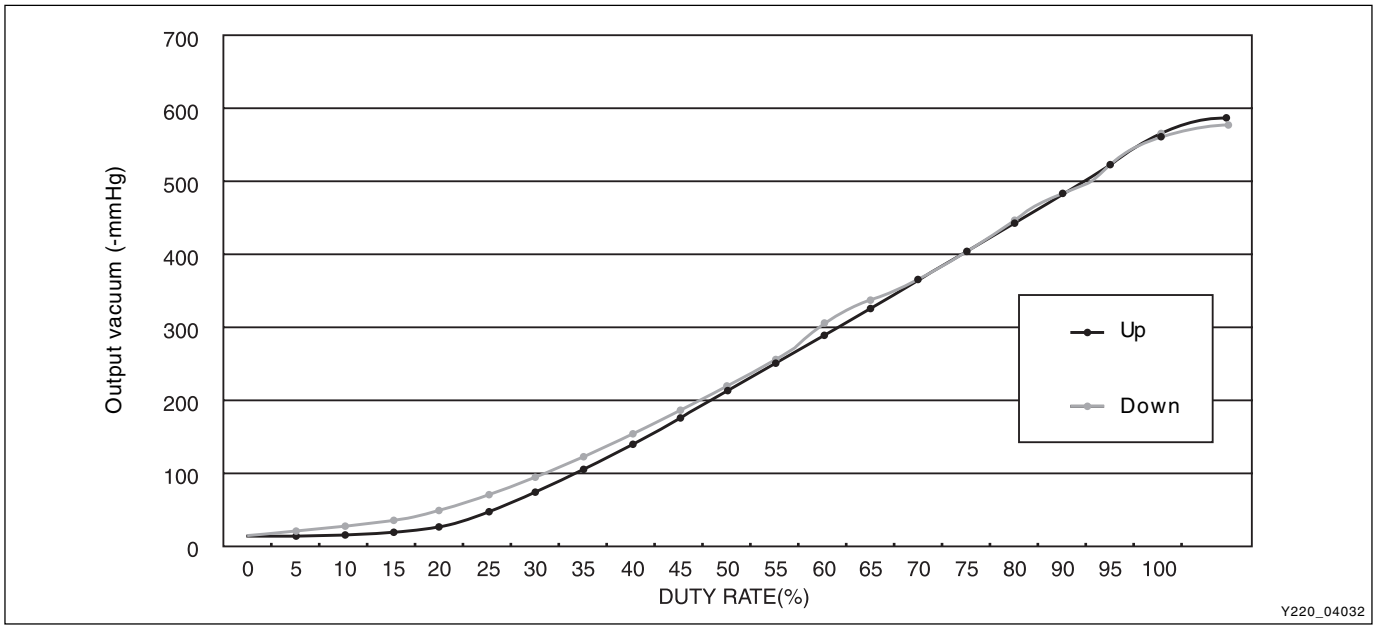


› Operating principles when duty is applied from 0 to 50 %

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



Output Characteristics



Operating Conditions

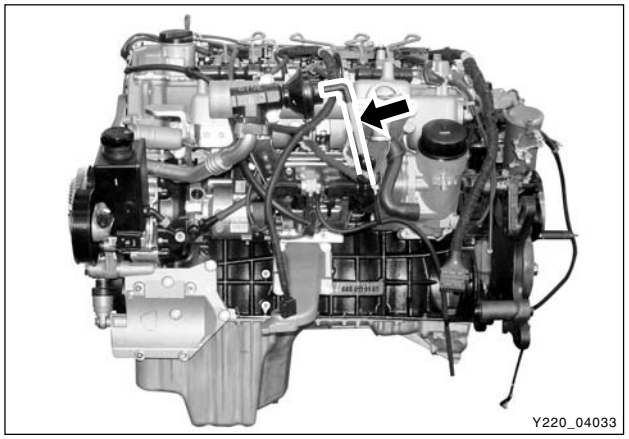
- Engine is running
- Engine RPM is within a specified range. (EGR OFF under high RPM range)
- Engine torque is within a specified range. (EGR OFF under high torque range)
- Vehicle speed is within a specified range. (EGR OFF under high speed range)
- Atmospheric pressure is within a specified range. (EGR OFF under high altitude and low atmospheric pressure)
- Coolant temperature is within a specified range. (EGR OFF under high or low temperature)
- EGR OFF under extended period of idling.

Control Logic

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

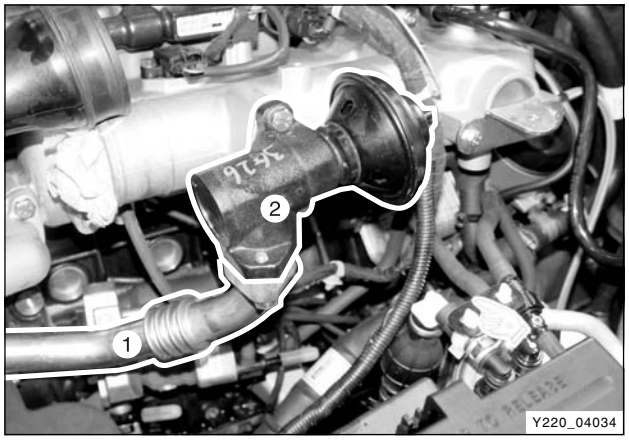
Shut-off Conditions

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



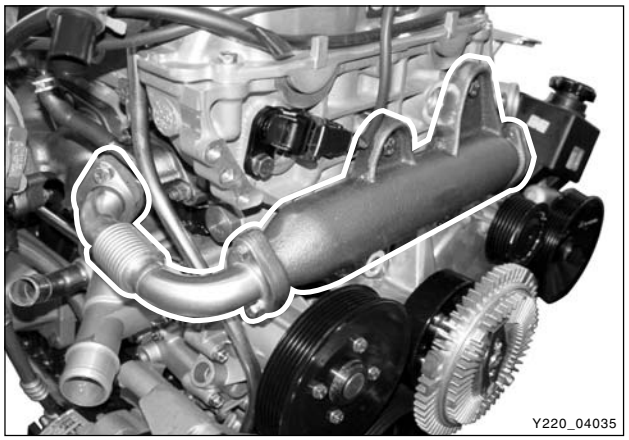
EGR Valve and Pipe - Removal and Installation

1. Remove the vacuum hose from the EGR valve.



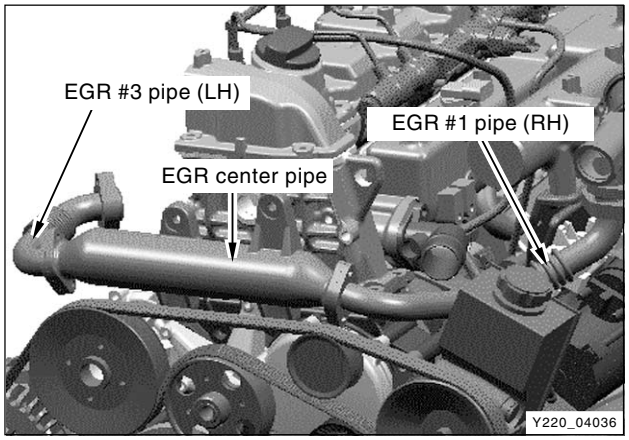
2. Unscrew the bolts and remove the EGR valve (2), EGR valve #1 pipe (1) and gasket.

Tightening torque	25 ± 2.5 Nm



3. Remove the EGR valve #1 pipe, #2 pipe, #3 pipe and gaskets from the engine.

Tightening torque	25 ± 2.5 Nm



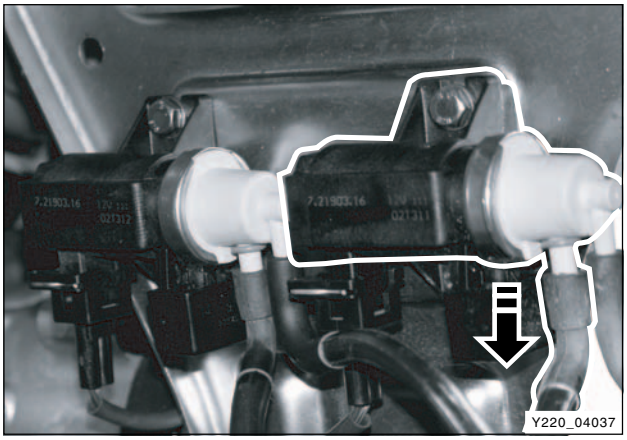
4. Install in the reverse order of removal.

Notice

- ***Make sure to observe the specified tightening torques.***
- ***Never reuse the EGR #1 pipe (intake) and #3 pipe (exhaust) once removed.***
- ***Replace the gaskets with new ones.***

Vacuum Modulator - Removal and Installation

1. Remove the vacuum hose from the vacuum modulator.



2. Remove the vacuum modulator from the bracket.

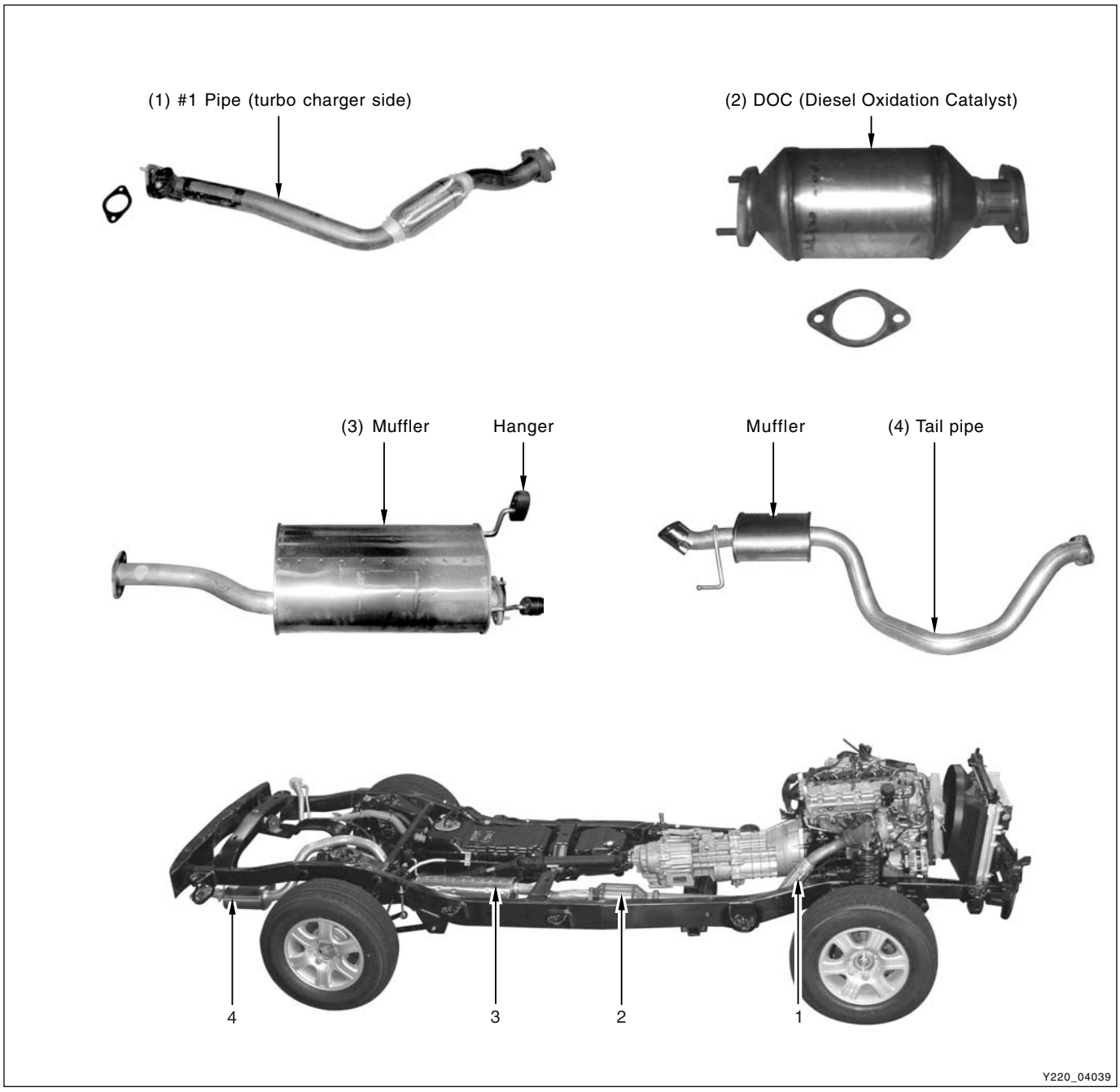
Tightening torque	10 ± 1.0 Nm

3. Install in the reverse order of removal.

Notice

Make sure that the vacuum hoses are connected to correct locations.

EXHAUST SYSTEM AND MUFFLER



MUFFLER

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

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

SYSTEM OVERVIEW

▶ Exhaust System

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

Notice

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

▶ DOC (Diesel Oxidation Catalyst)

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

Notice

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

▶ Muffler

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

▶ Heat Shield

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

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

▶ Hanger

The hanger is to support the components.

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

▶ DOC (Diesel Oxidation Catalyst)

System and principle

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

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

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

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

On the other hand, it is a problem that it makes the reaction of oxidation, which SO_2 produce SO_3 and H_2 SO_4 by reacting to oxygen in exhaust gas, if temperature of exhaust gas becomes over 300°C, and this produced gas is very harmful to human body. To prevent is, previously it is requested that the sulfur content rate of fuel should be below 0.05 %, and in the future it is being expected to keep it below 0.01 %.

Catalytic converter structure

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

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

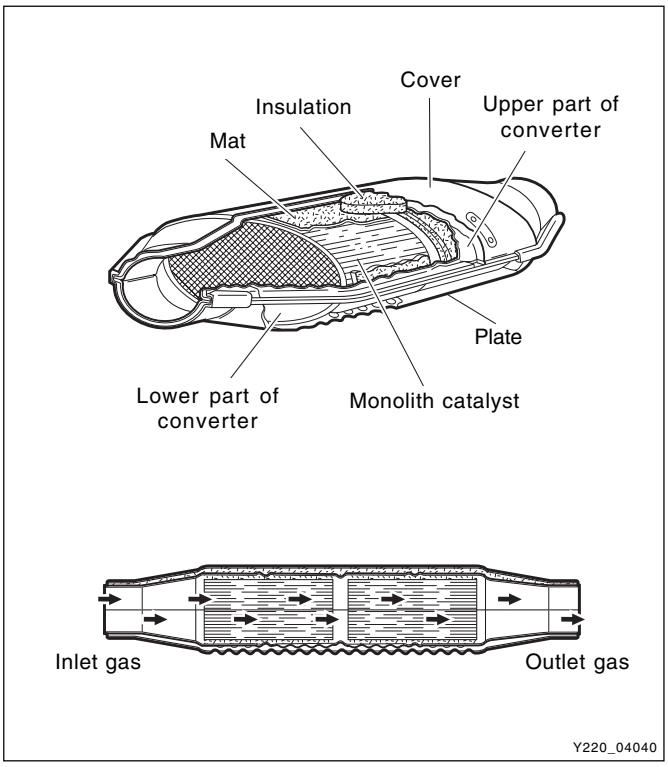
Monolith type is lighter than other types, easy to manufacture and quickly approaches to proper temperature.

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

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

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

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



Catalytic converter and temperature

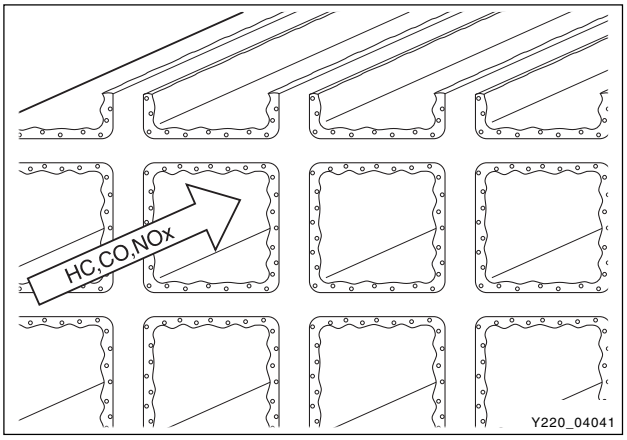
Catalytic converter has the normal function of purification at a range of the temperature. Because it has a weak point of decreasing of the purification rate in the condition of continuous high temperature, it should keep the temperature range of 400 to 500°C for normal condition. HC purification rate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

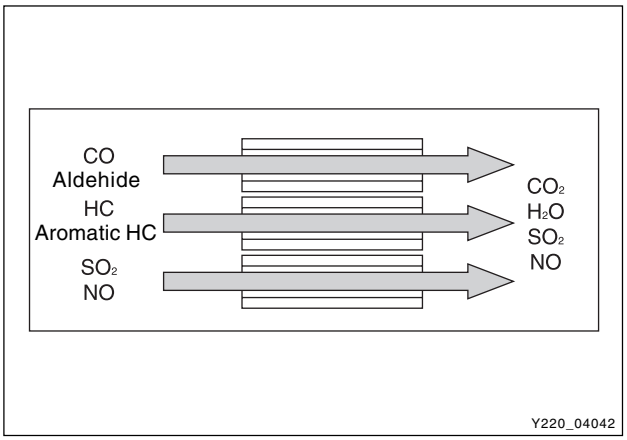
Purification of catalytic converter

- Adhesion of soluble organic fraction (SOF) below 180°C
- Purification of soluble organic fraction (SOF) over 180°C

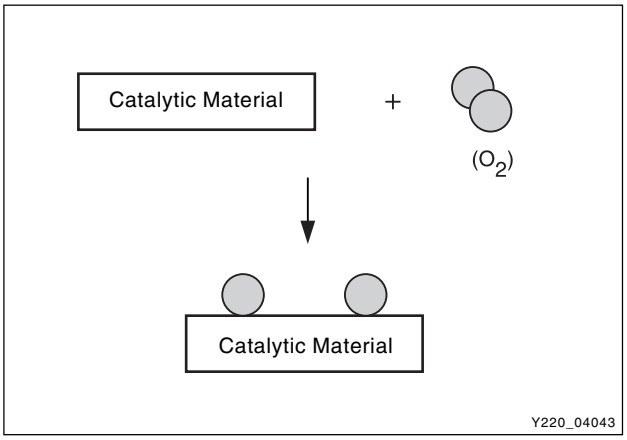
Chemical reaction formula

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





- Oxygen adheres to catalytic material : below 180°C



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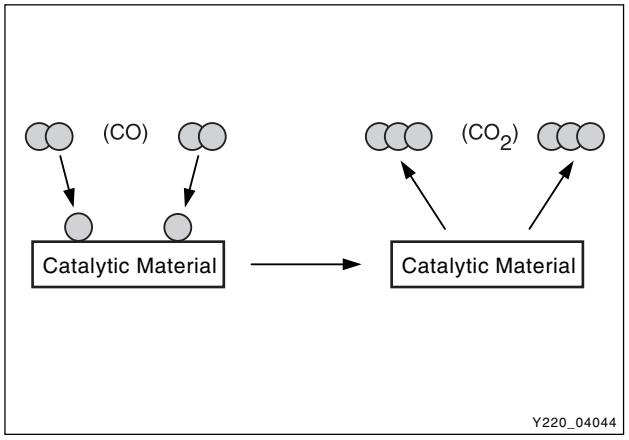
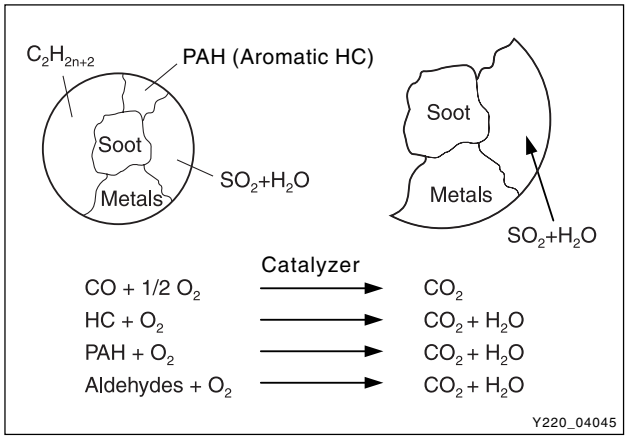


- Catalytic material supplies each CO and HC with O2 for their oxidation : above 180°C



- Catalytic material conversion process by DOC

Method for reduction of NOx

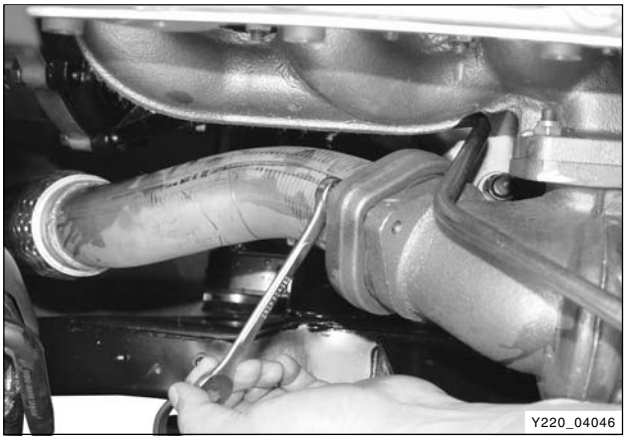
NOx is generated a great deal in case that combustion temperature and excess air factor are high. EGR valve can decrease NOx (30 to 35 % decrease) by making temperature of combustion chamber fall by means of exhaust gas recirculation.

#1 Exhaust Pipe - Removal and Installation

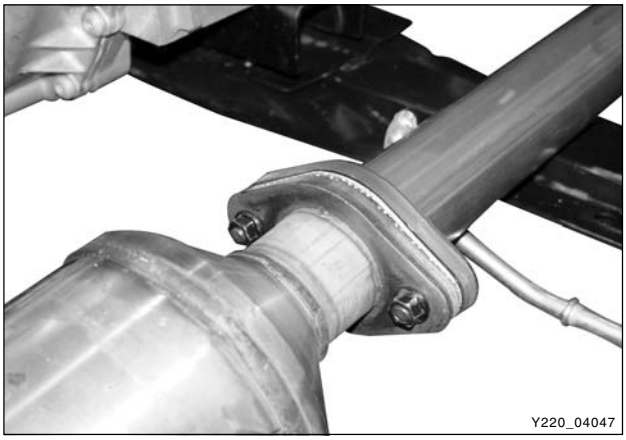
1. Remove the upper bolts at turbo charger.

Notice

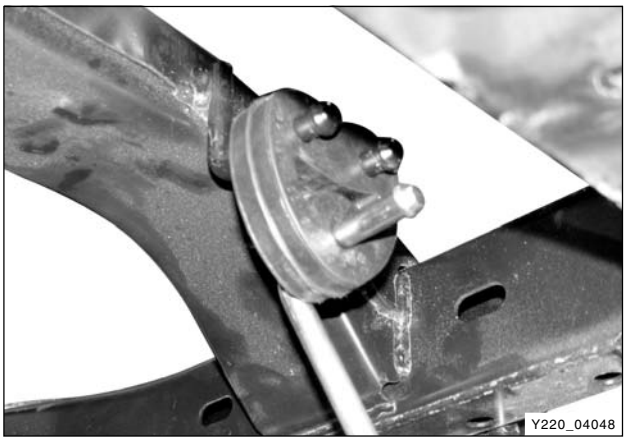
Use the universal type wrench.



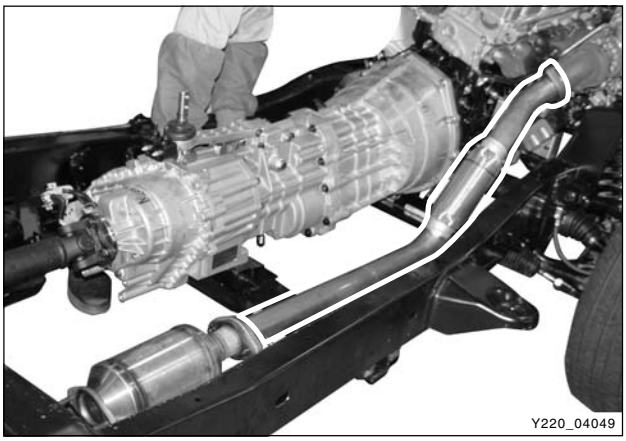
2. Remove the lower bolts and gasket.



3. Remove the pipe mounting rubber.



4. Remove the #1 exhaust pipe.
5. Install in the reverse order of removal.



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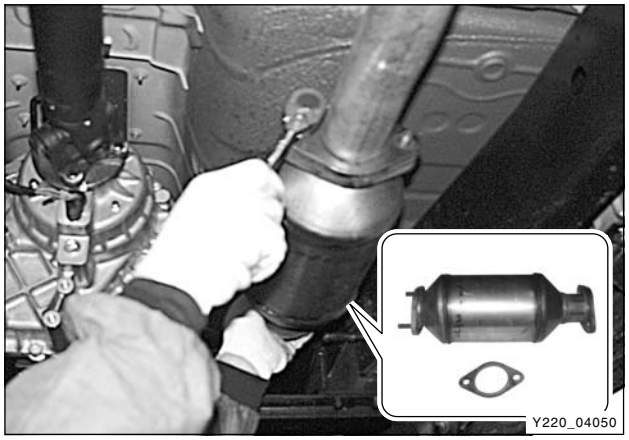
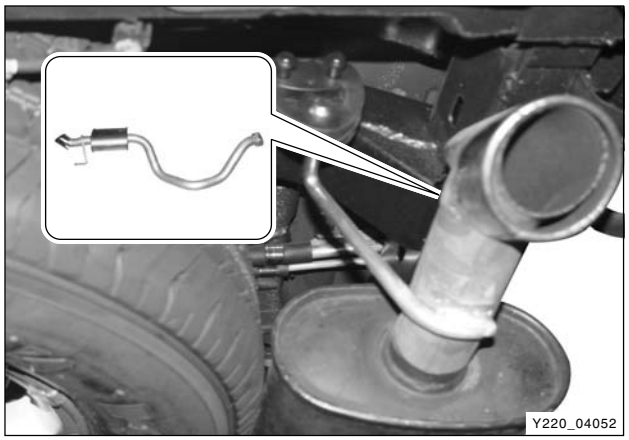


Catalytic Converter - Removal and Installation

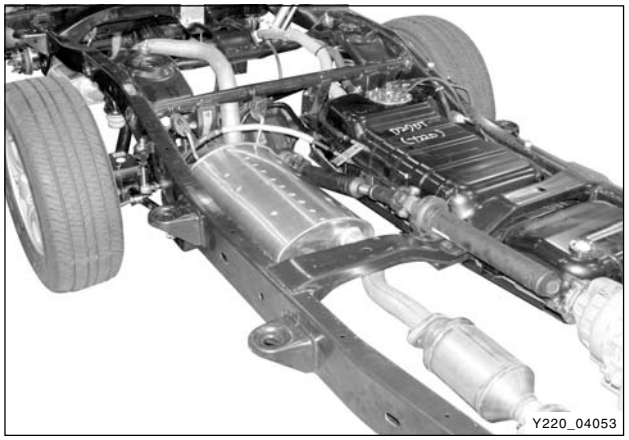
1. Unscrew the bolts at both sides and remove the gasket and the converter.
2. Install in the reverse order of removal.

#2 Exhaust Pipe - Removal and Installation

1. Unscrew the bolts and remove the gasket.



2. Release the rear mounting lever with a screwdriver.



3. Remove the #2 exhaust pipe.

4. Install in the reverse order of removal.

SECTION DI05

LUBRICATION SYSTEM

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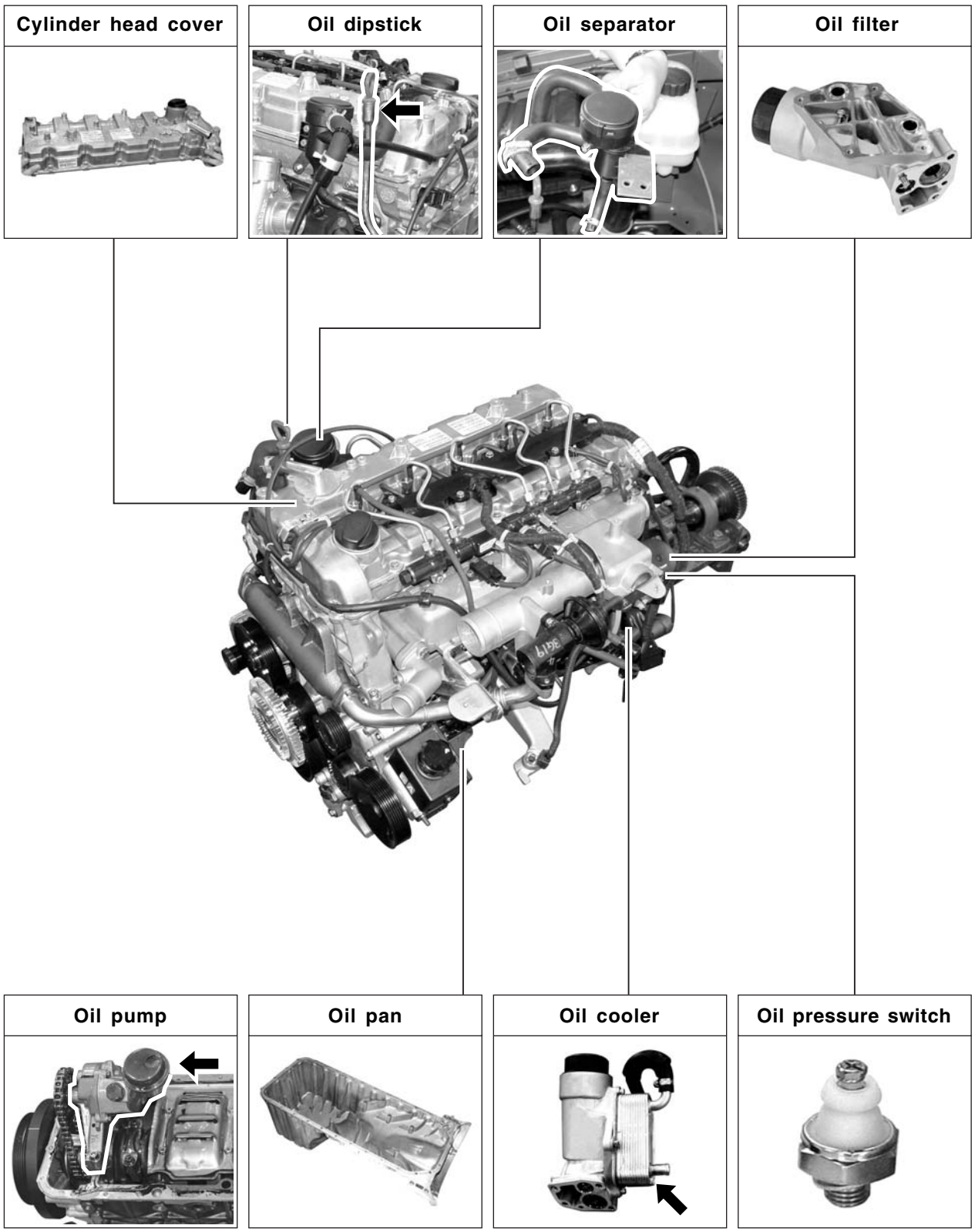
LUBRICATION SYSTEM



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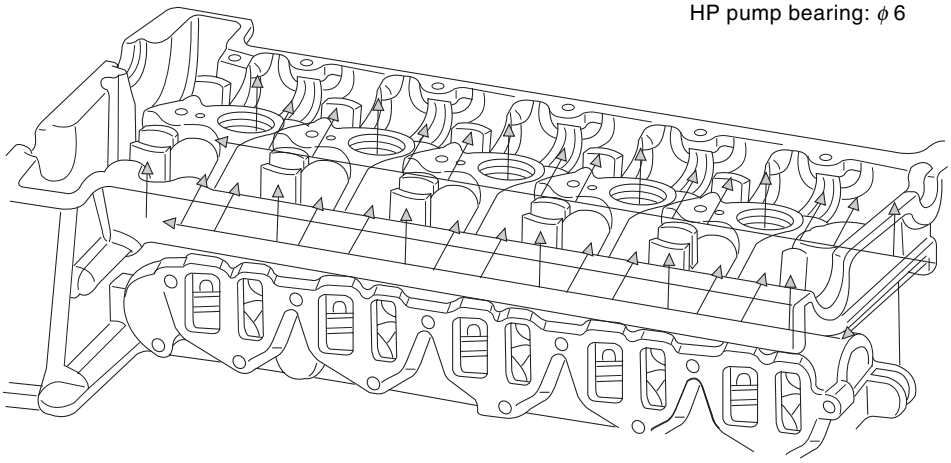
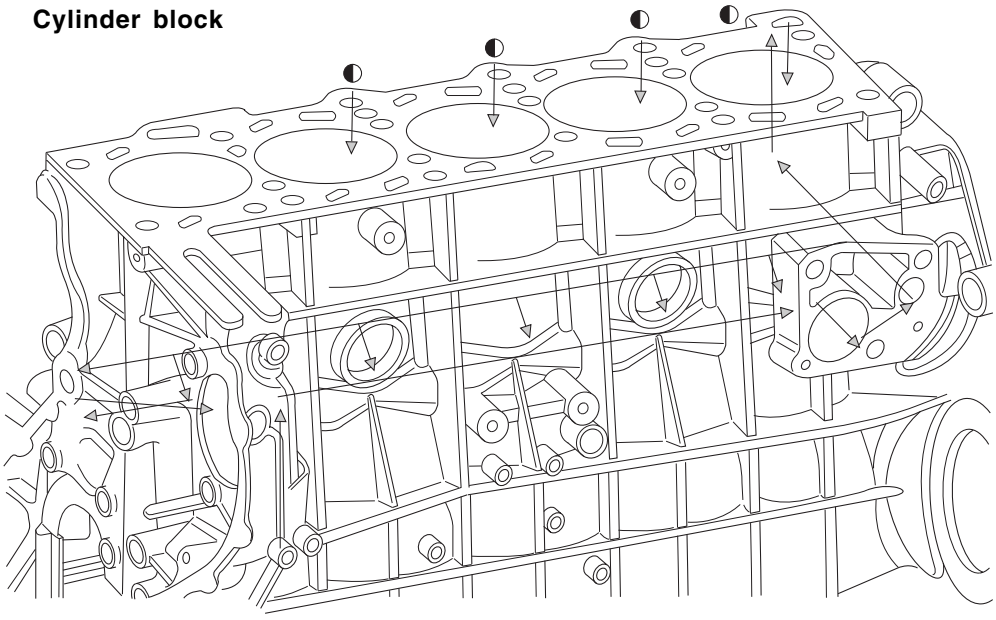
LUBRICATION SYSTEM LAYOUT

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

Cylinder head



Cylinder block



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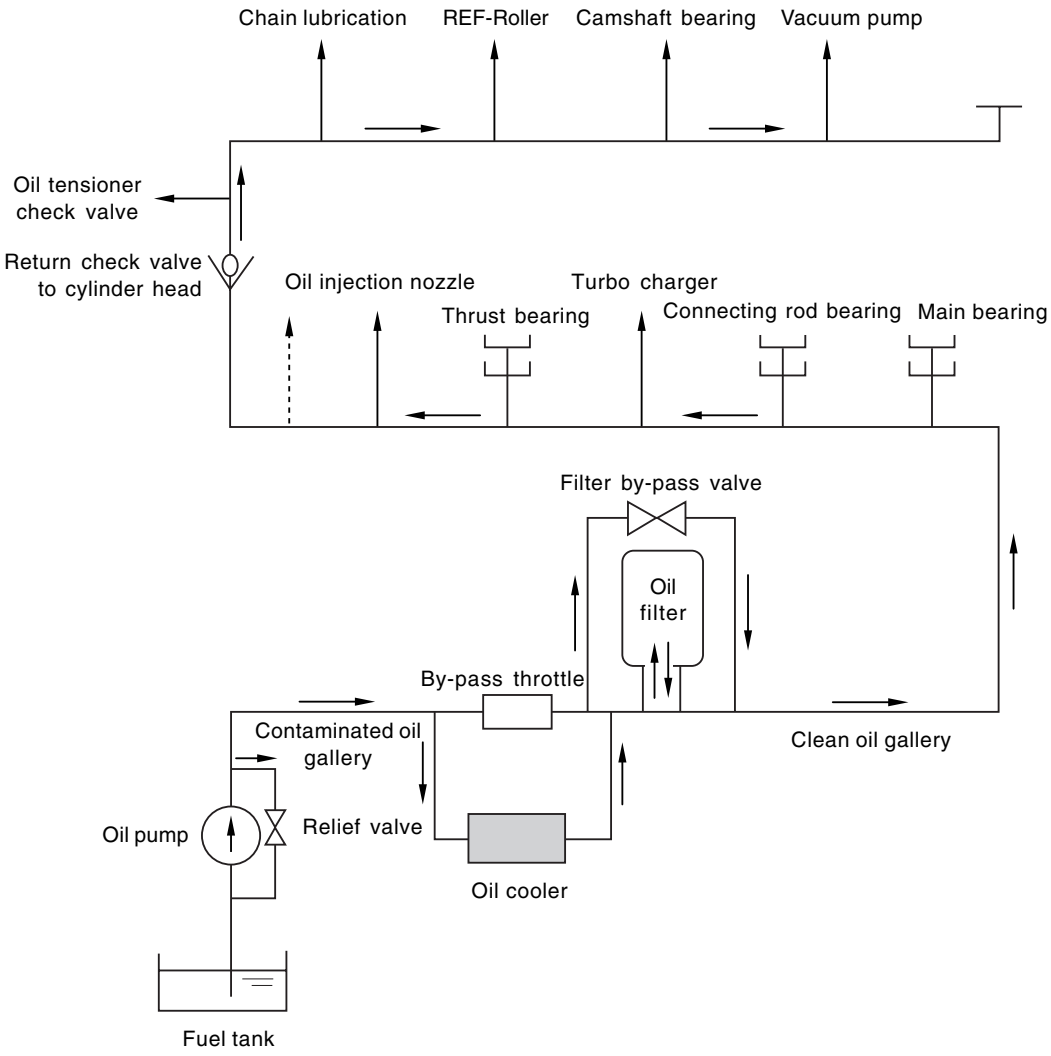
LUBRICATION DIAGRAM



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

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

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SPECIFICATIONS

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

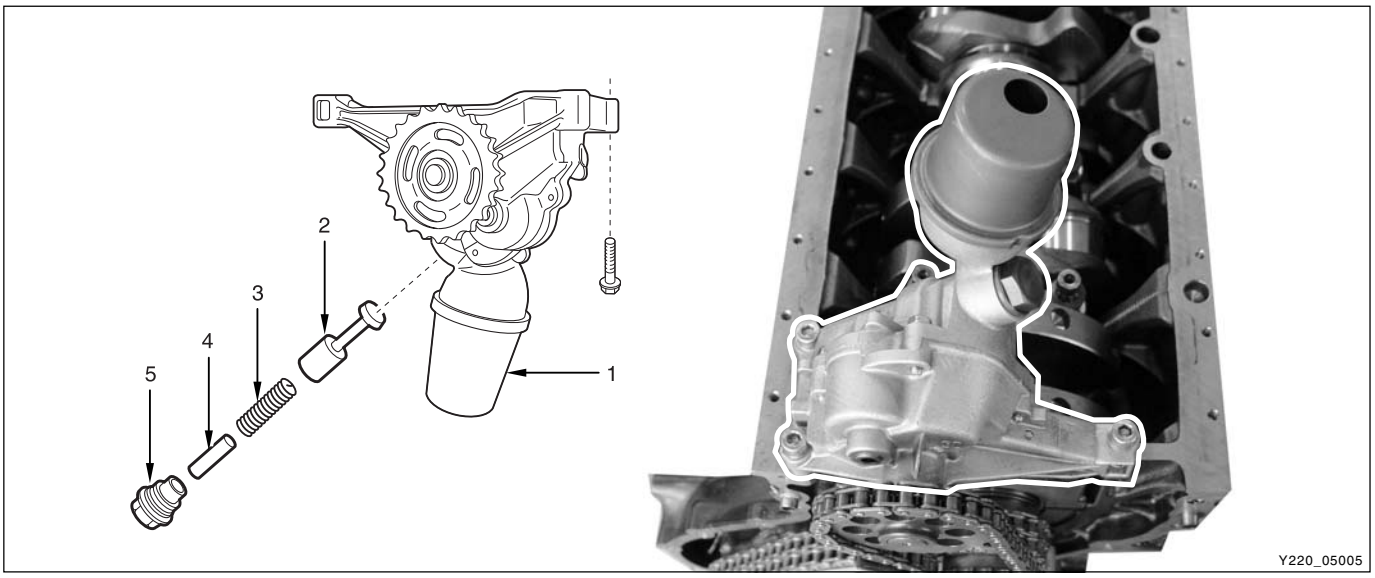
※ **Severe condition:**

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

▶ Oil Pressure Switch

- Operating temperature: -40 ~ 140°C
- Operating pressure: 0.3 ~ 0.55 bar
- Permissible pressure: 10 bar

▶ Oil Pump



Engine	Oil	Relief Valve Opening Pressure
D27DT	MB SHEET 229.1/3 SAE 10W 40, 5W 40	5.8 ± 0.3 bar

※ Differences between D27DT and old model (D29ST)

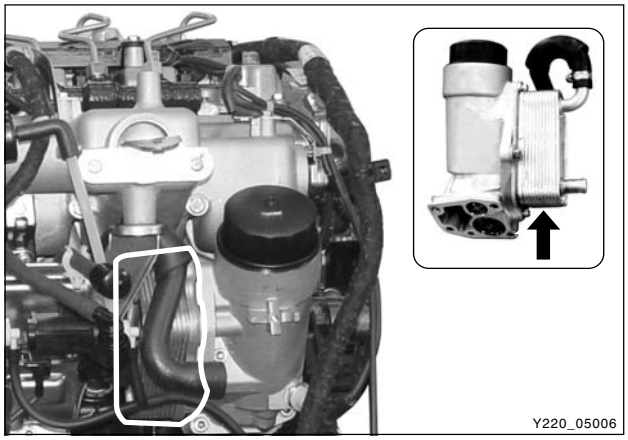
- Enlarged pump capacity: Width of tooth (pump gear): 33 mm (D29ST: 30 mm)
- Increased number of teeth (sprocket): 26 (D29ST: 24)

▶ Oil Cooler

- Oil cooler mounting bolt: M6 x 16: 4

Tightening torque	10 Nm

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



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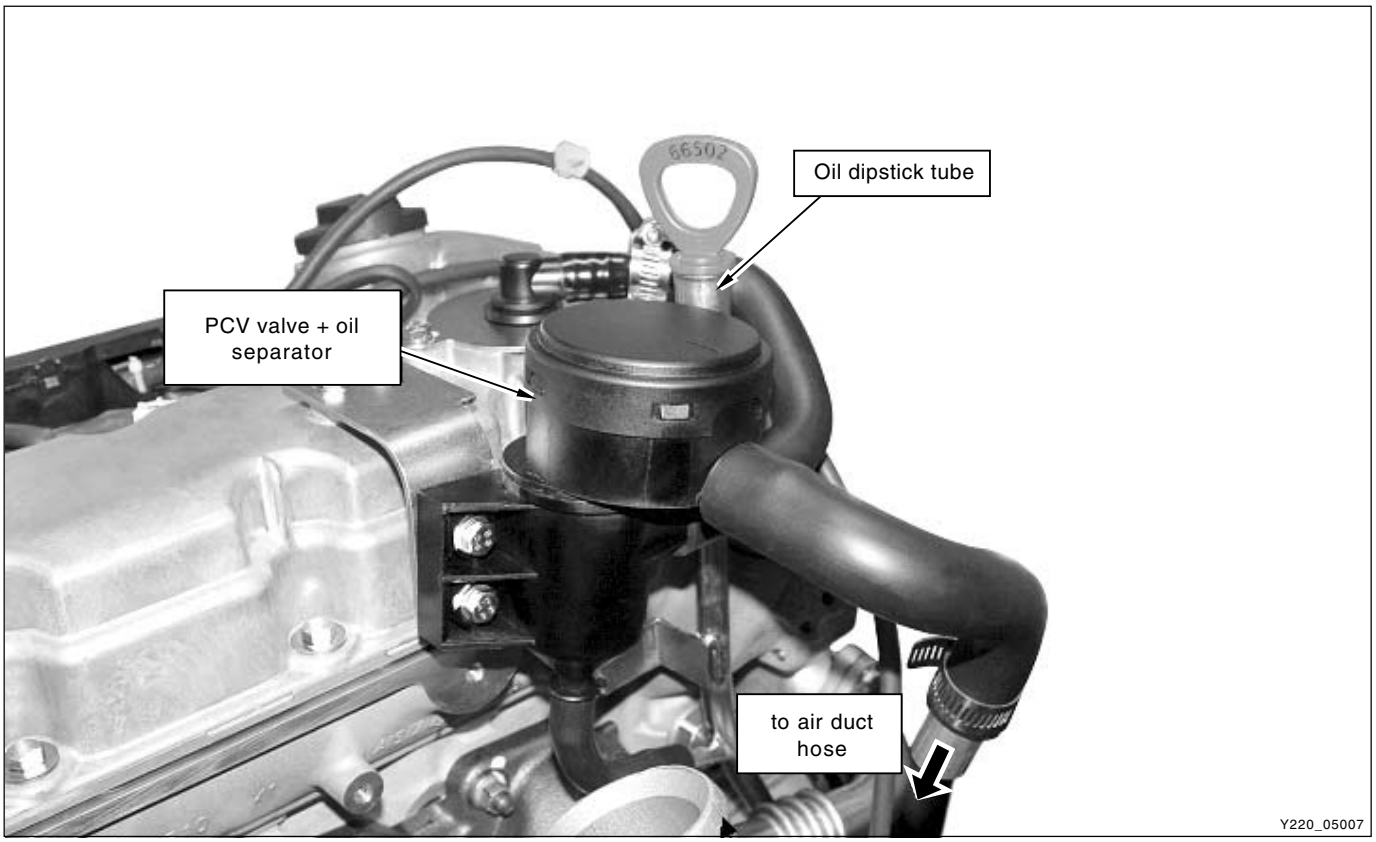
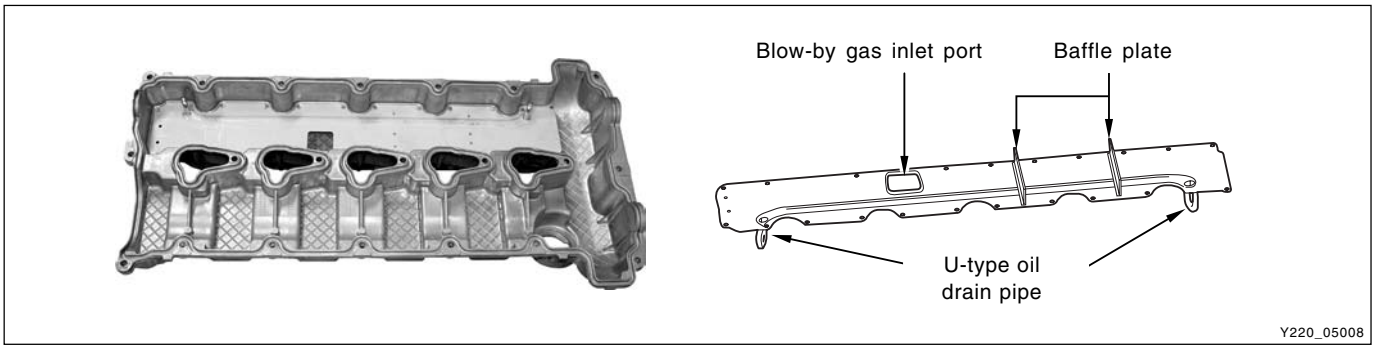
▶ Blow-by Gas Reduction Device

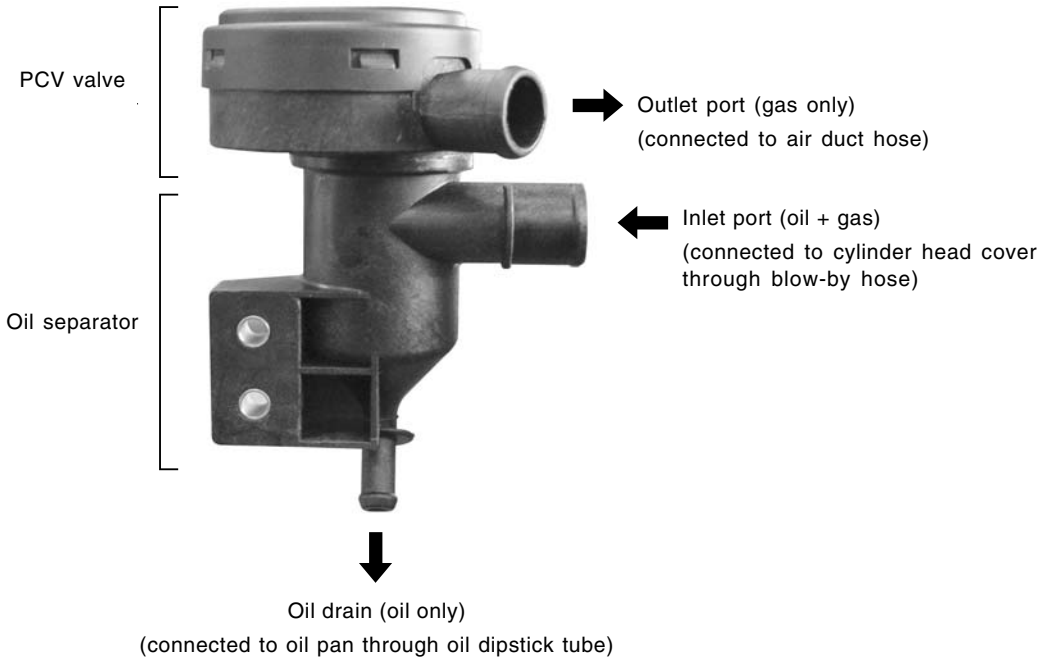


▶ Cylinder Head Cover



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

▶ Oil Separator



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

▶ Engine Oil Pressure Check

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

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

Specified oil pressure	2.5 ~ 3.0 kg/cm²(2000 RPM)

5. Install the switch and engage the connector.

Notice

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

Tightening torque	120 ~ 160 kg/cm²

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ENGINE OIL CHANGE

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

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

* Severe condition:

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

Notice

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

▶ Engine Oil Changing Procedures

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

   Notice

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

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

Oil drain plug	25 ± 2.5 Nm

Notice

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

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

   Notice

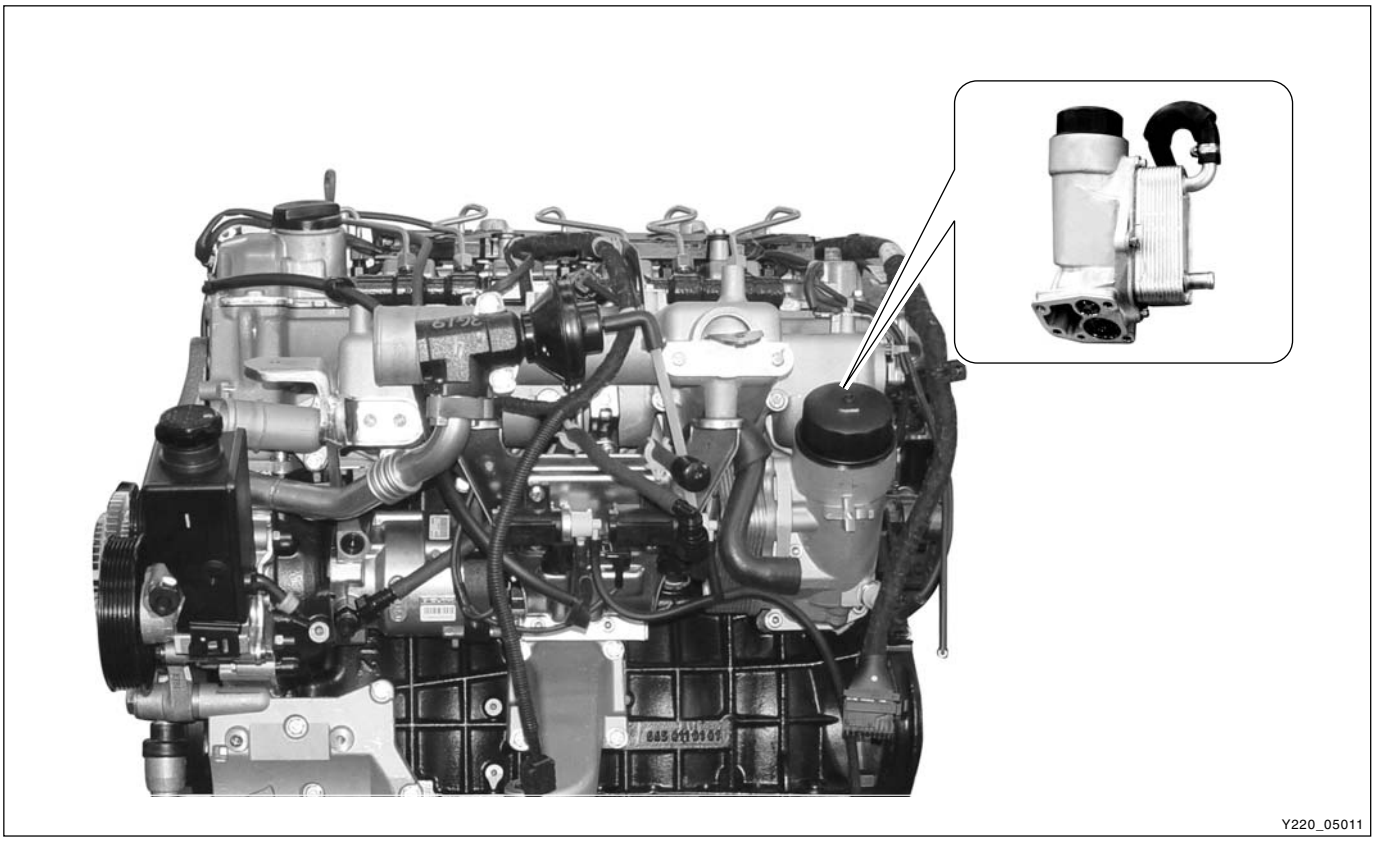
   The oil should not go above the upper mark on the dipstick. This would lead, for example, to increased oil consumption, fouling of the spark plugs and excessive formation of carbon residue.

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

Engine oil filter change

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

Oil filter	25 ± 2.5 Nm



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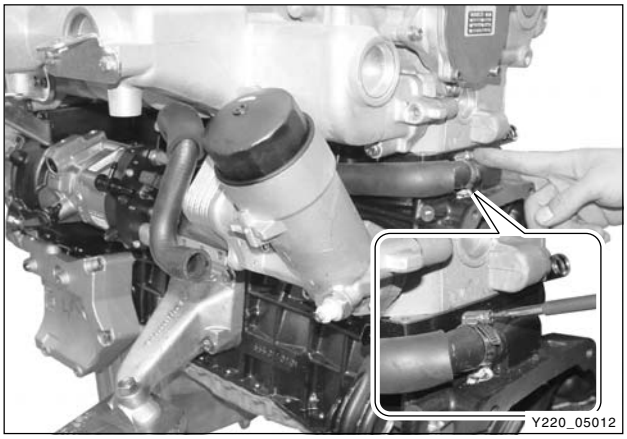
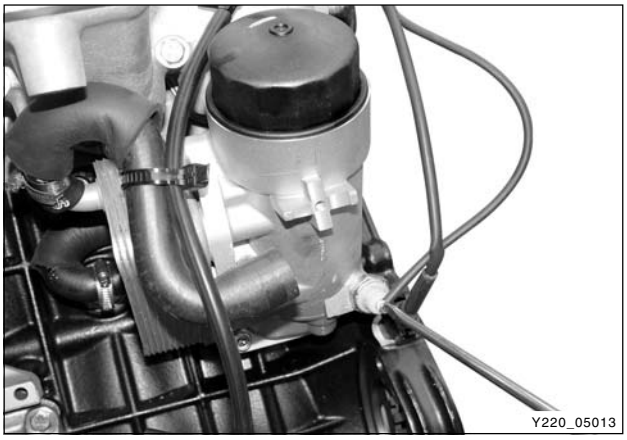
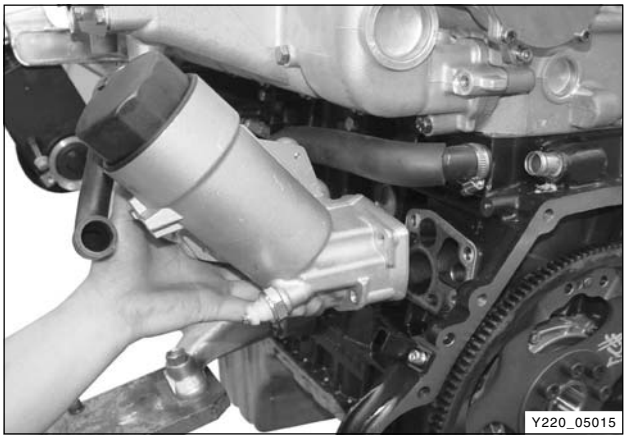






Oil Filter and Cooler - Removal and Installation

※ Preceding Works:

- Draining of engine oil
- Removal of EGR vacuum modulator bracket

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

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

3. Remove the oil cooler and filter mounting bolt.

Notice

Pay attention to the length of bolts.

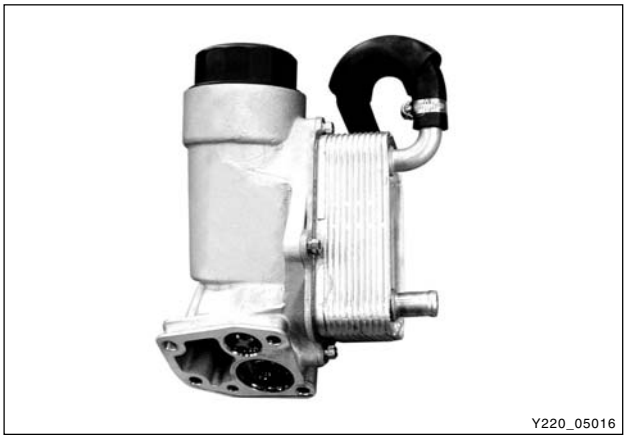
Tightening torque	23 ± 2.3 Nm

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

Notice

The oil cooler and filter assembly cannot be replaced separately.

5. Install in the reverse order of removal.



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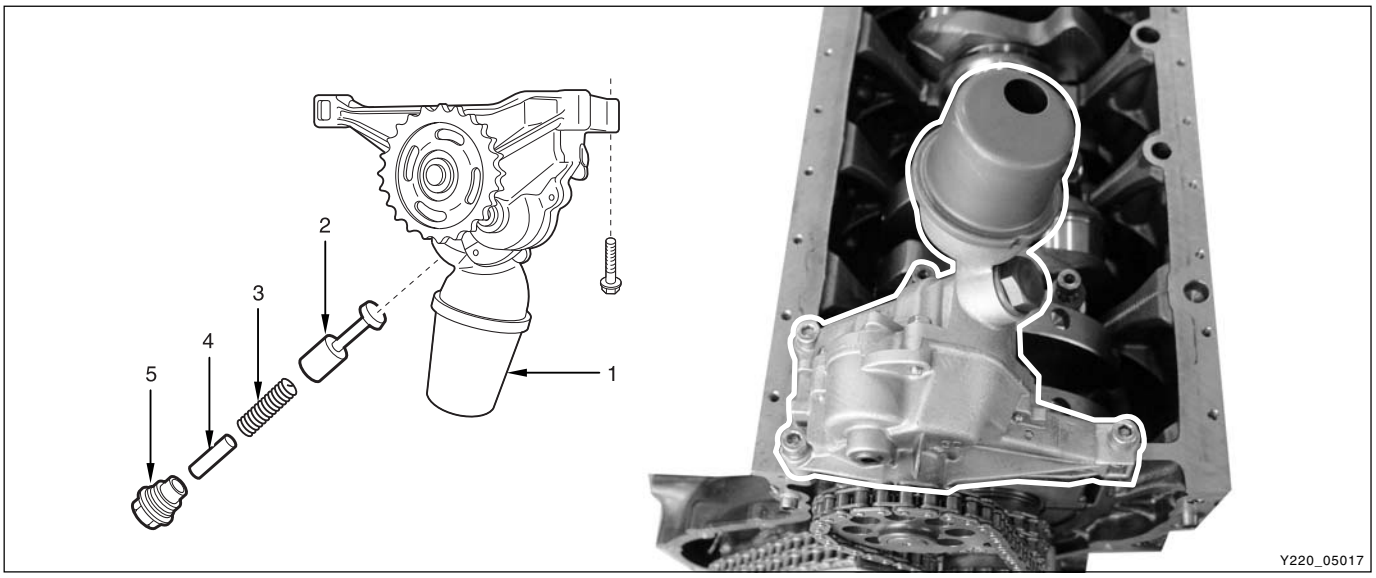
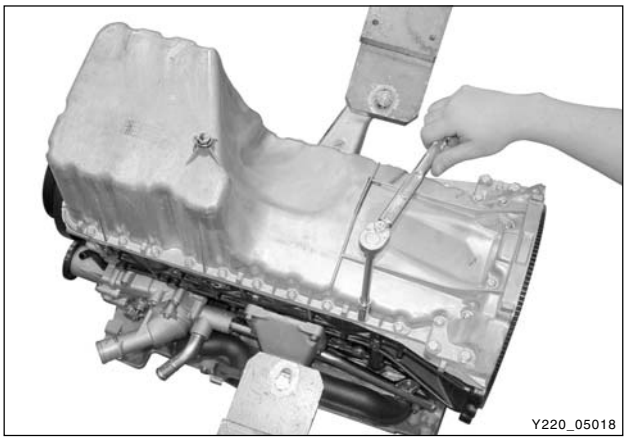
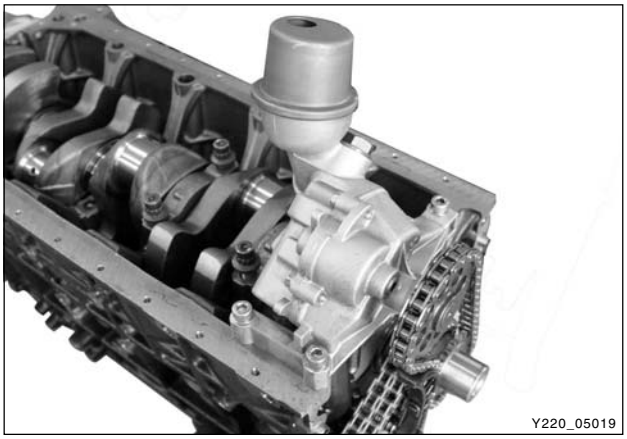
OIL PUMP



1. Oil pump
2. Plunger
3. Compression spring
4. Guide pin
5. Screw plug ..... 50 Nm
6. Combination bolt ..... 23 ± 2.3 Nm
7. Oil strainer





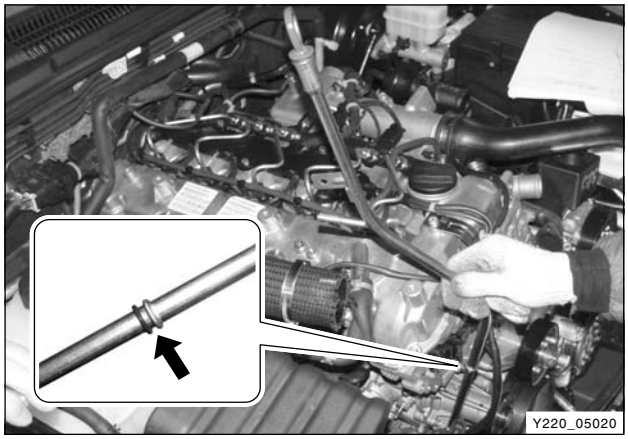
Oil Pump - Removal and Installation

1. Remove the oil pan.

Tightening torque	Nm
M6 x 20 (24 EA)	10 ± 1.0
M6 x 35 (2 EA)	10 ± 1.0
M6 x 85 (2 EA)	10 ± 1.0
M8 x 40 (4 EA)	25 ± 2.5

2. Remove the oil pump.
3. Remove the screw plugs and the relief valve.
4. Install in the reverse order of removal.
5. Start the engine and check for oil leaks.

Oil Dipstick Guide Tube - Removal and Installation



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

Tightening torque	35 ± 3.5 Nm

Notice

Replace the pipe with new one.

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

Notice

Replace the O-ring with new one.

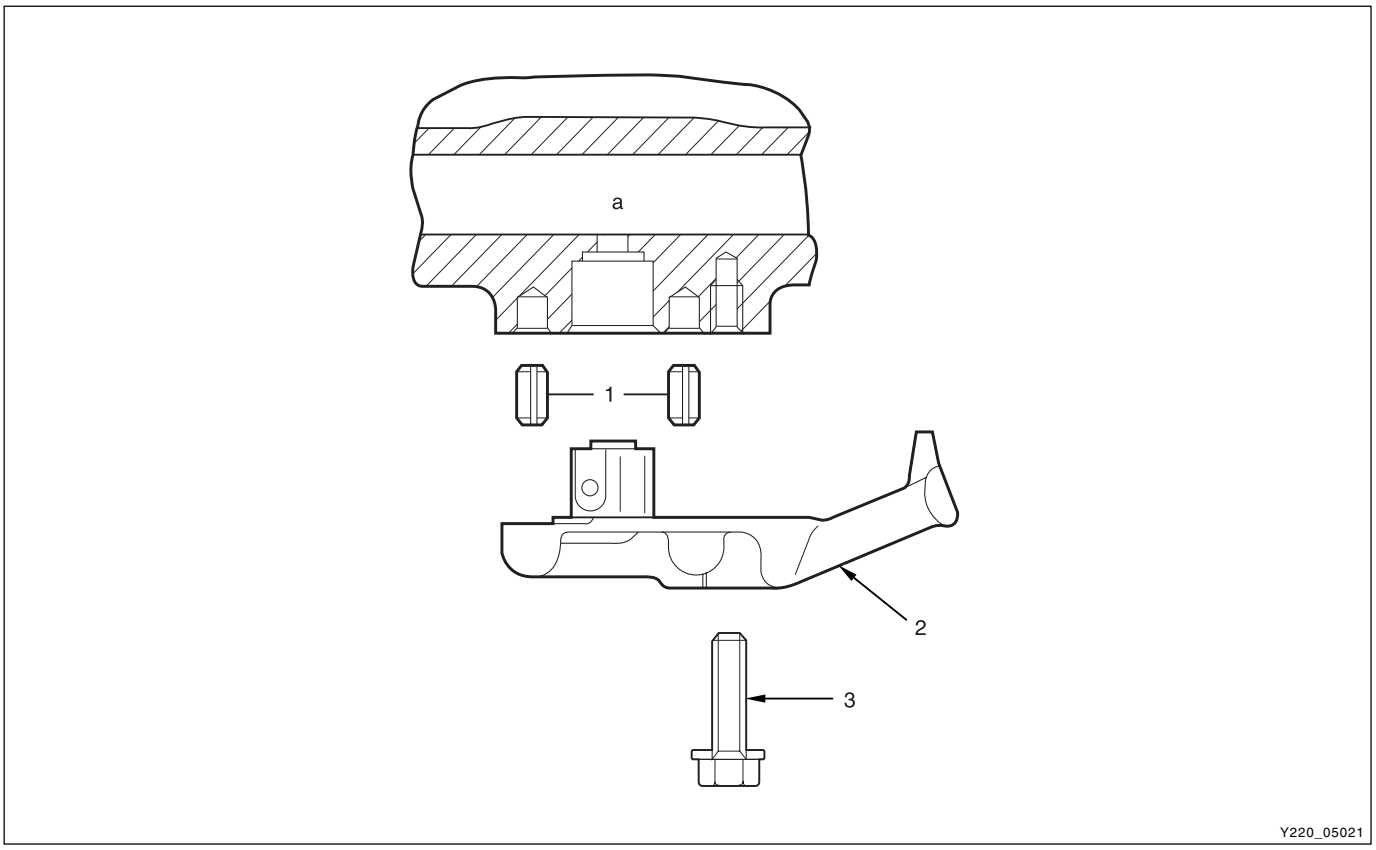
4. Install in the reverse order of removal.

Tightening torque	10 Nm

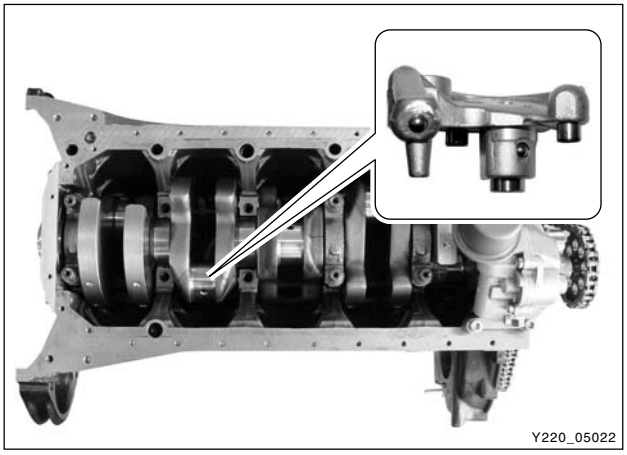
Notice

After installation, check for oil leaks.

OIL SPRAY NOZZLE



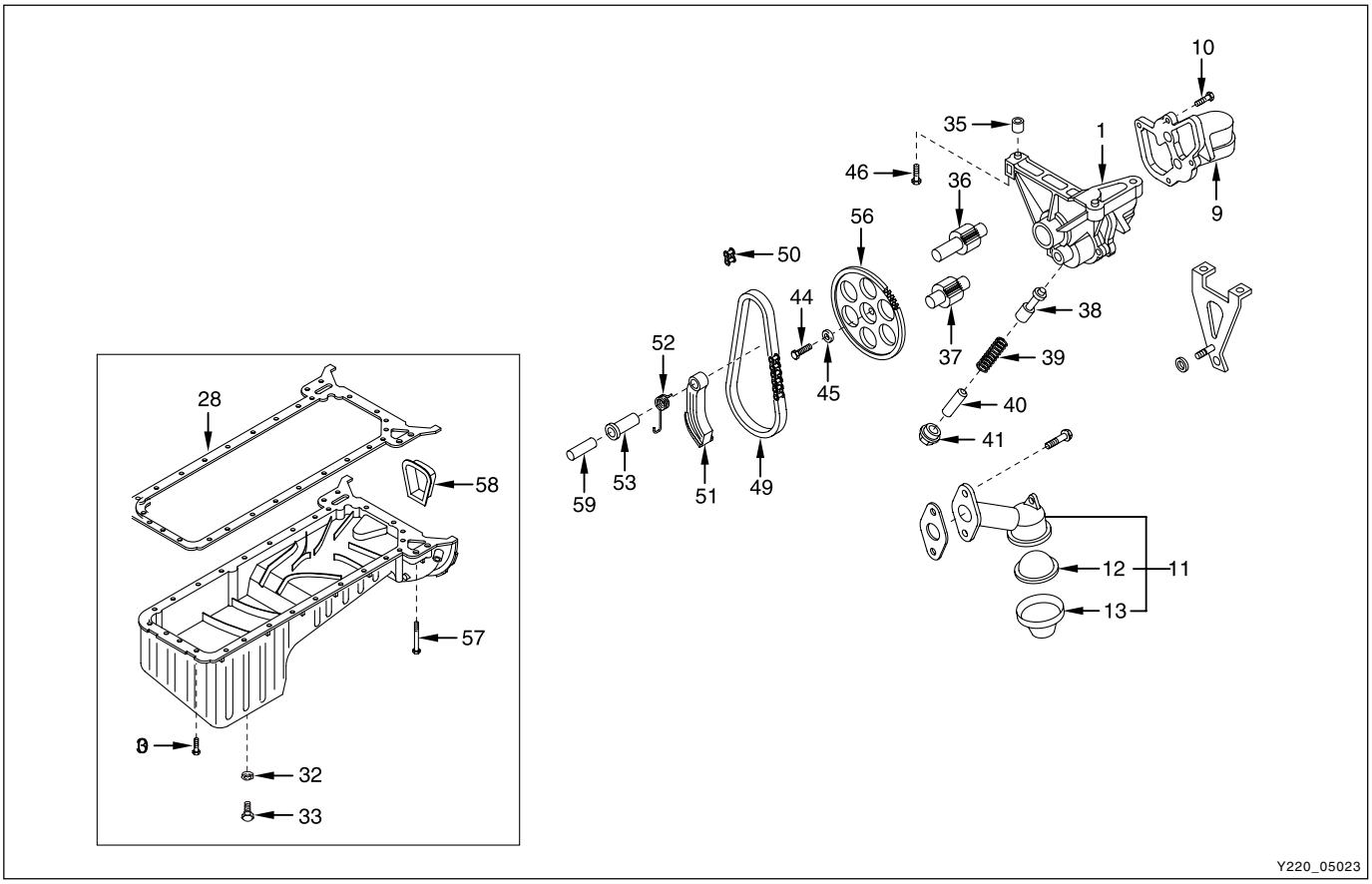
1. Fitting sleeve
2. Oil spray nozzle
3. Combination bolt ..... 10 Nm
4. Oil duct



Disassembly

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

OIL PAN ASSEMBLY



1. Oil pump
9. Oil pump cover
10. Bolt
32. Drain plug
33. Drain plug ..... 25 ± 2.5 Nm(replace the washer)
35. Spring pin
36. Oil pump drive shaft
37. Oil pump driven shaft
38. Oil pump relief valve piston
39. Spring
40. Oil pump relief valve pin
41. Oil pump relief valve plug
44. Bolt ..... 10 Nm
45. Washer
46. Bolt
49. Oil pump roller chain
50. Oil pump chain lock link
51. Oil pump chain tensioner
52. Oil pump chain spring
53. Bush
56. Oil pump sprocket
57. Bolt
58. Dust cover
59. Cylindrical pin

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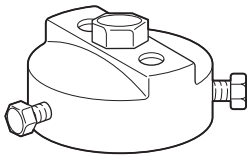
TROUBLE DIAGNOSIS

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

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
103 589 02 09 00 **Engine filter cap**  Y220_05024	

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SECTION DI06

COOLING SYSTEM

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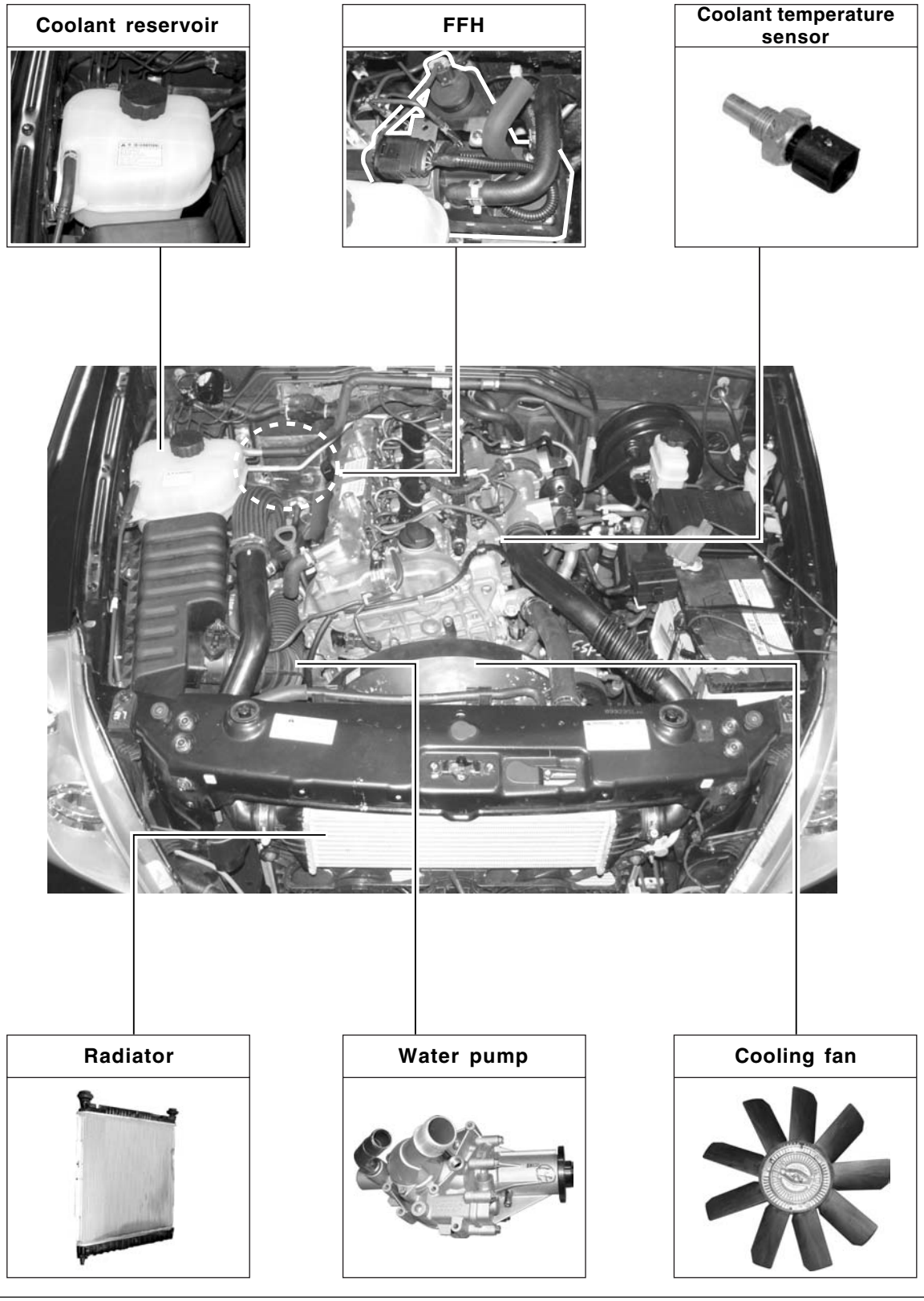
COOLING SYSTEM



※ FFH (Fuel Fired Heater): refer to “FFH System” in this manual.

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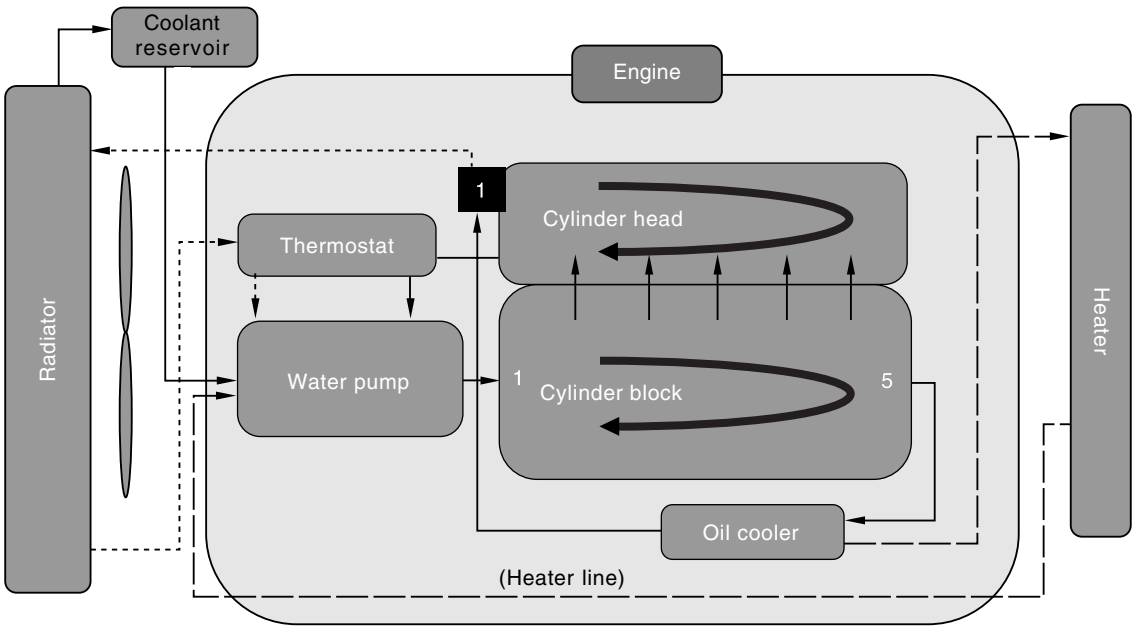
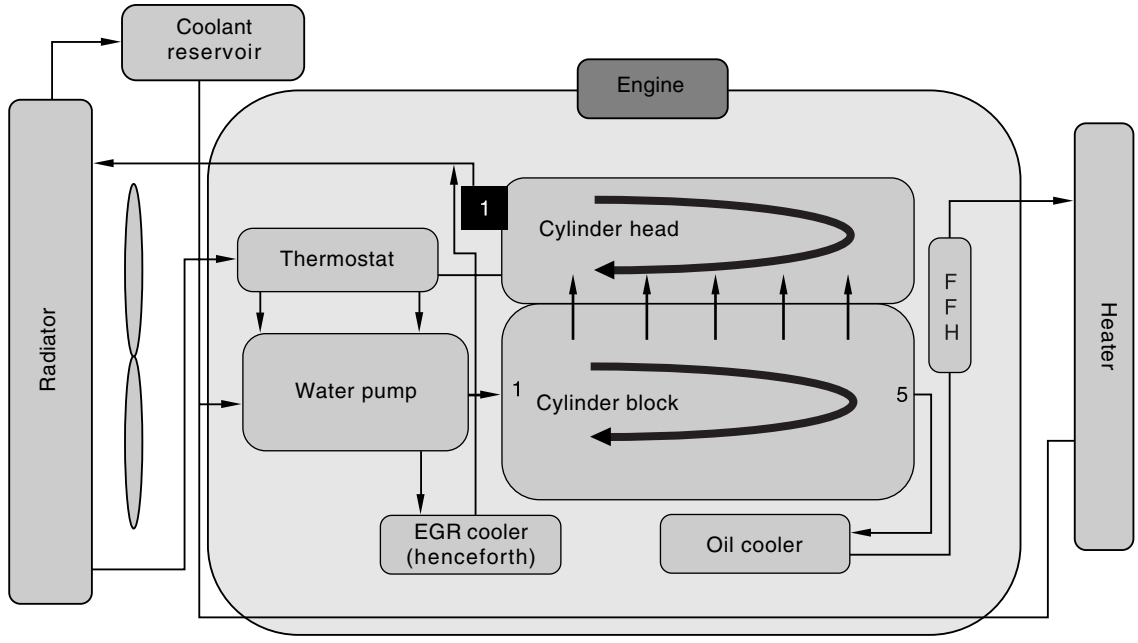
ENGINE COOLING SYSTEM



<PTC Engine Coolant Flows>



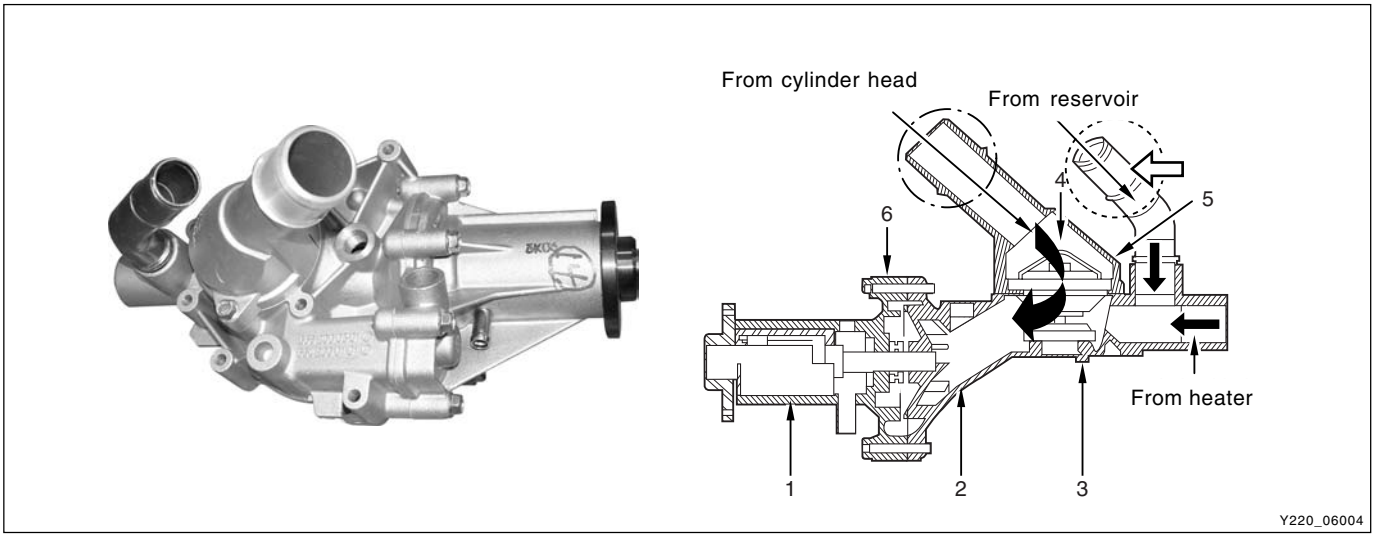
<FFH Engine Coolant Flows>

Y220_06002

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

▶ Function Description

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



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

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

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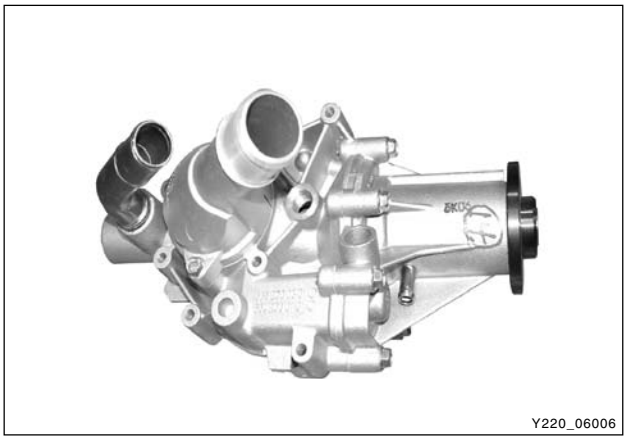
Radiator

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



Water pump

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

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

Coolant reservoir

Notice

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

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

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

▶ Thermostat


Y220_06008

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

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

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

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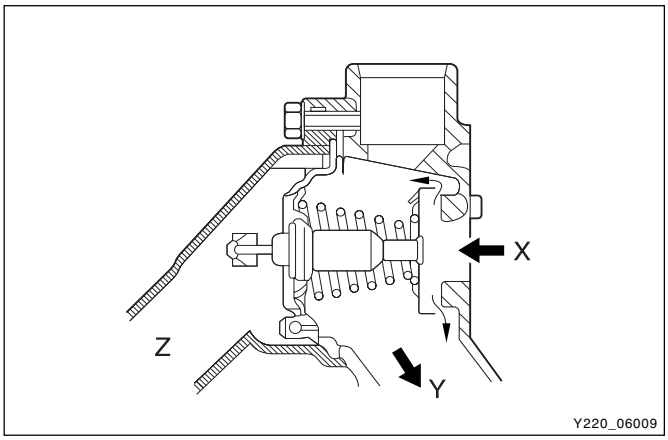
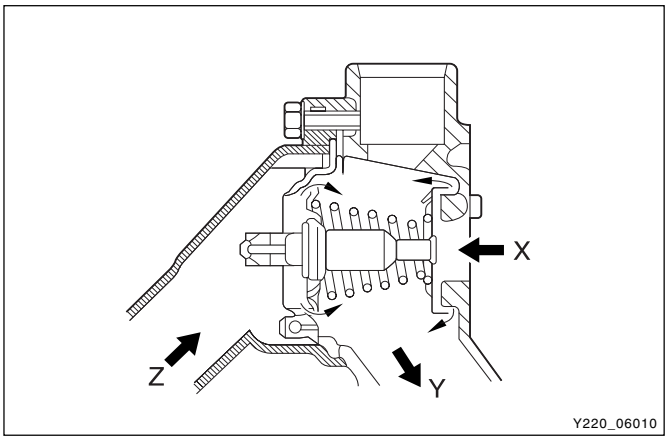
When closed (up to 85°C)



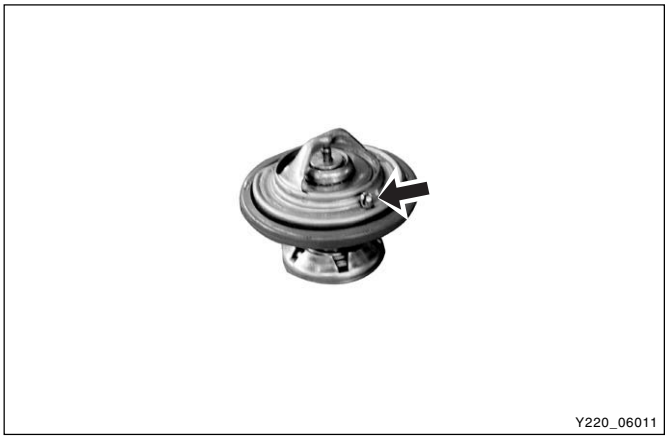
When partially opened (85°C ~ 100°C)

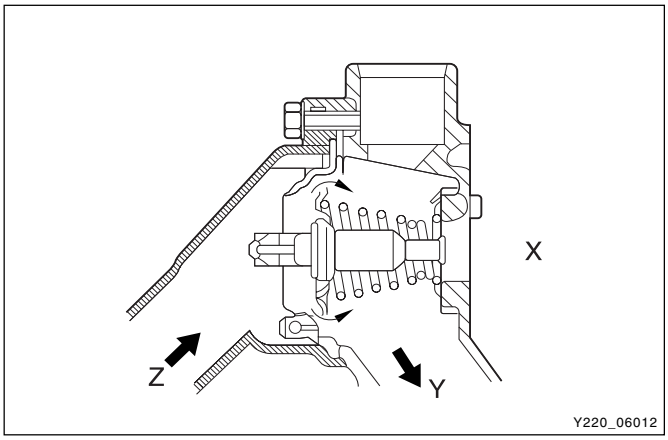


X. from vrankcase
Y. to crankcase
Z. from radiator

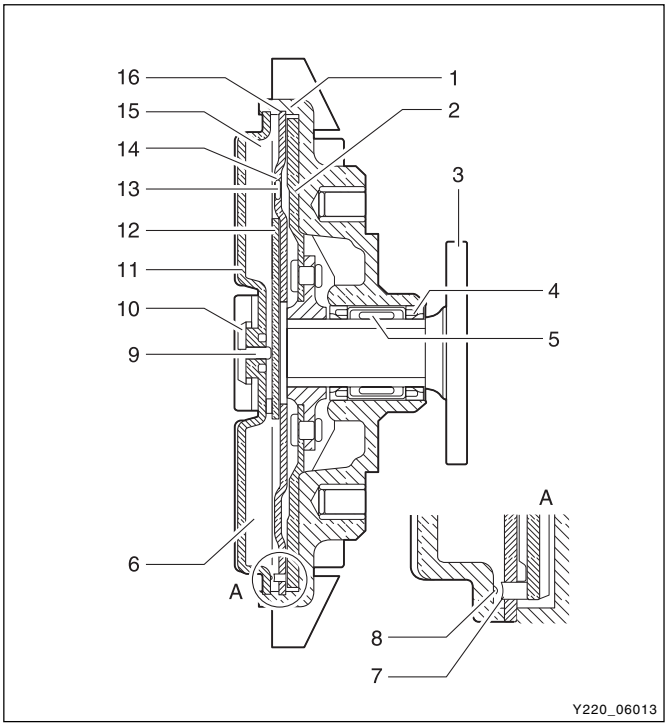
When fully opened (above 100°C)

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





Viscous fan clutch



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

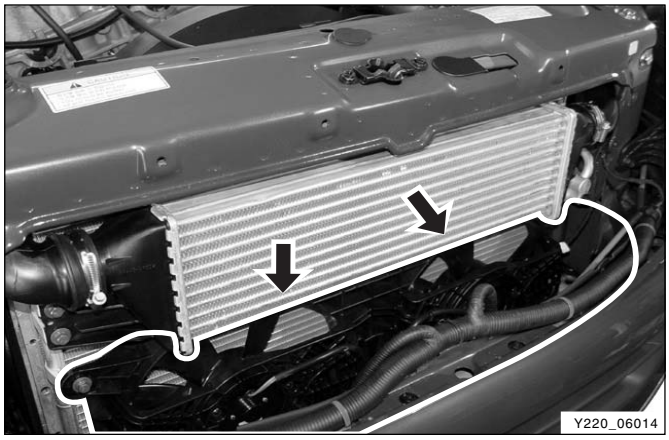
The cooling speed increases approx. 1,000 rpm with wind noise when the engine speed is 4,000 to 4,500 rpm and the coolant temperature is 90 to 95°C.

Notice

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

Notice

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

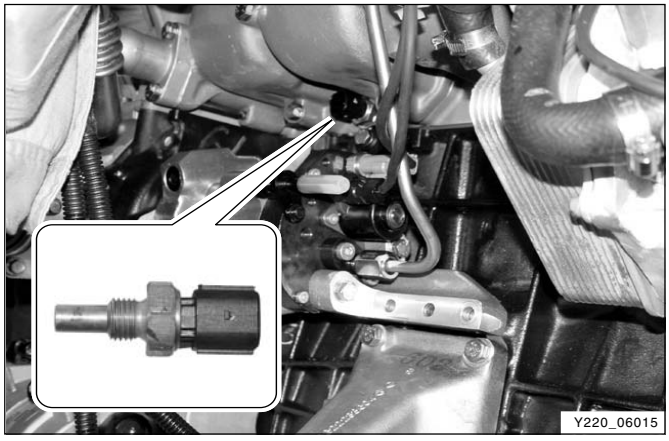


The cooling fans are mounted behind the radiator in the engine compartment. The electric cooling fans increase the flow of air across the radiator fins and across the condenser on air conditioner. The fan is 320 mm in diameter with five blades to aid the airflow through the radiator and the condenser.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

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

Engine coolant temperature sensor

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



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SPECIFICATIONS

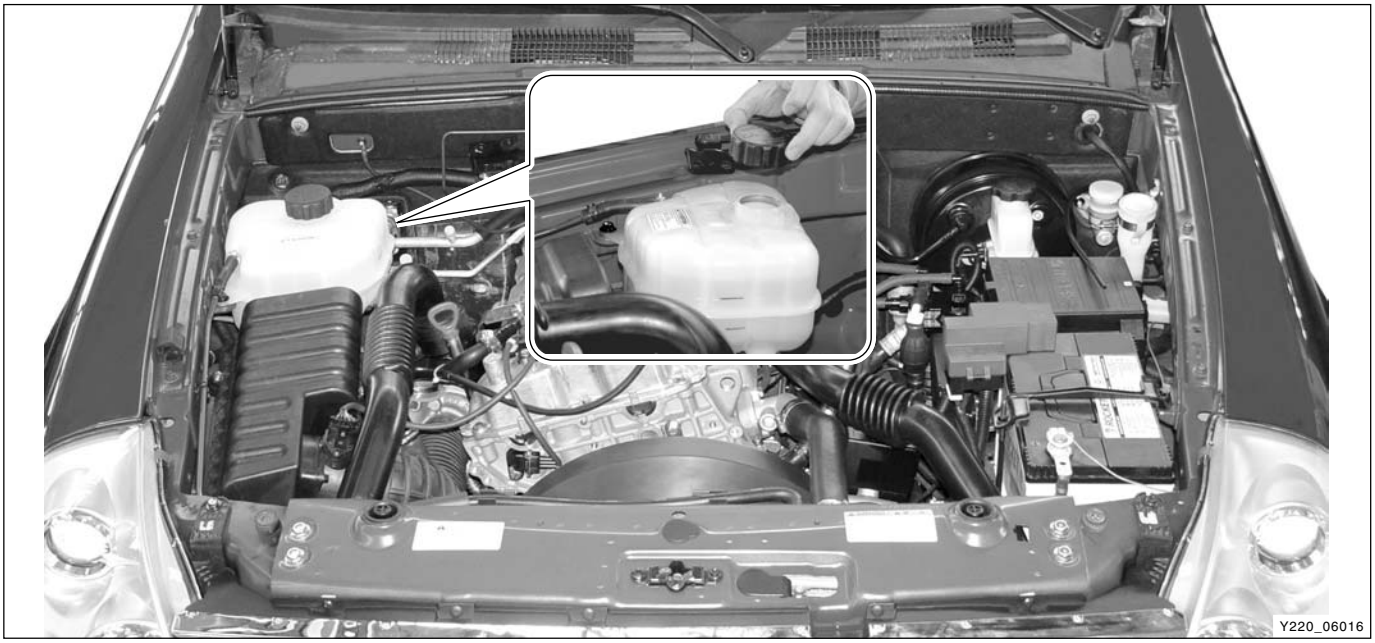
Description			Unit	Specification
Cooling system	Type		-	Water cooling forced circulation
Coolant	Capacity		ℓ	11.3
Thermostat	Type		-	Wax pellet type
	Initial opening temperature	DI Engine	°C	85
		IDI Engine	°C	80
	Fully opening temperature	DI Engine	°C	100
		IDI Engine	°C	95
	Fully closing temperature	DI Engine	°C	83
		IDI Engine	°C	78
	Stroke	DI Engine	mm	min. 8
		IDI Engine	mm	min. 8
Cooling fan	Type		-	Electric
	Blades			5
	Diameter		mm	320 (2)
	Low speed ON temp		°C	91
	Low speed OFF temp		°C	88
	High speed ON temp		°C	95
	High speed OFF temp		°C	92
	High speed ON temp. (By A/C pressure)		psi	270
Coolant reservoir	pressure valve opening pressure		Kg/cm^2	1.2 ~ 1.5
	Vacuum valve opening pressure		Kg/cm^2	0.1
Water pump	Type		-	Turbo centrifugal
	Impeller diameter		mm	72.3
	Impeller blades			10
Radiator	Type		-	Down-flow
	Core width		mm	701
	Core height		mm	372
	Core thickness		mm	18
	Minimum radiation capability		Kcal/h	45,000
Coolant temperature sensor	Resistance (at 20°C)		KΩ	3.33 ~ 3.78
	Resistance (at 80°C)		KΩ	0.32 ~ 0.35
Anti-freeze agent	Type		–	ALUTEC-P78
	Mixture ratio (water and anti-freeze)		–	50 : 50

▶ Coolant Level Check

Notice

- ***Scalding hot coolant and steam could be blown out under pressure, which could cause serious injury. Never remove the coolant reservoir cap when the engine and radiator are hot.***
- ***Take precautions to prevent antifreeze coming in contact with the skin, eyes or vehicle body. If contact happens, rinse affected areas immediately with plenty of water.***

1. Place the vehicle on a level ground and check the coolant level through the coolant reservoir.
2. Add if needed. Change the coolant if necessary.



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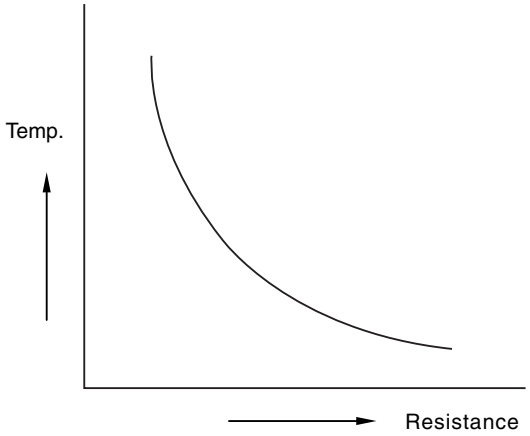
▶ Coolant Temperature Sensor

<Coolant Temperature Sensor>



<Output Characteristics of Coolant Temperature Sensor>

Y220_06017

Coolant temperature sensor is a NTC resister that sends coolant temperature to ECU.

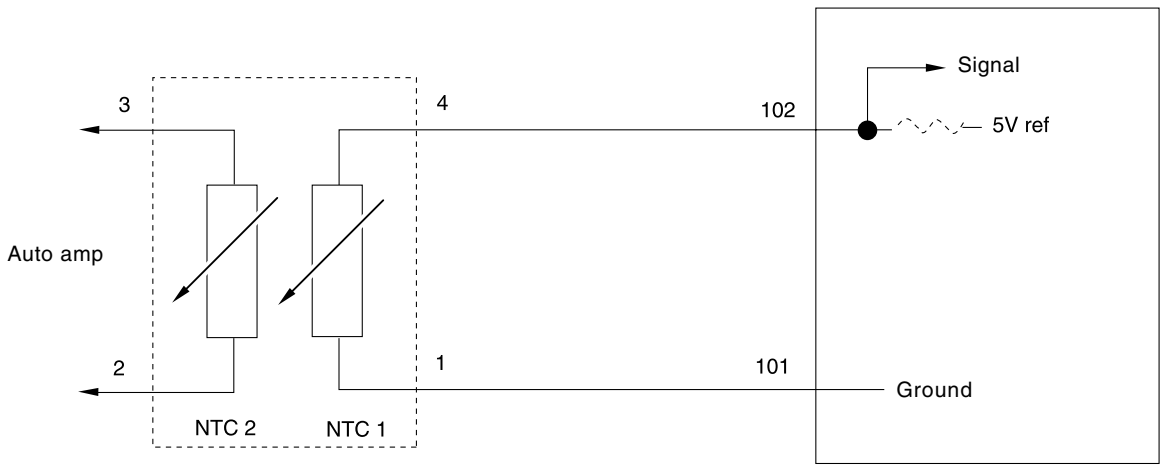
NTC resister has characteristics that if the engine temperature rises, the resistance lowers so the ECU detects lowering signal voltages.

If the fuel injected into the engine through injector has more turbulence, then combusts very well. However, if engine temperature is too low, the fuel injected as foggy state forms big compounds causing incomplete combustion. So the sensor detects coolant temperature and changes coolant temperature changes into voltage then sends to ECU to increase the fuel volume during cold start for better starting. And detects engine overheating for fuel volume reduction to protect the engine.

ECU functions as below with coolant temperature sensor signals.

- When engine is cold, controls fuel volume to correct idle speed
- When engine is overheated, controls electrical fan and A/C compressor to protect the engine
- Sends information for emission control

Temperature	NTC 1 Resistance (Ω)	NTC 2 Resistance (Ω)
20	2,550	6,062
50	826	1,800
80	321	638
120	123	200



<Coolant Temperature Sensor Circuit>

Y220_06018

▶ Trouble Diagnosis

Symptom	Cause	Action
Low coolant level	• Leaks in radiator	• Replace radiator
	• Leaks in coolant reservoir	• Replace coolant reservoir
	• Leaks in heater core	• Replace heater
	• Leaks in hose connection	• Reconnect hose or replace clamp
	• Damaged coolant hose	• Replace hose
	• Leaks in water pump gasket	• Replace gasket
	• Leaks in water pump internal seal	• Replace water pump
	• Leaks in coolant inlet cap	• Replace water inlet cap gasket
	• Leaks in thermostat housing	• Replace thermostat sealing
	• Improper tightening torque of cylinder head	• Retighten
	• Damaged cylinder head gasket	• Replace cylinder head gasket
Excessively high coolant temperature	• Coolant leaks (too low coolant level)	• Add coolant
	• Improper coolant mixture ratio	• Check coolant concentration
	• Kinked coolant hose	• Repair or replace hose
	• Defective thermostat	• Replace thermostat
	• Defective water pump	• Replace water pump
	• Defective radiator	• Replace radiator
	• Defective coolant reservoir and cap	• Replace coolant reservoir or cap
	• Cracks on cylinder head or cylinder block	• Replace cylinder head or cylinder block
	• Clogged coolant passages in cylinder head or cylinder block	• Clean coolant passages
	• Clogged radiator core	• Clean radiator core
	• Improper operation of cooling fan	• Replace cooling fan or repair related circuit
	• Faulty temperature sensor or defective harness	• Replace sensor or repair related circuit
Excessively low coolant temperature	• Stuck thermostat (with open)	• Replace thermostat
	• Improper operation of cooling fan	• Replace cooling fan or repair related circuit
	• Faulty temperature sensor or defective harness	• Replace sensor or repair related circuit

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SPECIFICATIONS

Description			Unit	Specification
Cooling system	Type		-	Water cooling forced circulation
Coolant	Capacity		ℓ	11.3
Thermostat	Type		-	Wax pellet type
	Initial opening temperature	DI Engine	°C	85
		IDI Engine	°C	80
	Fully opening temperature	DI Engine	°C	100
		IDI Engine	°C	95
	Fully closing temperature	DI Engine	°C	83
		IDI Engine	°C	78
	Stroke	DI Engine	mm	min. 8
		IDI Engine	mm	min. 8
Cooling fan	Type		-	Electric
	Blades			5
	Diameter		mm	320 (2)
	Low speed ON temp		°C	91
	Low speed OFF temp		°C	88
	High speed ON temp		°C	95
	High speed OFF temp		°C	92
	High speed ON temp. (By A/C pressure)		psi	270
Coolant reservoir	pressure valve opening pressure		Kg/cm^2	1.2 ~ 1.5
	Vacuum valve opening pressure		Kg/cm^2	0.1
Water pump	Type		-	Turbo centrifugal
	Impeller diameter		mm	72.3
	Impeller blades			10
Radiator	Type		-	Down-flow
	Core width		mm	701
	Core height		mm	372
	Core thickness		mm	18
	Minimum radiation capability		Kcal/h	45,000
Coolant temperature sensor	Resistance (at 20°C)		KΩ	3.33 ~ 3.78
	Resistance (at 80°C)		KΩ	0.32 ~ 0.35
Anti-freeze agent	Type		–	ALUTEC-P78
	Mixture ratio (water and anti-freeze)		–	50 : 50

INSPECTION AND REPAIR

INSPECTION

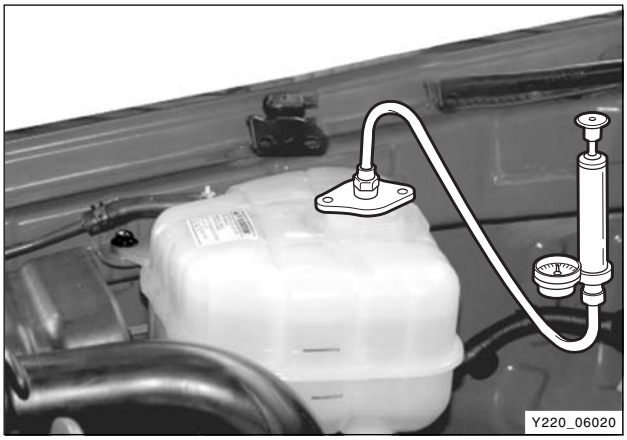
Cooling System

1. Release the pressure from coolant reservoir by loosening one notch of coolant reservoir cap, and then remove the cap.

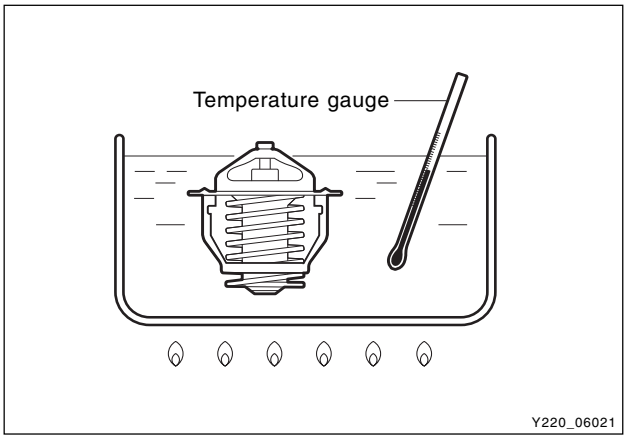
   Notice

   Scalding hot coolant and steam could be blown out under pressure, which could cause serious injury. Never remove the coolant reservoir cap when the before the temperature goes down below 90°C.

2. Add the coolant up to upper mark (arrow) on the reservoir.



3. Install the tester to the coolant reservoir and apply the pressure of 1.4 bar.
4. Check the coolant hoses, pipes and connections for leaks after the pointer of the tester drops. Replace or retighten as required.



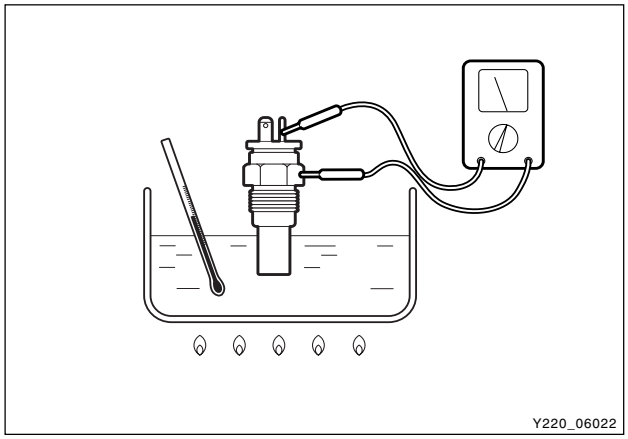
Thermostat

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

Valve opening temperature	DI Engine: 85 ± 2°C

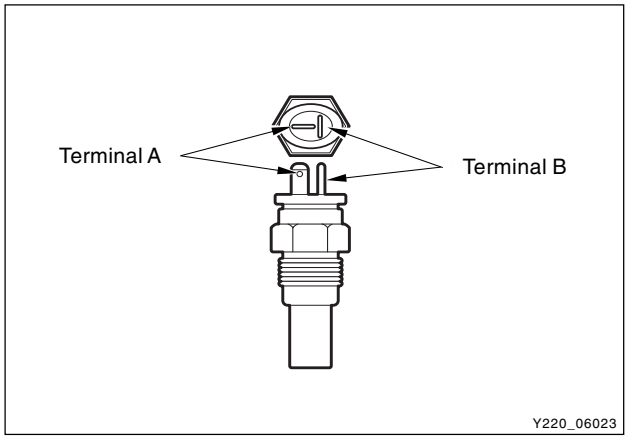
Coolant Temperature Gauge Unit

1. Immerse the senor unit into the water. Heat the water and check the resistance.



2. If the measured resistance is out of specified value, replace the gauge unit.
3. Measure the resistance between terminal A and gauge unit housing, and terminal B and gauge unit housing.

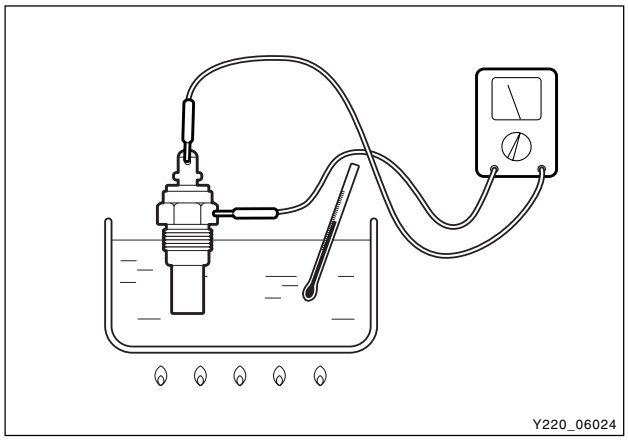
Terminal A (for coolant temp.)	0.4 Ω / 79°C
	23.8 Ω / 115°C
Terminal B (for glow plug)	24.8 Ω / -20°C
	3.25 Ω / 20°C



Thermostat

1. Immerse the thermostat into the oil. Heat the oil until it reaches the specified temperature and check if the coolant temperature switch is turned “OFF”.

Coolant temperature at point A	113 ± 3°C
Coolant temperature at point B	116°C



Notice

Use only engine oil for this inspection. Stir the oil during heating it. Never heat the oil over required temperature.

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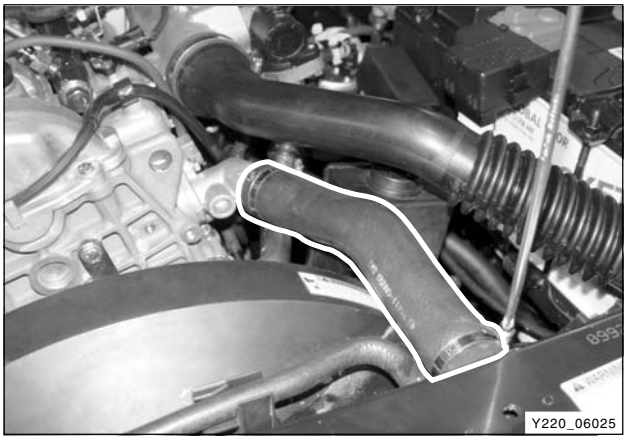
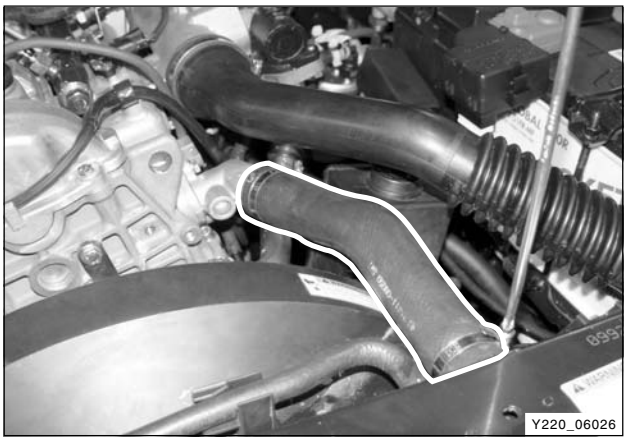
REMOVAL AND INSTALLATION



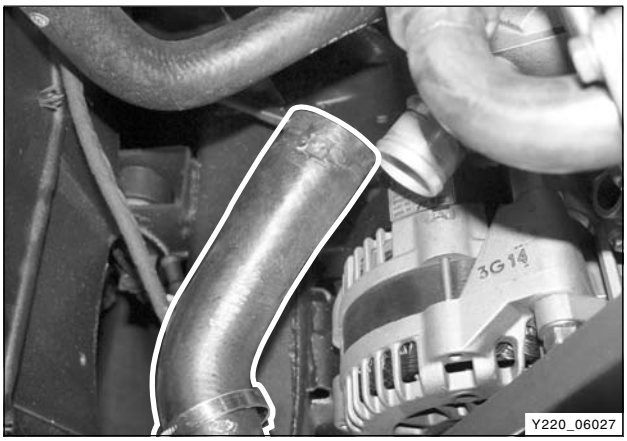
Coolant Hose (Inlet/Outlet)

※ Preceding Work: Draining of coolant

1. Loosen the clamp and remove the coolant outlet hose (engine to radiator).

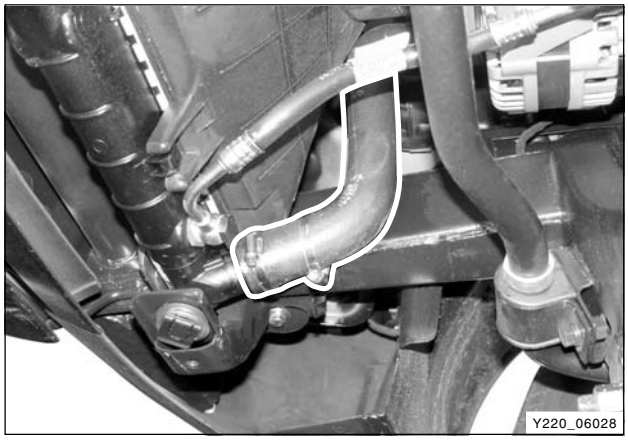


2. Disconnect the HFM sensor connector.
3. Remove the air intake duct from the air cleaner.



4. Loosen the clamp and remove the coolant inlet hose (radiator to thermostat housing).

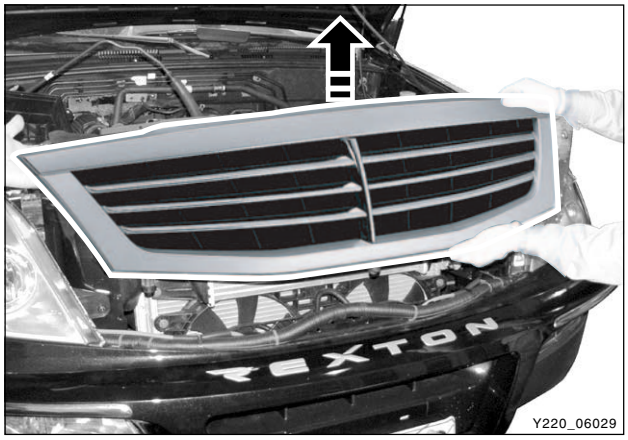
5. Lift up the vehicle and remove the skid plate.
6. Loosen the clamp and remove the lower inlet hose.



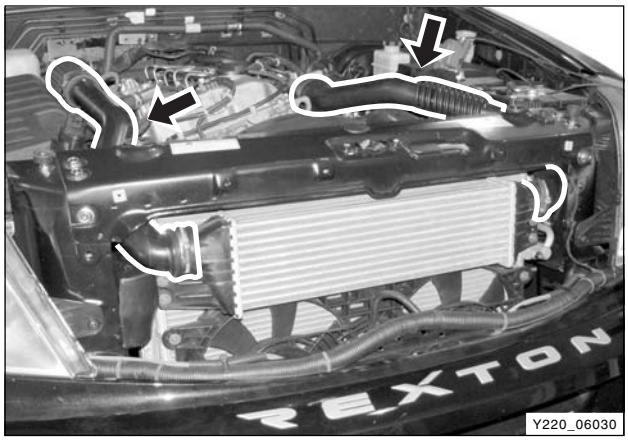
Shroud and Cooling Fan/Clutch

※ Preceding Works:
- Draining of coolant
- Removal of coolant inlet and outlet hose
- Removal of V-belt

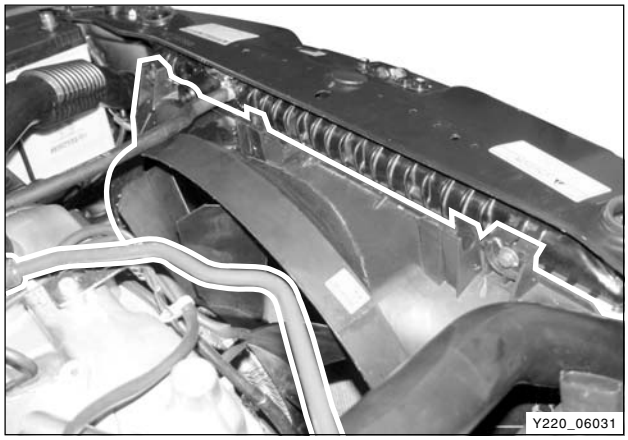
1. Remove the radiator grille.



2. Remove the air intake hoses.
3. Set aside the coolant return pipe.



4. Unscrew the upper bolts and loosen the shroud.



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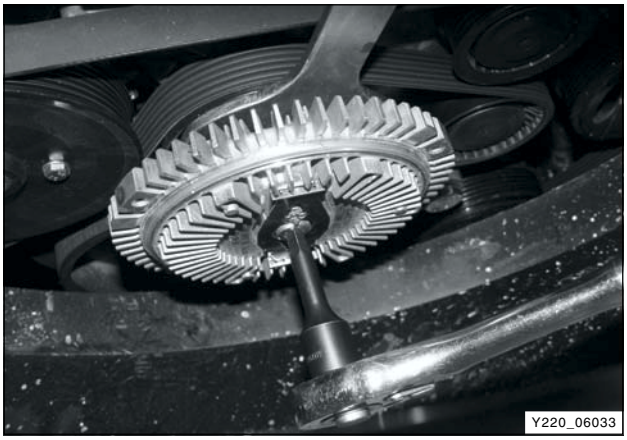
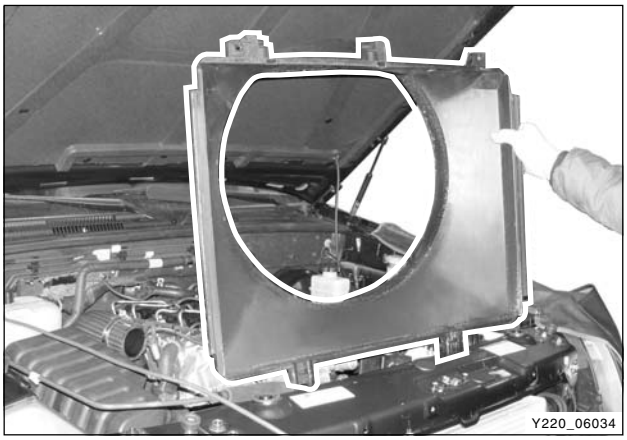


5. Unscrew the center bolt and remove the cooling fan clutch while holding the pulley with counter holder (special tool).

Installation Notice

Tightening torque	45 ± 4.5 Nm

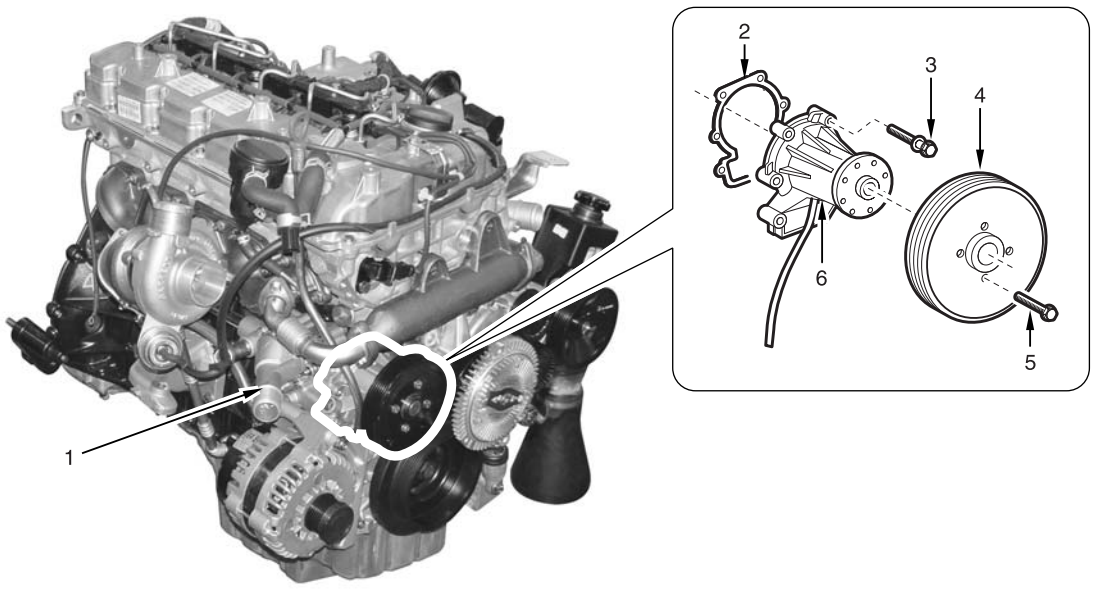


6. Remove the shroud.
7. Install in the reverse order of removal.

Water Pump - Assembly

※ Preceding Works:

- Draining of coolant
- Removal of V-belt
- Removal of shroud
- Removal of cooling fan



1. Thermostat housing
2. Gasket ..... Replace
3. Bolt ..... 10 Nm
4. Belt pulley
5. Bolt ..... 10 Nm
6. Water pump

1. Remove the V-belt while pressing down the auto tensioner adjusting bolt.

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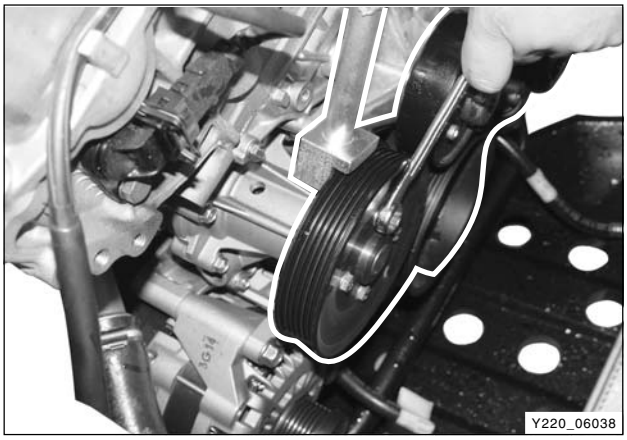
2. Unscrew the bolts and remove the EGR pipe and bracket.

Installation Notice

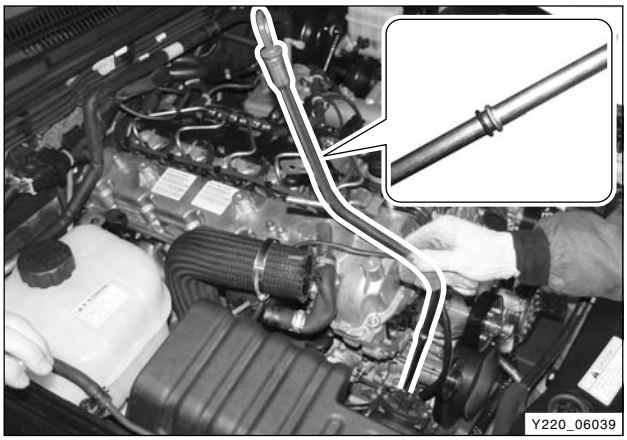
Tightening torque	23 ± 2.3 Nm



3. Unscrew the bolts and remove the belt pulley while holding the belt pulley with a special tool.

Installation Notice

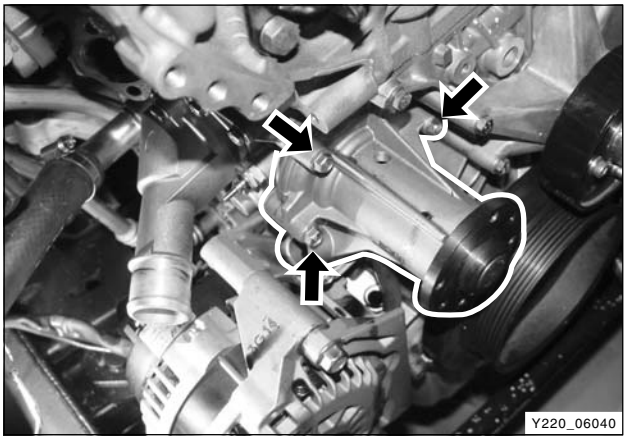
Tightening torque	10 Nm



4. Remove the oil dipstick tube.

Notice

- ***Replace the O-ring in oil dipstick with new one.***
- ***Plug the oil dipstick hole with a cap not to get the foreign materials into the engine.***



5. Unscrew the bolts and remove the water pump assembly.

Installation Notice

Tightening torque	10 Nm

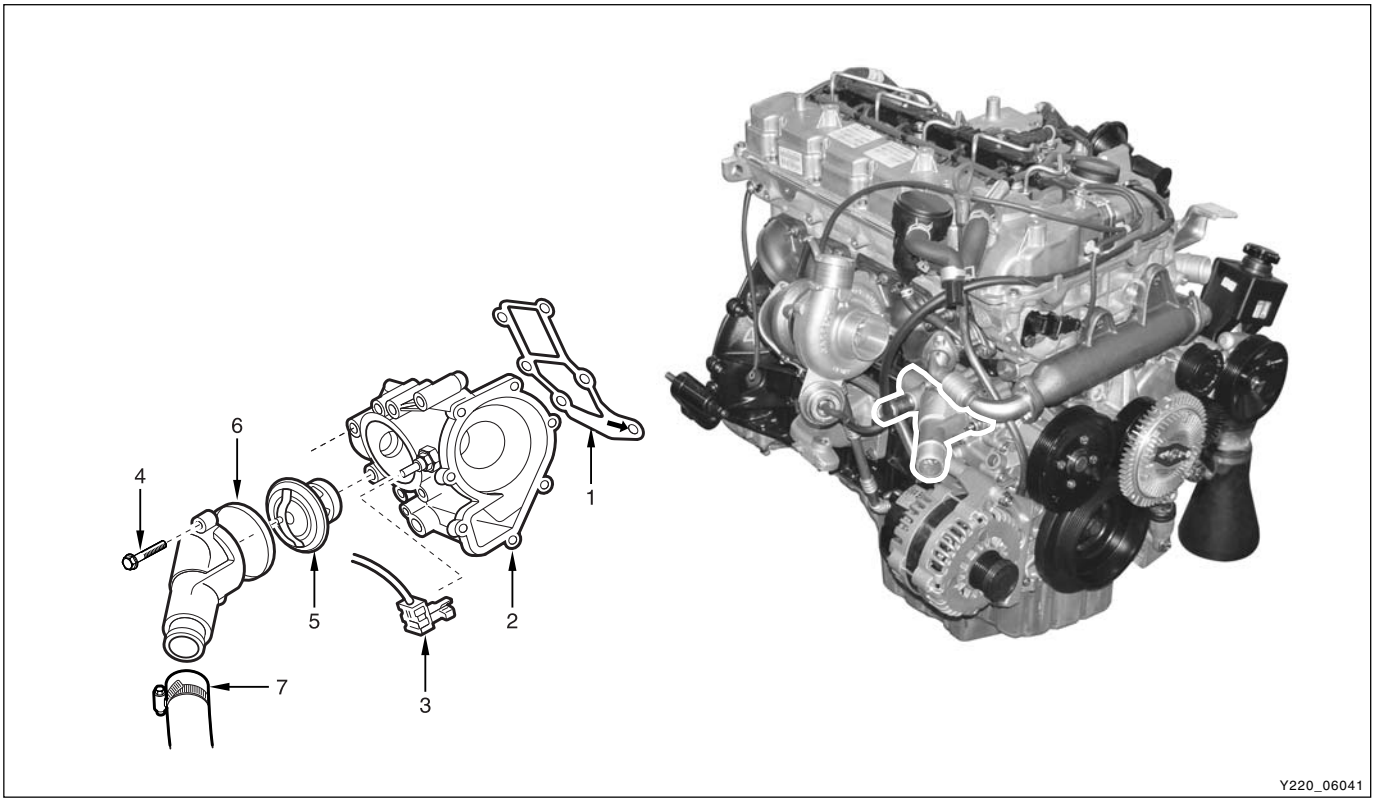
Notice

Remove the gasket residues from the sealing surface and replace the gasket with new one.

6. Install in the reverse order of removal.

Thermostat

* Preceding Works:
  - Draining of coolant
  - Removal of V-belt
  - Removal of cooling fan
  - Removal of intake duct (air cleaner to turbo charger)



1. Gasket ..... Replace
2. Water pump housing
3. Connector
4. Bolt ..... 10 Nm
5. Thermostat
6. Seal
7. Coolant hose

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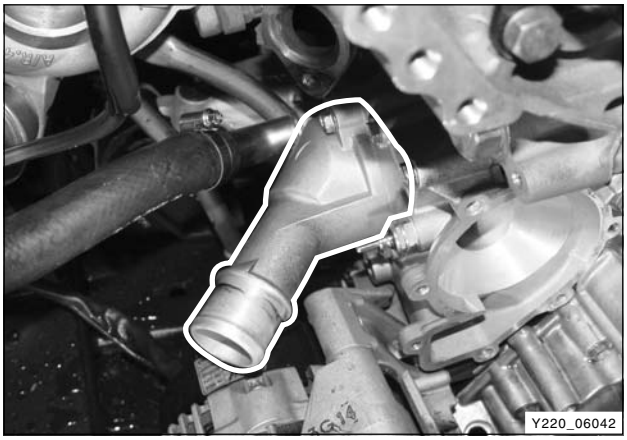
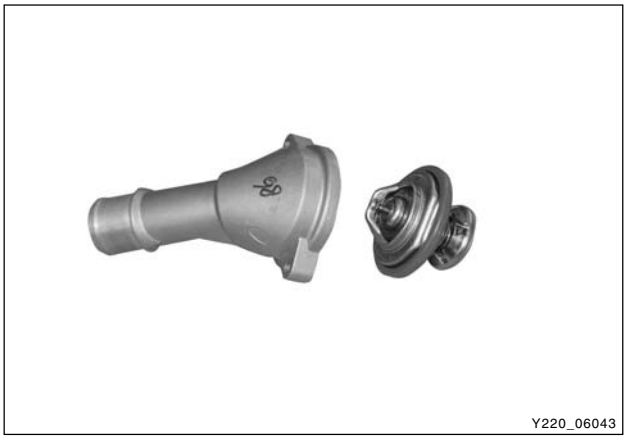


1. Unscrew the bolts and remove the thermostat housing.

Installation Notice

Tightening torque	10 ± 1.0 Nm

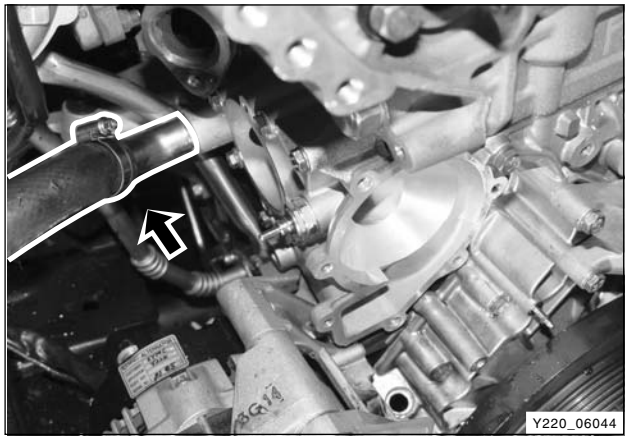


2. Remove the thermostat.
3. Install in the reverse order of removal.

Water Pump Housing

※ Preceding Works:
- Removal of water pump assembly
- Removal of thermostat assembly

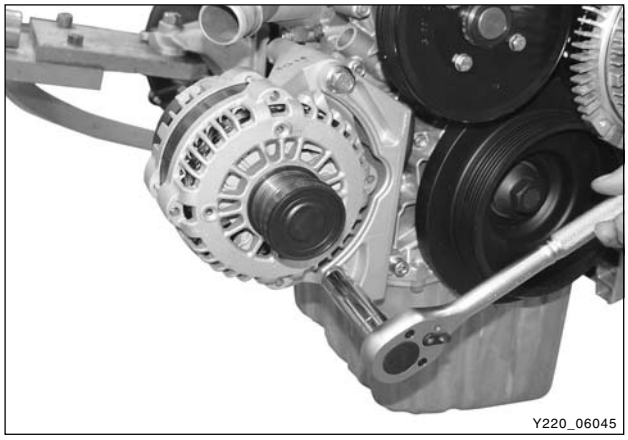
1. Remove the heater hose.



2. Unscrew the bolts and remove the alternator.

Installation Notice

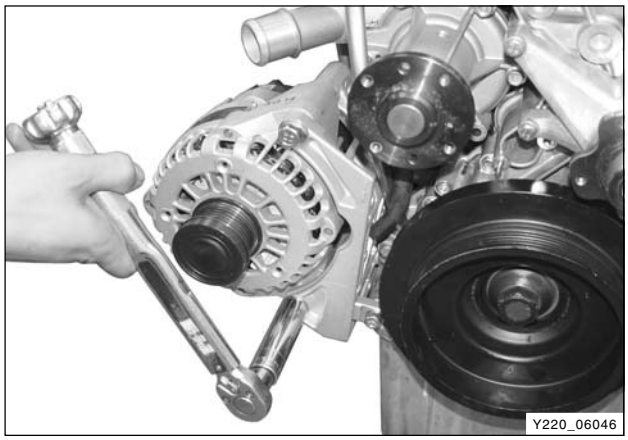
Tightening torque	46 ± 4.6 Nm



3. Unscrew the bolts and remove the alternator bracket.

Installation Notice

Tightening torque	25 ± 2.5 Nm



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

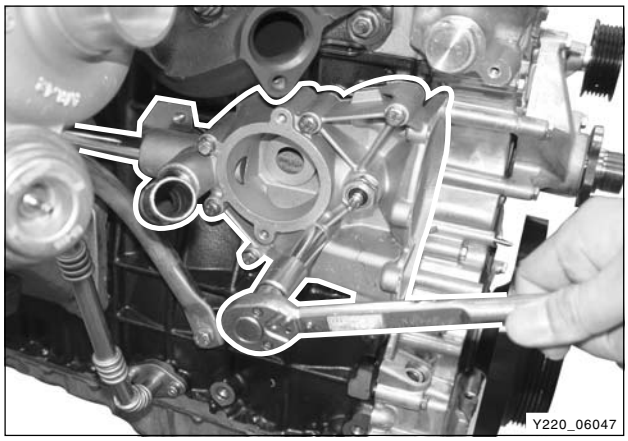
Installation Notice

Tightening torque	10 ± 1.0 Nm

Notice

- ***Be careful not to damage the O-ring in coolant outlet pipe (cylinder head side).***
- ***Remove the gasket residues from the sealing surface and replace the gasket with new one.***

5. Install in the reverse order of removal.



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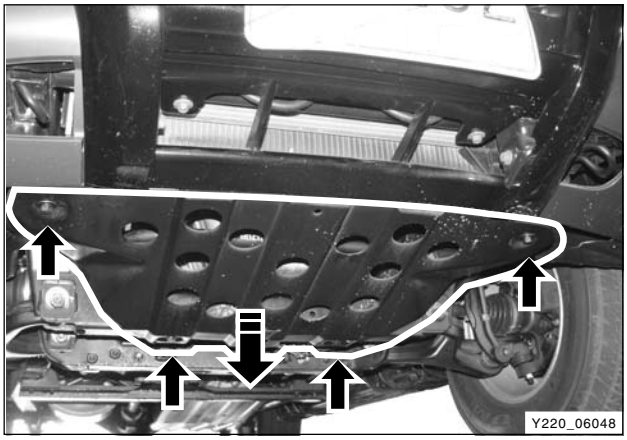
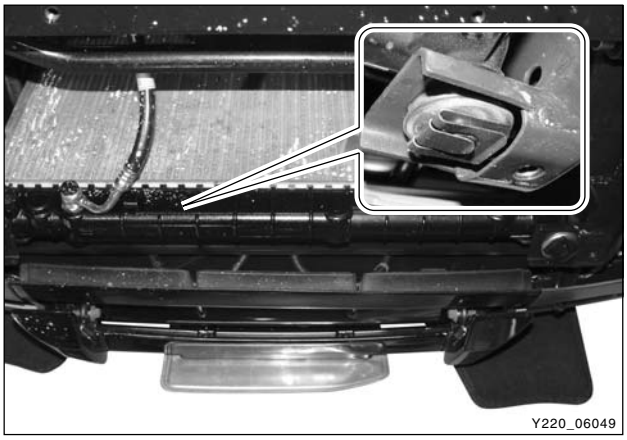


Radiator

※ Preceding Work: Draining of coolant

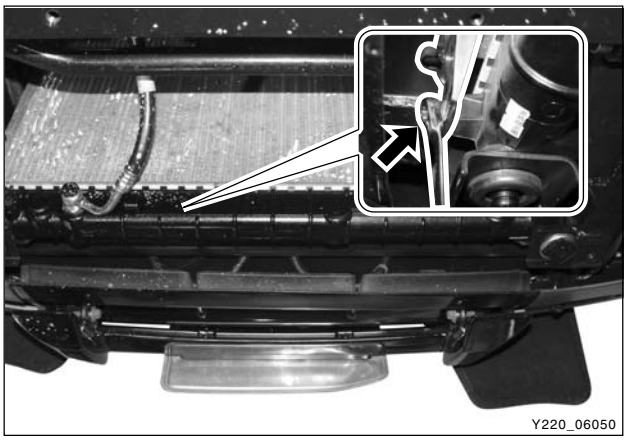
1. Lift up the vehicle and remove the skid plate.



2. Remove the clips and washers from bottom of radiator at both sides.

Notice

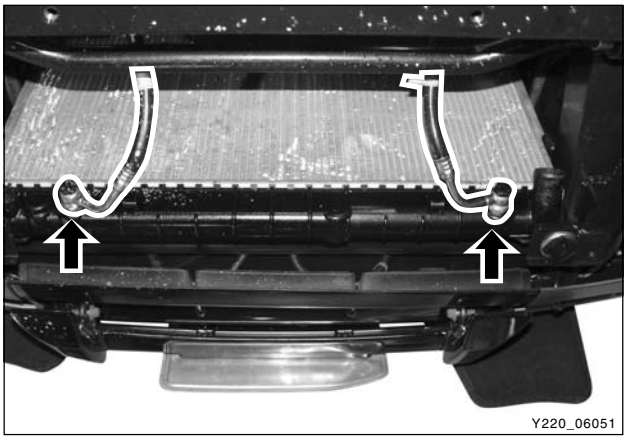
Be careful not to damage the rubber bushing.



3. Unscrew the bracket mounting bolts under the radiator condenser.

Installation Notice

Tightening torque	10 ± 1.0 Nm

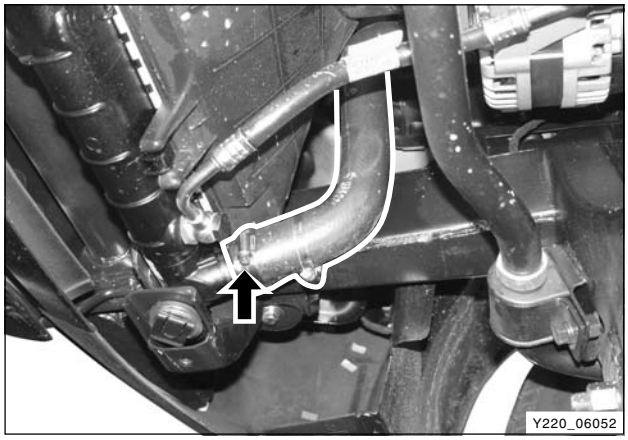


4. Disconnect the oil inlet and outlet hoses from bottom of radiator.

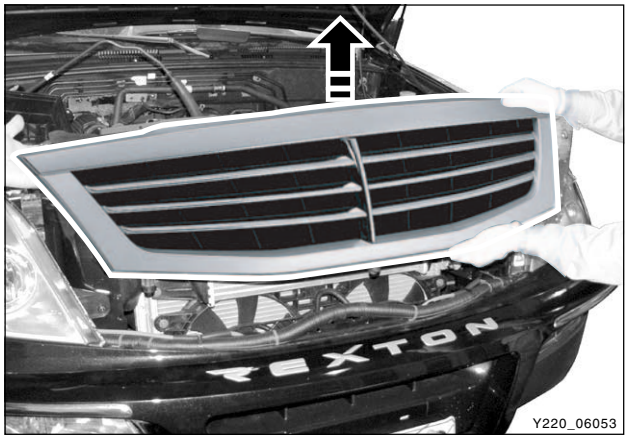
Notice

- ***Plug the radiator oil holes with caps.***
- ***Replace the hose washers with new ones.***

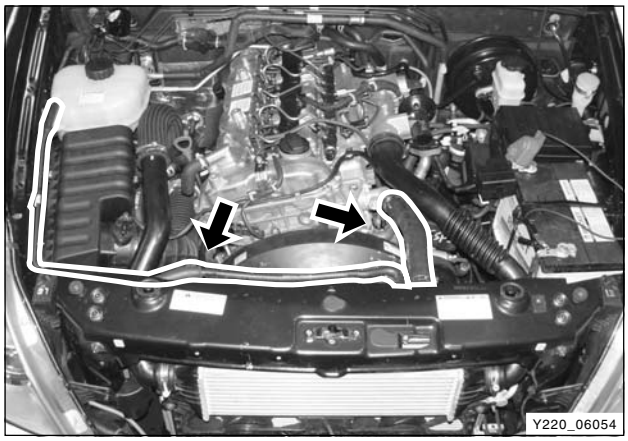
5. Remove the coolant outlet hose.



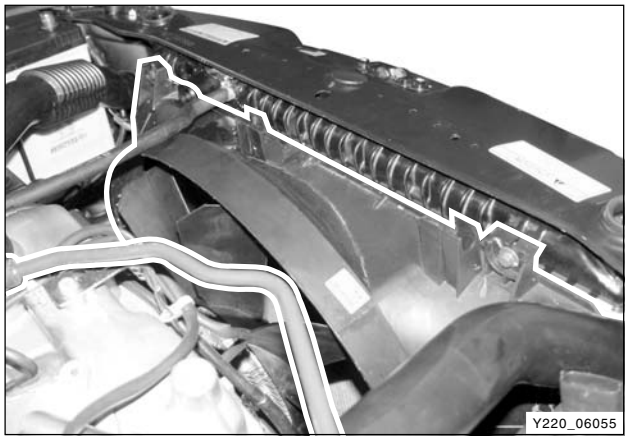
6. Remove the radiator grille.



7. Remove the coolant inlet hose and the cooler inlet hose.
8. Remove the coolant return hose.



9. Unscrew the bolts and remove the shroud.



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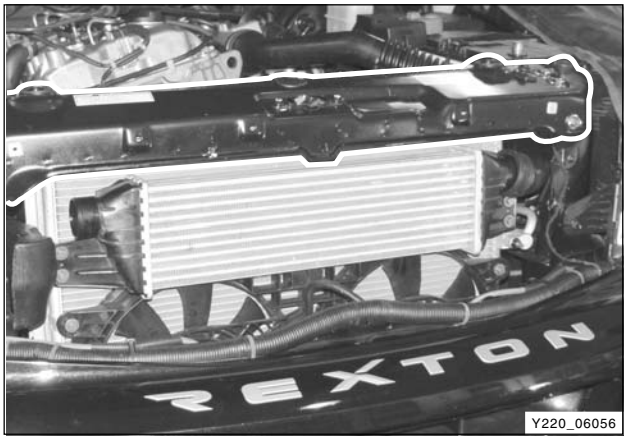
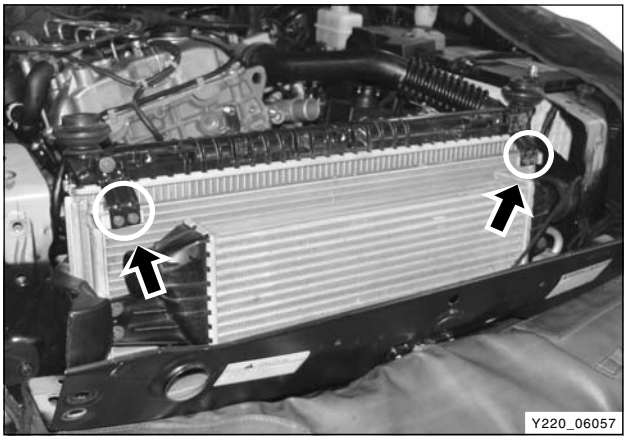


10. Unscrew the bolts and remove the radiator upper plate.

Installation Notice

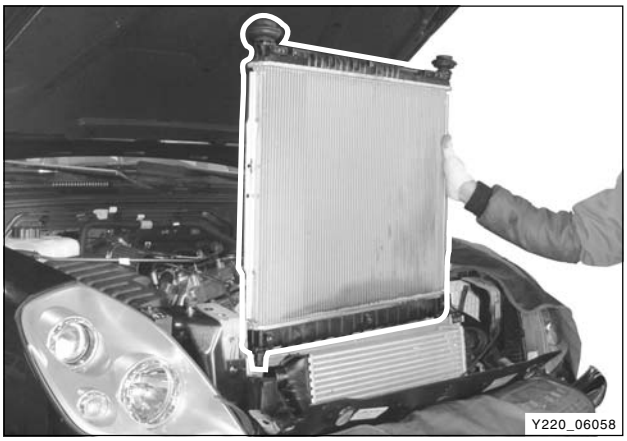
Tightening torque	10 ± 1.0 Nm



11. Unscrew the bracket mounting bolts on the radiator condenser.

Installation Notice

Tightening torque	10 ± 1.0 Nm

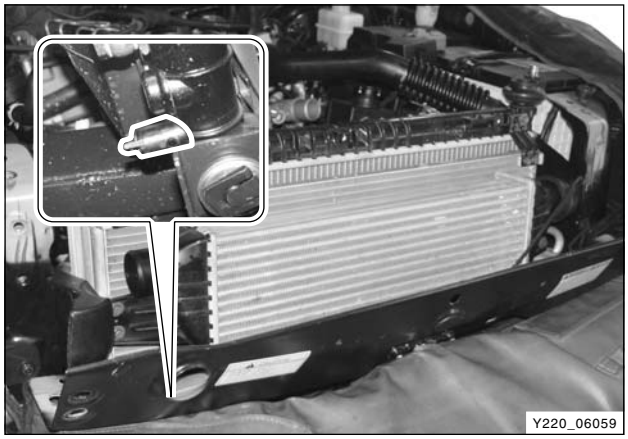


12. Remove the radiator by pulling it up carefully.

13. Install in the reverse order of removal.

Coolant Reservoir

1. Drain the coolant.
2. Remove the hoses.



3. Unscrew the bolts and remove the coolant reservoir.

Installation Notice

Tightening torque	7 Nm

4. Install in the reverse order of removal.

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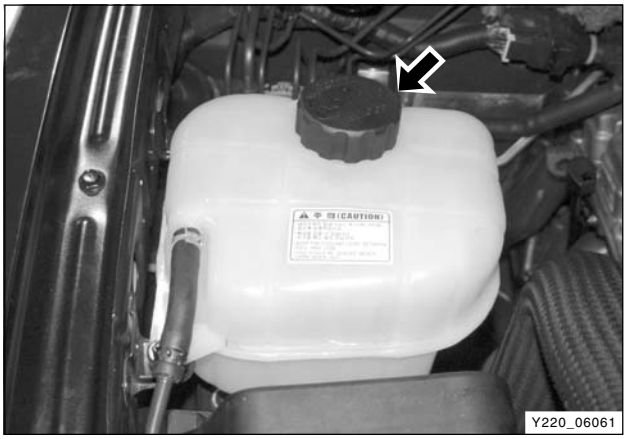
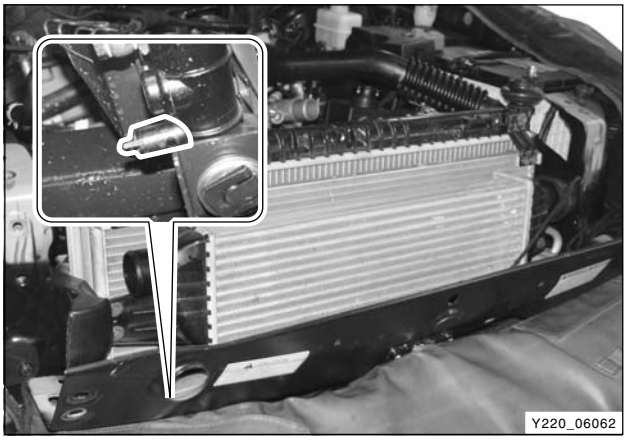
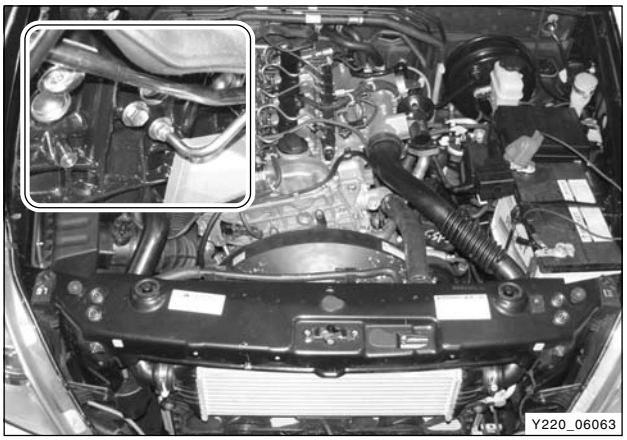






Draining and Adding of Coolant

1. Release the pressure from coolant reservoir by loosening one notch of coolant reservoir cap, and then remove the cap.

   Notice

   Scalding hot coolant and steam could be blown out under pressure, which could cause serious injury. Never remove the coolant reservoir cap when the before the temperature goes down below 90°C.

2. Loosen the drain plug in bottom of radiator and drain the coolant.

   Notice

   Collect the drained coolant with a proper container.

3. Remove the drain plug (1) and seal (2) in the cylinder block and drain the coolant.
4. Replace the seal with new one and install the drain plug.

   Installation Notice

Tightening torque	30 Nm

5. Install the drain plug in bottom of radiator.
6. Add the coolant through the coolant reservoir.

   Notice

   - ***Keep the coolant mixture ratio of 50:50 (water : anti-freezer).***
   - ***Add the coolant until the water flows out through the overflow hose.***

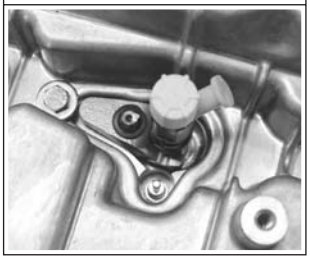
7. Warm up the engine until the thermostat begins to open and check if the coolant level is at “FULL” mark on the reservoir. Add if necessary.

PREHEATING SYSTEM

ECU

Glow indicator (meter cluster)

Glow plug



Preheating relay

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OVERVIEW

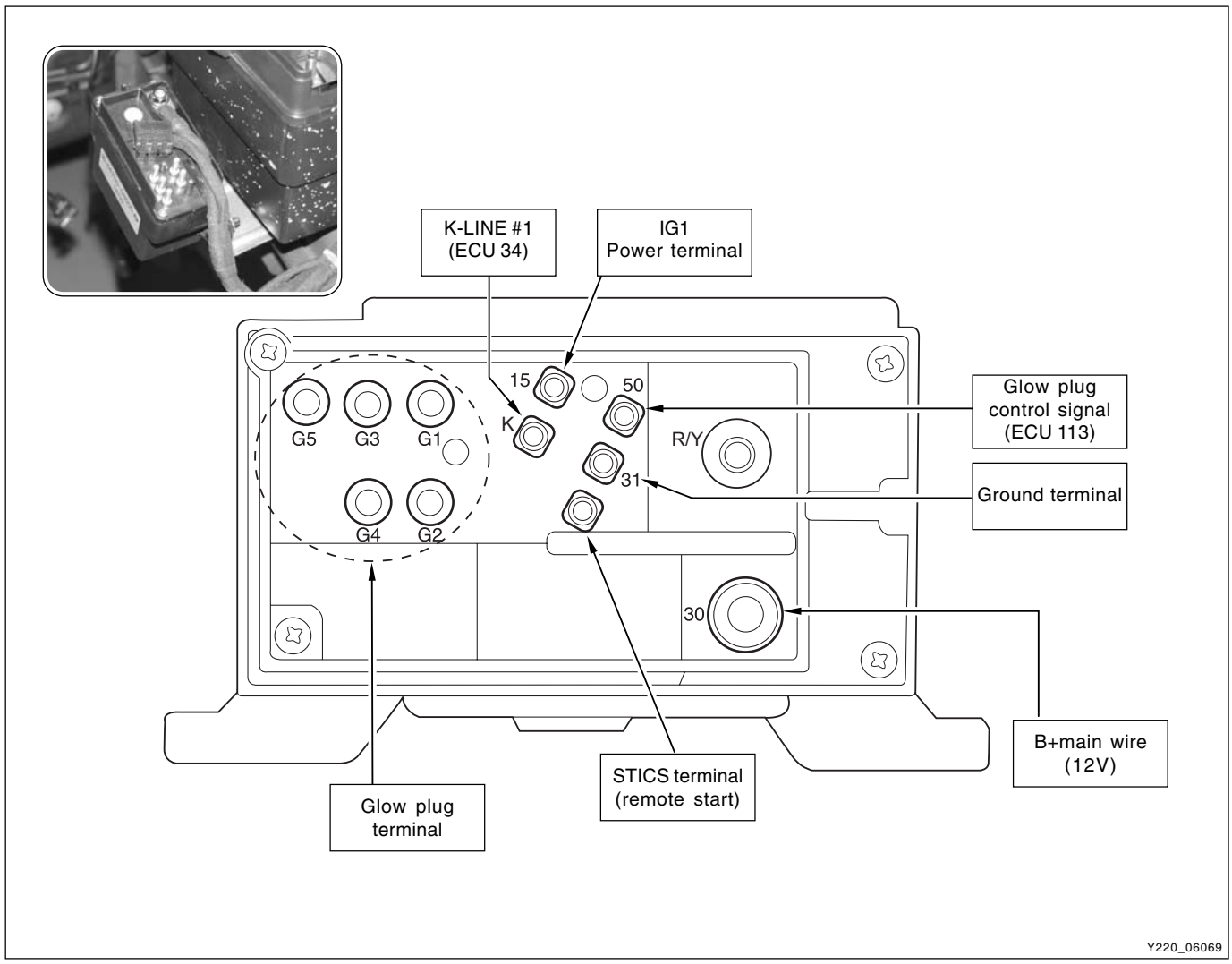
Glow plug is installed on the cylinder head (combustion chamber) in the D27DT preheating control unit system. Cold starting performance has improved and exhaust gas during cold starting has reduced.

ECU receives coolant temperature and engine speed to control; after monitoring the engine preheating/after heating and glow plug diagnosis function, the fault contents will be delivered to ECU.

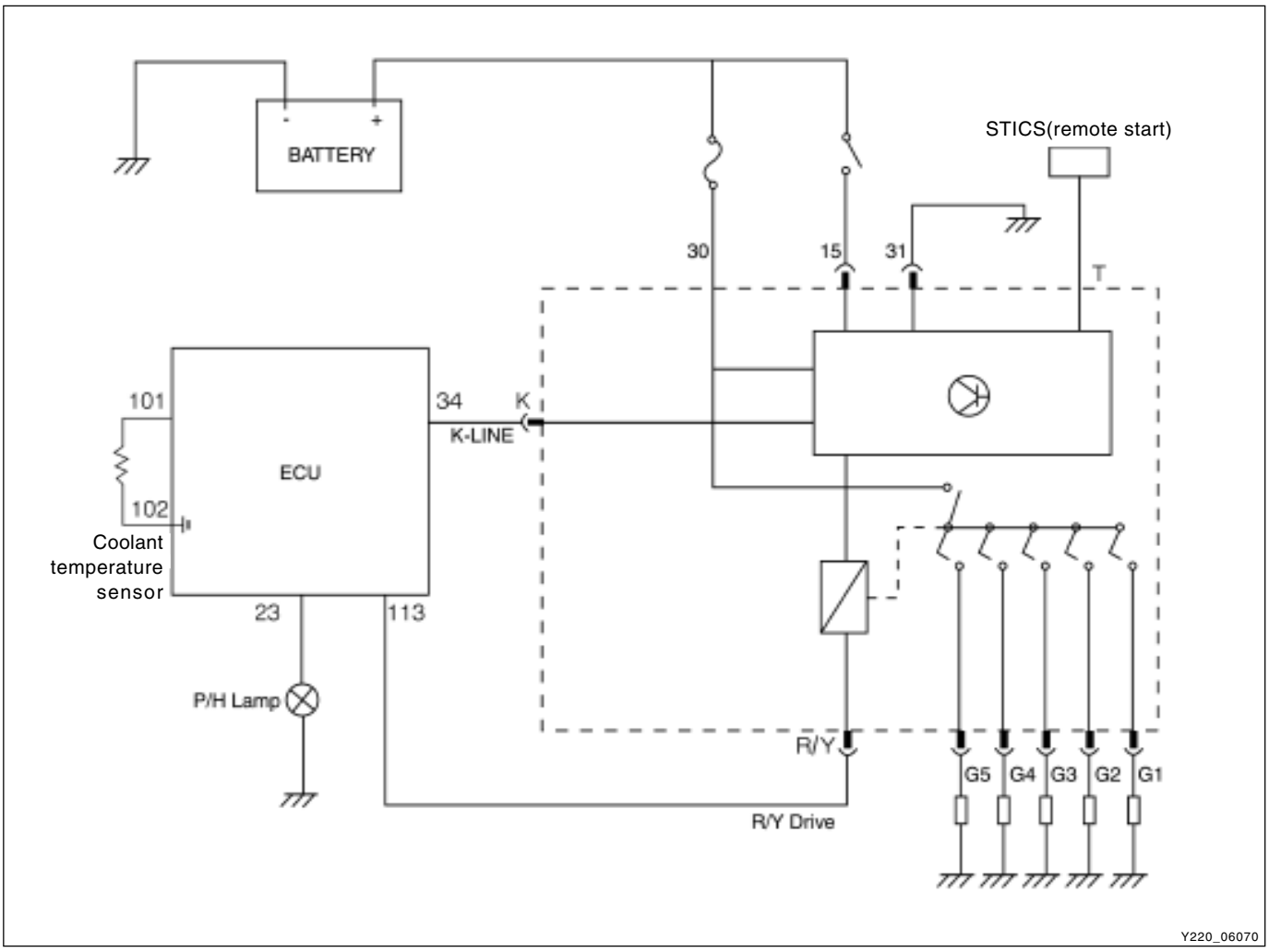
- Engine preheating/after heating functions
- Preheating relay activation by ECU controls
  - Senses engine temperature and controls the preheating/after heating time
  - Glow indicator
- K-LINE for information exchanges between preheating unit and ECU
  - Transmits preheating unit self-diagnosis results to ECU
  - Transmits glow plug diagnosis results and operating status to ECU

PREHEATING RELAY

▶ Structure



PREHEATING SYSTEM DIAGRAM



▶ Specifications

Description	Specification
Rated voltage	DC 12 V
Operating voltage range	DC 8 ~ 15 V
Operating range	- 40 ~ + 100°C
Relay operating voltage	Over 6.5 V
Relay releasing voltage	Over 1.5 V
Relay coil resistance	11.3 Ω
Voltage drop	Below 150 mV at each glow plug (at 16A of current)
Parasitic current	MAX 1mA

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▶ Function

Preheating system controls and checks following functions and operating conditions.

Pre-Heating

- The power will be supplied to the glow plugs by ECU controls when the power is supplied to the IG terminal from the battery and there are normal communications with ECU within 2 seconds. The surface of glow plug will be heated up to 850°C very quickly to aid combustion by vaporizing air-fuel mixture during compression stroke.
- Preheating time is controlled by ECU.

After-heating

- When the engine is started, after-heating starts by ECU controls. The idle rpm will be increased to reduce toxic smoke, pollutants and noises.
- After-heating time is controlled by ECU.

Checking glow plugs

- Check each glow plug for short in circuit
- Check each glow plug for open in circuit due to overvoltage
- Check glow plug for short to ground

Forceful relay shut-down

- When glow plug is shorted to ground

K-Line communication

- ECU sends the results to preheating time control relay through K-Line to start communication.
- Preheating time control relay sends messages including self-diagnosis data for glow plugs to ECU.
- Glow plug makes communication only as response to demand.
- When power is supplied, ECU starts self-diagnosis within 2 seconds.
- Under the following conditions, communication error occurs.
  - When there is no response from glow plug module within 2 seconds
  - When an error is detected in checksum
  - Less byte is received

Error code of “P1720 - Pre heating control communication fail” will be reported.

Operating time

<table>
<tr><td rowspan="3">Pre-heating</td><td>Coolant Temp.</td><td>-35 °C</td><td>-25 °C</td><td>-20 °C</td><td>-10 °C</td><td>0 °C</td><td>10 °C</td><td>20 °C</td></tr>
<tr><td>Operating Time</td><td>31 sec</td><td>22 sec</td><td>19 sec</td><td>17 sec</td><td>14 sec</td><td>0 sec</td><td>0 sec</td></tr>
<tr><td>Operating Conditions</td><td colspan="3">• IG: “ON”
• B+ : below 15.2V</td><td>Release Conditions</td><td colspan="3">• After operating time elapsed
• IG: “OFF” • When engine cranking</td></tr>
<tr><td rowspan="3">After-heating</td><td>Coolant Temp.</td><td>-30 °C</td><td>-20 °C</td><td>-10 °C</td><td>0 °C</td><td>10 °C</td><td>20 °C</td><td>35 °C</td></tr>
<tr><td>Operating Time</td><td>115 sec</td><td>80 sec</td><td>30 sec</td><td>19 sec</td><td>11 sec</td><td>11 sec</td><td>0 sec</td></tr>
<tr><td>Operating Conditions</td><td colspan="3">• After engine starting</td><td>Release Conditions</td><td colspan="3">• After operating time elapsed
• Torque : 190/170 Nm
• Speed: 2100/2050 rpm</td></tr>
<tr><td rowspan="3">Glow Indicator</td><td>Coolant Temp.</td><td>-30 °C</td><td>-25 °C</td><td>-20 °C</td><td>-10 °C</td><td>0 °C</td><td>10 °C</td><td>20 °C</td></tr>
<tr><td>Operating Time</td><td>18 sec</td><td>16 sec</td><td>10 sec</td><td>5 sec</td><td>2 sec</td><td>0 sec</td><td>0 sec</td></tr>
<tr><td>Operating Conditions</td><td colspan="3">• IG: “ON”</td><td>Release Conditions</td><td colspan="3">• When engine cranking</td></tr>
</table>

SECTION DI07

FUEL SYSTEM

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CAUTIONS FOR DI ENGINE

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

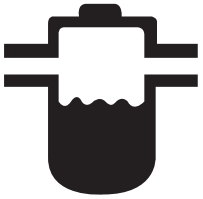
▶ DI Engine

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

▶ System Safety Mode

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

▶ Water Separator Warning Light



When the water level inside water separator in fuel filter exceeds a certain level (approx. 39 cc), this warning light comes on and buzzer sounds.

Also, the driving force of the vehicle decreases (torque reduction). If these conditions occur, immediately drain the water from fuel filter.

For the draining procedures, please refer to “How to drain the water from fuel filter” section.

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▶ Priming Pump

The priming pump installed in fuel pump is the device to fill the fuel into the fuel filter. When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

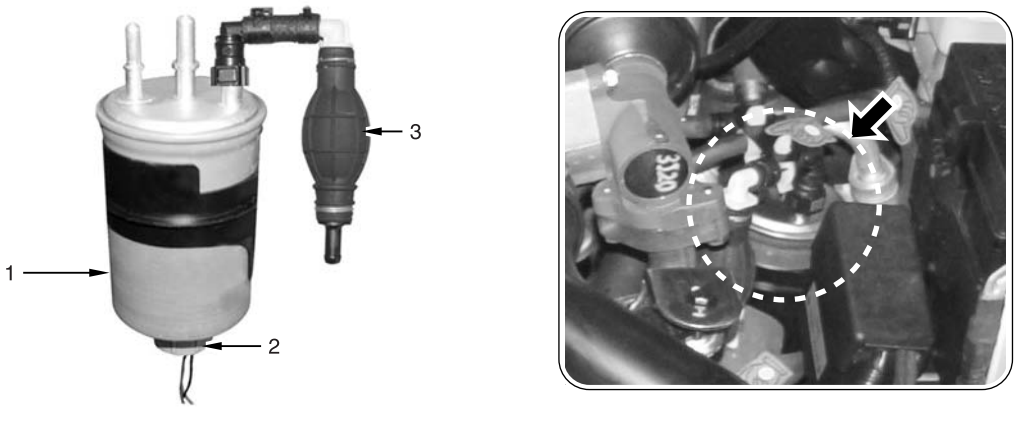
WARNING

Never reverse filter or use it in other place (clean side)

▶ Conditions for using Priming Pump

1. **After run out of fuel**
2. **After draining the water from fuel separator**
3. **After replacing filter or any intervention on system**

▶ Fuel Filter and Water Separator



Y220_07003

1. Fuel filter
3. Priming pump

2. Water drain plug
   (to be drained every 15,000km max.)
   Draining could be done at same time than oil change

Notice

- ***When replaced the fuel filter or drained the water from fuel filter, press the priming pump until it becomes rigid before starting the engine.***
- ***The water drain from fuel filter should be performed whenever changing the engine oil.***

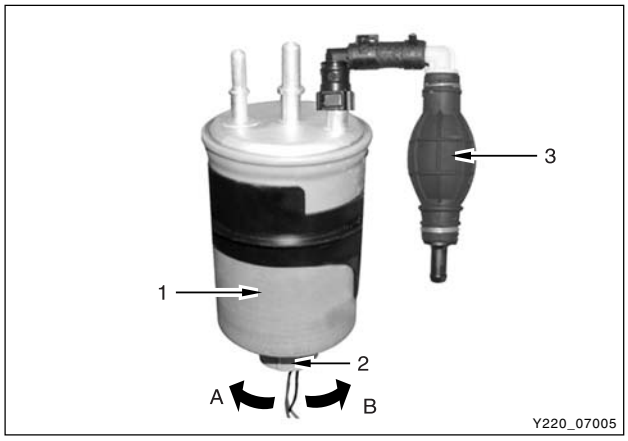
▶ Draining the Water From Fuel Filter

1. Place the water container under the fuel filter.

2. Turn the drain plug (2) to “A” direction to drain the water.
3. Press priming pump until all water is drained, then turn the drain plug to “B” direction to tighten it.

Notice

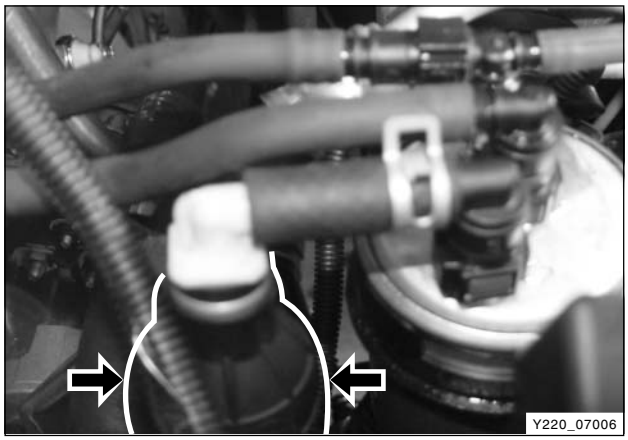
Be careful not to be injured by surrounding equipment during the working procedures.



4. Press the priming pump until it becomes rigid.
5. Start the engine and check the conditions.
6. Clear the fault code of ECU with scan 100.

WARNING

If the priming pump is not properly operated, air may get into the fuel line. It may cause starting problem or fuel system problem. Make sure to perform the job in step 4.



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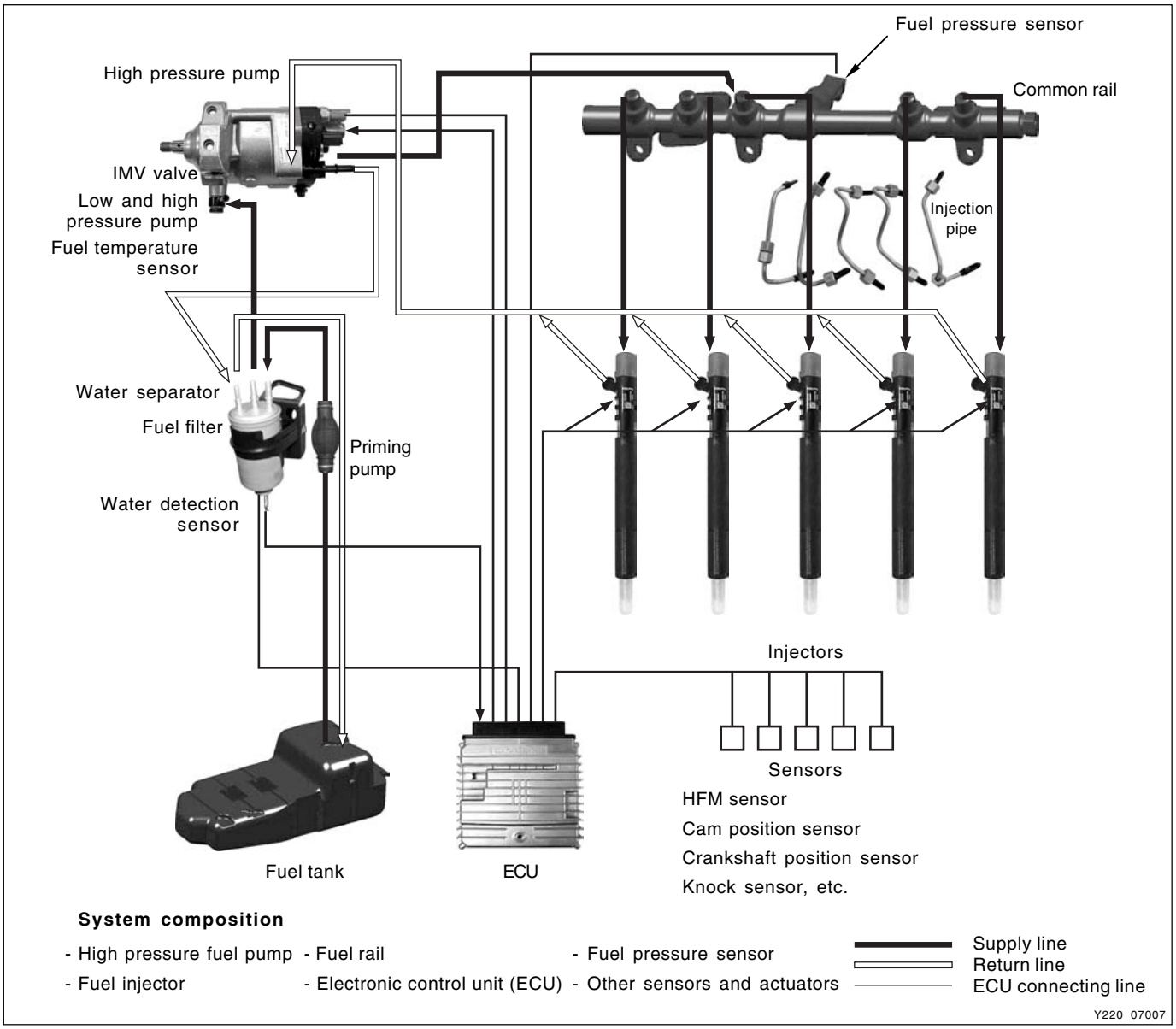
FUEL SYSTEM

FUEL INJECTION SYSTEM

▶ Electronic Control of Fuel System

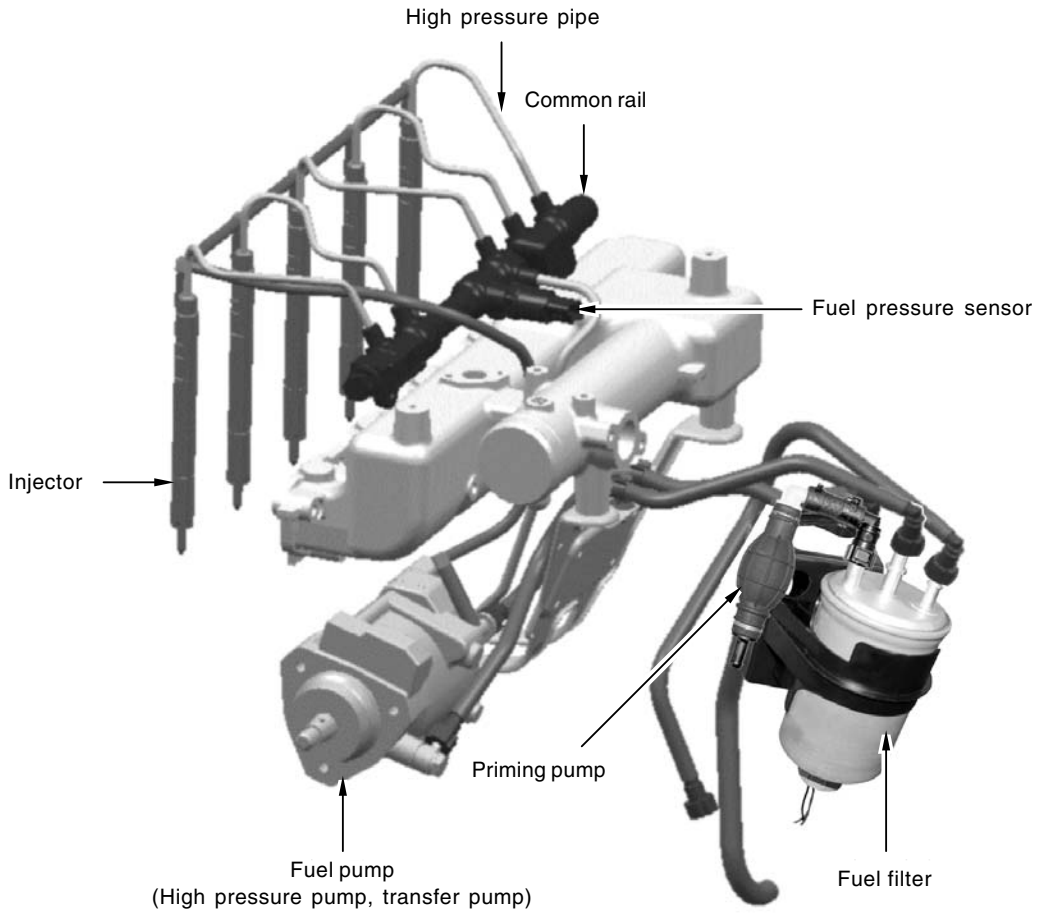


According to input signals from various sensors, engine ECU calculates driver's demand (position of the accelerator pedal) and then controls overall operating performance of engine and vehicle on that time.

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

▶ Composition of Fuel System

Components in fuel system are designed to generate and distribute high pressure, and they are controlled electronically by engine ECU. Accordingly, fuel system is completely different from injection pump type fuel supply system on the conventional Diesel engine. The fuel injection system in common rail engine is composed of transfer pressure section that transfers fuel in low pressure, high pressure section that transfers fuel in high pressure and ECU control section.



<Fuel line system>

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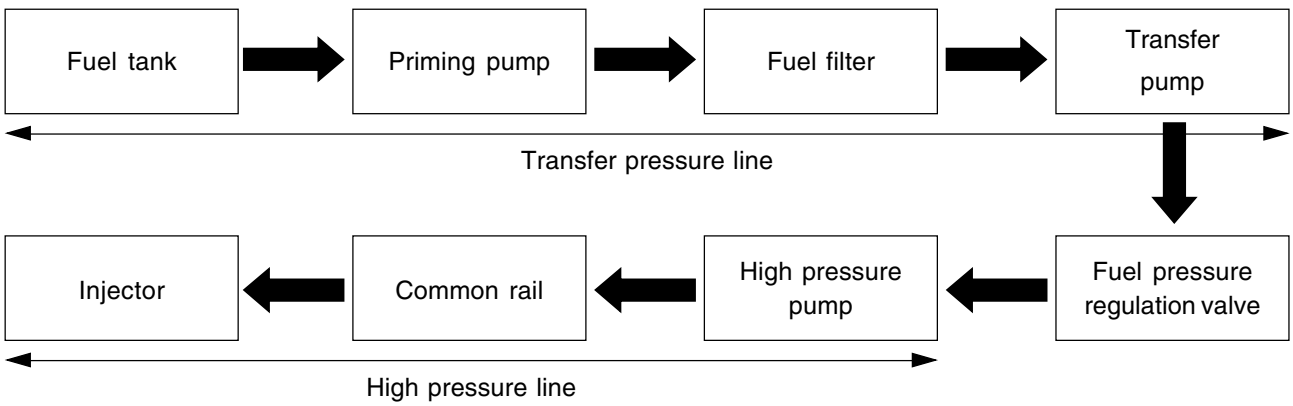
Fuel route



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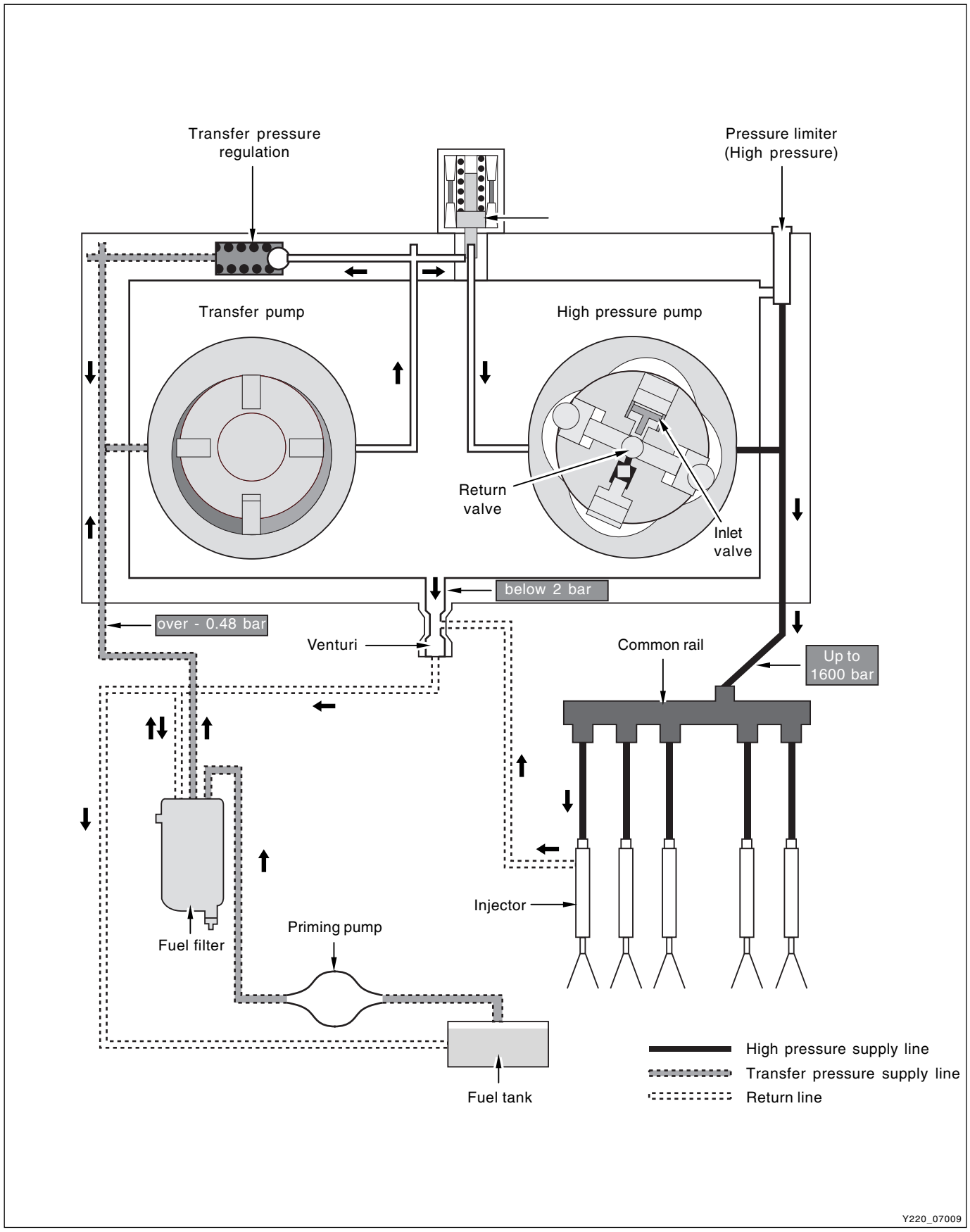
▶ Hydraulic cycle in Fuel Line (Transfer and High Pressure Line)



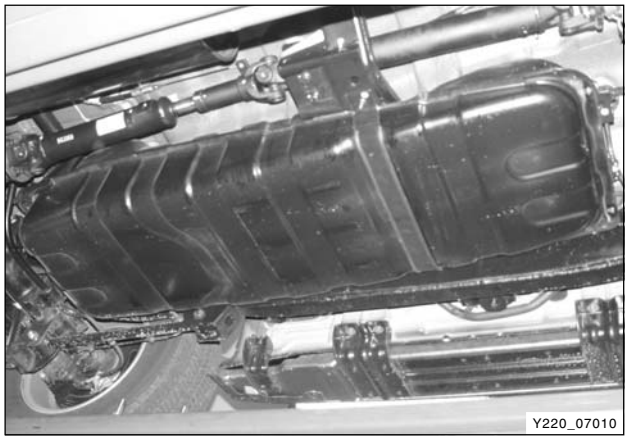
▶ Components of Low Pressure Transfer Line

Low pressure stage is to supply sufficient fuel to high pressure section and components are as below.

- Fuel tank (including strainer)
- Hand priming pump
- Fuel filter
- Transfer pump
- Other low pressure fuel hoses

Fuel tank

Fuel tank is made of anti-corrosion material and its allowable pressure is 2 times of operating pressure (more than 0.3 bar). It has protective cap and safety valve to prevent excessive pressure building. Also, it has structure to prevent fuel from leaking in shocks, slopes and corners and to supply fuel smoothly.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Priming pump

If fuel runs out during driving or air gets into fuel line after fuel filter replacement, it may cause poor engine starting or damage to each component. Therefore, the hand priming pump is installed to bleed air from transfer line.

When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

- After run out of fuel
- After draining the water from fuel filter
- After replacing the fuel filter

Press the priming pump until it becomes rigid before starting the engine.


Y220_07011

Fuel filter

It requires more purified fuel supply than conventional diesel engine. If there are foreign materials in the fuel, fuel system including pump components, delivery valve and injector nozzles may be damaged.

Fuel filter purifies fuel before it reaches to high pressure pump to help proper operations in high pressure pump. And more, it separates water from fuel to prevent water from getting into FIE system (high pressure line).


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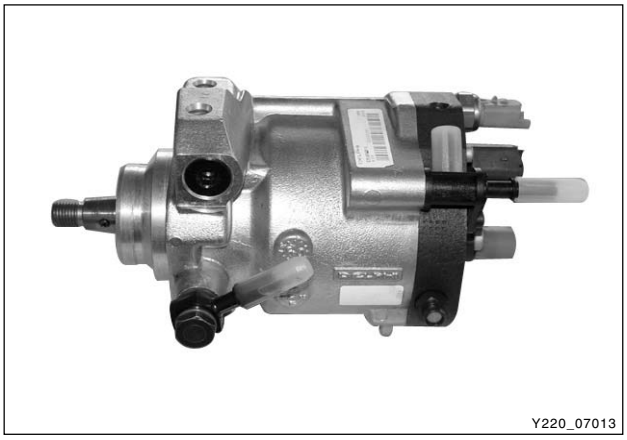
▶ Components of High Pressure Transfer Line

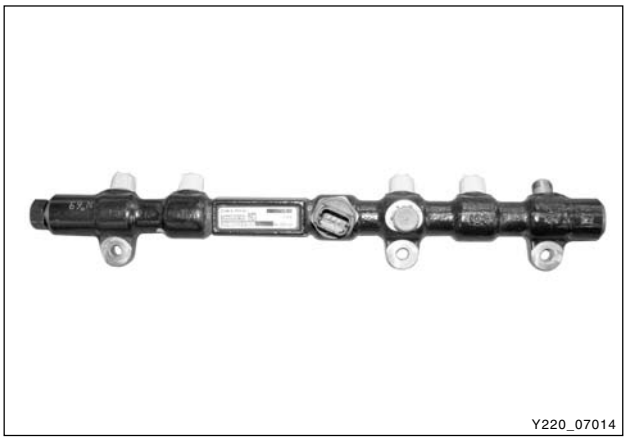
In the high pressure section, sufficient fuel pressure that injectors requires will be generated and stored. The components are as below:

- High pressure pump
- Rail pressure sensor
- Pressure limit valve
- Common rail
- High pressure pipe
- Injector
- Fuel pressure regulating valve (IMV)



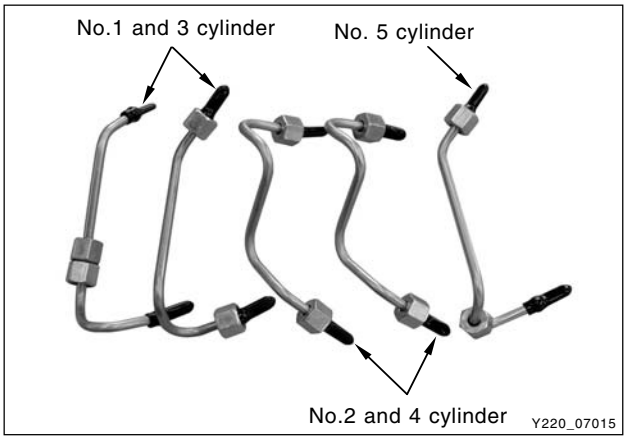
High pressure pump (including IMV and limit valve)

This is plunger pump that generates high pressure; and driven by crankshaft with timing chain. The high pressure pump increases system pressure of fuel to approx. 1,600 bar and this compressed fuel is transferred to high pressure accumulator (common rail) in tube through high pressure line.



Common rail (including pressure sensor)

It stores fuel transferred from high pressure pump and also stores actual high pressure of fuel. Even though the injectors inject fuel from the rail, the fuel pressure in the rail is maintained to a specific value. It is because the effect of accumulator is increased by unique elasticity of fuel. Fuel pressure is measured by rail pressure sensor. And the inlet metering valve (IMV) included in high pressure pump housing keeps pressure to a desired level.



High pressure pipe (fuel pipe)

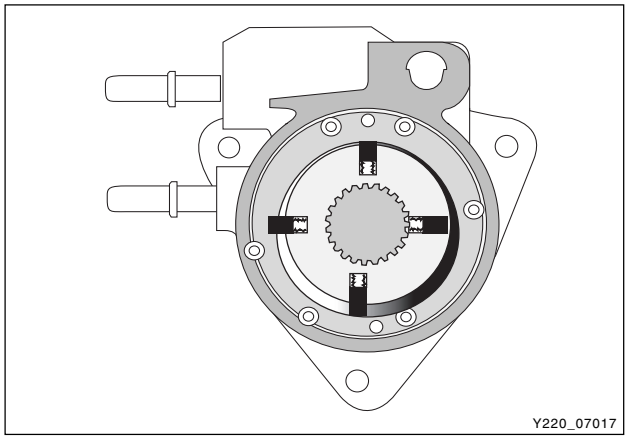
Fuel line transfers high pressure fuel. Accordingly, it is made of steel to endure intermittent high frequency pressure changes that occur under maximum system pressure and injection stops. Injection lines between rail and injectors are all in the same length; it means the lengths between the rail and each injector are the same and the differences in length are compensated by each bending.

Injectors

The fuel injection device is composed of electrical solenoid valve, needle and nozzle and controlled by engine ECU. The injector nozzle opens when solenoid valve is activated to directly inject the fuel into combustion chamber in engine. When injector nozzle is open, remaining fuel after injection returns to fuel tank through return line.

Transfer pump

The transfer pump is included in the housing of the high pressure pump. The transfer pump is the volumetric blade type pump. To deliver the continuously required fuel volume, the pump transfers fuel from the fuel tank to high pressure pump.



Fuel Filter Replacement

* Fuel filter change interval: every 30,000 km
* Water separation interval: every 15,000 km max. (same with engine oil change interval)
* Never reuse the removed fuel filter

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FUEL TRANSFER LINE

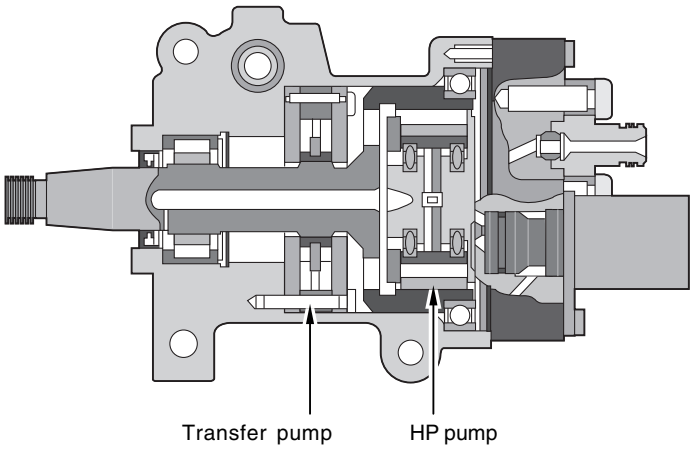
▶ Transfer Pump

Description

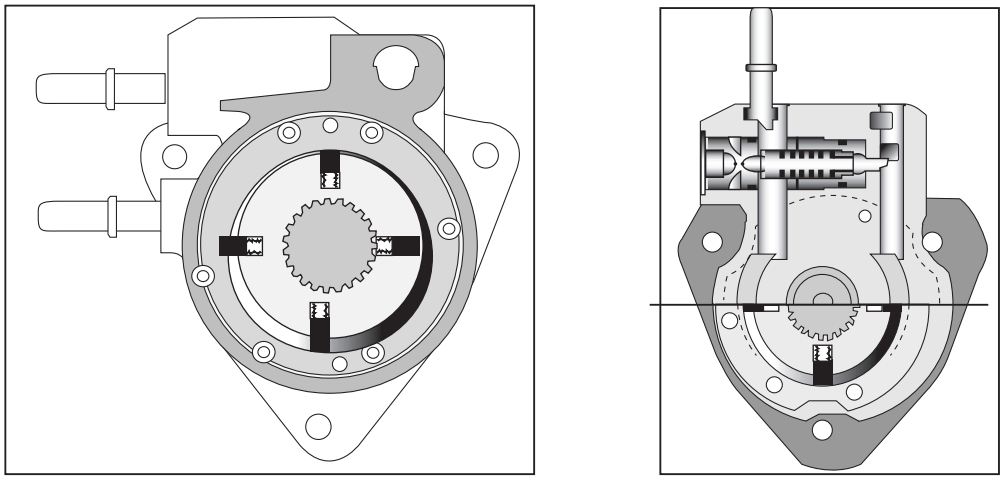
The transfer pump is the device to provide sufficient fuel to high fuel pressure line and is mechanical type feed pump that is driven by timing chain linked to crankshaft. This mechanical type feed pump is subject to air inflow, therefore, a hand priming pump is installed to fill fuel in Low fuel pressure(LP) circuit.

The transfer pump is included in the housing of the HP pump. The transfer pump is the volumetric blade type pump and consists of the following components:

- A rotor turned by the shaft of the HP pump. The connection is provided by splines.
- An eccentric liner fixed to the housing of the HP pump by 6 Torx bolts. The liner is positioned by two off-set pins in order to prevent any assembly errors.
- Four blades set at 90°. Each blade is held against the liner by a coil spring.
- The inlet and outlet orifice.



<Sectional view of fuel pump>



<Sectional view of transfer pump>

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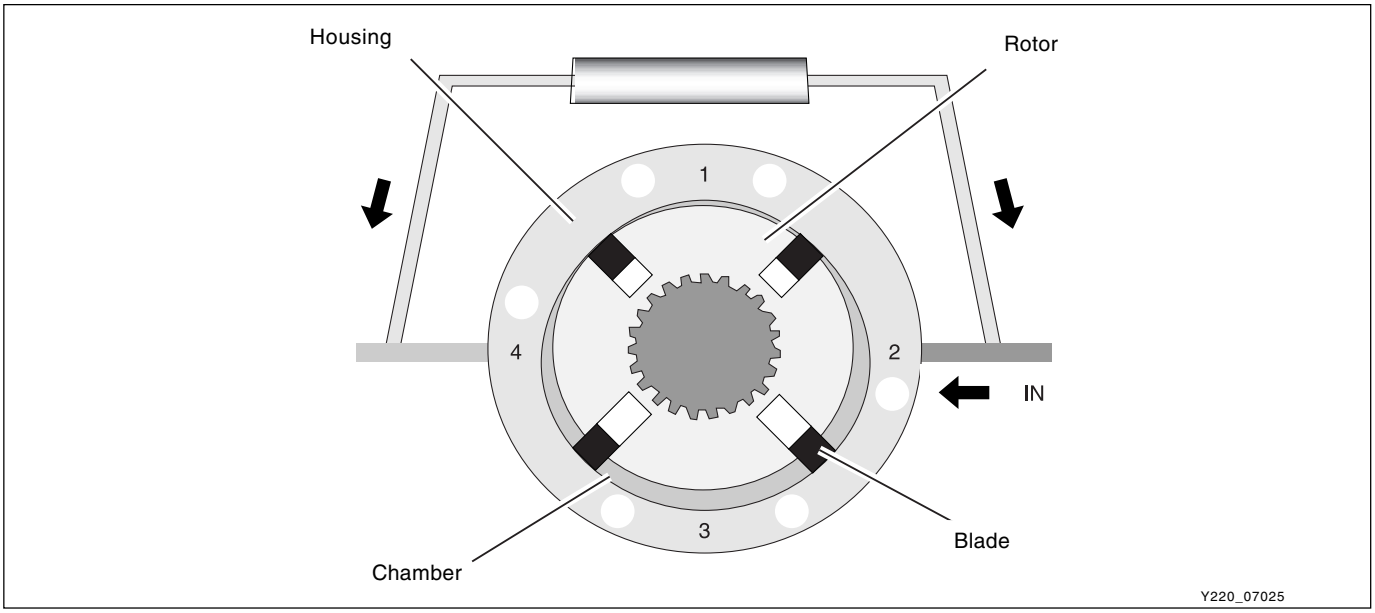
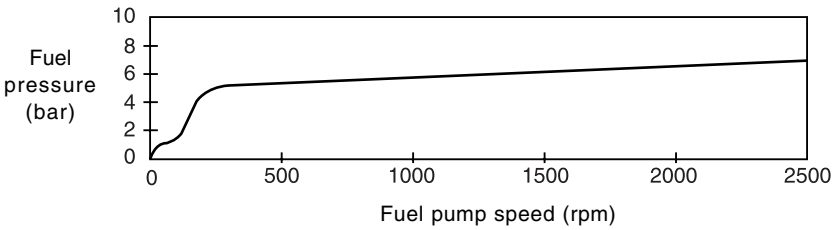
Principle of operation



Consider the chamber between the rotor, the liner and two successive blades (refer to above figure).

- When the chamber is in position 1, the volume of the chamber is minimal. The changes in volume according to the angle of rotation of the rotor are small.
- The rotor makes a quarter turn clockwise. The previous chamber is now in position 2.

  The inlet orifice is uncovered. The volume contained in the chamber quickly rises. The pressure inside the chamber drops sharply. Fuel is drawn into the chamber.
- The rotor continues to rotate. It is now in position 3. The inlet and outlet orifices are now sealed off. The volume area controlled by the rotor, the liner and the two blades is at the maximum. The changes in volume according to the angle of rotation of the rotor are small.
- The rotor continues to rotate. It is finally in position 4. The outlet orifice is uncovered. The volume area controlled by the rotor, the liner and the blades decreases quickly. The pressure inside the chamber rises sharply. The fuel is expelled under pressure. The depression caused by the transfer pump's rotation is sufficient to draw in diesel fuel through the filter. The transfer pump is driven by the shaft of the HP pump, transfer pressure thus rises with engine speed. A regulating valve allows the transfer pressure to be maintained at a practically constant level (about 6 bar) throughout the whole range of engine operations by returning some of the fuel to the pump inlet.



Characteristics of the transfer pump

Regulating pressure	6 bar
Volume controlled	5.6 cm^3/revolution
Flow	90 ℓ/h at 300 rpm pump
	650 ℓ/h at 2,500 rpm pump
Intake capacity	65 mbar at 100 rpm pump

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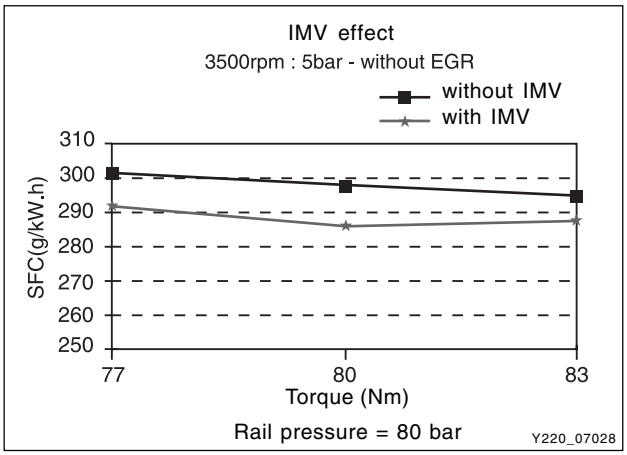
INLET METERING VALVE (IMV)


Y220_07027

▶ Overview

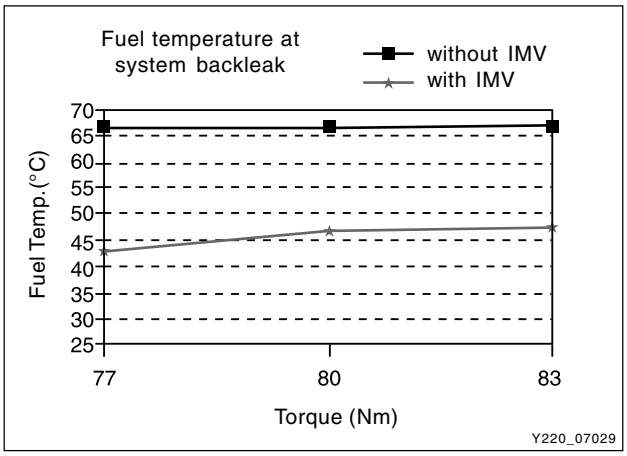
The LP actuator, also called the inlet metering valve, is used to control the rail pressure by regulating the amount of fuel which is sent to the pumping element of the HP pump.

This actuator has two purposes:



Y220_07028

1. Firstly, it allows the efficiency of the injection system to be improved, since the HP pump only compresses the amount of fuel necessary to maintain in the rail the level of pressure required by the system as a function of the engine's operating conditions.



Y220_07029

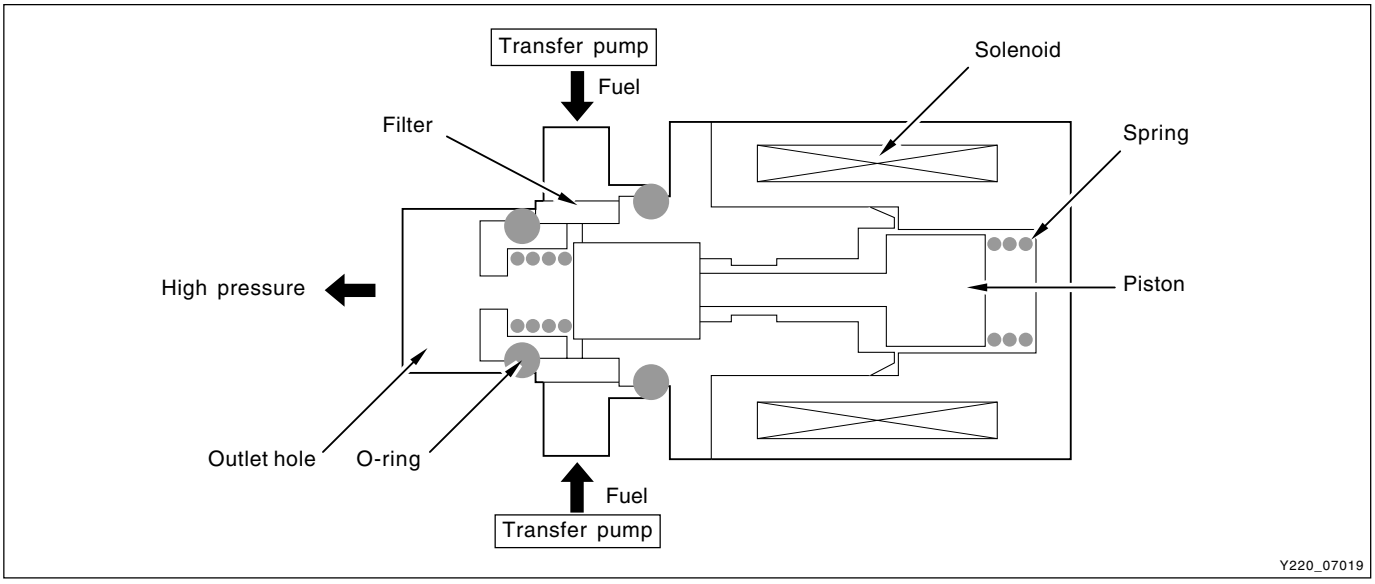
2. Secondary, it allows the temperature to be reduced in the fuel tank. When the excess fuel is discharged into the back leak circuit, the pressure reduction in the fluid (from rail pressure down to atmospheric pressure) gives off a large amount of heat. This leads to a temperature rise in the fuel entering the tank. In order to prevent too high a temperature being reached, it is necessary to limit the amount of heat generated by the fuel pressure reduction, by reducing the back leak flow. To reduce the back leak flow, it is sufficient to adapt the flow of the HP pump to the engine's requirements throughout its operating range.

▶ Composition of IMV

The IMV is located on the hydraulic head of the pump. It is fed with fuel by the transfer pump via two radial holes. A cylindrical filter is fitted over the feed orifices of the IMV. This makes it possible to protect not only the LP actuator, but also all the components of the injection system located downstream of the IMV.

The IMV consists of the following components:

- A piston held in the fully open position by a spring.
- A piston filter located at inlet.
- Two O-rings ensuring pressure tightness between the hydraulic head and the body of the IMV.
- A body provided with two radial inlet holes and an axial outlet hole.
- Coil



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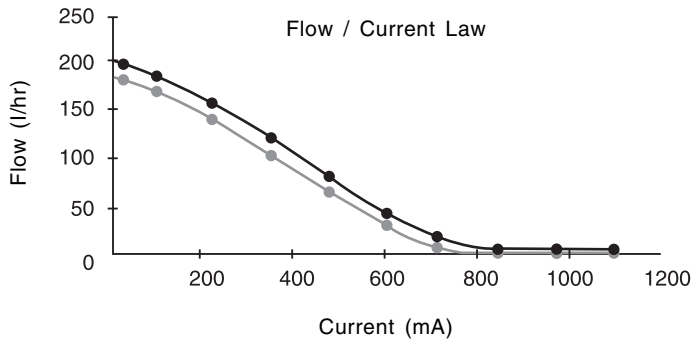
▶ Principle of Operation

The LP actuator is used to proportion the amount of fuel sent to the pumping element of the HP pump in such a way that the pressure measured by the HP sensor is equal to the pressure demand sent out by the ECU. At each point of operation, it is necessary to have:

- Flow introduced into the HP pump = Injected flow + Injector backleak flow + injector control flow

The IMV is normally open when it is not being supplied with fuel. It cannot therefore be used as a safety device to shut down the engine if required.

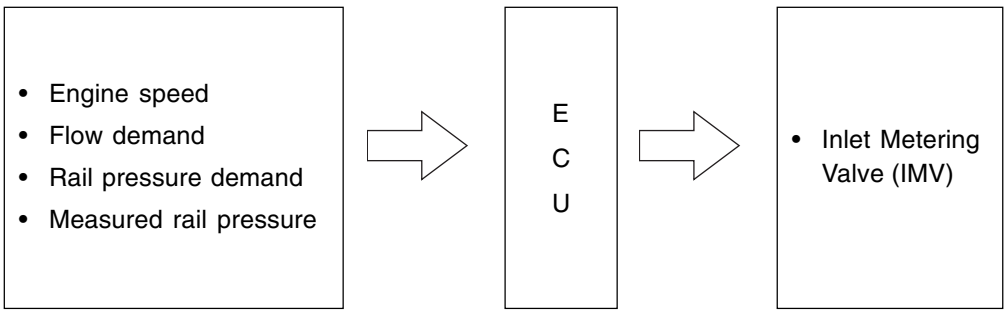
The IMV is controlled by current. The flow/current law is represented below.



Specifications

Piston stroke	1.4 mm
Diameter of holes	3.4 mm
Coil resistance	5.4 Ω (at 25°C)
Power supply	Battery voltage (It is prohibited to supply the IMV directly at the battery voltage during the diagnostic test)
Max. current	1 A
Weight	260 g
Operating temperature	40°C < T < 125°C
Fluid temperature	40°C < T < 90°C
Control logic	Normally open without power (The flow decreases as the current rises).

- ECU determines the value of the current to be sent to the IMV according to:



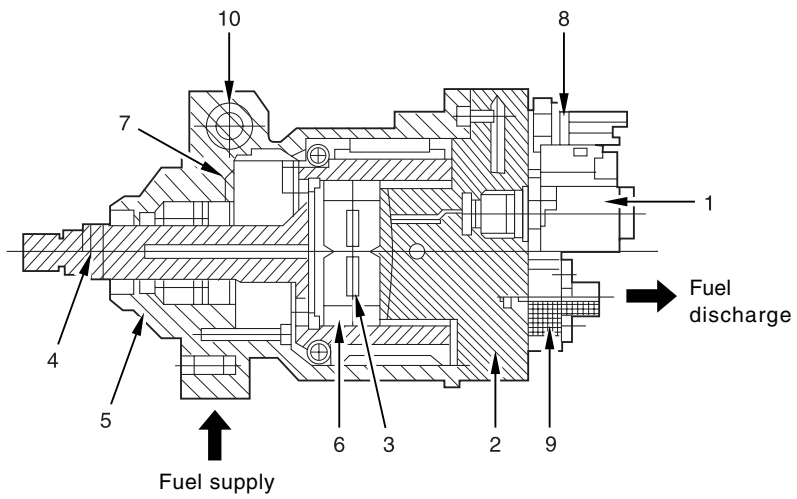
HIGH FUEL PRESSURE LINE

▶ High Pressure Pump

Description

This pump generates high fuel pressure and is driven by timing chain (radial plunger principle). This pump pressurizes the fuel to approx. 1600 bar and sends this high pressurized fuel to high pressure accumulator (common rail) via high pressure line.

It is possible to extend the pumping phase in order to considerably reduce drive torque, vibration and noise since the pump no longer determines the injection period. The differences from conventional rotary pumps lies in the fact that it is no longer the hydraulic head rotor which turns inside the cam, but the cam which turns around the hydraulic head. Thus, any problems of dynamic pressure tightness are eliminated because the high pressure is generated in the fixed part of the pump.



1. IMV (Inlet Metering Valve)
2. Hydraulic Head
3. Plunger
4. Drive shaft and cam ring
5. Housing
6. Roller and shoe
7. Transfer pump
8. Fuel temperature sensor
9. High fuel pressure - OUT
10. Pressure regulator

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Specifications

- Maximum operating pressure: 1600 ± 150 bar
- Max. Overpressure: 2100 bar
- Maximum sealing pressure: when using a plug instead of PRV, no leaks around pump outlet port (when applying 2500 bar of constant pressure)
- Operating temperature: Continuously operating within temperature range of -30°C ~ 120°C in engine compartment
- Inflowing fuel temperature: The maximum inflowing fuel temperature is 85°C (continuously able to operate)
- Pump inlet pressure: Relative pressure Min. - 0.48 bar (to end of filter's lifetime)
- Driving torque: 15 Nm / 1600 bar
- Gear ratio (engine: pump): 0.625
- Lubrication: - Inside lubrication (rear bearing): Fuel
  - Outside lubrication (front bearing): Engine oil

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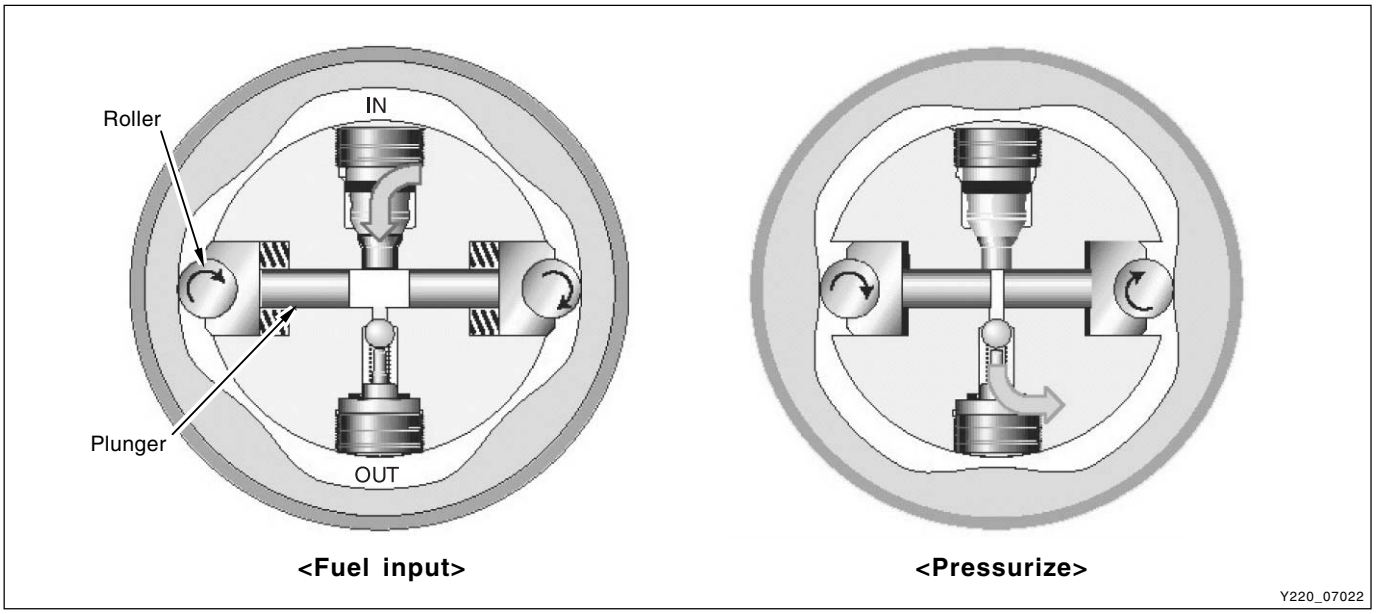
Principle of operation

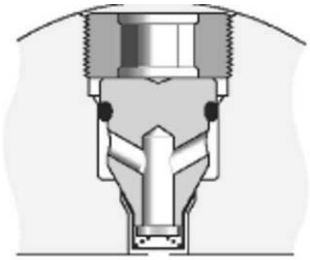
- During the filling phase, the rollers are kept in contact with the cam by means of coil springs mounted on either side of each shoe. The transfer pressure is sufficient to open the inlet valve and to move the pumping plungers apart. Thus, the dead volume between the two plungers fills with fuel.
- When the diametrically opposite rollers simultaneously encounter the leading edge of the cam, the plungers are pushed towards each other.
- As soon as the pressure becomes higher than the transfer pressure, the inlet valve closes. When the pressure becomes higher than the pressure inside the rail, the delivery valve opens. Consequently, the fuel is pumped under pressure into the rail.
- During the input phase, transfer pressure pushes back the inlet valve. Fuel enters the body of the pumping element. The valve closes as soon as the pressure in the pumping element becomes higher than the transfer pressure.
- During the input phase, the ball of the delivery valve is subject to the rail pressure on its outer face and to the transfer pressure on its inner face. Thus the ball rests on its seat, ensuring the pressure tightness of the body of the pumping element. When the pressure in the element becomes higher than the pressure in the rail, the ball is unbalanced and it opens. Fuel is then pumped into the rail at high pressure.



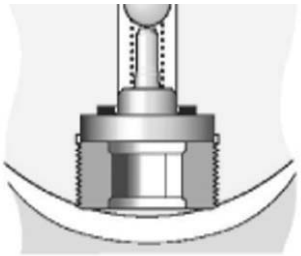
This high pressure pump generates the driving torque with low peak torque to maintain the stress to driving components. This torque is smaller than that of conventional injection pump, thus, only a small load will be applied to pump. The required power to drive pump is determined by set pressure for rail and pump speed (delivery flow). Note that the fuel leakage or defective pressure control valve may affect the engine output.

Inlet valve and delivery valve

During the input phase, transfer pressure pushes back the inlet valve. Fuel enters the body of the pumping element. Under the effect of the transfer pressure, the two plungers are forced apart. When the rollers simultaneously encounter the leading edge of the cam, pressure suddenly rises in the body. Of the pumping element. The valve closes as soon as the pressure in the pumping element becomes higher than the transfer pressure. During the input phase, the ball of the delivery valve is subject to the rail pressure on its outer face and to the transfer pressure on its inner face. Thus the ball rests on its seat, ensuring the pressure tightness of the body of the pumping element. When the two diametrically opposite rollers encounter the leading edges of the cam, the plungers are forced together and pressure quickly rises in the body of the pumping element. When the pressure in the element becomes higher than the pressure in the rail, the ball is unbalanced and it opens. The spring calibration is negligible compared with the pressure forces. Fuel is then pumped into the rail at high pressure.



<Inlet valve>



<Delivery valve>

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Lubrication and cooling of the HP pump

Lubrication and cooling of the pump are provided by the fuel circulation. The minimum flow required to ensure adequate operation of the pump is 50 ℓ/h.

Phasing of HP pump required and offer 2 advantages

Conventional fuel injection pumps ensure pressurizing and distribution of the fuel to the different injectors. It is essential to set the pump in such a way that the injection occurs at the required place during the cycle. The HP pump of the common rail system is no longer used for the fuel distribution, it is therefore not necessary to set the pump in relation to the engine.

Nevertheless, the setting or phasing of the pump offers two advantages:

- It allows the torque variations of the camshaft and the pump to be synchronized in order to reduce the stresses on the timing belt.
- It allows pressure control to be improved by synchronizing peak pressures produced by the pump with pressure-drops caused by each injection.

This phasing allows pressure stability to be improved, which helps to reduce the difference in flow between the cylinders.

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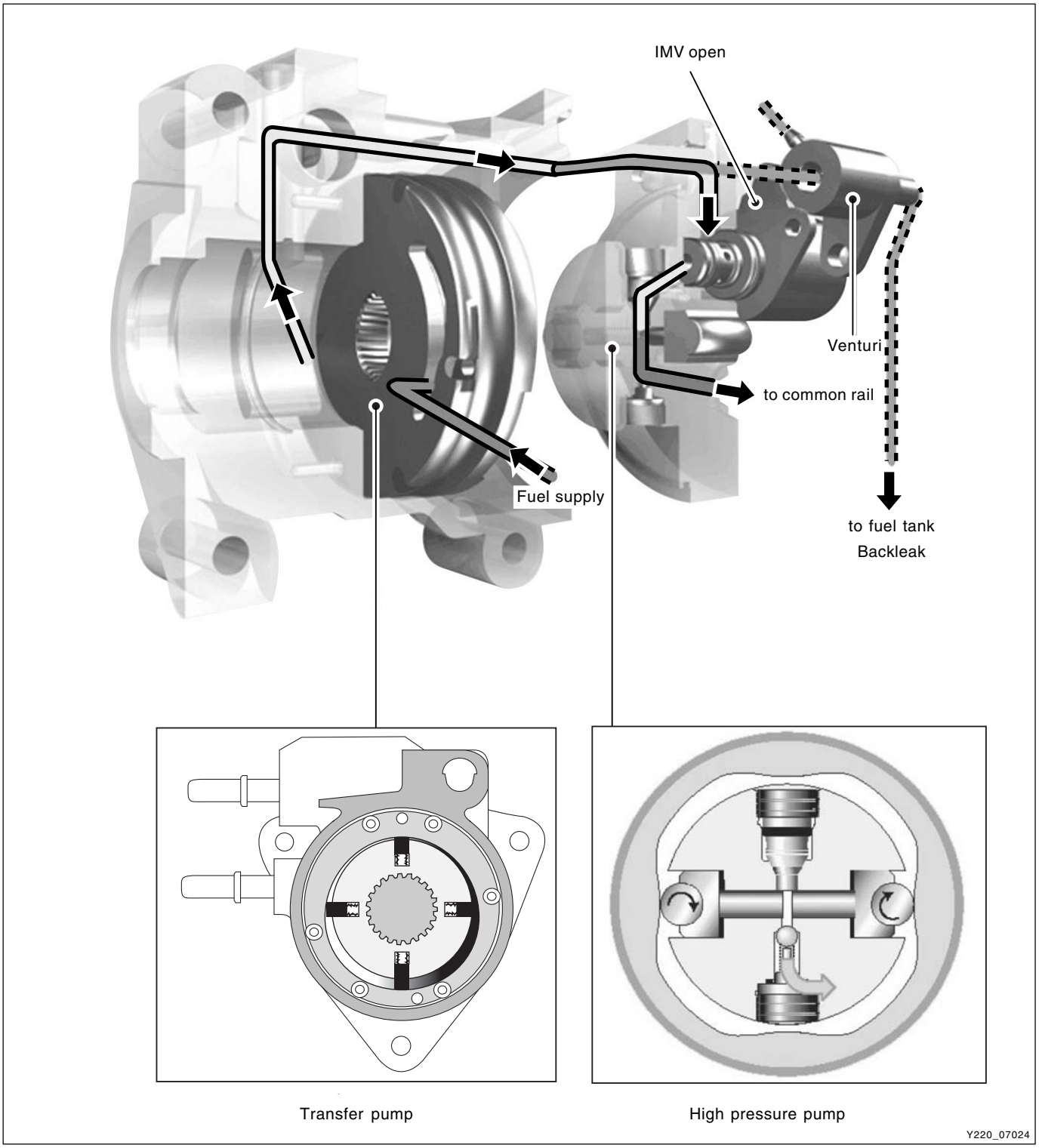
▶ HP Pump Fuel Route

The fuel passed through the fuel filter is sent to the transfer pump via the HP inlet pump. this fuel passes through the transfer pump by the transferring pressure and maintains the predefined value by the regulating valve in HP pump.

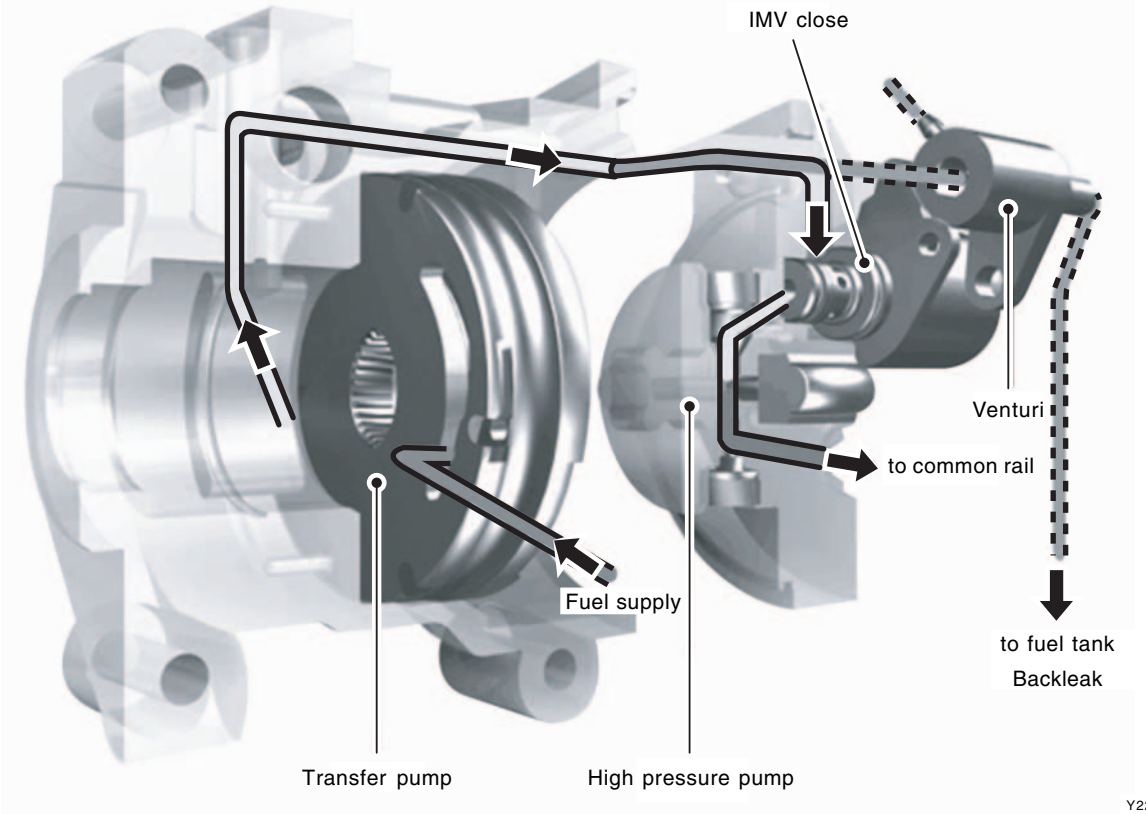
Also, this fuel gets into the IMV that controls only the fuel to the high pressure pump.

The below figure describes the pump operations when acceleration and deceleration.

When need high fuel pressure (acceleration)



When do not need high fuel pressure (deceleration)



The fuel is sent to the high pressure side (hydraulic head) and compressed by the plunger. And, goes into the common rail through the high pressure pipe.

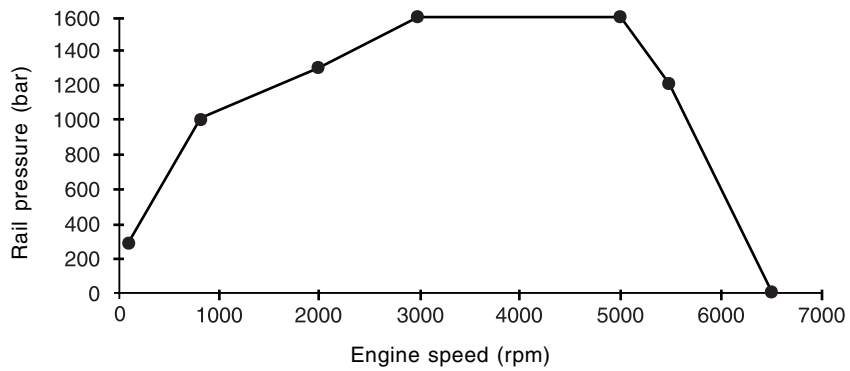
The IMV installed in the high pressure side (hydraulic head) of HP pump precisely controls the fuel amount and delivers the rail pressure feedback same as required amount.

The IMV is controlled by ECU.

Performance curve of HP pump

The time required to obtain a sufficient pressure in the rail to enable the engine to start depends on the volume of the system (definition of the rail, length of the pipes, etc.). The aim is to reach a pressure of 200 bars in 1.5 revolutions (3rd compression).

- Maximum operating pressure: 1600 ± 150 bar



<Pressure curve of HP pump>

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▶ Sectional View of HP Pump

<Transfer Pump>

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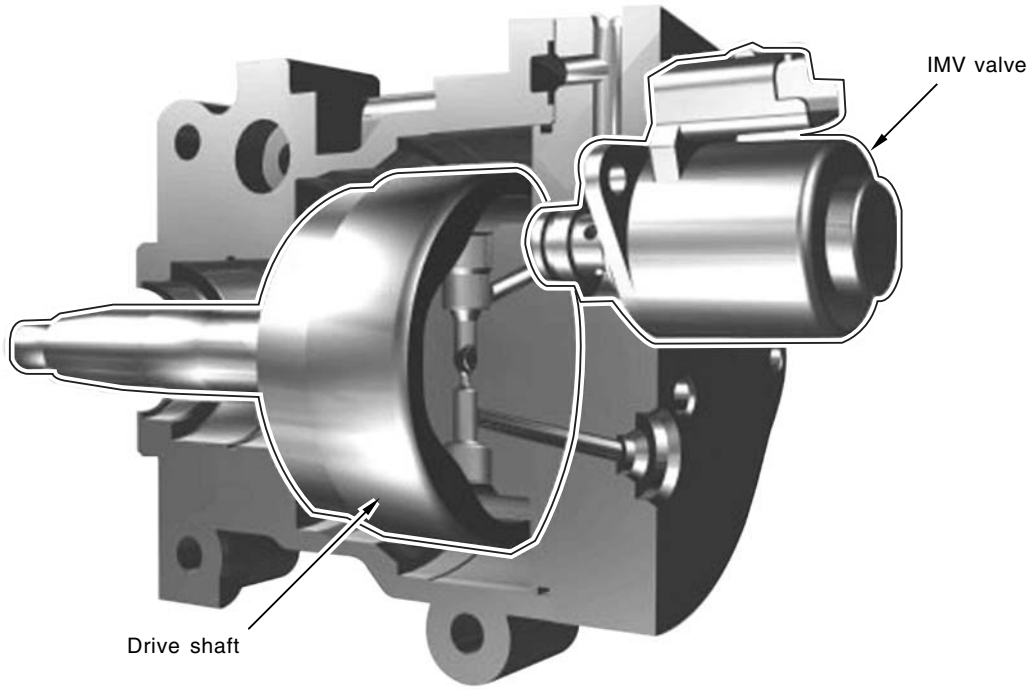

<IMV Valve and High Pressure Pump (Drive Shaft)>

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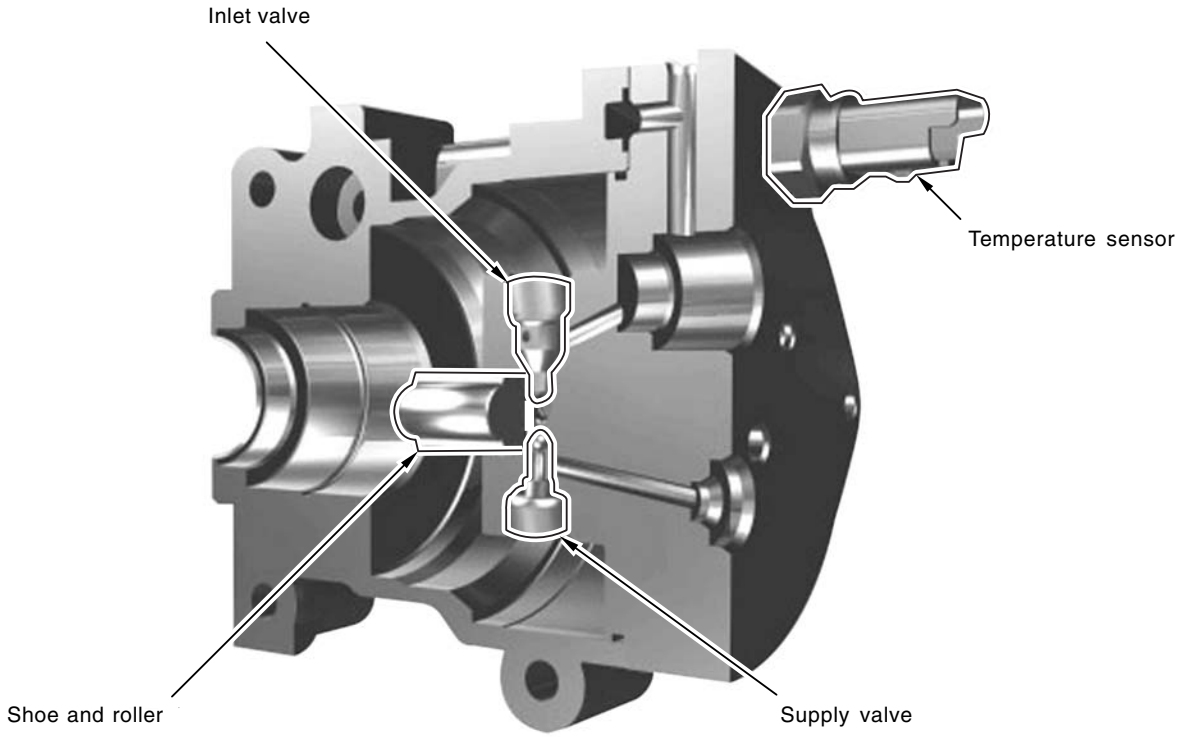
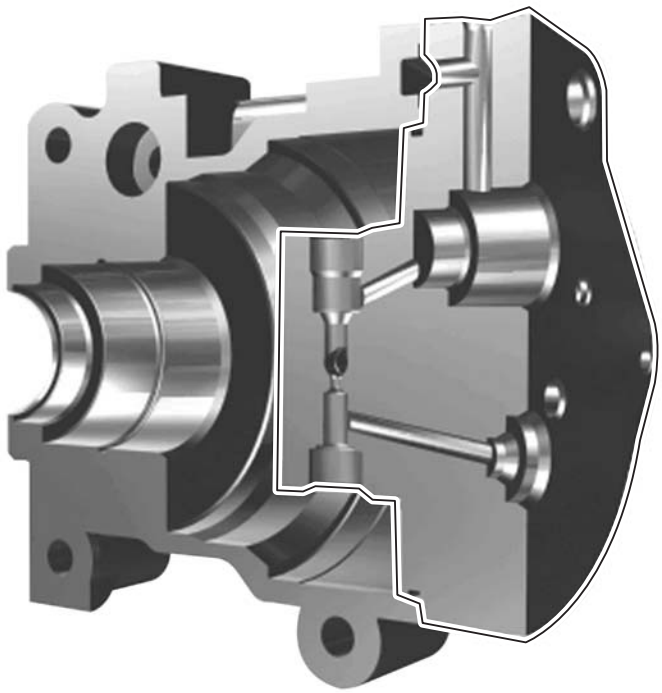


<Inlet Valve, Outlet Valve, Shoe and Roller, Temperature Sensor>

Y220_07034



<Hydraulic Head>

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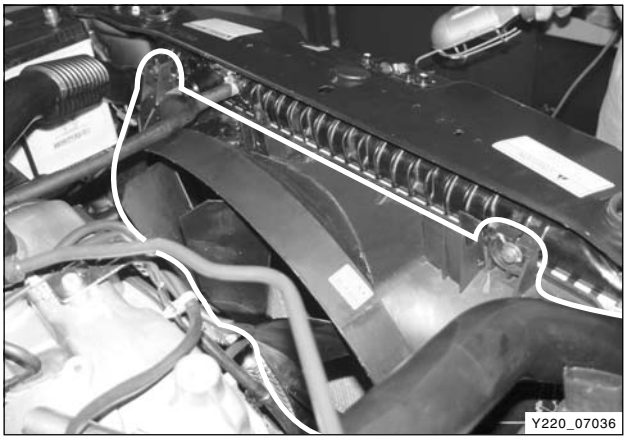
Removal

※ Preceding Works
- Disconnection of negative battery cable
- Removal of engine cover

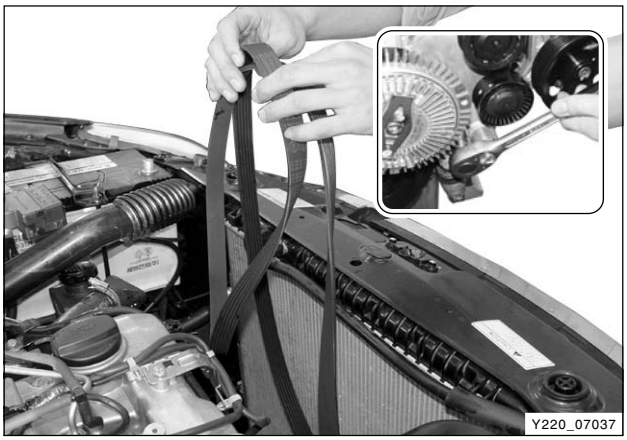
The trouble diagnosis should be performed before removing the HP pump. Refer to “Diagnosis” section.



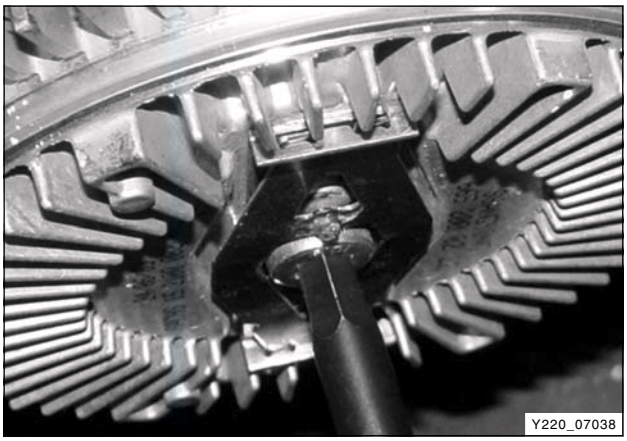
1. Remove the bolts on the fan shroud. Disconnect the air intake duct from intake manifold and the coolant outlet port connecting hose.

Notice

Plug the coolant port not to get the coolant into the engine. Add the coolant as required when installing.



2. Remove the fan belt while pressing down the auto tensioner adjusting bolt.



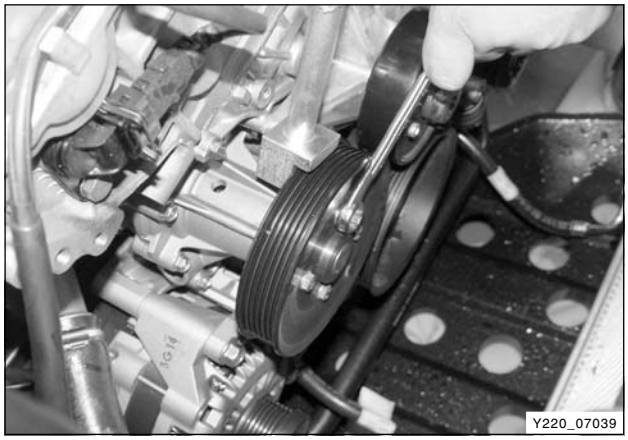
3. Unscrew the center bolt and remove the cooling fan clutch while holding the pulley with counter holder (special tool).

Tightening torque	45 ± 4.5 Nm

4. Remove the fan shroud and fan clutch simultaneously.

5. Unscrew the bolts and remove the belt pulley while holding the belt pulley with a special tool.

Tightening torque	10 ± 1.0 Nm

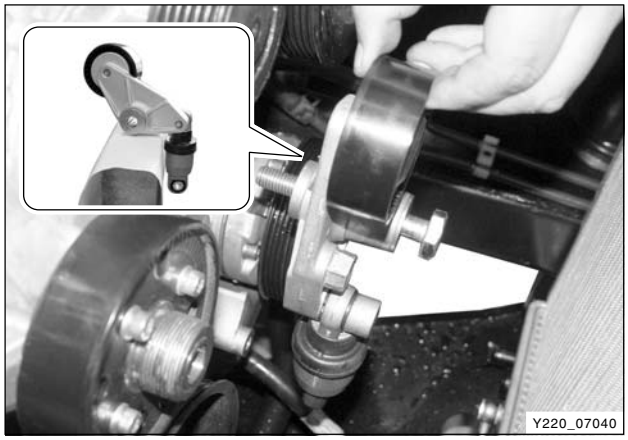


6. Unscrew the upper and lower bolts and remove the auto tensioner.

Tightening torque	Nm
Upper bolt	82 ± 6.0 Nm
Lower bolt	32 ± 3.0 Nm

Notice

To prevent oil leaks, store the removed auto tensioner in upright position.

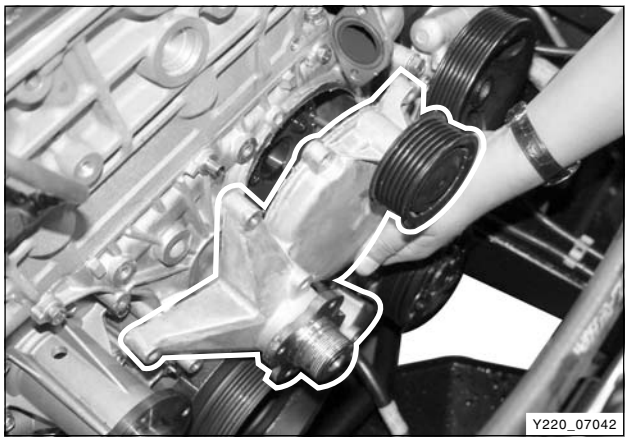


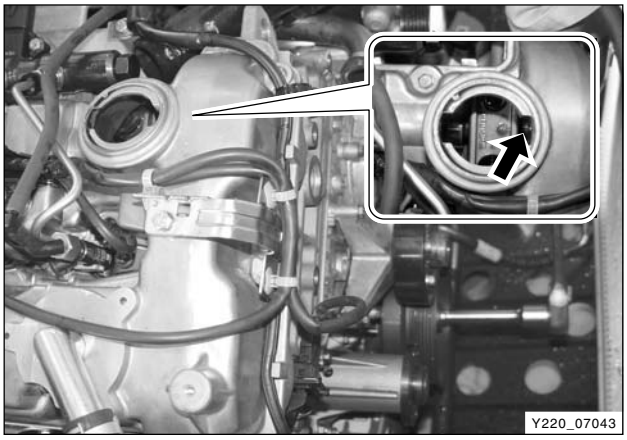
7. Unscrew the bolts and remove the idle pulley.

Tightening torque	10 ± 1.0 Nm

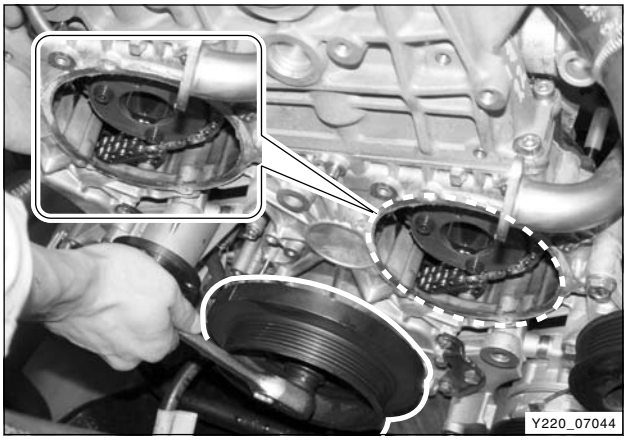
8. Unscrew the bolts and remove the cooling fan bracket (timing chain cover side).

Tightening torque	10 ± 1.0 Nm

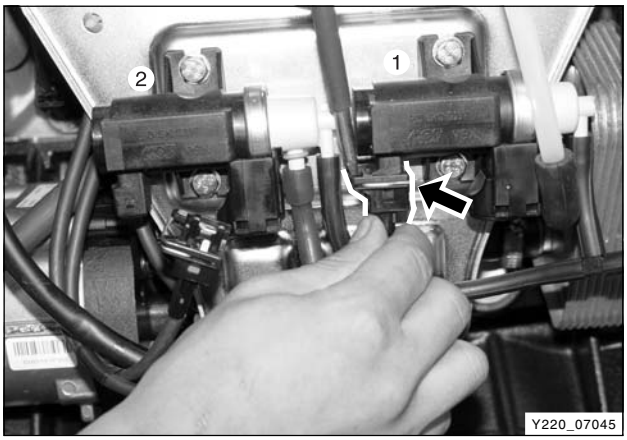




9. Remove the engine oil filler cap and adjust the mark on camshaft to TDC position.



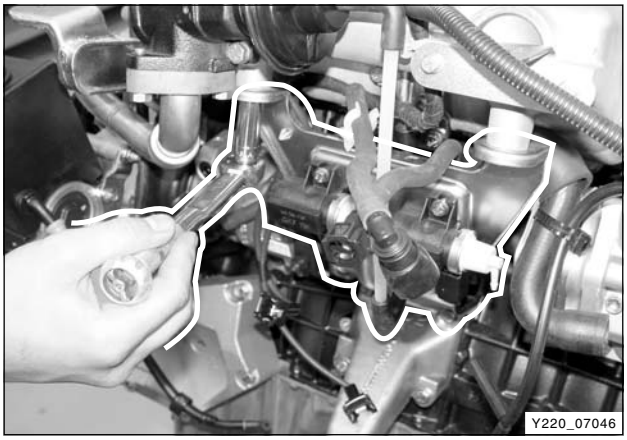
10. Align the TDC mark on the crankshaft pulley to the guide pin and rotate the pulley 720° counterclockwise. Check the mark on the camshaft again.



11. Disconnect the vacuum line of EGR vacuum modulator (1), the vacuum line of turbo charger vacuum modulator (2) vacuum line and connectors.

Notice

Be careful not to be mixed the lines when installing.

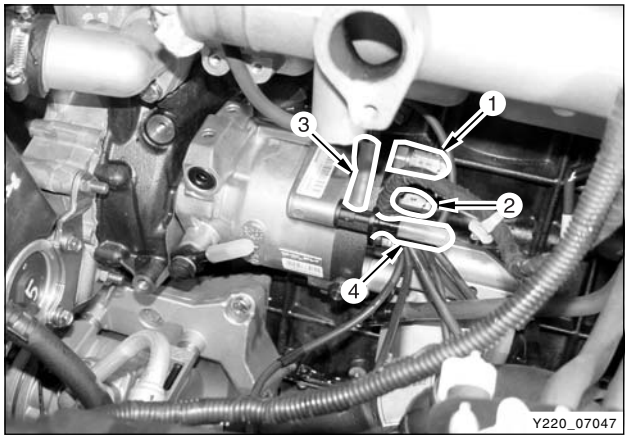


12. Unscrew the bolts and remove the intake manifold mounting bracket.
    - Upper bolts: 13M/ 2EA

      Lower boltes: 5M/ 2EA (Hexagon bolt)

Tightening torque	23 ± 2.3 Nm

13. Disconnect the connector behind HP pump, fuel pipes and hose lines.
    1) Fuel temperature sensor connector (green)
    2) IMV connector
    3) Fuel return hose (be careful not to break the HP pump connecting port)
    4) Venturi hose

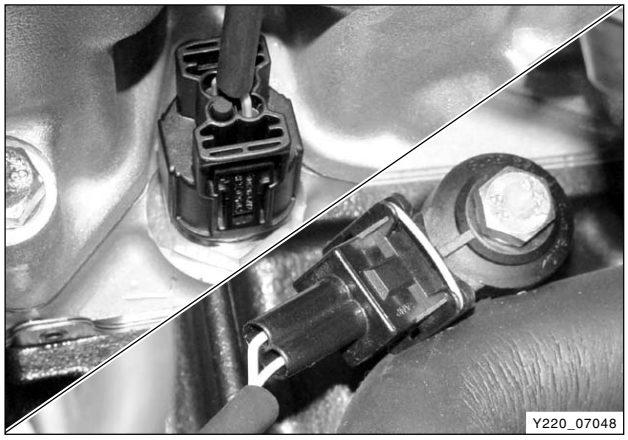


Notice

Plug each opening with sealing cap.

14. Remove the coolant temperature sensor and the knock sensor.

Tightening torque	Nm
Knock sensor	22 Nm
Temperature sensor	20 Nm

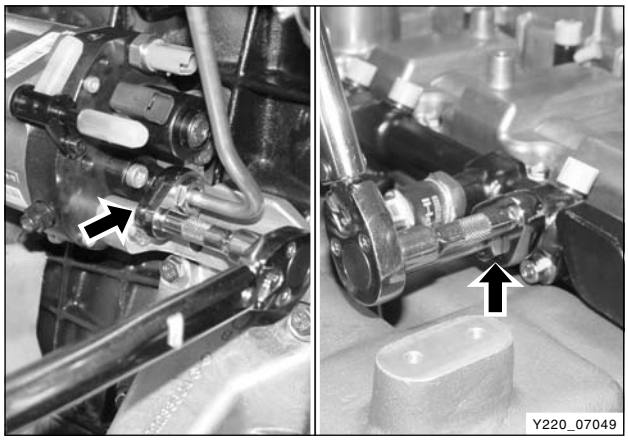


15. Unscrew the bolts and remove the high fuel pressure pipes at HP pump and common rail. Plug the openings with sealing caps.

Tightening torque	40 Nm

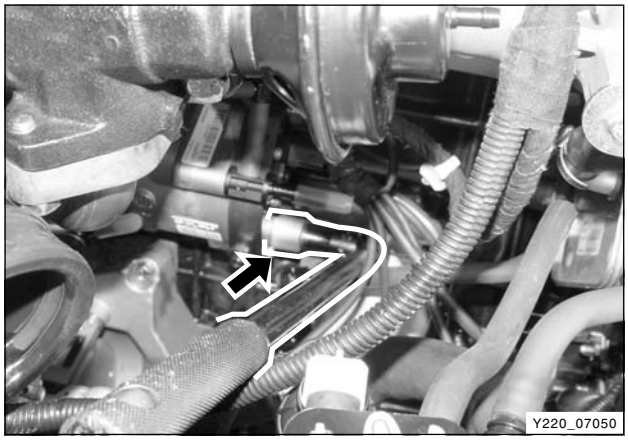
Notice

Replace the fuel pipes with new ones.



16. Remove the HP pump mounting bracket at engine.

Tightening torque	23 ± 2.3 Nm



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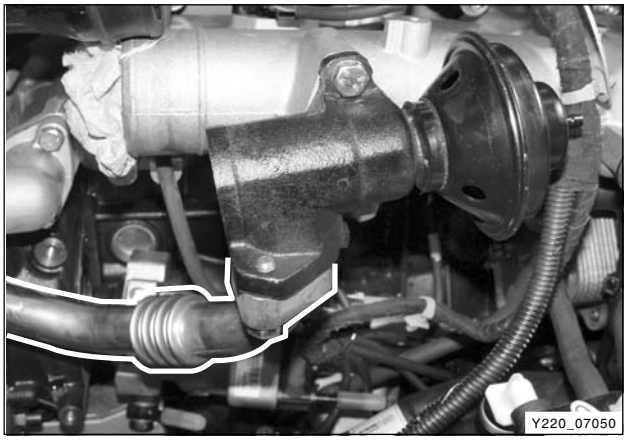
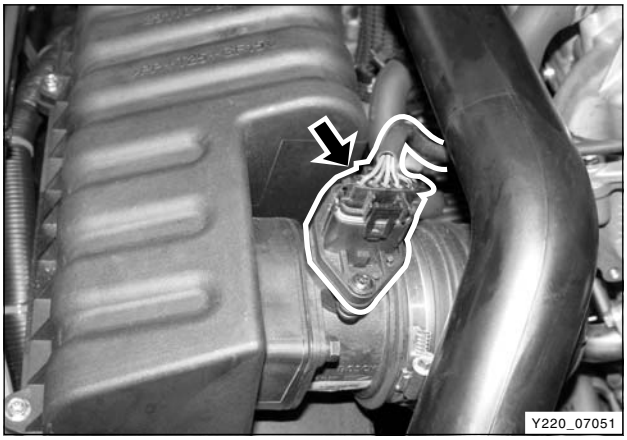


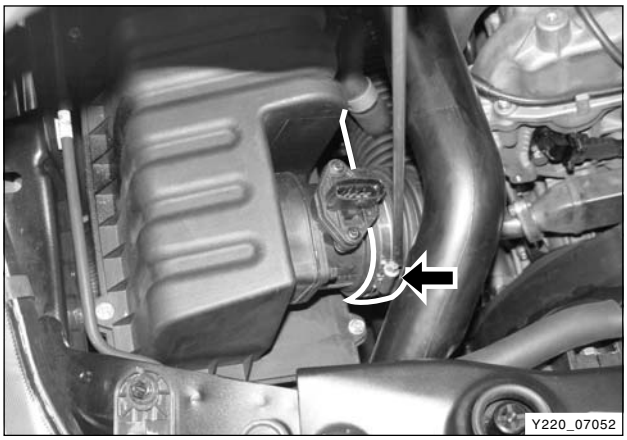
17. Remove the intake EGR pipe and gasket.

Notice

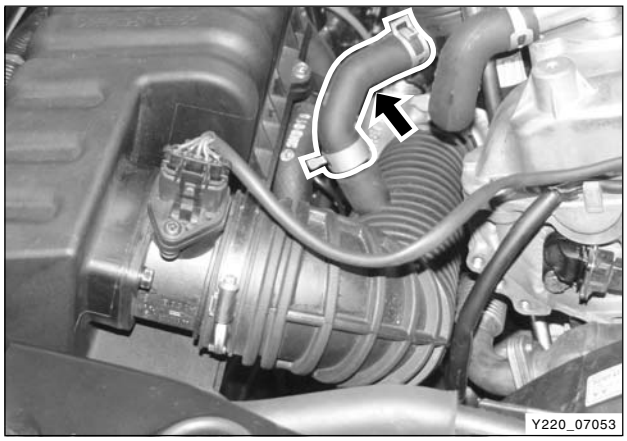
- ***Replace the removed gasket with new one.***
- ***Replace the removed #1 and #3 pipes with new ones.***



18. Disconnect the HFM sensor connector.

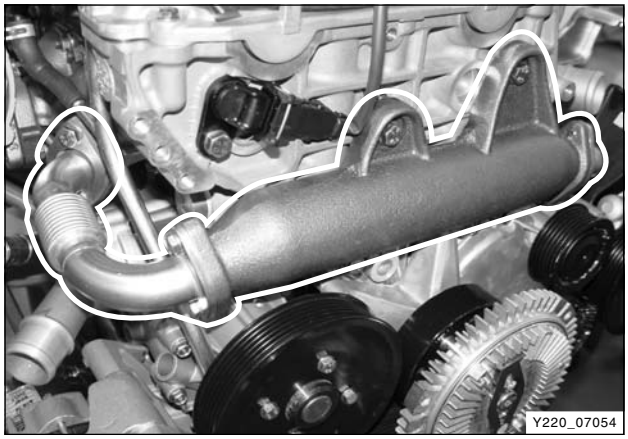


19. Loosen the clamp and separate the hose from air cleaner.



20. Separate the connection lines from turbo charger and PCV separator.

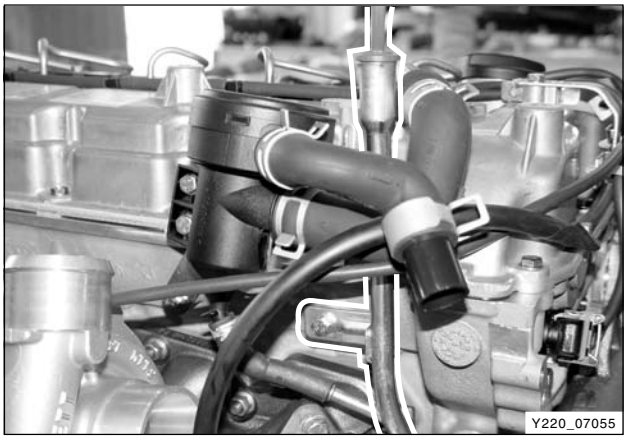
21. Remove the exhaust EGR pipe and gasket (Front side - 10 mm/ 2EA, Exhaust side - 13mm/ 2EA). Remove the center EGR pipe and mounting bolts (13mm/ 4EA).



Notice

- ***Replace the removed gasket with new one.***
- ***Replace the removed #1 and #3 pipes with new ones.***

22. Remove the oil dipstick mounting bracket and oil dipstick tube with O-ring.

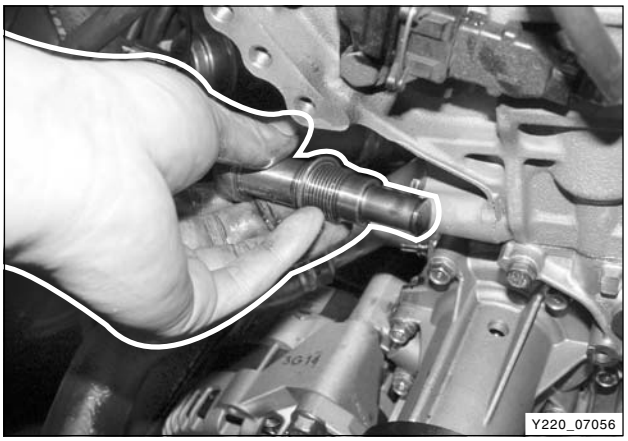


Tightening torque	10 Nm

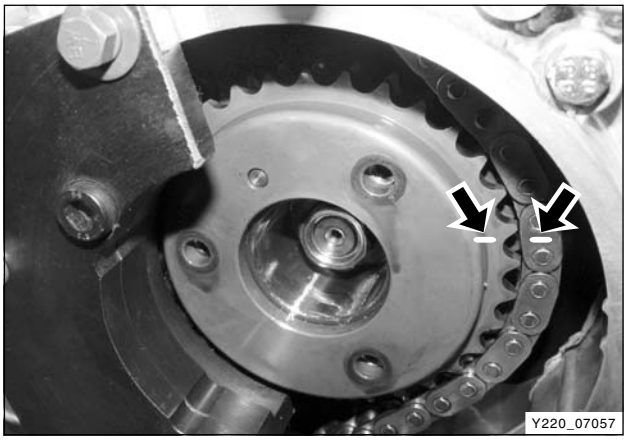
Notice

Replace the O-ring with new one.

23. Remove the chain tensioner.



24. Mark on the HP pump sprocket and timing chain.



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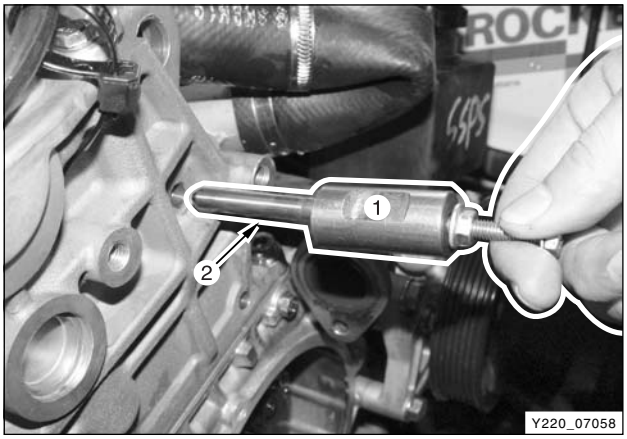
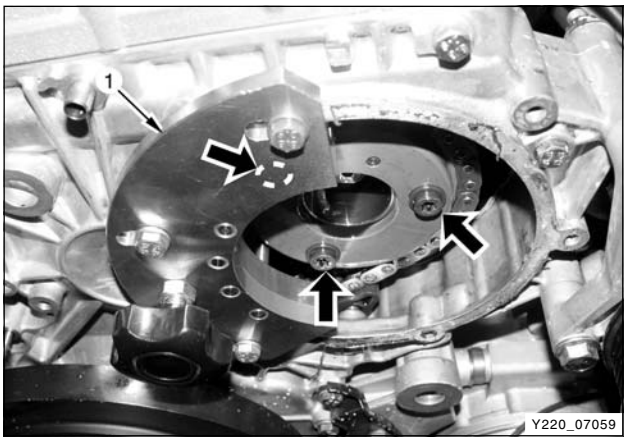
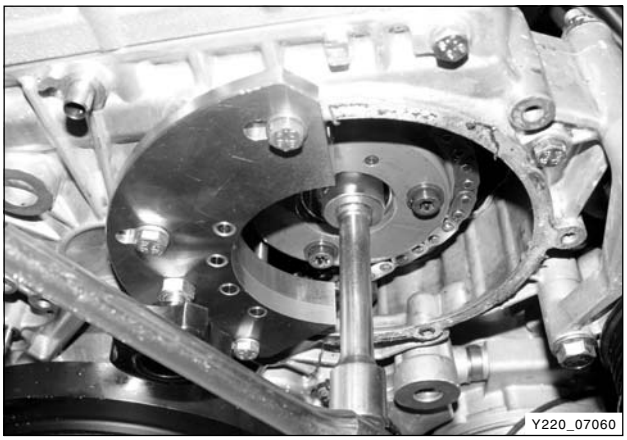


25. Remove the guide rail pins (lower and upper) with a special tool.



26. Install the special tool (1) for holding HP pump sprocket, unscrew the mounting bolts and remove the sprocket. At this time, rotate the crankshaft 30° to 45° counterclockwise to remove the sprocket.

Tightening torque	20 Nm ± 90°



27. Remove the center nut for HP pump shaft.

Tightening torque	65 ± 5 Nm

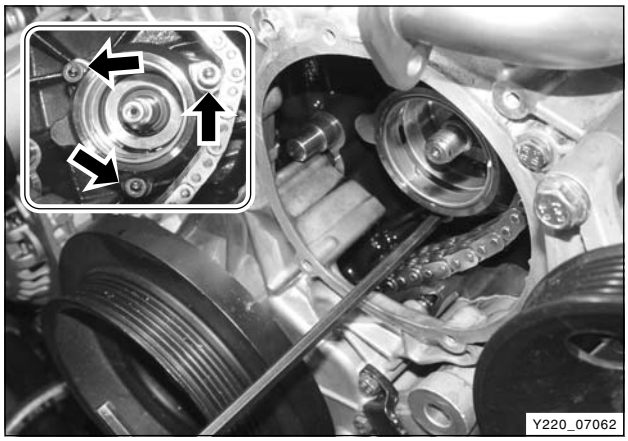
28. Pull out the HP pump bearing with a special tool.

Notice

Be careful not to damage the bearing.

29. Remove the HP pump bearing bracket (13mm - 3EA).

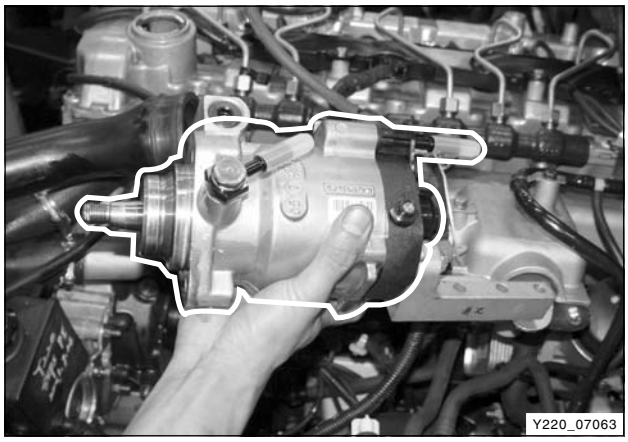
Tightening torque	24 Nm



30. Remove the mounting bracket behind the HP pump.
31. Slide the HP pump out rearward while holding it.

Notice

Plugs openings and put it in a box (for returns)



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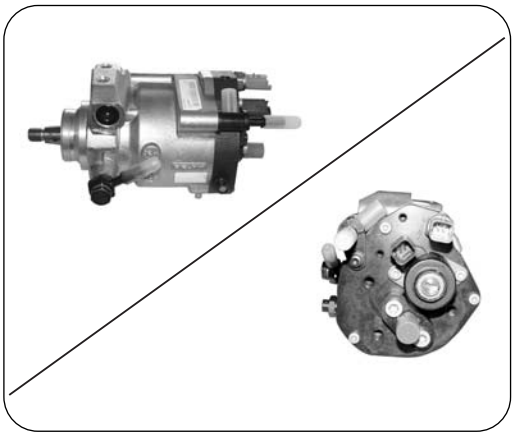
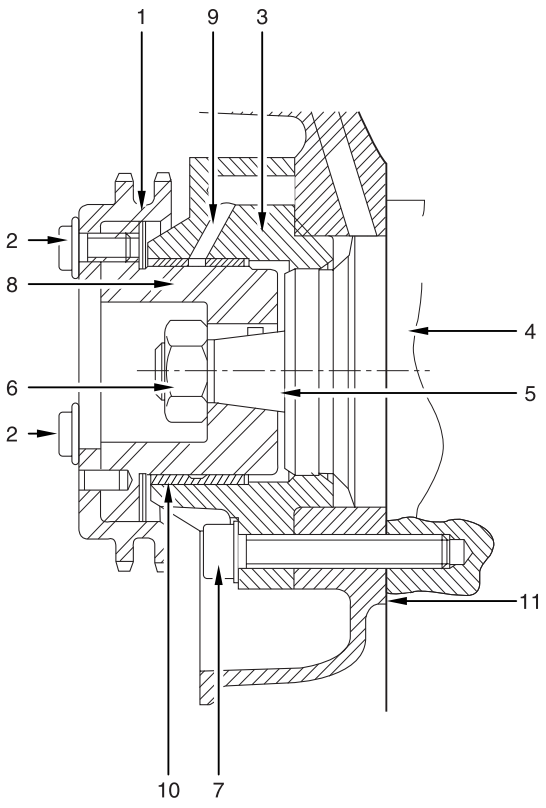




Y220_07064

1. HP pump sprocket
2. 12-sided bolt (20 Nm + 90°)
3. HP pump bearing housing
4. HP pump (High pressure pump)
5. HP pump shaft
6. HP pump center nut (65 ± 5 Nm)
7. HP pump external bolt (24 ± 2.4 Nm)
8. HP pump bearing shaft
9. Oil gallery
10. Bearing bushing
11. Gasket

Installation

1. Install the gasket and HP pump.

   Notice

   Replace the removed gasket with new one.

   Warning

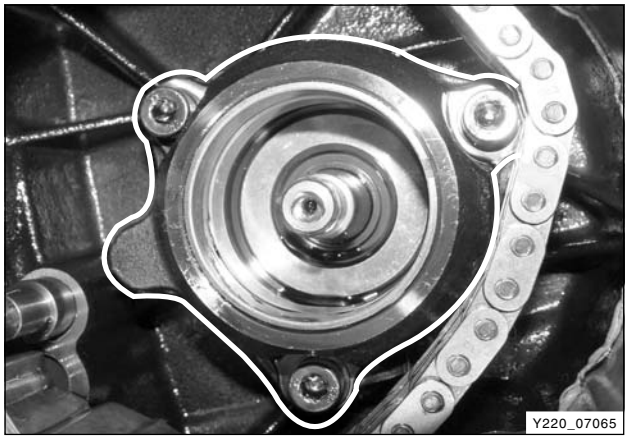
   Remove caps at last minute and always change removed HP pipes.

2. Install the HP pump bearing bracket and HP pump to the cylinder block.

Tightening torque	24 ± 2.4 Nm

   Notice

   Align the oil galleries in cylinder block and bearing bracket.

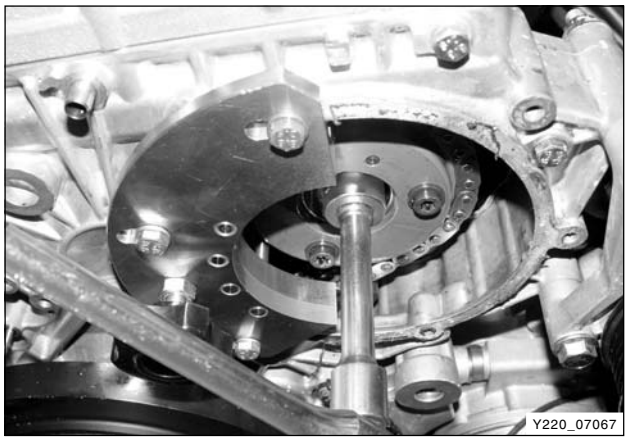


3. Install the bearing into the bracket.

4. Temporarily install the upper and lower guide rails to seat the chain.
5. Temporarily tighten the center nut for HP pump shaft.

   Notice

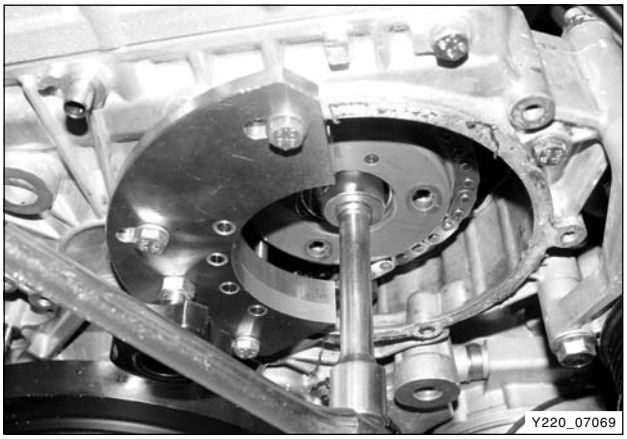
   Be careful not to rotate the shaft.



6. Install the timing chain on the sprocket and lock the sprocket with a special tool.

   Notice

   Do not apply excessive force to the timing chain. Otherwise, the TDC point deviates from correct position.



7. Tighten the center nut for HP pump.

Tightening torque	65 ± 5.0 Nm

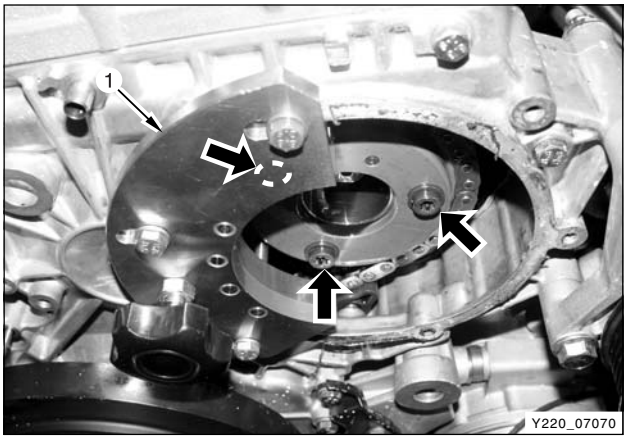
Notice

Replace the center nut with new one.

8. Press the upper and lower guide pins into the guide.

Notice

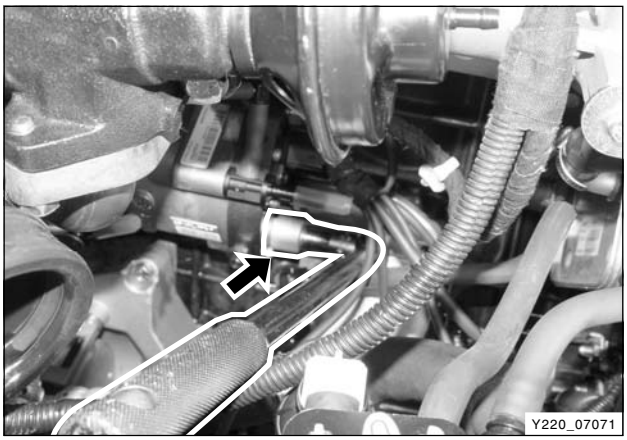
Check the timing chain and guide pin for contact.



9. Align the marks on the HP pump sprocket and the timing chain and tighten the bolts.

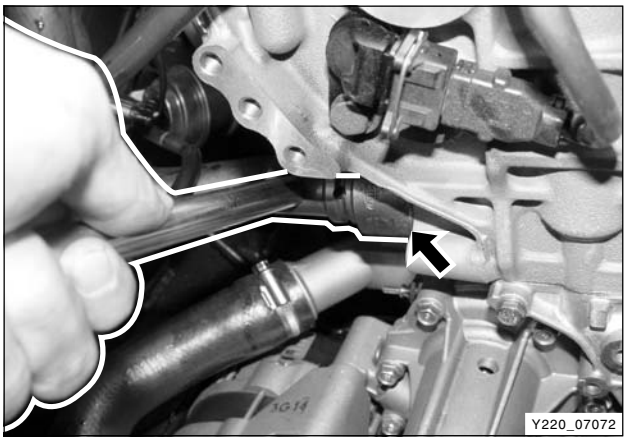
Tightening torque	20 Nm + 90°

10. Remove the special tool.



11. Install the mounting bracket behind HP pump.

Tightening torque	25 ± 2.5 Nm



12. Install the chain tensioner.

Tightening torque	80 ± 8 Nm

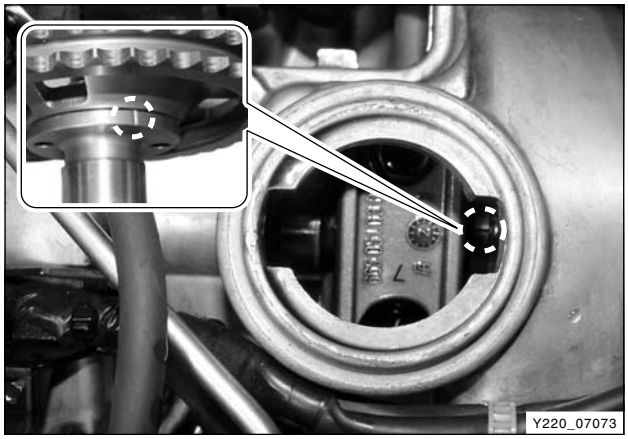
Notice

- ***Replace the chain tensioner washer with new one.***
- ***Be careful not to drop the washer into the hole.***

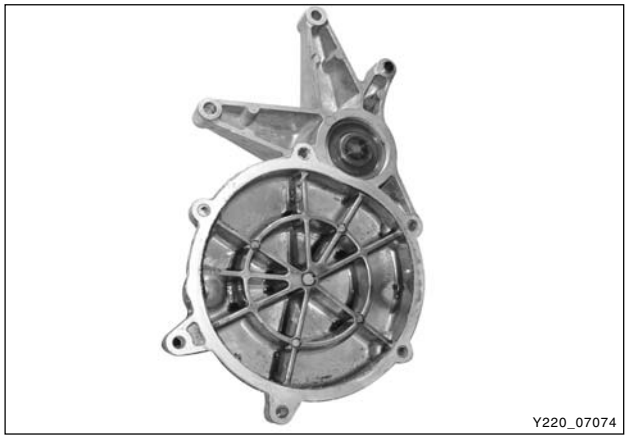
13. Check if the mark on the intake camshaft is at the correct position through oil filler opening.

Notice

Rotate the bolt on crankshaft damper pulley two revolutions and check if the mark on the intake camshaft is at the correct position.



14. Clean the timing chain cover parting surface and apply the sealant on it.

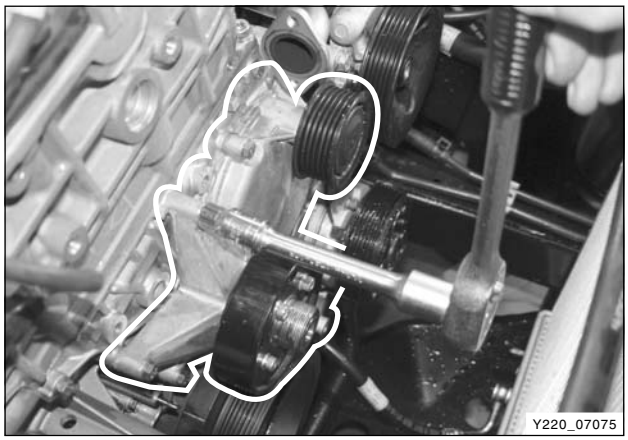


15. Install the timing chain cover.

Notice

Align the cover and the guide pin.

Tightening torque	10 ± 1.0 Nm

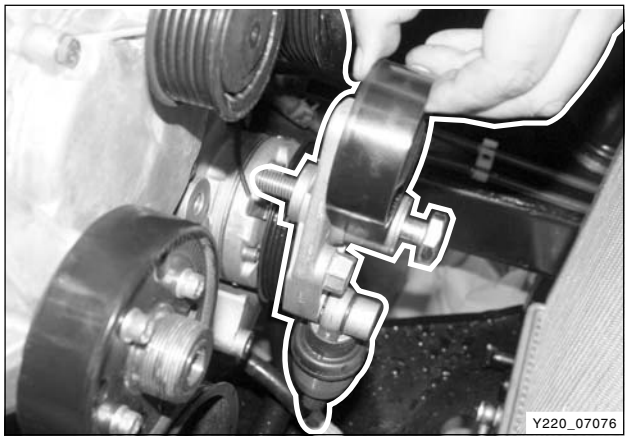


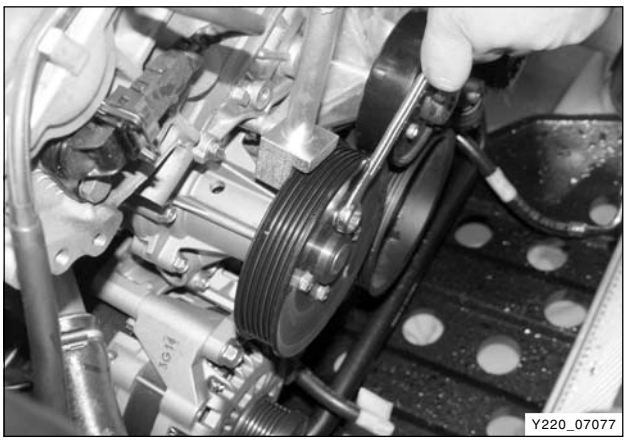
16. Install the auto tensioner assembly.
    - Upper bolt (24M):

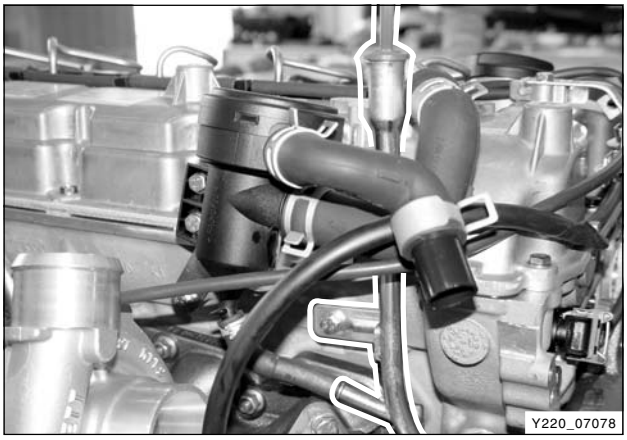
Tightening torque	82 ± 6.0 Nm

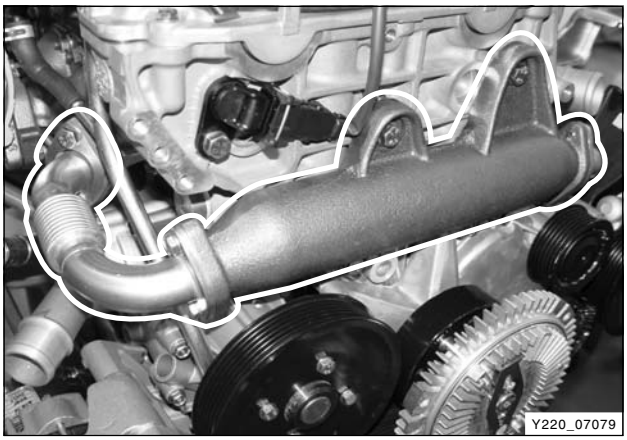
    - Lower bolt(13M):

Tightening torque	32 ± 3.0 Nm









Notice

If the initialization of fuel pressure has not been performed, the engine ECU controls new HP pump with the stored offset value. This may cause the poor engine output.

17. Install the coolant pump pulley.

Tightening torque	10 ± 1.0 Nm

18. Install the fan clutch with a special tool.

Tightening torque	10 ± 1.0 Nm

19. Install the oil dipstick tube and bracket.

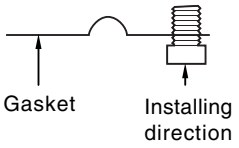
Tightening torque	10 ± 1.0 Nm

20. Install the exhaust EGR pipe and bracket.

Tightening torque	10 ± 1.0 Nm

Notice

Make sure that the convex surface of new steel gasket is facing the direction as shown in the figure.



21. Engage the turbo charger and PCV separator connecting lines.
22. Engage the air cleaner hose and tighten the clamp.
23. Connect the HFM sensor connector.
24. Install the EGR center pipe.

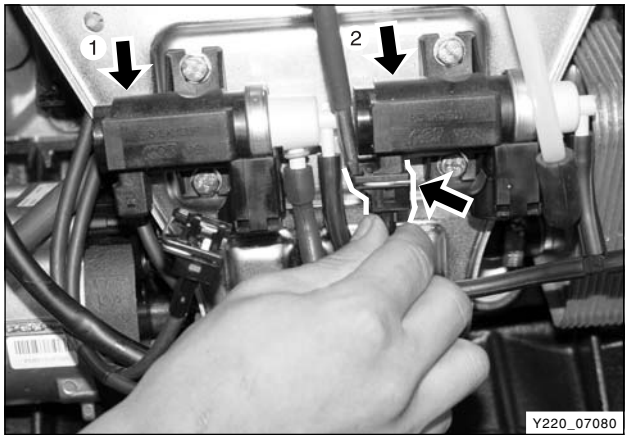
Tightening torque	25 ± 2.5 Nm

25. Connect the HP pump connectors and engage the hose lines.
    - Fuel temperature sensor connectors and IMV connector
    - Venturi hose and fuel return hose
26. Install the coolant temperature sensor and the knock sensor.
27. When replaced the HP pump, initialize the fuel pressure by using Scan-i. Refer to “Trouble Diagnosis” section in this manual.

27. Install the vacuum modulator to the intake manifold bracket.
28. Connect the vacuum modulator connecting lines and connector.
    (1) Vacuum modulator for turbo charger control
    (2) Vacuum modulator for EGR valve control

    Notice

    Ensure that the vacuum hoses are connected to correct positions.



29. Connect the hose to coolant outlet port and tighten the clamp.
30. Install the air intake duct.
31. Install the fan belt while pressing the auto tensioner adjusting bolt.

32. Place the fan shroud in its location and install the cooling fan by using an open end wrench.

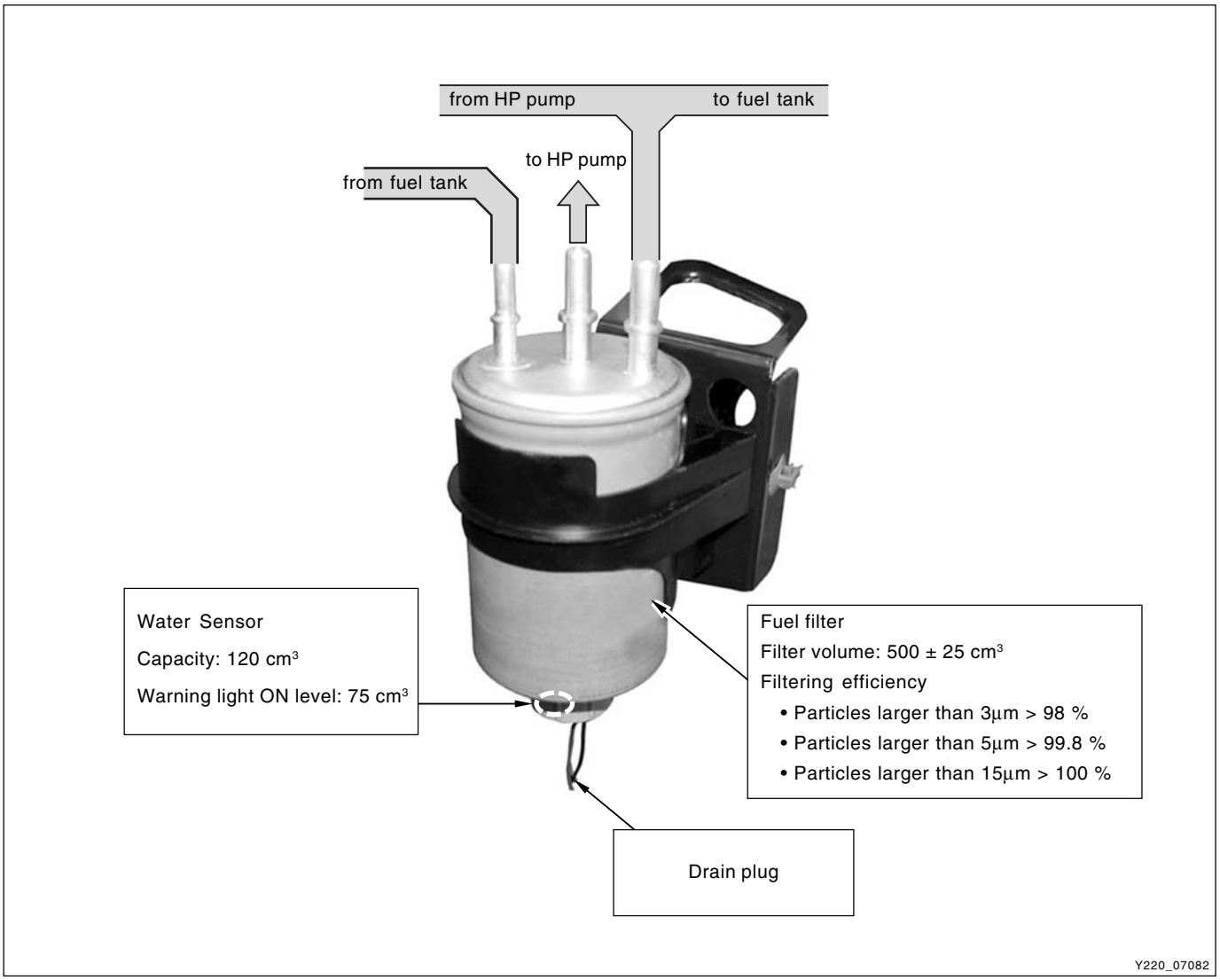
Tightening torque	10 ± 1.0 Nm

33. Install the fan shroud.
34. Add the coolant.
35. Check all the connections for tightness and pump the priming pump to deliver the fuel to the transfer line of HP pump.
36. Start the engine and check if abnormality is present.
37. Run leak detection cycle to get rid of air in the system using scan 100.

▶ Fuel Filter

Function

Foreign materials in fuel can damage the pump components, transfer valve and injectors. Therefore, the high pressure direct injection engine must use fuel filter. Otherwise, the operation performance will drop dramatically. And, diesel fuel may contain water due to condensation by temperature changes and this condensation water can damage the system by corroding the injection system. Thus, the common rail engine should have function that can drain water periodically.



Change Interval: 30,000 km

Water separation and storage function

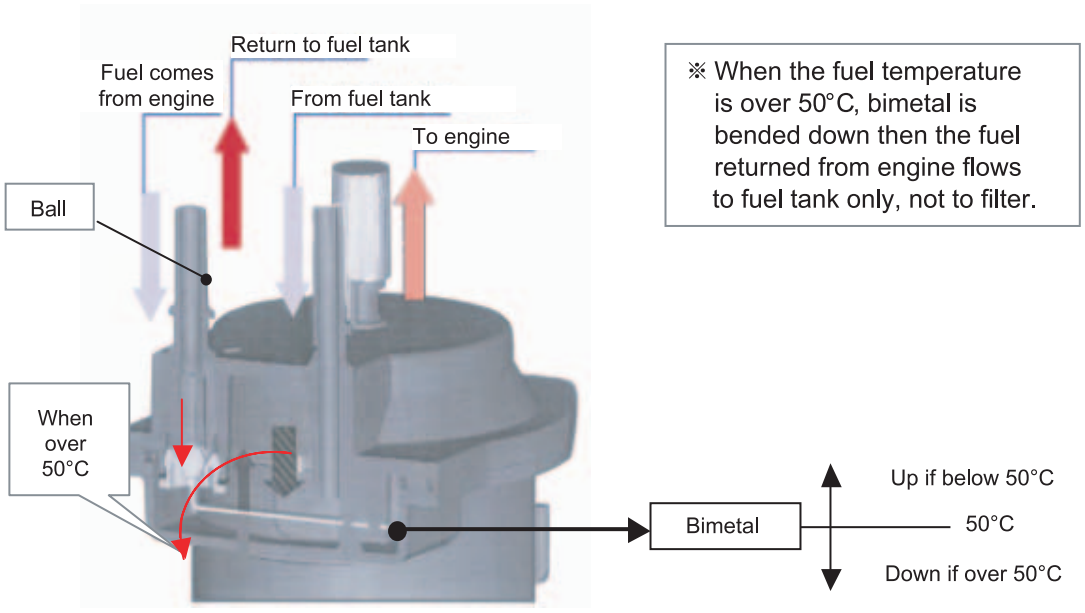
- Function: It separates the condensation water from diesel fuel to prevent the water from getting into FIE system, and results in protection of FIE system. (manual drain)
- Water storage capacity: 120 cc
- Water sensor: light if over 39 cc
- Water drain interval: When changing engine oil or every 20,000 km

Water sensor

It is integrated in the filter and sends signal to ECU when water level reaches at a specified value (over 39 cc) in the filter to let the driver drain the water.

Fuel De-Waxing – Improving starting performance in cold weather

Due to characteristics of diesel fuel, some of fuel components solidify during cold winter under below a specific temperature (-15°C). When those symptoms happen, engine may stall; however, some of the fuel (temperature rises due to high compression) in the HP pump in D27DT engine return to the filter to warm up fuel when temperature is below 50°C by improving cold start performance during cold winter.



<Fuel flow in the fuel filter>

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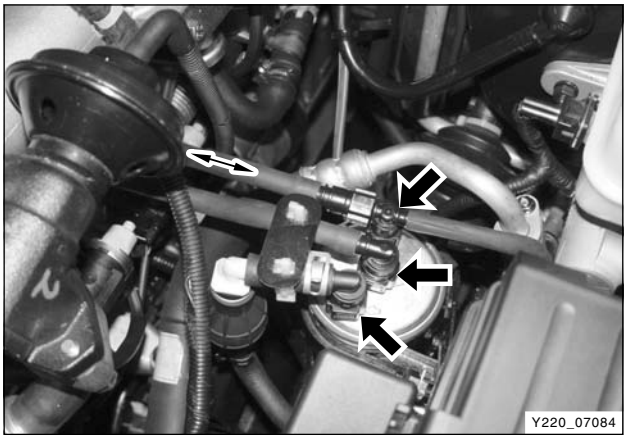


Removal and Installation

1. Disconnect the fuel supply and return hoses.

   Notice

   - ***Plug the openings of hoses and fuel filter with sealing caps.***
   - ***Ensure that the hoses are connected to correct positions.***

2. Loosen the bracket bolts and disconnect the hose from the drain plug.
3. Remove the fuel filter.
4. Install in the reverse order of removal.
5. Press the priming pump until it becomes rigid to deliver the fuel to the transfer line of HP pump.

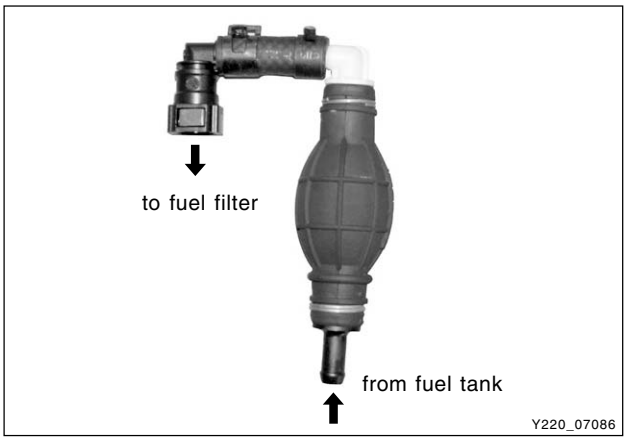
▶ Priming Pump

If fuel runs out during driving or air gets into fuel line after fuel filter replacement, it may cause poor engine starting or damage to each component. Therefore, the hand priming pump is installed to fill filter.

When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

Conditions for using Priming Pump

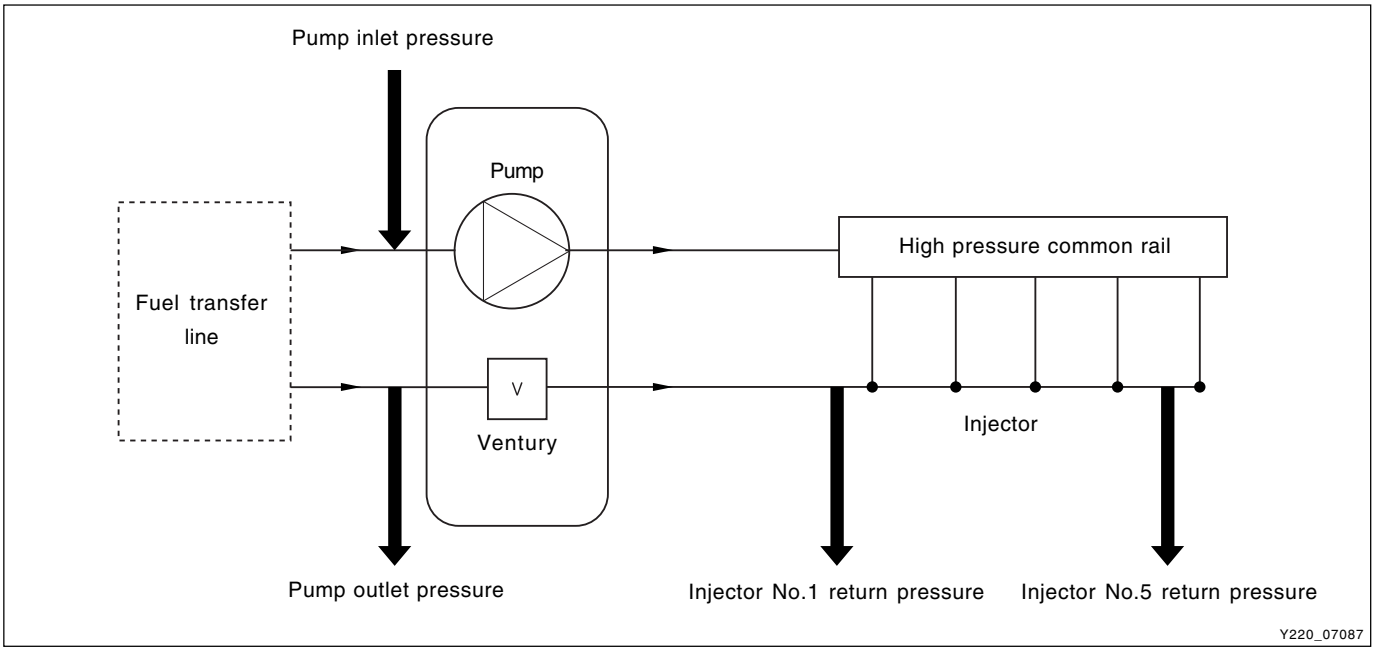
- After run out of fuel
- After draining the water from fuel filter
- After replacing the fuel filter



Notice

When the fuel filter is replaced, the fuel in the fuel tank should be transferred to the filter by using priming pump. So never transfer the fuel in the fuel tank to the filter by driving HP pump with cranking the engine.

▶ Relations Between Pressure and Temperature In Fuel Transfer Line



- The fuel transfer line is the line between fuel tank and HP pump inlet port. The pressure on this line affects the lifetime of fuel filter.
- Temperature of fuel transfer line
  - HP pump inlet temperature is less than 80°C.
  - The temperature of fuel pump inlet is up to 80°C.

    And, diesel fuel has lubrication effects due to its viscosity. Thus, the fuel is also used for pump lubrication. However, this lubrication performance drops as the temperature rises. Accordingly, when the fuel temperature is over 50°C, 100% of fuel is returned to fuel tank to cool down the temperature and then increase the lubrication effects of fuel and prevent heat damage on each section of high fuel pressure line.

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▶ High Pressure Accumulator (Common Rail)

Y220_07088

Description

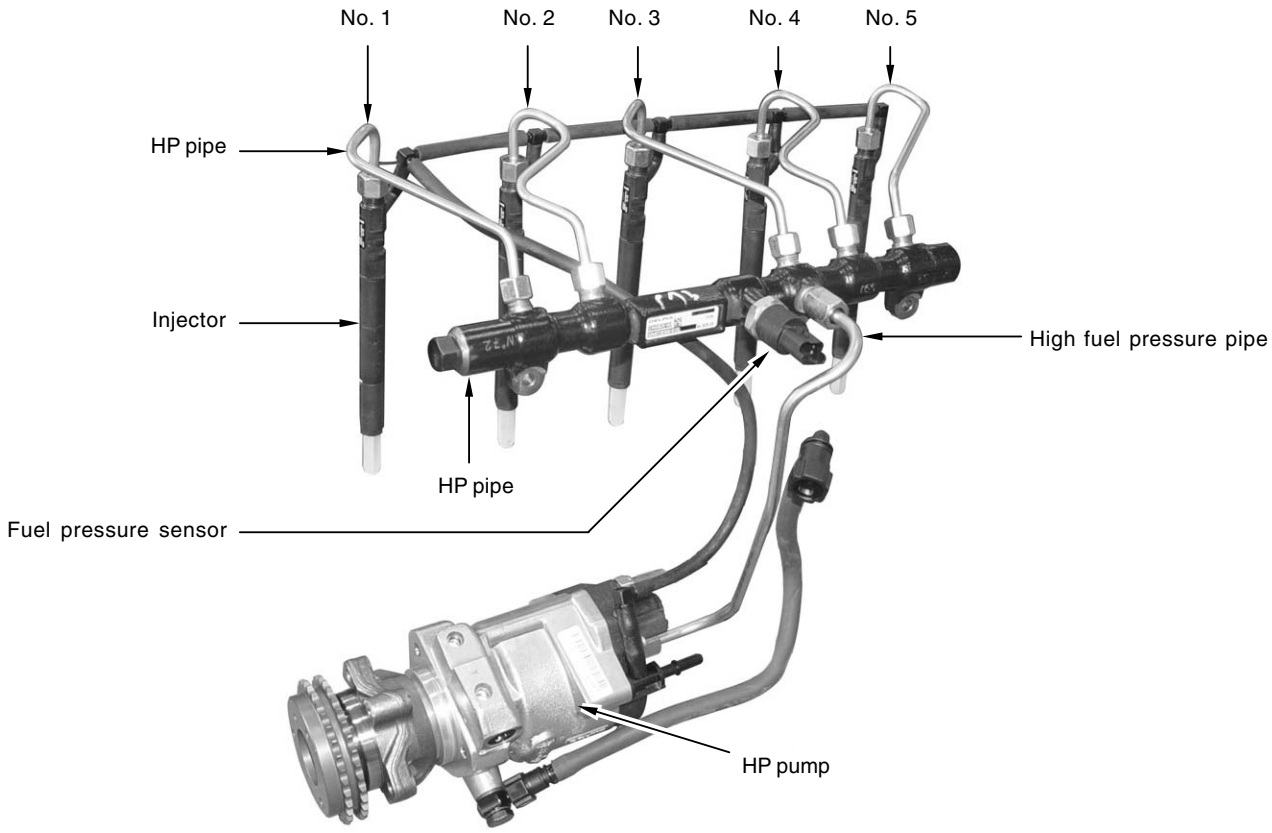
The high pressure accumulator reserves the high pressure fuel. Simultaneously, the pressure changes due to the delivery from HP pump and the fuel injection is diminished by rail volume. This high pressure accumulator is commonly used in all cylinders. Even when a large amount of fuel leaks, the common rail maintains its internal pressure. This ensures that the injection pressure can be maintained from when the injector opens.

Function

- Relieve the pressure pulsation
- Provide pressure information to ECU (fuel pressure sensor)

Specifications

- Material: Forged Steel
- Dimension: - Volume: 22 ± 1cc
  - Length: Max. 397.7 mm
  - Outer diameter: 25.3 mm
- Fuel pressure sensor Integrated type
  - Sensor input voltage: 5 ± 0.1V
  - Sensor output signal voltage: - 4.055 ± 0.125 V @ 1600 ± 15 bar
    - 0.5 ± 0.04 V @ 0 bar
- Operating pressure range
  - Normal condition: 0 ~ 1600 bar
  - Max. Overpressure: 2100 bar
- Ambient temperature: - available within -40°C ~ 125°C
  - Spontaneous max. temperature after engine stops: 140°C (acceptable against total 15 hours)
- Fluid temperature: -40 ~ 100°C under normal operating conditions
- Removal and installation: 10 times without any damage



<High pressure accumulator>

Y220_07089

▶ High Fuel Pressure Pipe

- Function: Resistant to pressure changes, tightness against surroundings, supplying fuel through pump, rail and injector with high pressure
- Material: Steel (Zn Plated)
- Common: Cylinder 1 & 3, 2 & 4, 5
- Internal pressure
  - Internal operating pressure: 0 ~ 1600 bar during its lifetime
  - Spontaneous max. pressure when restoring: 2100 bar (max. total period: 20 hours)
  - Bursting pressure: over 2500 bar
- To keep cleanness and tightness, the high pressure pipe assembly should be used only once.

Notice

- ***Make sure to replace the removed high fuel pressure pipes.***
- ***Tighten the fasteners with the specified tightening torque.***

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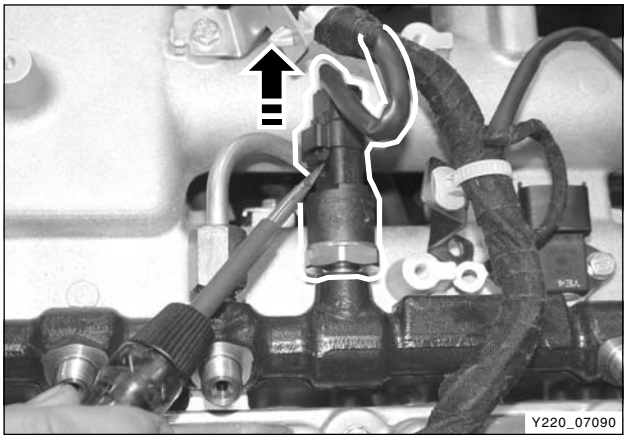
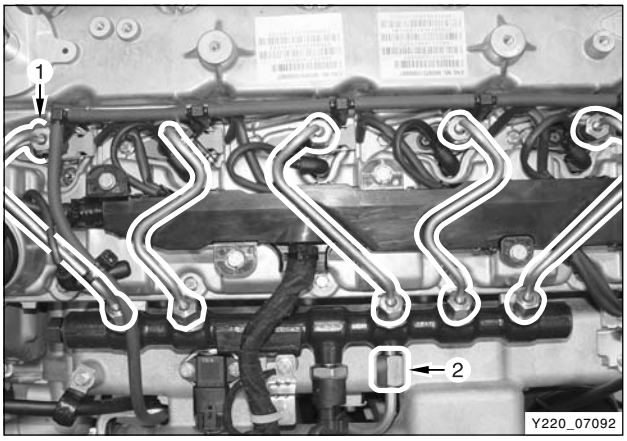
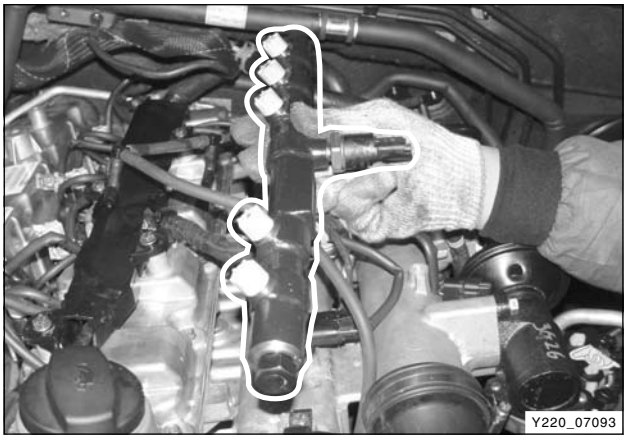






Removal and Installation

※ Preceding Work: Removal of engine cover

1. Disconnect the fuel pressure sensor connector.

   Notice

   - ***Replace the fuel pipes with new ones.***
   - ***Plug the openings of hole in the common rail with sealing caps.***
   - ***Check pressure is low before opening the circuit.***

2. Unscrew the nuts and remove the fuel supply main pipe from the fuel line.

   Installation Notice

Tightening torque	40 ± 10 Nm

   Notice

   - ***Replace the fuel pipes with new ones.***
   - ***Plug the openings of hole in the common rail with sealing caps.***

3. Unscrew the high fuel pressure line nuts and remove the fuel pipes.

   Installation Notice

Tightening torque	40 ± 10 Nm

   Notice

   - ***Replace the fuel pipes with new ones.***
   - ***Plug the openings of hole in the common rail with sealing caps.***

4. Unscrew the bolts and remove the common rail asssembly.

   Installation Notice

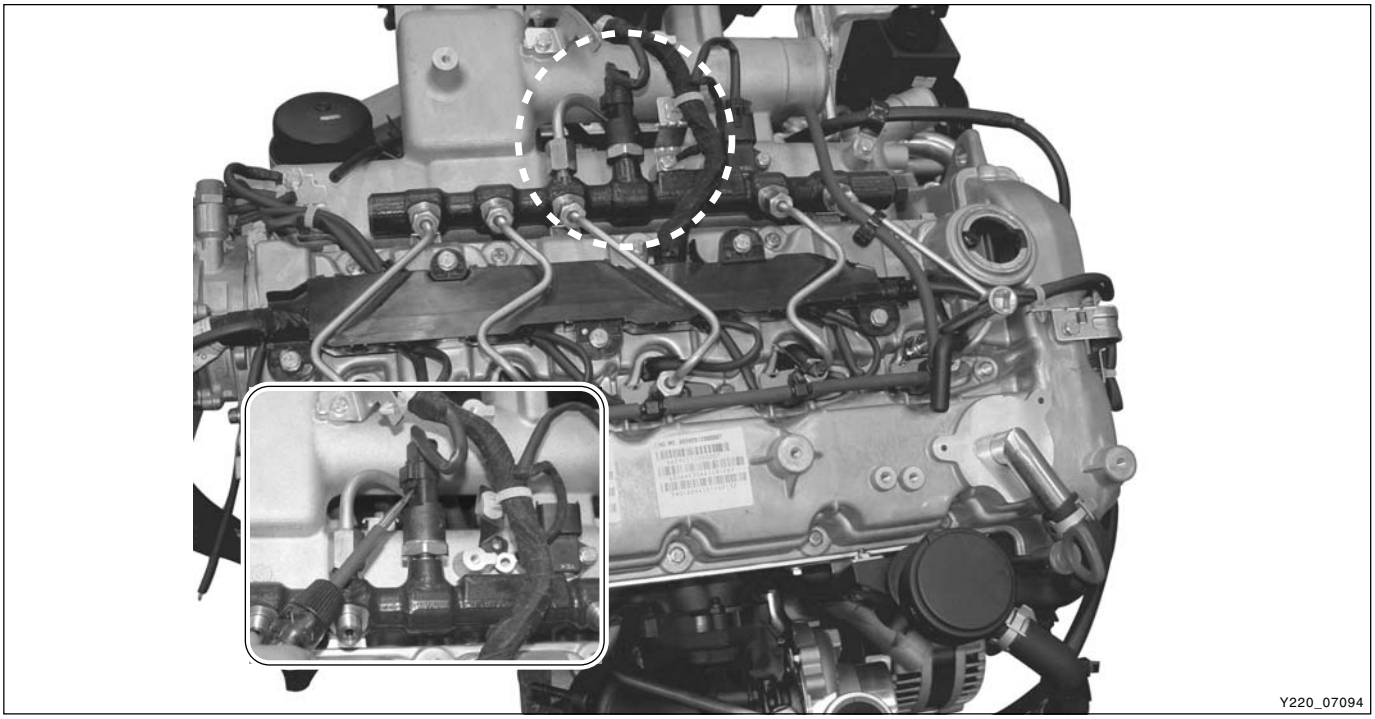
Tightening torque	25 ± 2.5 Nm

   Notice

   - ***Replace the fuel pipes with new ones.***
   - ***Plug the openings of hole in the common rail with sealing caps.***

5. Install in the reverse order of removal.

▶ Fuel Pressure Sensor



Fuel pressure sensor on the center of common rail detects instant fuel pressure changes and then sends to ECU. When received these signals, ECU uses them to control fuel volume and injection time.

The fuel in the rail reaches to sensor diaphragm via blind hole in the pressure sensor and the pressure signal converts to electrical signal. The signal measured by sensor will be amplified to input to ECU.

This piezo element type sensor changes pressure into electrical signal. Accordingly, when the shape of diaphragm changes, electrical resistance in the layers on the diaphragm changes then can measure 0.5 ~ 5 V.

- Sensor input voltage: 5 ± 0.1 V
- Output signal voltage of sensor
  - 4.055 ± 0.125 V: 1600 ± 15bar
  - 0.5 ± 0.04 V: 0 bar

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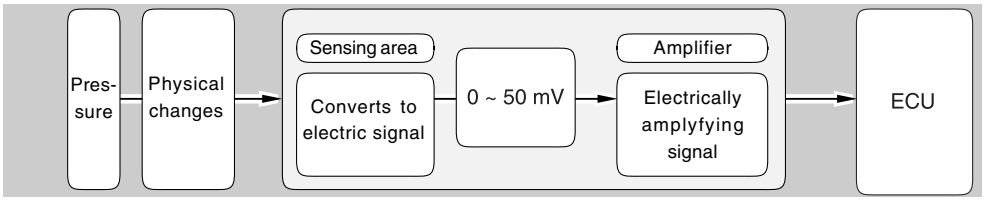
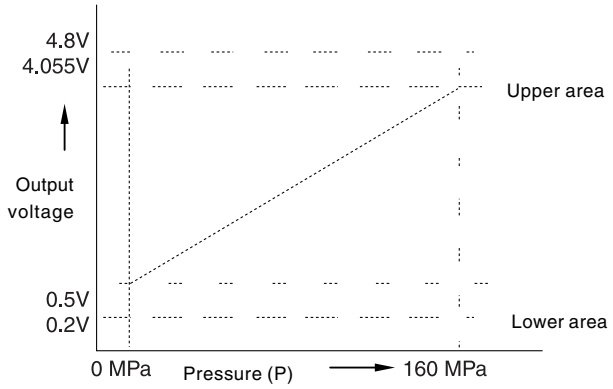


<Operation principle of fuel pressure sensor>

Y220_07095



<Sensor voltage>

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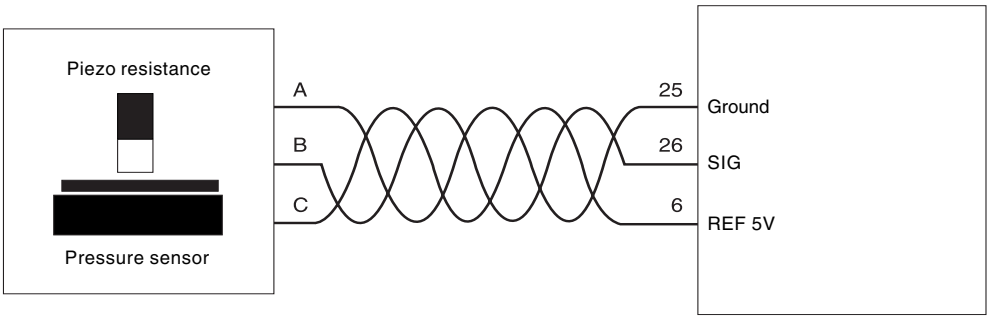
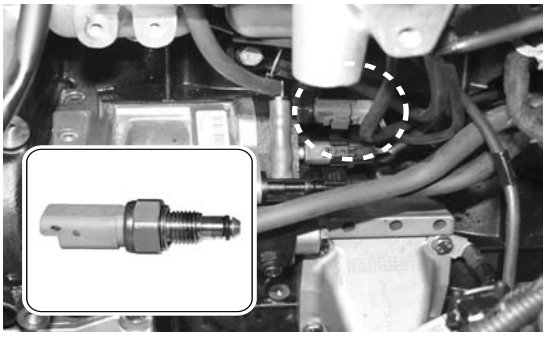


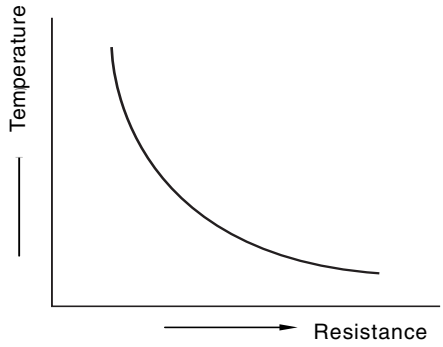
<Circuit diagram of fuel pressuer sensor>

Y220_07097

▶ Fuel Temperature Sensor



<Fuel temperature sensor>



<Output characteristics of fuel temperature sensor>

Y220_07098

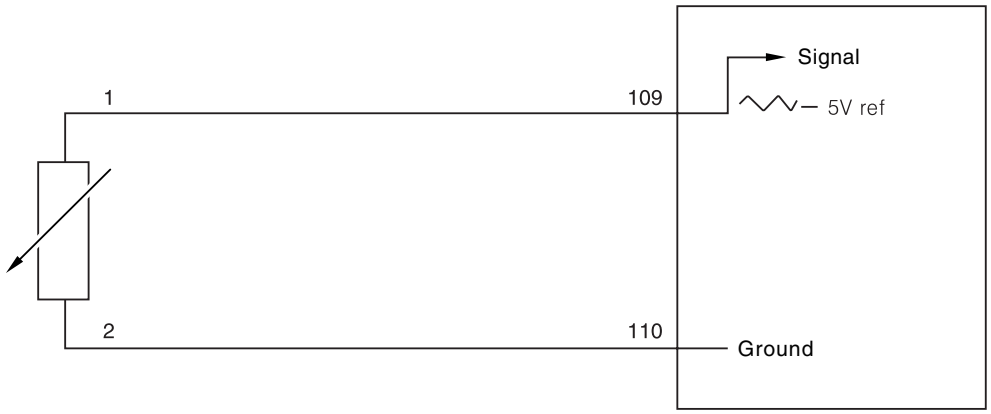
Fuel temperature sensor is a NTC resistor that sends fuel temperature to ECU.

In case of NTC resistor, the resistance lowers if engine temperature rises so the ECU detects lowering signal voltages.

Fuel temperature sensor is installed on the fuel return line to correct pressure after measuring fuel temperature. 5V is supplied to the sensor and voltage drop by temperature is delivered to ECU to measure the fuel temperature through analog-digital converter (ADC).

Notice

Fuel temp sensor not to be dismounted.



<Circuit diagram of fuel temperature sensor>

Y220_07099

▶ HFM Sensor

- Refer to “Intake System”

▶ Crankshaft Position Sensor

- Refer to “Engine Assembly”

▶ Knock Sensor

- Refer to “Engine Assembly”

▶ Camshaft Position Sensor

- Refer to “Engine Assembly”

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INJECTOR

The C21 labels including injector characteristics are attached in each injector. These C21 values should be input to ECU by using Scan-i when replacing the ECU or injectors.

Special cautions:

1. Plug the openings of hoses and pipes with the sealing caps.
2. Replace the copper washer with new one plus injector holder bolt & washer.
3. Tighten the injector holder bolts with the specified tightening torque.
4. Be careful not to drop the injector.

Specifications

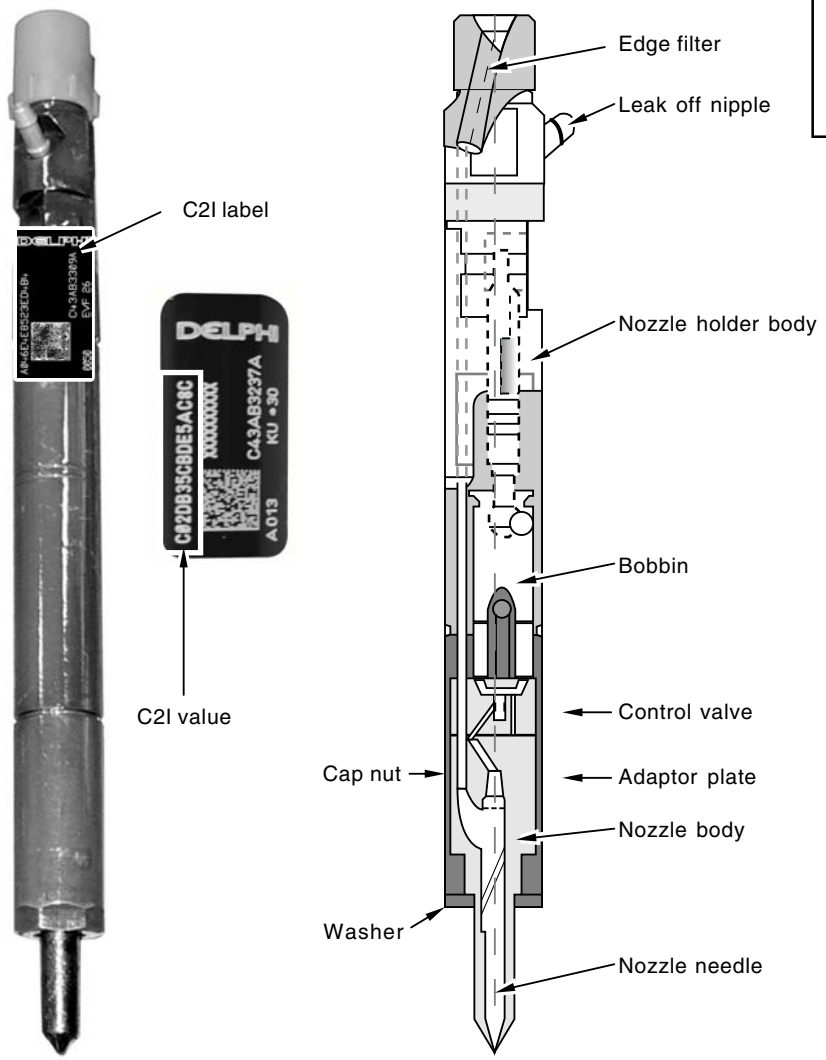
Length: · Injector body 181.35 mm
· Injector nozzle 22.155 mm

Nozzle basic: 5 Holes, 146°C Cone Angle, 840 mm^3/min

Control: PWM type (solenoid injector)

Tightening: Clamping by fork

Fuel return: Nipple



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The maximum injection pressures are approximately 1,600 bar. The forces to be overcome in order to lift the needle of the injector are therefore very large. Because of this, it is impossible to directly control the injector by using an electro-magnetic actuator, unless very high currents are used, which would be incompatible with the reaction times required for the multiple injections. The injector is therefore indirectly controlled by means of a valve controlling the pressurizing or discharging of the control chamber located above the needle:

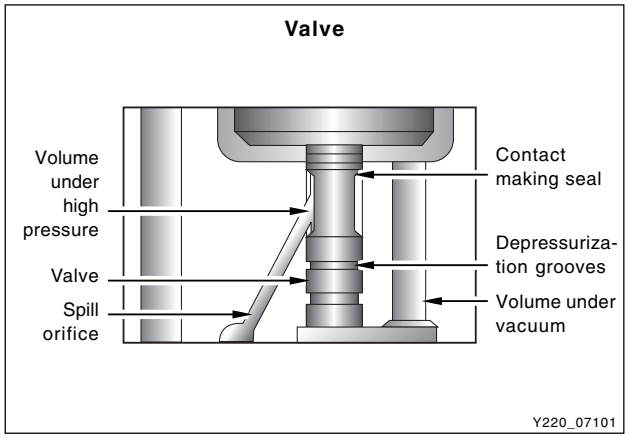
- When the needle is required to lift (at the start of injection): the valve is opened in order to discharge the control chamber into the back leak circuit.
- When the needle has to close (at the end of injection): the valve closes again so that pressure is re-established in the control chamber.

Valve

In order to guarantee response time and minimum energy consumption:

- The valve must be as light as possible.
- The valve stroke must be as short as possible.
- The effort needed to move the valve must be minimal, which means that the valve must be in hydraulic equilibrium in the closed position.

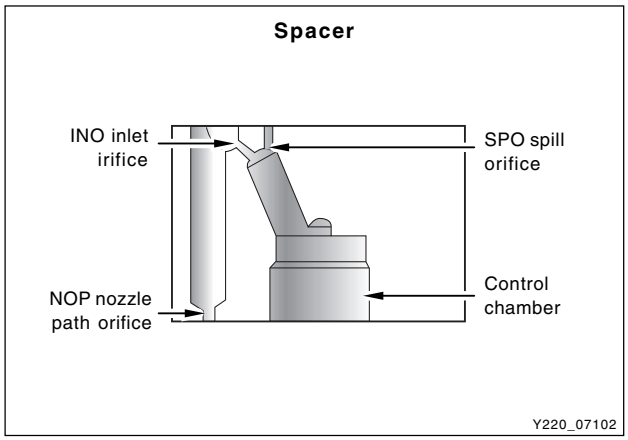
Spring pressure ensures contact between the valve and its seat. To lift the valve, it is therefore required to overcome the force being applied by this spring.



Spacer

The spacer is situated underneath the valve support. It integrates the control chamber and the three calibrated orifice which allow operation of the injector. These orifices are:

- The injector supply orifice (Nozzle Path Orifice: NPO)
- The control chamber discharge orifice (Spill Orifice: SPO)
- The control chamber filling orifice (Inlet Orifice: INO)



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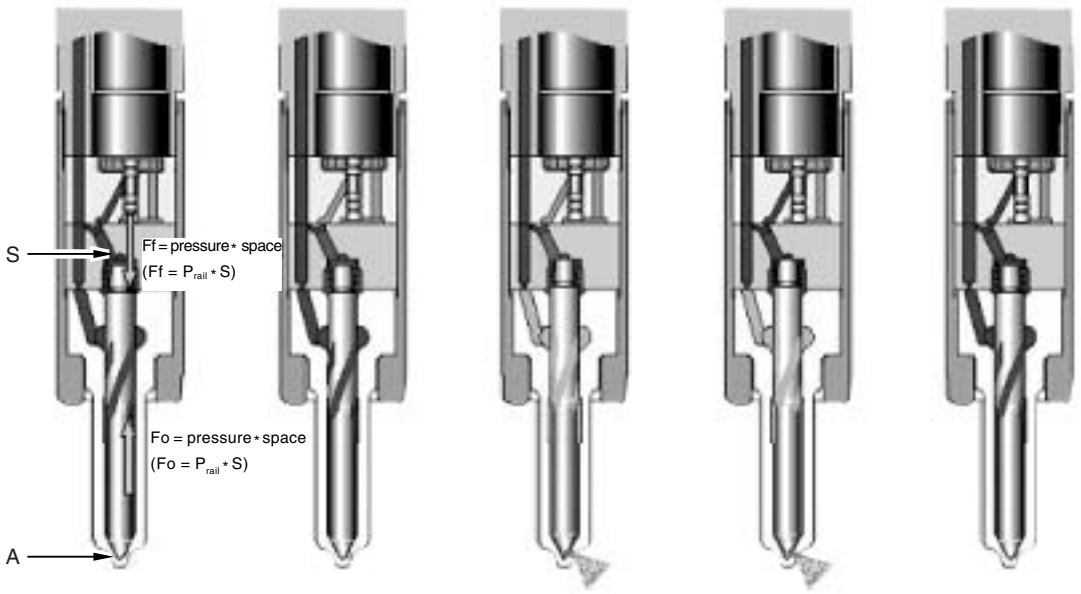
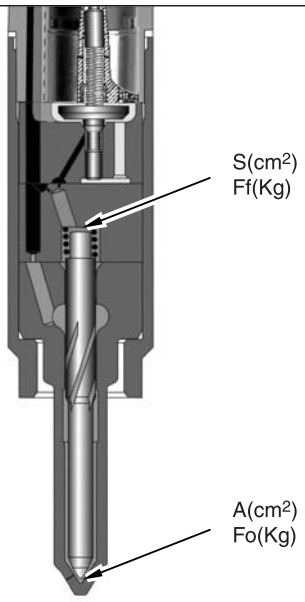
▶ Principle of Operation



Valve closed	Valve opens	Valve open	Valve closes	Valve closed
Needle closed	Needle closed	Needle opens	Needle open	Needle closed
No injection	No injection	Start of injection	End of injection	No injection

Y220_07103



* S: The area of the flat upper surface of the injector's needle
* A: The area of the needle surface situated above the section of contact between the needle and its seat
* Ff: The force applied by the fuel onto section "S"
* Fo: The force applied by the fuel onto section "A"

Y220_07104

Injector at rest

The valve is closed. The control chamber is subject to the rail pressure.

The pressure force applied by the fuel onto the needle is:

$$Ff = S * P_{rail}$$

The needle is closed and hence there is no fluid circulation through the NPO orifice. While static, the nozzle produces no pressure drop. The cone of the needle is therefore subject to the rail pressure. The force applied by the fuel to the needle is:

$$Fo = A * P_{rail}$$

Since Ff > Fo, the needle is held in the closed position. There is no injection.

Solenoid valve control

When the solenoid valve is energized, the valve opens. The fuel contained in the control chamber is expelled through the discharge orifice known as the Spill Orifice (SPO).

As soon as Ff > Fo, the needle remains held against its seat and there is no injection.

Start of injection

As soon as Ff < Fo, or in other words:

$$P_{control} < P_{rail} * A/S$$

The needle lifts and injection begins. As long as the valve is open, the injector's needle remains lifted. When injection begins, fuel circulation is established to feed the injector. The passage of the fuel through the inlet orifice of the injector (similar to a nozzle) leads to a pressure drop which depends on the rail pressure.

When the rail pressure is at its highest (1600 bar), this pressure drop exceeds 100 bar. The pressure applied to the cone of the needle (the injection pressure) is therefore lower than the rail pressure.

End of injection

As soon as the solenoid valve is de-energized, the valve closes and the control chamber is filled. Since the needle is open, the thrust section areas situated on either side of the needle is therefore to apply different pressures to each of these faces. The pressure in the control chamber cannot exceed the rail pressure, so it is therefore necessary to limit the pressure applied to the needle's cone. This pressure limitation is achieved by the NPO orifice which produces a pressure drop when fuel is passing through it.

$$Prail * S \geq (Prail - \triangle P) * S$$

When static, this pressure drop is zero. When the pressure in the control chamber becomes higher than the pressure applied to the needle's cone, the injection stops.

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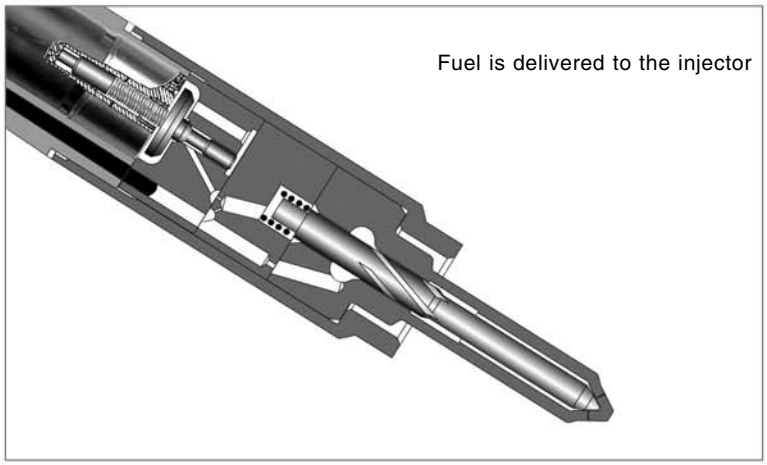
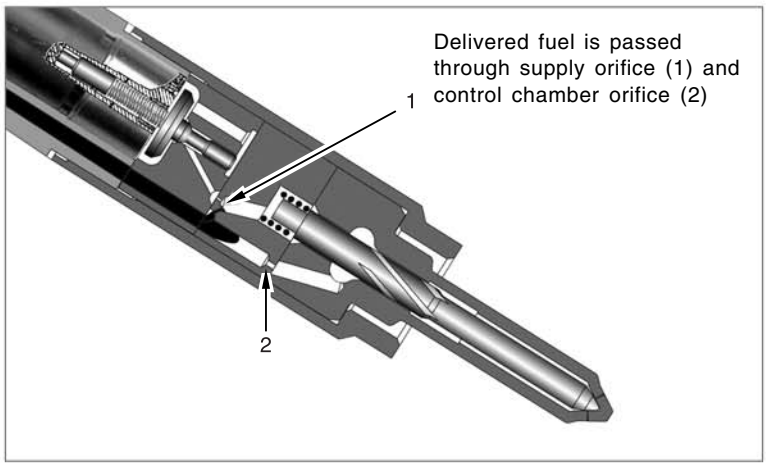
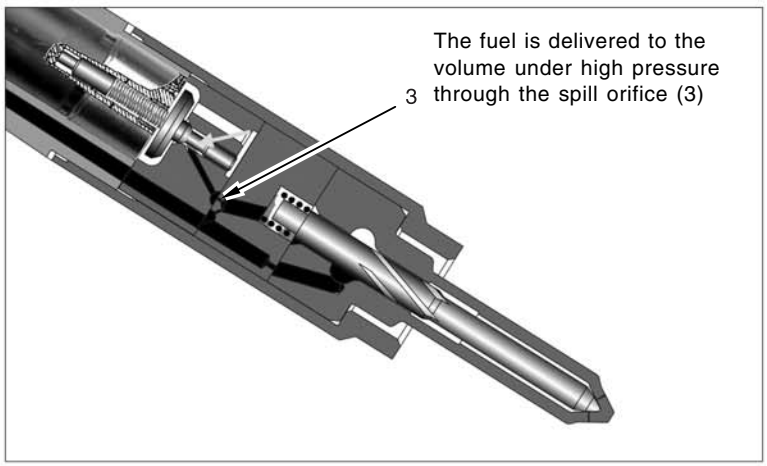
▶ Injecting Process







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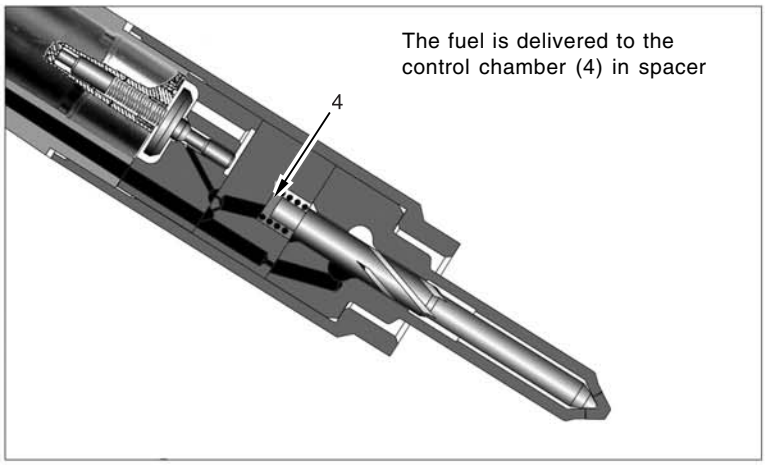
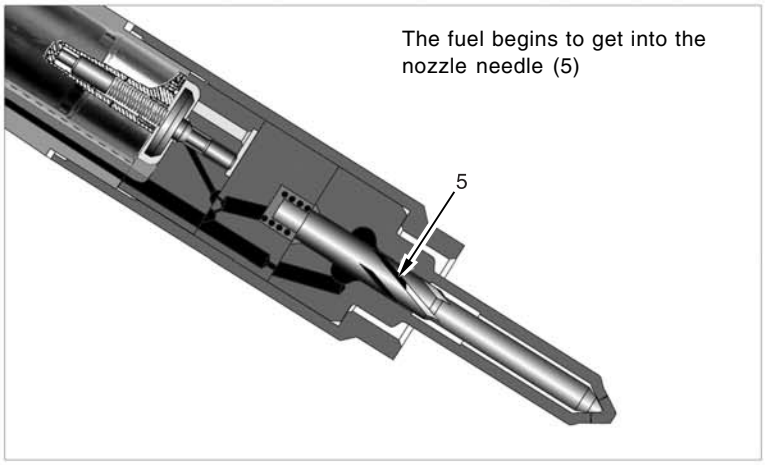
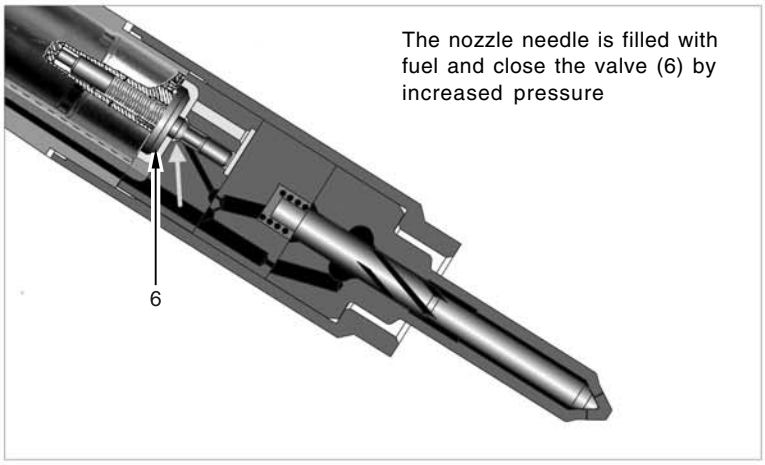


The fuel is delivered to the control chamber (4) in spacer



The fuel begins to get into the nozzle needle (5)



The nozzle needle is filled with fuel and close the valve (6) by increased pressure

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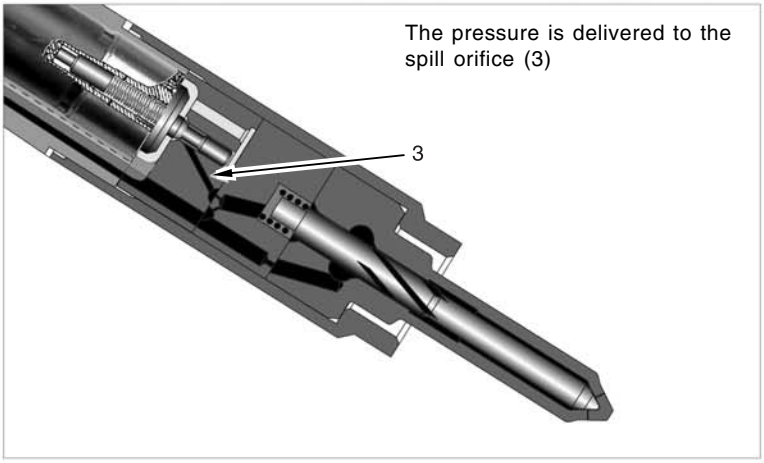
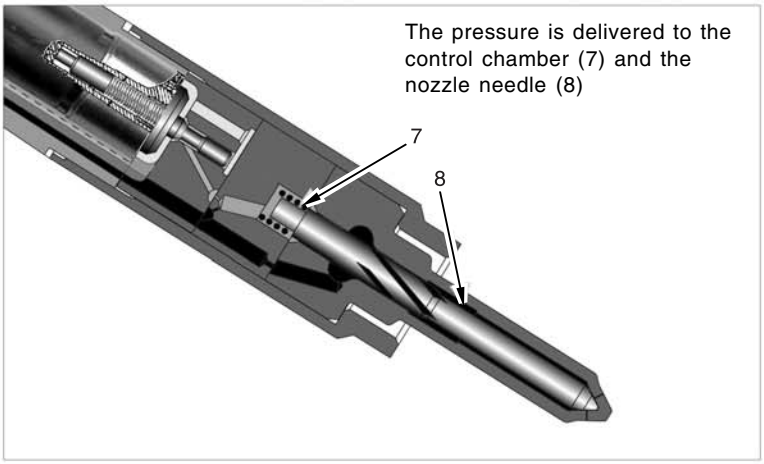
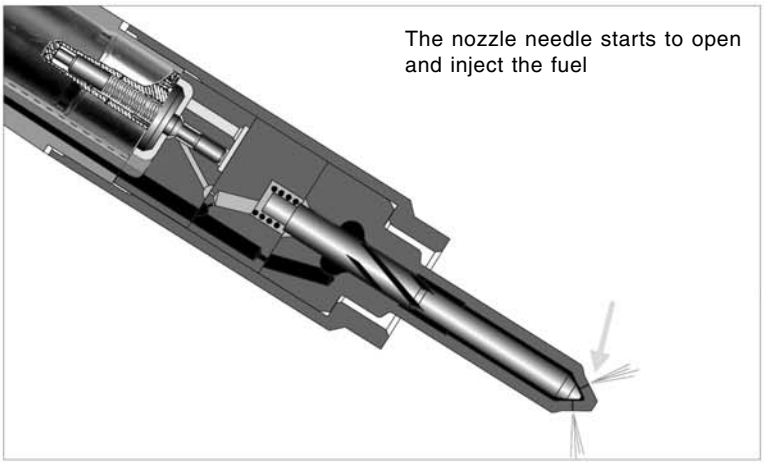
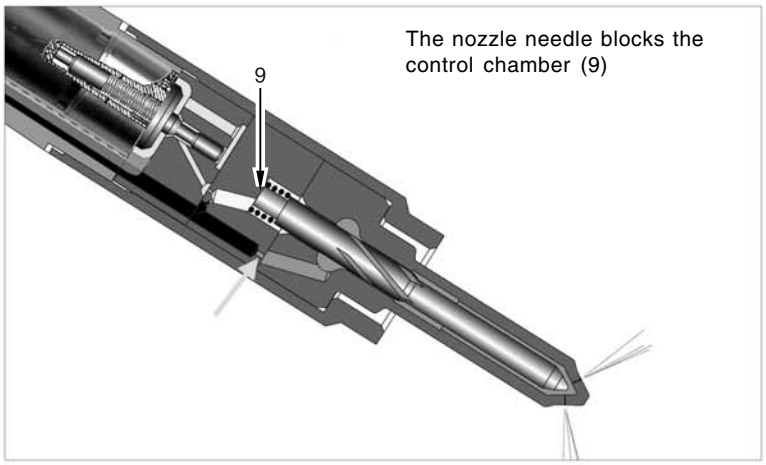

The pressure is delivered to the spill orifice (3)
3

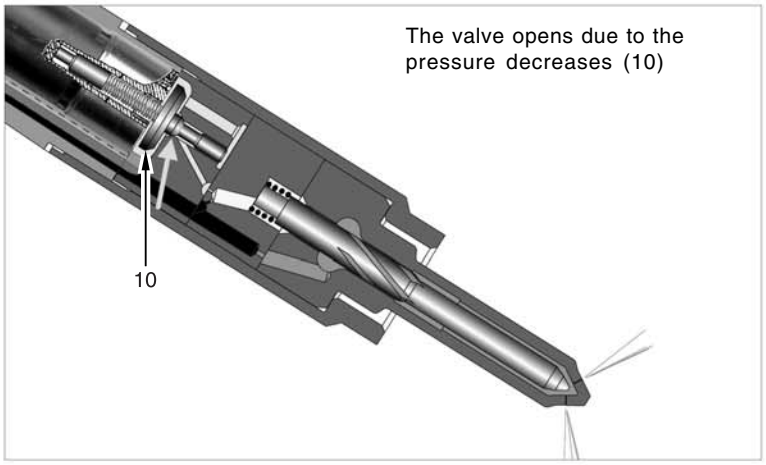

The pressure is delivered to the control chamber (7) and the nozzle needle (8)
7
8


The nozzle needle starts to open and inject the fuel

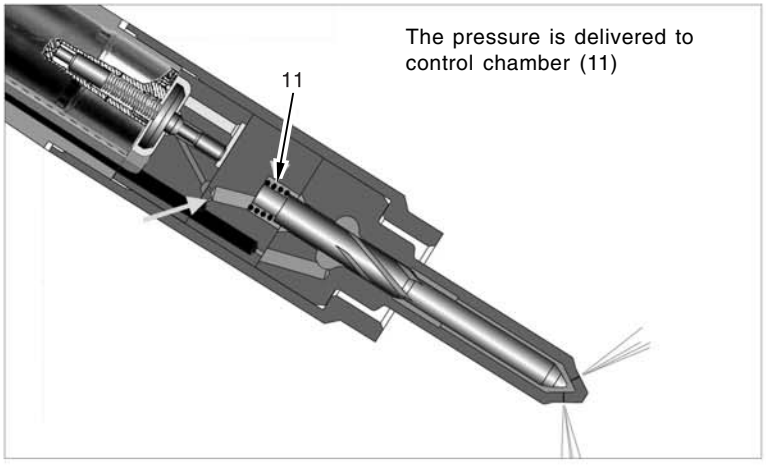
Y220_07107



The nozzle needle blocks the control chamber (9)



The valve opens due to the pressure decreases (10)



The pressure is delivered to control chamber (11)

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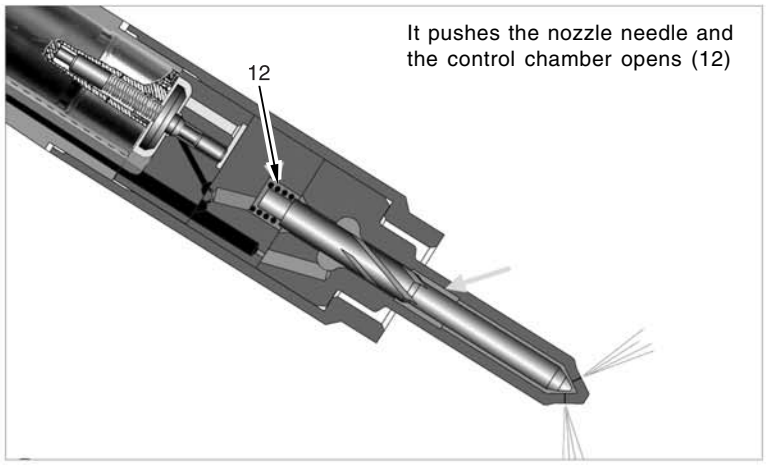
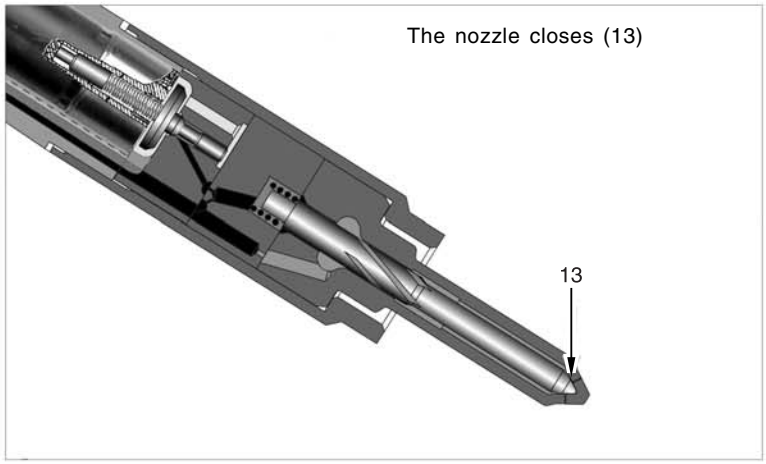

It pushes the nozzle needle and the control chamber opens (12)
12


The nozzle closes (13)
13

Y220_07109

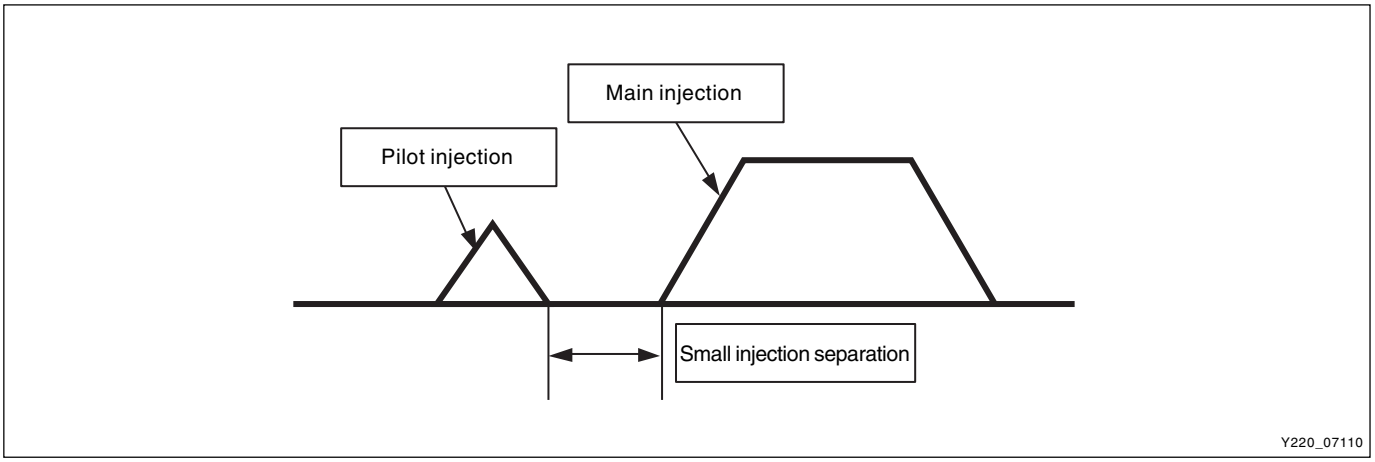
▶ Fuel pressure

Fuel pressure

- Minimum operating pressure: start injection over 100 bar
- Maximum operating pressure: 1,600 bar (max. operating pressure in normal conditions)
- Max overpressure: 2,100 bar

Maximum fuel volume at each injector cycle

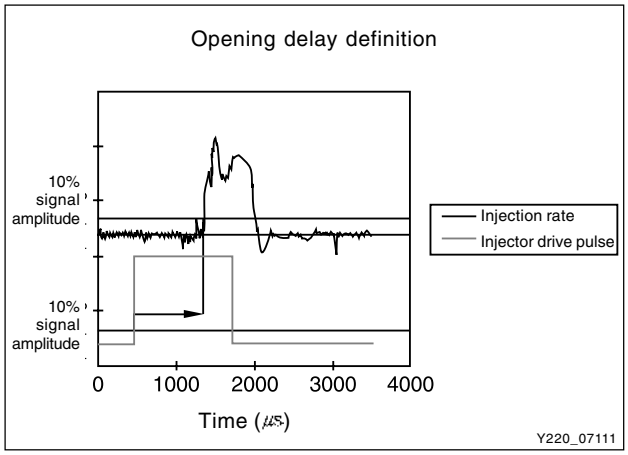
- Pilot Injection ≤ 5 mm^3
- Main Injection ≤ 85 mm^3 (within 200 ~ 1,600 bar)



- Small injection separation: min. 200㎲
  (duration between the end of pilot injection and start of main injection)

- Opening Delay
  : Delayed time from applying operating voltage to start of injection

- Adjustment of feedback injection volume: C2I



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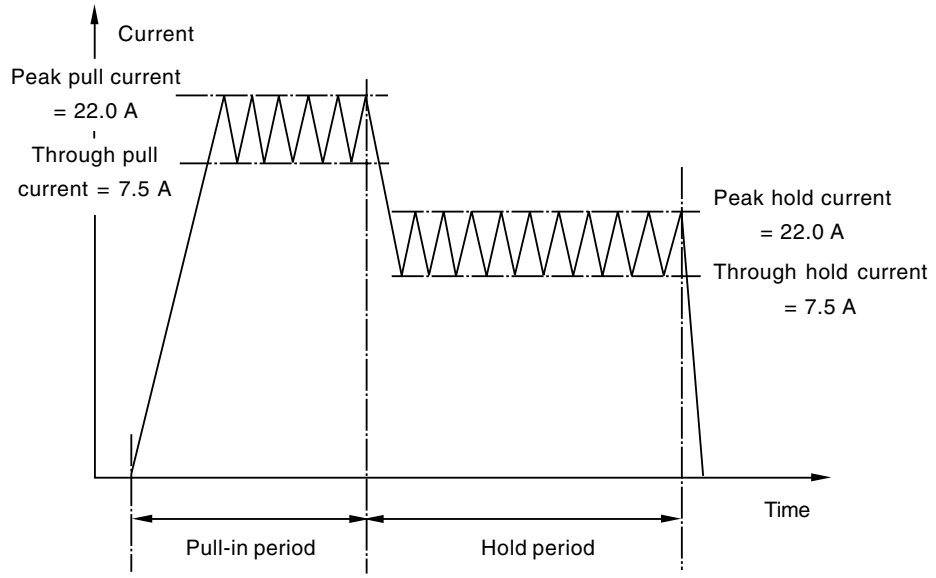
▶ Injector control



The control current of the coil takes the following form:

The low current allows the Joule effect losses in the ECU and injector to be reduced. The call current is higher than the hold current because during the hold phase.

- The air gap between the valve and the coil is reduced and the electromagnetic force to be applied to the valve can thus be reduced. It is no longer necessary to overcome the valve inertia.

Note

Joule Effect: ***The principle that the heat produced by an electric current is equal to the product of the resistance of the conductor, the square of the current, and the time for which it flows.***

I: current (A)

R: resistance (Ω)

T: time (sec)

H: calori (cal)

Heat capacity (H) = 0.24 I^2RT

▶ Fuel Injection

Other than conventional diesel engine, common diesel engine use two steps injection as follows:

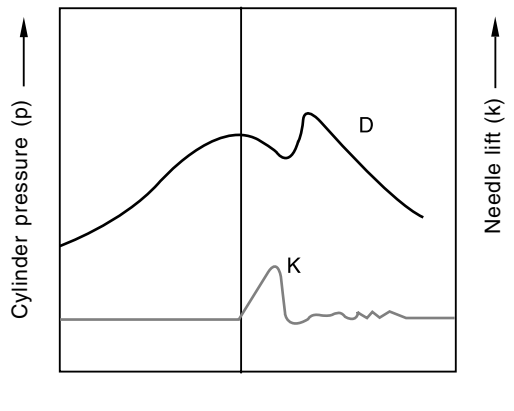
- Pilot Injection
- Main Injection

In above two step injection, the fuel injection volume and injection timing is calibrated according to fuel pressure and fuel temperature.

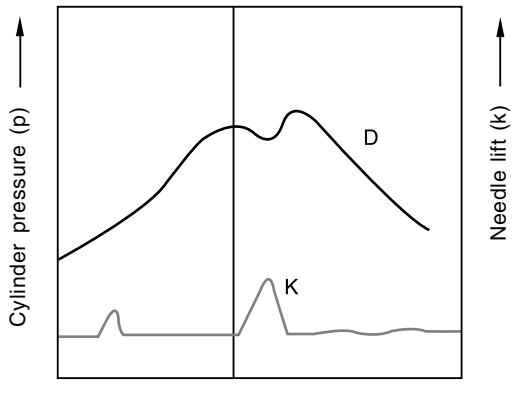
Pilot injection

Before starting main injection, a small amount of fuel is injected to help proper combustion. This injection is for reducing the engine noise and vibration.

In other words, it makes the pressure increase in combustion chamber during combustion smooth to reduce the engine noise and vibration (suppressing the surging). Basic values for pilot injection are adjusted according to the coolant temperature and intake air pressure.



<Characteristic curve of discharge without pilot injection>



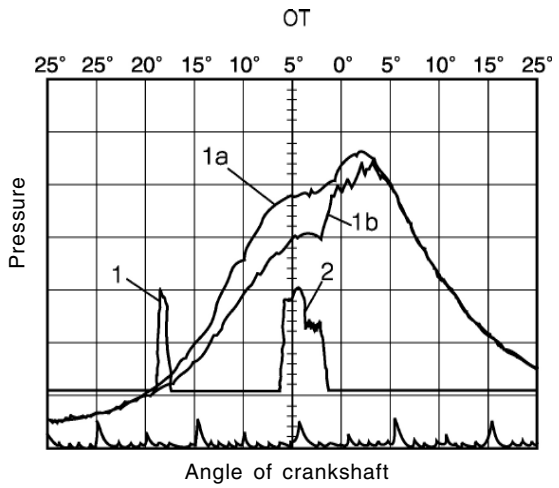
<Characteristic curve of discharge with pilot injection>

Y220_07113

Main injection

Actual output from engine is achieved by main injection.

The main injection determines the pilot injection has been occurred, then calculates the injection volume. Accelerator pedal sensor, engine rpm, coolant temperature, intake air temperature and atmospheric pressure are basic date to calculate the fuel injection volume in main injection.



1. Pilot injection
2. Main injection

1a. Ignition pressure with pilot injection

2a. Ignition pressure without pilot injection

<Characteristic curve of combustion chamber pressure during pilot injection>

Y220_07114

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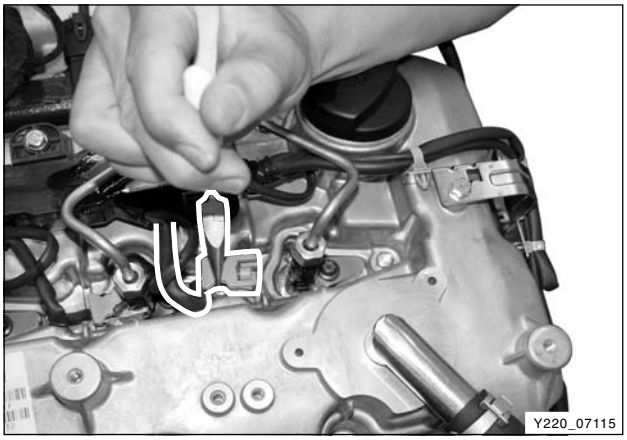

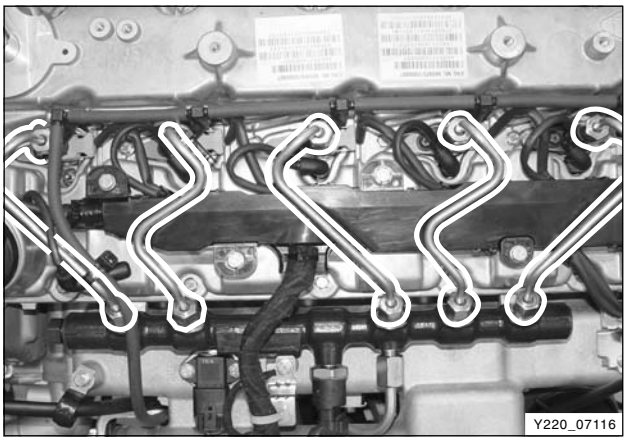

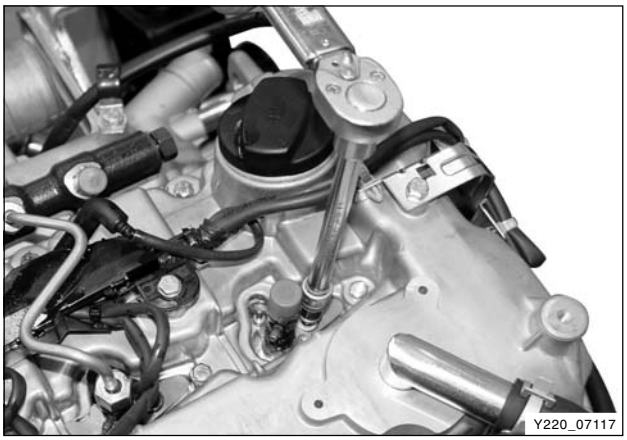

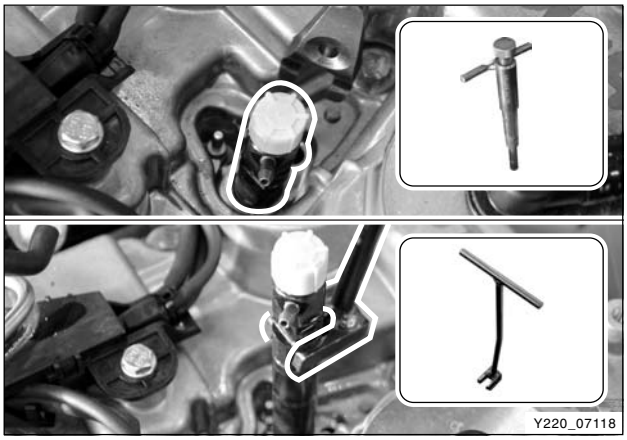

Removal and Installation

※ Preceding Work: Removal of engine cover

1. Disconnect the injector return hose.

   Notice

   Plug the openings with sealing caps.

2. Remove the relevant connector for the injector.

3. Unscrew the bolts and remove the fuel pipes.

   Installation Notice

Tightening torque	40 ± 10 Nm

   Installation Notice

   - ***Replace the fuel pipes with new ones.***
   - ***Plug the openings of the common rail with sealing caps.***

4. Unscrew the injector holder bolts.

   Installation Notice

Tightening torque	9 ± 1.0 Nm
	180° ± 10°

   Replace the bolts and washer with new ones.

5. Disconnect the injector holder.

6. Remove the injectors with a special tool.

   Notice

   - ***Plug the openings of the injectors with sealing caps.***
   - ***Pull the dropped washer out from the engine with a special tool.***
   - ***Clean carbon deposite in hole with specific tool.***

7. Install in the reverse order of removal.
8. Do not forget to update C2I with Scan 100 and cross old C2I on label fitted on engine.

   Notice

   Replace the copper washer, holder bolts and washer and fuel supply pipes with new ones.

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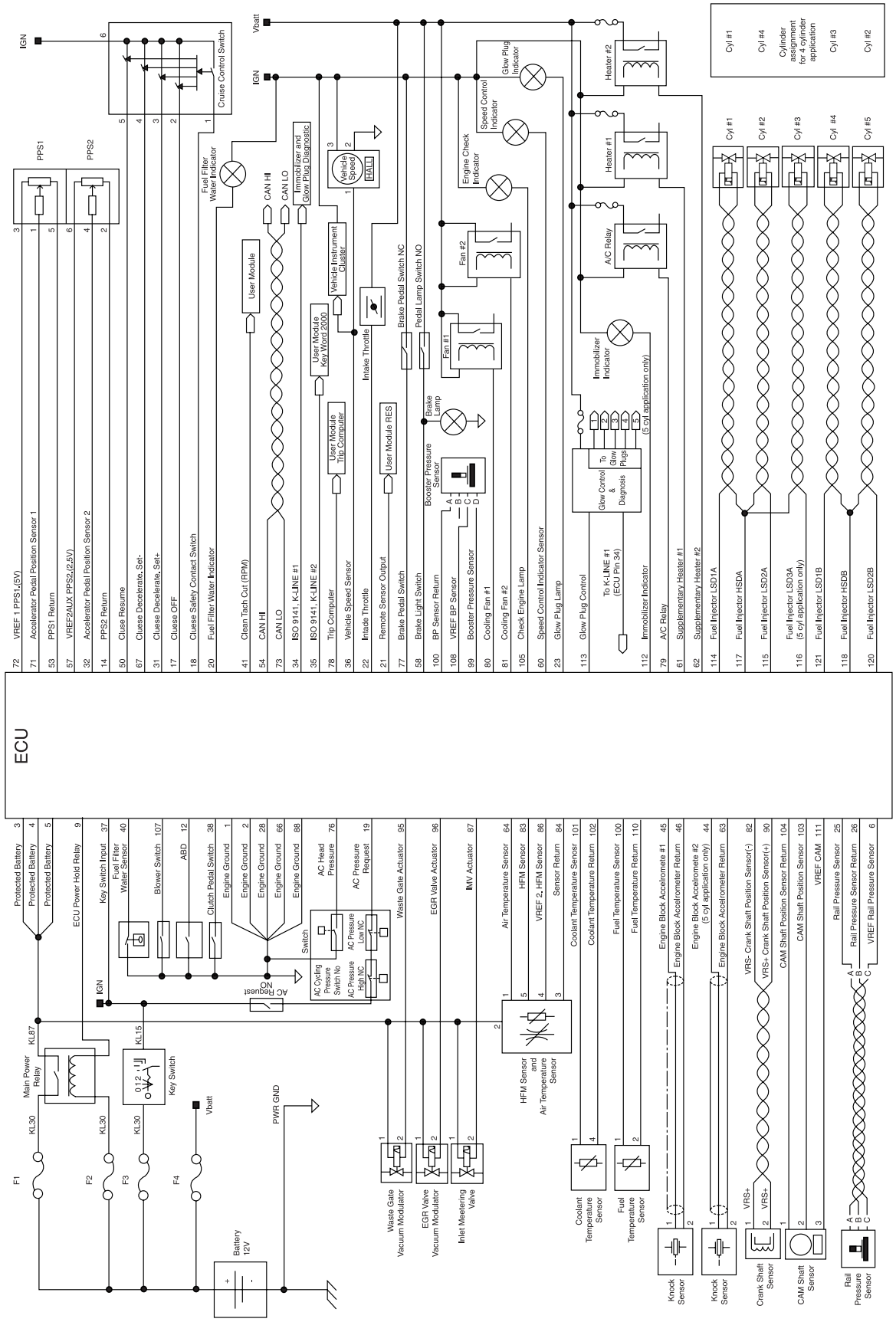
▶ ECU Wiring Diagram



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SECTION DI08

ENGINE CONTROL SYSTEM

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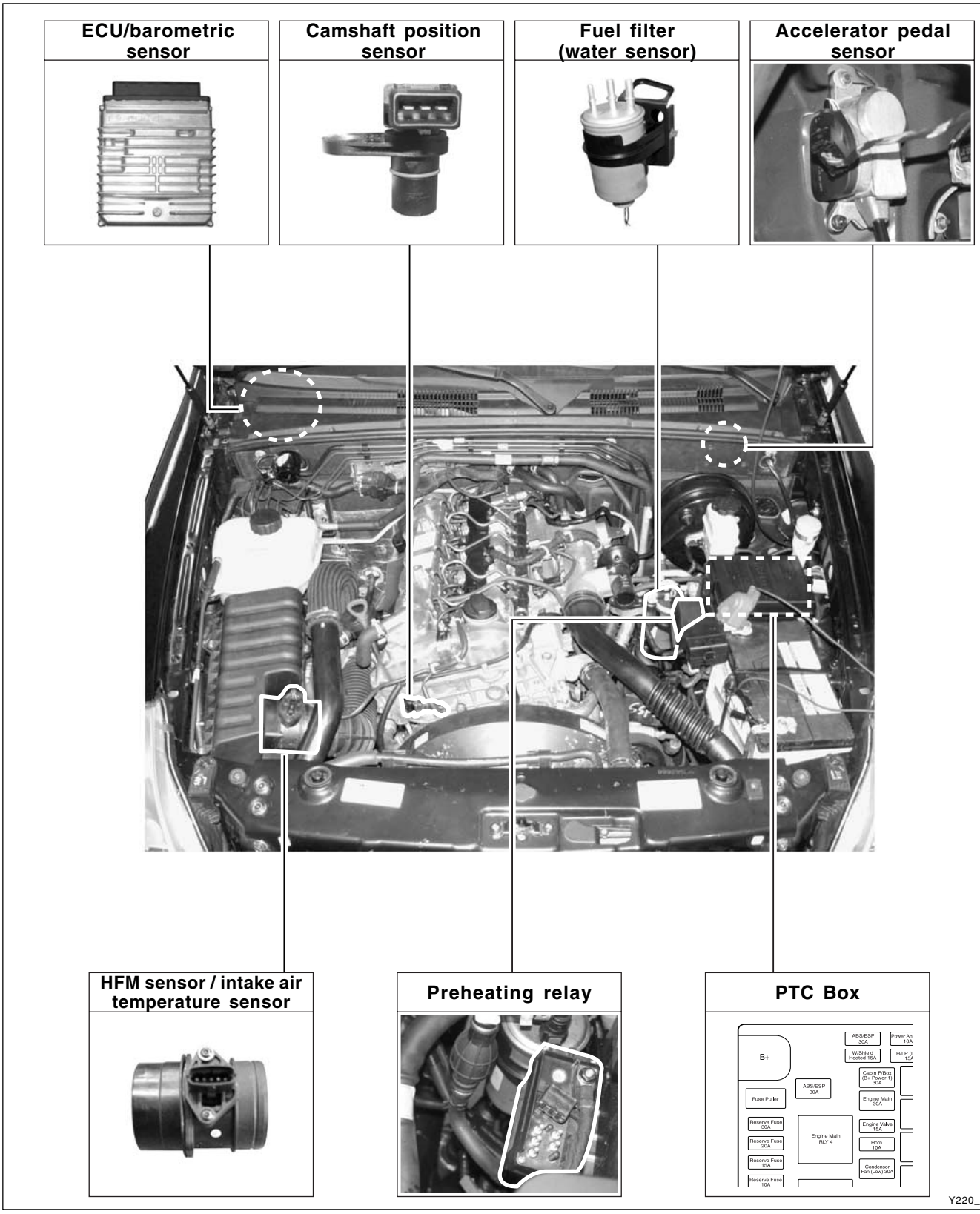
SENSORS FOR DIAGNOSIS

ENGINE ECU AND OTHER COMPONENTS



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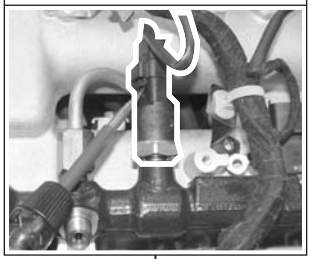
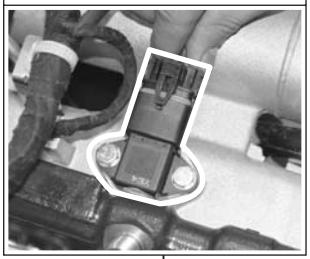
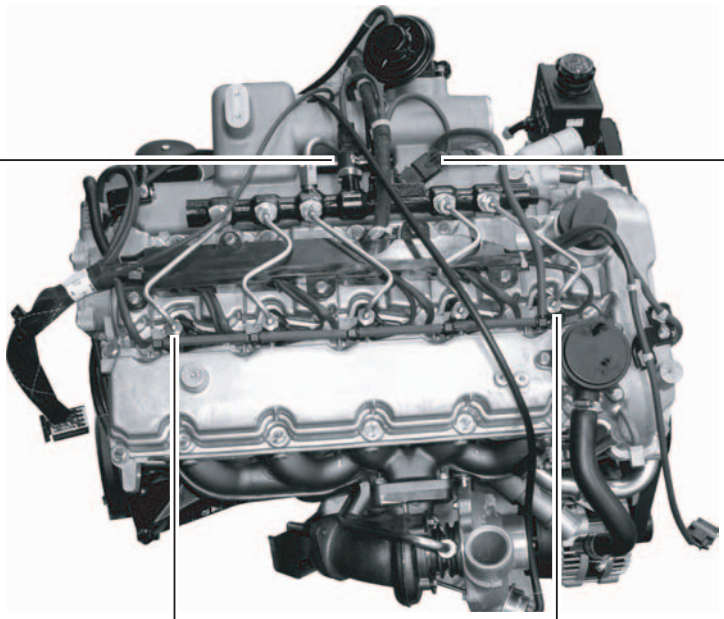
TOP VIEW

Fuel pressure sensor

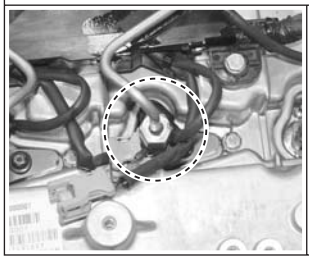


Booster pressure sensor

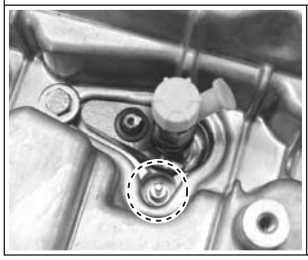




Injectors (5)



Glow Plugs (5)

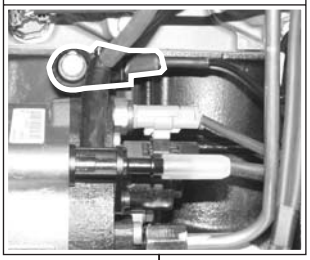


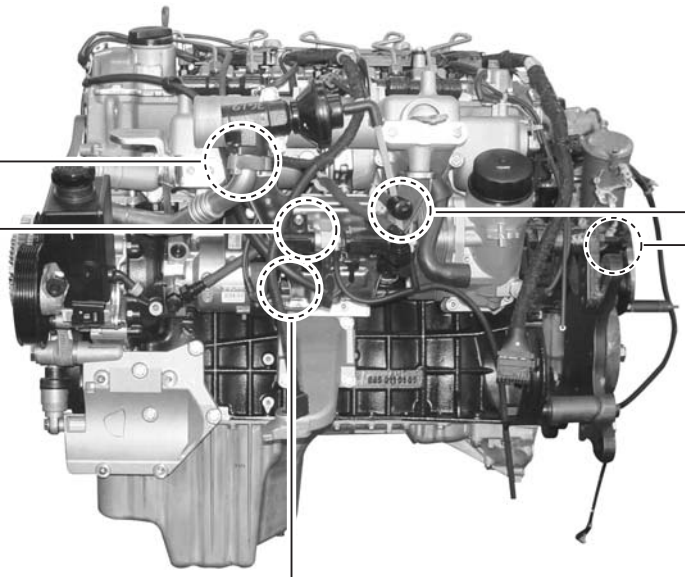
Y220_08002

SIDE VIEW

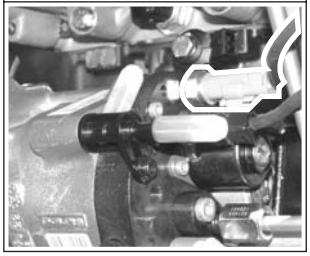
Coolant temperature sensor

Knock sensors (2)



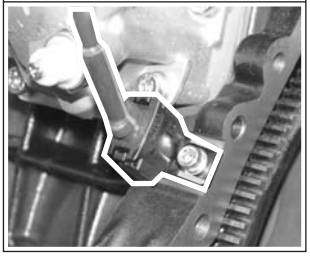


Fuel temperature sensor



Fuel pressure regulating valve

Crankshaft position sensor



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ENGINE CONTROL SYSTEM

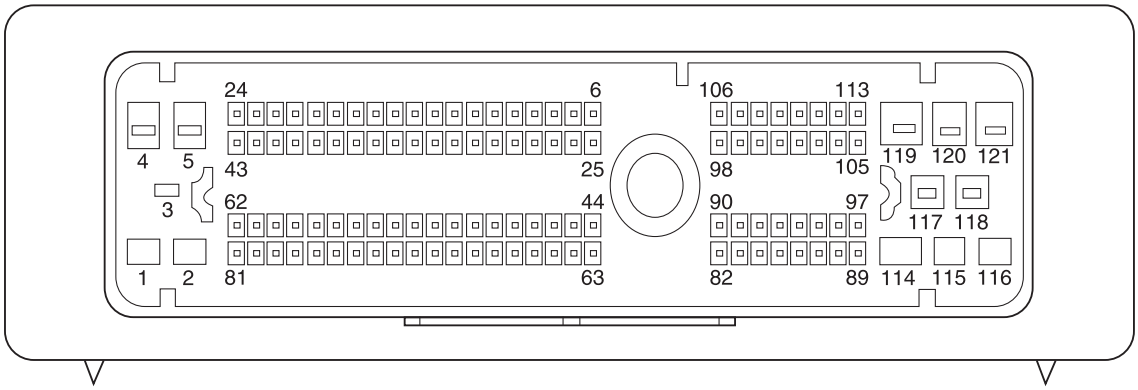
ECU

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

ECU receives signals from sensors through data line and then performs effective engine air-fuel ratio controls based on those signals.

Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's demand) through electrical signal that generated by variable resistance changes in accelerator pedal sensor.

Air flow (hot film) sensor detects intake air volume and then transmits to ECU. Especially, the engine ECU controls the air-fuel ratio by recognizing instant air volume changes through air flow sensor to pursue low emission gases (EGR valve control). Furthermore, the ECU uses signals from coolant temperature and air temperature sensor, booster pressure sensor and atmospheric pressure sensor as compensation signal to respond to injection start and pilot injection set values and to various operations and variables.



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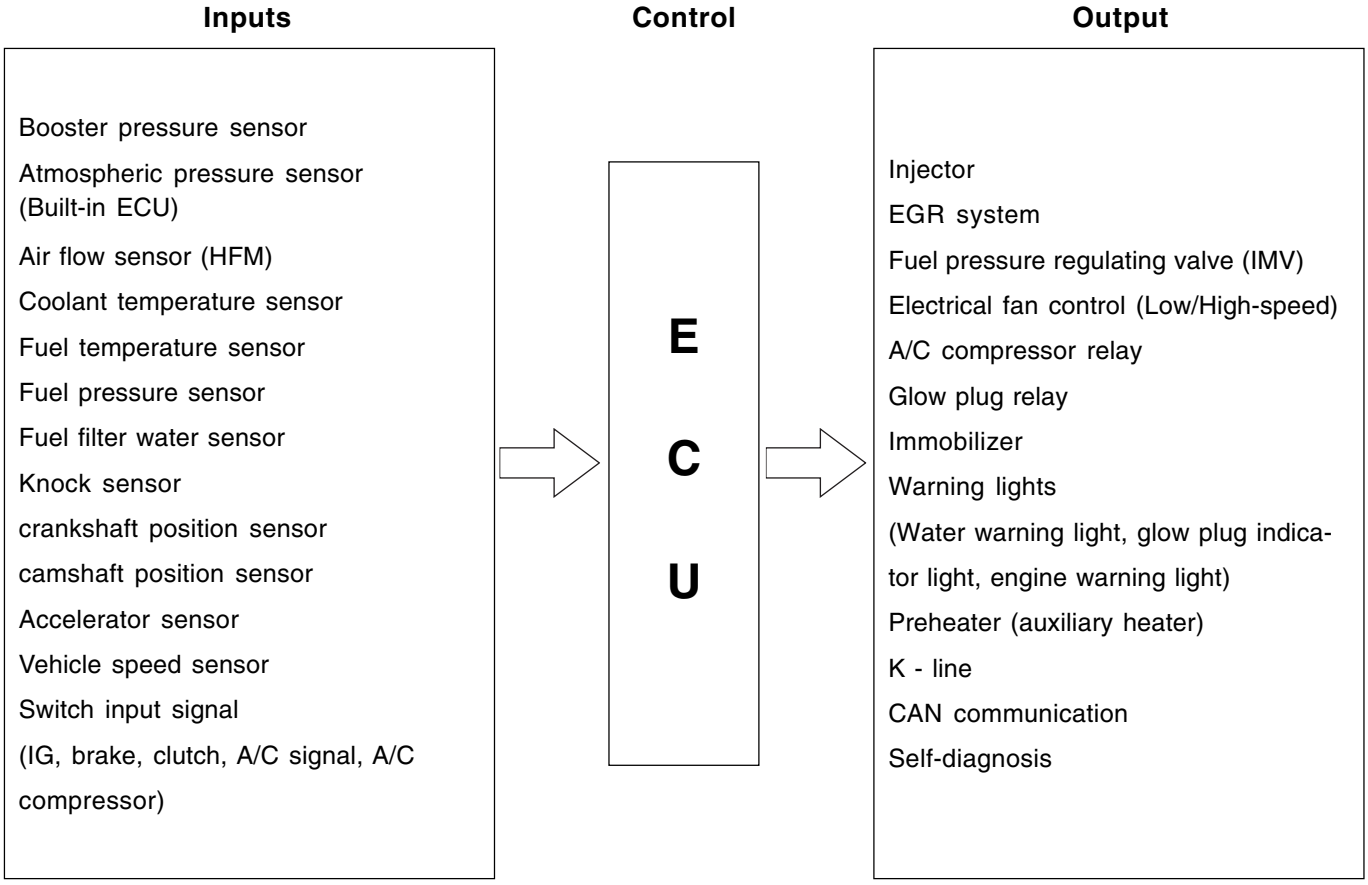
Pin No.	Description	Pin No.	Description
1	Engine ground	40	Fuel filter water detection sensor
2	Engine ground	41	RPM signal output
3	Main power (IG 1)	42	
4	Main power (IG 1)	43	
5	Main power (IG 1)	44	Knock sensor signal (#2)
6	Rail pressure sensor power supply	45	Knock sensor signal (#1)
7		46	Knock sensor ground (#1)
8		47	
9	ECU power hold relay	48	
10		49	
11		50	Auto cruise result signal
12	ABD signal	51	
13		52	
14	ACC 2 sensor ground	53	ACC 1 sensor ground
15		54	CAN- H1
16		55	
17	Auto cruise OFF	56	
18	Auto cruise safety switch	57	ACC 2 sensor power supply
19	A/C pressure signal	58	Brake lamp switch
20	Fuel filter water detection warning lamp	59	
21	Remote starter output	60	Vehicle speed indication lamp
22	Glow plug control	61	Preheater #1
23	Glow plug warning lamp	62	Preheater #2
24		63	Knock sensor ground (#2)
25	Rail pressure sensor signal	64	HFM sensor (air temperature sensor)
26	Rail pressure sensor ground	65	
27		66	Engine ground
28	Engine ground	67	Auto cruise deceleration signal
29		68	
30		69	
31	Auto cruise acceleration signal	70	
32	ACC 2 sensor signal	71	ACC 1 sensor signal
33		72	ACC 1 sensor power supply
34	K-LINE #1	73	CAN -LO
35	K-LINE #2	74	
36	Vehicle speed sensor signal input	75	
37	IG 1	76	A/C cycling pressure switch
38	Clutch pedal switch	77	Brake pedal switch
39		78	Trip computer

Pin No.	Description	Pin No.	Description
79	A/C relay	101	Coolant temperature signal
80	Cooling fan LOW	102	Coolant temperature sensor ground
81	Cooling fan HIGH	103	Camshaft position sensor signal
82	Crankshaft position sensor (-)	104	Camshaft position sensor ground
83	HFM sensor (air mass sensor)	105	Engine check warning lamp
84	HFM sensor (ground)	106	
85		107	Blower switch
86	HFM sensor (power supply)	108	Booster pressure sensor power supply
87	IMV (fuel pressure regulating valve)	109	Fuel temperature sensor signal
88	Engine ground	110	Fuel temperature sensor ground
89		111	Camshaft position sensor power supply
90	Crankshaft position sensor (+)	112	Immobilizer
91		113	Engine check warning lamp
92		114	Injector #1
93		115	Injector #4
94		116	Injector #3
95	Waste gate actuator	117	Injector ground (#1, 3, 4)
96	EGR valve	118	Injector ground (#2, 5)
97		119	
98		120	Injector #5
99	Booster pressure sensor signal	121	Injector #2
100	Booster pressure sensor ground		

▶ ECU Inputs·Outputs



▶ Structure and Function of ECU

Function of ECU

ECU receives and analyzes signals from various sensors and then modifies those signals into permissible voltage levels and analyzes to control respective actuators.

ECU microprocessor calculates injection period and injection timing proper for engine piston speed and crankshaft angle based on input data and stored specific map to control the engine power and emission gas.

Output signal of the ECU microprocessor drives pressure control valve to control the rail pressure and activates injector solenoid valve to control the fuel injection period and injection timing; so controls various actuators in response to engine changes. Auxiliary function of ECU has adopted to reduce emission gas, improve fuel economy and enhance safety, comforts and conveniences. For example, there are EGR, booster pressure control, autocruise (export only) and immobilizer and adopted CAN communication to exchange data among electrical systems (automatic T/M and brake system) in the vehicle fluently. And Scanner can be used to diagnose vehicle status and defectives.

Operating temperature range of ECU is normally -40 ~ +85°C and protected from factors like oil, water and 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.

▶ Control Function of ECU

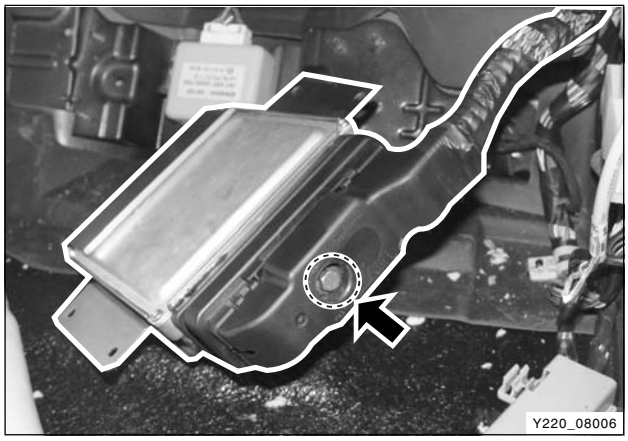
- Controls by operating stages
  : To make optimum combustion under every operating stage, ECU should calculate proper injection volume in each stage by considering various factors.
- Starting injection volume control
  : During initial starting, injecting fuel volume will be calculated by function of 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.

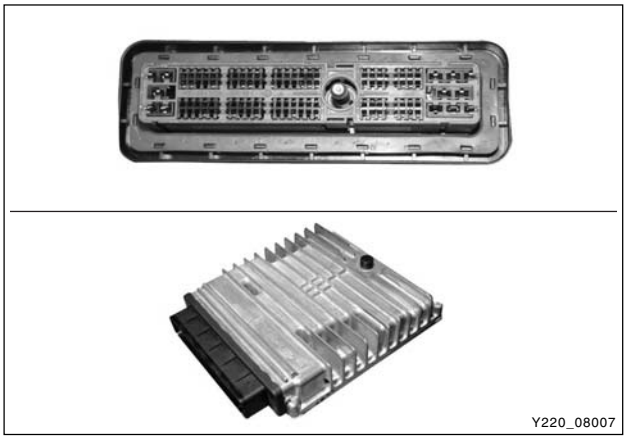
ECU - Removal and Installation

1. Flip up the front passenger's seat and remove the ECU cover nuts.
2. Remove the ECU bracket nuts.

3. Unscrew the ECU connect bolt and remove the ECU assembly.



4. Install in the reverse order of removal.
5. Backup the below data with Scan-i when replacing the ECU.
   - Current ECU data
   - Vehicle Identification Number (VIN)
   - Variant coding data
   - Then, input the data into new ECU. For immobilizer equipped vehicle, additional coding operation is necessary.



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FUEL PRESSURE CONTROL

▶ Fuel Pressure Control Elements

Pressure control consists of 2 principle modules.

- 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. The aim is to adapt the injection pressure to the engine's requirements.

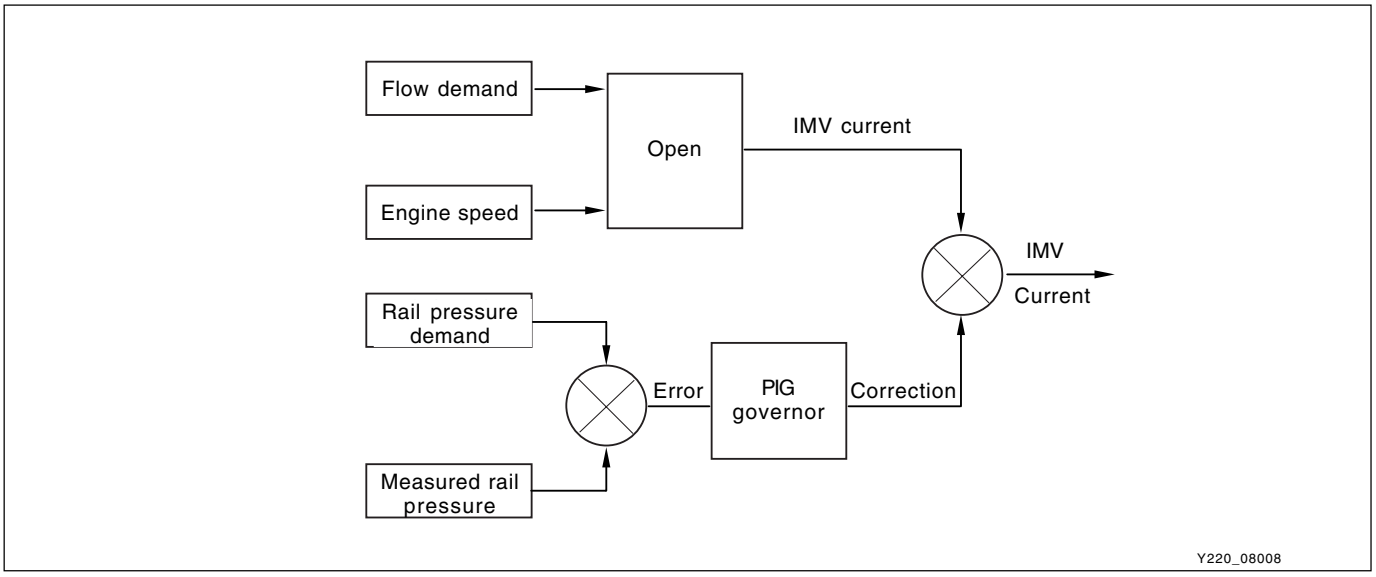
- When engine speed and load are high
  : The degree of turbulence is very great and the fuel can be injected at very high pressure in order to optimize combustion.
- When engine speed and load are low
  : The degree of turbulence is low. If injection pressure is too high, the nozzle's penetration will 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.

▶ Fuel Pressure Control

Rail pressure is controlled by closed loop regulation of IMV. A mapping system – open loop – determines the current which needs to be sent to the actuator in order to obtain the flow demanded by the ECU. The closed loop will correct the current value depending on the difference between the pressure demand and the pressure measured.

- 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.



FUEL INJECSTION CONTROL

▶ Fuel Injection Control

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

Injection control consists as below.

- Injection timing
- Injection volume
- Translating fuel injection timing and injection volume into values which can be interpreted by the injector driver.
  - a reference tooth (CTP)
  - the delay between this tooth and the start of the pulse (Toff)
  - the pulse time (Ton)

Main injection timing control

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

The elements are;

- 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. This requirement only concerns the starting phase, since once the engine has started the system must re-use the mapping and the corrections described previously.

Pilot injection timing control

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

The elements are;

- 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.

During the starting phase, the pilot injection timing is determined as a function of the engine speed and of the coolant temperature.

FUEL FLOW CONTROL

Main Flow Control

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

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

: The driver's demand is compared with the value of the minimum flow determined by the idle speed controller.

- 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 ASR trajectory control system. As soon as the injected fuel becomes lower than the flow limit determined by the ASR trajectory control system, the antagonistic torque (engine brake) transmitted to the drive wheels exceeds the adherence capacity of the vehicle and there is therefore a risk of the drive wheels locking. The system thus chooses the greater of these 2 values (main flow & pilot flow) in order to prevent any loss of control of the vehicle during a sharp deceleration.

This value is then compared with the flow limit determined by the cruise control. As soon as the injected fuel becomes lower than the flow limit determined by the cruise control, the vehicle's speed falls below the value required by the driver. The system therefore chooses the greater of these 2 values in order to maintain the speed at the required level.

This valve is then compared with the flow limit determined by the flow limitation strategy. This strategy allows the flow to be limited as a function of the operating conditions of the engine. The system therefore chooses the smaller of these 2 values in order to protect the engine. This value is then compared with the fuel limit determined by the ASR trajectory control system.

As soon as the injected fuel becomes higher than the fuel limit determined by the ASR trajectory control system, the engine torque transmitted to the wheels exceeds the adhesion capacity of the vehicle and there is a risk of the drive wheels skidding. The system therefore chooses the smaller of the two values in order to avoid any loss of control of the vehicle during accelerations.

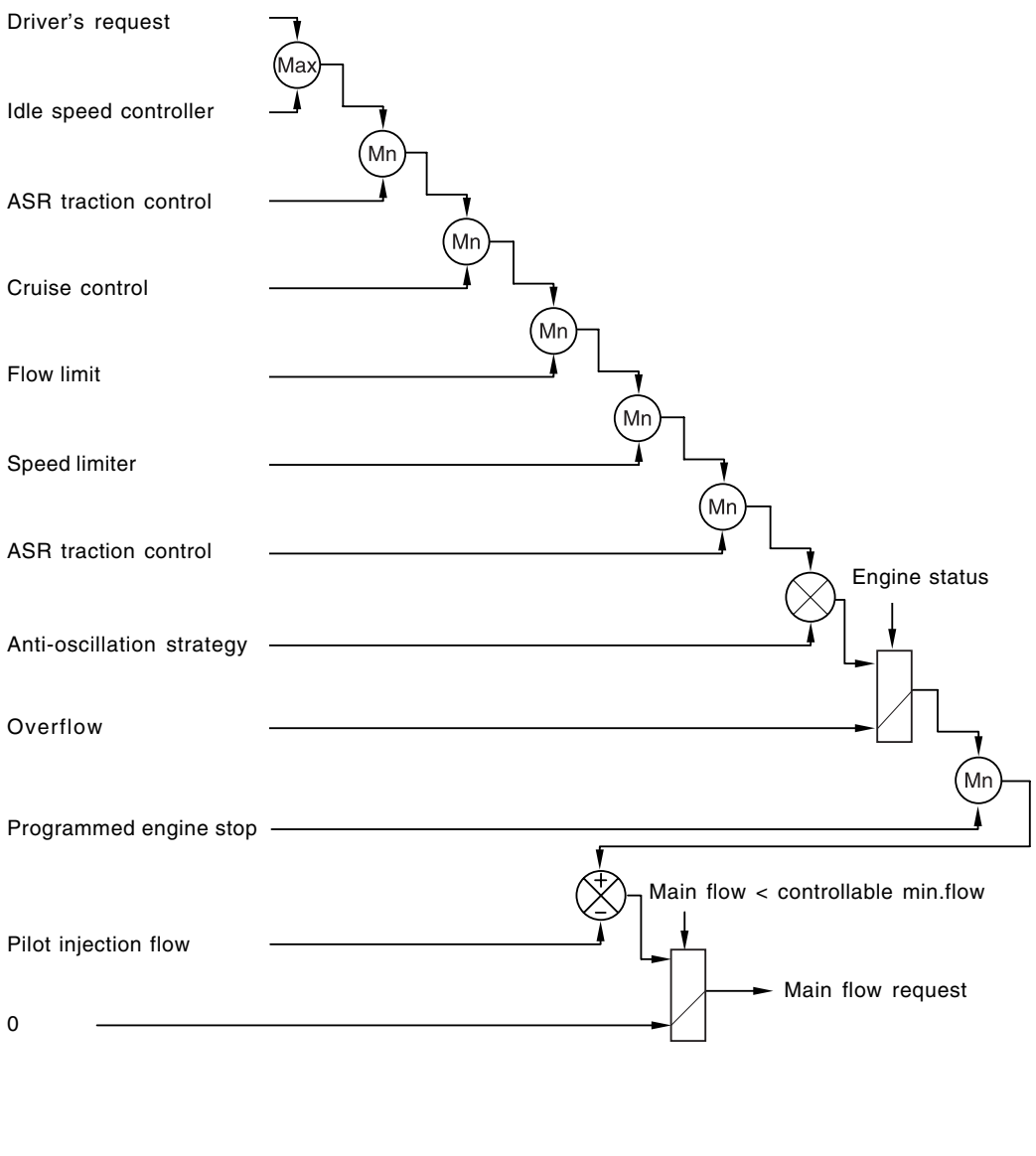
The anti-oscillation strategy makes it possible to compensate for fluctuations in engine speed during transient conditions. This strategy leads to a fuel correction which is added to the total fuel of each cylinder. The correction is determined before each injection as a function of the instantaneous engine speed.

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

- 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.



Driver Demand

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

Idle Speed Controller

The idle speed controller consists of 2 principal modules:

- 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, the accelerated idle speed is activated to prevent the engine from stalling when operating in degraded mode.
  - It is possible to increase or to reduce the required idle speed with the aid of the diagnostic tool.
- The second module is responsible for providing closed loop control of the engine's idle speed by adapting the minimum fuel according to the difference between the required idle speed and the engine speed.

Flow Limitation

The flow limitation strategy is based on the following strategies:

- 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 these values.

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

Superchager Flow Demand

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

Pilot flow control

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

- 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.

This correction is used to adapt the pilot flow according to the atmospheric pressure and therefore the altitude.

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

Cylinder Balancing Strategy

Balancing of the point to point flows

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

- 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.

Accelerometer Strategy

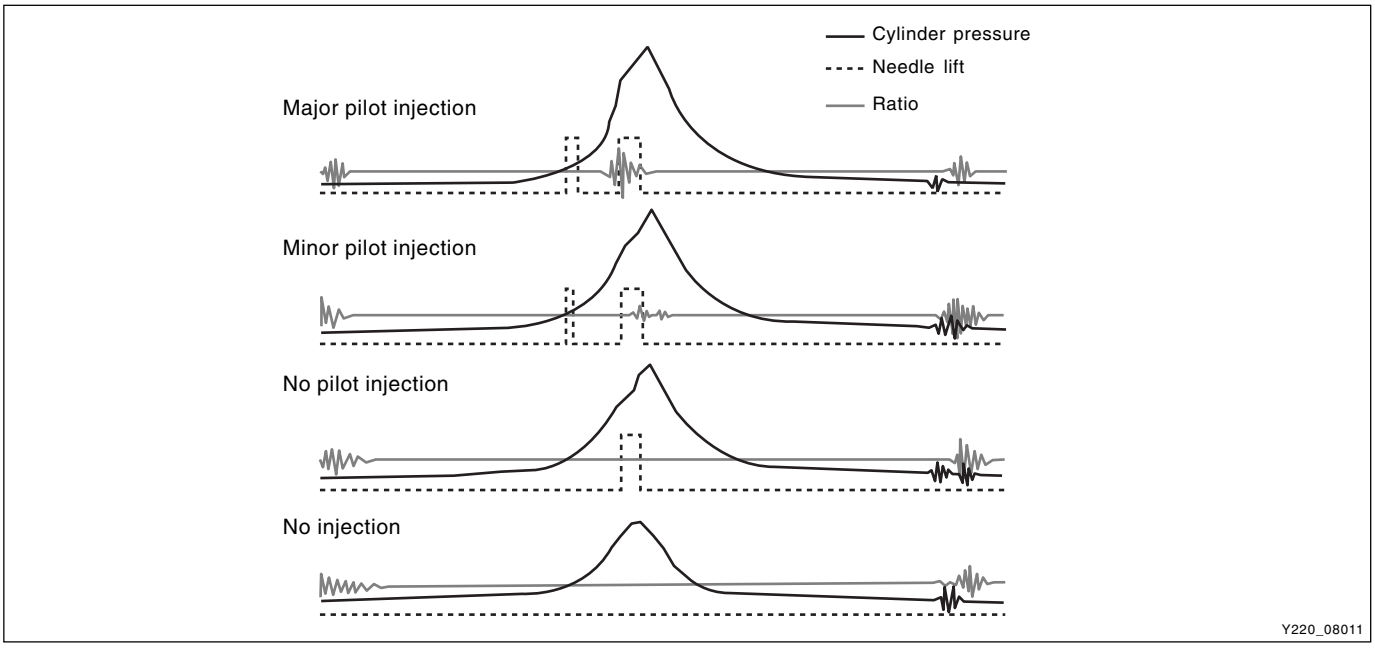
Resetting the pilot injection

The accelerometer is used to reset the pilot injection flow in closed loop for each injector. This method allows the correction of any injector deviations over a period of time. The principle of use of the accelerometer is based on the detection of the combustion noises.

The sensor is positioned in such a way as to receive the maximum signal for all the cylinders. The raw signals from the accelerometer are processed to obtain a variable which quantifies the intensity of the combustion. This variable, known as the ratio, consists of the ratio between the intensity of the background noise and the combustion noise.

- 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.
- 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 C2I. Each resetting then allows the closed loop of the MDP to be updated according to the deviation of the injector.

Detection of leaks in the cylinders

The accelerometer is also used to detect any injector which may have stuck open. The detection principle is based on monitoring the ratio. If there is a leak in the cylinder, the accumulated fuel self-ignites as soon as the temperature and pressure conditions are favorable (high engine speed, high load and small leak).

This combustion is set off at about 20 degrees before TDC and before main injection.

The ratio therefore increases considerably in the detection window. It is this increase which allows the leaks to be detected. The threshold beyond which a fault is signaled is a percentage of the maximum possible value of the ratio. Because of the severity of the recovery process (engine shut-down), the etection must be extremely robust.

An increase in the ratio can be the consequence of various causes:

- Pilot injection too strong
- 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.

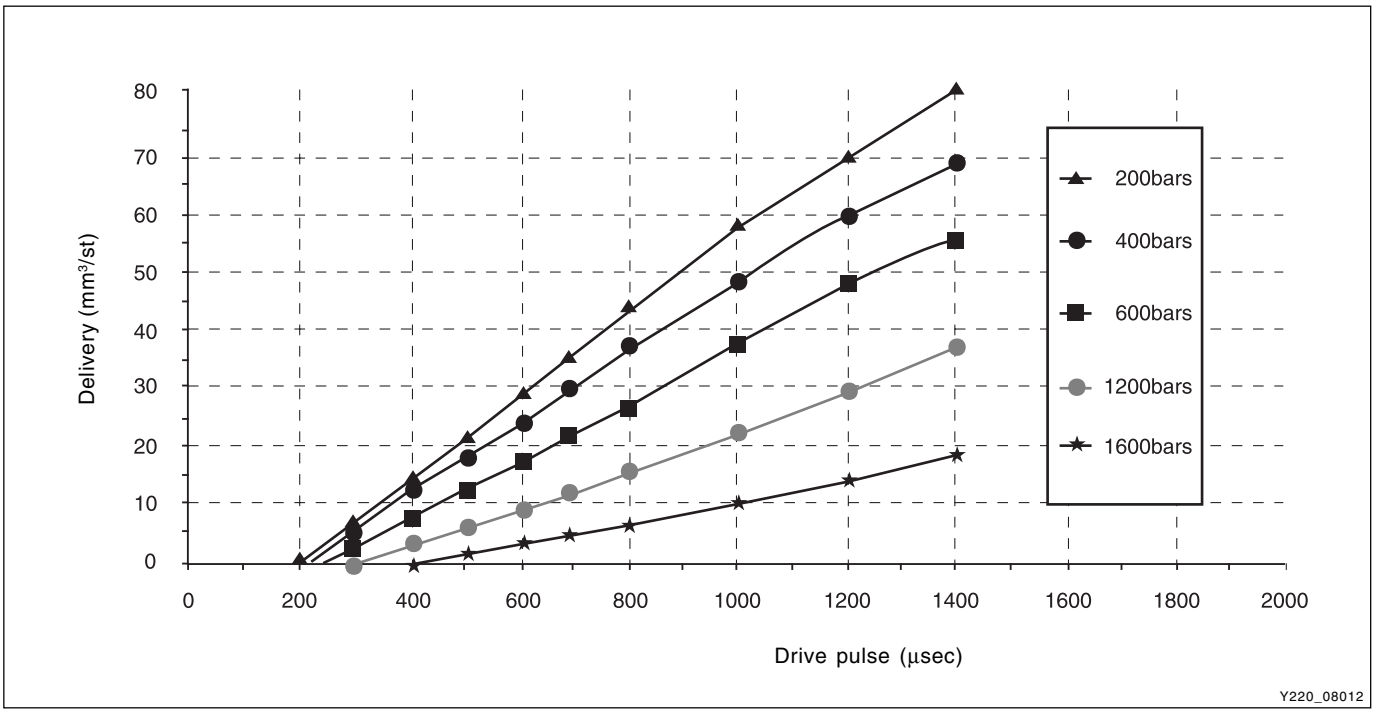
Detection of an accelerometer fault

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

INDIVIDUAL INJECTOR CALIBRATION (C2I)

Injected fuel is proportional to square root of injection time and rail pressure.

It is function between pulse and rail pressure and fuel injection curve is called injector characteristics curve having the following shape.



Common rail injectors are very accurate components. They are able to inject fuel delivery between 0.5 to 100 mg/str under pressure varying from 150 to 1600 bar.

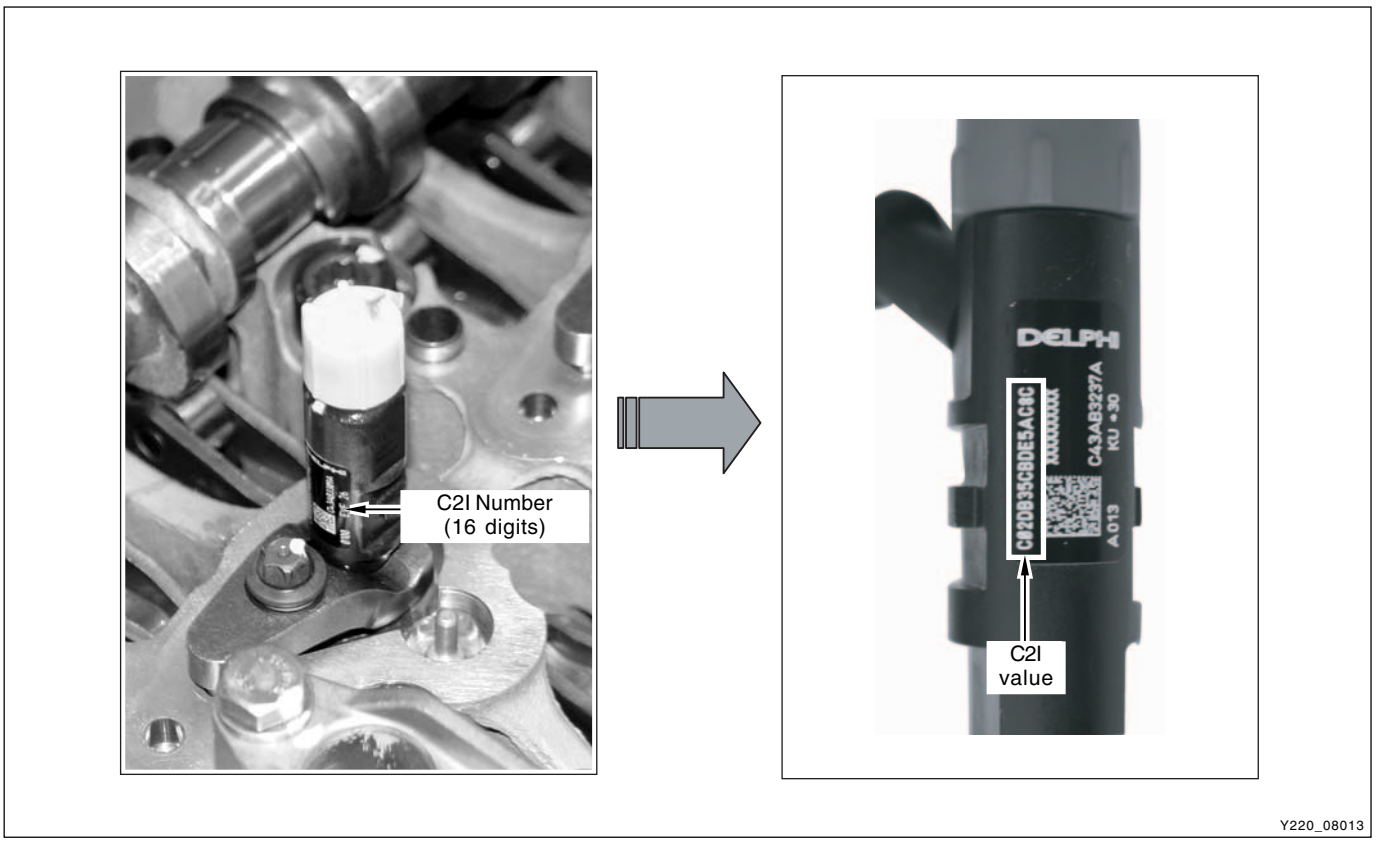
This high level of accuracy requires very low machining tolerances (few μm).

Nevertheless, due to the machining dispersion, the loss of charge through the functional orifices, the friction between moving parts and electromagnetic field level are different from one injector to the other. So, the difference of fuel delivery for the same pressure and the same pulse can reach 5 mg/str from one injector to the other. It is impossible to control efficiently the engine with such a dispersion between the different injectors. It is necessary to add a correction that allows injecting the demanded fuel delivery whatever the initial hydraulic characteristics of the injector is. The method consists in correcting the pulse that is applied to the injector with an offset that depends on the initial hydraulic map of the injector. So, the pulse should be corrected according to characteristics of each injector.

C2I is composed of models on these characteristics of injectors.

C2I consists of 16-digit; composed of numbers from 1 to 9 and alphabets from A to F. ECU remembers C2I, characteristics of each injector, to make the most optimal fuel injection.

- When replacing the injector, C2I code on the top of new injector should be input into ECU because the ECU is remembering the injector's C2I value. If C2I is not input, engine power drops and occurs irregular combustion.
- When ECU is replaced, C2I code of every injector should be input. If not, cannot accelerate the vehicle even when the accelerator pedal is depressed.



※ For coding of C2I, refer to "Diagnosis" section

MINIMUM DRIVE PULSE (MDP) LEARNING

When the pulse value that the injector starts injection is measured, it is called mininum drive pulse (MDP). Through MDP controls, can correct pilot injections effectively. Pilot injection volume is very small, 1 ~ 2 mm/str, so precise control of the injector can be difficult if it gets old. So there needs MDP learning to control the very small volume precisely through learning according to getting older injectors.

▶ Learning Conditions

Coolant temperature	> 75°C
Vehicle speed	> 50 Km/h (over 5 seconds)
Intake manifold pressure	> 0.7 bar
Engine speed	> 2,500 rpm
Battery voltage	10 V < MDP < 16 V
Fuel temperature	0 < fuel temperature < 80 °C
Initial MDP learning on each injector	5 seconds

▶ Trouble Codes

Trouble code	Description	Diagnosis
P1171	Fault MDP learning on injector No. 1	• Check each injector
P1172	Fault MDP learning on injector No. 2	
P1173	Fault MDP learning on injector No. 3	
P1174	Fault MDP learning on injector No. 4	
P1175	Fault MDP learning on injector No. 5	

▶ Accelerator Pedal Sensor

<Location of accelerator pedal sensor>

<When depressing the accelerator pedal and brake pedal simultaneously>

Y220_08014

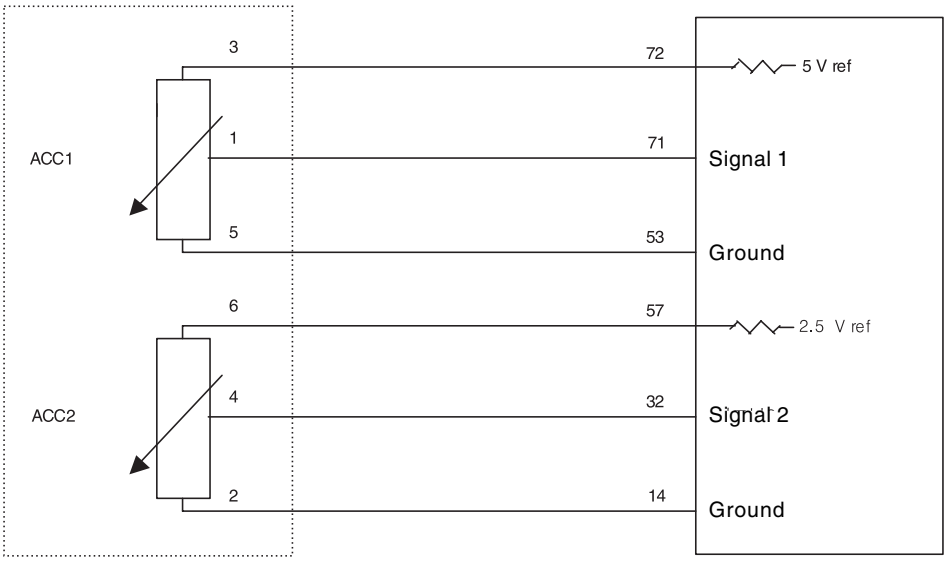
Accelerator pedal sensor changes accelerator pedal position into electrical signal and then sends to ECU to let know the driver's demand. There are 2 sensors in the accelerator pedal sensor. Accelerator pedal No.1 (ACC 1) sensor signal determines fuel injection volume and injection timing during driving, and accelerator pedal No. 2 (ACC 2) sensor signal compares whether the No. 1 sensor signal value is correct.

If accelerator pedal No. 1 and 2 sensors are defective, ECU remembers defect code, and acceleration responses are getting bad and engine rpm hardly increases.

Notice

When depressing the accelerator pedal and brake pedal simultaneously while driving, the acceleration response will be diminished abruptly and cannot drive with over 70 km/h even though depressing the accelerator pedal to its end. At this time, the trouble code of "P-1124 Accelerator pedal sensor stuck" is stored into ECU. If depressing the accelerator pedal over 3 times, it will be resumed to normal condition.

**** For detailed information, refer to "Diagnosis" section in this manual.***

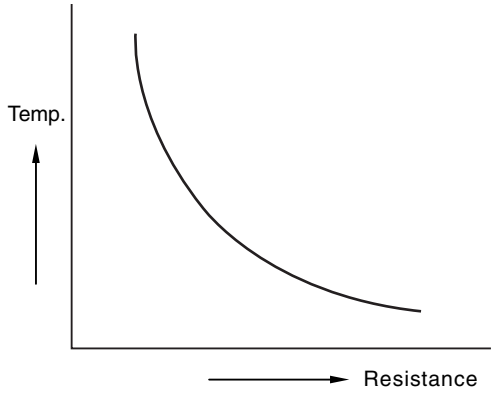


<Circuit diagram of Accelerator pedal sensor>

Y220_08015

▶ Coolant Temperature Sensor

<Coolant temperature sensor>



<Output characteristics of coolant temperature sensor>

Y220_08016

Coolant temperature sensor is a NTC resister that sends coolant temperature to ECU.

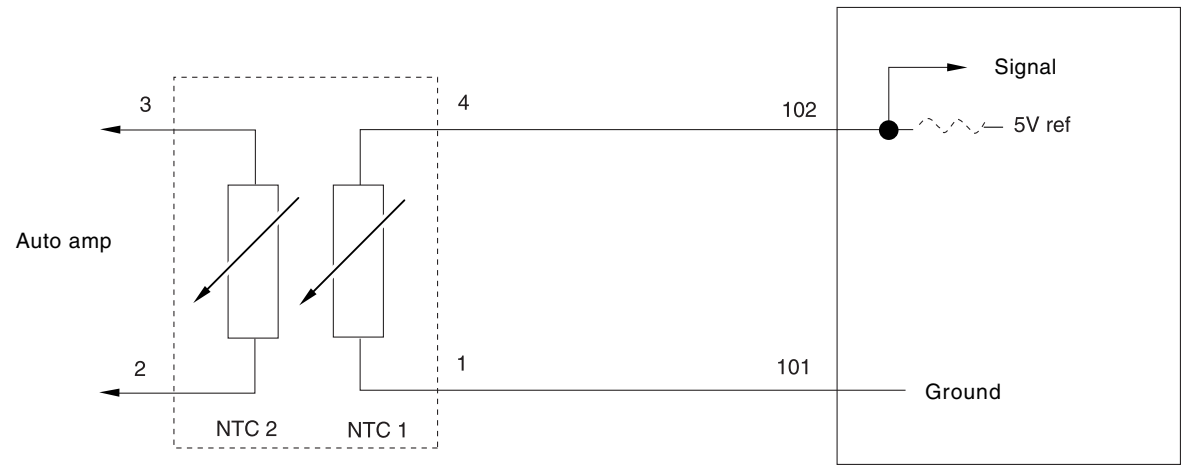
NTC resister has characteristics that if the engine temperature rises, the resistance lowers so the ECU detects lowering signal voltages.

If the fuel injected into the engine through injector has more turbulence, then combusts very well. However, if engine temperature is too low, the fuel injected as foggy state forms big compounds causing incomplete combustion. So the sensor detects coolant temperature and changes coolant temperature changes into voltage then sends to ECU to increase the fuel volume during cold start for better starting. And detects engine overheating for fuel volume reduction to protect the engine.

ECU functions as below with coolant temperature sensor signals.

- When engine is cold, controls fuel volume to correct idle speed.
- When engine is overheated, controls electrical fan and A/C compressor to protect the engine.
- Sends information for emission control.

Temperature (°C)	NTC 1 Resistance (Ω)	NTC 1 Resistance (Ω)
20	2,550	6,062
50	826	1,800
80	321	638
120	123	200



<Circuit diagram of coolant temperature sensor>

Y220_08017

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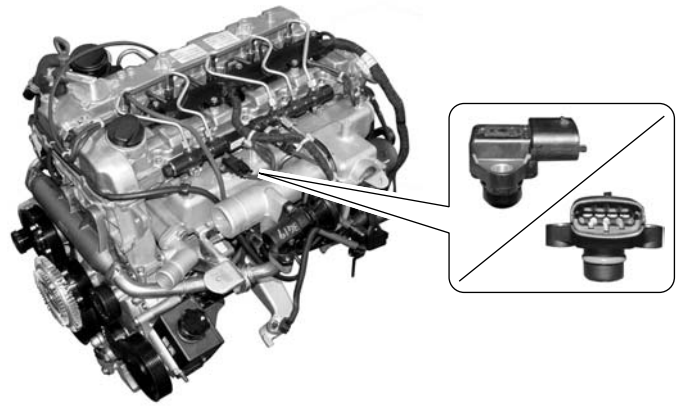
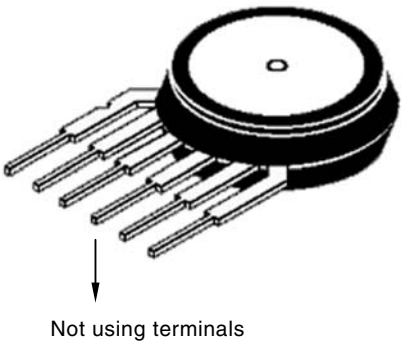
▶ Boost Pressure Sensor



<Location of boost pressure sensor>



<Boost pressure sensor>

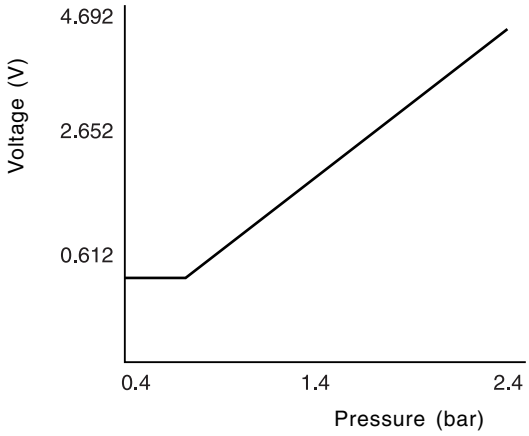
Y220_08018

Boost pressure sensor uses piezo element and uses only 3 terminals out of 6.

It sets fuel injection timing and corrects fuel injection volume according to atmospheric pressure.

The other function is determining EGR operation stops.

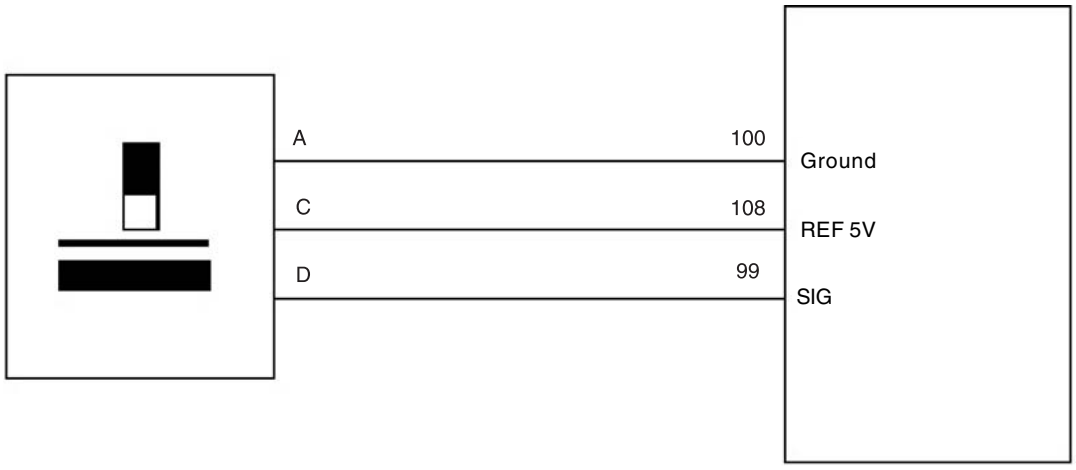
- Output voltage calculation
  $V_O = V_S \times (P \times 0.004 - 0.04)$
  V_O : Output voltage
  V_S : Supply voltage
  P : Applying voltage



<Output characteristics of sensor>

Y220_08019

Performance proofing pressure range	20 ~ 250 KPa
Performance proofing temperature range	- 40 ~ 110°C
Storage proofing temperature range	- 40 ~ 125°C
Performance proofing supply voltage	4.85 ~ 5.35 V
Max. consuming current	10 mA (supply voltage at 5.35 V)
Responsibility	$T_R \leq$ 7ms
Tightening torque	10 Nm



<Circuit diagram of booster pressure sensor>

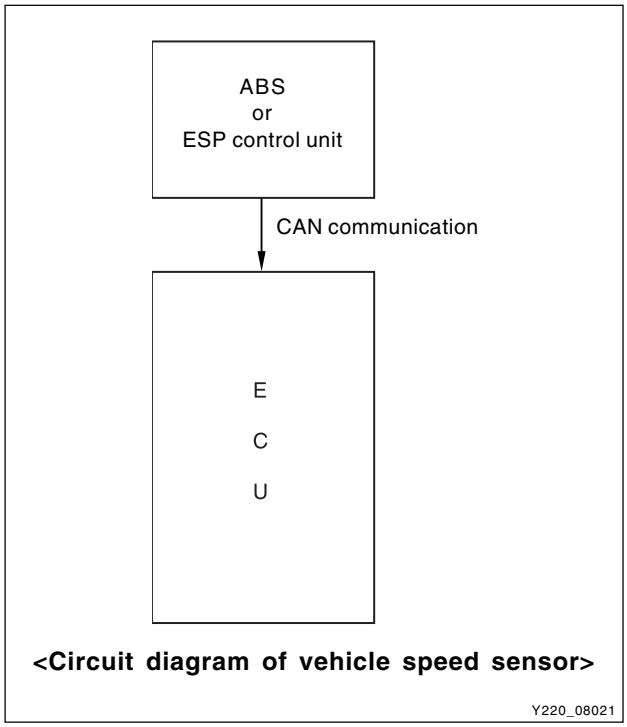
Y220_08020

▶ Vehicle Speed Sensor

The ABS or ESP control unit sends the vehicle speed signals to ECU. ECU uses these signals to calculate the vehicle speed and meter cluster shows signals as vehicle speed.

Function

- Limits idle control correction duty range
- Controls cooling fan
- Cuts fuel injection if exceeds max. speed
- Controls vehicle shifting feeling
- Used for exhaust gas control mode



<Circuit diagram of vehicle speed sensor>

Y220_08021

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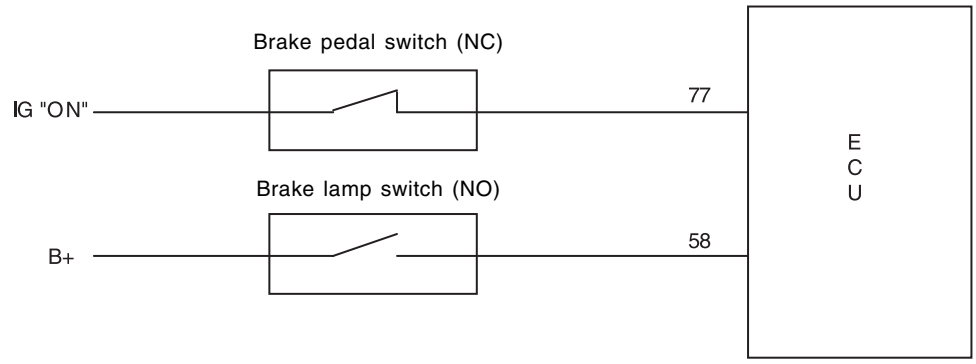
▶ Barometric Pressure Sensor

It is built-in the ECU and detects absolute pressure of atmosphere to correct fuel injection timing and injection volume according to altitude.

▶ Other switches

Brake switch

Brake switch detects brake pedal operations and then sends to engine ECU. It has dual structure with 2 combined switches and there are brake switch 1 and 2. When these 2 signals are input, engine ECU recognizes as normal brake signals. These switch signals are related with accelerator pedal sensor operations and used to control the fuel volume during braking. It means there are no problems in operating accelerator pedal when the brake pedal is operated but the fuel volume reduces if operates brake pedal while the accelerator pedal is depressed.

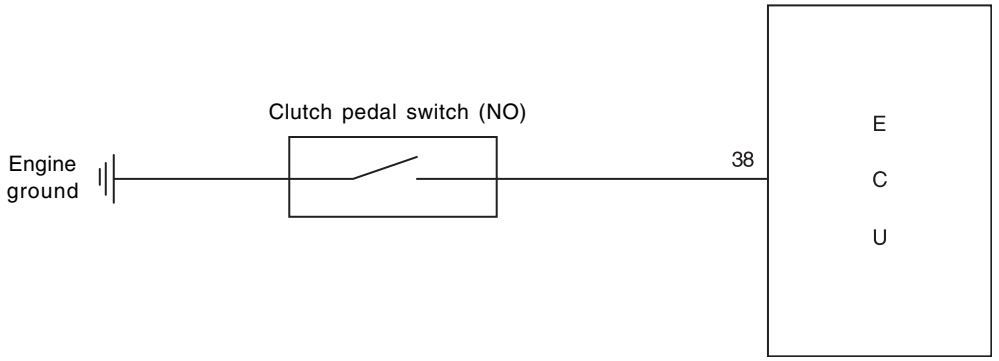


<Brake switch circuit>

Y220_08022

Clutch pedal switch

Clutch pedal switch is installed on the upper of the clutch and sends clutch pedal operations to engine ECU. Contact type switch allows engine ECU to recognize the shifting points to correct the fuel volume. It means it corrects fluctuation happens during gear shifting. Another different function is canceling auto cruise function if equipped (auto cruise control - equipped for export).



<Clutch pedal switch circuit>

Y220_08023

SECTION DI09

ELECTRIC DEVICES AND SENSORS

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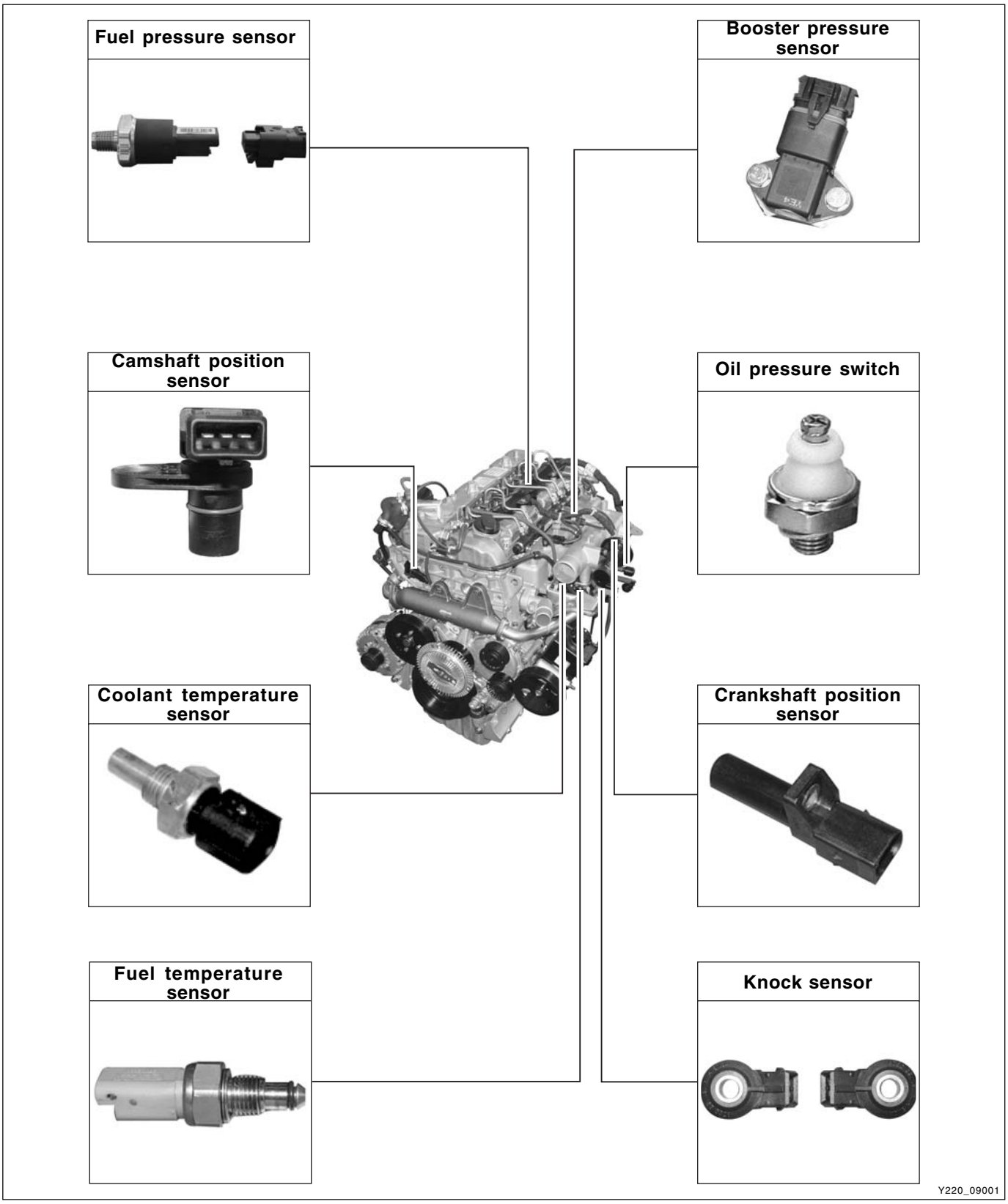
ELECTRIC DEVICES AND SENSORS

SENSORS IN ENGINE COMPARTMENT



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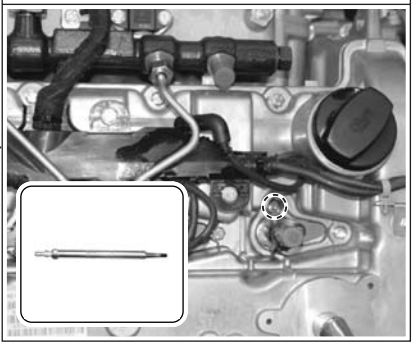
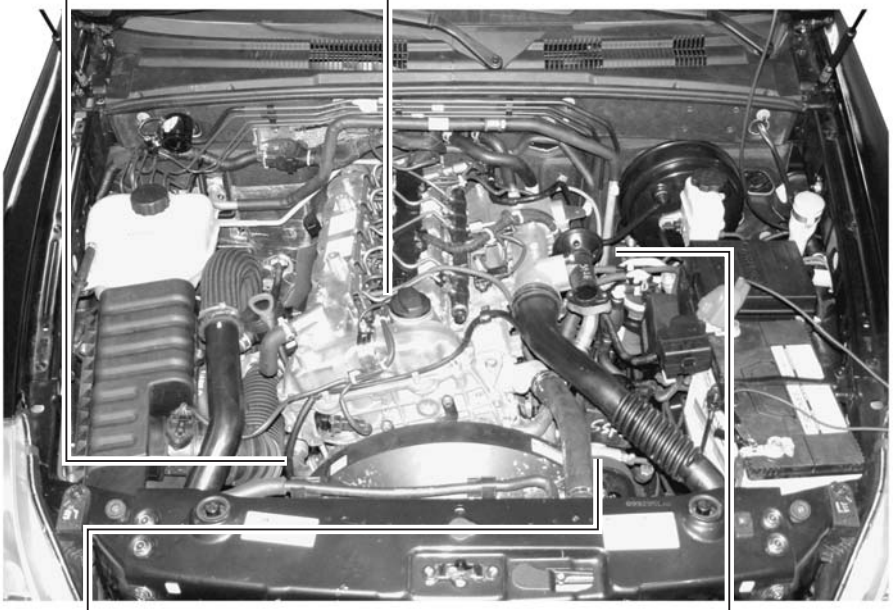
ELECTRIC DEVICES IN ENGINE COMPARTMENT

Alternator

* Capacity
  PTC equipped vehicle
  : 12V - 140A
  FFH equipped vehicle
  : 12V - 115A

Glow plug





Air conditioner compressor

Starter

Y220_09002

SPECIFICATIONS

Description			Unit	Specification
Starter	Type		-	WP220
	Output power		Kw	2.2
	No load test @ 12 volts		A	160
	Drive pinion speed at no load		rpm	4500
	Drive pinion speed at load		rpm/A	1700/430
	Brush length		mm	18
	Armature diameter		mm	55
	Armature run-out		mm	0.1
	Segment groove depth		mm	21.7
Alternator	Type		-	CS128D
	Output voltage / current		V/A	PTC equipped vehicle: 12V-140A FFH equipped vehicle: 12V-115A
	Regulator type		-	←
	Regulating voltage		V	14.6
	Brush	Length	mm	12.5
		Quantity	-	2
		Wear limit	mm	7
Battery	Type		-	M F
	Capacity		AH	12V - 90AH
	Rupture capatity		RC	160
Glow plug	Type		-	Seized type
	Rated voltage		-	11.5
	Circuit connection		-	Parallel
	Preheating time		sec	Max. 60 ~ 90

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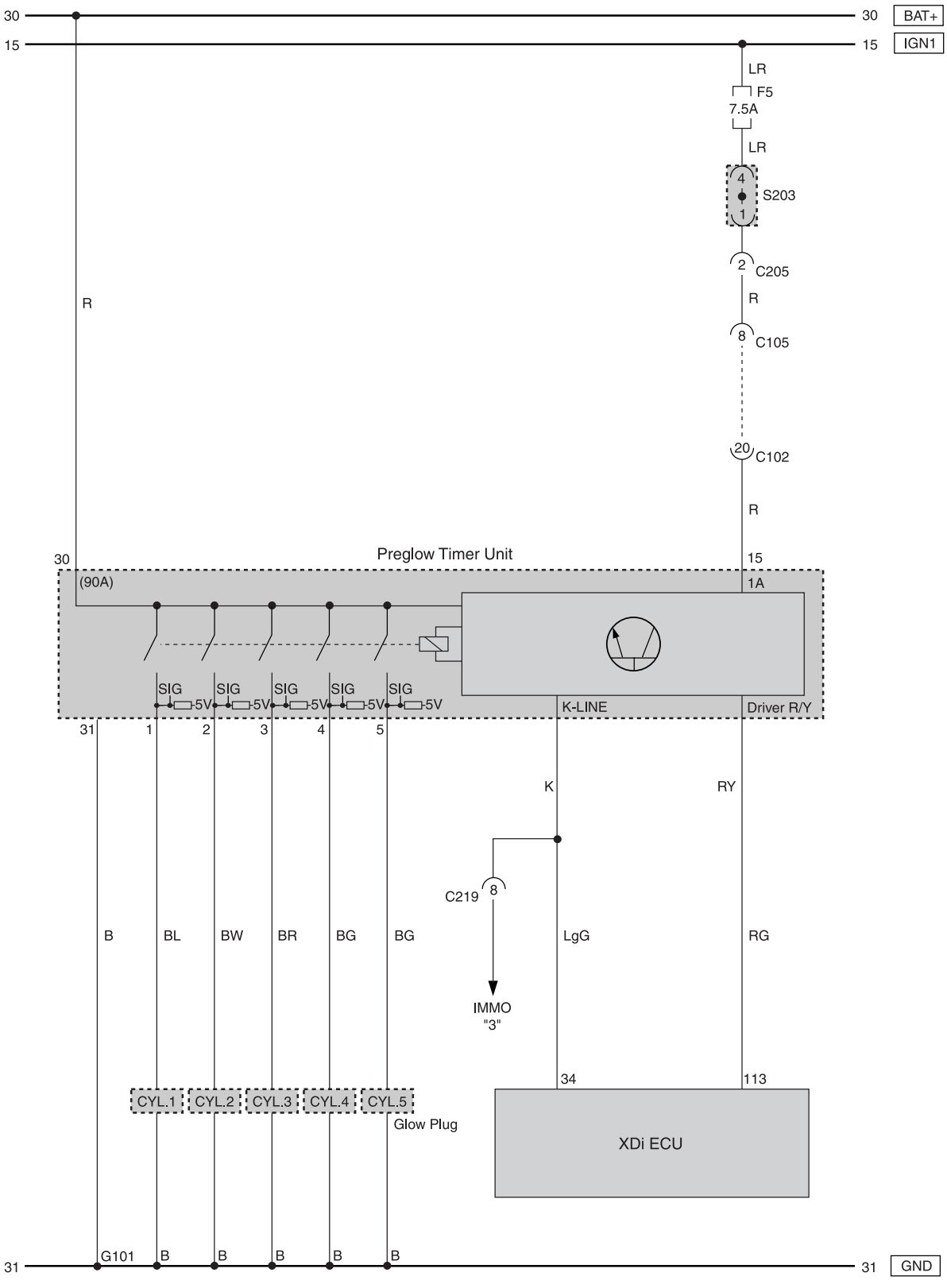
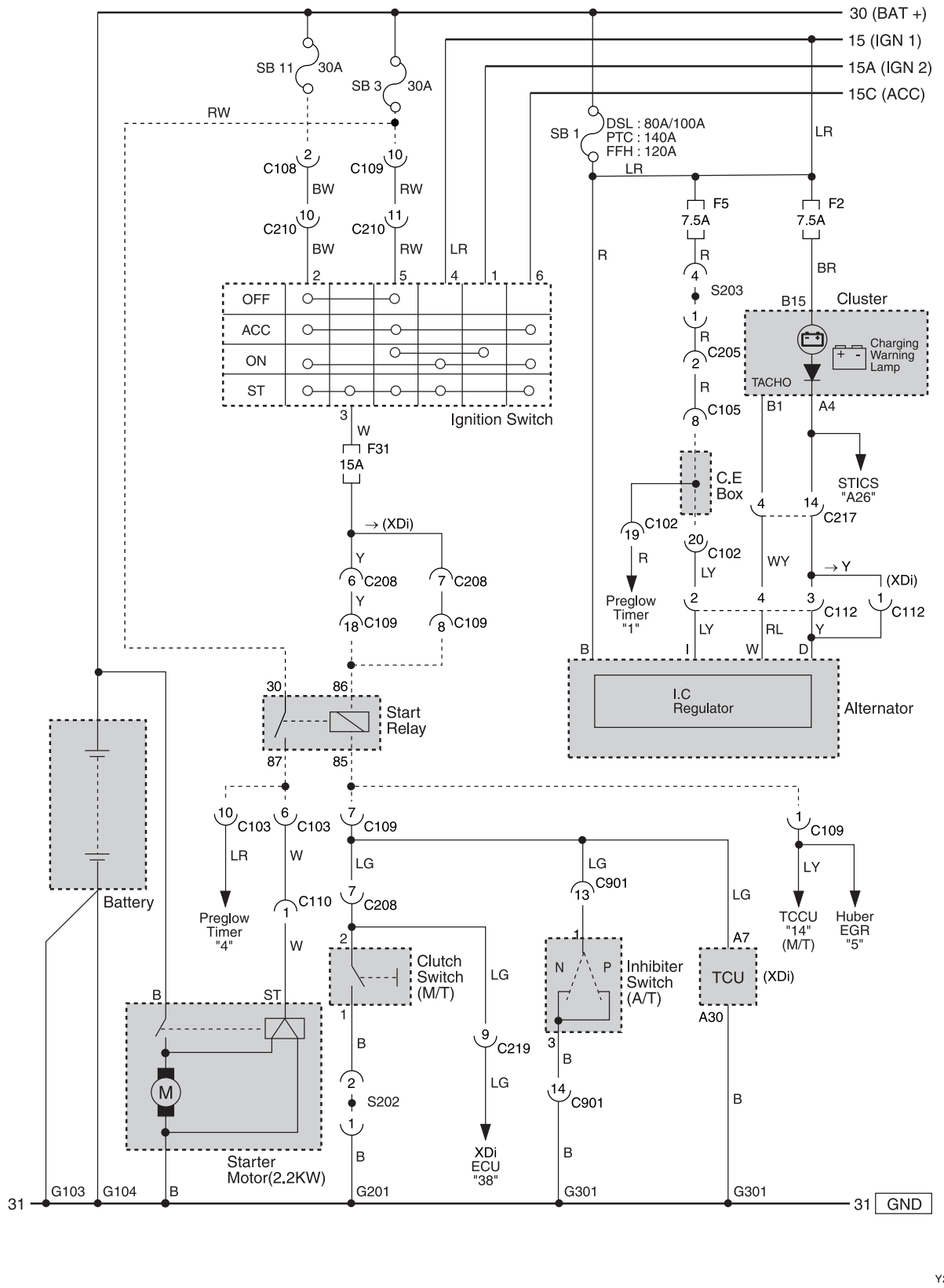
CIRCUIT DIAGRAM OF PREHEATING SYSTEM



CIRCUIT DIAGRAM OF STARTING AND ALTERNATOR



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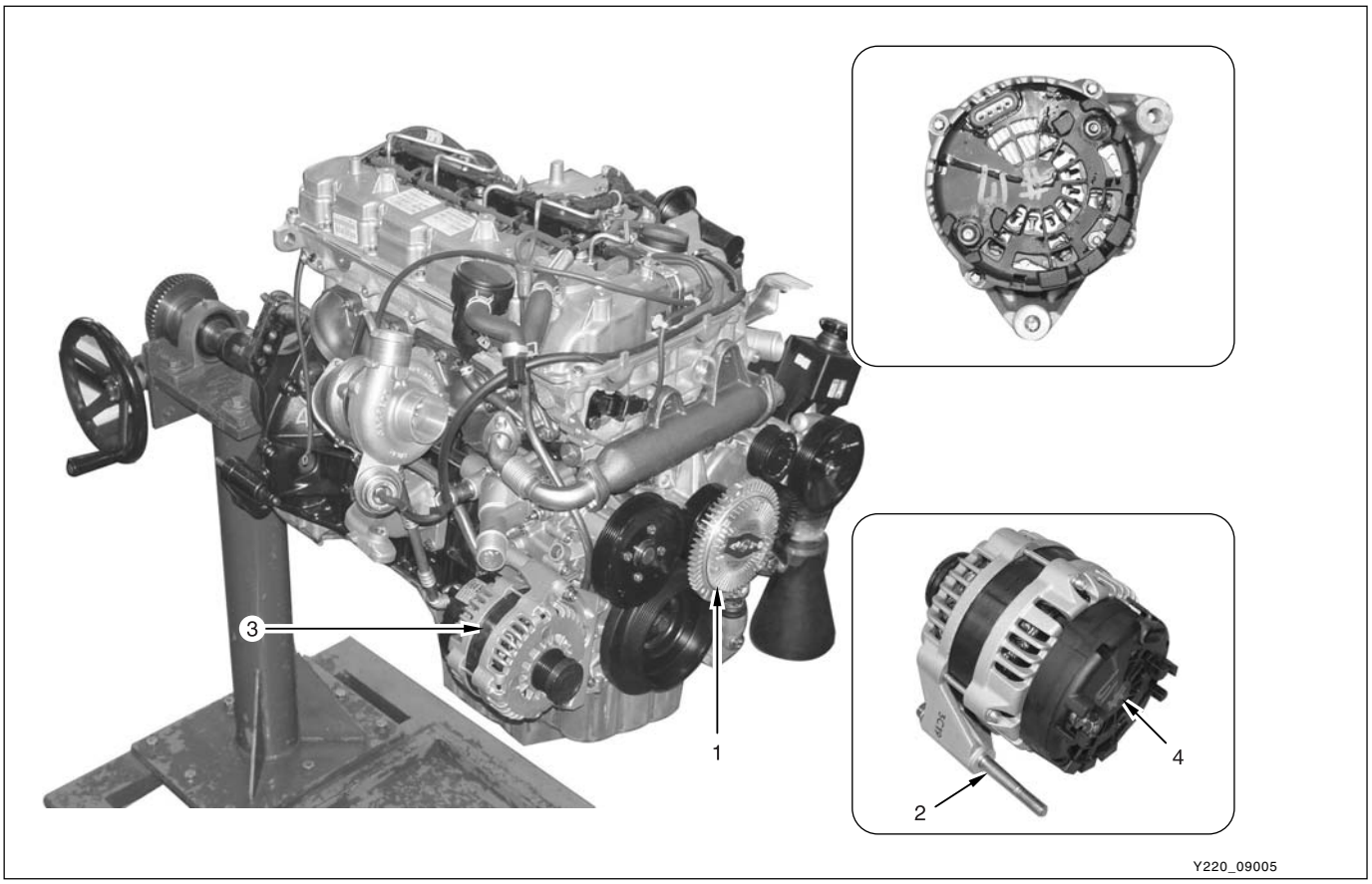
TROUBLE DIAGNOSIS

GENERAL

Condition	Probable Cause	Correction
No crank	• Low battery voltage.	• Charging the battery or replace the battery.
	• Battery cable is loose, corroded, or damaged.	• Repair or replace the battery cable.
	• Faulty starter motor or starter motor circuit is open.	• Repair or replace the starter motor/starter motor circuit.
	• Faulty ignition switch.	• Replace the ignition switch.
	• Ground short.	• Repair the ground short.
Crank ok, but too slow	• Low battery voltage.	• Charging the battery or replace the battery.
	• Battery. • Battery cables are loose, corroded, or damaged.	• Repair or replace the battery cable.
	• Faulty starter motor.	• Repair or replace the starter motor.
Starter motor does not stop	• Faulty starter motor.	• Repair or replace the starter motor.
	• Faulty ignition switch.	• Replace the ignition switch.
Starter motor running, but not cranking	• Broken the clutch pinion gear or faulty starter motor.	• Replace the starter motor.
	• Broken the flywheel ring gear.	• Replace the flywheel.
	• Connected circuit is open.	• Repair the open circuit.
Battery discharge	• Loosen the generator drive belt.	• Adjust the belt tension or replace the belt.
	• The circuit is open or a short.	• Repair the open or a short circuit.
	• Battery run down.	• Replace the battery.
	• Open ground circuit.	• Repair the open ground circuit.
Charging indicator lamp does not work when the ignition switch on (engine does not work)	• Charging indicator lamp is blown or fuse is blown.	• Repair or replace the charging indicator lamp/fuse.
	• Faulty ignition switch.	• Replace the ignition switch.
	• Generator ground circuit is open or a short.	• Repair the circuit.
Charging indicator lamp does not put out lights after starting the engine	• Battery cable is corroded or damaged.	• Repair or replace the battery cable.
	• Loosen the generator drive belt.	• Adjust the belt tension or replace the belt.
	• Faulty wiring harness.	• Repair the wiring harness.
Battery over charging	• Generator voltage regulator faulty	• Replace generator
	• Voltage detecfing wiring faulty	• Repair wiring

Symptom	Cause	Action
Hard engine starting	• Ignition coil faulty	• Replace ignition coil
	• Distributor (including optical sensor) faulty	• Replace distribator (or sensor)
	• Spark plug malfuntion	• Replace spark plug or adjust clearance
	• Ignition timing faulty (spark plug light is normal)	• Resetting valve timing
Unstable engine idling	• Spark plug malfunction	• Replace spark plug or adjust clearance
	• Ignition coil faulty	• Replace ignition coil
	• Ignition timing faulty	• Resetting valve timing
Enging acceralation malfunction	• Ignition timing faulty	• Resetting valve timing

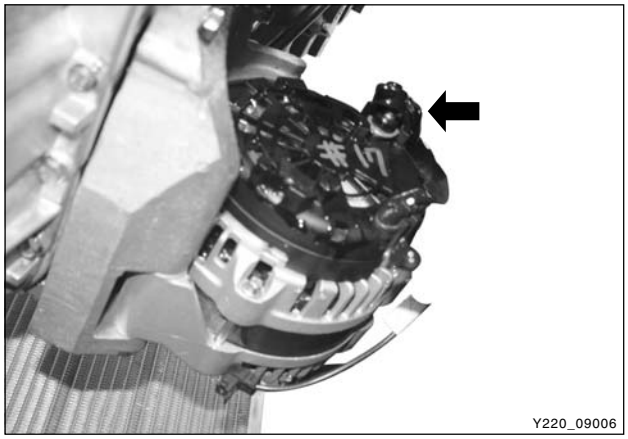
ALTERNATOR



1. Cooling fan
2. Bolt ..... 45 Nm
3. Alternator
4. Plug connection

Removal and Installation

1. Disconnect the negative battery cable.
2. Remove the plug connection.

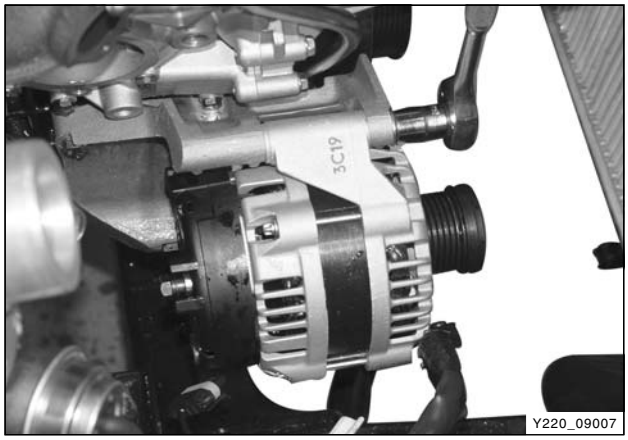


3. Unscrew the bolts and remove the alternator.

   Installation Notice

Tightening torque	45 Nm

4. Install in the reverse order of removal.



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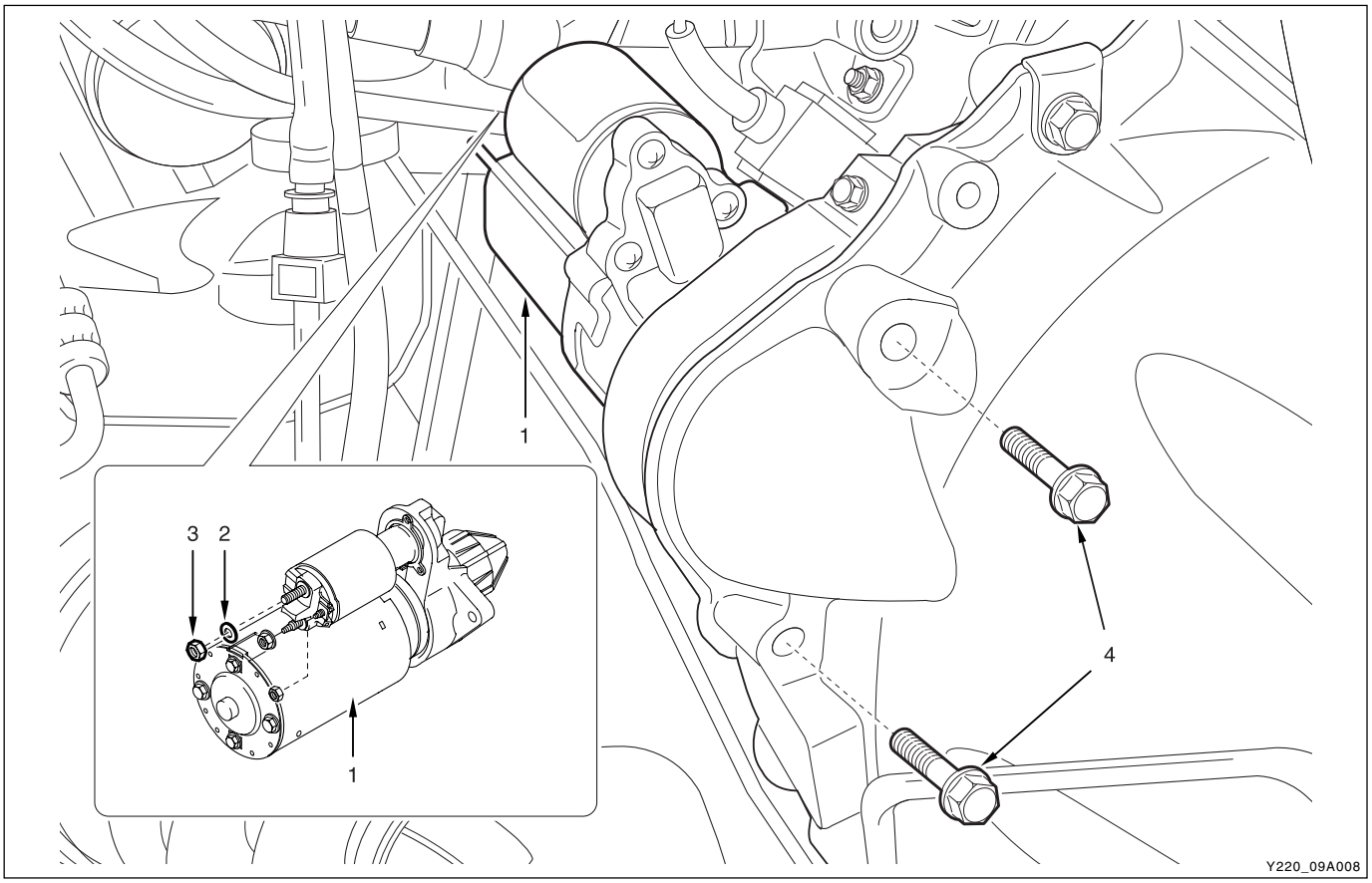
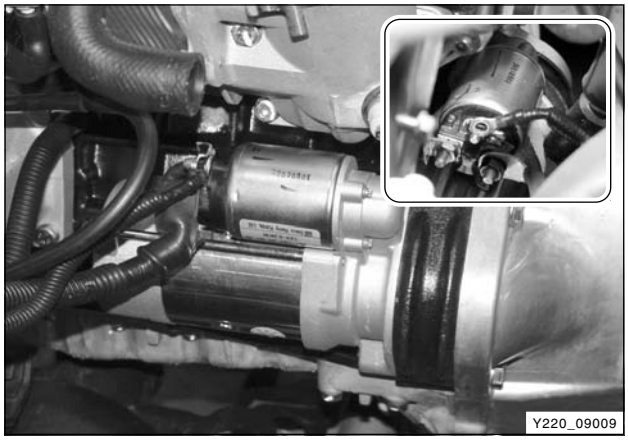
STARTER



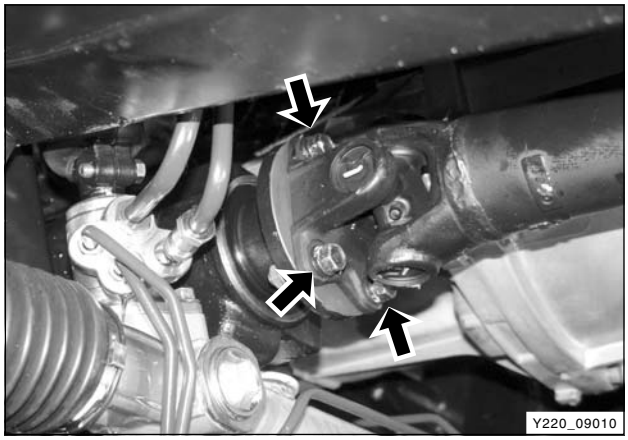
1. Starter
2. Washer
3. Nut ..... 15 Nm
4. Bolt ..... 48 Nm

Removal and Installation

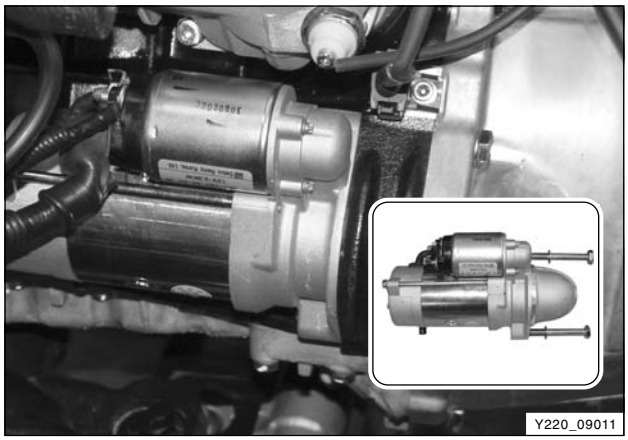
1. Disconnect the negative battery cable.
2. Disconnect the starter terminal.



3. Lift up the vehicle and remove the front propeller shaft mounting bolts.



4. Remove the upper and lower mounting bolts.



5. Install in the reverse order of removal.

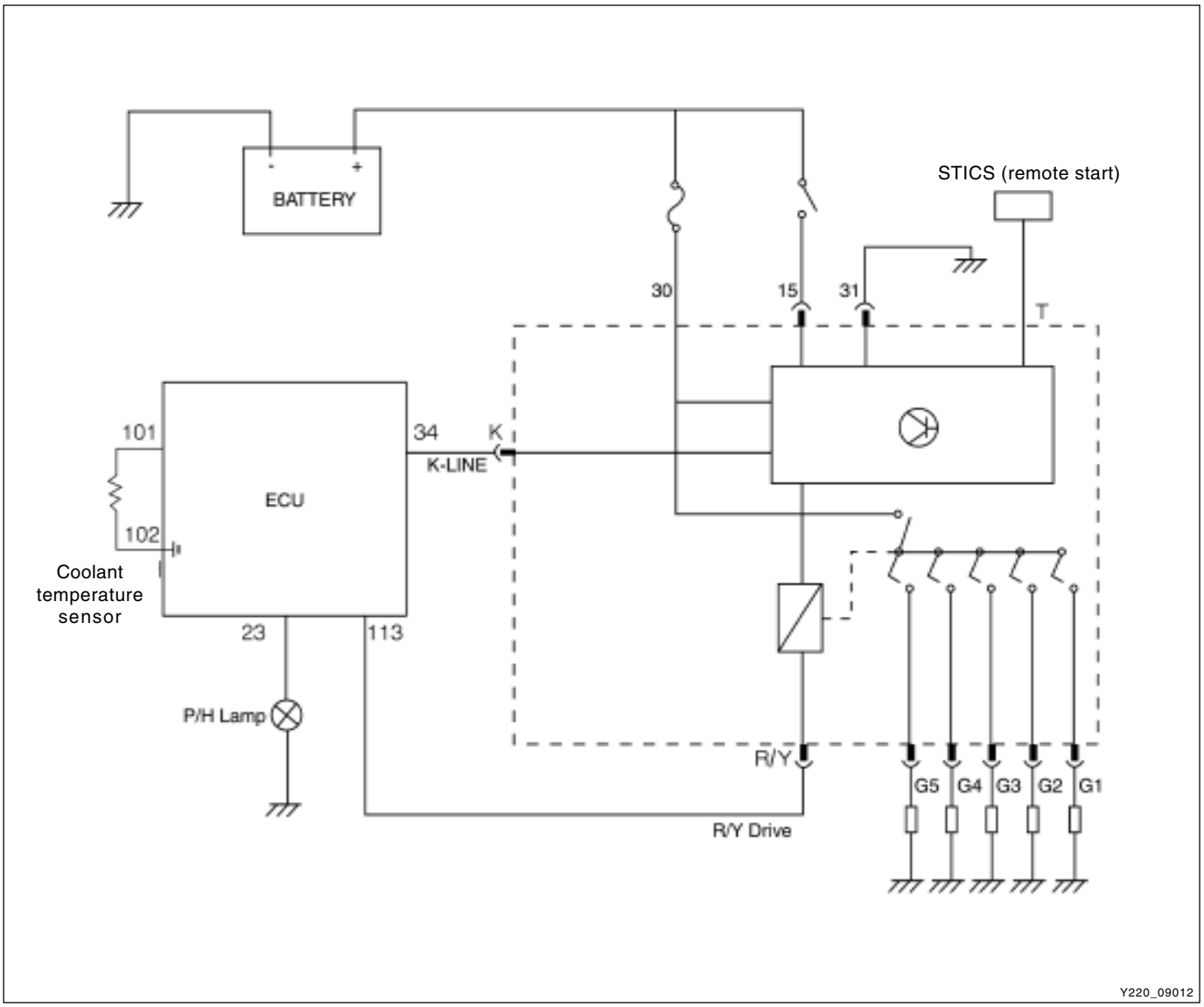
PREHEATING SYSTEM

▶ General

Glow plug is installed on the cylinder head (combustion chamber) in the D27DT preheating control unit system. Cold starting performance has improved and exhaust gas during cold starting has reduced.

ECU receives coolant temperature and engine speed to control; after monitoring the engine preheating/after heating and glow plug diagnosis function, the fault contents will be delivered to ECU.

- Engine preheating/after heating functions
- Preheating relay activation by ECU controls
  - Senses engine temperature and controls the preheating/after heating time
  - Preheating warning light
- K-LINE for information exchanges between preheating unit and ECU
  - Transmits preheating unit self-diagnosis results to ECU
  - Transmits glow plug diagnosis results and operating status to ECU



▶ Function

Preheating system controls and checks following functions and operating conditions.

- Pre-Heating
  : The power will be supplied to the glow plugs by ECU controls when the power is supplied to the IG terminal from the battery and there are normal communications with ECU within 2 seconds. The surface of glow plug will be heated up to 850°C very quickly to aid combustion by vaporizing air-fuel mixture during compression stroke.
  Preheating time is controlled by ECU.

- While engine starting
  : Help to warm up engine

- After-heating
  : When the engine is started, after-heating starts by ECU controls. The idle rpm will be increased to reduce toxic smoke, pollutants and noises.
  After-heating time is controlled by ECU.

- Checking glow plugs
  - Check each glow plug for short in circuit
  - Check each glow plug for open in circuit due to overvoltage
  - Check glow plug for short to ground

- Forceful relay shut-down
  - When glow plug is shorted to ground

- K-Line communication
  - ECU sends the results to preheating time control relay through K-Line to start communication.
  - Preheating time control relay sends messages including self-diagnosis data for glow plugs to ECU.
  - Glow plug makes communication only as response to demand.
  - When power is supplied, ECU starts self-diagnosis within 2 seconds.
  - Under the following conditions, communication error occurs.
    When there is no response from glow plug module within 2 seconds
    When an error is detected in checksum
    Less byte is received
    Error code of “Pre heating control communication fail” will be reported.

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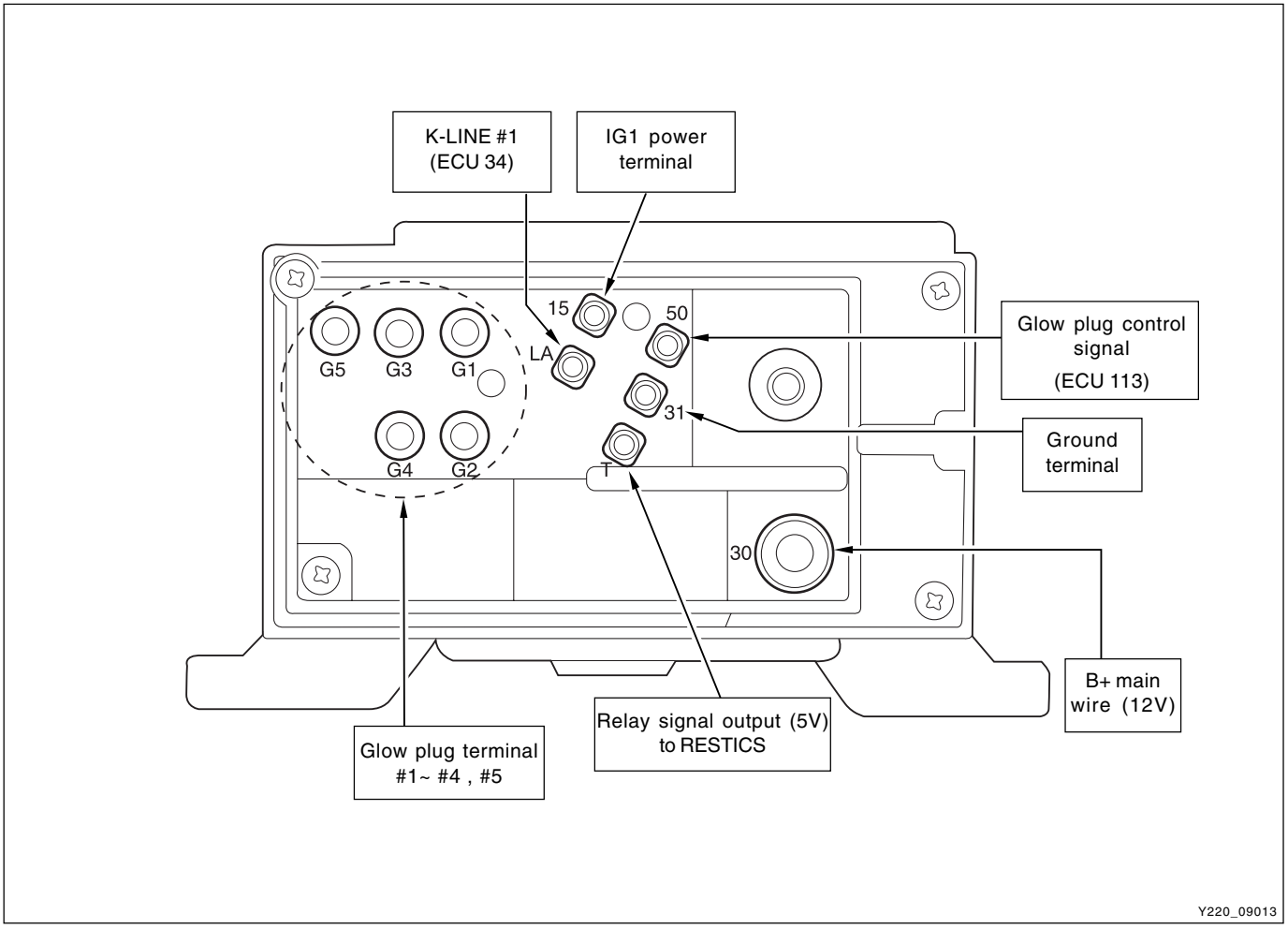
PREHEATING TIME RELAY

▶ Structure



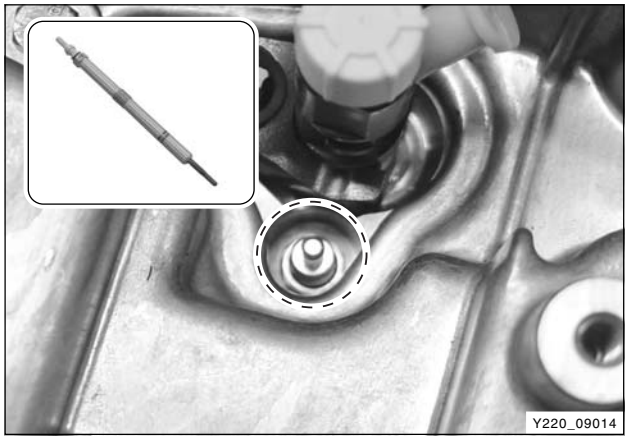
▶ Specifications

Description	Specification
Rated voltage	DC 12 V
Operating voltage range	DC 8 ~ 15 V
Operating range	- 40 ~ + 100°C
Relay operating voltage	Over 6.5 V
Relay releasing voltage	Over 1.5 V
Relay coil resistance	11.3 Ω
Voltage drop	Below 150 mV at each glow plug (at 16A of current)
Parasitic current	Max. 1mA

GLOW PLUG

Cylinder type glow plug is inserted into the cylinder and composed of heating pin and housing.

There are heating coil and control coil in the heating pin and those coils located inside of ceramic cover turn ON or OFF the internal switch.



▶ Purposes of use

- Preheating before engine starting
- During engine starting
- After-heating after engine starting

▶ Conditions for glow plugs

- Prompt heating and secured temperature stabilities (temperature changes) in low operating voltage
- Should not exceed permissible max. temperature under max. operating voltage
- Heating pin should have good heat-resisting properties against combustion gas and durability
- Material of the glow plug should meet high stressing conditions (e.g., temperature, vibration and environmental factors)

▶ Specifications

Description	Specification
Rated voltage	11 ± 0.1 V
Current consumption	Initial current I_{intial} < 30.0 A
Preheating time (From ambient temperature up to 85°C)	$T_{850°C}$ = 5 ± 1.5 sec.
Operating temperature	900 °C
Tightening torque	15 + 3 Nm

▶ Trouble Code

Refer to “Diagnosis” section in this manual.

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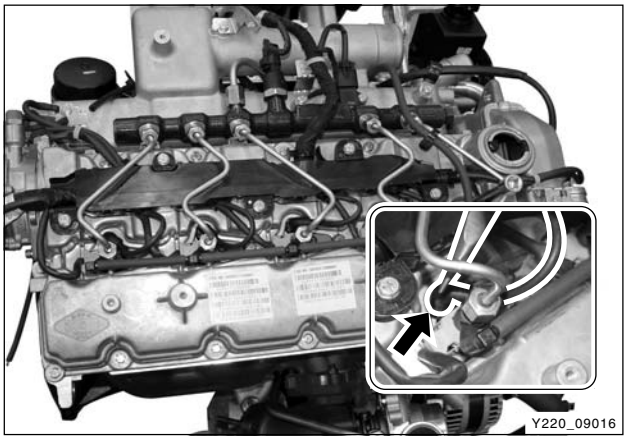
Removal and Installation

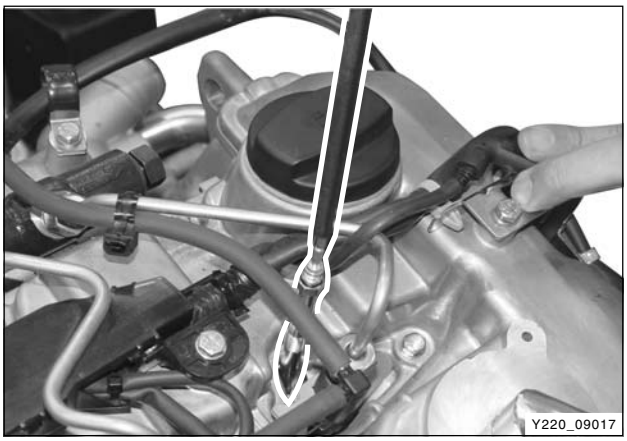
1. Turn the ignition switch to “OFF” position and disconnect the negative battery cable.
2. Set aside the harnesses on the cylinder head.



3. Disconnect the glow plug connectors and loosen the glow plugs.

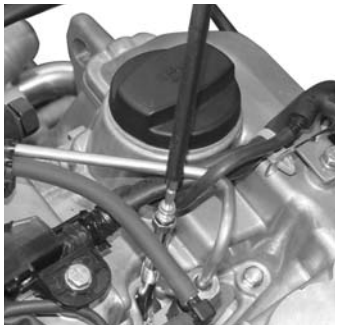
   Installation Notice

Tightening torque	15 Nm



4. Remove the glow plugs from the cylinder head with a special tool. Plug the openings of the glow plugs with sealing caps.

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
Glow plug remover Y220_09018	Removal of glow plug  Y220_09019

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AFFECTED VIN	

SCAN-I OPERATING PROCEDURES - XDi270 ENGINE

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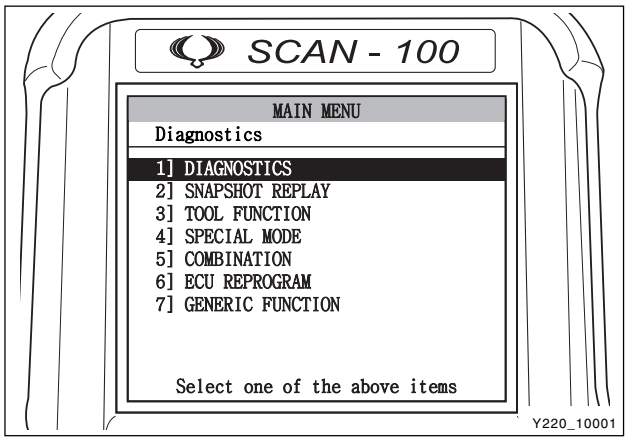
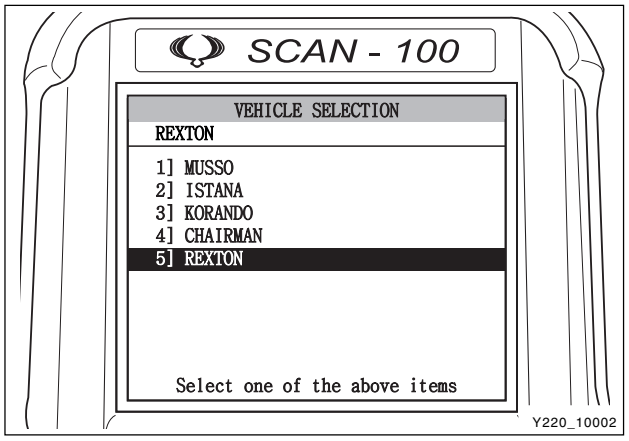
EFFECTIVE DATE	
AFFECTED VIN	

SCAN-I OPERATING PROCEDURES - D27DT ENGINE

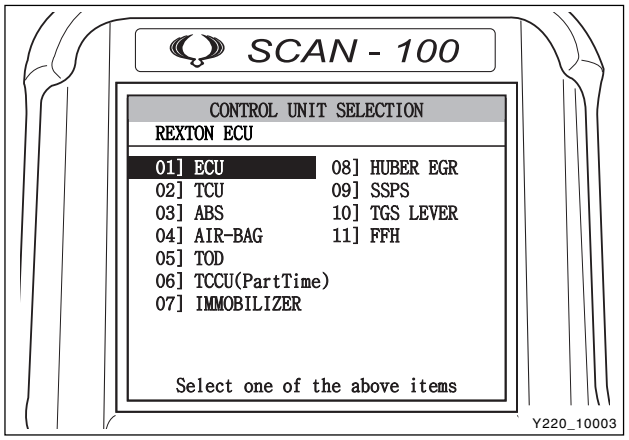


ENTERING DIAGNOSIS PROCEDURES

1. Select "1] DIAGNOSIS" and press "ENTER" in "MAIN MENU" screen.

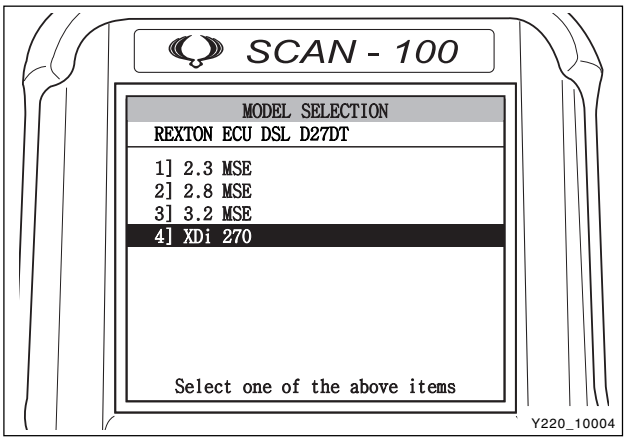


2. Select "5] REXTON" and press "ENTER" in "VEHICLE SELECTION" screen.

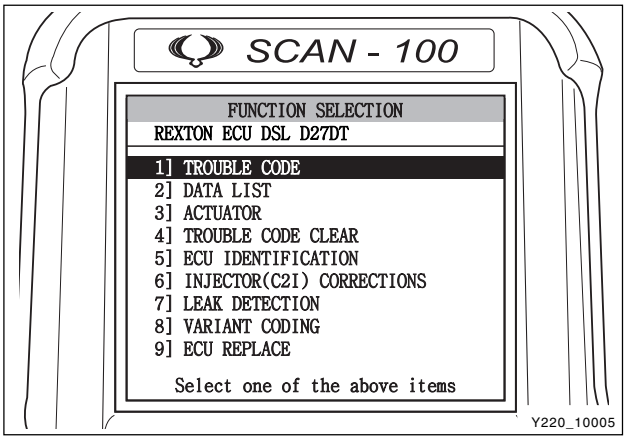


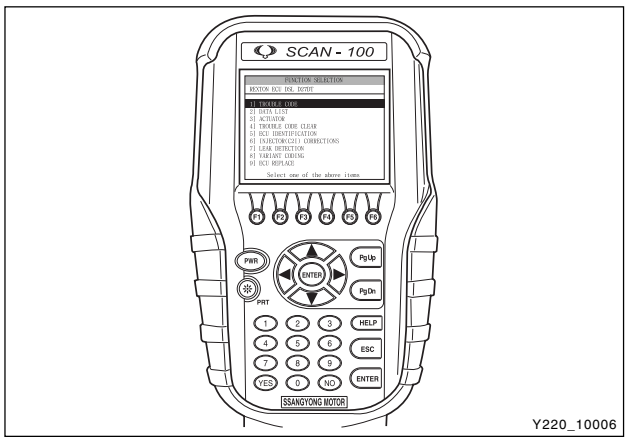
3. Select "1] ECU" and press "ENTER" in "CONTROL UNIT SELECTION" screen.

4. Select “4] XDi 270” and press “ENTER” in “MODEL SELECTION” screen.



5. The “FUNCTION SELECTION” screen is displayed.



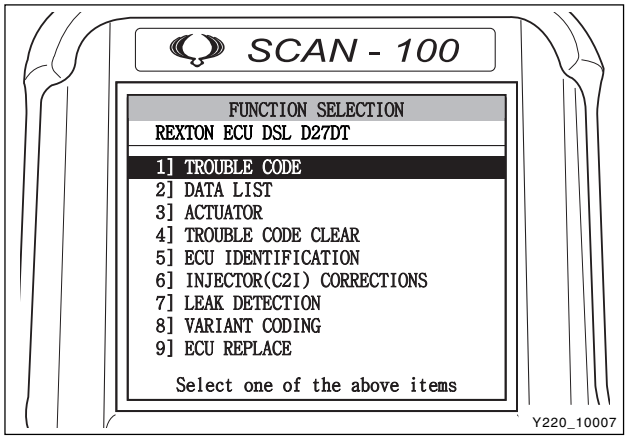


Y220_10006

FUNCTION SELECTION

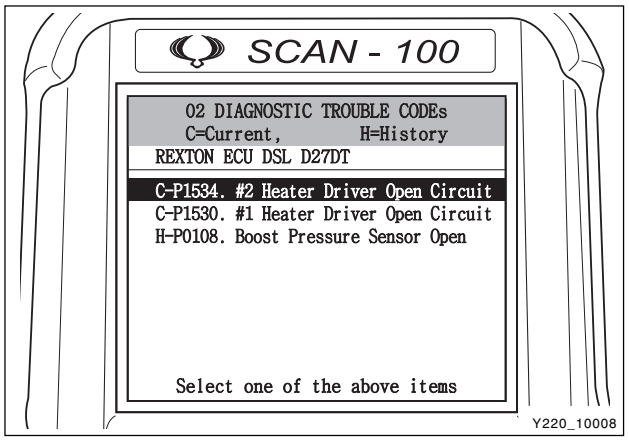
Check the Trouble Code

※ Preceding work: Perform the “Entering Diagnosis Procedures”



Y220_10007

1. Select “1] TROUBLE CODE” and press “ENTER” in “FUNCTION SELECTION” screen.

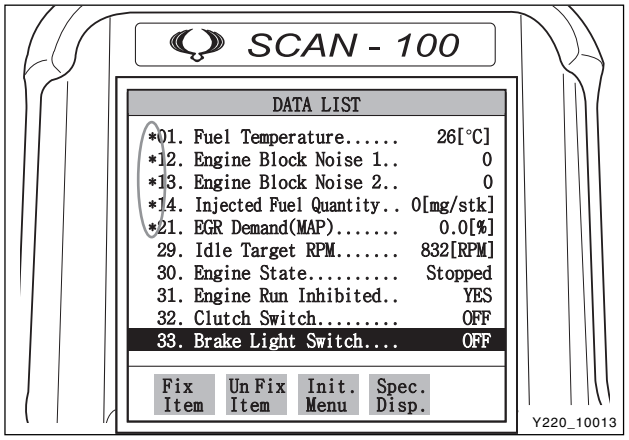


Y220_10008

2. The “DIAGNOSTIC TROUBLE CODEs” screen is displayed and it shows the trouble.

Note

If there is not any fault, “NO TROUBLE DETECTED” message appears.

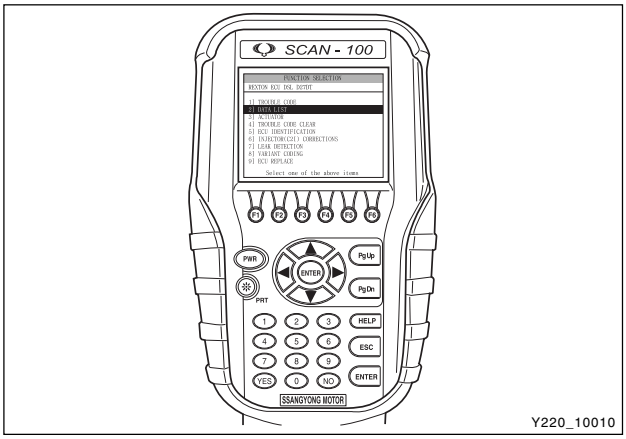


Y220_10013

3. When selecting a trouble code, then
   if you press “(ENTER)”: Displays the sensor data for the detected trouble (Freeze Frame Mode).
   if you press “(HELP)”: Displays the help tips for the detected trouble.

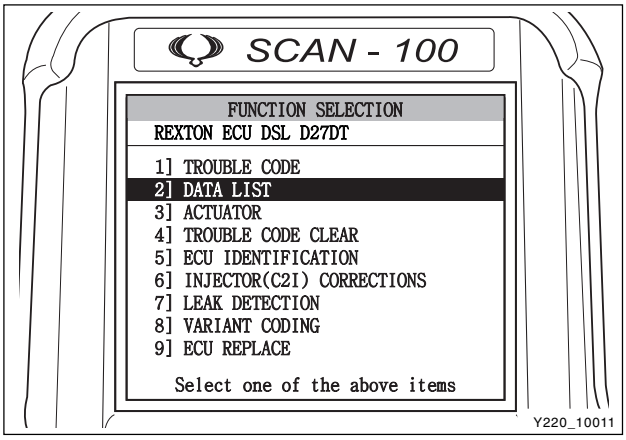
Sensor Data Check

※ Preceding Work: Perform the “Entering Diagnosis Procedures”



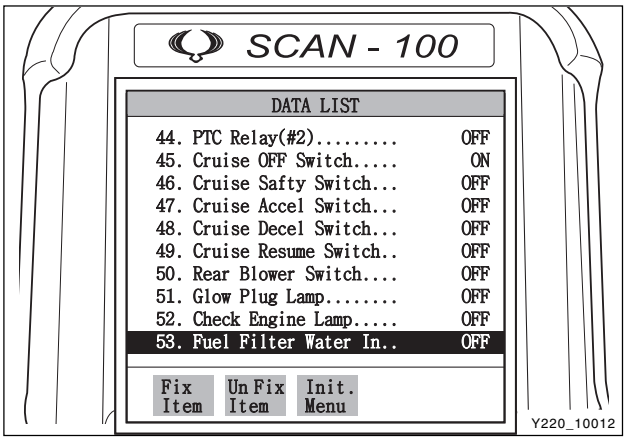
Y220_10010

1. Select “2] DATA LIST” and press “ENTER” in “FUNCTION SELECTION” screen.



Y220_10011

2. The screen shows approx. 54 sensor data.

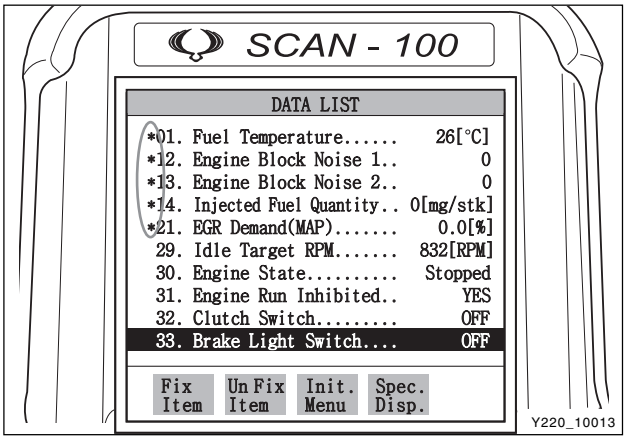


Y220_10012

3. Select the items you want to see and press “F1” key to freeze them.

Note

You can freeze up to 5 items (*: selected items).



Y220_10013

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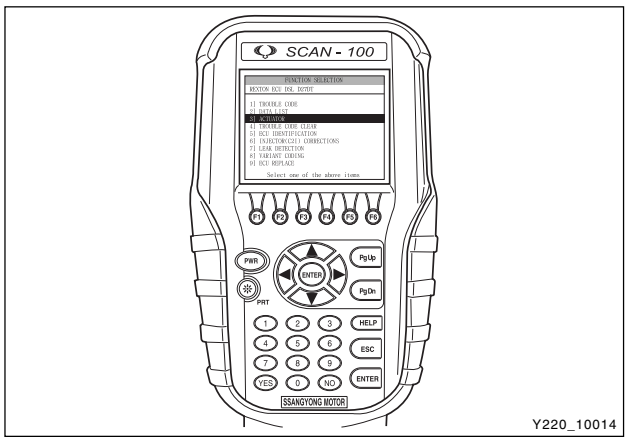
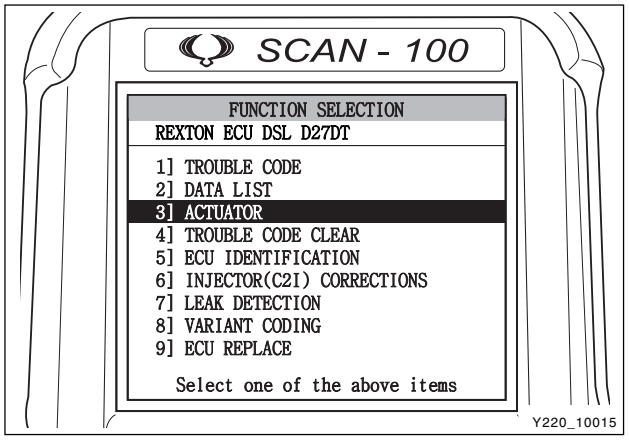


Y220_10014

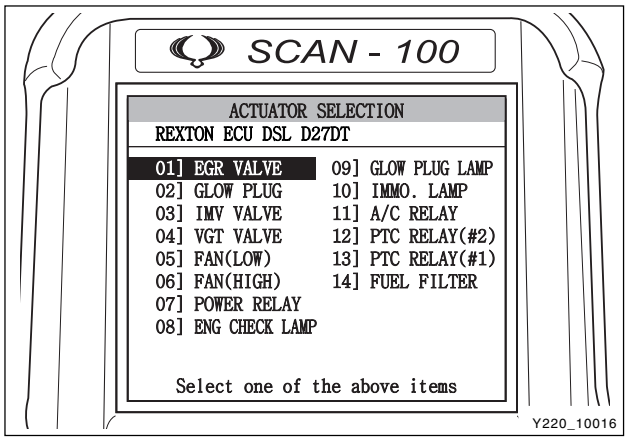
Actuator Check

※ Preceding Work: Perform the “Entering Diagnosis Procedures”



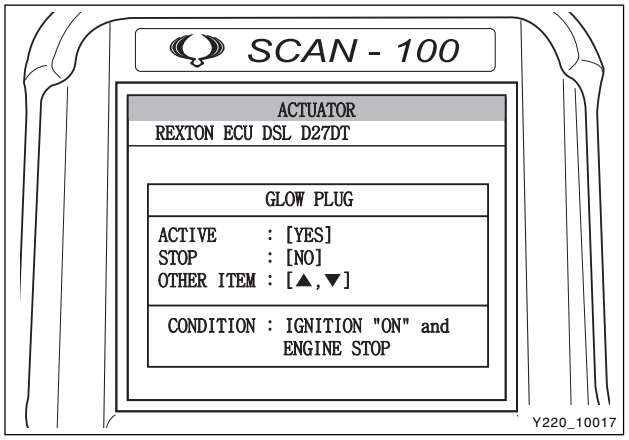
Y220_10015

1. Select “3] ACTUATOR” and press “ENTER” in “FUNCTION SELECTION” screen.



Y220_10016

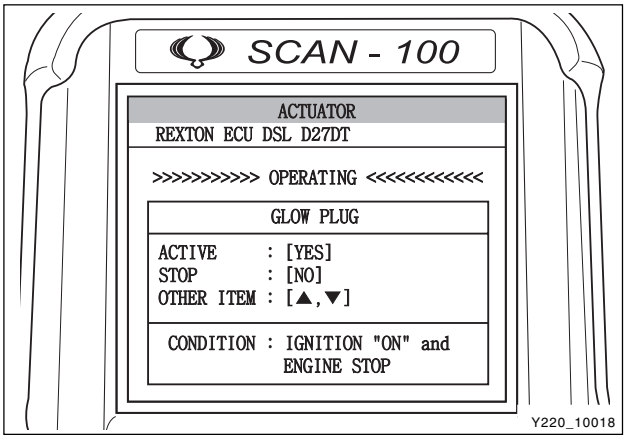
2. The screen shows 14 items. Select the item you want to see and press “ENTER”.



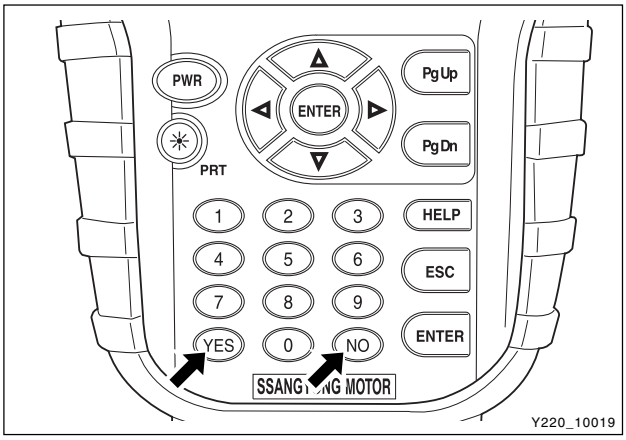
Y220_10017

3. For example, if you select “02] GLOW PLUG” item and press “ENTER”, the screen as shown in figure is displayed.

4. If you want to operate the glow plug relay, press "YES" key. The "OPERATING" message appears and the relay operation alarm sounds.



5. If you want to stop the operation press "NO" key in keyboard.



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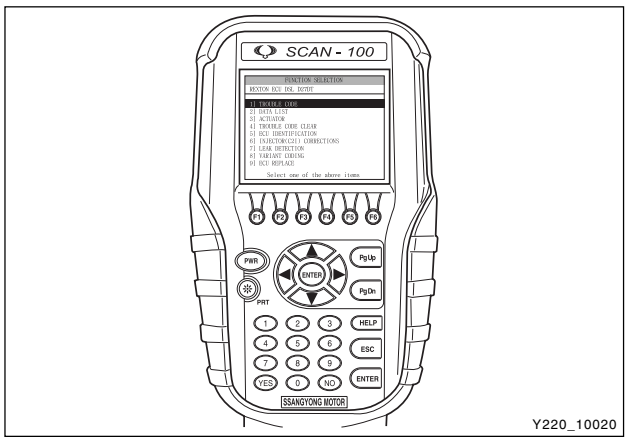
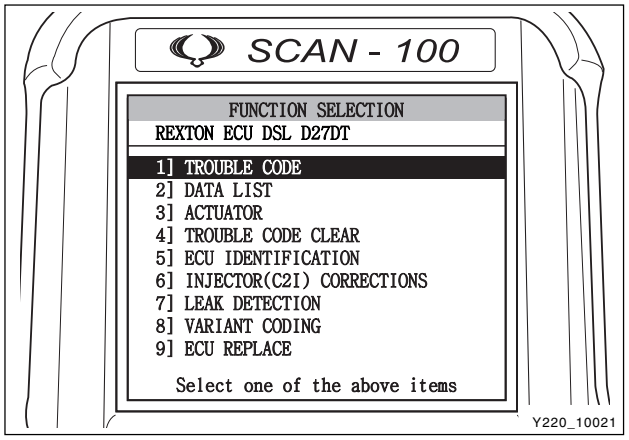


Y220_10020

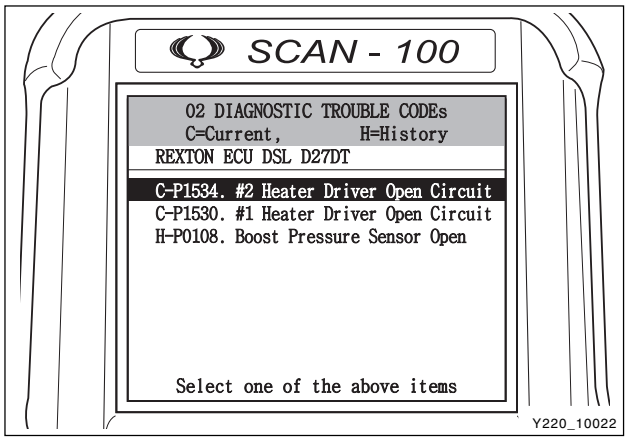
Trouble Code Clear

※ Preceding Work: Perform the “Entering Diagnosis Procedures”



Y220_10021

1. Select “1] TROUBLE CODE” and press “ENTER” in “FUNCTION SELECTION” screen.

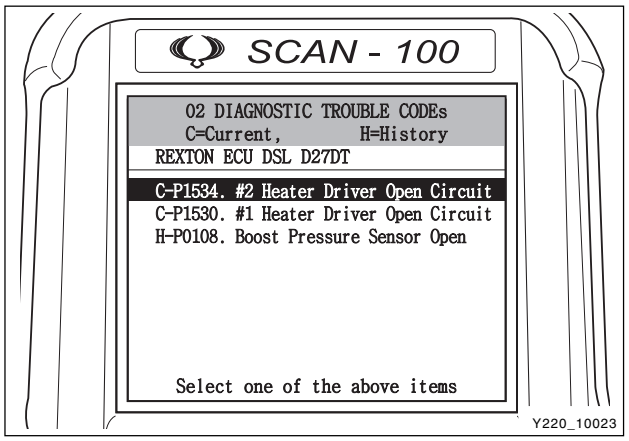


Y220_10022

2. The “DIAGNOSTIC TROUBLE CODEs” screen is displayed and it shows the trouble.

Note

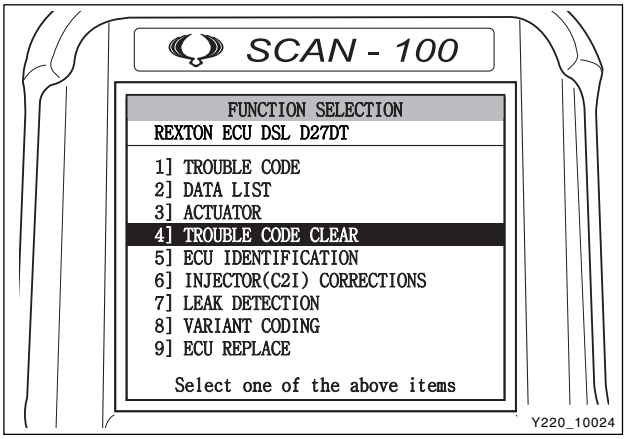
C = Current trouble, H = History trouble



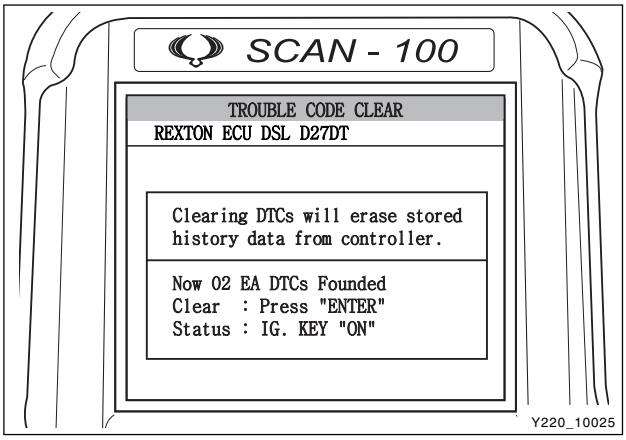
Y220_10023

3. Fix the trouble and go back to “1] TROUBLE CODE” screen and check if the trouble has been changed to “H (History trouble code)” code.

4. If the trouble has been change to “H (History trouble code)” code, press “(ESC)” key to go back to “FUNCTION SELECTION” screen. In this screen, select “4] TROUBLE CODE CLEAR” and press “(ENTER)”.

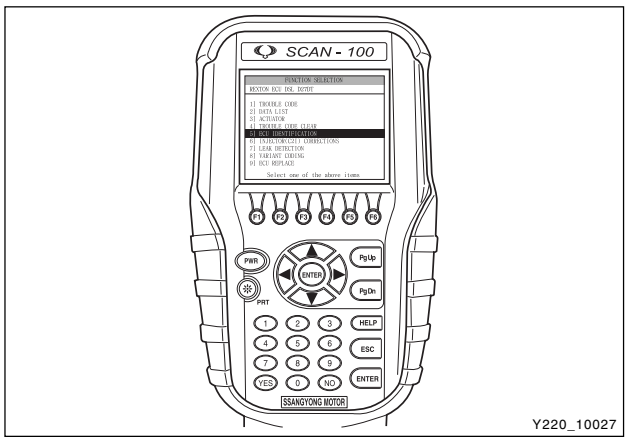


5. The “TROUBLE CODE CLEAR” screen is displayed. If you press “(ENTER)”, only the history trouble codes will be cleared.



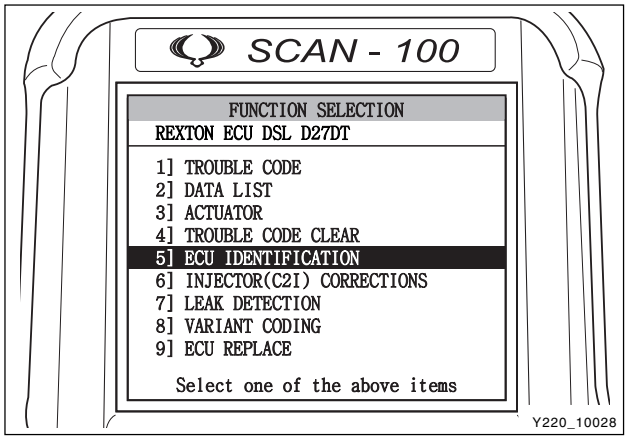
Note

- ***Current trouble codes will not be cleared.***
- ***Check the trouble codes after clearing the trouble codes.***

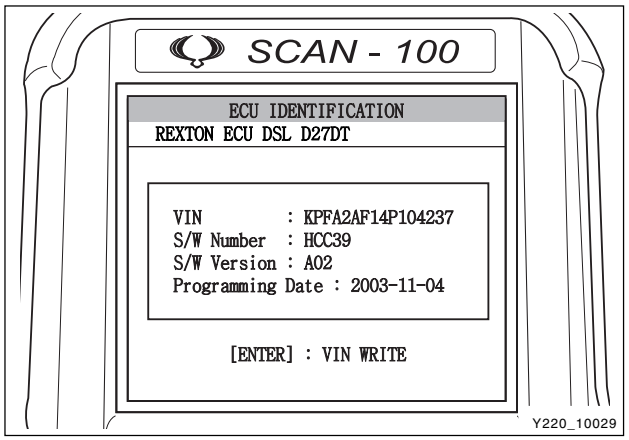


ECU Identification

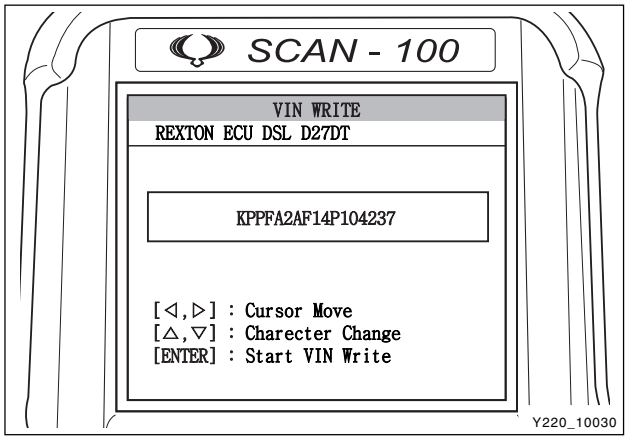
※ Preceding Work: Perform the “Entering Diagnosis Procedures”



1. Select “1] ECU IDENTIFICATION” and press “ENTER” in “FUNCTION SELECTION” screen.



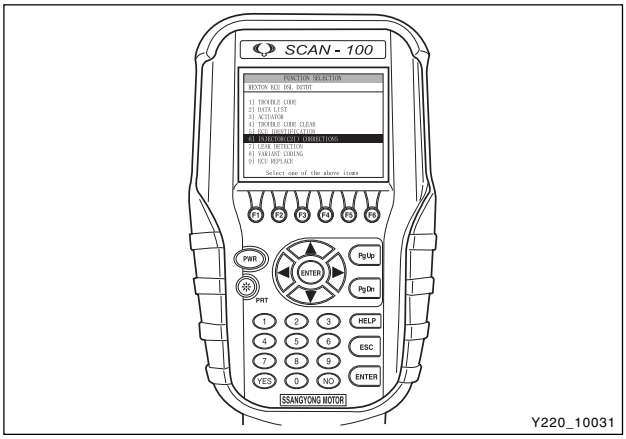
2. The “ECU IDENTIFICATION” screen that shows the VIN, ECU software number, ECU software version and programming date is displayed.



3. If you replaced the ECU, press “ENTER” to input the vehicle identification number.

Injector Coding (C2I)

※ Preceding Work: Perform the “Entering Diagnosis Procedures”

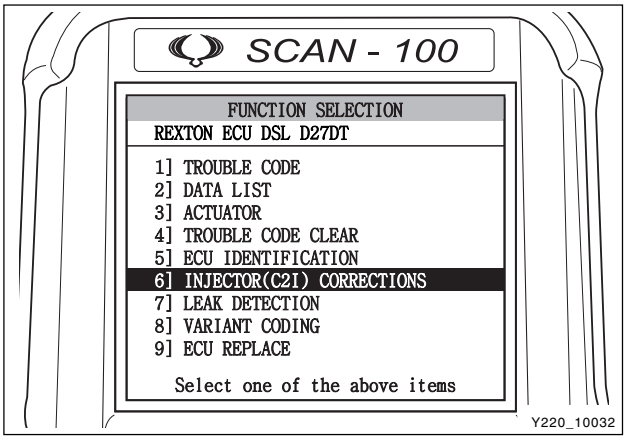


Y220_10031

Notice

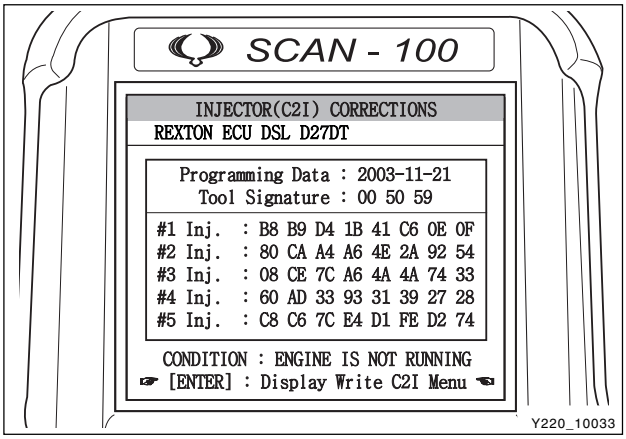
If the injector/ECU has been replaced or the injector system defective is suspected, go to C2I Coding item and check the injector and coded injector C2I value.

1. Select “6] INJECTOR (C2I) CORRECTIONS” and press “(ENTER)” in “FUNCTION SELECTION” screen.



Y220_10032

2. The “INJECTOR (C2I) CORRECTIONS” screen that shows current C2I coding values of #1 to #5 injector is displayed.
3. If you replaced the ECU, enter the C2I value of the relevant injector.



Y220_10033

Note

- ***The C2I value of replacing injector is recorded in the label.***
- ***C2I coding number: 16 digits (ex, B1 B9 D4 1B 43 C6 0E 4F)***

Y220_10034

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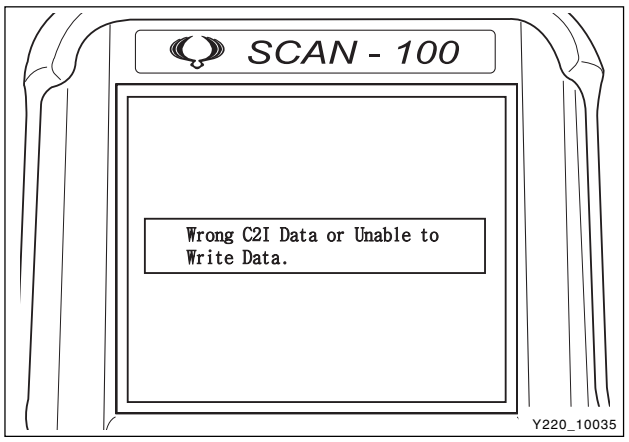
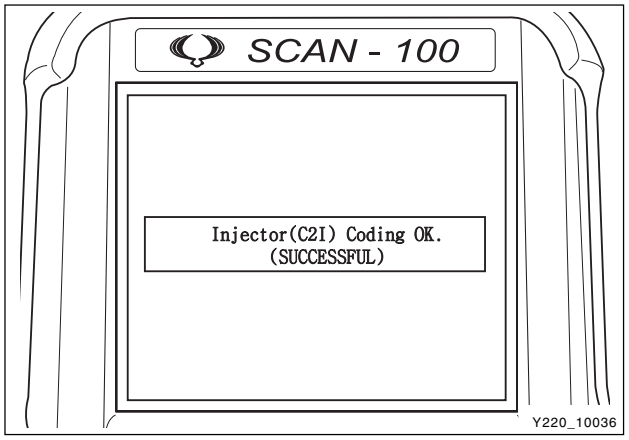


3-1. If you enter the invalid C2I value of the relevant injector, the message as shown in figure appears with alarm sound.

Note

If you want to go back to previous screen, press "ESC" key. You can see the previous C2I value.



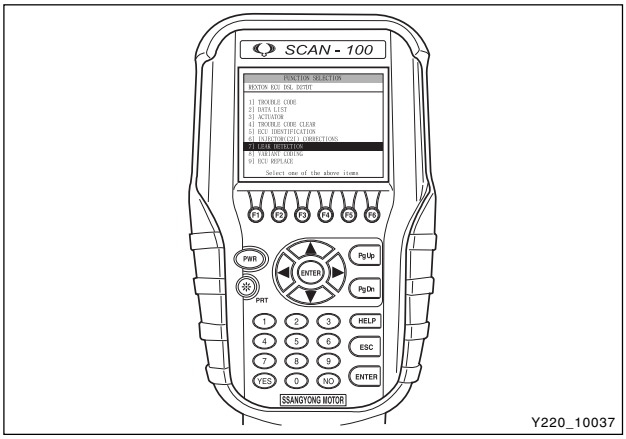
3-2. If you enter the valid C2I value of the relevant injector, the message as shown in figure appears with alarm sound.

Leak Detection

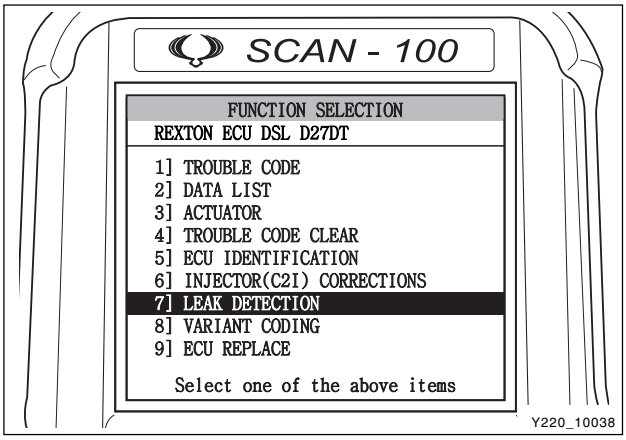
※ Preceding Work: Perform the “Entering Diagnosis Procedures”

Note

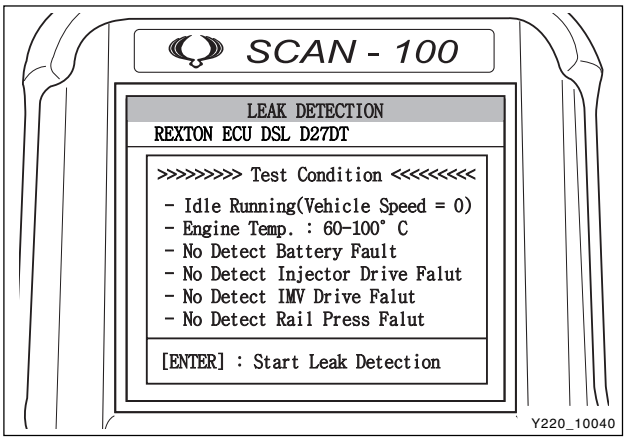
This item is for checking the high fuel pressure after the IMV supply line of HP pump in DI engine fuel system. If you still suspect that the fuel pressure system is defective even after no trouble is detected, perform the fuel pressure test again by using a fuel pressure tool kit.



1. Select “7] LEAK DETECTION” and press “ENTER” in “FUNCTION SELECTION” screen.



2. The “LEAK DETECTION” screen that shows the checking conditions as shown in figure is displayed.



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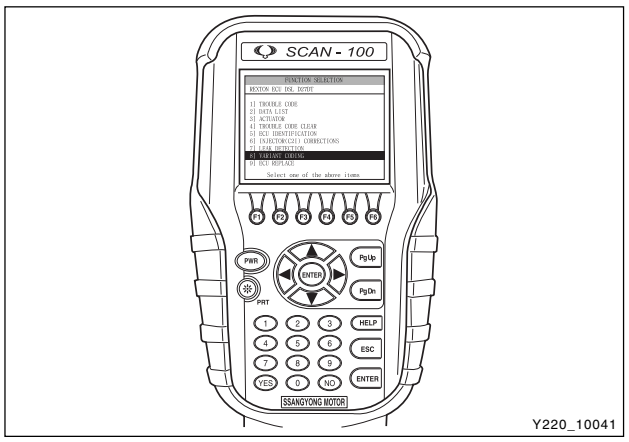
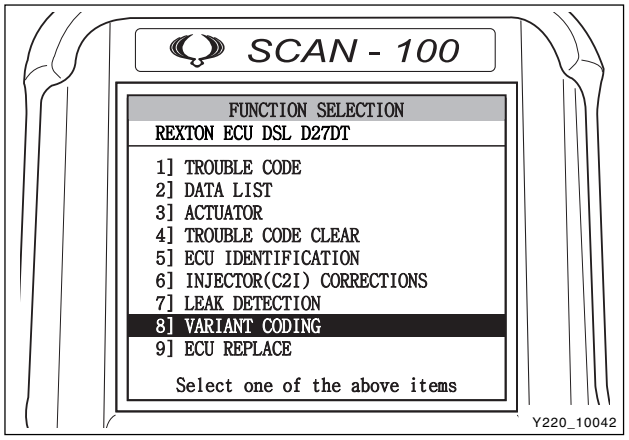
EFFECTIVE DATE	
AFFECTED VIN	

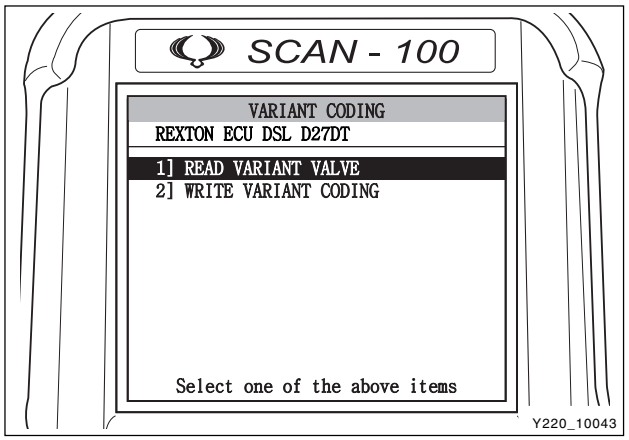


Variant Coding

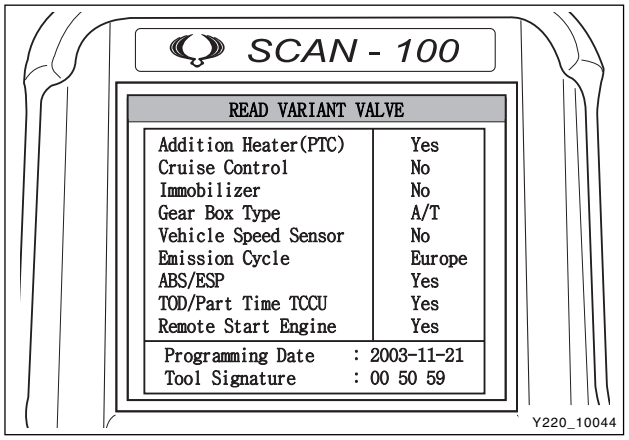
※ Preceding Work: Perform the “Entering Diagnosis Procedures”



1. Select “8] VARIANT CODING” and press “ENTER” in “FUNCTION SELECTION” screen.

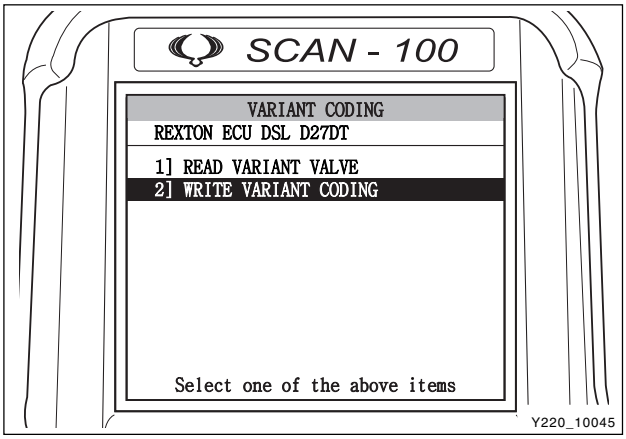


2. When the “VARIANT CODING” screen is displayed, select “1] READ VARIANT VALUE” and press “ENTER”.

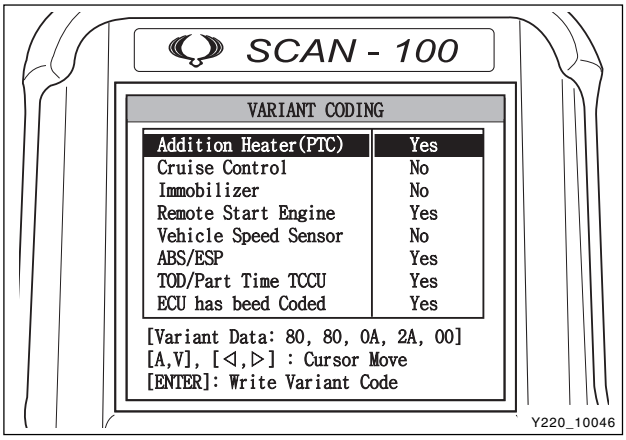


3. The “VARIANT CODING” screen that shows currently equipped devices is displayed.

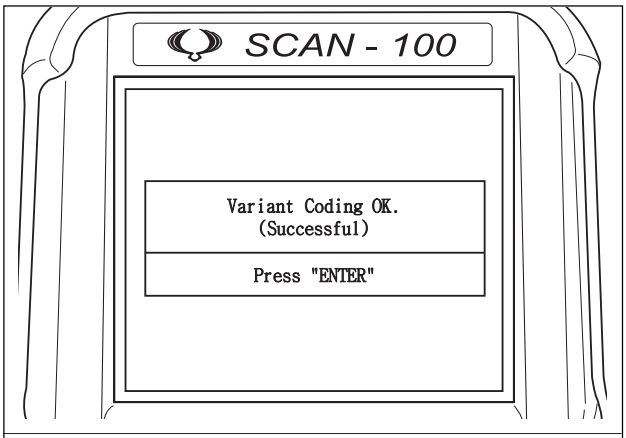
4. If you need to change the variant coding, press "(ESC)" key to go back to "VARIANT CODING" screen. In the screen, select "2] WRITE VARIANT CODING" and press "(ENTER)".



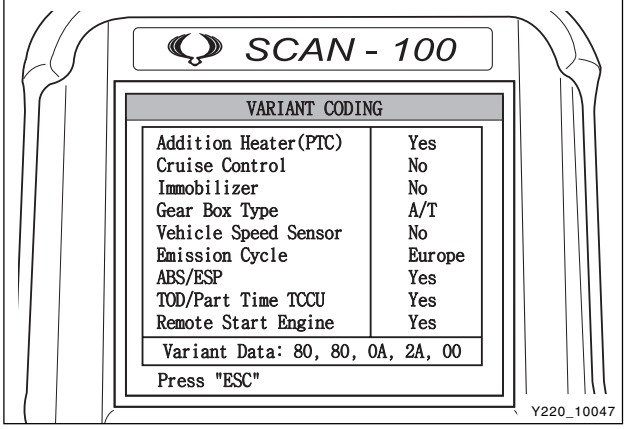
5. When the "VARIANT CODING" screen is displayed, change the item by using arrow keys.



6. If you press "(ENTER)", the message as shown in figure appears. And, then "VARIANT CODING" screen is displayed.



7. Select "READ VARIANT VALUE" to see the coding coded value.



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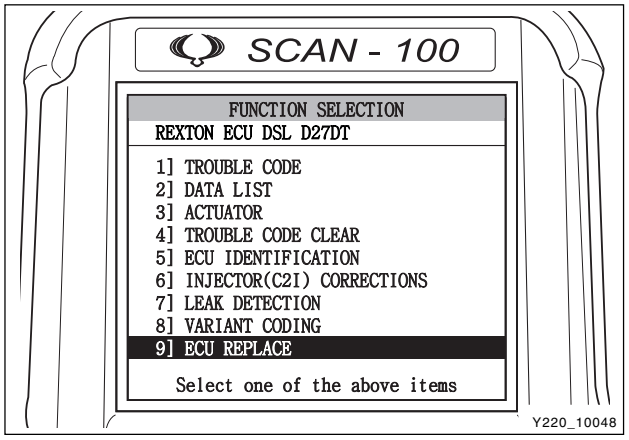
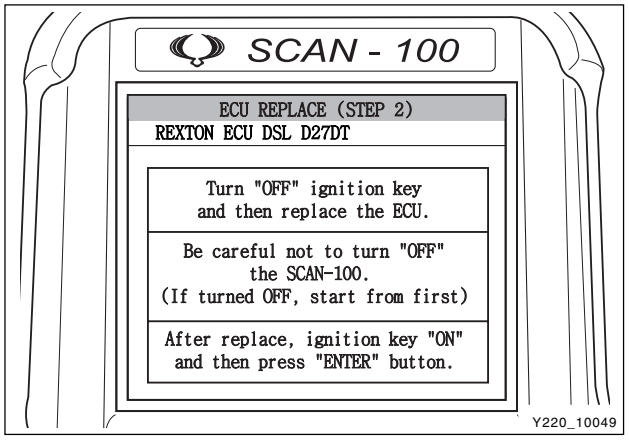
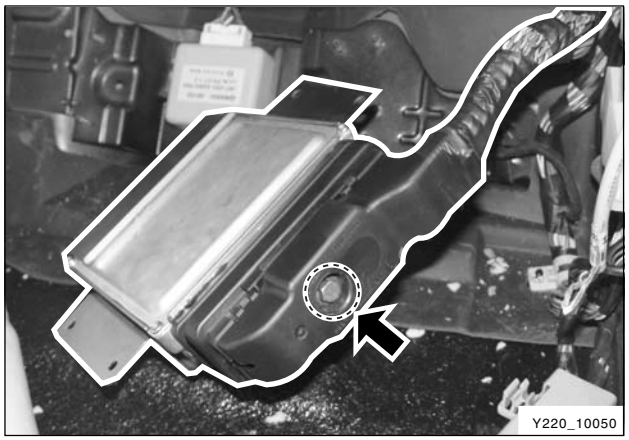






ECU Replace

※ Preceding Work: Perform the “Entering Diagnosis Procedures”

1. Select “9] ECU REPLACE” and press “ENTER” in “FUNCTION SELECTION” screen.

2. When the “ECU REPLACE (STEP 2)” screen is displayed followed by “ECU REPLACE (STEP 1) screen, turn the ignition “OFF” and remove the currently installed ECU.

Notice

Do not turn off the Scan-100 at this time.
Record the below data:

- ***Vehicle identification number***
- ***Variant coding value***
- ***C2I coding value***
- ***Multi calibration***

3. Install the new ECU.

4. If you turn the ignition switch to "ON" position and press "ENTER", the message as shown in figure 1 (system initialization) appears, and then "MULTI CALIBRATION SELECTION" screen (fig. 2) is displayed.

figure 1

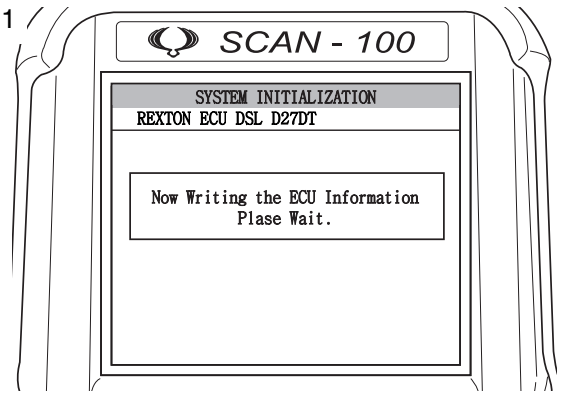
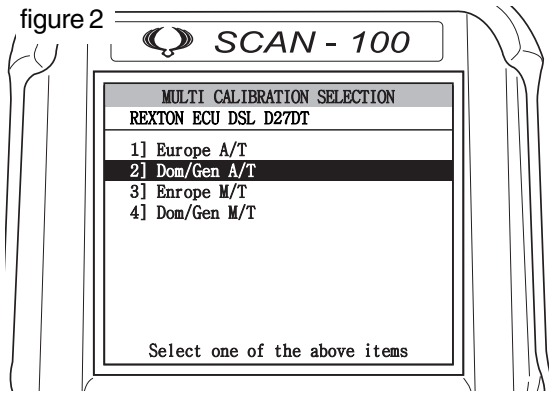
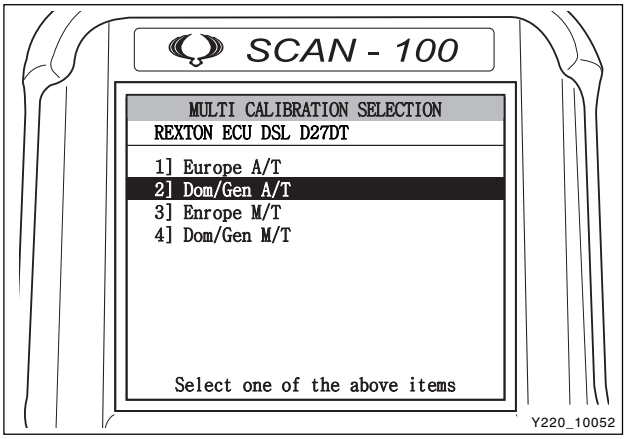


figure 2



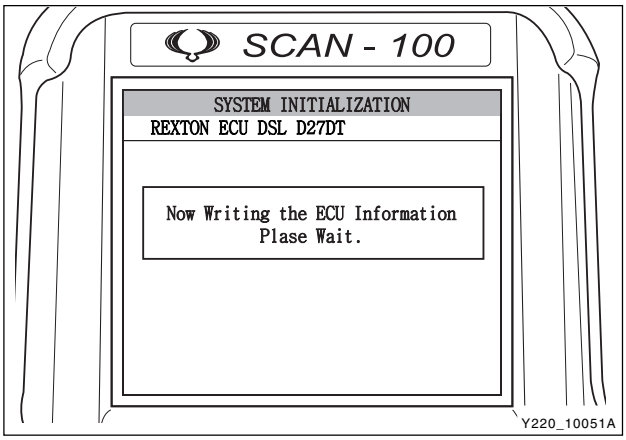
Y220_10051

5. In "MULTI CALIBRATION SELECTION" screen, select "2] DOM/GEN" for automatic transmission equipped vehicle and select "4] DOM/GEN" for manual transmission equipped vehicle.



Y220_10052

6. When you press "ENTER", the processing message as shown in figure appears.



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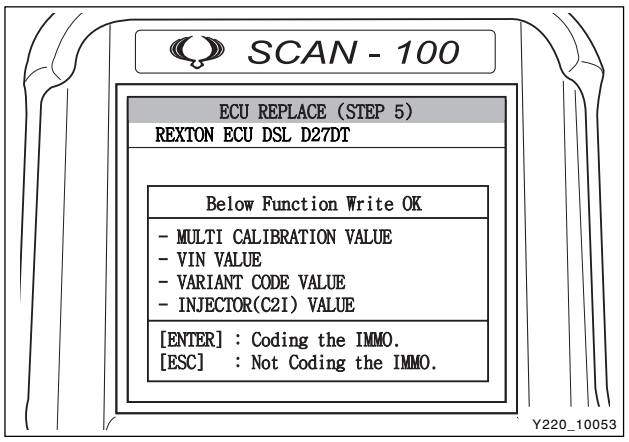
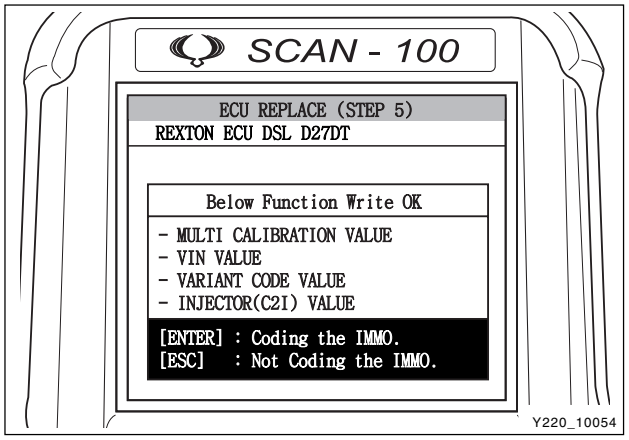


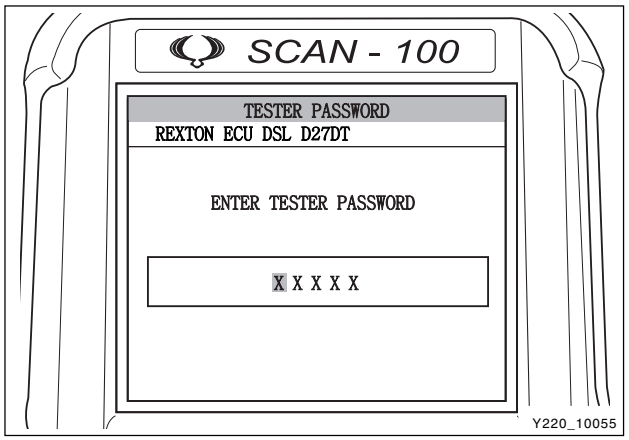
7. If the multi calibration is completed successfully, “ECU REPLACE (STEP 5) screen is displayed.

   Backup data:

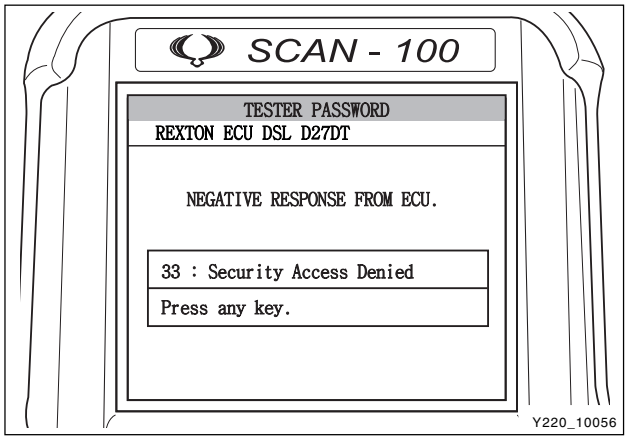
   - Multi calibration value
   - VIN value
   - Variant code value
   - Injector (C2I) value



8. In immobilizer equipped vehicle, the immobilizer coding should be done after completed the multi calibration.

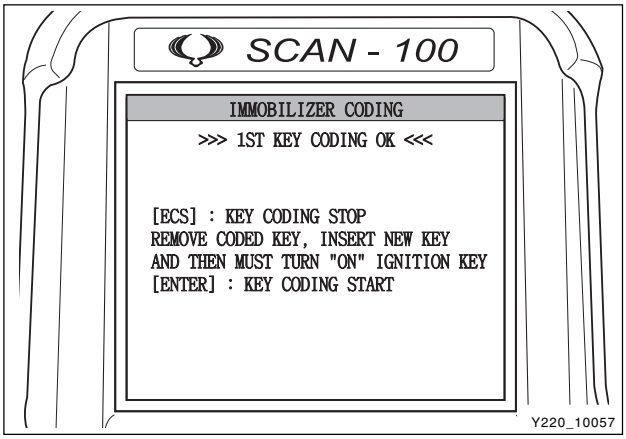


9. Press “ENTER” and enter the user password.

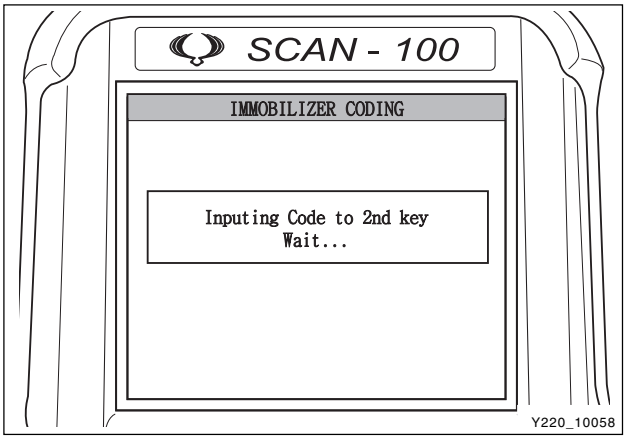


10. If the password is invalid, the “access denied” screen as shown in figure is displayed.

11. If the password is valid, an immobilizer coding is started.

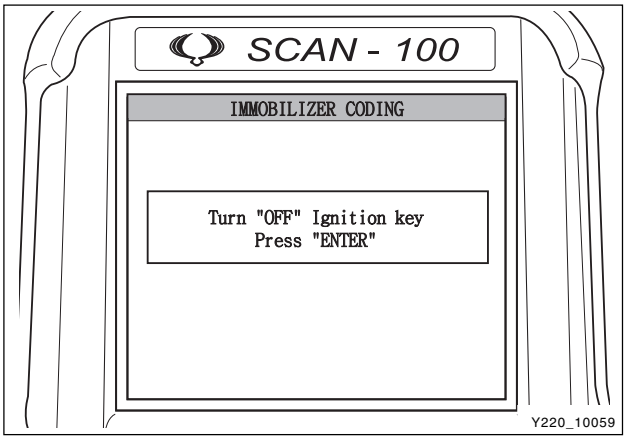


12. If you want to code for additional keys, remove the first key from key switch and insert the second key. Turn it to “ON” position and press “ENTER” to proceed.



13. You can code up to five keys with same manner.

14. When the immobilizer coding is completed, press “ESC”. The completion message as shown in figure appears.



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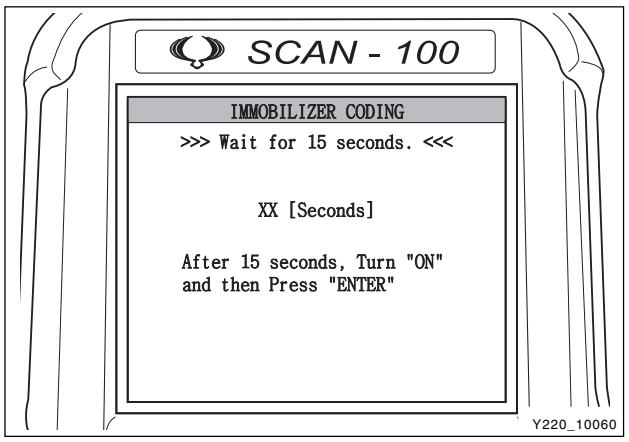
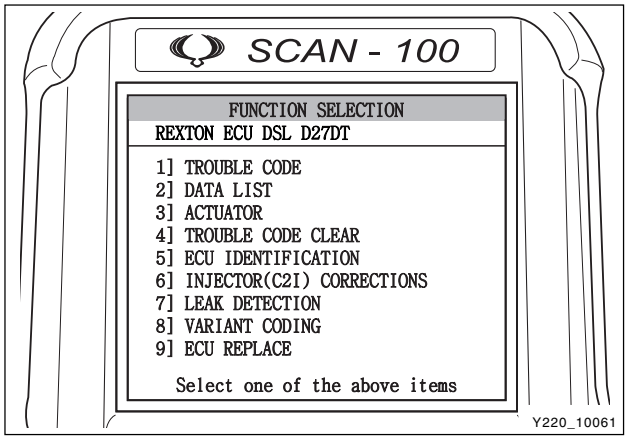


15. When you turn the ignition key to “OFF” position, the message screen as shown in figure is displayed. Wait for 15 seconds and turn the ignition key to “ON” position.



16. Press “ENTER” to return to “MAIN MENU” screen.

TROUBLE DIAGNOSIS TABLE

INDEX OF DTC

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TROUBLE DIAGNOSIS TABLE

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0102	Low HFM Sensor Signal (Circuit Open)	- HFM sensing values are lower than minimum sensing values. - Check the resistance in HFM sensor. - Check the ECU wiring harness (open and poor contact). • Check the ECU pin #82 and #84 for open circuit. - Actual air mass flow vs. Output voltages. • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.					
P0103	High HFM Sensor Signal (Circuit Short)	- HFM sensing values are higher than maximum sensing values. - Check the resistance in HFM sensor. - Check the ECU wiring harness (open and poor contact). • Check the ECU pin #82 and #84 for open circuit. - Actual air mass flow vs. Output voltages. • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0100	Air Mass Flow (HFM) Malfunction	- The external power supply is faulty. • Check the external power supply. • Check the sensor wiring harness (open, short, poor contact). - Actual air mass flow vs. Output voltages. • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.					
P0344	Cam Position Sensor Malfunction	- No cam recognition signal (missing events). - Check the source voltage of cam position sensor (ECU pin #111) (specified value: 4.5 ~ 12 V). - Check the sensor wiring harness for ECU pin #103 and #104 (open, short, poor contact). - Check the cam position sensor. - Measure the air gap: 0.2 ~ 1.8 mm - Replace the ECU if required.					
P0341	Cam Position Sensor Malfunction (Poor Synchronization)	- Not synchronized with Crank angle signal. - Check the source voltage of cam position sensor (specified value: 4.5 ~ 12 V). - Check the sensor wiring harness for ECU pin #103 and #104 (open, short, poor contact). - Check the cam position sensor. - Measure the air gap: 0.2 ~ 1.8 mm - Replace the ECU if required.					
P0219	Too Small Clearance of Crank Angle Sensor	- Crank angle signal faults or clearance too close. - Check the sensor wiring harness for ECU pin #90 and #82 (open, short, poor contact). - Check the resistance of crank angle sensor: 1090 Ω ± 15 %. - Measure the air gap: 0.3 ~ 1.3 mm • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. • Drive plate (A/T), DMF (M/T) - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0336	Too Large Clearance of Crank Angle Sensor	- Air gap of crank angle sensor is abnormal. - Check the sensor wiring harness for ECU pin #90 and #82 (open, short, poor contact). - Check the resistance of crank angle sensor: 1090 Ω ± 15 %. - Measure the air gap: 0.3 ~ 1.3 mm • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. • Drive plate (A/T), DMF (M/T) - Replace the ECU if required.					
P0372	Crank Angle Sensor Malfunction	- Even though cam position recognition is normal, no crank angle signal recognition (missing tooth). - Check the sensor wiring harness for ECU pin #90 and #82 (open, short, poor contact). - Check the resistance of crank angle sensor: 1090 Ω ± 15 %. - Measure the air gap: 0.3 ~ 1.3 mm • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. • Drive plate (A/T), DMF (M/T) - Replace the ECU if required.					
P1107	Barometric Sensor Circuit Short/GND Short	- Out of range about barometric sensor (short to ground). - Actual barometric pressure vs. Output voltages. • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU.					
P1108	Barometric Sensor Circuit Short	- Out of range about barometric sensor (short to B+). - Actual barometric pressure vs. Output voltages. • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU.					
P1105	Barometric Sensor Circuit Short	- Out of range about barometric sensor (over voltage). - Actual barometric pressure vs. Output voltages. • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0562	Low Battery Voltage	- Malfunction in recognition of system source voltage (Lower than threshold). • Less than minimum 8 Volts in 2000 rpm below • Less than 10 Volts in 2000 rpm above. - Check the battery wiring harness for ECU pin #3, #4 and #5 (open, short, poor contact). - Check the battery main relay and fuse. - Check the body ground. - Measure the resistance between body ground and ECU ground. • Repair the ECU ground if the resistance is high. - Replace the ECU if required.	O				
P0563	High Battery Voltage	- Malfunction in recognition of system source voltage (Higher than threshold). • More than minimum 16 Volts in 2000 rpm below - Check the battery wiring harness for ECU pin #3, #4 and #5 (open, short, poor contact). - Check the alternator. - Check the body ground. - Measure the resistance between body ground and ECU ground. • Repair the ECU ground if the resistance is high. - Replace the ECU if required.	O				
P0560	Battery Voltage Malfunction	- Malfunction in recognition of system source voltage (A/D converter faults). • Less than minimum 8 Volts in 2000 rpm below • Less than 10 Volts in 2000 rpm above. - Check the battery wiring harness for ECU pin #3, #4 and #5 (open, short, poor contact). - Check the battery main relay and fuse. - Check the body ground. - Measure the resistance between body ground and ECU ground. • Repair the ECU ground if the resistance is high. - Replace the ECU if required.	O				

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0109	Low Booster Pressure Sensor Signal	- Out of signal range about boost pressure sensor at Ignition key-On and Engine Stop (Lower than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					
P0106	High Booster Pressure Sensor Signal	- Out of signal range about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					

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DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0107	Booster Pressure Sensor Open/GND Short	- Out of signal range about boost pressure sensor at Engine running condition (Lower than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					
P0108	Booster Pressure Sensor Short	- Out of signal range about boost pressure sensor at Engine running condition (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545~2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0105	Supply Voltage Fault to Booster Pressure Sensor	- Out of range of supply voltages about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #100 and #108 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					
P1106	Booster Pressure Sensor Malfunction	- Out of range of supply voltages about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					

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DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1109	Booster Pressure Sensor Initial Check Fault	- Implausible signal values or range about boost pressure sensor at Engine running condition (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction					
P0571	Brake Pedal Switch Fault	- The brake pedal switch or light switch is faulty. • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake and light switch wiring harness. - Check the supply voltage to brake and light switch (12 V). - Check the brake and light switch for contact. - Check the ECU wiring harness for ECU pin #77 and #58 (short, poor contact). - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1572	Brake Lamp Signal Fault	- The brake pedal switch or light switch is faulty. • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake pedal switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake pedal and light switch wiring harness. - Check the supply voltage to brake pedal and light switch (12 V). - Check the brake pedal and light switch for contact. - Check the ECU wiring harness for ECU pin #58 (open, short, poor contact). - Replace the ECU if required.					
P1571	Brake Lamp Signal Fault	- The brake pedal switch is faulty. • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake pedal switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake pedal switch wiring harness. - Check the supply voltage to brake pedal switch (12 V). - Check the brake pedal switch for contact. - Check the ECU wiring harness for ECU pin #77 (open, short, poor contact). - Replace the ECU if required.					
P1286	Low Resistance for Injector #1 wiring harness	- Out of range about wiring harness resistance for Injector #1. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #1 wiring harness and electric isolation. - Check the injector #1 wiring harness for open circuit. • If the pin in injector #1 is defective, replace injector #1 and perform C2I coding, then check again. • If the pin in injector #1 is not defective, check the ECU wiring harness. - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1287	High Resistance for Injector #1 wiring harness	- Out of range about wiring harness resistance for Injector #1. • High: More than 0.573 Ω (injector circuit short) - Check the injector #1 wiring harness and electric isolation. - Check the injector #1 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #1 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.					
P1288	Low Resistance for Injector #2 wiring harness	- Out of range about wiring harness resistance for Injector #2. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #2 wiring harness and electric isolation. - Check the injector #2 wiring harness for open circuit. • If the pin in injector #2 is defective, replace injector #2 and perform C2I coding, then check again. • If the pin in injector #2 is not defective, check the ECU wiring harness. - Replace the ECU if required.					
P1289	High Resistance for Injector #2 wiring harness	- Out of range about wiring harness resistance for Injector #2. • High: More than 0.573 Ω (injector circuit short) - Check the injector #2 wiring harness and electric isolation. - Check the injector #2 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #2 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1292	Low Resistance for Injector #4 wiring harness	- Out of range about wiring harness resistance for Injector #4. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #4 wiring harness and electric isolation. - Check the injector #4 wiring harness for open circuit. • If the pin in injector #4 is defective, replace injector #4 and perform C2I coding, then check again. • If the pin in injector #4 is not defective, check the ECU wiring harness. - Replace the ECU if required.					
P1293	High Resistance for Injector #4 wiring harness	- Out of range about wiring harness resistance for Injector #4. • High: More than 0.573 Ω (injector circuit short) - Check the injector #4 wiring harness and electric isolation. - Check the injector #4 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #4 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.					
P1294	Low Resistance for Injector #5 wiring harness	- Out of range about wiring harness resistance for Injector #5. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #5 wiring harness and electric isolation. - Check the injector #5 wiring harness for open circuit. • If the pin in injector #5 is defective, replace injector #5 and perform C2I coding, then check again. • If the pin in injector #5 is not defective, check the ECU wiring harness. - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1295	High Resistance for Injector #5 wiring harness	- Out of range about wiring harness resistance for Injector #5. • High: More than 0.573 Ω (injector circuit short) - Check the injector #5 wiring harness and electric isolation. - Check the injector #5 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #5 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.					
P1290	Low Resistance for Injector #3 wiring harness	- Out of range about wiring harness resistance for Injector #3. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #3 wiring harness and electric isolation. - Check the injector #3 wiring harness for open circuit. • If the pin in injector #3 is defective, replace injector #3 and perform C2I coding, then check again. • If the pin in injector #3 is not defective, check the ECU wiring harness. - Replace the ECU if required.					
P1291	High Resistance for Injector #3 wiring harness	- Out of range about wiring harness resistance for Injector #3. • High: More than 0.573 Ω (injector circuit short) - Check the injector #3 wiring harness and electric isolation. - Check the injector #3 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #3 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.					
P0704	Clutch switch malfunction	- The clutch switch is faulty (Manual Transmission Only). - Check the switch wiring harness. • Check the ECU pin #38 for open, short and poor contact. - Check the switch supply voltage and operations. - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1115	Coolant Temperature Sensor Malfunction	- Implausible values of coolant temperature (If the temperature is below the limits values after warm up). - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual air temp. vs. Resistance • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (open, short and poor contact). • ECU pin #101 and #102 - Visually check the sensor and replace if required. - Check the thermostat, water pump radiator related coolant route (thermostat stuck). - Replace the ECU if required.					
P0118	Coolant Temperature Sensor Malfunction - Short	- Malfunction in recognition of coolant temperature • More than maximum values (Circuit Short) • External power supply malfunction - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual air temp. vs. Resistance • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (short and poor contact). • ECU pin #101 and #102 - Visually check the sensor and replace if required. - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0117	Coolant Temperature Sensor Malfunction - Open	- Malfunction in recognition of coolant temperature • Less than minimum values (Circuit Open) • External power supply malfunction - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual air temp. vs. Resistance • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (open and poor contact). • ECU pin #101 and #102 - Visually check the sensor and replace if required. - Replace the ECU if required.					
P0115	Supply Voltage Fault to Coolant Temperature Sensor	- Check if the supply voltage of approx. 12 V is applied.					
P0685	Main Relay Malfunction	- The the main relay is unexpectedly high/low state (ECU is supplied after 3 seconds). - Relay resistance: 92 ± 9 Ω (at 20°C) - Check the relay wiring harness (open, short and poor contact). • Check for open and short: ECU pin #9. - If the forced operation is not available, replace the ECU.					
P1405	EGR Solenoid Valve Malfunction - Short to ground	- Out of range about EGR gas: High. • EGR controller circuit: Open or short to ground - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check the EGR solenoid valve. - Check the EGR valve for stick. - Check the resistance of EGR actuator: 15.4 Ω. - Check the ECU wiring harness for open and short. • ECU pin #96					
P1406	EGR Solenoid Valve Malfunction - Short to +Batt	- Out of range about EGR gas: Low. • EGR controller circuit: Short to battery - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check the EGR solenoid valve. - Check the EGR valve for stick. - Check the resistance of EGR actuator: 15.4 Ω - Check the ECU wiring harness for open and short. • ECU pin #96					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1480	Condenser Fan #1 Circuit Malfunction - Open	- Condenser fan #1: Open - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #80 - If the forced operation is not available after replacing the relay, replace the ECU.					
P1481	Condenser Fan #1 Circuit Malfunction - Short	- Condenser fan #1: Short - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #80 - If the forced operation is not available after replacing the relay, replace the ECU.					
P1482	Condenser Fan #1 Circuit Malfunction - Short to Ground	- Condenser fan #1: Short to ground. - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #80 - If the forced operation is not available after replacing the relay, replace the ECU.					
P1526	Condenser Fan #2 Circuit Malfunction - Open	- Condenser fan #2: Open - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #81 - If the forced operation is not available after replacing the relay, replace the ECU.					
P1527	Condenser Fan #2 Circuit Malfunction - Short	- Condenser fan #2: Short - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #81 - If the forced operation is not available after replacing the relay, replace the ECU.					
P1528	Condenser Fan #2 Circuit Malfunction - Short to Ground	- Condenser fan #2: Short to ground - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. • ECU pin #81 - If the forced operation is not available after replacing the relay, replace the ECU.					

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DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0325	Accelerometer #1 (Knock Sensor) Malfunction	- The signal / noise ratio is too low about accelerometer # 1. - Check the accelerometer wiring harness and tightening torque. • Tightening torque: 20 ± 5 Nm - Check the ECU wiring harness for open and short. • ECU pin #45 and #46 - If the trouble still exists even after replacing the accelerometer, replace the ECU.					
P0330	Accelerometer #2 (Knock Sensor) Malfunction	- The signal / noise ratio is too low about accelerometer # 1. - Check the accelerometer wiring harness and tightening torque. • Tightening torque: 20 ± 5 Nm - Check the ECU wiring harness for open and short. • ECU pin #44 and #63 - If the trouble still exists even after replacing the accelerometer, replace the ECU.					
P1611	Injector Bank #1 Malfunction - Low Voltage	- Malfunction of injector (#1, #4, #3) circuit (Low): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #1: Open and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. • ECU pin #44 and #63 - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1612	Injector Bank #1 Malfunction - High Voltage	- Malfunction of injector (#1, #4, #3) circuit (High): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #1: Short and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. • ECU pin #44 and #63 - Replace the ECU if required.					
P1618	Injector Bank #2 Malfunction - Low Voltage	- Malfunction of injector (#2, #5) circuit (Low): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #2: Open and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. • ECU pin #44 and #63 - Replace the ECU if required.					
P1619	Injector Bank #2 Malfunction - High Voltage	- Malfunction of injector (#2, #5) circuit (High): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #2: Short and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. • ECU pin #44 and #63 - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0263	Injector #1 Balancing Fault	- Injector #1 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).					
P0266	Injector #2 Balancing Fault	- Injector #2 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).					
P0272	Injector #4 Balancing Fault	- Injector #4 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).					
P0275	Injector #5 Balancing Fault	- Injector #5 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).					
P0269	Injector #3 Balancing Fault	- Injector #3 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement).					
P0201	Injector #1 Circuit Open	- Injector #1 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #117, #114). - Replace the ECU if required.					
P0202	Injector #2 Circuit Open	- Injector #2 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #118, #121). - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0204	Injector #4 Circuit Open	- Injector #4 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #117, #115). - Replace the ECU if required.					
P0205	Injector #5 Circuit Open	- Injector #5 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #118, #120). - Replace the ECU if required.					
P0203	Injector #3 Circuit Open	- Injector #3 circuit malfunction: Open. • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #117, #116). - Replace the ECU if required.					
P1201	Injector #1 Circuit Short	- Injector #1 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #117, #114). - Replace the ECU if required.					
P1202	Injector #2 Circuit Short	- Injector #2 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #118, #121). - Replace the ECU if required.					
P1204	Injector #4 Circuit Short	- Injector #4 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #117, #115). - Replace the ECU if required.					
P1205	Injector #5 Circuit Short	- Injector #5 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #118, #120). - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1203	Injector #3 Circuit Short	- Injector #3 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #117, #116). - Replace the ECU if required.					
P0182	Fuel temperature sensor - Short to Ground	- The sensing values are higher than specified values for fuel temperature sensor. (More than maximum sensing values 140°C - Circuit Short) - Actual fuel temp. vs. Resistance • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. • ECU pin: #109, #110 - Check the ECU wiring and replace the ECU if required.					
P0183	Fuel temperature sensor - Short to B+	- The sensing values are lower than specified values for fuel temperature sensor. (Less than maximum sensing values - 40°C - Circuit Open) - Actual fuel temp. vs. Resistance • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. • ECU pin: #109, #110 - Check the ECU wiring and replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0180	Fuel temperature sensor - Malfunction	- The power source circuit is faulty for fuel temperature sensor. (Fuel temperature sensor is mounted in high pressure pump) - Actual fuel temp. vs. Resistance • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. • ECU pin: #109, #110 - Check the ECU wiring and replace the ECU if required.					
P1678	Glow Plug Malfunction - Open	- Glow plug circuit malfunction: Open. - Check the glow plug wiring harness for open. • ECU pin #113 - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required.					
P1679	Glow Plug Malfunction - Short	- Glow plug circuit malfunction: Short. - Check the glow plug wiring harness for open. • ECU pin #113 - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required.					
P1680	Glow Plug Malfunction - Short to Ground	- Glow plug circuit malfunction: Short to ground. - Check the glow plug wiring harness for open. • ECU pin #113 - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required.					
P1530	#1 Heater operating circuit - Open	- #1 heater circuit malfunction: Open. - Check the wiring harness for open. • ECU pin #61 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1531	#1 Heater operating circuit - Short	- #1 heater circuit malfunction: Short. - Check the wiring harness for short. • ECU pin #61 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.					
P1532	#1 Heater operating circuit - Short to Ground	- #1 heater circuit malfunction: Short to ground. - Check the wiring harness for short. • ECU pin #61 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.					
P1534	#2 Heater operating circuit - Open	- #2 heater circuit malfunction: Open. - Check the wiring harness for open. • ECU pin #62 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.					
P1535	#2 Heater operating circuit - Short	- #2 heater circuit malfunction: Short. - Check the wiring harness for short. • ECU pin #62 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.					
P1536	#2 Heater operating circuit - Short to Ground	- #2 heater circuit malfunction: Short to ground. - Check the wiring harness for short. • ECU pin #62 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1254	Maximum Rail Pressure Control Malfunction (IMV Fault)	- Rail pressure faults: Too high - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the high pressure fuel lines, fuel rails and high pressure pipes for leaks. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					
P1253	Minimum Rail Pressure Control Malfunction (IMV Fault)	- Rail pressure faults: Too low - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the high pressure fuel lines, fuel rails and high pressure pipes for leaks. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					

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DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1256	Too Small Transfer Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					
P1257	Too Large Transfer Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1258	Too Small High Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					
P1259	Too Large High Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					

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DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1191	Pressure Build Up - Too Slow	- The pressure build up during cranking is too slow. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					
P0255	IMV Driver Circuit Malfunction - Open	- IMV driver circuit malfunction: Open - Check the IMV wiring harness. • Check the ECU pin #87 for open. - Check the ECU wiring harness. - Check the IMV resistance. • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.			O		O
P0251	IMV Driver Circuit Malfunction - Short	- IMV driver circuit malfunction: Short - Check the IMV wiring harness. • Check the ECU pin #87 for short. - Check the ECU wiring harness. - Check the IMV resistance. • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.			O		O
P0253	IMV Driver Circuit Malfunction - Short to Ground	- IMV driver circuit malfunction: Short to ground - Check the IMV wiring harness. • Check the ECU pin #87 for short to ground. - Check the ECU wiring harness. - Check the IMV resistance. • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.			O		O

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0113	Intake Air Temperature Circuit Malfunction - Short	- The intake air temperature sensing value is lower than maximum value of 150°C: Open - Check the supply voltage to sensor. • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. • Check the source power circuit for short to ground. - Check the sensor resistance. • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. • Check the ECU pin #64 and #84 for open. - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0112	Intake Air Temperature Circuit Malfunction - Open	- The intake air temperature sensing value is lower than maximum value of 150°C: Open - Check the supply voltage to sensor. • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. • Check the source power circuit for short to ground. - Check the sensor resistance. • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. • Check the ECU pin #64 and #84 for open. - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0110	Intake Air Temperature Circuit Malfunction - Source Power Problem	- The intake air temperature sensing value is lower than minimum value or higher than maximum value, or the external power to HFM sensor is faulty. - Check the supply voltage to sensor. • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. • Check the source power circuit for short to ground. - Check the sensor resistance. • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. • Check the ECU pin #64 and #84 for open and short. - Replace the ECU if required.					
P1171	#1 Injector MDP Malfunction	- The #1 injector MDP is faulty. - Replace the injector and perform C2I coding again.					
P1172	#2 Injector MDP Malfunction	- The #2 injector MDP is faulty. - Replace the injector and perform C2I coding again.					
P1174	#4 Injector MDP Malfunction	- The #4 injector MDP is faulty. - Replace the injector and perform C2I coding again.					
P1175	#5 Injector MDP Malfunction	- The #5 injector MDP is faulty. - Replace the injector and perform C2I coding again.					
P1173	#3 Injector MDP Malfunction	- The #3 injector MDP is faulty. - Replace the injector and perform C2I coding again.					

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DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1252	Too High IMV Pressure	- The rail pressure is excessively high. - Check the IMV wiring harness. - Check the ECU wiring harness. • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.					
P1120	Accelerator Pedal Sensor #1 Malfunction	- The potentiometer 1 is not plausible with potentiometer 2. - Check the supply voltage to sensor. - Check the wiring harness. • Check the ECU pin #72, 53 and #32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.	O				
P1121	Accelerator Pedal Sensor #2 Malfunction	- The potentiometer 1 is not plausible with potentiometer 2. - Check the supply voltage to sensor. - Check the wiring harness. • Check the ECU pin #72, 53 and #32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.	O				
P1122	Accelerator Pedal Sensor Malfunction (Limp Home Mode)	- When triggering limp home mode. - Check the supply voltage to sensor. - Check the wiring harness. • Check the ECU pin #72, 71, 53 and #57, 32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1123	Accelerator Pedal Sensor Malfunction (Torque Mode)	- When triggering reduced torque mode. - Check the supply voltage to sensor. - Check the wiring harness. • Check the ECU pin #72, 71, 53 and #57, 32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required	O				
P1124	Accelerator Pedal Sensor Malfunction - Stuck	- The accelerator pedal sensor is stuck. - Check the brake switch wiring harness and operations. - Check the accelerator pedal operations. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.					O
P0122	Accelerator Pedal Sensor #1 Malfunction - Open	- Out of range about potentiometer 1 of pedal sensor: lower than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #71, #53 for open and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O				
P0123	Accelerator Pedal Sensor #1 Malfunction - Short	- Out of range about potentiometer 1 of pedal sensor: higher than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #71, #53 for short and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O				
P0120	Accelerator Pedal Sensor #1 Malfunction - Supply Voltage Fault	- The supply voltage is faulty. - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #72, #53 for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O				

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DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0222	Accelerator Pedal Sensor #2 Malfunction - Open	- Out of range about potentiometer 2 of pedal sensor: lower than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #32, #14 for open and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O				
P0223	Accelerator Pedal Sensor #2 Malfunction - Short	- Out of range about potentiometer 2 of pedal sensor: higher than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #32, #14 for short and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O				
P0220	Accelerator Pedal Sensor #2 Malfunction - Supply Voltage Fault	- The supply voltage is faulty. - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. • Check the ECU pin #57, #14 for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	O				
P0192	Fuel Rail Pressure Sensor Malfunction - Open	- The fuel rail pressure sensing values are lower than specified values. • Minimum sensing values: - 1 1 2 bar (Open) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for open and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0193	Fuel Rail Pressure Sensor Malfunction - Short	- The fuel rail pressure sensing values are higher than specified values. • Maximum sensing values: 1,600 bar (Short) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055± 0.125V • Output voltage at atmospheric pressure: 0.5±0.04V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for short and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				
P0190	Supply Voltage Fault to Fuel Rail Pressure Sensor	- The supply voltage to fuel rail pressure sensor is faulty. - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055± 0.125V • Output voltage at atmospheric pressure: 0.5±0.04V - Check the sensor and ECU wiring harness. • Check the ECU pin #6, #26 for open and short. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				
P0191	Fuel Rail Pressure Sensor Signal Fault	- The rail pressure drop is too high. - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #6, #26 for open and short. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				

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DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1192	Fuel Rail Pressure Sensor Initial Signal Fault - Low	- The rail pressure sensor initial values are lower than specified values with the ignition “ON”. • Minimum sensing values: - 90 bar (Open) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for open and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				
P1193	Fuel Rail Pressure Sensor Initial Signal Fault - High	- The rail pressure sensor initial values are higher than specified values with the ignition “ON”. • Maximum sensing values: 90 bar (Short) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for short and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				
P1190	Fuel Rail Pressure Sensor Initial Signal Fault	- The rail pressure sensor initial values are higher or lower than specified values with the ignition “ON”. • Maximum sensing values: 90 bar (Short) • Minimum sensing values: - 90 bar (Open) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the ECU pin #25, #26 for open and short. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O				

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0215	Main Relay Fault - Stuck	- The main relay is stuck ; Shut down. - Resistance of main relay: 92 Ω ± 9 Ω (at 20°C) - Check the main relay wiring harness. - Check the ECU wiring harness. • Check the ECU pin #3, 4, 5 for open and short. - If the forced operation is not available, replace the ECU. - Check the fuse for main relay					
P1500	Vehicle Speed Fault	- The vehicle speed signal through CAN communication is faulty. - Check the CAN communication line for open and short. - Check the ABS/ESP and TCU communication lines. - Check the ECU wiring harness. - Replace the ECU if required.					
P0642	ECU Supply Voltage 1 Fault - Low (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.					
P0643	ECU Supply Voltage 1 Fault - High (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.					
P0641	ECU Supply Voltage 1 Fault (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0652	ECU Supply Voltage 2 Fault - Low (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.			O		O
P0653	ECU Supply Voltage 2 Fault - High (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.			O		O
P0651	ECU Supply Voltage 2 Fault (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.			O		O
P0698	ECU Supply Voltage Fault - Low (2.5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 2.5 V - Check the supply voltage to each sensor • Supply voltage (2.5 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required.					
P0699	ECU Supply Voltage Fault - High (2.5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 2.5 V - Check the supply voltage to each sensor • Supply voltage (2.55 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0697	ECU Supply Voltage Fault (2.5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 2.5 V - Check the supply voltage to each sensor • Supply voltage (2.55 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required.					
P0245	Turbo Charger Actuator Circuit Fault - Short	- The waste gate driver circuit is short to ground or open - Check the actuator wiring harness. - Check the solenoid valve. - Check the ECU wiring harness. • Check the ECU pin #95 for open and short. - Replace the ECU if required.	O				
P0246	Turbo Charger Actuator Circuit Fault - Short to B+	- The turbo charger actuator power source circuit is short. - Check the actuator wiring harness. - Check the solenoid valve. - Check the ECU wiring harness for short and poor contact. - Replace the ECU if required.	O				
P0606	ECU Watchdog Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					
P1607	ECU Injector Cut Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					
P1600	ECU Shut Down Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					
P1601	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					
P1602	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1614	ECU C2I/MDP Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O
P1615	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O
P1616	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O
P1606	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O
P1620	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O
P1621	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O
P1622	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O
P1603	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.				O	
P1604	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.				O	
P1605	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.				O	
P1148	Accelerometer (Knock Sensor) Learning Fault	- Check if the MDP is successful. - Check the accelerometer (knock sensor) sensor and wiring harness. - Replace the ECU if required.		O			

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0400	EGR Control Valve Fault	- When the EGR emission is more than specified value. • The EGR controller circuit is open or short to ground. • The EGR controller is short to battery. - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check if the EGR valve is stuck. - Check the resistance of EGR valve: 15. 4 Ω. - Check the ECU wiring harness. • Check the ECU pin #96 for open and short.					
P1235	VGT Operation Fault	- The boost pressure control is faulty. - Check the air intake system. - Check the supply voltage to sensor. - Check the wiring harness and the ECU wiring harness. - Replace the ECU if required.	O				
P1608	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					
P0335	No Crank Signals	- Refer to P0372.					
P1170	Torque Trim Fault - High	- Refer to P0372.					
P1676	Glow Plug Communication Fault	- The communication between ECU and glow plug is faulty. - Check the communication line between ECU and glow plug. - Check the glow plug wiring harness. - Check the resistance of glow plug: below 1 Ω. - Check the glow plug relay. - Check the ECU wiring harness. • Check the ECU pin #113 for short to ground. - Replace the ECU if required.					
P1677	Glow Plug Controller Fault	- The communication between ECU and glow plug is faulty. - Check the communication line between ECU and glow plug. - Check the glow plug wiring harness. - Check the resistance of glow plug: below 1Ω. - Check the glow plug relay. - Check the ECU wiring harness. • Check the ECU pin #113 for short to ground. - Replace the ECU if required.					

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DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P0671	#1 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P0672	#2 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P0673	#3 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P0674	#4 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P0675	#5 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P1671	#1 Glow Plug Fault - Short (B+)	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1672	#2 Glow Plug Fault - Short (B+)	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P1673	#3 Glow Plug Fault - Short (B+)	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P1674	#4 Glow Plug Fault - Short (B+)	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P1675	#5 Glow Plug Fault - Short (B+)	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1Ω - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.					
P0700	TCU Signal Fault	- The communication between ECU and TCU is faulty. - Check the communication line between ECU and TCU. - Check the ECU pin #54, 73 for open and short. - Replace the ECU if required.					
P1540	Air Conditioner Operating Circuit Fault - Open	- Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required.					
P1541	Air Conditioner Operating Circuit Fault - Short	- Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required.					
P1542	Air Conditioner Operating Circuit Fault - Short to Ground	- Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required.					

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DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1149	Too High Water Level in Fuel Filter	- Drain the water from fuel filter.					
P1634	Immobilizer Fault (refer to immobilizer section)	- No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna. - Replace the ECU if required.					
P1635	No response from Immobilizer (refer to immobilizer section)	- No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna. - Replace the ECU if required.					
P1630	Wrong response from Immobilizer (refer to immobilizer section)	- The invalid key is inserted or no communication between transponder and immobilizer (no response from transponder). - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.					
P1631	Immobilizer Fault (refer to immobilizer section)	- The immobilizer is not operating. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.					
P1632	Immobilizer Fault (refer to immobilizer section)	- No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.					

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode
P1633	Immobilizer Fault (refer to immobilizer section)	- No key coding. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.					
P0633	Immobilizer Fault (refer to immobilizer section)	- Key memory is not available (permissible - 5). - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.					
P1636	Immobilizer Fault (refer to immobilizer section)	- Severe trouble is not defined. - Perform the immobilizer coding again. - Check the ECU wiring harness. • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.					

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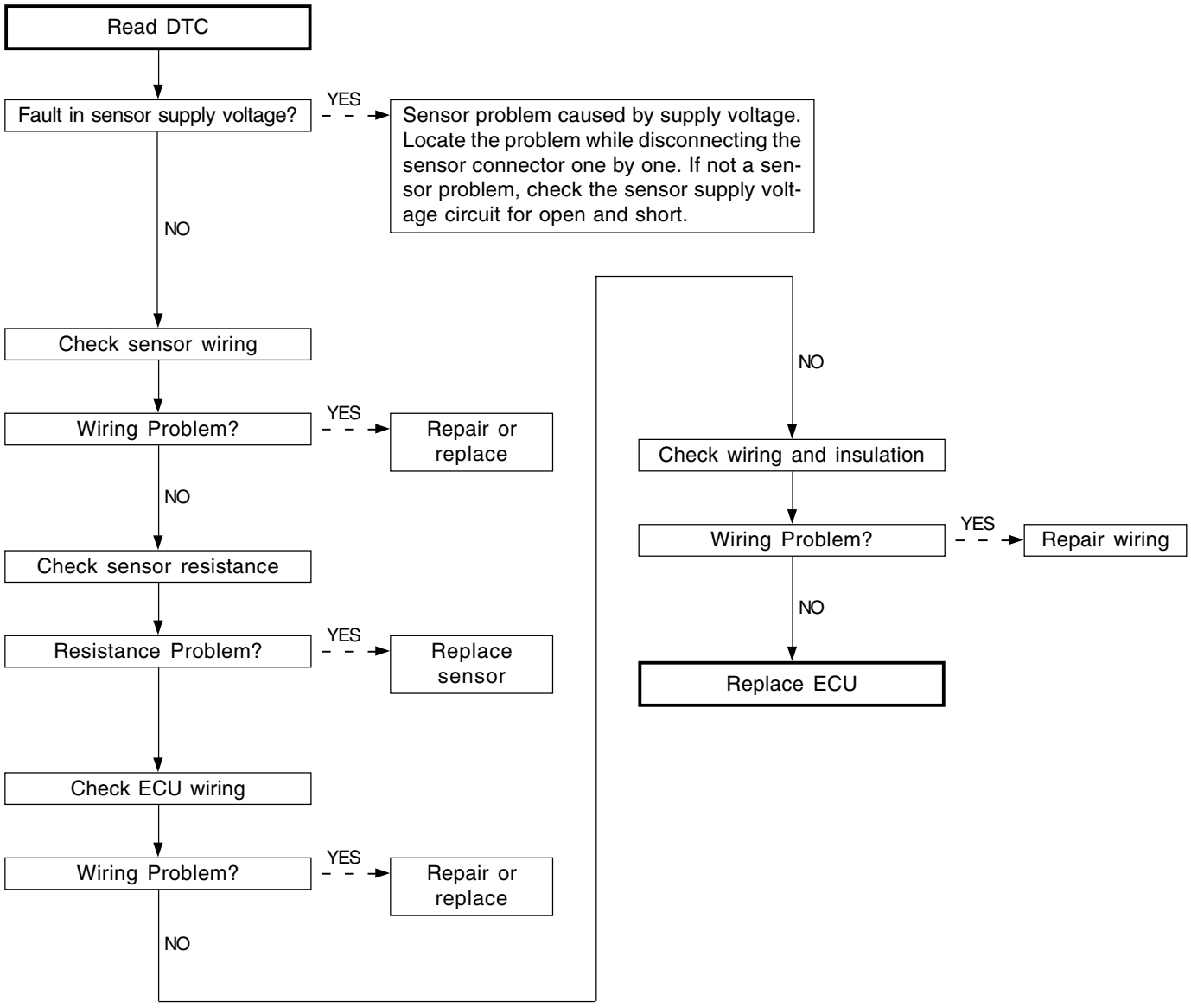
TROUBLE DIAGNOSIS PROCEDURES

HMF sensor Signal Fault (Electric Failure)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0102	Low Signal	MIL ON
P0103	High Signal	Not available EGR control(Air flow)
P0100	Supply Voltage	

▶ Diagnosis Procedures



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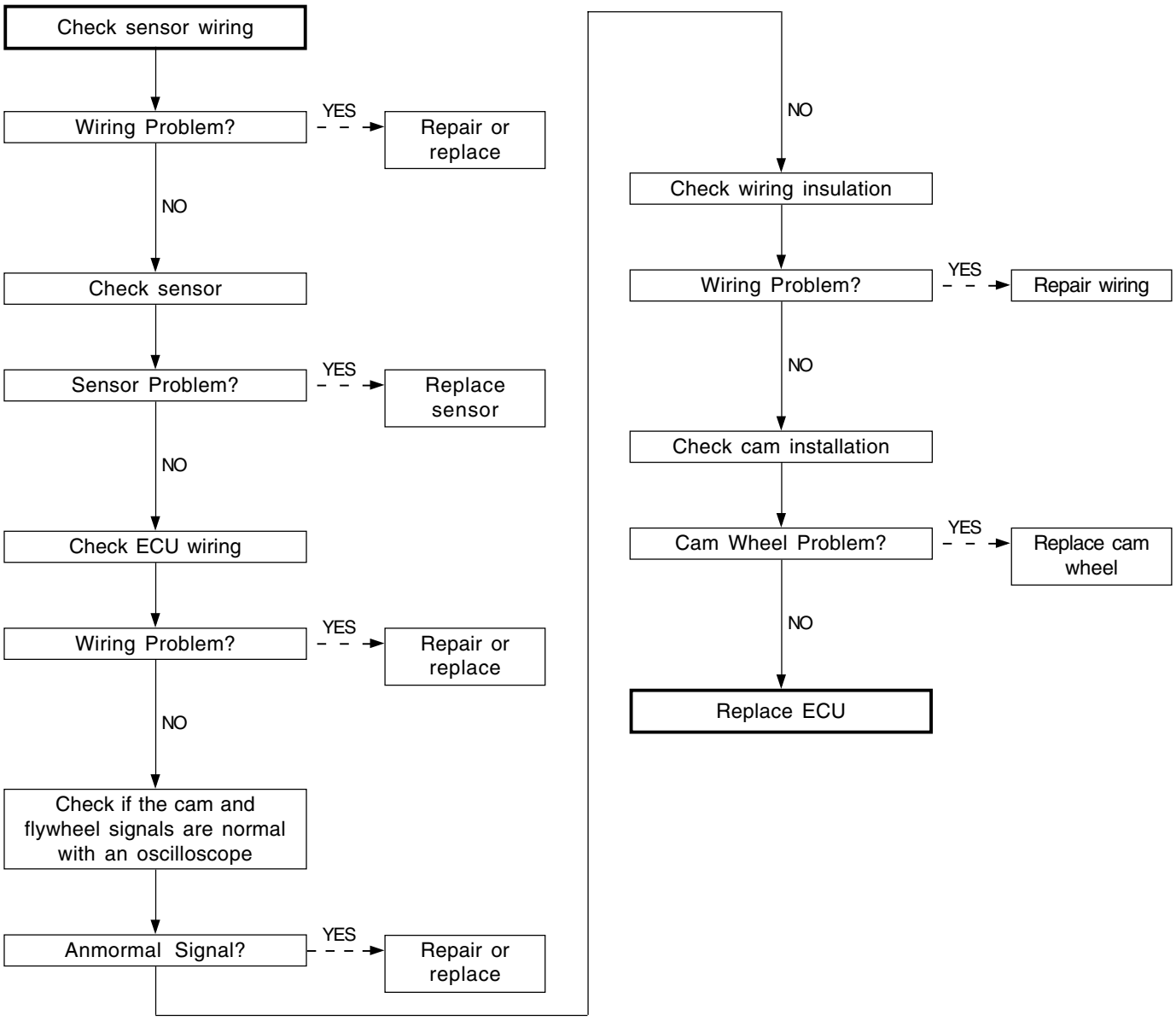
Cam Position Sensor (missing event)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0344	Cam Position Sensor Malfunction	

▶ Diagnosis Procedures

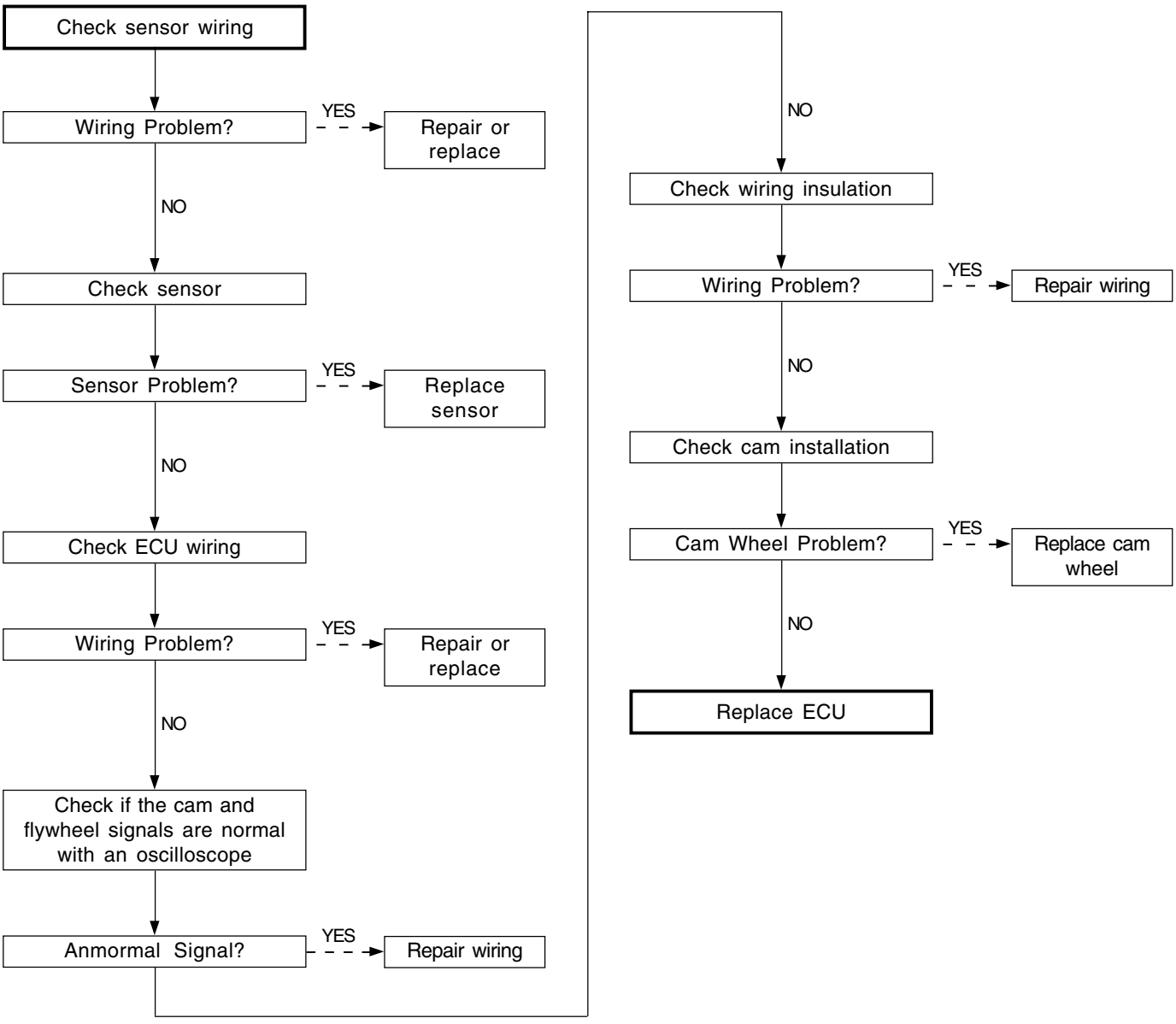


Cam Position Sensor Malfunction (Poor Synchronization of Crank and Cam)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0341	Cam Position Sensor Malfunction - Poor Synchronization	MIL ON

▶ Diagnosis Procedures



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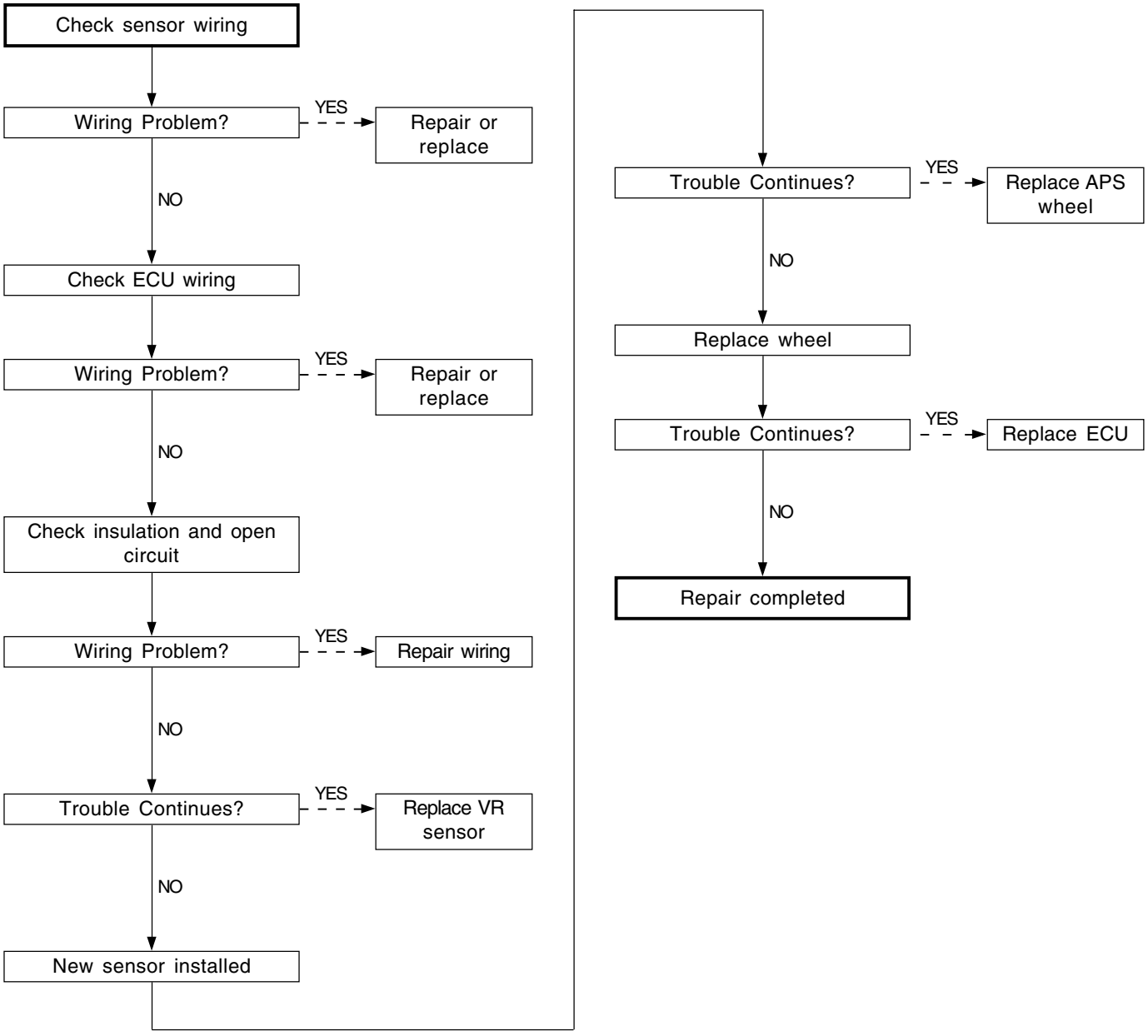
Too Small Clearance of Crank Angle Sensor

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0219	Too Small Clearance of Crank Angle Sensor	

▶ Diagnosis Procedures

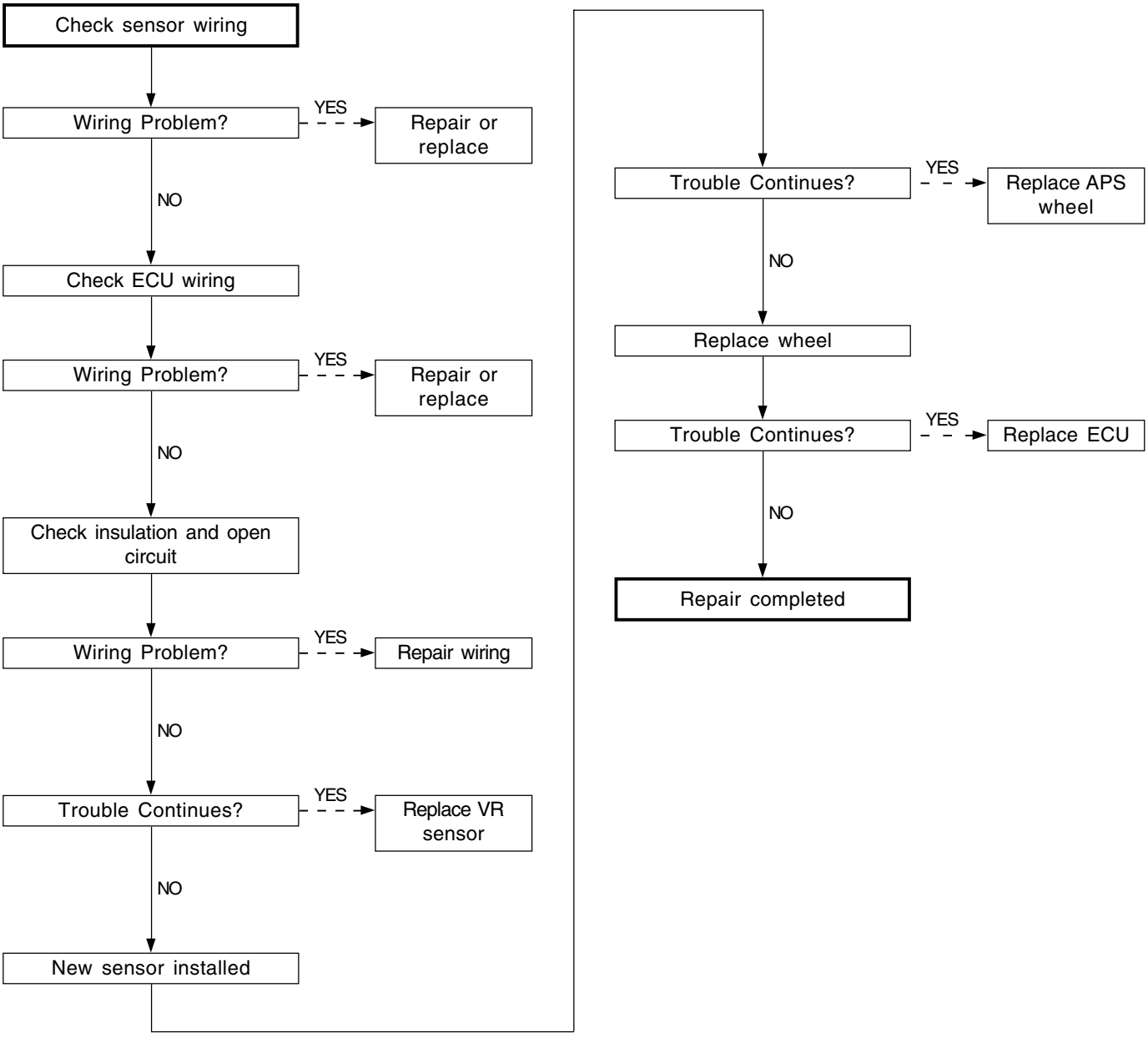


Too Large Clearance of Crank Angle Sensor

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0336	Too Large Clearance of Crank Angle Sensor	MIL ON

▶ Diagnosis Procedures

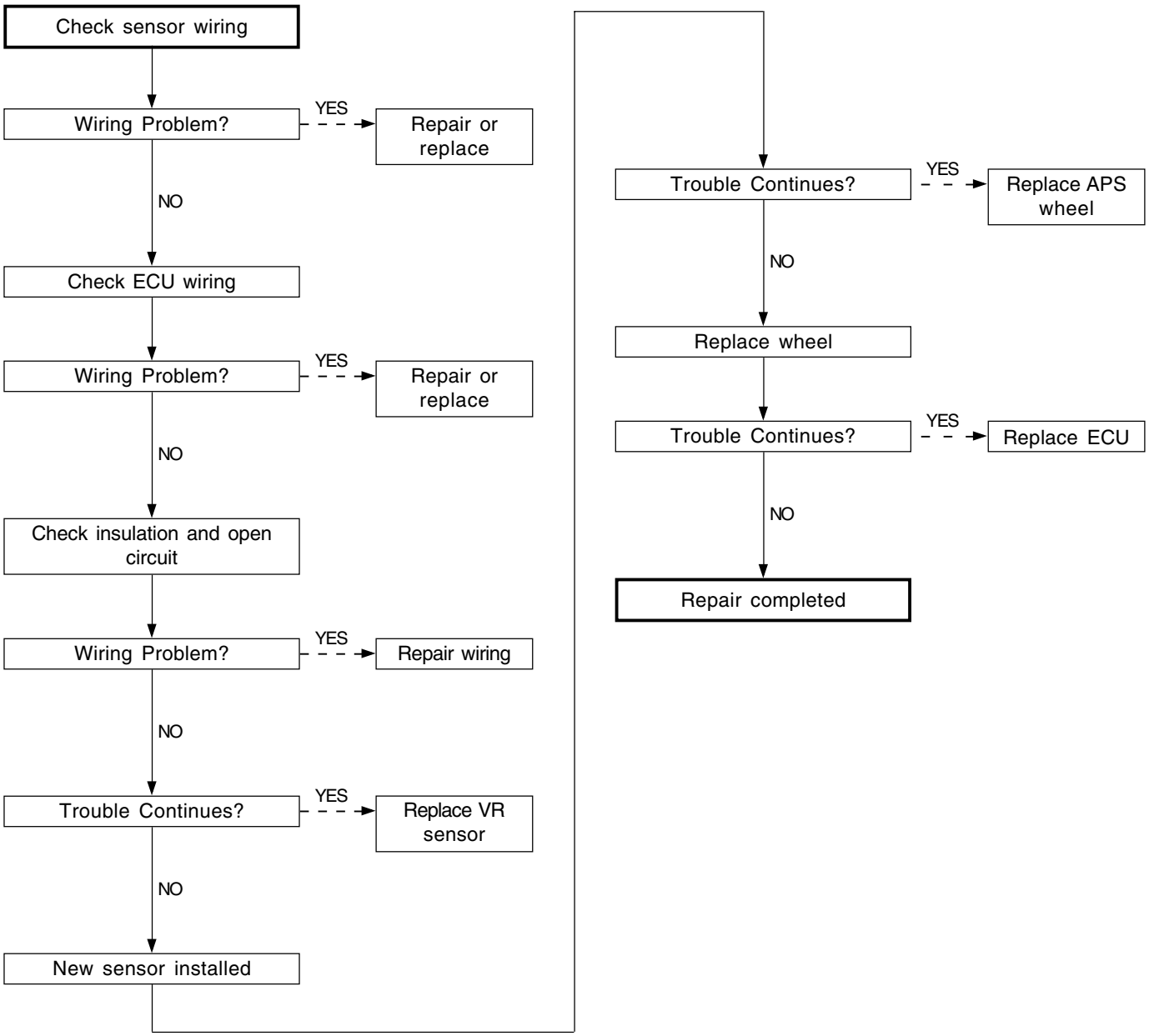


Crank Angle Sensor Malfunction

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0372	Crank Angle Sensor Malfunction 3	MIL ON

▶ Diagnosis Procedures



Barometric Sensor Malfunction (Out of range, using strategy of restoring by MAP sensor)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1107	Low Signal	
P1108	High Signal	
P1105	Supply Voltage	

▶ Diagnosis Procedures

Replace ECU

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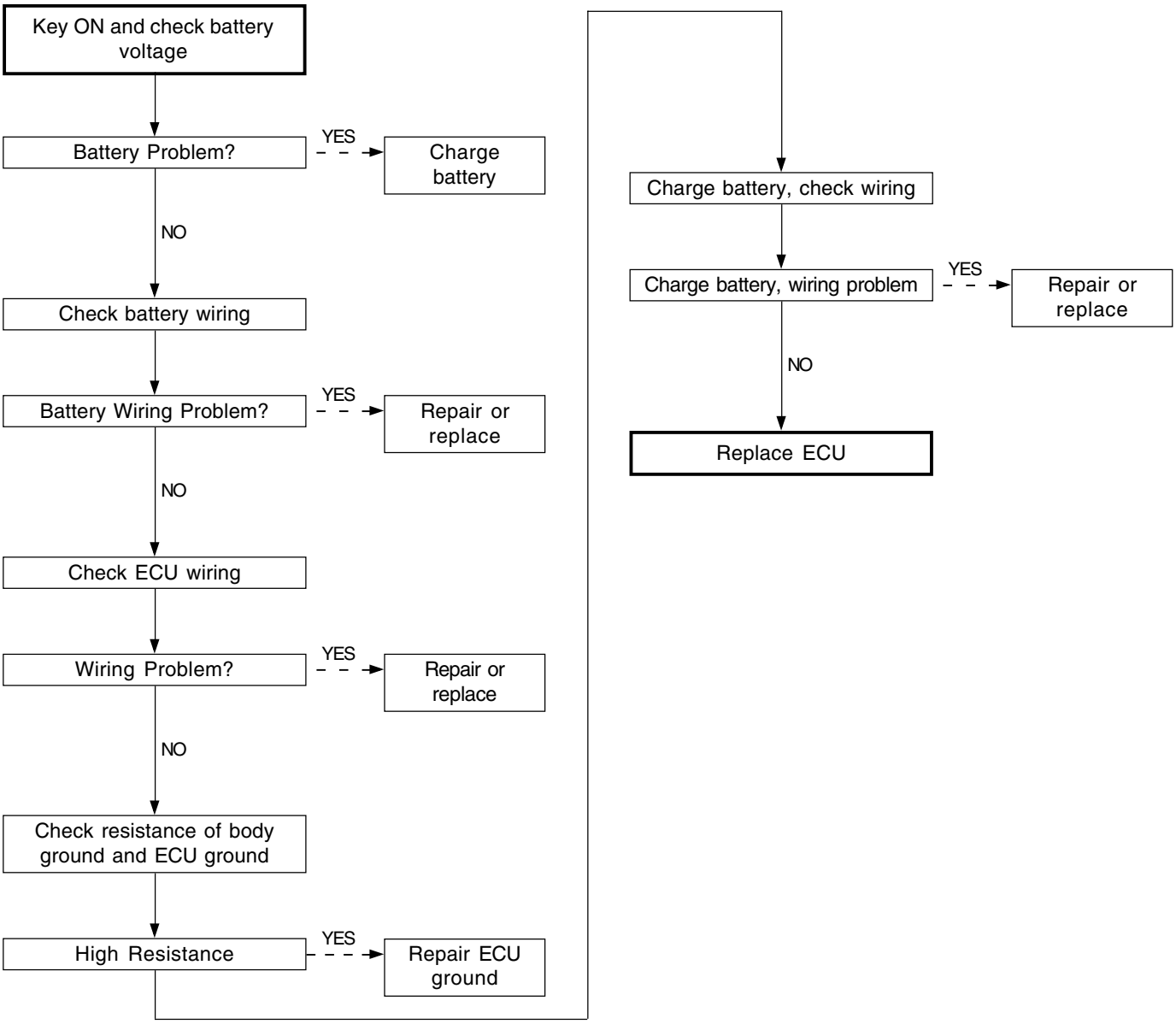
Battery Voltage Monitoring Signal Malfunction

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0562	Low Signal	Not operatable.
P0563	High Signal	Injector #1 resistance fault. Use estimate resistance level.
P0560	Supply Voltage	Injector #2 resistance fault. Use estimate resistance level.
		Injector #4 resistance fault. Use estimate resistance level.
		Injector #5 resistance fault. Use estimate resistance level.
		Injector #3 resistance fault. Use estimate resistance level.
		Unable EGR control (Air Flow)
		Unable RPC trim problem detection
		Unable HP leak detection
		Unable accelerometer learing strategy
		MIL ON
		Operating limited rail pressure mode
		TBD

▶ Diagnosis Procedures



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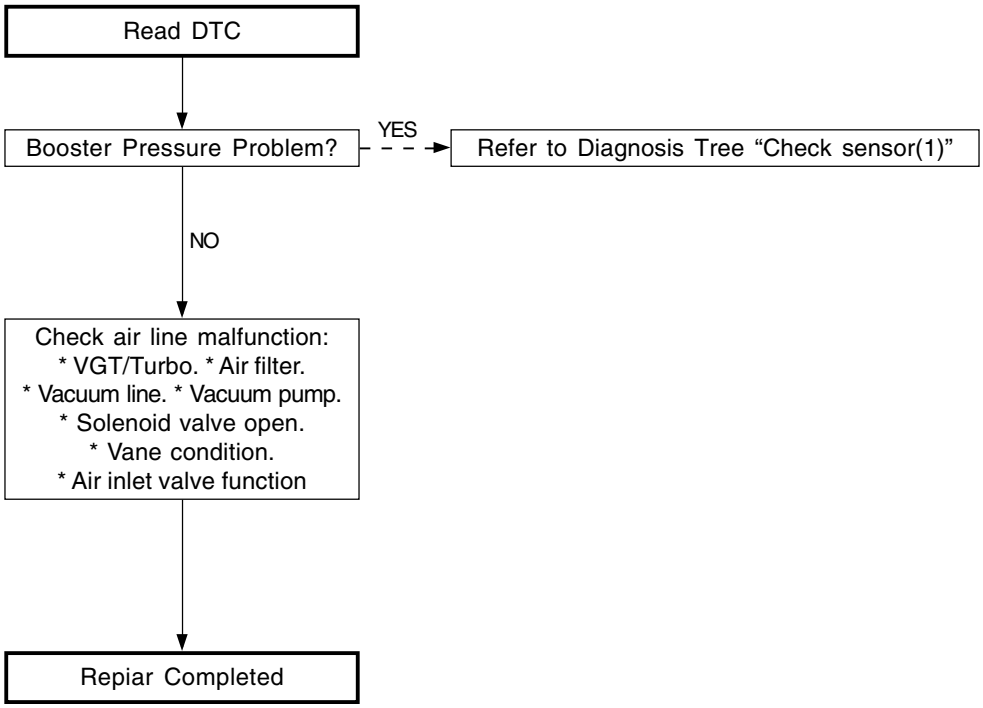
Booster Pressure Sensor Malfunction (Out of range with Key ON)

▶ Trouble Code and Symptom

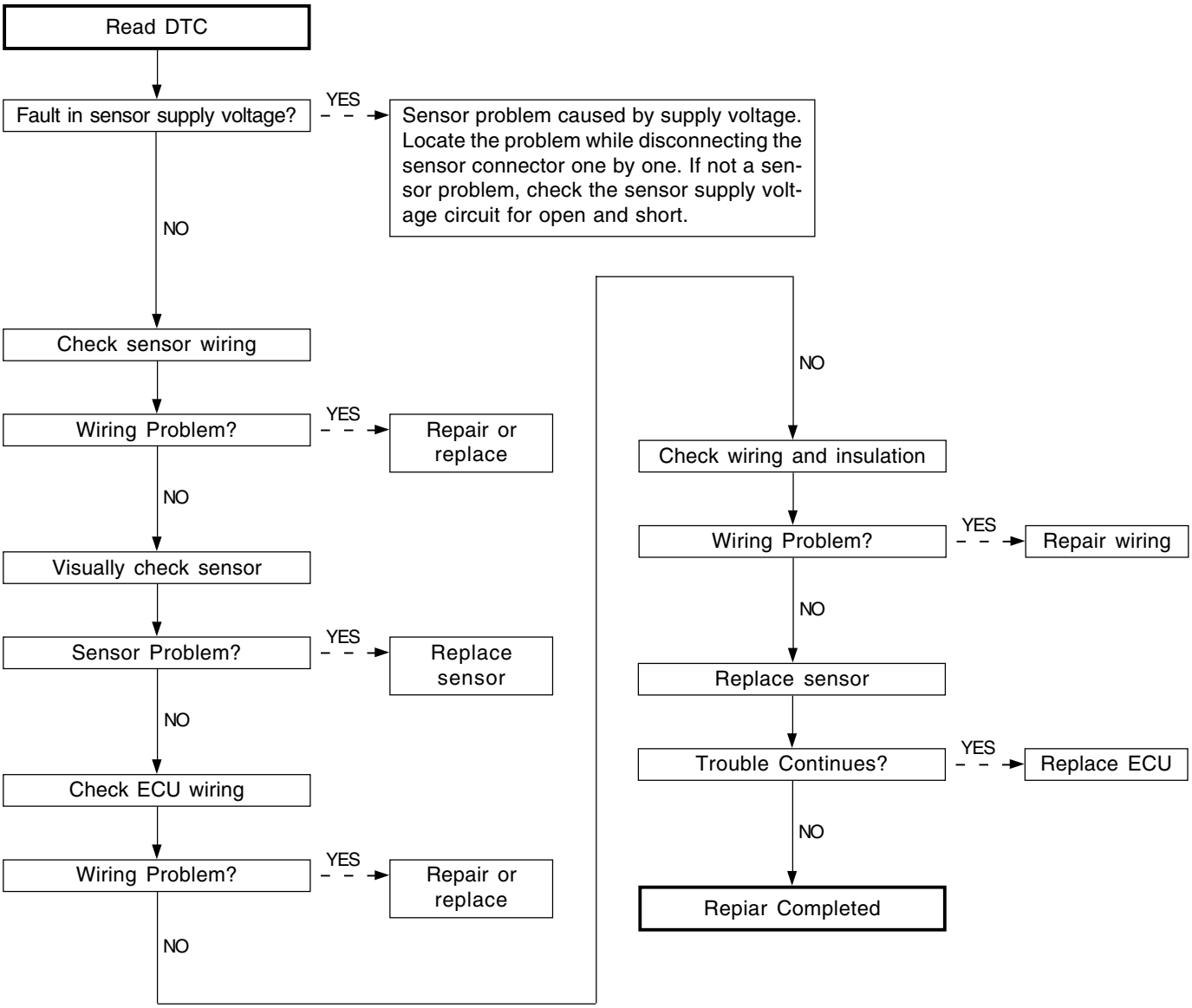
Trouble Code		Symptom
P0109	Low	
P0106	High	Location demand=change the boost control to O.L. mode at f (boost demand, engine cycling speed)

▶ Diagnosis Procedures

1. Diagnosis Procedures (Boost Pressure)



2. Diagnosis Procedure (Check sensor (1))



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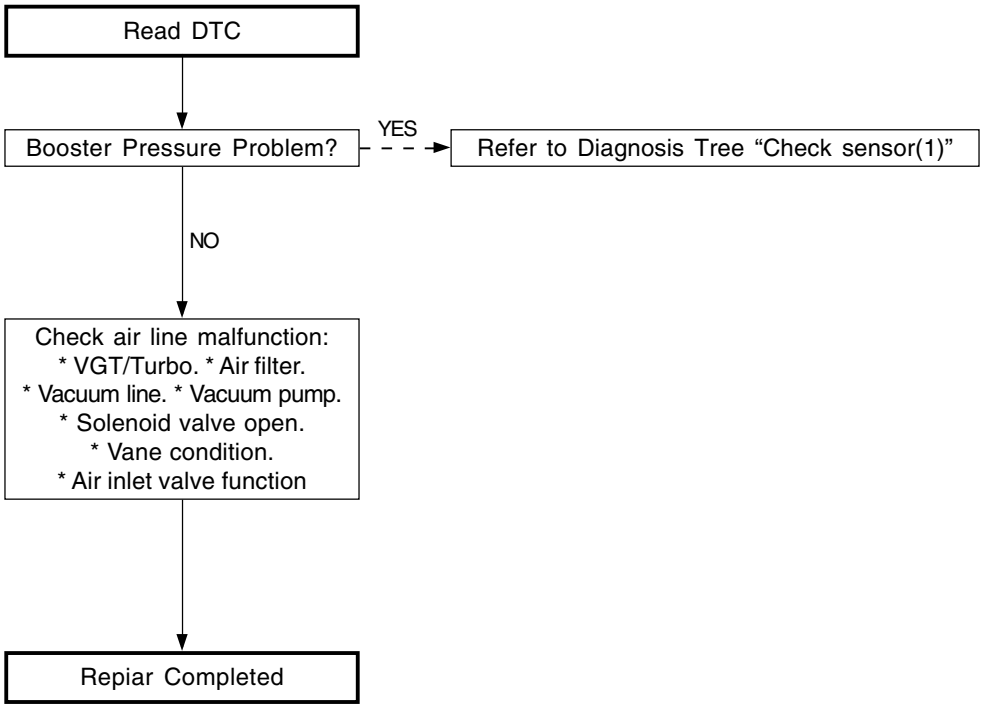
Booster Pressure Sensor Malfunction (Out of range with Key ON)

▶ Trouble Code and Symptom

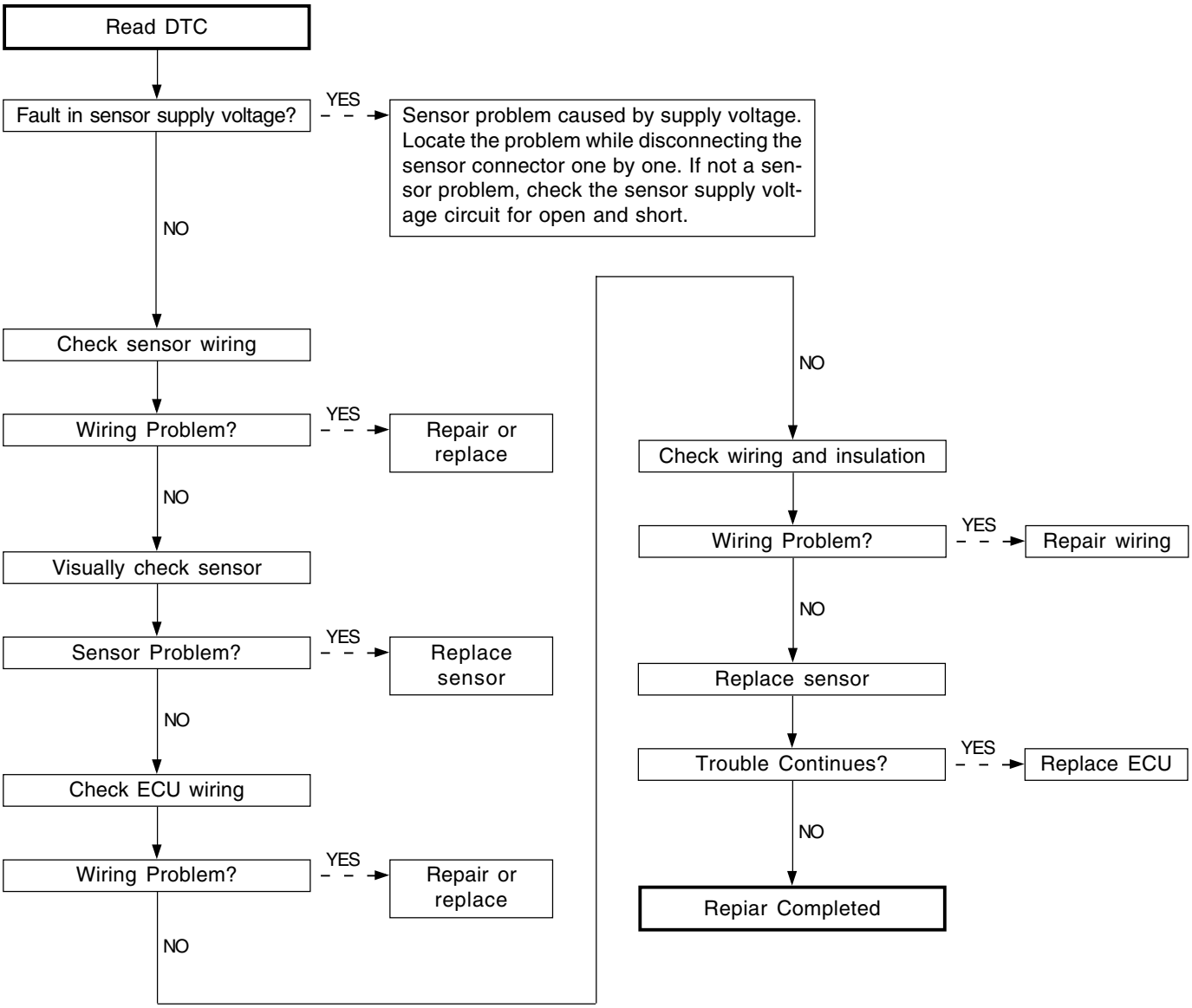
Trouble Code		Symptom
P0107	Low	
P0108	High	Location demand=change the boost control to O.L. mode at f (boost demand, engine cycling speed)
P0105	Supply Voltage	
P1106	GRAD	

▶ Diagnosis Procedures

1. Diagnosis Procedures (Boost Pressure)



2. Diagnosis Procedures (check sensor (1))



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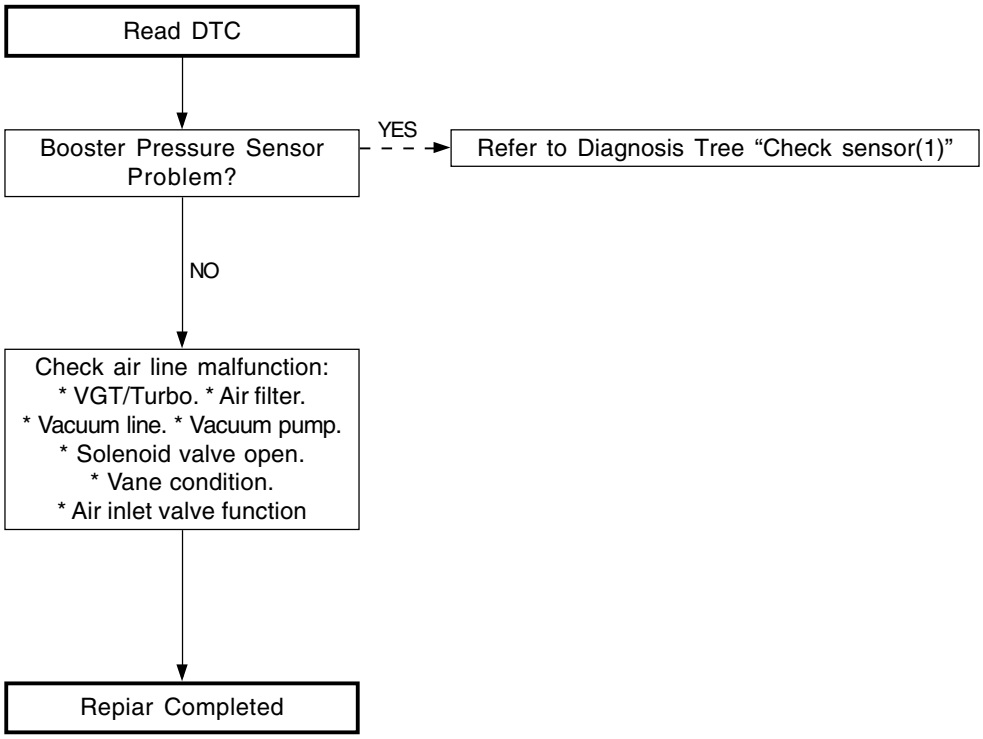
Booster Pressure Malfunction (Implausible Signal)

▶ Trouble Code and Symptom

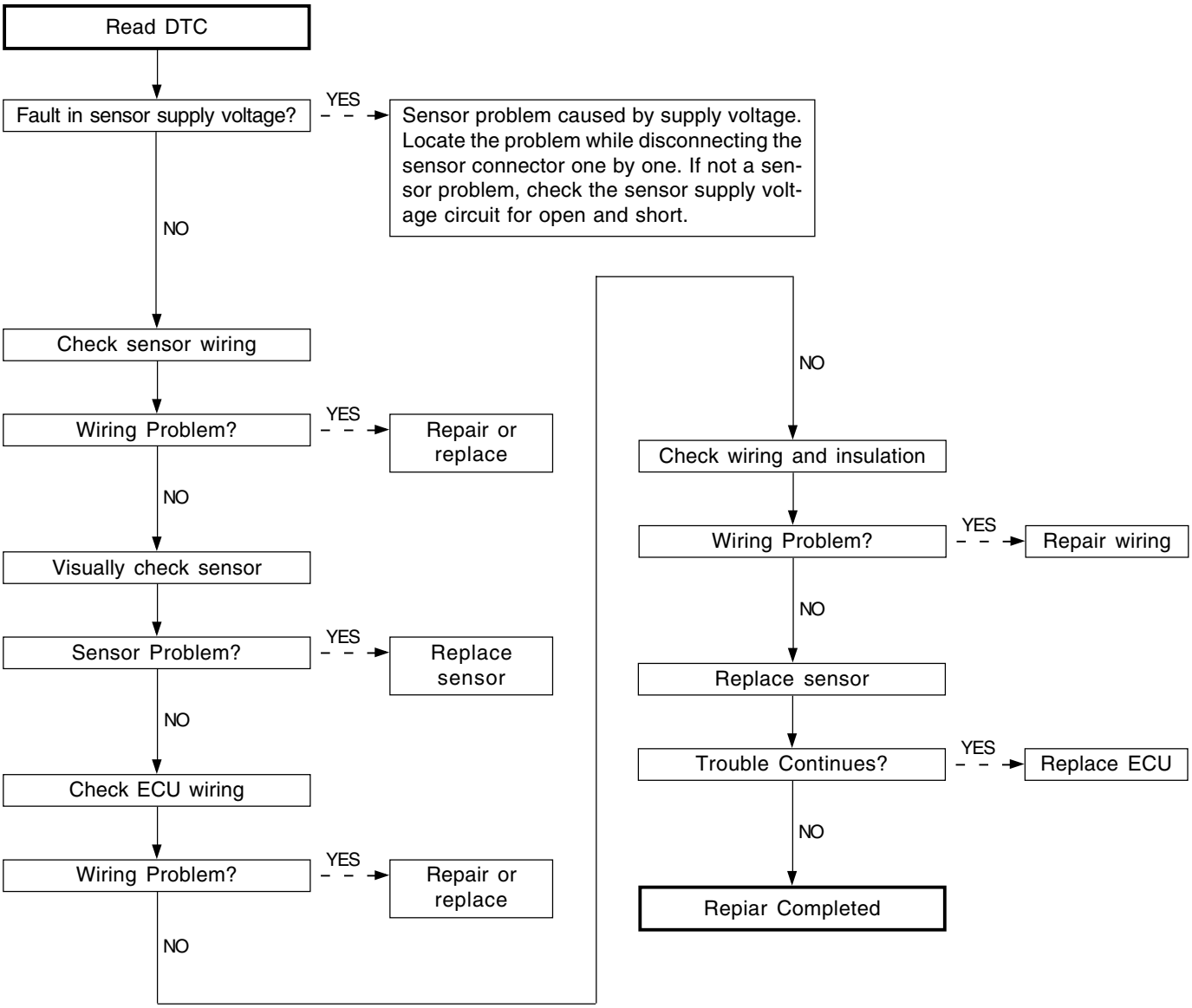
Trouble Code		Symptom
P1109	Booster Pressure Sensor Malfunction	
		Location demand=change the boost control to O.L. mode at f (boost demand, engine cycling speed)

▶ Diagnosis Procedures

1. Diagnosis Procedures (Boost Pressure)



2. Diagnosis Procedures (check sensor (1))



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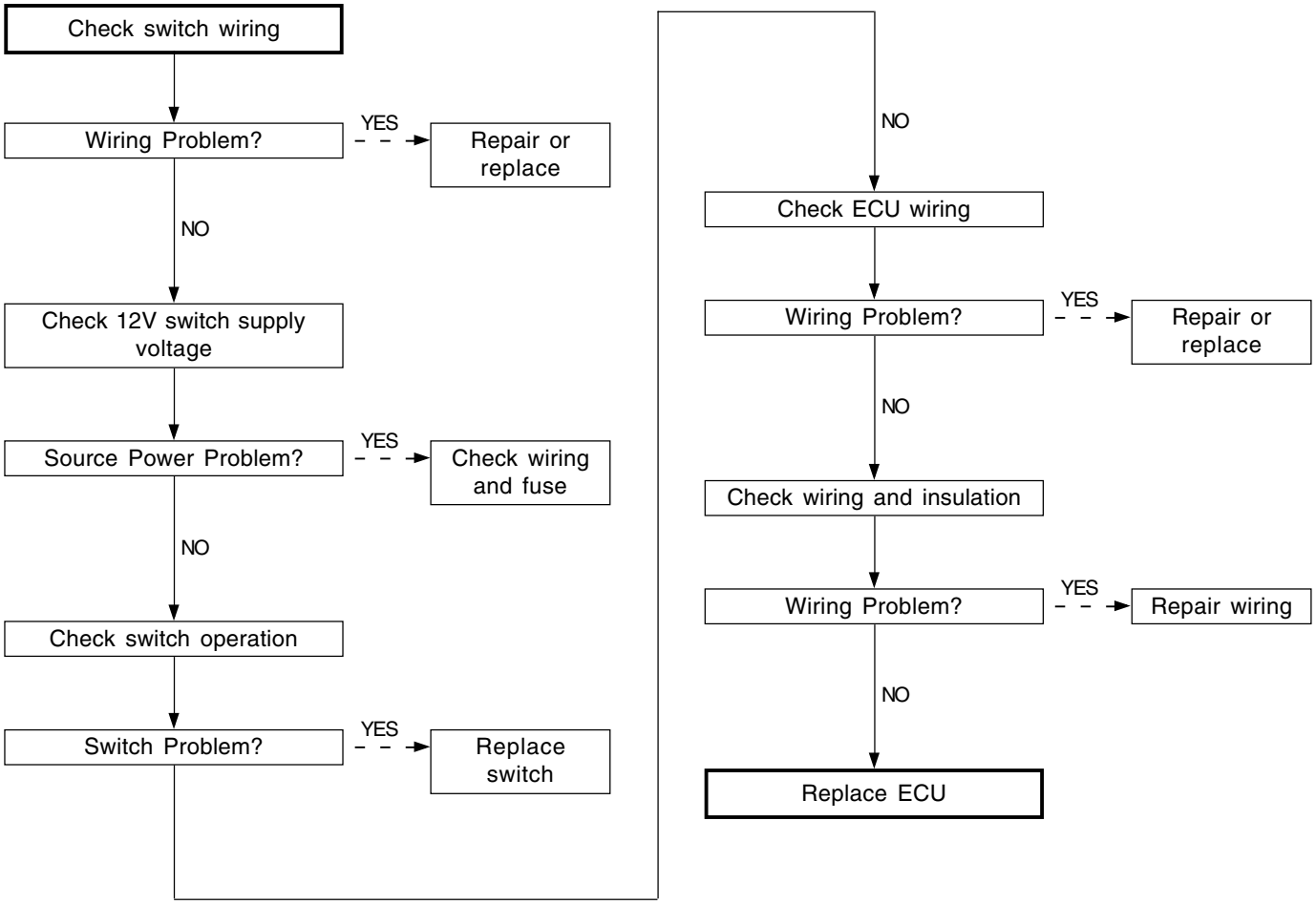
Brake Pedal Switch Malfunction

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0571	Brake Pedal Switch Malfunction	MIL ON
		Unable Cruise Control

▶ Diagnosis Procedures

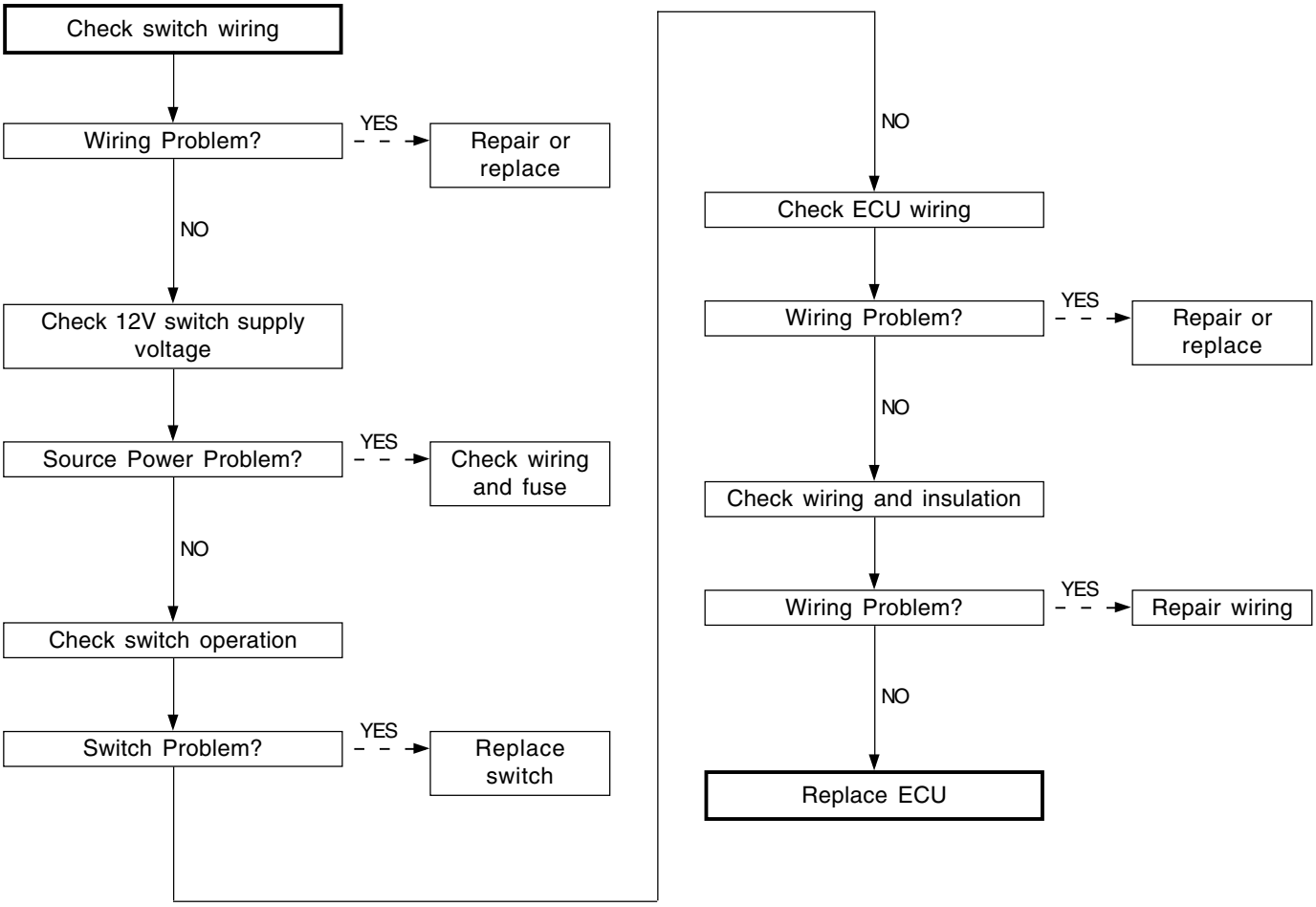


Brake Lamp Signal Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1572	Brake Lamp Signal Fault	MIL ON
P1571	Brake Lamp Signal Fault	MIL ON

▶ Diagnosis Procedures

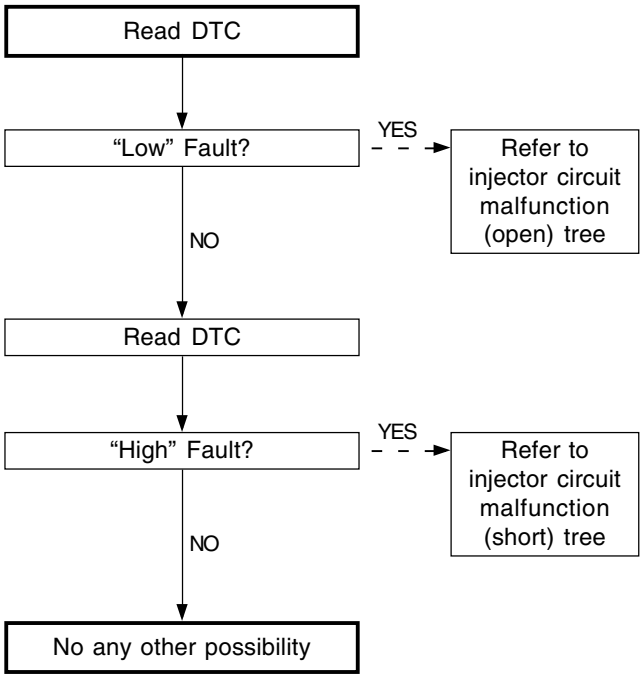


High Wiring Resistance (Injector #1)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1286	Low	Resistance of injector #1 fault. Use estimate resistance level.
P1287	High	MIL ON
		Unable Dynamic Leak of Injector #1
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

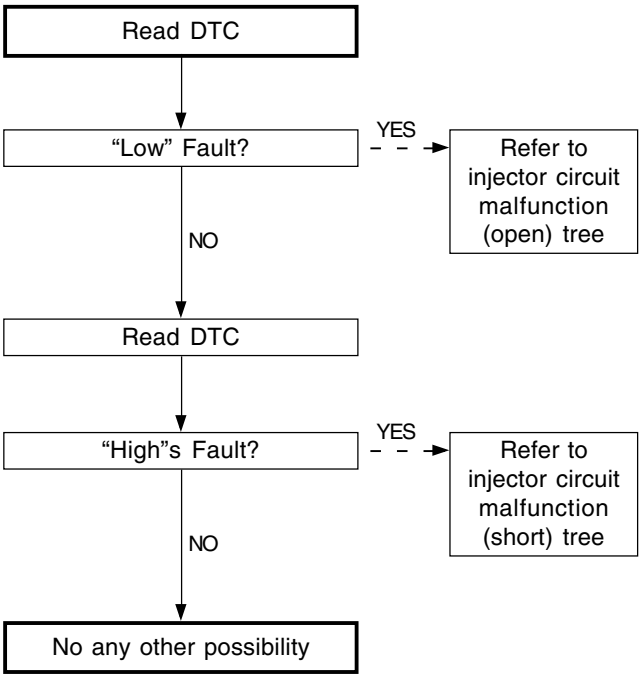


High Wiring Resistance (Injector #2)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1288	Low	Resistance of injector #2 fault. Use estimate resistance level.
P1289	High	MIL ON
		Unable Dynamic Leak of Injector #2
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

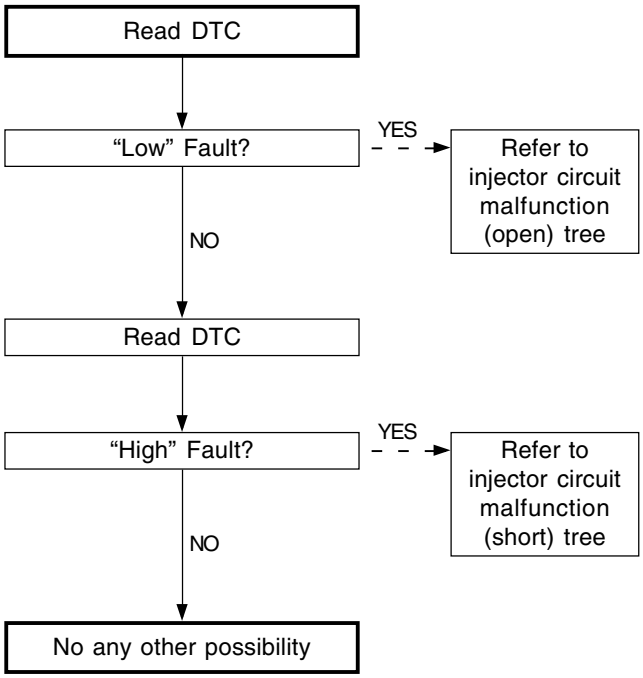


High Wiring Resistance (Injector #3)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1292	Low	Resistance of injector #4 fault. Use estimate resistance level.
P1293	High	MIL ON
		Unable Dynamic Leak of Injector #4
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

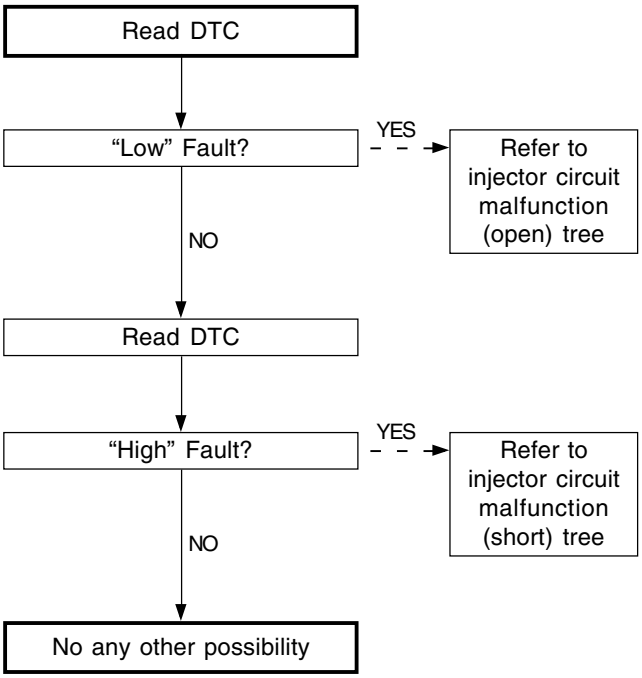


High Wiring Resistance (Injector #4)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1294	Low	Resistance of injector #5 fault. Use estimate resistance level.
P1295	High	MIL ON
		Unable Dynamic Leak of Injector #5
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

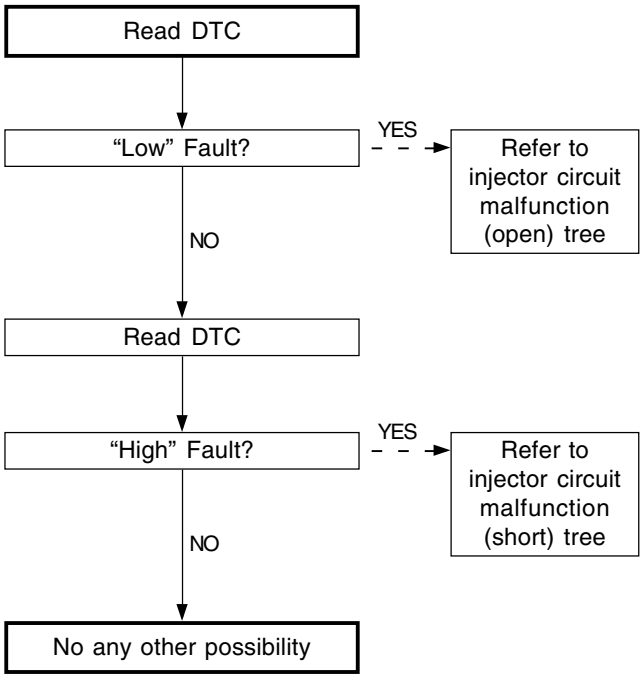


High Wiring Resistance (Injector #5)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1290	Low	Resistance of injector #3 fault. Use estimate resistance level.
P1291	High	MIL ON
		Unable Dynamic Leak of Injector #3
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

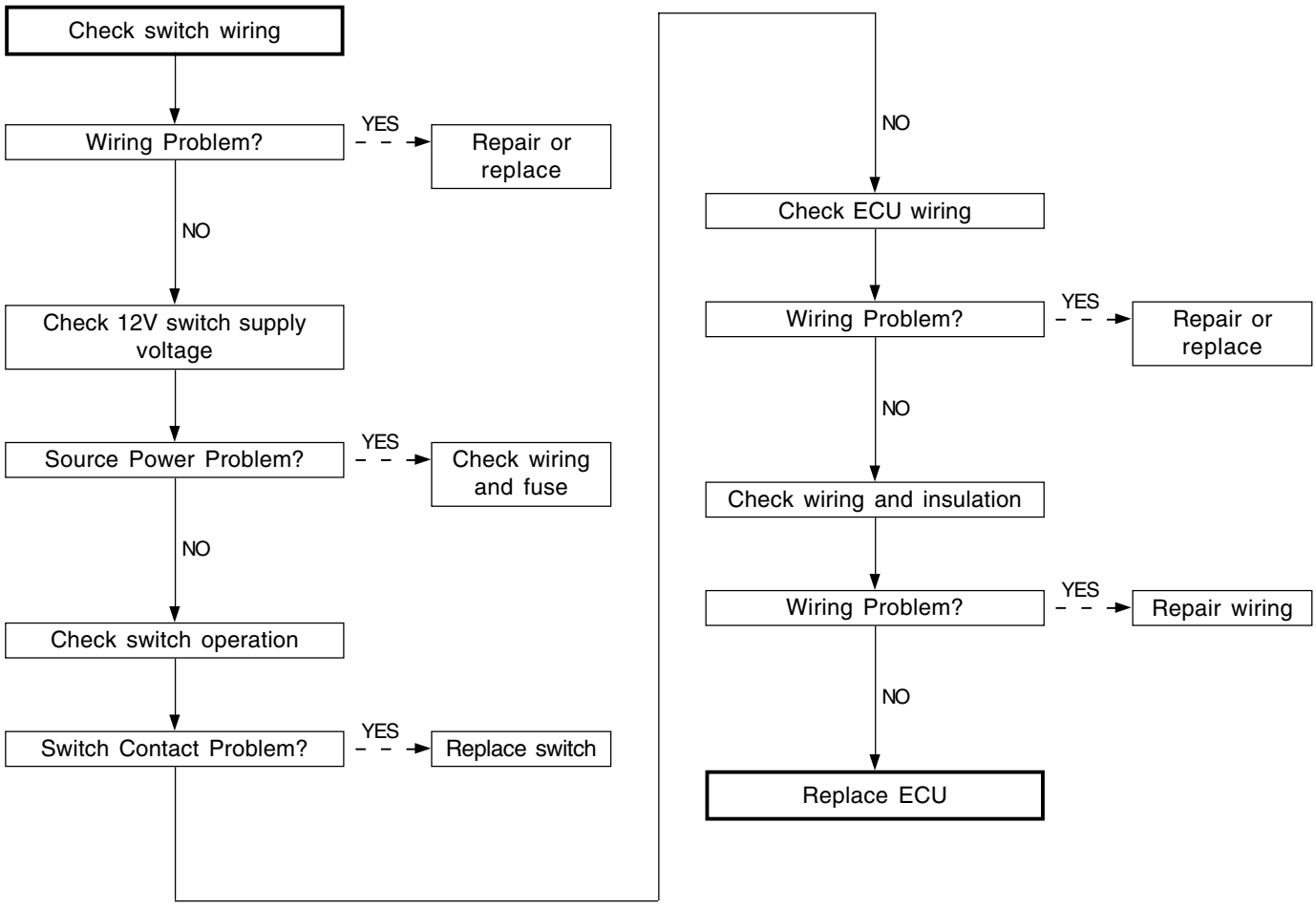


Clutch Switch Malfunction

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0704	Clutch Switch Malfunction	

▶ Diagnosis Procedures

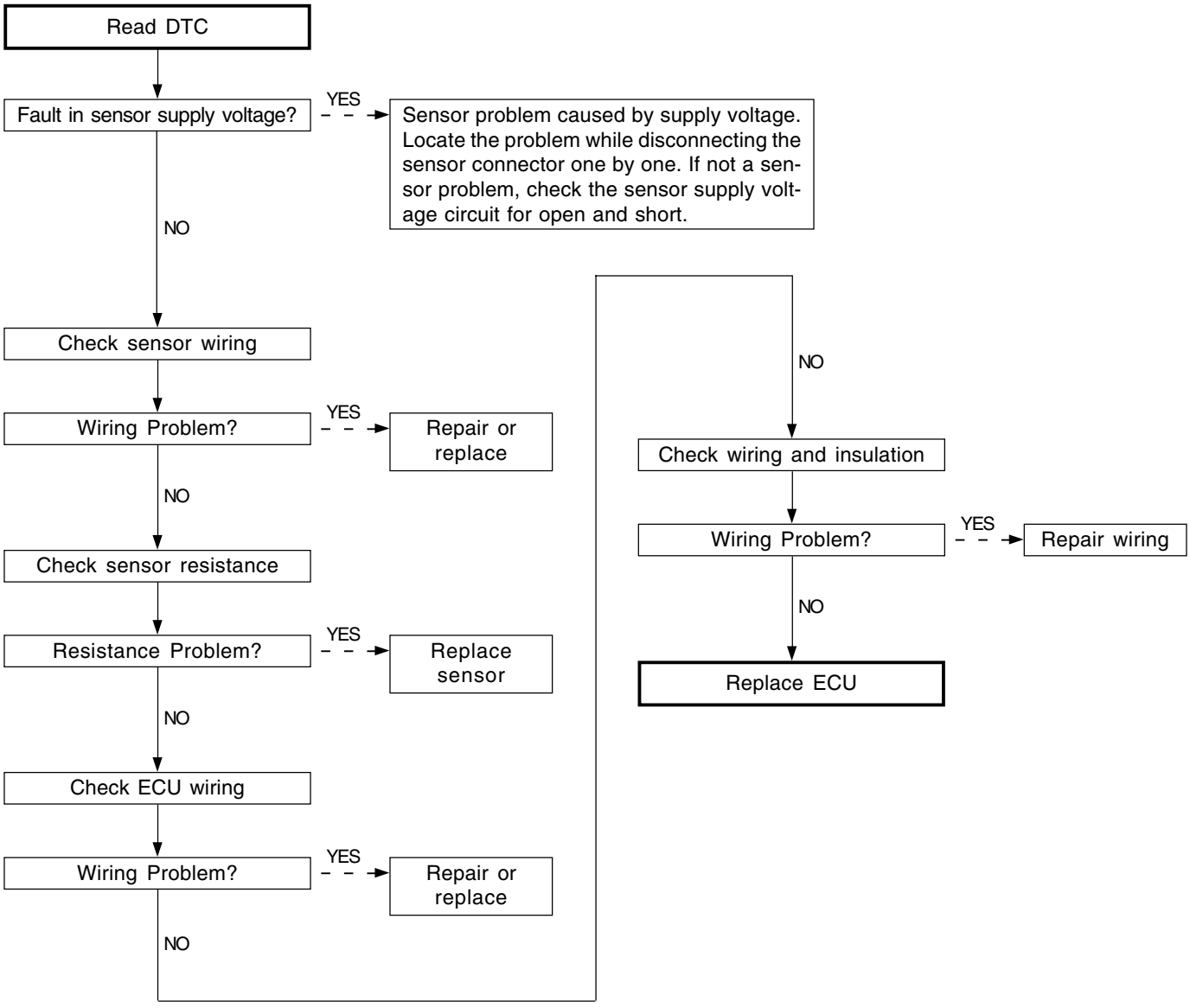


Coolant Temperature Sensor Malfunction (Implausible Signal)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1115	Coolant Temperature Sensor Malfunction	Unable Air Conditioner Operation
		Below Limited Temperature of Engine Overheat Detection

▶ Diagnosis Procedures

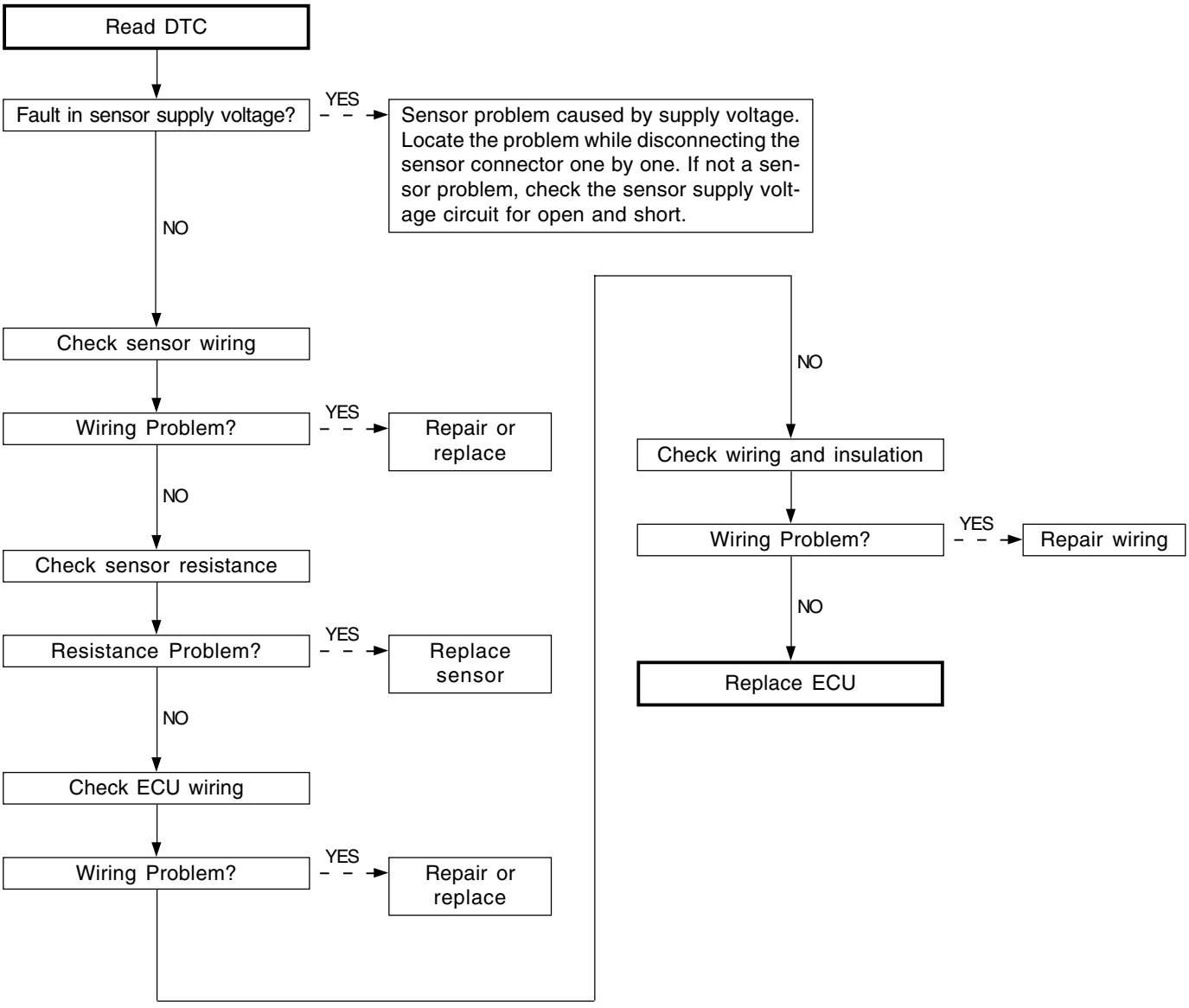


Coolant Temperature Sensor Malfunction (Electric Fault)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0117	Low	Unable Air Conditioner Operation
P0118	High	Below Limited Temperature of Engine Overheat Detection
P0115	Supply Voltage	

▶ Diagnosis Procedures



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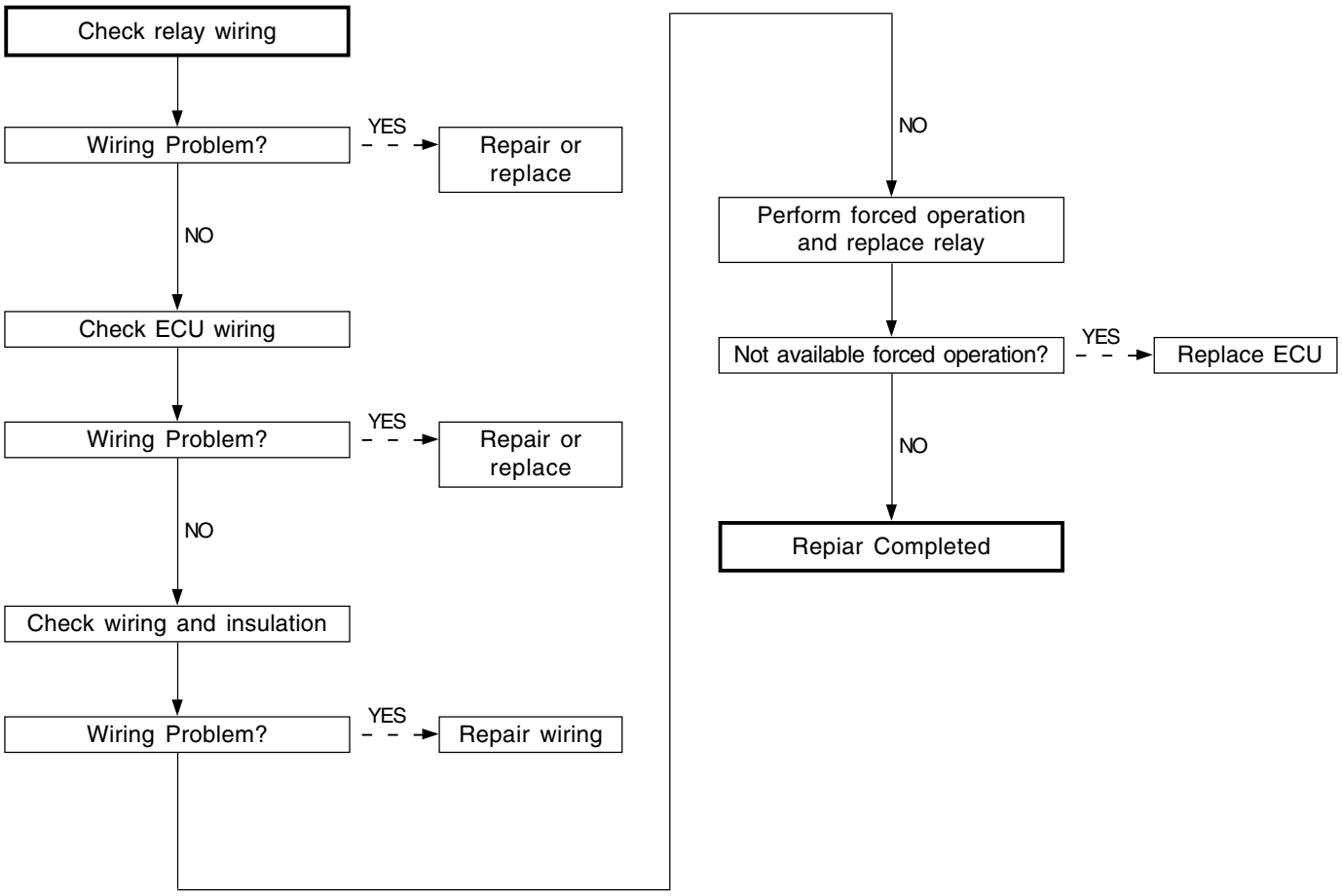
Too Fast or Low Main Relay Operation

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0685	Main Relay Malfunction	

▶ Diagnosis Procedures

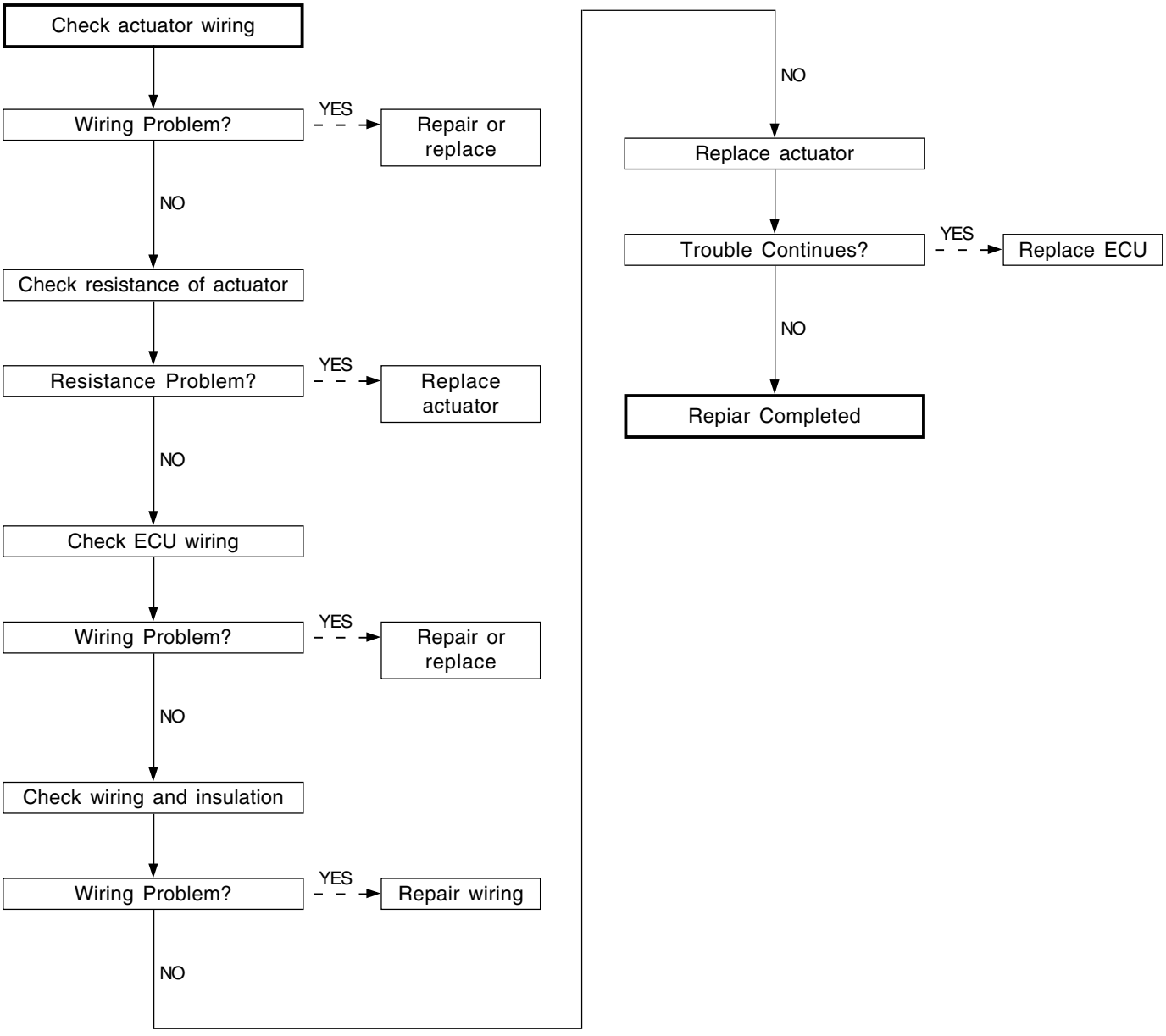


EGR Actuator Malfunction

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1405	EGR Vacuum Modulator - Short to GND	MIL ON
P1406	EGR Vacuum Modulator - Short to +Batt	Unable EGR Control (Air Flow)

▶ Diagnosis Procedures



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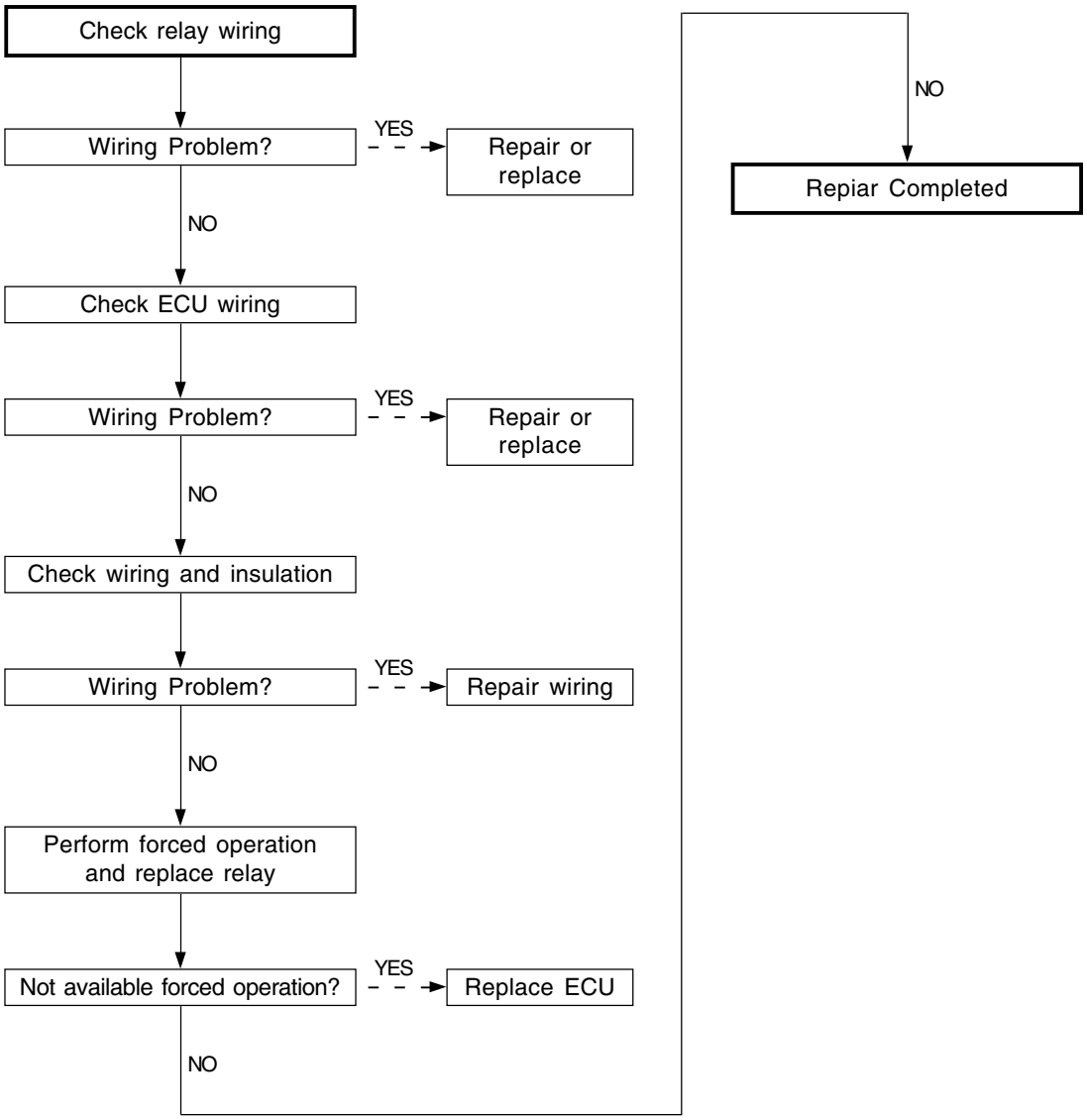
Condenser Fan Driving Signal Fault (Type 1)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1480	Open Circuit	Unable Air Conditioner Operation
P1481	Short Circuit	MIL ON
P1482	Short to Ground	Below Limited Temperature of Engine Overheat Detection

▶ Diagnosis Procedures

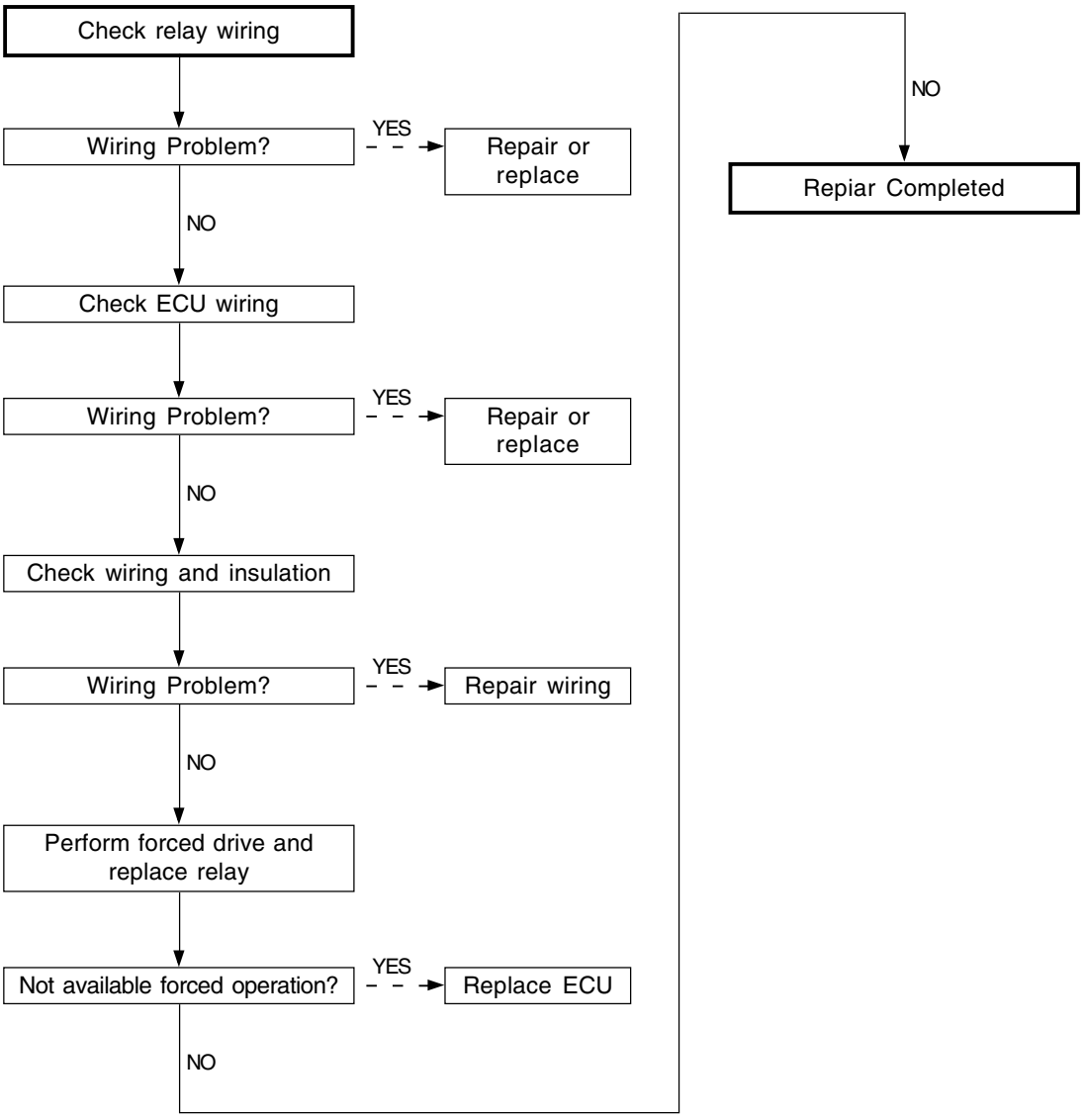


Condenser Fan Driving Signal Fault (Type 2)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1526	Open Circuit	Unable Air Conditioner Operation
P1527	Short Circuit	MIL ON
P1528	Short to Ground	Below Limited Temperature of Engine Overheat Detection

▶ Diagnosis Procedures



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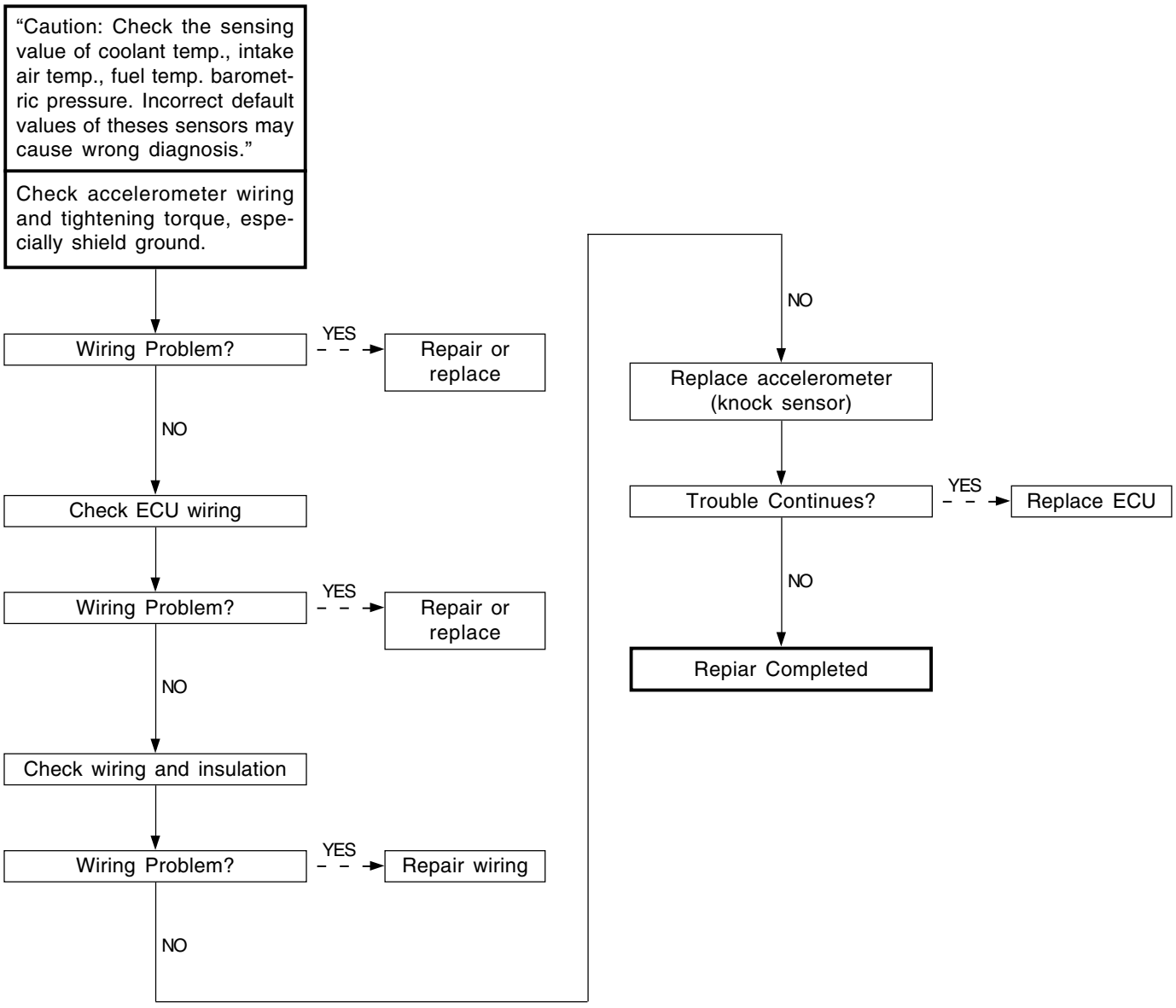
#1 Accelerometer Malfunction (Idling Signal/Too Small Noise Ratio)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0325	#1 Accelerometer (Knock Sensor) Malfunction	MIL ON
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

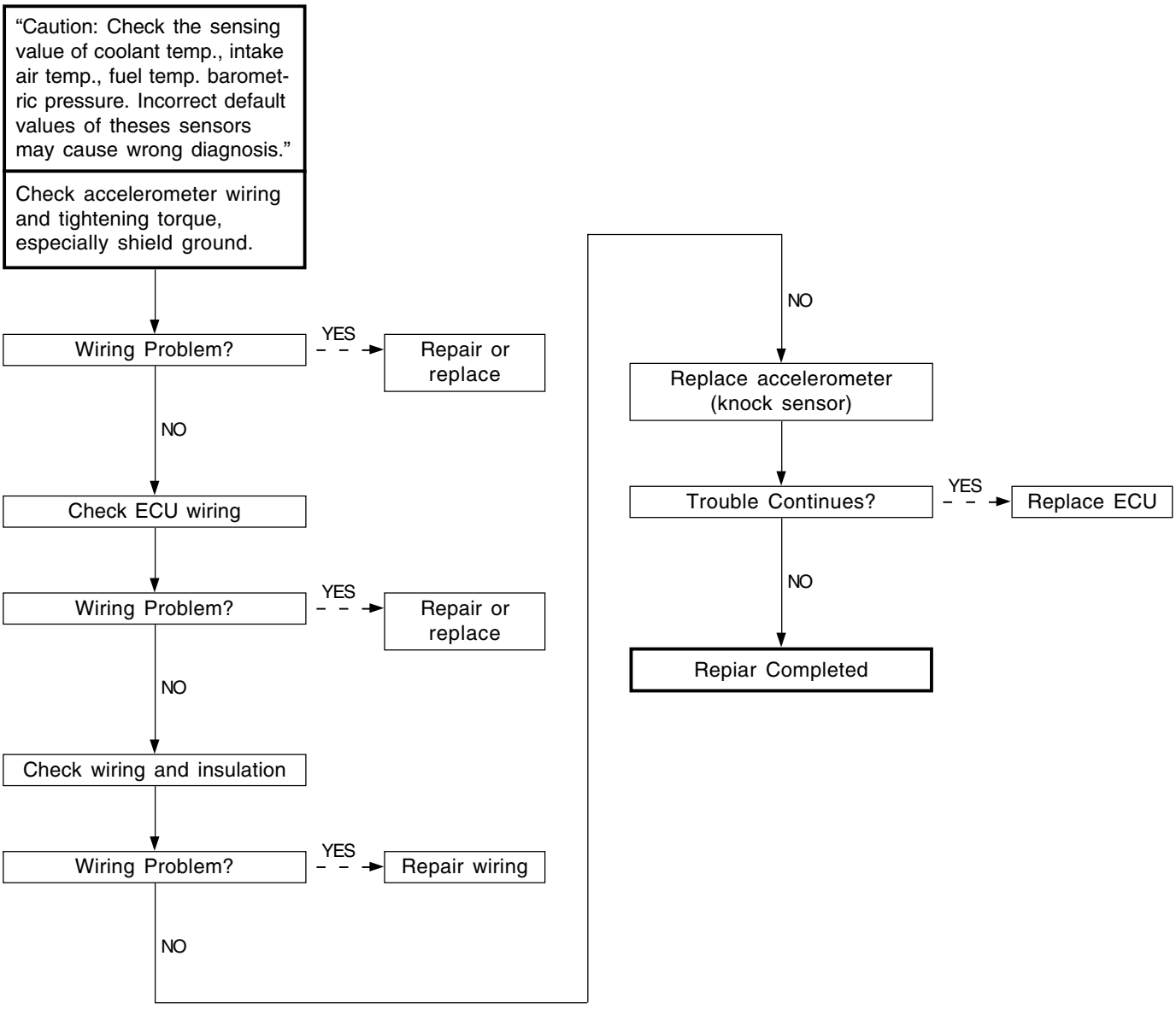


#2 Accelerometer Malfunction (Idling Signal/Too Small Noise Ratio)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0330	#2 Accelerometer (Knock Sensor) Malfunction	MIL ON
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures



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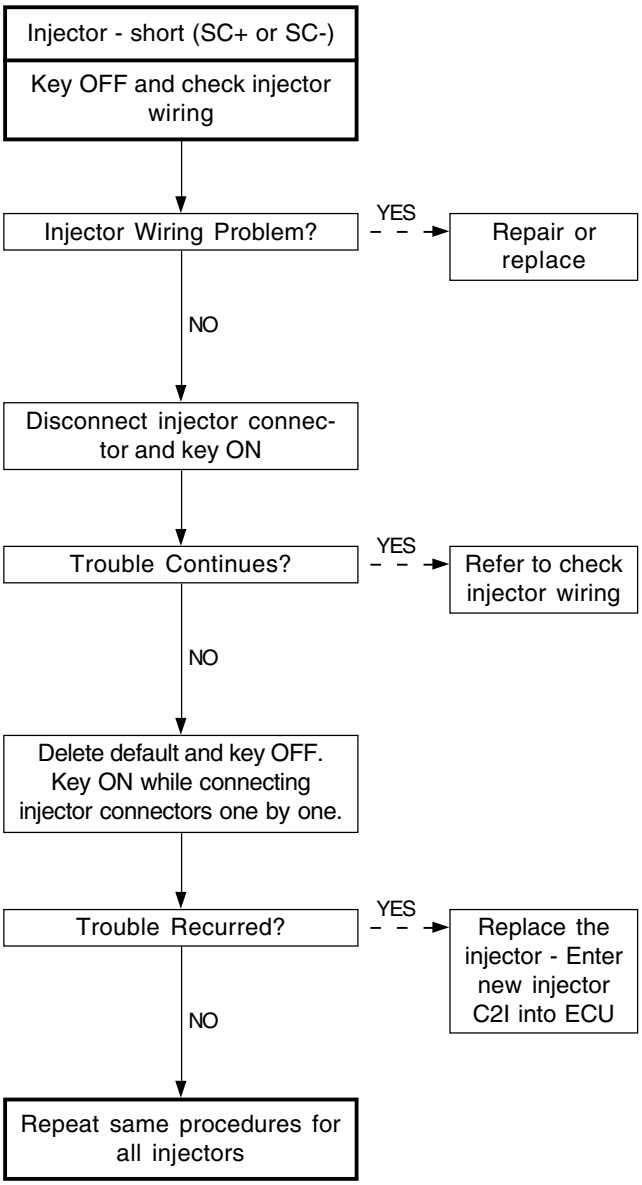
Injector Bank 1 Malfunction (Short to Ground or B+)

▶ Trouble Code and Symptom

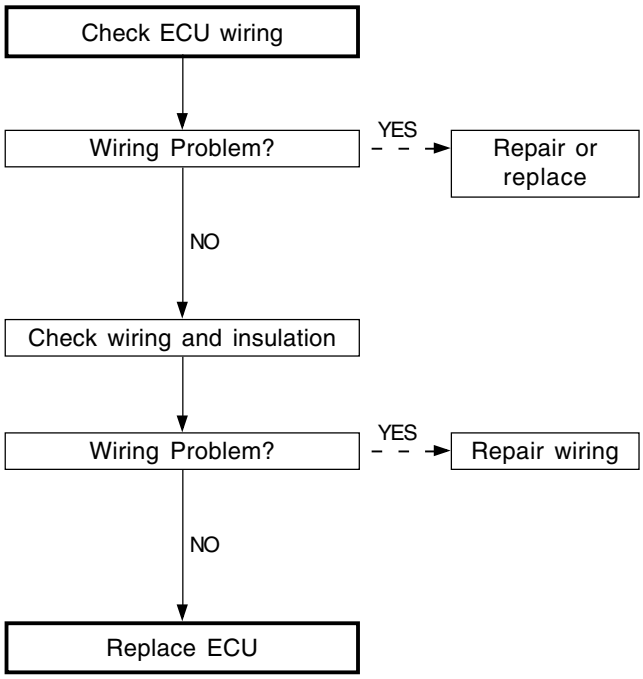
Trouble Code		Symptom
P1611	Low Injector Bank 1 Voltage	Resistance of injector #1 fault. Use estimate resistance level.
P1612	High Injector Bank 1 Voltage	Resistance of injector #4 fault. Use estimate resistance level.
		Resistance of injector #3 fault. Use estimate resistance level.
		MIL ON
		Unable Dynamic Leak of Injector #1
		Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #3
		Unable Cylinder Balancing
		Unable Injector #1 Operation
		Unable Injector #4 Operation
		Unable Injector #3 Operation
		Unable High Pressure Leak Detection
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

1. Fuel Injection Bank 1/2



2. Check Injector Wiring



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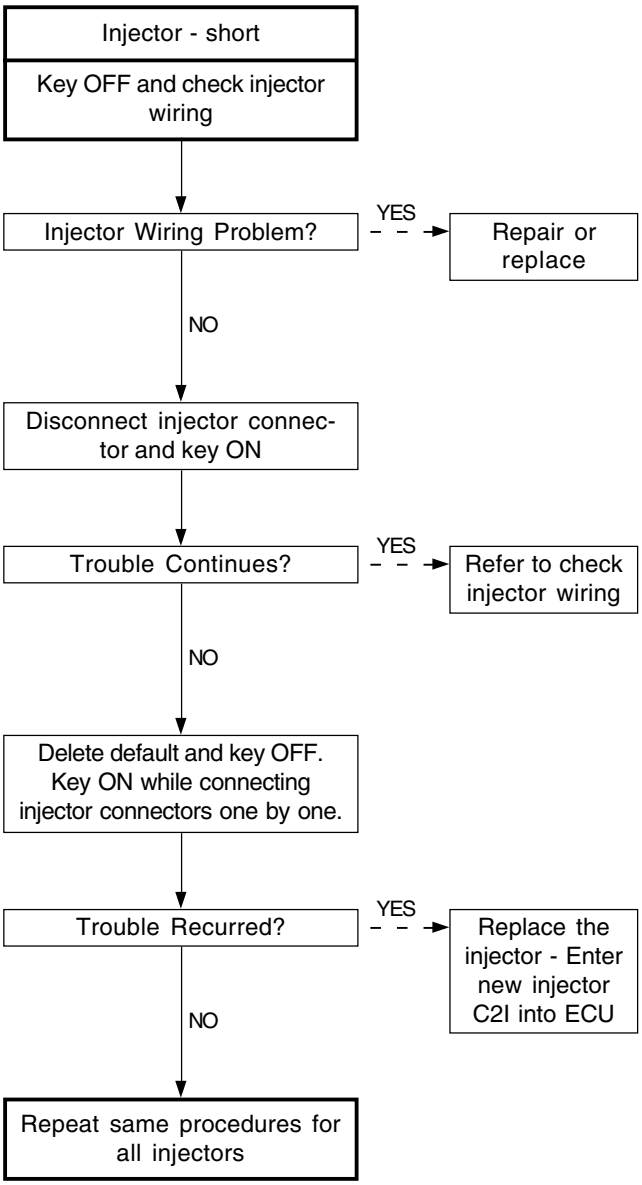
Injector Bank 2 Malfunction (Short to Ground or B+)

▶ Trouble Code and Symptom

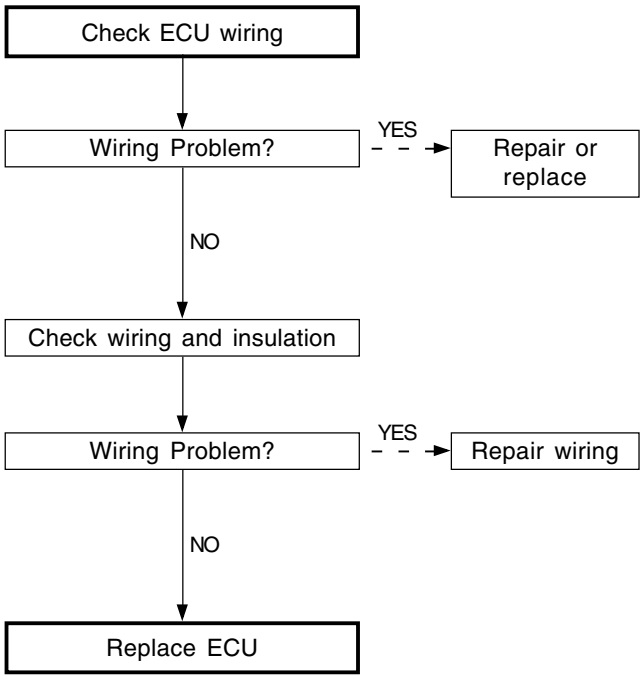
Trouble Code		Symptom
P1618	Low Injector Bank 2 Voltage	Resistance of injector #2 fault. Use estimate resistance level.
P1619	High Injector Bank 2 Voltage	Resistance of injector #5 fault. Use estimate resistance level.
		MIL ON
		Unable Dynamic Leak of Injector #2
		Unable Dynamic Leak of Injector #5
		Unable Cylinder Balancing
		Unable Injector #2 Operation
		Unable Injector #5 Operation
		Unable High Pressure Leak Detection
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

1. Fuel Injection Bank 1/2



2. Check Injector Wiring



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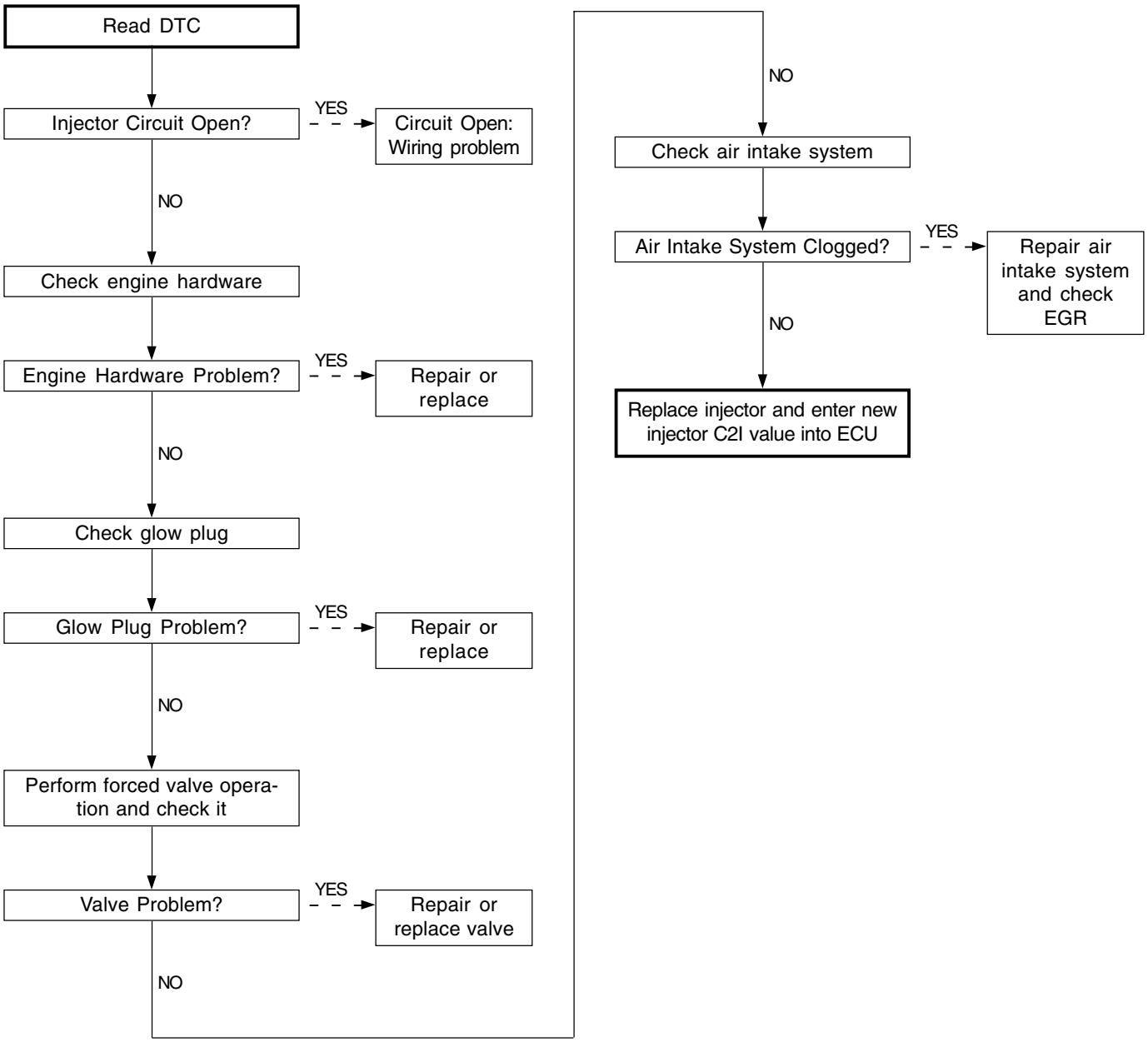
Cylinder Balancing Fault (Injector #1) = Clogged Air Intake System

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0263	#1 Cylinder Balancing Fault	MIL ON
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

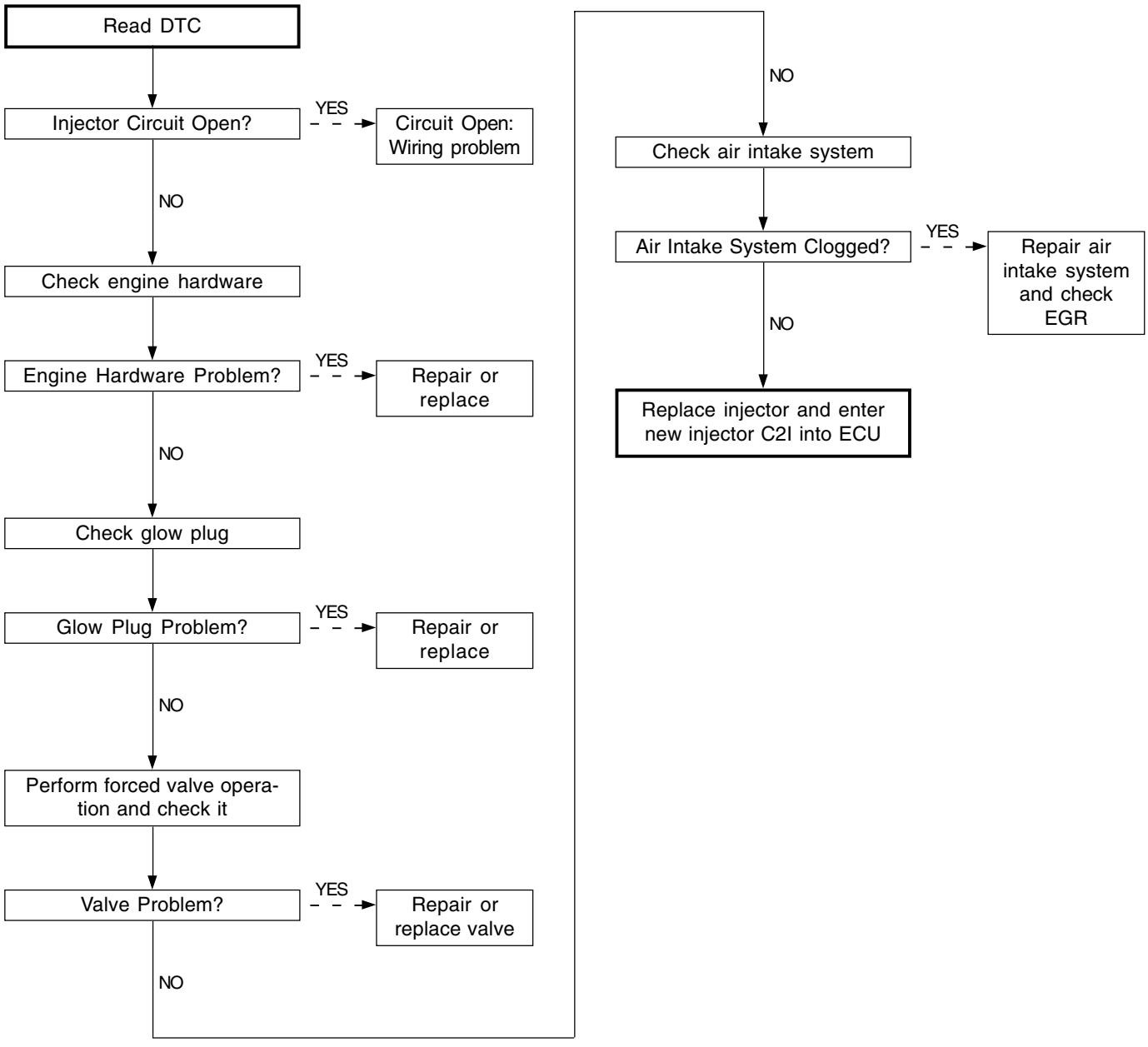


Cylinder Balancing Fault (Injector #2) = Clogged Air Intake System

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0266	#2 Cylinder Balancing Fault	MIL ON
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures



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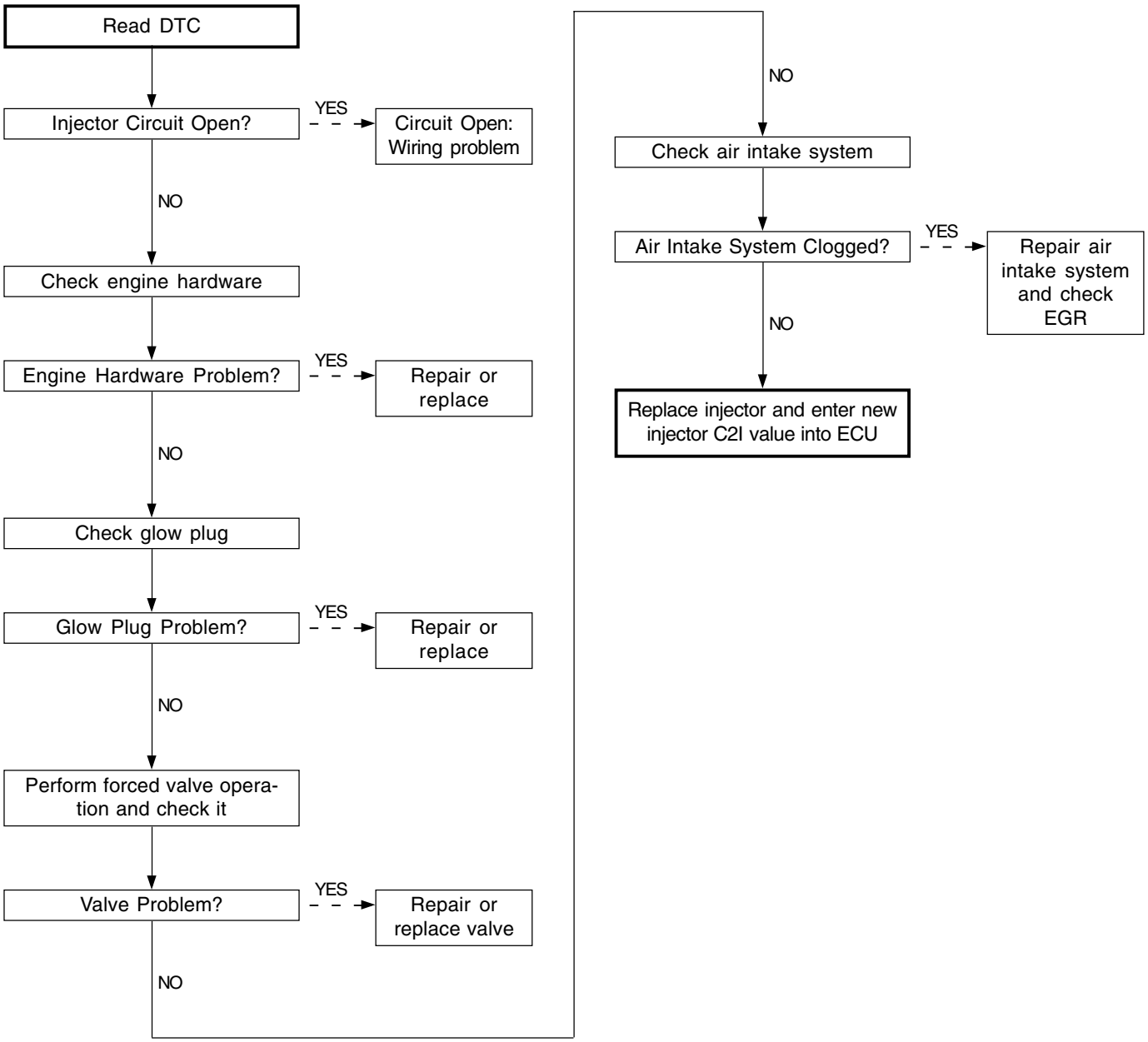
Cylinder Balancing Fault (Injector #4) = Clogged Air Intake System

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0272	#4 Cylinder Balancing Fault	MIL ON
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

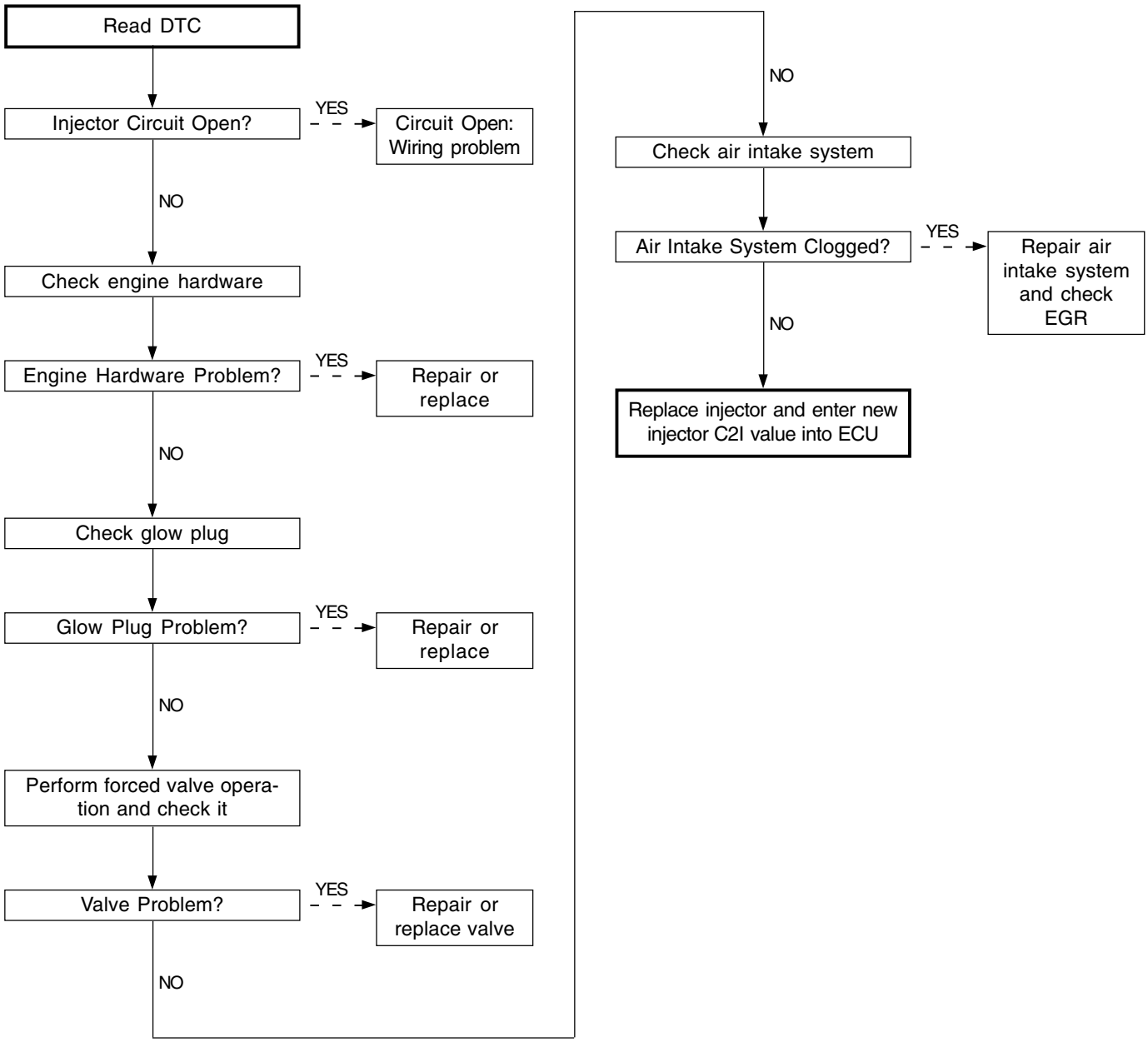


Cylinder Balancing Fault (Injector #5) = Clogged Air Intake System

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0275	#5 Cylinder Balancing Fault	MIL ON
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures



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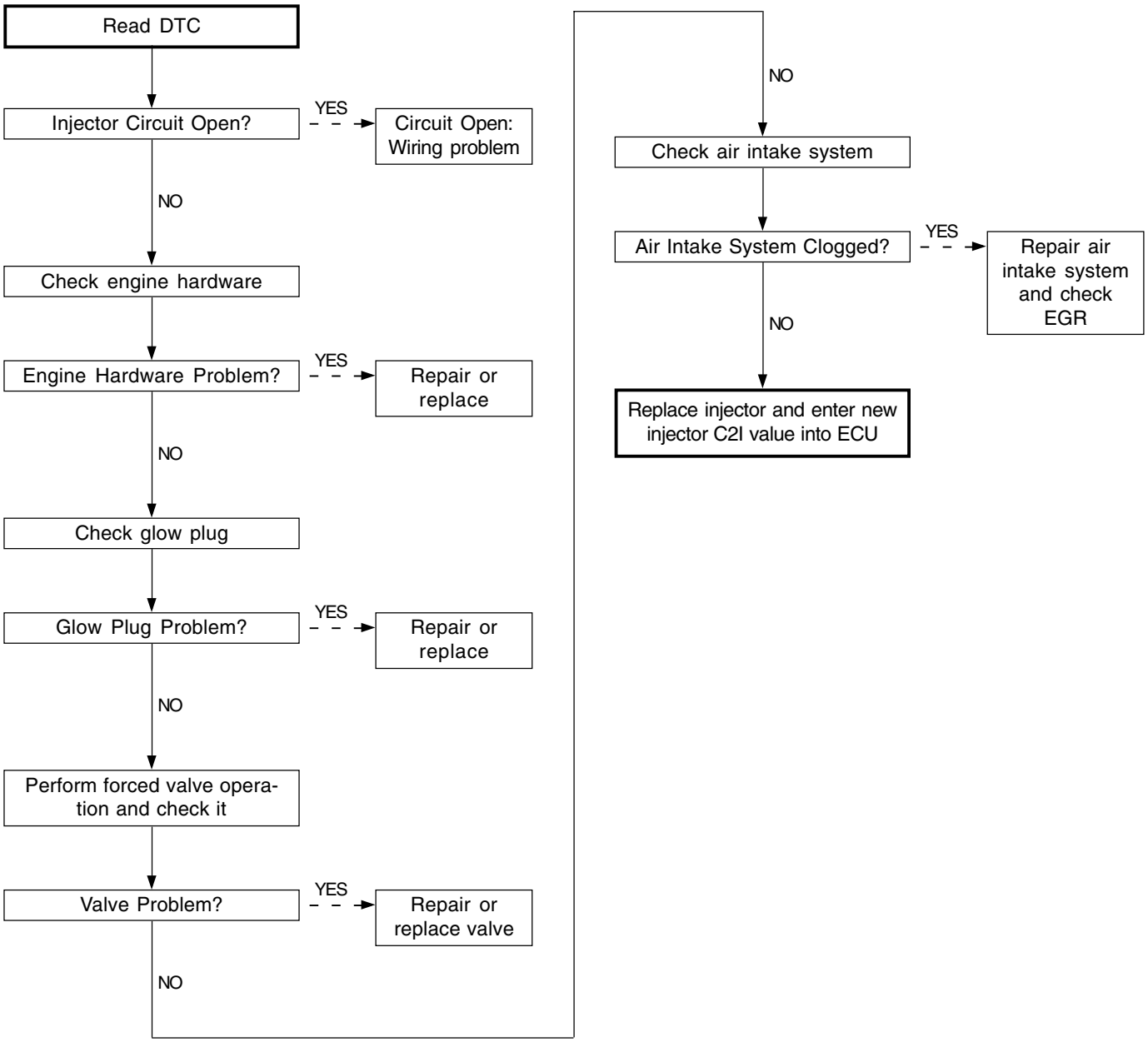
Cylinder Balancing Fault (Injector #3) = Clogged Air Intake System

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0269	#3 Cylinder Balancing Fault	MIL ON
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

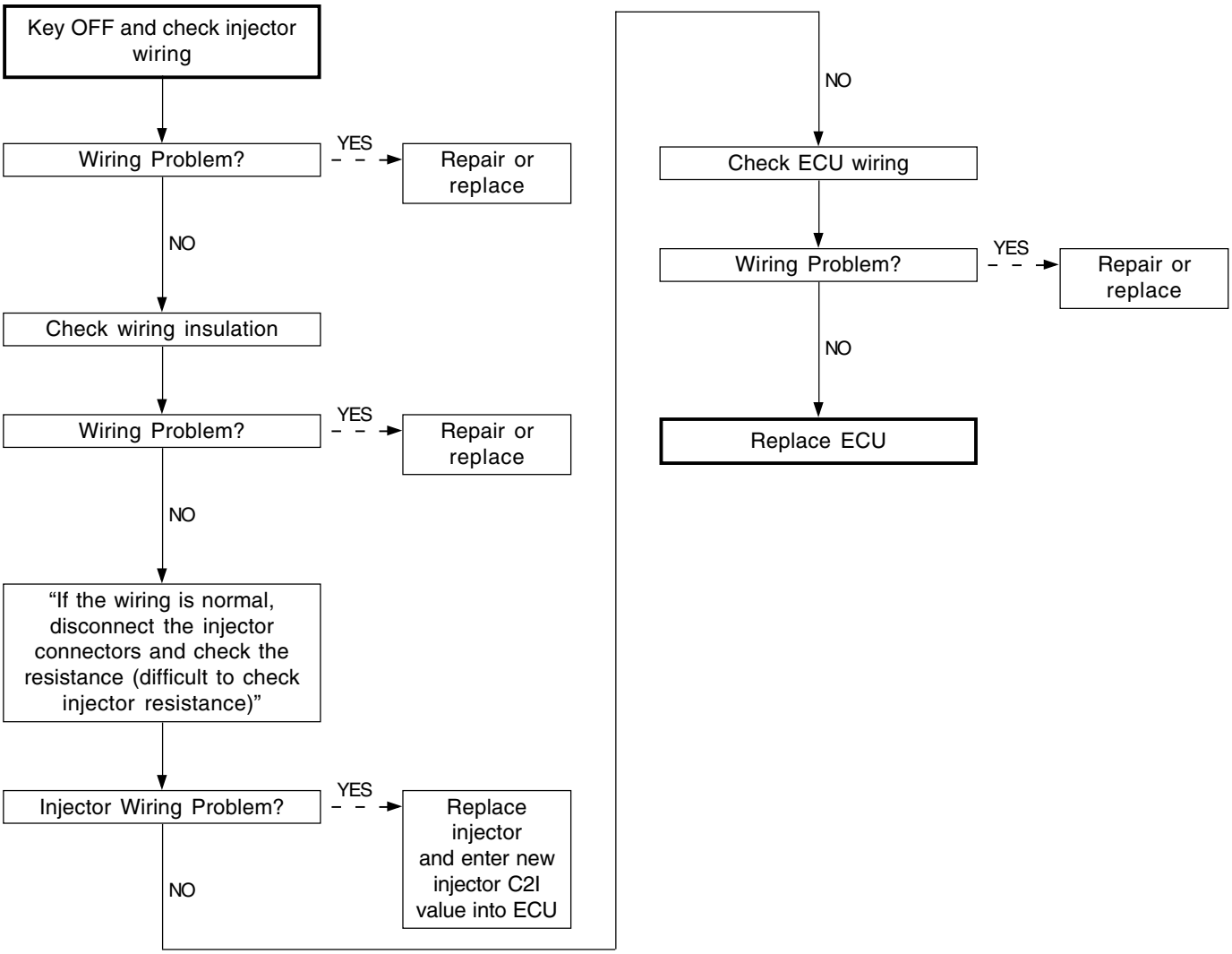


Open Circuit (Injector #1)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0201	#1 Injector Circuit - Open	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures



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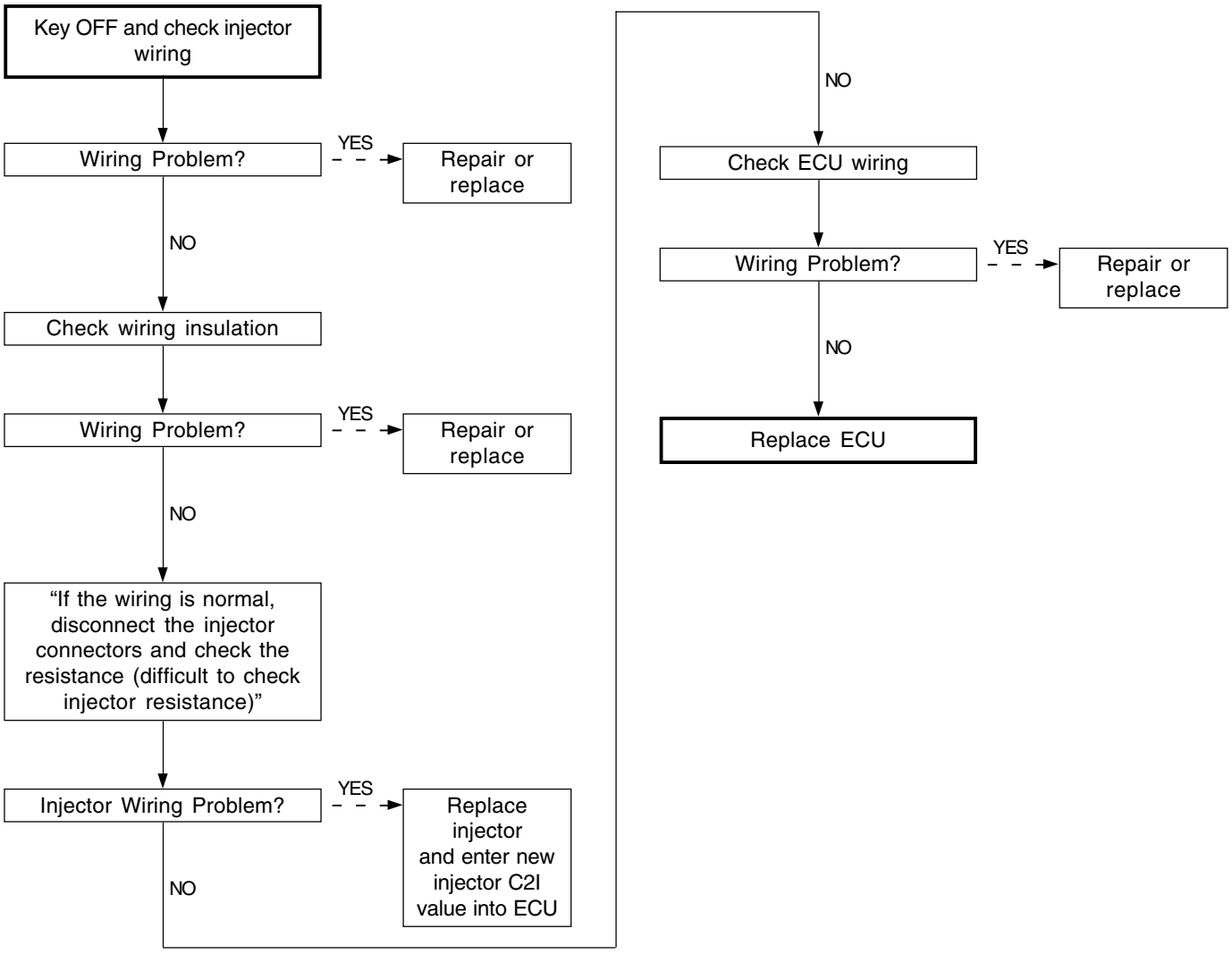
Open Circuit (Injector #2)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0202	#2 Injector Circuit - Open	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

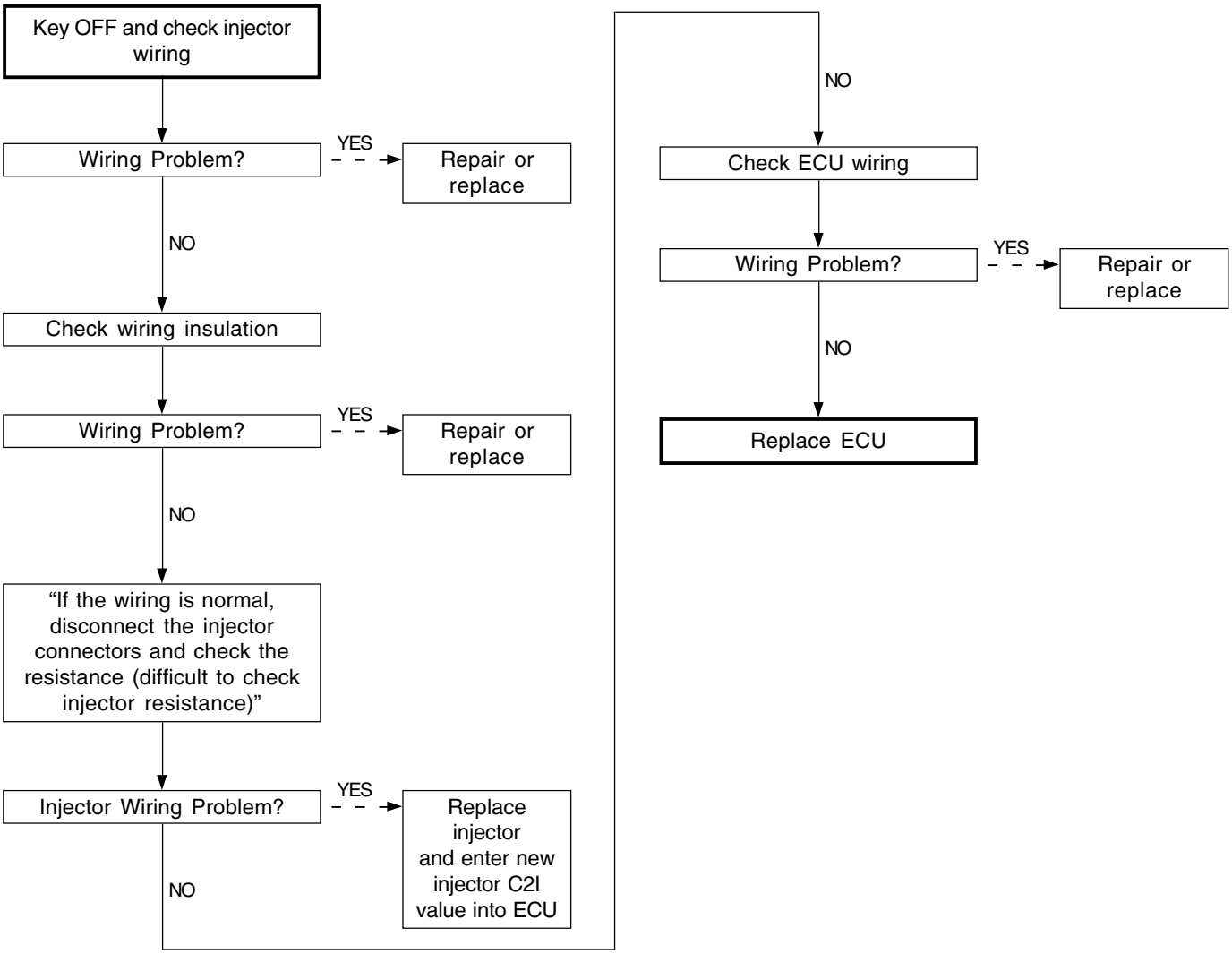


Open Circuit (Injector #4)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0204	#4 Injector Circuit - Open	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures



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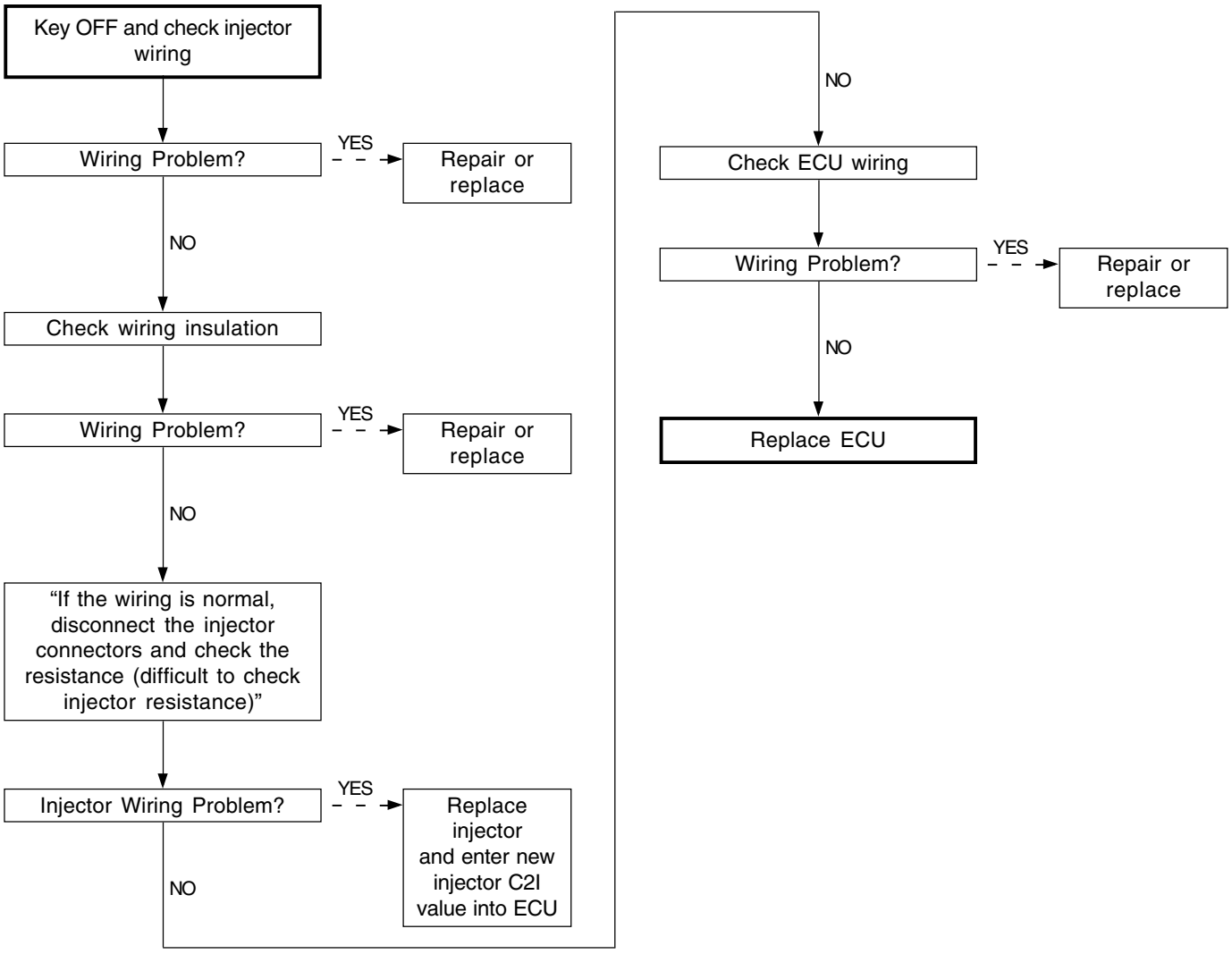
Open Circuit (Injector #5)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0205	#5 Injector Circuit - Open	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

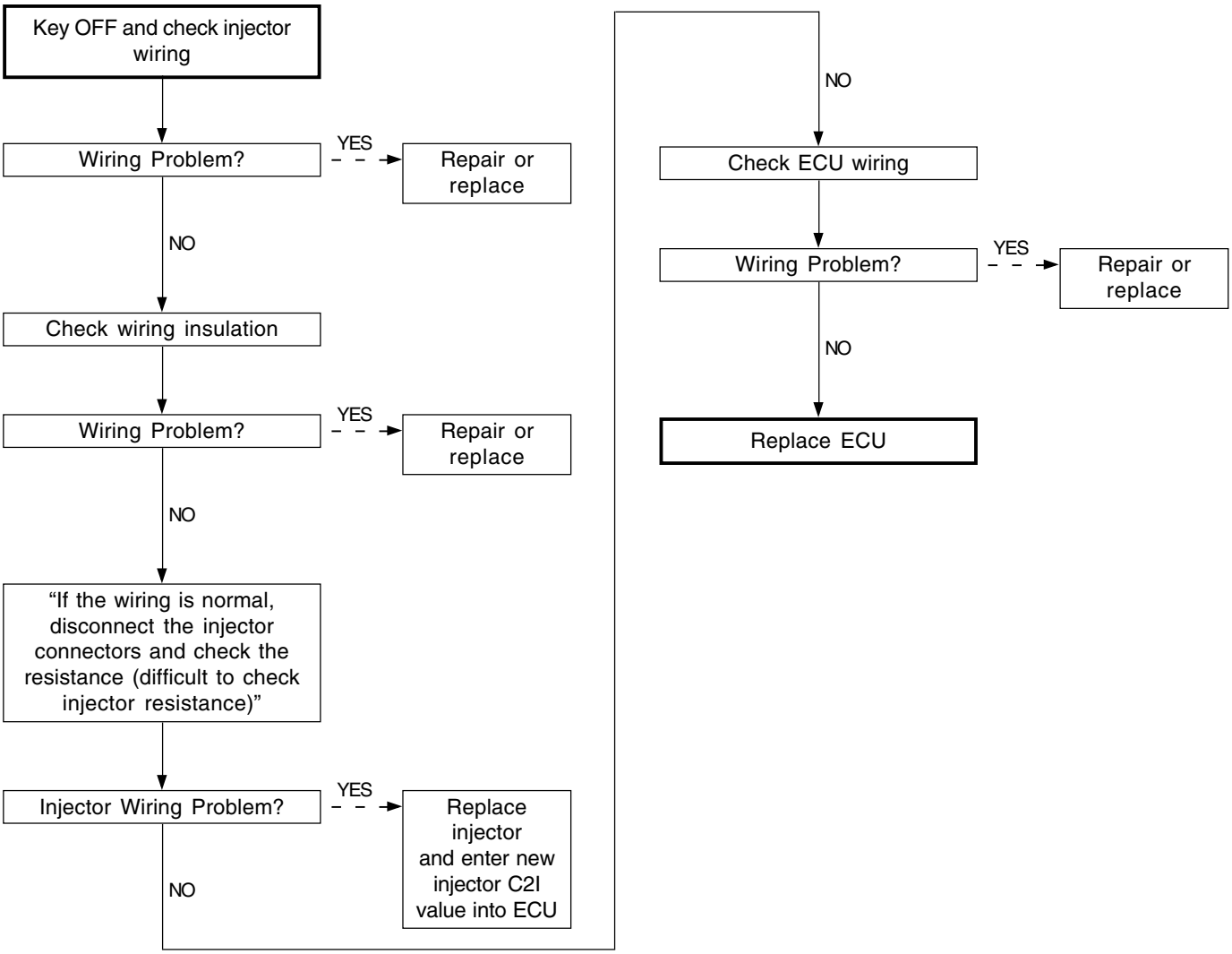


Open Circuit (Injector #3)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0203	#3 Injector Circuit - Open	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures



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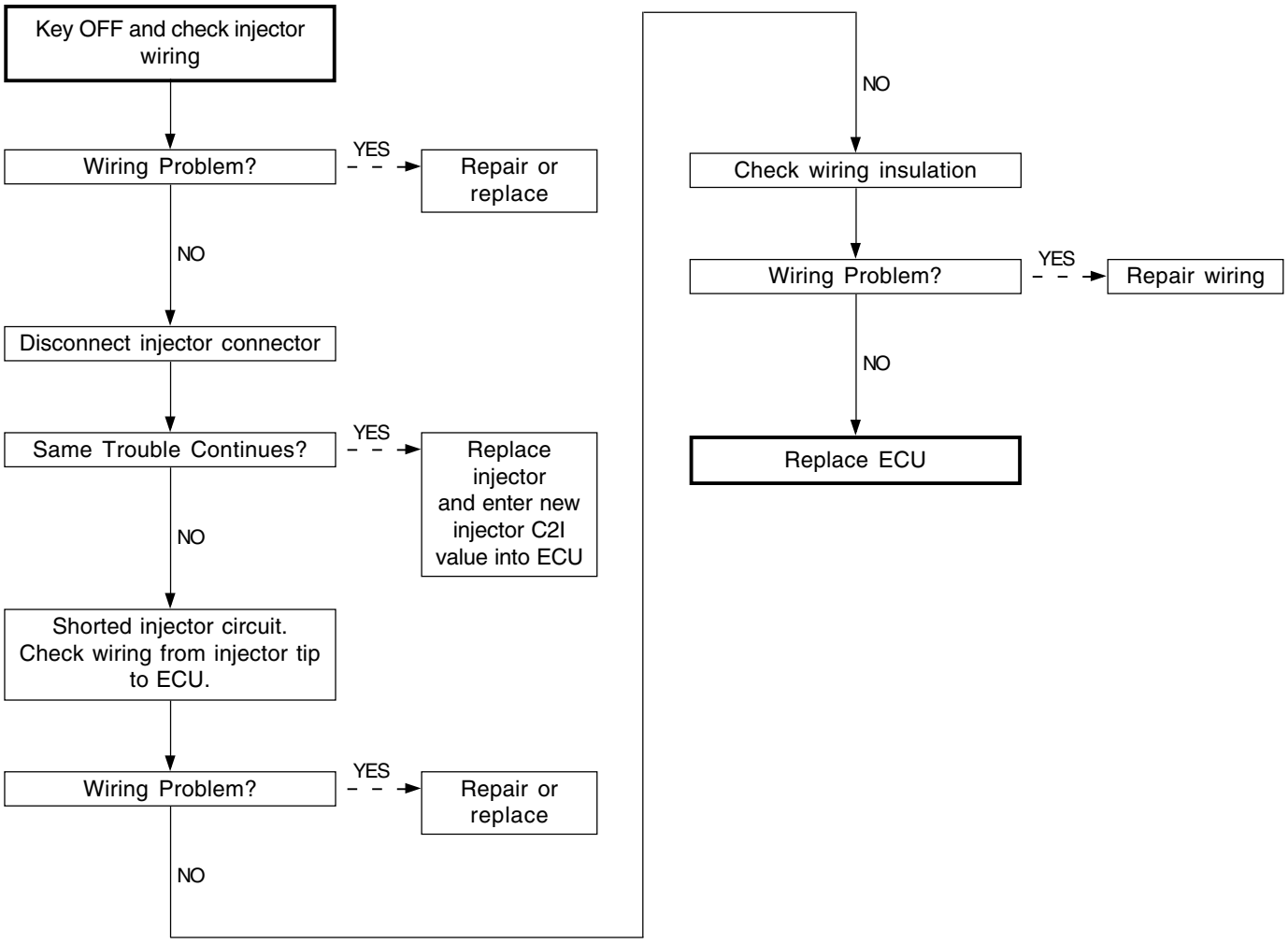
HSD Circuit Short to LSE (Injector #1)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1201	#1 Injector Circuit - Short	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

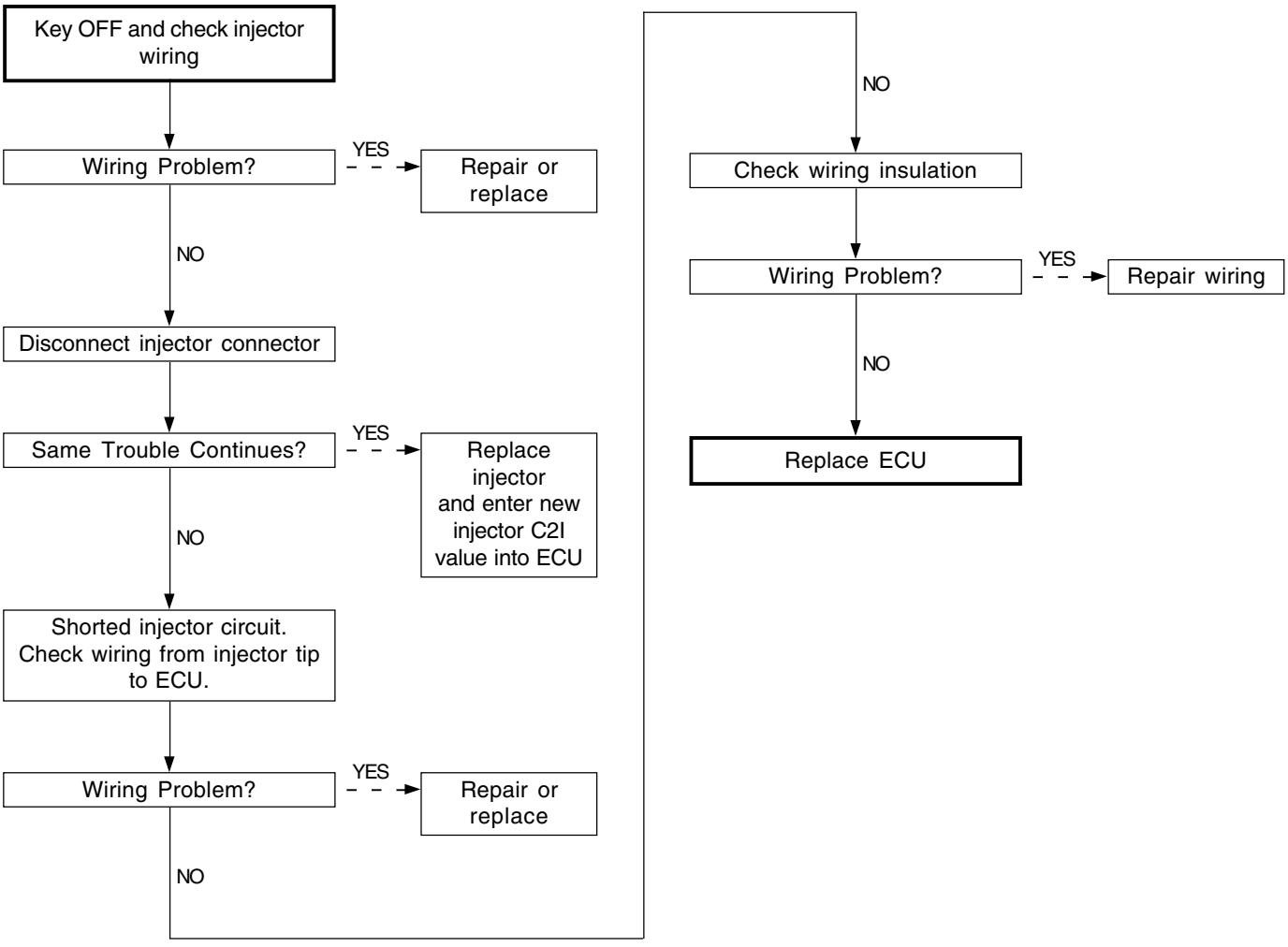


HSD Circuit Short to LSE (Injector #2)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1202	#2 Injector Circuit - Short	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures



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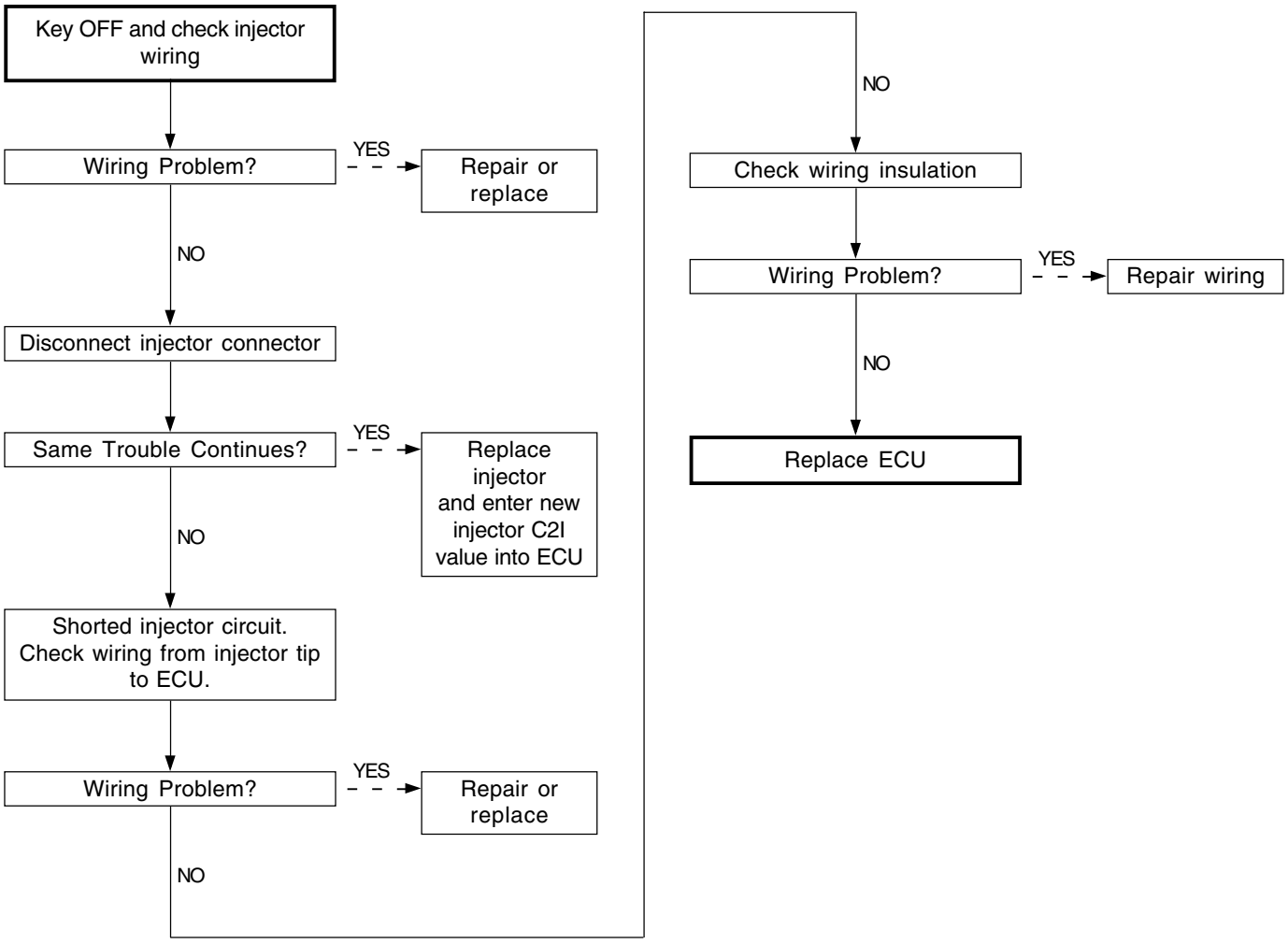
HSD Circuit Short to LSE (Injector #4)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1204	#4 Injector Circuit - Short	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

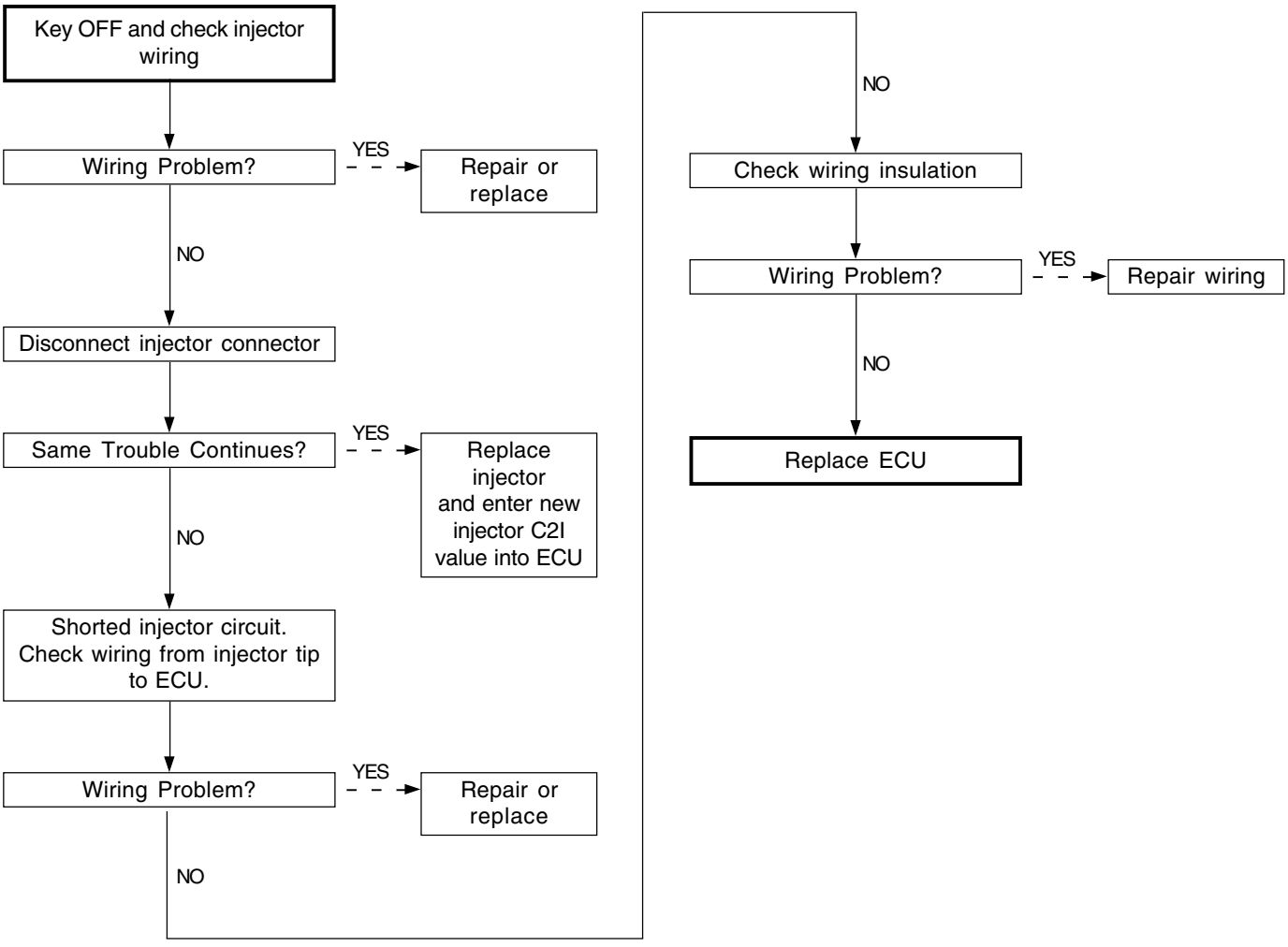


HSD Circuit Short to LSE (Injector #5)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1205	#5 Injector Circuit - Short	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

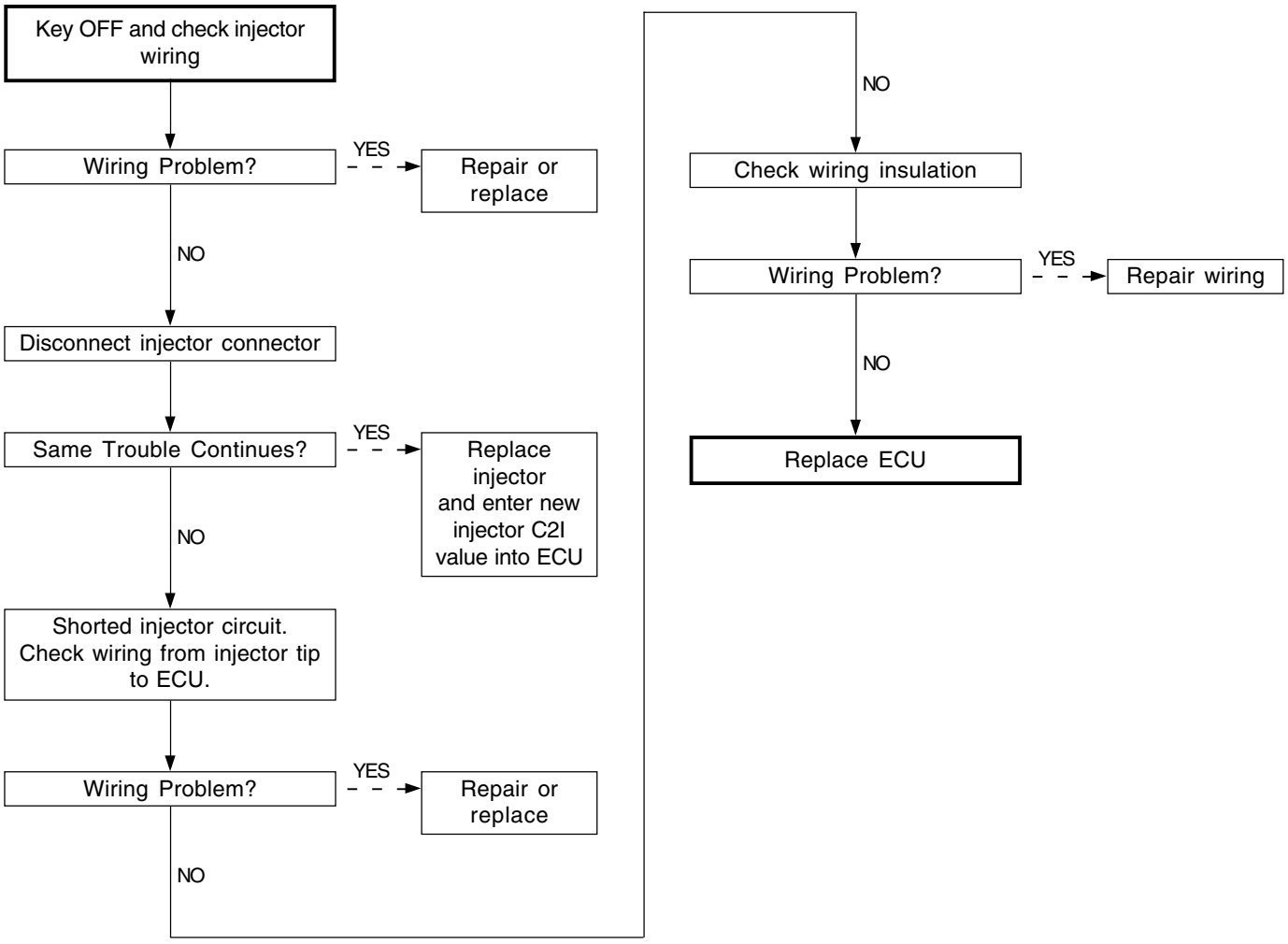


HSD Circuit Short to LSE (Injector #3)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1203	#3 Injector Circuit - Short	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

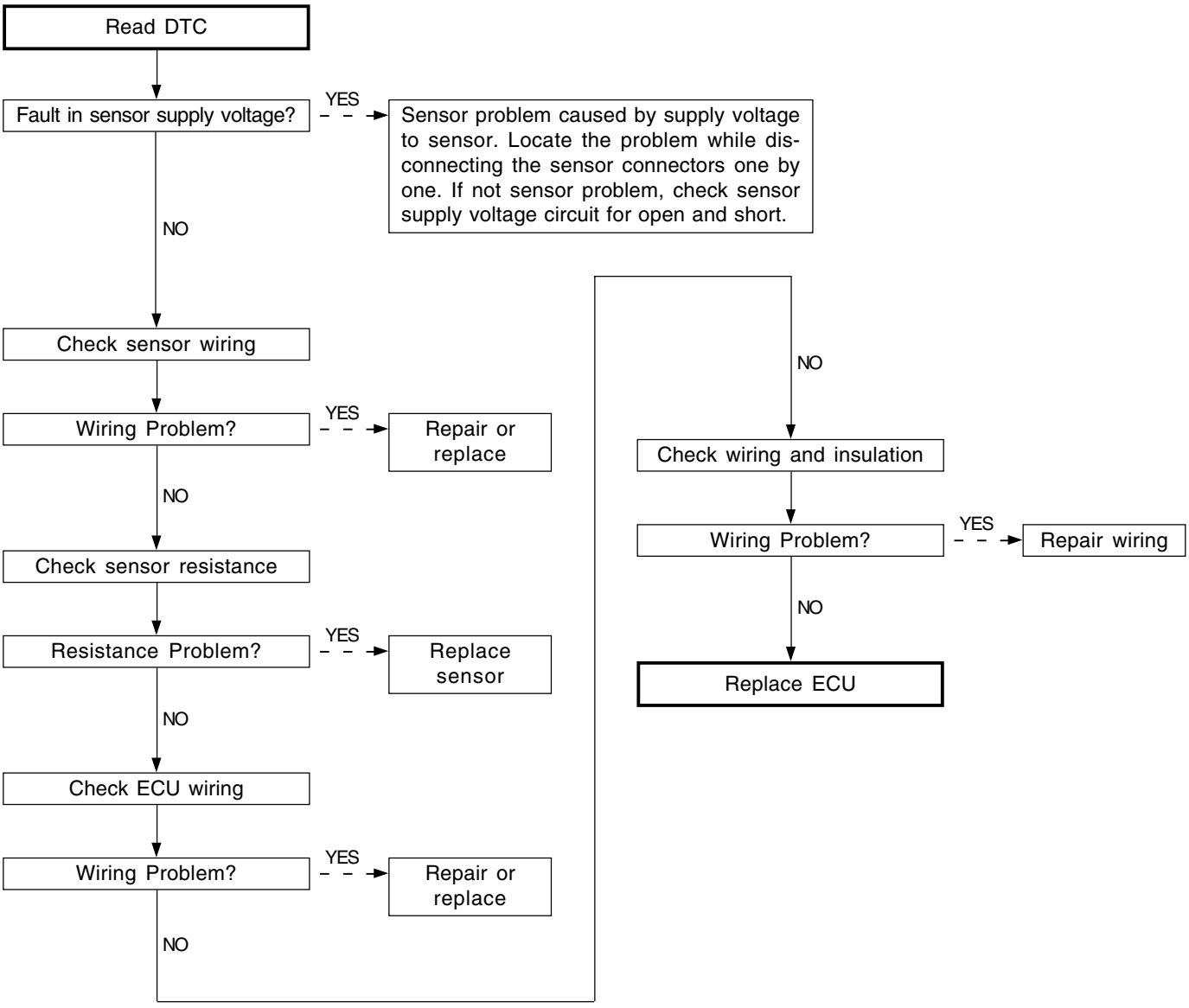


Fuel Temperature Sensor Malfunction

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0182	Low	
P0183	High	
P0180	Supply Voltage	

▶ Diagnosis Procedures



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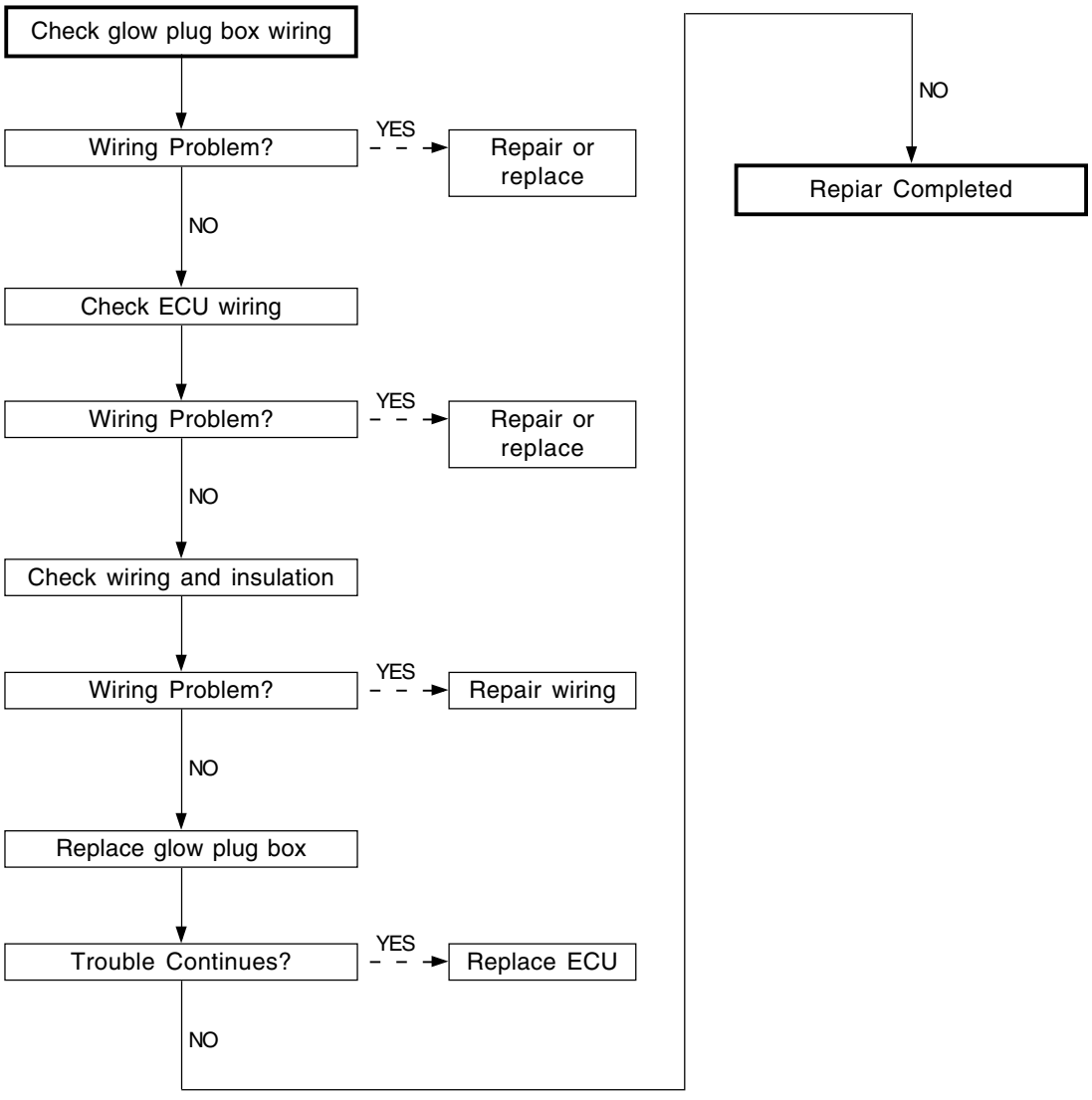
Glow Plug Malfunction (Driving Signal)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1678	Open Circuit	MIL ON
P1679	Short Circuit	Glow Plug Indicator ON
P1680	Short to Ground	

▶ Diagnosis Procedures

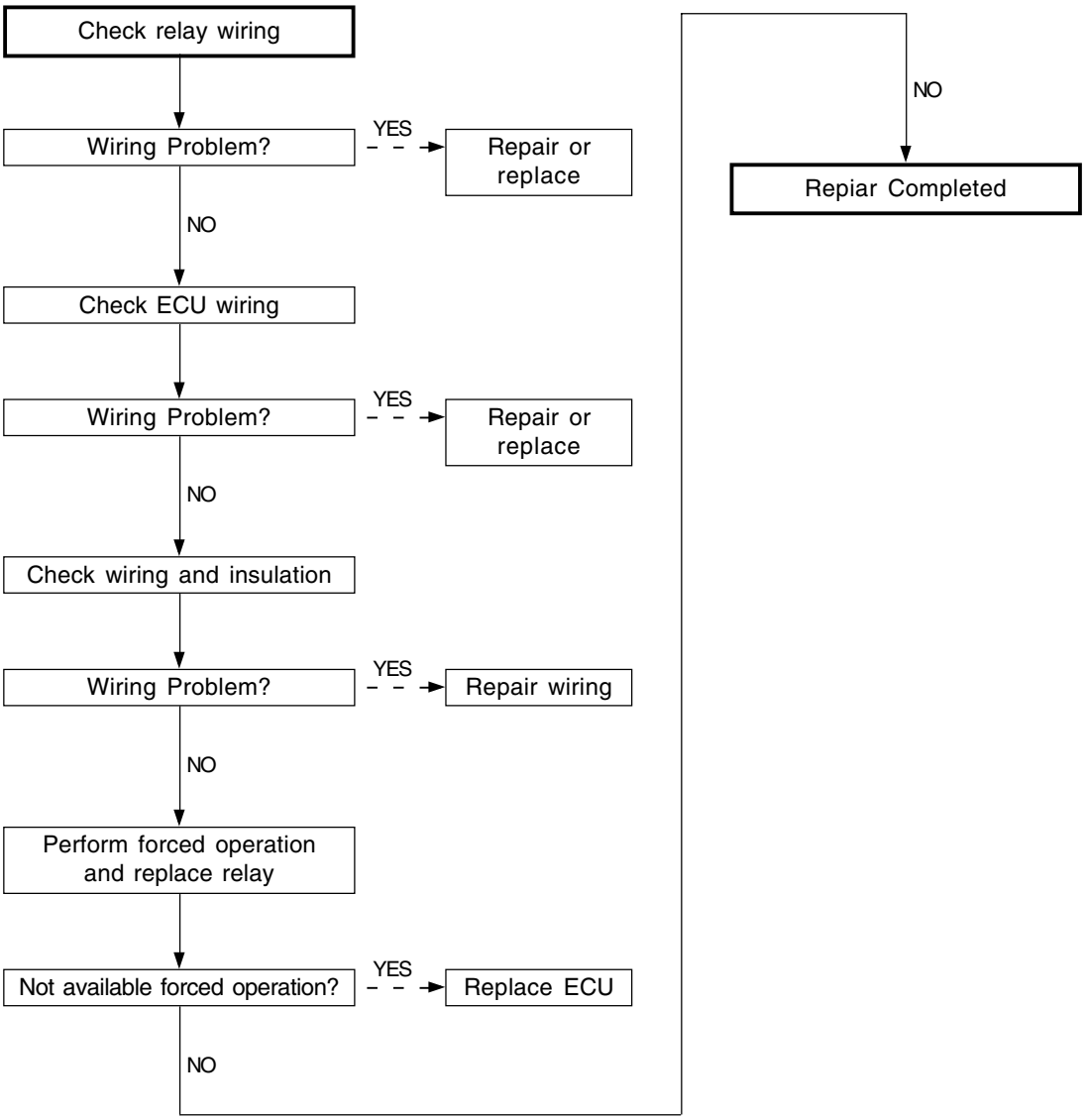


Heater 1 Malfunction (Driving Signal)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1530	Open Circuit	Unable Heater Operation
P1531	Short to +Batt	
P1532	Short to Ground	

▶ Diagnosis Procedures



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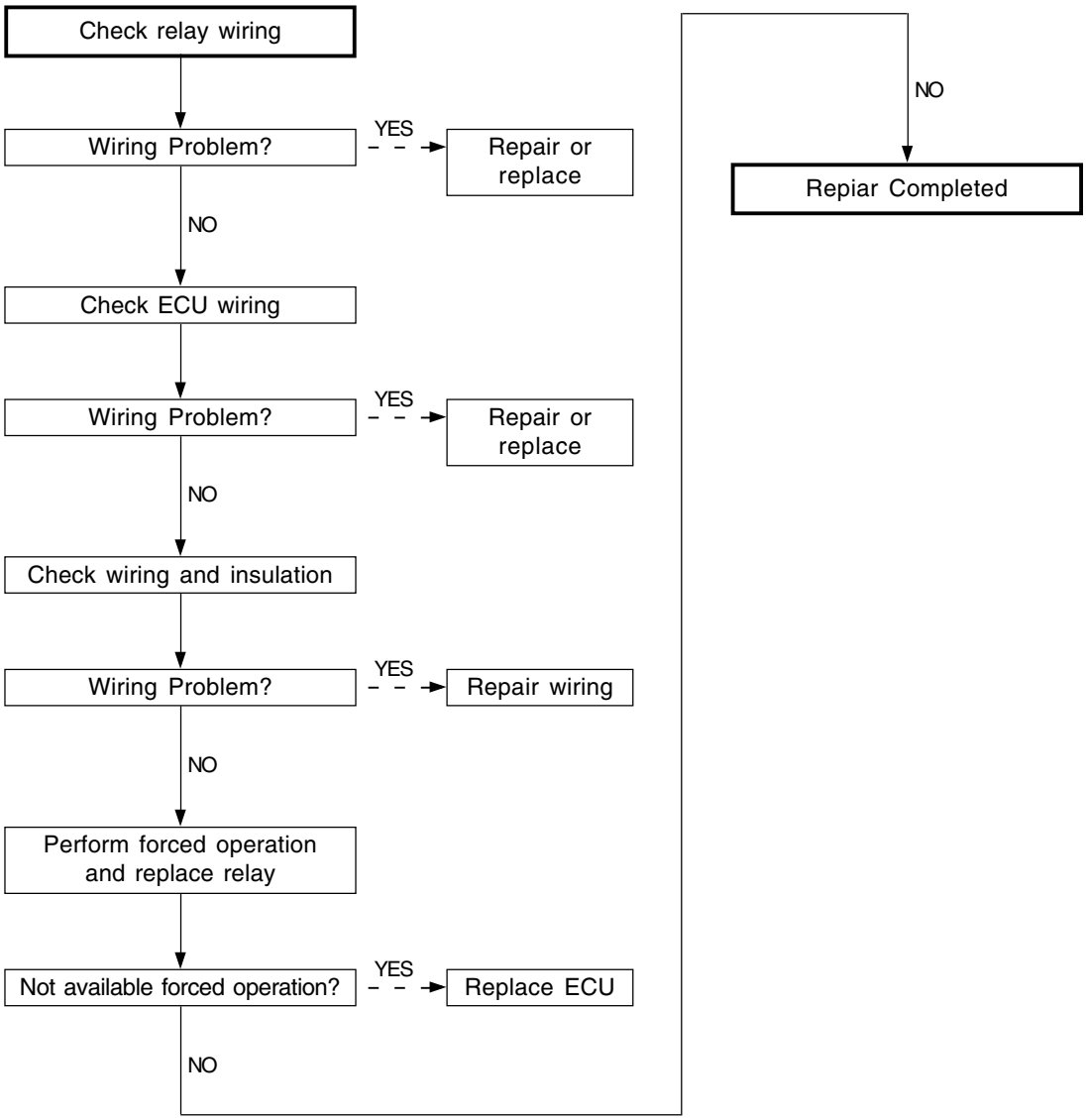
Heater 2 Malfunction (Driving Signal)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1534	Open Circuit	Unable Heater Operation
P1535	Short to +Batt	
P1536	Short to Ground	

▶ Diagnosis Procedures



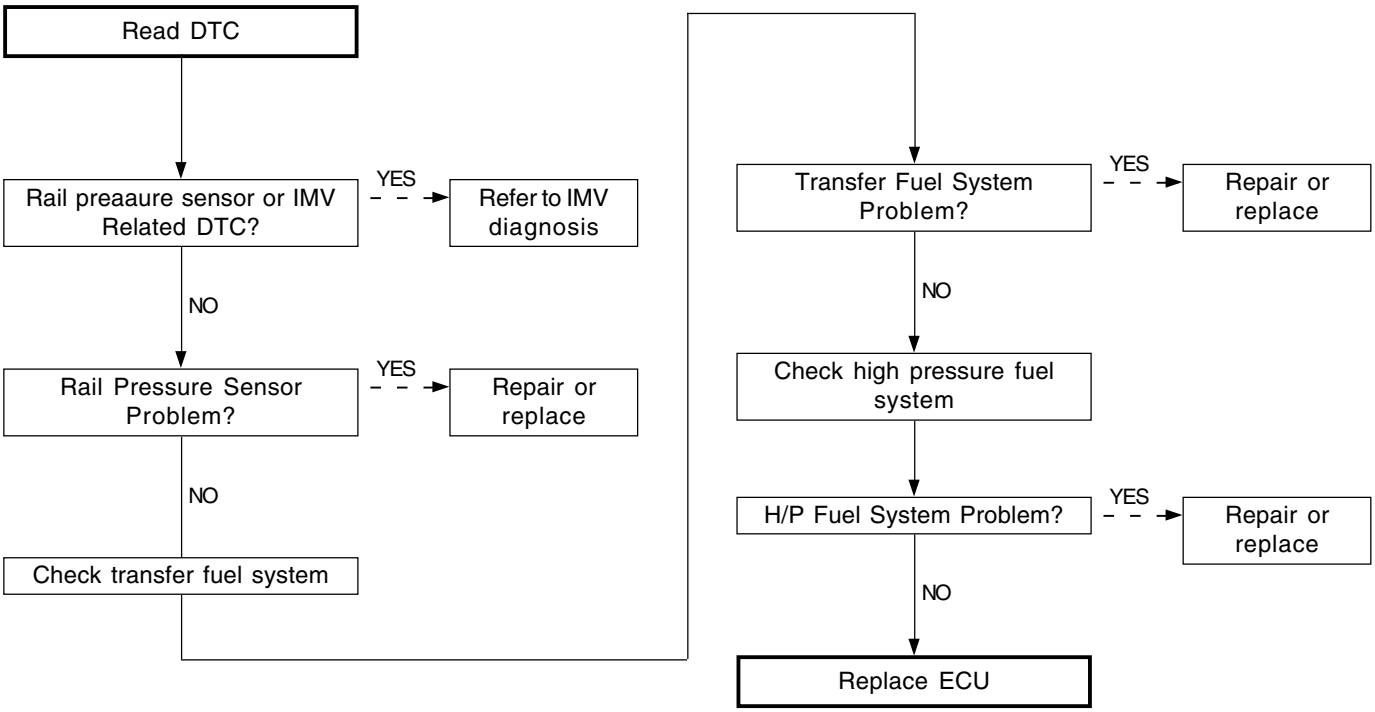
Rail Pressure Control Fault (Too High Pressure)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1254	Maximum Value	Unable Accelerometer Decoding
P1253	Minimum Value	MIL ON
		Unable Dynamic Leak of Injector #1
		Unable Dynamic Leak of Injector #2
		Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #5
		Unable Dynamic Leak of Injector #3
		Unable Cylinder Balancing
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

1. Rail Pressure Control



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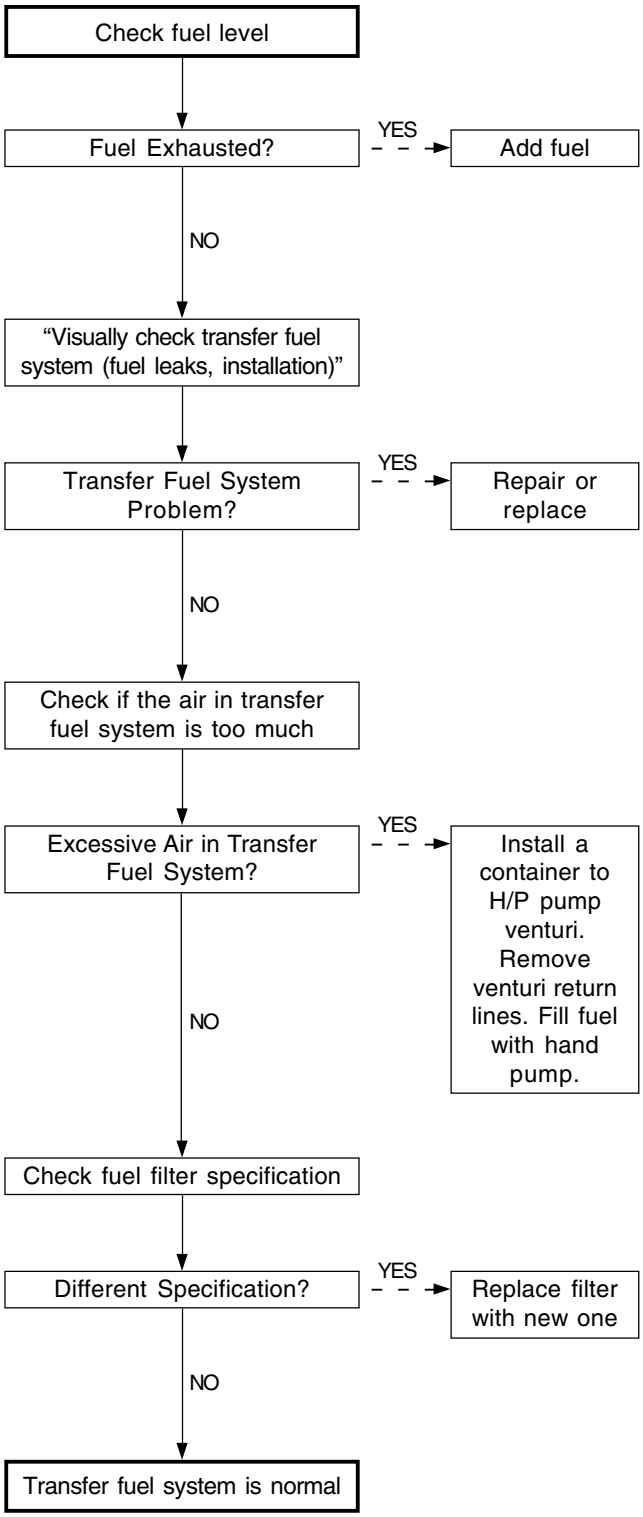
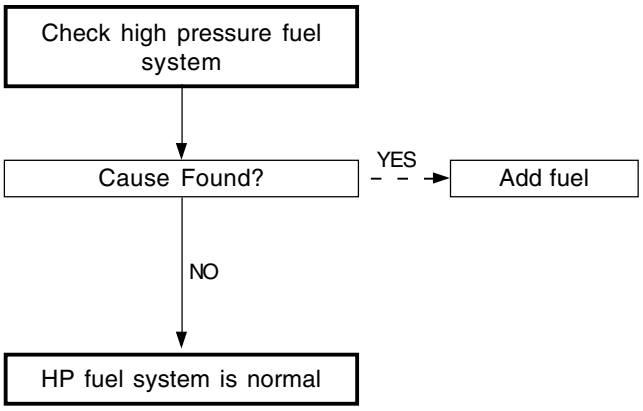
2. Transfer Fuel System



3. High Pressyre Fuel System



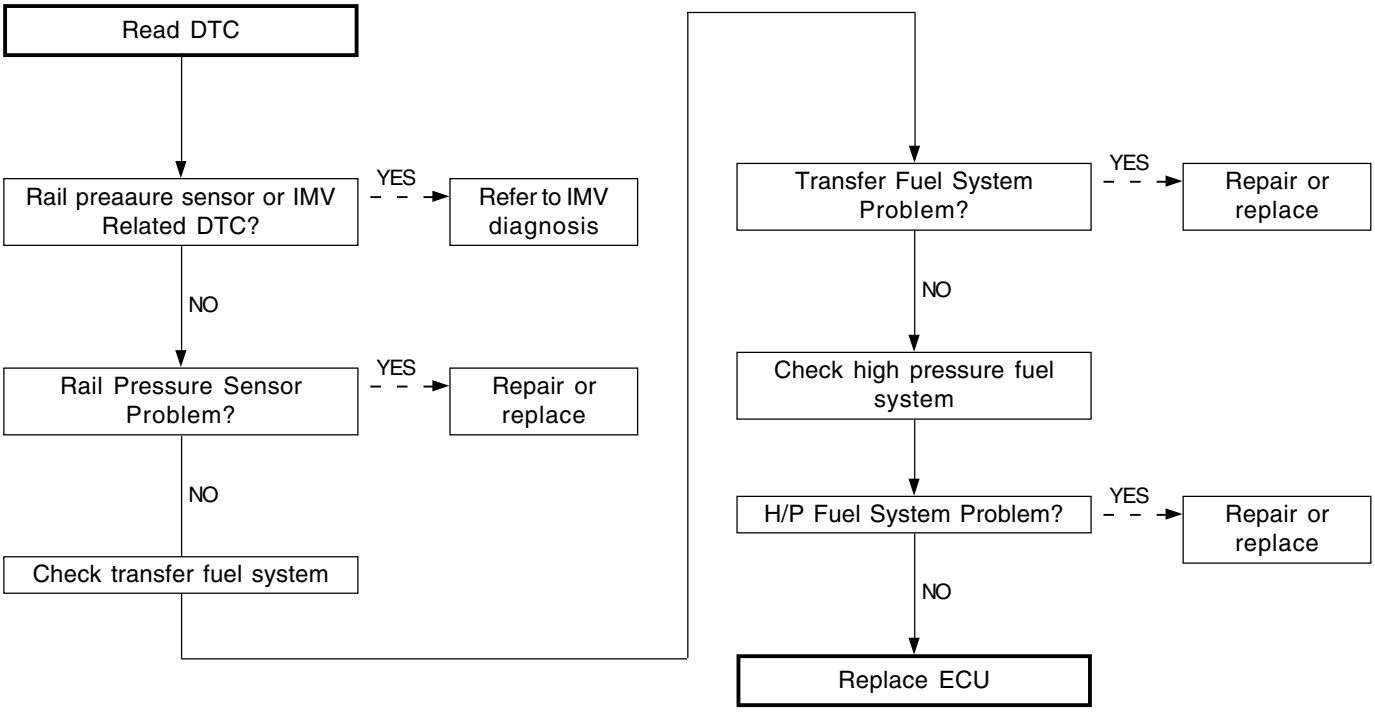
Rail Pressure Control Fault (Too High IMV Current Trim, drift)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1256	Small Delivery of Transfer Fuel	Unable Accelerometer Decoding
P1257	Large Delivery of Transfer Fuel	MIL ON
P1258	Small Delivery of High Pressure Fuel	Unable Dynamic Leak of Injector #1
P1259	Large Delivery of High Pressure Fuel	Unable Dynamic Leak of Injector #2
		Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #5
		Unable Dynamic Leak of Injector #3
		Unable Cylinder Balancing
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

1. Diagnosis Procedures (Rail Pressure Control)



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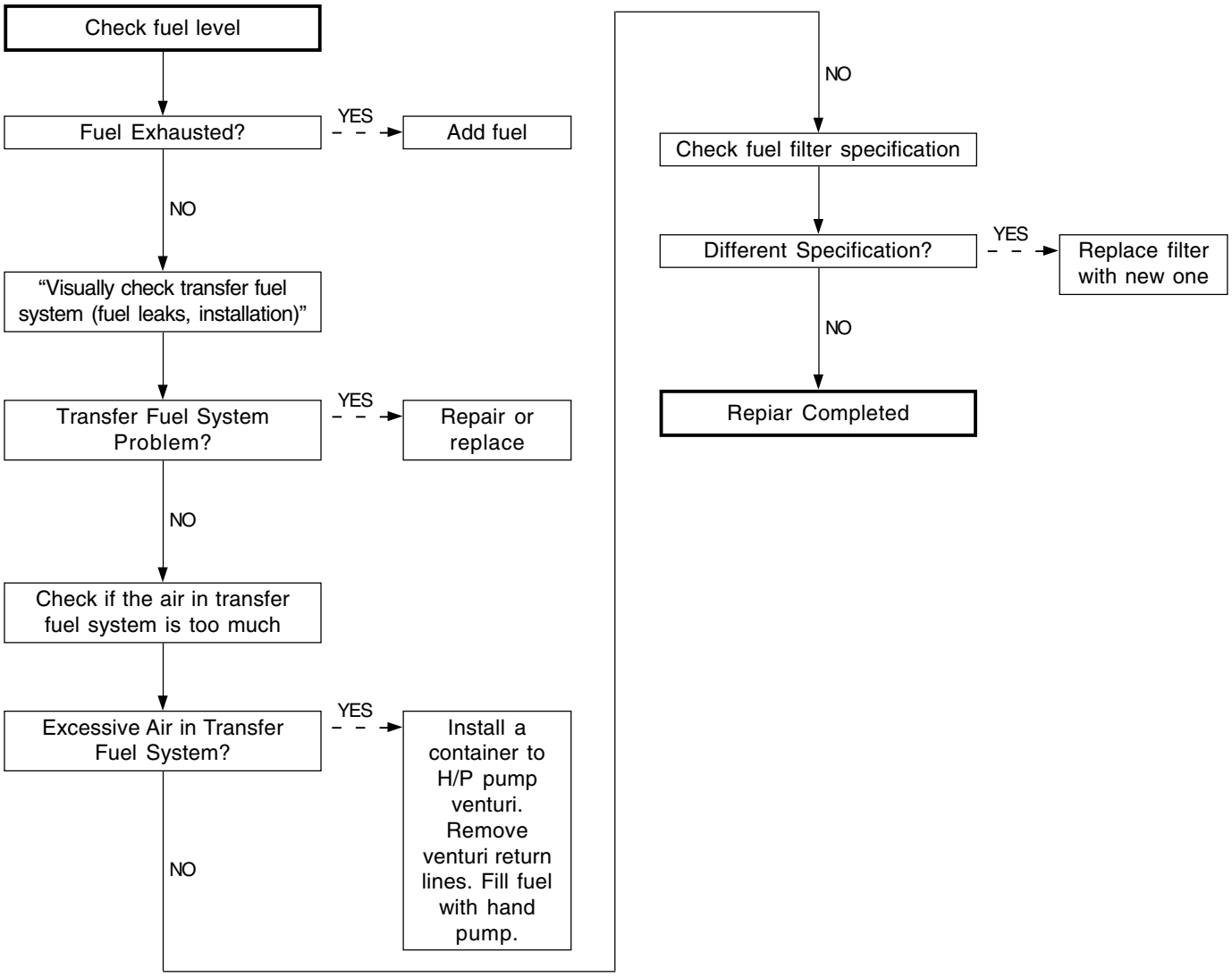
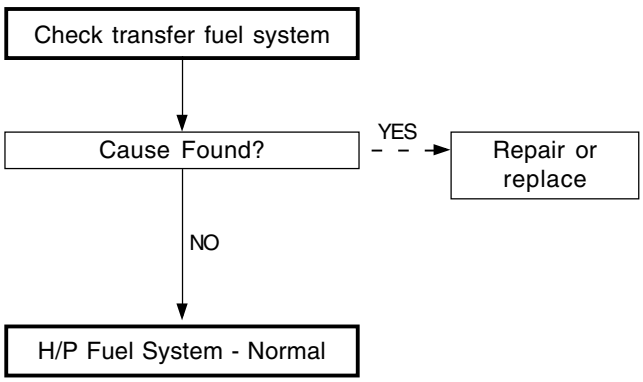
2. Diagnosis Procedures (Transfer Fuel System)



3. Diagnosis Procedures (High Pressure Fuel System)



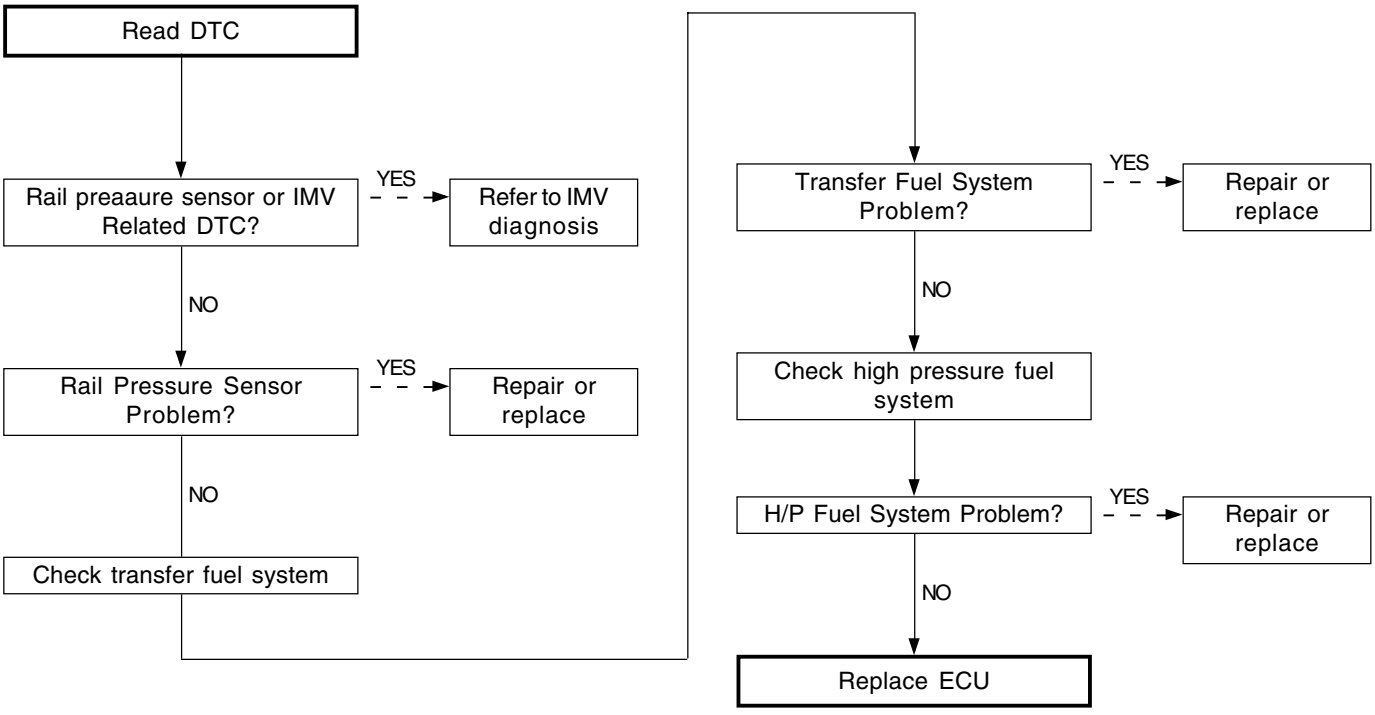
Rail Pressure Control Fault (Too Slow Pressure Build Up while Cranking)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1191	Rail Pressure Build Up - Too Slow	Unable Accelerometer Decoding
		Unable Dynamic Leak of Injector #1
		Unable Dynamic Leak of Injector #2
		Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #5
		Unable Dynamic Leak of Injector #3
		Unable Cylinder Balancing
		Unable Accelerometer Learning Strategy
		Limited Rail Pressure Mode Operation

▶ Diagnosis Procedures

1. Diagnosis Procedures (Rail Pressure Control)



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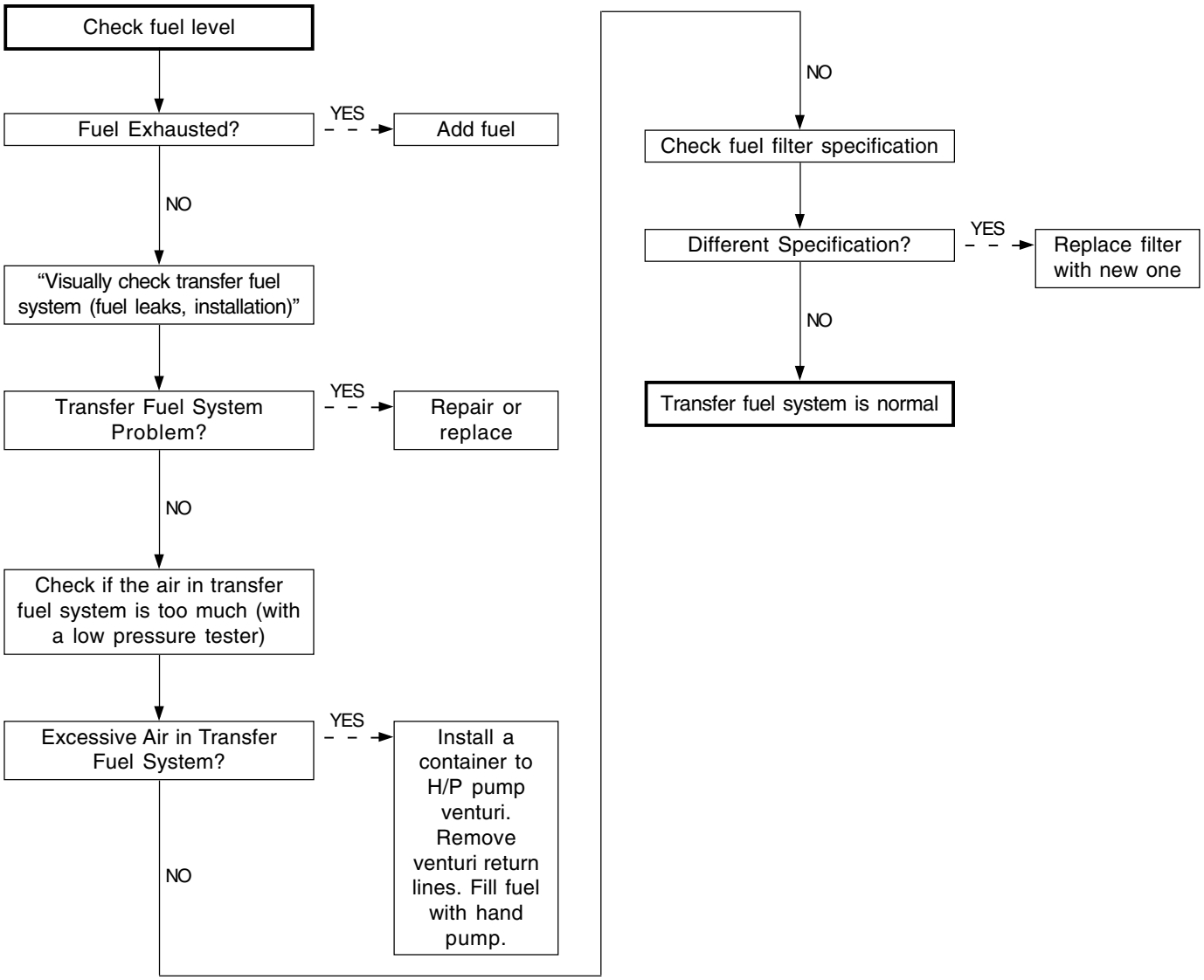
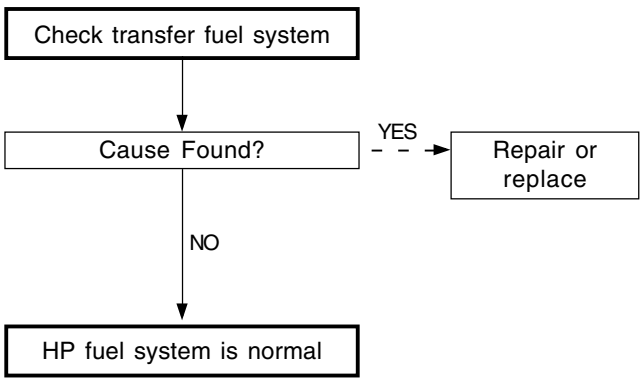
2. Diagnosis Procedures (Transfer Fuel System)



3. Diagnosis Procedures (High Pressyre Fuel System)

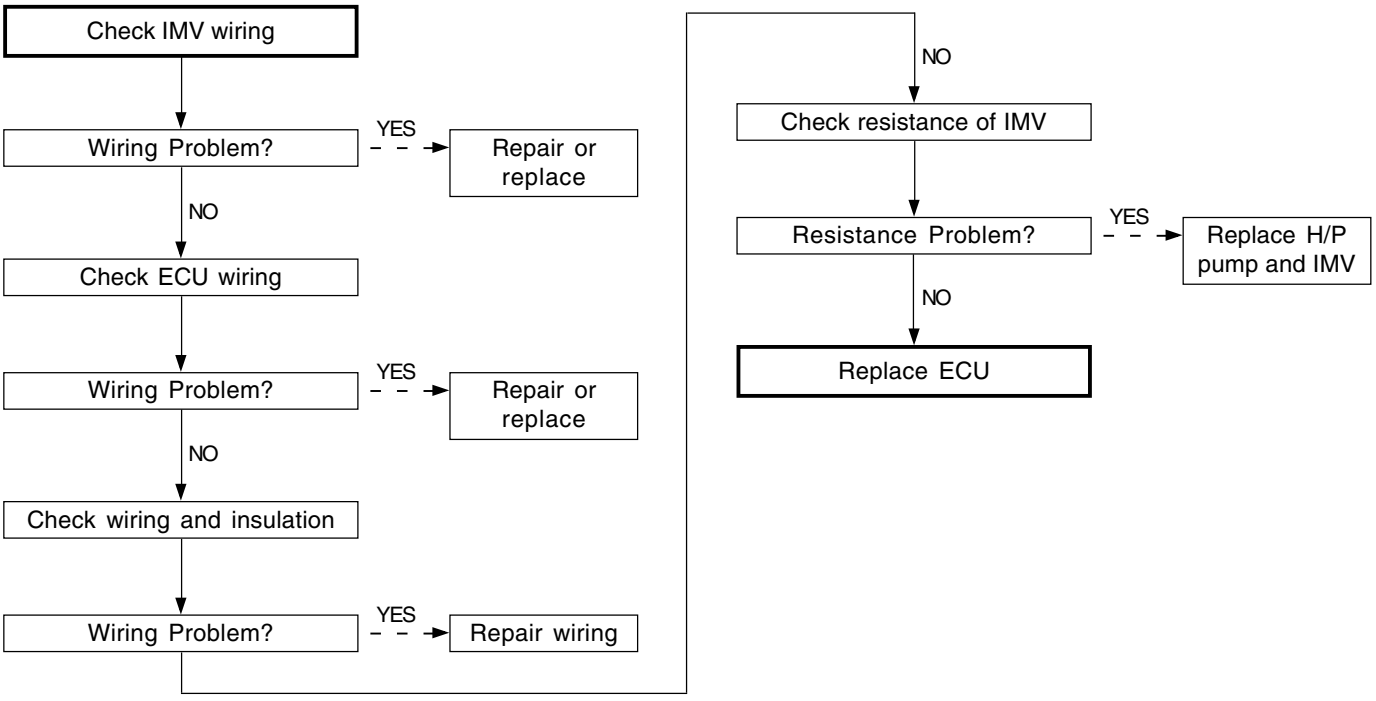


IMV Operation Fault (Electrical Fault)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0255	Open Circuit	Unable Accelerometer Decoding
P0251	Short Circuit	Delayed Engine Stop
P0253	Short to Ground	Unable Dynamic Leak of Injector #1
		Unable Dynamic Leak of Injector #2
		Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #5
		Unable Dynamic Leak of Injector #3
		Unable Cylinder Balancing
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy
		Limited Rail Pressure Mode Operation

▶ Diagnosis Procedures



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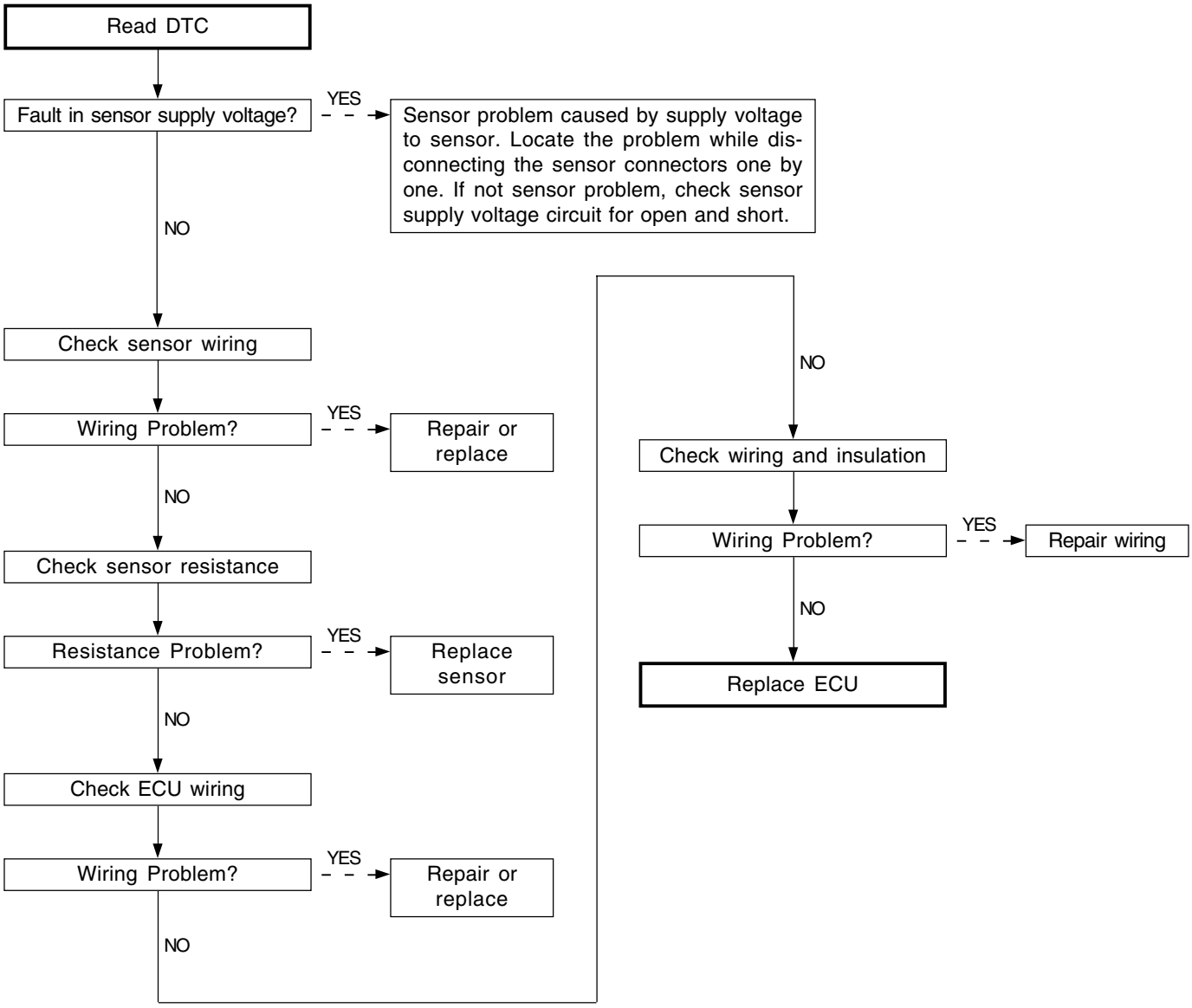
Intake Air Temperature Sensor Fault (Electric Fault)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0112	High	MIL ON
P0113	Low	
P0110	Supply Voltage	

▶ Diagnosis Procedures



MDP Fault (Injector #1)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1171	#1 Injector MDP Fault	Unable Accelerometer Decoding
		MIL ON
		Unable Pilot and Post Injection
		Unable Dynamic Leak of Injector #1
		Torque Limit For Injector Drift
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

Enter the injector data into ECU after replacing injector

MDP Fault (Injector #2)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1172	#2 Injector MDP Fault	Unable Accelerometer Decoding
		MIL ON
		Unable Pilot and Post Injection
		Unable Dynamic Leak of Injector #2
		Torque Limit For Injector Drift
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

Enter the injector data into ECU after replacing injector

MDP Fault (Injector #4)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1174	#4 Injector MDP Fault	Unable Accelerometer Decoding
		MIL ON
		Unable Pilot and Post Injection
		Unable Dynamic Leak of Injector #4
		Torque Limit For Injector Drift
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

Enter the injector data into ECU after replacing injector

MDP Fault (Injector #5)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1175	#5 Injector MDP Fault	Unable Accelerometer Decoding
		MIL ON
		Unable Pilot and Post Injection
		Unable Dynamic Leak of Injector #5
		Torque Limit For Injector Drift
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

Enter the injector data into ECU after replacing injector

MDP Fault (Injector #3)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1173	#3 Injector MDP Fault	Unable Accelerometer Decoding
		MIL ON
		Unable Pilot and Post Injection
		Unable Dynamic Leak of Injector #3
		Torque Limit For Injector Drift
		Unable Accelerometer Learning Strategy

▶ Diagnosis Procedures

Enter the injector data into ECU after replacing injector

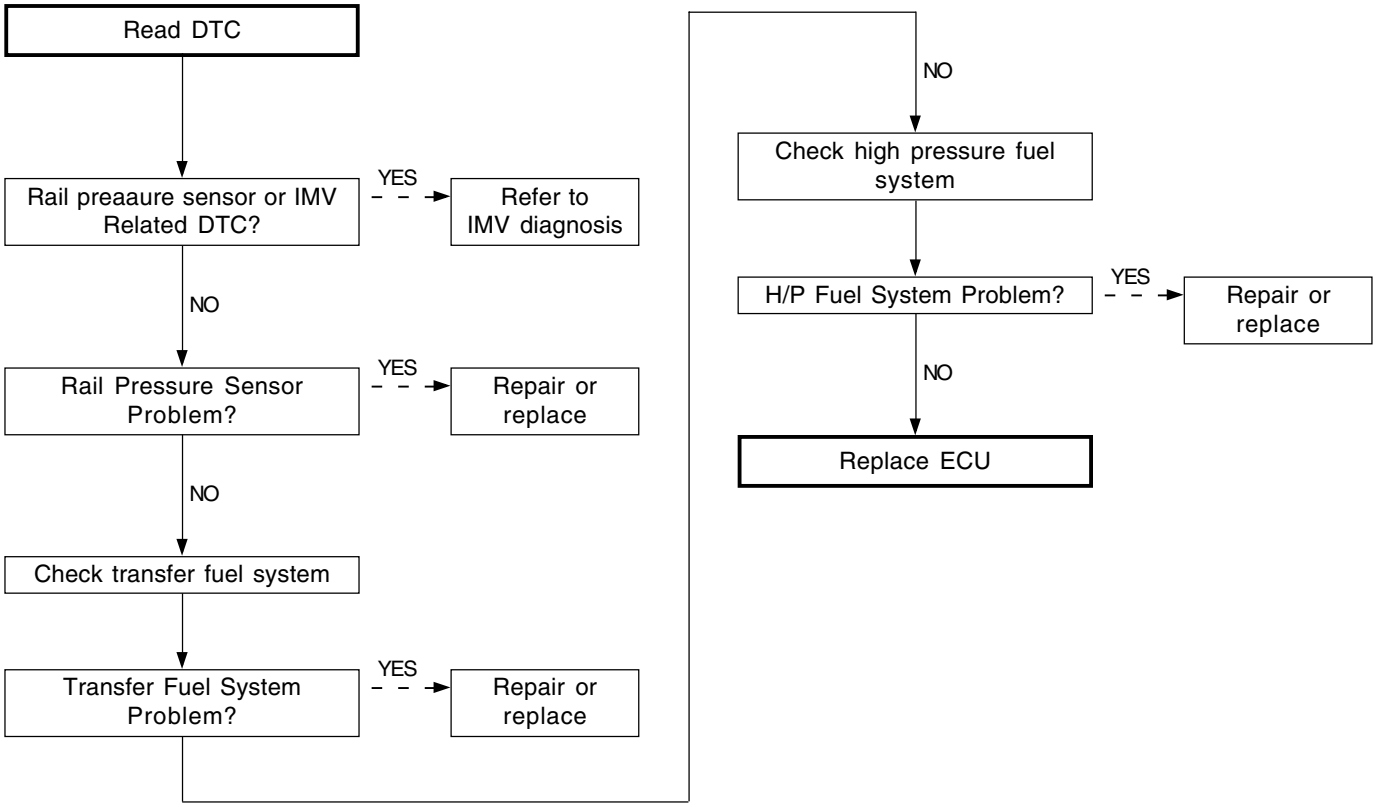
Rail Pressure Fault (Too High)

▶ Trouble Code and Symptom

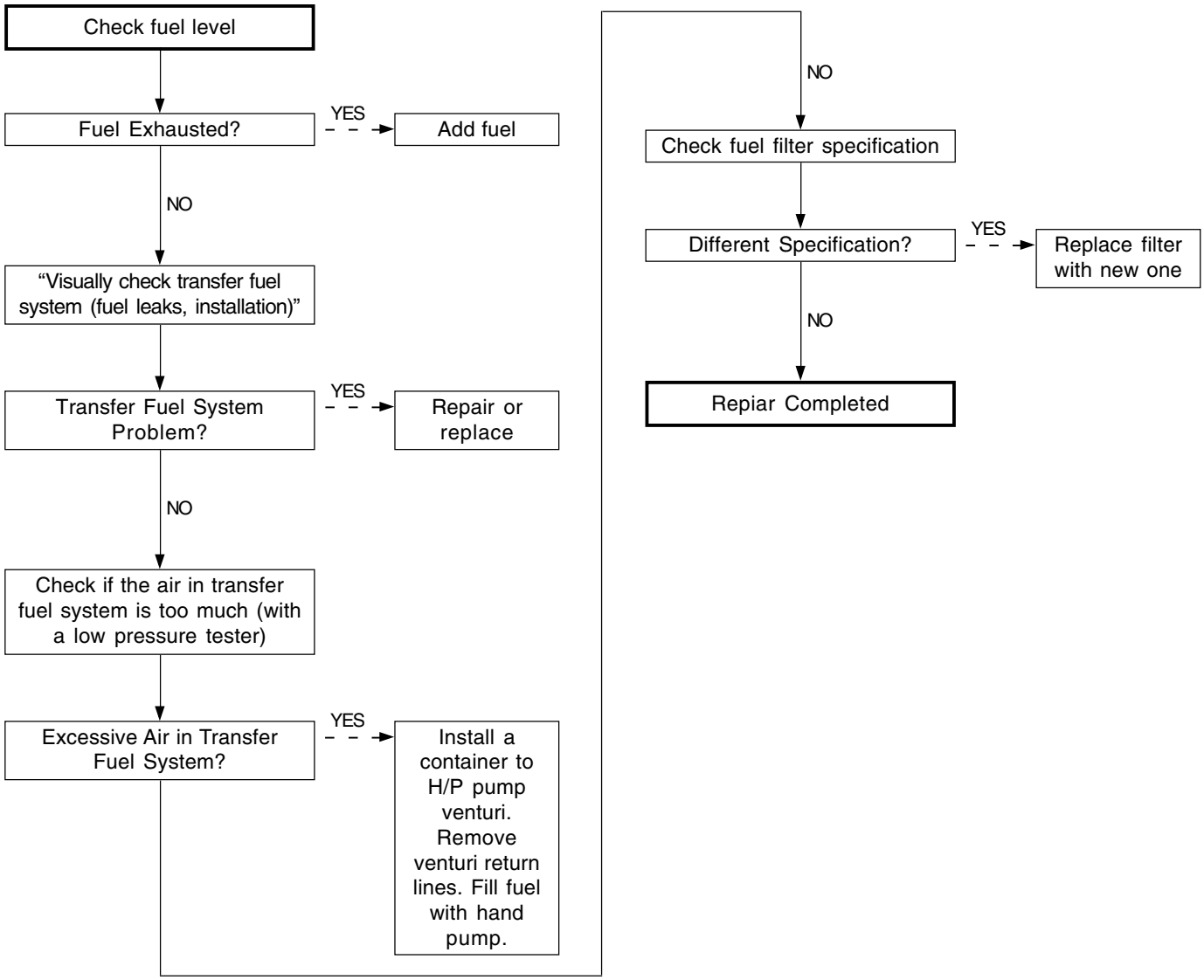
Trouble Code		Symptom
P1252	Too High IMV Pressure	

▶ Diagnosis Procedures

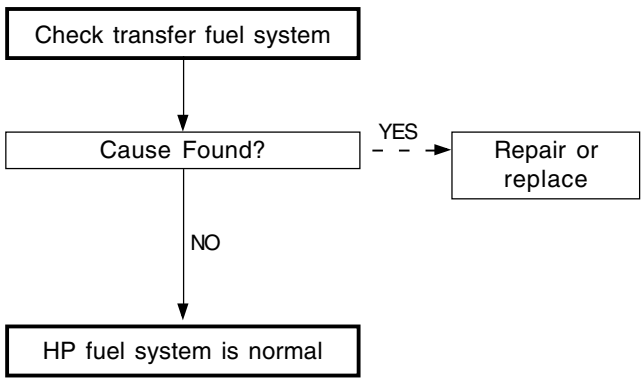
1. Diagnosis Procedures (Rail Pressure Control)



2. Diagnosis Procedures (Transfer Fuel System)



3. Diagnosis Procedures (High Pressyre Fuel System)



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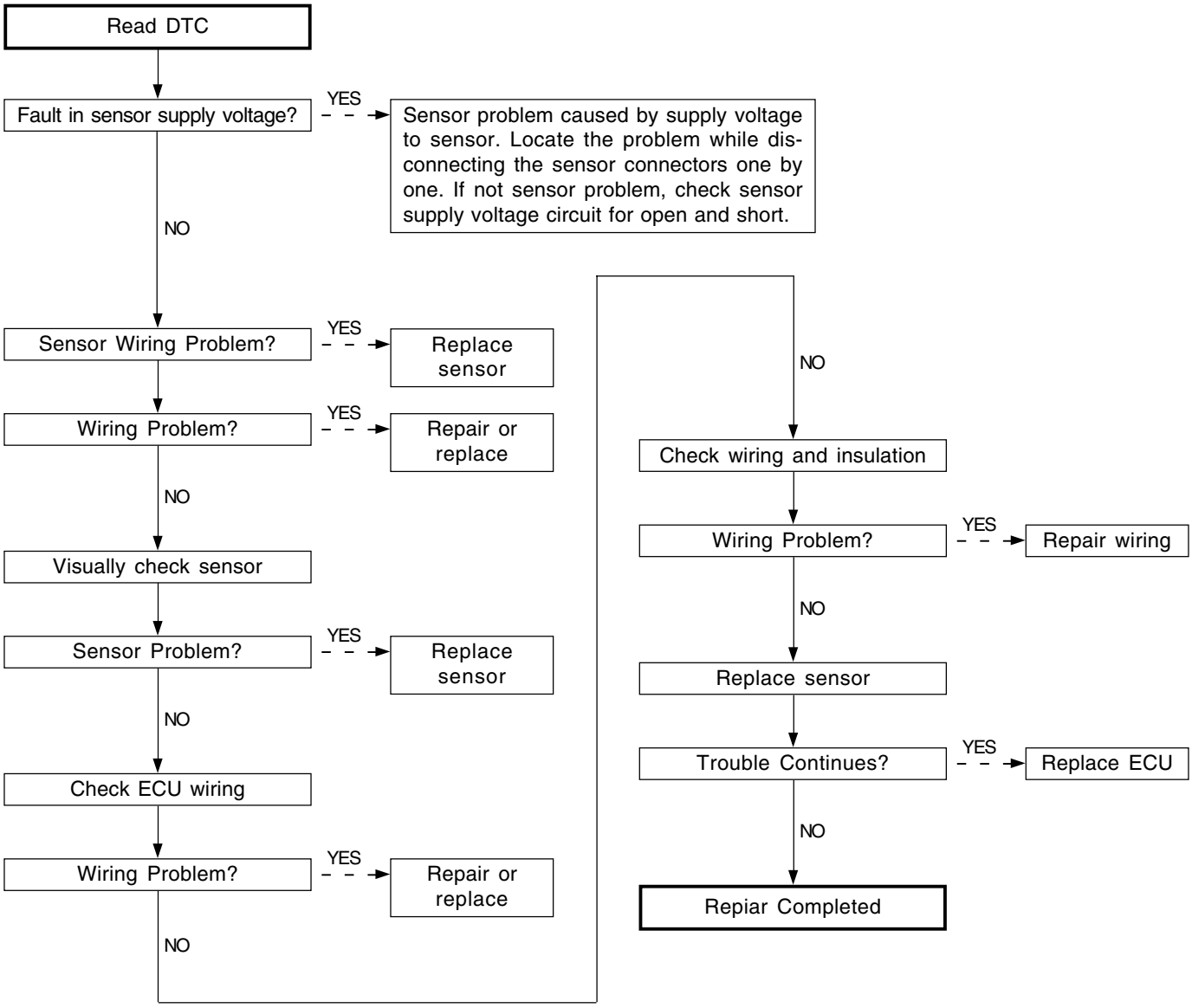
Accelerator Pedal Sensor Malfunction (Relationship between Track 1 and Track 2)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1120	Accelerator Pedal Sensor 1 Malfunction	Unable Cruise Control
P1121	Accelerator Pedal Sensor 2 Malfunction	
		Torque Reduction Mode Operation

▶ Diagnosis Procedures

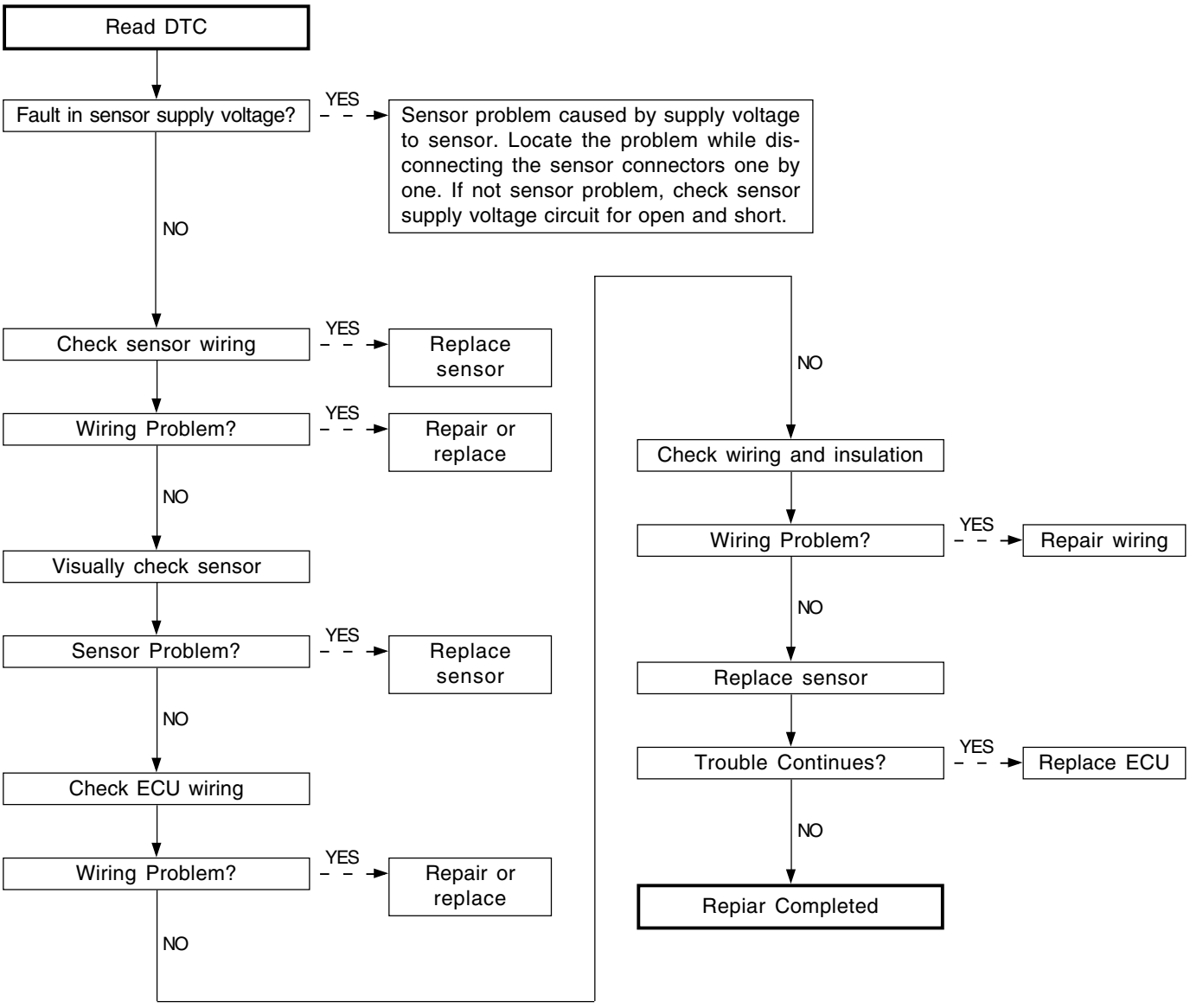


Accelerator Pedal Sensor Malfunction (Limp Home Mode Operation)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1122	Accelerator Pedal Sensor Malfunction (Limp Home Mode)	MIL ON
		Limp Home Mode Operation

▶ Diagnosis Procedures



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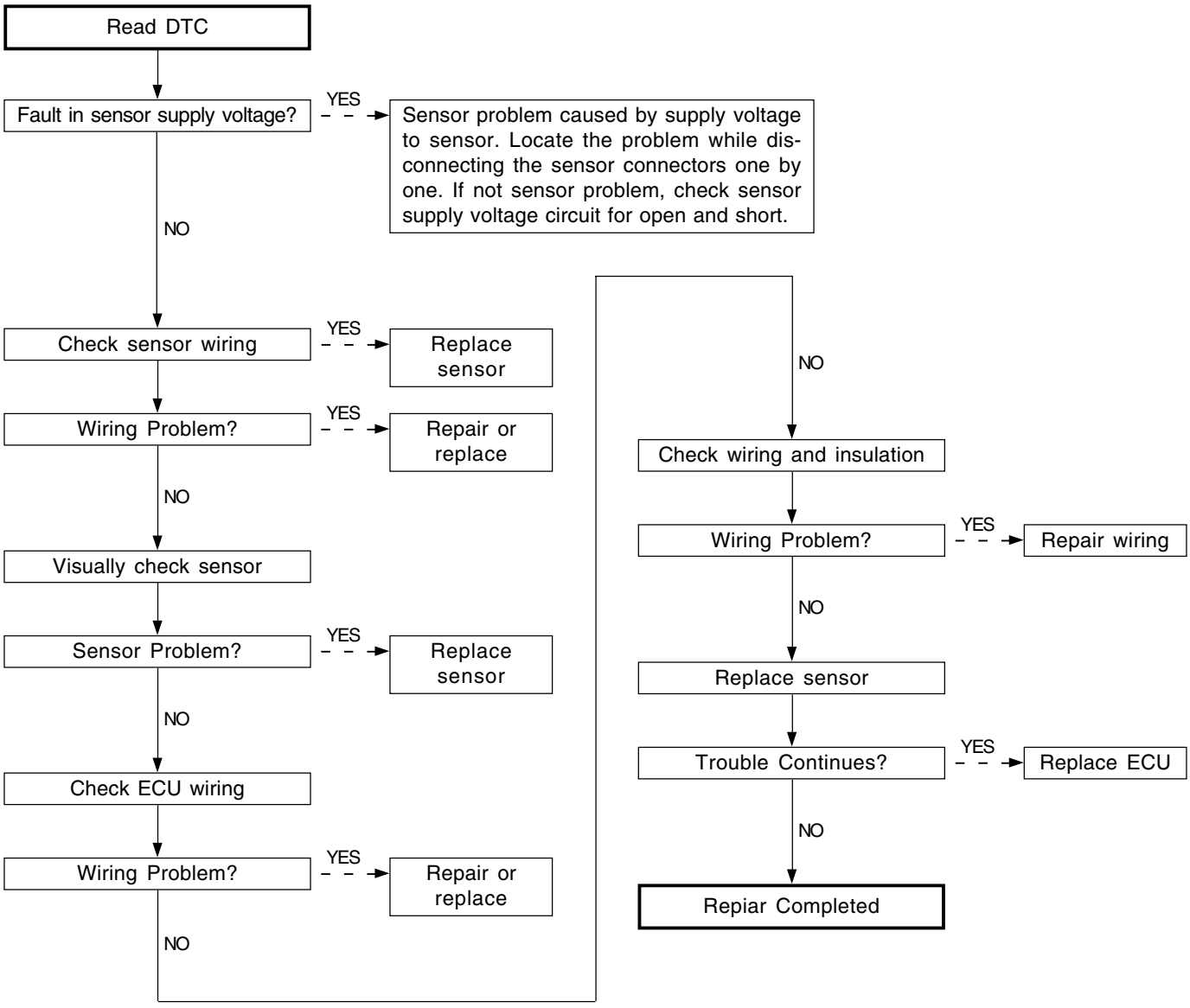
Accelerator Pedal Sensor Malfunction (Torque Reduction Mode Operation)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1123	Accelerator Pedal Sensor Malfunction (Torque Mode)	MIL ON
		Torque Reduction Mode Operation

▶ Diagnosis Procedures

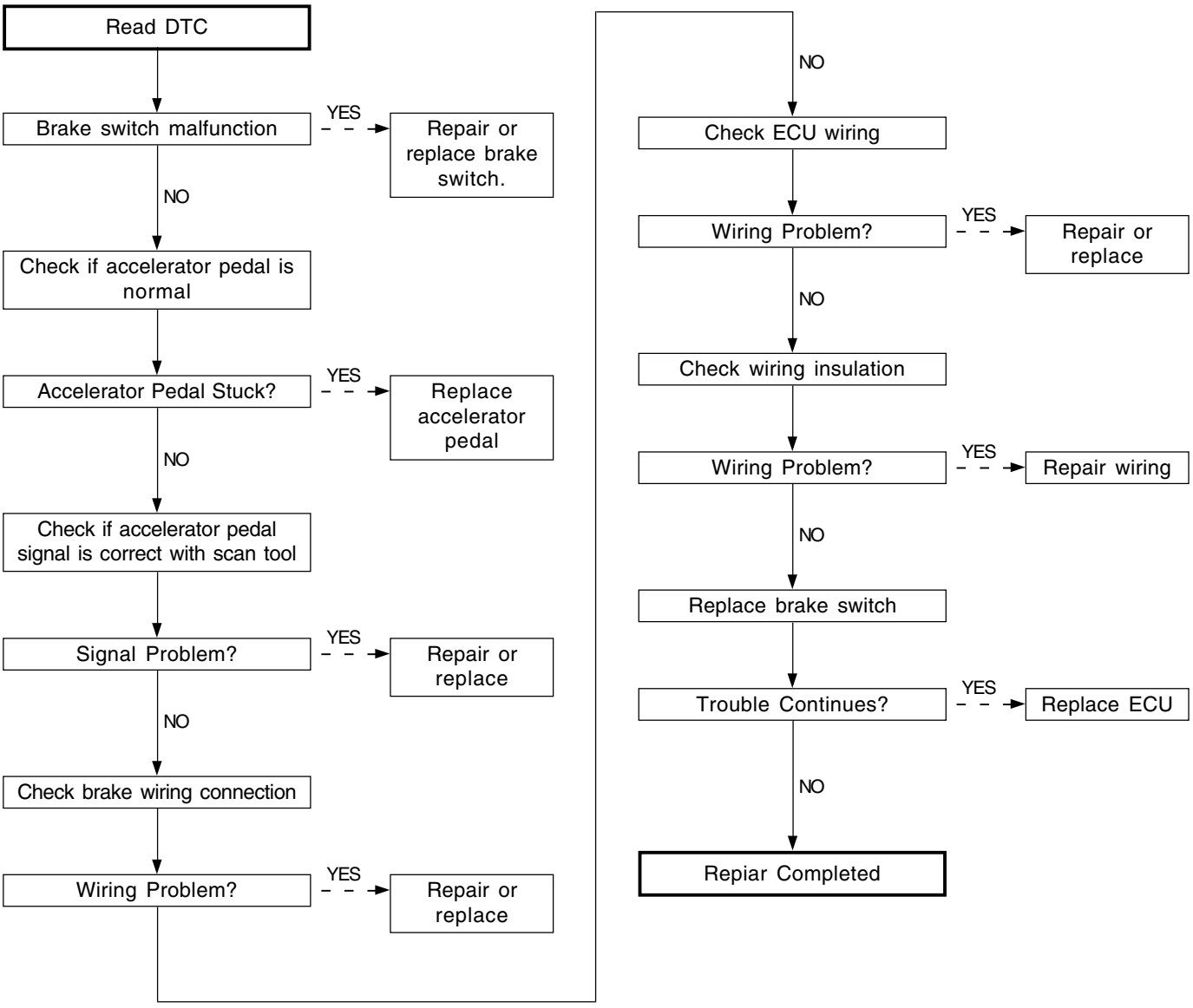


Accelerator Pedal Sensor Malfunction (Electrical Fault, Pedal Stuck)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1124	Accelerator Pedal Sensor Malfunction - Stuck	Unable Cruise Control
		Limp Home Mode Operation

▶ Diagnosis Procedures



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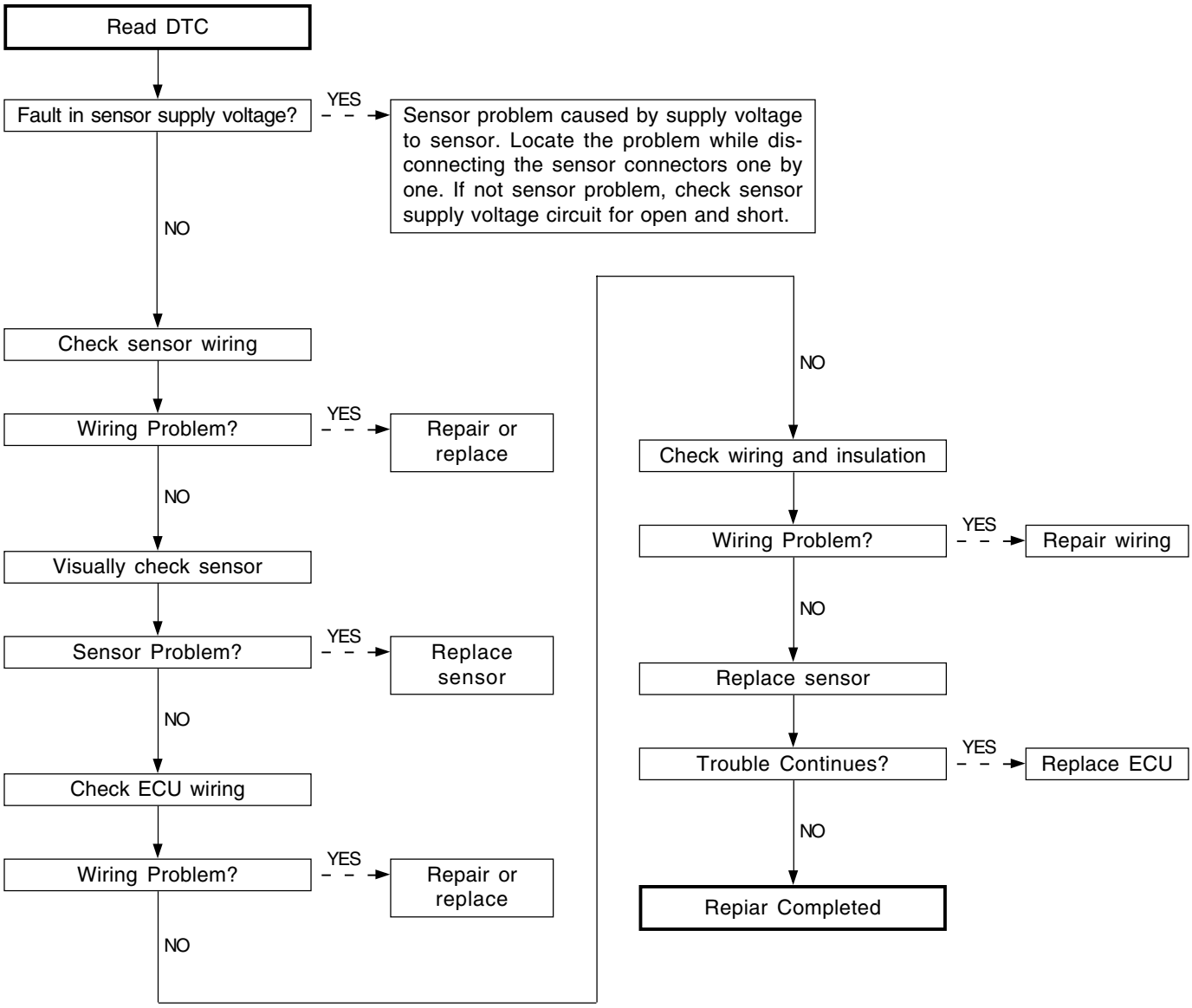
AFFECTED VIN	

Accelerator Pedal Sensor Malfunction (Electrical Fault, Track 1)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0122	Low	MIL ON
P0123	High	Unable Cruise Control
P0120	Supply Voltage	Limp Home Mode Operation

▶ Diagnosis Procedures

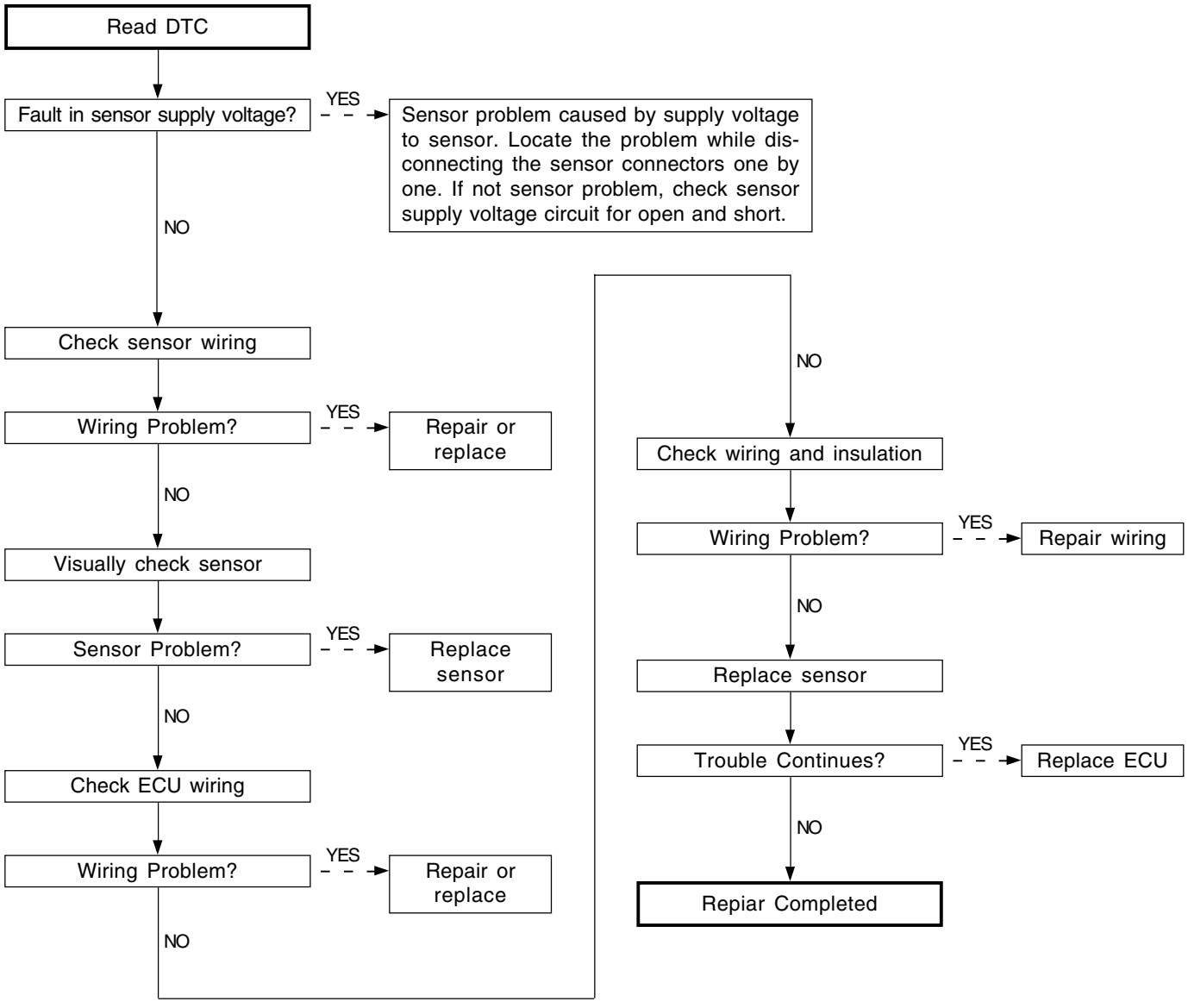


Accelerator Pedal Sensor Malfunction (Electrical Fault, Track 2)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0222	Low	MIL ON
P0223	High	Unable Cruise Control
P0220	Supply Voltage	Torque Reduction Mode Operation

▶ Diagnosis Procedures



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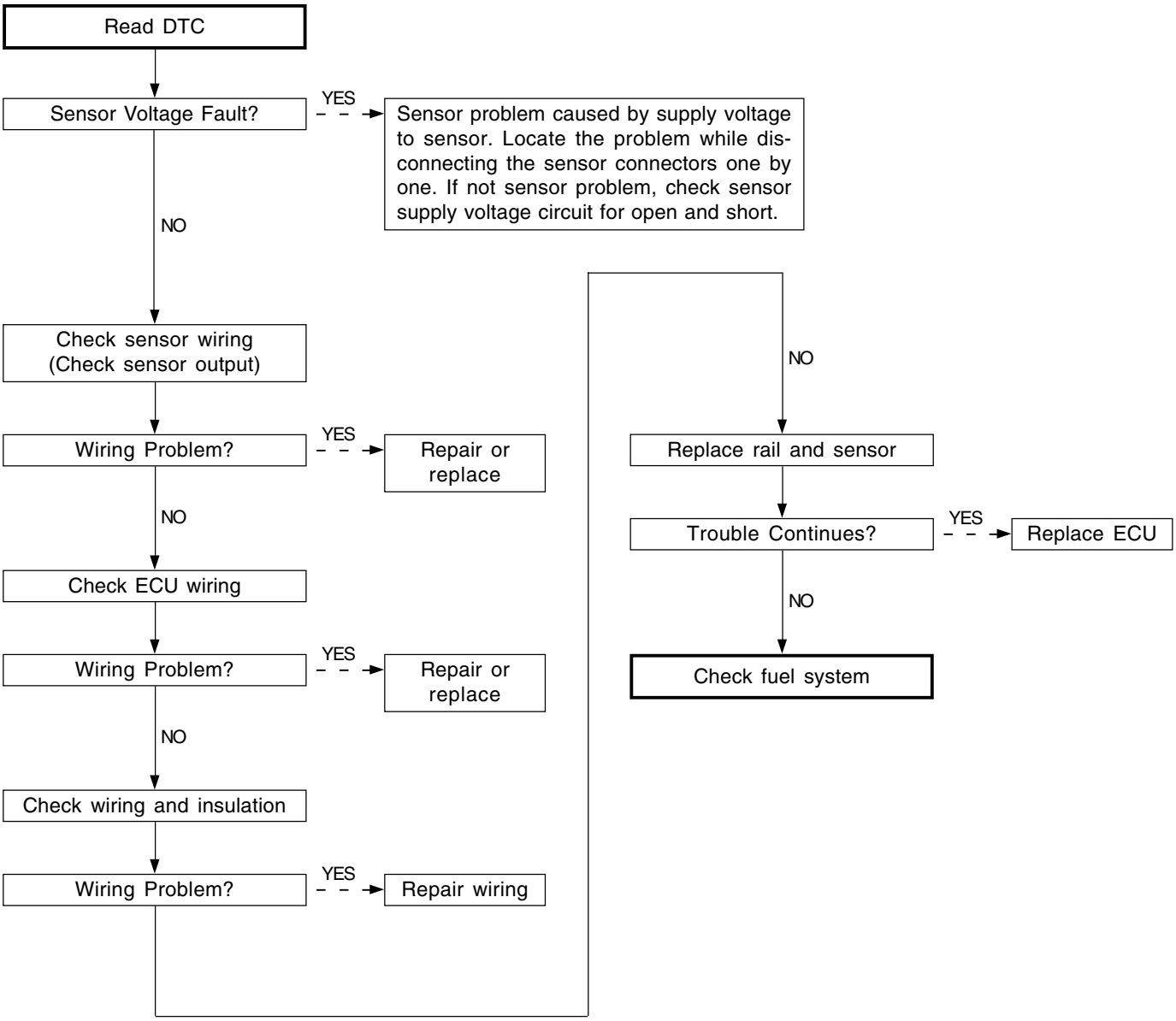
Fuel Rail Pressure Sensor Malfunction (Out of Range, ADC or Vref)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0192	Low	Unable Pilot and Post Injection
P0193	High	Unable Dynamic Leak of Injector #1
P0190	Supply Voltage	Unable Dynamic Leak of Injector #2
P0191	Excessive Pressure Drop	Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #5
		Unable Dynamic Leak of Injector #3
		Unable RPC Trim Fault Detection
		Unable Cylinder Balancing
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy
		Fully Forced Open IMV
		Limited Rail Pressure Mode Operation
		Unable High Rail Pressure Detection
		Torque Reduction Mode Operation

▶ Diagnosis Procedures



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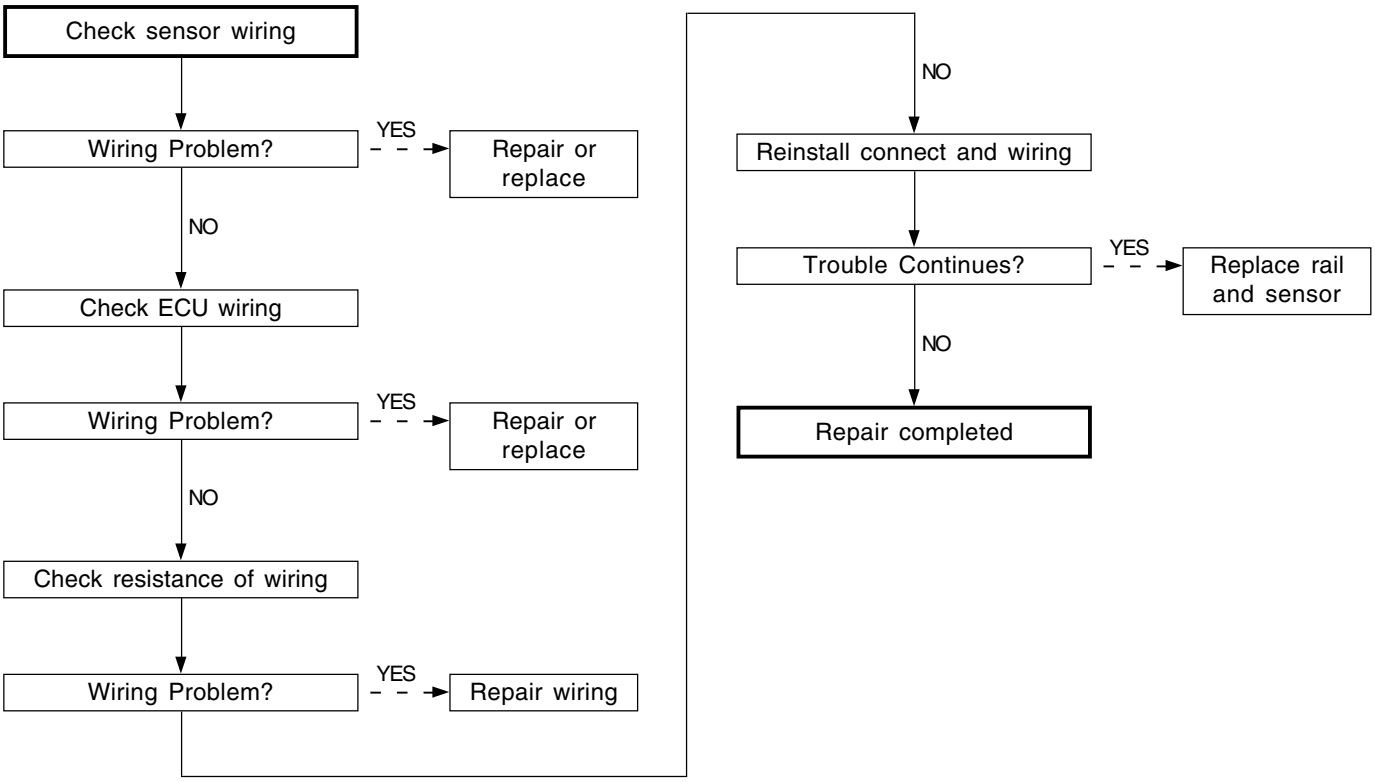
Fuel Rail Pressure Sensor Malfunction (Out of Range when Key ON)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1192	Low	Unable Pilot and Post Injection
P1193	High	Unable Dynamic Leak of Injector #1
P1190	Supply Voltage	Unable Dynamic Leak of Injector #2
		Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #5
		Unable Dynamic Leak of Injector #3
		Unable RPC Trim Fault Detection
		Unable Cylinder Balancing
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy
		Fully Forced Open IMV
		Limited Rail Pressure Mode Operation
		Unable High Rail Pressure Detection
		Torque Reduction Mode Operation

▶ Diagnosis Procedures



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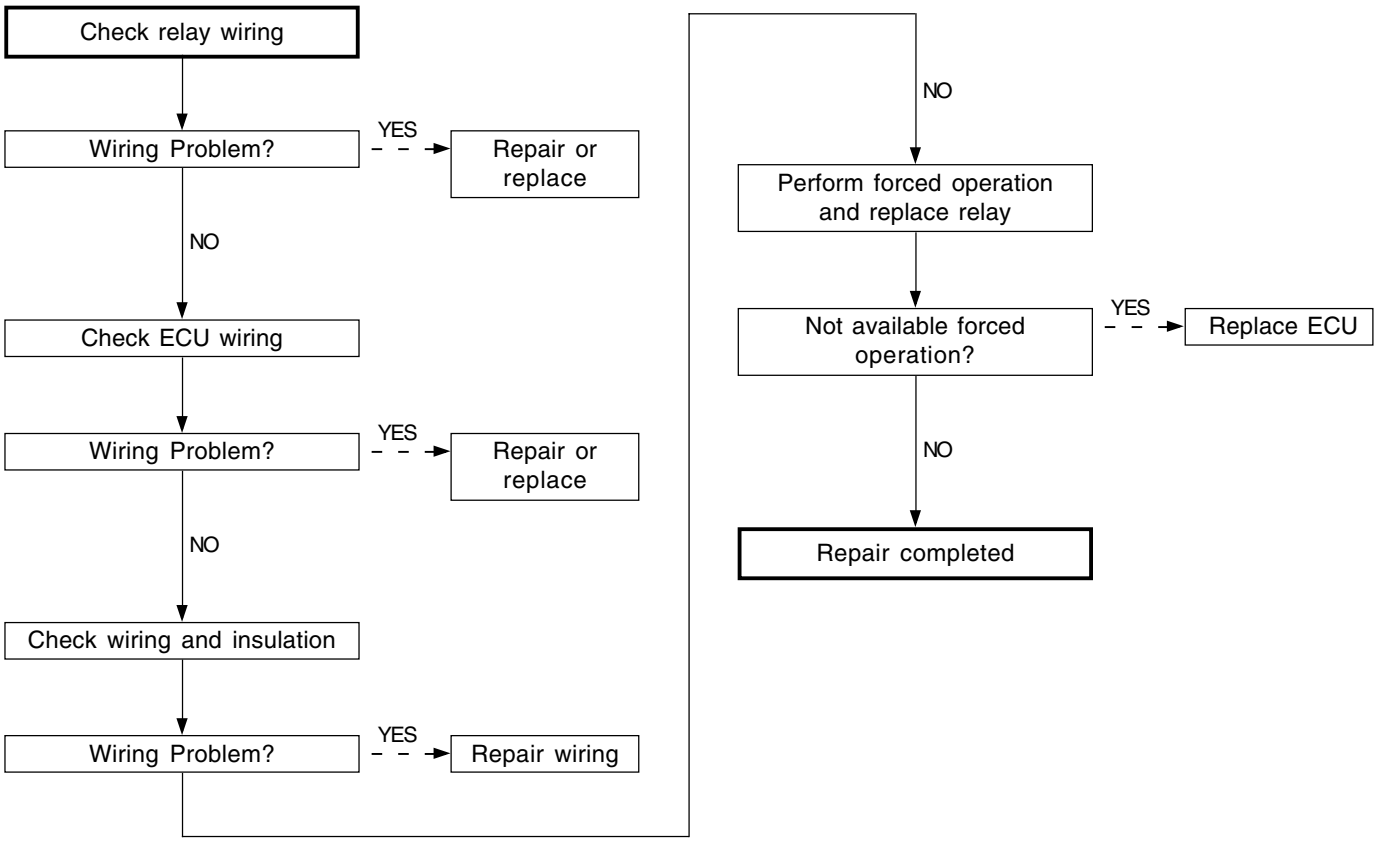
Main Relay Malfunction - Stuck

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0215	Main Relay Malfunction- Stuck	MIL ON

▶ Diagnosis Procedures

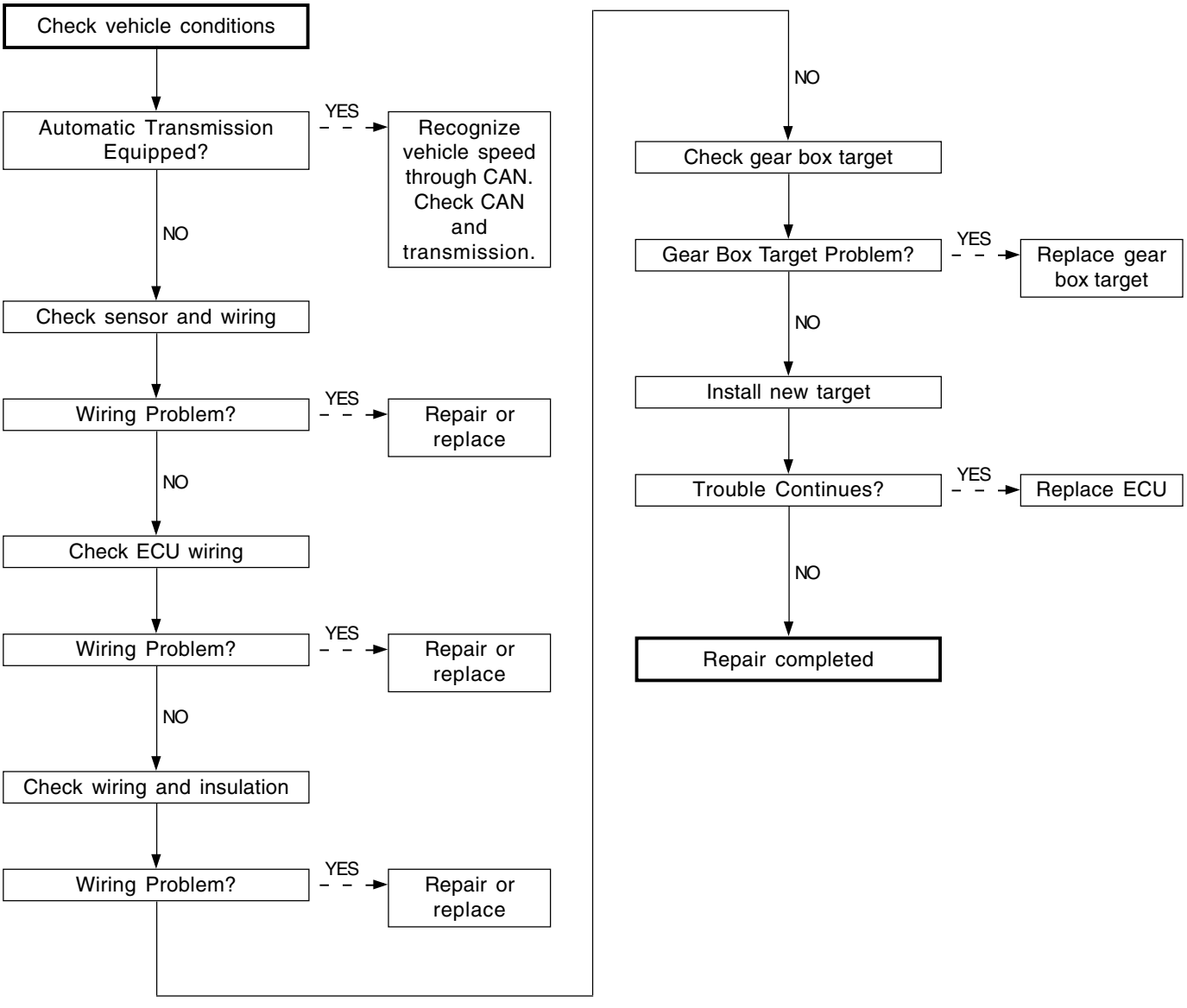


Vehicle Speed Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1500	Vehicle Speed Fault	Unable Cruise Control

▶ Diagnosis Procedures



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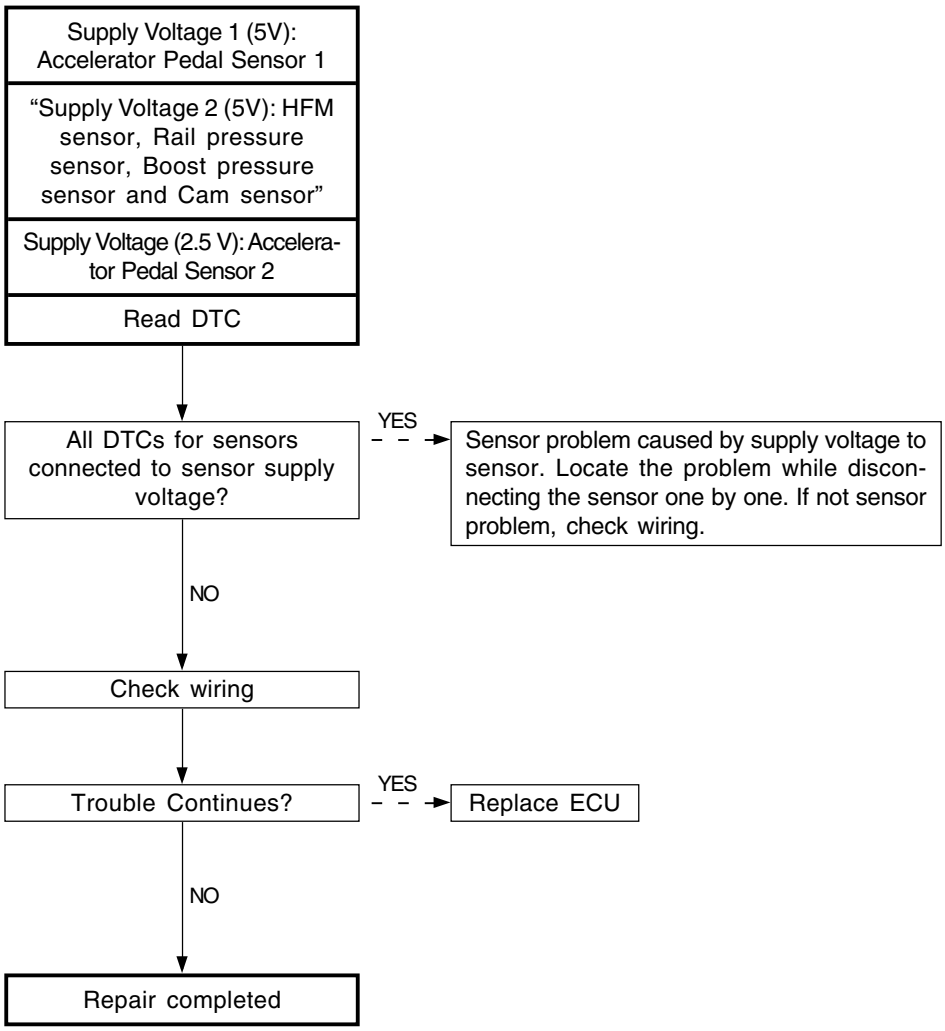
5V Supply Voltage 1 Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0642	Low	Unable Cruise Control
P0643	High	
P0641	Supply Voltage	

▶ Diagnosis Procedures

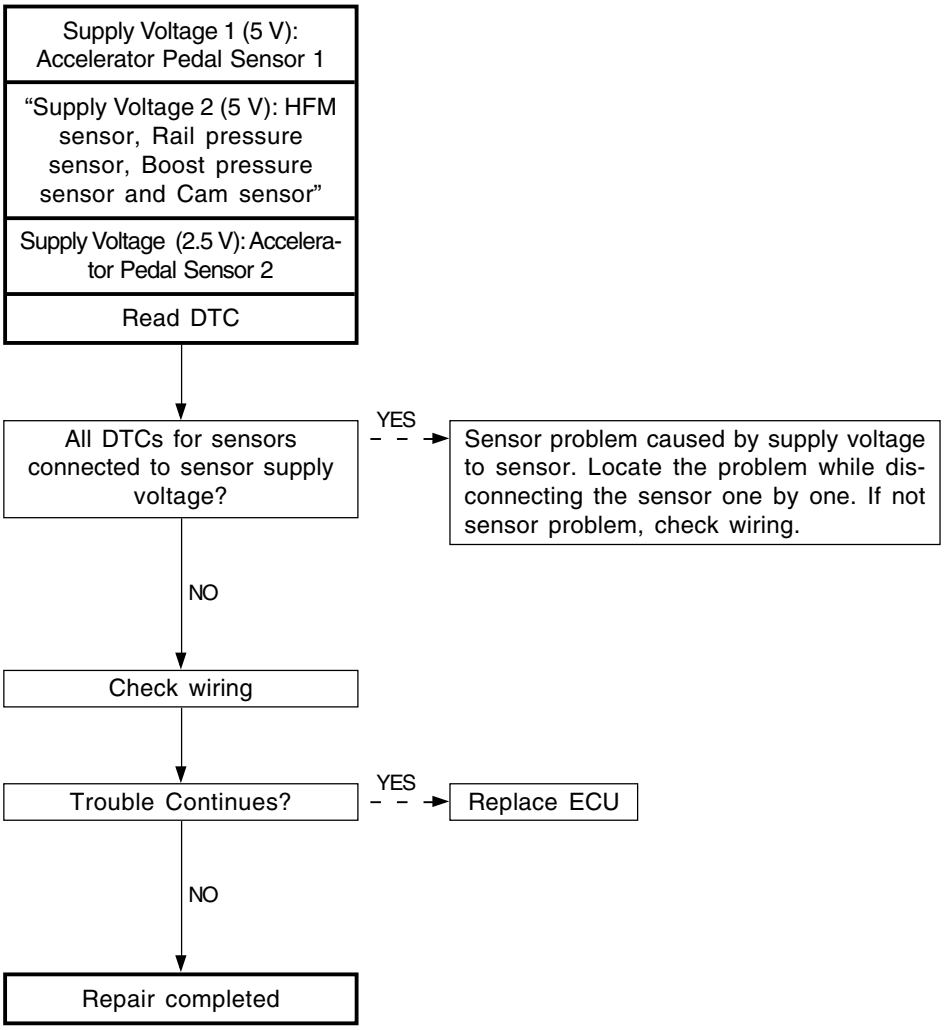


5V Supply Voltage 2 Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0652	Low	
P0653	High	
P0651	Supply Voltage	

▶ Diagnosis Procedures

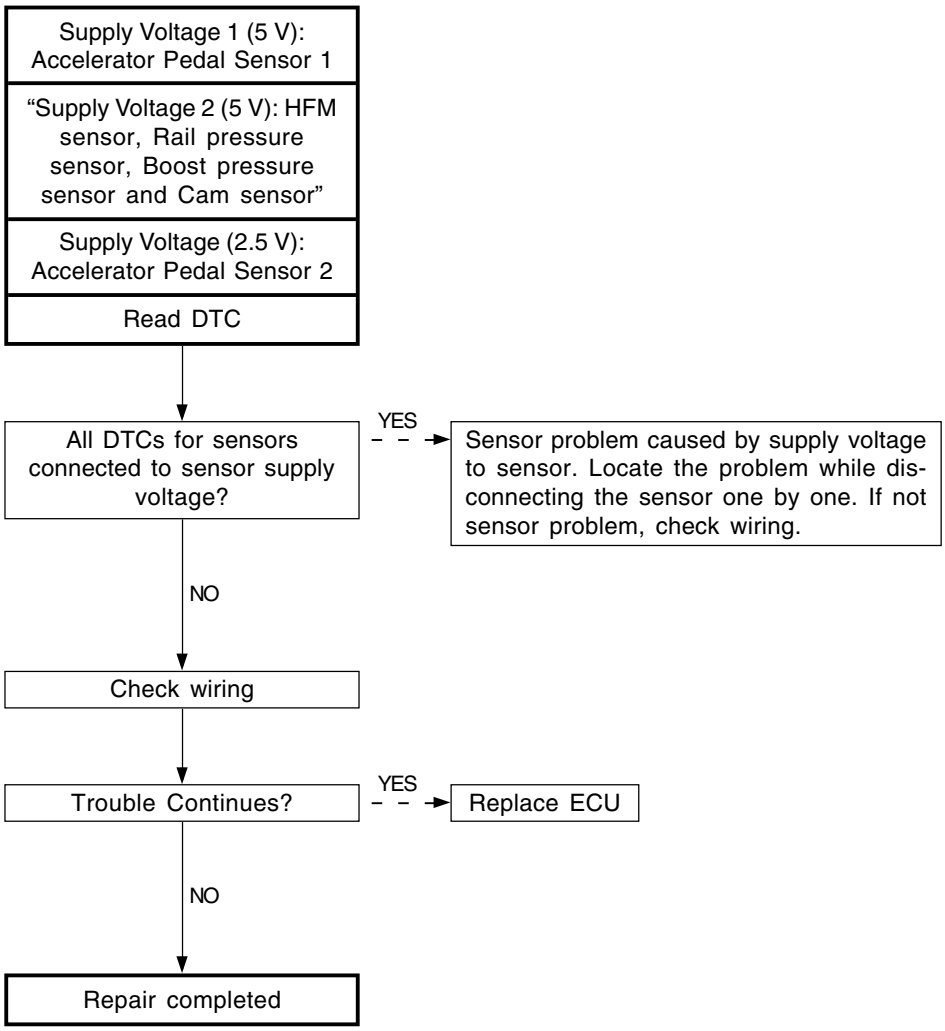


2.5V Supply Voltage Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0698	Low	Unable Cruise Control
P0699	High	
P0697	Supply Voltage	

▶ Diagnosis Procedures

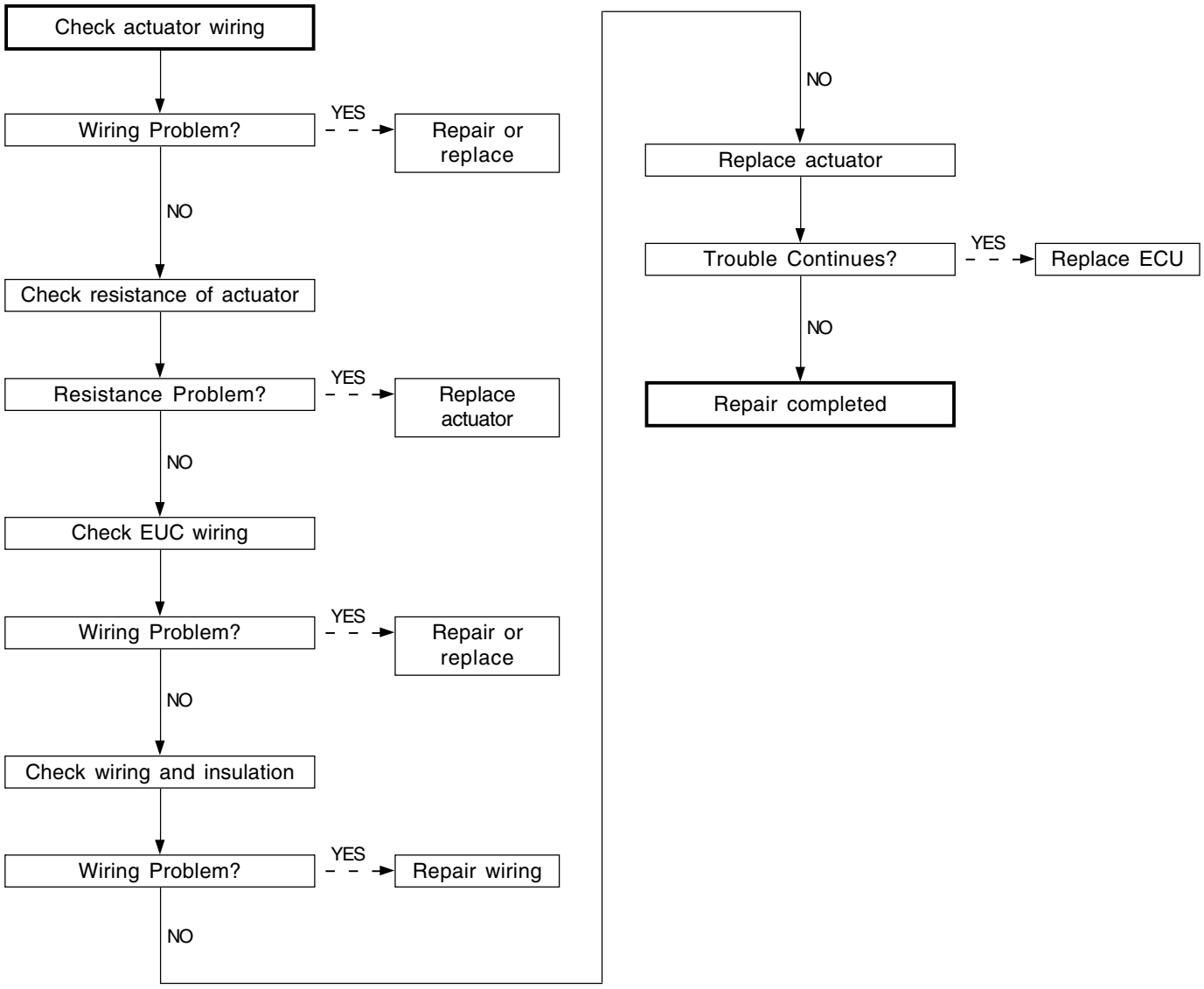


Turbo Charger Actuator Operation Fault (signal)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0245	Short to GND	Unable Cruise Control
P0246	Short Circuit to B+	Unable VGT Operation

▶ Diagnosis Procedures



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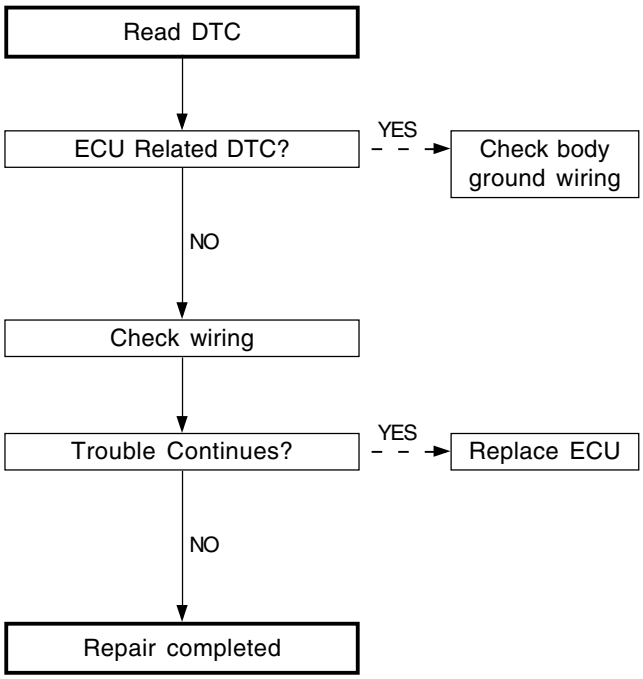
AFFECTED VIN	

ECU Watchdog Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0606	ECU Watchdog Fault	

▶ Diagnosis Procedures

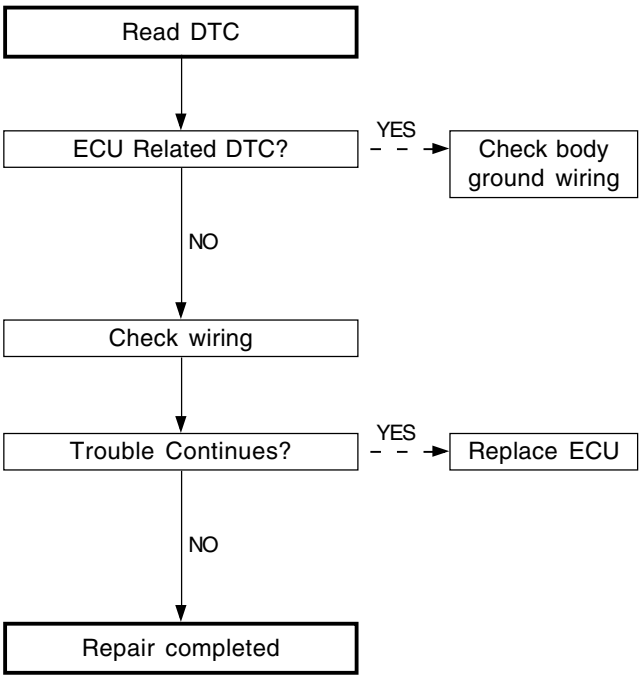


ECU Watchdog Fault (Injector Cut-off)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1607	ECU Injector Cut-off	

▶ Diagnosis Procedures



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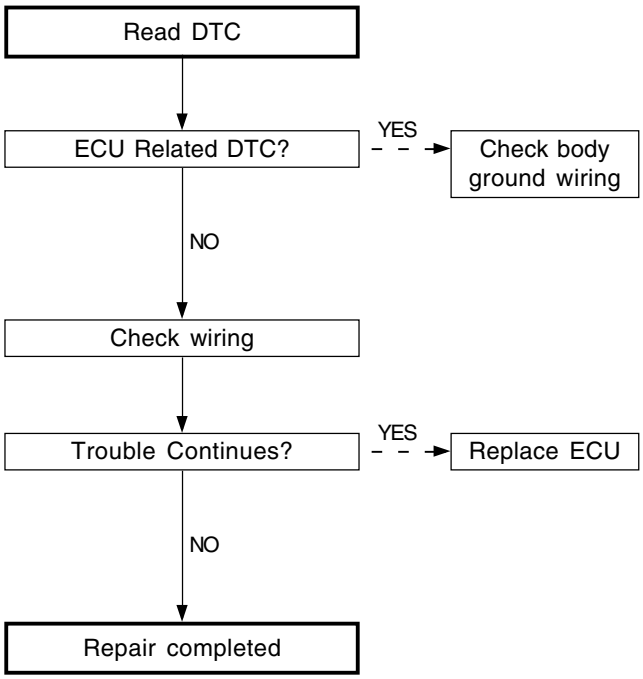
ECU Watchdog Fault (Watchdog Trip)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1600	Trip TPU Write Fault	
P1601	Trip Shut Dowm Write Fault	
P1602	Trip Noise Write Fault	

▶ Diagnosis Procedures

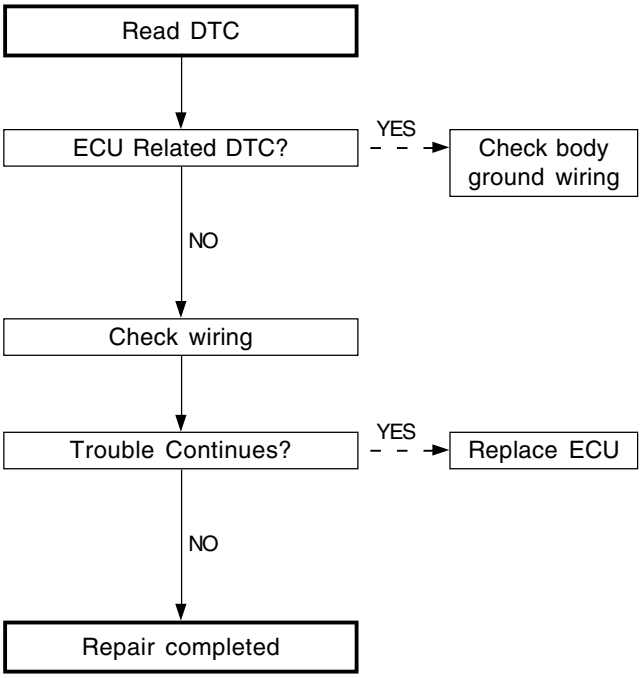


ECU Non-Volatile Memory Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1614	MDP	MIL ON/Limp Home Mode Operation
P1615	Tele-Coding	MIL ON/Limp Home Mode Operation
P1616	Watchdog	MIL ON/Limp Home Mode Operation
P1606	CAN	MIL ON/Limp Home Mode Operation
P1620	ECU Malfunction	MIL ON/Limp Home Mode Operation
P1621	ECU Malfunction	MIL ON/Limp Home Mode Operation
P1622	ECU Malfunction	MIL ON

▶ Diagnosis Procedures



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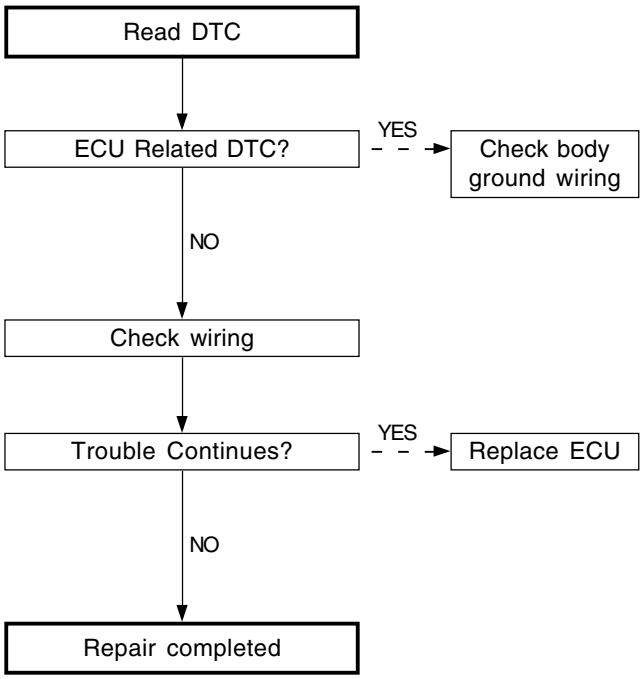
ECU Memory Integration Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1603	Code Integrity	Immediately Engine Stop
P1604	Code Integrity	Immediately Engine Stop
P1605	Code Integrity	Immediately Engine Stop

▶ Diagnosis Procedures

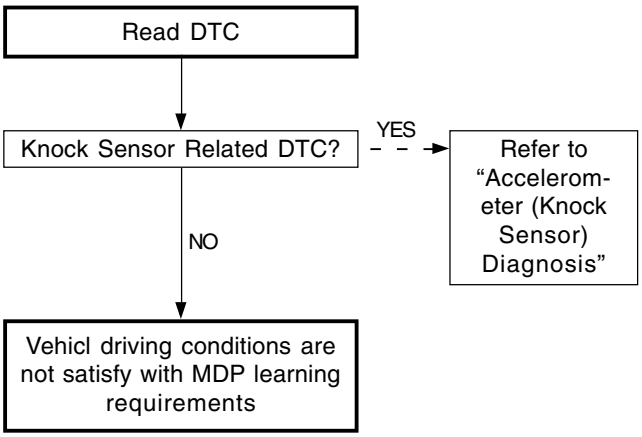


Accelerometer Learning Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1148	Accelerometer (Knock Sensor) Learning Fault	Torque Reduction Operation Unable Cruise Control

▶ Diagnosis Procedures



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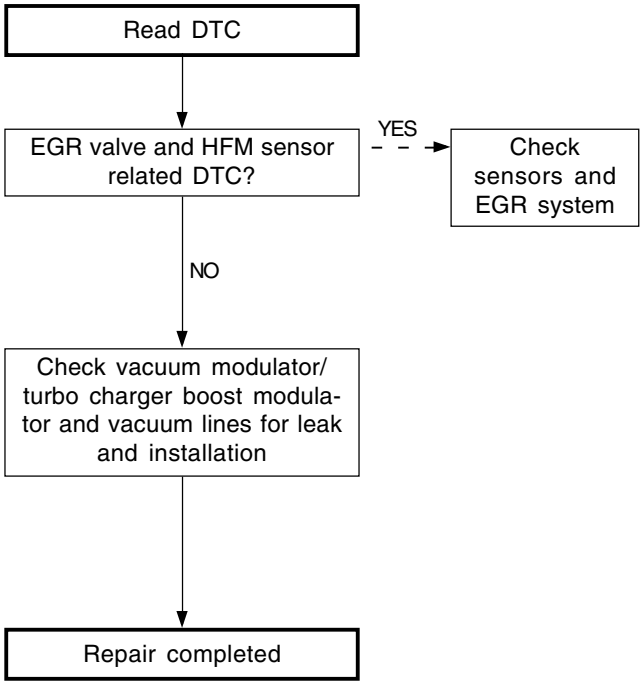
AFFECTED VIN	

EGR Valve Control Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0400	EGR Valve Control Fault	Unable Cruise Control

▶ Diagnosis Procedures



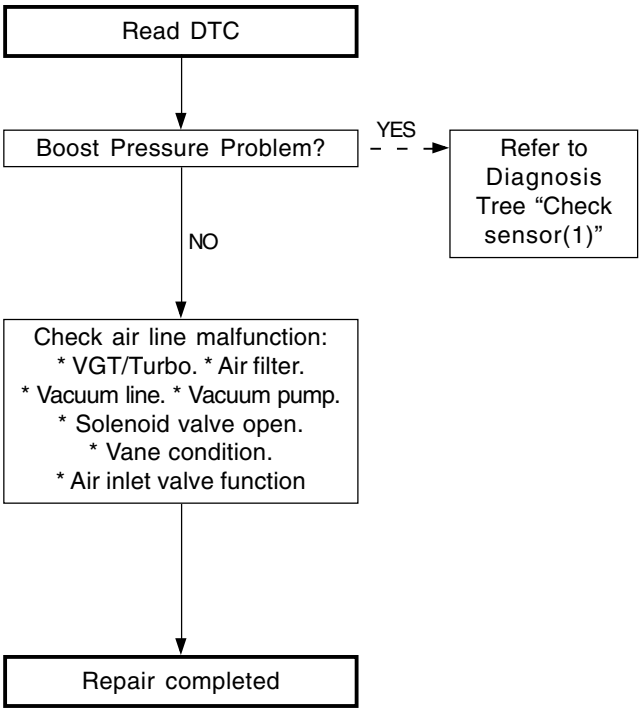
VGT Operation Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1235	VGT Operation Fault	Unable Cruise Control
		Location demand=change the boost control to O.L. mode at f (boost demand, engine cycling speed)

▶ Diagnosis Procedures

1. Diagnosis Procedures(Boost Pressure)



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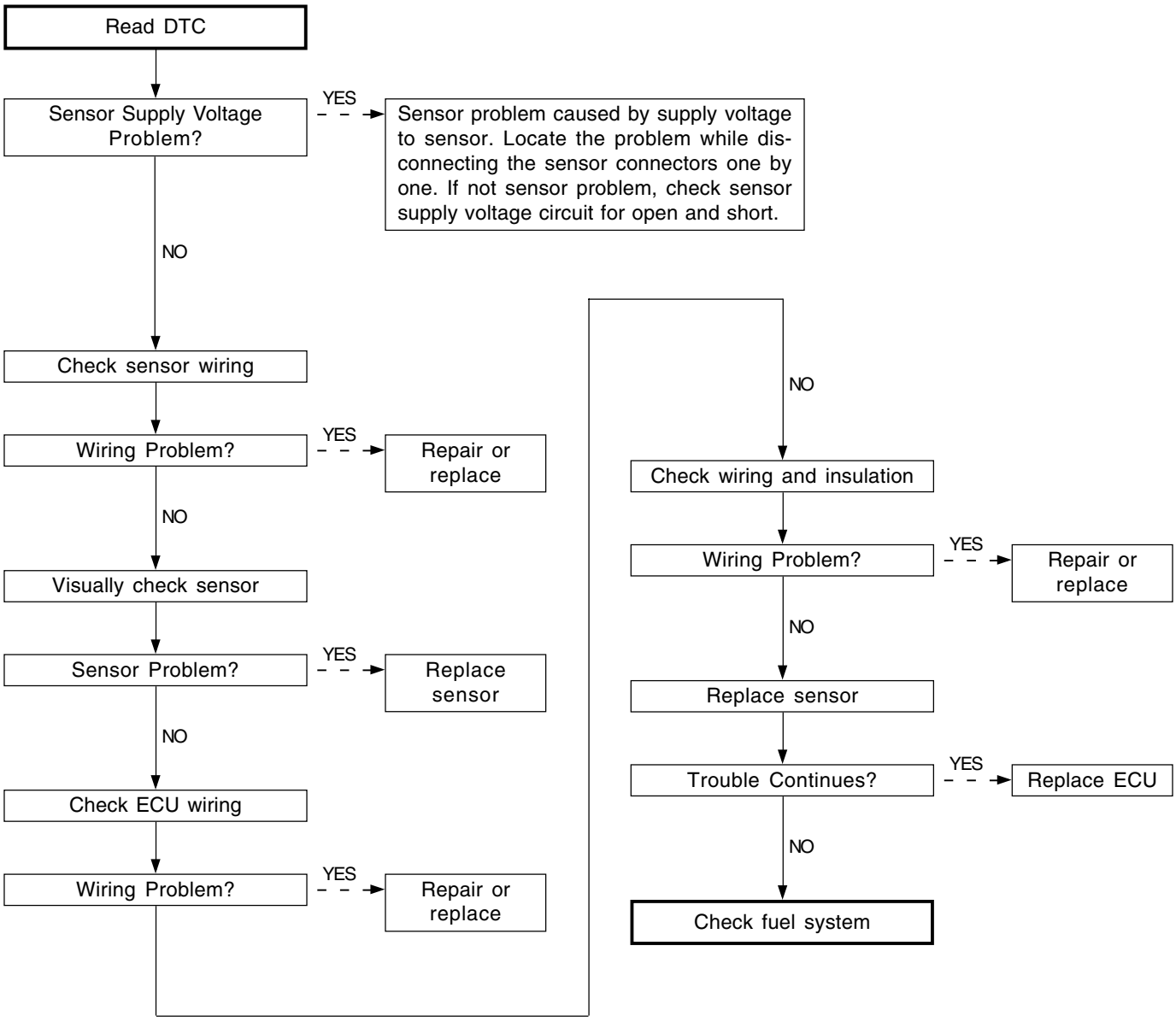
2. Diagnosis Procedures(Check sensor (1))

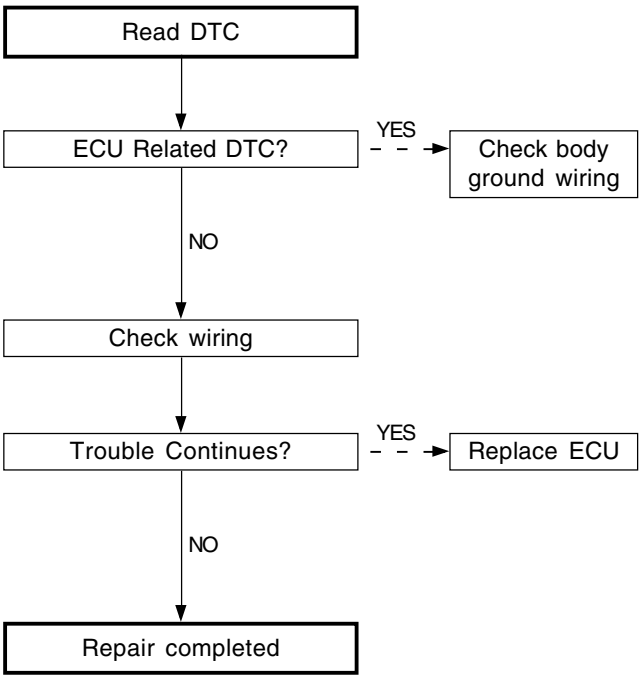


TBD

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1608	ECU Malfunction	

▶ Diagnosis Procedures



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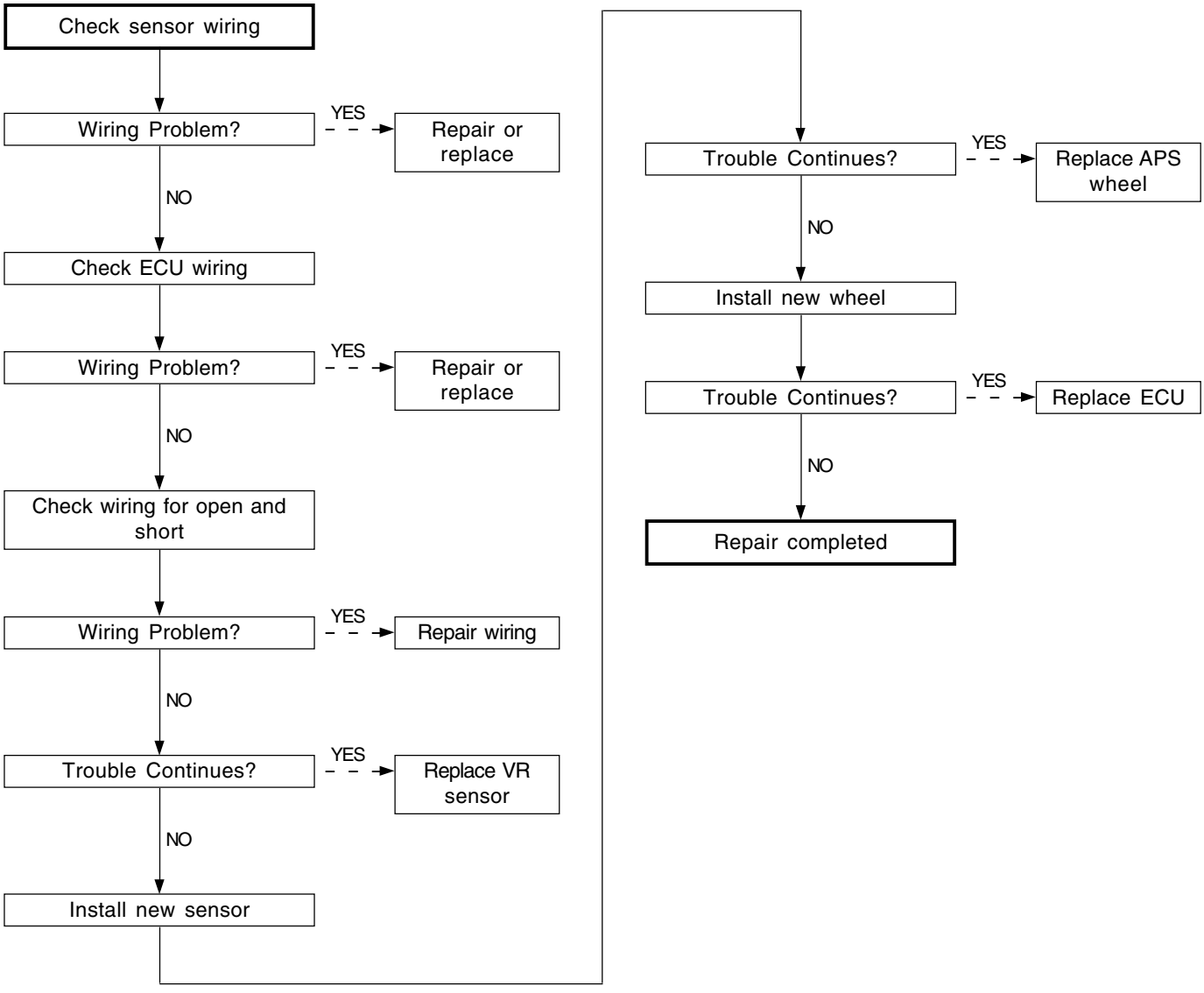
No Crank Signal

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0335	No Crank Signal	MIL ON

▶ Diagnosis Procedures

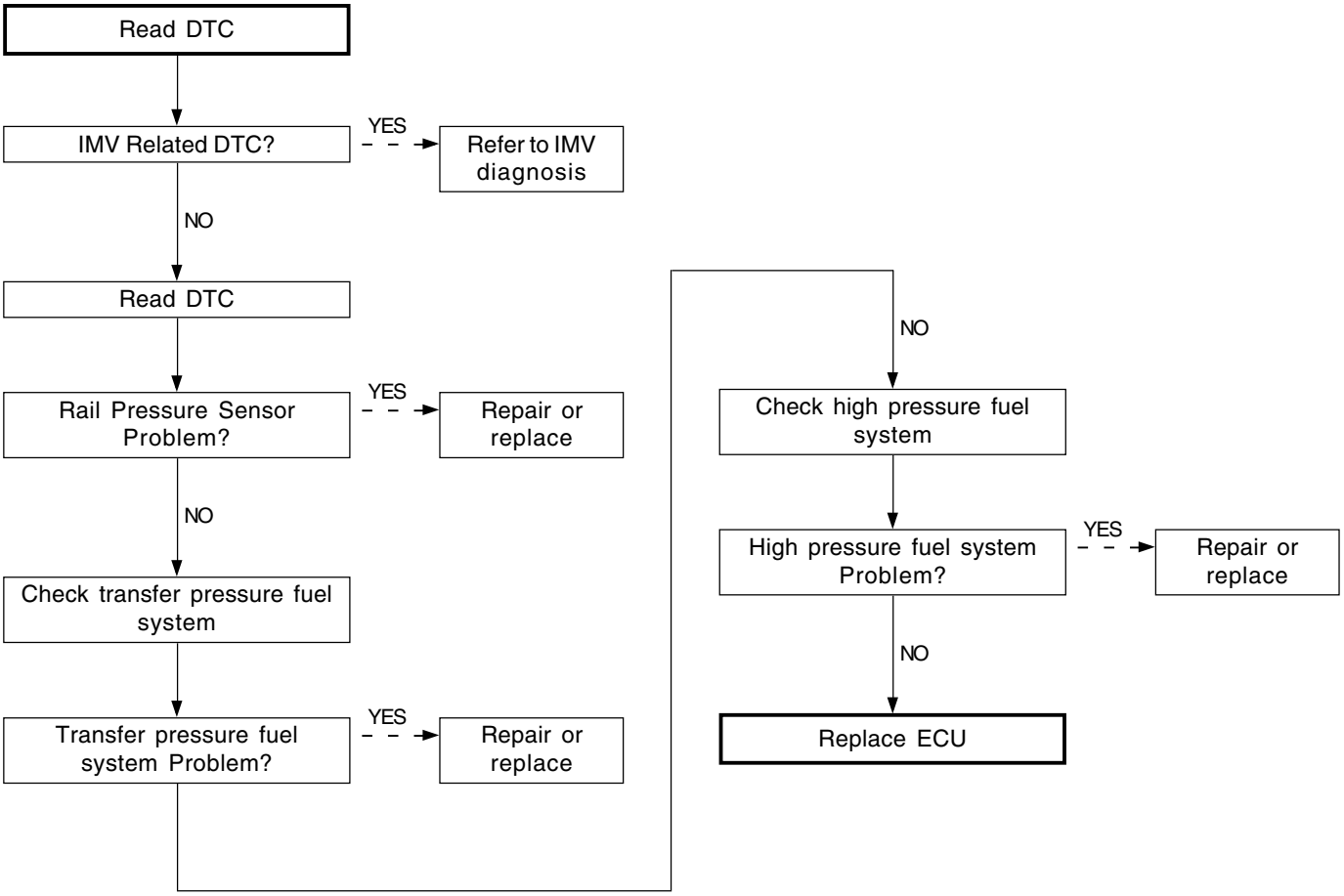


High Torque Trim

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1170	High Torque Trim	MIL ON

▶ Diagnosis Procedures



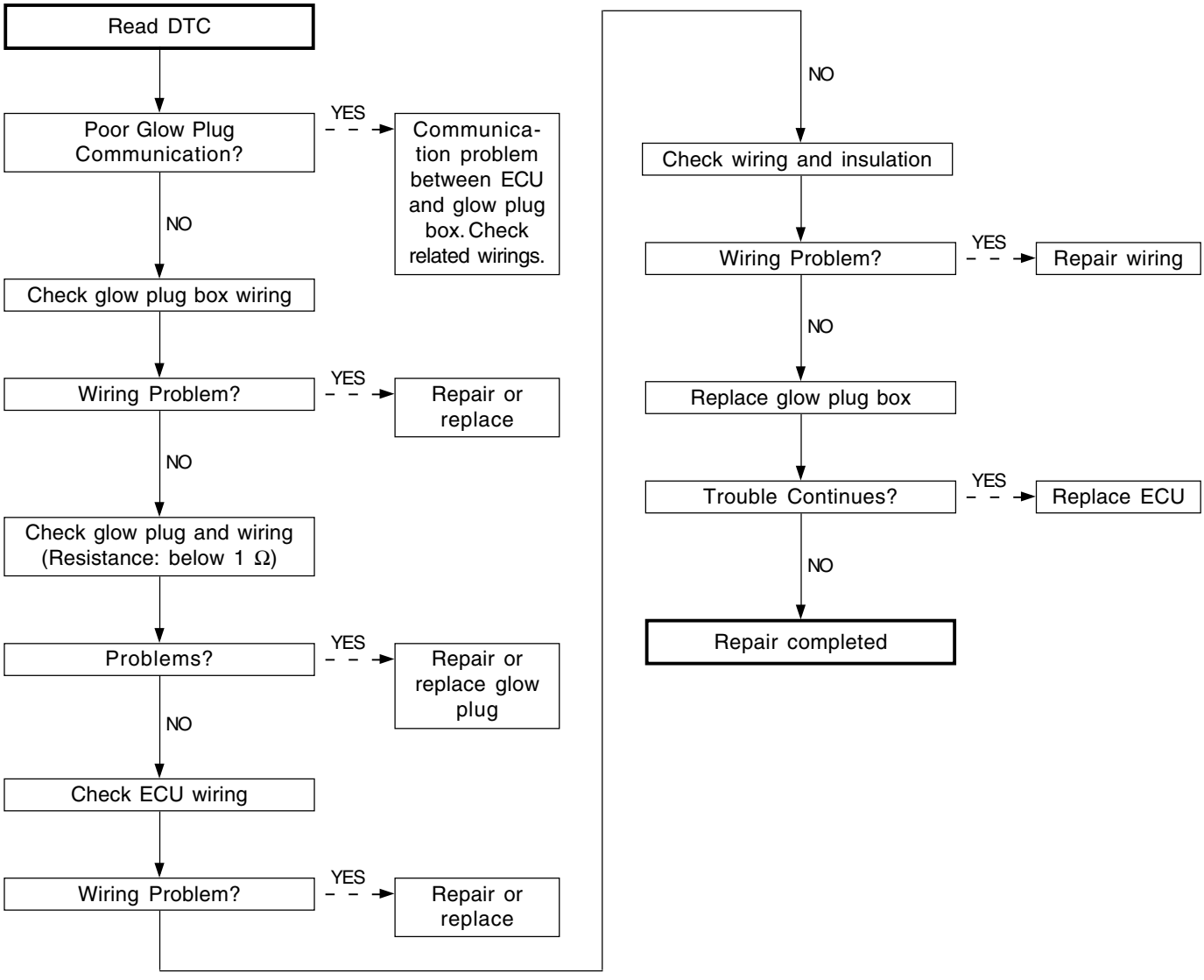
* Refer to “Check High and Transfer pressure system”.

Glow Plug Module Communication Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1676	Communication	
P1677	Controller	

▶ Diagnosis Procedures

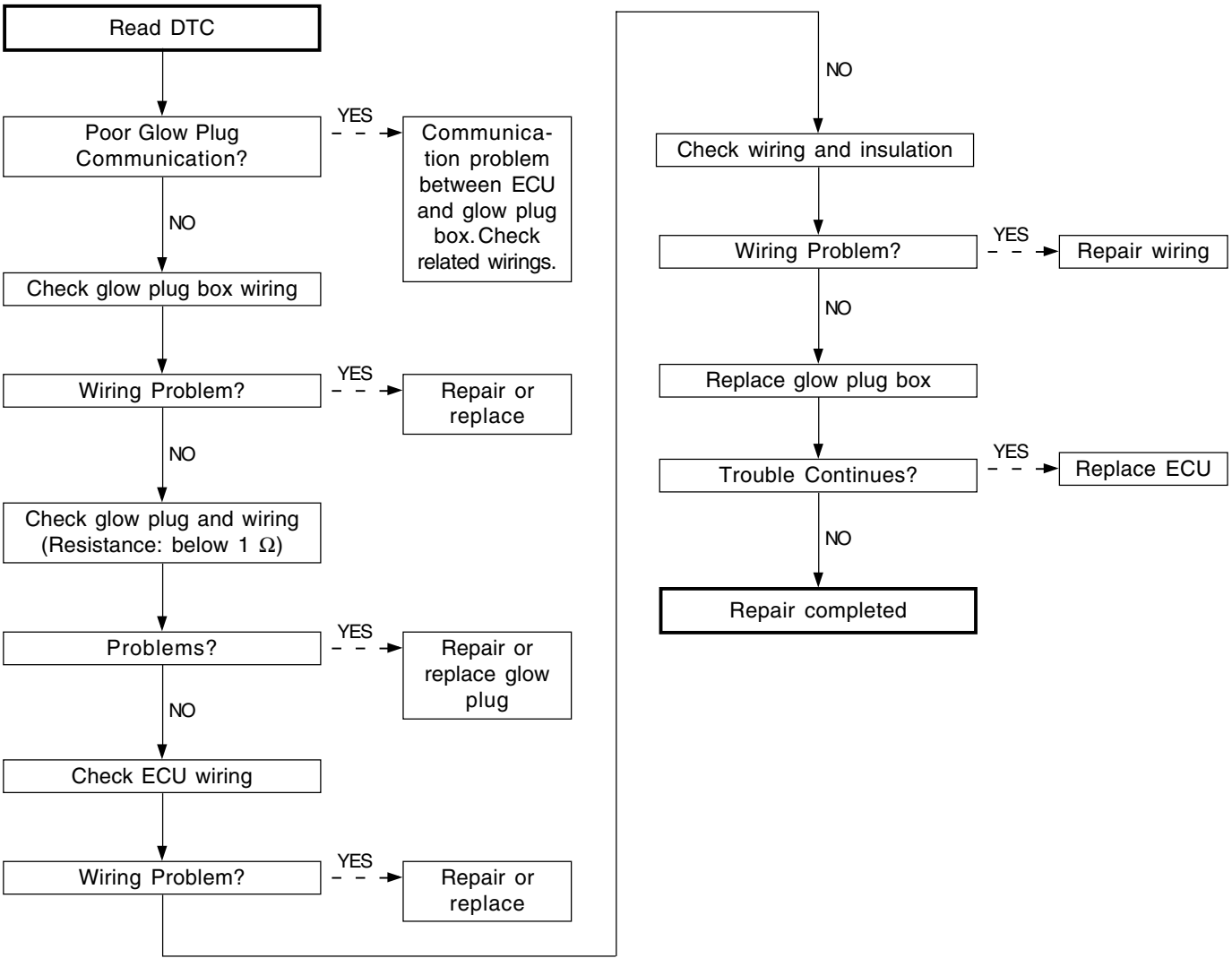


Glow Plug Module Circuit Malfunction - Open

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0671	Glow Plug #1	
P0672	Glow Plug #2	
P0673	Glow Plug #3	
P0674	Glow Plug #4	
P0675	Glow Plug #5	

▶ Diagnosis Procedures

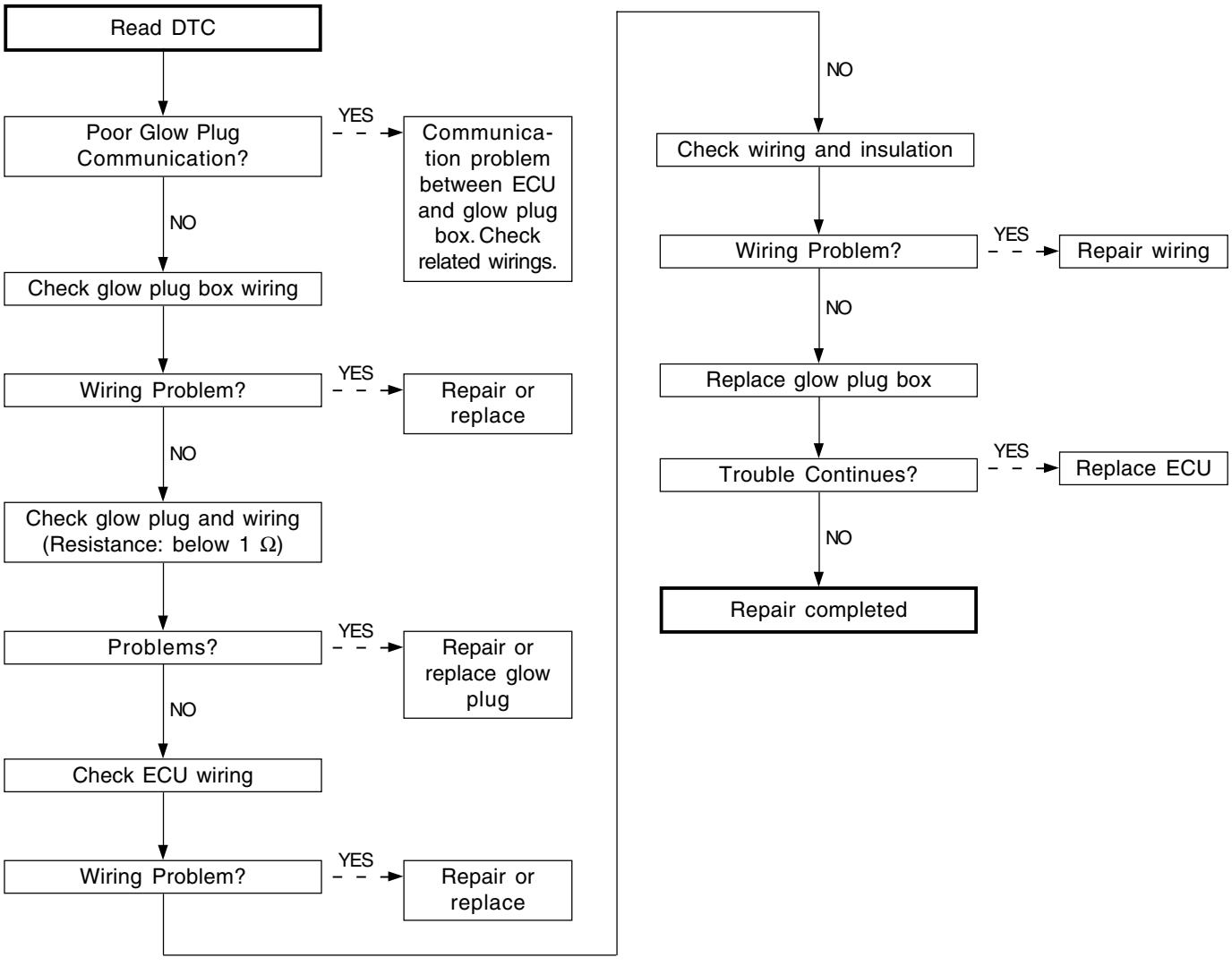


Glow Plug Module Circuit Malfunction - Short (B+)

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1671	Glow Plug #1	
P1672	Glow Plug #2	
P1673	Glow Plug #3	
P1674	Glow Plug #4	
P1675	Glow Plug #5	

▶ Diagnosis Procedures

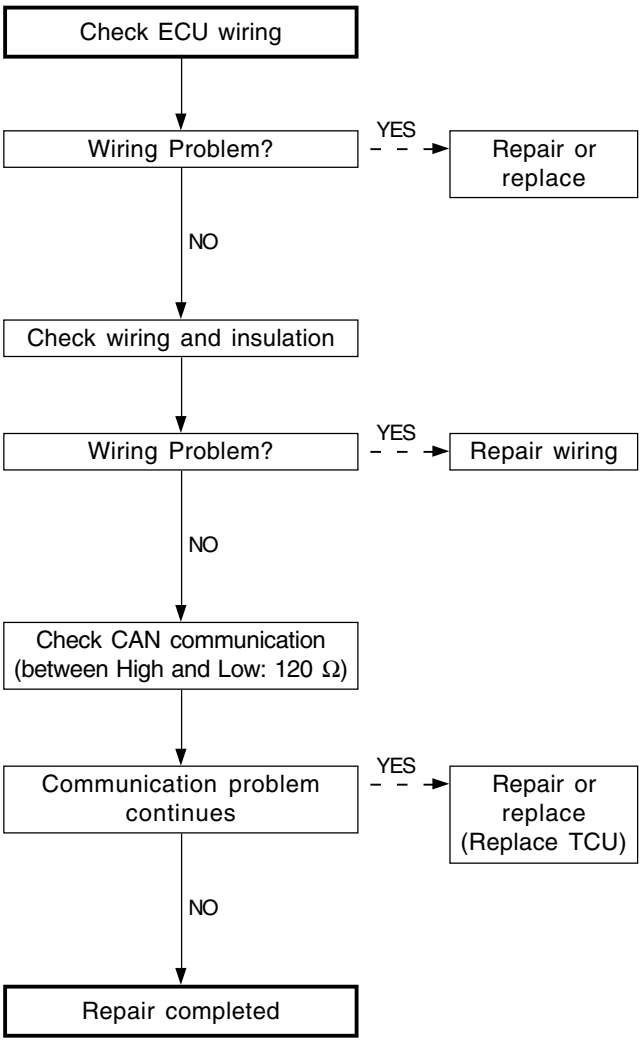


TCU Signal Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P0700	TCU Signal Fault	

▶ Diagnosis Procedures



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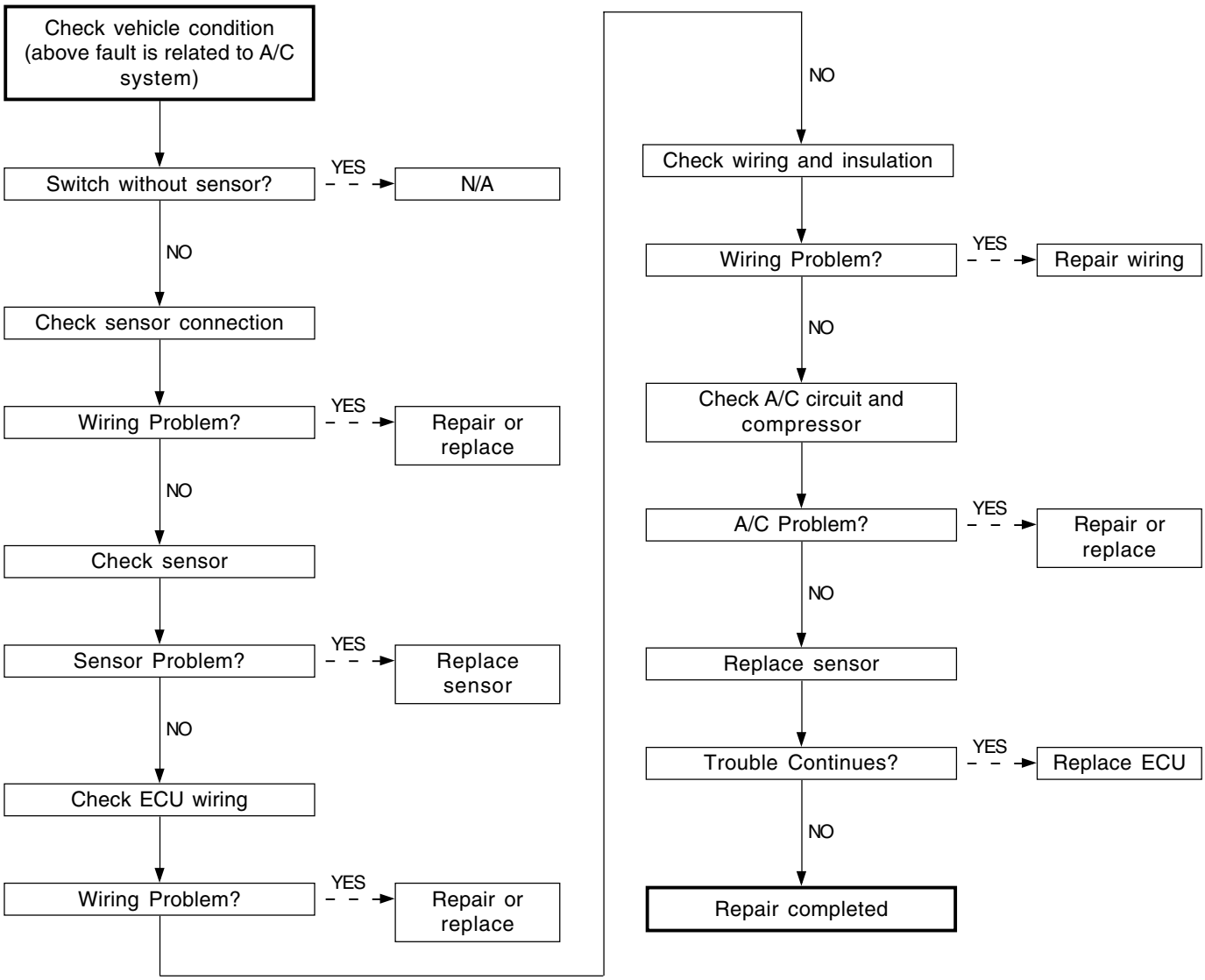
Air Conditioner Operating Circuit Fault

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1540	Open Circuit	Unable A/C Operation
P1541	Short to +Batt	Unable A/C Operation
P1542	Short to Ground	Unable A/C Operation

▶ Diagnosis Procedures

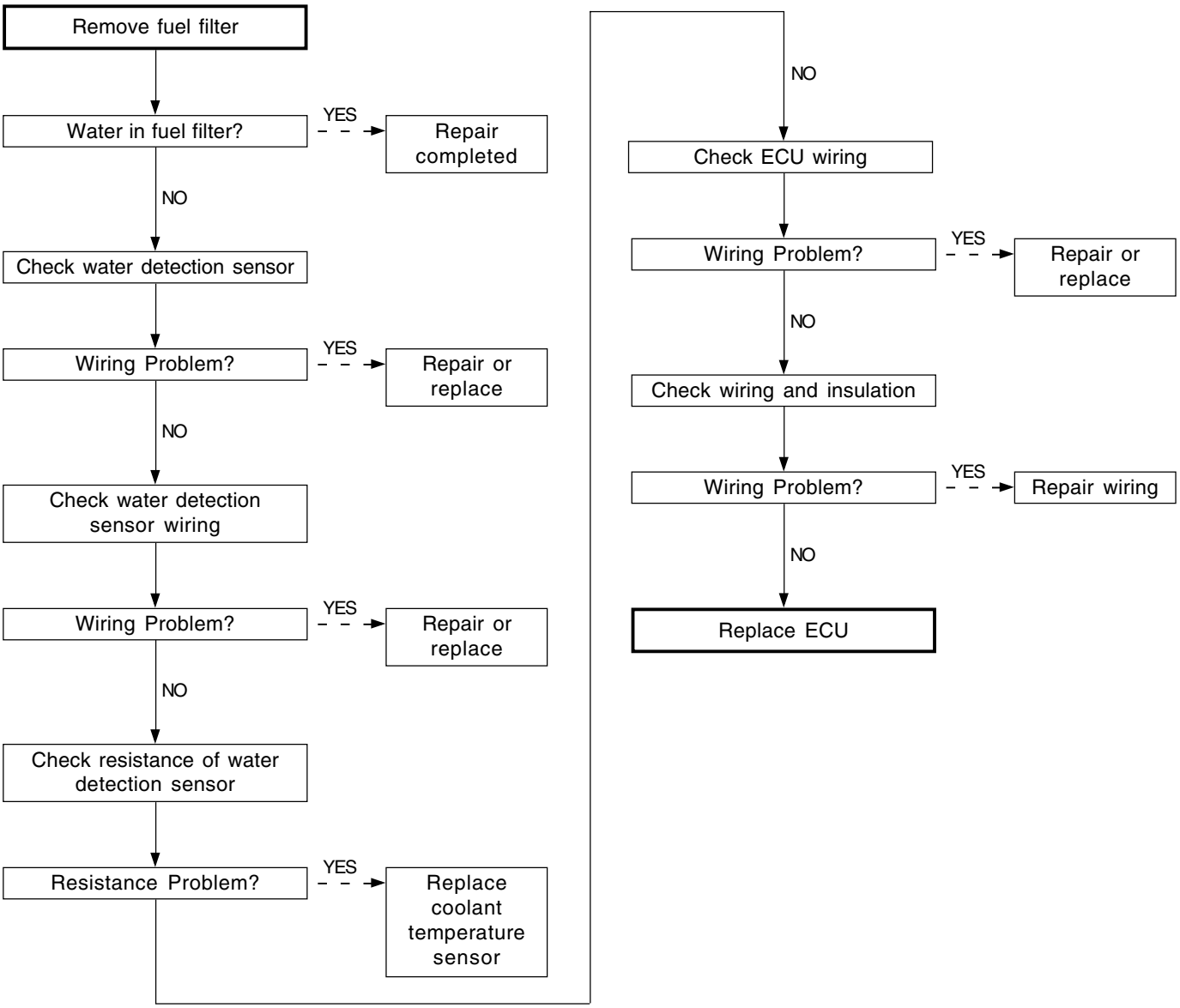


Excessive Water in Fuel Filter

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1149	Excessive Water in Fuel Filter	Water Separator Warning Light ON Torque Reduction Mode Operation

▶ Diagnosis Procedures



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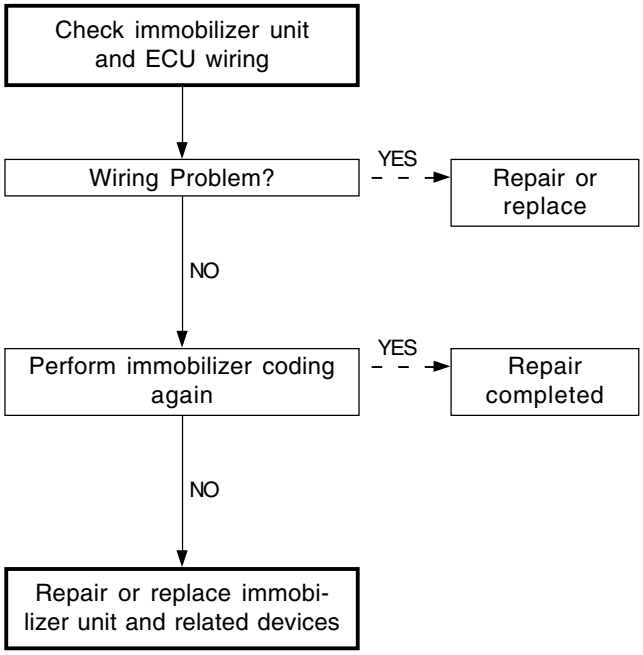
AFFECTED VIN	

Immobilizer Malfunction

▶ Trouble Code and Symptom

Trouble Code		Symptom
P1634	Immobilizer Malfunction	MIL ON
P4335		Immobilizer Warning Light ON
P1630		
P1631		
P1632		
P1633		
P0633		
P1636		

▶ Diagnosis Procedures



FUEL SYSTEM DIAGNOSIS

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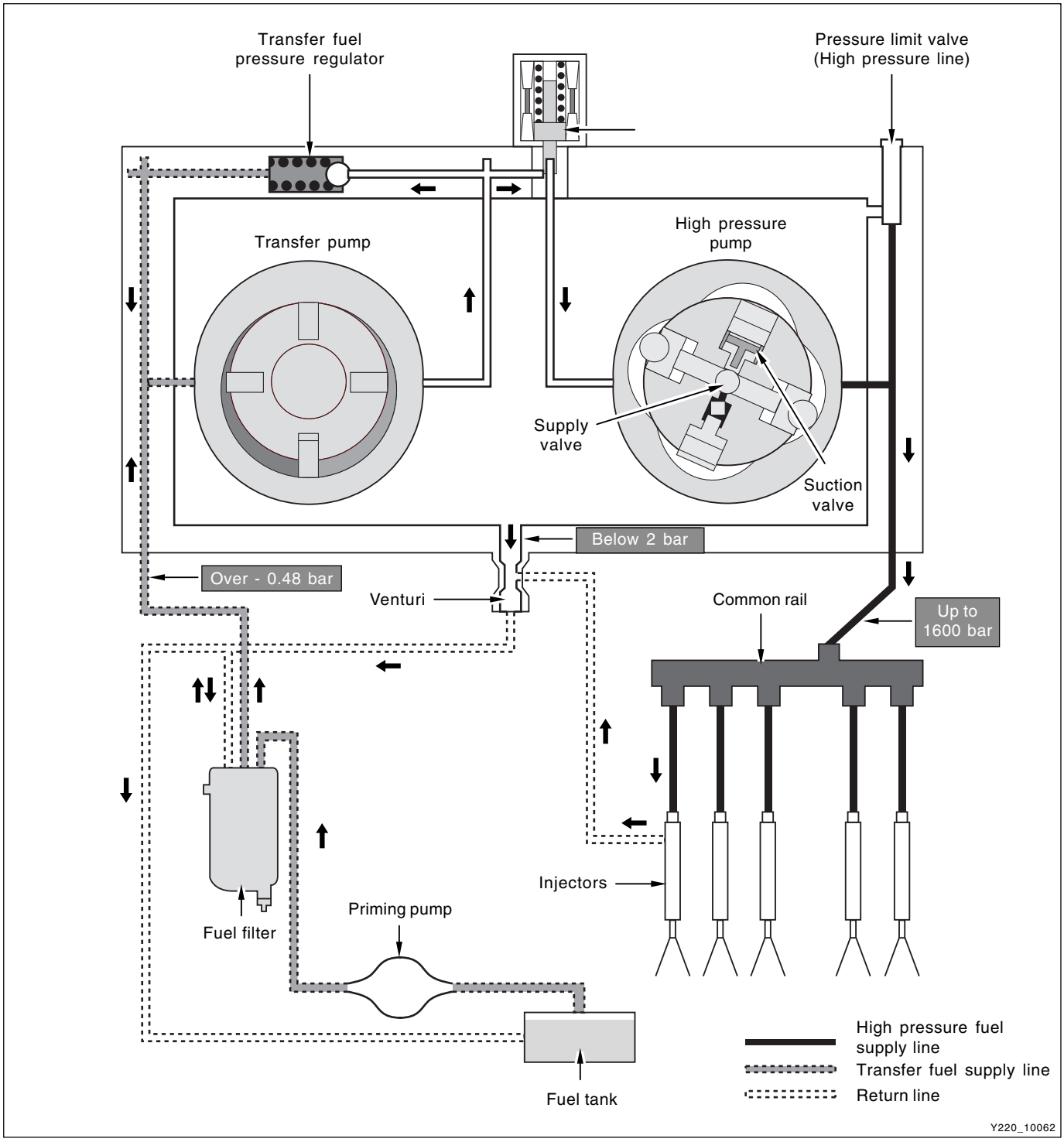
FUEL SYSTEM DIAGNOSIS

OVERVIEW

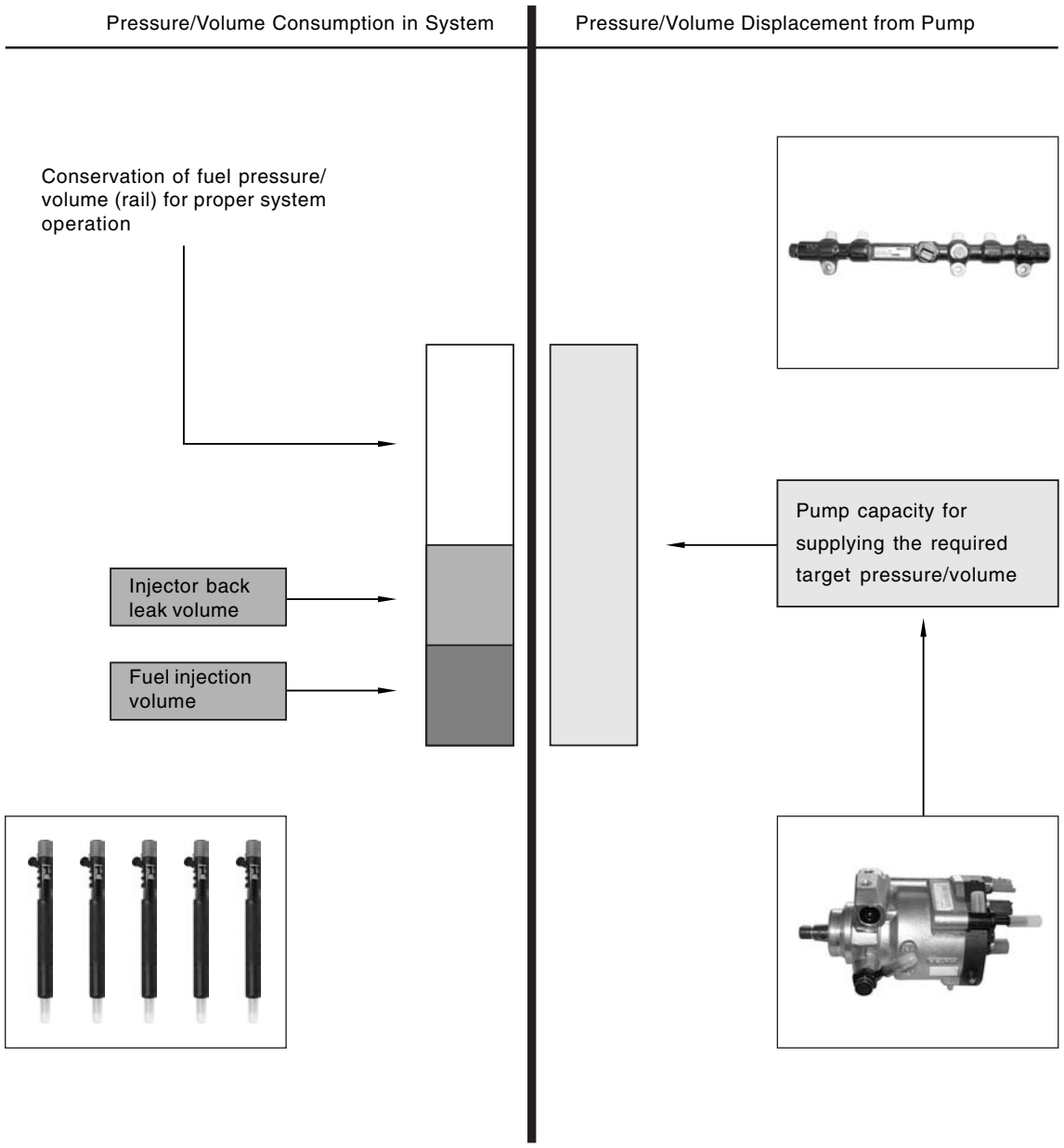
When the Diagnostic Trouble Code (DTC) is detected through scan tool, it's necessary to check the transfer and high pressure fuel lines in fuel system before replacing the components.

If the trouble continues even after the trouble has been fixed with scan tool, must perform the fuel pressure test.

Below schematic diagram shows the specifications of pressure, flow mass and temperature in fuel system.



FUEL PRESSURE SYSTEM



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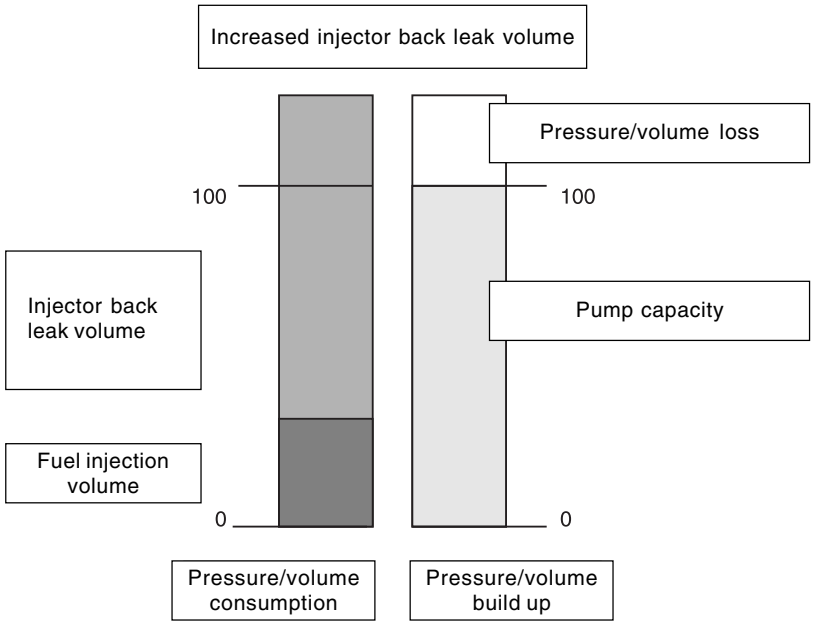
▶ Example of Too Much Injector Back leak



Y220_10064

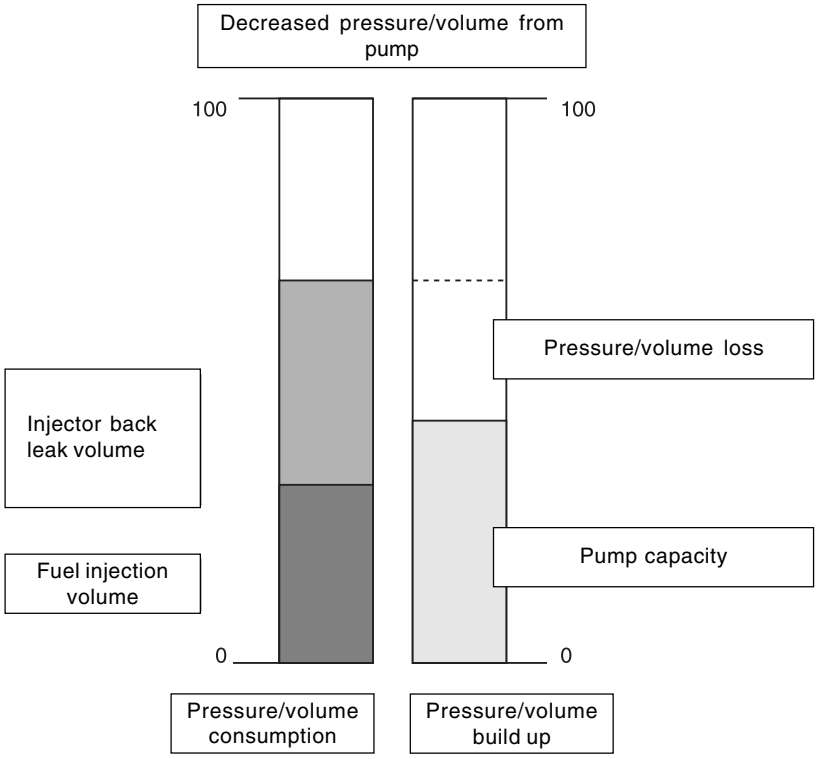
Too Much Injector Back leak

When the injector cannot be sealed due to entering the foreign materials

Ex.:

- Foreign materials in fuel
- Burnt out or worn high pressure pump
- Mechanical damage in inside of injector

▶ Example of Pressure/Volume Loss in Pump



Pressure/Volume Loss in High Pressure Pump

When the required target pressure/volume cannot be delivered due to fuel supply line or pump damage

Ex.:

- Air in fuel supply line
- Excessive vacuum pressure in fuel supply line (-300 mbar)
- Burnt out or mechanically damaged pump
- Supply fuel with increased temperature (> 65°C)

FUEL SYSTEM PRESSURE TEST

▶ Test Tool Kit

For High Pressure Line

Y220_10066

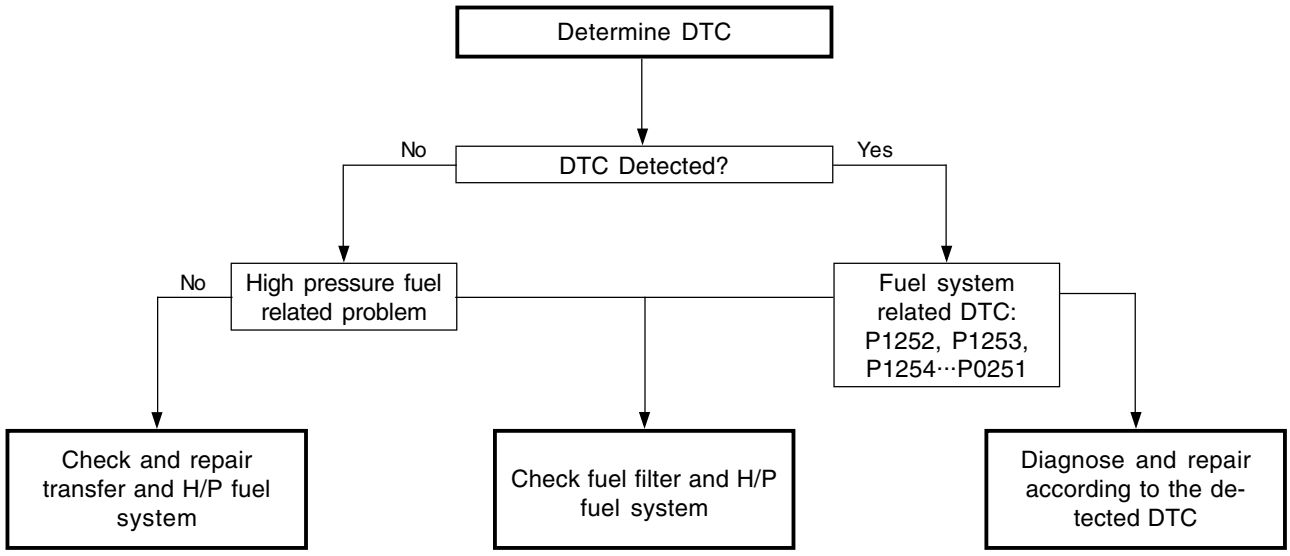
For Transfer Line

Y220_10067

▶ Prerequisite

1. Check the connections in fuel supply lines.
2. Check the fuel level in fuel tank.
3. Check if the air exists in fuel supply lines (air bubbles in fuel supply lines or fuel with air bubbles).
4. Check the fuel supply lines for leaks (transfer and high pressure).
5. Check if the specified fuel is used.
6. Check the fuel filter for contamination and abnormality.

▶ Fuel System Test Process

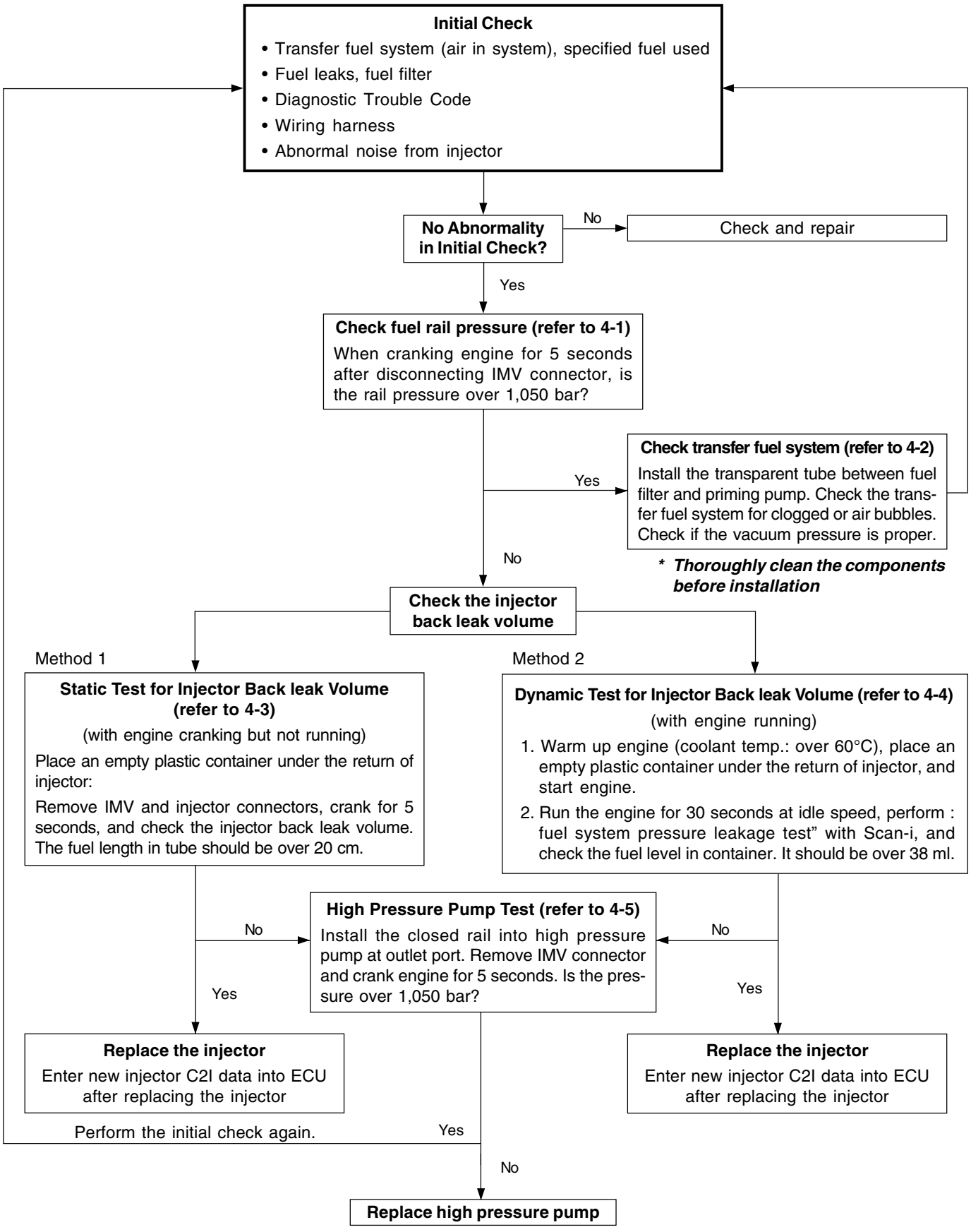


Notice

If more than one DTC have been detected, check the wiring harness for open or short first.

Check the transfer fuel system and fuel filter before proceeding the high pressure fuel system check in next page.

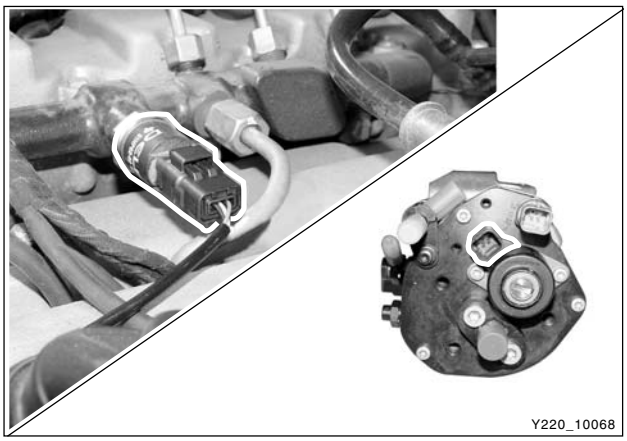
FUEL SYSTEM CHECK PROCESS



4-1. High Pressure System Pressure Test

▶ Fuel Rail Pressure Test

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



2. Install the pressure tester in tool kit to the fuel rail pressure sensor connector.

3. Crank the engine for 5 seconds (twice).
   - Read the maximum pressure displayed on the tester.
   - If the maximum pressure is below 1,050 bar, refer to “Fuel System Check Process” section.

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AFFECTED VIN	

▶ How To Use Pressure Tester

1. Check if the “TEST?” is displayed on the display when pressing the “(TEST)” button.

2. The maximum pressure will be displayed when pressing the button while cranking the engine (around 4 seconds elapsed from 5 seconds).

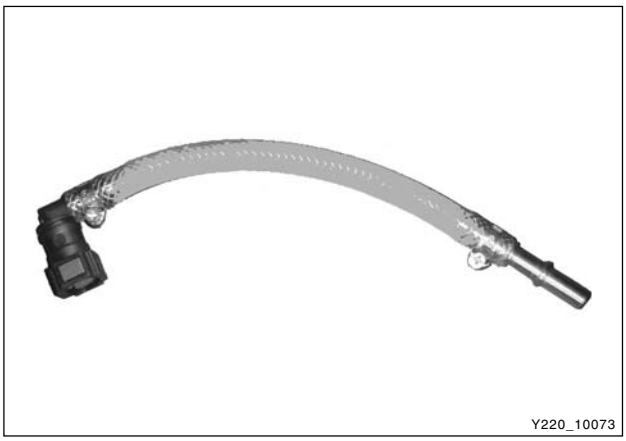
Note

The fuel rail pressure can be measured through the scan tool.

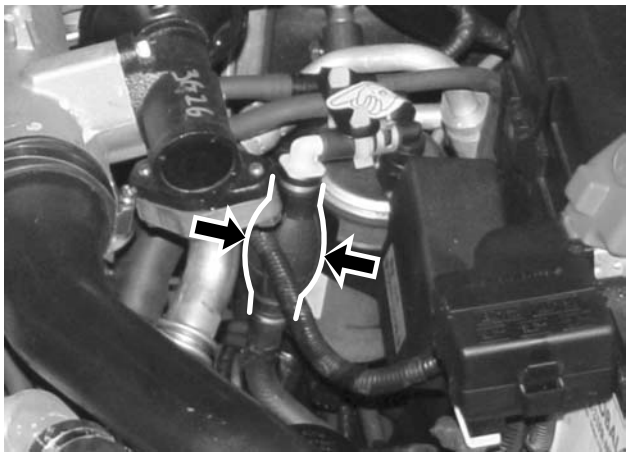
4-2. Transfer Fuel System Test

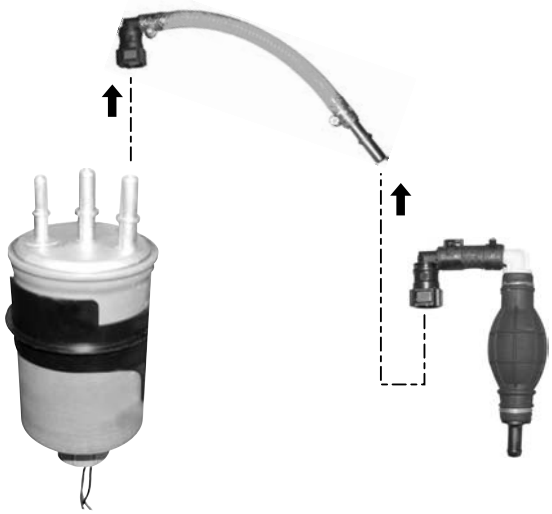
▶ Test Procedures

1. All wiring harnesses, connectors and fuel lines should be installed properly and the engine should be ready to start.
2. Prepare the special tools for transfer fuel system test and thoroughly clean the system.


Y220_10073

3. Disconnect the key connector for connecting the priming pump to fuel filter and install both connectors of the special tool to the fuel pump and the priming pump hoses.

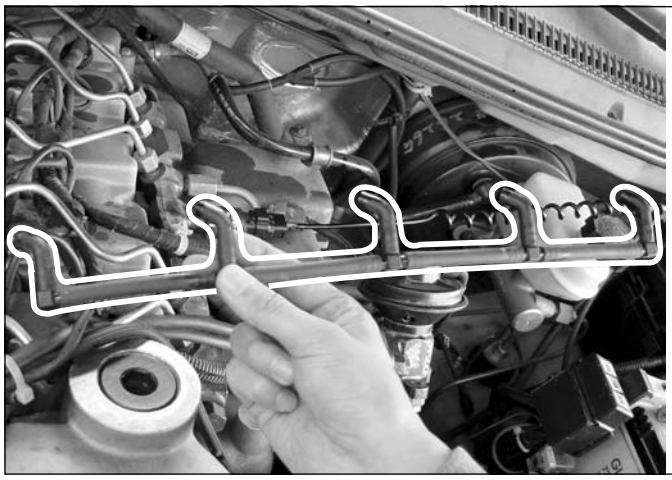


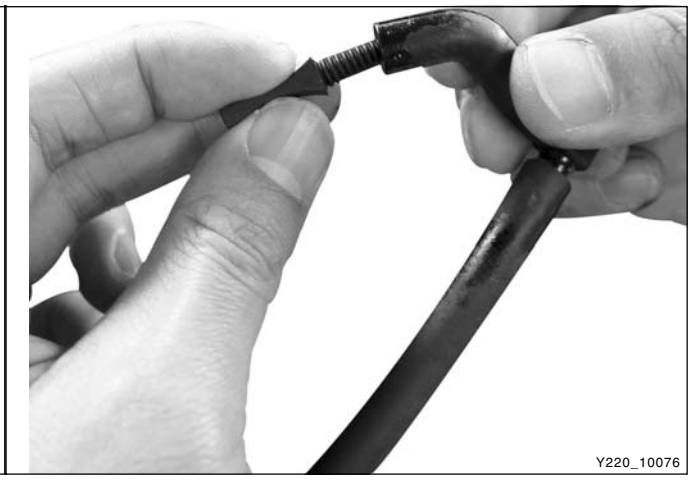

Y220_10074

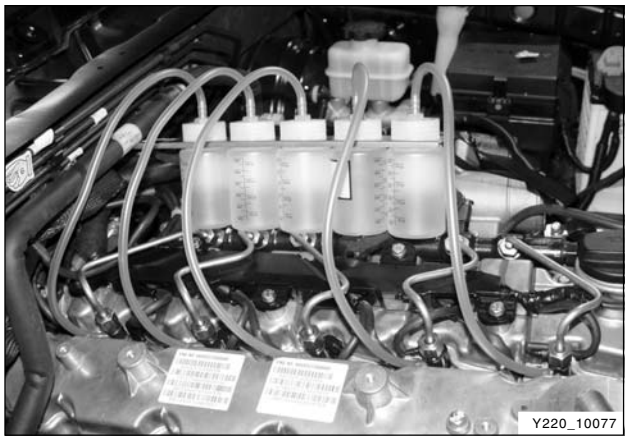
4. Start the engine and visually check the transfer line for clogged and air bubbles while running the engine at idle speed.
5. If the fuel flows are not smooth or air bubbles are found in fuel lines, locate the leaking area and correct it.

4-3. Static Test for Injector Back leak Volume

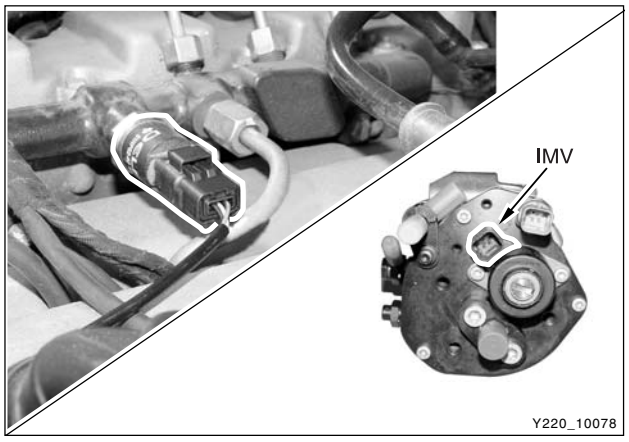
1. Remove the injector return hose and seal the openings with screw type caps (included in tool kit).







2. Install the hoses from back leak test containers to return nipples of injector.



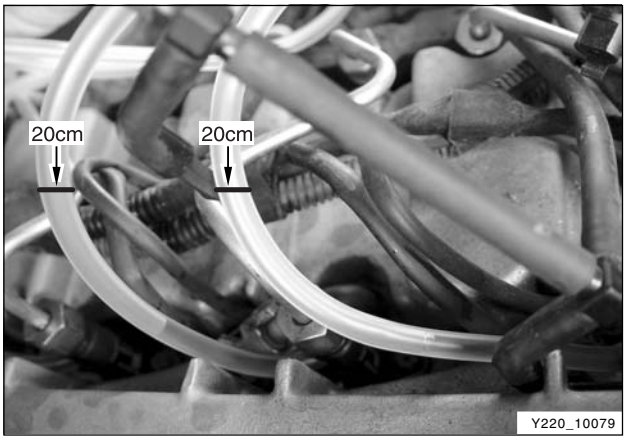
3. Disconnect the IMV connector in H/P pump and the fuel pressure sensor connector.

4. Crank the engine twice with 5 seconds of interval.
5. Check if the back leak volume meets the specification.

Specified value	Below 20 cm

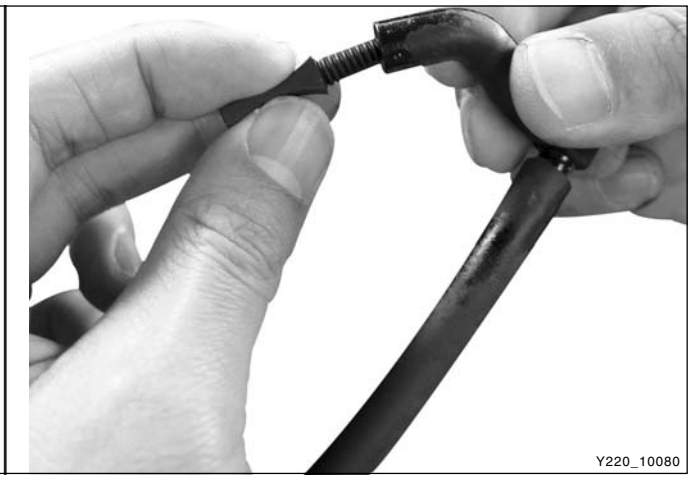
Note

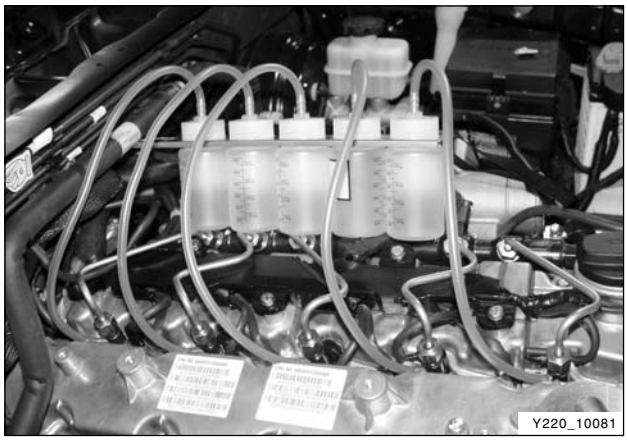
If the measured value is out of specified value, replace the injector.



4-4. Dynamic Test for Injector Back leak Volume

1. Start the engine and warm up until the coolant temperature reaches to 60°C.
2. Remove the injector return hose and seal the openings with screw type caps (included in tool kit).

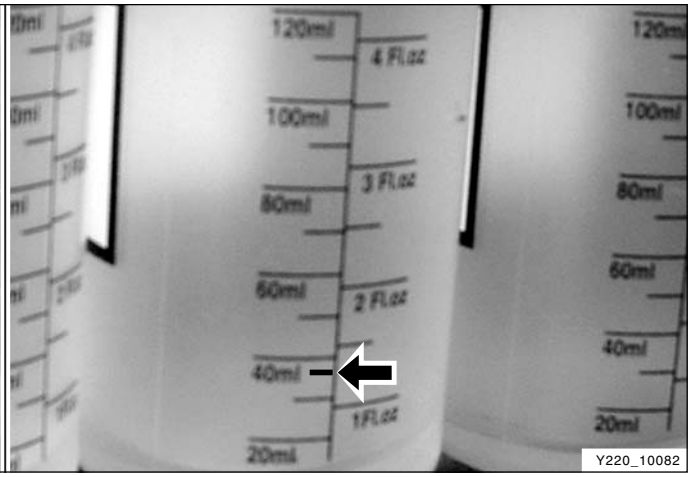




3. Install the hoses from back leak test containers to return nipples of injector.

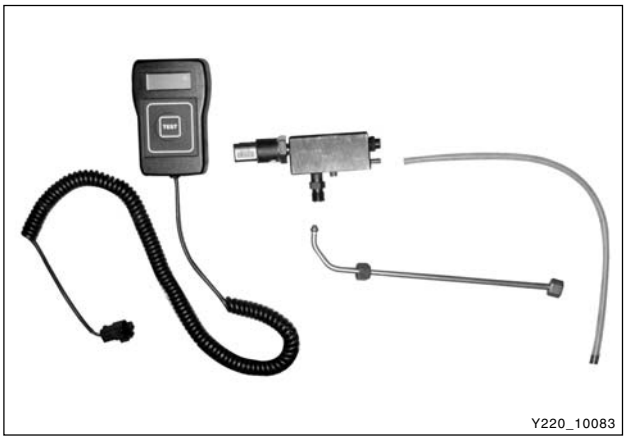
4. Start the engine and let it run for 2 minutes at idle speed.
5. Check if the back leak volume meets the specification.

Specified value	Below 38 ml



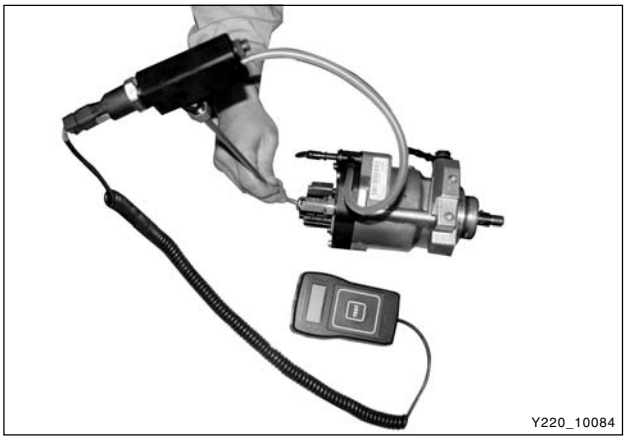
4-5 High Pressure Pump Test

1. Prepare the special tools for high pressure pump test and thoroughly clean the system.



2. Remove the high pressure fuel supply pipe and install the closed rail delivered with tool kit.

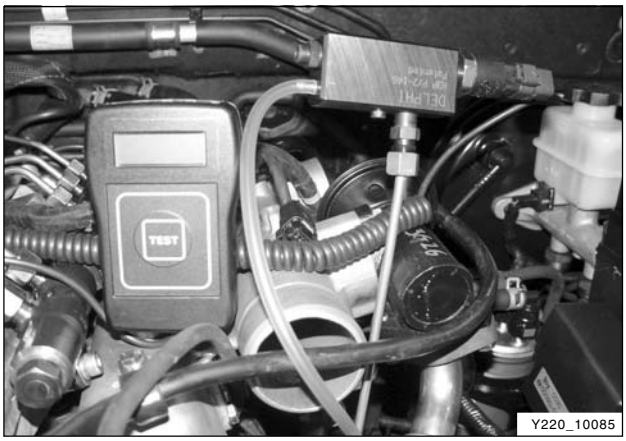
Specified value	40 Nm



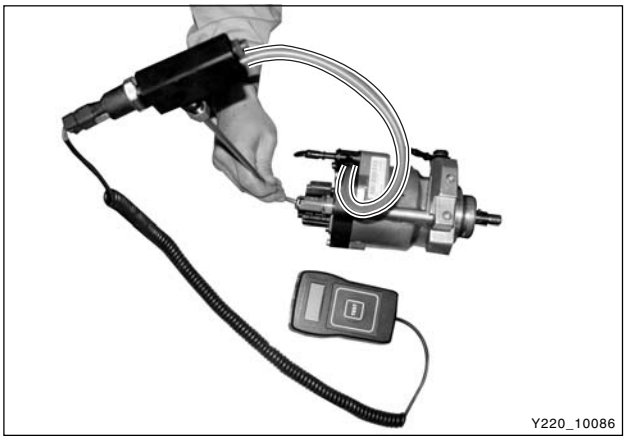
* The figure is to show the test method. However, the actual test operation should be done while the high pressure pump is installed in vehicle.

3. Install the opposite end of the closed rail into the fuel rail for test.

Specified value	40 Nm



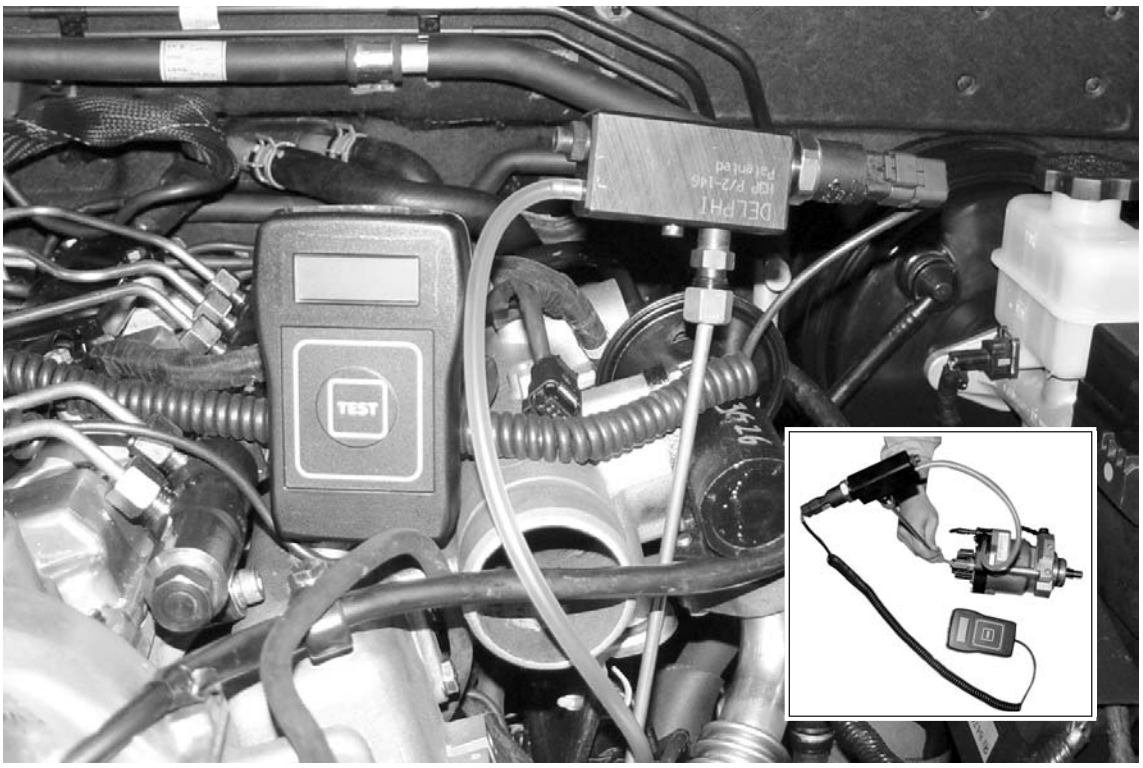
4. Remove the high pressure fuel return hose and install the transparent tube between the high pressure pump and the return port of fuel rail for test.




Y220_10087

5. Connect the digital tester connector into the sensor connector of fuel rail for test.
6. Disconnect the IMV connector and the fuel rail pressure sensor connector.
7. Check if the measured value on the digital tester meets the specified value.

Specified value	Over 1,050 bar



Y220_10088

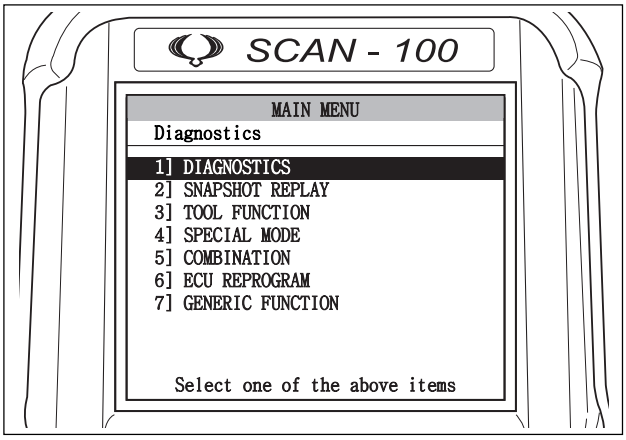
PRESSURE LEAKAGE TEST WITH SCAN-100

1. When performing the static test for injector back leak Volume, the fuel pressure leakage test with Scan-i should be done simultaneously. And, the fuel pressure leakage test with Scan-i can be done separately.

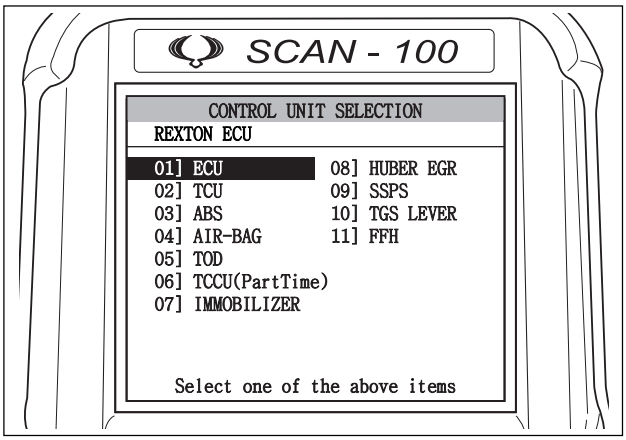
2. Test Conditions:
   - No defective or faulty sensors and components in fuel system: checked by Scan-i
   - Coolant temperature: over 60°C

3. The diagnosis procedures with Scan-i are as below:

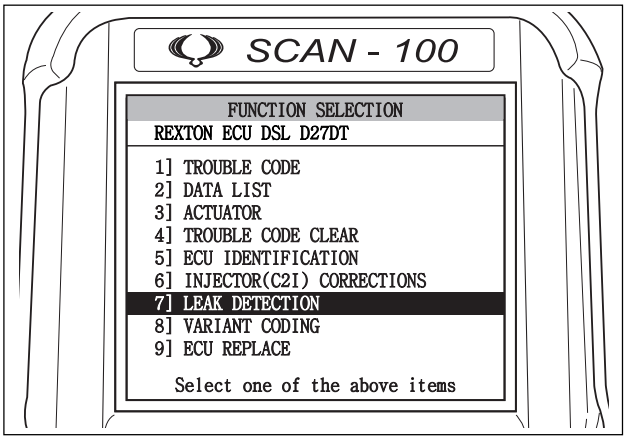
1) Install the Scan-i to the diagnostic connector. Select "DIAGNOSTICS" and press "ENTER" in "MAIN MENU" screen. Select "REXTON" and press "ENTER" in "VEHICLE SELECTION" screen.



2) Select "ECU" and press "ENTER" in "CONTROL UNIT SELECTION" screen.



3) Select "LEAK DETECTION" and press "ENTER" in "FUNCTION SELECTION" screen.



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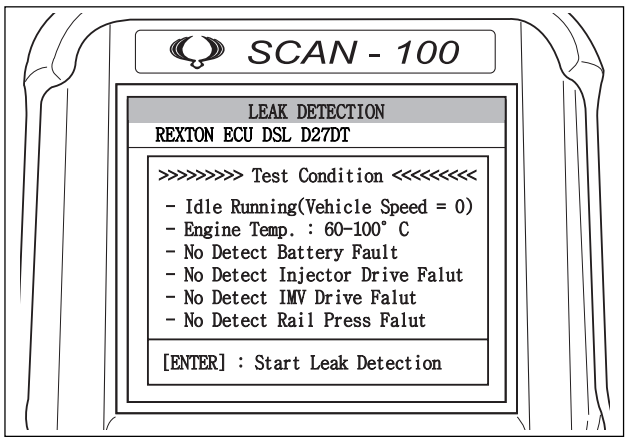

4) If there are not any troubled conditions in “TEST CONDITION” screen, press “ENTER”.

SECTION 3A1

DC 5-SPEED AUTOMATIC TRANSMISSION

Table of Contents

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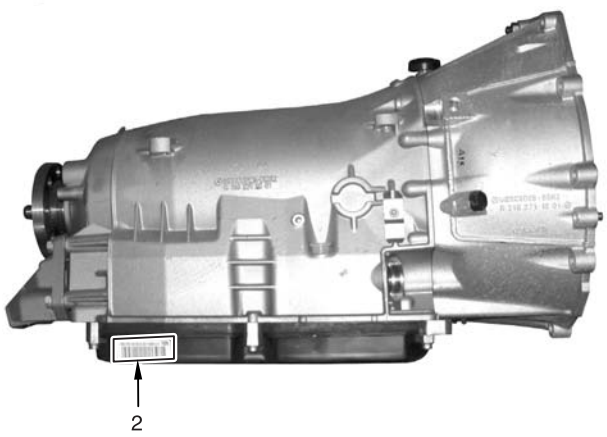
GENERAL INFORMATION

OVERVIEW

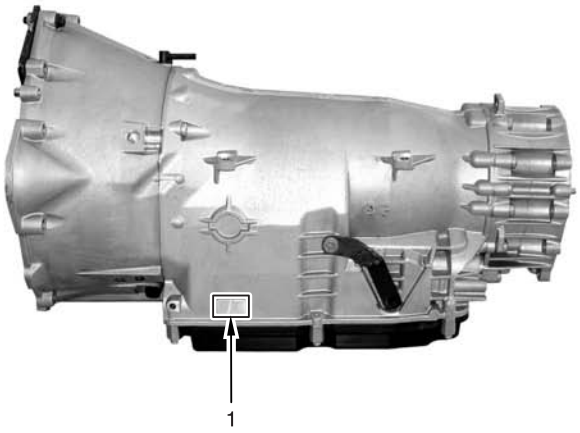
2WD



1
7202700600 — DC Part Number
722 600 0 — DC Variant Number
377900 — Serial Number

3 Automatic Transmission Assembly

4WD



722 600 0
- Engine Code Number
  - 34: D27DT (2WD)
  - 61: D27DT (4WD)
  - 62: E3.2 Engine (4WD)
- Transmission Type
- Automatic Transmission for Passenger Car

Y220_3A1001

▶ DC 5-Speed Automatic Transmission

DCAG 5-speed automatic transmission is an electronically controlled 5-speed transmission with a lockup clutch in the torque converter.

The ratios for the gears are realized by three planetary gear sets. The 5th gear is designed with a step-up ratio of 0.83 as an overdrive. The selector lever is controlled by electronically and mechanically. The gears are shifted by the corresponding combination of three hydraulically actuated multiple-disc brakes, three hydraulically actuated multiple-disc clutches and two mechanical one-way clutches.

This electronically controlled automatic transmission adjusts the operating pressure to provide proper shifting in relation to engine power. This function improves shifting quality significantly. And, the driver can select “S” (Standard) mode or “W” (Winter) mode according to the driving conditions.

This automatic transmission provides two gears even during reverse driving. The internal sensors and controls are connected to TCU by cylindrical 13-pin connector.

*** DCAG 5-speed automatic transmission offers the following advantages:**

1. Improved shifting quality
2. More gears
3. Extended working life and reliability
4. Reduced fuel consumption

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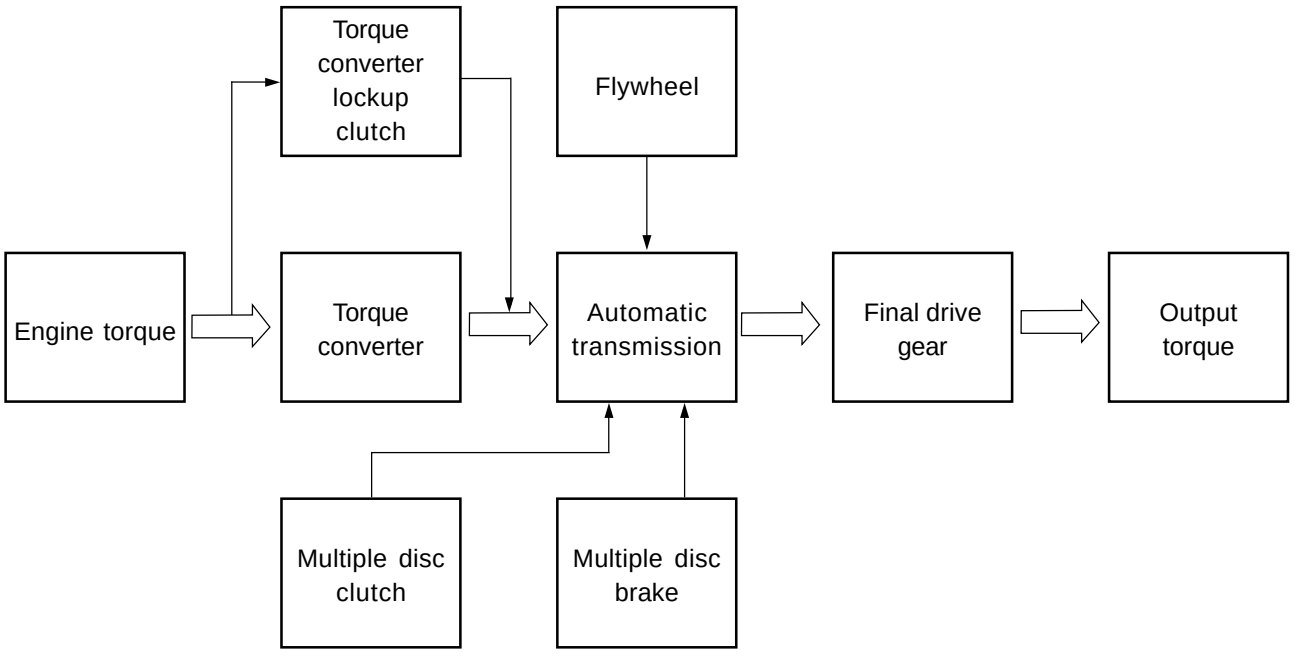
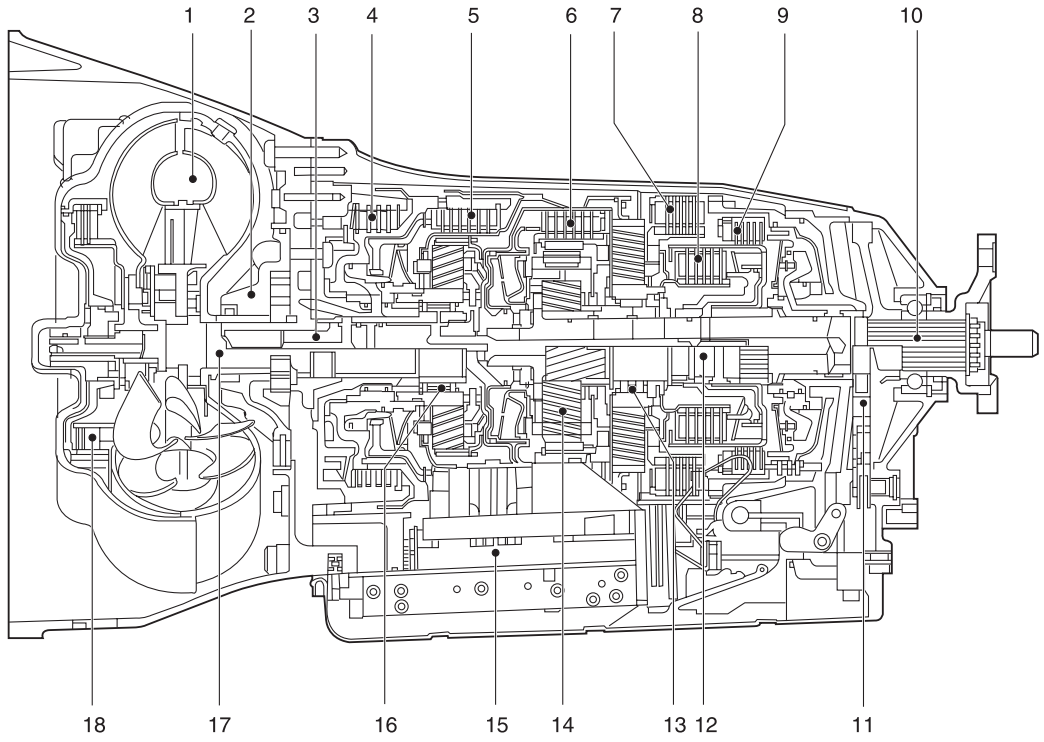
CHARACTERISTICS

Characteristic	Function and Description	Effect
Slope recognition (down hill, up hill)	Recognize it according to engine RPM and accelerator pedal position	Delay up shift
Engine torque limitation	During 1st gear driving or reverse driving with full throttle condition	Prevent automatic transmission from overheating
Engine torque decrease	Delay of ignition timing to reduce torque at all shifting moments	Improve shift quality
Engine rpm limitation	Limit engine rpm until the gears are fully engaged when shifting from “P” or “N” to “D”	Prevent shift shock
ESP Operation	When the ESP is controlling the engine torque, shifting is not available and vehicle starts off with 2nd gear.	Cannot use kick-down function and shift at maximum rpm
ABS Operation	Not any effect to brake control	
Fast-off function	Does not up shift when accelerator pedal is abruptly released	To get an engine brake effect during cornering
Altitude recognition	As altitude increases (atmospheric pressure reduces) engine torque decreases. Up shift while additionally depressing the accelerator pedal (adjusting shift diagram)	Improves driving performance and increases torque
Oil temperature	If transmission oil temperature is too low, the shifting point gets delayed in full throttle and kick down	Improves driving performance
Hydraulic pressure is produced in emergency driving mode	When starting the engine with cycling the ignition switch (“OFF” and “ON”) due to transmission trouble, the selector lever should be placed in “P” position. If starting the engine with selector lever “N” position, the lever should be moved into “P” position. Because, the hydraulic pressure can be produced in selector lever “P” position.	The hydraulic pressure flows with direct operation mode via “R” and “D” valve to operate “R” and “forward 2nd” gear.
Adaptation	Function to optimize the shifting quality.	To exclude play and wear



STRUCTURE



※ Basic structure of DC 5-speed automatic transmission

Y220_3A1002

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

Y220_3A1002A

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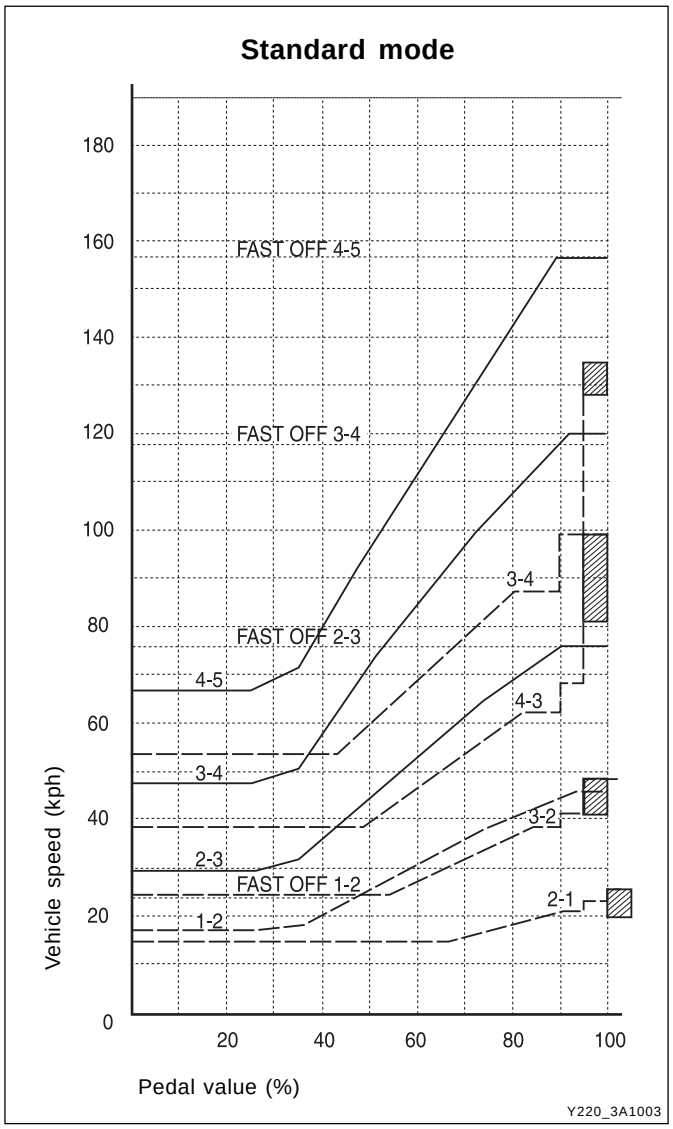
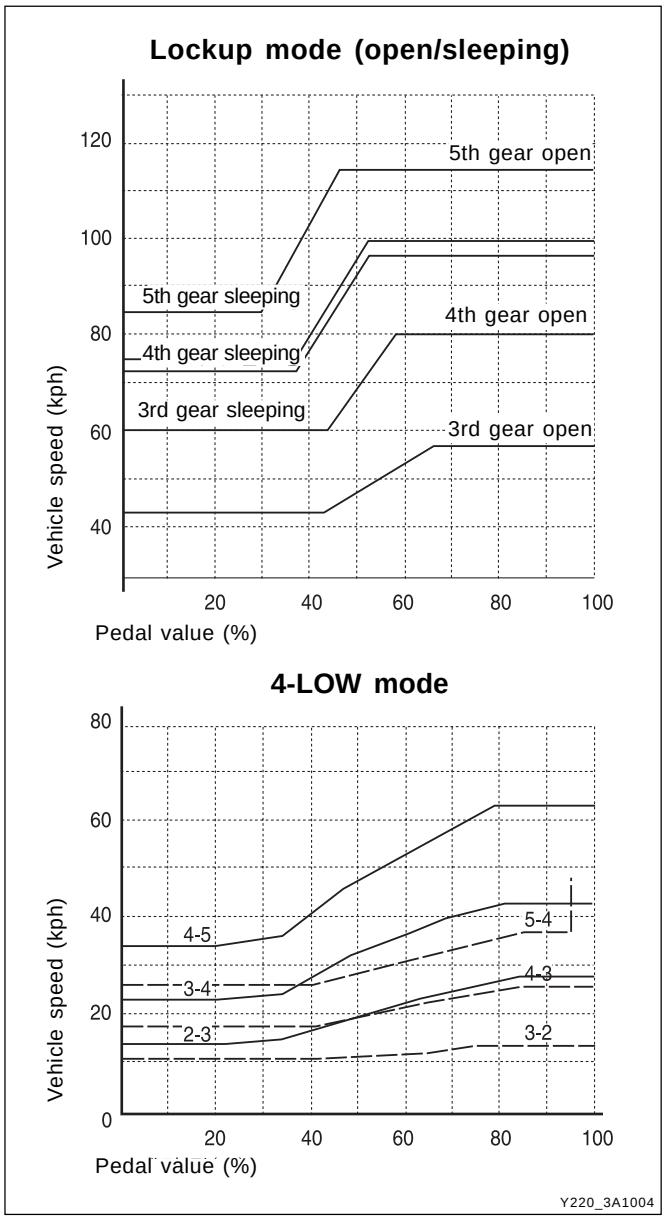
PERFORMANCE CURVE AND GENERAL CHARACTERISTICS





Note

1. ***Based on DI Engine + A/T equipped vehicle specifications***
   - ***Gear ratio***

     1st gear: 3.595 ***Rev. 1st gear: 3.167***
     2nd gear: 2.185 ***Rev. 2nd gear: 1.926***
     3rd gear: 1.405 ***Axle ratio: 3.31***
     4th gear: 1.000
     5th gear: 0.831
2. ***WINTER Mode: Standard Mode***
3. ***Allowable shifting point:***
   Upshift
   Downshift
   Lockup (sleeping)
   Unlock (open)
   FAST OFF
   Dynamic shift range
4. ***FAST OFF***
   - ***When abruptly releasing the accelerator pedal, the transmission remains at 4th gear other than 4 →4 shift (when slowly releasing the accelerator pedal, the transmission is shifted to 5th gear).***
5. ***Dynamic shift range***
   - ***When operating the accelerator pedal, the 4 →3 shift is completed by kick-down signal after completion of 4 →4 shift.***
   - ***When promptly operating the accelerator pedal, the 4 →3 shift is done in shaded arae.***

SPECIFICATIONS

Item		W5A330 (300)	W5A580 (400)
Input torque		330 Nm	580 Nm
Weight (including ATF)		78 kg	78 kg
Diameter (Torque converter)		270 mm	270 mm
Lockup function		Yes	Yes
Gear ratios	1st	3.951	3.595
	2nd	2.423	2.186
	3rd	1.486	1.405
	4th	1.000	1.000
	5th	0.833	0.831
	Reverse: S mode / W mode	3.147/1.93	3.167/1.926
Driving type		2WD (4WD)	
Fluid specification		Fuchs ATF 3353 or Shell ATF 3353	
Fluid capacity		approx. 8 ℓ	
Selector lever position	P.R.N.D	Mechanical	
	D+/D-	Electrical	
Parking lock system		Brake switch (signal) →TGS lever	
Reverse lock system		CAN →TGS lever	
Selected lever indication	P.R.N.D	Lever position	
	4, 3, 2, 1	CAN	
Oil temperature sensor	Resistance: R, D	0.5 ~ 2.5 kΩ	
	Resistance: P, N	20 kΩ	
TCU		EGS 52	
Shift solenoid valve (25°C)	Resistance	3.8 ± 0.2 Ω	
	Operating distance	0.2 mm	
	Operating current	1.5 ~ 2 A	
M/P, S/P solenoid valve (23°C)	Resistance	5.0 ± 0.2 Ω	
	Operating distance	0.6 mm	
	Operating current	0 ~ 1 A	
Lockup solenoid valve (25°C)	Resistance	2.5 ± 0.2 Ω	
	Operating distance	0.2 mm	
	Operating current	1.5 ~ 2.0 A	
	Operating range	3rd to 5th gears	
RPM sensor	Resistance	HALL type	
	Operating voltage	6 V	
Start lockout switch	Switch contact	ON (D, R position)	
	Switch contact	OFF (P, N position)	

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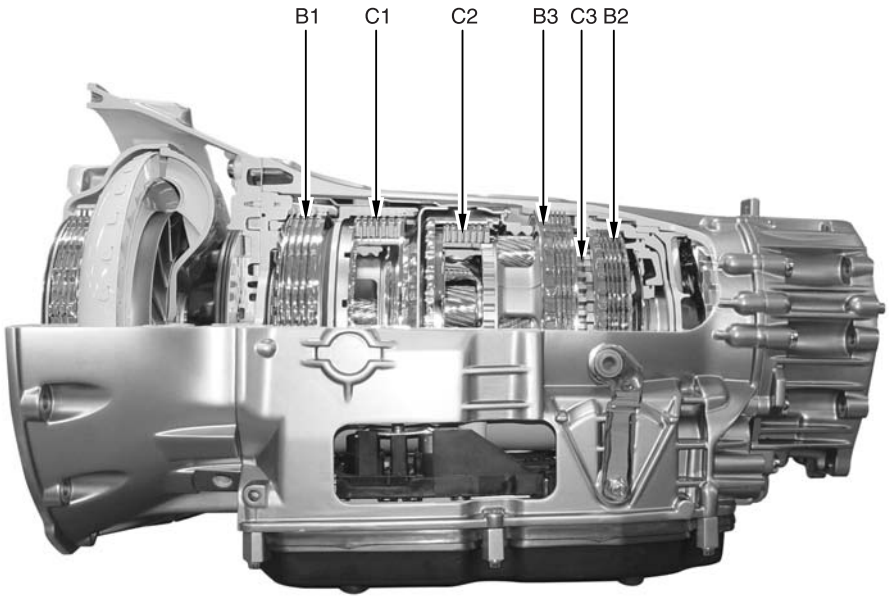
Item		W5A330 (300)	W5A580 (400)
Mode switch		W (Winter)	
		S (Standard)	
One-way clutch		F1, F2	
Planetary gear set	Plain planetary gear: 3 (number of pinion)	3, 4, 3	4, 4, 4
Disc clutch	Disc: C1, C3	Single, Double	
	Disc: C2	Only Double	
Disc brake	Disc: B1	Single, Double	
	Disc: B2, B3	Only Double	

POWER FLOW

▶ Sectional View



Y220_3A1005

Shifting elements

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

1) Selector program switch: “S” mode

2) Selector program switch: “W” mode

3) Overrun

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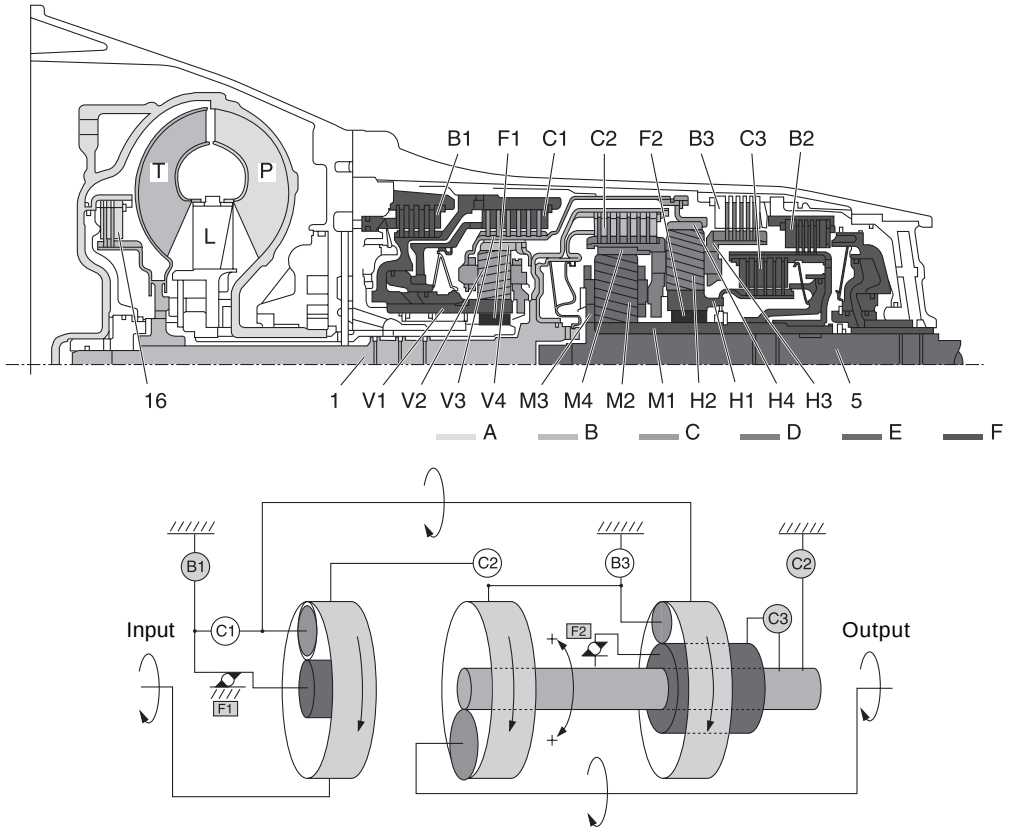
▶ 1st Gear (3.932)



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

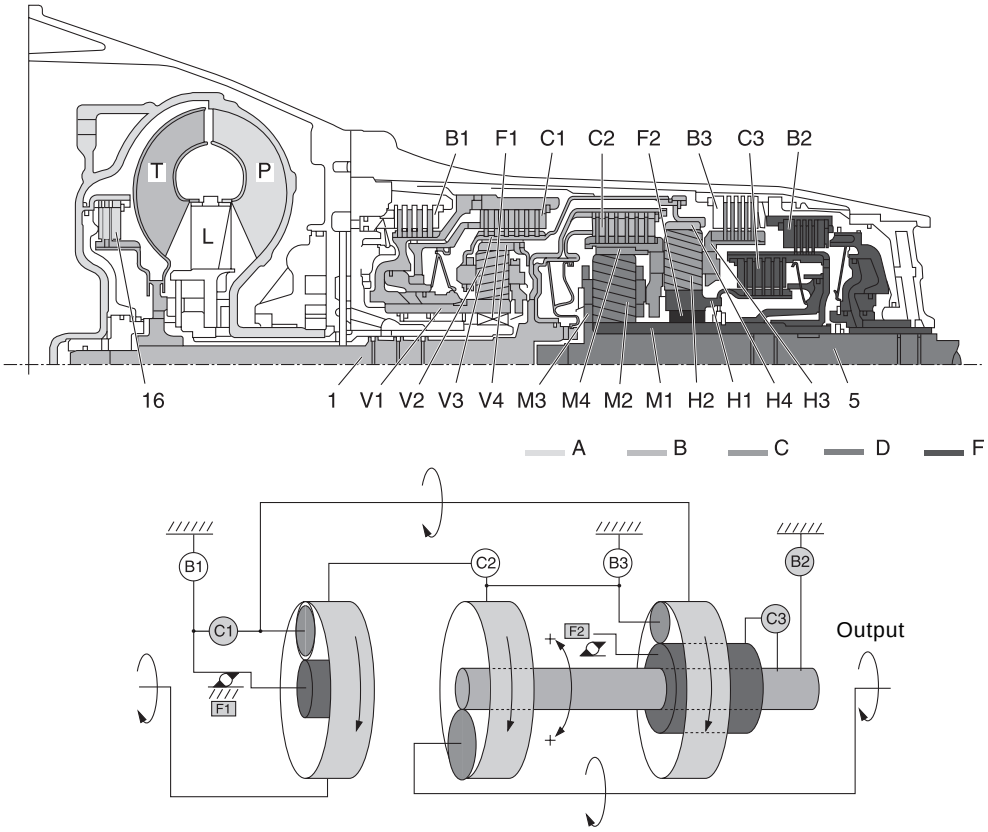
Y220_3A1006

* Input shaft: Clockwise rotation
* Front sun gear: Locked by F1 and B1, Planetary gear carrier: Rotation with reduced speed
* Rear ring gear: Counterclockwise rotation
* Rear sun gear: Locked by F2 and B2, Planetary gear carrier: Clockwise rotation with reduced speed
* Center ring gear: Clockwise rotation
* Center sun gear: Locked by B2, Rotation with reduced speed
* Output shaft: Clockwise rotation

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

3) Overrun

▶ 2nd Gear (2.408)



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

Y220_3A1007

* Input shaft: Clockwise rotation
* Sun gear and planetary gear carrier: Clockwise rotation by C1 activation
* Rear ring gear: Clockwise rotation
* Rear sun gear: Locked by F2 and B2, Planetary gear carrier: Rotation with reduced speed
* Center ring gear: Clockwise rotation
* Sun gear: Locked by B2, Planetary gear carrier: Rotation with reduced speed
* Output shaft: Clockwise rotation

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

3) Overrun

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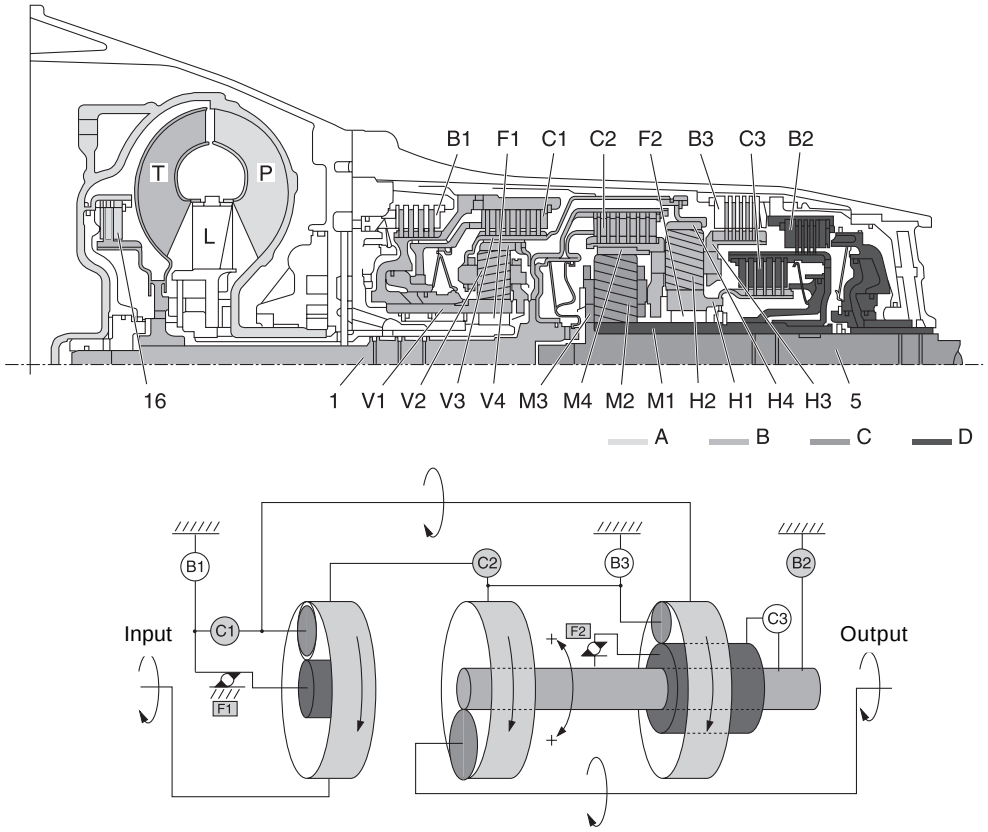
▶ 3rd Gear (1.486)



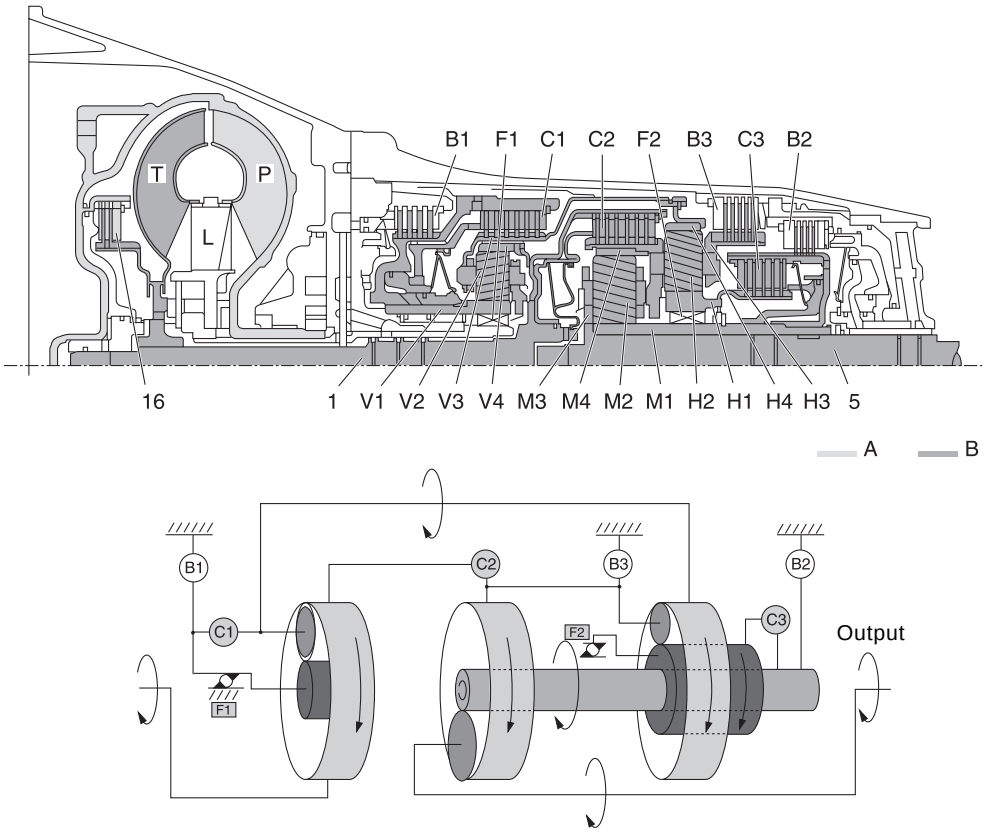
16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. Mounting elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

Y220_3A1008

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

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

▶ 4th Gear (1.000)



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

Y220_3A1009

* Input shaft: Clockwise rotation
* Front ring gear: Clockwise rotation
* Center ring gear and rear planetary gear carrier: Clockwise rotation
* Front sun gear and planetary gear carrier: Clockwise rotation (direct connection)
* Rear ring gear: Clockwise rotation
* Rear sun gear: Rotation by ring gear and planetary gear carrier (direct connection)
* Center ring gear: Clockwise rotation by C3 activation
* Planetary gear carrier: Clockwise rotation by center sun gear and ring gear (direct connection)
* Output shaft: Clockwise rotation

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

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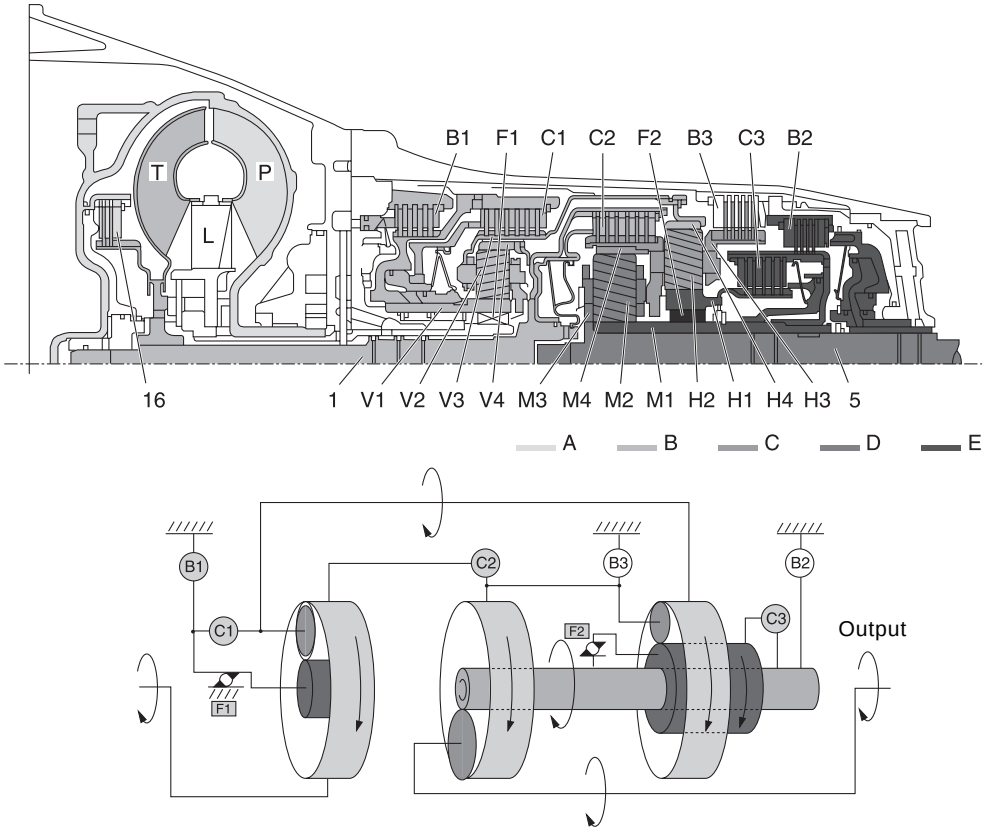
▶ 5th Gear (0.830)



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

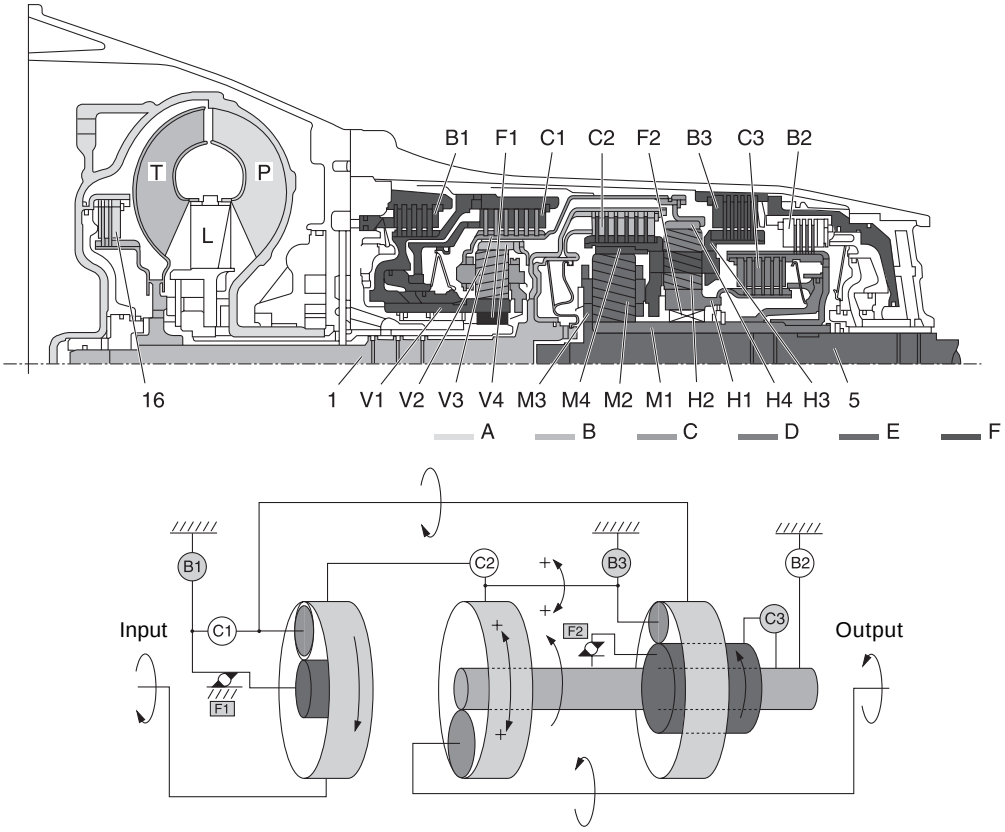
Y220_3A1010

* Input shaft: Clockwise rotation
* Front sun gear: Locked, Planetary gear carrier: Rotation with reduced speed
* Rear planetary gear carrier: Clockwise rotation with reduced speed
* Center ring gear and rear planetary gear carrier: Clockwise rotation by clutch C2 activation
* Rear sun gear: Clockwise rotation because rear planetary gear carrier rotates faster than rear ring gear (increased speed)
* Center sun gear: Clockwise rotation with increased speed by C3 activation
* Center planetary gear carrier: Clockwise rotation (increased speed)
* Output shaft: Clockwise rotation (increased speed)

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

3) Overrun

▶Reverse 1st Gear (3.160, “S” Mode)



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

Y220_3A1011

* Input shaft: Clockwise rotation
* Front ring gear: Clockwise rotation
* Front sun gear: Locked by one-way clutch F1
* Front planetary gear carrier: Clockwise rotation (reduced speed)
* Rear planetary gear ring gear: Clockwise rotation
* Rear planetary gear carrier: Locked by B3
* Rear sun gear and center sun gear: Counterclockwise rotation (increased speed)
* Center ring gear: Locked by B3
* Center planetary gear carrier: Counterclockwise rotation (reduced speed)
* Output shaft: Counterclockwise rotation

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

3) Overrun

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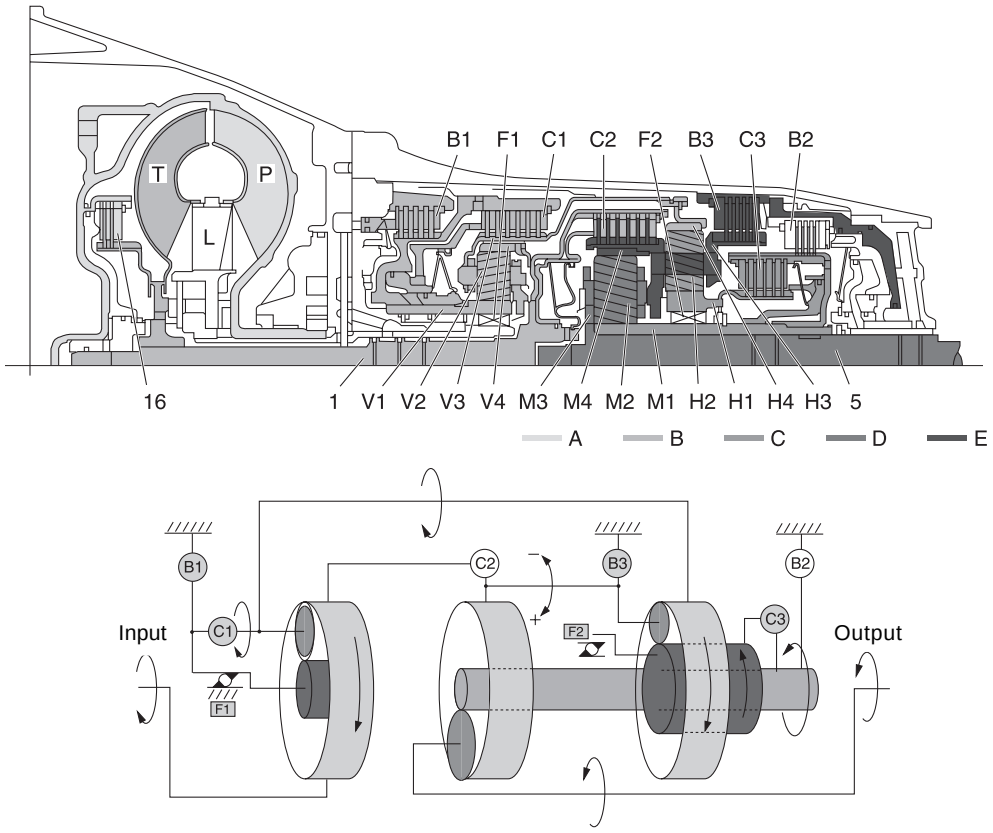
▶ Reverse 2nd Gear (1.930, "W" Mode)



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

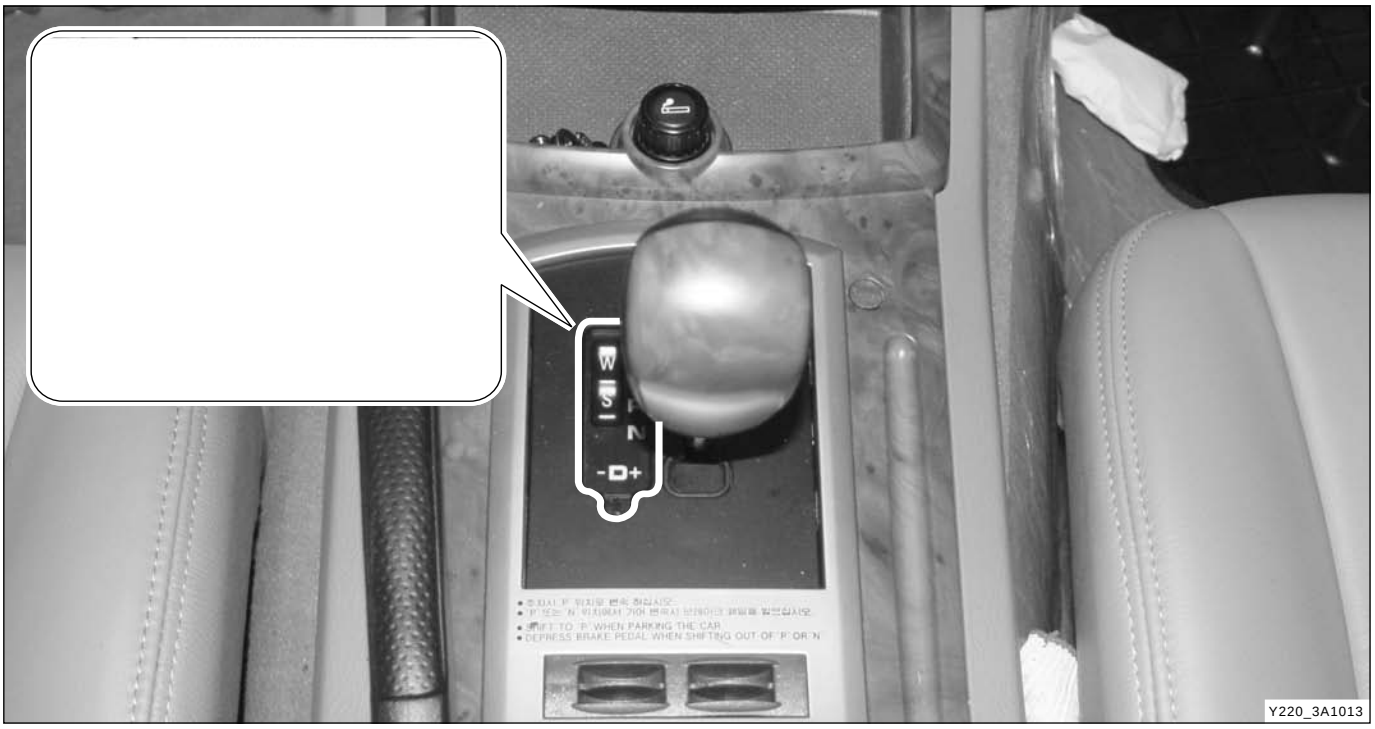
Y220_3A1012

* Input shaft: Clockwise rotation
* Front ring gear: Clockwise rotation
* Front planetary gear carrier: Clockwise rotation by clutch C1 activation (direct connection)
* Rear ring gear: Clockwise rotation
* Rear planetary gear carrier and center ring gear: Locked by brake B3
* Rear sun gear and center sun gear: Counterclockwise rotation (increased speed)
* Center planetary gear carrier: Counterclockwise rotation (reduced speed)
* Output shaft: Counterclockwise rotation

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

FUNCTION AND DESCRIPTION

SELECTOR LEVER



P: Parking and starting position

This position is used when the vehicle is parking, starting the engine or stationing the vehicle. In this position, the driving wheels are locked by parking pawl. To shift into any other positions, must depress the brake pedal (parking lock system).

R: Reverse driving

Conversion between Standard and Winter switch changes the reverse gear ratio but must be operated before the selector lever is moved. Pressing on the Winter switch allows to have effective driving when driving on the slippery road surface and, also, possible to have smooth driving in reverse as it starts in 2nd gear.

N: Neutral, starting and towing position

The engine can be started in this position. And, this position is used in temporary stop. If it is necessary to tow a vehicle, use a professional tow truck service. If not available, use emergency towing by towing vehicle and lope. In this case, the towing distance should be limited by 50 km with 50 km/h of towing speed.

D: All forward gears (1st ~ 5th)

This position is for all normal forward driving in 1st to 5th gear. At 5th gear, the gear ratio is 0.83:1. When driving forward at the speed of over 10 km/h, the selector lever cannot be changed to “P” or “R” position by parking reverse block function.

4: Up shifting only up to 4th gear

In general, up to 4th gear is automatically shifted at the normal road driving position. In “D” position, while driving, pushing the lever in the left (–) direction once makes down shift to 4th gear, which is the same function as the O/D OFF (Over Drive OFF) of normal vehicle.

3: Up shifting only up to 3rd gear

Automatically shifts up to only 3rd gear and able to achieve engine brake effect on long slope/down hill and, in “D” position, pushing the lever in the left (–) direction twice makes down shift from 5th gear to 3rd gear.

2: Up shifting only up to 2nd gear

Automatically shifts up to only 2nd gear and used in mountain road, unpaved road and while being towed by trailer. It can achieve engine brake effect and, in D position, pushing the lever in the left (–) direction 3 times makes down shift from 5th gear to 2nd gear.

1: Driving in 1st gear only

Drives only in 1st gear, and used in long mountainous terrain, steep heel and unpaved road. It is used when engine brake effect for driving down hill is required.

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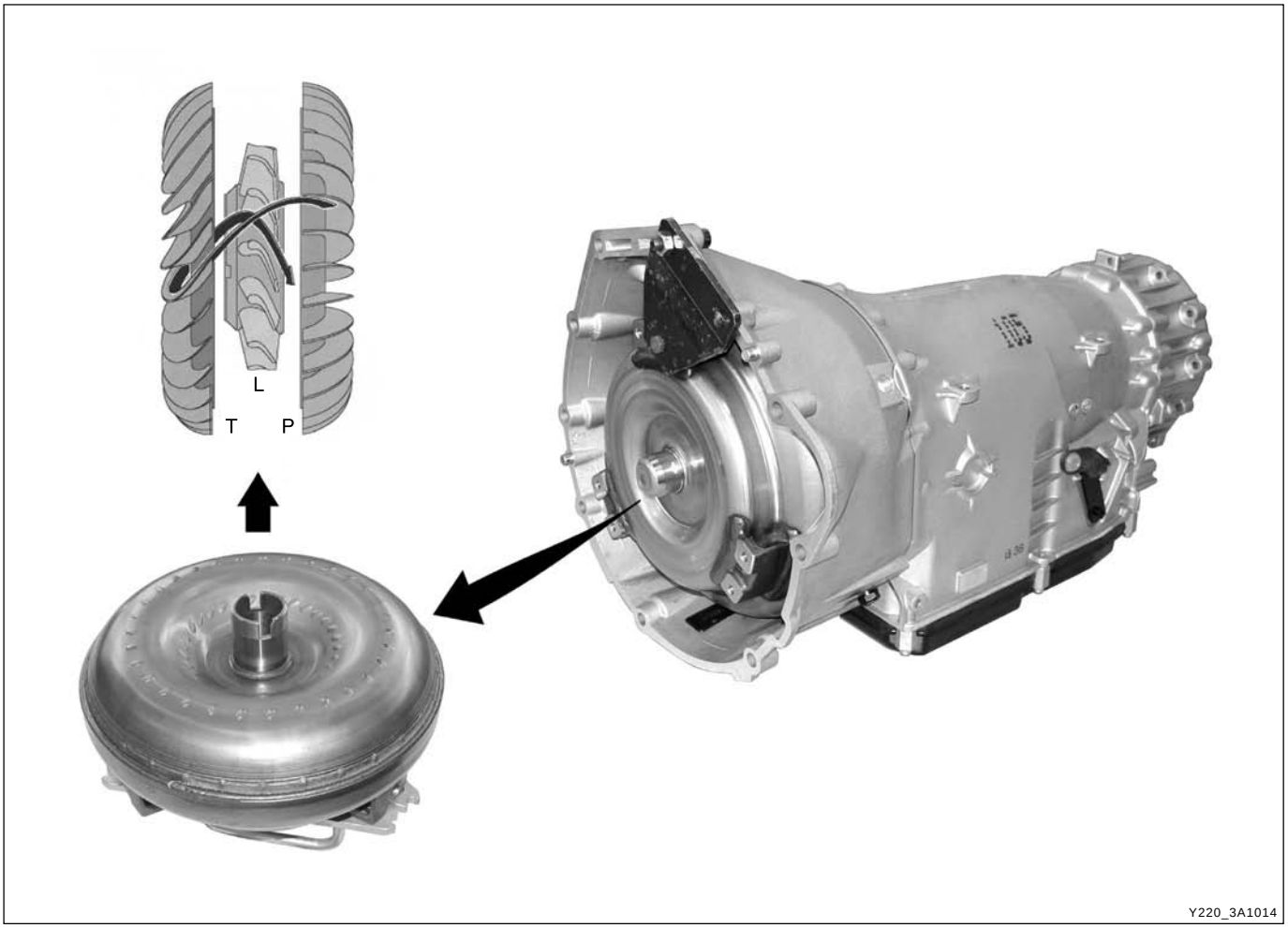
TORQUE CONVERTER

▶ Function (4WD)



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

The torque converter converts the mechanical energy from engine to hydraulic energy, and the turbine connected to transmission input shaft converts this hydraulic energy to mechanical energy again. The stator between pump and turbine increases the output torque from turbine by converting the flowing direction.

The stator has a torque converter area that changes the flowing direction and a fluid coupling area where the stator rotates. And, the lockup clutch integrated in torque converter prevents the power from losing and reduces fuel consumption.

Installation and Inspection

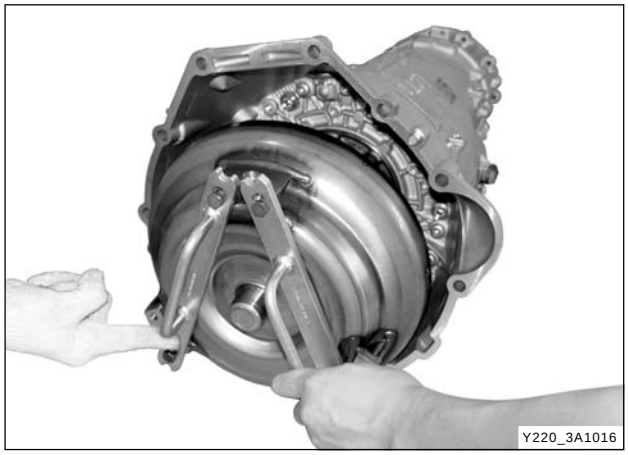
- Place the automatic transmission upright as shown in figure and install the torque converter by rotating the torque converter. When installing from sideway, the torque converter sealing ring may be damaged by driving flange which could cause oil leaks.

- Use special tools when removing and installing torque converter.

Notice

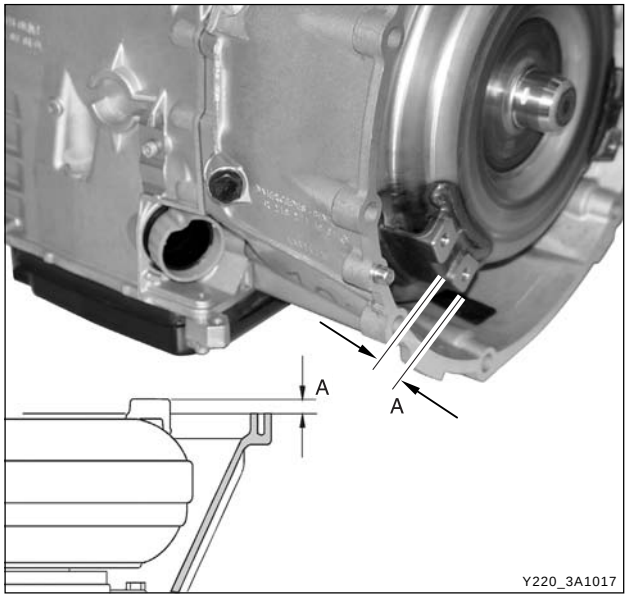
Place the automatic transmission upright when removing and installing torque converter.

If not, the oil seal may be damaged when servicing the torque converter.



- The distance between the upper end of torque converter and the mating surface of automatic transmission housing should be within specified value as follows:

Specified installation height (A)	below 6.5 mm



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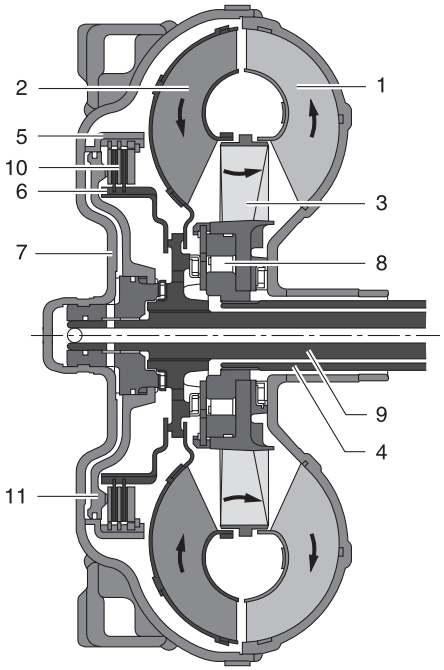
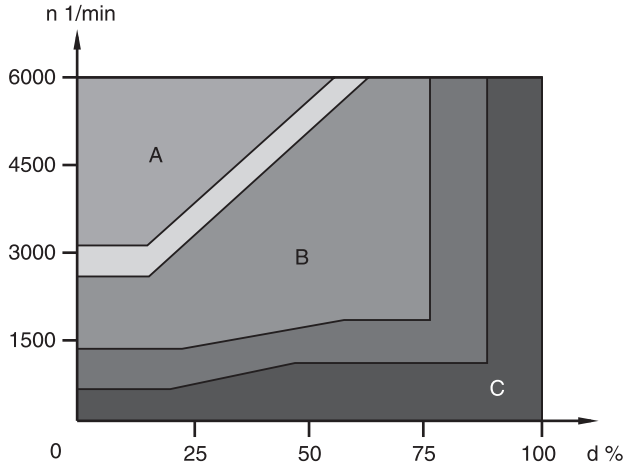
LOCKUP CLUTCH





Y220_3A1018

1. Impeller wheel
2. Turbine wheel
3. Stator wheel
4. Stator shaft
5. Multiple disc clutch drum
6. Multiple disc clutch hub
7. Converter cover
8. One-way clutch
9. Input shaft
10. Multiple disc clutch pack
11. Piston

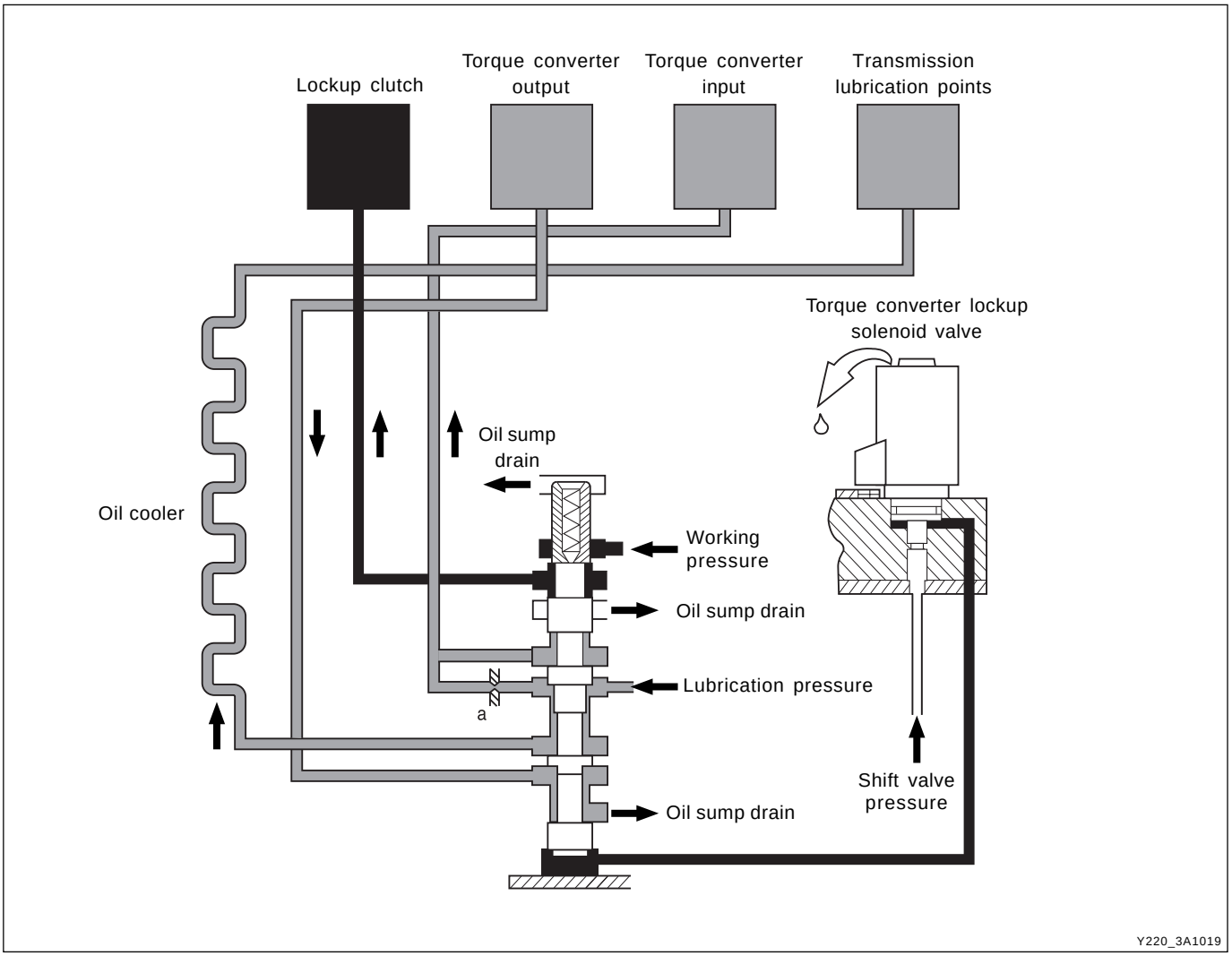
A : Closed (lockup clutch activates)
B : Slipping
C : Open (lockup clutch deactivates)
n : Transmission output speed
d : Accelerator pedal position

Lockup clutch consists of multiple disc clutches as shown in the figure and is activated in 3th, 4th and 5th gears. The aim of using torque converter lockup clutch is to reduce the fuel consumption and exhaust gas emissions of the vehicle by reducing torque converter slip. This stands in contradiction to the ride comfort demands made on the drive train with regard to its vibration behaviors. The task of the electronic transmission control is therefore to close the clutch in all driving situations relevant to fuel consumption, if possible, and ensure that the engine vibrations are isolated from the drive train.

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

- Variables influencing the states of the torque converter lockup clutch:
  1. Accelerator pedal movement
  2. Uphill and downhill gradients
  3. Transmission shift functions
  4. Transmission oil temperature
  5. Load conditions
  6. Engine control influences

▶ Lockup Clutch Regulating Valve



Lockup clutch regulating valve controls the lockup clutch in torque converter and distributes the lubricating oil to the friction parts. TCU generates the lockup clutch control pressure by duty controlling the lockup solenoid valve, and this pressure is applied to the lockup clutch regulating valve to engage, disengage and slip the lockup clutch. When the lockup clutch control pressure is increased, the lockup clutch regulating valve moves up and the working pressure is applied to lockup clutch. In its regulating position (slipping, torque converter lockup clutch pressurized), a reduced volume of lubricating oil flows through the annular passage bypassing the torque converter and passing direct through the oil cooler into the transmission. The rest of the lubricating oil is directed via the throttle “a” into the torque converter in order to cool the torque converter lockup clutch.

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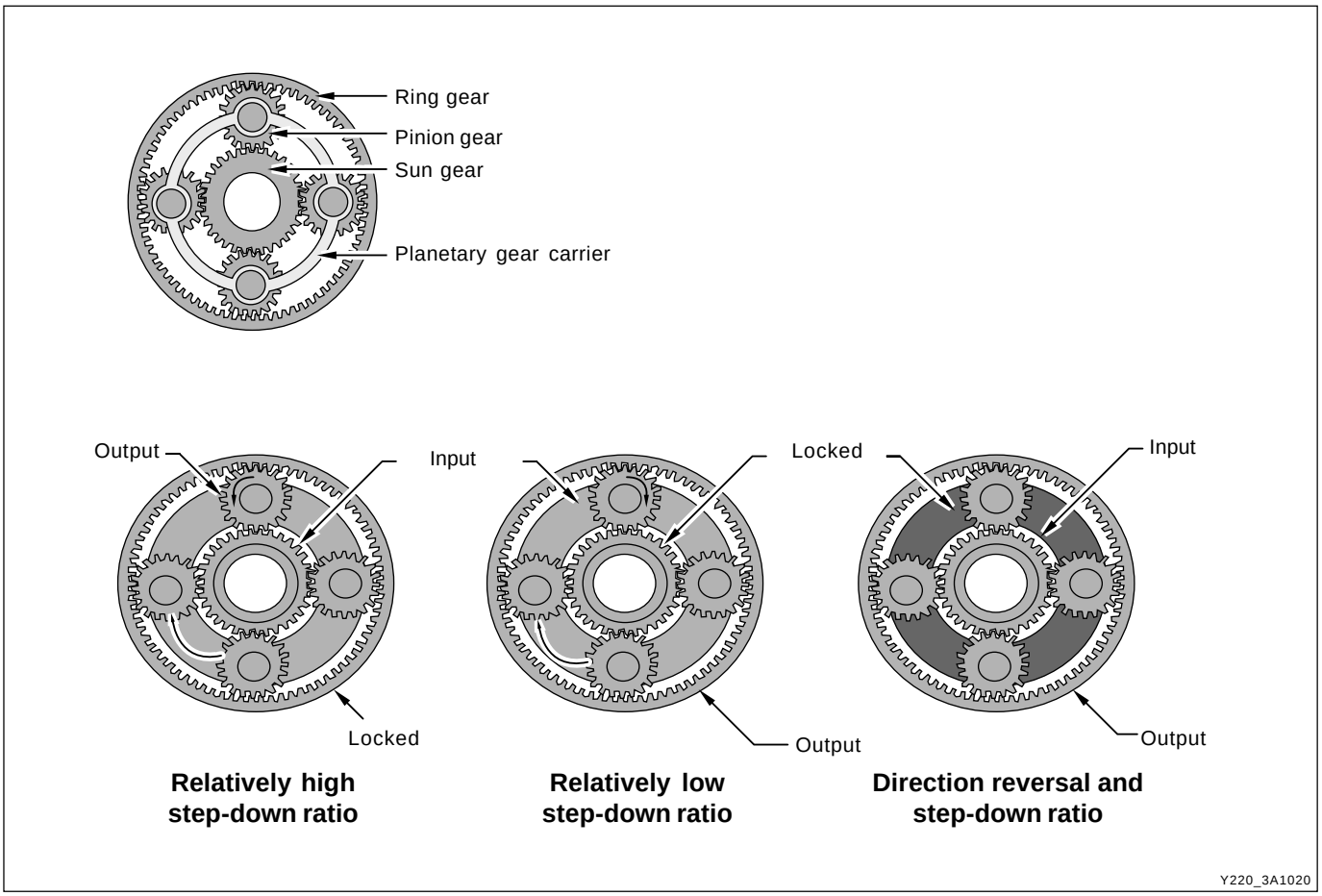
PLANETARY GEAR SET



Relatively high step-down ratio

Ring gear locked

Sun gear driving (clockwise)

Planet gears driven (rotating counterclockwise)

Planet carrier driven (revolving clockwise)

Relatively low step-down ratio

Sun gear locked

Ring gear driving (clockwise)

Planet gears driven (rotating clockwise)

Planet carrier driven (revolving clockwise)

Direction reversal and step-down ratio

Planet carrier locked

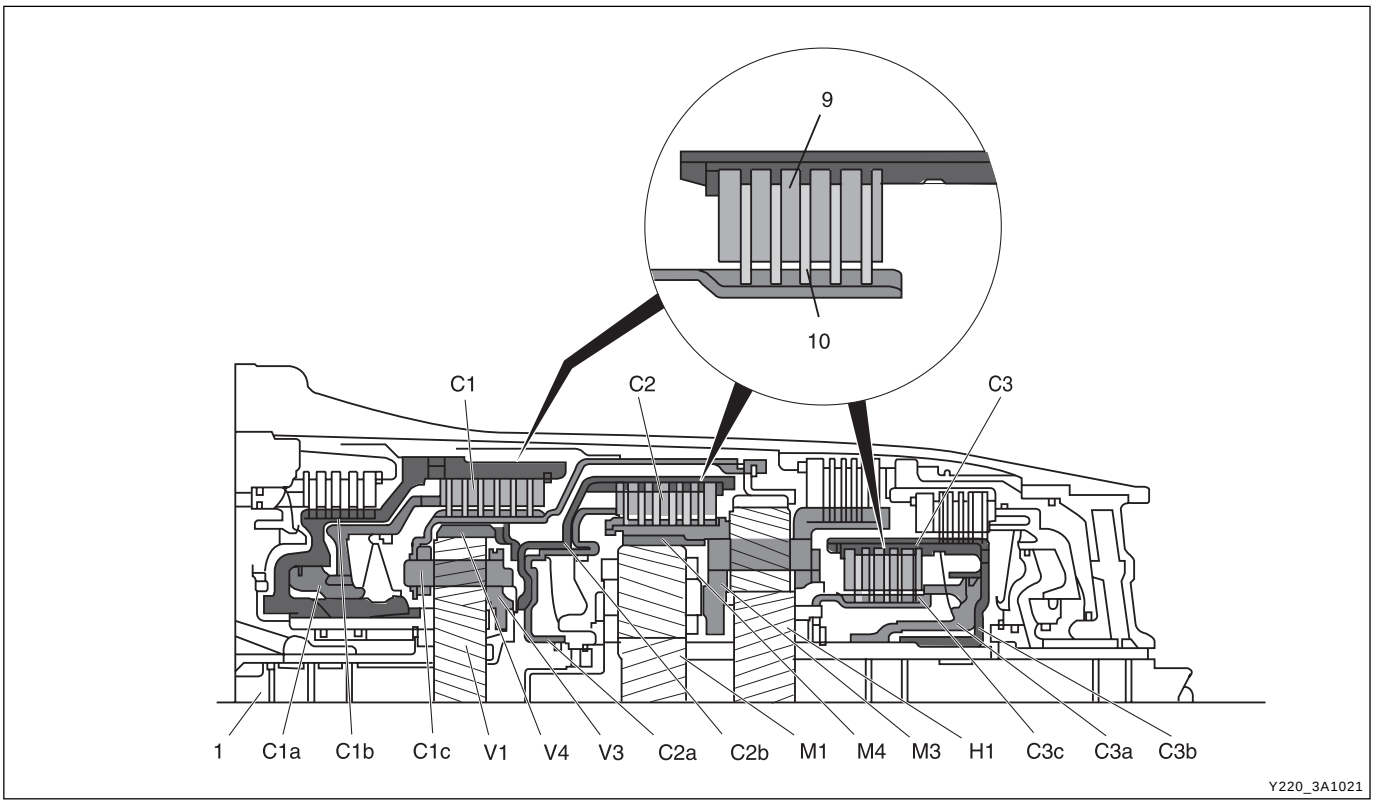
Sun gear driving (clockwise)

Planet gears driven (counterclockwise)

Ring gear driven (counterclockwise)

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

MULTIPLE-DISC CLUTCH



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

Location

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

Funtion and description

A multiple-disc clutch consists of a number of internally toothed discs (10) on an internally toothed disc carrier and externally toothed discs (9) on an externally toothed disc carrier.

If the piston (C1a) on multiple-disc clutch K1 is subjected to oil pressure, it presses the internal and external discs of the disc set together. The sun gear (V1) is locked with the planet carrier (V3) via the externally toothed disc carrier (C1b) and the internally toothed disc carrier (C1c). The front planetary gear set is thus locked and turns as a closed unit. If the multiple-disc clutch C2 is actuated via the piston (C2a), the piston compresses the disc set. The ring gear (V4) of the front planetary gear set is locked with the ring gear (M4) of the middle planetary gear set via the externally toothed disc carrier (K2b) and the middle planet carrier (M3) on which the internally toothed discs are seated. Ring gear (V4) and ring gear (M4) turn at the same speed as the input shaft (1). If the multiple-disc clutch C3 is actuated via the piston (C3a), the piston compresses the disc set. The sun gear (M1) of the middle planetary gear set is locked with the sun gear (H1) of the rear planetary gear set via the externally toothed disc carrier (C3b) and the internally toothed disc carrier (C3c). Sun gear (M1) and sun gear (H1) turn at the same speed.

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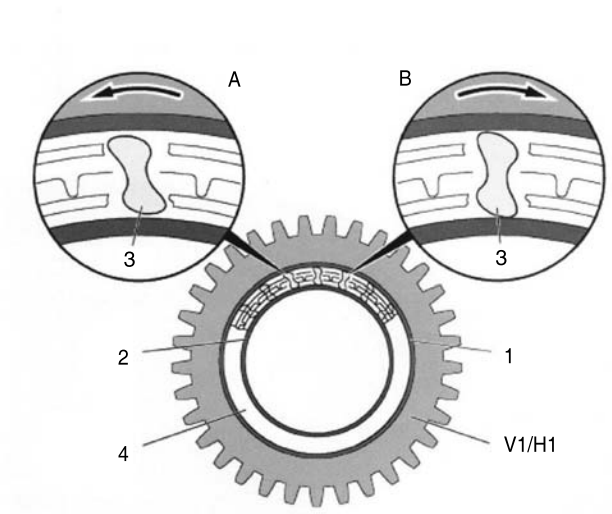
FREEWHEEL



Y220_3A1022

1. Outer race
2. Inner race
3. Locking elements
4. Locking element cage

A. Rotation direction “A”
B. Rotation direction “B”
V1/H1. Front or rear sun gear

Location

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

Function and description

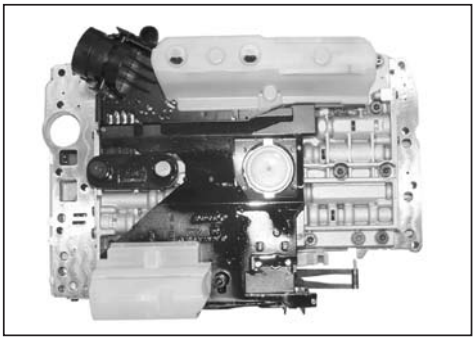
The freewheel consists of an outer race (1), an inner race (2), a number of locking elements (3) and a cage (4) for these locking elements.

If the inner race (2) of the freewheel is locked and the outer race (1) turns in direction “A”, the locking elements (3) adopt a diagonal position on account of their special contours, allowing the freewheel function.

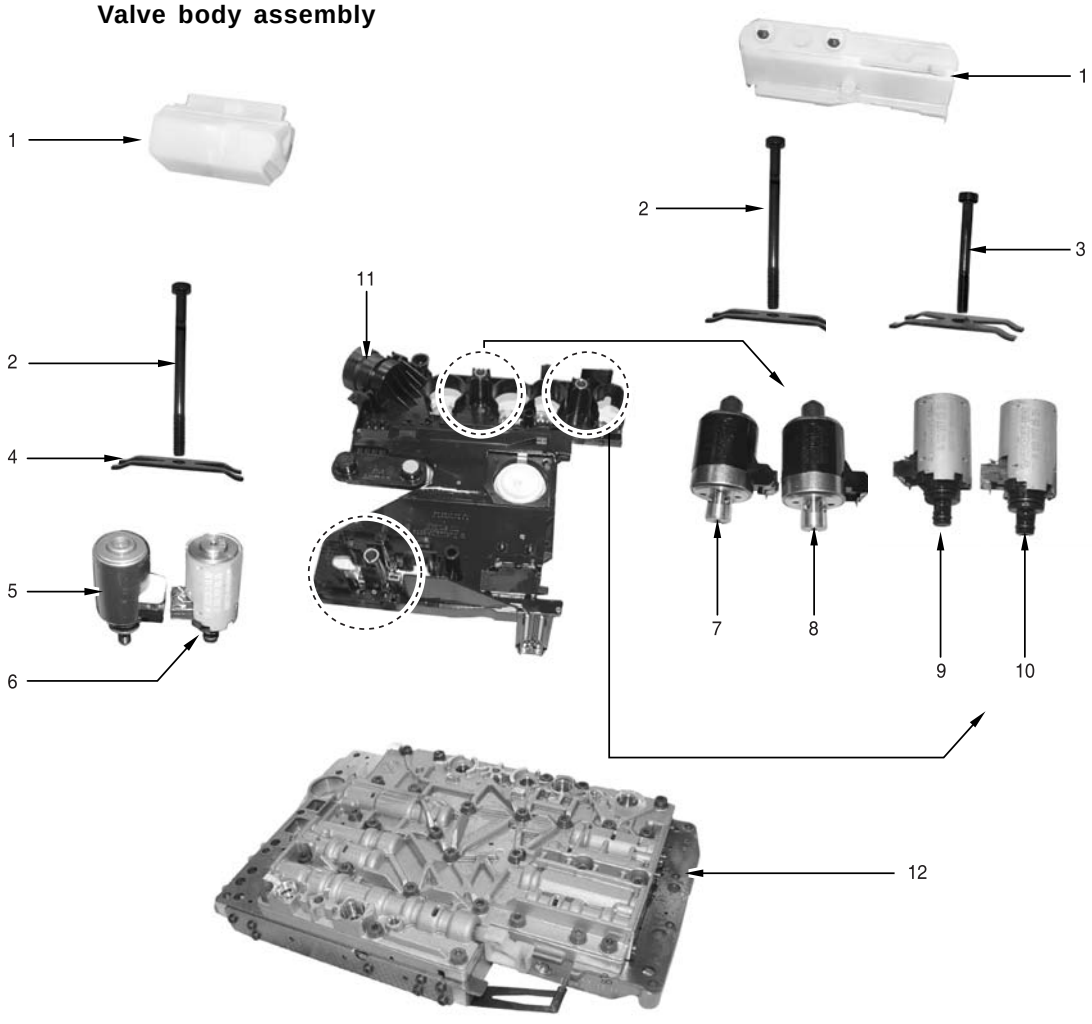
The outer race (1) slides over the locking elements (3) with negligible friction. If the rotation of the outer race (1) changes to direction “B”, the locking elements (3) stand up and lock the outer and inner races (1, 2) together.

SENSORS AND CONTROLS

▶ Components



Valve body assembly



Y220_3A1023

1. Cap
2. Socket bolt (M6 x 32)
3. Socket bolt (M6 x 30)
4. Leaf spring
5. Lockup PWM solenoid valve
6. 2-3 shift solenoid valve
7. Shift pressure (SP) solenoid valve
8. Modulating pressure (MP) solenoid valve
9. 1-2/4-5 shift solenoid valve
10. 3-4 shift solenoid valve
11. Electronic control module
12. Lockup clutch control solenoid valve

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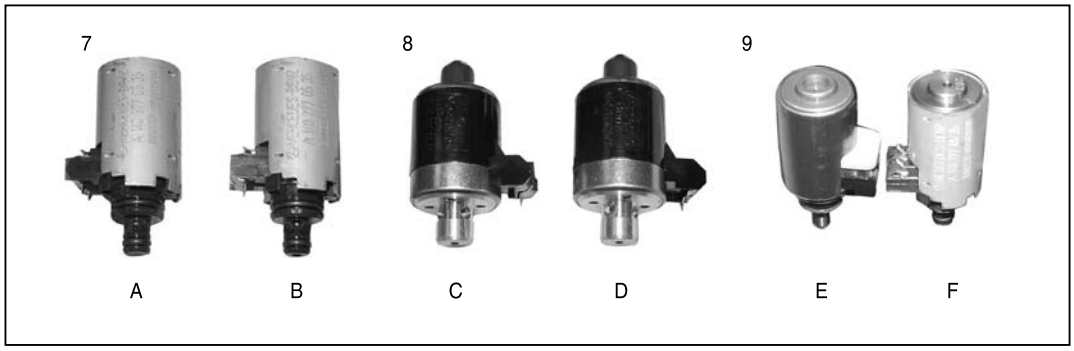
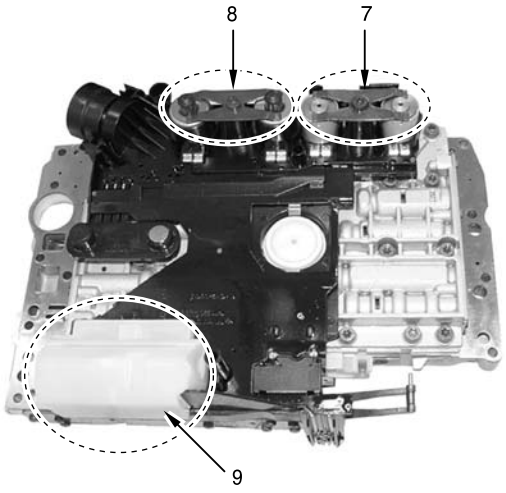
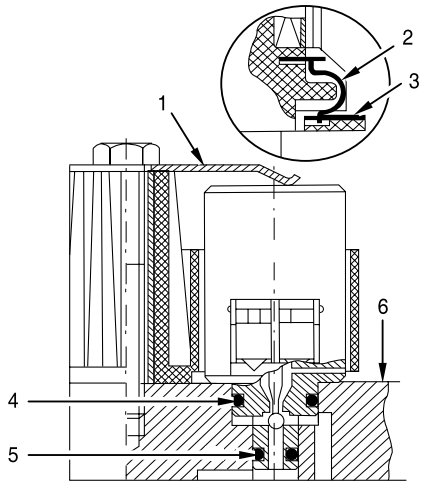
▶ Shift Pressure Control Solenoid Valve







Y220_3A1024

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

Function

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

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

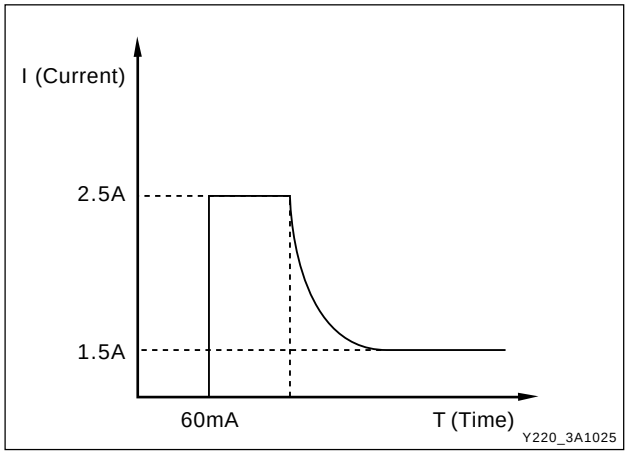
Three up/downshift solenoid valves are installed on the top of hydraulic control unit.

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

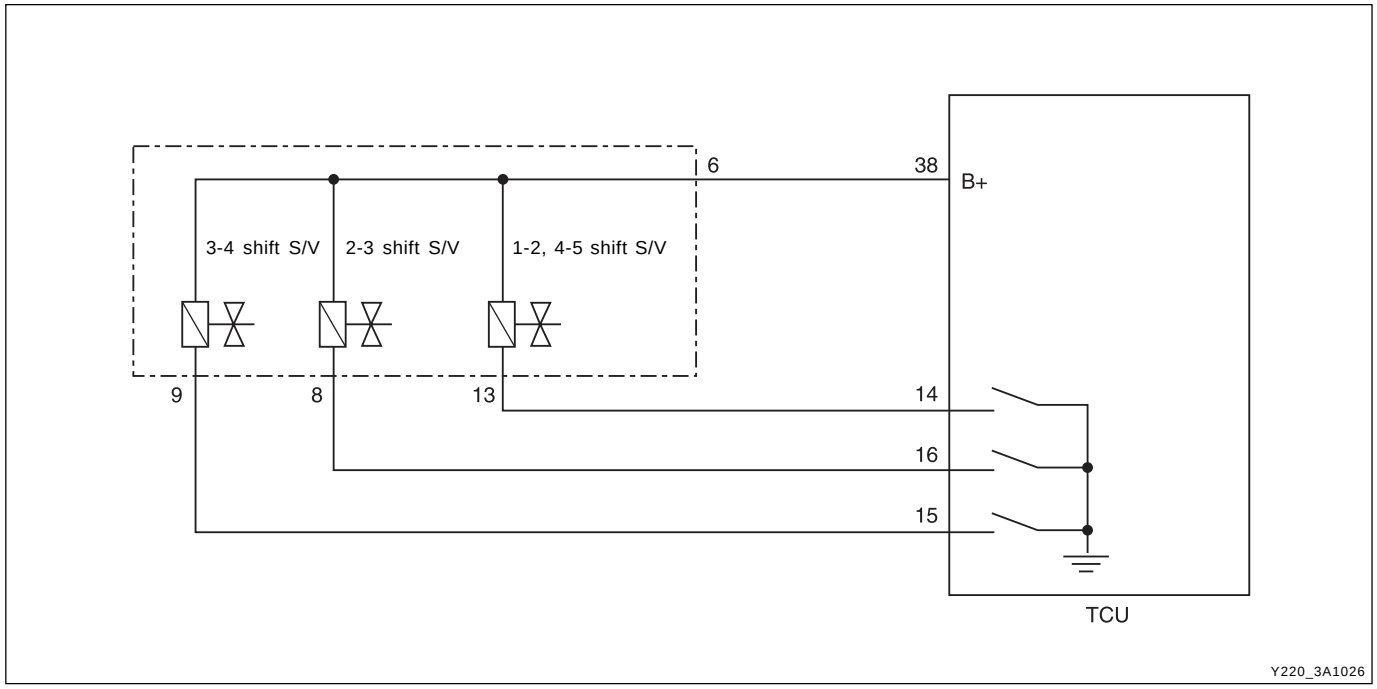
Characteristics of up/downshift solenoid valve

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

Working Current	1.5 ~ 2.0 A
Operating distance	0.2 mm
Resistance	3.8 ± 0.2 Ω (25°C)



Circuit diagram



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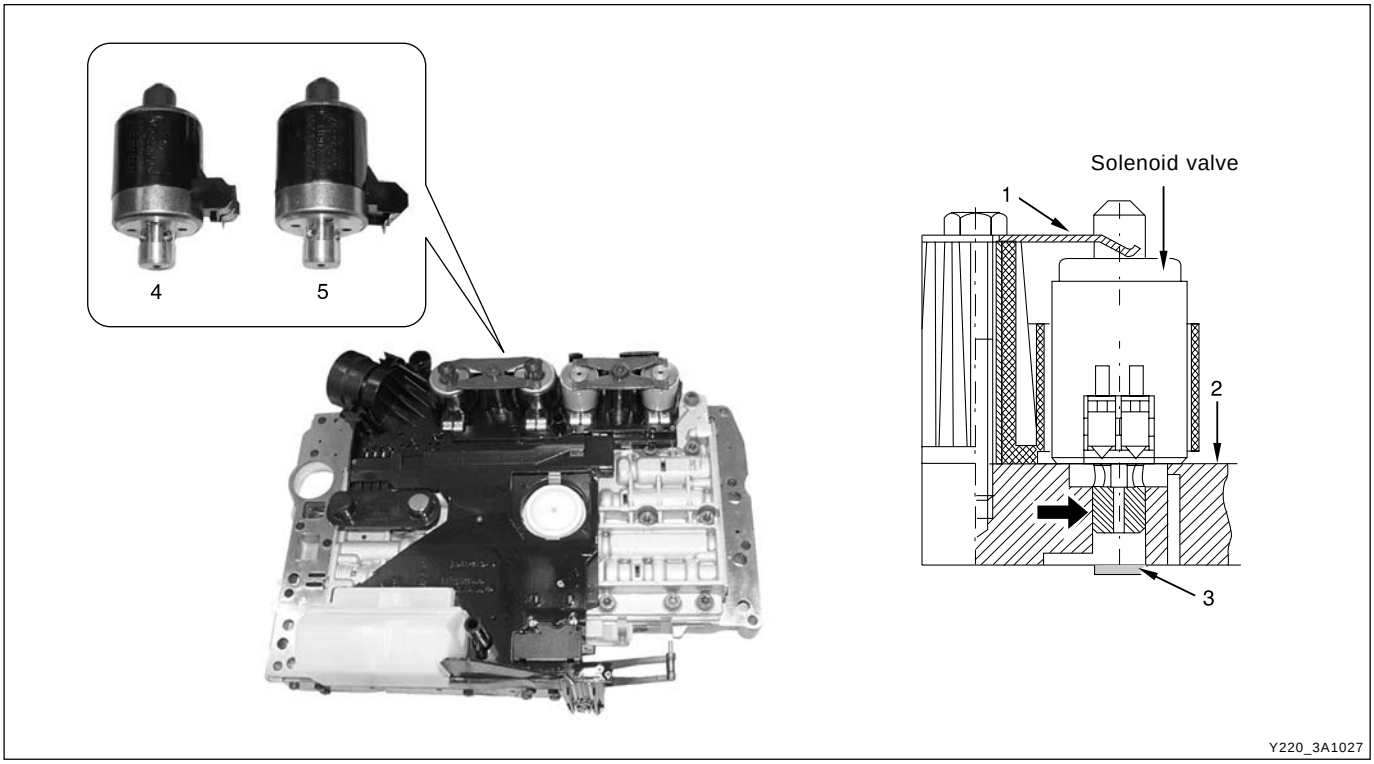
▶ Modulating Pressure (MP) and Shift Pressure (SP) Control Solenoid Valve



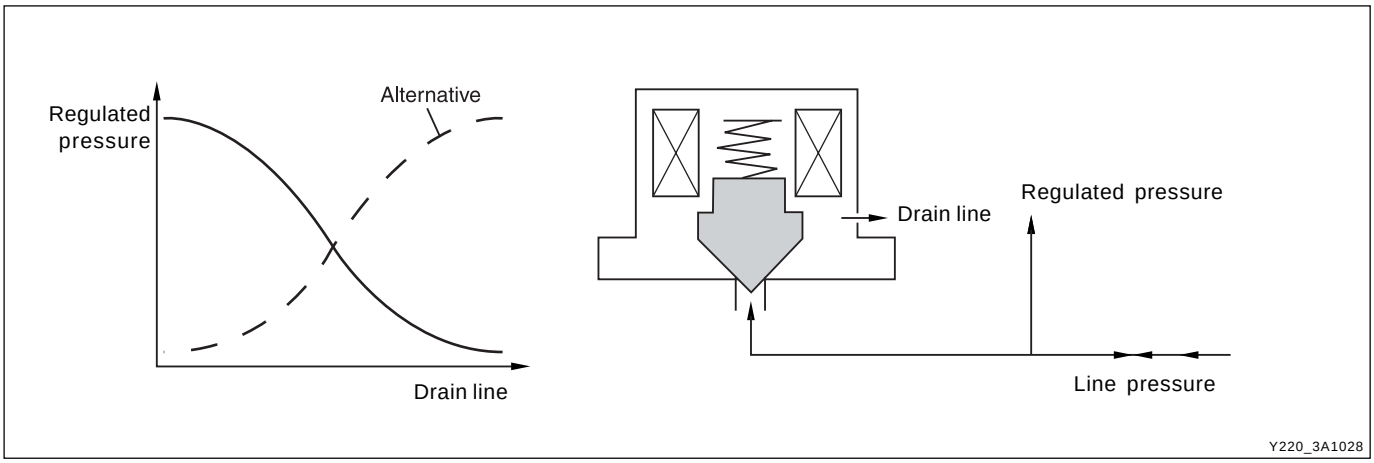
1. Leaf spring
2. Shift plate
3. Strainer
4. MP control solenoid valve
5. SP control solenoid valve

Function

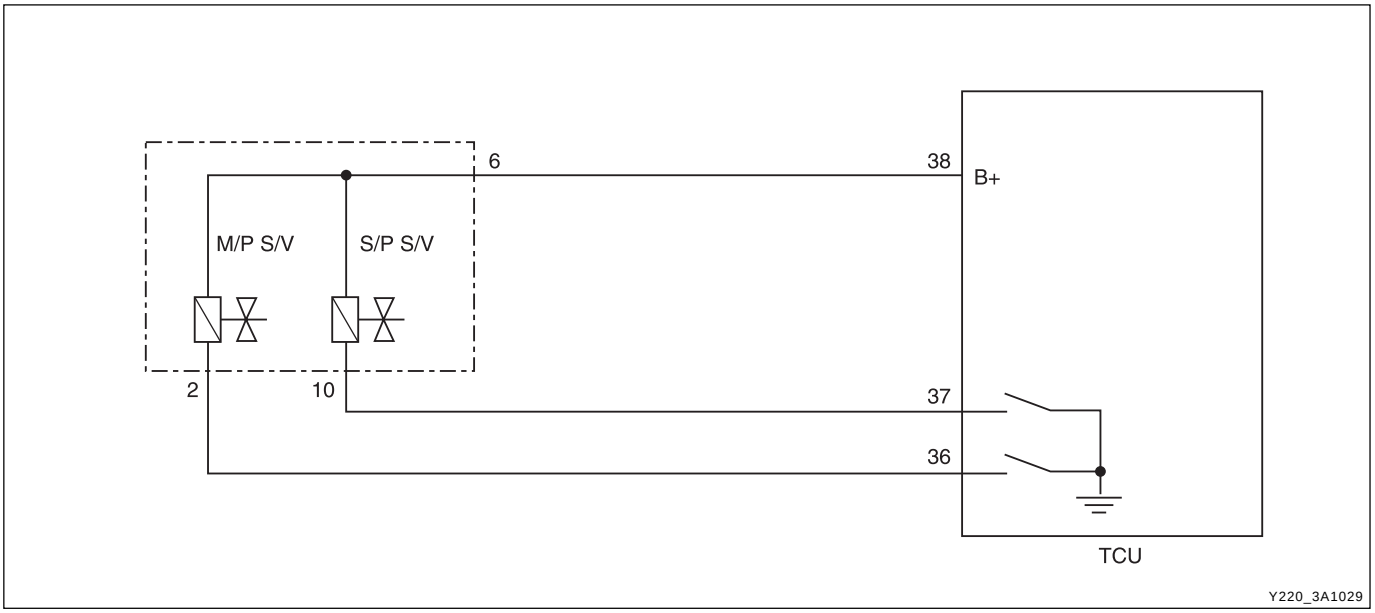
These valves control the modulating pressure and the shift pressure by applying appropriate electric current to solenoid valves according to driving condition of engine and transmission.

When the electric current from TCU is high/low, the regulated pressure decreases/increases.

Working Current	0 ~ 1.0 A
Operating distance	0.6 mm
Resistance	5 ± 0.2 Ω (25°C)



Circuit diagram



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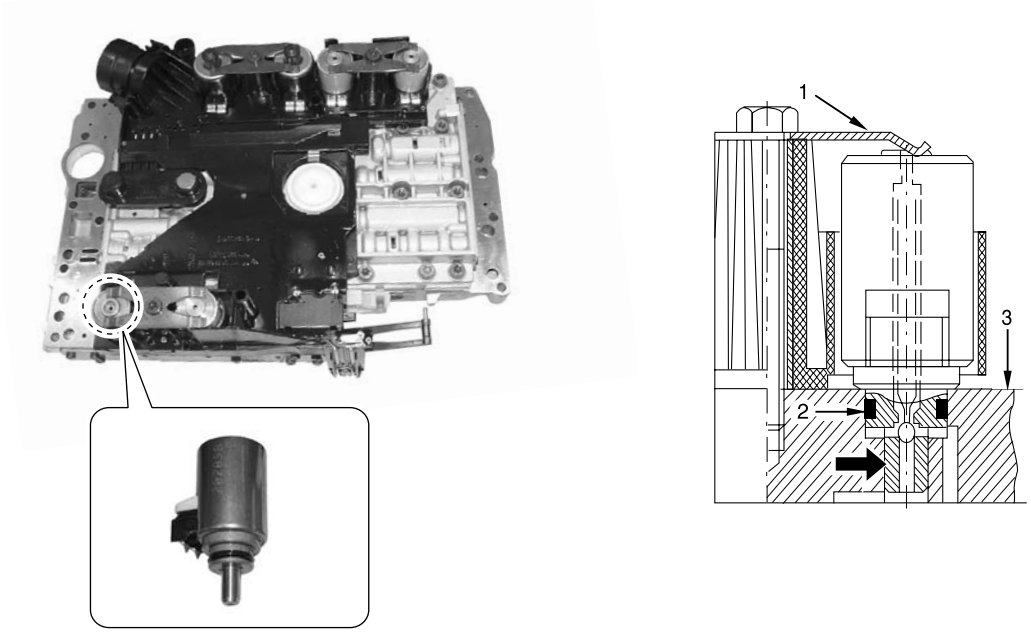
▶ Lockup Solenoid Valve



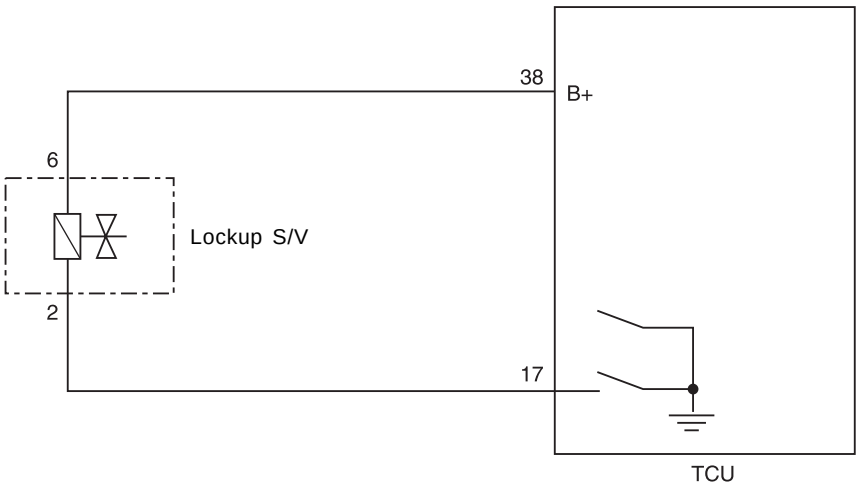
1. Leaf spring
2. O-ring
3. Shift plate

Function

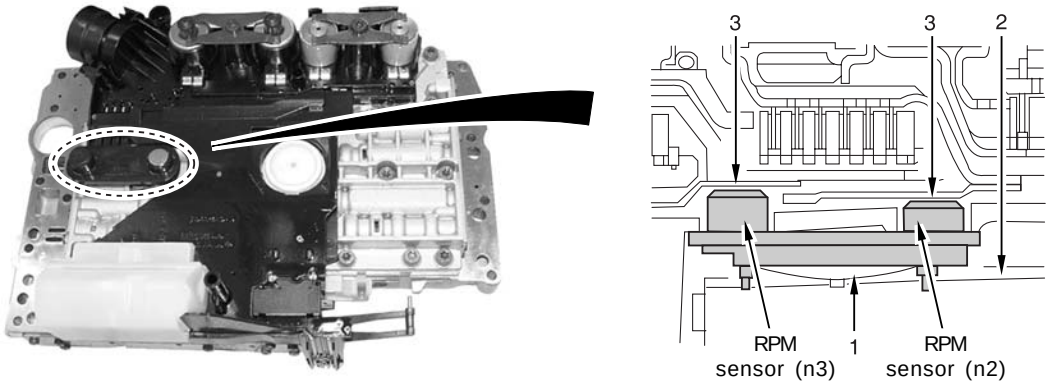
This valve activates and releases the lockup clutch by adjusting the current to solenoid valve according to engine throttle opening value and output shaft speed. The lockup clutch operates in 3rd, 4th and 5th gear with steps to reduce shift shocks.

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

Circuit diagram



▶ RPM Sensor



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

Function

The RPM sensors are fixed to the shell of the hydraulic control unit via the contact tabs. A leaf spring, which rests against the valve body, presses the RPM sensors against the transmission housing. This ensures a precise distance between RPM sensors and impulse rings. RPM sensor (n3) detects the speed of the front sun gear and RPM sensor (n2) detects the speed of the front planetary carrier. If the speed sensor is defective, the transmission is operated in emergency driving mode. Below table shows the detection of speed sensor.

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

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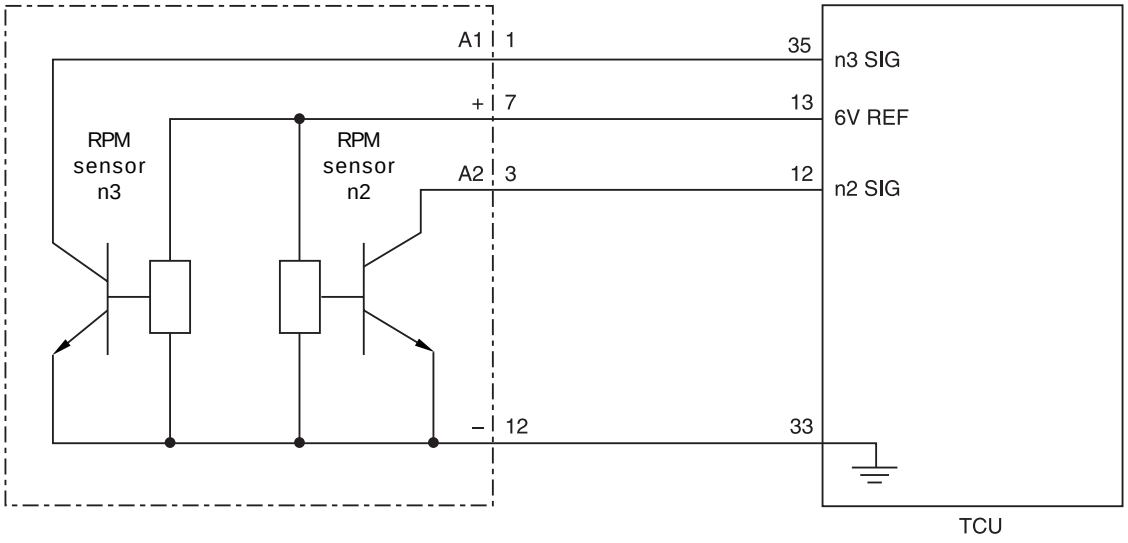
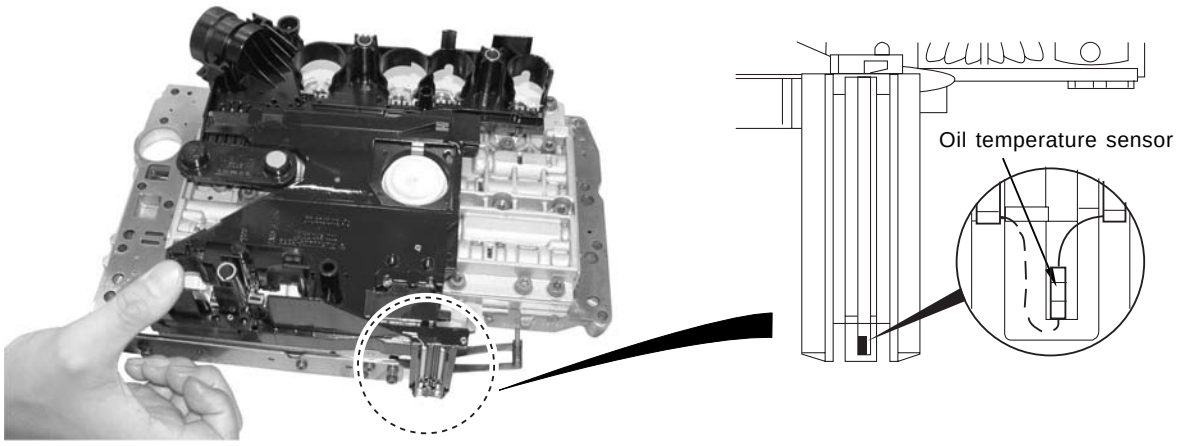
Circuit diagram



▶ Oil Temperature Sensor



Y220_3A1035

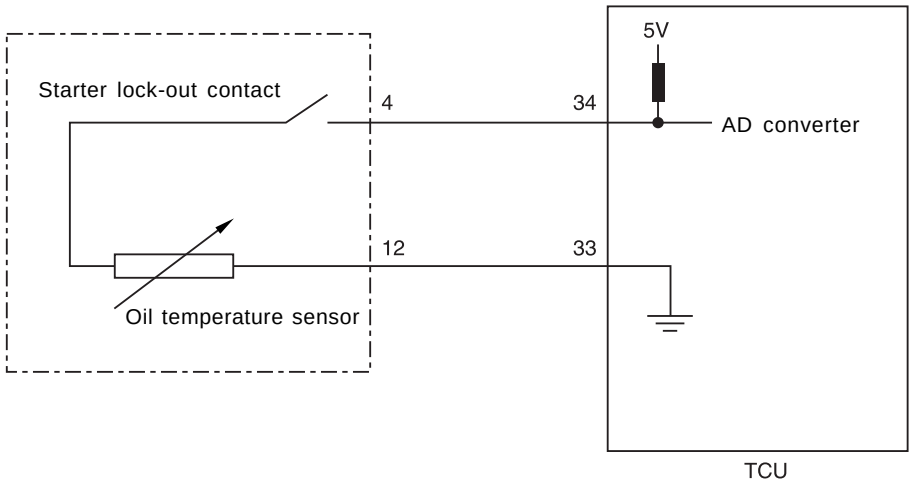
Function

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

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

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

Circuit diagram



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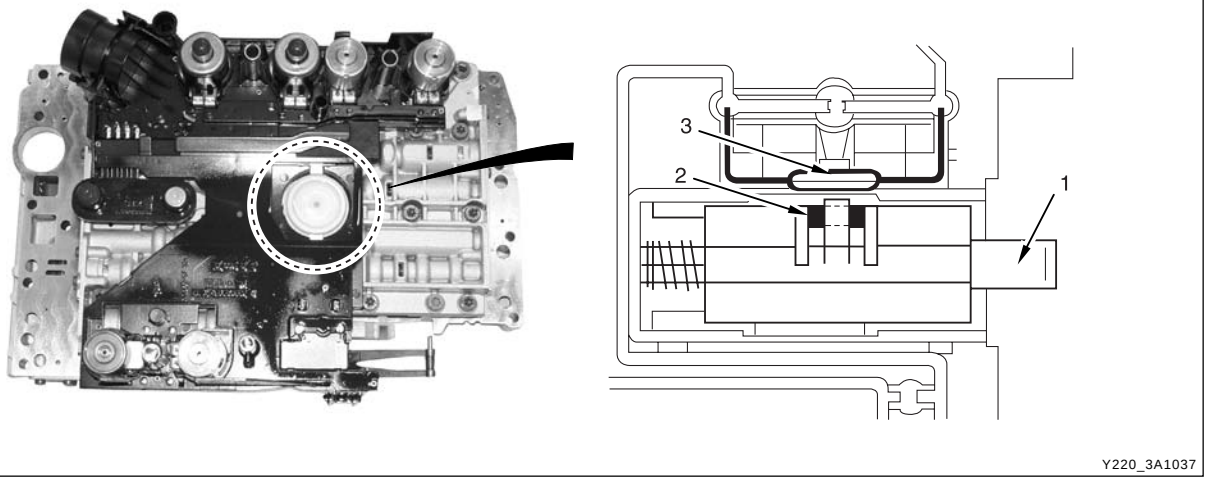
▶ Starter Lock-out Contact



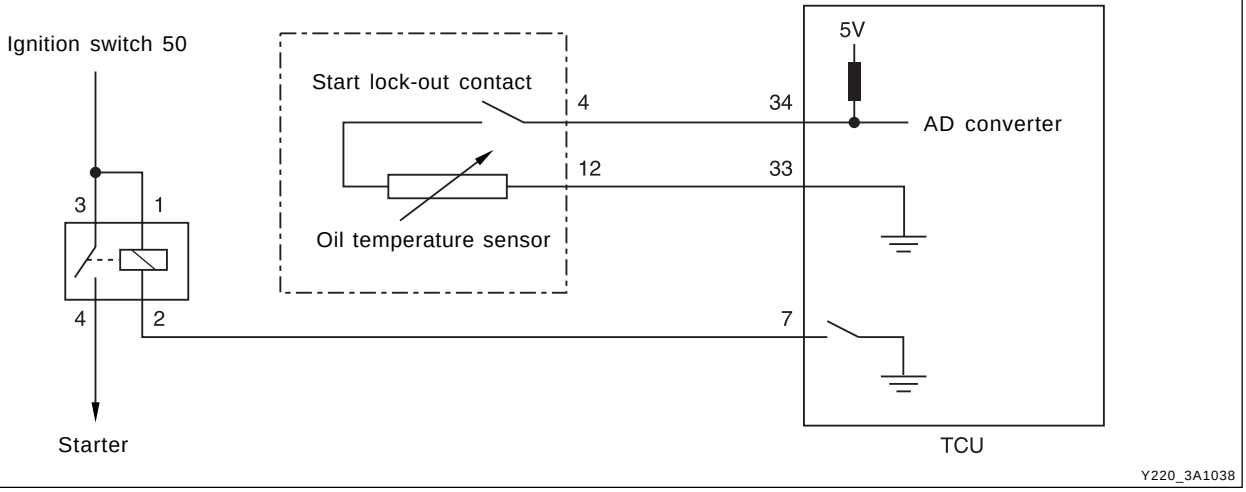
1. Plunger
2. Permanent magnet
3. Reed contact

Function

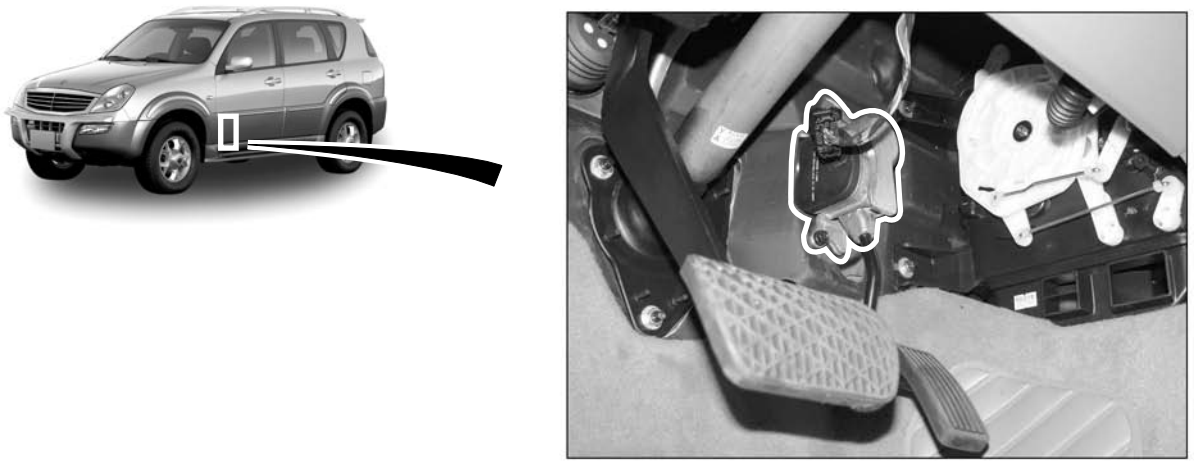
The starter lock-out contact is installed beside oil temperature sensor and is actuated by a cam rail, which is located on the latching plate.

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

Circuit diagram



▶ Kick-down Control



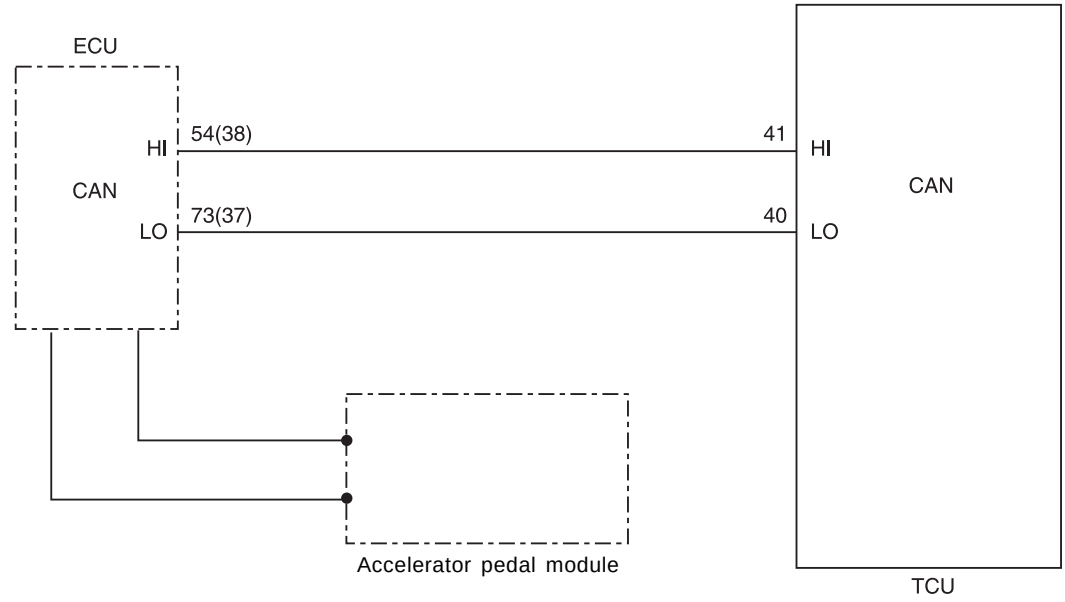
Y220_3A1039

Function

When the throttle valve is partially opened, the shifting point gets faster. When the throttle valve is widely opened, shifting point is delayed because the system needs low speed gear with bigger driving force.

Kick-down control is a system that enables to get bigger driving force as the down shift occurs by suddenly increasing the throttle openings during constant driving. It has no separate kick-down switch where the down shift operates when a certain point (about 1 second) lapses after opening of full throttle. The signal recognition allows to send control signal to TCU from engine ECU via CAN communication.

Circuit diagram



( ) : For gasoline engine

Y220_3A1040

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▶ Mode Switch

Function

The mode switch is installed beside the selector lever and it has two modes of “S” mode (Standard Mode) and “W” mode (Winter Mode).

- “S” mode is used in normal driving (starts off with 1st gear). TCU (Transmission Control Unit) provides pleasant driving by changing the shifting pattern according to the driving habits (downhill gripping: approx. 11 ~ 13.5 %)
- When “W” mode is selected, the Winter mode indicator in meter cluster comes on, and the vehicle starts off with 2nd gear to achieve smooth starting on the icy or slippery road.

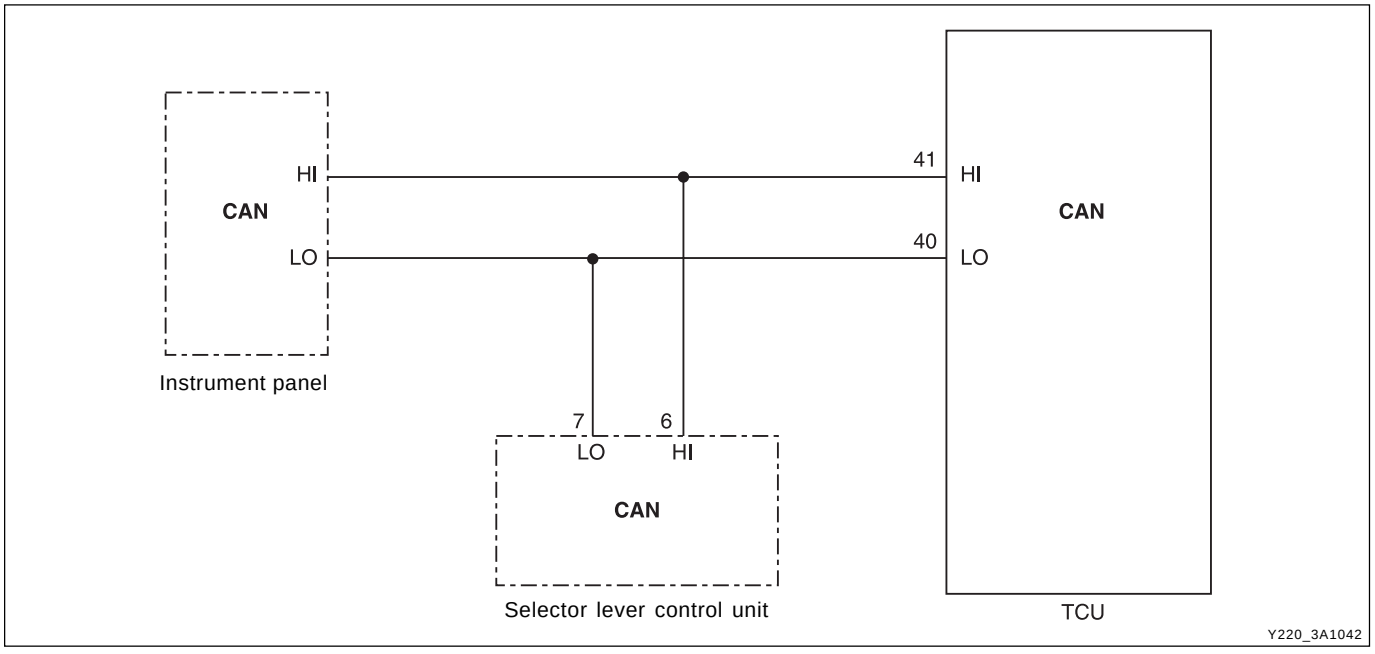
In winter mode, the up shift becomes faster and the down shift becomes slower for improving fuel consumption. The “W” mode is automatically changed to “S” mode in full throttle or kick-down operation. The vehicle can starts off with 2nd reverse gear (gear ratio: 1.92 ~ 1.93) when the “W” mode is selected.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

Even though “W” mode is selected, the vehicle starts off with 1st gear in following:

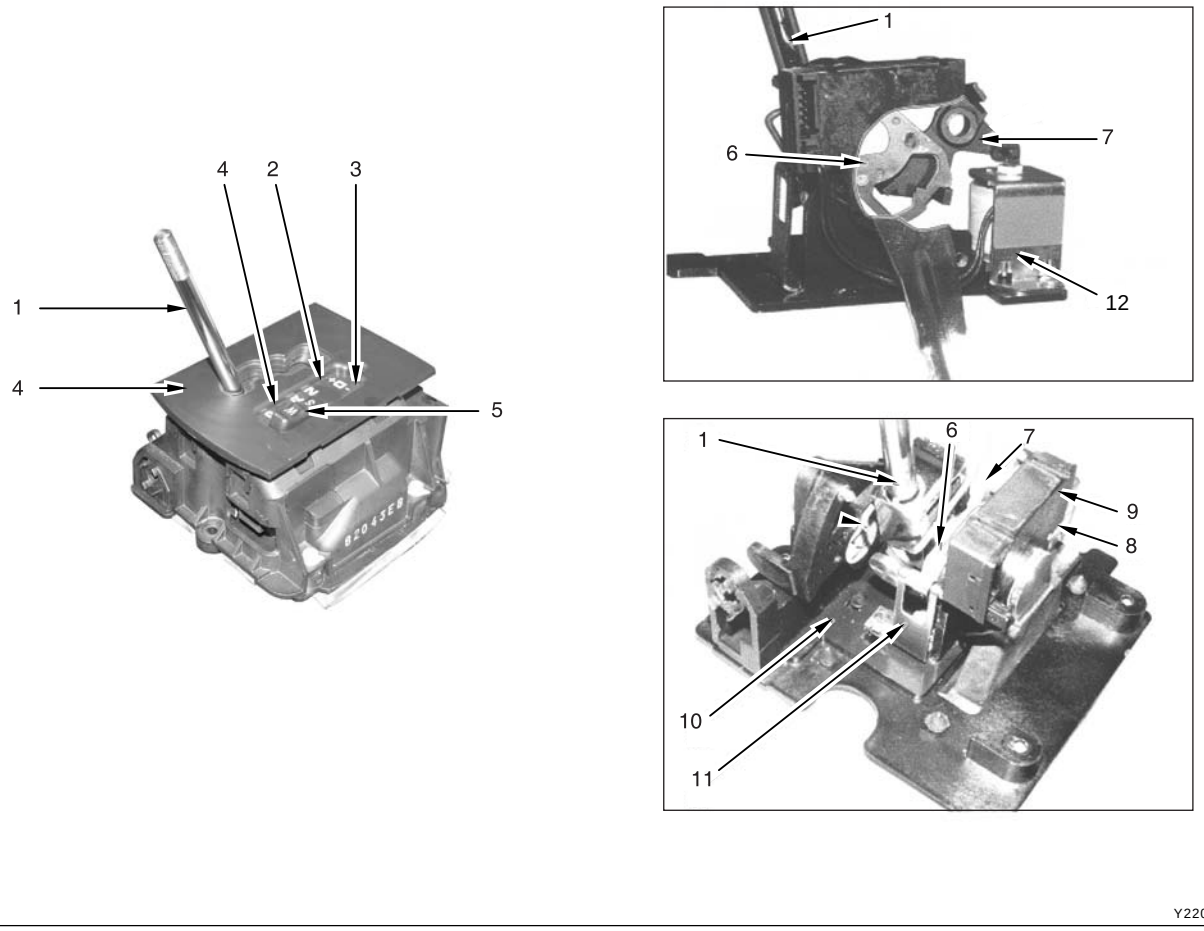
When the system recognizes the mode switch operation, the selector lever control unit sends the control signal TCU via CAN communication.

1. When the selector lever is in “1” position.
2. When fully depressing the accelerator pedal or when starting off with kick-down condition.

Circuit diagram



▶ Reverse/Parking (R/P) Lock System



1. Selector lever
2. Shift pattern display
3. Parking lock release flap
4. Selector lever control unit
5. Mode switch
6. Locking disc
7. Locking lever
8. Shift detene spring
9. Potentiometer for detecting selector lever position
10. Base body
11. Spring of shift detent mechanism
12. Solenoid valve

Function

Reverse (R) lock system is a safety system that prevents the selector lever from shifting to “P” or “R” position by activating the solenoid valve when the selector lever unit determines that the vehicle speed exceeds 10 km/h by checking the speed signal from wheel speed sensor via CAN communication.

Parking (P) lock system uses the signals from brake switch other than conventional cable system to shift to other positions. The wiring harness for detecting brake switch operation is connected to selector lever control unit.

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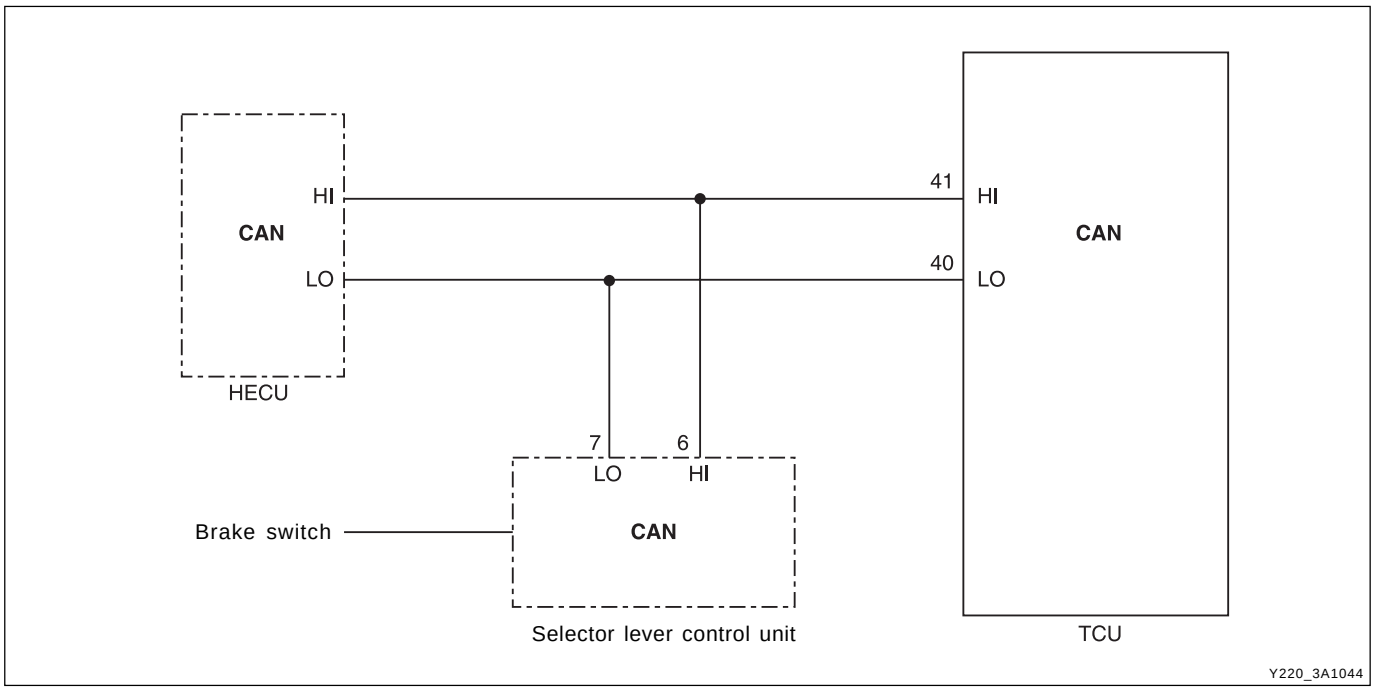
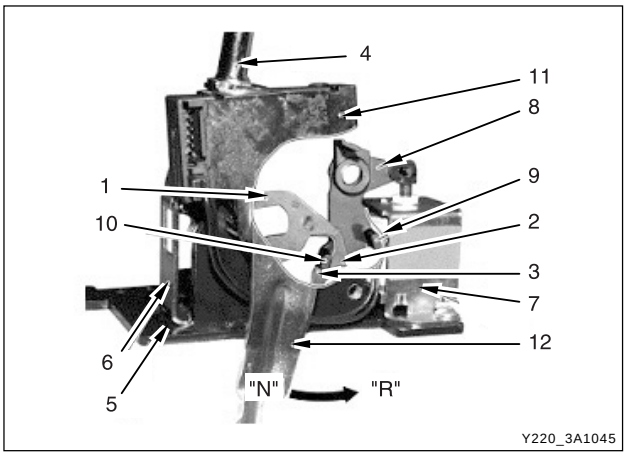
AFFECTED VIN	

Circuit diagram





1. Locking disc
2. Cam (P lock)
3. Cam (R lock)
4. Selector lever
5. Base body
6. Mode switch
7. R/P locking solenoid
8. Locking lever
9. Tab on lock lever (P lock)
10. Tab on lock lever (R lock)
11. Potentiometer for detecting selector lever position
12. Intermediate lever

Function of reverse (R) lock

Above a speed of approx. 10 km/h, the R/P locking solenoid is actuated by the selector lever control unit. The R/P lock lever (8) is turned to the lock position. The tab on lock lever (10) locks the locking disc (1). The selector lever (1) cannot be shifted into selector position “R”.

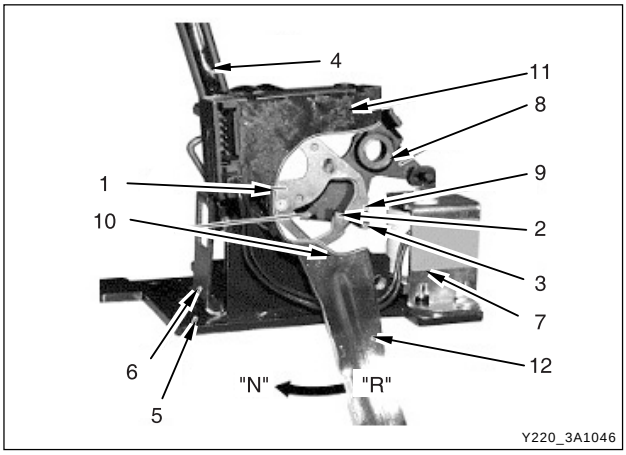
Function of parking (P) lock

The selector lever position “P” is locked whenever the R/P locking solenoid is not actuated by selector lever control unit.

The prerequisites for this are as follows:

* No voltage supply to the selector lever control unit (Ignition switch is not positioned to “ON”)
* Brake pedal not depressed

Under these conditions, the locking lever (8) is in the locking position. The tab on lock lever (9) locks the locking disc (1). It is not possible to shift the selector lever out of selector lever position “P”.

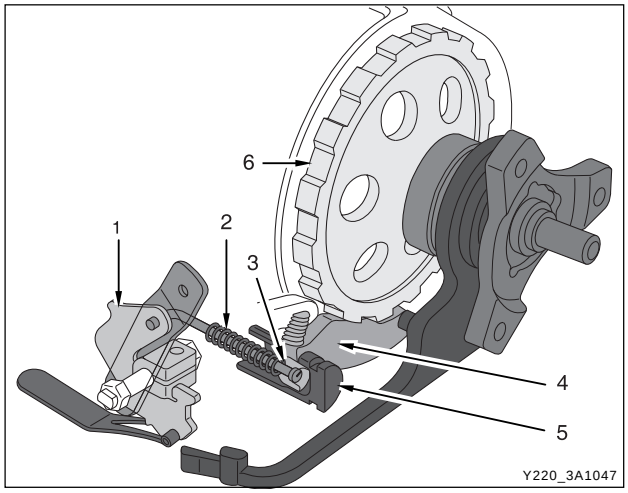


1. Locking disc
2. Cam (P lock)
3. Cam (R lock)
4. Selector lever
5. Base body
6. Mode switch
7. R/P locking solenoid
8. Locking lever
9. Tab on lock lever (P lock)
10. Tab on lock lever (R lock)
11. Potentiometer for detecting selector lever position
12. Intermediate lever

▶ Parking Lock Mechanism

Location and function

The parking lock gear (6) is located on the output shaft in the rear section of the transmission housing. In selector lever position “P”, the cone (3) slides between the parking lock pawl (4) and the guide sleeve (5). The parking lock pawl (4) is therefore pushed against the parking lock gear (6). If the tooth of the parking lock pawl (4) does not engage in a tooth space when the vehicle is stationary, but rather touches a tooth of the parking lock gear (6), the cone (3) is pre-tensioned by the spring (2) and positioned ready for operation. If the parking lock gear (6) continues to turn, the parking lock pawl (4) engages in the next tooth space. To prevent damage due to misuse, the widths of the tooth spaces are designed such that the parking lock pawl (4) can only engage when the vehicle is stationary or moving very slowly. If the vehicle rolls faster, the shape of the teeth prevents the parking lock pawl (4) from engaging.



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

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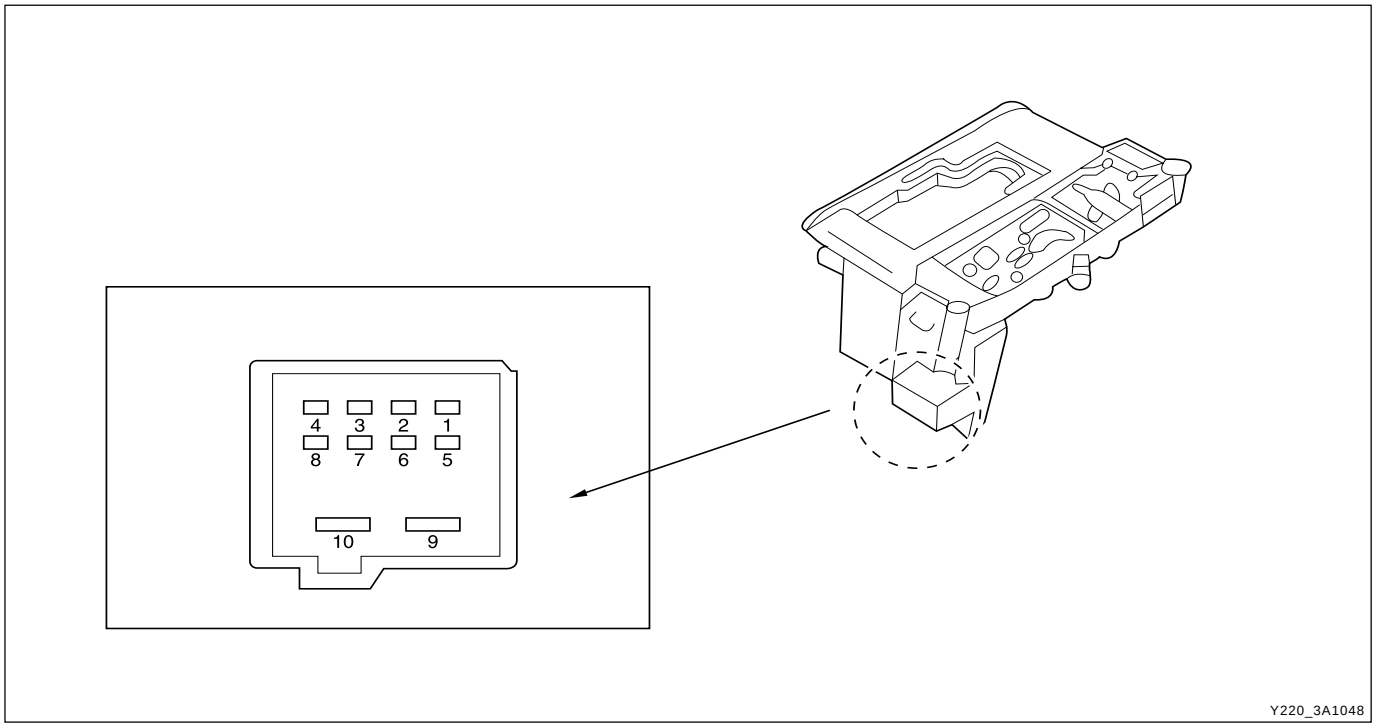
AFFECTED VIN	

▶ Selector Lever Control Unit

Function

Selector lever control unit functions as follows:

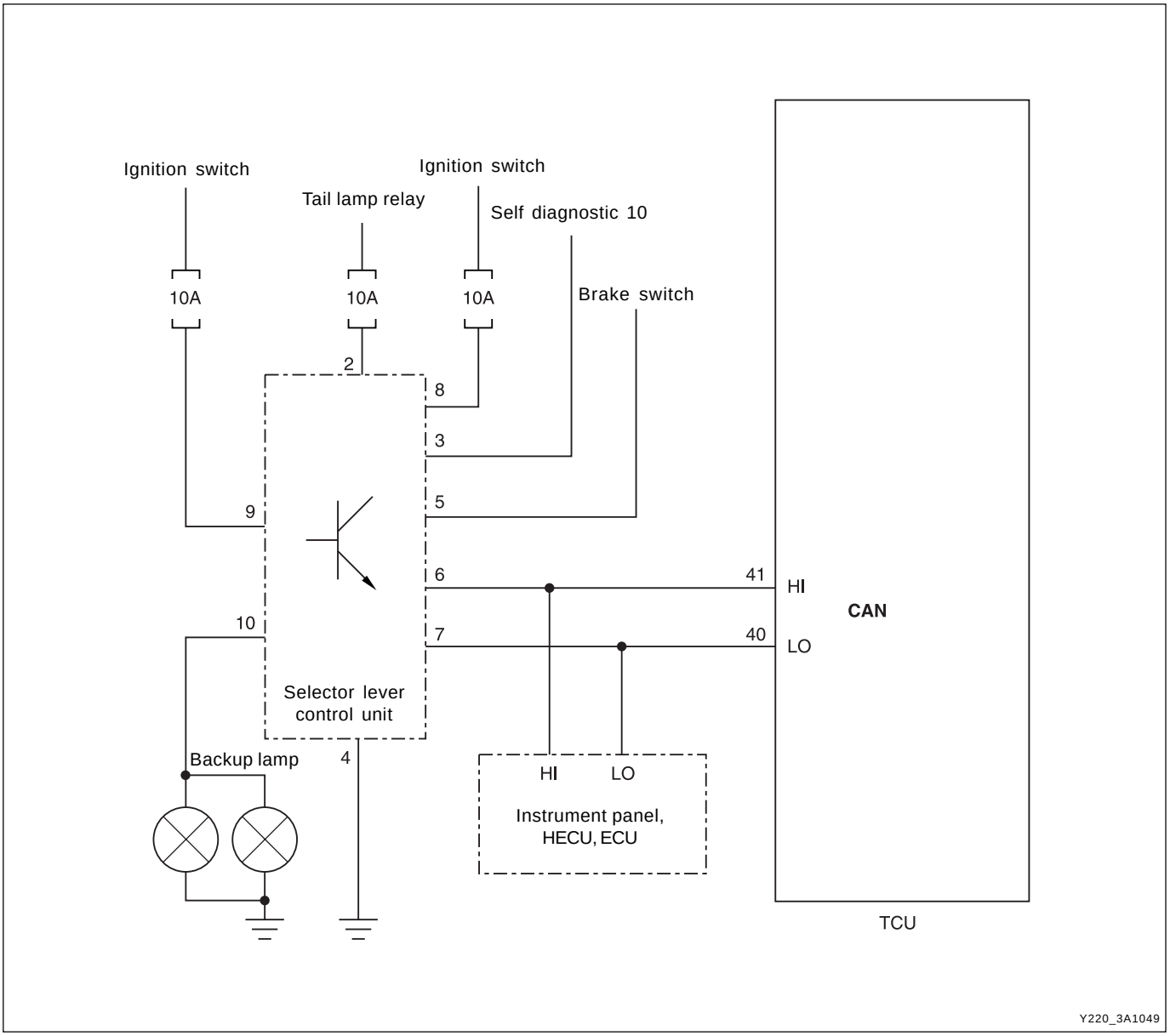
A. Informing the selector lever's position to other units via CAN.
B. Turning on the selector lever indicator while tail lamp is turning on.
C. Turning on the back-up lamp during reverse driving.
D. Operating the parking/reverse lock system.



Terminals

Pin No.	Use For	Remark
8	Selector lever unit power	
6	CAN HI	Connected to HECU, ECU, TCU, instrument panel etc.
7	CAN LO	
5	Brake switch signal	Parking lock operation
3	Self diagnosis	
2	Tail lamp	Turning on position indicator
9	Back-up lamp power	
10	Back-up lamp	
4	Ground	

Circuit diagram



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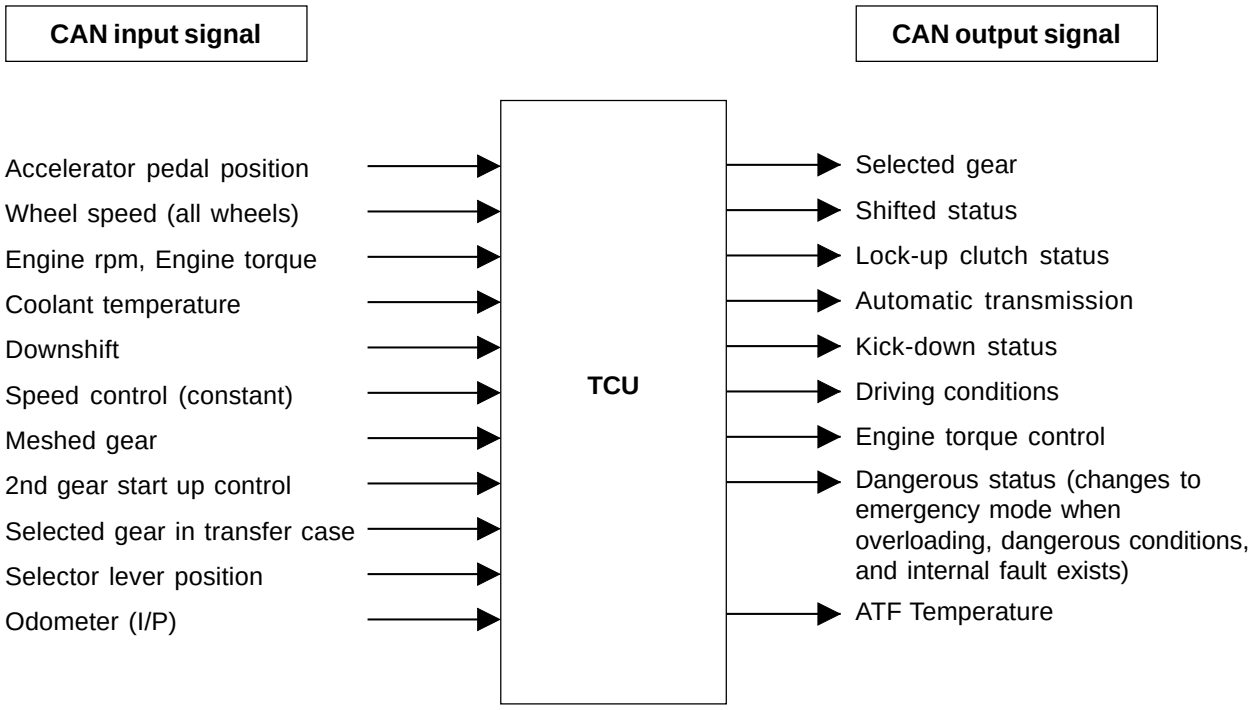
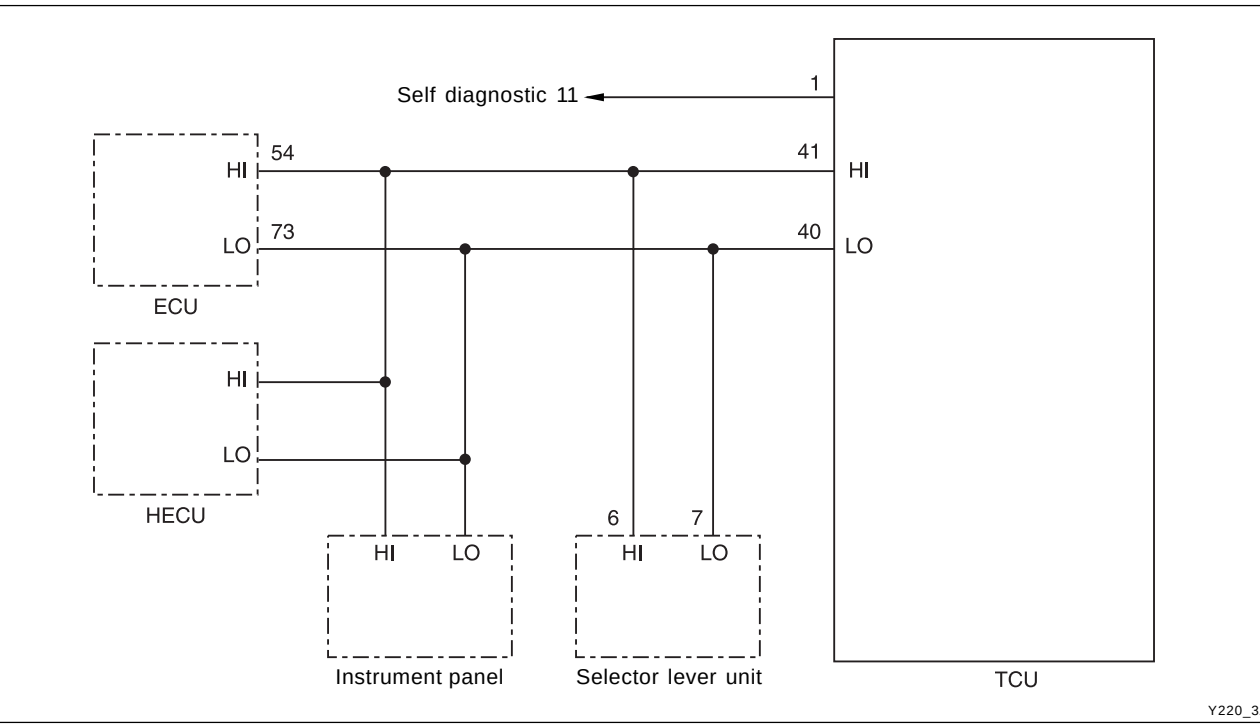
▶ CAN (Controller Area Network)

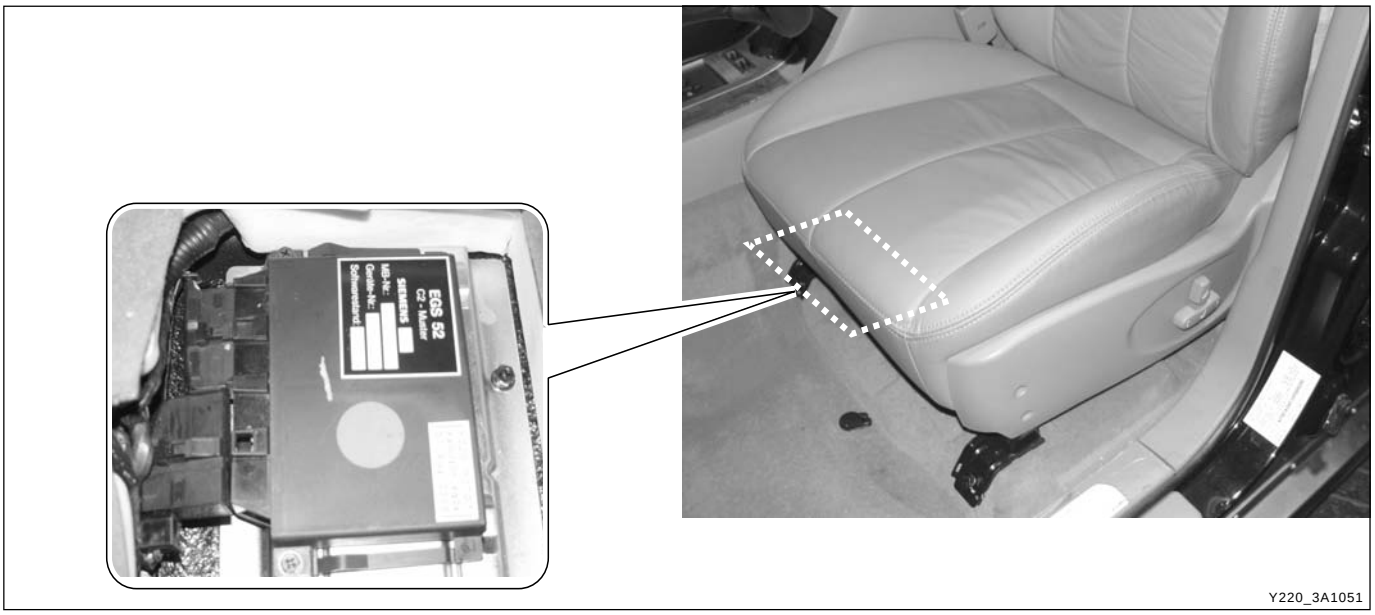
Function



Circuit diagram



▶ TCU (Transmission Control Unit)



Function

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

1. Shifting Method

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

2. Down Shift

   When engine speed increases excessively, the down shift does not occur. When driving down hill, the transmission is quickly down shifted to 3rd gear to get an engine brake effect in speed control mode. This down shift is operated when there is above 7 km/h difference from stored speed value and possible at below 125 Km/h.

3. Engine RPM Adjustment

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

4. Lock-Up Clutch Control

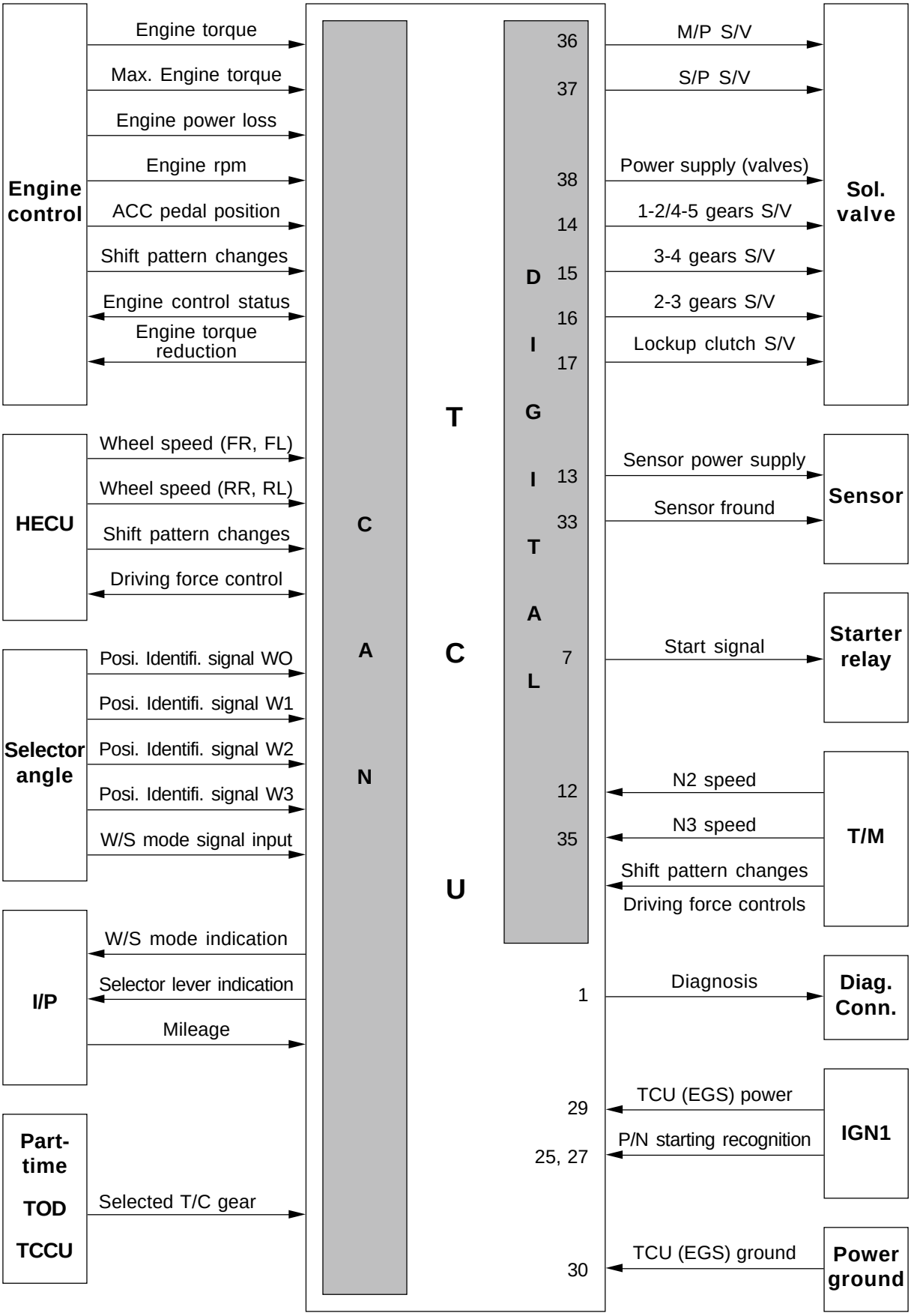
   The lockup clutch in torque converter is activated in 3rd, 4th and 5th gear and operates in sequence via PWM solenoid valve.

5. Others

   The transmission is automatically controlled to compensate durability and wear.

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

TCU block diagram



▶ Characteristics of TCU and Automatic Transmission (Emergency Driving Mode)

The emergency driving mode is to minimize vehicle's operation when is a mode for maintaining minimum driving condition when the automatic transmission is defective. In emergency driving mode, excessively long driving and unreasonable driving should be avoided to prevent bigger fault occurring in advance. Emergency driving mode can largely be divided in electrical defective and hydraulic pressure/mechanical defective.

Electrical defective

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

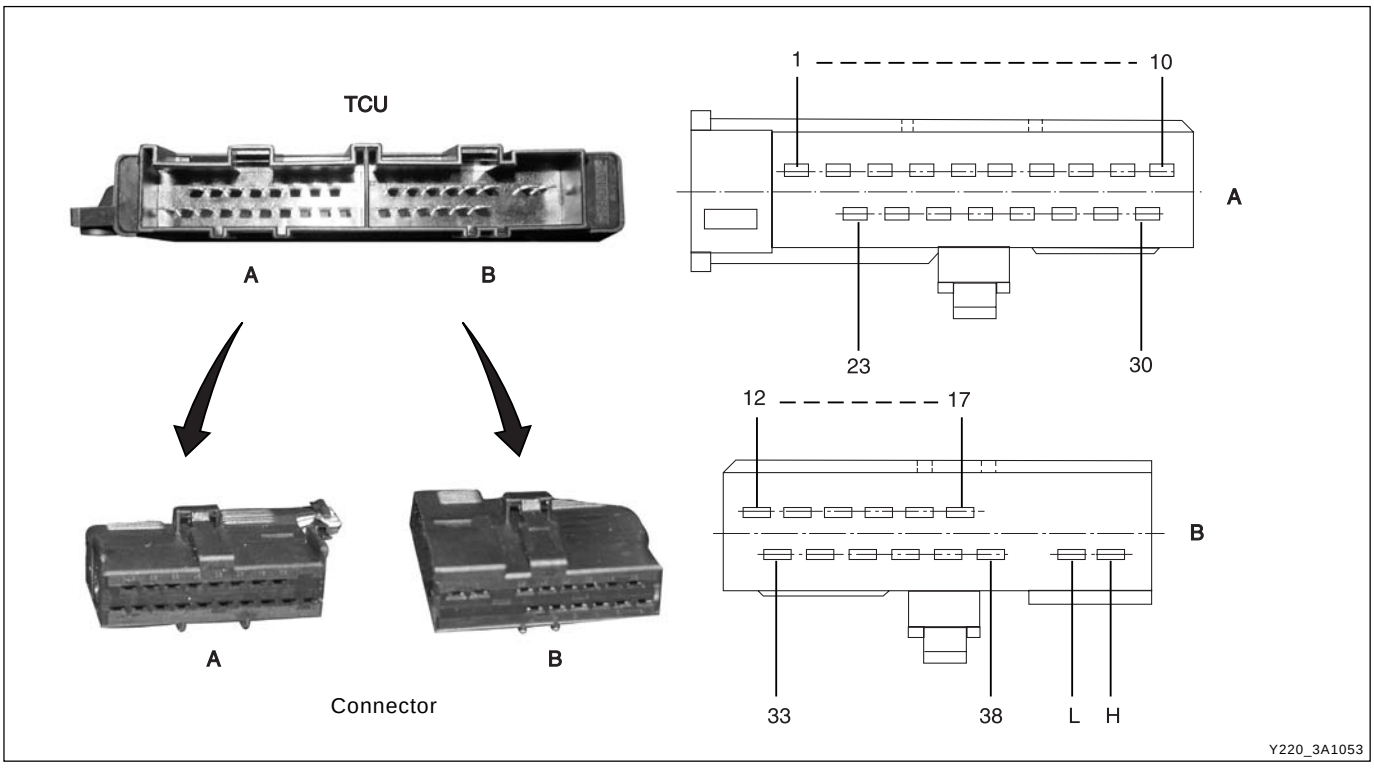
- If the shift operation cannot be activated, the driver must reset the system as follows:
  A. Stop the vehicle and place the selector lever to "P" position.
  B. Wait for 10 seconds after stopping the engine (release hydraulic pressure)
  C. Start the engine.
  D. Place the selector lever to "D" or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

Mechanical/hydraulic pressure defective

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

- If the shift operation cannot be activated, the driver must reset the system as follows:
  A. Stop the vehicle.
  B. Wait for 10 seconds after stopping the engine (release hydraulic pressure).
  C. In most cases, it is reset when the engine is started and the vehicle operates normally.

Connector arrangement and pin functions



Pin No.	Description	Connected to
1	Diagnostic	Diagnostic connector pin No.11
7	Initiating the starter relay	Starter relay
12	RPM sensor N2	13-pin plug No.3
13	RPM sensor voltage supply	13-pin plug No.7
14	1-2, 4-5 solenoid valve	13-pin plug No.13
15	3-4 solenoid valve	13-pin plug No.9
16	2-3 solenoid valve	13-pin plug No.11
17	Lockup clutch solenoid valve	13-pin plug No.11
29	TCU voltage supply	-
30	Ground	-
33	RPM sensor ground	13-pin plug No.12
34	ATF temperature, Starter lock-out contact	13-pin plug No.4
35	RPM sensor N3	13-pin plug No.1
36	Modulating pressure solenoid valve	13-pin plug No.2
37	Shift pressure solenoid valve	13-pin plug No.10
38	Each solenoid valve voltage	13-pin plug No.6
L	CAN Low	ECM, HECU, selector lever unit, instrument panel
H	CAN High	ECM, HECU, selector lever unit, instrument panel

OTHER FUNCTIONS

▶ Oil Level Control

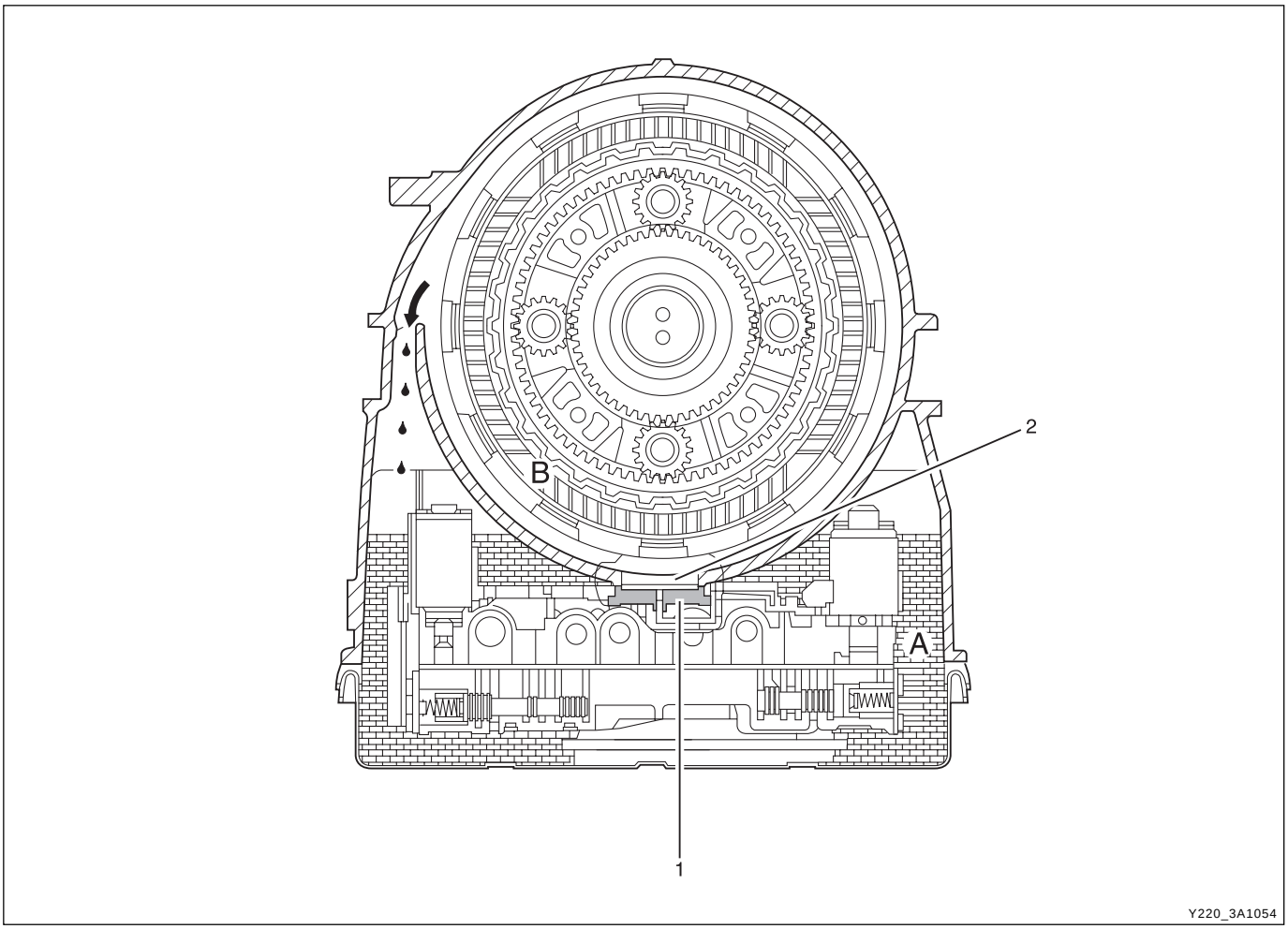
Function

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

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

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

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



1. Float
2. Opening

A. Oil chamber
B. Planetary gear set chamber

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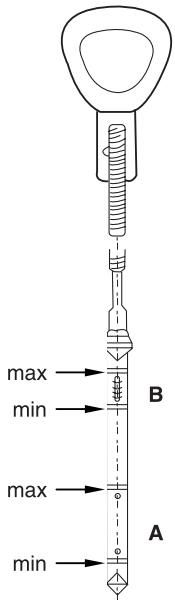
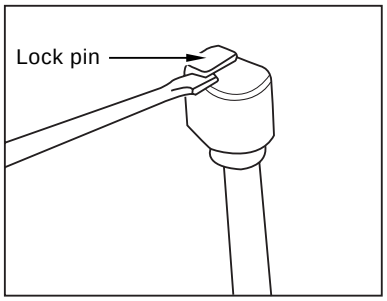
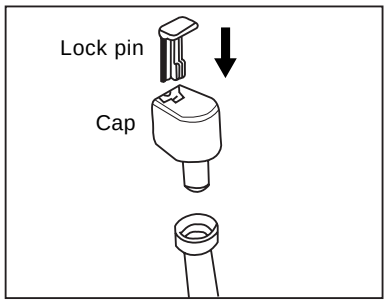
▶ Oil Check and Specification







Y220_3A1055

Checking and adding Tip

A. Place the vehicle on level ground. Pull out the lock pin and remove the cap (add 4 to 5 liter if oil has been completely drained out).

B. Place the selector lever to “P” position. Start the engine and leave it idling (add 2.5 liter if oil has been completely drained out).

C. Warm the engine up while moving the selector lever to all positions. Check if the oil temperature is approx. 80°C with a scanner (apply the parking brake).

: Selector lever position - R or D

D. Check the oil level with oil dipstick while engine is running in “P” position.

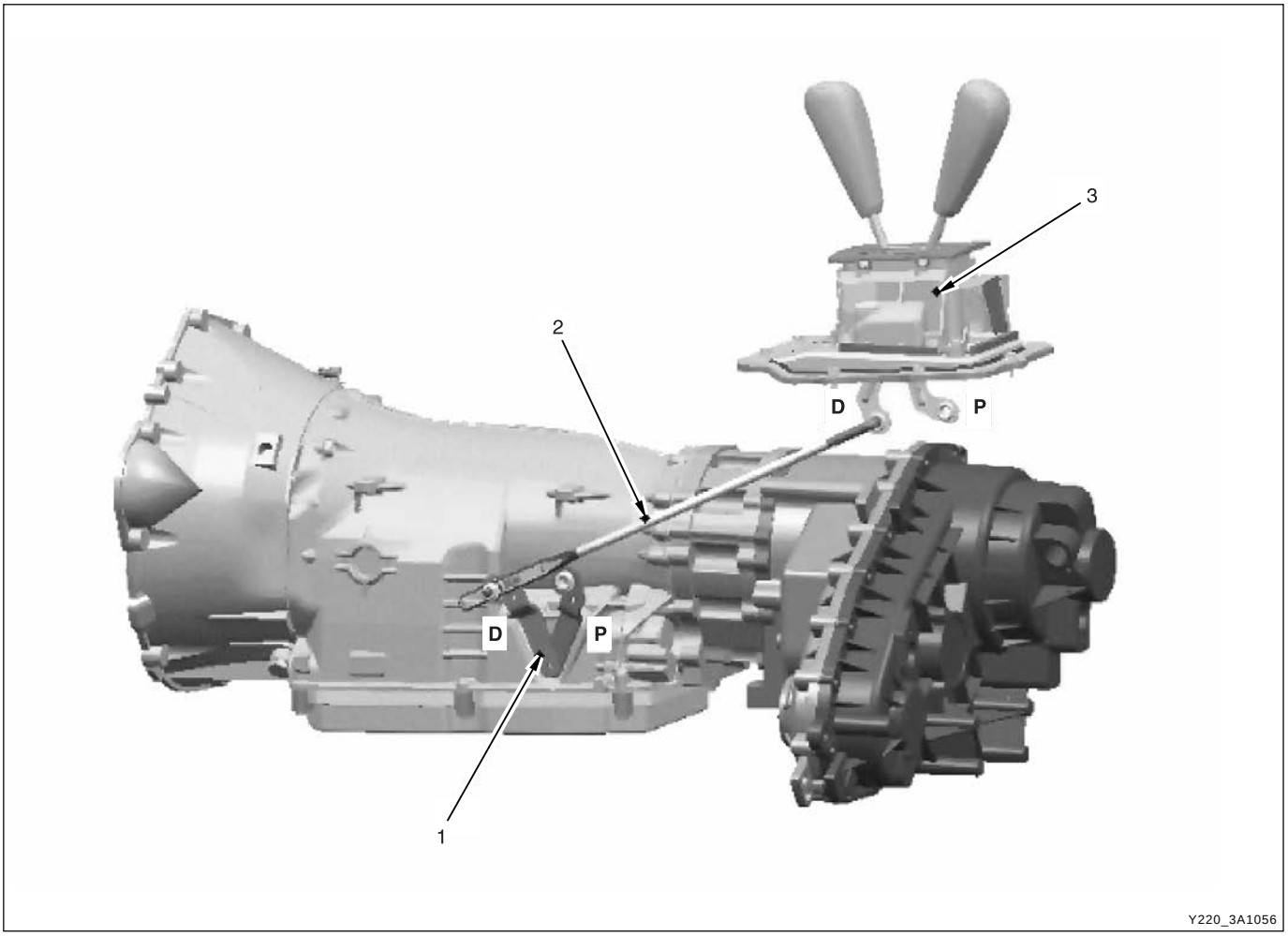
E. Check several times with attention, and add or drain the oil as required.

Automatic transmission fluid capacity and specification

Fluid capacity	Approx. 8 ℓ
Specification	Fuchs ATF 3353 or Shell ATF 3353

▶ Shift Rod Adjustment

Adjustment



1. Range lever
2. Shift rod
3. Selector lever

D. "D" range
P. "P" range

A. Disengage the shift rod from range lever and place the range lever at "D" position.
B. Place the selector lever at "D" position.
C. Insert the shift rod into range lever and tighten nut.

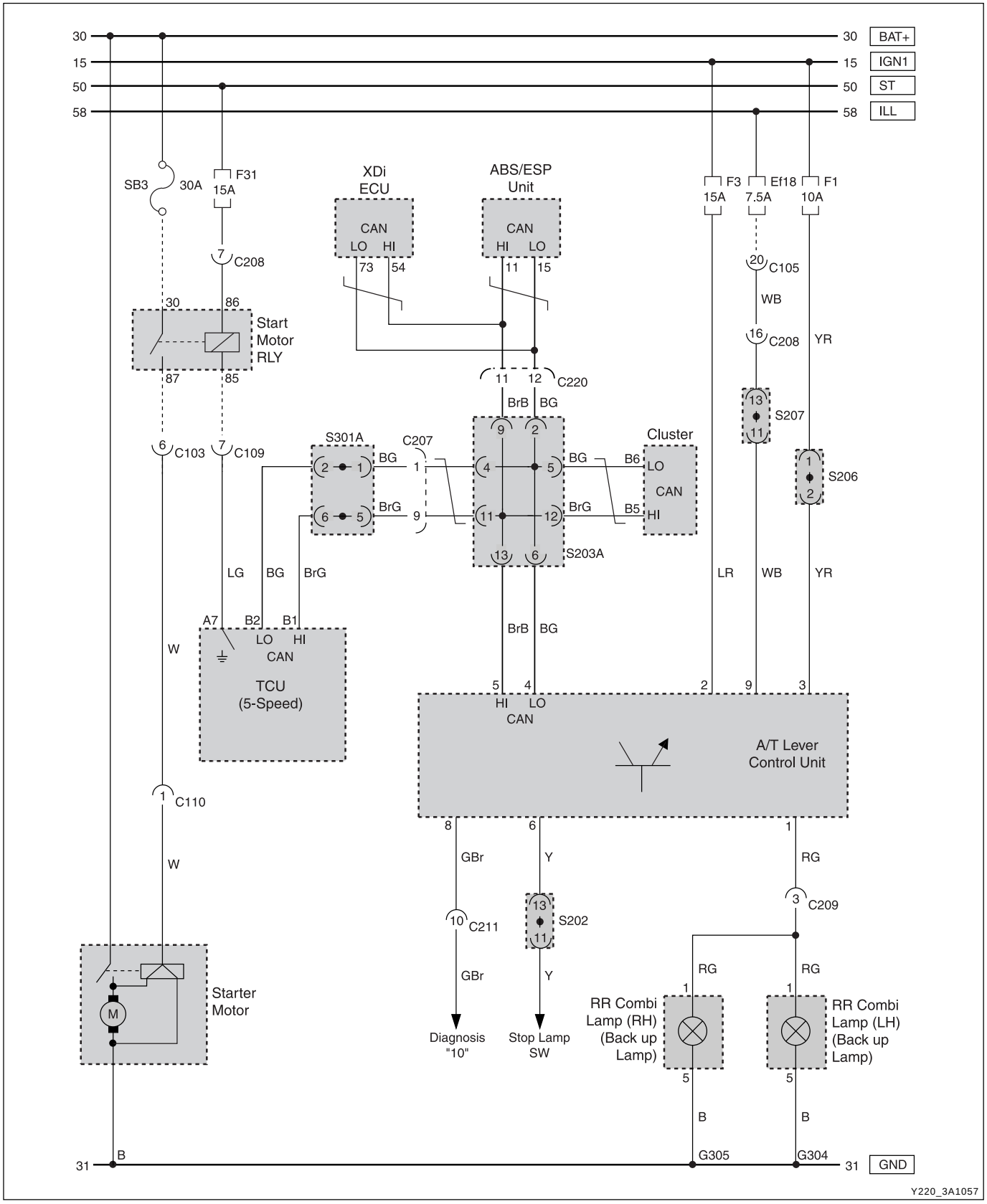
Notice

Lock the selector lever so that it will not move.

D. Check if the indication lamp in meter cluster indicates correct gear position while moving the selector lever to "P", "R", "N", and "D" position.
E. Check if the engine can be started at selector lever "P" or "N" position.

CIRCUIT DIAGRAM

▶ Starter, Selector Lever, CAN Communication



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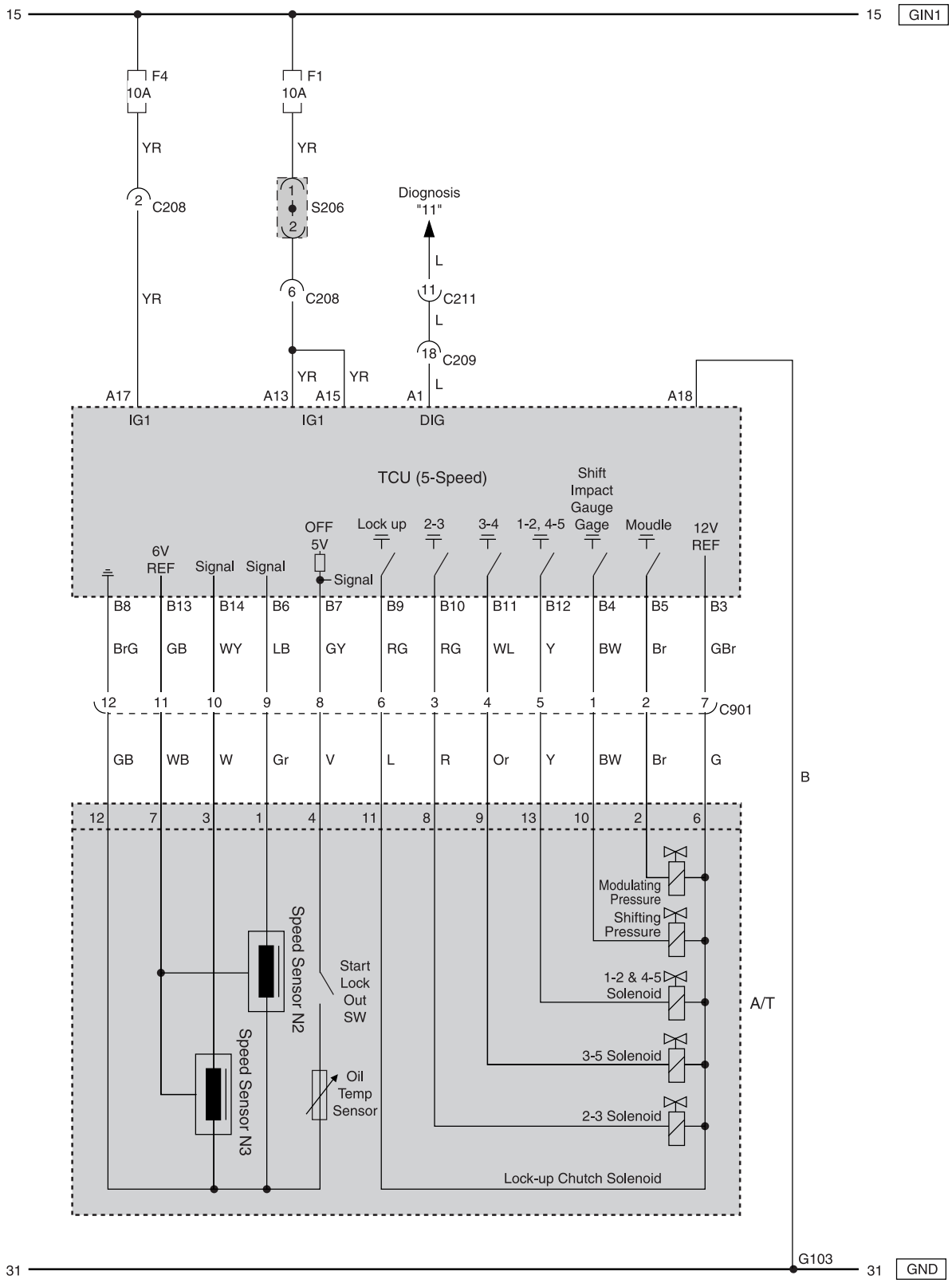
▶ Solenoid, Oil Temperature Sensor, RPM Sensor (N2, N3)



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TROUBLE CODE AND DIAGNOSIS

TROUBLE DIAGNOSIS WITH SCANNER

▶ Scanner Installation

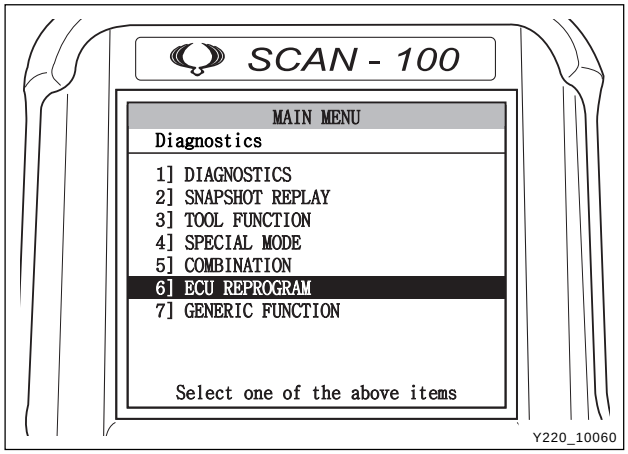
1. Connect the scanner connector to the diagnostic socket.
2. Turn the ignition switch to “ON” position.
3. Select [DIAGNOSTICS] in [MAIN MENU] screen and press [ENTER].
4. Select [REXTON] in [VEHICLE SELECTION] screen and press and press [ENTER].
5. Select [TCU] in [CONTROL UNIT SELECTION] screen and press [ENTER].
6. Select [TROUBLE CODE] in [FUNCTION SELECTION] screen and press [ENTER].
7. Determine the DTC and locate the trouble cause.

▶ TCU Coding for DC 5-Speed Automatic Transmission

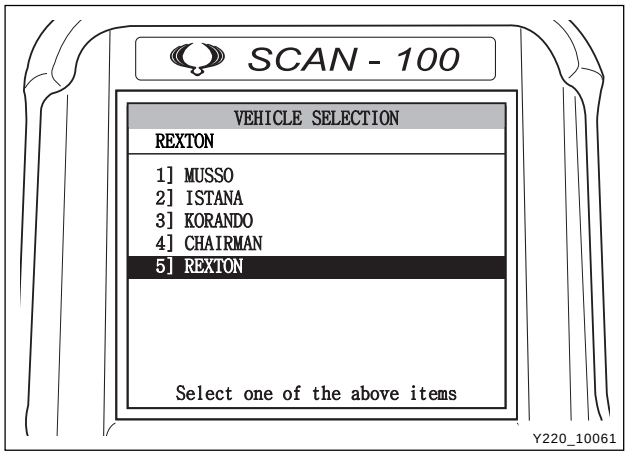
If the TCU or automatic transmission has been replaced, the TCU should be coded with Scan-i.

Entering the diagnosis procedures

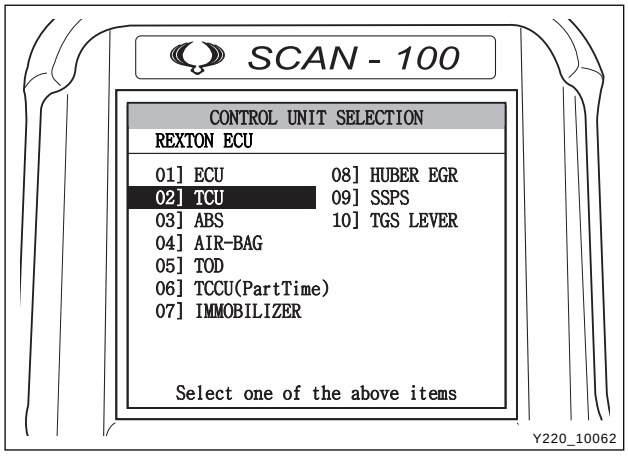
1. Select “6] ECU REPROGRAM” and press ENTER in MAIN MENU screen.



2. Select “5] REXTON” and press ENTER in VEHICLE SELECTION screen.



3. Select “2] TCU” and press ENTER in CONTROL UNIT SELECTION screen.



4. Select the transmission type and enter into the coding section.

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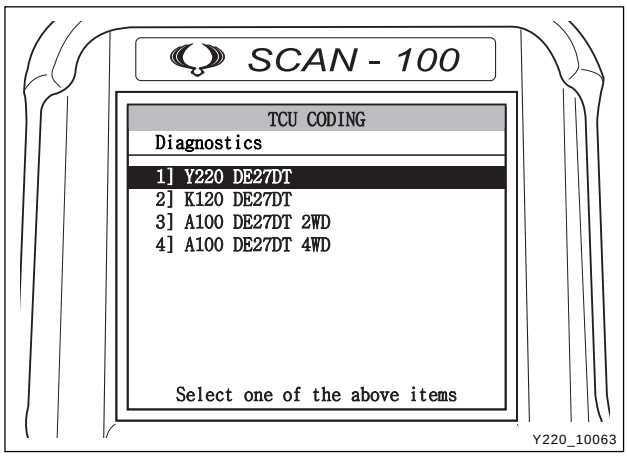
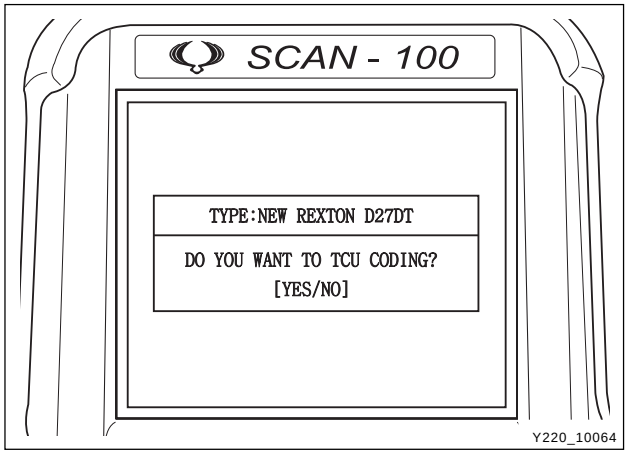
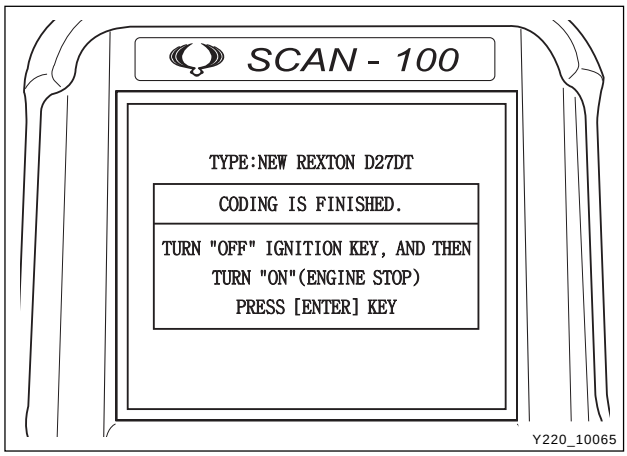


5. Select “1] Y220 DE27DT” and press ENTER in TCU CODING screen.



6. If the message as shown in the figure appears, select “YES” to start coding and press ENTER.



7. If the message as shown in the figure appears, turn the ignition key to “OFF” position and then turn it “ON” again.

▶ DTC (Diagnosis Trouble Code) of DC5AT

Trouble Code	Defectives	Action
P2000	Faulty TCU internal watchdog test	- Self-diagnosis with IGN ON. - Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2001	Faulty TCU internal watchdog function	- Self-diagnosis. - Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2002	Faulty TCU external watchdog test	- Self-diagnosis with IGN ON. - Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2003	Faulty TCU external watchdog function	- Self-diagnosis. - Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2004	Faulty TCU Clock	- Self-diagnosis. - Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2005	Faulty TCU RAM	- Self-diagnosis with IGN ON. - Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2006	Faulty TCU RAM CAN-Controller 1	- Self-diagnosis with IGN ON. - Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2007	Faulty TCU RAM CAN-Controller 2	- Self-diagnosis with IGN ON. - Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2008	Faulty TCU ROM	- Self-diagnosis with IGN ON. - When the TCU internal checksum is different from scanner checksum. - Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P200A	Faulty TCU EEPROM	- Self-diagnosis with IGN ON. - Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P200B	Faulty TCU CPU (internal)	- Self-diagnosis. - Check harness contact.
P200C	Faulty TCU program control	- Self-diagnosis. - Check harness contact.
P2010	No TCU variant coding	- Self-diagnosis with IGN ON. - When the TCU coding is not exist. - Check again after TCU coding.
P2011	Faulty TCU variant coding	- Self-diagnosis with IGN ON. - When the TCU coding is faulty. - Check again after TCU coding.
P2012	Faulty TCU checksum	- Self-diagnosis with IGN ON. - Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2013	Faulty TCU (internally)	- Self-diagnosis with IGN ON. - Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2100	Defective 1-2, 4-5 shift solenoid valve	- When 1-2 or 4-5 shift solenoid valve is defective. - Measure the resistance of 1-2 or 4-5 shift solenoid valve (turn the IGN OFF, then and disconnect TCU connector). • TCU connector terminals: B12, B3 • Specified value: 3.8 ± 0.2 Ω - Triggered emergency mode when the defective is detected. • Fixed at 2nd gear in “D” range. - Check the related harness for open, short and contact.

Trouble Code	Defectives	Action
P2101	1-2, 4-5 shift solenoid valve - short	- When 1-2 or 4-5 shift solenoid valve is defective. - Measure the resistance of 1-2 or 4-5 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). • TCU connector terminals: B12, B3 • Specified value: 3.8 ± 0.2 Ω - Triggered emergency mode when the defective is detected. • Fixed at 2nd gear in “D” range. - Check the related harness for open, short and contact.
P2102	Defective 2-3 shift solenoid valve	- When 2-3 shift solenoid valve is defective. - Measure the resistance of 2-3 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). • TCU connector terminals: B10, B3 • Specified value: 3.8 ± 0.2 Ω - Triggered emergency mode when the defective is detected. • Fixed at 2nd gear in “D” range. - Check the related harness for open, short and contact.
P2103	2-3 shift solenoid valve - short	- When 2-3 shift solenoid valve is defective. - Measure the resistance of 2-3 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). • TCU connector terminals: B10, B3 • Specified value: 3.8 ± 0.2 Ω - Triggered mechanical emergency mode when the defective is detected. • Fixed at 2nd gear in “D” range. - Check the related harness for open, short and contact.
P2104	Defective 3-4 shift solenoid valve	- When 3-4 shift solenoid valve is defective. - Measure the resistance of 3-4 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). • TCU connector terminals: B11, B3 • Specified value: 3.8 ± 0.2 Ω - Triggered mechanical emergency mode when the defective is detected. • Fixed at 2nd gear in “D” range. - Check the related harness for open, short and contact.
P2105	3-4 shift solenoid valve - short	- When 3-4 shift solenoid valve is defective. - Measure the resistance of 3-4 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). • TCU connector terminals: B11, B3 • Specified value: 3.8 ± 0.2 Ω - Triggered mechanical emergency mode when the defective is detected. • Fixed at 2nd gear in “D” range. - Check the related harness for open, short and contact.
P2106	Defective lockup clutch solenoid valve	- Measure the resistance of lockup clutch solenoid valve (turn the IGN OFF, then disconnect TCU connector). • TCU connector terminals: B9, B3 • Specified value: 2.5 ± 0.2 Ω - Triggered emergency mode when the defective is detected. • Fixed at 2nd gear in “D” range. - Check the related harness for open, short and contact.

Trouble Code	Defectives	Action
P2107	Defective modulator pressure solenoid valve	- Measure the resistance of modulator pressure solenoid valve (turn the IGN OFF, then disconnect TCU connector). • TCU connector terminals: B5, B3 • Specified value: 5.0 ± 0.2 Ω - Triggered emergency mode when the defective is detected. • Fixed at 2nd gear in “D” range. - Check the related harness for open, short and contact.
P2108	Defective shift pressure solenoid valve	- Measure the resistance of shift pressure solenoid valve (turn the IGN OFF, then disconnect TCU connector). • TCU connector terminals: B4, B3 • Specified value: 5.0 ± 0.2 Ω - Triggered emergency mode when the defective is detected. • Electrical error: Fixed at 2nd gear in “D” range. - Check the related harness for open, short and contact.
P2200	Faulty rpm sensor N2 signal	- When the rpm sensor N2 detects 0 rpm of front sun gear speed. - Check the related harness for open, short and contact. • TCU connector terminal B6: rectangular wave signal B8: signal ground B13: 6V
P2203	Faulty rpm sensor N3 signal	- When the rpm sensor N3 detects 0 rpm of planetary gear carrier speed. - Check the related harness for open, short and contact. • TCU connector terminal B6: rectangular wave signal B8: signal ground B13: 6V
P220A	Abnormal rpm sensor output signal (N2, N3)	- When the rpm difference between rpm sensor N2 and N3 is over 150 rpm. - Check the related harness for open, short and contact.
P2220	Oil temperature sensor - short	- Turn the IGN OFF, then disconnect TCU connector. - Selector lever position: R or D - Measure the resistance of oil temperature sensor. • TCU connector terminals: B7, B8 - Check the related harness for open, short and contact.
P2221	Abnormal oil temperature sensor signal	- Turn the IGN OFF, then disconnect TCU connector. - Selector lever position: R or D - Measure the resistance of oil temperature sensor. • TCU connector terminals: B7, B8 - Check the related harness for open, short and contact.
P2222	Abnormal oil temperature sensor signal	- Turn the IGN OFF, then disconnect TCU connector. - Selector lever position: R or D - Measure the resistance of oil temperature sensor. • TCU connector terminals: B7, B8 - Check the related harness for open, short and contact.
P2300	Faulty CAN communication	- Turn the IGN OFF, then disconnect TCU connector. - Check the communication line for open, short and contact. - Measure the resistance of CAN line: B1, B2 • Specified value: approx. 120 Ω

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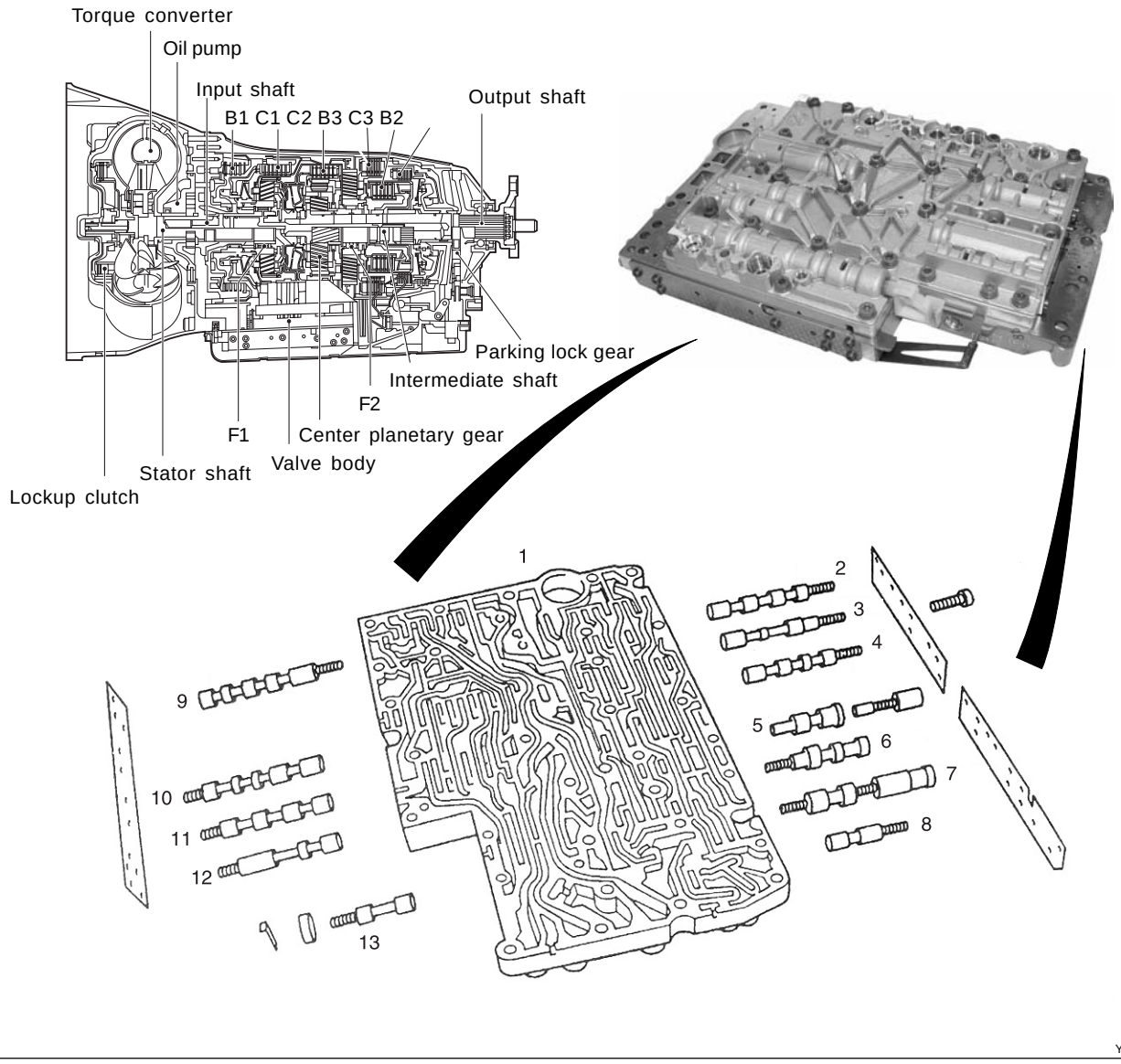
Trouble Code	Defectives	Action
P2301	Faulty CAN communication	- Turn the IGN OFF, then disconnect TCU connector. - Check the communication line for open, short and contact. - Measure the resistance of CAN line: B1, B2 • Specified value: approx. 120 Ω
P2310	CAN: Faulty brake system communication	- Check CAN communication line H and L. - Check ABS/ESP unit. - Check the related harness for open, short and contact.
P2311	CAN: Faulty ECU communication	- Check CAN communication line H and L. - Check engine ECU. - Check the related harness for open, short and contact.
P2312	CAN: Faulty ECU communication	- Check CAN communication line H and L. - Check engine ECU. - Check the related harness for open, short and contact.
P2313	CAN: Faulty selector lever control communication	- Check CAN communication line H and L. - Check selector lever. - Check the related harness for open, short and contact.
P2315	CAN: Faulty instrument panel communication	- Check CAN communication line H and L. - Check instrument cluster. - Check the related harness for open, short and contact.
P2317	CAN: Faulty communication between TCCU/TOD and CAN	- Check CAN communication line H and L. - Check TCCU/TOD unit. - Check the related harness for open, short and contact.
P2330	CAN: Faulty brake system signal	- Check CAN communication line H and L. - Check ABS/ESP unit. - Check the related harness for open, short and contact.
P2331	CAN: Faulty ECU message	- Check CAN communication line H and L. - Check engine ECU. - Check the related harness for open, short and contact.
P2332	CAN: Faulty ECU message	- Check CAN communication line H and L. - Check engine ECU. - Check the related harness for open, short and contact.
P2333	CAN: Faulty selector lever signal	- Check CAN communication line H and L. - Check selector lever. - Check the related harness for open, short and contact.
P2335	CAN: Faulty instrument cluster signal	- Check CAN communication line H and L. - Check instrument cluster. - Check the related harness for open, short and contact.
P2337	CAN: Faulty TCCU/TOD	- Check CAN communication line H and L. - Check TCCU/TOD unit. - Check the related harness for open, short and contact.

Trouble Code	Defectives	Action
P2400	CAN: Faulty rear RH wheel speed sensor signal	- Check CAN communication line H and L. - Check ABS/ESP unit. • Check wheel speed sensor connector. • Check the air gap between tooth wheel and wheel speed sensor. Check tooth wheel installation. (specified air gap: 0.309~0.958 mm). • Check the numbers of tooth wheel: 48 - Check the related harness for open, short and contact.
P2401	CAN: Faulty rear LH wheel speed sensor signal	- Check CAN communication line H and L. - Check ABS/ESP unit. • Check wheel speed sensor connector. • Check the air gap between tooth wheel and wheel speed sensor. Check tooth wheel installation. (specified air gap: 0.309~0.958 mm). • Check the numbers of tooth wheel: 48 - Check the related harness for open, short and contact.
P2402	CAN: Faulty front RH wheel speed sensor signal	- Check CAN communication line H and L. - Check ABS/ESP unit. • Check wheel speed sensor connector. • Check the air gap between tooth wheel and wheel speed sensor. Check tooth wheel installation. (specified air gap: 0.335~0.945 mm) • Check the numbers of tooth wheel: 48
P2403	CAN: Faulty front LH wheel speed sensor signal	- Check CAN communication line H and L. - Check ABS/ESP unit. • Check wheel speed sensor connector. • Check the air gap between tooth wheel and wheel speed sensor. Check tooth wheel installation. (specified air gap: 0.335~0.945 mm) • Check the numbers of tooth wheel: 48
P2404	CAN: No brake signal	- Check CAN communication line H and L. - Check ABS/ESP unit. - Check the related harness for open, short and contact.
P2405	CAN: No accelerator pedal signal	- Check CAN communication line H and L. - Check engine ECU. - Check the related harness for open, short and contact.
P2406	CAN: No engine torque signal	- Check CAN communication line H and L. - Check engine ECU. - Check the related harness for open, short and contact.
P2407	CAN: No ESP signal	- Check CAN communication line H and L. - Check engine ECU. - Check the related harness for open, short and contact.
P2408	CAN: No minimum engine torque signal	- Check CAN communication line H and L. - Check engine ECU. - Check the related harness for open, short and contact.
P2409	CAN: No maxmum engine torque signal	- Check CAN communication line H and L. - Check engine ECU. - Check the related harness for open, short and contact.

Trouble Code	Defectives	Action
P240A	CAN: No engine rpm signal	- Check CAN communication line H and L. - Check engine ECU. - Check the related harness for open, short and contact.
P240B	CAN: No engine coolant temperature signal	- Check CAN communication line H and L. - Check engine ECU. - Check the related harness for open, short and contact.
P240C	CAN: No selector lever position signal	- Check CAN communication line H and L. - Check selector lever. - Check the related harness for open, short and contact.
P240D	CAN: No transfer case position signal	- Check CAN communication line H and L. - Check TCCU/TOD unit. - Check the related harness for open, short and contact.
P2500	Invalid transmission gear ratio	- Cycle the IGN switch from OFF to ON. Check A/T system again after a certain period of driving. - If the trouble still exists, replace A/T assembly. - To protect transmission, any shift is not available.
P2501	Excessive engine rpm	- Check CAN communication line H and L. - Check engine ECU. - Check the related harness for open, short and contact.
P2503	Current selected gear	- Check selector lever. - Check the related harness for open, short and contact.
P220B	Excessive N2, N3 rpm	- Check rpm sensor N2 and N3.
P2510	Torque converter lockup clutch stuck	- Check the hydraulic lines for leaks (valve No.22 in valve body). - Check the resistanve of lockup clutch solenoid valve (Turn the IGN OFF, then disconnect TCU connector). • TCU connector terminals: B9, B3 • Specified value: 2.5 ± 0.2 Ω - Triggered emergency mode when the defective is detected. • Fixed at 2nd gear in “D” range. - Check the related harness for open, short and contact.
P2511	Faulty torque converter lockup heat control	- Check the hydraulic lines for leaks.
P2520	Faulty recognition of torque reduction	- Check ECU.
P2502	Poor gear mesh, transmission slip	- Check the hydraulic lines for leaks. - Check oil filter.
P2600	Too low TCU supplying voltage	- Check TCU supplying voltage.
P2601	Too high TCU supplying voltage	- Check TCU supplying voltage.
P2602	Abnormal solenoid valve supplying voltage	- Check solenoid supplying voltage.
P2603	Abnormal speed sensor supplying voltage	- Check speed sensor supplying voltage. • TCU connector terminals B13: 6V

HYDRAULIC SYSTEM

STRUCTURE OF VALVE BODY



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

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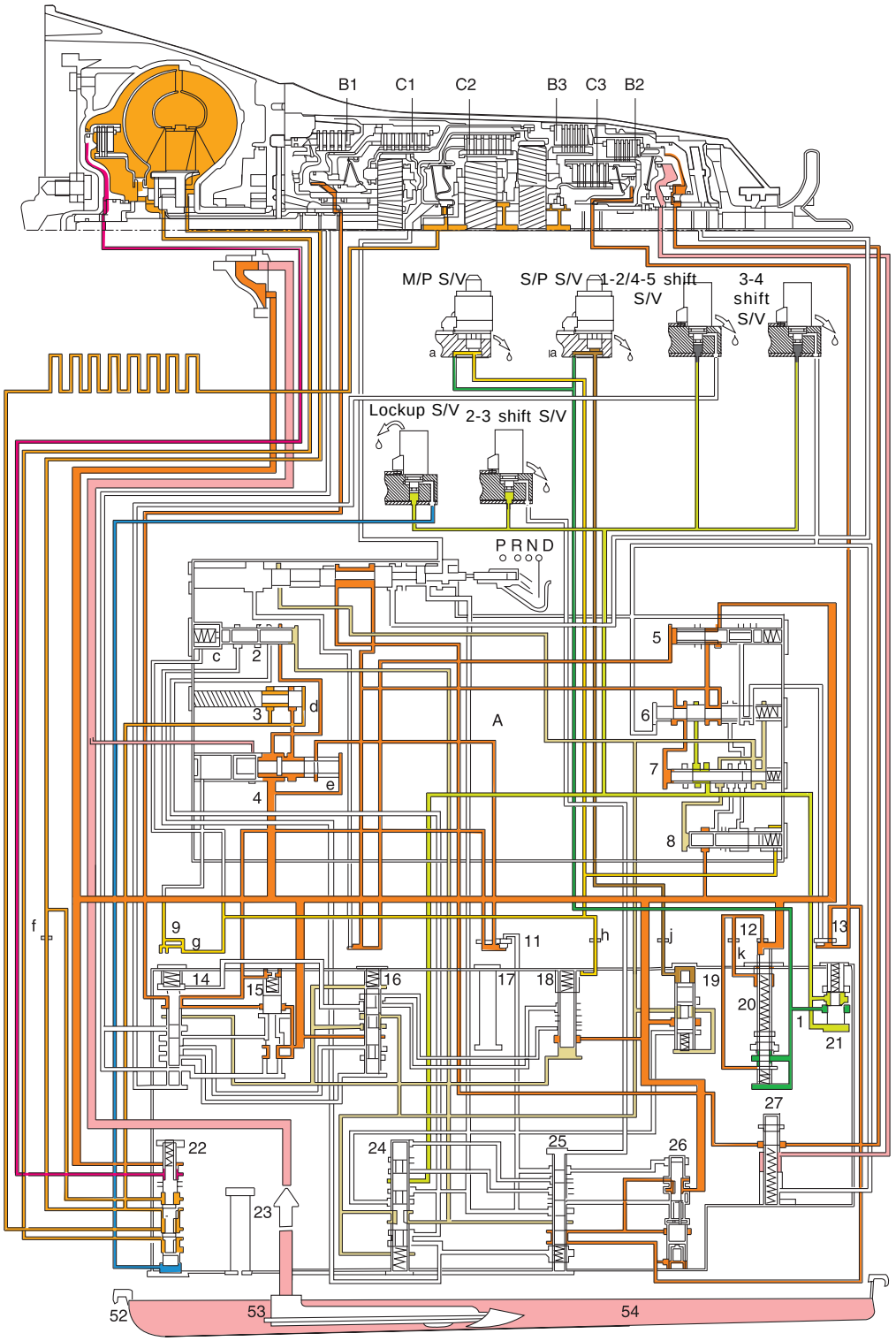
HYDRAULIC CIRCUIT



Y220_3A1062

1. Selector valve
2. 2-3 overlap control valve
3. Lubricating pressure control valve
4. Operating pressure control valve
5. Holding pressure shift valve
6. Command valve
7. 3-4 shift valve
8. 3-4 overlap control valve
9. One-way throttle valve
10. Ball change over valve
11. Ball change over valve
12. Filter screen
13. Ball change over valve
14. 1-2/4-5 command valve
15. 1-2/4-5 holding pressure shift valve
16. 1-2/4-5 shift valve
18. 1-2/4-5 overlap control valve
19. Shift pressure control valve
20. Regulating pressure control valve
21. Shift valve pressure control valve
22. Lock-up clutch control valve
24. 2-3 shift valve
25. 2-3 command valve
26. 2-3 holding pressure shift valve
27. B 2 shift valve
28. Modulating pressure solenoid valve
29. Shift pressure solenoid valve
30. 1-2/4-5 shift solenoid valve
31. 3-4 shift solenoid valve
32. Lock-up solenoid valve
33. 2-3 shift solenoid valve
50. Oil pump
51. Oil cooler
52. Oil pan
53. Oil filter
54. Oil sump

p-A. Operating pressure
p-Sm. Lubricating pressure
p-KUB. Lock-up clutch operating pressure
p-RV. Control valve pressure

p-Mod. Modulating pressure
p-S/RMV. Solenoid valve shift pressure
p-S. Shift pressure

p-SV. Shift valve pressure
p-S/KUB. Lock-up clutch control pressure
Huile. Reserved oil

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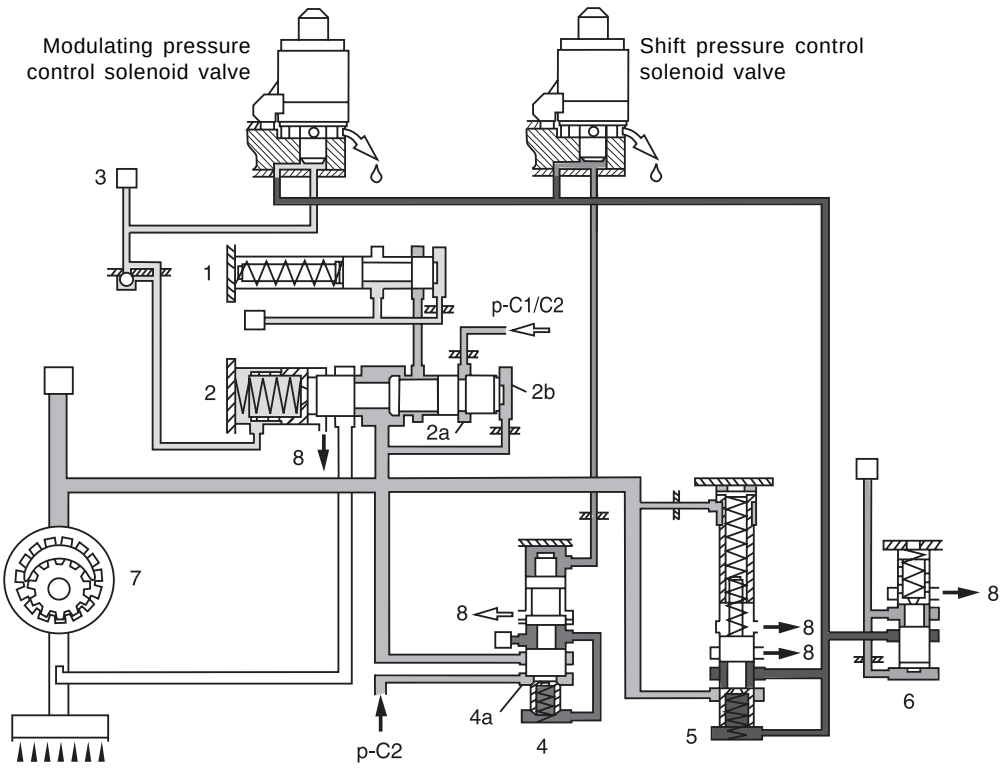
▶ Oil Pressure



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

p-A. Operating pressure

Operating Pressure (p-A)

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

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

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

Lubricating Pressure (p-SM)

This pressure limits the pressure in torque converter and lubricates and cools the mechanical transmission parts.

At the operating pressure control valve, excess fluid is diverted to the lubricating pressure control valve (1) and, from there, regulated for transmission lubrication use (including torque converter).

Control Valve Pressure (p-RV)

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

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

Modulating Pressure (p-Mod)

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

Shift Pressure (p-S)

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

Shift Valve Pressure (p-SV)

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

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▶ Shift Groups

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

The hydraulic system consists of 3 shift groups.

A shift group can be in two phases.

- Shift phase
- Stationary phase

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

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

It includes:

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

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

It includes:

- Clutch C2
- Clutch C3
- Command valve
- Holding pressure shift valve
- 2-3 shift solenoid valve
- Pressure overlap control valve
- 2-3 shift solenoid valve

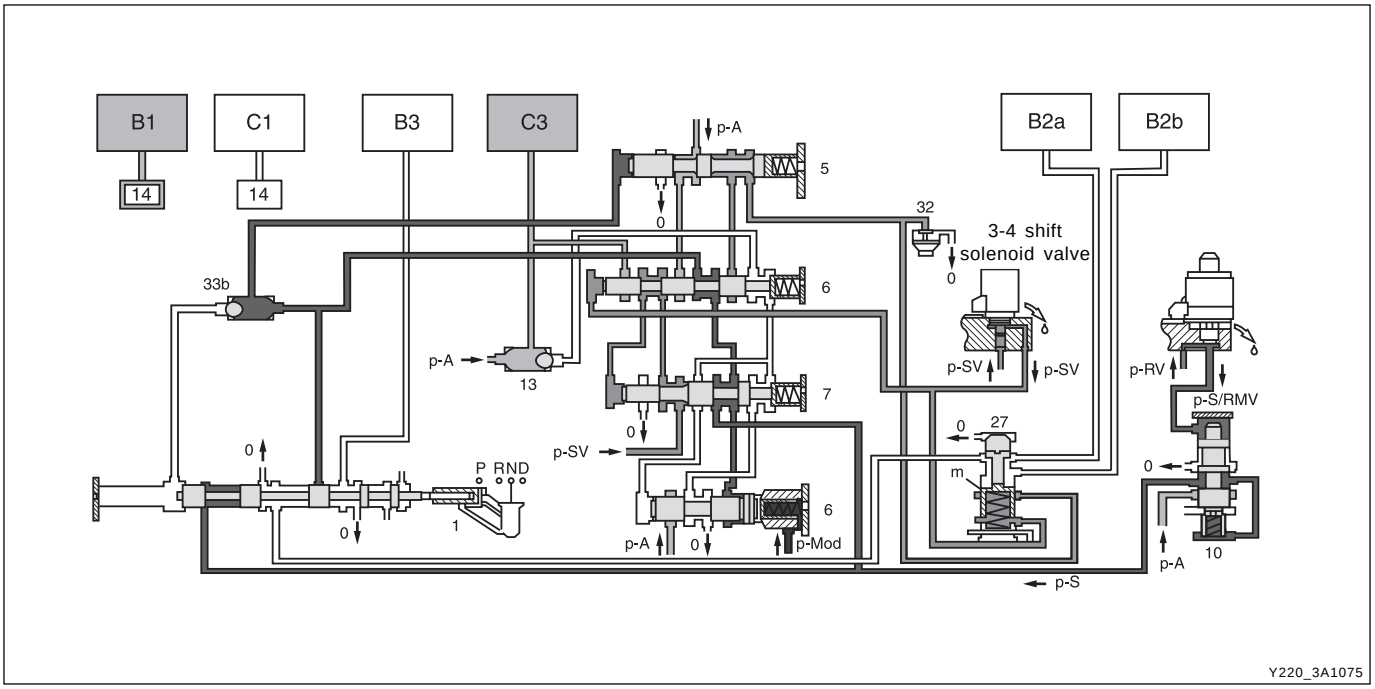
Shift group C3/B2 (gear change 3-4) is responsible for the up/down shifts 3-4/4-3 and the engagement process.

It includes:

- Clutch C3, 3-4 pressure overlap control valve
- Brake B2, 3-4 shift solenoid valve
- Brake B3
- Command valve
- Holding pressure shift valve
- 3-4 shift solenoid valve

HYDRAULIC CIRCUIT WHEN STARTING ENGINE

▶ Selector Lever "N"



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

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

The operating pressure (p-A) is formed and travels via the 2-3 holding pressure shift valve, the 2-3 command valve and ball valve (13) to clutch C3 and via the 3-4 command valve (6) to the end face of the 3-4 shift pressure shift valve (17). The 3-4 shift pressure pressure shift valve is moved against the force of the spring towards the right. At the same time, the 3-4 solenoid valve is energized. This allows shift valve pressure (p-SV) to enter the spring chamber of the shift valve B2 (27) and to reach the end face of the 3-4 command valve (6). The shift valve B2 (27) is held in the upper position and the 3-4 command valve (6) switches towards the right. At the end face of the 3-4 shift pressure shift valve (7), the operating pressure (p-A) is replaced by shift valve pressure (p-SV).

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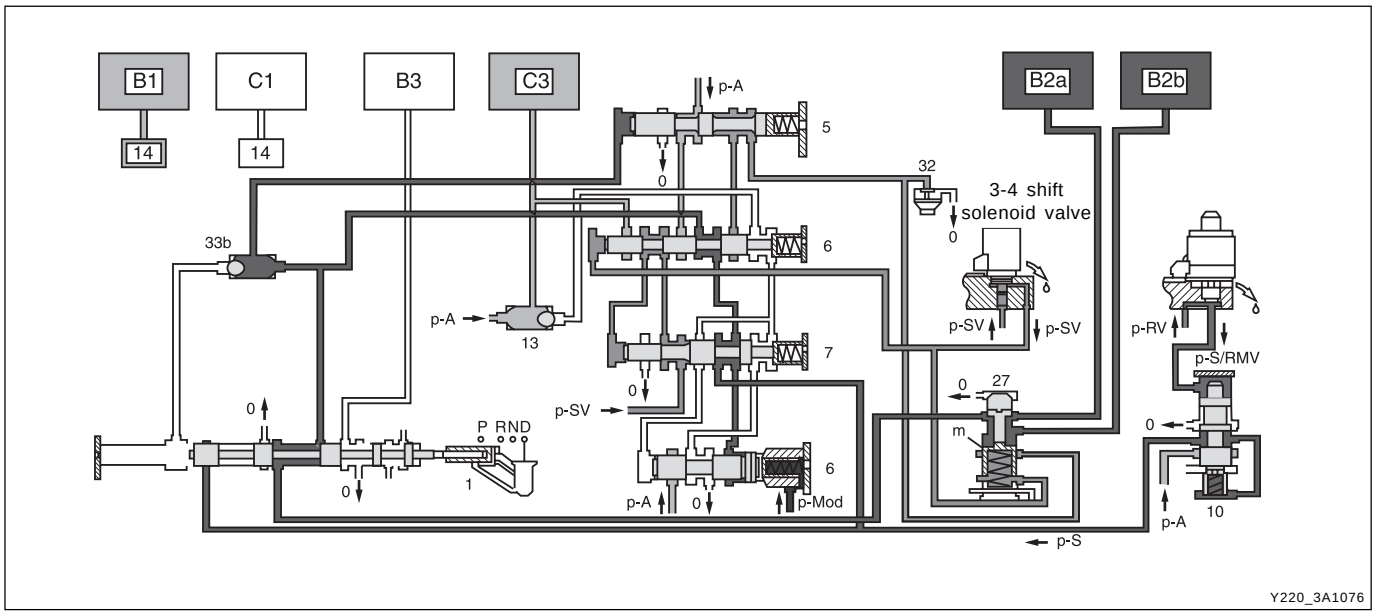
▶ Hydraulic Circuit When Moving Selector Lever From “N” to “D” (Shift Phase)

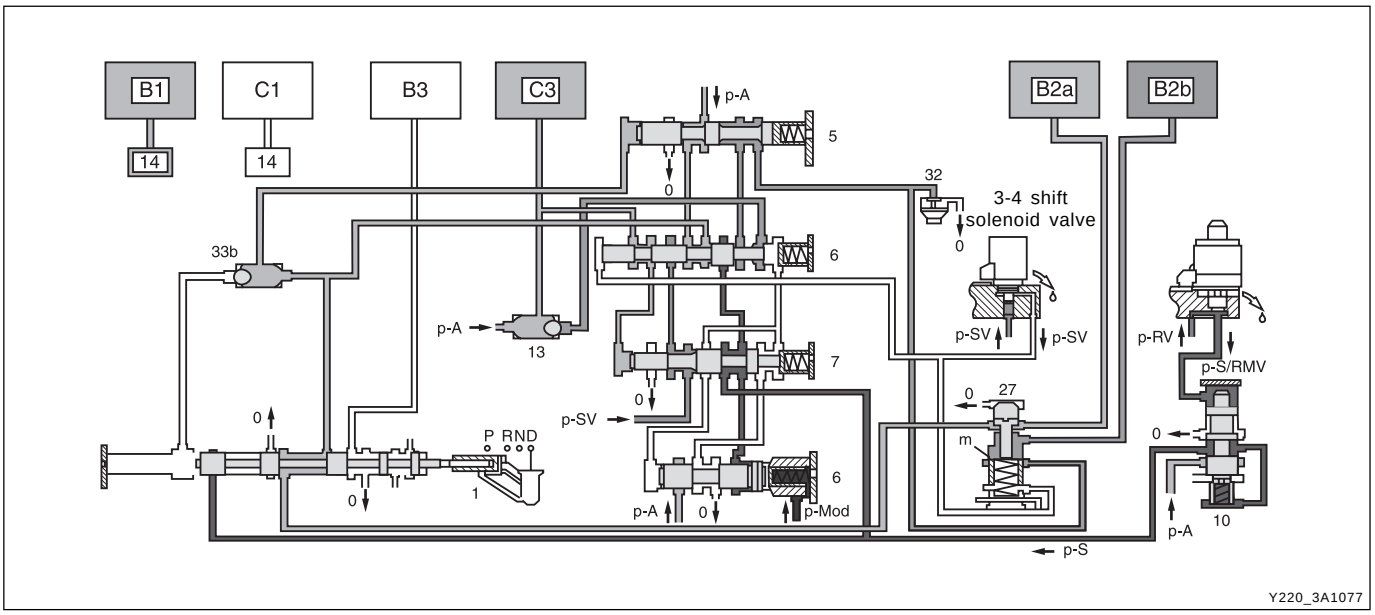


1. Selector valve
5. 3-4 holding pressure shift valve
6. 3-4 Command valve
7. 3-4 shift pressure shift valve
8. 3-4 overlap control valve
10. Ball valve
13. Ball valve
14. 1-2/4-5 Command valve
19. Shift pressure control valve
27. B2 shift valve

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

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

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

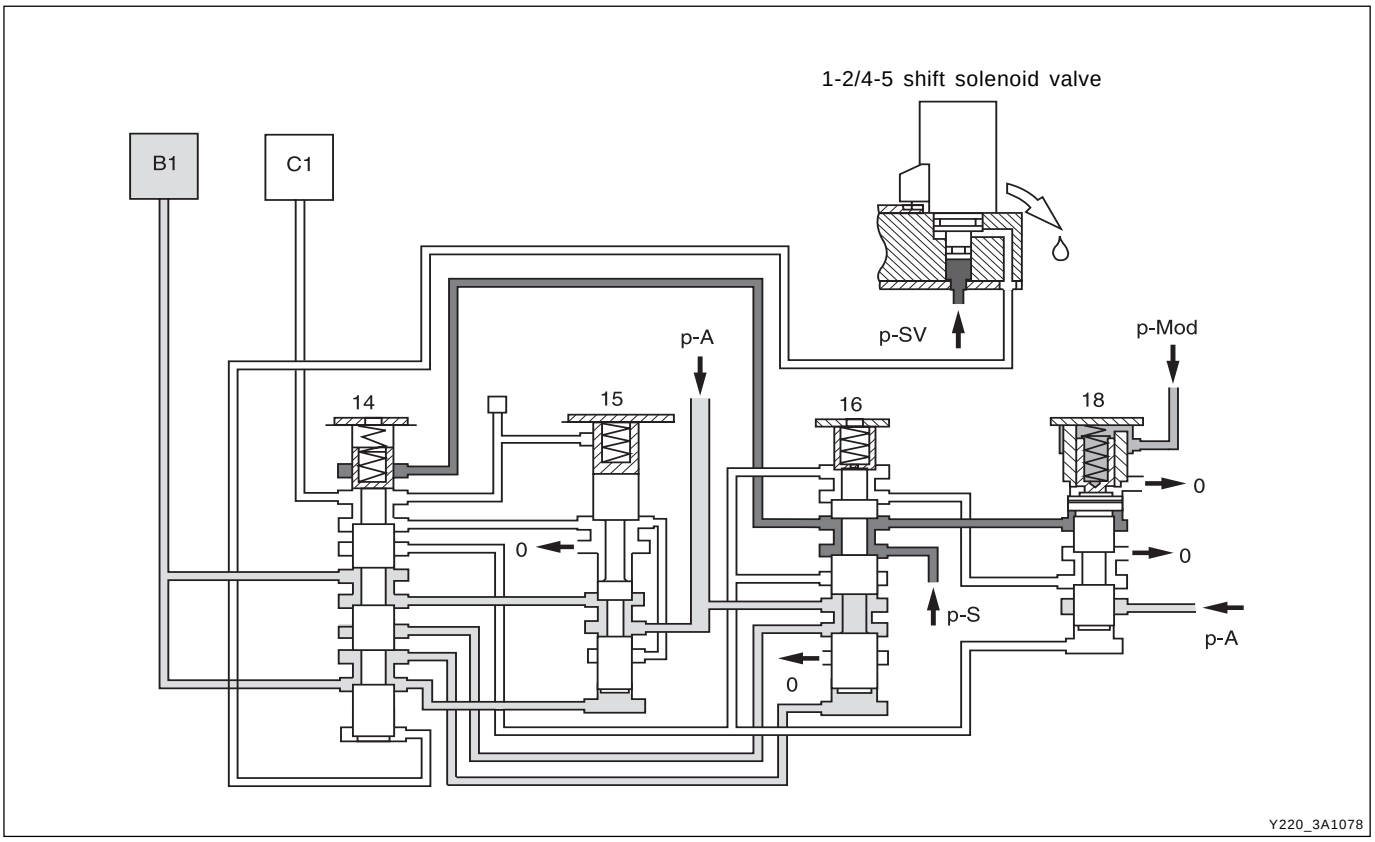


1. Selector valve
5. 3-4 holding pressure shift valve
6. 3-4 Command valve
7. 3-4 shift pressure shift valve
8. 3-4 overlap control valve
10. Ball valve
13. Ball valve
14. 1-2/4-5 Command valve
19. Shift pressure control valve
27. B2 shift valve
32. Pressure holding valve

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

The pressure on the opposing face of the piston B2 (B2b) ensures a soft activation of the brake B2. The TCU monitors the activation sequence via the speed of input shaft, which slows down as the frictional connection in the brake increases. When the speed drops to the specified level, TCU shuts off the power to the 3-4 shift solenoid valve. The spring chamber of the shift valve B2 (27) is depressurized and switches downwards. This connects the line to the opposing face of the piston B2 (B2b) with the pressure holding valve (32). The pressure on the opposing face of the piston B2 (B2b) drops to a residual pressure. The 3-4 command valve (6) moves to the left. The operating pressure (p-A) travels via the holding pressure shift valve (5) and the 3-4 command valve (6) to the piston of brake B2 (B2a). The activation sequence is completed and 1st gear is engaged.

▶ Hydraulic Circuit After Shifted to 1st Gear

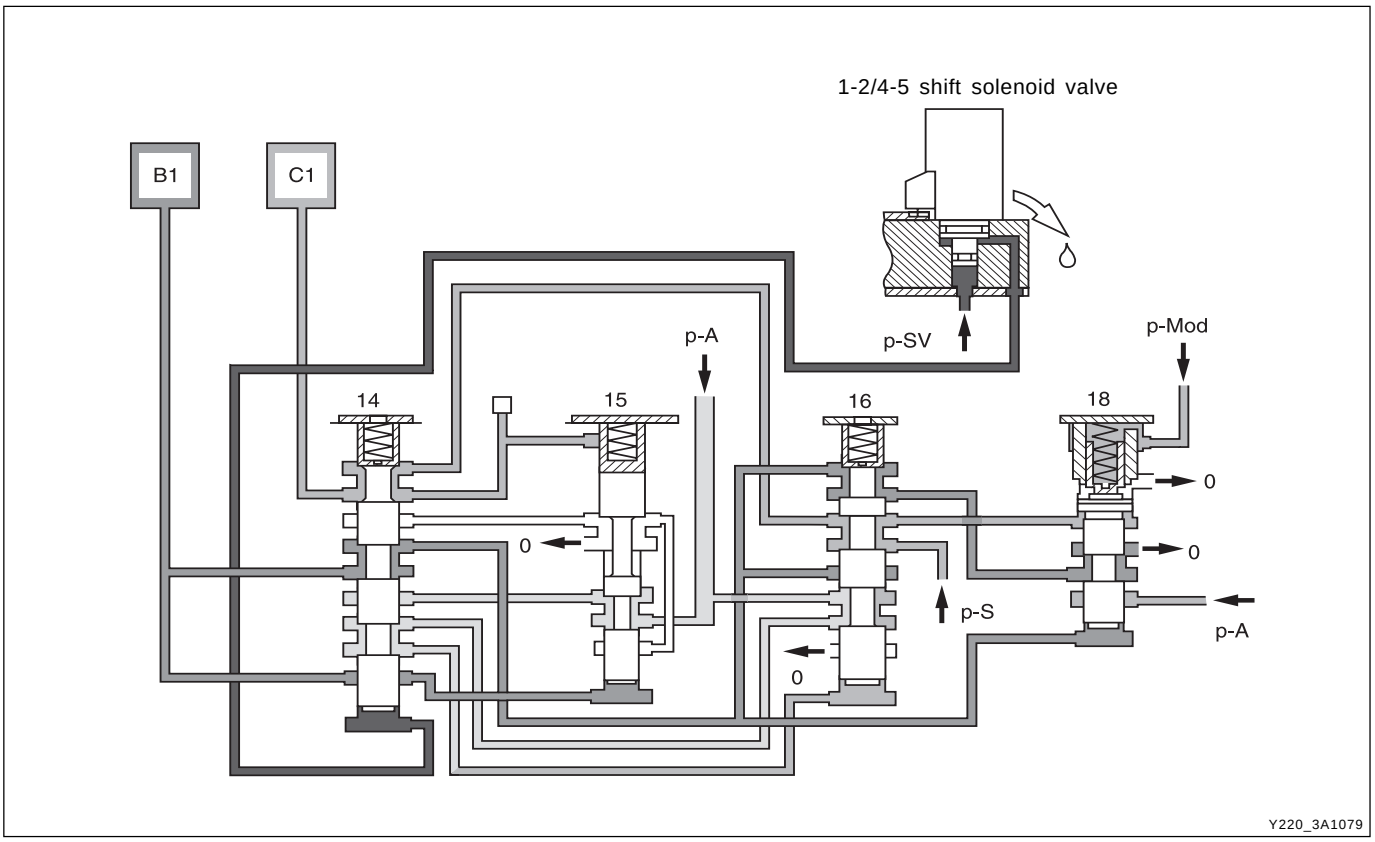


14. 1-2/4-5 command valve
15. 1-2/4-5 holding pressure shift valve
16. 1-2/4-5 shift valve
18. 1-2/4-5 pressure overlap control valve

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

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

▶ Hydraulic Circuit During Shift Phase



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

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

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

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EFFECTIVE DATE	
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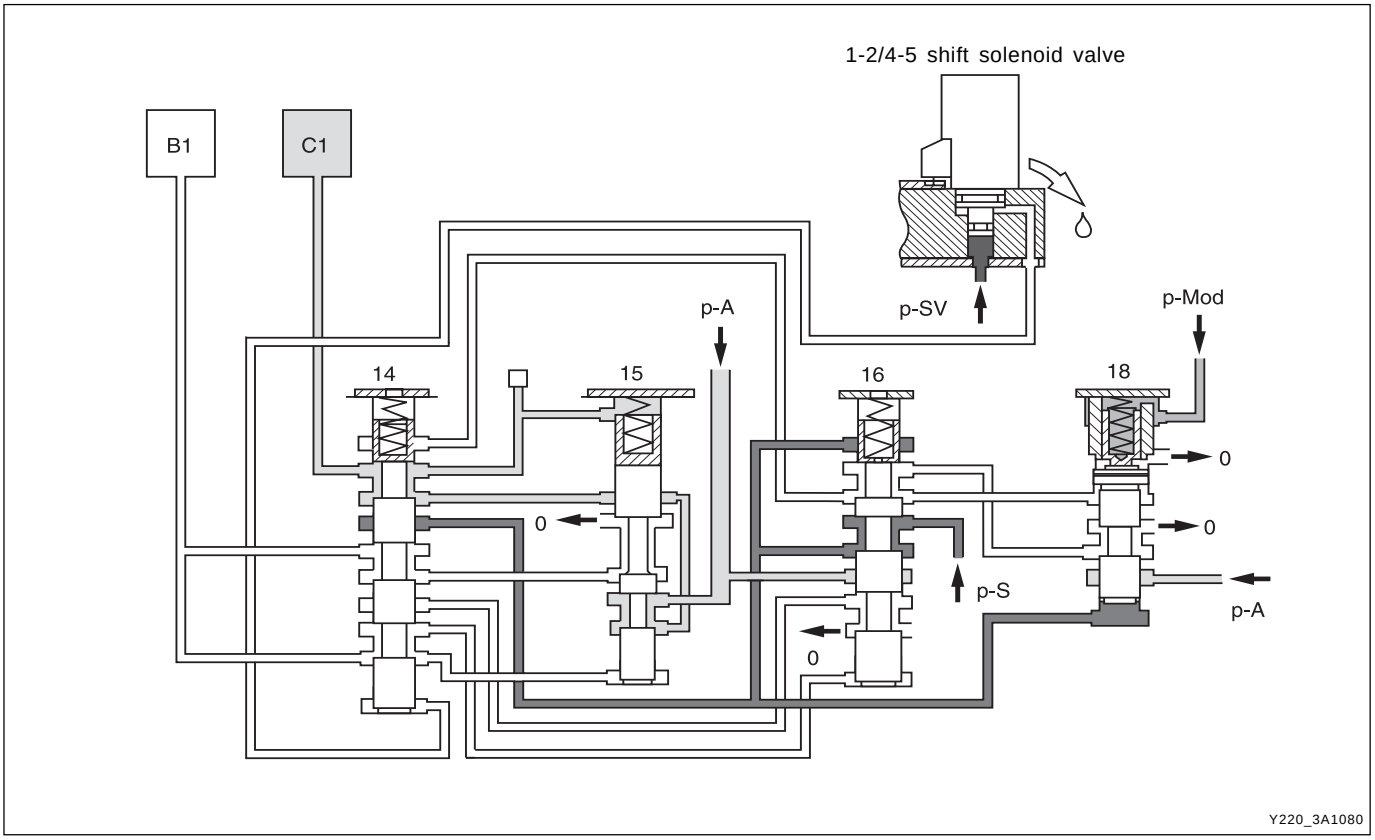
▶ Hydraulic Circuit After Completed Gear Change

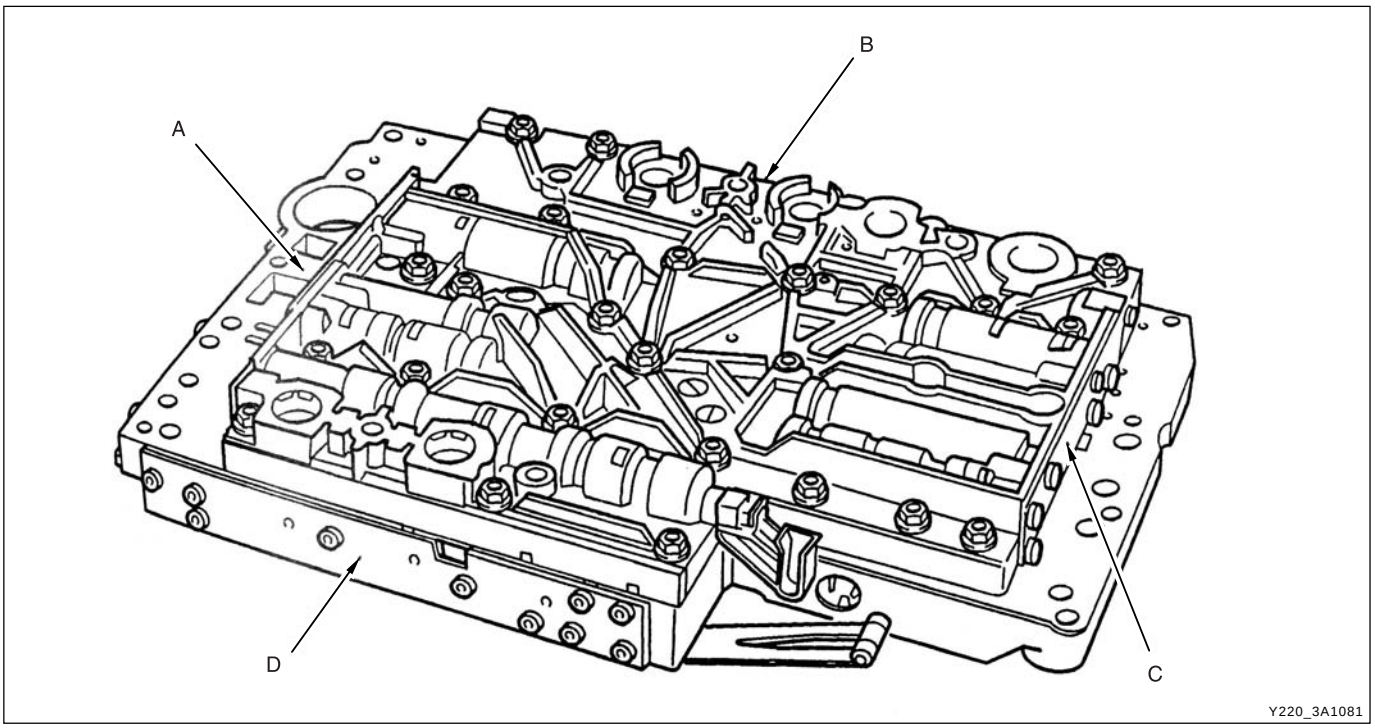


14. 1-2/4-5 command valve
15. 1-2/4-5 holding pressure shift valve
16. 1-2 /4-5 shift valve
18. 1-2/4-5 pressure overlap control valve

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

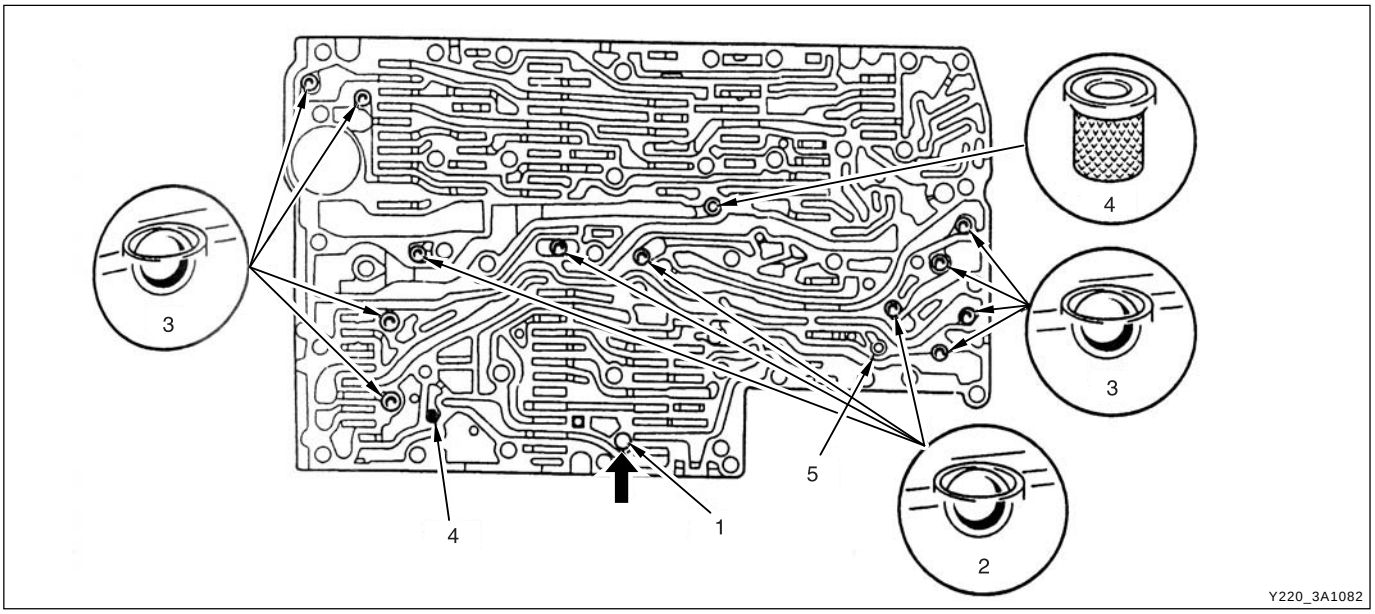
The 1-2/4-5 shift solenoid valve interrupts the pressure on the end face of the command valve (14) and it returns to its base position. The operating pressure (p-A) is now applied to clutch C1 via the holding pressure shift valve (15) and the command valve (14). The brake B1 is disengaged (unpressurized).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

STRUCTURE OF ELECTRO-HYDRAULIC CONTROL MODULE (SHIFT PLATE)



A. Adjusting valve: Operating pressure, Lubricating pressure, 2-3 group overlap
B. 1-2/4-5 shift group, control valve: Control valve pressure, Shift valve pressure
C. 3-4 shift group
D. 2-3 shift group, Clutch lockup control valve, shift valve B2

▶ Rear Section



1. Dowel pin
2. Valve ball (plastic)
3. Valve ball (steel)
4. Filter
5. Plastic valve

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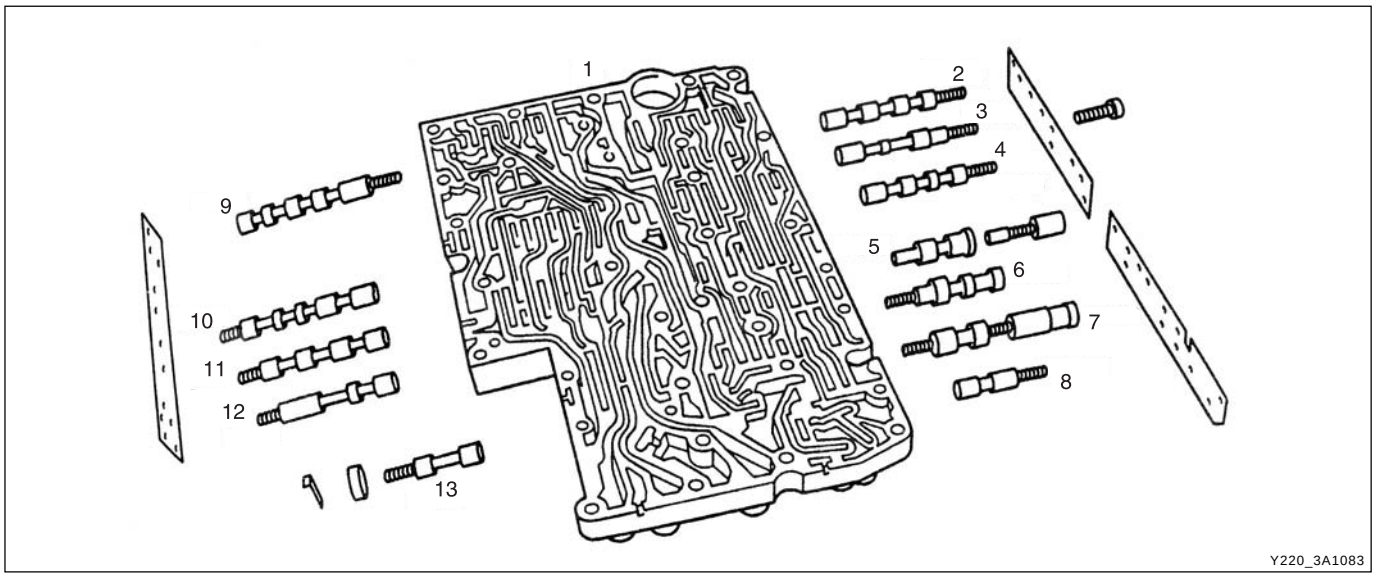
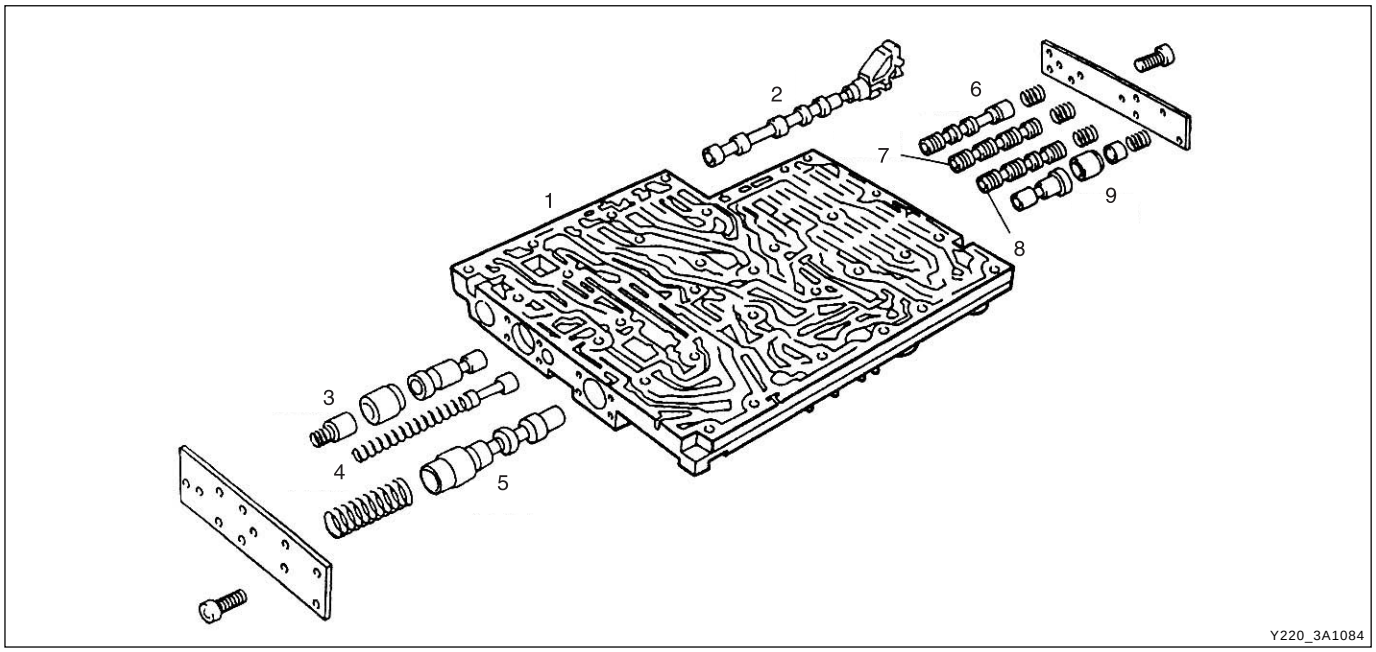
▶ Left Section



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

▶ Right Section



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

Removal and Installation

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

   Installation Notice

Tightening torque	8 Nm

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

   Notice

   Befor installation, make sure to insert the dowel pin into correct position.

4. Remove the sealing plate (3).

   Notice

   Be careful not to lose 4 plastic balls and 8 steel balls in shift housing.

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

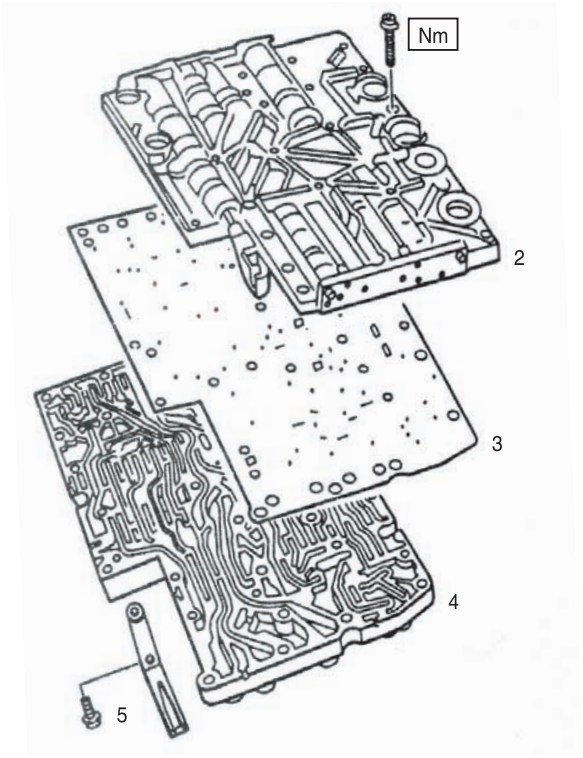
   Installation Notice

Tightening torque	14 Nm

   Notice

   Check the valves for damage, and replace if necessary.

6. Install in the reverse order of removal.



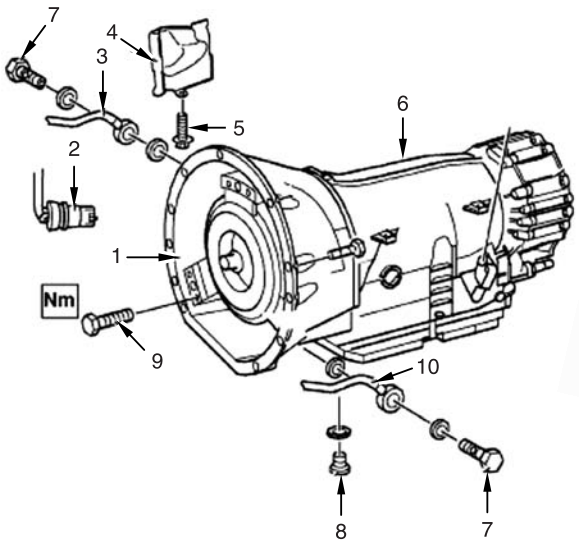
1. Bolts (29)
2. Valve housing
3. Sealing plate
4. Shift housing
5. Leaf spring

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

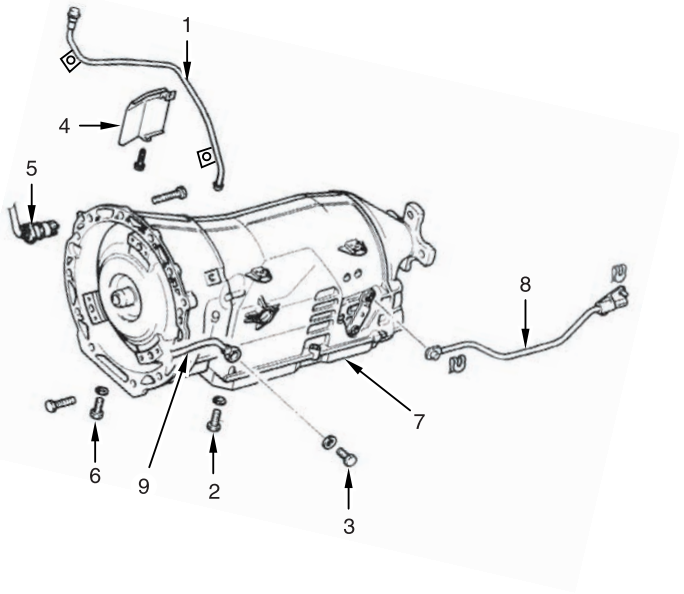
REMOVAL AND INSTALLATION (DC 5-SPEED A/T)

COMPONENTS LOCATOR

4WD



2WD



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4WD

1. Torque converter housing
2. Plug connector
3. Oil line
4. Shield
5. Bolts
6. Transfer case adapter housing
7. Union plugs
8. Drain plug
9. Torque converter bolts
10. Oil line

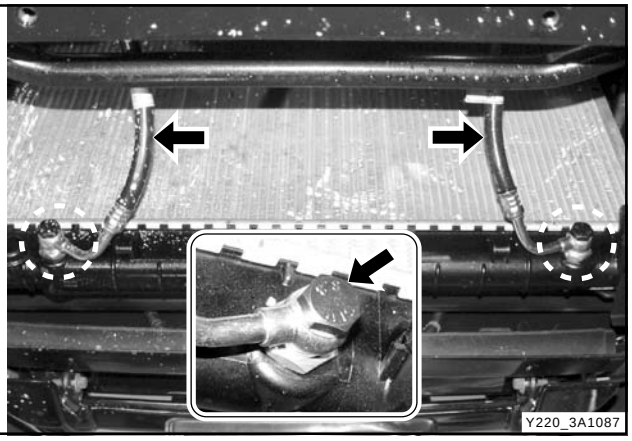
2WD

1. Oil filler pipe
2. Drain plug
3. Union bolt
4. Oil line
5. Plug connector
6. Torque converter bolts
7. Transmission assembly
8. Shift rod

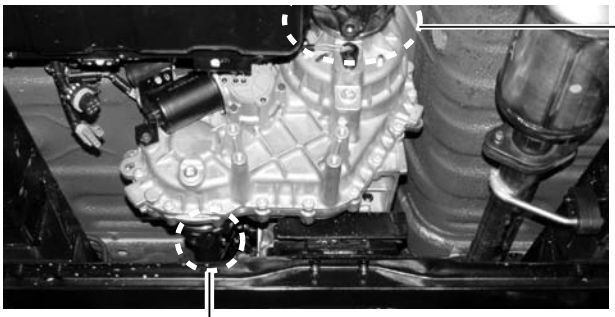
Removal and Installation

※ Preceding work: Disconnect negative battaery cable.

* Make sure that the oil cooler pipe hose is not be twisted, oil cooler pipe (radiator side) is not clogged. If it is contaminated with foreign materials, thoroughly clean before replacing transmission assembly (This work is necessary when removing and installing the radiator).



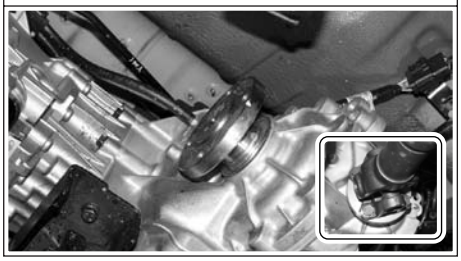
1. Unscrew the bolts and remove the front and rear propeller shafts.



Rear propeller shaft

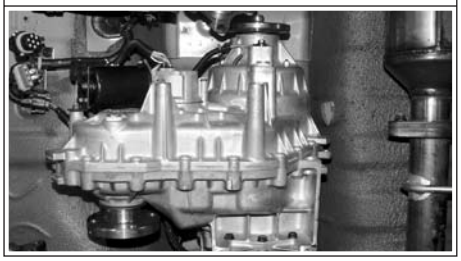
17M : 81~89 N·m
14M : 70~80 N·m

Front propeller shaft



17M : 81~89 N·m
14M : 70~80 N·m

Removed



Oil draining

**** If necessary, drain the oil. However, when removing or installing the transmission without any other processes, just add oil excluding drainage.***

Installation Notice

Tightening torque	14 Nm

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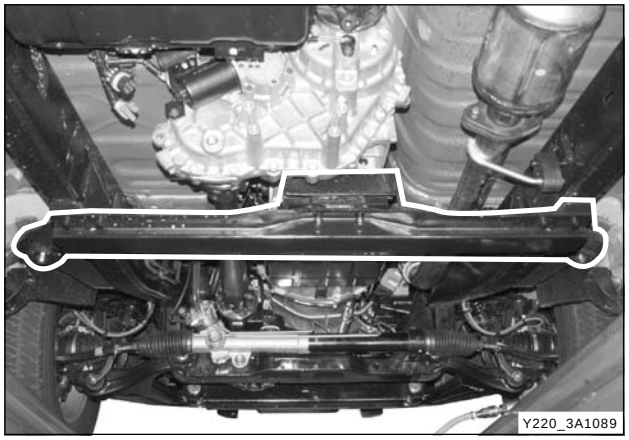
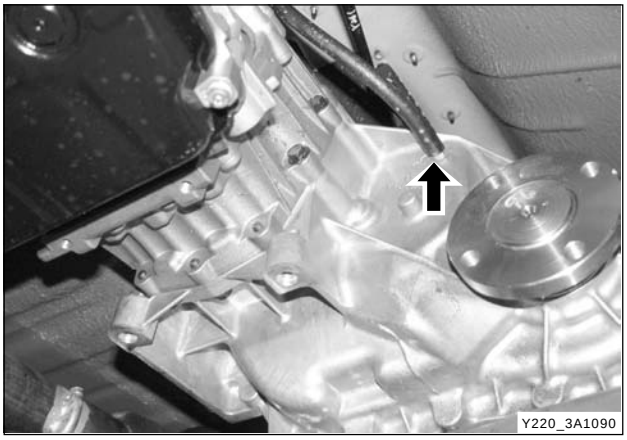
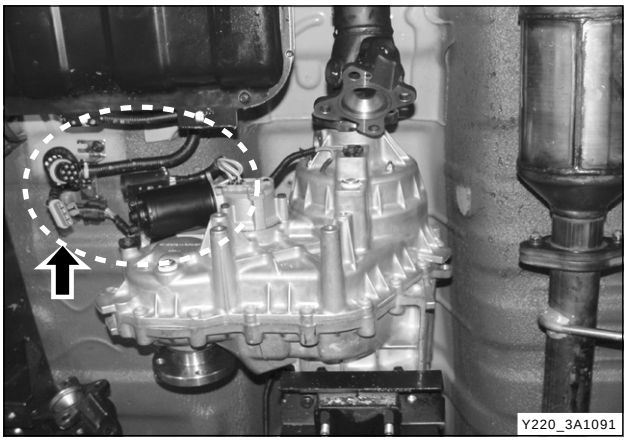


2. Remove the cross member and insulator under the connection area of transfer case and transmission.

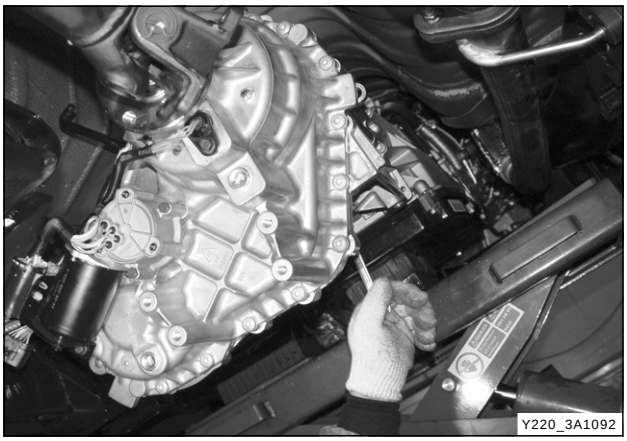
Tightening torque	Left/Right: 36 ~ 44 Nm
	Center: 20 Nm



3. Separate the air bleed hose from transfer case.



4. Disconnect transmission wiring harness from transfer case.



5. Unscrew the transfer case bolts (12M x 11) and remove the transfer case.

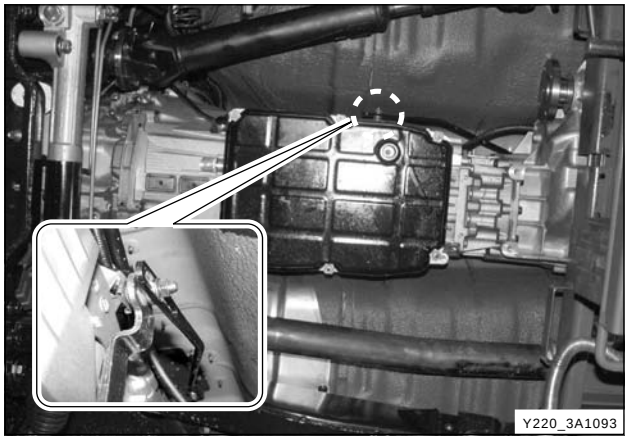
Installation Notice

Tightening torque	20 ~ 25 Nm

6. Disconnect selector lever.

Notice

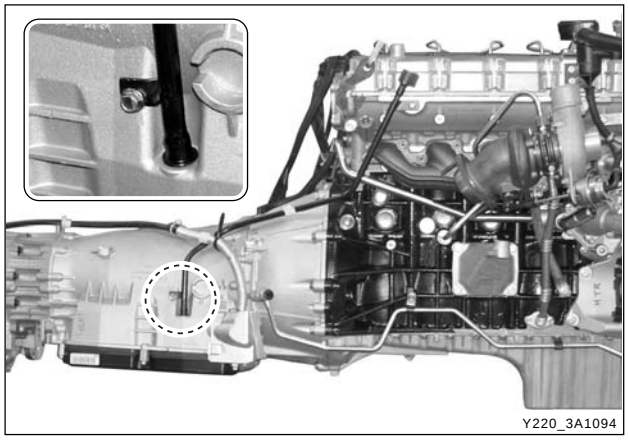
Place the selector lever at "P" position when removing/installing selector lever and wire cable.



7. Unscrew the bolts and remove the oil dipstick pipe and mounting bracket.

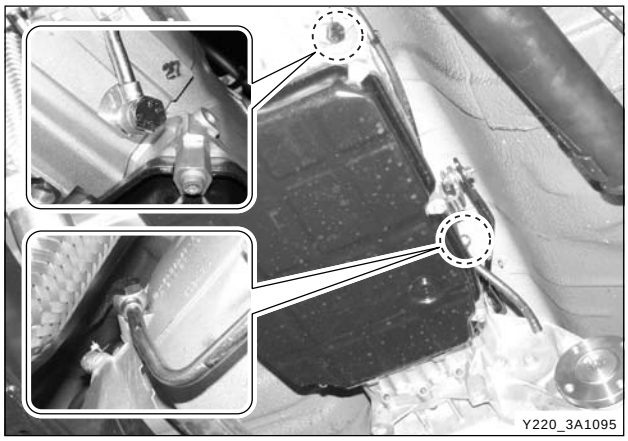
Installation Notice

Tightening torque	14 Nm



8. Unscrew the bolts and separate both oil cooler lines (supply/return).

Tightening torque	34 ± 4 Nm



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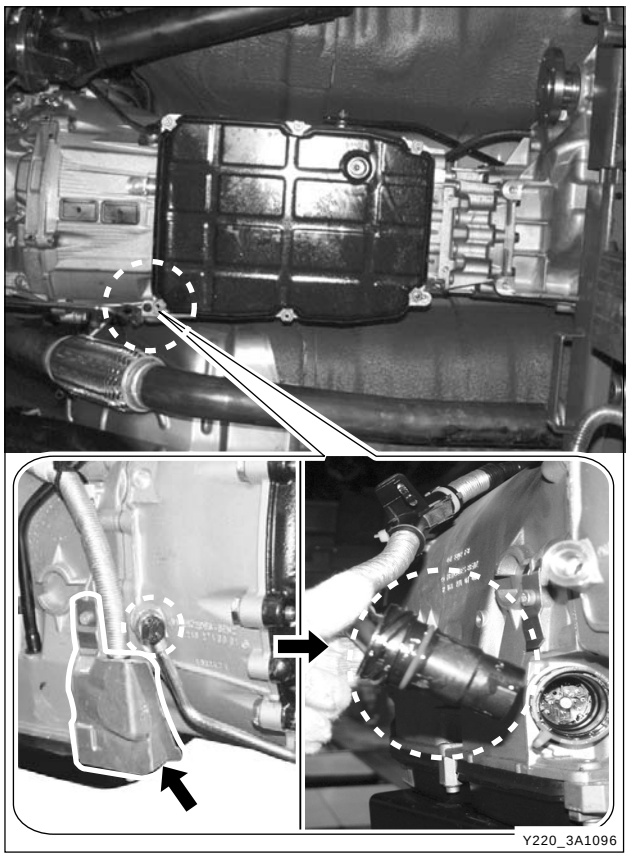
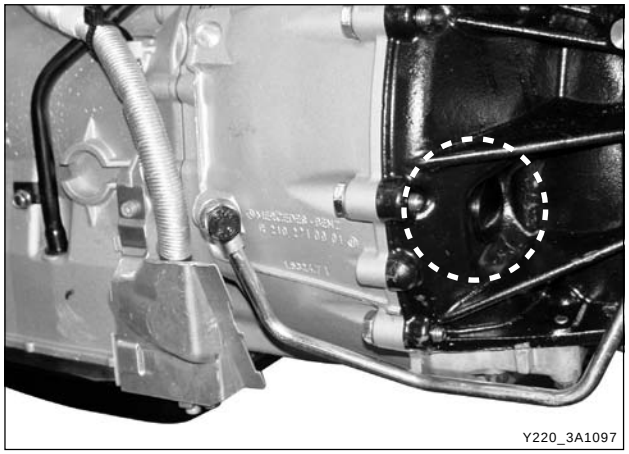


9. Unscrew the plug connector shield bolt and remove the plug connector from automatic transmission.



10. Remove the torque converter bolts from drive plate.

Installation Notice

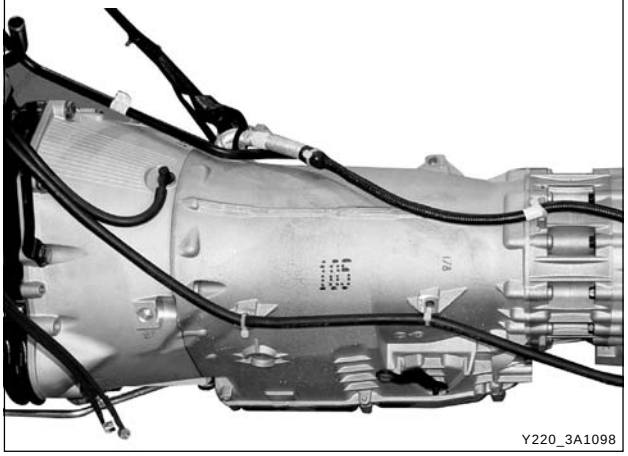
Tightening torque	42 Nm

11. Unscrew the transmission mounting bolts and remove the transmission assembly.

Tightening torque	50 ~ 60 Nm

Notice

Be careful not to drop torque conver.



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12. Remove the torque converter with special tool.

Notice

Apply a small amount of transmission oil on drive flange before installing torque converter.

Installation Notice

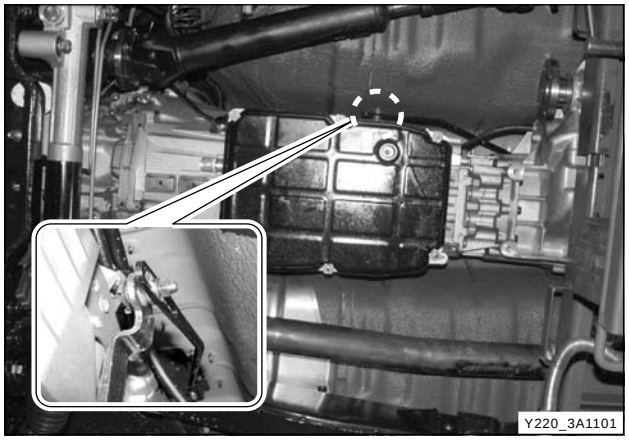
Distance "A"	below 6.5 mm

Y220_3A1099

13. Install in the reverse order of removal.

Notice

- ***Add transmission oil and check the level.***
- ***Thoroughly clean the transmission before installation.***



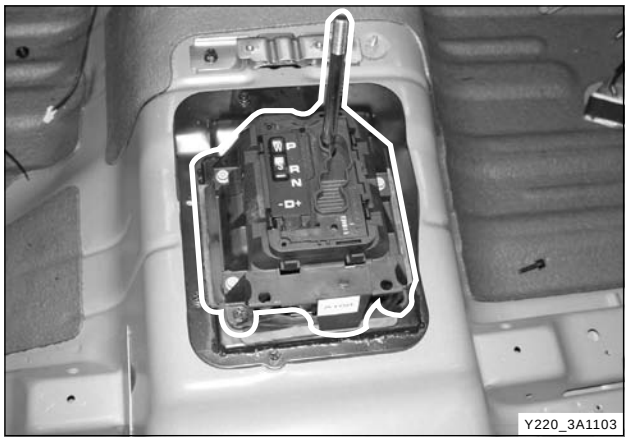
Selector Assembly - Removal and Installation

1. Separate selector lever.

Notice

Place the selector lever at "P" position when removing/ installing selector lever and wire cable.

2. Remove the console box (refer to "Body" section).
3. Remove the senter and rear air duct.



4. Unscrew the bolts and remove the selector assembly.

Installation Notice

Tightening torque	6 Nm

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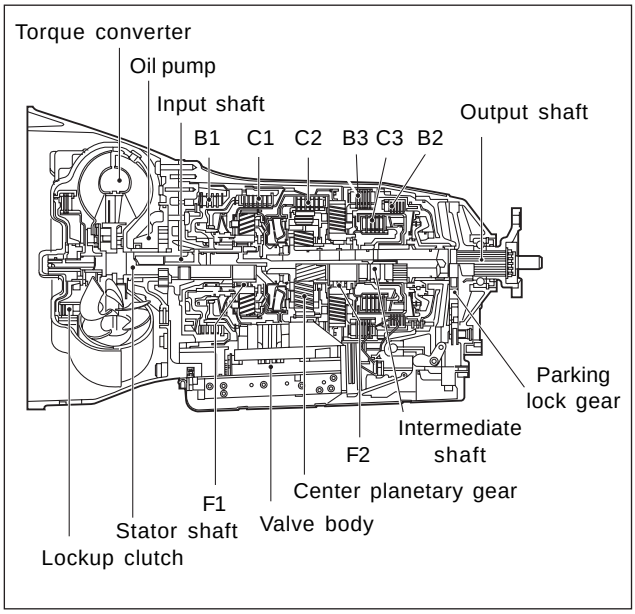
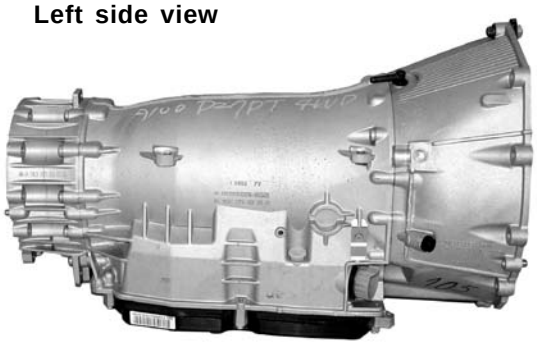
EFFECTIVE DATE	
AFFECTED VIN	

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

COMPONENTS

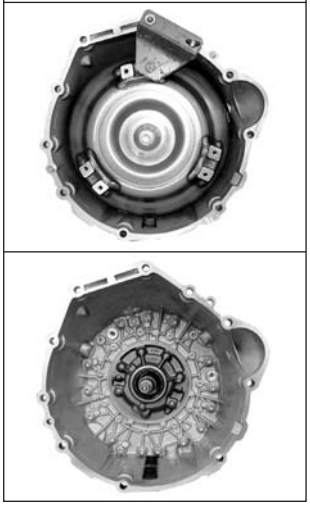


Left side view



Right side view

Front view



Rear view

Under view

Y220_3A1104

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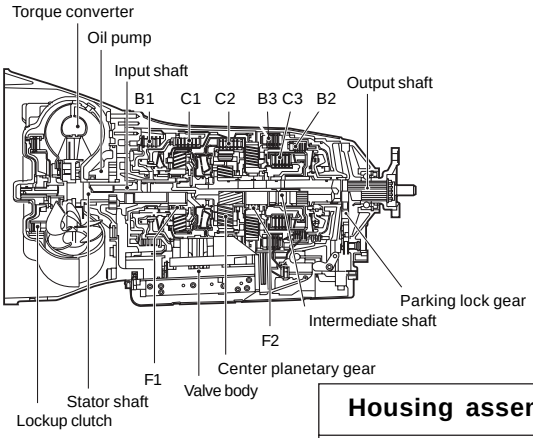
AFFECTED VIN	

COMPONENTS ASSEMBLY



C3 assembly

C2 assembly

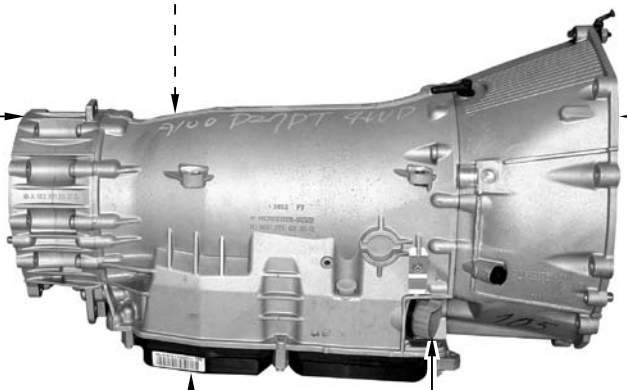
C1 assembly

B1 assembly

B3 assembly

Housing assembly

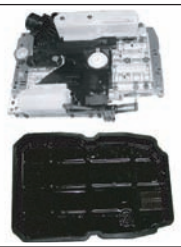
B2 assembly



Output flange

Oil pump

Valve body and oil pan



Adaptor plug (transmission wiring connection)

Torque converter

Y220_3A1105

▶ Friction Disc

Transmission	Friction Disc	C1	C2	C3	B1	B2	B3	Remark
W5A300 (G32D: 4WD)	Numbers	4	4	4	3	5	4	
	Type	Single face	Dual face	Single face	Single face	Dual face	Dual face	
W5A400 (D27DT: 4WD)	Numbers	5	5	4	4	5	5	
	Type	Single face	Dual face	Single face	Single face	Dual face	Dual face	

▶ Tightening Torque

No	Description	Tightening Torque (Nm)	Remark
1	Oil drain plug (oil pan)	14	Heaxgon, 5 mm
2	Oil filler pipe (upper)	12 ~ 14	-
3	Oil filler pipe (lower)	7 ~ 8	-
4	Oil cooler pipe	30 ~ 38	-
5	Oil pan	8	T 30
6	Torque converter housing/oil pump	20	-
7	Transmission rear mounting bracket (both sides)	36 ~ 44	-
8	Transmission rear mounting bracket (center)	20	-
9	Torque converter bolt	42	-
10	Converter housing/engine	50 ~ 60	-
11	Converter housing/transmission housing	20	T 45
12	Valve body	8	T 30
13	Valve body side cover	4	T 30
14	Solenoid valve	8	-
15	12-sided collar nut	200	12-sidede, each 30 mm
16	B2 housing bolt	16	T 45
17	Selector lever unit bolt	6	-

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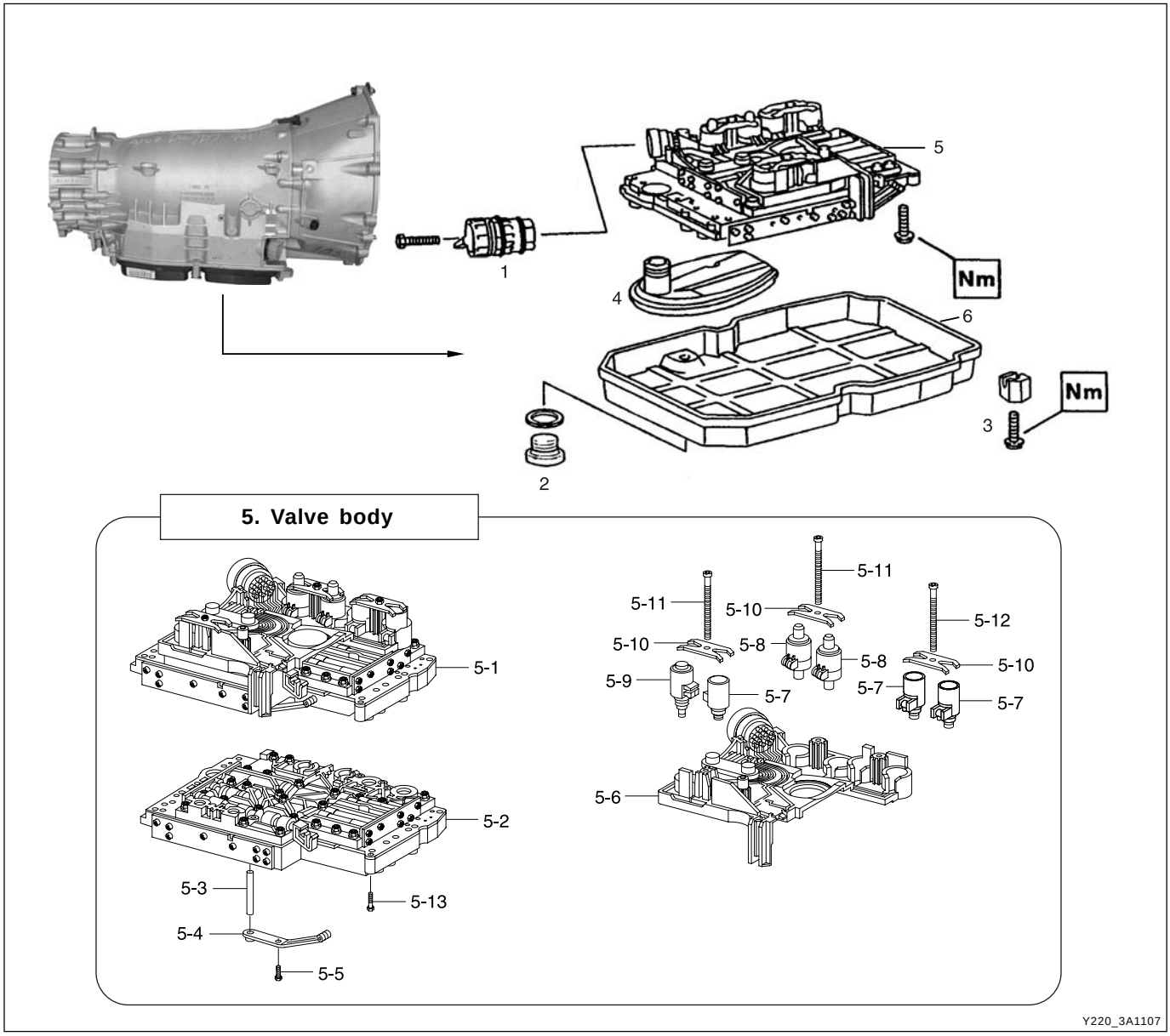
AFFECTED VIN	

DISASSEMBLY AND REASSEMBLY

▶ Valve Body Assembly



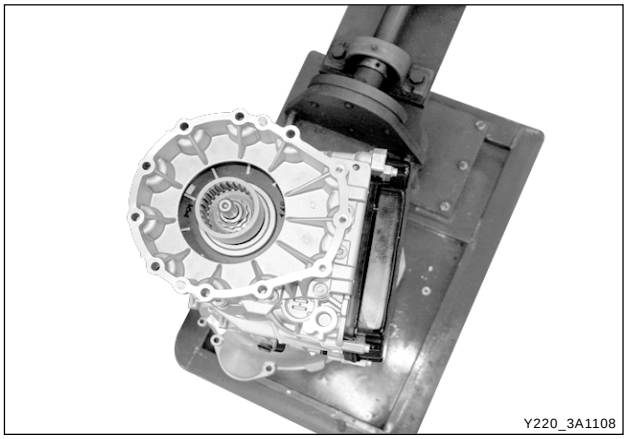
1. Guide bush
2. Drain plug
3. Bolts
4. Oil filter
5. Valve body
5-1. Valve body assembly
5-2. Body assembly
5-3. Pin
5-4. Plate leaf spring
5-5. Bolts
5-6. Electric kit
5-7. Solenoid valve
5-8. Lifting solenoid valve
5-9. Solenoid valve
5-10. Plate spring
5-11. Screw
5-12. Screw
5-13. Bolts
6. Oil pan

Disassembly and Reassembly

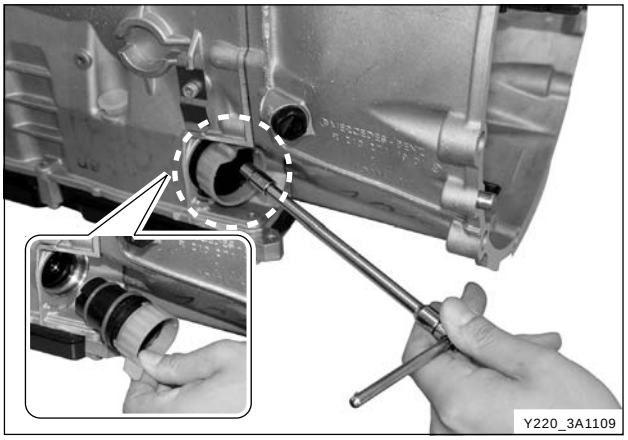
※ Preceding work: Install the transmission on work bench.

Note

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



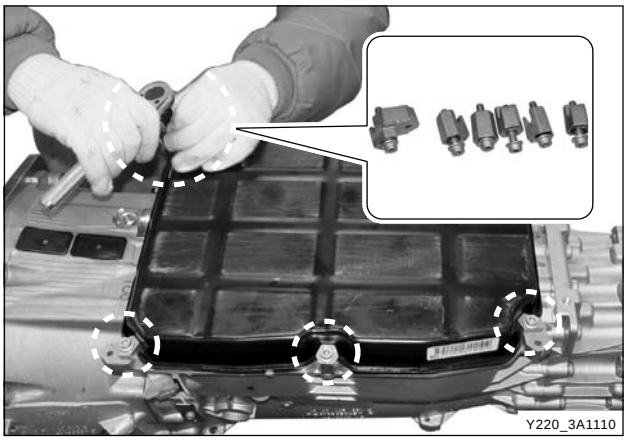
1. Unscrew the bolt and remove the guide bush (1).



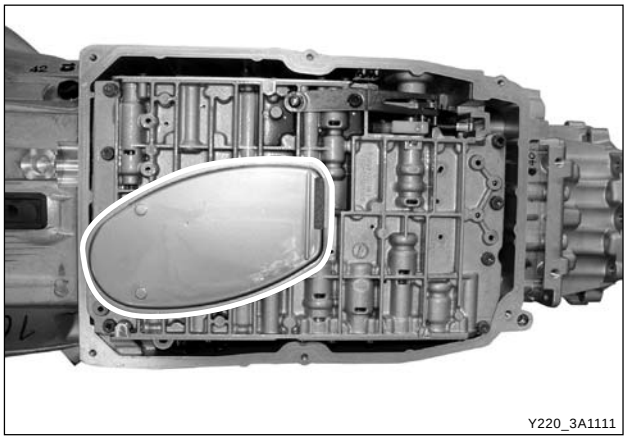
2. Unscrew the oil pan bolts and remove the oil pan (6).

   Installation Notice

Tightening torque	8 Nm



3. Remove the oil filter.



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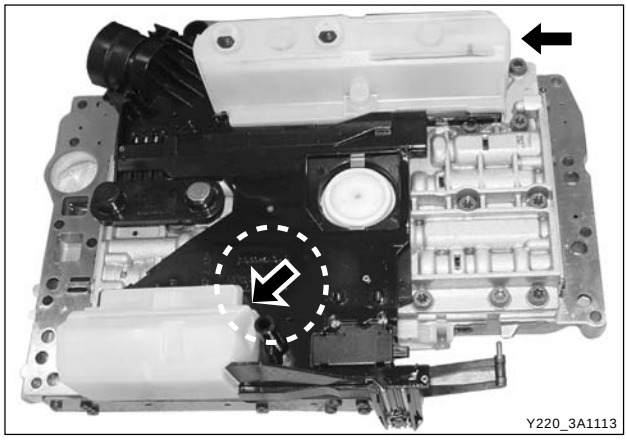
4. Unscrew the bolts and remove the valve body from transmission housing.

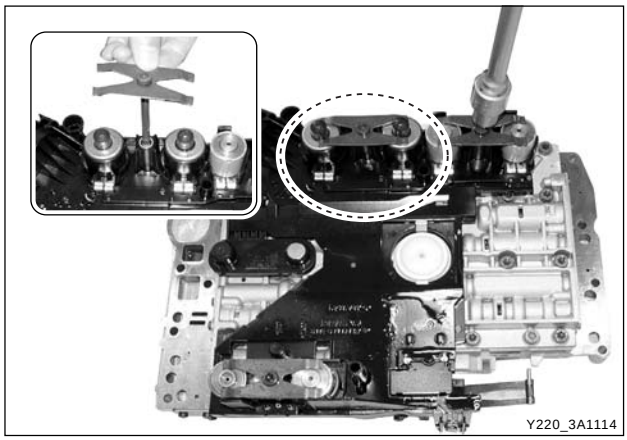
Installation Notice

Tightening torque	8 Nm



5. Disassembly and reassemblt the valve body assembly.

5-1. Remove the solenoid valve cap.



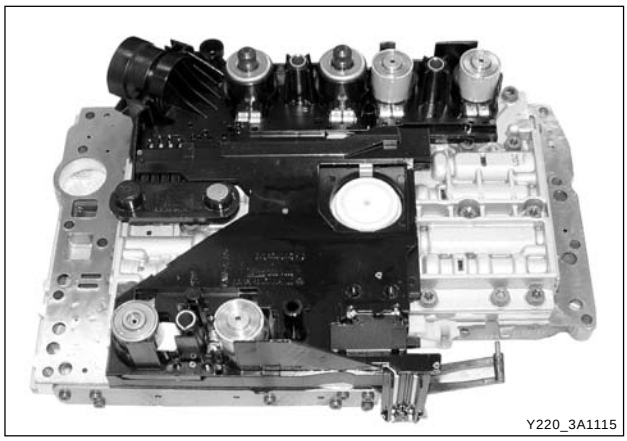
5-2. Unscrew the bolts on solenoid valve and remove the leaf springs.

Installation Notice

Tightening torque	8 Nm

Notice

The socket bolts do not have same length. Be careful not to mix up.



5-3. Remove the solenoid valves from valve body.

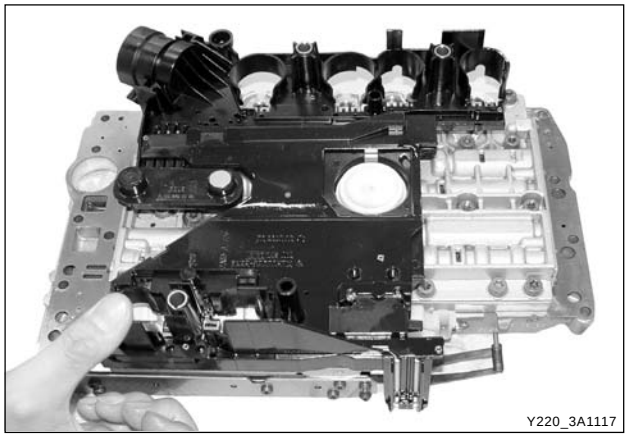
Notice

1. ***Make sure to install the solenoid valves at correct locations.***
2. ***Check the O-rings, and replace if necessary.***

5-4. Remove the electronic control module (Y3/6) from shift plate.

Notice

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



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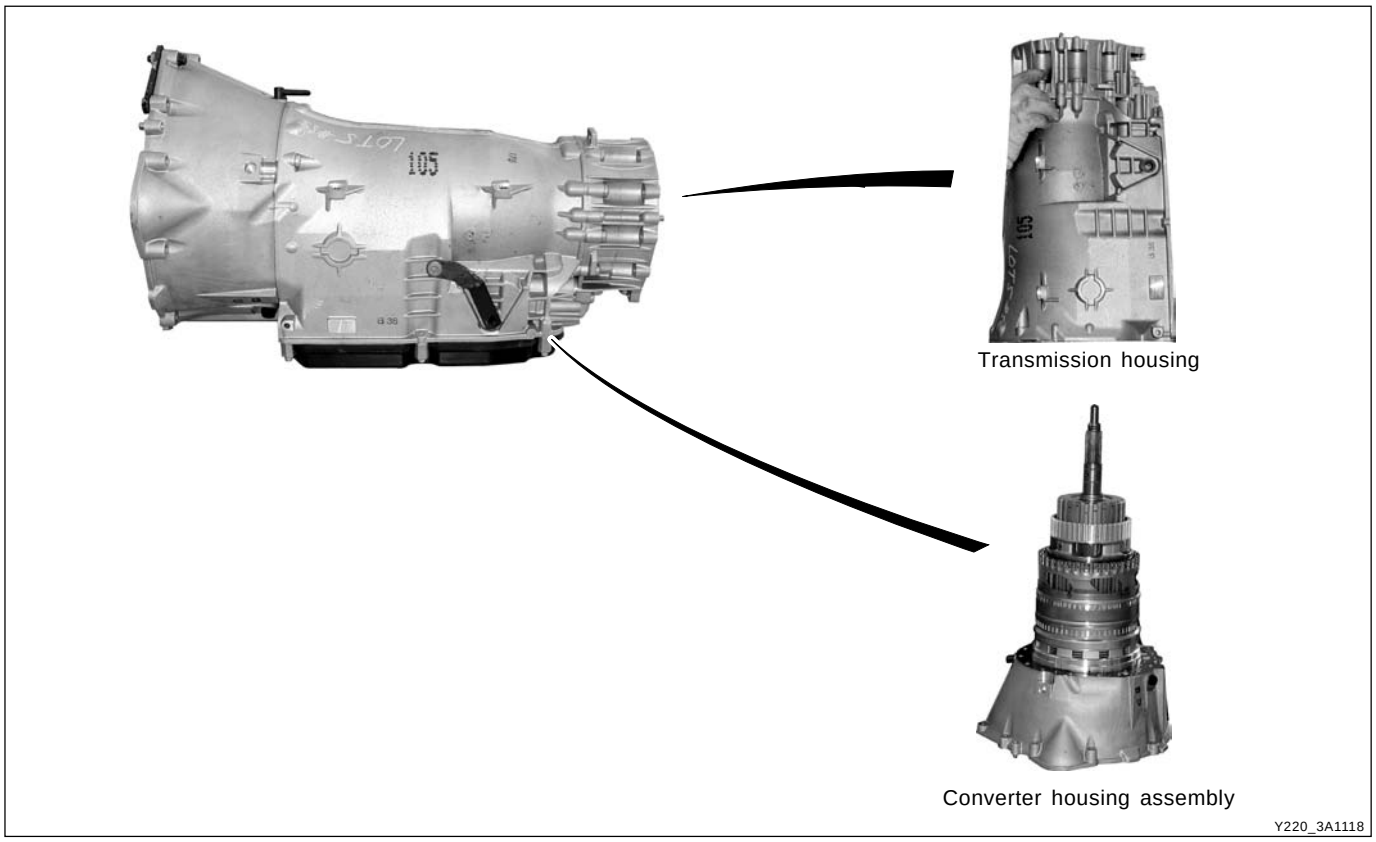
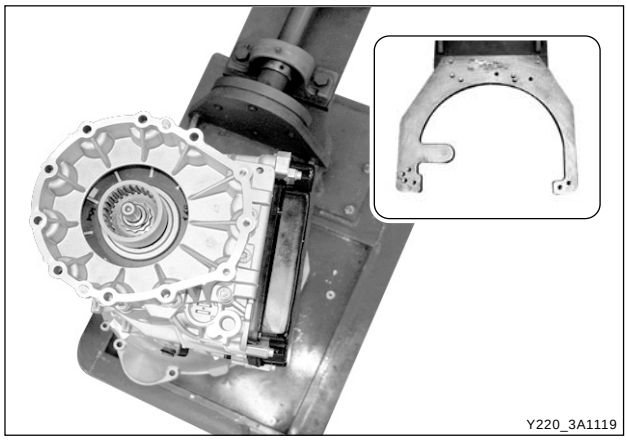
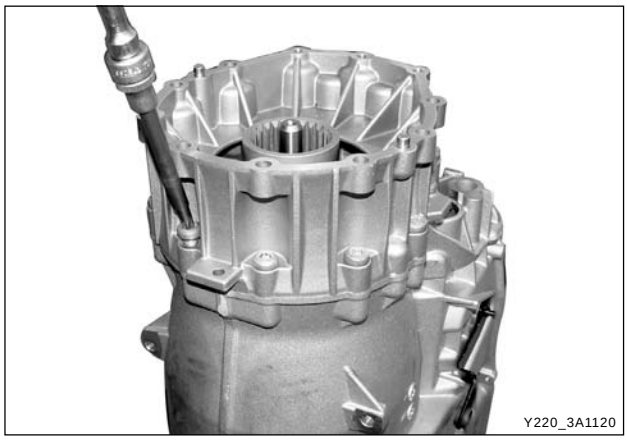
▶ Converter Housing and Transmission Housing







Disassembly and Reassembly

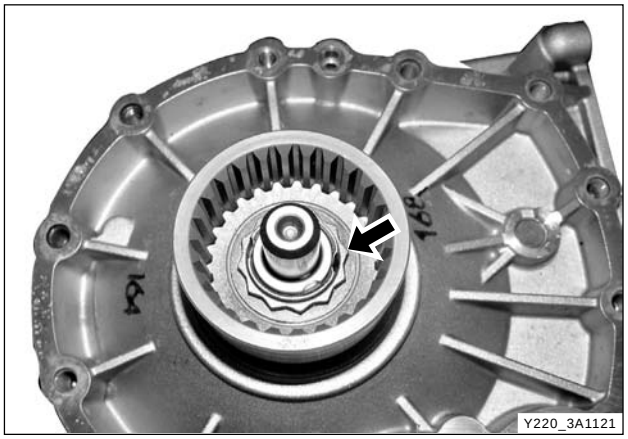
1. Install the transmission assembly on work bench.

2. Remove the rear extension housing from transmission housing.

   Installation Notice

Tightening torque	30 ~ 35 Nm

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



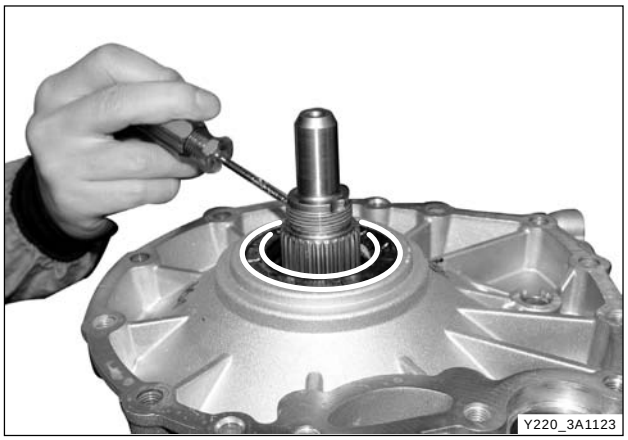
4. Unscrew the collar nut with special tool and remove output shaft flange.

Installation Notice

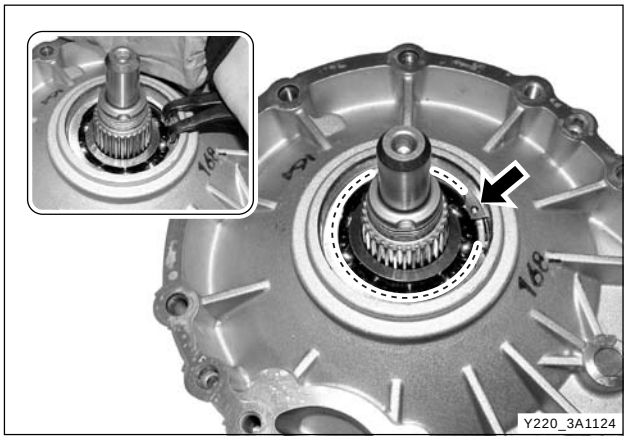
Tightening torque	200 Nm

* Bend the collar nut to lock it during installation.

5. Remove the rear oil seal ring.



6. Remove the snap ring with snap ring pliers and remove the washer.



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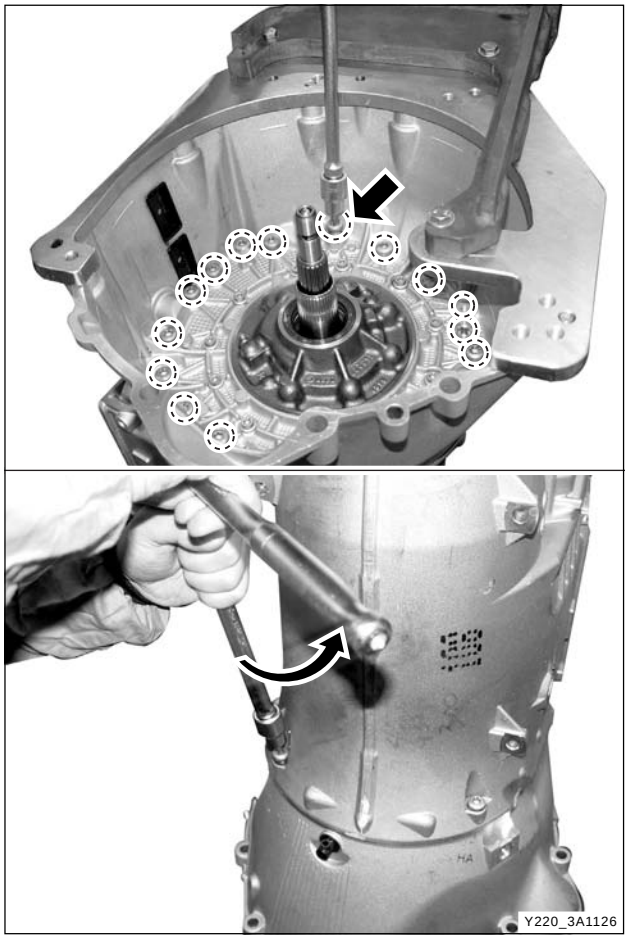
7. Remove the ball bearing from transmission housing.
   - Install the flare clamping pliers.
   - Install the puller onto inner bearing race.
   - Rotate the clamping pliers counterclockwise (arrow direction) to tighten.

Puller 001 589 50 33 00

Collet chuck 140 589 06 34 00

   - Remove the ball bearing from transmission housing with spanner.



8. Unscrew the socket bolts fastening converter housing and transmission housing and remove the transmission housing from converter housing.

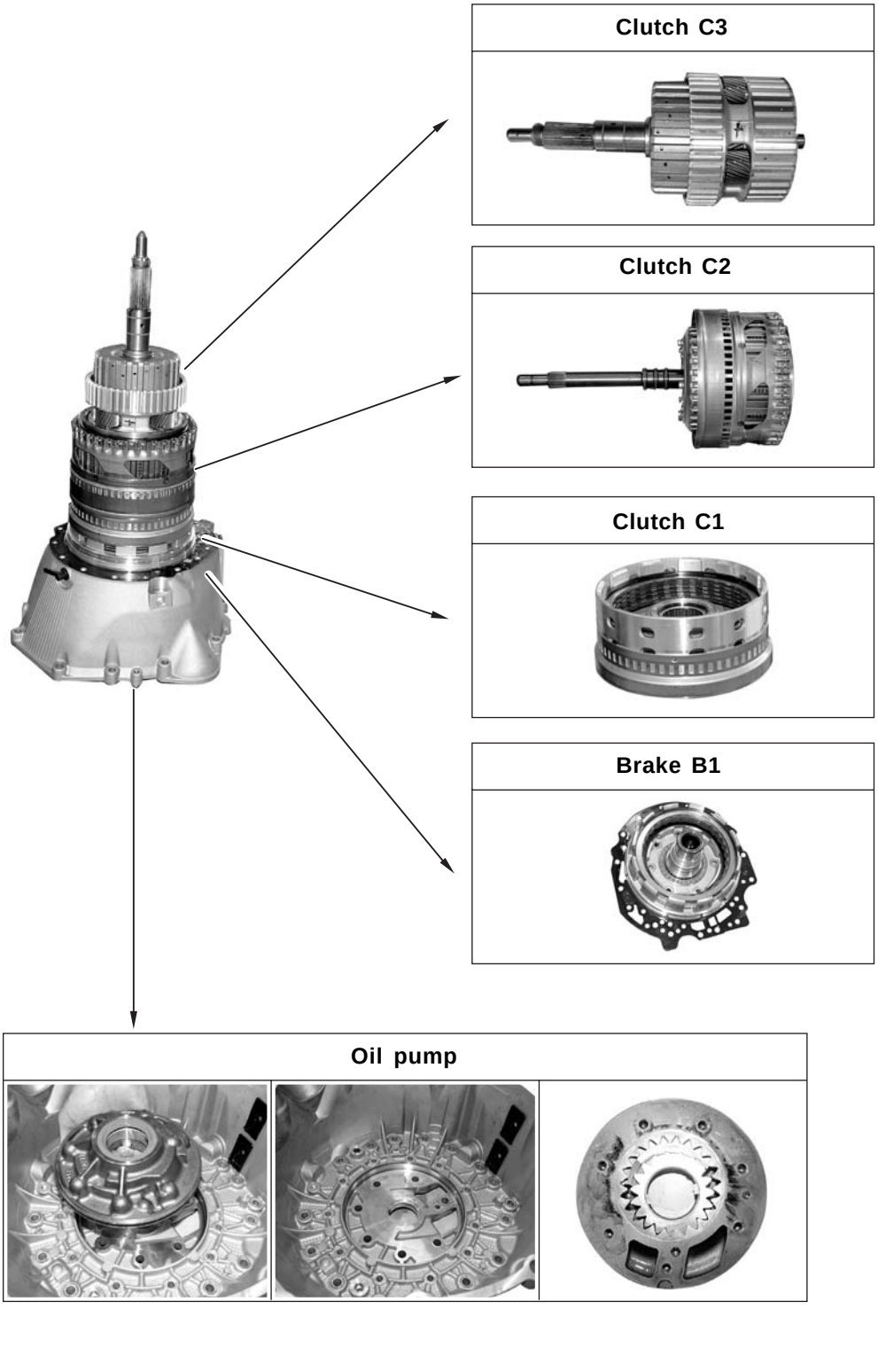
Installation Notice

Tightening torque	20 Nm

Note

Slightly turn the transmission housing to left and right direction to make the removal process easier.

▶ Converter Housing Assembly



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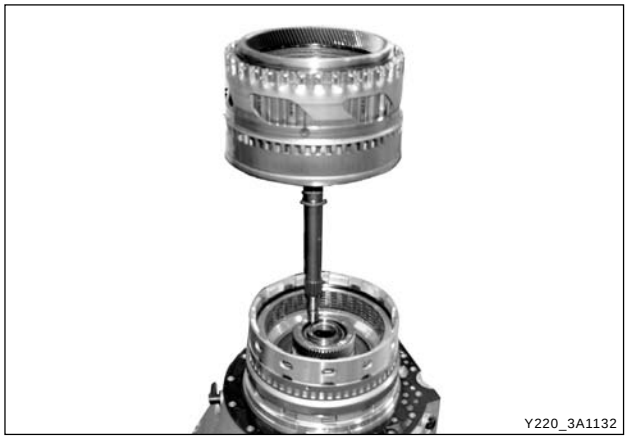
Y220_3A1131

Disassembly and Reassembly

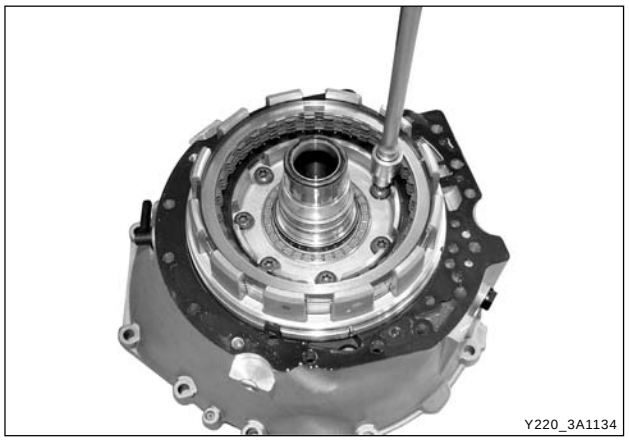
1. Remove the clutch C3 from converter housing assembly.


Y220_3A1132

2. Remove the clutch C2 from converter housing assembly.


Y220_3A1133

3. Remove the clutch C1 from converter housing assembly.


Y220_3A1134

4. Remove the brake B1.

4-1. Remove the bolts on brake B1.

Installation Notice

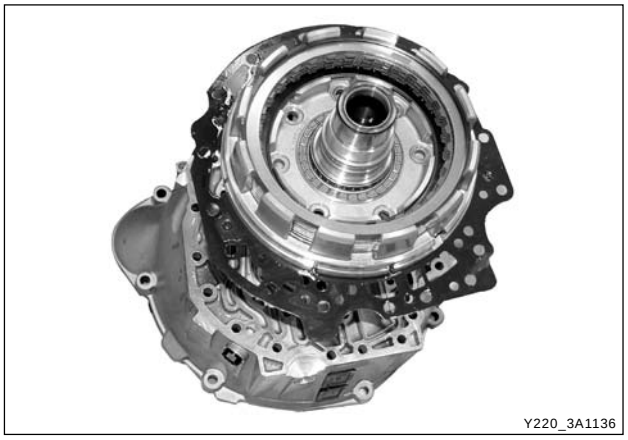
Tightening torque	16 Nm

4-2. Remove the bolts in converter housing.

Installation Notice

Tightening torque	8 Nm

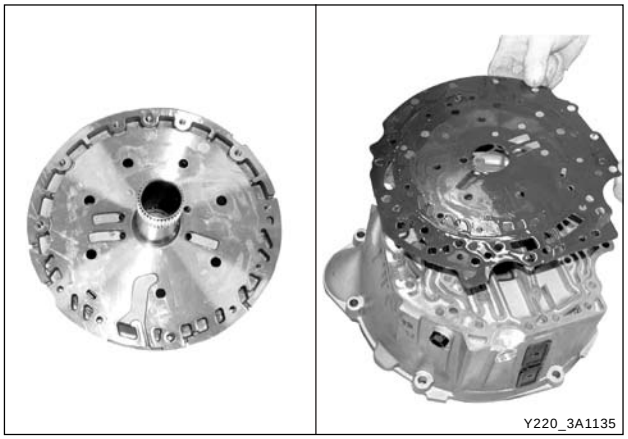
4-3. Remove the brake B1 from converter housing.



4-4. Separate the plate from valve body.

Notice

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



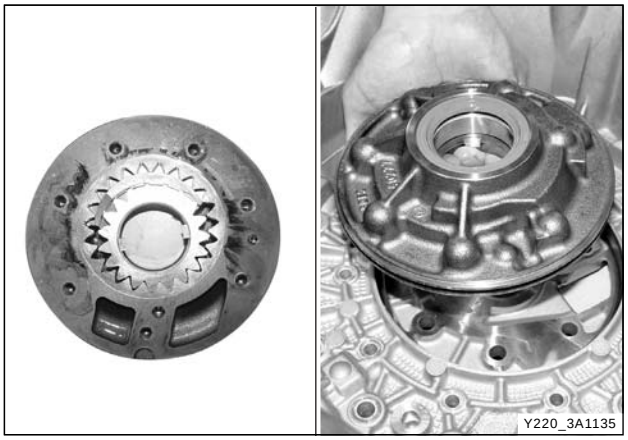
5. Unscrew the bolts and remove the oil pump.

Installation Notice

Tightening torque	20 Nm

Notice

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



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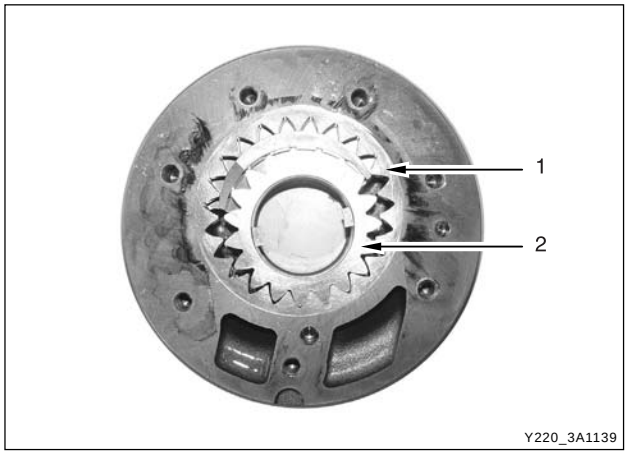
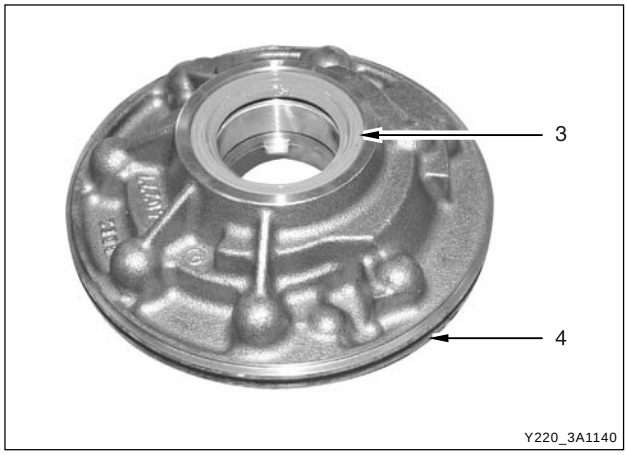


5-1. Remove the pump gears (1, 2) from pump housing.



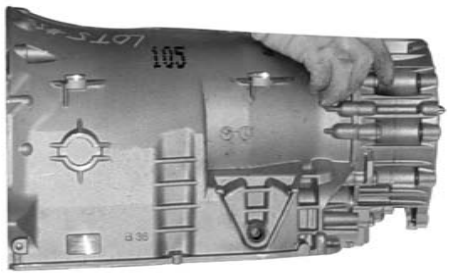
5-2. Check the radial seal ring (3), and replace if necessary.

5-3. Replace the O-ring (4) with new one.

Notice

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

▶ Transmission Housing Assembly

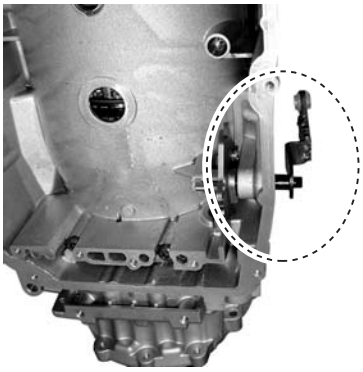


Parking lock gear

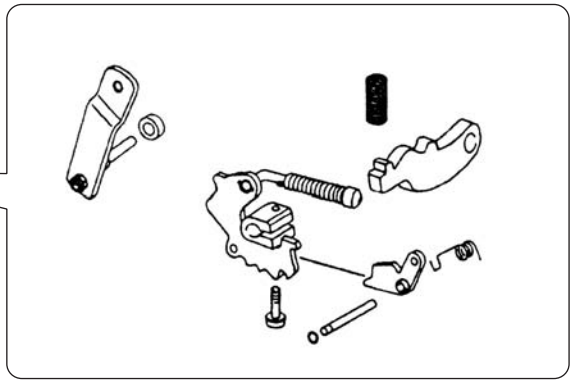
Brake B2

Brake B3

Snap ring



Components of selector lever



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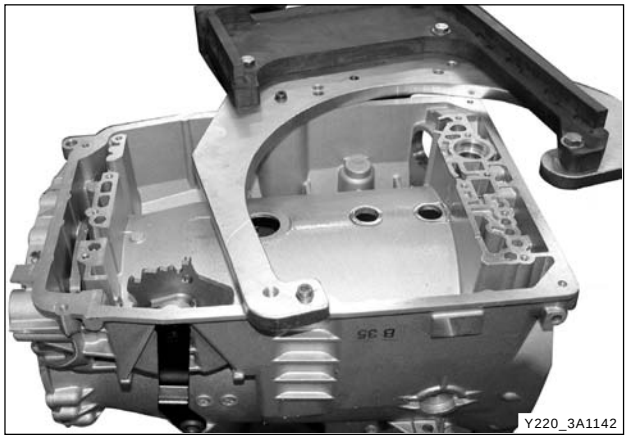
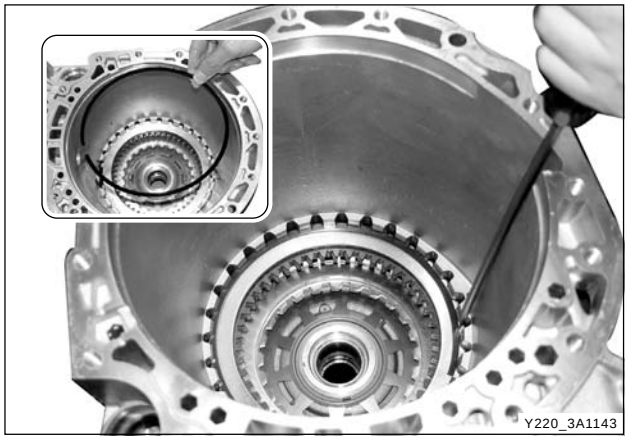
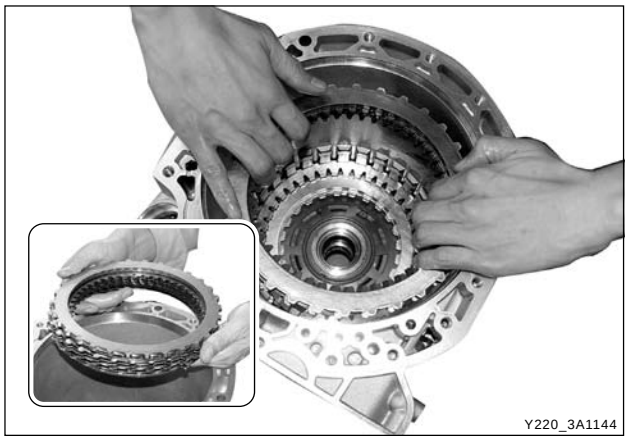


Disassembly and Reassembly

1. Install the transmission assembly on work bench.



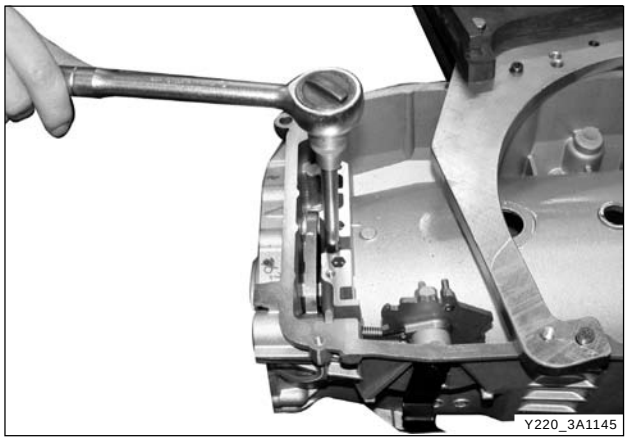
2. Remove the snap ring from transmission housing.



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

Notice

- ***To make the removal easier, remove the disc pack B3 while compressing it.***
- ***Check each disc for wear and burnt out.***

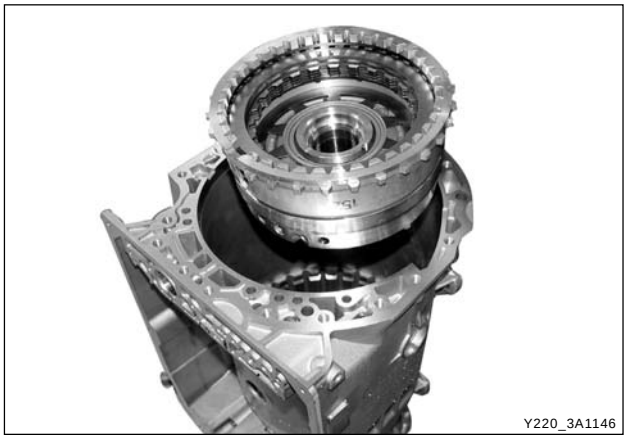


4. Remove the fixing bolts for brake B2 from transmission housing.

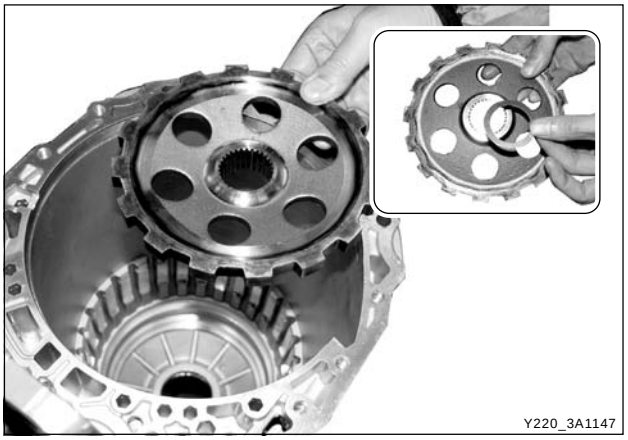
Installation Notice

Tightening torque	16 Nm

5. Remove the disc brake B2 from transmission housing.



6. Remove the parking lock gear.



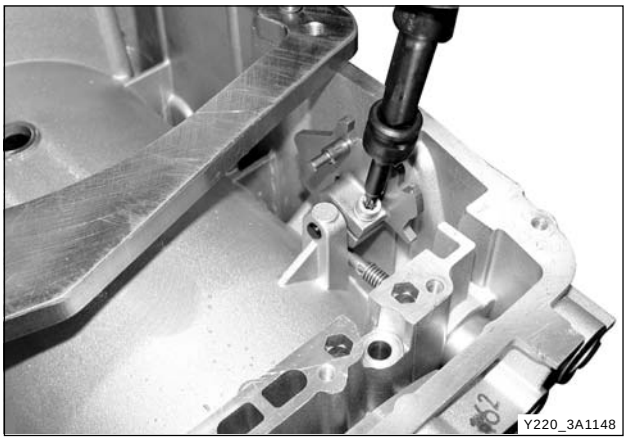
7. Remove the fixing bolts for range selector lever.

Installation Notice

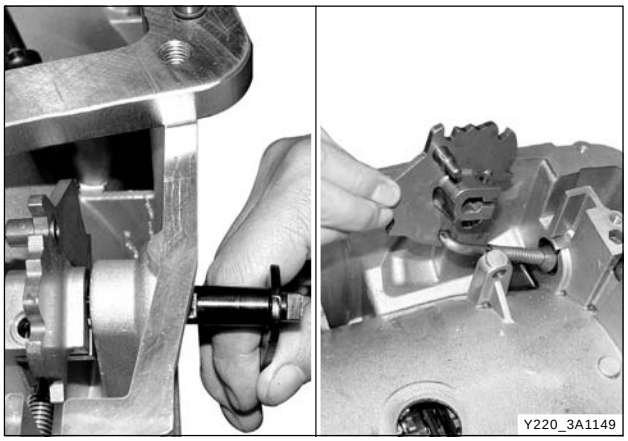
Tightening torque	8 Nm

Notice

Check the sealing ring for damage.



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



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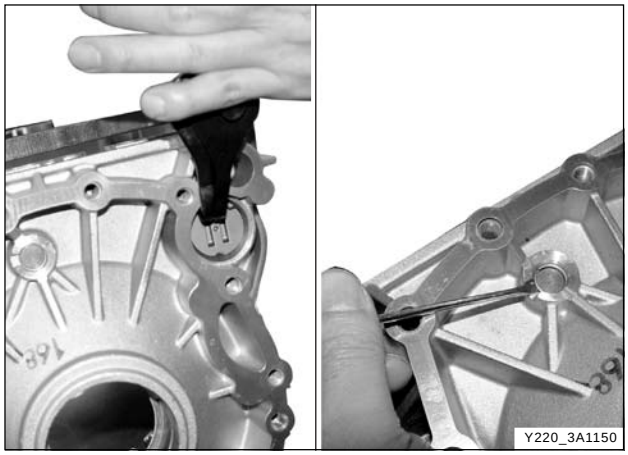
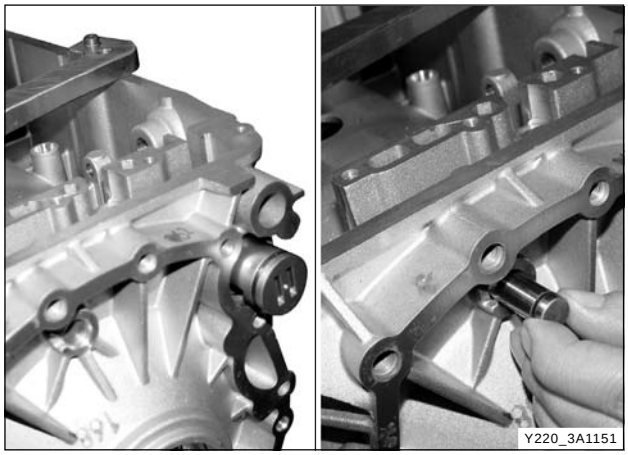
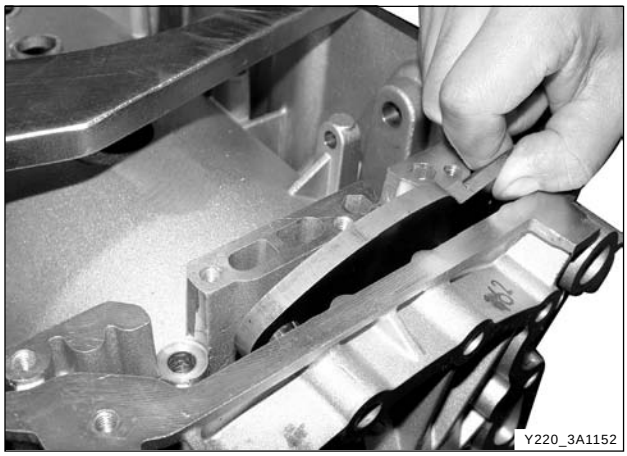


9. Remove the snap rings from parking lock pawl.



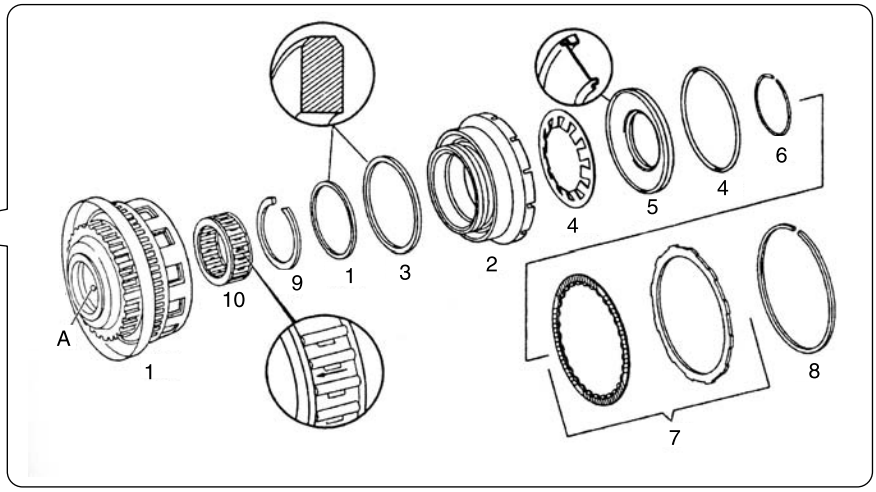
10. Remove the pin from transmission housing.



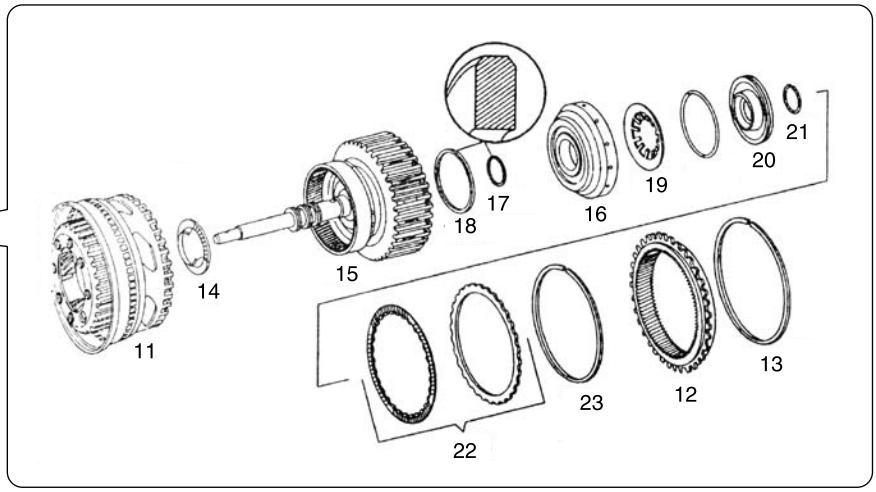
11. Remove the parking lock pawl from transmission housing.

▶ Components of Each Assembly

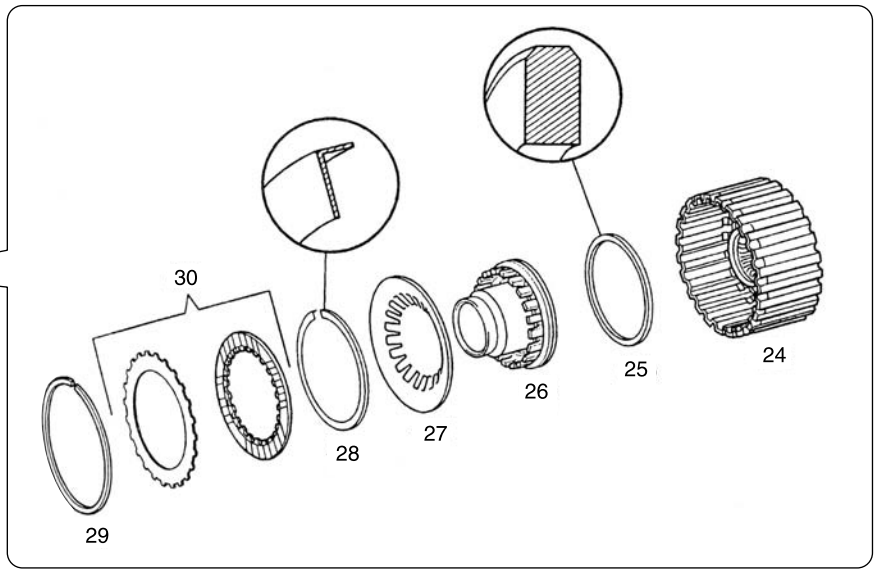
Clutch C1



Clutch C2



Clutch C3



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Clutch C1

1. Sealing ring in disc carrier
2. Piston
3. Sealing ring in piston
4. Return spring
5. Spring plate
6. Snap ring
7. Disc and steel plate
8. Snap ring
9. Snap ring
10. One-way clutch F1

A. Oil gallery in clutch C1

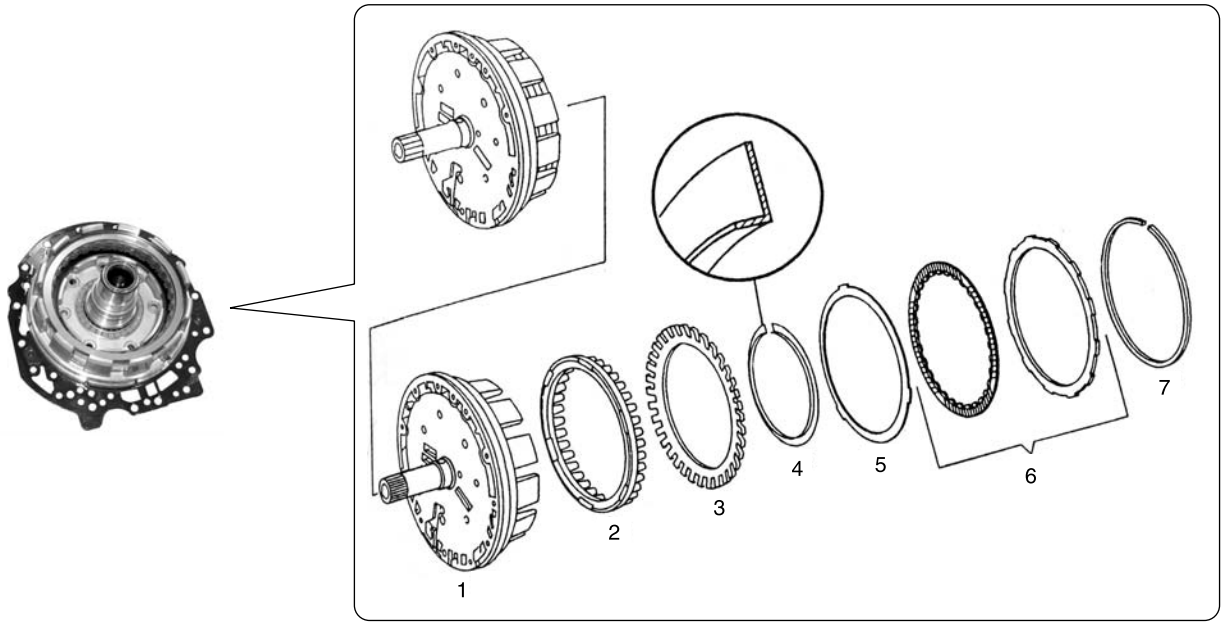
Clutch C2

11. Front planetary gear set
12. Gear wheel
13. Snap ring
14. Thrust bearing
15. Clutch C2 and input shaft
16. Piston
17. Inner sealing ring in piston
18. Outer sealing in piston
19. Return spring
20. Spring plate
21. Snap ring
22. Disc and steel plate
23. Snap ring

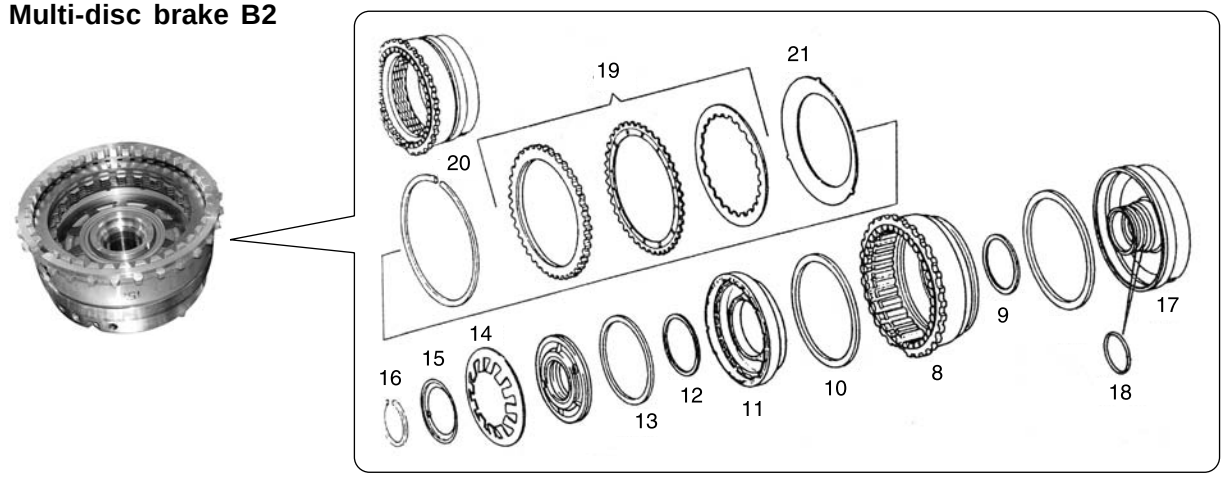
Clutch C3

24. Clutch C3
25. Sealing ring
26. Piston
27. Disc spring
28. Snap ring
29. Disc pack
30. Snap ring

Multi-disc brake B1



Multi-disc brake B2



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Multi-disc brake B1

1. Disc brake B1
2. Piston
3. Return spring
4. Snap ring
5. Cushion spring
6. Disc and steel plate
7. Snap ring

Multi-disc brake B2

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

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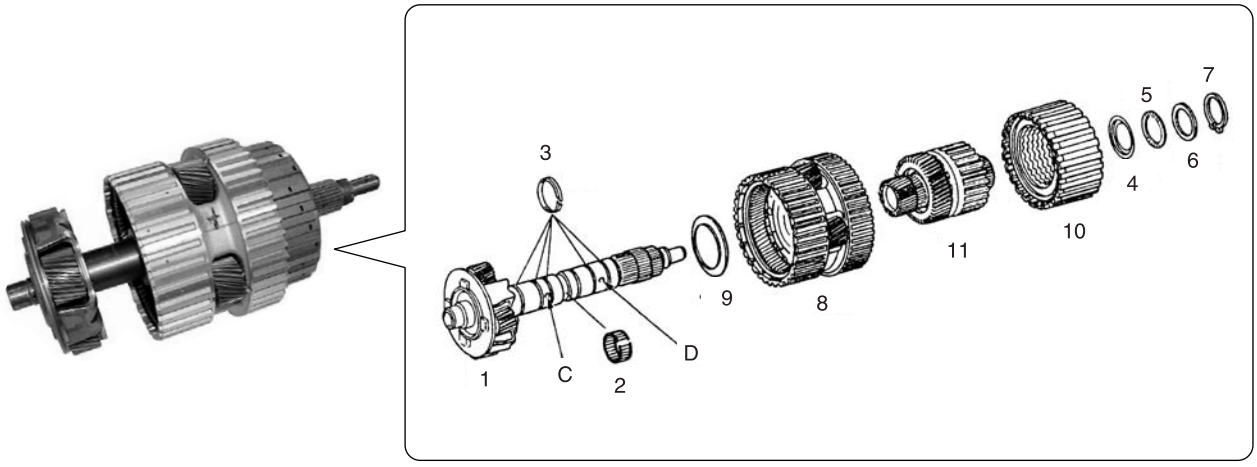
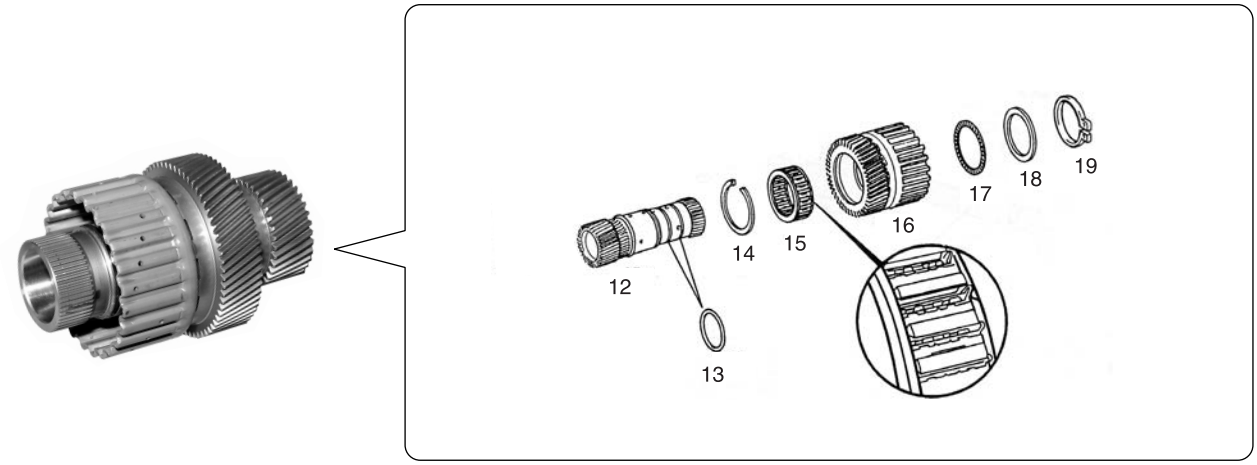
Rear gear set and center output shaft



Rear freewheel and rear hollow shaft



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Rear gear set and center output shaft

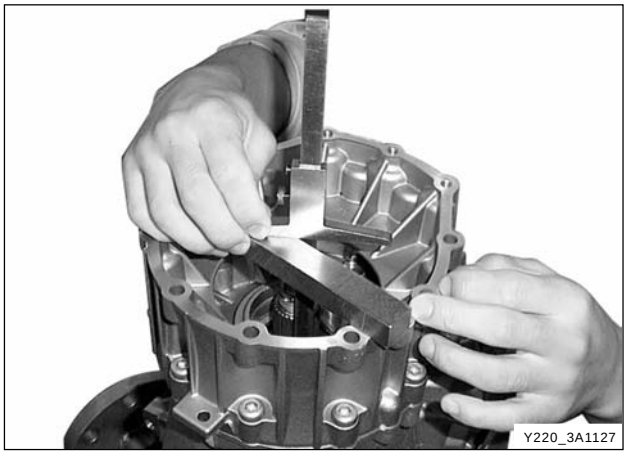
1. Output shaft in center gear set
2. Needle bearing
3. Teflon ring
4. Thrust washer
5. Thrust needle bearing
6. Shim
7. Snap ring
8. Rear gear set
9. Thrust washer
10. Clutch C3
11. Rear hollow shaft

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

Rear freewheel and rear hollow shaft

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

▶Installation



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

ex)

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

Axial play (specified value)	0.3 ~ 0.5 mm

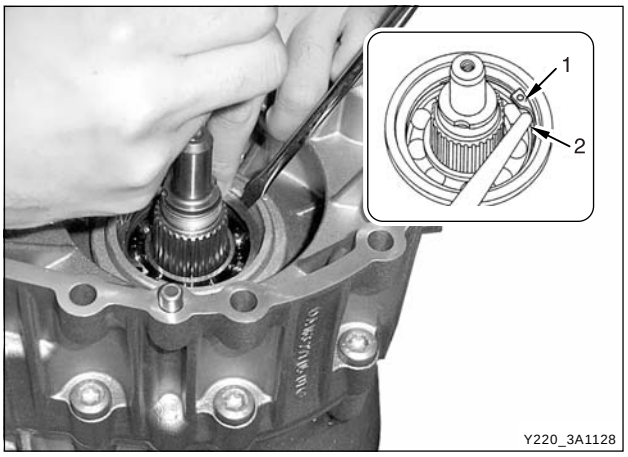
Notice

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

2. Install a shim.

   Straightedge 126 589 04 31 00

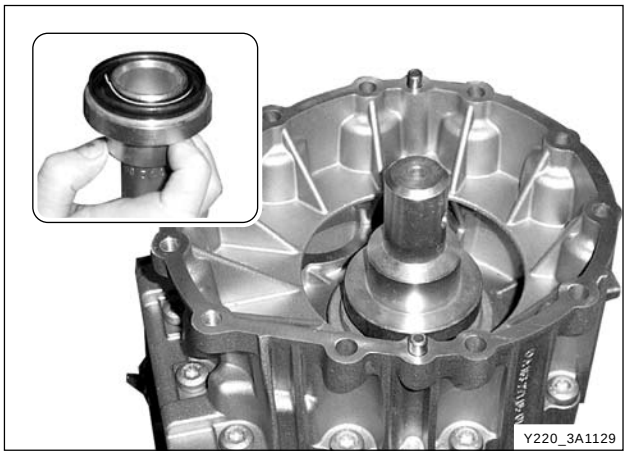
3. Insert the ball bearing into rear part of transmission housing.



Notice

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

4. Install the radial sealing ring.



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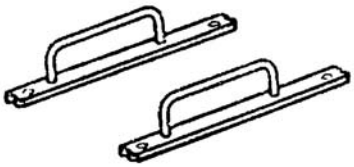
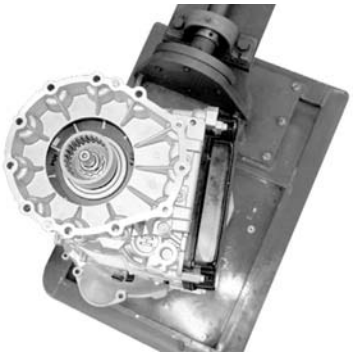
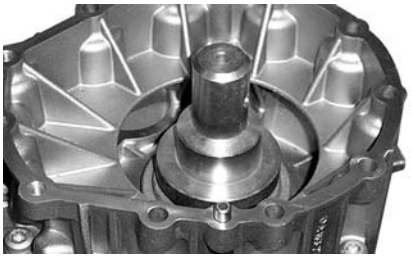
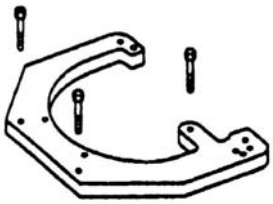
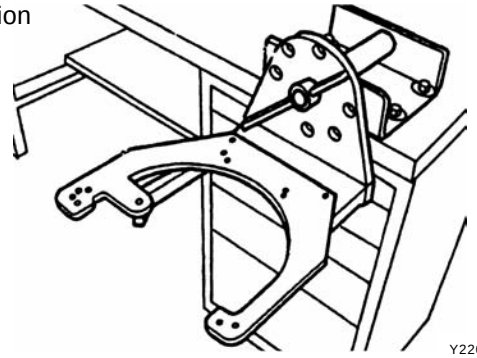
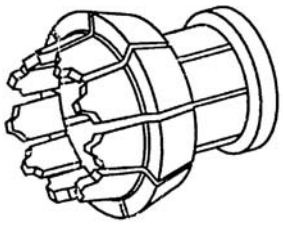
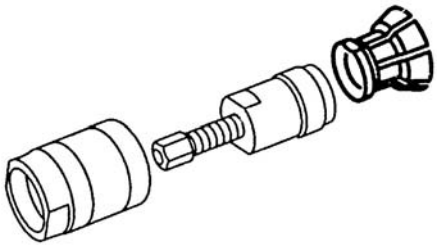
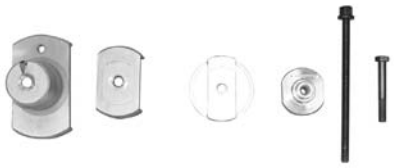
SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
W 126 589 01 62 00 **Handle**  Y220_3A1176	Removal and installation of torque converter  Y220_3A1177
W 116 589 06 59 00 **Fixture stand**  Y220_3A1178	Fixing automatic transmission  Y220_3A1179
W 140 589 12 15 00 **Drift punch**  Y220_3A1180	Installation of sealing ring  Y220_3A1181
W 001 589 50 33 00 **Puller**  Y220_3A1182	Removal and installation of transmission housing ball housing  Y220_3A1183

Name and Part Number	Application
W 140 589 34 63 00 **Mounting plate**  Y220_3A1184	Fixing automatic transmission  Y220_3A1185
W 140 589 06 34 00 **Collet chuck**  Y220_3A1186	Removal and installation of transmission housing ball bearing  Y220_3A1187
W 140 589 13 43 00 **Piston puller**  Y220_3A1188	Removal and installation of B1, B2, B3 piston  Y220_3A1189
Socket wrench  Y220_3A1190	Removal and installation of collar nut for output shaft  Y220_3A1191

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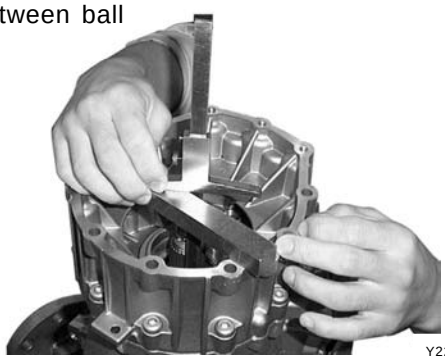
Name and Part Number	Application
128 589 04 31 00 **Straightedge**  Y220_3A1192	Measuring the clearance between ball bearing and parking lock gear  Y220_3A1193
Compressor  Y220_3A1194	Compressing clutch and disc brake  Y220_3A1195

SECTION 3A2

BTRA 4 AUTO TRANSMISSION

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DESCRIPTION AND OPERATION

BTRA M74 4WD AUTOMATIC TRANSMISSION

The BTR Automotive Model 74 Four Speed Automatic Transmission is an electronically controlled overdrive four speed unit with a lock-up torque converter. The lock-up torque converter results in lower engine speeds at cruise and eliminates unnecessary slippage. These features benefit the customer through improved fuel economy and noise reduction.

Of primary significance is the Transmission Control Module (TCM) which is a microprocessor based control system.

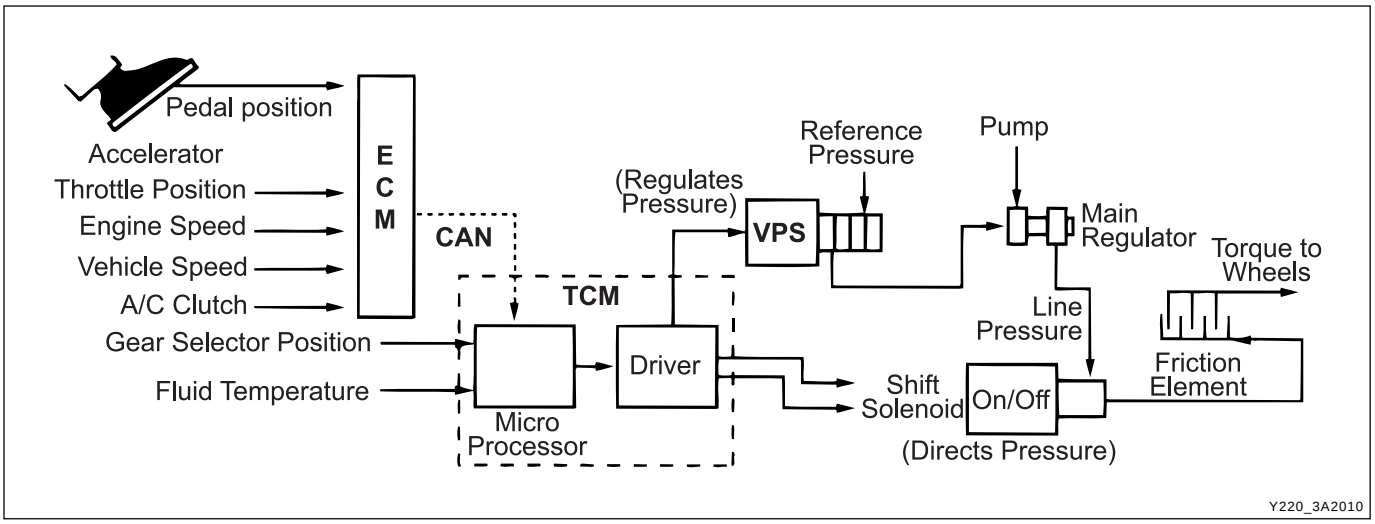
	Max. Power (kW)	Configuration
320	160	260 mm Torque Converter-Wide Ratio Gear Set Splined Output for Transfer Case

The TCM utilizes throttle position, rate of throttle opening, engine speed, vehicle speed, transmission fluid temperature, gear selector position and mode selector inputs, and in some applications a Kickdown Switch to control all shift feel and shift schedule aspects.

The TCM drives a single proportional solenoid multi-plexed to three regulator valves to control all shift feel aspects. The output pressure of this solenoid is con-trolled as a function of transmission fluid temperature to maintain consistent shift feel throughout the operating range.

Shift scheduling is highly flexible, and several independent schedules are programmed depending on the ve-hicle.

Typically the NORMAL schedule is used to maximize fuel economy and driveability, and a POWER schedule is used to maximize performance. WINTER schedule is used to facilitate starting in second gear.



OPERATORS INTERFACES

There are three operator interfaces as the following;

- Gear Shift Control Lever
- Driving Mode Selector
- Indicator Light

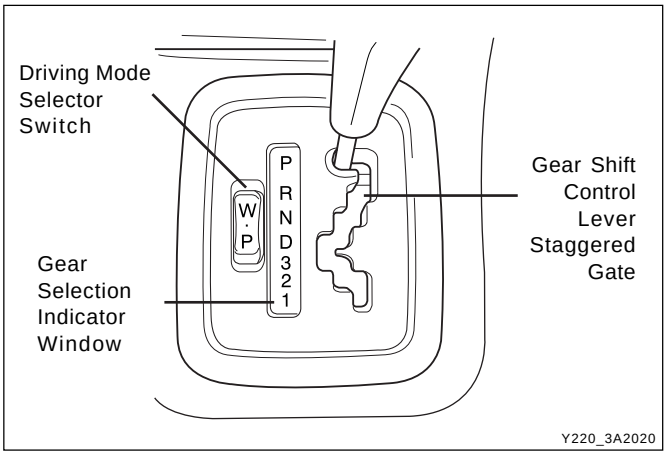
▶ Gear Shift Control Lever

The transmission uses a conventional shift control lever. The gear shift control lever can be moved from one position to another within the staggered configuration of the shift control lever gate to positively indicate the gear selection.

- P - Park position prevents the vehicle from rolling either forward or backward by locking the transmission output shaft. The inhibitor switch allows the engine to be started. For safety reasons, the parking should be used in addition to the park position. Do not select the Park position until the vehicle comes to a complete stop because it mechanically locks the output shaft.
- R - Reverse allows the vehicle to be operated in a rearward direction. The inhibitor switch enables re-verse lamp operation.
- N - Neutral allows the engine to be started and operated while driving the vehicle. The inhibitor switch allows the engine to be started. There is no power transferred through the transmission in Neutral. But the final drive is not locked by the parking pawl, so thewheels are free to rotate.
- D - Overdrive range is used for all normal driving conditions. 4th gear (overdrive gear) reduces the fuel consumption and the engine noise. Engine braking is applied with reduced throttle.

  First to second (1 →2), first to third (1 →3), second to third (2 →3), second to fourth (2 →4), third to fourth (3 →4), fourth to third (4 →3), fourth to second (4 →2), third to second (3 →2), third to first (3 →1) and second to first (2 →1) shifts are all available as a function of vehicle speed, throttle position and the time change rate of the throttle position.

  Downshifts are available for safe passing by depressing the accelerator. Lockup clutch may be enabled in 3rd and 4th gears depending on vehicle type.
- 3 - Manual 3 provides three gear ratios (first through third) and prevents the transmission from operating in 4th gear. 3rd gear is used when driving on long hill roads or in heavy city traffic. Downshifts are available by depressing the accelerator.
- 2 - Manual 2 provides two gear ratios (first and second). It is used to provide more power when climbing hills or engine braking when driving down a steep hill or starting off on slippery roads.
- 1 - Manual 1 is used to provide the maximum engine braking when driving down the severe gradients.



▶ Driving Mode Selector

The driving mode selector consists of a driving mode selector switch and indicator light. The driving mode selector is located on the center console and allows the driver to select the driving mode.

The driving modes available to be selected vary with vehicle types. Typically the driver should have the option to select among NORMAL, POWER and WINTER modes.

When NORMAL mode is selected upshifts will occur to maximize fuel economy. When POWER mode is se-lected, upshifts will occur to give maximum performance and the POWER mode indicator light is switched ON.

When WINTER mode is selected, starting in second gear is facilitated, the WINTER mode indicator light is switched ON and the POWER mode indicator light is switched OFF.

▶ Indicator Light

The indicator light is located on the instrument panel.

- Auto shift indicator light comes ON when the ignition switch ON and shows the gear shift control lever position.
- POWER mode indicator light comes ON when the POWER mode is selected and when the kickdown switch is depressed.
- WINTER mode indicator light comes ON when the WINTER mode is selected.

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CONTROL SYSTEMS

BTRA M74 4WD automatic transmission consists of two control systems. One is the electronic control system that monitors vehicle parameters and adjusts the transmission performance. Another is the hydraulic control system that implements the commands of the electronic control system commands.

ELECTRONIC CONTROL SYSTEM

The electronic control system comprises of sensors, a TCM and seven solenoids. The TCM reads the inputs and activates the outputs according to values stored in Read Only Memory (ROM).

The TCM controls the hydraulic control system. This control is via the hydraulic valve body, which contains seven electromagnetic solenoids. Six of the seven solenoids are used to control the line pressure, operate the shift valves and the torque converter lock-up clutch, and to turn ON and OFF the two regulator valves that control the shift feel.

The seventh solenoid is the proportional or Variable Pressure Solenoid (VPS) which works with the two regu-lator valves to control shift feel.

Transmission Control Module (TCM)

The TCM is an in-vehicle micro-processor based trans-mission management system. It is mounted under the driver's side front seat in the vehicle cabin.

The TCM contains:

- Processing logic circuits which include a central microprocessor controller and a back-up memory system.
- Input circuits.
- Output circuits which control external devices such as the Variable Pressure Solenoid (VPS) driver, On/Off solenoid drivers, a diagnostics output and the driving mode indicator light.

Processing logic

Shift schedule and calibration information is stored in an Erasable Programmable Read Only Memory (EPROM).

Throttle input calibration constants and the diagnostics information are stored in Electrically Erasable Programmable Read Only Memory (EEPROM) that retains the memory even when power to the TCM is disconnected. TCM continuously monitors the input values and uses these, via the shift schedule, to determine the required gear state. At the same time it monitors, via the solenoid outputs, the current gear state, whenever the input conditions change such that the required gear state is different to the current gear state, the TCM initiates a gear shift to bring the two states back into line.

Once the TCM has determined the type of gearshift required the TCM accesses the shift logic, estimates the engine torque output, adjusts the variable pressure solenoid ramp pressure then executes the shift.

The TCM continuously monitors every input and output circuit for short or open circuits and operating range.

When a failure or abnormal operation is detected the TCM records the condition code in the diagnostics memory and implements a Limp Home Mode (LHM).

The actual limp home mode used depends upon the failure detected with the object to maintain maximum driveability without damaging the transmission. In general input failures are handled by providing a default value. Output failures, which are capable of damaging the transmission, result in full limp mode giving only third or fourth gear and reverse. For further details of limp modes and memory retention refer to the Diagnostic Trouble Code Diagnosis Section.

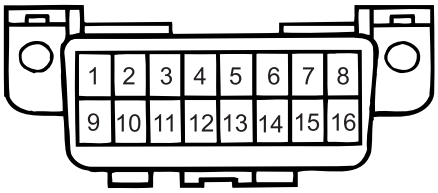
The TCM is designed to operate at ambient temperatures between - 40 and 85°C (- 40 and 185°F). It is also protected against electrical noise and voltage spikes, however all the usual precautions should be observed, for example when arc welding or jump starting.

Data Link Connector (DLC)

The Data Link Connector (DLC) is a multiple cavity connector. The DLC provides the means to access the serial data from the TCM.

The DLC allows the technician to use a scan tool to monitor the various systems and display the Diagnostic Trouble Codes (DTCs).

The DLC connector is located within the driver's compartment, directly below the instrument panel on the driver's side.



DATA LINK
CONNECTOR
(DLC)

A103A321

HYDRAULIC CONTROL SYSTEM

The hydraulic controls are located in the valve body, pump body and main case.

The valve body contains the following;

- Manual valve
- Three shift valves
- Sequence valve
- Solenoid supply pressure regulator valve
- Line pressure control valve
- Clutch apply feed regulator valve
- Band apply feed regulator valve
- Solenoid S1 to S6
- Reverse lockout valve

The pump cover contains the following;

- Primary regulator valve for line pressure
- Converter clutch regulator valve
- Converter clutch control valve
- Solenoid S7

The main case contains the following;

- B1R exhaust valve

All upshifts are accomplished by simultaneously switching on a shift valve(s), switching VPS pressure to the band and/or clutch regulator valve, and then sending the VPS a ramped current. The shift is completed by switching the regulators OFF and at the same time causing the VPS to reach maximum pressure.

All downshifts are accomplished by switching VPS pressure to the band and/or clutch regulator valve and sending a ramped current to the VPS. The shift is completed by simultaneously switching the regulators OFF, switching the shift valves and at the same time causing the VPS to return to stand-by pressure.

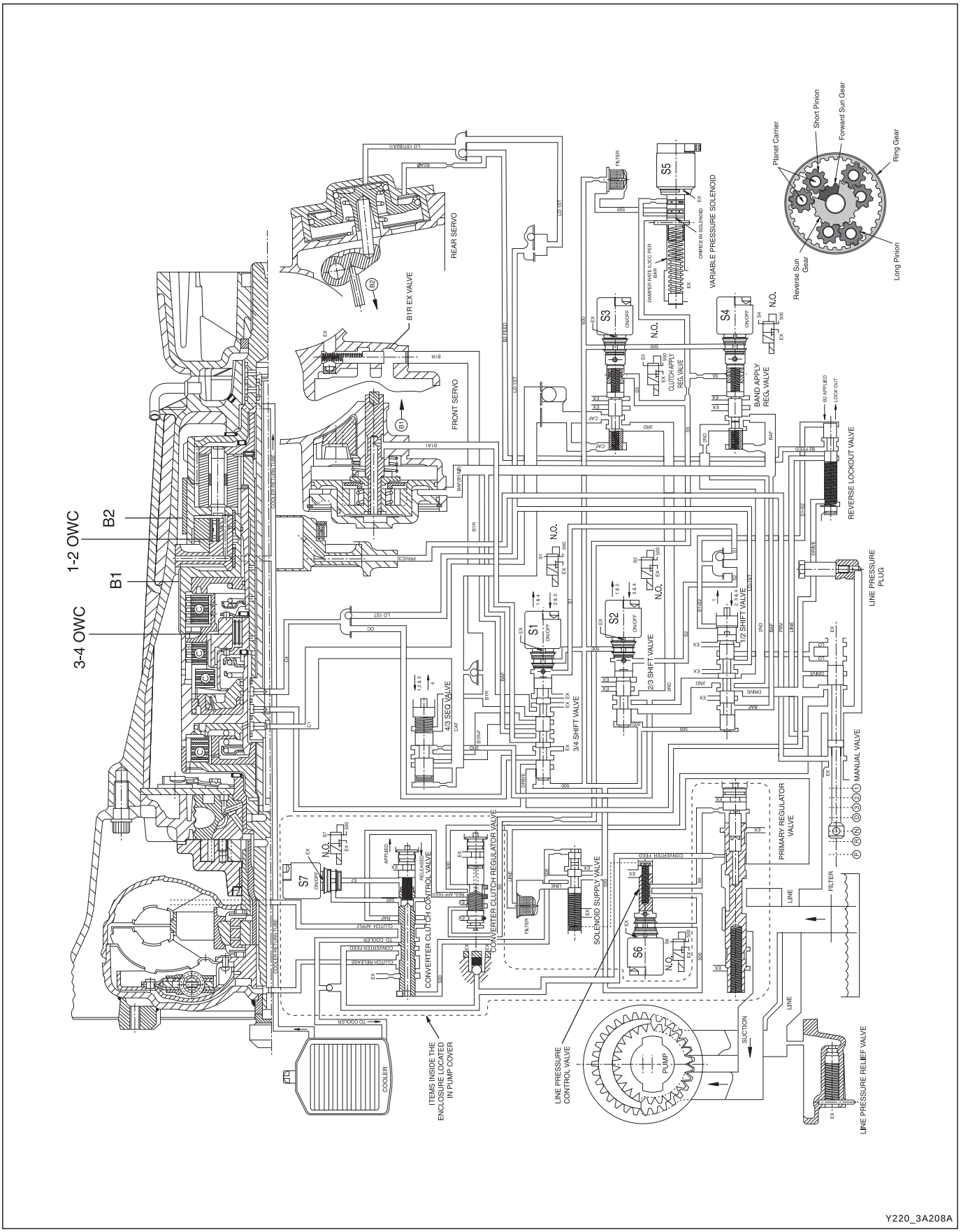
The primary regulator valve is located in the pump cover and supplies four line pressures; high and low for forward gears, and high and low for reverse. This pressure has no effect on shift quality and merely provides static clutch capacity during steady state operation. Low pressure can be obtained by activating an ON/OFF solenoid with high line pressure being the default mode.

Torque converter lock-up is initiated by toggling the converter clutch control valve with an ON/OFF solenoid.

The actual apply and release of the clutch is regulated by the VPS via the converter clutch regulator valve.

The solenoid supply pressure regulator valve provides reference pressure for all the solenoids.

HYDRAULIC CONTROL CIRCUIT



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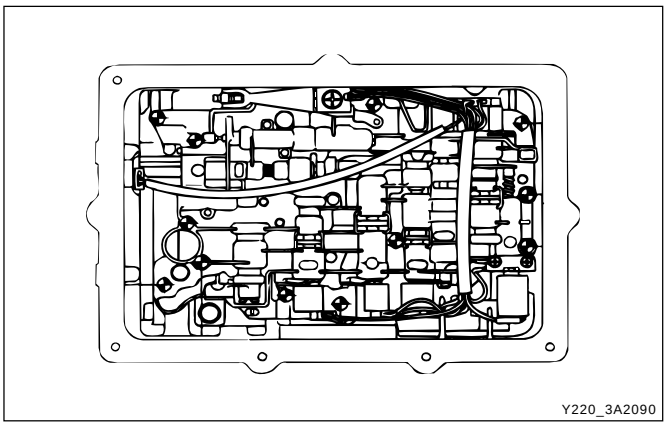
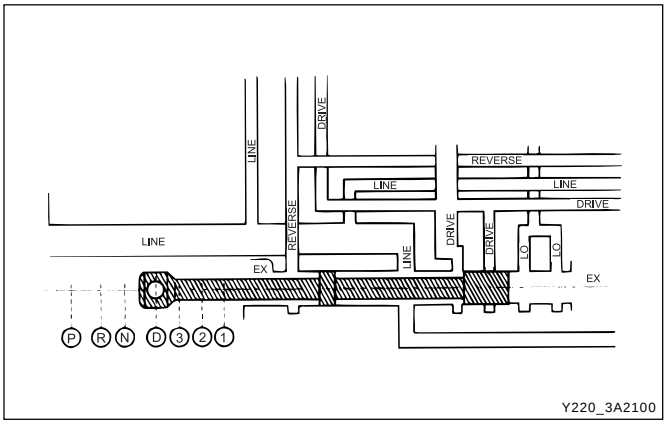
▶ Valve Body



Manual valve

The manual valve is connected to the vehicle selector mechanism and controls the flow of oil to the forward and reverse circuits. The manual valve function is identical in all forward gear positions except that in the Manual 1 position an additional supply of oil is directed to the 1-2 shift valve for application of the rear band and the C4 overrun clutch. The manual valve directs the line pressure into the PRND fluid circuits.



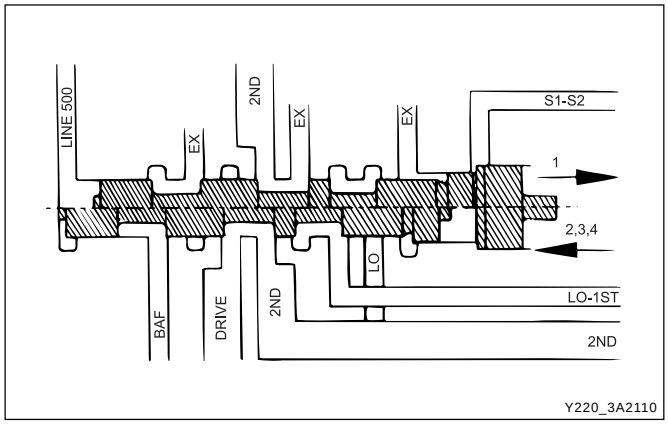
1-2 shift valve

The 1-2 shift valve is a two position valve that must be switched to the 2, 3 and 4 position in order to get any forward gear other than first gear. It is used for all 1-2 and 2-1 gearshifts.

The switching of this valve is achieved by using S1 and/ or S2.

During a 1-2 gearshift drive oil from the manual valve passes through to the second gear circuit. During a 2-1 gearshift the band apply feed oil is allowed to exhaust via the 1-2 shift valve.

The 1-2 shift valve works in conjunction with the 3-4 shift valve to disengage the C4 clutch in first gear, and engage C4 in second gear. When Manual 1 is selected the C4 clutch and rear band (B2) are engaged.



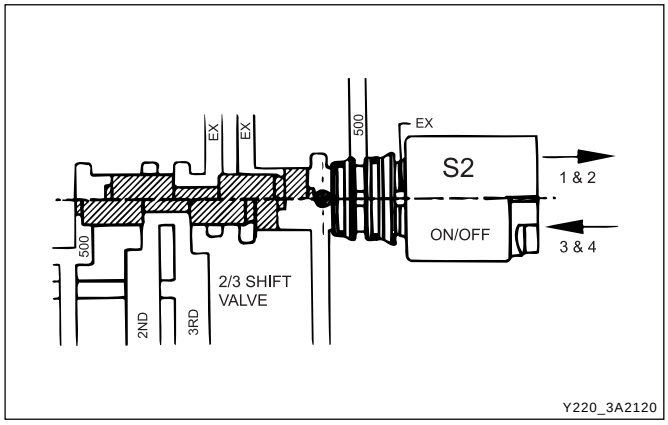
2-3 shift valve

The 2-3 shift valve is a two position valve. It is used on all 2-3 and 3-2 gearshifts.

The switching of this valve is achieved by S2 which is located at the end of the valve spool.

In the 1, 2 position, second gear oil from the 1-2 shift valve is prevented from entering the third gear circuit.

When the valve is moved to the 3, 4 position, oil from the second gear circuit is routed to the third gear circuit and the transmission is changed to third gear.



3-4 shift valve

The 3-4 shift valve is a two position valve. It is used for all 3-4 and 4-3 gearshifts.

The switching of this valve is achieved by S1 which is located at the end of the valve spool.

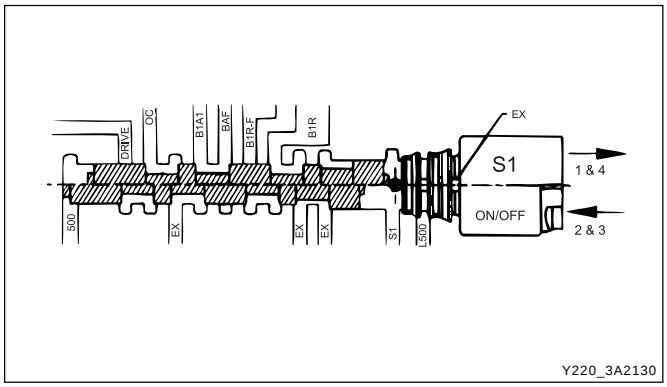
During a 3-4 gearshift the 3-4 shift valve:

- Exhausts the front band release (B1R) circuit thereby allowing the application of the front band (B1).
- Connects the inner apply area of the front servo (B1AI) to the Band Apply Feed (BAF) circuit thus allowing greater apply forces to the front band.
- Exhausts the Overrun Clutch (OC) circuit which allows the C4 clutch to disengage.

During a 4-3 gearshift, the C4 clutch is engaged and the front band (B1) is released. These actions are se-quenced by the 4-3 sequence valve.

The 3-4 shift valve also switches during 1-2 and 2-1 gearshifts where its function is to apply the overrun clutch (C4) in second gear but to release it in first gear.

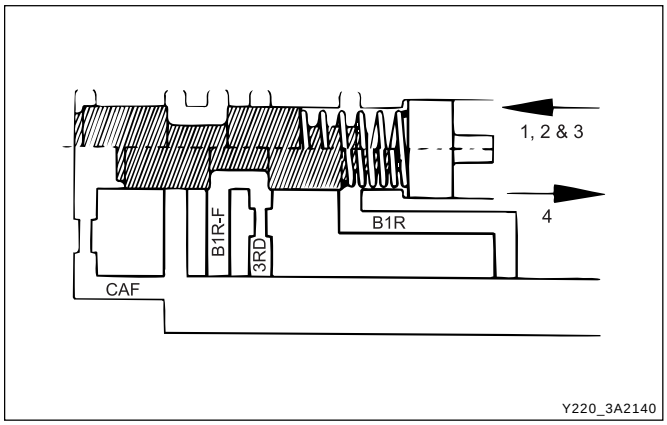
Note that the C4 clutch is applied in Manual 1 by virtue of the manual valve and the 1-2 shift valve. Refer to “1-2 Shift Valve” in this section.



4-3 sequence valve

The 4-3 sequence valve is a two position spring loaded valve. It switches during 3-4 and 4-3 gearshifts although it performs no function during the 3-4 shift.

During the 4-3 shift the 4-3 sequence valve delays the connection of the Clutch Apply Feed (CAF) circuit to the B1R circuit until the B1R circuit has been fully pressurized by using the third gear circuit. This prevents objectionable engine flare on completion of the 4-3 gearshift.



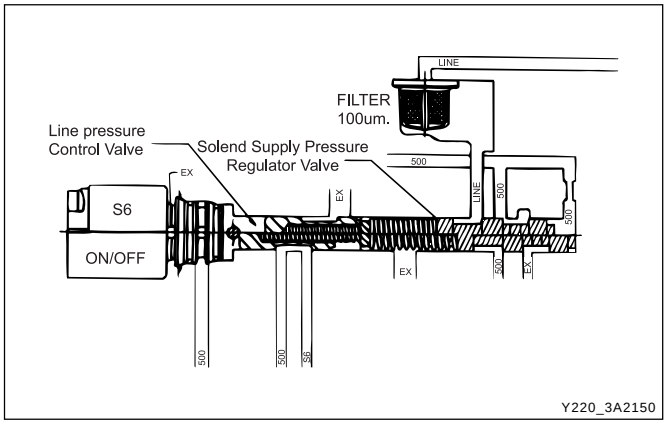
Solenoid supply pressure regulator valve

The solenoid supply pressure regulator valve supplies a constant pressure to all solenoids (S1 to S7). Line pressure is used as the feeding oil to this regulator and the output is termed line 500.

Line pressure control valve

Line pressure is controlled by S6, which acts as the line pressure control valve. When S6 pressure is applied to the end of the Primary Regulator Valve (PRV), it is opposed by spring force and causes LOW line pressure for light throttle application and cruising.

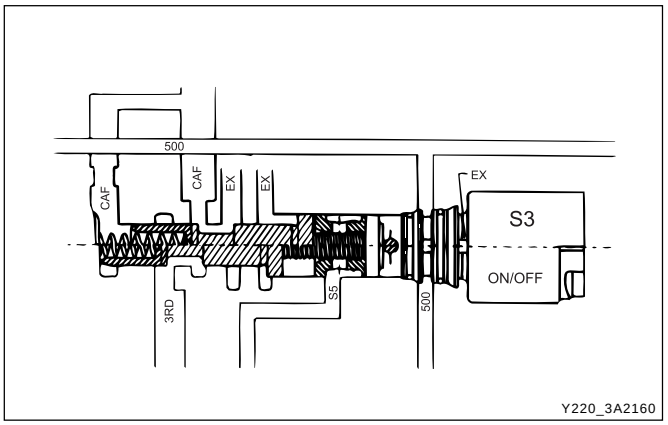
Heavy throttle application causes the normally open S6 to open (switch Off) thus closing line 500 and opening S6 to exhaust. Removal of S6 pressure from the PRV results in HIGH line pressure.



Clutch apply feed regulator valve

The clutch apply feed regulator valve is a fixed ratio (2.25: 1) valve. This valve provides a regulated pressure to the C1 clutch and controls the change rate of the clutch state to give the desired shift quality.

Third gear oil supplied to the valve is regulated to pro-vide an output pressure, Clutch Apply Feed (CAF) pres-sure, of 2.25 times the S5 signal pressure when S3 is ON. When S3 is OFF, the output pressure is 2.25 times the line 500 pressure.



Band apply feed regulator valve

The band apply feed regulator valve is a fixed ratio (1.4:1) valve. It provides a regulated pressure to the front servo, and controls the change rate of the front band (B1) state to give the desired shift quality.

Second gear oil supplied to the valve is regulated to provide an output pressure, Band Apply Feed (BAF) pressure, of 1.4 times the S5 signal pressure when S4 is ON. When S4 is OFF the output pressure is 1.4 times the line 500 pressure.

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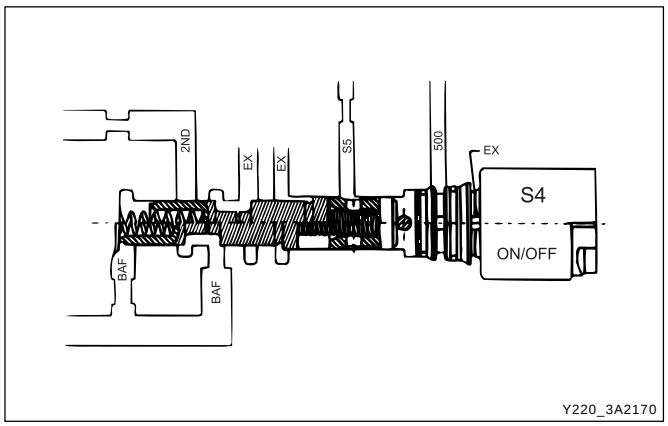
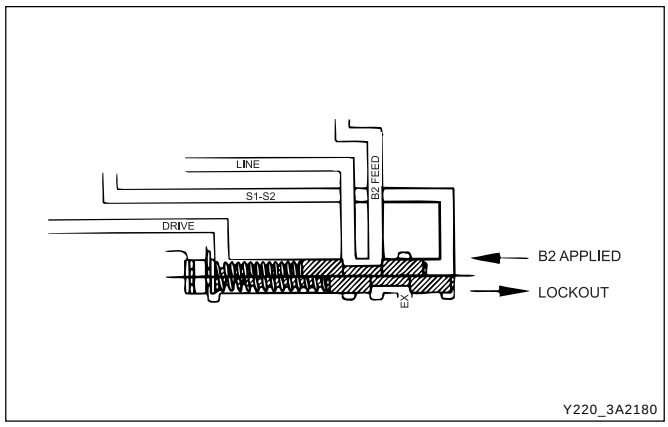


Reverse lockout valve

The reverse lockout valve is a two position valve con-tained in the upper valve body. This valve uses S1-S2 pressure as a signal pressure and controls the applica-tion of the rear band (B2).

While the manual valve is in D, 3, 2 or 1 positions, drive oil is applied to the spring end of the valve, overriding any signal pressures and holding the valve in the lockout position. This prevents the application of B2 in any of the forward driving gears except M1.



When the manual valve is in P, R or N positions, drive oil is exhausted and the reverse lockout valve may be toggled by S1-S2 pressure.

B2 is applied in P, R, and N if the following conditions are satisfied;

- In P or N, vehicle speed = 3 km/h.
- In R, vehicle speed = 10 km/h.
- Engine speed = 1600 rpm.
- Throttle position = 12 %.

Under these conditions, the TCM switches solenoids S1 and S2 to OFF. The reverse lockout valve toggles under the influence of the S1-S2 pressure, to connect the line pressure to the B2 feed. Oil is fed to both the inner and outer apply areas of the rear servo piston, applying B2.

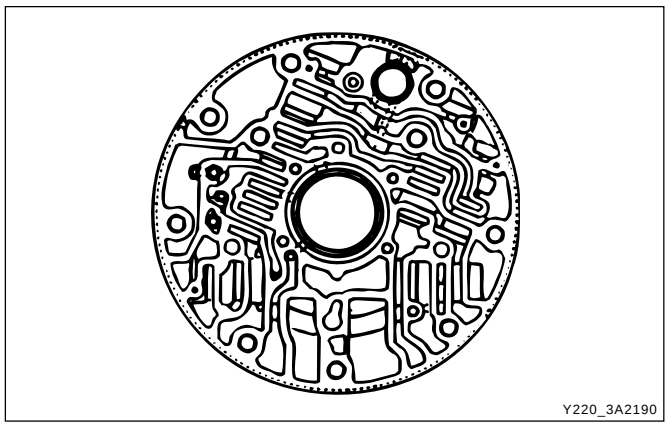
If any of the above conditions are not satisfied, the TCM switches solenoids S1 and S2 to ON.

S1- S2 pressure is exhausted and the valve is held in the lockout position by the spring. In this position, engagement of B2 is prohibited.

This feature protects the transmission from abuse by preventing the undesirable application of B2 at high speed, and by providing a reverse lockout function.

Note that if the transmission is in failure mode, the rear band will be applied at all times in P, R and N.

Pump cover



Primary regulator valve

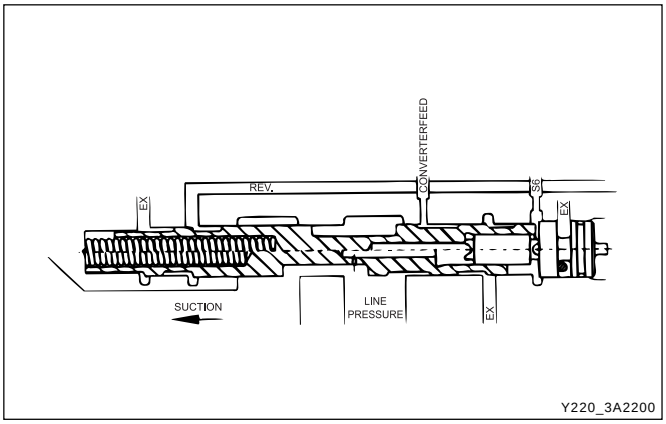
The Primary Regulator Valve (PRV) regulates the trans-mission line pressure (or pump output pressure). This valve gives either high or low line pressure depending on whether S6 is switched OFF or ON. When S6 is switched ON, S6 pressure is applied to the PRV moving it against spring pressure and opening the line pressure circuit to the pump suction port resulting in reduced line pressure.

Low line pressure is used during light throttle applica-tions and cruising. Heavy throttle will cause S6 to switch OFF and thereby cause high line pressure.

This stepped line pressure control has no detrimental effect on shift feel because all shifting pressures are controlled by separate band and clutch regulator valves, and the output of S5.

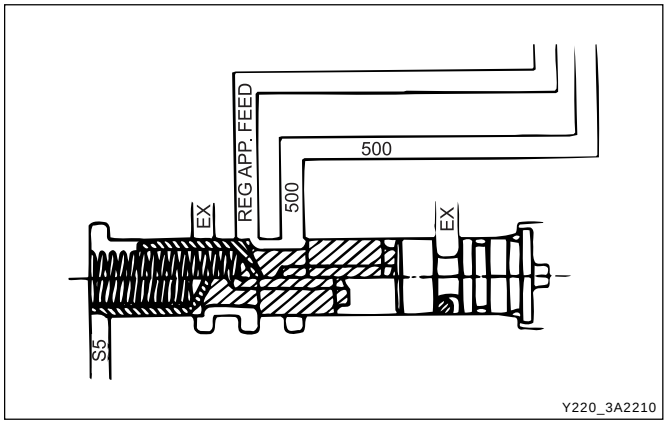
When reverse gear is selected, both the low and high line pressure values are boosted to guard against slip-page. This is achieved by applying reverse oil line pressure to the PRV to assist the spring load. The other end of the valve contains ports for line pressure feedback and S6 pressure.

The PRV also regulates the supply of oil to the converter via the converter feed port. The cascade effect of the PRV ensures the first priority of the valve is to maintain line pressure at very low engine speeds. When the engine speed increases and the pump supplies an excess of oil the PRV moves to uncover the converter feed port thereby pressurizing the converter. If there is an excess of oil for the transmission's needs then the PRV moves further to allow oil to return to the suction port.



Converter clutch regulator valve

The converter clutch regulator valve regulates the pressure of the oil which applies the converter clutch. Input oil from the line 500 circuit is regulated within the valve, with the output pressure being variable according to the signal pressure from the S5 circuit. Converter clutch apply and release application is smoothed by electronically varying the S5 circuit pressure.



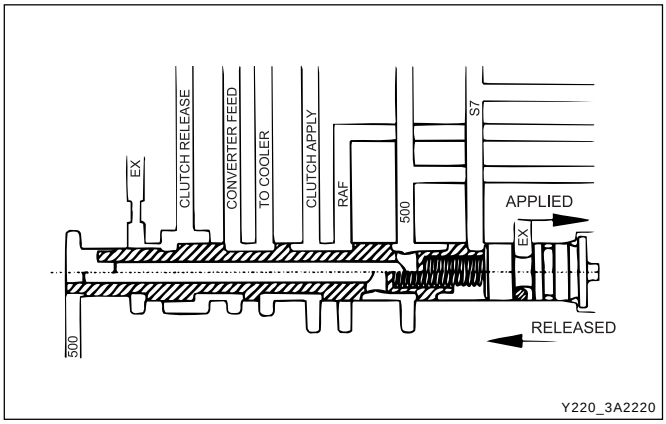
Converter clutch control valve

The converter clutch control valve is a two position valve which applies or releases the converter clutch.

The switching of this valve is governed by the signal pressure from S7.

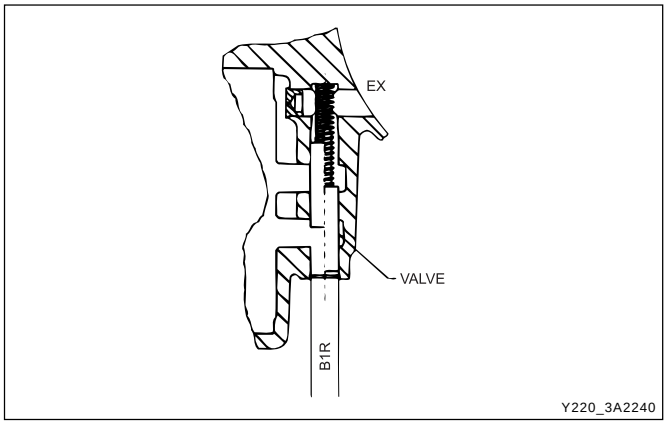
When the valve is in the OFF or released position, converter feed oil from the PRV is directed to the release side of the converter clutch. After flowing through the converter, oil returns to the converter clutch control valve and is then directed to the oil cooler.

When the valve is in the ON or applied position, regu-lated oil from the converter clutch regulator valve is directed to the apply side of the converter clutch. This oil remains within the converter because the converter clutch piston is sealed against the flat friction surface of the converter cover. To provide oil flow to the cooler the converter clutch control valve directs converter feed oil from the PRV directly to the cooler circuit.



B1R exhaust valve

The B1R exhaust valve is a two position spring loaded valve located in the transmission case directly adjacent to the front servo. It permits the servo release oil to be rapidly exhausted into the transmission case during application of the front band (B1). This prevents the need to force the oil back from the front servo through the valve body and through the 3-4 shift valve. The spring positions the valve to prevent oil entering the release area of the servo until the B1R circuit oil pressure reaches approximately 100 kPa.



POWER TRAIN SYSTEM

The Power Train System consists of;

- A torque converter with single face lock-up clutch
- Four multi-plate clutch assemblies
- Two brake bands
- Two one-way clutches
- Planetary gear set
- Parking mechanism

A conventional six pinion Ravigneaux compound planetary gear set is used with overdrive (fourth gear) being obtained by driving the carrier.

The cross-sectional arrangement is very modular in nature.

Four main sub-assemblies are installed within the case to complete the build. These subassemblies are;

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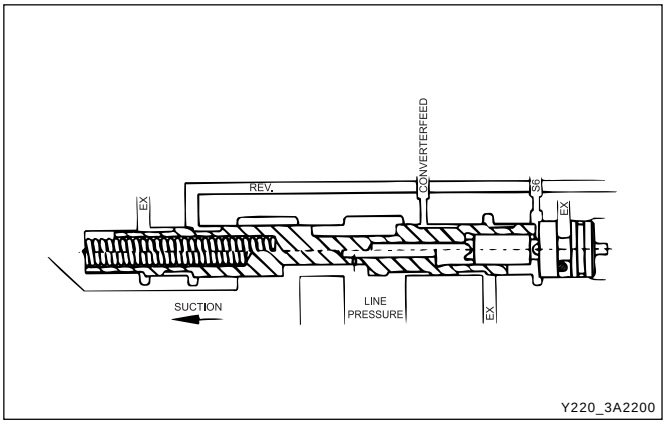

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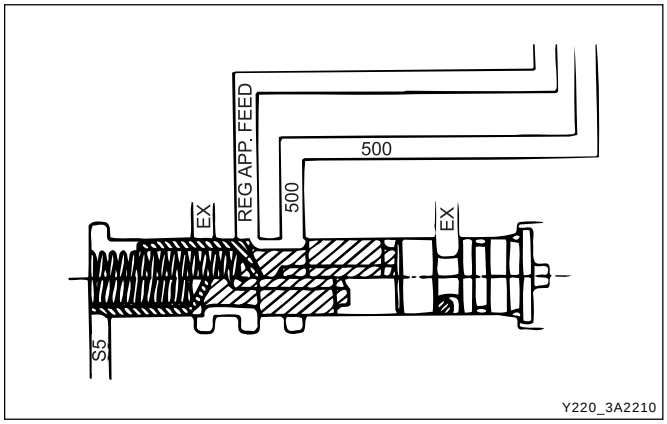

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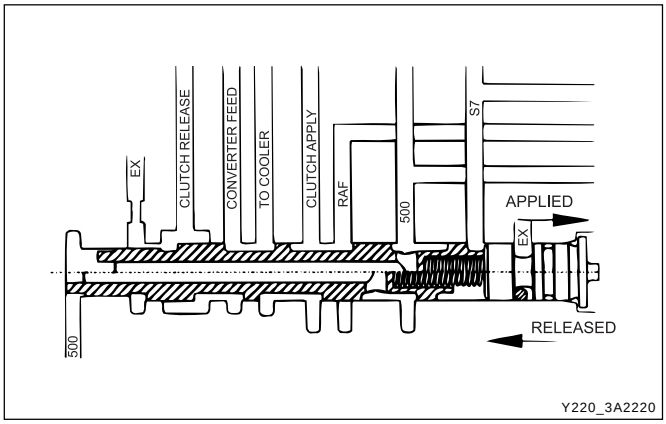

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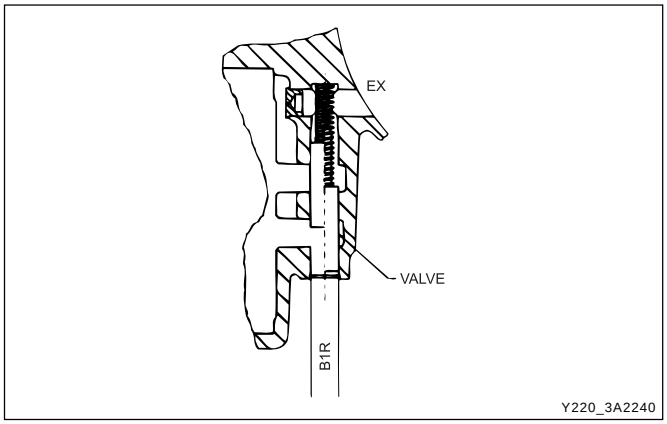

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- Gear set-sprag-centre support
- C1 -C2 -C3 -C4 clutch sub-assembly
- Pump assembly
- Valve body assembly

One, or a combination of selective washers are used between the input shaft flange and the number 4 bearing to control the transmission end float. This arrangement allows for extensive subassembly testing and simplistic final assembly during production.

A general description of the operation of the Power Train System is detailed below.

First gear is engaged by applying the C2 clutch and locking the 1-2 One Way Clutch (1-2 OWC). The 1-2 shift is accomplished by applying the B1 band and overrunning the 1-2 OWC. The 2-3 shift is accomplished by applying the C1 clutch and releasing the B1 band. The 3-4 shift is accomplished by re-applying the B1 band and overrunning the 3-4 OWC. Reverse gear is engaged by applying the C3 clutch and the B2 band.

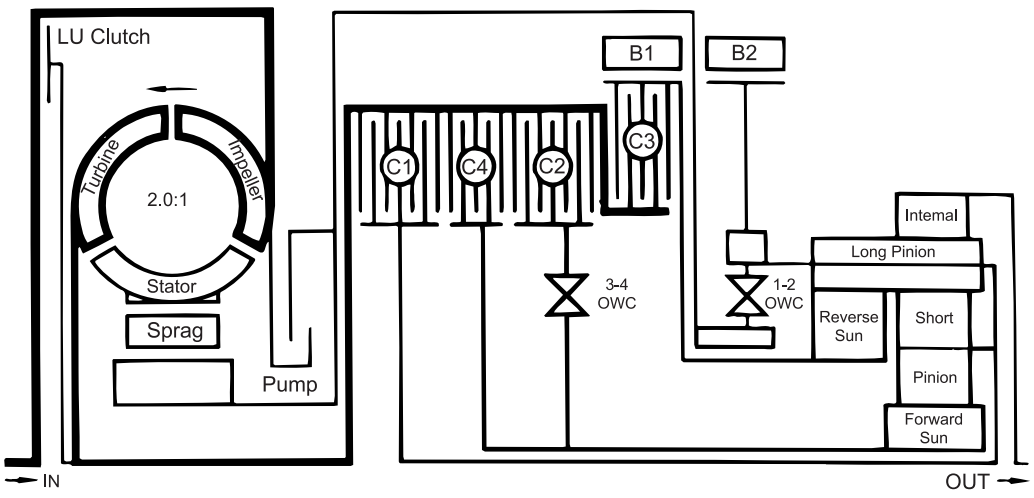
The C4 clutch is applied in the Manual 1, 2 and 3 ranges to provide engine braking. In addition, the C4 clutch is also applied in the Drive range for second and third gears to eliminate objectionable freewheel coasting.

The B2 band is also applied in the Manual 1 range to accomplish the low-overrun shift.

Both the front and rear servos are dual area designs to allow accurate friction element matching without the need for secondary regulator valves. All the friction elements have been designed to provide low shift energies and high static capacities when used with the new low static coefficient transmission fluids. Non-asbestos friction materials are used throughout.

		ELEMENTS ENGAGED								
Gear	**Gear Ratio**	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
First	2.741		X					X	X	
Second	1.508		X			X			X	
Third	1.000	X	X		X	X			X	X *
Fourth	0.708	X	X		X				X	X
Reverse	2.428			X			X			
Manual 1	2.741		X		X		X		X	

* For Certain Vehicle Applications, Refer to the Owner's Manual.

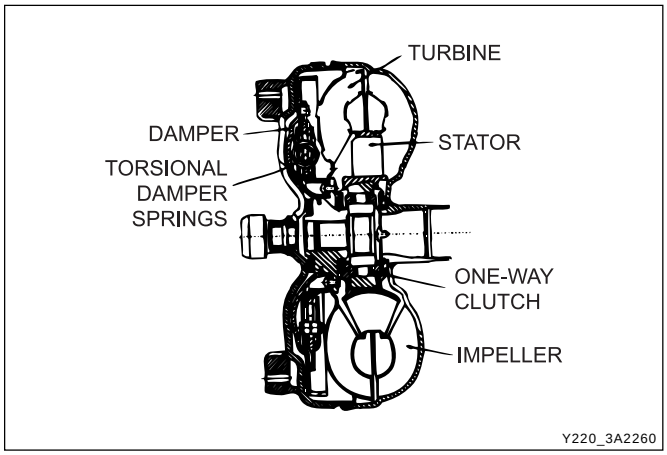


Torque converter

The torque converter consists of a turbine, stator pump, impeller and a lock-up damper and piston assembly. As in conventional torque converters, the impeller is attached to the converter cover, the turbine is splined to the input shaft and the stator is mounted on the pump housing via a one way clutch (sprag).

The addition of the damper and piston assembly en-ables the torque converter to lock-up under favorable conditions. Lock-up is only permitted to occur in third and fourth gears under specified throttle and vehicle speed conditions.

Lock-up is achieved by applying hydraulic pressure to the damper and piston assembly which couples the turbine to the converter cover, locking-up the converter and eliminating unwanted slippage. Whenever lock-up occurs, improved fuel consumption is achieved. Torsional damper springs are provided in the damper and piston assembly to absorb any engine torque fluctuations during lock-up.



Clutch packs

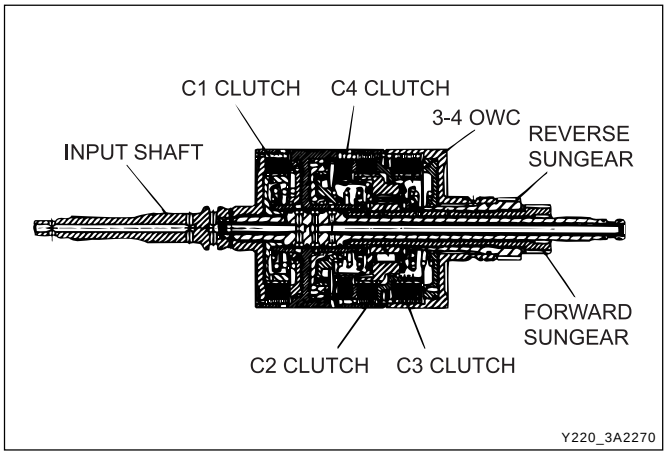
There are four clutch packs. All clutch packs are composed of multiple steel and friction plates.

C1 CLUTCH: When applied, this clutch pack allows the input shaft to drive the planet carrier. This occurs in third and fourth gears.

C2 CLUTCH: When applied this clutch pack allows the input shaft to drive the forward sun gear via the 3-4 OWC. This occurs in all forward gears.

C3 CLUTCH: When applied this clutch pack allows the input shaft to drive the reverse sun gear. This only occurs in reverse gear.

C4 CLUTCH: When applied this clutch provides engine braking on overrun. This occurs in Manual 1, 2 and 3 and also Drive 2 and Drive 3 to prevent objectionable free wheel coasting.



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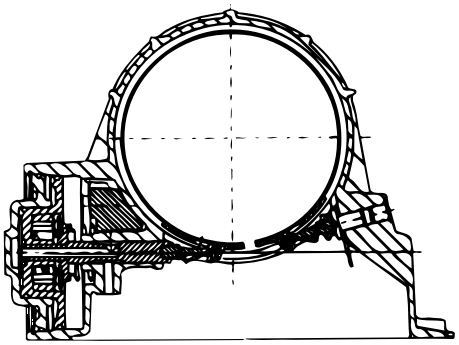
Bands

The transmission utilizes two bands, the B1 band (sometimes known as the 2-4 band), and the B2 band (sometimes known as the low-reverse band).

The B1 band is a flexible band which is engaged by the front servo piston. B1 is activated in second and fourth gear. When activated B1 prevents the reverse sun gear from rotating by holding the C3 clutch assembly stationary. In second gear only the outer area of the apply piston is utilized. In fourth gear both areas are utilized for greater clamping force.



FRONT SERVO AND BAND

Y220_3A2280

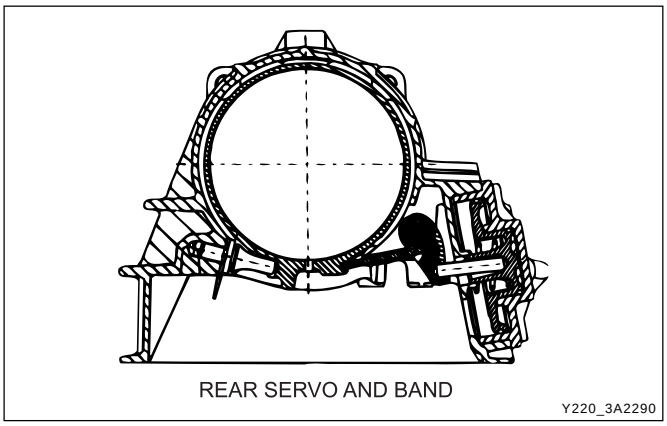
One way clutches

The transmission uses two OWCs, the 1-2 OWC and the 3-4 OWC. (Note that a third OWC is located in the torque converter, also known as a sprag.)

The 1-2 OWC is located between the planetary carrier assembly and the center support. This allows the carrier to rotate around the center support in one direction only. The one way clutch is engaged only in Drive 1.

This 3-4 OWC is located between the C4 and the C2 clutch assemblies. This allows the C2 clutch to drive the forward sun gear in first, second and third gears but unlocks in fourth gear and during overrun.

The B2 band is a solid band which is engaged by the rear servo piston. B2 is activated in Park, Reverse, Neutral and Manual 1. When activated B2 prevents the planet carrier assembly from rotating. In Manual 1 only the inner area of the apply piston is utilized. In Park, Reverse and Neutral, both areas are utilized for greater clamping force.



REAR SERVO AND BAND

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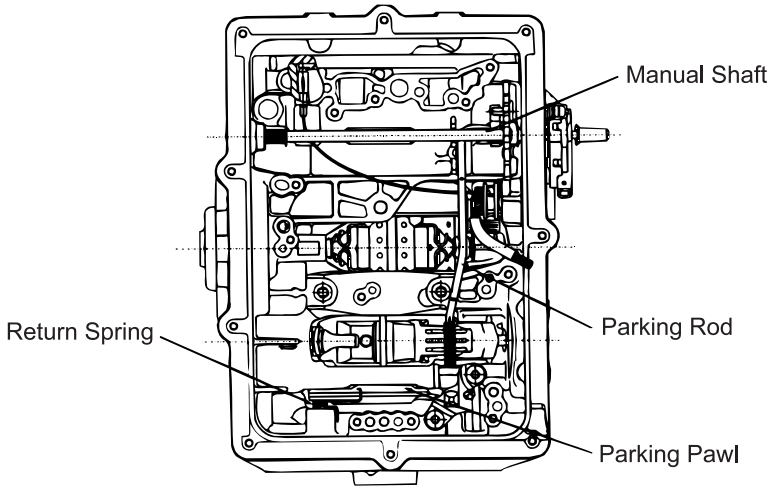
Planetary gear set

The planetary gear set used in the transmission is a conventional six pinion Ravigneaux compound gear set.

Parking mechanism

When Park is selected the manual lever extends the park rod rearwards to engage the parking pawl. The pawl will engage the external teeth on the ring gear thus locking the output shaft to the transmission case. When Park is not selected a return spring holds the parking pawl clear of the output shaft, preventing accidental engagement of Park.



Y220_3A2300

POWER FLOWS

The power flows for the various transmission selections are listed below;

- Power Flow - Neutral and Park
- Power Flow - Reverse
- Power Flow - Manual 1
- Power Flow - Drive 1
- Power Flow - Drive 2
- Power Flow - Drive 3
- Power Flow - Drive 3 Lock Up
- Power Flow - Drive 4 (Overdrive)
- Power Flow - Drive 4 Lock Up

The following table details the engaged elements versus the gear selected for all transmission selections.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Park and Neutral	-	-	-	-	-	X	-	-	-
Reverse	-	-	X	-	-	X	-	-	-
Manual 1	-	X	-	X	-	X	-	X	-
Drive 1	-	X	-	-	-	-	X	X	-
Drive 2 and Manual 2	-	X	-	X	X	-	-	X	-
Drive 3 and Manual 3	X	X	-	X	-	-	-	X	-
Drive 3 Lock Up and Manual 3 Lock Up	X	X	-	X	-	-	-	X	X
Drive 4 Overdrive	X	X	-	-	X	-	-	X	-
Drive 4 Lock Up	X	X	-	-	X	-	-	X	X

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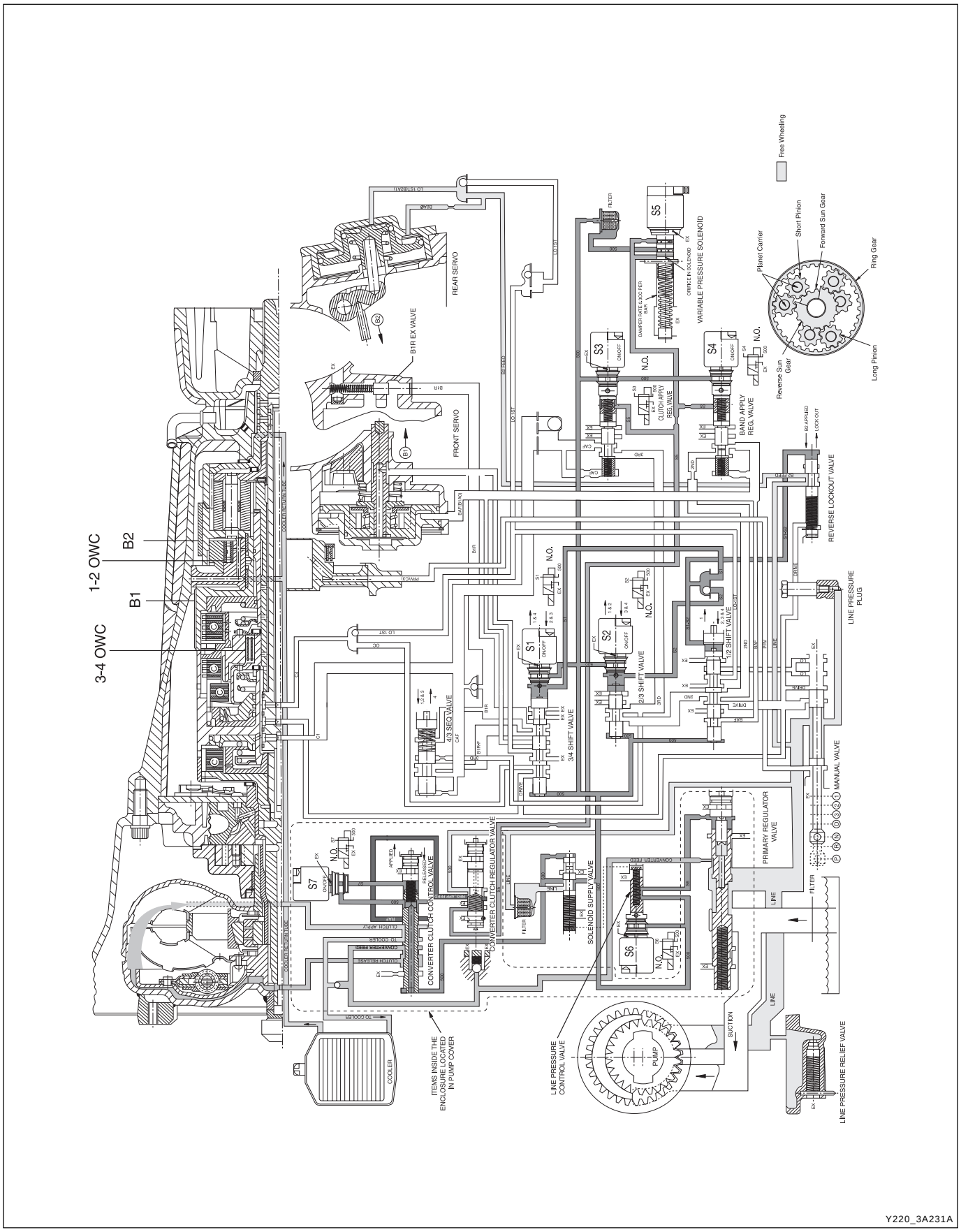
PARK AND NEUTRAL



Y220_3A231A

Power flow - Park and neutral

In Park and Neutral, there is no drive to the planetary gear set. The rear band is applied to eliminate 'clunk' on engagement of the reverse gear, and to improve the low range engagement for 4WD applications. No other clutches or bands are applied.

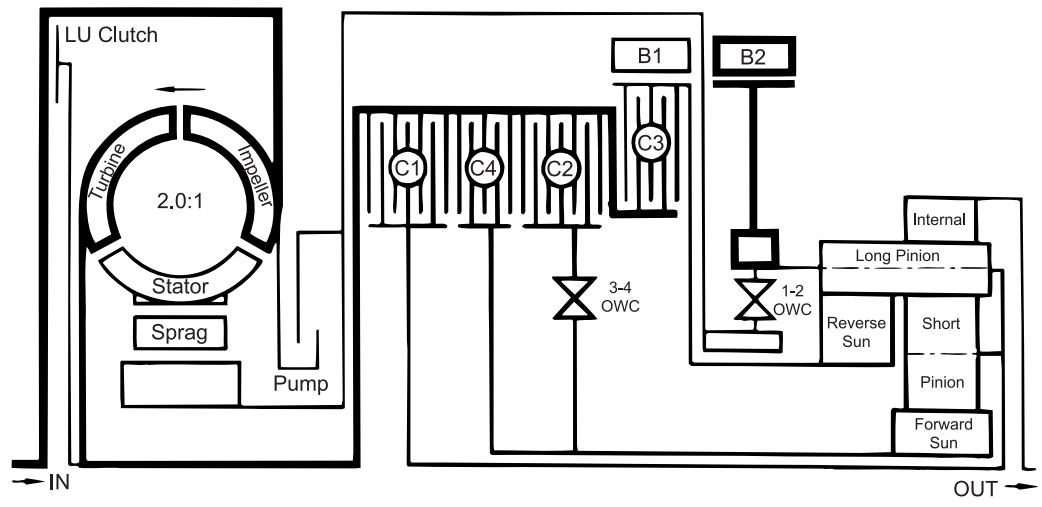
In Park the transmission is mechanically locked by engaging a case mounted pawl with teeth on the output shaft ring gear.

Control

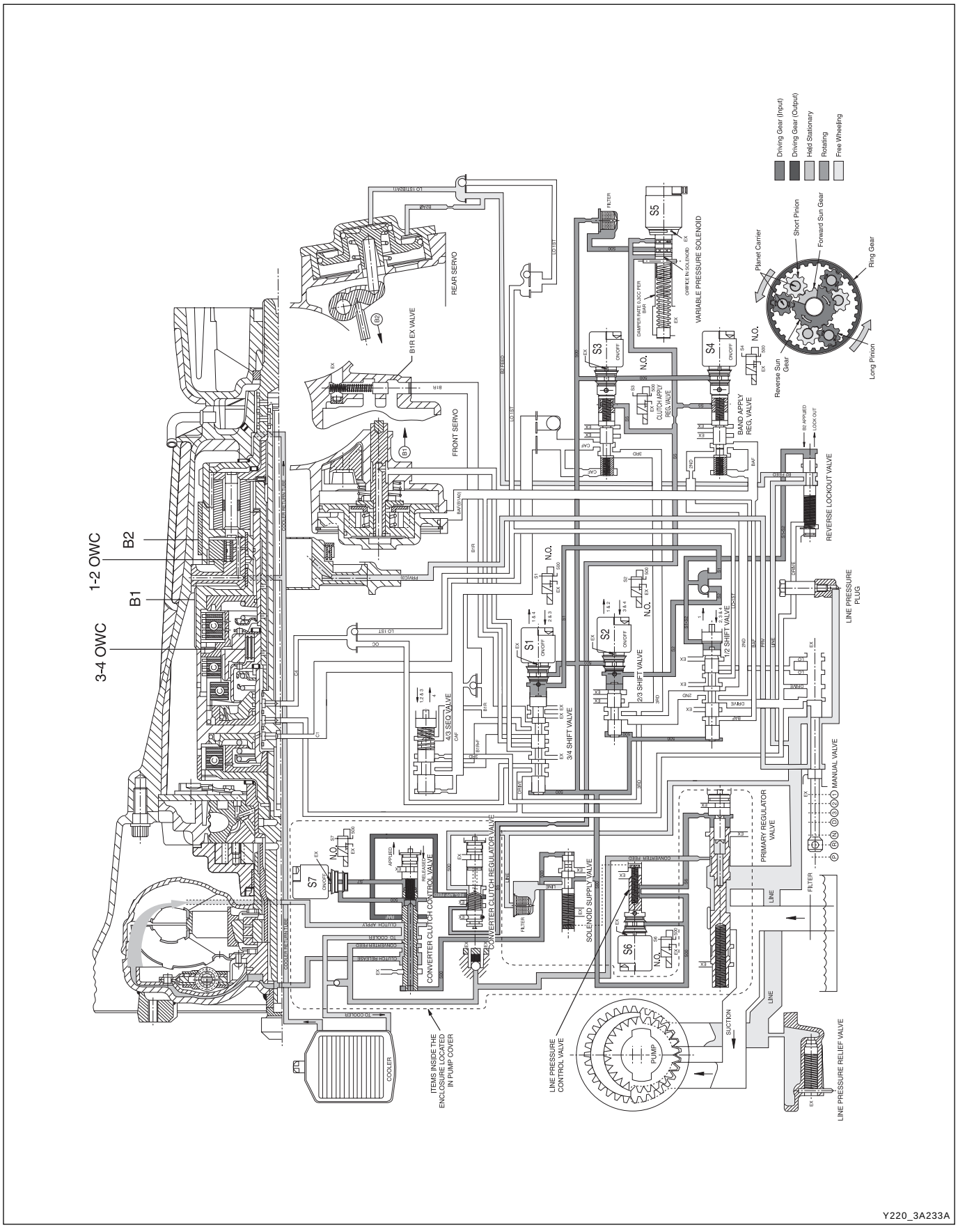
To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoids S1 and S2 are switched OFF.
- Line (pump) pressure is applied to the Primary Regulator Valve (PRV) and to the solenoid supply pressure regulator valve.
- The converter, oil cooler, and lubrication circuits are charged from the primary regulator valve.
- The line 500 circuit is charged by the solenoid supply pressure regulator valve.
- The S5 circuit is charged by the variable pressure solenoid (S5).
- Line pressure is prevented from entering the drive circuit by the manual valve.
- The B1 circuit and all clutch circuits are open to exhaust.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Park and Neutral	-	-	-	-	-	X	-	-	-



REVERSE



Y220_3A233A

Power flow - Reverse

In Reverse, transmission drive is via the input shaft and the forward clutch cylinder to the hub of the C3 clutch. The elements of the transmission function as follows;

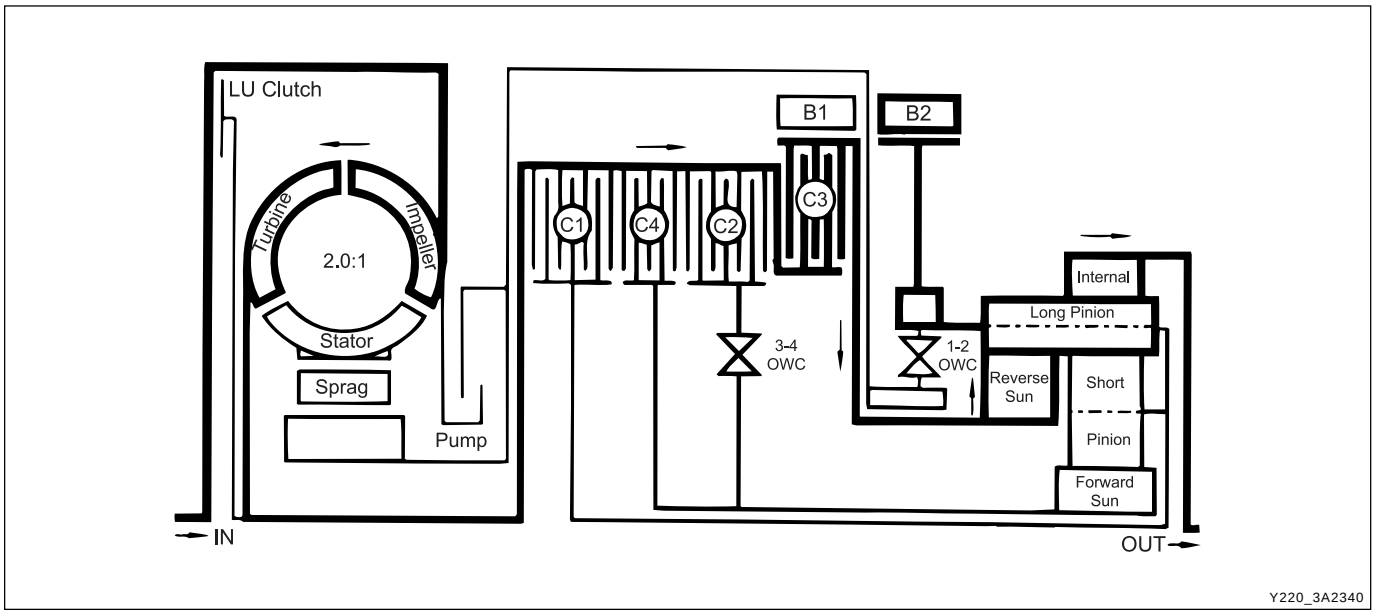
- The C3 clutch is engaged and drives the reverse sun gear in a clock-wise direction.
- The B2 band is engaged and holds the planetary gear carrier stationary causing the long pinion to rotate anti-clockwise about its axis on the pinion shaft.
- The long pinion drives the internal ring gear in the same direction.
- The internal ring being splined to the output shaft drives it in an anti-clockwise or reverse direction.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- Solenoids S1 and S2 are switched OFF.
- Line pressure is directed through the reverse lockout valve to both the inner and outer apply areas of the rear servo piston for B2 band application.
- Line pressure feeds the reverse oil circuit via the manual valve.
- Reverse oil is routed from the manual valve to the C3 clutch.
- Reverse oil is also applied to the spring end of the primary regulator valve to assist the spring and to boost the line pressure value.
- All other clutch and band apply circuits are open to exhaust.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Reverse	-	-	X	-	-	X	-	-	-



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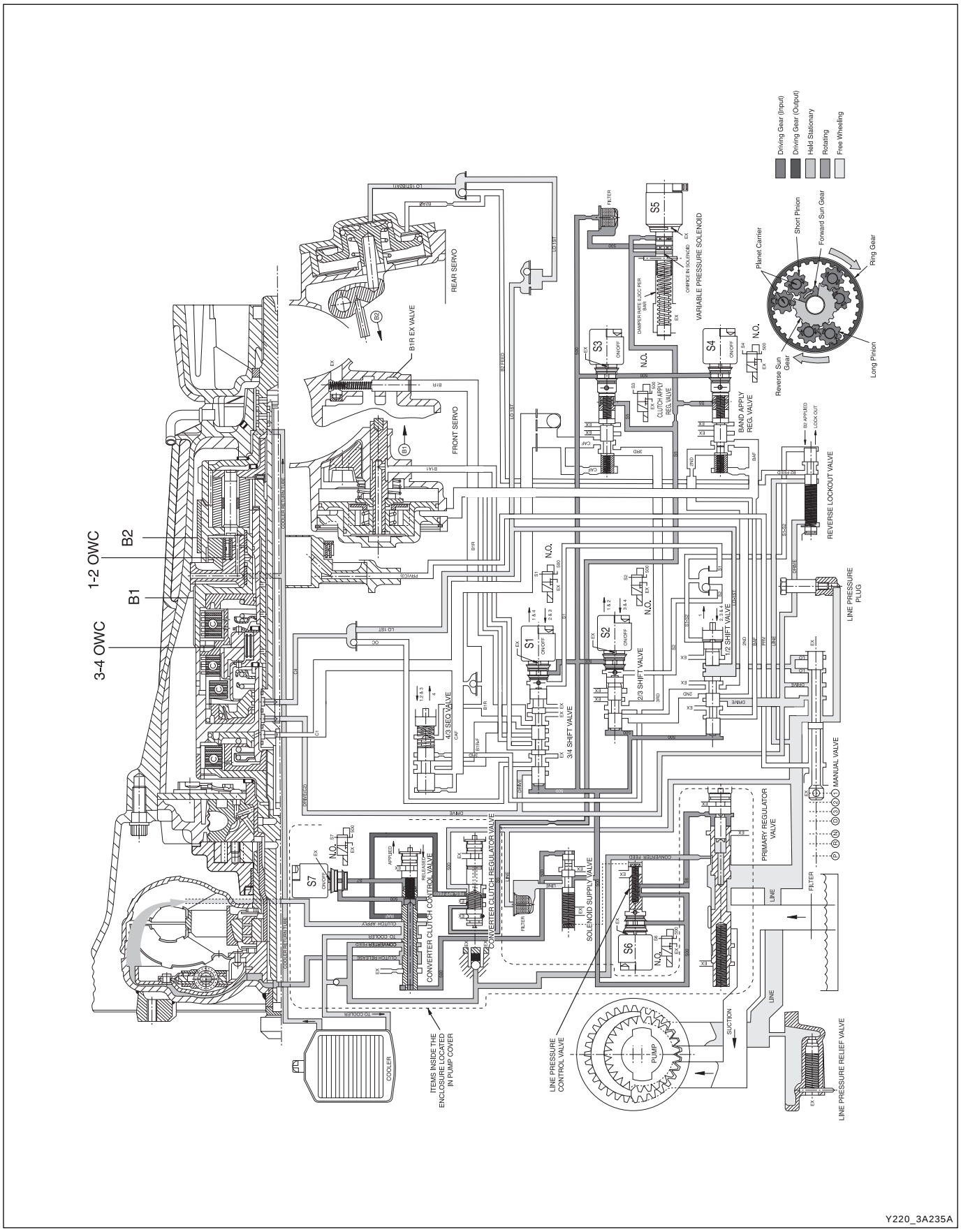
MANUAL 1



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Power flow - Manual 1

In Manual 1, transmission drive is via the input shaft to the forward clutch cylinder. The elements of the trans-mission function as follows;

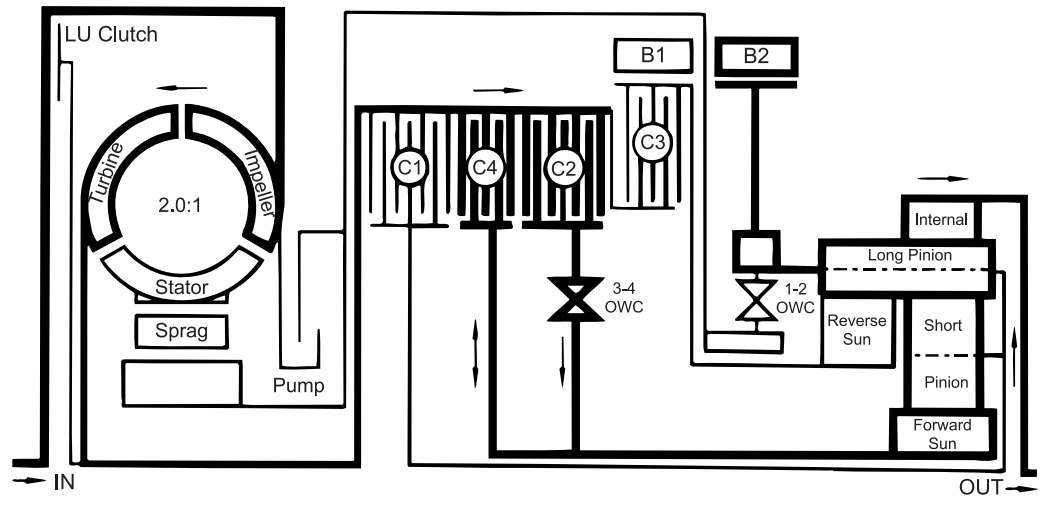
- The C2 clutch is engaged to drive the forward sun gear, via the 3-4 OWC.
- The B2 band is engaged to hold the planetary gear carrier stationary.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The long pinion rotating about its axis drives the internal ring gear and the output shaft in a clockwise or forward direction.
- The C4 clutch provides engine braking through the 3-4 OWC on overrun.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- Solenoids S1 and S2 are switched ON.
- The 1-2, 2-3, and 3-4 shift valves are held in their first gear positions by line 500 pressure.
- Drive (line pressure) oil from the manual valve en-gages the C2 clutch.
- Lo-1st (line pressure) oil is routed through the 1-2 shift valve to the C4 clutch, and to the inner apply area of the rear servo piston for B2 band application.

Gear State	ELEMENTS ENGAGED								
		C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LU CLUTCH
Manual 1		X	-	X	-	X	-	X	-



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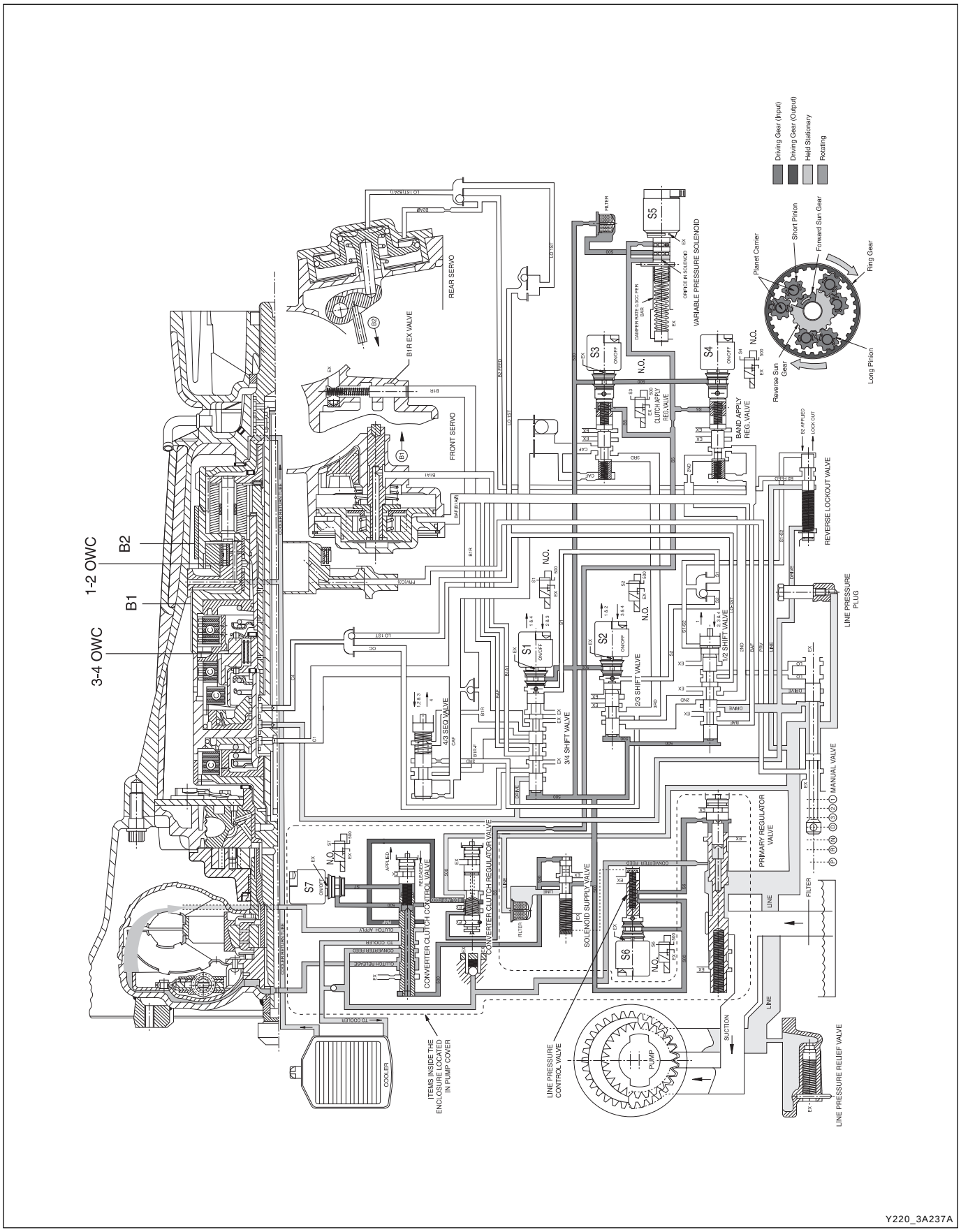
DRIVE 1



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Power flow - Drive 1

In Drive 1, transmission drive is via the input shaft to the forward clutch cylinder. The elements of the transmission function as follows:

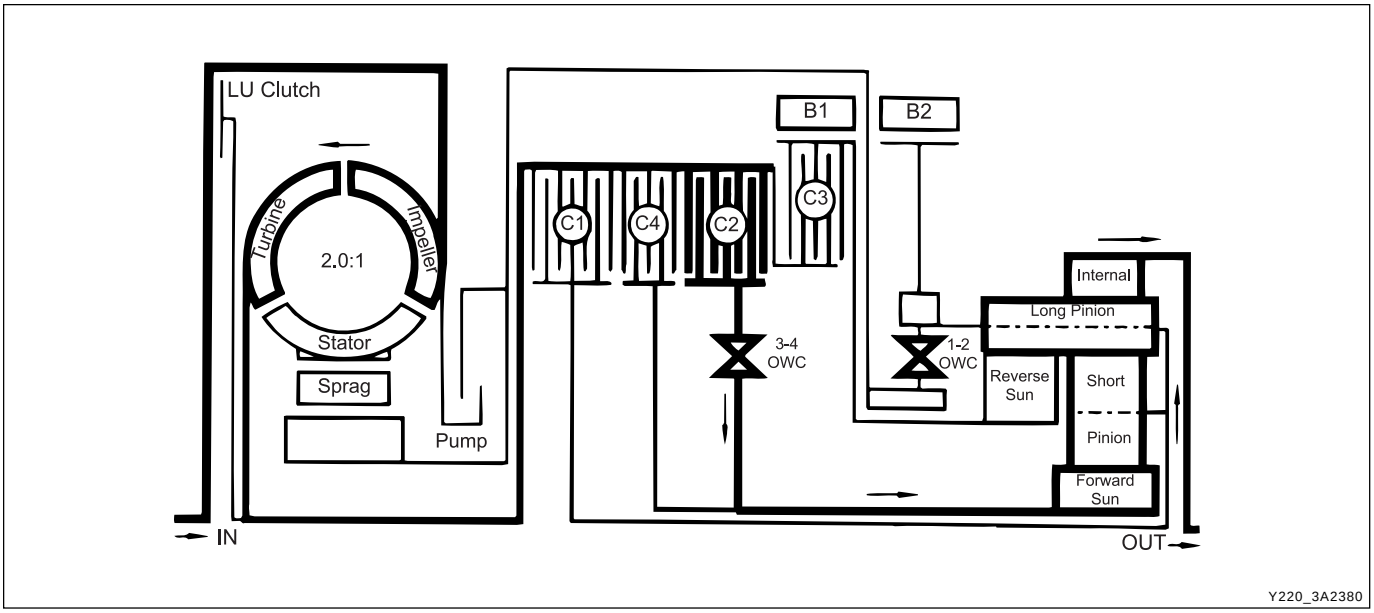
- The C2 clutch is engaged to drive the forward sun gear via the 3-4 OWC.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The 1-2 OWC prevents the planetary gear carrier from rotating under reaction force and the long pinion rotates on its axis driving the internal ring gear and output shaft in a clockwise or forward direction.
- There is no engine braking on overrun.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoids S1 and S2 are switched ON.
- The 1-2, 2-3, and 3-4 shift valves are held in their first gear positions by line 500 pressure.
- Drive (line pressure) oil from the manual valve en-gages the C2 clutch.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 1	-	X	-	-	-	-	X	X	-



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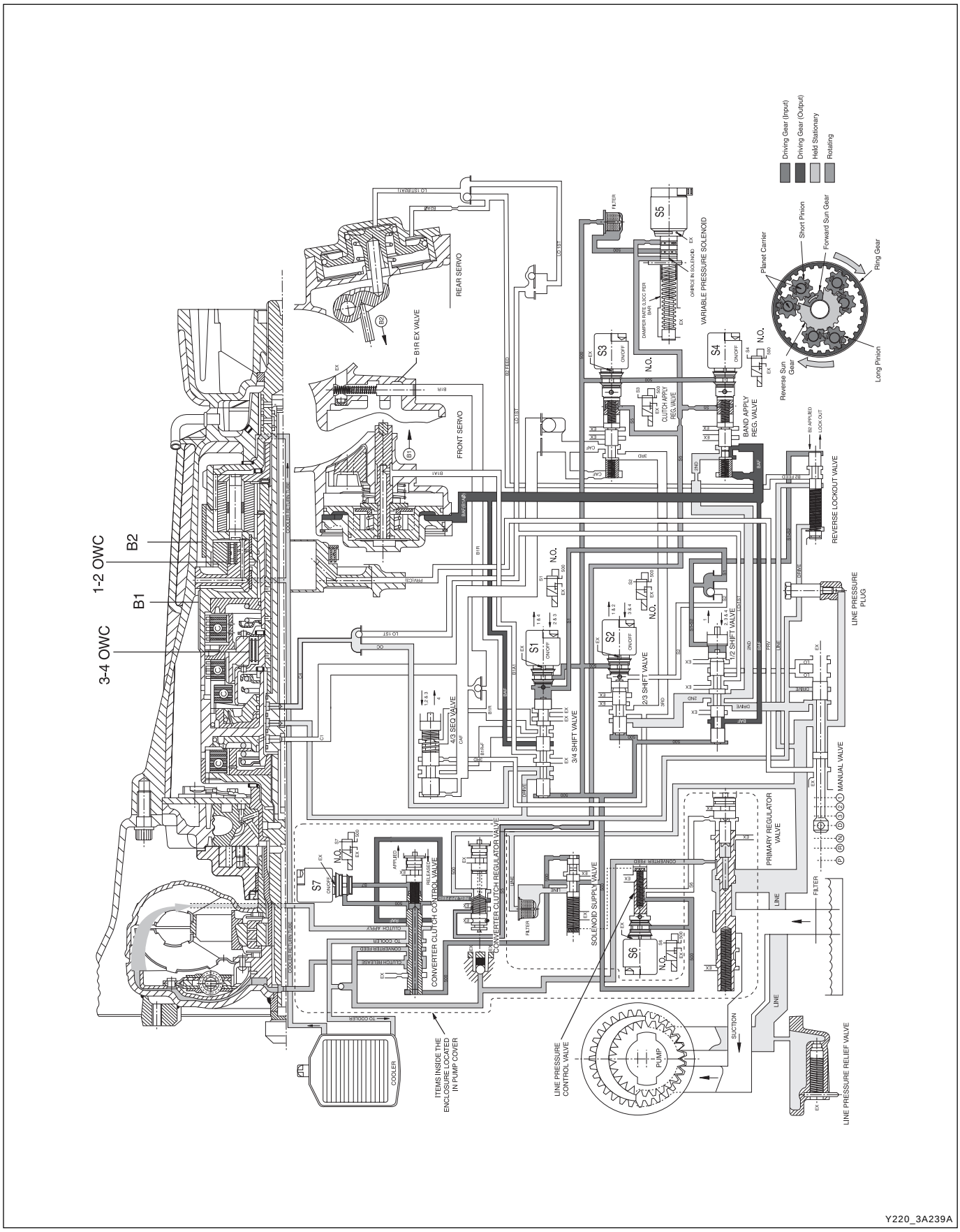
DRIVE 2 AND MANUAL 2



Power flow - Drive 2 and manual 2

In Drive 2 and Manual 2, transmission drive is via the input shaft and forward clutch cylinder. The elements of the transmission function as follows;

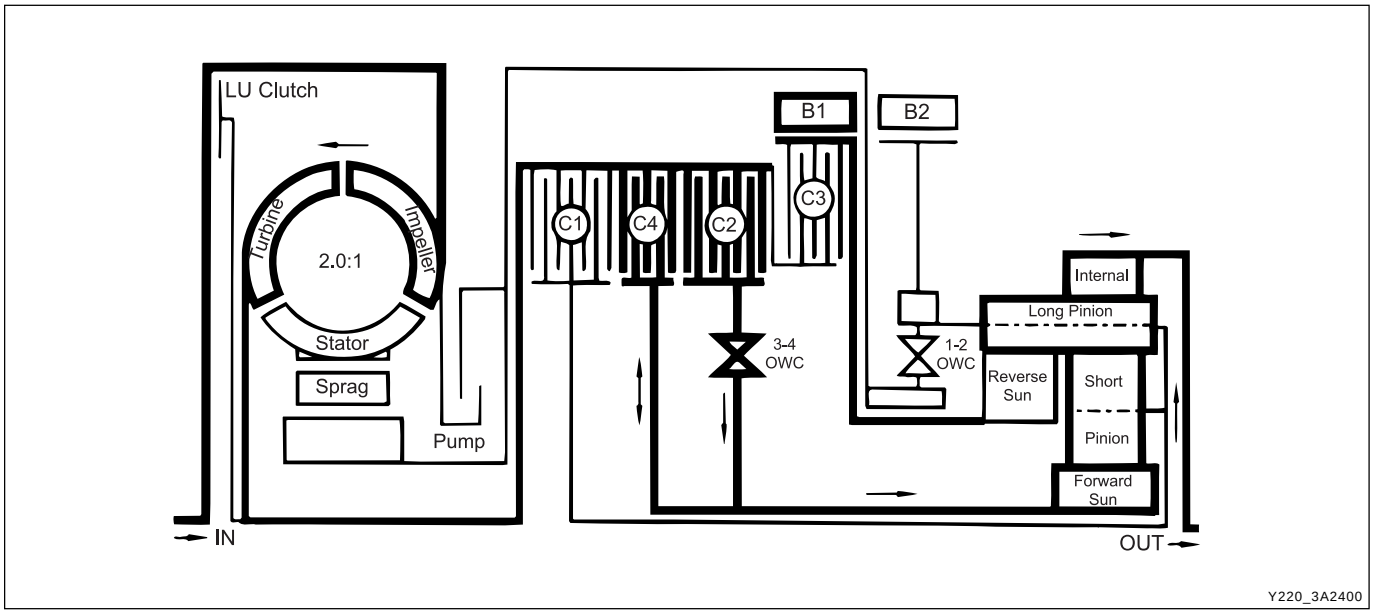
- The C2 clutch is applied to drive the forward sun gear.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The B1 band is applied holding the reverse sun gear stationary therefore the long pinion walks around the reverse sun gear taking the internal ring gear and output shaft with it in a clockwise or forward direction.
- The C4 clutch is applied to bypass the 3-4 OWC and provide engine braking on overrun.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- Solenoid S1 is switched OFF. S2 is switched ON.
- Drive (line pressure) oil from the manual valve en-gages the C2 clutch.
- When S1 switches OFF, S1 oil pressure, which is derived from line 500 pressure, moves the 3-4 shift valve to the left. At the same time S1 oil is directed to the 1-2 shift valve which moves the valve to the second gear position.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply regulator valve, and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ratio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to;
  - The outer apply area of the front servo
  - The 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
  - The 3-4 shift valve for use when the transmission is shifted into fourth gear
- Drive (line pressure) is routed through the 3-4 shift valve to apply the C4 clutch.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 2 and Manual 2	-	X	-	X	X	-	-	X	-



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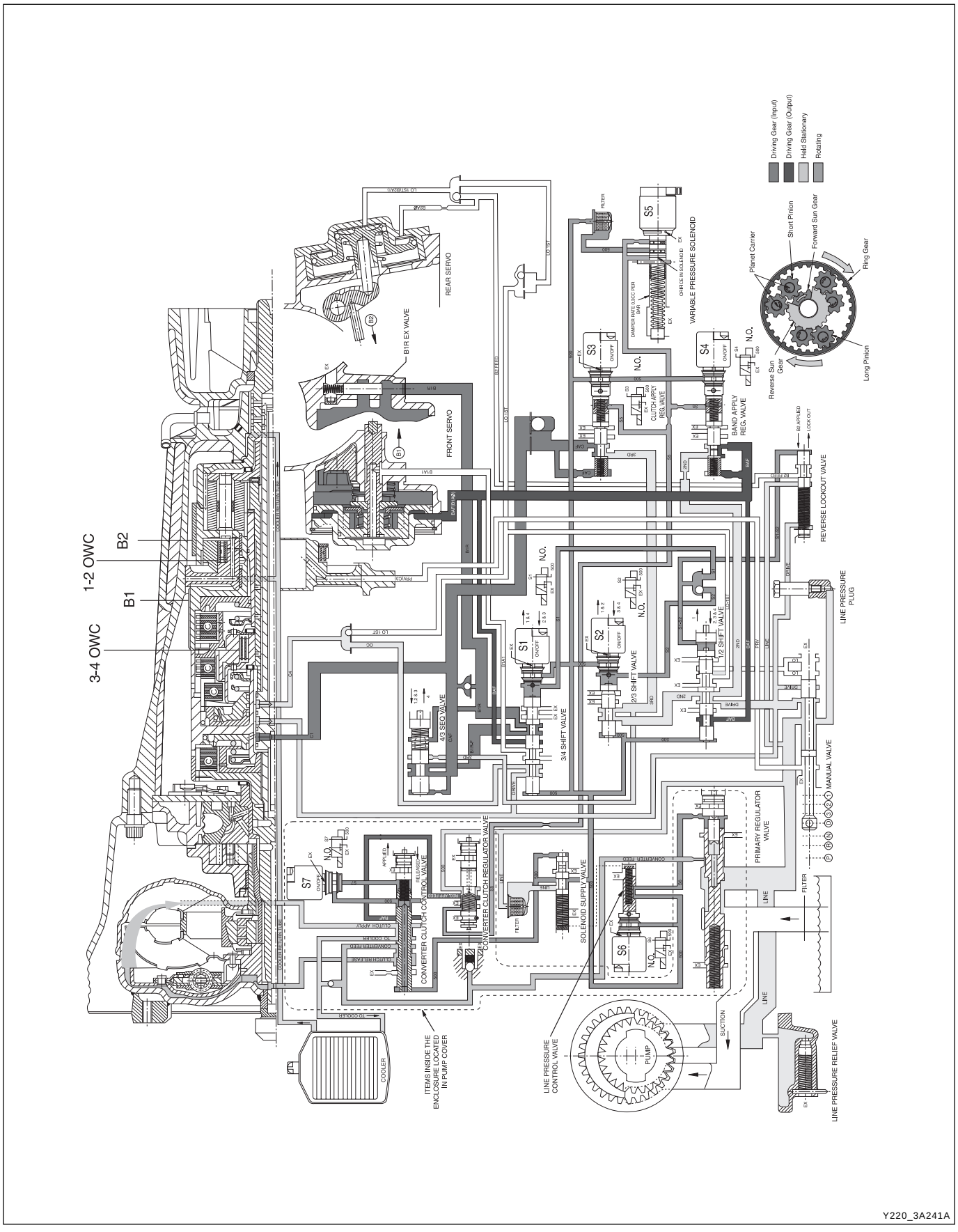
DRIVE 3 AND MANUAL 3



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Power flow - Drive 3 and manual 3

In Drive 2 and Manual 2, transmission drive is via the input shaft and forward clutch cylinder. The elements of the transmission function as follows;

- The C2 clutch is engaged to drive the forward sun gear.
- The C1 clutch is engaged to drive the planet carrier.
- The short pinion drives the long pinion clockwise.
- The forward sun gear and the planet carrier are driv-en clockwise at the same speed therefore there is no relative motion between the sun gear and the pinions.
- The ring gear and output shaft are driven in a clockwise or forward direction at input shaft speed.
- The C4 clutch is applied to bypass the 3-4 OWC and provide engine braking on overrun.

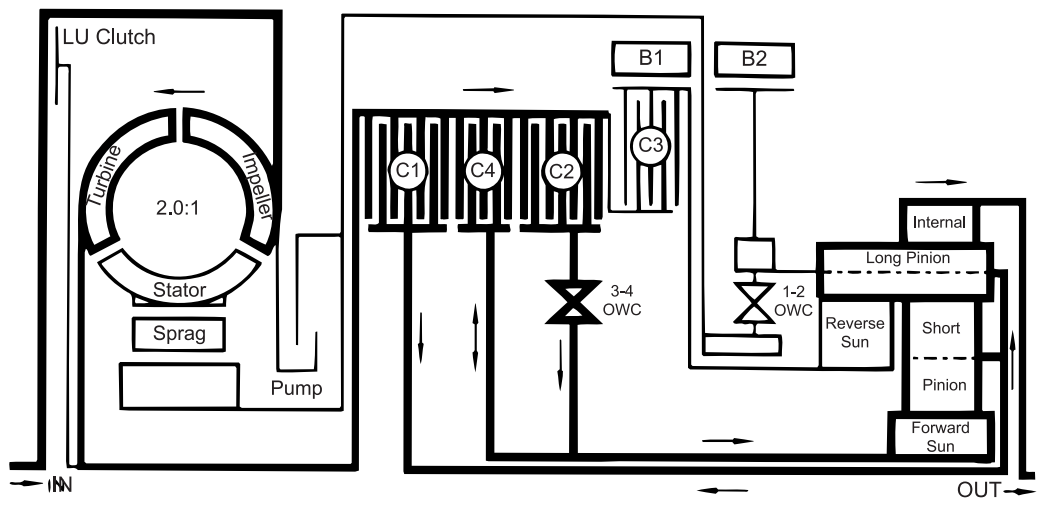
Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoid S1 is switched OFF. S2 is switched OFF.
- With S1 and S2 switched OFF, the 2-3 and 3-4 shift valves are held in the third gear position by line 500 pressure.
- The 1-2 shift valve is held in the third gear position by S1-S2 oil pressure.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply feed regulator valve and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ratio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to;
  - The outer apply area of the front servo
  - The 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
  - The 3-4 shift valve for use when the transmission is shifted into fourth gear
- 2nd oil at the 2-3 shift valve is directed to the 3rd oil circuit.
- 3rd oil from the 2-3 shift valve is directed to the clutch apply regulator valve, and to the 4-3 sequence valve.
- The clutch apply regulator valve supplies oil (regu-lated to line 500 pressure multiplied by the valve ratio) to the Clutch Apply Feed (CAF) circuit.

  The CAF oil is directed to;
  - The C1clutch
  - The 4-3 sequence valve
- At the 4-3 sequence valve the CAF oil becomes Band 1 Release Feed (B1R-F) oil, and is directed through the 3-4 shift valve to the spring end of the 4-3 sequence valve, and to the release side of the front servo piston to hold band 1 OFF.
- Drive (line pressure) is routed through the 3-4 shift valve to apply the C4 clutch.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 3 and Manual 3	X	X	-	X	-	-	-	X	-



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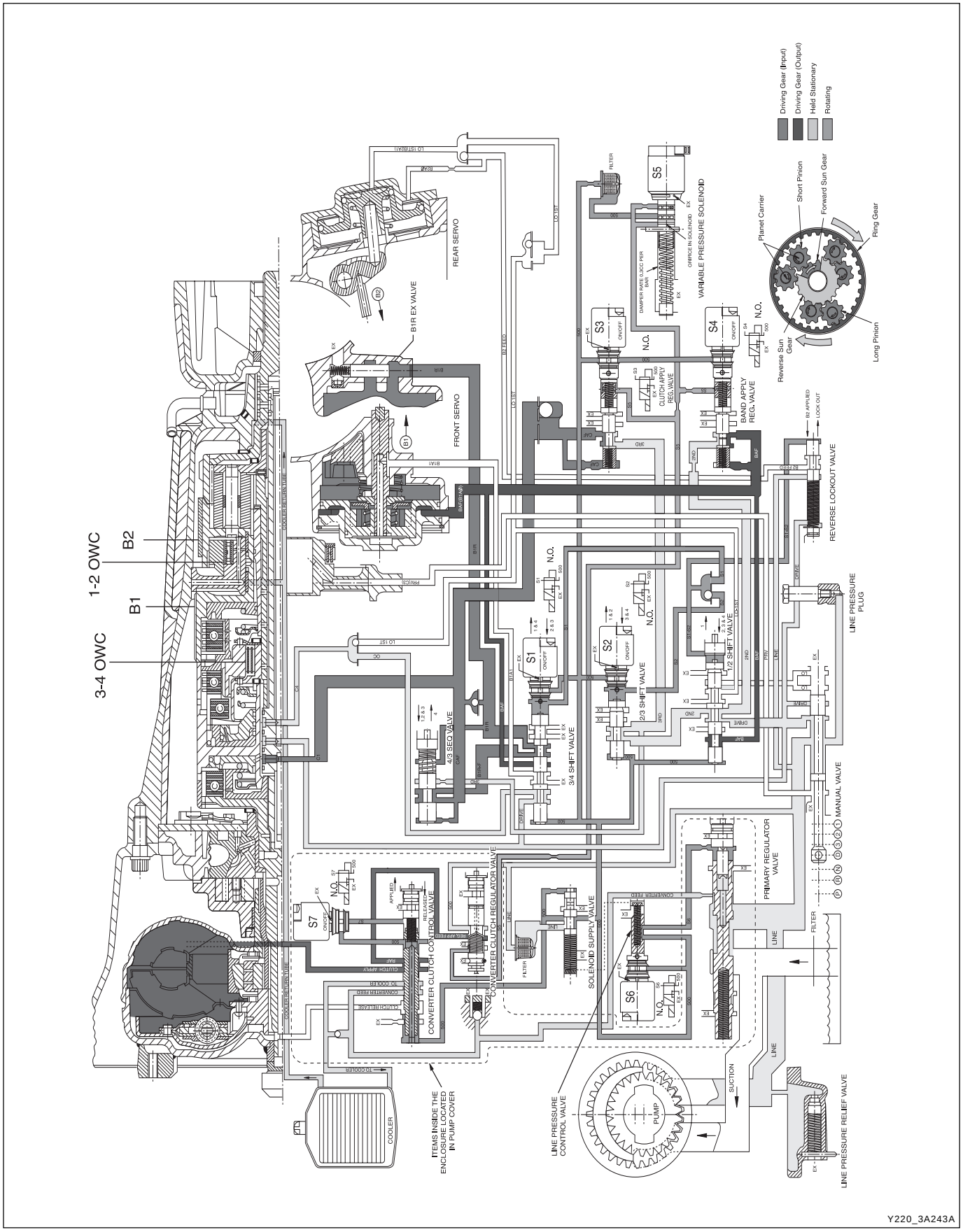
DRIVE 3 LOCK UP AND MANUAL 3 LOCK UP



Power flow - Drive 3 lock up and manual 3 lock up

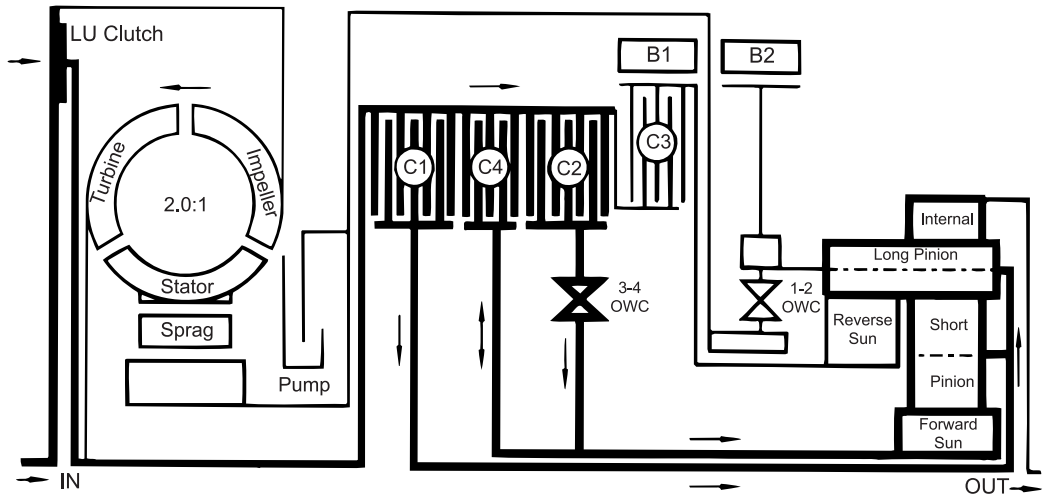
In Drive 3 Lock Up and Manual 3 Lock Up, transmission drive is the same as for Drive 3 but with the application of the converter lock up clutch to provide positive no-slip converter drive.

Control

Control for Drive 3 Lock Up and Manual 3 Lock Up is the same as for Drive 3 with the addition of the converter clutch circuit activated by solenoid S7.

- When S7 is switched ON, S7 feed oil to the converter clutch control valve is switched OFF and allowed to exhaust through the S7 solenoid. This allows the valve to move to the clutch engage position.
- Regulated apply feed oil, drive oil at the converter clutch regulator valve, is directed by the converter clutch control valve to the engage side of the converter clutch.
- Converter clutch release oil is exhausted at the converter clutch control valve.
- Converter feed oil is re-routed by the converter clutch control valve directly to the oil cooler and lubrication circuit.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 3 Lock Up and Manual 3 Lock Up	X	X	-	X	-	-	-	X	X



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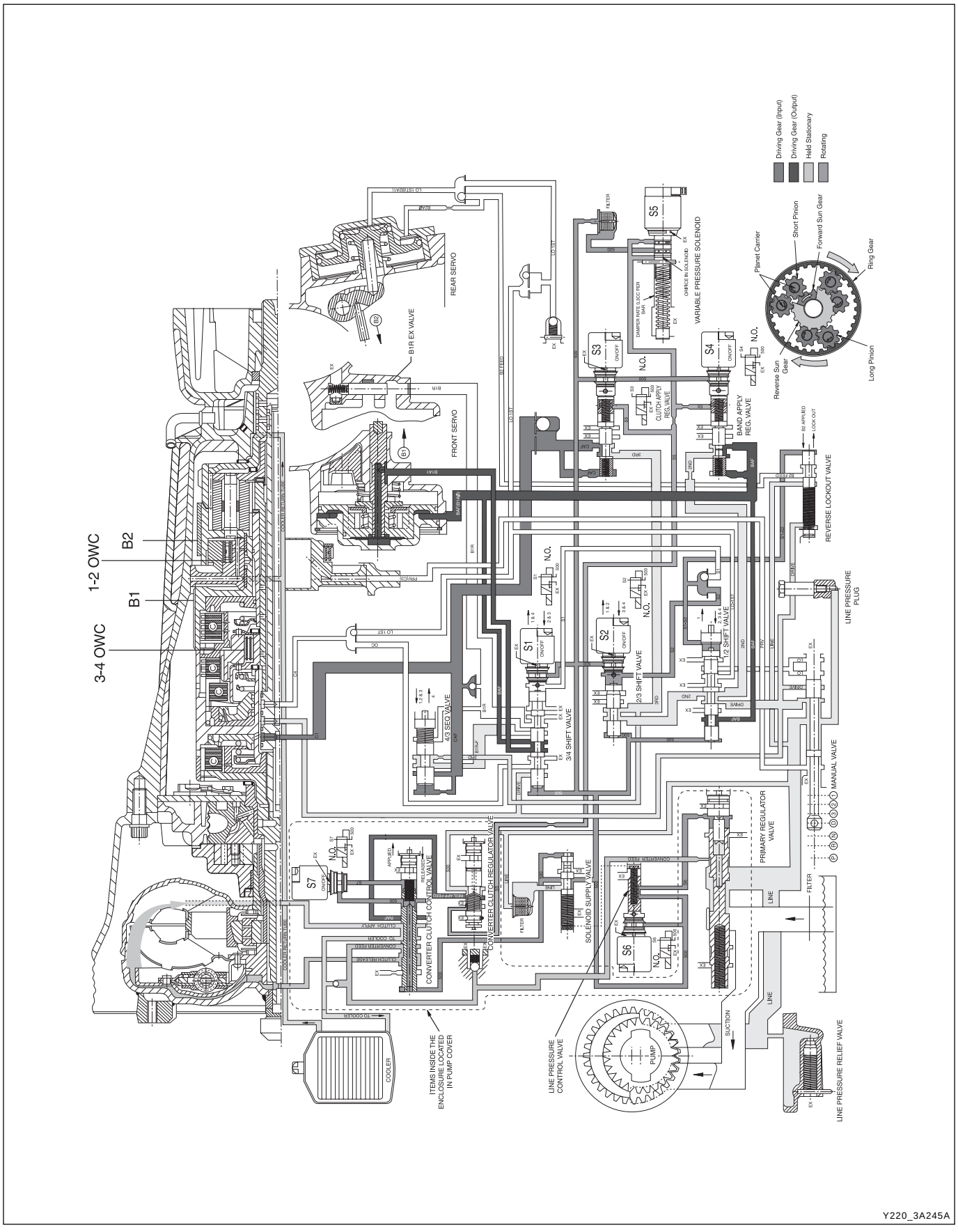
DRIVE 4 (OVERDRIVE)



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Power flow - Drive 4 (Overdrive)

In Drive 4 (Overdrive), transmission drive is via the input shaft to the forward clutch cylinder.

The elements of the transmission function as follows;

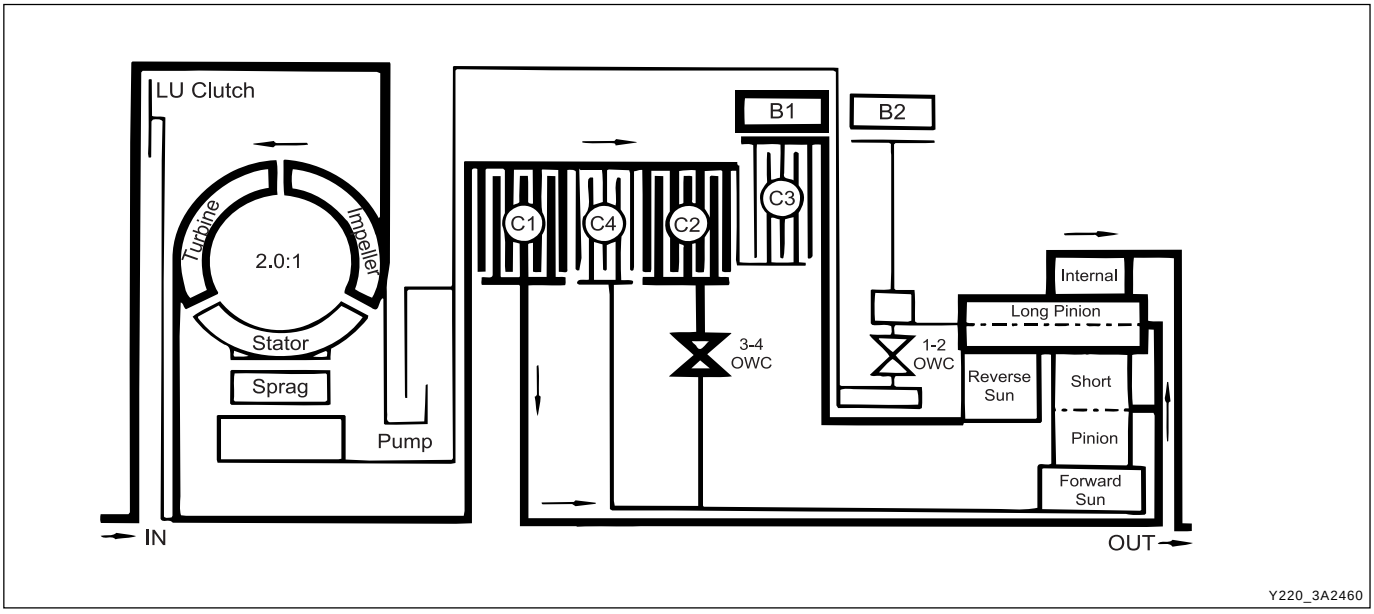
- The C1 clutch is applied to drive the planet carrier clockwise.
- The B1 band is applied to hold the reverse sun gear stationary.
- As the planet carrier tuns, the long pinion walks around the stationary reverse sun gear and rotates around its axis driving the internal ring gear and output shaft in a clockwise or forward direction at a speed faster than the input shaft i.e. in overdrive ratio.
- The forward sun gear is also driven faster than the input shaft and overruns the 3-4 OWC.
- The C2 clutch is engaged to reduce the speed differential across the 3-4 OWC.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- Solenoid S1 is switched ON. S2 is switched OFF.
- With S1 switched ON, the 3-4 shift valve is held in the fourth gear position by line 500 pressure on the small end of the valve.
- With S2 switched OFF, the 2-3 shift valve is held in the fourth gear position by line 500 pressure on the large end of the valve.
- The 1-2 shift valve is held in the fourth gear position by S2 oil pressure.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply feed regulator valve, and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ratio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to;
  - the outer apply area of the front servo
  - the inner apply area of the front servo piston via the 3-4 shift valve
  - the 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
- 2nd oil at the 2-3 shift valve is directed to the 3rd oil circuit.
- 3rd oil from the 2-3 shift valve is directed to the clutch apply regulator valve, and to the 4-3 sequence valve.
- The clutch apply regulator valve supplies oil (regu-lated to line 500 pressure multiplied by the valve ratio) to the Clutch Apply Feed (CAF) circuit.
- The CAF oil is directed to;
  - the C1 clutch
  - the 4-3 sequence valve
- Drive oil (line pressure) from the manual valve en-gages the C2 clutch.

Gear State	ELEMENTS ENGAGED								
	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LU CLUTCH
Drive 4 Overdrive	X	X	-	-	X	-	-	-	-



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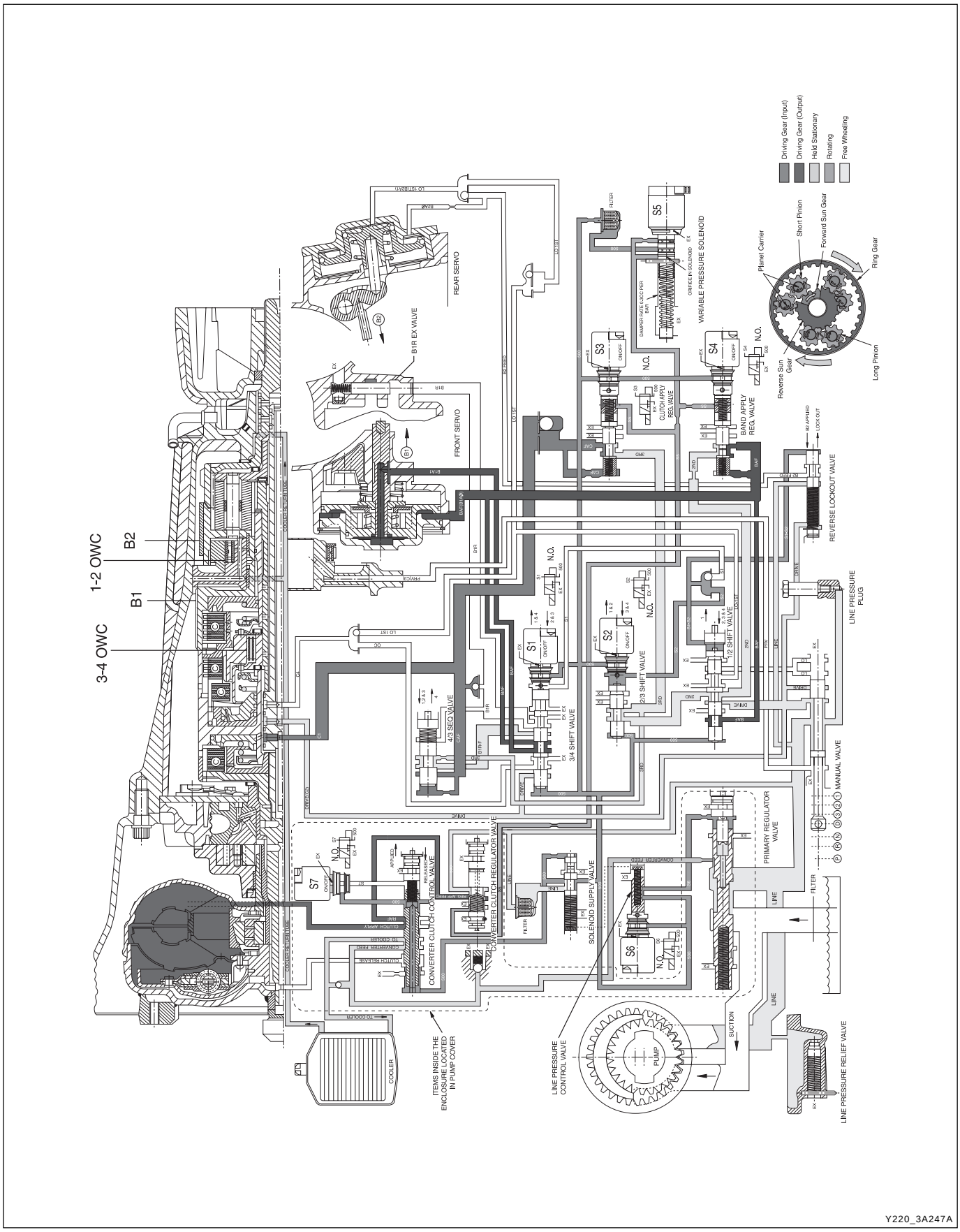
DRIVE 4 LOCK UP



Power flow - Drive 4 lock up

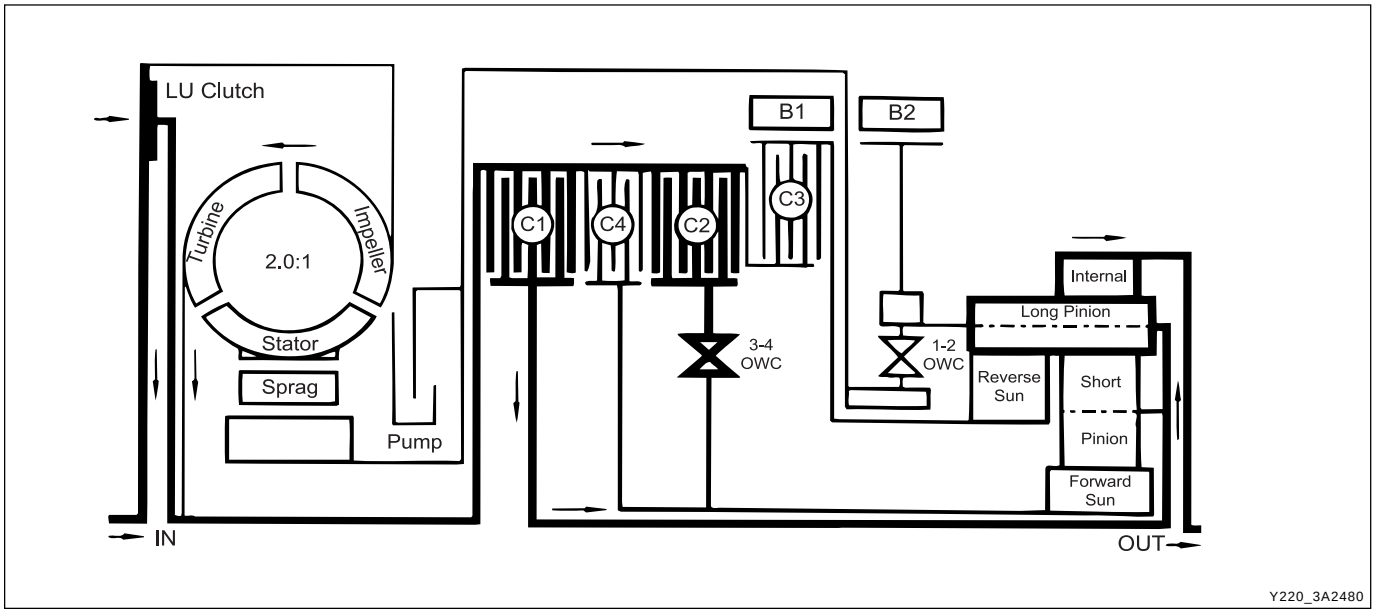
In Drive 4 Lock Up, transmission drive is the same as for Drive 4 but with the application of the converter lock up clutch to provide positive no-slip converter drive.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- When S7 is switched ON, S7 feed oil to the converter clutch control valve is switched OFF and allowed to exhaust through the S7 solenoid. This allows the valve to move to the clutch engage position.
- Regulated apply feed oil, drived from drive oil at the converter clutch regulator valve, is directed by the converter clutch control valve to the engage side of the converter clutch.
- Converter clutch release oil is exhausted at the converter clutch control valve.
- Converter feed oil is re-routed by the converter clutch control valve directly to the oil cooler and lubrication circuit.

Gear State	ELEMENTS ENGAGED								
	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LU CLUTCH
Drive 4 Lock Up	X	X	-	-	X	-	-	-	-



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DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSIS

BASIC KNOWLEDGE REQUIRED

You must be famillíar with some basic electronics to use this section of the Service Manual. They will help you to follow diagnostic procedures.

Notice

Lack of the basic knowledge of this transmis-sion when performing diagnostic procedures could re-sult in incorrect diagnostic performance or damage to transmission components. Do not, under any circum-stances, attempt to diagnose a transmission problem without this basic knowledge.

Notice

If a wire is probed with a sharp instrument and not properly sealed afterward, the wire will corrode and an open circuit will result.

Diagnostic test probes are now available that allow you to probe individual wires without leaving the wire open to the environment. These probe devices are inexpensive and easy to install, and they permanently seal the wire from corrosion.

▶ Special Tools

You should be able to use a Digital Volt Meter (DVM), a circuit tester, jumper wires or leads and a line pressure gauge set. The functional check procedure is designed to verify the correct operation of electronic components in the transmission. This will eliminate the unnecessary re-moval of transmission components.

FUNCTIONAL CHECK PROCE-DURE

Begin with the Functional Check Procedure which pro-vides a general outline of how to diagnose automatic transmission. The following functional check procedure will indicate the proper path of diagnosing the transmis-sion by describing the basic checks and then referenc-ing the locations of the specific checks.

- Check the fluid level according to the Fluid Level Service Procedure.
- Check the transmission fluid leak.
- Check if the transmission fluid is not burnt by smell.

Notice

The specific fluid used in this transmission turns brown during normal operation. Brown fluid does not indicate a transmission fault.

- Ensure that the transmission is not in Limp Home Mode (LHM).
- Check the battery terminals and the earth connec-tions for corrosion or looseness.
- Check that the cooler flow is not restricted.
- Check all electrical plug connections for tightness.
- Use on-board diagnostic tool or a scan tool to see if any transmission trouble codes have been set. Refer to the appropriate “Diagnostic Trouble Code (DTC)” information and repair the vehicle as directed. After repairing the vehicle, perform the road test and verify that the code has not set again.
- Perform the Electrical/Garage Shift Tests.
- Perform the Road Test Procedure in this section.
- Inspect the oil and check for metal or other contami-nants in the oil pan.

4. Lower the vehicle with the filler pump still connected and start the vehicle in P (Park) with the parking brake and the brake applied. With the engine idling, move the gear shift control lever through the gear ranges, pausing a few seconds in each range and adding the fluid until gear application is felt.

   Then add an additional 0.5 litres of fluid. Return the gear shift lever to P (Park). Turn the engine OFF and raise the vehicle. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
5. Drive the vehicle at 3.5 to 4.5 kilometers with light throttle so that the engine does not exceed 2500 rpm.

   This should result in the transmission temperature being in the range 50 - 60°C (82 - 140°F). With the brake applied, move the shift lever through the gear ranges, pausing a few seconds in each range at the engine idling.
6. Return the gear shift lever to P (Park).

   Turn the en-gine OFF and raise the vehicle on the hoist, if applicable, ensuring the vehicle is level. When the three minutes passed after the engine stopped, remove the filler plug.

   Check if the fluid level is aligned with the bottom of the filler hole. If not, add a small quantity of fluid to the correct level. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
7. Wipe any fluid around the filler plug with a rag or shop towel.

FLUID LEAK DIAGNOSIS AND REPAIR

The cause of most external leaks can generally be lo-cated and repaired with the transmission in the vehicle.

▶Methods for Locating Leaks

General method

1. Verify that the leak is transmission fluid.
2. Thoroughly clean the suspected leak area.
3. Drive the vehicle for approximately 25 km (15 miles) or until the transmission reaches normal operating temperature (88°C, 190°F).
4. Park the vehicle over clean paper or cardboard.
5. Turn the engine OFF and look for fluid spots on the paper.
6. Make the necessary repairs to correct the leak.

Powder method

1. Thoroughly clean the suspected leak area.
2. Apply an aerosol type powder (foot powder) to the suspected leak area.
3. Drive the vehicle for approximately 25 km (15 miles) or until the transmission reaches normal operating temperature (88°C, 190°F).
4. Turn the engine OFF.
5. Inspect the suspected leak area and trace the leak path through the powder to find the source of the leak.
6. Make the necessary repairs.

Dye and black light method

1. Add dye to the transmission through the transmission fluid filler plug. Follow the manufacturer's recommendation for the amount of dye to be used.
2. Use the black light to find the fluid leak.
3. Make the necessary repairs.

Repairing the fluid leak

Once the leak point is found the source of the leak must be determined. The following list describes the potential causes for the leak:

- Fasteners are not torqued to specification.
- Fastener threads and fastener holes are dirty or corroded.
- Gaskets, seals or sleeves are misaligned, damaged or worn.
- Damaged, warped or scratched seal bore or gasket surface.
- Loose or worn bearing causing excess seal or sleeve wear.
- Case or component porosity.
- Fluid level is too high.
- Plugged vent or damaged vent tube.
- Water or coolant in fluid.
- Fluid drain back holes plugged.

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSIS

BASIC KNOWLEDGE REQUIRED

You must be famillíar with some basic electronics to use this section of the Service Manual. They will help you to follow diagnostic procedures.

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Notice

If a wire is probed with a sharp instrument and not properly sealed afterward, the wire will corrode and an open circuit will result.

Diagnostic test probes are now available that allow you to probe individual wires without leaving the wire open to the environment. These probe devices are inexpensive and easy to install, and they permanently seal the wire from corrosion.

▶ Special Tools

You should be able to use a Digital Volt Meter (DVM), a circuit tester, jumper wires or leads and a line pressure gauge set. The functional check procedure is designed to verify the correct operation of electronic components in the transmission. This will eliminate the unnecessary re-moval of transmission components.

FUNCTIONAL CHECK PROCE-DURE

Begin with the Functional Check Procedure which pro-vides a general outline of how to diagnose automatic transmission. The following functional check procedure will indicate the proper path of diagnosing the transmis-sion by describing the basic checks and then referenc-ing the locations of the specific checks.

- Check the fluid level according to the Fluid Level Service Procedure.
- Check the transmission fluid leak.
- Check if the transmission fluid is not burnt by smell.

Notice

The specific fluid used in this transmission turns brown during normal operation. Brown fluid does not indicate a transmission fault.

- Ensure that the transmission is not in Limp Home Mode (LHM).
- Check the battery terminals and the earth connec-tions for corrosion or looseness.
- Check that the cooler flow is not restricted.
- Check all electrical plug connections for tightness.
- Use on-board diagnostic tool or a scan tool to see if any transmission trouble codes have been set. Refer to the appropriate “Diagnostic Trouble Code (DTC)” information and repair the vehicle as directed. After repairing the vehicle, perform the road test and verify that the code has not set again.
- Perform the Electrical/Garage Shift Tests.
- Perform the Road Test Procedure in this section.
- Inspect the oil and check for metal or other contami-nants in the oil pan.

TRANSMISSION FLUID LEVEL SERVICE PROCEDURE

This procedure is to be used when checking a concern with the fluid level in a vehicle. A low fluid level will result in slipping and loss of drive/ reverse or delay on engagement of drive/ reverse when the vehicle is cold.

The vehicle is first checked for transmission diagnostic messages on the scan tool. If the oil level is low, it is possible to register a vehicle speed signal fault.

The vehicle is to be test driven to determine if there is an abnormal delay when selecting drive or reverse, or loss of drive. One symptom of low fluid level is a momentary loss of drive when driving the vehicle around a corner. Also when the transmission fluid level is low, a loss of drive may occur when the transmission fluid temperature is low.

If there is no loss of drive when the vehicle is driven warm and a vehicle speed signal fault is registered, then fluid should be added to the transmission.

When adding or changing transmission fluid use only Castrol TQ 95 automatic transmission fluid. The use of incorrect fluid will cause the performance and durability of the transmission to be severely degraded.

▶ Fluid Level Diagnosis procedure

1. If the vehicle is at operating temperature allow the vehicle to cool down for two hours, but no greater than four hours. Or if the vehicle is at cool status, start the engine and allow the engine to idle for approximately 5 minutes or, if possible, drive the vehicle for a few kilometers. This will allow the transmission to be within the correct temperature range. Transmission fluid level should be checked at temperature 50 - 60°C (82 - 140°F).

   Caution

   Removal of the fluid filler plug when the transmission fluid is hot may cause injury if fluid drains from the filler hole.

2. With the brake pedal pressed, move the gear shift control lever through the gear ranges, pausing a few seconds in each range. Return the gear shift control lever to P (Park). Turn the engine OFF.
3. Park the vehicle on a hoist, inspection pit or similar raised level surface. The vehicle must be control level to obtain a correct fluid level measurement.
4. Place a fluid container below the fluid filler plug.
5. Clean all dirt from around the fluid filler plug. Remove the fluid filler plug. Clean the filler plug and check that there is no damage to the 'O' ring.
   - If fluid drains through the filler hole the transmission may have been overfilled. When the fluid stops draining the fluid level is correct. Install the fluid filler plug and tighten it to 33 Nm (24 lb-ft).
   - If fluid does not drain through the filler hole, the transmission fluid level may be low. Install the filler pump into the filler hole. Lower the vehicle with the filler pump still connected and partially fill the fluid through the filler hole.

     Start the vehicle in P (Park) with the parking brake and the brake applied. With the engine idling, move the gear shift. control lever through the gear ranges, pausing a few seconds in each range and adding the fluid until gear application is felt.

     Return the gear shift lever to P (Park).

     Turn the engine OFF and raise the vehicle. When the three minutes passed after the engine stopped, remove the filler pump.

     Check if the fluid level is aligned with the bottom of the filler hole. If not, add a small quantity of fluid to the correct level. Install the fluid filler plug and tighten it to 33 Nm (24 lb-ft).
   - If fluid does not drain through the filler hole although adding a total of 1.5 liters, the transmission should be inspected for fluid leaks and any leaks should be fixed before setting the transmission fluid level.
6. When the fluid level checking procedure is completed, wipe any fluid around the filler plug with a rag or shop towel.

▶ Fluid Level Set After Service

1. Depending on the service procedure performed, add the following amounts of fluid through the filler plug hole prior to adjusting the fluid level:

Converter empty	8.0 liters	(8.5 quarts)
Converter full	3.8 liters	(4.0 quarts)

2. Follow steps 1 through 4 of the Fluid Level Diagnosis Procedure.
3. Clean all dirt from around the fluid filler plug. Remove the fluid filler plug. Clean the filler plug and check that there is no damage to the 'O' ring.

4. Lower the vehicle with the filler pump still connected and start the vehicle in P (Park) with the parking brake and the brake applied. With the engine idling, move the gear shift control lever through the gear ranges, pausing a few seconds in each range and adding the fluid until gear application is felt.

   Then add an additional 0.5 litres of fluid. Return the gear shift lever to P (Park). Turn the engine OFF and raise the vehicle. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
5. Drive the vehicle at 3.5 to 4.5 kilometers with light throttle so that the engine does not exceed 2500 rpm.

   This should result in the transmission temperature being in the range 50 - 60°C (82 - 140°F). With the brake applied, move the shift lever through the gear ranges, pausing a few seconds in each range at the engine idling.
6. Return the gear shift lever to P (Park).

   Turn the en-gine OFF and raise the vehicle on the hoist, if applicable, ensuring the vehicle is level. When the three minutes passed after the engine stopped, remove the filler plug.

   Check if the fluid level is aligned with the bottom of the filler hole. If not, add a small quantity of fluid to the correct level. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
7. Wipe any fluid around the filler plug with a rag or shop towel.

FLUID LEAK DIAGNOSIS AND REPAIR

The cause of most external leaks can generally be lo-cated and repaired with the transmission in the vehicle.

▶Methods for Locating Leaks

General method

1. Verify that the leak is transmission fluid.
2. Thoroughly clean the suspected leak area.
3. Drive the vehicle for approximately 25 km (15 miles) or until the transmission reaches normal operating temperature (88°C, 190°F).
4. Park the vehicle over clean paper or cardboard.
5. Turn the engine OFF and look for fluid spots on the paper.
6. Make the necessary repairs to correct the leak.

Powder method

1. Thoroughly clean the suspected leak area.
2. Apply an aerosol type powder (foot powder) to the suspected leak area.
3. Drive the vehicle for approximately 25 km (15 miles) or until the transmission reaches normal operating temperature (88°C, 190°F).
4. Turn the engine OFF.
5. Inspect the suspected leak area and trace the leak path through the powder to find the source of the leak.
6. Make the necessary repairs.

Dye and black light method

1. Add dye to the transmission through the transmission fluid filler plug. Follow the manufacturer's recommendation for the amount of dye to be used.
2. Use the black light to find the fluid leak.
3. Make the necessary repairs.

Repairing the fluid leak

Once the leak point is found the source of the leak must be determined. The following list describes the potential causes for the leak:

- Fasteners are not torqued to specification.
- Fastener threads and fastener holes are dirty or corroded.
- Gaskets, seals or sleeves are misaligned, damaged or worn.
- Damaged, warped or scratched seal bore or gasket surface.
- Loose or worn bearing causing excess seal or sleeve wear.
- Case or component porosity.
- Fluid level is too high.
- Plugged vent or damaged vent tube.
- Water or coolant in fluid.
- Fluid drain back holes plugged.

ELECTRICAL / GARAGE SHIFT TEST

This preliminary test should be performed before a hoist or road test to make sure electronic control inputs are connected and operating. If the inputs are not checked before operating the transmission, a simple electrical condition could be misdiagnosed as a major transmission condition.

A scan tool provides valuable information and must be used on the automatic transmission for accurate diagnosis.

1. Move gear shift control lever to P (Park) and set the parking brake.
2. Connect scan tool to Data Link Connector (DLC) terminal.
3. Start engine.
4. Turn the scan tool ON.
5. Verify that the appropriate signals are present. These signals may include:
   - ENGINE SPEED
   - VEHICLE SPEED
   - THROTTLE POSITION
   - ACCEL. PEDAL POSITION
   - TRANSMISSION GEAR STATE
   - GEAR SHIFT LEVER POSITION
   - TRANSMISSION FLUID TEMPERATURE
   - CLOSED THROTTLE POSITION LEARN
   - OPEN THROTTLE POSITION LEARNT
   - CLOSED ACCEL. PEDAL POSITION LEARNT
   - OPEN ACCEL. PEDAL POSITION LEARNT
   - A/C COMPRESSOR STATUS
   - KICKDOWN SWITCH STATUS
   - 4WD STATUS
   - MODE SWITCH
   - THROTTLE POSITION VOLTAGE
   - GEAR SHIFT LEVER POSITION VOLTAGE
   - TRANS. FLUID TEMPERATURE VOLTAGE
   - A/C SWITCH
   - KICKDOWN SWITCH VOLTAGE
   - 4WD LAMP LOW VOLTAGE
   - 4WD LAMP HIGH VOLTAGE
   - MODE SWITCH VOLTAGE
   - BATTERY VOLTAGE
6. Monitor the A/C COMPRESSOR STATUS signal while pushing the A/C switch.
   - The A/C COMPRESSOR STATUS should come ON when the A/C switch is pressed, and turn OFF when the A/C switch is repushed.
7. Monitor the GEAR SHIFT LEVER POSITION signal and move the gear shift control lever through all the ranges.
   - Verify that the GEAR SHIFT LEVER POSITION value matches the gear range indicated on the instrument panel or console.
   - Gear selections should be immediate and not harsh.
8. Move gear shift control lever to neutral and monitor the THROTTLE POSITION signal while increasing and decreasing engine speed with the accelerator pedal.
   - THROTTLE POSITION should increase with engine speed.

ROAD TEST PROCEDURE

- Perform the road test using a scan tool.
- This test should be performed when traffic and road conditions permit.
- Observe all traffic regulations.

ELECTRONIC ADJUSTMENTS

Idle speed adjustments

Carry out the adjustments to the idle speed as detailed in the workshop manual.

Vehicle coding

The vehicle coding is integrated as part of the diagnostic software. A scan tool has the function to code the ve-hicle through the K-line.

Throttle clearing

The leant throttle clearing routine uses the mode switch and gear lever. Carry out the following steps to complete the automated throttle clearing procedure:

1. Switch ignition “ON” with handbrake applied and engine “OFF”.
2. Select the selector lever to 1st gear and “WINTER” mode.
3. Move the selector lever to 2nd gear and “ECONO” or “POWER” mode.
4. Move the selector lever to 3rd gear and “WINTER” mode.

ELECTRICAL / GARAGE SHIFT TEST

This preliminary test should be performed before a hoist or road test to make sure electronic control inputs are connected and operating. If the inputs are not checked before operating the transmission, a simple electrical condition could be misdiagnosed as a major transmission condition.

A scan tool provides valuable information and must be used on the automatic transmission for accurate diagnosis.

1. Move gear shift control lever to P (Park) and set the parking brake.
2. Connect scan tool to Data Link Connector (DLC) terminal.
3. Start engine.
4. Turn the scan tool ON.
5. Verify that the appropriate signals are present. These signals may include:
   - ENGINE SPEED
   - VEHICLE SPEED
   - THROTTLE POSITION
   - ACCEL. PEDAL POSITION
   - TRANSMISSION GEAR STATE
   - GEAR SHIFT LEVER POSITION
   - TRANSMISSION FLUID TEMPERATURE
   - CLOSED THROTTLE POSITION LEARN
   - OPEN THROTTLE POSITION LEARNT
   - CLOSED ACCEL. PEDAL POSITION LEARNT
   - OPEN ACCEL. PEDAL POSITION LEARNT
   - A/C COMPRESSOR STATUS
   - KICKDOWN SWITCH STATUS
   - 4WD STATUS
   - MODE SWITCH
   - THROTTLE POSITION VOLTAGE
   - GEAR SHIFT LEVER POSITION VOLTAGE
   - TRANS. FLUID TEMPERATURE VOLTAGE
   - A/C SWITCH
   - KICKDOWN SWITCH VOLTAGE
   - 4WD LAMP LOW VOLTAGE
   - 4WD LAMP HIGH VOLTAGE
   - MODE SWITCH VOLTAGE
   - BATTERY VOLTAGE
6. Monitor the A/C COMPRESSOR STATUS signal while pushing the A/C switch.
   - The A/C COMPRESSOR STATUS should come ON when the A/C switch is pressed, and turn OFF when the A/C switch is repushed.
7. Monitor the GEAR SHIFT LEVER POSITION signal and move the gear shift control lever through all the ranges.
   - Verify that the GEAR SHIFT LEVER POSITION value matches the gear range indicated on the instrument panel or console.
   - Gear selections should be immediate and not harsh.
8. Move gear shift control lever to neutral and monitor the THROTTLE POSITION signal while increasing and decreasing engine speed with the accelerator pedal.
   - THROTTLE POSITION should increase with engine speed.

ROAD TEST PROCEDURE

- Perform the road test using a scan tool.
- This test should be performed when traffic and road conditions permit.
- Observe all traffic regulations.

ELECTRONIC ADJUSTMENTS

Idle speed adjustments

Carry out the adjustments to the idle speed as detailed in the workshop manual.

Vehicle coding

The vehicle coding is integrated as part of the diagnostic software. A scan tool has the function to code the ve-hicle through the K-line.

Throttle clearing

The leant throttle clearing routine uses the mode switch and gear lever. Carry out the following steps to complete the automated throttle clearing procedure:

1. Switch ignition “ON” with handbrake applied and engine “OFF”.
2. Select the selector lever to 1st gear and “WINTER” mode.
3. Move the selector lever to 2nd gear and “ECONO” or “POWER” mode.
4. Move the selector lever to 3rd gear and “WINTER” mode.

SYMPTOM DIAGNOSIS

DRIVE FAULTS

Condition	Possible Causes	Action
No Drive in D	• Insufficient auto transmission fluid.	• Check the fluid level. Top up as necessary.
	• Blocked feed in C1/C2 cylinder.	• Inspect and clean C1/C2 feed.
	• "Z" link displaced.	• Reinstall/renew the 'z' link.
	• Primary Regulator Valve (PRV) jammed open.	• Remove, clean and re-install the PRV.
	• Overdrive shaft or input shaft seal rings failed.	• Inspect and replace as necessary.
	• 3-4 or 1-2 One Way Clutch (OWC) installed backwards or failed.	• Inspect and replace as necessary.
	• C2 piston broken or cracked.	• Inspect and replace as necessary.
No Drive in Reverse	• Damaged input shaft sealing rings.	• Inspect and replace as necessary.
- No engine braking in Manual 1	- Rear band or servo faulty.	- Check servo adjustment or replace rear band as necessary.
- Engine braking in Manual 1 is OK	- Failure in C3, C3 hub or C1/C2 cylinder.	- Check for failure in C3, C3 hub or C1/C2 cylinder. Repair as necessary.
No drive in Drive and Reverse	• Jammed Primary Regulator Valve (PRV).	• Inspect and clean PRV.
	• Damaged/broken pump gears.	• Inspect and replace pump gears as necessary.
	• Dislodged output shaft snap ring.	• Inspect and repair as necessary.

FAULTY SHIFT PATTERN

Condition	Possible Causes	Action
2-3 shift only (no 4th or 1st)	• S1 always OFF.	• Inspect S1. Repair or replace as necessary. • Check for 12 Volts applied to S1 at all times or for wiring fault.
1-4 shift only1-3-4 (Delayed 1-2 shift)	• S1 always ON.	• Inspect S1. Repair or replace as necessary. • Check for 12 Volts applied to S1 at all times or for wiring fault.
4-3 shift only	• S2 always OFF.	• Inspect S2. Repair or replace as necessary. • Check for open circuit or wiring fault.
1-2-Neutral (1st over run)	• S2 always ON.	• Inspect S2. Repair or replace as necessary. • Check for open circuit or wiring fault.
1-3 shift only	• B1 failed. • Loose band adjustment. • Front servo piston or seal failed. • S1/S2 ball misplaced,	• Inspect and repair as necessary. • Inspect and adjust as necessary. • Inspect and repair as necessary. • Inspect and replace or refit as necessary
1-3-4 only	• Smaller “O” ring on front servo piston failed or missing. • 2-3 shift valve jammed.	• Inspect “O” ring. Refit or replace as necessary. • Inspect the 2-3 shift valve. Repair or replace as necessary.
1-2-1 only	• C1 clutch failed or slipping in 3rd and 4th. (Gives 1st in 3rd and 2nd in 4th.)	• Inspect C1 clutch. Repair or replace as necessary.
No manual 4-3, 3-2 or 2-1	• Over-run Clutch (OC) /low ball misplaced.	• Inspect ball. Refit or replace as necessary.
No manual 1st	• Rear band slipping when hot. • Reverse/Low-1st ball misplaced. • Rear servo inner “O” ring missing.	• Inspect rear band adjustment. Adjust as necessary. • Inspect ball. Refit or replace as necessary. • Inspect “O” ring. Refit or replace as necessary.
1st gear only or 2nd,3rd, and 4th only	• 1-2 shift valve jammed.	• Inspect the 1-2 shift valve. Repair or replace as necessary.
1st and 2nd only or 1st, 3rd and 4th only	• 2-3 shift valve jammed.	• Inspect the 2-3 shift valve. Repair or replace as necessary.
1st, 2nd and 4th only or 1st, 2nd, and 3rd (tied up in 3rd)	• Inhibitor switch fault, 1-2-3 only. • 3-4 shift valve jammed.	• Inspect inhibitor switch. Repair or replace as necessary. • Inspect the 3-4 shift valve. Repair or replace as necessary.

Condition	Possible Causes	Action
Harsh 2-3 shift	• Jammed band 1 release valve.	• Inspect the release valve. Repair or replace as necessary.
	• Faulty S3 or S2 solenoid.	• Inspect S3 or S2. Repair or replace as necessary.
	• Faulty clutch apply regulator valve.	• Inspect the regulator valve. Repair or replace as necessary.
	• Missing or damaged clutch apply feed ball.	• Inspect the ball. Refit or replace as necessary.
	• Damaged input shaft sealing rings.	• Inspect the sealing rings. Refit or replace as necessary.
	• Damaged C1 piston “O” rings.	• Inspect the “O” rings. Refit or replace as necessary.
	• Damaged or dislodged C1 piston bleedball.	• Inspect the bleed ball. Refit or replace as necessary.
	• Faulty S1 or S4 solenoid.	• Inspect S1 or S4. Repair or replace as necessary.
Harsh 3-4 shift	• Jammed band 1 release valve.	• Inspect the release valve. Repair or replace as necessary.
	• Incorrect front band adjustment.	• Inspect the band. Adjust as necessary.
	• Damaged front servo piston “O” rings.	• Inspect the “O” rings. Refit or replace as necessary.
	• Faulty or damaged variable pressure solenoid (S5).	• Inspect S5. Repair or replace as necessary.
	• Faulty band apply regulator valve.	• Inspect the regulator valve. Repair or replace as necessary.

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SHIFT QUALITY FAULTS

Condition	Possible Causes	Action
All Shifts Firm	• Incorrect auto transmission fluid (ATF).	• Drain and fill with specified ATF.
	• S5 faulty won, or incorrectly fitted.	• Check that S5 is fitted correctly, or replace S5.
	• Band apply and clutch apply regulator springs misplaced.	• Inspect band apply and clutch apply regulator springs. Refit or replace as necessary
Manual 4-3-2-1 is soft delayed or missing	• Over-run Clutch (OC) /Low-1st ball misplaced.	• Inspect the ball. Refit or replace as necessary.
	• C4 clutch worn or burnt.	• Inspect C4 clutch. Replace or repair as necessary.
	• C4 wave plate not lined up with the holes in the piston.	• Check the alignment. Realign as necessary.
Firm 1-2 Hot	• S5 worn.	• Inspect S5 and replace as necessary.
4th Tied up	• Incorrect C4 pack clearance.	• Check the clearance and adjust as necessary.
	• Damaged C4 clutch.	• Inspect C4. Repair or replace as necessary.
	• Cracked C2 piston (leaking into C4).	• Inspect piston. Repair or replace as necessary.
Tied up on 2-3	• Incorrect band adjustment	• Inspect and adjust band as necessary.
	• Front servo plastic plug missing	• Replace the plug.
	• B1R spring broken.	• Replace the spring.
Flare on 2-3	• B1R spring/plug left out.	• Replace the spring/plug.
	• C1/B1R ball misplaced.	• Refit the ball.
	• C1 clutch damaged.	• Inspect the clutch. Repair the clutch as necessary.
	• Restriction in C1 feed.	• Inspect and clean C1 feed.
	• C1 piston check ball jammed.	• Replace the piston.
	• Overdrive or input shaft sealing rings damaged.	• Inspect and replace the sealing rings and/or shaft as necessary.
Slips in 4th	• C1/B1R ball misplaced.	• Inspect and replace the ball.
	• Overdrive or input shaft sealing rings damaged.	• Inspect and replace the sealing rings and/or shaft as necessary.
	• C1 clutch damaged.	• Inspect and repair the C1 clutch as necessary.
Slips in reverse, no manual 1st	• Rear band incorrectly adjusted or damage	• Inspect and adjust or replace rear band.
	• Low-1st check ball misplaced.	• Inspect and re-fit the ball.
Flare on 4-3, Flare on 3-2	• 4-3 sequence valve in backwards.	• Refit the valve.
Firm Manual low shift-high line press.	• Low-1st check ball misplaced.	• Replace the ball.

Condition	Possible Causes	Action
Harsh 1-2 shift	• Faulty inhibitor switch.	• Check the resistance. Replace the inhibitor switch as necessary.
	• Faulty throttle position sensor.	• Inspect and replace the sensor as necessary.
	• Incorrect front band adjustment.	• Inspect and adjust the band as necessary.
	• Damaged front servo piston “O” rings.	• Inspect and replace the “O” rings as necessary.
	• Faulty or damaged variable pressure solenoid (S5).	• Inspect, repair or replace S5 as necessary.
	• Faulty S1 or S4 solenoid.	• Inspect, repair or replace S1 or S4 as necessary.
	• Faulty Band Apply Regulator (BAR) valve.	• Inspect, repair or replace the BAR as necessary.
	• Misassembled front servo return spring.	• Inspect and repair as necessary.
Stalls when Drive or Reverse	• Jammed Converter Clutch Control Valve (CCCV).	• Inspect and clean CCCV.
Selected Shudder on Rolldown	• Faulty solenoid 7.	• Inspect, repair or replace as necessary.

AFTER TEARDOWN FAULTS

Condition	Possible Causes	Action
C2 burnt	• Gear shift lever linkage out of adjustment.	• Inspect, repair C2 and adjust the linkage as necessary.
	• S6 foiled - stuck low.	• Repair C2. Inspect, repair or replace S6 as necessary.
	• Overdrive/output shaft sealing rings damaged.	• Repair C2. Inspect, replace the sealing rings and/or shaft as necessary.
	• C2 piston cracked.	• Repair C2. Inspect, repair or replace the C2 piston as necessary.
C4 burnt	• Incorrect C4 pack clearance.	• Inspect C4 and repair as necessary.
		• Inspect and adjust the C4 pack clearance as necessary.
	• C4 wave plate not lined up properly.	• Repair C4. Inspect and realign the wave plate as necessary.
	• Overdrive or output shaft sealing rings damaged.	• Repair C4. Inspect and realign the sealing rings and/or shaft as necessary.
	• C2 piston cracked.	• Repair C4. Inspect and replace the C2 piston as necessary.
	• Over-run Clutch (OC) /low-1st ball misplaced.	• Repair C4. Inspect and refit the ball as necessary.
B1 burnt	• B1R spring broken.	• Inspect and repair B1 and replace the spring as necessary.
	• Input shaft sealing ring cut.	• Replace sealing ring.
	• C1/B1R ball misplaced.	• Repair B1. Refit the ball as necessary.
C1 burnt	• B1R spring left out.	• Inspect and repair C1 and replace the spring.
	• Overdrive or input shaft sealing rings damaged.	• Repair C1. Inspect and replace the sealing tongs and/or shaft as necessary.
	• C1 piston cracked.	• Repair C1. Inspect and replace the C1 piston as necessary.
	• Ball capsule jammed.	• Repair C1. Inspect and refit the capsule as necessary.
	• 4-3 sequence valve in backwards.	• Repair C1. Inspect and refit the valve as necessary.
	• Clutch Apply Feed (CAF) /B1R ball left out.	• Repair C1. Inspect and replace the ball as necessary.
B2 burnt (Slips in reverse - no manual 1st)	• Rear band incorrectly adjusted or damaged.	• Inspect and adjust the band as necessary.
	• Reverse-low/first ball misplaced.	• Inspect and refit the ball as necessary.

Condition	Possible Causes	Action
Firm converter lock or unlock	• Input shaft “O” ring missing or damaged. • Converter clutch regulator valve in backwards.	• Inspect and replace the “O” ring as necessary. • Inspect and refit the valve as necessary.
No lock up at light throttle	• Input shaft “O” ring missing or damaged. • C1 bias valve in backwards.	• Inspect and replace the “O” ring as necessary. • Inspect and refit the valve as necessary.

TROUBLE CODE DIAGNOSIS - GASOLINE VEHICLE

TCU DIAGNOSTIC SYSTEM OVERVIEW

Notice

To prevent Transmission Control Module (TCM) damage. The ignition key must be OFF when disconnection or reconnection the power to the TCM (for example bttery cable, TCM pigtail connector, TCM fuse, jumper cables, etc.).

When the TCM detects a system fault, a Diagnostic Trouble Code (DTC) is set in the TCM. This code is present while the fault conditions are met and is stored as a 'History DTC' until cleared. Condition for setting and clearing each TCM DTC are provided in the relevant sections.

In the case where the vehicle type is certified for Eure On-Board Diagnostic (EOBD) compliance, the Engine Control Module (ECM) provides the communication link to the EOBD scan tool to pass on any EOBD relevant codes from the TCM. The table below contains a list of all supported DTCs and the classification of each for EOBD purposes. Where a type B DTC has been set in an EOBD vehicle, the response to the fault may include action by the ECM, including the illumination of the Malfunction Indicator Lamp (MIL). Refer to Engine Control, for details on EOBD system function, checks and fault clearing.

CLEARING TROUBLE CODES

TCM DTCs should be cleared after repairs have been completed. Some diagnostic tables will tell you to clear the codes before using the chart, which will help to find the cause of the problem more quickly. Always note the DTCs present before clearing - this information may be helpful in the diagnostic process.

DIAGNOSTIC TROUBLE CODES

DTC	Description	Type
P0706	Transmission Range Sensor Circuit Range/Performance	B
P0707	Transmission Range Sensor Circuit Low input	B
P0708	Transmission Range Sensor Circuit High input	B
P0710	Transmission Fluid Temperature Sensor Circuit Malfunction	D
P0790	Normal/Performance Switch Circuit Malfunction	D
P1703	Engine Speed Signal Error	D
P1704	Shaft Speed Signal Error	D
P1708	TCM Supply Voltage Low	D
P1709	TCM Supply Voltage High	D
P1712	Kickdown Switch Circuit Malfunction	D
P1713	Pedal Signal Error	D
P1714	EEPROM Vehicle Code Error	D
P1715	VPS Offset Error	D
P1717	RAM Error	D
P1718	ROM Error	D
P1719	CAN Bus Error	D
P1720	EEPROM Error	D
P1721	Throttle Signal Error	D
P1722	Vehicle Type Determination Error	D
P1733	Solenoid 1 Circuit Open	D

TROUBLE CODE DIAGNOSIS - DIESEL VEHICLE

TCM DIAGNOSTIC SYSTEM OVERVIEW

Notice

To prevent Transmission Control Module (TCM) damage. The ignition key must be OFF when disconnection or reconnection the power to the TCM (for example bttery cable, TCM pigtail connector, TCM fuse, jumper cables, etc.).

When the TCM detects a system fault, a Diagnostic Trouble Code (DTC) is set in the TCM. This code is present while the fault conditions are met and is stored as a 'History DTC' until cleared. Condition for setting and clearing each TCM DTC are provided in the relevant sections.

CLEARING TROUBLE CODES

TCM DTCs should be cleared after repairs have been completed. Some diagnostic tables will tell you to clear the codes before using the chart, which will help to find the cause of the problem more quickly. Always note the DTCs present before clearing - this information may be helpful in the diagnostic process.

DIAGNOSTIC TROUBLE CODES

DTC	Description
P0707	Transmission Range Sensor Circuit Low Input
P0708	Transmission Range Sensor Circuit High Input
P0710	Transmission Fluid Temperature Sensor Circuit Malfunction
P0790	Normal/Performance Switch Circuit Malfunction
P1703	Engine Speed Signal Error
P1704	Shaft Speed Signal Error
P1708	TCM Supply Voltage Low
P1709	TCM Supply Voltage High
P1710	Air Conditioning Switch Circuit Malfunction
P1712	Kickdown Switch Circuit Malfunction
P1714	EEPROM Vehicle Code Error
P1715	VPS Offset Error
P1716	Throttle Not Learnt Error
P1717	RAM Error
P1718	ROM Error
P1720	EEPROM Error
P1721	Throttle Signal Error
P1722	Vehicle Type Determination Error
P1733	Solenoid 1 Circuit Open
P1734	Solenoid 2 Circuit Open
P1735	Solenoid 3 Circuit Open
P1736	Solenoid 4 Circuit Open

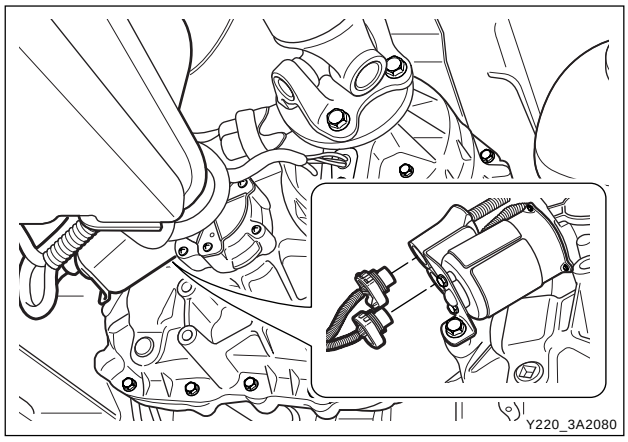
REPAIR INSTRUCTIONS

ON-VEHICLE SERVICE

TRANSMISSION

Removal and Installation Procedure

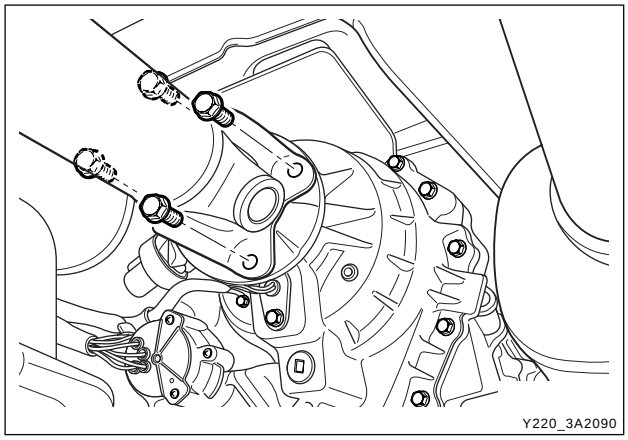
1. Disconnect the negative battery cable.
2. Disconnect the connectors from transfer case.
3. Disconnect the speedometer connector from transfer case.
4. Disconnect the inhibitor connector, gear position sensor connector and transmission case connector.



5. Remove the rear propeller shaft bolts.

Installation Notice

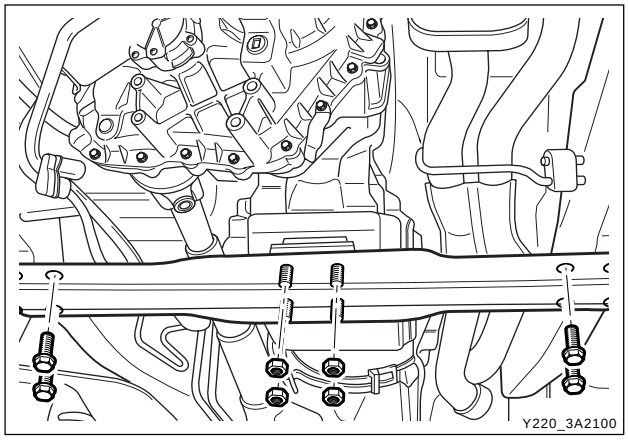
Tightening torque	70 ~ 80 Nm (52 ~ 59 lb-ft)



6. Remove the cross member bolts and nuts.

Installation Notice

Tightening torque	70 ~ 80 Nm (52 ~ 59 lb-ft)



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DISASSEMBLY PROCEDURE

Transmission

Tools Required

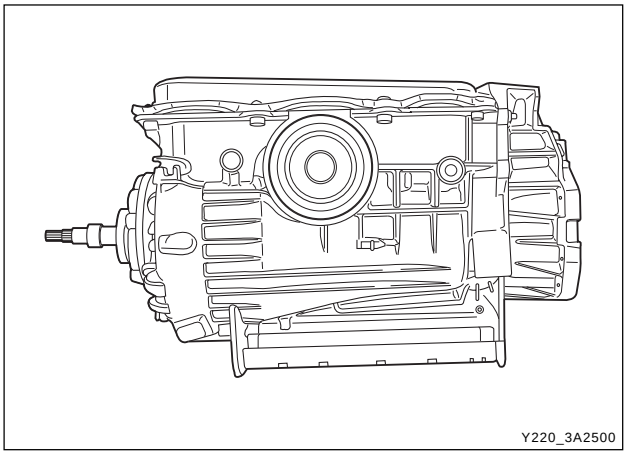
0555-336256 Transmission Bench Cradle

0555-336257 Pump Puller

Notice

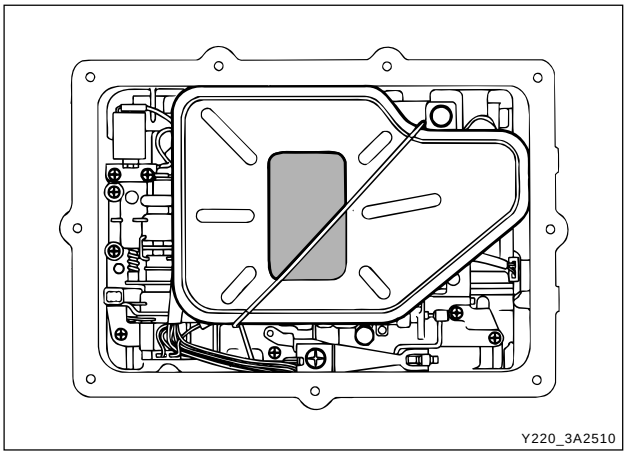
- ***Remove the inhibitor switch before washing the transmission in solvent or hot wash.***
- ***It is assumed that the transmission fluid has been drained when the transmission was removed from the vehicle and that the "special tools" quoted are available.***
- ***The transmission is dismantled in a modular fashion, and the details of disassembly for each module are given under the appropriate subject. Refer to Special Tools Table in this chapter for details of all special tools required when performing disassembly procedures.***
- ***Technicians overhauling these transmissions will also require a selection of good quality Torx bit sockets, in particular numbers 30, 40 and 50, and an 8mm, 10mm and 12 mm double hex socket.***

1. Remove the converter and the converter housing.
2. Mount the transmission on the transmission bench cradle 0555-336256.
3. Remove the oil pan and the oil pan seal.



Y220_3A2500

4. Remove each end of the filter retaining clip from the valve body and remove the filter.
5. Disconnect the wires from each solenoid and ground and lay the wiring to one side.
6. Remove the valve body securing screws and remove the valve body from the case.



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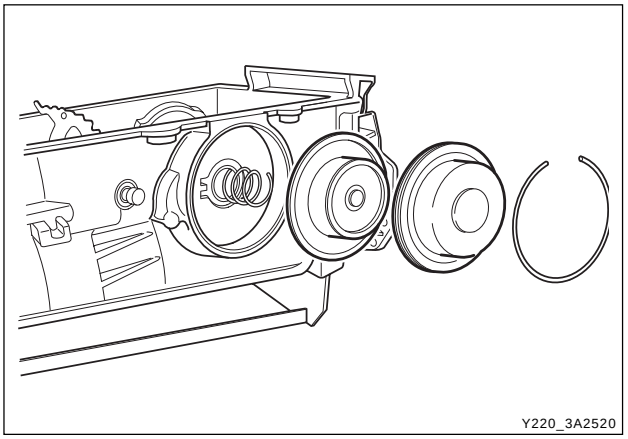
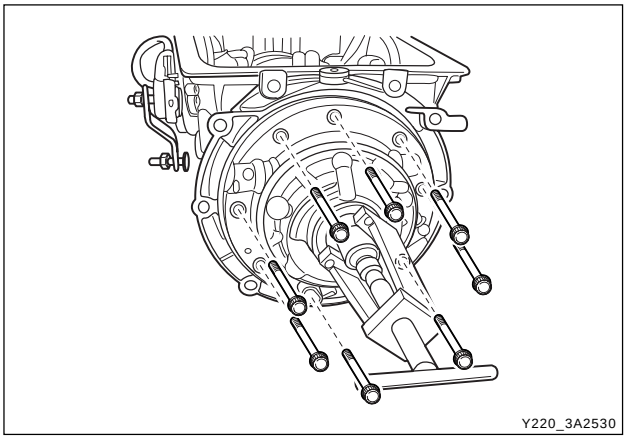


7. Remove the front servo cover circlip.
8. Remove the front servo cover, piston and spring.

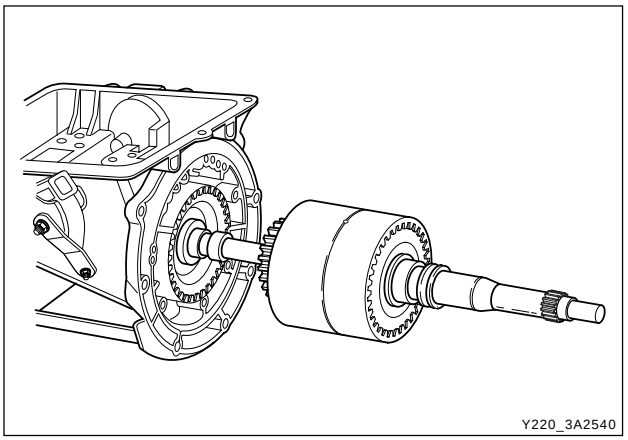
Notice

The plastic servo block is retained by the piston return spring only.

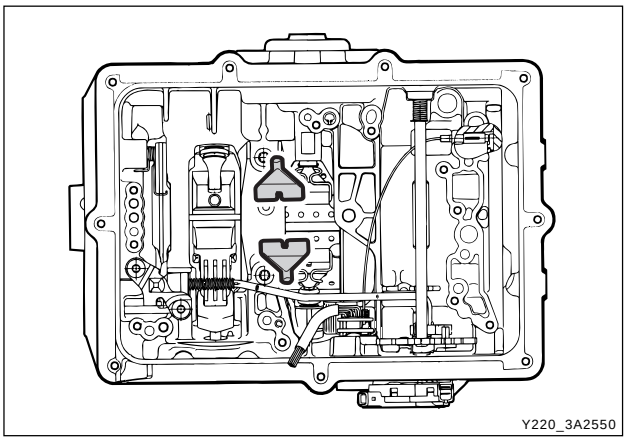
9. Remove the adaptor housing bolts and adaptor housing.



10. Remove the pump to case bolts using a multi-hex 8 mm spanner.
11. Using the pump puller 0555-336257, remove the pump and pump cover.



12. Remove the input shaft, forward clutch cylinder, and the overdrive shaft as an assembly, withdrawing them through the front of the case.
13. Remove the C3 clutch cylinder and sun gears.



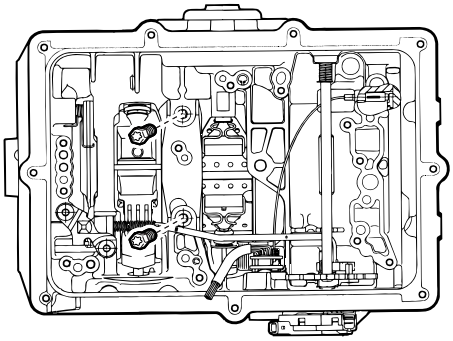
14. Remove the front band struts. Remove the front band.

15. Remove the two centre support retaining bolts using a T50 Torx bit.
16. Remove the centre support retaining circlip.

Notice

Do not hammer the output shaft to remove the centre support as this will cause permanent damage to the thrust bearing surfaces.

17. Remove the centre support, 1-2 one way clutch, and planetary gear set as an assembly.
18. Remove the parking rod cam plate using a T40 Torx bit.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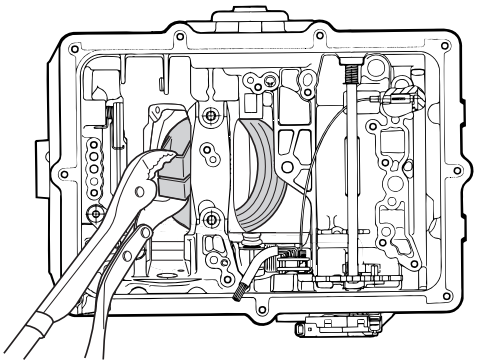
19. Remove the rear band struts and remove the band.

Notice

Vise the both end of rear band using the plier and lean forward about 15 degrees

20. Remove the output shaft assembly.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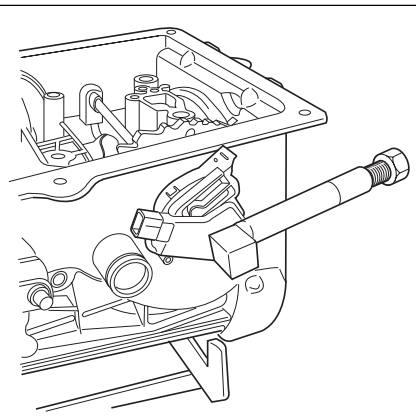
Transmission Case

Tools Required

0555-336258 Cross Shaft Pin Remover/Installer (Detent Lever)
0555-336261 Cross Shaft Seal Remover
0555-336265 Cross Shaft Pin Remover/Installer (Inhibitor Switch)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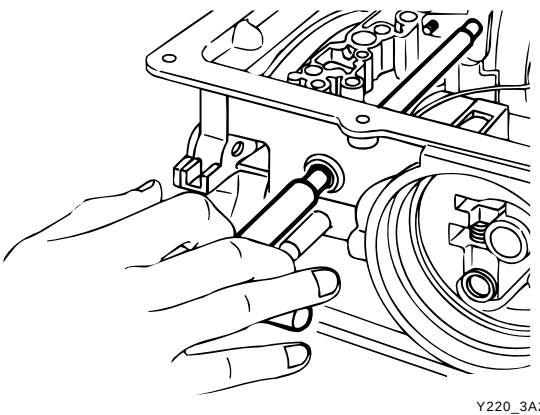
1. Remove the pin from the side of cross shaft inhibitor switch using cross shaft pin remover/installer (inhibitor switch) 0555-336265.
2. Remove the inhibitor switch bolts and inhibitor switch from the case.
3. Remove the cross shaft seals with cross shaft seal remover 0555-336261.
4. Remove the circlip from the cross shaft. Pull the shaft to release the drive pin from the selector quadrant.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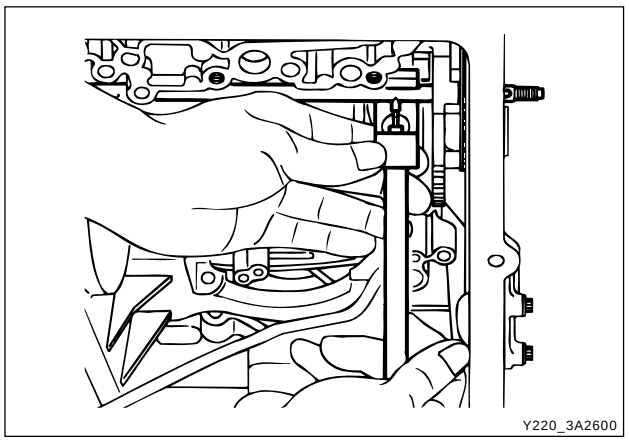
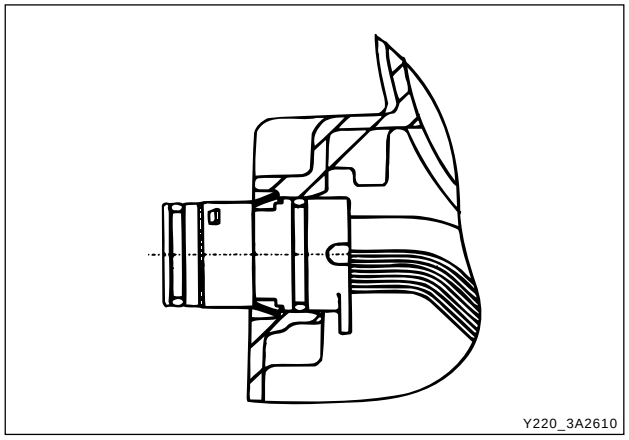
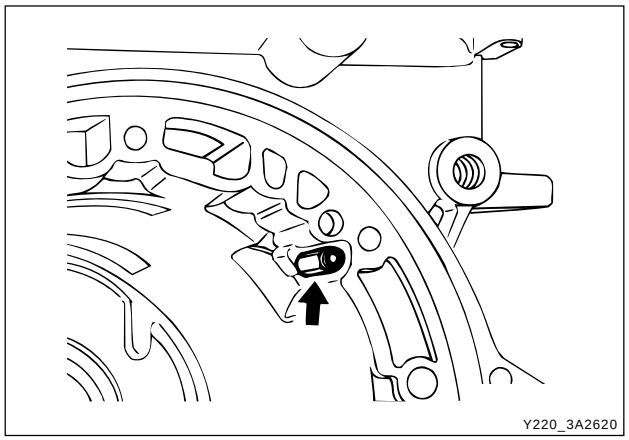


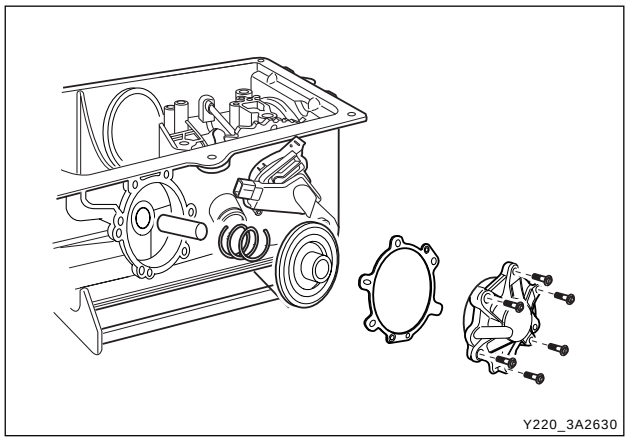
5. Using cross shaft pin remover/installer (detent le-ver) 0555-336258, press the pin from the cross shaft and withdraw the shaft from the case.
6. Remove the cross shaft pin and spring.
7. Remove the manual valve lever and the park rod.



8. Depress the tangs and withdraw the 10 pin connector into the case. Remove the wiring loom assembly.



9. Detach the No.7 solenoid wire from the front of the case.
10. Remove the parking pawl pivot pin and the pawl and spring from the case.
11. Remove the shaft and the rear servo lever.

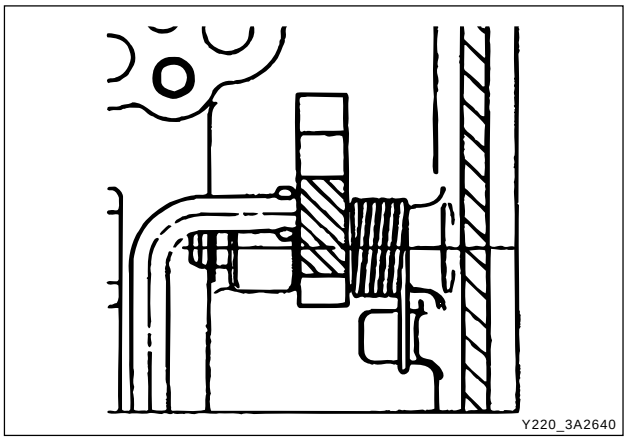


12. Remove the rear servo cover and piston assembly.
13. Remove the B1R circlip, valve and spring.
14. Remove both band adjustment shims.
15. Inspect the output shaft bushing in the case and replace if necessary.
16. Inspect cooler line fittings and replace as necessary.
17. Inspect the case for damage.

18. To remove the park rod lever: Remove the circlip from the inner end of the pivot shaft and tap the outer end of the shaft until it moves free from the case, then using a wide shallow tapered drift as a wedge, drive the pin out from the inside of the case and remove the lever and spring.

Notice

Do not remove the park rod lever unless absolutely necessary.

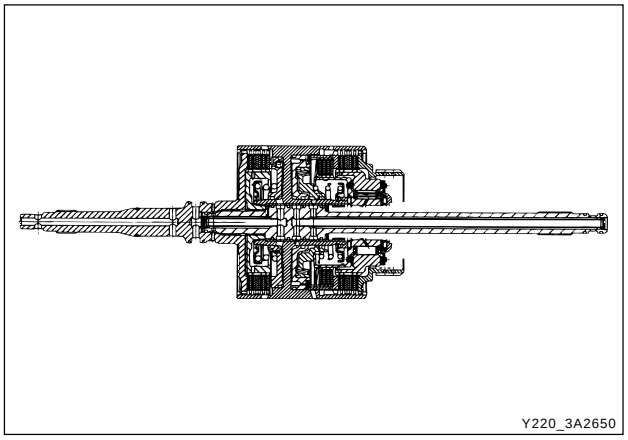


Forward Clutch Cylinder

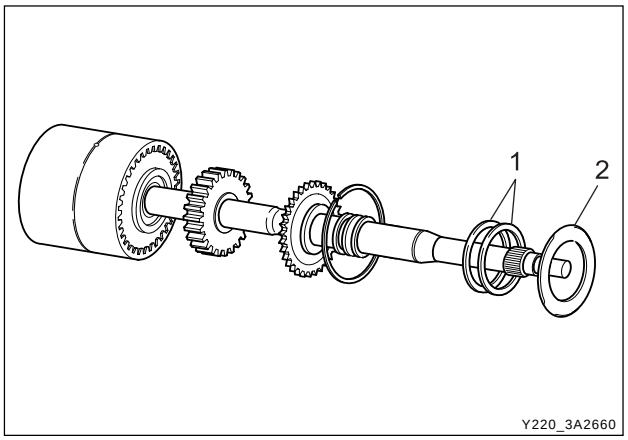
Tools Required

0555-336259 Clutch Spring Compressor

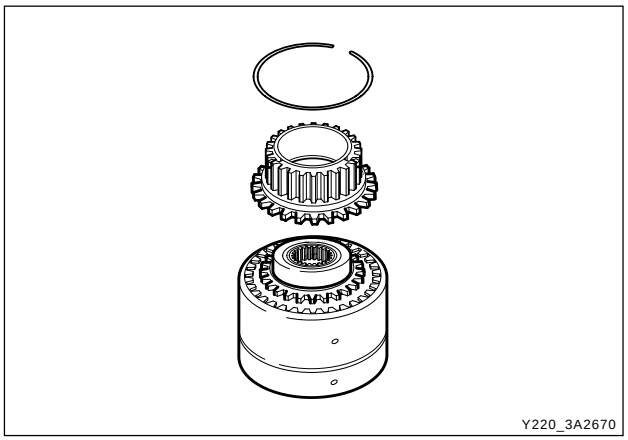
1. Place the assembly in a horizontal position.



2. Remove the No. 4 needle bearing (2) and adjust-ment shims (1) from the input shaft.
3. Remove the circlip from the front of the clutch cylinder and remove the input shaft.
4. Remove the overdrive shaft and the C1 clutch hub assembly from the clutch cylinder.
5. Remove the C1 clutch plates from the cylinder.



6. Remove the circlip retaining the C3 clutch hub in the rear of the clutch cylinder and remove the hub.
7. Remove the C2/C4 clutch hub assembly and remove the No. 5 needle bearing from the C4 hub.
8. Removethe C2 clutch plates.



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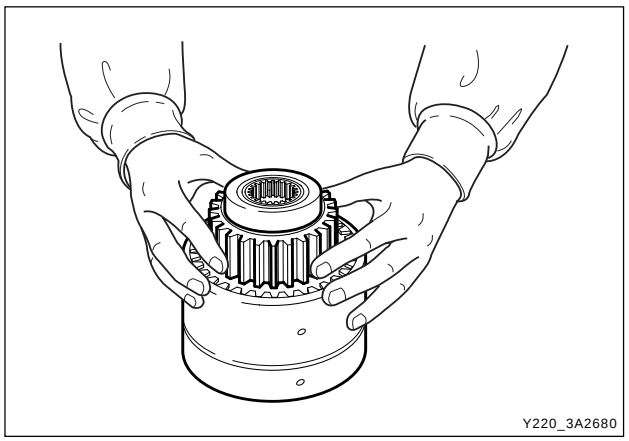
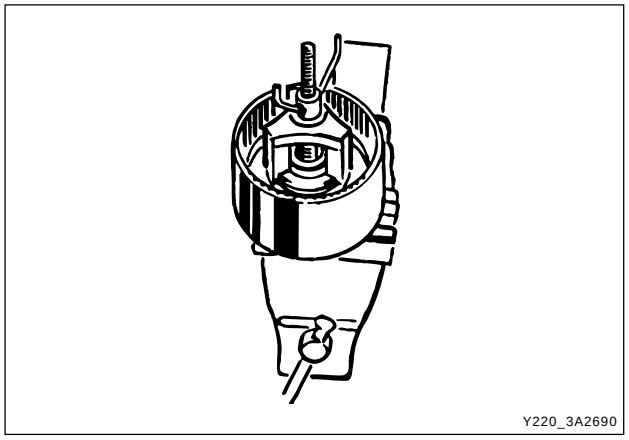

Y220_3A2680

9. Invert the clutch cylinder and remove the C4 clutch sleeve, clutch plates and the two wave washers. The 3-4 one way clutch is located between the C2 and C4 clutch hubs, and the hubs may be separated by rotating one hub clockwise and withdrawing it from the other.
10. Remove the thrust block from the C4 clutch cylinder hub.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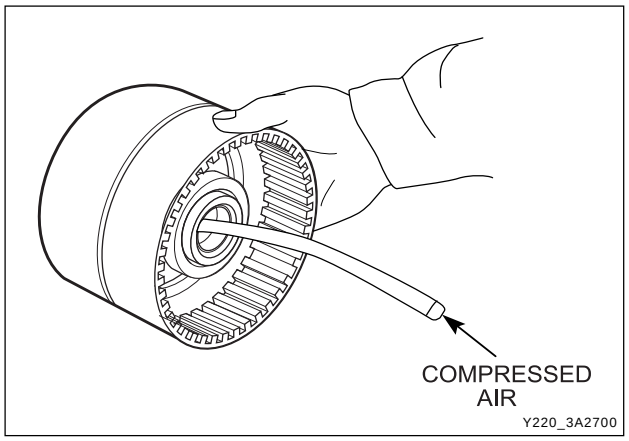
11. Mount the clutch cylinder on clutch spring compressor 0555-336259 with the C2/C4 end uppermost and compress the piston return spring. Remove the spring retaining circlip. Release the tool and remove the circlip, keeper and spring.

Notice

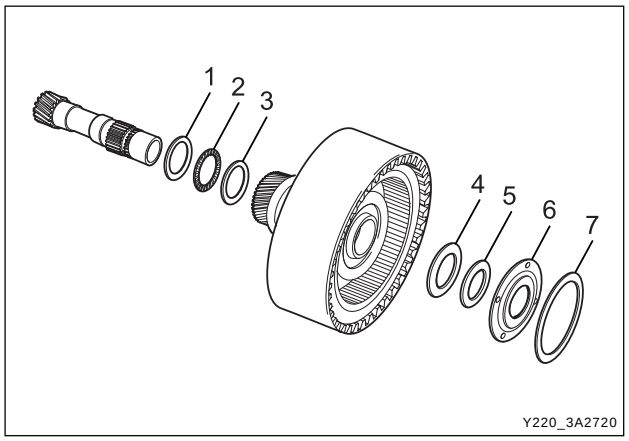
Make sure that the spring keeper is not caught in the circlip groove, and that all the spring pressure is released, before removing the tool.

12. Invert the clutch cylinder on the compressor tool and removethe C1 clutch piston return spring in asimilar manner.



Y220_3A2700

13. To remove the clutch pistons from the clutch cylinder, apply air pressure to the apply ports in the bore of the cylinder.



Y220_3A2720

C3 Clutch Cylinder

Tools Required

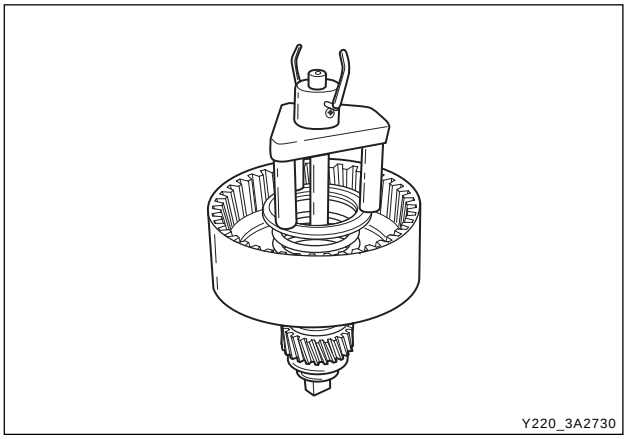
0555-336259 Clutch Spring Compressor

1. Remove the forward sun gear, No.7 needle bearing (2) thrust washer (1) and lipped thrust washer (3) from the C3 clutch cylinder.
2. Remove the thrust plate (4), No.6 needle bearing (5), thrust plate (6) and nylon thrust plate (7) from the clutch cylinder hub.
3. Remove the clutch plate retaining circlip and re-move the clutch plates.

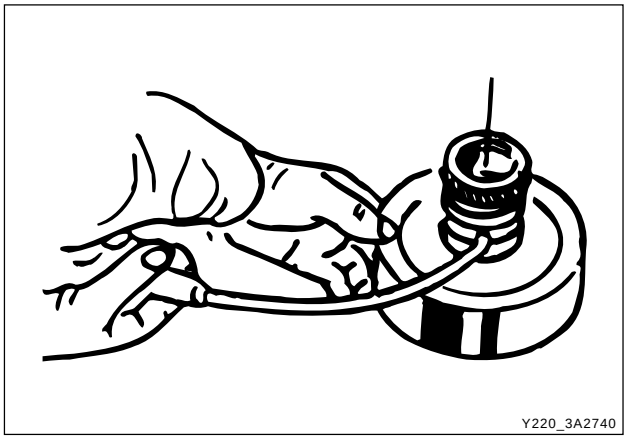
4. Mount the clutch assembly on clutch spring compressor 0555-336259 and compress the piston return spring.
5. Remove the circlip and release the spring.
6. Remove the tool, circlip, keeper and spring.

Notice

Make sure that the spring keeper has not been caught in the circlip groove, and that all spring pressure has been released, before removing the tool.

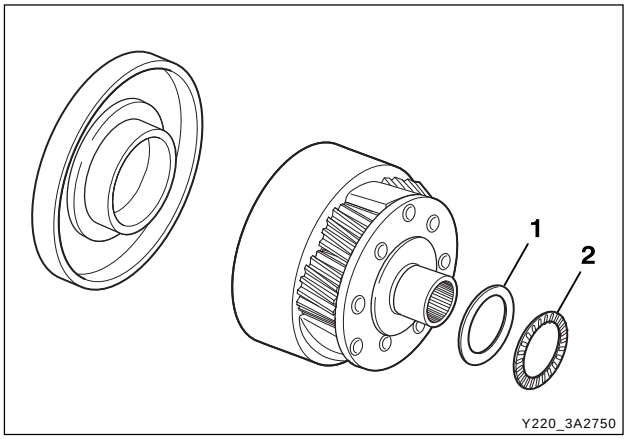

Y220_3A2730

7. Remove the sealing rings from the C3 clutch cylinder.
8. To remove the clutch piston from the clutch cylinder, apply air pressure to the port between the iron sealing rings on the bearing journals of the cylinder.
9. Remove the reverse sun gear and C3 washer from the cylinder.


Y220_3A2740

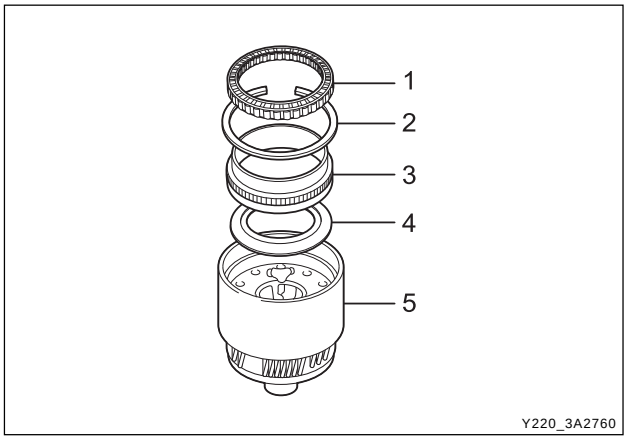
Planet Carrier Assembly and Centre Support

1. Remove the No. 9 (2) needle bearing and washer (1) from the output shaft and the planet carrier.
2. Separate the centre support from the planet carrier by rotating it anti-clockwise.



Y220_3A2750

3. Lift the one way clutch (1) from the planet carrier (5).
4. Remove the circlip (2) retaining the one way clutch outer race (3) in the planet carrier and remove the race.
5. Remove the one way clutch retainer (4) from the planet carrier.



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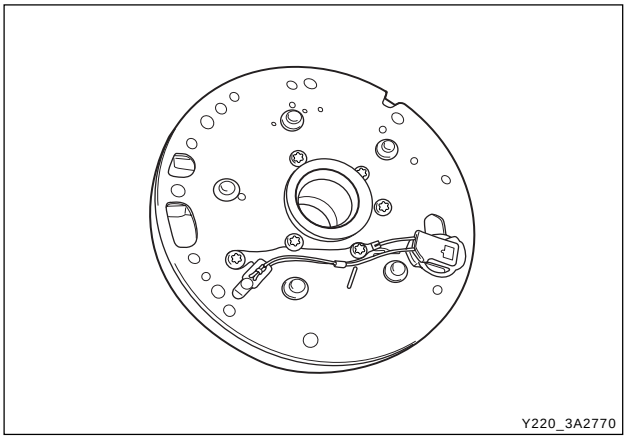
Pump

Notice

The following valves are housed in the pump cover:

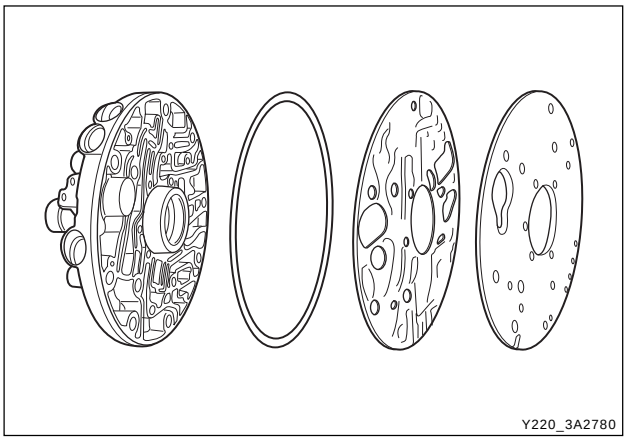
- ***Solenoid 7***
- ***Converter clutch control valve***
- ***Converter clutch regulator valve***
- ***Primary regulator valve***



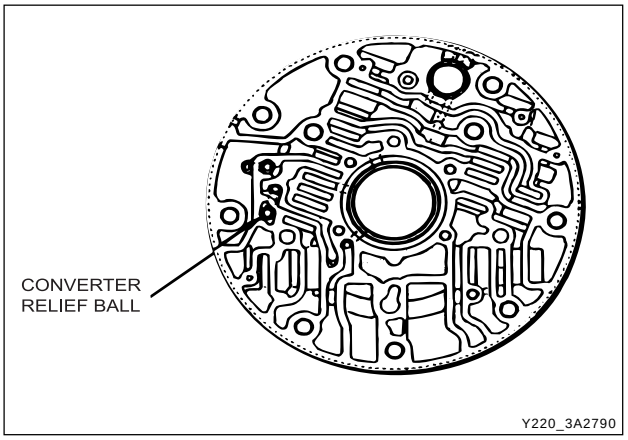
1. Remove the wiring loom retainer plate and remove solenoid 7 with a T30 Torx bit.
2. Remove the five washer head bolts from the cover plate using a multi-point 8 mm socket.
3. Remove the five Torx head screws from the cover plate with T30 Torx bit. Note that the long screw holds the pump body to the pump body cover.

Notice

Do not strike the converter support tube to loosen the pump body.



4. Separate the pump body from the pump cover.
5. Remove the cover plate, gasket and seal from the cover.



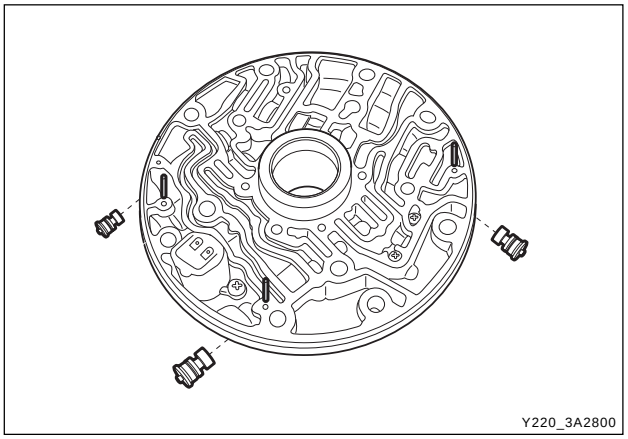
6. Remove the ball check valve and one spring from the pump cover.

7. Depress the plug inward and remove the retaining pin for each of the three valves.

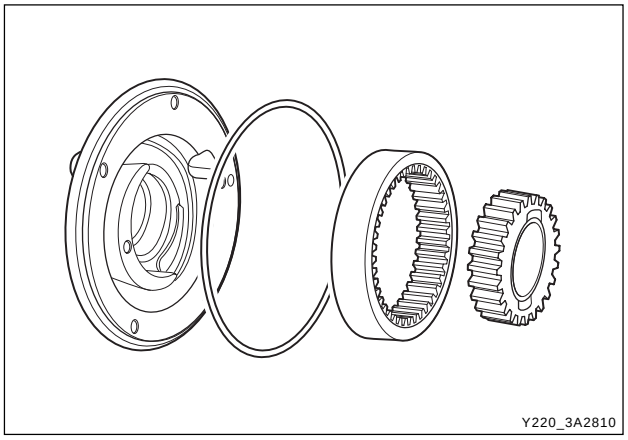
Notice

Some of the valves and plugs are preloaded by springs and may unexpectedly fall out of the cover when the pins are removed.

8. Remove the four valves, plugs and springs.


Y220_3A2800

9. Remove the pump gears from the pump body.
10. Remove the lip seal from the front of the pump body.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Valve Body

1. Remove the manual valve detent spring and retainer plate using a T40 Torx bit.
2. Slide the manual valve out of the lower valve body.

Notice

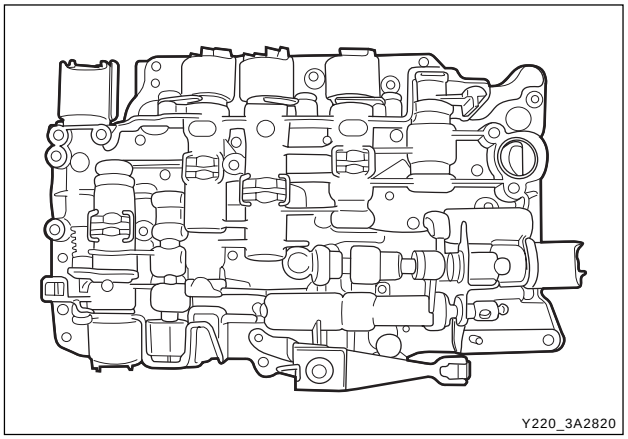
Be aware that the manual valve will fall out of the valve body.

3. Take note of the angular relationship of the solenoid terminals to the valve body and remove the solenoids 1, 2, 3, 4, 5, 6 and valve assemblies.

Notice

Take care that the bracket is not separated from the solenoid.

4. Place the valve body assembly on the bench with the upper body uppermost.
5. Remove the 24 clamping screws with a No. 30 Torx bit. Separate the upper and lower valve bodies by lifting the upper body and the separator plate together.
6. Turn the upper body over and place it on the bench with the separator plate uppermost.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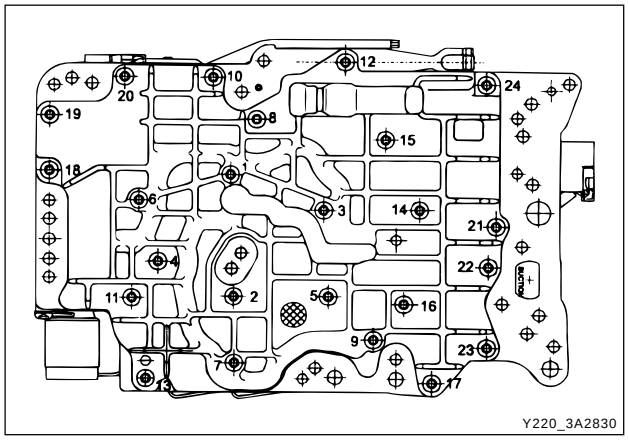

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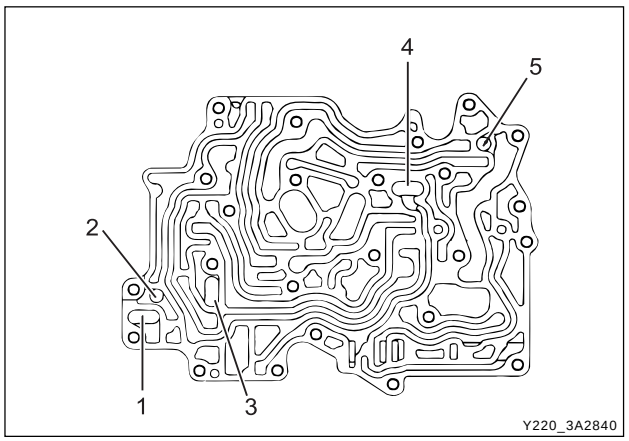
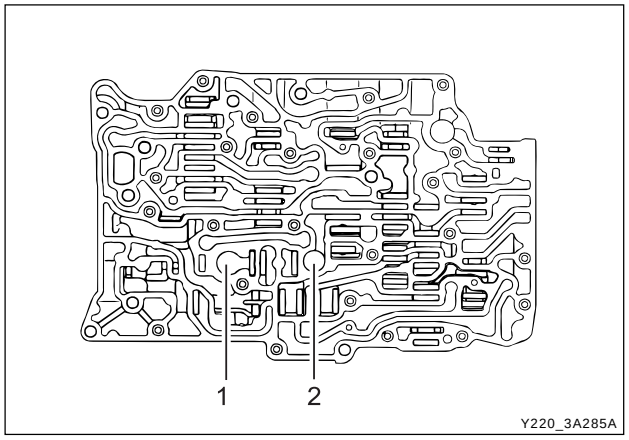


7. Lift the separator plate and gaskets from the upper valve body.
8. Remove the five nylon check balls exposed in the valve body.
9. Remove the retaining plate, plug, spring and re-verse lockout valve.

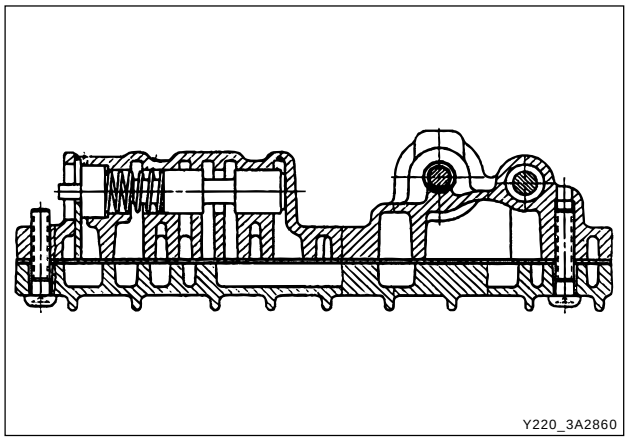


10. Remove the filter (1) and the large nylon check ball (2) from the lower valve body.
11. Remove the retaining plates and pins from the 1-2, 2-3, 3-4, BAR and CAR valves. The pins can be removed with a magnet.

Notice

Once the pins are removed, the plates are loose in the valve body and will drop out when the valve body is turned over.

12. Remove the 1-2, 2-3 and 3-4 shift valves.

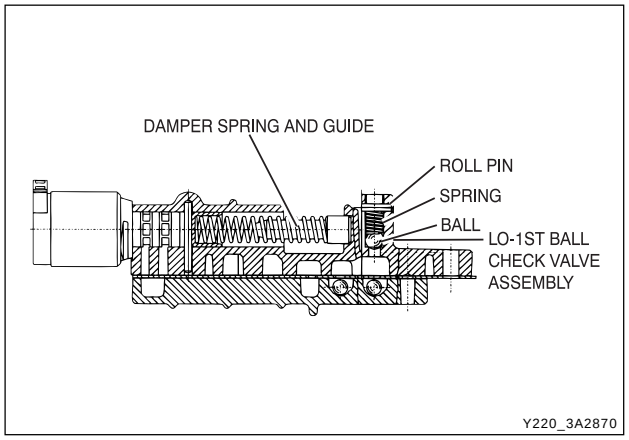


13. Depress the 4-3 sequence valve plug and remove the retaining plate.

Notice

The plug is preloaded by the spring and may unexpectedly fall out of the valve body.

14. Remove the plug, spring and valve



15. Depress the solenoid 5 valve. Remove the retaining in and remove the valve, damper guide and spring.

Notice

The valve is preloaded by the spring and may unexpectedly fall out of the valve body.

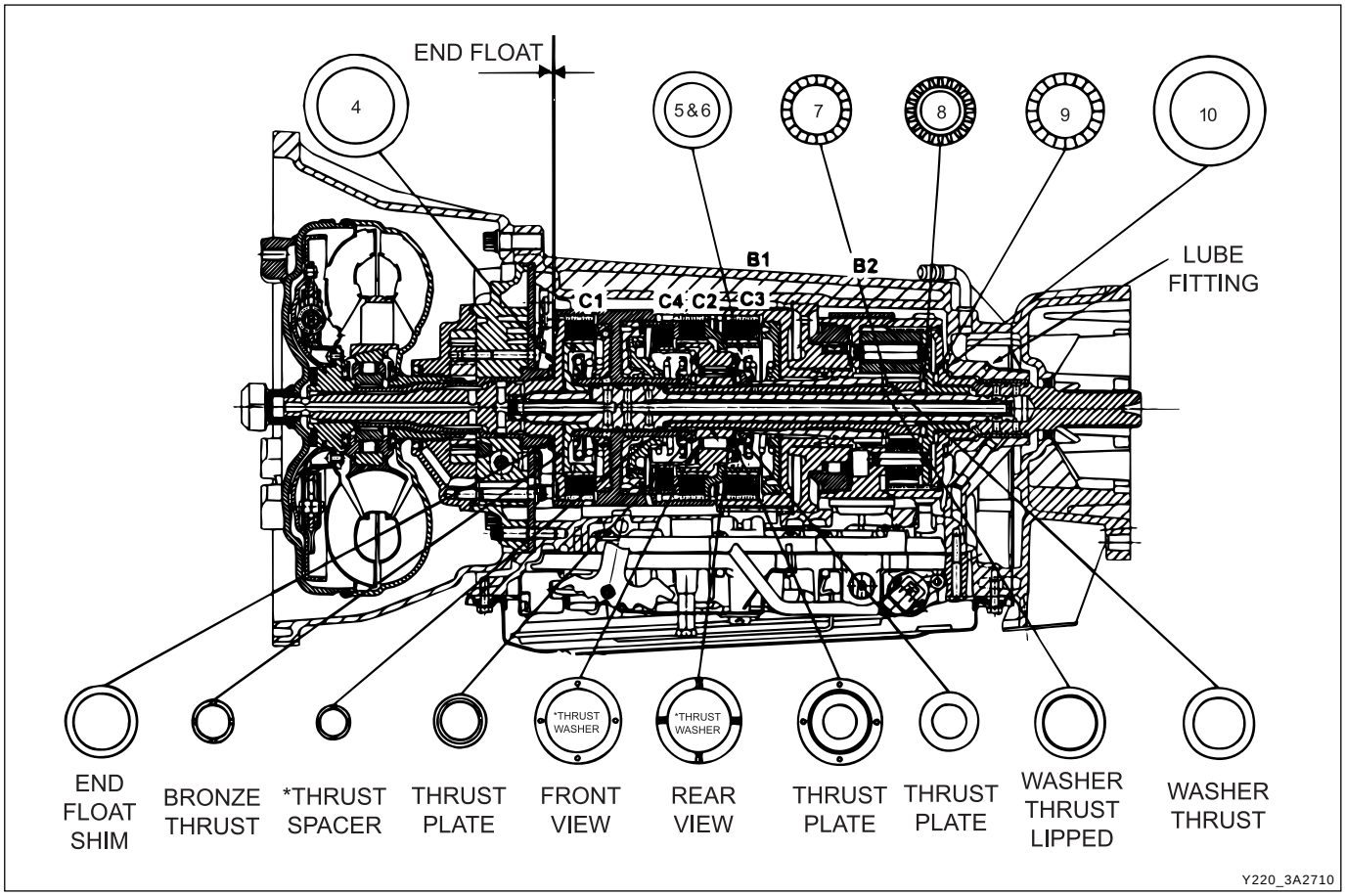
16. Depress the line pressure release valve, remove the retaining pin, disc (if fitted), spring and valve.
17. Drive out the retaining pin and remove the spring and ball check valve adjacent to the BAR valve.

UNIT REPAIR

REBUILD WARNINGS

Prior to rebuilding a transmission system, the following warnings are to be noted.

- Ensure that, before replacing a transmission the cooler lines are flushed out to remove any debris. This can be done by applying compressed air to the rear cooler line forcing oil and any contaminants out of the front cooler line.
- The cooler flow should be checked after the transmission has been fitted. With the front cooler line connected and the rear line run into a suitable container, measure the flow over 15 seconds with the vehicle idling in park.
- The flow rate should exceed 1 liter in 15 seconds.
- Be wary of any situation where water enters the transmission. This may result in fluid foaming and leaking through the breather.
- Ensure that both earth straps (one at the battery terminal and one on the vehicle body) are connected in the vehicle before connecting the positive side of the battery.
- Follow the throttle position calibration procedure in this manual if the engine control module/ transmission control module (ECM/TCM) is swapped.



ASSEMBLY PROCEDURE

Transmission

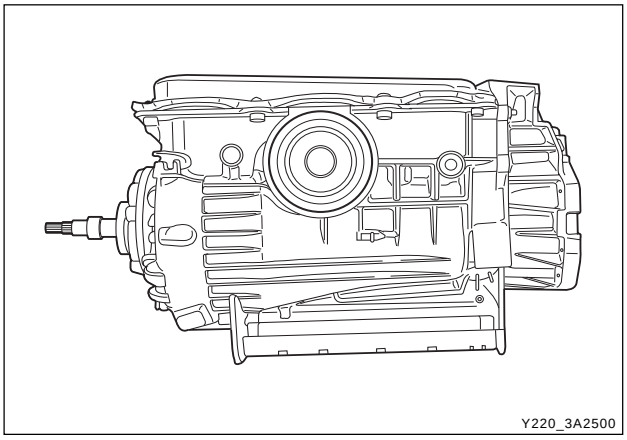
Tools Required

0555-336256 Transmission Bench Cradle
0555-336258 Cross Shaft Pin Remover/Installer (Detent Lever)
0555-336262 Cross Shaft Seal Installer
0555-336263 Cross Shaft bullet
0555-336265 Cross Shaft Pin Remover/Installer (Inhibitor Switch)

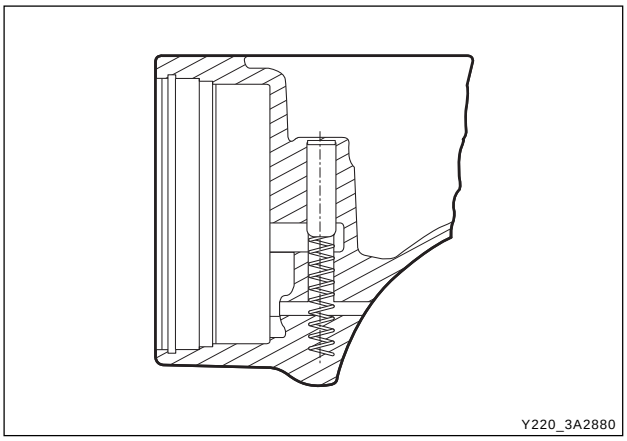
Notice

- ***The transmission is assembled in modular fashion and details of assembly for each module are given under the appropriate subject.***
- ***Technicians overhauling these transmissions will also require a selection of good quality Torx bit sockets, in particular numbers 30, 40 and 50, and an 8 mm, 10 mm and 12 mm double hex socket.***
- ***Ensure that the B1R circlip is fitted to the case. (If this is not fitted, the valve will peen its way into and through the separator plate)***
- ***Ensure that the 'E'clip is fitted to the cross shaft.***
- ***Ensure that all aspects of the parking mechanism are working.***

1. Turn the transmission case upside down on the bench and mount it to the transmission bench cradle 0555-336256.
2. Install all fittings, plugs and the breather, applying a sealant where applicable, Tighten the fittings to specifications. Ensurethatthebreatheris clear, andcheckthat the lube fitting in the rear of the case is fittedand clear of obstruction.


Y220_3A2500

3. Assemble the B1R valve and spring, and secure with the circlip. Ensure that the circlip is completely seated in its groove.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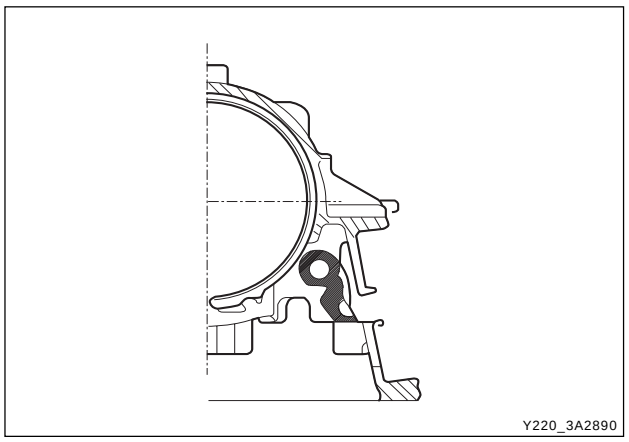
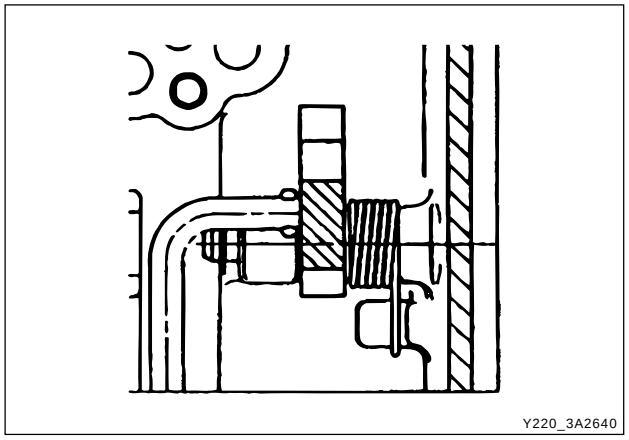


4. Install the rear servo lever and pivot pin.

Notice

The lever must pivot freely on its pin.



5. Assemble the park rod lever, complete with the return spring and pivot pin, applying a small amount of sealant to the outer end of the pivot pin.

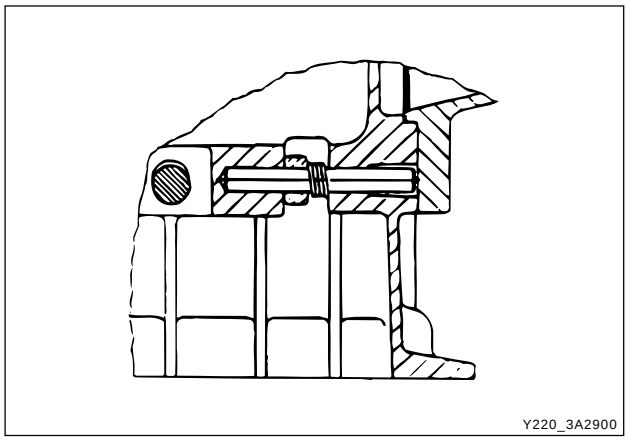
Notice

Care must be taken when applying sealant to ensure that it is not applied between the pin and the lever.

6. Secure the pivot pin with the circlip.

Notice

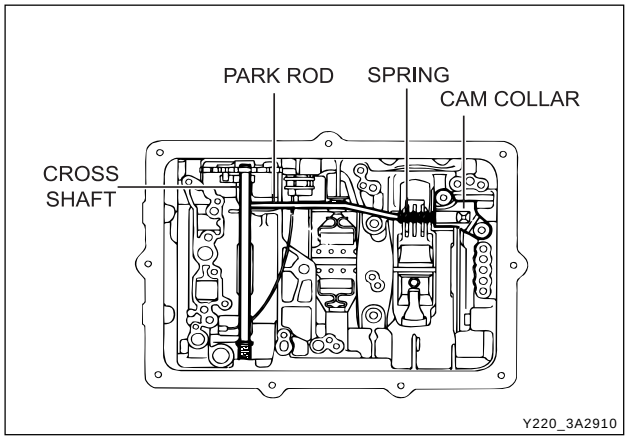
The lever must pivot freely on its pin and the spring must return the park rod lever to its correct location.



7. Install the parking pawl pivot pin and spring.

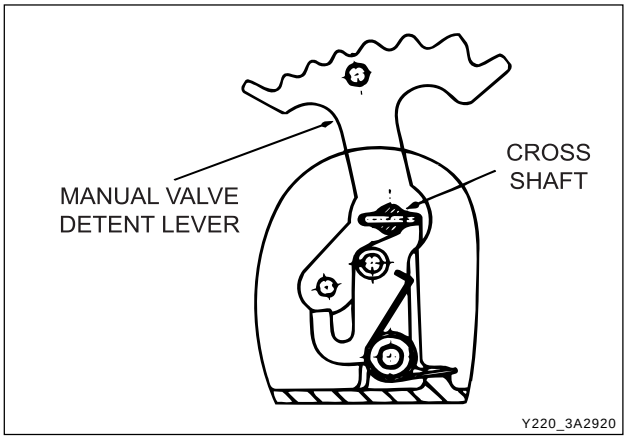
Notice

The pawl must pivot freely on its pin.

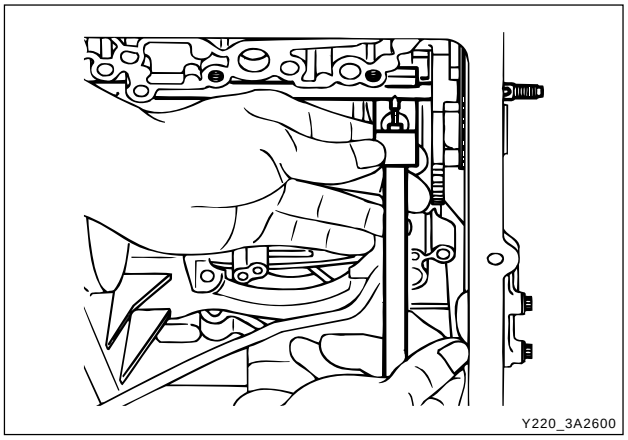


8. Connect the park rod to the manual valve detent lever. Ensure the spring and cam collar is firmly installed on the rod.
9. Check that the cam collar slides freely on the rod.
10. Insert the cross shaft into the case, from the side opposite to the inhibitor switch, then install the antirattle spring on the shaft.

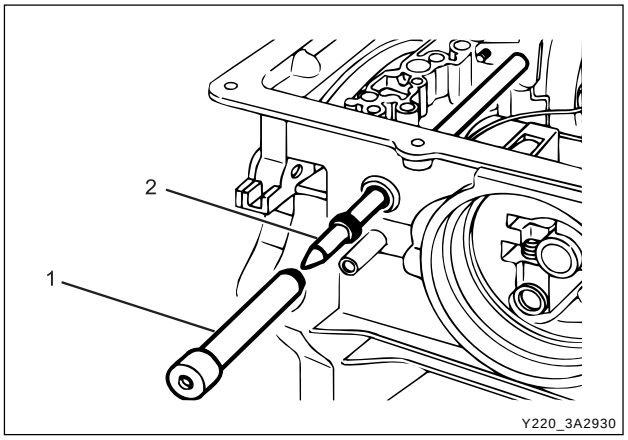
11. Poition the manual valve detent lever, aligning it with the cross-shaft bore in the case.
12. Push the shaft through the detent lever until it starts in the detent lever side of the case.



13. Install the detent lever drive pin in the shaft using cross shaft pin remover/installer (detent lever) 0555-336258 with the adaptor over the pin.
14. Press the pin into the shaft until the tool bottoms.
15. Remove the tool and fit the spring retaining circlip to the shaft.



16. Install the new cross shaft seals using cross shaft seal installer 0555-336262 (1) and cross shaft bullet 0555-336263 (2).

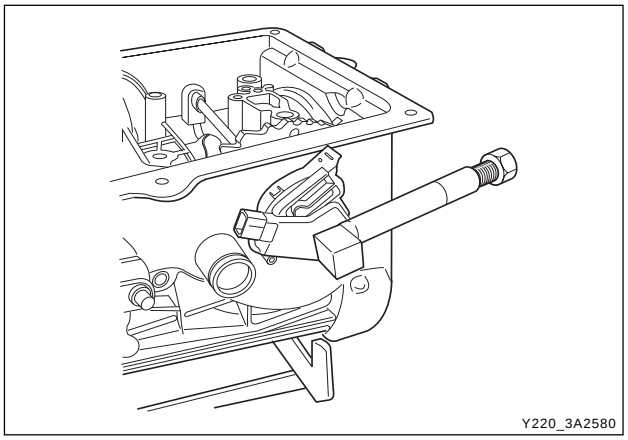


17. Install the inhibitor switch on the case. Torque the bolts as per specifications. Press the pin into the shaft until the tool bottoms using cross shaft pin installer/remover (inhibitor switch) 0555-336265.

Installation Notice

Tightening torque	4 ~ 6 Nm (35 ~ 53 lb-in)

18. Thoroughly check the terminal wiring loom for condition and continuity.



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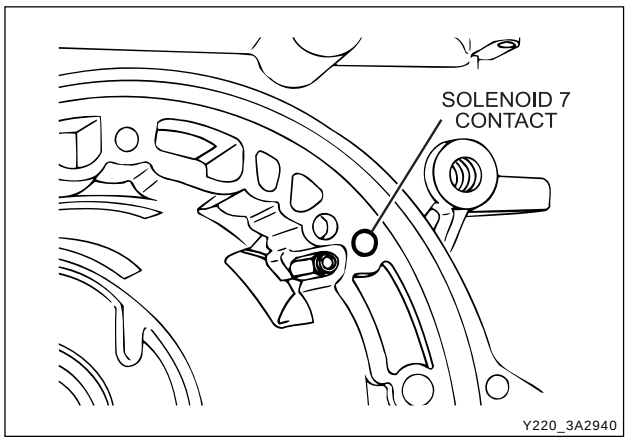
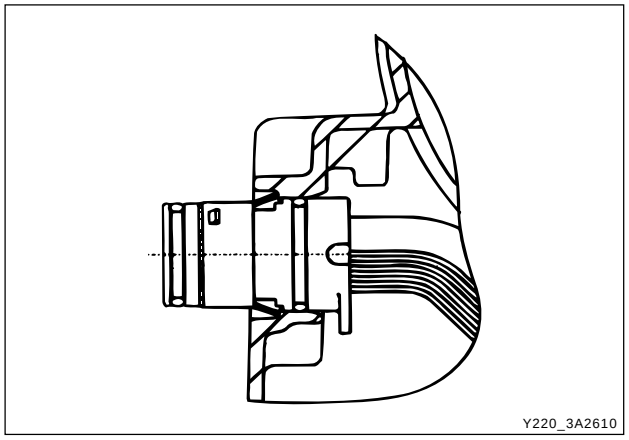
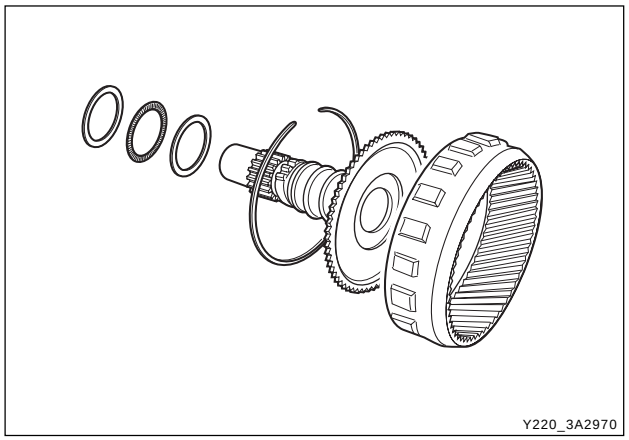


19. Position the wiring loom and locate the solenoid 7 contact and terminal in the pump mounting flange at the front of the case. The solenoid 7 wire is routed under the park rod and cross shaft in the case.

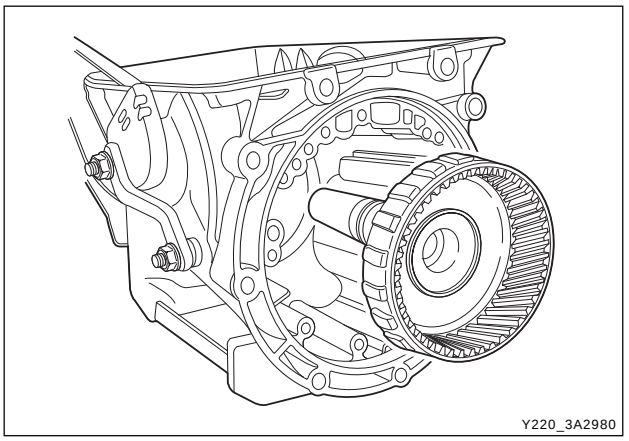


20. Install the 10 pin connector in the case engaging the tangs on the connector in the notches in case.



Output Shaft and Gear Assembly

1. Check that the output shaft bush is not worn or damaged. Replace if necessary.
2. Check for damage to parking pawl teeth on the ring gear. Replace if necessary.
3. Check that the sealing ring grooves have not been damaged.
4. Lubricate the sealing rings with automatic transmission fluid.
5. Assemble the sealing rings to the output shaft with the scarf cut uppermost.
6. If previously dismantled, assemble the ring gear to the output shaft and secure with circlip. Ensure that the circlip is firmly seated in its groove.
7. Install the No. 10 needle bearing assembly onto the output shaft using petroleum jelly.
8. Carefully install the output shaft assembly in the case to prevent damage to the sealing rings.



Rear Band Assembly

1. Check the rear band for any cracks or damage along the lining and metal backing.
2. Install the reaction anchor strut into the main case, without shims.
3. Carefully install the rear band into the transmission case and ensure that it is properly fitted in the case.

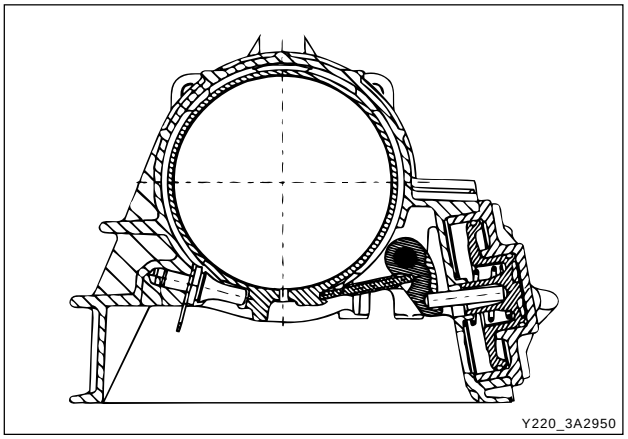
Notice

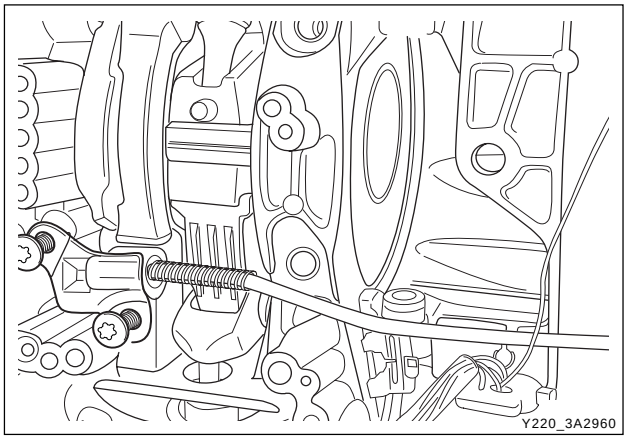
If fitting a new band, soak the new band in automatic transmission fluid for a minimum of five minutes prior to assembly.

4. Position the apply strut on the rear band then engage the apply strut in the servo lever.
5. Install the cam plate and tighten the screws to specification.

Installation Notice

Tightening torque	16 ~ 22 Nm (12 ~ 16 lb-ft)





Rear Servo Assembly

1. Check the servo piston “O” rings and gasket for any damage.
2. Lubricate the servo piston “O” rings with automatic transmission fluid, and fit the “O” rings to the piston grooves.
3. Assemble the piston to the cover, ensuring that “O” ring compression is adequate but not excessive.
4. Align the spring on the piston spigot, then position the rear servo rod into the spigot.
5. Assemble the gasket to the cover and fit the assem-bly to the case.

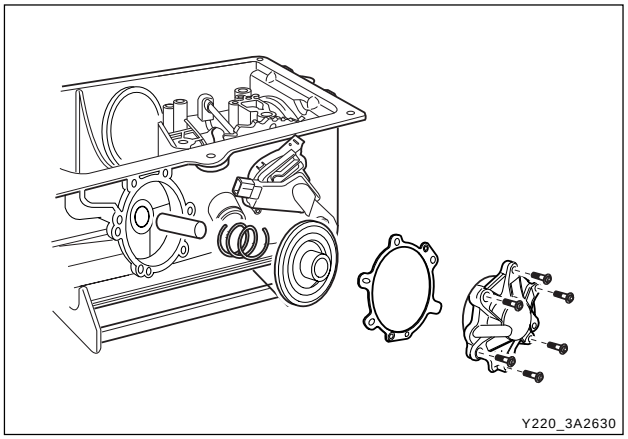
Notice

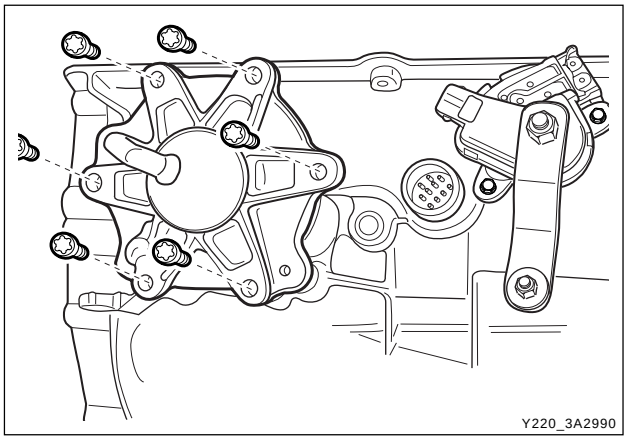
Do not use petroleum jelly on the gasket.

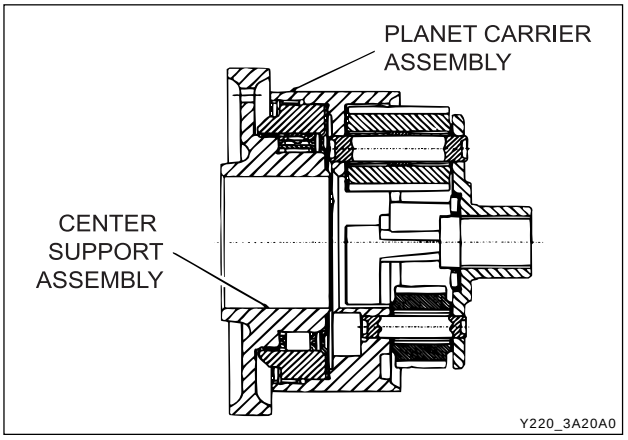
6. Apply additional Loctite 202 or equivalent as required to the rear servo to case bolts. Install the bolts and tighten to specification.

Installation Notice

Tightening torque	30 ~ 35 Nm (22 ~ 26 lb-ft)

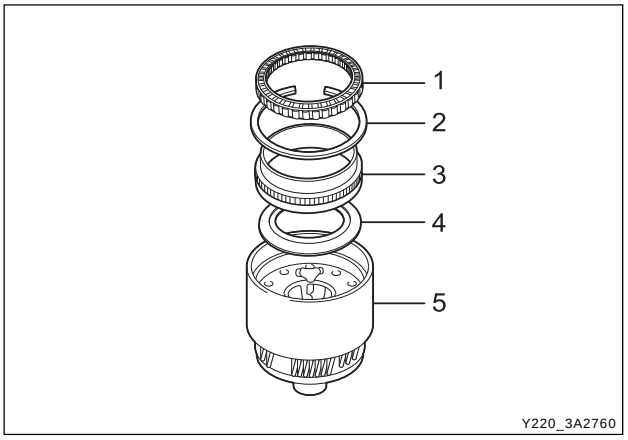




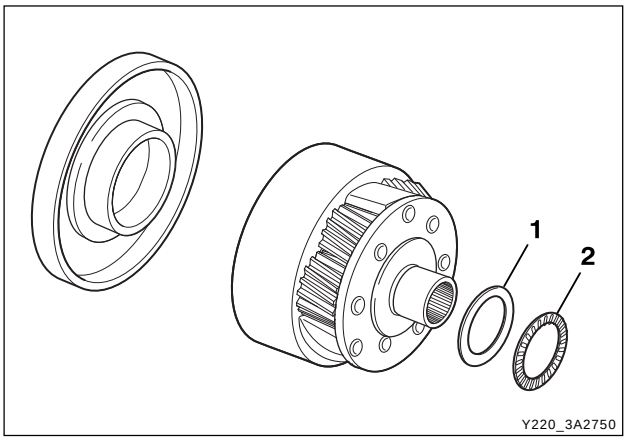


Planet Carrier Assembly and Centre Support

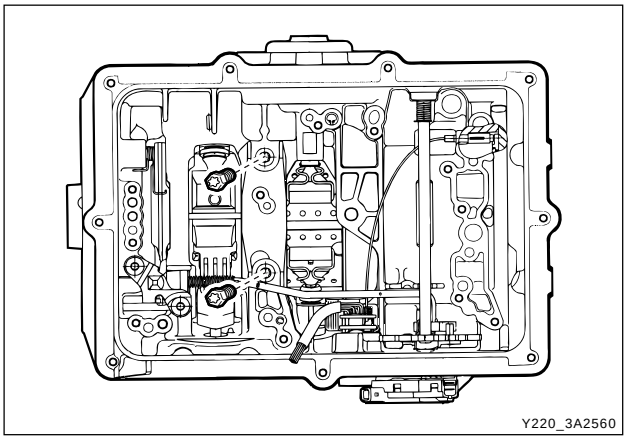
1. Check the carrier and planet assembly for any damage or irregularity and ensure that all pinions rotate freely and that the pinion end float is within 0.10 mm ~ 0.50 mm.



2. Install the One Way Clutch (OWC) retainer (1) to the planet carrier with the inner edge pointing down-wards. Inspect the OWC race and the sprag assemblies for wear or damage. Replace if necessary.
3. Install the outer (3) race in the drum. Press the race to the bottom of the drum and install the retaining circlip (2). Ensure the circlip is firmly seated in its groove.
4. Install the OWC (1) into the outer race with the lip edge uppermost. Lubricate the sprags with auto-matic transmission fluid.



5. Check that the plugs are fitted to the centre support, then assemble the centre support into the OWC, ensuring that the support will rotate in an anti-clock-wise direction only.
6. Lubricate the No. 9 needle bearing and washer with petroleum jelly and fit them to the rear face of the planet carrier.



7. Install the planet assembly and the centre support into the case, and align the centre support mounting bolt holes.
8. Install the centre support bolts finger tight.
9. Install the circlip retainer ensuring that the circlip is completely seated in the groove of the case.
10. Remove the centre support bolts and apply Loctite 222 or equivalent to the threads. Install the bolts and torque to specifications.

Installation Notice

Tightening torque	20 ~ 27 Nm (15 ~ 20 lb-ft)

Adaptor Housing Assembly

1. Install a new seal to the adaptor housing.
2. Position a new gasket onto the adaptor housing.

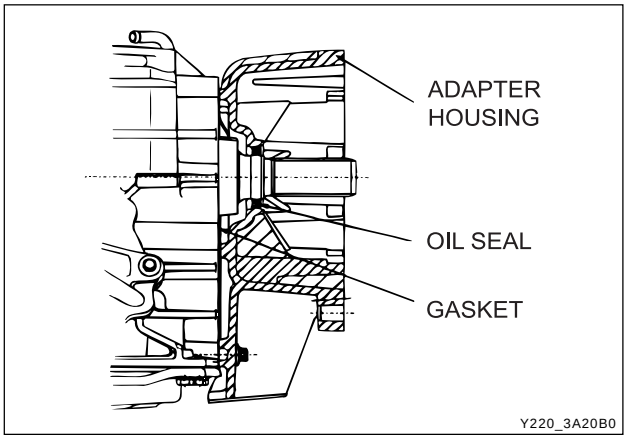
   Notice

   Do not use petroleum jelly to hold the gasket in position.

3. Apply additional Loctite 202 or equivalent as required to the adapter housing bolts. Install the adaptor housing and torque the bolts to specification.

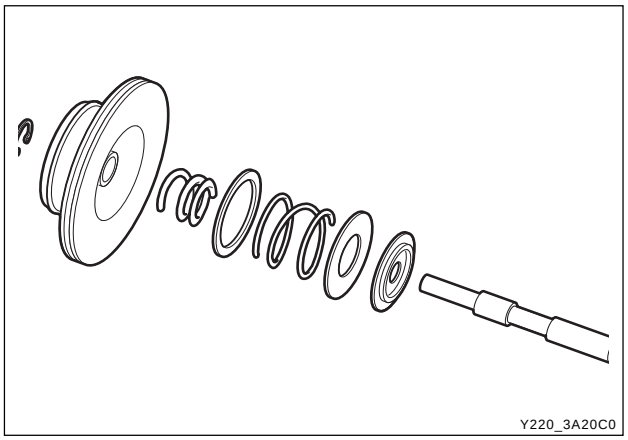
   Installation Notice

Tightening torque	30 ~ 35 Nm (22 ~ 26 lb-ft)

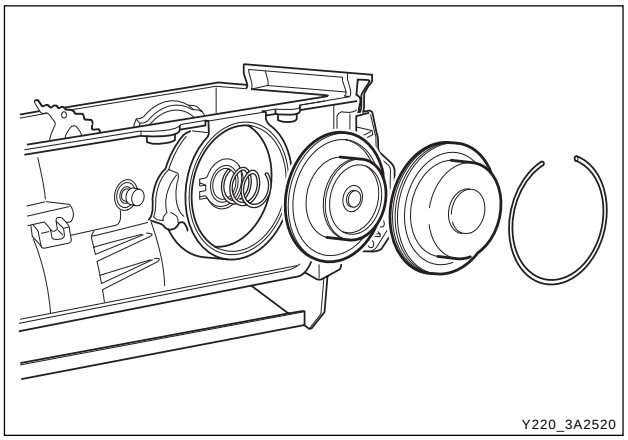


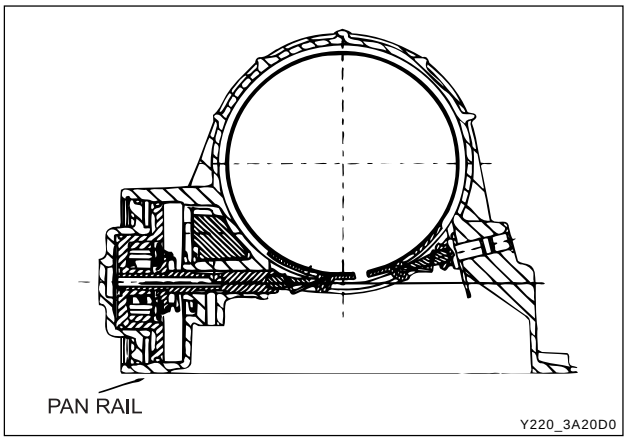
Front Servo Assembly

1. Lubricate the cover “O” ring with automatic transmission fluid and fit to the cover.
2. Lubricatethepiston “O” rings with automatic trans-mission fluid and fit to the piston.
3. Assemble the piston, push rod, spring, belleville washer, seat and retaining ring.
4. Fit the piston push rod assembly into the front servo cover.



5. Install the front servo block and spring into the case.
6. Install the front servo assembly into the case.

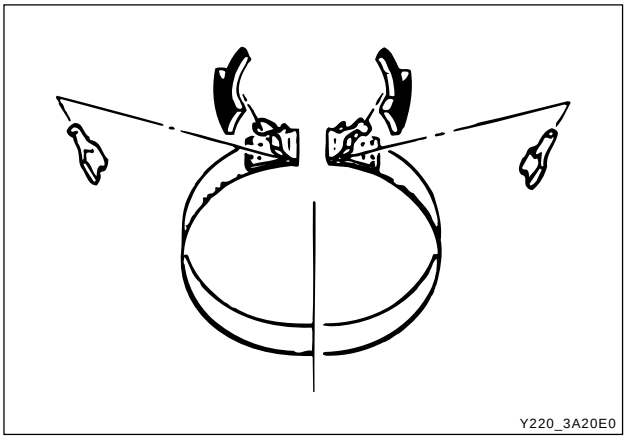




7. Compress the servo cover and fit the servo cover retaining circlip, aligning the gap with the pan rail, and ensuring that it is completely seated in its groove.

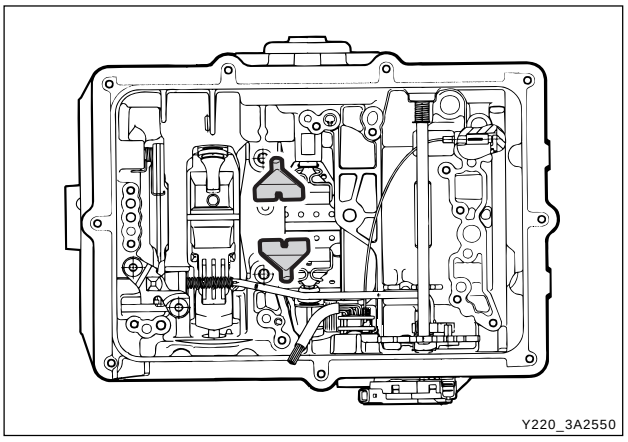
Notice

Ensure that the front servo snap ring is installed correctly. Orient the circlip with the gap at the bottom, near the pan rail.



Front Band Assembly

1. Install the reaction anchor strut to the case.
2. Check the band for all cracks or damage along its lining and metal backing.
3. Position the strut retainers on the band.



4. Install the front band into the transmission case, ensuring that it is properly seated in place.

Notice

If fitting a new band, soak the band in automatic transmission fluid for a minimum of 5 minutes prior to assembly.

5. Position the reaction strut in its retaining clip and engage it with the band and anchor strut.
6. Position the apply strut in its retaining clip and engage it with the band and the servo piston rod.

C2/C4 Clutch Assembly

Tools Required

0555-336259 Clutch Spring Compressor

0555-336260 Clutch Pack Clearance Kit

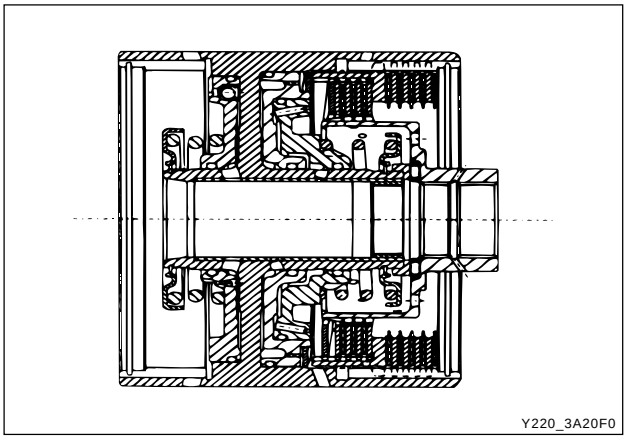
Notice

- ***Check pistons for cracks.***
- ***Do not mix the clutch piston return springs.***
- ***Ensure that the snap rings are fitted correctly.***

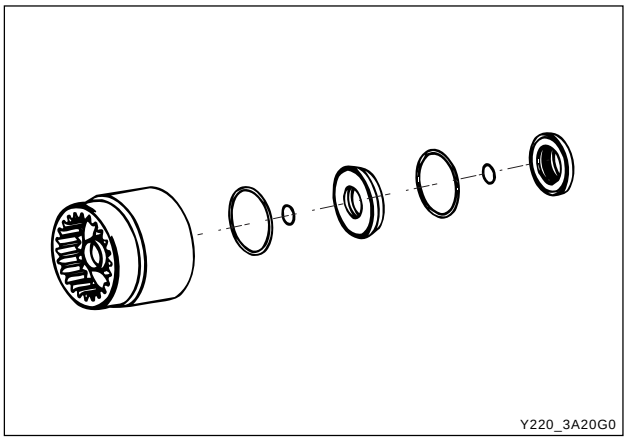
1. Check the feed orifices in the cylinder bore are clear of obstructions.
2. Check the C2 piston bleed orifices are clear of obstructions.
3. Lubricate the “O” rings with Automatic Transmission Fluid (ATF)
4. Fit the small “O” ring onto the inner groove, and the large “O” ring onto the outer groove of the piston.

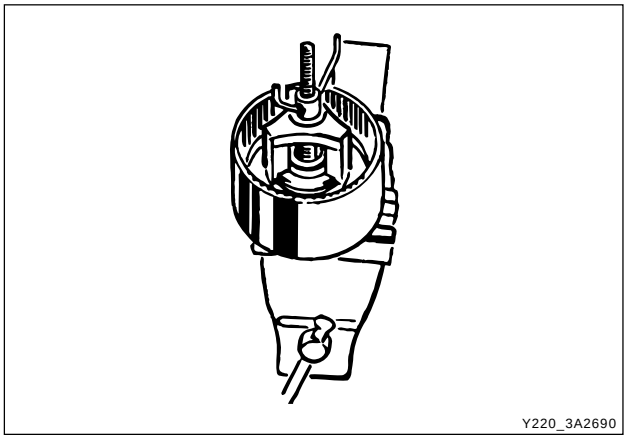
   Notice

   “O” rings must not be twisted in the grooves.



5. Check the C4 piston bleed orifices are clear of obstructions.
6. Lubricate the “O” rings with ATF.
7. Fit the small “O” rings onto the inner groove and the large “O” rings onto the outer groove of the piston.
8. Position the clutch cylinder with the C2/C4 cavity facing upwards.
9. Fit the C4 piston into the C2 piston with the bleed orifices in alignment.
10. Install the C2/C4 piston assembly into the cylinder, with the piston bleed orifices aligned with the holes on the outside of the cylinder, until the outer diameter of the C2 piston enters the inner diameter of the cylinder.





11. Assemble the piston return spring to the piston, and fit the spring retainer over the spring.
12. Using 0555-336259 clutch spring compressor, compress the spring sufficiently to enable the installation of the retaining circlip ensuring that the circlip is firmly seated in its groove, then remove the tool.

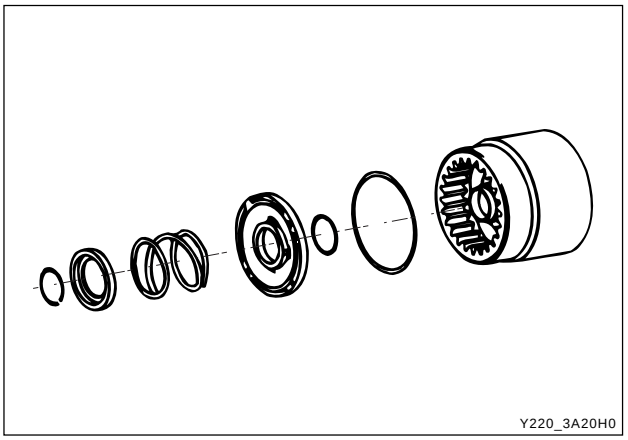
Notice

The wire diameter of this spring is 4.3 mm.

13. Check the C1 piston check valves are not damaged and are free to move, and that the cylinder feed orifices are clear of obstructions.
14. Lubricate the “O” rings with ATF and fit them to their respective grooves.

Notice

“O” rings must not be twisted in the grooves.

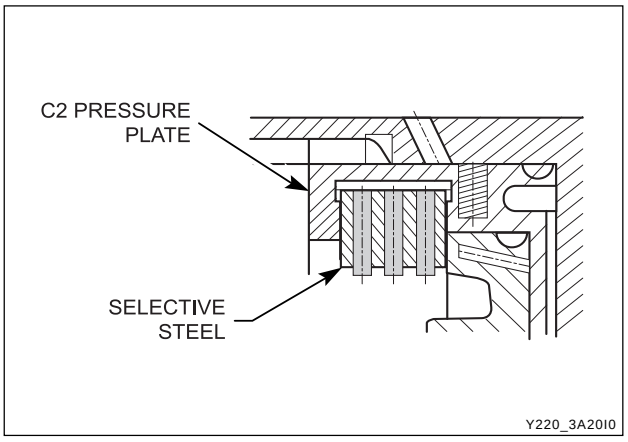


15. Position the cylinder with the C1 cavity upwards. Install the piston into the cylinder until the outer diameter of the piston enters the inner diameter of the cylinder.
16. Install the spring and spring retainer onto the piston.
17. Using 0555-336259 clutch spring compressor, compress the spring sufficiently to enable the installation of the retaining circlip ensuring that the circlip is firmly seated in its groove, then remove the tool.

Notice

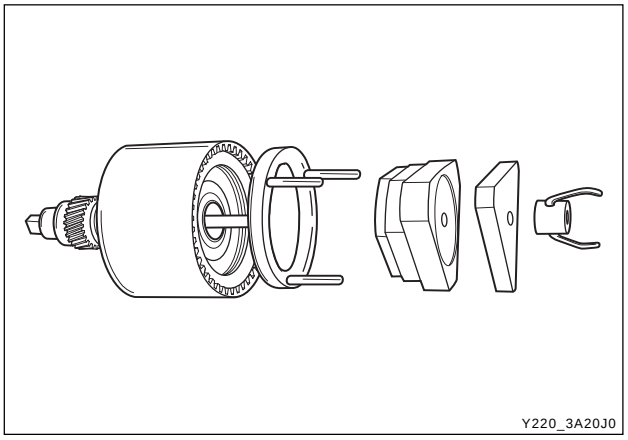
The wire diameter of this spring is 5.26 mm.

18. Install the C2 wave washer into the cylinder with the crest of one wave covering one of the bleed orifices inthe C2 piston.



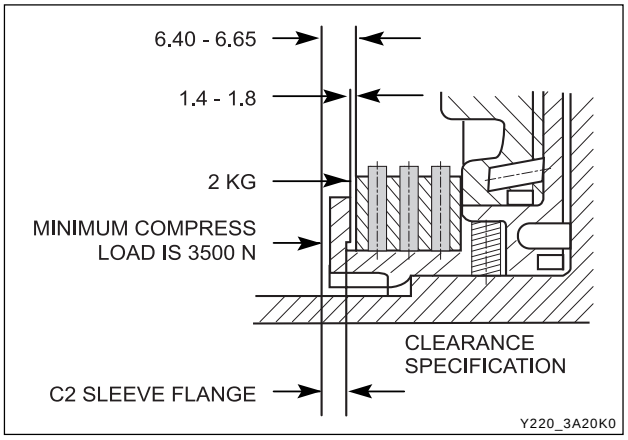
19. Measure and record the thickness of the flange of the C2 sleeve.
20. Install the C4 clutch plates and wave washer into the C2 actuating sleeve, with the rounded edge of the steel plates down, in the following sequence:
    - Steel plate (selective)
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Wave washer

21. Holding the cylinder horizontal, install the sleeve and clutch plate assembly into the cylinder, with the crest of one wave of the washer in line with one of the holes in the outside of the cylinder, until the sleeve contacts the C2 wave washer.
22. Check the C4 clutch pack clearance using 0555-336260 clutch pack clearance kit.



Notice

With the C2 wave spring compressed, and the clutch Pack supporting a 2 kg weight, the dimension from the underside of the C2 pressure plate to the selective steel is to be between 1.4 ~ 1.8 mm. If the clutch is to be gauged from the top of the pressure plate, then the dimension is to be the actual thickness of the pressure plate plus 1.4 ~ 1.8 mm.

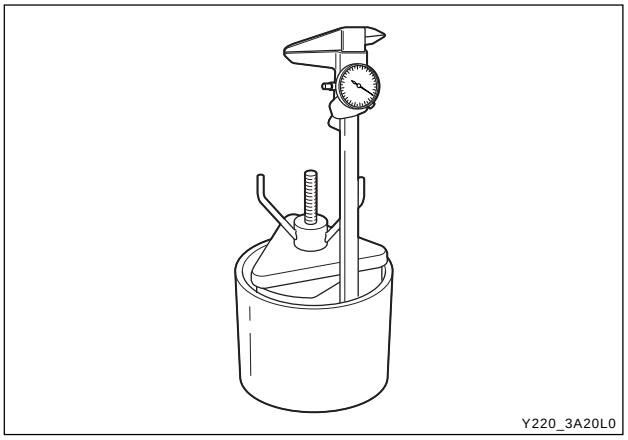


23. Use selective plates to achieve the correct specification. If new friction plates are being fitted, remove the clutch pack and soak the friction plates in ATF for a minimum of 5 minutes prior to reassembly.

Notice

The clutch pack clearance must be taken before the elements are soaked in ATF.

24. Reassemble the sleeve and clutch pack into the cylinder. Observe the alignment of the wave washer to the hole in the cylinder.
25. Install the C2 clutch plates in the cylinder in the following sequence:
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Steel plate (0574-000013, `014, `015, `016, `019, `022), or Friction disc (0574-000012 & `017)
    - Steel plate (selective)
    - Friction disc
    - Steel plate (selective)
    - Friction disc



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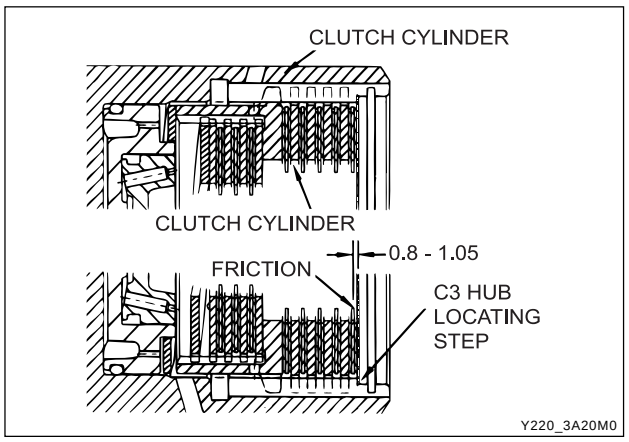


26. Check the clutch pack clearance using only the weight from 0555-336260 clutch pack clearance kit.

Notice

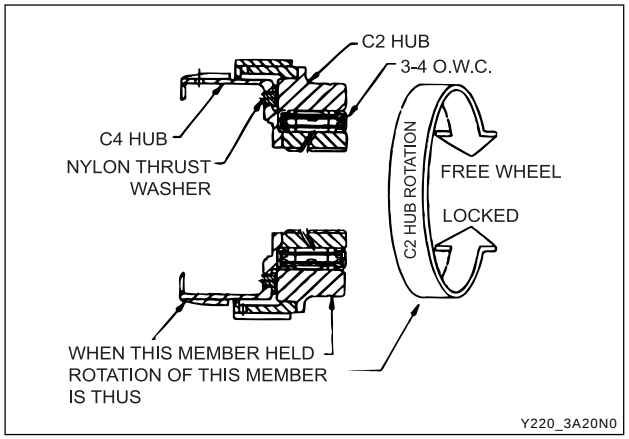
With the clutch pack supporting a 2 kgweight, the dimension from the C3 clutch hub locating step to the friction plate is to be between 0.80 ~ 1.05 mm.

27. Use selective plates to achieve the correct specifica-tion. If new friction plates are being fitted, remove the clutch pack and soak the friction plates in ATF for a minimum of 5 minutes prior to reassembly.

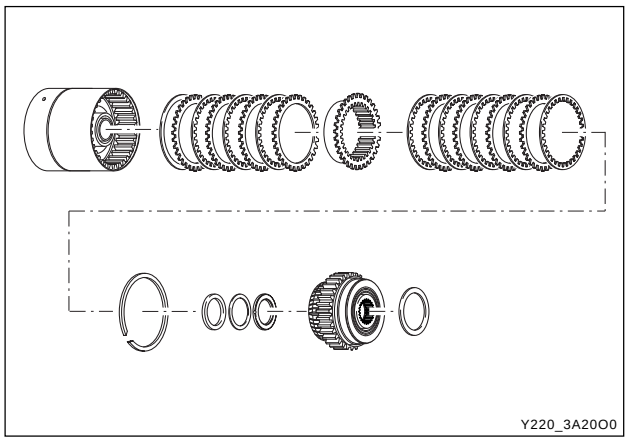
Notice

The clutch pack clearance must be taken before the elements are soaked in ATF.

28. Lubricate and fit the 3-4 OWC and end caps to the C2 hub.



29. Align the tangs and fit the nylon thrust washer onto the C4 hub.
30. Align and fit the C4 hub to the C2 clutch and the OWC assembly.
31. Check the rotation of the C2 hub. While holding the C4 hub, the C2 hub should rotate in the clockwise direction and lockup in the anti-clockwise direction when viewed from the C2 hub.



32. Apply petroleum jelly to the No. 5 needle bearing and fit it to the C4 hub.
33. Remove the C2 clutch plates from the clutch cylinder.
34. Fit the thrust plate over the cylinder inner hub.
35. Engage the C2/C4 clutch hub assembly in the C4 clutch plates.
36. Install the C2 clutch plates.
37. Install the C3 hub and secure it with the circlip, ensuring that the circlip is firmly seated in its groove.

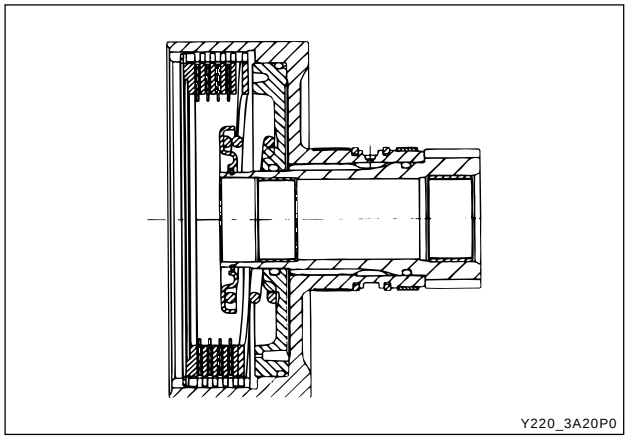
C3 Clutch and Reverse Sun Gear Assembly

Tools Required

0555-336259 Clutch Spring Compressor

0555-336260 Clutch Pack Clearance Kit

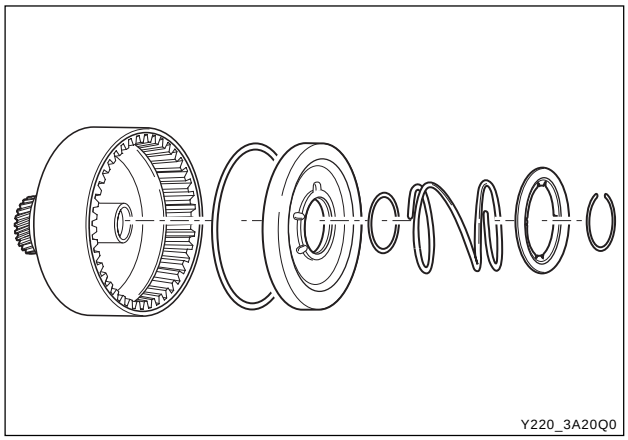
1. Check the orifices in the cylinder are clear of obstructions.
2. Check the C3 cylinder bush outside diameter and the centre support inside diameter are in good condition and not damaged. Coat the sealing rings with automatic transmission fluid and fit into the C3 cylinder grooves.
3. Check the reverse sun gear splines, grooves and thrust face for condition. Coat the “O” ring with automatic transmission fluid and fit it to the groove of the reverse sun gear.
4. Lubricate the C3 washer with petroleum jelly and fit to the inner face of the reverse sun gear.
5. Install the reverse sun gear in the C3 cylinder, en-suring that the “O” ring compression is adequate but not excessive.



Notice

“O” rings must not be twisted in the grooves.

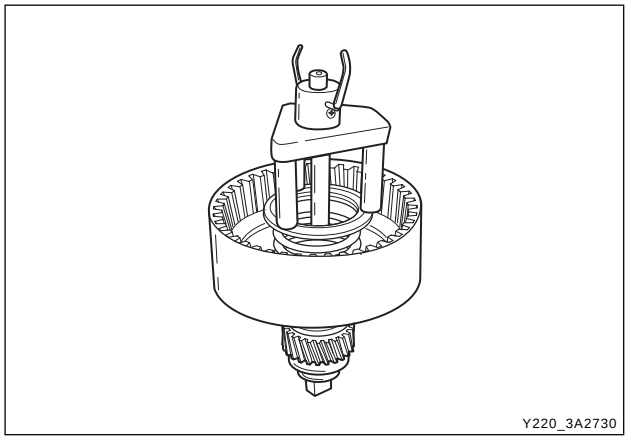
6. Coat the C3 piston “O” rings with automatic trans-mission fluid and fit the small “O” ring onto the inner ring and the large “O” ring onto the outer ring of the C3 piston.
7. Check that the bleed orifices of the piston are clean and clear of obstructions.
8. Install the C3 piston in the cylinder until the outside diameter of the piston enters the inside diameter of the cylinder.



Notice

Take care not to cut the “O” ring.

9. Assemble the spring and spring retainer on the piston. Using 0555-336259 clutch spring compressor compress the spring sufficiently to enable the installation of the retaining circlip, ensuring that the circlip is firmly seated in the groove, and remove the tool.
10. Fit the C3 wave plate to the C3 piston face, ensuring that one crest of the wave plate of the C3 piston face is aligned over one of the piston orifices.



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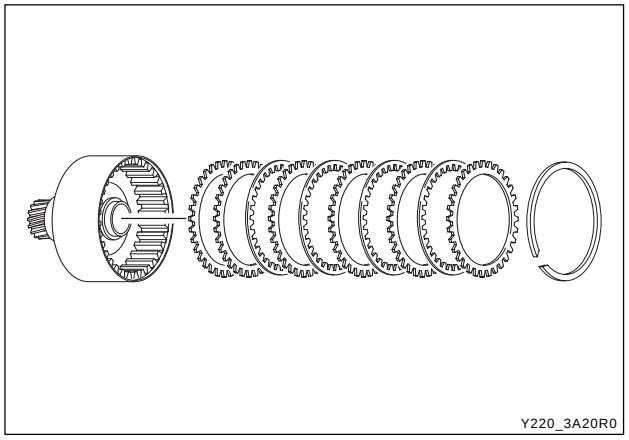
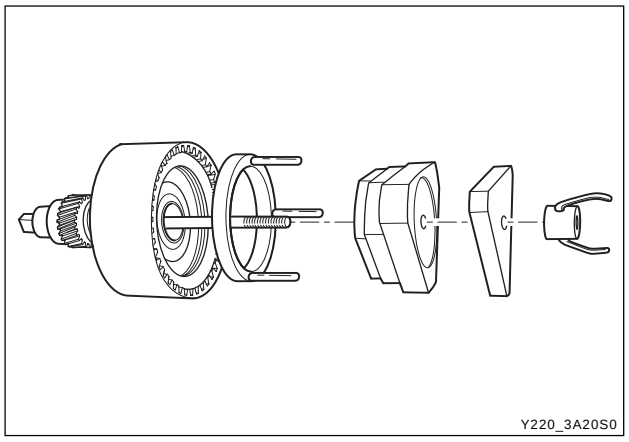
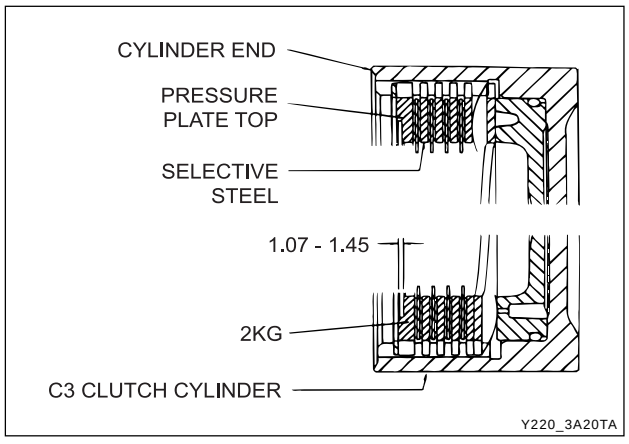


11. Assemble the clutch plates and discs into the cylinder in the following sequence :
    - Steel plate
    - Friction disc
    - Steel plate
    - Steel plate (0574-000013, `014, `015, `016, `019, `022), or Friction disc (0574-000012, `017)
    - Steel plate (selective)
    - Friction disc
    - Steel plate (selective)
    - Friction disc
12. Align and fit the pressure plate with the counterbore facing away from the clutch plates.



13. Install the circlip.
14. Check the C3 clutch clearance using 0555-336260 clutch pack clearance kit in the following manner (weight only).
    a. Place the weight on the pressure plate and measure the distance from the end of the cylinder to the top of the pressure plate.
    b. Record this figure.
    c. Remove the weight.
    d. Lift the pressure plate up against the circlip and measure the distance from the end of the cylinder to the top of the pressure plate.
    e. Record this figure.
    f. Subtract the second reading from the first reading to obtain the clutch pack clearance.



Notice

With the clutch pack supporting a weight of 2kg, the clearance between the snap ring and the top of the pressure plate is to be between 1.07 ~ 1.45 mm.

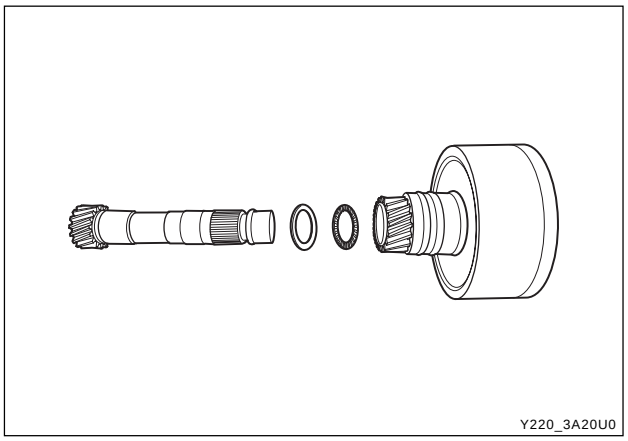
15. If new friction plates are being fitted, remove the clutch pack and soak the friction elements in auto-matic transmission fluid for a minimum of five min-utes prior to reassembly.

Notice

The clutch pack clearance must be taken before the elements are soaked in automatic transmission fluid.

Forward Sun Gear and C3 Clutch Pack Assembly

1. Fit the No.7 needle bearing assembly over the forward sun gear, ensuring that the thrust washer is between the bearing and the sun gear.
2. Lubricate the lipped thrust plate with petroleum jelly and fit the thrust plate onto the reverse sun gear.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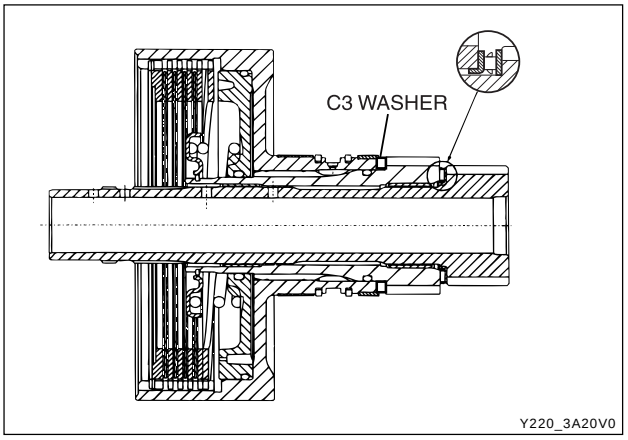
3. Align and fit the C3 clutch assembly over the forward sun gear.



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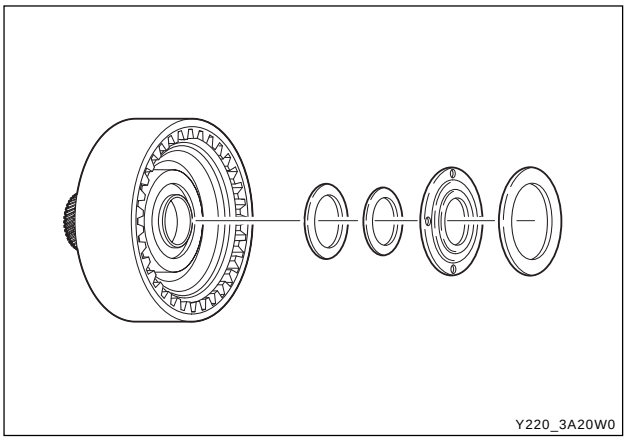
4. Lubricate the No.6 needle bearing with petroleum jelly and fit it to the thrust plate. Ensure the lugs on the outside diameter of the bearing fit in the thrust plate counterbore.
5. Align and fit the plastic thrust washer to the thrust plate with petroleum jelly.
6. Install the assembly over the forward sun gear shaft against the No. 6 needle bearing.
7. Place the assembly to one side.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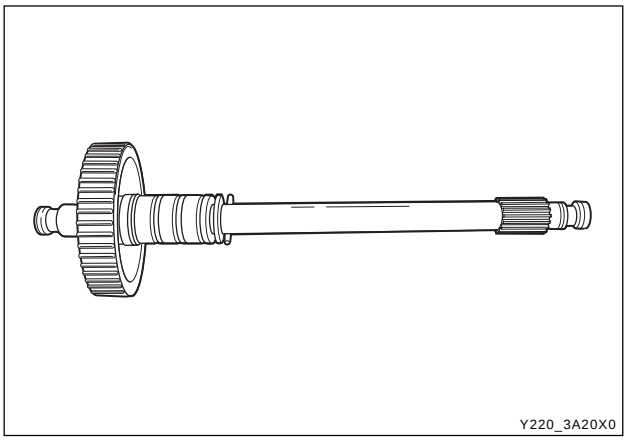
C1 Clutch Overdrive Shaft and Input Shaft Assembly

Tools Required

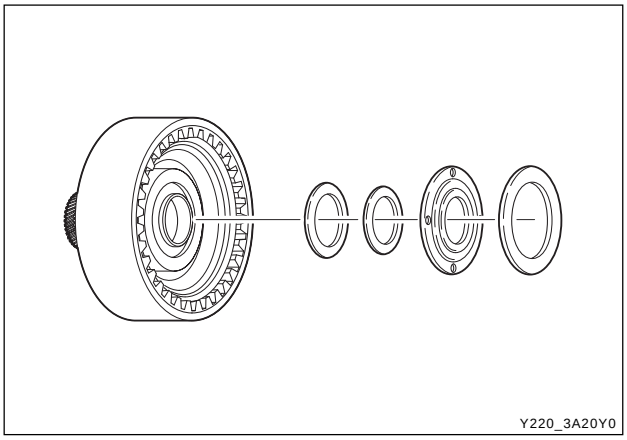
0555-336260 Clutch Pack Clearance Kit

Notice

- ***Ensure that the snap rings are fitted correctly.***
- ***Check pistons for cracks, especially the C1 piston.***
- ***Do not mix clutch piston return springs.***
- ***If the C1/C2 clutch packs separate from the C3 clutch pack, make sure the No. 6 bearing doesn't drop out of the bearing retainer.***



1. Check the overdrive shaft grooves for any defect.
2. Coat the sealing rings, large and small, with petro-leum jelly and fit them to the overdrive shaft. The sealing rings may be held in place with a small amount of petroleum jelly.



3. Assemble the clutch plate and disc into the cylinder in the following sequence:
   - Steel plate
   - Friction disc
   - Steel plate
   - Friction disc
   - Steel plate
   - Steel plate (0574-000013, `014, `015, `016, `019, `022), or friction disc (0574-000012 & `017)
   - Steel plate (selective)
   - Friction disc
   - Steel plate (selective)
   - Friction disc

4. Check the clutch pack clearance using 0555-336260 clutch pack clearance kit.
5. Use selective plates to achieve the correct specifi-cation.

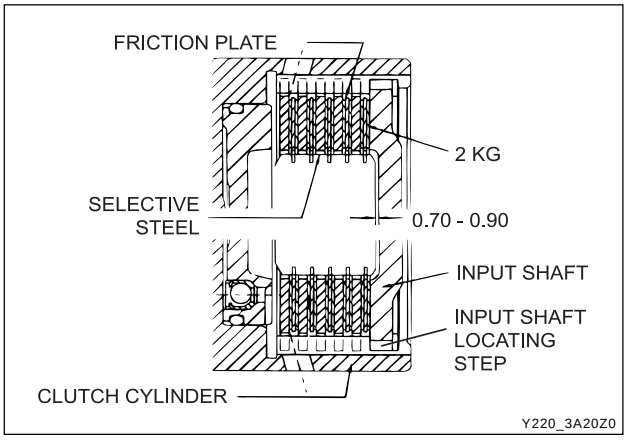
Notice

With the clutch pack supporting a 2 kg weight, the dimension from the input shaft locating stop to the friction disc must be 0.70 ~ 0.90 mm.

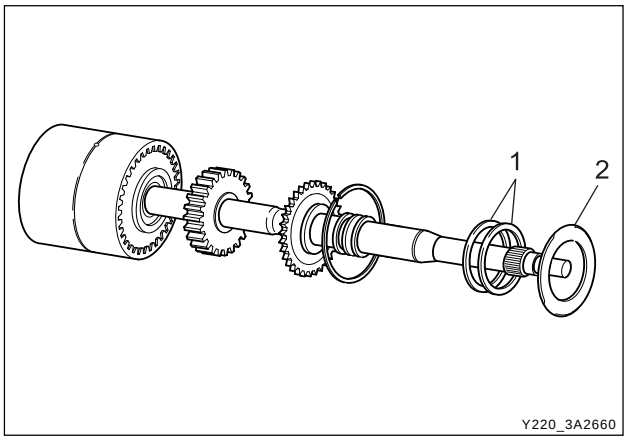
6. If new friction plates are being fitted, remove the clutch pack and soak the friction elements in auto-matic transmission fluid for a minimum of five minutes prior to assembly.

Notice

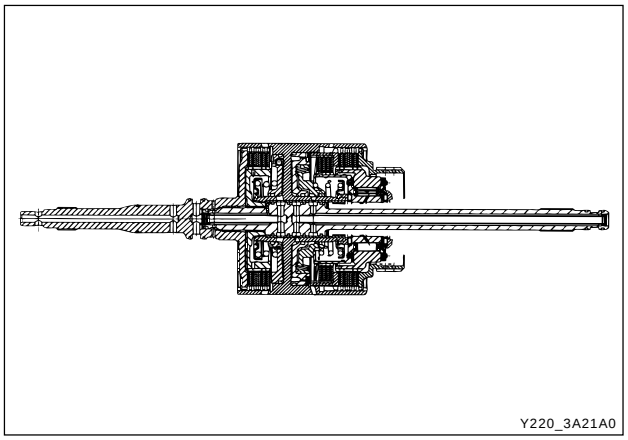
The clutch pack clearance must be taken before elements are soaked in automatic transmission fluid.

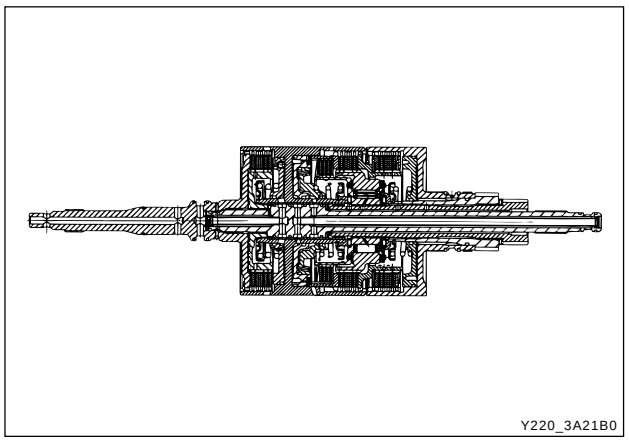


7. Check the fit of the C1 clutch hub on the overdrive shaft. If it is loose, the hub and shaft assembly must be replaced.
8. Coat the small nylon thrust spacer with petroleum jelly and install it over the overdrive shaft.
9. Carefully fit the overdrive shaft into the C1 cylinder so as not to damage the sealing ring.
10. Fit the small bronze C1 hub thrust washer in place with petroleum jelly.
11. Check the input shaft for any defect. Fit the input shaft into the cylinder and secure it with the circlip, ensuring that the circlip is completely seated in the groove.



12. Coat the sealing rings with petroleum jelly and fit onto the input shaft.



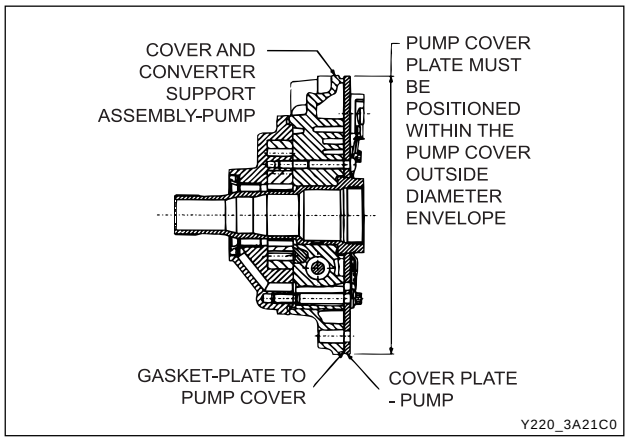


13. Assemble the C1/C2/C4 clutch assembly to the C3 clutch and sun gear assembly.
14. Install this assembly in the transmission case.

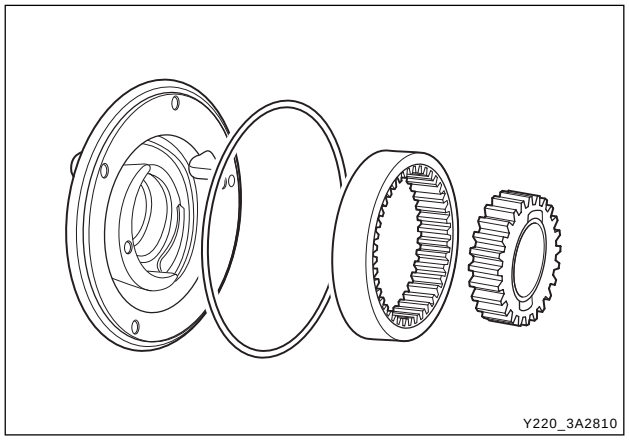
Pump Cover and Converter Support

Notice

- ***Do not wash the nose of solenoids in solvent.***
- ***Ensure that the correct "O" ring is fitted for the application.***
- ***Be careful not to damage the needle bearings on the assembly. Avoid any axial impact loads during assembly.***
- ***Check the transmission end float. This will help to detect any missing parts or incorrect assembly.***

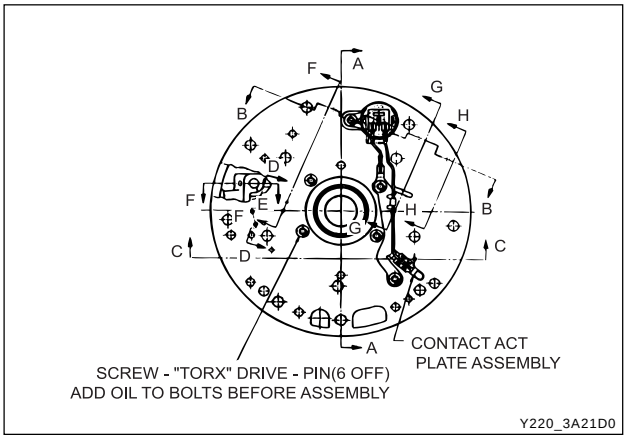


1. Check the pump body for any damage, chips or irregularity. Check that the bush is firmly staked in the drive gear.
2. Install the seal flush with the front face of the pump body.
3. Lubricate the pump bush, and the drive and driven gears, with automatic transmission fluid.

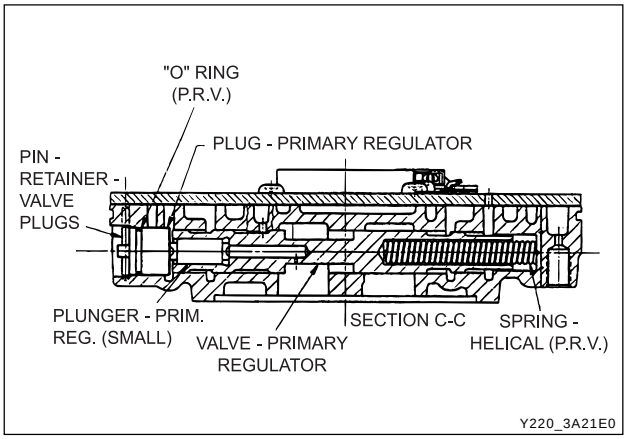


4. Install the pump driven gear and the pump drive gear into the pump body.
5. Using a straight edge and thickness gauge, check that the clearance between pump face and gears is 0.04 ~ 0. 018 mm.
6. Lubricate the pump body "O" ring with automatic transmission fluid and fit it to the pump body. Put the pump body to one side.

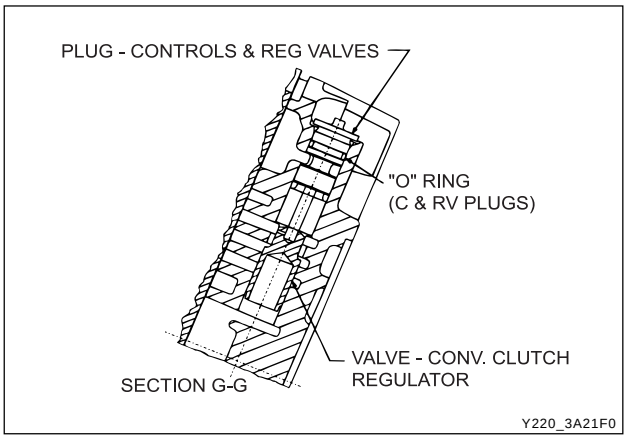
7. Ensure that the pump cover cavities, ports and holes are clean and free of any obstruction.
8. Lubricate all loose parts with automatic transmission fluid prior to assembly.



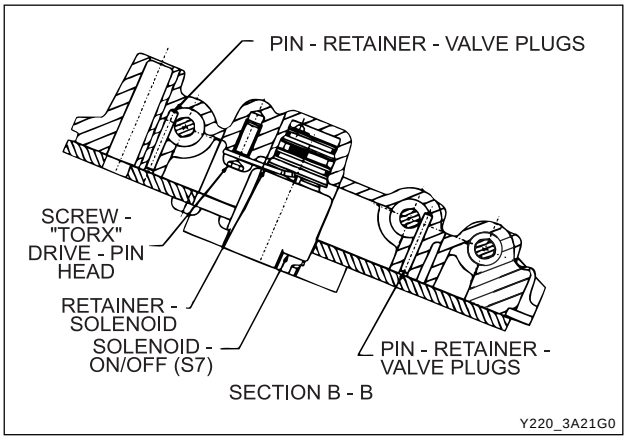
9. Assemble the primary regulator valve, spring and plunger to the pump cover, ensuring that the regulator valve slides freely, then fit the regulator valve plug and “O” ring.
10. Install the retaining pin.



11. Install the converter clutch regulator valve, plug, spring and “O” ring.



12. Install the retaining pin.



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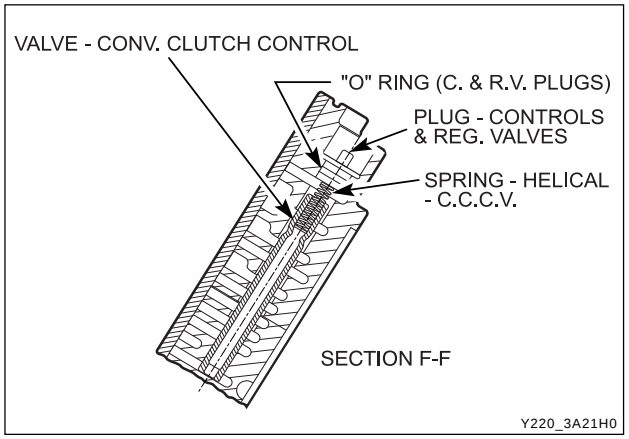
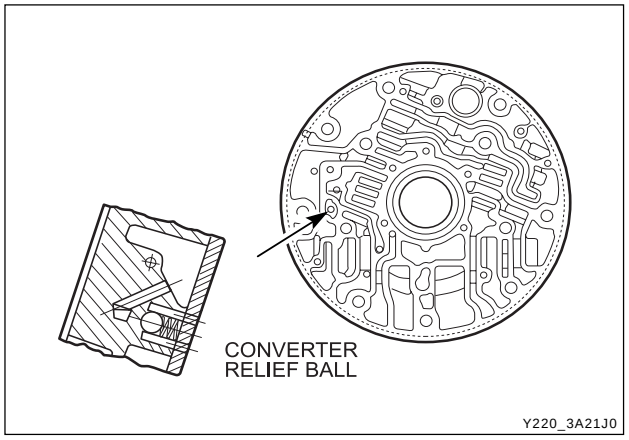
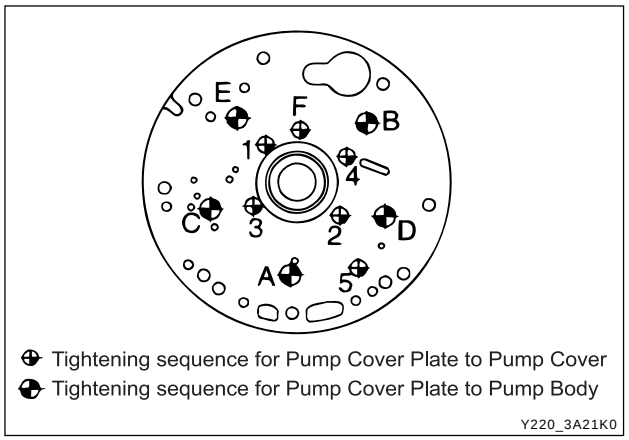


13. Install the converter clutch control valve, spring, plug, and “O” ring.
14. Install the retaining pin.



15. Install the converter release check ball and spring.
16. Install the gasket on the pump cover.



17. Install the cover plate, solenoid 7 with the retainer and the solenoid wiring retainer to the pump cover, ensuring that the periphery of the cover plate is flush with the periphery of the pump cover.
18. Tighten the screws to specification in the order. (1-5)

Installation Notice

Tightening torque	13 ~ 16 Nm (10 ~ 12 lb-ft)

19. Tighten the solenoid 7 screw.

Installation Notice

Tightening torque	13 ~ 16 Nm (10 ~ 12 lb-ft)

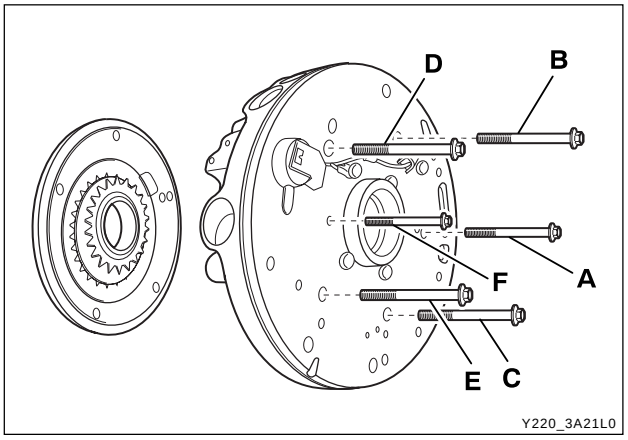
- Check that neither the wiring nor the connector protrudes excessively, in order that at assembly neither the wiring and the connector contacts or rubs on the input shaft or the C1/C2 clutch cylinder.

20. Assemble the pump to the pump cover.
21. Tighten all bolts and the crescent screw finger tight, ensuring that the pump is flush against the pump cover. Tighten the bolts and the screw to specification in the order. (A-F)

Installation Notice

Tightening torque	Bolt (A-E): 24 ~ 27 Nm (18 ~ 20 lb-ft)
	Screw (F): 13 ~ 16 Nm (10 ~ 12 lb-ft)

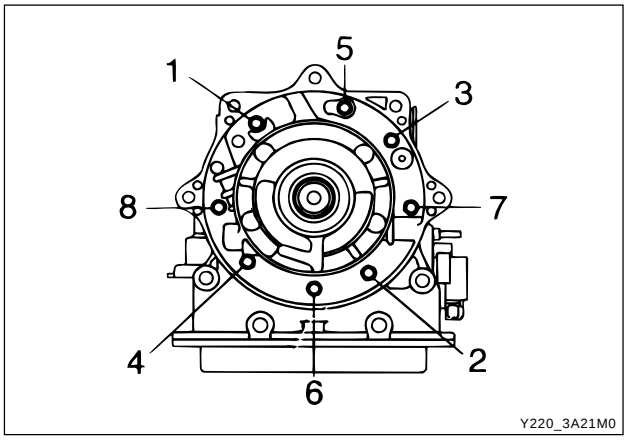
22. Install the pump to transmission case gasket onto the case.
23. Fit the “O” ring to the pump cover outer diameter.



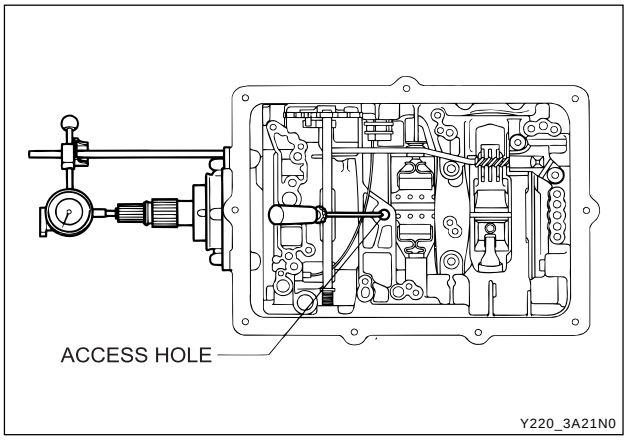
24. Install the pump and cover assembly over the input shaft being careful not to damage the sealing rings. Apply additional Loctite 202 or equivalent as required to the pump cover to case bolts. Install and tighten bolts to specification.

Installation Notice

Tightening torque	24 ~ 34 Nm (18 ~ 25 lb-ft)



25. Check that the transmission end float is 0.50 ~ 0.65 mm. If the unshimmed end float clearance is greater than specification, shims are to be placed between the No. 4 bearing and the input shaft bearing surface. If the end float clearance is less than 0.5 mm then the transmission has been assembled incorrectly or the parts are out of specification.
26. Perform the following steps to check the end float :
    a. Attach a dial indicator to the front of the trans-mission case with the stylus resting on the end of the input shaft.
    b. Apply a force of approximately 250 N or 25 kg to the input shaft.
    c. Zero the dial indicator.
    d. Place a small lever behind the forward clutch cylinder and lever the cylinder forward.
    e. The measurement recorded on the dial indicator is the transmission end float or clearance between the No.4 bearing and the converter support tube.
27. On completion of this procedure, adjust the front and rear bands to specifications. Refer to “Front and Rear Band Adjustment” in this section.



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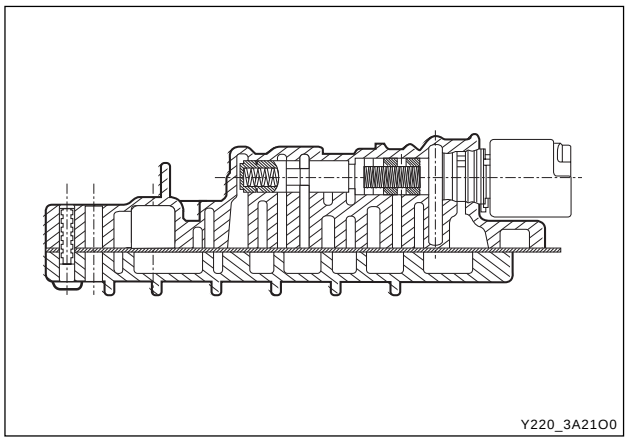
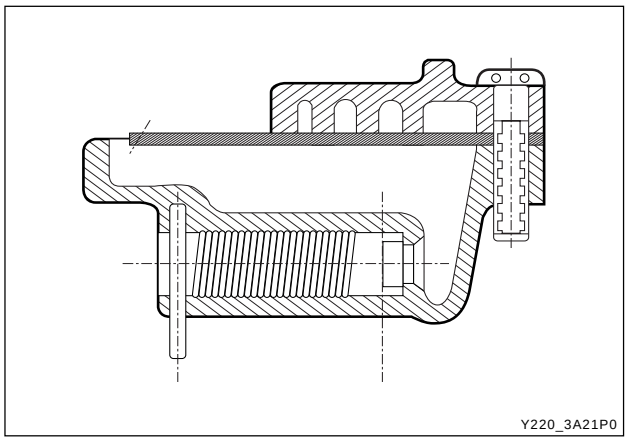
Valve Body

Notice

- ***Do not wash the nose of solenoids in solvent.***
- ***Be aware of ball positions in the upper valve body.***
- ***Be aware of 1-2 and 3-4 shift valve positions, they can be swapped.***
- ***Check the 4-3 sequence valve and spring orientation.***
- ***Check that the 12 mm ball is in the lower body.***
- ***Check the line pressure relief valve for swarf, and be aware of replacing the shims.***
- ***When servicing the transmission, ensure that the solenoid 5 damper spring is not broken.***
- ***Locate the detent spring central to the detent lever.***
- ***Wash the upper and lower valve bodies thoroughly with cleansing solvent and blow dry.***
- ***Check the valve body cavities, ports and holes for damage or obstructions.***
- ***The orifices in the valve body are for stability and safeguard. Do not drill them larger.***
- ***Thoroughly wash all loose components.***
- ***Check that all valves slide freely in their location.***

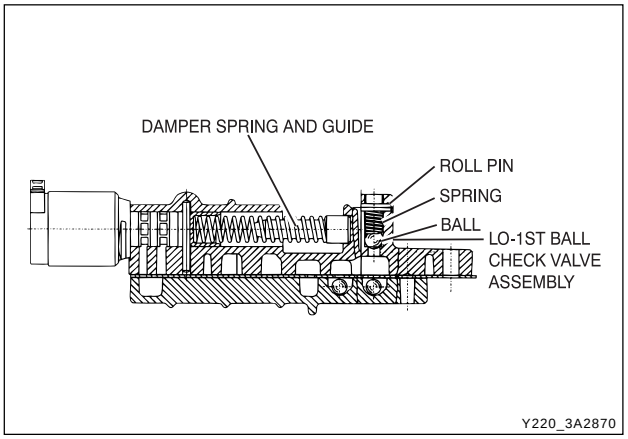


1. Install the detent lever locating pin
2. Install the Band Apply Regulator (BAR) valve, springs, plunger and retaining pin.

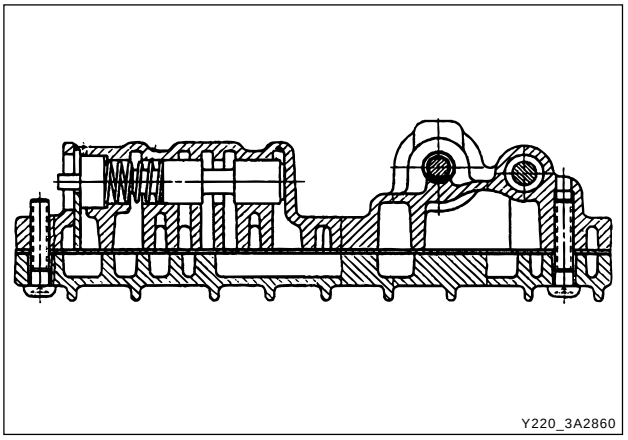


3. Install the line pressure relief valve, tapered end first, spring and disc. Secure with the retaining pin.

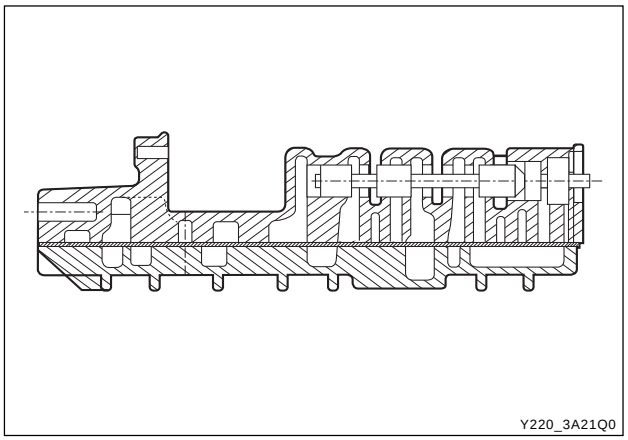
4. Install the solenoid 5 damper guide and spring, piston and retaining pin.



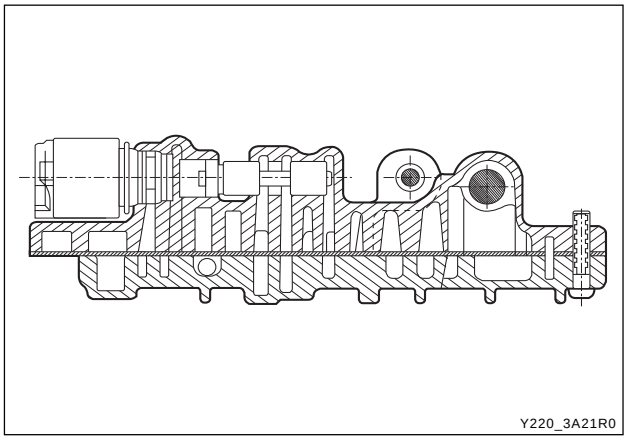
5. Install the 4-3 sequence valve, spring, plug and retaining plate.



6. Install the 1-2 shift valve, plug and retaining pin.



7. Install the 2-3 shift valve and retaining pin.



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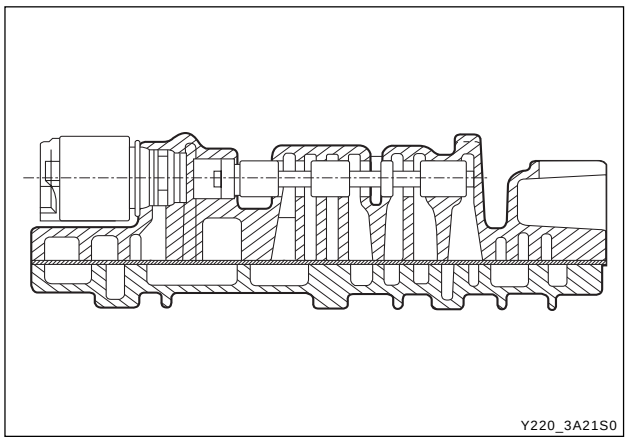
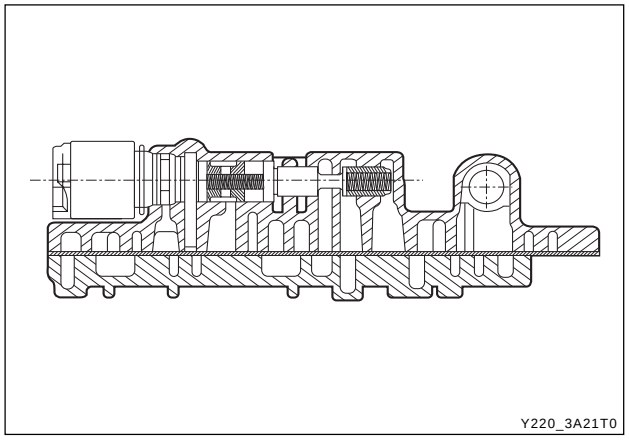
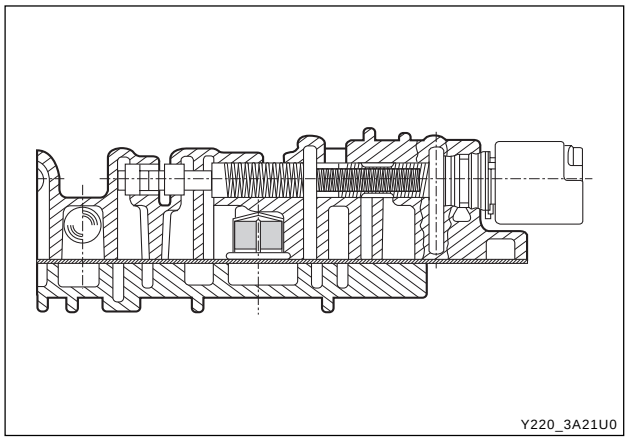


8. Install the 3-4 shift valve and retaining pin.



9. Install the Clutch Apply Regulator (CAR) valve, springs, plunger and retaining pin.

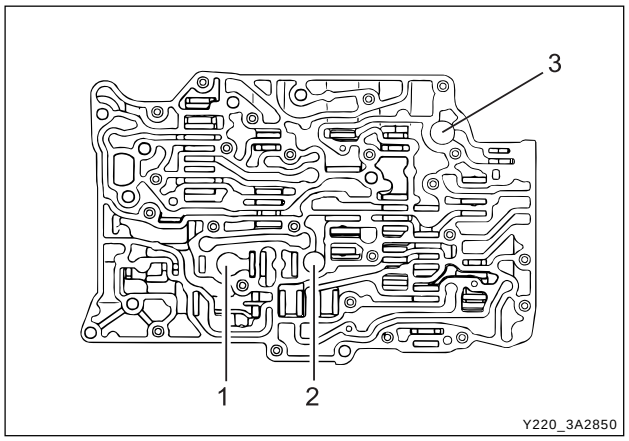


10. Install the solenoid supply valve, spring and retaining plate.

Notice

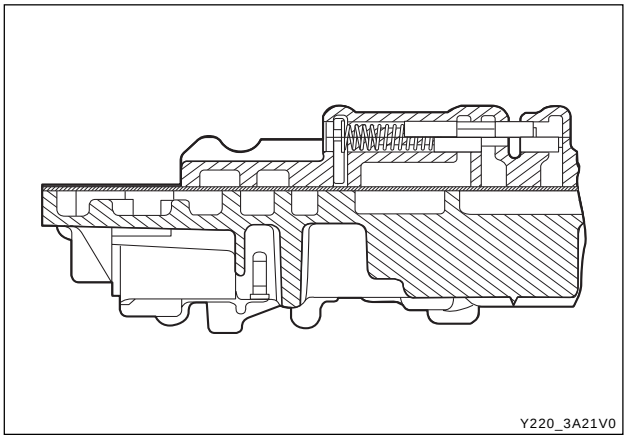
This aluminum valve is easily damaged.

11. Install solenoid 6 plunger, spring and retaining pin.

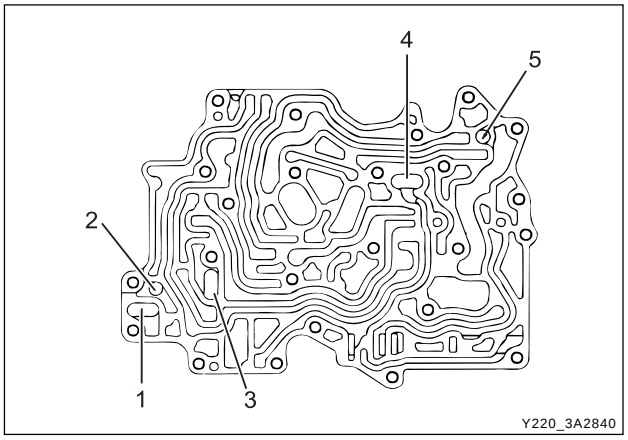


12. Position the third feed ball (large nylon) in the valve body and install the solenoid 6 filter.
13. Check the separator plate for burrs and damage. Repair or replace the separator plate as necessary.
14. Check the upper and lower valve body gaskets for damage. Replace the gaskets as necessary.
15. Install the lower valve body gasket on the lower valve body.

16. Install the reverse lockout valve, spring, plug and retaining plate. Ensure that the valve is correctly oriented.



17. Position the five nylon ball checks in the upper valve body.
18. Fit the upper valve body gasket. Install the separa-tor plate over the upper valve body.



19. Holding the separator plate to the upper valve body to prevent the check balls from falling out, install the upper valve body on the lower valve body. Install all screws finger tight then tighten the screws to specification in the prescribed sequence.

Installation Notice

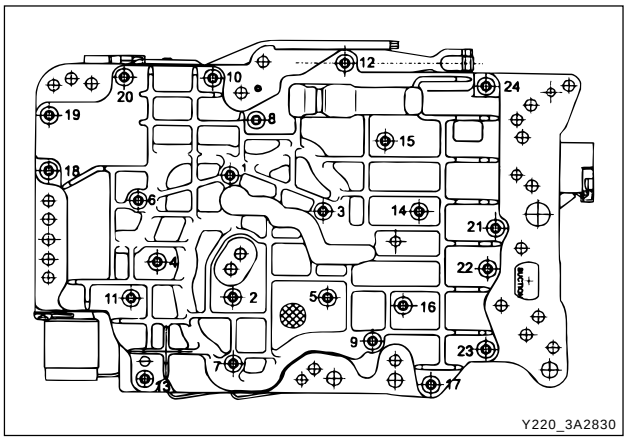
Tightening torque	11 ~ 16 Nm (8 ~ 12 lb-ft)

20. Install solenoids 1, 2, 3, 4 and 6. Ensure the solenoid is firmly secured by the retainer and that the screw is tightened to specification.

Installation Notice

Tightening torque	8 ~ 12 Nm (71 ~ 106 lb-in)

- The wiring loom ground wire eyelet terminal is secured beneath the solenoid 1 retainer.



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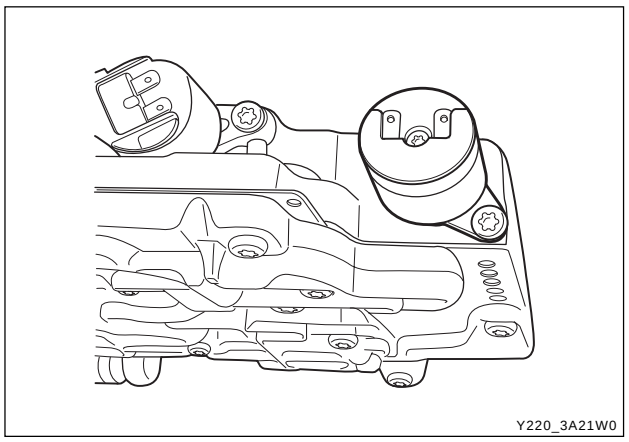
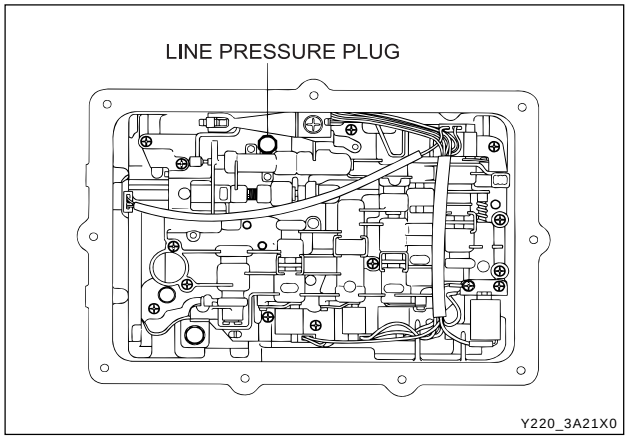


21. Install solenoid 5. Ensure that the solenoid is pushed firmly into the valve body by the retainer and that the screw is tightened to specification.

Installation Notice

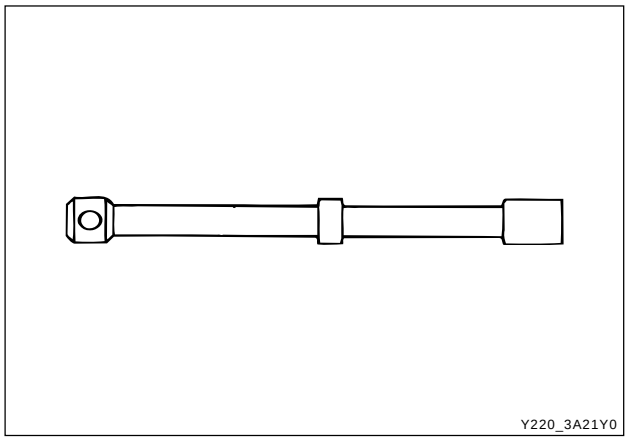
Tightening torque	8 ~ 12 Nm (71 ~ 106 lb-in)



22. Install the detent spring assembly (spring, support plate and screw), ensuring that the screw is tight-ened to specification. Check the spring for wear or damage.

Installation Notice

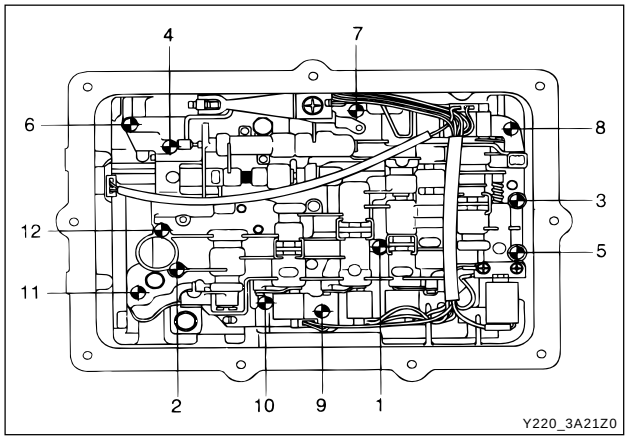
Tightening torque	20 ~ 22 Nm (15 ~ 16 lb-ft)



23. Install the manual shift valve.

Notice

Be aware that the manual valve will fall out of the valve body.



24. Align the valve body assembly on the transmission case and install the manual valve lever to manual valve link. Fit the long end of the link to the manual valve first. Install the securing bolts and tighten to specification in the specified sequence.

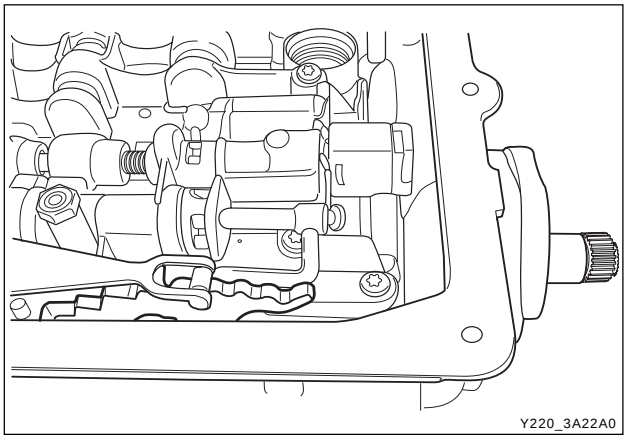
Installation Notice

Tightening torque	8 ~ 13 Nm (71 ~ 115 lb-in)

25. Check the alignment of the detent roller and the manual lever quadrant.
26. Connect the solenoid wiring as detailed below:
    Solenoid 1 - red
    Solenoid 2 - blue
    Solenoid 3 - yellow
    Solenoid 4 - orange
    Solenoid 5 - green
    Solenoid 6 - violet

Notice

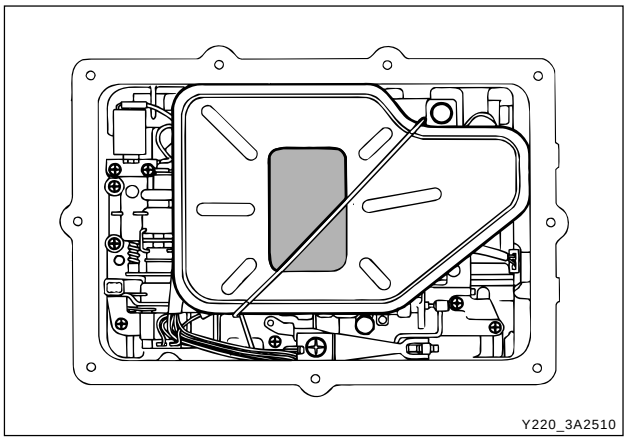
All hardware must be correctly installed and torqued to specification.



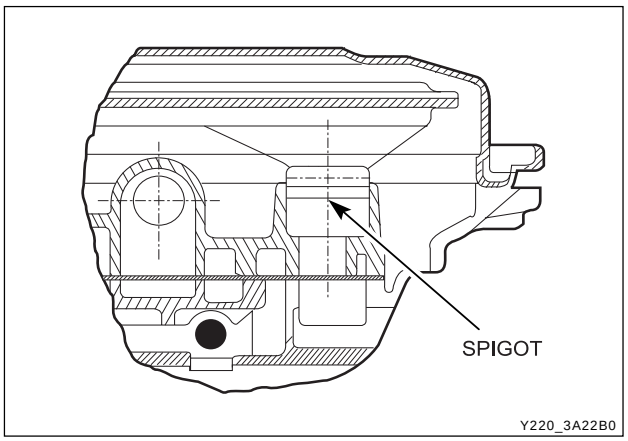
Oil Filter and Pan Assembly

Notice

- ***Replace the filter whenever rebuilding a transmission where a significant amount of mechanical damage has occurred.***
- ***To aid the assembly of the pan gasket, use a small amount of Vaseline at the pan/gasket interface. This ensures that the gasket remains on the pan ridge. Do not over torque pan bolts as this may distort the pan and cause leaks.***
- ***Ensure that the internal line pressure plus in the valve body is fitted.***



1. Lubricate the oil filter sealing ring with automatic transmission fluid.
2. Carefully assemble the oil filter to the valve body. The spigot must not lean on one side while being fitted.
3. Secure the oil filter assembly with the retainer.
4. Check that the magnet is located in the dimple in the corner of the oil pan.
5. Assemble the gasket on the pan lip. The gasket must be free of any distortion when installed.



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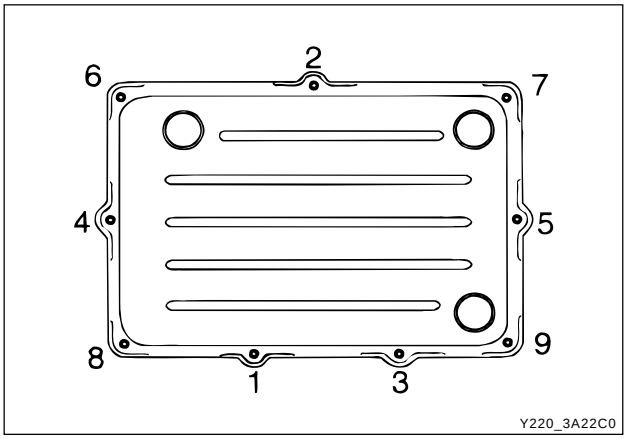
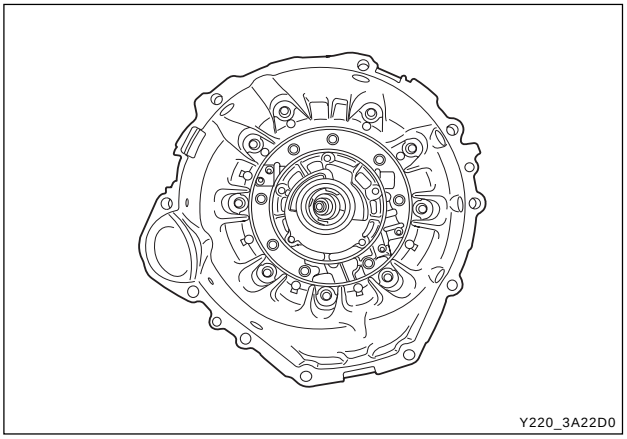


6. Fit the oil pan assembly to the transmission case and tighten the securing bolts to specification and sequence Do not over torque.

Installation Notice

Tightening torque	4 ~ 6 Nm (35 ~ 53 lb-in)



Torque Converter and Housing Assembly

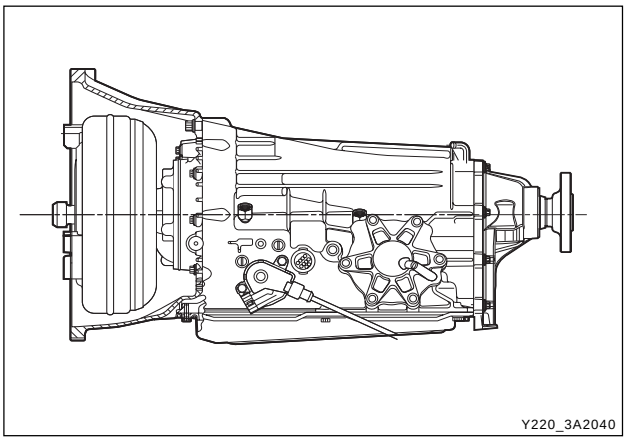
1. Locate the torque converter housing on the trans-mission main case.
2. Apply additional Loctite 202 or equivalent as required to the converter housing to case bolts. Install and tighten bolts to specification.

Installation Notice

Tightening torque	54 ~ 68 Nm (40 ~ 50 lb-ft)

- All the hardware must be correctly installed and torqued to specification.

3. Fit the converter ensuring that the tangs are engaged in the pump gear. Ensure that the tangs do not contact the pump seal.



Output Flange Assembly (2WD Mode)

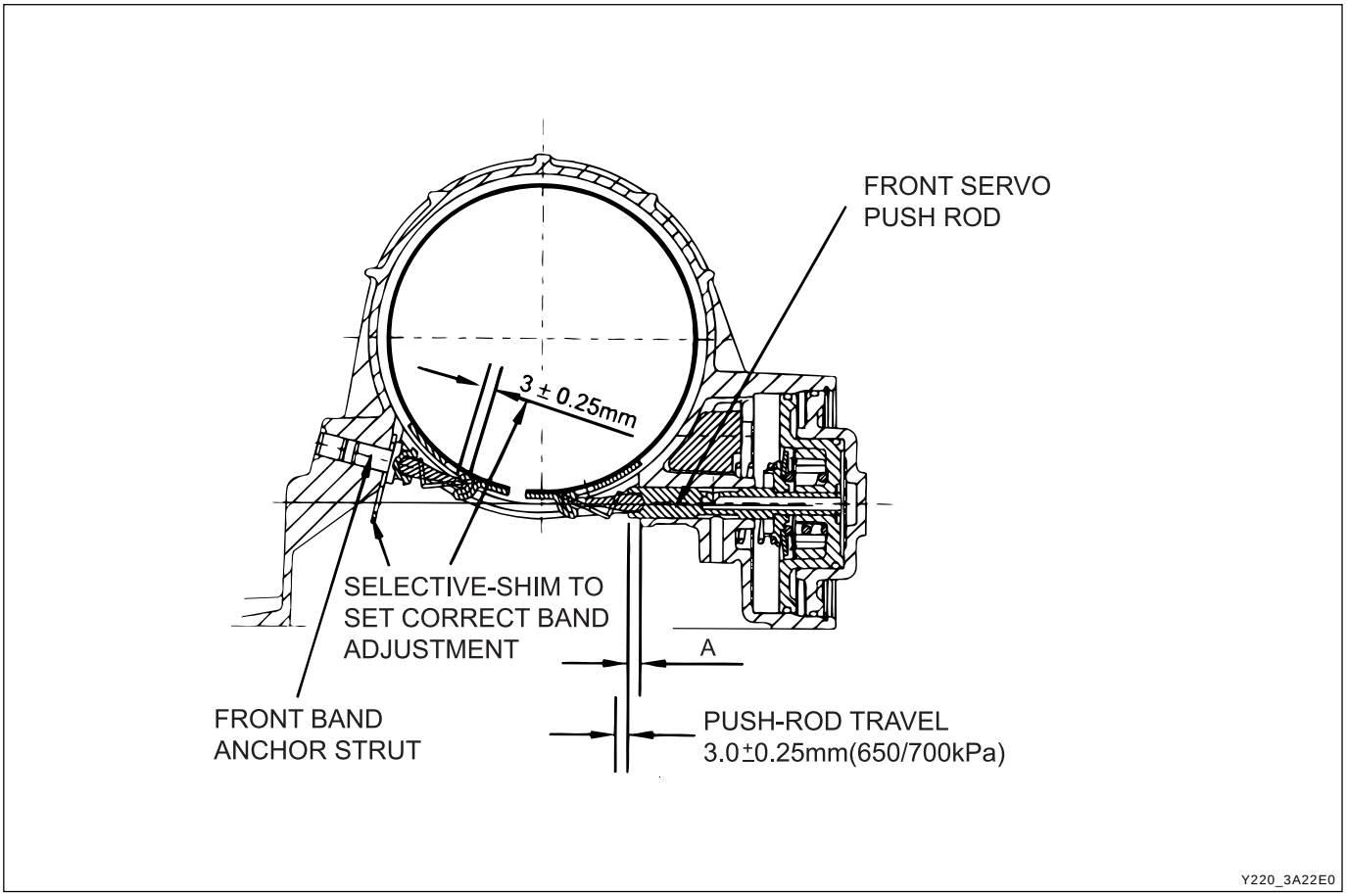
1. Position the transmission detent lever into the park position and lock the output shaft.
2. Clear the threads on the output shaft and apply Loctite 243 or equivalent as required to threads.
3. Install the flange, “O” ring and torque the nut to specification.

Installation Notice

Tightening torque	35 Nm (26 lb-ft)

FRONT AND REAR BAND ADJUSTMENT

▶ Front Band Setting Procedure



1. Measure the projection of the front servo push rod from the transmission case dimension 'A'.
   a. Apply air at 650/700 kPa to the front servo apply area (B1 outer)
   b. Measure the travel of the push rod and subtract 3 mm to find the shim size required.
   c. Release the air.

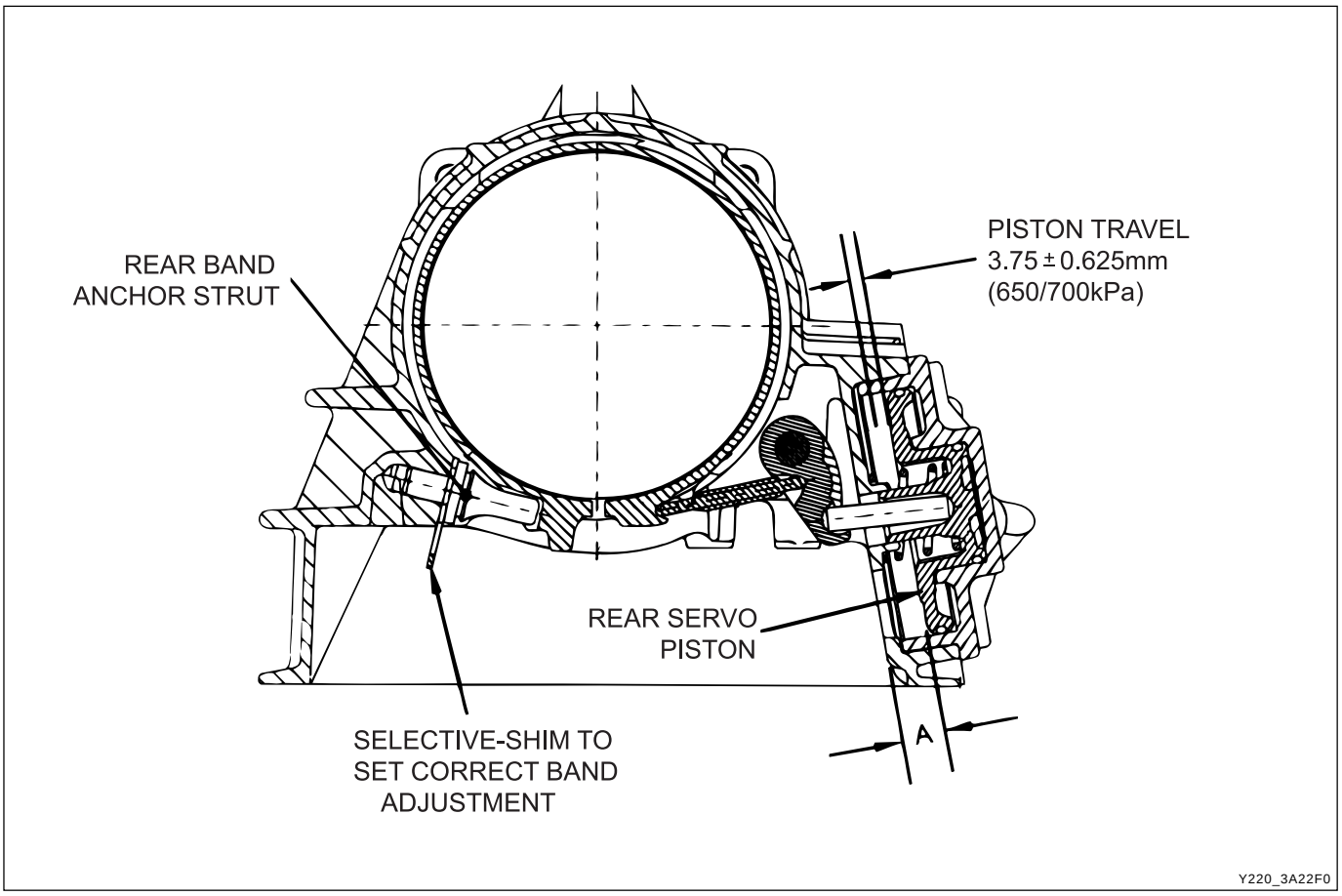
Thickness(mm)	Part Number
0.95/1.05	0574-037017
1.15/1.25	0574-037018
1.44/1.56	0574-037019
1.73/1.87	0574-037020
1.93/2.07	0574-037021
2.12/2.28	0574-037022
2.42/2.58	0574-037023
2.61/2.79	0574-037024

Notice

A minimum of one shim is required at all times - minimum shim size is 1 mm. The thickness of available shims are listed in the table below.

2. Fit the selected shim(s) to the shank of the anchor strut as follows:
   a. Inspect the shim(s) for damage, wear or corrosion. Replace as necessary.
   b. The shim(s) are to be installed between the case abutment face and the anchor strut flange.
   c. The shim(s) are to be fitted by hand and under no circumstances to be hammered or forced.
   d. Shim(s) are to be pressed on by hand until an audible click is heard. The click indicates that the shim is clipped home correctly.
3. Re-check that the push rod travel.
   (3mm ± 0.25mm)

▶ Rear Band Setting Procedure



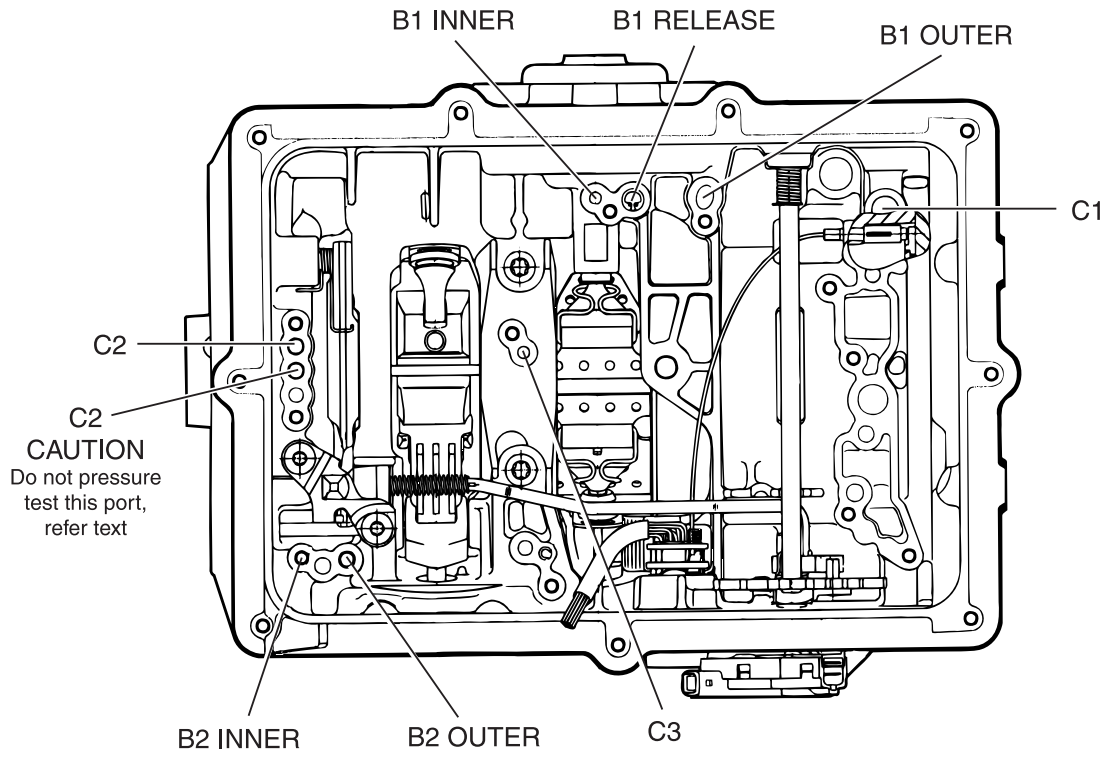
1. Measure distance “A” from the rear servo piston to the inner face of the transmission case using vernier calipers.
   a. Apply air at 650/700 kPa to the rear servo apply area (B2 outer)
   b. Measure the travel of the piston, subtract 3.75 mm and divide the remainder by 2.5 to find shim size.
   c. Release the air.

Thickness(mm)	Part Number
0.0.95/1.05	0574-037017
1.15/1.25	0574-037018
1.44/1.56	0574-037019
1.73/1.87	0574-037020
1.93/2.07	0574-037021
2.12/2.28	0574-037022
2.42/2.58	0574-037023
2.61/2.79	0574-037024

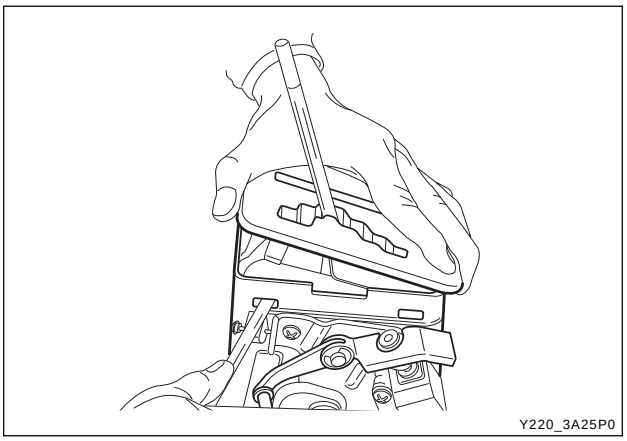
Notice

A minimum of one shim is required at all times - minimum shim size is 1 mm. The thickness of available shims are listed in the table below.

2. Fit the selected shim(s) to the shank of the anchor strut as follows.
   a. Inspect the shim(s) for damage, wear or corrosion and replace as necessary. The shim(s) are to be installed between the case abutment face and the anchor strut flange.
   b. The shim(s) are to be fitted by hand and under no circumstances to be hammered or forced
   c. The shim(s) are to be pressed on by hand until an audible click is heard. The click indicates that the shim is clipped home correctly.
3. Re-check that the piston travel.
   (3.75 mm ± 0.625 mm)

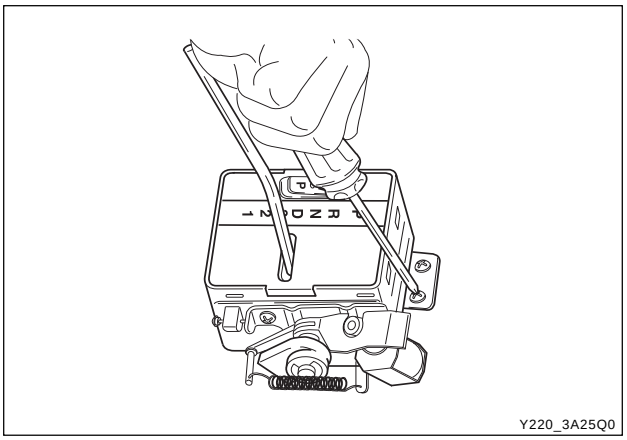

B1 INNER
B1 RELEASE
B1 OUTER
C1
C2
C2
CAUTION
Do not pressure test this port, refer text
B2 INNER
B2 OUTER
C3
Y220_3A22G0

GEAR SHIFT CONTROL LEVER


Y220_3A25P0

Disassembly and Assembly Procedure

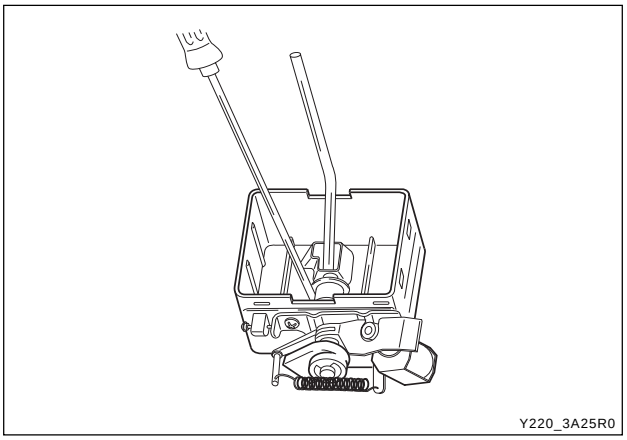
1. Disconnect the negative battery cable.
2. Remove the gear shift control lever assembly. Refer to *Section Interior Trim.*
3. Remove the gear shift control lever knob.
4. Separate the upper and middle housing from the gear shift control lever assembly by unlocking the lock.
5. Remove the upper housing.
6. Disconnect the P position lamp by turning it from the middle housing.


Y220_3A25Q0

7. Remove the P position switches assembly bolts.
8. Remove the middle housing with the mode selector switch wiring harness from the gear shift control lever assembly.
9. Separate the P position switches assembly with the P position lamp wiring harness from the gear shift control lever assembly.

Notice

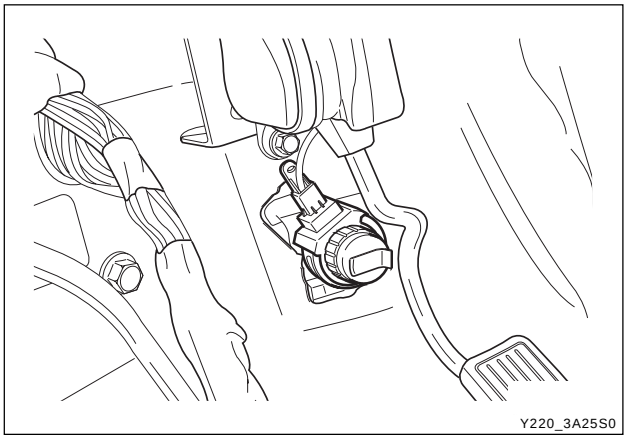
Adjust the brake transmission shift interlock ease the operation well.


Y220_3A25R0

10. Remove the clips supporting the springs and bushes from the pin of the pin of the gear shift control lever.
11. Remover the spring and bushes from the pin of the gear shift control lever.
12. Remove the gear shift control lever by pushing the pin.
13. Installation should follow the removal procedure in the reverse order.

KICKDOWN SWITCH

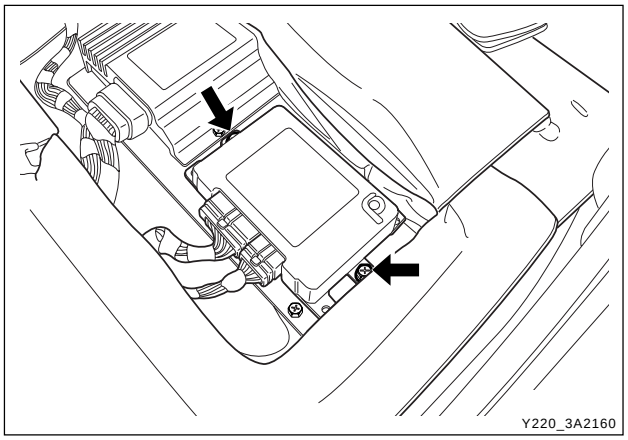
1. Separate the Kickdown Switch from the Kickdown Switch bracket by pushing the lock.
2. Disconnect the Kickdown Switch connector.
3. Installation should follow the removal procedure in the reverse order.



TRANSMISSION CONTROL MODULE

Removal and Installation Procedure

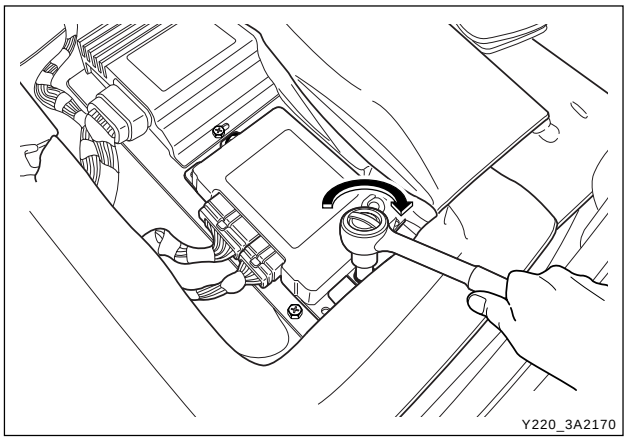
1. Disconnect the negative battery cable.
2. Push the driver's seat and disconnect the transmission control module connector.



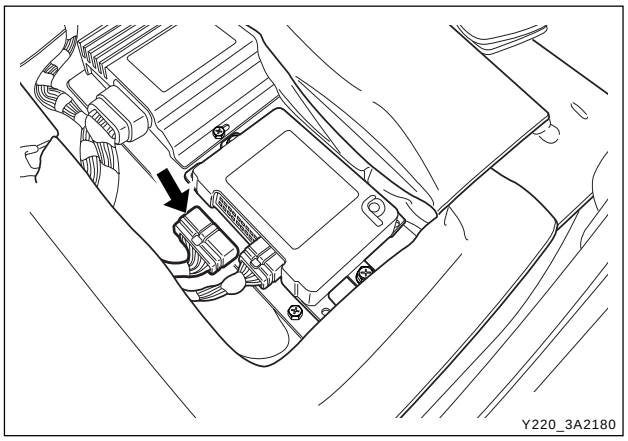
3. Removal the TCM mounting bolts and TCM.

   Installation Notice

Tightening torque	10 Nm (89 lb-ft)



4. Installation should follow the removal procedure in the reverse order.



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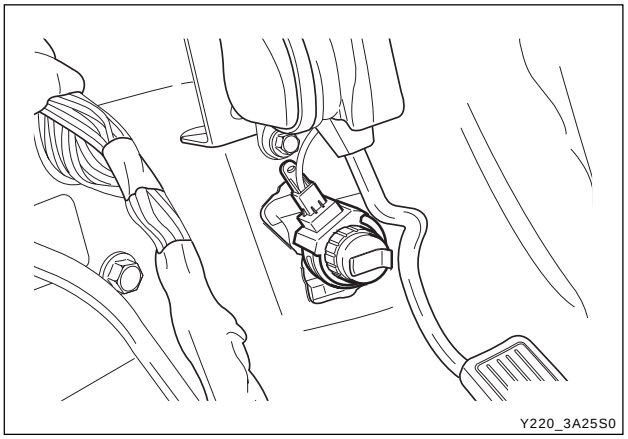
KICKDOWN SWITCH

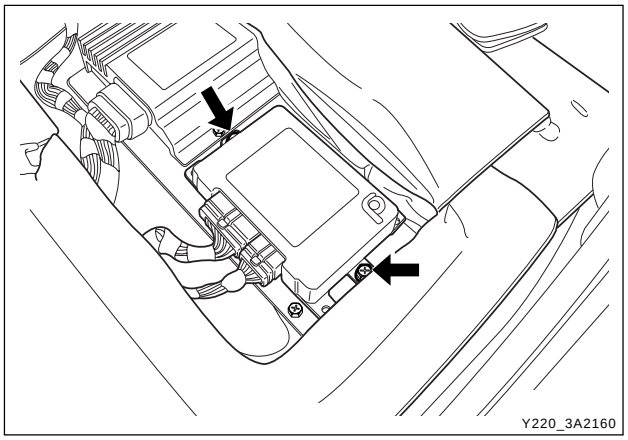
1. Separate the Kickdown Switch from the Kickdown Switch bracket by pushing the lock.
2. Disconnect the Kickdown Switch connector.
3. Installation should follow the removal procedure in the reverse order.



TRANSMISSION CONTROL MODULE

Removal and Installation Procedure

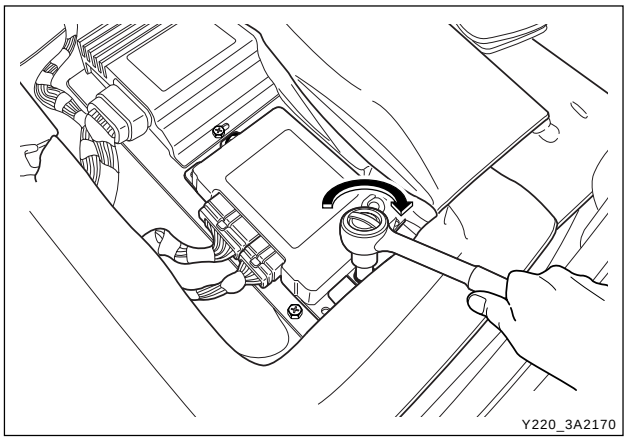
1. Disconnect the negative battery cable.
2. Push the driver's seat and disconnect the transmission control module connector.



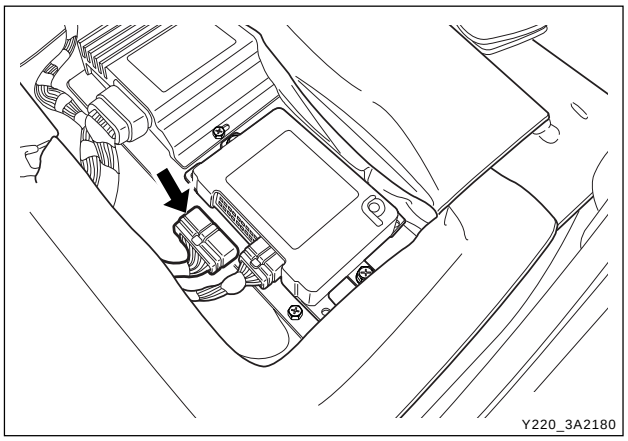
3. Removal the TCM mounting bolts and TCM.

   Installation Notice

Tightening torque	10 Nm (89 lb-ft)



4. Installation should follow the removal procedure in the reverse order.



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SPECIFICATIONS

GENERAL SPECIFICATION

▶ Model Part Numbers and Applications

SYMC P/NO	Transmission	Engine Version	Torque Converter
36100-05443	0574-000013	E23	179K
36100-05433	0574-000012	E32	150K
36100-05413	0574-000014	662LA	150K

▶ Model Specifications

Application	Descriprtion
Torque Converter	
Mean Diameter of Fluid Circuit Description	260 mm (10.2 in.)
Maximum Torque Multiplication	2.0 : 1
Gear Ratios	
First	2.741 : 1
Second	1.508 : 1
Third	1.000 : 1
Fourth	0.708 : 1
Reverse	2.429 : 1
Lubricant	
Type	Castrol TQ95
Capacity	
Dry System	9.0 Liters (approx.)
Service Refill	4.5 Liters (approx.)
Gear Train End Float	0.50 ~ 0.65 mm (0.020 ~ 0.026 in.)
Gear Set Pinion End Float	0.10 ~ 0.50 mm (0.004 ~ 0.020 in.)

▶ Clutch Pack Details

	0574-000012	0574-000013 (14)
C1		
Composition	5	4
Steel	5	6
C2		
Composition	5	4
Steel	4	5
C3		
Composition	4	3
Steel	4	5
C4		
Composition	3	3
Steel	4	4

▶ Model Part Numbers and Applications

E23 Gasoline Engine

MODE	THROTTLE OPENING	SHIFT (km/h)									
		1/2	2/3	3/4	4/3	3/2	2/1	UNL3	LCK3	UNL4	LCK4
NORMAL MODE	0 %	10.1	19.3	36.4	20.8	8.9	9.2	50.7	79.1	71.7	79.1
	16 %	10.1	19.3	36.4	20.8	8.9	9.2	50.7	79.1	71.7	79.1
	31 %	13.9	30.9	47.0	28.4	12.4	9.2	50.7	79.1	71.7	79.1
	49 %	22.3	46.1	70.5	41.8	18.9	9.3	50.7	90.3	74.2	90.3
	50 %	22.8	46.4	71.7	42	19.2	9.3	50.7	58.1	75.4	91.5
	58 %	27.2	53.2	89.0	52.7	24.7	10.9	59.4	66.8	81.6	100.2
	64 %	30.9	59.4	94.0	60	28.4	12.1	66.8	74.2	86.6	106.4
	71 %	34.1	66.5	103.3	69.3	32.6	18.6	71.7	76.7	95.8	115.0
	100 % (WOT)	47.4	91.9	147.2	98.9	45.5	34.6	81.6	95.1	134.3	147.2
	Kickdown	47.9	94.0	149.6	139.7	86.9	45.4	90.7	95.5	147.2	149.6
POWER MODE	0 %	11.9	22.8	42.0	20.8	8.9	9.2	73.0	75.4	73.0	75.4
	16 %	11.9	22.8	42.0	20.8	8.9	9.2	73.0	75.4	73.0	75.4
	31 %	22.5	42.0	70.0	33.4	17.3	9.2	73.0	79.1	73.0	79.1
	49 %	27.2	56.9	87.2	42.0	24.7	9.2	73.6	94.0	73.6	94.0
	50 %	30.7	64.3	96.5	49.5	29.7	10.4	76.2	103.9	76.2	103.9
	58 %	35.1	73.2	110.8	60.6	37.8	15.1	81.6	110.8	81.6	110.8
	64 %	37.6	77.4	116.3	68	42.5	18.1	86.6	116.3	87.8	116.3
	71 %	40.1	81.1	121.2	77.7	47.7	20.8	86.6	121.2	97.7	121.2
	100 % (WOT)	47.4	91.9	147.2	115.0	66.7	33.0	86.6	136.0	142.2	147.2
	Kickdown	47.9	94.0	149.6	139.7	86.9	45.4	90.7	95.5	147.2	149.6

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E32 Gasoline Engine

MODE	THROTTLE OPENING	SHIFT (km/h)									
		1/2	2/3	3/4	4/3	3/2	2/1	UNL3	LCK3	UNL4	LCK4
NORMAL MODE	0 %	11.7	20.2	39.5	24.6	10.2	10.5	37.4	81.9	73.1	81.9
	15 %	11.7	22.8	39.5	24.6	10.2	10.5	37.4	81.9	73.1	81.9
	25 %	13.3	30.4	67.3	32.2	14.6	10.5	37.4	81.9	73.1	81.9
	32%	16.8	36.6	76.0	38.0	19.7	11.0	39.5	83.4	73.1	83.4
	35 %	18.6	40.1	80.4	40.9	21.9	11.7	40.9	62.9	74.6	86.3
	45 %	24.0	49.7	93.6	52.6	27.8	13.9	46.8	70.2	81.9	93.6
	55 %	31.9	66.1	114.1	70.2	32.2	17.3	54.1	79.0	102.4	114.1
	70 %	42.1	85.4	146.2	90.7	39.5	21.9	64.3	93.6	128.7	146.2
	100 % (WOT)	56.7	110.0	170.4	119.9	46.8	26	93.6	114.1	152.1	170.4
	Kickdown	57.0	110.6	175.5	163.8	104.7	50.3	116.4	119.3	166.7	175.5
POWER MODE	0 %	12.3	24.6	40.9	24.6	10.2	10.5	76.0	81.9	76.0	81.9
	15 %	14.0	27.8	43.9	29.2	10.2	10.5	76.0	81.9	76.0	81.9
	25 %	23.4	43.9	65.8	39.5	17.5	11.0	76.0	81.9	76.0	81.9
	32 %	24.6	49.1	76.6	46.1	24.9	11.6	81.9	90.7	81.9	90.7
	35 %	26.3	52.6	81.9	51.2	27.8	12.0	84.8	96.5	84.8	96.5
	45 %	32.2	65.8	105.3	67.3	37.3	15.4	102.4	117.0	102.4	117.0
	55 %	38.6	76.9	125.8	87.7	51.2	21.4	111.1	125.8	114.1	125.8
	70 %	46.7	90.8	146.2	113.3	66.5	28.7	111.1	146.2	128.7	146.2
	100 % (WOT)	56.7	110.0	170.4	148.4	89.9	42.4	111.1	170.4	152.1	170.4
	Kickdown	57.0	110.6	175.5	163.8	104.7	50.3	116.4	119.3	166.7	175.5

662LA Diesel Engine

MODE	THROTTLE OPENING	SHIFT (km/h)									
		1/2	2/3	3/4	4/3	3/2	2/1	UNL3	LCK3	UNL4	LCK4
NORMAL MODE	0 %	11.4	20.4	35.4	26.7	9.3	9.5	47.6	76.2	72.1	76.2
	25 %	11.4	20.4	35.4	27.2	9.3	9.5	47.6	76.2	72.1	76.2
	40 %	12.2	25.4	40.8	29.9	13.6	9.5	47.6	76.2	72.1	76.2
	60 %	14.7	36.5	61.8	38.1	21.8	9.5	47.6	76.2	72.1	76.2
	61 %	14.7	36.7	62.0	38.4	22.0	9.5	47.6	50.3	72.1	76.2
	70 %	16.6	40.0	70.7	43.5	25.9	12.2	47.6	51.7	72.1	77.0
	75 %	18.2	43.3	76.2	49.0	28.6	13.6	47.6	54.4	72.1	81.6
	80 %	21.8	51.7	84.4	54.4	31.3	15.0	49.0	57.7	75.1	89.0
	100 % (WOT)	28.6	62.6	104.5	69.4	38.1	19.6	57.1	62.6	92.5	104.5
	Kickdown	34.8	68.0	110.2	100.7	63.9	31.3	61.2	68.0	100.7	110.2
POWER MODE	0 %	11.7	21.8	38.1	26.7	9.3	9.5	61.2	76.2	72.1	76.2
	25 %	11.7	21.8	38.1	31.3	9.3	9.5	61.2	76.2	72.1	76.2
	40 %	14.1	27.5	43.5	32.7	16.3	10.2	61.2	76.2	72.1	76.2
	60 %	21.8	44.6	69.4	47.6	27.2	12.8	61.2	76.2	72.1	76.2
	61 %	28.0	57.1	88.7	54.4	35.4	14.4	61.2	88.7	72.1	88.7
	70 %	29.9	59.9	93.9	61.2	40.8	15.8	61.2	93.9	72.1	93.9
	75 %	31.3	61.8	96.6	65.3	46.3	17.4	61.2	96.6	75.1	96.6
	80 %	32.7	64.8	100.4	70.7	50.3	20.4	61.2	100.4	81.6	100.4
	100 % (WOT)	34.0	67.8	105.3	83.0	54.4	23.1	61.2	105.3	92.5	105.3
	Kickdown	34.8	68.0	110.2	100.7	63.9	31.3	61.2	68.0	100.7	110.2

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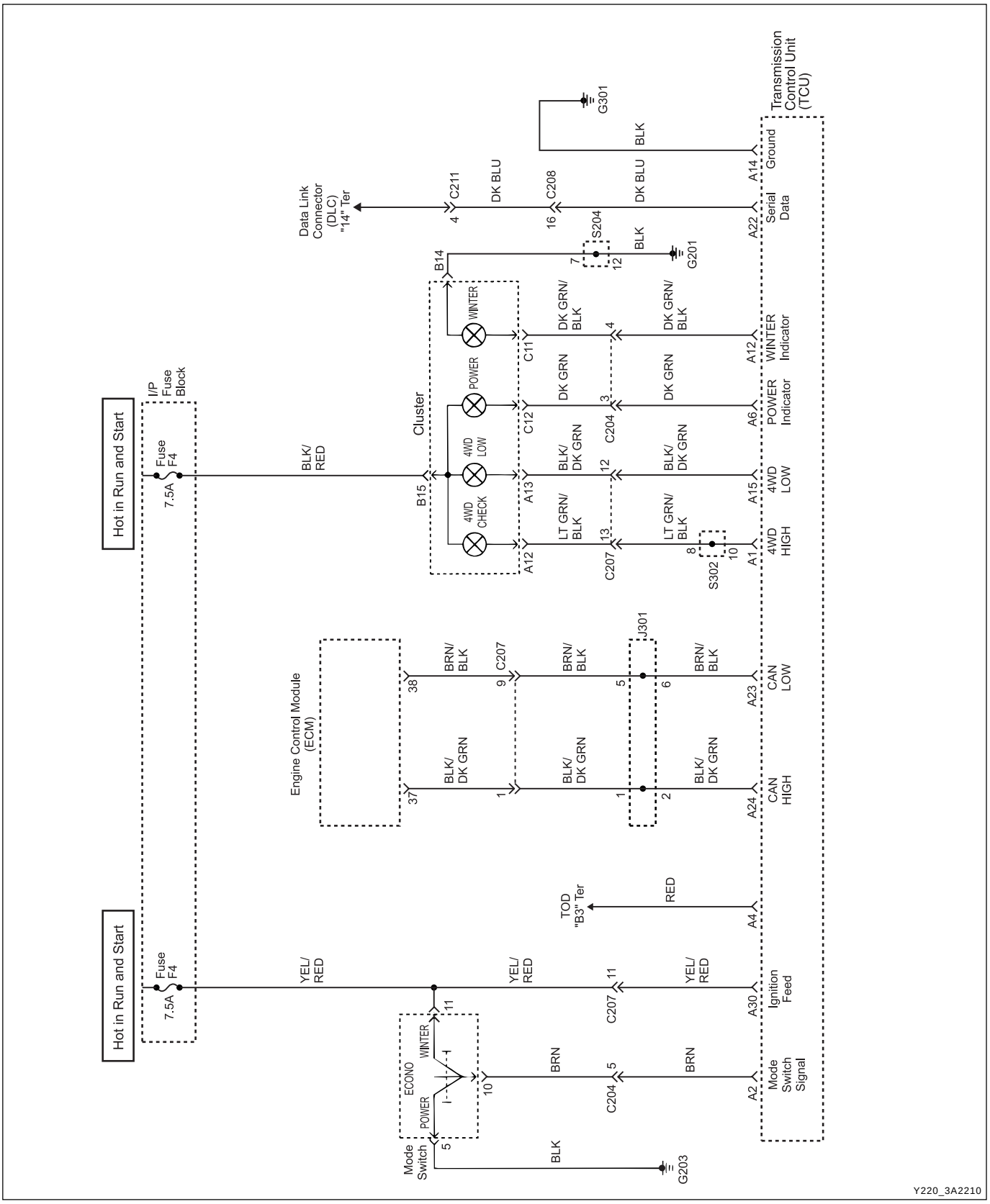
FASTENER TIGHTENING SPECIFICATIONS

Application	Nm	Lb-Ft	Lb-Ft
Adaptor Housing to Case Bolts	30 ~ 35	22 ~ 26	-
Cam Plate to Case (Parking Pawl) Screws	16 ~ 22	12 ~ 16	-
Centre Support to Case Bolts	20 ~ 27	15 ~ 20	-
Detent Spring Screw	20 ~ 22	15 ~ 16	-
Extension Housing to Case Bolts	54 ~ 68	40 ~ 50	-
Front Propeller Shaft Bolts	70 ~ 80	52 ~ 59	-
Inhibitor Switch to Case Bolts	4 ~ 6	-	35 ~ 53
Oil Cooler Pipes	40 ~ 45	29 ~ 33	-
Oil Pan to Case Bolts	4 ~ 6	-	35 ~ 53
On/Off Solenoid Retainer Screws	8 ~ 12	-	71 ~ 106
Output Flange Nuts	35	26	-
Pump Cover Plate to Crescent Screw	13 ~ 16	10 ~ 12	-
Pump Cover Plate to Pump Cover Screws	13 ~ 16	10 ~ 12	-
Pump Cover to Case Bolts	24 ~ 34	18 ~ 25	-
Pump to Pump Cover Bolts	24 ~ 27	18 ~ 20	-
Rear Propeller Shaft Bolts	70 ~ 80	52 ~ 59	-
Rear Servo Cover to Case Bolts	30 ~ 35	22 ~ 26	-
TCM Mounting Bolt	10	-	89
Torque Converter Housing to Case Bolts	54 ~ 68	40 ~ 50	-
Torque Converter Mounting Bolts	42	31	-
Transfer Case to Transmission Housing Bolts	35 ~ 60	26 ~ 44	-
Transmission Filler Plug	30 ~ 35	22 ~ 26	-
Upper Valve Body to Lower Valve Body Screws	11 ~ 16	8 ~ 12	-
Valve Body To Case Bolts	8 ~ 13	-	71 ~ 115
Variable Pressure Solenoid (S5) Retainer Screw	8 ~ 12	-	71 ~ 106

SCHEMATIC AND ROUTING DIAGRAMS

TCU WIRING DIAGRAM (GASOLINE ENGINE-1 OF 2)



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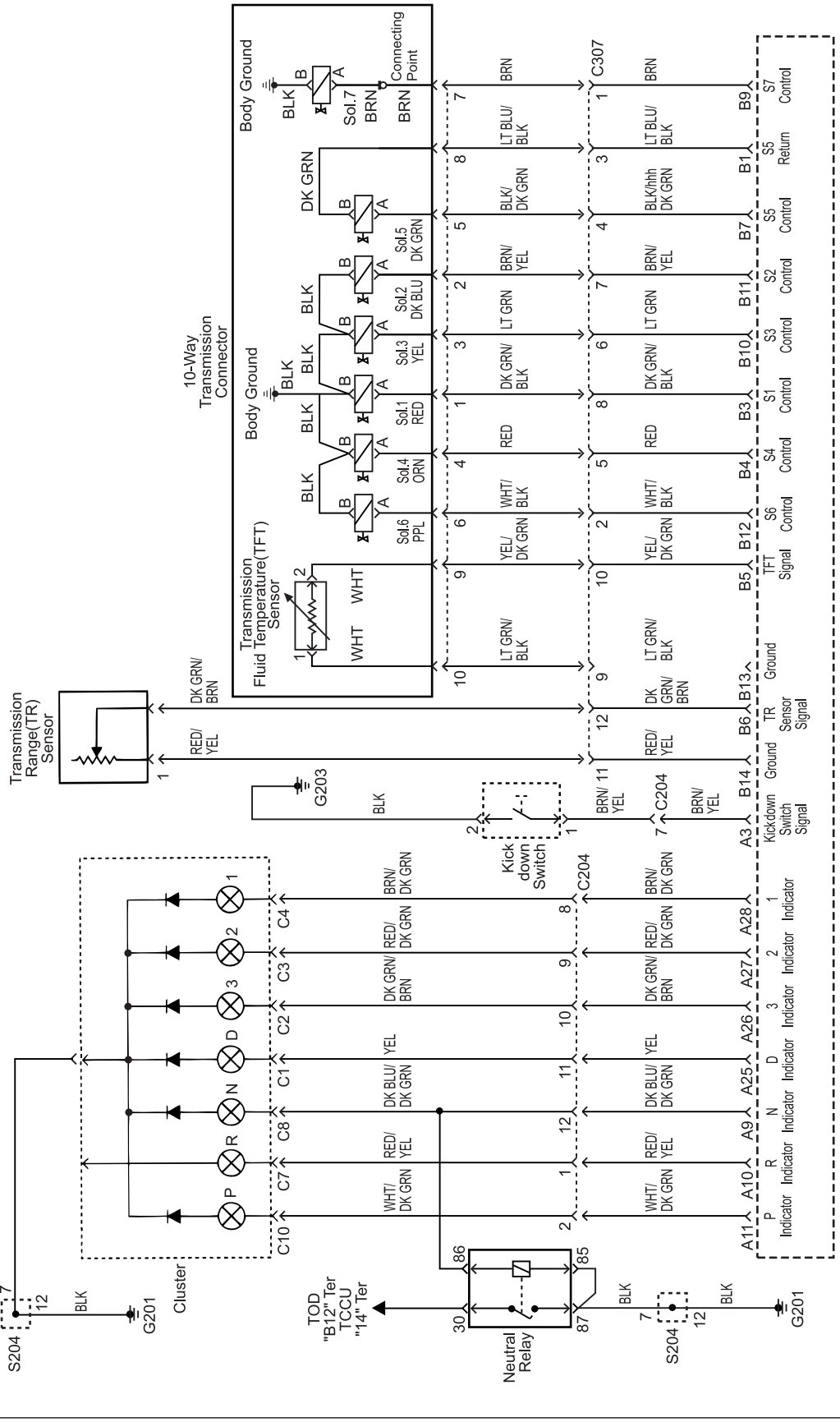
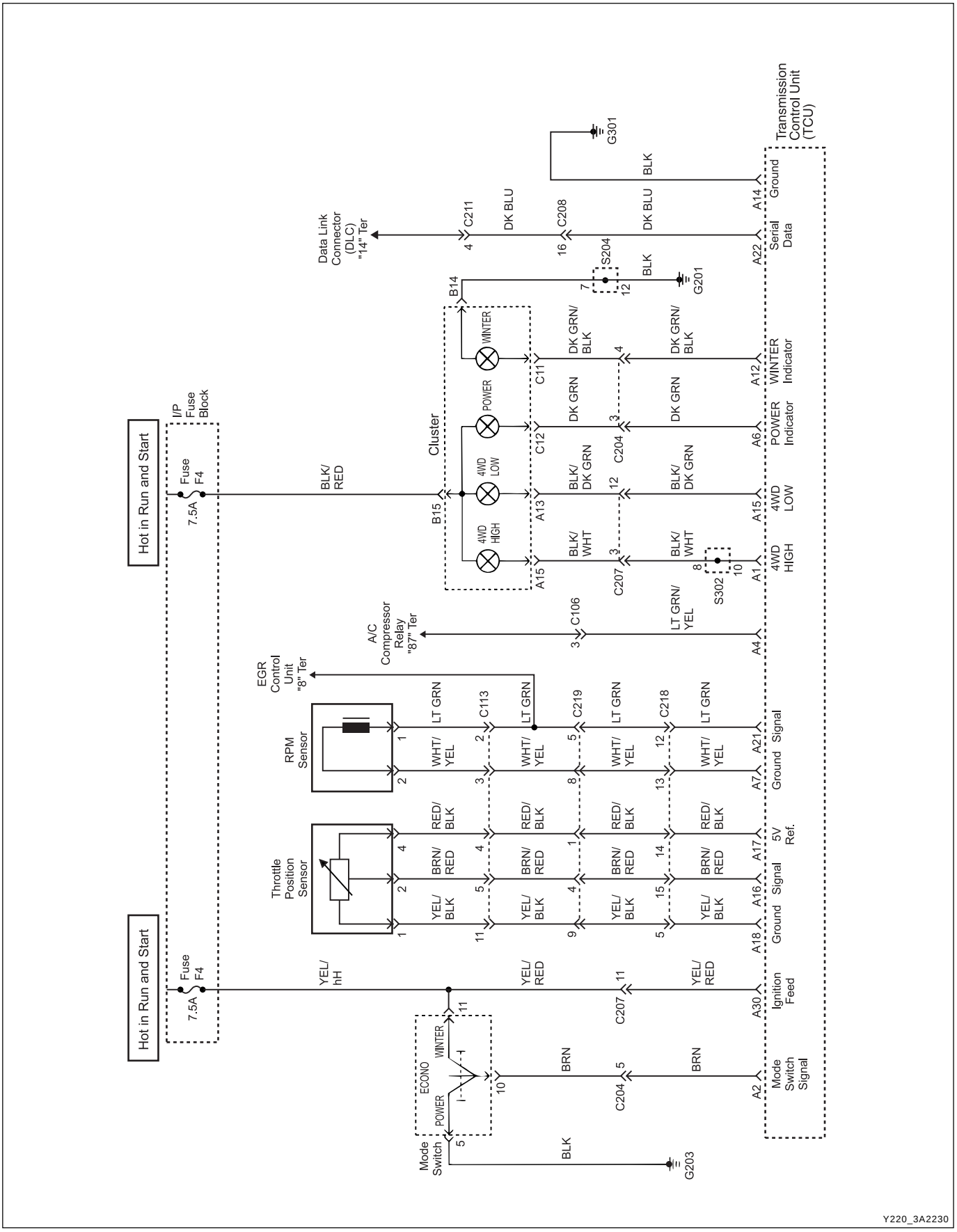
▶ TCU WIRING DIAGRAM (GASOLINE ENGINE-2 OF 2)



▶ TCU WIRING DIAGRAM (DIESEL ENGINE-1 OF 2)



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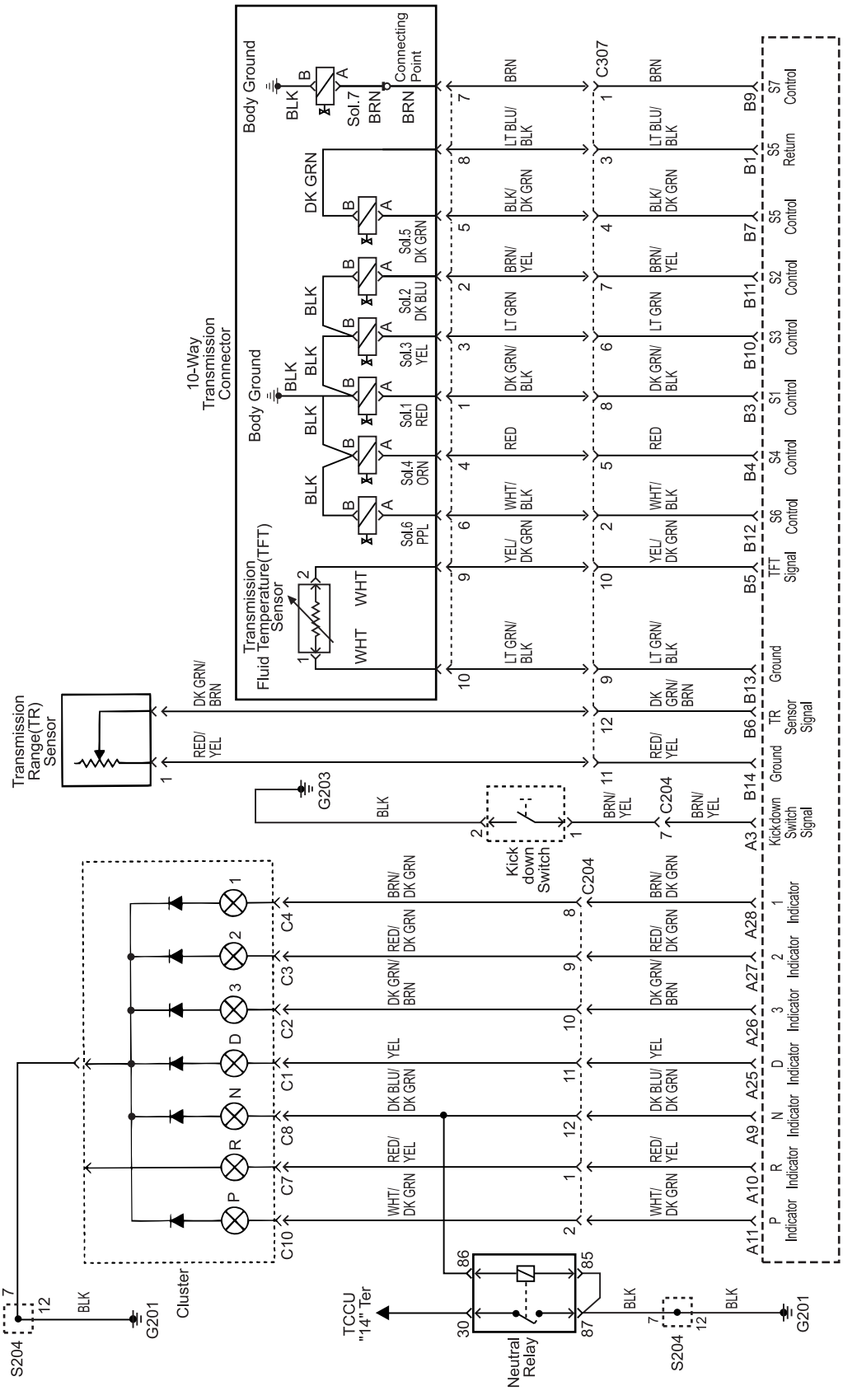
▶ TCU WIRING DIAGRAM (DIESEL ENGINE-2 OF 2)



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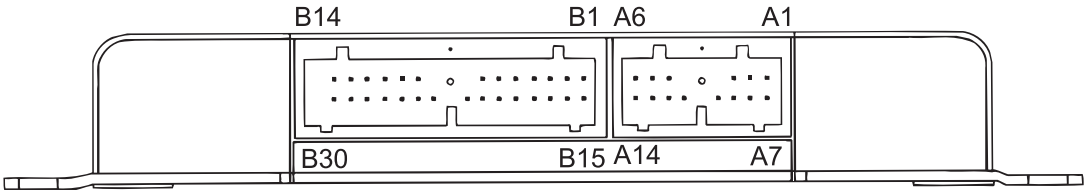
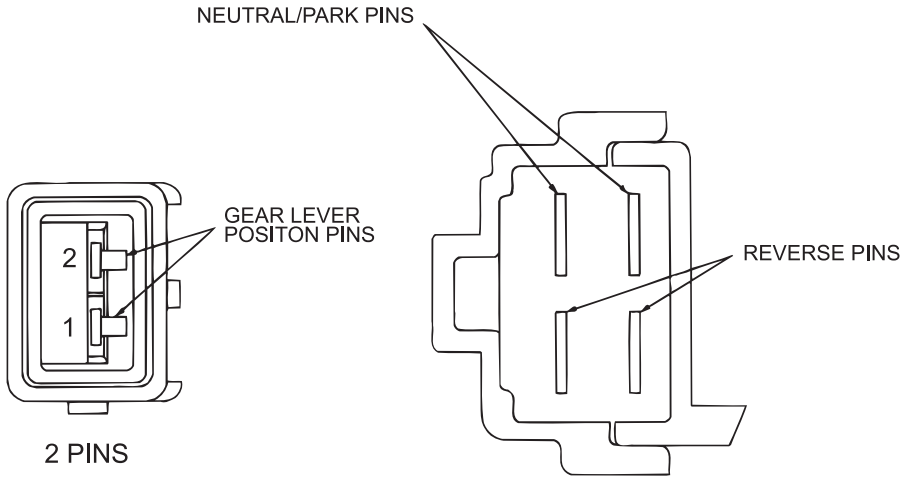
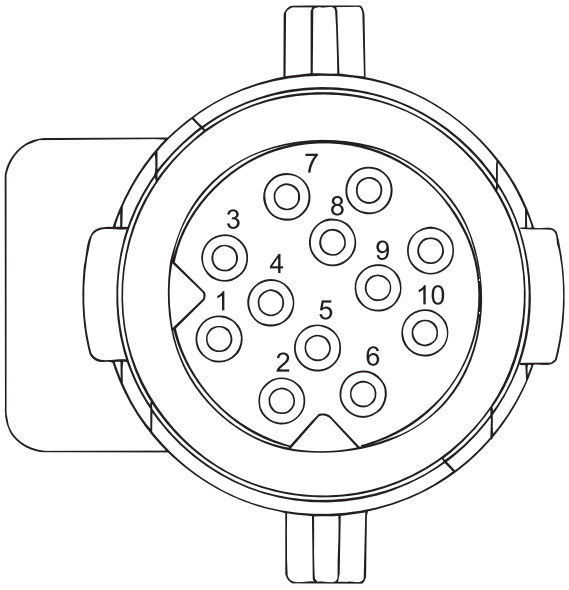
CONNECTOR END VIEW



Transmission Control Unit (TCU) Pin Numbers



Inhibitor Switch Pins



10-Way Transmission Connector

Y220_3A25O0

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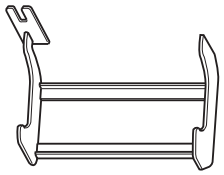
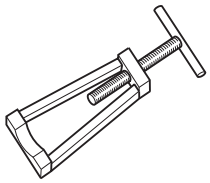
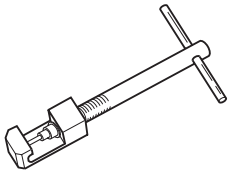
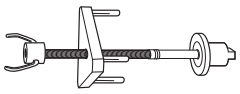
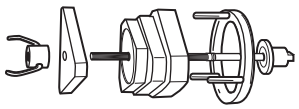
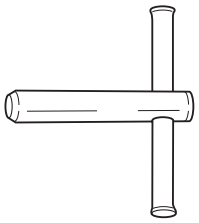
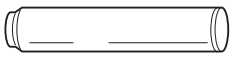
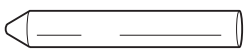
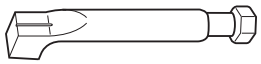
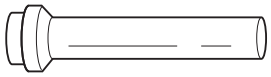
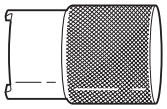
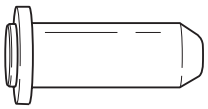
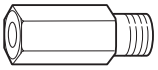
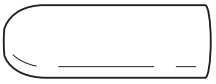
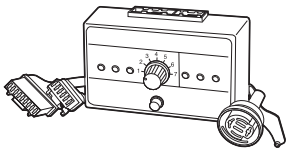
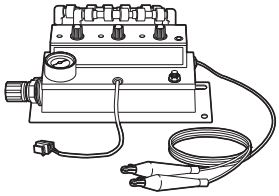
SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	
0555 - 336256 **Transmission Bench Cradle**  Y220_3A22P0	**0555 - 336257** **Pump Puller**  Y220_3A22Q0
0555 - 336258 **Cross Shaft Pin Remover/Installer (Detent Lever)**  Y220_3A22R0	**0555 - 336259** **Clutch Spring Compressor**  Y220_3A22S0
0555 - 336260 **Clutch Pack Clearance Kit**  Y220_3A22T0	**0555 - 336261** **Cross Shaft Seal Remover**  Y220_3A22U0
0555 - 336262 **Cross Shaft Seal Installer**  Y220_3A22V0	**0555 - 336263** **Cross Shaft Bullet**  Y220_3A22W0

Name and Part Number	
0555 - 336265 **Cross Shaft Pin Remover / Installer (Inhibitor Switch)**  Y220_3A22X0	**0555 - 336266** **Adaptor Housing Seal Installer**  Y220_3A22Y0
0555 - 336267 **Pump Alignment Tool**  Y220_3A22Z0	**0555 - 336268** **Pump Seal Installer**  Y220_3A23A0
0555 - 336269 **End Float Measuring Adaptor**  Y220_3A23B0	**0555 - 336270** **End Float Measuring Shaft**  Y220_3A23C0
0555 - 336302 **Output Shaft Bullet**  Y220_3A23D0	**0555 - 336045** **Solenoid Bench Tester**  KAC5A050
0555 - 332083 **Solenoid / Thermistor Electronic Tester**  KAC5A060	

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SECTION 3B

TSM54/52 MANUAL TRANSMISSION

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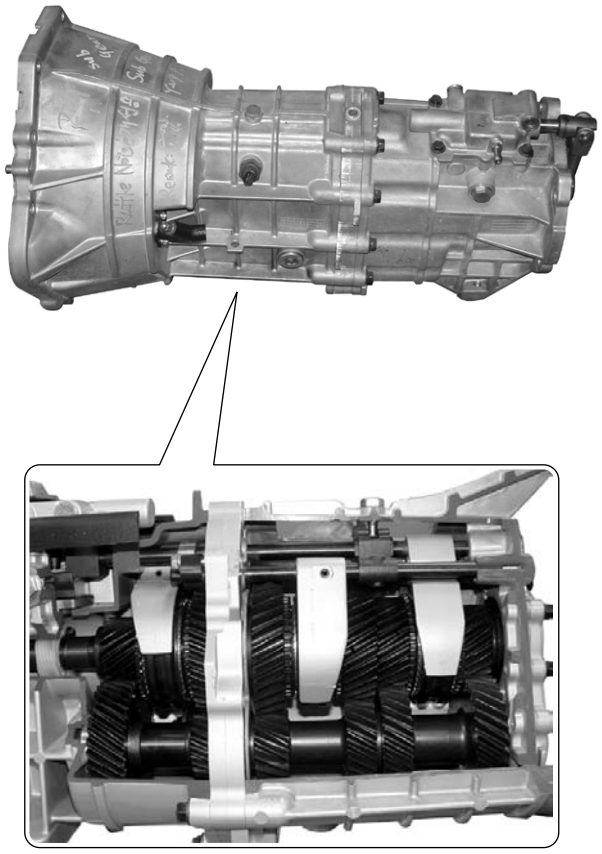
GENERAL INFORMATION

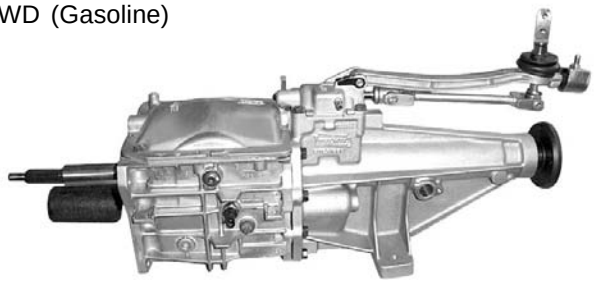
OVERVIEW

4WD



Y220_03B001

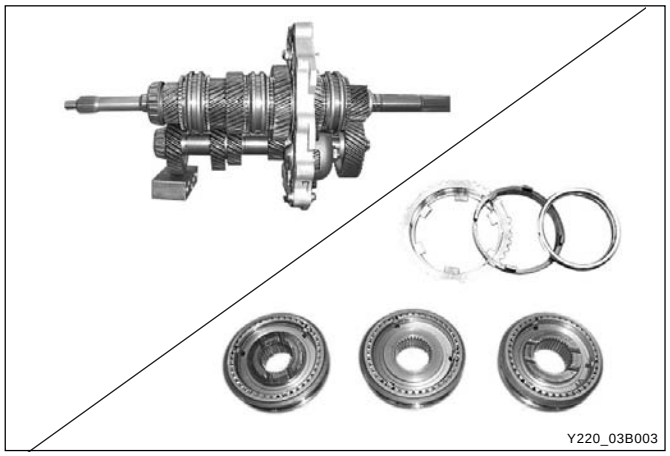
2WD (Gasoline)



Y220_03B002

1. TSM54/52 transmission is designed to link the gear ratio, installation dimensions and shapes with current T5 transmission and BTRA automatic transmission. It provides maximum drivability by the optimized engine torque and gear ratio.
2. TSM54/52 transmission uses linkage type shift elements directly connected to the transmission. It prevent the transmission from shifting to the reverse gear from 5th gear when shifting to reverse gear. It also prevents the break and wear.

▶ Features



Y220_03B003

1. All gears use the helical type and high strength materials.

   Note

   The helical type gear prevents the axial gear missing and provides less noise.

2. The synchronizing devices are installed in 1/2, 3/4, 5/R gears. To prevent the double engagement, the independent interlock devices are installed.

   Note

   TSM54/52 transmission uses the inertia lock type key to make smooth gear engagement and to provide silent gear engagement.

3. The clutch release system is available to use CSC (Concentric Slave Cylinder) or Fork type according to the vehicle model. New Rexton uses the fork type clutch release system.
4. The semi-remote control type gear shift mechanism is used to prevent incorrect shifting.

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SPECIFICATIONS

▶ General Specifications

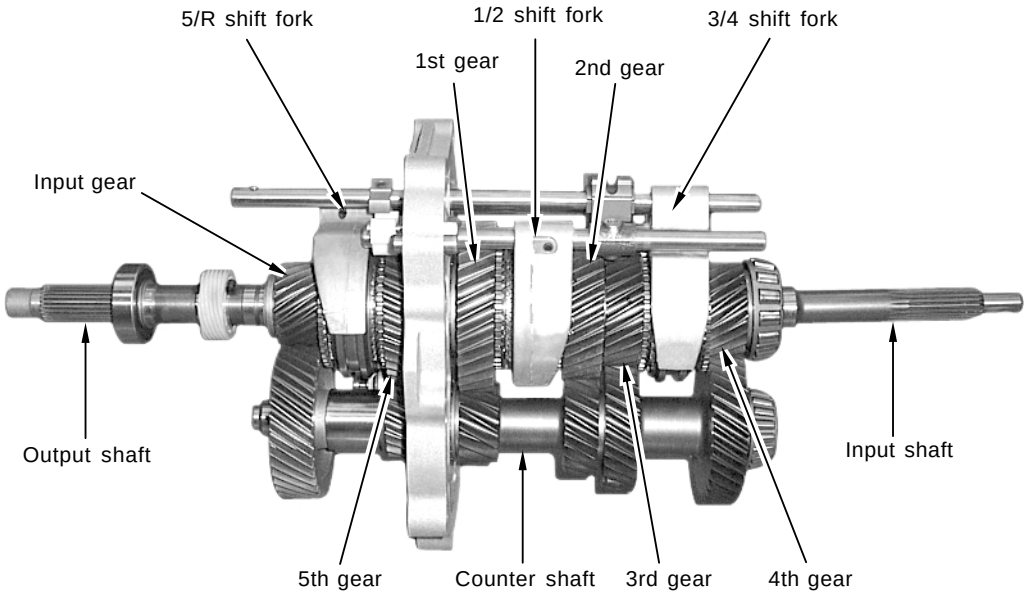
Description		IDI ENGINE	DI ENGINE
Length (mm)		4WD: 625, 2WD: 672	4WD: 628.3, 2WD: 672
Distance between shafts (mm)		81	
Input torque (kg·m)		32 (320 Nm)	34.7 (340 Nm)
Transmission control type		Semi-remote	
Weight (kg) - not including transmission fluid (kg·m)		4WD: 44, 2WD: 45	
Gear ratio/Gear teeth (input gear : main gear)	1st gear	4.007	4.315
	2nd gear	2.365	2.475
	3rd gear	1.473	1.536
	4th gear	1.000	1.000
	5th gear	0.872	0.807
	Reverse gear	3.700	3.591
Transmission fluid	Specification	ATF DEXRON II or III	
	Capacity (ℓ)	4WD: 3.6, 2WD: 3.4	
	Change interval	Inspect at every 10,000 km, replace at every 60,000 km (add or replace if necessary)	

▶ Tightening Torque

Description	Tightening Torque	
Oil drain plug	4 ~ 5 kgf·m	39.22 ~ 49.03 Nm
Backup lamp switch	3 ~ 4 kgf·m	29.42 ~ 39.22 Nm
Extension housing bolt	4.2 ~ 5.7 kgf·m	41.18 ~ 55.89 Nm
Selector lever lower cover bolt	1.7 ~ 5 kgf·m	16.67 ~ 49.03 Nm
Extension housing spring plug	3.0 ~ 3.5 kgf·m	29.42 ~ 34.32 Nm
Offset plate countersunk screw	0.4 ~ 0.6 kgf·m	3.92 ~ 5.88 Nm

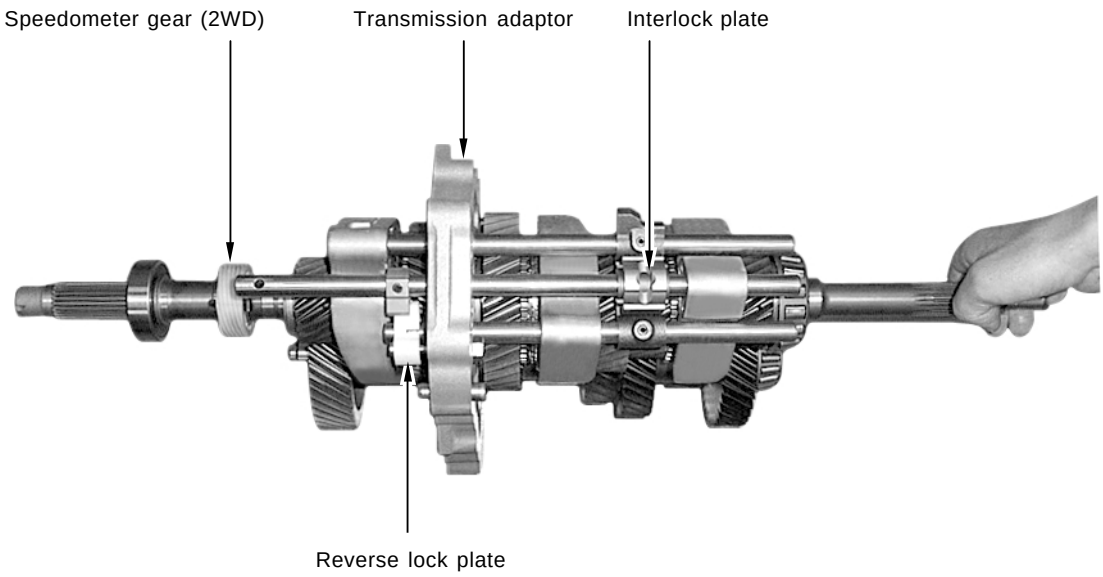
SYSTEM COMPONENTS

▶ Gear Combinations



Y220_03B006

▶ Shift Fork and Rail Combinations



Y220_03B007

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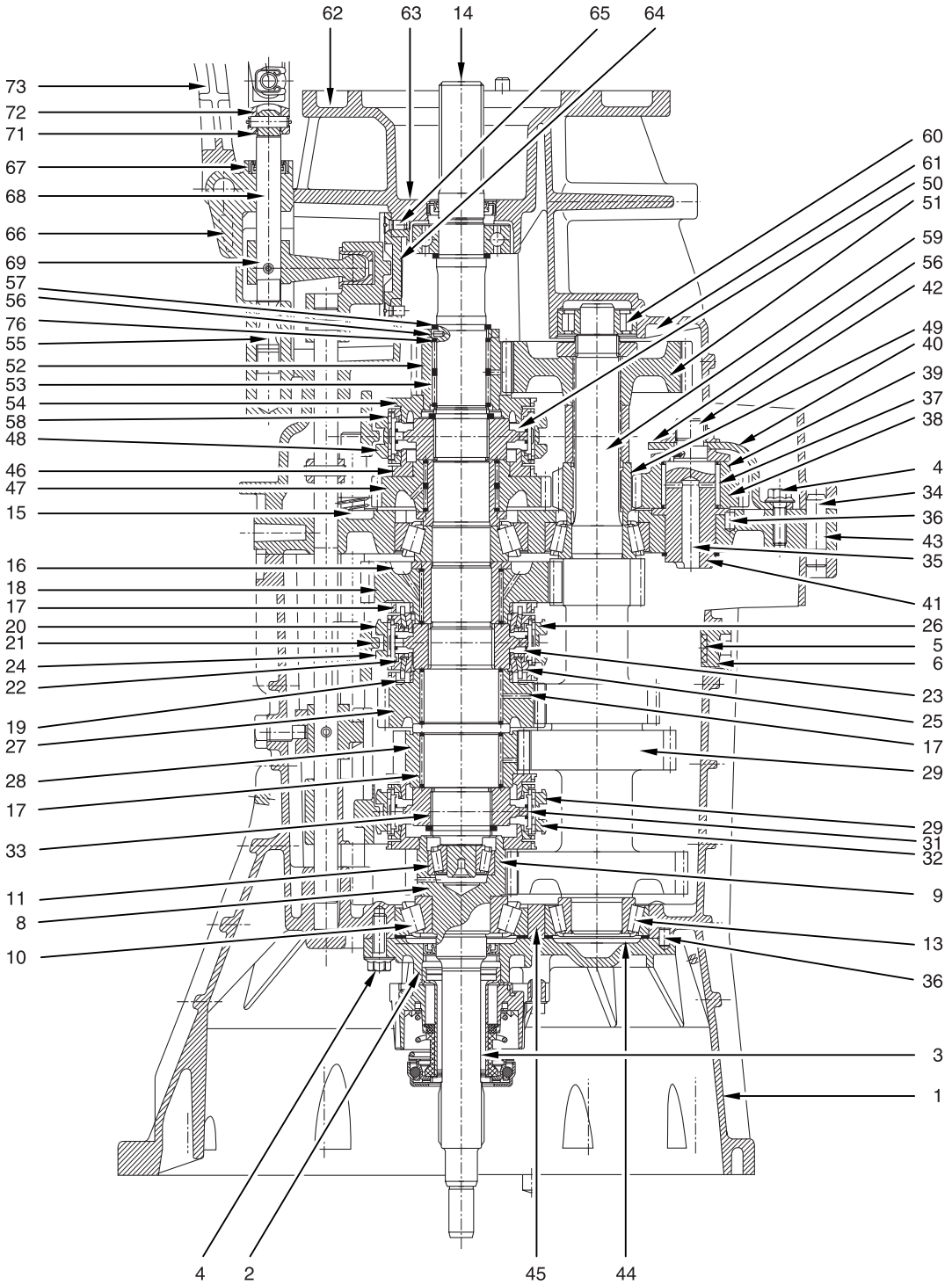
▶ Sectional View

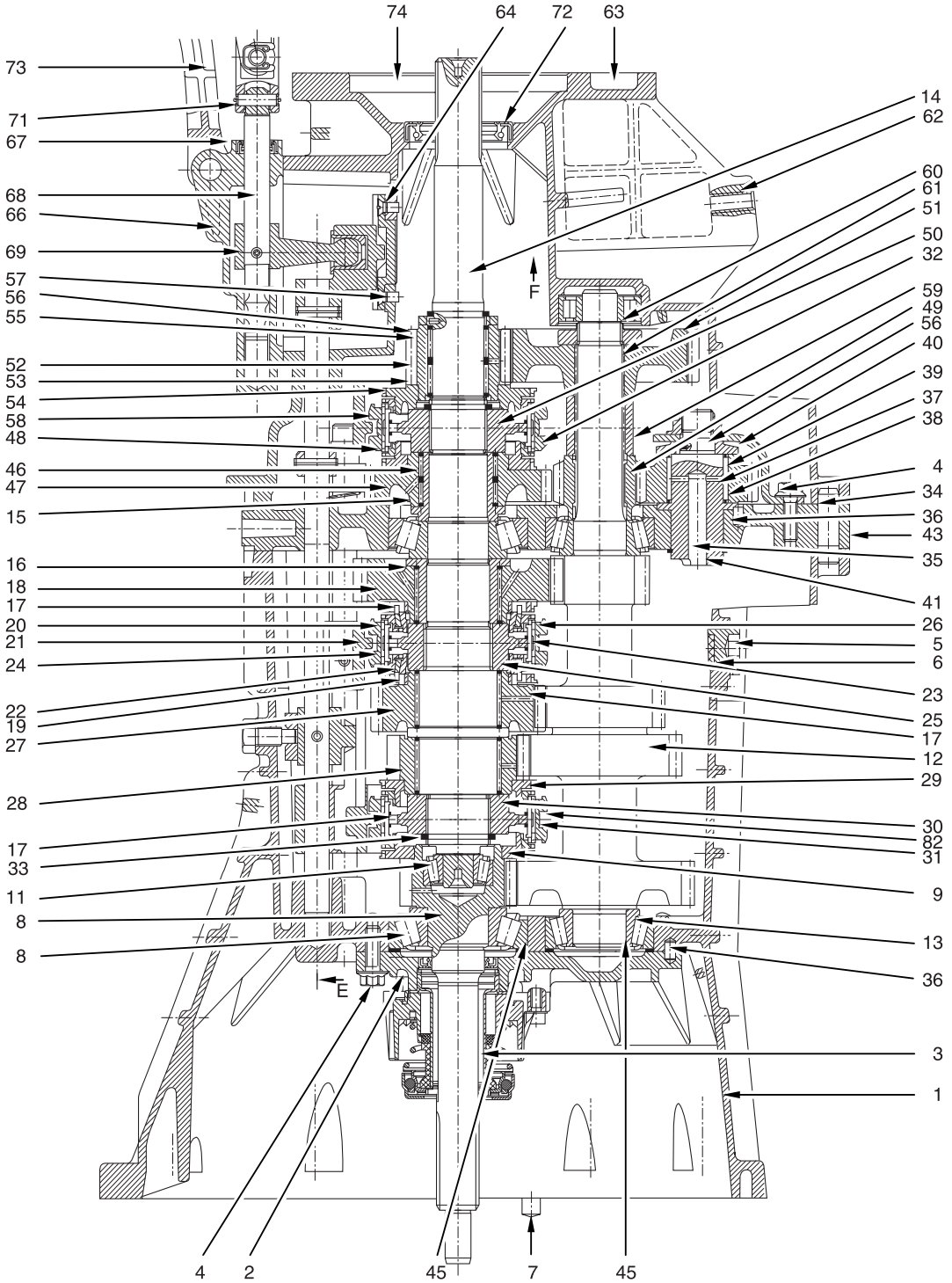
DI Engine equipped vehicle - 4WD



Y220_03B008

1. Transmission front housing
2. Input shaft oil seal
3. Front cover
4. Hexagon flange bolt (17 ~ 26 Nm)
5. Oil drain plug
6. Sealing
7. Pin
8. Input shaft
9. Clutch 4th gear
10. Taper roller bearing (main)
11. Taper roller bearing
12. Counter shaft
13. Taper roller bearing (counter)
14. Output shaft
15. Inner race (reverse)
16. Inner race (1st)
17. Needle bearing
18. 1st gear
19. 1st clutch gear
20. Synchro outer ring
21. Synchro - middle cone
22. Synchro inner ring
23. Synchro spring
24. Synchro key
25. Synchro hub
26. Double synchro sleeve
27. 2nd gear
28. 3rd gear
29. 3rd clutch gear
30. Synchro hub (3 & 4th)
31. Synchro ring (4/5/R)
32. Single synchro sleeve
33. Retainer ring
34. Adaptor dowel pin
35. Reverse idler shaft
36. Dowel pin
37. Needle bearing
38. Reverse idler gear
39. Reverse idler spacer
40. Reverse idler bracket
41. Retainer ring
42. Reverse lock nut
43. Transmission adaptor
44. Input shaft spacer
45. Counter spacer
46. Reverse needle bearing
47. Reverse gear
48. Reverse clutch gear
49. Reverse counter gear
50. Synchro hub
51. Counter 5th gear
52. 5th needle bearing
53. 5th gear
54. 5th clutch gear
55. Thrust washer
56. Spring pin
57. 5th outside retainer ring
58. 5th retainer ring
59. Counter shaft bushing
60. Counter roller bearing assembly
61. Retainer ring
62. Extension housing
63. Output shaft oil seal
64. Offset plate
65. Counter screw
66. Top cover
67. Counter oil seal
68. Shift shaft
69. Shift lever
70. Detent pin
71. Joint pin
72. Retainer ring
73. Semi remote lever assembly

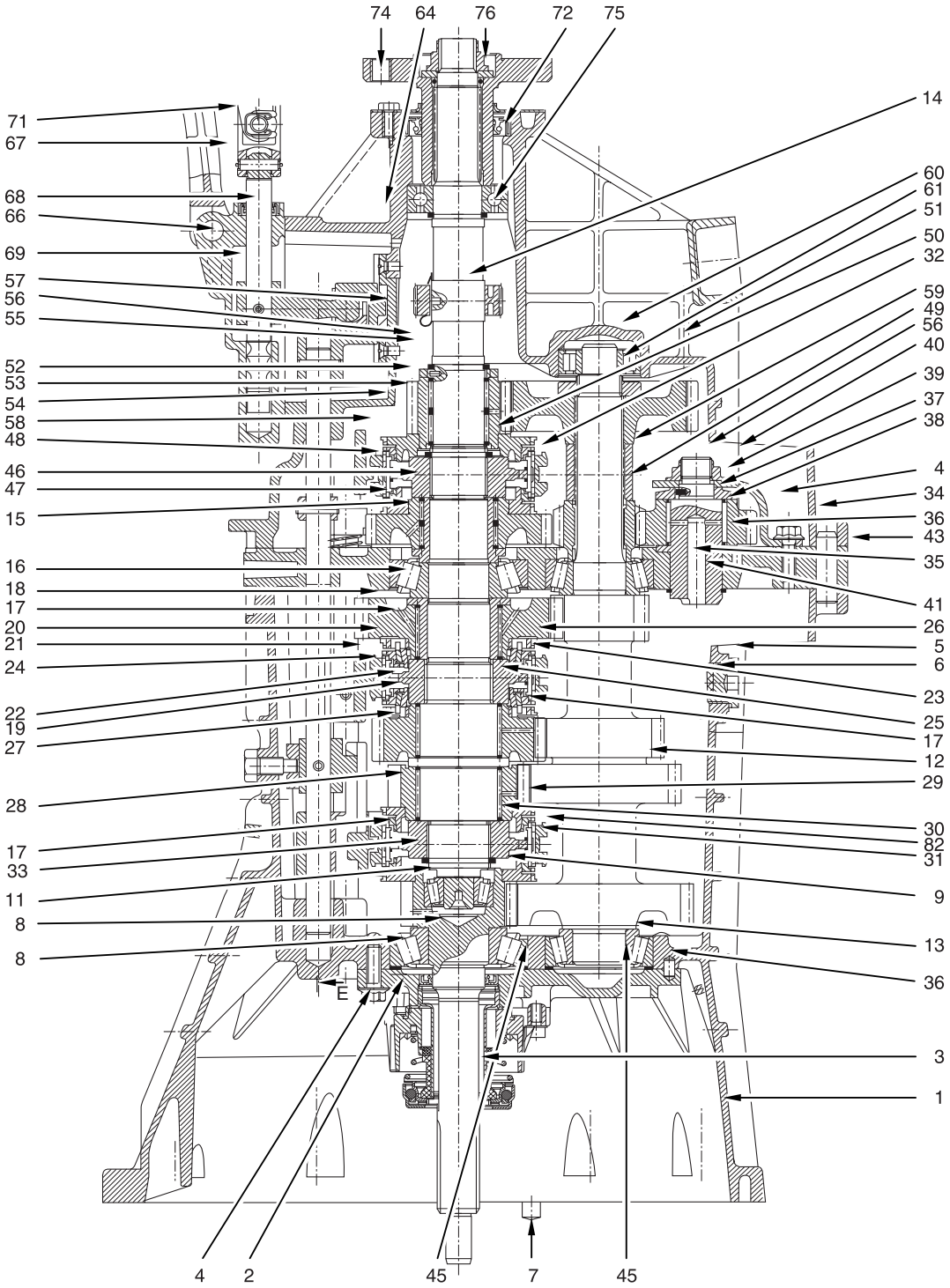
IDI Engine equipped vehicle - 4WD



Y220_03B008B

1. Transmission front housing
2. Input shaft oil seal
3. Front cover
4. Hexagon flange bolt (17~26 Nm)
5. Oil drain plug
6. Sealing
7. Pin
8. Input shaft
9. Clutch 4th gear
10. Taper roller bearing (main)
11. Taper roller bearing
12. Counter shaft
13. Taper roller bearing (counter)
14. Output shaft
15. Inner race (reverse)
16. Inner race (1st)
17. Needle bearing
18. 1st gear
19. 1st clutch gear
20. Synchro outer ring
21. Synchro - middle cone
22. Synchro inner ring
23. Synchro spring
24. Synchro key
25. Synchro hub
26. Double synchro sleeve
27. 2nd gear
28. 3rd gear
29. 3rd clutch gear
30. Synchro hub (3 & 4th)
31. Synchro ring (4/5/R)
32. Single synchro sleeve
33. Retainer ring
34. Adaptor dowel pin
35. Reverse idler shaft
36. Dowel pin
37. Bearing
38. Reverse idler gear
39. Reverse idler spacer
40. Reverse idler bracket
41. Retainer ring
42. Reverse lock nut
43. Transmission adaptor
44. Input shaft spacer
45. Counter spacer
46. Reverse needle bearing
47. Reverse gear
48. Reverse clutch gear
49. Reverse counter gear
50. Synchro hub
51. Counter 5th gear
52. 5th needle bearing
53. 5th gear
54. 5th clutch gear
55. Thrust washer
56. Spring pin
57. 5th outside retainer ring
58. 5th retainer ring
59. Counter shaft bushing
60. Counter roller bearing assembly
61. Retainer ring
62. Extension housing
63. Output shaft oil seal
64. Offset plate
65. Counter screw
66. Top cover
67. Counter oil seal
68. Shift shaft
69. Shift lever
70. Detent pin
71. Joint pin
72. Retainer ring
73. Semi remote lever assembly
74. Rear flange

IDI Engine equipped vehicle - 2WD

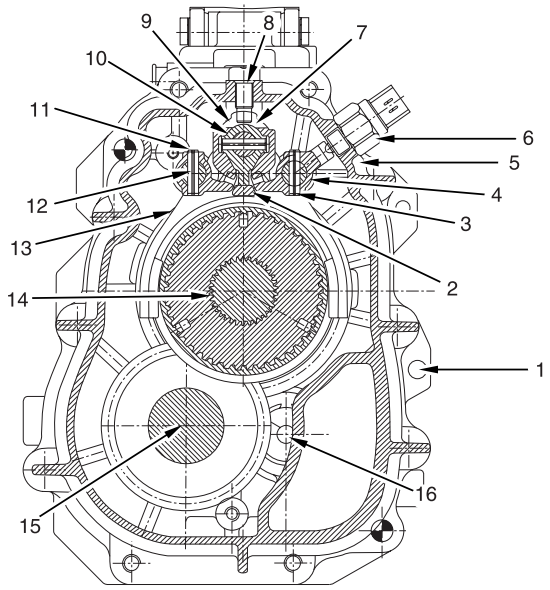


Y220_03B008C

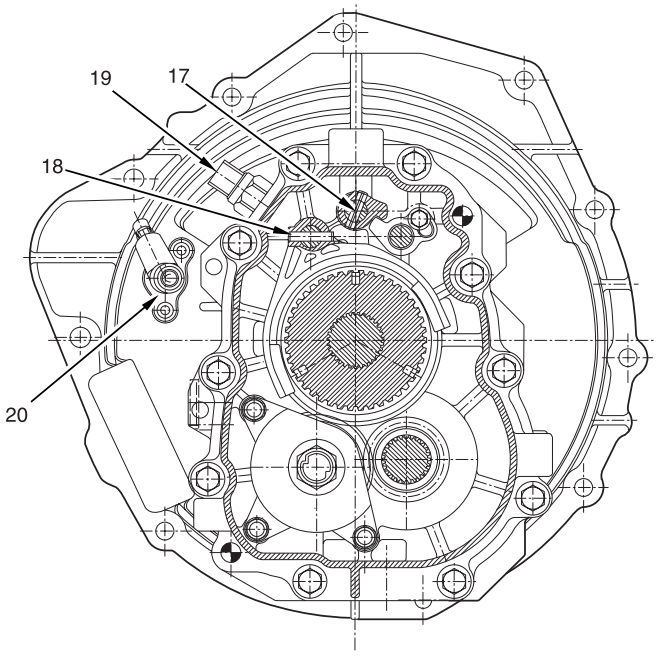
1. Transmission front housing
2. Input shaft oil seal
3. Front cover
4. Hexagon flange bolt (17 ~ 26 Nm)
5. Oil drain plug
6. Sealing
7. Pin
8. Input shaft
9. Clutch 4th gear
10. Taper roller bearing (main)
11. Taper roller bearing
12. Counter shaft
13. Taper roller bearing (counter)
14. Output shaft
15. Inner race (reverse)
16. Inner race (1st)
17. Needle bearing
18. 1st gear
19. 1st clutch gear
20. Synchro outer ring
21. Synchro - middle cone
22. Synchro inner ring
23. Synchro spring
24. Synchro key
25. Synchro hub
26. Double synchro sleeve
27. 2nd gear
28. 3rd gear
29. 3rd clutch gear
30. Synchro hub (3 & 4th)
31. Synchro ring (4/5/R)
32. Single synchro sleeve
33. Retainer ring
34. Adaptor dowel pin
35. Reverse idler shaft
36. Dowel pin
37. Bearing
38. Reverse idler gear
39. Reverse idler spacer
40. Reverse idler bracket
41. Retainer ring
42. Reverse lock nut
43. Transmission adaptor
44. Input shaft spacer
45. Counter spacer
46. Reverse needle bearing
47. Reverse gear
48. Reverse clutch gear
49. Reverse counter gear
50. Synchro hub
51. Counter 5th gear
52. 5th needle bearing
53. 5th gear
54. 5th clutch gear
55. Thrust washer
56. Spring pin
57. 5th outside retainer ring
58. 5th retainer ring
59. Counter shaft bushing
60. Counter roller bearing assembly
61. Retainer ring
62. Extension housing
63. Output shaft oil seal
64. Offset plate
65. Counter screw
66. Top cover
67. Counter oil seal
68. Shift shaft
69. Shift lever
70. Detent pin
71. Joint pin
72. Retainer ring
73. Semi remote lever assembly
74. Rear flange
75. Ball bearing
76. Lock nut

▶ Front View and Rear View

Front view



Rear view



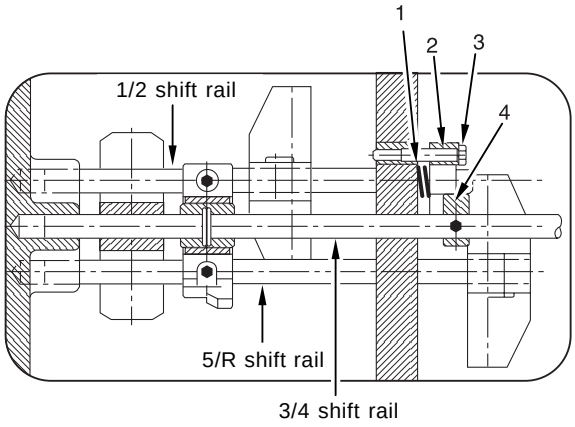
Y220_03B009

1. Oil filler plug (tightening torque: 40 ~ 50 Nm)
2. Shift rug (3 & 4th)
3. Spring pin (6 x 25)
4. Shift rug (5 & reverse)
5. Shift rail (5 & reverse)
6. Backup lamp switch (tightening torque: 30 ~ 40 Nm)
7. Shift rail (3 & 4th)
8. Interlock bolt (tightening torque: 40 ~ 50 Nm)
9. Shift lever
10. Interlock plate
11. Shift rail (1 & 2nd)
12. Shift rug (1& 2nd)
13. Shift fork (3 & 4th)
14. Input shaft
15. Counter shaft
16. Reverse idler assembly
17. Spring pin (6 x 25)
18. Spring pin (6 x 25)
19. Backup lamp switch
20. Concentric slave cylinder adaptor

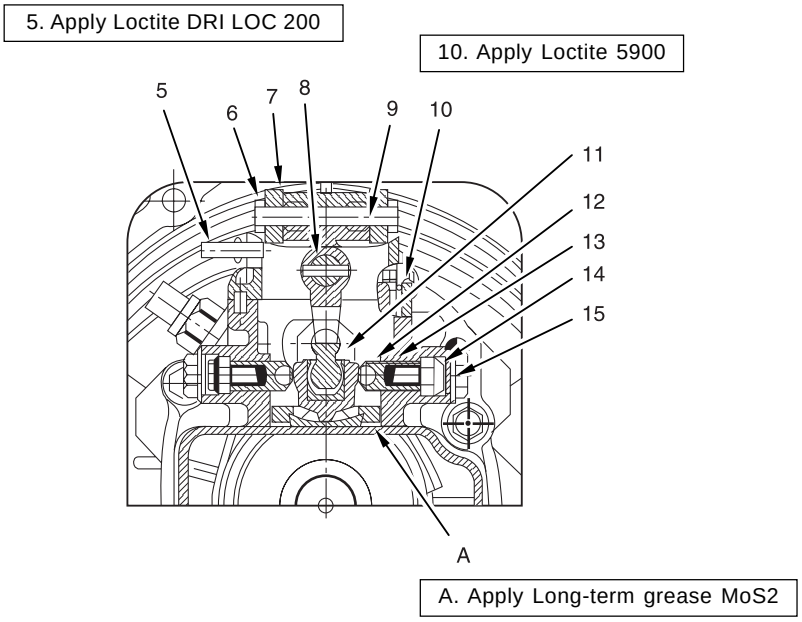
(8) Apply Loctite 243
(6) Apply Loctite DRI LOC 200

▶ Cross Sectional Diagram of Major Components

Shift rail and 5/R gear



Offset lever



Y220_03B010

1. Reverse lock spring
2. Reverse lock plate
3. Reverse lock bolt
4. Stopper plate
5. Air vent
   (tightening torque: 30 ~ 40 Nm)
6. Lock washer
7. TGS bushing
8. Outer spring pin
9. TGS pin
10. Lock bolt
    (tightening torque: 17 ~ 26 Nm)
11. Offset lever
12. Offset lever bushing
13. Rolling plunger
14. Return spring
15. Spring plug
    (tightening torque: 30 ~ 35 Nm)

A. Apply Long-term grease MoS2 when installing the offset lever.

CHANGED BY	
EFFECTIVE DATE	
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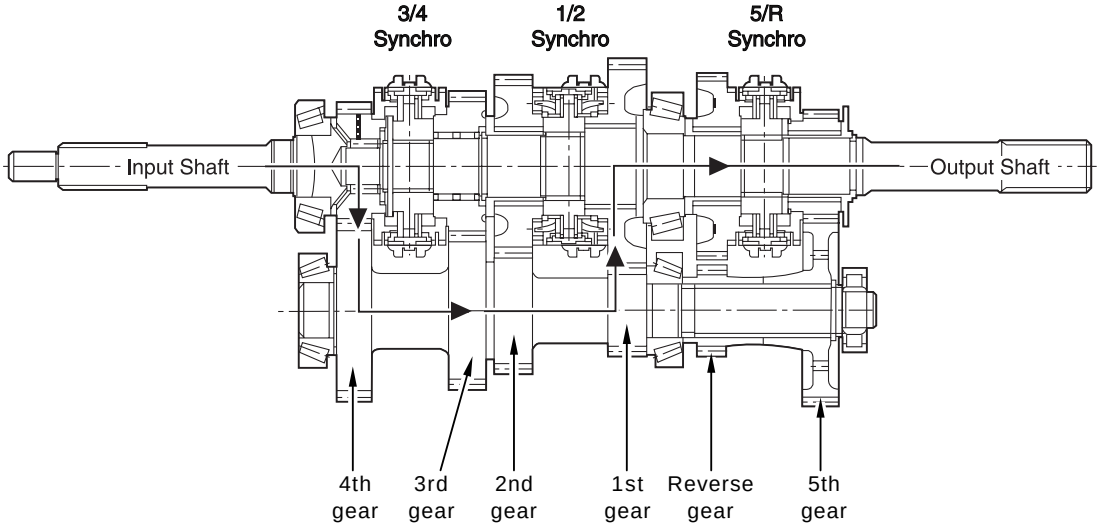
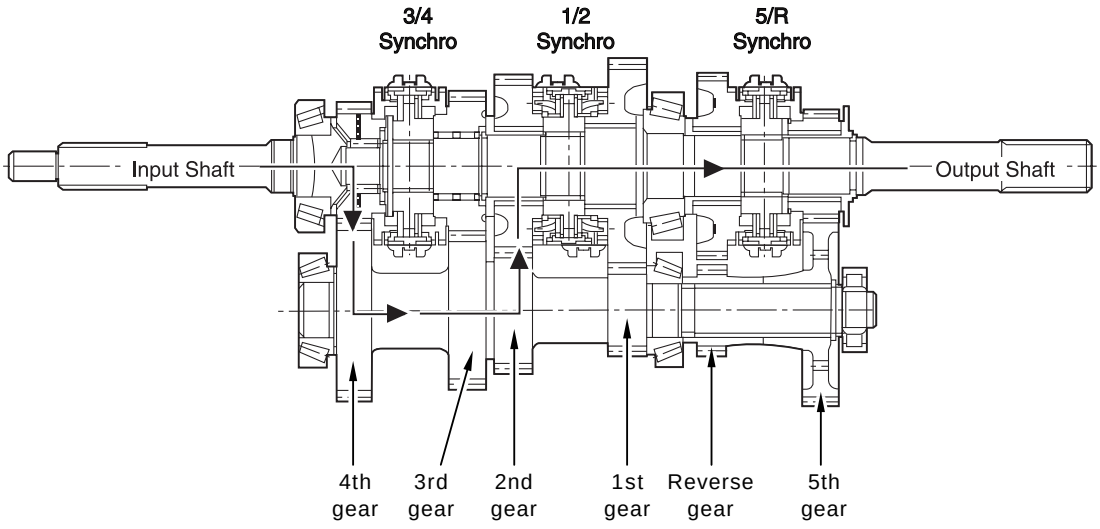
▶ Power Flows

1st gear

Counter shaft



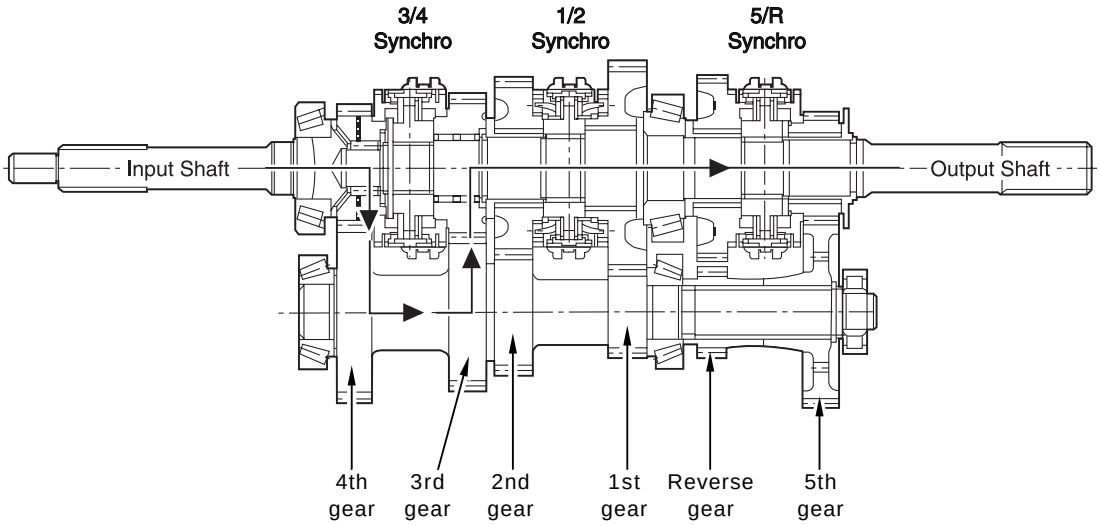
2nd gear



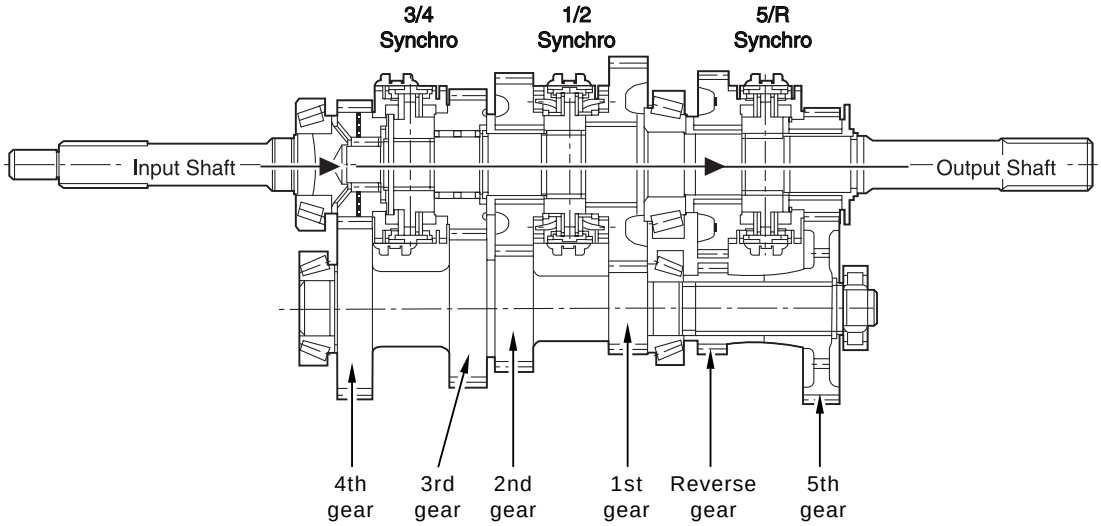
Y220_03B011

▶ Power Flows (Cont'd)

3rd gear



4th gear



Y220_03B012

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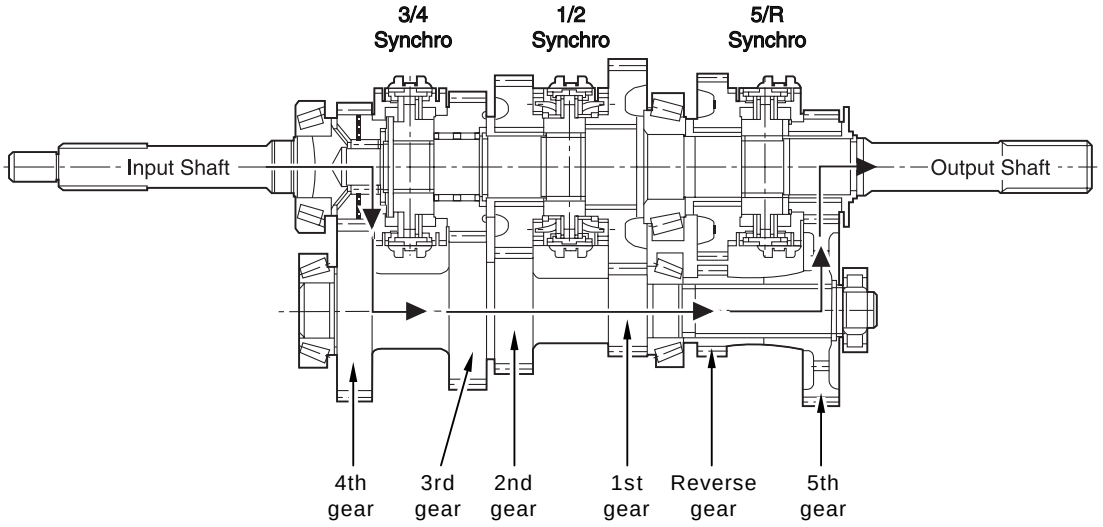
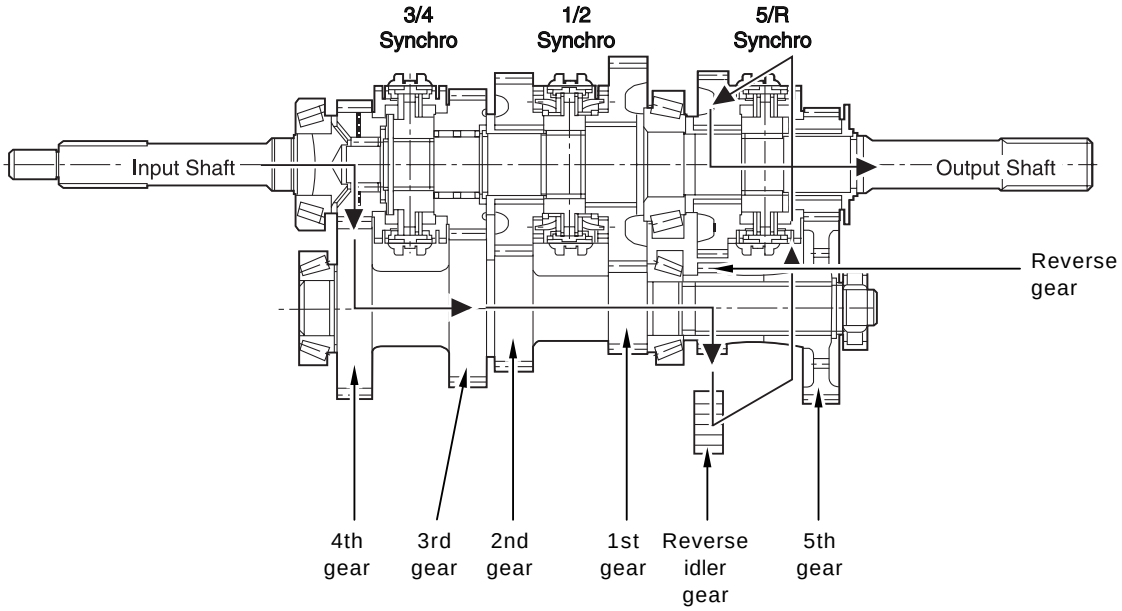
▶ Power Flows (Cont'd)

5th gear



Reverse gear

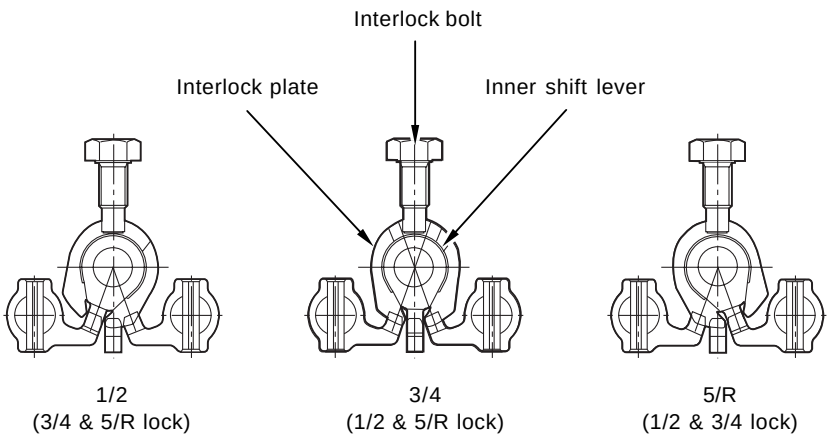


Y220_03B013

SHIFTING MECHANISM

▶ Interlock System

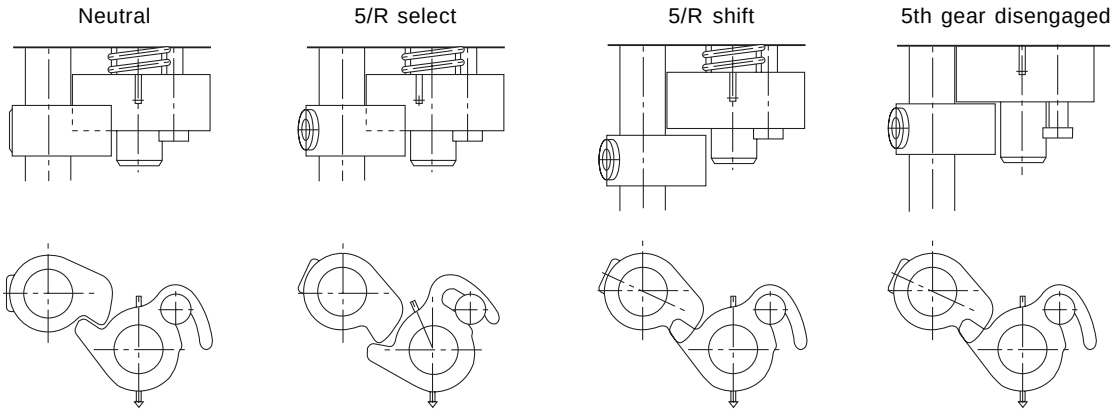
Interlock system prevents the gears from meshing over two sets.



Y220_03B014

▶ Reverse Interlock System

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



Y220_03B015

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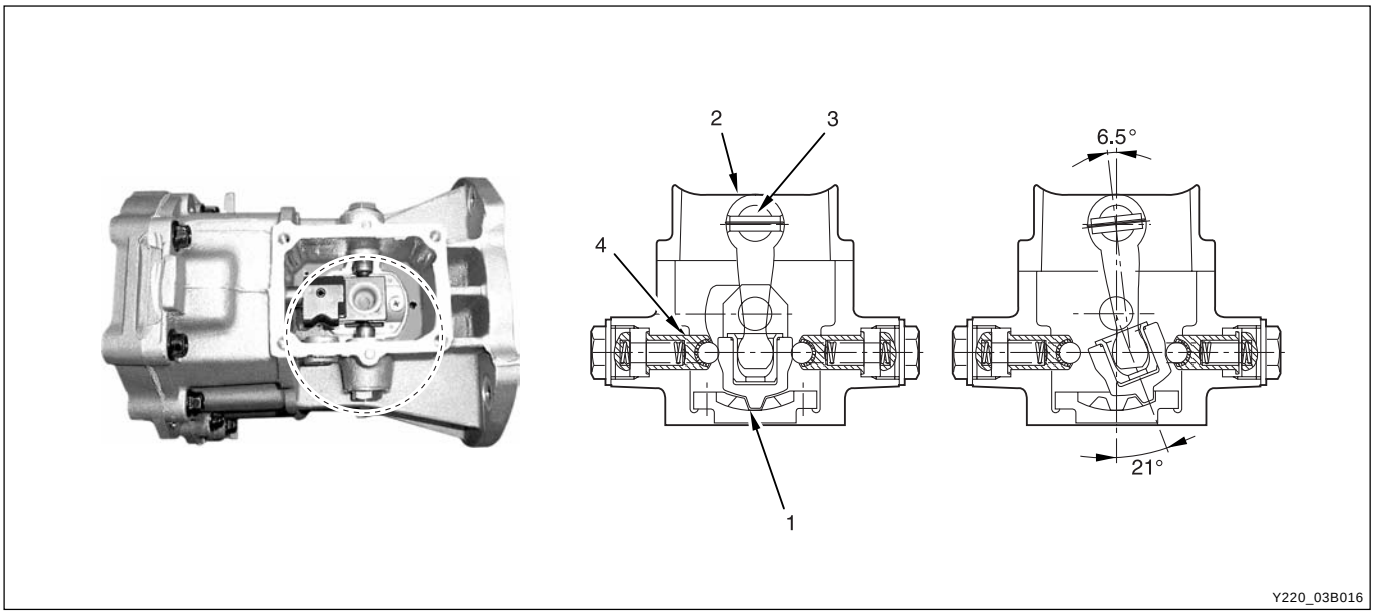
AFFECTED VIN	

▶ Offset Lever and Rolling Plunger

To make the next shift easier, the offset lever applies a reaction force to shift lever toward center position of gear selection gate after a gear has been selected.

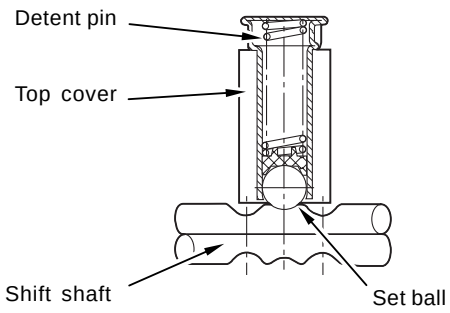


1. Offset lever
2. Shift lever
3. Shift shaft
4. Rolling plunger (rolling plunger return spring and ball)

1. Shift check device

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

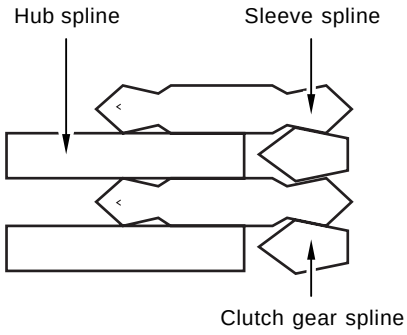
   Also, it prevent the selected gear from getting out of its meshed position.



Y220_03B017

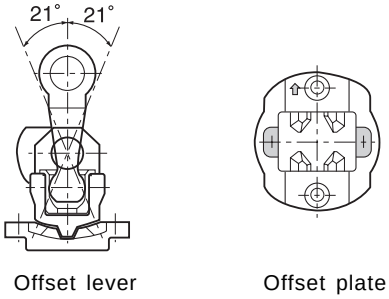
2. Gear pump out locking device

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



Y220_03B018

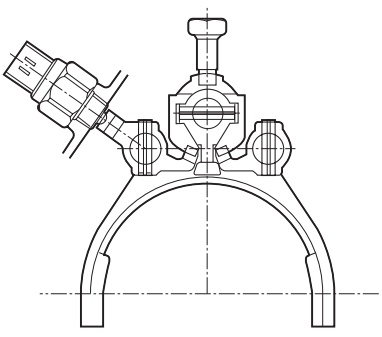
3. Guiding a control direction and preventing an over stroke



Y220_03B019

▶ Backup Lamp Switch

It is normal open type switch. Its circuit is formed when the reverse gear is selected.


Y220_03B021

Notice

Installation Notice

- ***Sealant: Loctite DRI LOC 200***
- ***Tightening torque: 3 kg•m ~ 4 kg•m***

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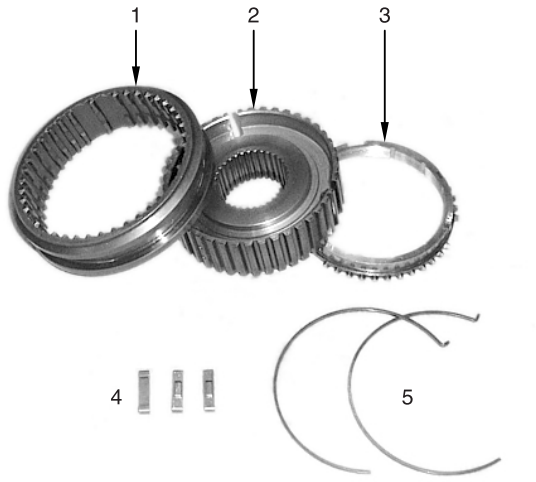
▶ Synchronizer

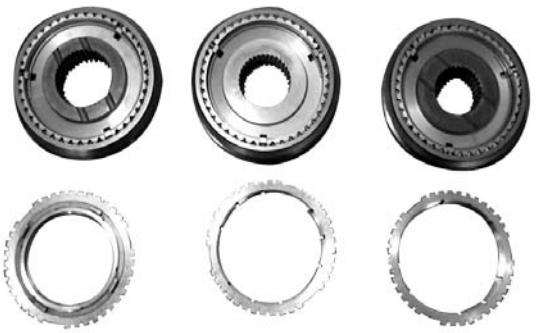
Composition

It consists of synchronizer hub, sleeve, ring, key and spring (1/2, 5/R, and 3/4 synchronizer are different from each other).

- 3/4 and 5/R shift: Single cone type
- 1/2 shift: Double cone type - Improving the capacity to bigger engine torque of 1/2 shift (added synchronizer inner cone and middle cone)

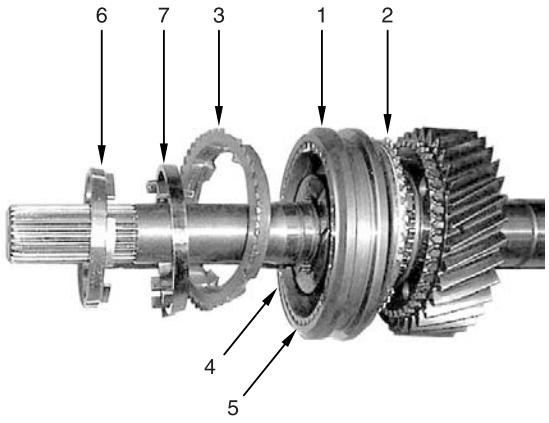
Single cone type





1/2 shift 3/4 shift 5/R shift

Double cone type



1/2 shift 3/4 shift 5/R shift

Y220_03B022

1. Synchronizer sleeve
2. Synchronizer hub
3. Synchronizer ring
4. Synchronizer key
5. Synchronizer key locking ring
6. Synchronizer inner cone
7. Synchronizer middle cone

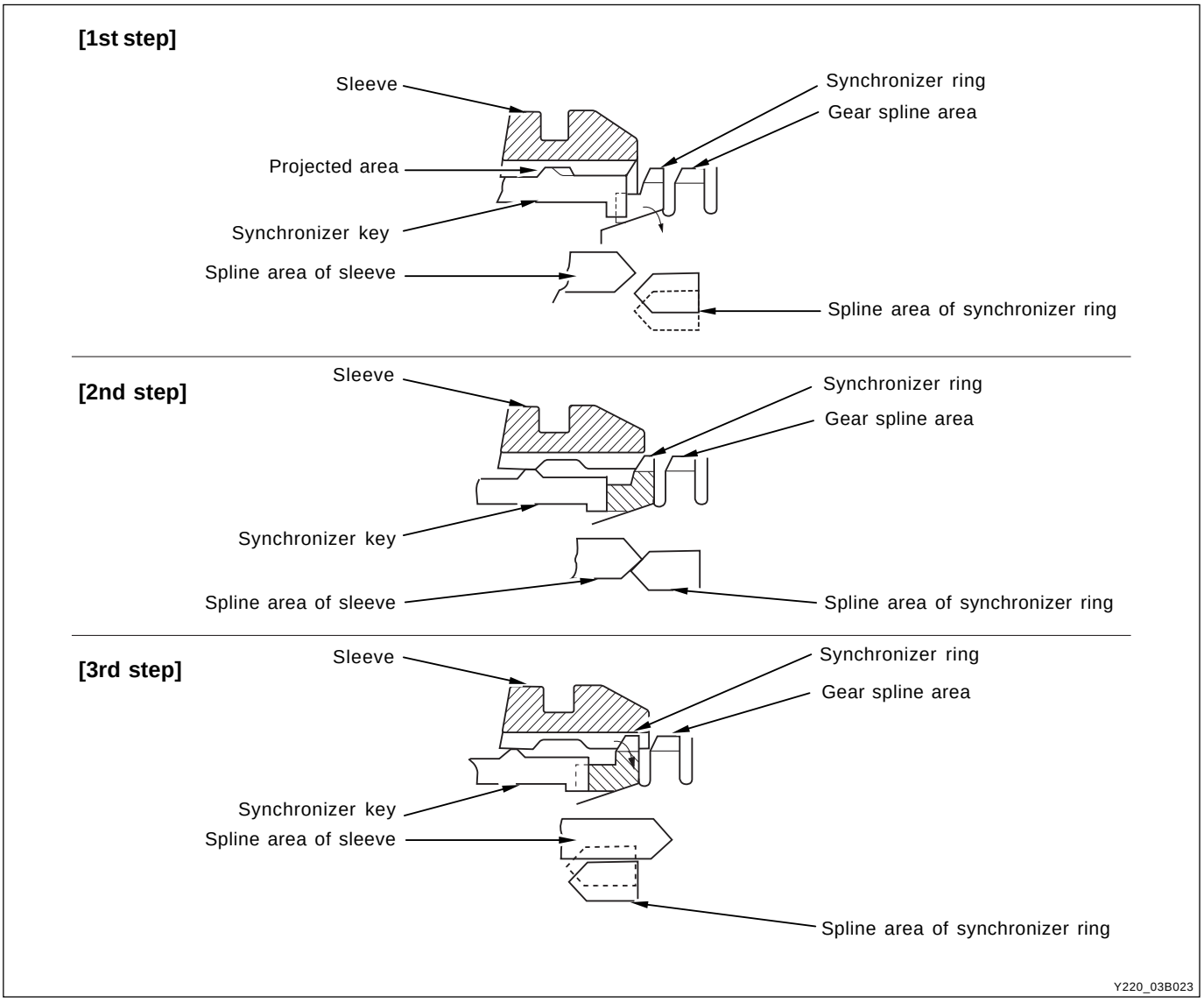
Notice

Be careful not to mix up the 1/2 shift synchronizer sleeve with 3/4 or 5/R shift synchronizer sleeve.

The 3/4 synchronizer hub also different from 1/2 and 5/R synchronizer hub (different oil gallery).

Synchronizer element

A cone or sleeve that slides to and fro on the transmission main shaft and makes the gears rotate at the same speed to prevent clash when the gears are about to mesh. Whenever a vehicle is rolling, the transmission main shaft is turning and the clutch gear is spinning. Even though the clutch is disengaged, the clutch gear continues to spin until friction slows it down or stops it. Thus when the driver shifts into another gear he is trying to mesh gears that may be moving at different speeds. By using synchronizers, the possibility of broken or damaged teeth is reduced and shifting effort is lowered.



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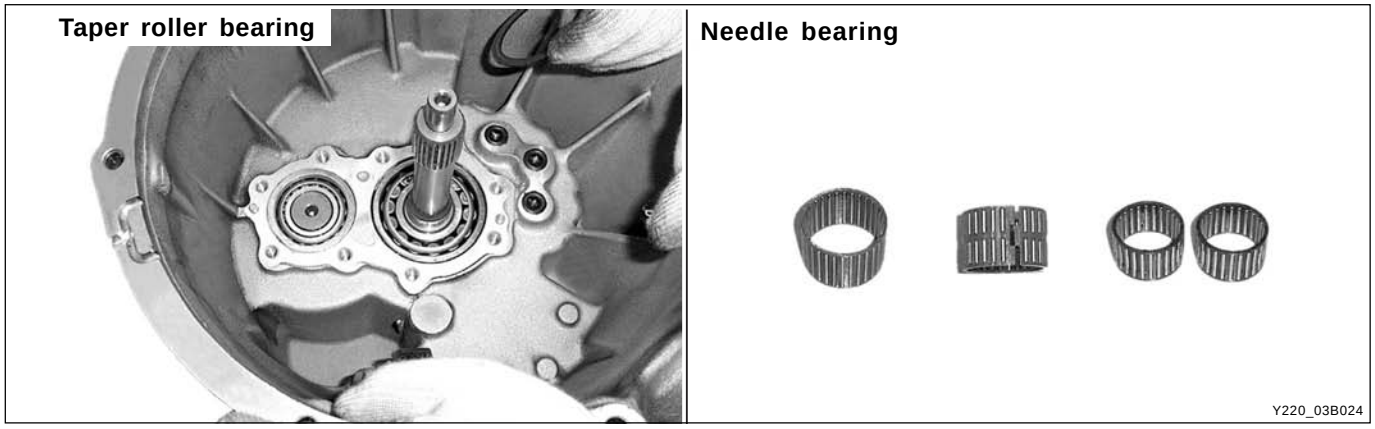
AFFECTED VIN	

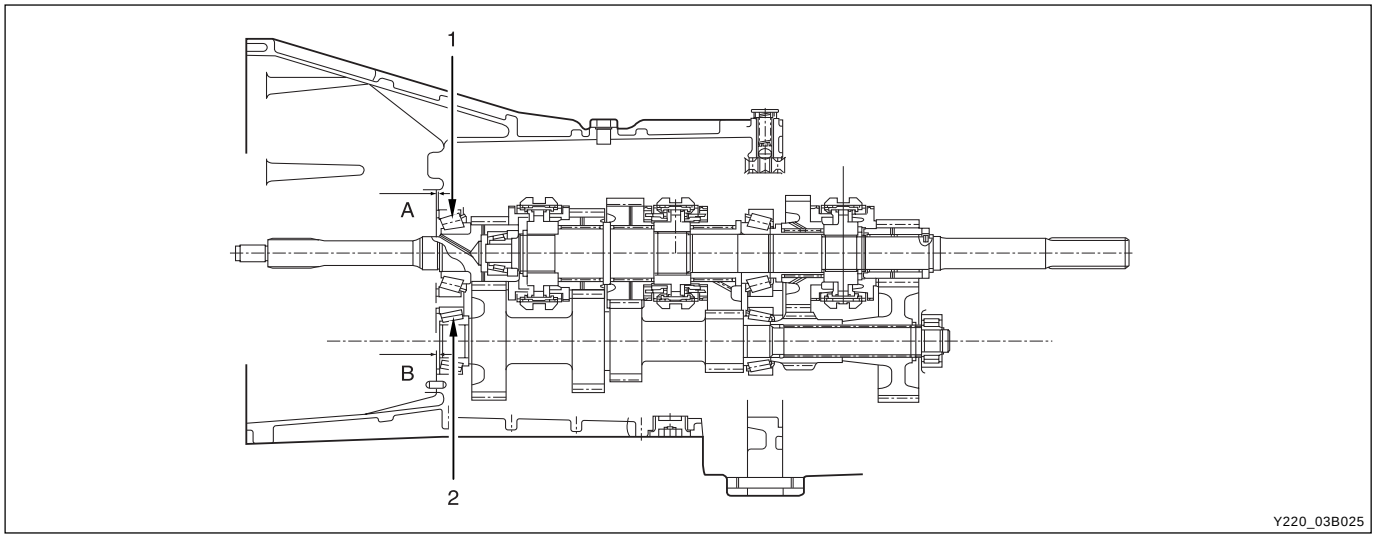
▶ Bearing

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



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

▶ End Play of Taper Roller Bearing



1. Taper roller bearing for input shaft
2. Taper roller bearing for counter shaft

A. End play A: 0.85 ~ 2.28 mm
B. End play B: 1.17 ~ 1.97 mm

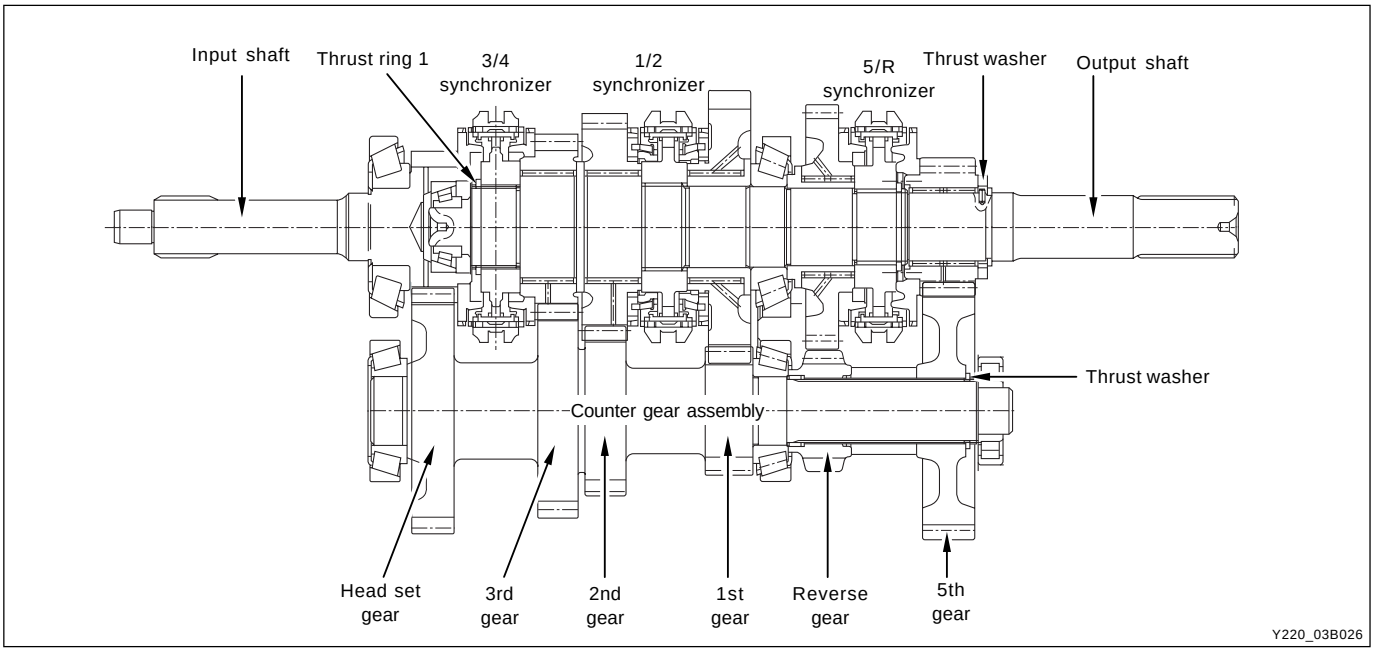
Notice

Use the following spacers to adjust the end play (A or B) between input shaft and counter shaft. (Specified range of end play: 0.05 ~ 0.1 mm)

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

▶ Thrust Ring (Washer)

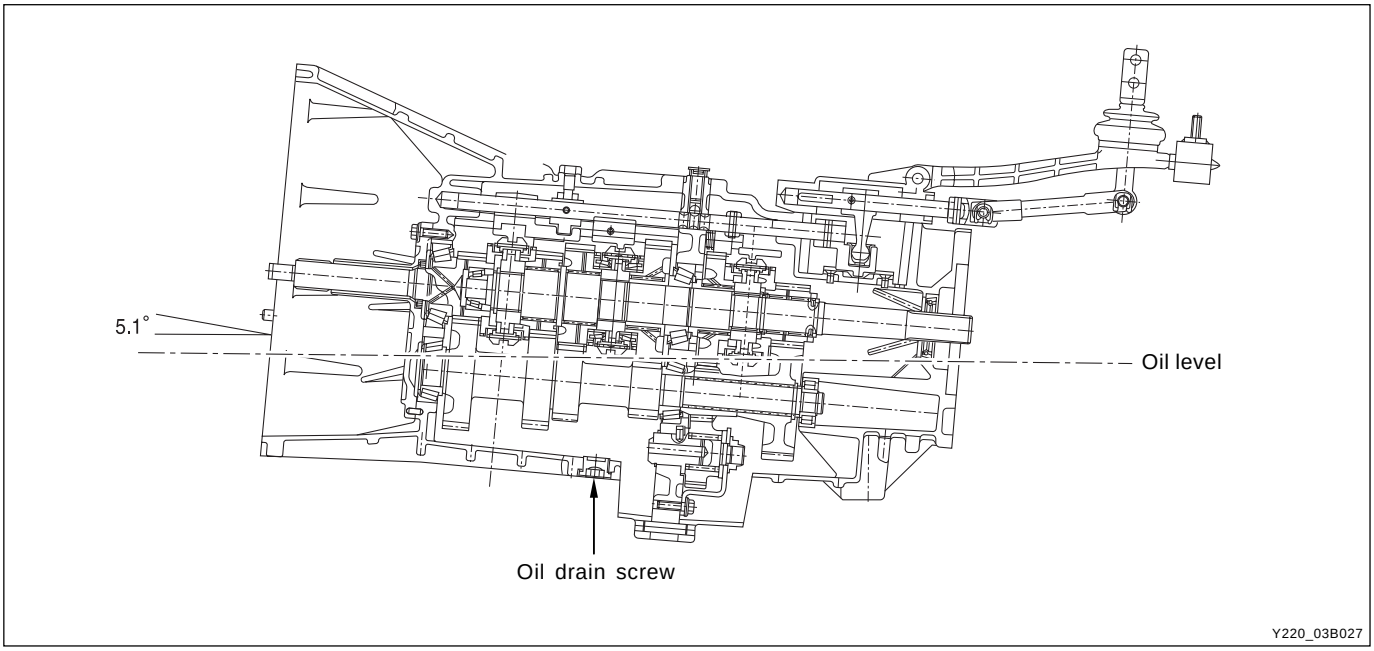
When the driving force from engine is transmitted to the output shaft of transmission, each shaft and gear assembly receives the axial force and this force acts as a resistance to rotating gears.



▶ Lubrication

Transmission oil: ATF DEXRON II or III

Initial installation for taper roller bearing and needle roller bearing, lubrication for shift rail: MoS2 Grease



Installation Notice

Sealant on oil drain screw during installation: Loctite DRI LOC 200

Tightening torque: 40 ~ 50 Nm

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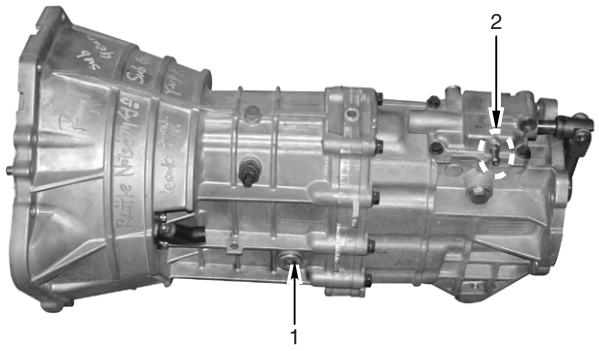
AFFECTED VIN	

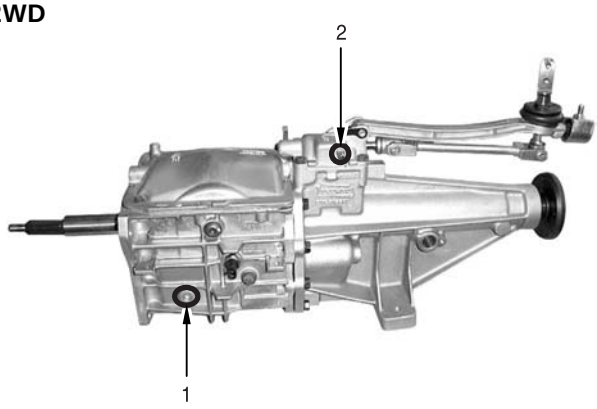
4WD



Y220_03B028

1. Oil filler plug

2WD



Y220_03B029

2. Air vent

Installation Notice

Sealant on oil drain screw during installation: Loctite DRI LOC 200

Tightening torque: 40 ~ 50 Nm

DIAGNOSTIC INFORMATION AND PROCEDURES

▶ Trouble Diagnosis

Symptom	Cause	Action
Will not shift (control lever moves)	Control lever assembly broken or damaged.	Replace control lever and housing assembly.
	Damaged offset lever, shift fork, selector place or selector arm.	Remove extension, adapter or case cover. Check or replace damaged parts.
Hard shift or control lever will not move into gear	Clutch not releasing.	Adjust or replace clutch.
	Improper or low transmission oil.	Add or replace with specified oil.
	Shift or shift rail binding.	Remove extension, adapter or case cover. Check or replace damaged parts.
	Binding of sliding synchronizers or gears.	Remove extension, adapter or case cover. Check synchronizers and gears and replace damaged parts.
	If reverse only, faulty backup switch.	Check or replace backup switch.
	Worn or damaged flywheel pilot bushing.	Replace pilot bushing.
Gears crash when shifting	Engine idle speed too high.	Adjust idle speed to specified speed.
	Damaged or faulty clutch.	Adjust or replace clutch.
	Pilot bearing between input shaft and output shaft binding.	Replace or check roller bearings.
	Damaged synchronizer.	Check or replace synchronizer parts.
	Bell housing misaligned.	Align bell housing and bore.
	Damaged gear(s).	Check or replace gear(s).
	Worn or damaged flywheel pilot bushing.	Replace pilot bushing.
Transmission jumps out	Loosened transmission or flywheel housing bolts, improper alignment.	Tighten bolts to specified value. Realign if necessary.
	Synchronizer damaged or excessively worn.	Check or replace synchronizer parts.
	Blocking ring damaged, worn index slots or friction surfaces worn or damaged.	Check or replace blocking ring.
	Excessive countershaft end play.	Check worn or damaged parts. Adjust shim thickness using roller bearings if necessary.
	Worn or damaged fork due to loosened shaft, rail or shifting fork.	Check for wear or damaged. Replace worn or damaged parts.
Transmission locked in one gear	Fork or offset lever loose on shaft or rail.	Replace extension, adapter or case cover. Check or replace loose parts on shaft or rail. Replace roll pin(s).
	Worn or damaged forks, offset lever, shaft or rail.	Remove extension, adapter or case cover. Check for wear or damaged. Replace damaged parts.

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Symptom	Cause	Action
Transmission locked in one gear	Worn or damaged synchronizer.	Check worn or damaged synchronizer parts and replace if necessary.
	Worn or damaged gears.	Check worn or damaged gears and replace if necessary.
Transmission noise	Improper or low transmission oil.	Add or drain and replace with proper oil.
	Loose bolts or other attaching parts.	Tighten as specified.
	Improper flywheel housing to engine crankshaft alignment.	Realign correctly.
	Noisy transmission bearing.	Check bearings, bearing rollers and parts for wear or damage. Replace if necessary.
	Noisy gears.	Check for worn or damaged gears (including speedometer gear). Replace if necessary.
Transmission leakage	Leakage from transmission.	Clean all exposed surfaces, then check for leaks.
	Vent or breather clogged.	Clean or replace vent or breather.
	Too much oil.	Check oil level.
	Loose bolts at sealing faces.	Tighten as specified.
	Improperly applied sealant.	Clean leaking surfaces. Reapply sealant.
	Worn or damaged oil seal.	Replace oil seal.

▶ Diagnosis table

Applicatio													Possible Faulty Part
1 Shift Hop-out													
	2 Shift Gear Crash												
		3 Shift Block-out											
			4 Hard Shift										
				5 Noise in Reverse Gear									
					6 Noise in 5th Gear								
						7 Noise in 4th Gear							
							8 Noise in 3rd Gear						
								9 Noise in 2nd Gear					
									10 Noise in 1st Gear				
										11 Noise in All Speeds			
											12 Leak at Transmission Rear Part		
												13 Leak at Transmission Center Part	
													14 Leak at Transmission Front
											●	●	Transmission Case
										●	●		Extension Housing
●			●								●	●	Shift Cover / Shift Shaft
●			●							●			Shift Control Lever
			●									●	Input Bearing Retainer
									●				Input Gear Set
●							●		●				3rd Speed Gear Set
●								●	●				2nd Speed Gear Set
				●									Reverse Speed Gear Set
●									●				1st Speed Gear Set
●									●				5th Speed Gear Set
			●						●				Clutch Housing and Release Derive
			●						●				Crankshaft Pilot Bushing and Release Bearing
									●				Input Bearing
									●				Main Shaft Input Bearing
●									●				Main Shaft Thrust Bearing
							●		●				3rd Speed Gear Bearing
								●	●				2nd Speed Gear Bearing
									●	●			1st Speed Gear Bearing
				●									Reverse Idler Gear Bushing
									●				Counter Shaft Front Bearing
									●				Counter Shaft Rear Bearing
●		●							●				Counter Shaft Thrust Bearing
					●				●				5th Speed Drive Gear Bearing
										●			Slip Yoke Bushing
										●			Slip Yoke Seal
										●			Speedometer Drive / Driven Gears
										●			Speedometer Driven Gear Housing
												●	Input Shaft Seal
●	●	●						●	●	●			1 - 2 Synchronizer Assembly
●	●	●				●	●			●			3 - 4 Synchronizer Assembly
●	●	●				●				●			5th Synchronizer Assembly

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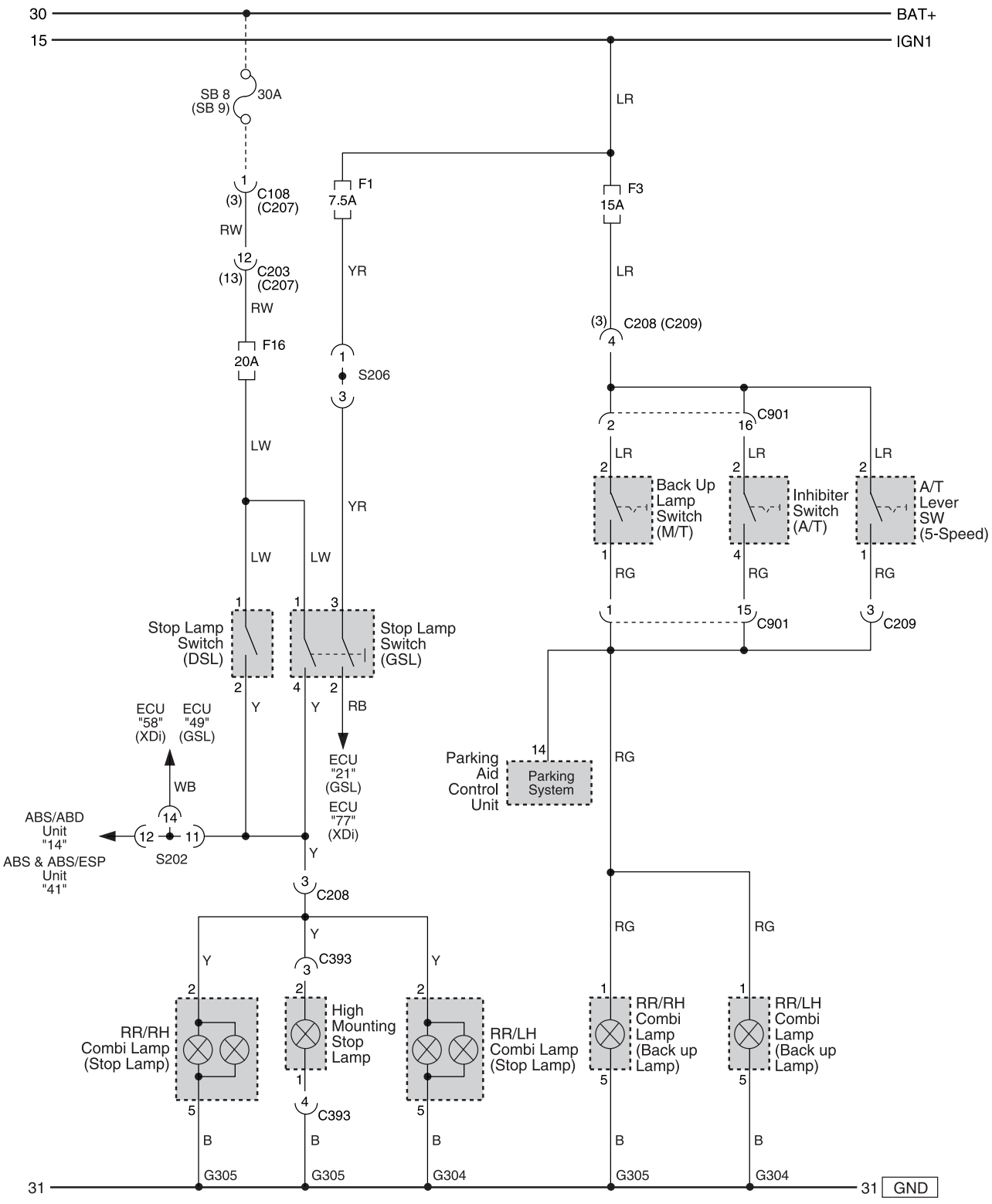
EFFECTIVE DATE	
AFFECTED VIN	

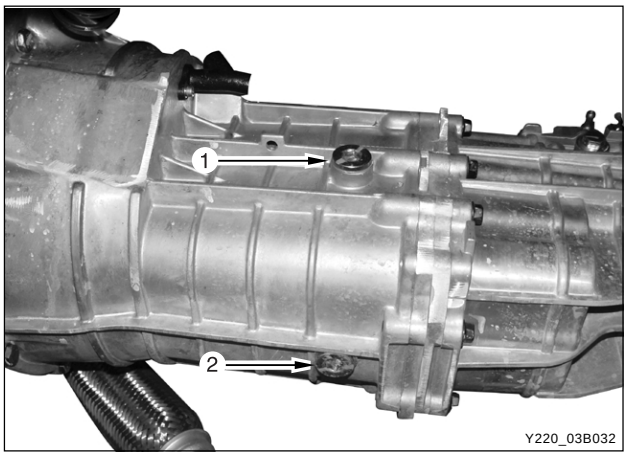
CIRCUIT DIAGRAM (BACKUP LAMP)



Y220_03B030

ON-VEHICLE SERVICE

OIL CHECK/CHANGE



1. Oil level check plug
2. Oil drain plug

Notice

Do not check or change the oil Immediately after driving off. It may cause serious hurt.

Place the vehicle on the flat and even ground and stop the engine. After 5 minutes, check the oil level.

1. Remove the oil level plug (1) and check the oil level.

   Notice

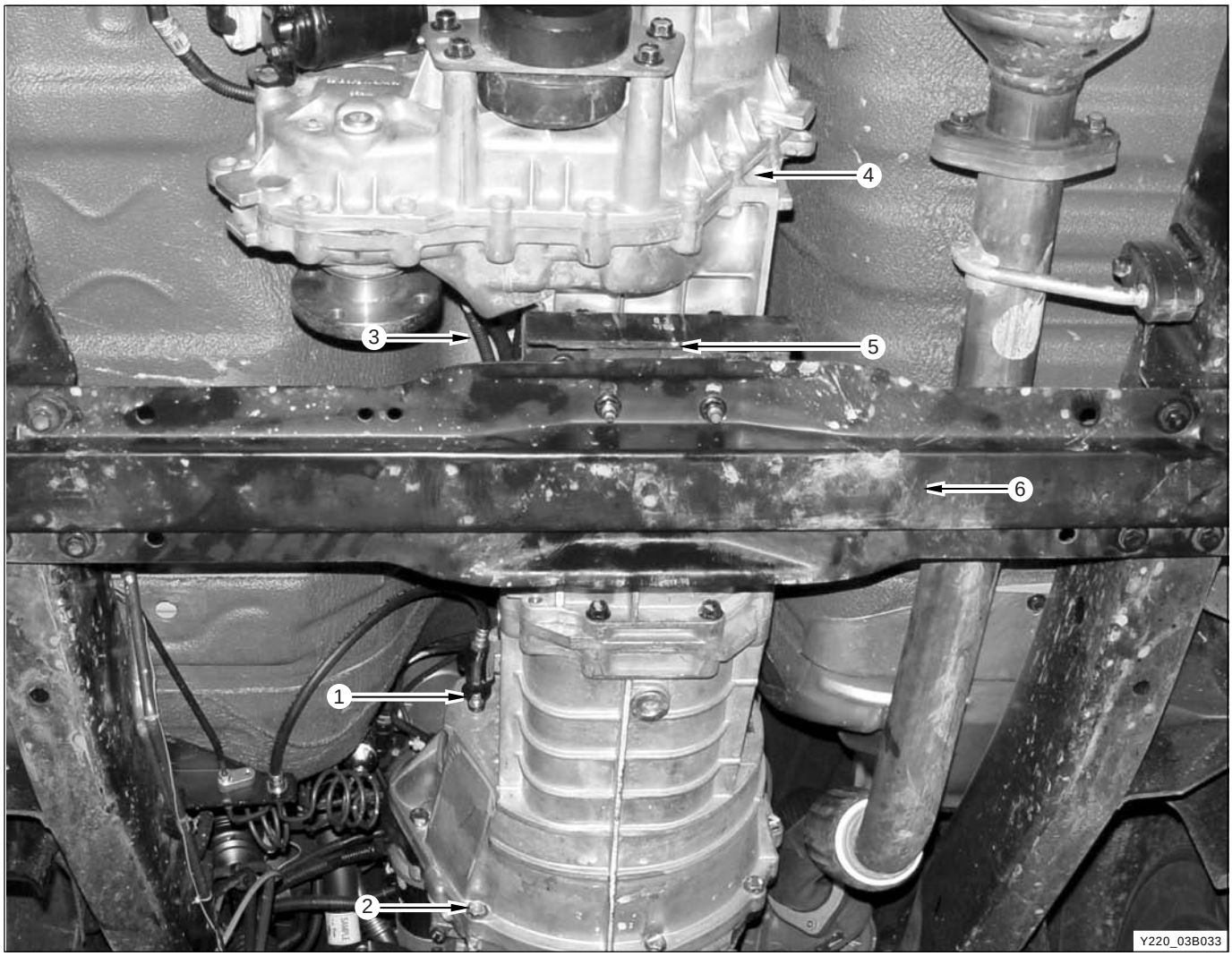
   If the oil level is up to the bottom line of plug hole, it is OK.

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

Notice

- ***The oil in manual transmission is major element for mechanical durability of transmission. Check the oil level with a specific interval and add if needed.***
- ***The oil replacement should be done at the qualified and authorized service station.***

REMOVAL AND INSTALLATION



1. Manual transmission assembly
2. Transmission housing mounting bolt
3. Air bleed hose
4. Transfer case
5. Transmission insulator
6. Center cross member

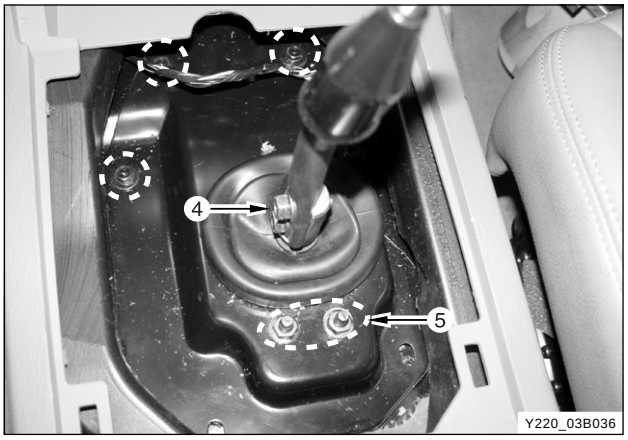
Removal and Installation

1. Disconnect the negative battery cable.
2. Remove the shift lever knob. Unscrew the screws and remove the console box cover.

3. Unscrew the nuts and remove the shift lever.

   Installation Notice

Tightening torque	70 ~ 90 Nm



4. Unscrew the bolts and remove the shift lever dust cover and bellows.

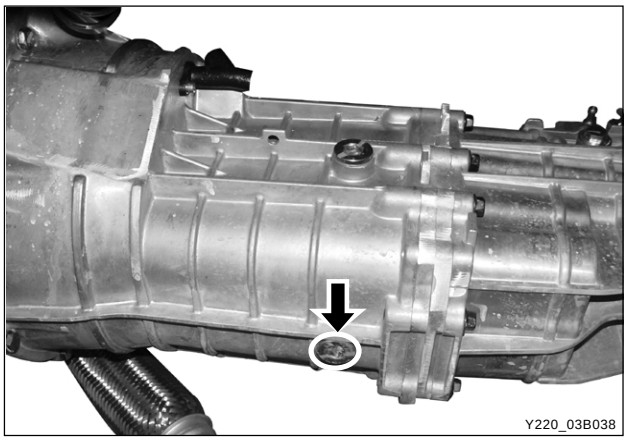
   Installation Notice

Tightening torque	70 ~ 90 Nm

5. If the oil should be changed, remove the oil drain plug in transmission housing and fully drain the oil. And, retighten the plug.

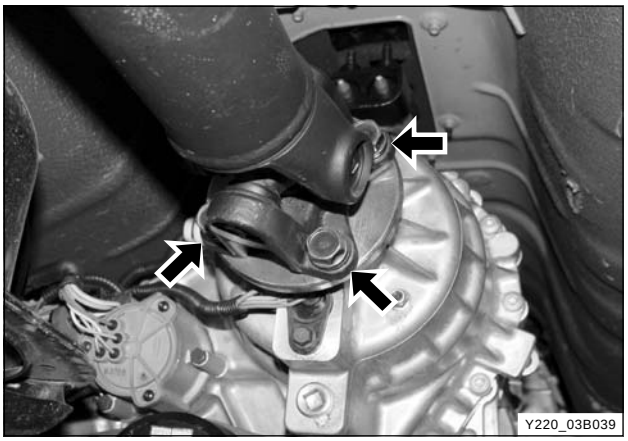
   Installation Notice

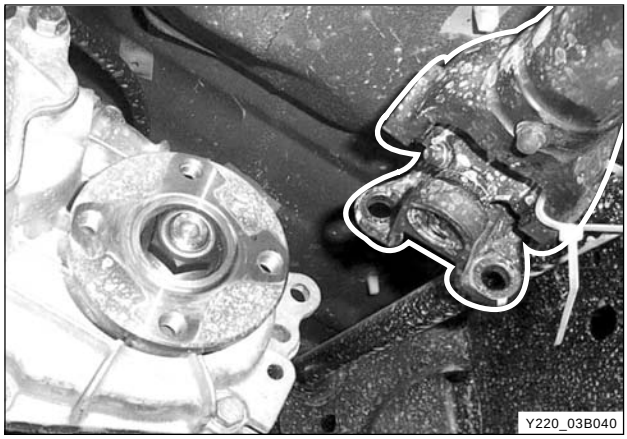
Tightening torque	40 ~ 50 Nm



6. Unscrew the bolts and detach the propeller shaft connected to transmission output shaft. Compress the propeller shaft not to disturb the operation.

Tightening torque	70 ~ 90 Nm

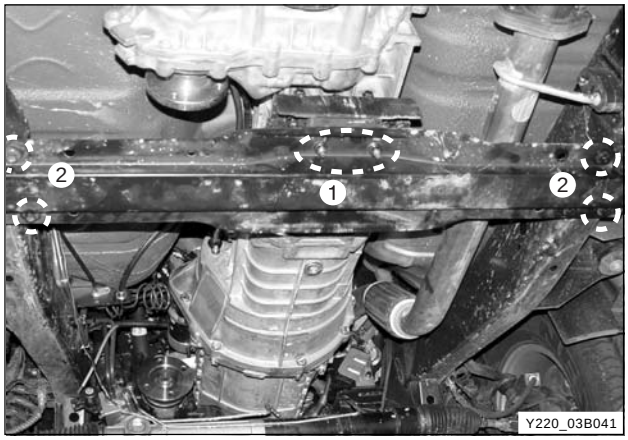




7. Unscrew the bolts and detach the propeller shaft connected to transfer case output shaft. Compress the propeller shaft and bind to torsion bar not to disturb the operation.

Installation Notice

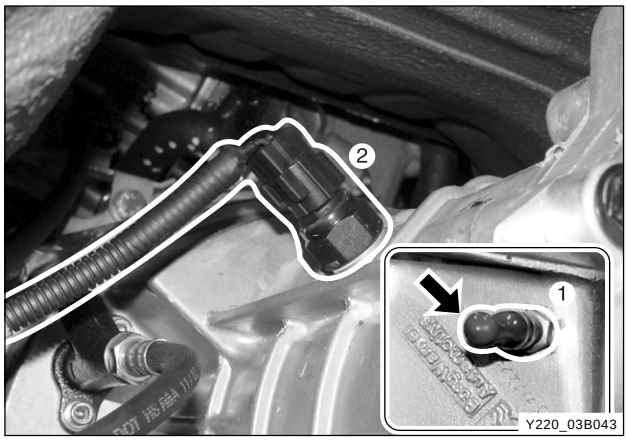
Tightening torque	80 ~ 90 Nm



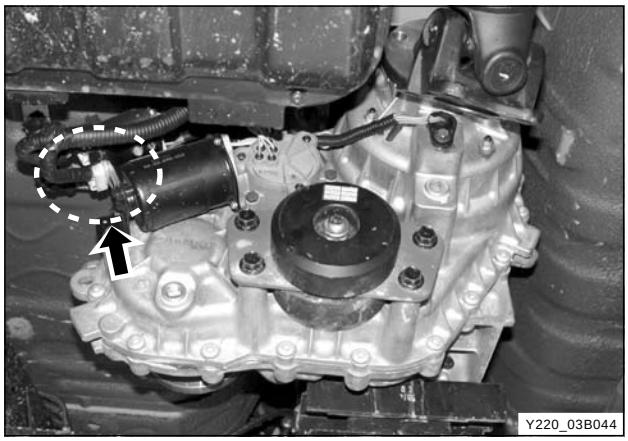
8. Support the underbody of transmission not to deflect it and unscrew the bolts and cross nuts and remove the cross member.

Installation Notice

Tightening torque (1)	20 ~ 35 Nm
Tightening torque (2)	70 ~ 95 Nm



9. Disconnect the air bleed hose (1).
10. Disconnect the backup lamp switch connector (2) and remove the backup lamp switch with a spanner.

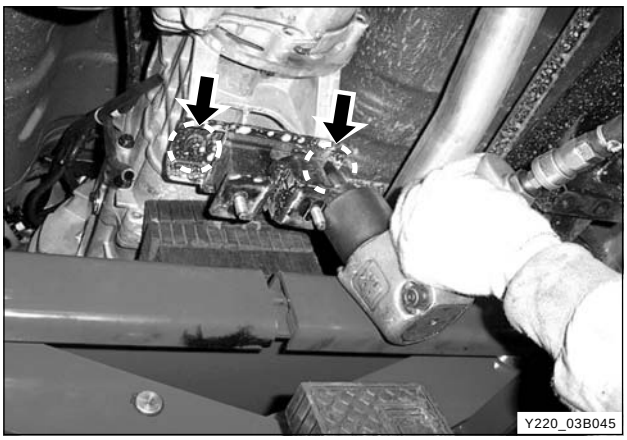


11. Disconnect the connectors from transfer case.

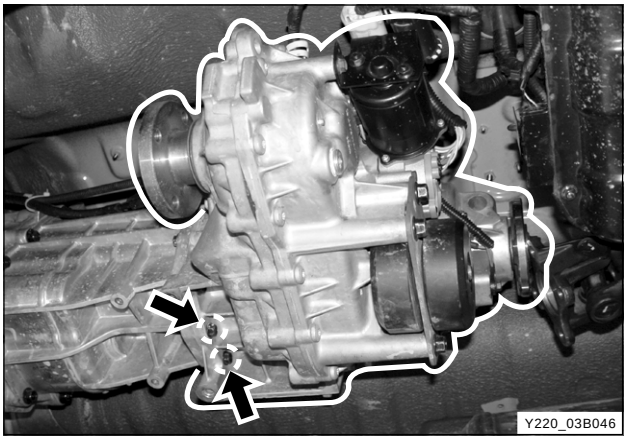
12. Unscrew the bolts and remove the transmission mounting insulator.

Installation Notice

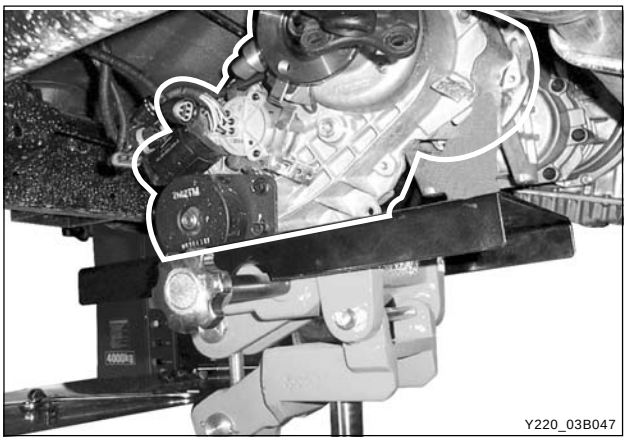
Tightening torque	25 Nm



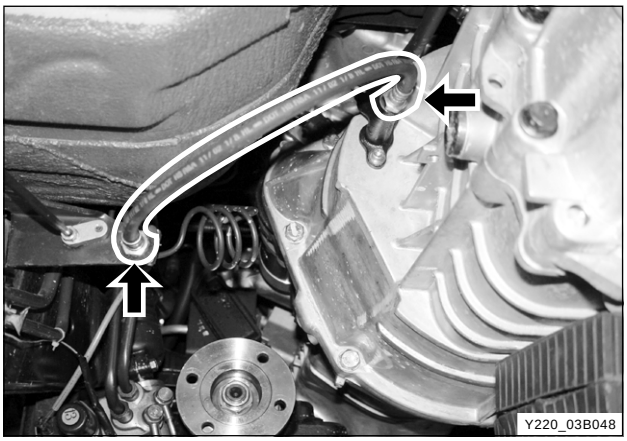
13. Unscrew the transfer case mounting bolts.

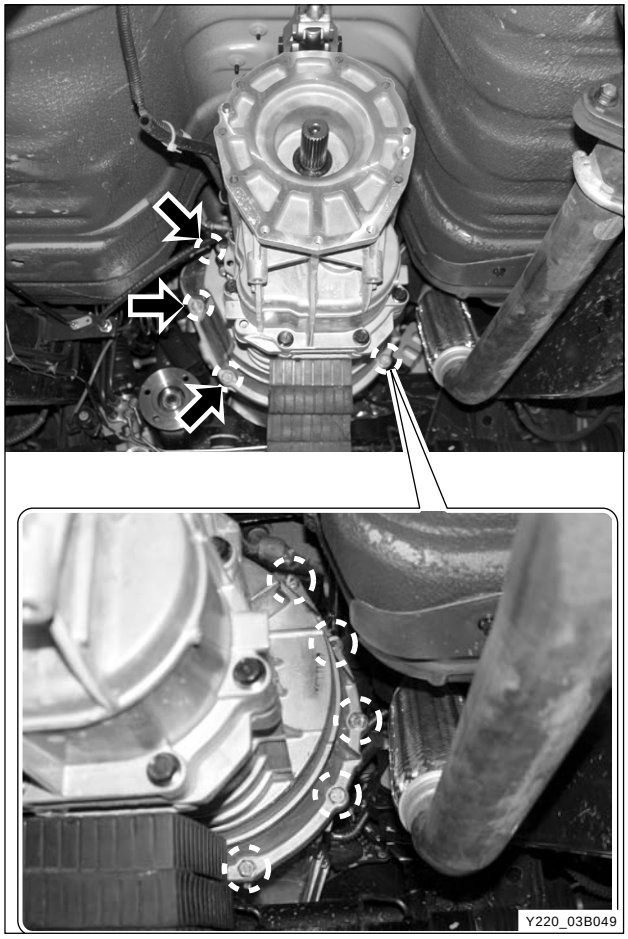


14. Remove the transfer case with a hydraulic jack. Be careful not to spill the oil.



15. Disconnect the clutch oil hose from the adaptor.





16. Securely support the transmission with a hydraulic jack. Unscrew the mounting bolts and remove the transmission.

Installation Notice

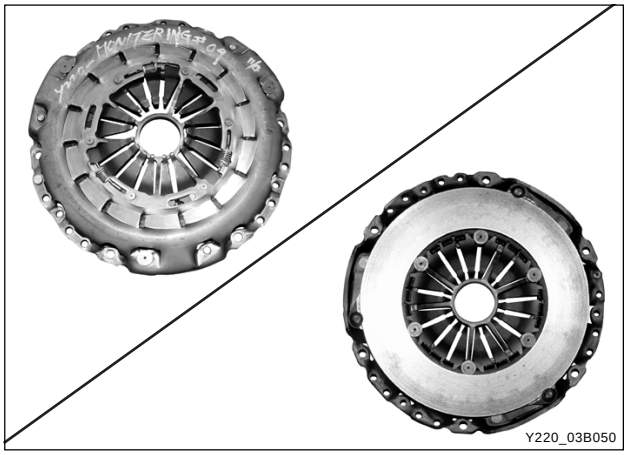
Tightening torque	75 ~ 85 Nm

17. Install in the reverse order of removal.

Inspection Before Installation

Check the components for wear and damage before installation.

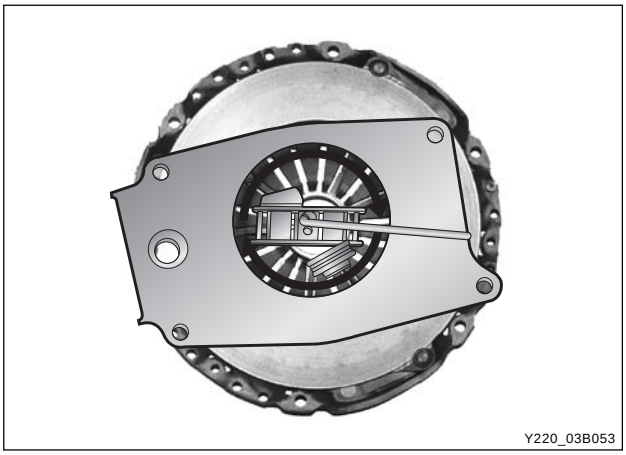
1. Check the release bearing for abnormal wear and replace if needed.
2. Check the conditions of pressure plate.


Y220_03B050

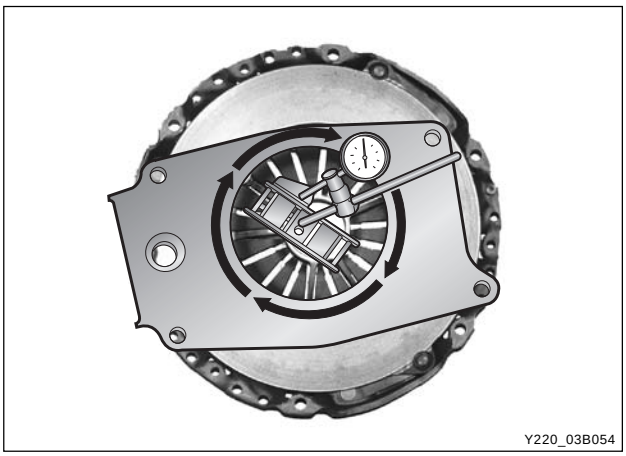
Notice

Check each component and replace if needed.

3. Check the alignment of clutch housing.
   1) Set the pressure plate at the housing bore.
   2) How to align the housing bore
      - Install a dial gauge on the magnetic plate.
      - Measure and record the gauge needle while rotating the crankshaft for one revolution.


Y220_03B053

   3) How to align the housing surface
      - Install a dial gauge on the housing surface.
      - Measure and record the gauge needle while rotating the crankshaft for one revolution.


Y220_03B054

Notice

If the measured value is greater than 0.010 inch, align it by inserting shims between housing and clutch.

4. Check the following components:
   - Pressure plate assembly
   - Disc
   - Flywheel

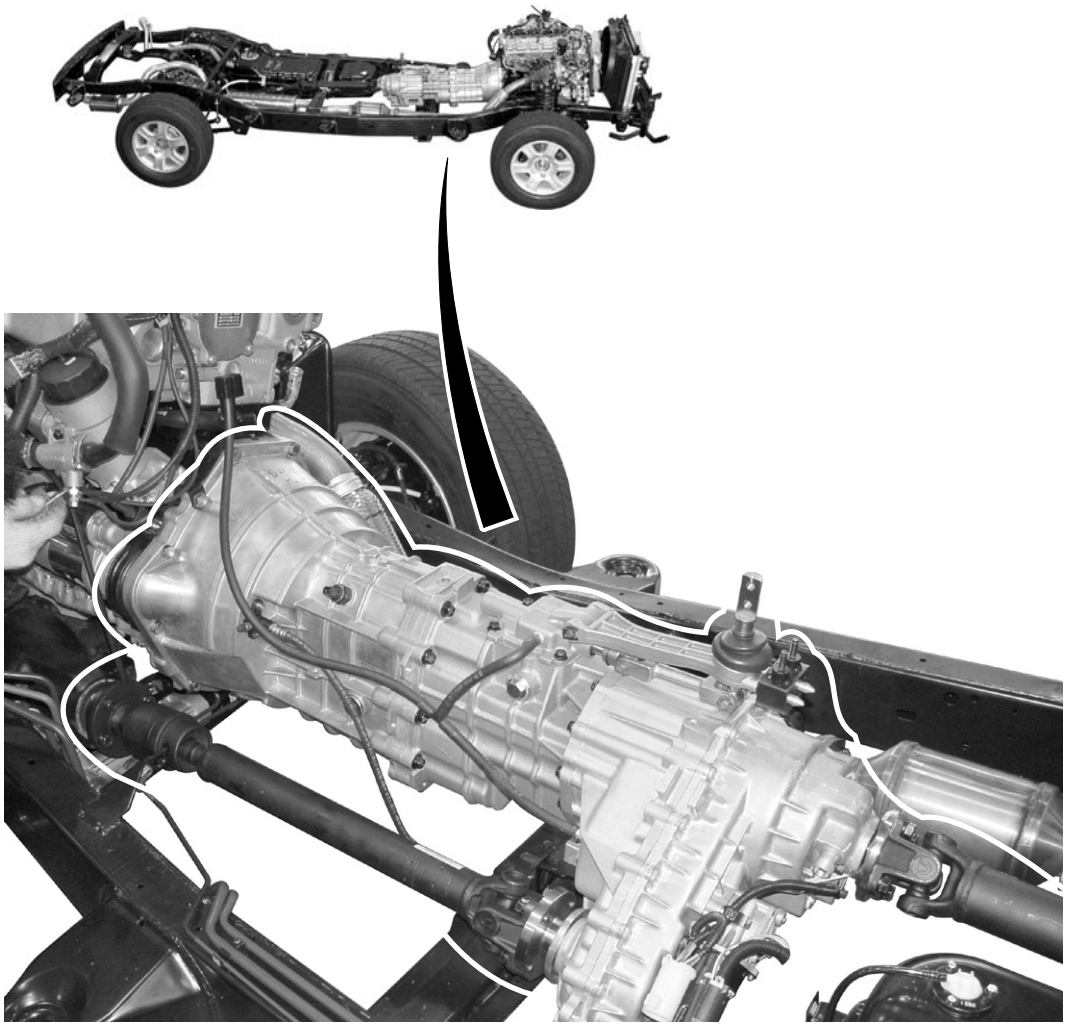
Notice

Replace the excessive worn components.

DISASSEMBLY AND REASSEMBLY

MANUAL TRANSMISSION ASSEMBLY

▶ System Layout



Y220_03B055

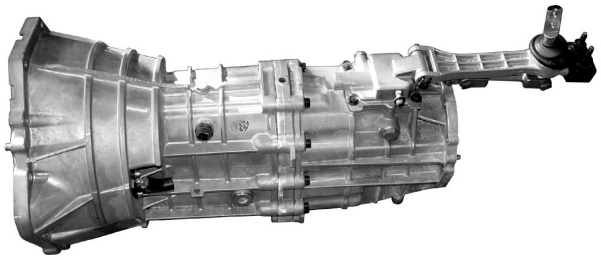
Disassembly

1. Unscrew the transmission oil drain plug (1) and drain the oil. Place the removed transmission on the work bench.

   Note

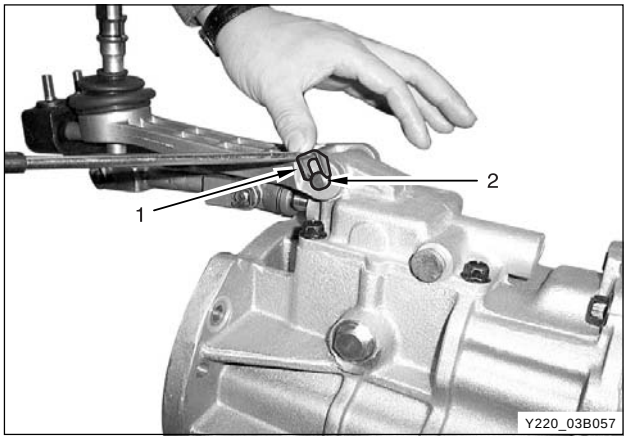
   This manual is described based on 4WD manual transmission because the service operation (disassembly and reassembly) of 4WD nad 2WD manual transmission is same. The difference between two transmissions is only the shape of extension housing.

4WD



Y220_03B056

2. Remove the lock washer (1) and TGS pin (2).

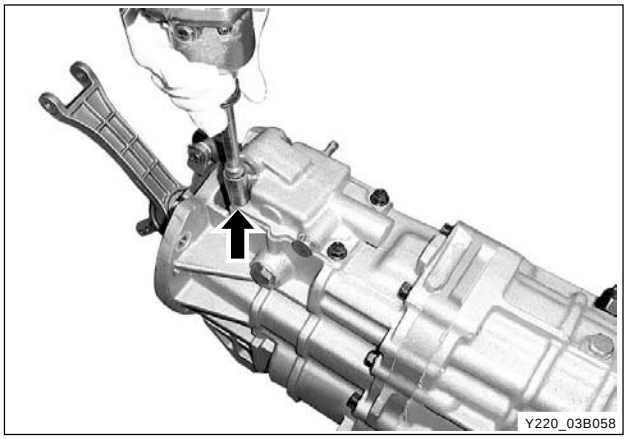


Y220_03B057

3. Pull back the semi-remote control lever. Unscrew the bolts and remove the top cover.

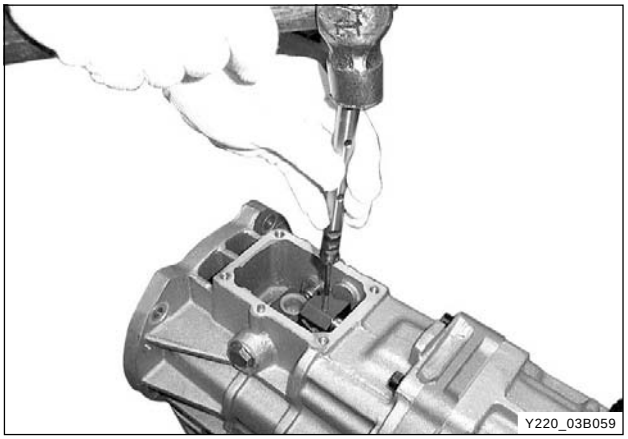
   Note

   Be careful not to lose the disassembled components.



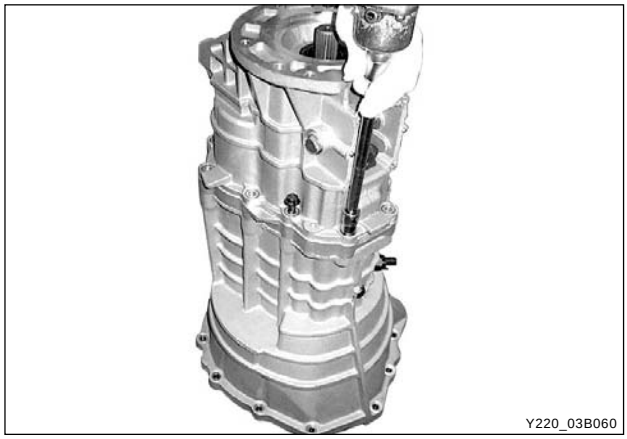
Y220_03B058

4. Set aside the offset lever and remove the spring pin (6 x 25) and offset lever.



Y220_03B059

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

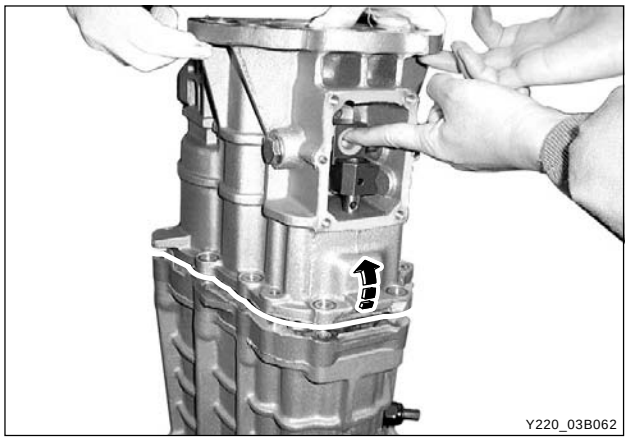


5. Remove the bolts from the extension housing.

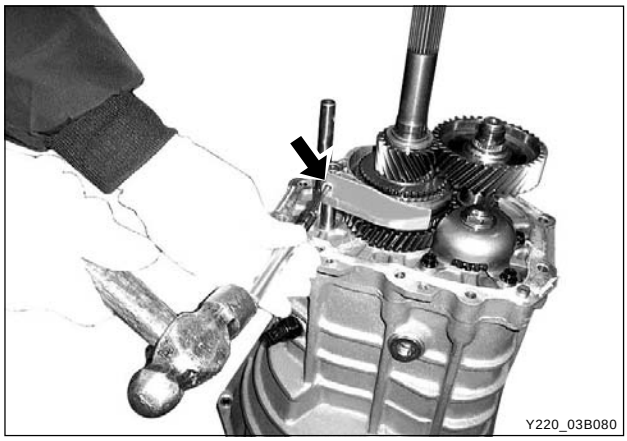
6. Remove the extension housing with a special tool.

Notice

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

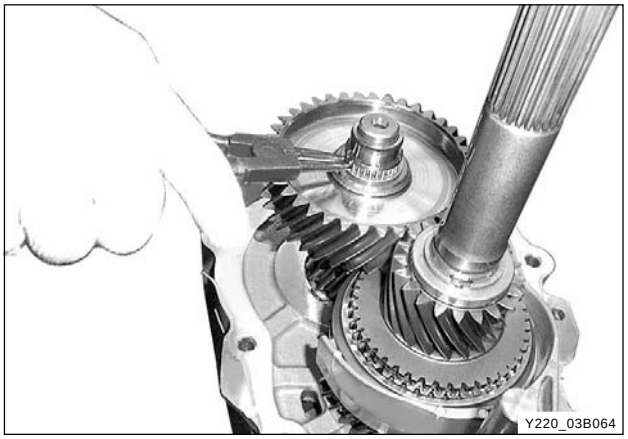


7. Remove the rear ball bearing with a puller and remove the speedometer driven gear.



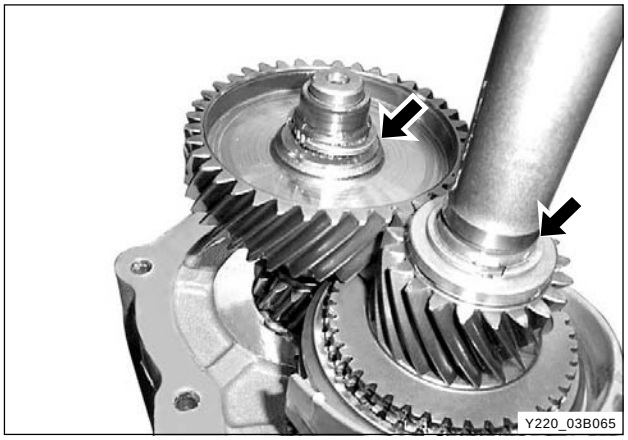
8. Remove the 5/R shift fork spring pin (6 x 28).

8-1. Pull the counter gear (5th gear) retainer ring out from the ring groove with a ring pliers.

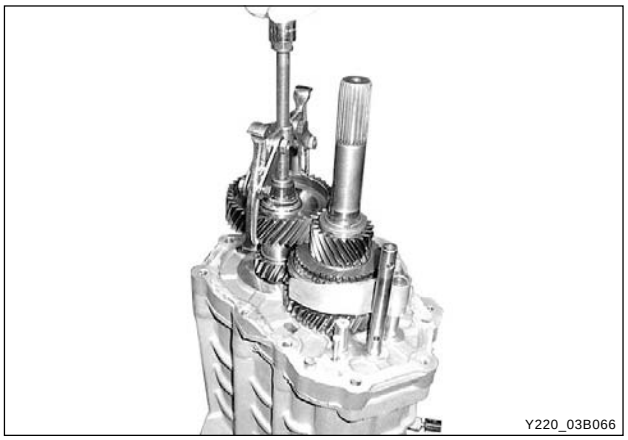


Notice

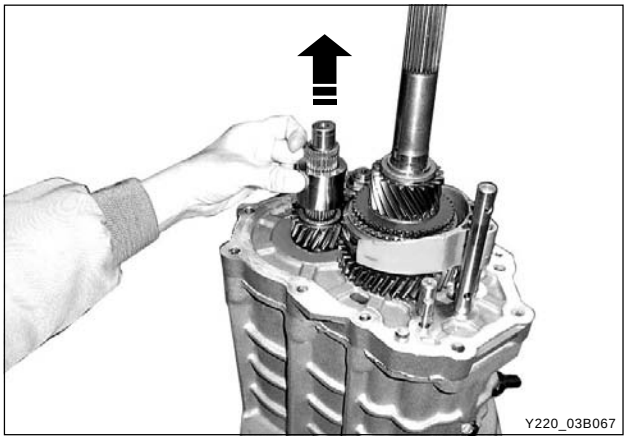
Be careful not to stiffen the retainer ring.

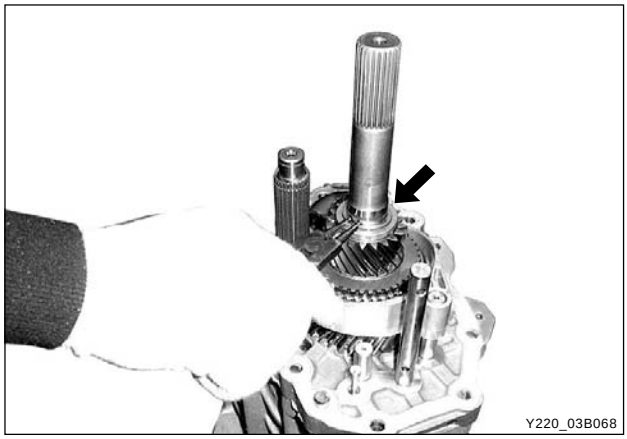


9. Spread the retainer ring and remove the counter 5th gear with a puller.

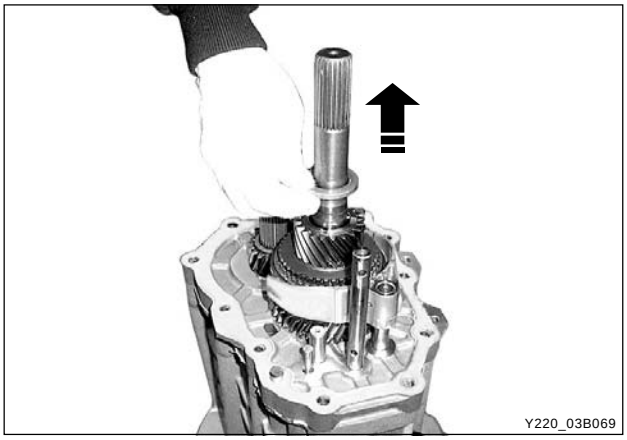


10. Remove the counter reverse spacer.

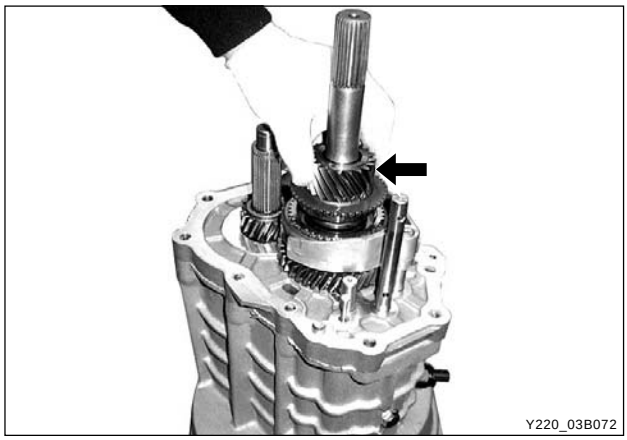




11. Remove the 5th gear retainer ring with a ring pliers.



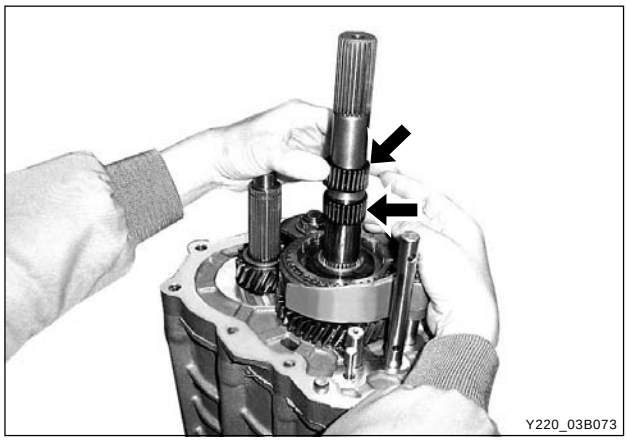
12. Remove the thrust washer from the shaft.



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

Notice

Be careful not to lose or mix the spring pins.



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

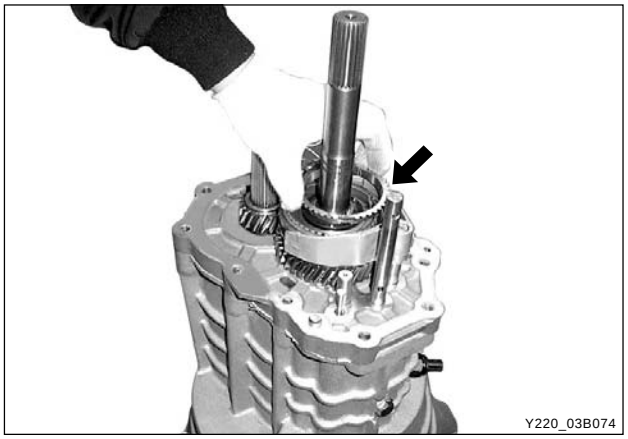
Notice

Be careful not to lose or mix the needle bearings.

15. Remove the 5th gear synchronizer ring.

Notice

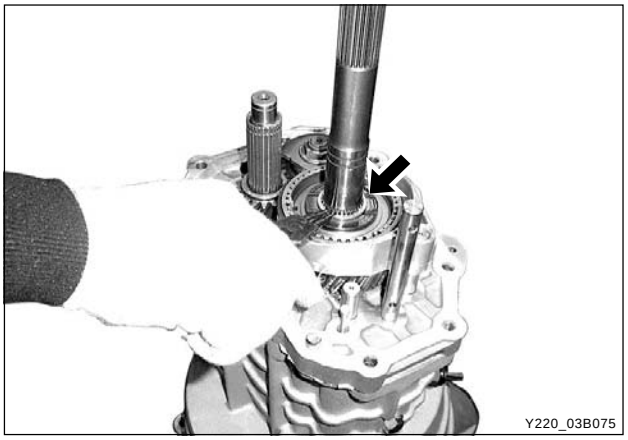
Store at a safe place not to be mixed with other synchronizer rings.



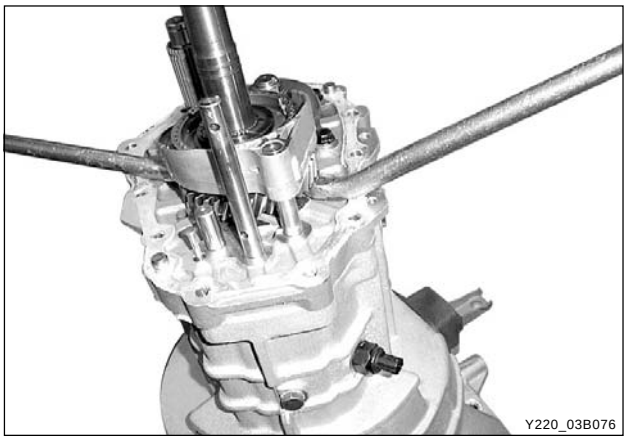
16. Remove 5/R gear retainer ring from the shaft with a ring pliers.

Notice

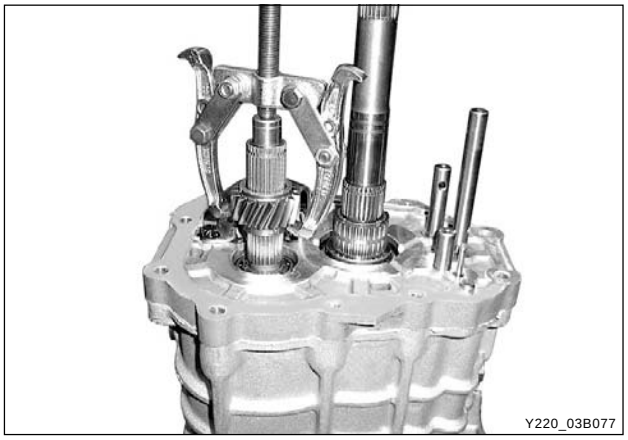
Store the ring with the relevant gear to prevent incorrect installation.

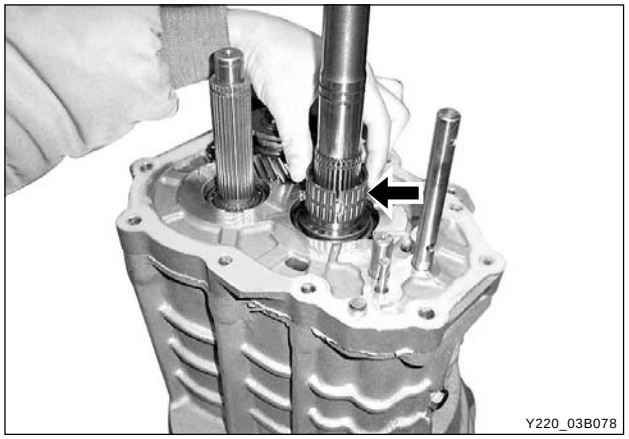


17. Remove the 5/R synchronizer hub assembly, the reverse gear and the shift fork at a time.



18. Remove the counter reverse gear.

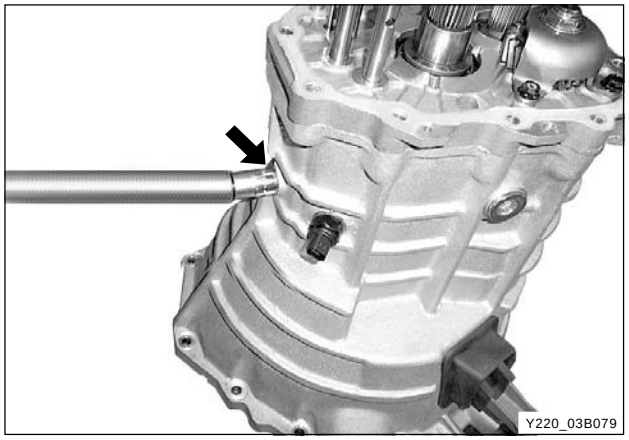




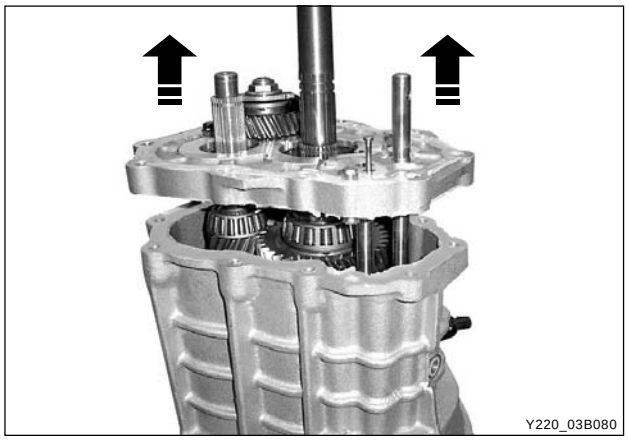
19. Remove the counter reverse gear needle bearing.

Notice

Store the needle bearing with the relevant gear.



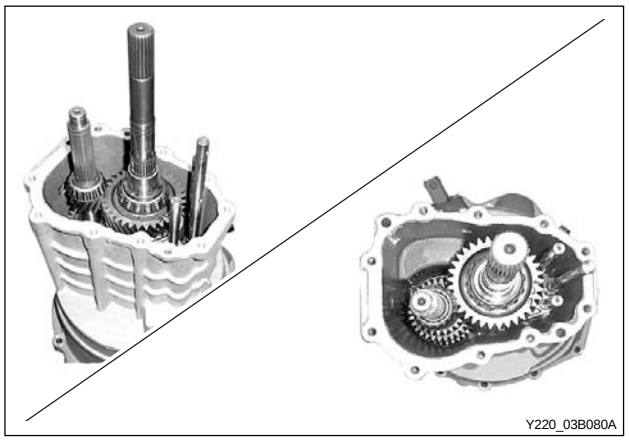
20. Remove the interlock bolt.



21. Remove the transmission adaptor from the transmission housing.

Notice

Be careful not to damage the adaptor mating surface.

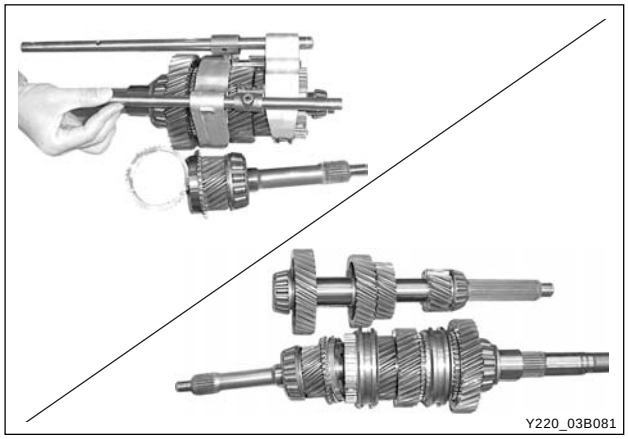


22. Remove the gear assembly from the housing.

Notice

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

23. Remove the main and counter gear assembly.
    - Pull out the pins from 5/R and 1/2 shift rails and remove the shift rails through rear section of adaptor.
    - Pull out the locking pins from shift forks.

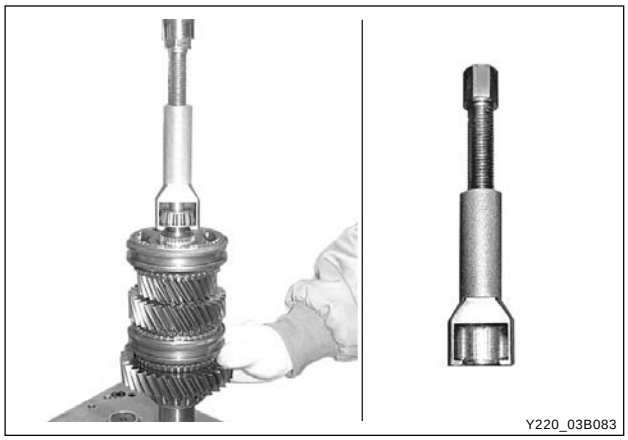


24. Remove the shift rail and shift fork. Place the output shaft and counter gear on the special tool.

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

    Notice

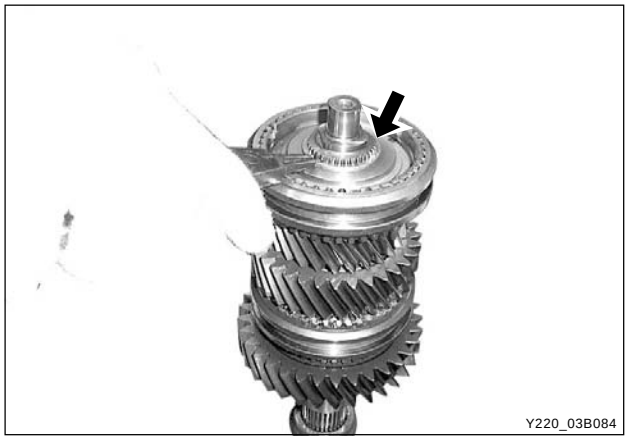
    - ***To prevent the bearing damage, securely seat the special tool before removing the intermediate taper roller bearing that is pressed in.***
    - ***Do not use general bearing puller.***

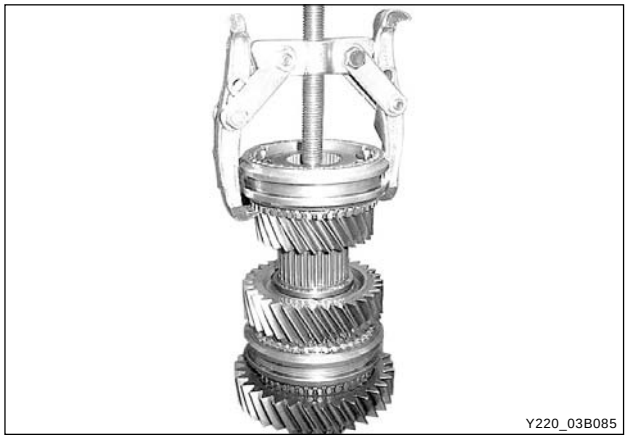


26. Remove the 3/4 gear retainer ring.

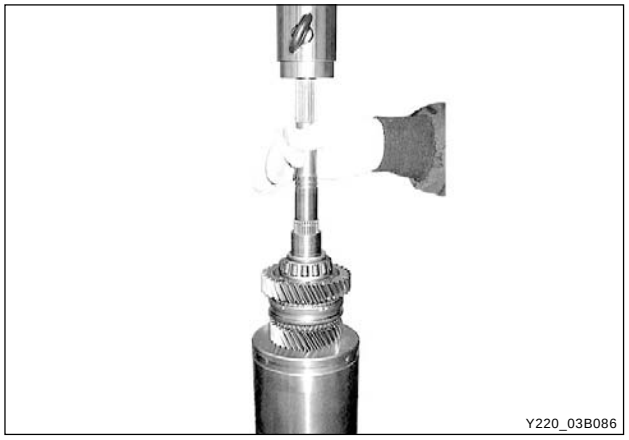
    Notice

    Be careful not to lose or mix the retainer ring.

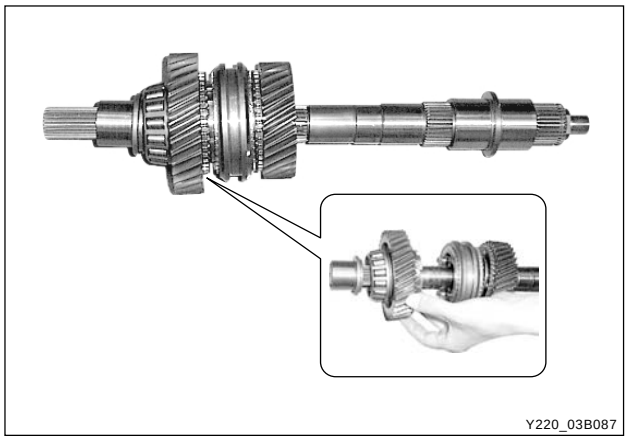




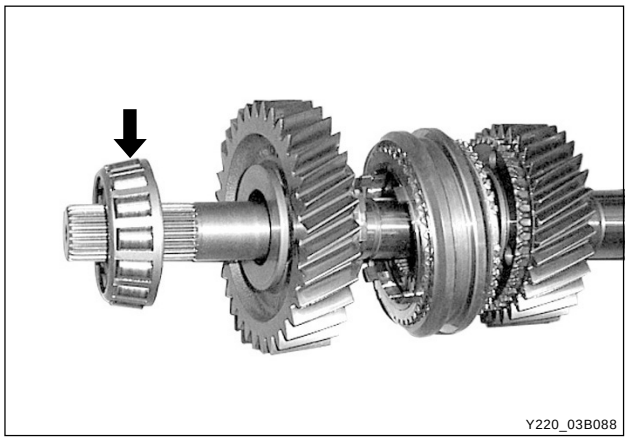
27. Remove the 3/4 gear synchronizer hub and single synchronizer sleeve and 3rd gear with a special tool. Pull out the needle bearing.



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



29. Remove the reverse gear inner race.

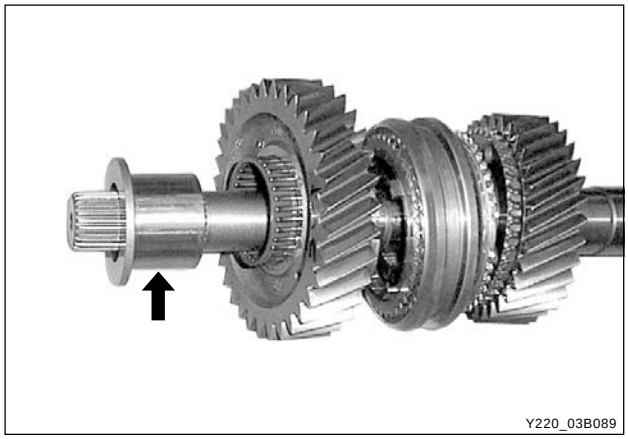


30. Remove the main taper roller bearing.

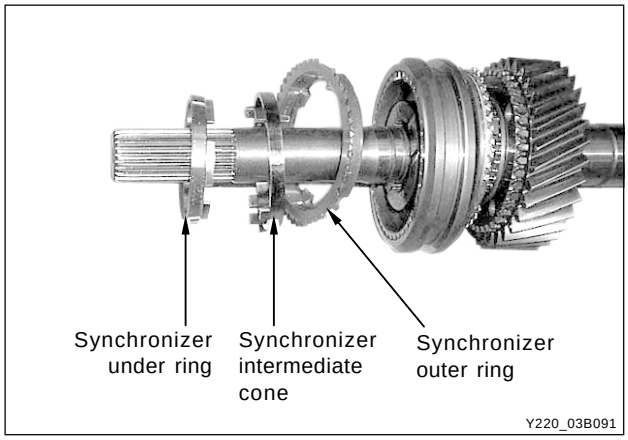
31. Remove the inner race and 1st gear from 1st gear, and remove the needle bearing from the shaft.

Notice

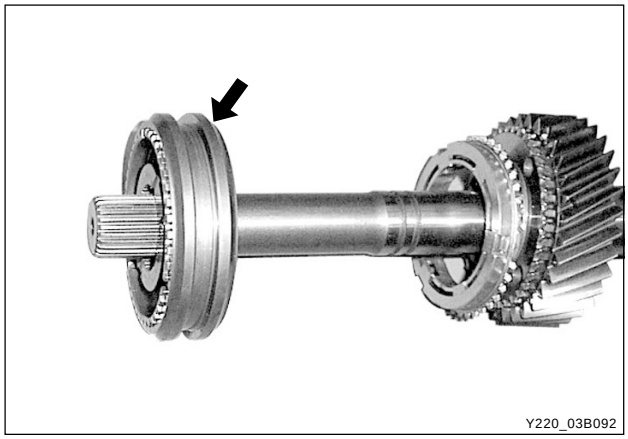
Store the disassembled gears by relevant components.



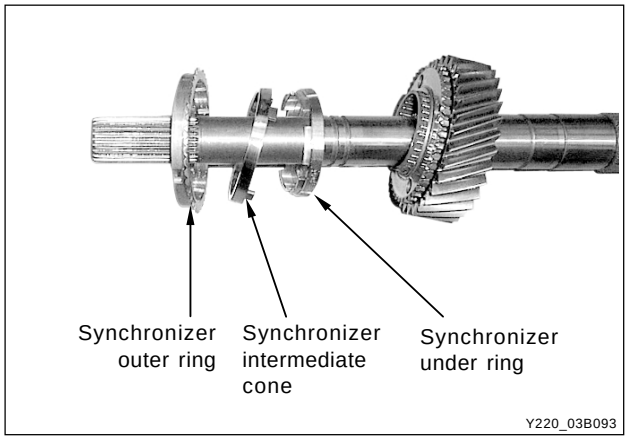
32. Remove the synchronizer inner intermediate cone and outer ring in 1st gear side.



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



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



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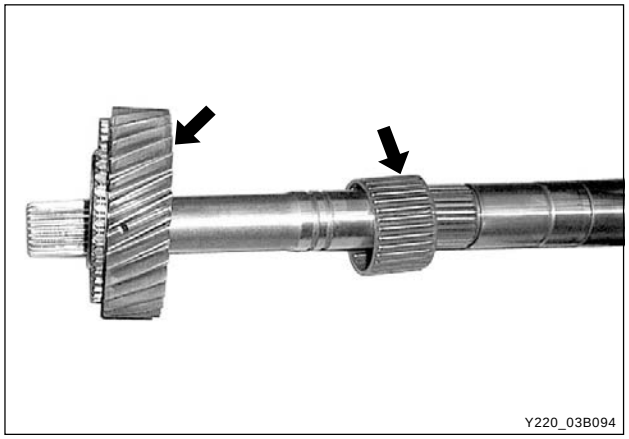


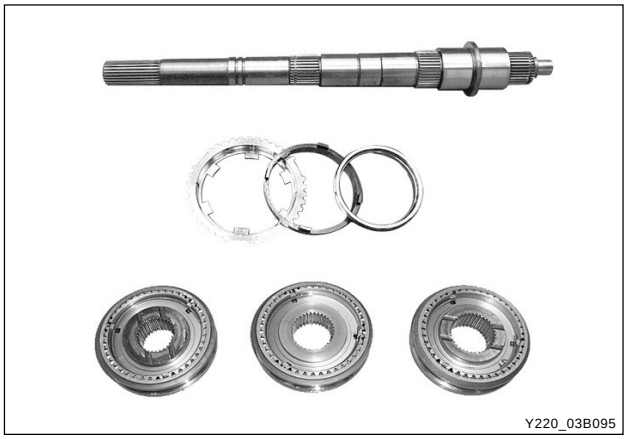
35. Remove the 2nd gear and needle bearing.

36. Remove the oil seal from the extension housing.

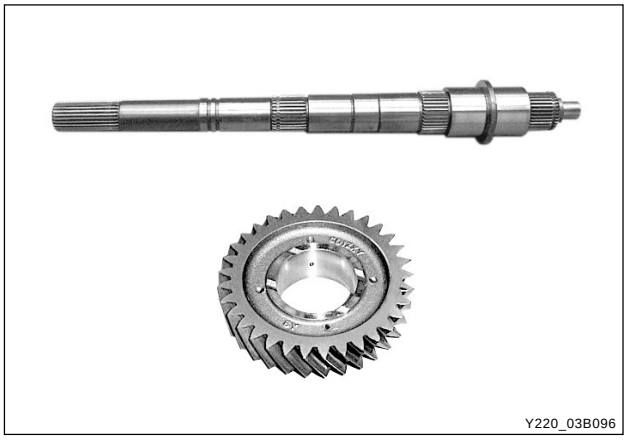
Inspection Before Reassembly

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

   Check the components for crack, wear and damage.
   - Case, extension housing, shift lever
   - Input bearing retainer
   - Counter shaft rear bearing retainer
2. Check the bearing and shaft supporting area for wear and replace if needed.


Y220_03B095

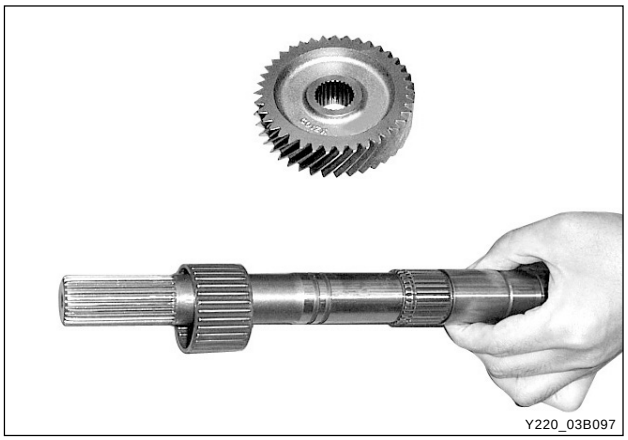
3. Check the surface conditions on:
   - Input shaft
   - Main shaft and gears
   - Counter shaft and 5th drive gear


Y220_03B096

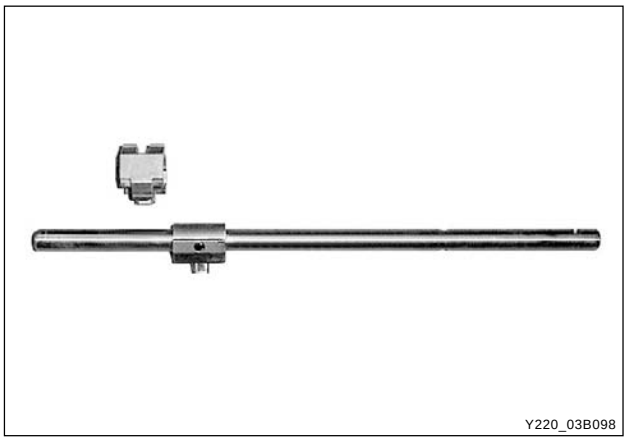
4. Reverse idler shaft and gears

   Notice

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


Y220_03B097

5. Check the following components for wear:
   - Selector arm
   - Interlock plate
   - 1/2 and 3/4 shift fork
   - Shift shaft
   - Detent/guide plate and offset lever
   - Each shift lever shift fork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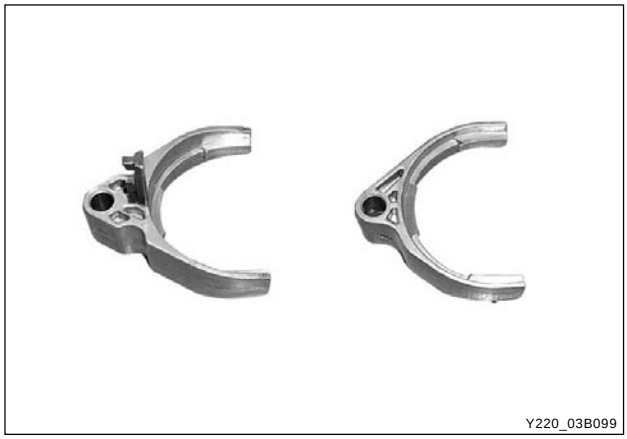
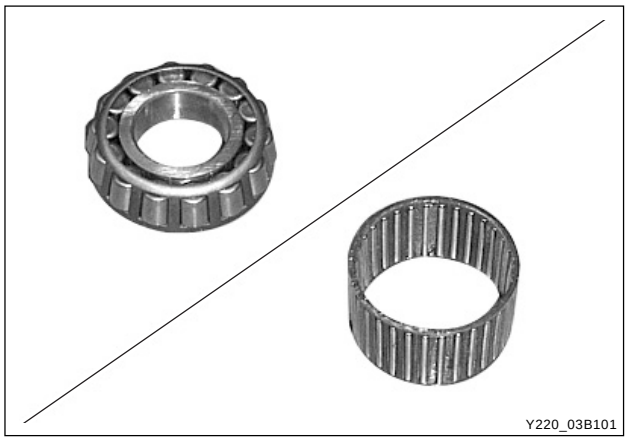

Y220_03B099

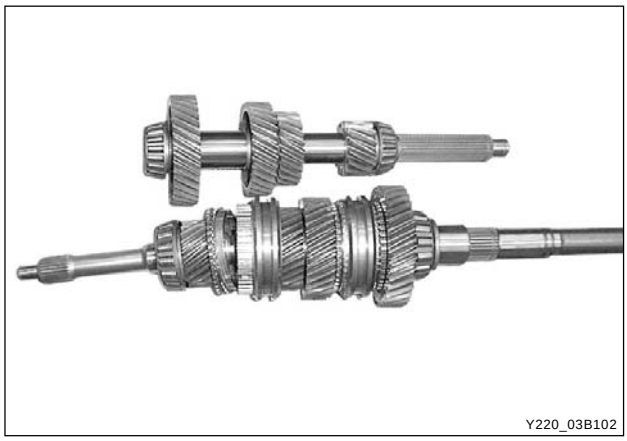
- Hub and sleeve
- 1/2 shift fork, pads, synchronizer sleeve


Y220_03B099A

- 3/4 shift fork, pads, synchronizer sleeve
- 5th gear shift rail/fork, pads, synchronizer sleeve
- Reverse fork and reverse idler gear sleeve

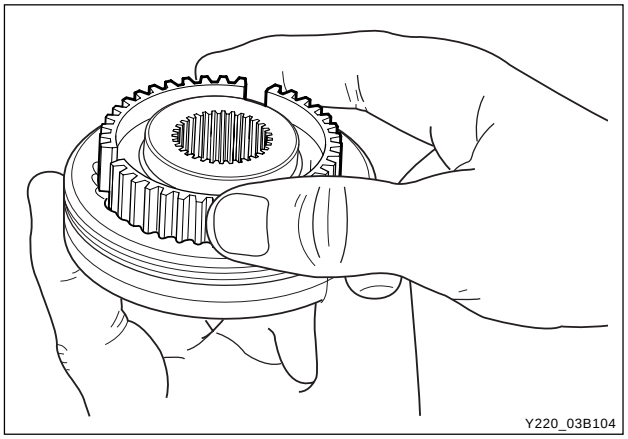

Y220_03B101

6. Check the following components for excessive wear:
   - Crankshaft bushing in front of input shaft
   - Clutch release bearing
   - Main shaft pilot bearing roller
   - Main shaft thrust bearing mating surface
   - Main shaft speed gear roller bearing
   - Main shaft rear bearing
   - Counter shaft front and rear bearing


Y220_03B102

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

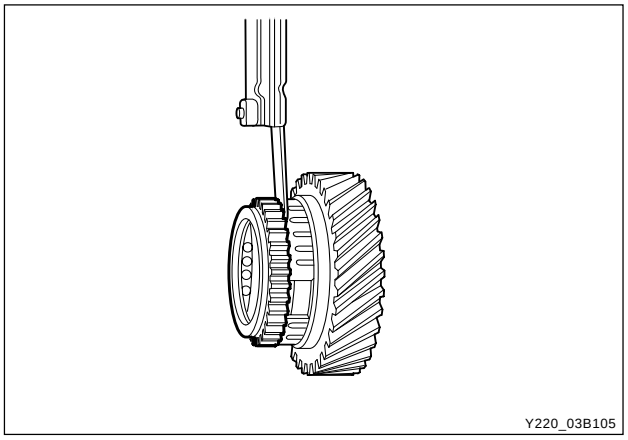
9. Check the conditions of each synchronizer sleeve and hub.
   - Engagement of hub and sleeve
   - Wear on cone clutch surface in blocking ring (brass) engaging the gears


Y220_03B104

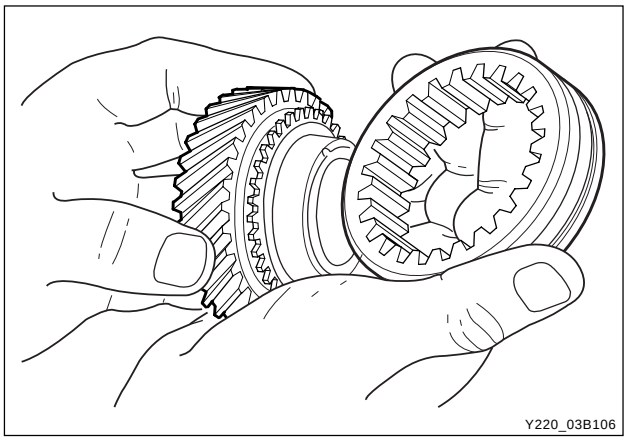
10. Measure the clearance between blocking ring and speed gear.
    - New 1/2 gear blocking ring: 0.87 ~ 1.4 mm
    - New 3/4 gear blocking ring: 0.88 ~ 1.5 mm

    Notice

    If the clearance is excessive, replace it with new one. Otherwise, it may cause the missing or breakage of the gears.


Y220_03B105

11. Check the speed gear clutch and synchronizer sleeve for damage in teeth surface.
12. Check the engagement of synchronizer sleeve and speed gear clutch.


Y220_03B106

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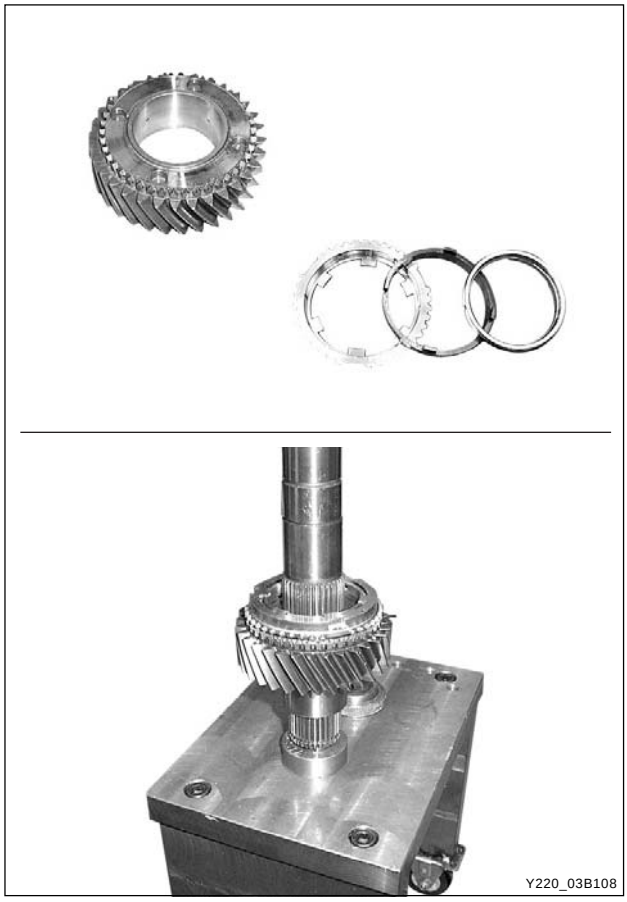
Reassembly

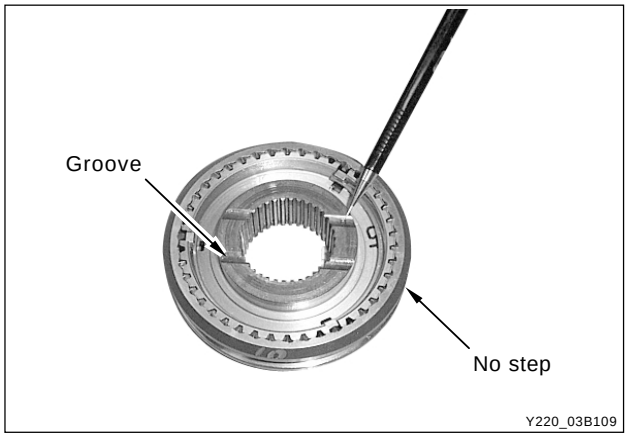
1. Install the 2nd gear needle bearing.

Notice

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



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



3. Insert three keys into 1/2 synchronizer hub and double synchronizer sleeve. Install the synchronizer spring in offset so that it should not be missed out.

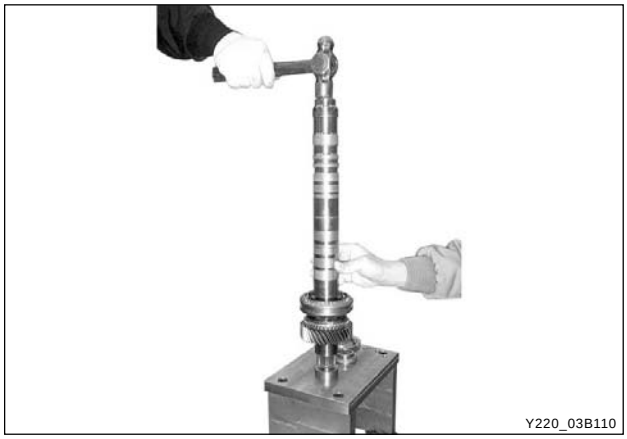
Notice

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

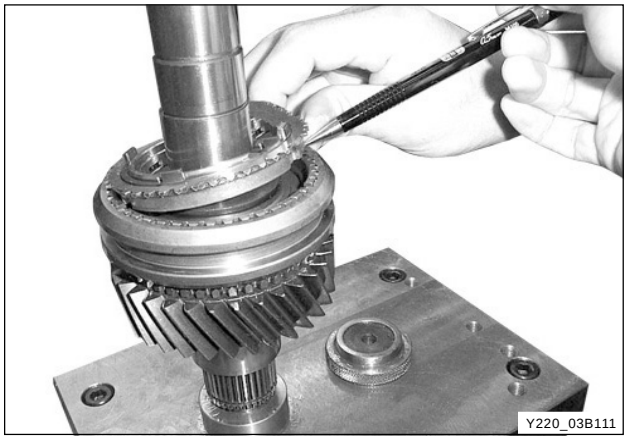
4. Install the 1/2 synchronizer hub and double synchronizer sleeve into the output shaft by using a press.

   Notice

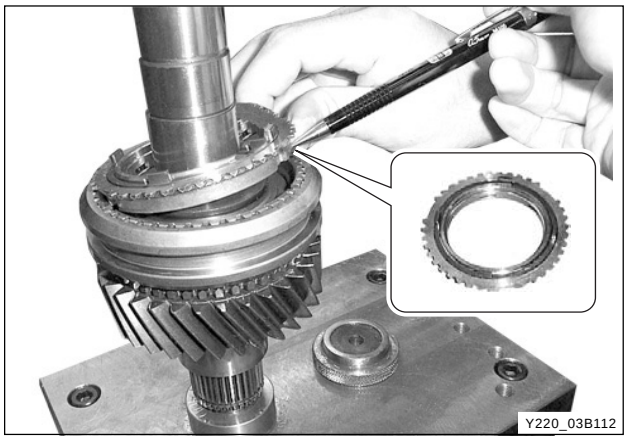
   Make sure that the hub groove faces to 2nd gear. Align the synchronizer key and the synchronizer ring groove in 2nd gear.



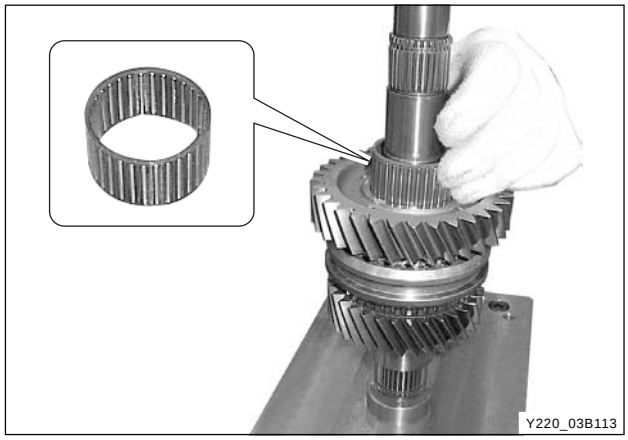
5. Install the synchronizer outer ring, intermediate cone and inner ring in regular sequence.



6. Install the 1st gear.



7. Install the 1st gear needle bearing.



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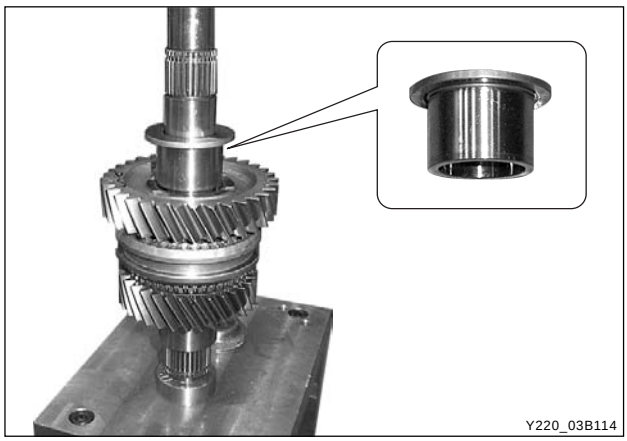
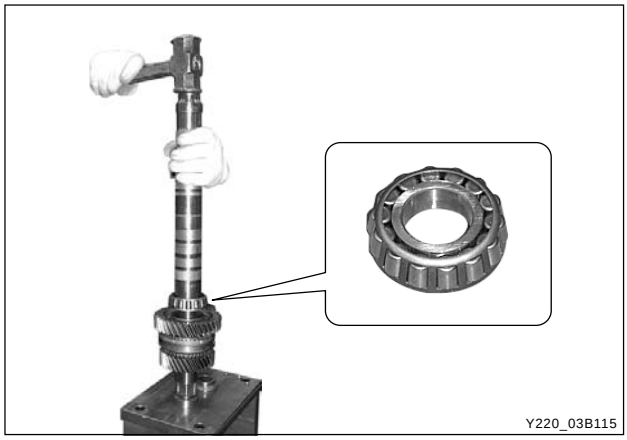


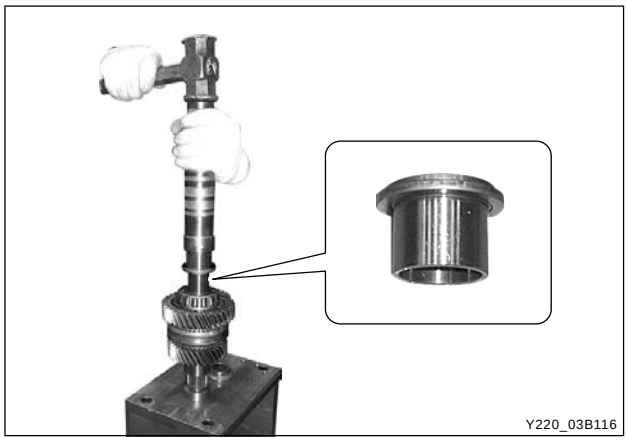
8. Install the 1st gear inner race by using a press.

Notice

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



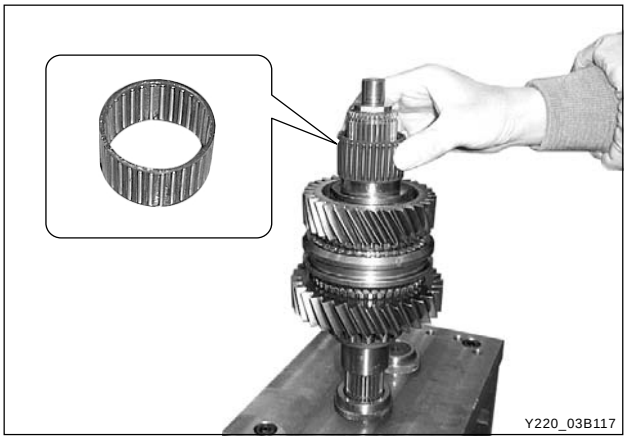
9. Install the main taper roller bearing by using a press.



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

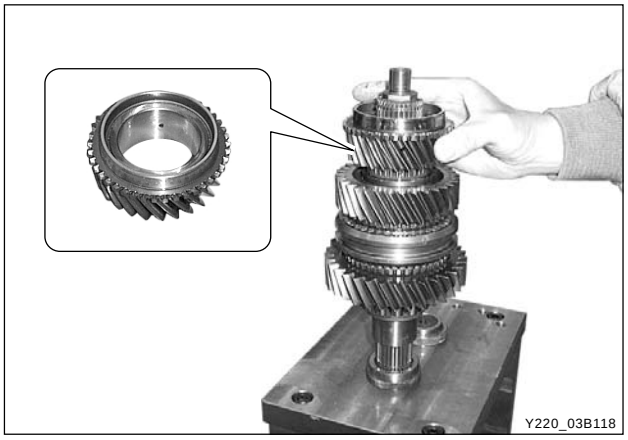
Notice

The reverse gear inner race has a step at edge.

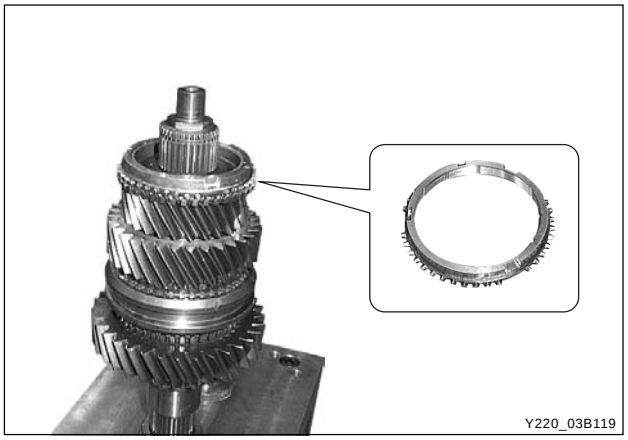


11. Place the output shaft assembly with the 1st gear facing downward and install the 3rd gear.

12. Install the 3rd gear.



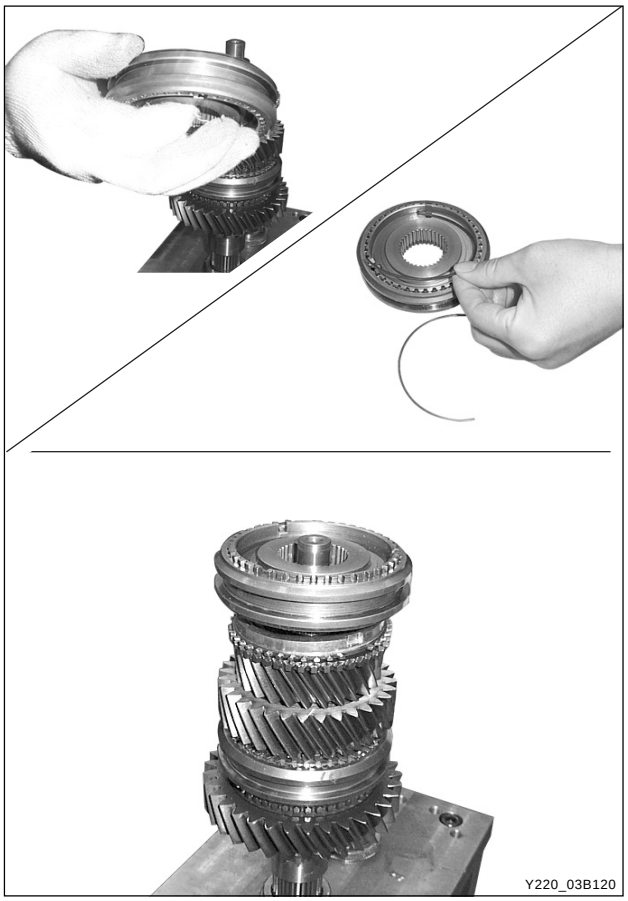
13. Install the synchronizer ring on the 3rd gear.



14. Insert three keys into 3/4 synchronizer hub and synchronizer sleeve. Install the synchronizer spring in offset so that it should not be missed out.

Notice

3/4 gear synchronizer sleeve have a step at edge. Place the groove in hub to face the 3rd gear and align the synchronizer key and the synchronizer ring groove in 3rd gear.



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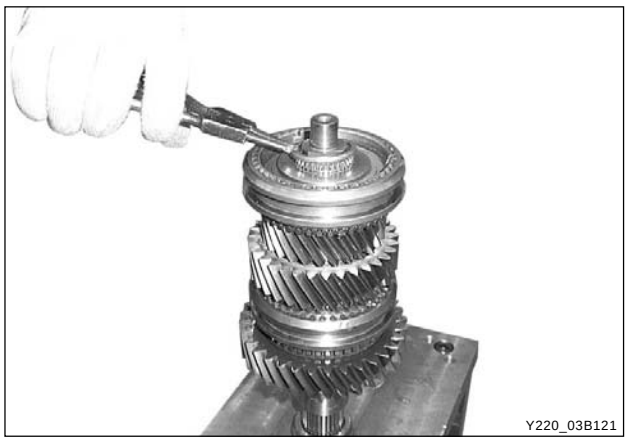
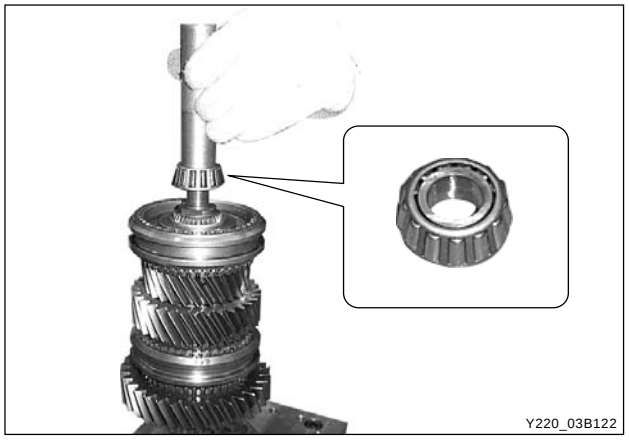


15. Install the 3/4 gear retainer ring.

Notice

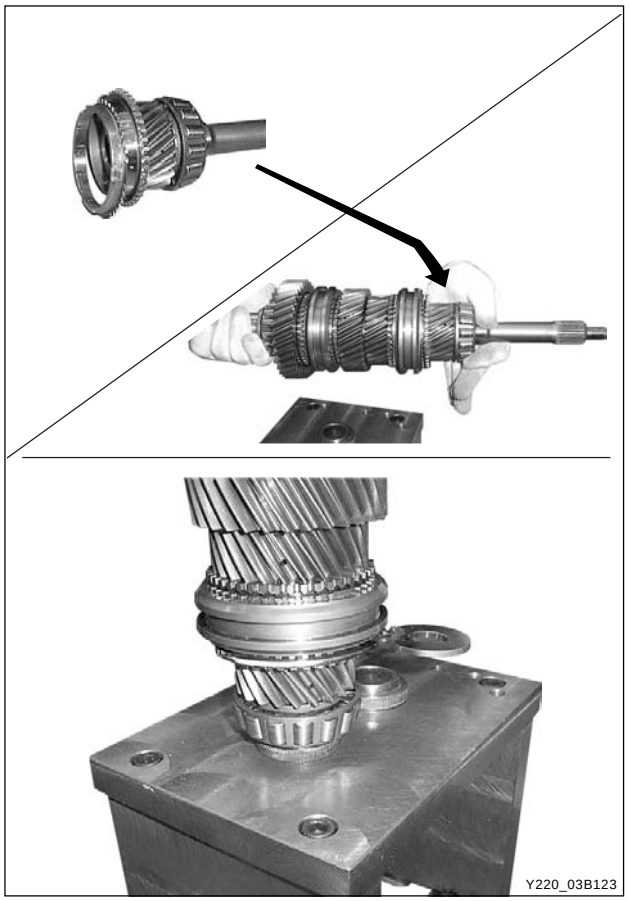
Adjust the end play between retainer ring and hub to a range of 0.05 to 0.1 mm by using a thickness gauge.



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

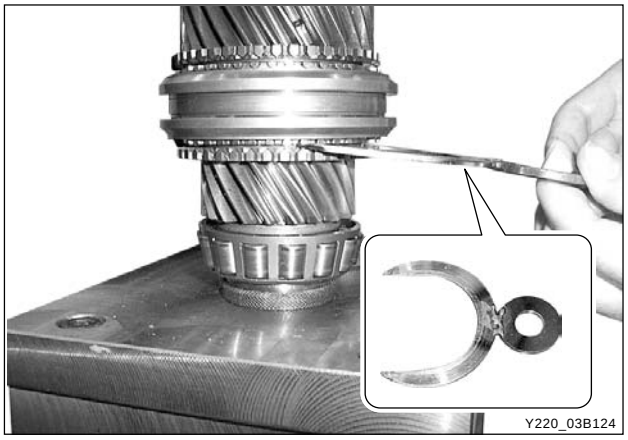
Notice

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

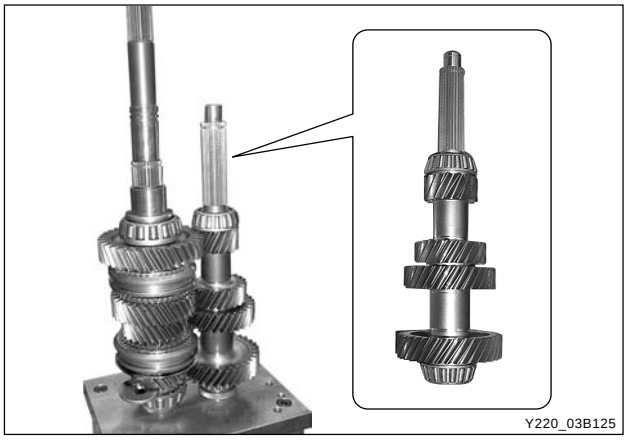


17. Install the input shaft along with the 4th synchronizer ring. Place the input shaft to face downward on the work bench.

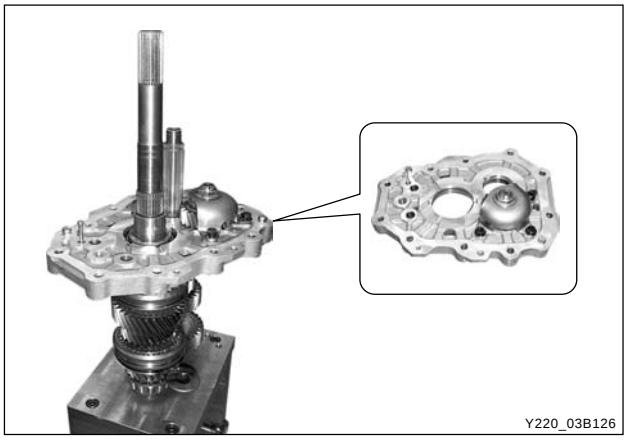
18. To relieve the load to the shaft bearing, insert a special tool.



19. Place the counter gear on the work bench with the same manner.



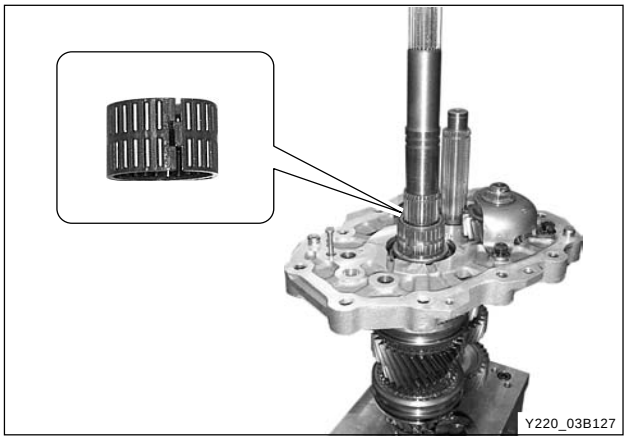
20. Install the transmission adaptor on the input shaft and the counter gear.



21. Install the reverse gear needle bearing.

Notice

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



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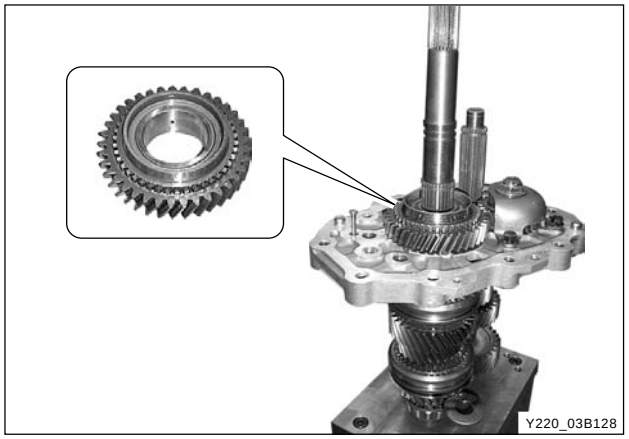
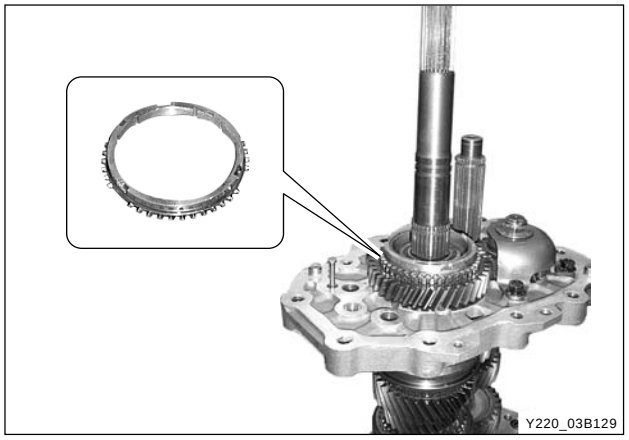
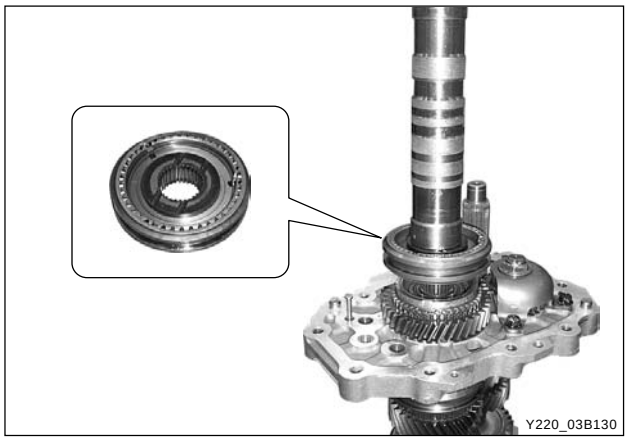


22. Install the reverse gear in the shaft.



23. Install the synchronizer ring on the reverse gear.



24. Insert three keys into 5/R synchronizer hub and synchronizer sleeve. Install the synchronizer spring in offset so that it should not be missed out.

Notice

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

25. Install the 5/R gear retainer ring.

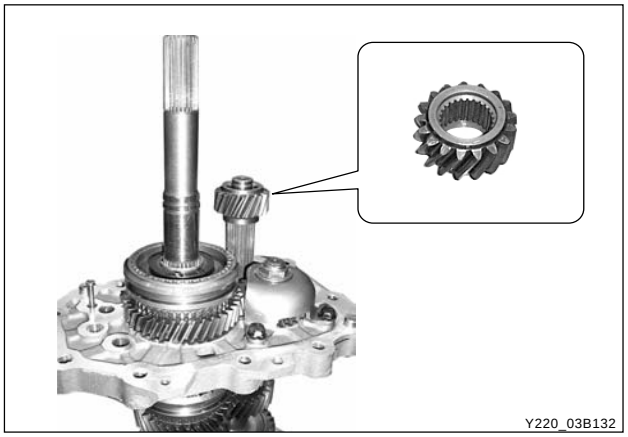
Notice

Adjust the end play between retainer ring and hub to a range of 0.05 to 0.1 mm by using a thickness gauge.

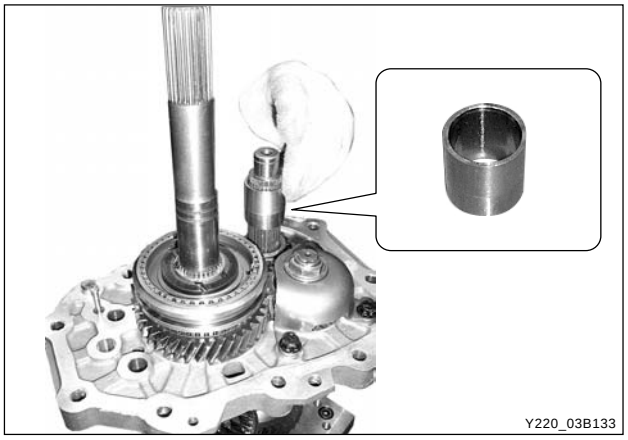
26. Install the counter reverse gear by using a press.

Notice

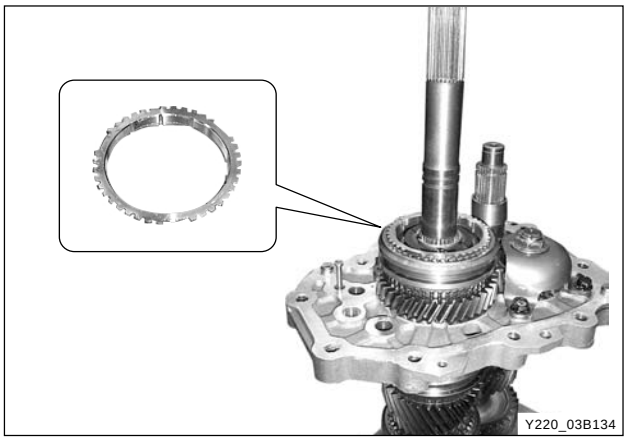
Place the counter reverse gear with a longer protrusion facing to the adaptor.



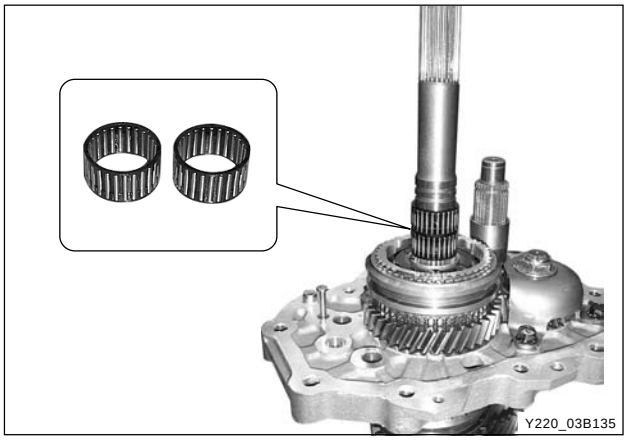
27. Install the counter reverse spacer.



28. Install the 5th synchronizer ring.



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



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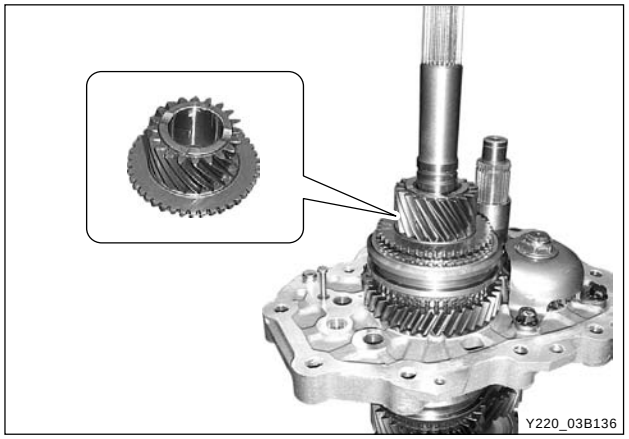
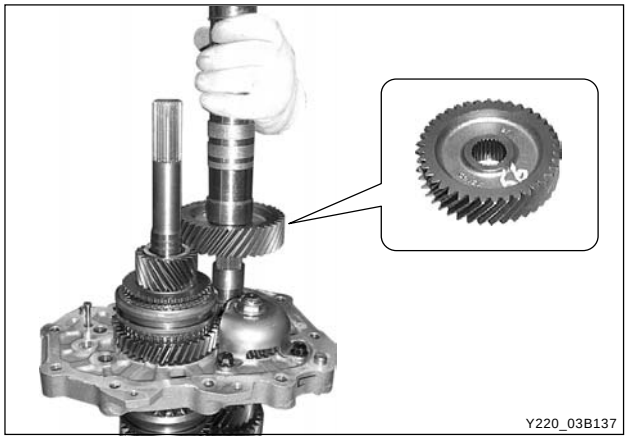
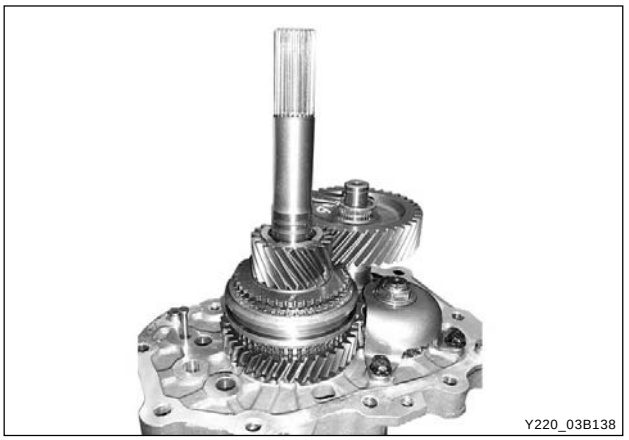


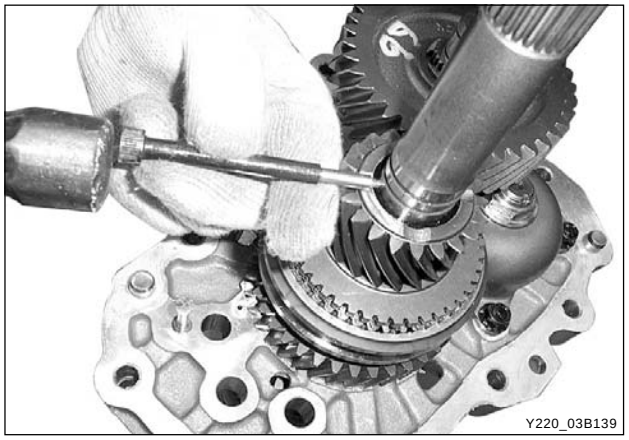
30. Install the 5th gear.



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

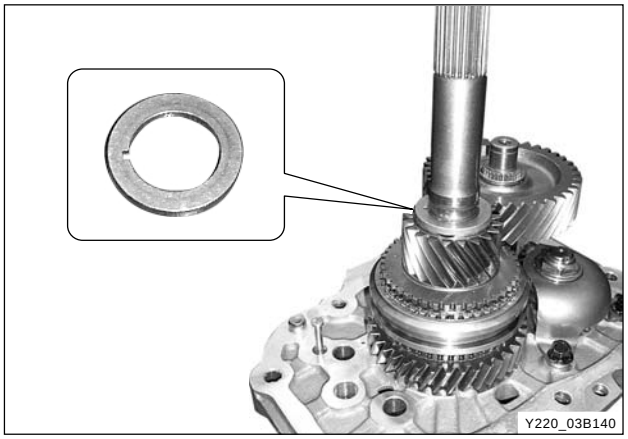


32. Install the counter 5th gear retainer ring.



33. Install the locking ball.

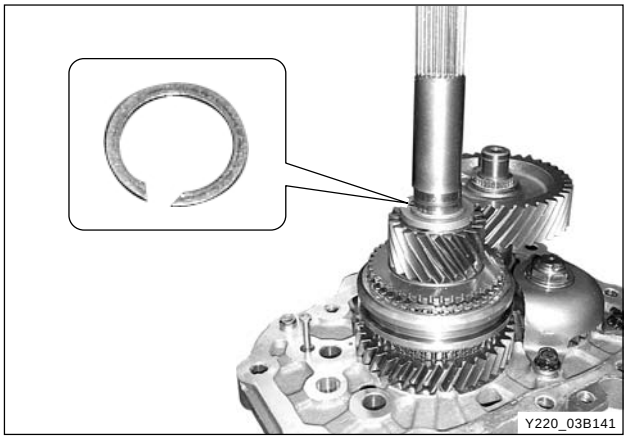
34. Install the thrust washer (t= 5.0) while aligning the key grooves.



35. Install the retainer ring.

Notice

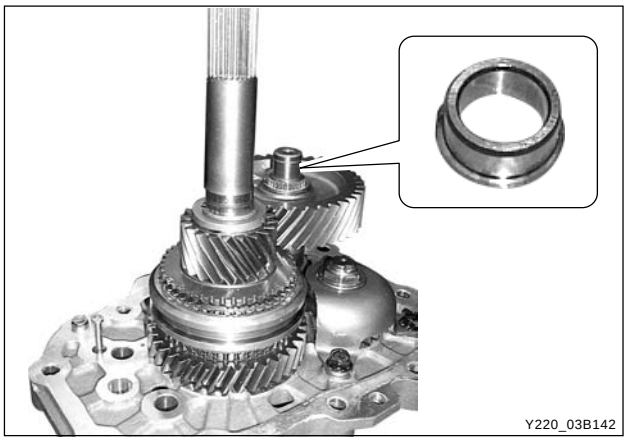
Adjust the end play between retainer ring and hub to a range of 0.08 to 0.22 mm by using a thickness gauge.



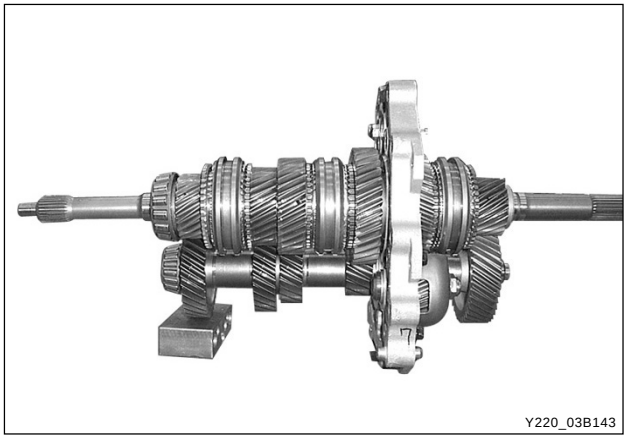
36. Install the inner race of counter roller bearing by using a press.

Notice

Place it with a protrusion facing to the adaptor



37. Place the gear assembly on a work bench in parallel.



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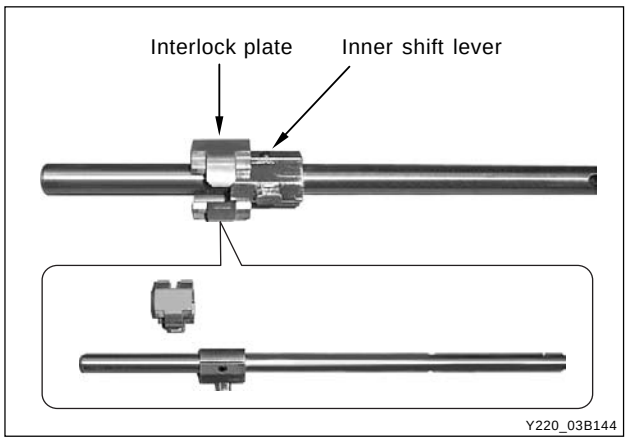
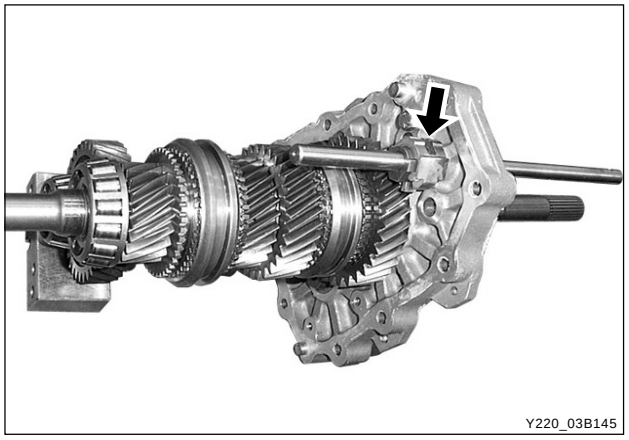


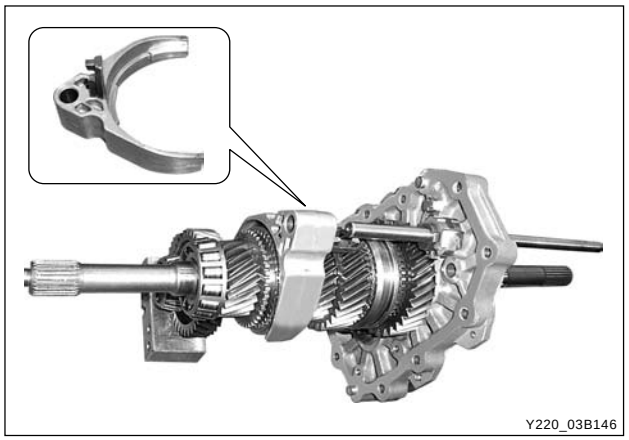
38. Install the inner shift lever and interlock plate in the 3/4 gear shift rail.

Notice

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



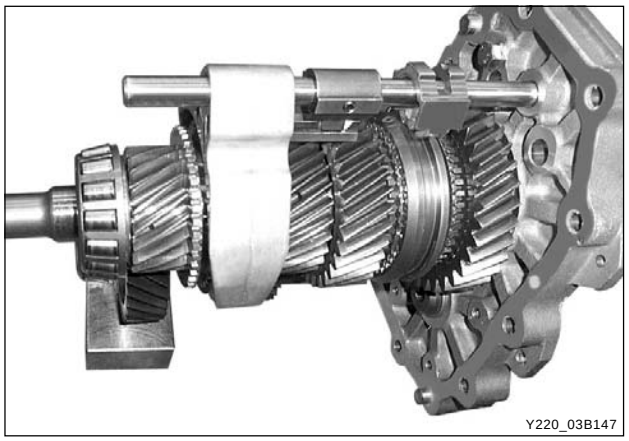
39. Install the 3/4 hear shift rail in the transmission adaptor.



40. Install the 3/4 gear shift fork.

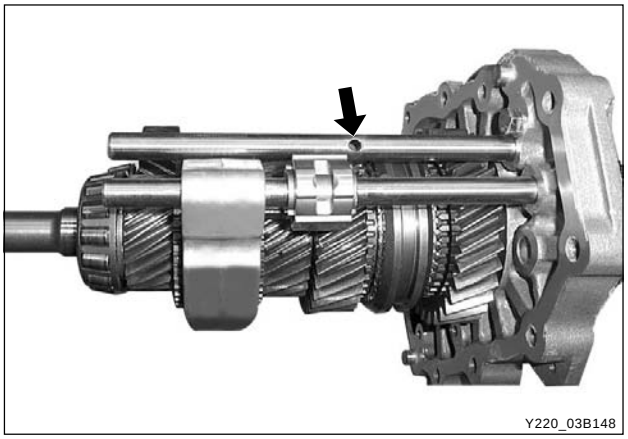
Notice

The 1/2 and 5/R shift fork are compatible, but 3/4 shift fork isn't. Also, the 3/4 shift fork is chamfered, but 1/2 and 5/R aren't.

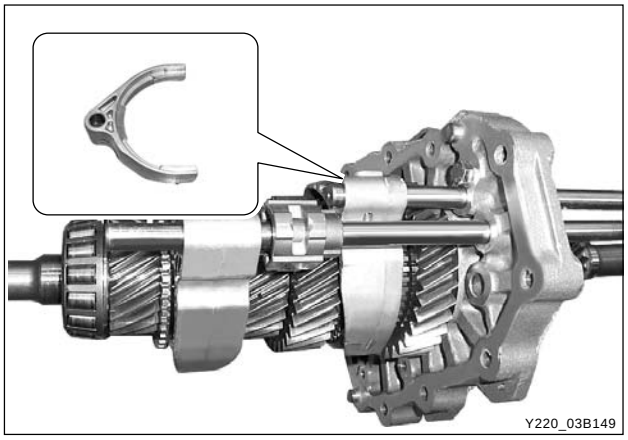


41. Install the 3/4 shift fork and shift rail while aligning the grooves.

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



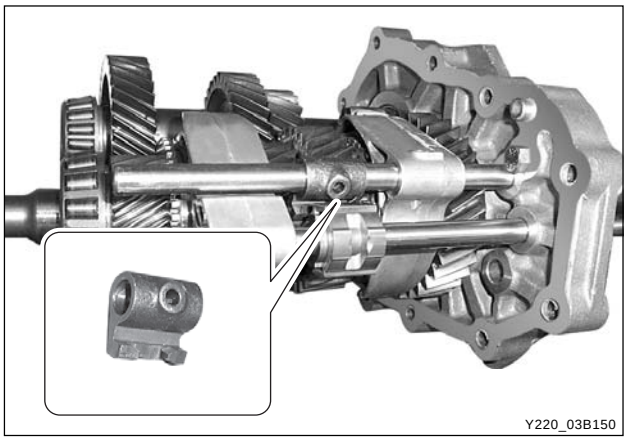
43. Partially engage the 1/2 shift fork to the shift rail.



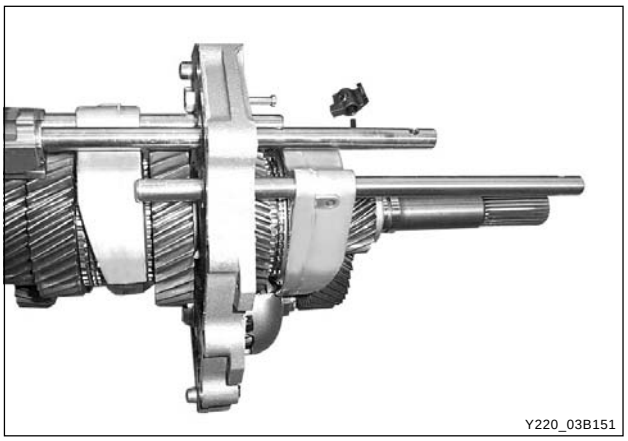
44. Install the shift lug on the 1/2 shift rail. Install the reverse lock spring, reverse lock plate and reverse lock bolts.

Notice

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



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



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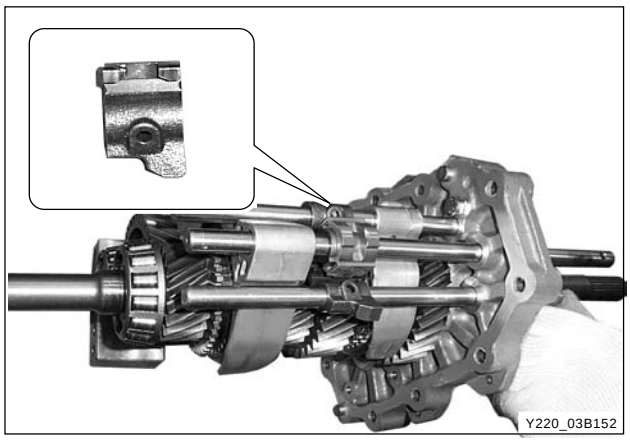
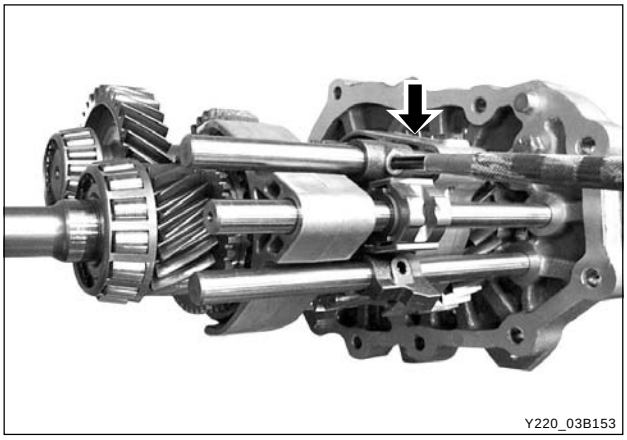


46. Install the 5/R shift lug and 5/R shift fork on the shift rail.

Notice

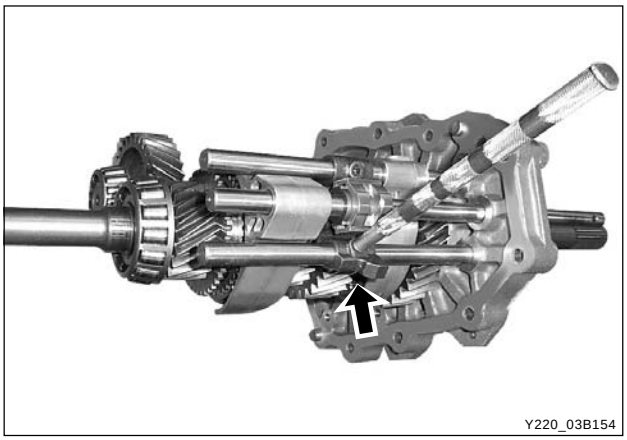
Align the 5/R shift lug and the interlock plate surface.



47. Install the spring pin into the 1/2 shift lug. (intermediate size: t= 6 x 25)

Notice

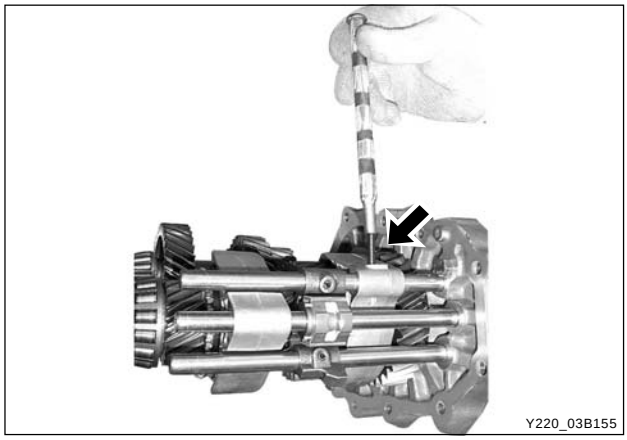
Place the spring pin with the pin slot facing to the shift.



48. Install the spring pin into the 5/R shift lug. (intermediate size: t= 6 x 25)

Notice

Place the spring pin with the pin slot facing to the shift.



49. Install the spring pin into the 1/2 shift fork. (longer size: t= 6 x 28)

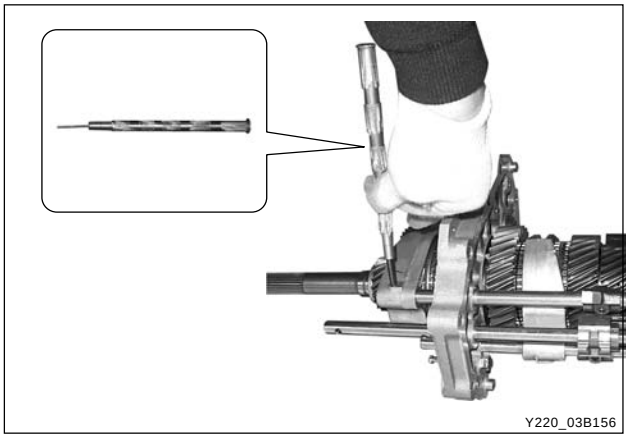
Notice

Place the spring pin with the pin slot facing to the shift.

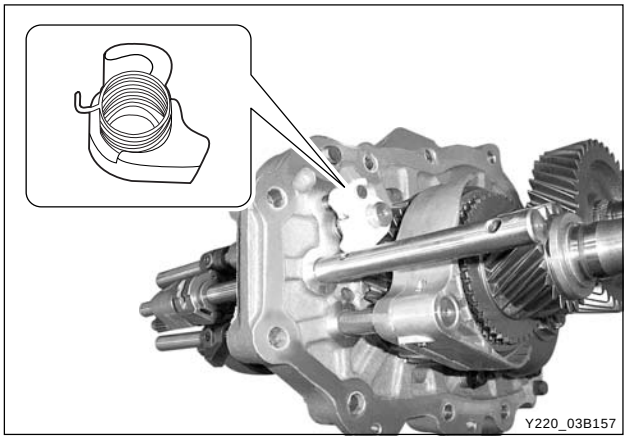
50. Install the spring pin into the 5/R shift fork. (longer size: t= 6 x 28)

Notice

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



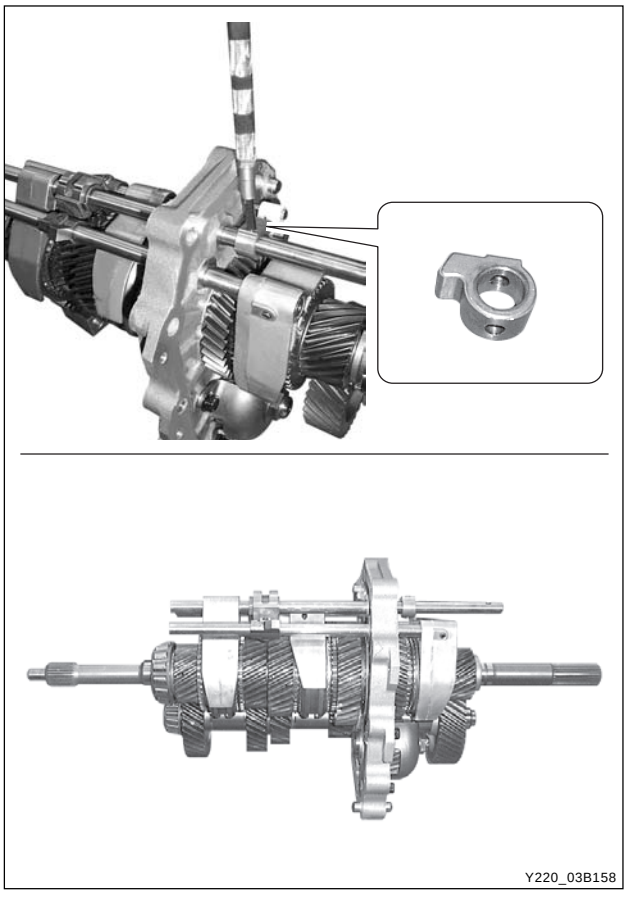
51. Install the reverse lock plate and reverse lock spring on the 1/2 shift rail.



52. Install the stopper plate on the 3/4 shift rail and insert the spring pin. (intermediate size: t= 6 x 25)

Notice

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



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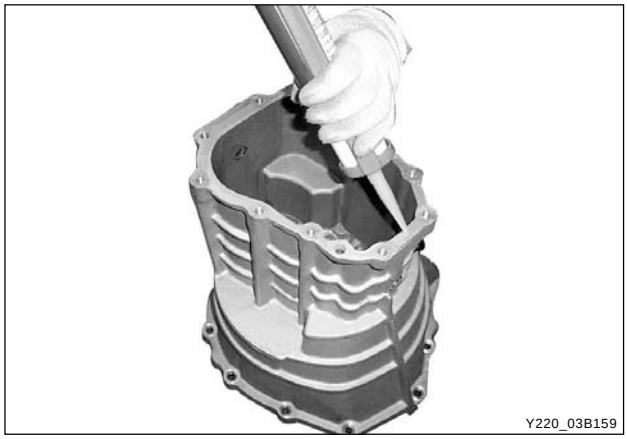
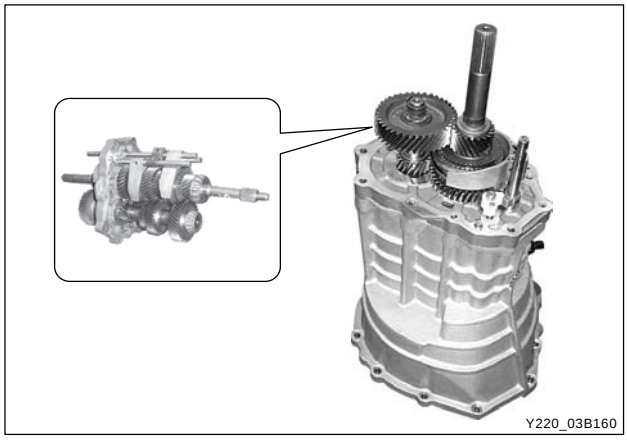


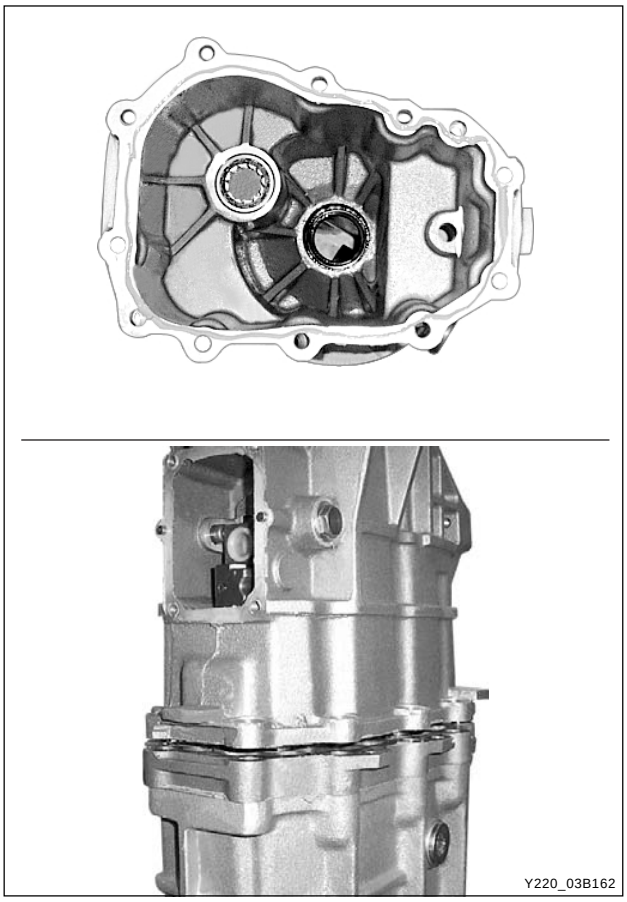
53. Apply the sealant to the transmission housing.

Notice

Sealant: LOCTITE 5900



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



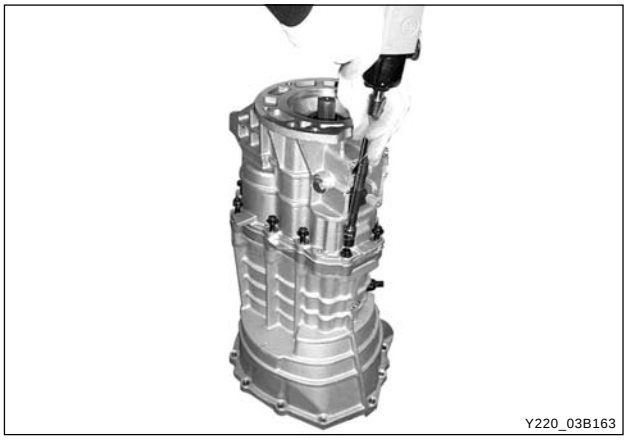
56. Apply the sealant to the extension housing. Press down the extension housing against the adaptor.

Notice

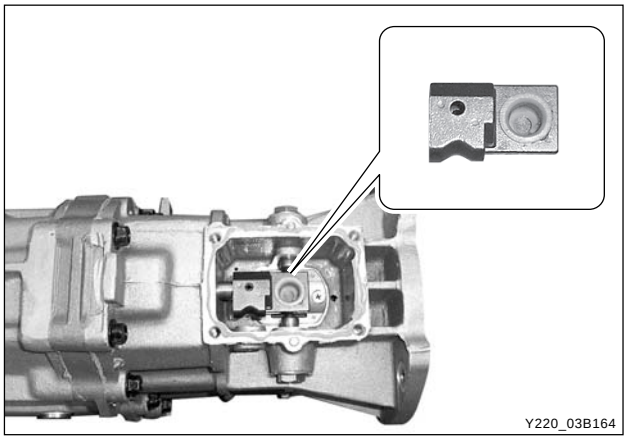
Sealant: LOCTITE 5900

57. Tighten the extension housing bolts.

Tightening torque	42 ~ 57 Nm



58. Insert the offset lever into the 3/4 rail and install the spring pin. (intermediate size: t= 6 x 25)
59. Apply the grease into the offset lever bushing.

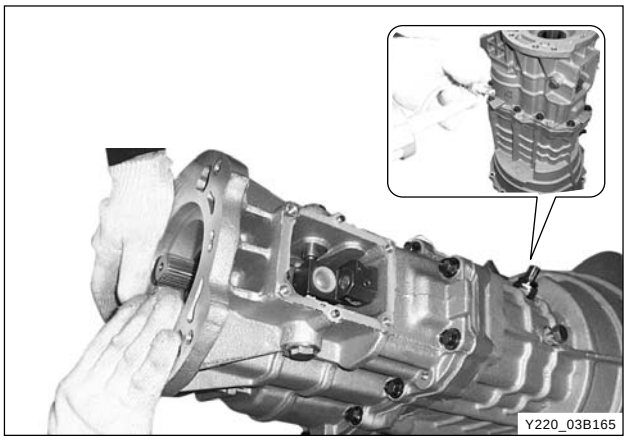


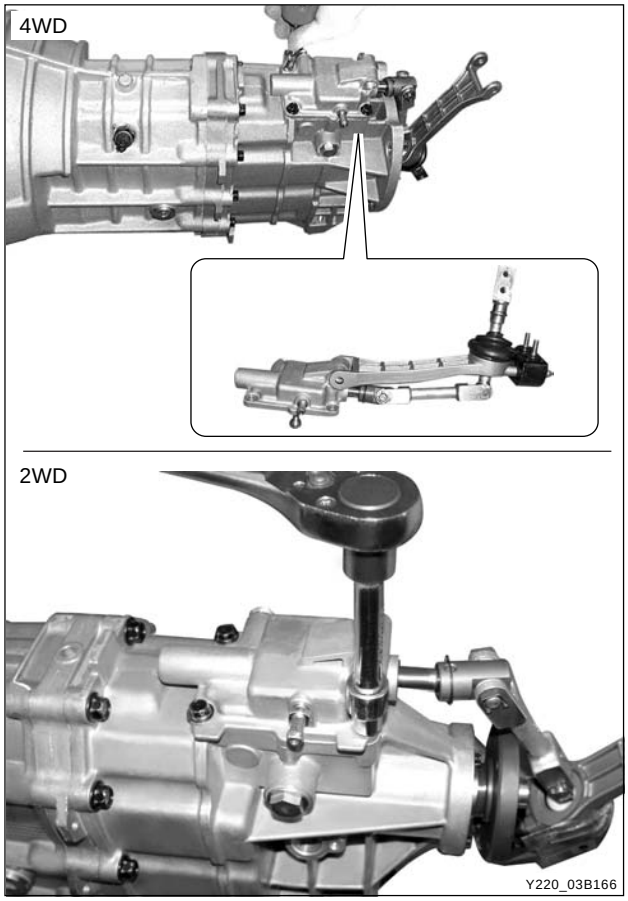
60. Apply the grease to the interlock bolt and insert it into the interlock plate hole and bolt hole.

Notice

Make sure that the gear is at neutral position. If not, the interlock bolt cannot be inserted into the interlock plate hole.

Sealant	LOCTITE 243
Tightening torque	40 ~ 50 Nm



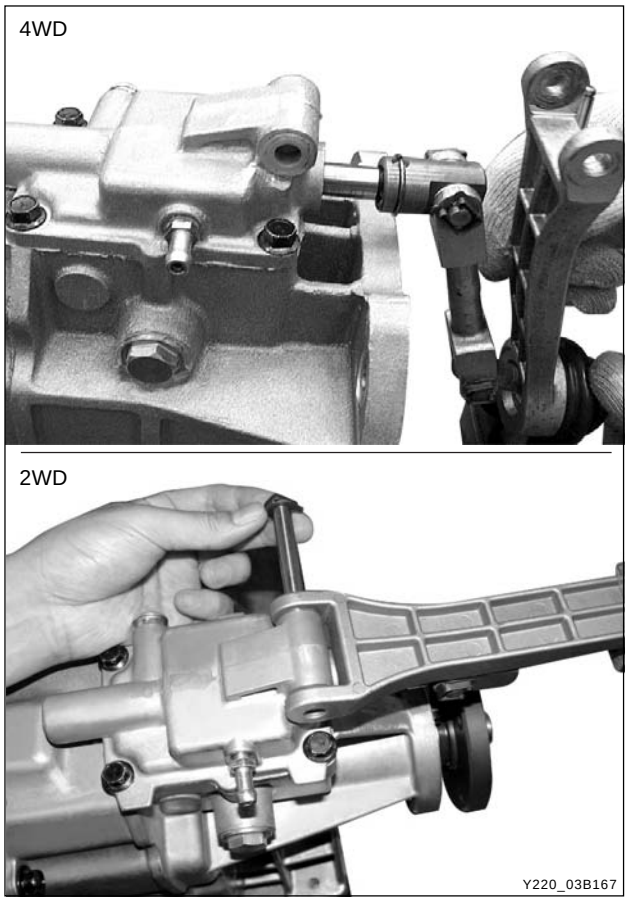


61. Apply the grease to the top cover and tighten the bolts.

Notice

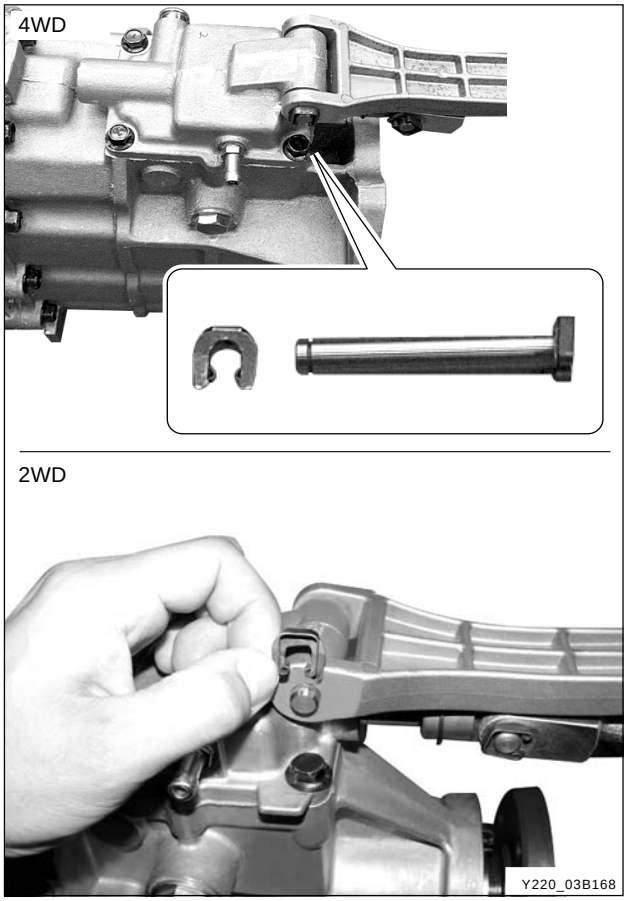
Place the gear in the neutral position.

Sealant	LOCTITE 5900
Tightening torque	17 ~ 50 Nm



62. Install the TGS bushing.

63. Insert the TGS pin and install the lock washer.



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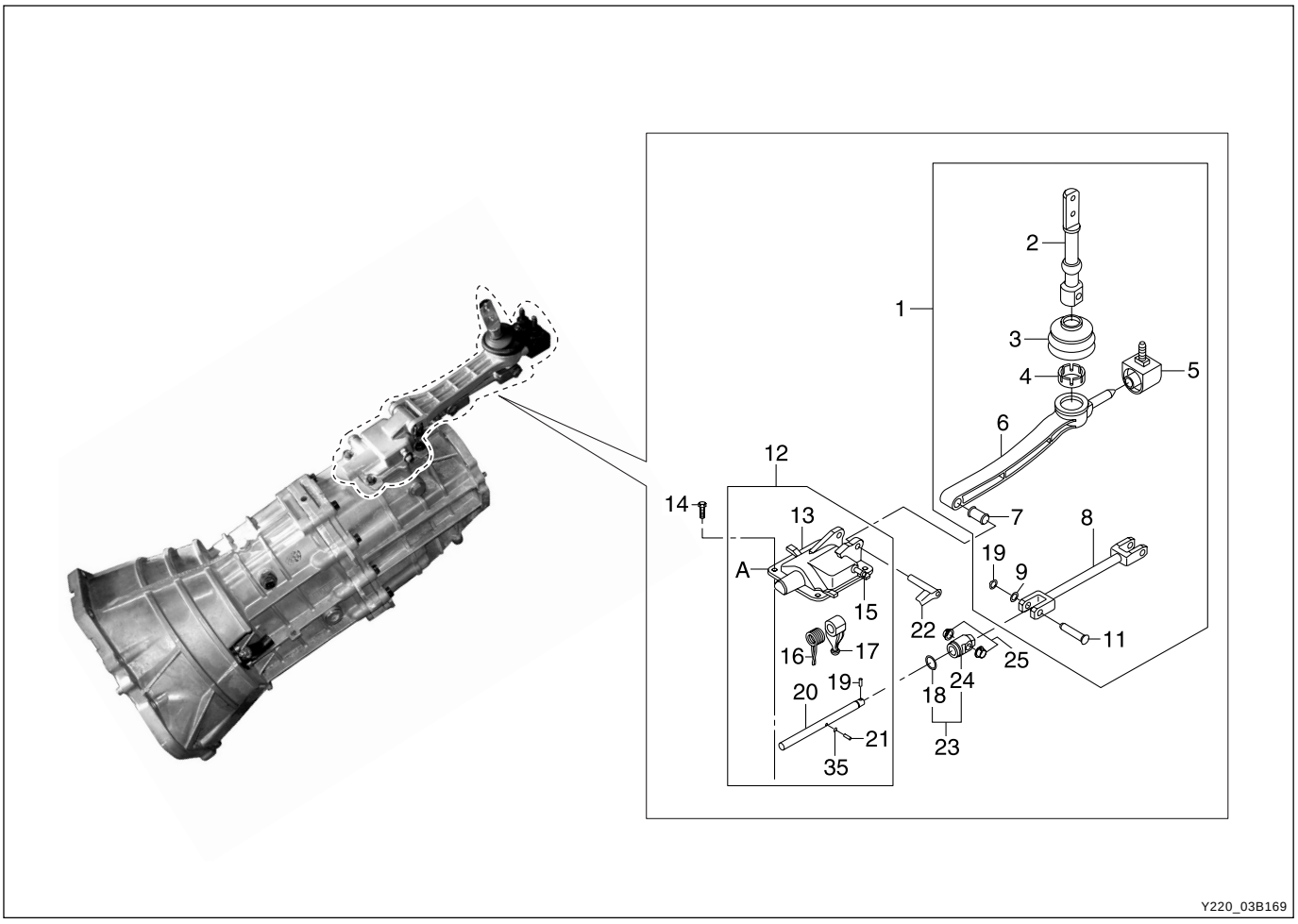
TOP COVER ASSEMBLY

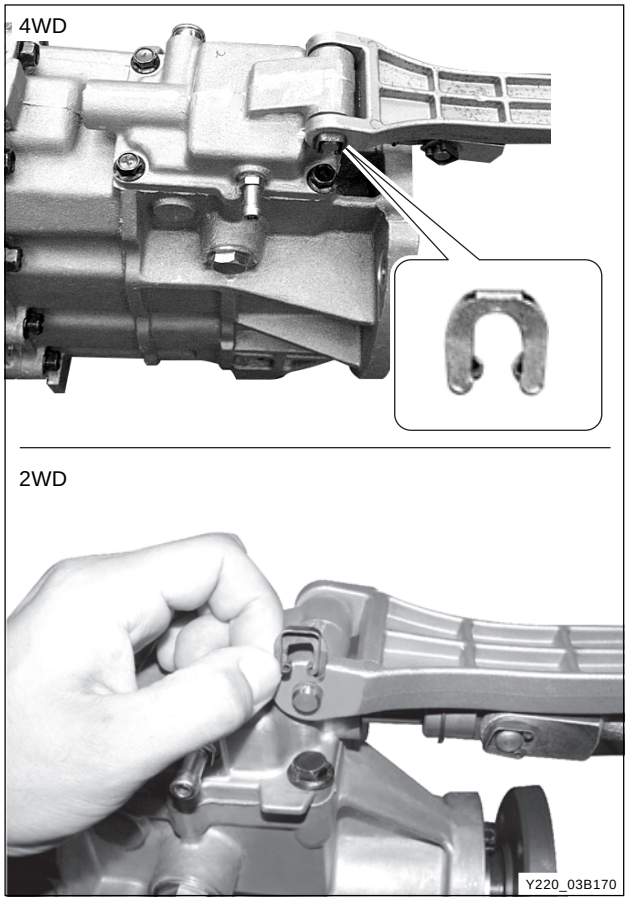
▶ System Layout



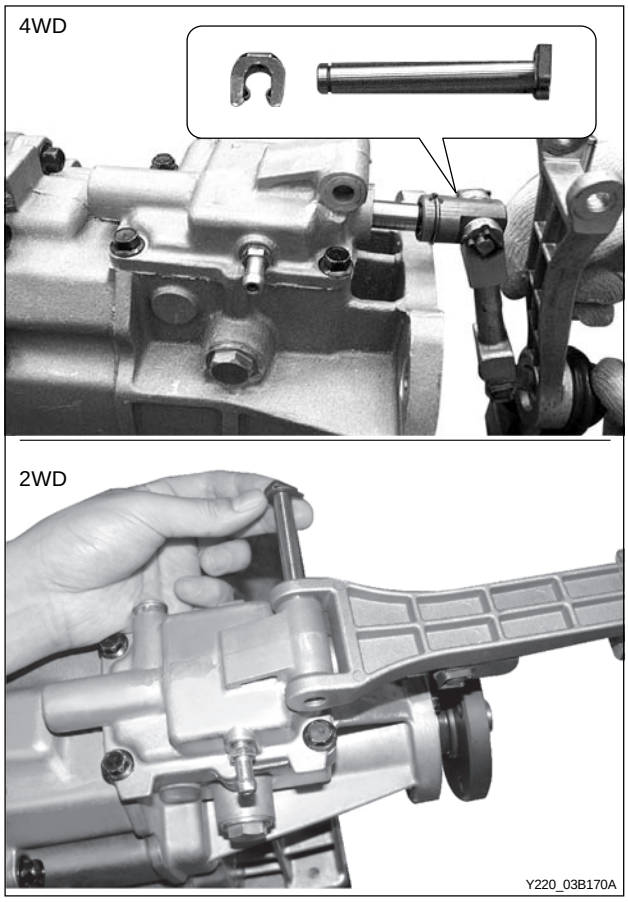
1. Remote shift
2. Shift lever
3. Shift inner boot
4. Lining shift socket
5. Control housing arm insulator
6. Control housing arm
7. Bushing
8. Shift rod link
9. Washer
10. Clip
11. Shift rod pin
12. Cover assembly
13. Shift lower cover
14. Bolt
15. Breather hose barb
16. Control shift spring
17. Offset control lever
18. Retainer ring
19. Pin
20. Shift rail
21. Groove pin
22. Pin and clip
23. Joint assembly
24. Joint housing
25. Bushing

Disassembly and Reassembly

1. Remove the lock washer from the TGS pin in the extension housing and the control arm. Remove the TGS pin.



2. Remove the TGS pin from the control arm and swing back the control arm.



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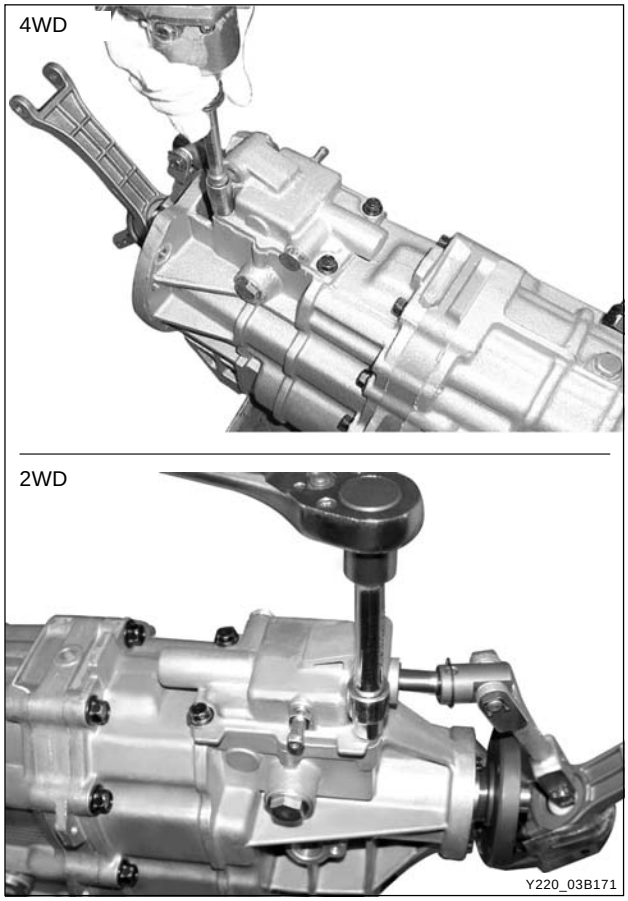
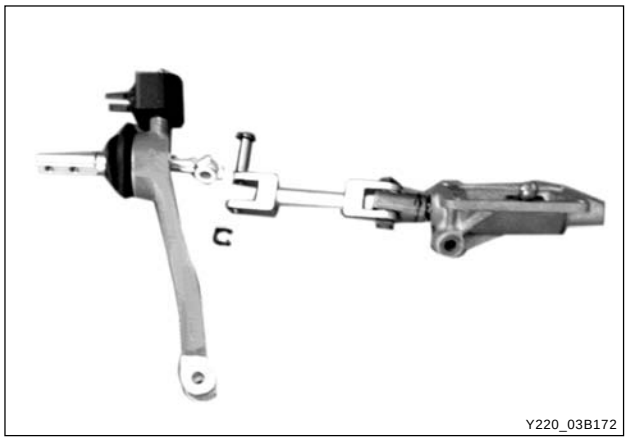
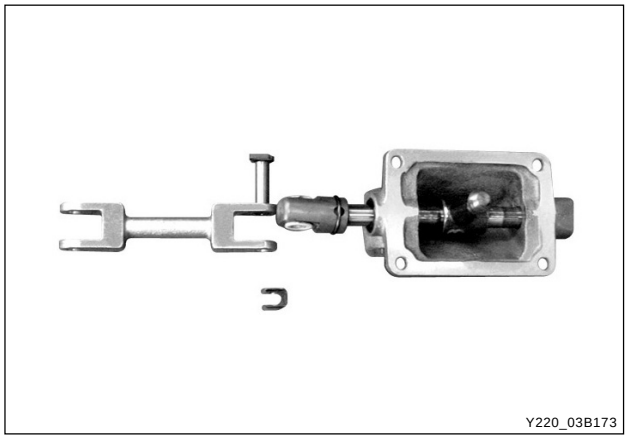


3. Lay down the semi-remote lever assembly and remove the top cover bolts.

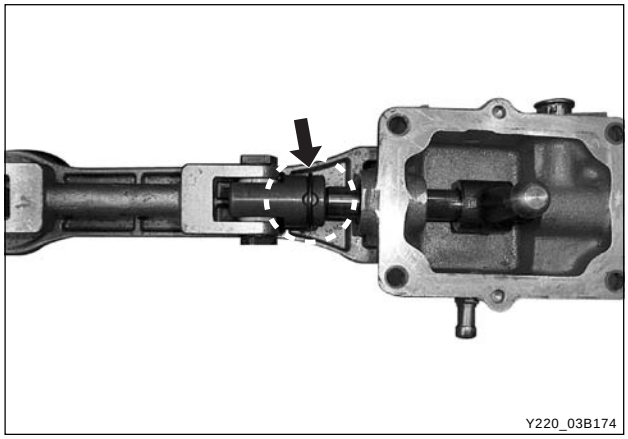


4. Remove the lock washer from the shift shaft connection link in the semi-remote lever assembly and pull out the pin.

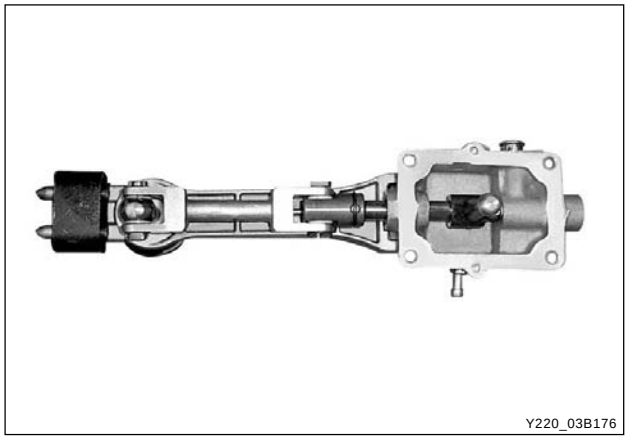


5. Remove the lock washer from the shift shaft connection link and pull out the pin.

6. Remove the retainer ring.
7. Remove the joint pin.


Y220_03B174

8. Install in the reverse order. Apply the MoS 2 grease to the shaft and top cover if cleaned them.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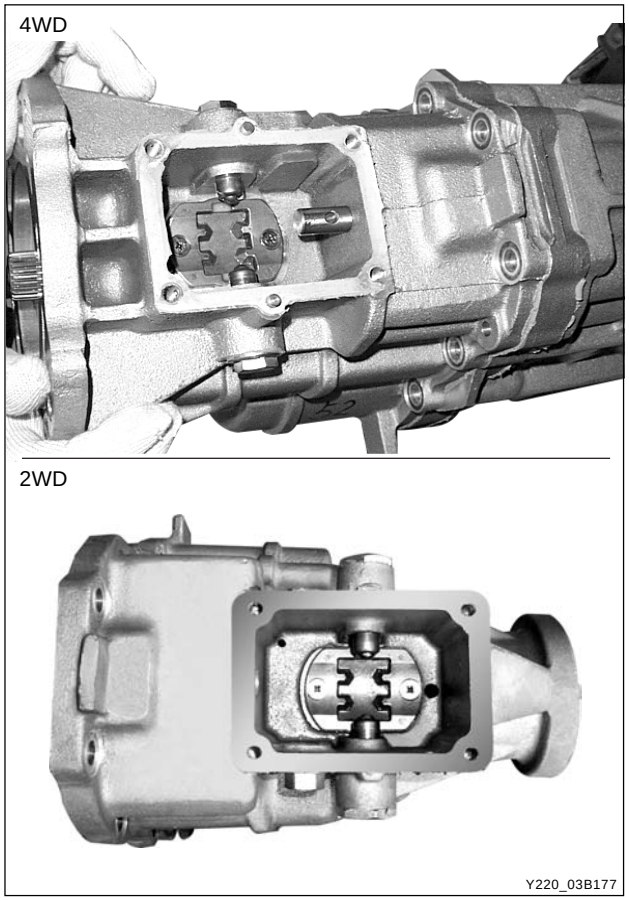
EXTENSION HOUSING ASSEMBLY

Disassembly and Reassembly

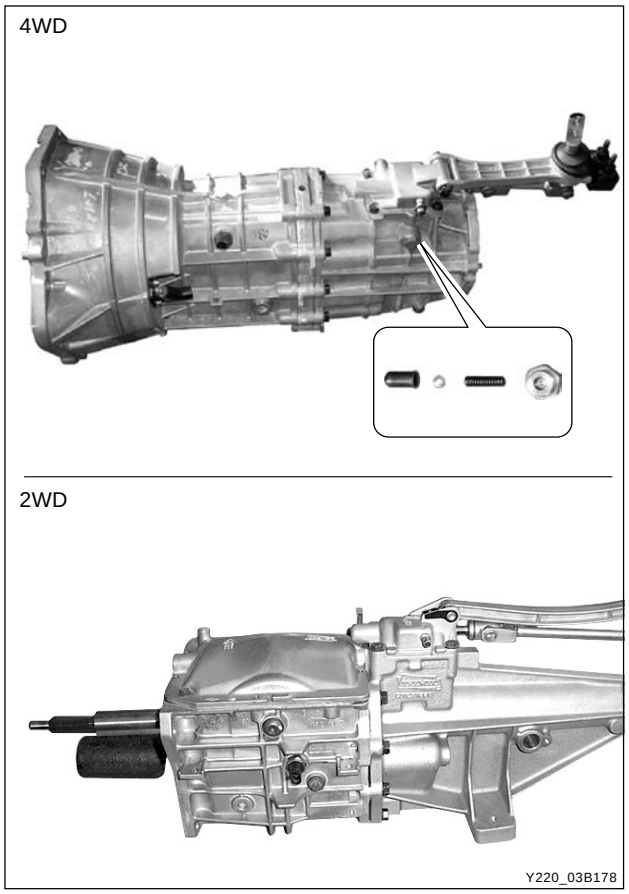
1. Separate the extension housing.



2. Unscrew the spring plug and remove the return spring and rolling plunger.

Installation Notice

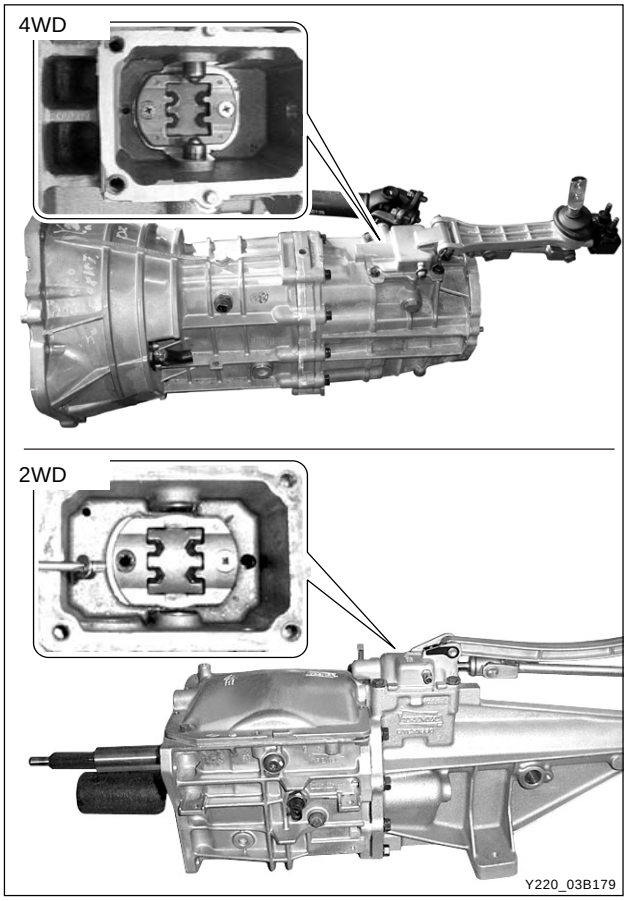
Tightening torque	30 ~ 35 Nm



3. Unscrew the counter screw and remove the offset plate.

Installation Notice

Tightening torque	4 ~ 6 Nm



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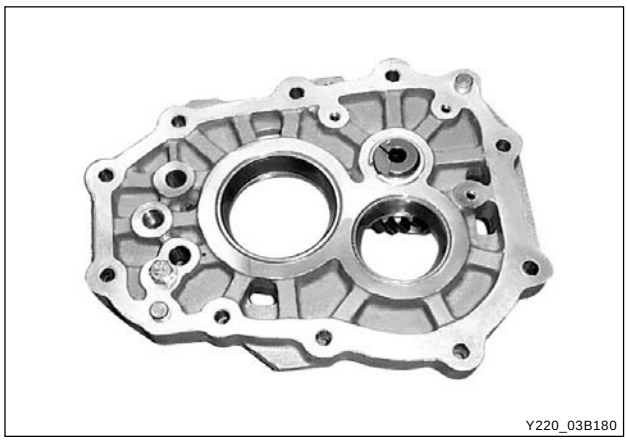
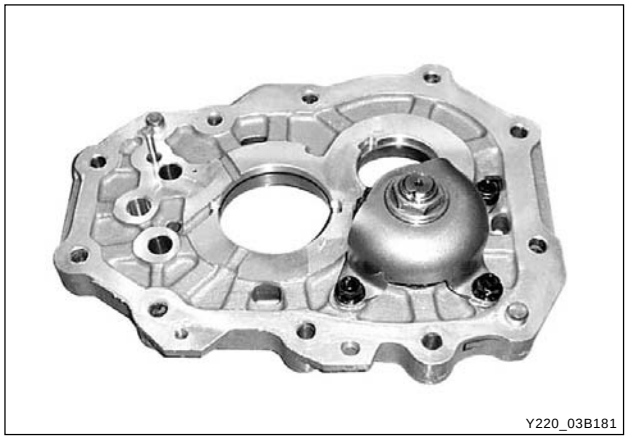

Y220_03B180

TRANSMISSION ADAPTOR

Disassembly and Reassembly

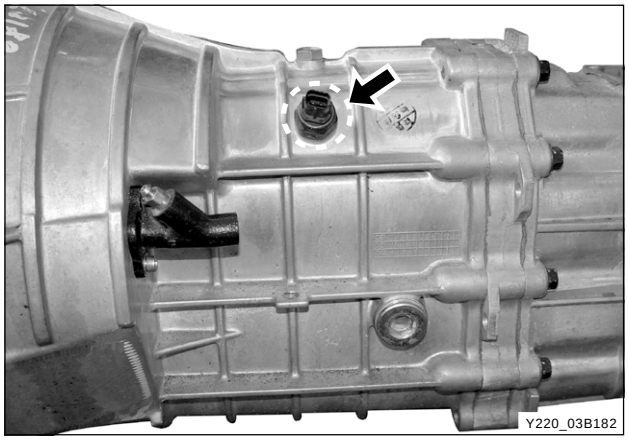
1. Remove the reverse idler retainer ring.


Y220_03B181

2. Remove the components as follows and install in the reverse order of removal.
   - Unscrew the reverse lock nut and idler bracket bolts and remove the bracket and spacer.
   - Remove the reverse idler gear and the needle bearing.
   - Pull out the dowel pin and remove the reverse idler shaft.

Installation Notice

Reverse idler bracket bolt	17 ~ 26 Nm
Reverse lock nut	70 ~ 100 Nm


Y220_03B182

BACKUP LAMP SWITCH

Remove the backup lamp switch with 24 mm wrench. Apply the sealant when installing.

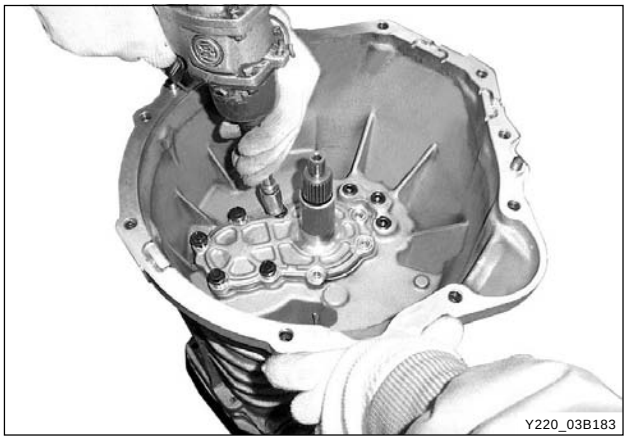
Installation Notice

Sealant	LOCTITE DRI LOC 200
Tightening torque	30 ~ 40 Nm

INSPECTION/MAINTENANCE

SHIM ADJUSTMENT

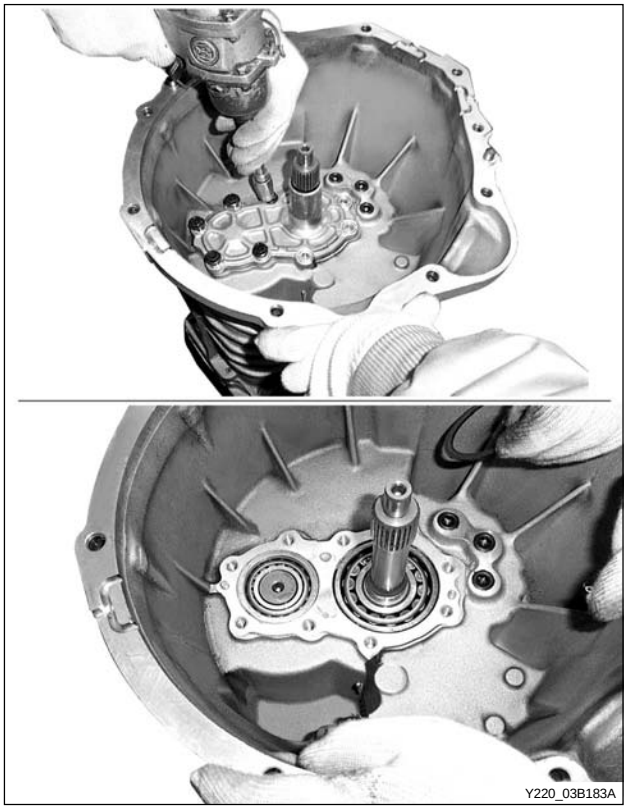
1. Unscrew the bolts and remove the front fork cover.



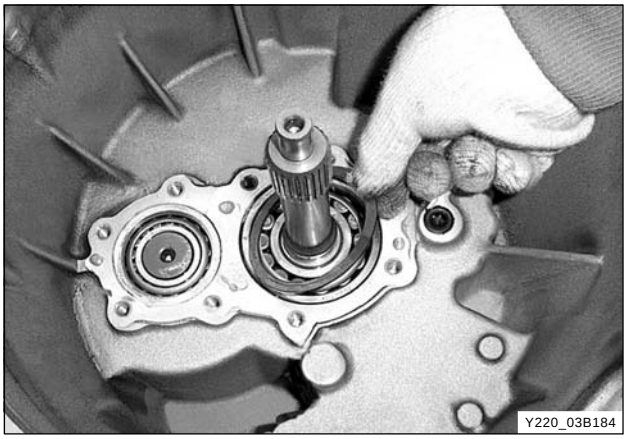
Notice

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

2. Separate the front fork cover from the housing.



3. Remove the input spacer.



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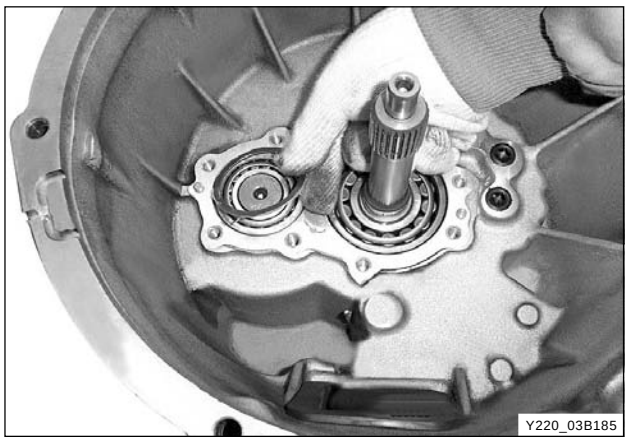
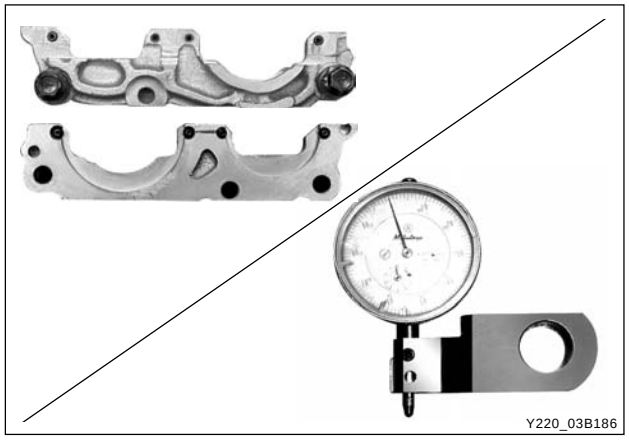
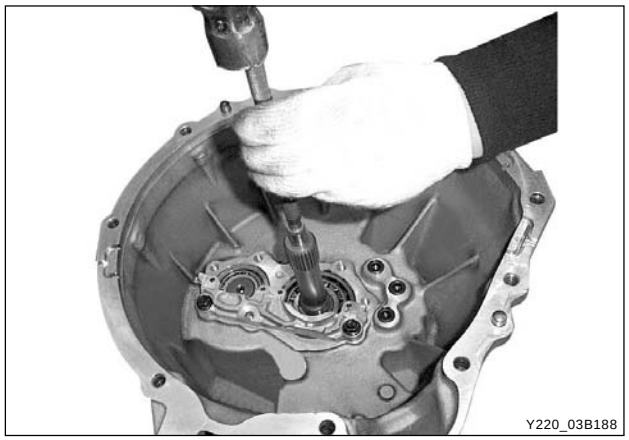


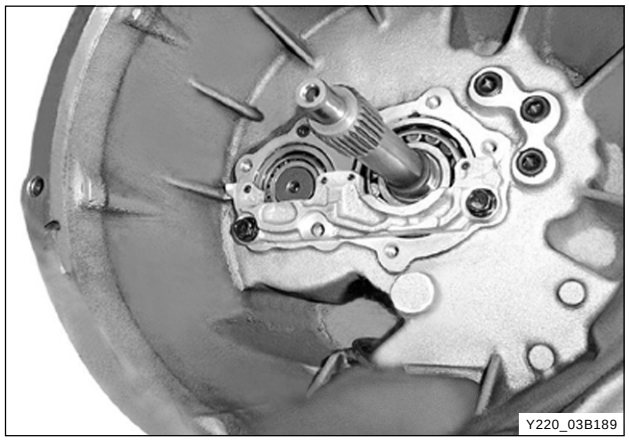
4. Remove the counter spacer.



5. Prepare the special tools and dial gauge.



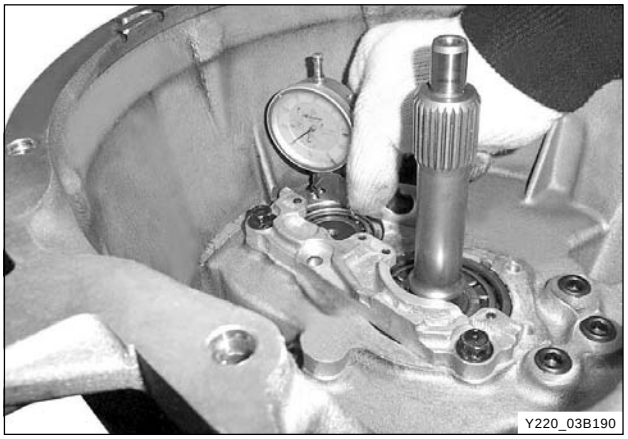
6. Place the transmission with the output shaft facing downward and set the special tool on the counter gear and input shaft. Apply a proper force to the counter gear and input shaft so that the end plays for bearings are maximized.



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

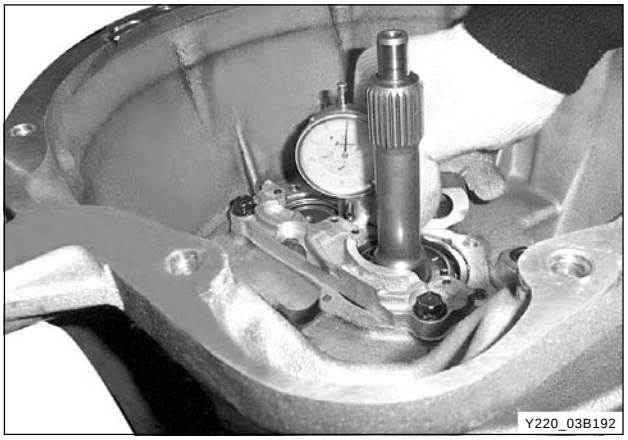
8. Set up the dial gauge on the transmission housing surface and put the gauge needle to “0” point.
9. Put the probe end of the gauge on the taper roller bearing outer race in counter gear and measure the end play.
   * If the measured value is out of the specified range, adjust it by using spacers.

End play	0.05 ~ 0.1 mm



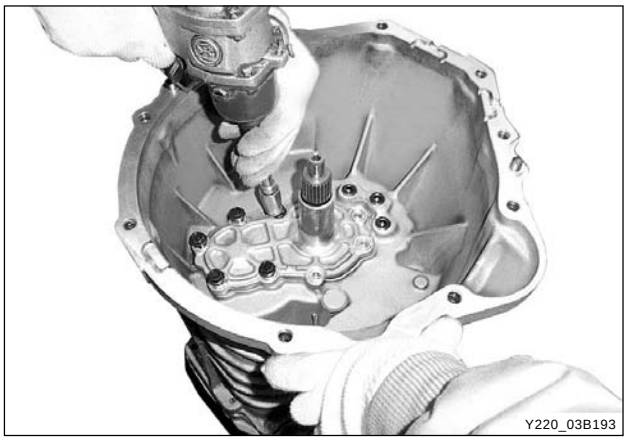
10. Put the probe end of the gauge on the main taper roller bearing outer race and measure the end play.
    * If the measured value is out of the specified range, adjust it by using spacers

End play	0.05 ~ 0.1 mm

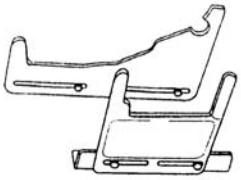
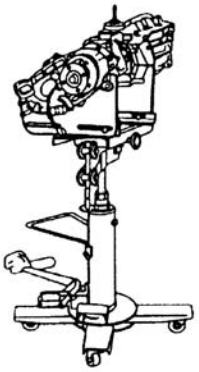
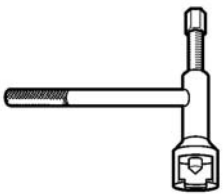
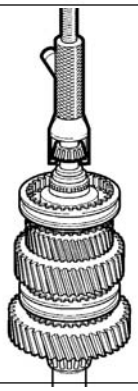
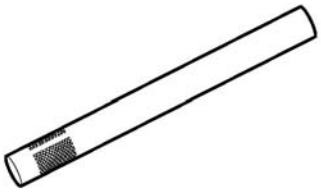
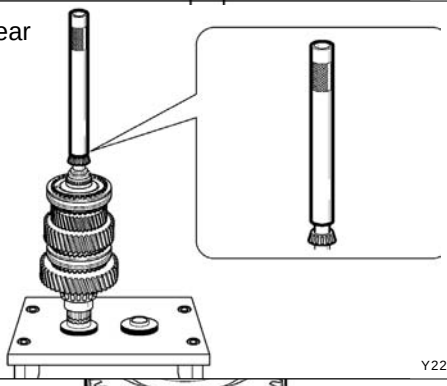
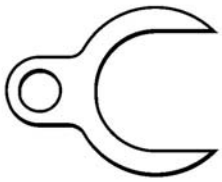
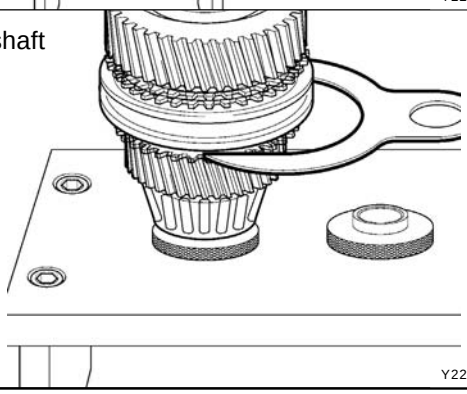


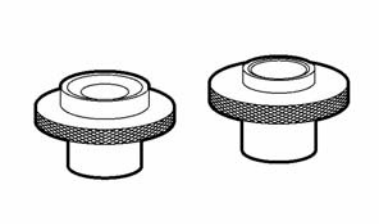
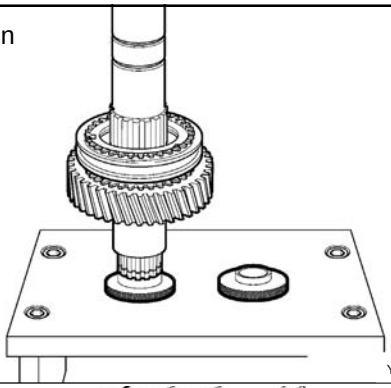
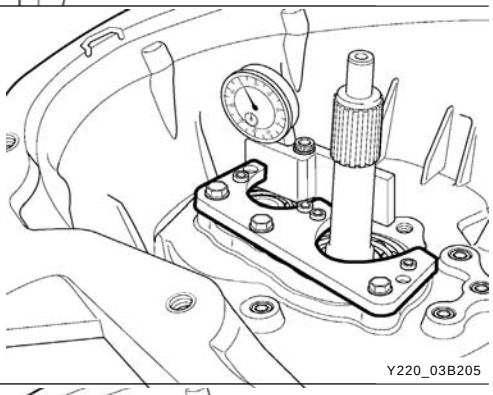
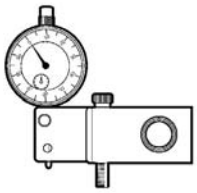
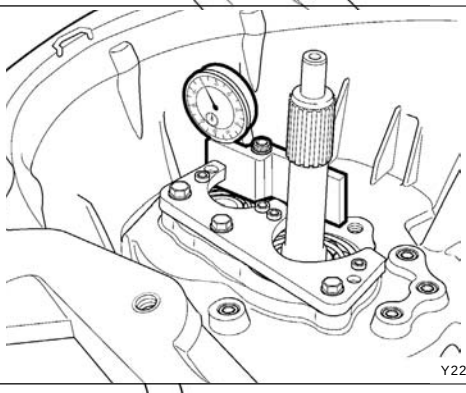
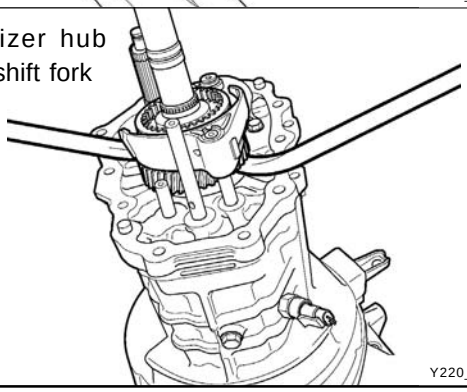
11. Apply the sealant to the front fork cover and tighten the bolts. Measure the starting torque after installation.

Starting torque	20 ~ 25 Nm
Sealant	LOCTITE 5900
Tightening torque	17 ~ 26 Nm



SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
661 589 04 62 00 (W 99 31 007 0B) **Transmission fixture**  Y220_03B194	Removal/installation of transmission  Y220_03B195
W 99 31 001 1B **Bearing puller**  Y220_03B196	Removal of pressed in taper roller bearing  Y220_03B197
W 99 31 002 1B **Pressure pipe**  Y220_03B198	Pressing of the bearing and gear  Y220_03B199
W 99 31 003 1B **Insert key**  Y220_03B200	Providing a space to input shaft bearing  Y220_03B201

Name and Part Number	Application
W 99 31 004 1B **Die**  Y220_03B202	Assembly of gears and bearings on the shafts  Y220_03B203
W 99 31 005 2B **Holder**  Y220_03B204	Measurement of taper roller bearing end play  Y220_03B205
W 99 31 006 1B **Dial gauge holder**  Y220_03B206	Measurement of taper roller bearing end play  Y220_03B207
W 99 31 007 1B **Drift**  Y220_03B208	Removal of 5/R synchronizer hub assembly, reverse gear and shift fork  Y220_03B209

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SECTION 3C

CLUTCH

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GENERAL DESCRIPTION AND OPERATION

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 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 pressure plate assembly.

▶ Operating Elements

The clutch release system consists of the clutch pedal are clutch release cylinder.

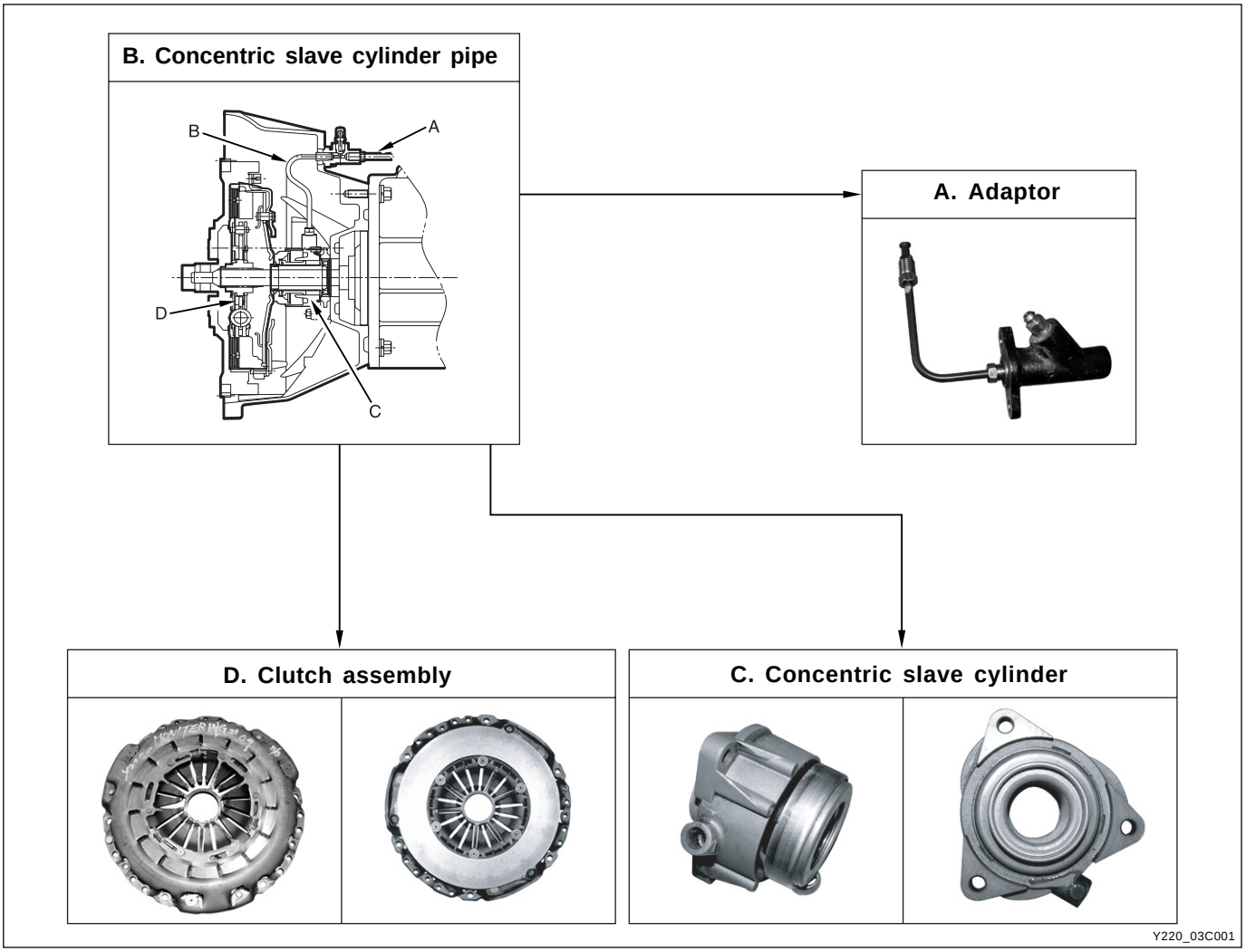
This system directly releases the clutch by using hydraulic pressure while the conventional clutch system releases the clutch by using release lever and release fork.

This system provides higher efficiency than conventional clutch system, and its durability is superior.

Clutch release cylinder pipe (mounted on transmission case)

Concentric slave cylinder pipe (mounted inside of transmission)

Concentric slave cylinder



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SPECIFICATIONS

▶ Specifications

Description		Specification
Operating type		Hydraulic
Clutch pedal	Type	Suspended
	Maximum pedal stroke	Diesel engine equipped vehicle: 158 mm
		Gasoline engine equipped vehicle: 150 mm
	Pedal free play	5 ~ 10 mm
Clutch disc	Type	Single dry diaphragm
	Dimension of facing	240 X 155 X 4.0 mm
	Facing size/quantity	263 cm^2/2
	Thickness of disc	Free: 9.35 ~ 9.95 mm When loaded: 8.9 ± 0.2 mm
Clutch cover assembly setting force		9,600 N
Clutch master cylinder	Stroke	28.4 mm
	Inner diameter	ϕ 15.87 mm
Concentric slave cylinder	Stroke	7.0 mm
	Sectional area	630 mm^2
Clutch fluid		DOT 3 or DOT 4

▶ Tightening Torque

Description	Tightening Torque	
Clutch housing bolt (8 locations)	5.0 ~ 6.0 kgf·m	49 ~ 59 Nm
Clutch cover (pressure plate) bolt	2.1 ~ 2.7 kgf·m	21 ~ 27 Nm
Concentric slave cylinder bolt (3 locations)	1.0 ~ 1.6 kgf·m	10 ~ 16 Nm
Concentric slave cylinder flare nut	2.0 ~ 2.5 kgf·m	20 ~ 25 Nm
Adaptor flare nut	2.0 ~ 2.5 kgf·m	20 ~ 25 Nm
Clutch oil pipe flange nut	1.52 ~ 1.83 kgf·m	15 ~ 18 Nm
Master cylinder bolt	3.05 ~ 4.07 kgf·m	30 ~ 40 Nm
Fulcrum (clutch pedal bushing) bolt/nut	1.63 ~ 2.24 kgf·m	16 ~ 22 Nm
Clutch pedal bracket mounting bolt	0.81 ~ 1.83 kgf·m	8 ~ 18 Nm
Stopper bolt	1.63 ~ 2.24 kgf·m	16 ~ 22 Nm

DIAGNOSTIC INFORMATION AND PROCEDURES

Check		Possible Cause	Action
Clutch slips		Excessive wear of facing	Replace
		Hard or oily facing	Repair or replace
		Damaged pressure plate or flywheel	Replace
		Damaged or burnt diaphragm spring	Replace
		Clutch pedal free play insufficient	Adjust
		Faulty operation of clutch pedal	Repair or replace
		Worn or damaged clutch disc	Replace
Poor disengagement		Vibration or excessive run-out of disc	Replace
		Rust or wear of disc spline	Repair or replace
		Oily facing	Repair or replace
		Damaged diaphragm spring	Replace
		Excessive clutch pedal free play	Adjust
Hard to shift or will not shift		Excessive clutch pedal free play	Adjust pedal freeplay
		Faulty clutch release cylinder	Repair release cylinder
		Worn disc, excessive run-out, damaged lining	Repair or replace
		Dirty or burred splines on input shaft or clutch disc	Repair as necessary
		Damaged clutch pressure plate	Replace
Clutch chatters when starting		Oily facing	Repair or replace
		Hard or faulty facing	Replace
		Burnt torsion spring	Replace
		Faulty pressure plate	Replace
		Bent clutch diaphragm spring	Replace
		Hard or bent flywheel	Repair or replace
		Engine mounts loose or burnt lever	Tighten or replace
Difficult pedal operation		Poor lubrication on clutch cable	Lubricate or replace
		Poor lubrication on pedal shaft	Lubricate or replace
		Poor lubrication on clutch pedal	Repair
Clutch noisy	Not using the clutch	Insufficient clutch pedal free play	Adjust
		Excessive wear of facing	Replace
	After disengagement	Worn or damaged release bearing	Replace
	When disengaging	Poor lubrication contact surface of bearing	Replace
		Faulty installation of clutch assembly or bearing	Repair
	Clutch pedal is partially depressed and vehicle speed is reduced	Damaged pilot bushing	Replace

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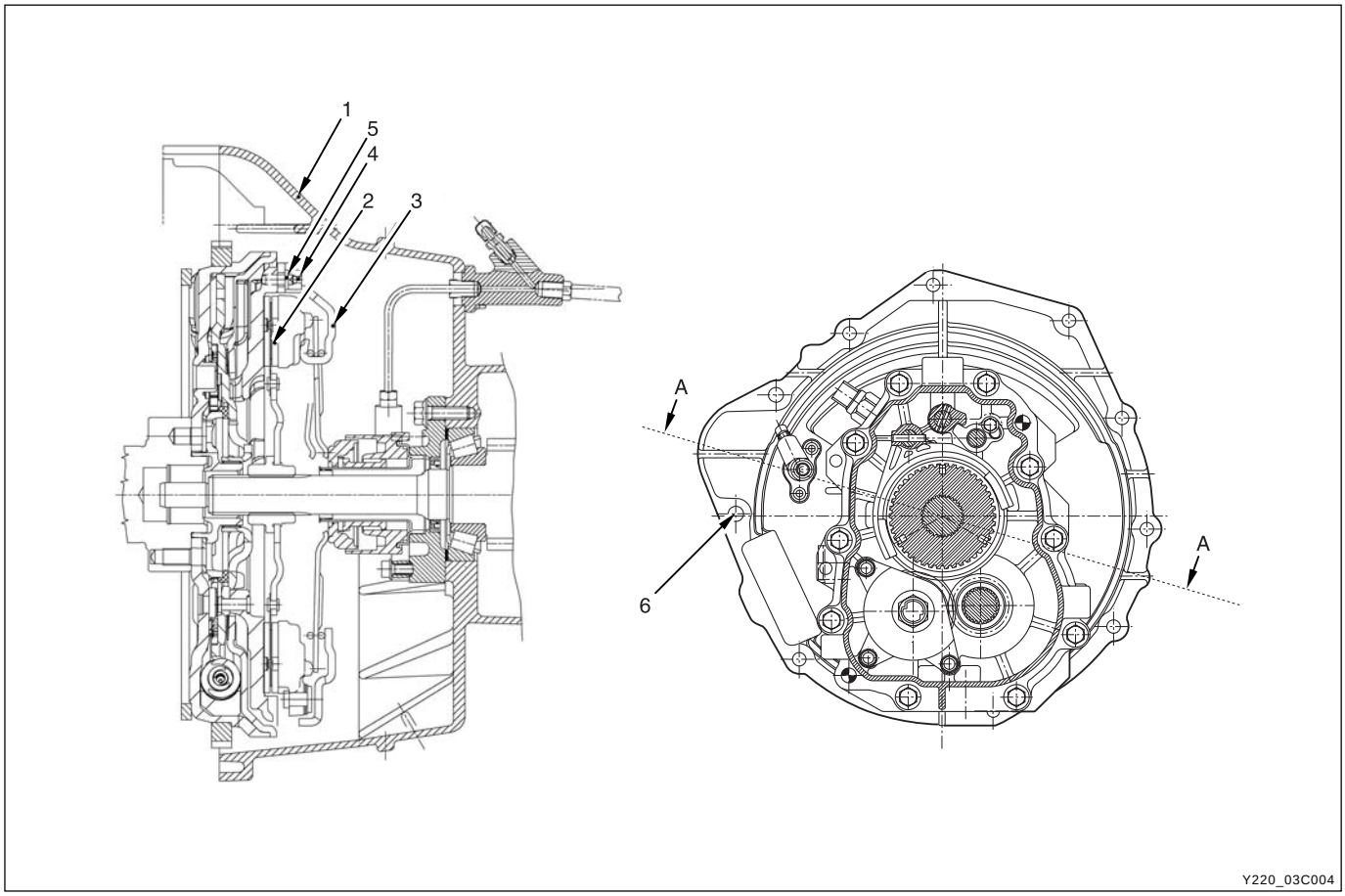
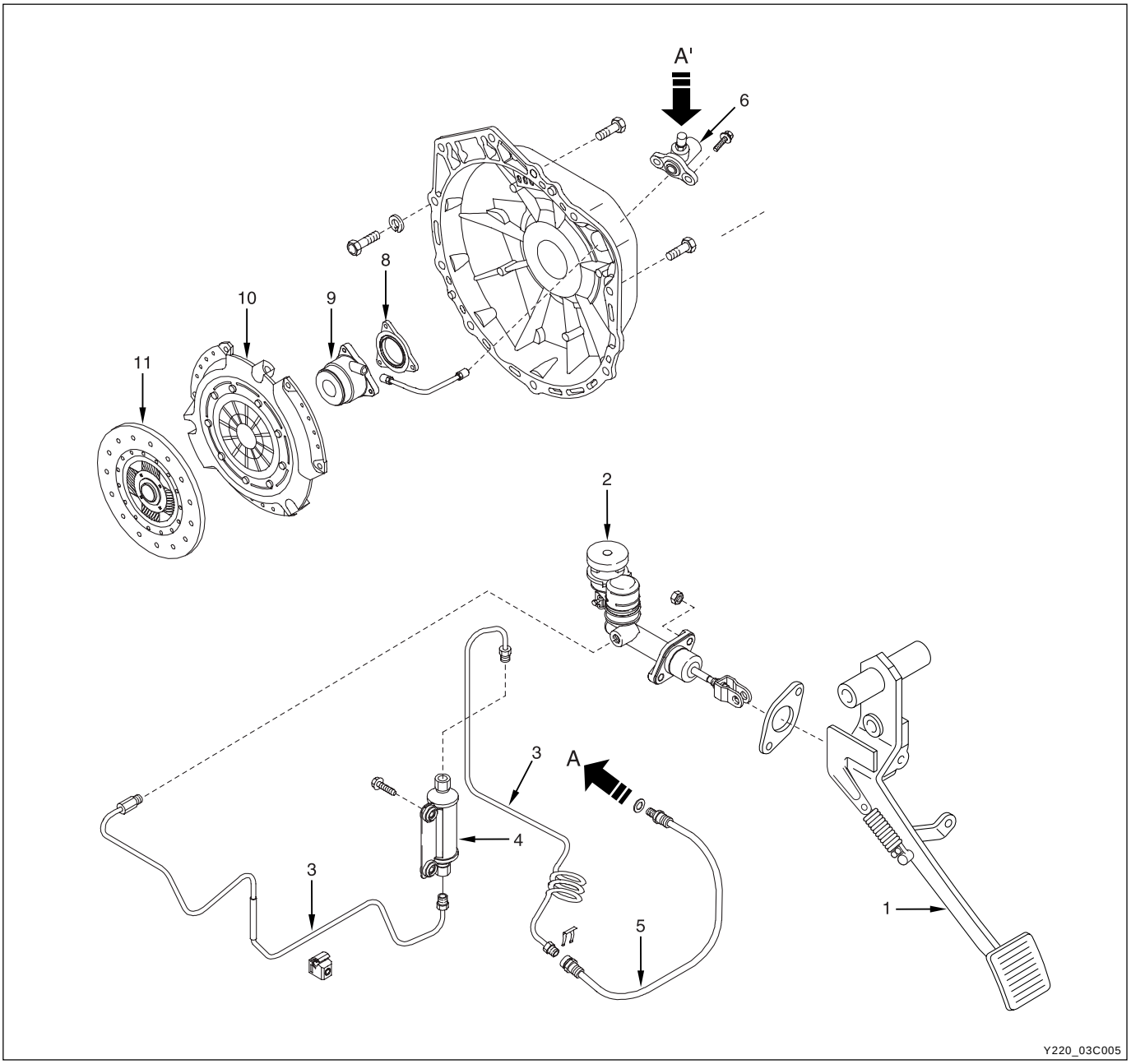
CROSS SECTIONAL VIEW OF CLUTCH ASSEMBLY



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

ON-VEHICLE SERVICE

CLUTCH COMPONENTS



1. Clutch pedal
2. Clutch master cylinder
3. Clutch hydraulic line
4. Clutch fluid chamber
5. Clutch fluid hose
6. Adaptor
7. Clutch housing
8. Concentric slave cylinder cover
9. Concentric slave cylinder
10. Clutch cover
11. Clutch disc

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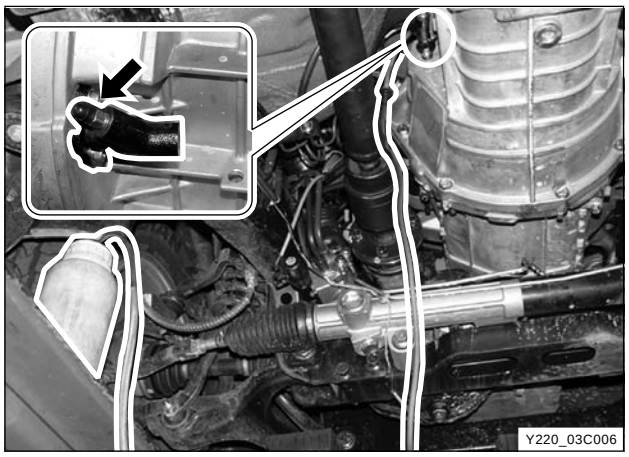
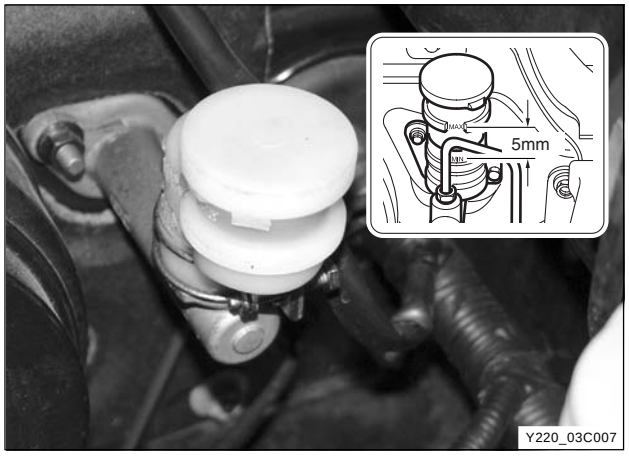
BLEEDING OF CLUTCH SYSTEM





Notice

- ***Keep the fluid level over MAX in reservoir during bleeding operation.***
- ***Do not let the fluid contact a painted surface.***

1. Remove the air bleed bolt cap on the release cylinder. Connect a plastic tube to the bolt.
2. Put the other side of the tube into a empty container.
3. Slowly pump the clutch pedal several times.
4. With clutch pedal fully depressed, open the air bleed bolt and bleed the air and fluid from the fluid line.
5. Repeat step 3 through 4 until no more air bubbles are in the escaping fluid.

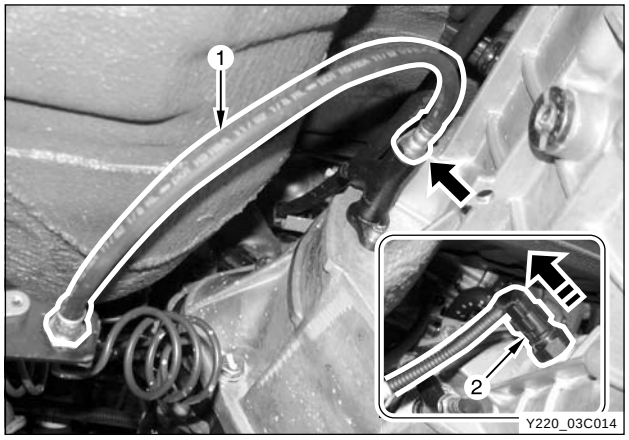
Note

- ***This work has to be done by two service persons.***
- ***After bleeding, check the clutch system for operation and noise.***
- ***Use only Ssangyong genuine clutch fluid, and check the clutch fluid level in reservoir.***

Clutch fluid	SAE J1730 or DOT 3, 4

Removal and Installation

1. Unscrew nut and disconnect the clutch fluid hose (1) from adaptor. Simultaneously, disconnect the backup lamp switch (2) connector.



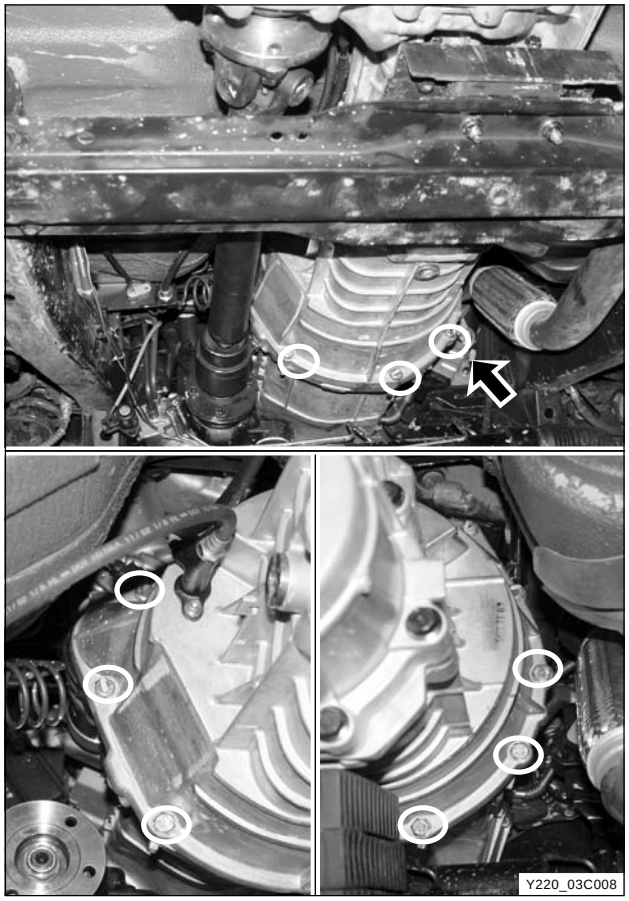
2. Unscrew the clutch housing bolts and remove the clutch housing with transmission. (refer to Manual Transmission section in this manual)

Installation Notice

Tightening torque	5.5 ± 0.5 kgf•m

Notice

Separating the clutch housing and transmission for removal may cause damage the concentric slave cylinder.



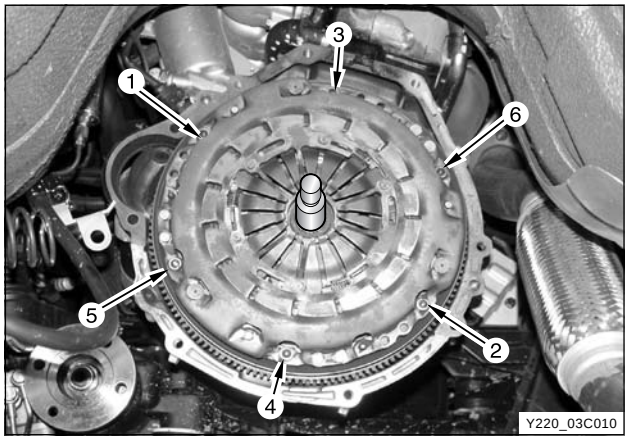
3. Insert the centering pin (special tool) into center spline. Loosen the clutch cover bolts 1/2 turns in crisscross sequence until the spring tension is released.

Notice

Do not remove the bolts at a time, or clutch cover may be damaged or deformed.

Installation Notice

Tightening torque	2.4 ± 0.3 kgf•m



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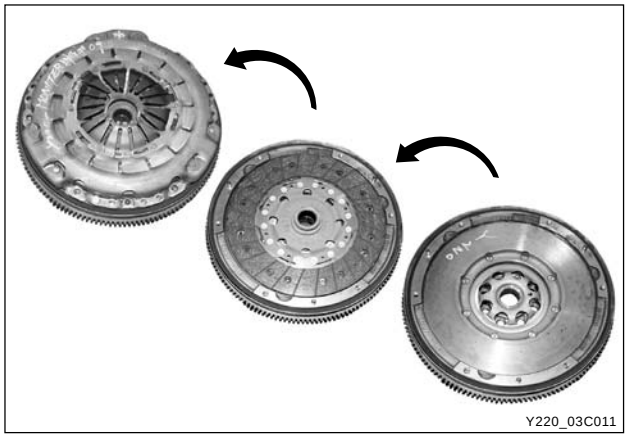

Y220_03C011

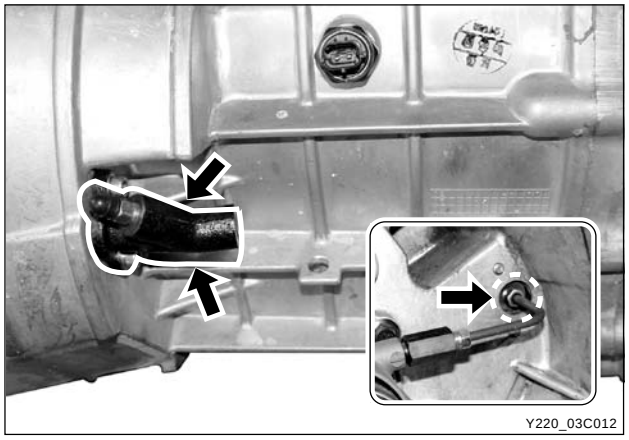
4. Unscrew the bolts and remove the clutch cover, pressure plate and clutch disc.

Notice

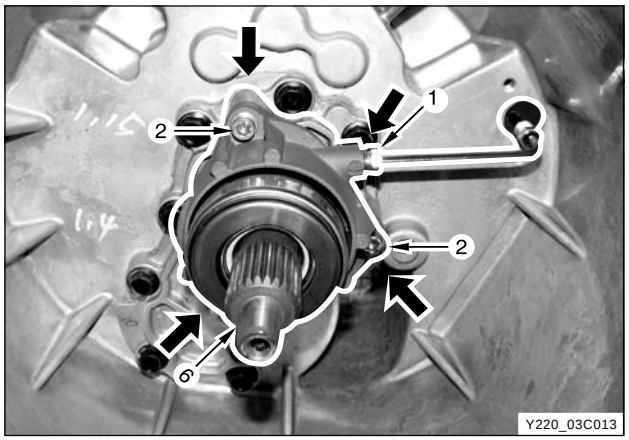
Be careful not to drop the pressure plate and clutch disc.

Installation Notice

Tightening torque	1.0 ~ 1.6 kgf•m


Y220_03C012

5. Remove the oil pipe and the adapter from the clutch housing.



Y220_03C013

6. Unscrew the nut (1) at the inside of clutch housing and remove the oil pipe.

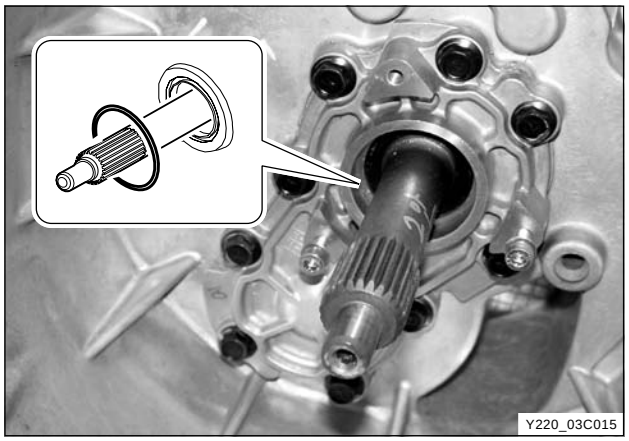
Installation Notice

Tightening torque	2.0 ~ 2.5 kgf•m

7. Unscrew three bolts (2) on cylinder input shaft and remove the concentric slave cylinder.

Installation Notice

Tightening torque	1.0 ~ 1.6 kgf•m


Y220_03C015

8. Remove the spacer from input shaft.
9. Install in the reverse order of removal.

Notice

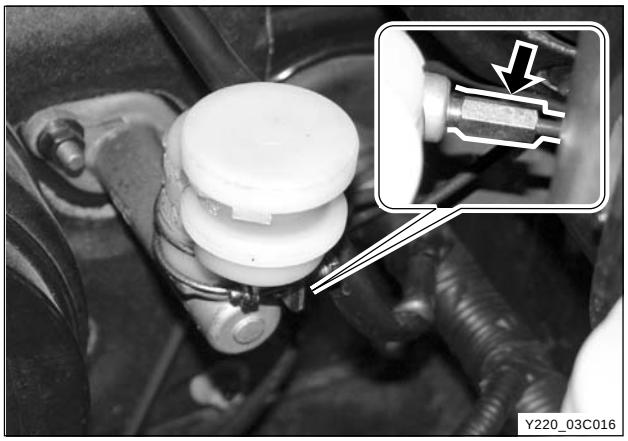
- ***Before installation, clean all the components.***
- ***Do not re-use the discharged clutch fluid.***
- ***Apply a small amount of clutch fluid on the internal components such as piston.***
- ***Replace parts if necessary.***

※ Keep the specified tightening torque.

CLUTCH MASTER CYLINDER

Removal and Installation

1. Drain the clutch fluid.
2. Pull out the snap pin and clevis pin from the clutch pedal connection.
3. Remove the clutch tube.



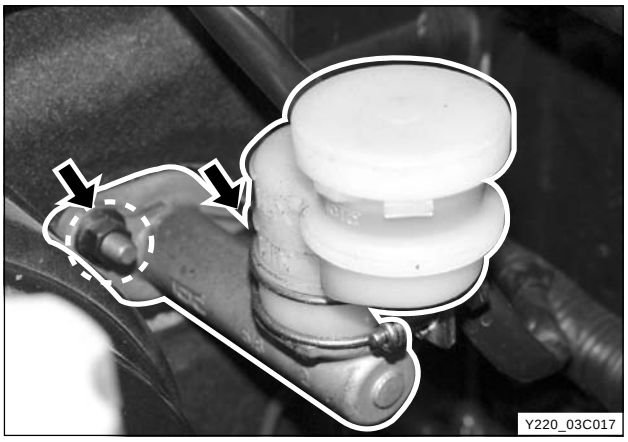
Installation Notice

Tightening torque	15 ~ 18 Nm

Notice

Be careful not to contact the fluid into a painted surface.

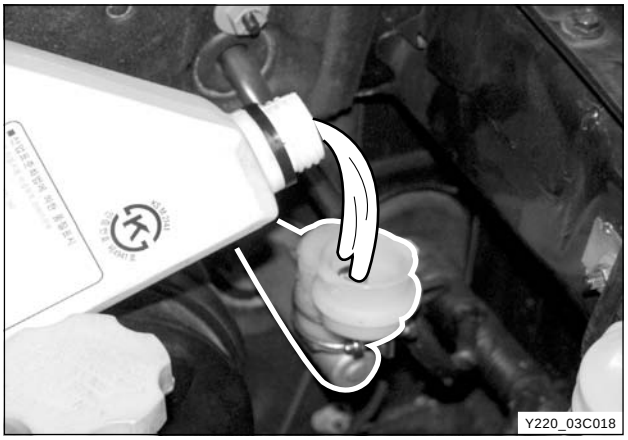
4. Remove the master cylinder mounting nuts and pull off the master cylinder.



Installation Notice

Tightening torque	8 ~ 18 Nm

5. Install in the reverse order of removal.
6. Check the clutch pedal operation.
7. Bleed the clutch system.



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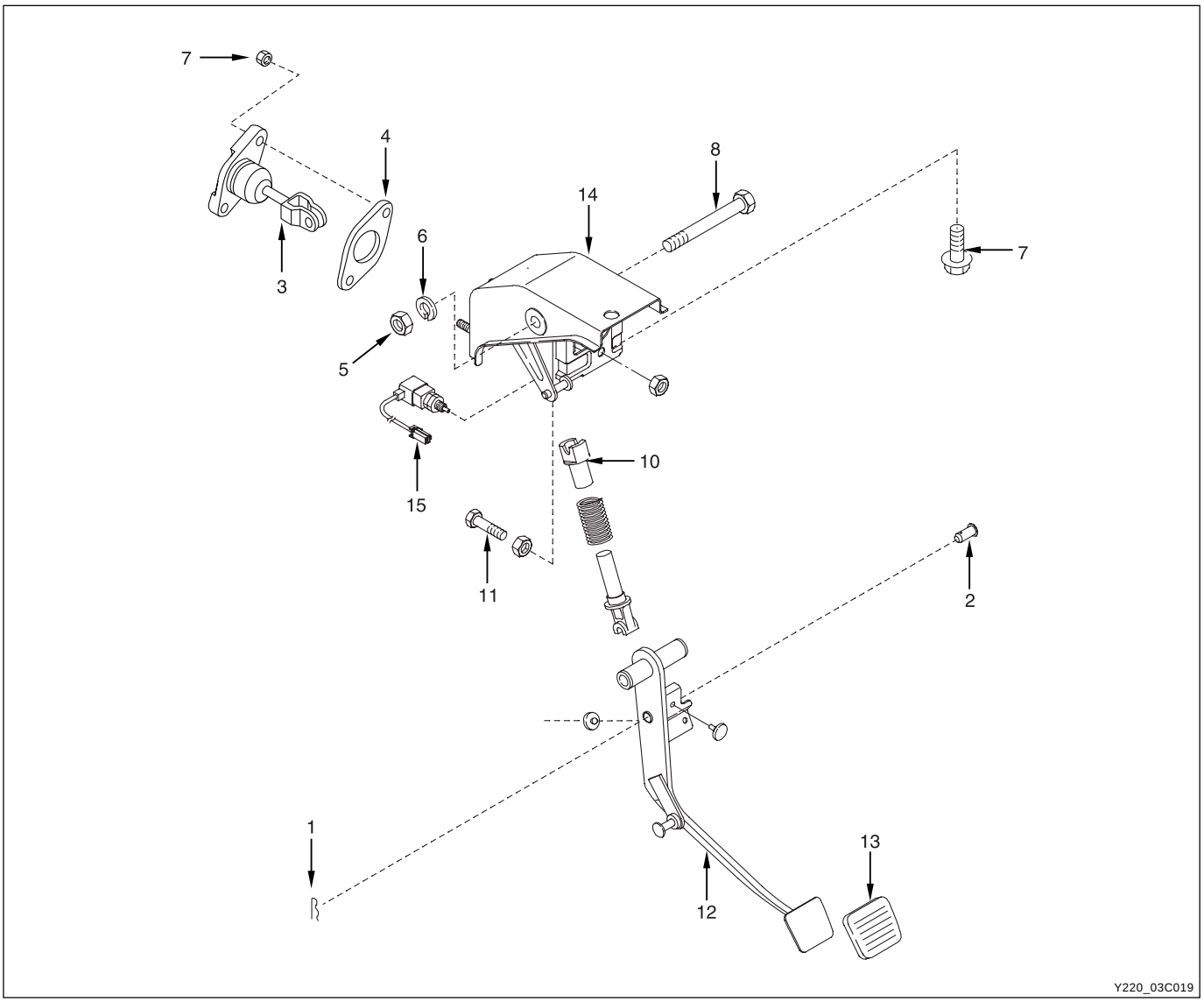
CLUTCH PEDAL



1. Snap pin ..... replace
2. Clevis pin ..... apply grease
3. Clutch master cylinder push rod
4. Gasket
5. Nut ..... 16 ~ 32 Nm
6. Spring washer
7. Nut ..... 8 ~ 18 Nm
8. Fulcrum bolt
9. Turnover spring ..... apply grease
10. Bushing ..... replace
11. Full stroke stopper contact pad
12. Interlock switch stopper pad
13. Clutch pedal
14. Pedal pad
15. Pedal mounting bracket
16. Stopper switch ..... 16 ~ 22 Nm

Notice

- ***Grease: Long-life grease (T/M DBL 6611.00)***

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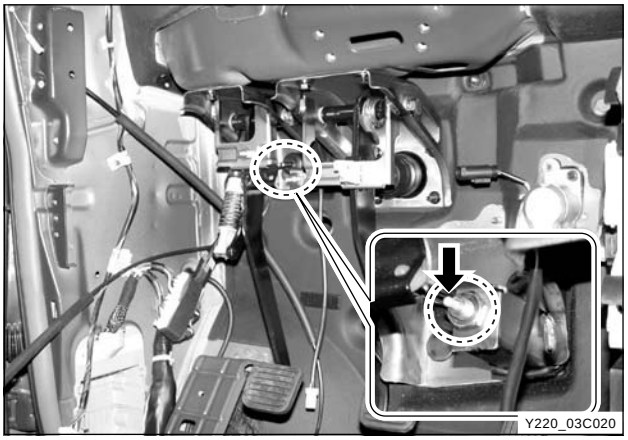
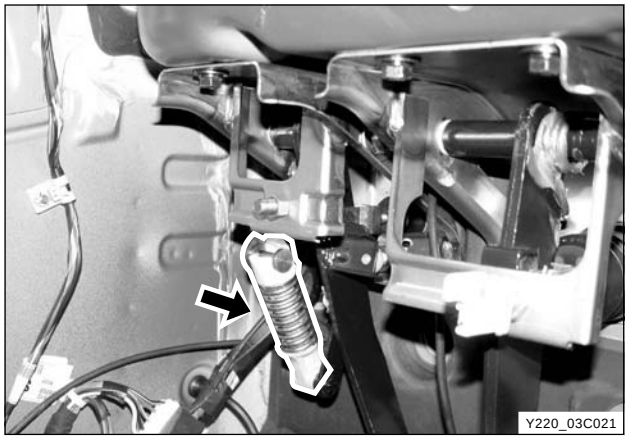
Removal and Installation

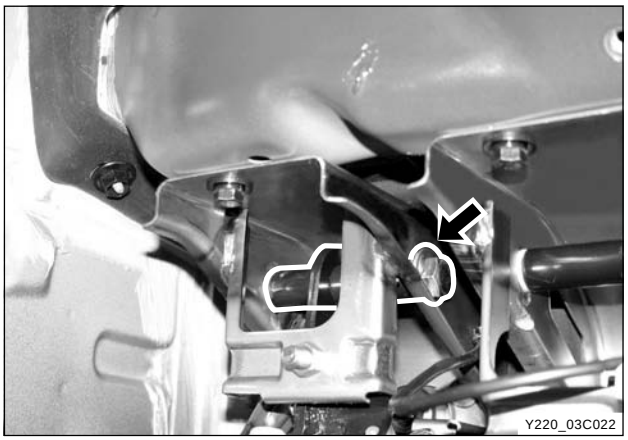
1. Remove the snap pin from master cylinder push rod and remove the clevis pin from pedal.



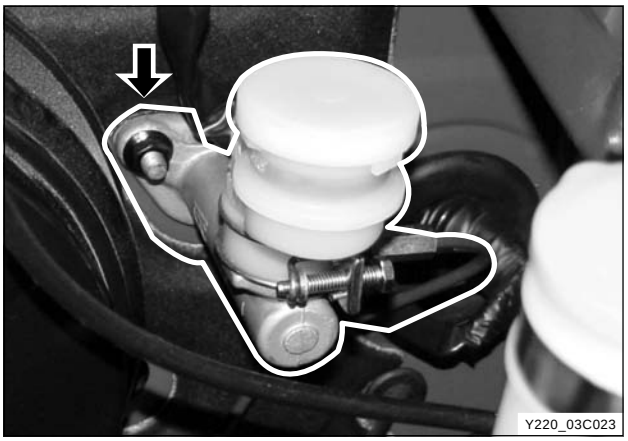
2. Remove the turnover spring.



3. Unscrew the fulcrum bolt and remove the clutch pedal from bracket



4. Unscrew the bolts and remove the master cylinder.



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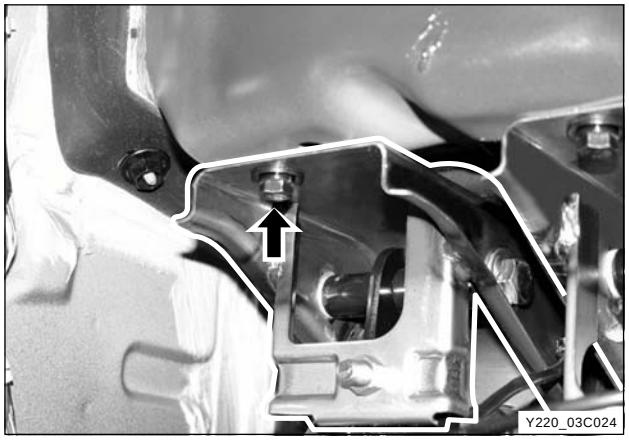


5. Unscrew the mounting bolts and remove the clutch pedal bracket.

Installation notice

1. Install in the reverse order of removal. Adjust pedal stroke after installation.

Notice

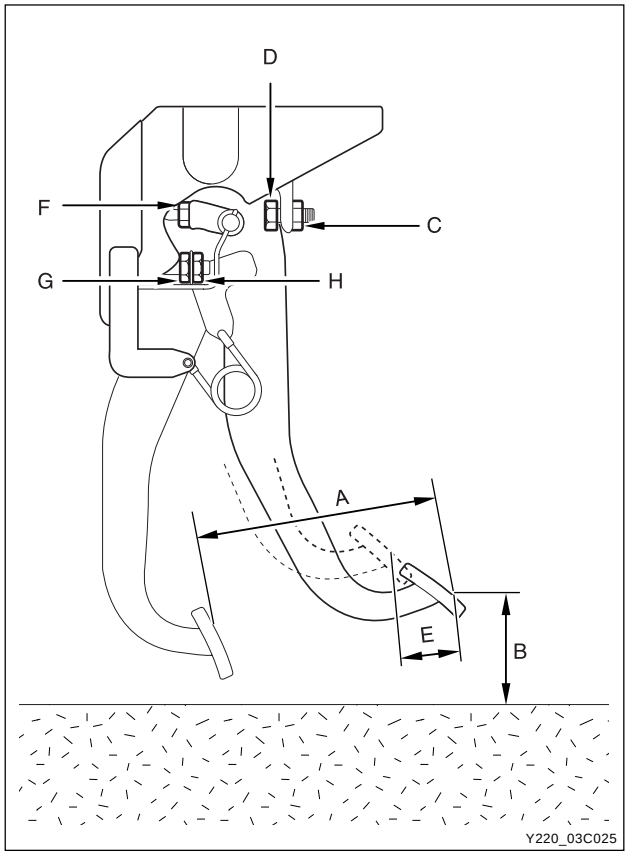
1. Apply long-life grease (T/M DBL 6611.00) to the connections.

2. Remove foreign materials.

3. Keep the tightening torque.

4. Replace the bushings with new ones.

Description	Tightening Torque
Fulcrum bolt/nut	16 ~ 22 Nm
Bracket mounting bolt	8 ~ 18 Nm
Stopper bolt	16 ~ 22 Nm



Inspection and adjustment

1. Pedal Stroke (A)

Maximum pedal stroke	158 mm

2. Pedal Height (B)

Height (from carpet)	192 ± 5 mm

Notice

To adjust the pedal stroke, loosen the lock nut (C) of the stopper bolt (D) and turn the stopper bolt until the stroke is correct. After adjustment, tighten the lock nut.

3. Pedal Free Play (E).

Free play	5 ~ 10 mm

Notice

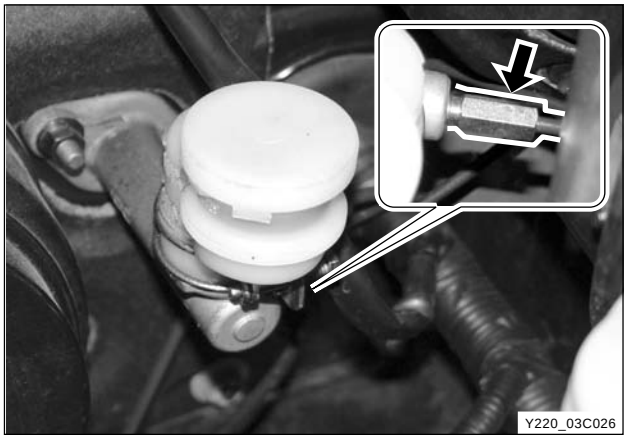
To adjust the pedal free play, loosen the lock nut (F) of the master cylinder and turn the push rod until the free play is correct.

4. Check the fulcrum bolt and the bushing for wear, the pedal for bending and the spring for damage.

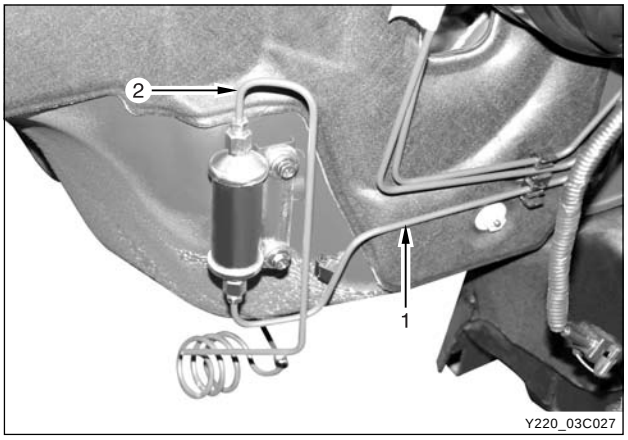
Clutch Fluid Pipe

Removal and installation

1. Draw out the fluid.
2. Unscrew the bolt and remove the supply pipe from clutch master cylinder.



3. Unscrew the supply pipe bolt (2) and remove primary oil pipe from clutch fluid chamber.
4. Unscrew the bolt and remove the secondary clutch fluid pipe from clutch release cylinder.
5. Install the pipes. Be careful not to mix the pipes.



Notice

- ***Make sure to bleed the air from the system after installation.***
- ***Check each pipe bolt for oil leaks.***
- ***Clutch pipes are reusable. However, must check the pipes for damages and cracks.***

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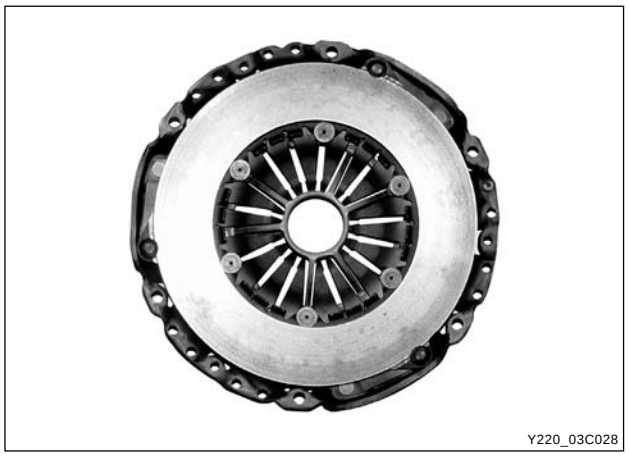
INSPECTION PROCEDURE

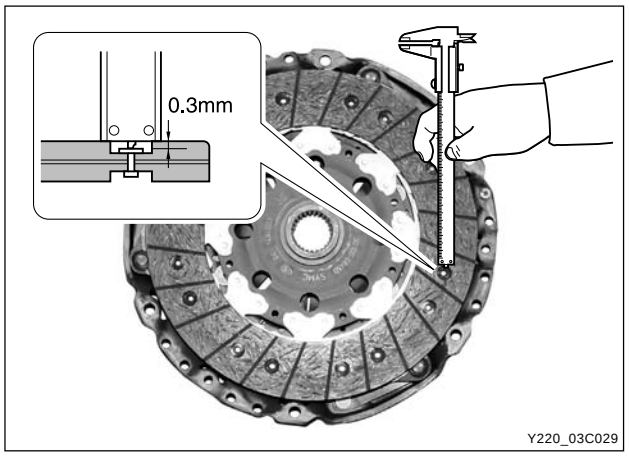

Y220_03C028

Clutch Disc

1. Clutch cover assembly
   - Check the diaphragm spring tip for wear and height unevenness.

Unevenness limit	0.8 mm

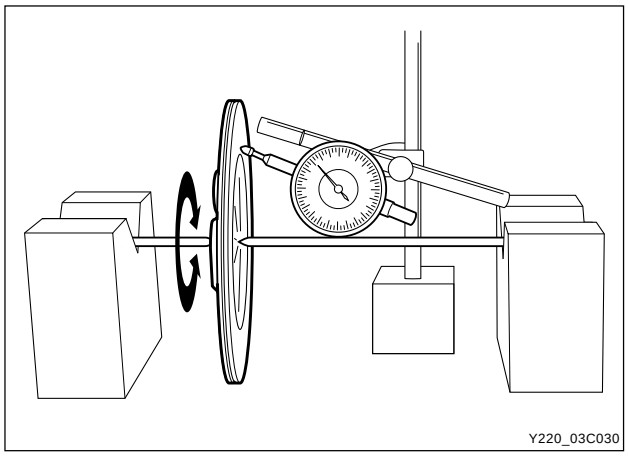
   - Check the pressure plate surface for wear, crack and discoloration.
   - Check the strap plate rivet for looseness and replace if necessary.



Y220_03C029

2. Clutch disc
   - Check the facing for rivet looseness, sticks, oil and grease.
   - Measure the rivet head depth. If out of limit, replace the disc.

Wear limit	0.3 mm


Y220_03C030

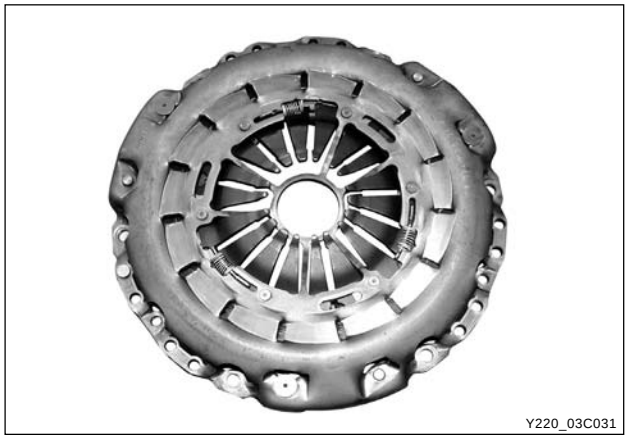
3. Clutch disc run-out
   - Measure the clutch disc run-out and replace if necessary.

Run-out limit	0.7 mm

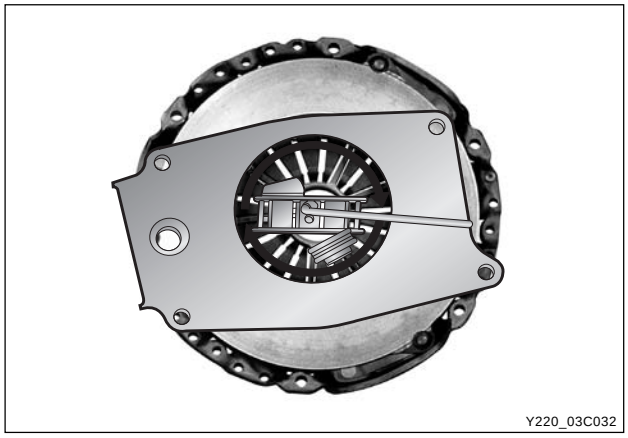
4. Pressure plate
   1) Check the pressure spring for wear.

Notice

The excessively worn components should be replaced.


Y220_03C031

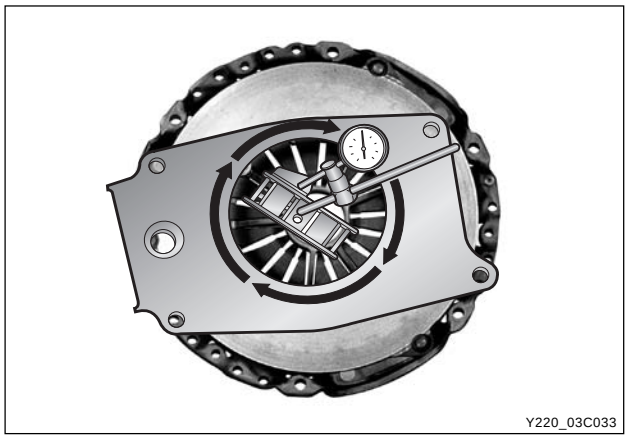
   2) Check the alignment conditions of clutch housing as follows:
      - Install the magnetic holder on pressure spring.
      - Alignment check for housing bore
        A. Install a dial gauge in the housing bore.
        B. Measure and record the pointer value while rotating the crankshaft.


Y220_03C032

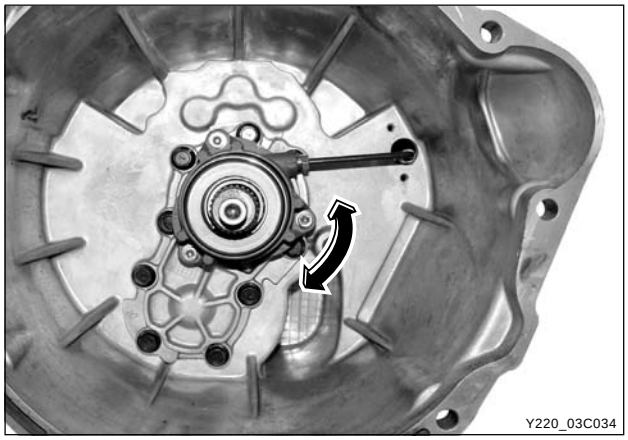
      - Alignment check for clutch housing surface
        A. Install a dial gauge on the clutch housing surface.
        B. Measure and record the pointer value while rotating the crankshaft.

Notice

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


Y220_03C033

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


Y220_03C034

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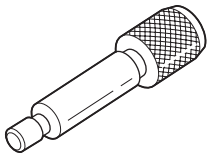
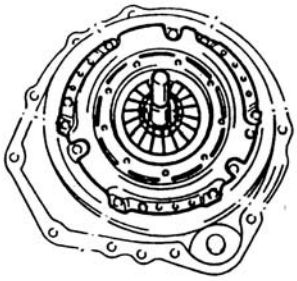
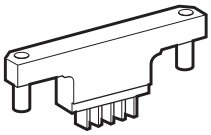
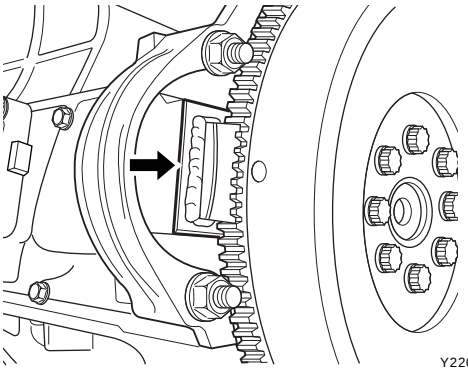
SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
661 589 00 15 00 (L 99 30 001 0B) **Centering pin**  Y220_03C037	Centering the clutch disc  Y220_03C038
601 589 02 40 00 (A 99 10 014 0B) **Engine lock**  Y220_03C035	Locking the crankshaft  Y220_03C036

SECTION 3D

PART TIME - T/C

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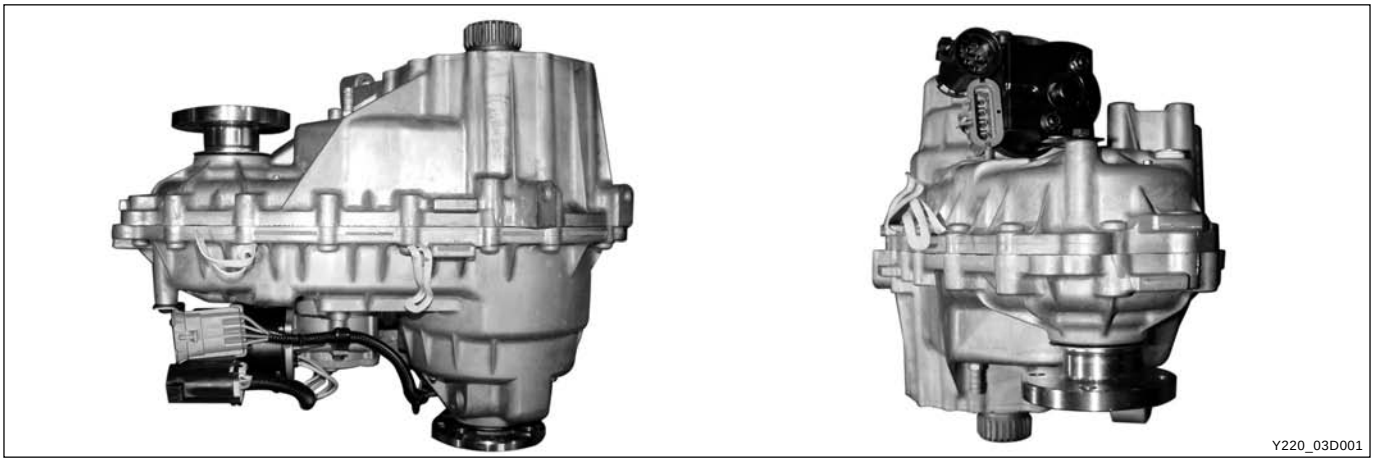
GENERAL INFORMATION

OVERVIEW

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

Simple operation of switches on instrument panel allows to shift to “2H”, “4H” and “4L” easily while driving. The warning lamp alarms the driver when the system is defective.



OPERATION

Application	Mode Position		Operating Condition
Driving type	2H	2WD Drive (Rear Wheel Drive)	Normal Driving on the normal road and highway, or high speed driving
	4H	4WD Drive (High Speed)	Slippery road such as snow, rainy, sand, mud etc.
	4L	4WD Drive (Low Speed)	Maximum driving force required condition such as towing, rough road. When a vehicle is driven in turning at low speed on the paved road, a vibration and a noise may be occurred by tight corner braking.
When shifting the mode	2H ↔ 4H	2WD Drive ↔ 4WD Drive (High Speed)	It is possible to shift the mode between 2WD and ↔ 4WD without clutch operation under the vehicle speed is below 70 km/h.
	2H, 4H ↔ 4L	2WD Drive, 4WD Drive (High Speed) ↔ 4WD Drive (Low Speed)	Manual Transmission • Before shifting the mode, stop the vehicle and fully depress the clutch pedal. Automatic Transmission • Before shifting the mode, stop the vehicle and place the selector lever at [N] position. **Note** ***To make the mode shift easier, stop the vehicle, depress the brake pedal, select the mode switch, and move the selector lever with the sequence of [N-P-N].***

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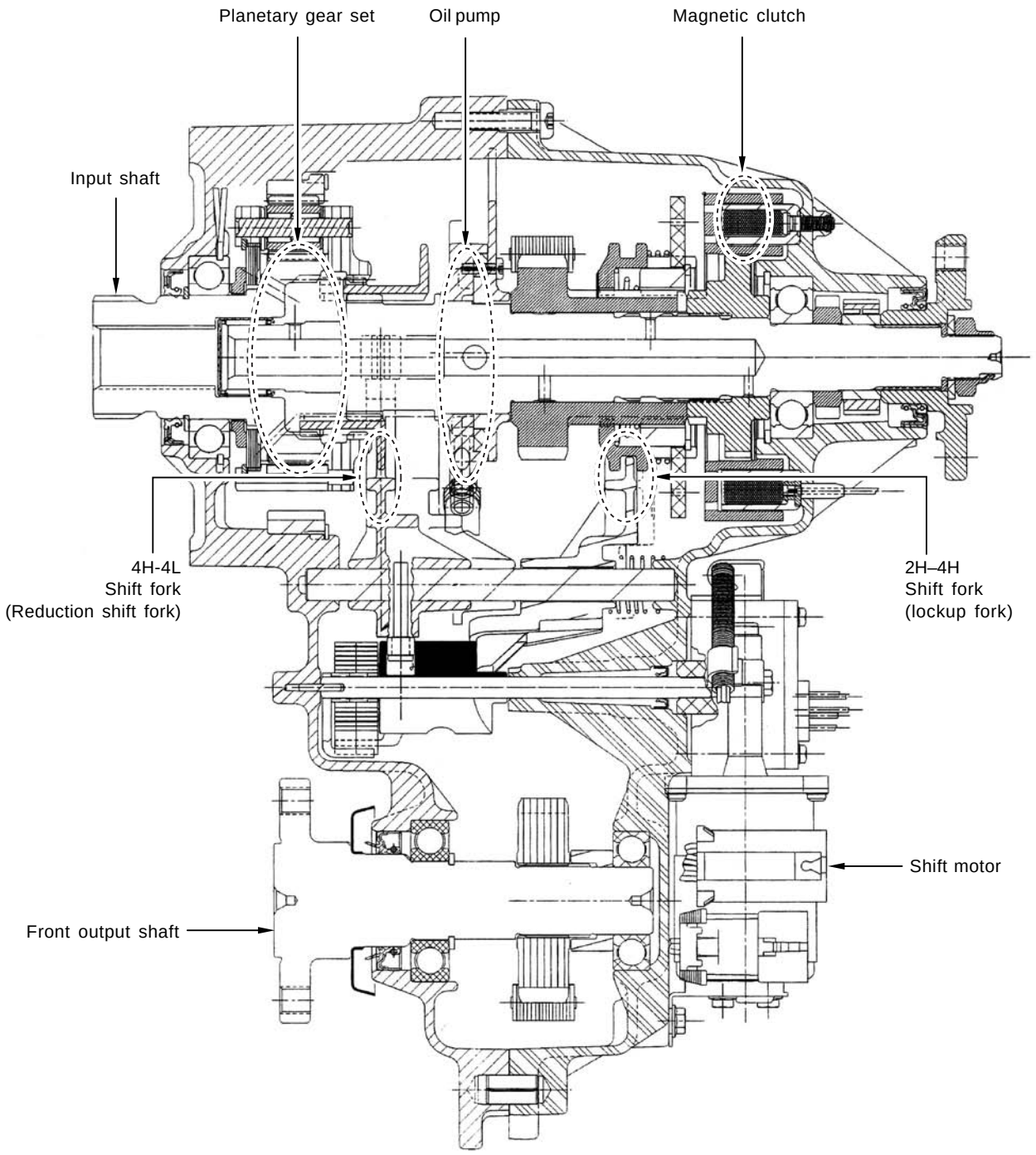
SPECIFICATIONS

Description		New Part Time T/C
Total length		343 mm
Mating surface of front flange		40 mm
Weight		33.8 kg (without oil)
Oil capacity		1.4 L
Location		Transfer case
Major elements	Housing	Part time & TOD (common)
	Tightening bolt	11 EA, M8 x 1.25
	Input shaft	A/T: External spline M/T: Internal spline
	Ring gear	Inserted into housing groove
	Sun gear	Separated input shaft and sun gear

SECTIONAL DIAGRAM



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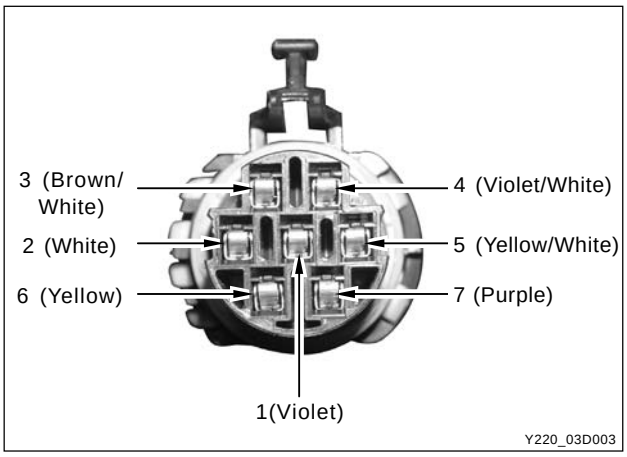
▶ Shift Motor

When selecting a position in 4WD switch, the shift control unit exactly changes the motor position to 2H, 4H and 4L by the position encoder in control unit that monitors motor position.



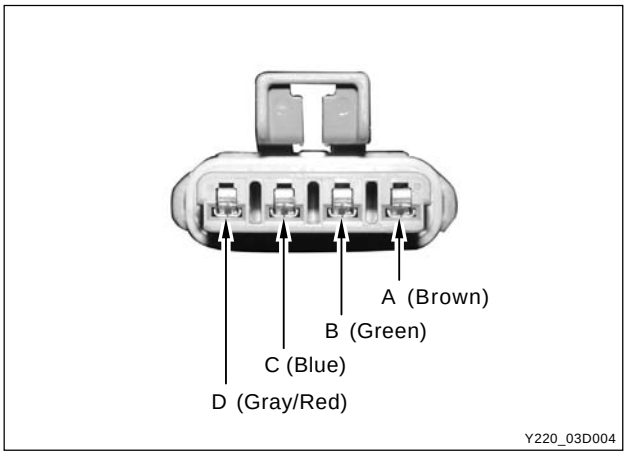
Rear view of connector

Pin	Function
1	Position A
2	Position B
3	Position C
4	Position D
5	Position ground
6	Control (4L - 4H - 2H)
7	Control (2H - 4H - 4L)

▶ Speed Sensor and Clutch Coil

The rear speed sensor utilizes the hall effect. It generates 0V and 5V of square type digital wave according to the rotation of the wheel with teeth of transfer case rear output shaft. The speed signal from rear propeller shaft is entered into control unit.

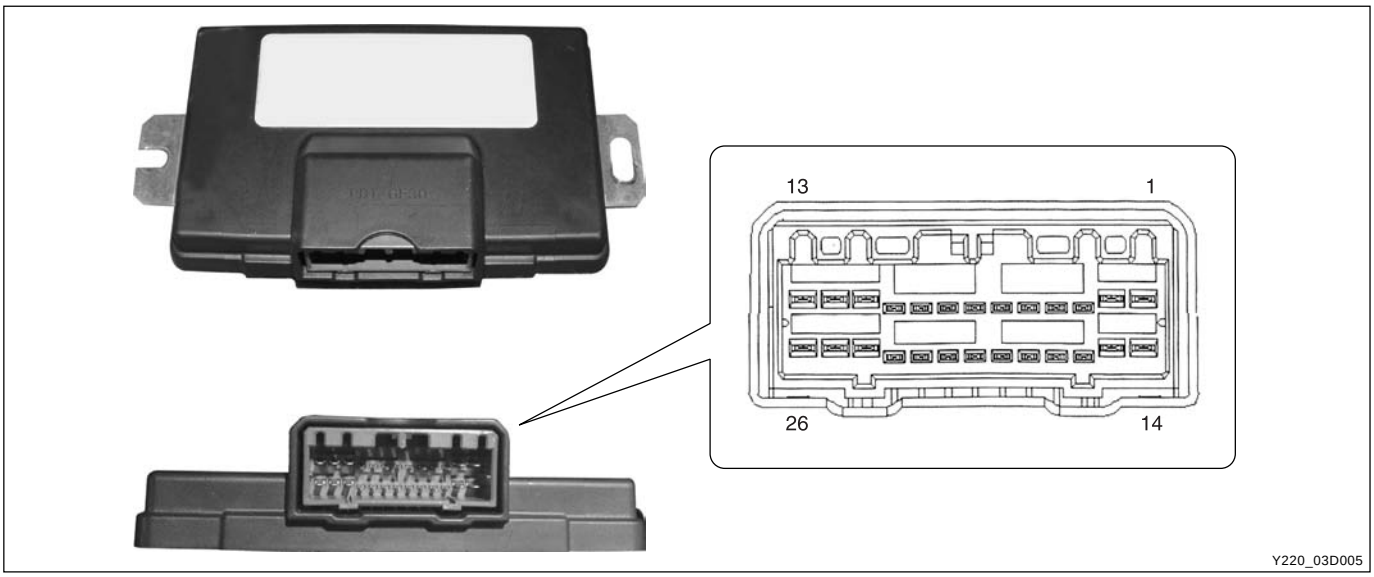
When the control unit determines that 4WD HIGH operation is available, electric current flows into the clutch coil. The coil magnetized by this electric current pull in the lockup hub to engage into output spline. Accordingly, the power is transferred to front wheels.



Rear view of connector

Pin	Function
A	Clutch coil
B	Sensor power (5V)
C	Sensor signal
D	Sensor ground

TCCU



Description	TCCU
Connector type	One integrated connector
Number of pins	26
Weight	0.22 kg
CAN-BUS	-
Vehicle speed signal	CAN communication
Lamp	CAN communication
Clutch signal (M/T)	CAN communication
Neutral signal (A/T)	CAN communication

▶ Appearance and Function

Pin No.	Description	Pin No.	Description
1	Motor HI - LO	14	Motor HI - LO
2	Motor LO - HI	15	Motor LO - HI
3	Ground - speed sensor	16	HI - LO switch
4	2/4 switch	17	Position 4
5	Position 2	18	Position 1
6	N/A	19	Position 3
7	Rear speed sensor	20	Ground - position
8	CAN HIGH	21	K-Line
9	CAN LOW	22	N/A
10	Speed sensor signal	23	Ignition
11	Clutch coil	24	Hub solenoid
12	Ground	25	Ground
13	Battery	26	Battery

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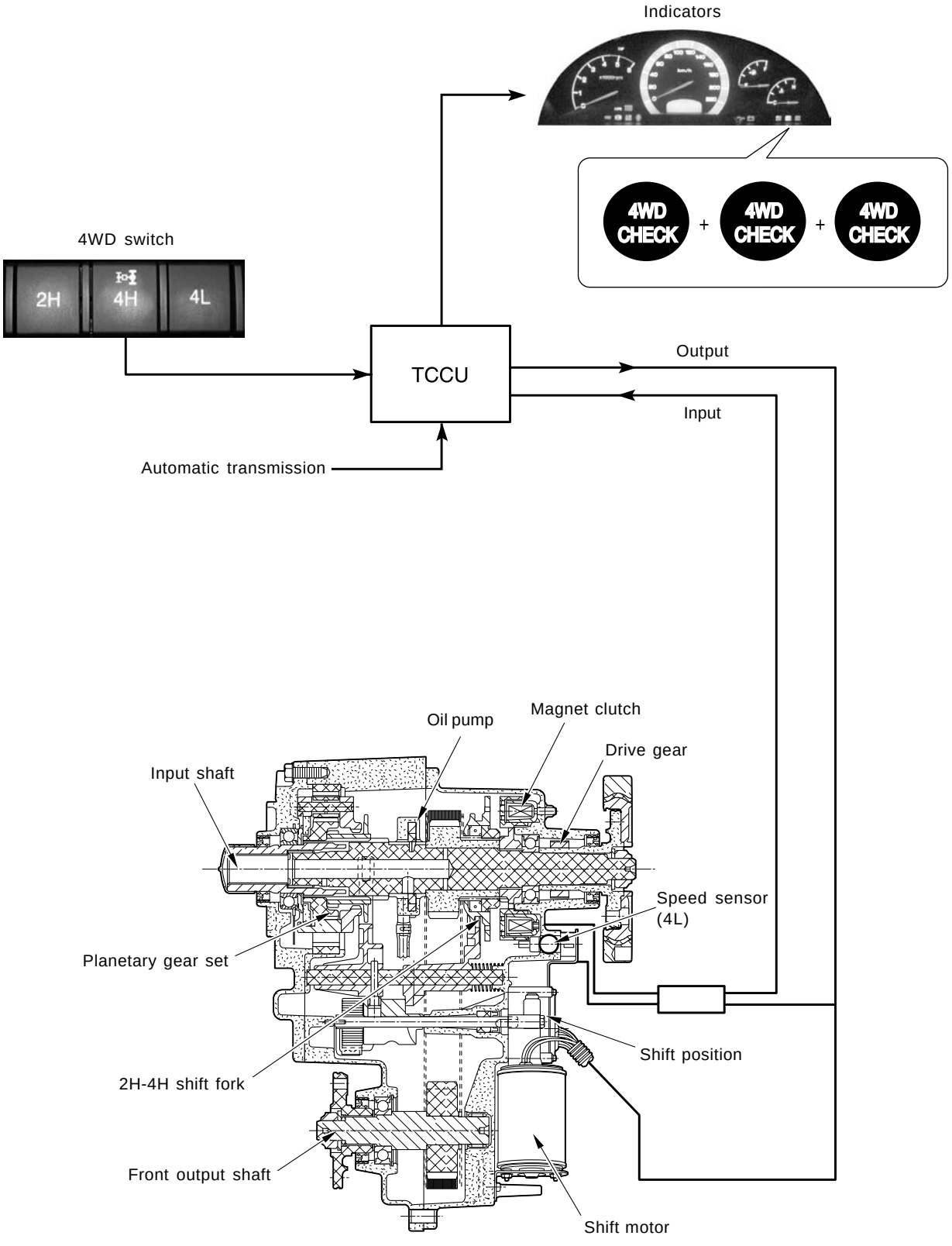
SYSTEM LAYOUT

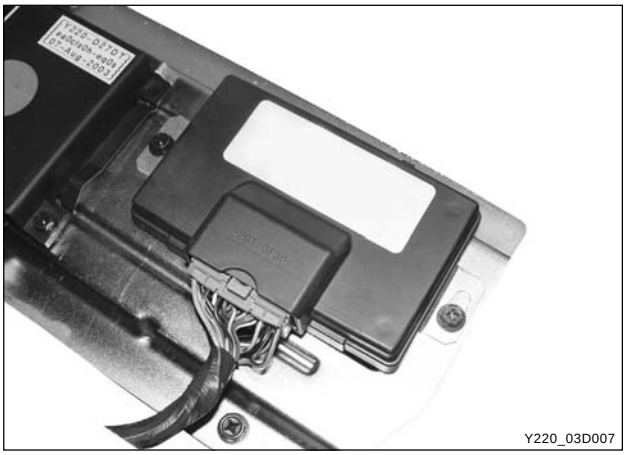


SYSTEM OPERATION

TRANSFER CASE CONTROL UNIT (TCCU)

▶ 4WD Operation

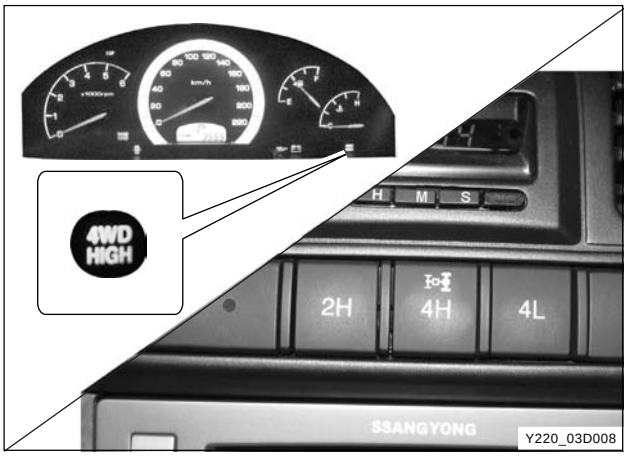
TCCU is located under the driver's seat and permits the vehicle to shift from two-wheel drive to four-wheel drive (and back shift) according to drivers switch operation during driving (For the shifting between 4WD HIGH and 4WD LOW, stop the vehicle).


Y220_03D007

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

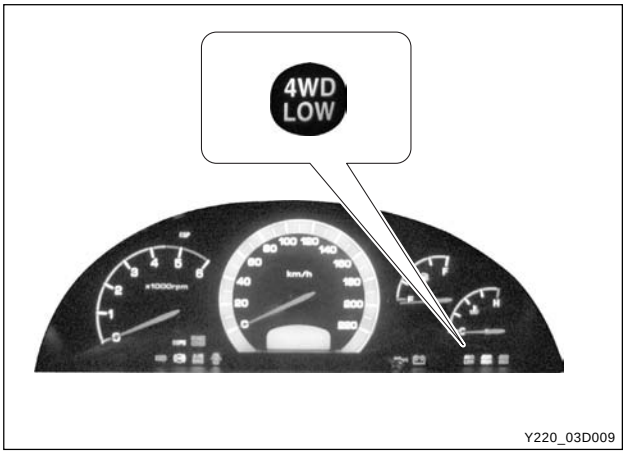
When the system is defective

- "4WD CHECK" warning lamp comes on



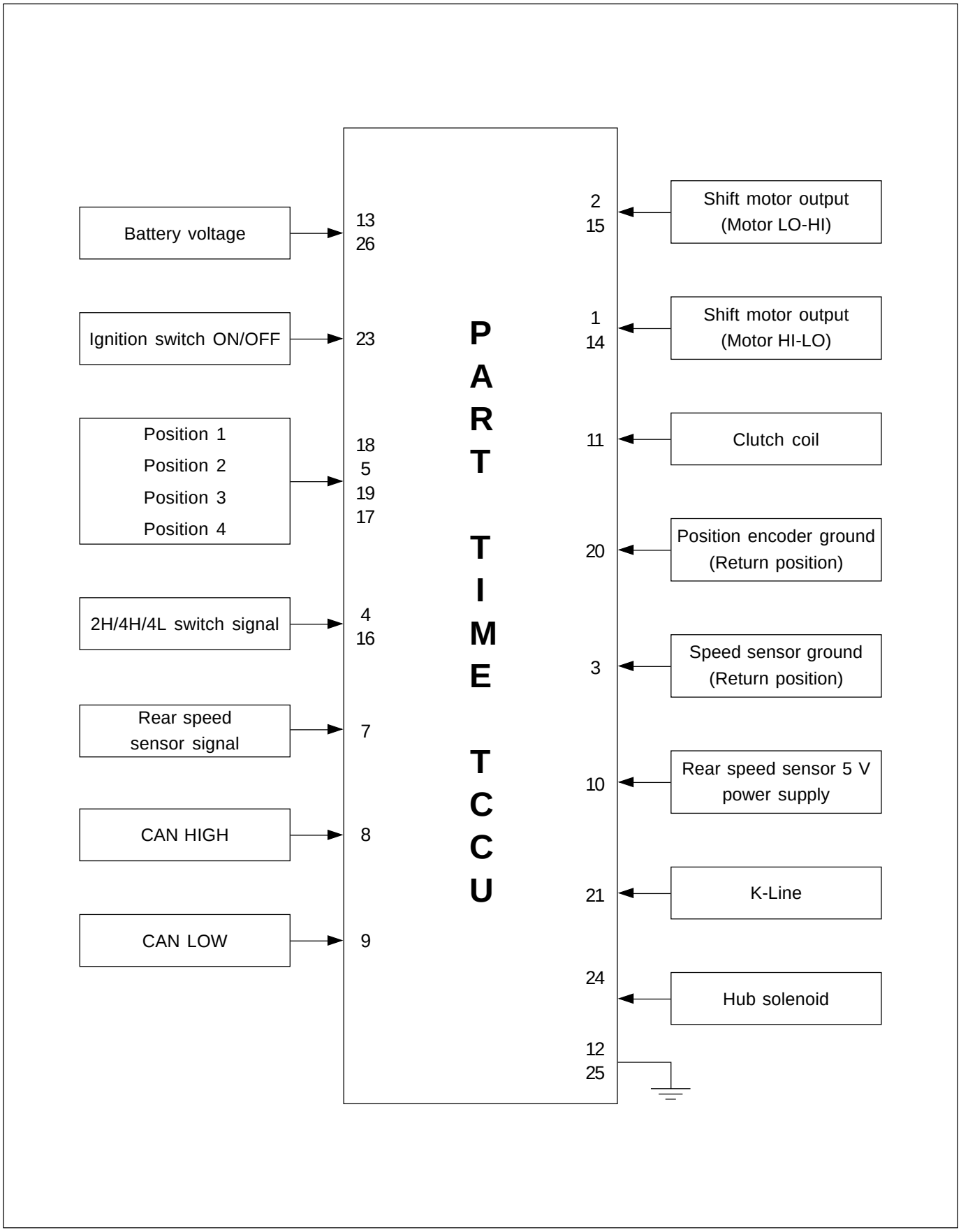
Y220_03D008

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



Y220_03D009

▶ Transfer Case Block Diagram



Section	Pin No.	Name	Description
Power supply	12, 25	Ground	Part time TCCU ground
	13, 26	B+	Part time TCCU battery voltage input
Input side	23	Ignition switch	Ignition switch voltage : ON - above 4V, OFF - below 0.9 V
	18	Position 1	Position encoder : recognize shift motor position HIGH - above 4 V, LOW - below 0.9 V
	5	Position 2	Same a above
	19	Position 3	Same a above
	17	Position 4	Same a above
	4, 16	2H, 4H, 4L switch	Mode input by 2H, 4H, 4L selection : HIGH - above 4V, LOW - below 0.9 V
	7	Rear speed sensor	Rear speed sensor (Hall effect) signal input
Both sides	8	CAN HIGH	CAN bus HIGH line
	9	CAN LOW	CAN bus LOW line
	21	K - LINE	Connected to diagnosis connector
Output side	10	Speed sensor voltage	Supply 5V to front and rear speed sensors
	1, 14	Motor HI-LO	Motor output port - Connected to battery when shifting to LO from HI - Connected to ground when shifting to HI from LO or when braking the motor
	2, 15	Motor LO-HI	Motor output port - Connected to battery when shifting to HI from LO - Connected to ground when shifting to LO from HI or when braking the motor
	11	EMC	Supply voltage to clutch coil - Max. current: 9 A
	20	Position ground (return)	Provide ground to position encoder
	3	Speed ground (return)	Provide ground to speed sensor
	24	Hub solenoid	Supply voltage to hub solenoid

▶ TCCU System

Position Encoder

The position encoder is the code that TCCU can determine the shift motor position.

Position Code				Motor Position	Remark
1	2	3	4		
0	0	0	0	Left stop	Input voltage 1 : above 4.5 V (HIGH) 0 : below 0.5 V (LOW)
1	0	1	0	2 H	
0	0	1	0	Zone 1	
0	1	1	0	Zone 2	
0	0	1	0	Zone 3	
0	0	1	1	4 H	
0	0	0	1	Zone 4	
1	0	0	1	Zone 5	
1	0	0	0	Zone 6	
1	1	0	0	4 L	
0	0	0	0	Right stop	
1	1	1	1	Encoder OFF	

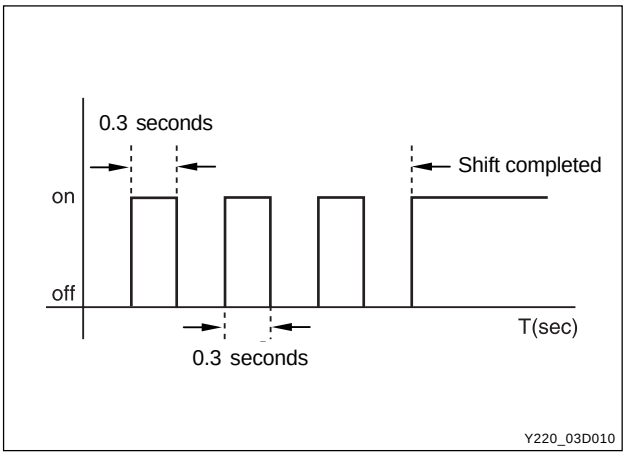
Operation

TCCU initialization and operation

- TCCU sends relevant data to meter cluster via CAN to diagnose and check the indicators when the ignition switch is turned to ON. At this time, the 4WD indicators (4WD LOW and 4WD HIGH) comes on for 0.6 seconds.
- TCCU starts diagnosis by operating clutch and hub solenoid for 1.5 seconds.
- If the selector switch position and the shift motor position code does not match when the IG power is turned ON, the shift is controlled to move in the direction of the selector switch position.
- The shift operation is controlled to move only toward selector switch position if the selector switch position is not met with shift motor position code when the ignition switch is turned to ON.

Function of indicating lamp during shifting

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



Shift conditions

Shift operation is only allowed when some conditions are satisfied. These shift conditions should be satisfied for 2 seconds before starting motor. The motor has three seconds of delay at its initial operation to do trouble diagnosis. Once the motor starts, the shift conditions are no longer checked.

Shift conditions are as follows:

- Normal battery voltage and shift motor for all gears
- 2H and 4H shifts has nothing to do with vehicle speed, “N” position in automatic transmission or clutch signal.
- Shift operation between 2H/4H and 4L is only available when the vehicle speed is below 46 km/h.
- No defective speed sensor

Motor controls

- The shift steps have the sequence of 2H→4H→4L and 4L→4H→2H. TCCU operates the shift motor until it reads required position code. If it detects the faulty code, the system is operated with the compensation mode.
- Once the shift operation is started, it is completed regardless of ignition power. If there are not operating signals from position sensor, the shifting failure due to timeout occurs. This failure appears when the shifting time between 2H and 4H and between 4H and 4L is delayed over 5 seconds compared to normal shift. Once the shifting time exceeds the specified time, TCCU cannot properly supply the voltage to shift motor and is operated in compensation mode.
- Even though the system recognize a fault before motor starts, it is considered as fault.
- Motor stops operation when it reaches at target range.

Synchronization

Synchronization occurs during shifting from 2WD (2H) to 4WD (4H or 4L). The synchronizer clutch and hub solenoid are controlled during synchronization as follows:

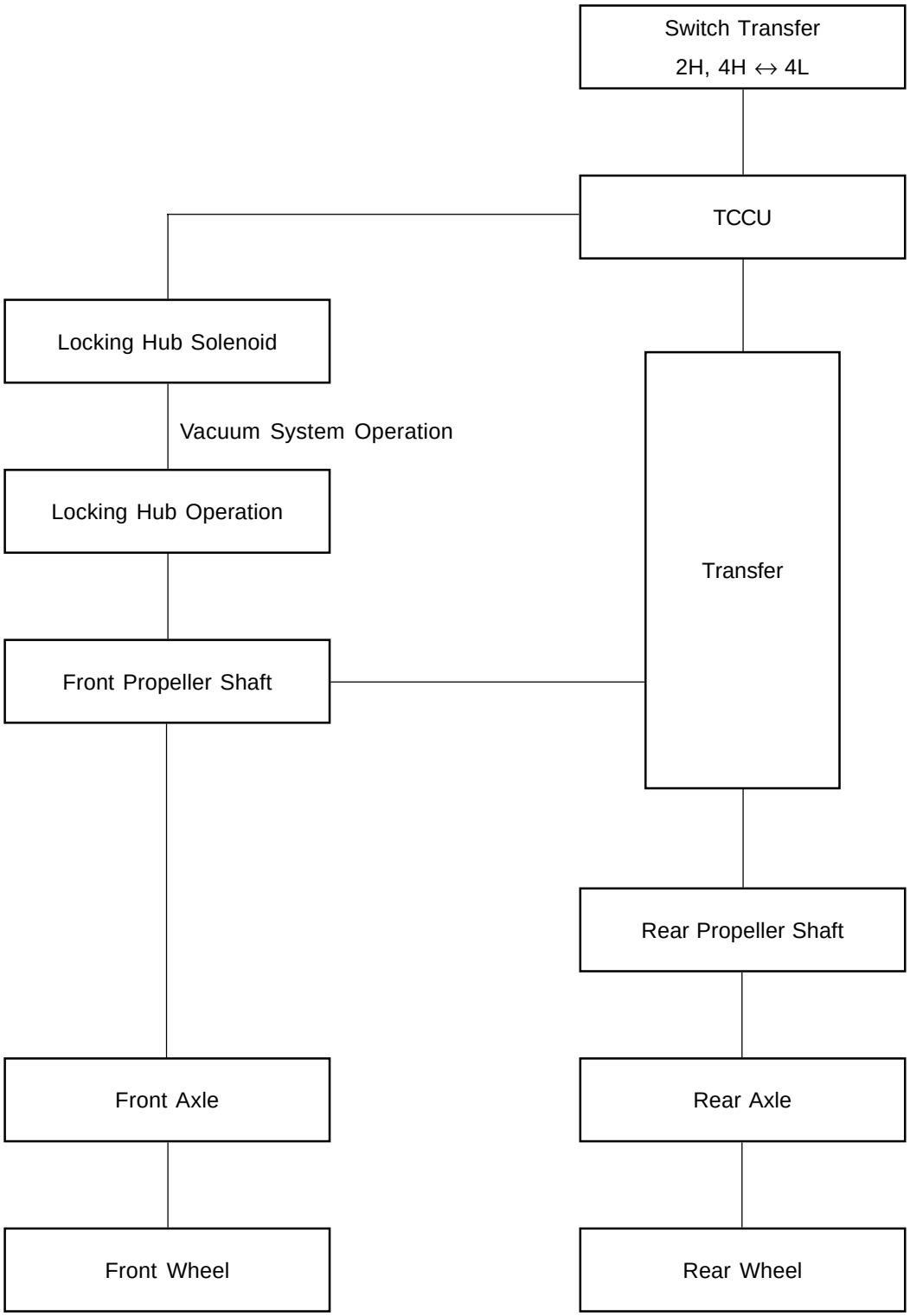
- Clutch coil operates when the selector changes from 2H to 4H/4L.
- Shift motor moves in 4H mode.
- Hub solenoid starts its operation 4 seconds after shifted to 4H.
- Clutch coil stops its operation 5 seconds after the hub solenoid is activated.

Compensation

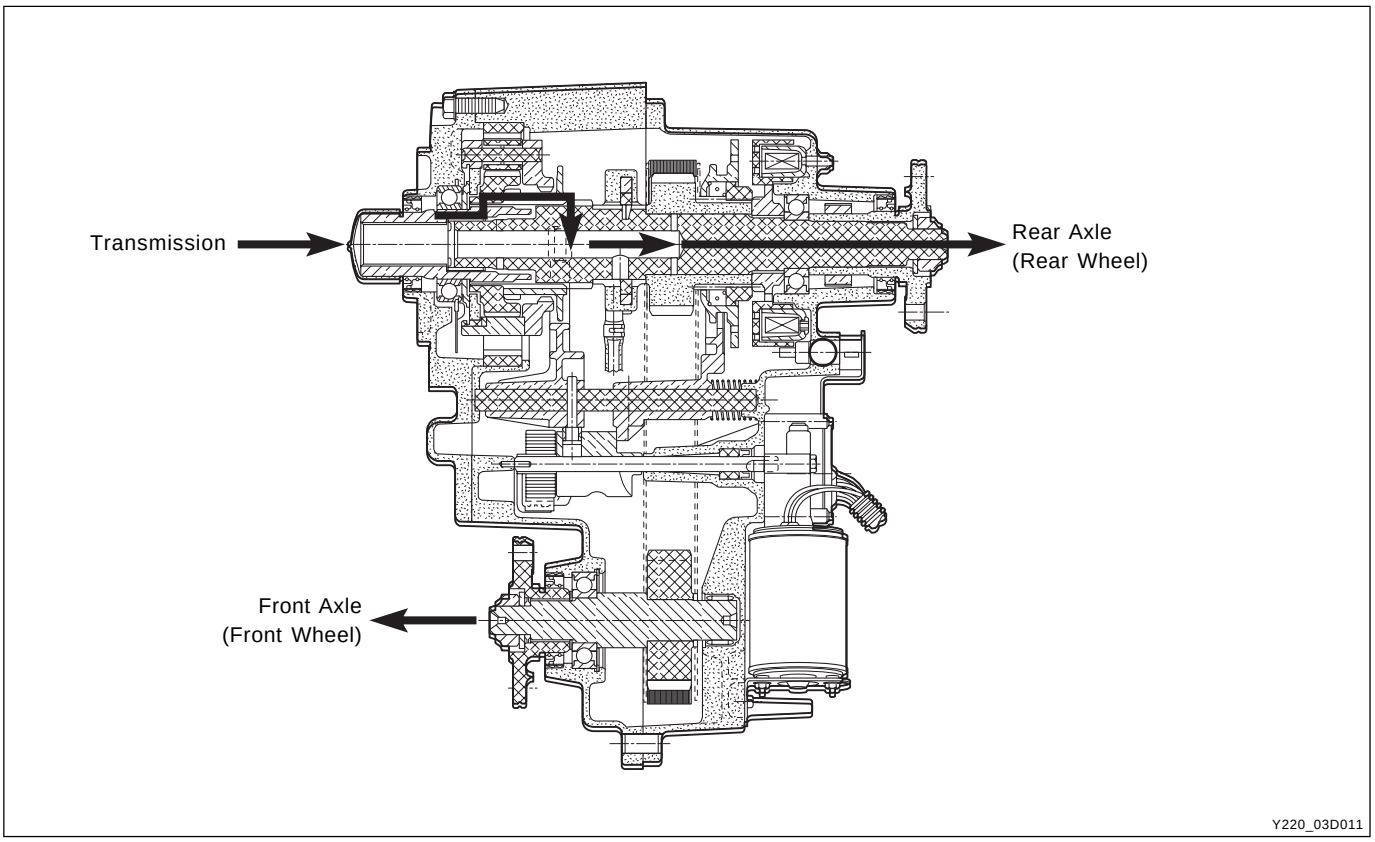
The motor stops when the encoder related troubles are detected during shift operation. It moves toward LOW-HIGH direction for 5 seconds so that the motor is not left in unidentified position.

POWER FLOW

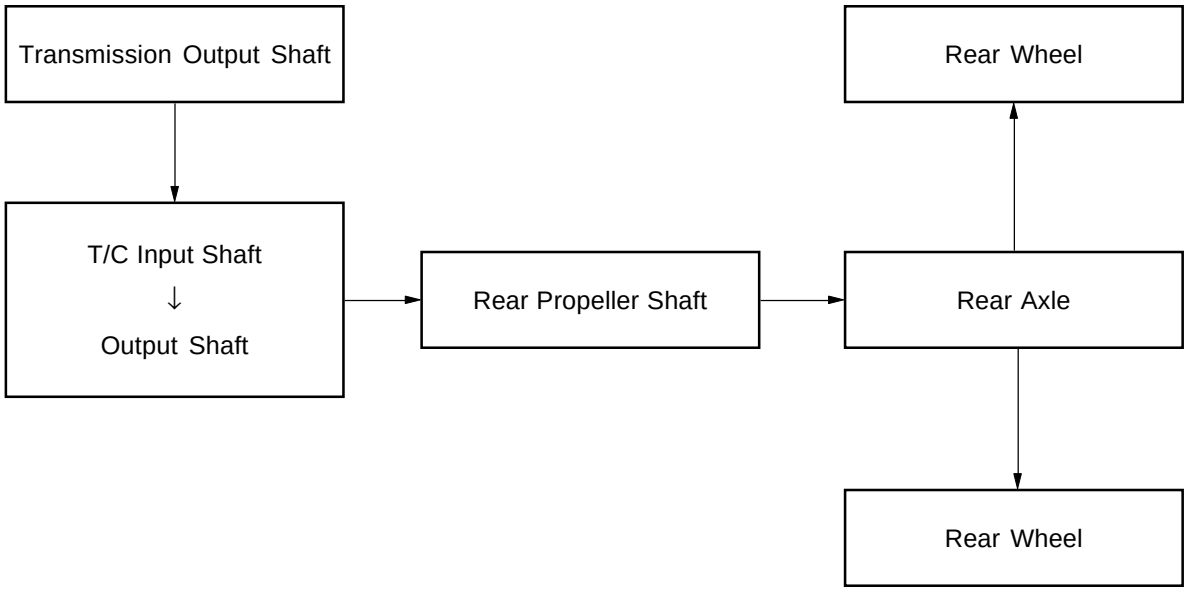
POWER FLOW



2H MODE (REAR WHEEL DRIVE)



▶ Power Flow



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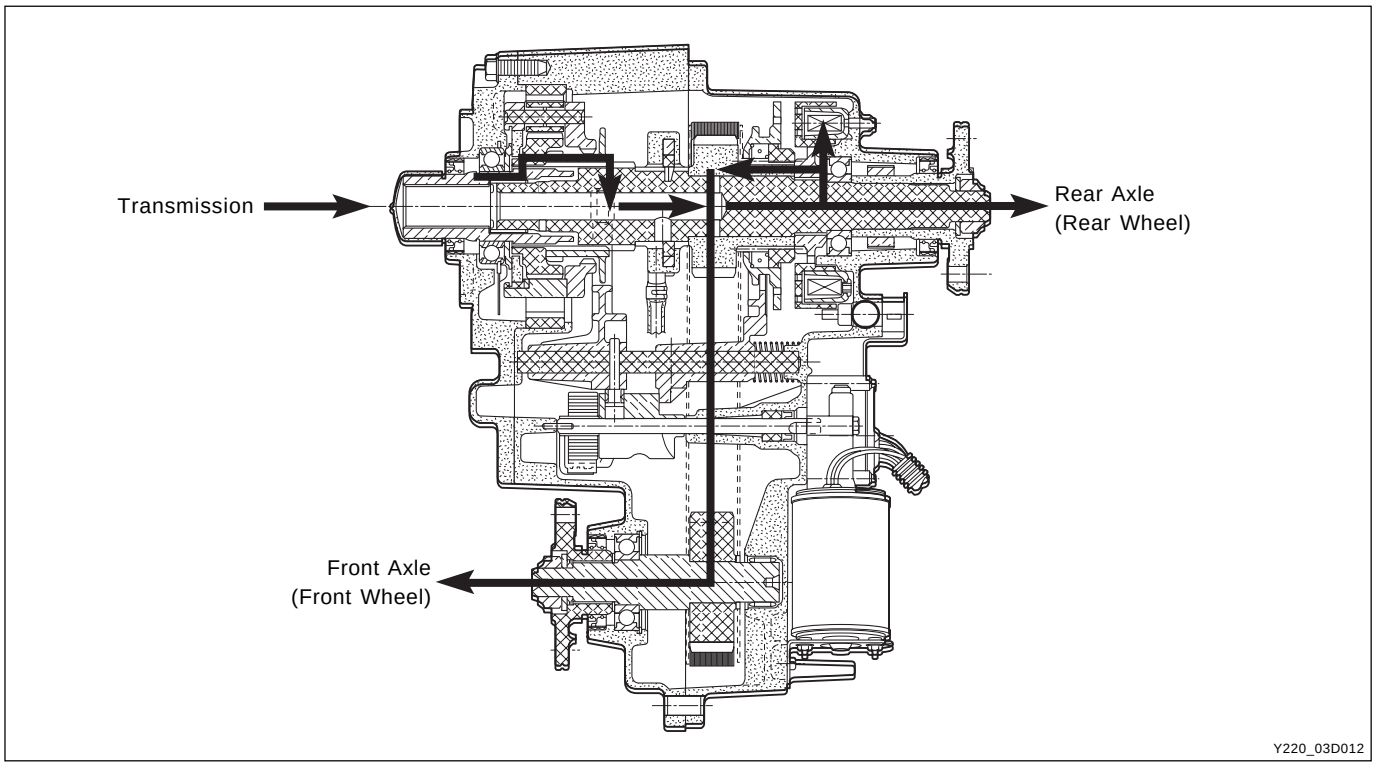
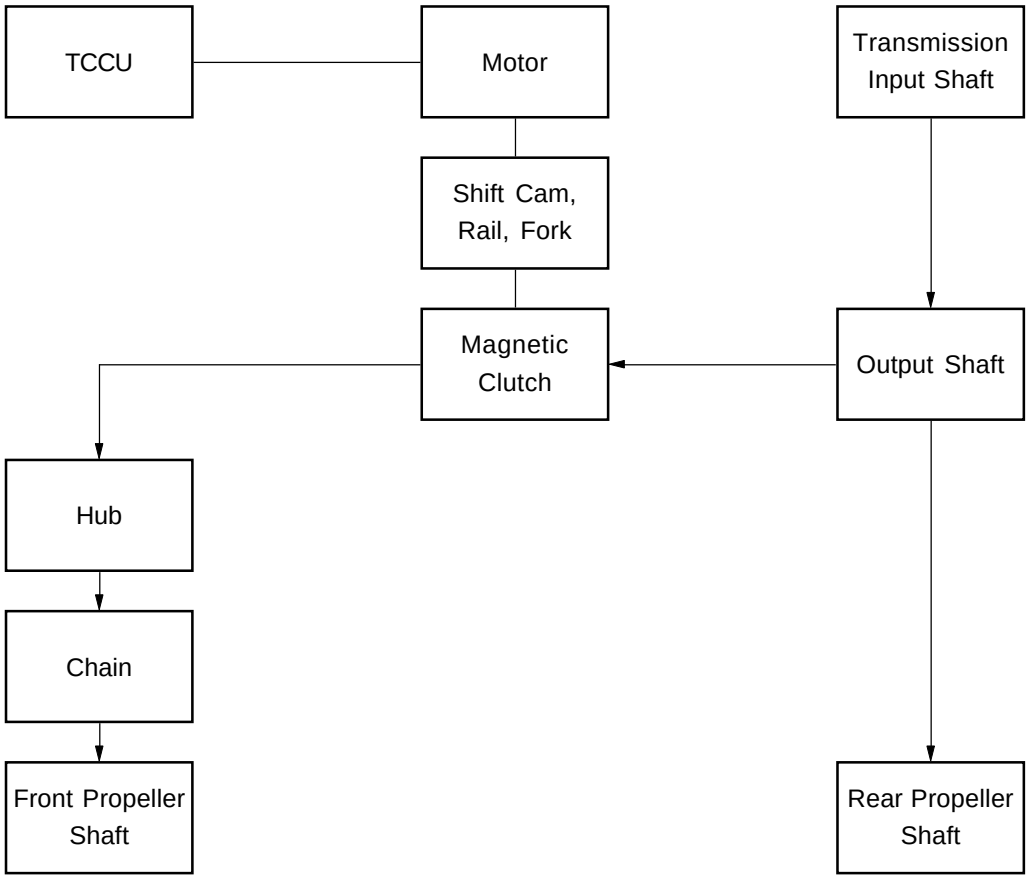
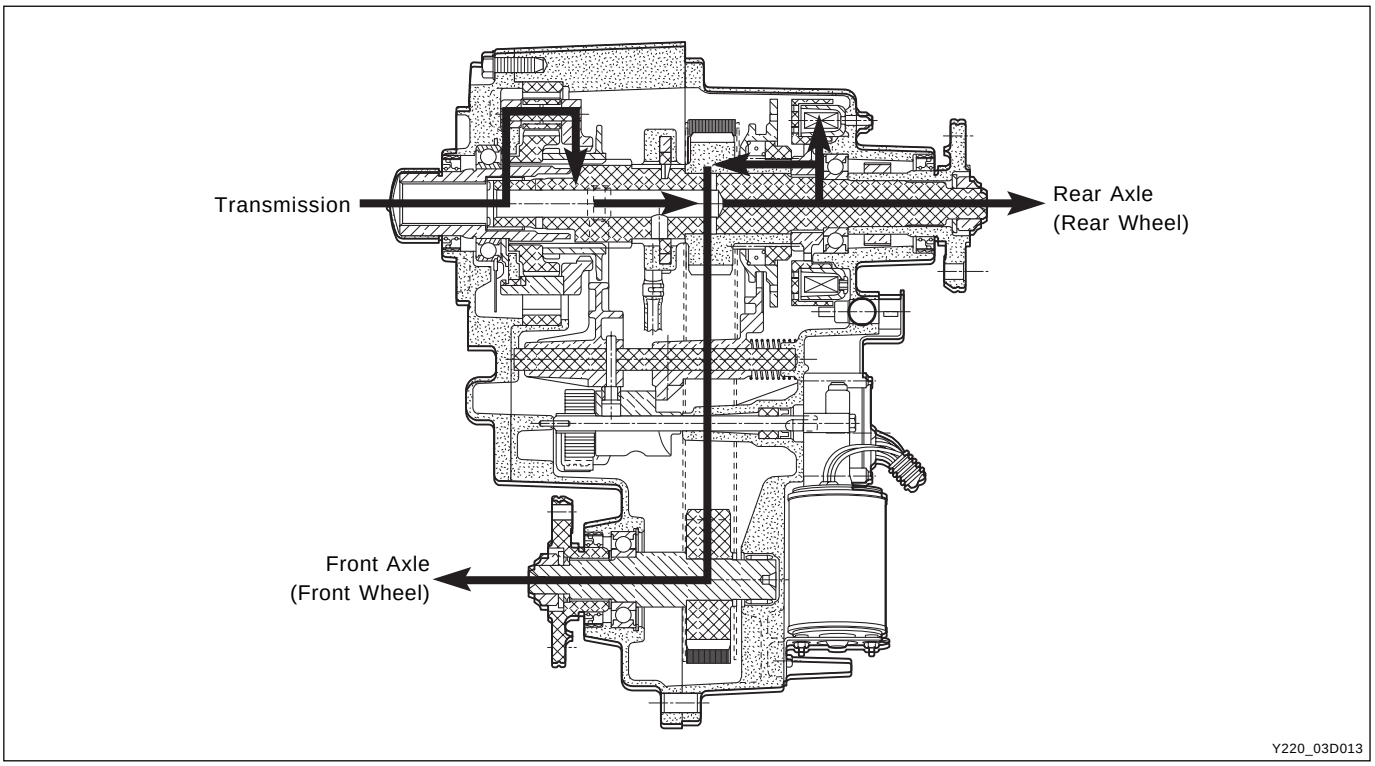
4H MODE (4WD DRIVE - HIGH SPEED)



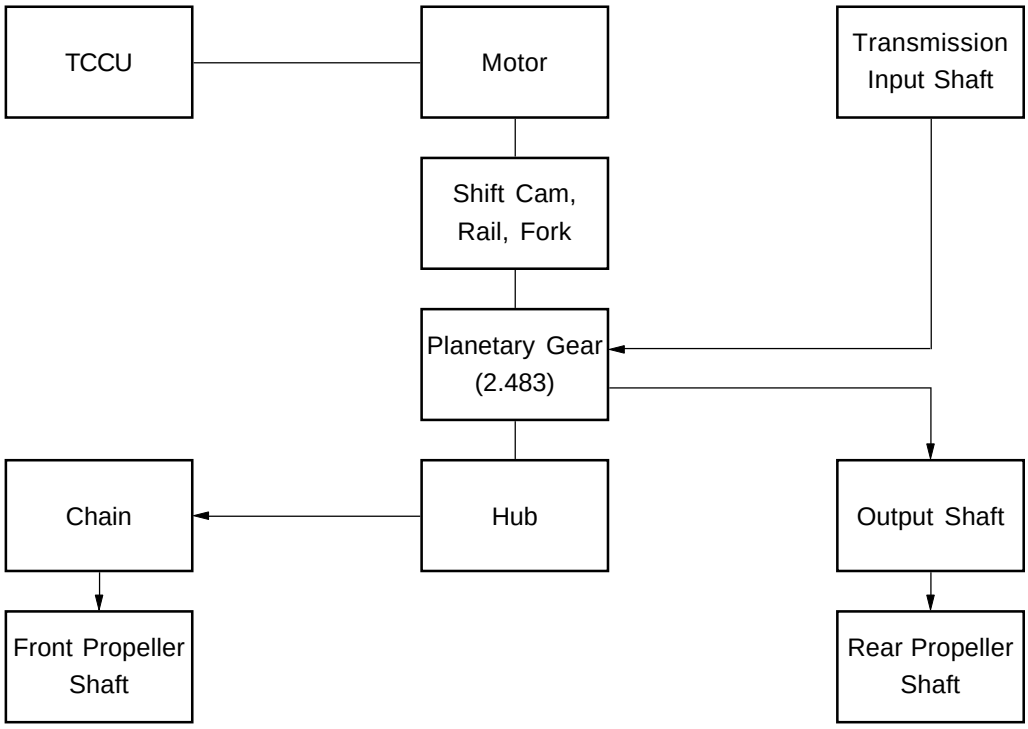
▶ Power Flow



4L MODE (4WD DRIVE - LOW SPEED)



▶ Power Flow



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DIAGNOSTIC INFORMATION AND PROCEDURES

GENERAL DIAGNOSIS

Symptoms	Check	Action
Electric shift problems	• Faulty or damaged TCCU, speed sensor, motor, clutch or internal wirings	• Overhaul and check, replace if necessary.
	• Damaged or worn shift cam, hub, fork and rail shift	• Overhaul and check for wear and damage.
	• Binding shift fork, hub collar or gear	• Replace if necessary.
Cannot front wheel drive when shifted 4H,4L	• Broken drive chain	• Check sliding parts, replace if necessary.
Noise in 4WD operation	• Improper or low oil	• Drain and replace with specified oil.
	• Loosened bolts or mounted parts	• Retighten as specified.
	• Noisy T/C bearing	• Disassemble bearings and parts and check for wear or damage. Replace if necessary.
	• Gear abnormal noise	• Check for wear and damage including speedometer gear, replace if necessary.
Noise in 4H or 4L	• Worn or damaged sprockets or drive chain	• Disassemble and check for wear and damage, replace if necessary.
	• Incorrect tire pressure	• Adjust tire pressure.
Transfer case oil leakage	• Cracked transfer case	• Replace the case.
	• Leakage from other parts	• Clean case and parts and check for leakage.
	• Breather clogging	• Remove breather hose and clean, replace if necessary.
	• Improper or too much oil	• Use specified oil and adjust oil level.
	• Loosened sealing bolts	• Retighten
	• Improperly applied sealant	• Use specified sealant and retighten.
	• Worn or damaged oil seal	• Replace

TCCU periodically monitors the input and output while the system is in operation. When a fault is detected, the trouble code is stored into TCCU memory.

If the ignition switch is turned to “OFF”, TCCU stops monitoring for input and output, however, when the ignition switch is turned to “OFF” before shifting completes, TCCU continues monitoring for input and output required for the shifting.

TROUBLE DIAGNOSIS TEST

▶ Shift Motor Test

- Check short and open for circuit before and during shifting.
- When the system detects a fault in shift motor for over 1 second, “4WD CHECK” warning lamp comes on and the trouble code is stored into memory.
- The trouble code being detected in shift motor during its operation is defined as timeout.
- The trouble code for shift motor can be erased by using scanner.

▶ Transmission System Timeout Test

- Shift timeout occurs when the position sensor of shift motor does not try to operate, which happens 1.5 seconds after completion of 2H-4H shift and 3 seconds after completion of 4H-4L shift.
- When the timeout occurs, TCCU cuts off the voltage to shift motor and operates the compensation mode.

▶ Position Encoder Test

- When the system detects a fault in shift motor for over 1 second, “4WD CHECK” warning lamp comes on and the trouble code is stored into memory.
- Position encoder fault can be divided into general encoder fault and short to ground of position encoder circuit.
  - General encoder fault: Invalid position code input
  - Short to ground of position encoder circuit: Ground for encoder circuit

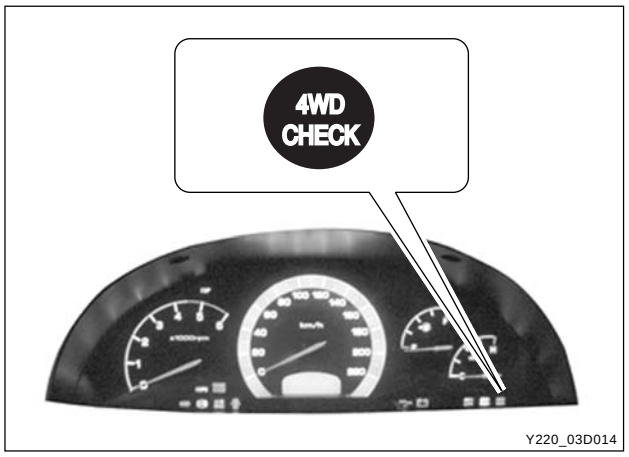
▶ Rear Speed Sensor Test

- When the system detects a fault from rear speed sensor for over 0.5 second, “4WD CHECK” warning lamp comes on. If the shift motor is in operation, the shift operation completes, however, TCCU stops operation until ignition switch is turned to “ON” again.
- When the rear speed sensor is restored continuously for 0.5 seconds, TCCU operates normally and the “4WD CHECK” warning lamp goes out but the trouble code is stored into memory.

▶ Clutch Coil Test

1. Check the clutch coil for open and short circuit.
2. When the system detects a fault in shift motor for over 0.8 seconds, “4WD CHECK” warning lamp comes on and the trouble code is stored into memory.

SELF-DIAGNOSIS TEST



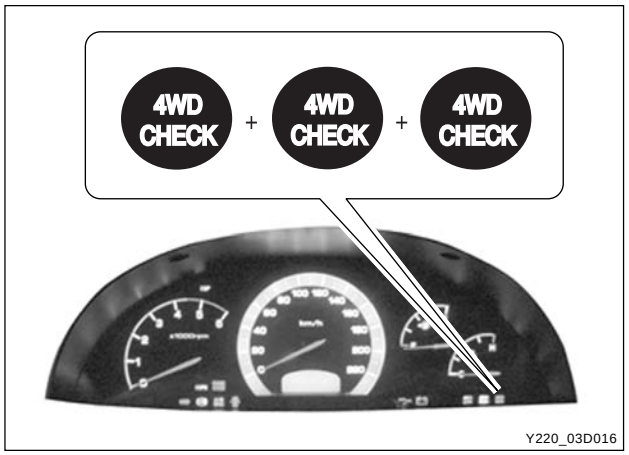
Y220_03D014

1. TCCU detects transfer case system malfunctions and indicates malfunctioning part(s) through flickering of “4WD CHECK” indicator.

   Using a service connector, connect it to the diagnosis box in the engine room and read the flickering of “4WD CHECK” indicator. The flickering indicator will show you defective code(s).


Y220_03D015

2. Read the flickering pattern of “4WD CHECK” indicator.
3. Transfer case system is malfunctioning when:
   - “4WD CHECK” indicator remains on after 0.6 second when turning the ignition switch ON.
   - “4WD CHECK” indicator continuously comes on during driving.



Y220_03D016

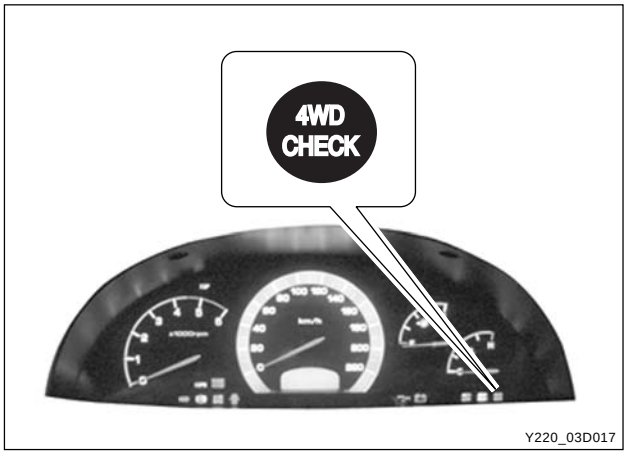
4. To read defective code, connect the service connector and turn the ignition switch “ON” (refer to Diagnosis Table).
5. After repairing, eliminate the defective code stored in the TCCU.

Notice

Before replacing the malfunction parts with defective code, check the wires and connectors for proper condition.

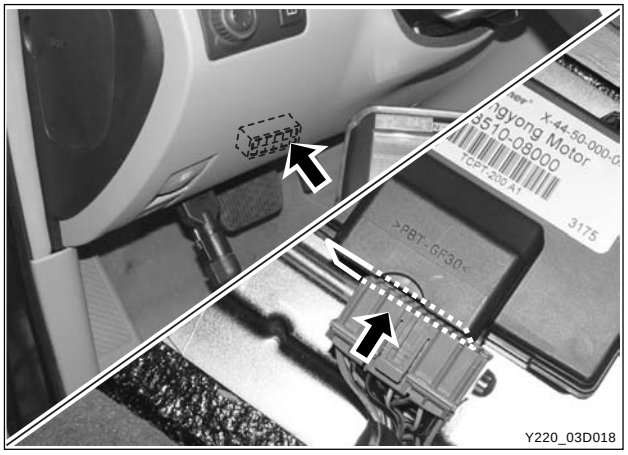
▶ Trouble Code Reading

1. Position the ignition switch to OFF.
2. Connect the service connector.
3. Position the ignition switch to ON.
4. Read the flickering of “4WD CHECK” indicator and identify the malfunctioning (refer to Diagnosis Table).



▶ How to Clear the Trouble Code

1. Position the ignition switch to OFF.
2. Connect the service connector.
3. Position the ignition switch to ON.
4. Clear the trouble code with scanner.
5. Make sure that all trouble codes are eliminated.



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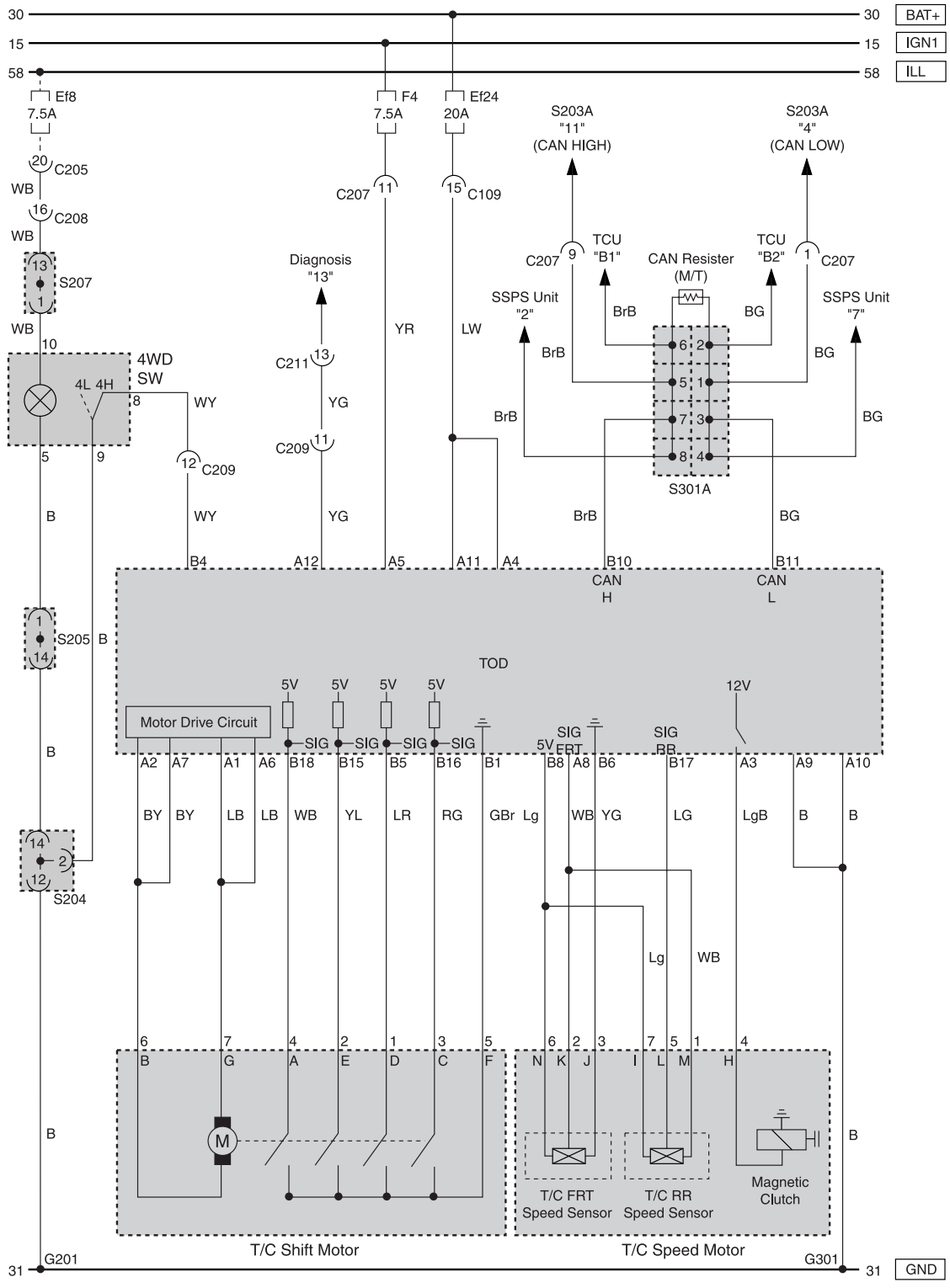
DIAGNOSTIC TROUBLE CODE

Code	Description	Action
P1806	CAN Bus OFF	- Check communication line. - Replace TCCU if necessary.
P1805	Defective mode switch	- When the mode switch is defective - Check TCCU pin No.4 and 16. - Mode change • 2H (Pin No.4: Ground) • 4H (No contact: Open) • 4L (Pin No.16: Ground)
P1821	Open or short to battery in magnetic clutch coil circuit	- Voltage at TCCU pin No.11: 11 ~ 15 V - EMC resistance: 2.5 Ω - Check the relevant connectors for contact. - Replace TCCU if necessary.
P1822	Short to ground in magnetic clutch coil circuit	- Voltage at TCCU pin No.11: 11 ~ 15 V - EMC resistance: 2.5 Ω - Check the relevant connectors for contact. - Replace TCCU if necessary.
P1830	Abnormal rear speed sensor signals	- The indicator is flickering over 0.5 seconds. - The indicator is flickering even after IG switch ON. - Check the rear speed sensor harness for contact. - Replace TCCU if necessary.
P1833	Too low rear speed sensor voltage	- Pin voltage: below 0.9 V - Check the rear speed sensor harness for contact. - Replace TCCU if necessary.
P1834	Too high rear speed sensor voltage	- Pin voltage: 4.75 ~ 5.25 V - Check the rear speed sensor harness for contact. - Replace TCCU if necessary.
P1835	Too low speed sensor reference voltage	- Reference voltage: below 4 V - Check the rear speed sensor harness for contact. - Replace TCCU if necessary.
P1836	Too high speed sensor reference voltage	- Reference voltage: over 8 V - Check the rear speed sensor harness for contact. - Replace TCCU if necessary.
P1841	Open to ground in shift motor circuit	- When TCCU detects the motor failure for 1 second (Action: IG switch ON) - Check the relevant harnesses for contact. - Replace TCCU if necessary.
P1842	Short to ground in shift motor output circuit	- When TCCU detects the motor failure for 1 second (Action: IG switch ON) - Check the rear speed sensor harness for contact. - Replace TCCU if necessary.

Code	Description	Action
P1843	Shift system timeout	- 2H-4H: after 1.5 seconds - 4H-4L: after 3 seconds - Check the relevant harnesses for contact. - Replace TCCU if necessary.
P1844	Too low position encoder voltage (Stuck in Low)	- When no signals from the position encoder - Check the relevant harnesses for contact. - Replace TCCU if necessary.
P1850	Defective position encoder	- When the position encoder is defective - Check the relevant harnesses. - Check the relevant connectors for contact. - Check the shift motor.
P1851	Short to ground for position encoder 1	- Short to ground for position encoder 1 in shift motor - Check the relevant harnesses for short. • TCCU pin No.18 - Check the relevant connectors for contact. - Check the shift motor.
P1852	Short to ground for position encoder 2	- Short to ground for position encoder 2 in shift motor - Check the relevant harnesses for short. • TCCU pin No.5 - Check the relevant connectors for contact. - Check the shift motor.
P1853	Short to ground for position encoder 3	- Short to ground for position encoder 3 in shift motor - Check the relevant harnesses for short. • TCCU pin No.19 - Check the relevant connectors for contact. - Check the shift motor.
P1854	Short to ground for position encoder 4	- Short to ground for position encoder 4 in shift motor - Check the relevant harnesses for short. • TCCU pin No.17 - Check the relevant connectors for contact. - Check the shift motor.

CIRCUIT DIAGRAM (DI & 5-SPEED A/T)



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MAINTENANCE AND REPAIR

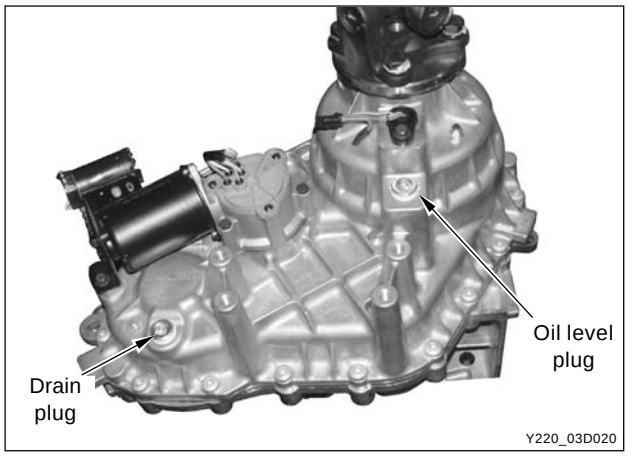
OIL LEVEL CHECK AND CHANGE

1. Oil level check

- Clean the oil level plug and surroundings.
- Remove the oil level plug and check whether oil is spilled out.
- Add oil if necessary.
- Tighten the oil level plug.

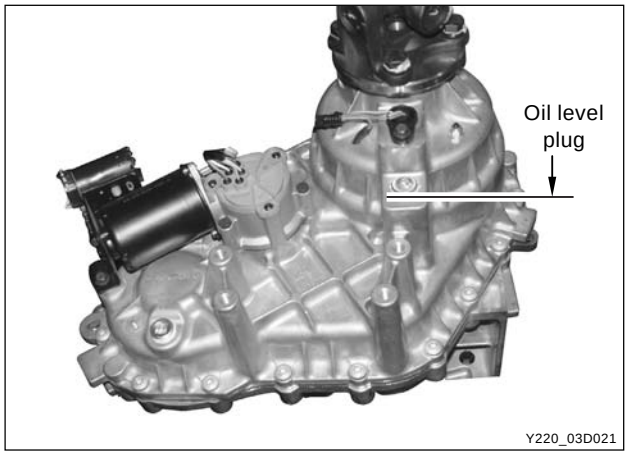
Installation Notice

Tightening torque	19 ~ 30 Nm



2. Oil change

- Clean the oil level plug and surroundings.
- Place a suitable container under the transfer case.
- Remove the oil and tighten the drain plug.
- Fill the oil through the oil level plug until oil begins to drip out.
- Tighten the oil level plug.



3. Cautions for oil level check and plugs tightening

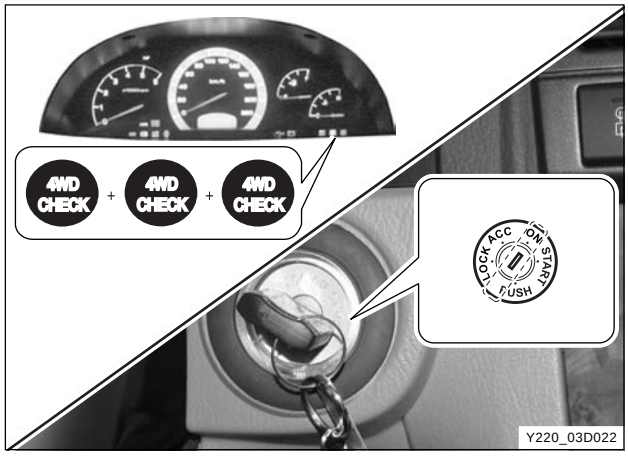
- Do not use an impact wrench to remove or tighten the oil level plug or drain plug since this will damage the threads in the transfer case.

4H, 4L AND 4WD CHECK INDICATOR

When the ignition switch turns on, 4H, 4L and 4WD CHECK indicators come on for 0.6 seconds and the go off.

Notice

If the indicators do not come on, check the related bulb, the wiring harness and TCCU.



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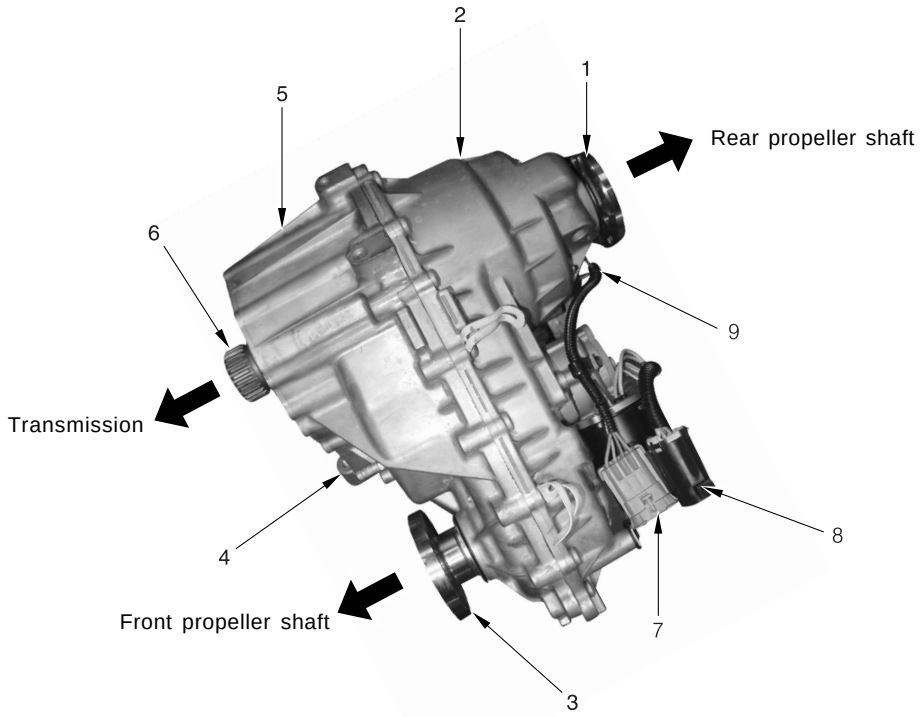
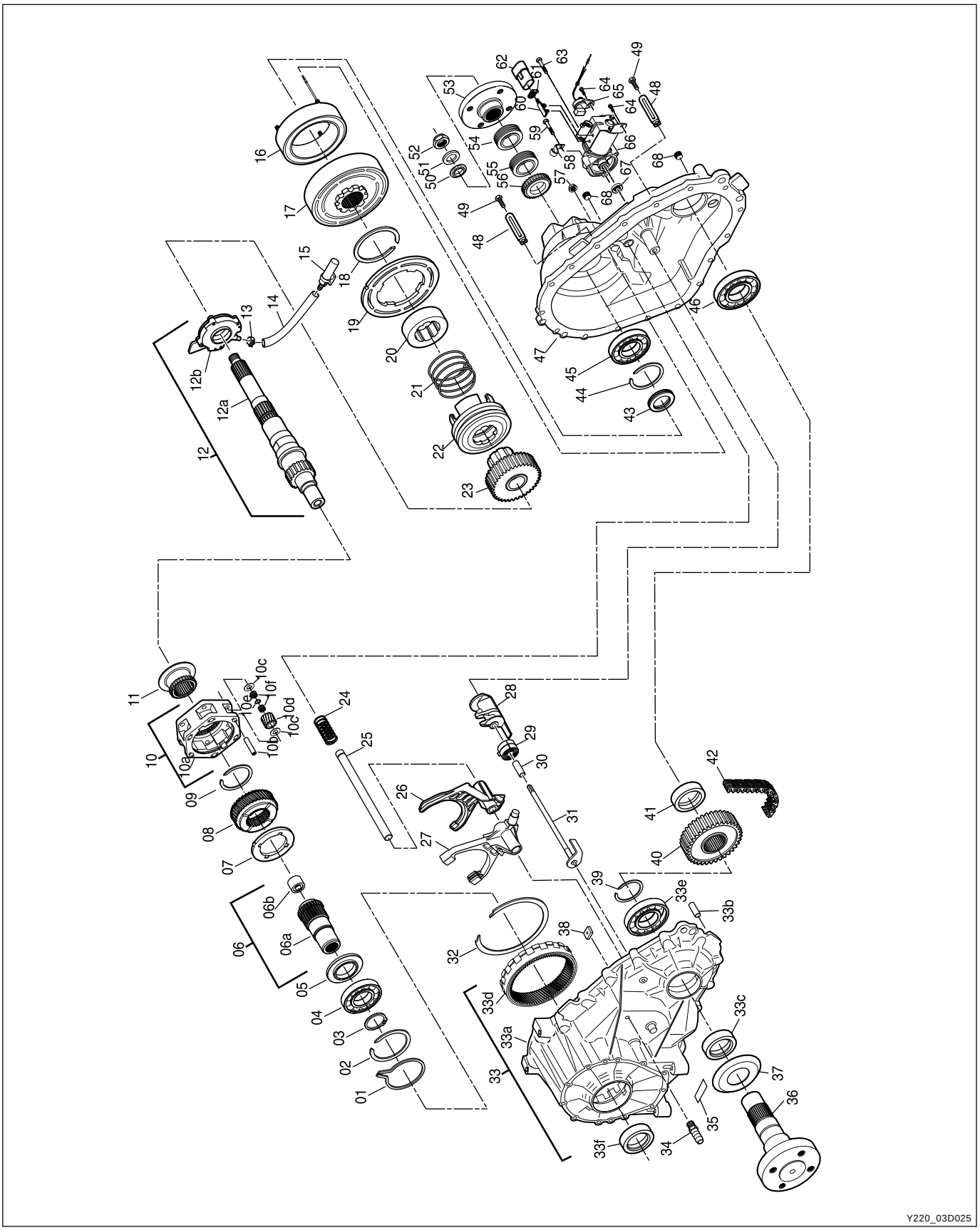
REMOVAL AND INSTALLATION OF TRANSFER CASE

COMPONENT LOCATOR



1. Companion flange
2. Case cover
3. Front companion flange
4. Air adjusting cover
5. Transfer case and adaptor
6. Input shaft
7. Front and rear speed sensor
8. Shift motor/electronic magnetic clutch
9. Speed sensor

▶ Exploded View



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1. Snap ring
2. Snap ring
3. Snap ring
4. Bearing
5. Hub
6. Input shaft assembly
7. Thrust plate
8. Sun gear
9. Snap ring
10. Carrier assembly
11. Reduction hub
12. Main shaft assembly
14. Hose clamp
15. Hop
16. Filter
17. Electric coil assembly
18. Cam/coil housing assembly
19. Snap ring
20. Armature
21. Lockup hub
22. Sleeve return spring
23. Lockup collar
24. Driving sprocket
25. Return spring
26. Shift rail
27. Shift fork
28. Shift fork assembly
29. Electric shift cam
30. Torsion spring
31. Spacer
32. Shift shaft
33. Retaining ring
34. Transfer case assembly
35. Breather
36. Name plate
37. Output shaft
38. Dust shield
39. Magnet
40. Snap ring
41. Lower sprocket
42. Spacer
43. Chain
44. Thrust bearing assembly
45. Retaining ring
46. Bearing
47. Bearing
48. Cover
49. Clip
50. Bolt
51. Oil seal
52. Washer
53. Nut
54. Companion flange
55. Oil seal
56. Spacer
57. Tone wheel (upper)
58. Nut
59. “J” clip
60. Hexagon bolt
61. Wiring clip
62. Locking clip
63. Connector
64. Hexagon bolt
65. Hexagon cap screw
66. Speed sensor
67. Electric motor assembly
68. Oil seal
69. Pipe plug

REMOVAL AND INSTALLATION

Transfer Case

※ Preceding work: Place the selector lever to “N” position.

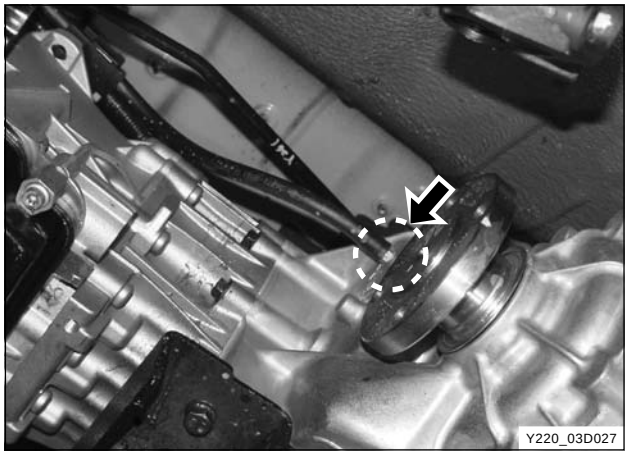
1. Disconnect the negative battery cable.
2. Lift up the vehicle and fix it safely.
3. Remove the damper mounting bolt.
4. Remove the drain plug and drain the oil. Reinstall the drain plug.

   Installation Notice

Tightening torque	19 ~ 30 Nm

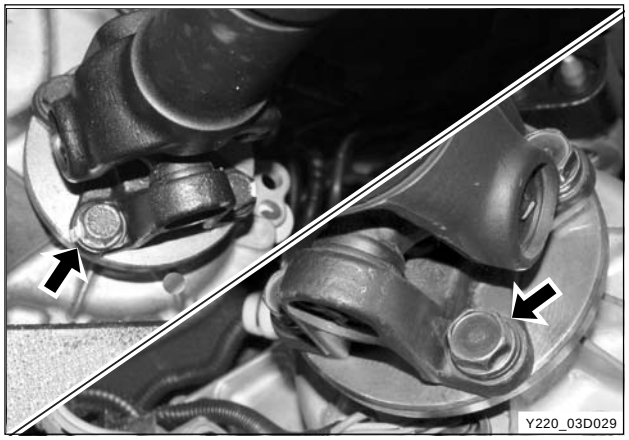

Y220_03D026

5. Remove the breather hose.


Y220_03D027

6. Disconnect the speedometer cable connector and other cable connectors and wiring harnesses.

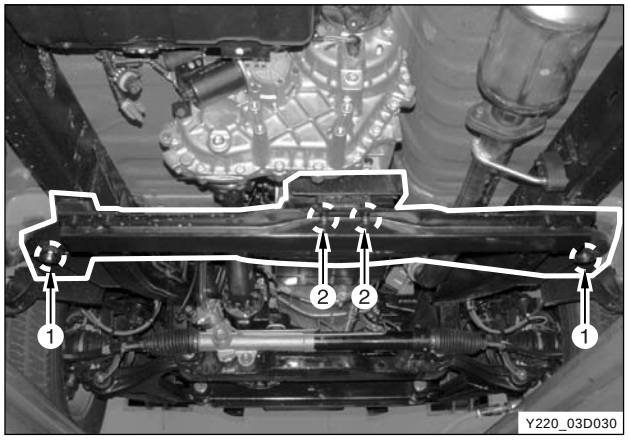

Y220_03D028



7. Support the transfer case with jack and remove the front and rear propeller shafts from the transfer case.

Installation Notice

Tightening torque	Front	81 ~ 89 Nm
	Rear	70 ~ 90 Nm



8. Remove the center mounting nuts and end sides mounting bolts of the cross member and then remove the cross member.

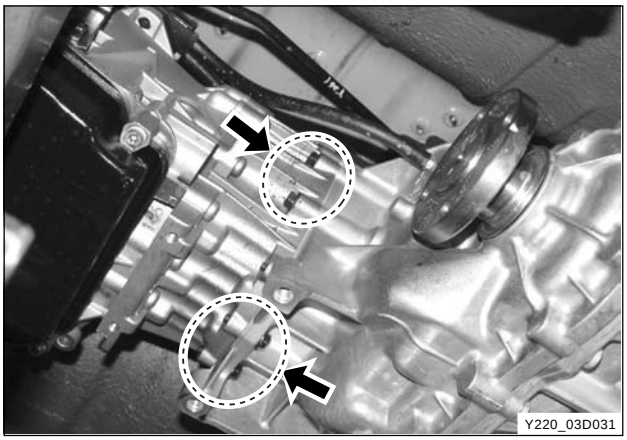
Installation Notice

Tightening torque (1)	21 ~ 35 Nm
Tightening torque (2)	62 ~ 93 Nm

9. Remove the insulator mounting bolts.

Installation Notice

Tightening torque	25 Nm



10. Unscrew the mounting bolts and remove the transfer case.

Installation Notice

Tightening torque	19 ~ 30 Nm

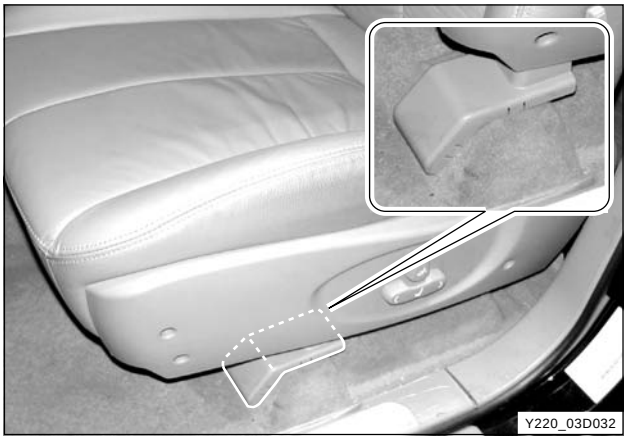
Notice

Apply long-term grease to inner spline of the transfer case input shaft.

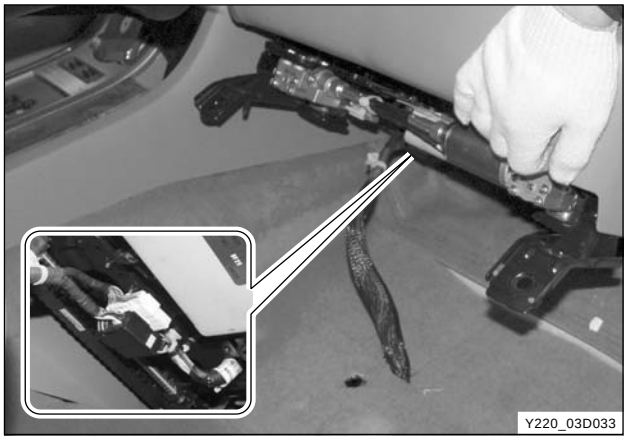
11. Install in the reverse order of removal.

TCCU

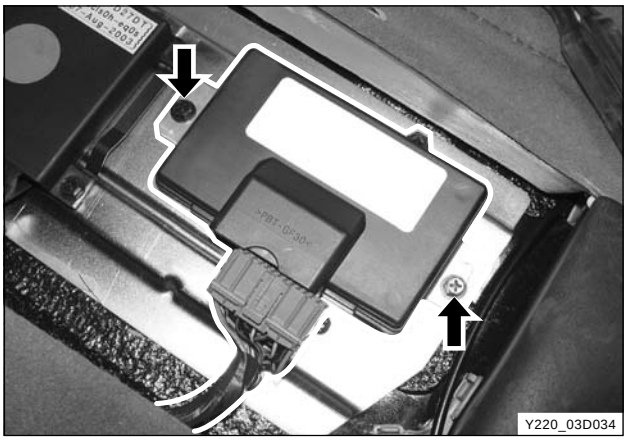
1. Move the driver's seat, remove the seat frame cover, and remove the seat frame mounting bolts.



2. Disconnect the driver's seat sliding/tilting motor connector and pull back the seat.



3. Disconnect the TCCU unit connector and remove the TCCU.



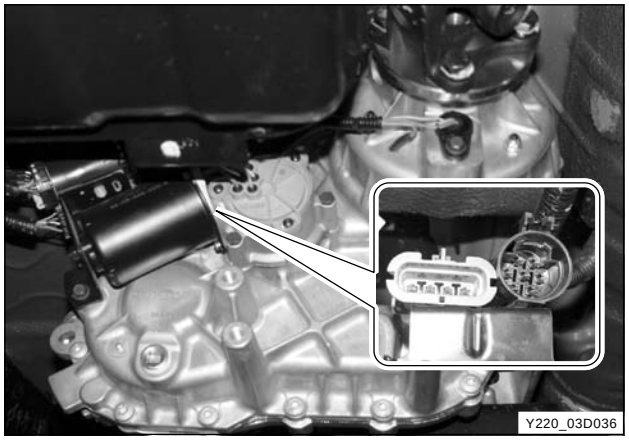
4. Install in the reverse order of removal.

Notice

Be careful not to apply any impact to TCCU body.

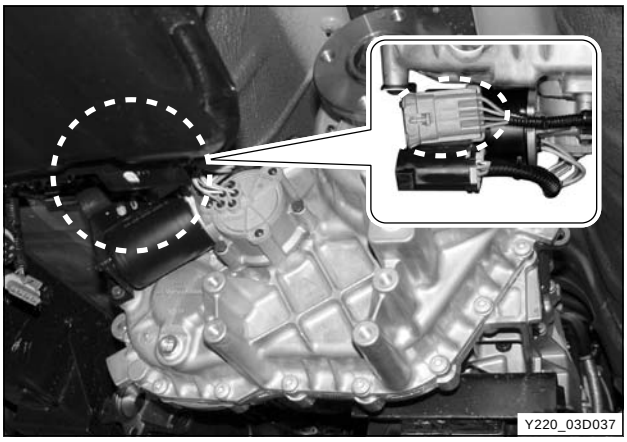
Installation Notice

TCCU mounting bolt	10 Nm

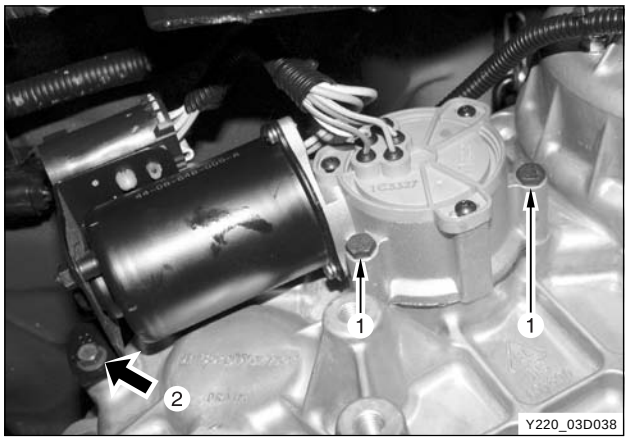


Shift Motor

1. Disconnect the negative battery cable.
2. Disconnect the shift motor/electronic magnetic clutch connector (black, 7-pin) and front and rear speed sensor connector (white, 4-pin) at the rear top section of the transfer case.



3. Disconnect the front and rear speed sensor connector (white, 4-pin) from bracket.



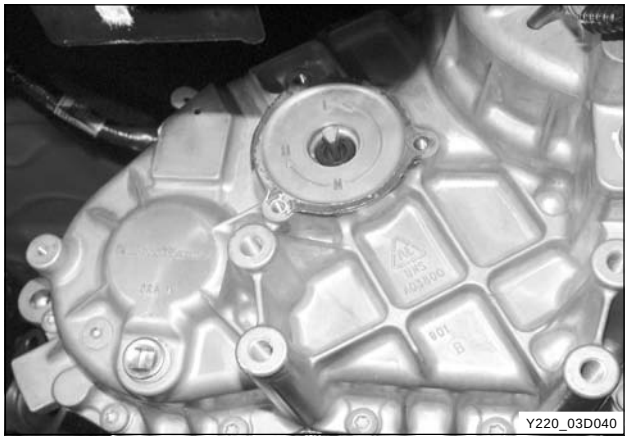
4. Remove shift motor mounting bolts (①).
5. Remove bracket mounting bolt (②).

Notice

Remove two bolts for fixing the motor and bracket before removing the shift motor and bracket.

6. Pull the shift motor assembly out while keeping the level.

7. Clean the mating surface of the transfer case and shift motor.


Y220_03D040

Notice

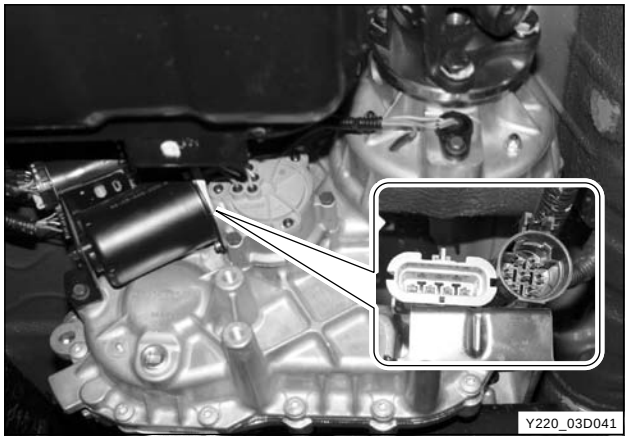
Do not disassemble the shift motor since it is replaced as an assembled unit.

8. Apply sealant on the mating surface if new shift motor assembly.

9. Install in the reverse order of removal. Make sure that the mode switch selection is matched with the motor's driving position before installation.

Notice

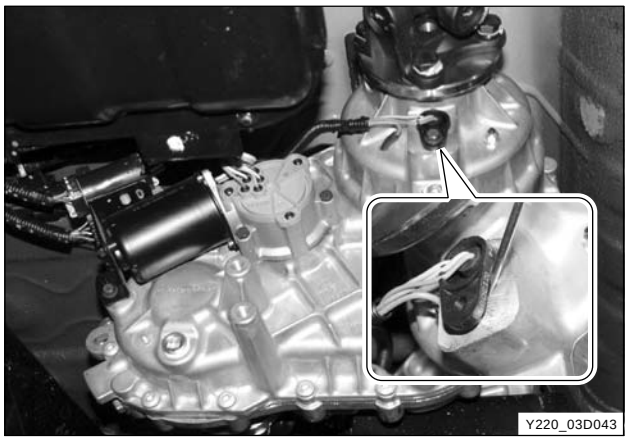
To do that, install a new shift motor on the same location that the used shift motor was on.



Speed Sensor

1. Disconnect the negative battery cable.
2. Remove the shift motor assembly.
3. Disconnect the front and rear speed sensor connector (white, 4-pin) at the rear top section of the transfer case.
4. Disconnect the speed sensor connector from the locking sleeve.
5. Remove the wire fixing retainer at the rear side of disconnected connector.

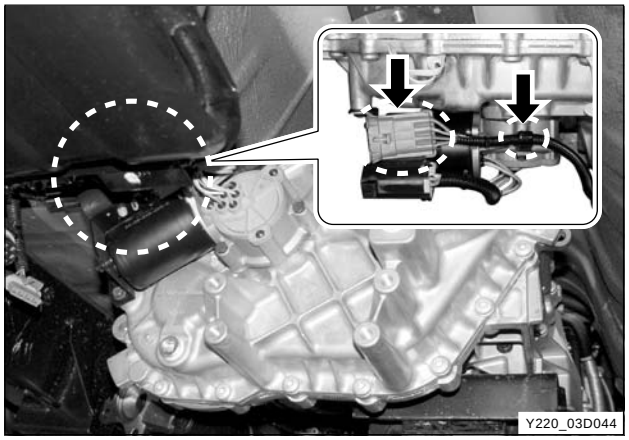
6. Remove the rear speed sensor bolts on the rear case flange.



7. Remove the rear speed sensor with a suitable tool.

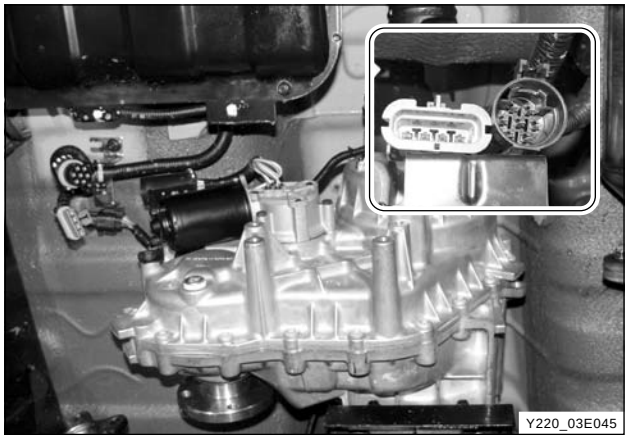
Notice

Do not apply excessive force to protect mounting area and sensor.



8. Remove the tapings in both sides of protective tube.
9. Remove the tube.

10. Hold the “L” pin in speed sensor connector with long nose pliers and push it rearward to disconnect from the connector.
11. Disconnect the “M” and “N” pin and wire from the connector with same manner.



Notice

EMC wire cannot be disconnected from outside, therefore do not try to disconnect it.

12. Get a new speed sensor.
13. Insert three pins and wires into each location from rear side of the connector.
14. Hold each pin with long nose pliers and pull it to securely install in the connector.
15. Insert each rubber cap into the connector to prevent the pins from disconnecting.
16. Insert the protective tube for connector into the harness.
17. Bind both ends of the protective tube with tape.
18. Install the rear speed sensor into the mounting hall and press both ends of it to be securely seated.
19. Tighten the bolts.

Installation Notice

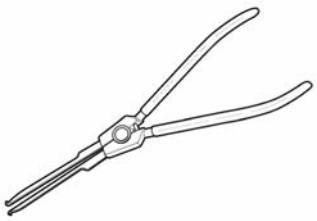
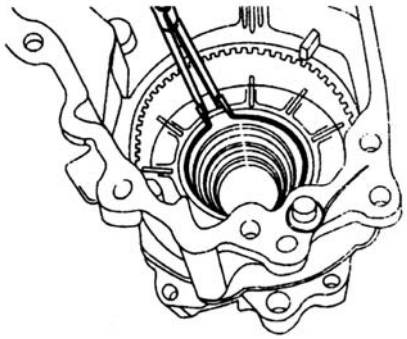
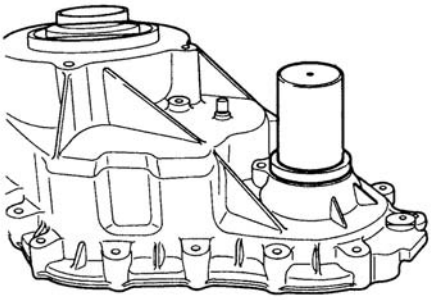
Tightening torque	3 ~ 6 Nm

20. Install the speed sensor connector. Insert the connector into the locking sleeve.

Notice

Remove the shift motor first before removing the front propeller shaft speed sensor. When replacing the sensor assembly after removing the shift motor, use the same manner for removal of rear speed sensor.

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
661 589 01 37 00 (W 99 31 001 1B) **Pliers**  Y220_03E078	Removal/installation of carrier assembly in transfer case  Y220_03E079
SY 220 - 080 (W 99 31 005 0B) **Oil seal installer**  Y220_03E080	Installation of oil seal to transmission case  Y220_03E081

SECTION 3E

TOD

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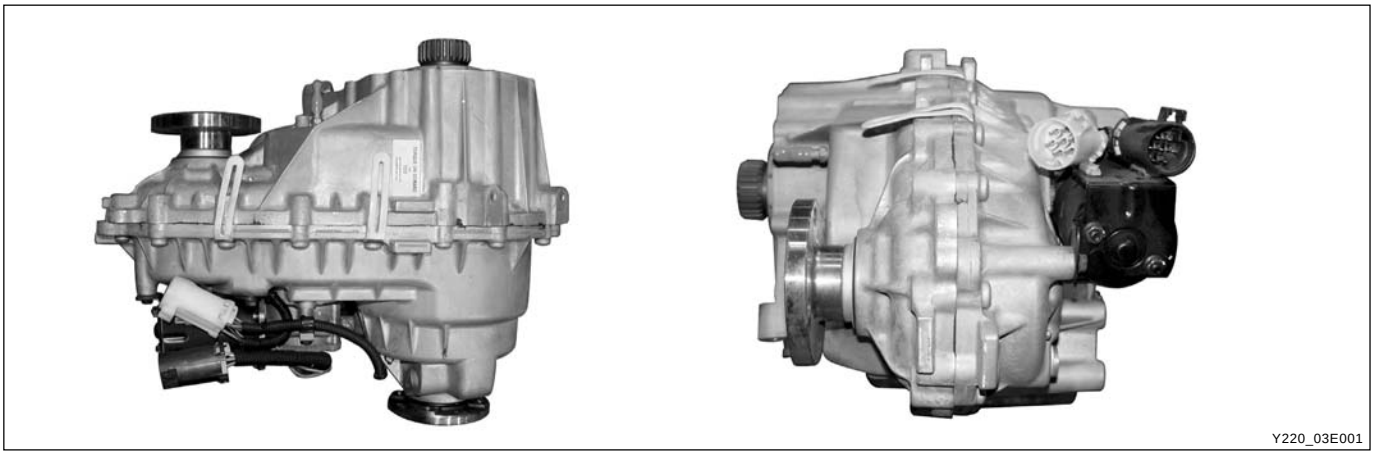
GENERAL INFORMATION AND OPERATION

OVERVIEW



TOD system means the full time 4WD system and the registered trade mark of Borg Warner. TOD is an abbreviation of Torque On Demand.

TOD (Torque On Demand) system, which is superior than existing Full Time 4WD, checks the road surface and vehicle conditions via various sensors and, subsequently, according to the situations and conditions, distributes the most optimal driving force to front wheels and rear wheels by activating the electro-magnetic clutch located inside of TOD Transfer Case.

TOD receives the speed signals from speed sensors installed in front axle and rear axle, the TPS signals from engine, and the operating signals from ABS control unit via CAN. Based on these data, TOD control unit controls the electro-magnetic clutch to distribute the 3:97 ~ 44:56 of driving force to front wheels and rear wheels.

The conventional system uses “FR driving” (theoretically, the 100 % of driving force is transferred to rear wheels) on normal paved road. When the system detects a slip in the rear wheels, a proper percentage of driving force is transferred to front wheels.

TOD control unit receives the wheel speed signals from the speed sensors in propeller shaft of transfer case and engine output information from the engine control unit. TOD control unit changes the pressure force of the electro-magnetic clutch based on the analyzed data.

▶ Distribution of Driving Force According to Road Surface

1. On normal road surface
   In vehicle with existing part time transfer case, when a driver turns the steering wheel to park in the 4WD mode, the vehicle may halt sensation of tight corner braking phenomena. However, in vehicle with TOD system, this phenomena does not occur and the driving force is properly and automatically distributed.
2. On paved road with high speed
   Driving at high speed on roads such as highway mainly uses rear wheels as driving wheel. At this moment, some of torques is also distributed to front wheels so that the vehicle could maintain safe ground grab capacity against side winds and rain. Distribution ratio: 15 % for front wheels and 85% for rear wheels.
3. When turning on the road with low friction rate
   During cornering on roads such as unpaved, snowy, icy and muddy, ground grab capacity is increased by distributing required torque and, at the same time, comfortable steering operation is maintained by controlling the ground grab capacity at high level. Distribution ratio: 30 % for front wheels and 70 % for rear wheels.
4. When climbing or starting off on the road with low friction rate
   In order to secure the maximum ground grab capacity and driving force during climbing or starting off on the roads such as unpaved, snowy and icy road, the system controls the driving force to distribute properly in full 4WD mode. Distribution ratio: 50 % for front wheels and 50 % for rear wheels.

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▶ Function

Selection Mode

The TOD system has 2 selectable mode, 4H and 4L. 4H is the normal operating mode when drive of which gear ratio is 1:1 and 4L mode distributes power to front and rear wheels 50:50 of which gear ratio is 2.48:1.

4L Mode

When selecting 4L mode, EMC is locked to apply maximum torque into front and rear propeller shafts. Shift motor rotates also 4L position by rotation of cam thus propeller shaft torque changes from 1:1 to 2.48:1 by planetary gear set.

Releasing the 4L Mode

When selecting 4H mode, 4L drive mode is released and 4H mode is resumed.

- "4H" switch: Self-return type
- "4L" switch: Push lock type

▶ 4WD Operation Overview

Application	Mode Position		Operation Condition
Driving type	4H	4WD Drive (High Speed)	Normal Driving on the normal road or highway, or high speed driving. Slipped road such as snow, rainy, sand, mud etc.
	4L	4WD Drive (Low Speed)	Max driving force requiring condition such as towing, rough road. Same function as part time transfer case 4L.
Transferring	4H ↔ 4L	4WD Drive High Speed ↔ Low Speed	A vehicle should stop for transfer. Manual Transmission • Transfer starts after the vehicle stops and the clutch is applied Automatic Transmission • Transfer starts after the vehicle stops and the shift lever is shifted [N] position.

Note

To make the mode shift easier, stop the vehicle, depress the brake pedal, select the mode switch, and move the selector lever with the sequence of [N-P-N].

SPECIFICATIONS

Description			Specification
TOD	Model		TOD transfer case
	Overall length		343.0 mm
	Weight (including oil)		37.9 kg
	Shifting mode		4H and 4L
	Gear ratio	High	1:1
		Low	2.48:1
	Oil specification	Specification	Ssangyong genuine oil (ATF S-3, S-4 or Dexron II/III)
		Capacity	≒ 1.4 ℓ
		Change interval	Check at every 15,000 km, replace at every 60,000 km
TOD control unit	Maximum torque (front)		Approx. 76 kg•m
	Voltage	Normal operating range	9 ~ 16 V
		CAN communication	6 ~ 16 V
	Current (below maximum operating voltage)	IG switch OFF	2 mA
		IG switch ON	1 A
	Maximum operating current	Motor OFF	7 A
		Motor ON	20 A

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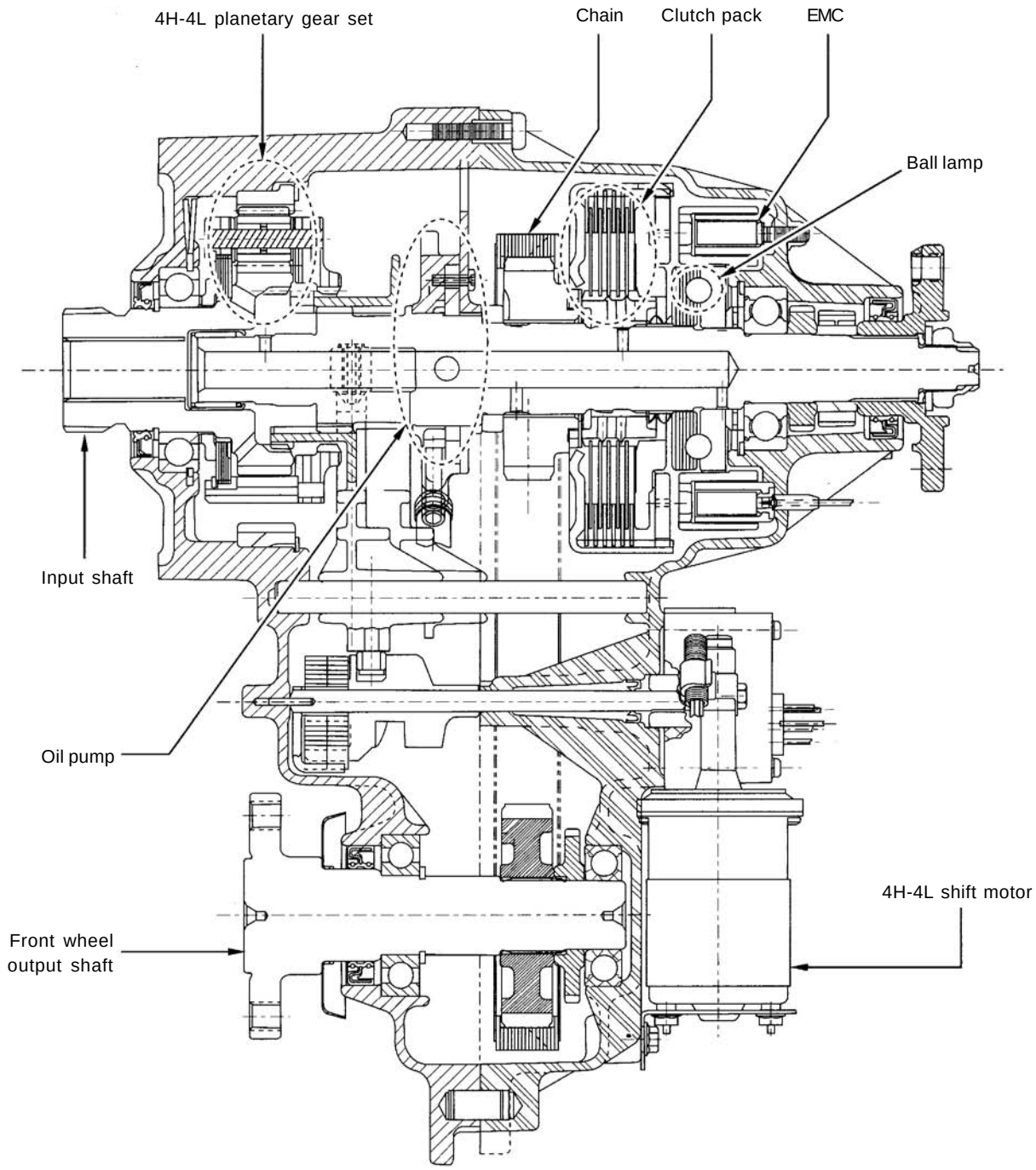
CROSS SECTIONAL DIAGRAM (TOD TRANSFER CASE)

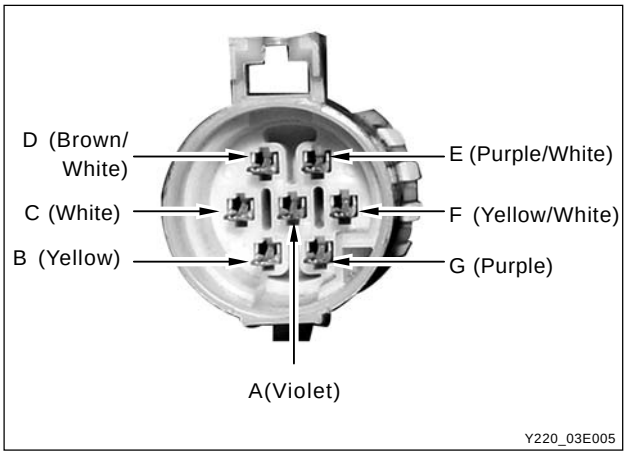


Y220_03E004

▶ Shift Motor

When selecting a position in 4WD switch (4H/4L), TOD control unit exactly changes the motor position to 4H and 4L by detecting the electric signals from position encoder that monitors motor position.

Pin	Function
A	Position 4 shift
B	Shift motor LO – HI (clockwise)
C	Position 3
D	Position 2
E	Position 1
F	Position ground
G	Motor HI – LO (clockwise)

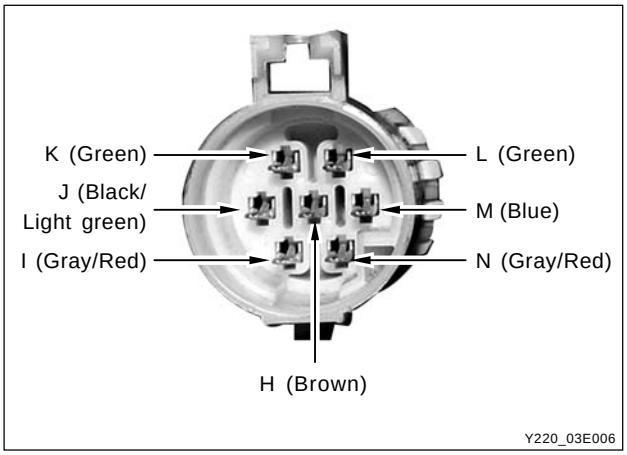


Rear view of connector

▶ Speed Sensor and Clutch Coil

The front and rear speed sensor utilizes the hall effect. These sensors generate 0V and 5V of square type digital wave according to the rotation of the wheel with teeth of transfer case front and rear output shaft. The speed signal from front and rear propeller shaft is entered into TOD control unit.

Pin	Function
H	Clutch coil
I	Front speed sensor ground
J	Front speed sensor signal
K	Front speed sensor voltage (5V)
L	Rear speed sensor voltage (5V)
M	Rear speed sensor signal
N	Front speed ground



Rear view of connector

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▶ Transfer Case

Planetary gear set

Planetary Gear set consists of sun gear, ring gear and carrier. It is engaged with the gear in “HIGH-LOW” collar to increase the driving force by reducing vehicle speed.

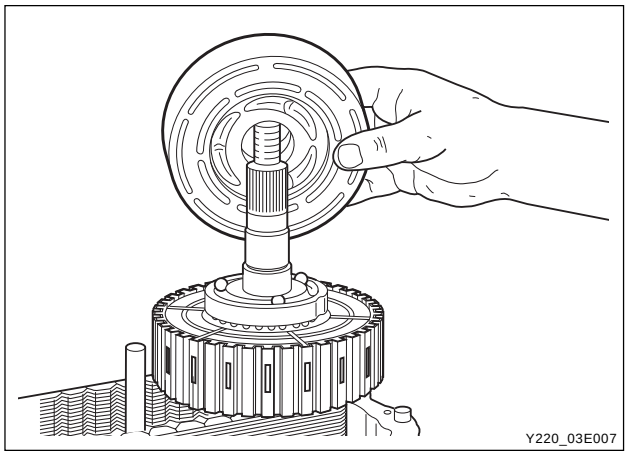
Sun gear is connected to input shaft and ring gear is fixed into the transfer case.

Splined rear output shaft is able to slide on the “HIGH - LOW” collar.

The inside and outside ends of “HIGH - LOW” collar have machined gear. The input shaft transmits the power to driving wheels by engaging with sun gear and carrier gear.

If the 4WD switch is at “4WD HIGH”, the TOD control unit operates the shift motor to engage “HIGH - LOW” collar directly with input shaft for transmitting the driving force to front and rear propeller shafts.

When a driver selects “4WD LOW”, the TOD control unit controls the electro-magnetic clutch and operates the shift motor to engage “HIGH - LOW” collar with carrier. The power from transmission is increased up to 2.48:1 by reduction ratio from planetary gear, and then is sent to front and rear propeller shafts.

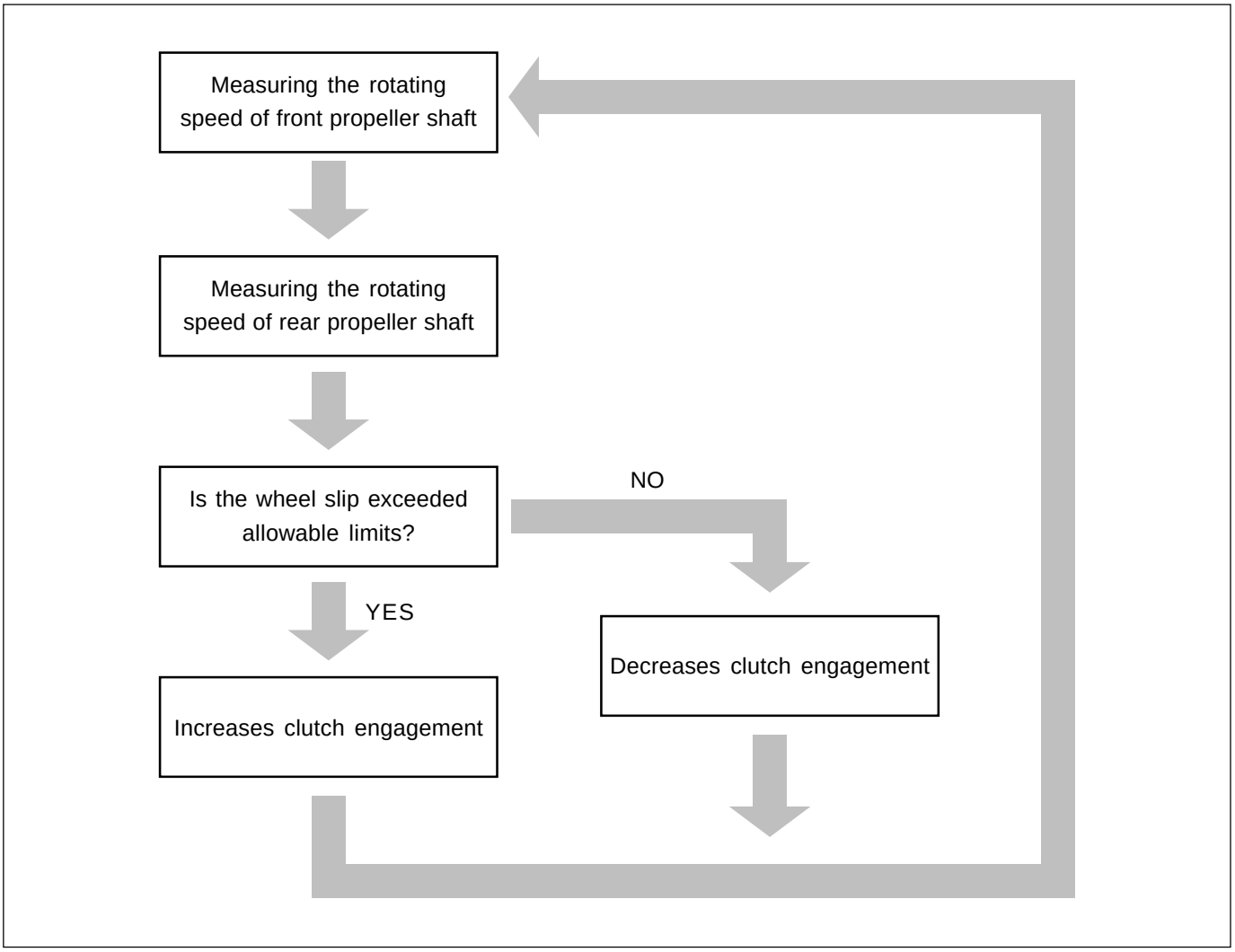


Ball type slant cam and clutch disc pack

If the speed sensors installed on front and rear propeller shafts detect the slips at front and rear wheels, and these slips exceed the specified range, TOD control unit controls electro-magnetic clutch to transmit driving force to front wheels. At this time, ball slant cam is moved to compress multi-disc located in clutch disc to transmit driving force to front wheels.

Electro Magnetic Clutch (EMC)

EMC consists of coil and housing. TOD control unit controls EMC by controlling duty cycle according to the road and driving conditions. These controls use the continuity time and amount of electric current to determine the torque to be transmitted to front wheels.



Basic controls in EMC

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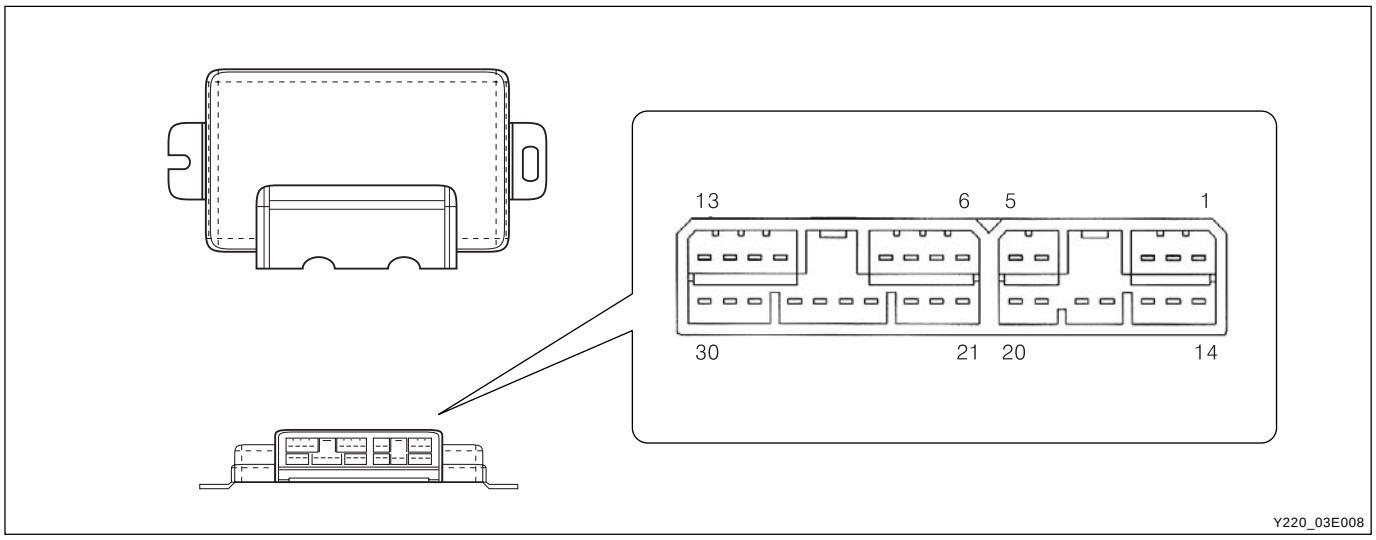
TCCU

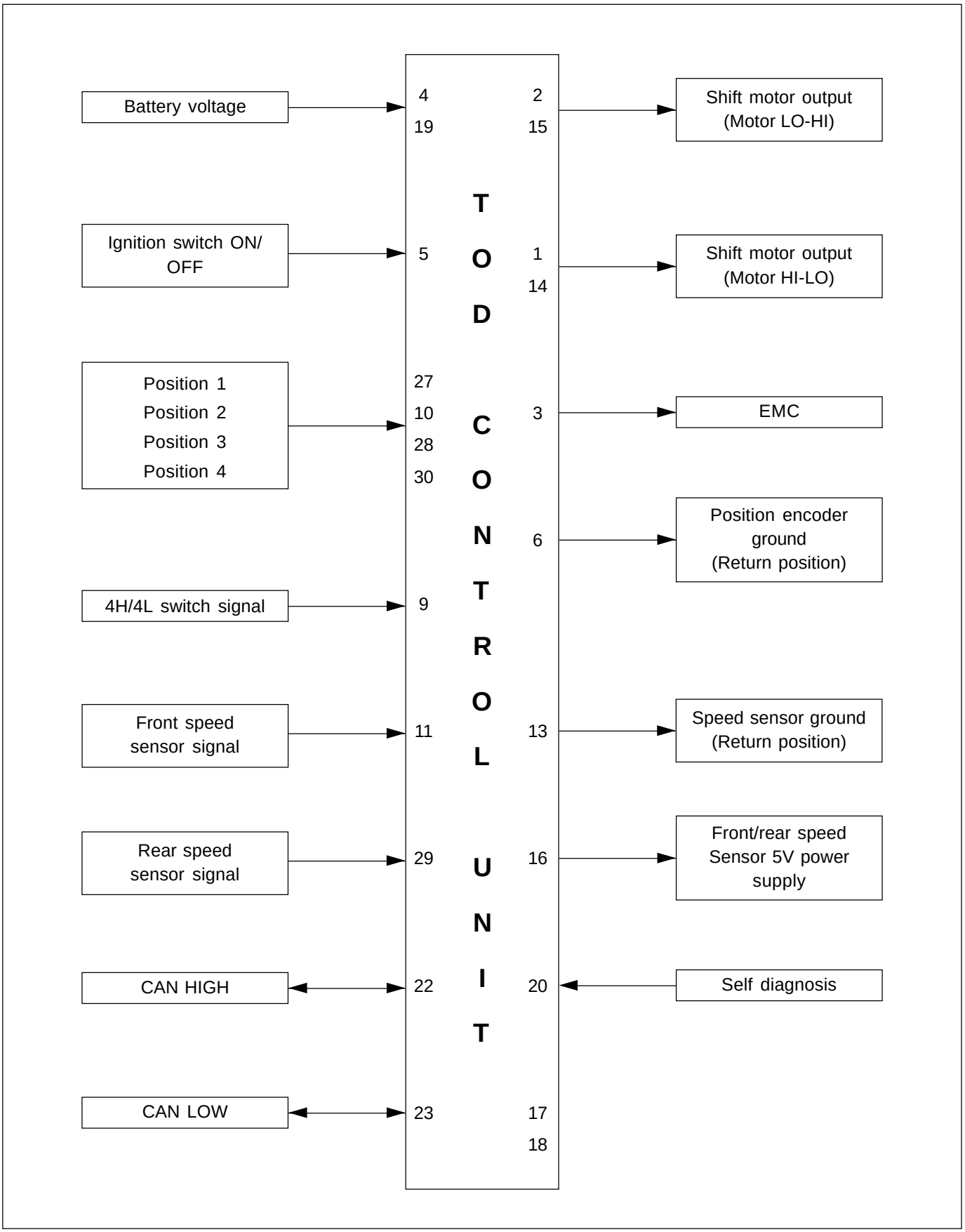


Description	New TCCU
Connector type	Two separated connectors
Number of pins	30
Weight	0.22 kg
CAN-BUS	O
Vehicle speed signal	CAN communication
Lamp	CAN communication
Clutch signal (M/T)	CAN communication
Neutral signal (A/T)	CAN communication

▶ Appearance and Function

Pin No.	Description	Pin No.	Description
1	Motor HI - LO	16	Speed sensor voltage supply
2	Motor LO - HI	17	Ground
3	EMC	18	Ground
4	Battery	19	Battery
5	Ignition	20	K-Line
6	Position ground	21	N/A
7	N/A	22	CAN H
8	N/A	23	CAN L
9	4H-4L switch	24	N/A
10	Position 2	25	ABS operation
11	Front speed sensor	26	N/A
12	N/A	27	Position 1
13	Ground – speed sensor	28	Position 3
14	Motor HI-LO	29	Rear speed sensor
15	Motor LO-HI	30	Position 4

▶ Transfer Case Block Diagram



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Section	Pin No.	Name	Description
Power supply	17, 18	Ground	TOD control unit ground
	4, 19	B+	TOD control unit battery voltage input
Input side	5	Ignition switch	Ignition switch power : ON - over 4 V, OFF - below 0.9 V
	27	Position 1	Position encoder – shift motor position recognition HIGH - over 4 V, LOW - below 0. 9 V
	10	Position 2	Same as above
	28	Position 3	Same as above
	30	Position 4	Same as above
	9	4H and 4L switch	Mode input according to 4H and 4L selection : HIGH - over 4 V, LOW - below 0.9 V
	11	Front speed sensor	Front speed sensor (hall effect) signal input
	29	Rear speed sensor	Rear speed sensor (hall effect) signal input
	25	ABS operation	ABS operating signal input (ABS ON/OFF) Operation - over 4 V, Not operation - below 0.9 V (NON CAN ABS model)
Both sides	22	CAN HIGH	CAN bus HIGH line
	23	CAN LOW	CAN bus LOW line
	20	K - LINE	Connected to trouble diagnosis connector
Output side	16	Speed sensor voltage	Supplying 5V to front/rear speed sensors
	1, 14	Motor HI-LO	Motor output port - Connected to battery when shifting to LO from HI - Connected to ground when shifting to HI from LO or braking the motor
	2, 15	Motor LO-HI	Motor output port - Connected to battery when shifting to HI from LO - Connected to ground when shifting to LO from HI or braking the motor
	3	EMC	Supplying the voltage to clutch coil - Frequency: 50 Hz, - Duty ratio: 0 ~ 88 %
	6	Speed return	Providing the ground to position encoder
	13	Speed return	Providing the ground to speed sensor

SYSTEM OPERATION

TCCU SYSTEM

▶ TCCU Initialization

- TCCU sends relevant data to meter cluster via CAN to diagnose and check the indicators when the ignition switch is turned to ON. At this time, the 4WD indicators (4WD LOW, 4WD HIGH, 4WD CHECK) comes on for 0.6 seconds.
- If the selector switch position and the shift motor position code does not match when the IG power is turned ON, the shift is controlled to move in the direction of the selector switch position

▶ Interpretation of Position Sensor

- When the 4H/4L switch is operated and the position sensor recognizes the shift motor position while the system is energized, the system operates as follows:

4H/4L Switch Input	Motor Position	Operation
4H	Left stop	Does not operate, 4L lamp off
4H	Left top	Does not operate, 4L lamp off
4H	Top	Does not operate, 4L lamp off
4H	Right top	- 4L lamp flickers - Tries shifting to 4H if shifting conditions are satisfied. - After shifting to 4h the flickering of 4l lamp stops.
4H	Zone 1	Same as above
4H	Neutral	Same as above
4H	Zone 2	Same as above
4H	Bottom	Same as above
4H	Right stop	Same as above
4L	Left stop	- 4L lamp flicker - Tries shifting to 4L if shifting conditions are satisfied. - After shifting to 4l the 4l lamp lights on.
4L	Left top	Same as above
4L	Top	Same as above
4L	Right top	Same as above
4L	Zone 1	Same as above
4L	Neutral	Same as above
4L	Zone 2	Same as above
4L	Bottom	Does not operate, 4L lamp lights on
4L	Right stop	Does not operate, 4L lamp lights on

If 4H/4L switch position is not matched with shift motor position code with the ignition switch “ON”, the shift requirements operate to the direction of 4H/4L switch. However, the shifting requirements should be met to shift.

- **Shifting requirements:**
  - The transmission is in neutral for 2 seconds after the shift is requested.
  - Both propeller shaft speeds are below 43 Hz.

A command to shift will only be acted upon if the TOD is reading a valid code at the time the command to shift is made.

After a shift has started, the TOD will power the shift motor until the code for the requested position is read. If an invalid code is read, the TOD will go into a default mode.

During a shift attempt, the shift motor will be energized for a maximum of 5 seconds.

※ In case of manual transmission, the clutch pedal should be depressed.

ELECTRIC SHIFT SYSTEM OPERATION

The electric shift system is responsible for changing the transfer case gear ratio by controlling the electric shift motor.

The TOD monitors the 4H/4L switch, neutral switch, speed sensors, position encoder, and ignition switch.

A range change is initiated when:

1. The 4H/4L switch is changed from 4H to 4L or from 4L to 4H.
2. The motor position (as indicated by the position encoder) does not match the 4H/4L switch immediately after the ignition is turned on.

▶ Shift Requirements

When a range change is initiated a diagnostic test will be completed on the motor, speed sensors, and position encoder. If the diagnostic test fails, the shift will not be attempted. If all components are operating properly, the TOD will attempt a range change after the following shift requirements are met:

1. The transmission is in neutral for 2 seconds after the shift is requested.

※ In case of manual transmission, the clutch pedal should be depressed.

2. Both propeller shaft speeds are below 43 Hz.

If the transmission is taken out of neutral before 2 seconds has elapsed, or either propeller shaft speed increases above the limit, the shift will be suspended and the 4L indicator will continue to flicker until the requirements are met again or the 4H/4L switch is returned to the original position. However, if the initial switch position is “4L”, “4L” indicator remains on. If the shift requirements are met, the shift motor attempt to shift again.

▶ Range Change

When the shift requirements are met, the motor rotates to the appropriate direction (as determined by the selector switch) until one of the following occurs:

1. The motor reaches its destination.
2. The motor is on for 5 seconds without reaching its destination. The shift has failed and the TOD will respond as default mode.
3. A fault occurs with either the motor or position encoder. Refer to the diagnosis requirement.

When the motor is energized, the Ignition, 4H/4L switch, propeller shaft speeds, and transmission neutral inputs are ignored.

Shift operation is only allowed when some conditions are satisfied. These shift conditions should be satisfied for 2 seconds before starting motor. The motor has three seconds of delay at its initial operation to do trouble diagnosis. Once the motor starts, the shift conditions are no longer checked.

Shift conditions are as follows:

- Normal battery voltage and shift motor for all gears
- Shift operation between 2H/4H and 4L is only available when the vehicle speed is below 43 Hz.
- No defective speed sensor
- The selector lever should be in “N” position (in case of manual transmission, the clutch pedal should be depressed).

▶ Shift Conditions

Shift is allowed only when certain conditions for the vehicle are satisfied. This means that the shift conditions must satisfy the operating conditions for 2 seconds before motor starts and 2 seconds of delay at initial stage is to diagnose the system.

The shift requirements are as follows:

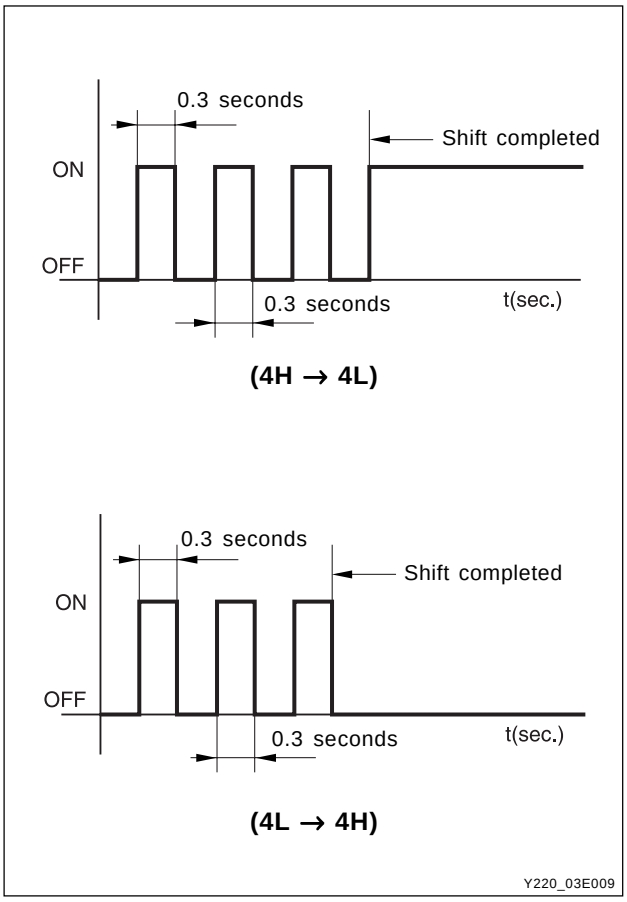
- There should be no fault with battery voltage and shift motor for all shifts.
- Shift between 4H and 4L is operated only under the vehicle speed of below 43 Hz.
- There should be no fault with speed sensors.
- Transmission must be in neutral position (In case of manual transmission, the clutch pedal should be depressed).

▶ Motor Controls

- The shift steps have the sequence of 4H ¡æ 4L and 4L ¡æ 4H ¡æ 2H. TCCU operates the shift motor until it reads required position code. If it detects the faulty code, the system is operated with the compensation mode.
- Once the shift operation is started, it is completed regardless of ignition power. If there are not operating signals from position sensor, the shifting failure due to timeout occurs. This failure appears when the shifting time between 2H and 4H and between 4H and 4L is delayed over 5 seconds compared to normal shift. Once the shifting time exceeds the specified time, TCCU cannot properly supply the voltage to shift motor and is operated in compensation mode.
- Even though the system recognize a fault before motor starts, it is considered as fault.
- Motor stops operation when it reaches at target range.

▶ Compensation Mode

The motor stops when the encoder related troubles are detected during shift operation. It moves toward LOW-HIGH direction for 5 seconds so that the motor is not left in unidentified position.



▶ Indicator Function On Shifting

Once a range change has been initiated the 4L Indicator will begin to blink at a rate of 0.3 seconds on, 0.3 seconds off until the shift is completed or canceled.

4L Indicator illuminates as below figure.

▶ Electric Shift Default Mode

If the motor fails to reach its destination, the TOD will attempt the following (in order):

1. The TOD will wait 3 seconds then attempt the shift again.
2. If the second attempt to reach the destination fails the TOD will wait 3 seconds then attempt to rotate the motor back to the original position. If successful, all future shifts will be inhibited until the Ignition is cycled.
3. If the attempt to return to the original position fails, the TOD will wait 3 seconds then attempt to rotate the motor to the original position again. If the second attempt to return to the original position is successful, the “4WD CHECK” indicator will be illuminated, and all future shifts will be inhibited until the Ignition is cycled.
4. If the second attempt to return to the original position fails the motor will be turned off, the “4WD CHECK” indicator will be illuminated, and all future shifts will be inhibited until the Ignition is cycled.

TOD SYSTEM OPERATION

The TOD system is responsible for distributing torque between the front and rear axles. The TOD monitors the propeller shaft speeds, operating range (High/Low), and ABS activity and then applies a calculated amount of torque to the front axle by Pulse Width Modulating the current applied to the EMC.

Touch-off torque

The minimum EMC Duty Cycle is based on the vehicle speed and throttle position.

The TOD receives the TPS signal from the following sources:

On vehicles equipped with CAN, the TOD receives the TPS signal from the CAN bus.

When slip detection

The TOD continuously monitors the front and rear propeller shaft speeds to detect wheel slip.

Wheel slip control

When wheel slip is detected the TOD controls the EMC duty cycle as necessary until the wheel slip is reduced below the allowable limit. The EMC Duty Cycle will then be reduced to the Touch-Off value.

Brake/ABS strategy

When the ABS System is active, the EMC Duty Cycle is set to a fixed duty cycle (30 %) to aid in braking without counteracting the ABS System.

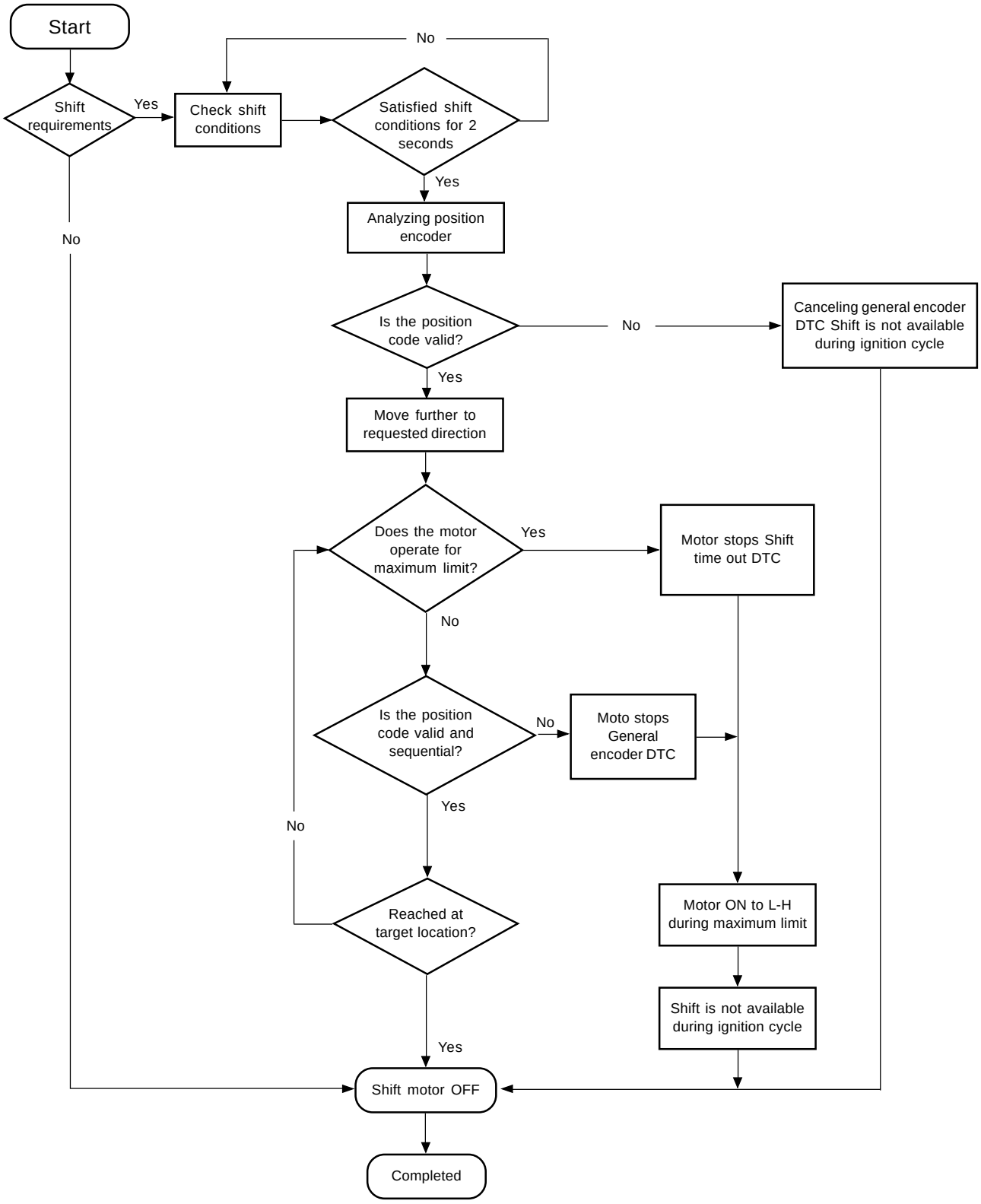
4L strategy

When the system is operating in 4L, the TOD continues TOD (operation provided that the propeller shaft speed is below 10 Hz). When the speed increases above 10 Hz, the EMC Duty Cycle is set to the maximum value (88 %) which applies the maximum available torque to the front axle.

SHIFT OPERATION

▶ Shifting Sequence

Flow chart



▶ Shift Requirements

- If 4H/4L switch position is not matched with shift motor position code with the ignition switch “ON”, the shift requirements operate to the direction of 4H/4L conversion switch.
- The next shift requirements are identified only when those are different from current operation.

▶ Shift Conditions

Shift is allowed only when certain conditions for the vehicle are satisfied. This means that the shift conditions must satisfy the operating conditions for 2 seconds before motor starts and 2 seconds of delay at initial stage is to diagnose the system.

The shift requirements are as follows:

- There should be no fault with battery voltage and shift motor for all shifts.
- Shift between 4H and 4L is operated only under the vehicle speed of below 43 Hz.
- There should be no fault with speed sensors.
- Transmission must be in neutral position (In case of manual transmission, the clutch pedal should be depressed).

Reading position encoder

The position encoder is the code that TCCU can determine the shift motor position.

Position				Motor Position	Remark
1	2	3	4		
1	1	1	0	Left Stop	Input voltage 1 : above 4.5V (HIGH) 0 : below 0.5V (LOW)
1	0	1	0	Left top	
0	0	1	0	Top	
0	0	0	0	Right top	
1	0	0	0	Zone 1	
1	0	0	1	Neutral	
0	0	0	1	Zone 2	
0	1	0	1	Bottom	
0	1	0	0	Right stop	
1	1	1	1	Off State	

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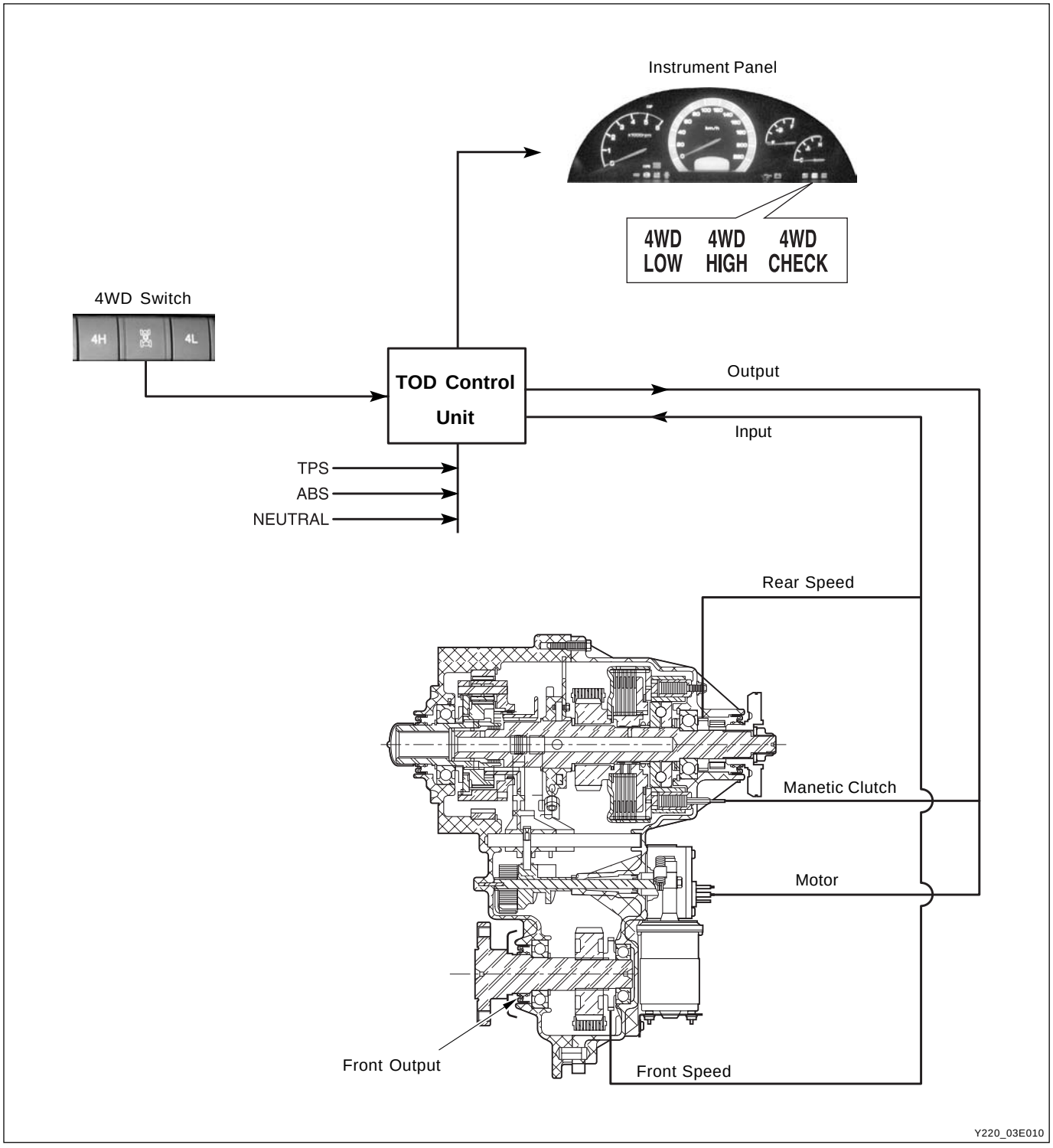
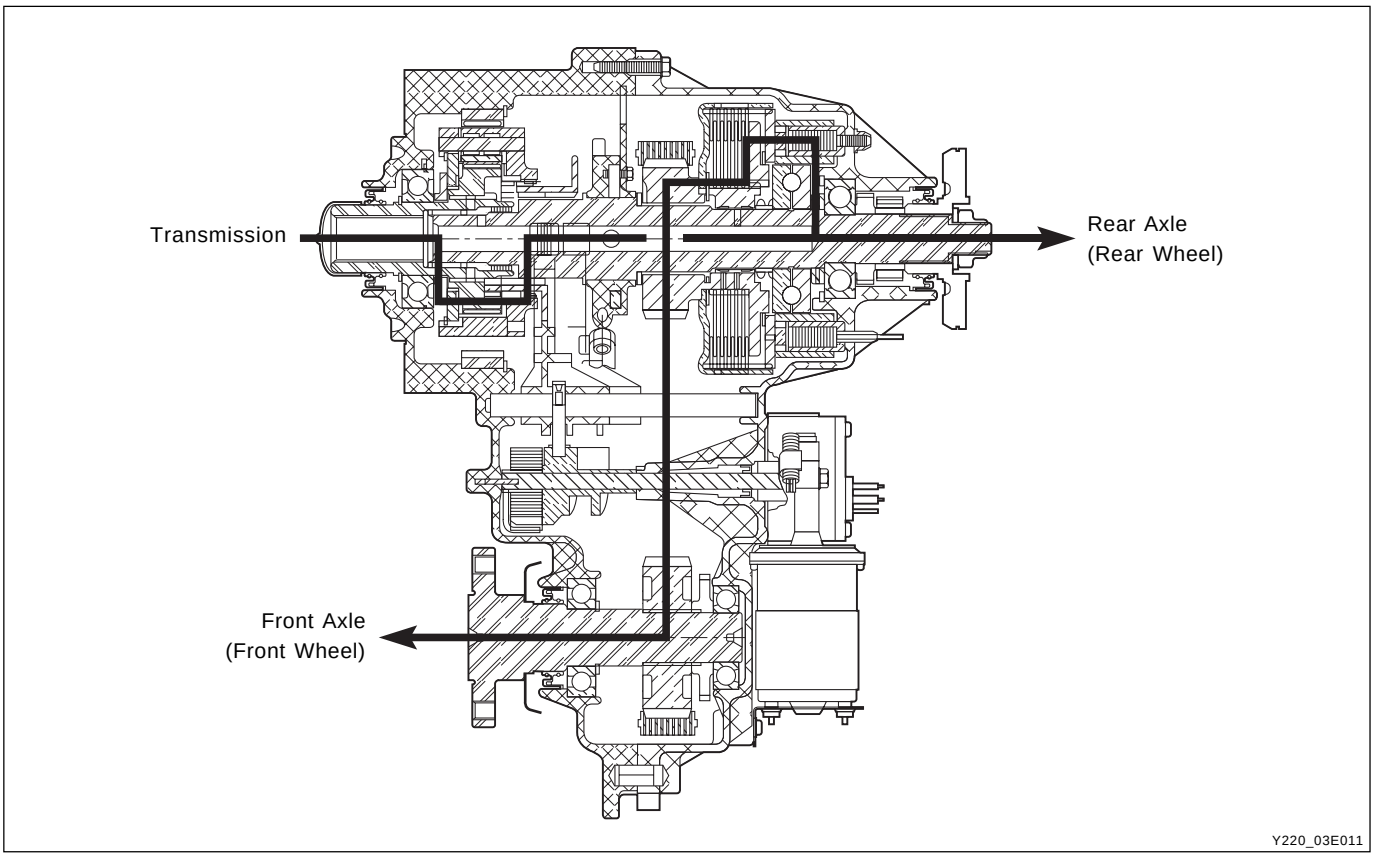
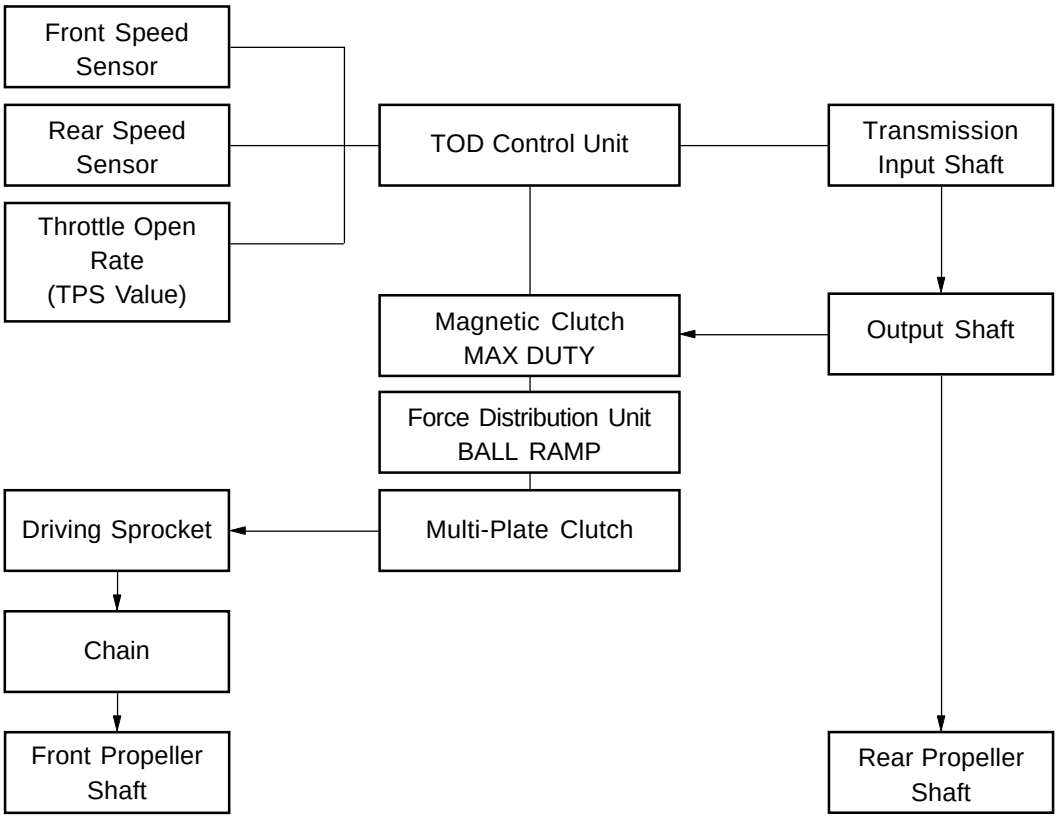
POWER FLOW

▶ System Layout



▶ 4H Mode (4WD Drive - High Speed)





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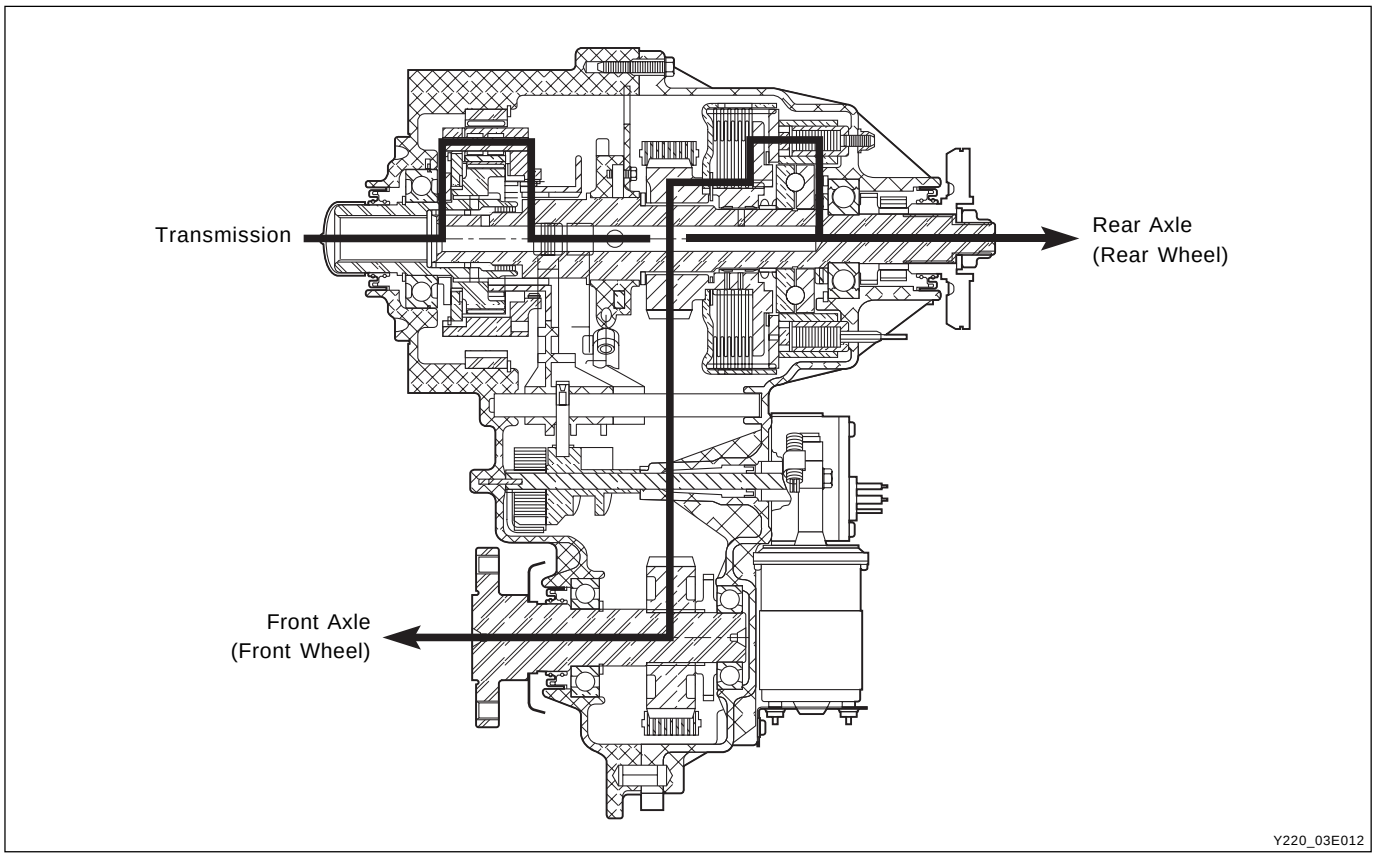
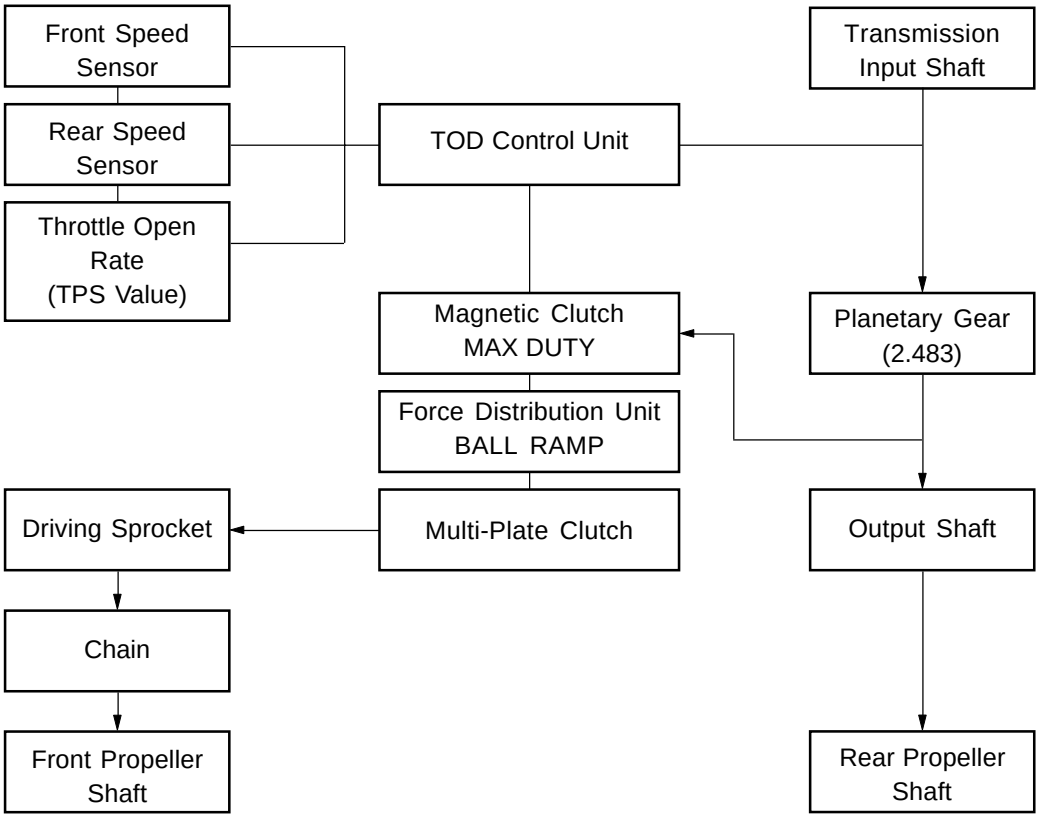
▶ 4L Mode (4WD Drive - Low Speed)





TROUBLE DIAGNOSIS

TCCU periodically monitors the input and output while the system is in operation. When a fault is detected, the trouble code is stored into TCCU memory.

If the ignition switch is turned to “OFF”, TCCU stops monitoring for input and output, however, when the ignition switch is turned to “OFF” before shifting completes, TCCU continues monitoring for input and output required for the shifting.

SELF DIAGNOSIS TEST

▶ Shift Motor Test

When TOD control unit detects a fault in shift motor or position encoder for over 1 second, “4WD CHECK” warning lamp comes on and the trouble code is stored into memory.

- Shift motor fault occurs when the motor is in “OFF” state:
  - short to ground in motor HI-LO circuit
  - short to ground in motor LO-HI circuit
  - open in motor circuit
- Shift motor fault occurs when the motor is in normal operation state:
  - short to ground in motor HI-LO circuit
  - short to ground in motor LO-HI circuit
  - short between motor LO-HI and motor HI-LO circuit
  - open in motor circuit
- Position encoder fault occur when
  - Detected unmatched code with 9 valid position codes
  - An encoder circuit is short to ground
- When the fault occurs before the shift operation is started, the TOD control unit does not respond to any shift command.
- When, after receiving shift command, the fault occurs without any operation, the TOD control unit cancels the command and does not respond to any following shift command.
- If TOD control unit, even while shift command is in progress, detects an invalid position code, it stops the operation and turns motor to “HIGH” position. After then, TOD control unit does not respond to any shift command.
- When the shift motor and position encoder assembly fault (fault other than motor fault that is caused when normal power supply is applied) is restored continuously for 1 second, the TOD control unit function becomes normal. At this time, “4WD CHECK” warning lamp comes on but the trouble code is stored into memory.
- The trouble code being detected in shift motor during its operation is defined as timeout.
- The trouble code for shift motor can be erased by using scanner.

▶ Position Encoder Test

- When the system detects a fault in shift motor for over 1 second, “4WD CHECK” warning lamp comes on and the trouble code is stored into memory.
- Position encoder fault can be divided into general encoder fault and short to ground of position encoder circuit.
  - General encoder fault: Invalid position code input
  - Short to ground of position encoder circuit: Ground for encoder circuit

▶ Front Sensor Speed Test

When the system detects a fault from front speed sensor for over 0.5 second, “4WD CHECK” warning lamp comes on. At this time, the responds from TOD control unit are as follows:

- If the system is in “4H” state, the TOD control unit uses rear speed sensor value to determine the amount of EMC touch off and the wheel slip control stops.
- If the system is in “4L” state, the EMC duty cycle is set at maximum value (according to the vehicle speed) until system stops “4L” operation.
- All electrical shift operations are stopped until ignition switch is cycled from “OFF” to “ON” position. Any shift operation in progress completes the process. When the front speed sensor is restored continuously for 0.5 seconds, the TOD control unit becomes normal status. At this time, “4WD CHECK” warning lamp comes on but the trouble code still remains in the memory.

▶ Rear Speed Sensor Test

When the system detects a fault from rear speed sensor for over 0.5 second, “4WD CHECK” warning lamp comes on. At this time, the responds from TOD control unit are as follows:

- If the system is in “4H” state, the TOD control unit uses front speed sensor value to determine the amount of EMC touch off and the wheel slip control stops.
- If the system is in “4L” state, the EMC duty cycle is set at maximum value (according to the vehicle speed) until system stops “4L” operation.
- All electrical shift operations are stopped until ignition switch is cycled from “OFF” to “ON” position. Any shift operation in progress completes the process. When the rear speed sensor is restored continuously for 0.5 seconds, the TOD control unit becomes normal status. At this time, “4WD CHECK” warning lamp comes on but the trouble code still remains in the memory.

▶ All Troubles From Speed Sensor

When the system detects a fault from front and rear speed sensors for 0.5 seconds, “4WD CHECK” warning lamp comes on. At this time, the responds from TOD control unit are as follows:

- If the system is in “4H” state, the TOD control unit is set up based on EMC touch off amount and the wheel slip control stops.
- If the system is in “4L” state, the EMC duty cycle is set at maximum value (according to the vehicle speed) until system stops “4L” operation.
- All electrical shift operations are stopped until ignition switch is cycled from “OFF” to “ON” position. Any shift operation in progress completes the process. When the rear speed sensor is restored continuously for 0.5 seconds, the TOD control unit becomes normal status. At this time, “4WD CHECK” warning lamp comes on but the trouble code still remains in the memory.

▶ EMC Test

The EMC tests whether the circuit is short or open to ground. When the system detects a fault for 0.8 seconds, “4WD CHECK” warning lamp comes on and TOD stops its operation. When the EMC is restored continuously for 0.8 seconds, the TOD control unit functions normally. At this time, “4WD CHECK” warning lamp comes on but the trouble code still remains in the memory.

▶ CAN TPS Test

- When TCCU receives CAN message including TPS value of over 100 % continuously for 1 second, TCCU determines it as signal error and “4WD CHECK” warning lamp comes on.

  When the system is in TOD mode, the TOD control unit considers that the throttle is in idle.
- When the TPS value is restored continuously for 1 second, the TCCU functions normally and “4WD CHECK” warning lamp comes on but the trouble code still remains in the memory.
- TCCU receives CAN TPS messages periodically. If TCCU cannot receive the messages for 4 periods, TCCU determines it as signal loss. If it happens continuously for 1 second, TCCU considers it as the invalid signal and “4WD CHECK” warning lamp comes on.
- When the CAN message including ABS value is restored continuously for 1 second, TCCU functions normally and “4WD CHECK” warning lamp comes on but the trouble code still remains in the memory.

▶ Transmission Neutral Test

- If TCCU cannot receive the messages for 4 periods, TCCU determines it as signal loss. If it happens continuously for 1 second, TCCU considers it as the invalid signal and “4WD CHECK” warning lamp comes on. And TCCU determines that the transmission is not in neutral position.
- When CAN message including indication of transmission in neutral is restored continuously for 1 second, TCCU functions normally and “4WD CHECK” warning lamp comes on but the trouble code still remains in the memory.

▶ Stuck in Low Test

- Stuck in low DTC is set when the shift conditions are satisfied, no encoder trouble exists and the TCCU is not formed outside of shift range. Stuck in low trouble completing time is 1 second longer than the maximum shift. If the trouble is detected, “4WD CHECK” warning lamp comes on and shifting is not possible.
- If stuck in low fault is not valid, it is erased at the next ignition cycle and the “4WD CHECK” lamp lights out but fault code remains in the memory.

▶ CAN Bus Off Test

- CAN bus off trouble is set when the transferring trouble exceeds 255 times and CAN bus in TCCU goes to off condition. When the trouble counter exceeds 255 times, the signal is recognized as invalid and the “4WD CHECK” warning lamp comes on.
- If CAN bus in TCCU goes to reset condition while in Bus off condition, the transferring and receiving signals are interrupted and the synchronization for bus disappears. Once it is reset, TCCU tries to resynchronize with CAN bus. When the resynchronization stops, the communication is resumed. At this time, the trouble is erased and “4WD CHECK” warning lamp comes on but the trouble code still remains in the memory.

CODING ON TOD CONTROL UNIT

▶ What's Coding?

An input activity of data for the proper performance by matching specification, devices and system with control unit.

Coding required

1. Replacement of TOD control unit.
2. Adjustment by input error.

Coding method

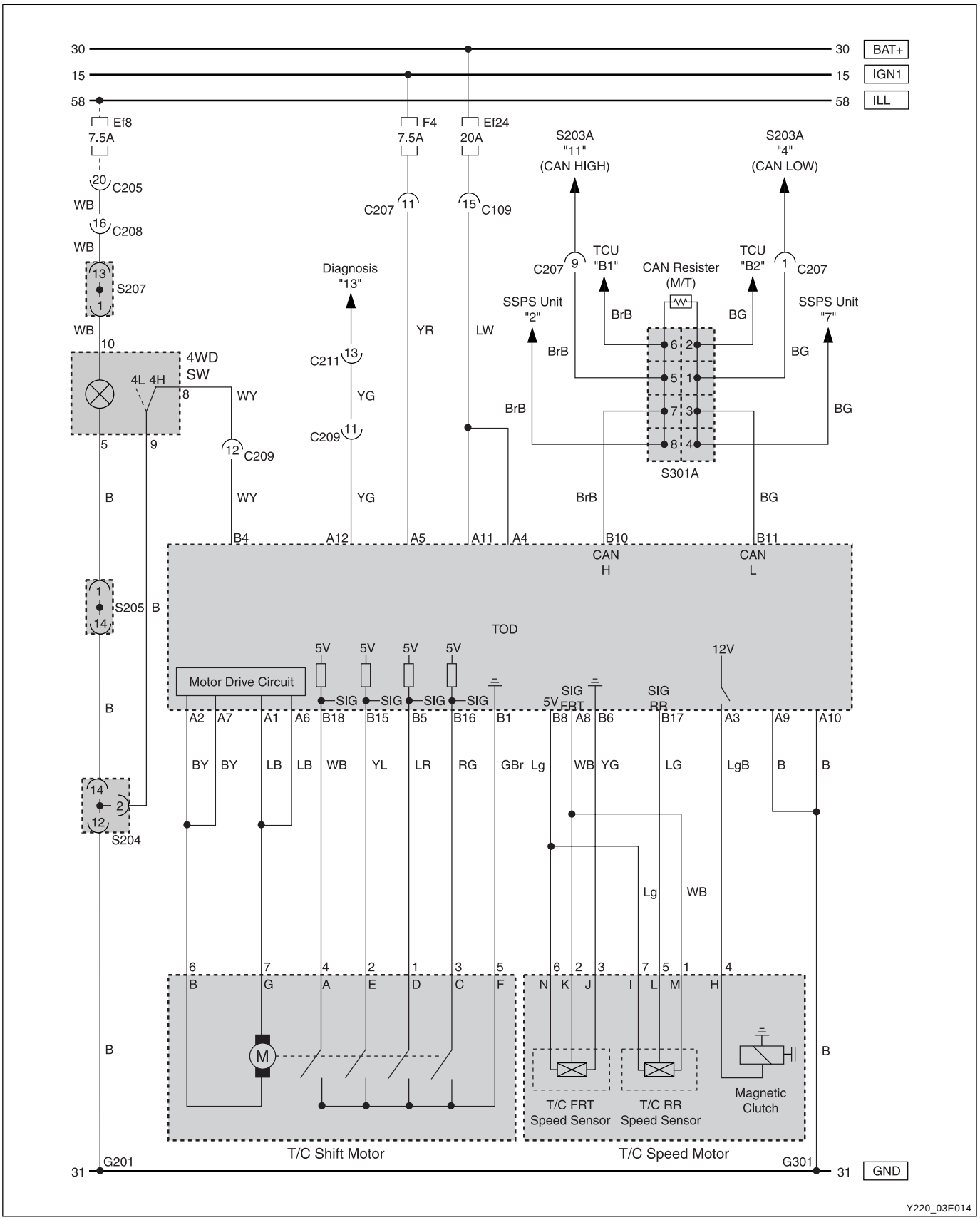
1. Check and record engine type, axle ratio and tire size.
2. Turn the ignition switch to "OFF" position.
3. Connect the scanner with diagnosis connector.
4. Turn the ignition switch to "ON" position.
5. Select "TOD" from "CONTROL UNIT SELECTION" screen and press "ENTER".
6. Read the current memorized specification in TOD control unit.
7. Compare memorized specification with the checked record. If not matched, perform a coding.
8. Read again memorized coding specification in TOD control unit for confirmation of coding.
9. Turn the ignition switch to "OFF" position.
10. After 5 seconds, turn the ignition switch to "ON" position.
11. Check coding specification whether it matches with vehicle or not. If not, perform a coding again.

DIAGNOSTIC TROUBLE CODE

Code	Description	Action
P1806	CAN Bus OFF	- Check communication line. - Check the relevant connectors for contact. - Replace TOD unit if necessary.
P1816	CAN: abnormal TPS signal	- Check communication line. - Check the relevant connectors for contact. - Check engine ECU. - Replace TOD unit if necessary.
P1814	CAN: no TPS signal	- Check communication line. - Check the relevant connectors for contact. - Check engine ECU. - Replace TOD unit if necessary.
P1815	CAN: no neutral signal	- Check communication line. - Check the relevant connectors for contact. - Check TCU. - Replace TOD unit if necessary.
P1817	CAN: no ABS signal	- Check communication line. - Check the relevant connectors for contact. - Check ABS/ESP unit. - Replace TOD unit if necessary.
P1821	Open or short to battery in magnetic clutch coil circuit	- Check communication line. - Replace TOD unit if necessary.
P1822	Short to ground in magnetic clutch coil circuit	- Voltage at TCCU pin No.11: 11 ~ 15 V - EMC resistance: 2.5 Ω - Replace TOD unit if necessary.
P1830	Abnormal rear speed sensor signals	- The indicator is flickering even after IG switch ON. - The indicator is flickering over 0.5 seconds. - Check the relevant harnesses. - Check the relevant connectors for contact. - Replace sensors if necessary.
P1831	Too low front speed sensor voltage	- Too low front speed sensor voltage - Check the relevant harnesses. - Check the relevant connectors for contact.
P1832	Too high front speed sensor voltage	- Too high front speed sensor voltage - Check the relevant harnesses. - Check the relevant connectors for contact. - Replace sensors if necessary.
P1833	Too low rear speed sensor voltage	- Pin voltage: below 0.9 V - Check the rear speed sensor harness for contact. - Replace TCCU if necessary.
P1834	Too high rear speed sensor voltage	- Pin voltage: 4.75 ~ 5.25 V - Check the relevant harnesses. - Check the relevant connectors for contact. - Replace sensors if necessary.

Code	Description	Action
P1835	Too low speed sensor reference voltage	- Reference voltage: below 4 V - Check the relevant harnesses. - Check the relevant connectors for contact. - Replace sensors if necessary.
P1836	Too high speed sensor reference voltage	- Reference voltage: over 8V - Check the relevant harnesses. - Check the relevant connectors for contact. - Replace sensors if necessary.
P1841	Open to ground in shift motor circuit	- When TCCU detects the motor failure for 1 second (Action: IG switch ON) - Check the relevant harnesses for contact. - Replace shift motor if necessary.
P1842	Short to ground in shift motor output circuit	- When TCCU detects the motor failure for 1 second (Action: IG switch ON) - Check the relevant harnesses for contact. - Replace shift motor if necessary.
P1843	Shift system timeout	- 2H-4H: after 1.5 seconds - 4H-4L: after 3 seconds - Check the relevant harnesses for contact. - Replace shift motor if necessary.
P1844	Too low position encoder voltage (Stuck in Low)	- When no signals from the position encoder - Check the relevant harnesses for contact. - Replace shift motor if necessary.
P1850	Defective position encoder	- When the position encoder is defective - Check the relevant harnesses. - Check the relevant connectors for contact. - Check the shift motor.
P1851	Short to ground for position encoder 1	- Short to ground for position encoder 1 in shift motor - Check the relevant harnesses for short. • TCCU pin No. B15 - Check the relevant connectors for contact. - Check the shift motor.
P1852	Short to ground for position encoder 2	- Short to ground for position encoder 2 in shift motor - Check the relevant harnesses for short. • TCCU pin No. B5 - Check the relevant connectors for contact. - Check the shift motor.
P1853	Short to ground for position encoder 3	- Short to ground for position encoder 3 in shift motor - Check the relevant harnesses for short. • TCCU pin No. B16 - Check the relevant connectors for contact. - Check the shift motor.
P1854	Short to ground for position encoder 4	- Short to ground for position encoder 4 in shift motor - Check the relevant harnesses for short. • TCCU pin No. B18 - Check the relevant connectors for contact. - Check the shift motor.

▶ Circuit Diagram

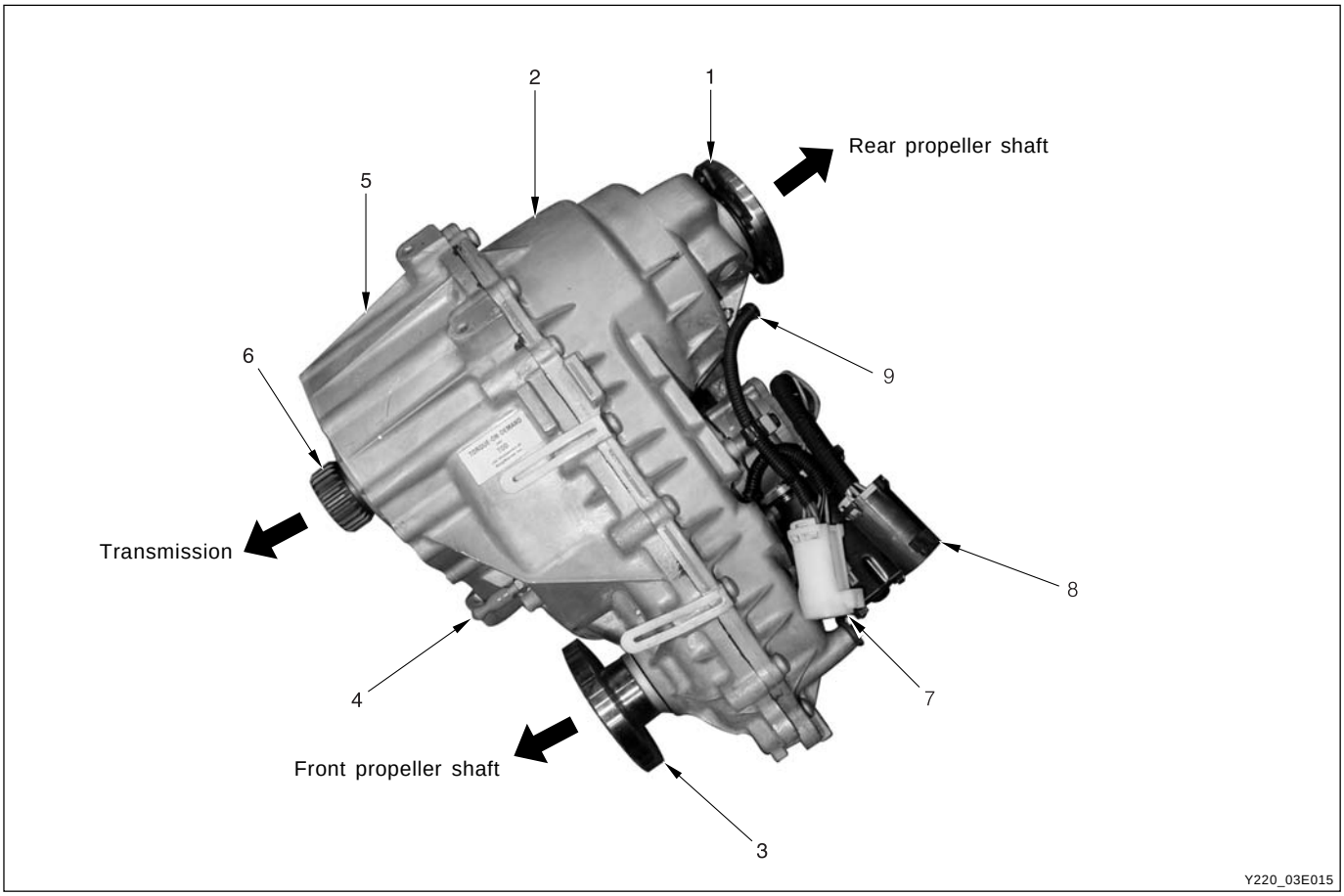


Y220_03E014

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

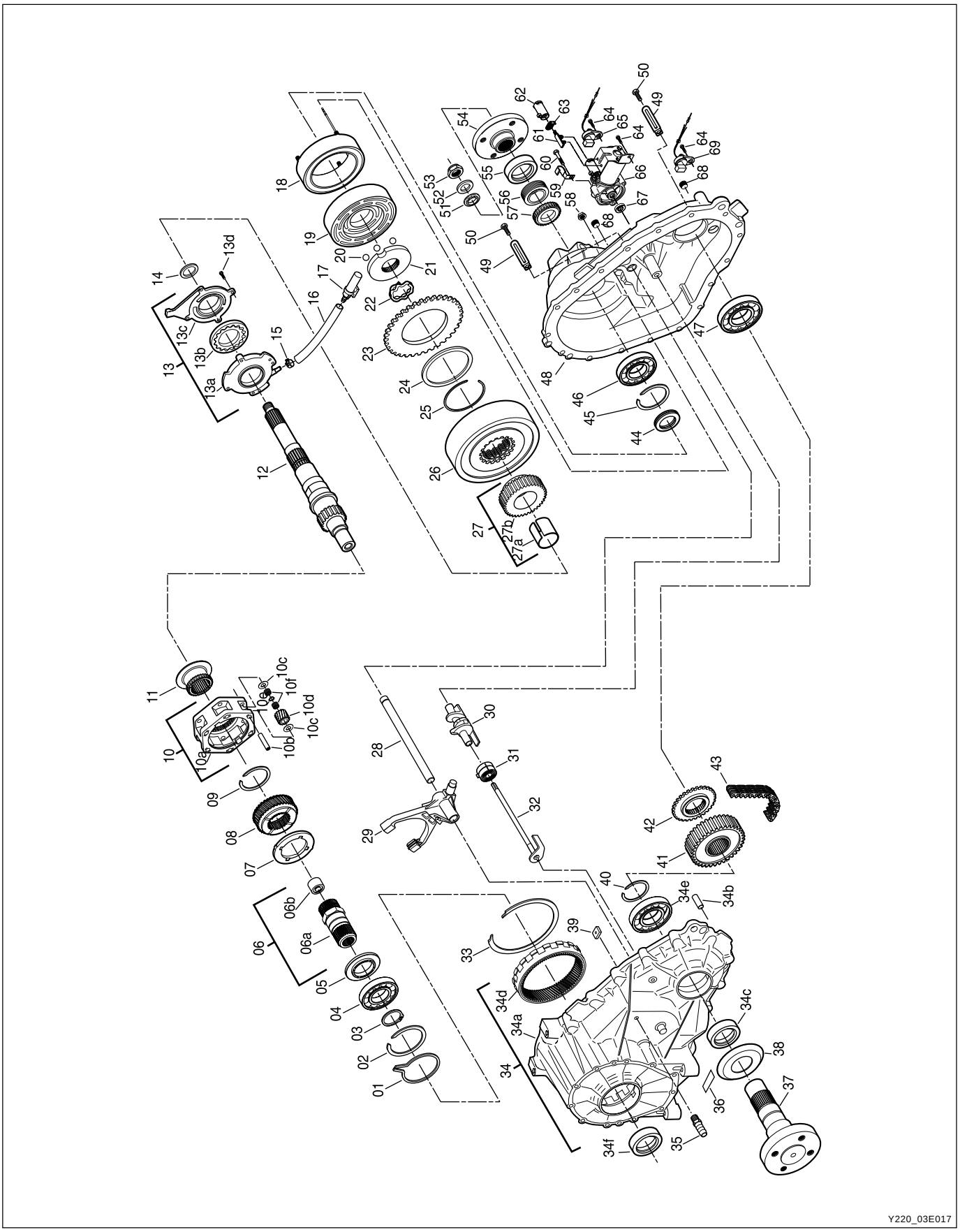
REMOVAL AND INSTALLATION

COMPONENT LOCATOR



1. Companion flange
2. Case cover
3. Front companion flange
4. Air adjusting cover
5. Transfer case and adaptor
6. Input shaft
7. Front and rear speed sensor
8. Shift motor/electronic magnetic clutch
9. Speed sensor

EXPLODED VIEW



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

1. Snap ring
2. Snap ring
3. Snap ring
4. Bearing
5. Hub
6. Input shaft assembly
7. Thrust plate
8. Sun gear
9. Snap ring
10. Carrier assembly
11. Reduction hub
12. Main shaft assembly
13. Geroter pump assembly
14. Thrust washer
15. Hose clamp
16. Hop
17. Filter
18. Electric coil assembly
19. Cam/coil housing assembly
20. Ball
21. Cam
22. Spring
23. Armature
24. Insulator washer
25. Retaining ring
26. Clutch pack assembly
27*. Sprocket assembly
28. Shift rail
29. Shift fork assembly
30. Electric shift cam
31. Torsion spring
32. Shift shaft
33. Retaining ring
34*. Transfer case assembly
35. Breather
37. Output shaft
38. Dust shield
39. Magnet
40. Snap ring
41. Lower sprocket
42. Tone wheel (lower)
43. Chain
44. Thrust bearing assembly
45. Retaining ring
46. Bearing
47. Bearing
48. Cover
49. Clip
50. Bolt
51. Oil seal
52. Washer
53. Nut
54. Companion flange
55. Oil seal
56. Spacer
57. Tone wheel (upper)
58. Nut
59. “J” clip
60. Hexagon bolt
61. Clip
62. Connector
63. Connector lock
64. Hexagon cap screw
65. Speed sensor (upper)
66. Electric motor assembly
67. Oil seal
68. Pipe plug
69. Speed sensor (lower)

TOD

Removal and Installation

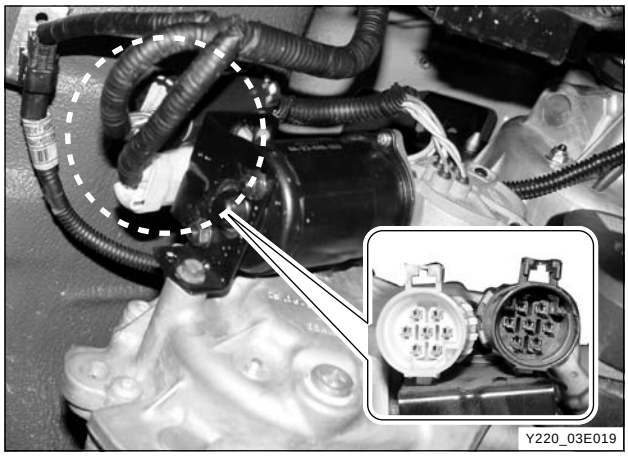
1. Disconnect the negative battery cable.
2. Lift up the vehicle and fix it safely.
3. Place the empty container to collect the draining oil.
4. Remove the drain plug and drain the oil. Reinstall the drain plug.


Y220_03E018

Notice

Oil drain should be along with whole transfer case disassembly and assembly.

5. Disconnect transmission extension wiring connector from rear side of transfer case.


Y220_03E019

Notice

When disconnect connector, make sure on direction of locking tab towards inside.

6. Disconnect the shift motor/clutch coil connector (black, 7-pin) and front and rear speed sensor connector (white, 7-pin) at the rear top section of the transfer case.

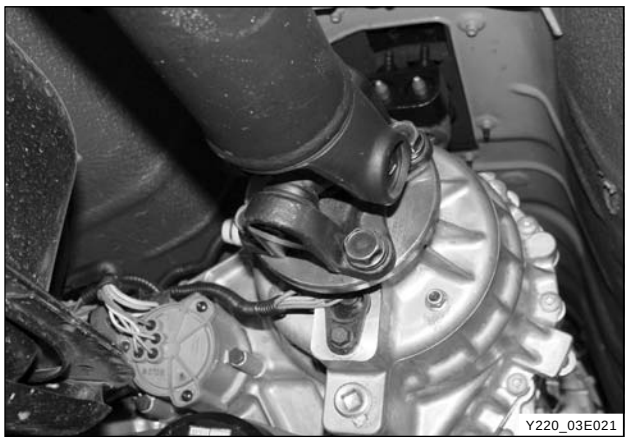
7. Remove the breather hose.
8. Support the transfer case with jack and remove the front propeller shafts bolts (4ea).


Y220_03E020

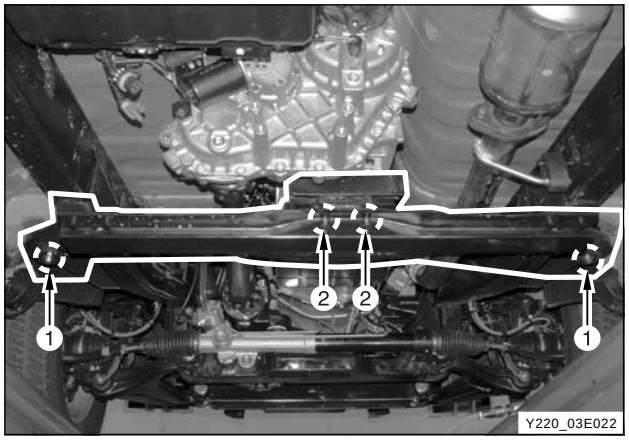
Installation Notice

Tightening torque	81 ~ 89 Nm

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

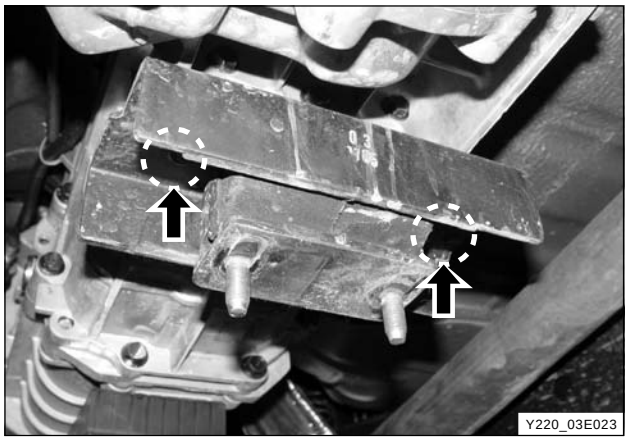


9. Remove the rear propeller shaft mounting bolts (4).



10. Unscrew the bolts and remove the crossmember from the transmission.

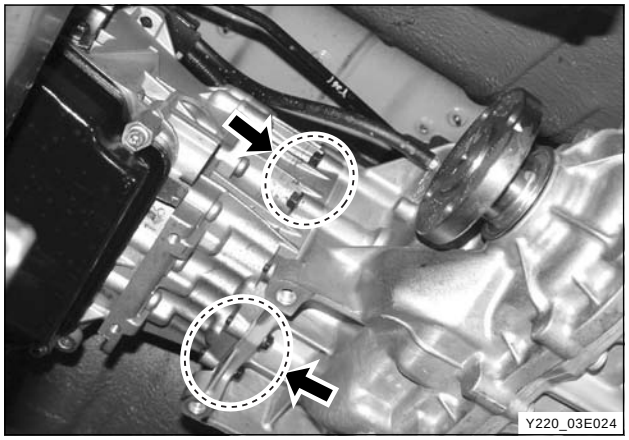
L/R Mounting Bolt ①	21 ~ 35 Nm
Center Mounting Bolt ②	62 ~ 93 Nm



11. Remove the insulator mounting bolts.

Installation Notice

Tightening torque	62 ~ 93 Nm



12. Unscrew the bolts and remove the transfer case.

Installation Notice

Tightening torque	20 ~ 25 Nm

Notice

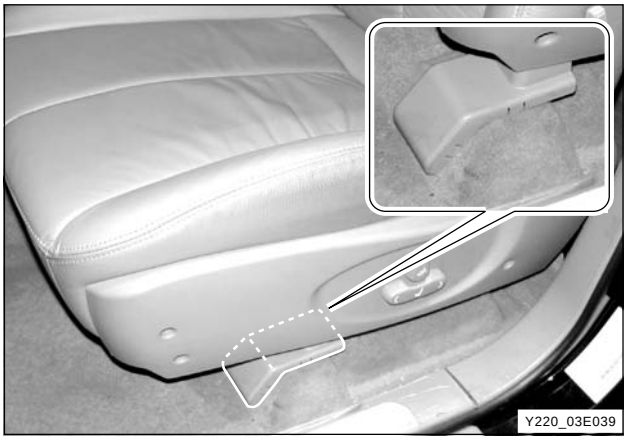
Apply long-life grease to the inner spline of transfer case input shaft.

13. Install in the reverse order of removal.

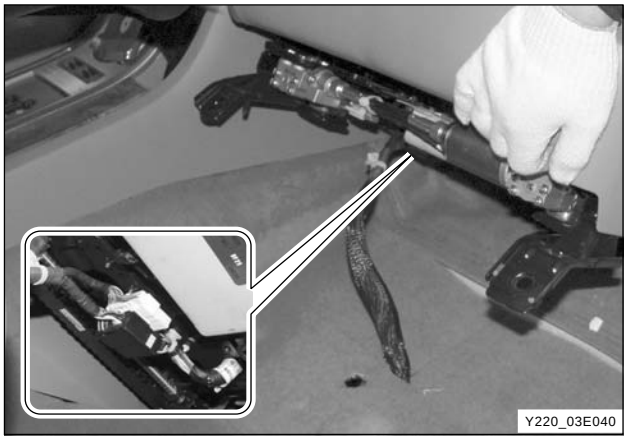
TCCU

Removal and Installation

1. Move the driver's seat, remove the seat frame cover, and remove the seat frame mounting bolts.



2. Disconnect the driver's seat sliding/tilting motor connector and pull back the seat.



3. Disconnect the TCCU unit connector and remove the TCCU.

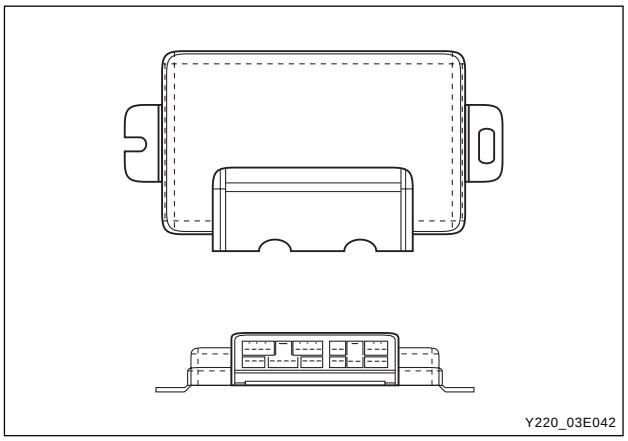
4. Install in the reverse order of removal.

Notice

Be careful not to apply any impact to TCCU body.

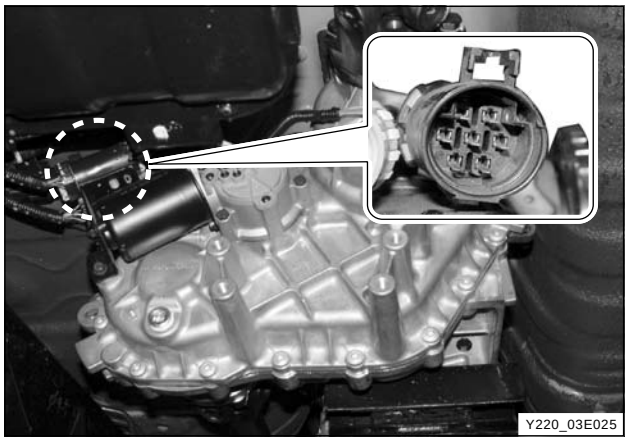
Installation Notice

TCCU mounting bolt	10 Nm

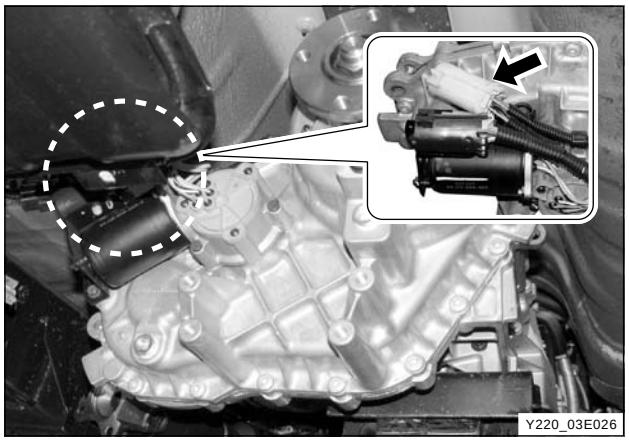


SHIFT MOTOR

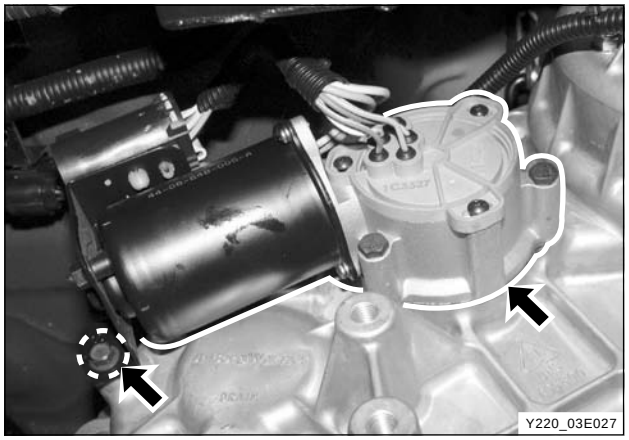
Removal and Installation



1. Disconnect the negative battery cable.
2. Disconnect the shift motor/electronic magnetic clutch connector (black, 7-pin) and front and rear speed sensor connector (white, 4-pin) at the rear top section of the transfer case.



3. Disconnect the front and rear speed sensor connector (white, 4-pin) from bracket.

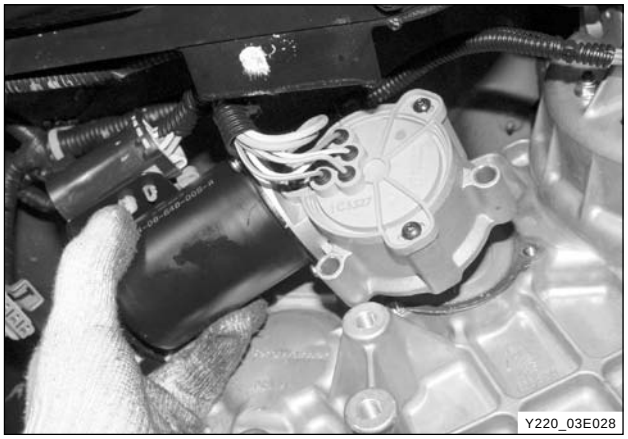


4. Remove shift motor mounting bolts.
5. Remove bracket mounting bolt.

Notice

Remove two bolts for fixing the motor and bracket before removing the shift motor and bracket.

6. Pull the shift motor assembly out while keeping the level.


Y220_03E028

7. Clean the mating surface of the transfer case and shift motor.

Notice

Do not disassemble the shift motor since it is replaced as an assembled unit.


Y220_03E029

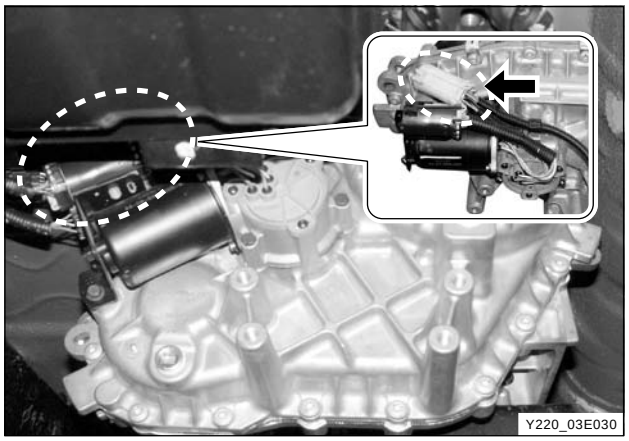
8. Apply sealant on the mating surface if new shift motor assembly.
9. Install in the reverse order of removal. Make sure that the mode switch selection is matched with the motor's driving position before installation.

Notice

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

SPEED SENSOR

Removal and Installation



1. Disconnect the negative battery cable.
2. Remove the shift motor assembly.
3. Disconnect the front and rear speed sensor connector (white, 7-pin) at the rear top section of the transfer case.
4. Disconnect the speed sensor connector from the locking sleeve.
5. Remove the wire fixing retainer at the rear side of disconnected connector.

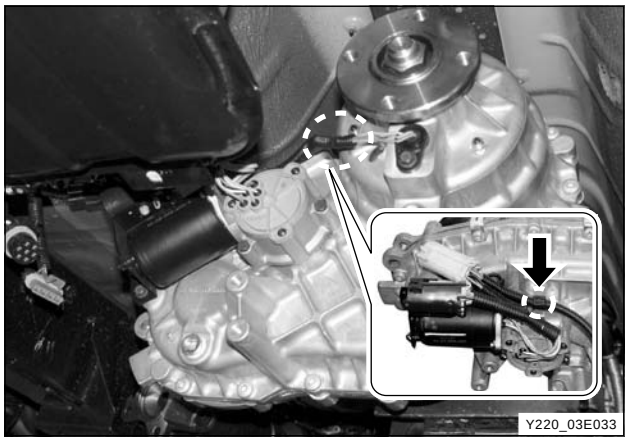
6. Remove the rear speed sensor bolts on the rear case flange.

7. Remove the rear speed sensor with a suitable tool.

Notice

Do not apply excessive force to protect mounting area and sensor.

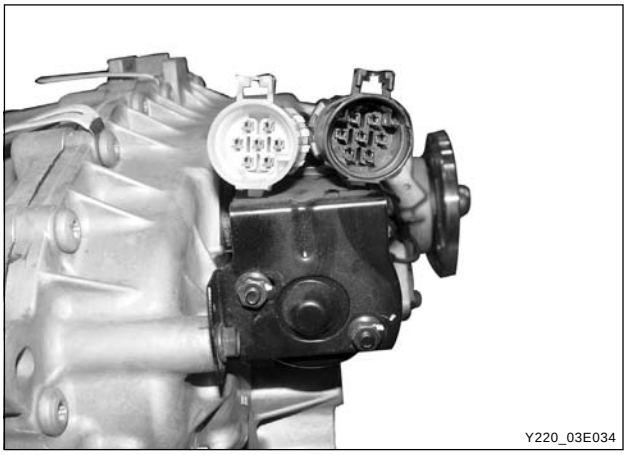
8. Remove the tapings in both sides of protective tube.
9. Remove the tube.



10. Hold the “L” pin in speed sensor connector with long nose pliers and push it rearward to disconnect from the connector.
11. Disconnect the “M” and “N” pin and wire from the connector with same manner.

Notice

EMC wire cannot be disconnected from outside, therefore do not try to disconnect it.



12. Get a new speed sensor.
13. Insert three pins and wires into each location from rear side of the connector.
14. Hold each pin with long nose pliers and pull it to securely install in the connector.
15. Insert each rubber cap into the connector to prevent the pins from disconnecting.
16. Insert the protective tube for connector into the harness.
17. Bind both ends of the protective tube with tape.
18. Install the rear speed sensor into the mounting hall and press both ends of it to be securely seated.
19. Tighten the bolts.

Installation Notice

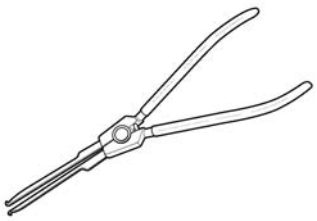
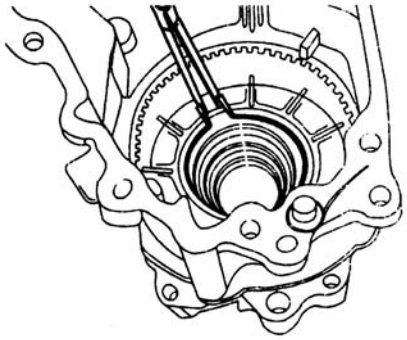
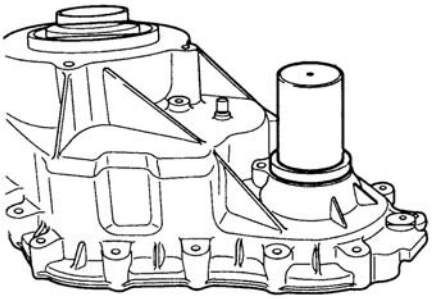
Tightening torque	3 ~ 6 Nm

20. Install the speed sensor connector. Insert the connector into the locking sleeve.

Notice

Remove the shift motor first before removing the front propeller shaft speed sensor. When replacing the sensor assembly after removing the shift motor, use the same manner for removal of rear speed sensor.

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
661 589 01 37 00 (W 99 31 001 1B) **Pliers**  Y220_03E078	Removal/installation of carrier assembly in transfer case  Y220_03E079
SY 220 - 080 (W 99 31 005 0B) **Oil seal installer**  Y220_03E080	Installation of oil seal to transmission case  Y220_03E081

SECTION 4A

FRONT AXLE

Table of Contents

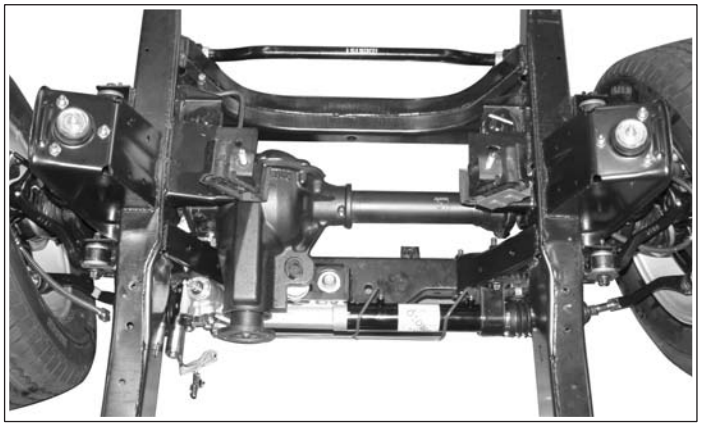
GENERAL INFORMATION

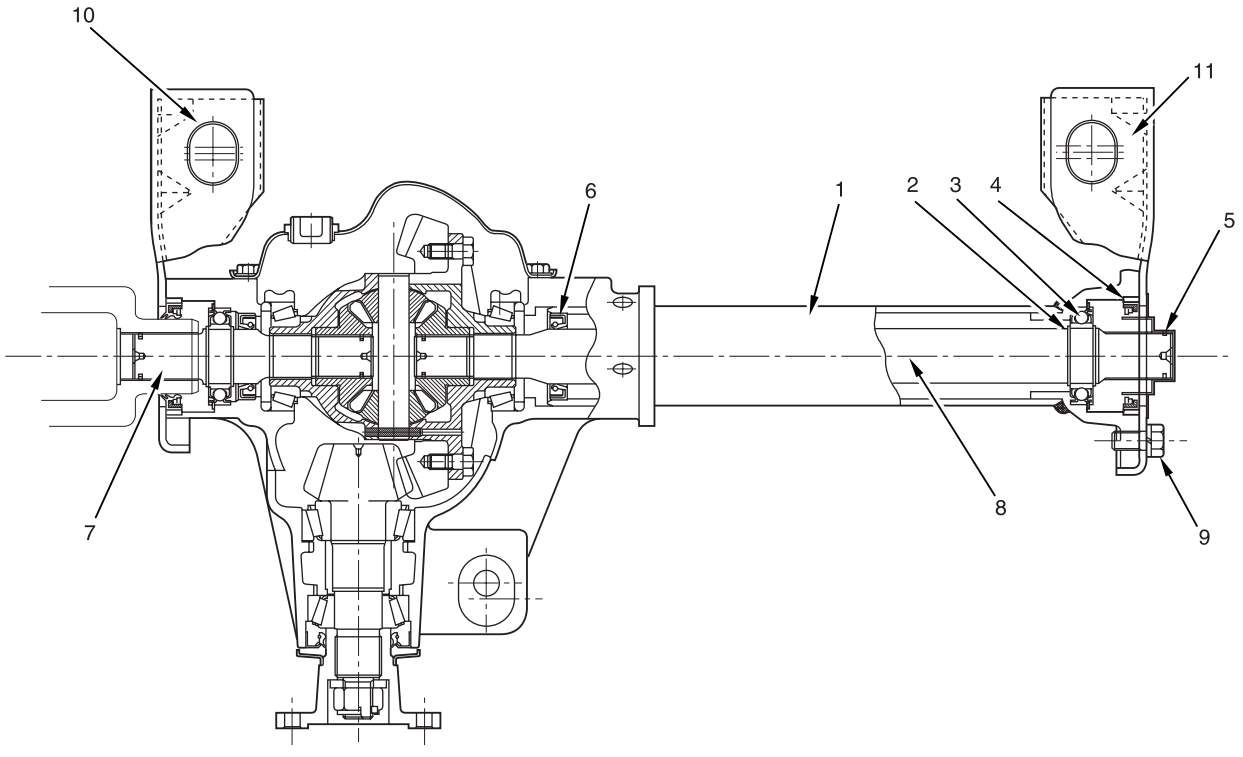
SPECIFICATION

Description		Specification
Drive shaft type		CV (constant velocity) joint
Axle housing type		Build-up
Differential	Type	Conventional
	Gear type	Hypoid
Final gear reduction ratio	DI engine + M/T	3.73
	DI engine + A/T	3.31
	Gasoline engine + A/T	4.27
Oil	Capacity	1.4 liter (DI engine + Tongil axle: 1.5 liter)
	Specification	SAE 80W/90 or API GL-5

COMPONENT LOCATOR

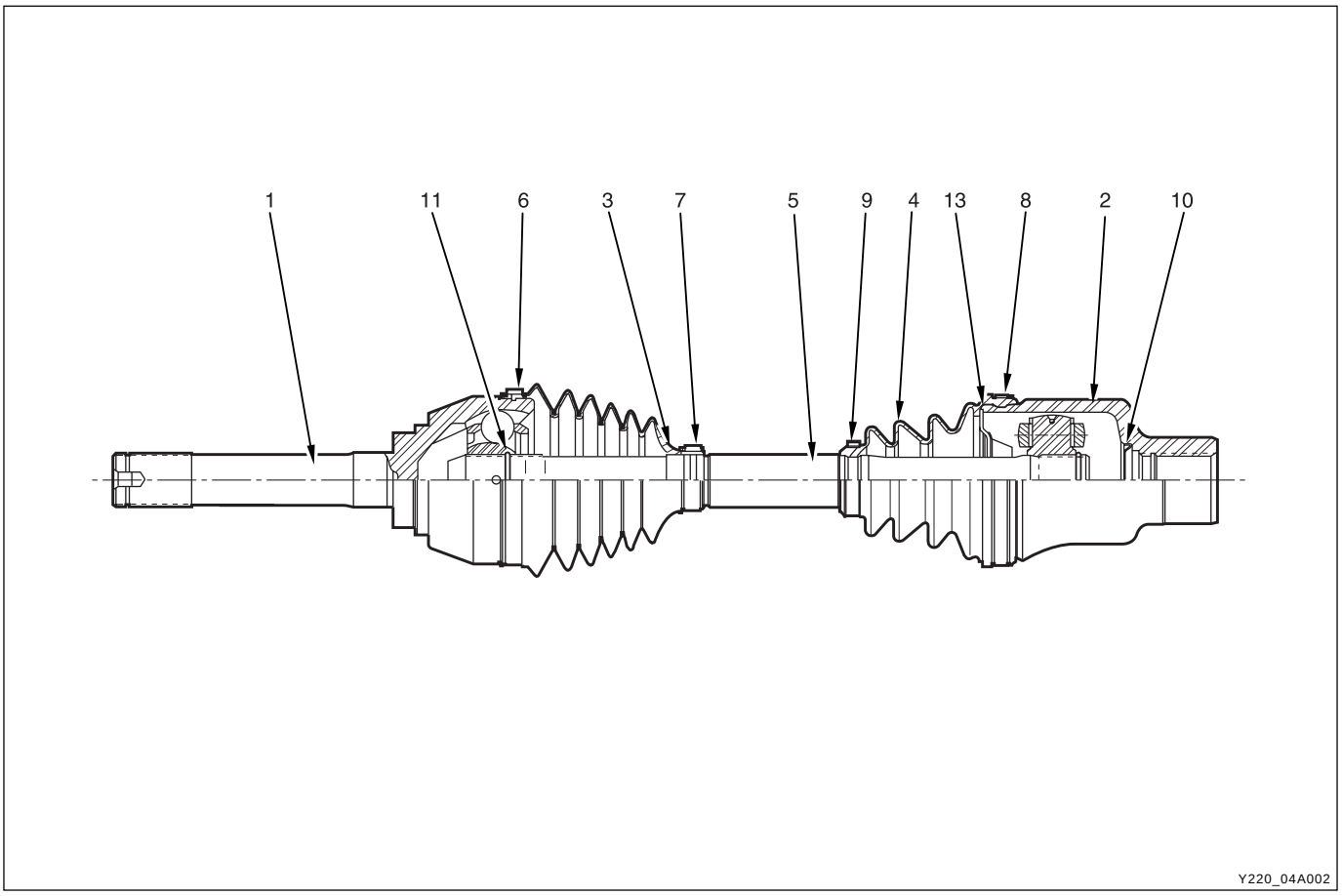
▶ Front Axle Housing





1. Axle tube assembly
2. Snap ring
3. Ball bearing
4. Oil seal
5. Protector
6. Retainer
7. Inner shaft (LH)
8. Inner shaft (RH)
9. Bolt
10. Front axle bracket (LH)
11. Front axle bracket (RH)

▶ Axle Shaft (Drive Shaft)



1. Drive shaft
2. Housing (inboard)
3. Boot (outboard)
4. Boot (inboard)
5. Shaft
6. Boot band
7. Boot band
8. Boot band
9. Boot band
10. Seal
11. Ball joint

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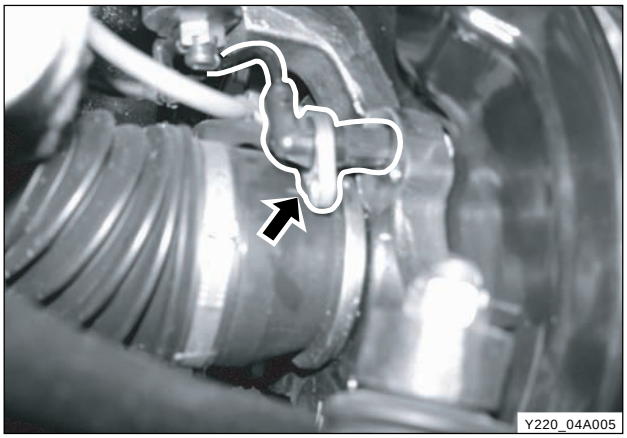
REMOVAL AND INSTALLATION

FRONT AXLE SHAFT (FOR PART TIME T/C)

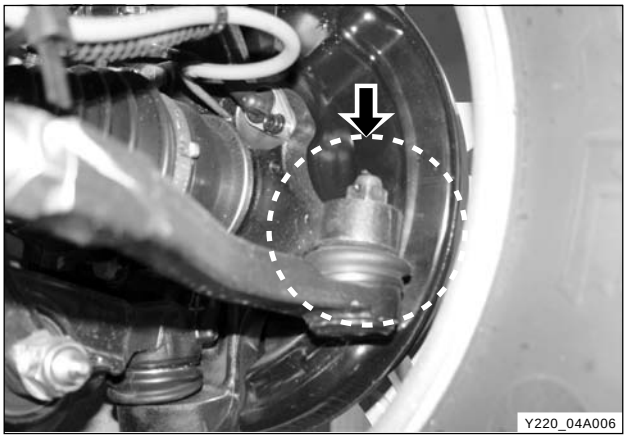
Removal

1. Remove the tire.



2. Vehicle with ABS system (Only for part time T/C equipped vehicle)

   Unscrew the mounting bolt and remove the wheel speed sensor and cable from steering knuckle.

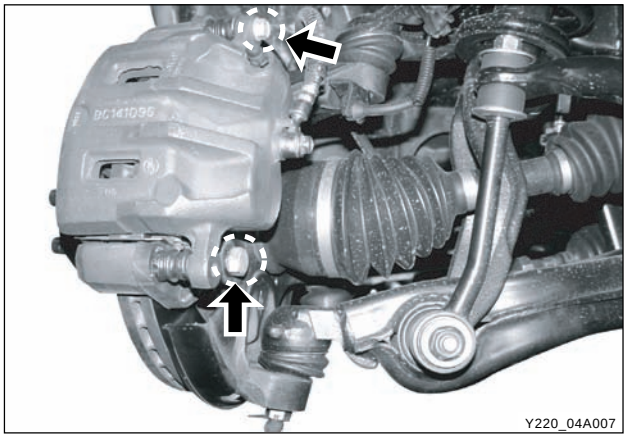


3. Remove the split pin from steering linkage mounting. Remove the slotted nut and separate the knuckle arm and linkage.

   Notice

   Change new one whenever install split pin.

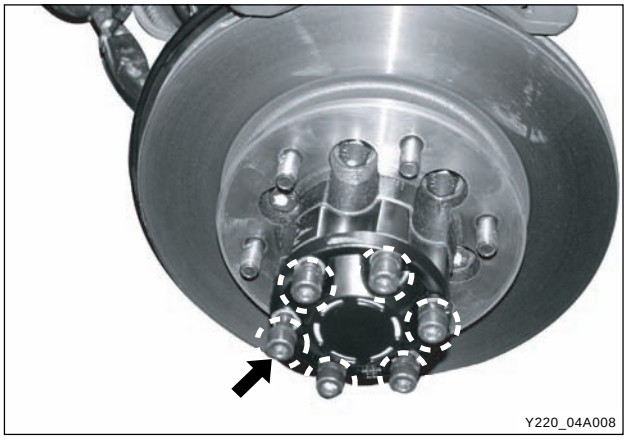
4. Unscrew two bolts (arrows) and remove the brake caliper assembly.



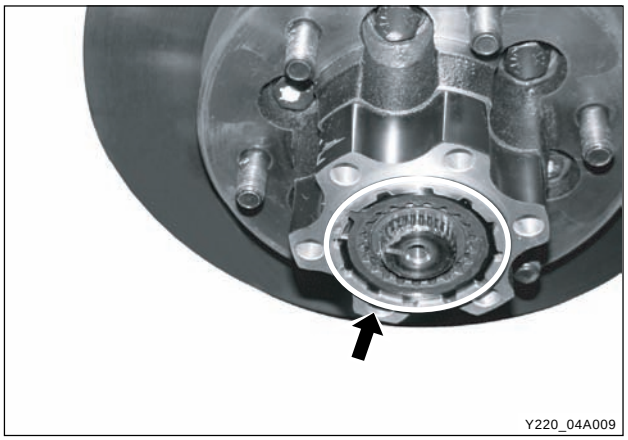
Notice

Be careful not to damage the brake oil hose.

5. Vehicle with part time transfer case only.
   1) Remove the hub mounting bolt and washer, and remove the hub cover.



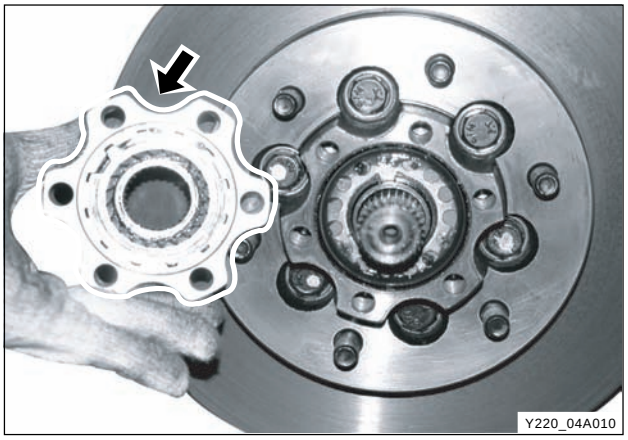
   2) Remove the retainer ring and outer shim between hub body and drive shaft, and remove the locking hub.



Installation Notice

- ***Adjust the clearance between snap ring and hub cover with appropriate shims (shim thickness: 0. 2, 0.3, 0.5 and 1.0 mm) so that it is below 0.2 mm.***
- ***Be careful not to damage the O-ring in locking hub.***

   3) Remove the locking hub from steering knuckle.



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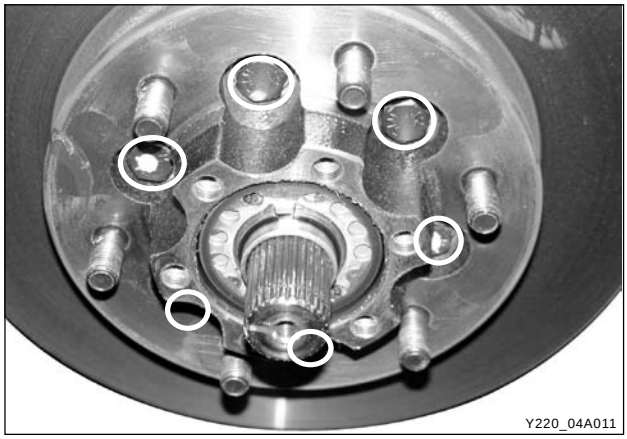
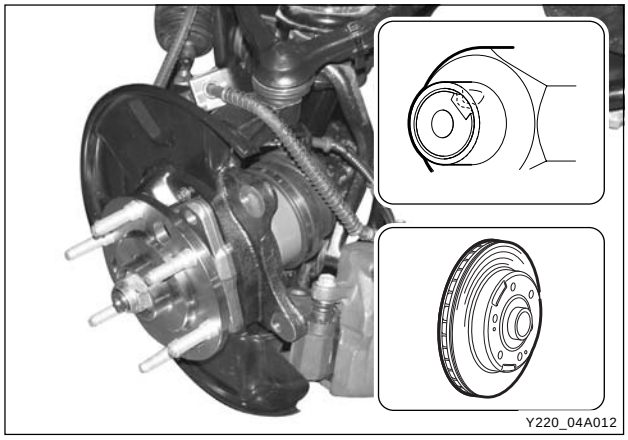


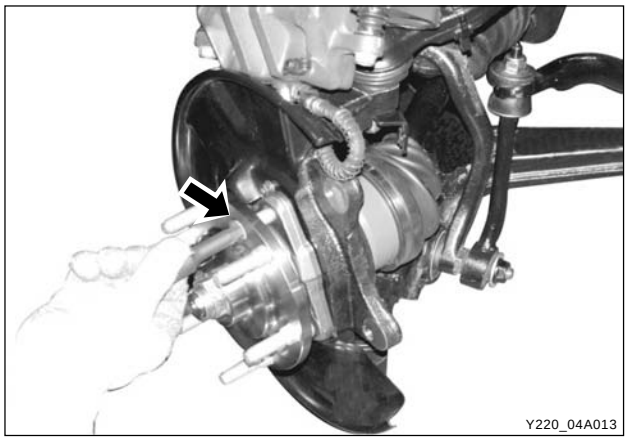
4) Remove the hub and brake disc assembly.



6. Vehicle with full time transfer case only
   1) Remove the hub nut and washer.
   2) Remove the front disc assembly from axle shaft.

Installation Notice

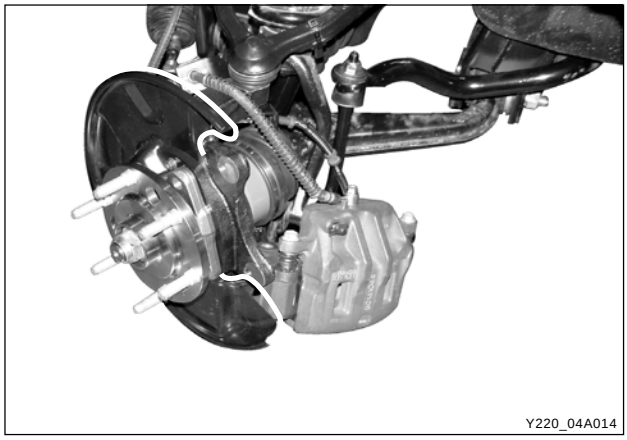
Replace the nut with new one, and caulk the nut end to lock the nut. After caulking, apply grease or paint on the caulked area.



3) Unscrew the wheel bearing bolts (M12 x 3, hexagon wrench type) and remove the hub assembly with special tool.

Installation Notice

Replace the wheel bearing bolts with new ones with Loctite applied (blue).

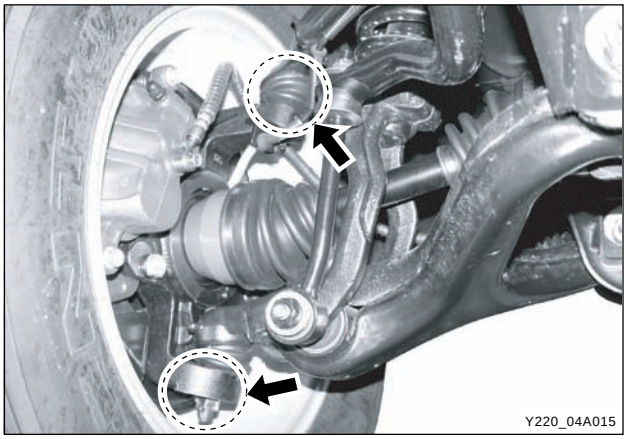


7. Unscrew the bolts (M6 x 2) and remove the dust shield.

8. Remove the split pin and nut from the connection of the upper arm and steering knuckle.

   Installation Notice

   Replace the wheel split pin with new one.

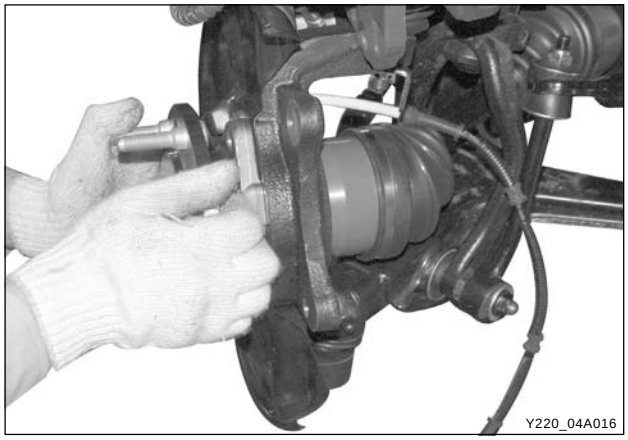


9. Remove the split pin and nut from the connection of the lower arm and steering knuckle.

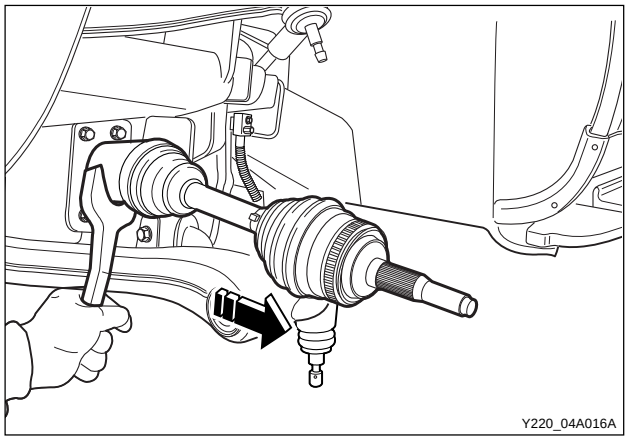
   Installation Notice

   Replace the wheel split pin with new one.

10. Remove the steering knuckle assembly.



11. Remove the drive shaft with special tool.



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Installation

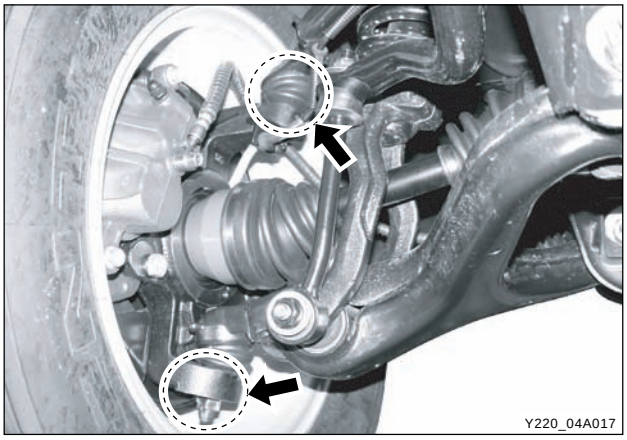
Clean all the removed elements. Check O-ring and snap ring for wear and damage. Replace the defective elements with new ones.

1. Install the axle shaft to axle housing. Make sure to securely seat the axle shaft onto the housing.

   Notice

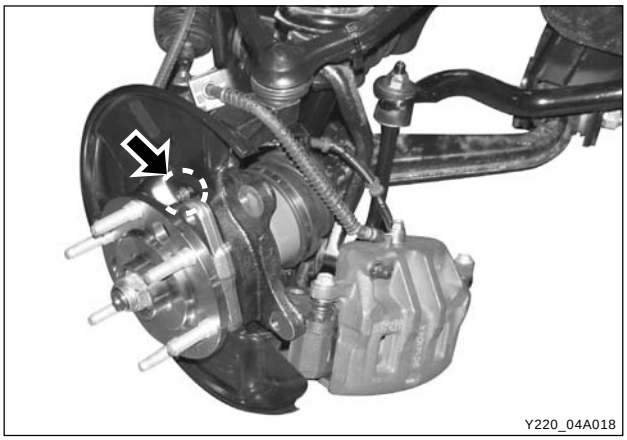
   Be careful not to damage the boots during installation.

2. Securely connect the steering knuckle and axle shaft.

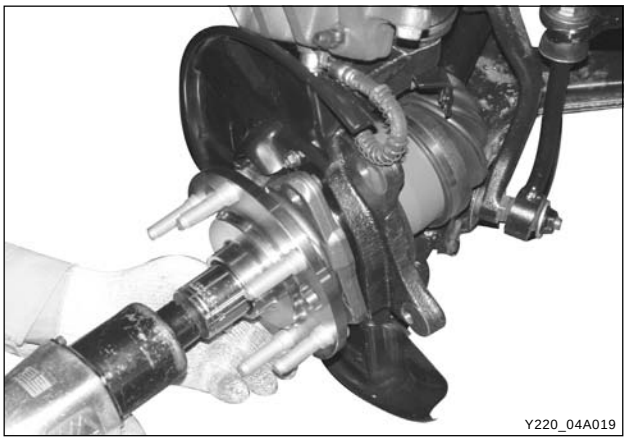


3. Install the steering knuckle to the upper arm and lower arm and lock them with split pins.

Tightening torque (Lower arm, 1)	140 ~ 160 Nm
Tightening torque (Upper arm, 2)	140 ~ 160 Nm



4. Install the dust shield to knuckle.



5. With full time transfer case only
   1) Install the hub assembly to axle shaft and tighten the hexagon nut with Loctite applied (blue).

Tightening torque	100 ~ 130 Nm

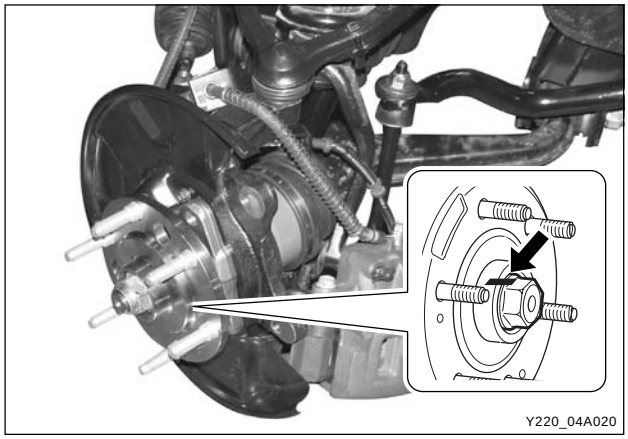
Notice

Replace it with new one.

2) Install the washer and hub nut. Caulk the nut end to lock the nut. After caulking, apply grease or paint on the caulked area.

Tightening torque	250 ~ 350 Nm

3) Install the brake disc and brake caliper.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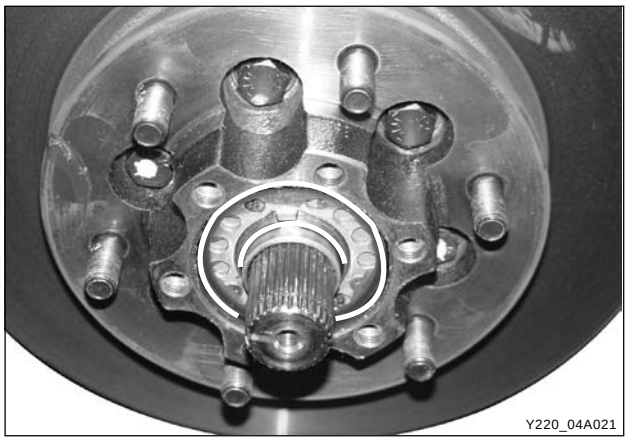
6. With part time transfer case
   1) Tighten the hub nut with special tool.

Tightening torque	15 Nm

   2) Separate the vacuum hose for auto locking hub from steering knuckle.
   3) Remove the screws and pull out the locking plate.

Notice

Make sure to check the O-ring for wear and damage.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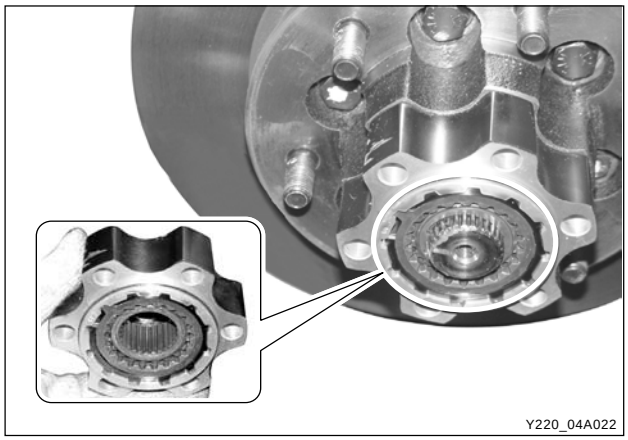
   4) Adjust the clearance between snap ring and hub cover with appropriate shims so that it is below 0.2 mm.

Shims	0.2, 0.3, 0.5, 1.0 mm
Max. clearance	below 0.2 mm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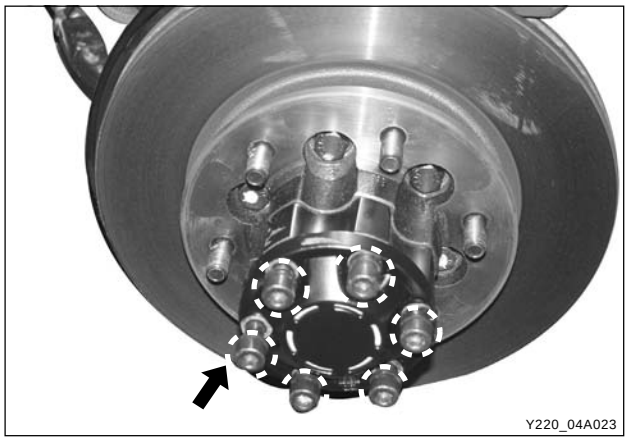
   5) Install the hub cover.

Tightening torque	50 ~ 60 Nm

Note

The washer cams should be engaged each other.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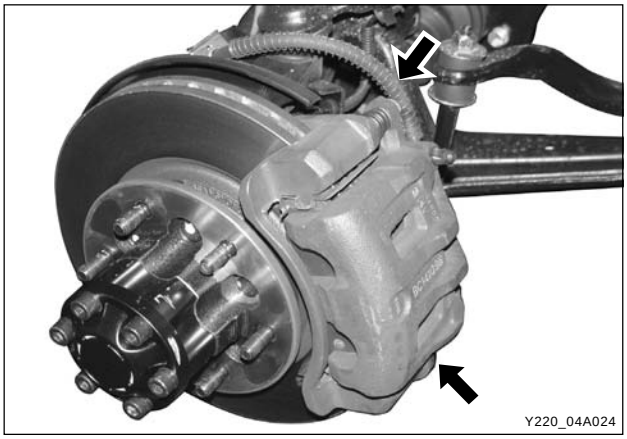
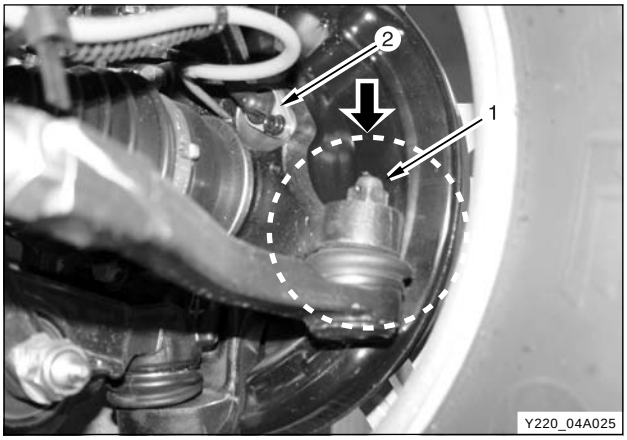


7. Tighten the front disc brake caliper mounting bolts with the front disc installed.

Tightening torque	85 ~ 105 Nm



8. Install the steering linkage end to steering knuckle and tighten the slotted nut ①.

Notice

Replace the split pin with new one.

Tightening torque	35 ~ 45 Nm

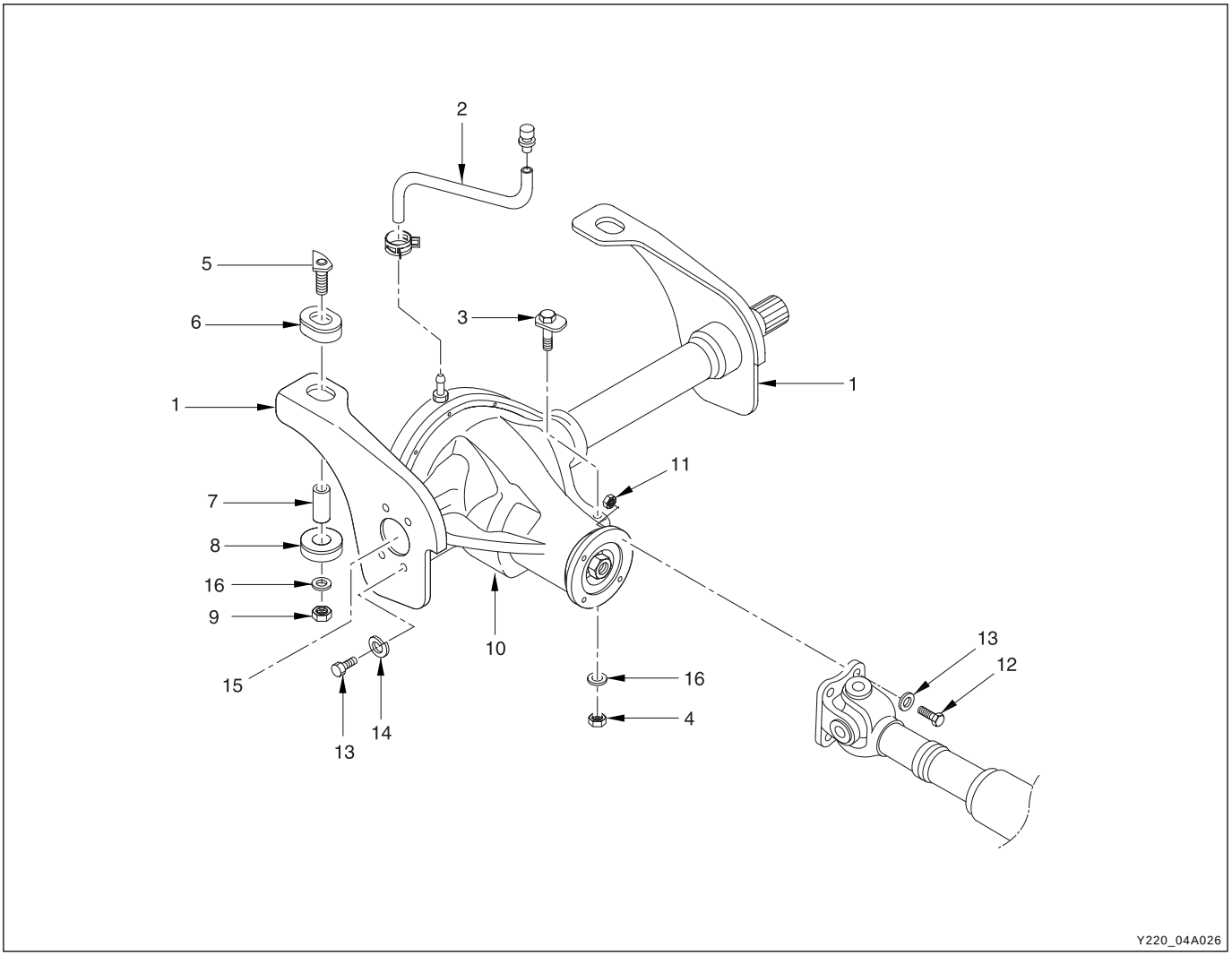
9. Install the wheel speed sensor ② and connect the vacuum line (only for ABS equipped vehicle).

Length of bolt	192 ± 5 mm

10. Install the tires and test the brake function.

AXLE HOUSING ASSEMBLY

※ Preceding work: Removal of axle shaft



1. Axle mounting bracket
2. Breather hose
3. Bolt
4. Nut
5. Bolt
6. Bush
7. Spacer
8. Bush
9. Nut
10. Front axle housing
11. Nut
12. Bolt
13. Washer
14. Washer - spring
15. Inner shaft (left)
16. Plain washer

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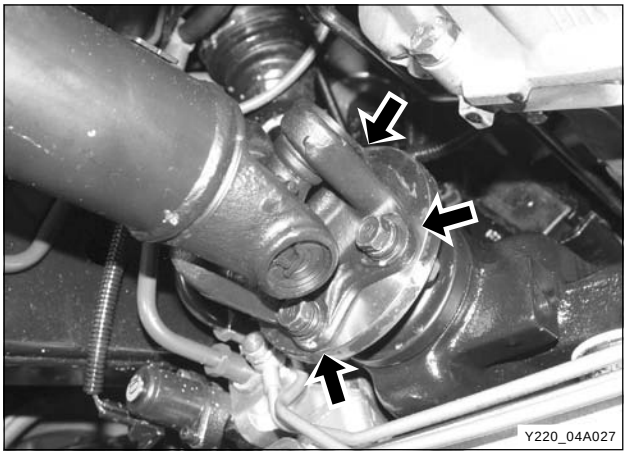
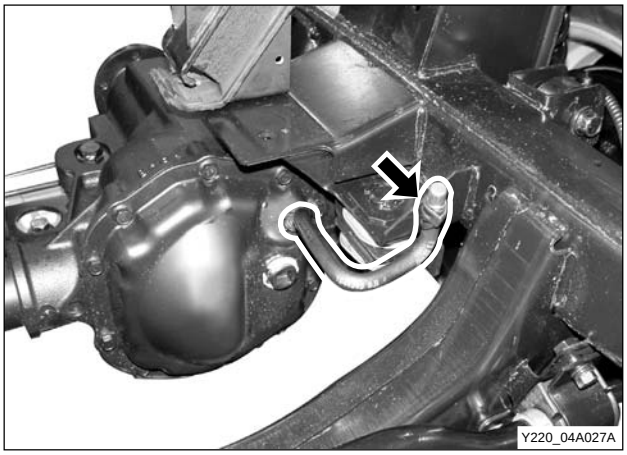
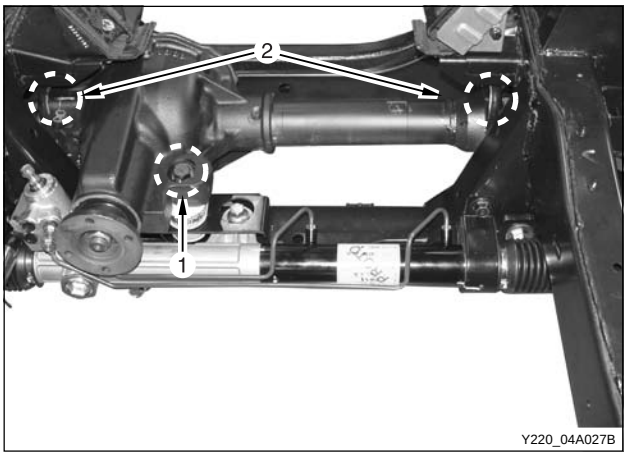






Removal and Installation

※ Preceding work: Removal of axle shaft

1. Remove the propeller shaft from the front axle input shaft.

   Installation Notice

Tightening torque	70 ~ 80 Nm

2. Remove the steering gear linkage.

3. Remove the breather hose.

4. Remove the axle housing mounting nut (1).

   Installation Notice

Tightening torque	80 ~ 100 Nm

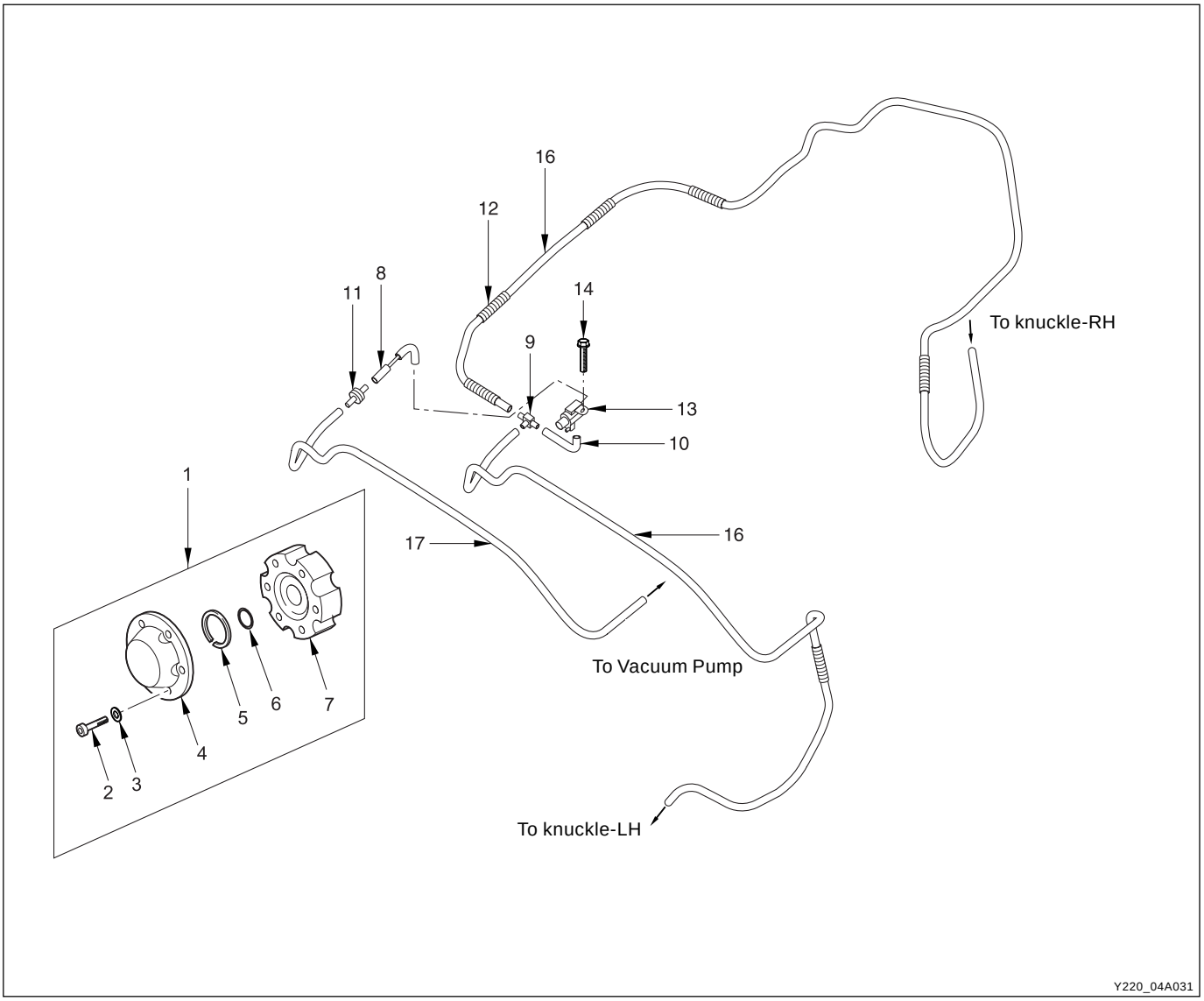
5. Support the axle housing with safety jack and remove the axle housing mounting bracket nut (2).

   Installation Notice

Tightening torque	68 ~ 93 Nm

6. Remove the axle housing assembly while lowering the jack very carefully.
7. Install in the reverse order of removal.

VACUUM LINE



1. Vacuum type auto locking hub hssembly
2. Bolt ..... 30 ~ 40 Nm
3. Washer
4. Auto locking hub cap
5. Retaining ring
6. Shim
7. Locking hub
8. Hose and tube assembly
9. T-connector
10. Molded hose
11. Check valve
12. Corrugated tube
13. Auto locking hub solenoid valve
14. Bolt
15. Hose (L: 2000/Yellow)
16. Hose (L: 3200/Red)
17. Hose (L: 1500/White) (DSL)
    Hose (L: 800/Blue) (GSL)

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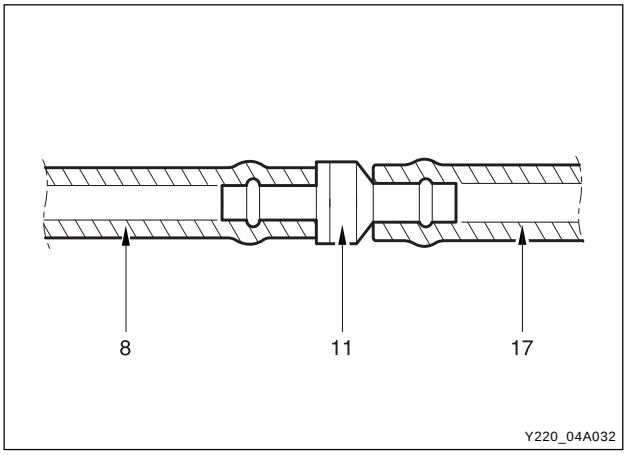
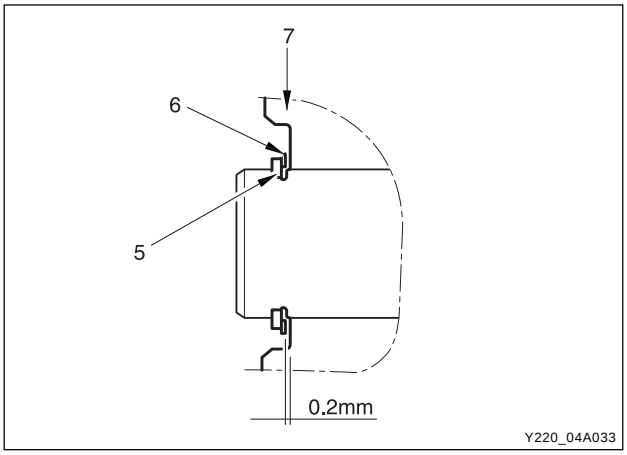




Removal and Installation Notice

1. Be careful not to change the direction of valves when connecting the check valve (11) to hoses.

2. Adjust the clearance between the retainer ring (5) and locking hub (7) to the specified value by using the appropriate shims (6).

Specified value	Max. 0.2 mm

Notice

Shim thickness: 0.1, 0.2, 0.3, 0.5, 1.0 mm

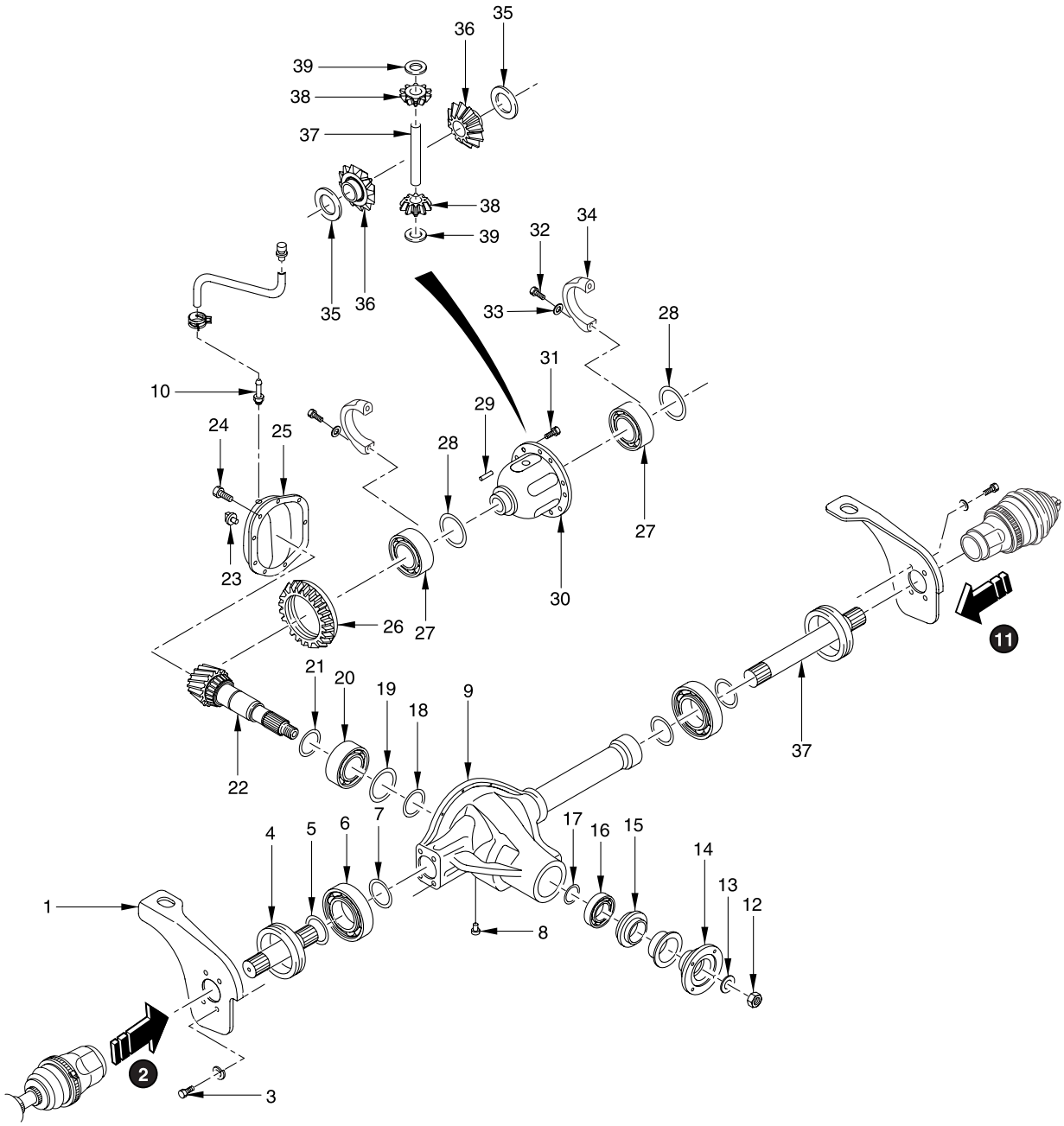
3. Tighten the auto locking hub cap bolt to the specified value and order.

Tightening torque	50 ~ 60 Nm

DISASSEMBLY AND REASSEMBLY

EXPLODED VIEW

▶ Front Axle Housing



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1. Front axle housing mounting bracket
2. Inner shaft (left)
3. Bolt
4. Oil seal ..... replace, apply grease to the sealing rib
5. Snap ring
6. Bearing
7. Snap ring
8. Oil drain plug
9. Front axle housing
10. Breather nipple
11. Inner shaft (right)
12. Pinion lock nut
13. Washer
14. Companion flange
15. Oil seal ..... replace, apply grease to the sealing rib
16. Bearing
17. Shim
18. Bearing baffle
19. Shim
20. Bearing
21. Oil slinger
22. Driver pinion
23. Oil filler plug
24. Bolt
25. Axle housing cover ..... apply liquid gasket
26. Ring gear
27. Bearing
28. Shim
29. Shaft lock pin
30. Differential case
31. Bolt
32. Bolt
33. Washer
34. Bearing cap
35. Thrust washer
36. Side gear
37. Differential shaft
38. Differential pinion (spider gear)
39. Thrust washer

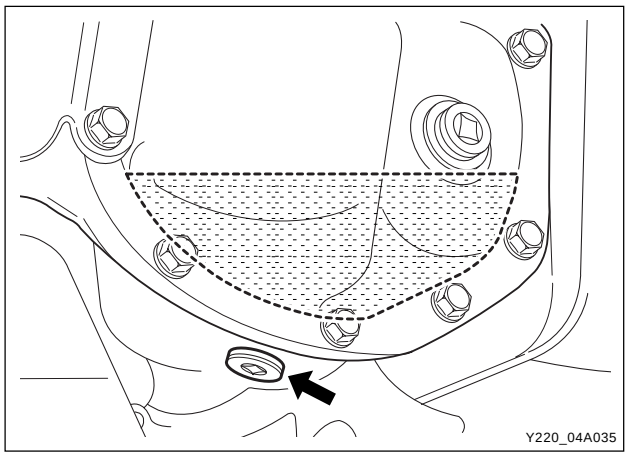
AXLE HOUSING ASSEMBLY

Disassembly

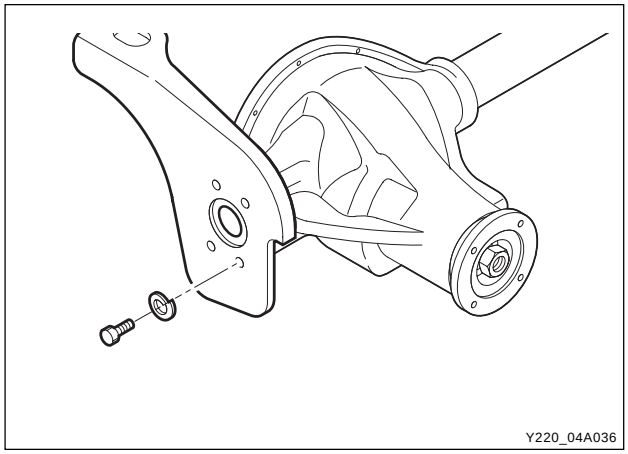
1. Remove the drain plug and drain the oil. Install the drain plug.

   Installation Notice

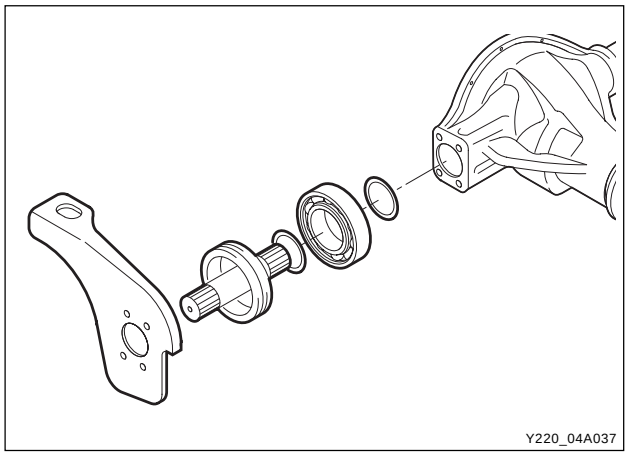
Tightening torque	28 ~ 42 Nm



2. Unscrew the axle housing mounting bracket bolts and remove the bracket and inner shaft assembly.



3. Remove the snap ring and inner shaft bearing. Remove the inner shaft and axle housing mounting bracket.



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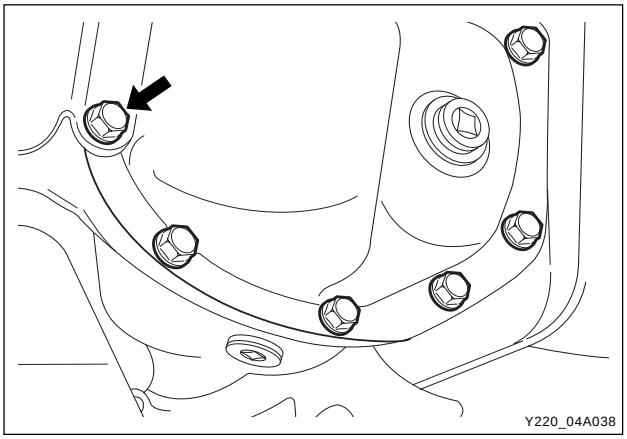
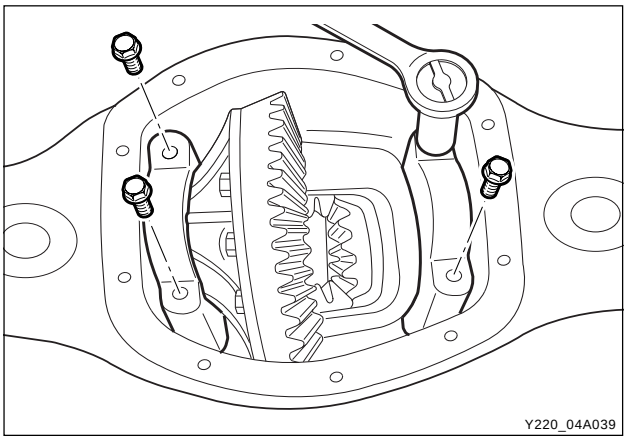


4. Remove the axle housing cover.

Notice

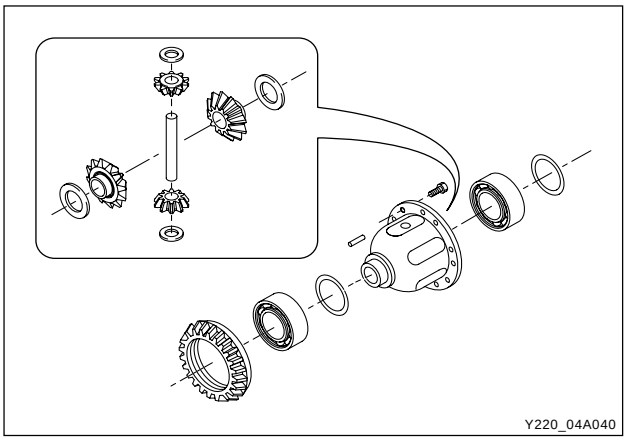
Remove the gasket residues from cover and housing mating surface.



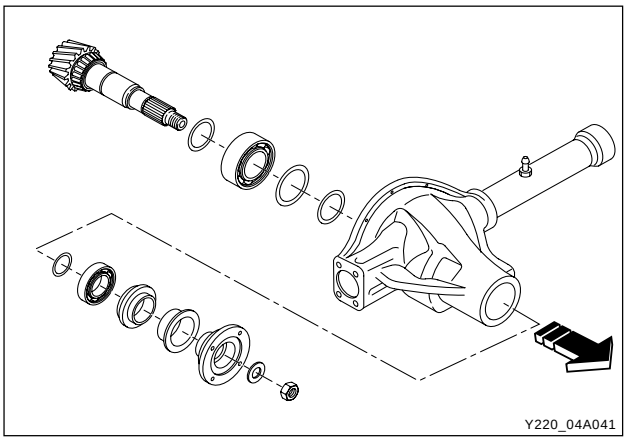
5. Unscrew bolts and remove the bearing cap, then remove the differential carrier assembly.

Notice

Before removal, place the alignment marks on the bearing cap so that they cannot be changed. Be careful not to damage the axle housing while removing.



6. Disassemble the differential carrier assembly.

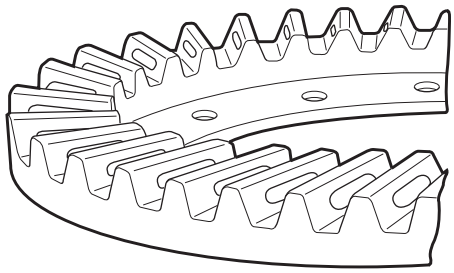


7. Unscrew the lock nut and disassemble the driving pinion assembly.

Inspection of Ring Gear Tooth Contact Pattern

1. Normal Contact

   Apply gear-marking compound (Prussian blue / red lead) on the ring gear teeth. Rotate the ring gear and check the tooth contact pattern.



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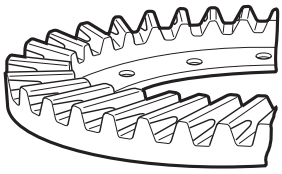
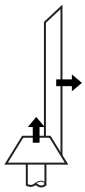
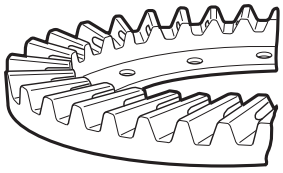
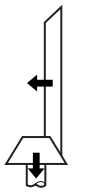
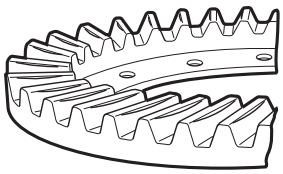
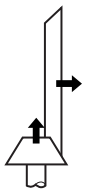
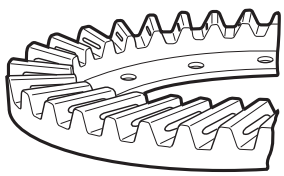
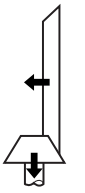
2. Abnormal Contact

Tooth Contact pattern	Possible Cause	Remedy
1. Heel contact  A Y220_04A043	Excessive backlash • Noise can be occurred	Adjust backlash (Drecrease backlash) • Select proper shin to move the drive pinion toward the ring gear (toward toe)  B Y220_04A044
2. Toe contact  A Y220_04A045	Insufficient backlash • Tooth can be damaged or broken under heavy load	Adjust backlash (Increase backlash) • Select proper shim to move the drive pinion against the ring gear (toward heel)  B Y220_04A046
3. Face contact  A Y220_04A047	Excessive backlash • Drive pinion shaft is apart from the ring gear • Noise can be occurred	Adjust backlash (Increase pinion shim) • Move the drive pinion toward the ring gear (toward center of ring gear)  B Y220_04A048
4. Flank contact  A Y220_04A049	Insufficient backlash • Gear contacts on the low flank • Gear can be damaged or worn • Noise can be occurred	Adjust backlash (Decrease pinion shim) • Move the ring gear toward the drive pinion (toward ring gear center line)  B Y220_04A050

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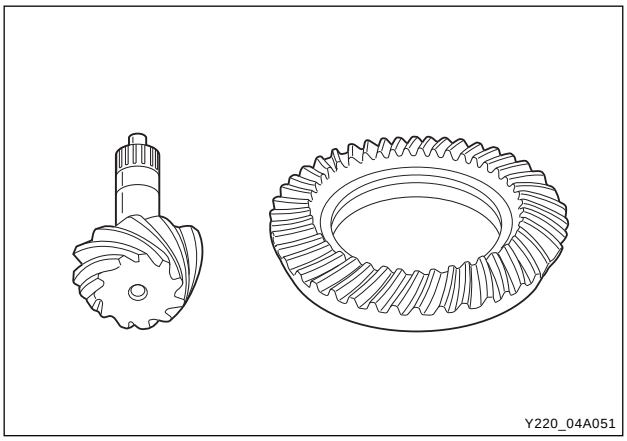
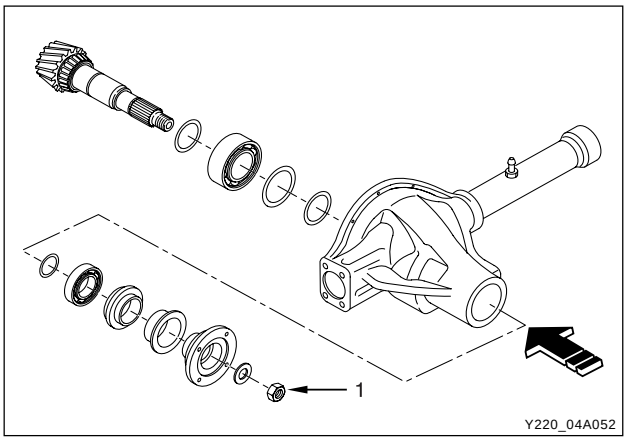
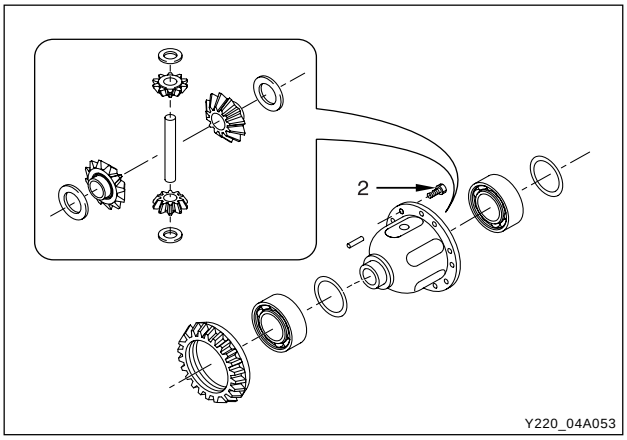

Y220_04A051



Y220_04A052



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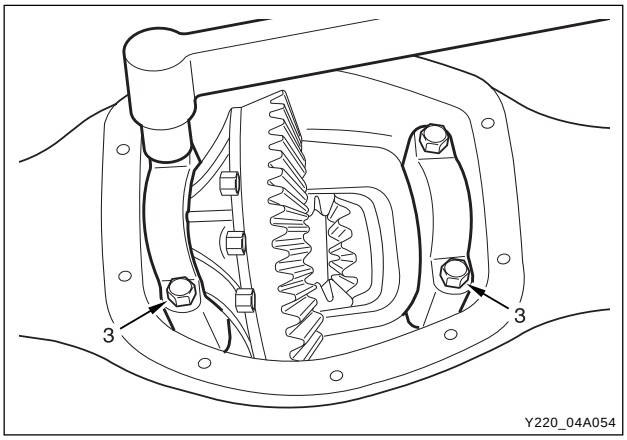


Y220_04A054

Assembly

1. Clean all parts and check the followings:
   - Check the ring gear, drive pinion for wear and damage. If damaged, replace it as a set.
   - Check the bearing for sticks, wear, noise and turning resistance.
   - Check the side gear, pinion, pinion shaft and thrust washer for wear and damage.
   - Check the differential carrier for crack and wear (bearing sliding surface). Check the gear case for crack.
2. Insert the drive pinion assembly into the axle housing and tighten the pinion lock nut (1).

Tightening torque	240 ~ 310 Nm

3. Assemble the differential carrier assembly. At this time, align the ring gear to the mark on the differential carrier and tighten the bolts (2).

Tightening torque	75 ~ 90 Nm

4. Measure the backlash between side gear and pinion gear.

Specified value	0 ~ 0.5 mm

5. Install the differential carrier assembly into the axle housing. Install the bearing cap.

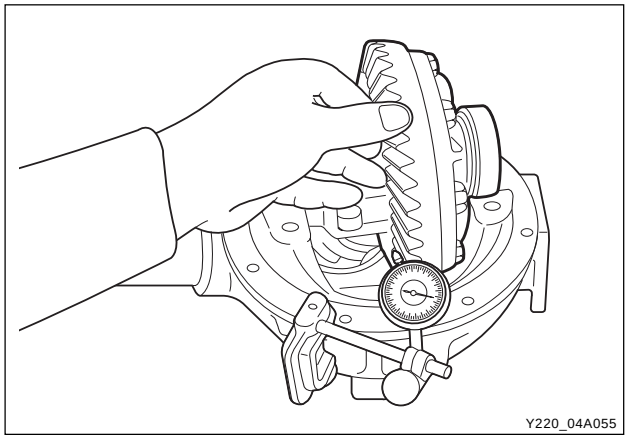
Tightening torque	48 ~ 69 Nm

Notice

Be careful not to mix the caps.

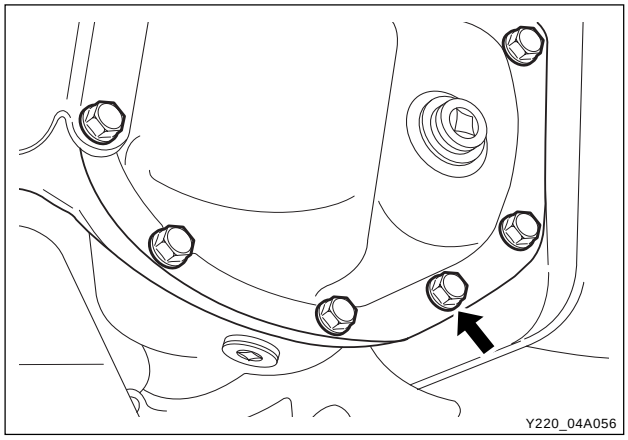
6. Measure the backlash between drive pinion and ring gear.

Specified value	0.13 ~ 0.20 mm



7. Install the axle housing cover.

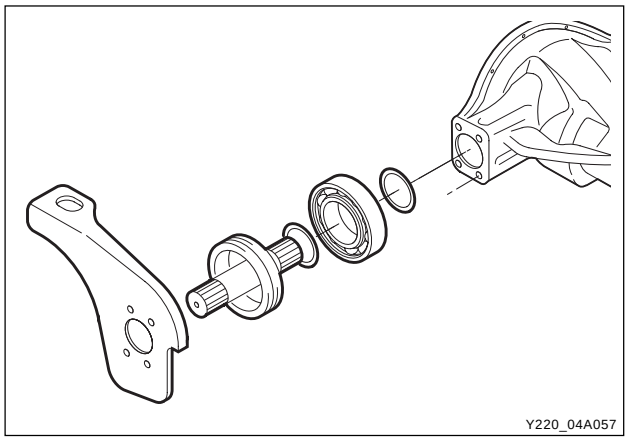
Tightening torque	39 ~ 46 Nm



8. Assemble the front axle inner shaft and housing mounting bracket components.

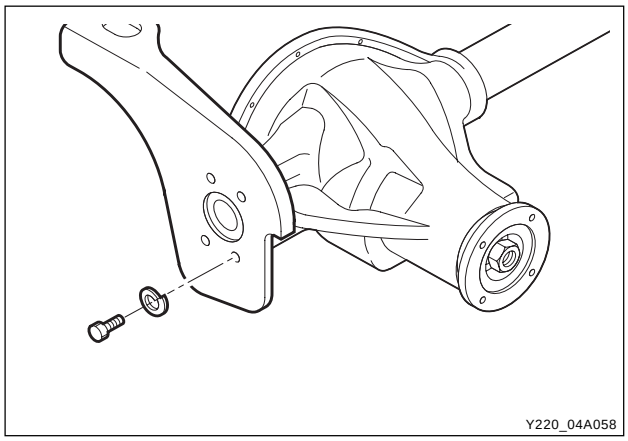
Notice

Apply the grease to the oil seal rib.



9. Insert the inner shaft into the differential carrier. Assemble the axle housing mounting bracket and axle housing.

Tightening torque	80 ~ 100 Nm



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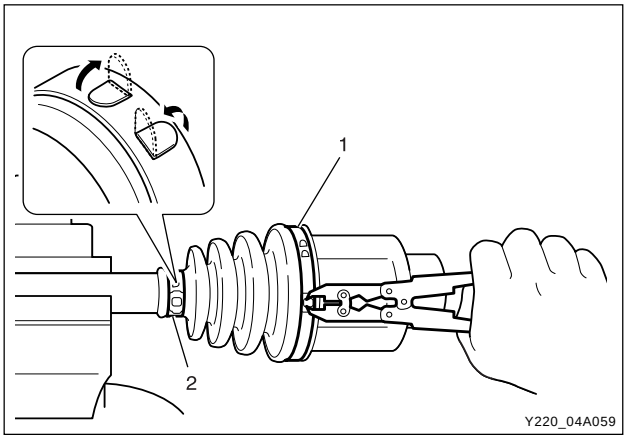
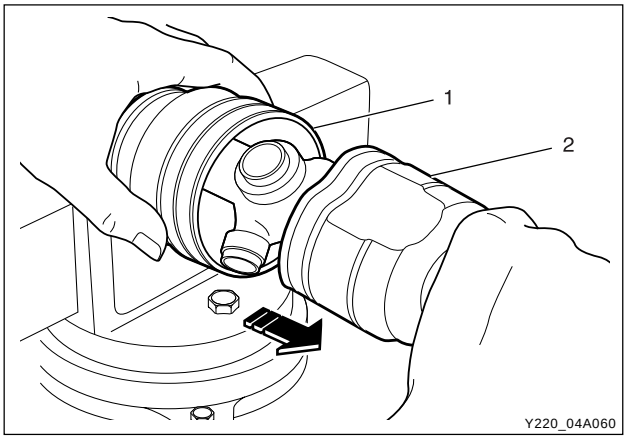


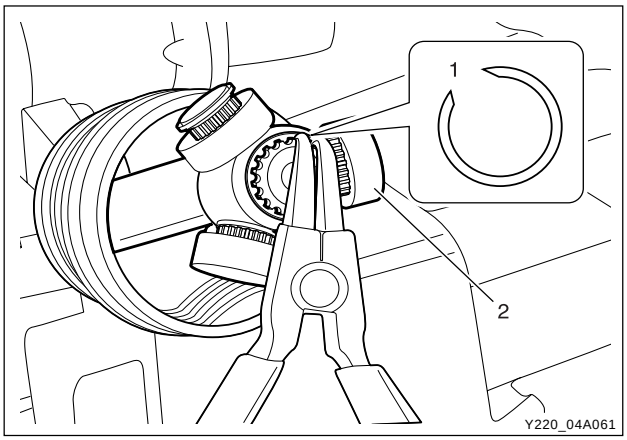
DIFFERENTIAL JOINT ASSEMBLY

Disassembly

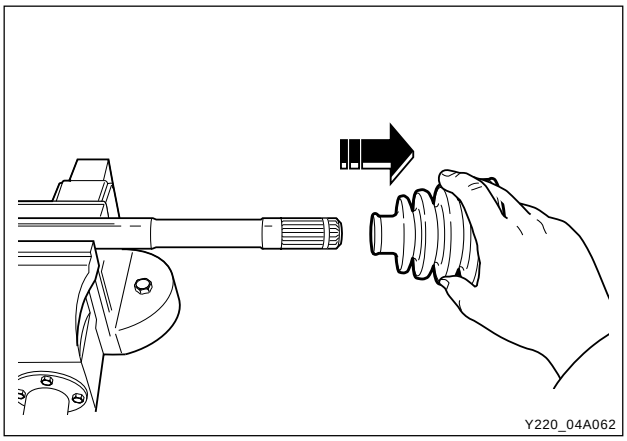
1. Remove the drive axle.
2. Remove the joint boot clamp.
   (1) Remove the larger boot clamp.
      • Compress the clamp tabs with special tool.
   (2) Remove the smaller boot clamp.
      • Unfold the clamp holding with a screwdriver.



3. Separate the joint housing from boot.
   (1) Boot
   (2) Joint housing



4. Remove the grease on the joint assembly.
5. Remove the tripod joint.
   (1) Pull out the circlip.
   (2) Pull out the tripod joint.



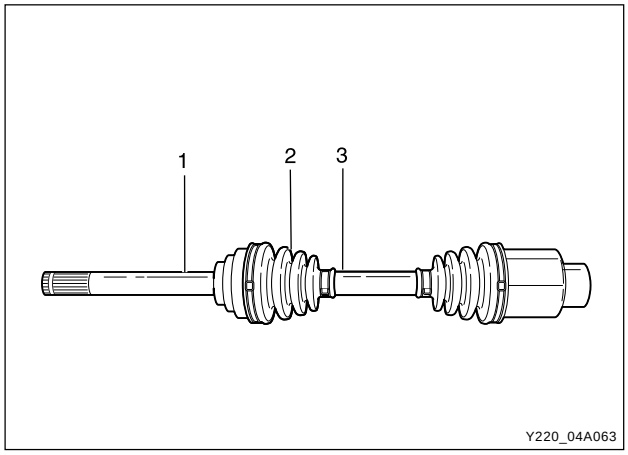
6. Remove the drive axle shaft boot.

Inspection

1. Check the shaft spline for wear and damage.
2. Check the boot for crack and leaks by tearing.
3. Check the shaft for bend.

Notice

If any of shafts is defective, both shafts should be replaced as a set since the other shaft is liable to be affected.



Assembly

1. Assemble in the reverse order of disassembly.
2. Fill the specified grease in the joint housing.

Capacity	90 ~ 100 g

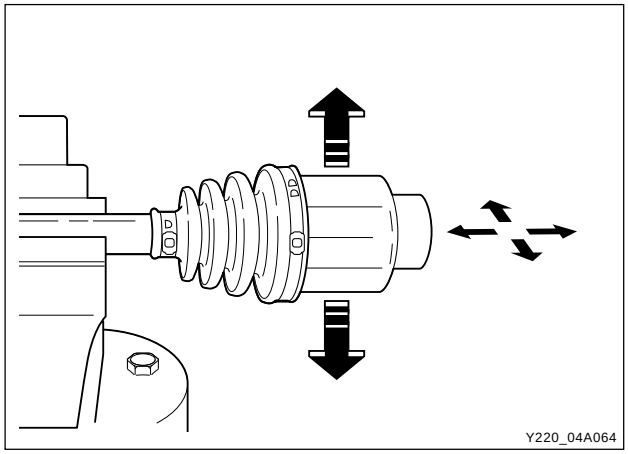
Notice

Use only specified grease. Otherwise, the joint and boot may be damaged.

Notice

Replace the boot clamps with new ones.

3. Check whether the joint moves freely to any direction. Check the clamping connections for leaks.



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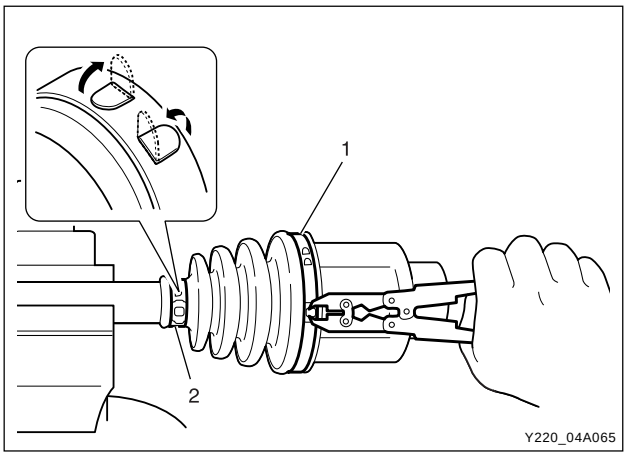
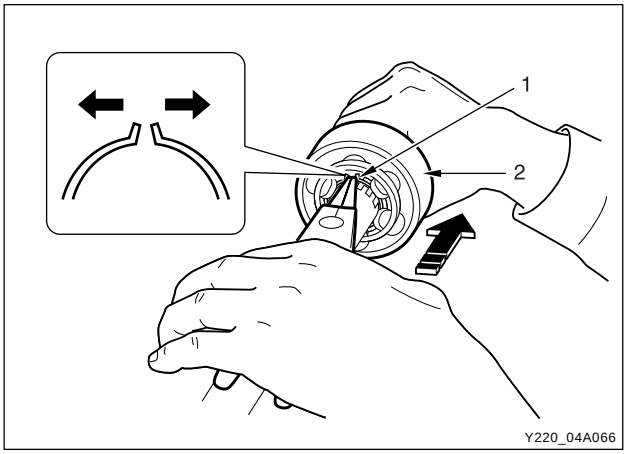
WHEEL JOINT



Disassembly

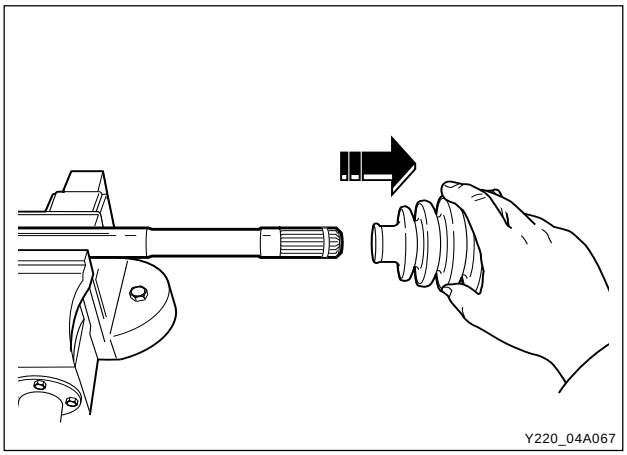
1. Remove the drive axle.
2. Remove the joint boot clamp.
   (1) Remove the larger boot clamp.
   (2) Remove the smaller boot clamp.
      • Unfold the clamp holding with a screwdriver.



3. Remove the grease on the joint assembly.
4. Remove the joint assembly.
   (1) Open the circlip.
   (2) Pull out the joint assembly toward wheel.

Notice

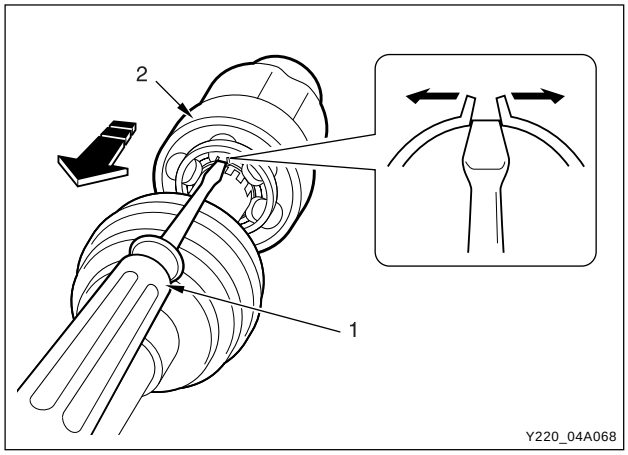
Apply the uniform force to both tabs to remove the joint assembly.



5. Remove the drive axle shaft.

Assembly

1. Assemble in the reverse order of disassembly.
2. Install the joint assembly.
   - Insert the joint assembly into the drive axle shaft until the circlip opens slightly.
   (1) Keep the openings with screwdriver.
   (2) Insert the joint assembly until it reaches to the circlip groove.



3. Fill the specified grease in the joint housing.

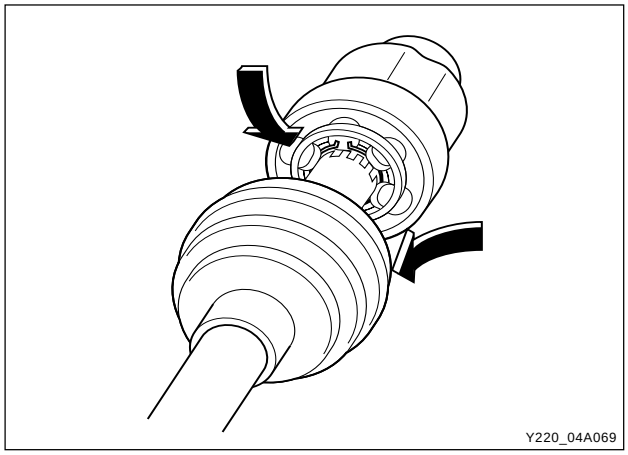
Capacity	80 ~ 90 g

Notice

Use only specified grease. Otherwise, the joint and boot may be damaged.

Notice

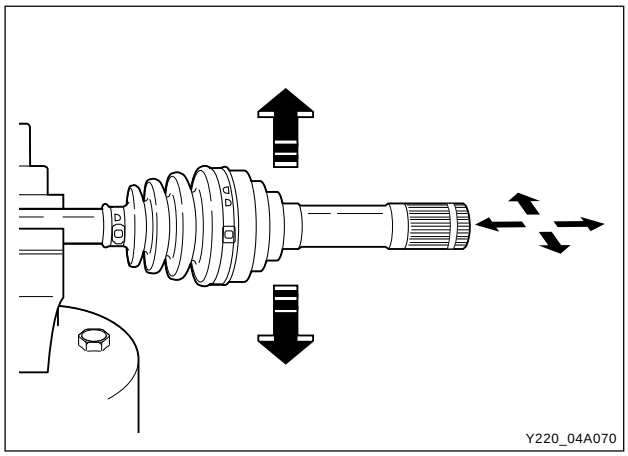
Replace the boot clamps with new ones.



4. Check whether the joint moves freely to any direction. Check the clamping connections for leaks.

Notice

Replace the wheel joint as an assembly.



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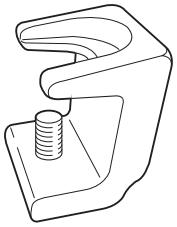
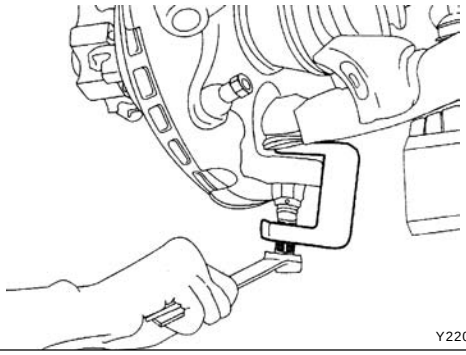
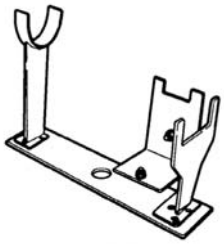
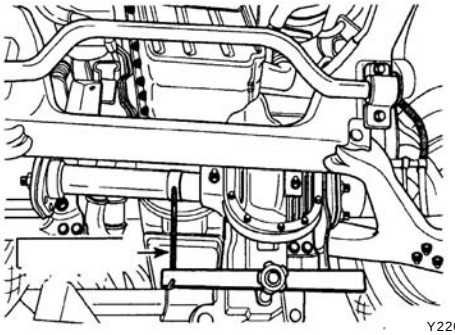
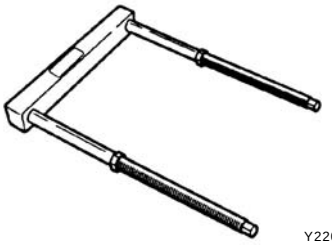
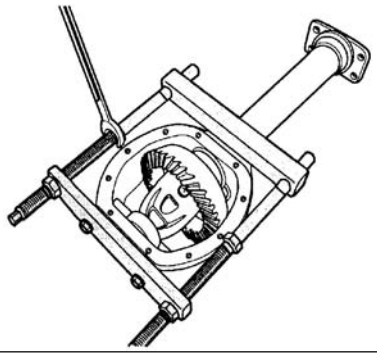
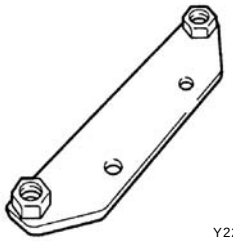
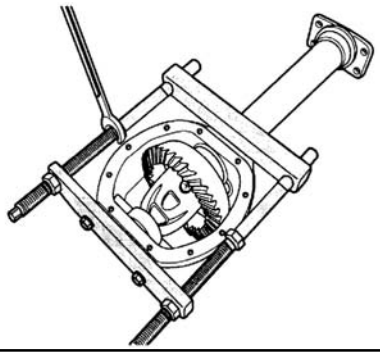
TROUBLE DIAGNOSIS

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

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
661 589 13 33 00 **Ball joint remover**  Y220_04A071	 Y220_04A072
SY 340 - 080 (L 99 42 014 0B) **Front drive axle stand**  Y220_04A073	Supporting the front axle during removal and installation  Y220_04A074
SY 340 - 090 - 01 (W 99 42 001 1B) **Drive differential remover and installer**  Y220_04A075	Removal and installation of drive axle differential gear  Y220_04A076
SY 340 - 090 - 02 (W 99 42 002 1B) **Front drive differential remover and installer**  Y220_04A077	Removal and installation of front drive axle differential  Y220_04A078

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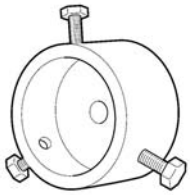
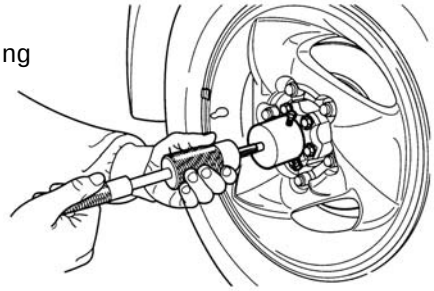
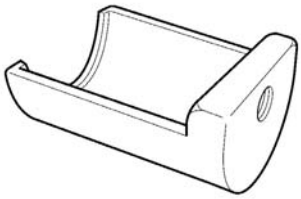
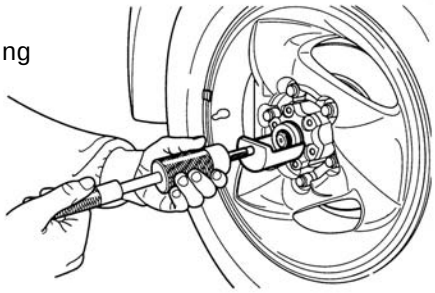
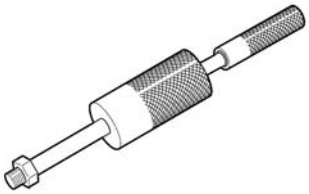
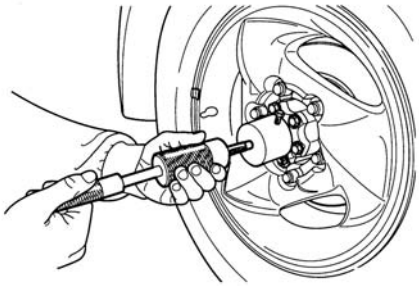
Name and Part Number	Application
SY 340 - 060 (W 99 48 010 0A) **Front hub cap remover and installer**  Y220_04A079	Removal and installation of front hub cap Using with SY340-050 (sliding hammer)  Y220_04A080
SY 340 - 070 (W 99 48 011 0A) **Front hub flange remover**  Y220_04A081	Removal and installation of front hub flange Using with SY340-050 (sliding hammer)  Y220_04A082
SY 340 - 050 (W 99 482 009 0A) **Sliding hammer**  Y220_04A083	Removal and installation of hub cap  Y220_04A084

SECTION 4B

REAR AXLE

Table of Contents

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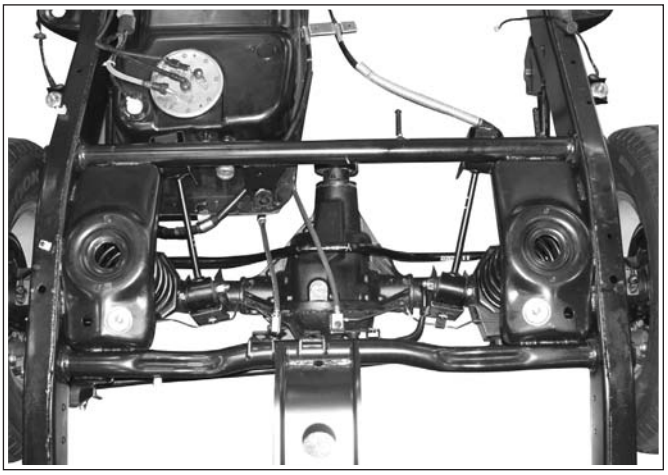
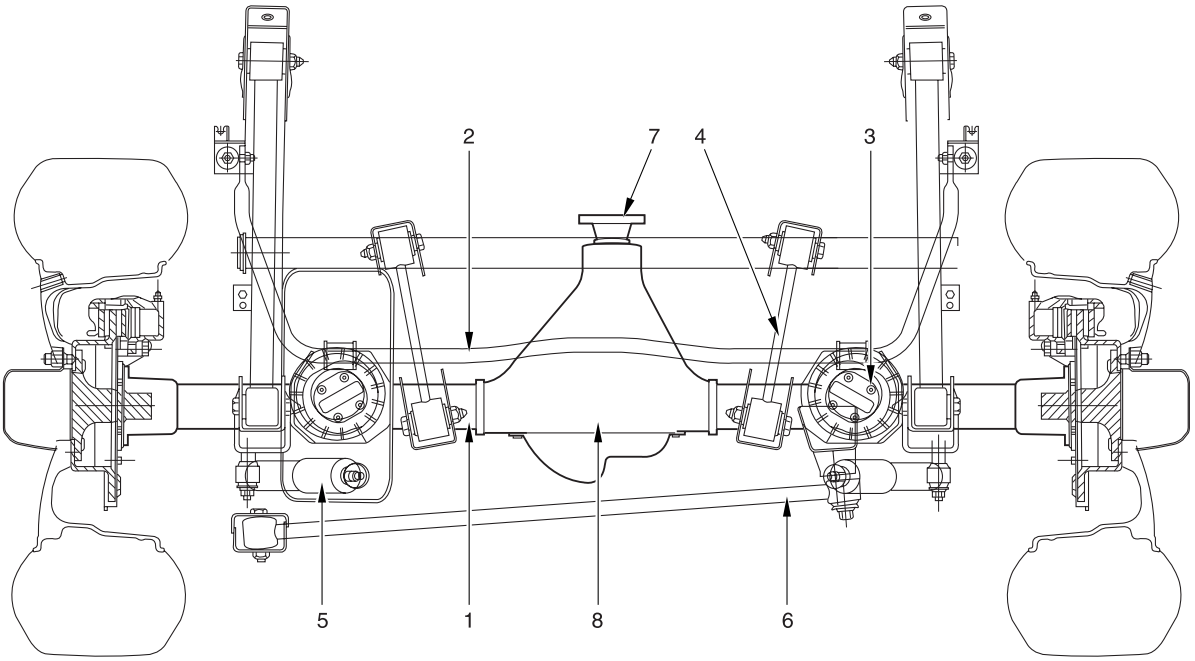
GENERAL INFORMATION

SPECIFICATIONS

Description	Specification	
Axle shaft type	Semi-floating	
Axle housing type	Build up	
Differential	Type	Conventional type
	Gear type	Hypoid Gear
Final gear reduction ratio	DI engine + M/T	3.73
	DI engine + A/T	3.31
	Gasoline engine + A/T	4.27
Oil	Capacity	2.2 ℓ
	Specification	SAE 80W/90 or API GL-5

COMPONENTS LOCATOR

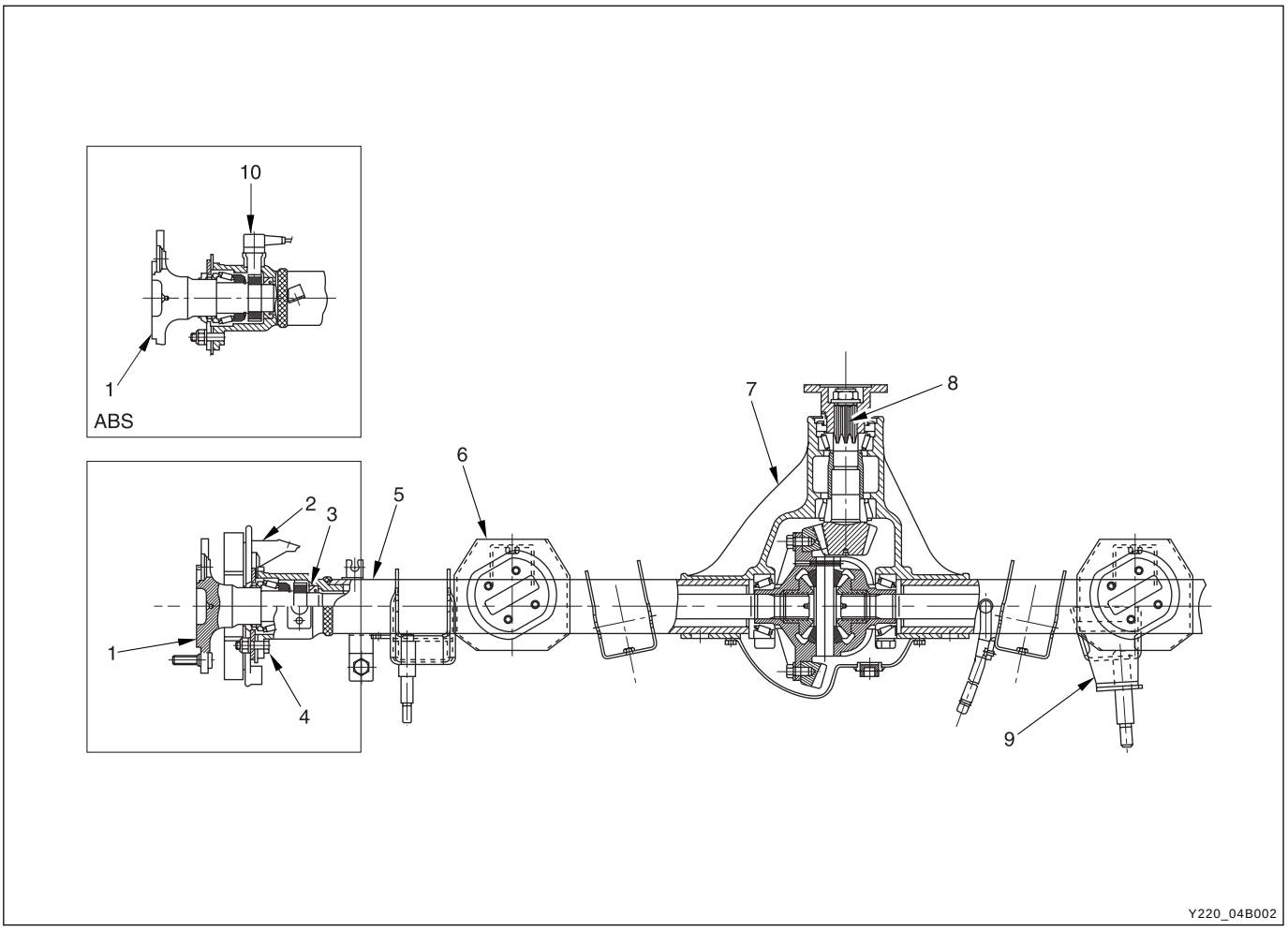




Y220_04B001

1. Axle shaft/Tube
2. Stabilizer bar
3. Spring seat and spring
4. Upper arm
5. Shock absorber
6. Lateral rod
7. Flange
8. Axle housing

CROSS SECTIONAL VIEW



1. Rear axle shaft assembly
2. Brake assembly (parking brake)
3. Oil seal - inner
4. Bolt
5. Axle shaft tube
6. Coil spring seat (lower)
7. Carrier assembly
8. Input shaft/Flange
9. Rod mounting bracket
10. Wheel speed sensor

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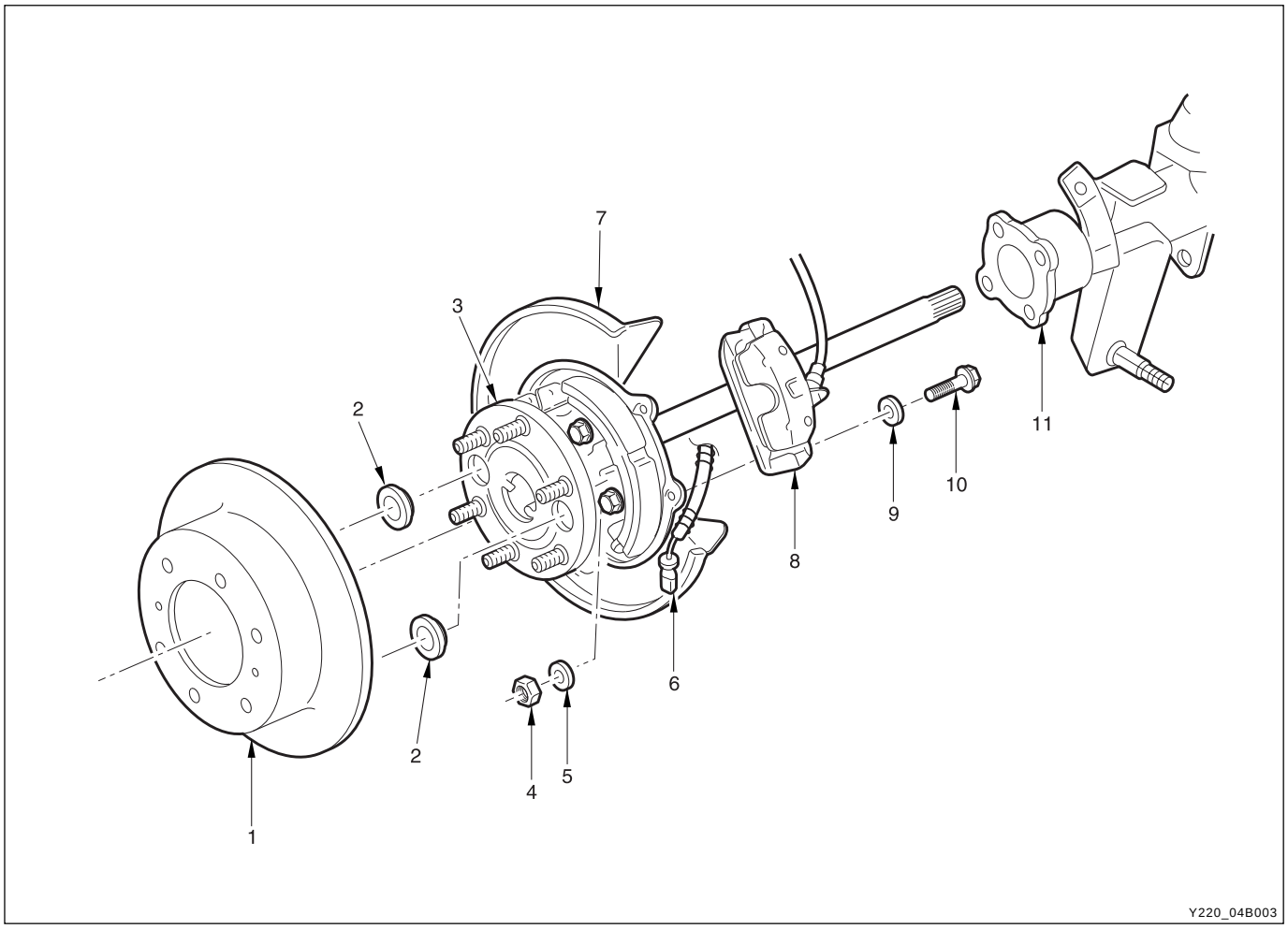
REMOVAL AND INSTALLATION

REAR AXLE SHAFT

▶ Disc Brake Equipped Vehicle

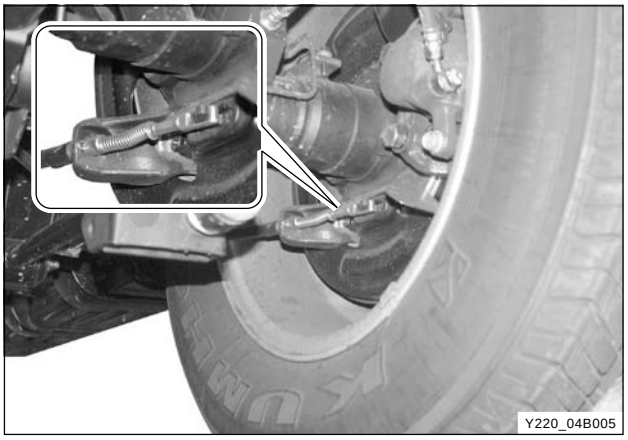


1. Brake disc
2. Plug
3. Rear axle shaft
4. Nut
5. Washer
6. Parking brake cable
7. Parking brake lining and back plate assembly
8. Brake caliper assembly
9. Spring washer
10. Bolt
11. Rear axle housing

Removal

1. Remove the tire.

2. Release the parking brake.
3. Remove the parking brake lock pin.
4. Remove the parking brake lever and disconnect the cable.



5. Remove two brake caliper bolts (1).

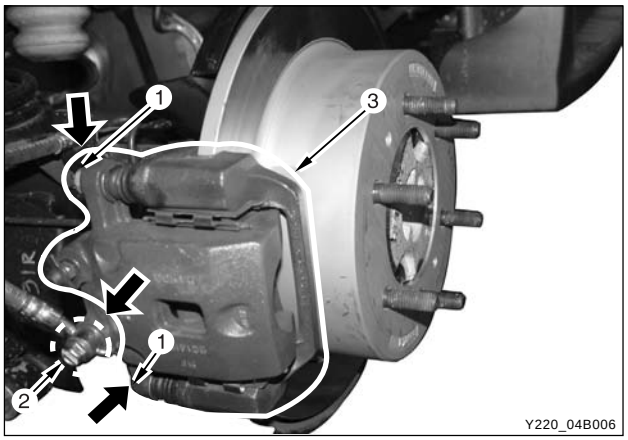
Notice

Be careful not to damage the brake oil hose.

6. Remove the brake caliper assembly (3).

Notice

If replacing only the brake pad, remove the upper caliper bolt and swing the caliper down.



7. Remove the brake disc.

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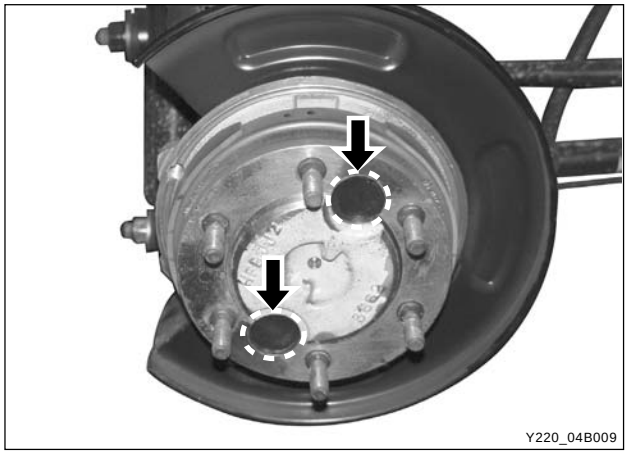
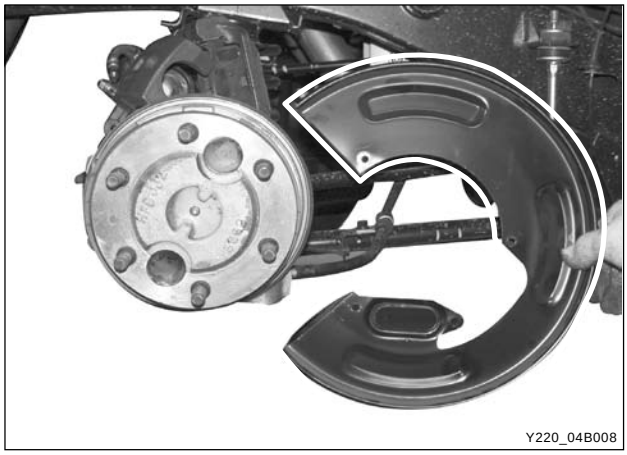


8. Remove two plastic plugs from the axle shaft flange.



9. Unscrew four bolts and remove the dust shield cover.
10. Remove four axle housing flange bolts and washers with retainer plate.
11. Remove the rear axle drive shaft.

Installation

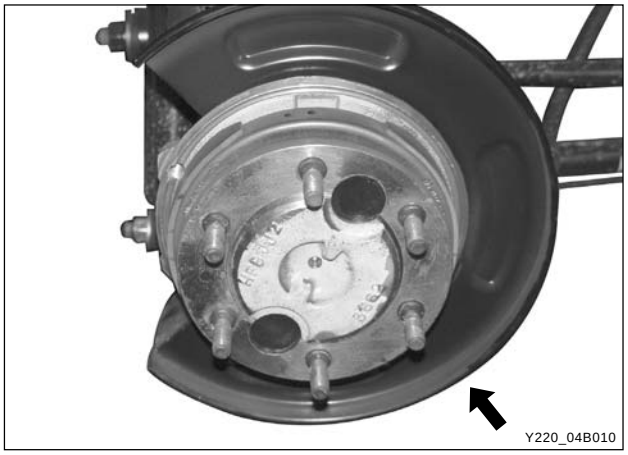
Clean the disassembled axle shaft and check it damage or wear.

1. Check the rear axle shaft spline and insert it into the rear axle housing.
2. Install four axle housing flange bolts and washers with retainer plate.

Tightening torque	50 ~ 65 Nm

3. Fit the plastic plugs into the rear axle flange and install the dust shield.

Tightening torque	4 ~ 8 Nm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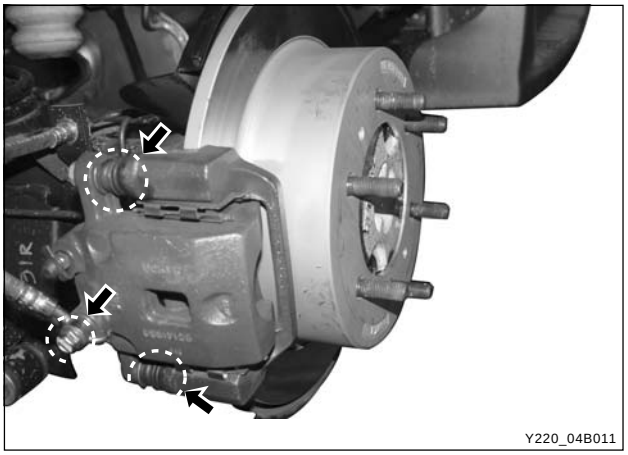
4. Install the brake disc and caliper assembly.

Tightening torque	85 ~ 105 Nm

5. Connect the parking brake cable and install the tire.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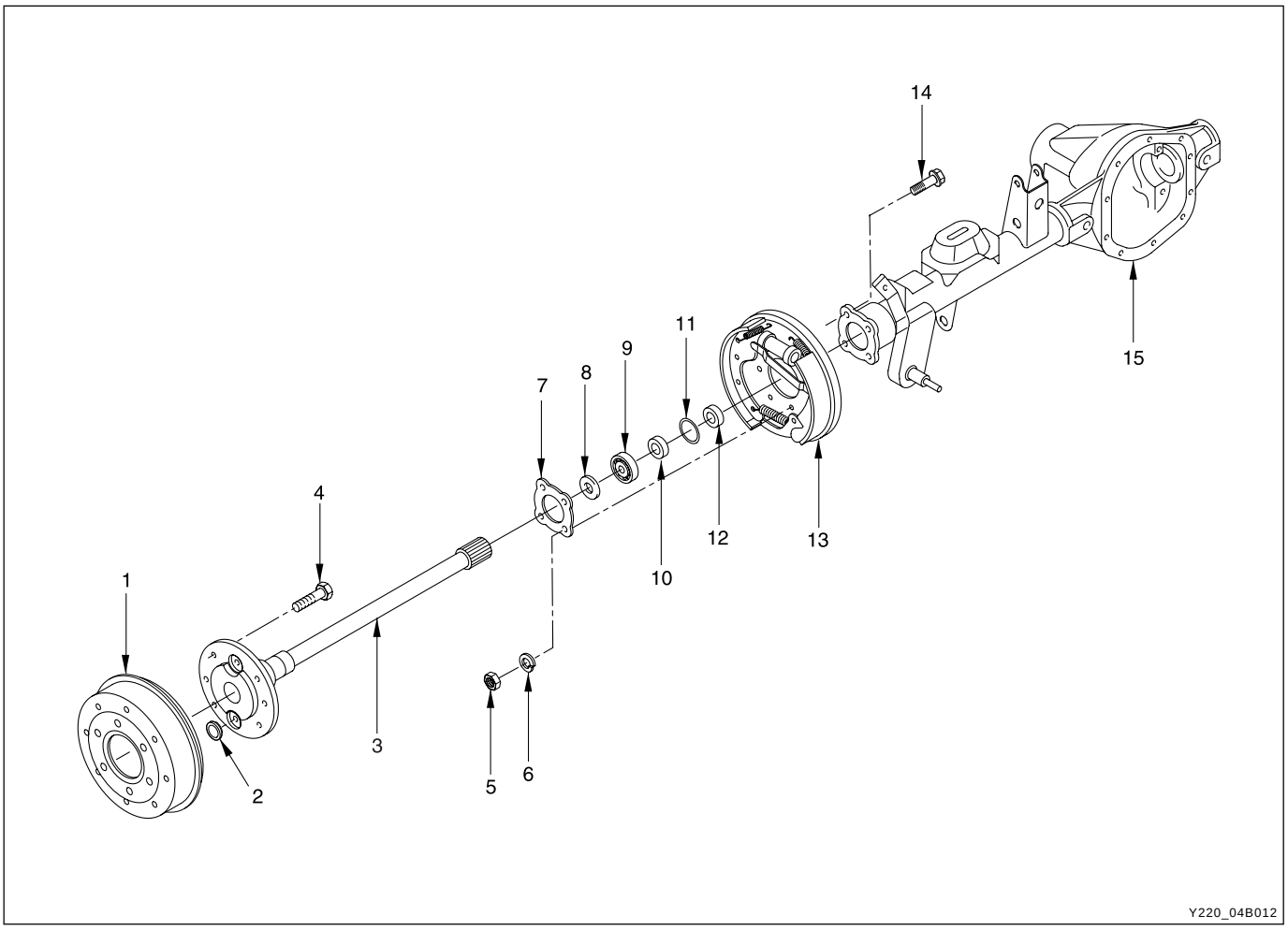
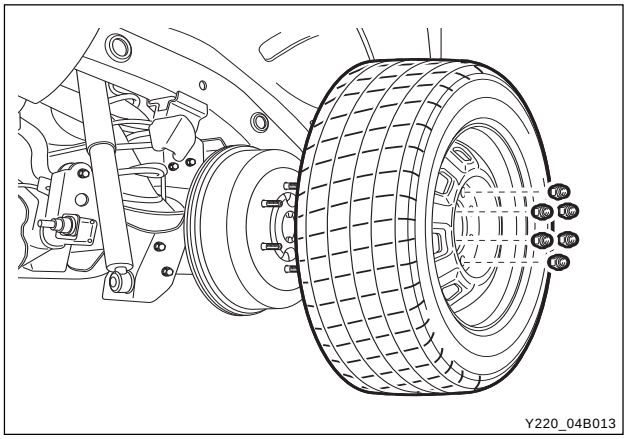
▶ Drum Brake Equipped Vehicle



1. Brake drum
2. Plug
3. Rear axle shaft
4. Wheel bolt
5. Nut
6. Washer
7. Retainer plate
8. Oil seal
9. Bearing
10. Retainer ring
11. Snap ring
12. Oil seal
13. Brake shoe and back plate assembly
14. Bolt
15. Rear axle housing

Removal

1. Release the parking brake.
2. Remove the tire.

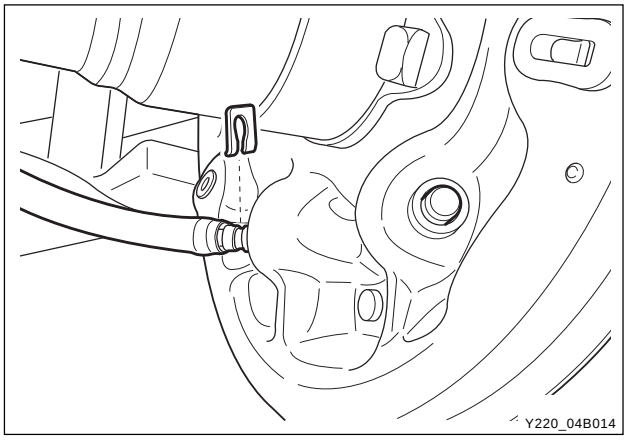


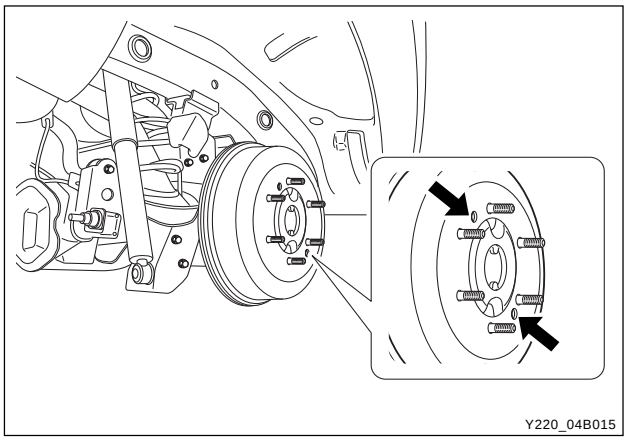
3. Remove the brake drum.

   Notice

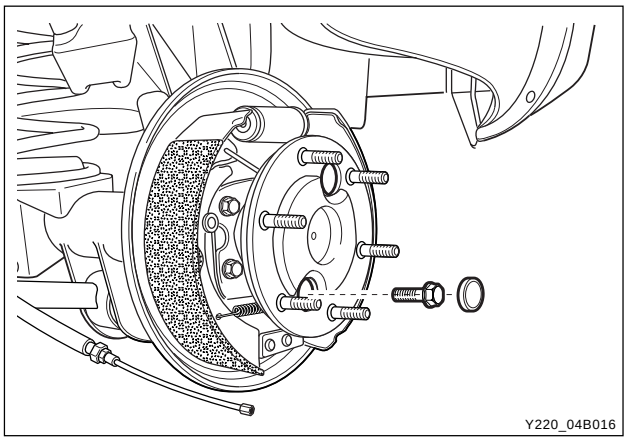
   Insert two bolts into the service holes and tighten both bolts evenly.

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





6. Remove two plastic plugs from the axle shaft flange and remove inner bracket nuts.



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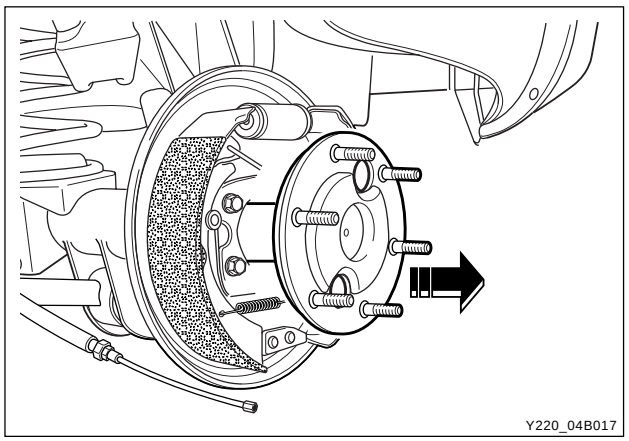
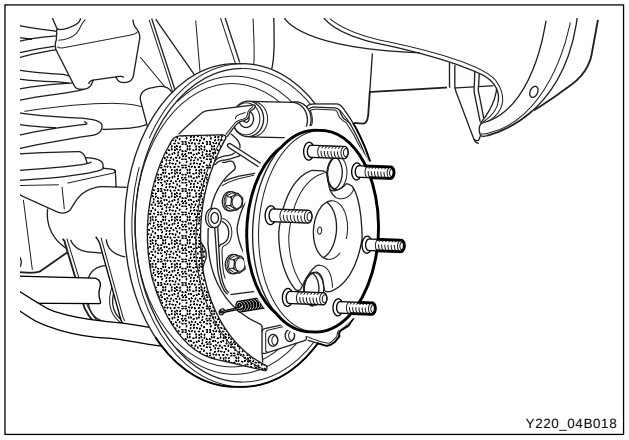


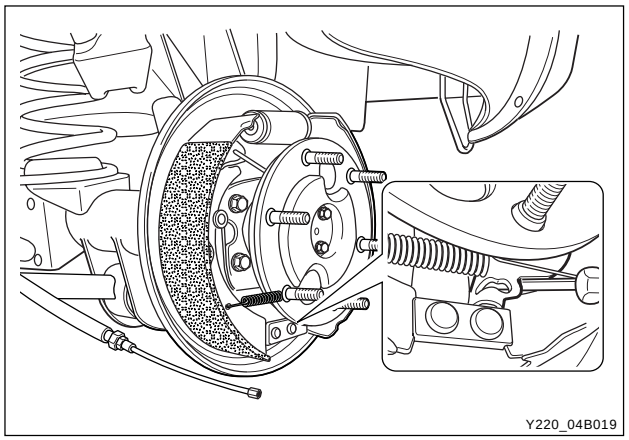
7. Remove the axle shaft.



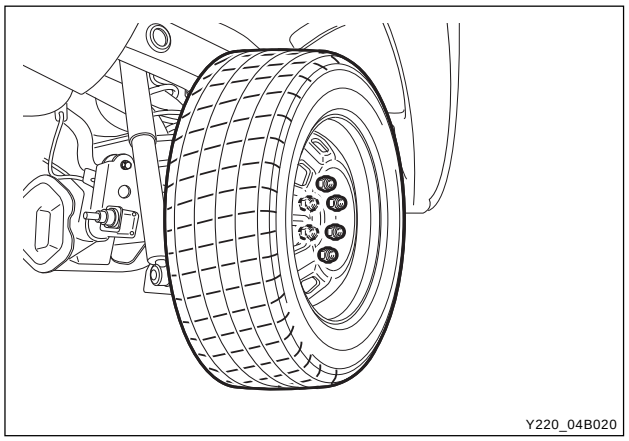
Installation

1. Check the rear axle shaft.
2. Insert the rear axle shaft into the axle housing and tighten the flange nuts.

Tightening torque	50 ~ 65 Nm



3. Connect the parking brake cable and install the brake drum.



4. Install the tire and test the brake function.

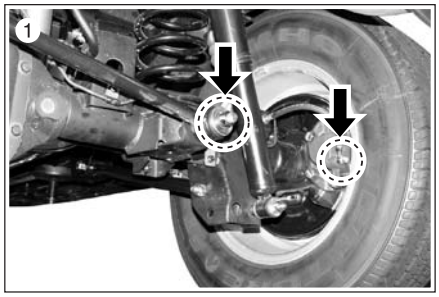
REAR AXLE HOUSING

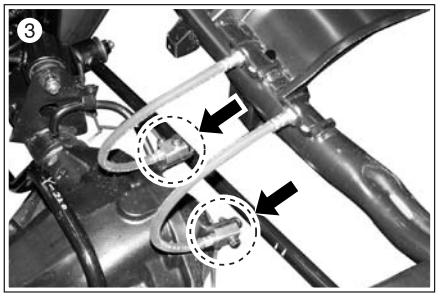
Removal

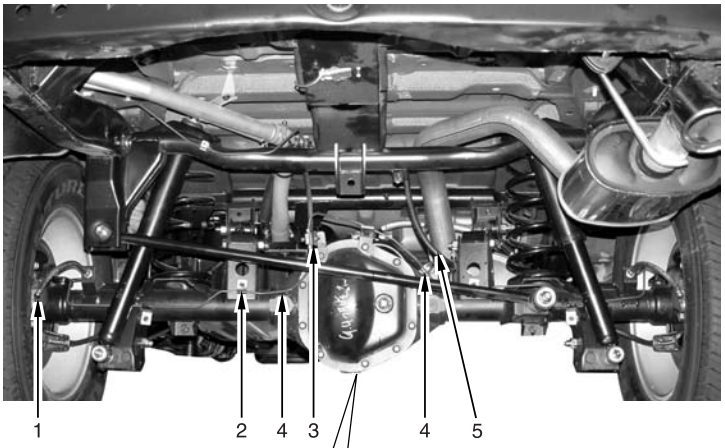
1. Remove the tire.
2. Remove the brake oil hoses and pipes.
   (1) Brake pipe flare nut
   (2) Brake pipe mounting clip
   (3) 3-way connector
   (4) Brake pipe assembly
3. Remove the air breather (5).
4. Remove the propeller shaft from rear axle input shaft.

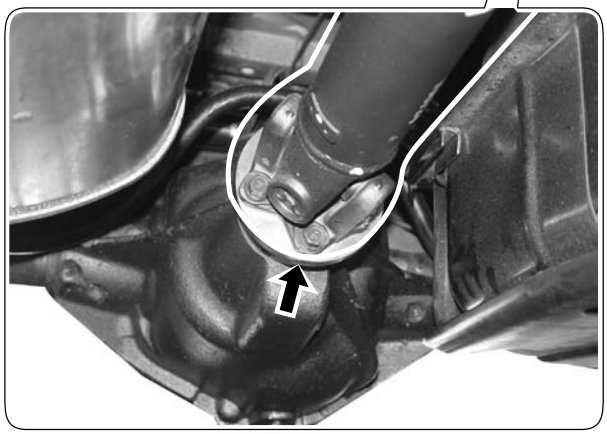
Notice

Place an alignment mark before removing.









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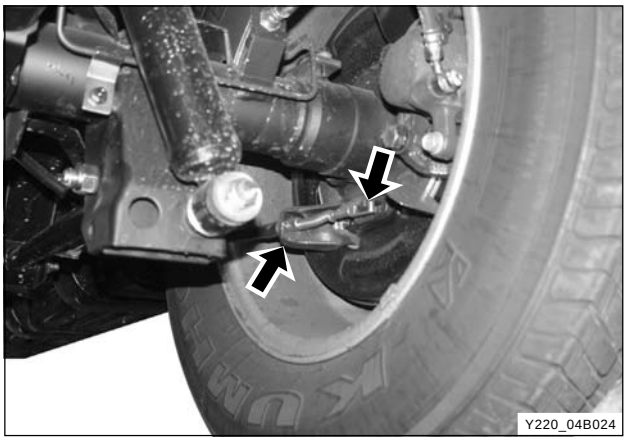
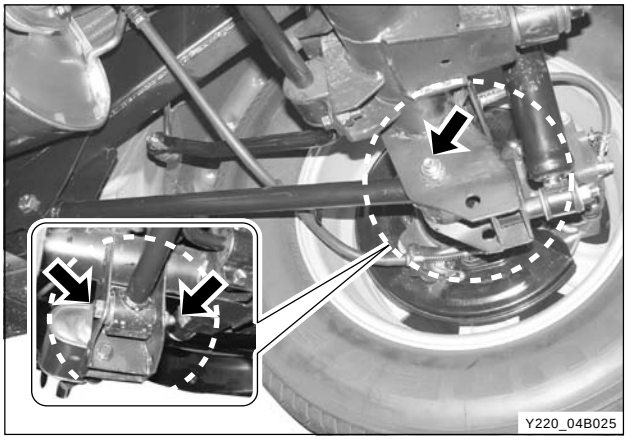
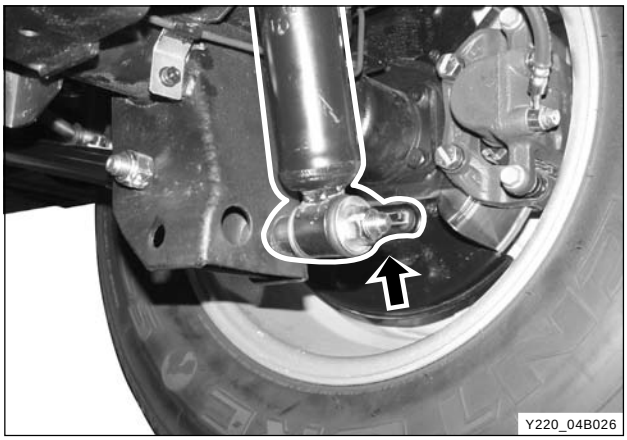


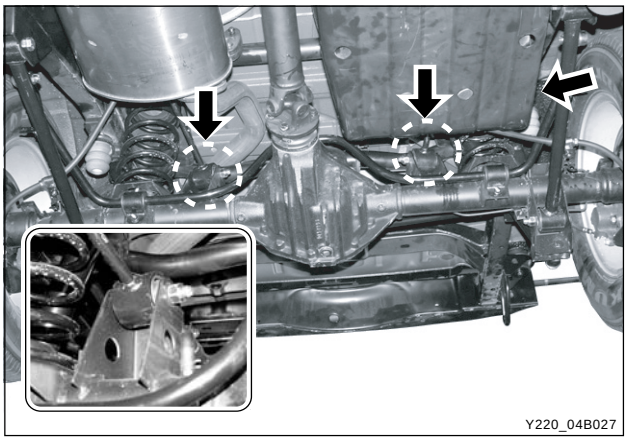
5. Remove the parking brake lock pin.
6. Remove the parking brake lever and disconnect the cable.



7. Unscrew the nuts and remove the lower arm from axle housing.

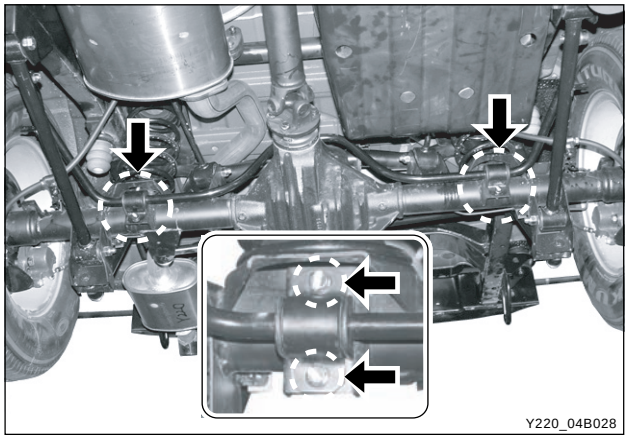


8. Separate the shock absorber base from axle housing.

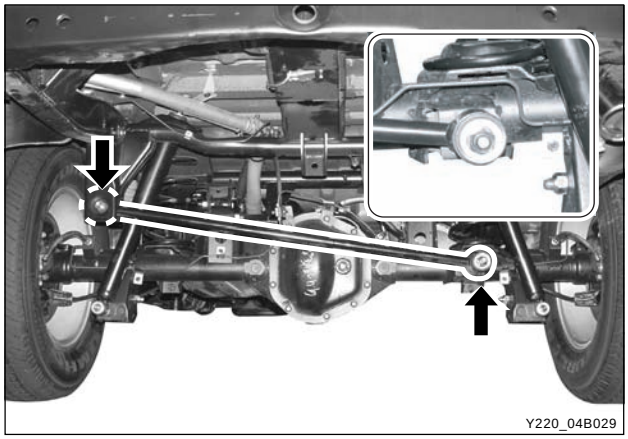


9. Unscrew the nuts and remove the upper arm from axle housing.

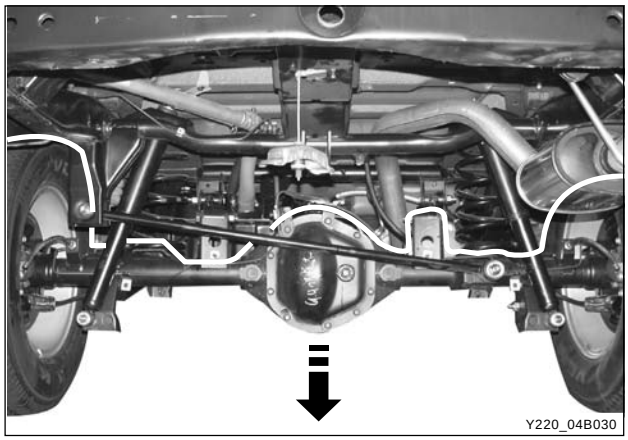
10. Remove the stabilizer bar.



11. Unscrew the nuts and remove the lateral rod from axle housing.

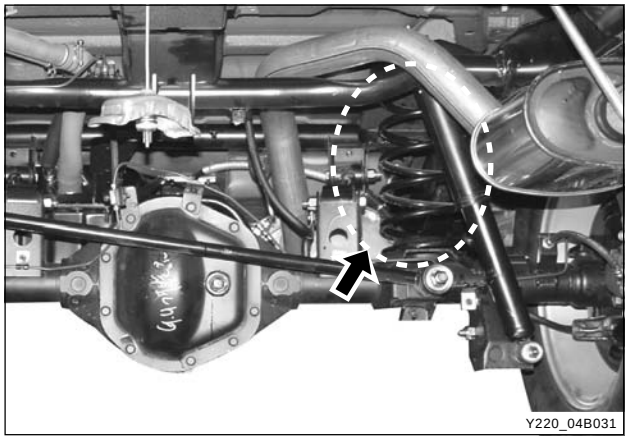


12. Remove the coil spring and spring seat while lowering one end of axle very carefully.
13. Lower the safety axle very carefully to remove the axle.



Installation

1. Place the rear axle housing in the installation position and install both coil springs.



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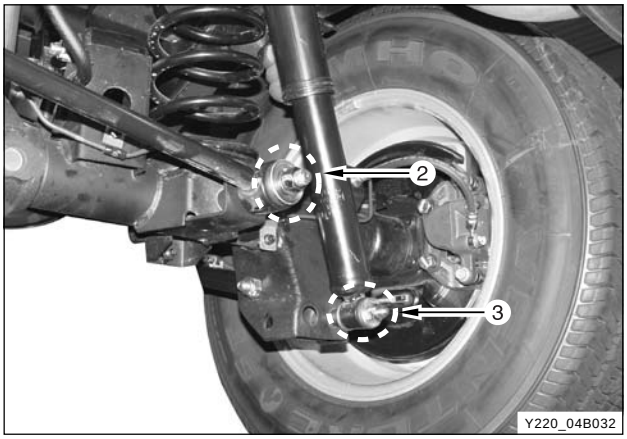


2. Install the lateral rod to axle housing.

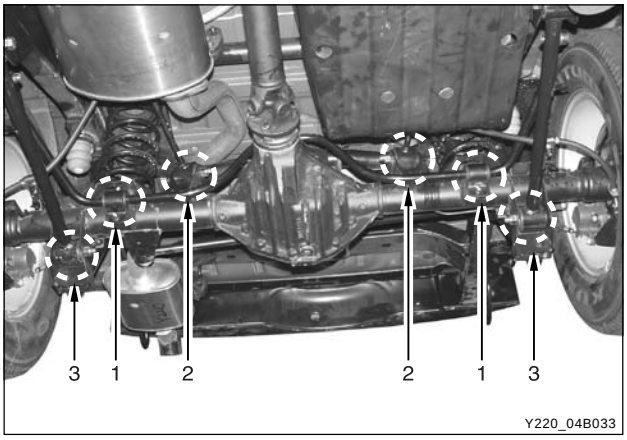
Notice

Do not fully tighten the nut.

Tightening torque ②	150 ~ 180 Nm

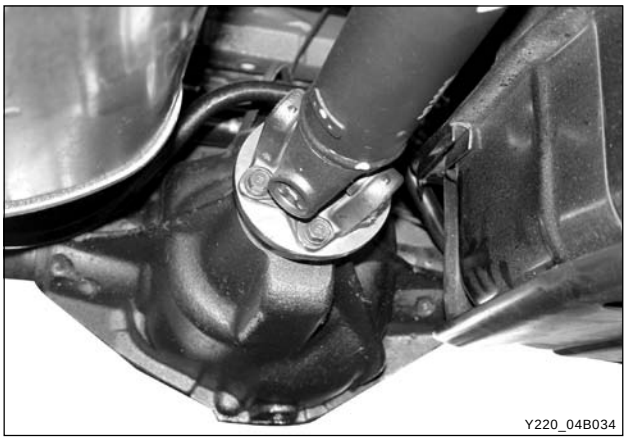
3. Install the shock absorber base to axle housing.

Tightening torque ③	50 ~ 65 Nm



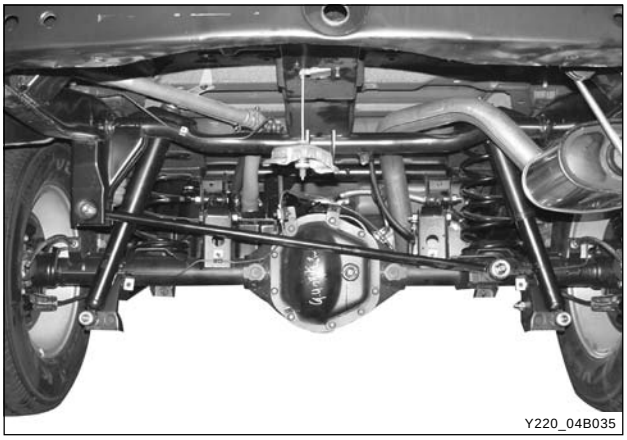
4. Install the stabilizer bar, upper arm and lower arm to axle housing.

Stabilizer bar cap bolt ①	30 ~ 45 Nm
Upper arm nut ②	150 ~ 180 Nm
Lower arm nut ③	150 ~ 180 Nm



5. Install the propeller shaft to rear axle.

Tightening torque	70 ~ 80 Nm



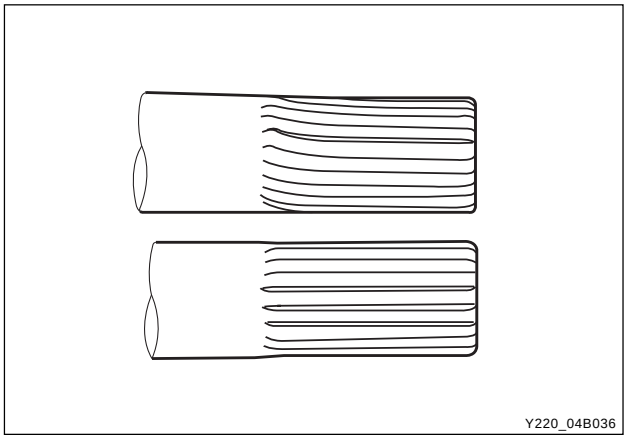
6. Install the brake cable, air breather hose, oil pipes and LCRV device to rear axle assembly.

LCRV bolt	12 ~ 23 Nm
Air breather hose bolt	6 ~ 8 Nm
Brake oil pipe	15 ~ 19 Nm

7. Bleed the air from the brake system and install the tire.

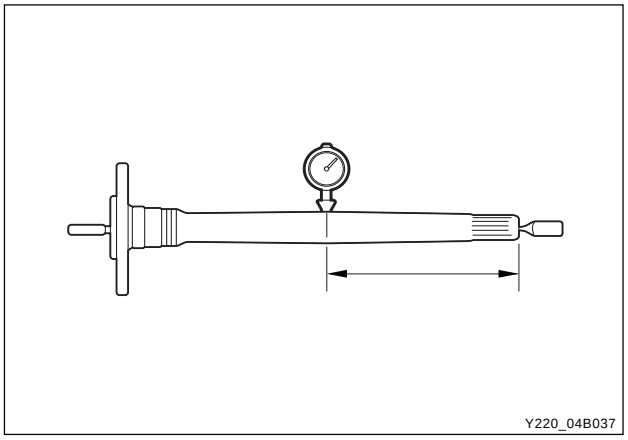
Inspection

1. Check the shaft spline for wear and damage.



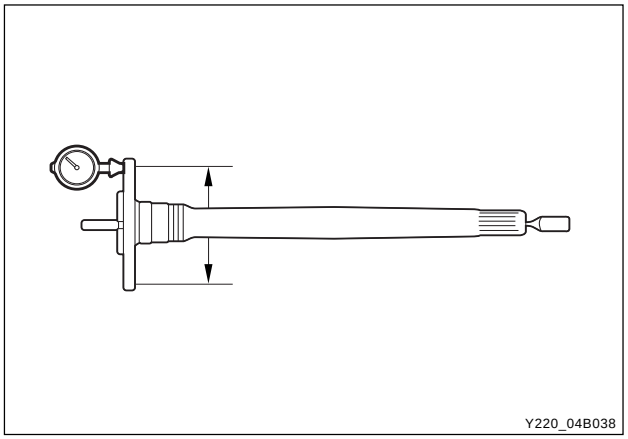
2. Measure the run-out of shaft.

Specified value	below 1.0 mm



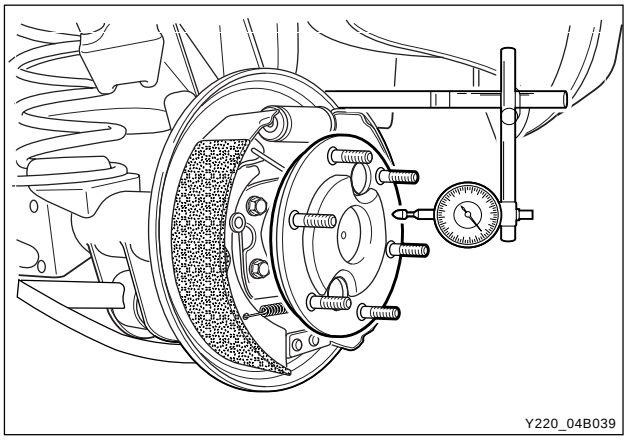
3. Measure the run-out at bearing hub in shaft flange.

Specified value	below 0.13 mm



4. Install the axle shaft and measure the axial play.

Specified value	below 0.38 mm



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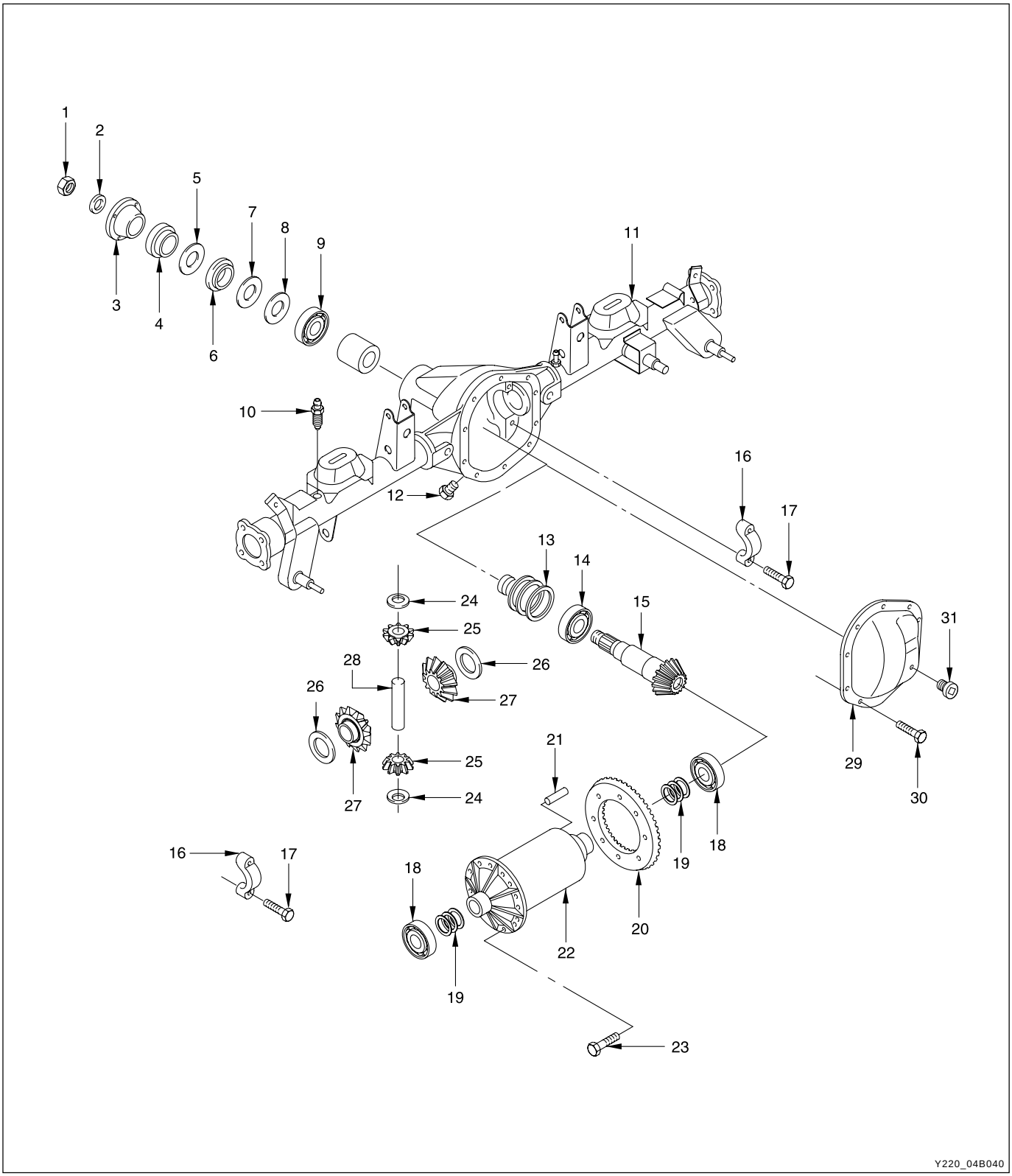
DISASSEMBLY AND REASSEMBLY

EXPLODED VIEW



1. Drive pinion lock nut ..... 240 ~ 310 nm
2. Washer
3. Companion flange
4. Pinion oil seal
5. Bearing slinger
6. Bearing
7. Shim
8. Shim
9. Bearing cup
10. Breather nipple
11. Rear axle housing
12. Oil drain plug ..... 28 ~ 42 Nm
13. Shim
14. Bearing
15. Drive pinion
16. Bearing cap
17. Bolt ..... 87 ~ 124 Nm
18. Bearing
19. Shim
20. Ring gear
21. Shaft lock pin
22. Differential case
23. Ring gear mounting bolt ..... 75 ~ 90 Nm
24. Thrust washer
25. Differential pinion (spider gear)
26. Thrust washer
27. Side gear
28. Differential shaft
29. Housing cover
30. Bolt ..... 38 ~ 46 Nm
31. Oil filler plug ..... 28 ~ 42 Nm

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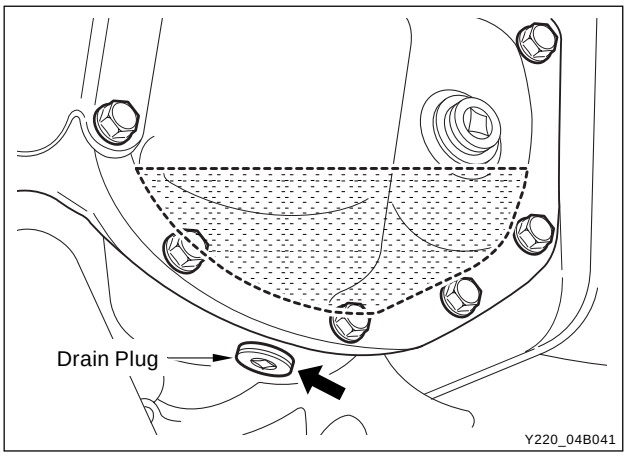
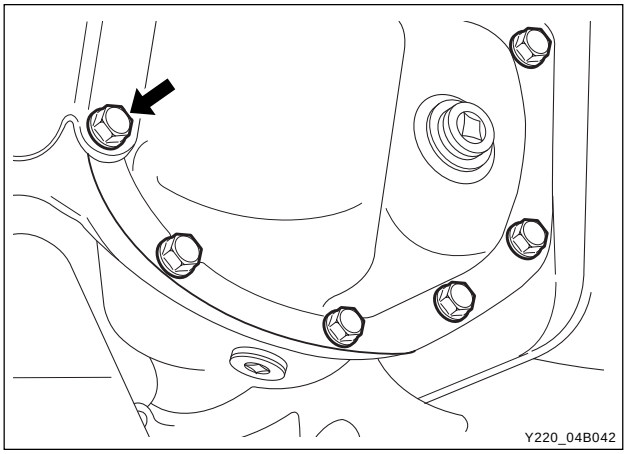
REAR AXLE ASSEMBLY

Disassembly



1. Remove the drain plug and drain the oil. Install the drain plug.

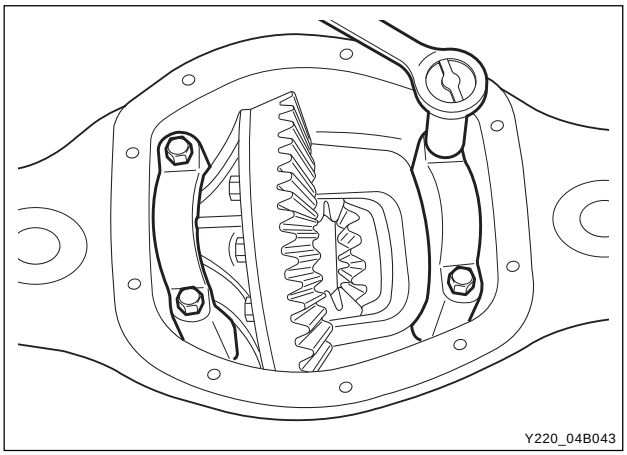
Tightening torque	28 ~ 42 Nm



2. Remove the axle housing cover.

Notice

Remove the gasket residues from cover and housing mating surface.

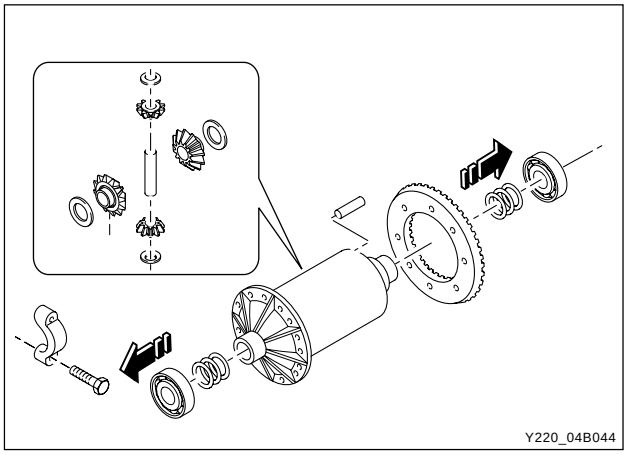


3. Unscrew bolts and remove the bearing cap, then remove the differential carrier assembly.

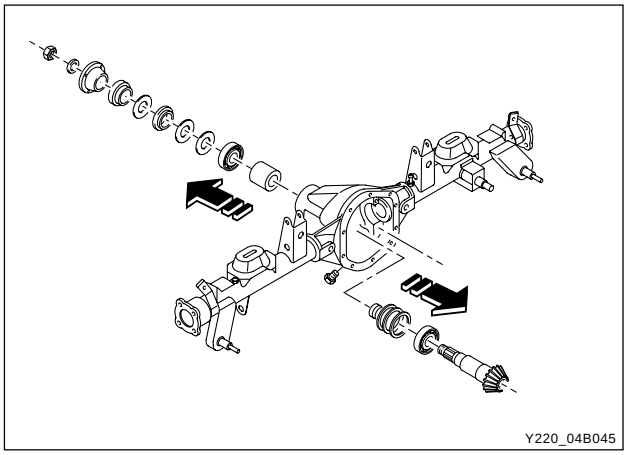
Notice

Before removal, place the alignment marks on the bearing cap so that they cannot be changed. Be careful not to damage the axle housing while removing.

4. Disassemble the differential carrier assembly.



5. Unscrew the lock nut and disassemble the driving pinion assembly.



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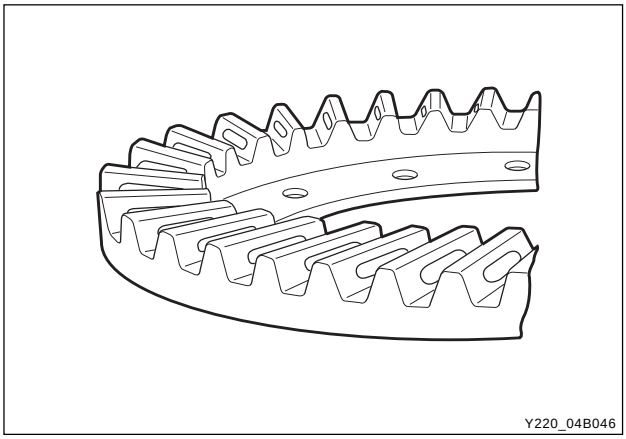
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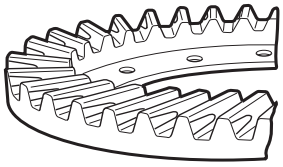
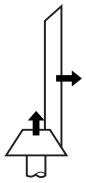
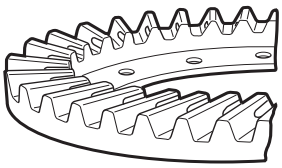
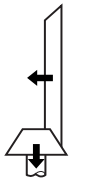
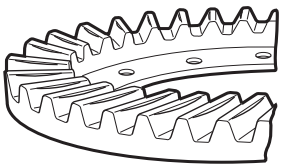
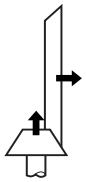
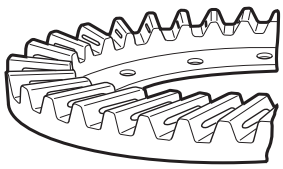
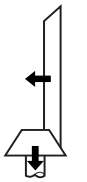
Inspection of Ring Gear Tooth Contact Pattern

1. Normal Contact

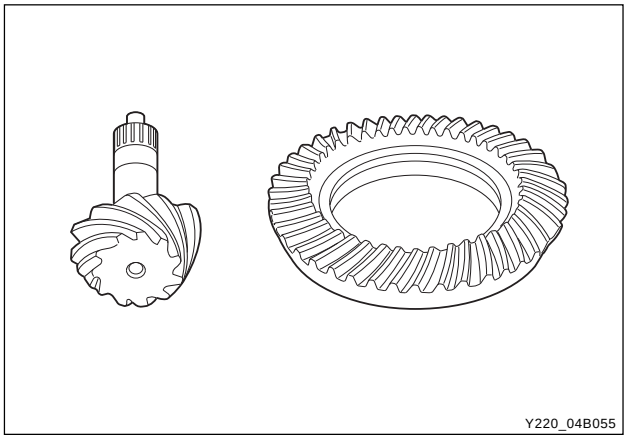
   Apply gear-marking compound (Prussian blue / red lead) on the ring gear teeth. Rotate the ring gear and check the tooth contact pattern.

2. Abnormal Contact

Tooth Contact Pattern	Possible Cause	Remedy
1. Heel contact  A Y220_04B047	Excessive backlash • Noise can be occurred	Adjust backlash (Drecrease backlash) • Select proper shin to move the drive pinion toward the ring gear (toward toe)  B Y220_04B048
2. Toe contact  A Y220_04B049	Insufficient backlash • Tooth can be damaged or broken under heavy load	Adjust backlash (Increase backlash) • Select proper shim to move the drive pinion against the ring gear (toward heel)  B Y220_04B050
3. Face contact  A Y220_04B051	Excessive backlash • Drive pinion shaft is apart from the ring gear • Noise can be occurred	Adjust backlash (Increase pinion shim) • Move the drive pinion toward the ring gear (toward center of ring gear)  B Y220_04B052
4. Flank contact  A Y220_04B053	Insufficient backlash • Gear contacts on the low flank • Gear can be damaged or worn • Noise can be occurred	Adjust backlash (Decrease pinion shim) • Move the ring gear toward the drive pinion (toward ring gear center line)  B Y220_04B054

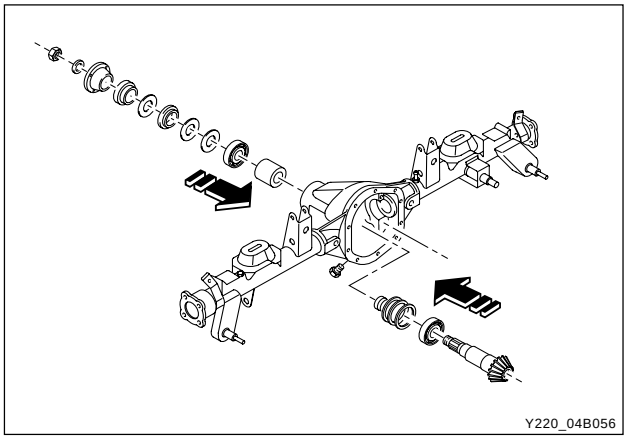
Assembly

1. Clean all parts and check the followings:
   - Check the ring gear, drive pinion for wear and damage. If damaged, replace it as a set.
   - Check the bearing for sticks, wear, noise and turning resistance.
   - Check the side gear, pinion, pinion shaft and thrust washer for wear and damage.
   - Check the differential carrier for crack and wear (bearing sliding surface). Check the gear case for crack.


Y220_04B055

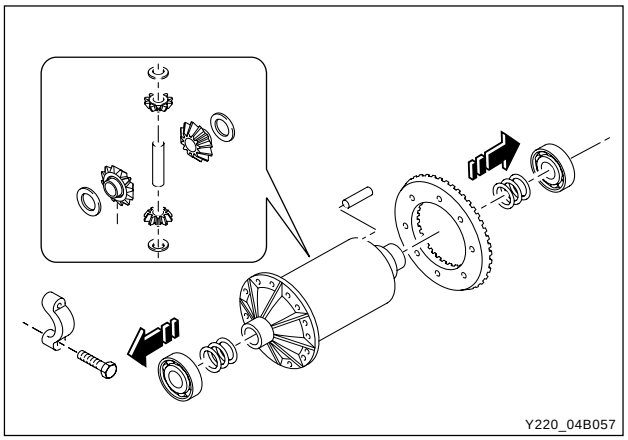
2. Insert the drive pinion assembly into the axle housing and tighten the pinion lock nut.

Tightening torque	240 ~ 310 Nm


Y220_04B056

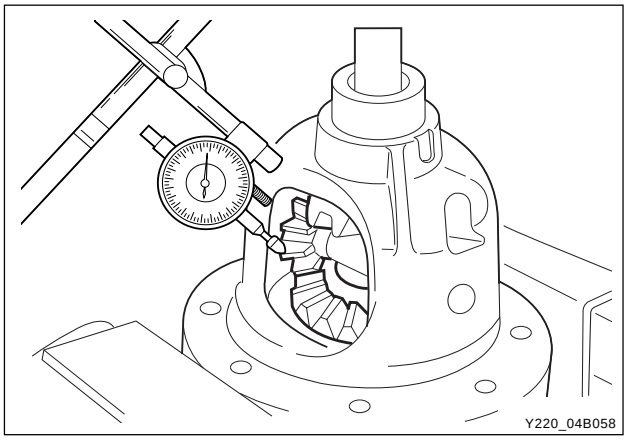
3. Assemble the differential carrier assembly. At this time, align the ring gear to the mark on the differential carrier and tighten the bolts.

Tightening torque	75 ~ 90 Nm


Y220_04B057

4. Measure the backlash between side gear and pinion gear.

Specified value	0 ~ 0.05 mm


Y220_04B058

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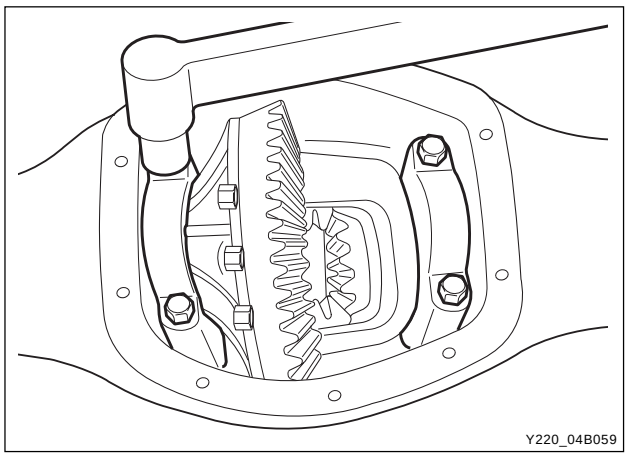
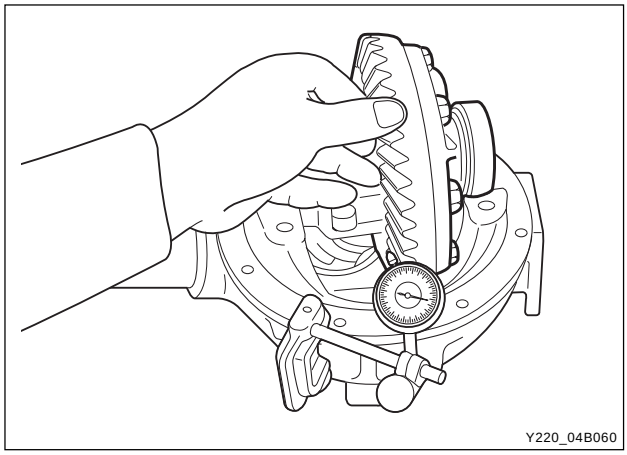


5. Install the differential carrier assembly into the axle housing. Install the bearing cap.

Tightening torque	240 ~ 310 Nm

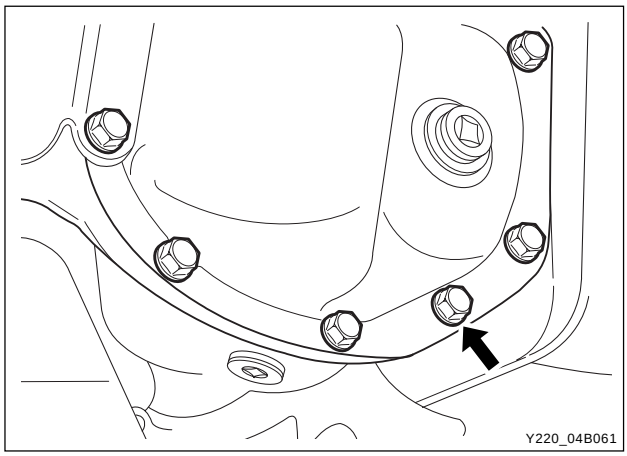
Notice

Be careful not to mix the caps.



6. Measure the backlash between drive pinion and ring gear.

Specified value	0.13 ~ 0.20 mm



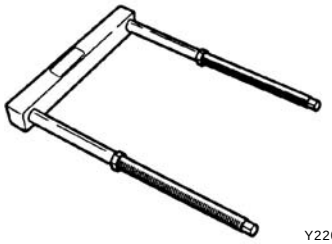
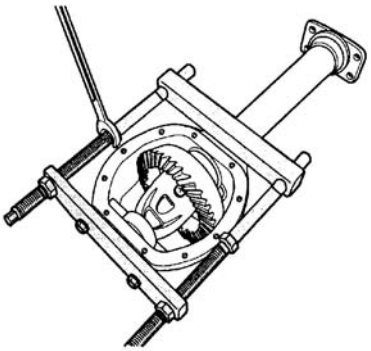
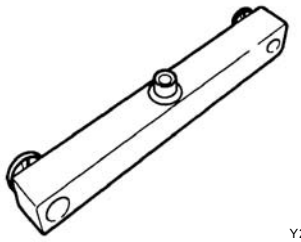
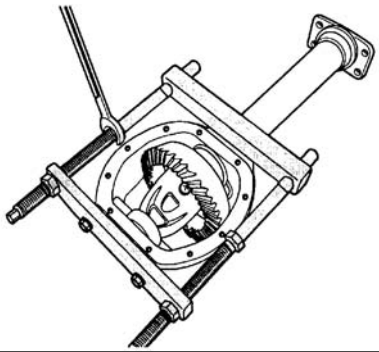
7. Install the axle housing cover.

Tightening torque	39 ~ 46 Nm

TROUBLE DIAGNOSIS

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

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
SY 340 - 090 - 01 (W 99 42 001 1B) **Drive differential remover and installer**  Y220_04B062	Removal and installation of drive axle differential gear  Y220_04B063
SY 340 - 090 - 03 (W 99 42 003 1B) **Rear drive differential remover and installer**  Y220_04B064	Removal and installation of rear drive axle differential gear  Y220_04B065

SECTION 4C

PROPELLER SHAFT

Table of Contents

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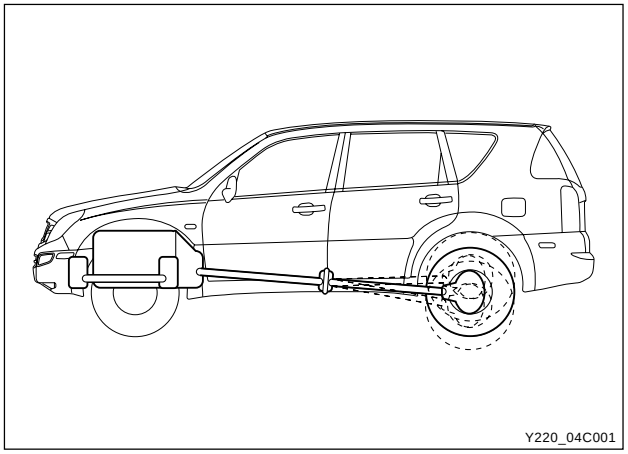
GENERAL INFORMATION

OVERVIEW

The propeller shaft transfers the power through the transmission and transfer case to the front/rear axle differential carrier (final reduction gear). It is manufactured by a thin rounded steel pipe to have the strong resisting force against the torsion and bending.

Both ends of propeller shaft are connected to the spider and the center of propeller shaft is connected to the spline to accommodate the changes of the height and length. The rubber bushing that covers the intermediate bearing keeps the balance of rear propeller shaft and absorbs its vibration.



SPECIFICATION

Description	Specification		
Structure			Yoke and spider type universal joint
Joint type			Spider (Needle roller bearing)
Number of spiders	Front	Full time T/C	1
		Part time T/C	2
	Rear		3
Outer diameter of spider (mm)			ϕ17.91
Tube run-out (after installation)			below 0.4 mm
Front shaft dimension Length x Inner diameter x Outer diameter (mm)	Diesel + M/T(A/T) + 4408 TC (Part time)		607.1 x ϕ 59.5 x ϕ 63.5 (compressed)
	Gasoline + M/T(A/T) + 4421 TC (TOD)		577.9 x ϕ 44.7 x ϕ 50.8 (center position)
Front shaft dimension Length x Inner diameter x Outer diameter (mm)	Diesel + M/T(A/T) + 4408 TC		(585.2 + 567.5) x ϕ 59.5 x ϕ 63.5 (compressed)
	Gasoline + M/T(A/T) + 4421 TC		(566.1 + 567.5) x ϕ 59.5 x ϕ 63.5 (compressed)
Unbalance	below 30 g·cm @ 4500 rpm (Front shaft + Part time TC, Rear shaft)		
	below 14.5 g·cm @ 5300 rpm (Front shaft + Full time TC)		
Front shaft dimension Length x Inner diameter x Outer diameter (mm)	DI engine + M/T(A/T) + Part time TC		575.7 x ϕ 59.5 x ϕ 63.5 (compressed)
	DI engine + M/T(A/T) + Full time TC		560.8 x ϕ 44.7 x ϕ 50.8 (center position)
Front shaft dimension Length x Inner diameter x Outer diameter (mm)	DI engine + M/T(A/T) + Part time TC		(565.9 + 547.6) x ϕ 59.6 x ϕ 63.5 (compressed)
	DI engine + M/T(A/T) + Full time TC		

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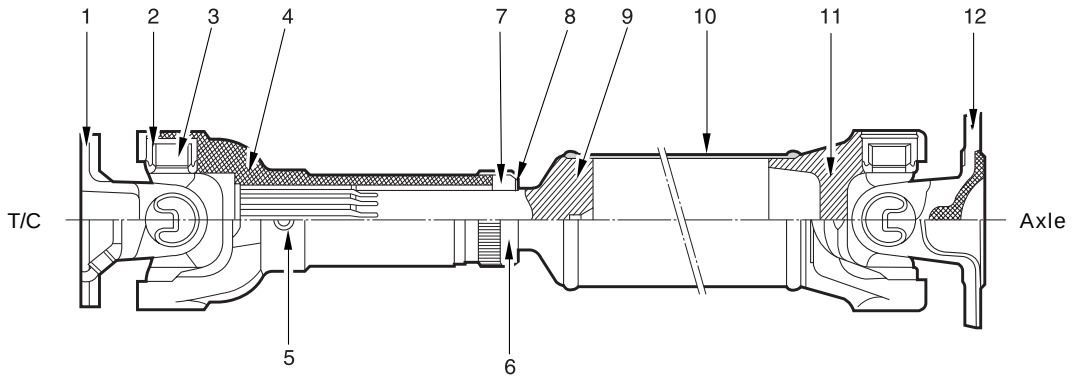
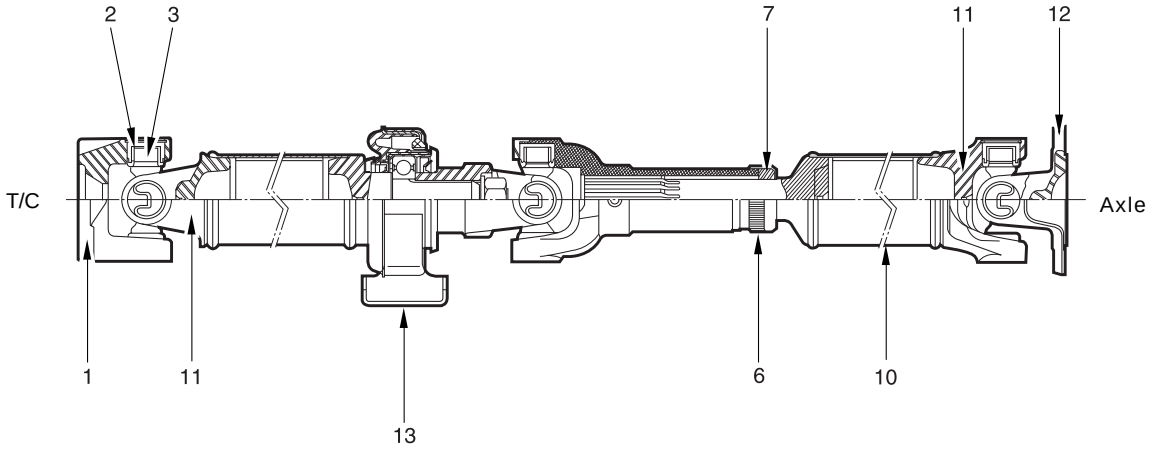
COMPONENT LOCATOR

▶ Cross Sectional View

Front Propeller Shaft



Rear Propeller Shaft

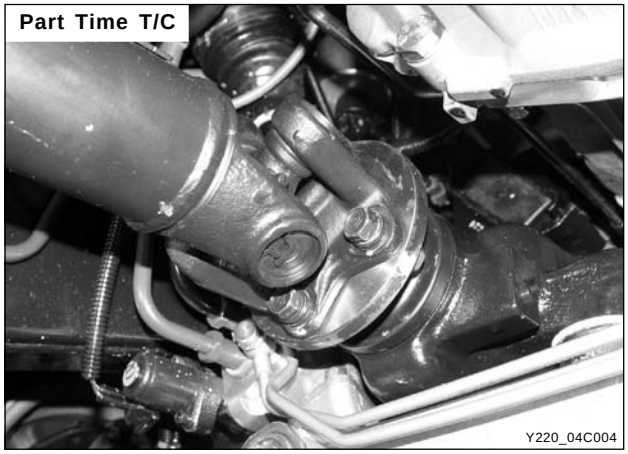


Y220_04C002

1. Flange yoke
2. Journal bearing cap
3. Spider journal
4. Slip yoke assembly
5. Grease nipple
6. Dust cap
7. Oil seal
8. Split washer
9. Slip tube shaft
10. Tube
11. Tube yoke
12. Flange yoke
13. Center bearing

REMOVAL AND INSTALLATION

Part Time T/C



Y220_04C004

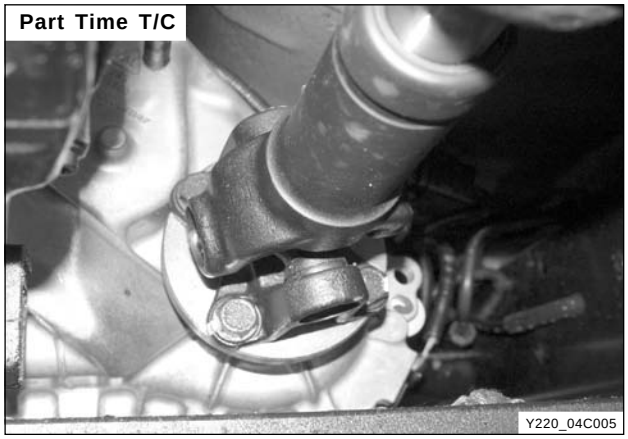
TOD

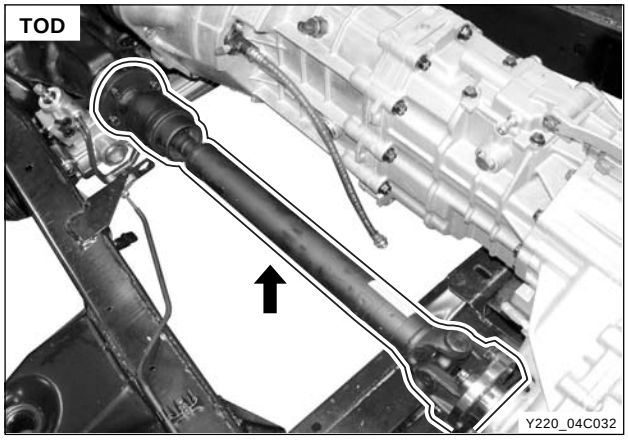
Y220_04C031

Removal

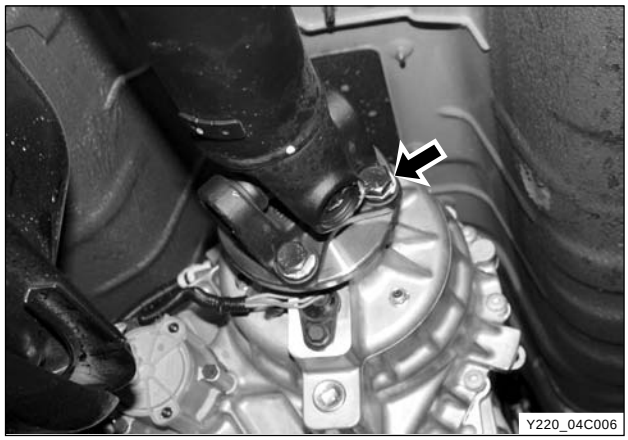
1. Place the alignment on the propeller shaft.

2. Remove the front propeller shaft.





3. Remove the transfer case flange yoke bolts and nuts from rear propeller shaft.



4. Remove the intermediate bearing (center) bolts.

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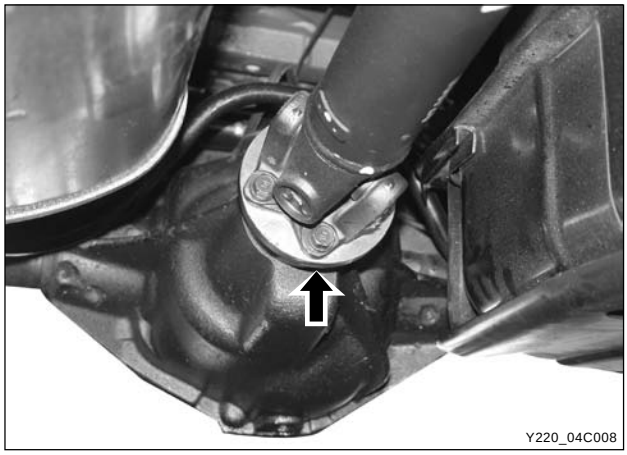


Y220_04C008

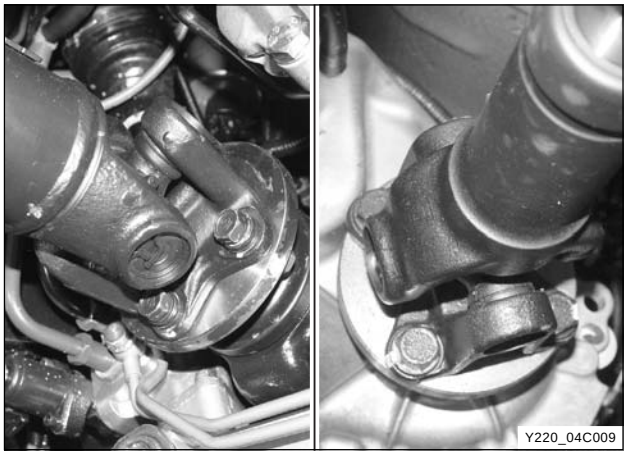
Y220_04C033

5. Unscrew the rear axle housing flange yoke bolts and nuts and remove the rear propeller shaft assembly.

Installation

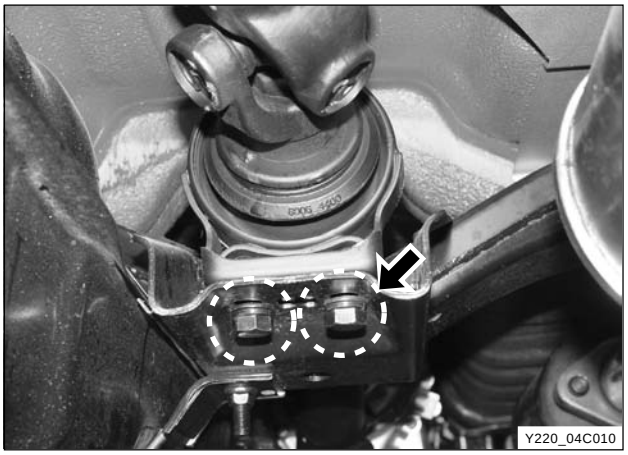
1. Check the removed elements.
2. Align the marks on each propeller shaft.
3. Install the front propeller shaft.

Axle	70 ~ 80 Nm
Transfer case	80 ~ 88 Nm



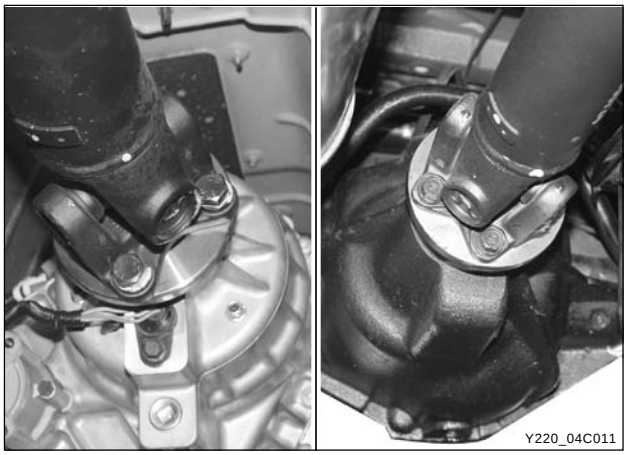
4. Place the rear propeller shaft between transmission and axle housing and temporarily install the intermediate (center) bearing.

Tightening torque	80 ~ 95 Nm



5. Install the rear propeller shaft with the aligning the marks and tighten the intermediate bearing.

Axle side	70 ~ 80 Nm
Transfer case side	80 ~ 88 Nm



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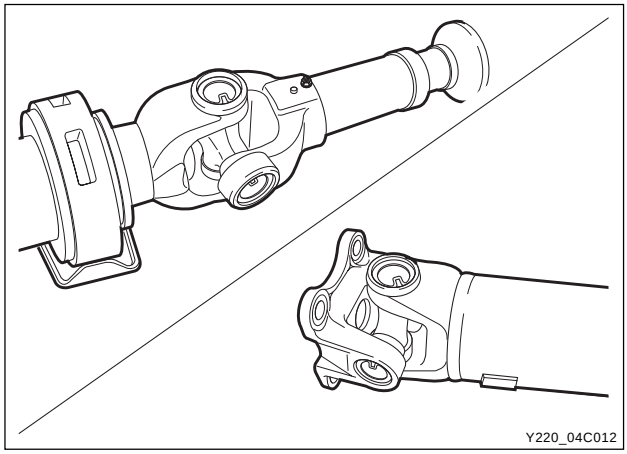
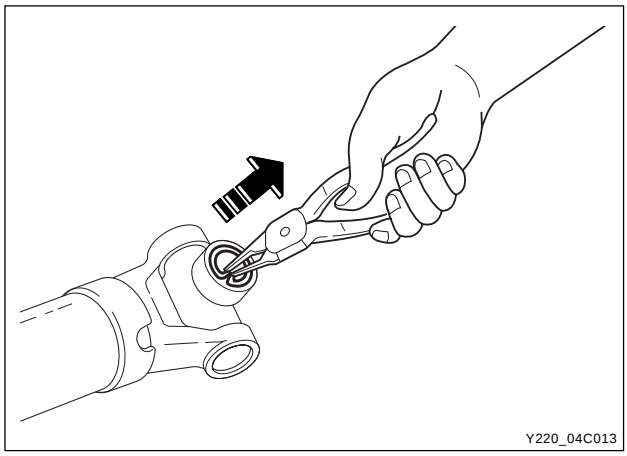
DISASSEMBLY AND REASSEMBLY

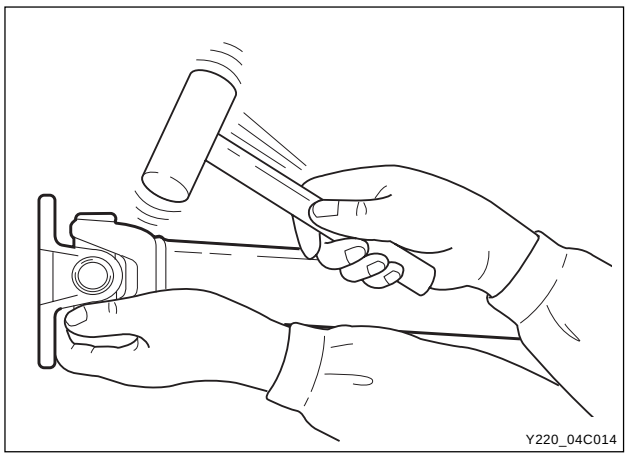


Disassembly

1. Place an alignment mark and remove the propeller shaft.
2. Place an alignment on the spiders before removing.

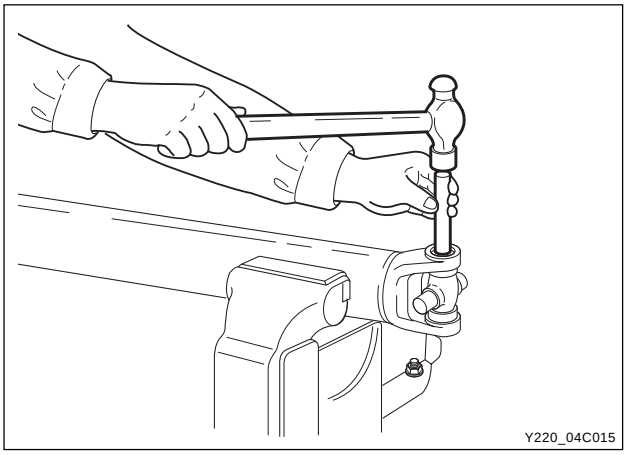


3. Remove the snap ring with snap ring pliers.



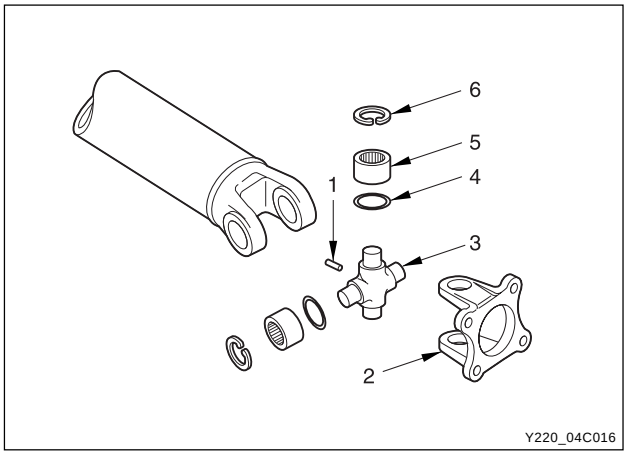
4. Tap the yoke shoulder on shaft with copper hammer to remove the roller bearing. Remove the other bearings with same manner.

5. If it cannot be removed, hold the welding area with vise and remove the needle bearing by using a suitable drift and hammer.

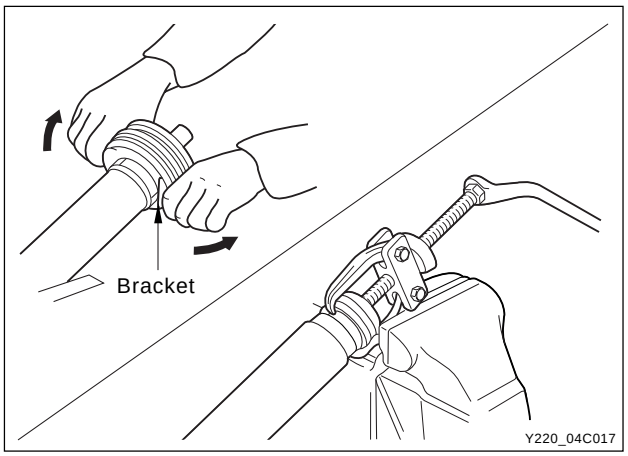


6. Disassemble the universal joint.

   The universal joint compensates the angle changes due to vertical movement of the axle shaft.



7. Remove the intermediate bearing bracket and remove the bearing with special tool.



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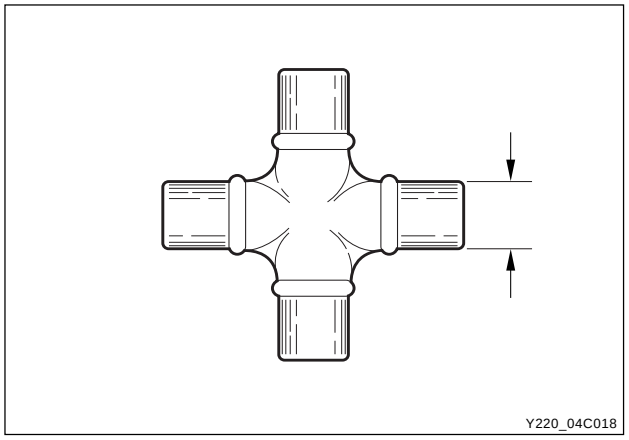

Y220_04C018

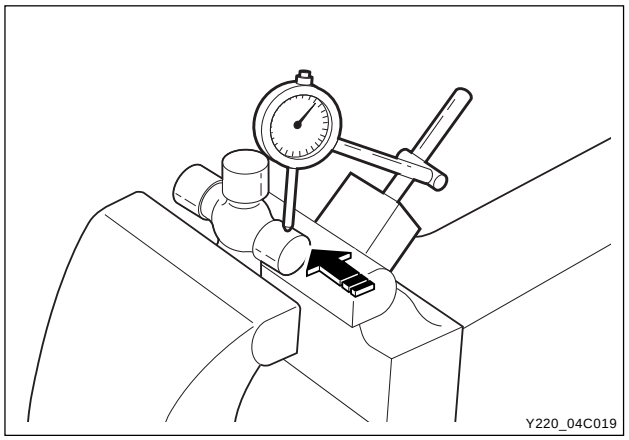
Check

1. Visual Check

   Check the components for wear and crack and replace if needed.

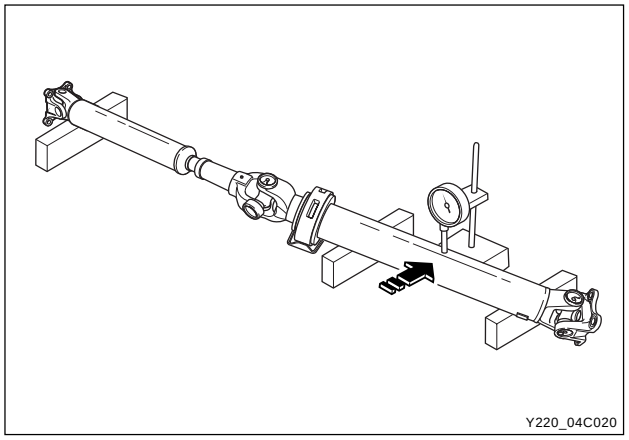
2. Outer diameter of spider journal

Specified value	17.893 mm
Limit	17.910 mm


Y220_04C019

3. Clearance between spider journal and bearing

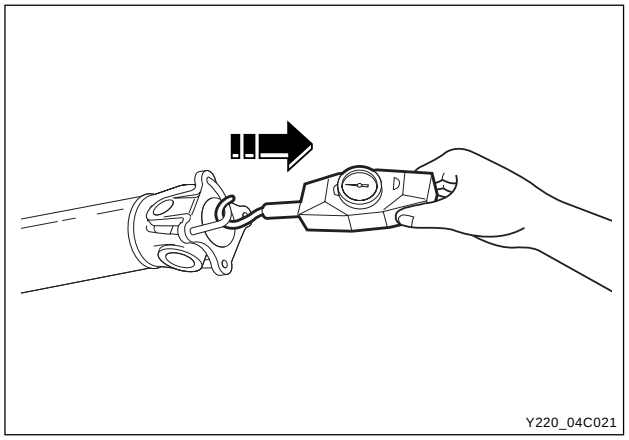
Specified value	0.03 ~ 0.098 mm
Limit	0.25 mm


Y220_04C020

4. Run-out of propeller shaft

   Set up the dial gauge on the center point of propeller shaft and measure the run-out. If the run-out is out of the specified range, correct it with press or replace it with new one.

Limit	0.4 mm


Y220_04C021

5. Starting torque of universal joint

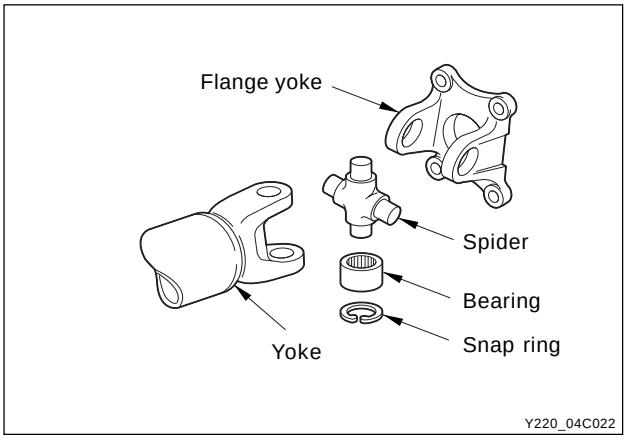
Specified value	3 ~ 8 kg· cm

6. Major causes of vibration
   - Balance weights missing
   - Excessive run-out of propeller shaft
   - When using the general bolts
   - Excessive wear of universal joint
   - Stuck in sleeve joint
   - Vibration is mainly caused by the angle changes in front and rear universal joint. It normally occurs when the vehicle speed is 60 ~ 100 km/h.

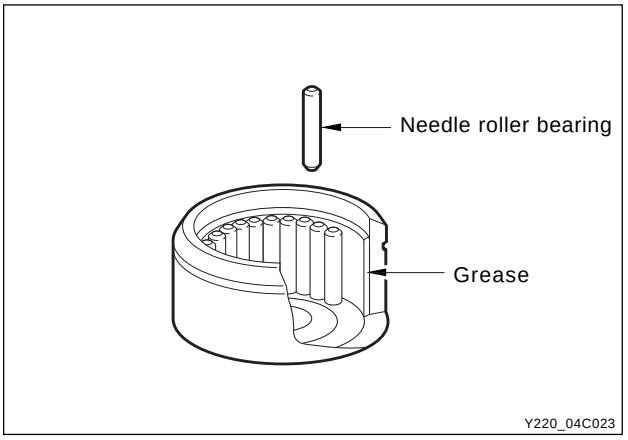
Assembly

Clean the components and replace if damaged.

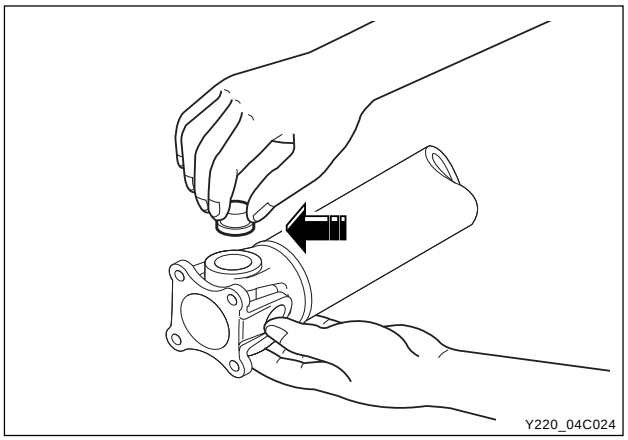
1. Align the alignment marks on the yoke and assemble the spider, bearing and snap ring.



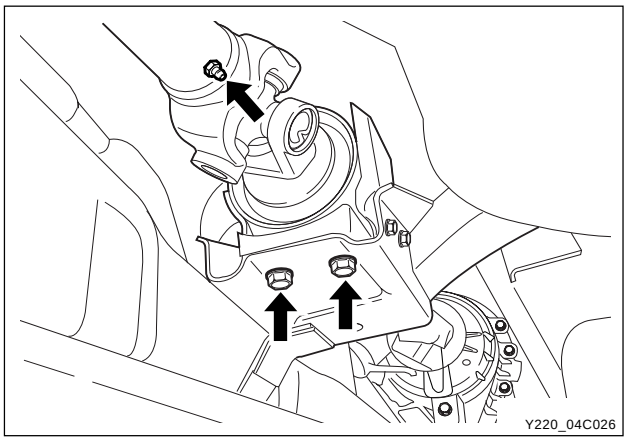
2. Apply the grease to the inner lip of needle roller bearing and assemble the needle roller.



3. Install the yoke bearing shaft on the shaft and insert the spider. Place the cap on the opposite side and tap it with plastic hammer to seat it. Adjust the clearance of spider below 0.1 mm and install the snap ring.



4. Install the intermediate bearing to the rear propeller shaft.
5. Apply the grease on the propeller shaft and install it.



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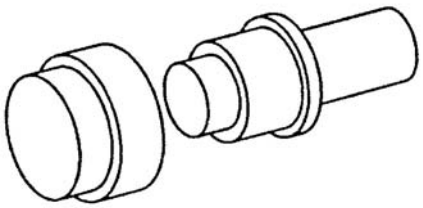
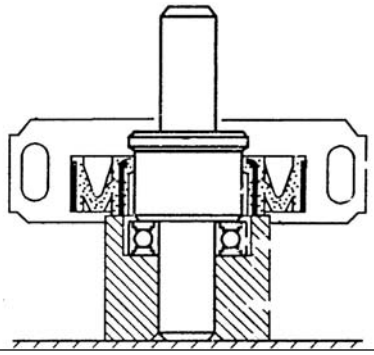
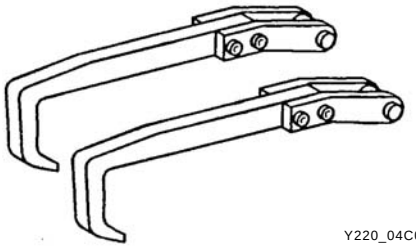
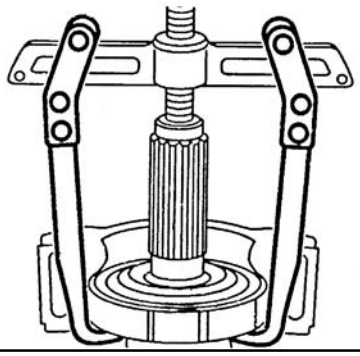
TROUBLE DIAGNOSIS

Symptom	Cause	Action
Vibration	Poor installation of sliding joint	Adjust
	Bending of propeller shaft	replace
	Incorrect symmetry of universal joint snap rings	Adjust
	Loose yoke bolt	Tighten
Noise	Worn or damaged universal joint bearing	Replace
	Missing universal joint snap ring	Adjust and replace
	Loose yoke connection	Tighten
	Worn sliding joint spline	Replace
	Lack of grease	Add

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
116 589 09 43 00 (P 99 48 003 0A) **Remover and installer**  Y220_04C027	Centering the clutch disc  Y220_04C028
129 589 00 34 00 (P 99 33 002 0B) **Pulling arms**  Y220_04C029	Removal of bearing  Y220_04C030

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SECTION 5A

WHEEL & TIRE

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DESCRIPTION AND OPERATION

GENERAL

▶ Tire and Wheel Balancing

There are two types of the tire and wheel balancing: static and dynamic.

Static balance is the equal distribution of weight around the wheel. Assemblies that are statically unbalanced cause a bouncing action called wheel tramp. This condition may eventually cause uneven tire wear.

Dynamic balance is the equal distribution of weight on each side of the centerline so that when the assembly spins there is no tendency for it to move from side to side. Assemblies that are dynamically unbalanced may cause wheel shimmy.

▶ General Balance Precautions

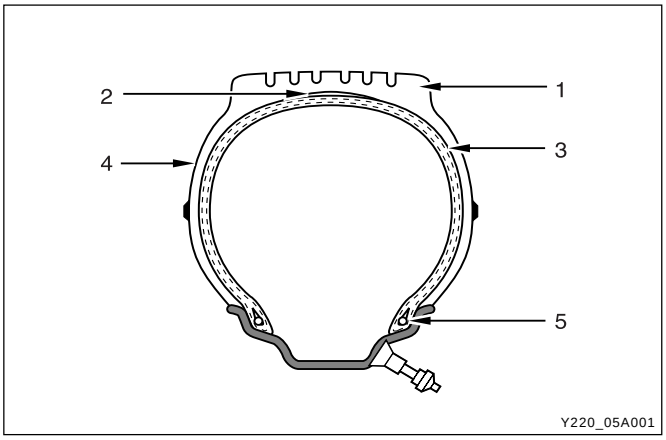
Remove all deposits of foreign material from the inside of the wheel.

Notice

Remove stones from the tread in order to avoid operator injury during spin balancing.

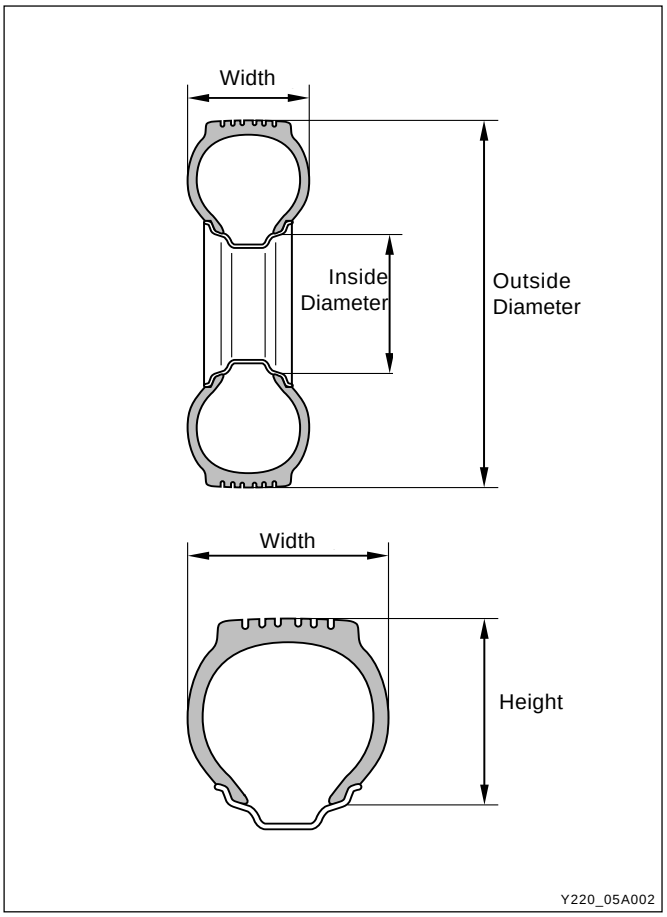
Inspect the tire for any damage. Balance the tire according to the equipment manufacturer's recommendations.

▶ Structure of Tubeless Tube



The tire structure is different slightly according to the types of the tire but a various type of the tire has the common structure as following;

1. Tread
   A part (that contacts) road surfaces directly is fixed on the outsude of carcass and breaker.
   It is a strong rubber coat made of high anti-abrasion rubber. Its running performance depends on is surface profile.
2. Breaker
   A cord belt between tread and carcass prevents damages of inner code due to outer shock and vibration.
3. Carcass
   This major part made by pilling code papers of strong synthetic fiber forms a structure of tire. Since it maintains tire pressure and endures applied load and shock to tire, it should have a high anti-fatigue characteristic.
4. Side Wall
   It is provided to improve the comfortable driving by protecting carcass and cushion movement.
5. Bead
   A steel wire winding the ending part of carcass code, coated with rubber film and wrapped with nylon cord papers. It fixes tire to a rim.



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▶ Conventions for Radial Tire

P 235 / 70 R - 16 102 T

- T: Max Speed : 190 km/h
- 102: Load Index : 850 kg
- 16: Rim Diameter : 16 inch.
- R: Radial Tire
- 70: Aspect Ratio = (Section Height ÷ Section Width) x 100 : 75 %
- 235: Section Width : 235 mm
- P: Passenger Car

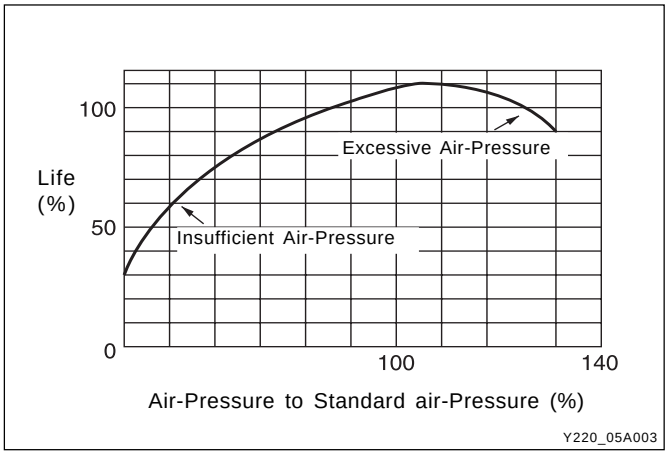
Max Speed Symbol

Symbol	Limit Speed (km/h)
F	80
M	130
N	140
P	150
Q	160
R	170
S	180
T	190
U	200
H	210
V	240
Z	Above 240

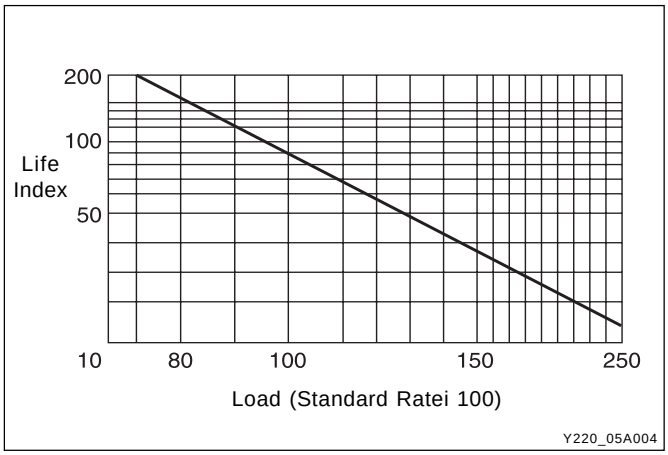
Load Index

Symbol	Limit Speed (km/h)
94	670
95	690
96	710
97	730
98	750
99	775
100	800
101	825
102	850
103	875
104	900
105	925

▶ The Relations Between Inflation Pressure and Tire



▶ The Relations Between Load and Tire



SPECIFICATIONS

Description		Specification	
Wheel	Size	Aluminum type	7JJ x 16
	Wheel nut tightening torque	Aluminum wheel	8 ~ 12 kgf·m
Tire	Type	Radial tire	Radial Tire
	Inflation pressure (psi)	P235/70R16	30 psi
		P255/65R16	30 psi
Wheel alignment	Toe-in	2 ± 2 mm	
	Camber	0° ± 30' (Below 30' the difference between right and left)	
	Caster	2° 45 ± 30' (Below 30' the difference between right and left)	

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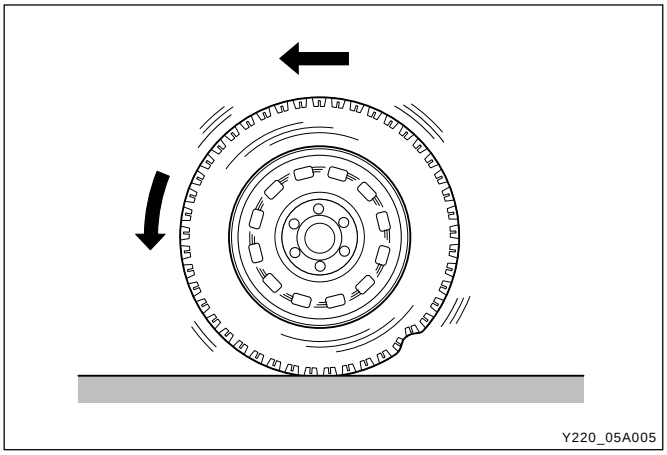
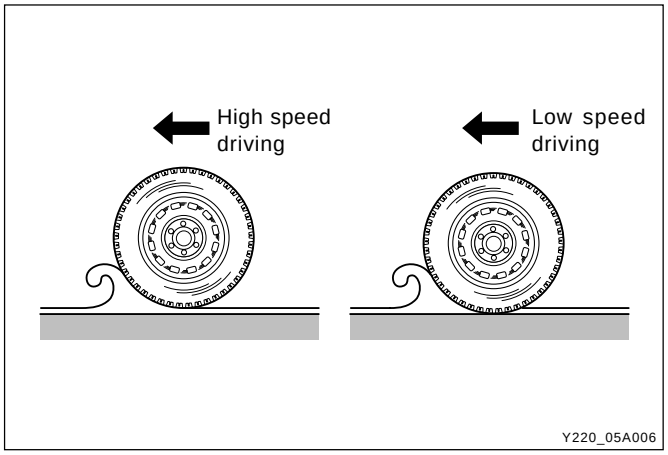
TIRE'S ABNORMAL ACTION

▶ Standing Wave



During running the rotating tire repeats deformation and restoring movement generated in tread. But when the wheel rotating speed reaches high, the next deformation applied to tire before restoring last deformation so the trembling wave appears in the tread portion. The lower the tire pressure the severe the trembling wave appears during the high speed.

▶ Hydroplaning



The condition of driving a vehicle fast on the road surface covered with water can cause tires to fail to rotate with a good contact on the surface, so results in remaining them a float. This is so-called hydroplaning. It causes brake failure, lower tractive force and losing the steering performance so it is very vulnerable condition.

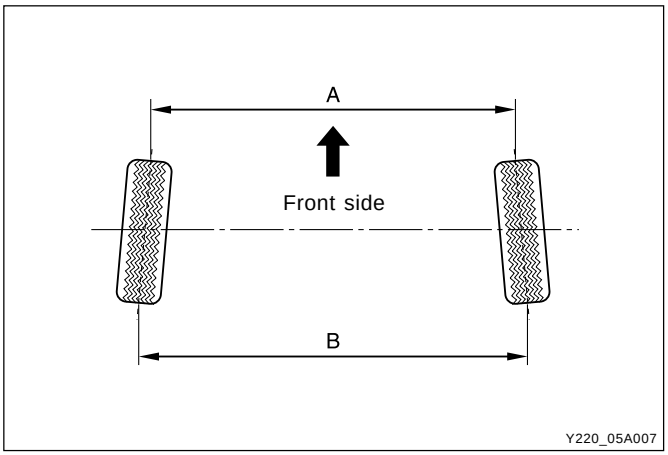
WHEEL ALIGNMENT

The first responsibility of engineering is to design safe steering and suspension systems. Each component must be strong enough to with stand and absorb extreme punishment. Both the steering system and the front and the rear suspension must function geometrically with the body mass.

The steering and suspension systems require that the front wheels self-return and that the tire rolling effort and the road friction be held to a negligible force in order to allow the customer to direct the vehicle with the least effort and the most comfort.

A complete wheel alignment check should include measurements of the rear toe and camber.

▶ Toe-in



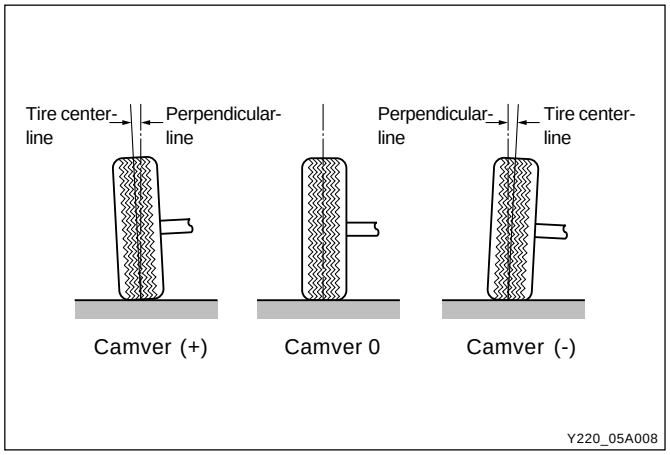
Toe-in is the turning in of the tires, while toe-out is the turning out of the tires from the geometric centerline or thrust line. The toe ensures parallel rolling of the wheels.

The toe serves to offset the small deflections of the wheel support system which occur when the vehicle is rolling forward.

The specified toe angle is the setting which achieves-degrees “0°” of toe when the vehicle is moving.

Incorrect toe-in or toe-out will cause tire wear and reduced fuel economy. As the individual steering and suspension components wear from vehicle mileage, additional toe will be needed to compensate for the wear. Always correct the toe dimension last.

▶ Camber



Camber is the tilting of the top of the tire from the vertical when viewed from the front of the vehicle. When the tires tilt outward, the camber is positive. When the tires tilt inward, the camber is negative. The camber angle is measured in degrees from the vertical. Camber influnces both directional control and tire wear.

If the vehicle has too much positive camber, the outside shoulder of the tire will wear. If the vehicle has too much negative camber, the inside shoulder of the tire will wear. Camber is measured in degrees and is not adjustable.

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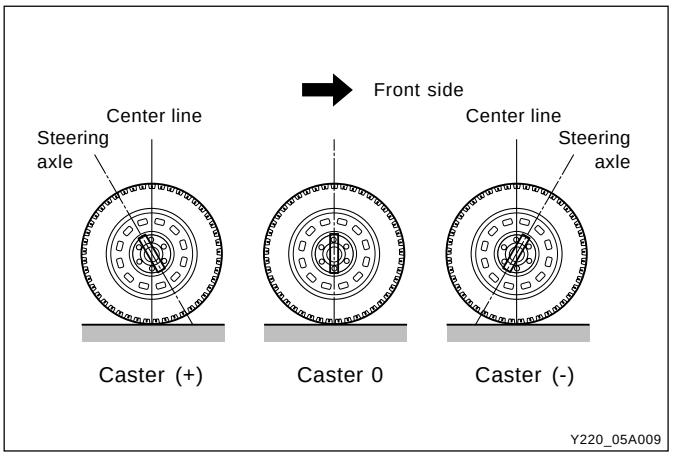
▶ Caster



Caster is the tilting of the uppermost point of the steering axis either forward or backward from the vertical when viewed from the side of the vehicle. A backward tilt is positive and a forward tilt negative. Caster influences directional control of the steering but does not affect tire wear.

Weak springs or overloading a vehicle will affect caster. One wheel with more positive caster will pull toward the center of the car. This condition will cause the car to move or lean toward the side with the least amount of positive caster. Caster is measures in degrees and is not adjustable.

REMOVAL AND INSTALLATION

Tire

1. Remove the wheel cap.

2. Support the vehicle with safety jack. Loosen the wheel nuts and raise the vehicle carefully.
3. Remove the wheel nuts.

4. Install in the reverse order of removal.

Notice

- ***Clean the mating surface of wheel and hub. Do not apply grease or oil to bolts and nut. It may cause the looseness of the fasteners.***
- ***Lift up the vehicle until the tire is off approx. 3 mm from ground.***
- ***Tighten the wheel nuts by the order as shown in the figure with several steps.***

Tightening torque	Aluminum wheel: 120 ~ 130 Nm

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Spare Tire

1. Prepare the spare tire handle and wheel nut wrench.
2. Install the handle through the hole at the rear side of the vehicle.
3. Connect the wheel nut wrench at the end of the handle.
4. Turn the wheel nut wrench counterclockwise until the wire is loosened.
5. Pull out the lift plate from spare tire.
6. Put the lift plate into the center of the wheel when installing.
7. Turn the handle clockwise until it sounds “click”.
8. Remove the handle and the wheel nut wrench.

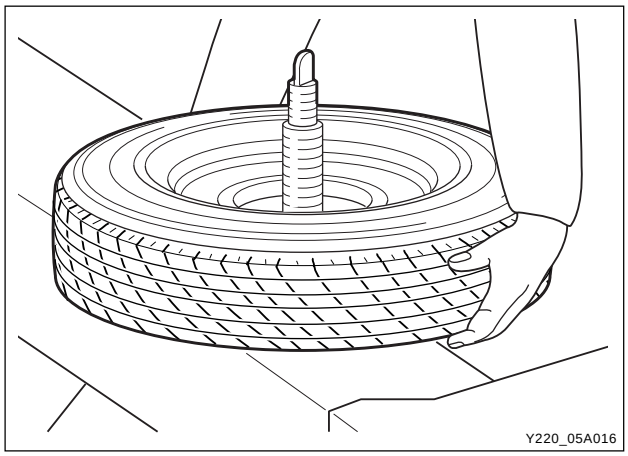
Notice

- ***Always keep the spare tire available.***
- ***When reinstalling the spare tire, securely fasten it.***
- ***If the lift plate is not in the center position or the spare tire is not securely fastened, the spare tire may be out of position during driving.***
- ***If a movement of spare tire is found, check the system and reinstall in needed.***
- ***The wheel nut tightening surface of the spare tire should be faced toward ground.***
- ***This device is desined only for manual operation. Never use the impact type tool to remove the spare tire.***

MAINTENANCE AND REPLACEMENT

SEPARATION

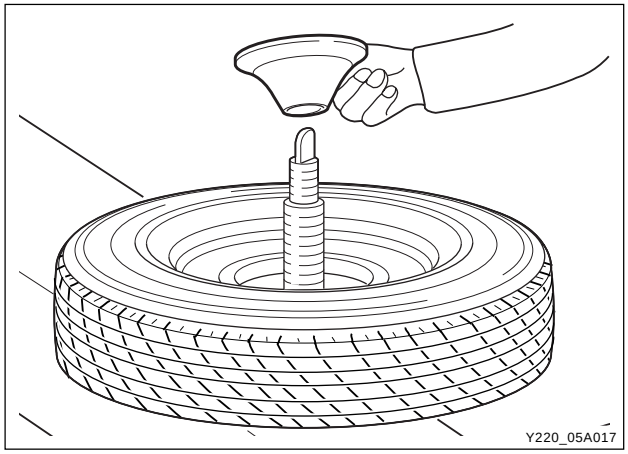
1. Fix the tire into the equipment and pull out the valve core from the tire. Discharge the air inside the tire completely.



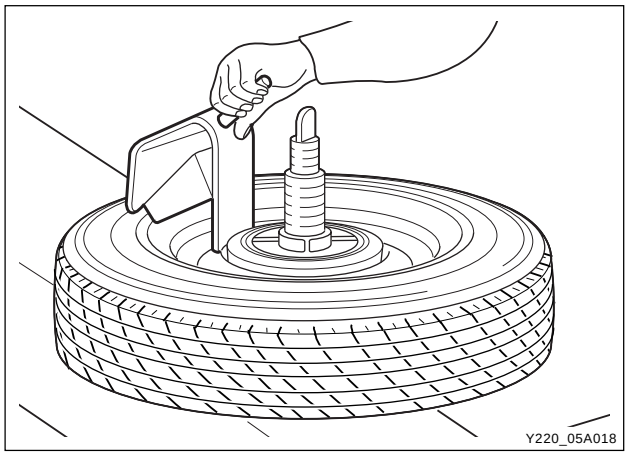
Notice

The assembly and disassembly of the tire is dangerous working job. So, only the skillful worker must work this job following the approved procedures.

2. Tighten the locker in the center of the equipment to assemble the rim to the equipment.
3. Remove the balance weight on the rim.



4. Separate the tire's bead from the rim flange using the approved lubricant.



Notice

Do not use silicone, synthetic detergent and gasoline, etc.

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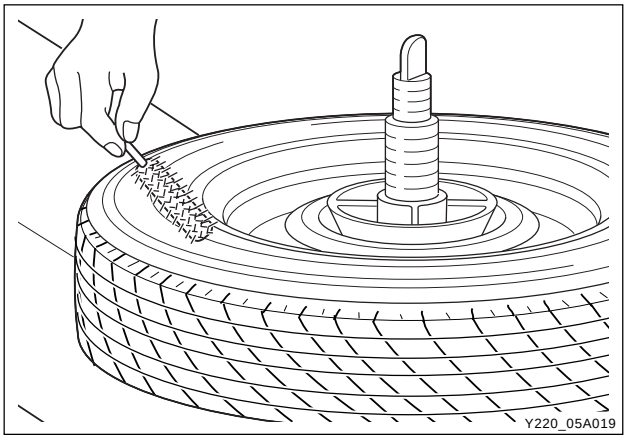
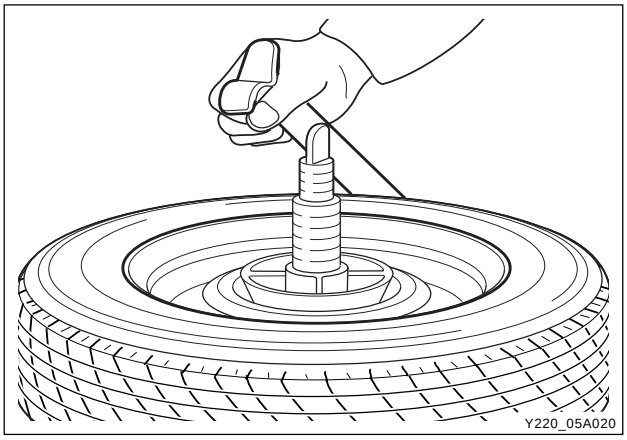


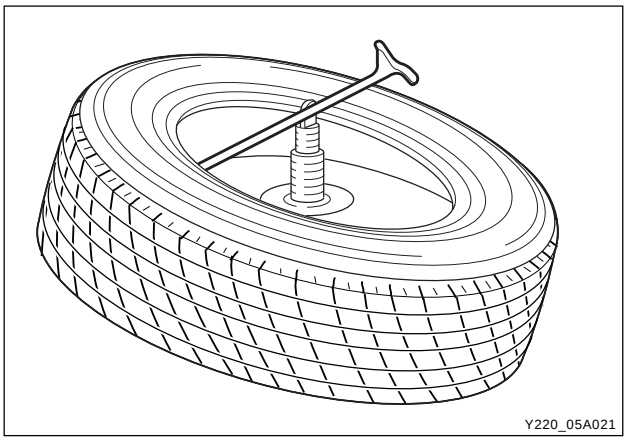
5. Apply the lubricant between the rim and the bead.



6. Insert the removal lever between the tire's bead and the rim and separate the rim from the tire.

Notice

Do not use the tool that may cause any damage such as pipe, damaged bar.



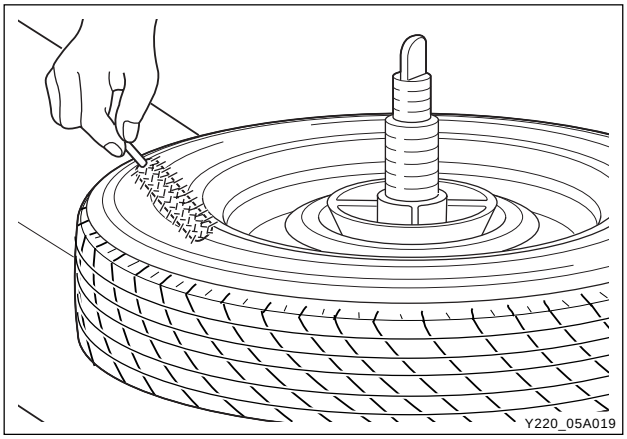
7. Pull out the opposite bead upward using the lever and then separate the bead from the rim.

MAINTENANCE

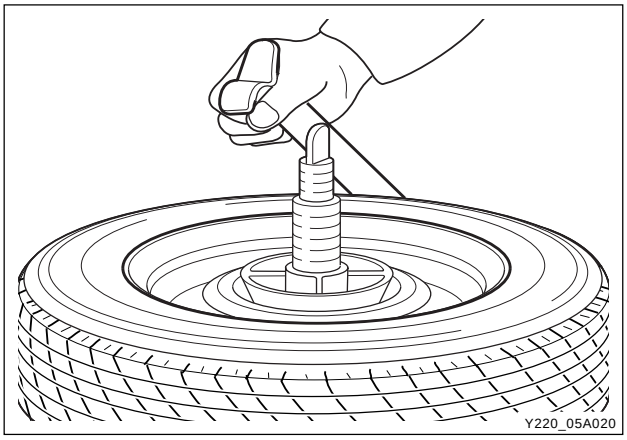
1. Check any damage the rim and replace as needed.

Notice

- ***Do not repair the rim as welding or soldering.***
- ***Replace the new valve as replaces new tire.***



5. Apply the lubricant between the rim and the bead.



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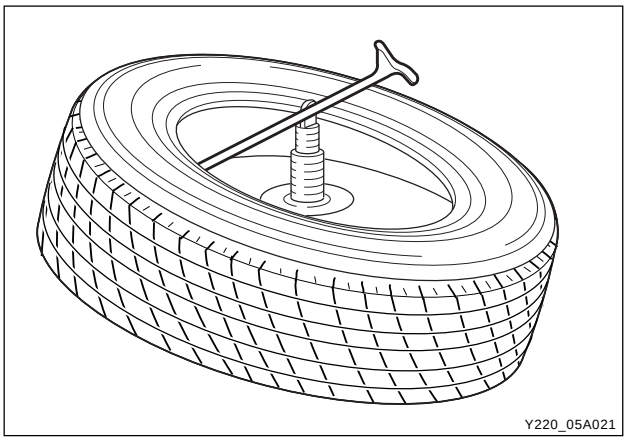


7. Pull out the opposite bead upward using the lever and then separate the bead from the rim.

MAINTENANCE

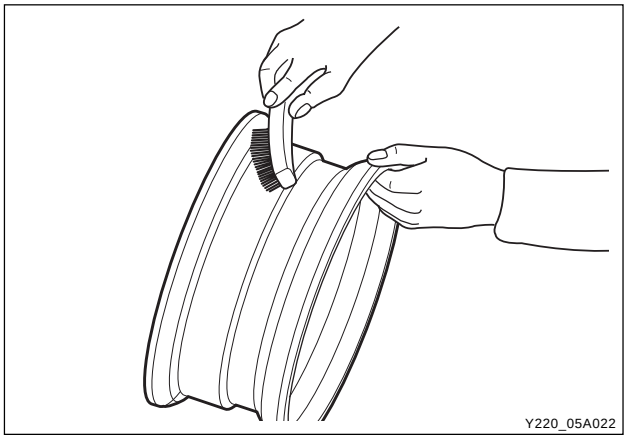
1. Check any damage the rim and replace as needed.

Notice

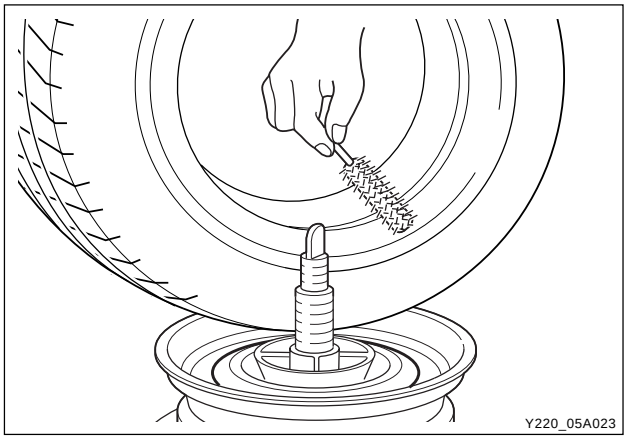
- ***Do not repair the rim as welding or soldering.***
- ***Replace the new valve as replaces new tire.***

INSTALLATION

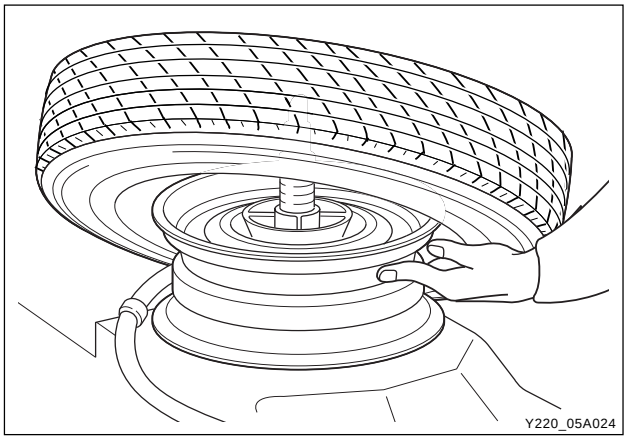
1. Clean the rust, damaged rubber and dust, etc on the rim's surface with the brush.



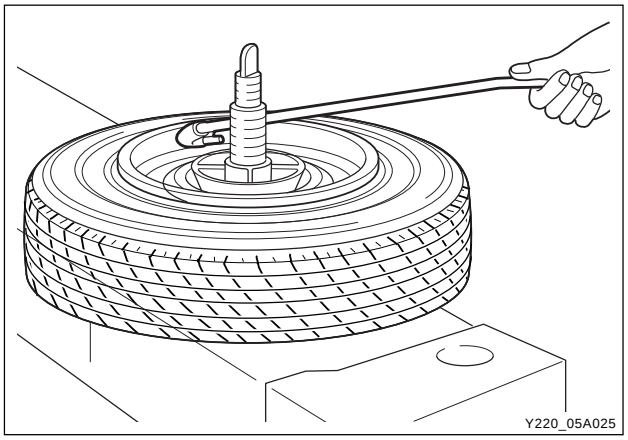
2. Install the rim to the equipment with the valve upward.
3. Tighten the locker in the center of the equipment to assemble the rim to the equipment.



4. Apply the lubricant at the both bead portions and both rim's flange of the tire.



5. Check any foreign material or liquid for the tire inside and then install to push down the tire.



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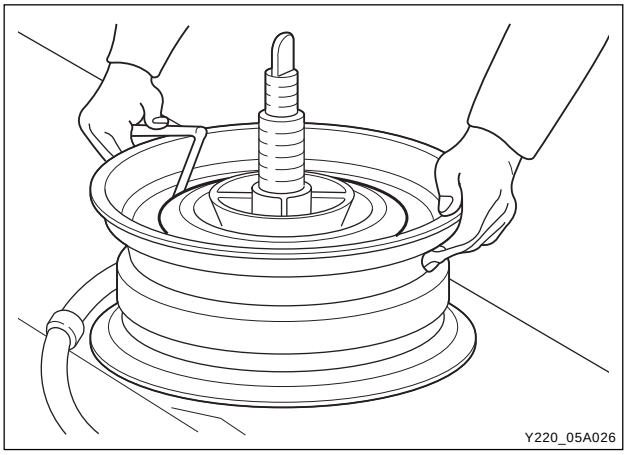


6. Set the tire pressure to the specifications.

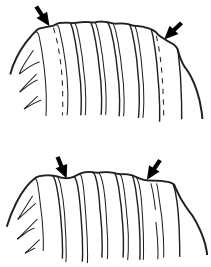
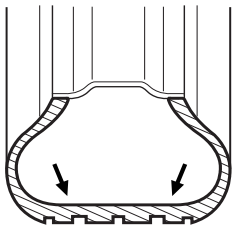
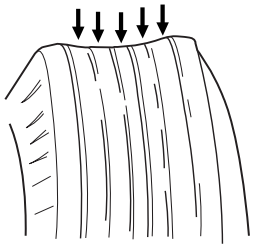
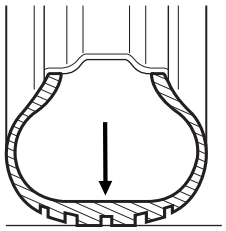
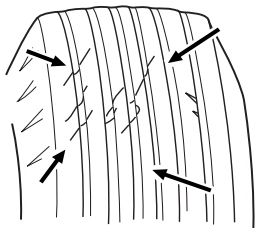
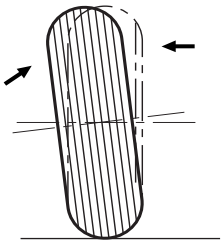
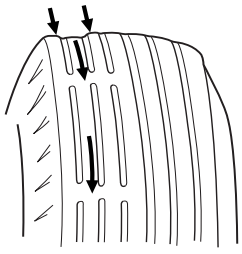
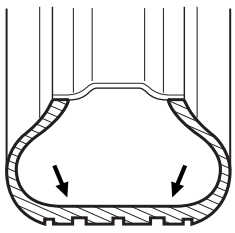
Notice

Do not remove the tire from the equipment before setting the tire pressure.

Specification of the tire pressure	30 psi (2.1 kg· cm^2)

INSPECTION

VISUAL CHECK

Condition	Cause	Action
Rapid wear at shoulders  Y220_05A028	Under inflation or lack of rotation  Y220_05A029	Adjust inflation pressure
Rapid wear at center  Y220_05A030	Over inflation or rotation  Y220_05A031	
Tread damage  Y220_05A032	Low the inflation pressure  Y220_05A033	
Uneven wear  Y220_05A034	Incorrect camber Incorrect toe-in  Y220_05A035	Adjust camber

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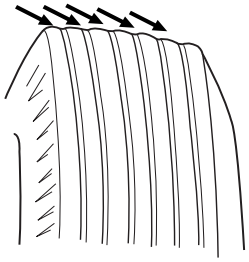
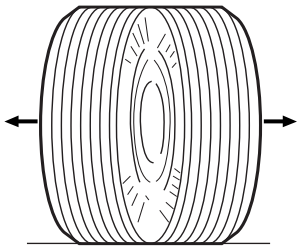
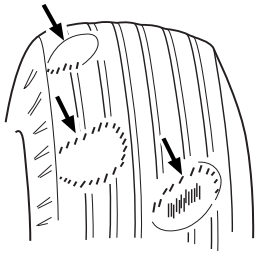
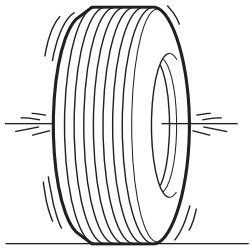
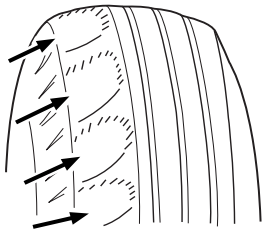
Condition	Cause	Action
Feathered edge  Y220_05A036	Incorrect toe-in  Y220_05A037	Adjust toe-in
Bold spot  Y220_05A038	Unbalanced wheel  Y220_05A039	Adjust wheel balance
Sharply wear at the tread outside  Y220_05A040	Unbalanced wheel	Adjust
	Wheel bearing play	Check play Check pre-load
	Ball joint play	Check
	Faulty shock absorber	Check

GENERAL INSPECTION

Tread

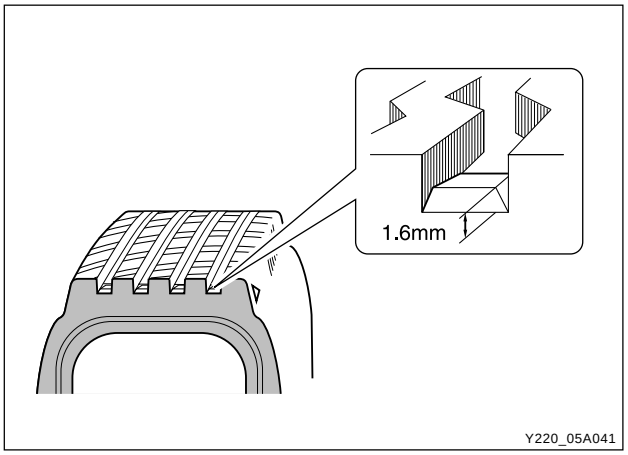
Inspect the tread condition on the tire surface and various damages resulting from the foreign material, crack, stone or nail etc. If there is any damage in the tire, repair or replace it.

Tire Wear

- Measure the depth of the tire tread. If the depth of the tread is below the specified value, replace the tire.

Limit of the Tread Wear	1.6 mm

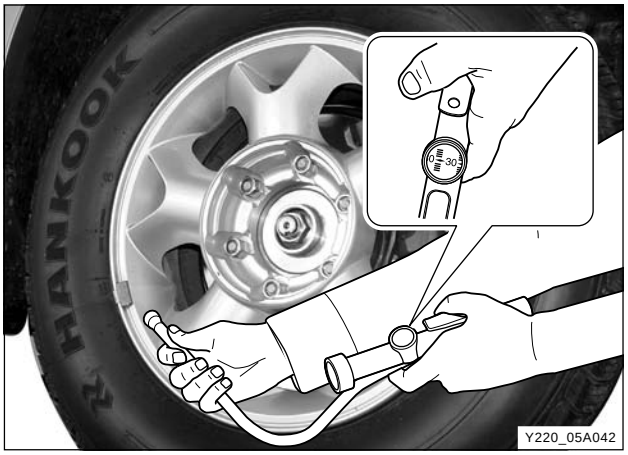
- You can see the mark '▲' in the groove, this is the indicator of the tread wear limit.
- The limit of the tread wear for all season tires are 1.6 mm as same as the general tires and the platform mark indicates as '↓ '.



Tire Inflation Pressure

1. Inflation pressure

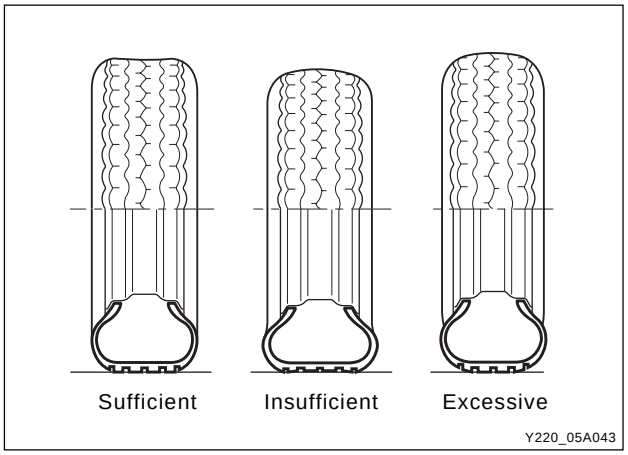
Front / Rear	2.1 kg/cm^2 (30 psi)



2. Inspect the pressure of the tire surface and check the inflation pressure.

Notice

- ***Lower than recommended pressure can cause tire squeal on turns, hard steering, tire cord breakage and tire rim bruises, etc.***
- ***Higher than recommended pressure can cause hard ride, tire bruising or damage and rapid tread wear at the center of the tire.***



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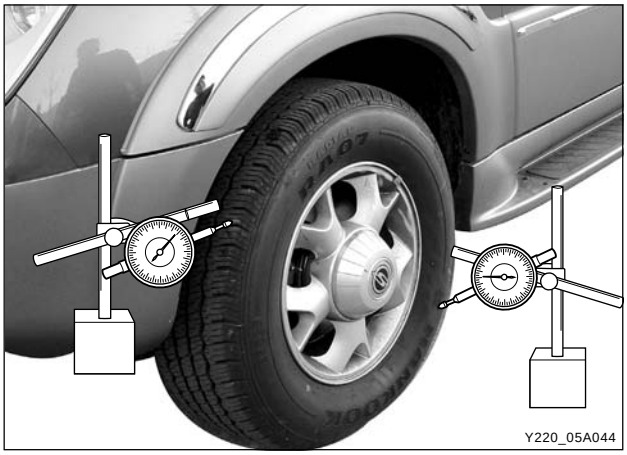

Y220_05A044

Wheel Runout

Measure wheel runout with an accurate dial indicator. Measurement may be taken with the wheels either on or off the vehicle, using an accurate mounting surface such as a wheel balancer. Measurements may be taken with or without the tire mounted on the wheel.

1. Measure the dial runout and lateral runout on both the inboard and outboard rim flanges.

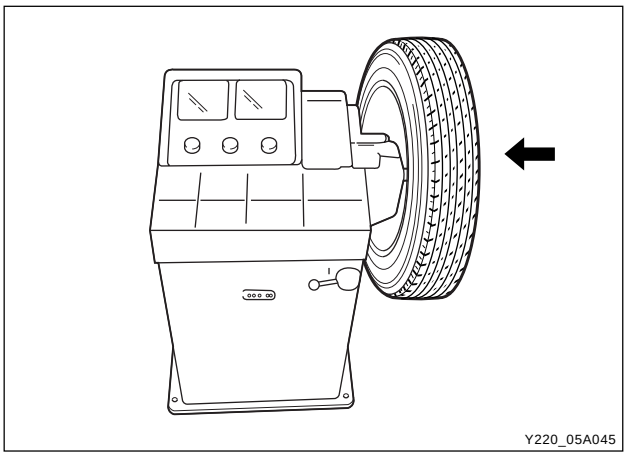
Specification	2.66 mm

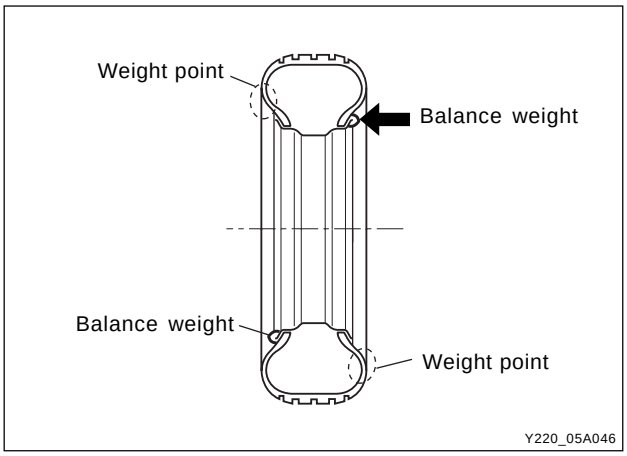
2. Measure free radial runout on the tire tread.

Specification	2.03 mm

Notice

If any measurement exceeds the above specifications, replace the applicable tires or wheels.


Y220_05A045



Y220_05A046

Wheel Balance

Balance is the easiest procedure to perform and should be done first if the vibration occurs at high speeds or if the tires or the wheels are replaced.

When proceeding the wheel balancing procedure refer to the following;

1. Do not the wheel weight over two at the inboard and the outboard flanges.
2. The total weight ofthe wheel weight should not exceed the 150 g (3.5 ounces)
3. Balancing the assemblies with the factory aluminum wheels requires the use of the special nylon-coated, clip-on wheel weights.

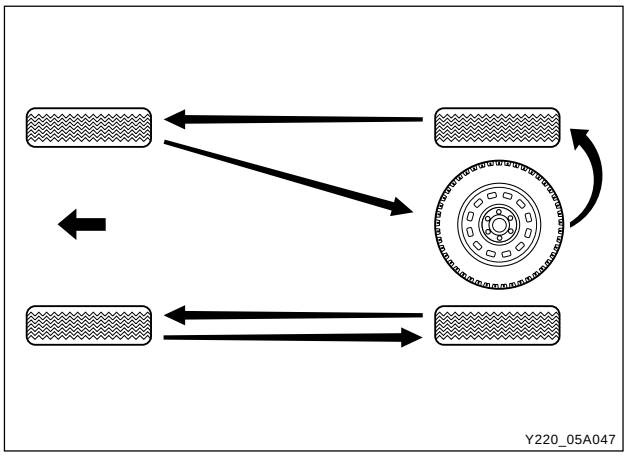
Balance weight

10 g	20 g	30 g	40 g	50 g	60 g
0.4 oz	0.7 oz	1.10 oz	1.40 oz	1.80 oz	2.10 oz

ROTATION OF TIRES

Front and rear tires perform different jobs and can wear differently depending on the tires of road driven, driving condition, etc.

The front tires will wear faster than the rear ones. To avoid uneven wear of tires and to prolong tire life, inspect and rotate the tires every 5,000 km (3,100 miles). After rotating the tires, adjust the tire inflation pressures and be sure to check wheel nuts tightness.



Cautions when Replacing Tires

Do not mix different types of tires on the same vehicle such as radial, bias and bias-belted tires except in emergencies, because vehicle handling may be seriously affected and may result in loss of control.

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TROUBLE DIAGNOSIS

Condition	Cause	Action
Irregular tires wear	Improper tire inflation pressure	Adjust
	Poor wheel balance	Adjust
	Improper tire rotation	Rotation tires on the maintenance schedule
	Poor toe-in	Adjust
	Poor adjusting the pre-load of the wheel bearing	Adjust
	Poor braking performance	Adjust
Driving noise, vibration	Low tire inflation pressure	Adjust
	Poor balance of wheels, tires	Adjust
	Severe vibration due to wheels, tires	Adjust or replacement
	Irregular tires wear	Check and adjust
Rapid wear	Excessive tire inflation pressure	Adjust
	High speed driving with low tire pressure	Adjust
	Excessive vehicle weight	Proper weight

SECTION 6A

STEERING COLUMN

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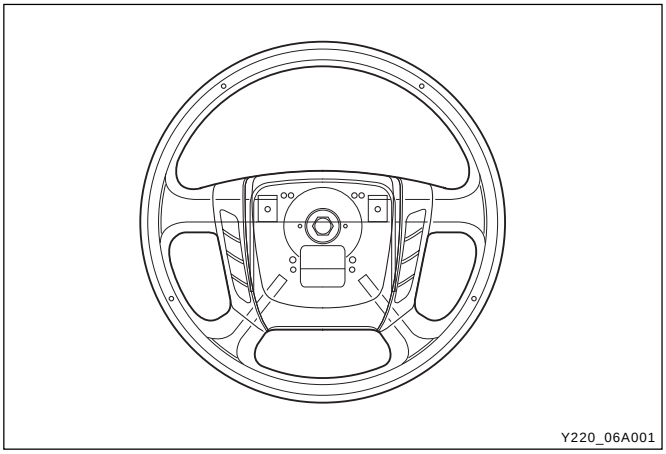
GENERAL INFORMATION

OVERVIEW

When colliding the steering wheel and column release the impact by the steering wheel and also are designed in order that the steering column shaft may be folded or absorb the impact. The steering column has the ignition switch and lock cylinder. If removing the ignition key with the ignition switch in “LOCK” position, the lock cylinder locks the steering wheel.

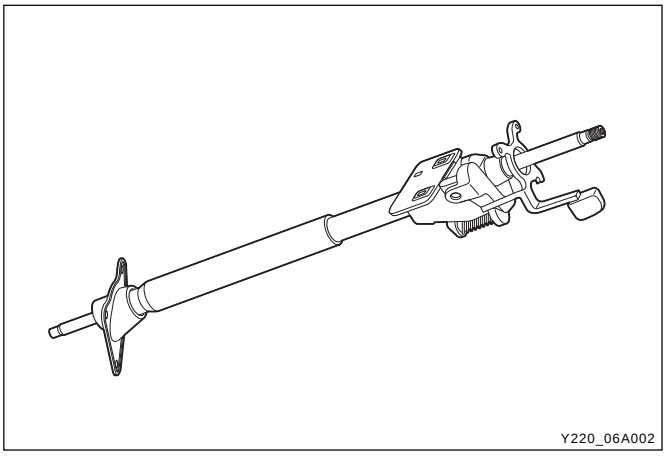
▶ Steering Wheel



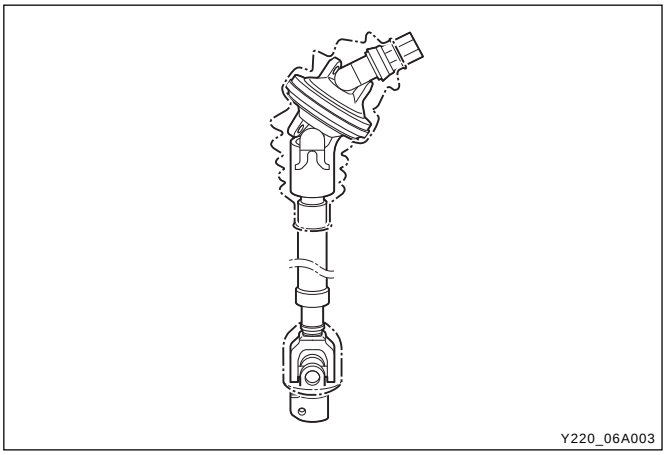
Type	4-spoke type
Outer Diameter	390 mm
Material	Forming PU/leather

The vibration damper absorbs the vibration from vehicle to minimize it.

▶ Column and Shaft Assembly



▶ Lower Shaft



Type	Double cardan constant velocity joint
Angle	62 ~ 68°
Composition	CV joint (top) Hook joint (bottom) Elastic sleeve

This minimizes the torque changes due to angular speed changes.

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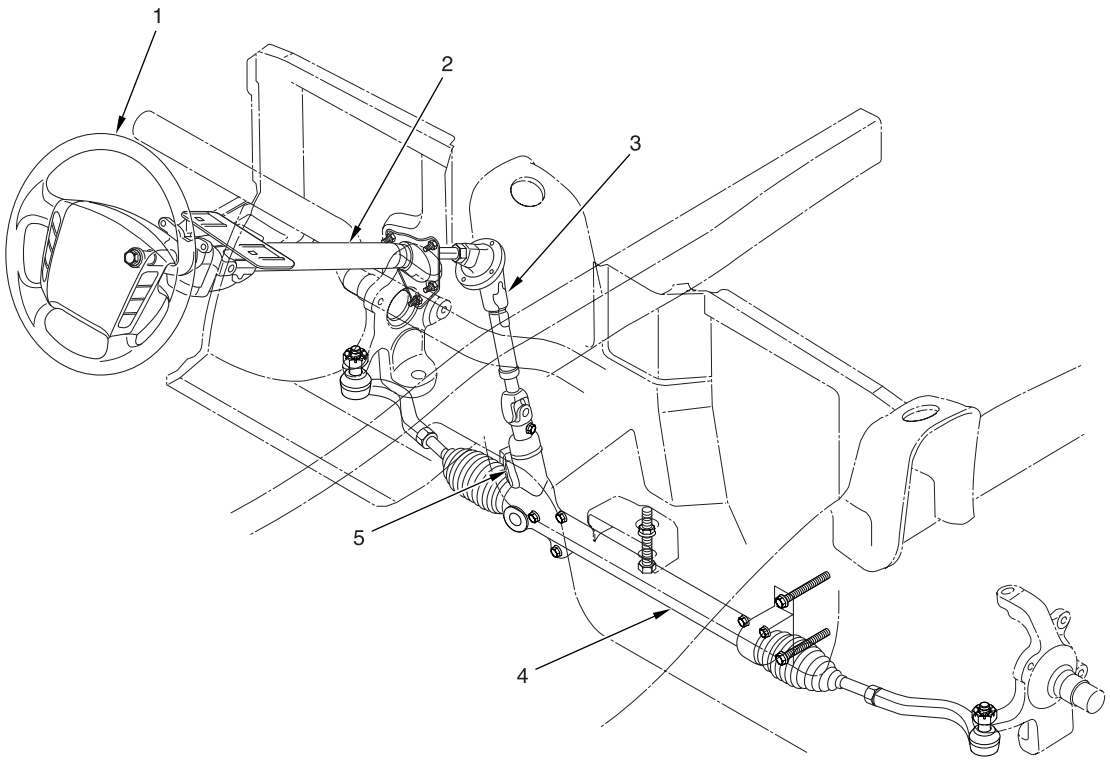
SYSTEM LAYOUT

▶ Steering Column Assembly



Y220_06A004

1. Steering wheel
2. Column shaft assembly
3. Lower shaft assembly
4. Steering gear assembly
5. ECPS solenoid valve

TIGHTENING TORQUE

Description		Kgf•m	Nm
Steering column shaft	Steering column mounting bolt (upper)	2.0 ~ 2.5	20 ~ 25
	Steering column mounting bolt (lower)	1.8 ~ 2.5	18 ~ 25
	Steering wheel and steering column shaft lock nut	4.0 ~ 6.0	40 ~ 60
	Steering column and airbag module connection bolt	0.7 ~ 1.1	7.0 ~ 11
	Steering column and lower shaft connection bolt	2.5 ~ 3.0	25 ~ 30
Power steering gear box	Steering gear box and gear box cross member mounting bolt	10.0 ~ 13.0	100 ~ 130
	Steering gear box and lower shaft connection bolt	2.5 ~ 3.0	25 ~ 30
	Tie rod end and steering lock connection nut	3.5 ~ 4.5	35 ~ 45
	Tie rod end lock nut	6.5 ~ 8.0	65 ~ 80
	Steering gear box and pressure hose connection nut	1.2 ~ 1.8	12 ~ 18
	Steering gear box and return line connection nut	1.2 ~ 1.8	12 ~ 18
Power steering pump	Power pump bracket and timing gear case cover mounting bolt	2.0 ~ 2.3	20 ~ 23
	Power pump and pressure hose connection nut	4.0 ~ 5.0	40 ~ 50
Power steering line	Return line and cilp connection bolt	0.9 ~ 1.4	9.0 ~ 14

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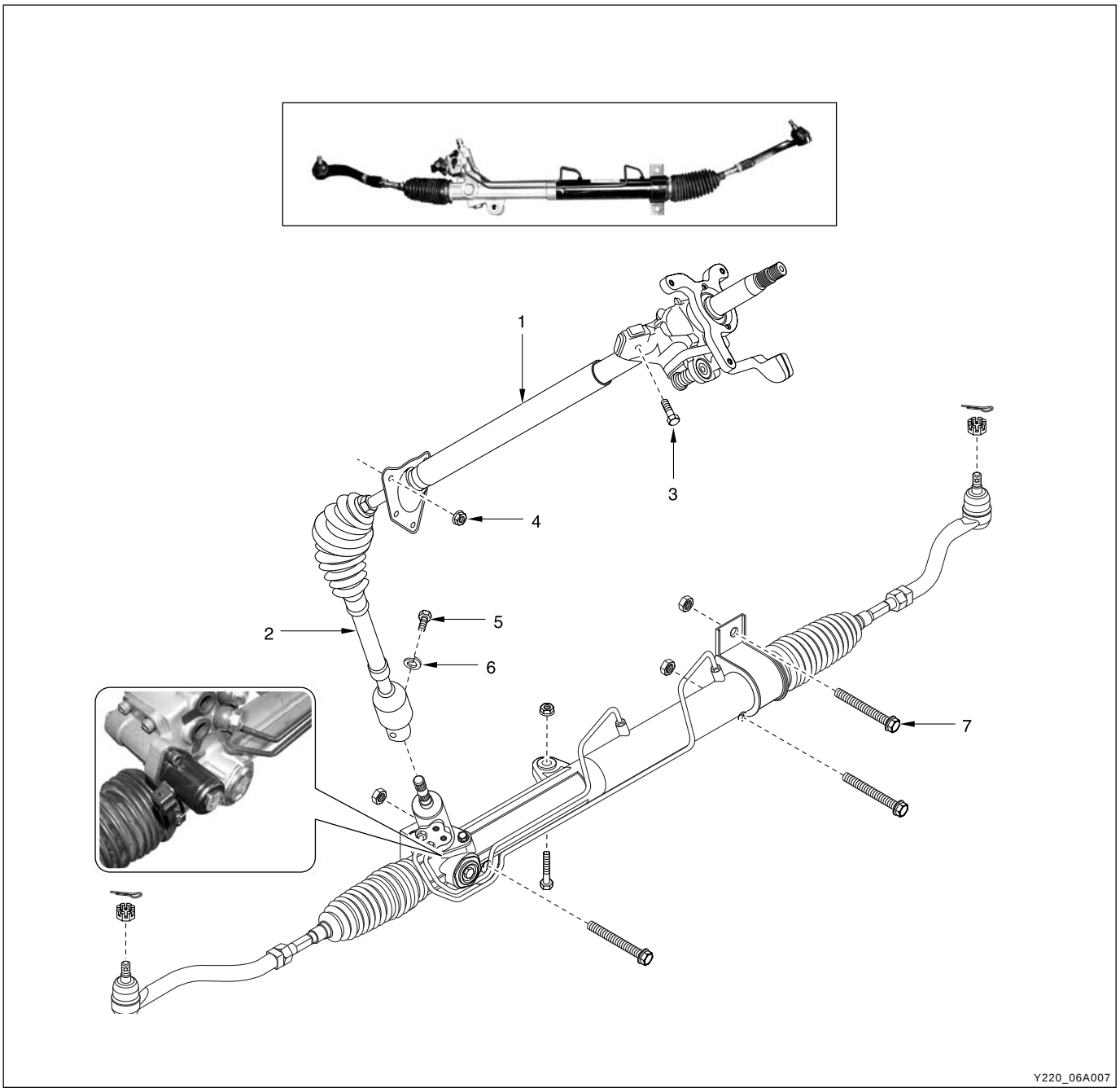
REMOVAL AND INSTALLATION

COMPONENTS LOCATOR



1. Steering column shaft
2. Lower shaft
3. Bolt
4. Nut
5. Bolt
6. Washer
7. Bolt

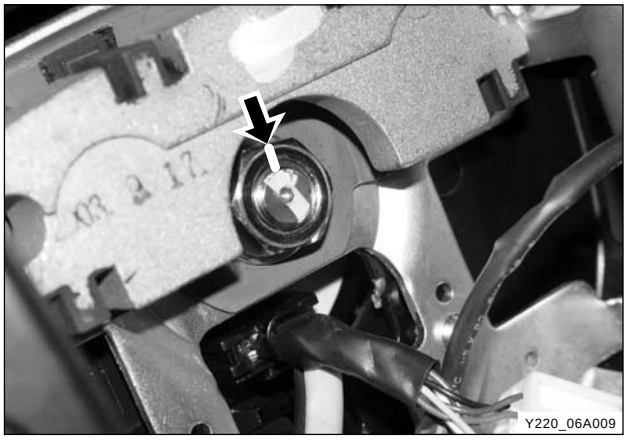
Steering Column - Removal

1. Disconnect the negative battery cable and place the tires to straight ahead direction.
2. Unscrew the screws at both sides of steering wheel and remove the horn pad (air bag module). Disconnect the air bag module connector.

3. Unscrew the steering wheel nut and remove the steering wheel with special tool.

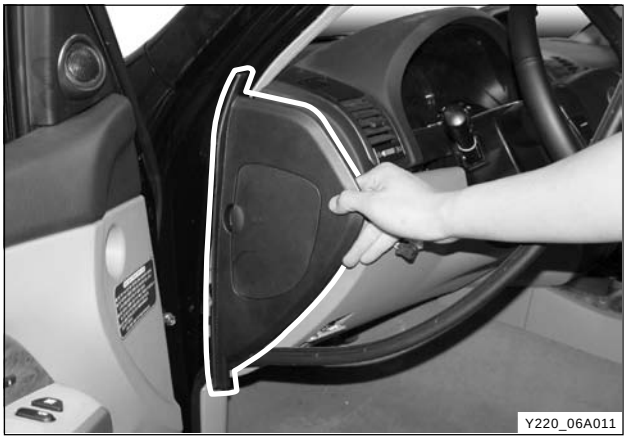
   Notice

   - ***Place an alignment on the steering column shaft and steering wheel nut.***
   - ***Disconnect the remote control switch connectors on each connector (air bag and horn).***



4. Disconnect all the connectors from the instrument panel.

5. Remove the instrument panel side cover and unscrew the interior fuse box nuts.



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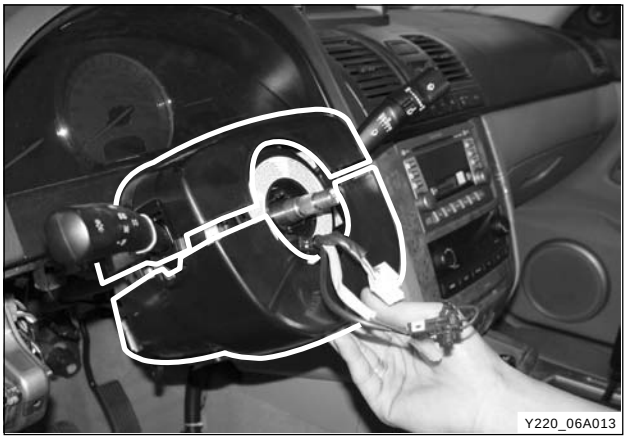
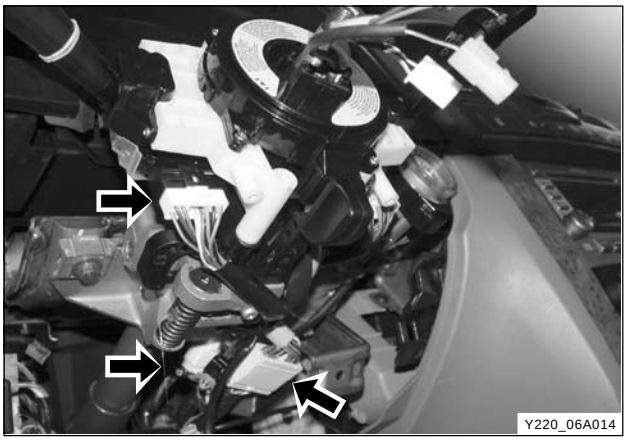
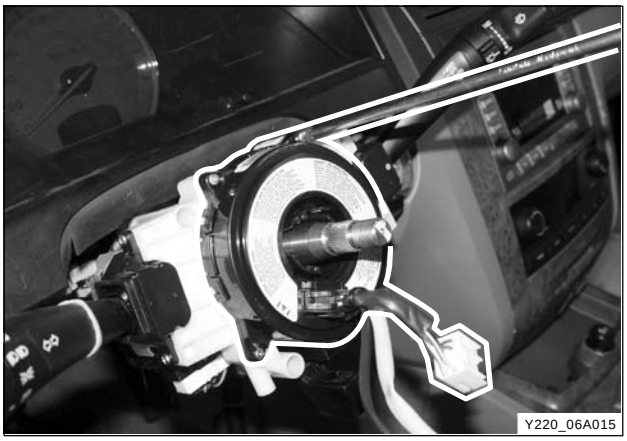
6. Unscrew the instrument panel side bolts and screws and remove the panel.



7. Unscrew the bolts and remove the steering column upper cover and lower cover.



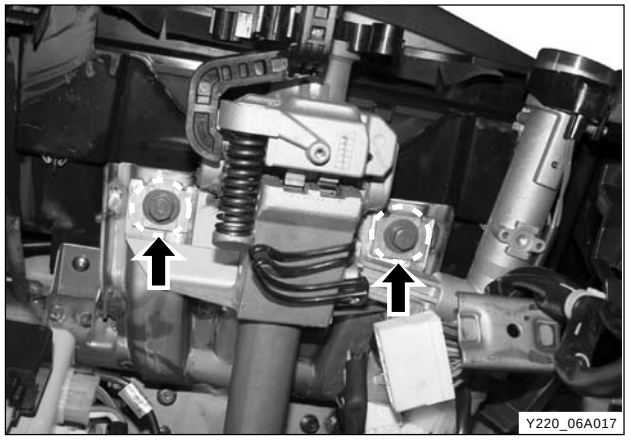
8. Disconnect the multifunction switch connector and fuel-cut vacuum hose.



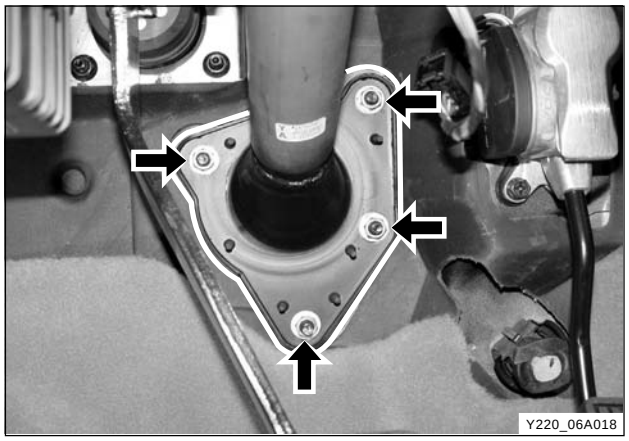
9. Remove the contact coil from steering column shaft.

10. Remove the multifunction switch assembly.

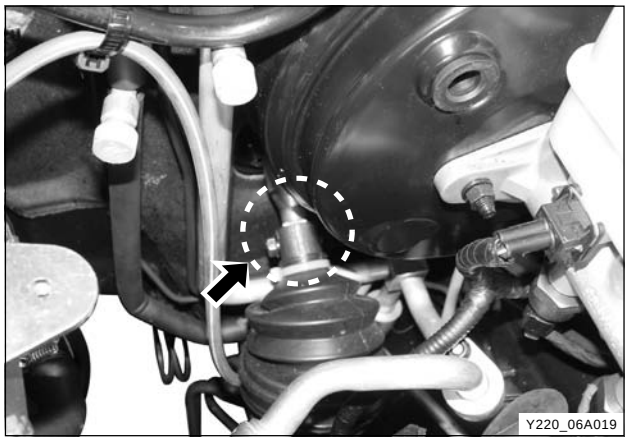
11. Place an alignment mark on the steering column shaft and lower shaft and remove the column shaft upper mounting bolts.



12. Loosen the steering column shaft housing bolts.



13. Unscrew the upper mounting bolts (2) and remove the steering column assembly.



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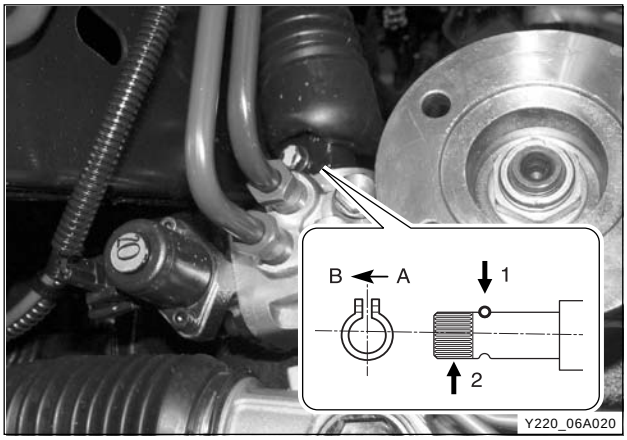
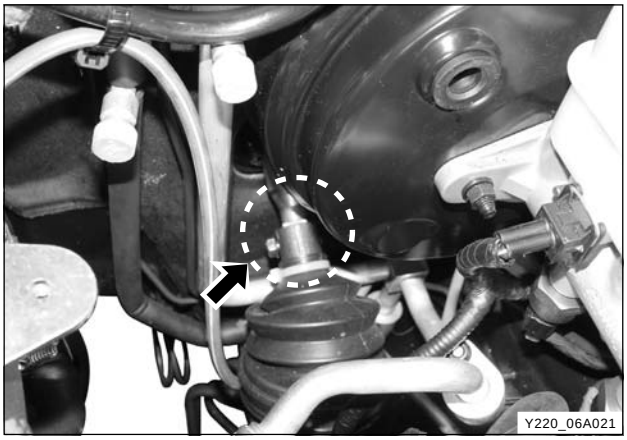
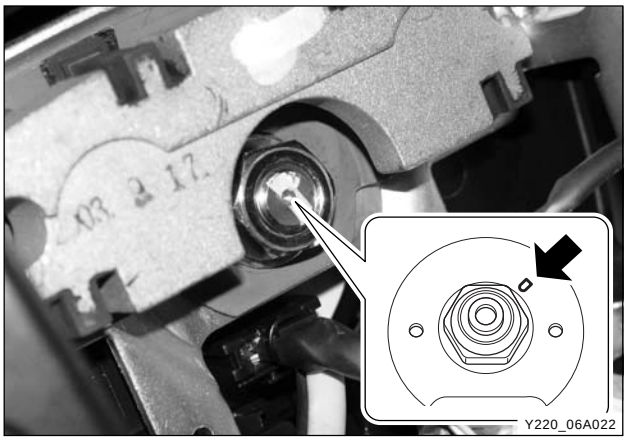
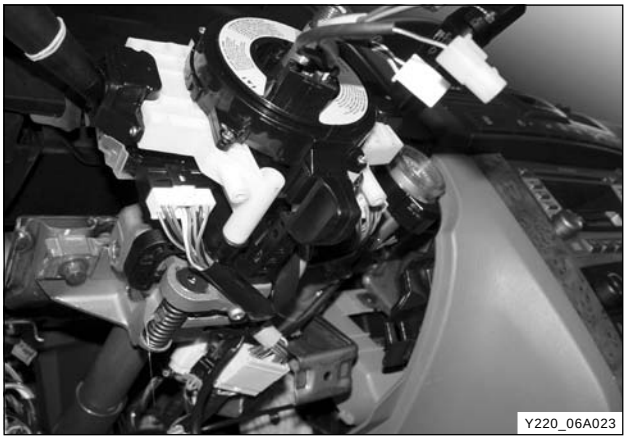








Steering Column - Installation

1. Insert the steering column lower shaft into the gear box (spline) and tighten the bolts.

   Notice

   - ***Install the lower shaft so that the bolt can be inserted into the area without spline.***
   - ***Install it with aligning the marks.***

Tightening torque	25 ~ 30 Nm

2. Insert the steering column shaft into lower shaft with aligning the marks.

   Notice

   - ***Install the steering column shaft so that the bolt can be inserted into the area without spline.***
   - ***Install it with aligning the marks.***

Tightening torque	25 ~ 30 Nm

3. Tighten the steering column mounting bolts to floor.

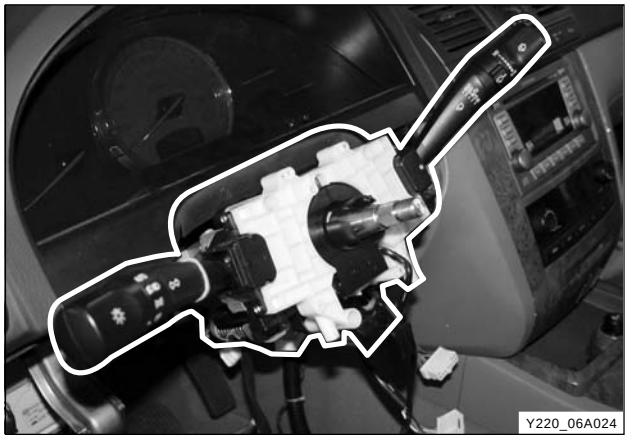
Tightening torque	18 ~ 25 Nm

4. Tighten the steering column shaft upper mounting bolts.

Tightening torque	20~ 25 Nm

5. Connect all the connectors for steering column.

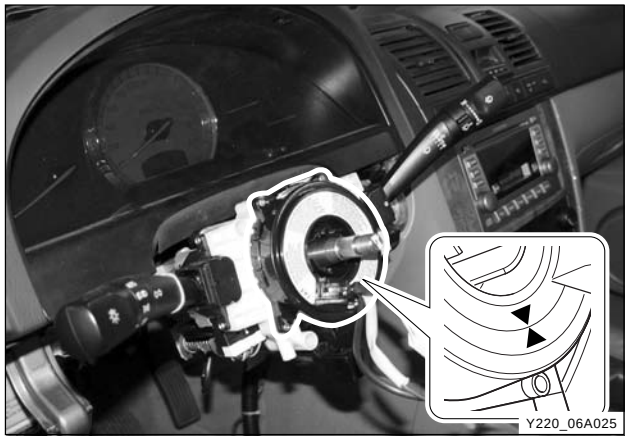
6. Install the multifunction switch assembly to the steering column shaft.



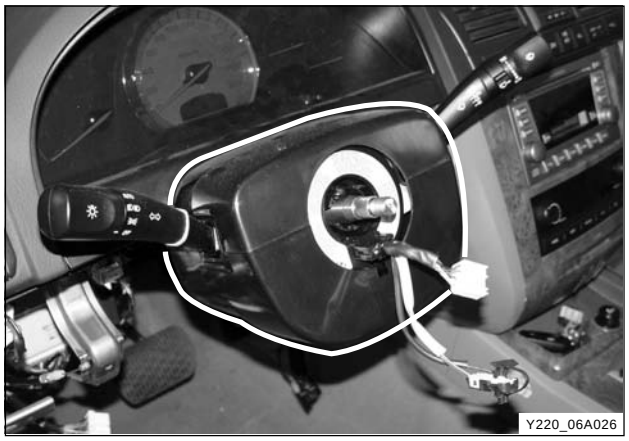
7. Install the contact coil to the steering column shaft.

Notice

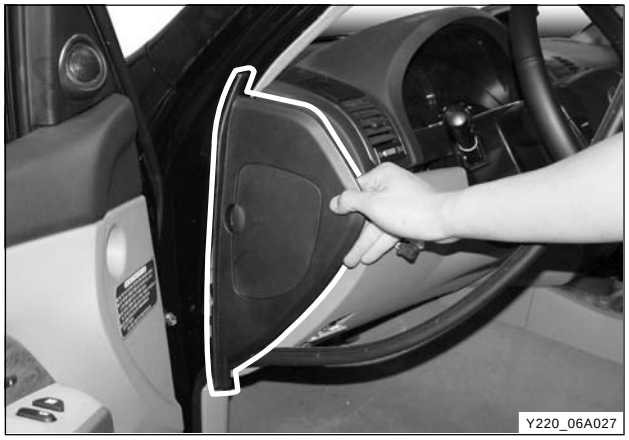
When adjusting the neutral position of contact coil, rotate the contact coil to clockwise direction until it stops and then again rotate it by 2.9 ± 0.2 to counterclockwise direction. Align the ▶ ◀ marks on the contact coil.



8. Connect all the connectors.



9. Install the steering column cover and instrument panel.



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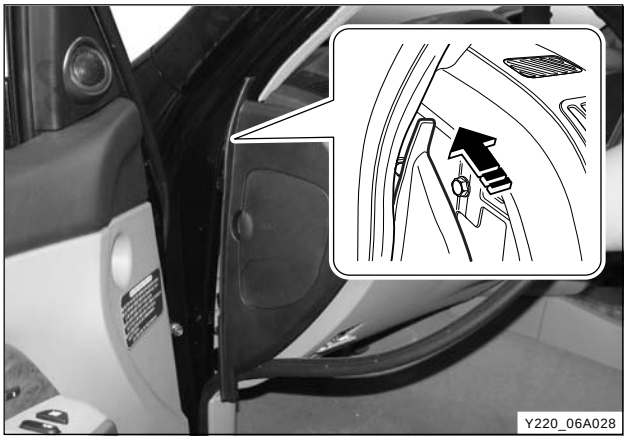
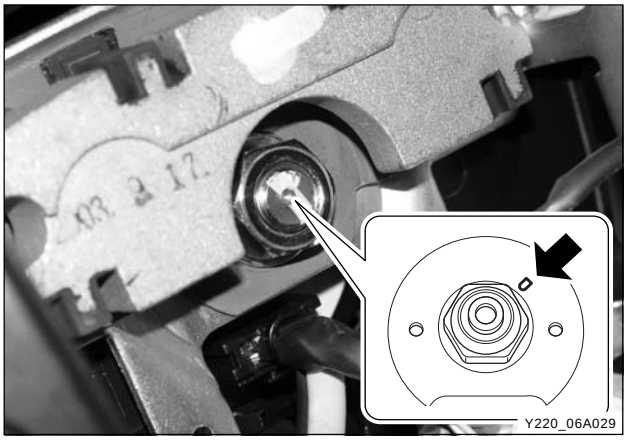


10. Install the fuse box, cables and switches and install the panel side cover.

Notice

Insert the side cover into the molding as shown in the figure.



11. Install the steering wheel with aligning the marks on the steering column shaft and steering wheel nut.

Notice

Apply grease on the shaft spline to insert it easily.

12. Connect al the connectors and install the horn pad.

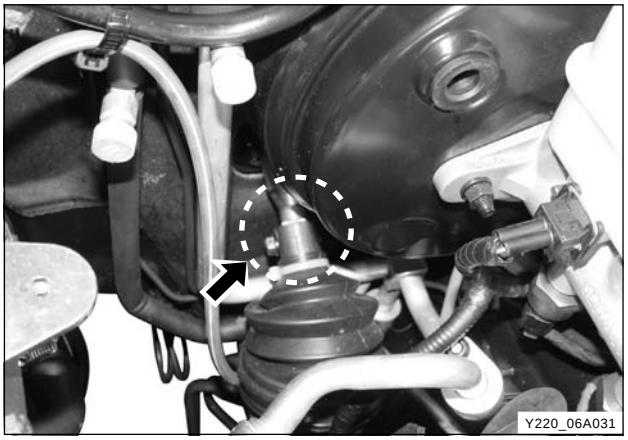
Note

When installing the horn pad, insert the safety pin into the wheel hole and align the shaft end to pad groove.

13. Tighten the screws at both sides of steering wheel and connect the negative battery cable.

Steering Lower Shaft - Removal and Installation

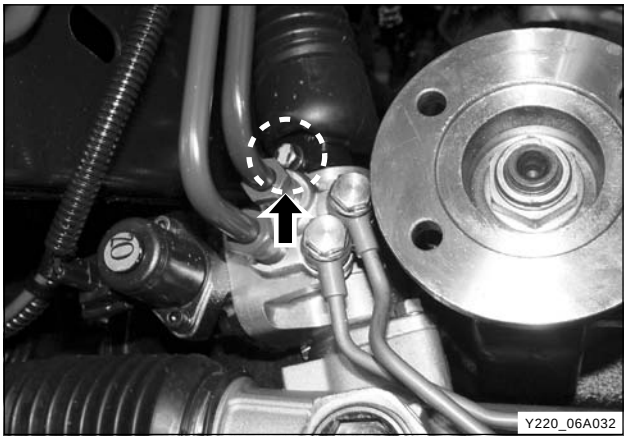
1. Unscrew the upper bolts on the steering lower shaft.



2. Unscrew the lower shaft bolts to steering gear box and remove the steering lower shaft.

Notice

Place an alignment mark.



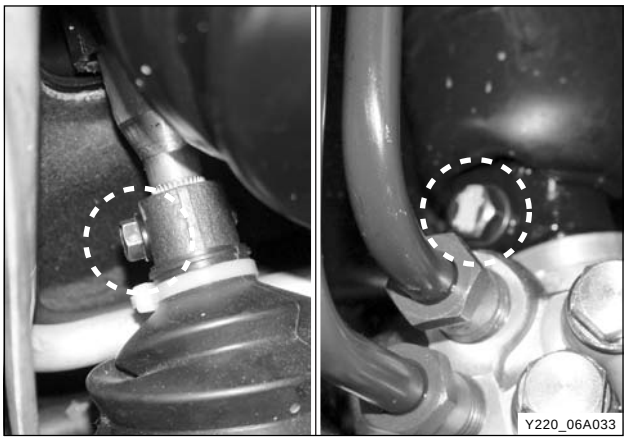
3. Installation Notice

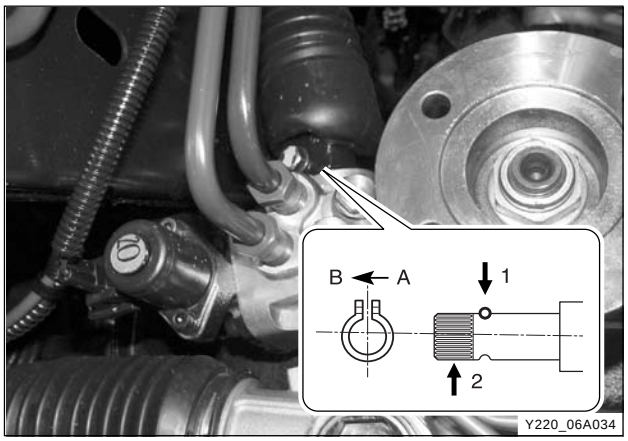
Install the steering lower shaft into the steering column shaft and gear box with aligning the marks.

Upper bolt (column side)	25 ~ 30 mm
Lower bolt (gear box side)	25 ~ 30 mm

Notice

Make sure to align the ball and alignment mark while installing the lower shaft.





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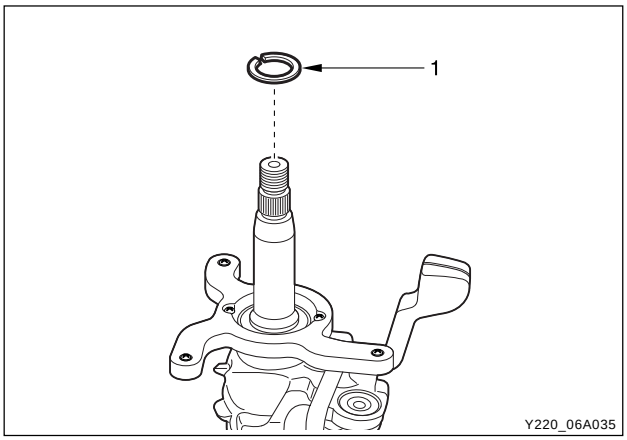
DISASSEMBLY AND REASSEMBLY

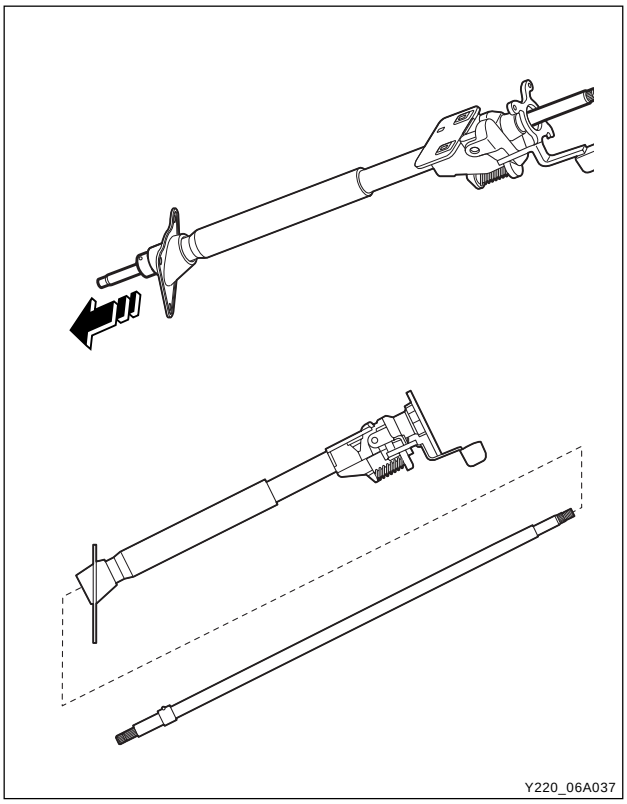


Disassembly

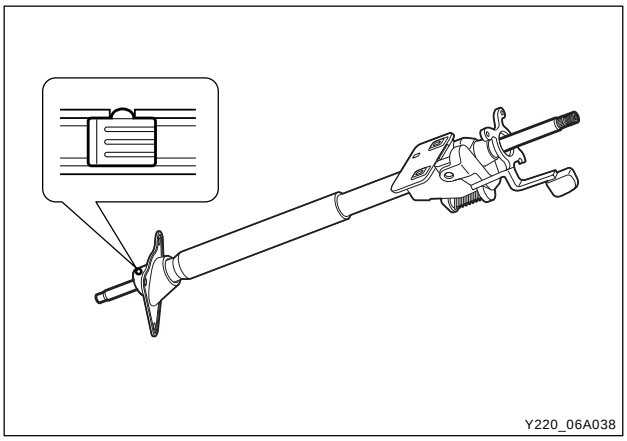
1. Remove the steering column assembly.

Notice

Be careful not to impact the steering column and steering column shaft. Otherwise, the plastic sleeve may be broken in case of frontal colliding.



2. Remove the steering column shaft from steering column.
   1) Remove the retainer ring.
   2) Forcefully push the steering column shaft downward.

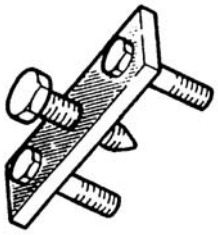
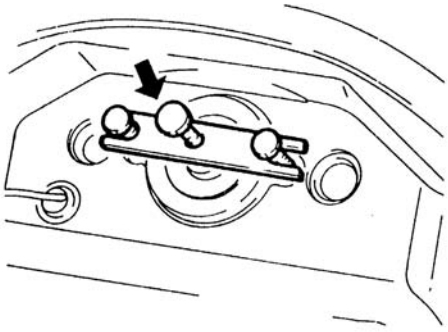


3. Assemble in the reverse order of disassembly.

TROUBLE DIAGNOSIS

Symptom	Cause	Action
Noise (When operating the steering wheel)	Loosened steering column nuts	Retightening
	Worn or damaged steering shaft bearing	Replace the steering column
	Loosened intermediate shaft pinch bolts	Retightening
Excessive steering force	Worn or damaged steering shaft bearing	Replace the steering column
Poor operation of the ignition switch	Internal defects in lock cylinder	Replace the steering column
	Internal defects in ignition switch	Replace the ignotion switch

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
661 589 00 33 00 (L 99 46 001 0A) **Steering wheel puller**  Y220_06A039	Removal of steering wheel  Y220_06A040

SECTION 6B

ECPS

(ELECTRONIC CONTROL POWER STEERING)

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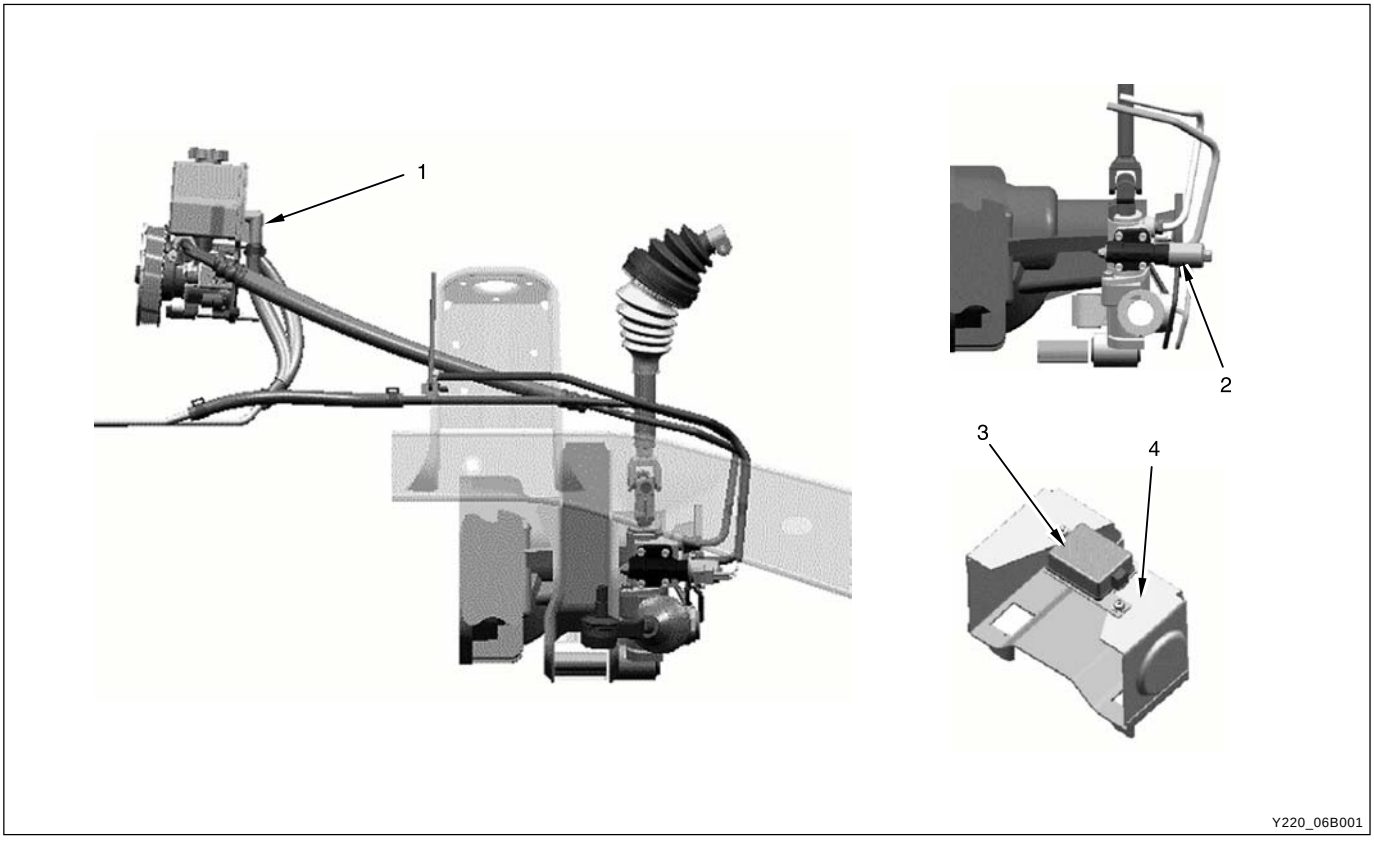
GENERAL INFORMATION

OVERVIEW

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

SSPS, by providing appropriate steerability to driver according to the changes of vehicle speed, gives steering stability. In other words, the steering wheel gets lighter by adjusting steerability in stop or low speed and provides steering stability by adjusting steering wheel to become heavier in high speed.

SSPS system applied in Rexton is ECPS (Electronic Control Power Steering: Hydraulic Pressure Reaction Force Control) type that allows to change the steerability according to the vehicle speed. The power steering control unit adjusts the hydraulic pressure to reaction plunger by controlling the pressure solenoid valve located in gear box to optimize the steerability.



1. Pump
2. Solenoid valve
3. Control unit
4. Jack bracket

Notice

It is not easy to locate the ECPS system solenoid valve (2) at correct position when replacing it. Thus, even though the fault is only in the solenoid valve, you must replace the power steering assembly. Be careful not to damage the solenoid valve during storage and shipment.

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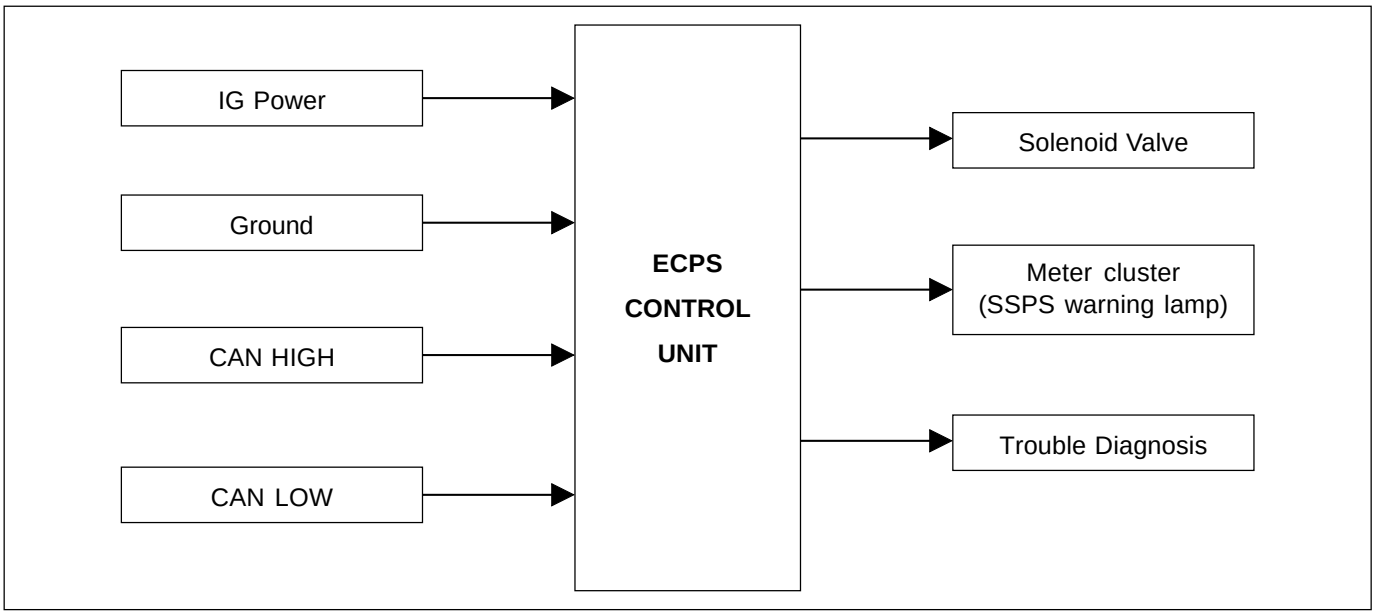
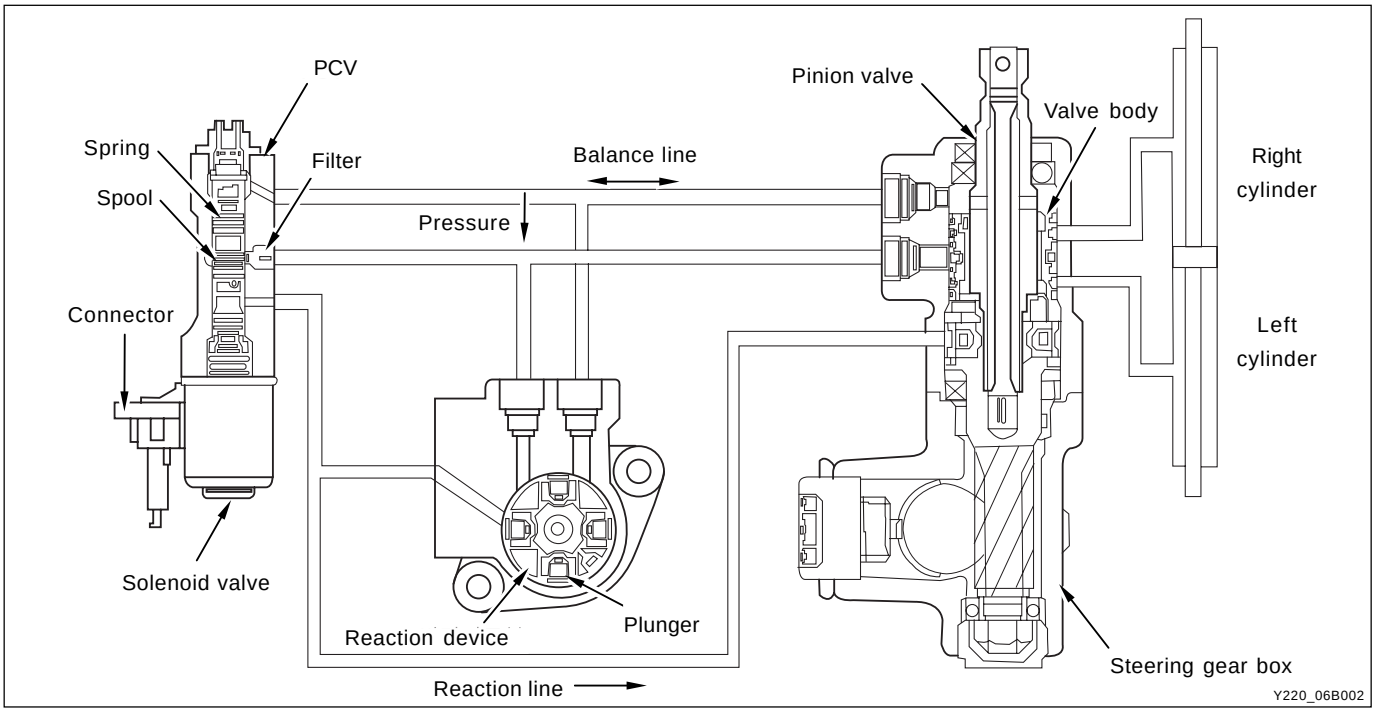
INPUT/OUTPUT OF ECPS CONTROL UNIT



ECPS CONFIGURATION



PCV (Pressure Control Valve)

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

Reaction device

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

Solenoid valve

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

SOLENOID VALVE

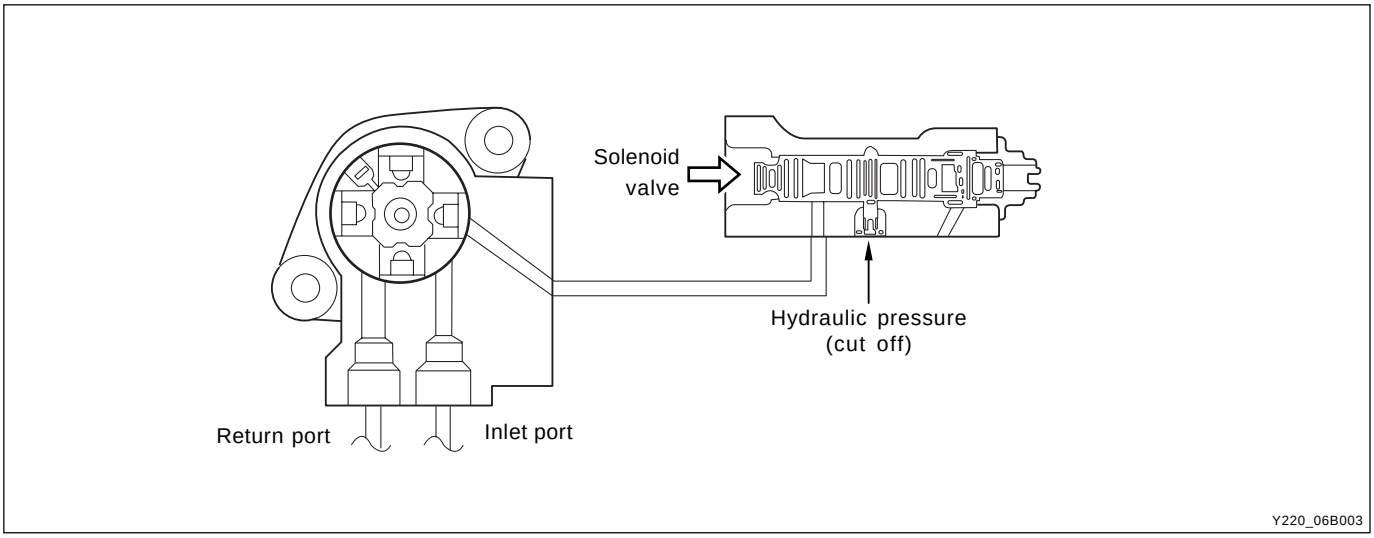
ECPS control unit controls the amount of electric current to solenoid valve according to the vehicle speed. In other words, the solenoid valve controls the hydraulic pressure applied to reaction plunger by changing the valve spool position that is linked with solenoid valve according to the amount of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

▶ Specifications

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

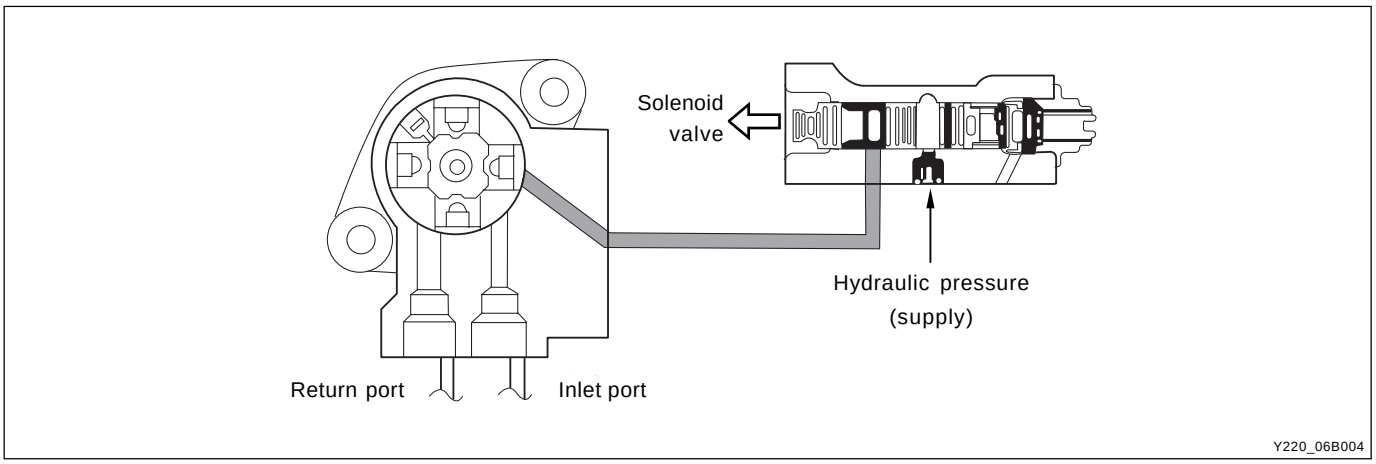
▶ Operation

1. During parking and low speed driving



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

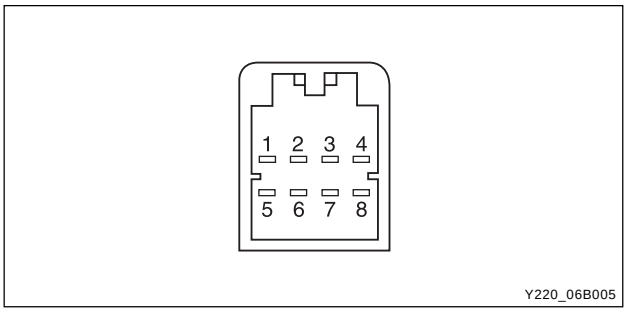
2. In medium and high speed driving

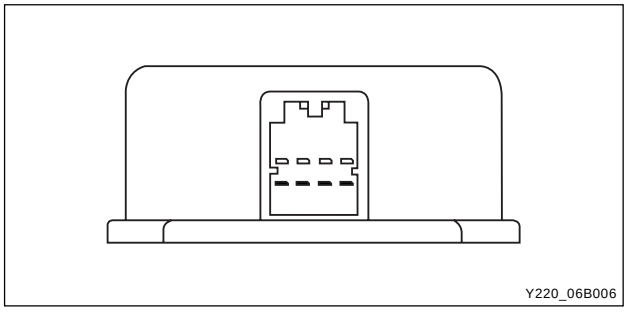


1. The shaft operation force of solenoid rod is reduced due to the reduction of output current from ECPS control unit.
2. The coil spring pulls the PCV spool toward solenoid valve to open it.
3. The hydraulic pressure from pump flows to pinion reaction area through orifice and applies reaction force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

ECPS CONTROL UNIT

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

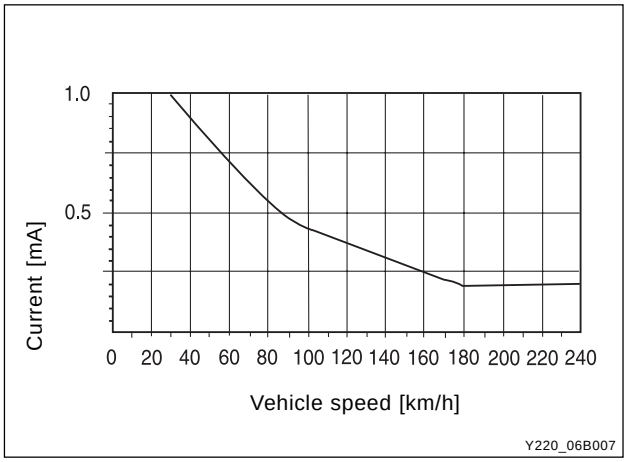




Pin No.	Function
1	Solenoid
2	Solenoid
3	CAN HIGH
4	Ignition Power Supply
5	Self Diagnosis
6	CAN LOW
7	Warning Lamp (SSPS)
8	Ground

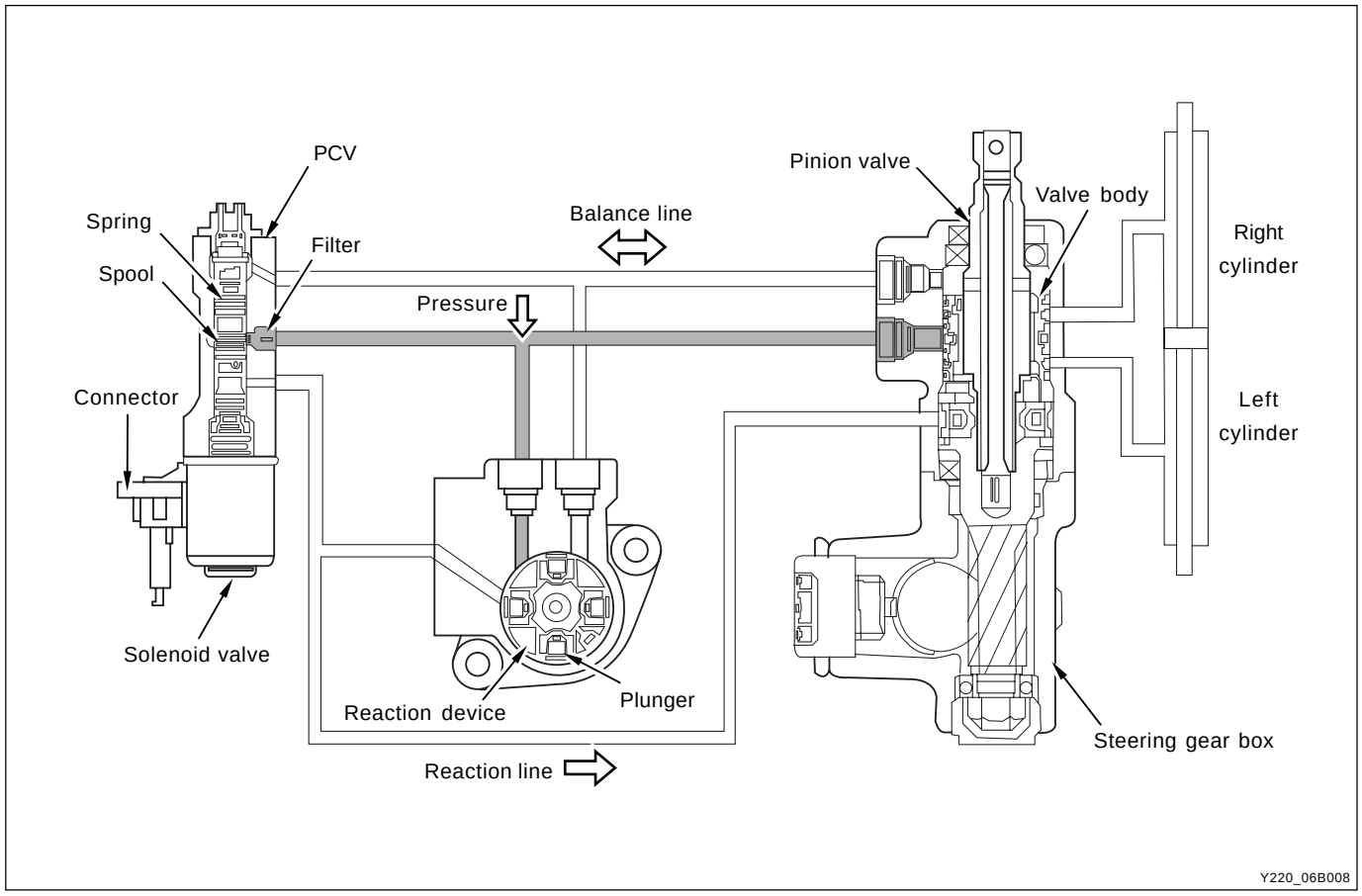
SYSTEM CONTROL

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



1. During parking and low speed driving

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



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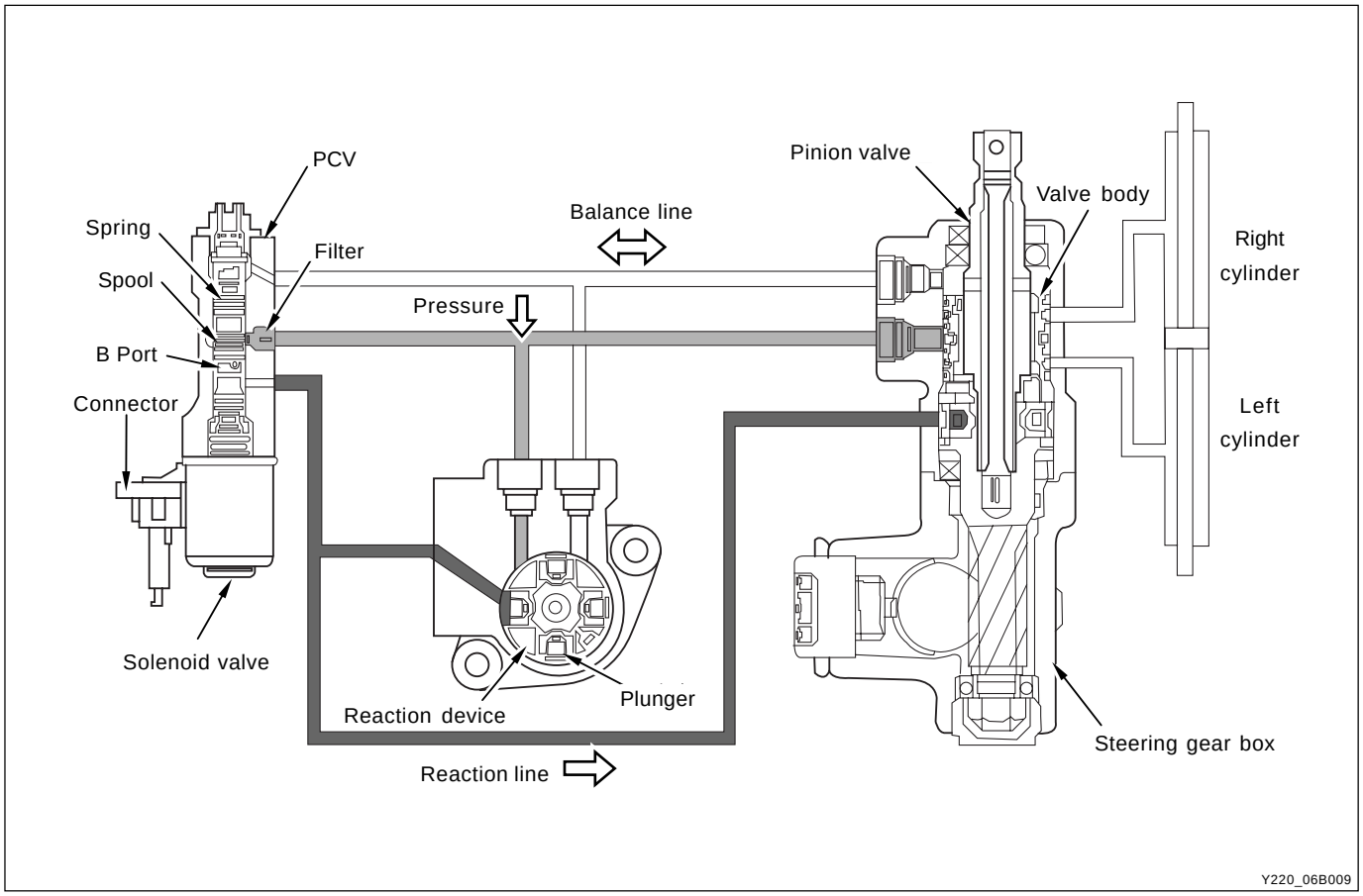
2. During high speed driving

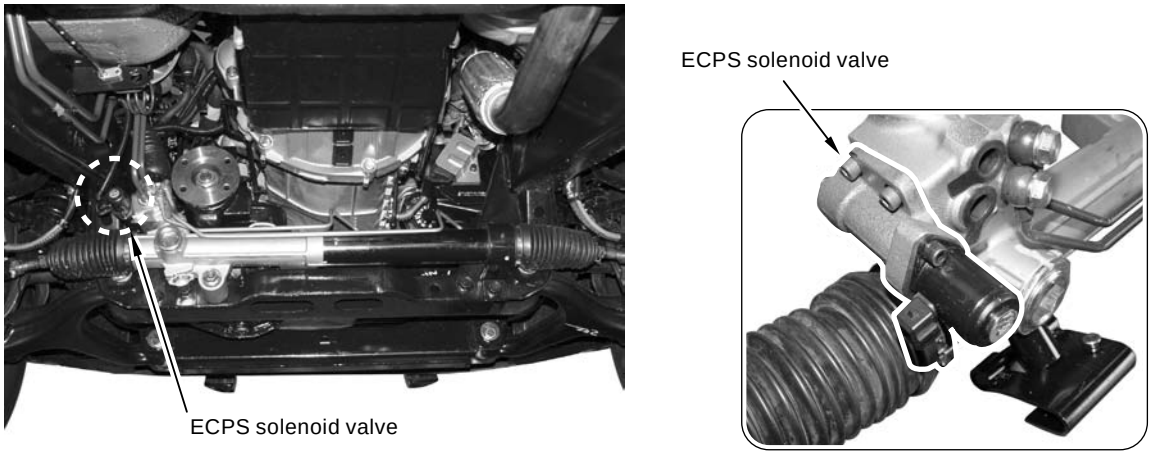
During high speed driving, the control unit supplies weak electric current to solenoid valve. Then, the spool located PCV moves from top to bottom, and the working pressure (A port) from oil pump is applied to reaction plunger (C port) through B port. As a result, the pressing force from reaction plunger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



TROUBLE DIAGNOSIS

POWER STEERING SOLENOID VALVE

▶ Location

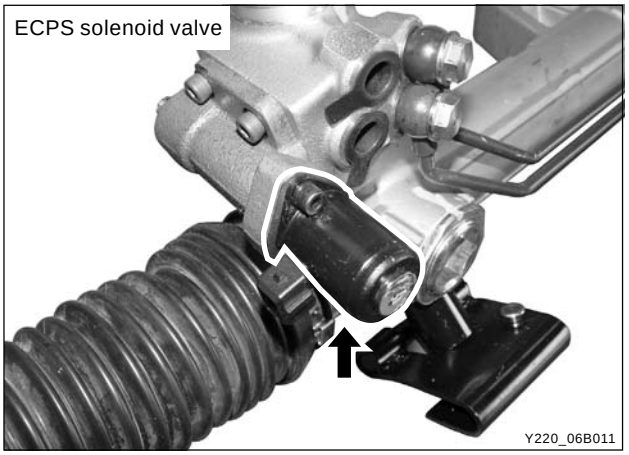


▶ Electric Current Check

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

Notice

Do not ground the solenoid terminal.



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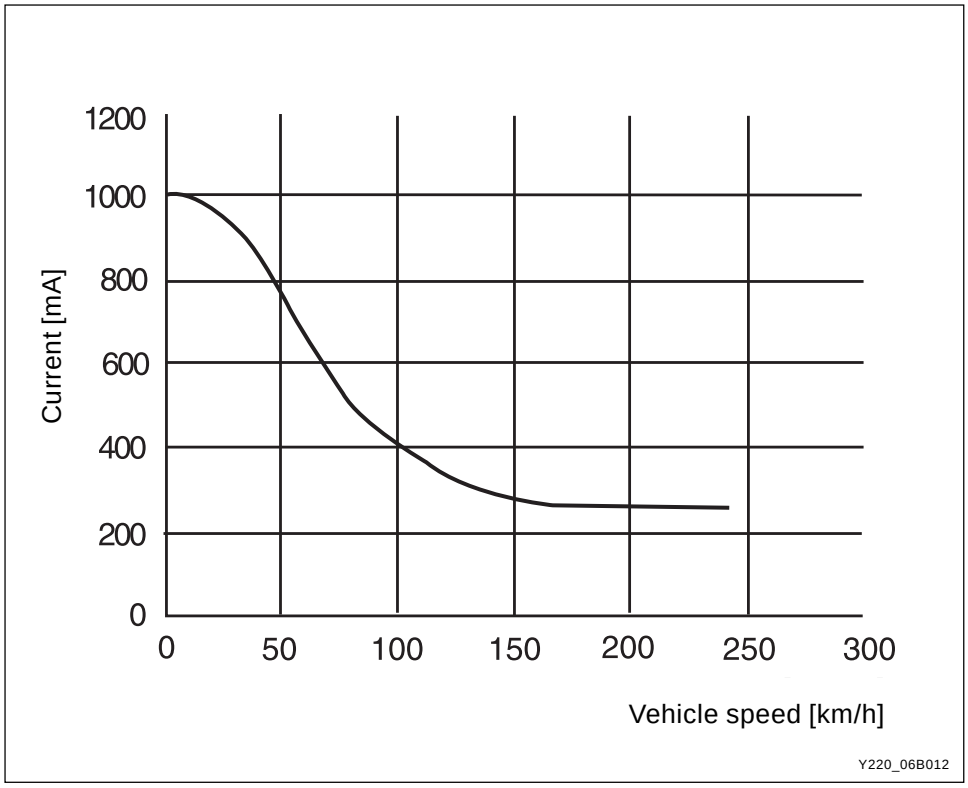
2. When the vehicle speed is at 0 km/h, check whether the electric current for solenoid is in specified range and check that the current is reduced as the vehicle speed increases.

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

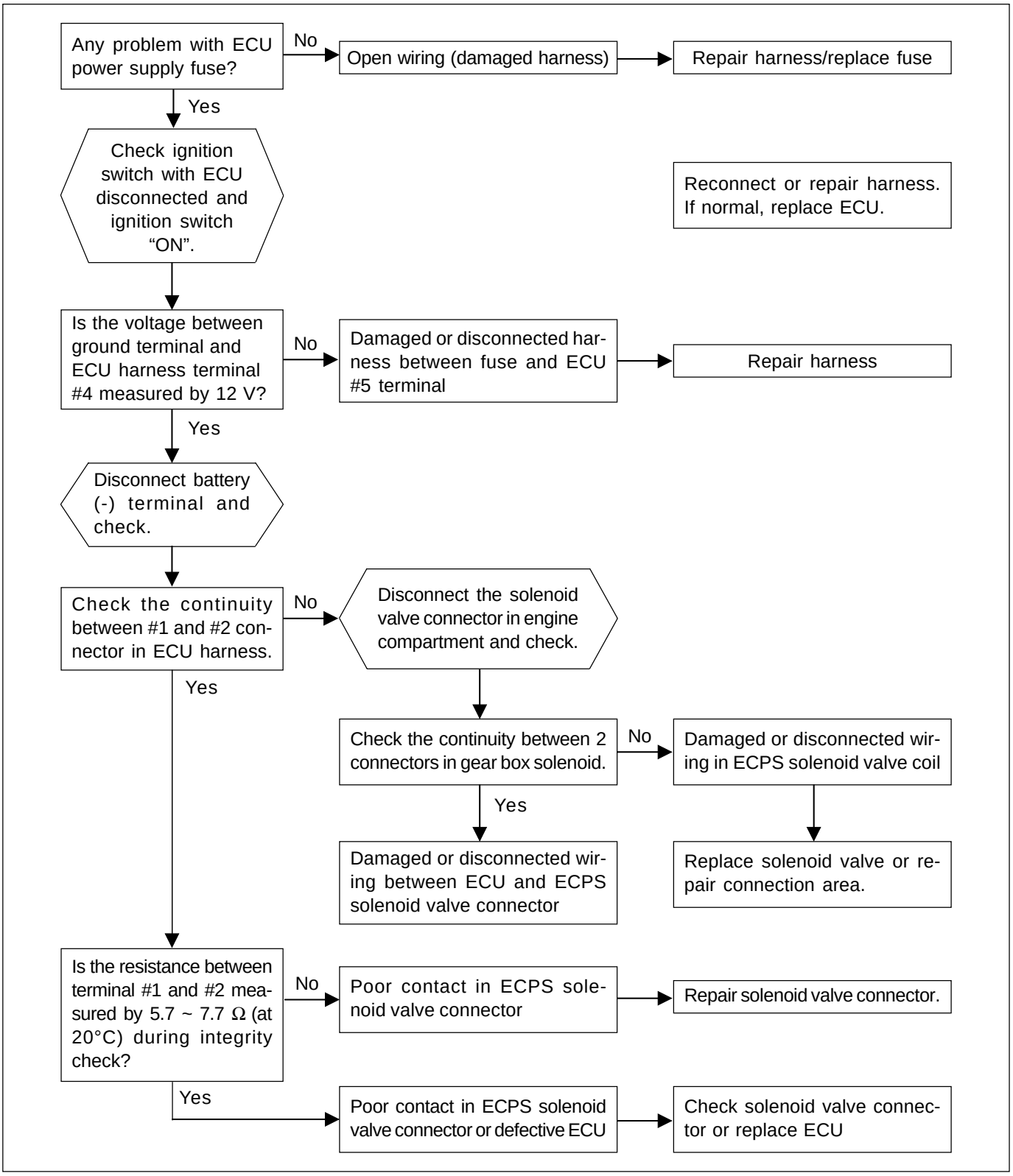


FLOW CHART FOR TROUBLE DIAGNOSIS

Note

1. Use a scanner to check.

2. Refer to circuit diagram for ECPS ECU.



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FAIL SAFE FUNCTION

No.	Trouble	Trouble Condition	Detecting Time	Trouble Code	Action	Description
1	Over voltage	V_{IG} > 17 V	1 sec	C1101	Solenoid current: 0 A	10 V<V_{IG}<16 V
2	Low voltage	V_{IG} < 8 V	1 sec	C1102	Solenoid current: 0 A	10 V<V_{IG}<16 V
3	Vehicle speed sensor	PW > 30 %, vehicle speed 0 km/h	60 sec	* C1212	Vehicle speed: 80 km/h	Input signal of vehicle speed of 5 km/h for over 1 second
4	ECU error	Faulty EEPROM Read/Write, PWM management error	1 sec	C1604	Solenoid current: 0 A	IG ON/OFF
5	Detected current	Detected Current > 1.28 A	1 sec	C2230	Solenoid current: 0 A	Power On Reset
		When solenoid disconnected	1 sec			
		Target current – detected current > 0.2 A, and V_{IG} > 13 V	2 sec			
6	CAN error	No CAN messages	30 sec	C1623	Vehicle speed: 80 km/h	Received messages more than once

* C1212 Help

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

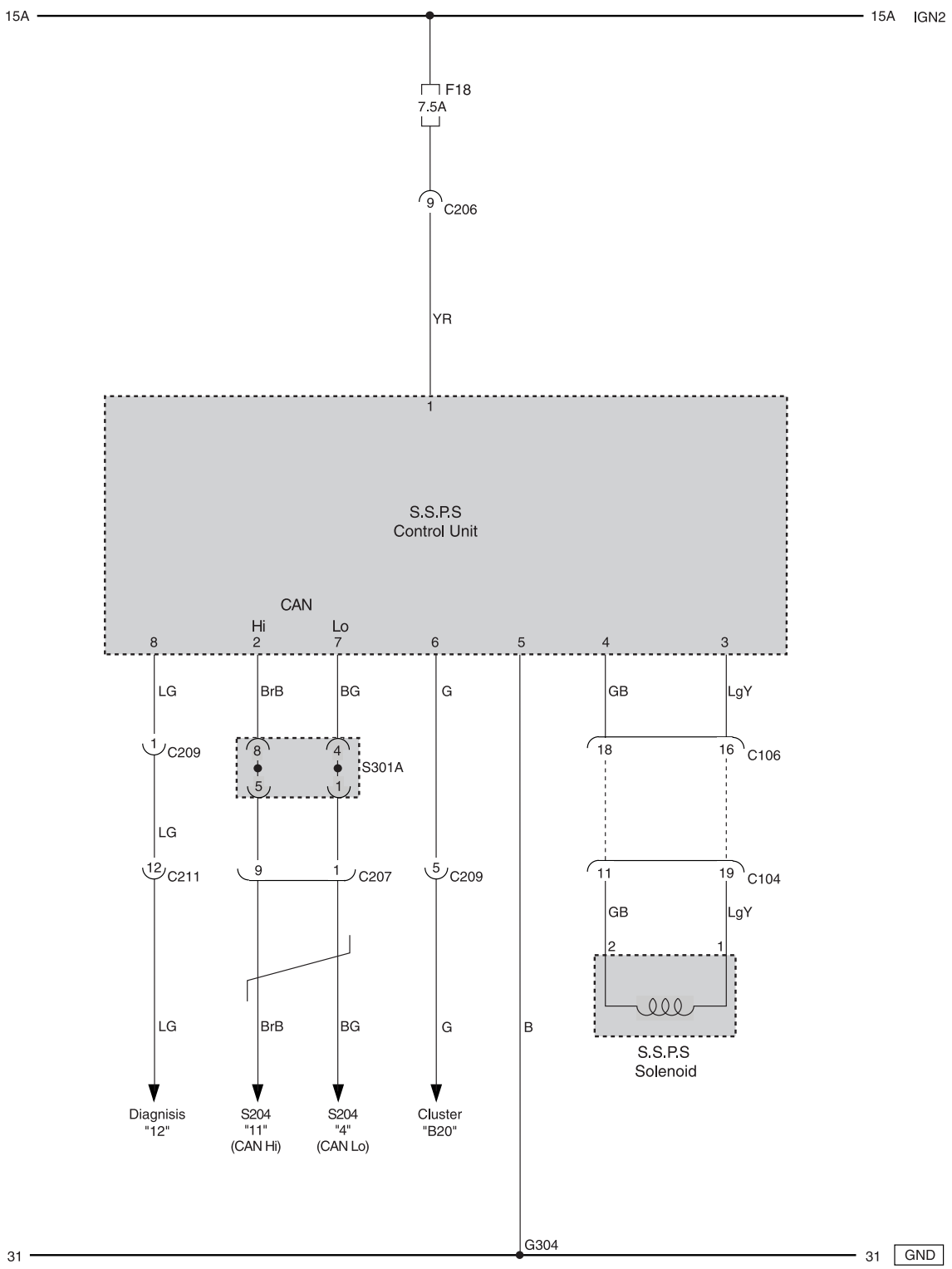
- If the vehicle is 0 km/h for 60 seconds when depressing the accelerator pedal, is determined by 80 km/h.
- Release condition: goes back to normal status when the vehicle speed is oveer 5 km/h for 1 second.
- Check for CAN communication line (pin # 3, 6)
- Check the connectors for poor contact

Notice

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

CIRCUIT DIAGRAM

S.S.P.S (SPEED SENSITIVE POWER STEERING)



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REMOVAL AND INSTALLATION OF ECPS CONTROL UNIT

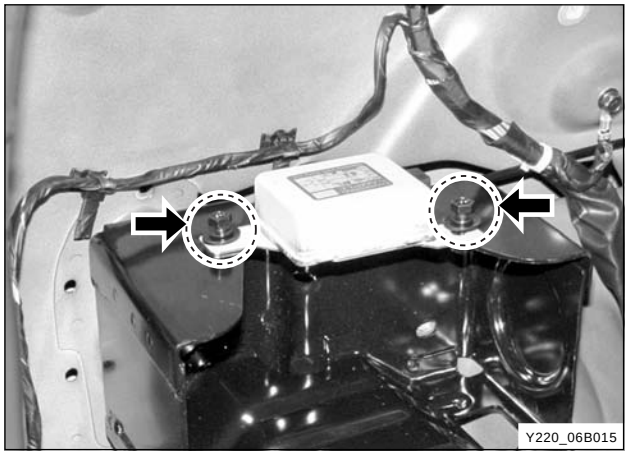
The ECPS control unit is installed on the hydraulic jack mounting bracket in luggage compartment.

Notice

Overhaul and separate part changing is not allowed. Thus, even though the fault is only in the ECPS related system likes solenoid valve, you must replace the power steering assembly. Be careful not to damage the solenoid valve during storage and shipment.

Removal and Installation

1. Disconnect the negative battery cable.
2. Disconnect the ECPS control unit connector.



3. Unscrew the bolts and remove the ECPS control unit from bracket.
4. Install in the reverse order of removal.

SECTION 6C

POWER STEERING

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GENERAL INFORMATION

OVERVIEW

This chapter describes the basic power steering system without ECPS installed in Rexton.

The power steering system consists of pump, oil reservoir, rack and pinion gear. The power steering pump is a vane type and delivers hydraulic pressure to operate the power steering system. The pressure relief valve in pump controls the discharging pressure.

The rotary valve in rack and pinion gear directs the oil from the power steering pump to one side of rack piston.

The integrated rack piston converts the hydraulic pressure to linear movement.

The operating force of rack moves the wheels through tie rod, tie rod end and 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.

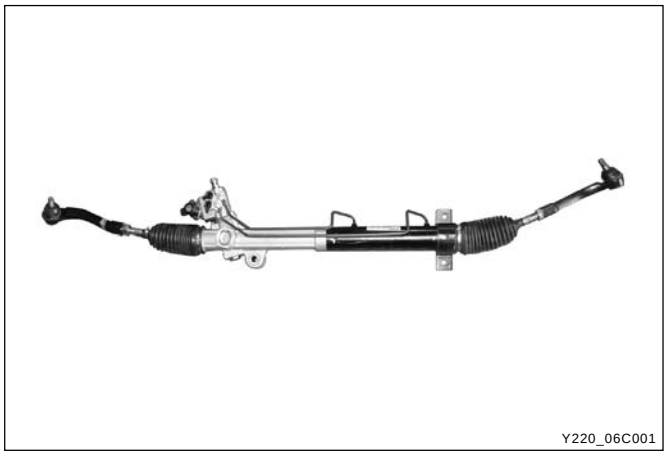
In this case, the operating force of steering wheel is conveyed to pinion, and the movement of pinion moves the rack through pinion gear combined to rack gear.

▶ Power Steering Pump

The vane type pump that is connected to engine by belt is used for the power steering system. This pump generates and controls a proper hydraulic pressure and flows by using the flow control valve and pressure relief valve.

The flow control valve regulates the excessive amount of discharging oil. When the steering wheel is stationary or the oil circuit is blocked, the pressure relief valve returns the over pressurized oil to the oil reservoir to maintain a specified oil pressure level all the time.

▶ Power Steering Gear Assembly



The power steering gear consists of power cylinder and control valve.

The power cylinder has cylinder, piston and piston rod. The control valve directs the oil to one end face of the piston to enhance the steering force.

The control valve controls the directions and operations of power cylinder.

Additionally, the safety check valve is installed so that the system can be operated manually when the system is defective.

▶ Oil Reservoir

The oil reservoir sends the oil to the power steering pump and receives the oil from the power steering gear.

The oil level in the reservoir depends on the steering wheel positions. therefore, measure the oil level when the steering wheel is positioned at straight ahead direction (neutral).

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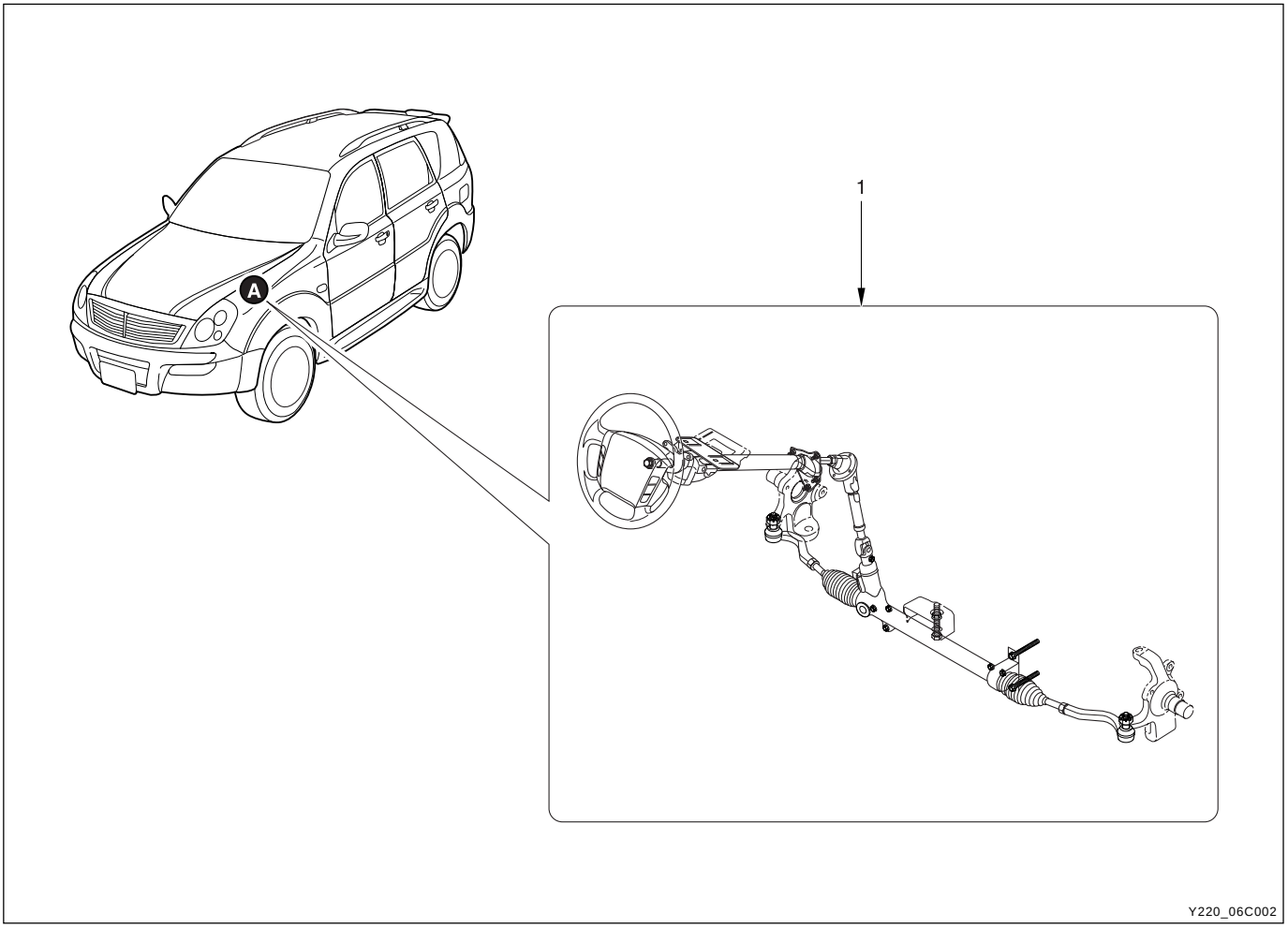
SPECIFICATIONS

Description			Specification
Steering wheel	Type		4-spoke type
	Outer diameter	(mm)	390
Steering gear box	Type		Rack and pinion
	Gear ratio		∞
	Steering angle	Inner	36° 17'
		Outer	32° 40'
Oil pump	Type		Vane type
	Maximum pressure	(kgf/cm^2)	85 ~ 92
	Displacement	(ℓ /min)	10.5
	Pulley size	(mm)	124
Tilt column adjusting angle	Up		4°
	Down		8°
Minimum turning radius		(m)	5.7
Oil	Specification		ATF Dexron II or III
	Capacity	(ℓ)	1.1

COMPONENT LOCATOR

▶ System Layout



A. Installation point

1. Steering components

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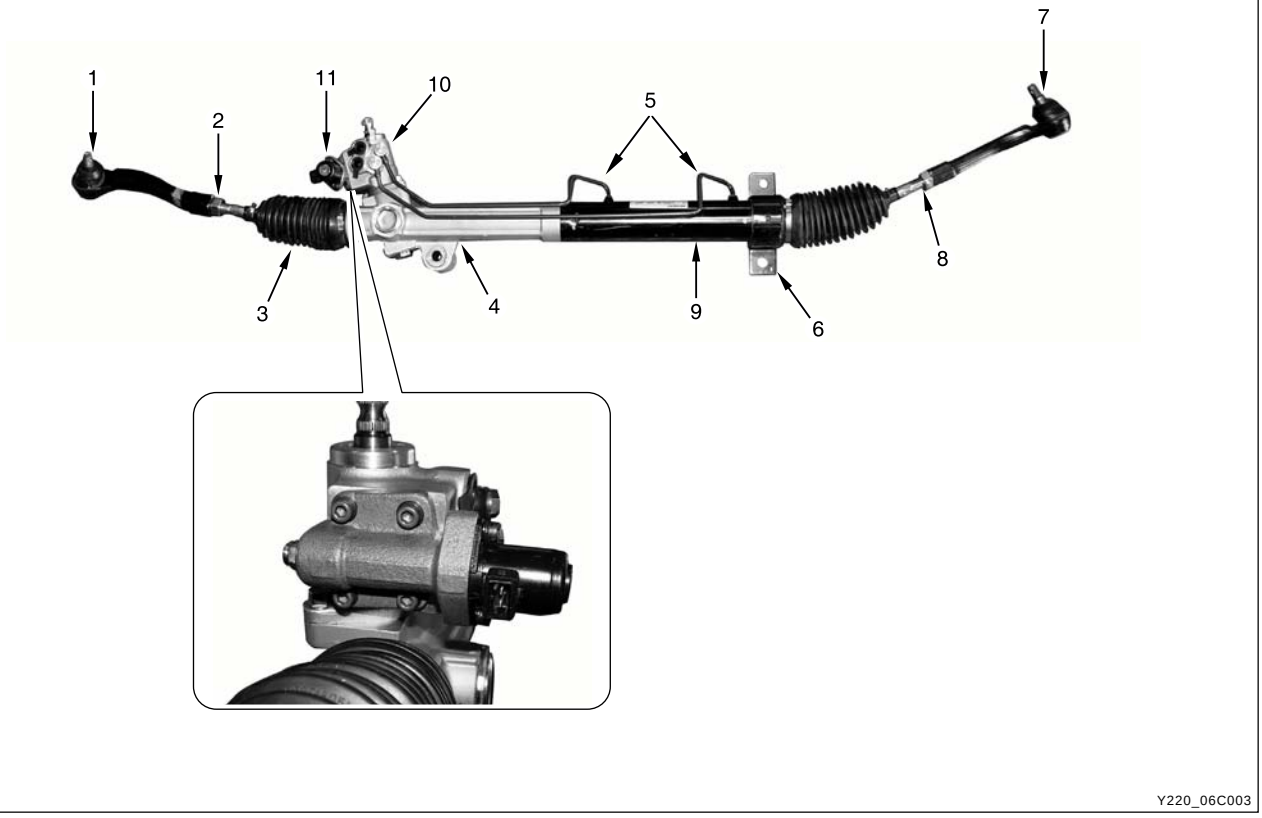
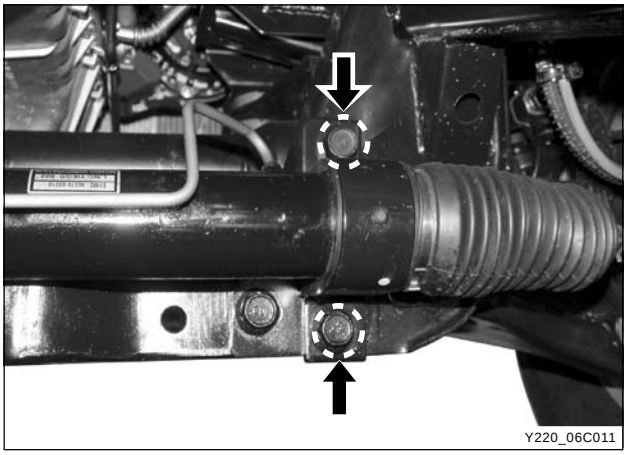
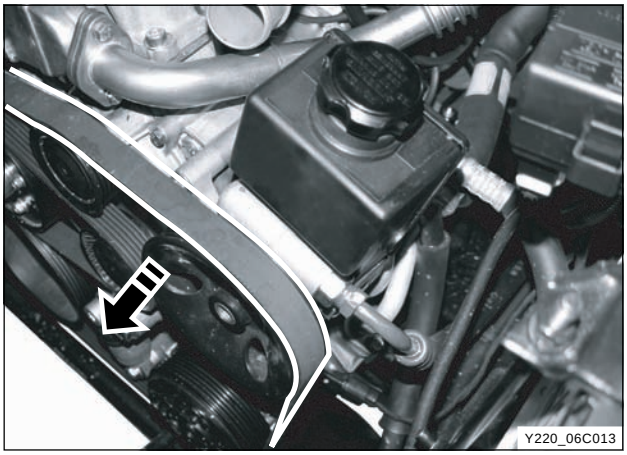
▶ Sectional View of Steering Gear Box



1. Tie rod end
2. Tie rod
3. Bellows
4. Rack housing
5. Feed tube
6. Mounting bracket
7. Tie rod end
8. Tie rod
9. Cylinder tube
10. Valve assembly
11. ECPS solenoid valve

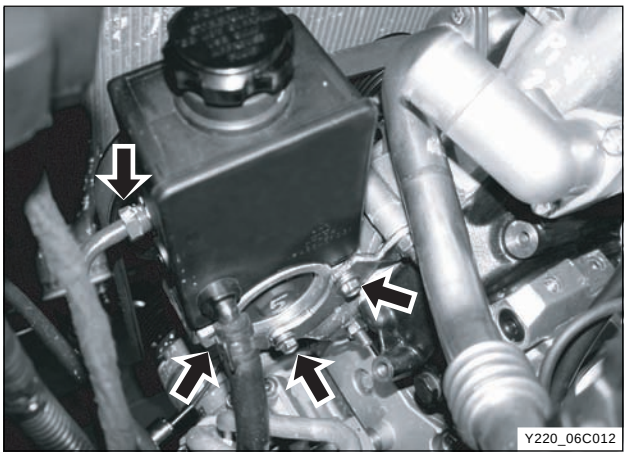


4. Unscrew the clamping bolts and remove the steering gear box assembly.



Steering Gear Pump

1. Remove the drive belt from pump pulley with the pipes and hoses disconnected.



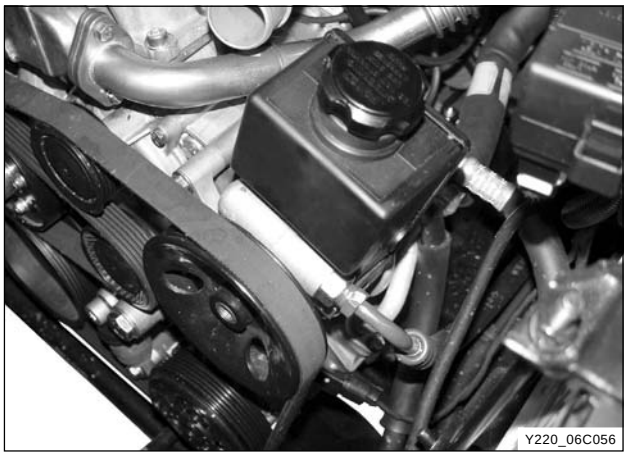
2. Unscrew the bolts and nuts, and remove the pump assembly (reservoir integrated type).

INSTALLATION

Check the removed components for wear, crack and damage. Replace or repair the defective components.

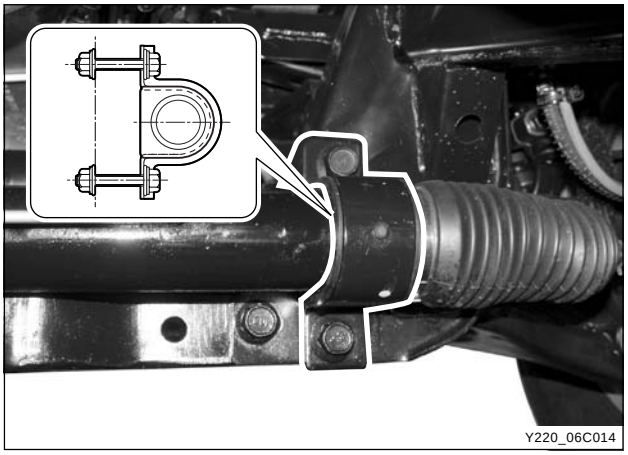
1. Install the power steering pump to the engine.

Upper bolts	23 Nm
Lower bolts	23 Nm



2. Install the power steering gear box to the frame and temporarily tighten the mounting bolts. Install the right gear box clamp.

Tightening torque	100 ~ 130 Nm

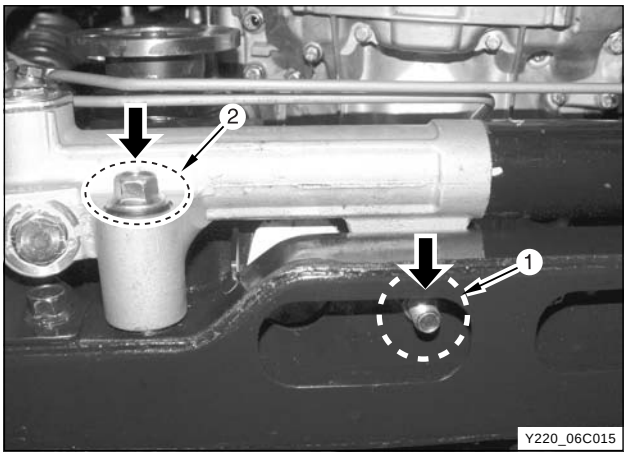


3. Fully tighten the mounting bolts and nuts.

Notice

Tighten the center bolts and nuts first, then tighten the left bolts and nuts.

Tightening torque	100 ~ 130 Nm



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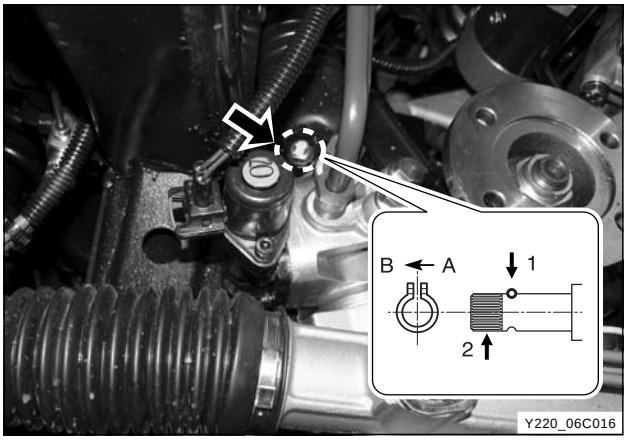
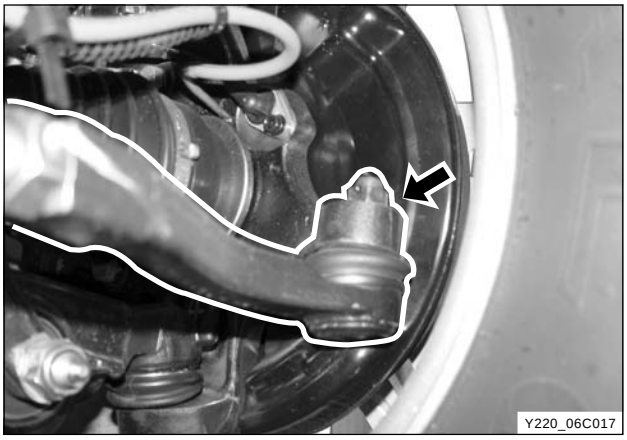


4. Install the steering lower shaft to the gear box. The joint bolt should be inserted from “A” (no threaded side) to “B” (threaded side).

Tightening torque	25 ~ 30 Nm

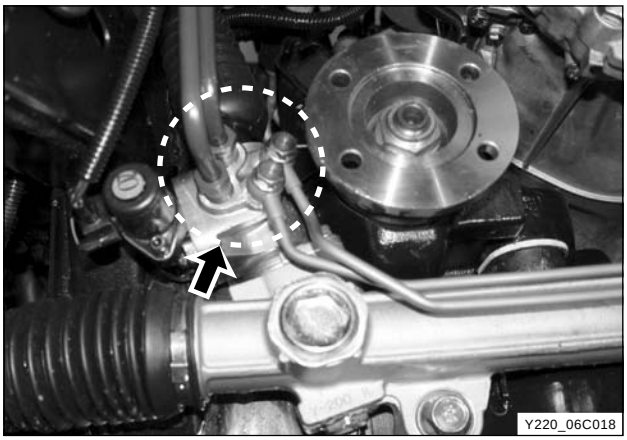
Notice

The joint bolt (1) should be inserted the groove in pinion shaft spline when installing the lower shaft.



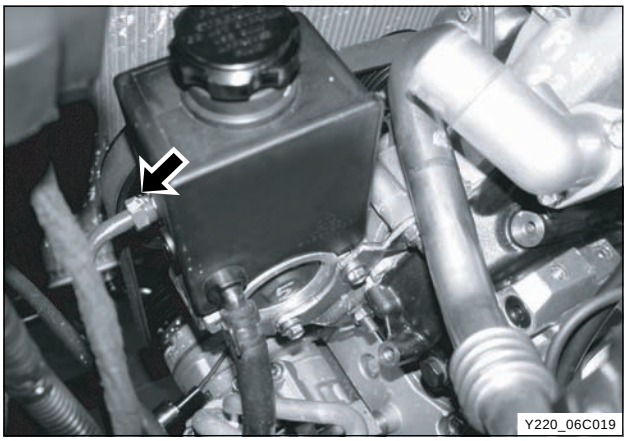
5. Install the tie rod end to the steering knuckle, tighten the slotted nut, and insert new split pin.

Tightening torque	35 ~ 45 Nm



6. Install the supply and return pipes.

Supply pipe (2)	12 ~ 18 Nm
Return pipe (1)	12 ~ 18 Nm

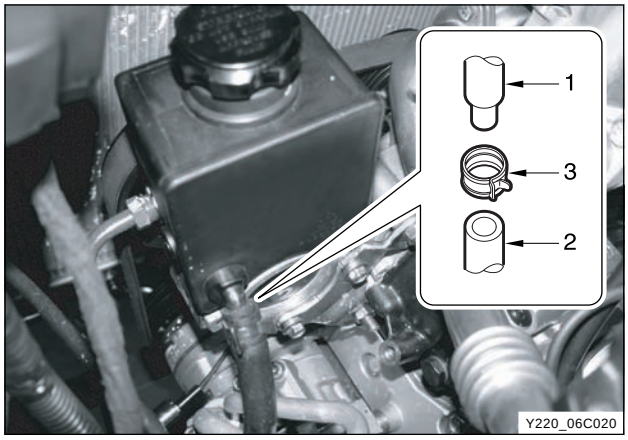


7. Install the supply pipe to the steering gear pump.

8. Connect the return hose (2) to the steering gear pump reservoir and install the spring clamp.
9. After installation, bleed the air from the system.

Notice

Fully insert the hose to the reservoir and locate the spring clamp at the center of the nipple.



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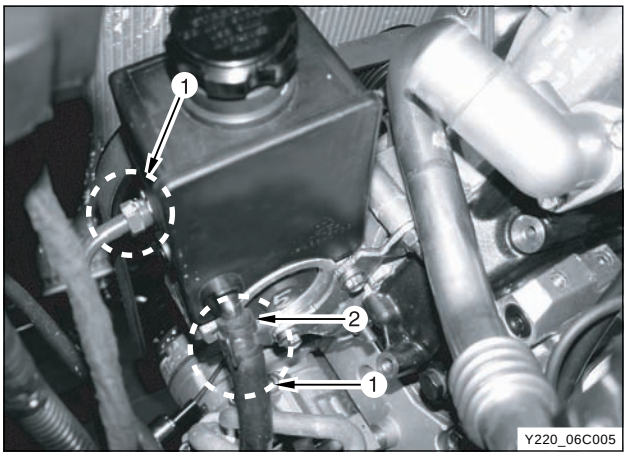
REMOVAL

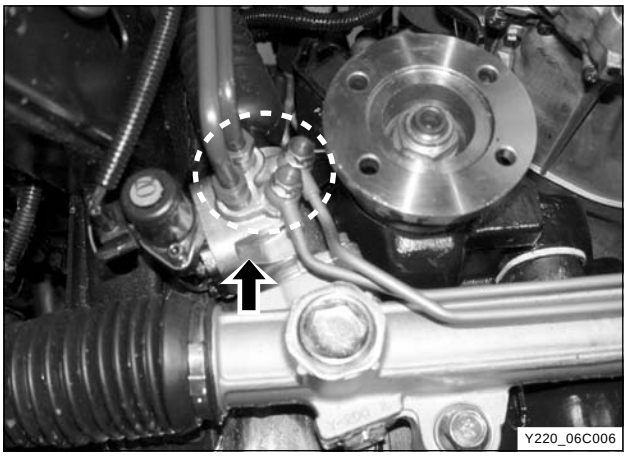
Power Steering Pipe and Hose



1. Remove the supply pipe (1) and return hose (2) from the power steering pump.

Notice

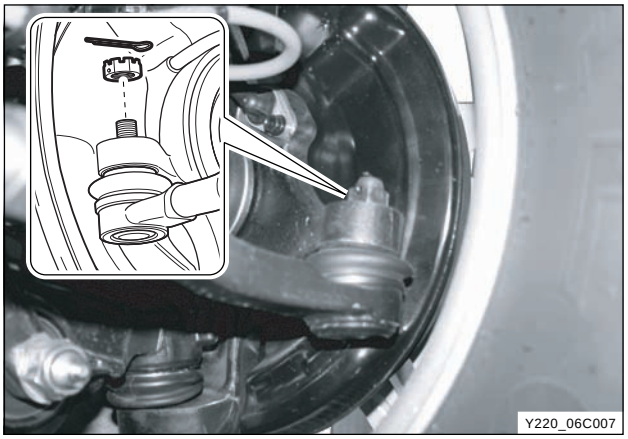
Collect the spilled oil with a proper container.



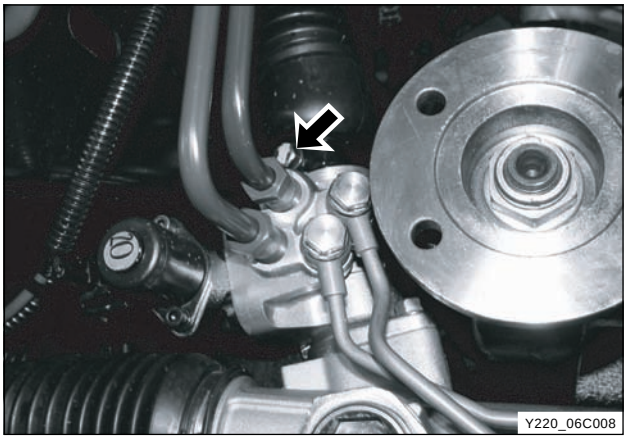
2. Remove the supply pipe and return pipe from the power steering gear box.

Power Steering Gear Box

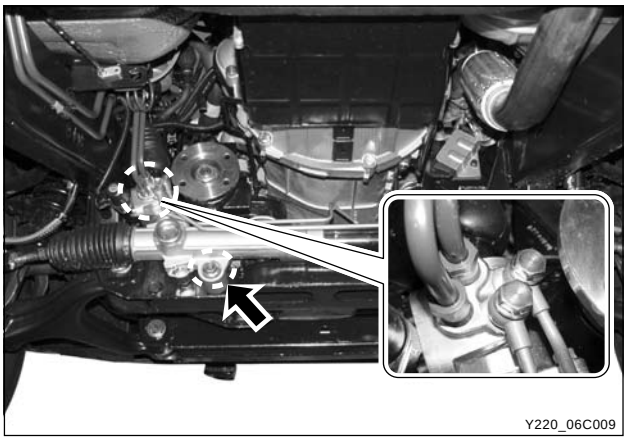
1. Remove the tie rod from steering knuckle. Remove the split pin and slotted nut from tie rod end and pull off the tie rod by using special tool.



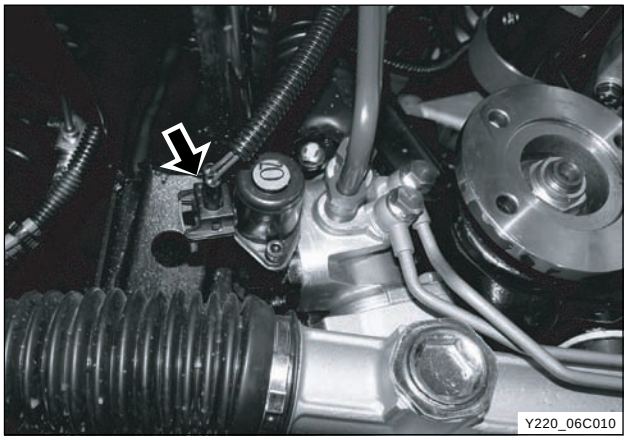
2. Unscrew the joint blots in steering lower shaft and remove the lower shaft and gear box.



3. Remove the center bolts in gear box and left mounting bolts. Remove the supply and return pipe bolts.



3-1. Disconnect the solenoid valve connector.



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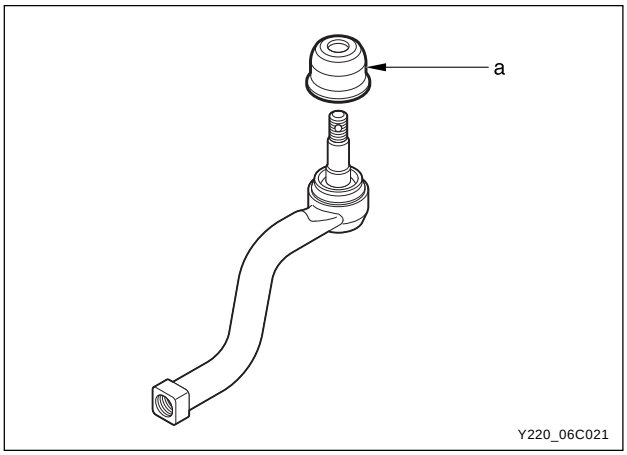
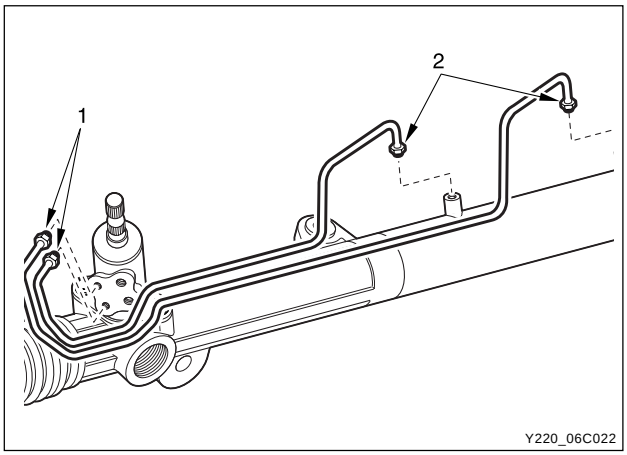
DISASSEMBLY AND REASSEMBLY

DISASSEMBLY

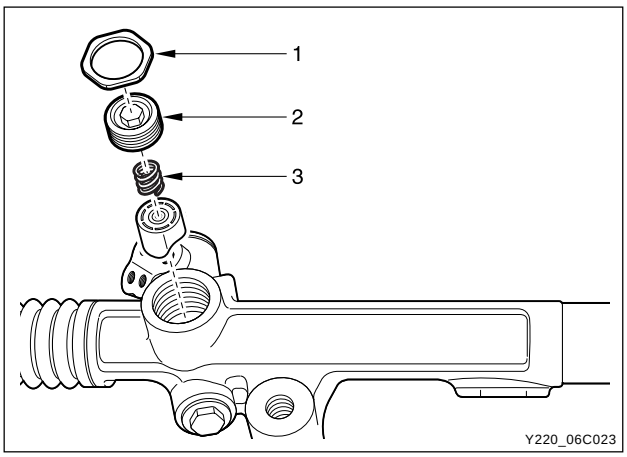
* describes the basic power steering assembly.



1. Remove the tie rod end boot (a).

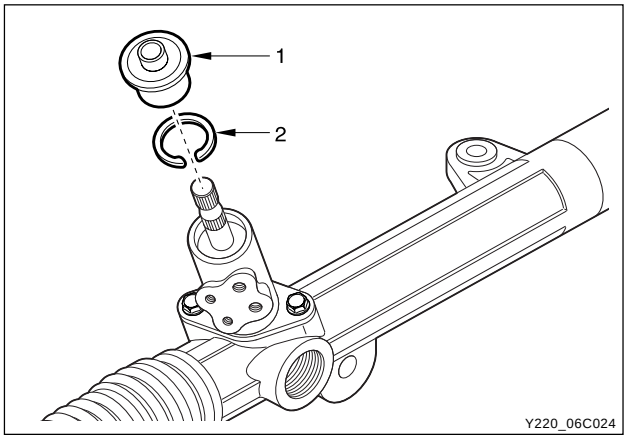


2. Remove the feed lines (2) from the cylinder tube in gear box.
3. Remove the feed lines (1) from the valve housing in gear box.



4. Unscrew the lock nut (1) and remove the plug (2) and spring (3).

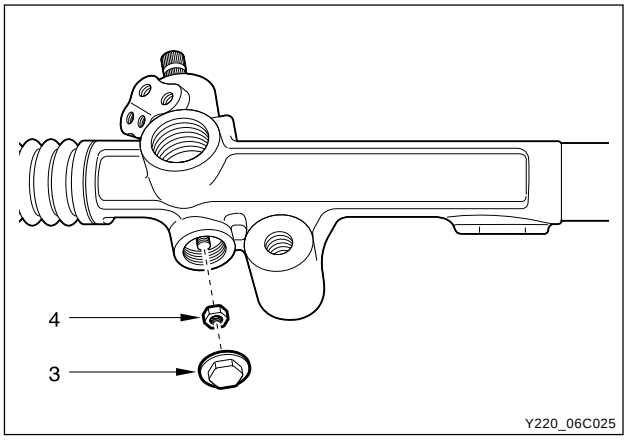
5. Remove the dust cover (1) and retainer ring (2).



6. Remove the pinion dust cover (lower, 3) and unscrew the pinion lock nut (4).

Notice

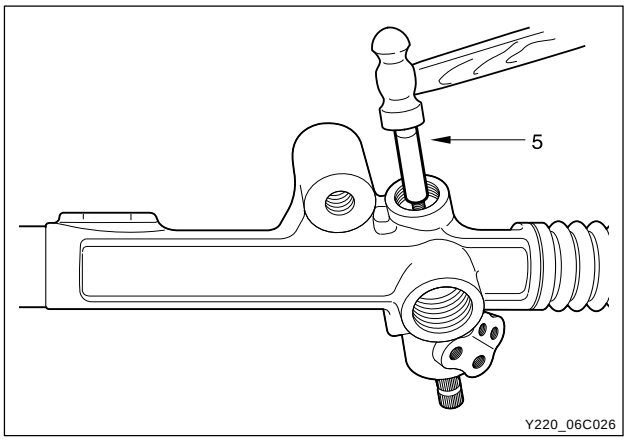
Before removing the pinion lock nut, make sure to lock the pinion gear to prevent it from damaging.



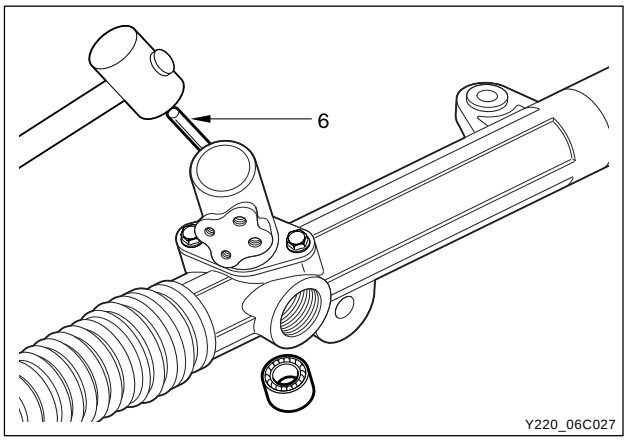
7. Remove the steering pinion (5) from pinion bearing by tapping the bottom end of steering pinion with a flat drift and plastic hammer.

Notice

Align the center of the drift and the bottom end of steering pinion.



8. Remove the pinion bearing (6) by tapping it with a long and flat head drift and plastic hammer.



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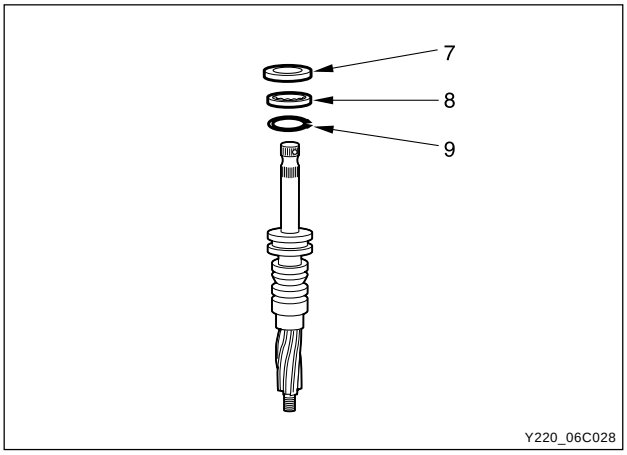


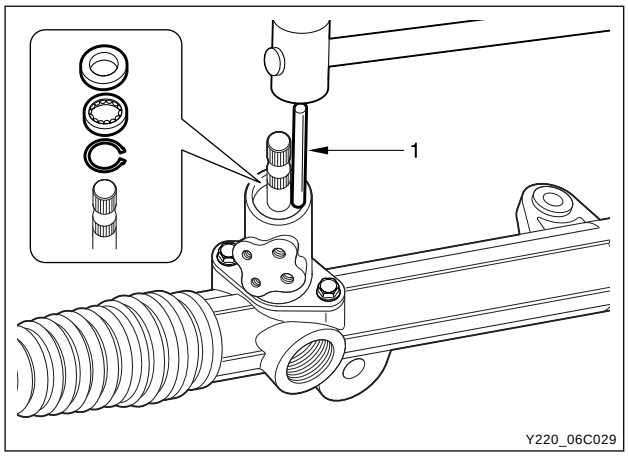
9. Remove the pinion shaft seal (7), needle bearing (8) and retaining ring (9).

Notice

Do not disassemble the power steering gear housing and rack gear. Replace it as an assembly if needed.

REASSEMBLY

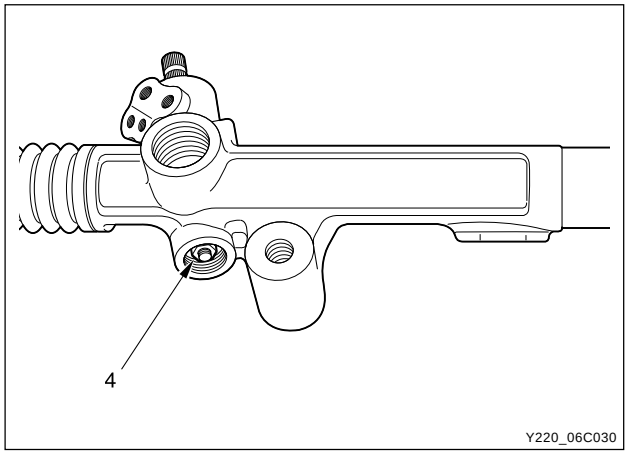
1. Install the steering pinion gear.
   1) Install the retaining ring.
   2) Install the needle bearing.
   3) Install the pinion shaft seal by tapping it with a long and flat end drift.



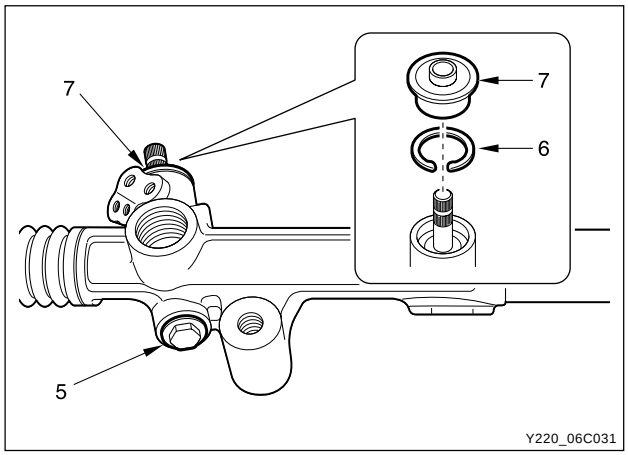
2. Tighten the steering pinion lock nut (4) with a specified tightening torque.

   Notice

   Make sure that the pinion bearing is not offset with the steering pinion lock nut.



3. Tighten the steering pinion dust cover (5) with a specified tightening torque.
   1) Install the retaining ring (6).
   2) Install the plastic dust cover (7).



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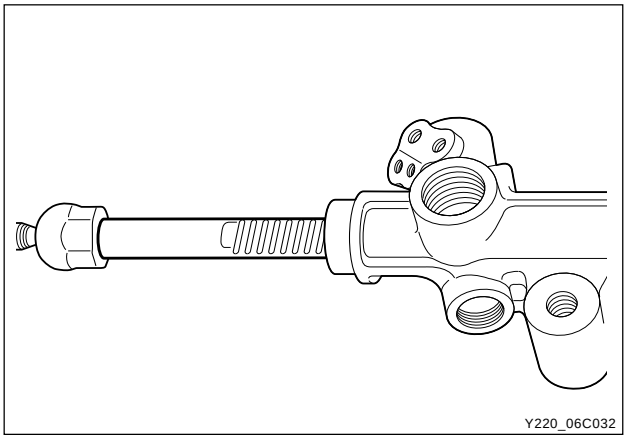
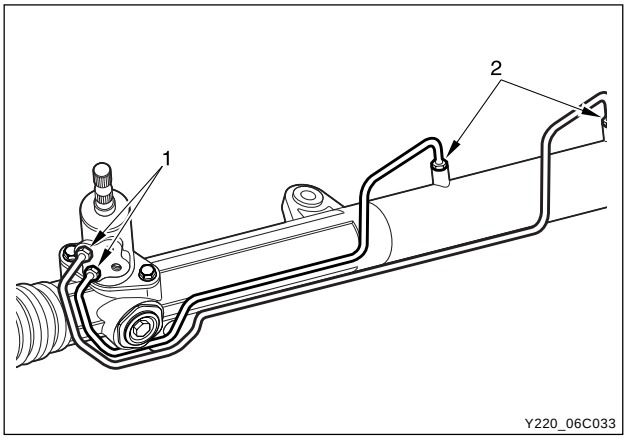

Y220_06C032

4. Install the rack bearing.
   - Install the adjusting spring.
   - Tighten the adjusting plug with a specified tightening torque.
   - Tighten the lock nut.
   - Adjust the preload of steering gear.



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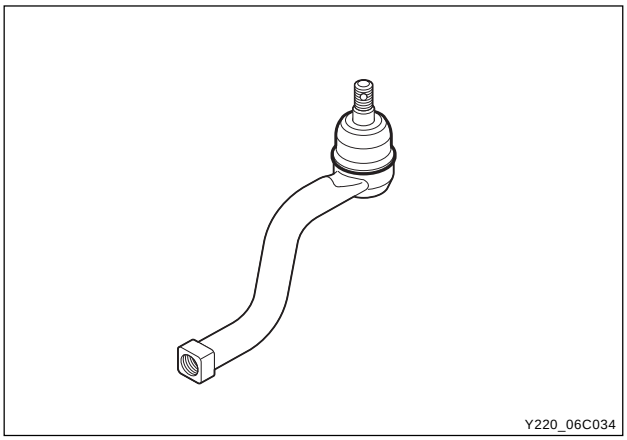
5. Install the hydraulic pipes.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6. Install the tie rod end boot.

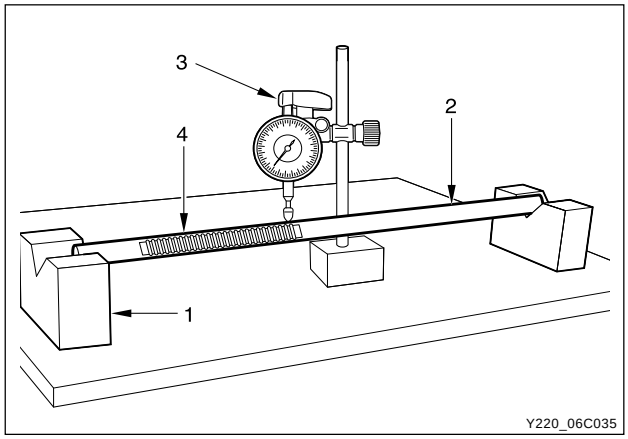
Notice

Apply grease into the ball joint of tie rod end and the boot.

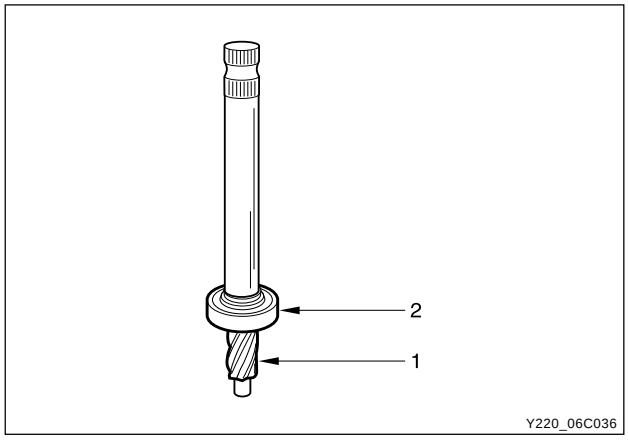
INSPECTION

Rack Gear Shaft

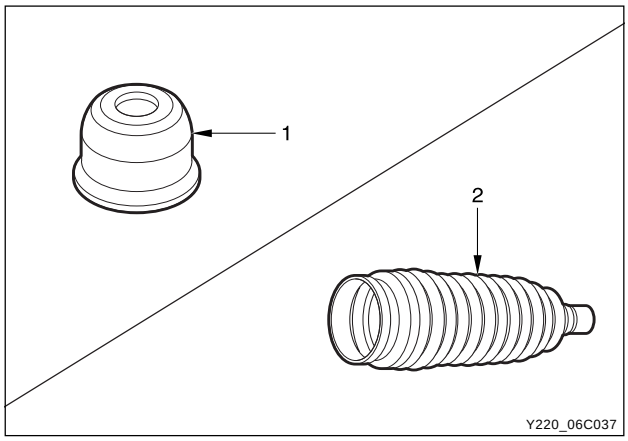
1. Check the rack gear for deformation and damage.
   - Place the V-blocks (1) on the flatten plate.
   - Put the rack gear (2 and 4) on the V-blocks.
   - Measure the straightness of rack gear with a dial gauge.
   - Check the rack gear for abnormal wear and damage.



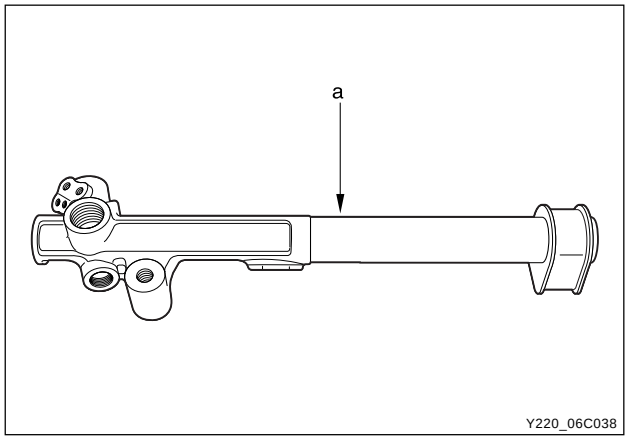
2. Check the steering pinion gear for damage.
   - Check the pinion gear (1) for abnormal wear and damage.
   - Check the bearing (2) for looseness and operation.



3. Check the tie rod end and the rack and pinion bellows for damage.
   - Check the tie rod end boot (1) for crack and abnormal wear.
   - Check the rack and pinion boot (2) for crack and abnormal wear.



4. Check the steering gear housing (a) for crack, distortion and abnormal wear.



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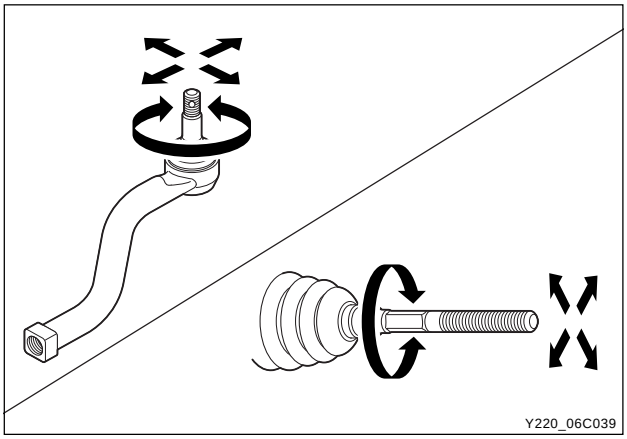
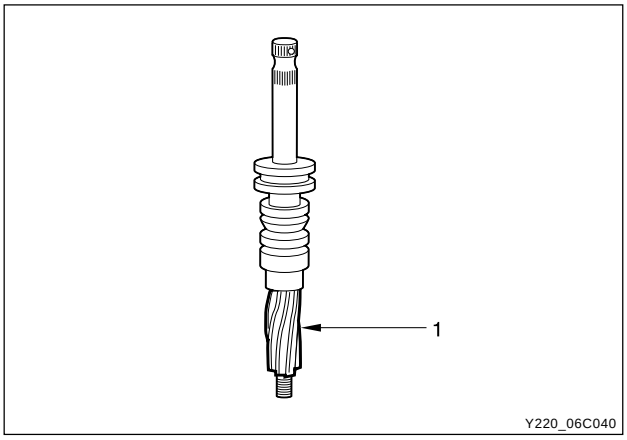
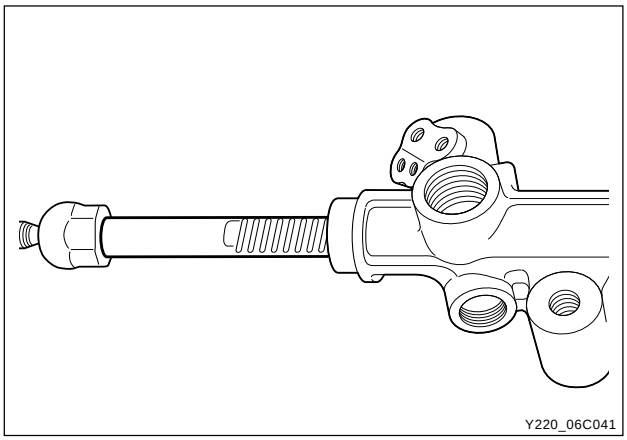


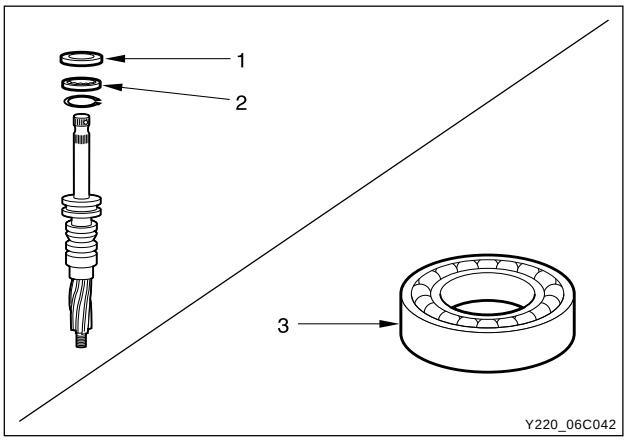
5. Check the tie rod end and the tie rod ball joint for damage.
   - Check the tie rod end ball joint for operation.
   - Check the tie rod ball joint for operation. Check the tie rod for deflection due to its weight.
6. Replace all the defective components with new ones.



7. Check the tie rod end and the rotating area (1) of tie rod ball joint for damage.



8. Check the tie rod end and the rack and pinion boot for crack and abnormal wear.
9. Check the metal components for wear.
   - Check the pinion gear for abnormal wear and damage.
   - Check the rack gear for abnormal wear and damage.
   - Check the steering gear housing for wear and damage.



10. Check the bearings and oil seals for damage.
    - Check the pinion shaft seal (1) for wear and leakage.
    - Check the needle bearing (2) for wear.
    - Check the steering pinion bearing (3) for wear.
11. Replace all the defective components with new ones.

TROUBLE DIAGNOSIS

Symptom	Cause	Action
Hard steering	Lack of lubrication	Lubricate
	Abnormal wear or binding of steering ball joint	Replace
	Damaged or faulty steering gear	Replace gear assembly
	Improper preload of steering pinion	Adjust
	Faulty steering shaft joint	Replace
	Steering fluid leaks	Repair or replace
	Lack of fluid or air-in system	Replenish or bleed
	Faulty steering oil pump	Replace
Steering pulls to one side	Damaged or loosened pump drive belt	Adjust or replace
	Clogging oil line	Repair or replace
	Damaged wheel or tire	Repair or replace
	Faulty suspension system	Repair or replace
	Damaged steering linkage	Repair
	Damaged wheel and tire	Repair or replace
	Faulty brake system	Repair or replace
	Faulty suspension system	Repair or replace
Excessive wheel play	Worn steering gear	Replace gear assembly
	Worn or damaged steering ball joint	Replace
	Loosened steering gearbox bolts	Retighten
Poor return of steering wheel	Damaged or binding steering ball joint	Replace
	Improper preload of steering pinion	Replace gear assembly
	Damaged wheel or tire	Repair or replace
	Faulty suspension system	Repair or replace
Steering wheel shimmy	Damaged steering linkage	Replace
	Loosened steering gearbox mounting bolt	Retighten
	Damaged or binding steering ball joint	Replace
	Worn or damaged front wheel bearing	Replace
	Damaged wheel or tire	Repair or replace
	Faulty suspension system	Repair or replace
Abnormal noise from steering system	Loosened steering gearbox mounting bolt	Retighten
	Faulty steering gear	Replace gear assembly
	Steering column linterference	Replace
	Loosened steering linkage	Retighten
	Damaged or loosened oil pump drive belt	Adjust or replace
	Loosened oil pump bracket	Retighten
	Loosened oil pump mounting bolt	Retighten
	Air-in system	Bleed
	Faulty oil pump	Replace

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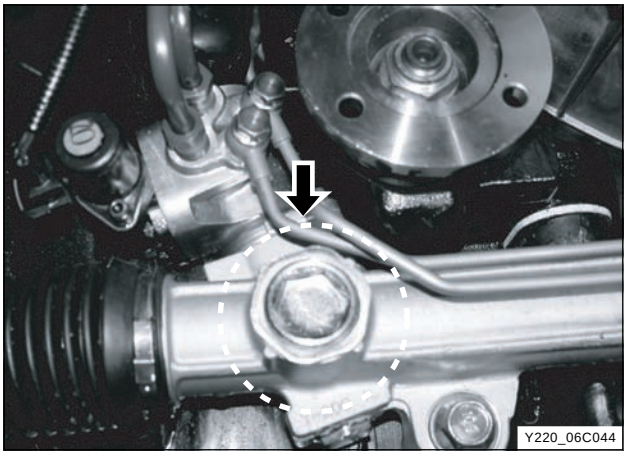
GENERAL INSPECTION

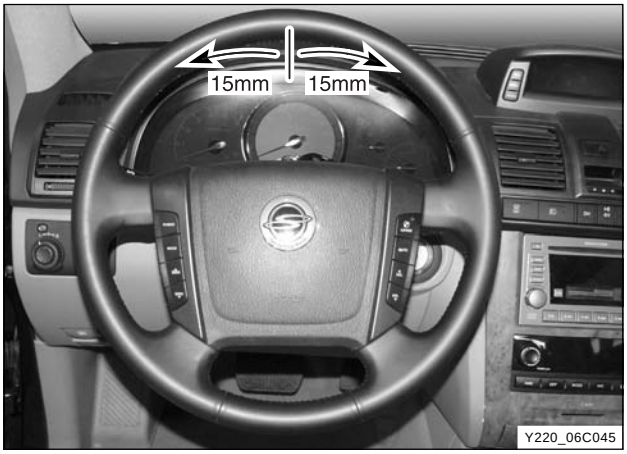
POWER STEERING GEAR PRELOAD ADJUSTMENT

1. Place the steering wheel at straight ahead direction.
2. Lift up the vehicle very carefully.
3. Remove the adjusting plug lock nut.
4. Measure the torque of adjusting plug.



5. If the measured torque is out of range, adjust it to the specified value.
   - Place the rack gear in center position.
   - Tighten the adjusting plug by 100 kg.cm
   - Turn the pinion gear to move the rack gear between both ends by 5 times.
   - Remove the adjusting plug.
   - Tighten the adjusting plug by 45 ~ 55 kg.cm
   - Release the adjusting plug by 67.5°.
6. Tighten the adjusting plug lock nut.

POWER STEERING WHEEL FREE PLAY CHECK



1. Start the engine and place the wheels at straight ahead direction.
2. Turn the steering wheel until the tires starts to move and measure the distance on the circumference of the steering wheel.

Specified value	30 mm

Notice

If the free play is out of the specified value, check the clearance in steering column shaft connection and steering linkage. Replace or repair if necessary.

STEERING EFFORT CHECK

1. Park the vehicle on a paved and flat ground and place the front wheels at straight ahead direction.
2. Start the engine and let it run around 1,000 rpm.
3. Install the spring scale on the circumference of the steering wheel and measure the steering effort in both directions.

Tightening torque	below 3.0 kg

Notice

The difference between both sides should be within 0.6 kg.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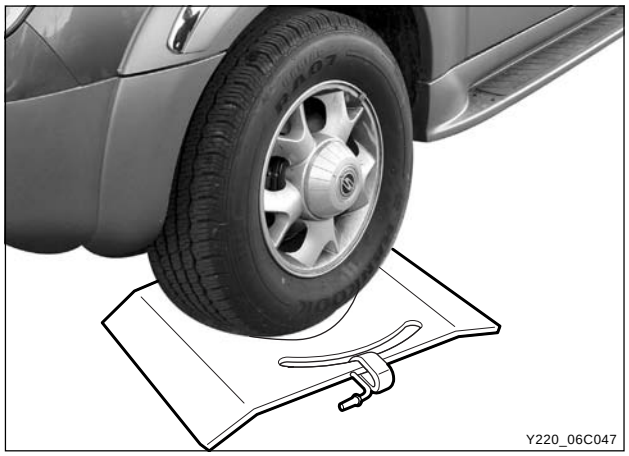
STEERING ANGLE CHECK

1. Place the front wheel on a turning radius measuring tool.
2. Turn the steering wheel to the its both ends and measure the maximum steering angle.

Specified value	Inner	36° 17′
	Outer	32° 40′

Notice

If the free play is out of the specified value, check and adjust the toe-in.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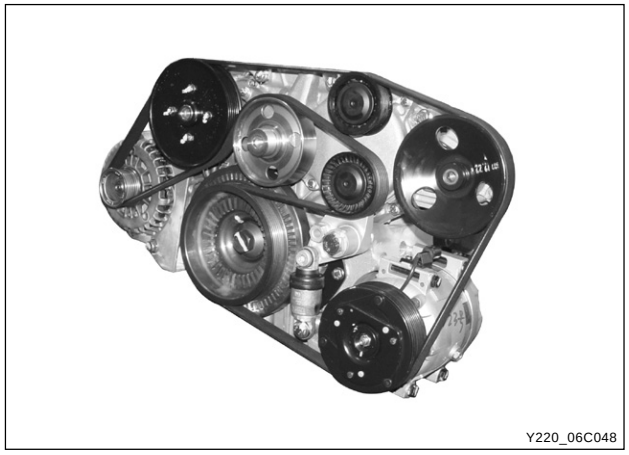
BELT TENSION CHECK/ADJUSTMENT

1. Check the belt for wear, crack and damage. Replace it if needed.
2. Press the center of belt with around 10 kg of force and check the deflection.

Notice

If the deflection is too large:

- ***Replace the auto tensioning assembly.***
- ***Check the belt and replace.***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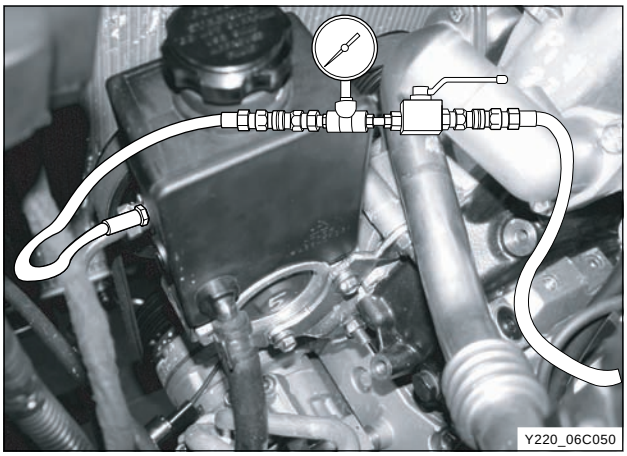
OIL PUMP PRESSURE



Check the oil pump pressure to locate any defect in oil pump.

Notice

Before checking the pressure, check the oil level and belt tension. Prepare the empty container to collect the spilled oil during the service.

1. Unscrew the pressure line fitting in power steering pump.
2. Install the pressure gauge between the power steering pump and the power steering oil pressure line.
3. Place the shift lever to neutral position.
4. Apply the parking brake.
5. Open the valve in pressure gauge.
6. Start the engine and let it run at idle speed.
7. Turn the steering wheel several times so that the oil temperature reaches to normal operating level.
8. Fully close the valve in pressure gauge and measure the oil pressure.

   ### Notice

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

Pump relief valve pressure	53 ~ 58 kg/cm^2

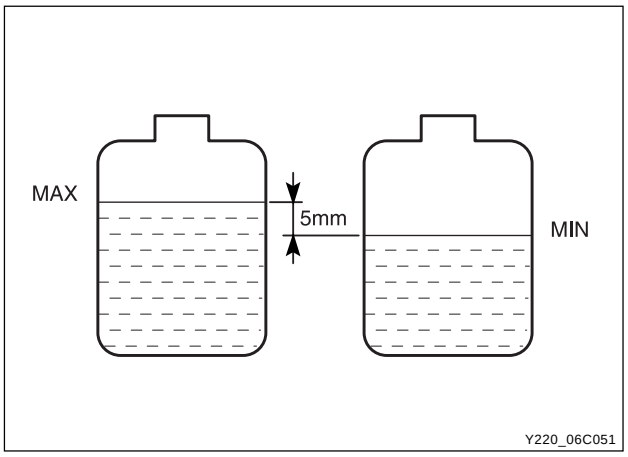
9. Measure the oil pressure with the gauge valve fully closed.

Pump pressure at no load	3 ~ 5 kg/cm^2

10. If the pump pressure is in specified range, the pump is normal. If not, replace the power steering pump.

OIL LEVEL CHECK

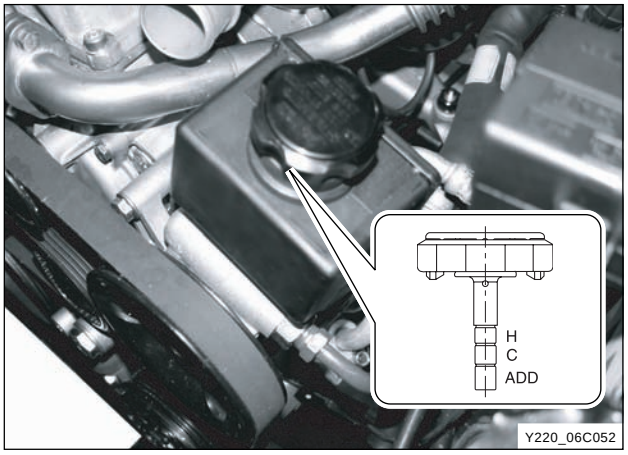
The power steering oil level have to be checked by two conditions; one is checked at normal operating temperature, and the other one is checked when it is cooled. If the difference between two measurements is below 5 mm and the level is between Max and Min level, it's normal. If it is over 5 mm, bleed air from the system.



1. Place the vehicle on a flat ground and start the engine and let it run at idle speed.
2. Turn the steering wheel several times so that the oil temperature reaches to normal operating level.
3. Place the steering wheel at straight ahead direction.
4. Measure the oil level in the power steering oil reservoir.
5. Adjust the oil level between Max and Min.

OIL CHANGE

1. Lift up the vehicle very carefully.
2. Disconnect the oil supply hose from the power steering pump.
3. Drain the oil from the power steering oil reservoir.
4. Connect the oil supply hose to the power steering pump.
5. Disconnect the oil return line from the power steering oil reservoir.
6. Remove the high tension cables from the ignition coils.
7. Periodically crank the starting motor and turn the steering wheel to its both ends to drain the oil in the reservoir through the return line.
8. Connect the return line to the steering oil reservoir.
9. Fill the oil into the steering oil reservoir to the specified level.
10. Bleed the air from the system.



H. MAX - when the oil is hot
C. Leverage value - when the oil is cooled
ADD. MIN

Note

Always keep the oil level over the ADD line.

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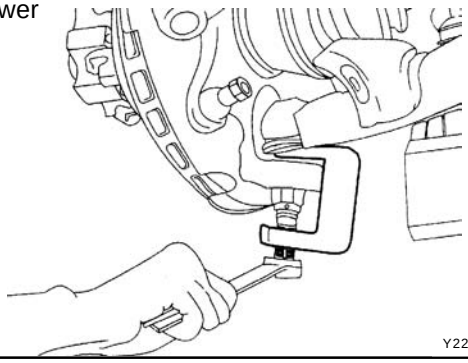
SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
661 589 13 33 00 **Ball joint puller**  Y220_06C054	Removal of the upper and lower end assemblies of front suspension  Y220_06C055

SECTION 7A

FRONT SUSPENSION

Table of Contents

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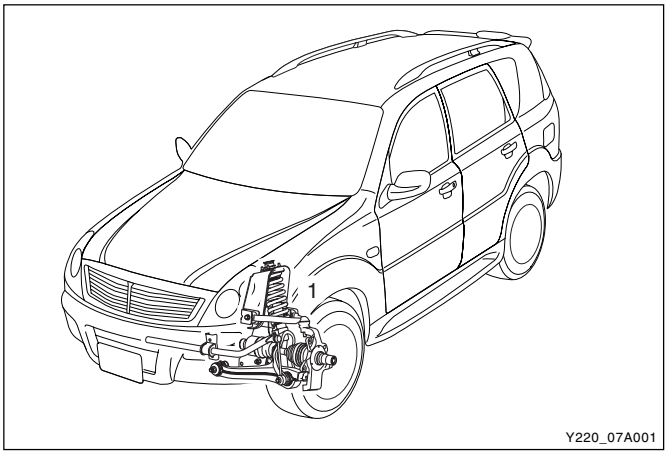
GENERAL INFORMATION

OVERVIEW

▶ Description and Operation of Front Suspension

The suspension is the device to connect the axle and vehicle frame. It absorbs the vibrations and impacts from road surface, which enhances the comforts, driving force, braking force and drivability.



1. Front suspension type: Double Wishbone
2. Component
   - Knuckle, upper arm assembly, lower arm assembly, coil spring, shock absorber assembly, stabilizer.

▶ Stabilizer

If the spring with lower spring constant is applied on the vehicle in order to increase the 'ride comforts', the vehicle's slope increases on turning due to the centrifugal force. Because its trend increases for the independent suspension system, the stabilizer bar should be applied to the system in order to make a balance the vehicle.

The stabilizer bar is a certain type of torsion bar. Its both ends are connected to the control arm and the its center area is mounted to the body frame.

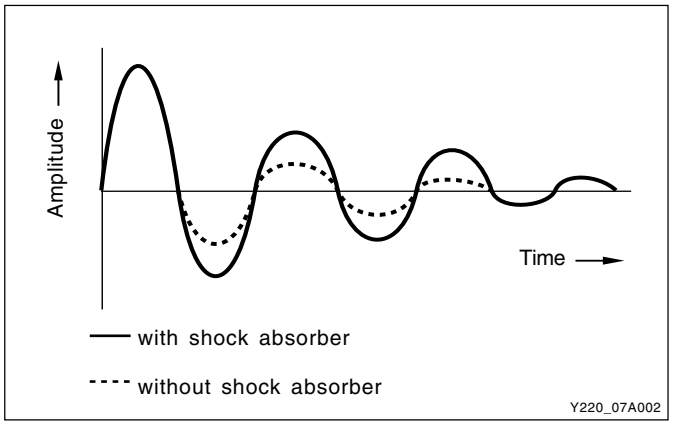
It is not activated when both wheels are moving up or down simultaneously. However, it minimizes the vehicle's slope when each wheel moves up or down independently.

▶ Coil Spring

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.

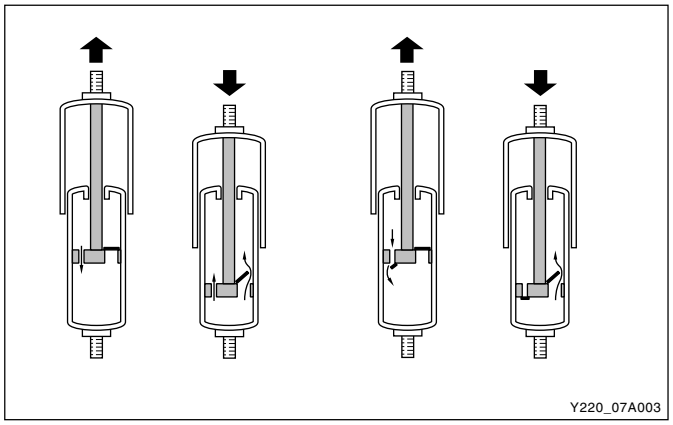
▶ Shock Absorber

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



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

This double tube type shock absorber restrains the vibrations by using oil resistance. This provides better drivability even though the structure is complicated.



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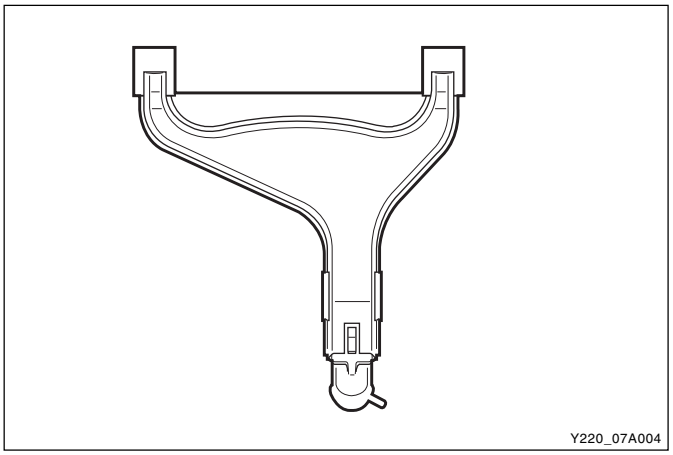
▶ Upper Arm and Lower Arm Assembly

The shock absorber is mounted to the upper arm and the lower arm with bushings. The upper arm relieves the load delivered from spring, shock absorber and bumper. The lower arm relieves the load to knuckle. This enables to absorb the various impacts according to the load shapes and to ensure the drivability.



SPECIFICATIONS

Description		Specification
Suspension type		Double wishbone
Spring type		Coil spring
Shock absorber type		Cylindrical double tube (gas type)
Stabilizer type		Torsion bar
Wheel alignment	Toe-in	2 ± 2 mm
	Camber	0° ± 30° (the difference between both ends is should be below 30°)
	Caster	3° ± 30° (the difference between both ends is should be below 30°)

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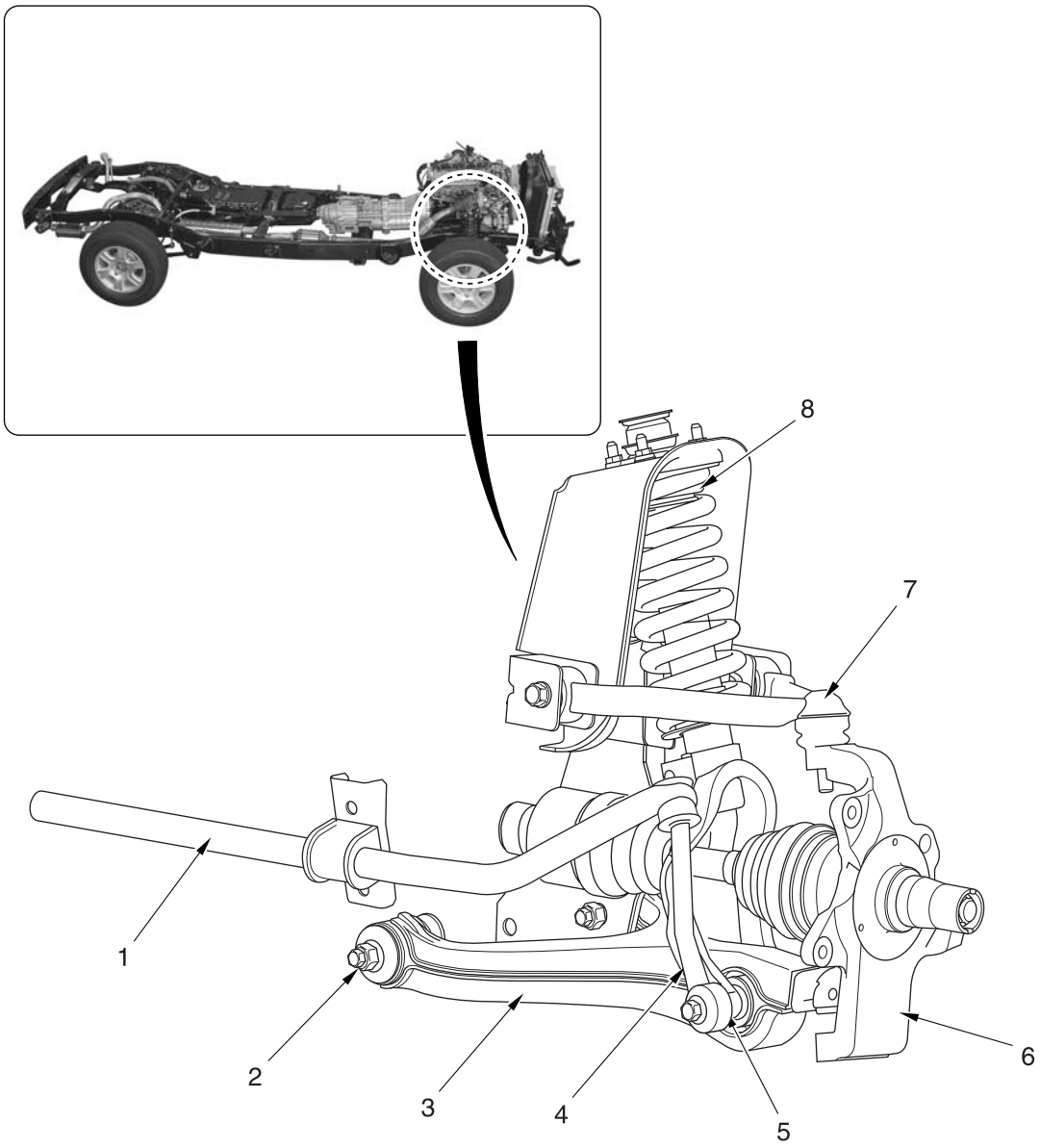
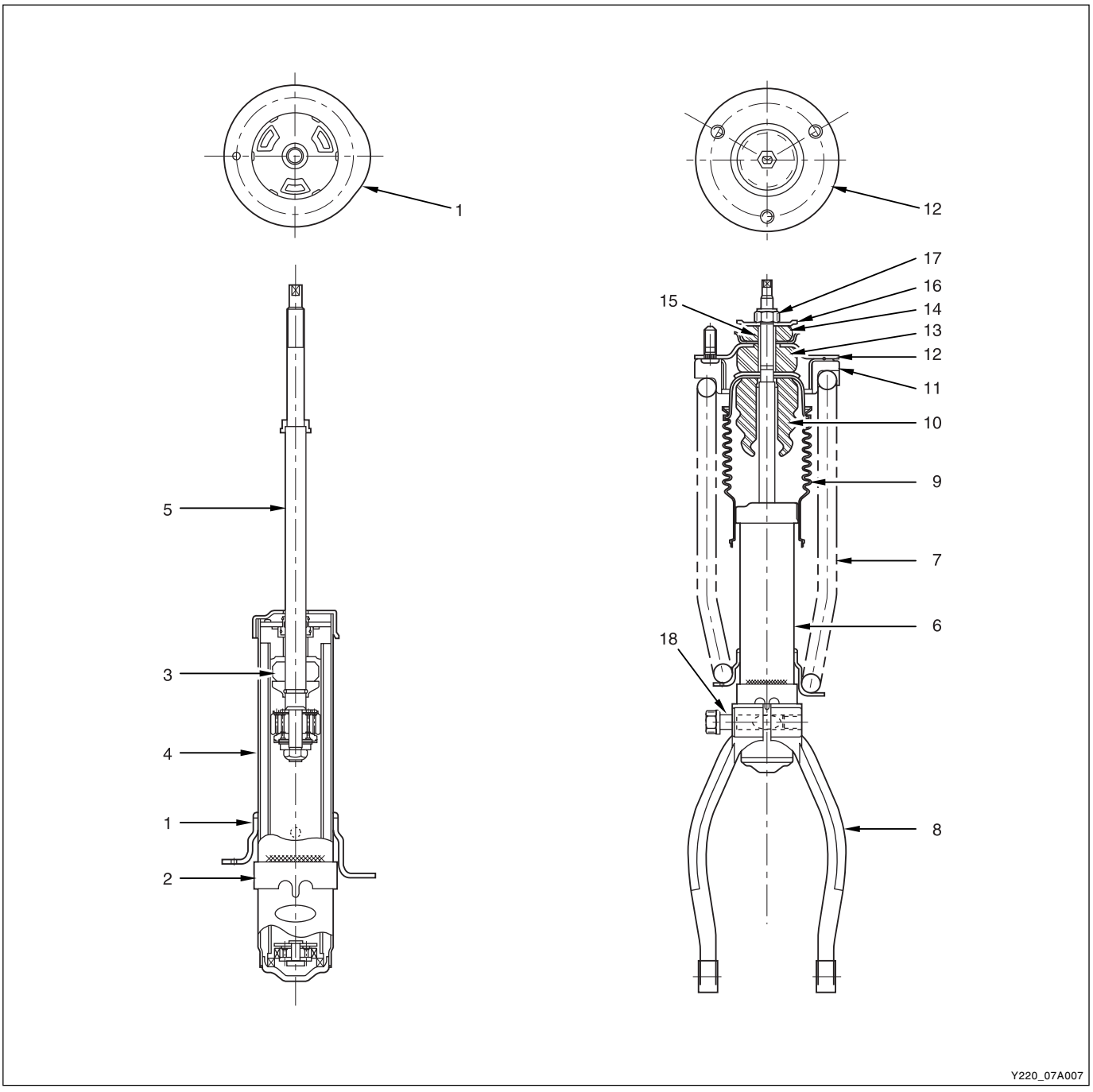
SYSTEM LAYOUT

▶ Components Locator



1. Stabilizer bar
2. Cam bolt
3. Lower arm
4. Yoke
5. Stabilizer bar link
6. Knuckle
7. Upper arm
8. Shock absorber assembly (including coil spring)

SECTIONAL VIEW OF SHOCK ABSORBER ASSEMBLY



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

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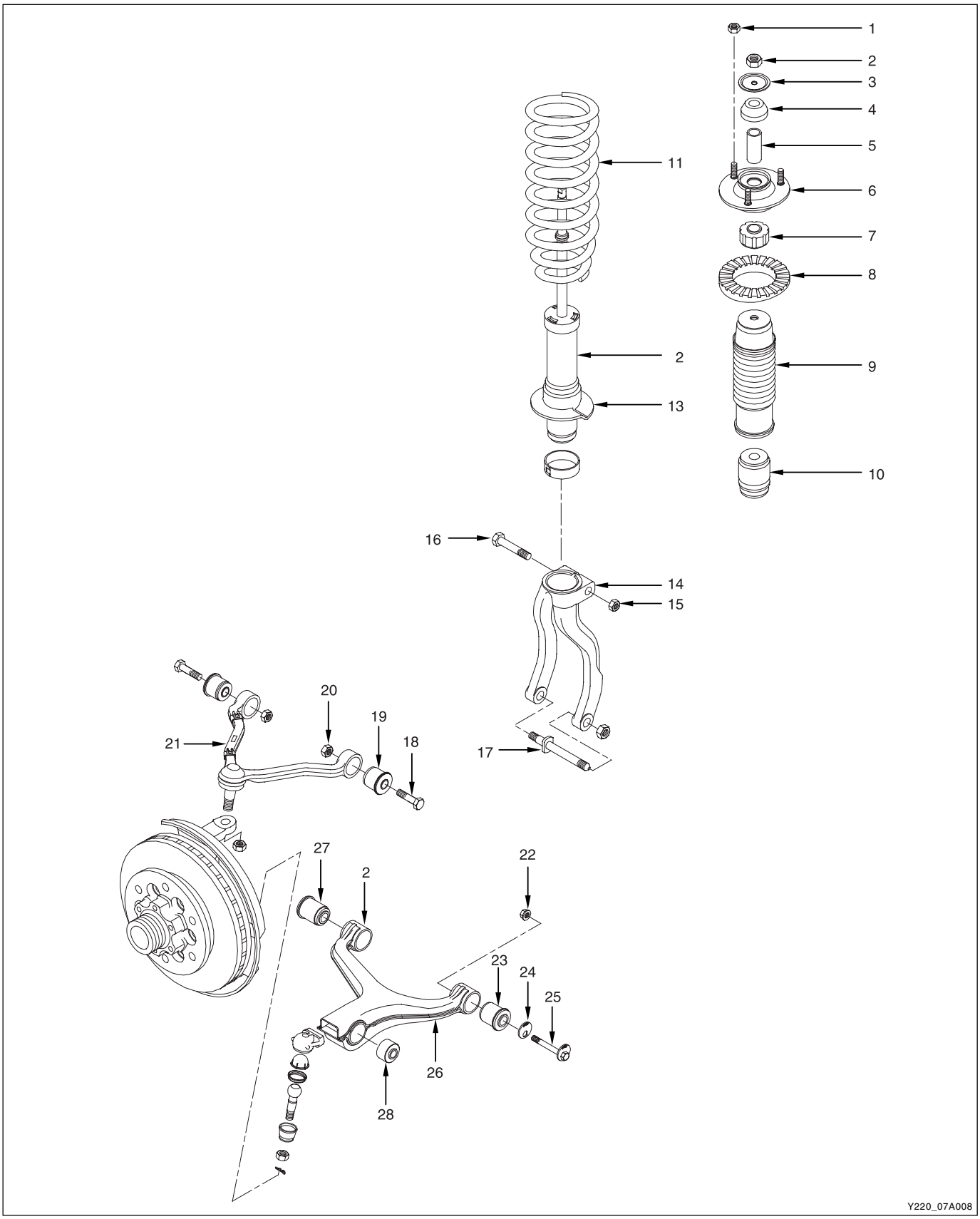
REMOVAL AND INSTALLATION



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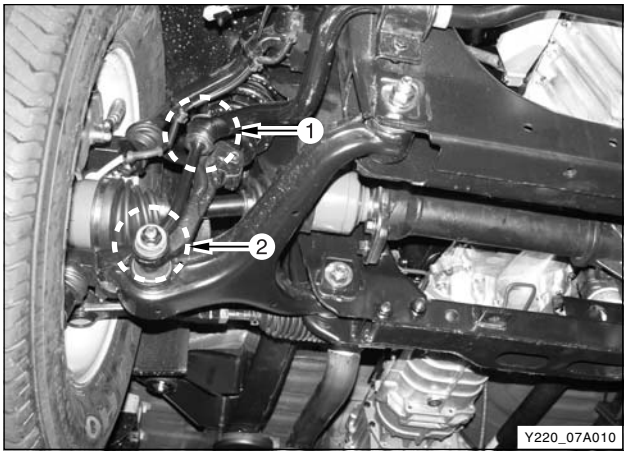
1. Nut
2. Nut
3. Washer
4. Rubber
5. Bushing
6. Upper spring seat
7. Rubber
8. Spring seat rubber
9. Boot
10. Boot
11. Spring
12. Shock absorber
13. Lower spring seat
14. Yoke
15. Nut
16. Bolt
17. Bolt
18. Bolt
19. Bushing
20. Nut
21. Upper arm
22. Nut
23. Bushing
24. Washer
25. Bolt
26. Lower arm
27. Bushing
28. Bushing

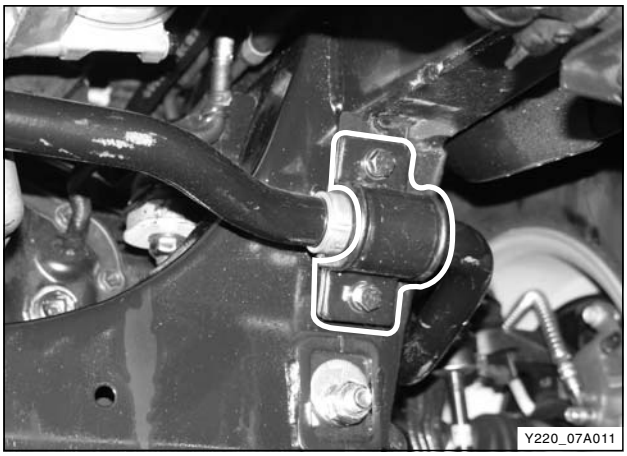
STABILIZER

Removal

1. Remove the under cover (skid plate).



2. Remove the upper mounting nut (1) and the lower mounting nut (2) from the front stabilizer bar link. Remove the front stabilizer bar link.

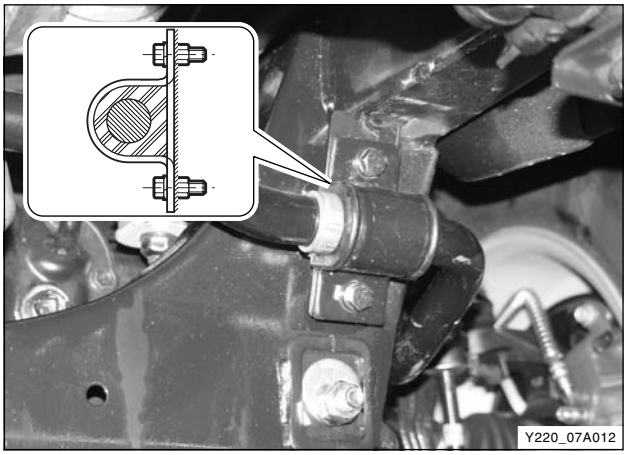


3. Unscrew the mounting cap bolts and remove the front stabilizer bar.

Installation

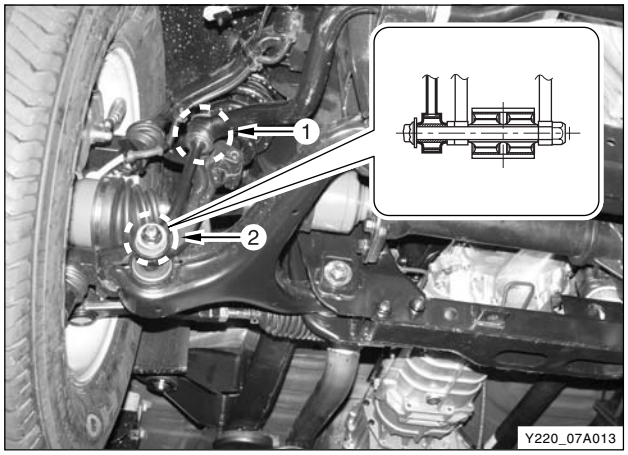
1. Install the front stabilizer bar to the frame

Mounting cap bolt	60 ~ 80 Nm



2. Install the stabilizer bar link to the stabilizer and the lower arm.

Tightening torque	(1) 110 ~ 120 Nm
	(2) 110 ~ 130 Nm



3. Tighten the mounting cap bolts to the specified value and install the under cover (skid plate).

Tightening torque	35 Nm

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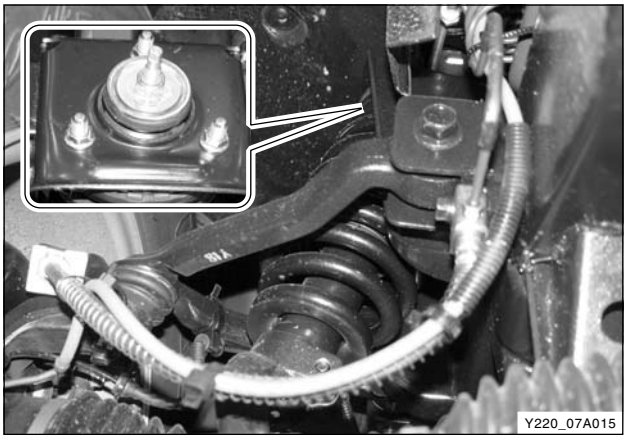
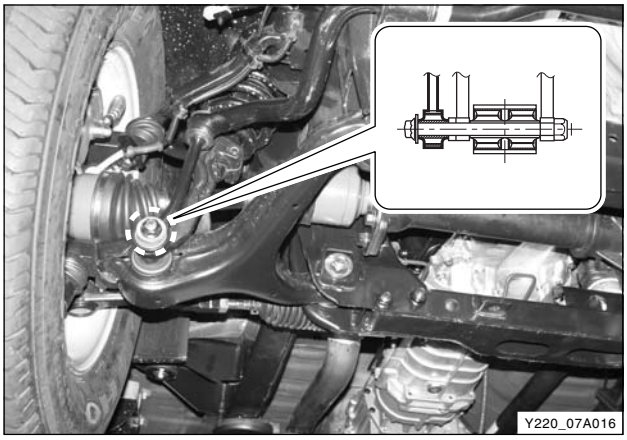
SHOCK ABSORBER ASSEMBLY

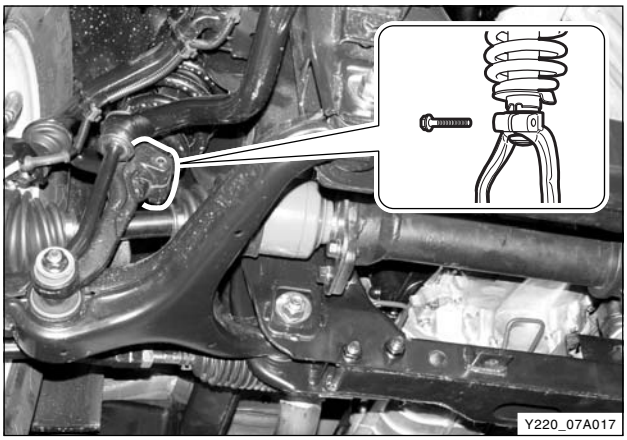
Removal



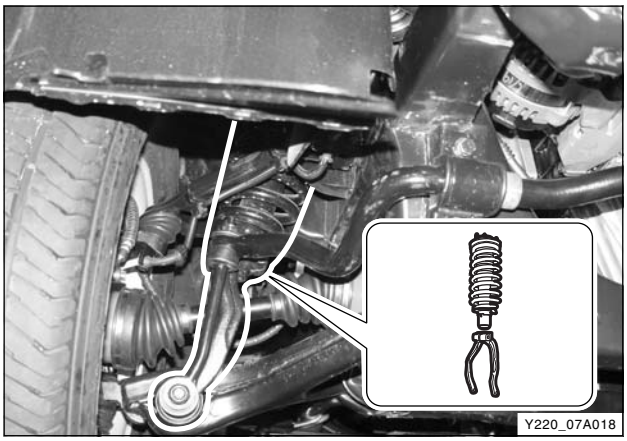
1. Remove three upper nuts from shock absorber assembly.



2. Unscrew the nut and remove the shock absorber yoke lock pin from lower arm.



3. Unscrew the nuts and separate the lower yoke from coil spring assembly.
4. Remove the shock absorber yoke.

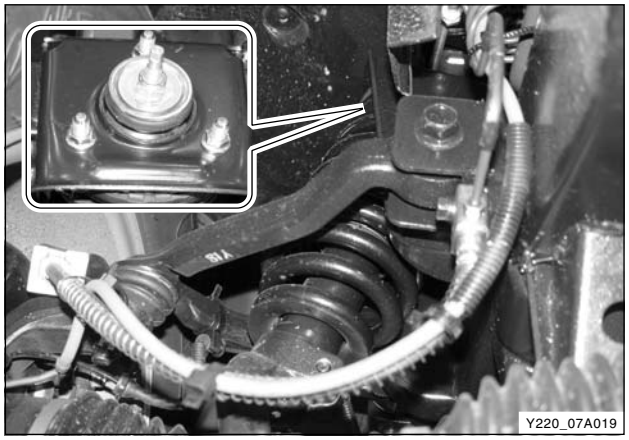


5. Remove the shock absorber assembly while pushing down the lower arm as possible.

Installation

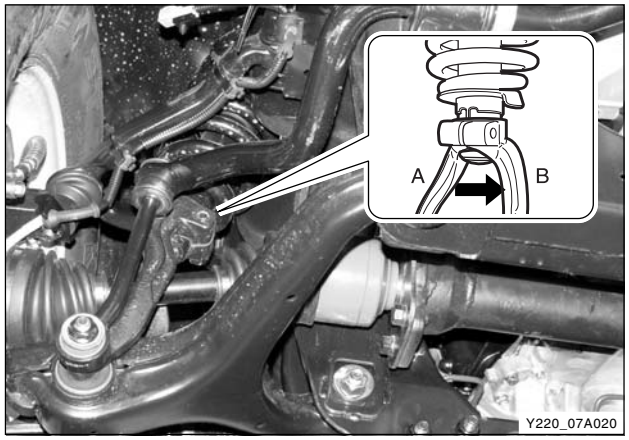
1. Install the coil spring (shock absorber) assembly and yoke. To do this, arrange the bottom of the shock absorber to yoke clevis and insert the top of it into the bolt hole, and temporarily tighten the nut by hand.

Tightening torque	40 ~ 60 Nm



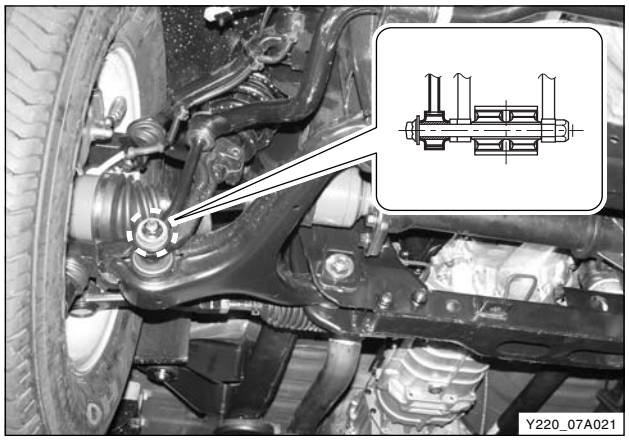
2. Tighten the lock bolts to shock absorber assembly and yoke. Make sure to insert the bolt from unthreaded side (A) to the threaded side (B).

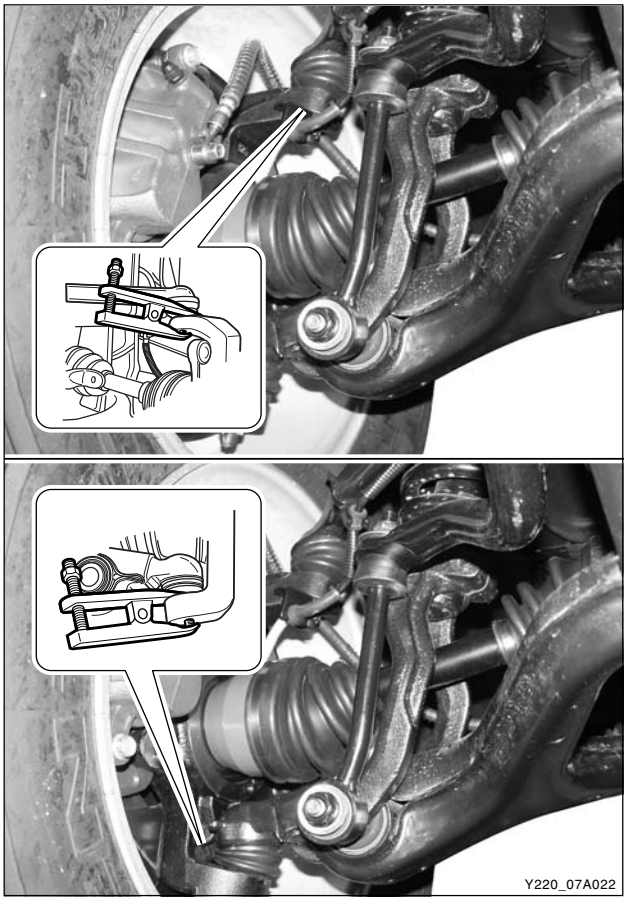
Tightening torque	60 ~ 70 Nm



3. Align the shock absorber yoke to the lower arm bolt hole, insert the yoke lock pin, and tighten the lock nut.

Tightening torque	150 ~ 180 Nm





UPPER ARM AND LOWER ARM ASSEMBLY

Removal

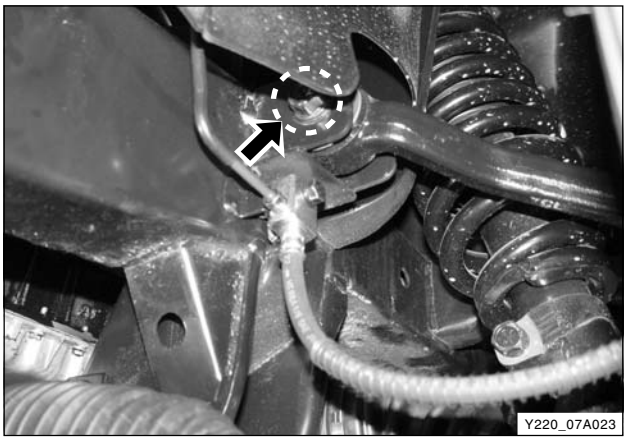
Preceding works:

- Remove the shock absorber assembly.
- Remove the steering knuckle (refer to Steering section).

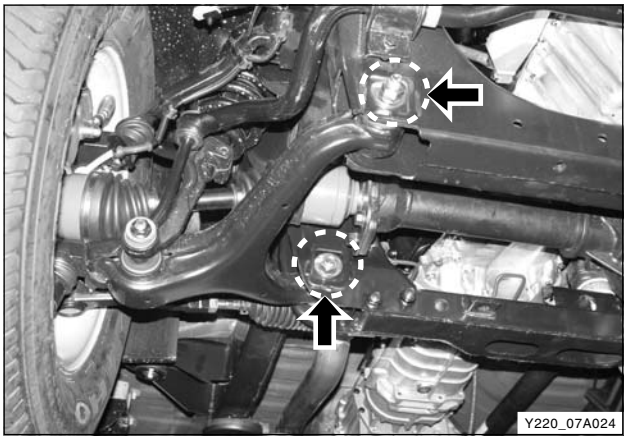
1. Remove the slotted nuts and split pins from the upper arm joint and the lower arm joint.

Note

Use only the special tool as shown in figure to separate the ball joint and steering knuckle.



2. Remove the mounting bolts and nuts and separate the upper arm from the frame bracket.



3. Remove the mounting bolts and nuts and separate the lower arm from the frame bracket.

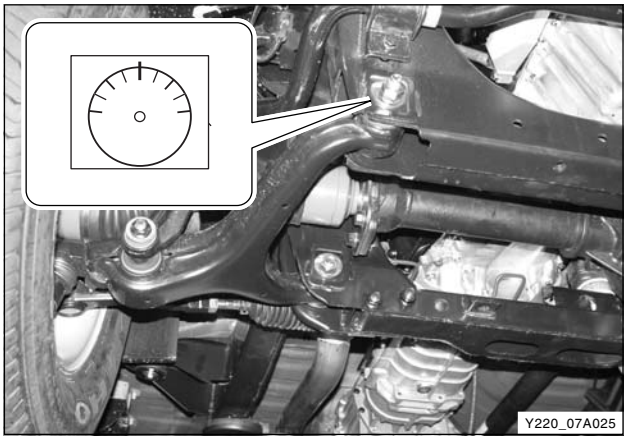
Installation

1. Install the lower arm to the frame bracket.

   Notice

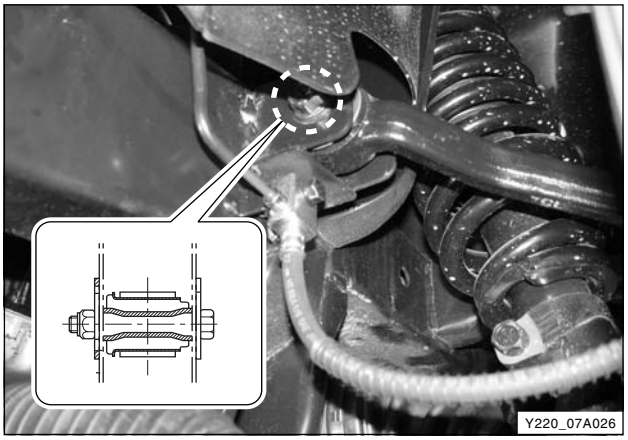
   - ***Insert the bolts from rear side of vehicle.***
   - ***Align the center scale of the bolt to the mark on the bracket.***

Tightening torque	180 ~ 190 Nm



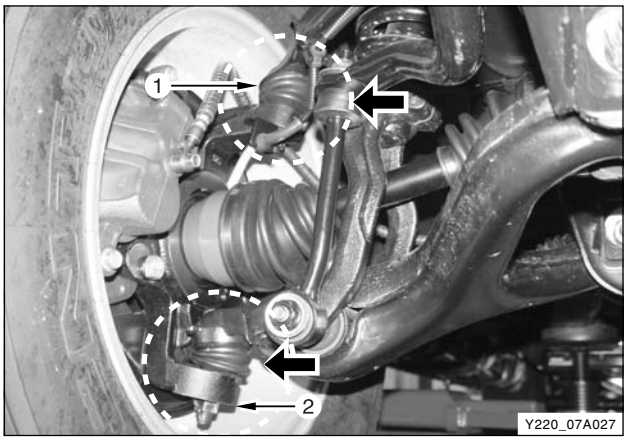
2. Install the upper bracket to the frame bracket.

Tightening torque	110 ~ 130 Nm



3. Install the knuckle assembly, connect the upper arm and lower arm ball joints, and install the slotted nuts and split pins.

Tightening torque of slotted nut	Upper (1)	140 ~ 160 Nm
	Lower (2)	140 ~ 160 Nm



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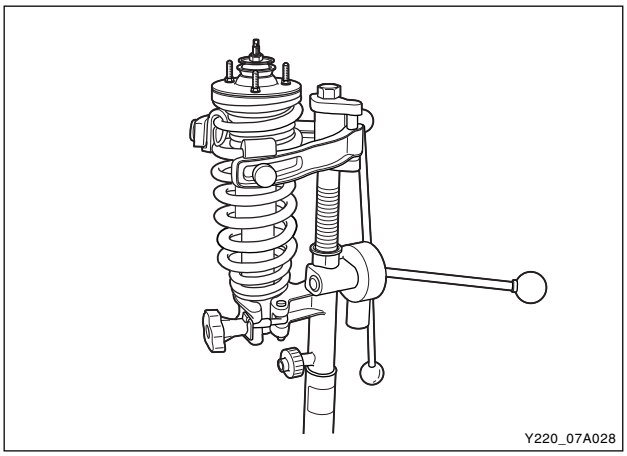
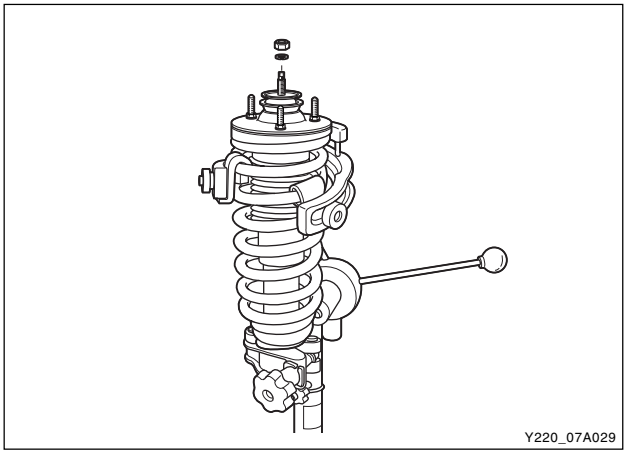
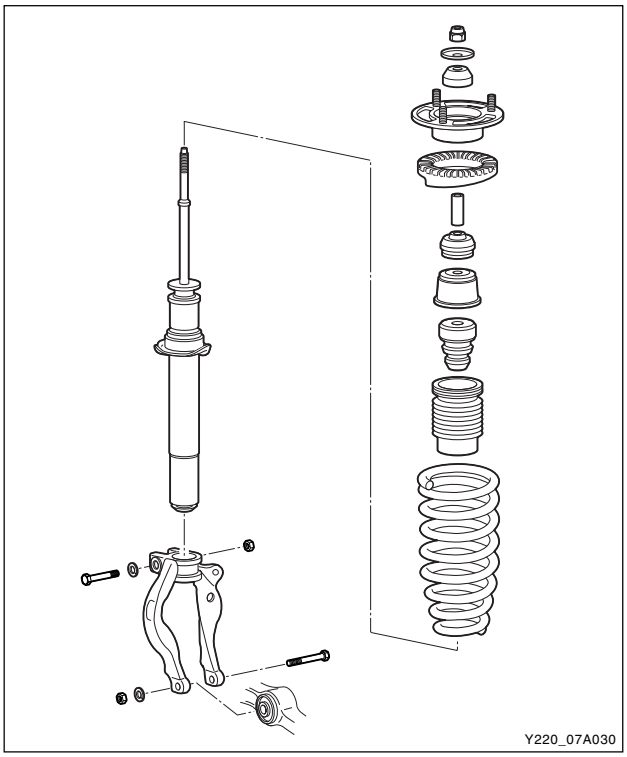
DISASSEMBLY AND ASSEMBLY







FRONT COIL SPRING

Disassembly

1. Remove the front coil spring assembly.
2. Compress the coil spring coil assembly with a special tool as shown in figure.

Notice

Securely install the coil spring with the special tool. Do not let the spring end face to your body while compressing it.

3. Unscrew the shock absorber nut, and then remove the lock nut on the special tool to disassemble the shock absorber assembly.

4. Disassemble the front coil spring components.

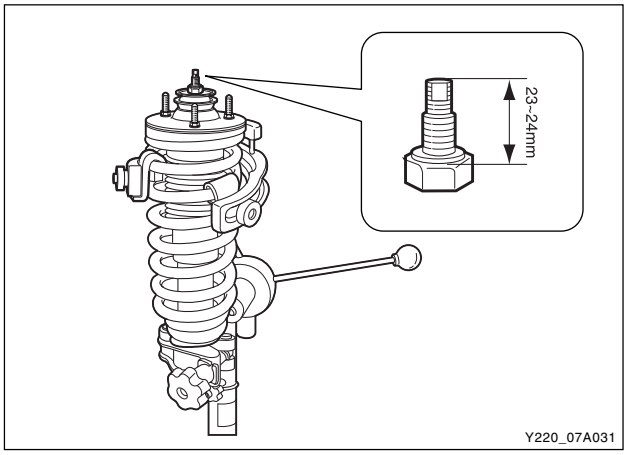
Notice

Be careful not to be injured by spring force while separating the coil spring.

Reassembly

1. Compress the coil spring to the specified length, assemble all components and tighten the lock nut.

Compressed length	344 mm
Tightening torque of lock nut	25 ~ 40 Nm

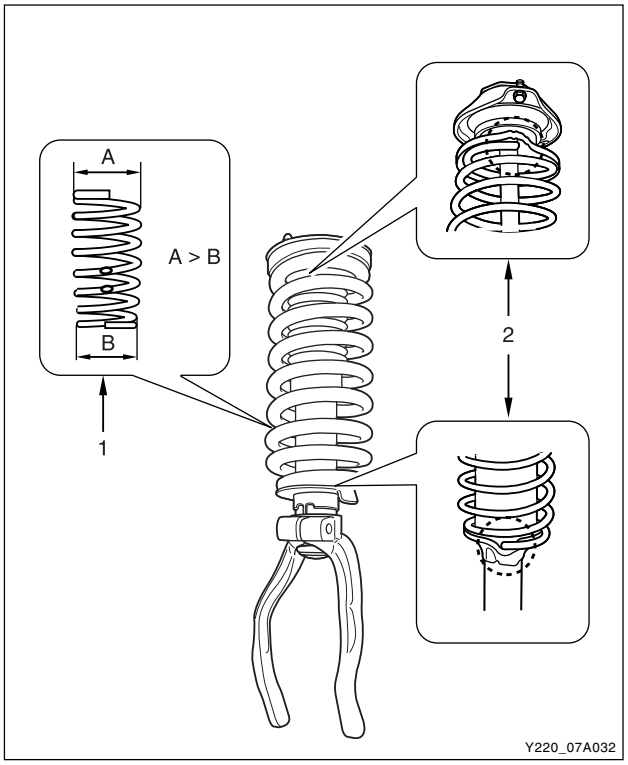


Notice

1. Make sure to install the coil spring in correct direction.

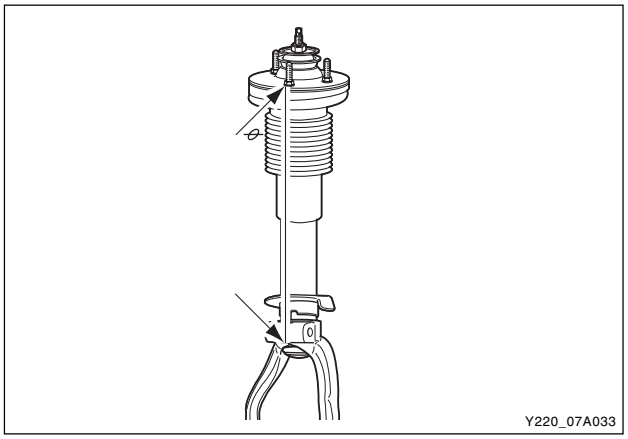
2. If you cannot tighten the nut with the specified value, tighten the nut until the distance between the upper face of lock nut and top end of the bolt is 23 ~ 24 mm.

2. Check the installation conditions of coil spring.
   - Make sure to install the coil spring in correct direction.
   - Make sure to seat the coil spring onto the spring seat.



Notice

One of the upper bracket bolts should be at the same longitudinal position with the projected area of the lower yoke. If not, the coil spring assembly cannot be installed.



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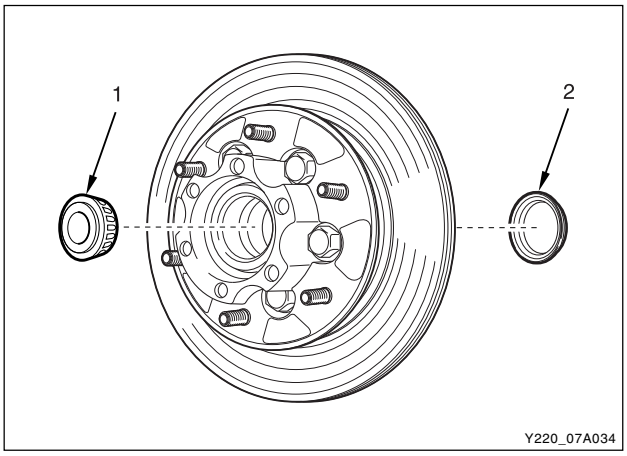
HUB AND BEARING

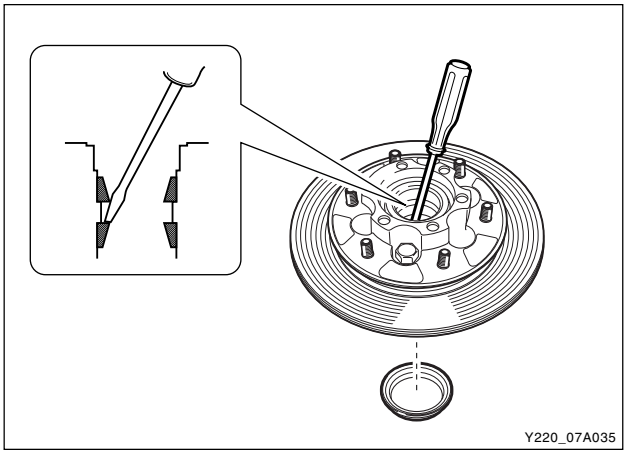
Disassembly and Reassembly (Part time TC)



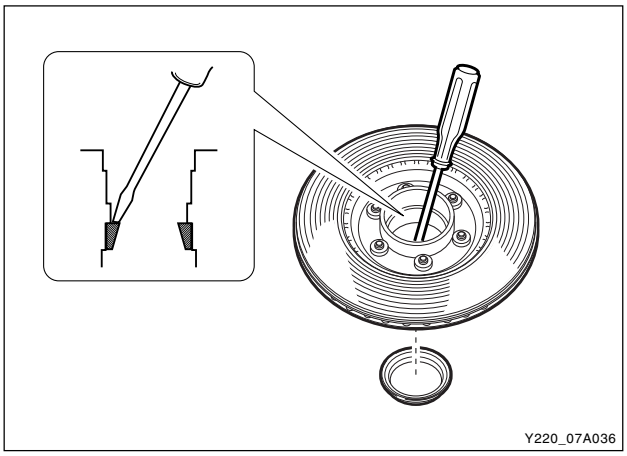
1. Remove the front hub and bearing assembly.
2. Remove the outer bearing (1) and inner seal.

Installation Notice

Replace the oil seal with new one.



3. Remove the inner bearing (2).

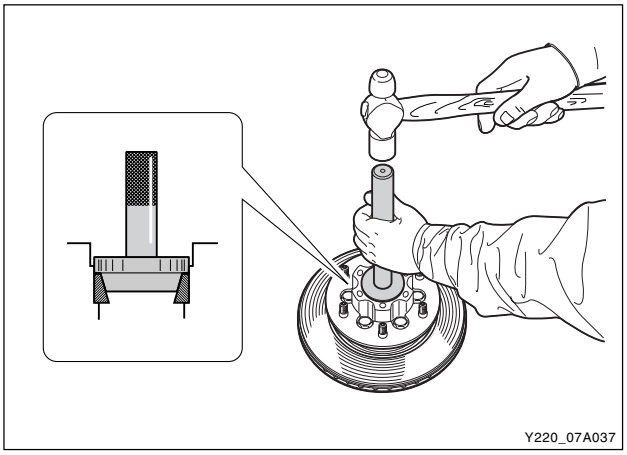


4. Remove the inner bearing race.

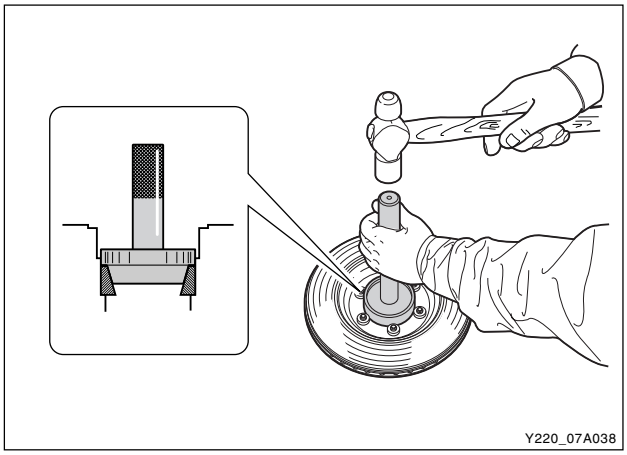
5. Remove the outer bearing race.

Installation Notice

- ***Install the outer bearing race with a outer bearing race installer and handle.***



- ***Install the inner bearing race with a inner bearing race installer and handle.***

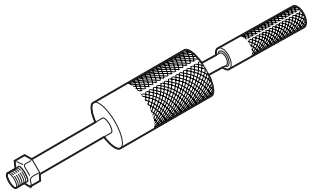
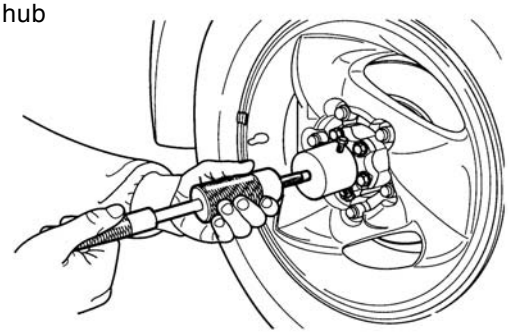
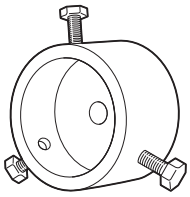
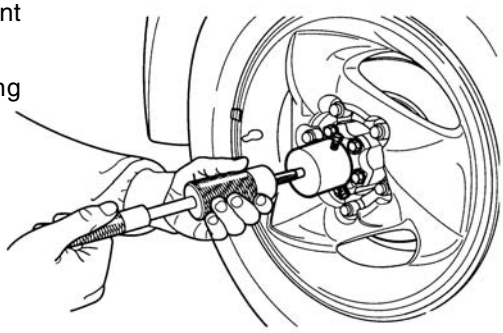
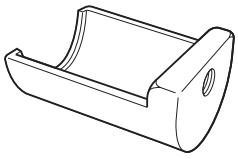
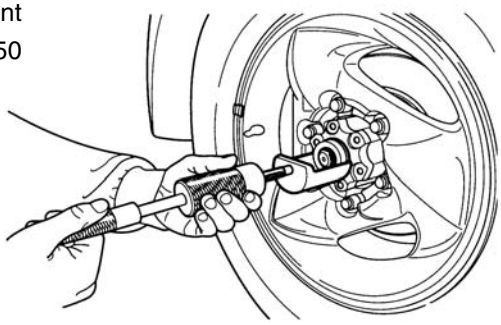
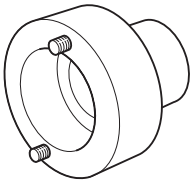
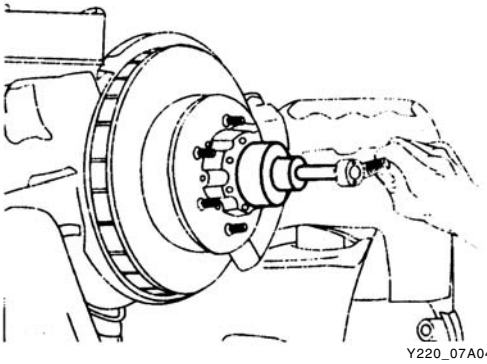


6. Reassemble in the reverse order of disassembly.

TROUBLE DIAGNOSIS

Symptom	Cause	Action
Vehicle rolling	Broken stabilizer bar	Replace
	Faulty shock absorber	Replace
Abnormal noises	Loosening mountings	Re-tighten
	Damaged or worn wheel bearing	Replace
	Damaged shock absorber	Replace
	Damaged tire	Replace
Poor riding	Over inflated tire	Pressure adjust
	Faulty shock absorber	Replace
	Loosened wheel nut	Tighten as specified torque
	Bent or broken coil spring	Replace
	Damaged tire	Replace
	Worn bushing	Replace
Vehicle pulls to right or left	Deformed arm assembly	Replace
	Worn bushing	Replace
	Bent or broken coil spring	Replace
Hard steering	Incorrect front wheel alignment	Repair
	Excessive resistance of lower arm ball joint	Replace
	Insufficient tire pressure	Adjust
	Faulty power steering	Repair or replace
Steering instability	Incorrect front wheel alignment	Repair
	Worn or loosened lower arm bushing	Re-tighten or replace
Vehicle bottoming	Worn or broken coil spring	Replace

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
SY 340 - 050 (W 99 48 009 0A) **Sliding hammer**  Y220_07A039	Removal and installation of hub cap  Y220_07A040
SY 340 - 060 (W 99 48 010 0A) **Front hub cap remover/installer**  Y220_07A041	Removal and installation of front hub cap Using with SY340-050 (sliding hammer)  Y220_07A042
SY 340 - 070 (W 99 48 011 0A) **Front hub flange remover**  Y220_07A043	Removal and installation of front hub flange Using with SY340-050 (sliding hammer)  Y220_07A044
661 589 01 07 00 (L 99 42 009 0A) **Hub nut wrench**  Y220_07A045	Removal and installation of front axle hub  Y220_07A046

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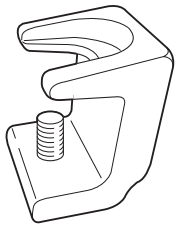
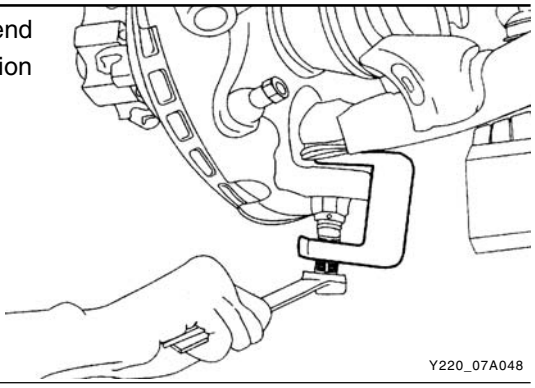
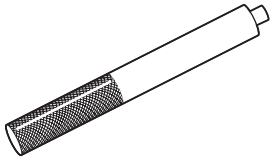
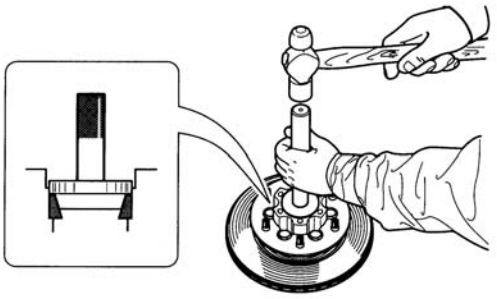
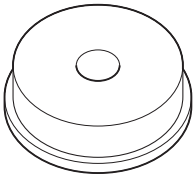
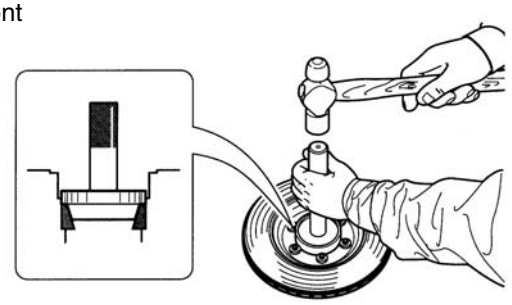
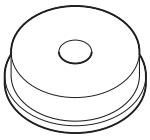
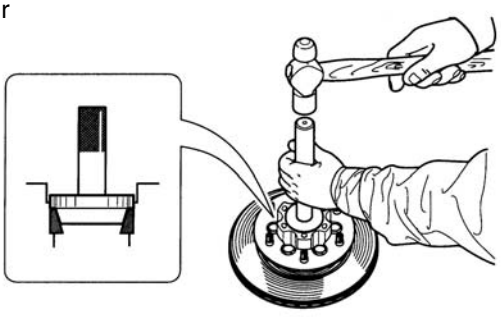
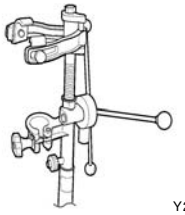
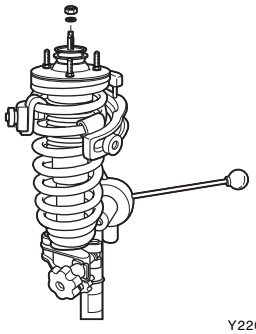
Name and Part Number	Application
661 589 13 33 00 (W 99 44 002 0A) **Ball joint puller**  Y220_07A047	Removal of upper and lower end assembly from front suspension  Y220_07A048
SY 340 - 021 - 01 (W 99 48 006 0A) **Handle**  Y220_07A049	Removal and installation of front bearing  Y220_07A050
SY 340 - 021 - 02 (W 99 48 007 0A) **Front inner bearing race installer**  Y220_07A051	Removal and installation of front inner bearing  Y220_07A052
SY 340 - 021 - 03 (W 99 48 008 0A) **Front outer bearing race installer**  Y220_07A053	Removal and installation of outer bearing  Y220_07A054

Name and Part Number	Application
SY 310 - 010 (Y 99 44 001 0A) **Front coil spring remover and installer**  Y220_07A055	Removal and installation of front coil spring  Y220_07A056

SECTION 7B

REAR SUSPENSION

Table of Contents

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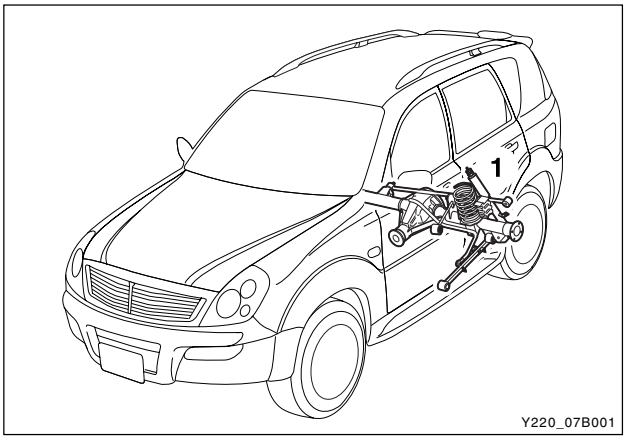
GENERAL INFORMATION

OVERVIEW

The rear suspension is also to keep the ride comforts and drivability and this vehicle uses 5-link suspension system. It consists of coil springs on both sides, upper and lower arm, lateral rod, stabilizer, connecting rod and bumper.



1. Stabilizer:

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

   It controls the transverse load to the vehicle.
3. Upper/Lower Arm:

   It controls the longitudinal load to the vehicle.
4. Shock Absorber:

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

   It is installed between the rear axle and body frame.

   It relieves the vibrations and impacts delivered from wheels to vehicle body.

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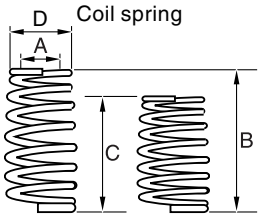
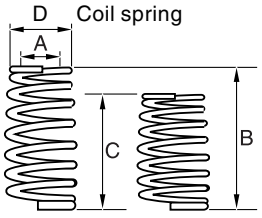
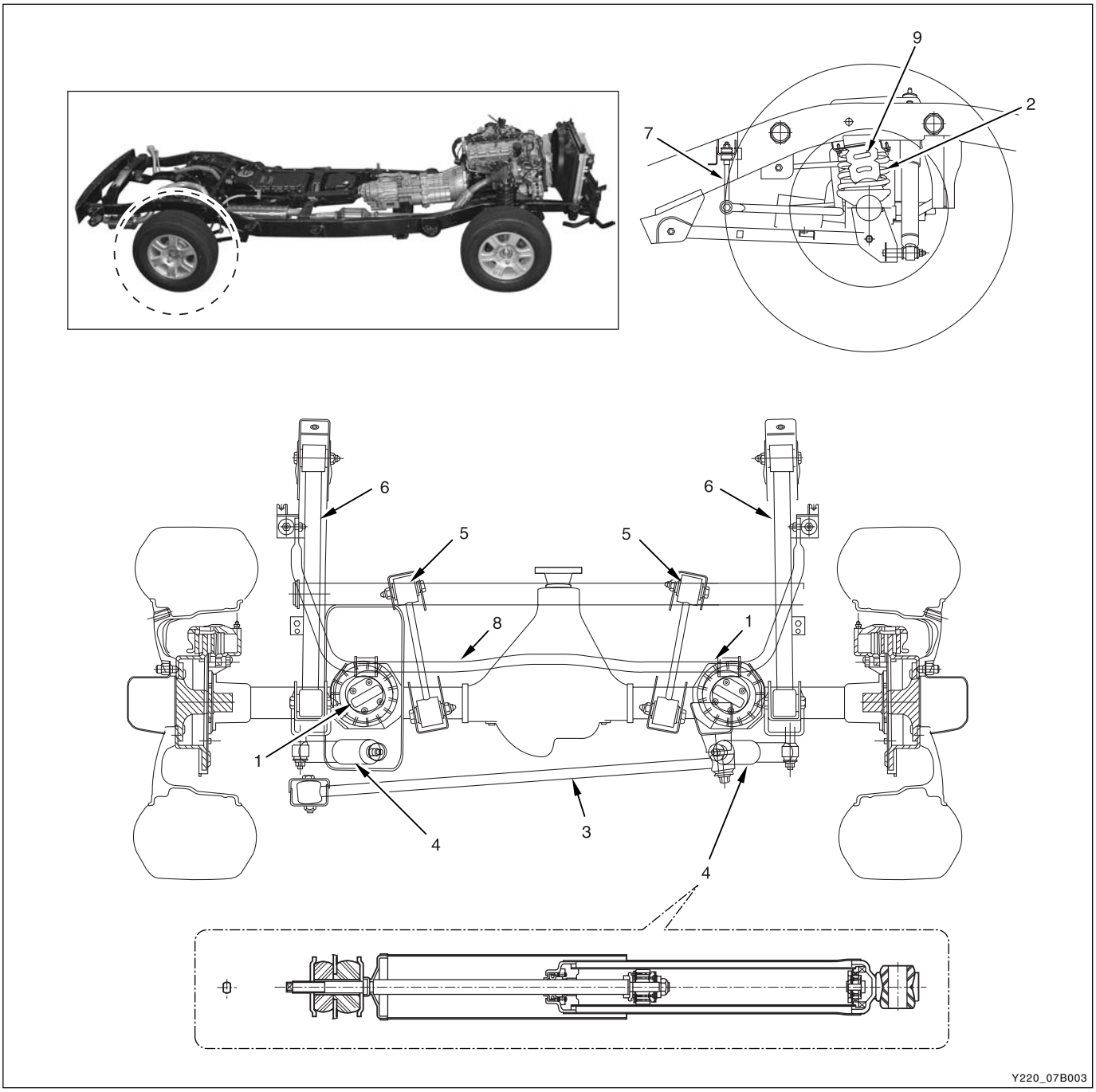
SPECIFICATIONS

Description		Specification
Suspension type		5-Link type (2 upper arms, 2 lower arms, 1 lateral rod)
Spring type		Coil spring
Stabilizer type		Torsion bar
Shock absorber	Type	Cylindrical double tube
	Max. length	495 mm
	Min. length	308 mm
 Y220_07B002	Engine	Gasoline 3.2, Diesel (A/T)
	Coil thickness	13.1 mm
	Inner diameter of coil (A)	ϕ 114 mm
	Free length (B)	405.7 mm
	Length at load (C)	260.0 mm
	Outer diameter of coilspring (D)	ϕ 127.1 mm
	Constant	2.45 ± 5 %
 Y220_07B002	Engine	Diesel (M/T)
	Coil thickness	13.0 mm
	Inner diameter of coil (A)	ϕ 114 mm
	Free length (B)	386.8 mm
	Length at load (C)	250.0 mm
	Outer diameter of coil spring (D)	ϕ 127.0 mm
	Constant	2.45 ± 5 %

SYSTEM LAYOUT

REAR SUSPENSION ASSEMBLY



1. Coil spring seat (upper)
2. Coil spring
3. Lateral rod
4. Shock absorber
5. Upper arm (link)
6. Lower arm (link)
7. Stabilizer link
8. Stabilizer
9. Bumper stopper

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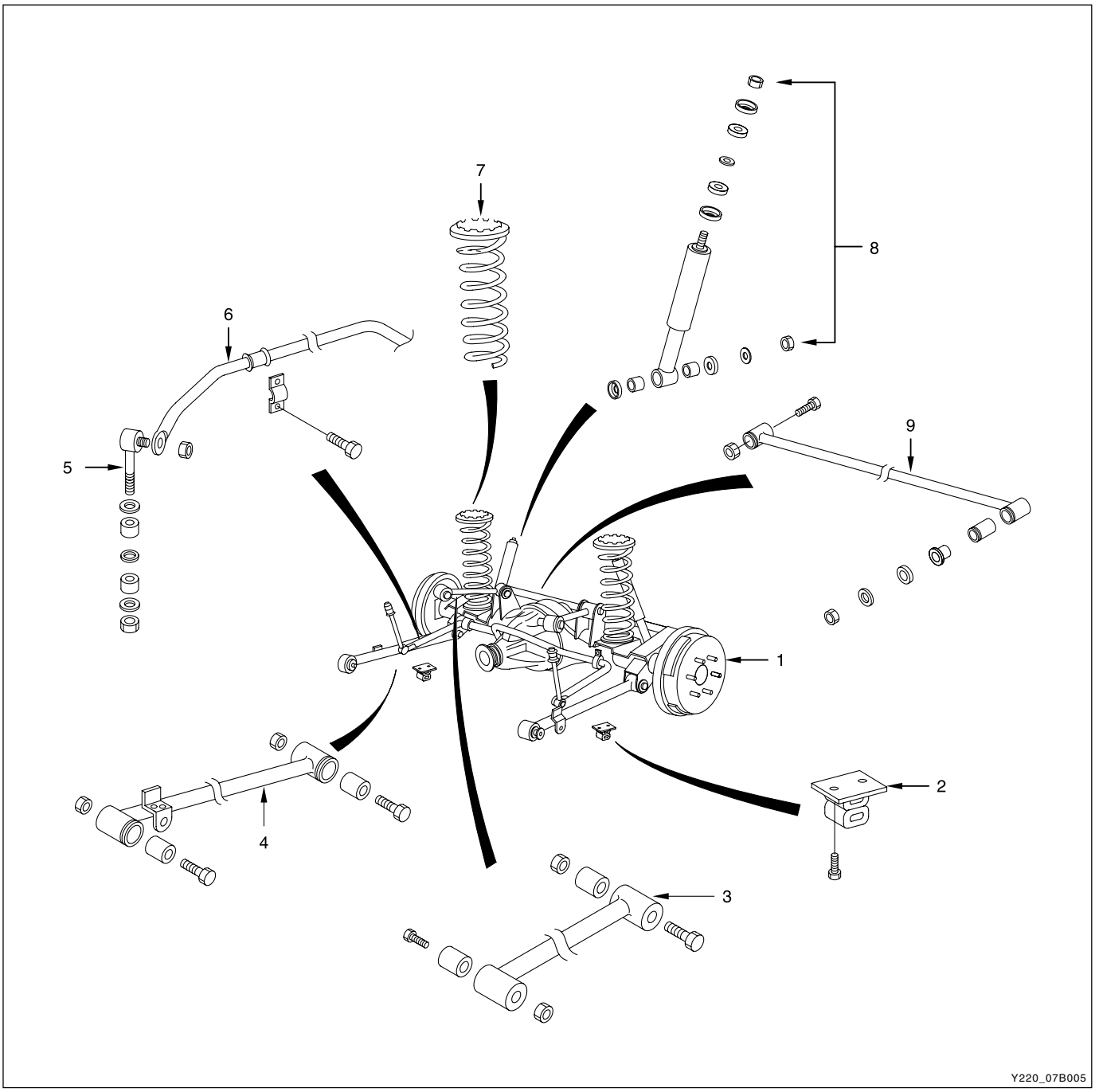
REMOVAL AND INSTALLATION

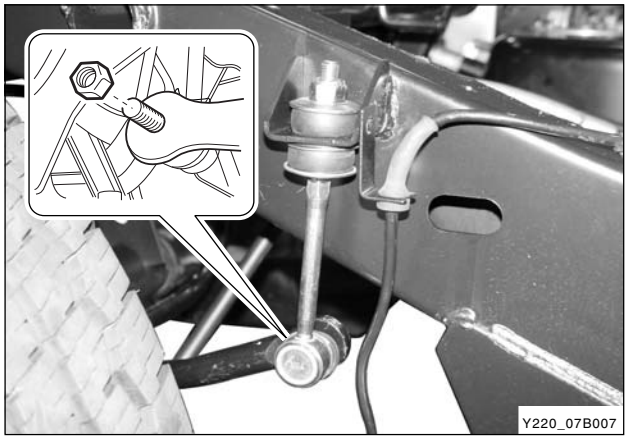


1. Rear suspension assembly
2. Rubber
3. Upper arm
4. Lower arm
5. Stabilizer link
6. Stabilizer
7. Coil spring
8. Shock absorber
9. Lateral rod

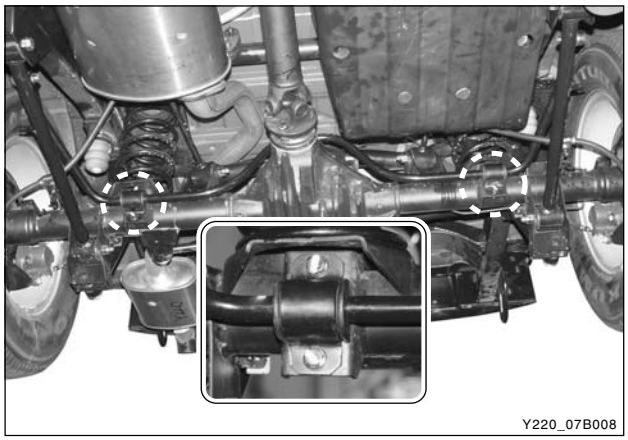
Removal

1. Support the rear axle housing with a jack and place the blocks under the wheels.

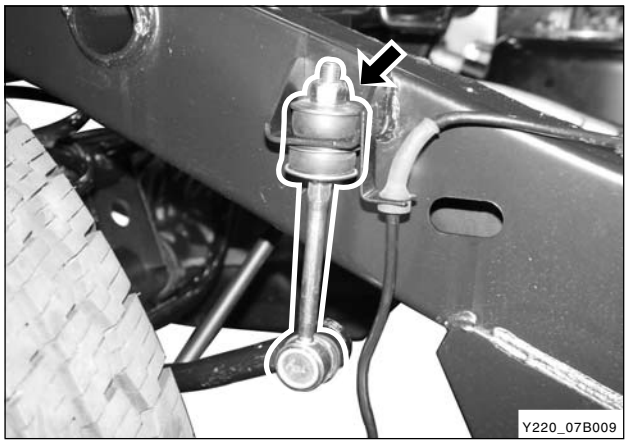
2. Remove the mounting nut at the lower link and separate the stabilizer bar.



3. Unscrew the mounting cap bolts at both sides and remove the stabilizer bar and bushings.



4. Unscrew the upper mounting nut and remove the link.



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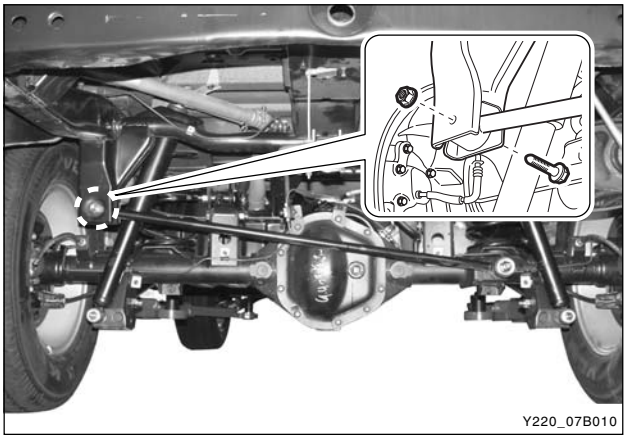
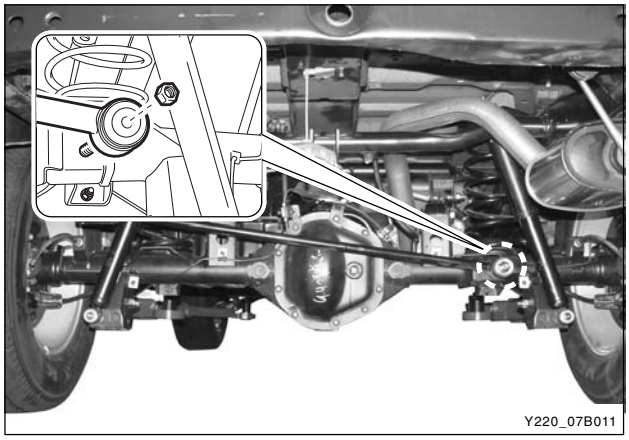
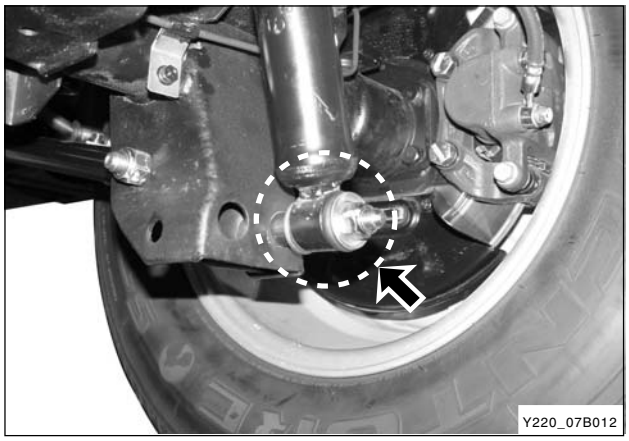


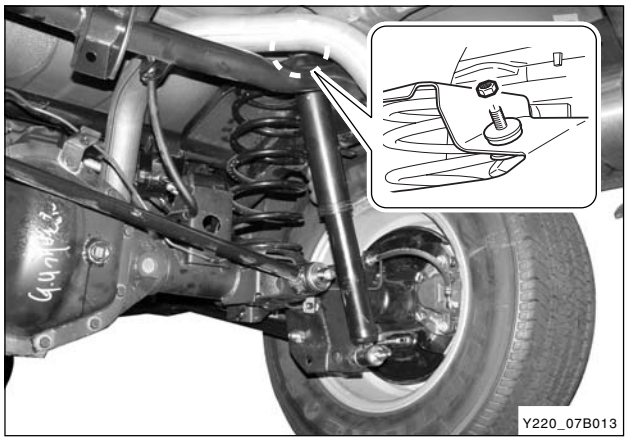
5. Remove the lateral rod mounting bolts on frame.



6. Unscrew the lateral rod mounting bolts on axle and remove the rod assembly.

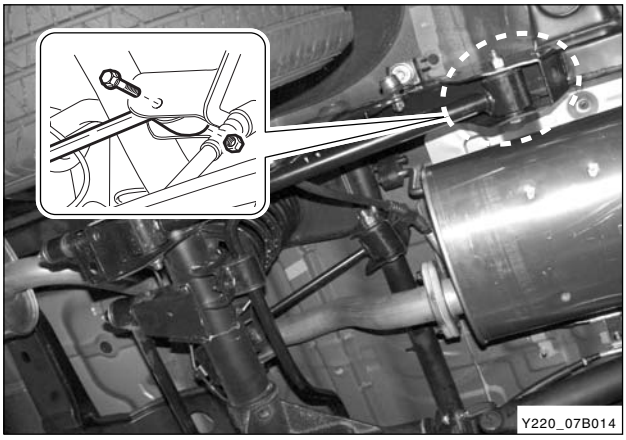


7. Remove the lower nut of shock absorber.

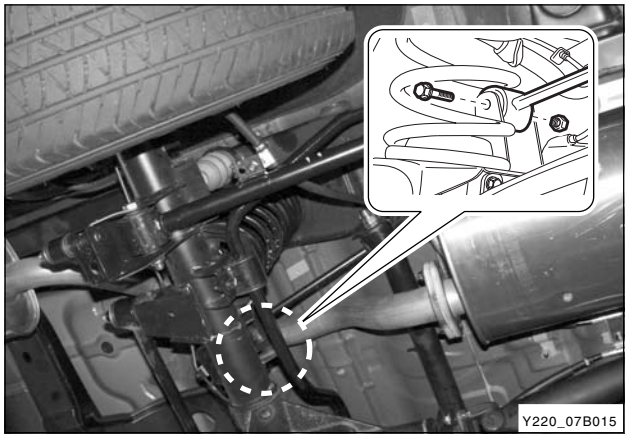


8. Unscrew the upper nut and remove the shock absorber.

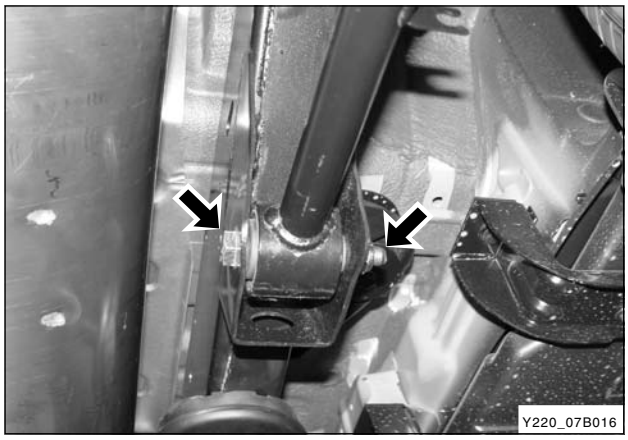
9. Remove the upper arm bolt and nut on frame.



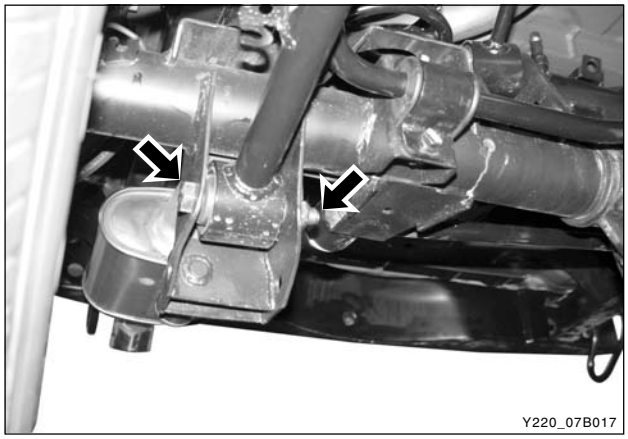
10. Unscrew the upper bolt and nut on axle and remove the upper arm.



11. Remove the lower arm connected to frame.



12. Unscrew the lower arm bolt and nut on axle and remove the lower arm.



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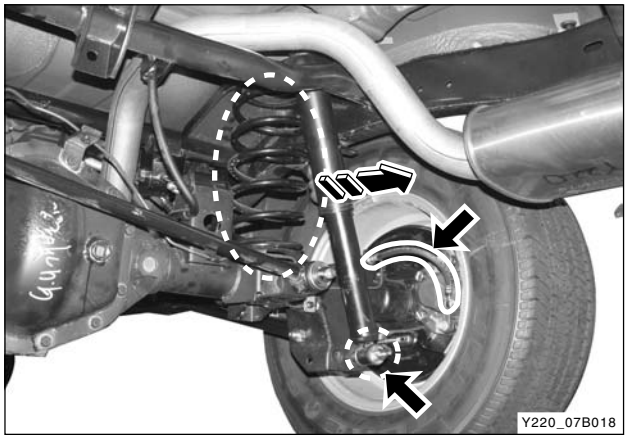


13. Disconnect the brake pipes and hoses and remove the spring while rocking the rear axle.
14. Unscrew the shock absorber lower nut and the upper arm bolt on axle and remove the spring through the space between frame and rear axle.

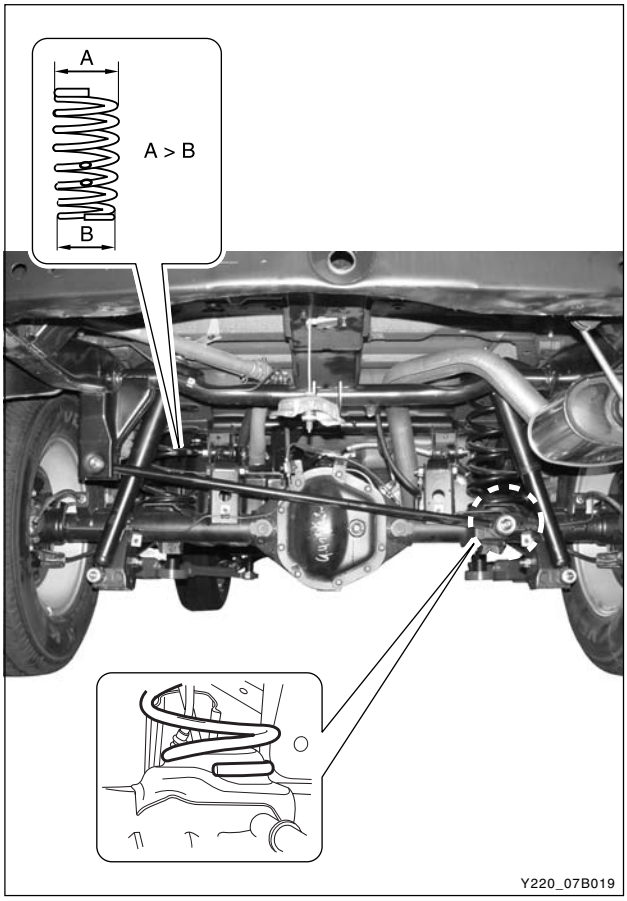
Installation

1. Install in the reverse order of removal.
2. Place the spring on the its installation position.

Notice

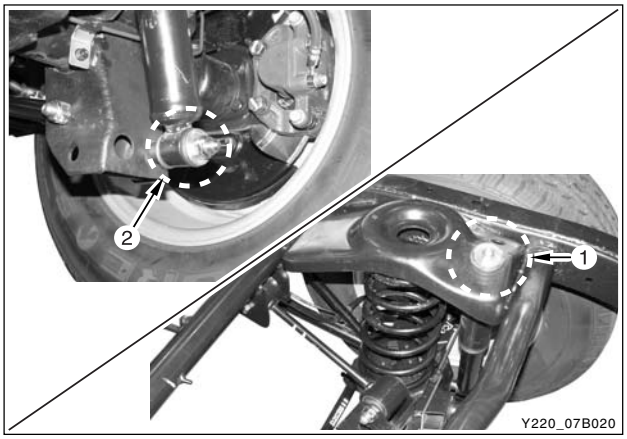
1. The top side of the spring is larger than the bottom side of it.

2. The coil spring should be securely seated between the spring seat on axle and the spring seat in frame.



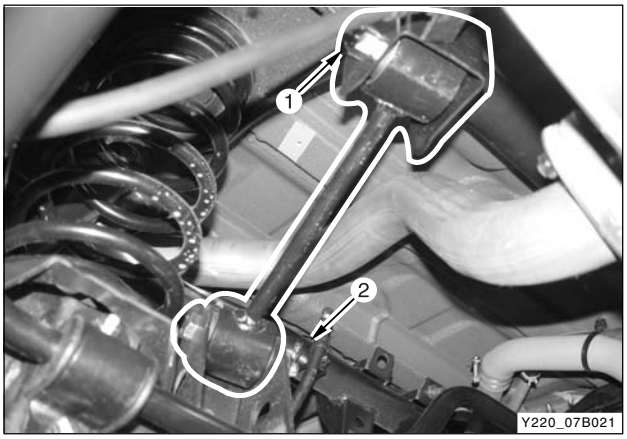
3. Install the shock absorber.

Top ①	Tightening torque	30 ~ 45 Nm
	Distance A	6 ~ 9 mm
Bottom ②	Tightening torque	50 ~ 65 Nm



4. Install the upper arm.

Frame ①	Tightening torque	165 Nm
Axle ②	Tightening torque	165 Nm



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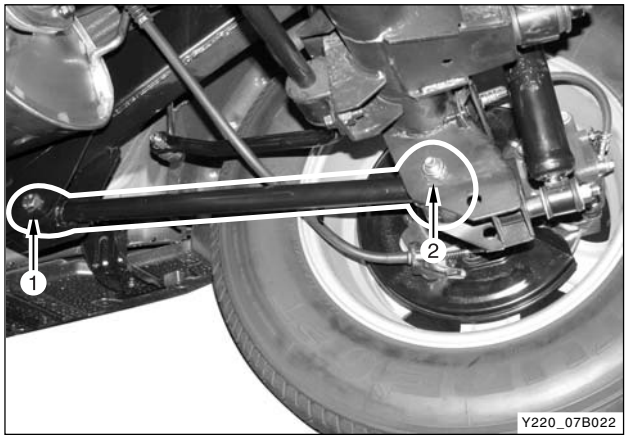
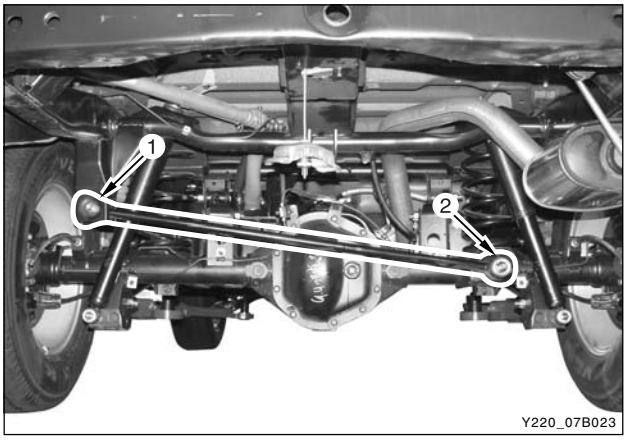


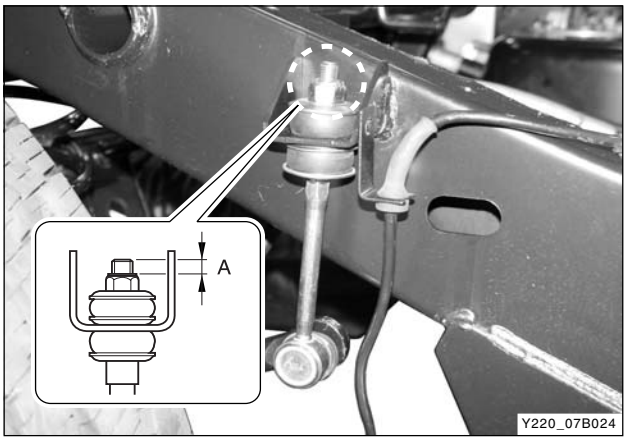
5. Install the lower arm.

Frame ①	Tightening torque	165 Nm
Axle ②	Tightening torque	165 Nm



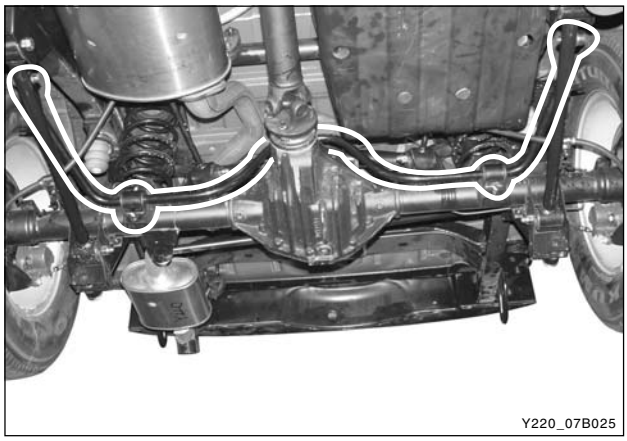
6. Install the lateral rod.

Frame ①	Tightening torque	165 Nm
Axle ②	Tightening torque	165 Nm



7. Install the connecting rod to frame bracket.

Tightening torque	38 Nm
Distance (A)	7 ~ 12 mm



8. Install the stabilizer bar with mounting cap to axle bracket.

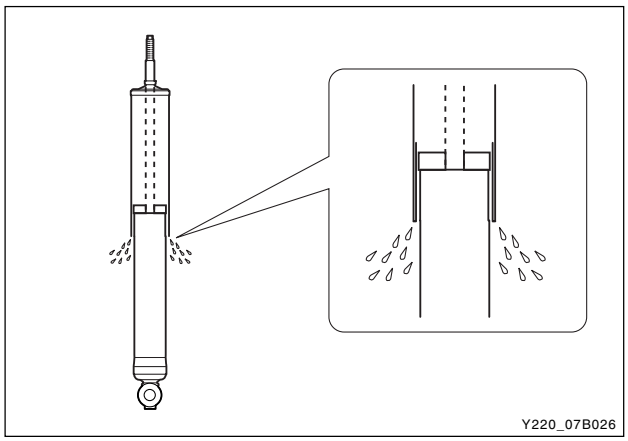
Tightening torque	30 ~ 45 Nm

9. Install the rubbers (packings) with correct order.

Notice

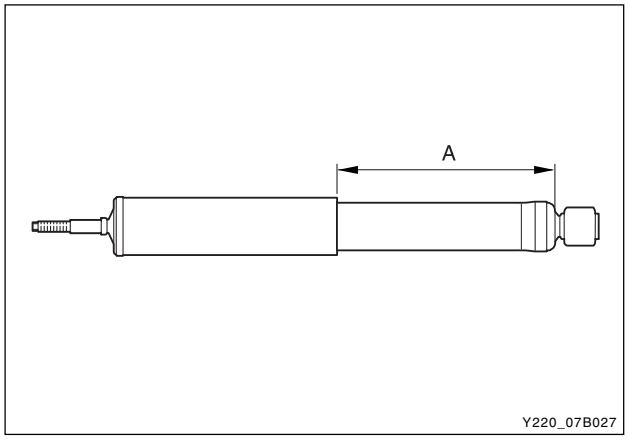
Replace the cracked or worn rubbers with new ones.

10. Check the shock absorber for leak and abnormal noise.


Y220_07B026

Notice

Before disposal, fully extend the shock absorber and drill out a hole in "A" range to discharge the internal gas.



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TROUBLE DIAGNOSIS

Symptom	Cause	Action
Vehicle rolling	Broken stabilizer bar	Replace
	Faulty shock absorber	Replace
Abnormal noises	Loosening mountings	Re-tighten
	Damaged or worn wheel bearing	Replace
	Damaged shock absorber	Replace
	Damaged tire	Replace
Poor riding	Over inflated tire	Pressure adjust
	Faulty shock absorber	Replace
	Loosened wheel nut	Tighten as specified torque
	Bent or broken coil spring	Replace
	Damaged tire	Replace
	Worn bushing	Replace
Vehicle pulls to right or left	Deformed arm assembly	Replace
	Worn bushing	Replace
	Bent or broken coil spring	Replace
Hard steering	Excessive resistance of lower arm ball joint	Replace
	Insufficient tire pressure	Replace
	Faulty power steering	Adjust
Steering instability	Worn or loosened lower arm bushing	Re-tighten or replace
Vehicle bottoming	Worn or broken coil spring	Replace

INSPECTION

WHEEL BEARING END PLAY

1. Release the parking brake.
2. Raise the rear wheel.
3. Check if the wheel bearing end play exists while rocking the wheel.

End play	0 mm

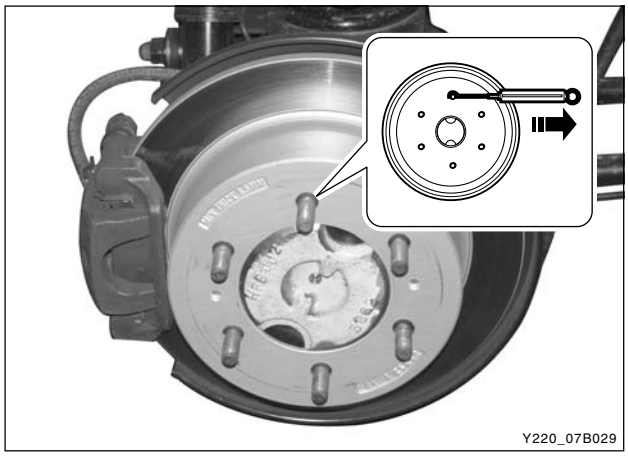
4. If the end play exists, retighten the slotted nut.
5. If the end play still exists, replace the wheel bearing.

WHEEL BEARING PRELOAD

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

Specified value	1.4 ~ 4.3 kg·cm

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



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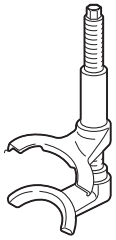
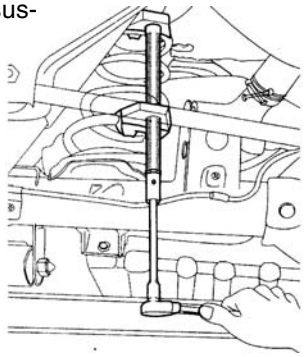
SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
661 589 12 33 00 (Y 99 45 001 0A) **Coil spring compressor**  Y220_07B030	Removal and installation of rear suspension  Y220_07B031

SECTION 8A

BRAKE SYSTEM

Table of Contents

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GENERAL INFORMATION

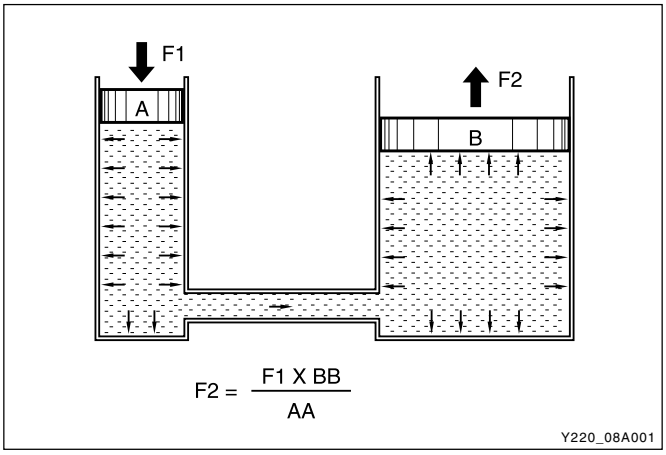
DESCRIPTION AND OPERATION

▶ Brake System

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

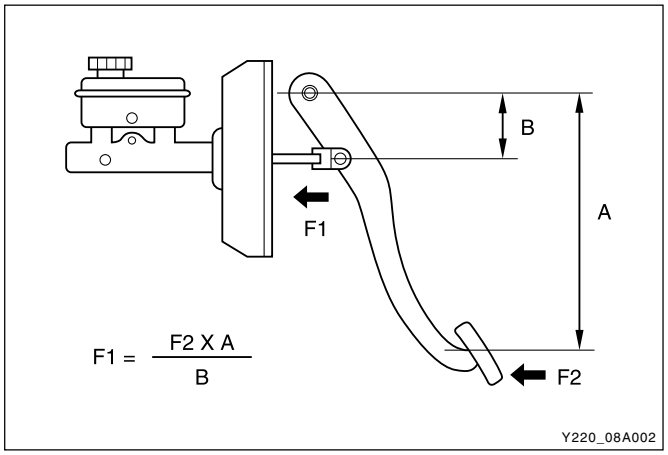


This system uses the leverage effect and Pascal's principle. When depressing the brake pedal, the pedal pressure is increased by booster and is delivered to master cylinder to generate hydraulic pressure.

The hydraulic pressure generated by the master cylinder is delivered to the brake caliper through the brake pipes or hoses.

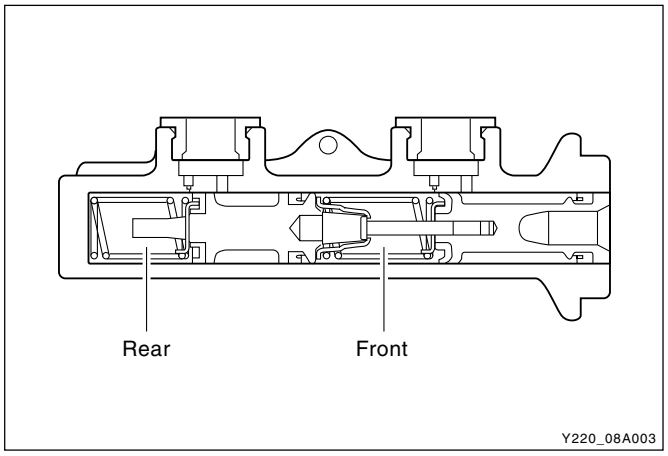
This hydraulic pressure pushes the brake calipers, accordingly the caliper pads are contacted to brake disc to generate the braking force.

▶ Brake Pedal



Brake pedal uses the leverage effect to apply bigger force to the brake master cylinder.

▶ Master Cylinder



The brake master cylinder is designed to convert the force from the brake master cylinder to the high hydraulic pressure. The brake system uses the tandem type master cylinder with in-line 2 pistons.

The in-line 2 pistons generate the hydraulic pressure. The piston cup on the piston keeps the sealing conditions in cylinder and prevents the oil leaks. The hydraulic pressure generated by the primary piston is delivered to the front wheels, and the hydraulic pressure generated by the secondary piston is delivered to the rear wheels.

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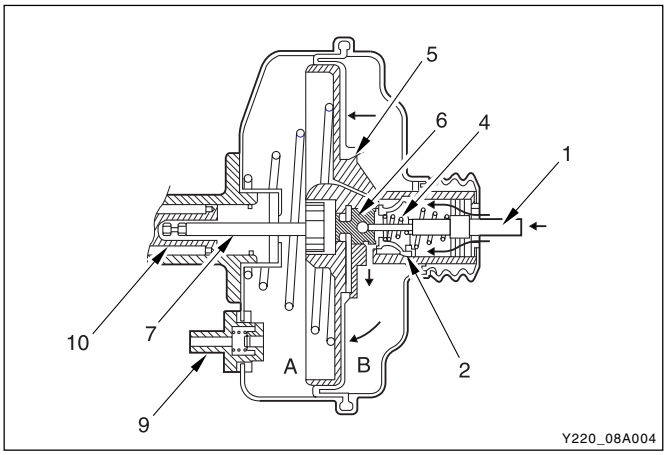
▶ Brake Booster

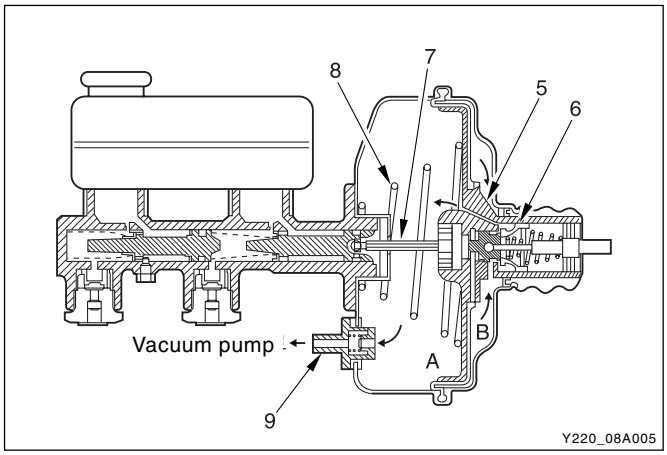
The brake booster is a power assist device for brake system. It relieves the pedal depressing force by using the pressure difference between the vacuum pressure generated by vacuum pump in intake manifold and the atmospheric pressure.

1. Pressure distribution at working



When depressing the brake pedal, the push rod (1) in booster pushes the poppet (2) and valve plunger (3). The poppet (2) pushes the power piston seat (5) resulting in closing the vacuum valve (9). The chamber (A) and (B) in power cylinder are isolated and the valve plunger (3) is separated from the poppet (2). And then the air valve (6) opens and air flows into the chamber (B) through filter. Then, the power piston (5) pushes the master cylinder push rod (7) to assist the brake operation.

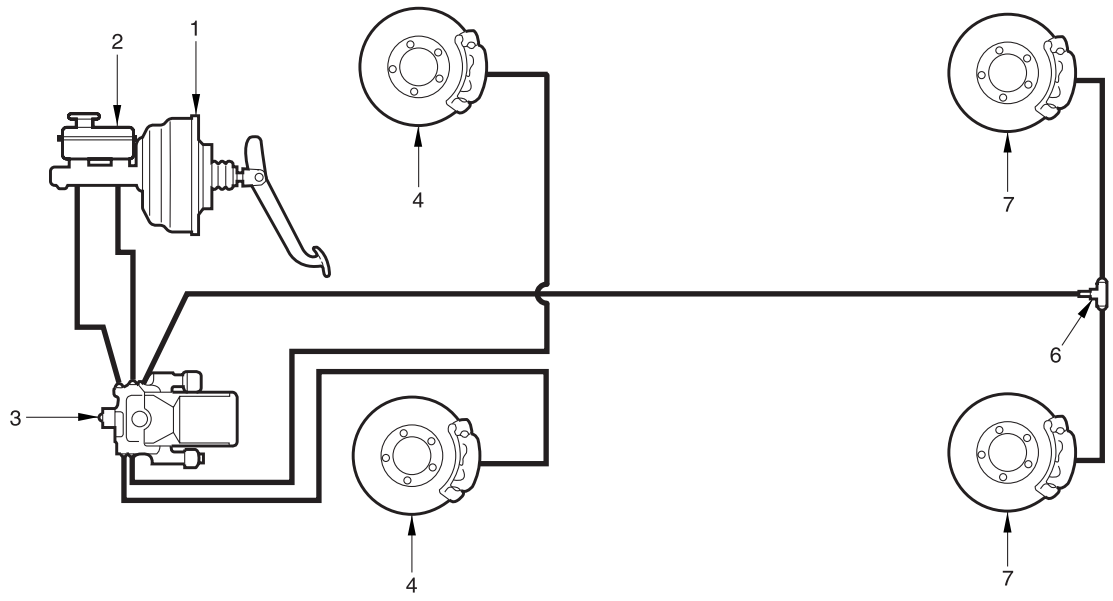
2. Pressure distribution after working



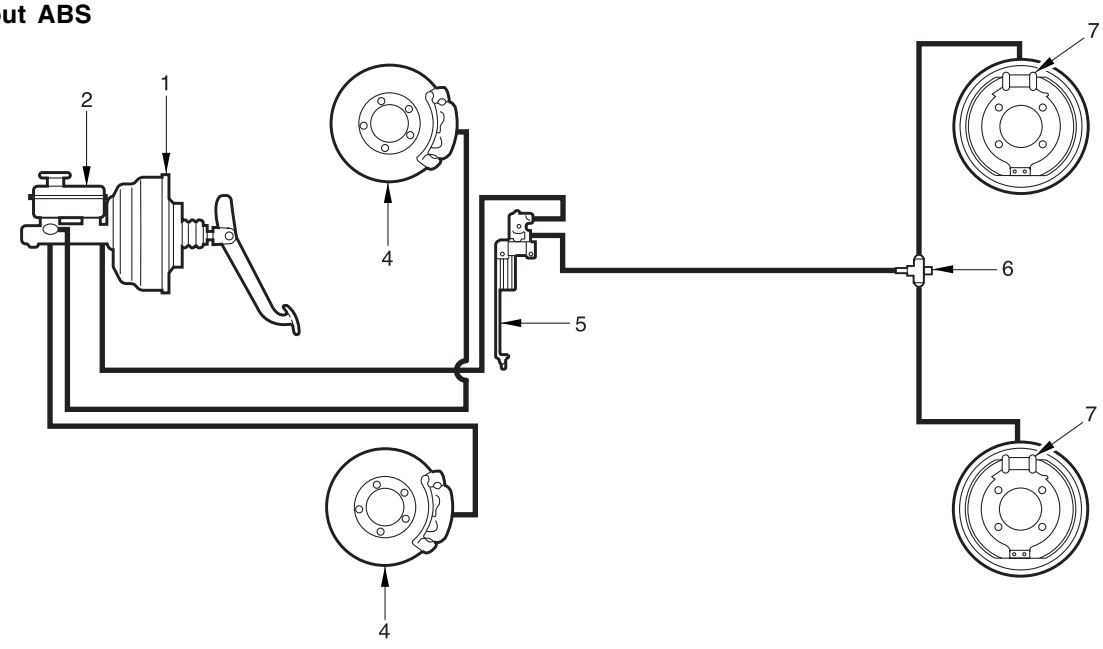
When releasing the brake pedal, the valve plunger (3) returns back to the original position by return spring (4) and the air valve (6) closes. At this time, the vacuum valve (9) opens and the pressure difference between chamber (A) and (B) in power cylinder is eliminated. Accordingly, the power piston (5) returns back to original position by the reaction of master cylinder (10) and the diaphragm return spring (8).

SYSTEM LAYOUT (HYDRAULIC LINE)

With ABS



Without ABS



Y220_08A006

1. Brake booster
2. Brake reservoir and master cylinder
3. ABS control unit
4. Front disc brake and caliper
5. Load conscious reducing valve (LCRV)
6. 3-way connector
7. Rear drum (disc) and wheel cylinder (caliper)

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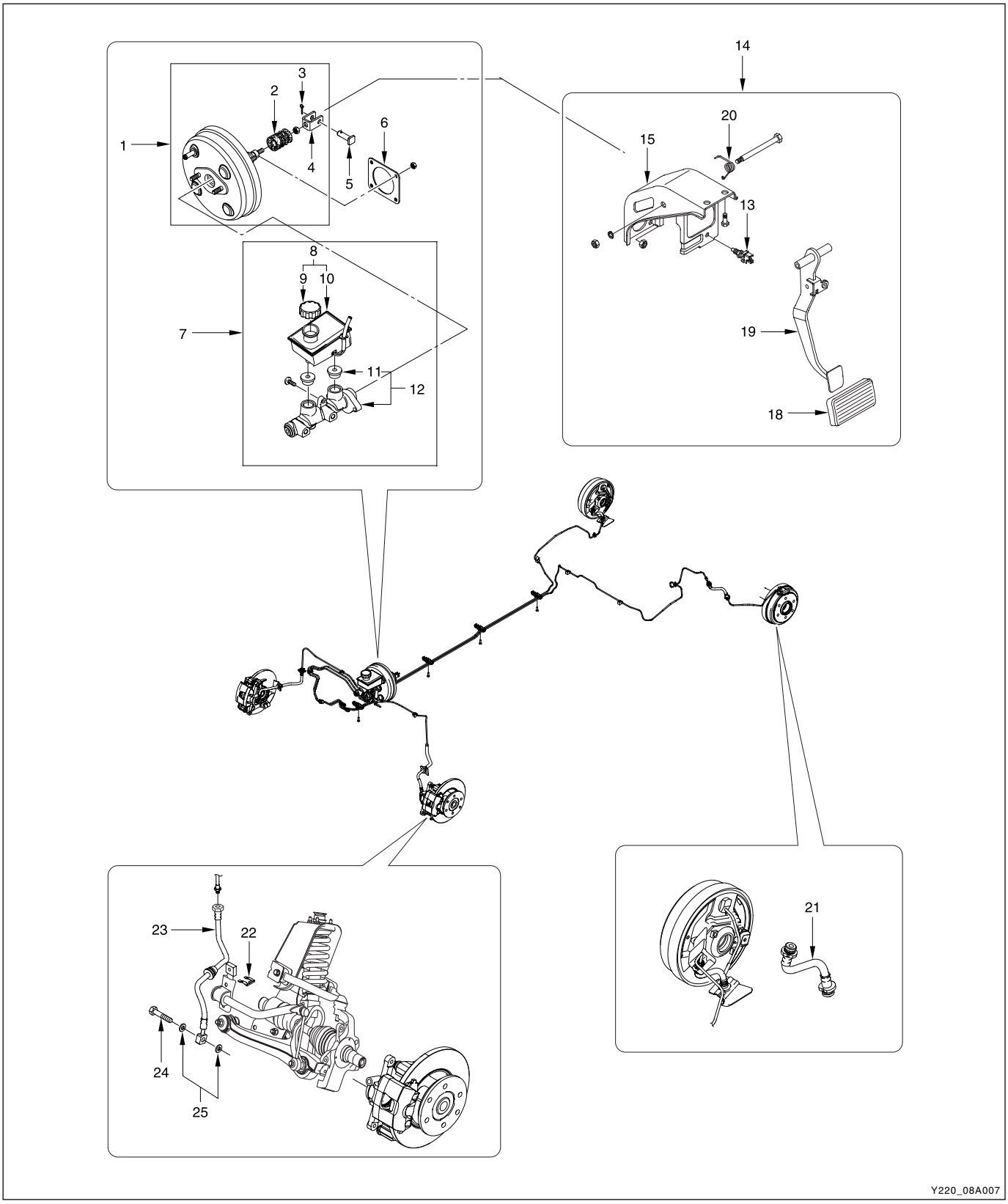
COMPONENTS LOCATOR

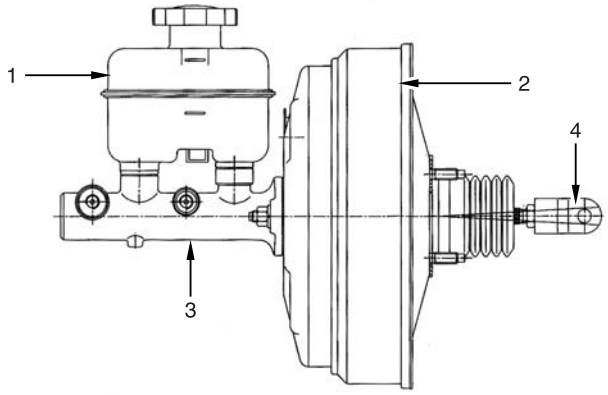
BRAKE SYSTEM



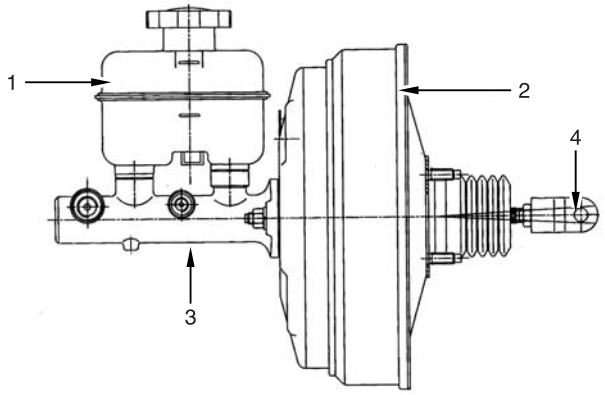
1. Brake booster
2. Brake booster boot
3. Cotter pin
4. Clevis
5. Clevis pin
6. Packing (1)
7. Master cylinder assembly
8. Brake reservoir assembly
9. Brake reservoir cap
10. Brake reservoir
11. Grommet seal
12. Master cylinder
13. Stop lamp switch
14. Pedal assembly
15. Pedal bracket assembly
16. Brake pedal pad
17. Brake pedal
18. Brake pedal spring
19. Rear brake hose
20. Clip
21. Front brake hose
22. Union bolt
23. Plane washer

MASTER CYLINDER AND BOOSTER

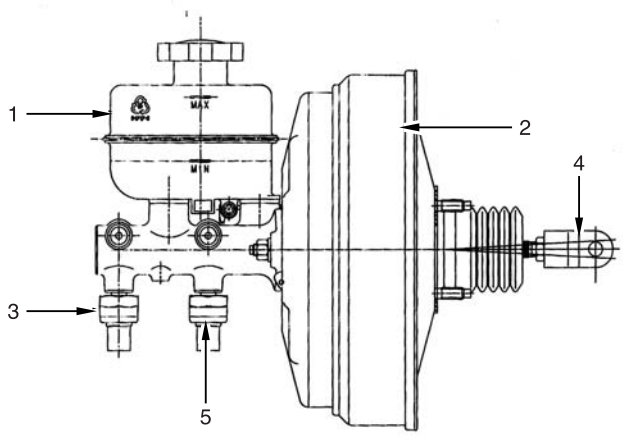
Without ABS



With ABS and ABD



With ESP

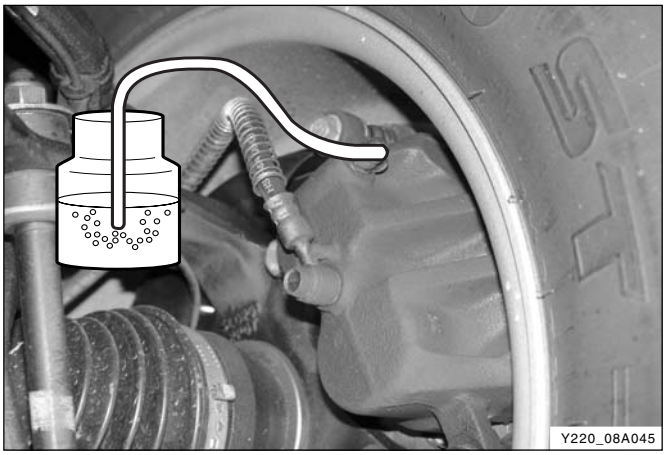


Y220_08A008

1. Reservoir
2. Master cylinder
3. Booster
4. Push rod
5. Pressure sensor

INSPECTION

Air Bleeding (With ABS)



Notice

Bleed air in the following order:
Right rear brake → Left rear brake → Right front brake → Left front brake
Check the fluid level repeatedly during air bleeding, and add fluid if needed.

1. Apply the parking brake and start the engine when the shift lever is at “P” position.
2. Connect the oil supply device (air bleeding device) with air compressor to brake reservoir. The oil supply device should be filled with sufficient oil.
3. Loosen the air bleed screw in caliper and place an empty container under the screw.
4. Bleed the air in each wheel by using diagnostic device (Scanner). At this time, the modulator motor runs for 180 seconds.
5. Simultaneously, run the oil supply device to supply oil and depress the brake pedal repeatedly.

   This procedure needs at least 3 persons for doing below jobs:

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

Notice

Keep the brake pedal depressing until the bleed screw is fully tightened.

6. Repeat the step 4 through 5 until clear brake fluid comes out of air bleed screw.
7. Perform the same procedures at each wheel.

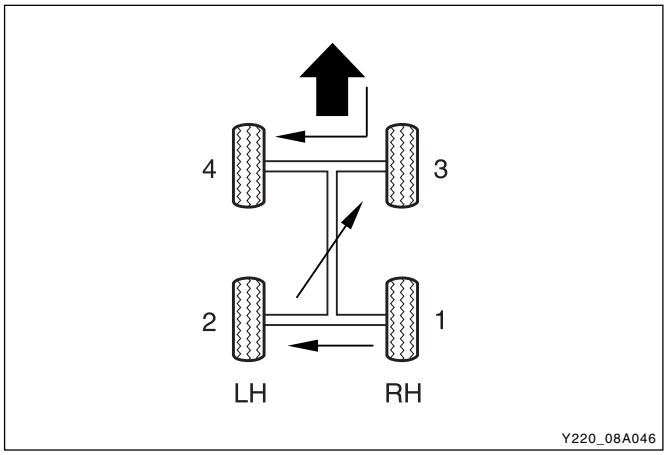
Notice

Repeat the step 4 through 5 until clear brake fluid comes out of air bleed screw.

After bleeding the air, make sure that the brake system is properly operated.

Notice

Replace the brake oil at every 2 years.



8. Always start to bleed the air at the farthest wheel from the brake master cylinder. Observe the sequence number as shown in the above figure.

Notice

- ***Always bleed the air after replacing the brake fluid or master cylinder, caliper, brake hose and pipe.***
- ***Never reuse the used brake fluid.***
- ***Do not pump the brake pedal too fast. It may cause some troubles for air bleeding operation.***
- ***Be careful not to splash the brake fluid on painted area or body.***
- ***Check the connection areas for leaks after air bleeding.***

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Y220_08A047

After Replacing Master Cylinder

1. Add oil after replacing the master cylinder.
2. Pump the brake pedal several times until the hydraulic pressure is generated. Then, keep the pedal depressing.
3. Loosen the pipe screw at the outlet port in master cylinder to bleed the air.
4. Repeat step 3 until clear brake fluid comes out of air bleed screw.
5. If the hydraulic pressure is not properly generated during pumping the brake pedal, bleed the at the outlet pipe in hydraulic unit and wheel.


Y220_08A048

After Replacing Hydraulic Unit

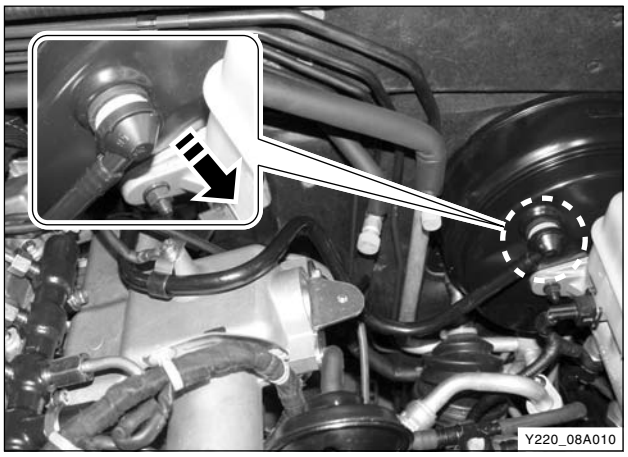
1. Add oil after replacing the hydraulic unit.
2. Pump the brake pedal several times until the hydraulic pressure is generated. Then, keep the pedal depressing.
3. Loosen the pipe screw at the outlet port in hydraulic unit to bleed the air.
4. Repeat step 3 until clear brake fluid comes out of air bleed screw.
5. If the hydraulic pressure is not properly generated during pumping the brake pedal, bleed the at the wheel.

REMOVAL AND INSTALLATION

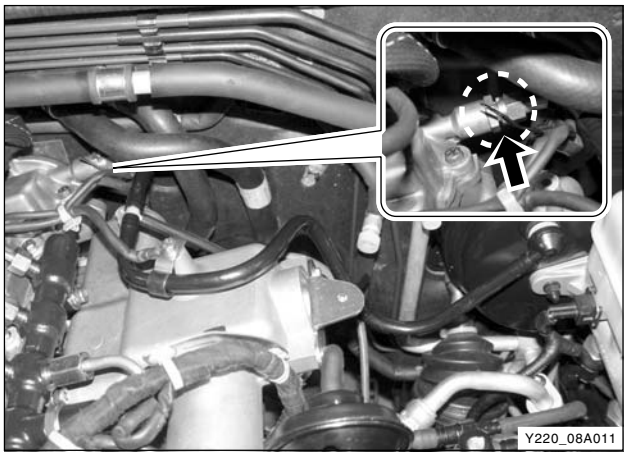
BRAKE BOOSTER VACUUM HOSE

Removal

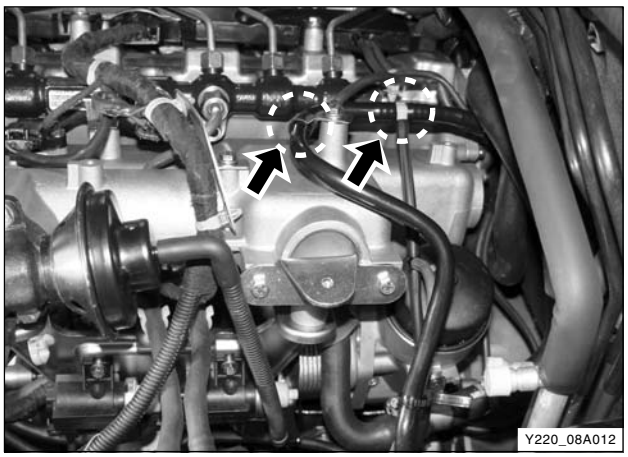
1. Disconnect the vacuum hose from brake booster.



2. Disconnect the vacuum hose from vacuum pump.



3. Disconnect the vacuum hose from vacuum modulator.
4. Remove the vacuum hose with vacuum hose bracket.



5. Install in the reverse order of removal.

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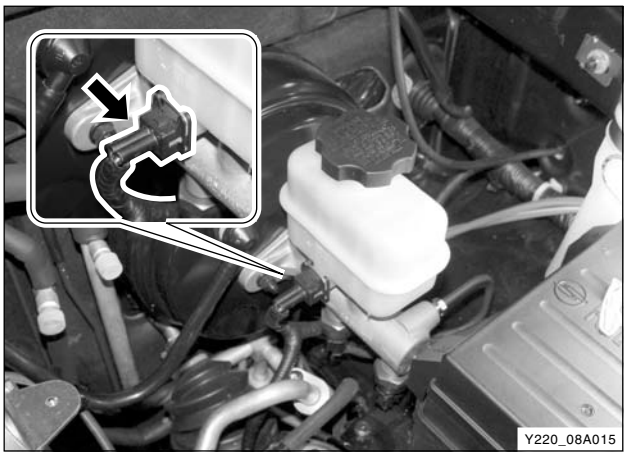
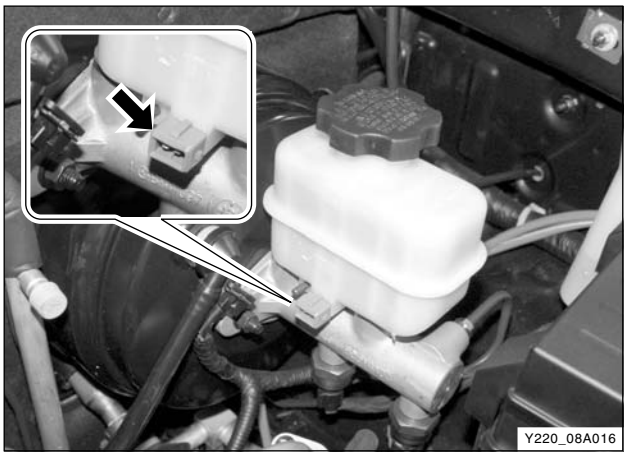
BRAKE FLUID LEVEL SWITCH

Removal and Installation



1. Disconnect the brake fluid level switch connector.



* ESP equipped vehicle

2. Disconnect the switch from brake fluid reservoir.

3. Install in the reverse order of removal.

BRAKE FLUID RESERVOIR

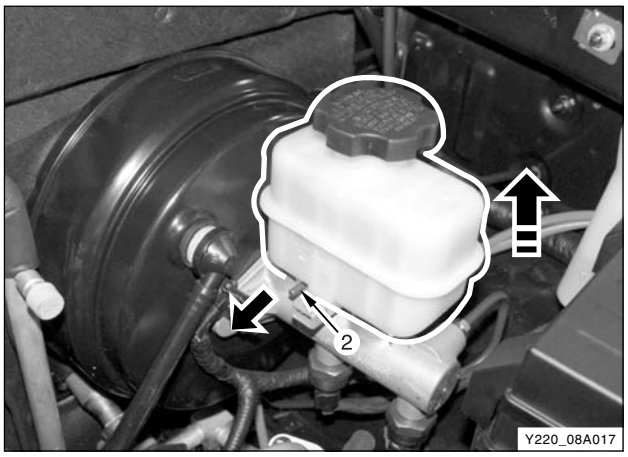
Removal and Installation

1. Open the reservoir cap and drain the oil.
2. Remove the brake fluid reservoir.

Notice

1.Do not apply excessive force when removing the reservoir.

2.Incase of the reservoir equipped vehicle, pull out the lock pin (2) and remove the reservoir.



* ESP equipped vehicle

3. Remove the grommet from master cylinder.
4. Install in the reverse order of removal.

Notice

- ***Use only specified brake fluid.***
- ***Always bleed the air from the brake system after replacing the brake fluid reservoir.***

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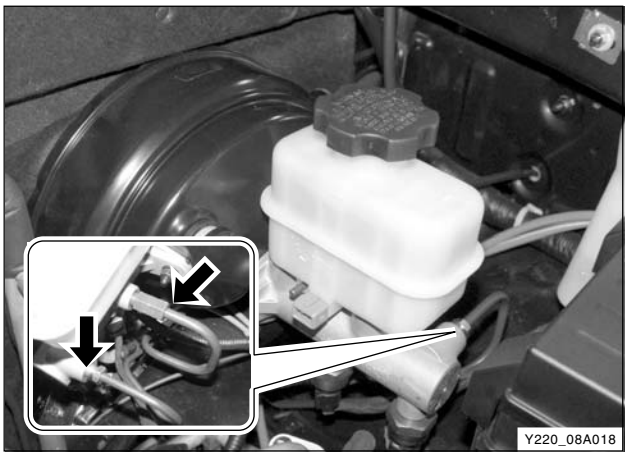
MASTER CYLINDER

Removal

※ Preceding work: Drain the oil.

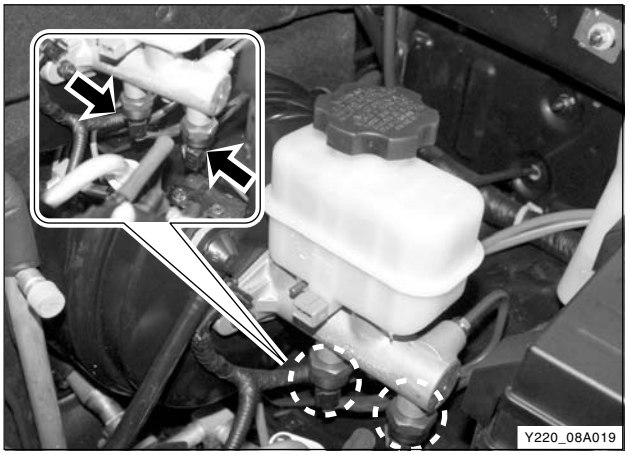
1. Disconnect the master cylinder connector.



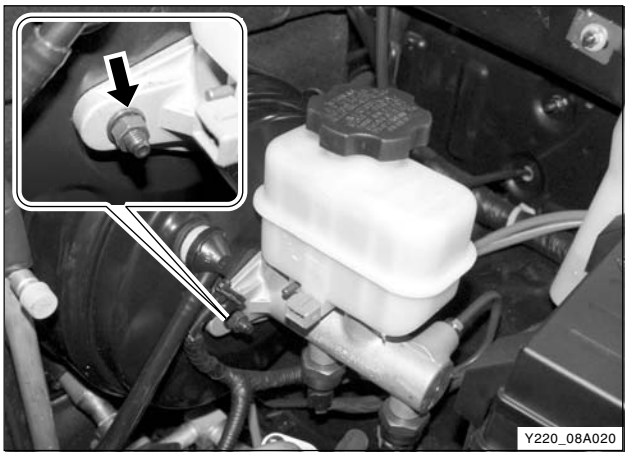
2. Disconnect the brake pipes from master cylinder.

Notice

Be careful not to splash the brake fluid on painted area. If splashed, immediately clean the affected area.



3. Unscrew the nuts and remove the master cylinder from booster.

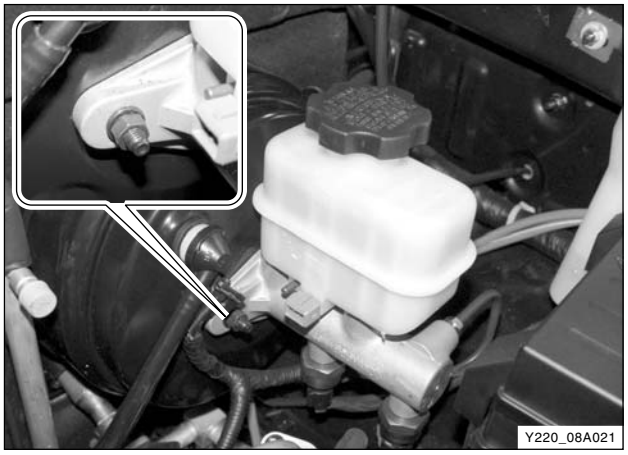


* ESP equipped vehicle

Installation

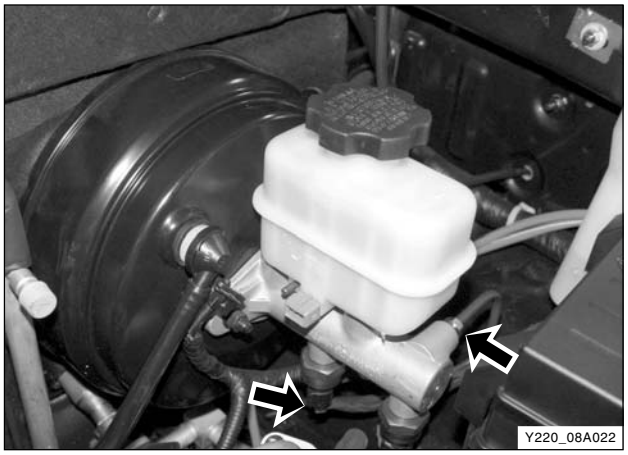
1. Install the assembled master cylinder to booster.

Tightening torque	8 ~ 12 Nm



2. Install the brake pipes to master cylinder.

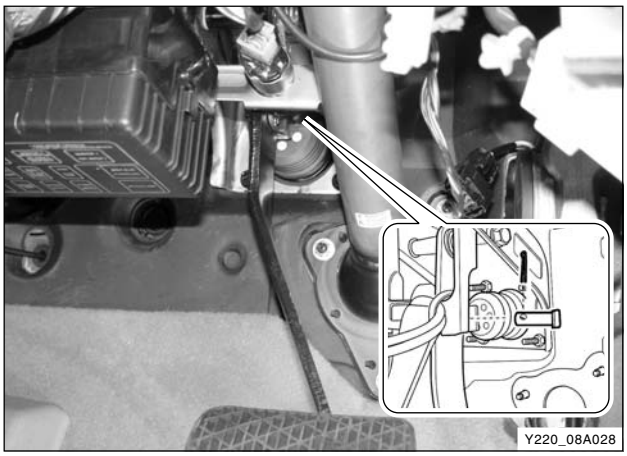
Tightening torque	15 ~ 18 Nm



3. Engage the master cylinder connector.
4. Bleed the air from the brake system.

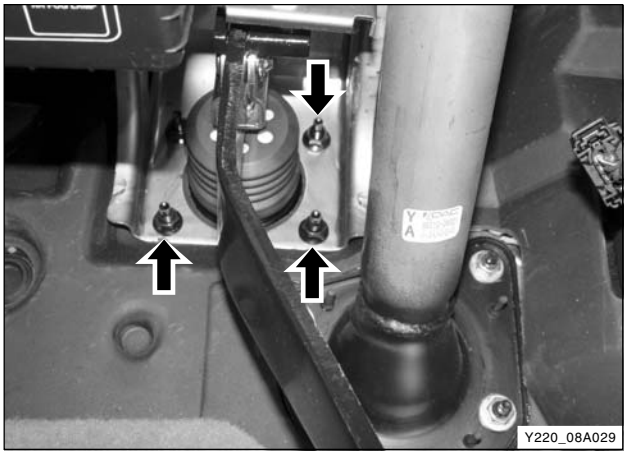
BRAKE BOOSTER

Removal and Installation



※ Preceding work: Drain the oil.

1. Remove the master cylinder assembly and pull out the cotter pin from brake booster push rod.
2. Remove the clevis pin.



3. Remove the booster mounting nuts.

4. Remove the brake booster.
5. Install in the reverse order of removal.

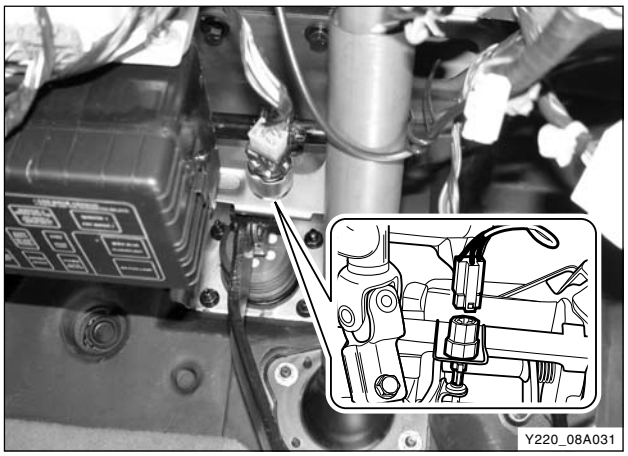
Notice

Always bleed the air from the brake system after replacing the brake booster.

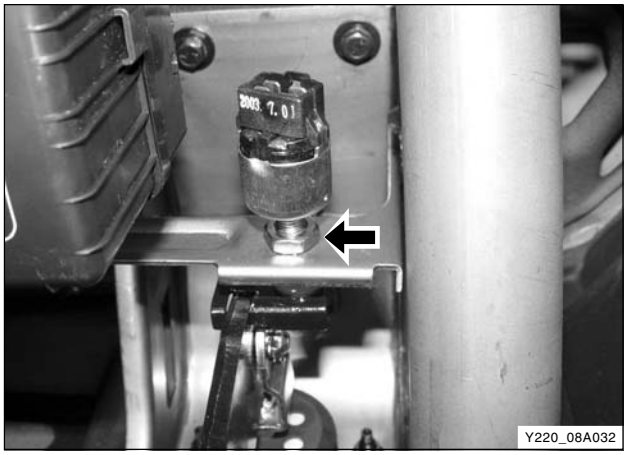
STOP LAMP SWITCH

Removal and Installation

1. Disconnect the negative battery cable.
2. Disconnect the stop lamp switch connector.

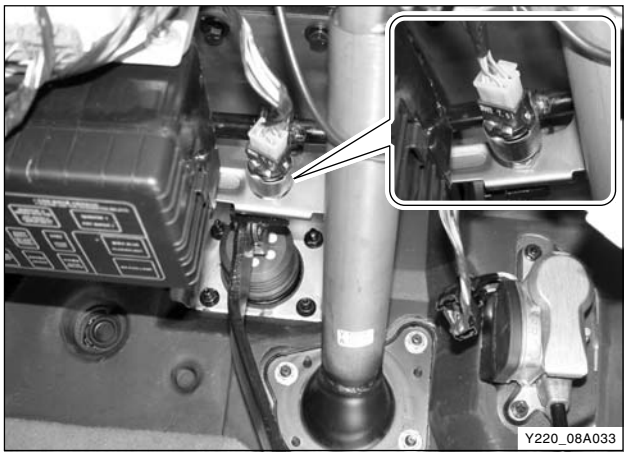


3. Unscrew the stop lamp switch nuts and remove the switch.



4. Install in the reverse order of removal.

Tightening torque	21 ~ 35 Nm



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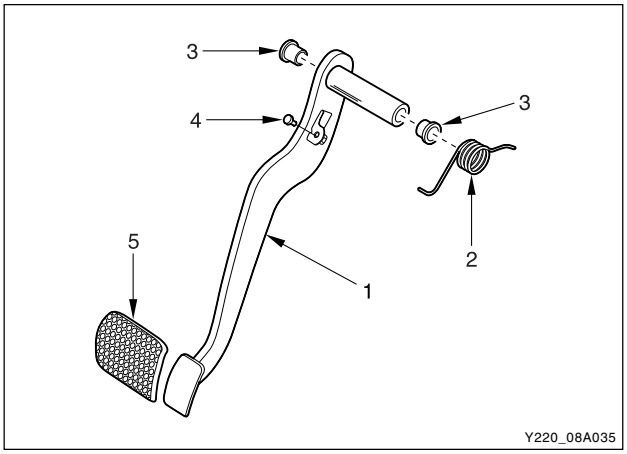
BRAKE PEDAL

Removal and Installation

1. Unscrew the brake pedal bolts and nuts and remove the cotter pin.



2. Remove the brake pedal assembly.

1. Brake pedal
2. Return spring
3. Bushing
4. Stopper
5. Brake pedal pad

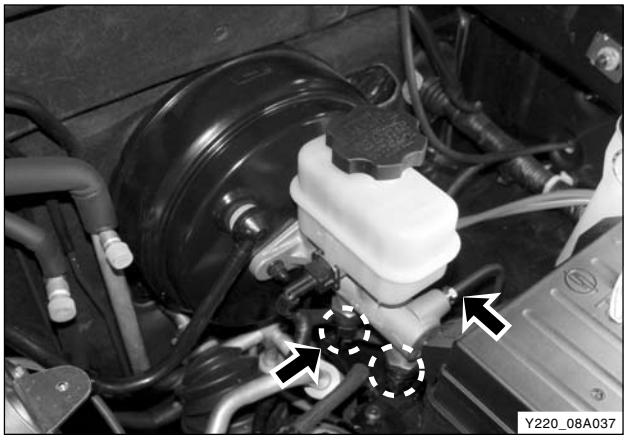
3. Install in the reverse order of removal.

Tightening torque	16 ~ 32 Nm

BRAKE HOSE/PIPE

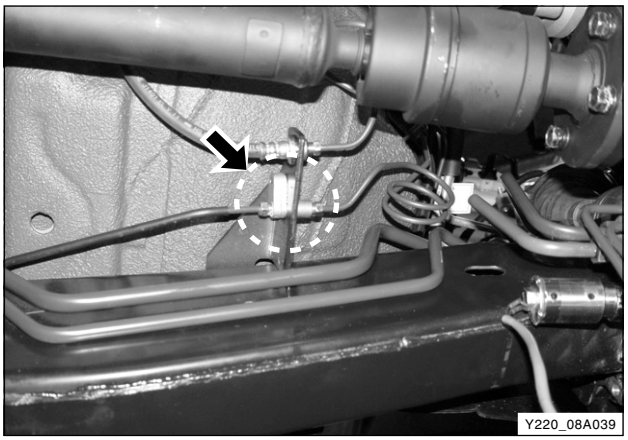
Removal

1. Remove the brake pipes.
   - Remove the pipes and pressure sensor from master cylinder.

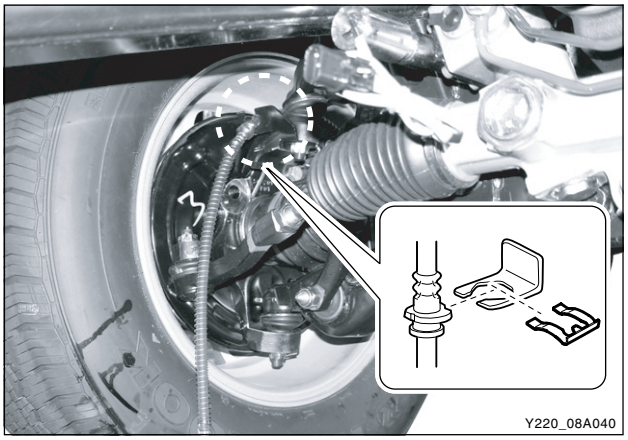


   - In case of ABS/ESP equipped vehicle, remove the pipes from control unit.

   - Remove the pipes from 3-way connector and remove the brackets for connecting pipes.



2. Remove the front and rear brake hoses.
   - Unscrew the brake pipe nuts.
   - Remove the strut from brake mounting.
   - Unscrew the union bolt from brake caliper and remove the brake hose.



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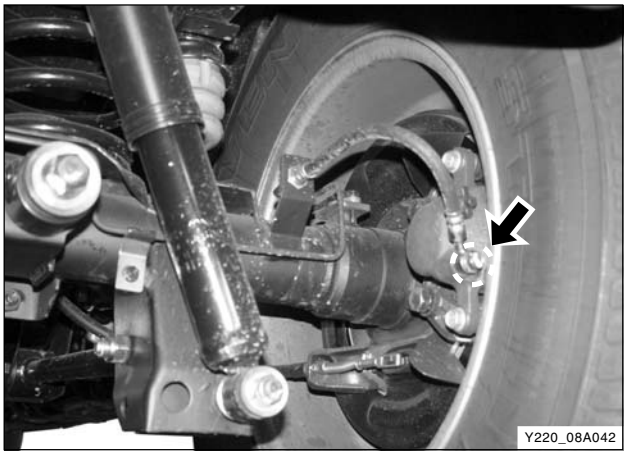
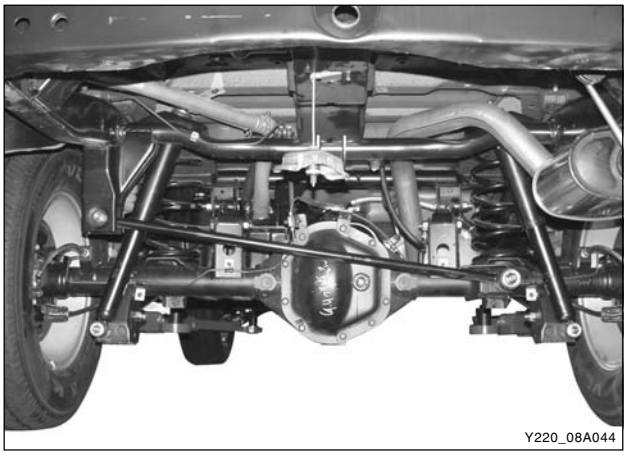




Installation

1. Engage the rear brake hose and tighten the union bolt.

Tightening torque	20 ~ 30 Nm

2. Engage the front brake hose and tighten the union bolt.

Tightening torque	20 ~ 30 Nm

3. Install the brake pipes at correct positions.

3-way connector	15 ~ 19 Nm
ABS/ABD control unit	15 ~ 19 Nm
Port section (M12)	20 ~ 24 Nm

4. Always bleed the air from the brake system after replacing the pipes/hoses.

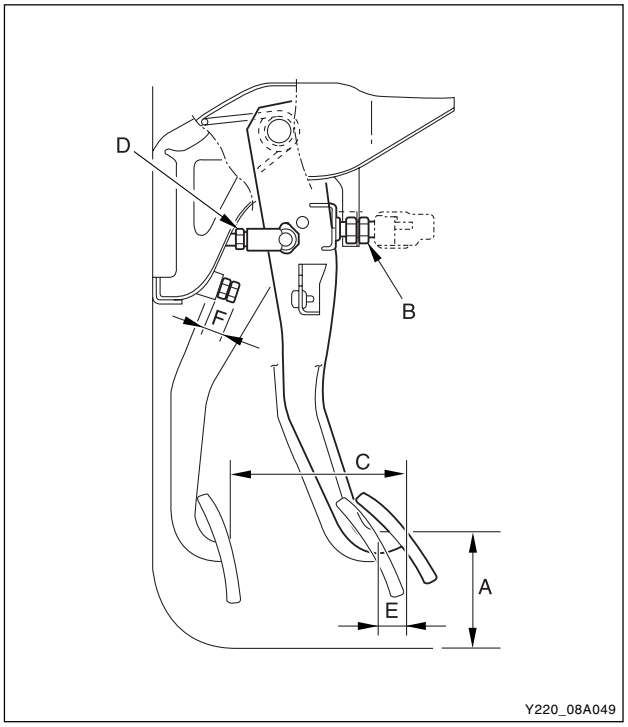
BRAKE PEDAL CHECK

Pedal Height / Maximum Stroke

Check the brake pedal with below procedures:

1. Start the engine.
2. Depress the brake pedal around 3 times.
3. Depress the brake pedal with approx. 30 kg and measure the distance (A) between the upper surface of pedal pad and the lower dash panel.
4. If the measured value is below the specified value, check the following causes:

   Pad wear, Shoe wear, Air in brake system, Defective automatic clearance adjuster of rear brake shoe.
5. If the measured value is out of the specified range, adjust the length of push rod by using lock nut in the brake booster push rod.

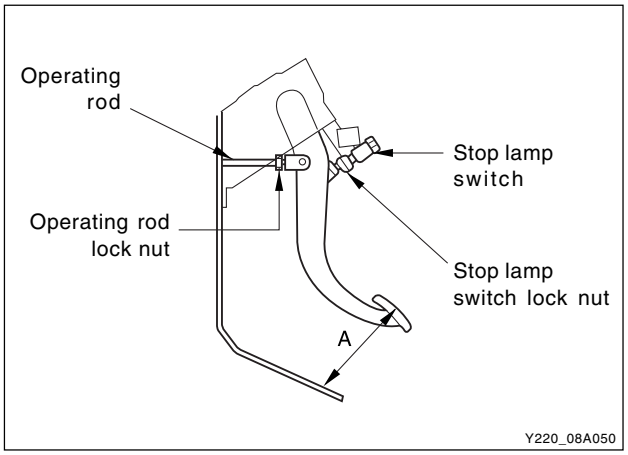


Pedal height

Specified value (A)	177 mm (from carpet surface)

Notice

If the value is out of the specified range, adjust the pedal height by using lock nut of stop lamp switch.



MAXIMUM STROKE

Specified value (C)	138 mm

Notice

If the value is out of the specified range, adjust the maximum stroke by using stop lamp and lock nut.

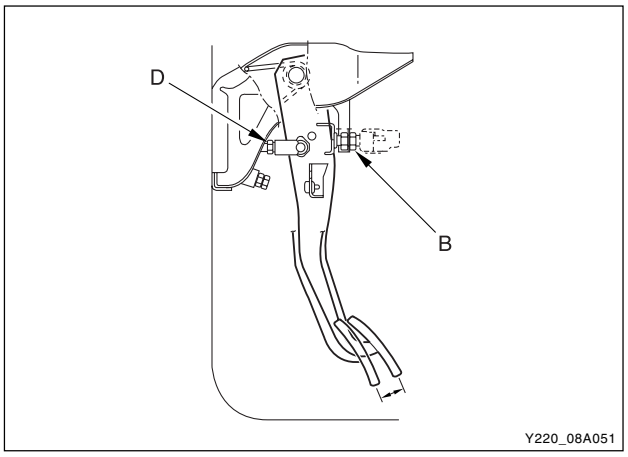
PEDAL FREE PLAY

Depress the brake pedal several times to discharge the vacuum pressure of the power booster. Measure the pedal free play while pressing the brake pedal by hand.

Specified value	3 ~ 8 mm

If the free play is below the specified value, check if the clearance between the outer case of the stop lamp and the brake pedal is within the specified range.

If the clearance is out of the specified range, the clearance between the clevis pin and the brake pedal arm is too large. Check the components and repair if needed.



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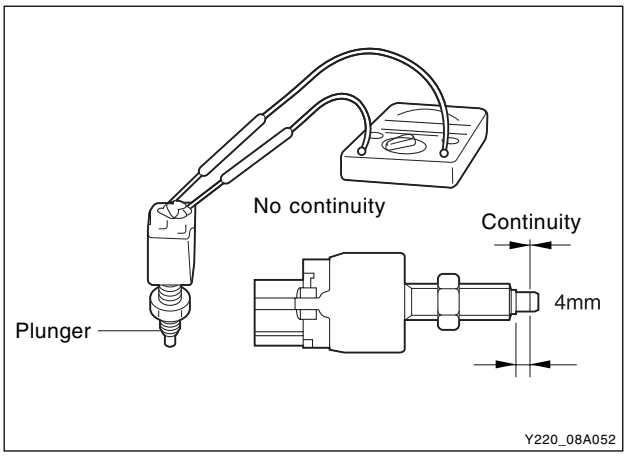
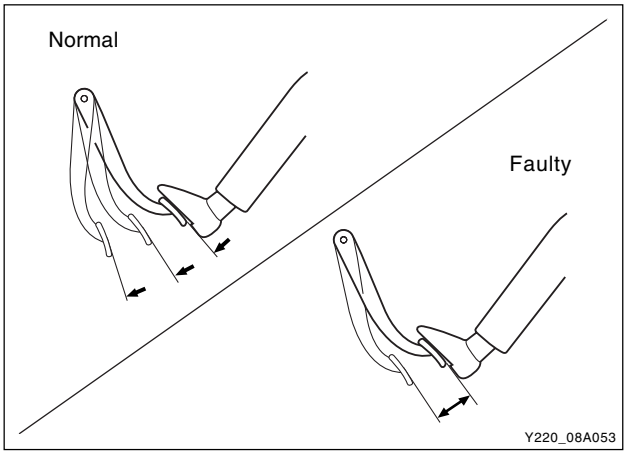
STOP LAMP SWITCH CHECK

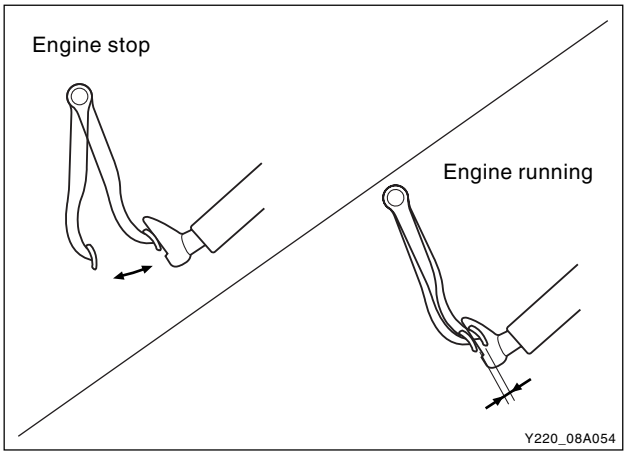


Connect the multimeter to stop lamp switch connector and check if the continuity exists when pushing in the plunger. If the continuity doesn't exist, the stop lamp switch is normal.

BRAKE BOOSTER CHECK



1. Let the engine run for 1 ~ 2 minutes and stop it. If the brake pedal stroke is shortened as pumping the brake pedal, the system is normal. If not, the system is defective.
2. Depress the brake pedal several times with engine off. If the brake goes down when starting engine with pedal depressed, the system is normal. If not, the system is defective.
3. Depress the brake pedal when the engine is running. If the pedal height is not changed when stop the engine, the system is normal. If not, the system is defective.



TROUBLE DIAGNOSIS

Symptom	Cause	Action
Noise or vehicle vibration when applied	Incorrectly mounted back plate or caliper	Repair
	Loosened bolt of back plate or caliper	Retighten
	Crack or uneven wear of brake drum or disc	Replace
	Foreign material inside the brake drum	Clean
	Pad or lining sticking to contact surface	Replace
	Excessive clearance between caliper and pad	Repair
	Uneven contact of pad	Repair
	Lack of lubrication	Lubrication
	Loosened suspension	Retighten
Pulls to one side when braking	Incorrect tire pressure between left and right	Adjust
	Poor contact of pad or lining	Repair
	Oil or grease is applied to pad or lining	Replace
	Bent or uneven wear of drum	Replace
	Incorrectly mounted wheel cylinder	Repair
	Faulty auto adjuster	Repair
Poor braking	Dirty or lack of fluid	Replenish or replace
	Air in brake system	Bleeding
	Faulty brake booster	Repair
	Poor contact of pad or lining	Repair
	Oil or grease on pad	Replace
	Faulty auto adjuster	Repair
	Over heated rotor due to dragging pad or lining	Repair
	Clogging brake line	Repair
	Faulty proportioning valve	Repair
Increasing pedal stroke (Pedal goes to floor)	Air in brake system	Bleeding
	Fluid leaking	Repair
	Excessive clearance between push rod and m/cylinder	Adjust
Brake dragging	Parking brake is not fully released	Repair
	Incorrect adjustment of parking brake	Adjust
	Weak return spring of brake pedal	Replace
	Incorrect pedal free-play	Repair
	Broken rear drum brake shoe return spring	Replace
	Lack of lubrication	Lubrication
	Damaged master cylinder check valve or piston return spring	Replace
Poor parking brake	Insufficient clearance between push rod and master cylinder	Adjust
	Worn brake lining	Replace
	Dirty brake lining surface by grease or oil	Replace
	Binding parking brake cable	Replace
	Faulty auto adjuster	Repair
	Excessive lever stroke	Adjust lever travel or check the cable

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SECTION 8B

FRONT BRAKE

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GENERAL INFORMATION

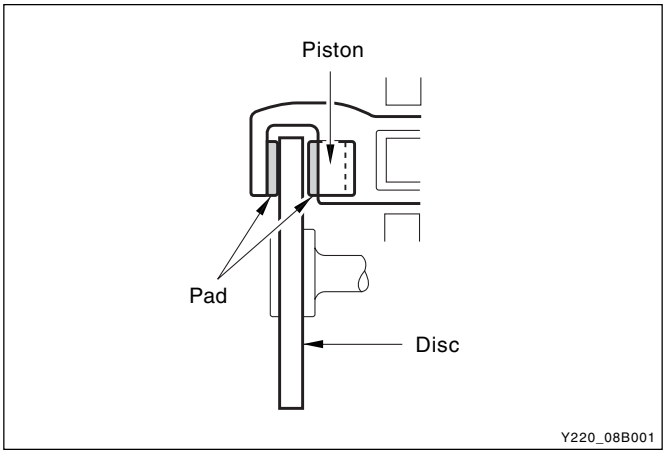
DESCRIPTION AND OPERATION

▶ Caliper

The disc brake is normally used for front wheels, however, currently it is also used for rear wheels. The floating caliper type disc brake installed in this vehicle has only one brake cylinder at one side of caliper. The hydraulic pressure generated by master cylinder pushes the piston to contact the pad against the disc. The caliper is moved to contact to the opposite pad.

The brake disc features:

* Excellent radiation due to it is exposed to ambient air
* Less braking force changes
* No uneven braking
* Simple structure and operation



* General description

▶ Adjustment of Clearance

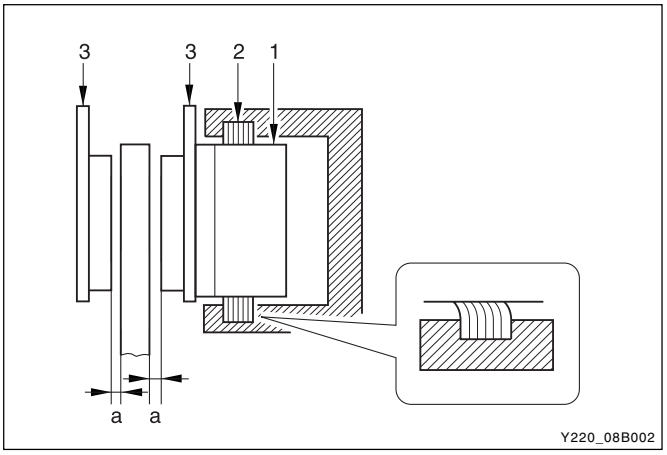
When the hydraulic pressure is applied to the piston, the piston moves to push the pad. The piston seal, which extent considerable pressure against the piston, moves with cylinder.

However, the piston seal shape is deformed since the piston seal is fixed at the cylinder groove as shown in below figure.

When the pressure is released from the piston, the piston comes back to its original position by a restoring and elastic force of the seal.

When the pad wear is excessive, the piston seal cannot reach to the desired point because the seal's deformation is limited.

Accordingly, the piston always comes back by the deformed distance of piston seal, it keeps the initial clearance.



1. Piston
2. Piston seal
3. Pad
a. Clearance

SPECIFICATIONS

Description	MANDO
Type	Ventilated disc type
Inner diameter of caliper cylinder	ϕ 42.9 x 2 mm
Pad thickness	10.5 mm
Disc thickness	26 mm

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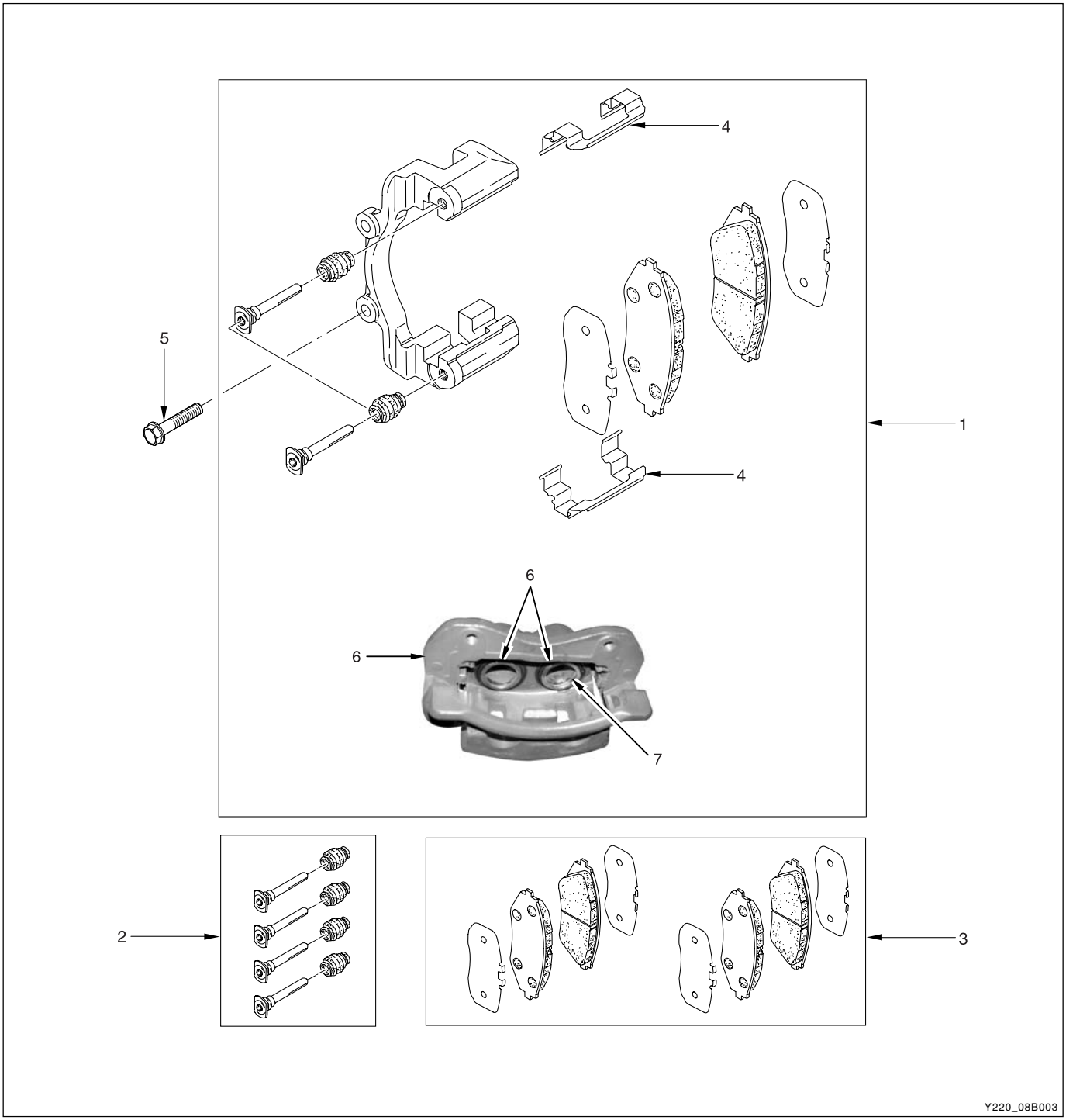
REMOVAL AND INSTALLATION



1. Brake caliper assembly
2. Guide rod set
3. Brake pad
4. Brake pad spring
5. Caliper mounting bolt
6. Piston seal
7. Piston
8. Caliper

FRONT BRAKE

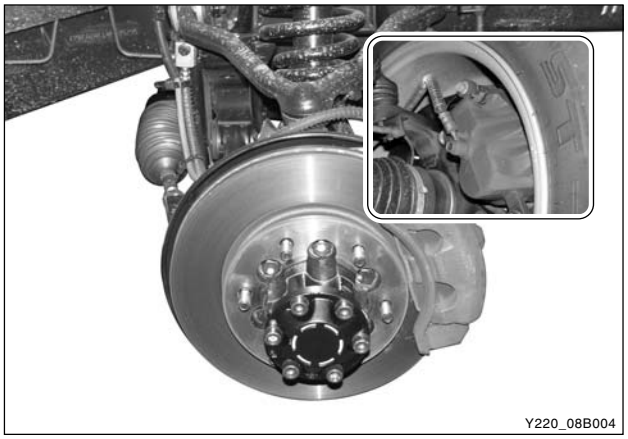
Removal

※ Preceding work: Remove the negative battery cable.

1. Remove the tire and disconnect the brake hose from brake caliper.

Notice

Be careful not to splash the oil.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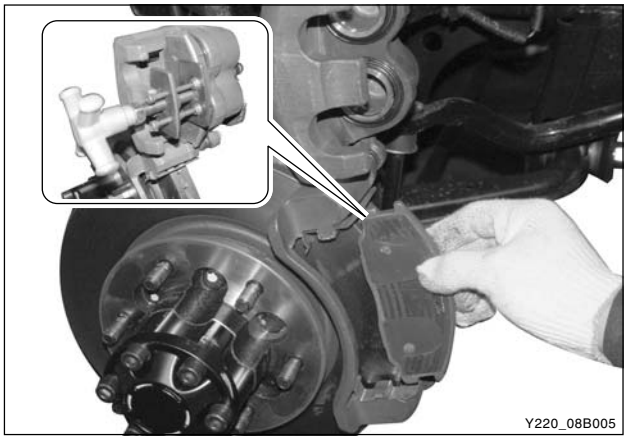
2. Unscrew the bolts and remove the cylinder and disc pads.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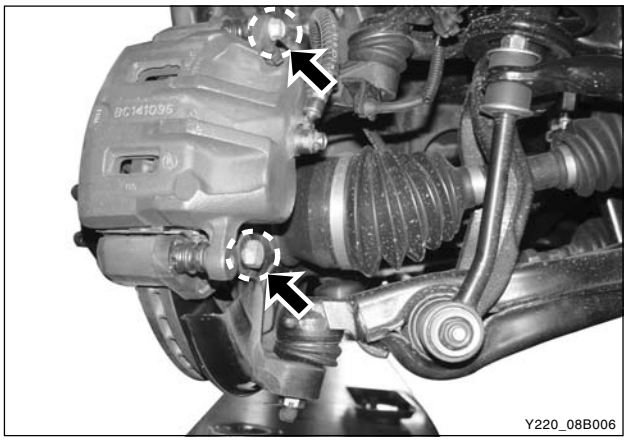
3. Unscrew the mounting bolts and remove the brake caliper assembly.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4. Remove the brake disc.
5. Unscrew the mounting bolts and remove the hub assembly.

Notice

In case of part-time transfer case equipped vehicle, remove the locking hub assembly and hub range before removing the brake disc.


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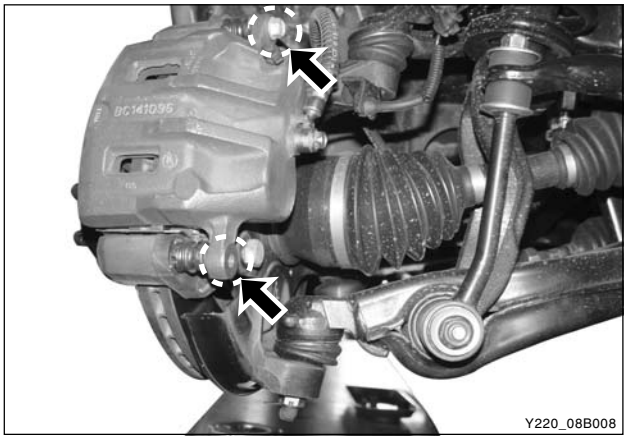
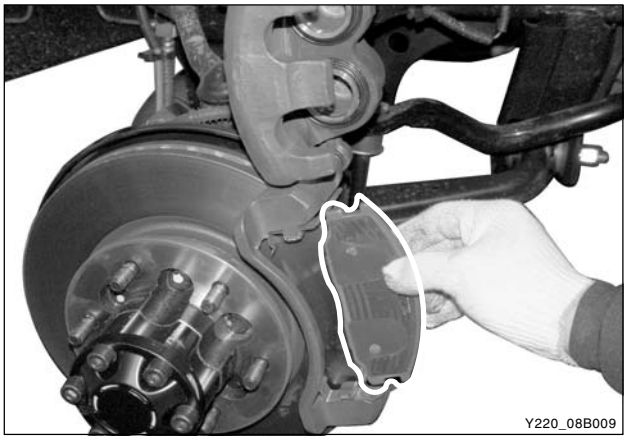
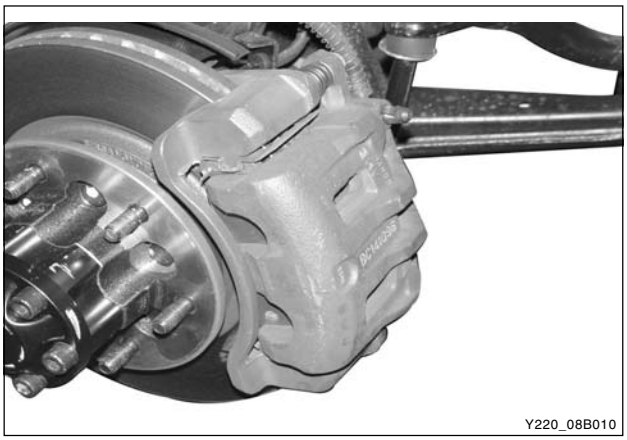


Brake Pad Change

1. Unscrew the bolts at bottom side of brake caliper cylinder.



2. Swing up the caliper cylinder assembly and hold it not to damage the hose.

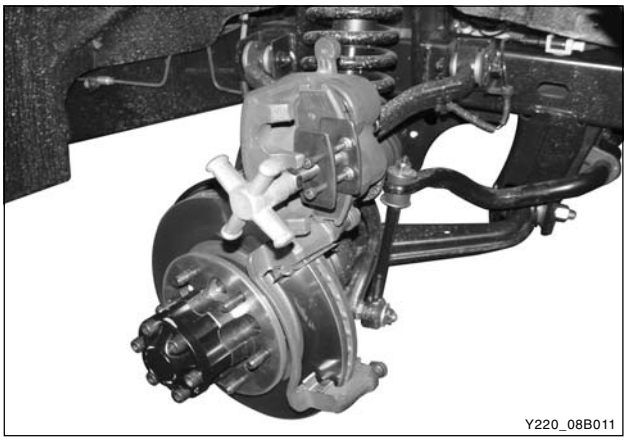


3. Remove the brake pads and replace them with new ones.
4. Install the brake caliper cylinder assembly.

Tightening torque	22 ~ 32 Nm

Notice

Depress the brake pedal several times after replacing the brake pads.



Note

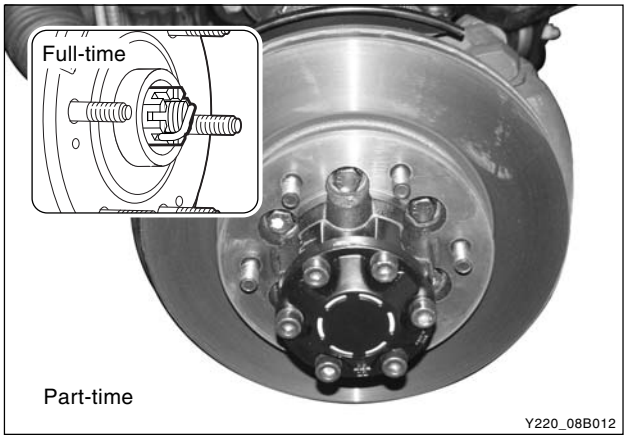
Use the piston compressor when replacing the pads.

Notice

Insert the used pad between compressor and piston when compressing the piston.

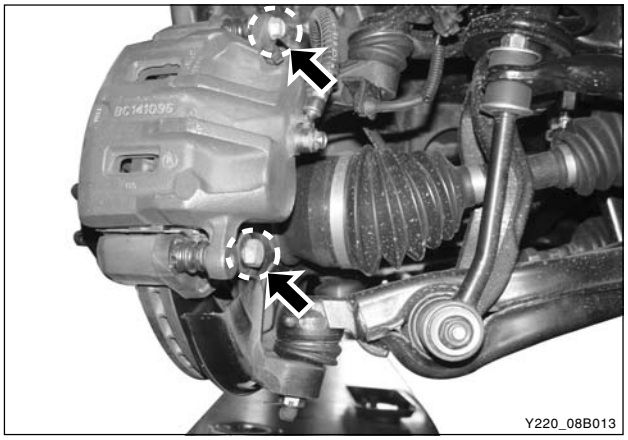
Installation

1. Place the front disc assembly to the knuckle and tighten the lock nut with the specified value. (Full-time 4WD)
2. Place the disc, locking hub and hub range and tighten the mounting bolts. (Part-time 4WD)



3. Install the caliper assembly to front disc.

Tightening torque	85 ~ 105 Nm



4. Install the brake hose to caliper cylinder.

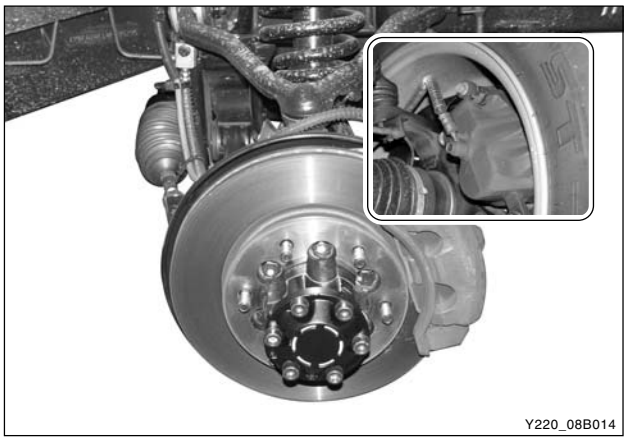
Tightening torque	20 ~ 30 Nm

Notice

Replace the copper washer with new one.

5. Bleed the air from the brake system after replacing the brake pads.

Air bleed screw tightening torque	7 ~ 13 Nm



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BRAKE DISC RUN-OUT

1. Install the dial gauge on the side of brake disc and measure the run-out while rotating the brake disc.
2. If the measured value exceeds the limit, replace the brake disc with new one. Otherwise, it may cause the pedal vibration and shimmy when braking.

Limit	0.03 mm (before installation)
	0.07 mm (when installed)


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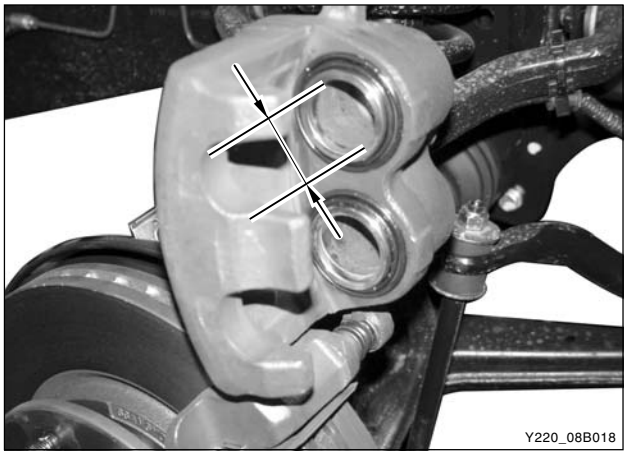
INNER DIAMETER OF CALIPER HOUSING

Description		Specified Value
With ABS	Wear limit	42.9 mm
Without ABS		43.9 mm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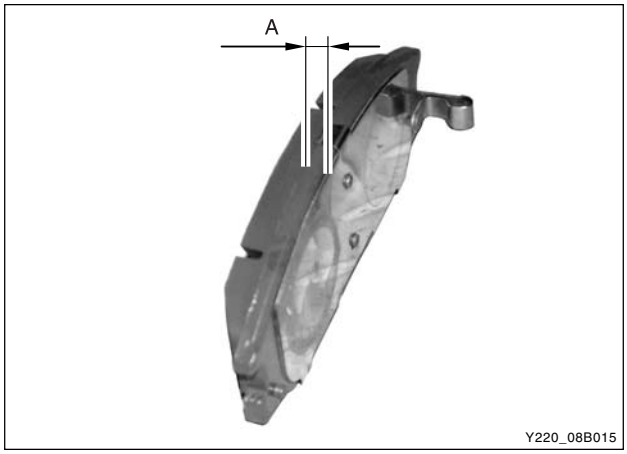
INSPECTION

Clean the dissembled components and visually check the followings:

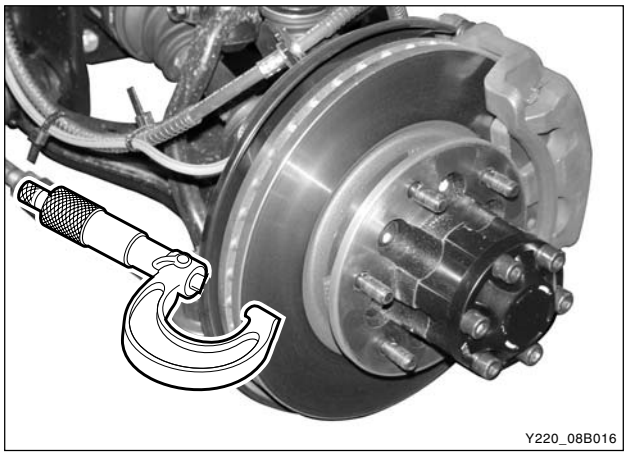
- Wear, rust and damage on the cylinder and piston
- Damage, crack and wear on cylinder body and guide pin
- Uneven wear and oil contamination on boot
- Damage and tear on boot
- Scratch and bending on disc plate



PAD THICKNESS

1. Remove the tire.
2. Measure the pad thickness and replace it if it is below the wear limit.

New pad thickness	Wear limit
10.5 mm	2 mm



BRAKE DISC THICKNESS

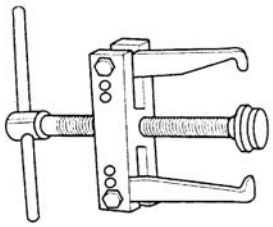
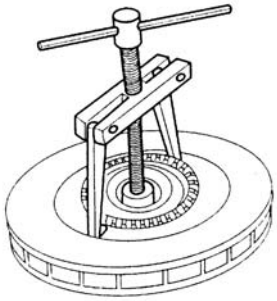
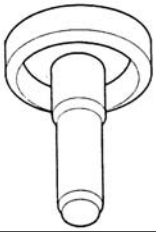
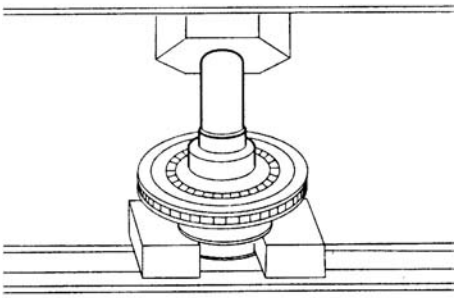
1. Measure the disc thickness at over four points.
2. If any of measured points is below the wear limit, replace the brake disc with new one.

New pad thickness	Wear limit
26 mm	23.4 mm

TROUBLE DIAGNOSIS

Symptom	Cause	Action
Poor braking	Pad wear, hardening	Replace
	Oil or water contamination on the pad	Replace and repair
	Inoperative caliper	Replace
Uneven braking	Pad wear, hardening	Replace
	Oil or water contamination on the pad	Replace and repair
	Uneven wear or twisted of the disc	Replace
	Inoperative caliper	Replace
Dragging brake	Inoperative caliper returning	Replace
Excessive pedal travel	Pad wear	Replace
Noise and vibration when brake applied	Pad wear, hardening	Replace
	Damage on the disc	Replace
	Interference of the dust cover	Repair
	Loose caliper mounting bolts	Tighten

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
661 589 16 33 00 (W 99 48 002 0A) **Front ABS tooth wheel puller**  Y220_08B019	Removal of ABS front brake tooth wheel  Y220_08B020
661 589 17 33 00 (W 99 48 003 0A) **Front ABS tooth wheel installer**  Y220_08B021	Installation of ABS front brake tooth wheel  Y220_08B022

SECTION 8C

REAR BRAKE

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GENERAL INFORMATION

DESCRIPTION AND OPERATION

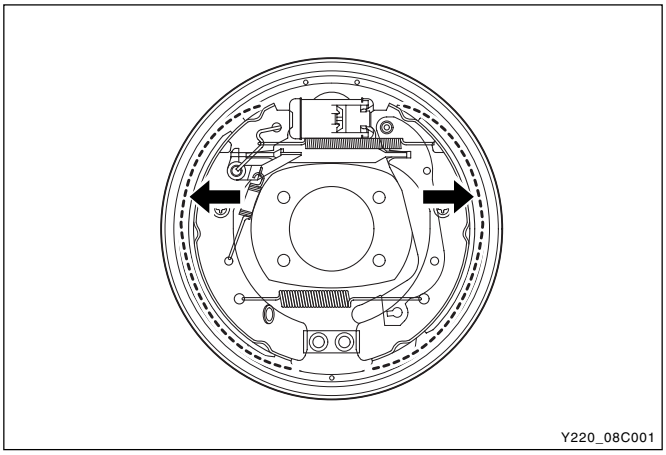
▶ Drum Brake

This drum brake assembly is a leading/trailing shoe design.

▶ Brake Drum

The brake drum must have high abrasion resistance, heatproof, high stiffness, fatigue stiffness and strength enough not to make any deformation. The temperature of the drum surface comes up to 500 ~ 700°C on brake operation by the friction with the lining. When the temperature of the drum surface continues to keep high, the friction coefficient goes down and the “fade phenomenon” occurs. When the brake is applied often on the hill, any accident may be occur.

The brake shoes are not fixed. When applying the brake,



the wheel cylinder pushes the primary and secondary shoes with same force to contact the drum and linings. The primary shoe pushes the rod under the shoe by frictional force with the drum. Thus, the primary and secondary shoes are contacted to brake drums by pivoting the anchors. During the straight ahead driving, The primary shoe generates bigger braking force than the secondary shoe. On the contrary, in the reverse driving, the secondary shoe generates the bigger force than the primary shoe. If the linings are worn, the clearance between lining and drum is automatically adjusted.

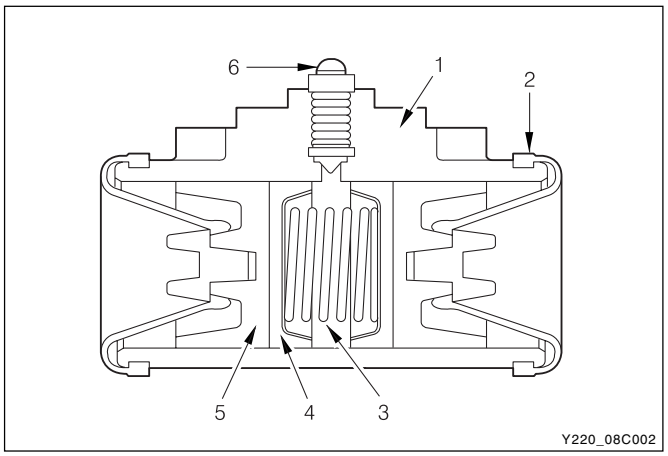
Brake lining and drum clearance automatic control system

If the lining’s wear is excessive, the piston moves to long distance and the pedal travel increases. The clearance between the drum and the brake lining should be adjusted. Generally the drum brake must be adjusted regularly and thus the clearance automatic control system enables to adjust the clearance between the brake lining and the drum resulting from brake lining wear.

▶ Wheel Cylinder

Both wheel cylinder diameters are same in order to balance the friction forces of both shoes.

The hydraulic pressure from the master cylinder is provided to the wheel cylinder and the piston in the wheel cylinder allows to push both shoes toward the drum resulted in generating the braking force.



1. Cylinder housing
2. Boot
3. Spring
4. Piston cup
5. Piston
6. Air bleed screw

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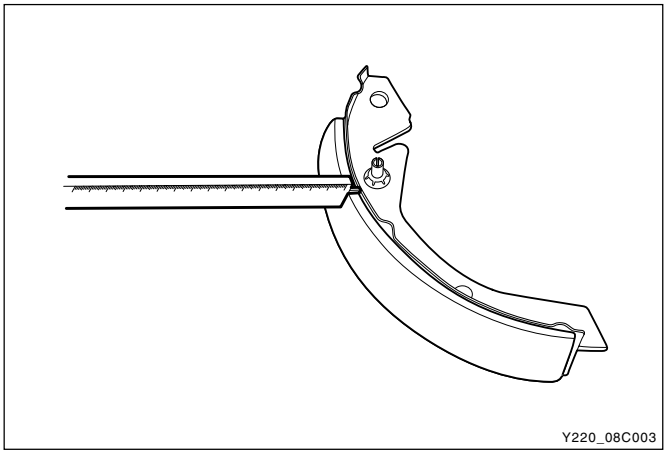
▶ Brake Lining

The brake lining is installed with the brake shoe and pushed toward the drum for applying the brake pedal. Thus, lining must have high-heat tolerance, abrasion resistance and high friction coefficient.

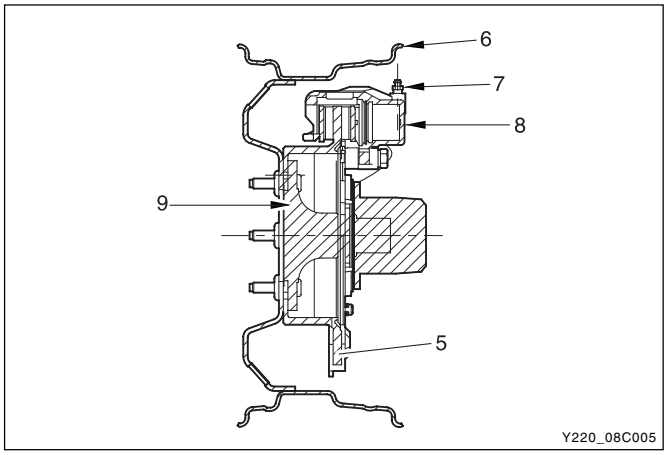


DISC BRAKE

The disc brake is normally used for front wheels, however, currently it is also used for rear wheels. The floating caliper type disc brake installed in this vehicle has only one brake cylinder at one side of caliper. The hydraulic pressure generated by master cylinder pushes the piston to contact the pad against the disc. The caliper is moved to contact to the opposite pad.

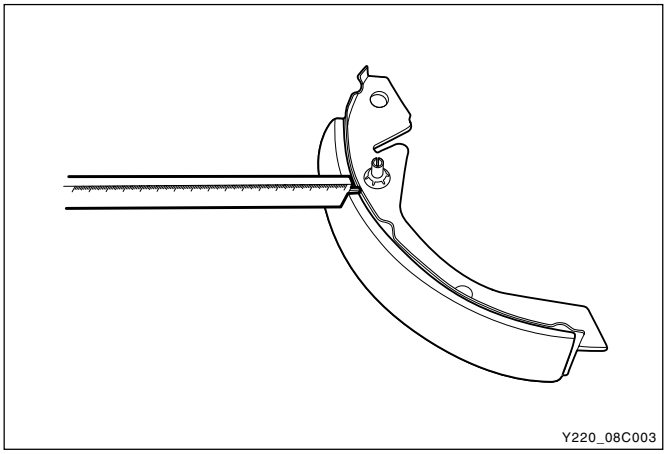
The brake disc features:

* Excellent radiation due to it is exposed to ambient air
* Less braking force changes
* No uneven braking
* Simple structure and operation



▶ Brake Lining

The brake lining is installed with the brake shoe and pushed toward the drum for applying the brake pedal. Thus, lining must have high-heat tolerance, abrasion resistance and high friction coefficient.



DISC BRAKE

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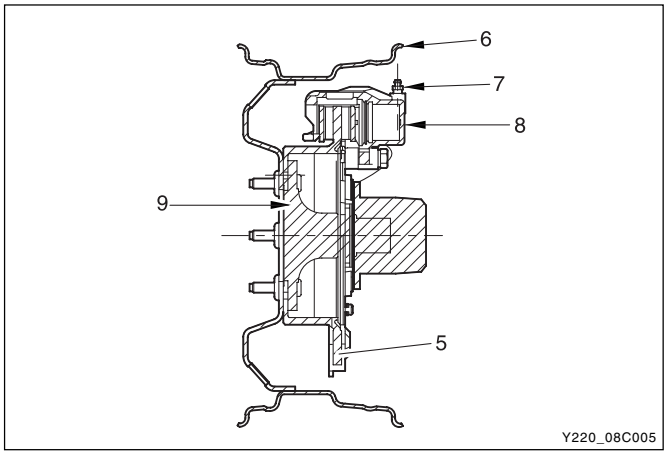
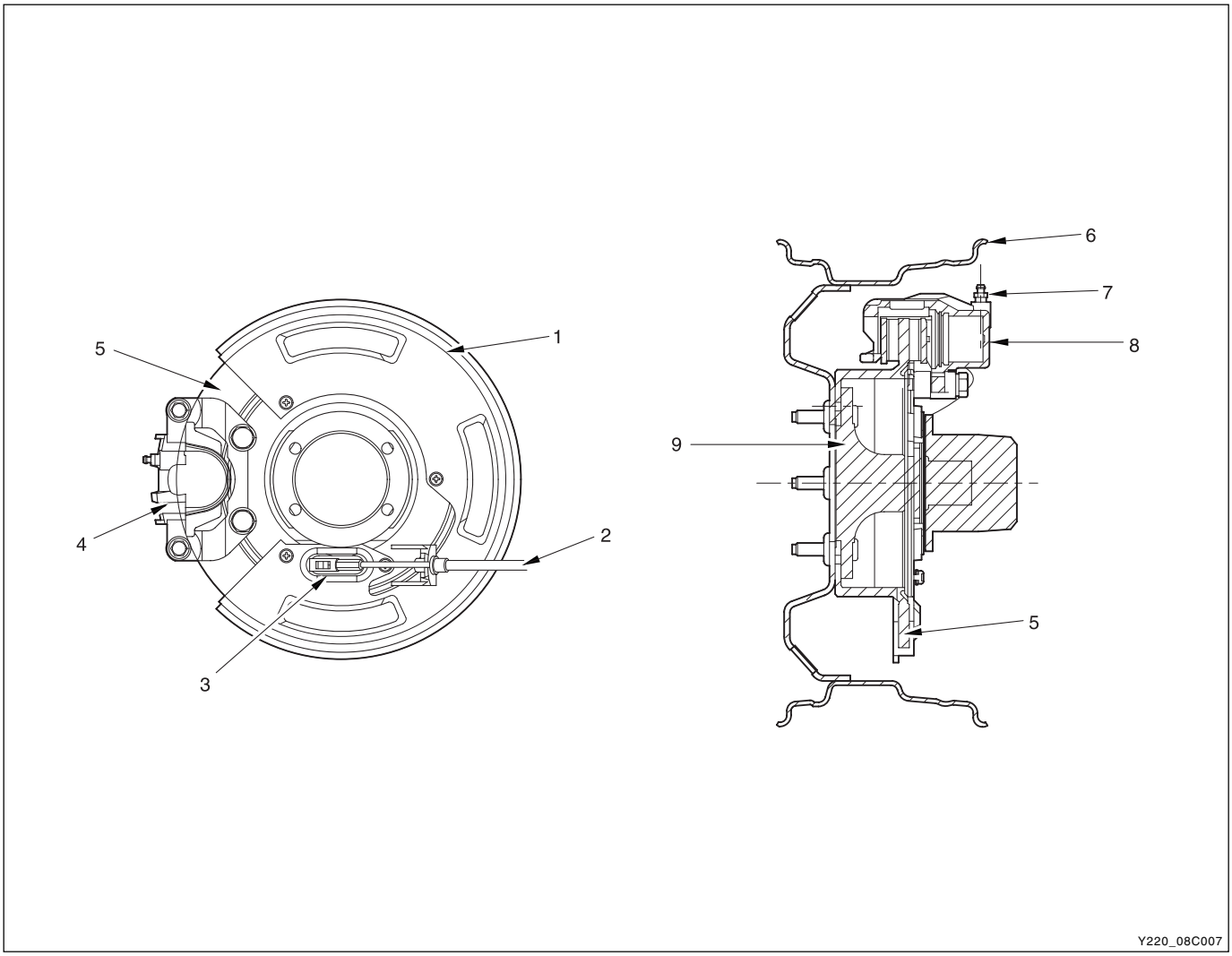


SPECIFICATIONS

Description	Drum Brake	Disc Brake
Inner diameter of drum	ϕ 254 mm	-
Shoe Type	Leading and trailing	-
Lining width x Length x Thickness	55 X 243 X 4.7 mm	-
Inner diameter of wheel cylinder	ϕ 23.81 mm	-
Inner diameter of caliper cylinder	-	ϕ 42.9 mm
Brake pad thickness	-	10 mm
Disc thickness	-	10.4 mm

COMPONENTS LOCATOR

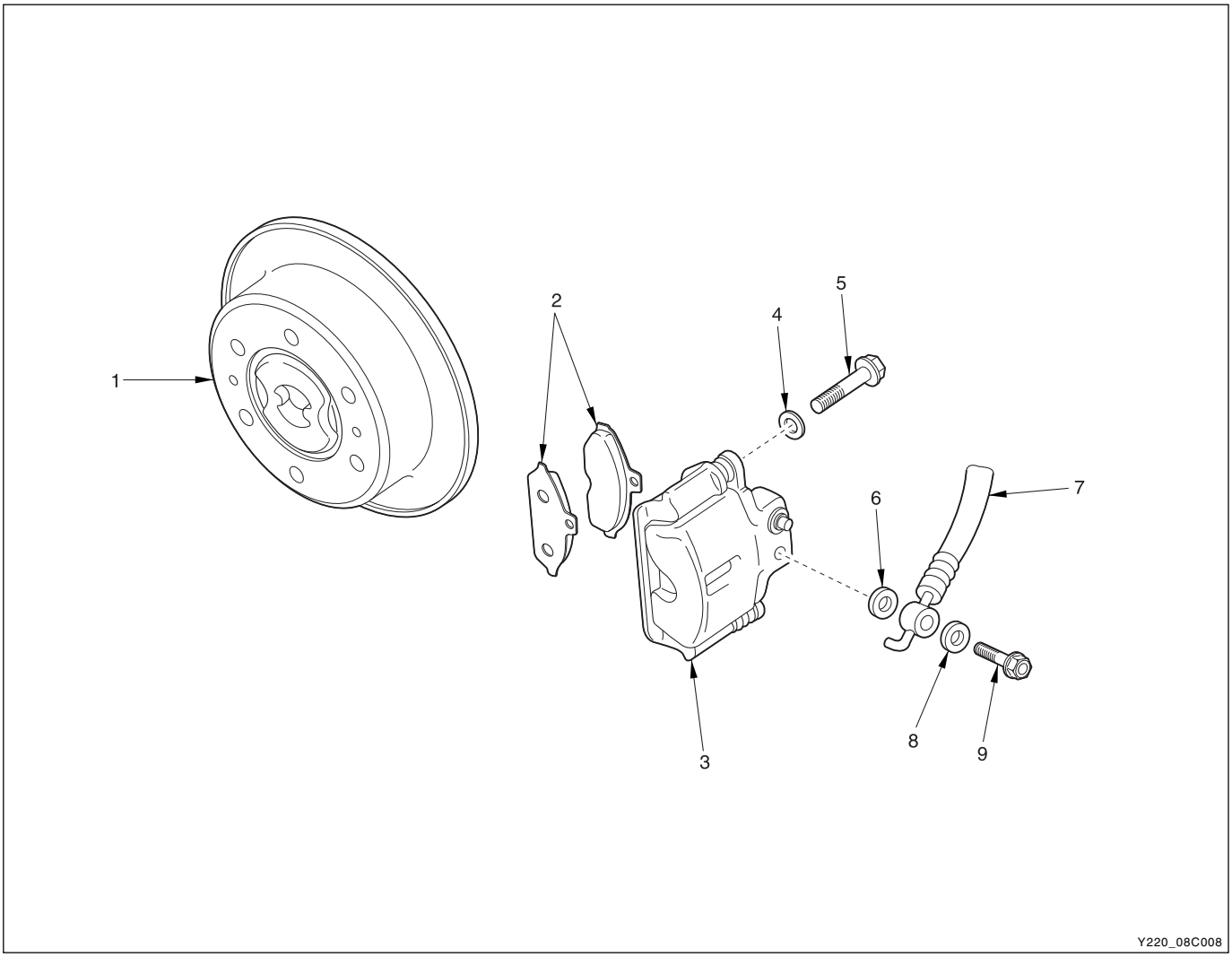
DISC BRAKE



1. Backing plate
2. Parking cable
3. Parking cable lever
4. Caliper assembly
5. Disc
6. Wheel
7. Air bleeder nipple
9. Shaft assembly

REMOVAL AND INSTALLATION

DISC BRAKE



1. Rear brake disc assembly
2. Brake pad
3. Brake caliper
4. Gasket ..... replace
5. Bolt ..... 20 Nm
6. Gasket ..... replace
7. Brake hose
8. Gasket ..... replace
9. Eye hose bolt ..... 8 ~ 18 Nm

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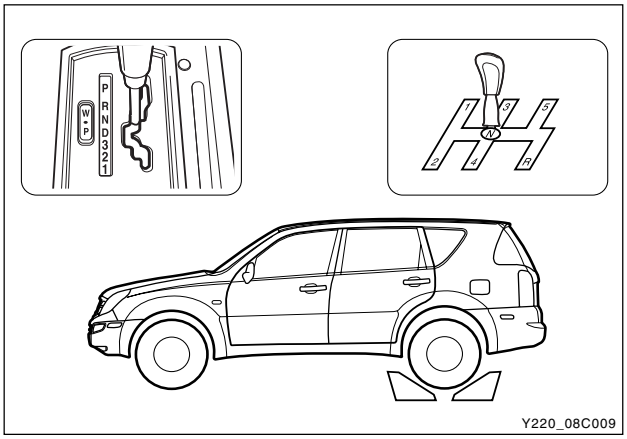


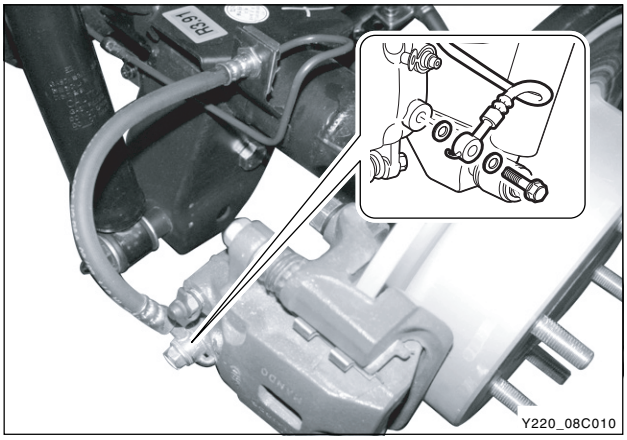
Y220_08C009

Removal

1. Remove the rear tire.

Notice

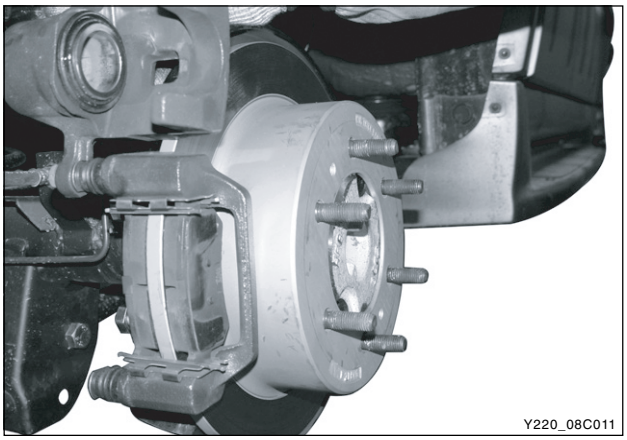
- ***Park the vehicle on the flat and even ground and set the blocks under the front tires.***
- ***Release the parking brake.***
- ***Place the shift lever to "N" (A/T) or "NEUTRAL" (M/T) position.***


Y220_08C010

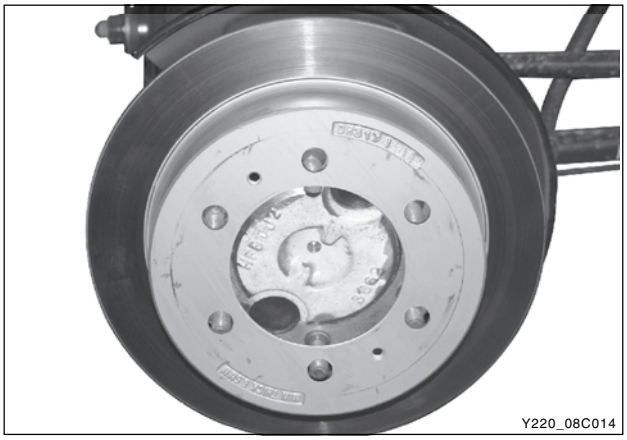
2. Disconnect the brake hose from rear brake caliper.

Notice

Be careful not to splash the oil.


Y220_08C011

3. Unscrew the bolts and remove the caliper cylinder and disc pads.
4. Unscrew the bolts and remove the caliper assembly.

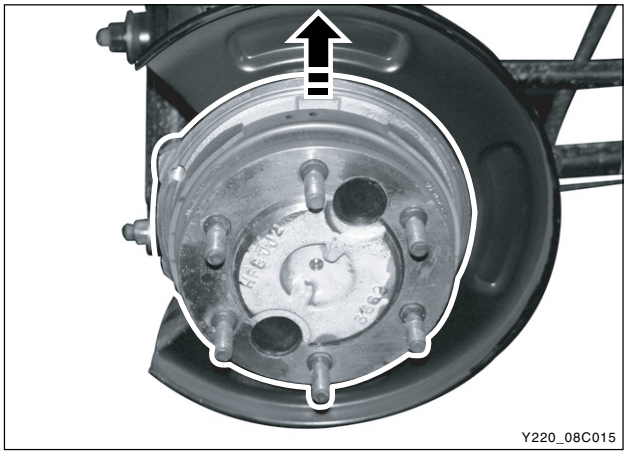

Y220_08C014

5. Remove the brake disc.

Notice

Release the parking brake.

6. Separate the parking brake lining by tapping it with rubber hammer and pull it up to remove.



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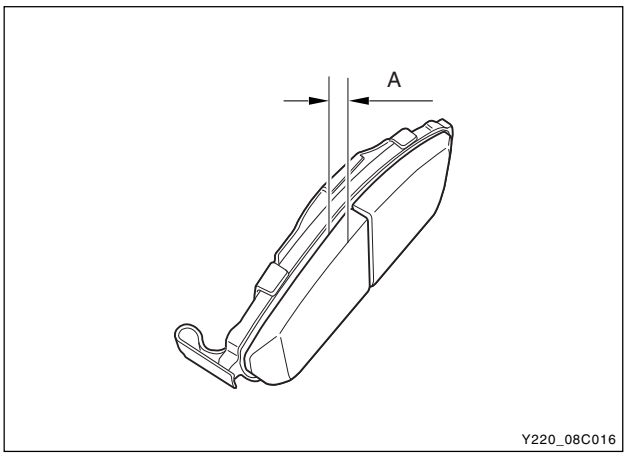
Inspection

1. Clean the dissembled components and visually check the followings:
   - Wear, rust and damage on the cylinder and piston
   - Damage, crack and wear on cylinder body and guide pin
   - Uneven wear and oil contamination on boot
   - Damage and tear on boot

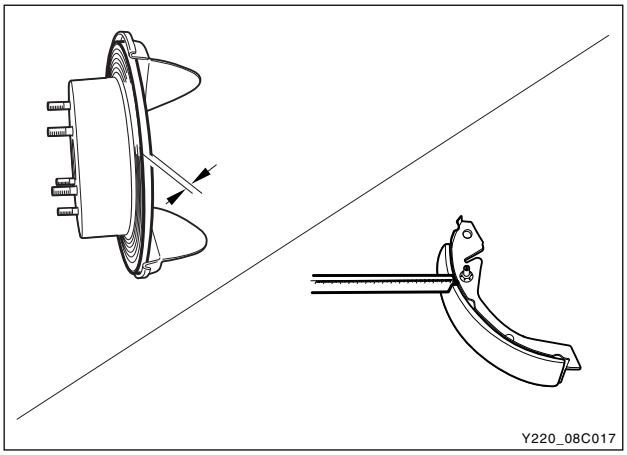


2. Measure the pad thickness.

New pad thickness	Wear limit
10 mm	2 mm

Notice

If any of pads is below the wear limit, replace both pads at a time.



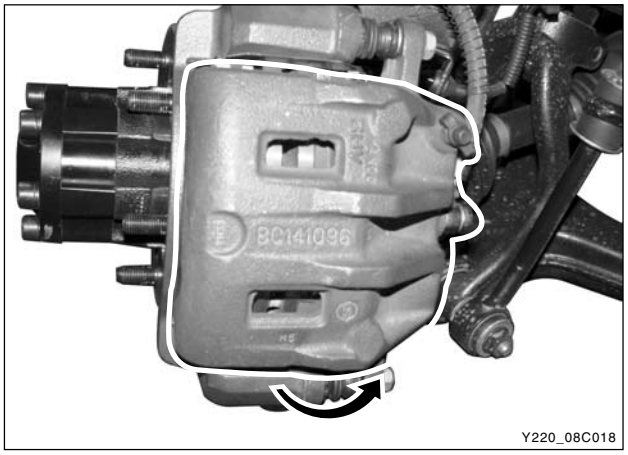
3. Measure the disc thickness.

New pad thickness	Wear limit
10.4 mm	8.5 mm

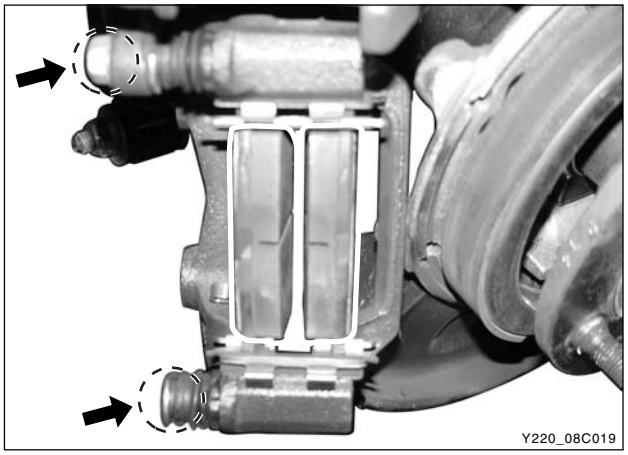
4. Check the disc plate for scratch and bend.

Brake Pad Change

1. Unscrew the bolts at bottom side of brake caliper cylinder.
2. Swing up the caliper cylinder assembly and hold it not to damage the hose.

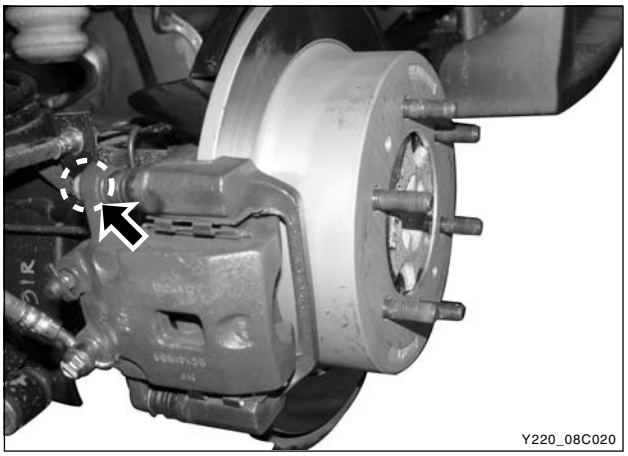


3. Remove the brake pads and replace them with new ones.



4. Install the brake caliper cylinder assembly.

Tightening torque	22 ~ 32 Nm



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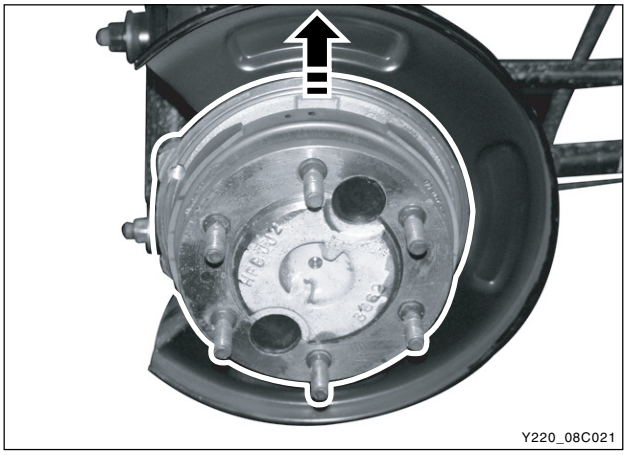
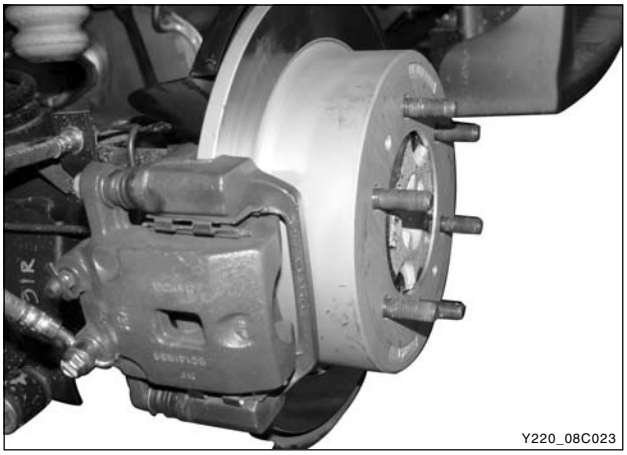
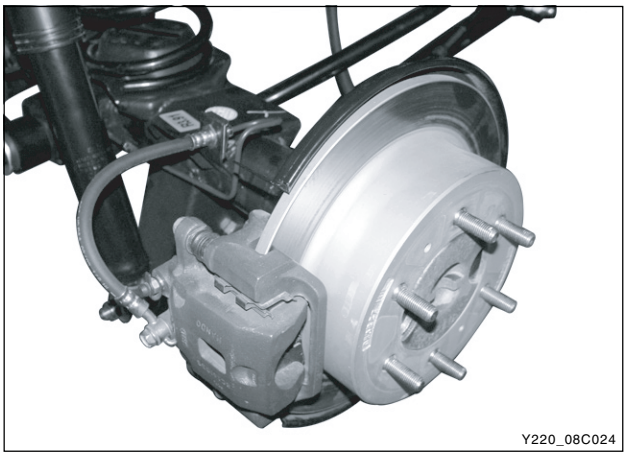






Installation

1. Insert the parking brake lining between backing plate and flange.

Tightening torque	4 ~ 8 Nm

Notice

Apply a proper amount of grease to the parking brake side contacting surface.

2. Install the caliper to brake disc.

Tightening torque	85 ~ 105 Nm

3. Install the brake hose.

Tightening torque	20 ~ 30 Nm

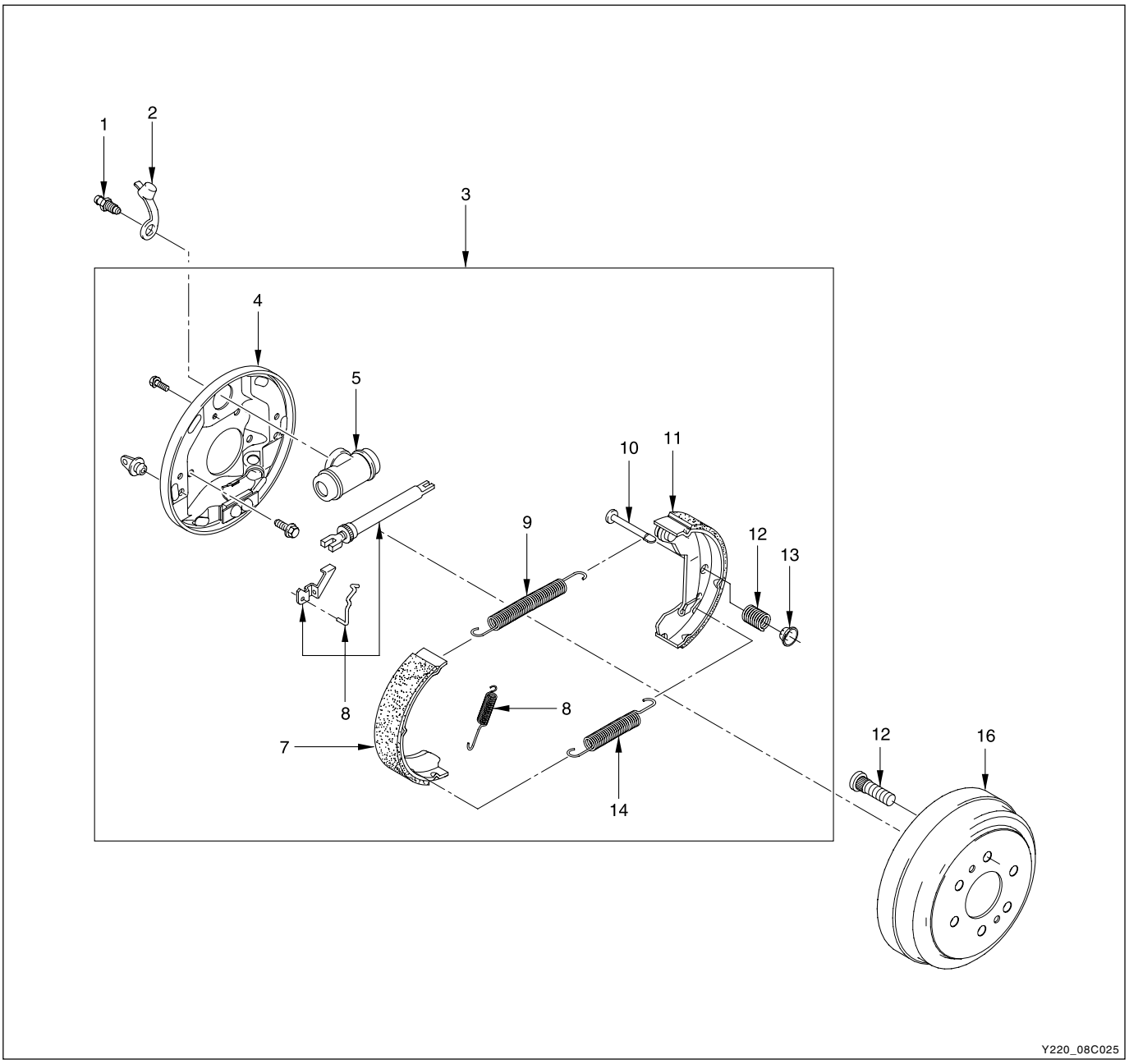
Notice

Replace the copper washer with new one.

4. Bleed the air from the brake system after installation.
5. Tighten the air bleed screw.

Tightening torque	7 ~ 13 Nm

DRUM BRAKE



1. Bleed screw
2. Bleed screw cap
3. Rear brake assembly
4. Rear brake plate
5. Wheel cylinder
6. Strut assembly (automatic clearance adjuster)
7. Brake leading shoe
8. Intermediate return spring
9. Upper return spring
10. Brake shoe locking spring pin
11. Trailing shoe
12. Brake shoe locking spring
13. Brake shoe locking spring cap
14. Lower return spring
15. Hub bolt
16. Rear brake drum

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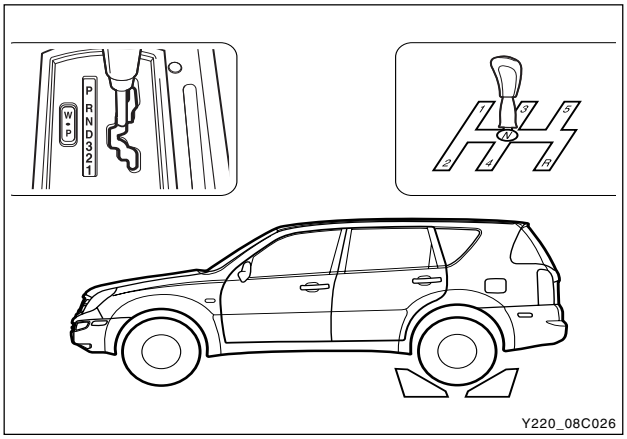


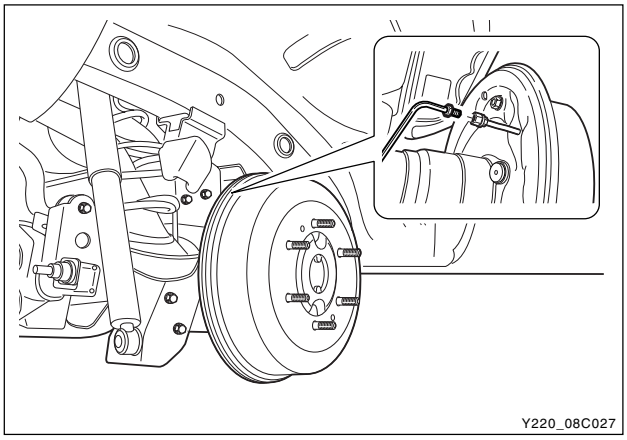
Y220_08C026

Removal

1. Remove the rear tire.

Notice

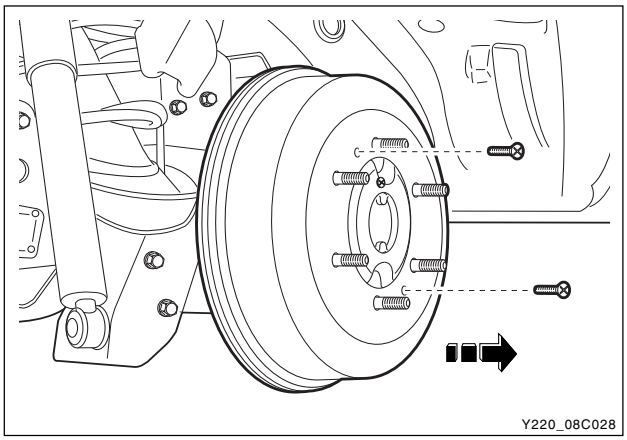
- ***Park the vehicle on the flat and even ground and set the blocks under the front tires.***
- ***Release the parking brake.***
- ***Place the shift lever to "N" (A/T) or "NEUTRAL" (M/T) position.***


Y220_08C027

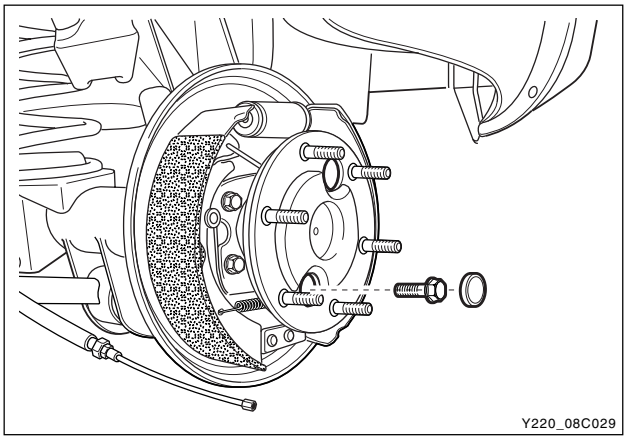
2. Disconnect the rear brake pipe.

Notice

Collect the drained oil in a proper container.

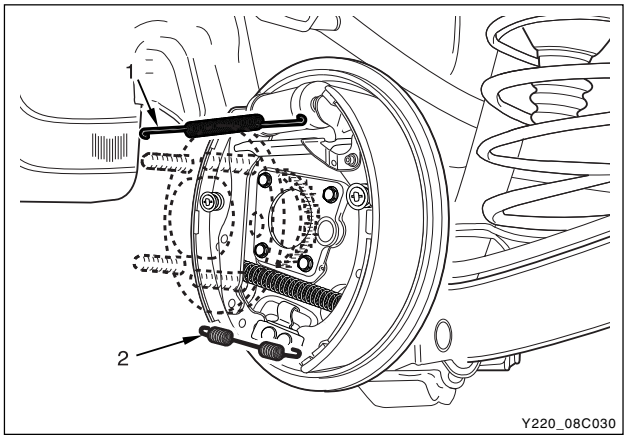

Y220_08C028

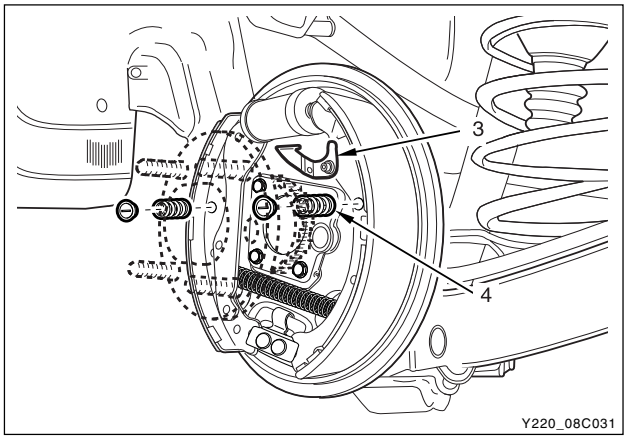
3. Insert two bolts (M8) into service holes and tighten them to replace the brake drum.


Y220_08C029

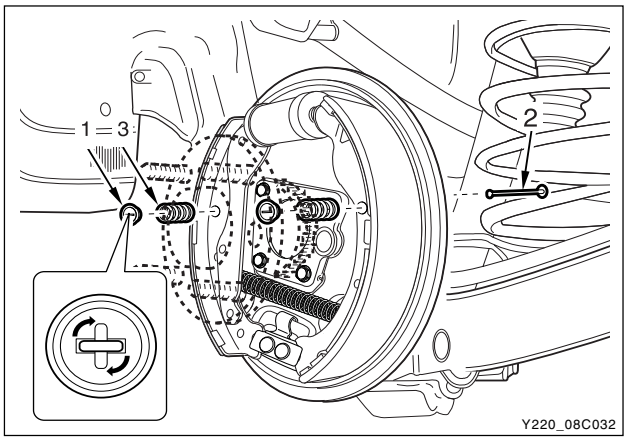
4. Remove the service hole plug from axle shaft.

5. Remove the return spring.
   1) Remove the upper return spring.
   2) Remove the lower return spring.
   3) Remove the lever spring.
   4) Remove the adjuster operating lever from the adjuster.

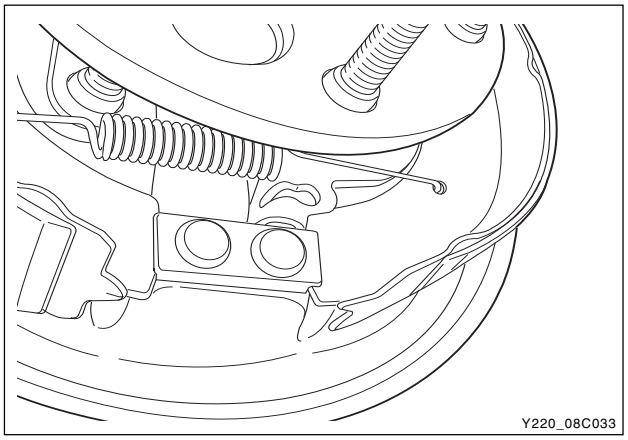




6. Remove the pin and spring by turning the lining shoe hold down washer through plug hole in the axle shaft flange.



7. Disconnect the parking cable from the parking brake lever.



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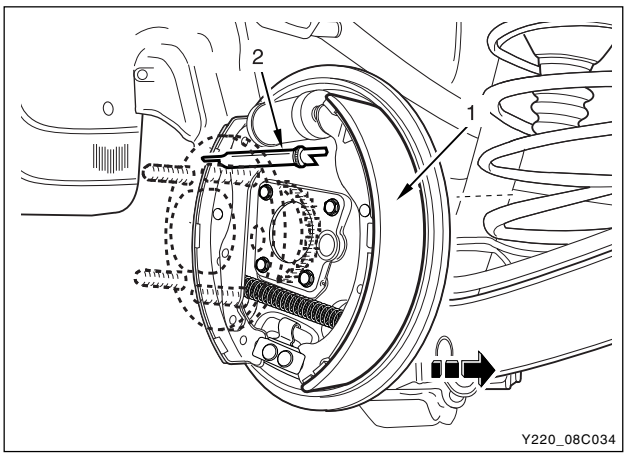
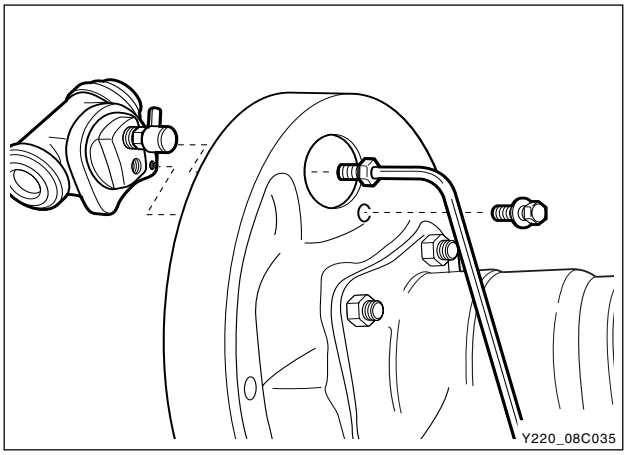


8. Separate the adjust lever from the brake lining.



9. Unscrew the bolts and remove the wheel cylinder.

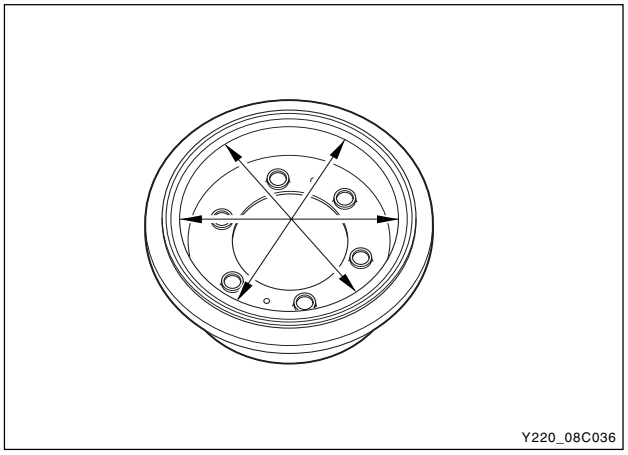
Inspection

1. Measure the inner diameter of brake drum and replace if needed.

New drum	Wear limit
ϕ 254 mm	ϕ 255.5 mm

Notice

Measure the inner diameter at over two points.

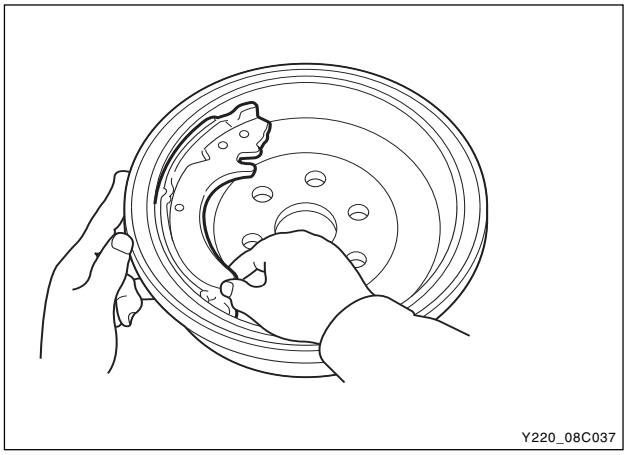

Y220_08C036

2. Check the contacting surface of lining and brake drum.

   Mark the brake drum inside using chalk and scrub the shoe and lining assembly. If the contact condition is significantly poor, replace the shoe and lining assembly or the brake drum.

Notice

Clean the marked area after inspection.


Y220_08C037

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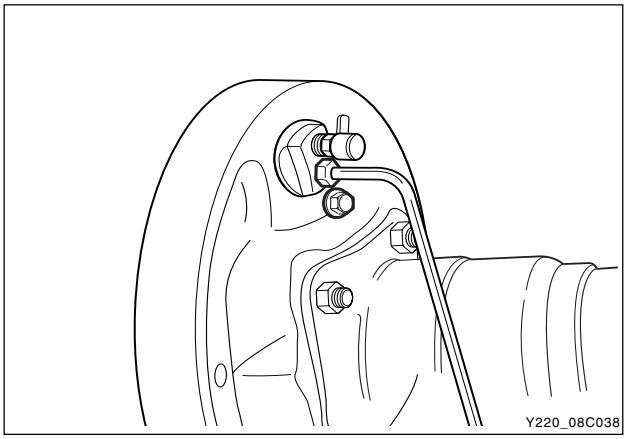
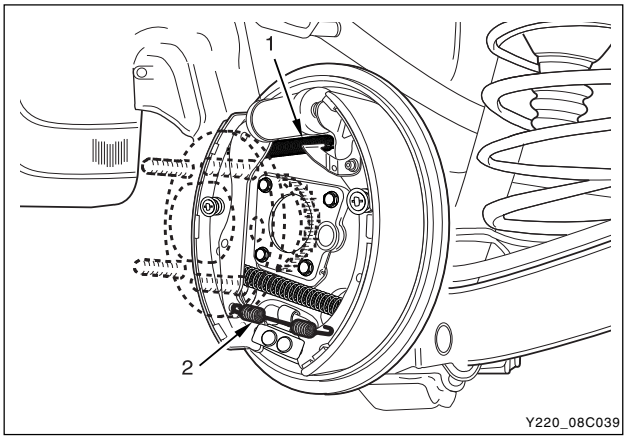


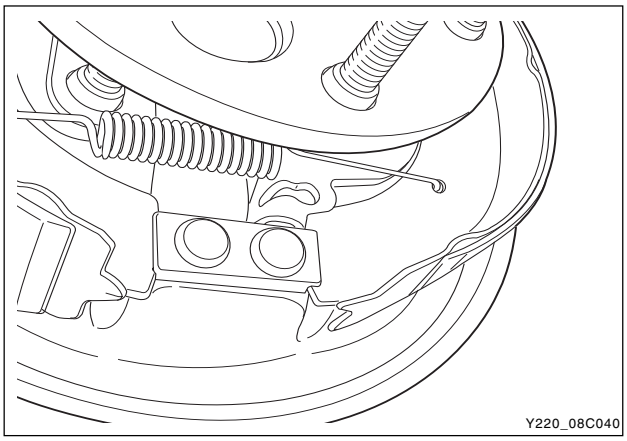
Installation

1. Install the wheel cylinder to the backing plate.

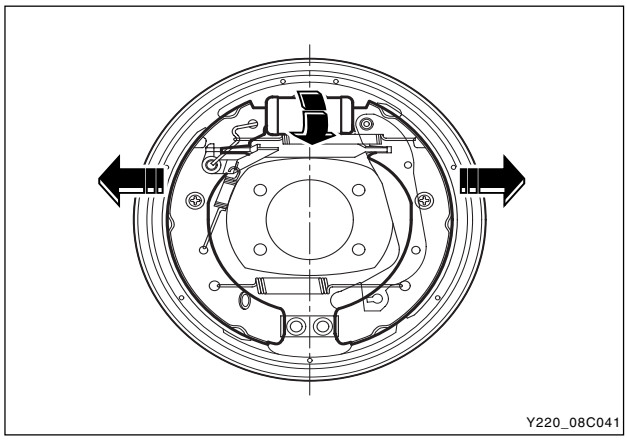
Tightening torque	8 ~ 12 Nm



2. Install the both brake linings between wheel cylinder and lower anchor plate. Install the adjuster and return springs.



3. Engage the parking brake cable.

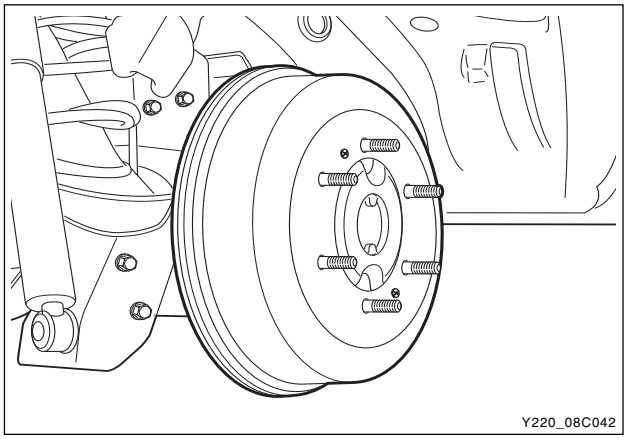


4. Adjust the outer diameter of linings to ϕ253.08 ~ ϕ253.50 mm with adjusting screw.

5. Put the plate on the axle shaft and install the brake drum.
6. Check if the brake drum turns freely while rotating it by hand.

Notice

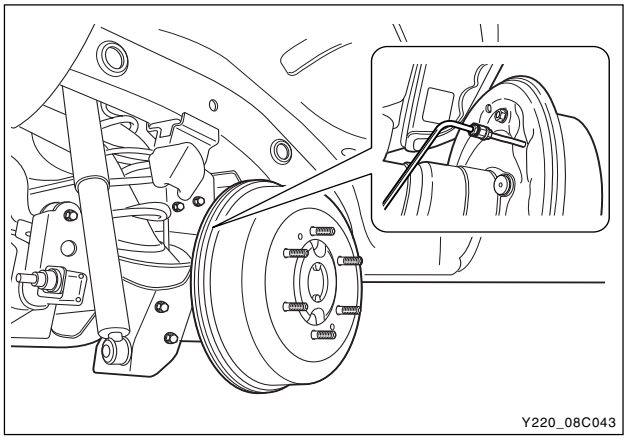
Adjust the outer diameter of linings with adjusting screw if needed.



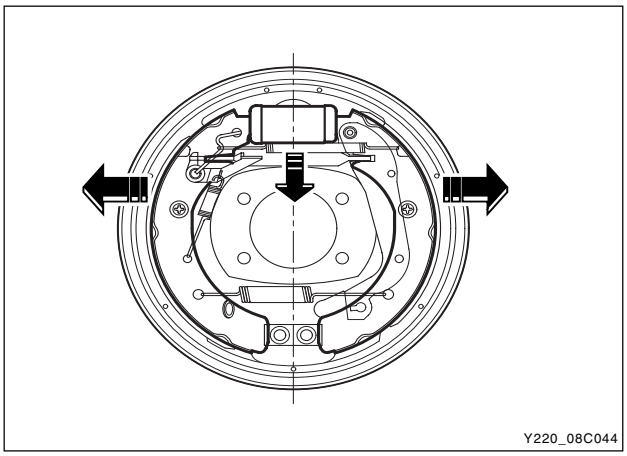
7. Engage the brake pipe to wheel cylinder.

Tightening torque	15 ~ 19 Nm

8. Bleed the air from the brake system and check if the parking brake operates properly. Install the tires.

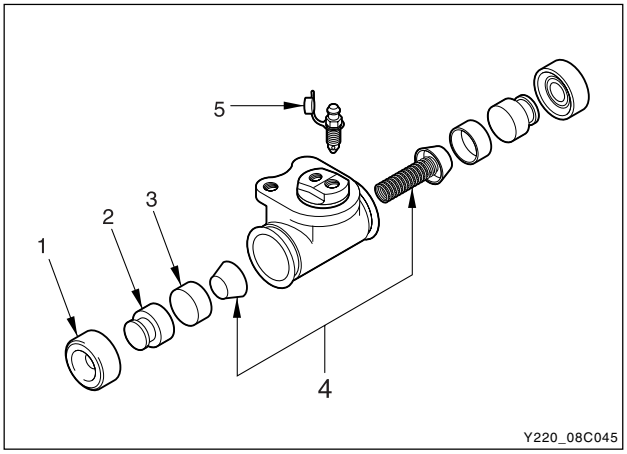


DISASSEMBLY AND REASSEMBLY


Y220_08C044

WHEEL CYLINDER

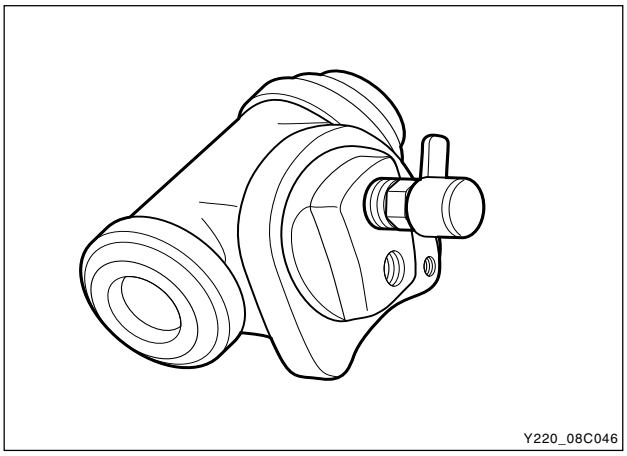
1. Remove the upper return spring and wheel cylinder.



Y220_08C045

2. Disassemble the wheel cylinder.
   - Remove and dispose the dust boot.
   - Remove the piston.
   - Remove and dispose the piston cup.
   - Remove the spring assembly.
   - Unscrew the bleed screw.

3. Clean all the components with isopropyl alcohol and dry them with compressed air.


Y220_08C046

4. Reassemble in the reverse order of disassembly.
5. Install the bleed screw and wheel cylinder.

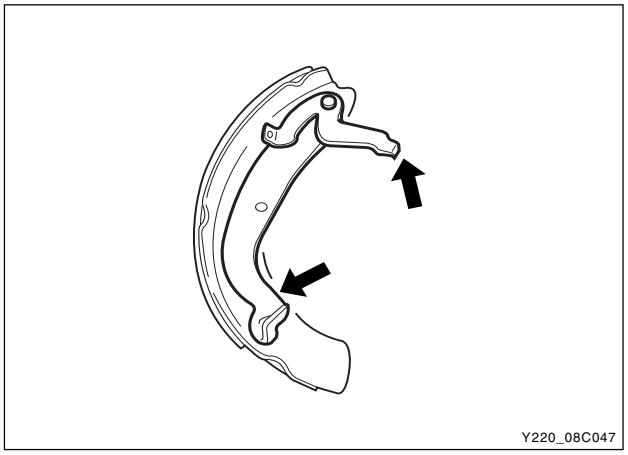
Bleed screw	7 ~ 10 Nm
Wheel cylinder bolt	8 ~ 12 Nm

Notice

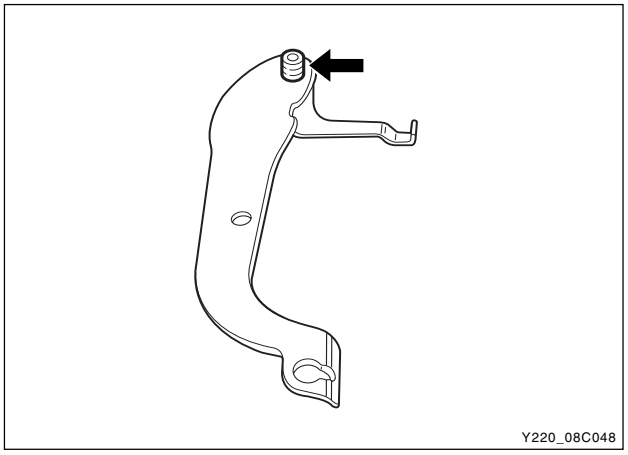
Apply a small amount of brake fluid to piston, piston cup and inside of wheel cylinder.

PARKING BRAKE LEVER

1. Separate the parking brake operating lever and adjuster operating lever from disassembled lining.



2. Remove the lever pin (arrow) and separate the parking brake operating lever and adjuster operating lever.
3. Reassemble in the reverse order of disassembly.



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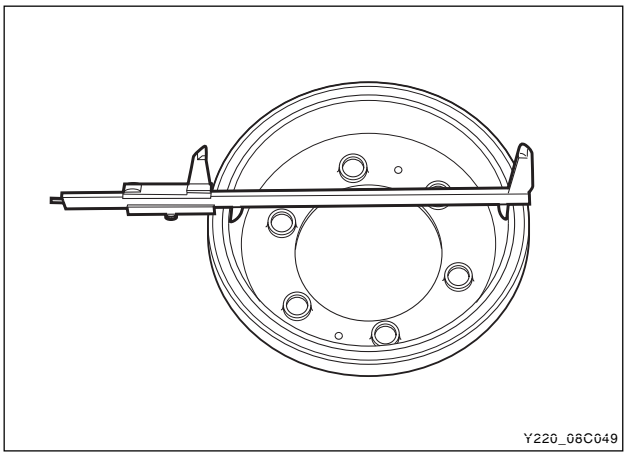
INSPECTION



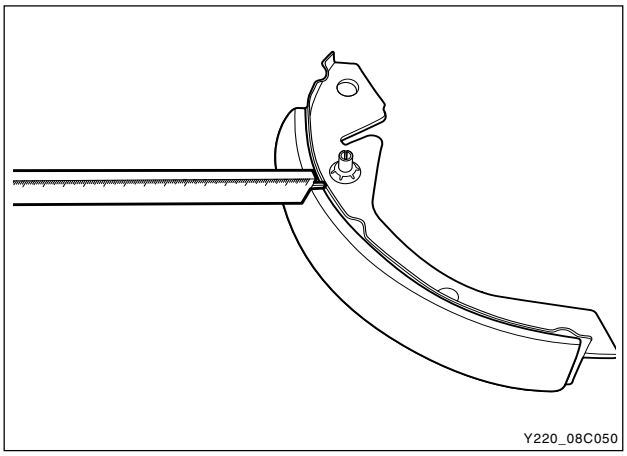
DRUM BRAKE TYPE

▶ Brake Drum

1. Check the drum for crack, damage and deformation.
2. Measure the inner diameter of brake drum.

New drum	Wear limit
ϕ 254 mm	ϕ 255.5 mm

- Measure the inner diameter at over two positions.



▶ Brake Lining

1. Check the linings for surface hardened, abnormal wear and oil contamination.
2. Measure the lining thickness.

Wear limit	1 mm

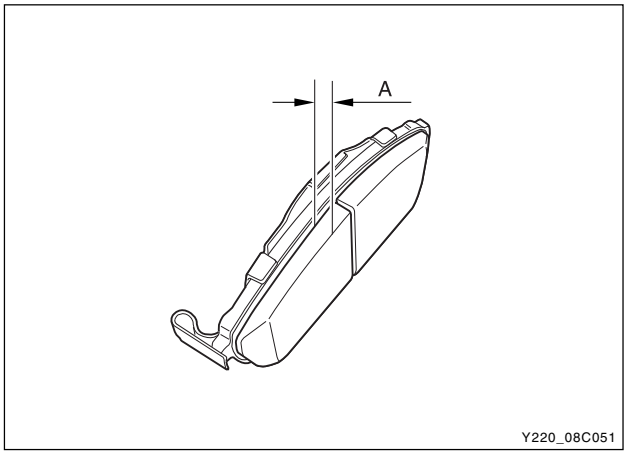
- If the thickness is below wear limit, replace it with new one.

DISC BRAKE TYPE

▶ Pad Thickness

1. Remove the front tires.
2. Measure the pad thickness. If the thickness is below wear limit, replace it with new one.

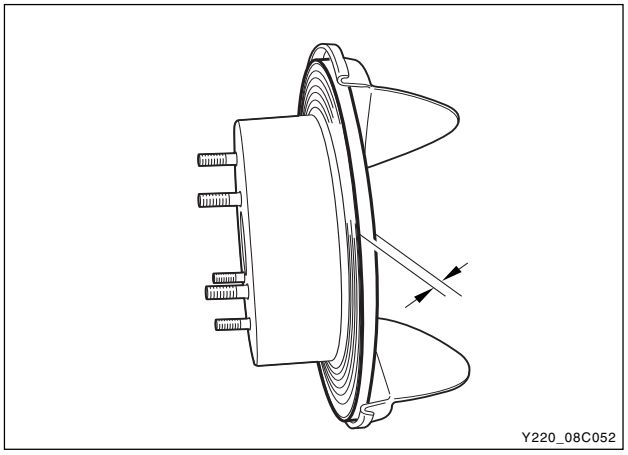
Wear limit	2 mm



▶ Brake Disc Thickness

1. Measure the disc thickness at over four points.
2. If any of measured points is below the wear limit, replace the brake disc with new one.

Wear limit	8.5 mm

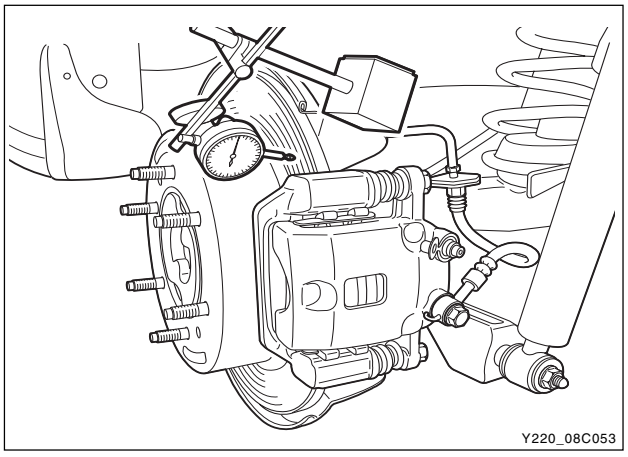


▶ Brake Disc Run-out

1. Install the dial gauge on the side of brake disc and measure the run-out while rotating the brake disc.

Limit	0.03 mm (disk itself)
	0.07 mm (when installed)

2. If the measured value exceeds the limit, replace the brake disc with new one. Otherwise, it may cause the pedal vibration and shimmy when braking.



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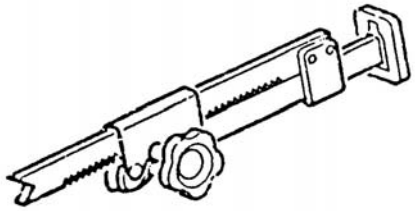
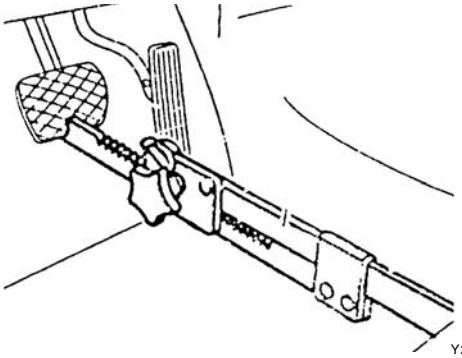
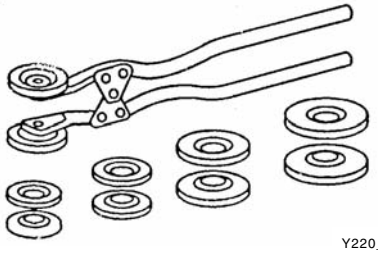
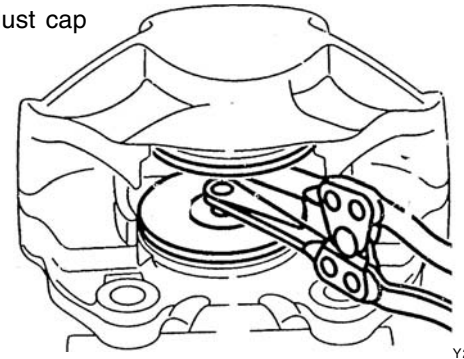
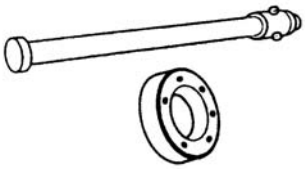
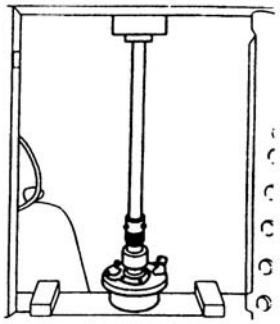
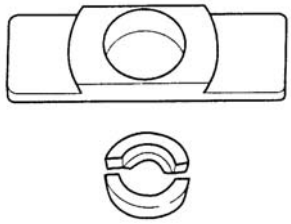
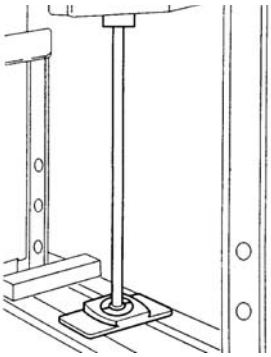
TROUBLE DIAGNOSIS

Symptom	Cause	Action
Poor braking	Lining wear, hardening	Replace
	Oil or water contamination on the lining	Replace or repair
	Inoperative wheel cylinder	Replace
	Inoperative clearance automatic control system	Repair
Uneven braking	Lining wear, hardening	Adjust
	Oil or water contamination on the lining	Replace or repair
	Inoperative wheel cylinder	Replace
	Inoperative clearance automatic control system	Repair
Dragging brake	Damage of the brake shoe return spring	Replace
	Inoperative wheel cylinder returning	Replace
Excessive pedal travel	Lining wear	Replace
	Inoperative clearance automatic control system	Repair
Noise and vibration when brake applied	Lining wear, hardening	Replace
	Foreign material inside drum	Clean
	Loosen the brake plate bolt	Tighten
	Drum deformation or surface damage	Replace
Inoperative parking brake	Lining wear, hardening	Replace
	Oil contamination on the lining	Replace
	Inoperative clearance automatic control system	Repair

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
000 589 18 31 00 (A 99 48 002 2A) **Brake pedal fixture**  Y220_08C054	Holding the brake pedal  Y220_08C055
000 589 49 37 00 (P 99 48 001 0A) **Pliers**  Y220_08C056	Seating the brake caliper dust cap  Y220_08C057
661 589 15 33 00 (W 99 48 001 0A) **Rear ABS tooth wheel installer**  Y220_08C058	Installation of rear ABS brake tooth wheel  Y220_08C059
661 589 18 33 00 (W 99 48 004 0A) **Rear ABS tooth wheel puller**  Y220_08C060	Removal of rear ABS brake tooth wheel (using with 661 589 18 33 01)  Y220_08C061

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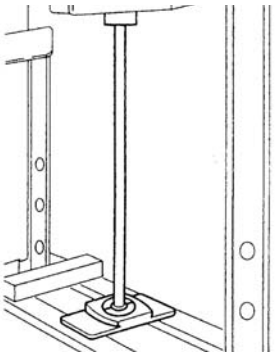
Name and Part Number	Application
661 589 18 33 01 (W 99 48 005 0A) **Rear ABS tooth wheel puller**  Y220_08C062	Removal of rear ABS brake tooth wheel (using with 661 589 18 33 00)  Y220_08C063

SECTION 8D

PARKING BRAKE

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GENERAL INFORMATION

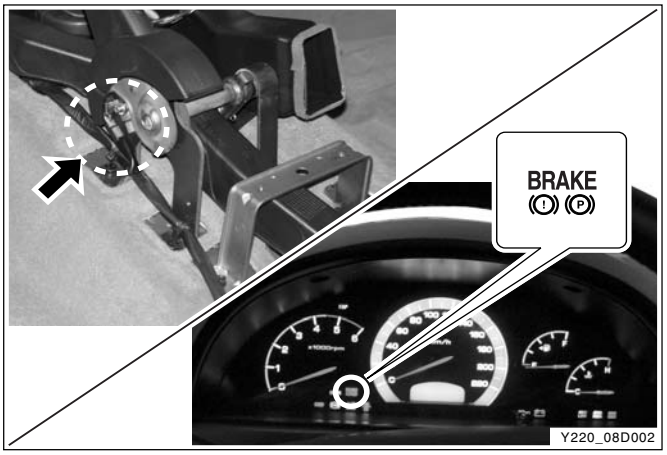
DESCRIPTION AND OPERATION

▶ Parking Brake

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.

▶ Parking Brake Switch and Indicator

When pulling up the parking brake lever with the ignition ON, the parking brake indicator comes on.



SPECIFICATIONS

Description		Specification
Parking brake	Type	Mechanically expanded rear brake lining
	Operation type	Manual type

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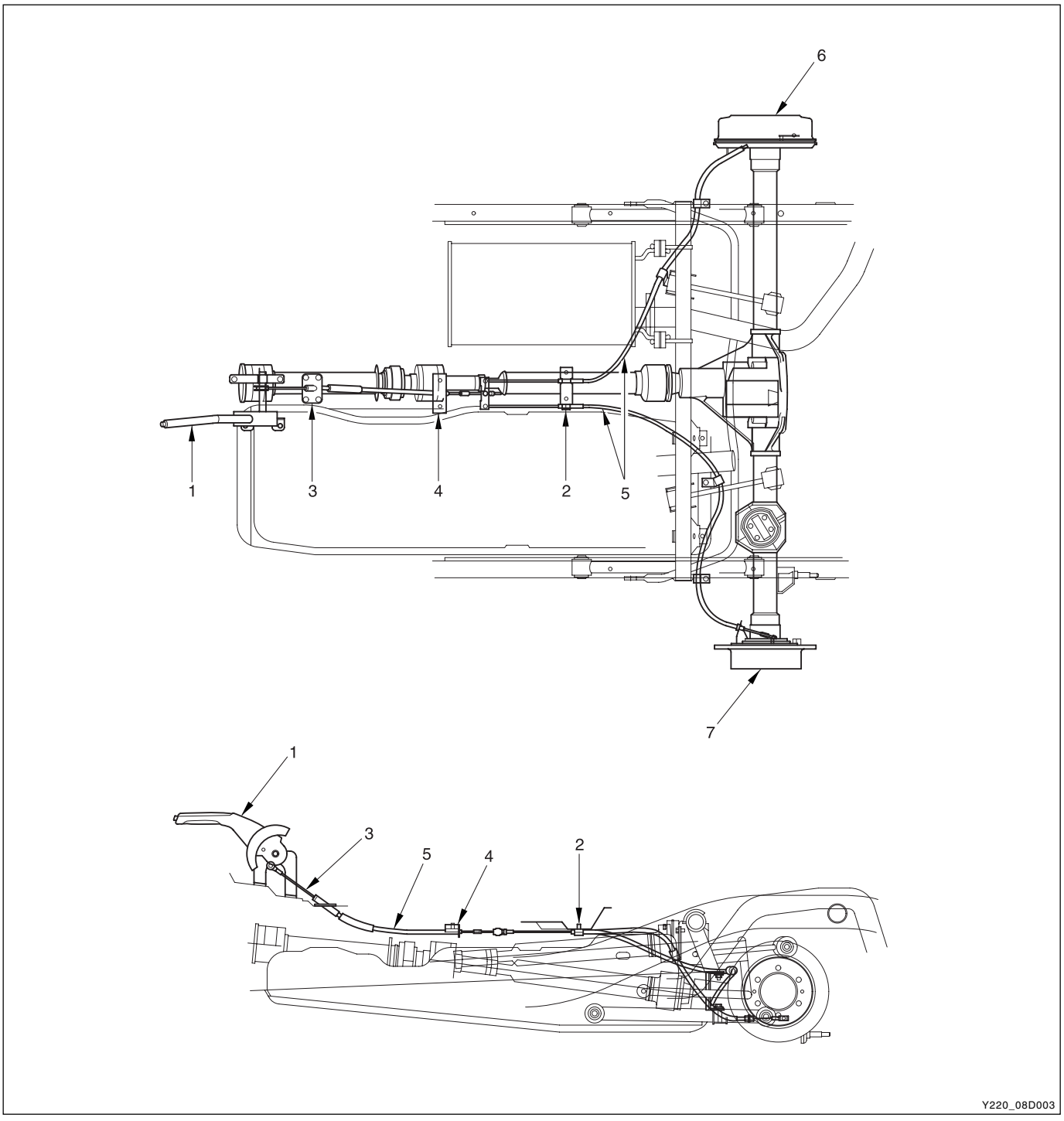
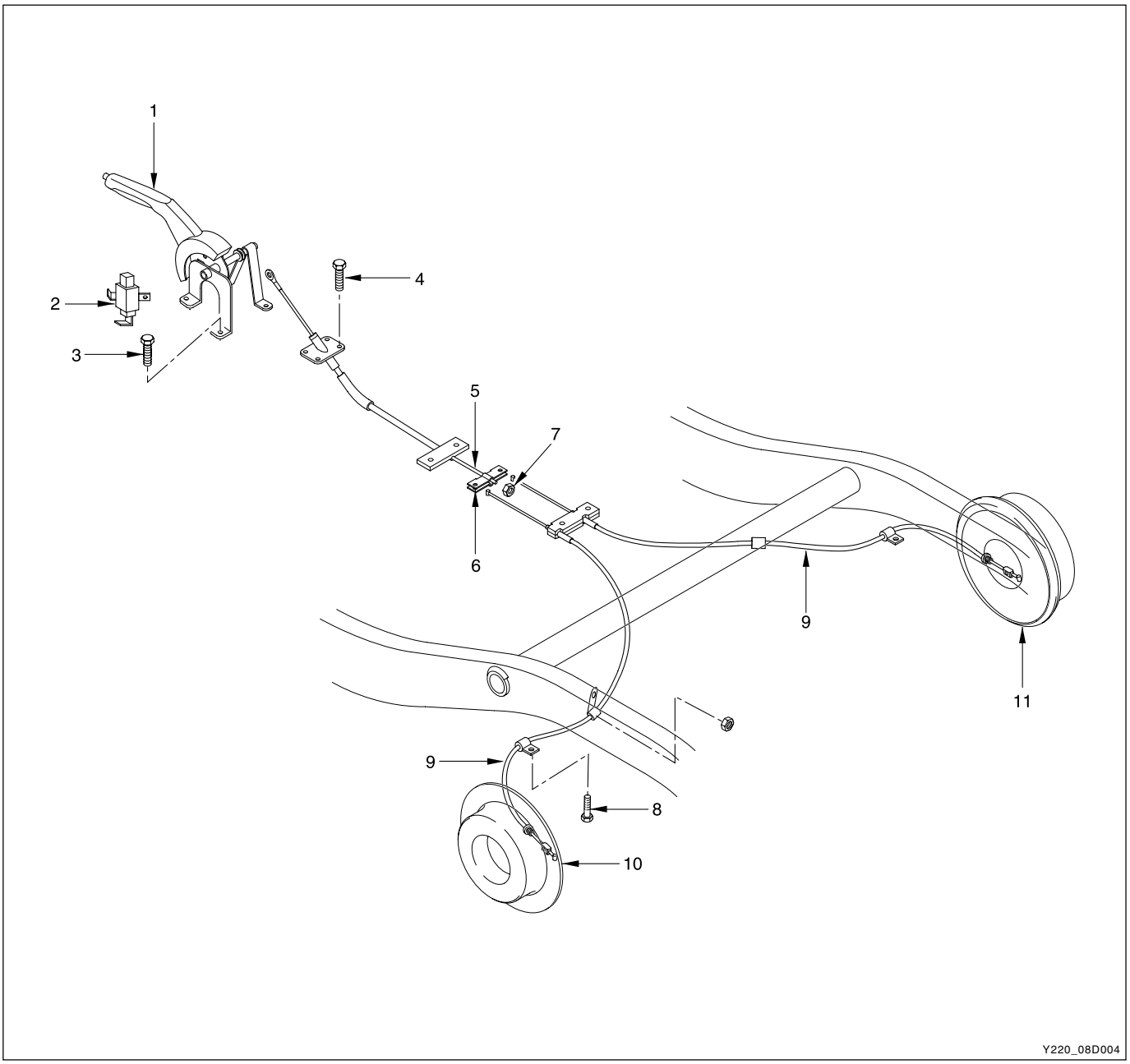
COMPONENTS LOCATOR



1. Parking brake lever
2. Parking brake cable bracket (rear)
3. Parking brake cable bracket (front)
4. Parking brake cable bracket (center)
5. Cable
6. When equipped with drum brake
7. When equipped with disc brake

REMOVAL AND INSTALLATION



1. Parking brake lever
2. Parking brake indicator switch
3. Bolt
4. Bolt
5. Front parking brake cable
6. Equalizer
7. Nut
8. Bolt
9. Rear parking brake cable
10. Brake disc (when equipped with rear disc brake)
11. Brake drum (when equipped with rear drum brake)

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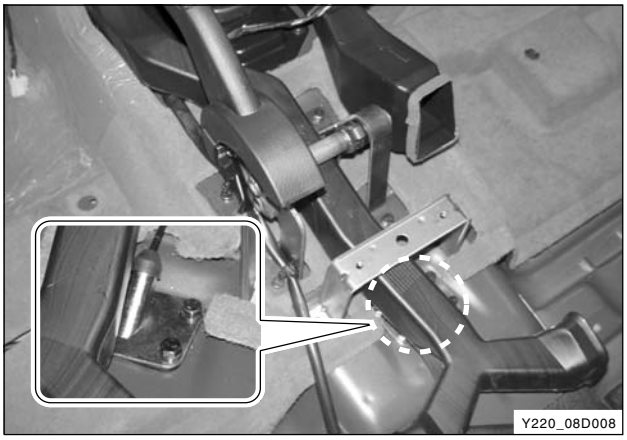
PARKING BRAKE

Removal

1. Remove the console assembly.

2. Disconnect the parking brake indicator switch.

3. Disconnect the parking brake cable from parking brake lever with the parking braked released.



4. Unscrew the bolts and remove the parking brake lever.
5. Remove the cable plate from under floor.
6. Separate the parking brake cable.

Disc type

- Disconnect the parking brake cable from brake lever.
- Remove the clip from brake plate.

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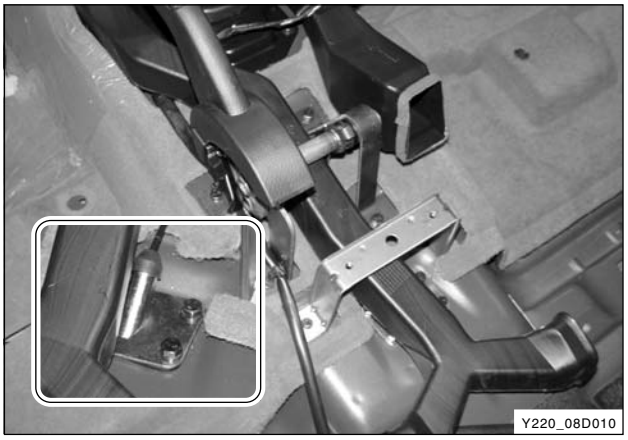
Installation

1. Engage the parking brake cable to parking brake lever.
2. Install the bracket with parking brake cable to body.

Tightening torque	8 ~ 18 Nm

3. Install the parking brake lever assembly.

Tightening torque	8 ~ 18 Nm



4. Put the parking brake cable into lever groove and install the cable plate.

Tightening torque	8 ~ 18 Nm

5. Install the parking brake switch and check the indicator operation and operating force.

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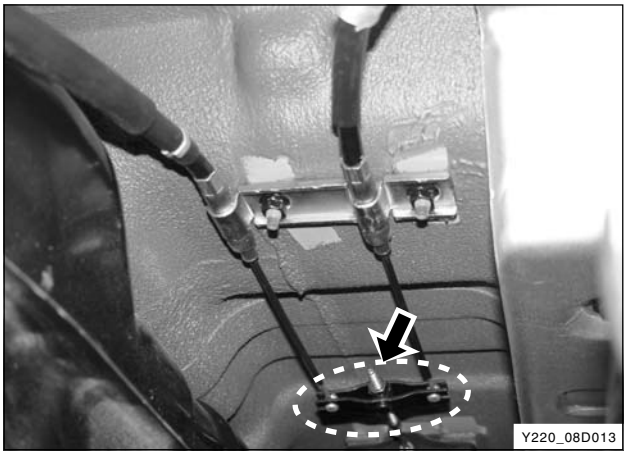


6. If it needs excessive force (notch), adjust the tension at the equalizer where both cables are combined.
7. Install the console assembly and perform the brake test.

INSPECTION

CHECKING THE BRAKING FORCE

Inspect the parking brake as following;

1. Count the number of the clicks (notches) when pulling up the parking brake with 19 kg of force.

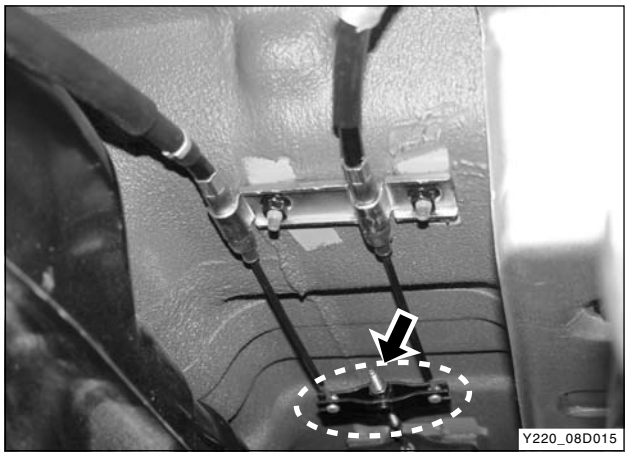
Specified Notch	5

2. If the clicks are over or below the specified value, adjust the clicks to the specified value with the parking brake adjusting nut.
3. Check the parking brake force after adjustment.

4. If the specified parking brake force cannot be achieved, check the parking brake lever and cable. Replace the components if needed.

Notice

Never park the vehicle only with the parking brake on the stiff hill. It may cause roll down of the vehicle due to release of the parking brake. Must put the wheel blocks under the wheels



TROUBLE DIAGNOSIS

Symptom	Cause	Action
Poor Braking	Lining wear, hardening	Replace
	Oil or water contamination on the lining	Replace or repair
	Brake cable sticked or damage	Replace
	Excessive pedal travel	Notch adjustment
	Inoperative clearance automatic control system	Repair

SECTION 8E1

ABS

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GENERAL

SUMMARY

The aim of the ABS is to mmaintain steerability and driving stability and to take the burden off the driver. If the stopping distance is shorter on some road surfaces (carriageway conditions), this is a gift of physics and not a development aim. ABS is a device which senses that one or more of the wheels are locking up during braking. It monitors the rotational speeds of the wheels and reduces hydraulic pressure to any wheel it senses locking up. It is controlled by both mechanical and electronic components. When you apply the brakes, the ABS will regulate the flow of brake fluid being delivered to the brake calipers. By the use of electronic computers, the brakes rapidly alternate (at a rate of 30 times per second) from full pressure to full release.

DRIVING PHYSICS

To give you a better understanding of the tasks and functions of ABS, we will first look at the physics principles.

▶ The 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.

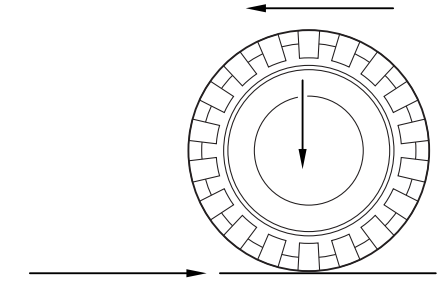
▶ Brake Force On A Wheel

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

FB_{max} = Wheel load F_R x Adhesion coefficient$_{mh}$

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.



Brake force on a wheel

Y220_8E1001

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EBD (ELECTRONIC BRAKE FORCE DISTRIBUTION) SYSTEM

▶ System Description

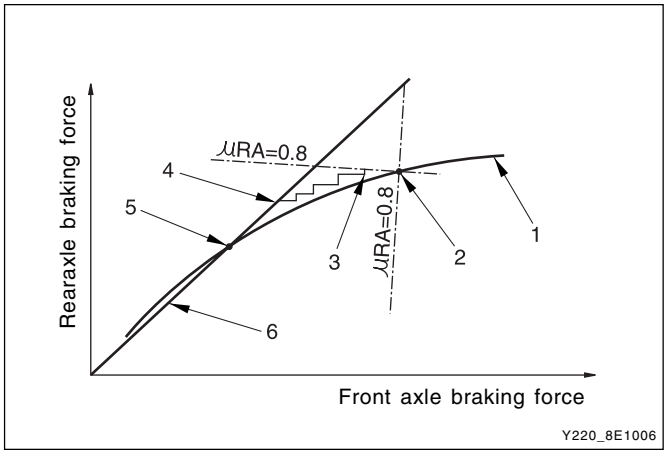
As an add-on logic to the ABS base algorithm, EBD works in a range in which the intervention thresholds for ABS control can not be reached.

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 loaden vehicle the efficiency of the EBD system is higher due to the better use of rear axle braking capability.

▶ The Benefits of EBD

- 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).
- “Keep alive” function.



Service precautions

Observe the following general precautions during any ABS/TCS service. Failure to adhere to these precautions may result in ABS/TCS system damage.

1. Disconnect the EBCM harness connector before performing the electric welding procedures.
2. Carefully note the routing of the ABS/TCS wiring and wiring components during removal. The ABS/TCS components are extremely sensitive to EMI (eletromagnetic interference). Proper mounting is critical during component service.
3. Disconnect the EBCM connector with the ignition OFF.
4. Do not hang the suspension components from the wheel speed sensor cables. The cables may be damaged.
5. Do not use petroleum based fluids in the master cylinder. Do not use any containers previously used for petroleum based fluids. Petroleum causes swelling and distortion of the rubber components in the hydraulic brake system, resulting in water entering the system and lowering the fluid boiling point.

REPAIR INSTRUCTIONS

ON-VEHICLE SERVICE

▶ Service Precautions

Notice

Brake Fluid may irritate eyes and skin. In case of contact, take the following actions:

- ***Eye contact - rinse thoroughly with water.***
- ***Skin contact - wash with soap and water.***
- ***Ingestion - consult a physician immediately.***

Notice

To help avoid personal injury due to poor braking. DO NOT Tap into the vehicle's brake system to operate a trailer brake system.

Note

When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread-locking compound will be called out. The correct torque values must be used when installing fasteners that require them. If the above procedures are not followed, parts or system damage could result.

Note

Use only DOT-3 equivalent hydraulic brake fluid. The use of DOT-5 (silicone) brake fluid is not recommended. Reduced brake performance or durability may result.

Note

Avoid spilling brake fluid on any the vehicle's painted surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen the damage.

Electronic system service precautions

Take care to avoid electronic brake control module (HECU) circuit overloading. In testing for opens or shorts, do not ground or apply voltage to any circuit unless instructed to do so by the diagnostic procedure.

Test circuits only with a high-impedance multi-meter. Never remove or apply power to any control module with the ignition switch in the ON position. Always turn the ignition to the OFF position before removing or connecting battery cables, fuses or connectors.

General service precautions

Disconnect the HECU connector before performing any vehicle welding work using an electric arc welder.

Do not attempt to disassemble any component designated as nonserviceable. The hydraulic modulator and the HECU can be seperated. (There is however no access to repair the each components.)

Bleeding system

Replacement modulators are shipped already filled and bled. In normal procedures requiring removal of the modulator, such as to replace the HECU, air will not enter the modulator, and normal bleeding will be all that is needed.

If air enters the hydraulic modulator, or if an unfilled modulator is installed, use the brake bleeding program in the scan tool to bleed the modulator. Manual bleeding of the hydraulic modulator is not possible.

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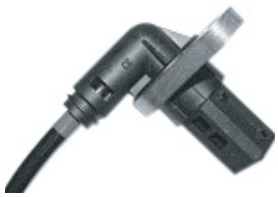
▶ System Layout

Newly introduced ABS has a different shape of integrated hydraulic modulator and HECU (Hydraulic and Electronic Control Unit) compared to existing ABS. And, the wheel speed sensor uses different method to detect wheel speed. The basic function of the ABS that maintains the vehicle stability by controlling the steerability of the vehicle when braking has not been changed.

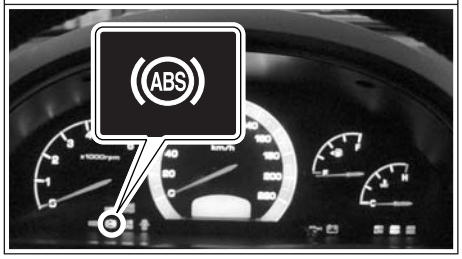
1. Wheel speed sensor



2. ABS HECU

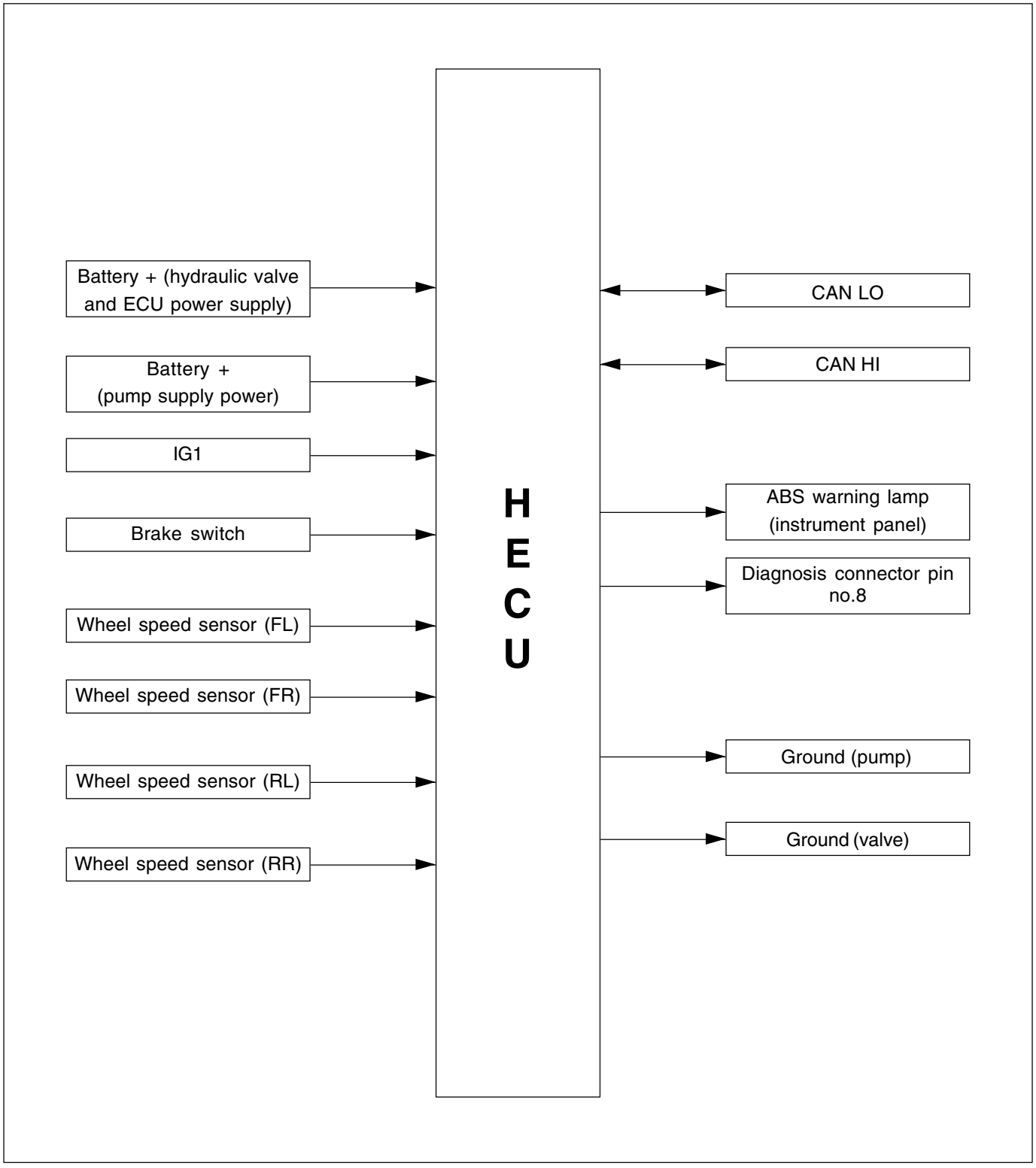
3. Brake master cylinder

4. ABS warning lamp



Y220_8E1010

INPUT AND OUTPUT DIAGRAM OF ABS UNIT



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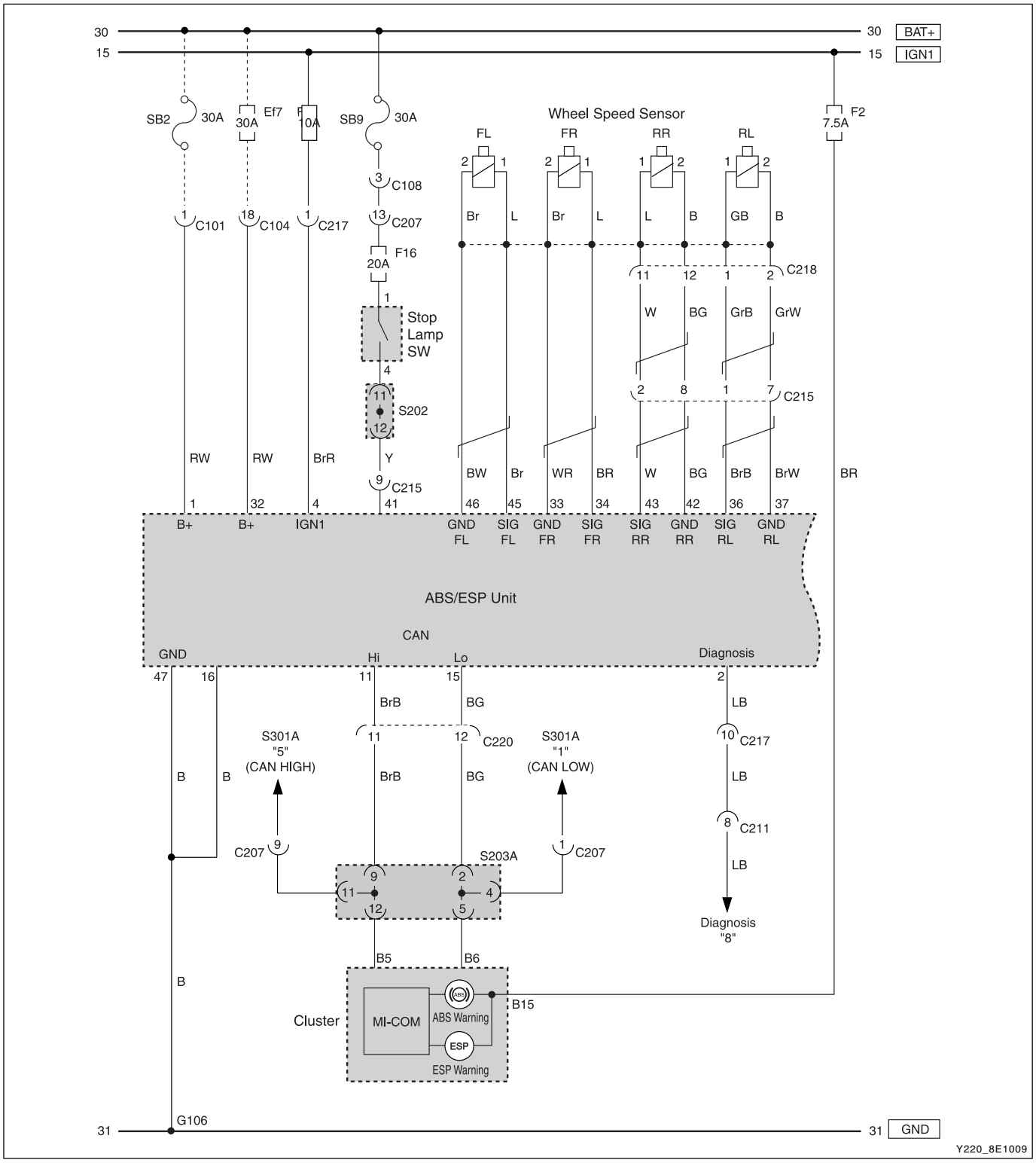
ELECTRIC CIRCUIT DIAGRAM

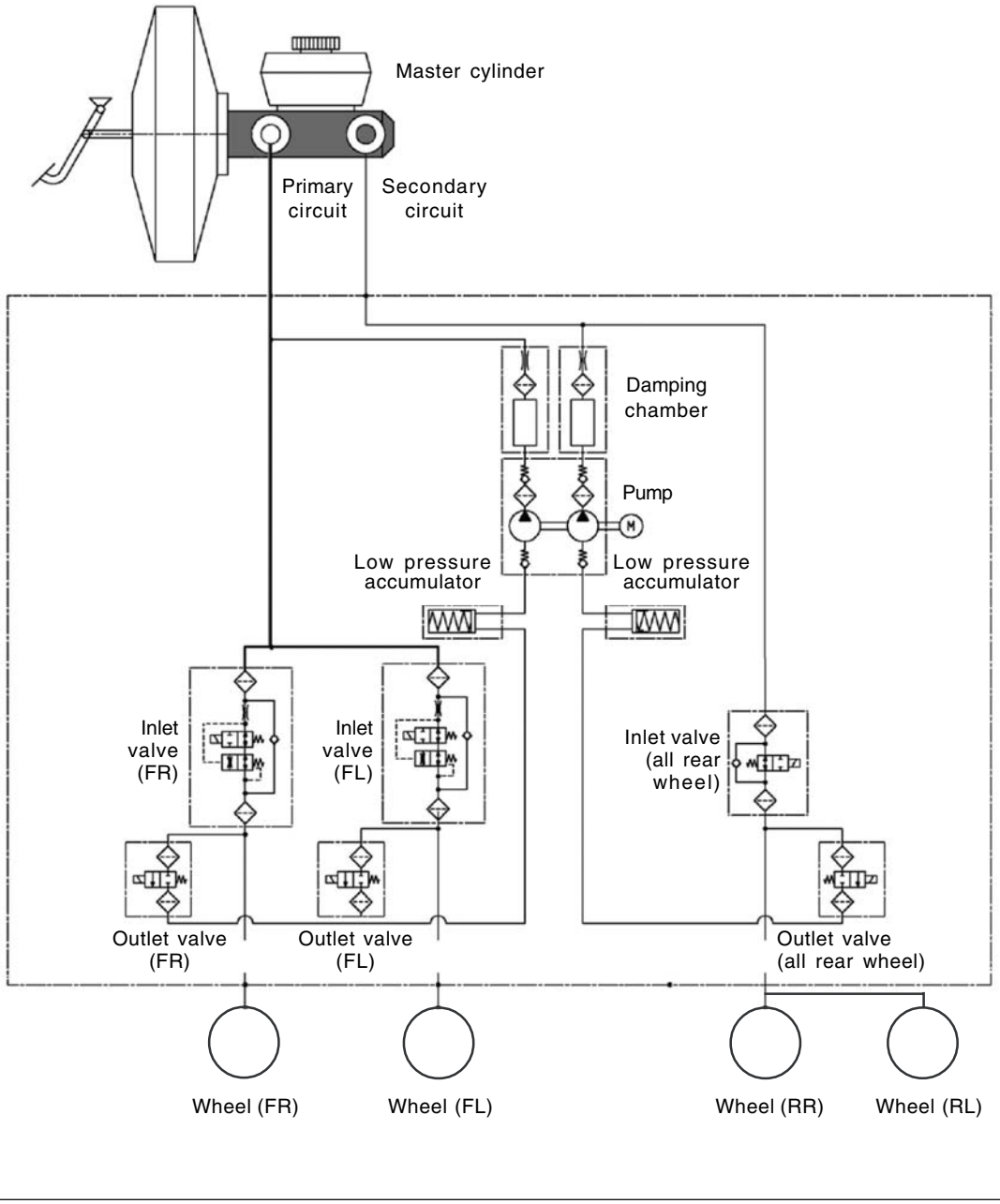
ABS

▶ Wheel Speed Sensor, Stop Lamp Switch, Diagnostic Connector, Warning Lamp (ABS/ESP)



HYDRAULIC CIRCUIT DIAGRAM

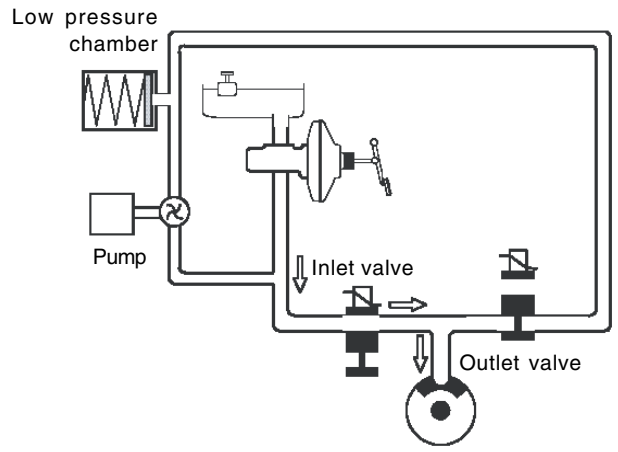
ABS HYDRAULIC CIRCUIT DIAGRAM



The vehicle equipped only with the ABS controls the wheel's braking force using three 3-channel 4-sensor method. The front wheels that are the primary circuit of the brake system is composed of two wheel speed sensors and two channel valves system with two inlet valves and two outlet valves. The rear wheels that are the secondary circuit of the brake system is composed of two wheel speed sensors, one inlet valve and one outlet valve. This system is similar to the one from the previous model.

ABS HYDRAULIC CIRCUIT PER ABS OPERATION RANGE

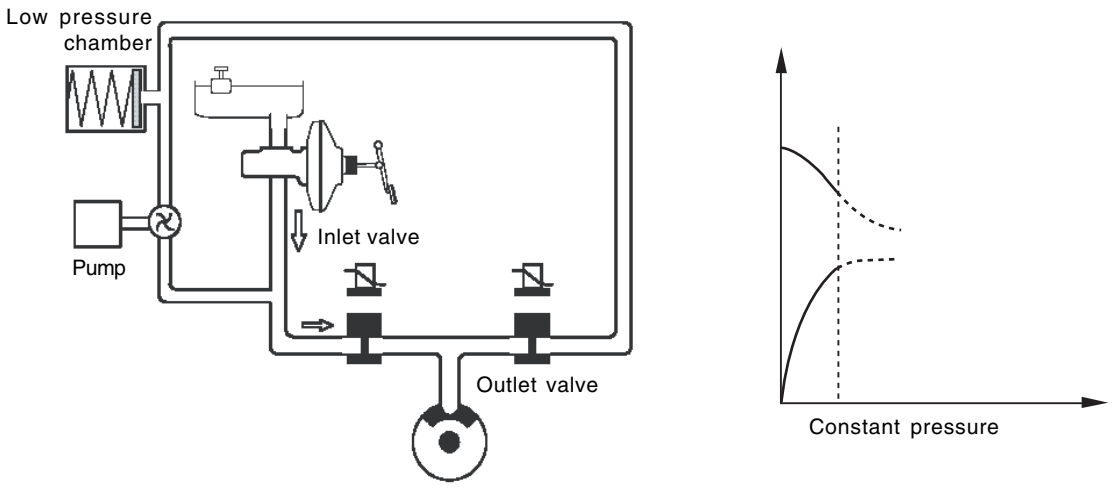
▶ Hydraulic Pressure Circuit when ABS is Not Operating



Y220_8E1013

The hydraulic pressure in the master cylinder increases through the vacuum booster and it is delivered to the wheel via the normal open inlet valve. At this moment, the normally-closed outlet valve is closed. The speed of the wheel that hydraulic pressure is delivered reduces gradually .

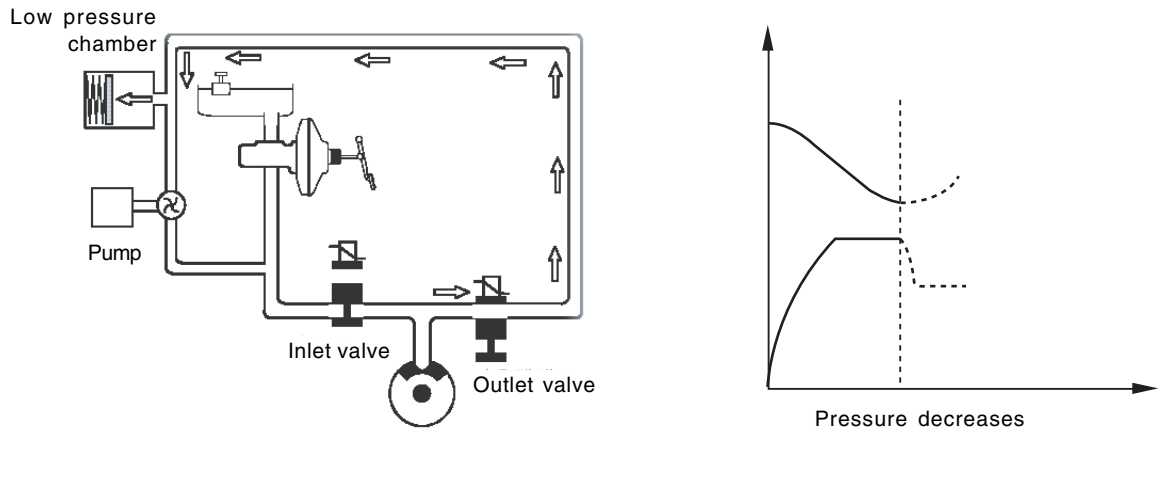
▶ No Hydraulic Pressure Circuit when ABS is Operating



Y220_8E1014

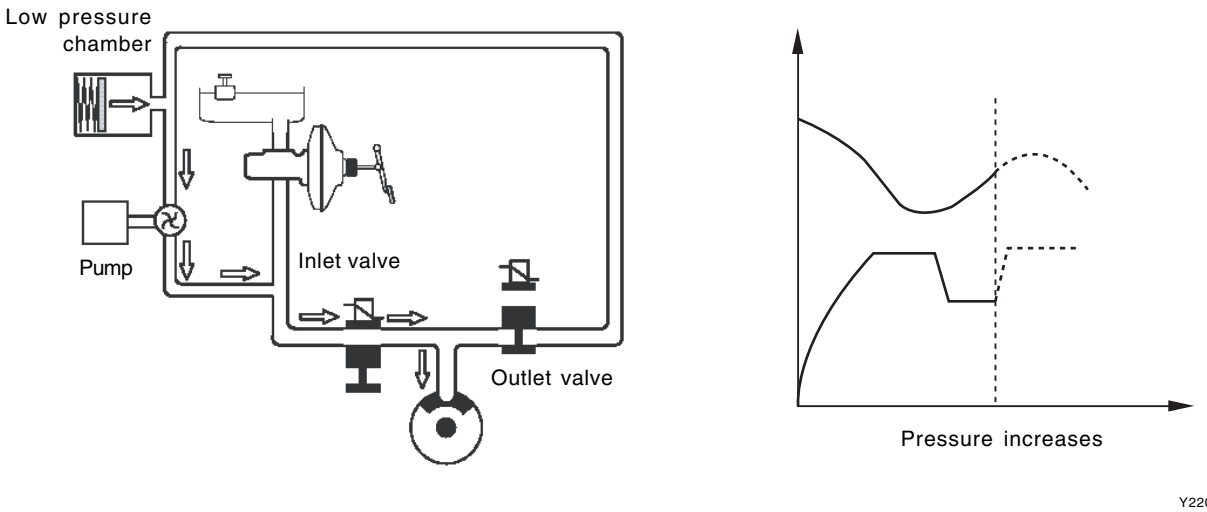
As hydraulic pressure on each wheel increases, the wheel tends to lock. In order to prevent the wheel from locking, the hydraulic valve modulator operates the inlet valve control solenoid to close the inlet valve and stop the hydraulic pressure increases. At this moment, the outlet valve is closed. This procedure helps the wheel to maintain a stable hydraulic pressure.

▶ Pressure Decreases in the Circuit when ABS is Operating



Even when the hydraulic pressure on each circuit is stable, the wheel can be locked as the wheel speed decreases. This is when the ABS ECU detects the wheel speed and the vehicle speed and gives the optimized braking without locking the wheels. In order to prevent from hydraulic pressure increases, the inlet valve is closed and the outlet valve is opened. Also, the oil is sent to the low pressure changer and the wheel speed increases again. The ABS ECU operates the pump to circulate the oil in the low pressure chamber to the master cylinder. This may make the driver to feel the brake pedal vibration and some noises.

▶ Pressure Increases in the Circuit when ABS is Operating



As the wheel speed increases, the inlet valve opens and the wheel's pressure increases due to the master cylinder pressure. The oil in the low pressure chamber circulates to the wheel by the pump and the wheel speed decreases as the hydraulic pressure at wheel increases. This operation continues repetitively until there are no signs that the ECU is locking the wheels. When the ABS hydraulic pressure control takes place, there may be some vibration and noises at the brake pedal.

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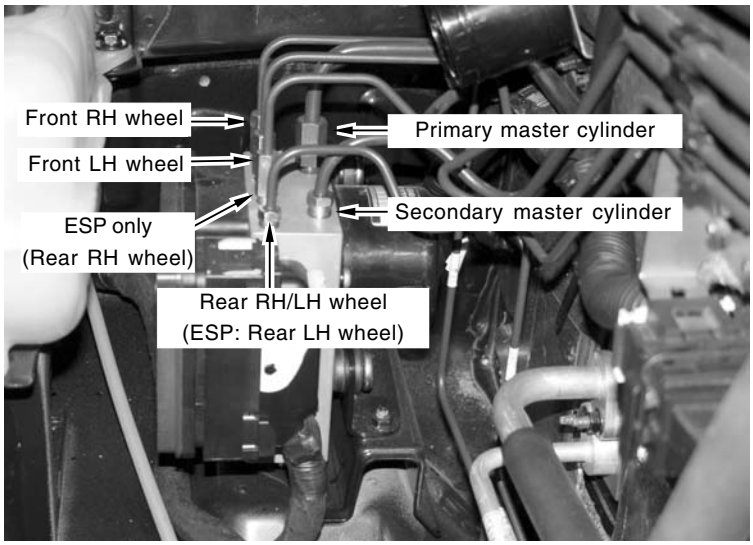
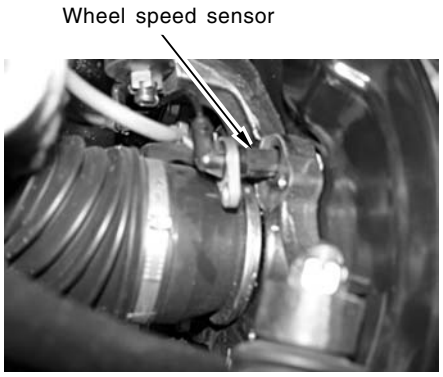
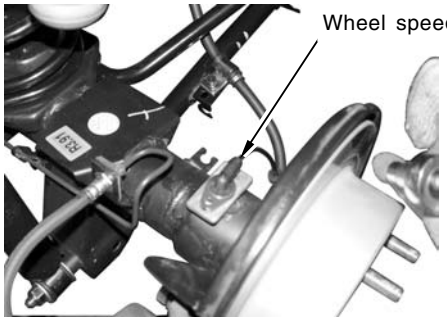
COMPONENTS LOCATION

▶ When Installed In Vehicle





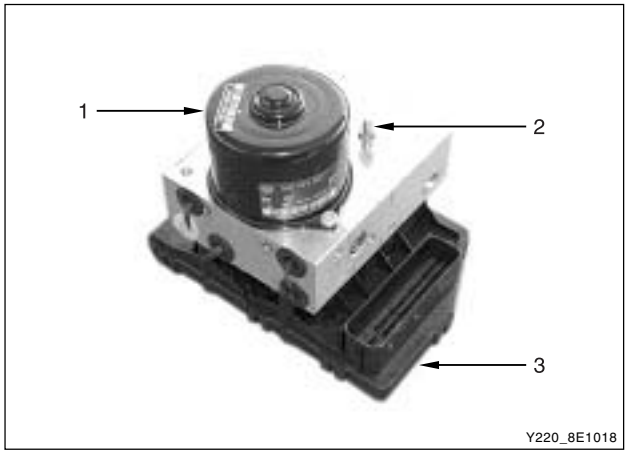
Front wheel speed sensor



Rear wheel speed sensor

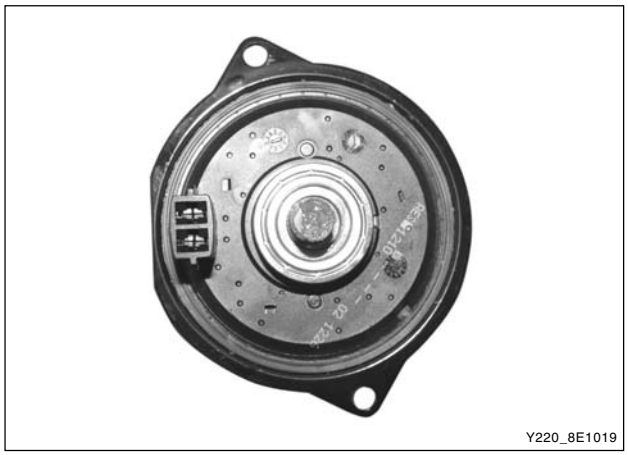
Y220_8E1017

HECU (HYDRAULIC & ELECTRONIC CONTROL UNIT)



HECU consists of motor pump (1), solenoid valve (2) and ECU (3).

ECU connector has 47 pins and the number of valves in valve body is 6 when equipped with only ABS and 12 when equipped with ESP system.



▶ Motor Pump

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.

▶ Valve Body

The cam bushing is installed between plungers and it draws and discharges the brake fluid.

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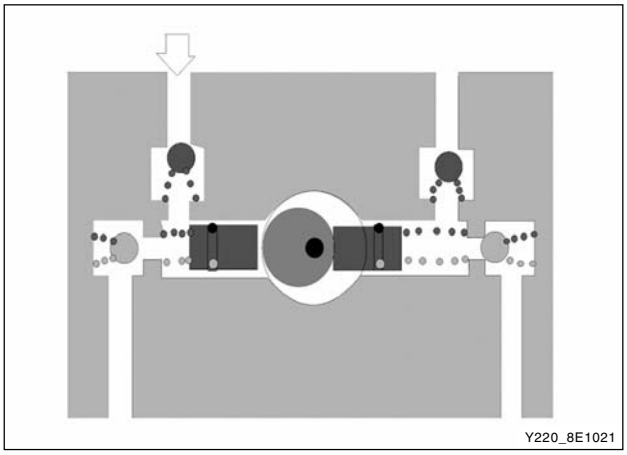
(Pumping)

When the cam pushes the left plunger during motor operation, the system pressure is generated in the left cylinder. At this time, the right plunger is expanded by spring force and the expanded volume of the right cylinder draws the brake fluid.



Y220_8E1021

▶ ECU (Including Solenoid Valves – ESP Equipped Model)

HECU controls the hydraulic valves by supplying or cutting off the voltage to solenoid valves depending on the wheel speed and other information from wheel speed sensors.

The figure shown in left side is for ESP ECU. There are two channels for front wheels and one channel for rear wheels. Each channel has one inlet and one outlet valve, therefore, there are six solenoid valves.

Y220_8E1022

(ECU lower cover)

The electrical components are weak to moisture. To protect ECU, GoreTex-based plate is used at ECU lower cover. The vent hall (arrow) allows air to ventilate but does not allow moisture to penetrate.

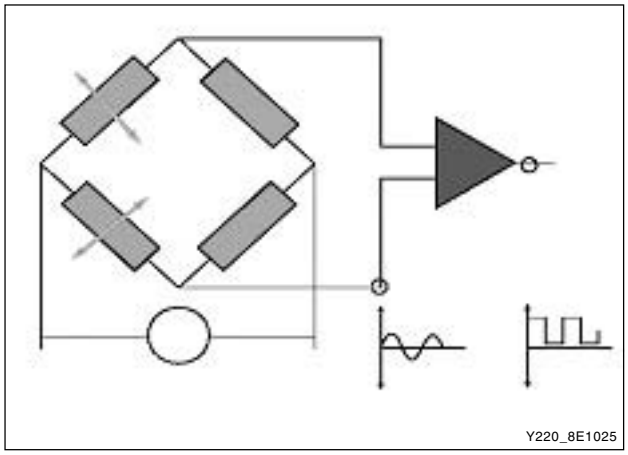
Y220_8E1023


Y220_8E1024

WHEEL SPEED SENSOR

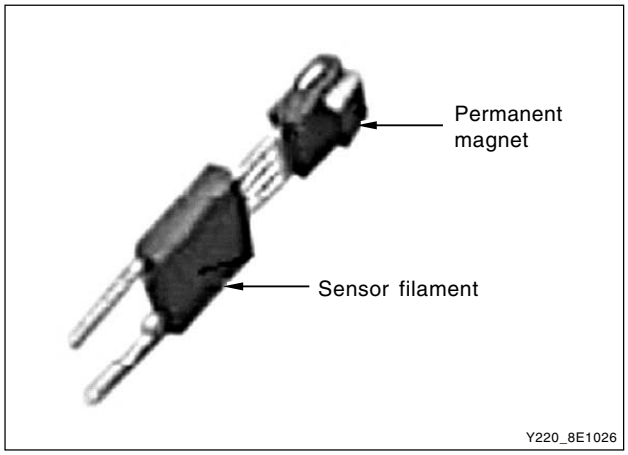
▶ Active Wheel Sensor

- Measuring bridge with four resisters
- Measuring the current
- Supplying the voltage (12 V)
- Amplifier/comparison measuring device


Y220_8E1025

▶ Function of Active Wheel Sensor

The speed sensor used in traditional ABS is made of permanent magnet and transmits the output voltage that changes as the wheel rotor rotates to the HECU system. New wheel speed sensor detects the wheel speed through the current value that depends on the resistance that changes according to the magnetic field by using four resisters and supplying the 12 V power supply to the sensor.



Y220_8E1026

The system uses the wheatstone bridge that detects and compares the changes in each resistance value. Before passing through the comparison measuring device, the sine wave current is obtained. But, after passing through it, a square wave, that is recognized by ECU, will be generated.

▶ Specifications

Item	Specifications	Reference
Supplying voltage	DC 12V	
Air gap	Front: 0.335 ~ 0.945 mm	Cannot measure the air gap
	Rear: 0.309 ~ 0.958 mm	
Output current(vehicle speed: at 2.75 km/h)	7mA (Lo) ~ 14mA (Hi) +20 % / -16 %	
Tightening torque	Front: 19 ~ 25 Nm	7.5 ~ 20 V
	Rear: 6 ~ 10 Nm	

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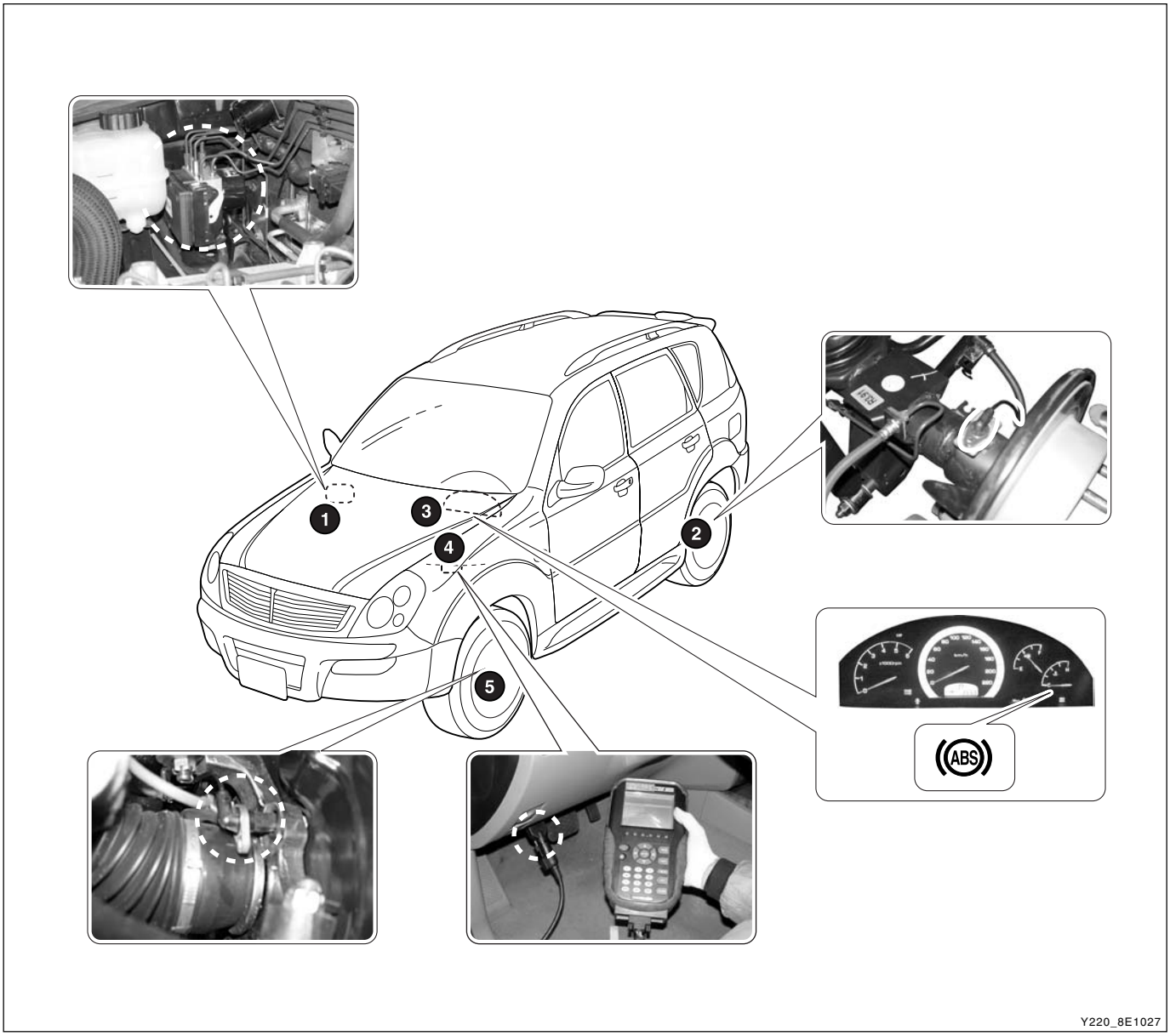
COMPONENTS LOCATOR

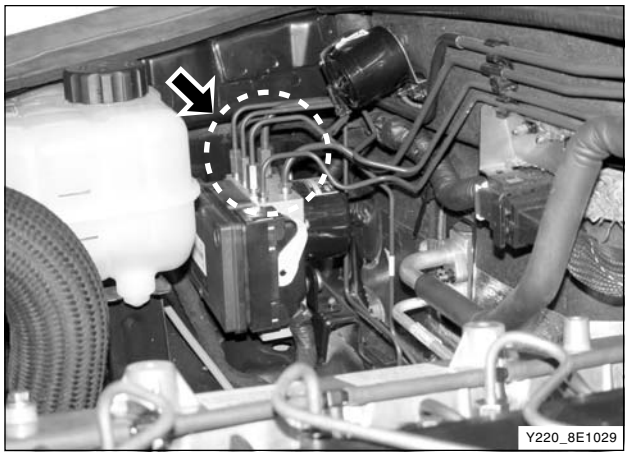
ABS

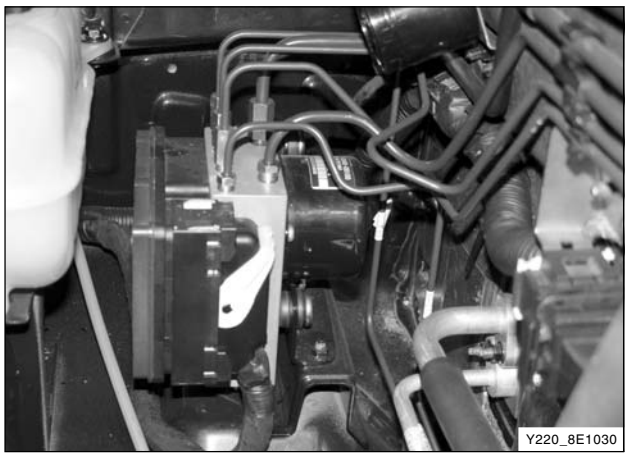


1. ABS hydraulic device and control unit
2. Rear wheel speed sensor
3. ABS warning lamp
4. Diagnostic connector
5. Front wheel speed sensor

REMOVAL AND INSTALLATION

HYDRAULIC DEVICE/HECU ASSEMBLY





Removal and Installation

1. Disconnect the negative cable.
2. Disconnect the ABS wiring harness connector from HECU socket.
3. Cover the connector and the socket with shop cloths to protect them from brake fluid.

Notice

Take care not to allow air into the hydraulic modulator. If air gets into the hydraulic unit, it will require a bleeding procedure using a scan tool programmed for the ABS 5.3 system. As long as no air enters the hydraulic unit, a simple bleeding procedure is all the system will require.

4. Remove the brake pipes from the hydraulic modulator.

   Installation Notice

Tightening torque	14 Nm

5. Loosen the mounting nuts on the hydraulic unit.
6. Move the brake pipes aside far enough to allow for lifting the ABS 5.3 unit out of the mounting bracket.
7. Cap the brake pipes.

   Installation Notice

Tightening torque	6 Nm

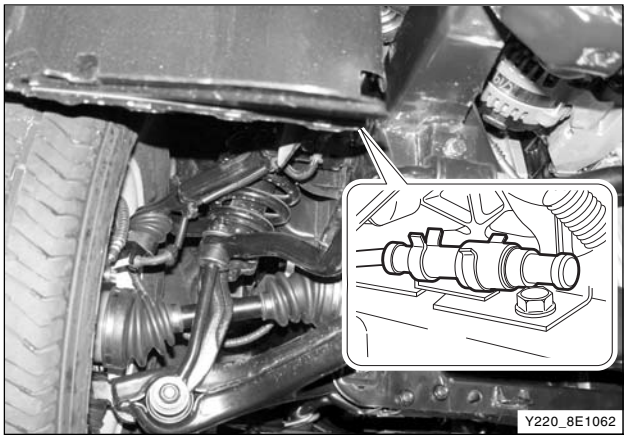
   Bleed the air from the hydraulic system.

8. Install in the reverse order of removal.

FRONT WHEEL SPEED SENSOR

Removal and Installation

1. Disconnect the negative battery cable.
2. Disconnect the front wheel speed sensor connector.

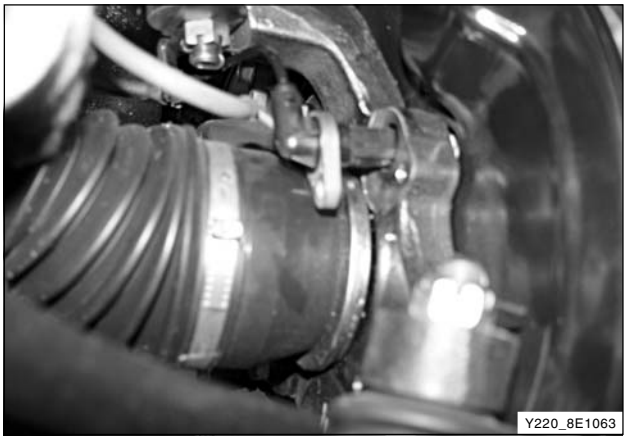


3. Raise and suitably support the vehicle.
4. Turn the steering wheel to expose the front wheel speed sensor.
5. Unscrew the bolt and remove the front wheel speed sensor from the steering knuckle.

   Installation Notice

Tightening torque	7 Nm

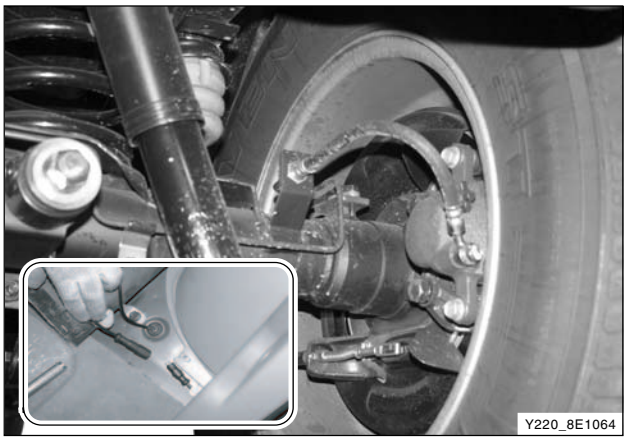
6. Install in the reverse order of removal.



REAR WHEEL SPEED SENSOR

Removal and Installation

1. Disconnect the negative battery cable.
2. Disconnect the rear wheel speed sensor connector.

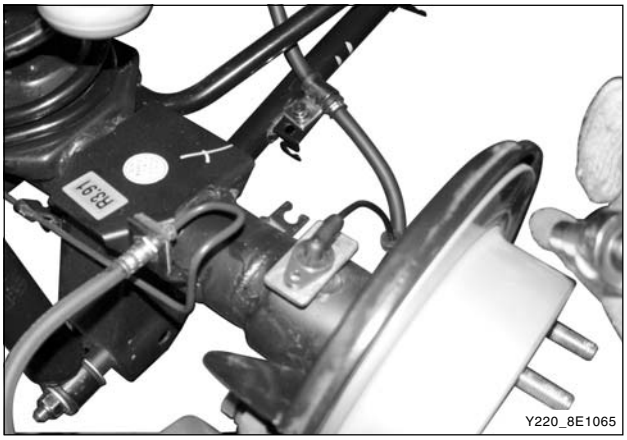


3. Raise and suitably support the vehicle.
4. Remove the rear wheel speed sensor.

   Installation Notice

Tightening torque	7 Nm (62 lb-in)

5. Install in the reverse order of removal.

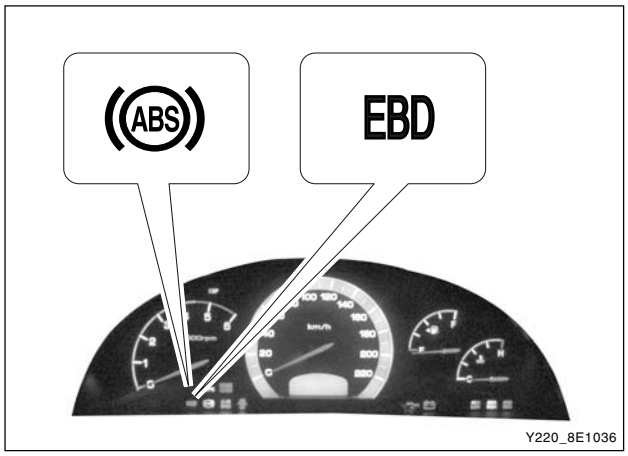


SYSTEM FUSE


Y220_8E1035

The ABS/TCS system fuse and SB2 is located at the fuse box in engine compartment.

INDICATORS



Y220_8E1036

The ABS and TCS indicators are in instrument cluster.

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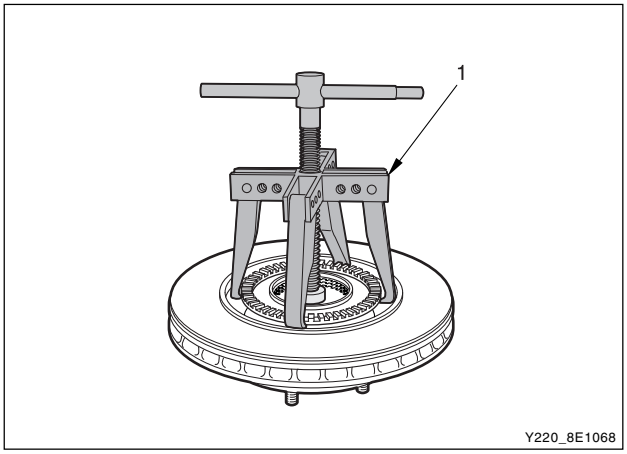
ABS FRONT TOOTH WHEEL

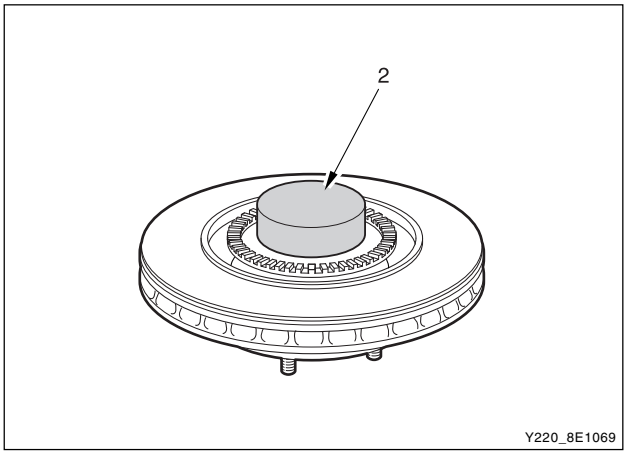
Removal

1. Remove the disc brake rotor. Refer to Front Disc Brakes Section.
2. Remove the ABS front tooth wheel using the ABS tooth wheel puller (1).

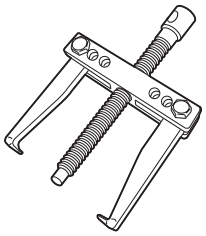
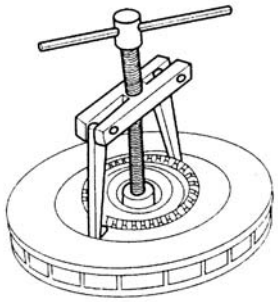
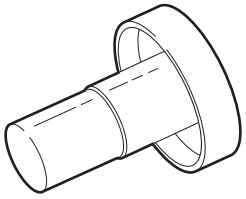
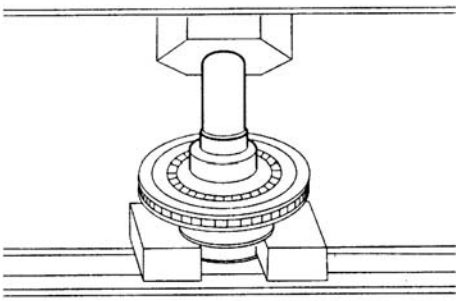


Installation

1. Install the ABS front tooth wheel using the ABS tooth wheel installer (2).



SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
661 589 16 33 00 **ABS tooth wheel puller**  Y220_8E1070	 Y220_8E1071
661 589 17 33 00 **ABS tooth wheel installer**  Y220_8E1072	 Y220_8E1073

SECTION 8E2

ESP SYSTEM

Table of Contents

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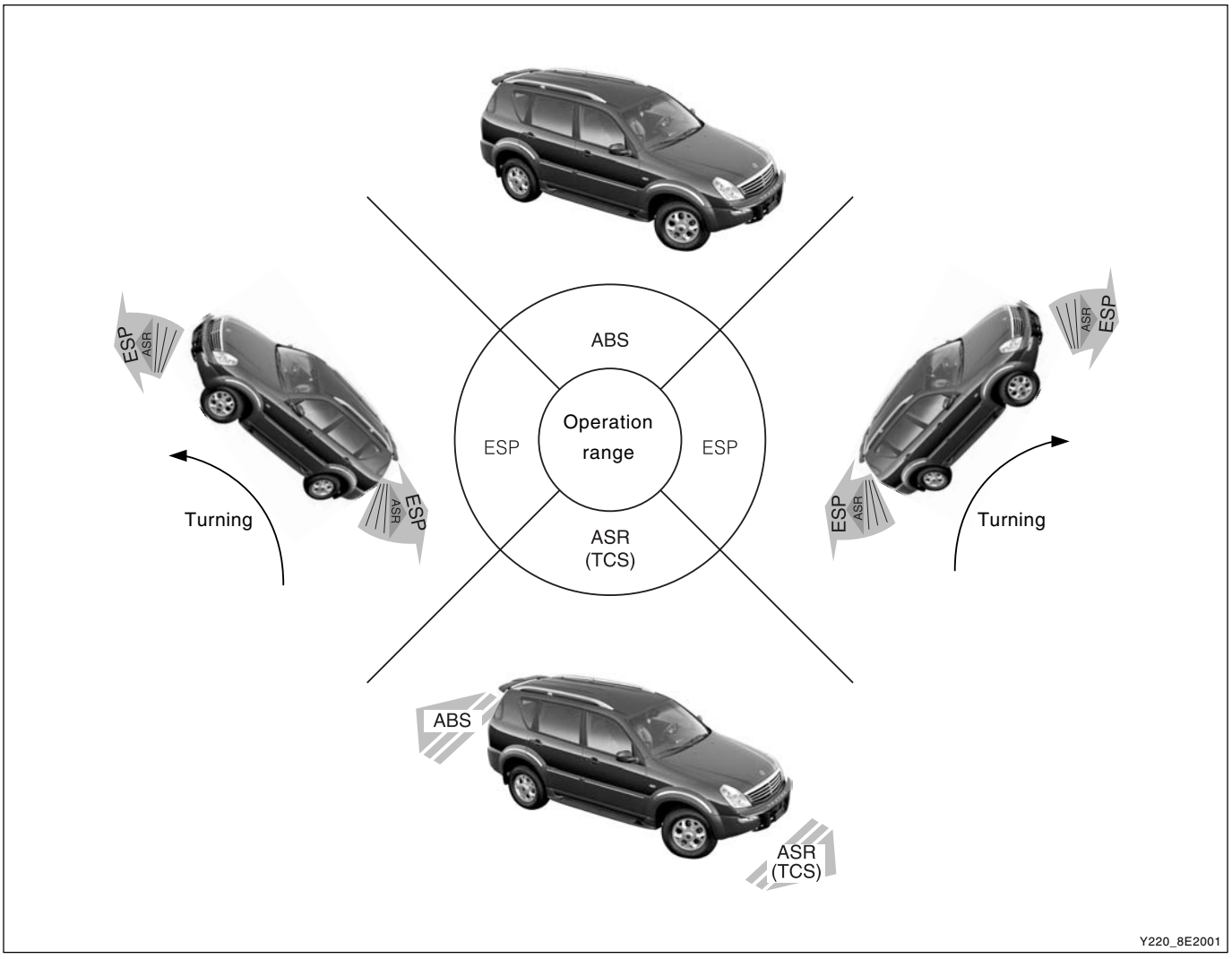
GENERAL

SUMMARY

ESP (Electronic Stability Program) recognizes critical driving conditions, such as panic reactions in dangerous situations, and stabilizes the vehicle by wheel-individual braking and engine control intervention with no need for actuating the brake. This system is developed to help the driver avoid the danger of losing the control of the vehicle stability due to under-steering or over-steering during cornering.

The yaw rate sensor, lateral sensor and longitudinal sensor in the sensor cluster and the steering wheel angle sensor under the steering column detect the spin present at any wheels during over-steering, under-steering or cornering. The ESP ECU controls against over-steering or under-steering during cornering by controlling the vehicle stability using the input values from the sensors and applying the brakes independently to the corresponding wheels.

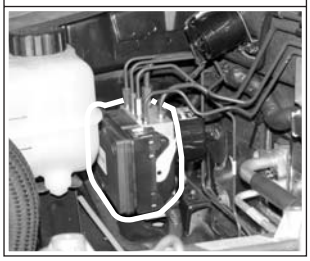
The system also controls during cornering by detecting the moment right before the spin and automatically limiting the engine output (coupled with the ASR system).



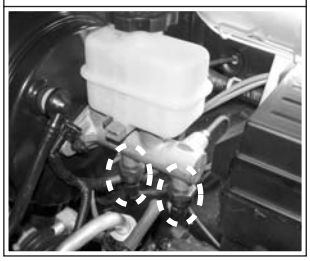
COMPONENTS

COMPONENTS LOCATION

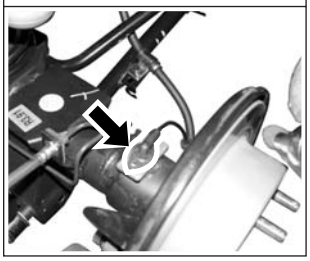
1. HECU

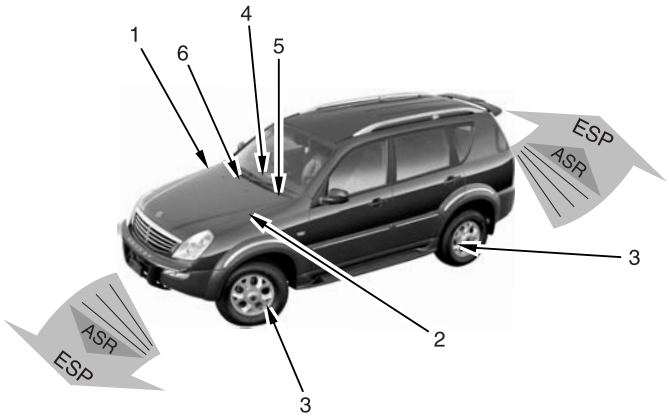


2. Pressure sensor



3. Wheel speed sensor





4. Sensor cluster

5. Steering wheel angle sensor

6. ESP OFF switch

Y220_8E2002

	Name	Location
1	HECU	In front of RH dash panel in engine compartment
2	Pressure sensor	Under master cylinder (two)
3	Wheel speed sensor	Active wheel speed sensor (four)
4	Sensor cluster	Under center audio (directional)
5	Steering wheel angle sensor	Inside multifunction switch
6	ESP OFF switch	In center instrument panel

COMPARISON FOR SPECIFICATIONS

Name	Specifications		Reference
	ABS	ESP	
HECU	CPU: MCU60 (32 bit) Clock Frequency: 28 MHz Memory: 128 ~ 256 KB Switched Orifice	CPU: MCU60 (32 bit) Clock Frequency: 33 MHz Memory: 256 ~ 512 KB Switched Orifice	
Wheel speed sensor	Active Type	Active Type	Output: 7 ~ 14 mA
Steering wheel angle sensor	N/A	Maximum angular velocity: 1500°/Sec Working voltage: 9 ~ 12 V	Pulse duty: 50 ± 10 %
Sensor cluster	N/A	2WD: Yaw rate sensor + Lateral sensor 4WD: Yaw rate sensor + Lateral sensor + Longitudinal sensor	Directional (CAN communication)
Longitudinal acceleration sensor	Integrated into HECU		
Pressure sensor	N/A	Analog Output	

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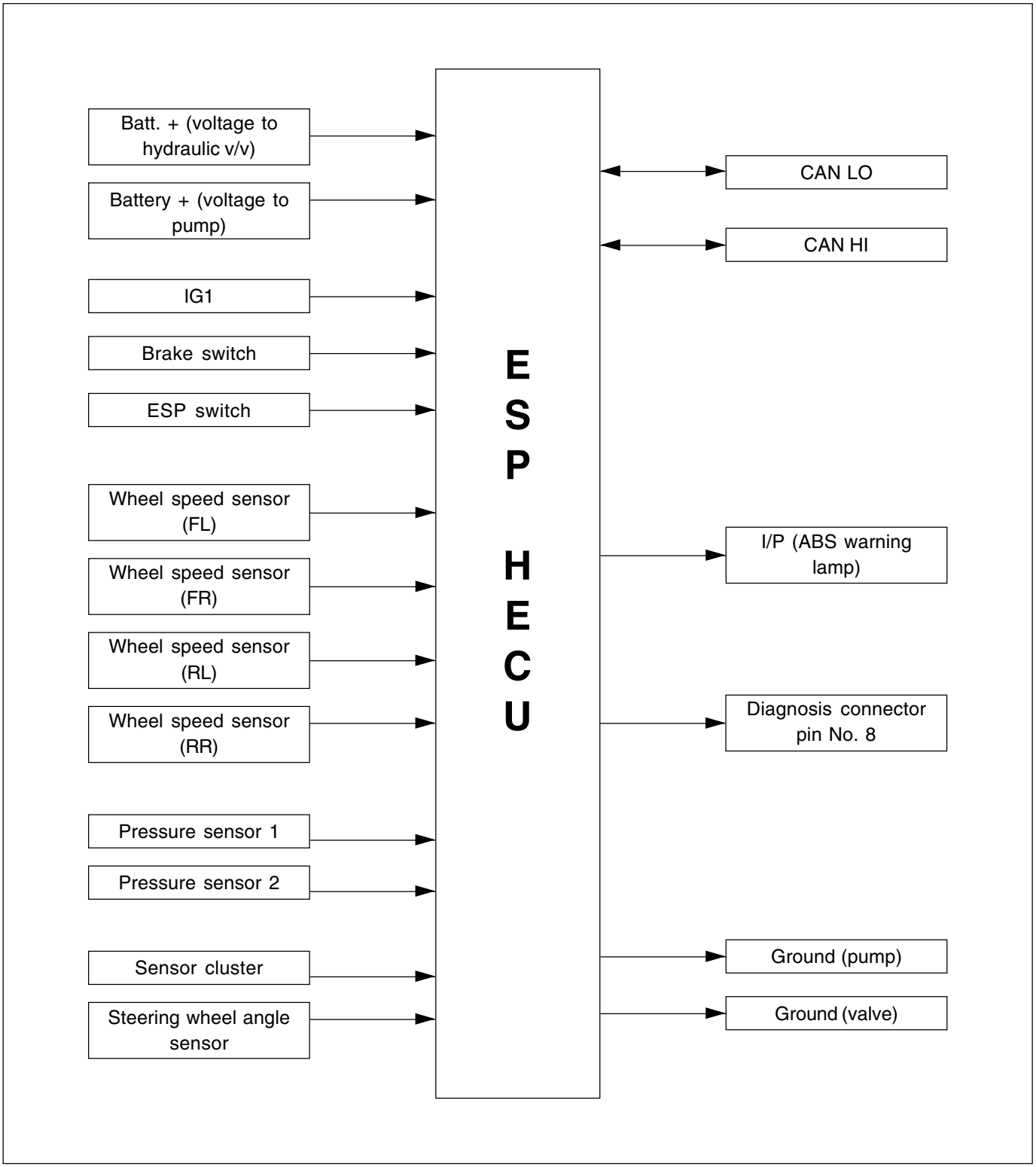
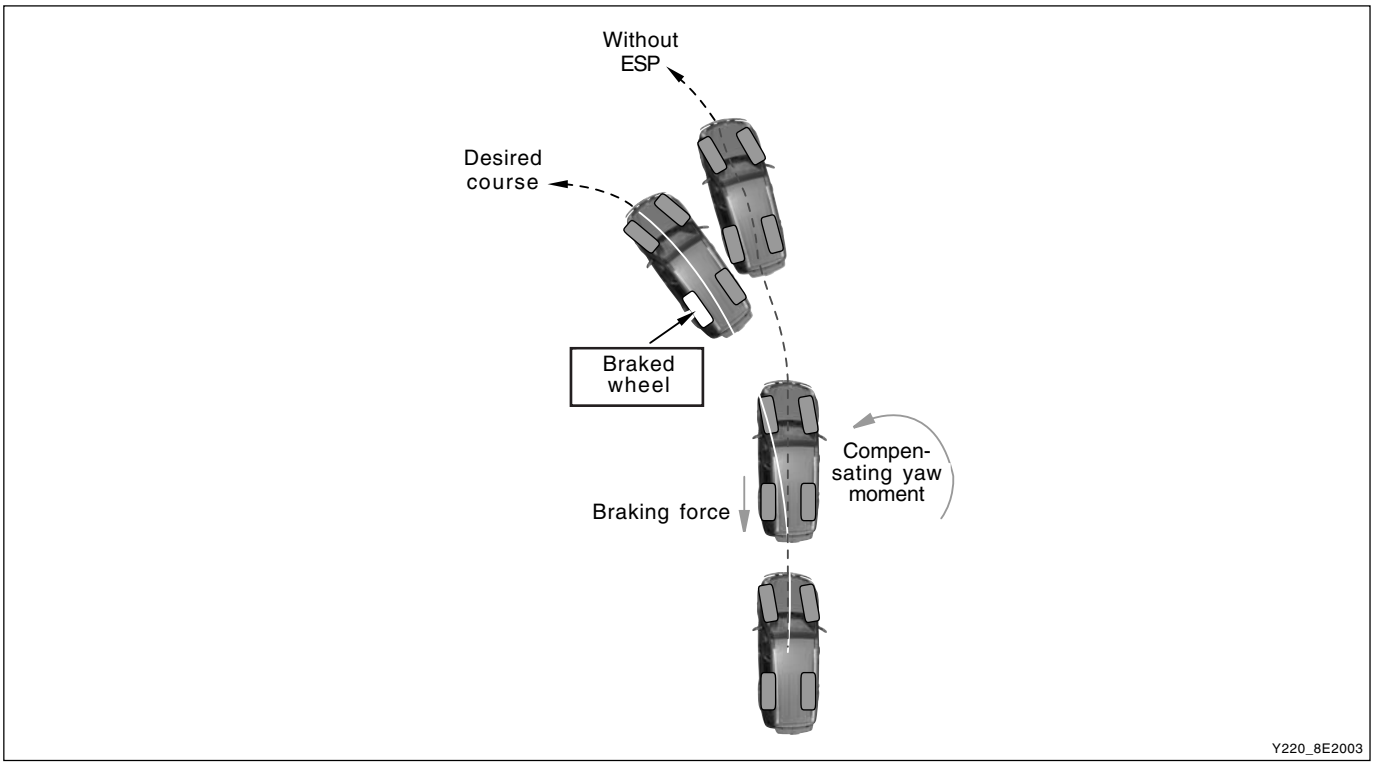
INPUT AND OUTPUT DIAGRAM OF ESP UNIT



ESP CONTROL

The ESP system includes the ABS/EBD and ASR systems allowing the system to be able to operate depending to the vehicle driving conditions. For example, when the brakes are applied during cornering at the speed of 100 km/h, the ABS system will operate at the same time the ASR or ABD systems operate to reduce the power from the slipping wheel. And when yaw rate sensor detects the rate exceeding 4¡Æ/seconds, the ESP system is activated to apply the brake force to the corresponding wheel to compensate the yaw moment with the vehicle stability control function. When various systems operate simultaneously under a certain situation, there may be vehicle control problems due to internal malfunction of a system or simultaneous operations. In order to compensate to this problem, the ESP system sets the priority among systems. The system operates in the order of TCS (ASR or ABD), ESP and ABS. The order may be changed depending on the vehicle driving situations and driving conditions. As the single-track vehicle model used for the calculations is only valid for a vehicle moving forward, ESP intervention never takes place during backup.

▶ Understeering



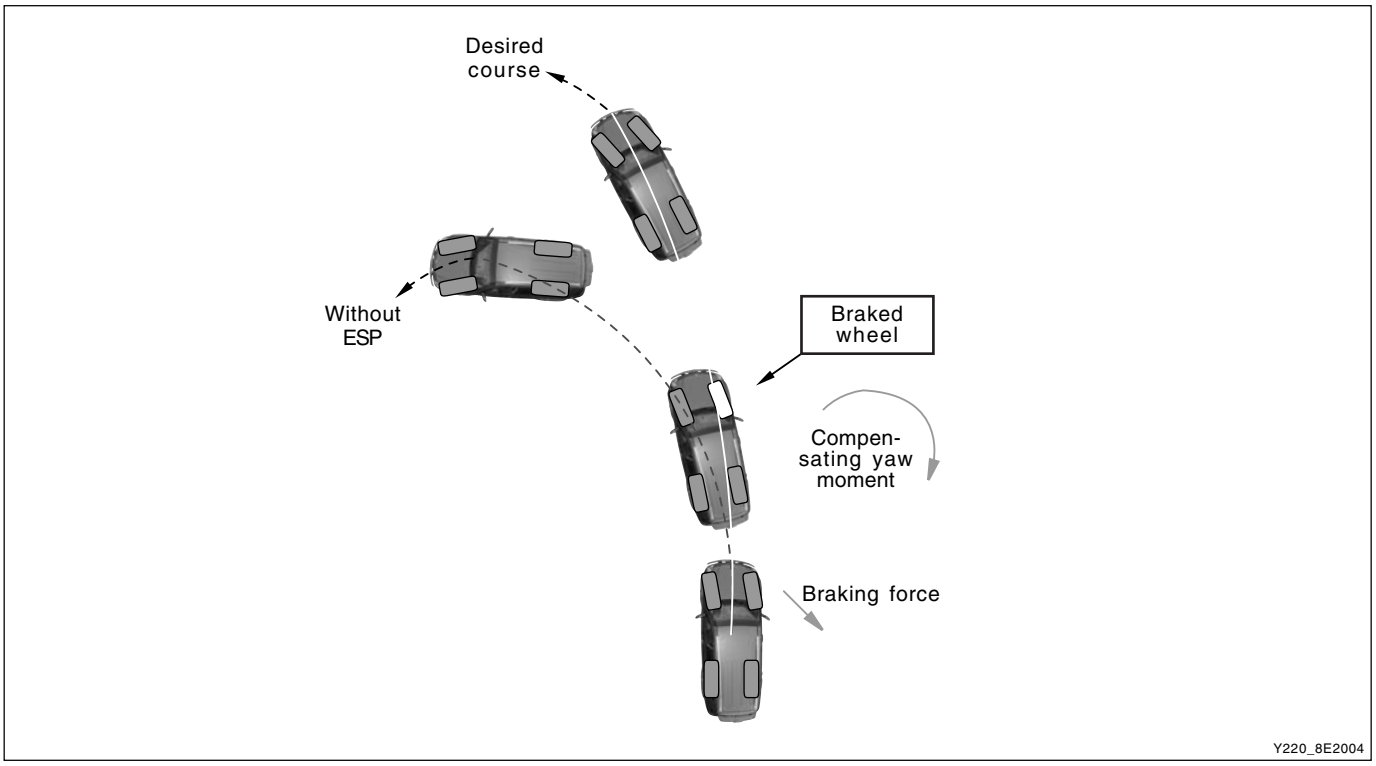
Understeering

Understeering is when the steering wheel is steered to a certain angle during driving and the front tires slip toward the reverse direction of the desired direction. Generally, vehicles are designed to have under steering. The vehicle can return back to inside of cornering line when the steering wheel is steered toward the inside even when the vehicle front is slipped outward. As the centrifugal force increases, the tires can easily lose the traction and the vehicle tends to slip outward when the curve angle gets bigger and the speed increases.

ESP controls during under steering

The ESP system recognizes the directional angle with the steering wheel angle sensor and senses the slipping route that occurs reversely against the vehicle cornering direction during understeering with the yaw rate sensor and the lateral sensor. Then the ESP system applies the brake at the rear inner wheel to compensate the yaw moment value. In this way, the vehicle does not lose its driving direction and the driver can steer the vehicle as driver intends.

▶ Oversteering



Oversteering

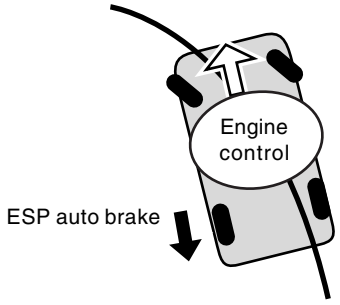
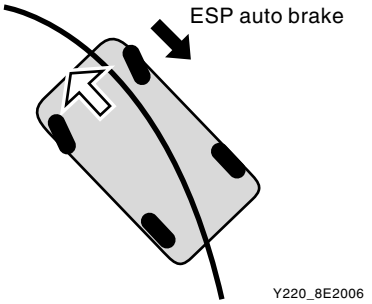
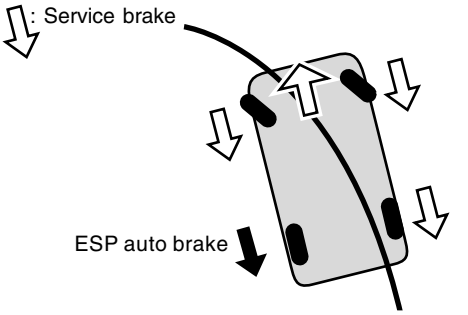
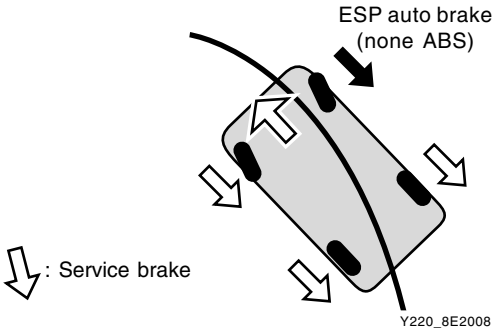
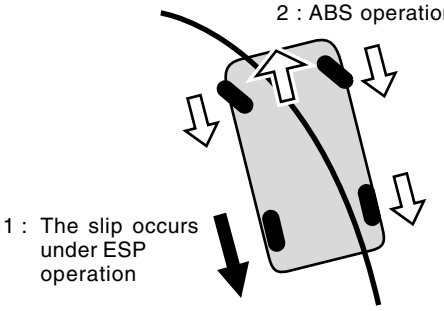
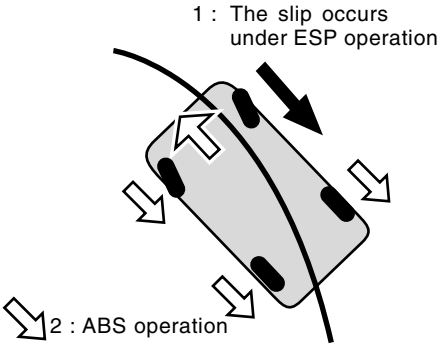
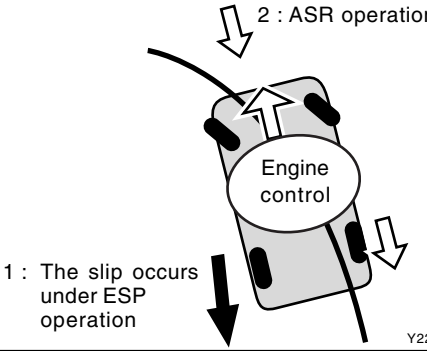
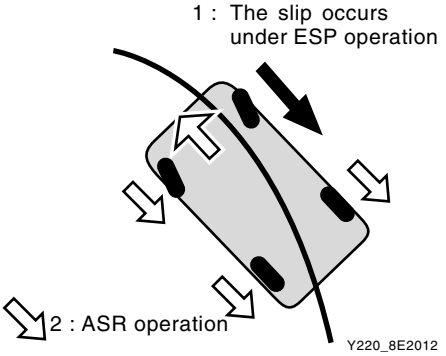
Oversteering is when the steering wheel is steered to a certain angle during driving and the rear tires slip outward losing traction. When compared with under steering vehicles, the controlling of the vehicle is difficult during cornering and the vehicle can spin due to rear wheel moment when the rear tires lose traction and the vehicle speed increases.

ESP controls during oversteering

The ESP system recognizes the directional angle with the steering wheel angle sensor and senses the slipping route that occurs towards the vehicle cornering direction during oversteering with the yaw rate sensor and the lateral sensor. Then the ESP system applies the brake at the front outer wheel to compensate the yaw moment value. In this way, the vehicle does not lose its driving direction and the driver can steer the vehicle as he or she intends.

▶ Vehicle Control During Cornering

The figure below shows the vehicle controls by ESP system under various situations such as when the brake pedal is pressed (or not pressed) during cornering and when the ABS is operating or when just the conventional brake is operating during braking. It also includes the vehicle conditions when the TCS that is included in the ESP system is operating.

Operations	Understeering Control	Oversteering Control
Only ESP operating No braking by driver		
ESP + Conventional brake (ABS not operating)		
ESP + ABS brake		
ESP + ASR		

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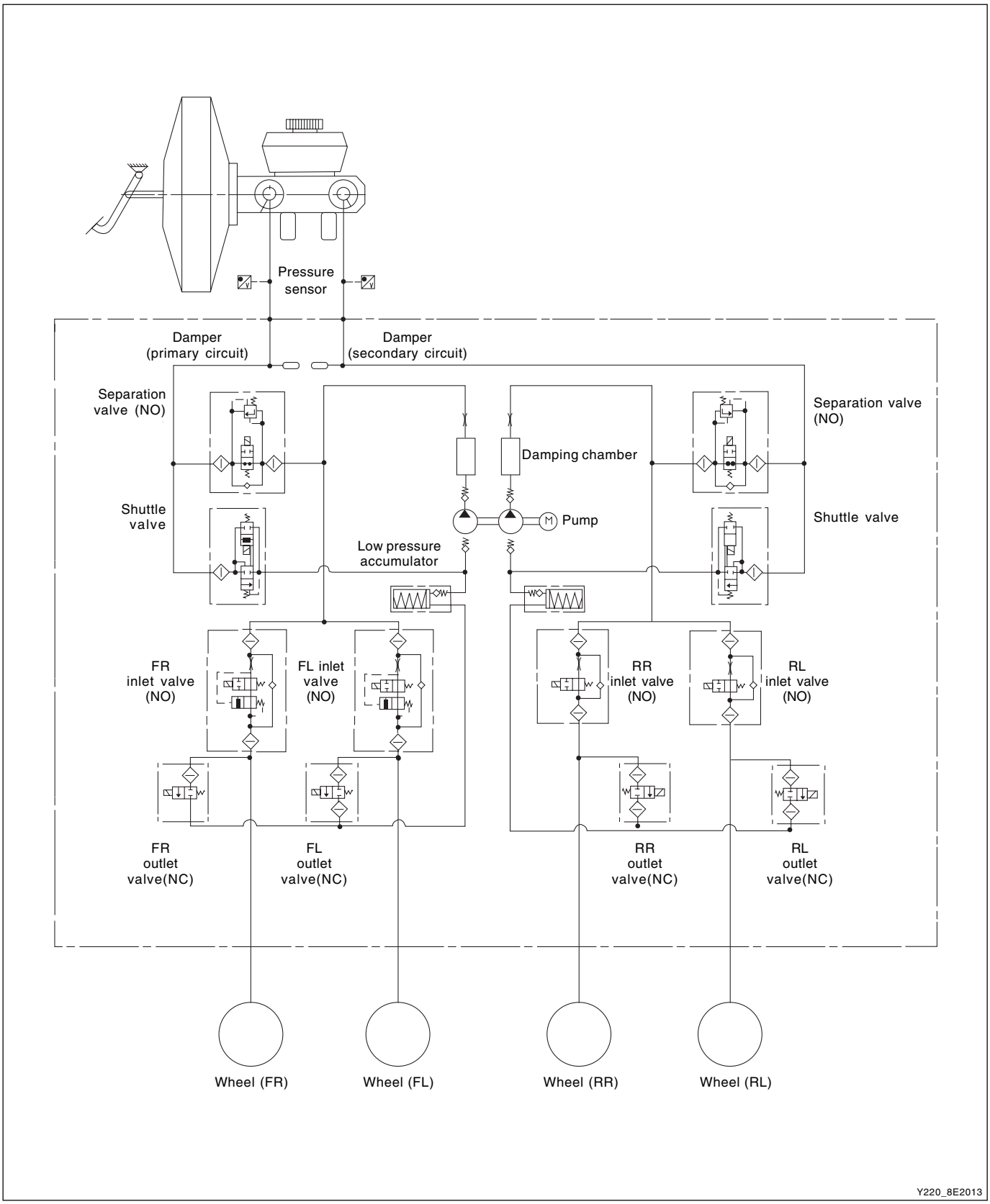
▶ Hydraulic Diagram of ESP



When equipped with ABS, the braking force at each wheel will be controlled with 3-channel 4-sensor method. And when equipped with ESP, 4 wheels will be controlled independently with 4-channel method. (When controlling ABS system only, it will be operated with 3-channel method.) When compared to the vehicle equipped with ABS/EBD only, the internal hydraulic circuit has a normally-open separation valve and a shuttle valve in primary circuit and in secondary circuit. When the vehicle brakes are not applied during engine running or when applying the non-ABS operating brakes, the normally-open separation valve and the inlet valve are open, whereas the normally-closed shuttle valve and the outlet valve are closed. When the ESP system is operating, the normally-open separation valve will be closed by the solenoid valve operation and the hydraulic circuit will be established by the shuttle valve. Then, the inlet and outlet valves will be closed or open depending on the braking pressure increase, decrease or unchanged conditions. For details, refer to “Hydraulic circuit by ESP operation range”.

The warning lamp comes on and warning beep sounds when the ESP is operating

When the ESP operates during vehicle movement, the ESP warning lamp on the instrument panel flickers and beep comes on every 0.1 seconds. The ESP operation shows that the vehicle stability is extremely unstable and it is used to warn the driver. The ESP system is just a supplementary system for the vehicle motion and it cannot control the vehicle when it exceeds the physical limits. Do not solely rely on the system but be advised to drive the vehicle safely.

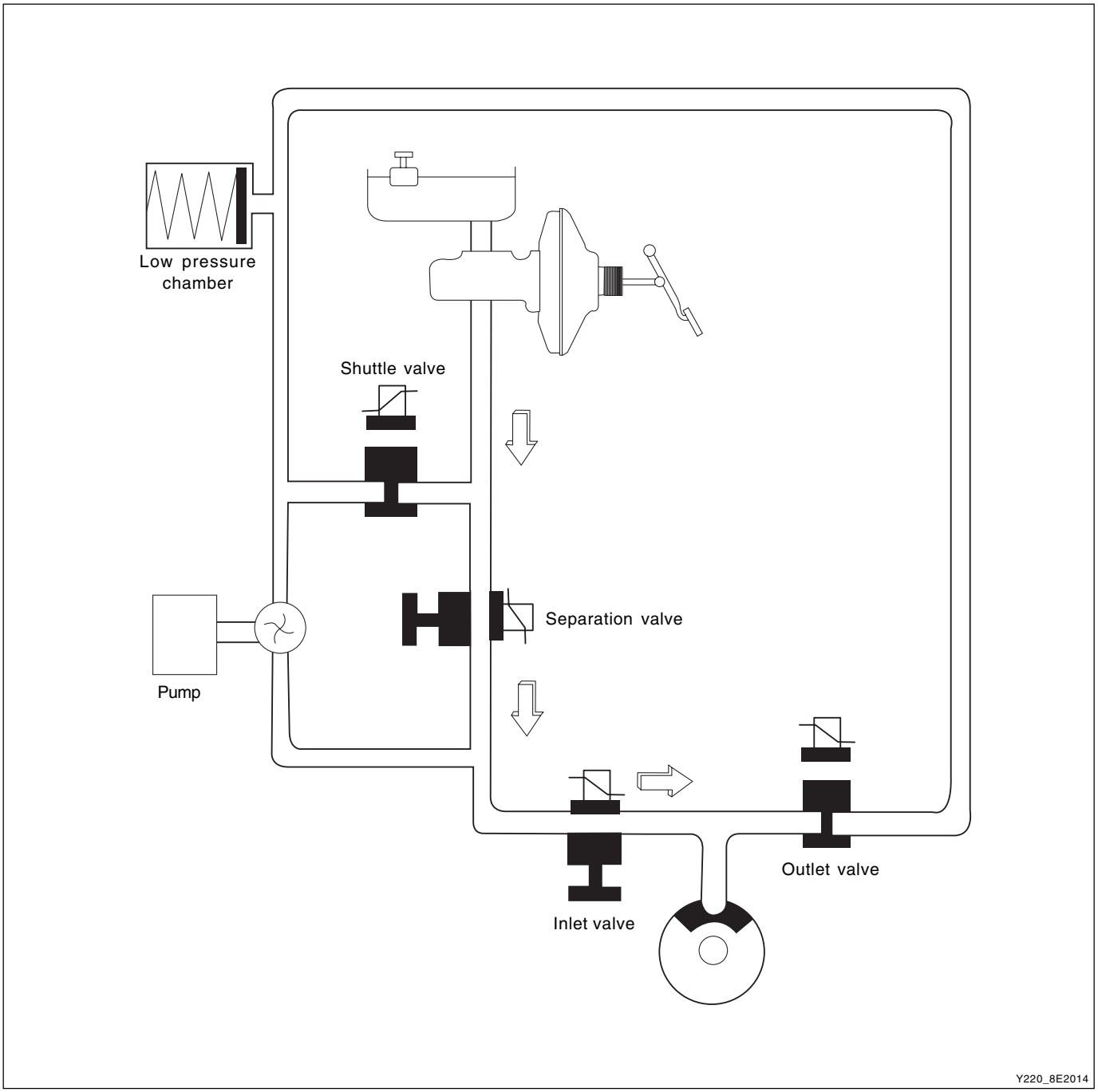
Driving feeling when the ESP is operating

When the ESP system activates, the driving feeling can be different depending on vehicle driving conditions. For example, you will feel differently when the ESP system is activated during when ABS is operating with the brakes applied and when brakes are not applied on a curve. Thus, the ESP system would make the driver feel more abruptly when the brakes are applied during the ESP system activation.

Noise and vibration that driver senses when the ESP is operating

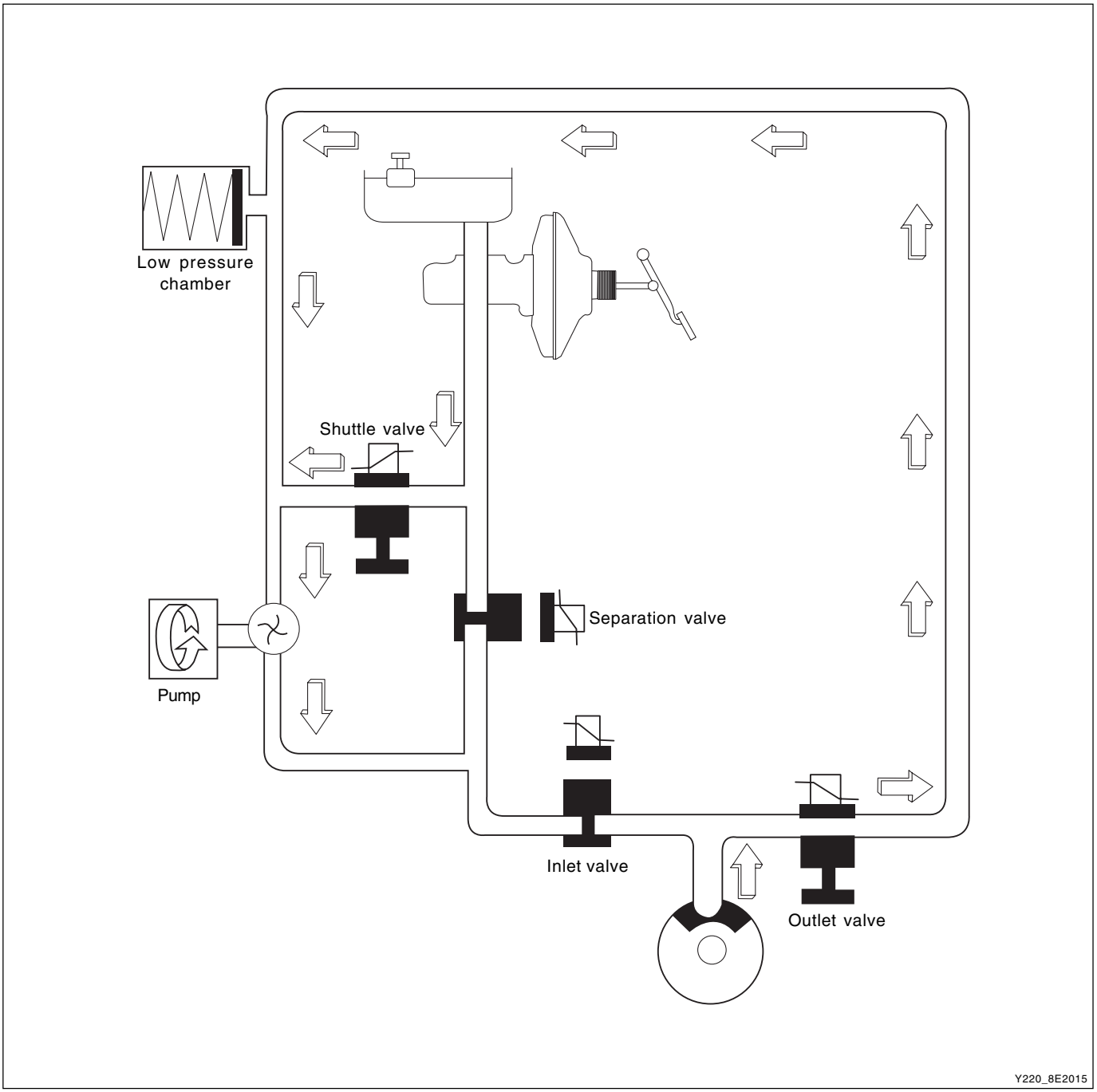
The ESP system may transfer noise and vibration to the driver due to the pressure changes caused by the motor and valve operations in a very short period of time. Extreme cornering will trigger the ESP operation and this will make the driver feel noise and vibration due to sudden brake application. Also, the ESP system controls the engine output. So, the driver may notice the engine output decrease even when the accelerator pedal is being applied.

(1) ESP Hydraulic unit in idling and normal braking position



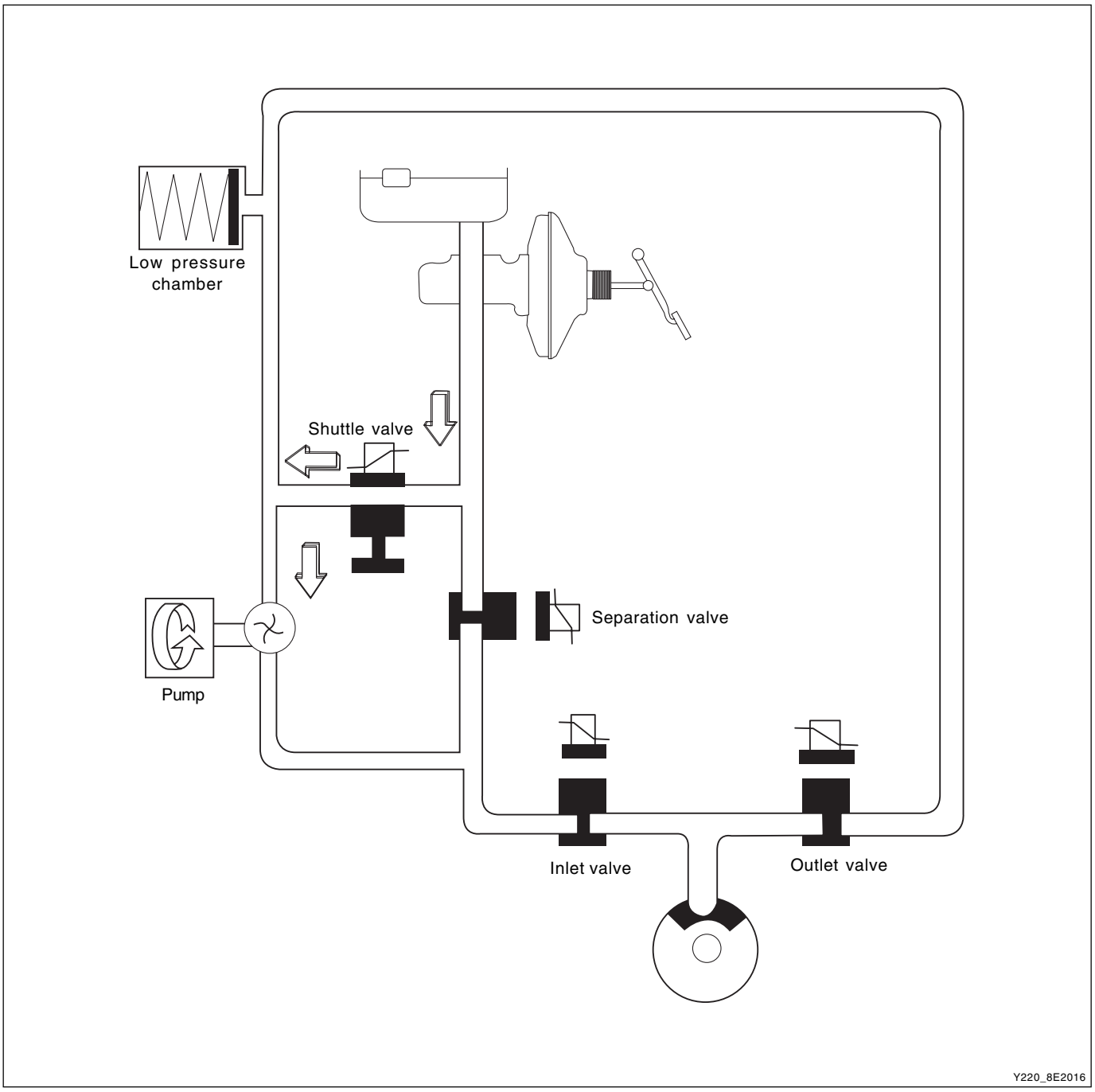
In this position, the separation valve and the inlet valve are open (normal open), the electrically operated shuttle valve and the outlet valve are closed. When the brake is applied under these conditions, the brake fluid will be sent to each wheel via the separation valve and inlet valve.

(2) When applied ABS (decreased pressure)



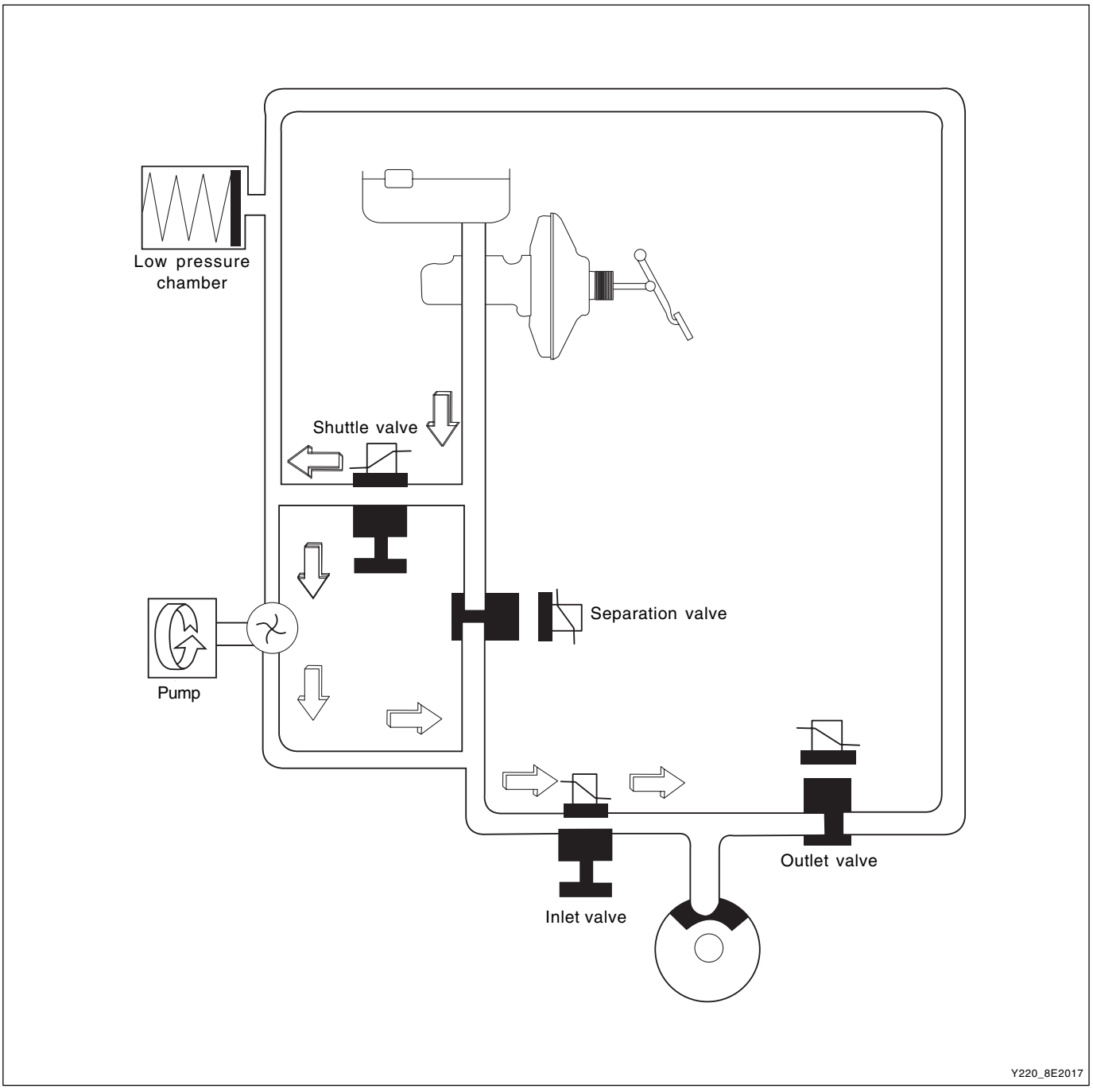
The pressure decreases just before the wheel speed drops and the wheels. The inlet valve closes and the outlet valve opens as in the ABS HECU and the oil is gathered at the low pressure chamber while no additional oil is being supplied. Then the pump operates to allow fast oil drainage.

(3) When applied ABS (maintained pressure)



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.

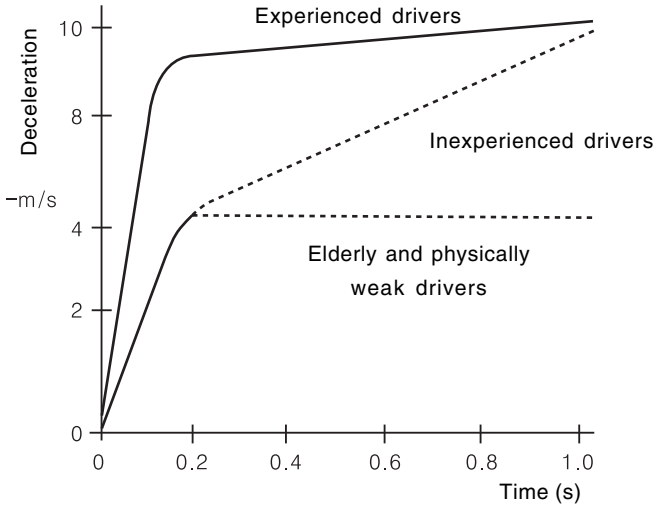
(4) When applied ABS (increased pressure)



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.

▶ HBA (Hydraulic Brake Assist System)



Y220_8E2018

(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.

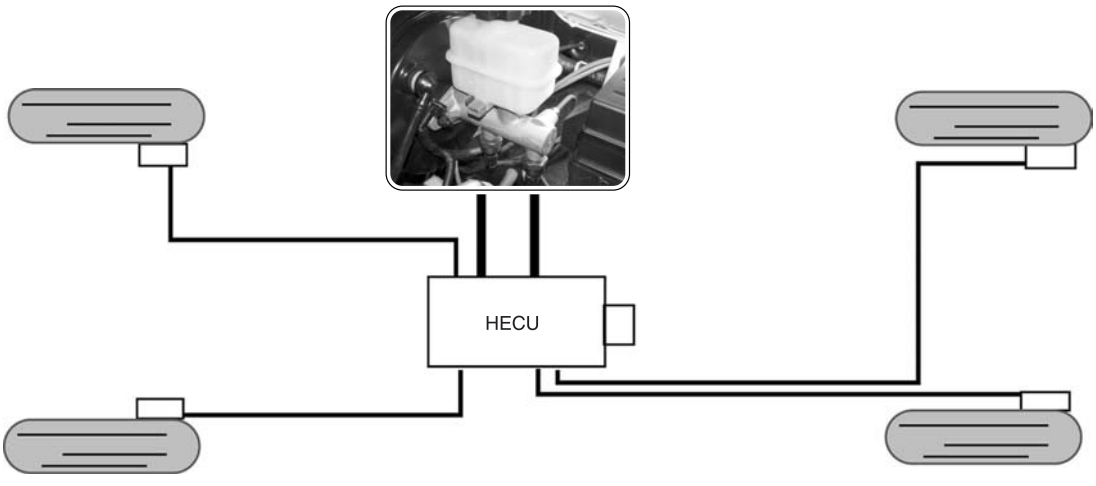
Based on the fact that some drivers depress the brake pedal too soft even under when hard braking is necessary, the HECU system is a safety supplementary system that builds high braking force during initial braking according to pressure value of the brake pressure sensor and the pressure changes of the 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

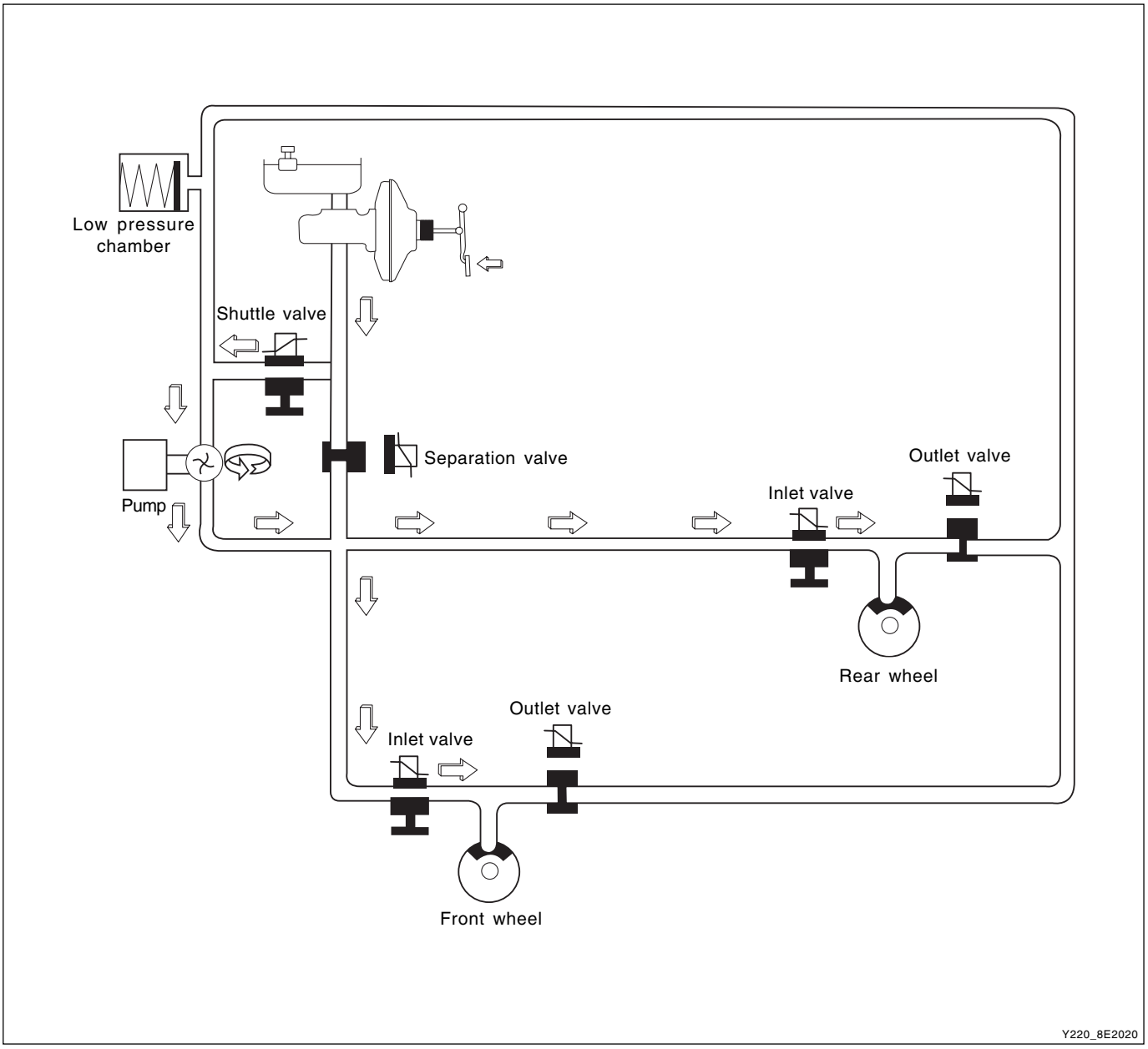
The brake pressure value and the changed value of the pressure sensor are the conditions in which the HBA System operates. There are 2 pressure sensors under the master cylinder. When the ESP ECU system determines that emergency braking is present, the pump operates, the brake fluid in the master cylinder 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.



Y220_8E2019

(3) Hydraulic Diagram 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 are will stay closed. When the wheel starts to lock, the HBA function cancels and switches to ABS operation.

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ESP COMPONENTS

HECU (HYDRAULIC AND ELECTRONIC CONTROL UNIT)


Y220_8E2021

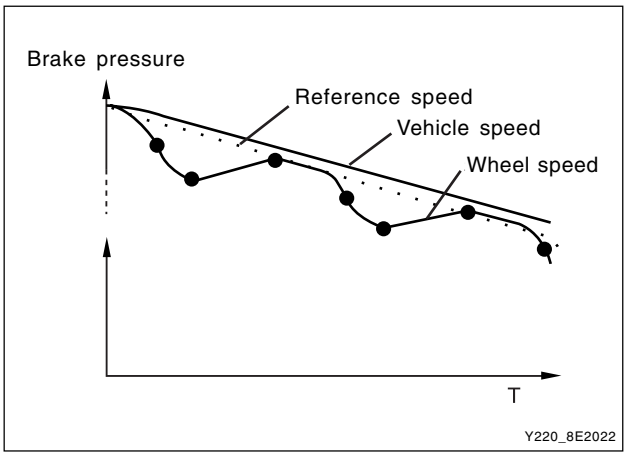
▶ ECU (Electronic Control Unit)

The electronic control unit performs the following functions:

- controlling the ABS and ESP
- cotinuous monitoring of all electrical components

In the integrated control unit, the coils of the solenoid valves are integrated into the control unit housing. The necessary relays are mounted on the circuit board of the electronic control unit.

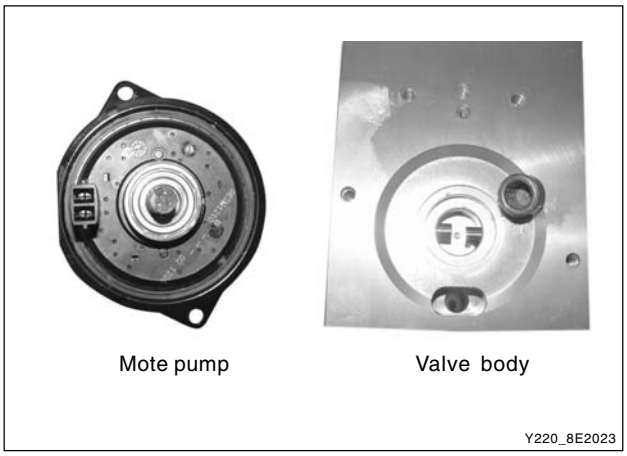
- yaw rate
- G sensor
- lateral/longitudinal acceleration
- pressure in hydraulic system
- wheel speed
- reference speed
- deceleration
- slip



Y220_8E2022

 # ABS control

If during braking, one wheel speed deviates from the reference speed, the ABS control unit attempts to correct that wheel 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.



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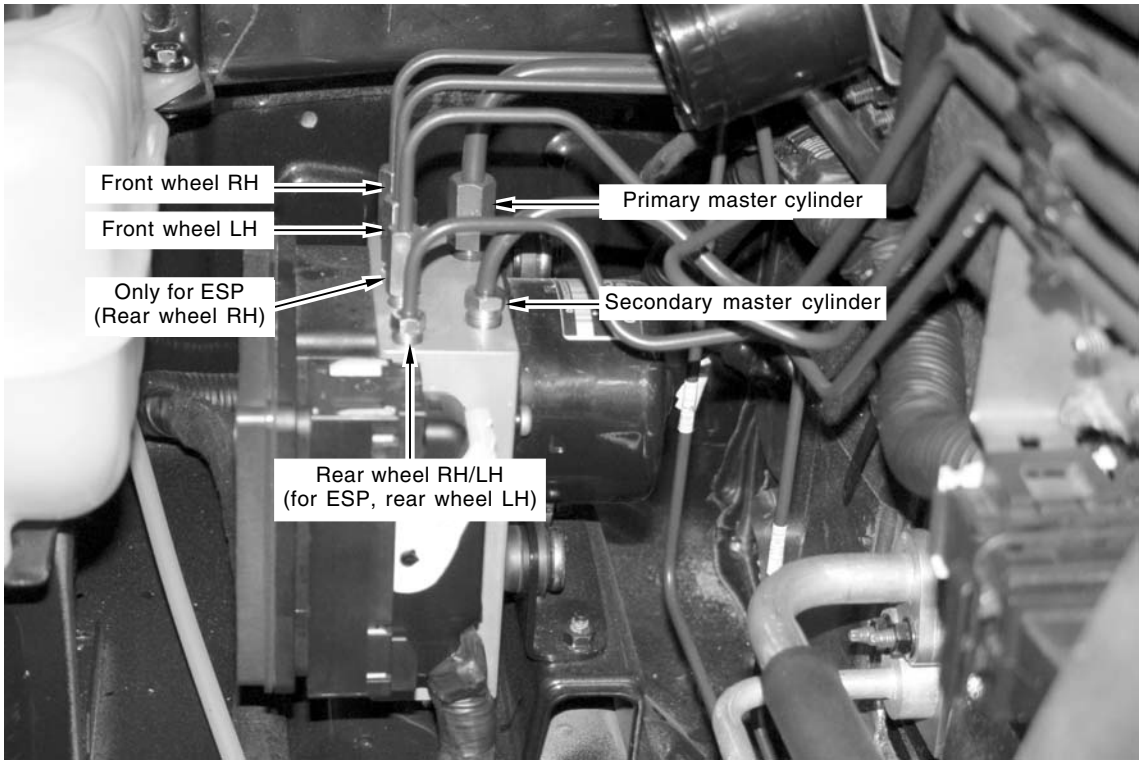
▶ Hydraulic Control Unit

The pump and the valve body are grouped together in one housing, forming one compact unit with the electric motor.

Four pairs of valves (4 inlet valves, 4 outlet valves) are provided for modulating the pressure at the wheels plus two isolating valves and two electrically operated shuttle valves.

(1) When installed in vehicle

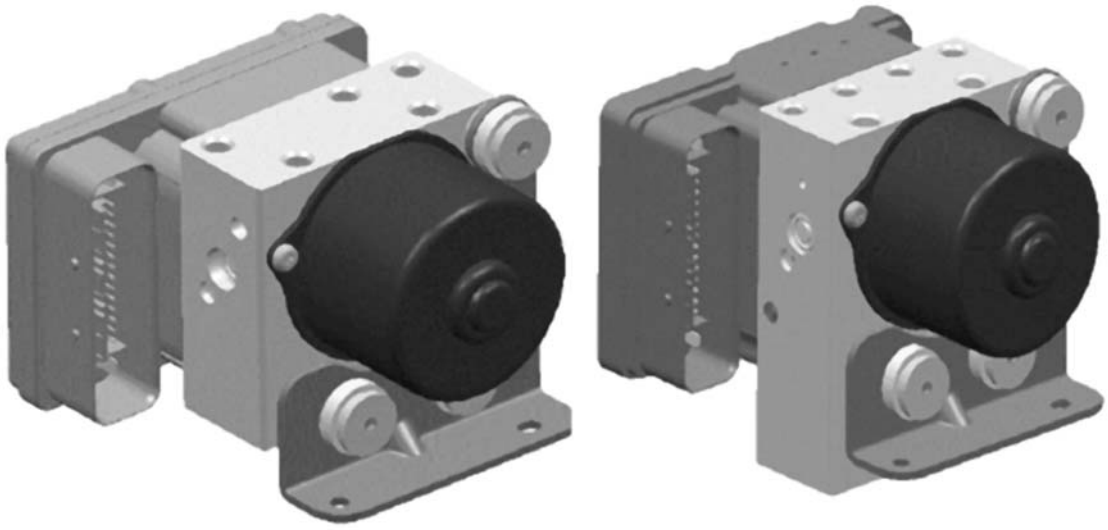


Y220_8E2024

HECU consists of motor pump, solenoid valve and ECU.

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

(2) Comparison between ESP HECU and ABS/EBD HECU



ABS/EBD HECU ESP HECU

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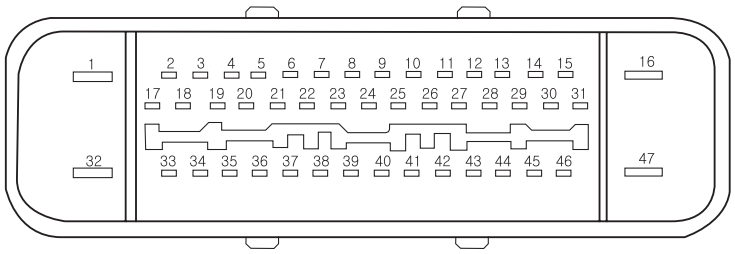
▶ Connector



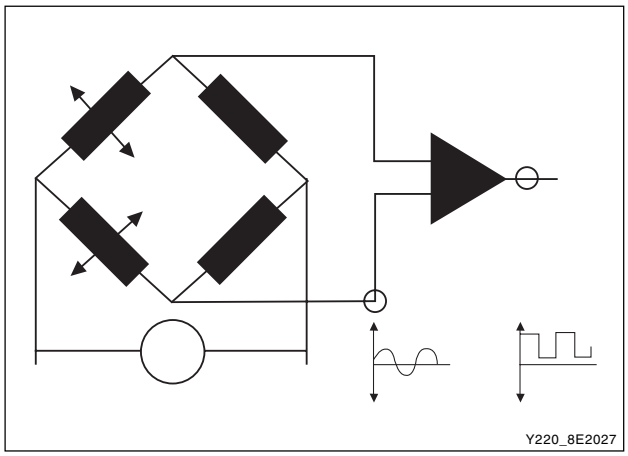
Y220_8E2026

Pin no.	Name	Current Tange	Voltage Range	ABS ECU
1	Battery (B+)	Max. 30 A	0 ~ 18 V	O
2	Self diagnosis (K-Line)	Max.100 mA	0 ~ 18 V	O
3	Steering wheel angle sensor (STN)	Max. 10 mA	0 ~18 V	-
4	IGN1	Max. 200 mA	0 ~ 18 V	O
5	Steering wheel angle sensor ground	Max. 100 mA	0 V	-
6	Sensor cluster power	Max. 250 mA	0 ~ 18 V	-
7	Steering wheel angle sensor power	Max. 10 mA	0 ~ 18 V	-
8	-	-	-	-
9	-	-	-	-
10	-	-	-	-
11	CAN (High)	Max. 100 mA	0 ~ 18 V	O
12	-	-	-	-
13	-	-	-	-
14	-	-	-	-
15	CAN (Low)	Max. 100 mA	0 ~ 18 V	O
16	Ground	Max. 20 A	0 V	O
17	-	-	-	-
18	Pressure sensor (No.1) power	Max. 20 mA	5 V	-
19	Pressure sensor (No.1) ground	Max. 20 mA	0 V	-
20	Pressure sensor (No.1) signal	Max. 10 mA	5 V	-
21	Pressure sensor (No.2) ground	Max. 20 mA	0 V	-
22	Pressure sensor (No.2) power	Max. 20 mA	5 V	-
23	Pressure sensor (No.2) signal	Max. 10 mA	5 V	-
24	-	-	-	-
25	Sensor cluster CAN (Low)	Max. 10 mA	0 ~ 18 V	-
26	-	-	-	-
27	-	-	-	-
28	Steering wheel angle sensor (ST2)	Max. 10 mA	1.3 ~ 4.1 V	-
29	Sensor cluster CAN (HIGH)	Max. 10 mA	0 ~ 18 V	-
30	Steering wheel angle sensor (ST1)	Max. 10 mA	1.3 ~ 4.1 V	-
31	Sensor cluster ground	Max. 250 mA	0 V	-
32	Battery (B+)	Max. 20 A	0 ~ 18 V	O
33	Wheel speed sensor ground (FR)	3 ~ 45 mA	0 V	O
34	Wheel speed sensor ground signal (FR)	3 ~ 45 mA	0 ~ 18 V	O
35	-	-	-	-
36	Wheel speed sensor ground signal (RL)	3 ~ 45 mA	0 ~ 18 V	O
37	Wheel speed sensor ground ground (RL)	3 ~ 45 mA	0 V	O
38	-	-	-	-
39	-	-	-	-
40	ESP OFF switch	Max. 10 mA	0 ~ 18 V	-
41	Stop lamp switch	Max. 10 mA	0 ~ 18 V	O
42	Wheel speed sensor ground ground (RR)	3 ~ 45 mA	0 V	O
43	Wheel speed sensor ground signal (RR)	3 ~ 45 mA	0 ~ 18 V	O
44	ABS warning lamp	Max. 20 mA	0 ~ 18 V	O
45	Wheel speed sensor ground signal (FL)	3 ~ 45 mA	0 ~ 18 V	O
46	Wheel speed sensor ground ground (FL)	3 ~ 45 mA	0 V	O
47	Ground	Max. 30 A	0 V	O

WHEEL SPEED SENSOR

▶ Active Wheel Sensor

- Measuring bridge with four resisters
- Measuring the current
- Supplying the voltage (12 V)
- Amplifier/comparison measuring device



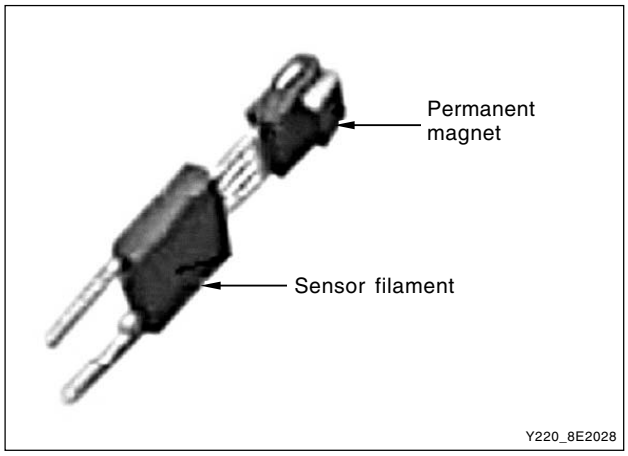
Composition and function of active wheel sensor

▶ Function of Active Sensor System

The basic tone wheel and the magnetized encoder wheel to activate the sensor. When the vehicle is moving, the sine wave signal is changed in the magnetic field of wheatstone bridge due to the rotation of tone wheel. This can be done directly by ABS control unit.

▶ Active Sensor Element of Encoder Wheel

This sensor has the measuring bridge integrated plastic housing and is fixed to small permanent magnet. Four lead wires that receive electrical output value are connected to the IC integrated plastic housing. Two connecting pins are used for signal output and voltage supply.



Active sensor element in encoder wheel

▶ Specifications

Description	Specifications	Reference
Supplying voltage	DC 12 V	
Air gap	Front: 0.335 ~ 0.945 mm	Cannot measure the air gap
	Rear: 0.309 ~ 0.958 mm	
Output current (vehicle speed at 2.75 Km/h)	7mA(Lo) ~ 14 mA(Hi) +20 % / -16 %	
Tightening torque	Front: 19 ~ 25 Nm	7.5 ~ 20 V
	Rear: 6 ~ 10 Nm	

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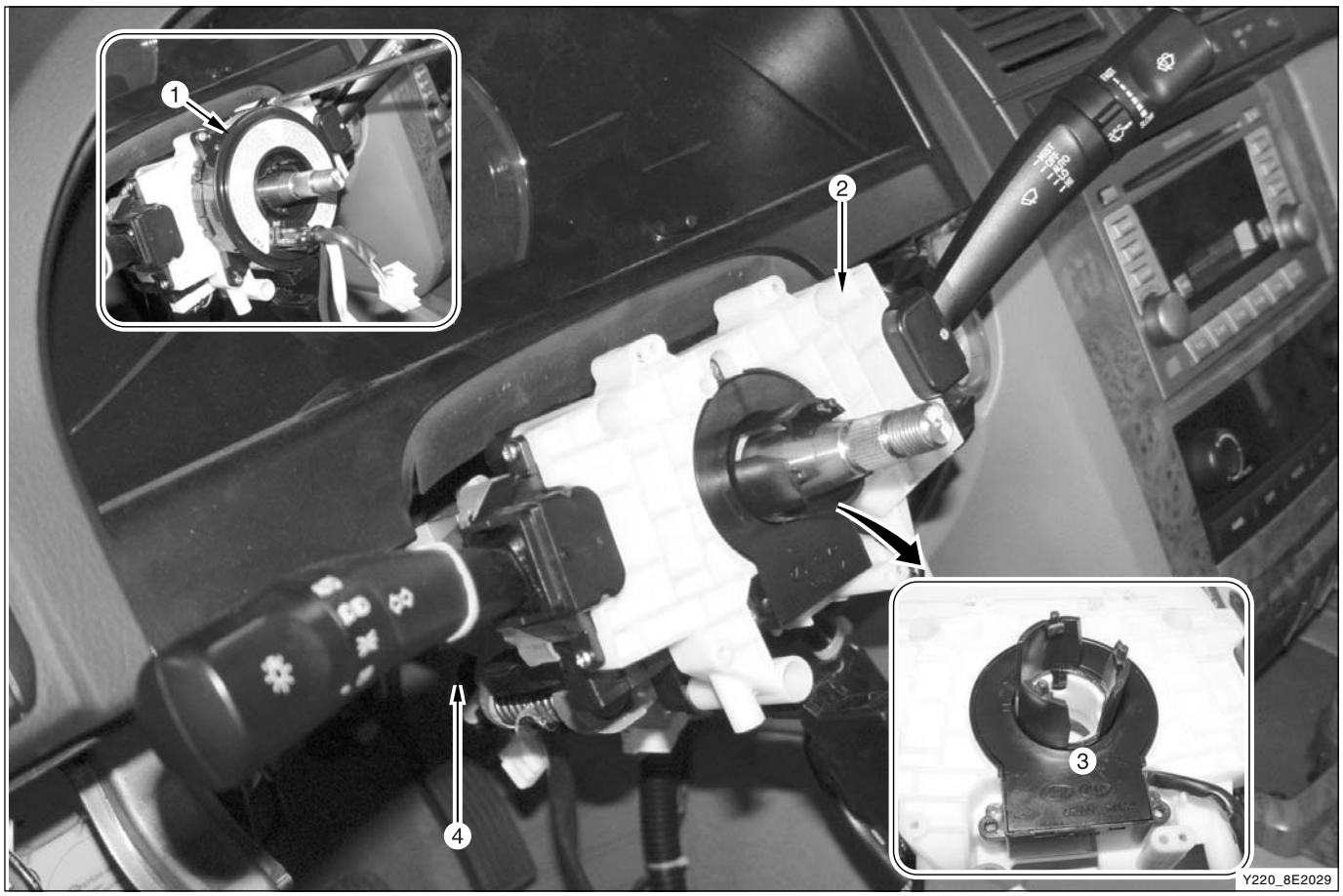
FUNCTION DESCRIPTION AND REMOVAL/INSTALLATION

STEERING WHEEL ANGLE SENSOR (SWAS)

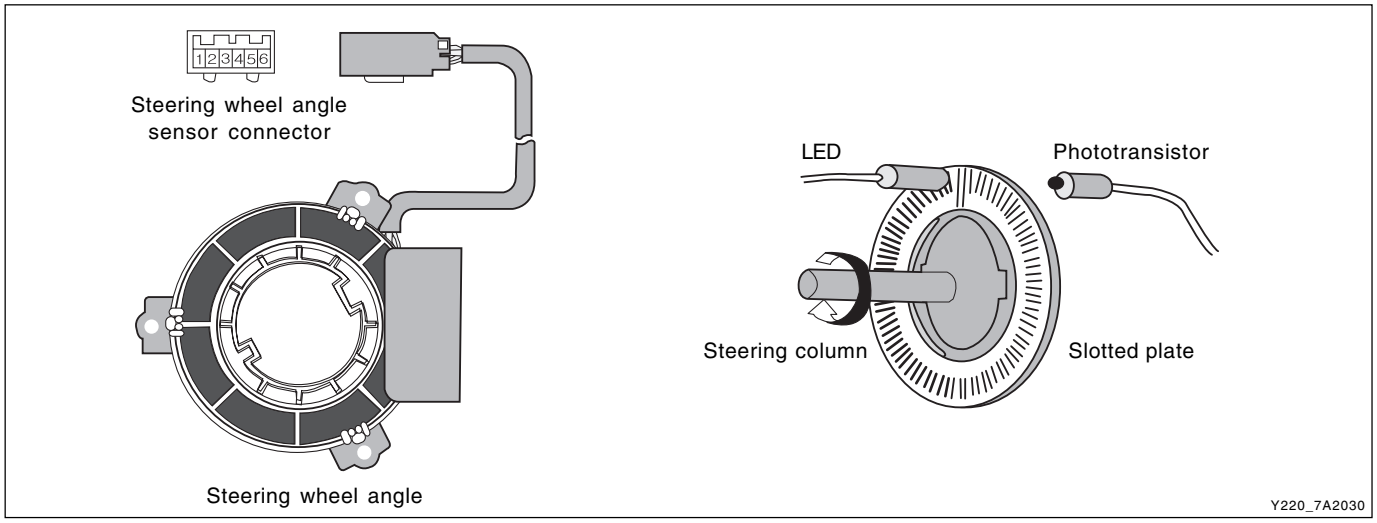
The steering wheel angle sensor is located between clock spring and multifunction switch. This sensor is used for recognition of driver's intends. If the sensor is replaced with new one, it can detect the neutral position after the vehicle is moving over 20 km/h for more than 5 seconds.



1. Clock spring
2. Multifunction switch
3. Steering wheel angle sensor
4. Steering column

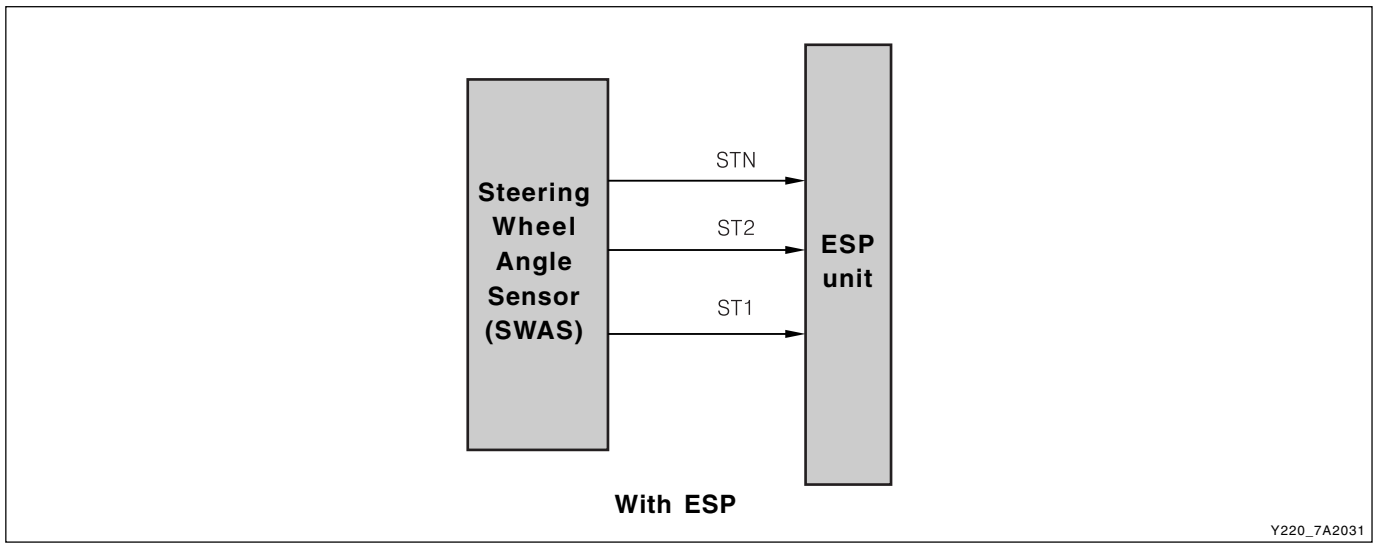
Specifications

Descriptions	Specifications
Working voltage	9 ~ 16 V
Max. output current	10 mA
Detected max. angular velocity	1500°/S
Working temperature	-30 ~ 75°C
Supplying voltage	9 ~ 16 V(battery voltage)
When short	0V
When short to sensor	Power voltage - 0.7 V
Output voltage (HI)	Approx. 3.50 V (3.0 ~ 4.1 V)
Output voltage (LO)	Approx. 1.50 V (1.3 ~ 2.0 V)

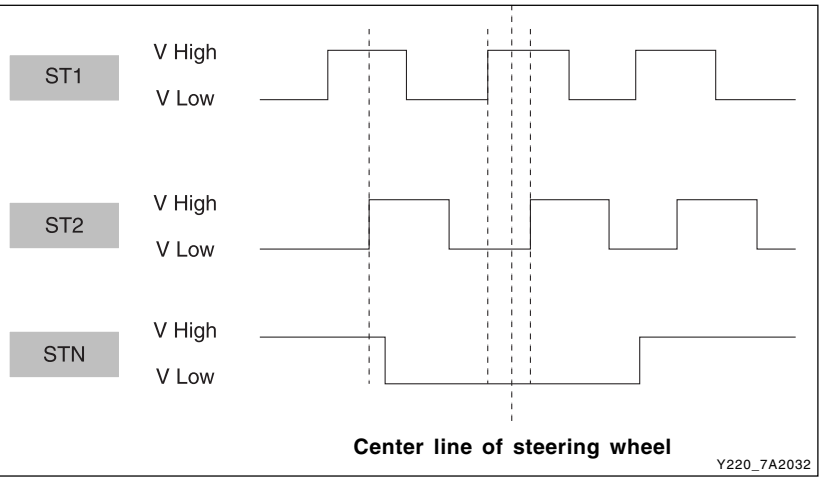


The steering wheel angle sensor is integrated with the phototransistor and the LED and there is a slotted plate between them. When the inner slotted plate rotates with the steering column shaft when the steering wheel is turned, the voltage occurs through the holes. The detected voltage will be transmitted to the ESP unit as a pulse from the 3 terminals.

Then, the two voltage pulses are used to get the average value for detecting the steering wheel position and its angle speed. And the other pulse is used for checking the alignment of the steering wheel.



Working voltage	9 ~16 V
Number of pulse per revolution	45 Pulses /1rev
Duty	Approx. 50 %
High - V	3.0 ~ 4.1 V
Low - V	1.3 ~ 2.0 V
ST1 and ST2	Detects steering wheel angle and angular velocity as an average value
STN	Detects the center value of steering wheel



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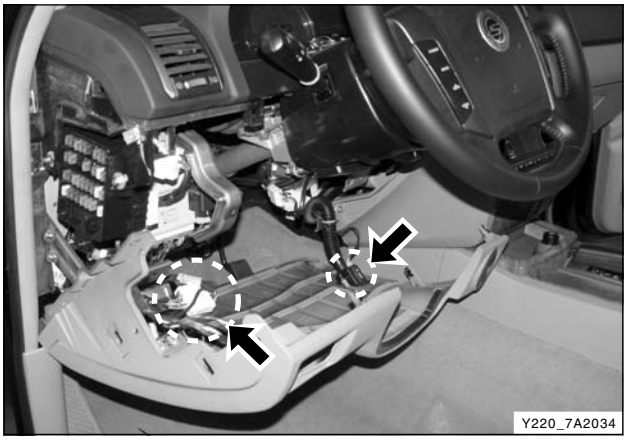
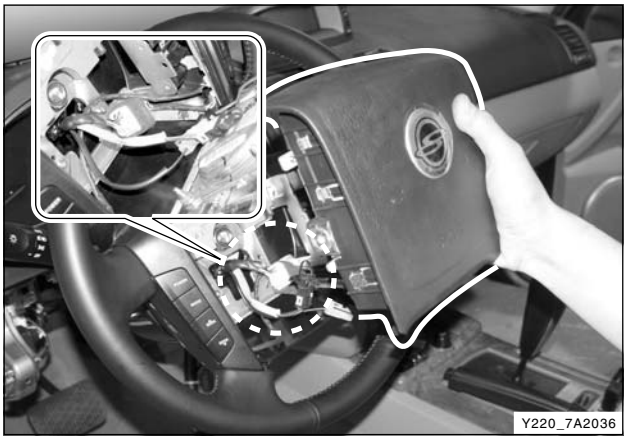
Removal and Installation

1. Disconnect the negative battery cable.
2. Place the steering wheel and tires to straight ahead direction.
3. Unscrew the mounting screws on driver's side dash panel and remove the lower blinder outer panel and cover.



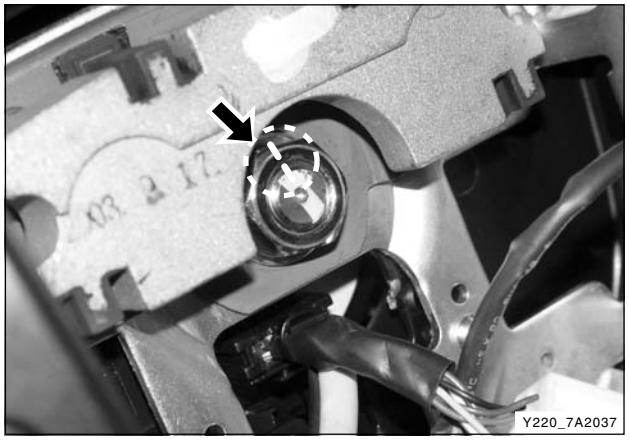
4. Disconnect all the connectors from the outer panel.

5. Disconnect all the connectors from the steering column assembly.

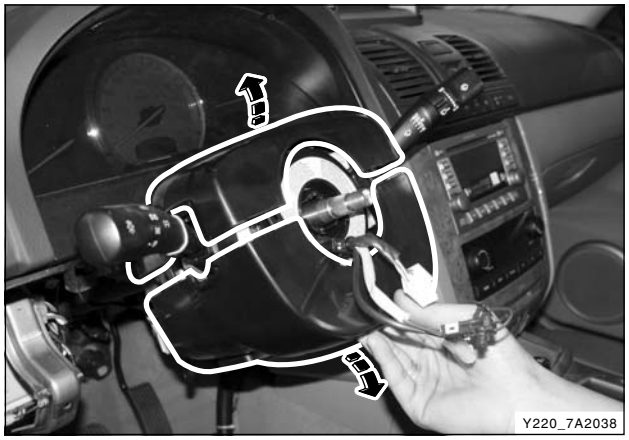


6. Unscrew the mounting nuts and remove the horn switch on the steering wheel.

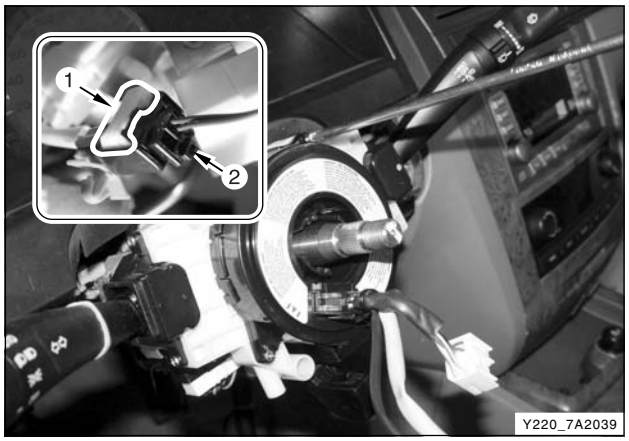
7. Mark on steering wheel mounting nut and remove the steering wheel.



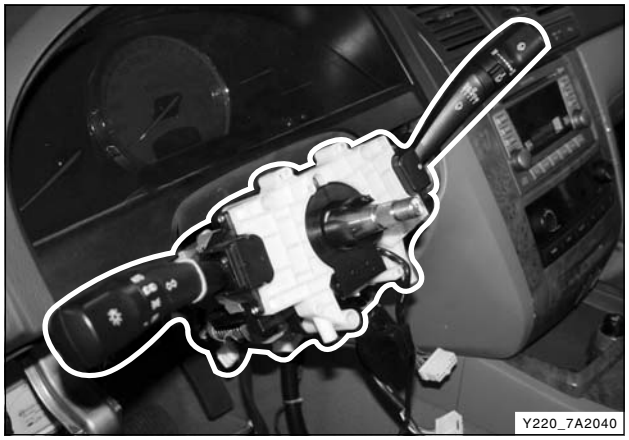
8. Unscrew the upper and lower mounting screws and remove the steering column cover.



9. Remove the air bag sensor module from the steering wheel.



10. Remove the acceleration sensor from the multifunction switch.
11. Install in the reverse order of removal.



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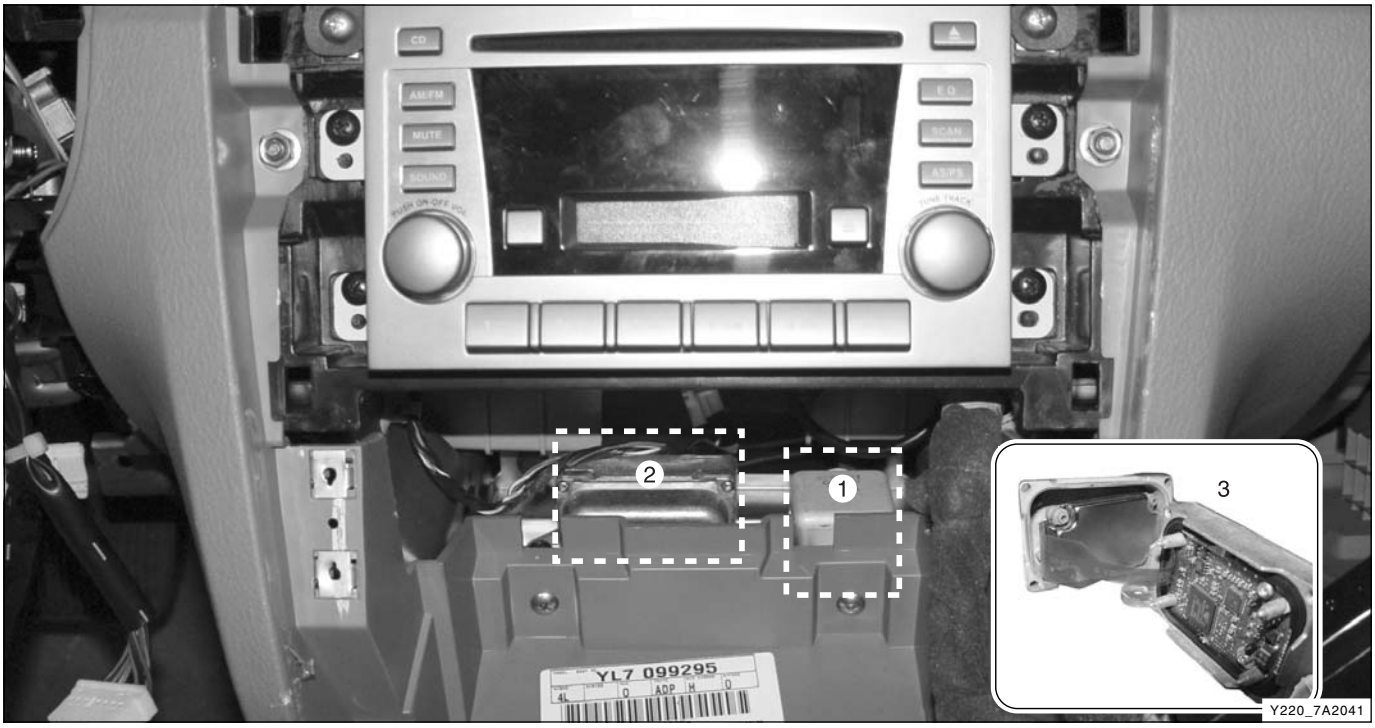
SENSOR CLUSTER

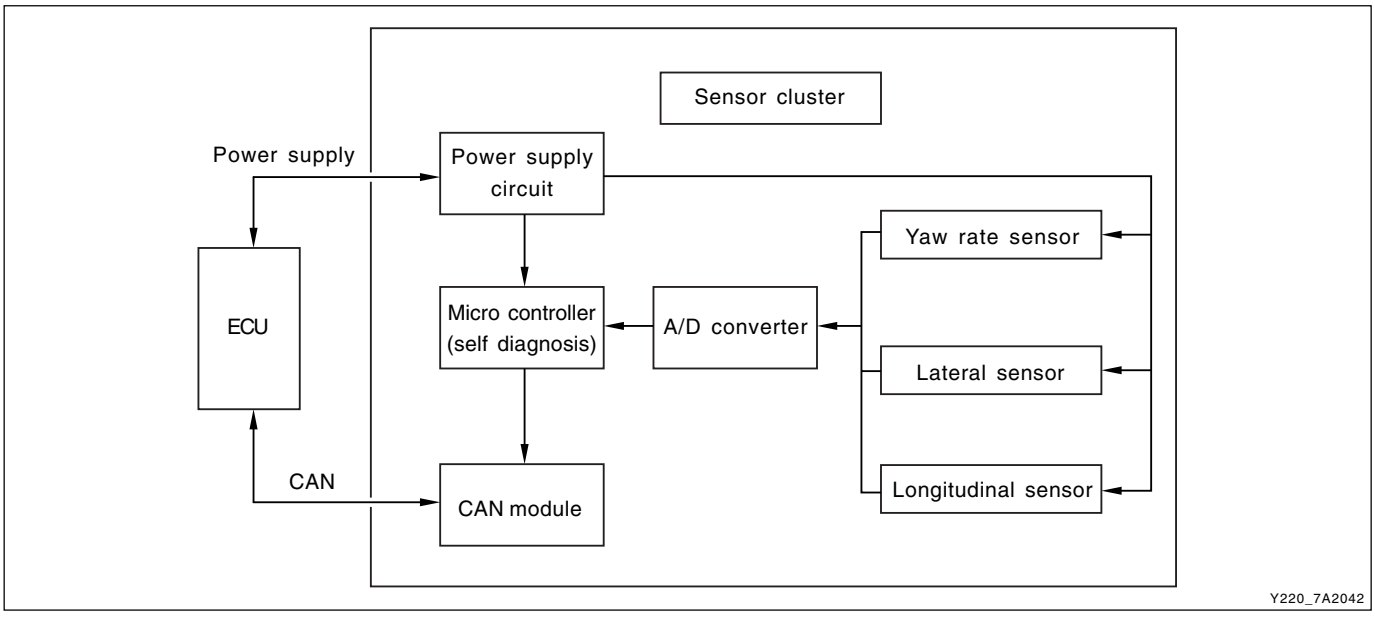
The lateral acceleration sensor and the yaw rate sensor are important components of the Electronic Stability Program. The cluster links these sensors to an on-board computer unit and to a CAN interface, incased in a sturdy housing, that is mounted on the chassis. Its modular concept allows the integration of further sensor functions.

(1) Location

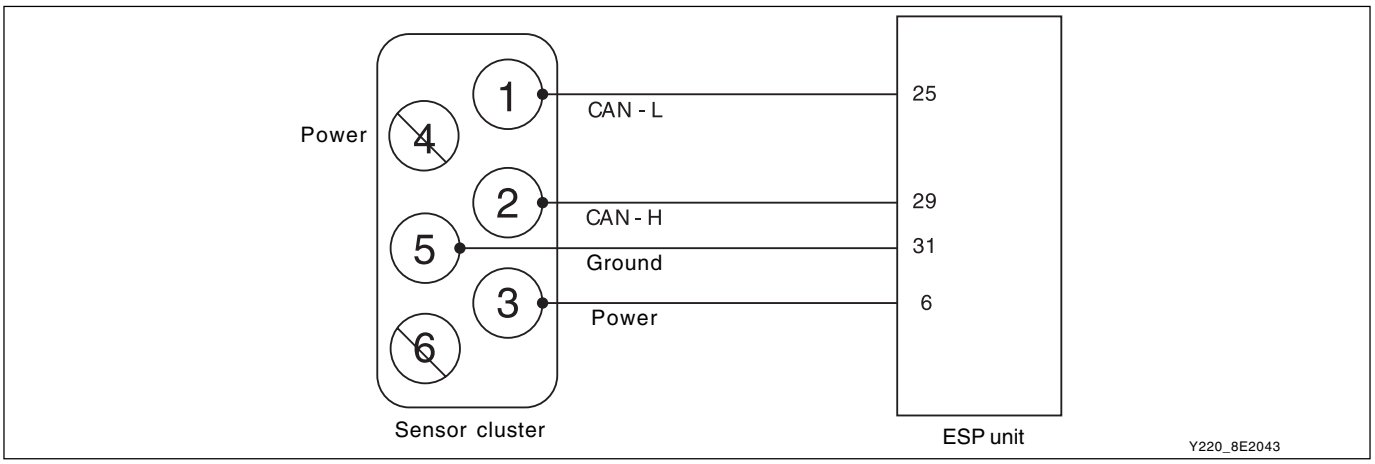


1. Chime bell
2. Sensor cluster: Yaw rate sensor + Lateral acceleration sensor / Yaw rate sensor + Lateral acceleration sensor + Longitudinal acceleration sensor
3. Inside of sensor cluster

(2) Internal electric circuit of sensor cluster



(3) Sensor cluster circuit



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

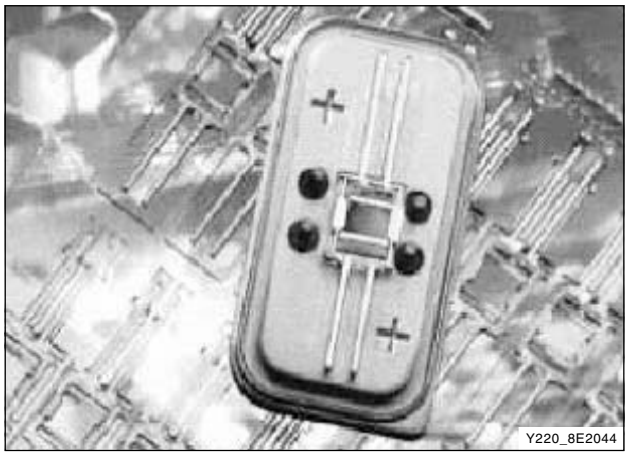
Descriptions	Specifications
Supplying voltage	Approx. 5 V (4.75 ~ 5.25 V)
Output voltage when stop	Approx. 2.5 V (Ignition switch “ON”)
Output range	0.2 ~ 4.8 V
Operation start speed	4 °/s

(5) Yaw rate sensor

Detect the yawing motion of the vehicle, triggering an ESP control intervention if the yaw velocity reaches roundabout 4°/s (= full circle in 90 s)

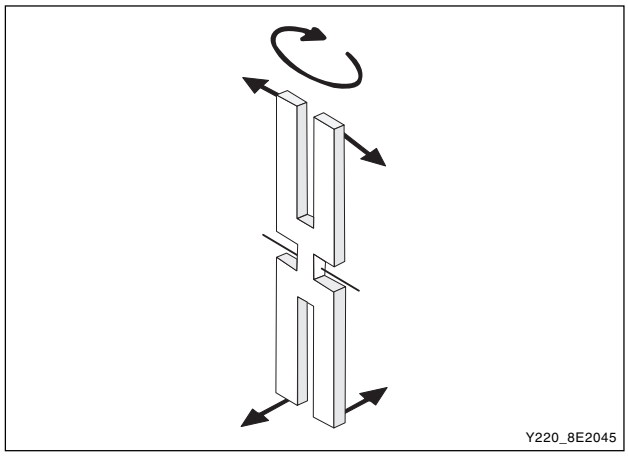
The yaw rate sensor relies on the action of micro-scopic tuning forks. The plane in which these forks vibrate shifts when the car turns around its vertical axis. This shift is evaluated electronically.

A faulty yaw rate sensor produces an output signal of 0 V.



Installation position

- Tuning forks vertical
- Required accuracy of position: max. ± 3° tolerance to maintain full comfort
- Failure to maintain the specified installation position will result in asymmetrical control



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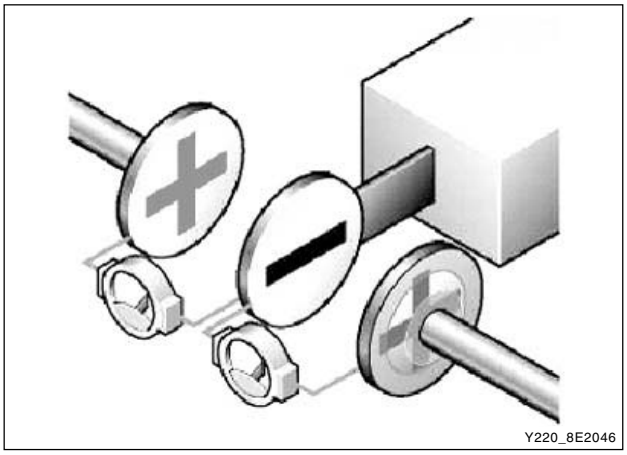
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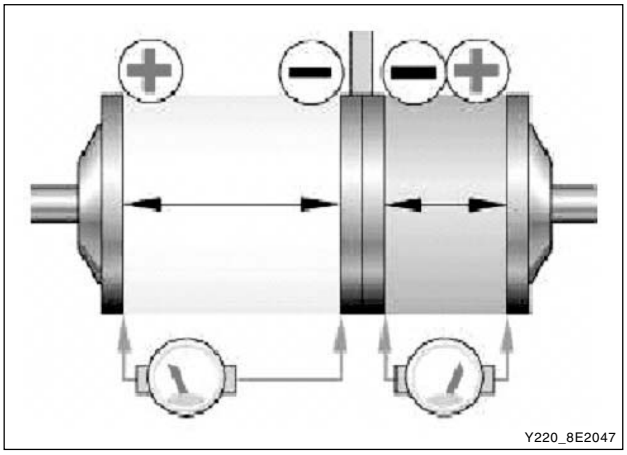
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(6) Lateral/Longitudinal acceleration sensor

These sensors sense the lateral/longitudinal acceleration of the vehicle and located in sensor cluster. For 4WD vehicle, the longitudinal sensor is located in sensor cluster and the functions are same only except the direction. The lateral acceleration sensor detects the movement of lateral direction and the longitudinal acceleration sensor detects the movement of longitudinal direction (driving direction).

Between two electrically charged stationary plates having the same polarity, an electrically charged silicon element having the opposite polarity is attached to the end of a cantilever arm. Between these three plates, two electric fields are generated by the capacitors C1 and C2. The capacitances of C1 and C2 change in response to lateral acceleration. This change can be used to calculate the direction and amount of lateral/longitudinal acceleration acting on the vehicle. For 0 g lateral acceleration, the sensor produces an output signal with a voltage of 2.5 V.

The signal of the lateral acceleration sensor alone cannot trigger an ESP intervention.

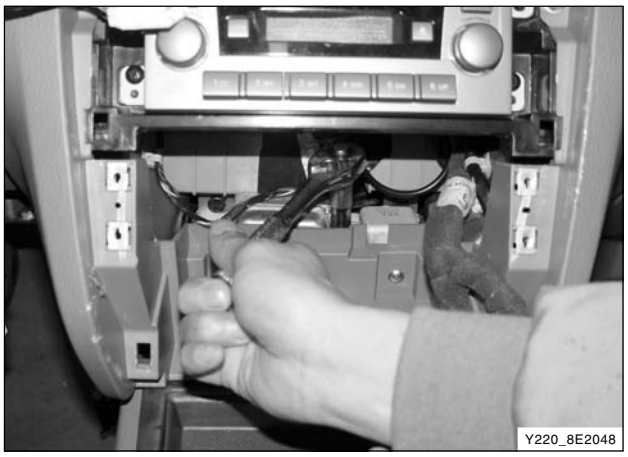
The ESP sensor cluster can be considered as one module. The measured value by lateral/longitudinal and yaw rate sensors is transmitted to ESP unit via two CAN lines.

The supplied voltage from ESP unit is approx. 5 V with ignition key “ON” and the output range through CAN line is approx. 0.2 to 4.8 V.

When a sensor is faulty, the sensor cluster produces an output signal of 0 V (fail safe function).

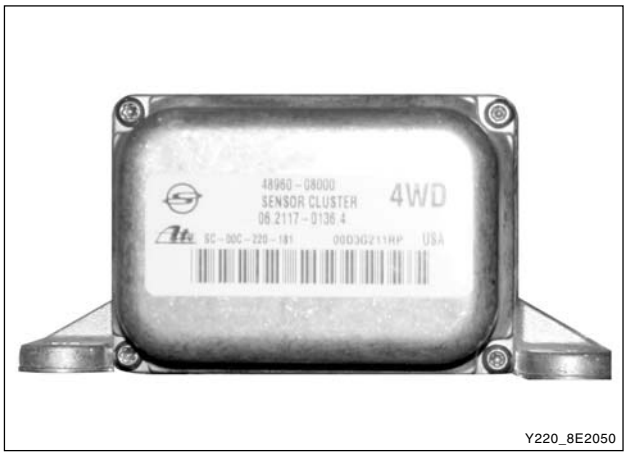
REMOVAL AND INSTALLATION

1. Remove the sensor cluster mounting bolts.



2. Disconnect the sensor cluster connector.

3. Remove the sensor cluster unit.



4. Install in the reverse order of removal.

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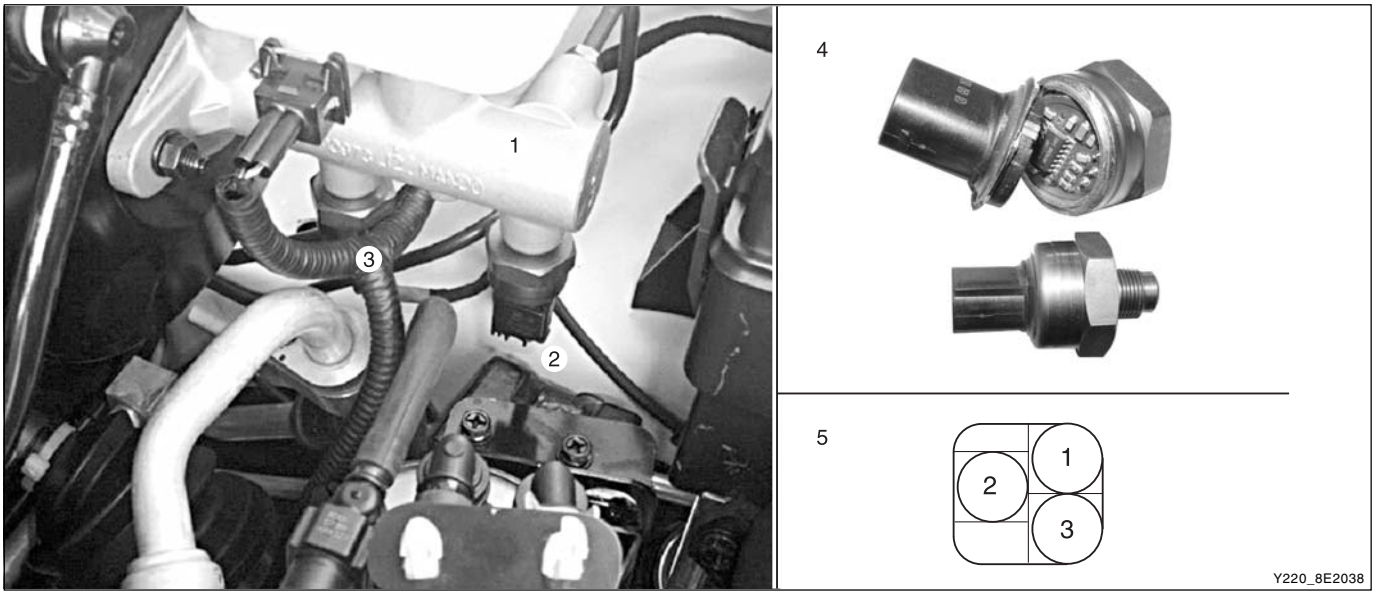
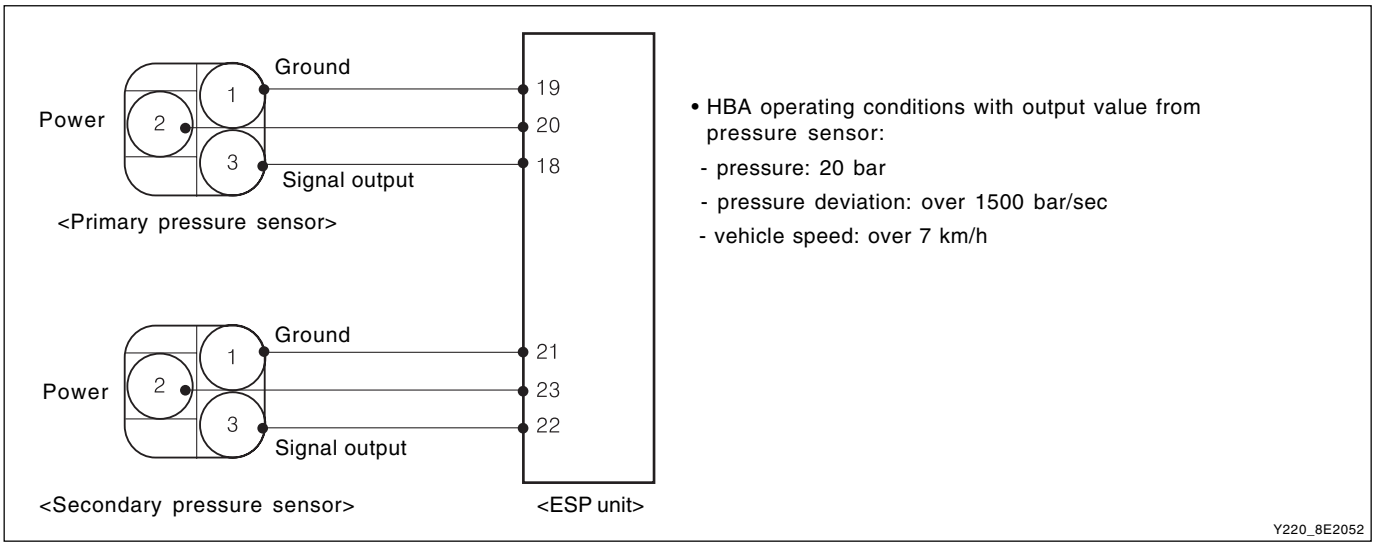
PRESSURE SENSOR

(1) Location



1. Master cylinder
2. Primary pressure sensor
3. Second pressure sensor
4. Inside of pressure sensor
5. Connector

(2) Pressure sensor circuit



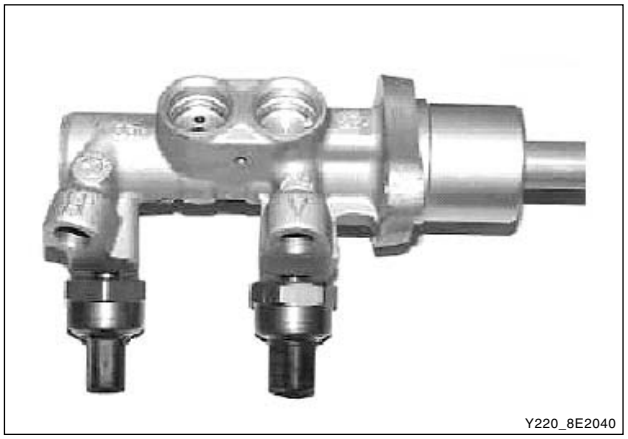
- HBA operating conditions with output value from pressure sensor:
  - pressure: 20 bar
  - pressure deviation: over 1500 bar/sec
  - vehicle speed: over 7 km/h

(3) Specifications

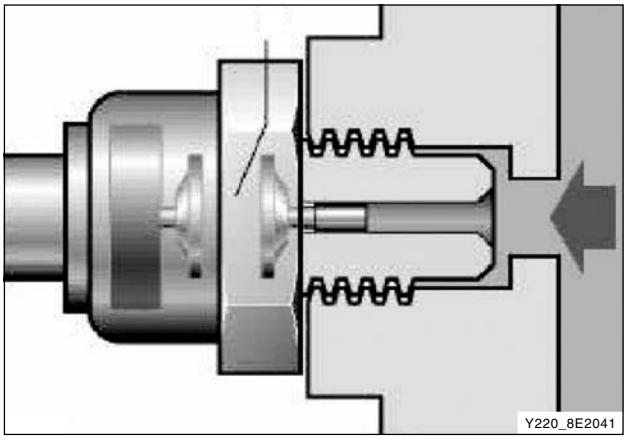
Descriptions	Specifications
Supplying voltage	4.75 ~ 5.25 V
Output range	0.25 ~ 4.75 V
Output voltage when stop	2.5 V
Working pressure range	0 ~ 170 bar

(4) Pressure sensor

a. The pressure sensor senses the driver's braking intentions (braking while an ESP intervention is in progress) and controls the precharging pressure.

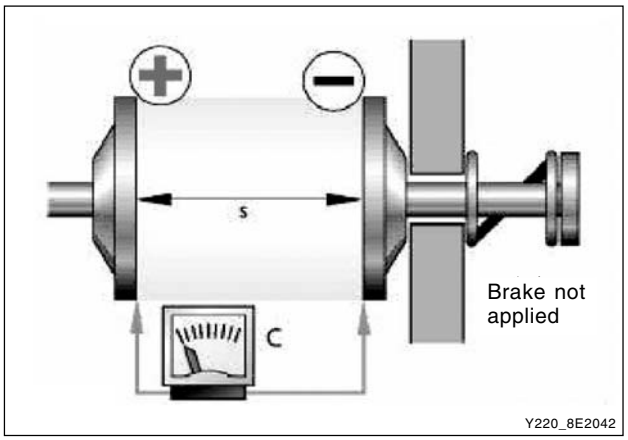


b. The sensor consists of two ceramic disks, one of which is stationary and the other movable. The distance between these disks changes when pressure is applied.

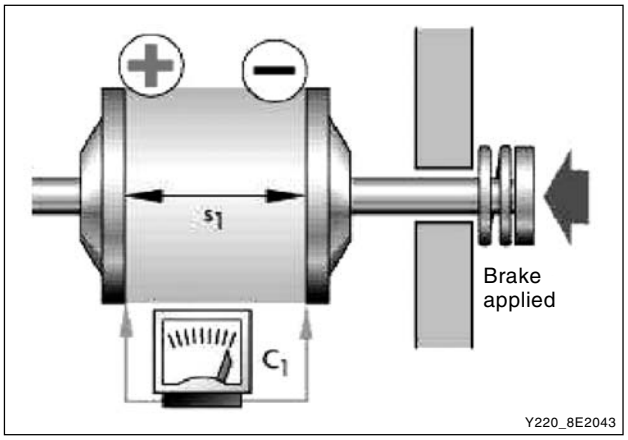


c. The pressure sensors operate on the principle of changing capacitance (a).

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



d. When brake pressure is applied from the master cylinder, the ceramic disk moves towards the fixed ceramic disk and the electric charge volume changes accordingly.



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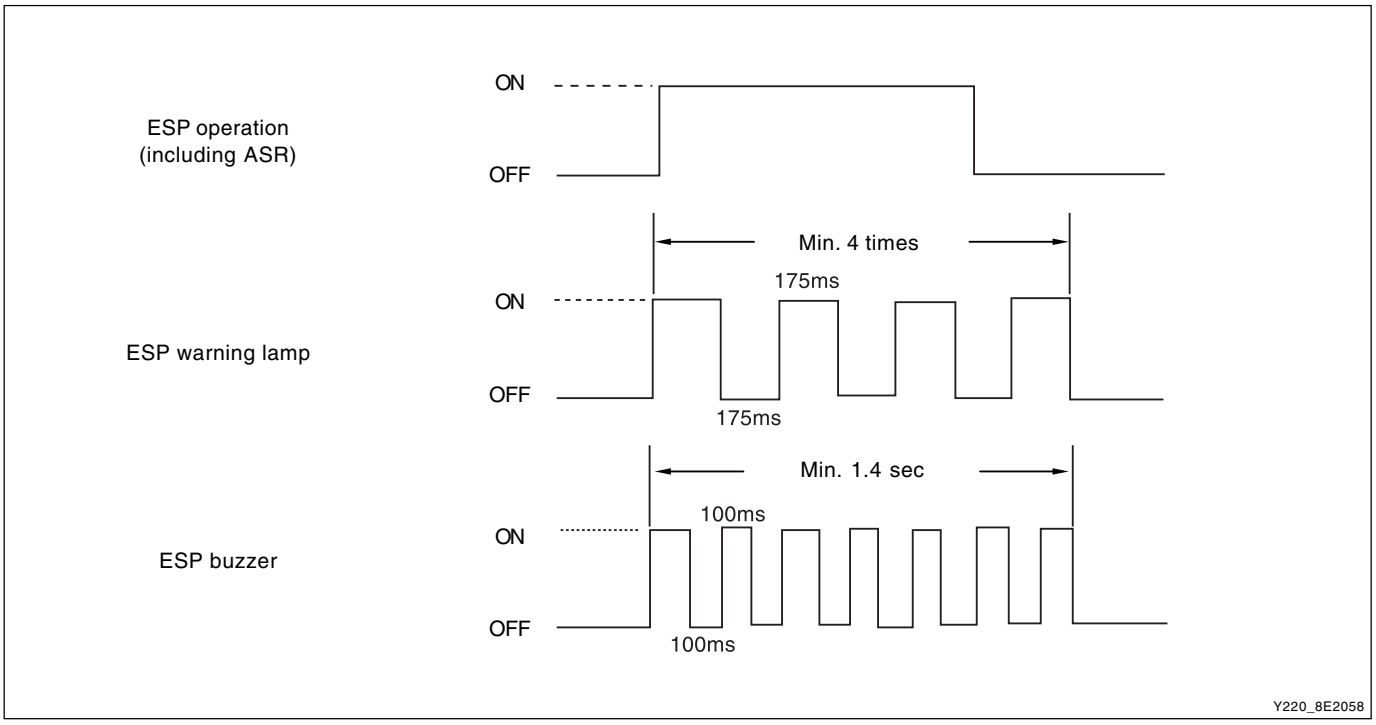
If two signals from pressure sensor deviates from the specified value, HECU determines the sensor is faulty. The sensor output is analog signal that is proportional to voltage and the HECU recognized the pressure value as signal value against supplying voltage.

- Maximum measurable pressure: 170 bar
- Linear changes of about 0.5 volts when the brake is not operating and 4.75 volts when the brake is operating.

WARNING LAMP AND INDICATOR

(1) ESP warning lamp blinking in control

ESP warning lamp blinks when ESP control is activated. If the activation reaches a certain limitation, a beep sounds to warn the driver. The ESP warning lamp goes off when ESP function is deactivated. Even when the ESP is operated for a very short period of time, the ESP warning lamp blinks minimum of 4 times every 175 milliseconds and the buzzer sounds for at least 1.4 seconds with 100 ms interval.



(2) ESP system cancellation using the ESP OFF switch

When the ESP switch at the center switch panel is pushed (for over approximately 150 ms), the ESP system will be cancelled and the vehicle will be driven regardless of the output values from the corresponding sensors. Then, the ESP warning lamp on the instrument panel comes on.

The detailed operation procedures are as follows:

1) The ESP warning lamp comes on when the ESP OFF switch is pushed for over 150 ms.
2) The switch returns to normal position when the OFF switch is released.
3) The ESP system will be cancelled after approximately 150 ms.

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

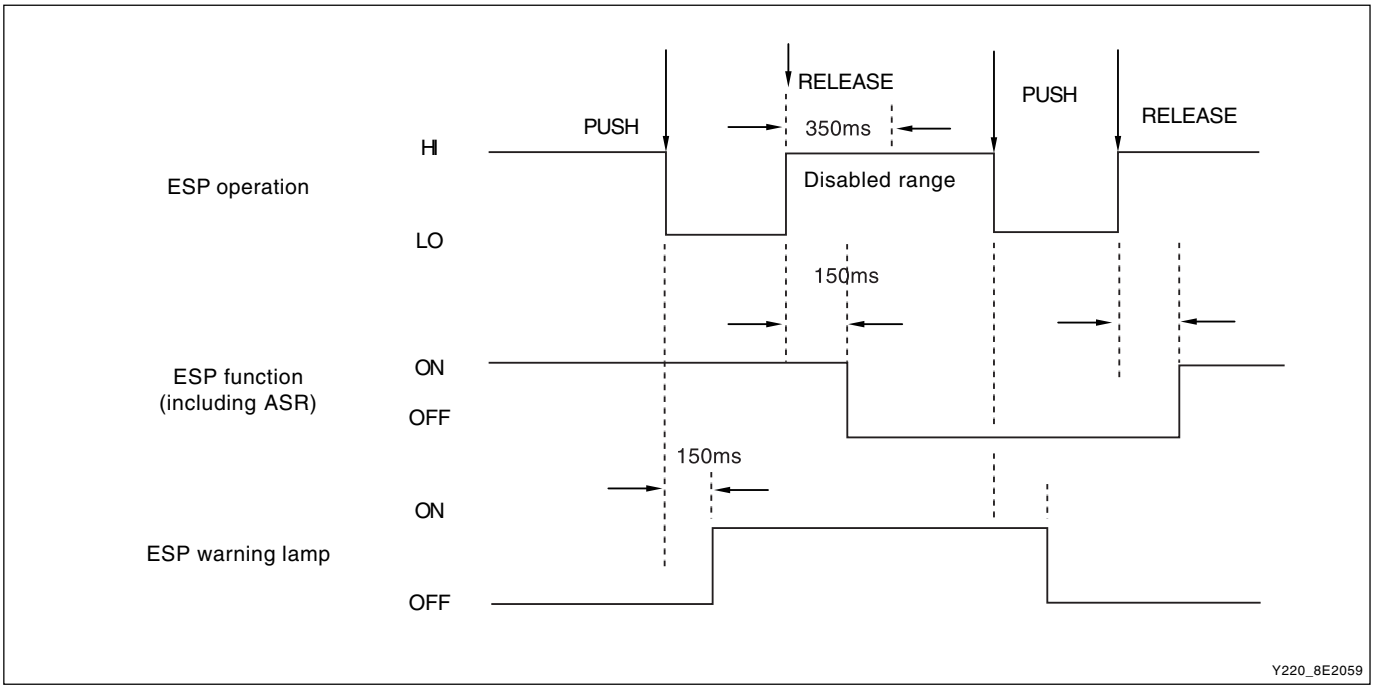
When you turn the ESP system off by pressing the ESP switch for over 150 ms, the TCS system is turned off. And the basic ABS system will operate.

(3) Resuming the ESP system by using the ESP OFF switch

The ESP system will be resumed and the ESP warning lamp at the instrument panel goes off when the ESP switch at the center switch panel is pushed (for over approximately 150 ms) while the ESP system is not operating.

The detailed operation procedures are as follows.

1) The ESP warning lamp comes on when the ESP OFF switch is pushed for over 150 ms.
2) The switch returns to normal position when the OFF switch is released.
3) The ESP system will be resumed after approx. 150 ms.



Notice

- ***When turning the ignition switch off while the ESP system is activated, the ESP system will be resumed when ignition switch is turned on again.***
- ***When the vehicle is controlled by ESP system during driving, the ESP OFF switch does not operate.***
- ***The ESP OFF switch operates when it is pushed for over 150 ms. When it is pushed for less than 150 ms, the ESP OFF mode and the ESP warning lamp will not be changed.***
- ***When the ESP OFF switch is pushed within 350 ms of being turned off, the ESP warning lamp and ESP system will not be turned on.***

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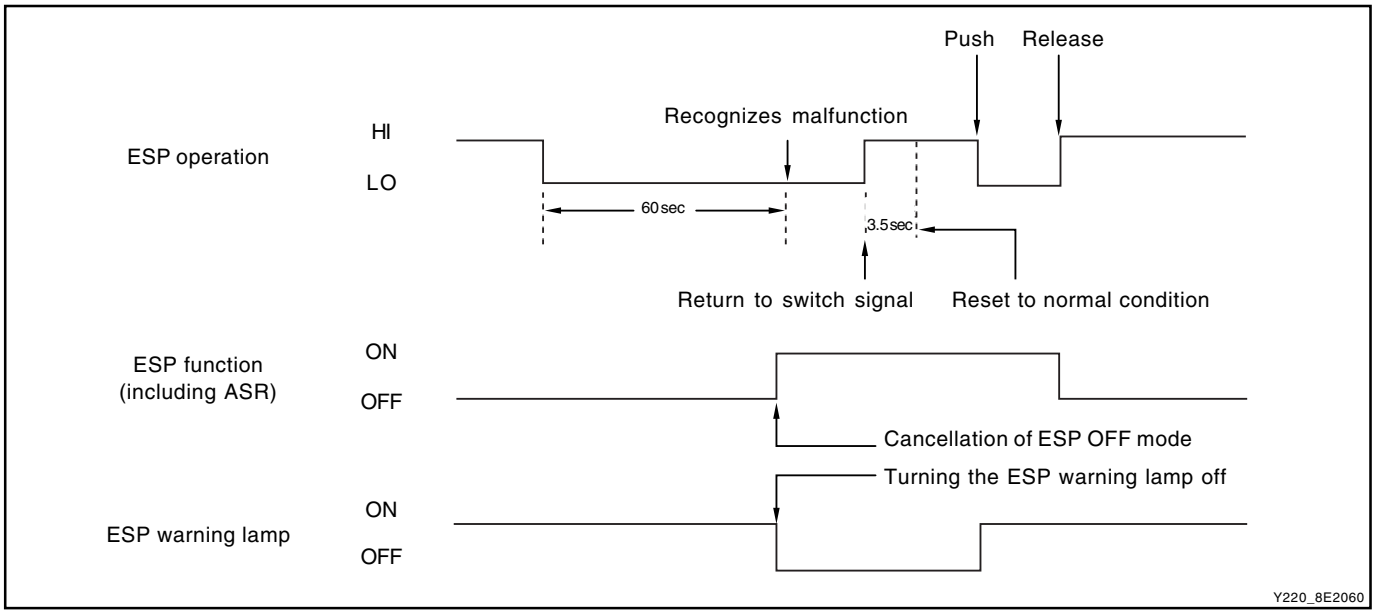
(4) ESP OFF switch monitoring

When the ESP unit recognizes that the ESP OFF switch is pushed for over 60 seconds, the ESP unit determines it as a ESP OFF switch malfunction. When the ESP OFF switch is pushed, the ESP system is resumed after 60 seconds. However, the ESP warning lamp comes on when the ESP OFF switch is pushed (for over 150 ms) and then goes out when the ESP system is resumed. When the ESP OFF switch returns to normal position, the ESP unit resets the ESP OFF switch for approx. 3.5 seconds.



(5) ESP warning lamp operation depending on system conditions

The table shows ESP warning lamp operations when the ESP system is defective or ESP (including TCS function) is working.

	Warning Lamp				Controls				
	EBD W/L	ABS W/L	ESP W/L	ESP BUZZER	EBD	ABS	ASR	ABD	Vehicle yaw control
Initial start	ON	ON	ON	OFF	X	X	X	X	X
(for 1.8 sec) Normal mode	OFF	OFF	BLINKS WHEN ESP OPERATION	INTERMITTENT BEEP SOUNDS WHEN ESP OPERATION	O	O	O	O	O
ESP fault	OFF	OFF	ON	OFF	O	O	X	X	X
ABS fault	OFF	ON	ON	OFF	O	X	X	X	X
System fault	ON	ON	ON	OFF	X	X	X	X	X
Low batt. voltage 1st	OFF	ON	ON	OFF	O	X	X	X	X
Low batt. voltage 2nd	ON	ON	ON	OFF	X	X	X	X	X
High battery voltage	ON	ON	ON	OFF	X	X	X	X	X
High brake pad temp.	OFF	OFF	ON	OFF	O	O	* * O	X	O
ESP-OFF mode	OFF	OFF	ON	OFF	O	O	X	X	*O
Entering diag. mode	ON	ON	ON	OFF	X	X	X	X	X

*) When the driver presses the brake pedal during the ESP OFF mode, the yaw control is performed to compensate the vehicle stability (posture) during ESP operation.

* *) The ASR controls only engine control

AIR BLEEDING FROM BRAKE SYSTEM

The vehicle equipped only with ABS can use the conventional air bleeding procedures, however, the vehicle equipped with ESP should use the oil supply device with compressor to bleed the air.

Air bleeding should be done when:

1. Removal and installation of the brake master cylinder
2. Removal and installation of the ABS HECU
3. Removal and installation of the brake oil pipes and hoses
4. Replacing the brake fluid

Air bleeding procedures

1. Apply the parking brake and start the engine when the shift lever is at “P” position.
2. Connect the oil supply device (air bleeding device) with air compressor to brake reservoir. The oil supply device should be filled with sufficient oil.
3. Loosen the air bleed screw in caliper and place an empty container under the screw.
4. Bleed the air in each wheel by using diagnostic device (Scanner). At this time, the modulator motor runs for 180 seconds.
5. Simultaneously, run the oil supply device to supply oil and depress the brake pedal repeatedly.

   This procedure needs at least 3 persons for doing below jobs:

   1) Collect the bleeding oil into the container.
   2) Depress the brake pedal repeatedly.
   3) Check the conditions of oil supply device.
6. Repeat the step 4 through 5 until clear brake fluid comes out of air bleed screw.
7. Perform the same procedures at each wheel.

Notice

Replace the brake oil at every 2 years.

Notice

- ***Always bleed the air after replacing the brake fluid or master cylinder, caliper, brake hose and pipe.***
- ***Never reuse the used brake fluid.***
- ***Do not pump the brake pedal too fast. It may cause some troubles for air bleeding operation.***
- ***Be careful not to splash the brake fluid on painted area or body.***
- ***Check the connection areas for leaks after air bleeding.***

TROUBLE DIAGNOSIS

[O: Applied, X: N/A]

Trouble Code	Defective Components	Descriptions	ABS	ESP
C1011 (5011)	Wheel speed sensor front left-electrical	Cause - Defective front LH wheel speed sensor - Short or poor contact wire to sensor Action - Check the wheel speed sensor connector and HECU connector - Check the harness connection	O	O
C1012 (5012)	Wheel speed sensor front left-other	Cause - Defective front LH wheel speed sensor - No signals from wheel speed sensor and tooth wheel - Different number of teeth in tooth wheel Action - Check air gap and tooth wheel mounting - Check the number of teeth in tooth wheel: 48	O	O
C1021 (5021)	Wheel speed sensor front right-electrical	Cause - Defective front RH wheel speed sensor - Short or poor contact wire to sensor Action - Check the wheel speed sensor connector and HECU connector - Check the harness connection	O	O
C1022 (5022)	Wheel speed sensor front right-other	Cause - Defective front RH wheel speed sensor - No signals from wheel speed sensor and tooth wheel - Too large air gap between wheel speed sensor and tooth wheel - Different number of teeth in tooth wheel Action - Check air gap and tooth wheel mounting - Check the number of teeth in tooth wheel: 48	O	O
C1031 (5031)	Wheel speed sensor rear right-electrical	Cause - Defective rear RH wheel speed sensor - Short or poor contact wire to sensor Action - Check the wheel speed sensor connector - Check the EBCM connector - Check the harness connection	O	O

Trouble Code	Defective Components	Descriptions	ABS	ESP
C1032 (5032)	Wheel speed sensor rear right-other	Cause - Defective rear RH wheel speed sensor - No signals from wheel speed sensor and tooth wheel - Too large air gap between wheel speed sensor and tooth wheel - Different number of teeth in tooth wheel Action - Check air gap and tooth wheel mounting - Check the number of teeth in tooth wheel: 48	O	O
C1041 (5041)	Wheel speed sensor rear left-electrical	Cause - Defective rear LH wheel speed sensor - Short or poor contact wire to sensor Action - Check the wheel speed sensor connector - Check the HECU connector - Check the harness connection	O	O
C1042 (5042)	Wheel speed sensor rear left-other	Cause - Defective rear LH wheel speed sensor - Check the wheel speed sensor connector - Too large air gap between wheel speed sensor and tooth wheel - Different number of teeth in tooth wheel Action - Check air gap and tooth wheel mounting - Check the number of teeth in tooth wheel: 48	O	O
C1051 (5051)	Pressure sensor	Cause - Abnormal signals from pressure sensor - Defective pressure sensor or harness Action - Check the pressure sensor connector - Check the output voltage (stop): 0.5 V - Check the output voltage (brake applied): 0.25 ~ 4.75 V	X	O
C1061 (5061)	Steering wheel Angle sensor	Cause - Internally defective steering wheel angle sensor - Abnormal signals from steering wheel angle sensor - Short circuit between supplying voltage output and ground - Abnormal signal voltage from steering wheel angle sensor - Poor installation of steering wheel angle sensor and abnormal signal Action - Check the harness connection of steering wheel angle sensor - Check the working voltage : LOW – 1.3 ~ 2.0 V HIGH – 3.0 ~ 4.1 V	X	O

Trouble Code	Defective Components	Descriptions	ABS	ESP
C1071 (5071)	Longitudinal acceleration sensor		X	X
C1072 (5072)	Longitudinal acceleration sensor		X	X
C1073 (5073)	Sensor cluster -electrical	Cause - Operating voltage exceeds specified range (Hi: 18.0 ± 1.0 V / Lo: 6.5 ± 0.5 V) - Poor contact or installation of harness Action - Check the sensor cluster connector - Others	X	O
C1074 (5074)	Sensor cluster-internal	Cause - Internally defective HECU - Abnormal A/D converter voltage: 5.0 ± 3 % - Abnormal supplying voltage (4.580 ~ 4.960 V) to sensor cluster → Short circuit between supplying voltage output of sensor cluster and ground - Poor ground of sensor cluster (0.0 ~ 0.5 V) → Short to ground on sensor cluster - Abnormal signals from longitudinal acceleration sensor - Abnormal signals from lateral acceleration sensor - Abnormal signals from yawing sensor - Poor installation of sensor - Defective sensor cluster - Defective or short circuit of CAN communication line Action - Replace the sensor - Initialize the sensor	X	O
C1101 (5101)	Battery under voltage	Cause - Low voltage out of specified range (9.7 ± 0.3 V) Action - Check the supplying voltage	O	O
C1102 (5102)	Battery over voltage	Cause - Over voltage out of specified range (18.0 ± 1.0 V) Action - Check the supplying voltage	O	O
C1111 (5111)	Disk temperature is high	Cause - Overheated brake disk due to braking force: over 500°C Action - Stop driving for a period of time after turning off the ESP	O	O

Trouble Code	Defective Components	Descriptions	ABS	ESP
C1201 (5201)	Brake lamp switch	Cause - Mechanical defective in brake switch - Defective brake switch harness Action - Check the harness and connector	X	O
C1202 (5202)	ESP OFF switch	Cause - Mechanical defective in ESP OFF switch - Defective ESP OFF switch harness (short to ground) Action - Check the harness and connector for ESP OFF switch	X	O
C1301 (5301)	Valve, valve relay	Cause - Abnormal supplying voltage to valve solenoid - Internally defective HECU Action - Check the battery voltage - Check the HECU connector - Replace the HECU	X	X
C1311 (5302)	Motor pump	Cause - Too low (below 6.0 V) or no supplying voltage to pump motor - Over 0.93 V from pump motor voltage - Poor contact in pump motor connector - Poor ground Action - Check the supplying voltage - Check the HECU connector - Replace the HECU	O	O
C1401 (5401)	HECU hardware	Cause - Internally defective HECU - Defective A/D converter, internal voltage regulator, and controller - Defective sensor and short to supplying voltage line Action - Replace the HECU	O	O
C1501 (5501)	No calibration or SC checksum error	Cause - Abnormal signals from sensors - Poor calibration for sensors Action - Check and initialize the sensors	X	O

Trouble Code	Defective Components	Descriptions	ABS	ESP
C1170 (5170)	Variant coding error	Cause - Coding error - Defective CAN communication line - Discrepancy between HECU coding and vehicle coding Action - Check the HECU coding and vehicle coding - Replace the HECU	(O)	O
C1601 (5601)	CAN bus off	Cause - Defective CAN communication line Action - Check CAN communication line	(O)	O
C1602 (5602)	CAN timeout EMS (communication error between engine ECU and CAN)	Cause - Short to CAN communication line - Overload to CAN communication Action - Check the engine ECU - Check the CAN communication line - Check the engine ECU connector	X	O
C1603 (5603)	CAN timeout TCU (communication error between TCU and CAN)	Cause - Short to CAN communication line - Overload to CAN communication Action - Check the TCU - Check the CAN communication line - Check the engine TCU connector	X	O

ABS/ESP SENSOR VALUE

No	Contnet	Unit	ESP	ABS
1	Wheel Speed Front RH	1 km/h	O	O
2	Wheel Speed Front LH	1 km/h	O	O
3	Wheel Speed Rear RH	1 km/h	O	O
4	Wheel Speed Rear LH	1 km/h	O	O
5	Battery Voltage	0.1 V	O	O
6	Longitudinal Acceleration Sensor	0.01 g - : Straight ahead	O	X (Fixed Value: 0)
7	Lateral Aceleration Sensor	0.01 g + : Left Turn	O	X (Fixed Value: 0)
8	Yaw Rate Sensor	0.5 deg/s + : Left Turn	O	X (Fixed Value: 0)
9	Steering Wheel Angle Sensor	5 deg + : Left Turn	O	X (Fixed Value: 0)
10	Pressur Sensor (Primary)	1 bar	O	X (Fixed Value: 0)
11	Pressur Sensor (Secondary)	1 bar	O	X (Fixed Value: 0)
12	EBD Control	Operation / Non-operation	O	O
13	BTCS Control	Operation / Non-operation	O	X
14	Engine TCS Control	Operation / Non-operation	O	X
15	ESP Control	Operation / Non-operation	O	X
16	ESP / TCS OFF Switch	ON / OFF	O	X
17	ABS Control	Operation / Non-operation	O	O
18	Stop Lamp Switch	ON / OFF	O	O

[O: Applied, X: N/A]

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ABS/ESP FORCED OPERATION

No	Name	Operation
1	Front LH Inlet	Operation / Non-operation
2	Front LH Outlet Valve	Operation / Non-operation
3	Front RH Inlet	Operation / Non-operation
4	Front RH Outlet Valve	Operation / Non-operation
5	Rear (or RL) Inlet Valve (x1)	Operation / Non-operation
6	Rear (or RL) Outlet Valve (x1)	Operation / Non-operation
7	(Rear RH Inlet Valve (x2))	Operation / Non-operation
8	(Rear RH Outlet Valve (x2))	Operation / Non-operation
9	TCS Valve Primary (x3)	Operation / Non-operation
10	TCS Valve Secondary (x3)	Operation / Non-operation
11	ESV Valve Primary (x3)	Operation / Non-operation
12	ESV Valve Secondary (x3)	Operation / Non-operation
13	-	-
14	-	-
15	Motor Pump	Operation / Non-operation

INITIALIZATION

INTIALIZE SENSOR(Only ESP)

↓

INTIALIZE SENSOR

1] LONGITUDINAL ACCEL SENSOR(4WD only)

2] LATERAL ACCEL SENSOR

3] PRESSURE SENSOR

4] ABOVE 1, 2, 3 ALL SENSOR

↓

Select one of the above items

↓

INTIALIZE SENSOR

LONGITUAINAL ACCEL SENSOR(4WD only)

DO YOU START INITIALIZE ? (Yes/No)

- -

CONDITION :

- ENGINE IS NOT RUNNING.
- VEHICLE STATUS IS FLAT.
- DO NOT PUT THE BRAKE PEDAL.

PROCEDURE :

MUST BE FOLLOW THE ABOVE CONDITION.

IF YOU START "INITIALZE SENSOR",

ADART TO AUTOMATIC.

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ACTUATOR

ACTUATOR TEST

↓

ACTUATOR TEST

1] FRONT/LEFT INLET VALVE
2] FRONT/LEFT OUTLET VALVE
3] FRONT/RIGHT INLET VALVE
4] FRONT/RIGHT OUTLET VALVE
5] REAR(ESP: REAR/LEFT) INLET VALVE
6] REAR(ESP: REAR/LEFT) OUTLET VALVE
7] REAR/RIGHT(Only ESP) INLET VALVE
8] REAR/RIGHT(Only ESP) OUTLET VALVE
9] 1st TCS VALVE(Only ESP)
10] 2nd TCS VALVE(Only ESP)
11] 1st ESV VALVE(Only ESP)
12] 2nd ESV VALVE(Only ESP)
13] PUMP MOTOR

↓

Select one of the above items

↓

FRONT/LEFT INLET VALVE

ON(ACTIVE) : "YES" KEY
OFF(STOP) : "NO" KEY
OTHER ITEM : "△, ▽"

ACTIVE TIME : Max. 10Sec
CONDITION : IG. ON or IDLE

AIR BLEEDING

AIR BLEEDING(TEVES ABS/ESP)

↓

1] REAR/RIGHT CHANNEL
2] REAR/LEFT CHANNEL
3] FRONT/LEFT CHANNEL
4] FRONT/RIGHT CHANNEL

↓

Select one of the above items

↓

AIR BLEEDING(TEVES ABS/ESP)

> > > > REAR/RIGHT AIR BLEEDING < < < <

1] OPEN THE BLEED SCREW.
2] CONTINUALLY PUMPING BRAKE PEDAL.
(PUMP MOTOR & VALVE ACTIVATING)
3] TOTAL ACTIVE TIME : 100 [Sec]

DO YOU START AIR BLEEDING ?
(YES / NO)

↓

AIR BLEEDING(TEVES ABS/ESP)

> > > > REAR/RIGHT AIR BLEEDING < < < <

1. OPEN THE BLEED SCREW.
2. CONTINUALLY PUMPING BRAKE PEDAL.
(PUMP MOTOR & VALVE ACTIVATING)
3. TOTAL ACTIVE TIME : 100 [Sec]

BUBBLE FREE(FOAMLESS) ?
(YES / NO)

↓

AIR BLEEDING(TEVES ABS/ESP)

> > > > REAR/RIGHT AIR BLEEDING < < < <

FINISHED BLEEDING.
CLOSE BLEEDER SCREW.

PRESS "Enter".

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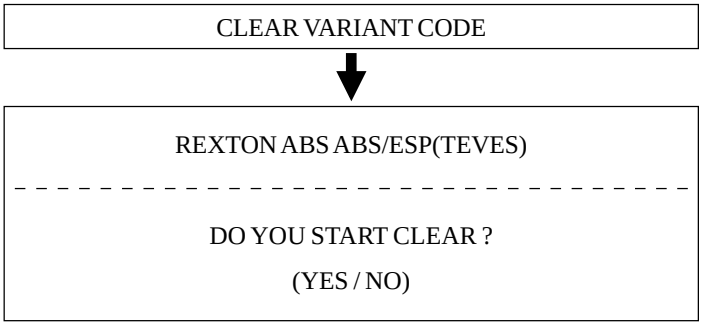
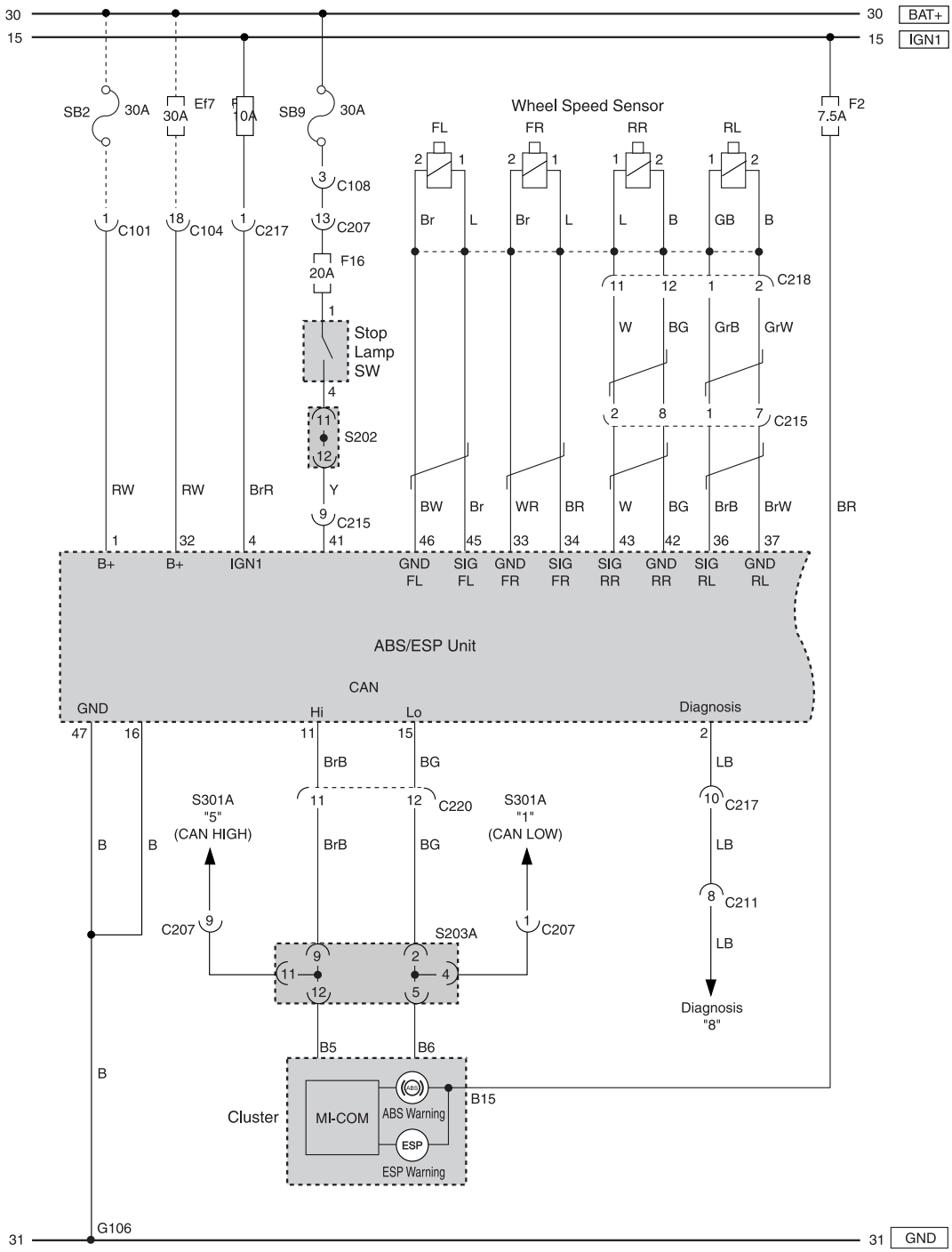
CODE CLEAR


CLEAR VARIANT CODE
REXTON ABS ABS/ESP(TEVES)
DO YOU START CLEAR ?
(YES / NO)

ELECTRIC CIRCUIT DIAGRAM

ABS/ESP

▶ Wheel Speed Sensor, Stop Lamp Switch, Diagnostic Connector, Warning Lamp (ABS/ESP)



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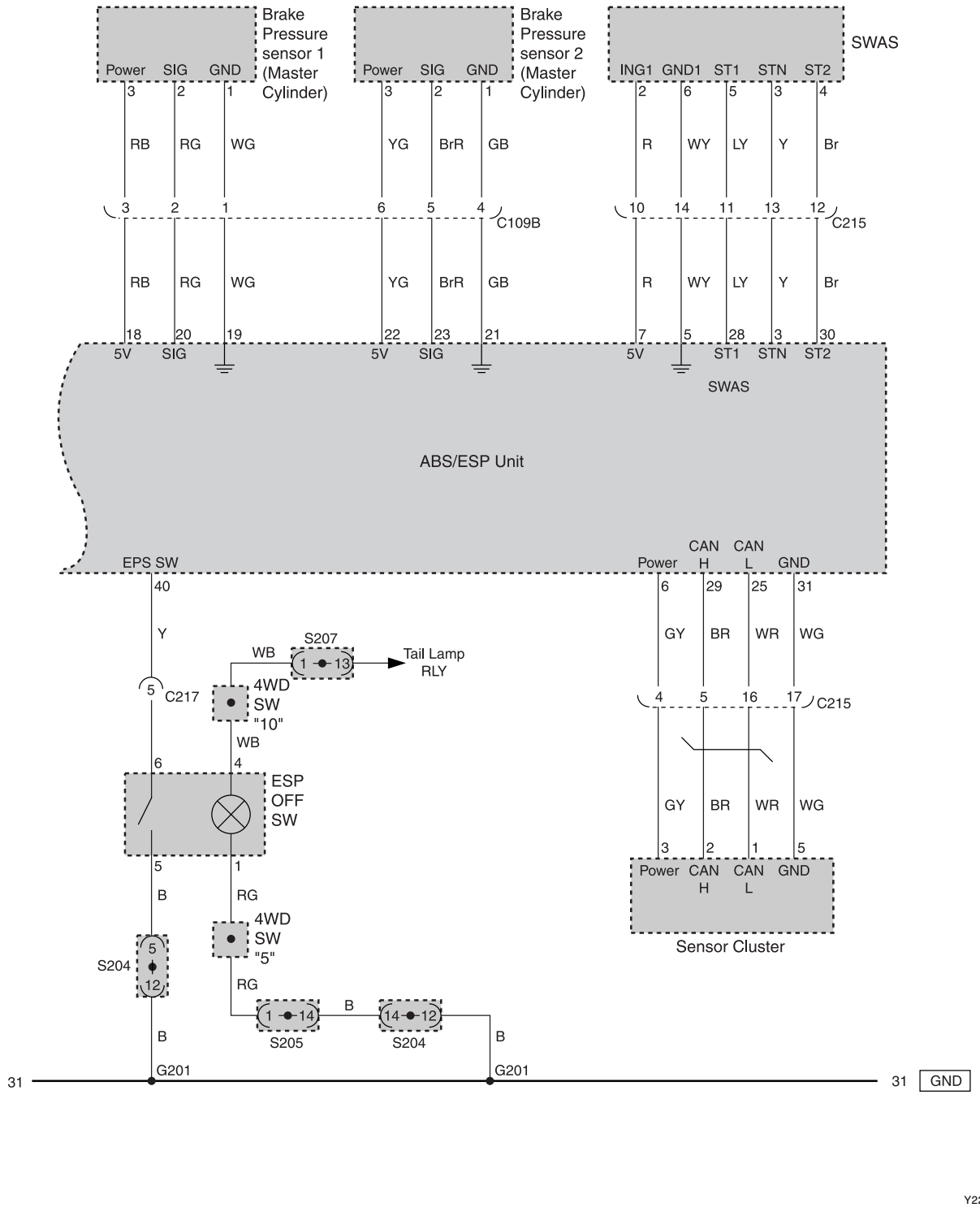
▶ Brake Pressure Sensor, Steering Wheel Angle Sensor, Sensor Cluster, ESP OFF Switch



SECTION 9A

GENERAL

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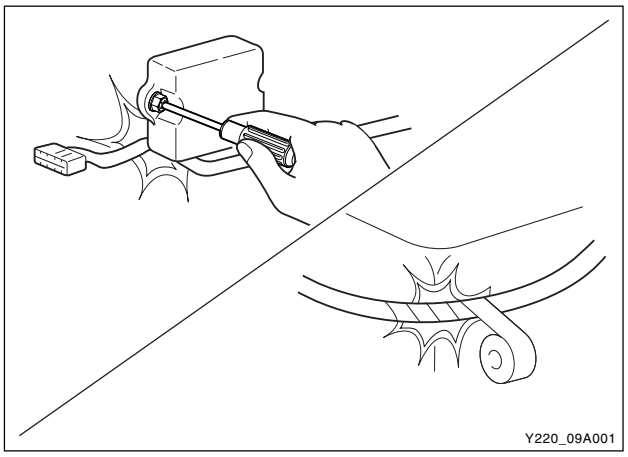
GENERAL INFORMATION

1. Before starting repairs which do not require battery power:
   Turn off ignition switch.
   Disconnect the negative battery cable.

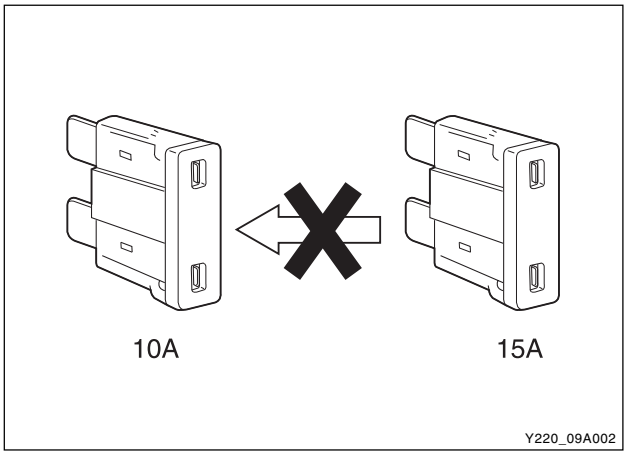
   Notice

   - ***Turn off all the electrical devices before disconnecting and connecting the negative battery cable. Otherwise, the semiconductor components are subject to be damaged.***
   - ***The volatile memory in electrical devices may be erased. Store them with safe methods.***

2. The harnesses that can be touched with a sharp edge or corner should be wrapped with insulating tape to prevent damaging.
3. Carefully handle the wiring harnesses not to damage them during servicing the electric components.

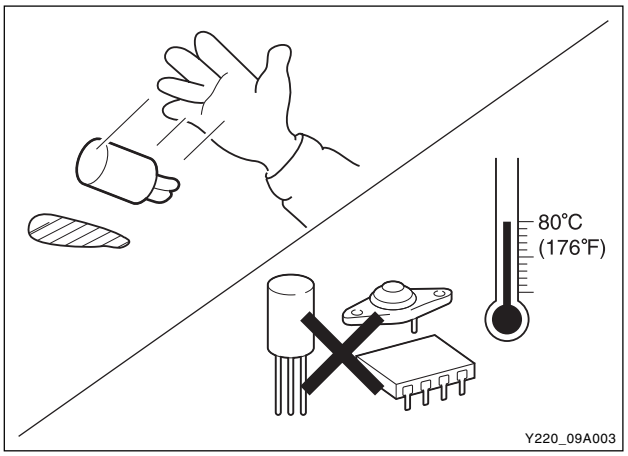

Y220_09A001

4. If a fuse is blown, be sure to eliminate the cause of problem before installing a new fuse. Use only the fuse of specified rating. Never use a fuse of more than specified rating. It may cause a fire or damage to the electric components.



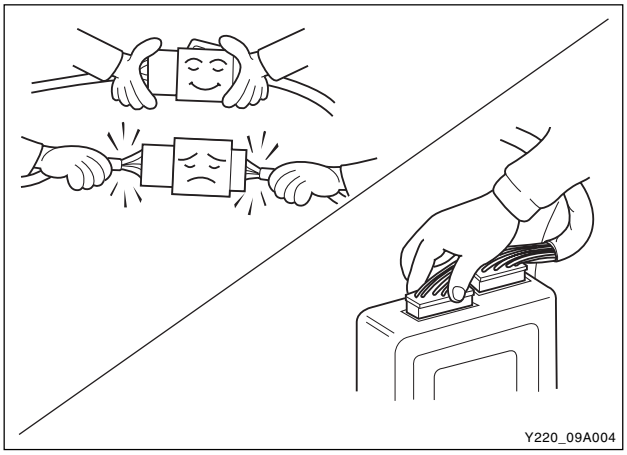
Y220_09A002

5. Be careful not to drop or jar the sensors and relays.
6. The electric components used in computer and relays are heat sensitive. If the working temperature will be exceeded 80°C, remove the components before starting the service operation.

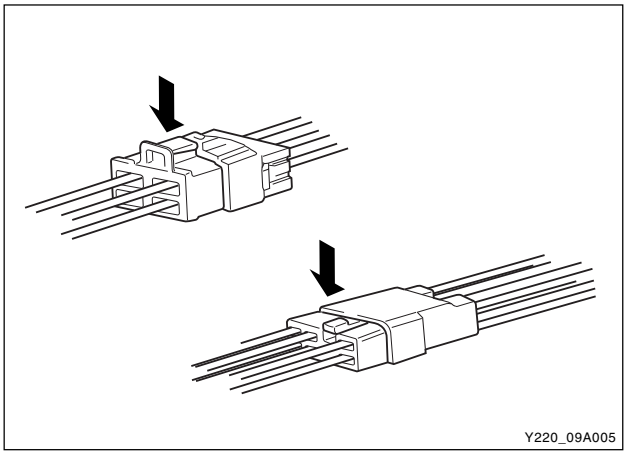


Y220_09A003

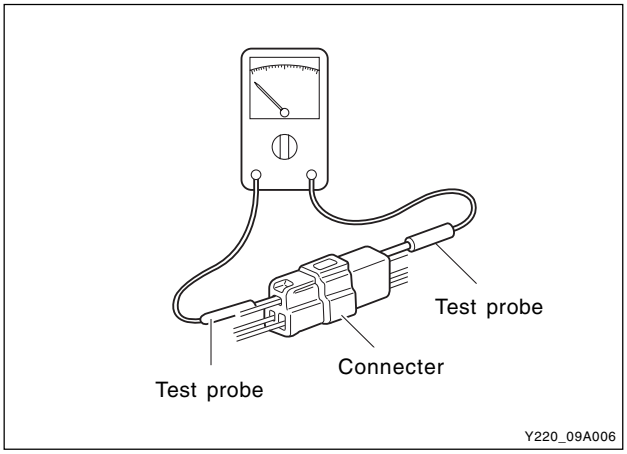
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



7. Loosened connection may cause a malfunction. Always firmly engage the connector.
8. When connecting, push the connector until it sounds “click”.
9. When disconnecting, always hold the connector body other than the harness.



10. Disconnect the connector while pressing down the locking tab if applicable.



11. When checking the continuity or voltage, the test probes of the circuit tester should be inserted from harness side (rear of connector). In case of sealed connector, insert the test probe through the cavity in wiring rubber cap. Be careful not to damage the wire insulation. And, the test probe should be insert until its end contacts to the connecter pin.

Notice

The circuit tester cannot be used for checking the air bag system. Use only the diagnostic tool (Scanner).

INSPECTION OF CABLES AND WIRES

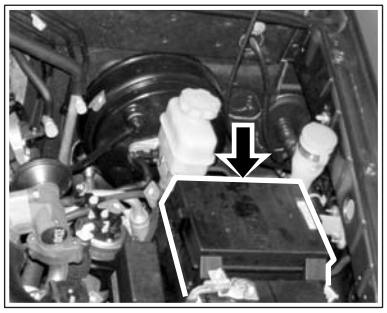
1. Check the connections for looseness and rust.
2. Check the terminals and wires for corrosion due to electrolyte.
3. Check the circuit for open.
4. Check the wire insulation. Check the cover clothing of the wire for damage, crack and deterioration.
5. Check if any electric continuity can be transferred to other metal components such as vehicle body.
6. Check if the continuity exists on the bolt and vehicle body in ground connection.
7. Check the wire arrangement.
8. Securely fasten the wiring harnesses not to contact to a sharp edge and hot elements (exhaust manifold and pipes).
9. Keep the proper clearance between the wire harness and the moving components such as fan pulley and fan belt.
10. In case of the wiring harnesses connected to the vehicle body and vibrating components such as engine, to avoid damage, do not bind the harnesses without marginal length.

FUSES AND RELAYS

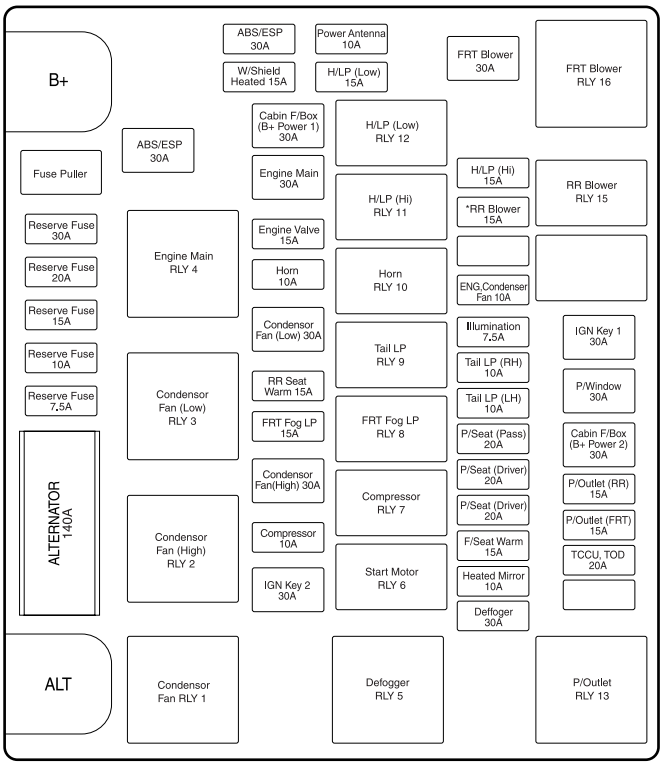
DI (D27DT) ENGINE EQUIPPED VEHICLE

▶ Fuse Box In Engine Compartment

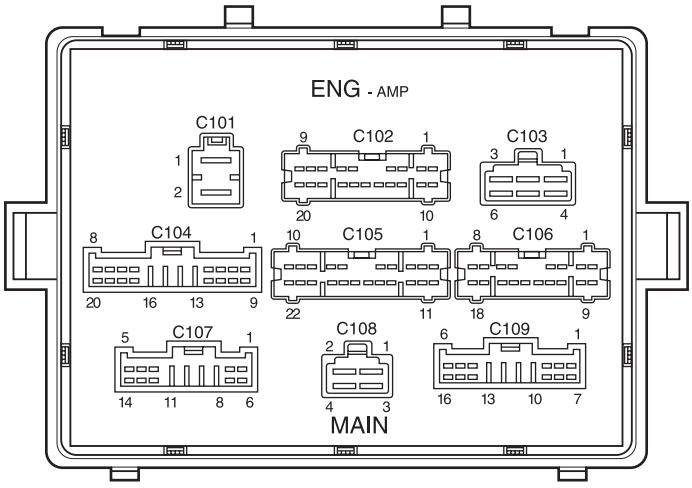
It is installed in the left side of engine compartment.



Name and Capacity



Connector Arrangement

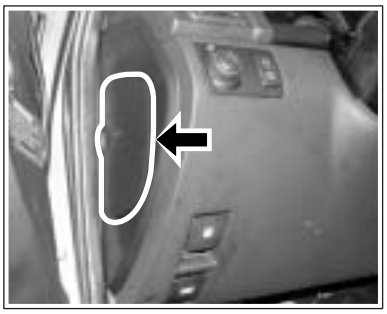


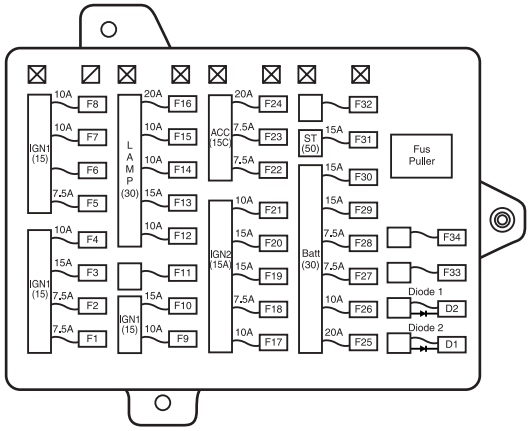
Y220_09A007

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Interior Fuse Box

It is install at left side of the instrument panel.





Name and Capacity

Diode		NO.25	Sun Roof	NO.17	Head Lamp	NO.9	C/Fan	NO.1	A/T SHFT Lever Lock Immobilizer
		20A		10A		10A		7.5A	
		NO.26	RR Wiper	NO.18	A/Con O/S Mirror	NO.10	OVPR	NO.2	Cluster STICS
		10A		7.5A		15A		7.5A	
NO.33		NO.27	Clock STICS Cluster	NO.19	FRT Wiper FRT Washer	NO.11		NO.3	B/UP Lamp T/SIG Lamp
		7.5A		15A		15A		15A	
NO.34		NO.28	Siren P/W Window	NO.20	RR Wiper RR Washer	NO.12	Stop Lamp (Trailer)	NO.4	TCU TCCU
		7.5A		15A		10A		7.5A	
		NO.29	Audio Multi Vision	NO.21	Defogger Blower A/Con	NO.13	Hazard Lamp	NO.5	I/S Mirror ENG Preheat'G Auto Light
		15A		10A		15A		7.5A	
		NO.30	Door Lock	NO.22	Power Outlet O/S Mirror Clock	NO.14	RR Fog Lamp	NO.6	Speed Sensor
		15A		7.5A		10A		10A	
Fuse Puller		NO.31	Start Motor	NO.23	Audio Multi Vision Navigation	NO.15	Interior Lamp	NO.7	ABS ESP
		15A		7.5A		10A		10A	
		NO.32		NO.24	Cigar Lighter	NO.16	Stop Lamp	NO.8	Air Bag
				20A		20A		10A	
		20A	Spare Fuse	15A	Spare Fuse	10A	Spare Fuse	7.5A	Spare Fuse

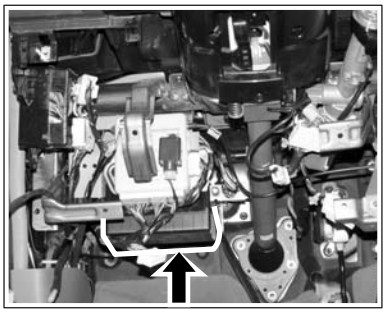
Y220_09A010

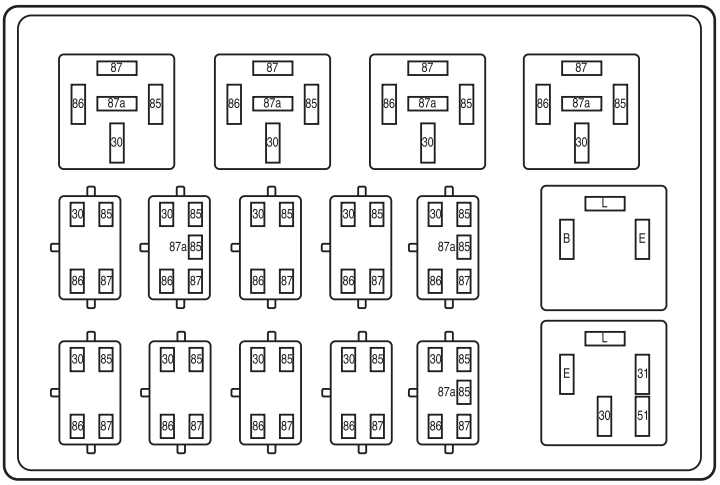
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Interior Relay Box

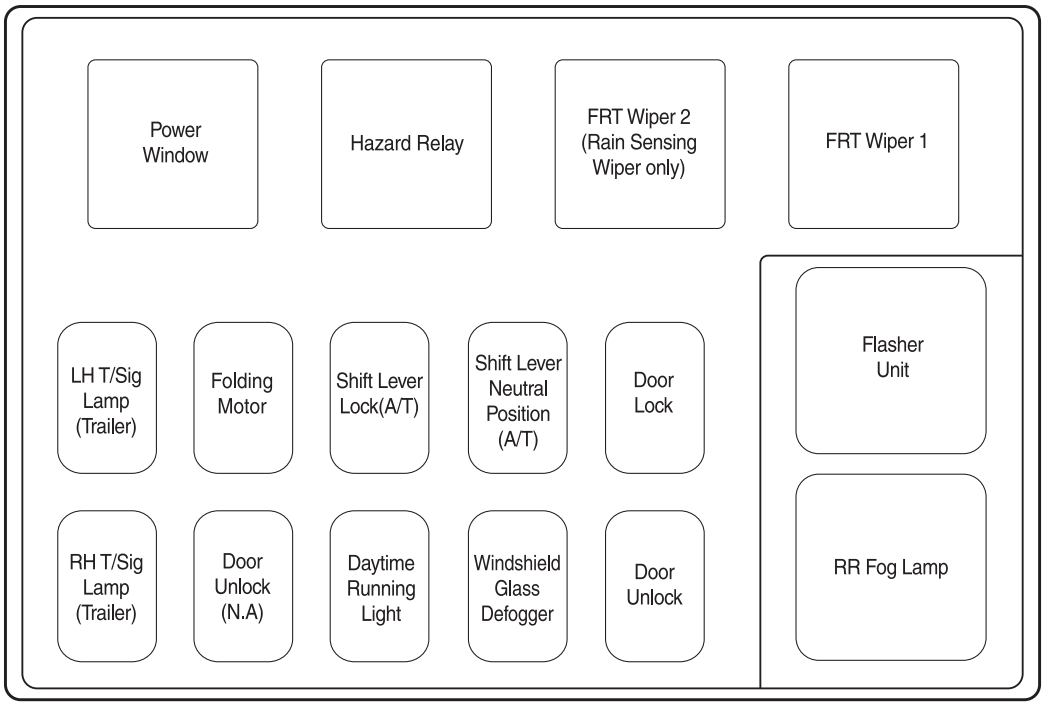
It is installed behind the lower instrument panel.

Relay Arrangement





Relay Name



Y220_09A013

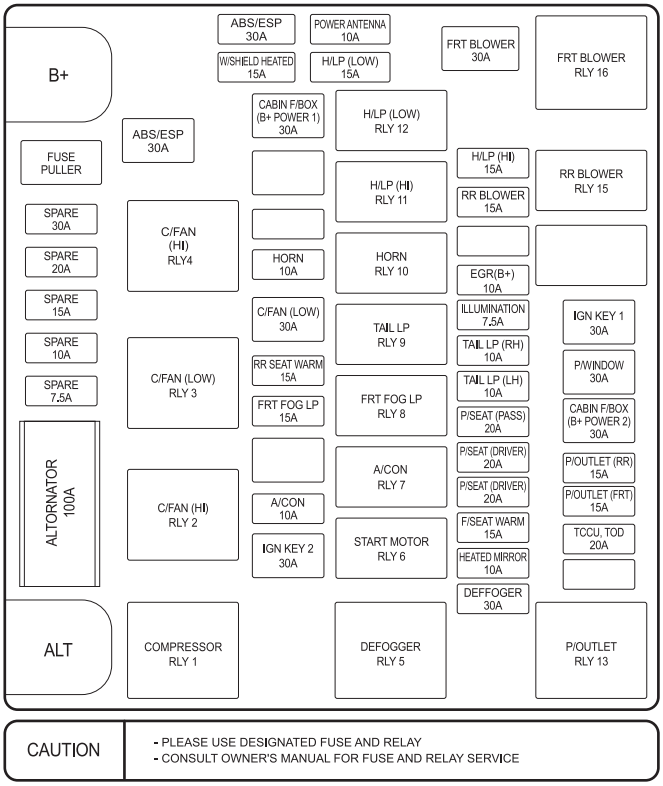
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

IDI (D29ST) ENGINE EQUIPPED VEHICLE

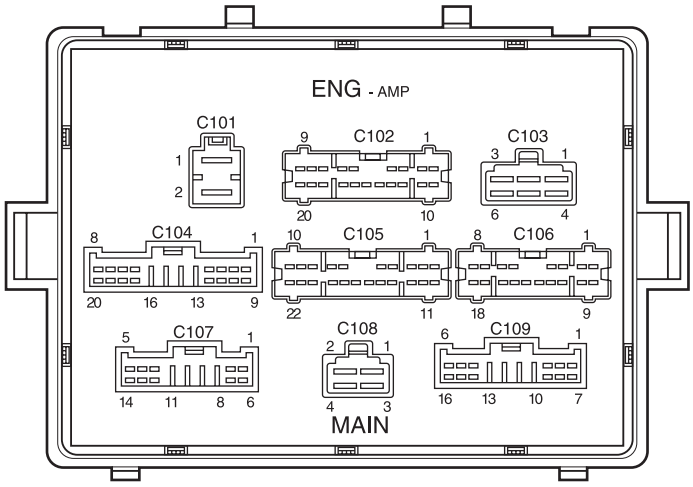
▶ Fuse Box In Engine Compartment

It is installed in the left side of engine compartment.

Fuse Name and Capacity



Connector Arrangement



Y220_09A016

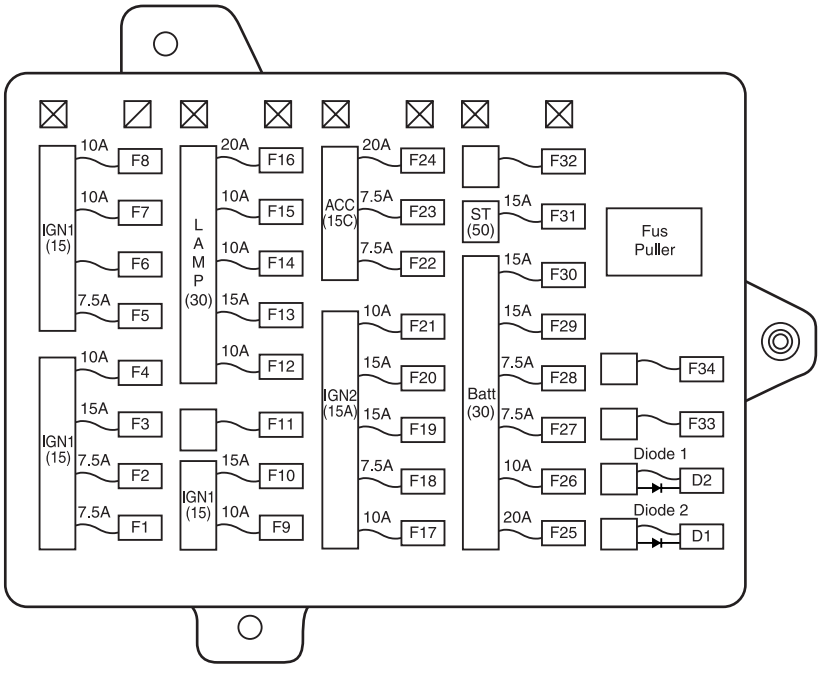
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Interior Fuse Box

It is install at left side of the instrument panel.

Name and Capacity

Diode	NO.25 20A	Sun Roof	NO.17 10A	Head Lamp	NO.9 10A	C/Fan	NO.1 7.5A	A/T SHFT Lever Lock Immobilizer
	NO.26 10A	RR Wiper	NO.18 7.5A	A/Con O/S Mirror	NO.10 15A	OVPR	NO.2 7.5A	Cluster STICS
NO.33	NO.27 7.5A	Clock STICS Cluster	NO.19 15A	FRT Wiper FRT Washer	NO.11 15A		NO.3 15A	B/UP Lamp T/SIG Lamp
NO.34	NO.28 7.5A	Siren P/W Window	NO.20 15A	RR Wiper RR Washer	NO.12 10A	Stop Lamp (Trailer)	NO.4 7.5A	TCU TCCU
	NO.29 15A	Audio Multi Vision	NO.21 10A	Defogger Blower A/Con	NO.13 15A	Hazard Lamp	NO.5 7.5A	I/S Mirror ENG Preheat'G Auto Light
	NO.30 15A	Door Lock	NO.22 7.5A	Power Outlet O/S Mirror Clock	NO.14 10A	RR Fog Lamp	NO.6 10A	Speed Sensor
Fuse Puller	NO.31 15A	Start Motor	NO.23 7.5A	Audio Multi Vision Navigation	NO.15 10A	Interior Lamp	NO.7 10A	ABS ESP
	NO.32		NO.24 20A	Cigar Lighter	NO.16 20A	Stop Lamp	NO.8 10A	Air Bag
	20A	Spare Fuse	15A	Spare Fuse	10A	Spare Fuse	7.5A	Spare Fuse

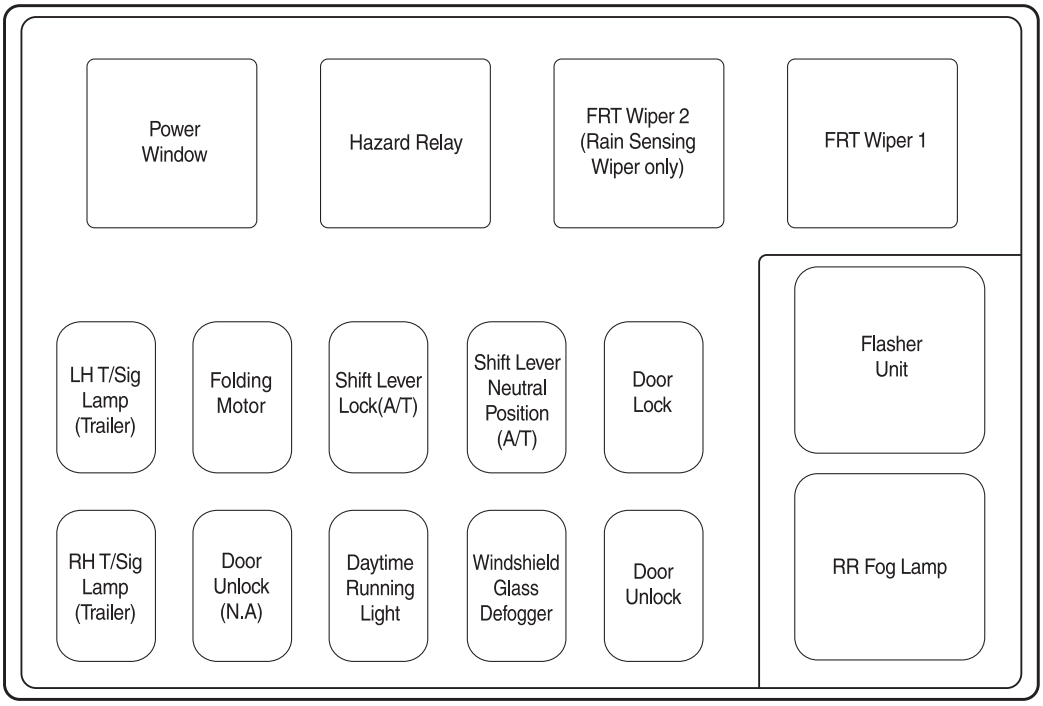


Y220_09A019

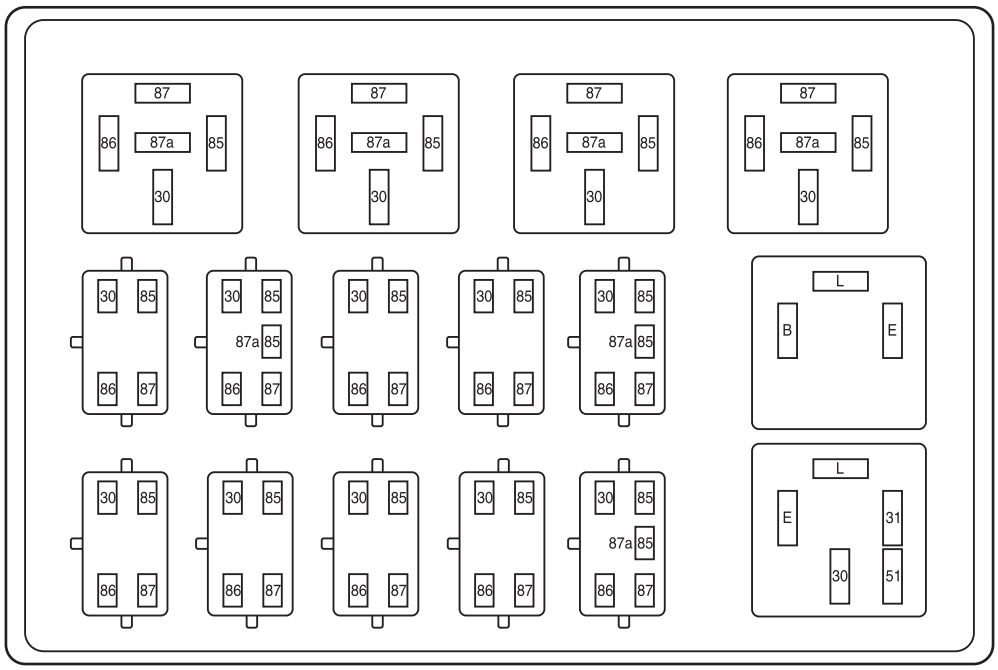
▶ Interior Relay Box

It is installed behind the lower instrument panel.

Relay Arrangement



Relay Name



Y220_09A023

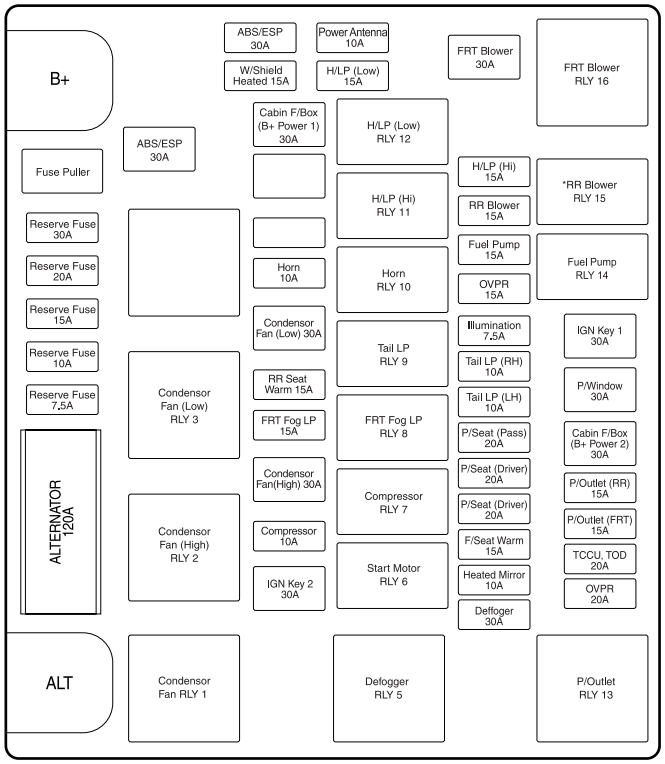
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

GASOLINE ENGINE EQUIPPED VEHICLE

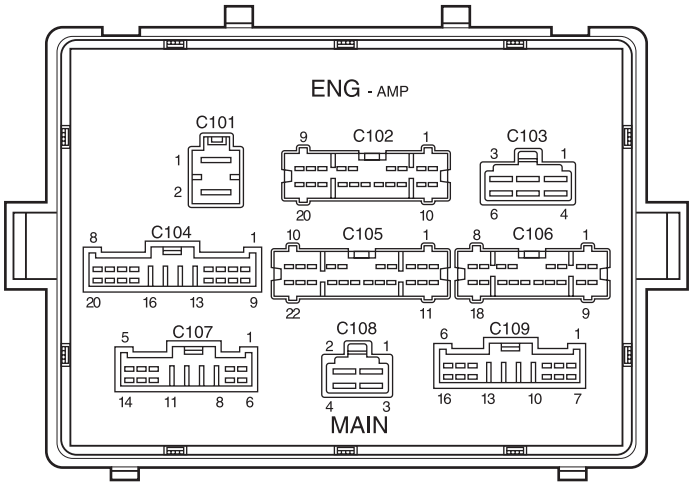
▶ Fuse Box In Engine Compartment

It is installed in the left side of engine compartment.

Fuse Name and Capacity



Connector Arrangement



Y220_09A024

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

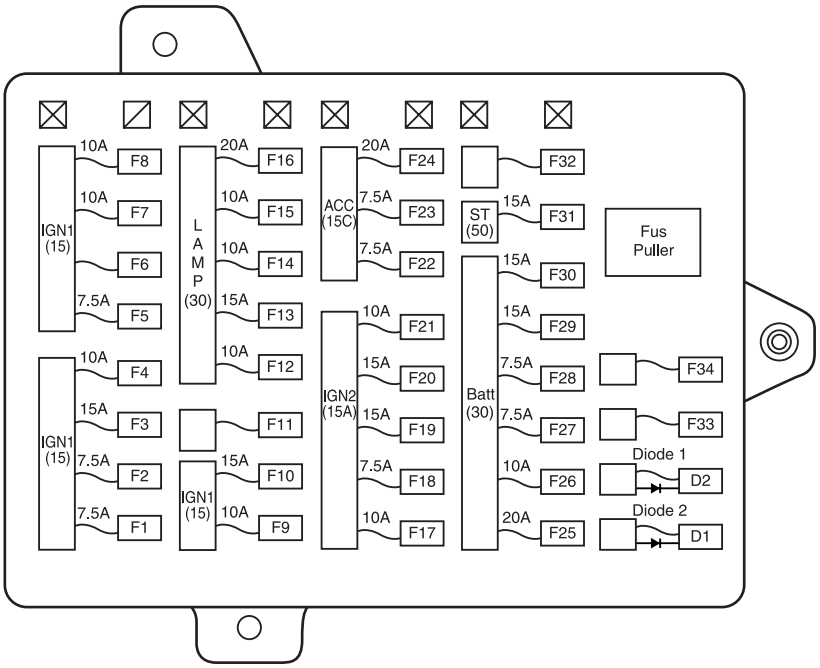
▶ Interior Fuse Box

It is install at keft side of the instrument panel.

Name and Capacity

Diode	NO.25 20A	Sun Roof	NO.17 10A	Head Lamp	NO.9 10A	C/Fan	NO.1 7.5A	A/T SHFT Lever Lock Immobilizer
	NO.26 10A	RR Wiper	NO.18 7.5A	A/Con O/S Mirror	NO.10 15A	OVPR	NO.2 7.5A	Cluster STICS
NO.33	NO.27 7.5A	Clock STICS Cluster	NO.19 15A	FRT Wiper FRT Washer	NO.11 15A		NO.3 15A	B/UP Lamp T/SIG Lamp
NO.34	NO.28 7.5A	Siren P/W Window	NO.20 15A	RR Wiper RR Washer	NO.12 10A	Stop Lamp (Trailer)	NO.4 7.5A	TCU TCCU
	NO.29 15A	Audio Multi Vision	NO.21 10A	Defogger Blower A/Con	NO.13 15A	Hazard Lamp	NO.5 7.5A	I/S Mirror ENG Preheat'G Auto Light
	NO.30 15A	Door Lock	NO.22 7.5A	Power Outlet O/S Mirror Clock	NO.14 10A	RR Fog Lamp	NO.6 10A	Speed Sensor
Fuse Puller	NO.31 15A	Start Motor	NO.23 7.5A	Audio Multi Vision Navigation	NO.15 10A	Interior Lamp	NO.7 10A	ABS ESP
	NO.32		NO.24 20A	Cigar Lighter	NO.16 20A	Stop Lamp	NO.8 10A	Air Bag
	20A	Spare Fuse	15A	Spare Fuse	10A	Spare Fuse	7.5A	Spare Fuse

Fuse



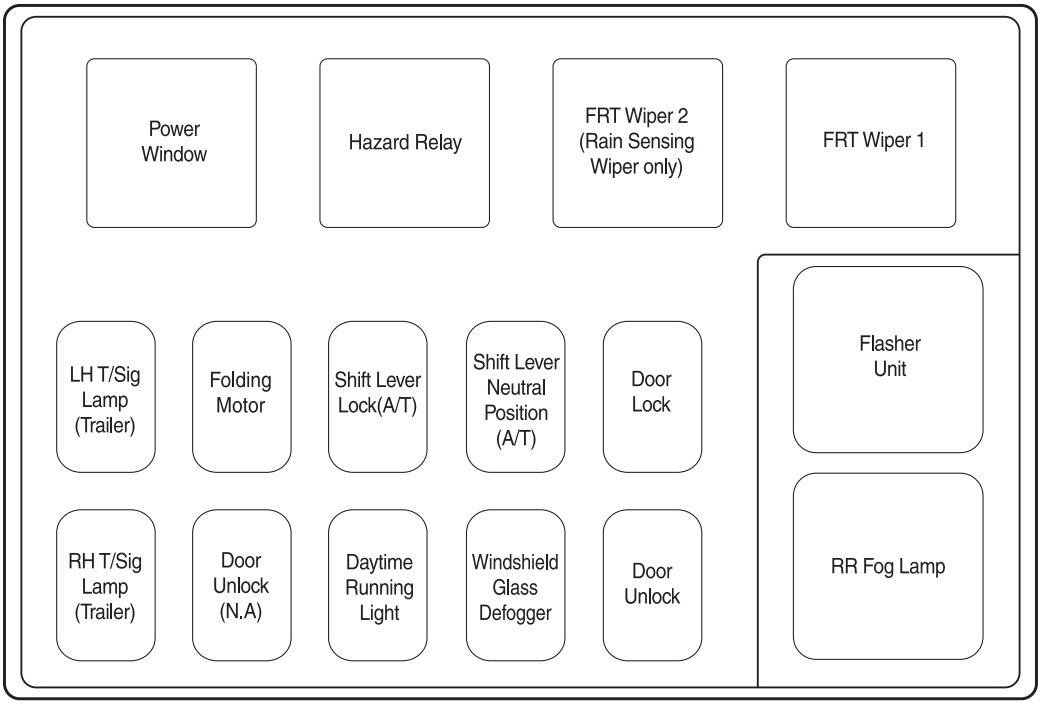
Y220_09A027

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

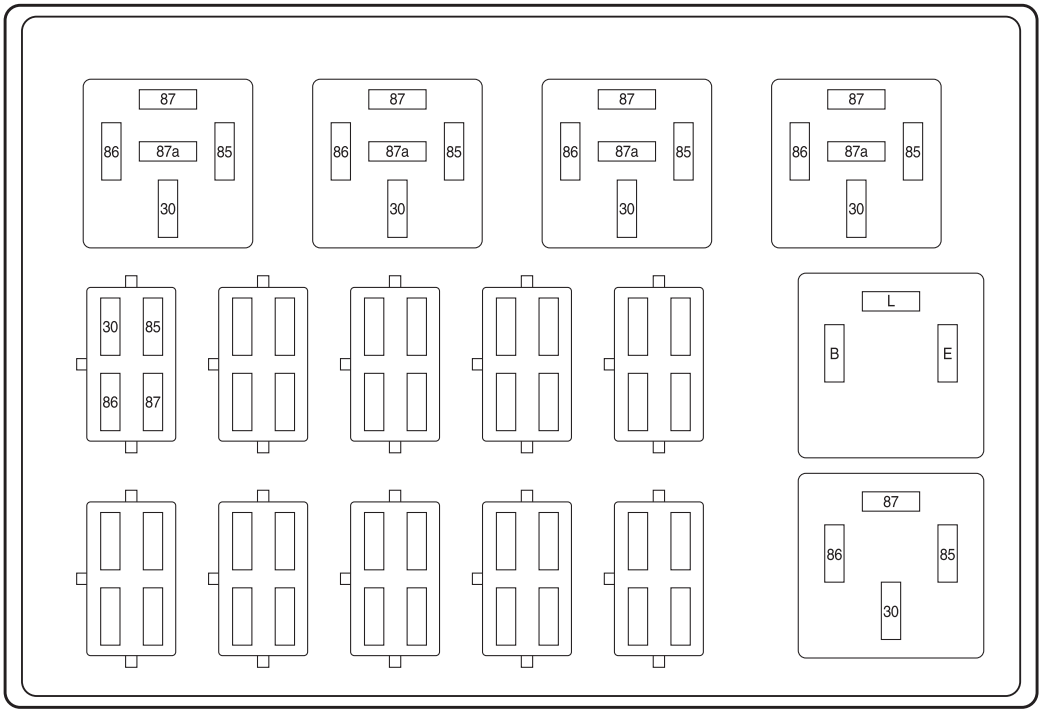
▶ Interior Relay Box

It is installed behind the lower instrument panel.

Relay Name

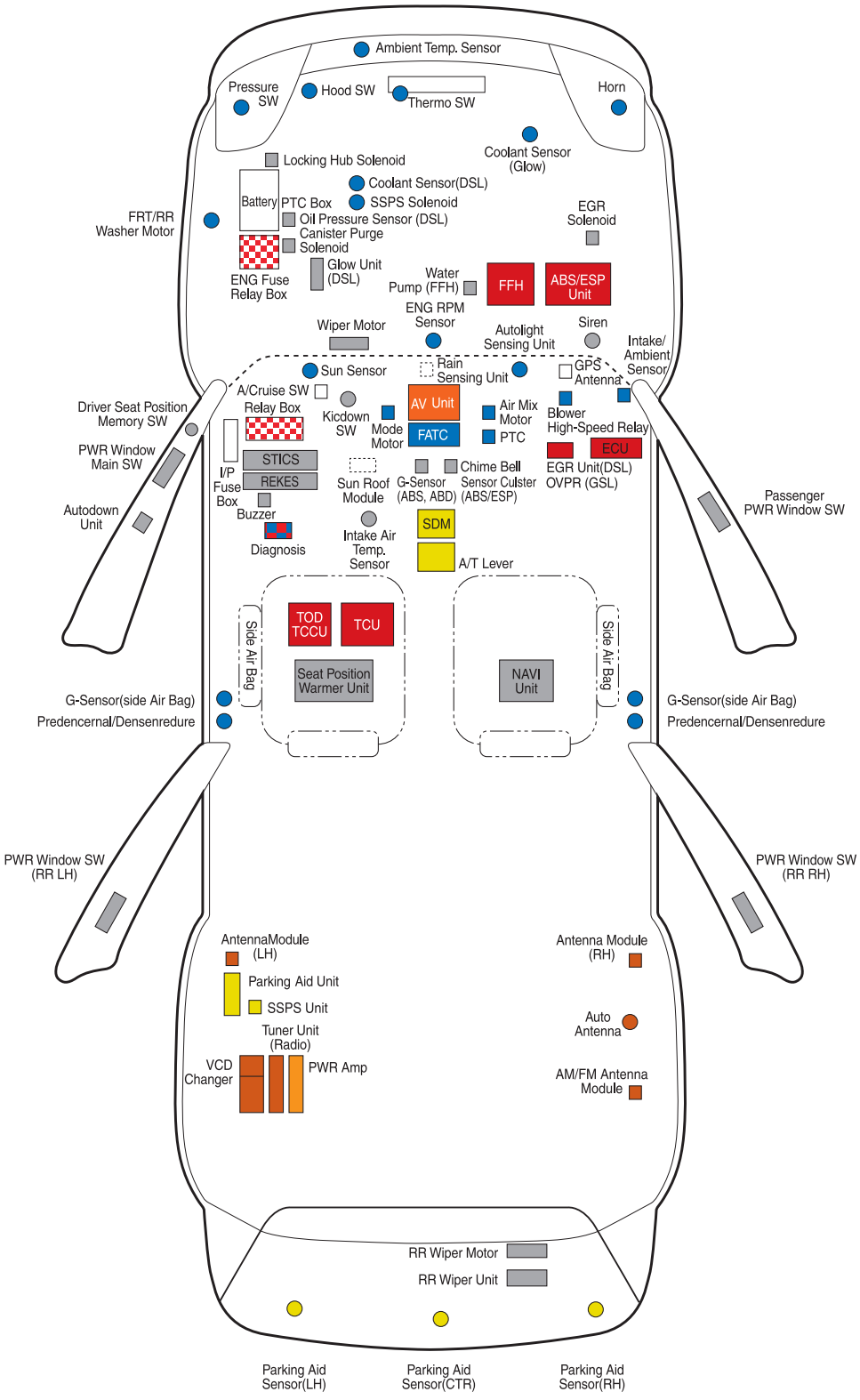


Relay Arrangement



Y220_09A031

ELECTRIC COMPONENTS LOCATOR



Y220_09A032

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SECTION 9B

ELECTRIC SYSTEM

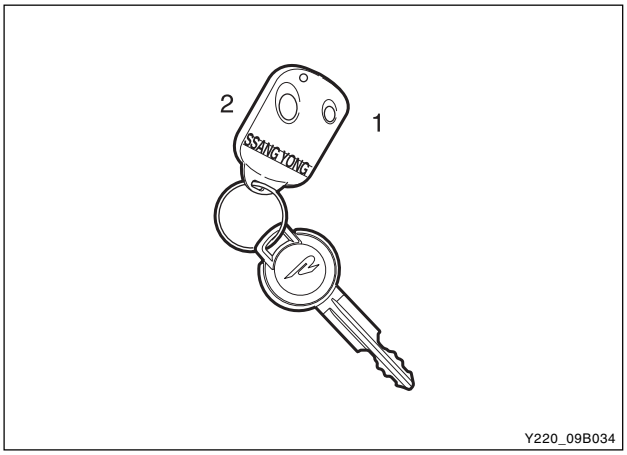
Table of Contents

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

IGNITION KEY AND REMOTE CONTROL KEY

REMOTE KEYLESS ENTRY SYSTEM (REKES)

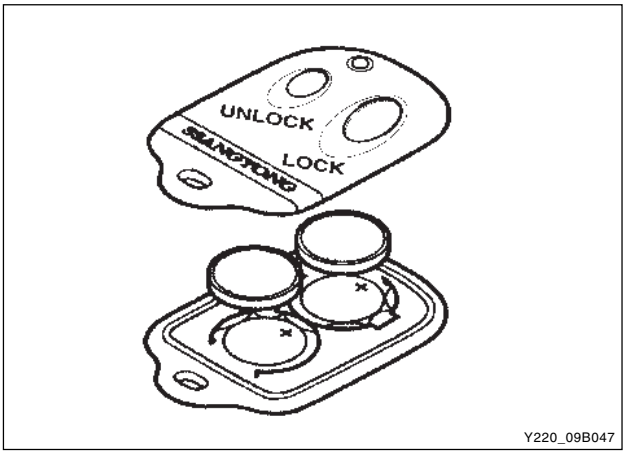
1. UNLOCK button (1): Unlocks all doors.
2. LOCK button(2): Locks all doors.



Y220_09B034

▶ Battery Replacement

Use a CR 2025 battery for replacement.



Y220_09B047

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

▶ Immobilizer System

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.

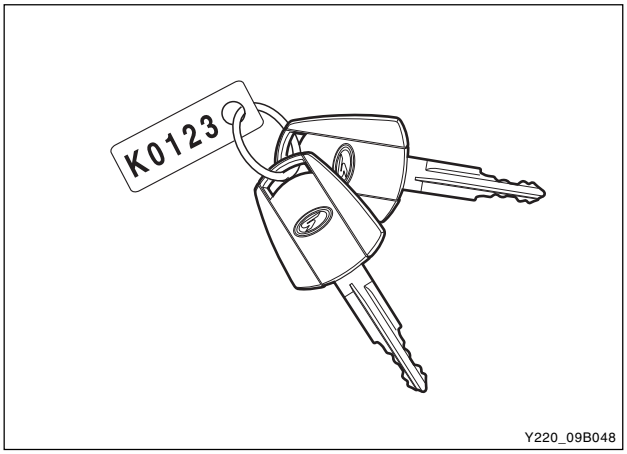
When the ignition key with integrated transponder is turned to the ON position, ECU (Engine Control Unit) checks the crypto code of key and, if correct, allow the vehicle to start the engine. Only valid ignition keys can be used to start the engine. The immobilizer system isolates fuel injection control system in ECU (electric control unit) when invalid keys are used.

Transponder code

The 2 keys have respectively coded transponders.

When lost the keys

When lost the keys, the transponder key have to be erased from the engine control unit.



The ignition key with immobilizer system has a key illumination lamp. It will help to find the door lock when dark.

Notice

- ***In any cases, the immobilizer system can not be removed from the vehicle.***

  If you attempt to remove it and damage the system, starting will be impossible, so never attempt to remove, damage or modify it.
- ***Do not drop or shock to the transponder in the key, or it could be damaged.***

When the transponder has damaged

When the transponder has damaged, replace it with new one and register new code on engine control unit at our authorized service network. Otherwise, the engine cannot be started.

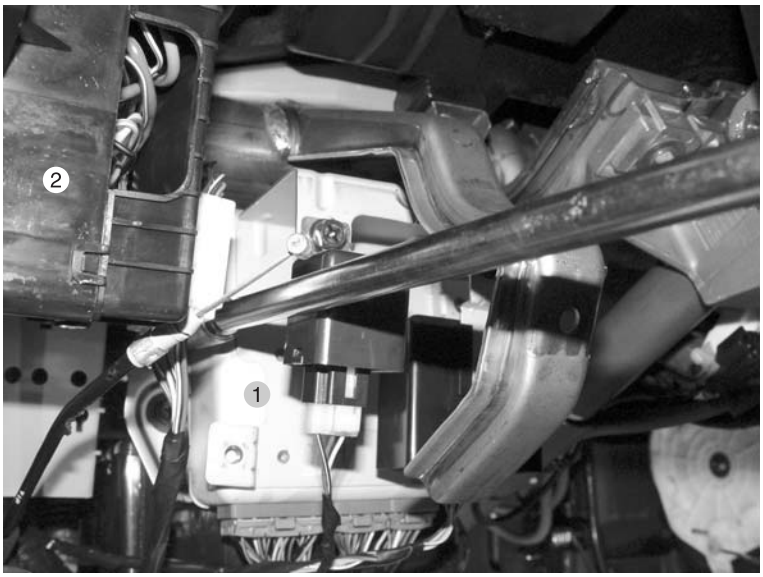
Notice

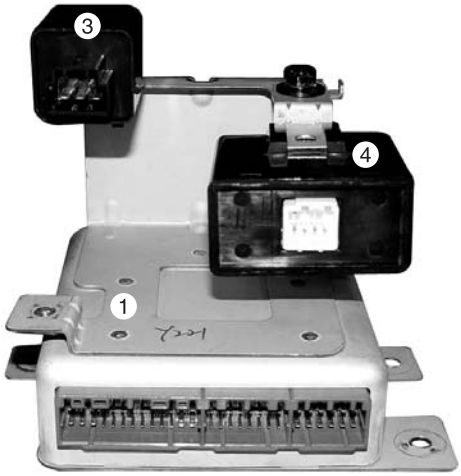
- ***In any cases, the immobilizer system can not be removed from the vehicle.***

  If you attempt to remove it and damage the system, starting will be impossible, so never attempt to remove, damage or modify it.
- ***Do not drop or shock to the transponder in the key, or it could be damaged.***
- ***If the transponder has damaged, replace the key and register the code to the engine control unit to be started.***
- ***When replacing the engine control unit, replace all transponders at the same time.***

REKES + STICS (RKSTICS)

COMPONENTS LOCATOR





Y220_09B053

1. RK-STICS
2. Interior fuse box
3. Buzzer
4. Outside mirror folding unit

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SPECIFICATIONS

Description	Specification	Remark
Rated voltage	DC 12 V	
Operating voltage	DC 9 ~ 16 V	
Operating temperature	-30°C ~ +80°C	
Reserved temperature	-40°C ~ +85°C	
Max. operating humidity	95 %	
Resistible voltage	24 V	
Insulating resistance	No heat and fire due to the current leaks	Confined with PCB, waterproof and coating that require the insulation
Parasitic current	below 4.0 mA (MASK type) below 4.5 mA (OTP type) below 1.5 V	IGN1 = OFF, IGN2 = OFF, Full output load = OFF, T x 30 seconds (after received the signals), No input changes for 2 seconds
Voltage drop	below 1.8 V below 2.0 V	Pin no. 1 and 2, 3, 5, 7, 10, 14, 15, 20
		Pin no. 1 and 13, 23, 40, 51, 53
		Pin no. 1 and 12, 18, 19

RATED LOAD

Description	Rated Load
Wiper relay	DC12 V 250 mA (inducted load)
Power window relay	DC 12 V 200 mA (Inducted load)
Rear defogger relay	DC 12 V 200 mA (Inducted load)
Tail relay	DC 12 V 200 mA (Inducted load)
Hazard warning relay	DC 12 V 200 mA (Inducted load)
Start inhibit relay	DC 12 V 200 mA (Inducted load)
Lock relay	DC 12 V 200 mA (Inducted load)
Unlock relay	DC 12 V 200 mA (Inducted load)
Door unlock relay	DC 12 V 200 mA (Inducted load)
Room lamp	DC 12 V 16 W (Lamp load)
Door ajar warning lamp	DC 2.2 V 20 mW (LED load)
Parking brake warning lamp	DC 2.2 V 20 mW (LED load)
Seatbelt warning lamp	DC 2.2 V 20 mW (LED load)
Hey hole illumination	DC 12 V 1.2 W (Lamp load)
Siren	DC 12 V 250 mA (Inducted load)
Chime bell	DC 12 V 350 mA (Inducted load)
Buzzer	DC 12 V 40 mA (Inducted load)

CHATTERING OF INPUT SIGNALS

1. Vehicle speed input

   The vehicle speed calculating time is 1.0 second. The elapsed time of 1.5 seconds after IGN1 switch “ON” is not included.

2. 150 ms target input

   Door lock switches, tailgate lock switch

3. 80 ms target input

   IGN1 switch, IGN2 switch, door switches, tailgate switch

4. 40 ms target input

   Inputs except 10 ms, 80 ms and 150 ms target inputs

5. 20 ms target input

   Wiper motor stop, speed sensor

* The time described for each function doesn’t include the time from switch input change to chattering process.

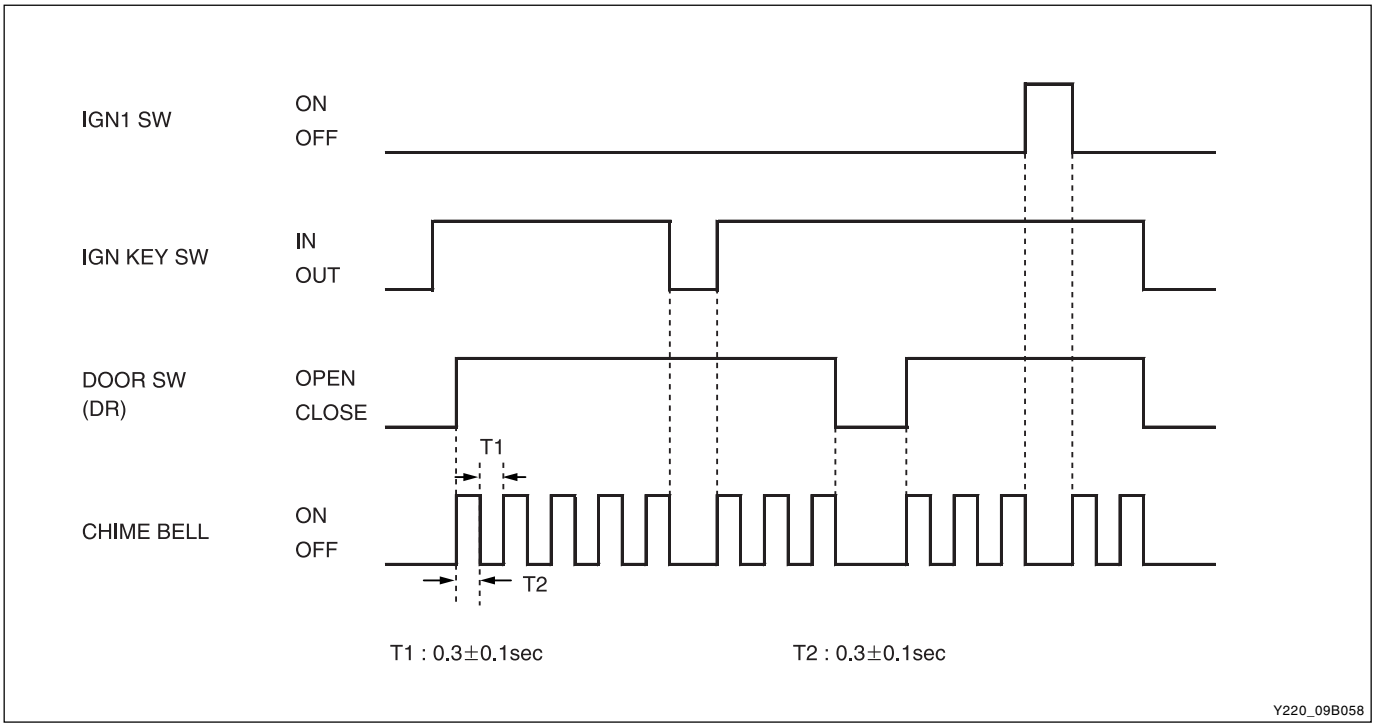
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

IGNITION KEY REMINDER

The ignition key reminder warning has priority over the “MARKER LAMP LEFT ON WARNING”.

▶ Chime Bell Control

1. The chime bell output is “ON” when opening the driver’s door while the ignition key is inserted into ignition switch.
2. In above conditions, the chime bell output is “OFF” when closing the driver’s door or removing the ignition key from ignition switch.
3. This function is not available when the IGN 1 switch is “ON”.

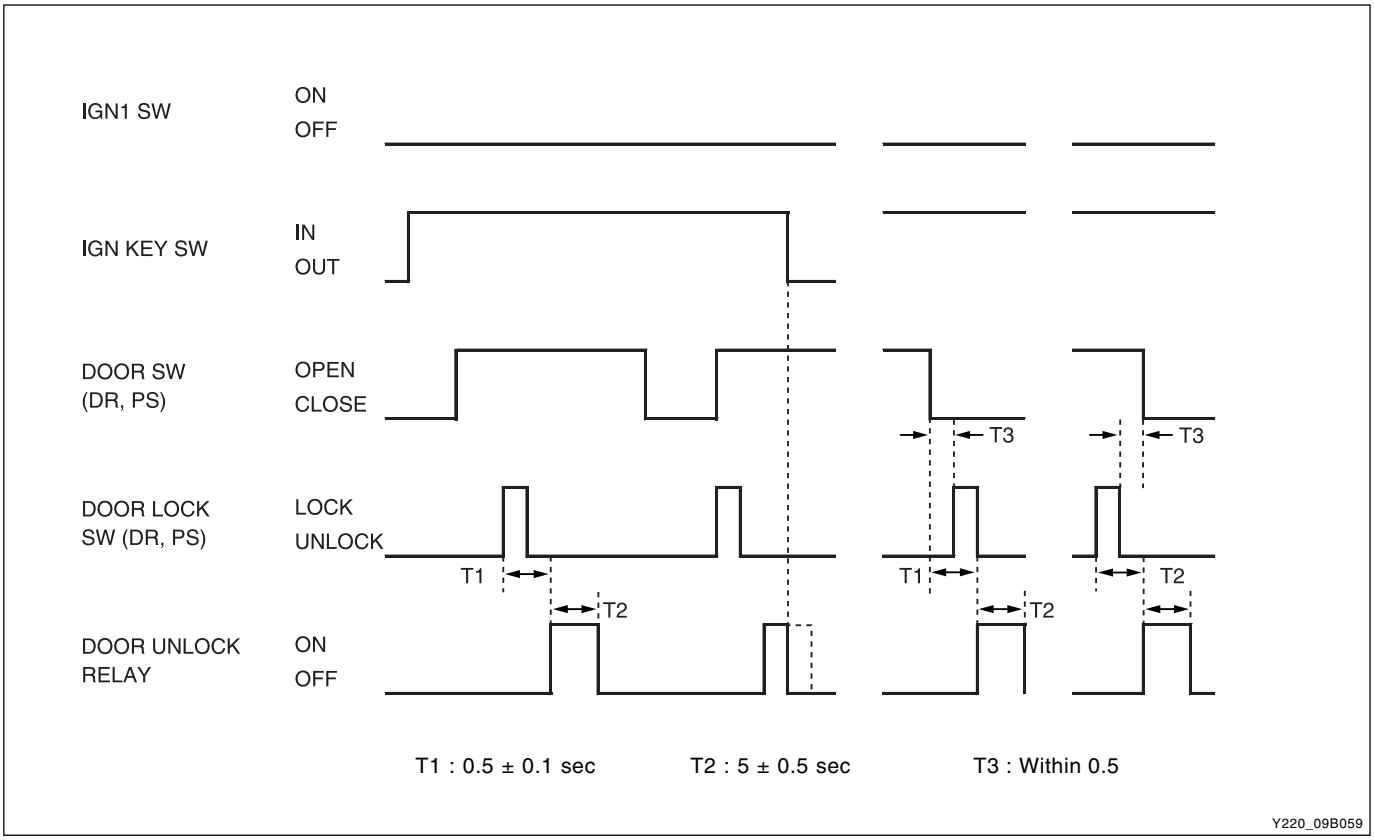


▶ Door Control

1. The door unlock relays output is “ON” when the driver’s door lock switch turns “ON” while the ignition key is inserted into ignition switch and the driver’s door opens.
2. The door unlock relays output is “ON” when the passenger’s door lock switch turns “ON” while the ignition key is inserted into ignition switch and the passenger’s door opens.
3. The door unlock relay output is “ON” when the door lock switch turns “ON” within T3 after closing door while the ignition key is inserted into ignition switch and driver’s door opens.
4. The door unlock relay output is “ON” when closing the door within T3 after turning “ON” the door lock switch while the ignition key is inserted into ignition switch and driver’s door opens.
5. The unlock relay output is “ON” when any of unlock conditions are changed within T1.
6. The unlock relay output will not be “ON” when removing the ignition switch from the ignition switch from T1 after changing the conditions.

   (The output is “OFF” when removing the ignition key with unlocked for 5 seconds)

   (This function is not available when IGN 1 switch is “ON” and vehicle speed is over 3 km/h)



DR : Driver’s door
PS : Passenger’s door
RR : Rear door

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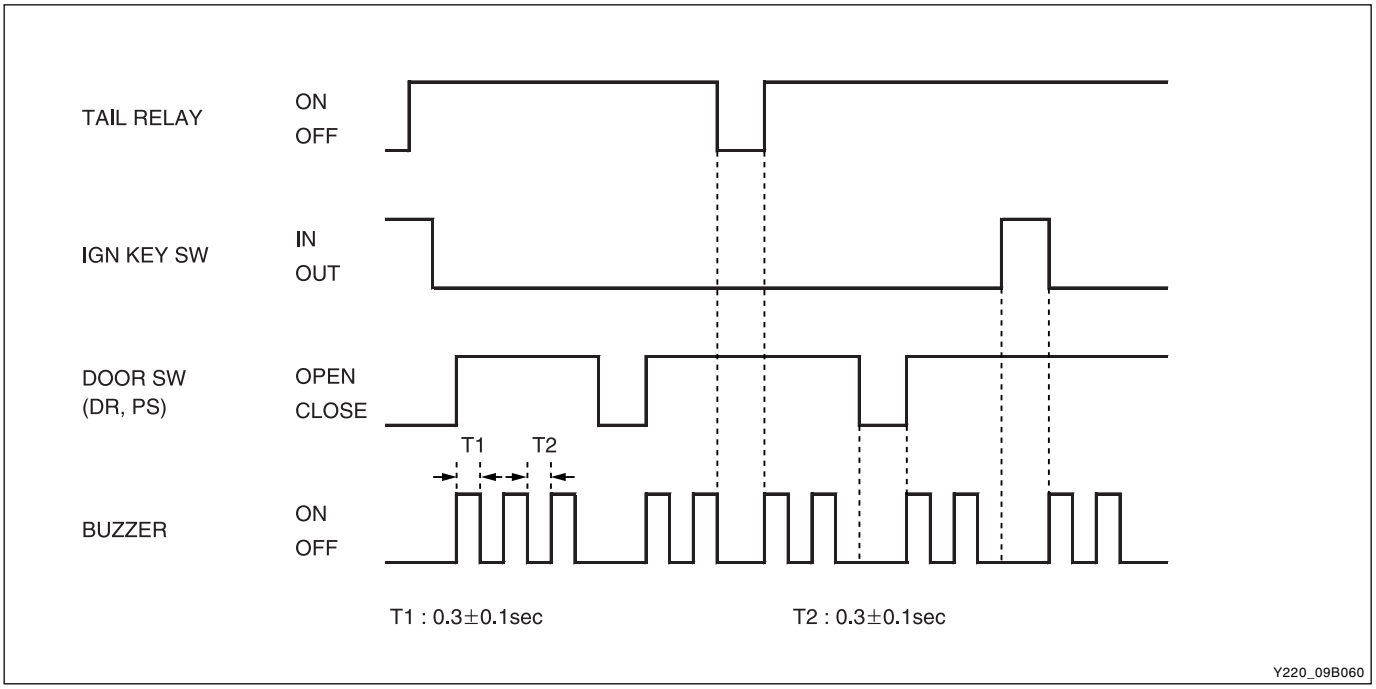
MARK LAMP LEFT ON WARNING

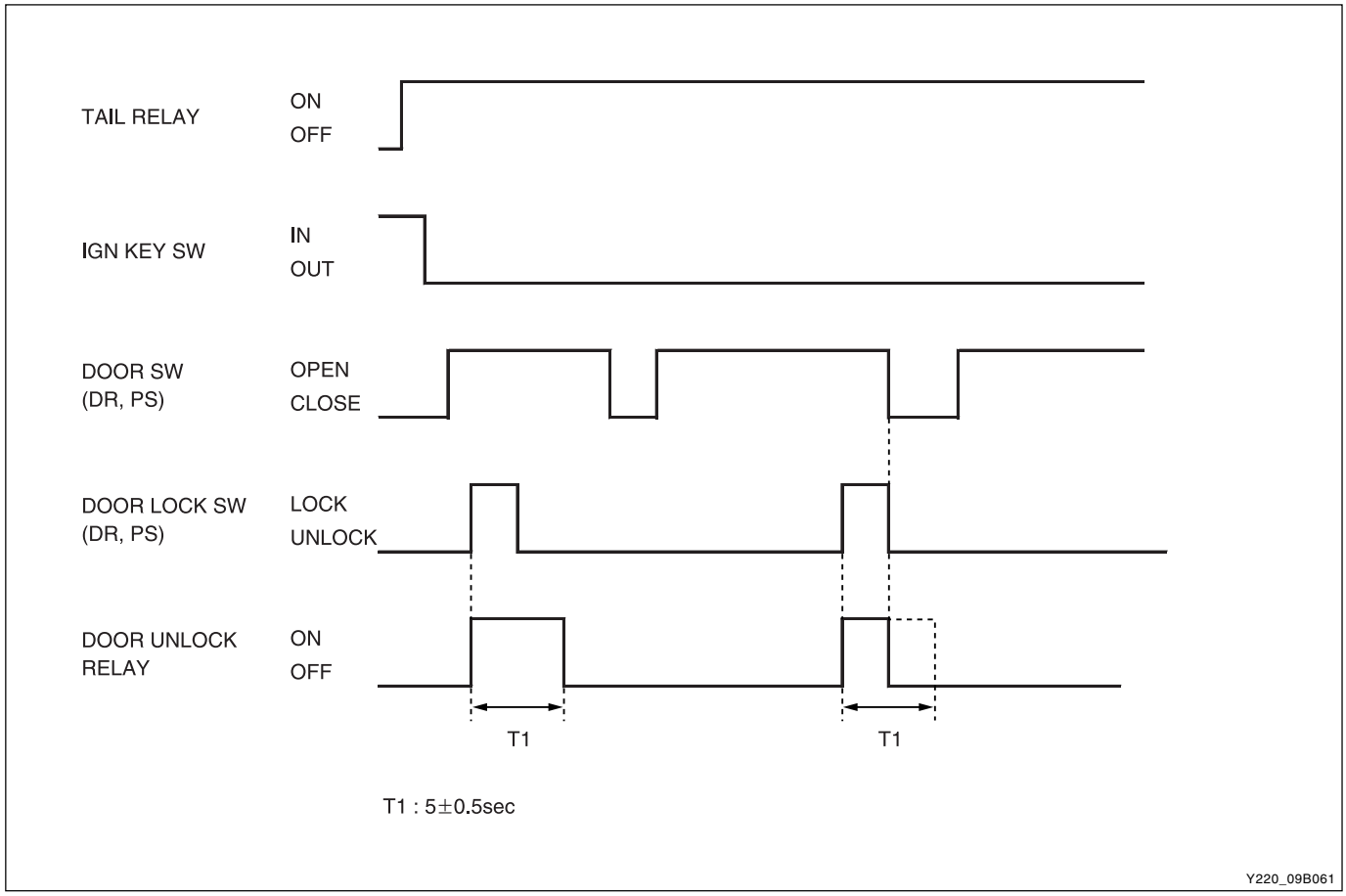
▶ Buzzer Control

1. The buzzer output is “ON” when opening the driver’s door or passenger’s door while the tail lamp relay turns “ON” and the ignition key is removed..
2. The buzzer output is “OFF” when any of above conditions are not met.
3. This function is not available when IGN 1 is “ON”.
4. This function is not available when the tail lamp relay output is “OFF” by the battery saver function.



▶ Door Control

1. The door unlock relay output is “ON” when opening the driver door or passenger’s door and locking the door lock switch while the tail lamp relay output is “ON” and the ignition key is removed.
2. The door unlock relay output is “OFF” when closing both doors or turning off the tail lamp switch.
3. This function is not available when IGN 1 is “ON”.
4. This function is not available when the tail lamp automatically turns off.



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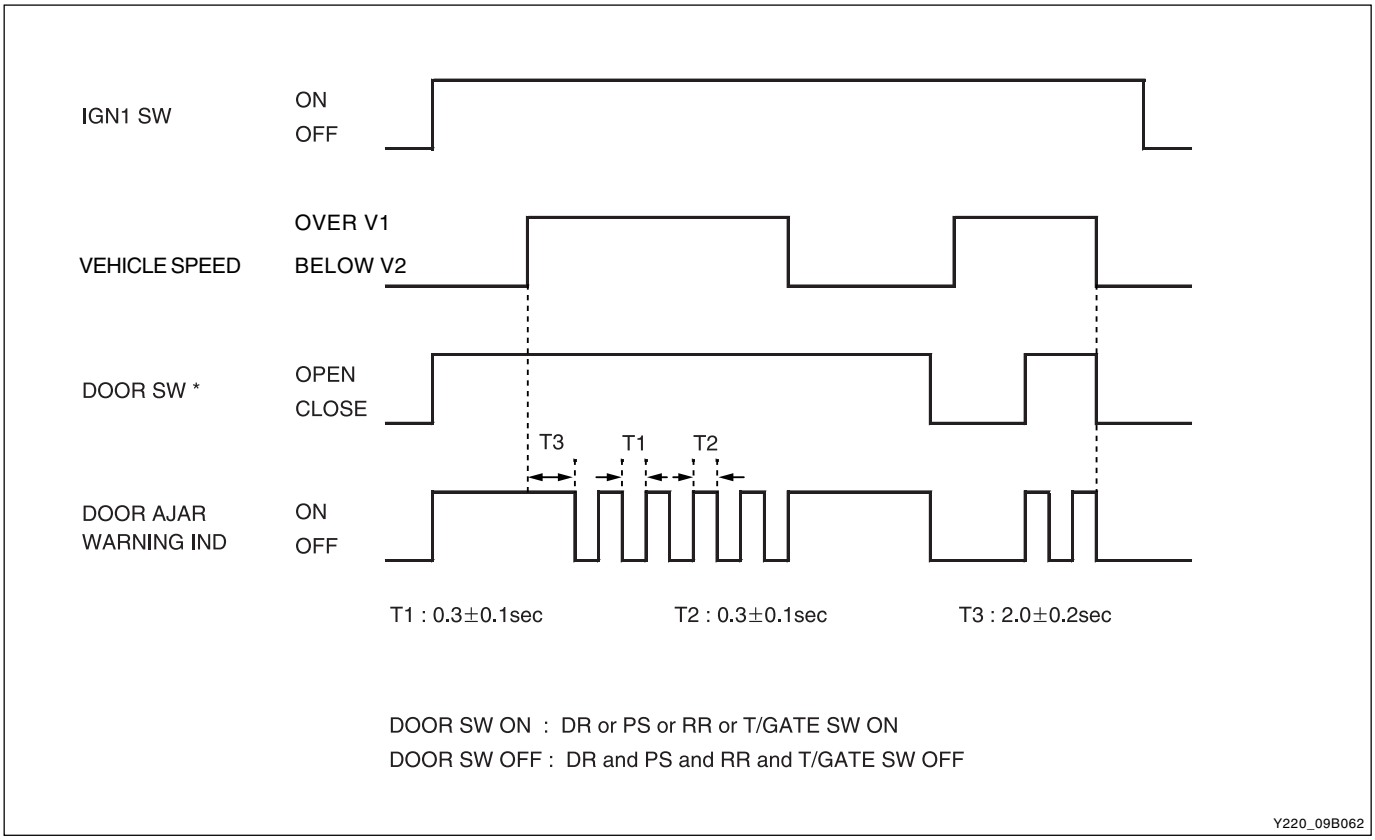
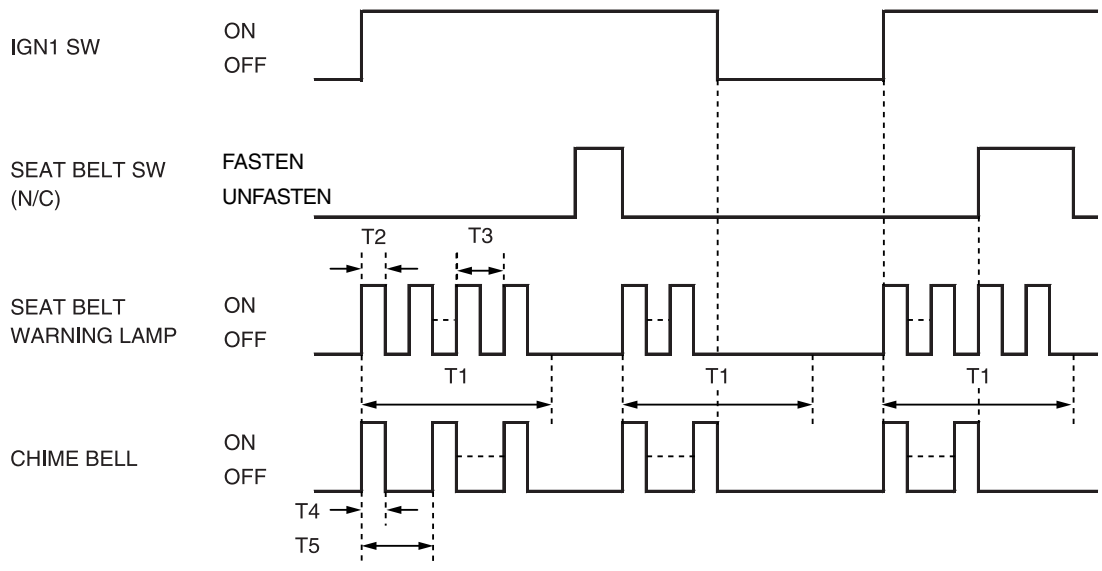
DOOR AJAR WARNING

1. The warning lamp comes on when opening a door while the vehicle speed is below 3 km/h.
2. The warning lamp blinks when opening a door while the vehicle speed is over V1 (10 km/h).
3. The warning lamp goes off when closing the door (in step 1 and step 2).
4. The warning lamp comes on when the vehicle speed is below V1 (in step 2).
5. This function is not available when IGN 1 is “OFF”. (However, the vehicle speed can be detected from 1.5 seconds after turning “ON” the IGN 1 switch.)



SEATBELT WARNING TIMER

1. The seatbelt warning lamp comes on and the chime bell sounds for 6 seconds when turning “ON” the IGN 1 switch.
2. The seatbelt warning lamp goes off and the chime bell stops when turning “OFF” the IGN 1 switch during the warning operation.
3. The chime bell stops and the seatbelt warning lamp stays on for the specified duration (6 seconds) when fastening the seatbelt during the warning operation.
4. The seatbelt warning lamp comes on and the chime bell sounds when unfastening the seatbelt with IGN 1 switch “ON”.



T1 : 6±1sec T2 : 0.3±0.1sec T3 : 0.6±0.1sec

T4 : 0.45±0.1sec T5 : 0.9±0.1sec

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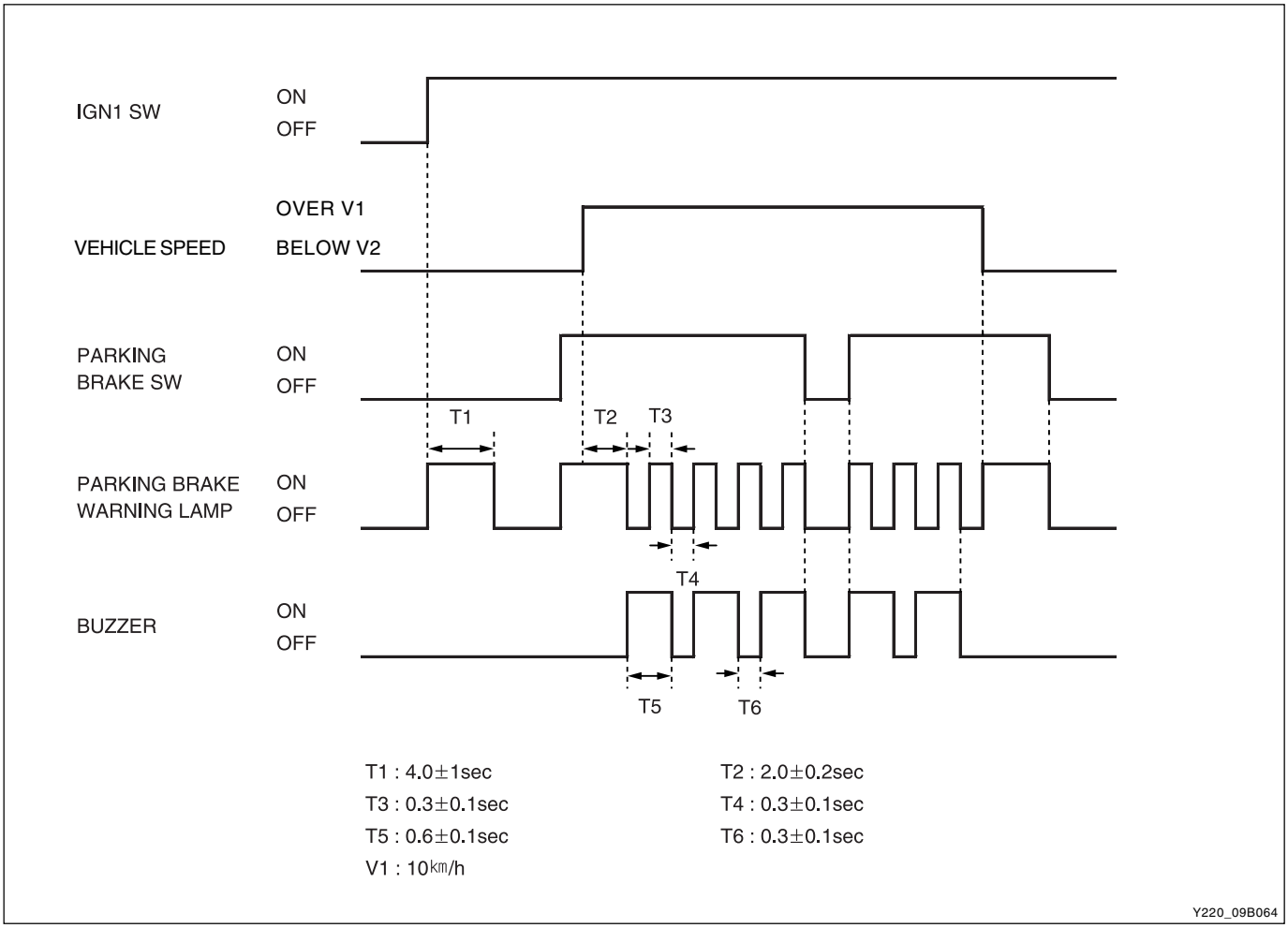
PARKING BRAKE WARNING

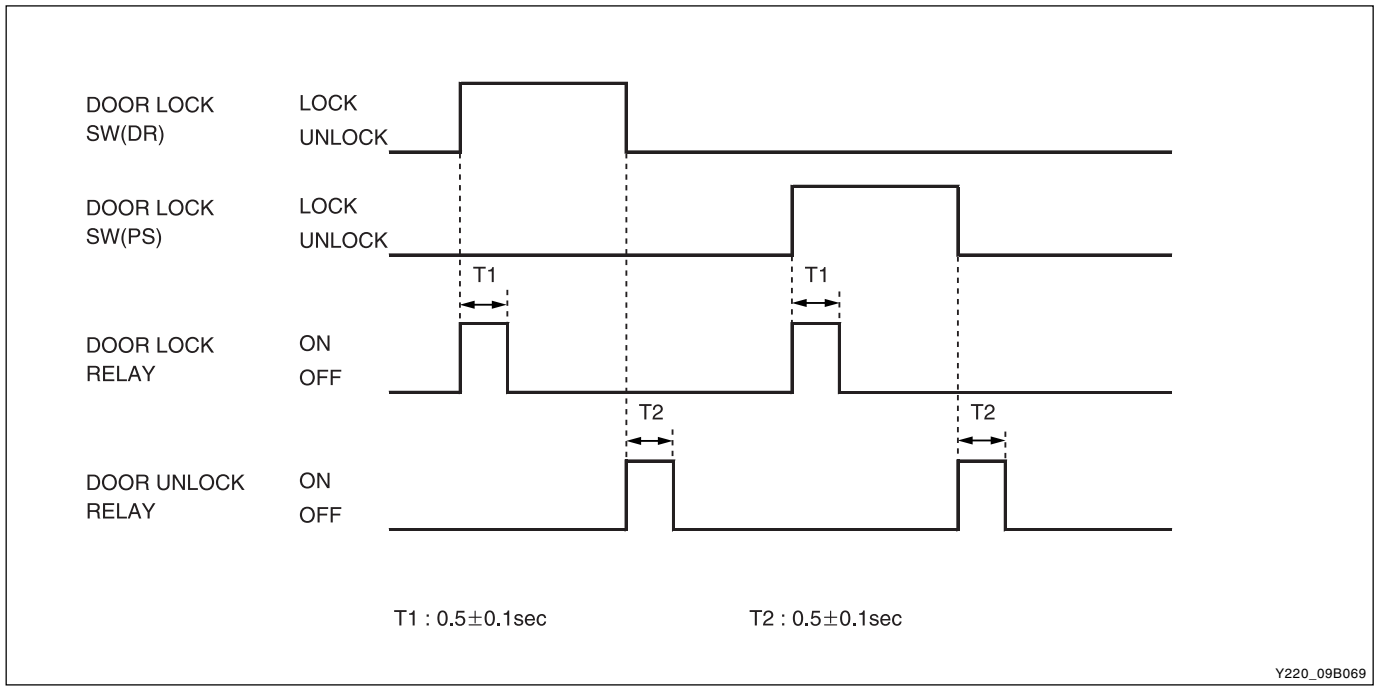
1. The parking brake warning lamp comes on for approx. 4 seconds when turning “ON” the IGN 1 switch regardless of the vehicle speed and parking brake switch position. After this 4 seconds, the warning lamp comes on, goes off and blinks according to the vehicle speed and parking brake switch position.
2. The warning lamp comes on when the parking brake switch output is “ON” while the vehicle speed is below V1.
3. The warning lamp blinks and the buzzer sounds when the vehicle speed is over 10 km/h for 2 seconds with the warning lamp “ON” and when turning “ON” the parking brake switch while the vehicle is over 10 km/h (PARKING START WARNING).
4. The warning lamp comes on and the buzzer stops when the vehicle speed goes down below V1 in step 3.
5. The warning lamp goes off and the buzzer stops when turning “OFF” the parking brake switch with step 3.
6. The warning lamp and the buzzer do not work when the IGN 1 switch output is “OFF”. (However, the vehicle speed can be detected from 1.5 second after turning “ON” the IGN 1 switch.)



DOOR LOCK/UNLOCK CONTROL

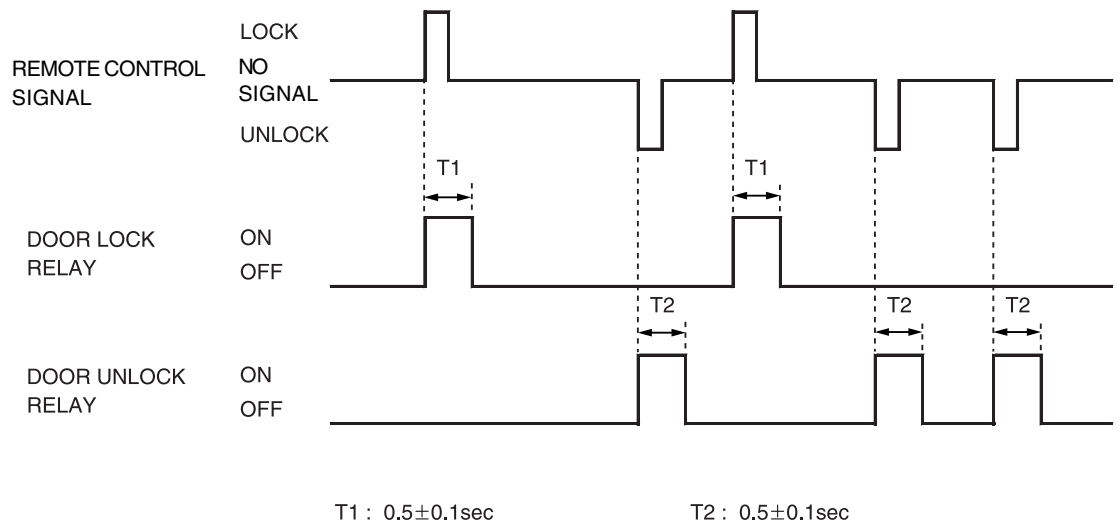
▶ Door Lock/Unlock by Door Lock Switch

1. The door lock output is “LOCK” for T1 when positioning the driver’s or passenger’s door lock switch to lock position.
2. The door lock output is “UNLOCK” for T2 when positioning the driver’s or passenger’s door lock switch to unlock position.
3. The changes of locking position are disregarded when outputting the “LOCK” or “UNLOCK” by other functions.
4. The door lock/unlock is not operating regardless of the door lock switch positions when connecting to battery.
5. If the LOCK/UNLOCK conditions are generated along with IGN KEY REMINDER conditions, outputs only when the ignition key is removed (after 0.5 seconds).
6. In case of operation by the outside door lock control (key operation), outputs same with step 1 and step 2.
7. The signal shorter than 0.15 seconds is disregarded.



▶ Lock/Unlock by REKES (Remote Keyless Entry System)

1. The door lock relay output is “ON” for 0.5 seconds when receiving the remote control lock signal.
2. The door unlock relay output is “ON” for 0.5 seconds when receiving the remote control unlock signal.



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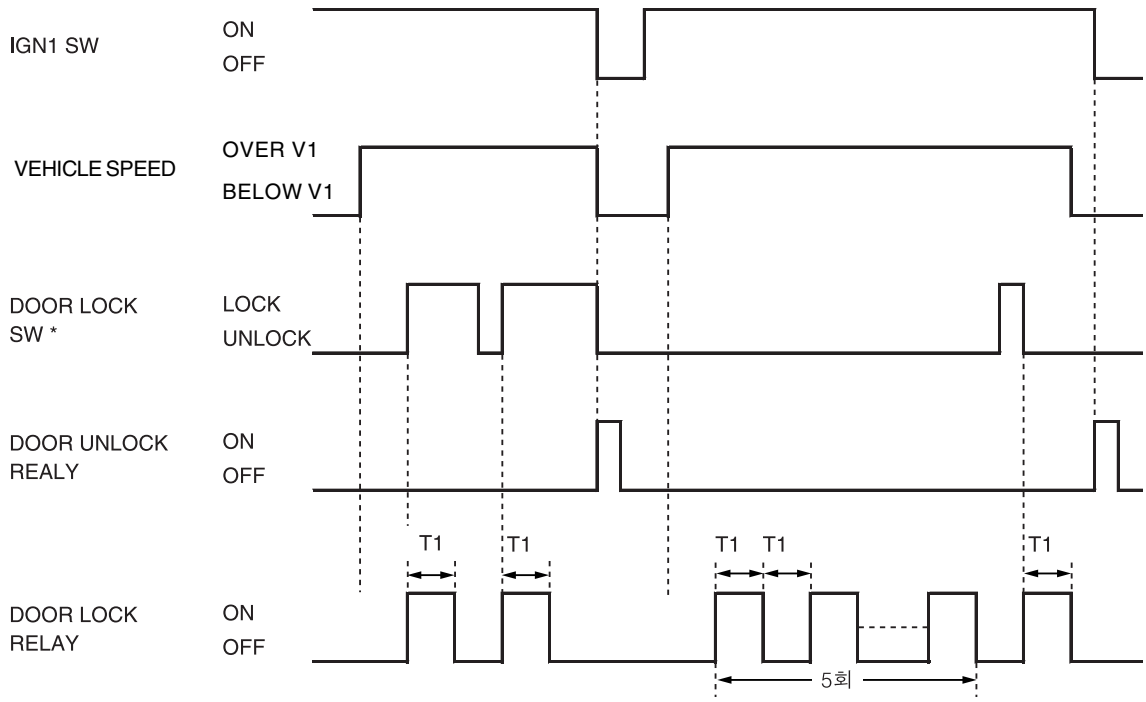
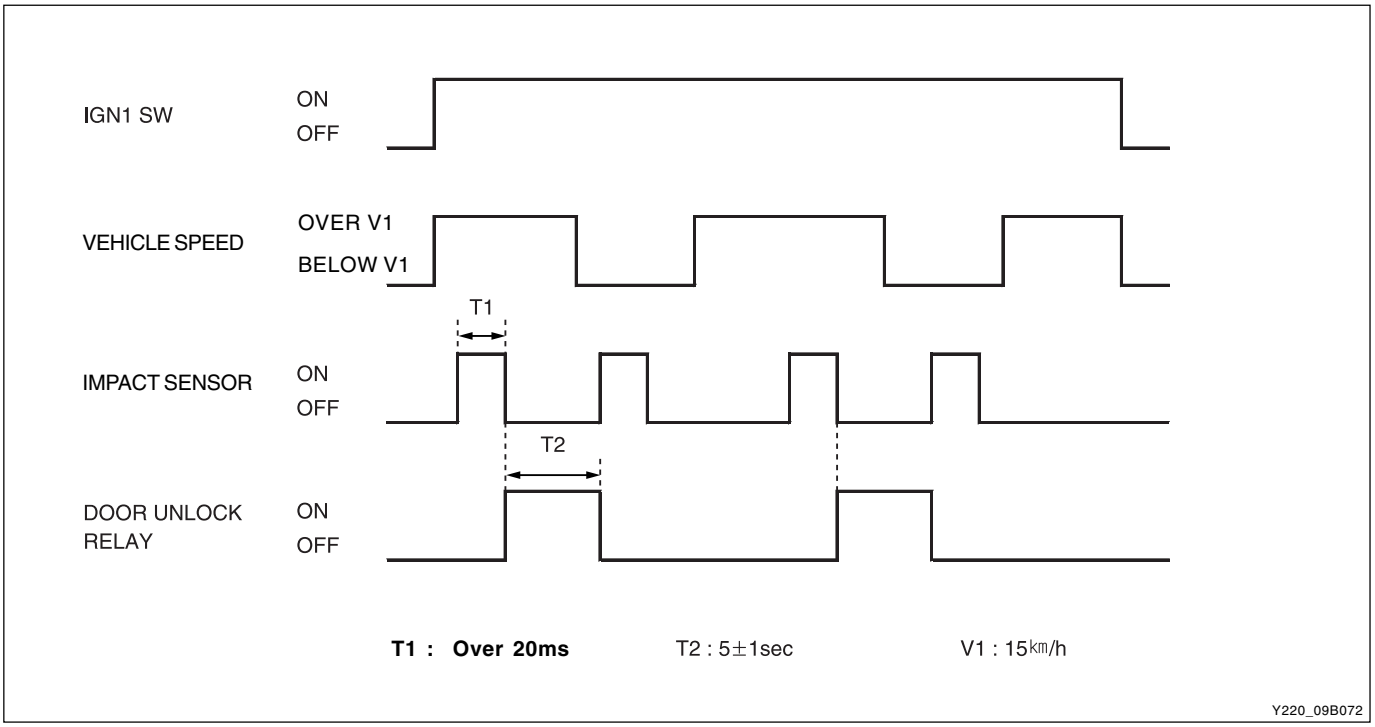
▶ Auto Door Lock

1. All door lock relay outputs are “ON” when the vehicle speed keeps over V1 while the IGN 1 switch turns “ON”. However, if all doors are locked or failed, the output will not be “ON”.
2. If any of doors is unlocked after outputting the “AUTO DOOR LOCK”, “LOCK” output can be done up to 5 times.
3. If any of doors is unlocked after 5 times of “LOCK” outputs, the door is regarded as “FAIL”. However, the door that is changed to “UNLOCK” from “LOCK” during the 5 outputs will not be regarded as “FAILED”. If the door that was regarded as “FAIL” will be unlocked again, only one “LOCK” output will be done.
4. If the door that was “LOCK” is changed to “UNLOCK”, only one “LOCK” output will be done.
5. Do not try “AUTO DOOR LOCK” operation for the vehicle speed after the completion of auto door unlock operation.
6. The “FAIL” is erased when turning “OFF” the IGN 1 switch.
7. All doors unlock relay output are “ON” when turning “OFF” the IGN 1 switch after completion of step 1 operation. (However, the vehicle speed input can be detected from 1.5 seconds after turning “ON” the IGN 1 switch.)



▶ Auto Door Unlock (Unlocking When Taking An Impact)

1. The auto door unlock relay turns “ON” automatically when taking an impact while the IGN 1 switch turns “ON” and the vehicle speed is over 15 km/h.
2. If taking an impact again after manually locking in above “UNLOCK” condition (IGN “ON”), “UNLOCK” can be done regardless of the numbers of operation. (However, the vehicle speed input can be detected from 1.5 seconds after turning “ON” the IGN 1 switch.)



The impact sensor in unit moves to unlock all doors when taking an impact.

However, the “AUTO DOOR UNLOCK” function may not be operated when the door has been damaged or the internal electric components are defective due to the impact.

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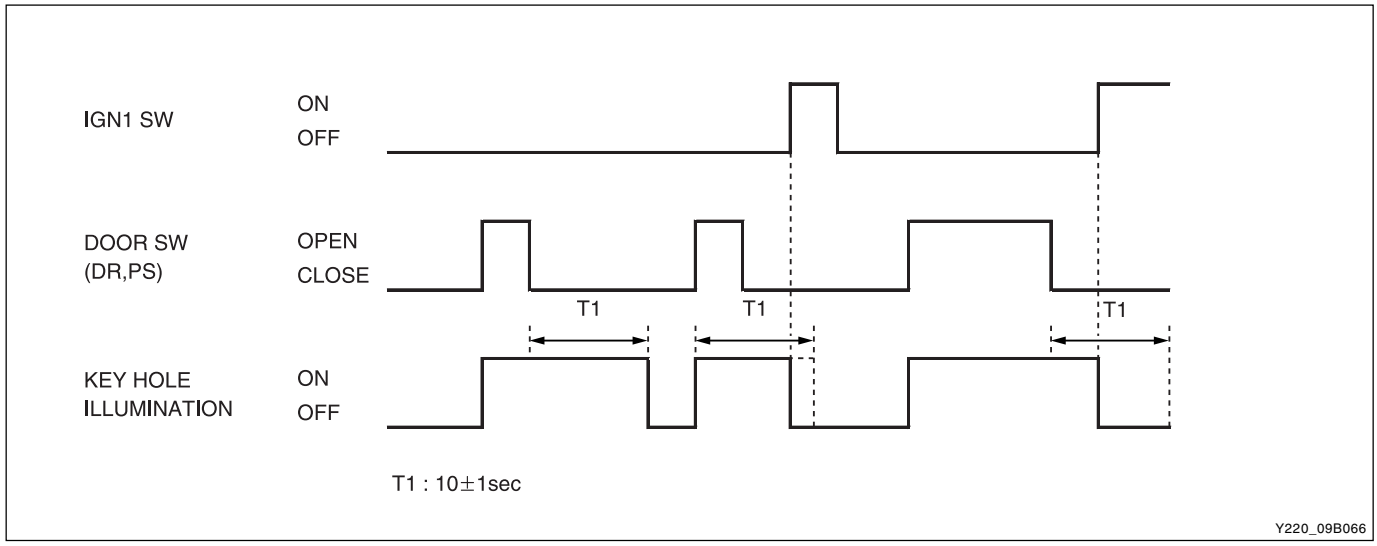
IGNITION KEY HOLE ILLUMINATION

1. The ignition key hole illumination comes on when opening the door while the ignition key is removed.
2. The ignition key hole illumination stays on 10 seconds after closing the door in step 1.
3. The ignition key hole illumination stops when turning “ON” the IGN 1 switch or when receiving the lock signal from remote control key within 10 seconds.

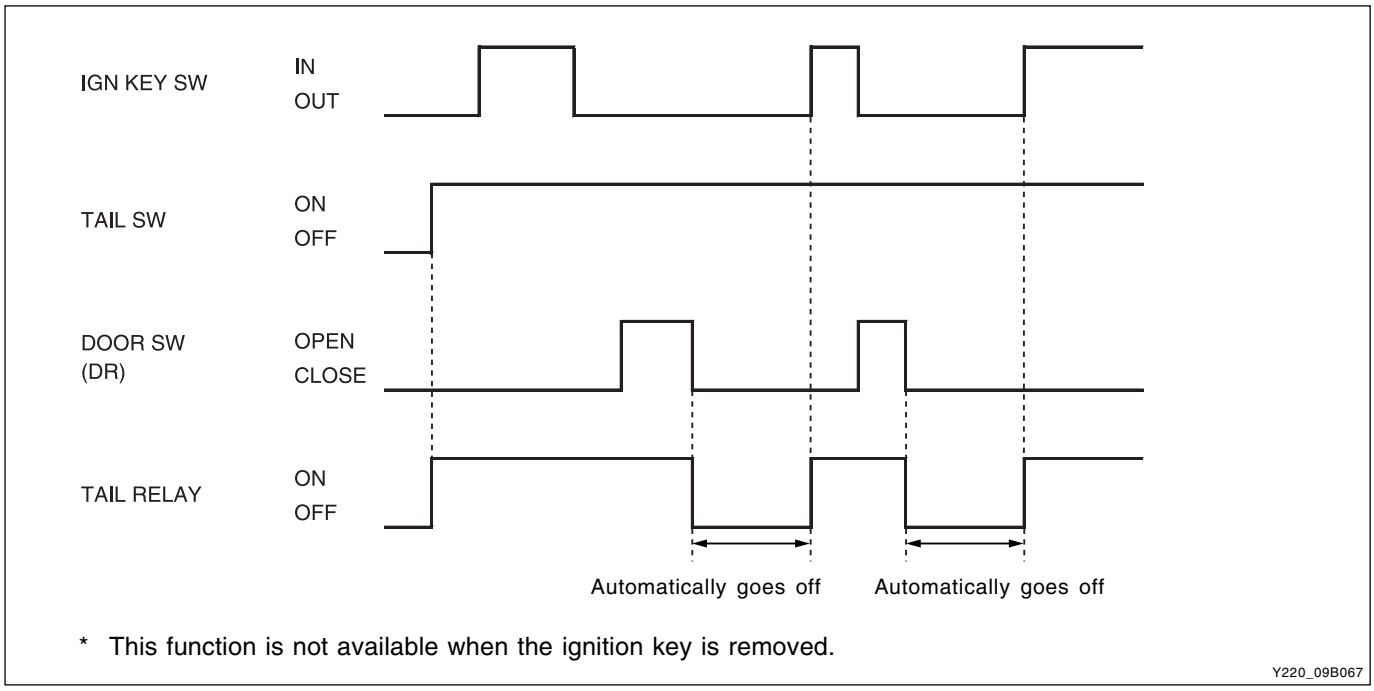
Notice

This function is not available in the immobilizer equipped vehicle.



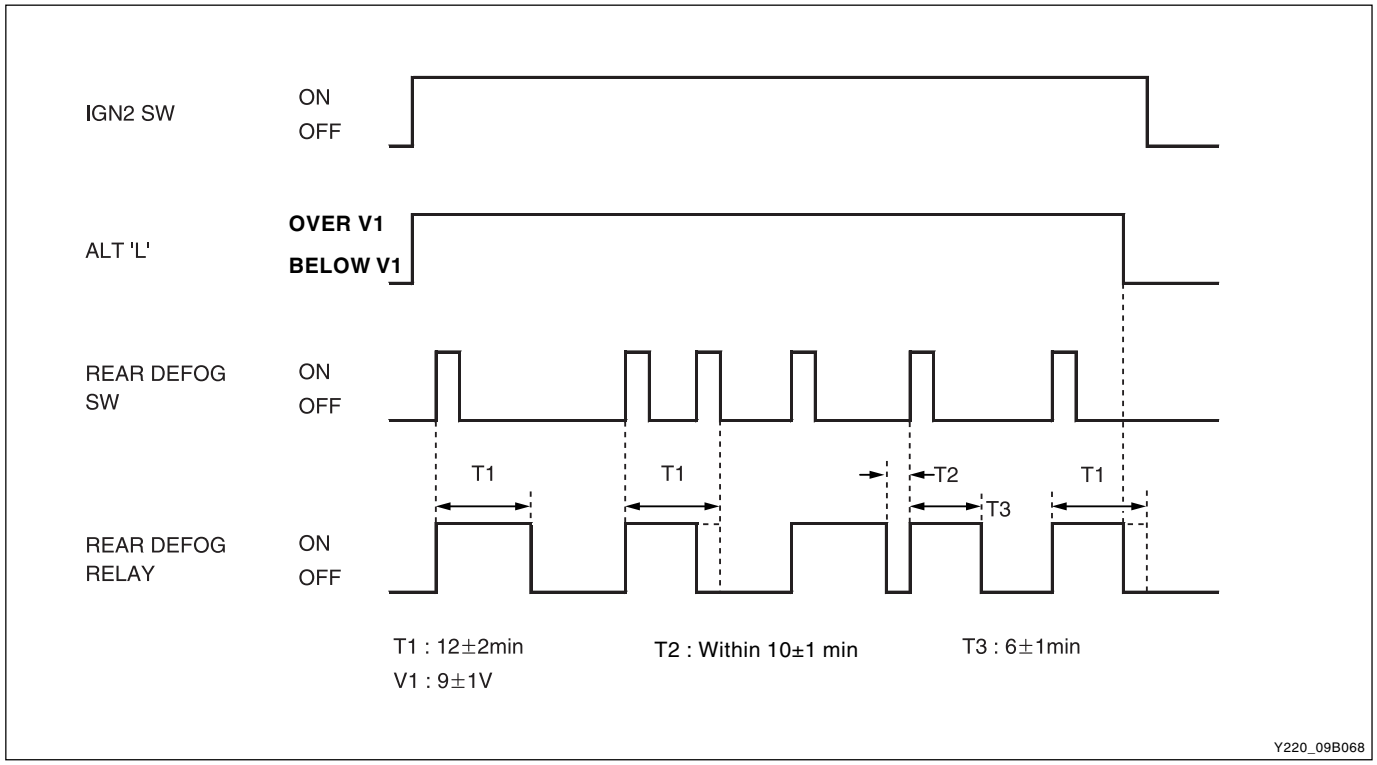
BATTERY SAVER

1. The tail lamp relay output is “OFF” when removing the ignition key from the ignition switch and opening and then closing the door while the tail lamp is coming on.
2. The tail lamp relay output is “OFF” when inserting the ignition key into the ignition switch after completion of step 1.



REAR DEFOGGER TIMER

1. The rear defogger output is “ON” when turning “ON” the rear defogger switch while the IGN 2 switch is “ON” (with engine running).
2. The output is “OFF” when turning “ON” the rear defogger switch again during outputting.
3. The output is “ON” only for T3 when turning “ON” the rear defogger switch within T2 after completion of output. This can be done only once.
4. The output is “OFF” when the IGN 2 switch is “OFF” or the ALT ‘L’ terminal is below V1.



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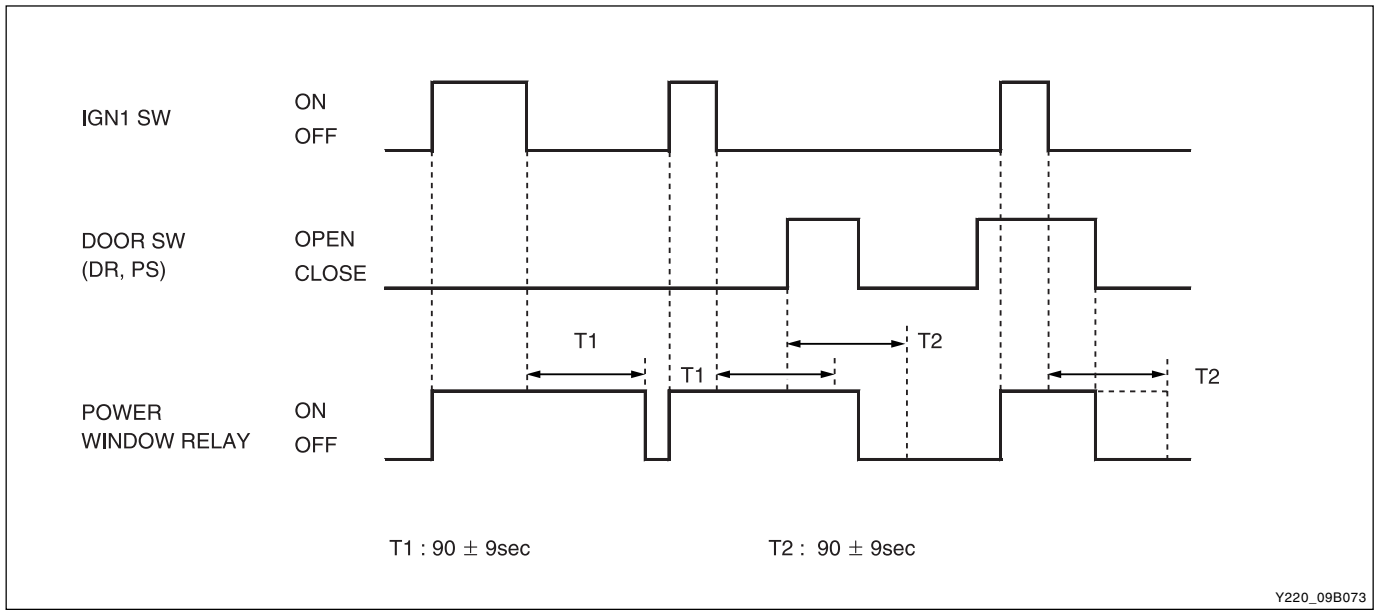
TIME LAG POWER WINDOW CONTROL

1. The power window relay output is “ON” when turning on the IGN 1 switch.
2. The power window relay output is “ON” for T1 when turning off the IGN 1 switch.
3. The power window relay output is “ON” for T2 when opening the door within T1.
4. The power window relay output is “OFF” when closing the door within T2.

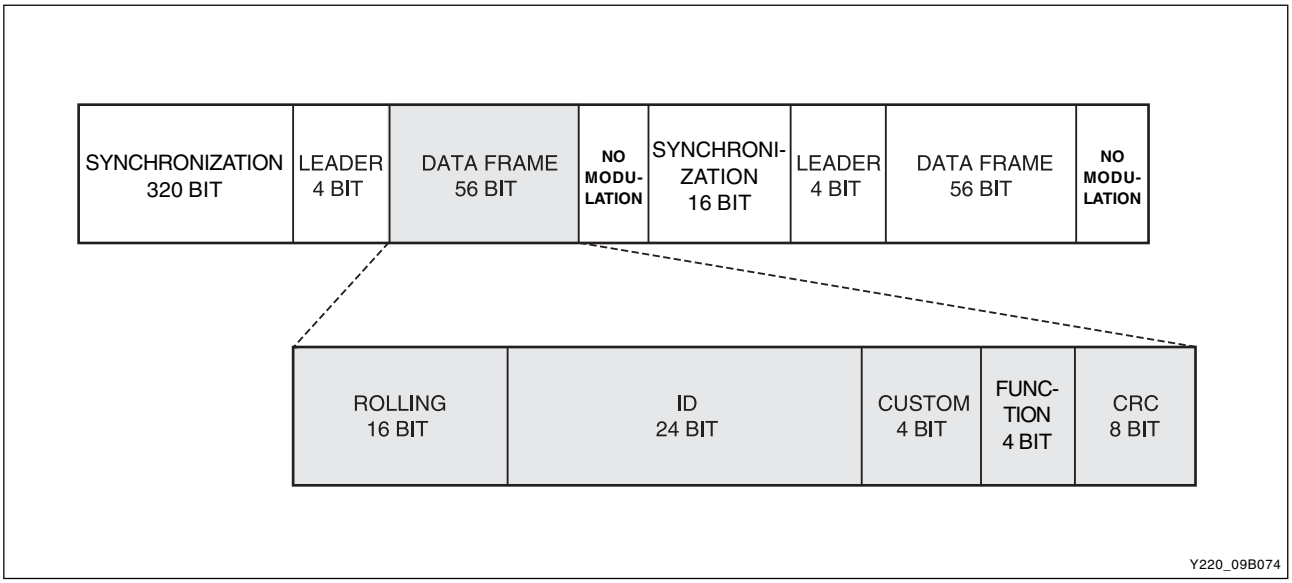


REKES

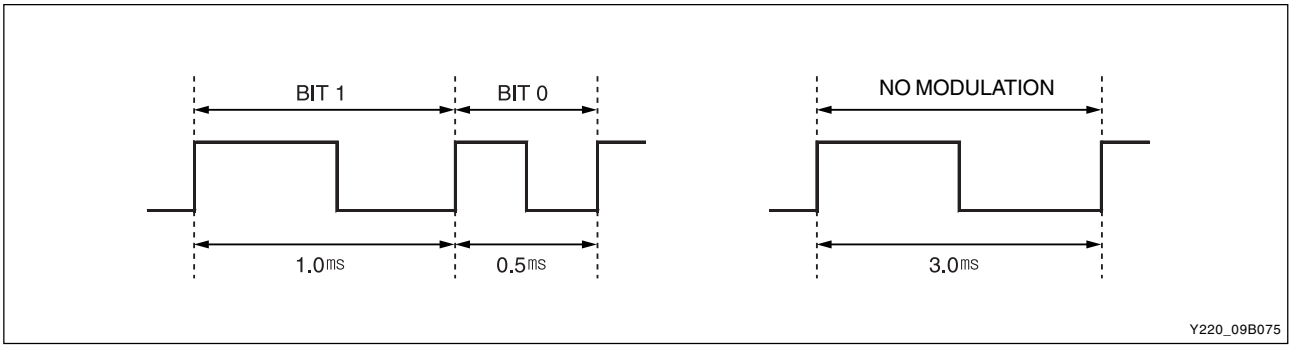
▶ Specifications of Transmitter

1. Transmitter signals
   - When pressing a switch on the transmitter, sends the data as follows.
   - When pressing over two switches at a time, only one signal can be sent according to the below priority.
   - Priority: LOCK ⇒ UNLOCK

2. Data structure



3. Definition of data



▶ Specifications of Receiver

1. Operating requirements
   - The ignition key should be removed.

2. Code registration requirement
   - After connecting the B+ to external code save terminal (applying battery voltage)

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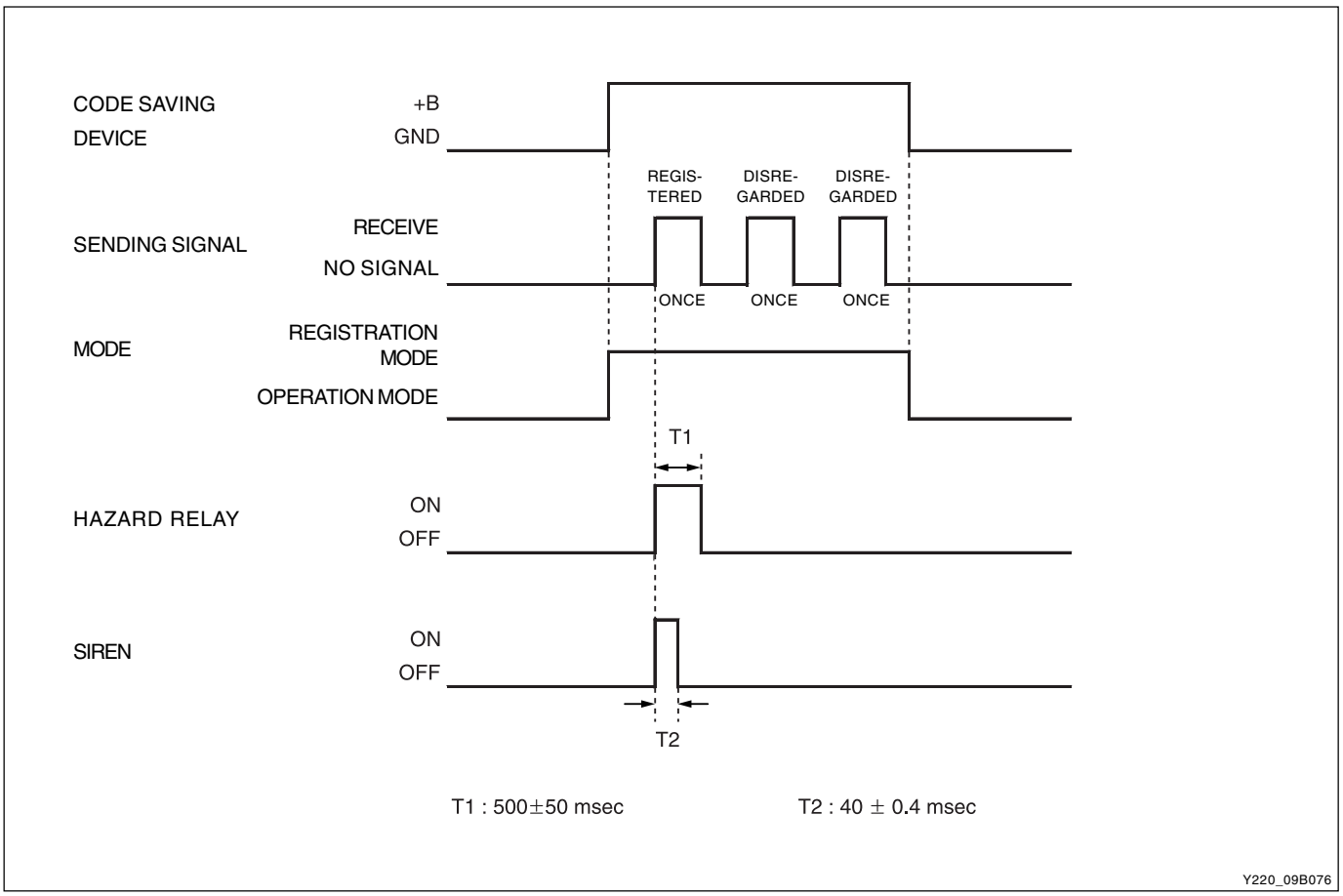
3. Registration of receiver code
   - Only one receiver code can be registered.
   - The received code cannot be output during the registration.
   - The hazard relay output is “ON” for T1 and the siren output is “ON” for T2 when registering the code.
     - Code saving terminal: OFF ⇒ ON (applying battery voltage)
     - Press the lock switch or the unlock switch on the transmitter.



4. Code output requirements
   - When the “customer” and “ID” codes are correct and the “rolling” code is within operating range while the ignition switch is removed and the code saving device is turned off, the code can be output after identifying the “function” code.
   - The function codes that can be output are “LOCK” and “UNLOCK”.

THEFT WARNING

▶ Theft Warning Selection

1. When the theft warning selection switch is “ON”
   - When a warning operating condition occurs, the warning outputs (Hazard relay/Siren) will not be done. However, if the armed mode is started, the hazard relay output is “ON”.
   - When turning “OFF” the theft warning selection switch from “ON” while the operating condition is present, the warning operation output will not be done.
2. When the theft warning selection switch is “OFF”
   - When a warning operating condition occurs, the warning outputs (Hazard relay/Siren) will be done.
   - When turning “ON” the theft warning selection switch from “OFF” during the warning output, the warning operation output can be done by remained time.
3. Determination for ON/OFF position of theft warning selection switch
   - Can be determined only when the theft warning operating is in normal mode (before receiving Tx LOCK signal).
   - Disregards the changes of theft warning selection switch in the armed mode or warning operation.
4. Definition of terms

   Door

   OPEN: Door switch (hood, driver’s door, passenger’s door, rear doors and tailgate) = OPEN

   CLOSE: Door switch (hood, driver’s door, passenger’s door, rear doors and tailgate) = CLOSE

   Door Lock Switch

   LOCK: Door lock switch (driver’s door, passenger’s door, rear doors and tailgate) = LOCK

   UNLOCK: Door lock switch (driver’s door, passenger’s door, rear doors and tailgate) = UNLOCK

▶ Description of Theft Warning Function

1. Armed mode activation requirements
   - The “LOCK” output is “ON” when receiving the T x LOCK signal while the ignition key is removed and all doors are closed. The armed mode is activated when the door lock switch is locked (siren output: once, hazard relay output: twice)
   - The siren and hazard relay outputs are “ON” when receiving T x LOCK signal again in armed mode (maintaining the armed mode).
   - When receiving Tx LOCK signal while any of doors are not closed, only the “LOCK” output can be done and then activates the armed ready mode (without siren and hazard relay output). At this moment, if the ignition key is in the ignition switch, the door unlock switch is turned “ON” or the door lock switch is unlocked (after 0.6 seconds), cancels the armed mode and activates the normal mode. However, in these cases, if closing the door and locking the door lock switch, the siren outputs once and the hazard relay outputs twice and then activates armed mode.
   - When the door is opened, the door unlock switch is “ON” or the ignition key is not inserted into ignition switch for 30 seconds after receiving T x UNLOCK signal, outputs “LOCK” and then activates armed mode (RELOCK operation).
   - The armed mode will not be activated except above conditions.

     ex) The armed mode is not activated when locked by door unlock switch.

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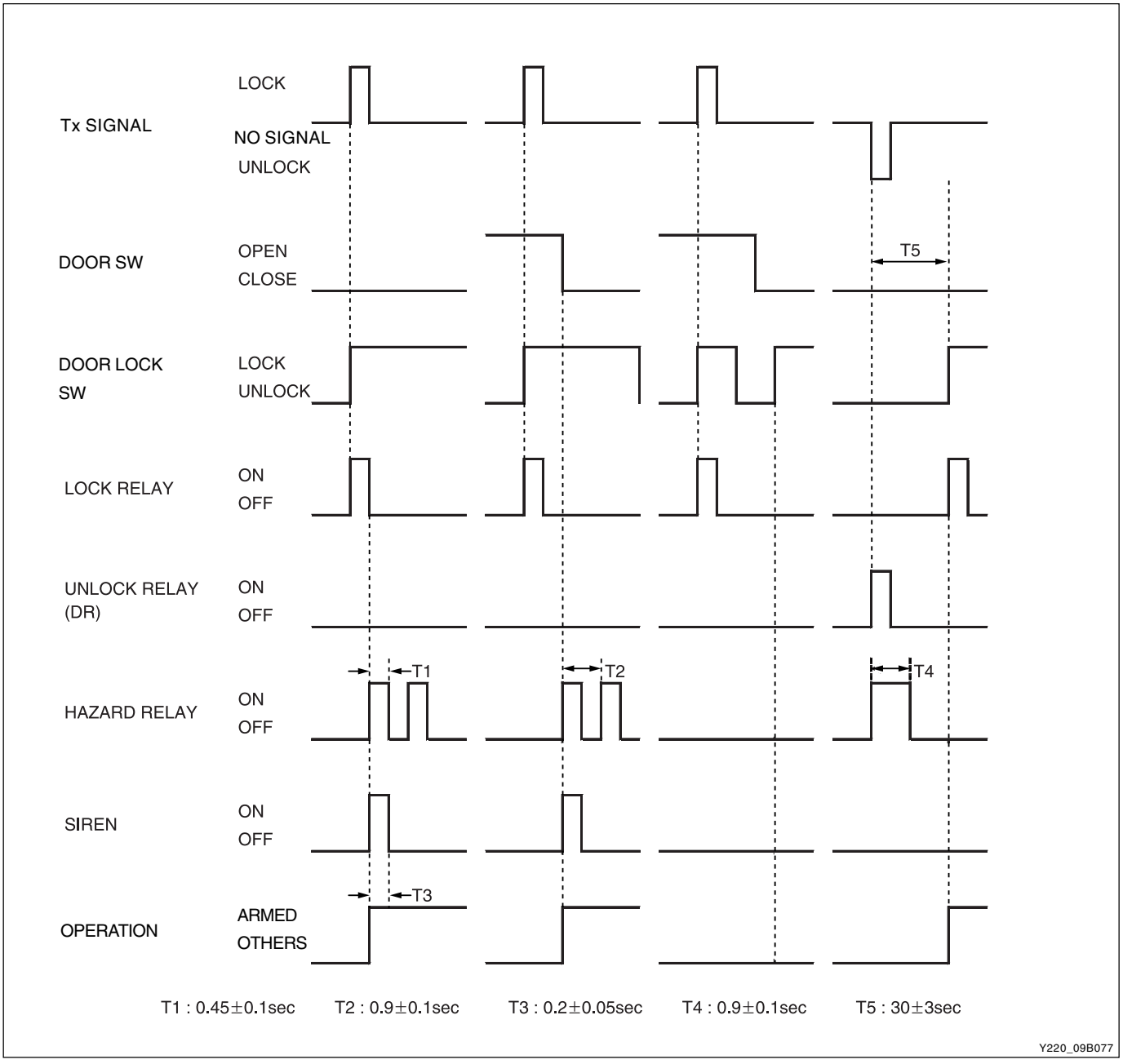
2. Armed mode cancellation requirements
   - Unlocking by Tx, turning “ON” the door unlock switch, inserting the ignition key into the ignition switch, turning “ON” the IGN 1 switch, turning “ON” the IGN 2 switch
   - Armed mode cancellation requirements for tailgate

     The armed ready mode for tailgate is activated when turning “ON” the tailgate cylinder switch in the armed mode. At this moment, if opening and then closing the tailgate, the armed mode is activated with one siren output and two hazard relay outputs.

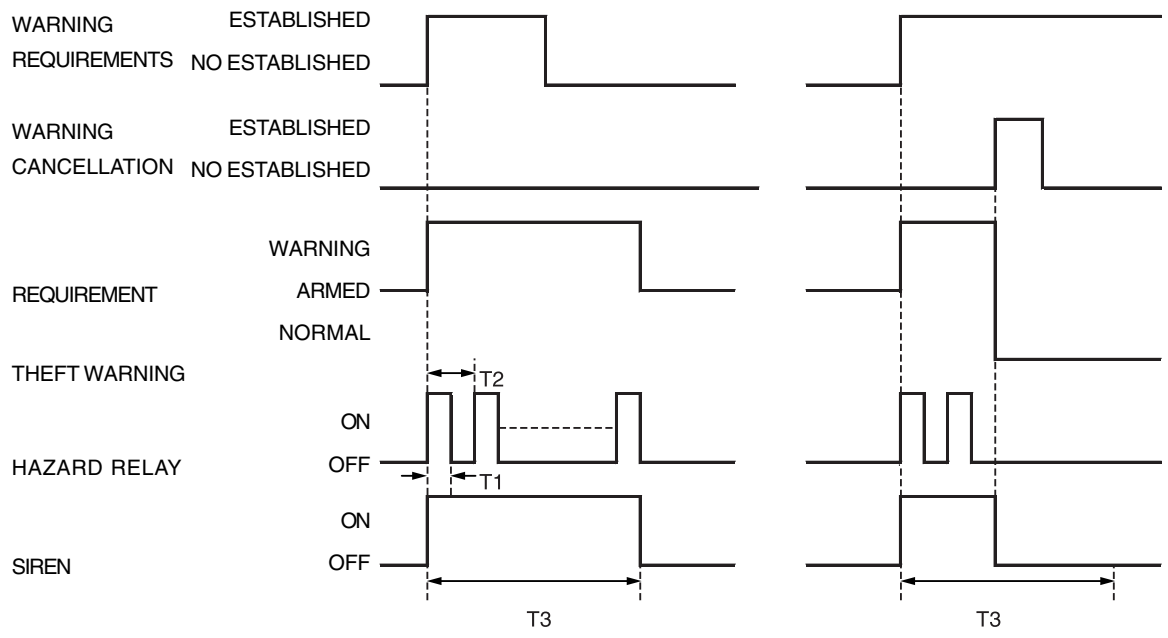


3. Warning operating requirements
   - When opening the door in armed mode
   - When unlocking the door lock switch in armed mode
   - When closing and then opening the door after completion of warning (27 seconds)

4. Warning operation
   - The siren output is “ON” for T3 and the hazard relay output is “ON” for T3 with the interval of T2.

5. Warning cancellation requirements
   - When locking or unlocking by Tx
   - When turning “ON” the door unlock switch

6. Warning cancellation operation
   - The siren and the hazard relay outputs are “OFF”.



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7. Operations when removing and installing the battery

Removed \ Installed	Normal	Armed	Warning	Remark
Normal Armed	○			
Armed Ready	○			
Armed		○		
Warning			○	
Warning Completion			○	
RELOCK Ready	○			

▶ System Power Consumption

1. The “SLEEP” mode is activated to save the system power when:
   - All doors (driver’s door, passenger’s door, rear doors, tailgate, hood) are closed
   - The IGN 1 switch and the IGN 2 switch are turned “OFF”
   - Driver’s and passenger’s door lock switch and the ignition key switch are not changed for 2 seconds while the door unlock switch and the tailgate cylinder switch are turned “OFF”

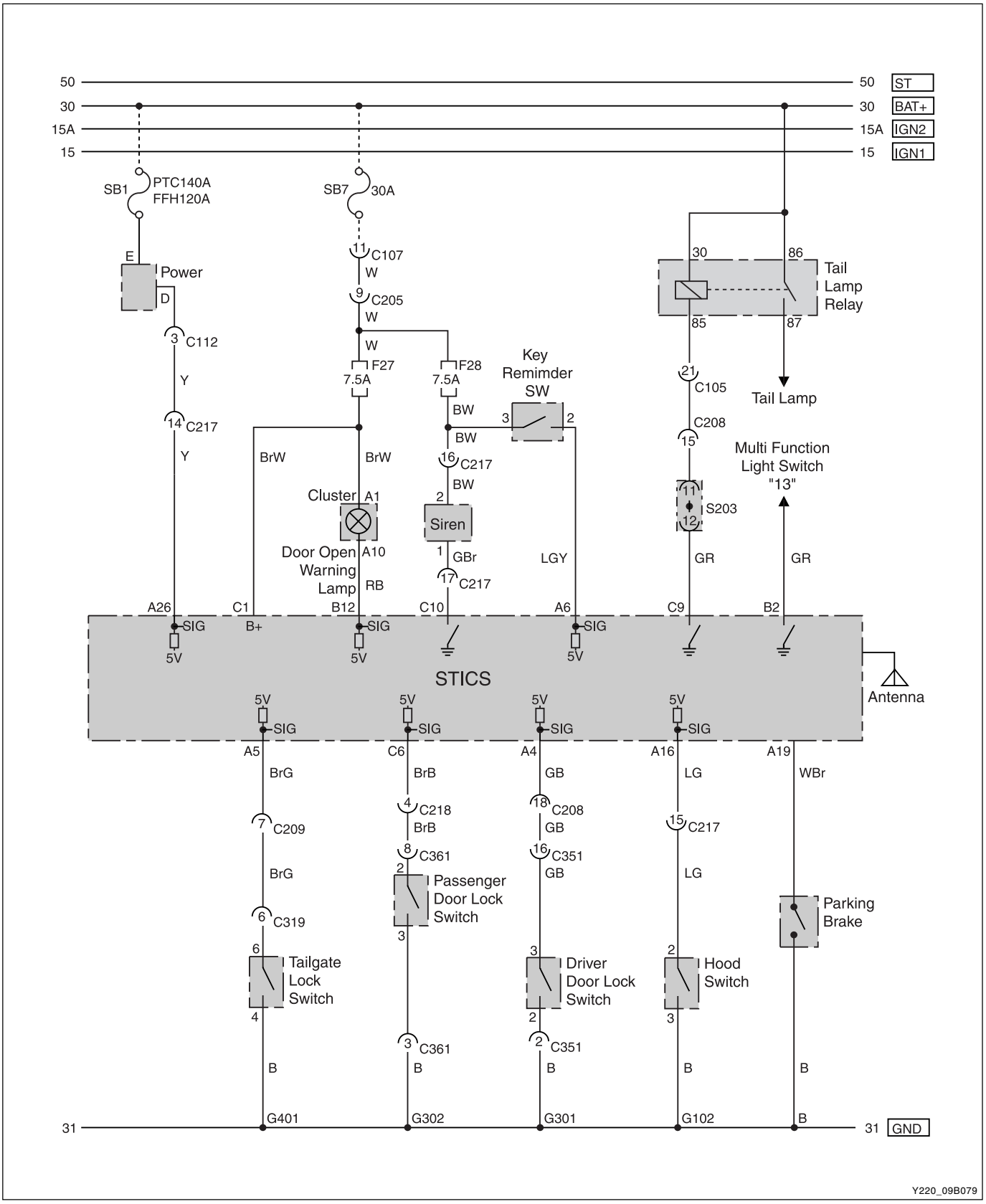
2. The “WAKE UP” mode is activated immediately after any of above requirements is failed (canceling the “SLEEP” mode).

3. The “WAKE UP” mode is activated immediately after inputting the “KEYLESS” signal (canceling the “SLEEP” mode).

4. The above output conditions and ready conditions are cancelled after a certain period of waiting when some outputs (room lamp, key hole illumination, tail lamp, power windows etc.) are “ON” in the conditions in step 1 and all the doors are closed for 30 seconds after unlocking by keyless system. The “SLEEP” mode is activated when the driver’s or passenger’s door lock switch and the ignition switch is not changed for 2 seconds.

RK-STICS

▶ Tail Lamp and Switch



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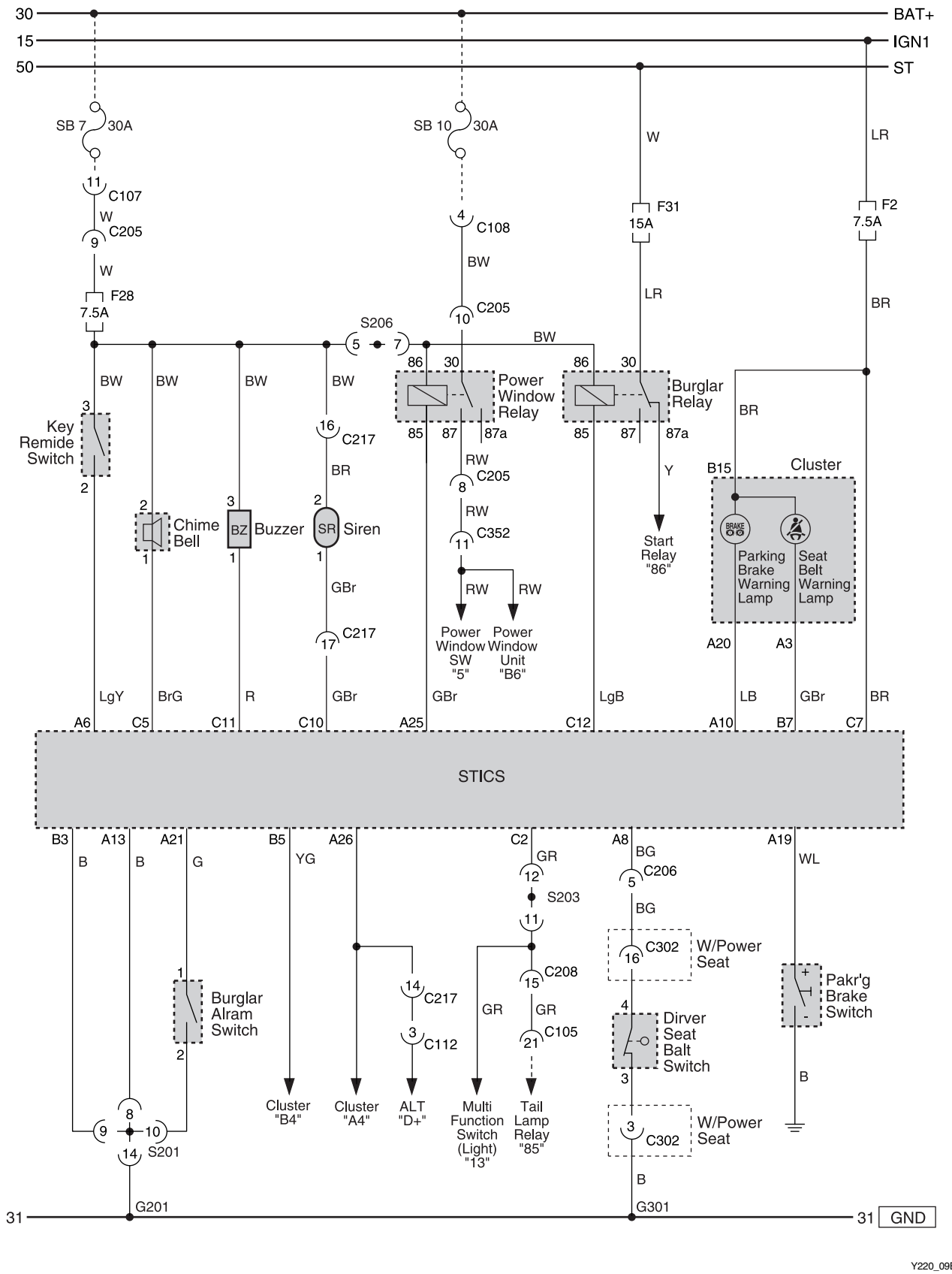
▶ Warning Lamps



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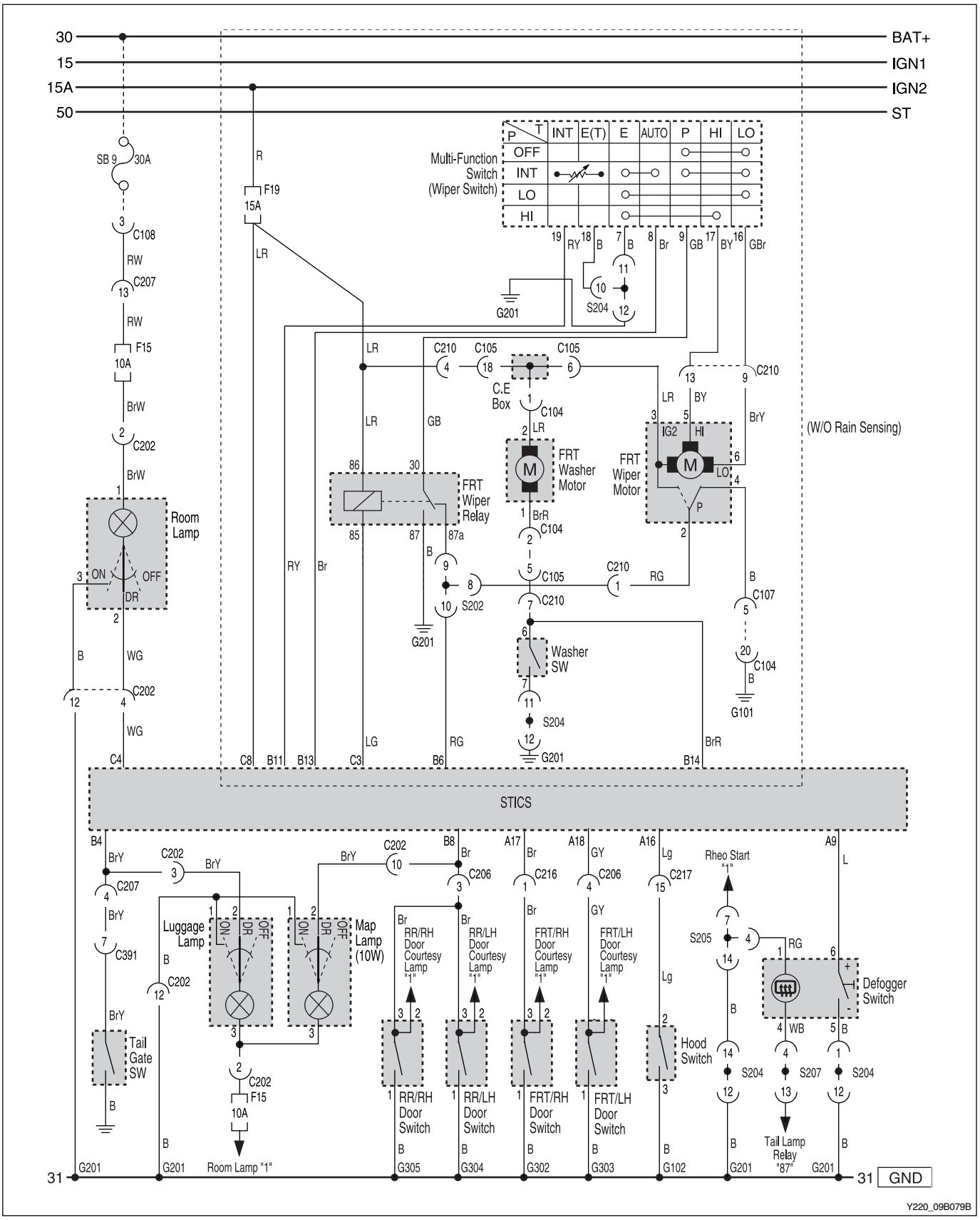
▶ Wiper, Door Switch, Lamps (Room Lamp, Map Lamp), Door Ajar Warning Lamp



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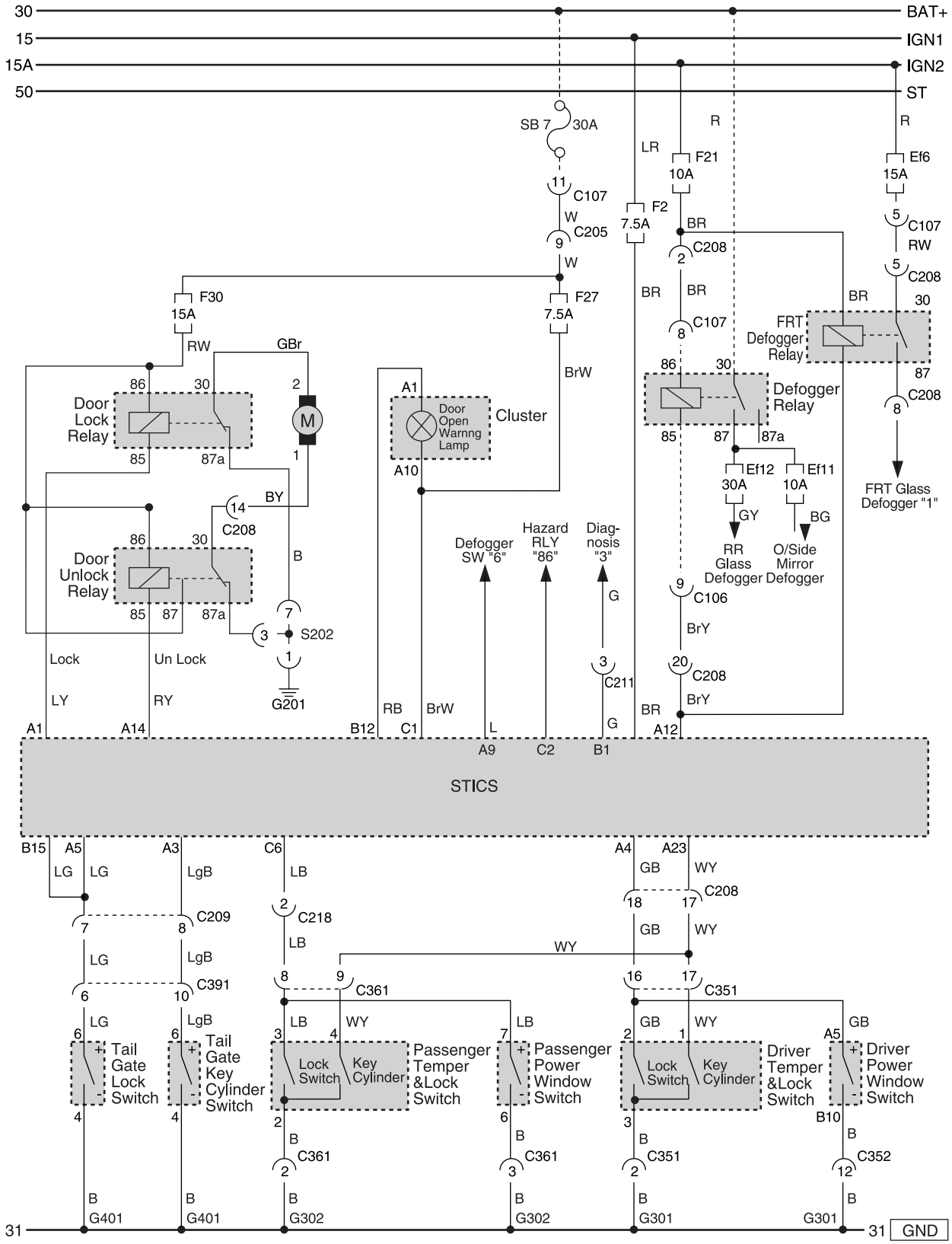
▶ Door Lock, Heated Wire



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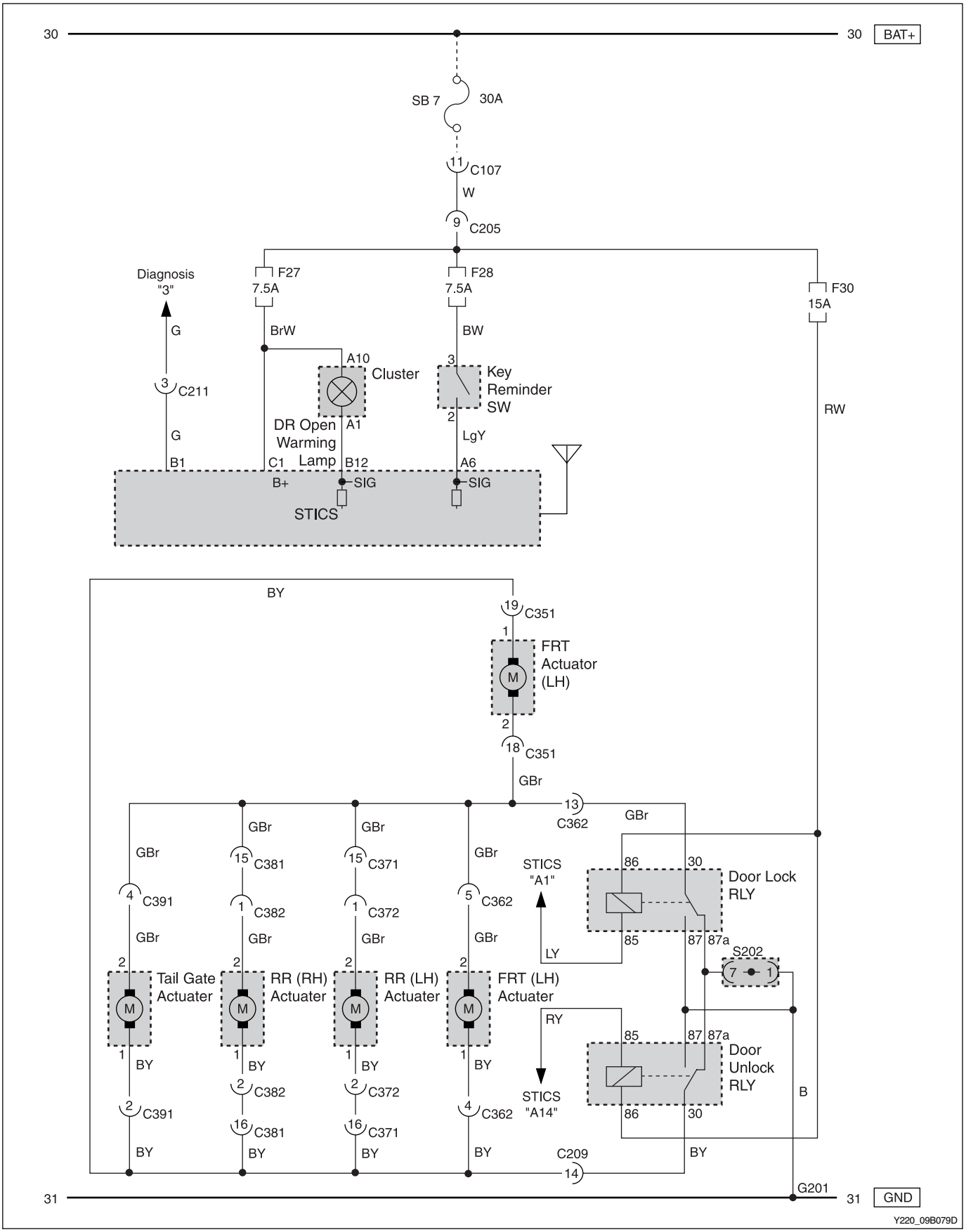
▶ Central Door Locking Device



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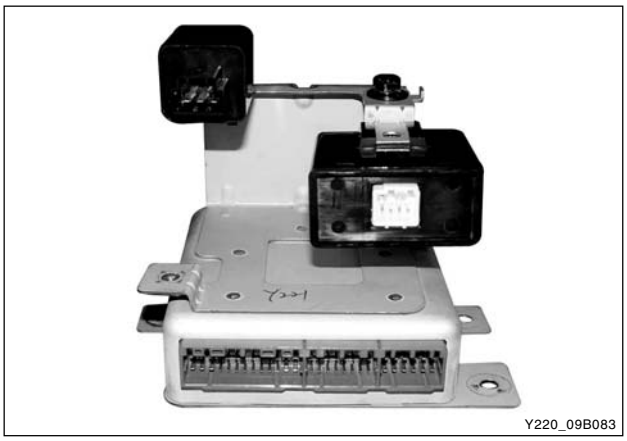
Removal and Installation

1. Disconnect the battery negative cable and remove the lower panel in front of driver's seat.

2. Disconnect the buzzer and folding unit connectors and remove them at a time.

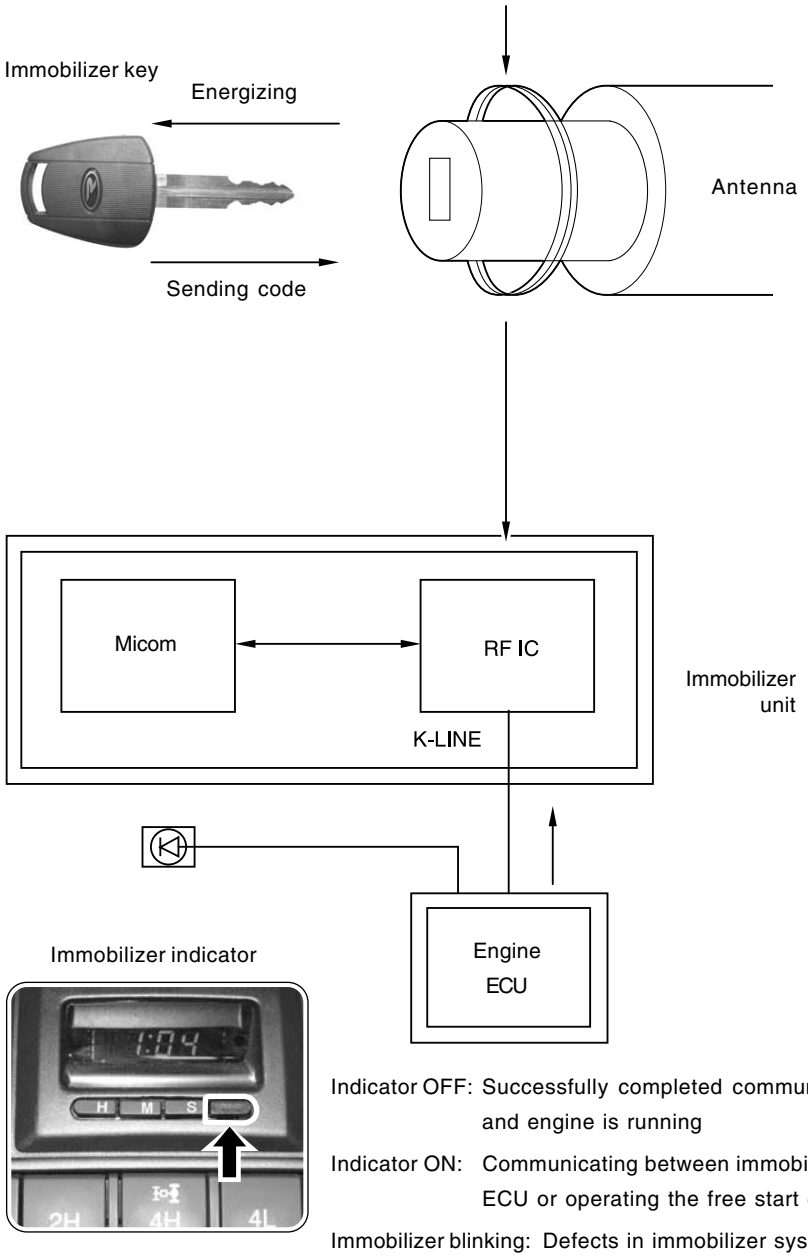
3. Disconnect three connectors and remove the RK-STICS unit.



4. Install new RK-STICS unit in the reverse order of removal.

IMMOBILIZER (FOR D27DT ENGINE EQUIPPED VEHICLE)

SYSTEM LAYOUT



Total 5 immobilizer key can be coded to ECU with Scan-i. Refer to the coding procedures in Troubleshooting section.

The immobilizer should be coded whenever replacing the immobilizer related components and ECU at the Ssangyong Authorized Service Operation.

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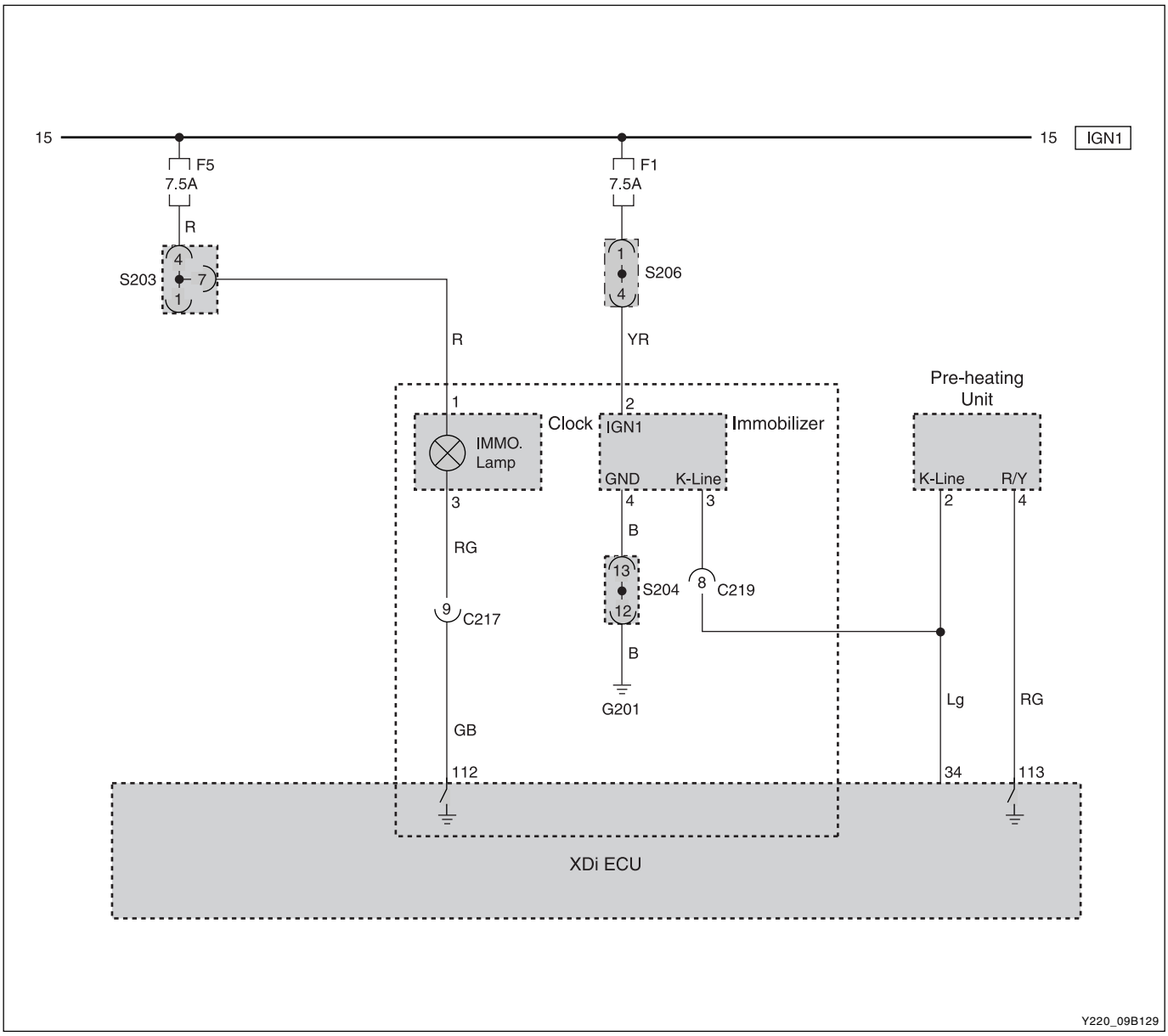
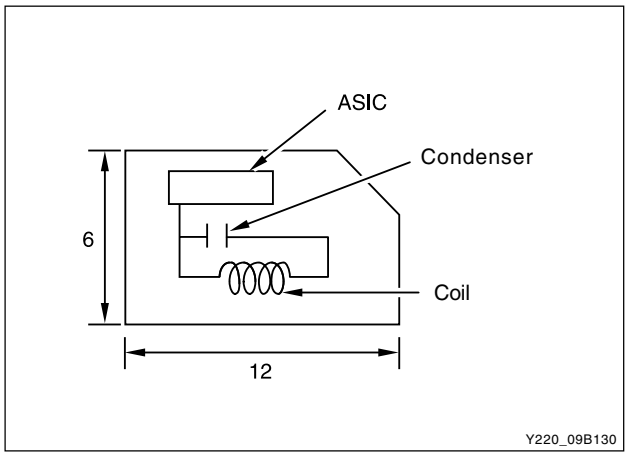
CIRCUIT DIAGRAM



COMPONENTS

▶ Transponder

It receives the “ENERGY” and “CHALLENGE” signals and computes them by the crypto key in ASCI and sends the “RESPONSE” and serial number



▶ Coil Antenna

Ls (inductance): 1.08 mH

It provides the “ENERGY” and “CHALLENGE” to the transponder, receives the output signals from the transponder, and delivers them to the immobilizer ECU. It is installed at the top of steering handle lock. It uses the active type to enhance the sensitiveness and stability.

▶ Immobilizer RF IC

It drives the coil antenna, converts the received signals from the coil antenna to special code, and delivers it to the immobilizer ECU.

▶ Immobilizer Unit

It analyzes the received signals from the immobilizer RF IC, confirms the authorized transponder, and delivers the result (start or start inhibition) to the engine ECU.

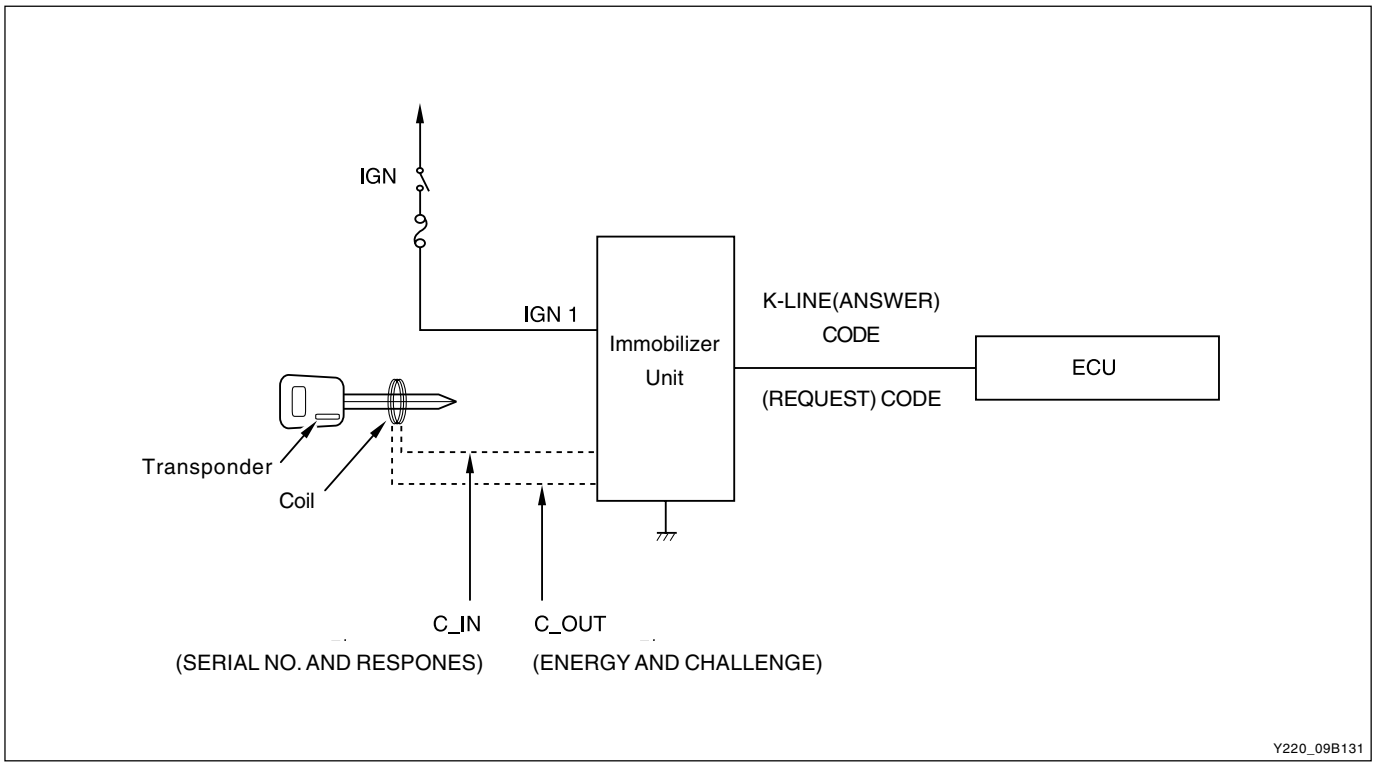
▶ Engine ECU

It provides the start or start inhibition command by using the transponder related information from the immobilizer ECU when turning on the ignition switch.

▶ Diagnostic Tester

It diagnoses the immobilizer ECU and the engine ECU.

SCHEMATIC DIAGRAM



SECTION 9C

INSTRUMENT PANEL AND MULTI-METER

Table of Contents

CHANGED BY	
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CLUSTER

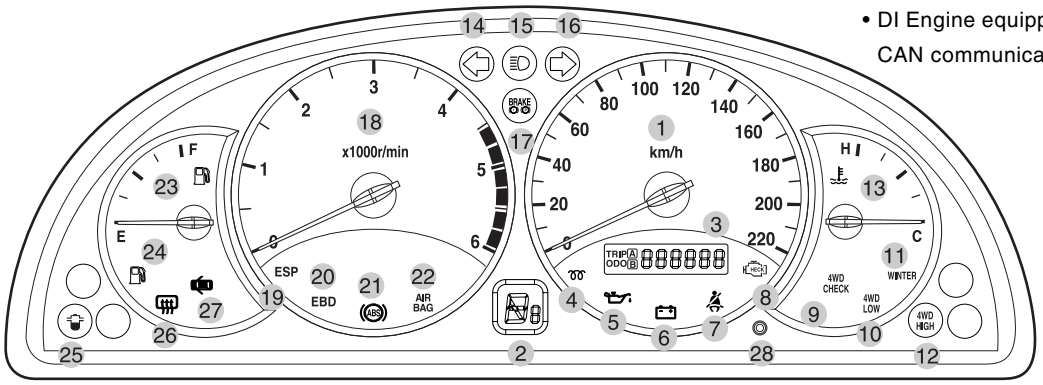
Several types of clusters are used according to the vehicle models.

- IDI Engine (D29ST): Conventional cluster that cannot communicate with CAN
- DI Engine (D27DT): Conventional appearance + CAN communication function (internal function)
  New cluster with BLACK-FACE appearance (CAN communication)
- Gasoline Engine (G32D): New cluster with BLACK-FACE appearance (CAN communication)

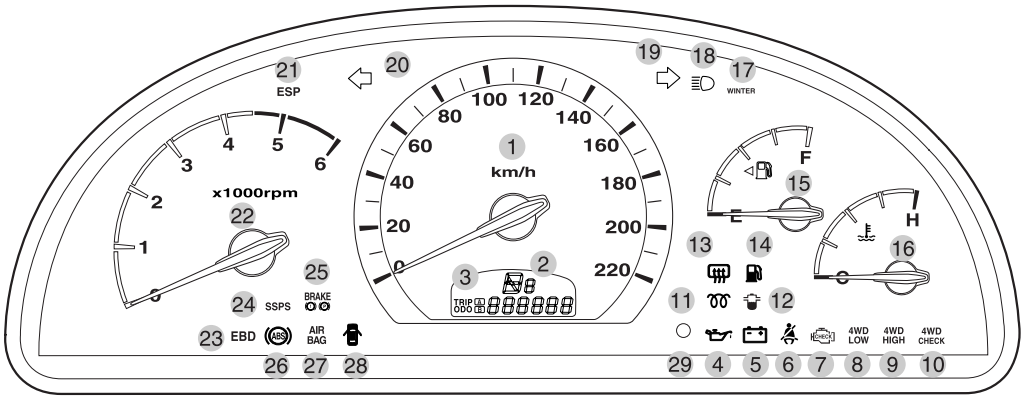
Appearance

IDI Engine (D29ST) / DI Engine (D27DT) equipped vehicle

- IDI Engine equipped vehicle: CAN communication (X)
- DI Engine equipped vehicle: CAN communication (O)



DI Engine (D27DT) / Gasoline Engine (G32D) equipped vehicle



BLACK-FACE Cluster

Y220_09C214

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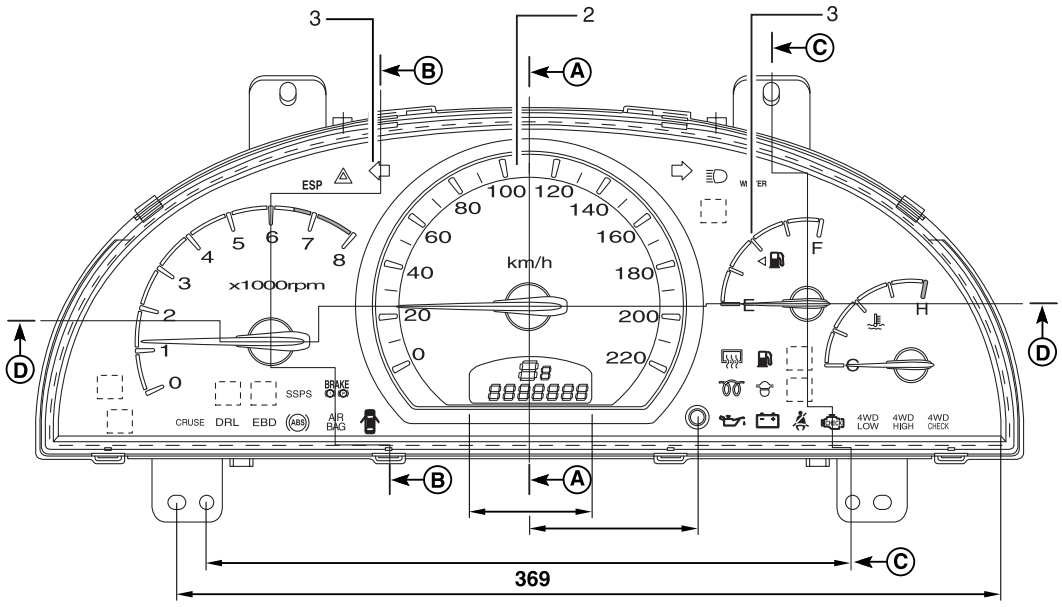
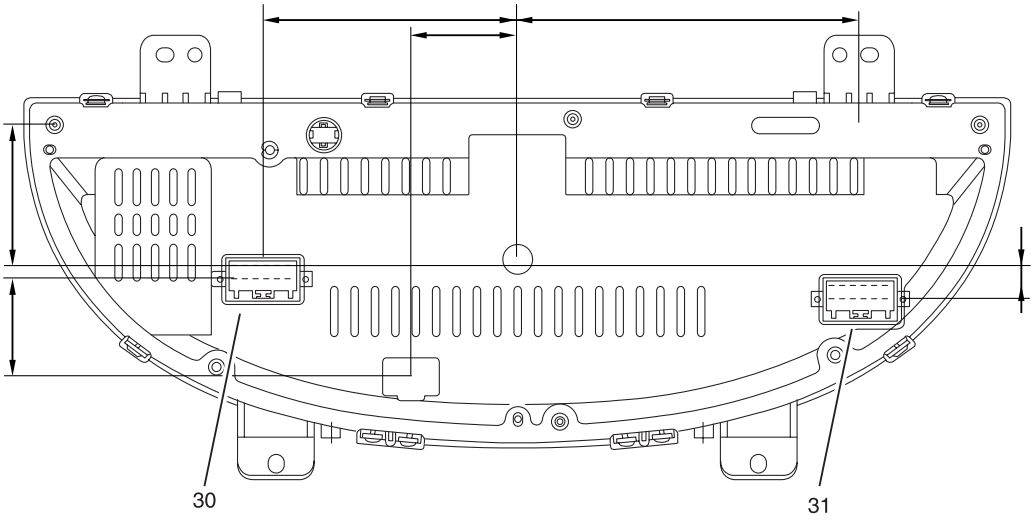
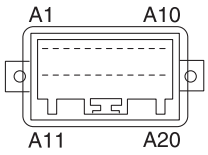
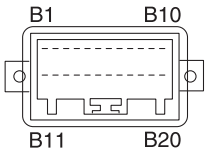
BLACK-FACE TYPE CLUSTER (DI/GASOLINE ENGINE EQUIPPED VEHICLE)





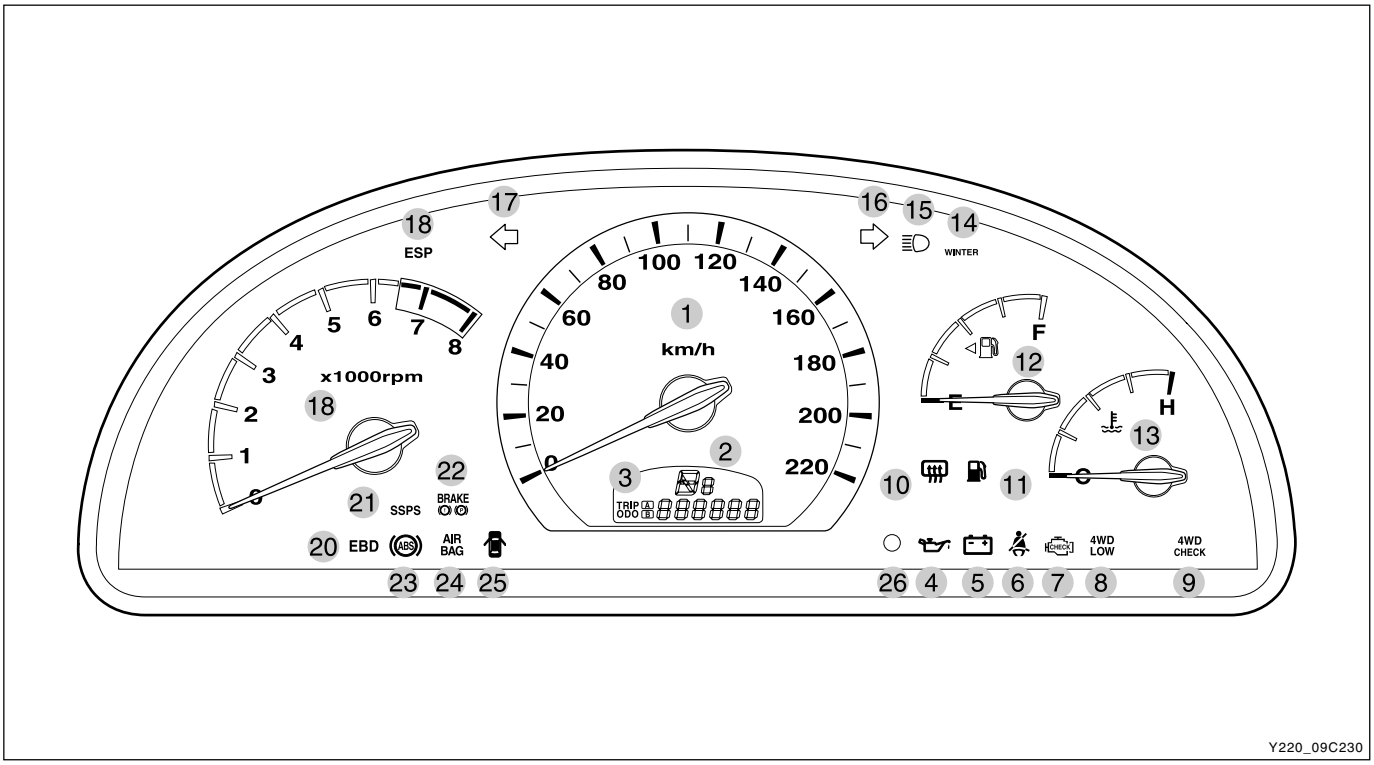




Y220_09C125

BLACK-FACE TYPE CLUSTER

GASOLINE ENGINE EQUIPPED VEHICLE



Y220_09C230

1. Speedometer
2. Auto shift indicator (A/T)
3. Odometer/Trip odometer
4. Engine oil pressure warning light
5. Battery charge warning light
6. Seatbelt reminder
7. Engine CHECK indicator
8. 4WD LOW indicator
9. 4WD CHECK indicator
10. Defogger indicator
11. Low fuel level warning light
12. Fuel gauge
13. Temperature gauge
14. WINTER mode indicator (A/T)
15. High beam indicator
16. Turn signal indicator (right)
17. Turn signal indicator (left)
18. ESP warning light
19. Tachometer
20. EBD waring light
21. SSPS warning light
22. Brake system warning light
23. ABS warning light
24. Aigbag warning light
25. Door open warning light
26. Trip odo meter reset button/Rheostat button

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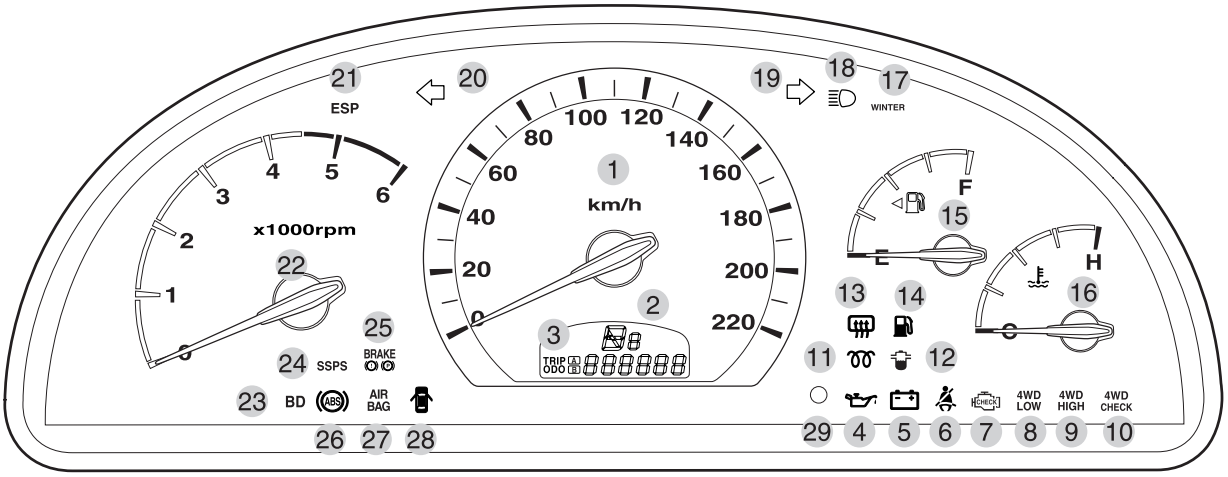
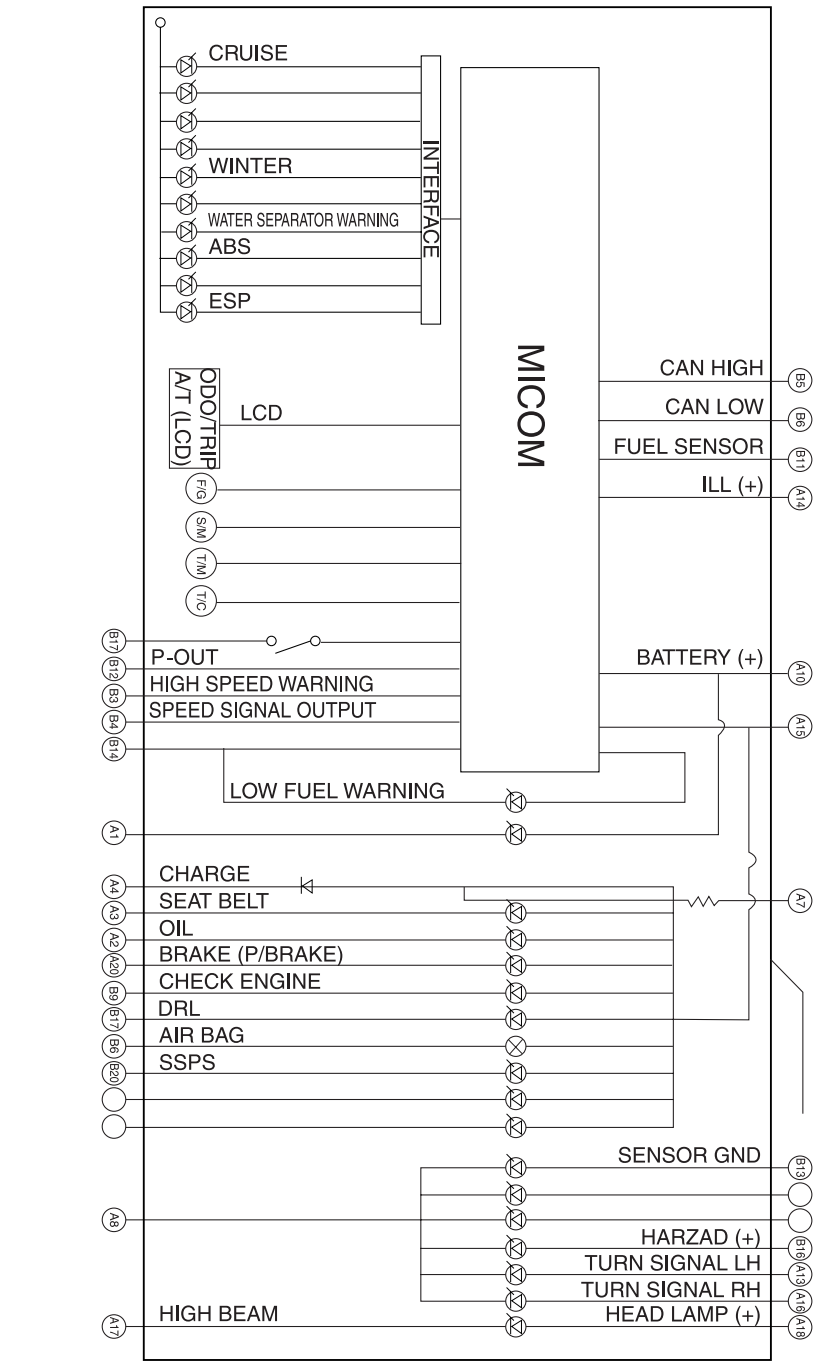
DIRECT INJECTION DIESEL ENGINE EQUIPPED VEHICLE (WITH CAN COMMUNICATION)



1. Speedometer
2. Auto shift indicator (A/T)
3. Odometer/Trip odometer
4. Engine oil pressure warning lightt
5. Battery charge warning light
6. Seatbelt reminder
7. Engine CHECK indicator
8. 4WD LOW indicator
9. 4WD HIGH indicator
10. 4WD CHECK indicator
11. Glow indicator
12. Water separator warning light
13. Defogger indicator
14. Low fuel level warning light
15. Fuel gauge
16. Temperature gauge
17. WINTER mode indicator (A/T)
18. High beam indicator
19. Turn signal indicator (right)
20. Turn signal indicator (left)
21. ESP warning light*
22. Tachometer
23. EBD waring light
24. SSPS warning light
25. Brake system warning light
26. ABS warning light
27. Aigbag warning light
28. Door open warning light
29. Trip odo meter reset button/Rheostat button

CIRCUIT DIAGRAM AND CONNECTER PIN ARRANGEMENT



Y220_09C218

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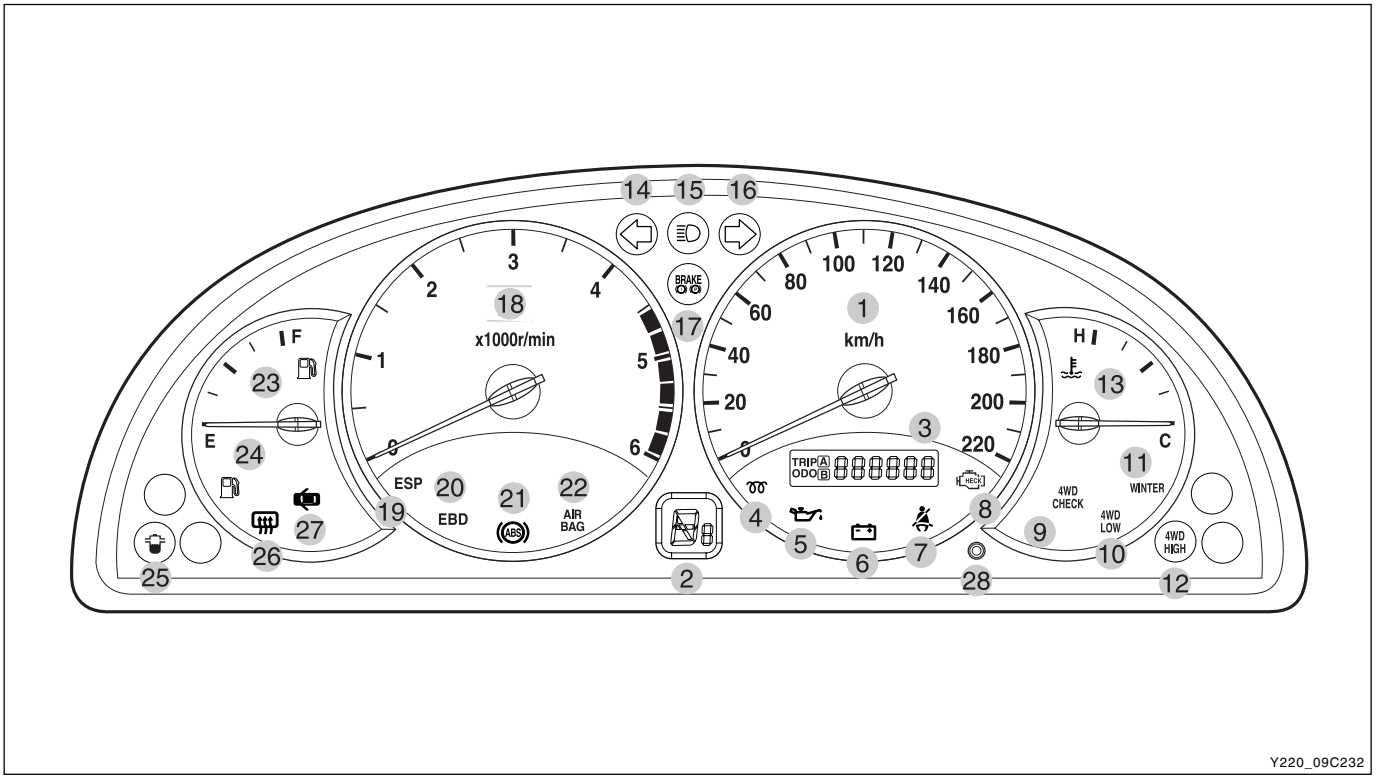
EFFECTIVE DATE	
AFFECTED VIN	

CLEAR GLASS TYPE CLUSTER

DIRECT INJECTION DIESEL ENGINE EQUIPPED VEHICLE (WITH CAN COMMUNICATION)

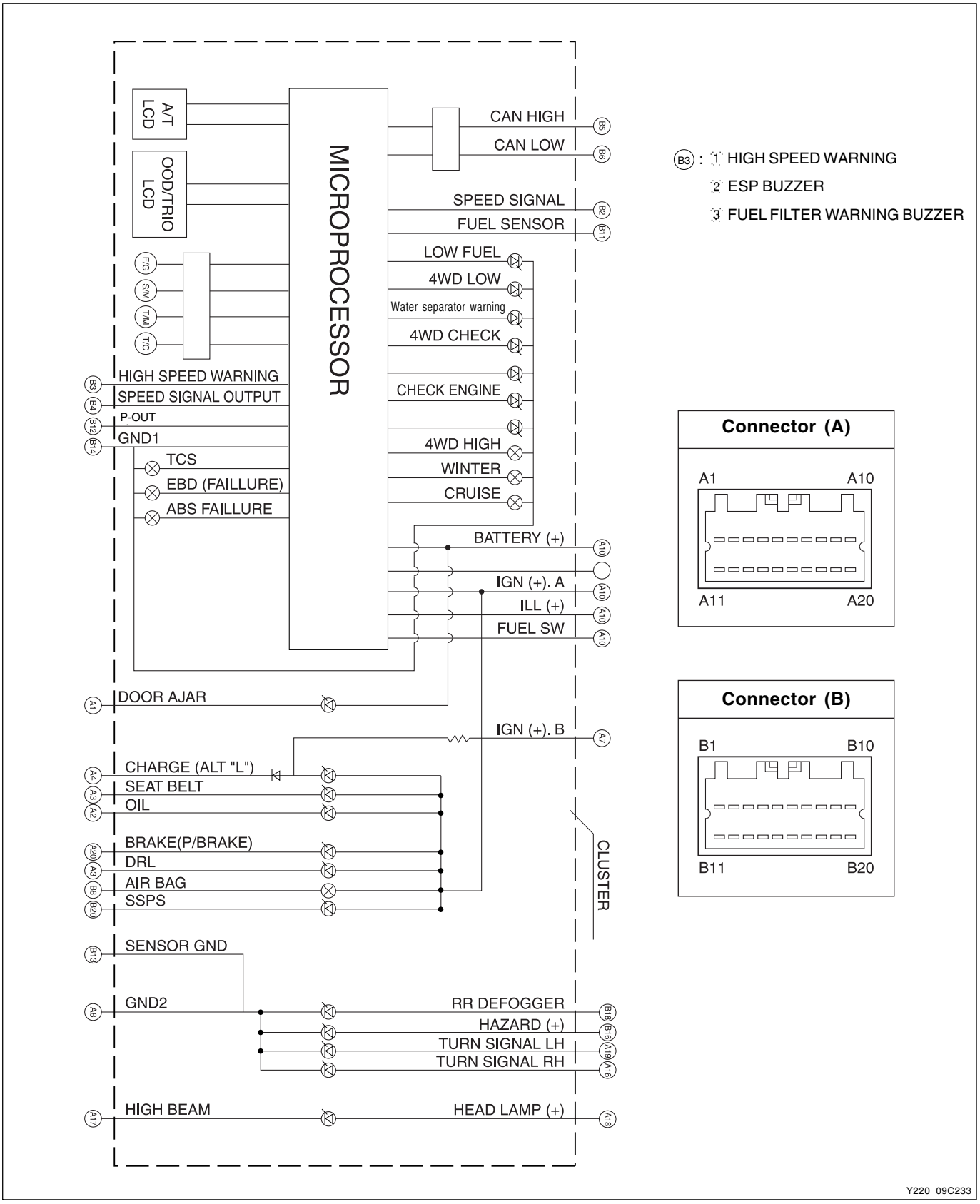


Y220_09C232

1. Speedometer
2. Auto shift indicator
3. Odometer/Trip odometert
4. Glow indicator
5. Engine oil pressure warning light
6. Battery charge warning light
7. Seatbelt reminder
8. Engine CHECK indicator
9. 4WD CHECK indicator
10. 4WD LOW indicator
11. WINTER mode indicator (A/T)
12. 4WD HIGH indicator
13. Temperature gauge
14. Turn signal indicator (left)
15. High beam indicator
16. Turn signal indicator (right)
17. Brake system warning light
18. Tachometer
19. ESP warning light
20. EBD waring light
21. ABS warning light
22. Aigbag warning light
23. Fuel gauge
24. Low fuel level warning light
25. Water separator warning light
26. Defogger indicator
27. Door open warning light
28. Trip odo meter reset button

CIRCUIT DIAGRAM AND CONNECTER PIN ARRANGEMENT

▶ DI Engine Equipped Vehicle



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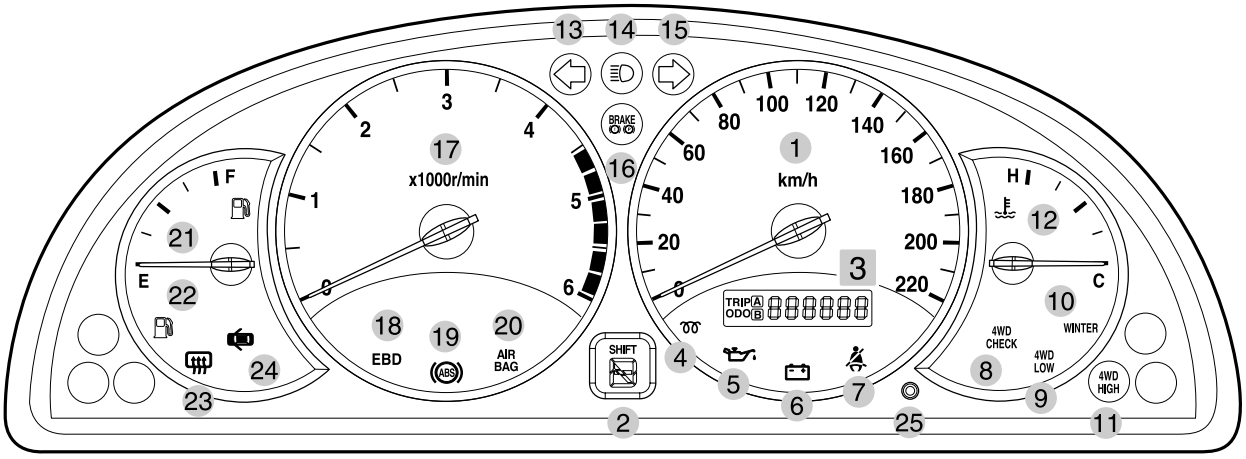
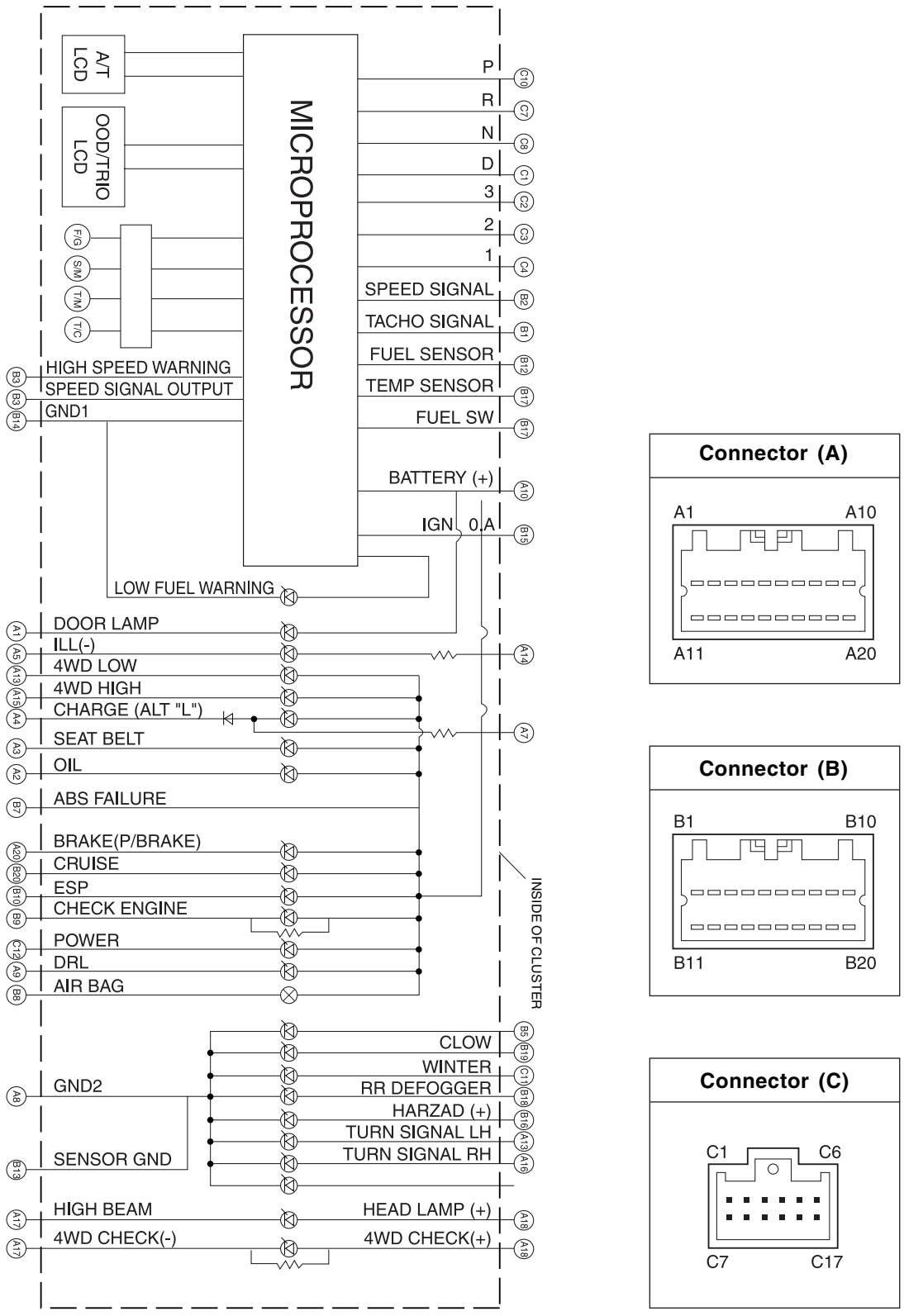
INDIRECT INJECTION DIESEL ENGINE EQUIPPED VEHICLE (WITHOUT CAN COMMUNICATION)



Y220_09C230A

1. Speedometer
2. Auto shift indicator
3. Odometer/Trip odometer
4. Glow indicator
5. Engine oil pressure warning light
6. Battery charge warning light
7. Seatbelt reminder
8. 4WD CHECK indicator
9. 4WD LOW indicator
10. WINTER mode indicator (A/T)
11. 4WD HIGH indicator
12. Temperature gauge
13. Turn signal indicator (left)
14. High beam indicator
15. Turn signal indicator (right)
16. Brake system warning light
17. Tachometer
18. EBD waring light
19. ABS warning light
20. Aigbag warning light
21. Fuel gauge
22. Low fuel level warning light
23. Defogger indicator
24. Door open warning light
25. Trip odo meter reset button

▶ IDI Engine Equipped Vehicle (without CAN Communication)



Y220_09C234

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MAINTENANCE AND REPAIR

▶ Speedometer

1. Check the allowable tolerance and operations for the speedometer and odometer by using a tester.
2. Check if the speedometer pointer is shaking and the abnormal noise sounds.
3. Eliminate the hysteresis by tapping the speedometer.

Note

The allowable tolerance increases when the tires are worn or the tire pressure is out of specified range.

Measuring Condition (VIN= 13 ± 0.1 V, Temperature: 25°C)

Speed (Km/h)		20	40	(60)	80	100	(120)	140	(160)	(180)	200	Remark
DATA (HEX)	BYTE1	01	02	03	04	06	07	08	09	0A	0B	
	BYTE2	2E	5B	8B	B9	E7	15	44	72	A1	0F	
Tolerance (Km/h)		+4	+4	+7	+9	+10.5	+12.5	+14.5	+16.0	+18	+18	
		0	0	+2.5	+3.5	+4	+6	+7.5	+8.5	+10	+10	

▶ Tachometer

1. Connect the tachometer for tune-up test and start the engine.
2. Compare the values on the tester and the tachometer and replace the tachometer if the tolerance is excessive.
3. Eliminate the hysteresis by tapping the tachometer.

TACHO Indication

2-1) Diesel Engine — Measuring Condition (VIN= 13 ± 0.1 V, Temperature: 25°C)

Speed (Km/h)		700	1000	2000	3000	4000	5000	6000
DATA (HEX)	BYTE1	02	03	07	0B	0F	13	17
	BYTE2	BC	E8	D0	B8	A0	88	70
Tolerance (Km/h)		+50	±100	-199	+261	+298	+335	-
		-100		-15	-39	-2	+35	

2-2) Gasoline Engine

Speed (Km/h)		700	1000	2000	3000	4000	5000	6000	7000	8000
DATA (HEX)	BYTE1	02	03	07	0B	0F	13	17	1B	1F
	BYTE2	BC	E8	D0	B8	A0	88	70	58	40
Tolerance (Km/h)		+50 -100	±100	±125	±150	±150	±150	±180	±210	-

▶ Fuel Gauge

1. Disconnect the fuel sender connector.
2. Ground the harness side connector (B11, B14) through 12 V, 3.4 W lamp.
3. Turn the ignition switch to “ON” position.
4. Check it the test lamp comes on and the fuel gauge pointer moves to “F” slowly.

Checking the fuel sender resistance

1. Place the float at “F” and “E” and measure the resistance between B11 and B14.
2. Check if the resistance is slowly changed when the float moves to “F” from “E”.

2	FUEL Indication	Measuring Condition (VIN= 13 ± 0.1 V, Condition: 25°C)				
LEVEL		FULL	(3/4)	1/2	1/4	EMPTY
GAUGE Indicating Angle		80°	60°	40°	20°	0°
GAUGE Tolerance		+4.0 -1.0	-	±5	-	±2.5
Diesel	F/SENSOR Resistance	40 Ω	67 Ω	99.5 Ω	152 Ω	285 Ω
Gasoline	Fuel Level	78.3 ℓ	60.6 ℓ	43.0 ℓ	25.0 ℓ	7.0 ℓ
	Communication Data(HEX)	9C	79	56	32	E

Fuel sensor

1. Connect the test lamp (12 V, 3.4 W) of fuel gauge terminal and soak the thermister into water.
2. Check if the test lamp goes off when the thermister is under water, and vice versa.

Note

- ***Replace the fuel sender assembly if needed.***
- ***Thoroughly dry the fuel sender before installation.***

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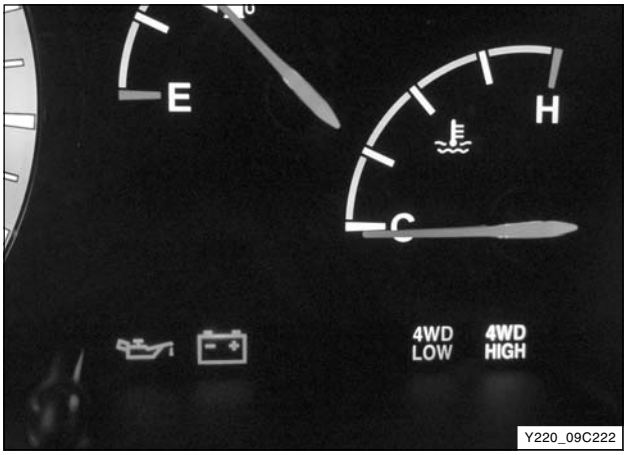


▶ Temperature Gauge

1. Disconnect the temperature sensor connector in engine compartment.
2. Ground the harness side connector through 12 V, 3.4 W lamp.
3. Turn the ignition switch to “ON” position.
4. Check if the test lamp comes on and the temperature gauge is moving.

Checking the temperature sensor resistance

Measure the resistance between the terminal and the ground with an ohmmeter and replace if the resistance is out of specified range.

TACHO Indication	Measuring Condition (VIN= 13 ± 0.1 V, Condition: 25°C)					
	Indication °C	40°C	DSL 70°C	GSL 80°C	110°C	125°C
	Gauge Indicating Angle	0°	40°			80°
	Gauge Tolerance	+2.5°	+0°			+5°
		-2.5°	-6°			0°
	Communication Data (HEX)	50	6E	78	96	A5

▶ Trip Odometer and Odometer

Battery Voltage

Rated voltage: DC 12 V

Inspection voltage: DC 13.5 V

Operating voltage range: DC 9 V ~ 16 V

Operating temperature range: -30°C ~ +75°C (use same checking conditions with driving conditions)

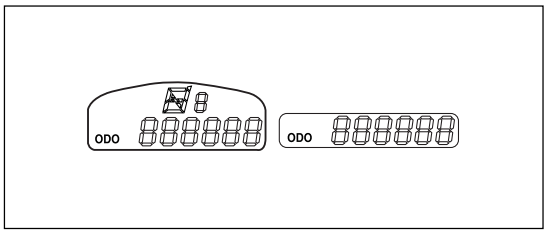
Battery Current

Parasitic current: below 3 mA (Battery voltage 12 V at 25°C)

Odometer

A) Indication range: 0 ~ 999999 km

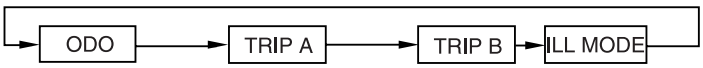
B) Increment: 1 km (Miles)



When pressing the mode switch over 1 second, the odometer/trip odometer is converted and the meter resets to 0.0 km (Miles) in Trip A and Trip B.

The converting sequence is as shown in figure below:

(The display shows latest mode when turning on the ignition switch after turning it off.)

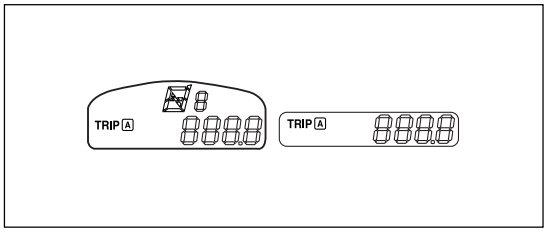


TRIP METER "A"

A) Display range: 0.0 ~ 999.9 km (Miles)

B) Overflow: Reset to 0.0 km (Miles)

C) Increment: 0.1 km (Miles)

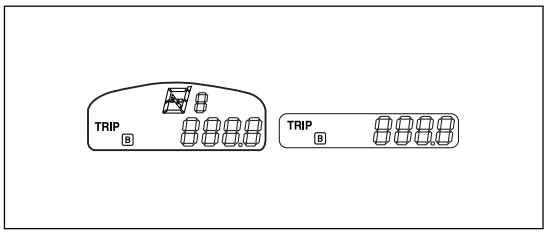


TRIP METER "B"

A) Display range: 0.0 ~ 999.9 km (Miles)

B) Overflow: Reset to 0.0 km (Miles)

C) Increment: 0.1 km (Miles)



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▶ Colors and Sizes of Indicators

Display

NO	Description		Color		
			Day	Night	
1	Background		BLACK	BLACK	
2	Scale, Letter, Number, Mark		WHITE	WHITE	
3	Speedometer	Scale, Letter, Number	WHITE	WHITE	
4		Scale background	SKYBLUY	SKYBLUY	
5		120 km/h Mark	RED	RED	GCC Spec.
6	Tachometer Warning range	Diesel: 4500 ~ 6000	RED	RED	
7		Gasoline: 6500 ~ 8000			
8	Tachometer sub-scale		GREEN	GREEN	
9	“E (Empty)”		RED	RED	
10	“H (High)”		RED	RED	

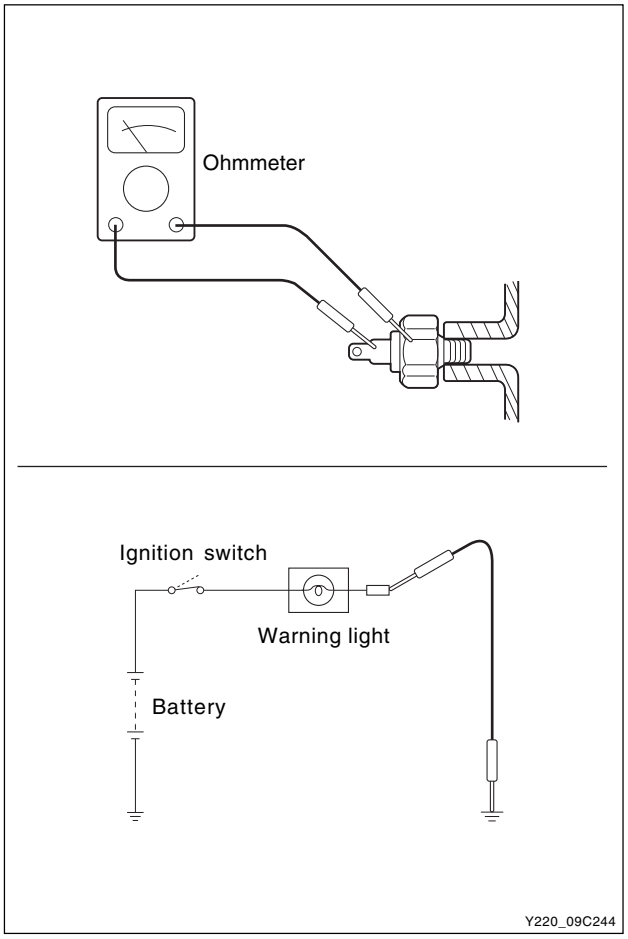
Warning Lamp: LED Emifting

Description	Color
TURN SIGNAL. CRUISE (export). 4WD HIGH. WINTER	Green
HIGH BEAM	Blue
SEAT BELTS. BATTERY CHARGE. 4WD CHECK	
OIL PRESSURE. DOOR AJAR. EBD (FAILURE)	Red
BRAKE. AIR BAG. HAZARD. EBD (FAILURE)	
CHECK ENGINE. ABS FAILURE.	Amber
LOW FUEL. GLOW. ESP. REAR DEFOGGER.	
4WD LOW. SSPS	

BULB

▶ Oil Pressure Switch

1. Stop the engine and check the continuity between terminal and ground.
2. Start the engine and check the continuity between terminal and ground.
3. Disconnect the connectors from the warning switch in wiring harness side and ground terminal.
4. Check if the warning light comes on when turning the ignition switch to “ON” position. If it doesn’t come on, check the bulb and wiring harness.



▶ Brake

The brake warning light comes on when the brake oil level goes below the specified level or the parking brake is applied while the ignition switch is turned to “ON”.

Note

The brake oil sensor is installed on the brake master cylinder reservoir.

1. Disconnect the oil level gauge connector.
2. Check the continuity between terminals when turning “OFF” the switch.
3. Check the continuity between terminals when turning “ON” the switch. If the continuity is out of specified standard, replace the sensor.

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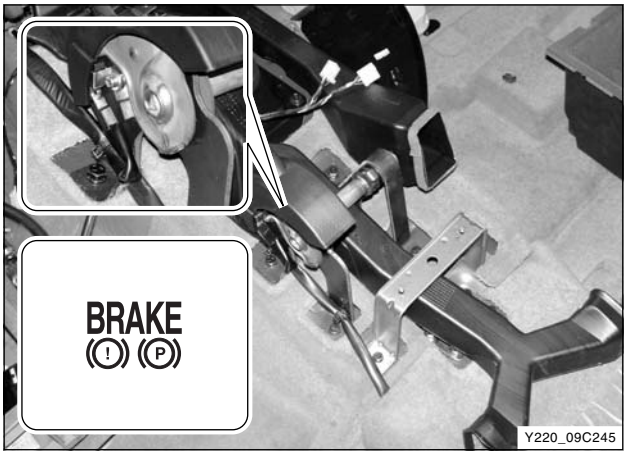
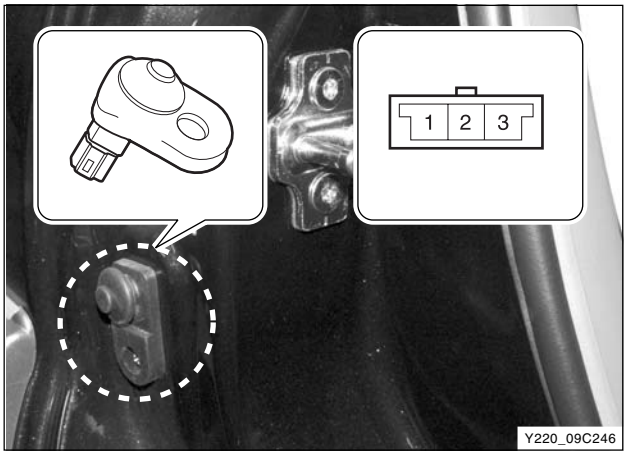


▶ Parking Brake Switch

The parking brake switch is installed under the parking brake lever.

1. Check the continuity between terminal and switch when turning “ON” the switch (applying the parking brake).
2. Check the continuity between terminal and switch when turning “OFF” the switch (releasing the parking brake). If the continuity is out of specified standard, replace the switch or check the ground.



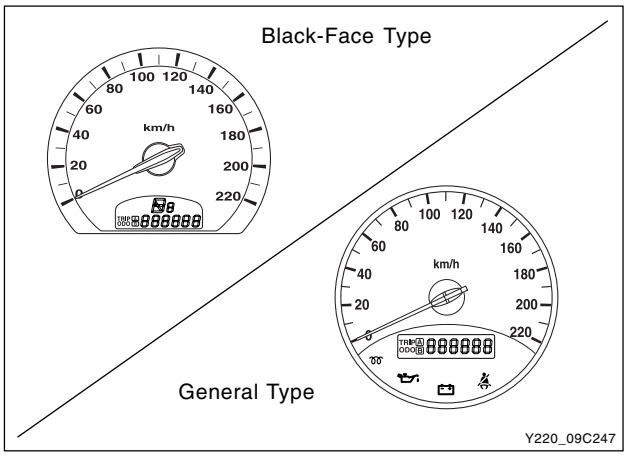
▶ Door Switch

1. Remove the door switch and check the continuity between terminals.
2. If the continuity is out of specified standard, replace the door switch.

METERS/INDICATORS/WARNING LIGHTS

▶ Speedometer

The speedometer indicates the vehicle speed in kilometers per hour (km/h) or mile per hour (m/h).



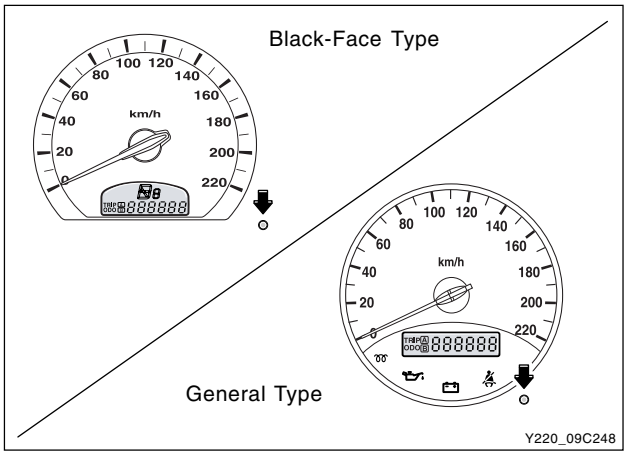
▶ Odometer/Trip Odometer

When the reset button located in the right and lower area of odometer is pressed once, the first driving distance (TRIP A) will be indicated and pressed again, the second driving distance (TRIP B) will be indicated.

When the button is pressed once more, total distance (ODO) will be indicated.

Note

If pressing and holding the reset button for over 3 seconds in TRIP A or TRIP B mode, the trip odometer resets to zero.



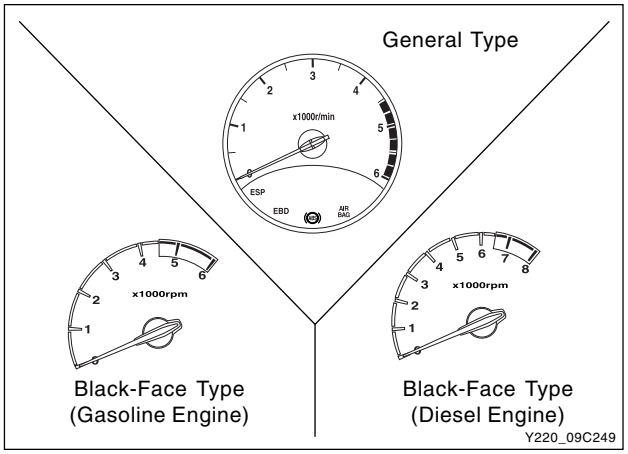
▶ Tachometer

The tachometer indicates engine speed in revolutions per minute.

Multiply 1,000 to the current number, then it will be the current number of engine revolutions.

Ideal engine idle speed

1. DI Engine	700 ~ 800 rpm
2. IDI Engine	700 ~ 800 rpm
3. Gasoline Engine	650 ~ 750 rpm



Warning

Excessive speed can damage engine.

Do not let engine reach excessive speed, indicated by pointer being in red zone.

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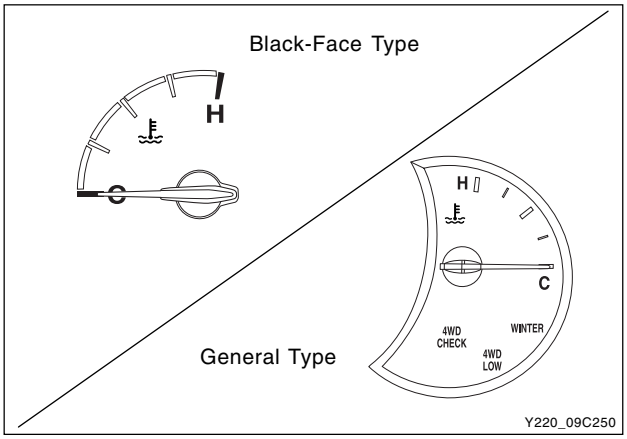


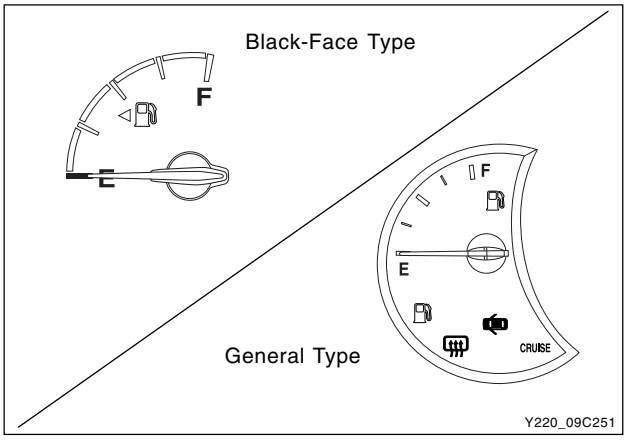
▶ Temperature Gauge

The temperature gauge indicates the temperature of engine coolant when the ignition switch is in the “ON” position.

Notice

The engine can overheat.

- ***If the pointer reaches the red zone, stop the vehicle.***
- ***Allow engine to cool.***



▶ Fuel Gauge

This gauge indicates the level of fuel remaining in the fuel tank. This gauge operates only when the ignition switch is in “ON” position.

- F : Full
- E : Empty

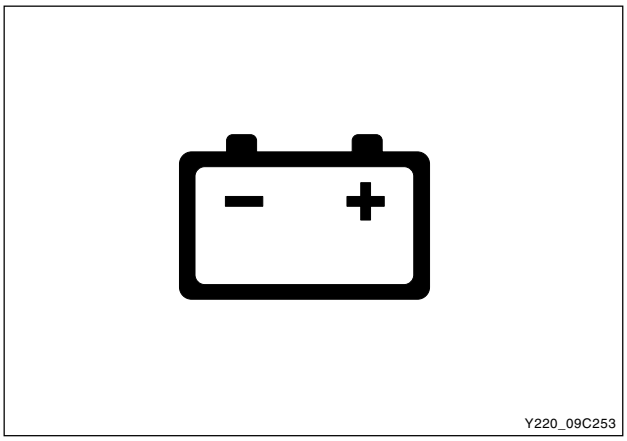
▶ Engine Oil Pressure Warning Light

This warning light comes on when the ignition is switched on and should go out after the engine is started.

Notice

Severe engine damage could result.

- ***Do not run the engine with the engine oil pressure warning light illuminated.***
- ***If oil level is normal, have the system checked and repaired immediately by the nearest Ssangyong Dealer or Ssangyong Authorized Service Operation.***



▶ Battery Charge Warning Light

This warning light indicates that the battery is being discharged. When the ignition is switched on, this warning light comes on and should go out when the engine is started.
If the light illuminates while driving,

- Pull off the road and stop the car.
- Check the alternator drive belt for looseness or breakage.
- If the belt is OK, there is a problem somewhere in the charging system. The problem should be located and corrected as soon as possible. Have the system checked and repaired immediately by the nearest Ssangyong Dealer or Ssangyong Authorized Service Operation.

▶ Seat Belt Reminder

The seat belt warning light comes on whenever the ignition switch is placed in the “ON” position unless the driver’s seat belt is securely fastened. Also the seat belt warning chime will sound for about 6 seconds when the ignition switch is in the “ON” position unless the driver’s seat belt is secured fastened.

▶ Winter Mode Indicator (for Automatic Transmission)

The indicator will come on when the Winter mode (W) switch near the gear selector lever is selected.

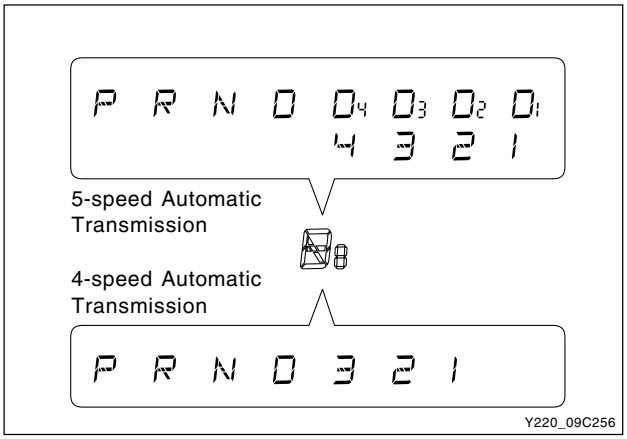
Use this mode to drive off smoothly under icy and slippery road.

Note

In winter mode, vehicle starts with 2nd gear so the power could be a little bit reduced.

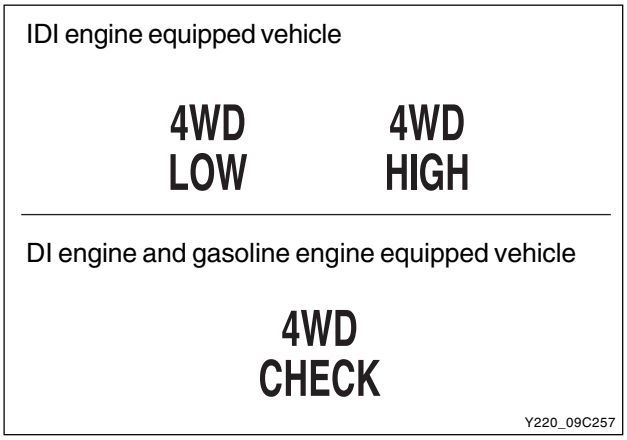
▶ Auto Shift Indicator (for Automatic Transmission)

The indicator comes on when the ignition switch is ON and the indicator shows the automatic transmission selector lever position.



▶ 4WD Check Warning Light

These indicators come on when the ignition switch is turned to ON and should go out if the system is normal. If the “4WD LOW” and “4WD HIGH” warning light come on or blink (IDI Engine), or “4WD CHECK” warning light stays on, have the 4WD system checked at Ssangyong Dealer or Ssangyong Authorized Service Operation.



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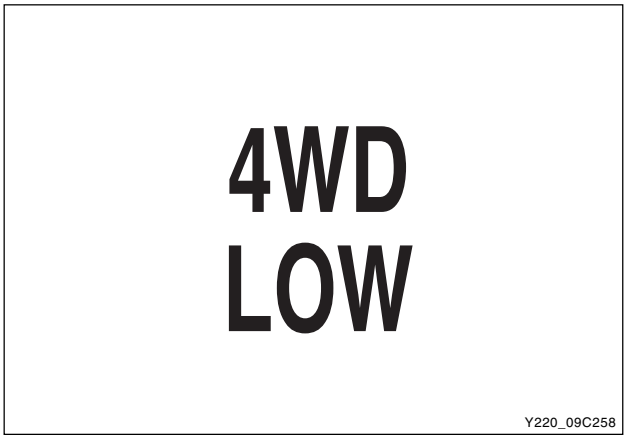


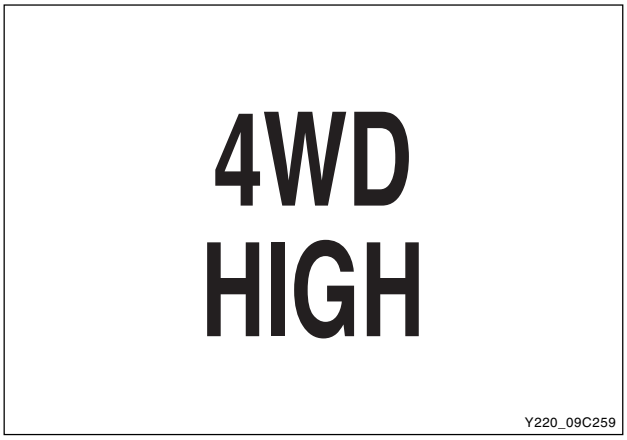
Y220_09C258

▶ 4WD LOW Indicator

This indicator comes on when the 4WD LOW mode is selected by pushing 4L switch.

To shift “4L” position, completely stop the vehicle and always depress the clutch pedal, for manual transmission, or position the selector lever to “N”, for automatic transmission, and select the 4WD switch to “4L”.

When the switch is selected and the mode is shifting into 4L, the indicator blinks for a moment.



Y220_09C259

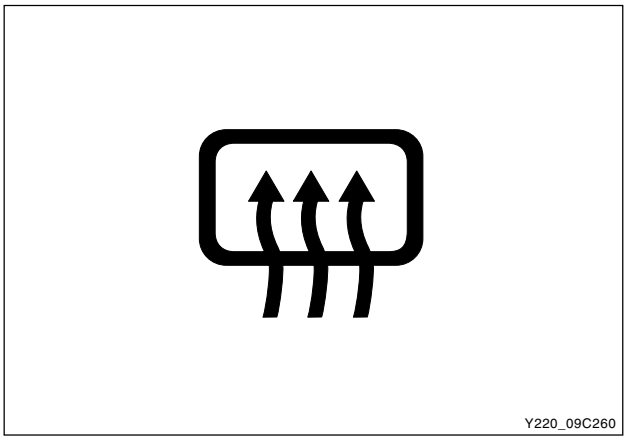
▶ 4WD HIGH Indicator (for Part-Time 4WD)

This indicator comes on when the 4WD HIGH mode is selected by pushing 4H switch. Shift the driving mode from 2WD to 4WD HIGH only when the vehicle speed is under 70 km/h.

Note

When shifting the driving mode from 4WD LOW to 4WD HIGH, this indicator will blinks until the shift is completed. After completion of shift, the indicator stays on.

The indicator comes on without blinking when shifting from 2WD to 4WD HIGH.


Y220_09C260

▶ Defogger Indicator

The indicator comes on when the tailgate glass defogger is switched “ON”.

It goes out after specified time.

Note

- ***The defogger is operated only when the engine is running.***
- ***The outside rear view mirror defogger and the wiper deicer, if applicable, are operated simultaneously when operating the defogger switch.***

Note

If it does not come on, or if it does not go out, or if it flashes or illuminates continuously while driving, it means that there is malfunction in the system.

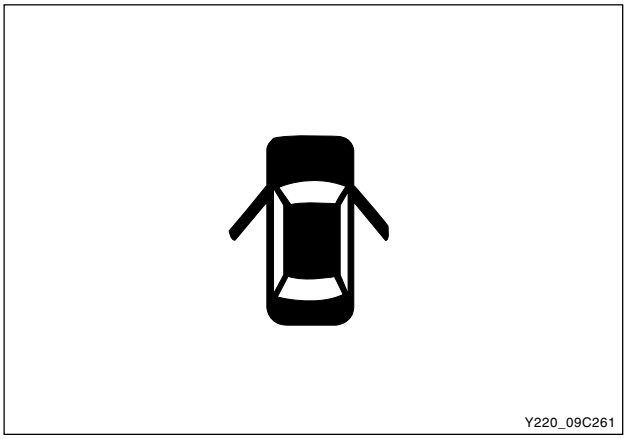
▶ Door Open Warning Light

This light comes on when a door or tailgate is either opened or not closed completely.

Warning

Driving with door open can cause injury to people inside and outside the vehicle.

- ***Before driving off, close all doors.***
- ***Check warning light is off.***


Y220_09C261

▶ Air Bag Warning Light

When the ignition is switched on, this warning light illuminates and then should go out, to confirm that the air bag is operational.

The air bag system would therefore not be triggered in the event of an accident. Have the air bag system checked without delay by a Ssangyong Dealer or Ssangyong Authorized Service Operation.

Note

If it does not come on, or if it does not go out, or if it flashes or illuminates continuously while driving, it means that there is malfunction in the system.

Y220_09C262

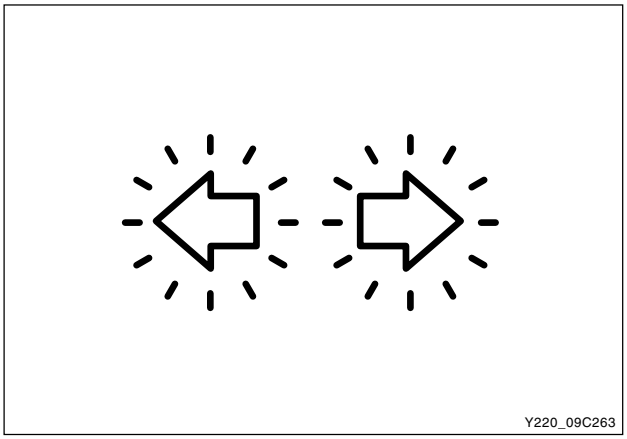
▶ Turn Signal/Hazard Flasher Indicator

When the turn signal switch is turned on, this indicator flashes to indicate operation of the external turn signal. Shorter flashes indicate the failure of a turn signal lamp bulb. Both right and left lights flash when the hazard warning switch is turned on.

Note

If a bulb is burned out, replace it immediately to help avoid an accident.

If the indicating arrows don't go on at all when a driver signals a turn, check the fuse and for burnt out bulbs.

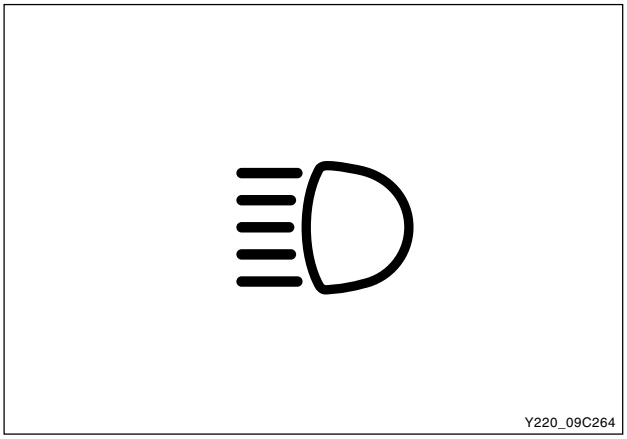

Y220_09C263

▶ High Beam Indicator

This indicator illuminates when the headlight high beam is switched on.

Note

Driving with high beam headlamp disturbs the approaching vehicle's visibility for safe driving. Use the high beam headlamp only during very dark situations when it is very hard to see the road.


Y220_09C264

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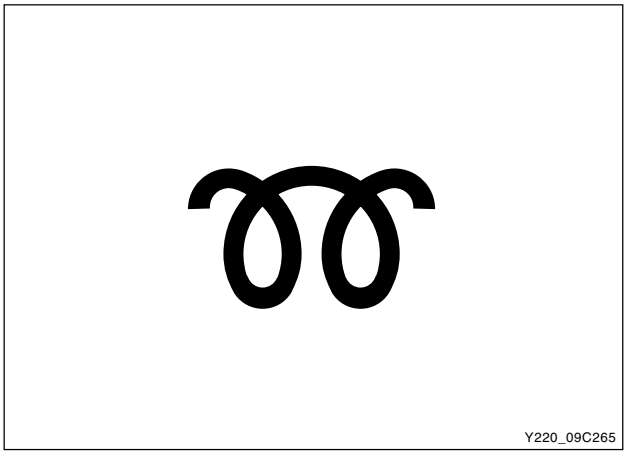
high beam headlamp only during very dark situations when it is very hard to see the road.


Y220_09C265

▶ Glow Indicator (for Diesel Engine)

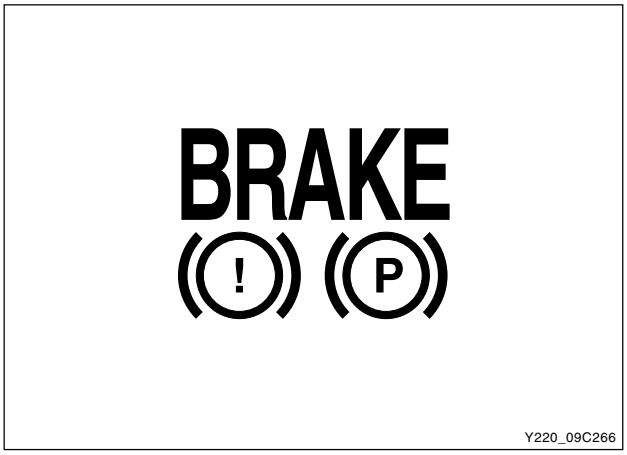
This indicator comes on when the ignition switch is turned on and stays on for a short time or may go off right away. The waiting time will vary according to the engine coolant temperature. When the glow plugs are sufficiently heated for cold starting, the light will go out. Then, the engine should be started.

Note

In DI engine equipped vehicle, the illumination period of indicator may be very short or the indicator may not come on in normal temperature.

The symptoms when the glow system is faulty:

- ***the indicator comes on during driving***
- ***the indicator doesn't come on when the ignition key is turned to "ON" position***
- ***hard to start the engine***



Y220_09C266

▶ Brake System Warning Light

This warning light comes on when the parking brake is applied with the ignition on and goes out when the parking brake is released.

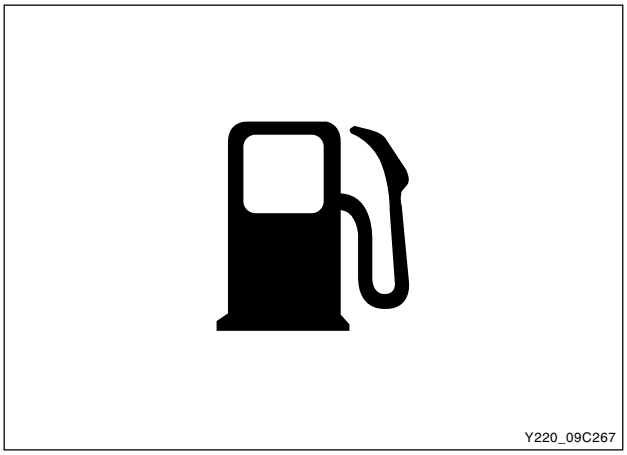
Notice

If the parking brake is applied, this warning light still remains on until the parking brake released. Make sure the parking brake is fully released before driving.

If this warning light comes on even when the parking brake is completely released, it may indicate that the brake fluid in the reservoir is low.

Driving the vehicle with the brake fluid warning light on is dangerous.

Have the brake system checked and repaired immediately by nearest Ssangyong Dealer or Ssangyong Authorized Service Operation.


Y220_09C267

▶ Low Fuel Level Warning Light

This warning light indicates that the fuel will

soon be exhausted.

Fill up the fuel tank as soon as possible if this warning light comes on.

Notice

During driving on steep hill or rough roads, this warning light may come on if the remaining fuel is low.

▶ EBD Warning Light

When the ignition is switched on, this warning light comes on and should go out after 2 seconds. If the EBD system is abnormal, the warning light comes on and when the relative ABS system is also abnormal, it comes on with ABS warning light.

Y220_09C268

Notice

If this warning light fails to go out or comes on, have the system checked and repaired immediately by the nearest Ssangyong Dealer or Ssangyong Authorized Service Operation.

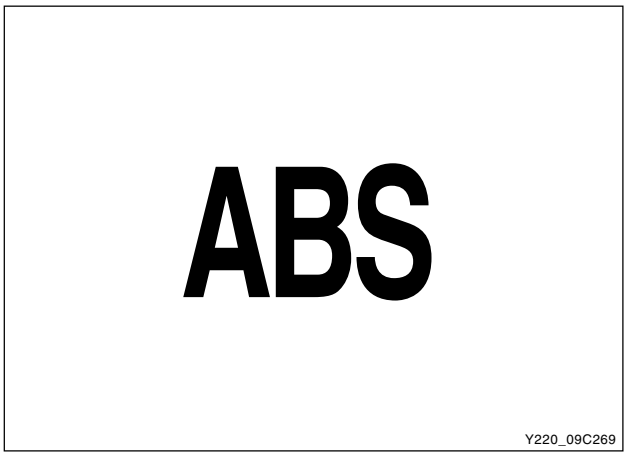
Note

- ***EBD (Electronic Brake-force Distribution)?***

  When the brake pedal is applied, it controls the braking pressure electronically to effectively distribute the braking forces to the front wheels and rear wheels. EBD operates when the speed differences between the most fast front wheel and the rear wheel are over 1 km/h and if ABS is engaged, it does not operate.

▶ ABS Warning Light

This warning light illuminates when the ignition is switched on and should go out after about 2 seconds.



Y220_09C269

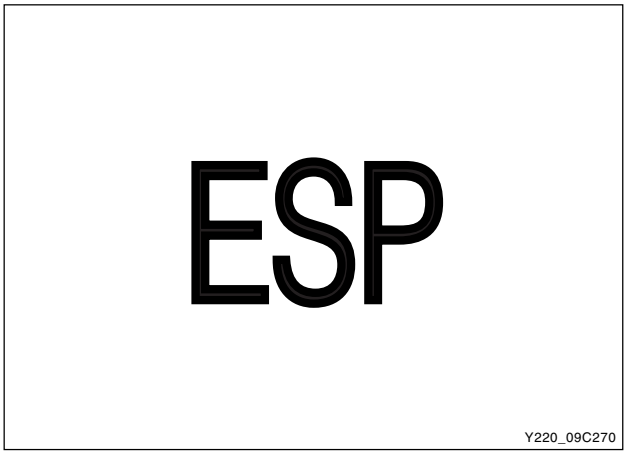
Note

- ***ABS (Anti-Lock Brake System)?***

  When a driver brake abruptly or on the slippery road, the vehicle keeps going on ahead but the wheels are locking not to rotate. At this time, the vehicle will not be steered or rotate and could be resulted in accident. ABS controls the wheels properly not to be locked and allows steering to increase the vehicle's stability.

Notice

- ***If this light illuminates while driving, a malfunction of ABS is indicated. In this case the brake system performs its regular function but without the anti-locking capability. Have the system checked by Ssangyong Dealer as soon as possible if this condition occurs.***
- ***If the brake system warning light and ABS warning light illuminate at the same time while driving, it may indicate a failure in the base brake system due to the malfunction of ABS.***
- ***Even though the vehicle is equipped with ABS, it may need normal braking distances like conventional brake vehicles or could be longer according to road conditions, so keep the safety distance.***
- ***ABS is auxiliary system for safety. Do not over rely on the system and keep on safety driving.***



Y220_09C270

▶ ESP Warning Light

If pressing the ESP OFF switch "ESP_{off}", the ESP function stops and the indicator lamp in instrument panel comes on.

Press this switch again to resume the ESP function. At this time, the indicator lamp goes out. If the ESP function operates while driving, the indicator lamp flickers and the alarm sounds.

Notice

If the ESP warning light comes on, the ESP related system is defective. At this moment, the ABS works in a basic way. However, make sure to check the vehicle at the nearest Ssangyong Dealer or Ssangyong Authorized Service Operation.

Y220_09C271

▶ SSPS Warning Light

This warning light comes on when the SSPS system is defective. When this warning light comes on, the steerability becomes heavy.

Notice

If this light comes on, have the SSPS system checked by Ssangyong Dealer or Ssangyong Authorized Service Operation.

Note

- ***SSPS?***

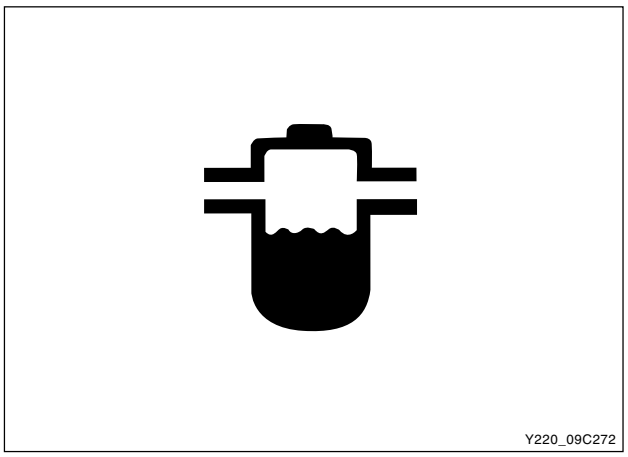
  In traditional constant power assist steering system, the steerability gets lighter as vehicle speed rises, and this may cause dangerous situation.

  SSPS, by providing appropriate steerability to driver according to the changes of vehicle speed, gives steering stability. In other words, the steering wheel gets lighter by adjusting steerability in stop or low speed and provides steering stability by adjusting steering wheel to become heavier in high speed.

▶ Water Separator Warning Light (Direct Injection Diesel Engine Equipped Vehicle)

When the water level inside water separator in fuel filter exceeds a certain level, this warning light comes on and buzzer sounds. Also, the driving force of the vehicle decreases. If these conditions occur, immediately drain the water from fuel filter. For the draining procedures, please refer to "How to drain the water from fuel filter" on next page.

This warning light goes out when the draining is completed.



Notice

- ***Drain the water from fuel filter immediately after the warning light comes on. If you cannot do that by yourself, visit nearest Ssangyong Dealer or Ssangyong Authorized Service Operation.***
- ***For the draining procedures, please refer to "How to drain the water from fuel filter" on next page. After draining the water, press the priming pump until it becomes rigid.***
- ***The fuel system in engine may get serious damage if you keep driving while the warning light is coming on. Prompt correction should be necessary.***

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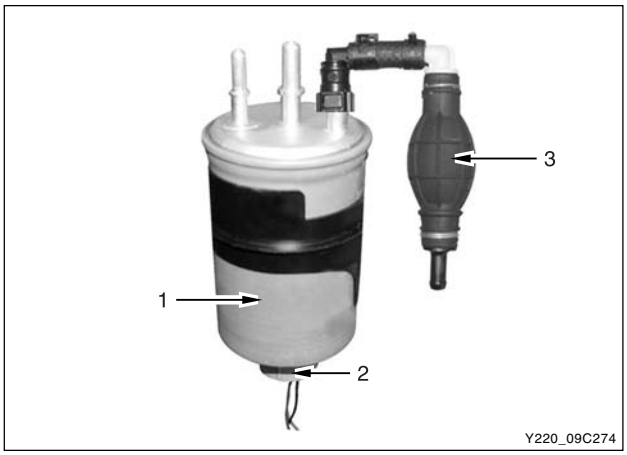
▶ How to Drain the Water from Fuel Filter (Direct Injection Diesel Engine Equipped Vehicle)

1. Locate the fuel filter in engine compartment.
2. Place the water container under the fuel filter.

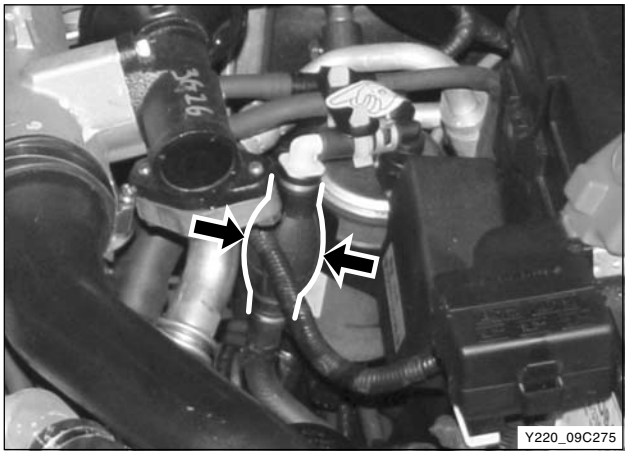


1. Fuel filter
2. Drain plug
3. Priming pump

3. Disconnect the connector under the drain plug.
4. Turn the drain plug to clockwise direction to drain the water.

Notice

Be careful not to be injured by surrounding equipment during the working procedures.



5. Wait until a certain amount of fuel gets out from the port, then turn the drain plug to counterclockwise direction to tighten it.
6. Engage the connector under the drain plug and press the priming pump until it becomes rigid.
7. Close the engine hood and start the engine.

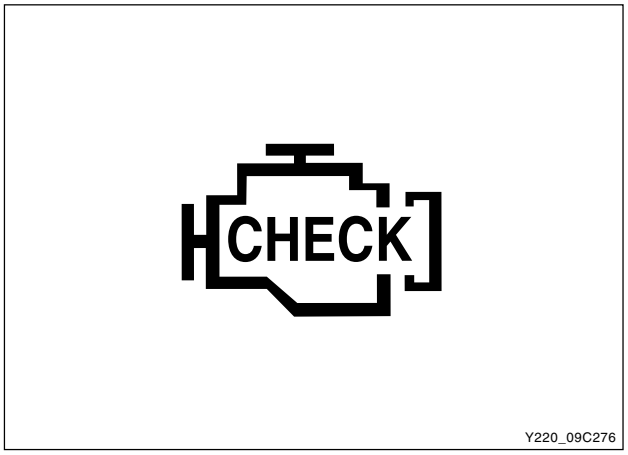
Notice

If the priming pump is not properly operated, air may get into the fuel line. It may cause starting problem or fuel system problem. Make sure to perform the job in step 6.

▶ Engine CHECK Indicator

This warning light comes on when the ignition switch is turned to ON and goes out if the engine is in normal condition.

If the light stays ON, inspect the vehicle by Ssangyong Dealer or Ssangyong Authorized Service Operation.



Notice

Do not drive with the engine check indicator lamp on.

The indicator lamp signals that the vehicle has a problem that requires attention.

- ***Driving with the engine check indicator lamp on can damage the emissions control system and can affect the fuel economy and drivability or the vehicle.***
- ***Consult a Ssangyong Dealer or a Ssangyong Authorized Service Operation to repair the problem as soon as possible.***

▶ Rheostat (Black-Face type)

Press and hold the Trip odometer reset button/Rheostat button to adjust the instrument panel illumination. Release the button when the illumination reaches the brightness.

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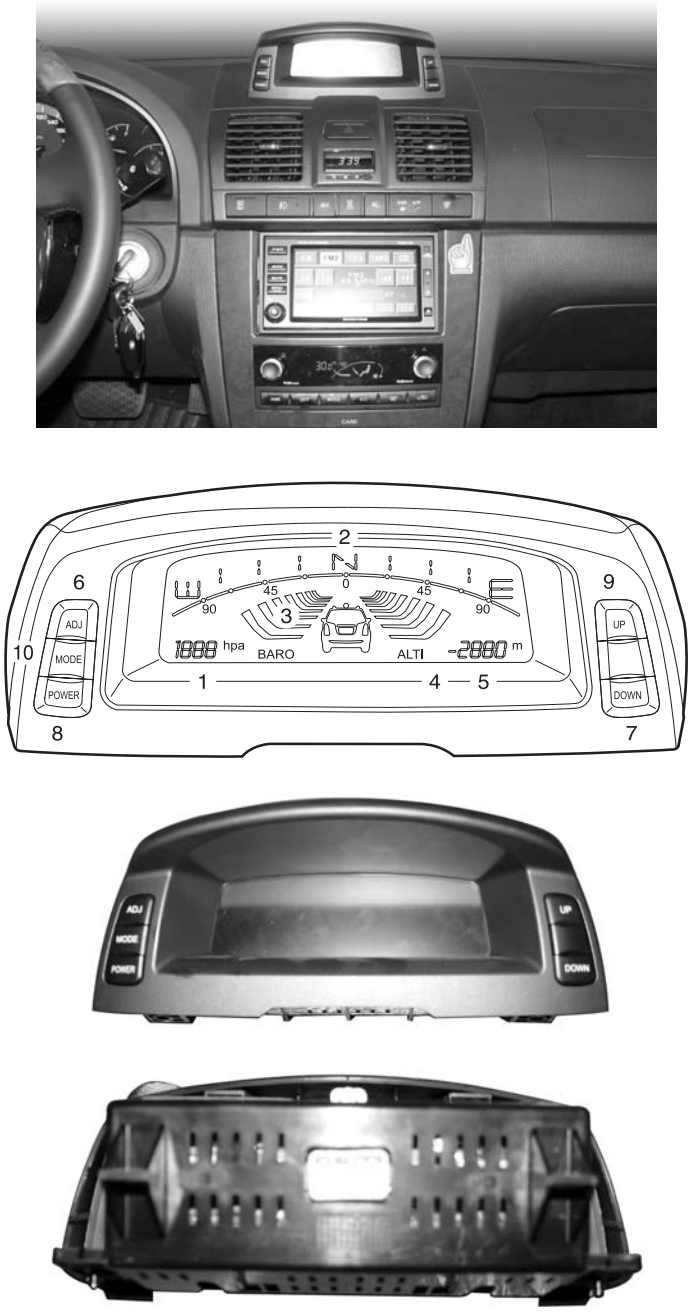
MULTI-METER

SYSTEM LAYOUT



Y220_09C278

1. Barometer
2. Electronic compass
3. Speed sensing indicator
4. Relative altimeter
5. Altimeter
6. Adjustment switch
7. Down switch
8. Power switch
9. Up switch
10. Mode switch

ELECTRONIC COMPASS

1. It indicates 16-direction by intervals of 22.5° according to the vehicle's driving direction.
   - Direction:
     - E: East
     - W: West
     - S: South
     - N: North
   - When the first equipped to the vehicle or the battery is exchanged, you have to perform calibration by circulating your vehicle. If not, there will be misreading in direction.

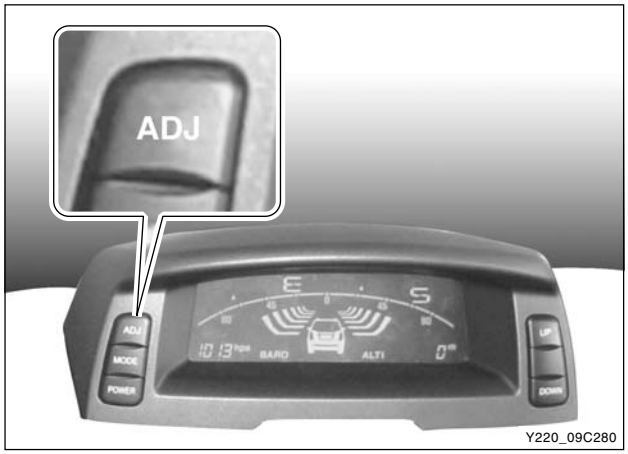
Y220_09C279

▶ Turning Calibration

1. If you press the adjustment switch for 0.5~5 seconds, the current direction flashes.
2. Turn the vehicle over 1 complete circle within 128 seconds slowly, then the calibration will be accomplished.
3. When the calibration is finished, the vehicle's new direction will be indicated.

Note

- ***If the compass continues to flash, turn again slowly until it goes off.***



Y220_09C280

▶ Release Conditions for Turning Calibration

- When the adjustment switch is pressed over 0.6 second.
- When the vehicle is not turned within 128 seconds after calibration mode started.

Warning for turning

When the vehicle has been turned out of the specification due to external elements, direction indicator flashes to inform you that there are abnormal signals.

Y220_09C281

Notice

- ***Warning for turning occurs if the abnormal signals has been received more than 5 minutes continuously, however, it is not the malfunction of the vehicle and returns to normal condition if the external magnetic field becomes to normal.***
- ***The direction indicator may be delayed when you drive on sharp corner, however it is normal, not malfunction.***
- ***On the place where the terrestrial magnetism is dispersed, the compass may not indicate the correct direction, however, when you leave the place, it returns to normal. (Examples: in the tunnel, parking lot in a building, underground parking lot, building complex, above the subway lines, near to substation, under the power lines of the electric railways, etc.)***

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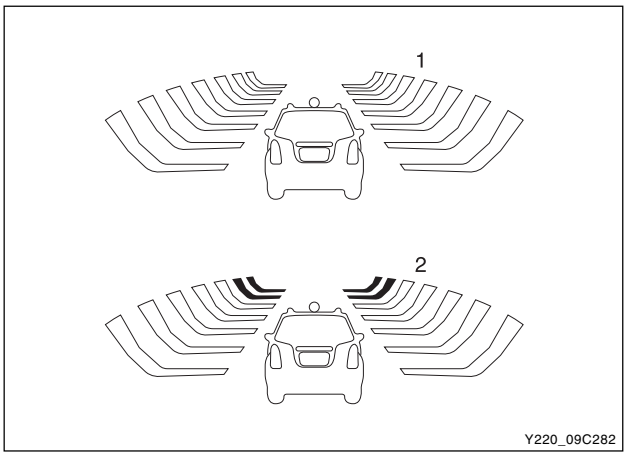
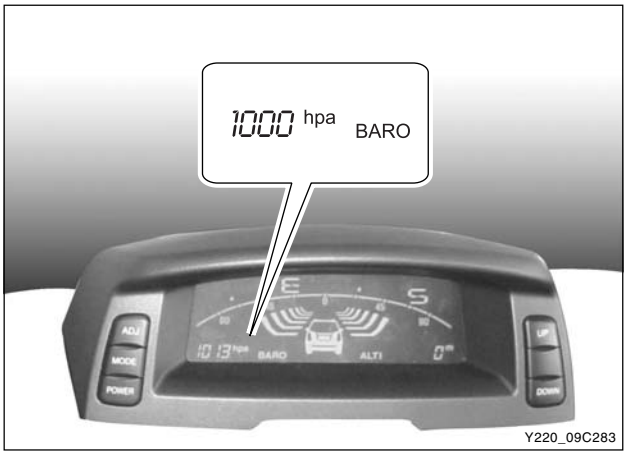


SPEED SENSING INDICATOR

The flashing interval of the road signs changes gradually according to the vehicle speed.

Flashing intervals by speed ranges

Speed Range	Flashing Interval
Less than 1.8 km/h	All “ON”
Less than 40 km/h	per 1 second
Less than 60 km/h	per 0.8 second
Less than 80 km/h	per 0.5 second
Less than 100 km/h	per 0.3 second
Over 100 km/h	per 0.2 second



BAROMETER

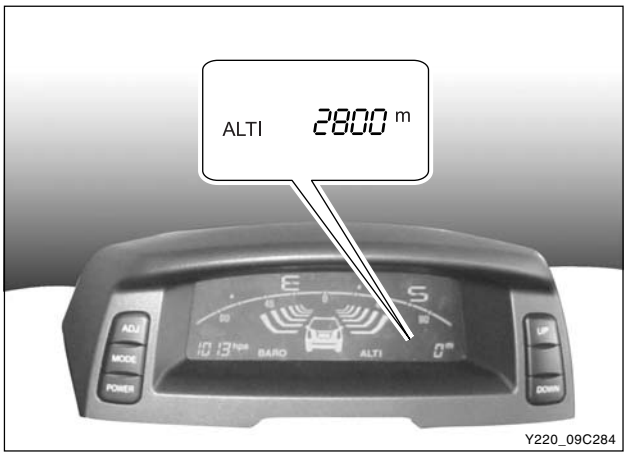
It indicates the current atmospheric pressure up to 600 hpa ~ 1,100 hpa by 1 hpa.

Note

- ***The atmospheric pressure means the pressure or weight exerted by the gasses in the air exert upon the earth and on all things exposed to it. It is indicated higher at higher place such as a mountain, and vice versa.***
- ***The atmospheric pressure may vary even at same place due to the weather.***

ALTIMETER (ABSOLUTE ALTIMETER)

It operates by atmospheric pressure. 0m above the sea level is equivalent to 1013.25 hpa and the altimeter convert the difference between this pressure and atmospheric pressure to altitude and shows by every 20 m. (however, if less than 20 m, it indicates as 0 m)



▶ How to Calibrate the Altitude

SWITCH	SWITCH	SWITCH
UP	ON (less than 0.5 sec.)	Increase by 20 m
	ON (more than 0.5 sec.)	Automatic increase by 20 m (per 0.2 sec.)
DOWN	ON (less than 0.5 sec.)	Decrease by 20 m
	ON (more than 0.5 sec.)	Automatic decrease by 20 m (per 0.2 sec.)

▶ How to Erase the Calibrated Altitude Value

Press the UP and DOWN switches simultaneously for more than 1 second then the calibrated altitude value will be erased and the current altitude will be indicated after showing -0000 for 2 seconds.

▶ Altitude Calibration Ranges

The difference between minimum value and maximum value is 3000 m: the calibration is available within the altitude range of -200 ~ +2800 m.

Note

Altitude Calibration: Adjustment of the altitude value on multimeter to the map altitude at a specified place when it is different from the map altitude.

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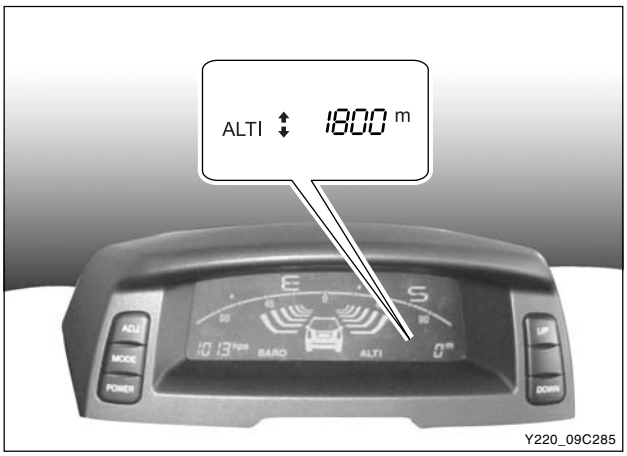
RELATIVE ALTIMETER



Y220_09C285

Use this to see the specific area's altitude; it shows the specific area's relative altitude based on the current altitude of the vehicle.

▶ Mode Setting of the Relative Altimeter

1. Press the "MODE" switch over 0.5 second.
2. To see the difference of the altitude Set the vehicle's altitude to 0 by pressing "UP" and "DOWN" switches simultaneously over 1 second.
   → read the indicated altitude after arrival.

▶ To See the Destination's Altitude

1. Enter the altitude of the point where you know the altitude from the sea level.
2. The indicated value on the destination is the altitude from the sea level.

Notice

The altimeter operates by using changes of atmospheric pressure.

So, sometimes, the indicated altitude may different due to changing atmospheric pressure in the same place, however, it is normal, not malfunctions.

▶ Coming Out Order of the Road Signs

- If the vehicle stops, the currently turned off area of the signs will remain as it is.
- If the vehicle drives off again, the next area from the turned off signs will start to flash.

Removal and Installation

1. Remove the rear cover of the multi-meter.

2. Unscrew the bolts at rear side of the multi-meter and separate the multi-meter from the instrument panel.

3. Disconnect the multi-meter connector and remove the multi-meter.
4. Install in the reverse order of removal.

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SECTION 9D

SWITCHES

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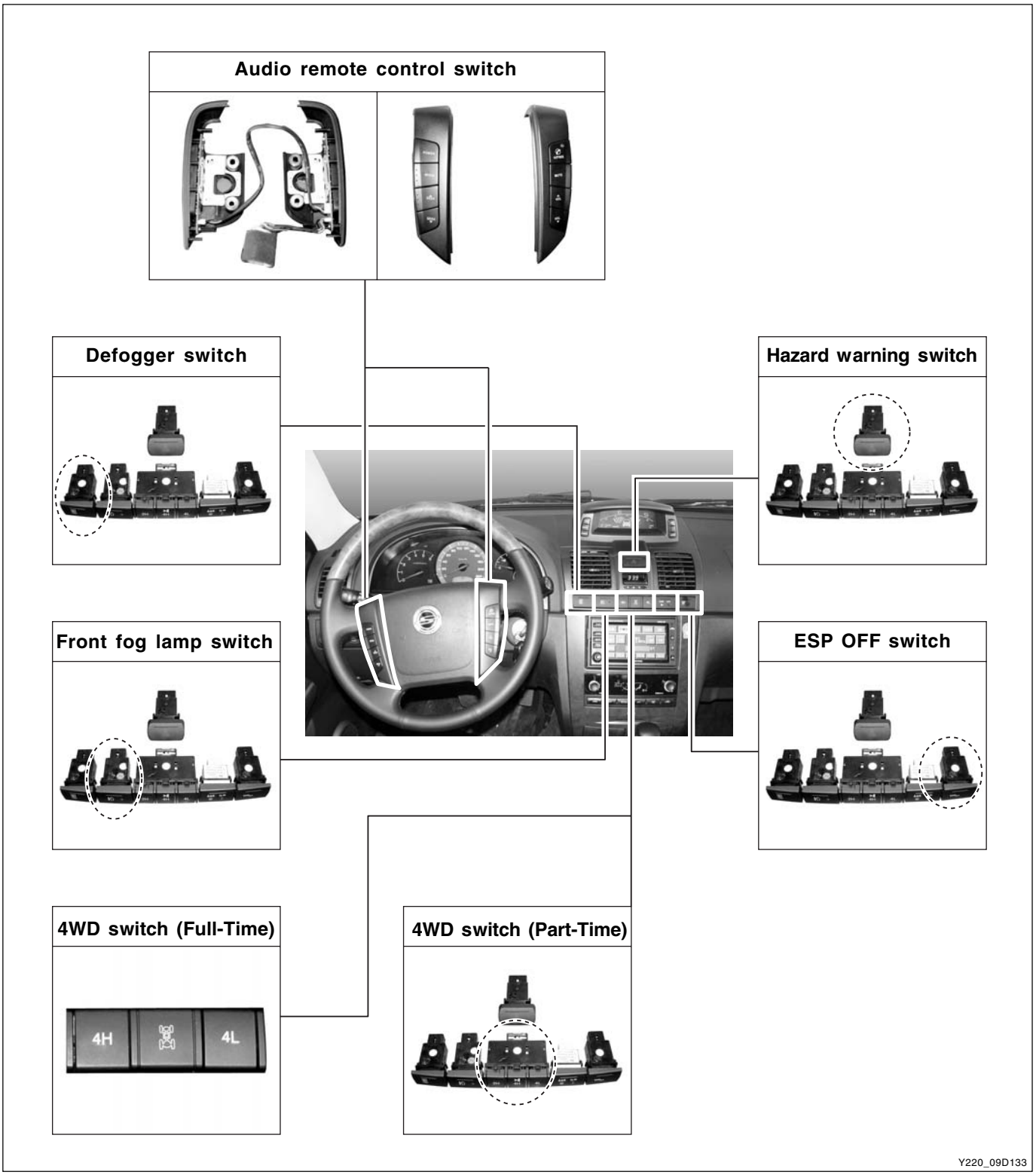
SWITCH

COMPONENTS LOCATOR

▶ Center Switches



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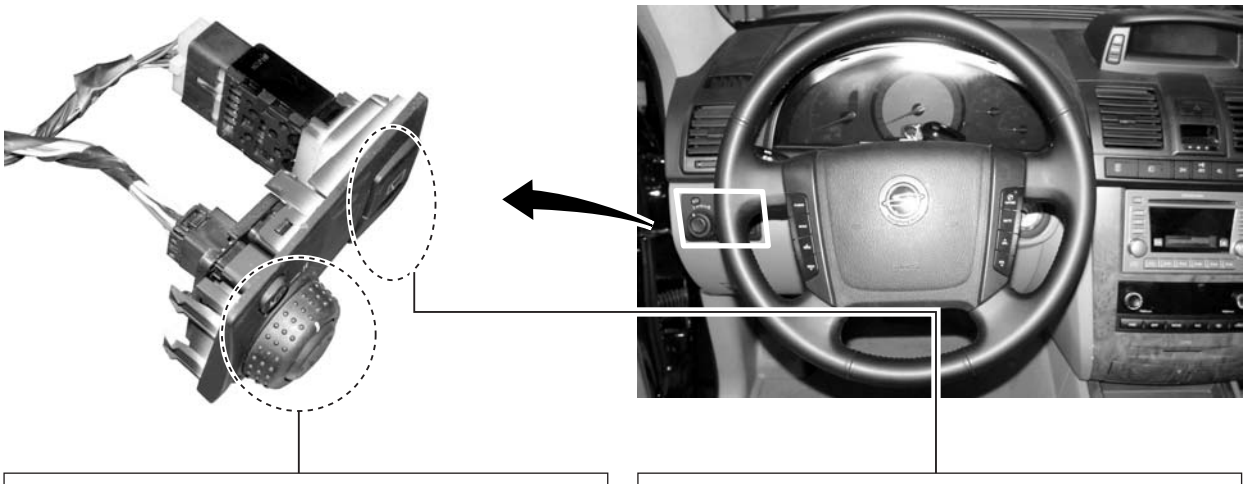
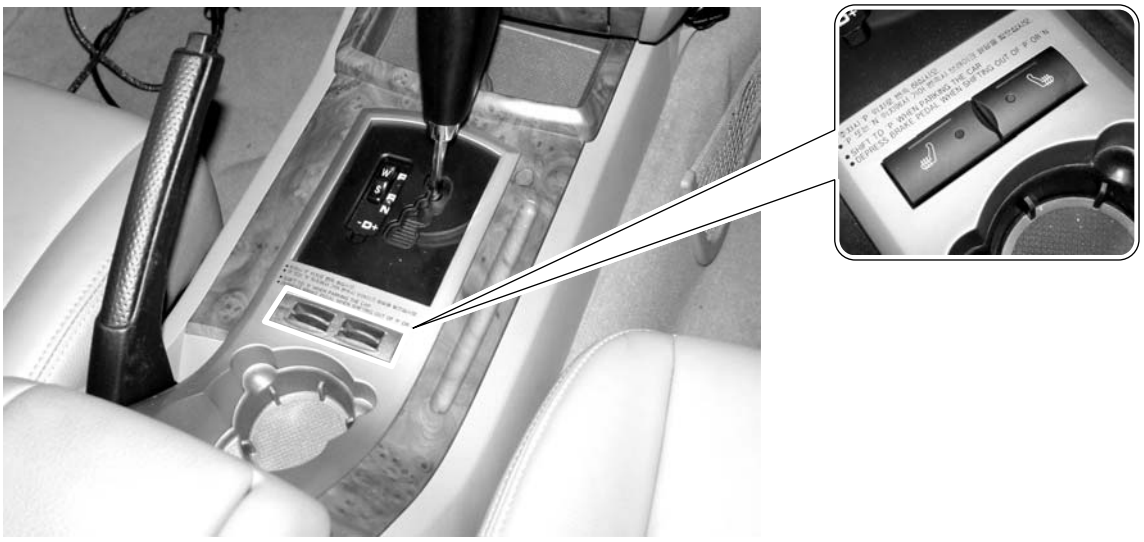
▶ Others



Outside rearview mirror switch	Tailgate window wiper/washer switch

Y220_09D134

▶ Seat Warmer Switch



Y220_09D135

Warm the seat in the cold weather for comfortable driving.

Press the button to warm the seat, and press it again to stop the operation.

Notice

- ***Do not place anything sharp on the seat. This may cause damages to the seat warmer.***
- ***When cleaning the seats, do not use organic solvents such as benzene or thinner. The seat surfaces may get deteriorated.***

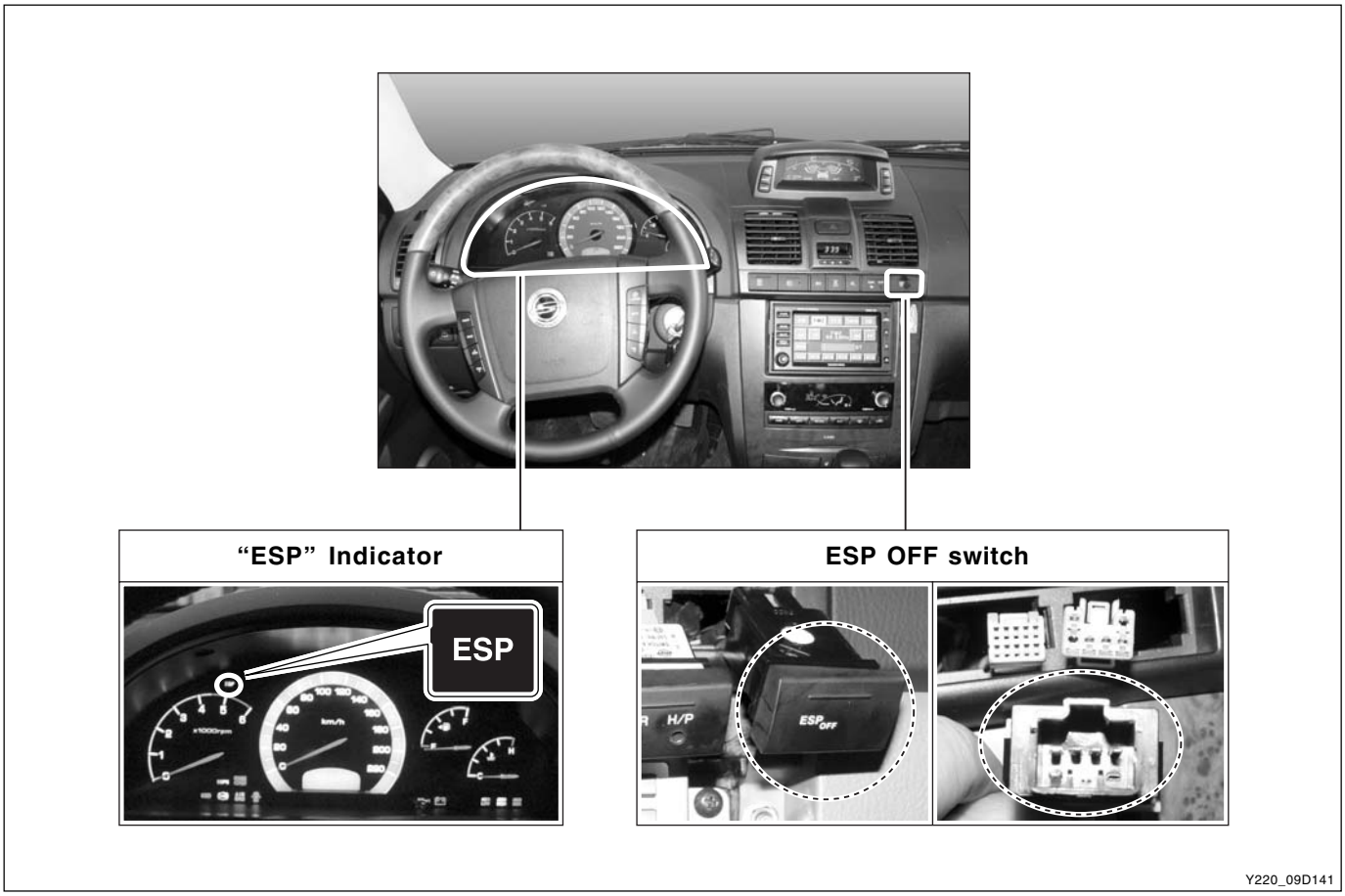
Notice

- ***Do not operate when the engine is not running.***

FUNCTION AND CIRCUIT OF SWITCHES

CENTER SWITCHES

▶ ESP OFF Switch



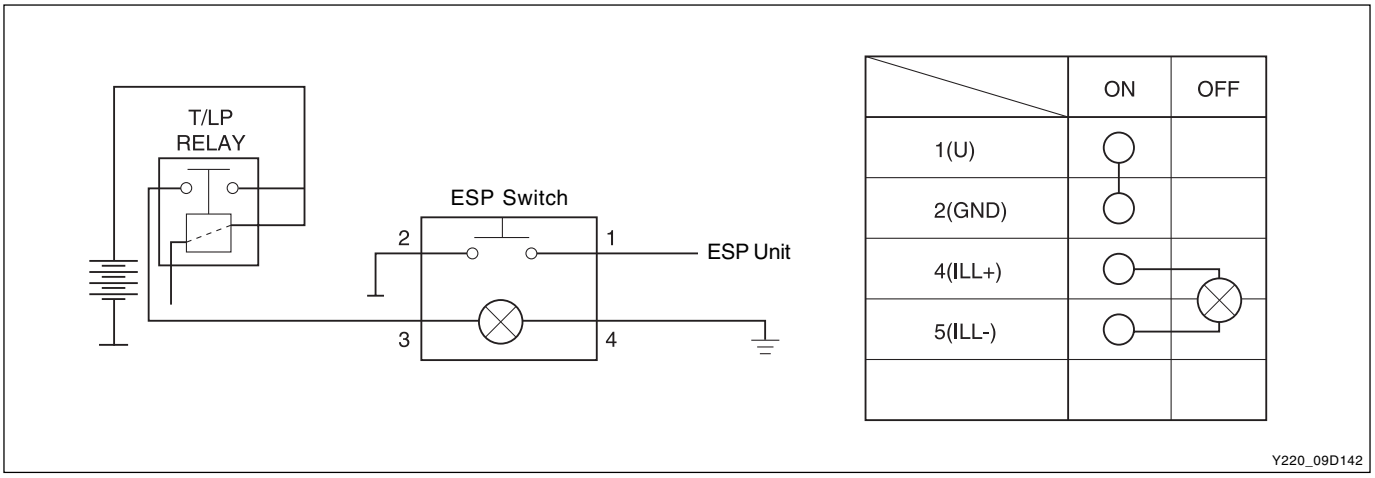
ESP OFF Switch

- ESP indicator comes on:

  When pressing the ESP OFF switch, the ESP function stops and the indicator in instrument panel comes on.
- ESP indicator flickers and buzzer sounds:

  If the ESP function operates while driving under unstable conditions, the indicator flickers and the buzzer sounds.
- Press the ESP OFF switch again to resume the ESP function. At this time, the indicator goes out.

Circuit diagram and connector pin arrangement



Stopping ESP function with ESP OFF switch

If the driving wheels are slipping on the snowy or icy road, the engine rpm may not be increased even when you depress the accelerator pedal, and accordingly, the driver may not start off the vehicle. In this case, stop the ESP function by pressing the ESP OFF switch. When the ESP switch is pressed, the ESP function stops and the vehicle is driven independently from the sensor outputs.

Resuming ESP function with ESP OFF switch

The ESP function is resumed when pressing the ESP switch again while ESP system is operating (ESP indicator “ON”).

Notice

- ***The ESP system deactivates when stopping the engine. It will be resumed when the engine is started again.***
- ***If the vehicle is controlled by ESP during driving, the ESP OFF switch will not work.***
- ***If the ESP function operates while driving, the indicator lamp flickers and the alarm sounds.***
- ***If the ESP warning light comes on, the ESP related system is defective.***
  At this moment, the ABS works in a basic way.
- ***If the ESP warning light and the ABS warning light come on simultaneously, both ESP and ABS system are not working.***
- ***If the ESP warning light flickers and the alarm sounds, it means that the vehicle stability is controlled by the ESP function when vehicle stability is extremely unstable.***

▶ Front Fog Lamp Switch

Y220_09D143

To turn on the front fog lamp, push this switch while the light switch is turned on.
Pushing this switch again will turn off the fog lamps.

▶ Outside Rearview Mirror & Tailgate Glass Defogger Switch

Defogger switch	Defogger switch connector
	

Y220_09D144

The Outside Rearview Mirror & Tailgate Glass Defogger operates for approx. 12 minutes when pressing this switch while the light switch is turned on.

- It stops when pressing the switch again during its operation. If pressing this switch again within 10 minutes after completion of first operation, it will operate for about 6 minutes.
- It stops when the ignition switch is turned to “OFF” or the voltage of “L” terminal in the alternator is below 10 V.

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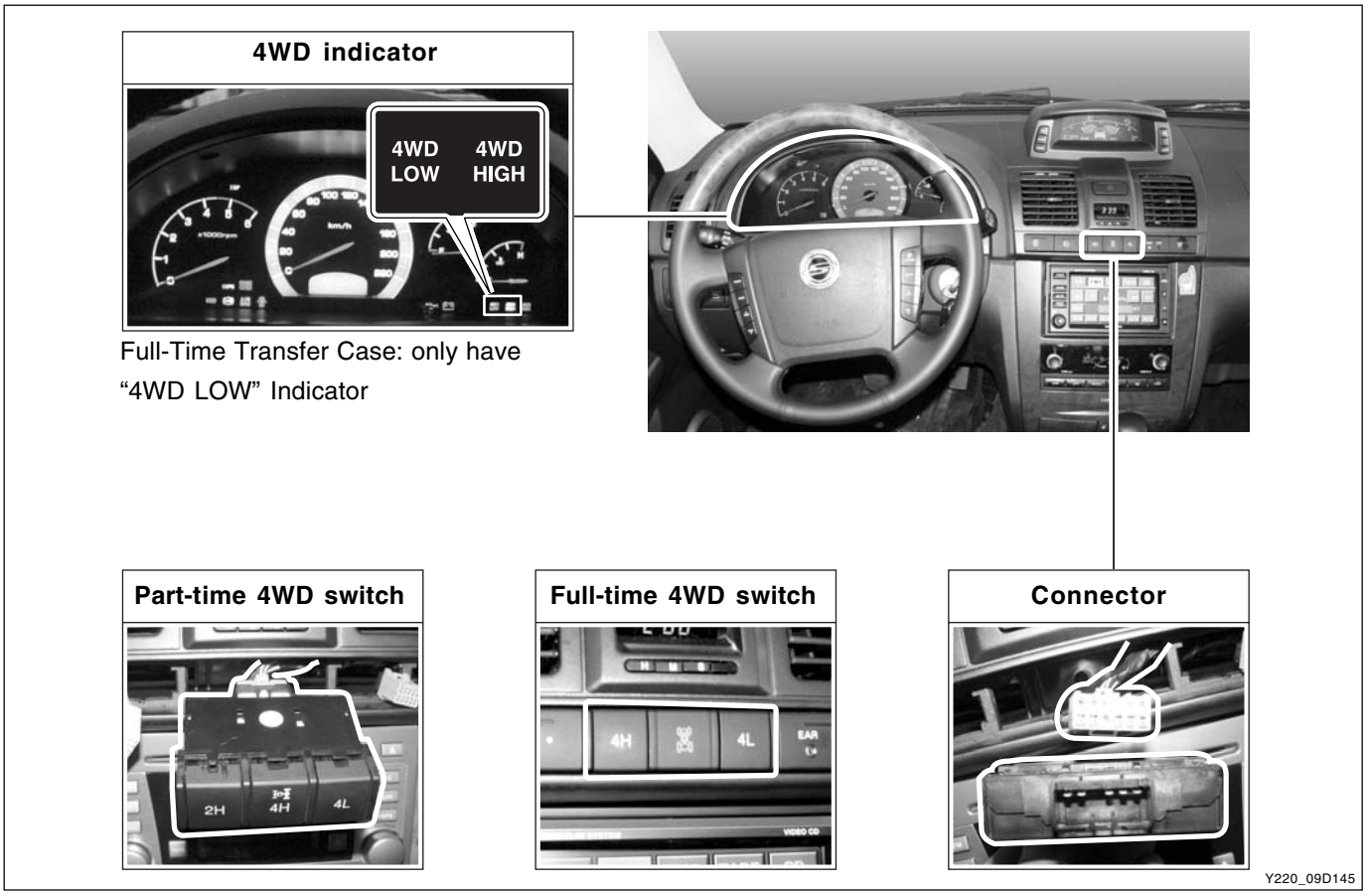
▶ 4WD Switch



- "2H" (2-Wheel drive)
  This is rear wheel drive with high speed. Use this for normal driving. This position gives greater economy, quieter ride and least drive train wear.
- "4H" (4-Wheel Drive, High)
  Use this for driving on wet or slippery roads such as roads with snow, mud or sand. This position provides greater traction than 2-wheel drive. The front hubs will be locked automatically.
- "4L" (4-Wheel Drive, Low)
  Use this for maximum power and traction. Use "4L" for climbing or descending steep hills, hard pulling in sand, mud or deep snow.

Vehicle equipped with manual transmission

Description	2H ↔ 4H	2H, 4H ↔ 4L
Driving conditions	below 70 km/h	Stop
Clutch operation	No need	Depressing the clutch pedal
Shift position	-	N (Neutral)

Vehicle equipped with automatic transmission

Description	2H → 4H	2H, 4H → 4L
Driving conditions	below 70 km/h	Stop
Shift position	-	N (Neutral)

Switch position

- "4H" (4-Wheel Drive, High)
  Use this for normal driving.
- "4L" (4-Wheel Drive, Low)
  Use this for maximum power and traction. Use '4L' for climbing or descending steep hills, hard pulling in sand, mud or deep snow.

Mode switching

Description	4H ↔ 4L
Driving conditions	Stop
Shift position	N (Neutral)

4WD CHECK warning light

These indicators come on when the ignition switch is turned to ON and should go out if the system is normal. If the “4WD LOW” and “4WD HIGH” warning light come on or blink (IDI Engine), or “4WD CHECK” warning light stays on, have the 4WD system checked at Ssangyong Dealer or Ssangyong Authorized Service Operation.

IDI engine equipped vehicle

4WD LOW 4WD HIGH

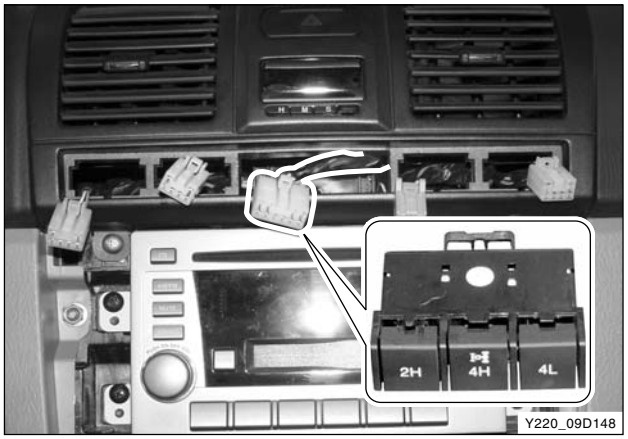
DI engine or gasoline engine equipped vehicle

4WD CHECK

Removal and Installation

1. Separate the switches with a special tool.

2. Disconnect the connectors from the switches and remove the switches.
3. Install in the reverse order of removal.



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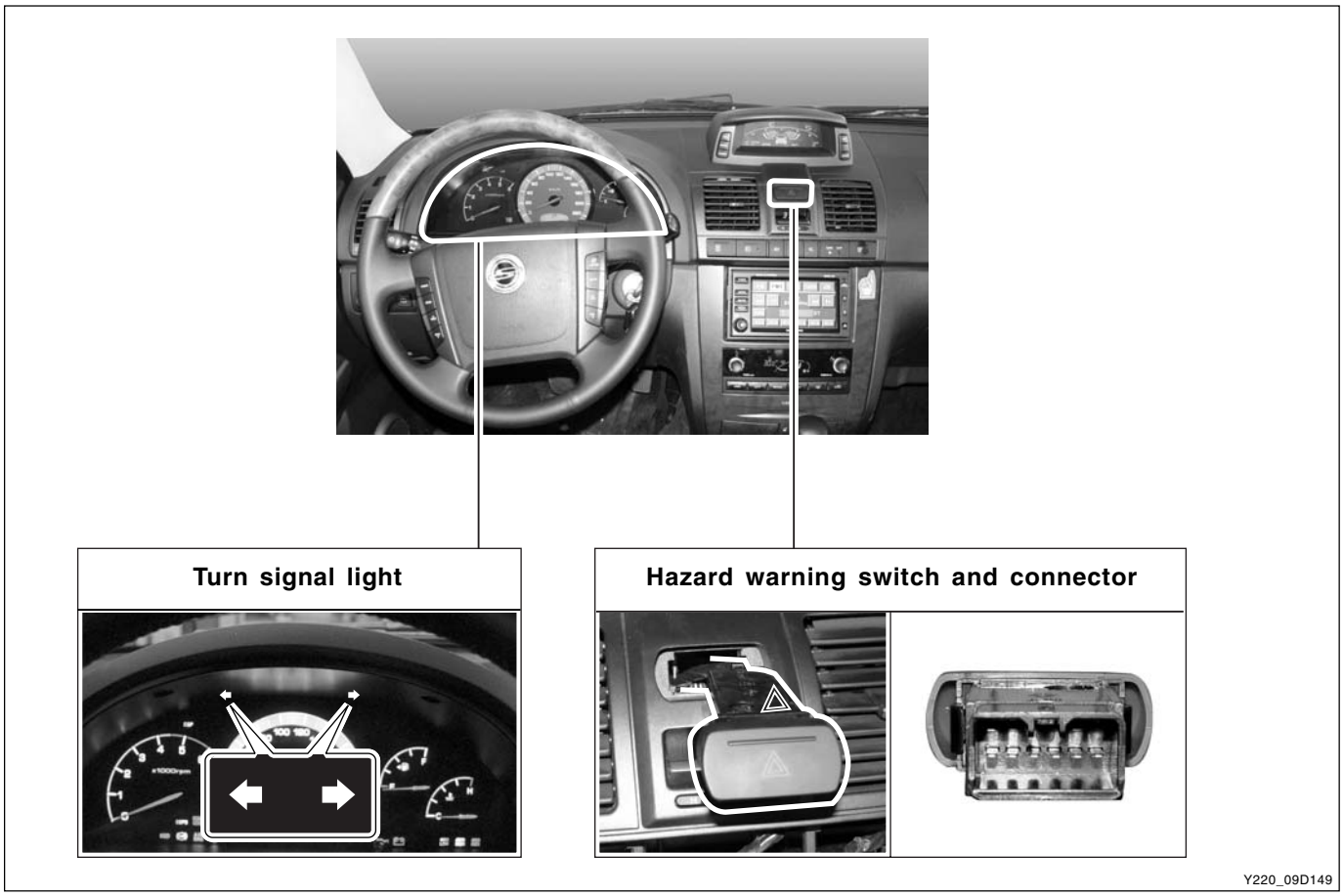
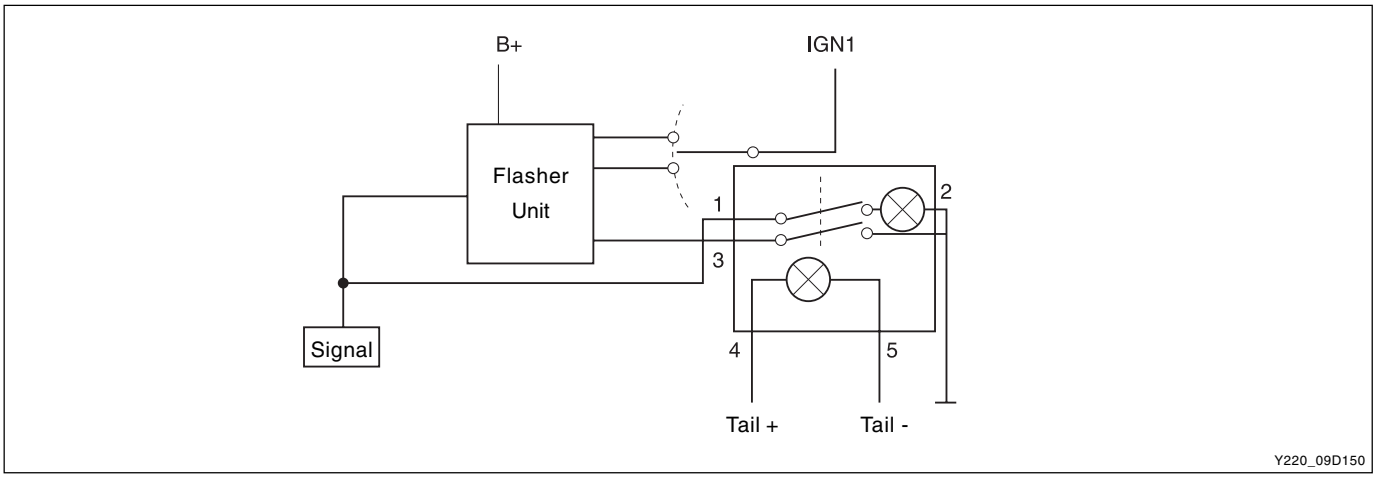
▶ Hazard Warning Switch

When pressing this switch, both turn signal lights flash.



Circuit diagram and connector pin arrangement

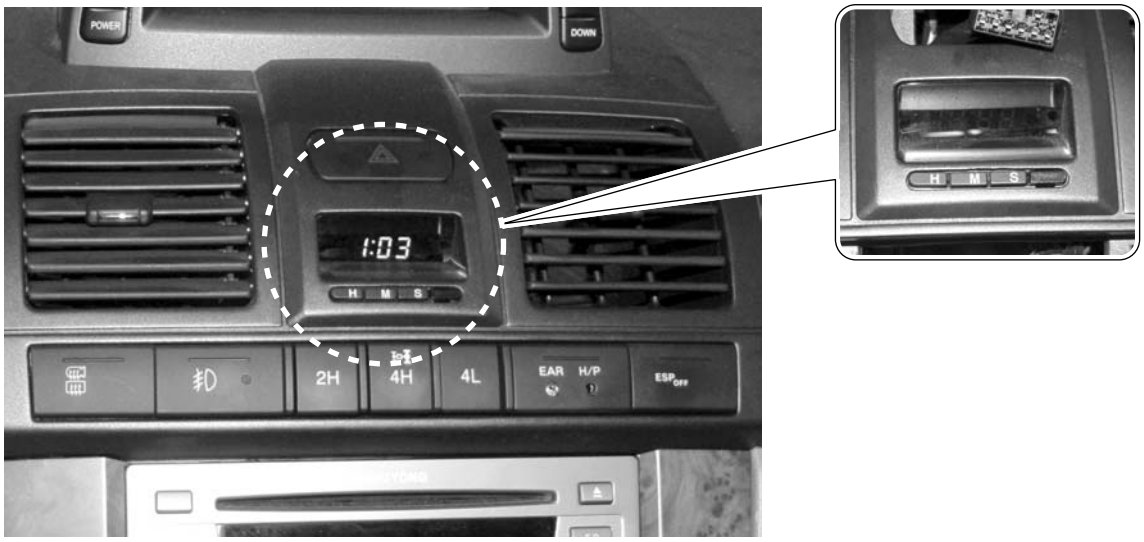


Removal and Installation

1. Separate the hazard warning switch.

2. Disconnect the connector and remove the switch.
3. Install in the reverse order of removal.

▶ Digital Clock



Y220_09D153

Time Setting

1. S : Setting Button

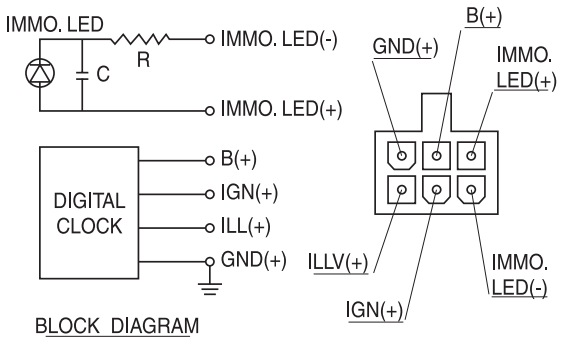
   To reset the time by the time signal, press the SET button using a pointer, such as ball-point pen, with the ignition on. For example, if this button is pressed while the time is between 8:00 and 8:29 the display is set to 8:00. If this button is pressed while the time is between 8:30 and 8:59, the display is set to 9:00.

2. H : Hour Adjusting Button

   To go forward one hour, press H button once using a pointer, such as ball-point pen, with the ignition on.

3. M : Minute Adjusting Button

   To go forward one minute, press MIN button once using a pointer, such as ball-point pen, with the ignition on.



BLOCK DIAGRAM

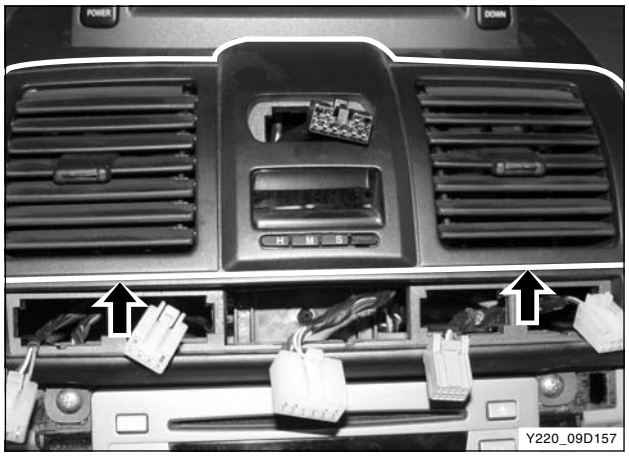
Y220_09D154

Removal and Installation

1. Remove the instrument center panel.

2. Remove the multi-meter and the upper center panel.

3. Disconnect the connector, unscrew the screws, and remove the digital clock.
4. Install in the reverse order of removal.



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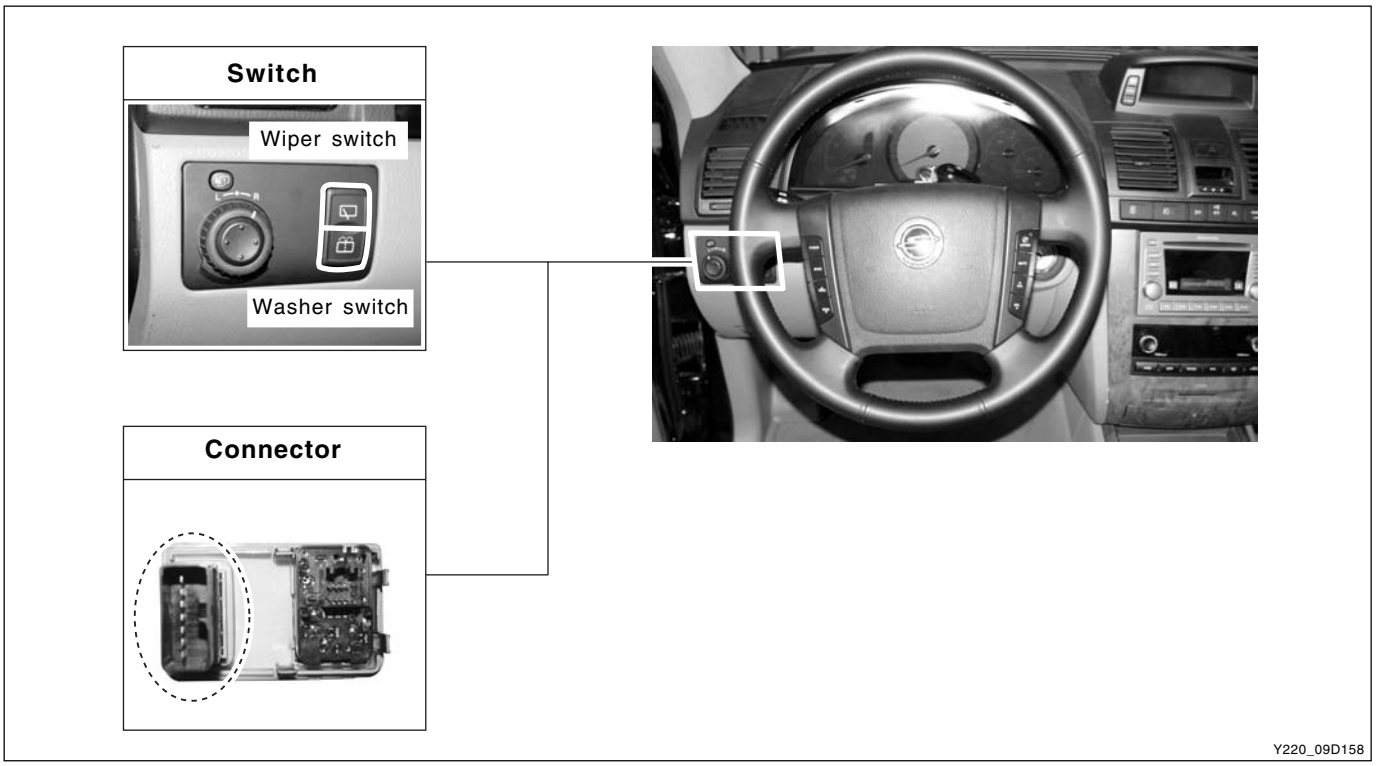
LEFT SWITCH PANEL

▶ Tailgate Window Wiper Switch



Tailgate window wiper switch

To operate the tailgate window wiper, push the switch. To cancel the operation of the window wiper, push the switch again.

Tailgate window washer switch

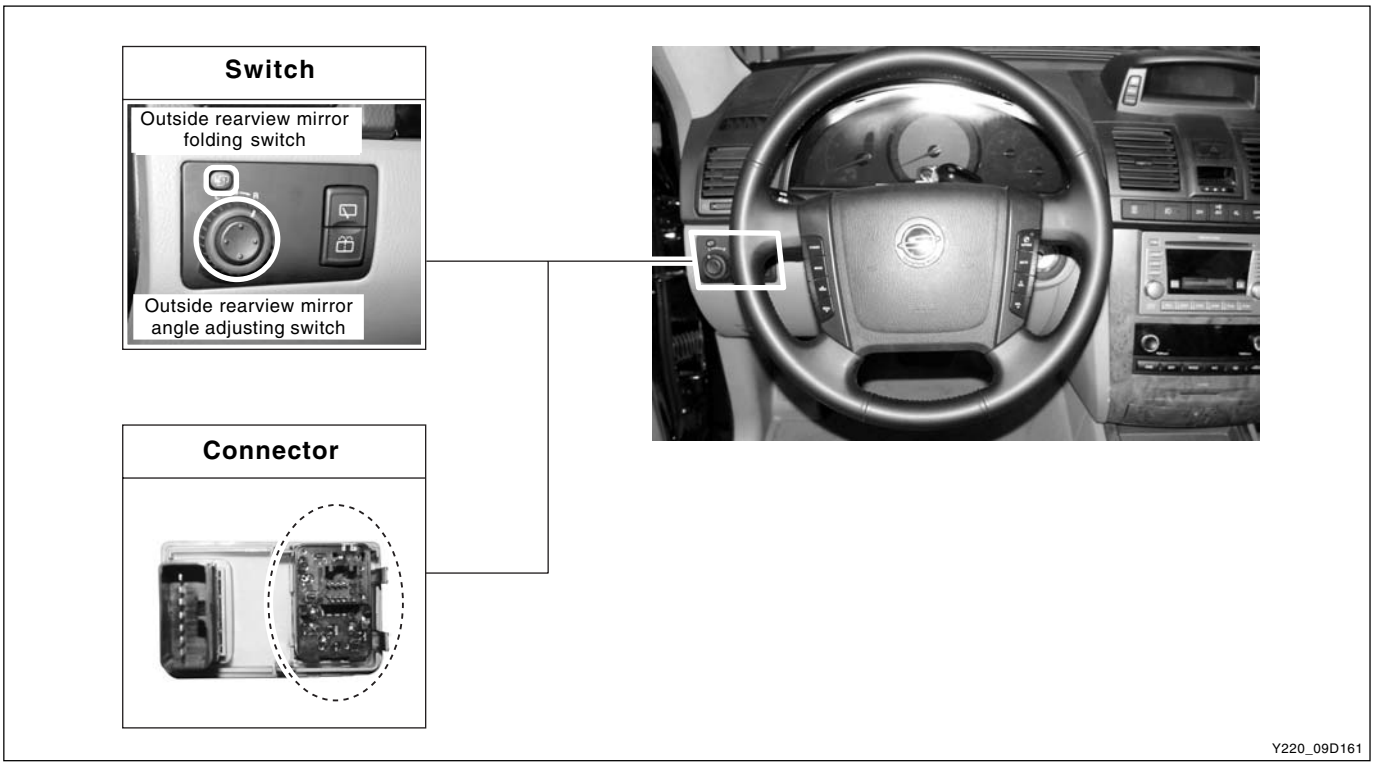
To spray the washer fluid, push the tailgate washer switch.

When pressing the switch for more than about 0.6 second, the washer fluid is sprayed onto the tailgate window and the rear wiper is operated.

Note

The wiper coupled operation is only available in the flip-up window equipped vehicle.

▶ Outside Rearview Mirror Control Switch



Outside rearview mirror angle adjusting switch

- Mirror selection switch
  L: Left outside rearview mirror
  R: Right Left outside rearview mirror

- Angle adjusting switch
  The mirror angle moves to as pressed position.

Outside rearview mirror folding switch

To fold the outside rearview mirrors, press the switch for more than 0.5 second. To unfold the mirrors, press again.

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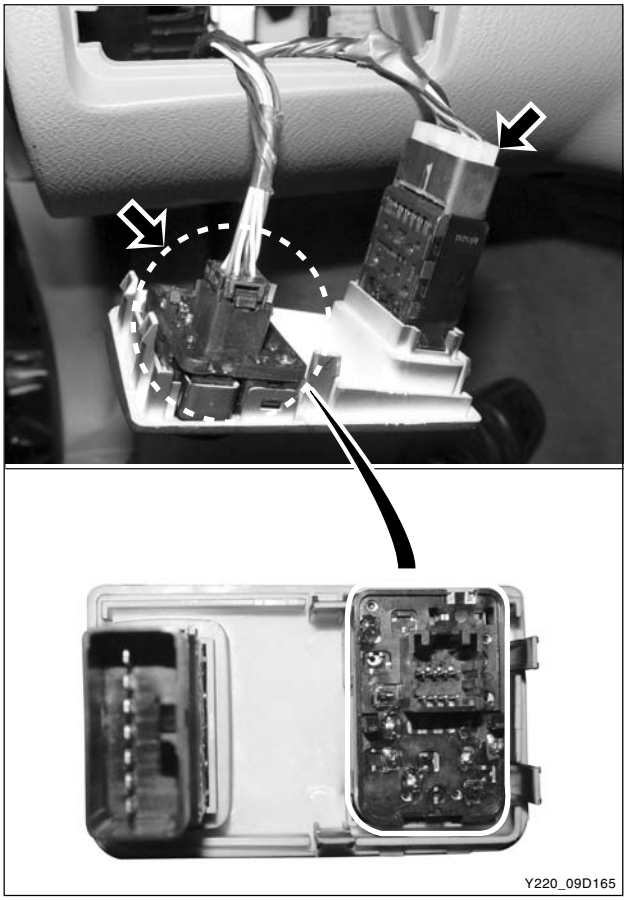
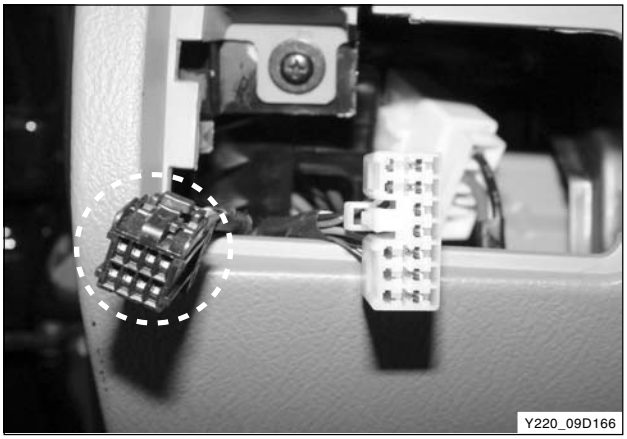
Removal and Installation

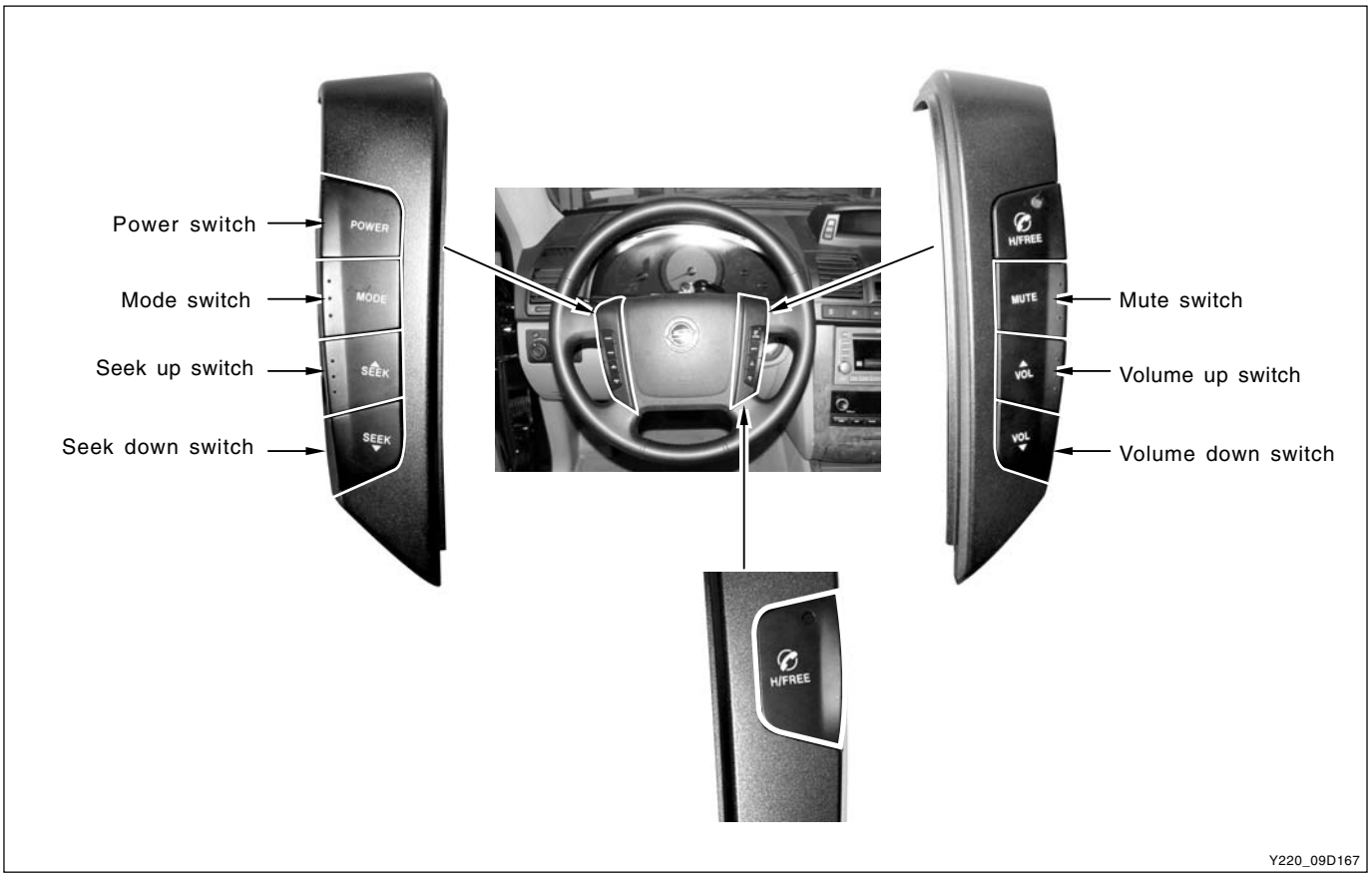
1. Separate the lower switch panel from the instrument panel.



2. Disconnect the connector and remove the switch assembly.



STEERING WHEEL REMOTE CONTROL SWITCH



The steering wheel remote control switch operates the audio system.

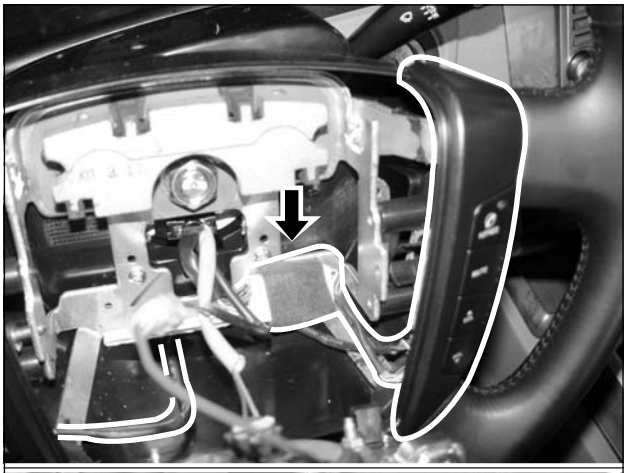
- POWER switch: Power ON/OFF
- MODE switch: Audio mode changes in order as below

TUNER (RADIO) mode
(FM1 → FM2 → AM)
↓
TAPE mode
↓
CD shuttle (6-CD changer)

- SEEK: Automatic station selection
- MUTE switch: Audio sound elimination
- VOL switch: Volume up or down

Removal and Installation

1. Remove the horn switch on the steering wheel.
2. Unscrew the mounting screws.



3. Disconnect the connector and remove the steering wheel remote control switch.

4. Remove the ECU under the passenger seat.

SEAT WARMER SWITCH

▶ Seat Warmer Switch

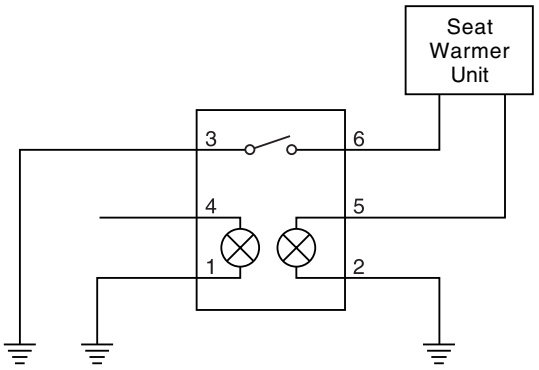
Warm the seat in the cold weather for comfortable driving.

Press the button to warm the seat, and press it again to stop the operation.

Notice

Do not operate when the engine is not running.

Circuit diagram and connector pin arrangement



P / T	ON	OFF
(SIG) - 6	○	
(-) - 3	○	
(+) - 5	○	
(IND) - 2	○	
(ILL+) - 4	○	
(ILL-) - 1	○	

Y220_09D174

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Removal and Installation

1. Front Seat Warmer Switch

1-1. Lift up the switch with a special tool from the center console.

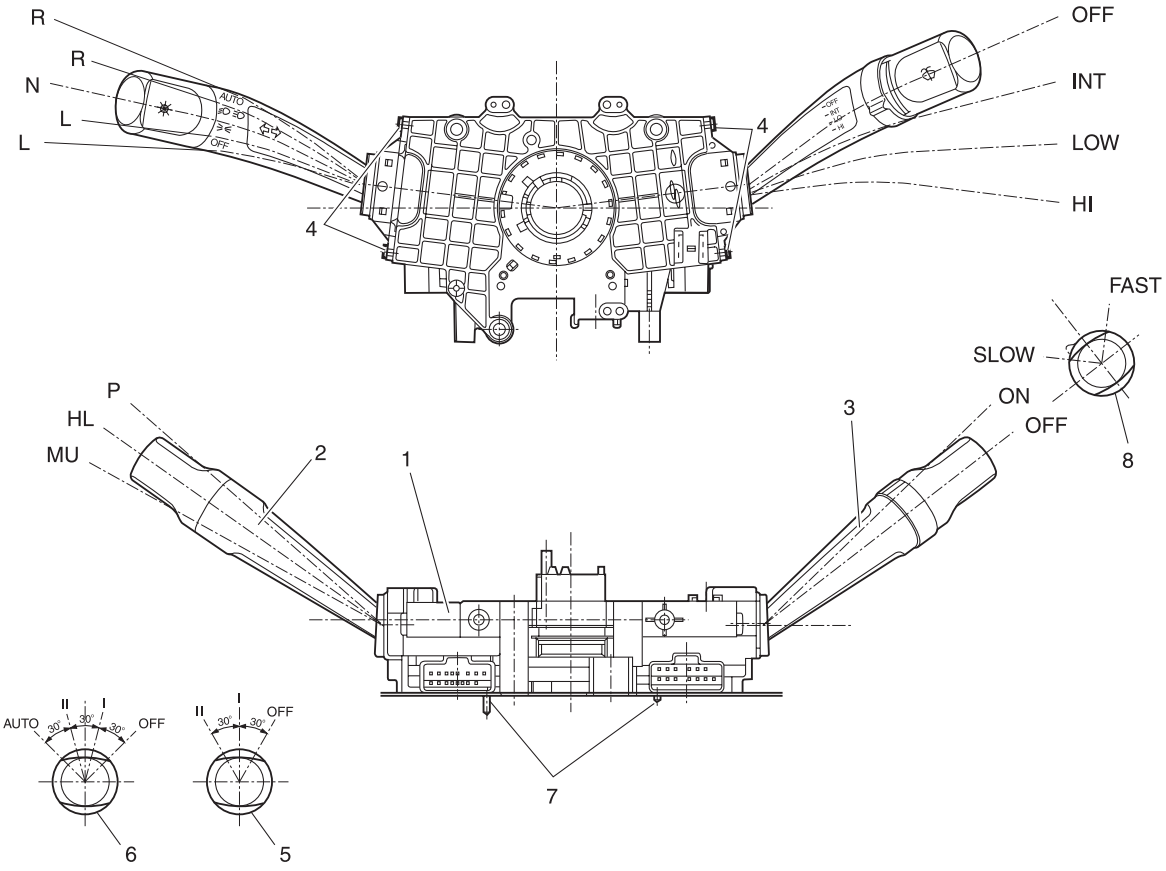
1-2. Disconnect the connector and remove the switch.

2. Rear Seat Warmer Switch

2-1. Remove the door panel.

2-2. Disconnect the connector and remove the switch.

MULTI-FUNCTION SWITCH



1. Multi-function switch assembly
2. Turn signal light switch assembly
3. Wiper switch
4. Screw
5. Light switch
6. Auto light switch
7. Connector
8. FS switch

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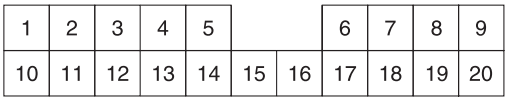
CONNECTOR PIN ARRANGEMENT

Connector Layout	Pin Number	Name	
	1	TL	Turn signal switch (LH)
	2	TB	Flasher unit - Power
	3	TR	Turn signal switch (RH)
	4	HU	Headlamp high beam - Power
	5	HS (2)	Headlamp switch - Passing
	6	W	Front washer switch
	7	EW	Wiper and washer - Ground
	8	AUTO	Auto wiper
	9	P	Wiper - Parking
	10	ES	Light switch - Ground
	11	A	Auto light switch
	12	HS (1)	Headlamp switch
	13	TS	Tail lamp switch
	14	EB	Dimmer and passing switch - Ground
	15	-	-
	16	LO	Wiper low speed
	17	HI	Wiper high speed
	18	ET	Intermittent wiper - Ground
	19	INT	Intermittent wiper
	20	HORN	Horn relay

SPECIFICATIONS

Description			Specifications
Multifunction switch	Rated voltage		DC 12 V
	Operating temperature range		-30°C ~ +80°C
	Rated load	Light switch	Turning on: 1 A (Relay load)
		Dimmer and passing switch	High beam: 9.2 A (Relay load)
			Low beam: 1 A (Relay load)
			Passing: 10 A (Relay load)
		Turn signal light switch	6.6 ± 0.5 A (Relay load)
		Wiper switch	Low: 5 A, High: 7 A (Motor load)
			Intermittent: 0.22 ± 0.05 A (Relay load)
			Fixed: Max. 28 A (Motor load)
		Washer switch	4 A (Motor load)
		Intermittent wiper switch	Max. 25 mmA
		Horn connector	1 A (Relay load)

FUNCTION AND COMPOSITION OF SWITCHES

▶ Light Switch

Pos. \ Ter.	TS(13)	HS-1(12)	EL(10)
OFF			
I	○		○
II	○	○	○

Y220_09D176

Position	OFF			AUTO
Headlamp	X	X	O	Auto ON/OFF
Clearance lamp	X	O	O	
Tail lamp	X	O	O	
License plate lamp	X	O	O	
Cluster lamp	X	O	O	
Fog lamp	X	O	O	

The fog lamp comes on when the fog lamp switch is operated.

▶ High Beam Switch

Y220_09D177

To turn on the high beam headlights push the lever towards the instrument panel with the low beam headlights on. The headlight high beam indicator light in the instrument panel comes on when the headlights are on high beam.

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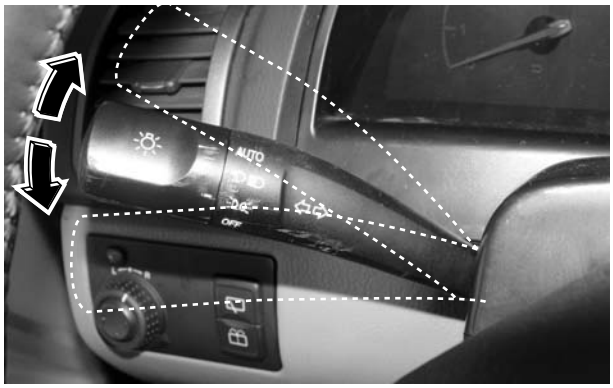
▶ Passing Light Switch

Pos. \ Ter.	EB(14)	HS(1)	HU(4)	HS-2(5)
HU(Hign)	○	——	○	
HL(Low)	○	——		
P(Passing)	○	——	○	○

Y220_09D178

To flash the high beam, pull the lever towards the steering wheel and release it.
The lever will return to the normal position when released.

▶ Turn Signal Light Switch



Hazard \ Turn \ Ter.		TB(2)	TL(1)	TR(3)
OFF	L.L	○	—— ○	
	N			
	R.R	○	——	○

Y220_09D179

Move this lever up to the stop position to signal a right turn.
Move this lever down to the stop position to signal a left turn.

▶ Washer Switch (Windshield Glass)

Pos. \ 단자 Ter.	W(6)	EW(7)
OFF		
ON	○	○

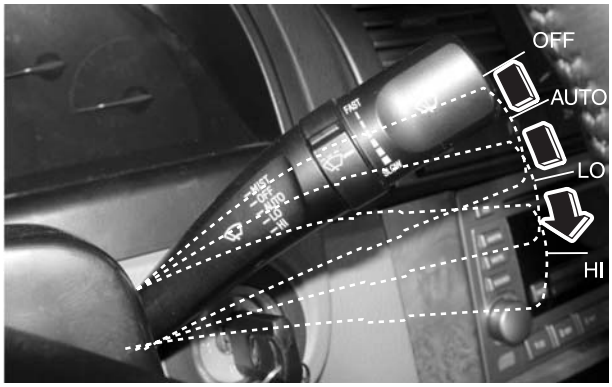
EARTH

Y220_09D180

To spray washer fluid on the windshield, pull the lever towards the steering wheel with the ignition on.

When pulling up the lever for less than about 0.6 seconds, the washer fluid is sprayed onto the windshield, but the windows wipers are not operated.

▶ Wiper Switch (Windshield Glass)



Pos. \ 단자 Ter.	W(6)	EW(7)
OFF		
ON	○	○

EARTH

Y220_09D181

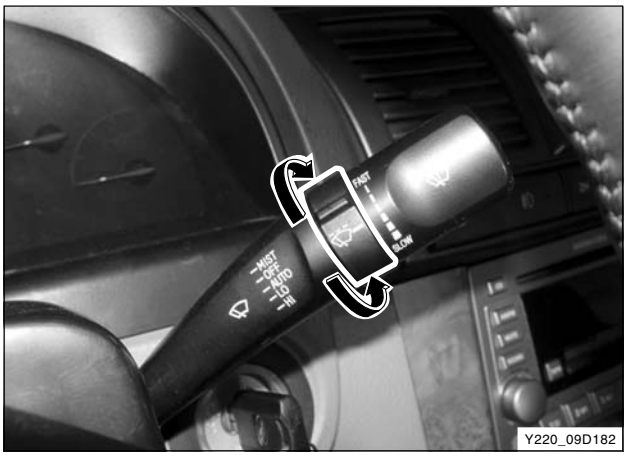
To operate the windshield wipers, move the lever in 3 downwards steps with the ignition on.

The wiping speed is automatically controlled according to the vehicle speed when the wiper switch is at "AUTO" position.

In the rain sensing wiper equipped vehicle, the wiping speed is automatically controlled according to the amount of rain.

Description	Wiper Operation
OFF	Off
AUTO	Operates automatically according to the vehicle speed or amount of rain (rain sensor equipped vehicle)
LO	Continuous wipe, slow speed
HI	Continuous wipe, fast speed

▶ Automatic Wiper Control Switch



The interval of wiper swings can be adjusted by twisting the control knob upward or downward when the windshield wiper switch is in AUTO position.

F: Fast interval

S: Slow interval

▶ Auto Light Switch

Pos. \ Ter.	TS(13)	HS-1(12)	ES(10)	A(11)
OFF				
I	○	—	○	
II	○	○	○	
AUTO			○	○

Y220_09D183

Headlamp and tail lamp will automatically come on or off according to the ambient illumination intensity when the light switch is at “AUTO”.

Removal and Installation

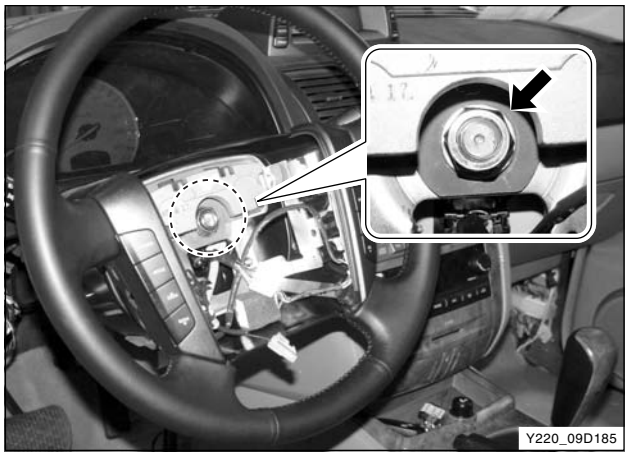
1. Disconnect the negative battery cable.
2. Place the steering wheel to straight ahead direction. Unscrew the bolts and remove the horn pad (airbag module).


Y220_09D184

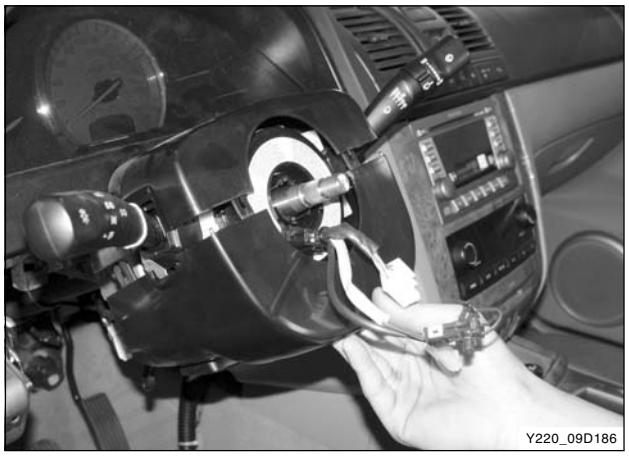
3. Mark on the wheel nut and unscrew the nut.
4. Remove the steering with a special tool.

Notice

Disconnect all the connectors.


Y220_09D185

5. Remove the steering column shaft cover.


Y220_09D186

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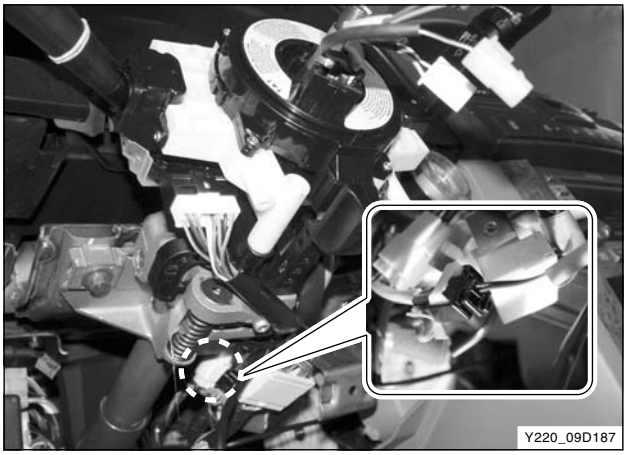
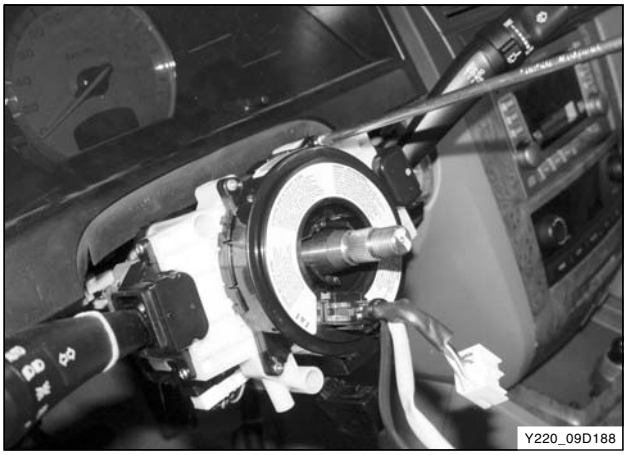


6. Disconnect the multifunction connector and airbag contact coil connector and remove the contact coil.



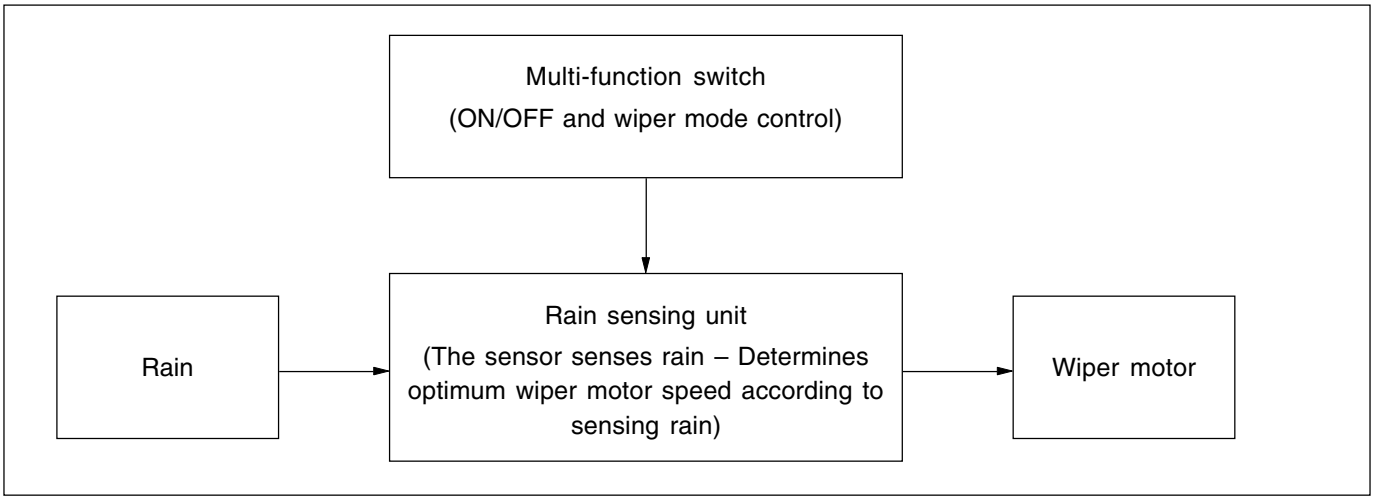
7. Remove the multifunction switch.
8. Install in the reverse order of removal.

RAIN SENSING WIPER SYSTEM

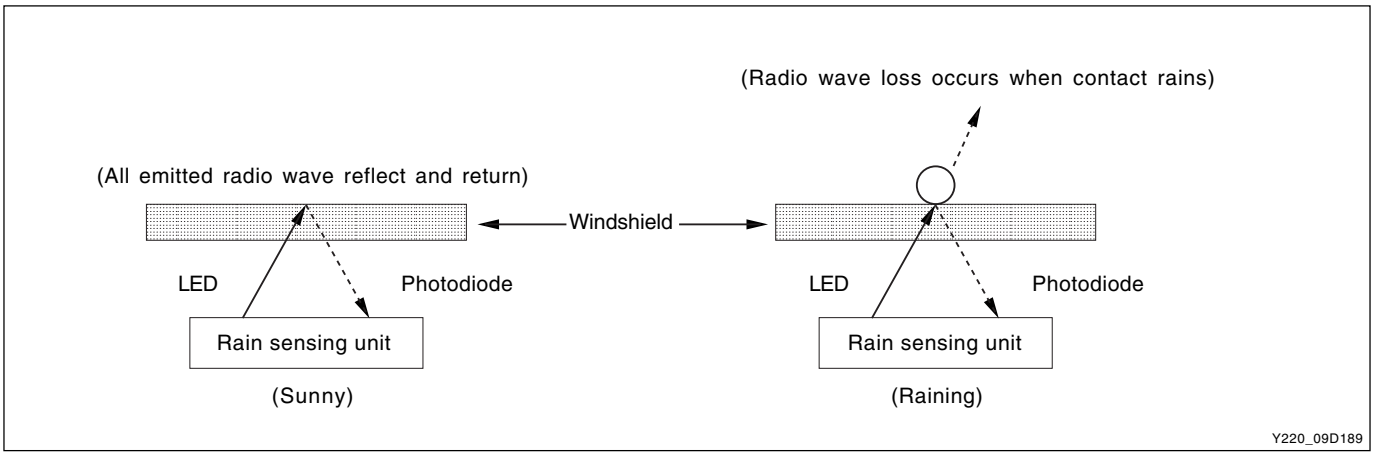
▶ Overview

Rain sensor wiper system is a wiper operation system that sets wiper operation time to fast or slow automatically without driver's operation by controlling wiper motor drive when the rain sensing unit on the inner upper central windshield senses rain.

▶ System Diagram



▶ Principle of Rain Sensor



1. Rain sensing unit detects amount of rains through LED and photodiode.
2. When infrared rays emitted from LED are reflected against rains on the windshield surface, photodiode detects the amount of rains.
3. Rain sensing unit has glass transmitting rate compensation circuit so it can detect rains constantly regardless of transmitting rays.
4. Windshield transmitting rate can be measured at the central point on the glass between LED and photodiode.

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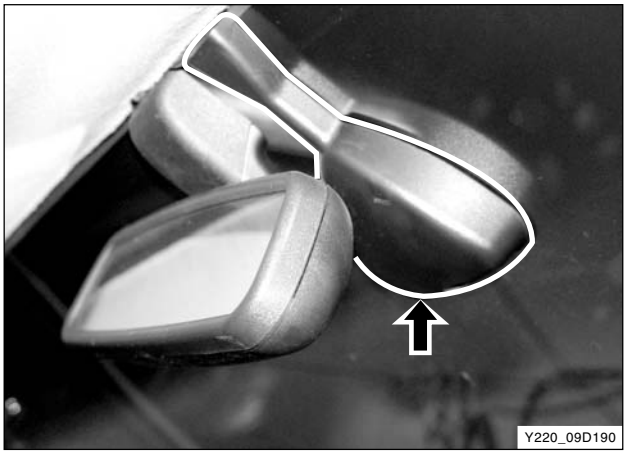


▶ Operation Mode

Rain sensor wiper control system has AUTO mode (on the conventional INT position) in addition to conventional wiper functions of OFF, MIST, LOW and WASHER. When positioned to AUTO, the rain sensor detects rains on the windshield and then controls wiper operation time and wiper operation speed to LOW or HIGH automatically.

Wiper Switch Position	Rain Sensor Operation Mode	System Operation Mode
MIST	MIST	As long as the switch is in MIST position, the wiper motor operates in low speed. The wiper blade returns to park position after wiping and does not affect on the sensor.
OFF	OFF	When wiper is not in park position, the wiper motor continues to operate in low speed until the wiper returns to park position.
AUTO (Sensitivity of AUTO mode can be controlled to stage 1 ~ 5)	AUTO	Automatic delay (INT)/automatic speed control in AUTO (can be controlled by driver) position, the sensitivity against rains on windshield can be controlled by wiper switch.
LOW	MANUAL	Wiper motor operates continuously in low speed of approx. 45 rev./min.
HI	MANUAL	Wiper motor operates continuously in high speed of approx. 60 rev./min.
WASHER (When washer button pressing time is ≥ 0.6)	WASHER	When the washer switch is pressed over 0.6 sec., the wiper operates for 2.5 ~ 3.8 sec.
WASHER (When washer button pressing time is < 0.6)	WASHER	When the washer switch is pressed for 0.2 ~ 0.6 sec., the wiper operates once.

1. **OFF mode**

   When wiper switch is in OFF position and ignition switch is in ON position, rain sensor operates in OFF mode. On this mode, the wiper motor does not operate. During OFF mode, rain sensor monitors windshield conditions and then sets the wiper switch sensitivity stage. So the sensor performance can be optimized when turned from OFF mode to AUTO mode. Control algorism in OFF mode is assumed as set to normal detection.

2. **AUTO mode**

   When wiper switch is turned to AUTO mode from OFF, wiper operates once immediately to notice the driver wiper system operation. When operated once, the wiper stays on park position to determine whether the wiper parking time is proper for rain volume. However, this operation varies according to driver's set volume. When parking period is completed, rain sensor inputs signal to wiper motor to wipe out rains on windshield.

3. **Automatic intermittent**

   Under AUTO INT mode, the wiper cleans windshield once and then takes variable parking time on the inner area position.

4. **Automatic low speed**

   AUTO LO mode operates when rains on windshield exceed critical value of AUTO INT and AUTO LO. This critical value has magnetization characteristics that prevents repeating operation between AUTO INT and AUTO LO while accumulating rain.

5. **Automatic high speed**

   AUTO HI mode operates when rains on windshield exceed critical value of AUTO LO and AUTO HI. This critical value has magnetization characteristics that prevents repeating operation between AUTO LO and AUTO HI while accumulating rain.

6. **Washer mode**

   Rain sensor monitors whether the wiper switch has selected washer function. When washer switch on the wiper switch in wiper system is pressed on for over 0.6 sec., wiper operates for 2.5 ~ 3.8 sec. and, if not, operates once only. Under washer mode, wiper motor operates in low speed to clean the windshield.

7. **Manual mode**

   If the driver operates switch, the wiper motor operates in low or high speed. At this moment, the wiper operation is controlled by direct ground from wiper switch, not by rain sensor controls.

NOTE

When rain sensor is defective, wiper operates in low/high speed normally.

▶ Operational Characteristics of Rain Sensor

1. **Power stabilization time**

   When power is supplied, rain sensor outputs OFF signal until there is effective output within 250 msec. Effective output is available after 2 sec. from the power supply.

2. **Control of wiper speed and frequency**

   Main function of rain sensor is controlling wiping speed and delay time between wiping operations and maintaining level of rains (degree of rains that covering windshield) that driver has selected. According to set sensitivity and level of rains, rain sensor algorism determines operation mode among AUTO INT, AUTO LO and AUTO HI. When sensitivity is set, wiper operation continues without driver's switch operations.

3. **Shifts between modes**

   Rain sensor algorism shifts among AUTO INT, AUTO LO and AUTO HI at lower so does not make shocks.

4. **Adjustable sensitivity performance**

   Sensitivity of rain sensor can be set by increasing/decreasing INT on wiper switch. Sensitivity can be set from stage 1 to stage 5 according to actual system. Each stage can be identified so that can satisfy every driver's desire on level of rains. Adjustable ranges are from short delay time (1 ~ 5 sec.) to long delay time (over 20 sec.), so that can meet very small amount of rain. However, if rains heavily, wiper operates continuously in high speed regardless of set sensor sensitivity.

5. **Response characteristics of AUTO LO**

   If rains and the wiper should be operated from 0 to AUTO LO, rain sensor's high speed demand signal output period does not exceed 9 sec.

6. **Response characteristics of AUTO HI**

   If rains and the wiper should be operated from 0 to AUTO HI, rain sensor's high speed demand signal output period does not exceed 9 sec.

7. **Response characteristics when shifting from AUTO LO to AUTO HI**

   If rains and wiper operation changes from AUTO LO to AUTO HI, rain sensor's high speed demand signal output period does not exceed 9 sec.

8. **Response characteristics when shifting from AUTO HI to OFF**

   If rains and wiper operation changes from AUTO HI to 0, the system counts wiping times when it is high and low (12-time) and when it is changing from INT to OFF (7-time) not to exceed 19 times in total.

9. Instant wipe

When wiper system is operated by wiper switch, it wipes windshield once before returning to operation position. This one-time operation happens every time when wiper switch is operated to increase the sensitivity by changing INT volume from lower state (state 1) to higher stage. However, it does not happen when wiper switch is changed into lower sensitivity. If ignition switch is turned ON when ignition switch is turned off and wiper switch is set to a certain sensitivity, wiper operates once immediately to notice the driver wiper system operation. If rain is too small to operate the wiper system with AUTO mode, rain sensor remains in AUTO INT mode for long time.

▶ Rain Sensor Unit Inspection

Checking sensitivity selection (checking variable resistance knob position)

Check that variable resistance knob on multi-function switch is in middle position (between S and F).

When knob is located on F (Fast) or S (Slow), the sensitivity is too high or low so can cause customer's complaint if he/she does not know correct usage.

Self-diagnosis

1. Rain sensor has below 2 self-diagnosis test modes.
   1) Fault A self-diagnosis

      If rain sensor servo operation point exceeds the value determined by software, the sensor is in Fault A. It happens when the portion of the windshield with coupler is damaged or sensor is removed from coupler.
   2) Fault B self-diagnosis

      If rain sensor does not respond to rain signal, it means Fault B. It happens when the portion of the windshield with coupler is damaged or sensor is defective.
2. Adhesion value

   When Fault A is detected, adhesion value will be determined. Adhesion value is 140. In this case, windshield operates under every condition if not damaged severely.
3. Malfunctions when INT volume sensitivity has adjusted

   Self-diagnosing methods based on sensitivity adjustment and wiper movement are as below.
   1) Set INT volume sensitivity to stage 5 (fast) under ignition ON and wiper switch AUTO position.
   2) Change sensitivity from stage 5 to 4 under above conditions.
   3) If wiper operates once, it is Fault A self-diagnosis. Check that windshield has damaged or sensor is installed on the coupler completely from service shop.
   4) After checking above 3), change sensitivity from stage 4 to 3 (medium).
   5) If wiper operates once, it is Fault B self-diagnosis and replace rain sensor with new.

Wiper blade

Check wiper blade for wear. If worn excessively and cannot clean sensor portion, the sensor cannot detect rain volume correctly.

Coupler

Check coupler surface on the windshield for excessive bubbles. If there are bubbles inside of sensor, cannot sense correctly. Also check coupler for correct position. Check that sensor portion of the coupler is locating inside of opening space on ceramic coating section on the windshield. If sensing portion is covered by ceramic coating, infrared rays from sensor cannot transmitted so cannot sense correctly.

Windshield

Check outer surface of windshield on sensing space for excessive wear, scratch or damage. To a certain degree, the sensor compensate for that wear but if excessive, cannot sense correctly. To check it, use self-diagnosis function.

Outer cover

Check the state of rain sensor outer cover. Check whether fixing portion of the cover has loosened and moving so that damaging sensor.

And also check whether there are interferences with windshield and head lining.

Spring clip

To check whether the rain sensor has separated from coupler, remove the outer cover and check spring clip state.

Connector

Check close connection between connector terminal and wiring and then locking when terminal is inserted into connector correctly.

And check connection between wiring connector and rain sensor connector not to cause poor connection.

Relay

Check wiper low speed relay and wiper high speed relay for normal operation. When the relay is blown, wiper motor cannot be operated so the wiper blade does not respond in AUTO mode.

Circuit

Check circuit. Especially check whether variable resistance of multi-function switch inputs normally. To check it, wiper motor should operate once every time when the variable resistance knob on the multi-function switch has rotated from slow to fast by stage (It is called instant wipe). Also check whether correct position signal of the wiper motor inputs correctly. If there is no correct position signal, wiper motor can be operated more fast than normal and wiper motor intermittent speed changing point can be incorrect so the wiper motor does not operate normally.

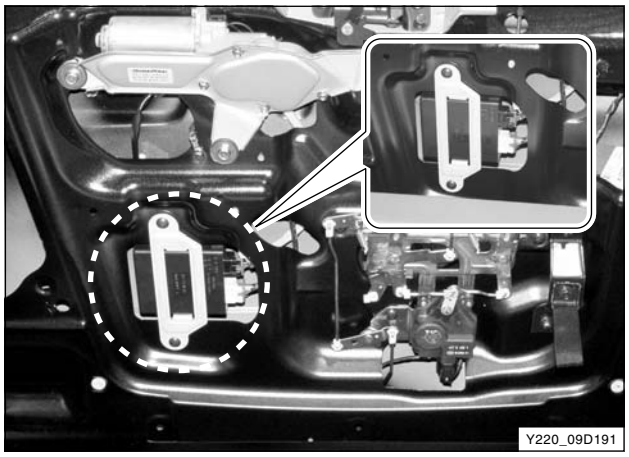
Cautions when removing rain sensor unit

1. ***Remove outer cover. If remove forcefully, coupler fixing hook can be damaged. When removing, pry off fixing hook outer with small "–" driver through hole on the cover.***
2. ***To remove rain sensor from coupler, open spring clip with small "–" driver.***
3. ***Disconnect wiring connector from sensor.***

▶ Rear Wiper Control System

General

Conventional rear wiper system is controlled when rear wiper relay is operated by operating switch. However, rear wiper system on Rexton is controlled by separate ECU. The reason is that the conventional vehicle has rear wiper brush on the rear glass but the Rexton can open the rear glass so cannot install rear wiper brush on the rear glass. The rear wiper brush is installed on the back panel and the wiper motor is operated in 2 stages.



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▶ Description on System Operation

Wiping mode

1. Wiper switch is turned on, relay 1 on CONT turns on to rotate the motor clockwise.
2. When "W" and "C" points on the CAM switch are connected during revolution, relay 1 on CONT turns off and then relay 2 turns on to rotate the motor counterclockwise.
3. If "W" and "C" points on the CAM switch are connected during revolution again, relay 2 on CONT turns off and then relay 1 turns on to rotate the motor clockwise. It means by changing motor polarities between 2 and 4 with CAM switch, the wiper operates.

Parking mode operation

1. Parking while operating clockwise: If turns off wiper switch during wiper operation, "W" and "C" points on the CAM switch are connected during revolution, then relay 1 on CONT turns off to stop the motor. After 1 second, relay 1 on CONT turns on to rotate the motor clockwise and then "P" and "C" grounds on the CAM switch are connected to turn off relay 1 on CONT and to stop motor.
2. Parking while operating counterclockwise: If turns off wiper switch during wiper operation, "W" and "C" points on the CAM switch are connected with ground during revolution, then relay 2 on CONT turns off to stop the motor. After 1 second, relay 2 on CONT turns on to rotate the motor counterclockwise and then "P" and "C" grounds on the CAM switch are connected to turn off relay 2 on CONT and to stop motor.

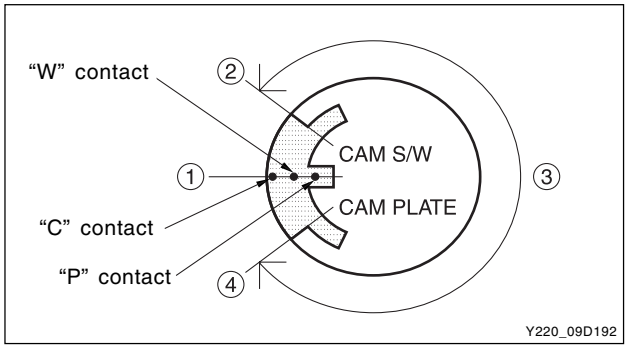
Washer mode operation

When washer switch is turned on for over 0.5 sec., wiper mode operates 2 times and then performs parking mode operation to stop motor.

However, when washer switch is turned on for less than 0.5 sec., wiper motor does not operate.

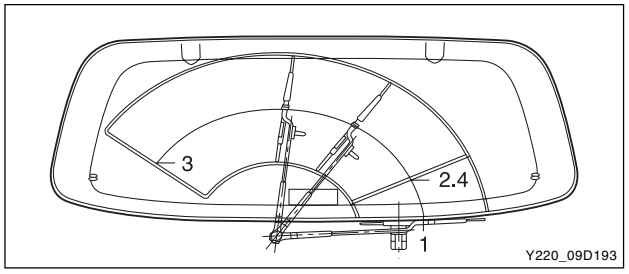
Limit switch ON mode operation

1. Limit switch ON during wiper operation: If turn on limit switch during wiper operation, returns to parking position immediately to stop the motor.
2. Limit switch ON under parking position: Even when the wiper switch or INT switch is turned on, the motor does not operate.



(1) position: park position

(2), (4) positions: reversing positions



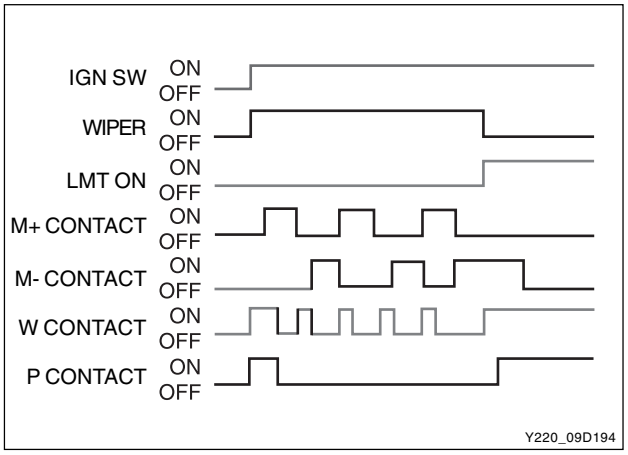
System operation description

1. If turn on motor operation switch, relay 1 on controller turns on to rotate the motor clockwise (operation order: (1) → (2) → (3) → (4))
2. When "W" and "C" points on the CAM switch are connected during revolution, relay 2 on controller turns off and relay 1 on controller turns on to rotate the motor clockwise. It means by changing motor polarities between wiping ranges with CAM switch, the wiper operates. (operation order: reciprocates (2) → (3) → (4) → (3) → (2))
3. DSP angle means angle between (1) and (2) or (1) and (4).
4. If rotates from (3) to (4) in clockwise, the motor parks in position (1). If rotates from (3) to (2) in counterclockwise, the motor parks in position (1).

   It means when motor is in park position, "W", "C" and "P" points are in a line as shown in below.

Washer coupled mode

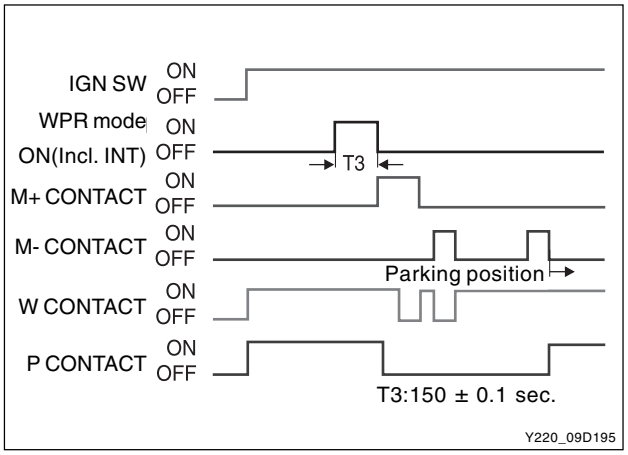
1. When wiper switch is turned on for over 0.6 sec. under ignition switch on condition, washer coupled wiper output comes on.
2. When washer switch is turned off, wiper mode operation will be performed 2 times and then return to parking position.
3. Wiper motor output works same as the wiper operation mode.



Limit switch ON/OFF mode operation

1. If turn on limit switch while wiper motor is operating under ignition switch on condition, returns to parking position without delay to stop the motor.
2. Under limit switch on condition, wiper motor output control will be stopped.

   (It is to control the wiper blade not to be blocked by rear glass when opened.)



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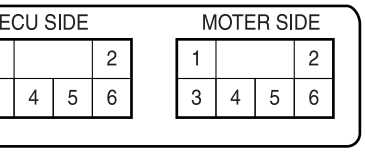
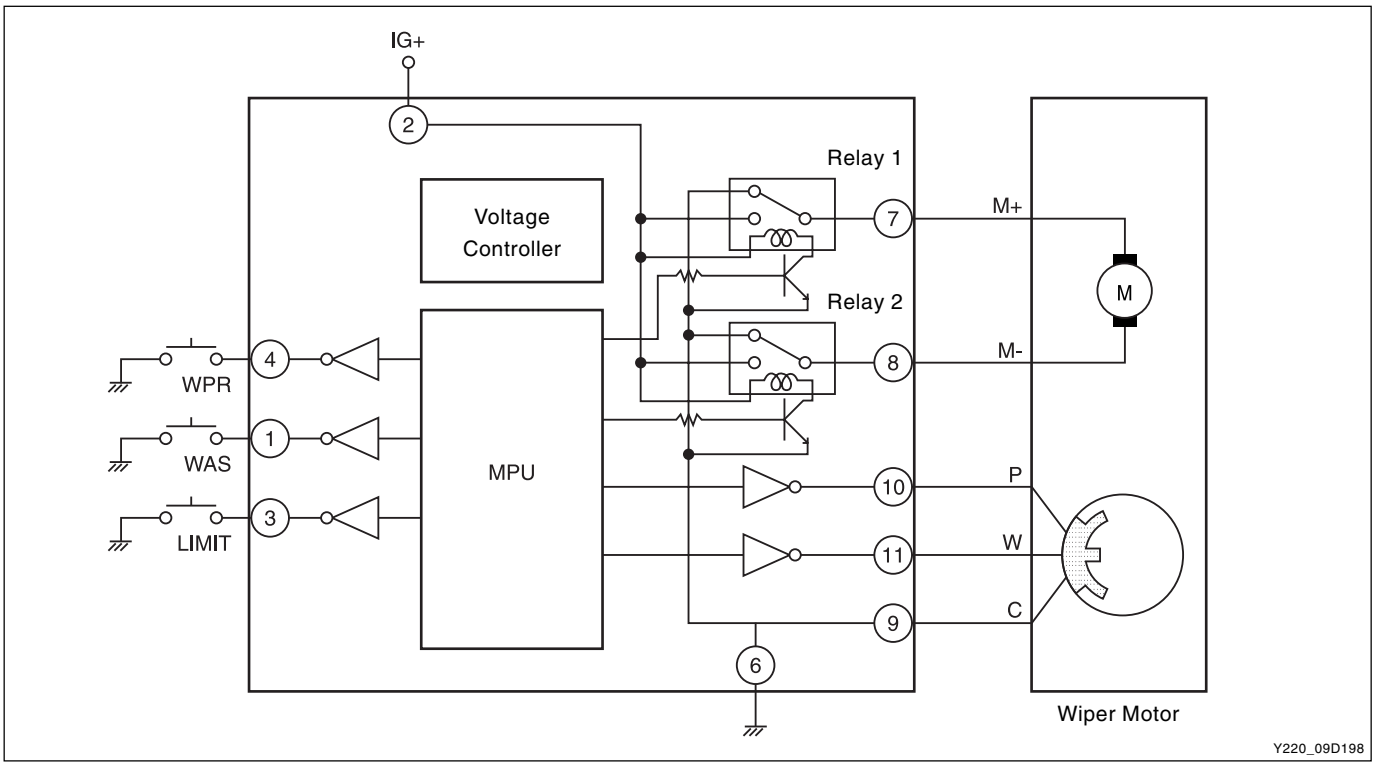
▶ Specifications

Item			Specification
Motor	Rated voltage		DC 12 V ± 0.3 V
	Test voltage		DC 13.5 ± 0.3 V
	Operating voltage range		DC 10 ~ 15 V
	Min. operation voltage		Below DC 8 V
	Insulation resistance		Over 500 V mega 1 M
	Lock test	Torque	Over 1.1 Km
		Current	Below 14 A
	Operating temperature range		- 40°C ~ + 80°C
Control	Rated voltage		DC 12 V
	Operating voltage range		DC 9 ~ 16 V
	Operating temperature range		- 30°C ~ + 80°C
	Storage temperature range		- 40°C ~ + 90°C
	Insulation resistance		Over 1 M
	Voltage drop		Below 0.5 V (Load current between terminals 5-7, 6-8, 5-8 and 6-7 at 5 A)
	Test voltage		14.0 ± 0.5 A
	Allowable load current		Max. 10 A



▶ Circuit Diagram



AUTO LIGHT SYSTEM

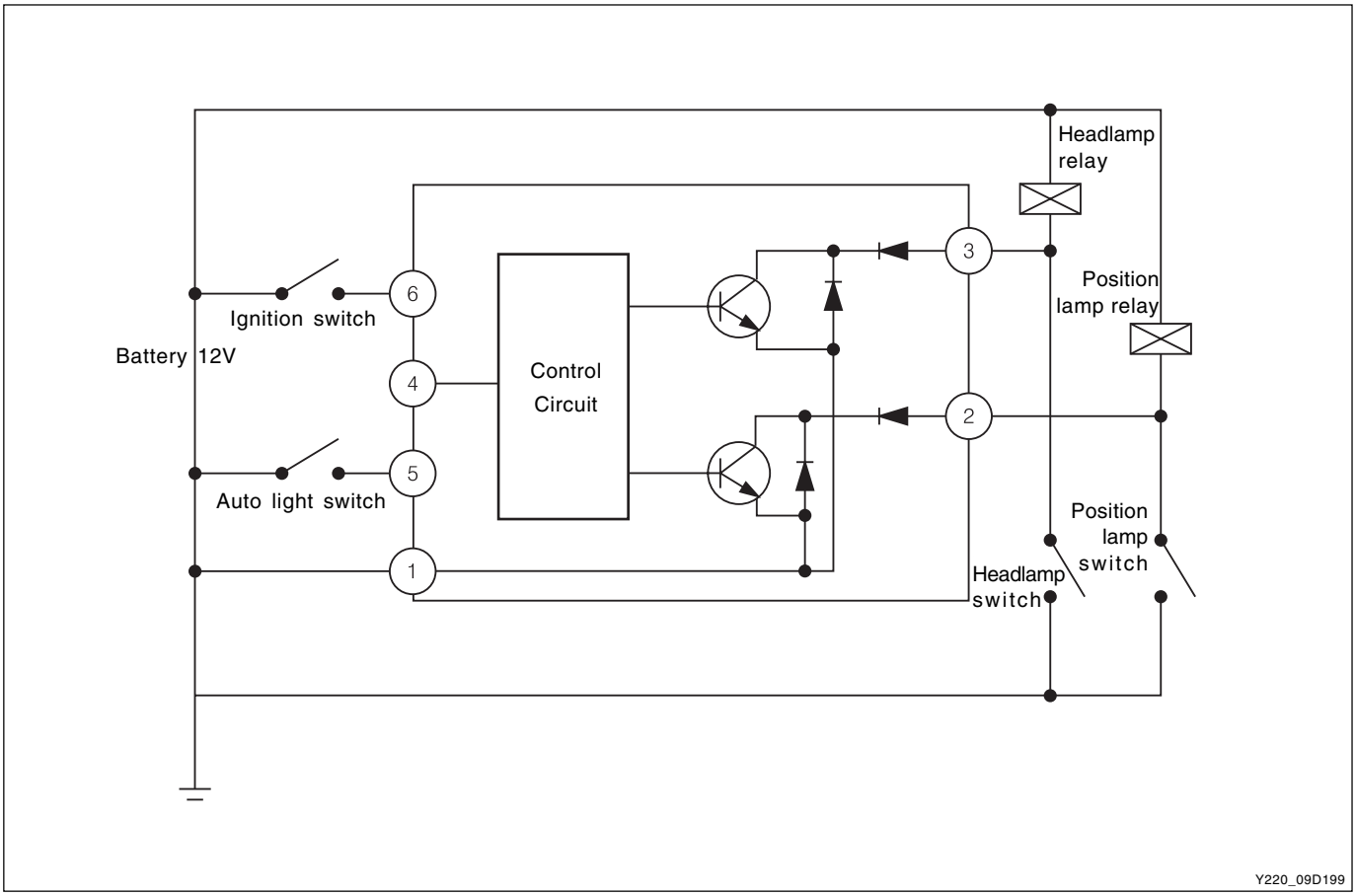
▶ Overview

Auto light control is a system that turns on/off position lamps and headlamps automatically. Auto light sensor unit on the instrument panel upper (passenger) detects surrounding brightness and then turns on or off position lamps and headlamps automatically if light switch is in AUTO mode even when the driver does not operate light switch. If enters tunnel during day driving or gets dark due to fog, rain or snow, it also operates.

▶ Specifications

Item	Specifications	
Auto light sensor unit	Operating voltage	9 ~ 16 V
	Load	Max. 200 mA of relay load
	Operating temperature	- 30 ~ + 85°C
	Storage temperature	- 40 ~ + 120°C
	Installation position	Interior IP upper right (Passenger)

▶ Input/Output Diagram



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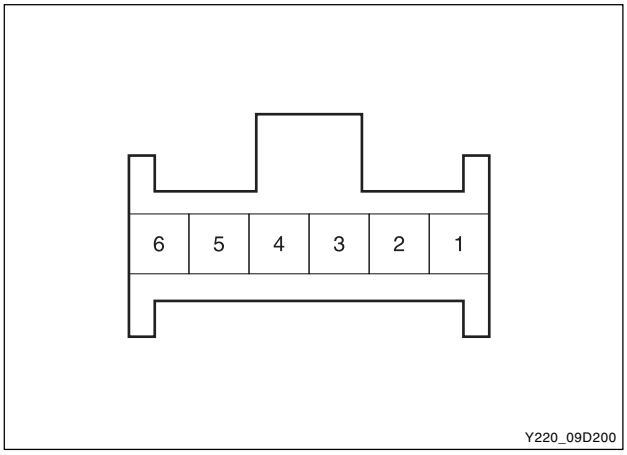


▶ Auto Light Sensor Unit Terminal

1. System power supply
2. Auto light switch
3. Reserved
4. Headlamp relay
5. Position lamp relay
6. System ground

▶ Auto Light Operation and Turning on Condition

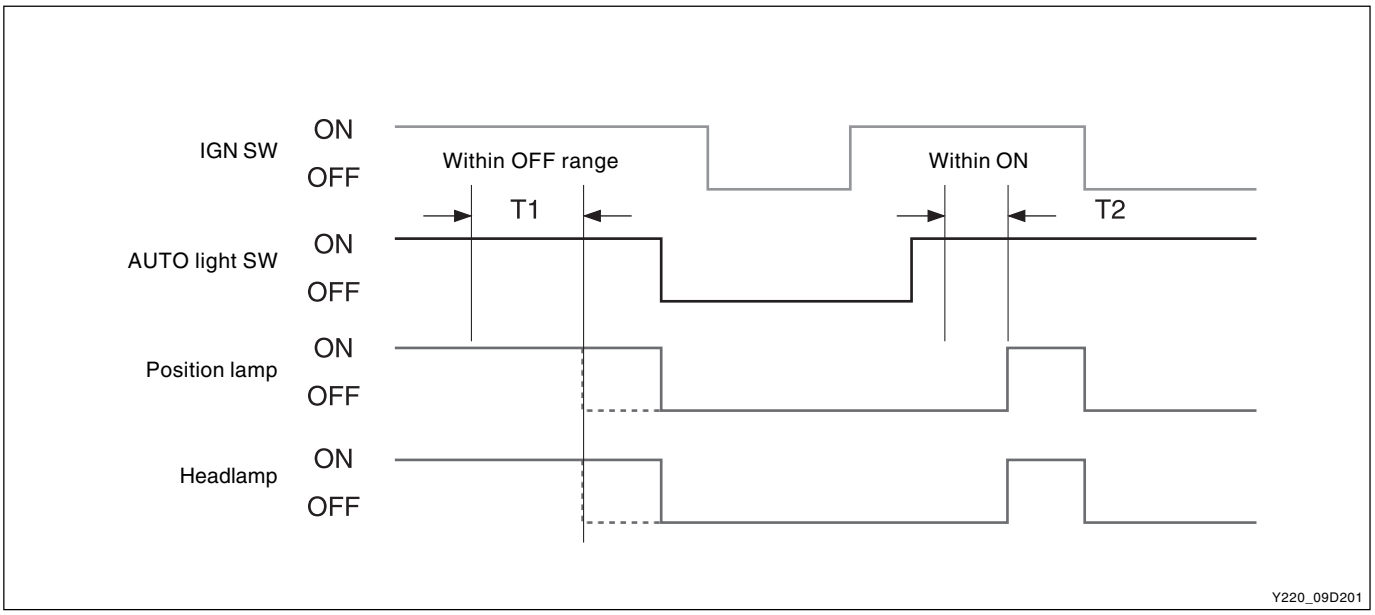
Switch operations by function

1. Turn on the ignition switch and operate the multi-function switch in the order of OFF → position lamp → headlamp → AUTO → switch.
2. Turn on/off the position lamp, headlamp and switch.
3. Turn on the AUTO switch. At this moment, position lamps and headlamps come on automatically if brightness of light that reflected on the photodiode in the auto light sensor unit is the same as voltage that set by software in CPU.
4. If operate position lamp and headlamp switch manually again, the lamps turn on/off according to switch operations not by brightness of light that detected by sensor.
5. When ignition switch is removed, position lamps and headlamps turn off.

Turning on conditions

Lamp / Brightness	Position lamp ON condition	Headlamp ON condition	Operation delay time
For ON	30.5 ± 5 (LUX)	8.9 ± 3 (LUX)	0.5 ± 0.1 sec.
For OFF	60.5 ± 5 (LUX)	17.2 ± 3(LUX)	3 ± 1 sec.

▶ Operational Characteristics



However, the condition is position lamp and headlamp are within ON and OFF ranges.

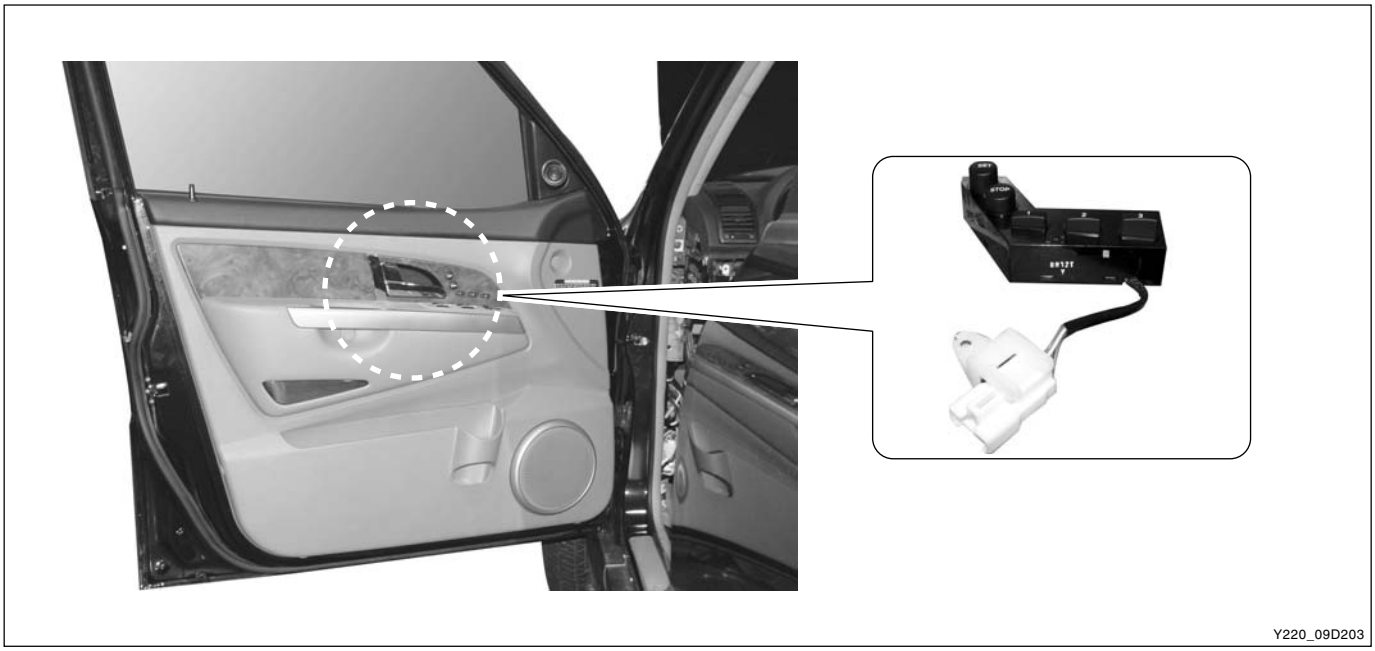
T1: 3 ± 1.0 sec T2: 500 ± 100 msec

▶ Inspection

Locate the multi-function switch to AUTO position and cover the auto light sensor on the upper instrument panel (in front of passenger seat) with cloth or so to block the light coming from outside and then check for normal operation.

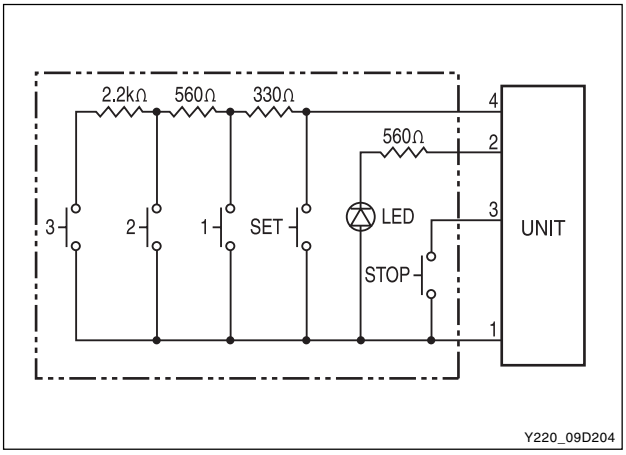
SEAT MEMORY SWITCH

SEAT POSITION MEMORY SETTING AND OPERATION



1. “SET” switch
2. “STOP” switch
3. Position (1, 2, 3) switch

Up to 3 different drivers, the memory setting of seat position is available. Each driver can set his/her own driver’s seat and outside rearview mirrors positions and it will be stored in the computer. Even if someone have moved your seat and outside rearview mirrors, the memory positions will be recalled automatically by pressing the position button.



▶ Storing Memory Settings

1. Place the selector lever in “P” (automatic transmission) or “N” (manual transmission) position, and apply the parking brake with the ignition switch “ON”.
2. Adjust the driver’s seat and outside rearview mirrors.
3. Press the “SET” button. Indicating light on the button will come on and beep sounds.
4. Within five seconds, press button you want among 1, 2 or 3 of the position buttons. Adjusted positions will be stored in the computer with “Beep” sound.

▶ Operating Memory Settings

1. Place the selector lever in “P” (automatic transmission) or “N” (manual transmission) position, and apply the parking brake with the ignition switch “ON”.
2. Keep the position button pushed (for more than 1.5 second) until driver’s seat and outside rearview mirrors start to move.
3. If pressing the button, driver’s seat and outside rearview mirrors will be recalled automatically to the memory positions.

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FUNCTION DESCRIPTION

▶ Seat Position and Warmer Unit

This unit is installed under the driver's seat and functions as follows:

- Memory return of driver's and passenger's seat
- Memory return of outside rearview mirror
- Warming up the driver's and passenger's seat
- Folding the outside mirrors

▶ Specifications

Description		Operating Range	Operating Condition
Seat	Slide	228 ± 3mm	Operating regardless of ignition switch positions
	Recline	23° ↔ 0° ↔ 48°	
	Lift (front/rear)	30 ± 3	
	Warmer (driver's/ passenger's)	40 ± 5°C	Operating with ignition switch "ON"
Outside rearview mirror	Up/Down	± 8°	
	Left/Right	± 8°	
	Folding	± 67°	30 seconds delayed operation after turning the ignition switch to "OFF"

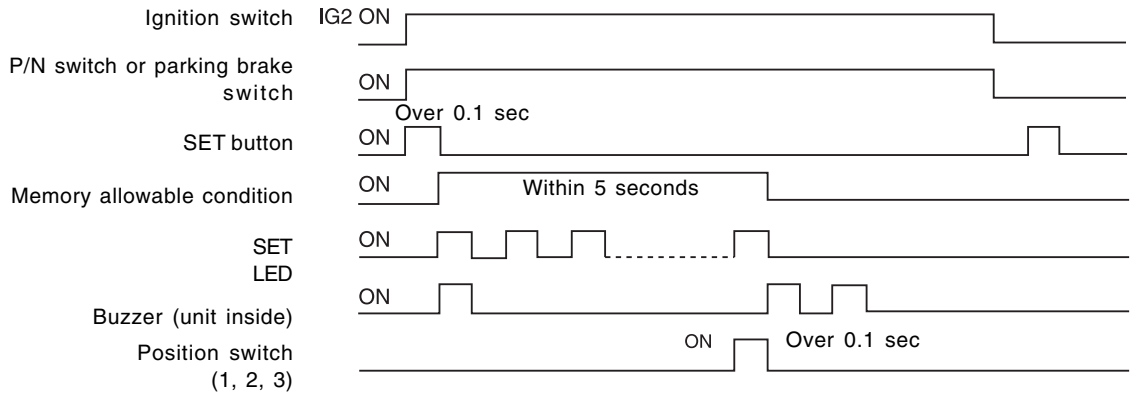
▶ Memory Setting

Description		Memory Procedure	Memory Setting
Seat	Slide	1. IGN "ON" 2. P/N SW "ON" or Parking SW "ON" 3. Pressing the setting button for over 0.1 second (buzzer sounds once) 4. Pressing a position button (1, 2, 3) within 5 seconds 5. Indicator blinks for setting period (5 seconds) and buzzer sounds twice at end of operation	- 5 seconds after pressing set button - Manually operating the seat or outside rearview mirror switch - GN "OFF" - When canceled by manual operation, buzzer sounds 5 times and able to set 5 seconds after then
	Recline		
	Lift (front/rear)		
Outside rearview mirror	Up/Down		
	Left/Right		

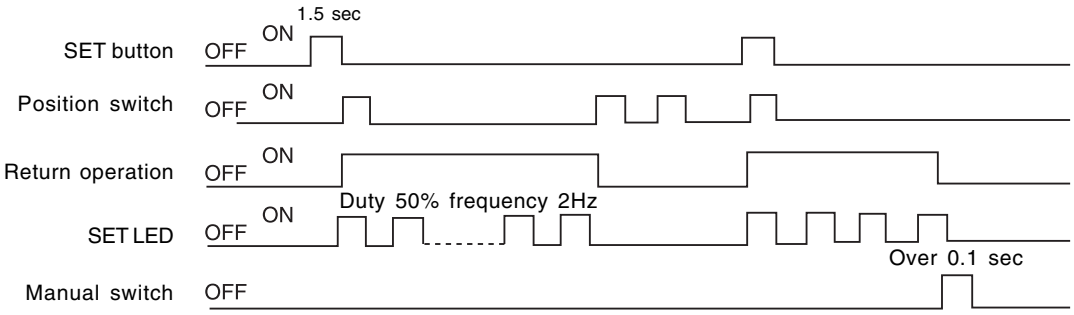
▶ Memory Return

Item	Description
Operating procedure	1. Ignition key "ON" 2. P/N switch "ON" or Parking switch "ON" 3. Vehicle stationary (vehicle speed 0 km/h) 4. Operating a position button (1, 2, 3) for over 1.5 seconds
Input another condition during memory recall operation	- When pressing a position button (1, 2, 3) again, the latest input value is recalled - When pressing the stop button or operating manually, the memory recall operation is immediately stops

Storing Memory

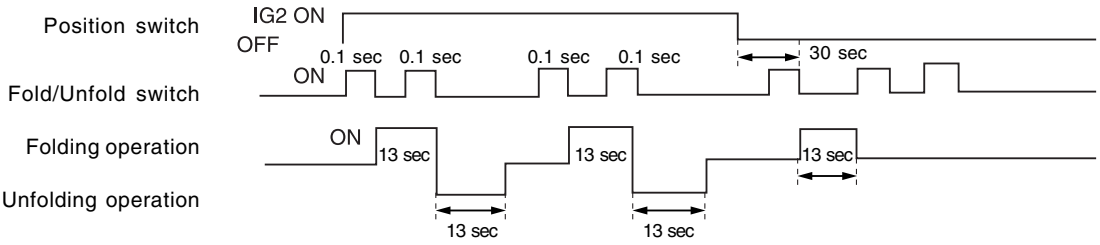


Memory Return

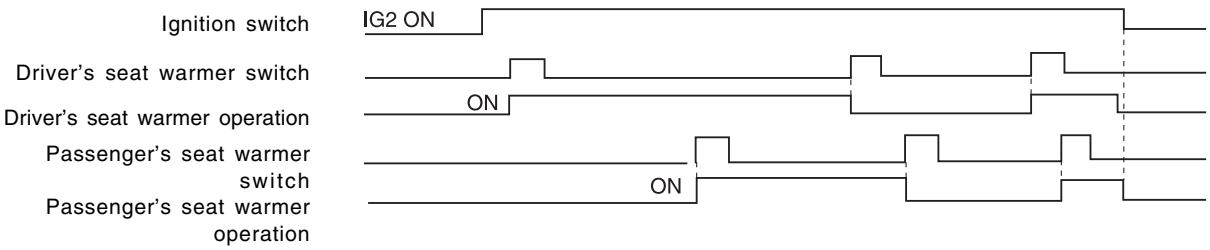


* Manual switch: power seat switch, STOP switch, outside rearview mirror switch

Outside Rearview Mirror Folding/Unfolding



Seat Warmer



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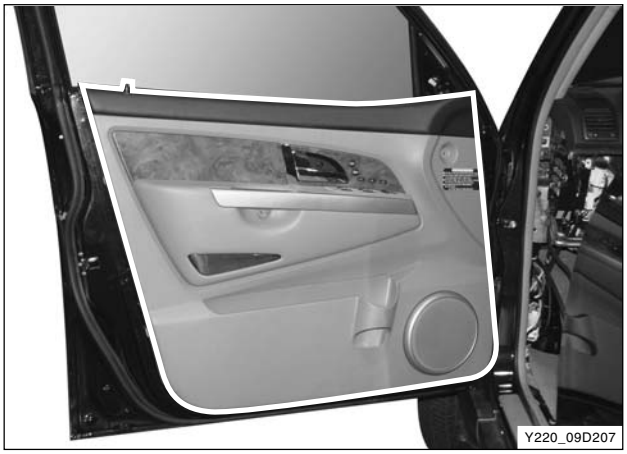
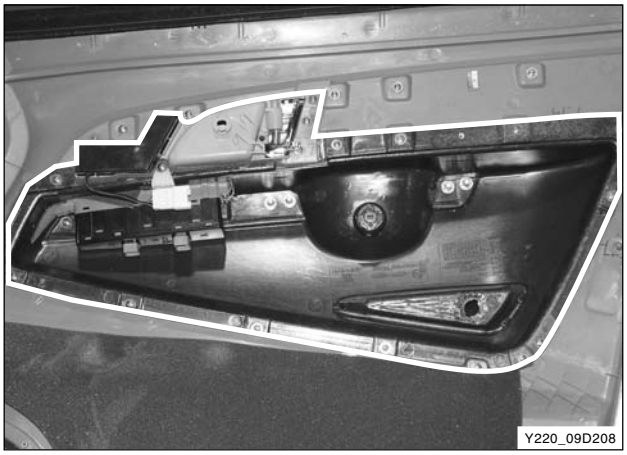

Y220_09D207

Removal and Installation

1. Disconnect the negative battery cable.
2. Remove the driver's door panel.


Y220_09D208

3. Unscrew the switch mounting screws from the door panel.

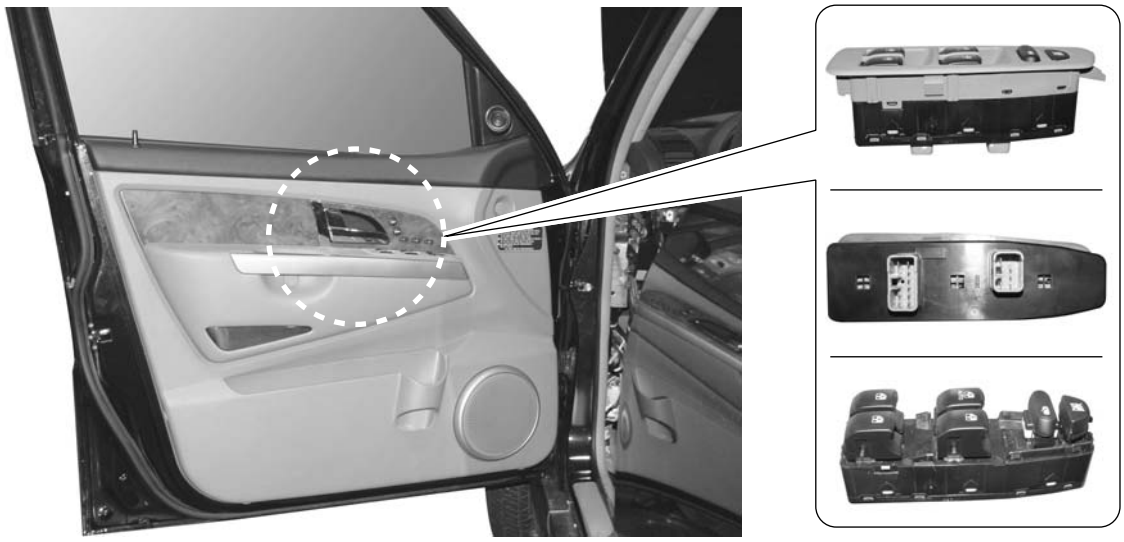
Y220_09D209

4. Remove the memory switch.
5. Install in the reverse order of removal.

WINDOW SWITCH

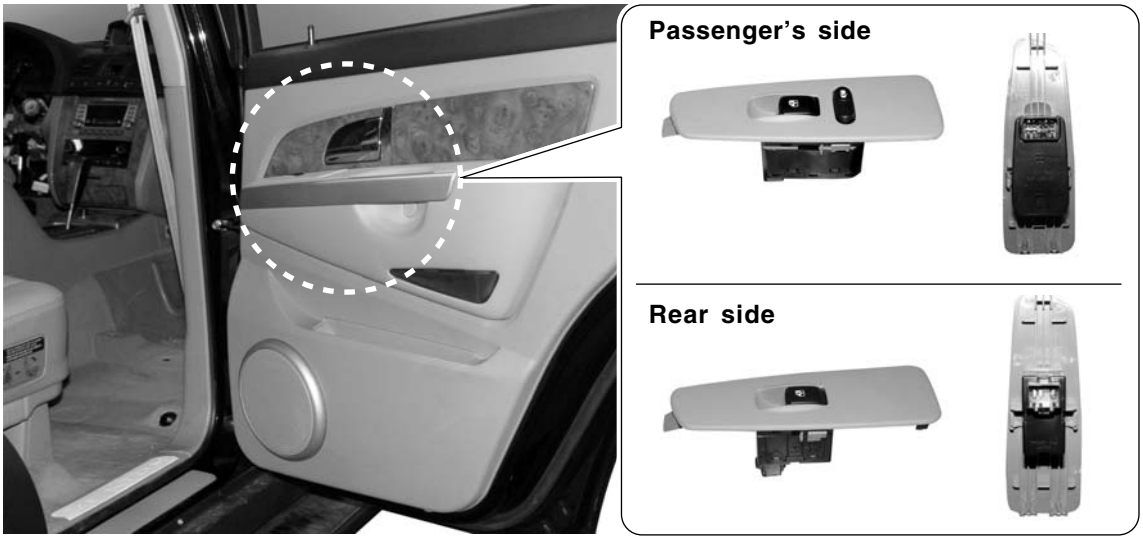
SYSTEM LAYOUT

▶ Front (Driver's) Window Switch



Y220_09D210

▶ Passenger's/Rear Window Switch



Y220_09D211

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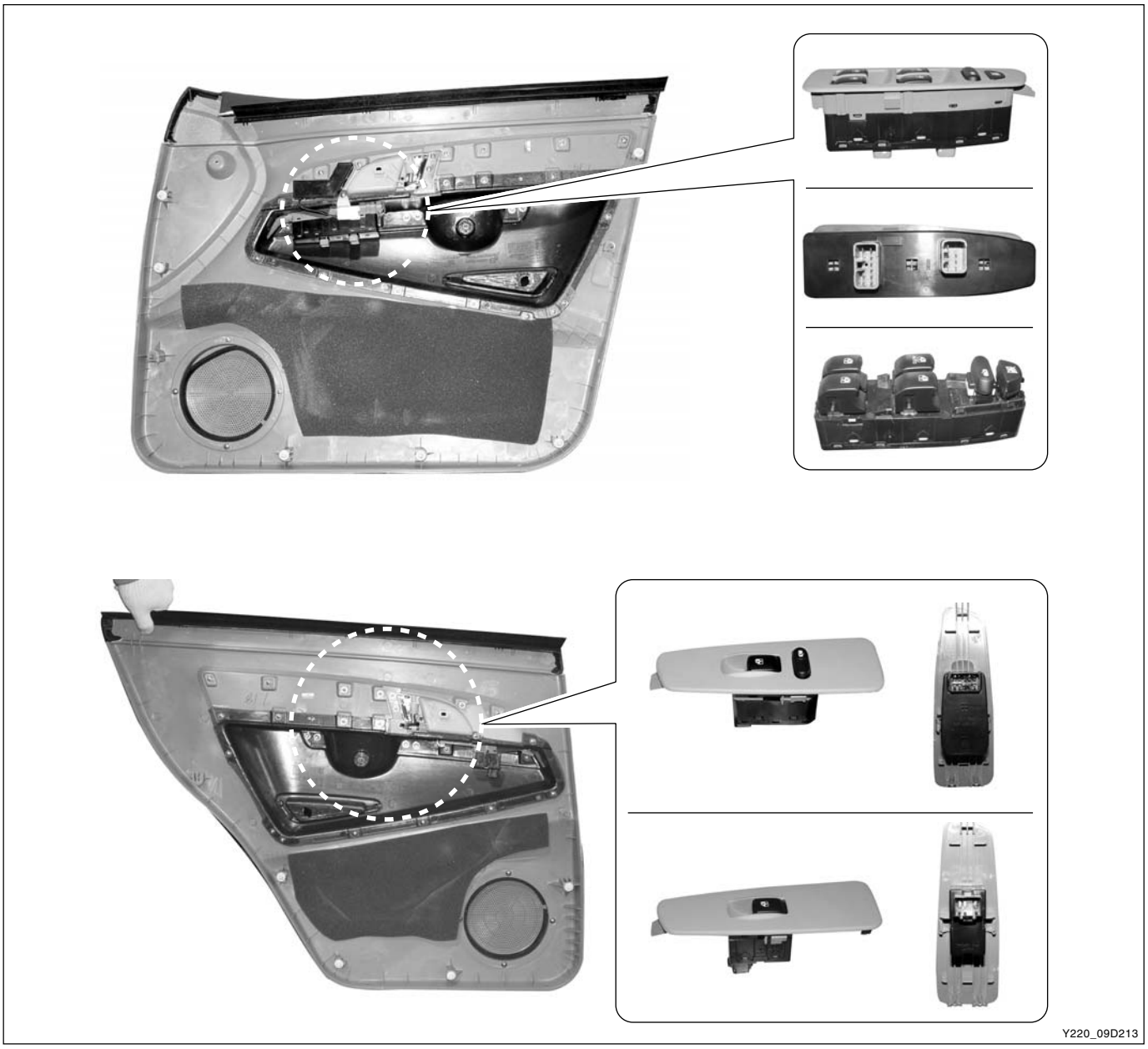
Y220_09D212

Removal and Installation

1. Remove the door panel.
2. Unscrew the switch mounting screws and remove the switch.
3. Install in the reverse order of removal.


Y220_09D213

SECTION 9G

LAMPS

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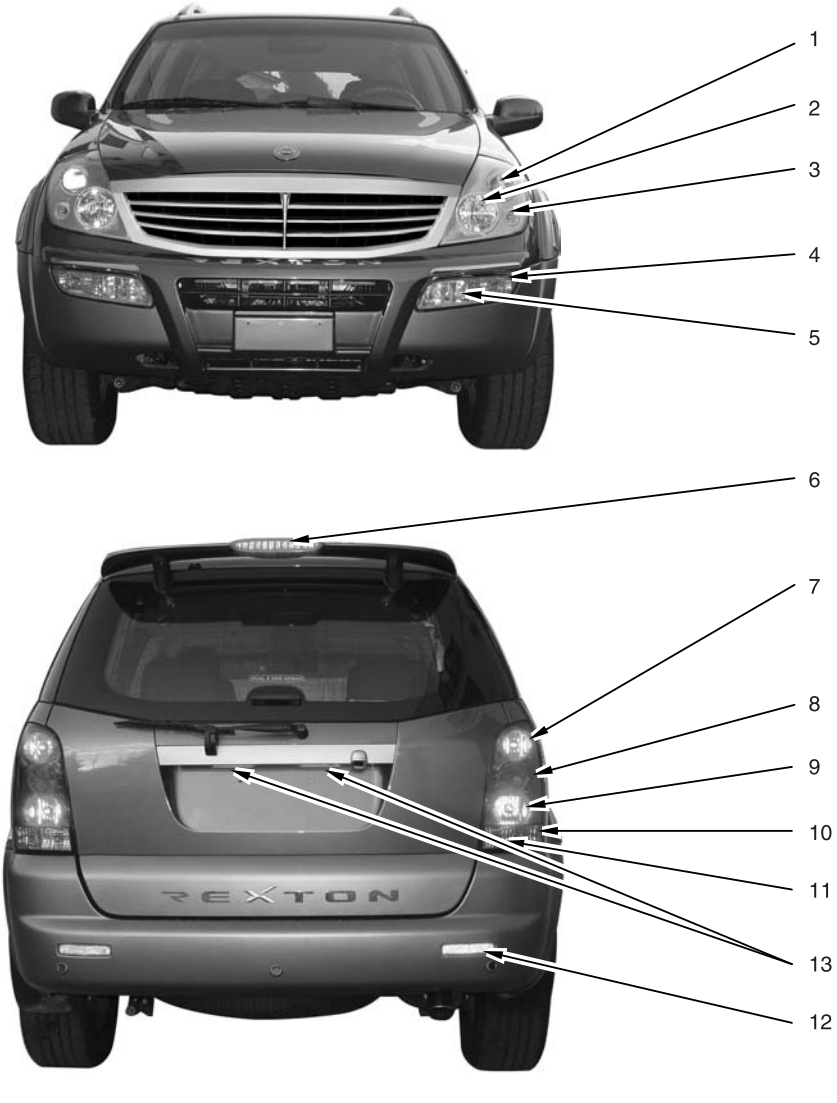
LAMP LOCATIONS

EXTERIOR LAMPS



Y220_09G325

1. Headlamp - Low beam
2. Headlamp - High beam
3. Clearance lamp
4. Turn signal lamp
5. Fog lamp
6. High mounted stop lamp
7. Tail and stop lamp
8. Tail lamp
9. Stop lamp
10. Turn signal lamp
11. Back-up lamp
12. Rear deflector
13. License plate lamp

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SPECIFICATIONS

Description		Specification	Description		Specification
Headlamp	Low beam	55W x 1	Rear combination lamp	Back-up lamp	27W x 1
	High beam	55W x 1	Deflector	Rear	-
	Clearance lamp	5W x 2	License plate lamp	License plate lamp	5W x 2
Front combination lamp	Fog lamp	27W (H27W)	Interior	Glove box	10W x 1
	Turn signal lamp	28/8W		Front room lamp	8W x 2
Rear	High mounted stop lamp	5W x 4		Center room lamp	10W x 2
Rear combination lamp	Tail/Stop	27/8W x 1		Door lamp	5W x 4
	Tail lamp	8W x 1		Vanity mirror lamp	
	Stop lamp	27W x 1	Side turn signal lamp	Turn signal lamp	5W x 1
	Turn signal lamp	27W x 1			

MAINTENANCE AND ADJUSTMENT

HEADLAMP AIMING

An approved beam setting device should be used for a correct headlamp aiming.

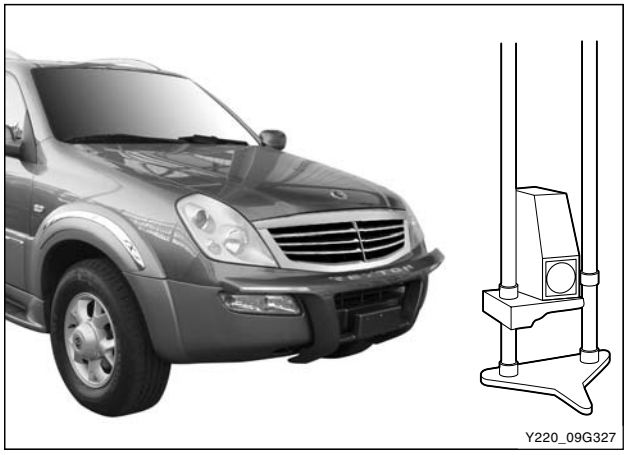
Make sure to follow the operating instructions provided by the manufacturer.

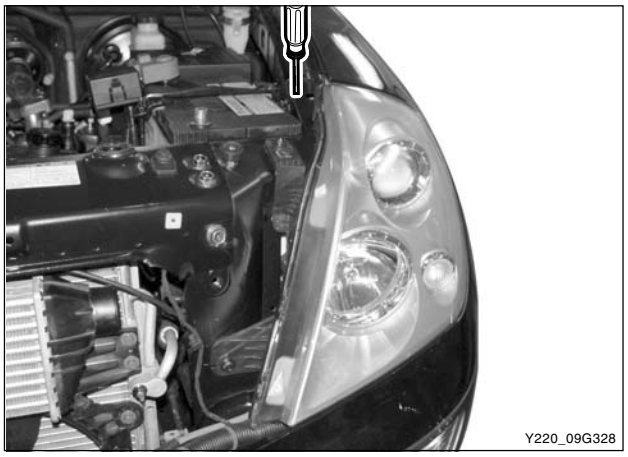
Headlamp aiming requirements: parking on a flat surface specified tire pressure, one passenger (driver, 65 kg), spare tire loaded, OVM tools loaded (unlade all other loads)

If not available to use the beam setting device, adjust the headlamp aiming with a screen.

▶ When Using a Beam Setting Device

1. Arrange the vehicle and beam setting device according to the operating instructions provided by the manufacturer.
2. Adjust the headlamp aiming by turning the direction control lever with a screwdriver.





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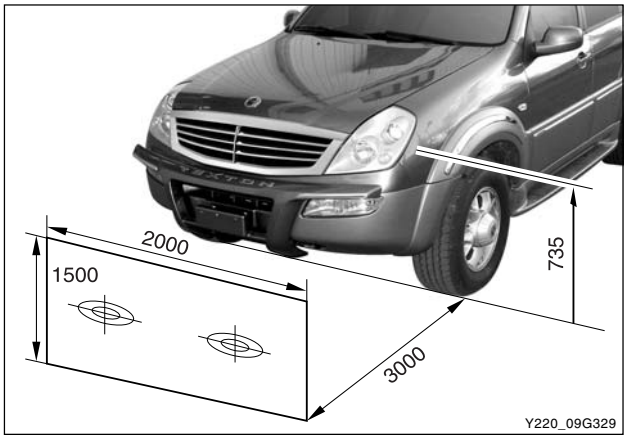
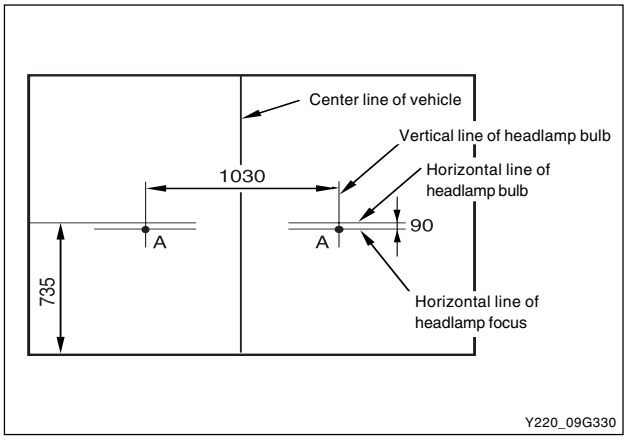
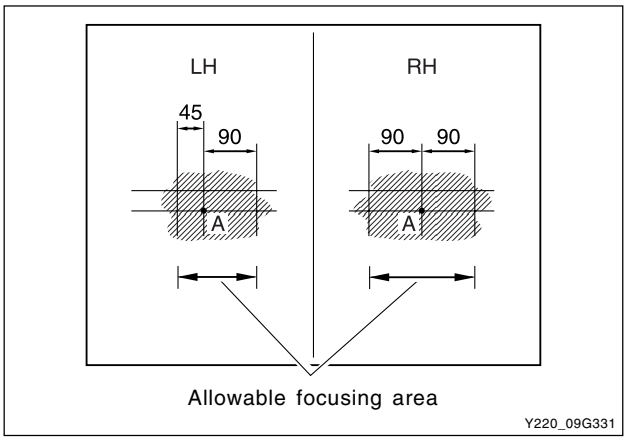


▶ When Using a Screen (unit: mm)

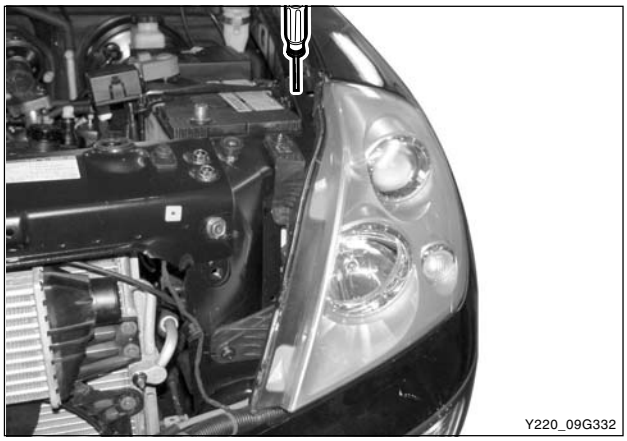
1. Install the screen (2 m x 1.5 m) in front of the headlamps by 3 meters and align the center lines of the vehicle and the screen.



2. Align the horizontal line through the headlamp center and the center line of the screen.

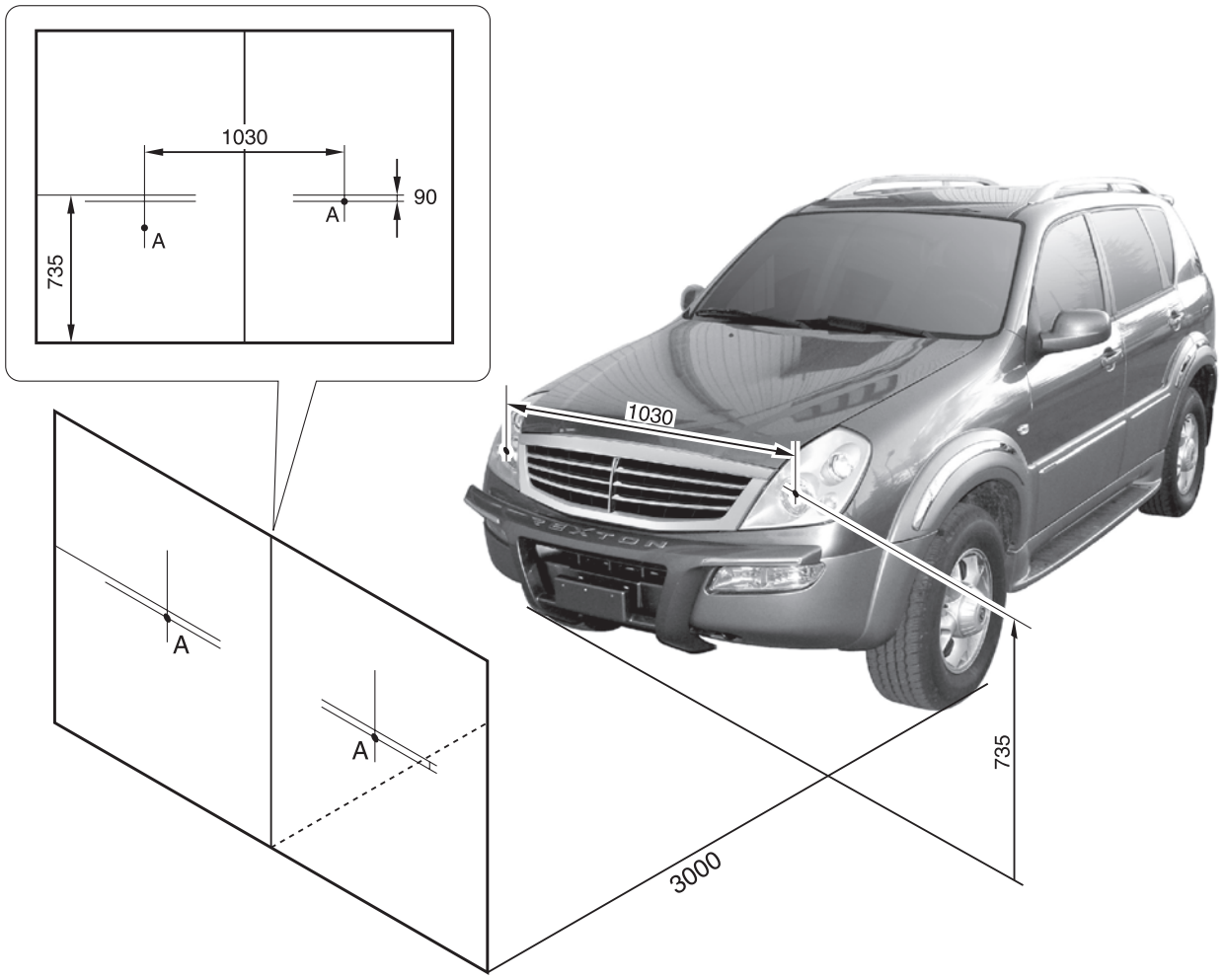


3. Run the engine with approx. 2,000 rpm and turn on the headlamp. At this moment, the focus of the headlamp should aim the “A” point.



4. If the focus deviates the “A” point, adjust the headlamp aiming by turning the direction control lever with a screwdriver.

MEASUREMENT OF HEADLAMP AIMING



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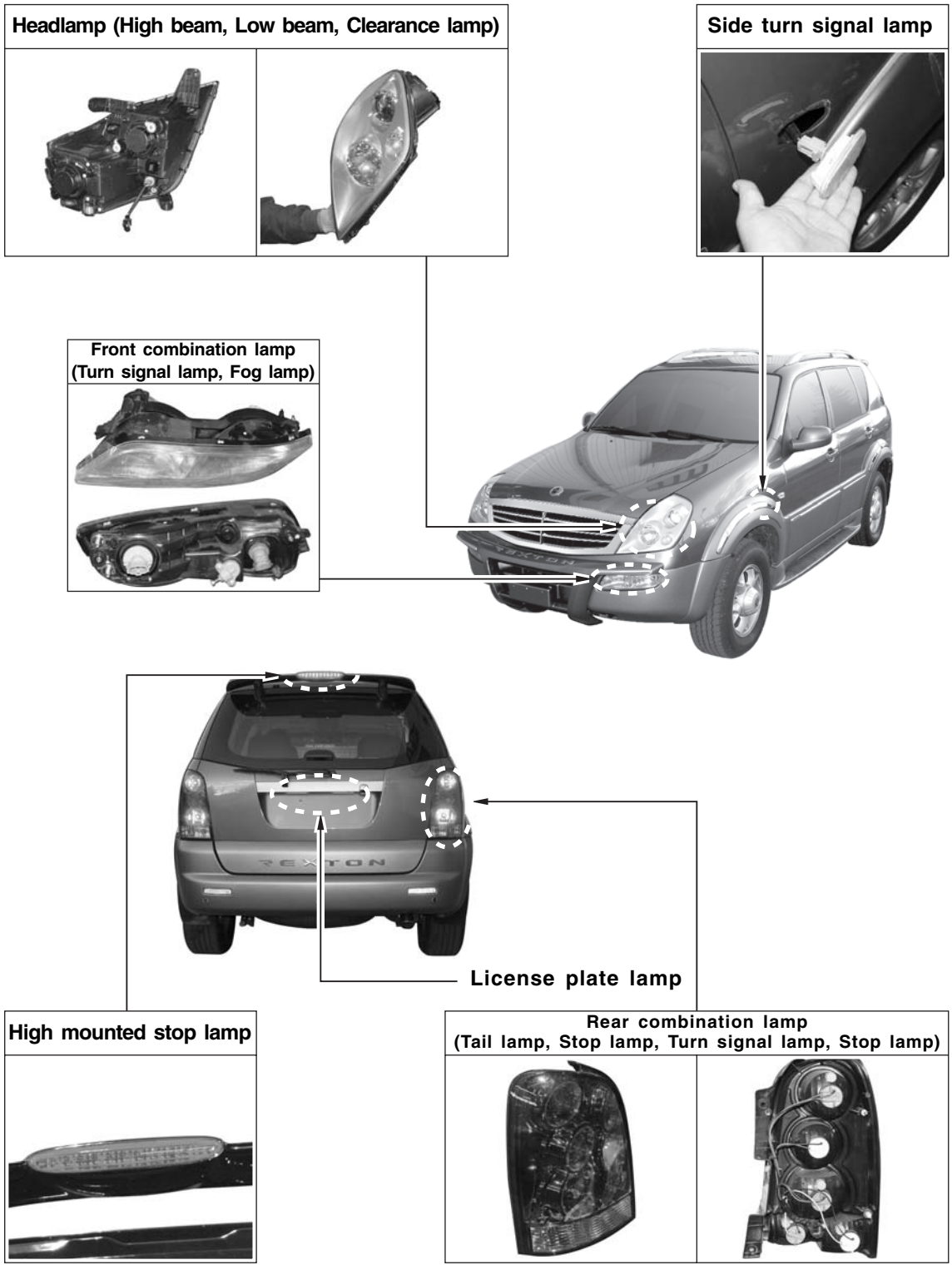
TROUBLE DIAGNOSIS

Symptom	Cause	Action
Inoperative one side lamp (all external lamps)	Burnt out bulb	Replace bulb
	Defective socket or wiring, or poor ground	Replace if needed
Inoperative headlamps	Burnt out bulb	Replace bulb
	Defective fusible link	Replace fusible link
	Defective headlamp relay	Check for relay
	Defective light switch	Check for switch
	Defective wiring or poor ground	Repair if needed
Inoperative tail lamp and license plate lamp	Burnt out fuse	Replace fuse and check for short
	Defective tail lamp fusible link	Replace fusible link
	Defective tail lamp relay	Check for relay
	Defective light switch	Check for switch
	Defective wiring or poor ground	Repair if needed
Inoperative stop lamp	Burnt out fuse	Replace fuse and check for short
	Defective stop lamp switch	Repair or replace switch
	Defective wiring or poor ground	Repair if needed
Cannot turn off stop lamp	Defective stop lamp relay	Replace relay
	Defective stop lamp switch	Repair or replace switch
Inoperative cluster illumination lamp (tail lamp “ON”)	Poor connection	Check for connection
	Defective wiring or poor ground	Repair if needed
Inoperative one side turn signal lamp	Burnt out bulb	Replace bulb
	Defective turn signal lamp switch	Check for switch
	Defective wiring or poor ground	Repair if needed
Inoperative turn signal lamp	Burnt out bulb	Replace fuse and check for short
	Defective flasher unit	
	Defective turn signal lamp switch	Check for switch
	Defective wiring or poor ground	Repair if needed
Inoperative hazard lamp	Burnt out fuse	Replace fuse and check for short
	Defective flasher unit	Check for flasher unit
	Defective hazard lamp switch	Check for switch
	Defective wiring or poor ground	Repair if needed
Too fast or slow flashing interval	Out of specifications of bulb	Replace bulb
	Burnt out bulb or poor connection	Check for bulb and connection
	Defective flasher unit	Replace flasher unit
Inoperative back-up lamp	Burnt out fuse	Replace fuse and check for short
	Defective back-up lamp switch	Check for switch
	Defective wiring or poor ground	Repair if needed
Inoperative overhead console box lamp	Burnt out fusible link	Replace fusible link
	Defective wiring or poor ground	Repair if needed

EXTERIOR LAMPS



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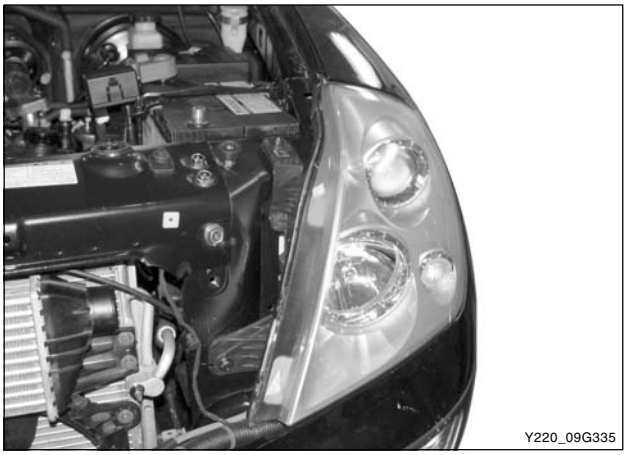
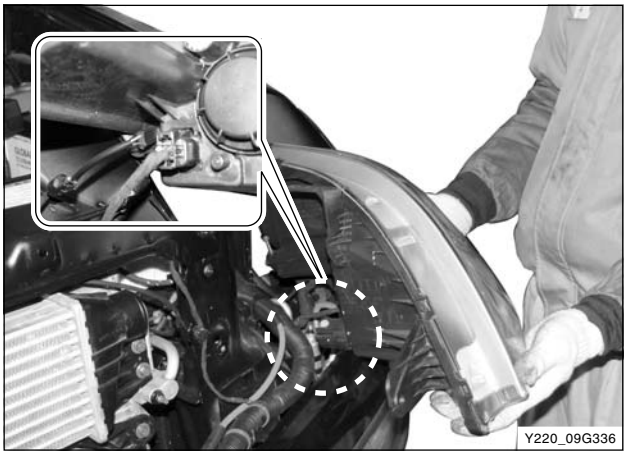


Headlamp - Removal and Installation

1. Disconnect the negative battery cable.
2. Remove the radiator grille.
3. Remove the headlamp mounting bolts.



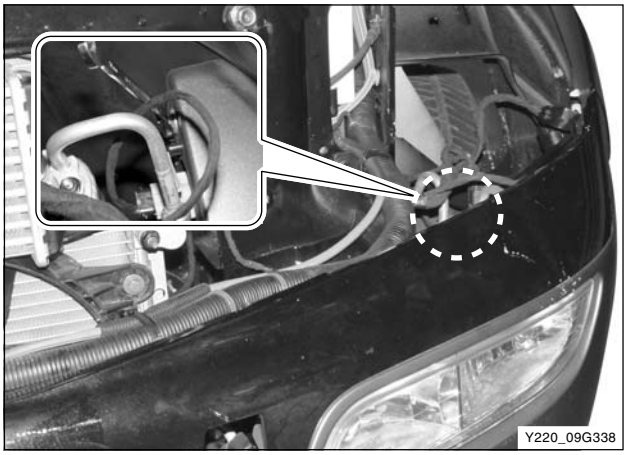
4. Disconnect the connector and remove the headlamp assembly.

5. Disassemble the bulb cover, connector and bulb.

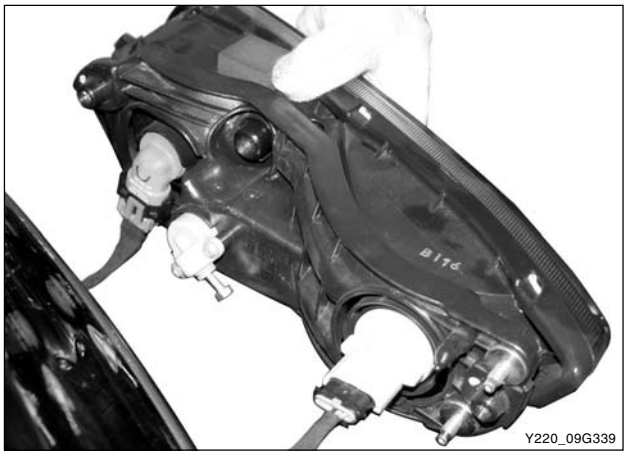
6. Install in the reverse order of removal.
   - After installation, align the headlamp aiming.

Front Turn Signal Lamp/Fog Lamp - Removal and Installation

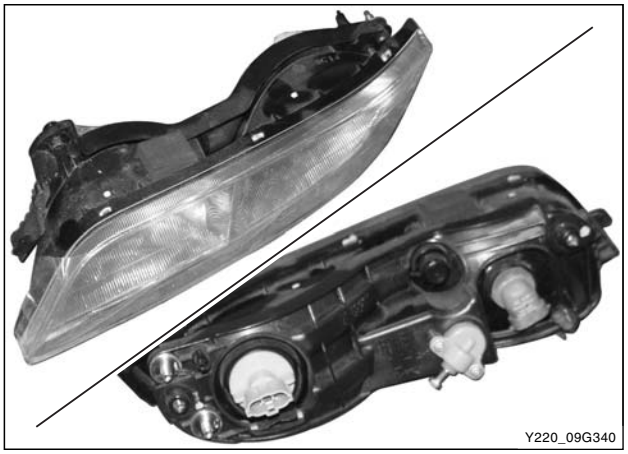
1. Disconnect the negative battery cable and remove the headlamp.
2. Unscrew the nuts and disconnect the lamp connectors (front turn signal lamp/fog lamp).



3. Remove the lamp assembly.



4. Install in the reverse order of removal.
   - Engage the left side of the lamp on the hook and tighten right side mounting nuts.



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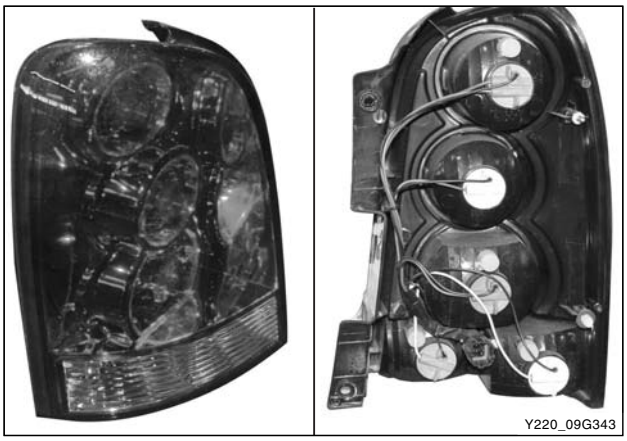
Rear Combination Lamp - Removal and Installation

1. Disconnect the negative battery cable.
2. Remove the rear combination lamp mounting screws.

3. Disconnect the rear combination lamp connector and remove the lamp assembly.



4. Remove the bulb from the removed lamp assembly.
5. Install in the reverse order of removal.

License Plate Lamp - Removal and Installation

1. Remove the license plate lamp.
2. Remove the bulb from the lamp.
3. Install in the reverse order of removal.

Side Turn Signal Lamp - Removal and Installation

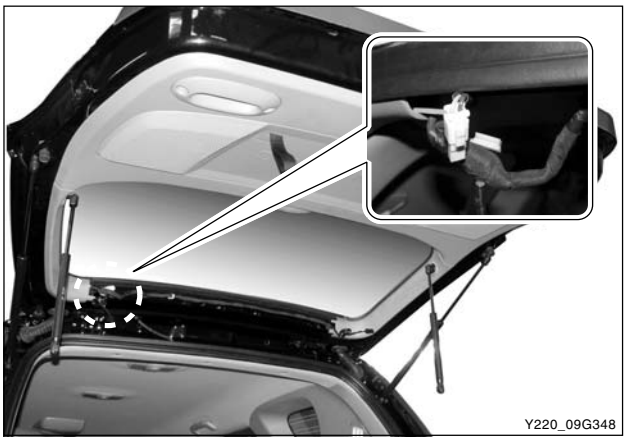
1. Push the side turn signal lamp forward and pull in the rear side of the lamp to separate.

2. Disconnect the connector and remove the lamp.

High Mounted Stop Lamp - Removal and Installation

1. Remove the spoiler on the tailgate.

2. Unscrew the lamp spoiler screws on the tailgate and disconnect the connector.
3. Remove the lamp assembly.
4. Install in the reverse order of removal.



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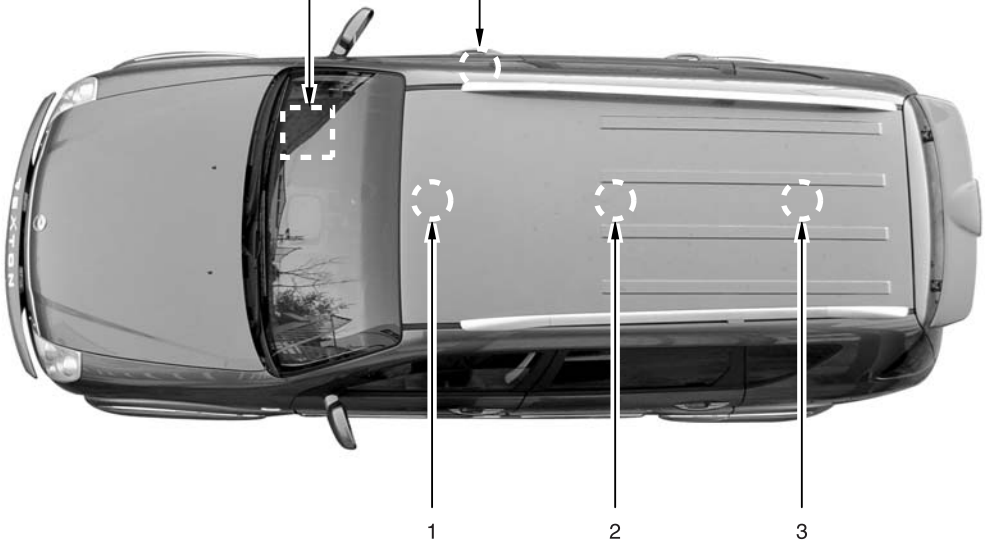
INTERIOR LAMPS

Glove box lamp

Courtesy lamp



1. Front room lamp

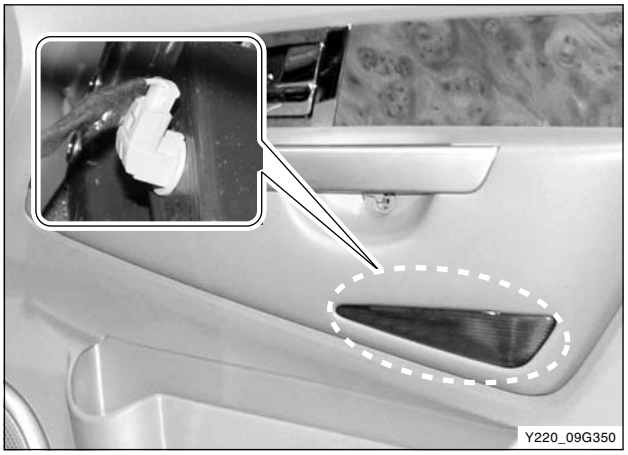
2. Center room lamp

3. Rear room lamp

Y220_09G349

Door Lamp - Removal and Installation

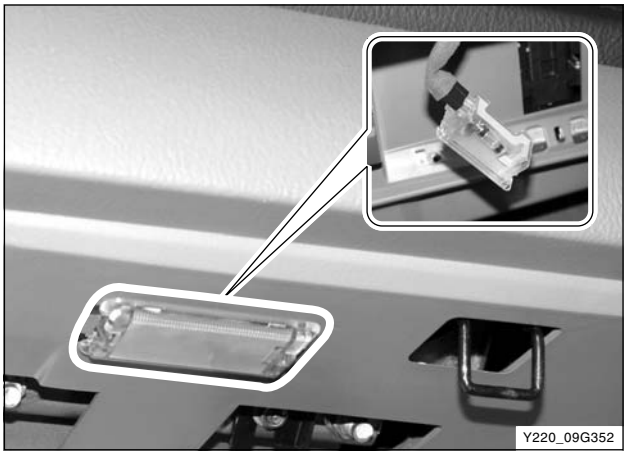
1. Disconnect the negative battery cable.
2. Detach the door trim and disconnect the lamp connector.



3. Unscrew the mounting screws and remove the lamp.
4. Install in the reverse order of removal.

Glove Box Lamp - Removal and Installation

1. Open the glove box cover.
2. Separate the lamp by pushing it to arrow direction.
3. Disconnect the connector and remove the lamp.
4. Install in the reverse order of removal.



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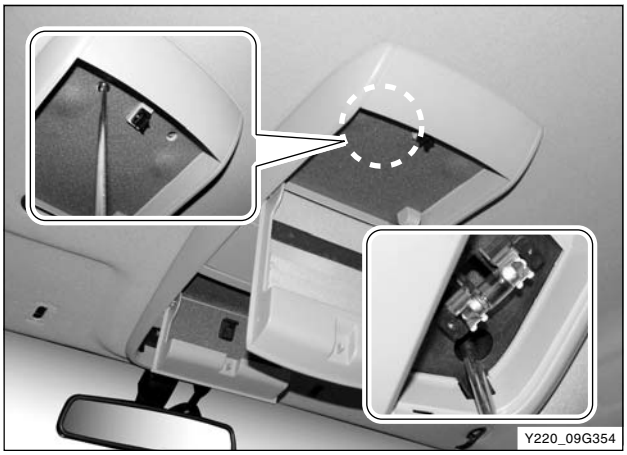
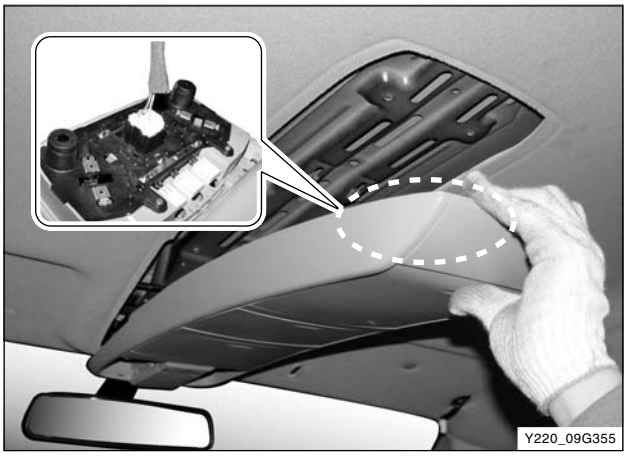
Interior Lamp - Removal and Installation

Front Lamp

1. Separate the lamp cover and remove the bulb.



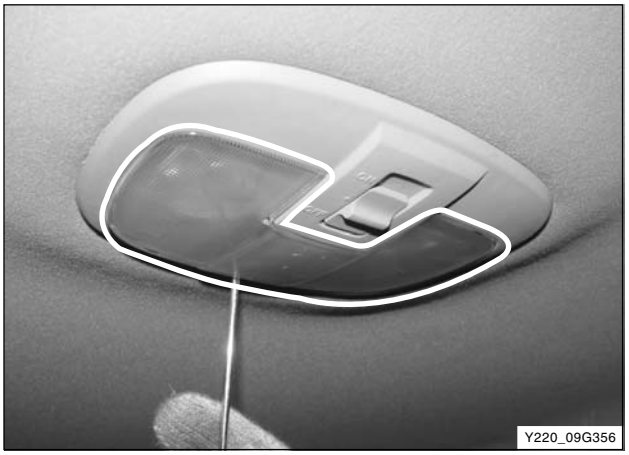
2. Unscrew the mounting screws and separate the front room lamp housing.



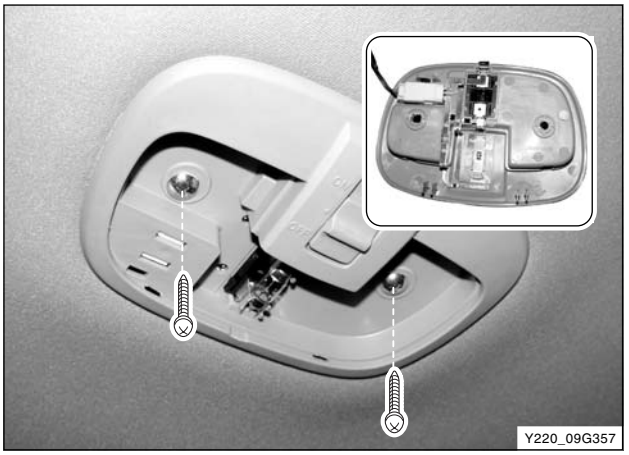
3. Disconnect the connector and remove the lamp housing.
4. Install in the reverse order of removal.

Center/Rear Lamp

1. Separate the lamp cover and remove the bulb.



2. Unscrew the mounting screws and separate the front room lamp housing.
3. Disconnect the connector and remove the lamp housing.
4. Install in the reverse order of removal.



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SECTION 9H

WIPER & WIPER MOTOR/HORN

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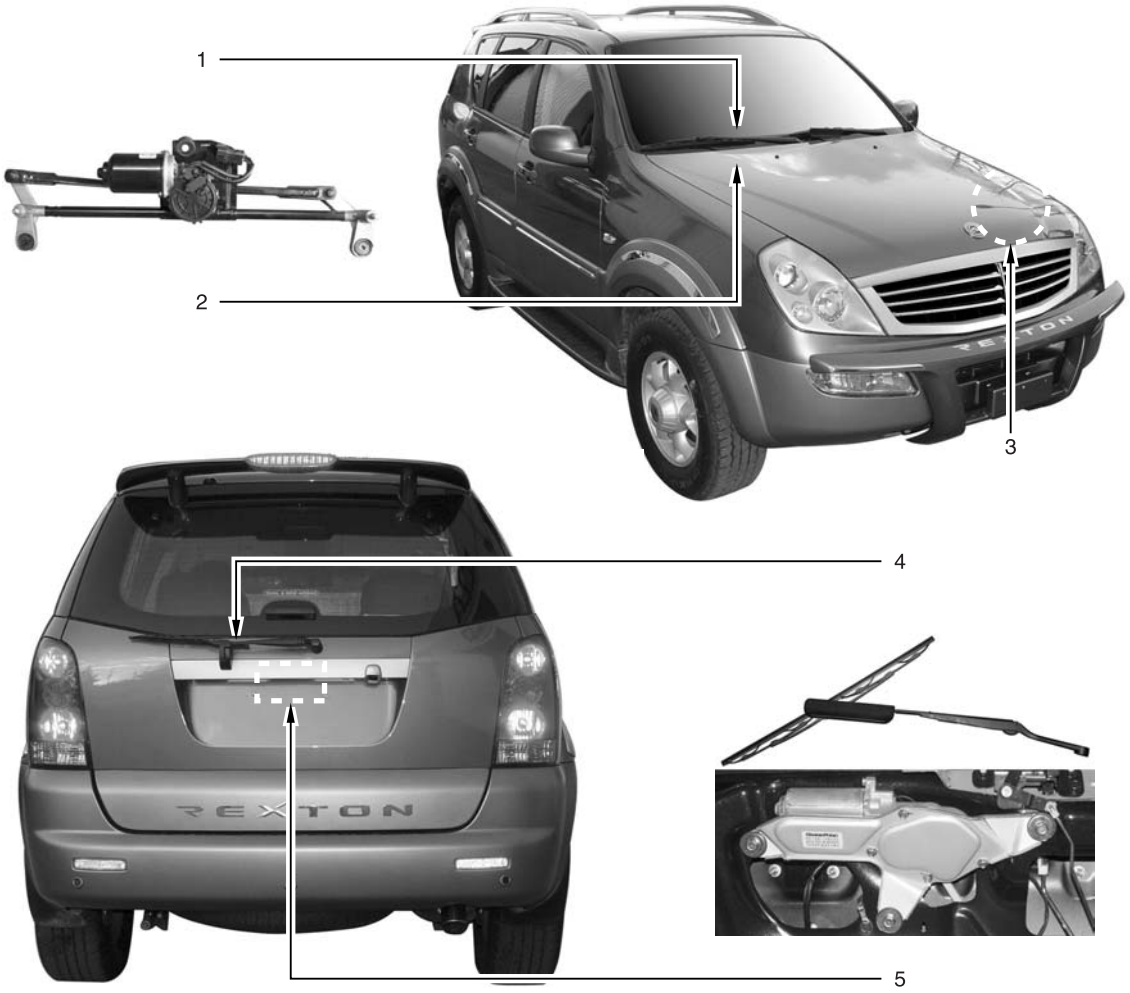
COMPONENTS LOCATOR



1. Wiper blade
2. Wiper motor and linkage
3. Washer reservoir assembly
4. Wiper blade
5. Wiper motor

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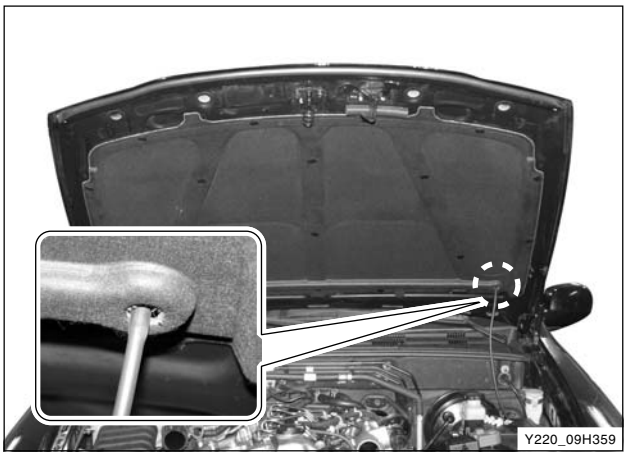
REMOVAL AND INSTALLATION

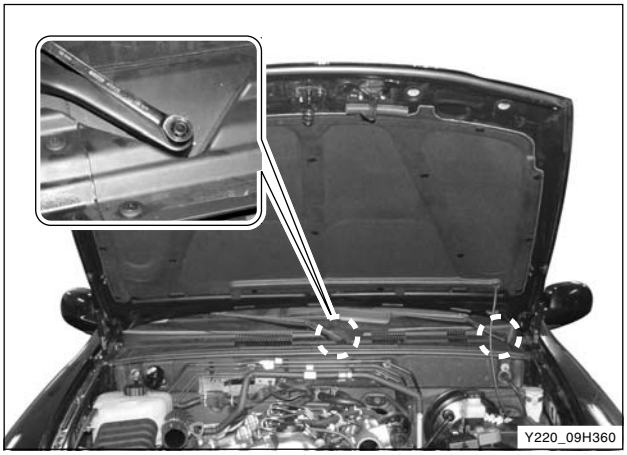
Front Wiper Assembly



Notice

Disconnect the negative battery cable and make sure that the "A101" switch is at "OFF" position.

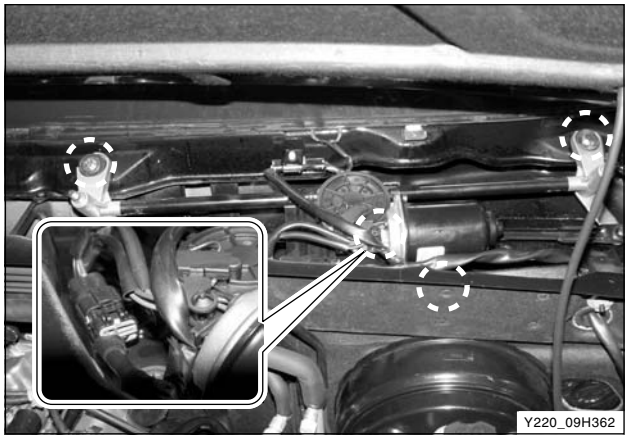
1. Open the hood and disconnect the washer hose.



2. Remove the wiper arms.

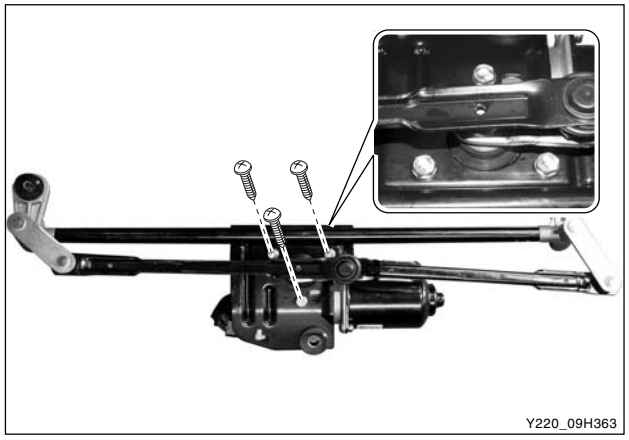
3. Remove the cowl.

4. Disconnect the wiper motor connector and remove the wiper linkage assembly.



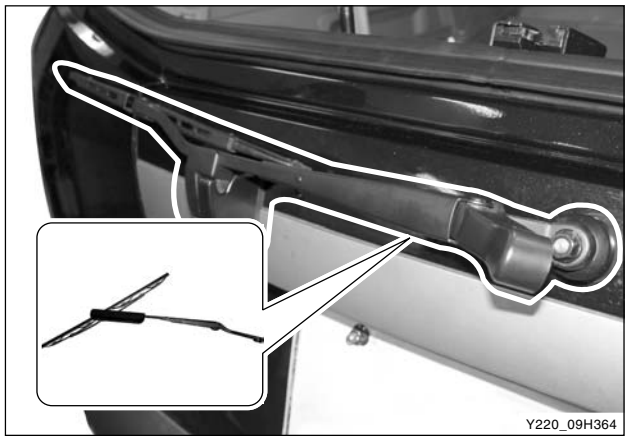
5. Unscrew wiper motor mounting bolts from the removed linkage and separate the linkage and motor.
6. Install in the reverse order of removal.

Motor mounting bolt	7 ~ 11 Nm
Linkage nut	4 ~ 6 Nm
Blade nut	19 ~ 28 Nm

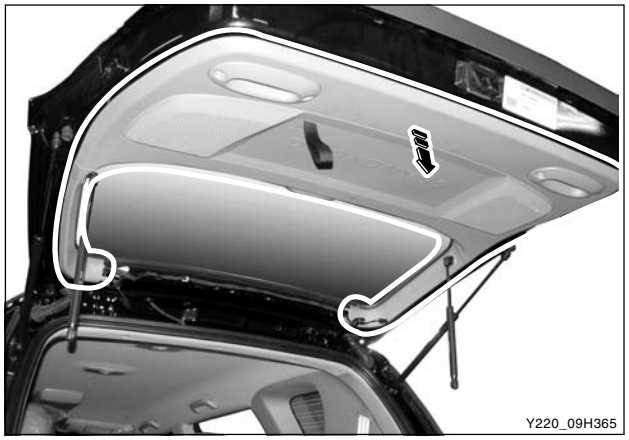


Rear Wiper Assembly

1. Open the wiper arm cap, unscrew the wiper nut and remove the wiper blade.



2. Detach the tailgate trim.



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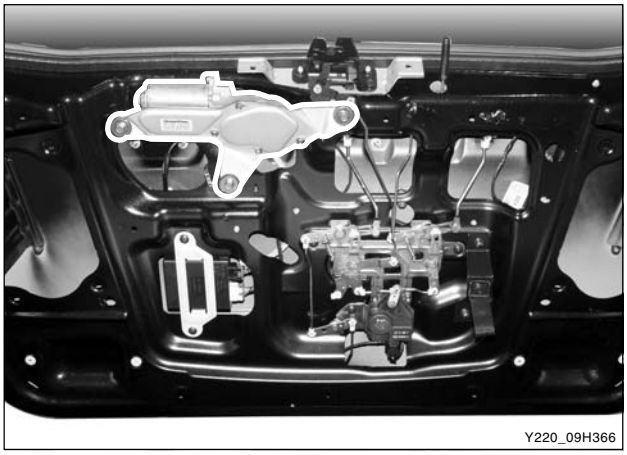


Y220_09H366

Y220_09H367

3. Disconnect the wiper motor connector and unscrew the mounting bolts.
4. Remove the wiper motor assembly from the tailgate.
5. Install in the reverse order of removal.

Wiper motor assembly

Motor bolt	7 ~ 11 Nm
Motor bracket bolt	7 ~ 9 Nm

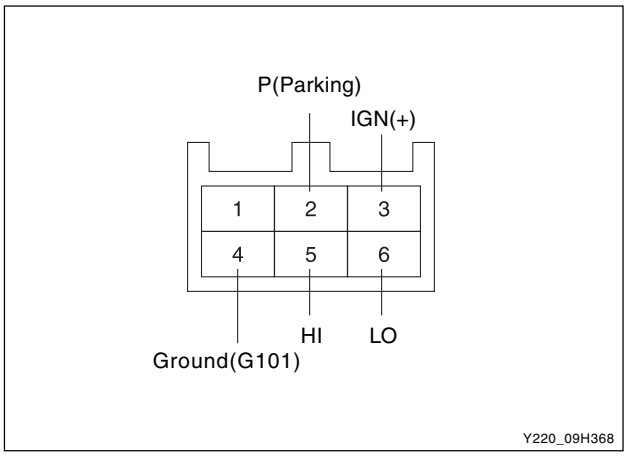
Rear wiper blade

Mounting nut	19 ~ 28 Nm

INSPECTION

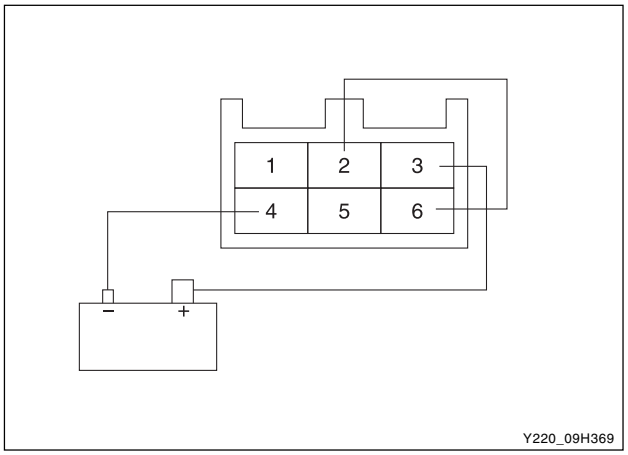
▶ Front Wiper Motor Speed

1. Disconnect the wiper motor connector.
2. Connect the positive battery terminal to No. 3 terminal and the negative battery terminal to No. 6 terminal.
3. Check if the wiper motor operates with “LO” speed.
4. Connect the positive battery terminal to No. 3 terminal and the negative battery terminal to No. 5 terminal.
5. Check if the wiper motor operates with “HI” speed.



▶ Front Wiper Auto Stop

1. Run the wiper motor with “LO” speed.
2. Stop the wiper motor by disconnecting No. 6 terminal in other than “OFF” position.
3. Connect the No. 2 and No. 6 terminals.
4. Connect the positive battery terminal to No. 3 terminal and No. 5 terminal to ground.
5. Check if the wiper motor stops at “OFF” position.



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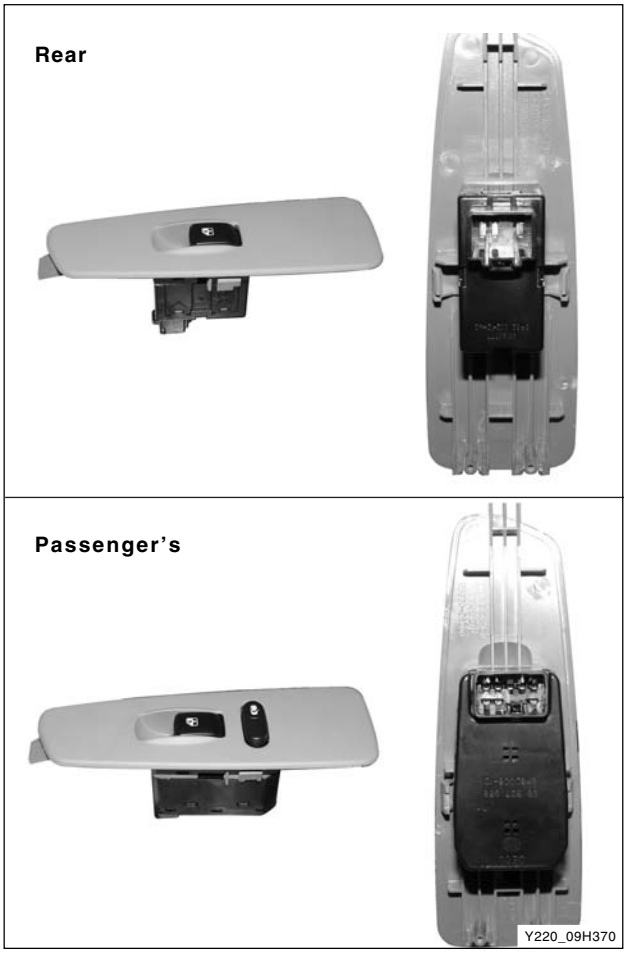
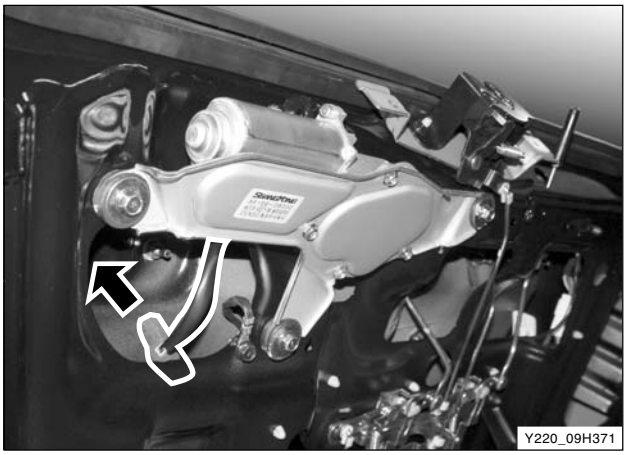


▶ Passenger's Door and Rear Sub Switches

1. Remove the switch and check the continuity between terminals.

Pos. \ Ter.		1	2	3	4	5	6	7	8
Window	Up		○	○	○				○
	Down	○	○		○				○
Door lock release							○	○	

Pos. \ Ter.		1	2	3	4	5	6	7	8
Window	Up		○		○	○			○
	Down	○	○			○			○



▶ Power Window Motor

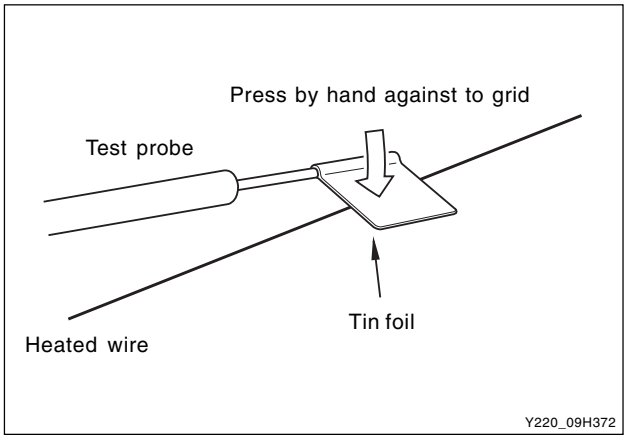
Connect the motor terminal to battery and check if the motor operates smoothly.

And, change the polarity conversely and check if the motor operates smoothly. If the operations are abnormal, replace the wiper motor.

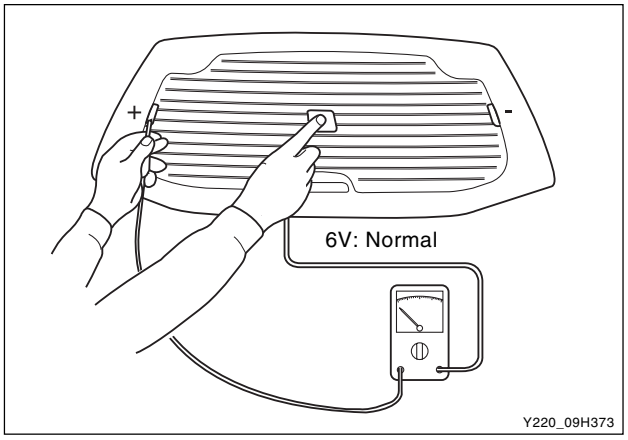
▶ Tailgate and Side Quarter Glass Defogger

Notice

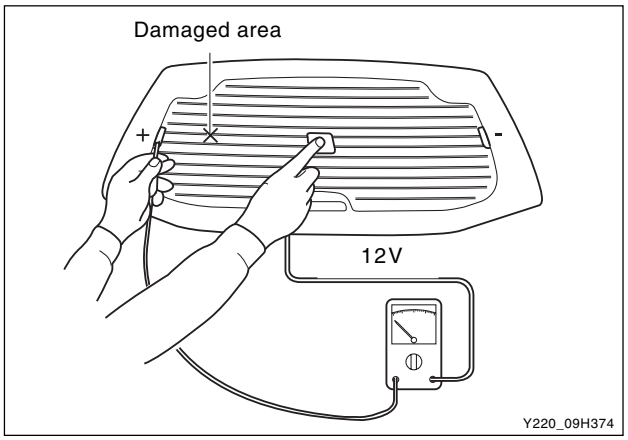
To prevent from damage, wrap the tester probe end with tin foil and check the circuit for open by moving the tester probe along the grid line.



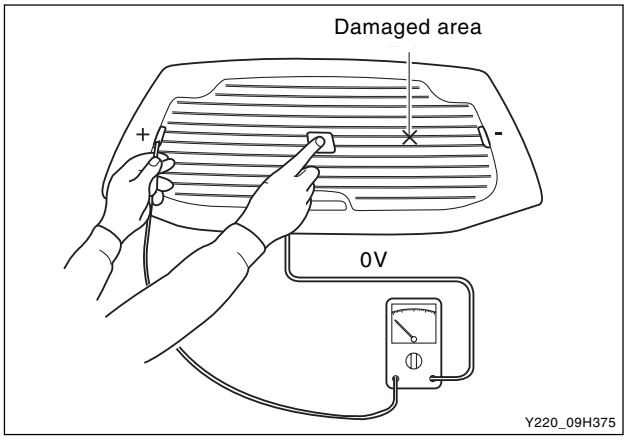
1. Turn the defogger switch “ON” at engine idling check as follows.
   1) If the measured voltage at the center of glass is 6 V, the tailgate glass is normal.



   2) If the tailgate defogger between the center and the positive terminal has been damaged, the voltmeter indicates 12 V.



   3) If the tailgate defogger between the center and the negative terminal has been damaged, the voltmeter indicates 12 V.



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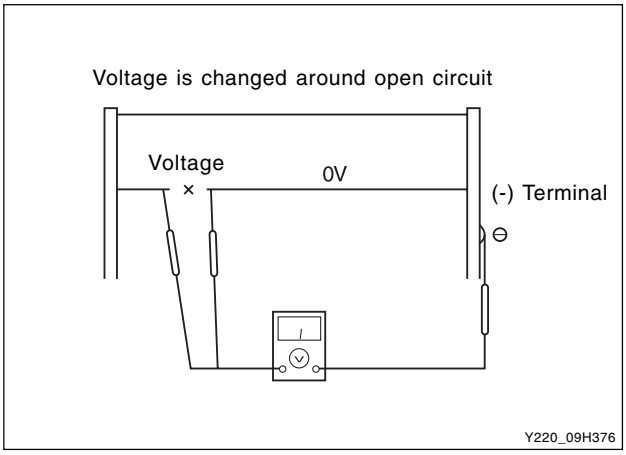
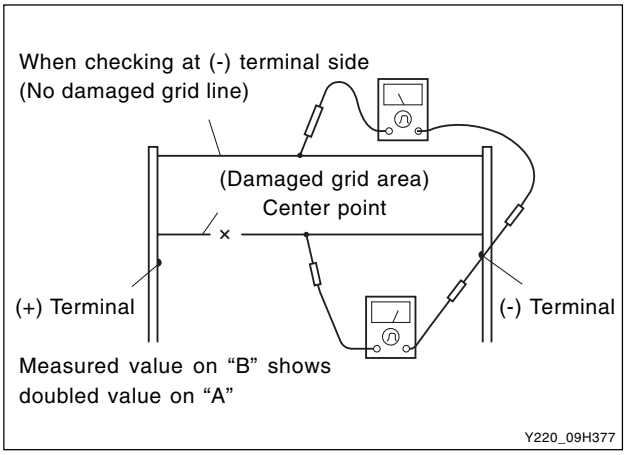
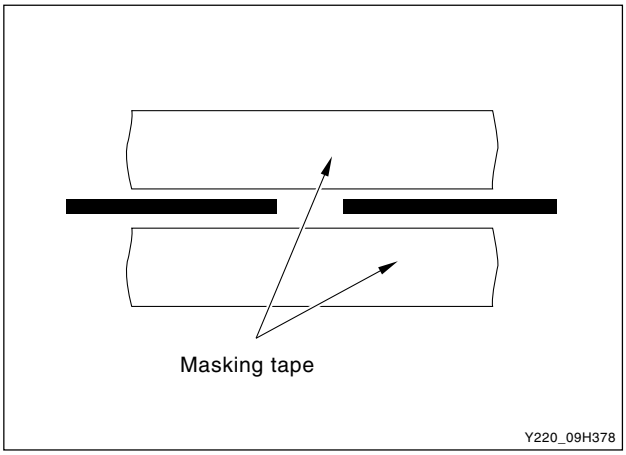


4) Move the test leads around suspected area to check the circuit for open. The broken point shows the voltage changes.



2. Turn the defogger switch “OFF” and check as follows.

   Measure the resistance between the terminals and center grid line. The broken point shows doubled resistance value for other points. And, the damaged point shows sharp voltage changes.



▶ Repairing the Tailgate defogger Grid Line

Preparations:

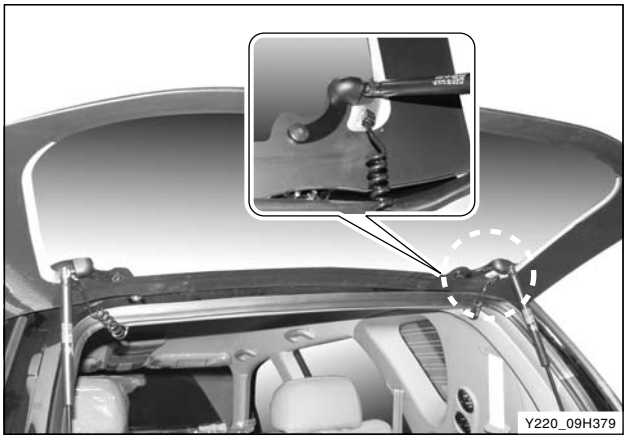
1) Conductible paint
2) Thinner
3) Masking tape and decal etc.
4) Alcohol
5) Thin brush

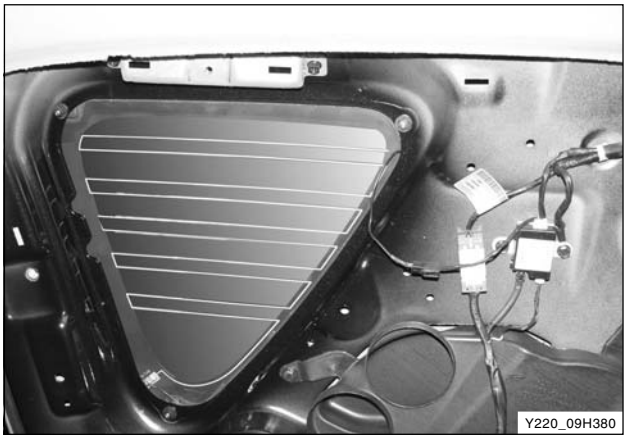
   Clean around the damaged area and attach the masking tape along the grid line as shown in figure. Clean the area with alcohol. Apply the conductible paint with thinner on the area 3 times with 15 minutes of interval. Remove the masking tape before supplying the power. If required, remove the excessive paint with a knife after completely dried.

Notice

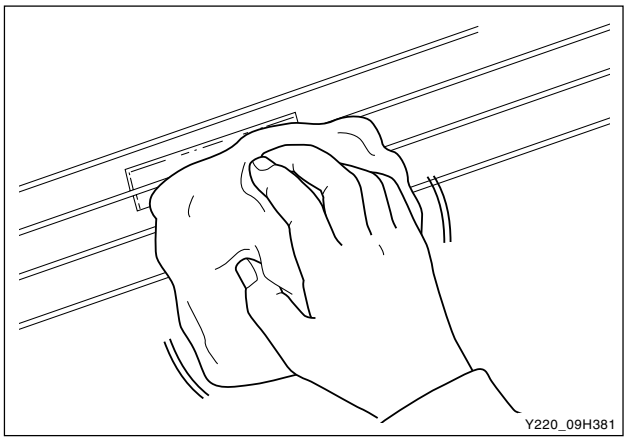
Clean the glass with dampened cloth after repair.

1. Disconnect the negative battery cable.
2. Disconnect the tailgate defogger connector.

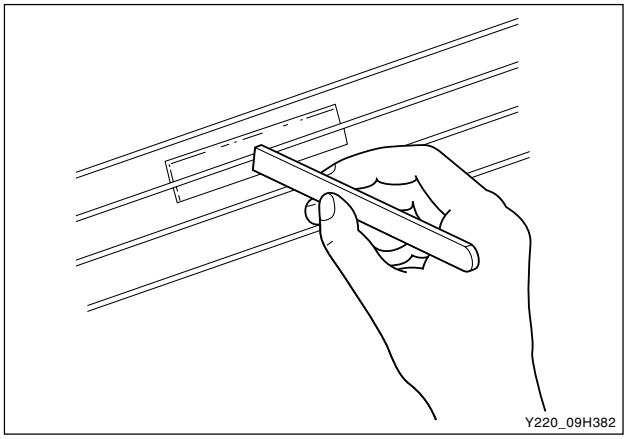




3. Inspect the tailgate defogger grid lines.
4. Mark the grid line break on the outside of the glass with a wax pencil or a crayon.
5. Buff the grid lines that are to be repaired with steel wool. Wipe the lines clean using a cloth dampened with alcohol. Buff and clean about 6 mm beyond each side of the break in the grid line.



6. Attach two strips of masking tape above and below the repair areas.
   - A masking tape must be used in order to control the width od the repair areas.
7. Apply the grid repair material to the repair area using a small wooden stick or a spatula. The grid repair material should be at room temperature.
8. Carefully remove the tape.



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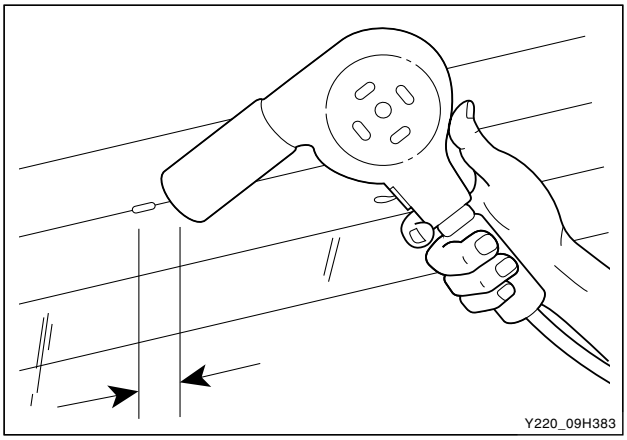
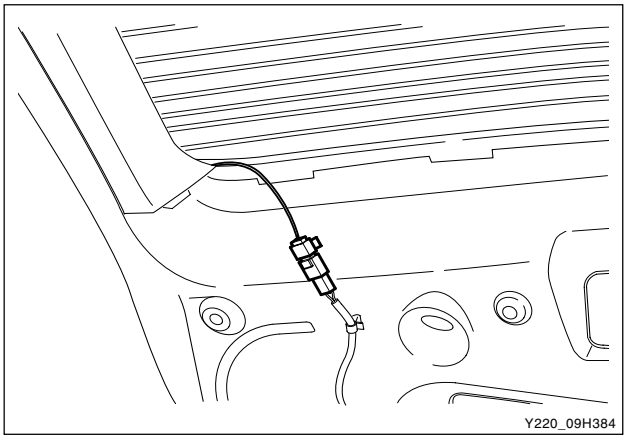


9. Heat the repair area for 1 to 2 minutes.

Notice

The grid line repair material must be cured with heat heat. In order to avoid heat damage to the interior trim, protect the trim near the repair area where heat will be applied.

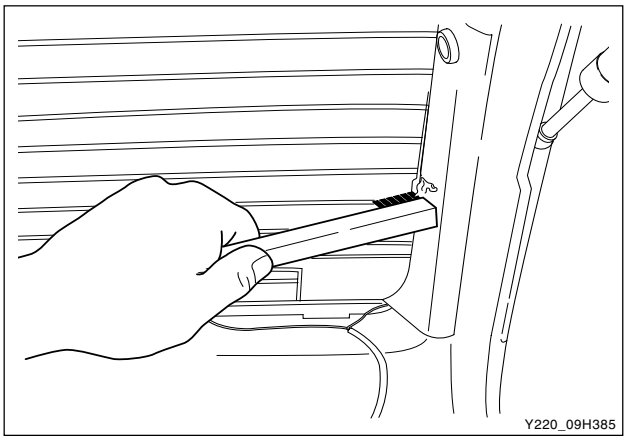
10. Hold the heat gun nozzle 25 mm from the surface. A minimum temperature of 149°C is required.



11. Inspect the grid line repair area. If the repair appears discolored, apply a coating of tincture of iodine to the area using a pipe cleaner or a line brush. Allow the iodine to dry for about 30 seconds. Carefully wipe off the excess iodine with a lint-free cloth.
12. Test the operation of the tailgate defogger in order to verify that the repair was successful.

Notice

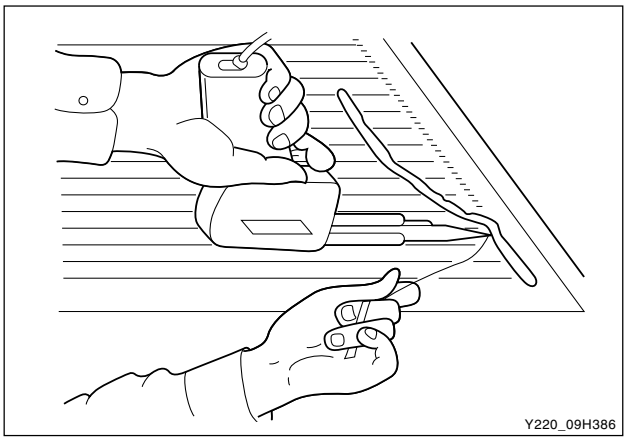
At least 24 hours is required for complete curing of the repair materials. The repair area should not be physically disturbed until after that time.



▶ Repairing the Braided Lead Wire

The tailgate defogger bus lead wire or the terminal can be reattached by resoldering. Use a solder containing 30 percent silver and a rosin flux paste.

1. The repair area should be buffed with fine steel wool before soldering the bus lead wire.
2. Apply the paste-type rosin flux in small quantities to the wire lead and the bus lead wire repair area using a brush.
3. Coat the soldering iron tip with solder. Use only enough solder to ensure a complete repair.



4. Use only enough heat to melt the solder. Do not overheat the wire when resoldering to the bus lead wire.

HORN

1. Disconnect the negative battery cable.
2. Remove the radiator grille and headlamp assembly.


Y220_09H311

3. Disconnect the horn connector.


Y220_09H312

4. Unscrew the mounting bolts and remove the horn.
5. Install in the reverse order of removal. If required, adjust the tone with adjusting screw.

Notice

Apply the paint on the adjusting screw not to loosen after adjustment.

SECTION 10A

FFH/PTC SYSTEM

Table of Contents

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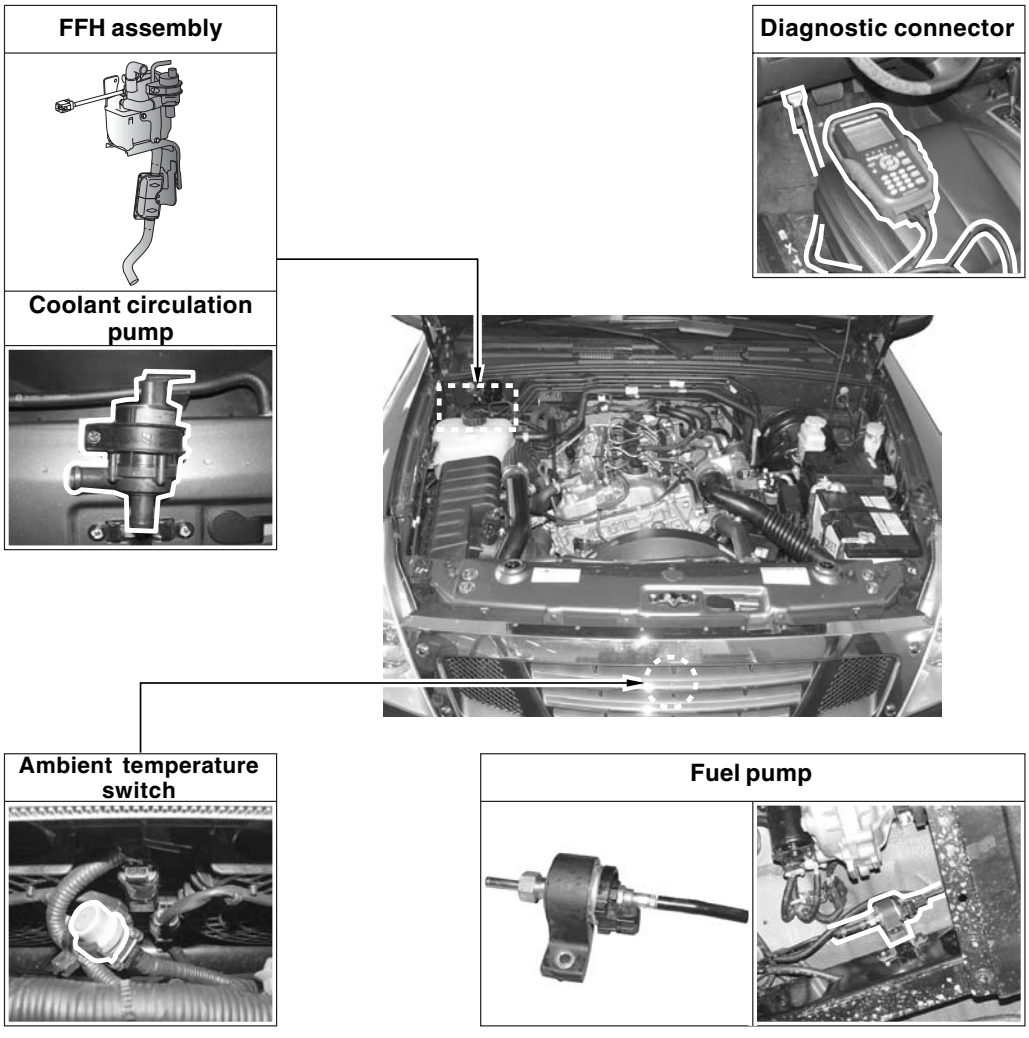
FFH SYSTEM

FUEL FIRED HEATER (FFH) SYSTEM

In fuel fired heater system equipped vehicle (D27DT engine equipped), when the ambient temperature and coolant temperature is low, the burner installed in engine cooling system increases the temperature of coolant that flows into heater by firing diesel fuel for a certain period of time.
The D27DT engine equipped vehicle has the Positive Temperature Coefficient (PTC) system as a basic equipment. FFH is operated by the coolant temperature and ambient temperature while PTC is operated by the coolant temperature intake air temperature.
FFH system consists of independent fuel lines and fuel pump, coolant circuit and coolant circulation pump, electrical glow plug and exhaust system. It also provides the diagnostic function.
FFH system cannot be operated or stopped by driver's intention. The FFH system is automatically operated by the coolant temperature and the ambient temperature.
The FFH system operates up to more 2 minutes to burn the residual fuel inside the system when stopping the engine during its operation. Therefore, a certain period of FFH operation after stopping the engine is not a malfunction.

COMPONENTS LOCATOR



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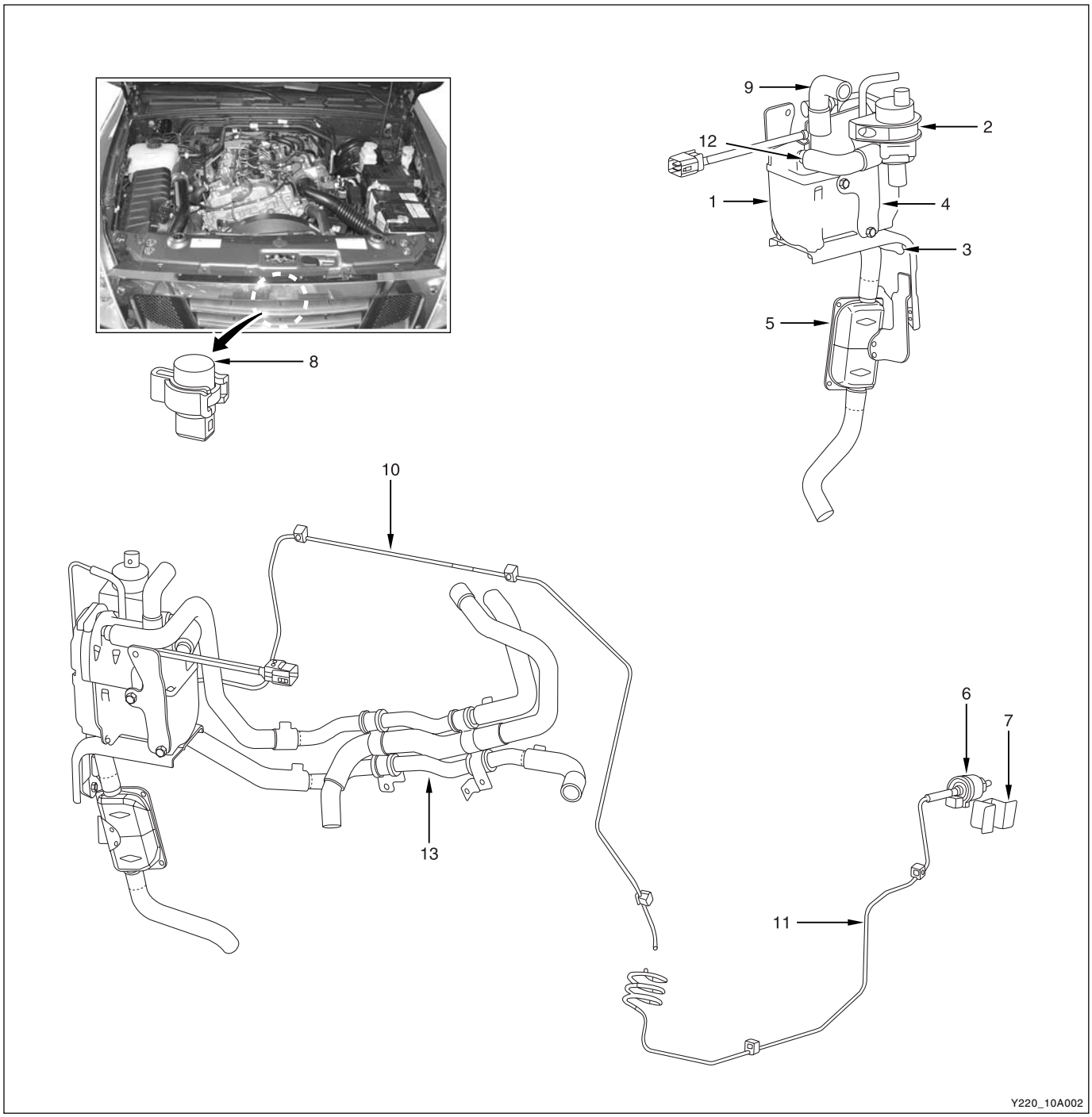
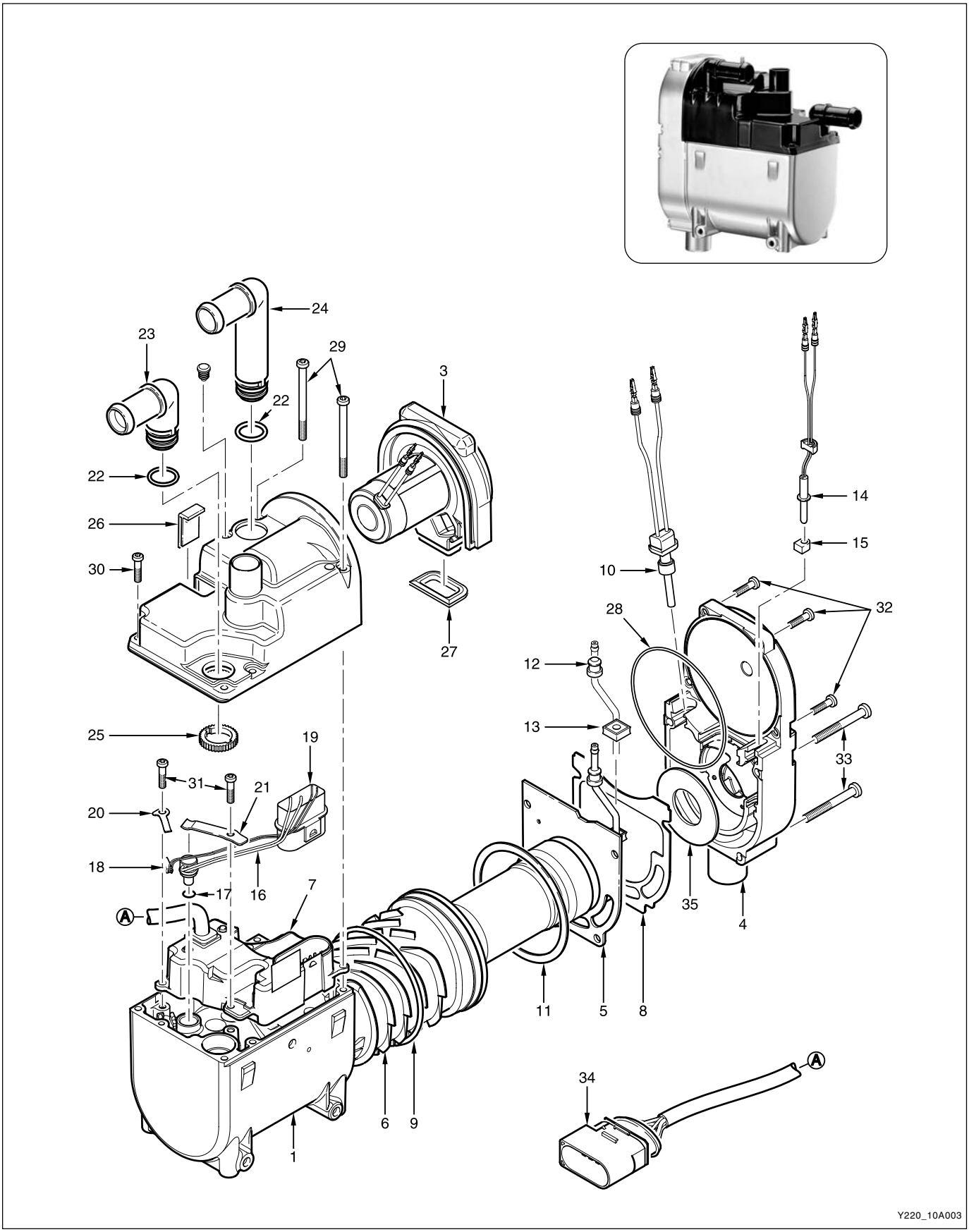
SYSTEM LAYOUT



1. FFH assembly
2. Water pump and bracket assembly
3. FFH No.1 bracket assembly
4. FFH No.2 bracket assembly
5. Silencer and pipe assembly
6. Fuel pump assembly
7. Fuel pump bracket assembly
8. Temperature sensor assembly
9. Intake hose
10. Fuel pipe No.1
11. Fuel pipe No.2
12. Pump outlet hose
13. FFH inlet/outlet hose assembly

▶ Exploded View



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1. Jacket
2. Jacket cover
3. Combustion air fan
4. Combustion chamber
5. Combustion chamber with flame tube
6. Heat exchanger
7. Controller
8. Seal (between combustion chamber and combustion air fan)
9. O-ring
10. Glow plug with cable
11. Seal (between combustion chamber and heat exchanger)
12. Upper bush for fuel pipe
13. Lower bush for fuel pipe
14. Flame sensor
15. Bush for flame sensor (graphite)
16. Control and overheating sensor with cable
17. O-ring
18. Surface sensor with cable
19. Controller connector - 14-pin connector (waterproof)
20. Pressure spring for surface sensor
21. Pressure spring for control and overheating sensor
22. O-ring
23. Coolant hose (inlet)
24. Coolant hose (outlet)
25. Tooth ring (2x)
26. Cable harness cover
27. Rubber seal
28. O-ring
29. Screw (M4 x 55 TORX/2x)
30. Screw (M4 x 16 TORX/2x)
31. Screw (M4 x 12 TORX/2x)
32. Screw (M4 x 16 TORX/4x)
33. Screw (M4 x 44 TORX/4x)
34. Controller cable harness
35. Insulation washer

▶Specifications

Heater		D 5 S-H	
Heating medium		Coolant	
Control of the heat flow		Large (full load)	Small (small load)
Heat flow		5000 W	2300 W
Fuel consumption per hour		≒ 0.62 ℓ	≒ 0.27 ℓ
Mean electric power consumption	in operation	35 W	11 W
	at start	100 W	
	after-running	12 W	
Rated voltage		12 V	
Operating range • Lower voltage limit: An undervoltage protection device in the controller switches the heaters off at approx. 10 volt.		10 V	
• Upper voltage limit: An overvoltage protection device in the controller switches the heaters off at approx. 15 volt.		15 V	
Tolerable operating pressure		up to 2.5 bar overpressure	
Minimum water flow through the heater		200 L/h	
Fuel		From main fuel tank	
Tolerable ambient temperature	operation	-40°C ~ 80°C	
	storage	-40°C ~ 105°C (2h for 125°C)	
Weight (without coolant and mounted parts)		approx. 2.3 kg	

▶ FFH Operating Process

FFH (Fuel Fired Heater) is operated according to the ambient temperature and coolant temperature.

Initial and Repeat Operating Conditions of FFH

Initial Operating Conditions of FFH:

Ambient temperature: below 5°C

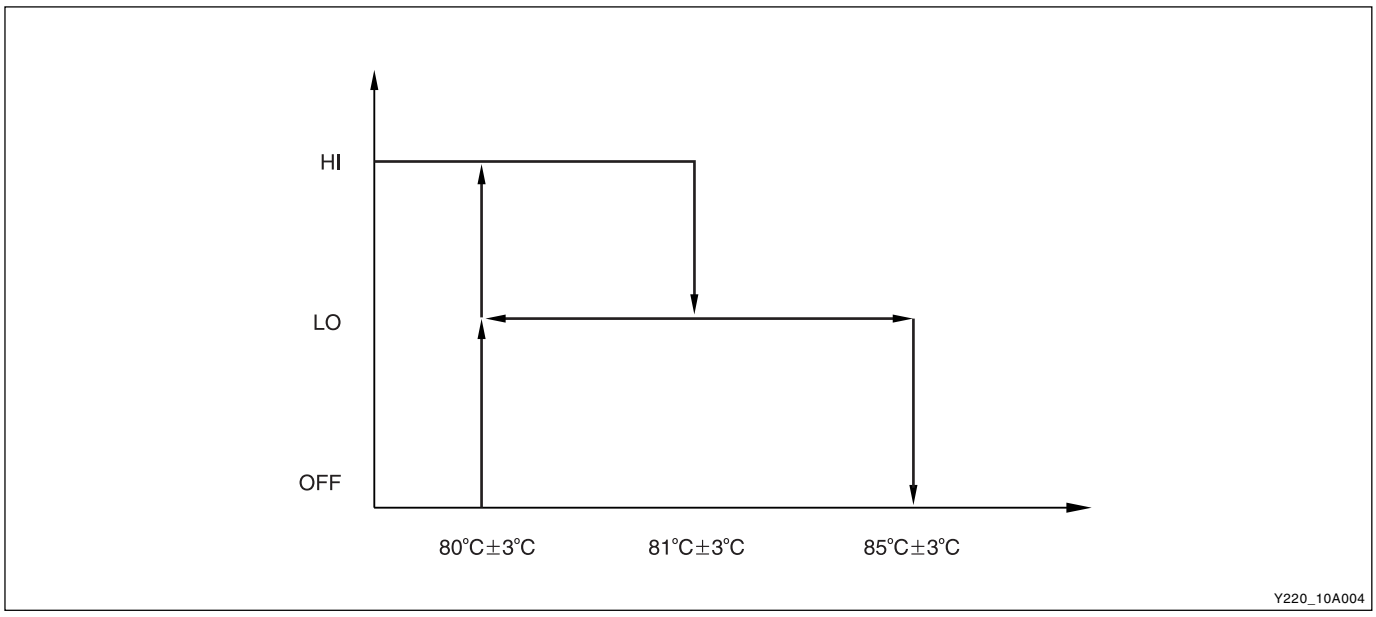
Coolant temperature: below 75°C

Repeat Operating Conditions of FFH:

Coolant temperature: below 75°C

When the difference between the ambient temperature at initial operation and current ambient temperature is over 3°C (to reduce the hysteresis with the temperature difference when operating FFH), FFH is operated again. For example, if the initial operating temperature was 4°C, the ambient temperature at repeat operation should be below 1°C and the coolant temperature should be below 75°C.

FFH Operations According to the Changes of Coolant Temperature



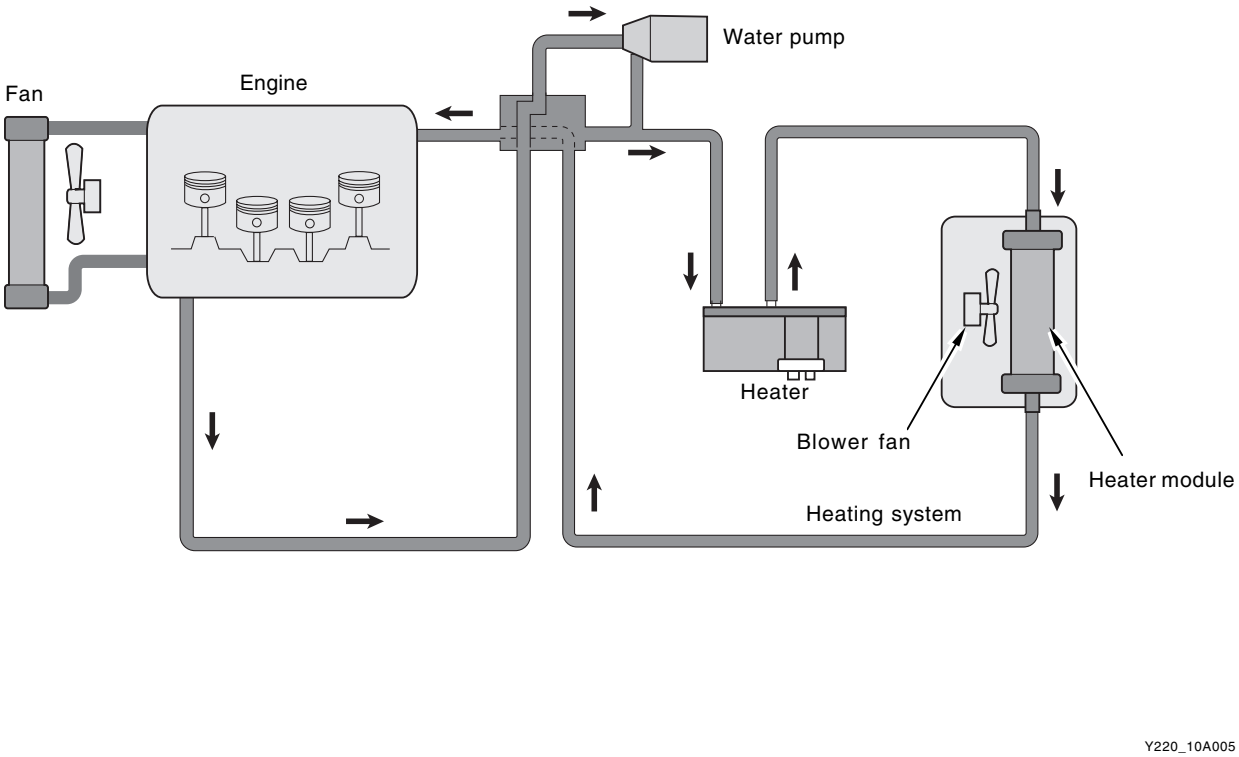
Above graph shows the FFH control process while the FFH is operating.

The control element is coolant as shown in the graph.

The FFH is operated in HI mode (high output: approx. 5000 W) until the coolant temperature reaches at 80°C and starts to be operated in LO mode (low output: approx. 2300 W) from 81°C.

When the coolant temperature reaches at approx. 85°C, FFH stops its operation until the operating conditions will be met again.

▶ Coolant Circulating Route



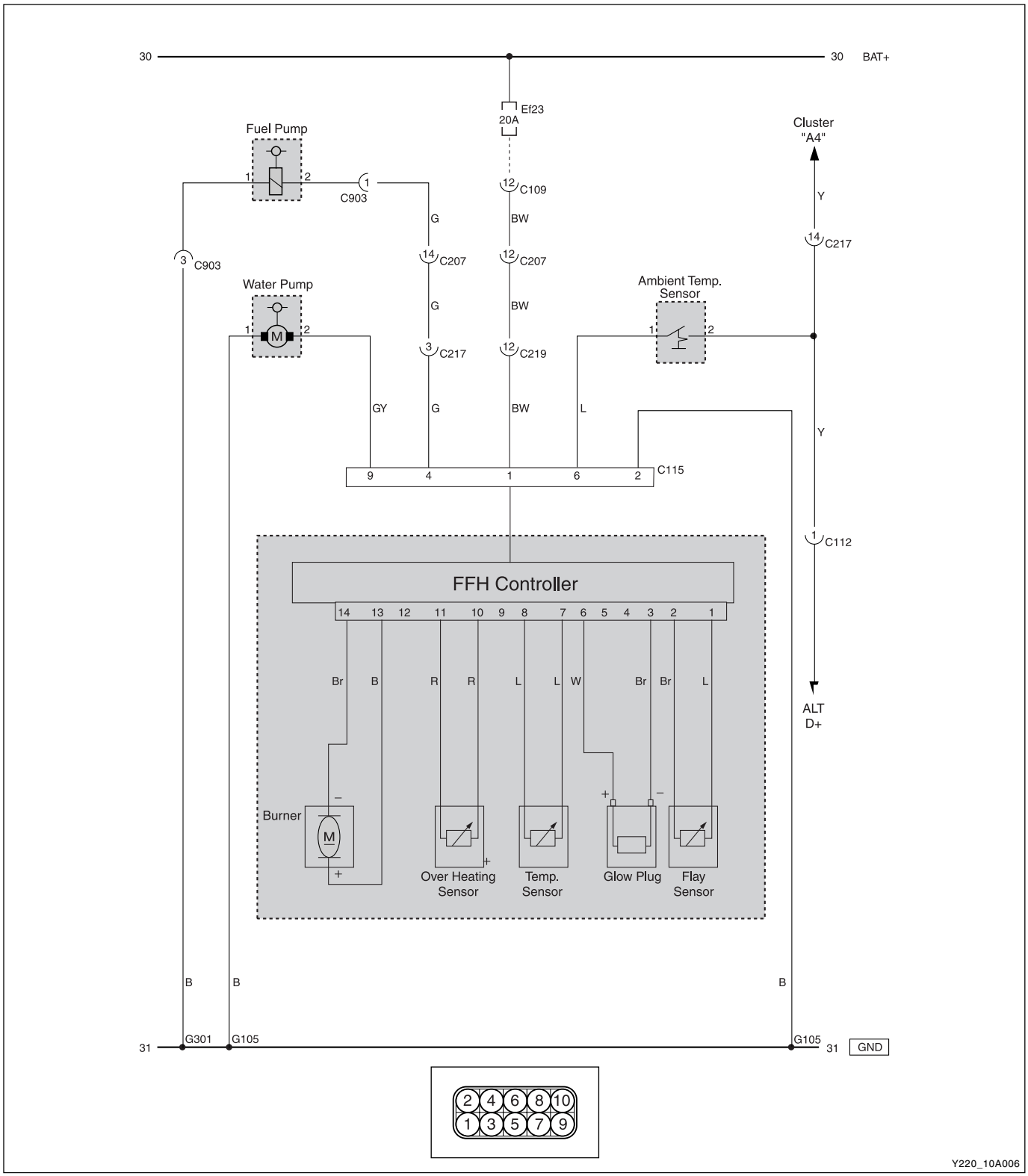
▶ Connecting the Coolant Circuit

The heater is connected to the coolant circuit in the coolant feed pipe from the vehicle engine to the heat exchanger.

Notice

- ***Parts conveying coolant must be routed and fastened in such a way that they pose no temperature risk to person or material sensitive to temperature from radiation and direct contact.***
- ***Before working on the coolant circuit, disconnect the negative battery cable and wait until all components have cooled down completely.***
- ***When installing the heater and the water pump, note the direction of flow of the coolant circuit.***
- ***Fill the heater and water hoses with coolant before connecting to the coolant circuit.***
- ***When routing the coolant pipes, observe a sufficient clearance to hot vehicle parts.***
- ***Protect all coolant hoses/coolant pipes from chafing and from extreme temperatures.***
- ***Secure all hose connections with hose clips.***

▶ Circuit Diagram



The FFH has various sensors in FFH unit, and the FFH unit is connected to the water pump, the fuel circulation pump and the ambient temperature sensor (switch) that provides important signals for the initial and repeat operations.

For diagnosis, remove the FFH system connector and install the scan tool. Currently, the K-Line that is connected to the diagnostic connector is not available.

▶ Control and Safety Mode

Heater operations and safety mode

* If the fuel pump

1. If the fuel pump fails to ignite within 90 seconds after fuel pumping starts, the start procedure is repeated as described. If after a further 90 seconds fuel pumping the fuel pump still fails to ignite, the heater is switched off in fault mode.

   The controller is locked after a certain number of failed starts.
2. If the flame does out by itself during operation, firstly a new start is activated. If the fuel pump fails to ignite within 90 seconds after fuel pumping has started again, the heater is switched off.
3. If the heater is overheated (lack of water, poorly vented cooling circuit), the overheating sensor triggers, the fuel supply is interrupted and the heater is switched off.
4. The heater is switched off if the lower or upper voltage limit is reached.
5. The fuel pump does not start when the glow plug is defect or electrical lead to the dosing pump is interrupted.
6. The fan motor speed is monitored continuously. If the fan motor does not start up, the heater is switched off in fault mode after 120 seconds.
7. It is possible to diagnose the system by connecting the diagnostic device to controller. For details, refer to the “Diagnosis Procedures” section.

[Emergency shutdown]

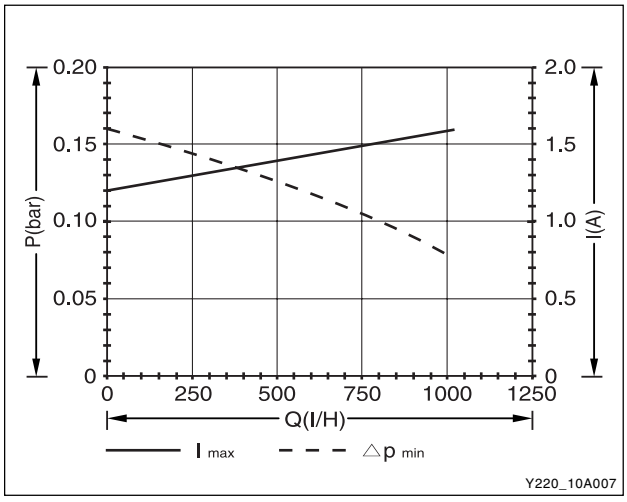
If an emergency shutdown -EMERGENCY OFF- is necessary during operation, proceed as follows;

- Pull the fuse (Ef23: 20A) out.
- Disconnect the heater from the battery.

▶ Technical Data - Water Pump

Rated voltage	12 V
Operating voltage	9 V ~ 15 V
Power consumption	16 W
Pumping capacity (0.1 bar)	800 l/h
Operating temperature	-40°C ~ 135°C
Weight	0.28 kg

▶ Characteristic Curve of Water Pump (12 V)



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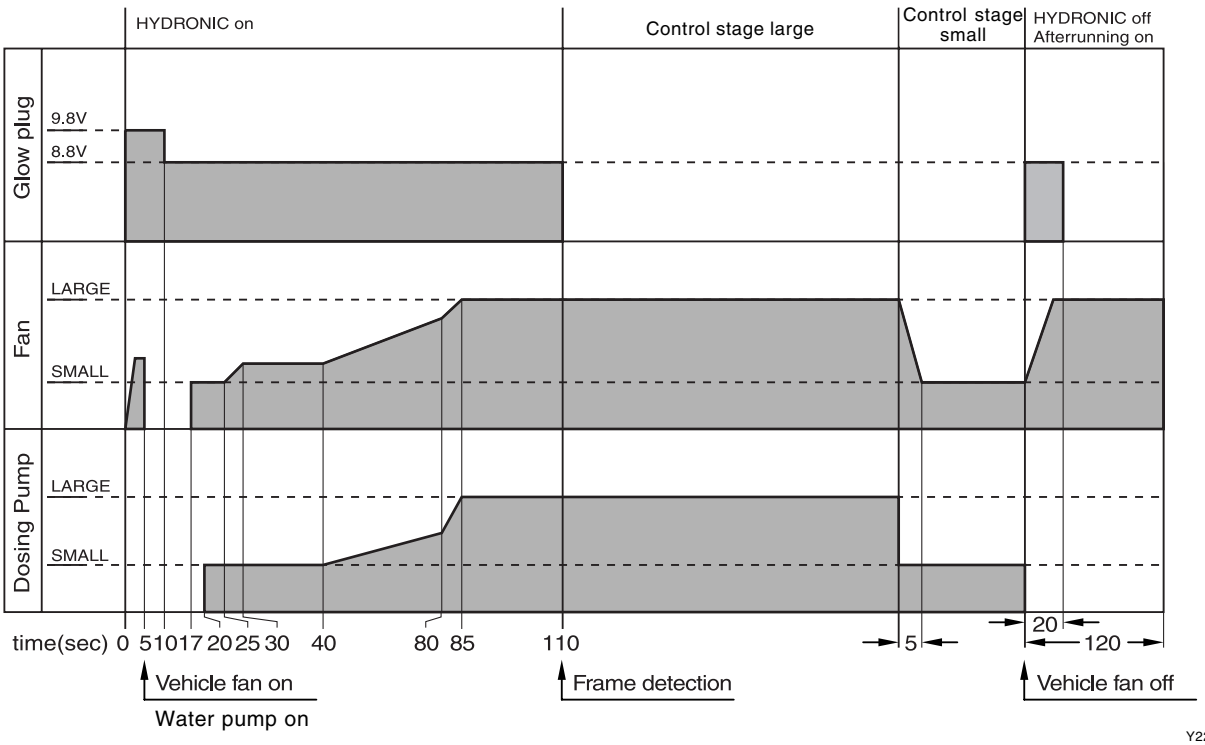
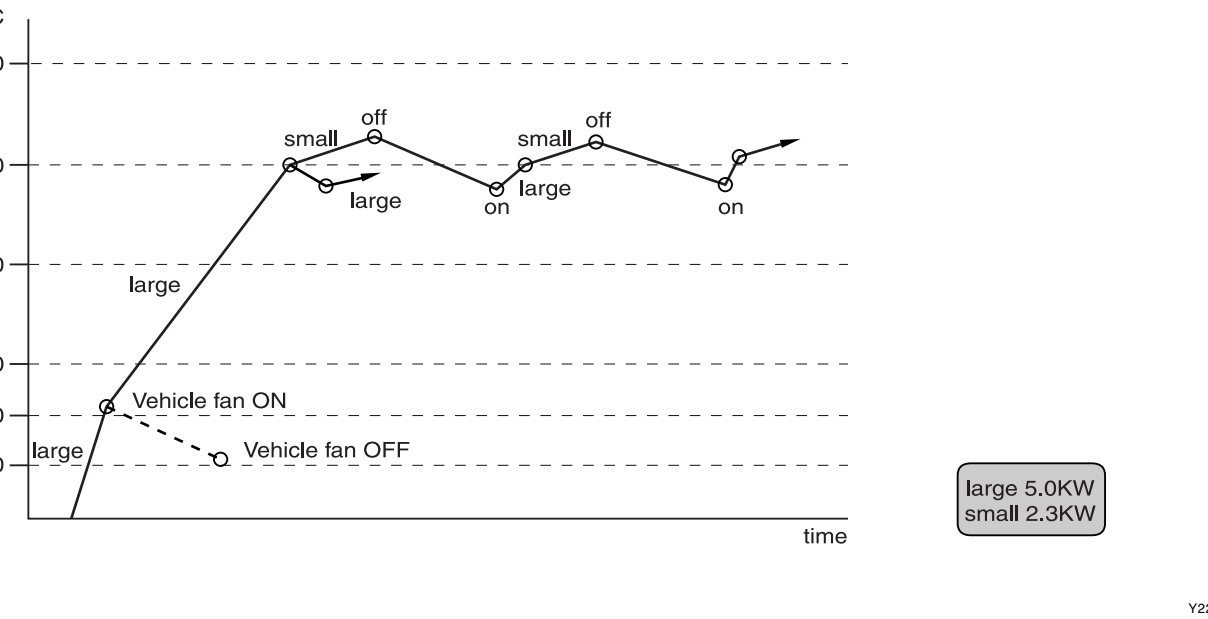
▶ Function Diagram



▶ Sectional Drawing according to the Temperatures



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TROUBLE DIAGNOSIS

▶ When Faults Occur, First Check...

- Faulty wiring?
  (short circuits, interruptions)
- Visual check for
  - corroded contacts
  - defect fuses
  - damaged electrical leads, links and connections
  - damaged exhaust and combustion air guidance
- Check battery voltage
  Battery voltage < 10 volt: the undervoltage protection has triggered
- Check fuel supply

Check Voltage Supply U_{batt} (terminal 30)

Disconnect the 10-pin connector and measure the voltage present in connector between chamber 1 and chamber 2.

For deviations in the battery voltage, check the fuses, supply lines, ground connection and plus point on battery for loss of voltage (corrosion / interruption).

Check Key-ON signal (D+)

Disconnect the 10-pin connector and measure the voltage present in connector 1 between chamber 6 and chamber 2.

Notice

Heater operating conditions

- ***Ambient temperature: below 5°C***
- ***Engine coolant temperature: below 75°C***

▶ Controller Lock

- The controller is locked when the following faults occur:

Overheating

- If FFH overheats 10 times in succession, error code 015 appears and the controller is locked.

Too many start attempts

If FFH performs 10 start attempts in vain, error code 050 appears and the controller is locked.

▶ Cancel the Controller Lock

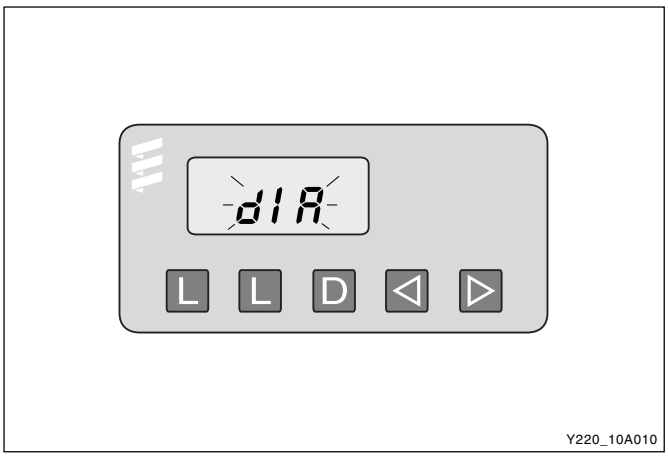
Canceling the controller lock depends on the corresponding testing equipment and is described in Diagnosis Instrument section.

▶ Testing Equipment

The electronic controller of FFH can save up to 5 errors. The errors can be read and displayed from the controller using one of the following items of equipment. In addition, the controller lock can be cancelled.

Diagnosis instrument

After connecting the diagnosis instrument, the function or error is shown numerically in the display. For connection and handling of the diagnosis instrument, refer to next section. An adapter cable is necessary to connect up the diagnosis instrument.



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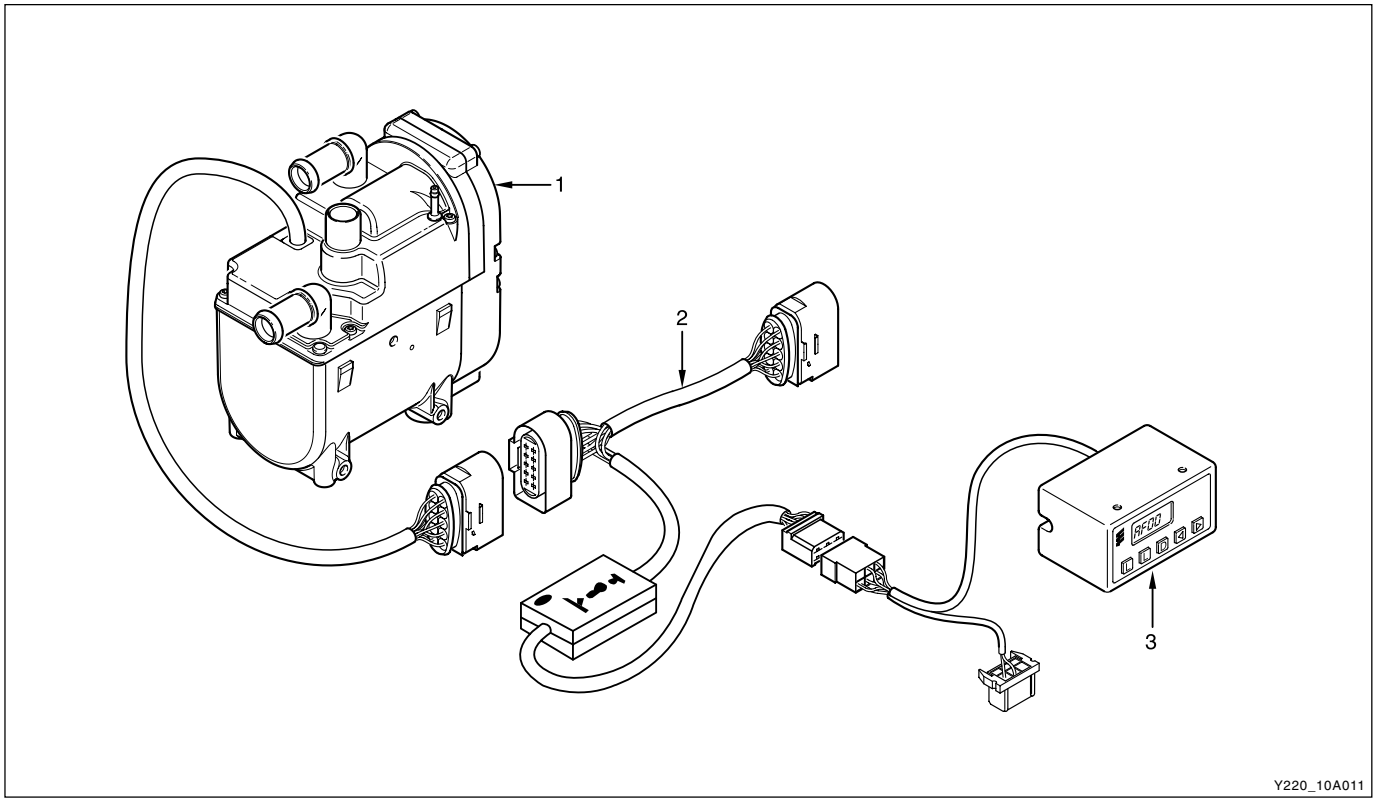
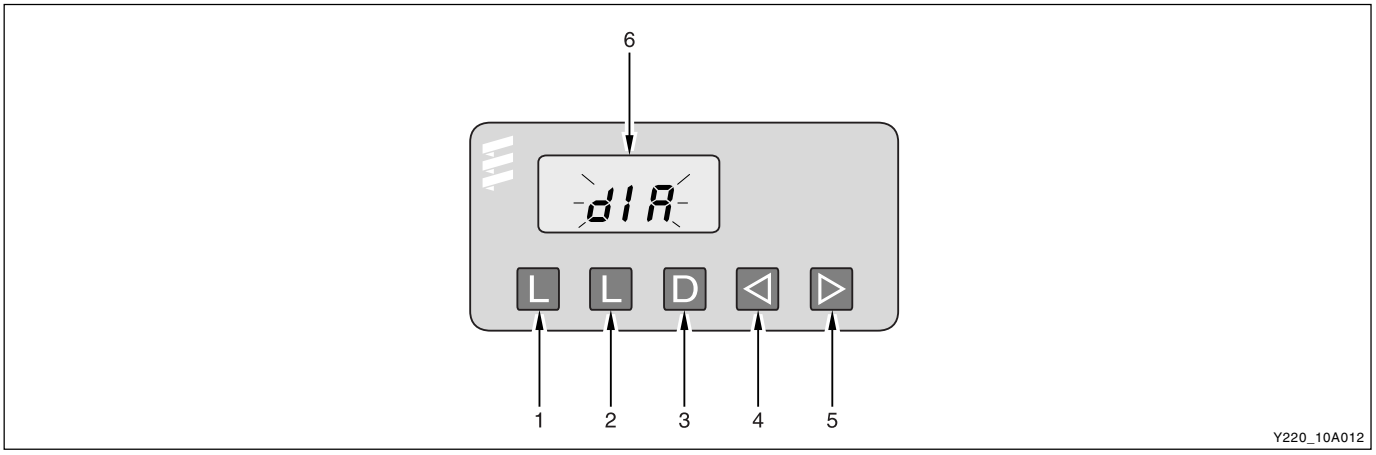
▶ Fault Diagnosis with the Diagnosis Instrument

Self- Diagnosis



1. Fuel fired heater
2. Adapter cable
3. Diagnosis instrument

Diagnosis Instrument



1. Delete Fauit Memory Button
2. Delete Fauit Memory Button)
3. Switch Heater On/Off Request Diagnosis Button)
4. Fault Backwards Button, AF, F1 ~ F5
5. Fault Forwards Button, AF, F1 ~ F5
6. Display

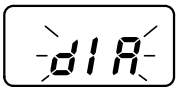
How to use diagnosis instrument

The electronic controller of HYDRONIC can save up to 5 faults, which can be read and displayed with the diagnosis instrument. The current fault is shown as " AF" and a 2-digit number and always written in memory place F1. Previous faults are transferred to memory places F2 to F5, and the contents of memory place F5 are overwritten.

Connecting up the diagnosis instrument

- Disconnect the 8-pole connector from the HYDRONIC cable harness and connect the adapter cable.
- Then connect the diagnosis instrument to the adapter cable.

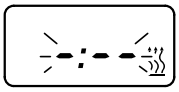
  The display shows:



Querying the fault memory

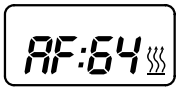
- Press the button D on the diagnosis unit to switch on HYDRONIC.

  The display shows:

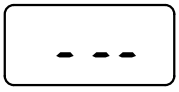


- After 8 seconds, the display shows:

no error



current fault



Fault diagnosis not possible

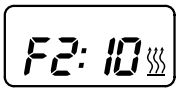
Possible causes:

- adapter cable not connected properly
- controller defect or not capable of diagnosis (not a universal controller)

Display of fault memory F1 – F5 or F5 – F1

- Press the buttons " ◀ " or " ▶ " once or several times to show the individual fault memories in decreasing or increasing order.

  The display shows:

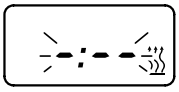


e.g. fault memory 2 / error code 10

Only those fault memories occupied by a fault are shown

Delete fault memory

- Eliminate cause of fault.
- Press both buttons "L" at the same time until the display shows:



- Once the fault memories are deleted, the last current fault is shown. The current fault is not reset to 00 until the next restart of HYDRONIC, insofar as no other current fault has occurred.

  The display shows:

HYDRONIC no faults

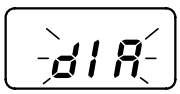
Controller lock

- Overheating
  : If HYDRONIC overheats 10 times in succession, fault 012, AF 015 appears in the display, i.e. the controller is locked.
- Too many start attempts
  : If HYDRONIC performs 10 start attempts in vain, fault 052, AF 050 appears in the display, i.e. the controller is locked.

Canceling the controller lock

- Delete the fault memory as described and switch off HYDRONIC with button "D".
- The controller lock is cancelled and the diagnosis finished.

  The display shows:



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▶ Trouble Code

Trouble Code	Trouble Description	Remedies
0	No faults	
10	Shutdown for overvoltage	• Measure battery voltage (must be < 15.9 V) • Check alternator
11	Shutdown for undervoltage	• Measure battery voltage (must be > 10.2 V under load) • Check alternator • Check lead
12	Overheating (software threshold)	Temperature at overheating sensor >125°C • Check cooling system: • Check the temperature sensor and overheating sensor, replace if necessary
14	Overheating (difference evaluation)	Difference in temperature values between surface sensor and control overheating sensor is too large. (Prerequisite for this trouble code display is that the heater is in operation and the water temperature at the overheating sensor has reached min. 80°C) • Check cooling system • Check the temperature sensor and overheating sensor, replace if necessary
15	Overheating (operating block)	The controller is locked. • Delete the fault memory to release the controller • Check cooling system • Check the temperature sensor and overheating sensor, replace if necessary
16	Difference evaluation 2	If the surface sensor has a far higher temperature value than the control overheating sensor, then the system proceeds with a fault shutdown.
17	Overheating (hardware, device)	Temperature at control overheating sensor > 125°C • Check cooling system • Check the temperature sensor and overheating sensor,replace if necessary
20	Glow plug interruption	• Check cable harness for this component for damage and through current and replace component if necessary • Check plug-in connection, replace component if necessary
21	Overload, short-circuit or ground contact, glow plug output	• Check cable harness for this component for damage, replace component if necessary
22	Glow plug output defect	• Check cable harness for this component for damage, replace component if necessary

Trouble Code	Trouble Description	Remedies
30	Speed of combustion fan motor outside tolerable range	Fan wheel or combustion air fan motor blocked (frozen, contaminated, stiff, cable harness scrapes on shaft end, ...) • Eliminate blockage • Measure speed of combustion air fan motor: - dismantle combustion air fan - check with 8.2 V + 0.2 V, to do so, unclip the cable 0.75^2 black from chamber 13 of the 14-pin connector and the cable 0.75^2 brown from chamber 14. Apply marking (white paint) to the fan wheel and measure speed with contactless speed meter. If the measured speed is outside a range of 8,800 rpm to 10,400 rpm, then replace the combustion fan. If the measured speed is within a range of 8800 rpm to 10400 rpm, then replace the controller.
31	Burner motor interruption	• Check cable harness for this component for damage and through current • Check plug-in connection, replace component if necessary
32	Overload, short-circuit or ground contact, burner motor	• Fan wheel or combustion air fan motor blocked (contaminated, stiff) • Check cable harness of this component for damage, if necessary replace component
34	Burner motor output defect	• Check whether the lead to this component has a short-circuit to GND, if not, check component for ground contact, if necessary replace controller
47	Overload, short-circuit or ground contact, fuel pump	• Check cable harness to the external component for damage and through current and replace external component if necessary
48	Fuel pump interruption	• Check cable harness to the external component for damage and through current • Check plug-in connection, replace external component if necessary
49	Fuel pump output defect	• Check whether lead to this component has short-circuit to +Ub, if not, check component for ground contact, replace controller if necessary
50	Operating block because too many start attempts in vain (10 start attempts, also one start repeat for every start attempt)	Too many start attempts, the controller is locked • Delete the fault memory to release the controller • Check fuel quantity and fuel supply
51	Time exceeded for cold blowing	• During start (no flame formed yet), the flame sensor reports temperature value too high for too long • Check exhaust and combustion air • Check flame sensor

Trouble Code	Trouble Description	Remedies
52	Safety time exceeded	• Check exhaust and combustion air system • Check fuel quantity and fuel supply • Clean or replace sieve used in fitting of fuel pump
53 54 56	Flame aborted from “power” stage Flame aborted from “large” stage Flame aborted from “small” stage	**Warning** ***In the case of flame aborted in “power”, “large” and “small” stage and with still tolerable start attempts, the heater proceeds with a new start or with subsequent start repeat. If the new start or start repeat is successful, the trouble code display goes off.*** Fault(because no more start attempt allowed) • Check exhaust and combustion air system • Check fuel quantity and fuel supply • Check flame sensor - see trouble code 64 and 65
60	Control overheating sensor interruption	• Check cable harness to this component for damage and through current • Check plug-in connection • Check sensor resistance value, replace component if necessary
61	Short circuit or ground contact control overheating sensor	• Check cable harness to this component for damage • Check sensor resistance value, replace external component if necessary
64	Flame sensor interruption	• Check cable harness to this component for damage and through current • Check plug-in connection • Check sensor resistance value, replace component if necessary
65	Short circuit flame sensor	• Check cable harness to this component for damage • Check sensor resistance value, replace external component if necessary
71	Surface sensor interruption	• Check cable harness to this component for damage and through current • Check plug-in connection • Check sensor resistance value, replace component if necessary
72	Short circuit surface sensor	• Check cable harness to this component for damage • Check sensor resistance value, replace external component if necessary
74	Overheating hardware defect, operating block	• Replace controller
87	Internal temperature sensor short-circuit	• Replace controller
88	Internal temperature sensor interruption	• Replace controller
89	CAN error	• Check CAN interface
90	Watch dog reset	• Replace controller

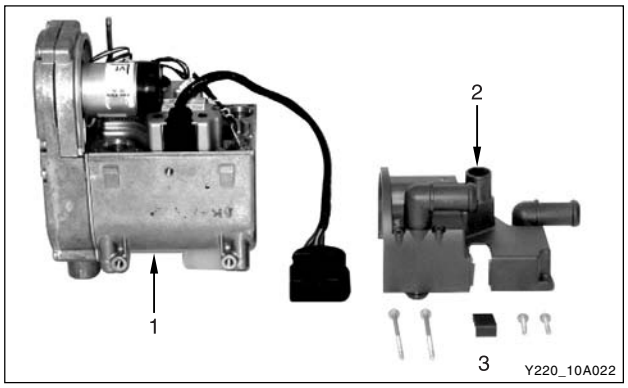
Trouble Code	Trouble Description	Remedies
91	Too many resets	• Replace controller
92	ROM error	• Replace controller
93	RAM error	• Replace controller
94	Transistor fault occurs too frequently - operation block	• Remedy short-circuit of the component to +Ub to GND, replace controller if necessary
95	Software stack overflow	• Replace controller
96	No valid process, operation lock	• Replace controller
97	Resonator/quartz faulty, wrong processor cycle	• Replace controller
98	Main relay faulty	• Replace controller
99	EEPROM error	• Replace controller

▶ Components and Compositions

Notice

There is no need to disassemble the FFH unit for repair. This section is to show the internal components of the FFH unit.

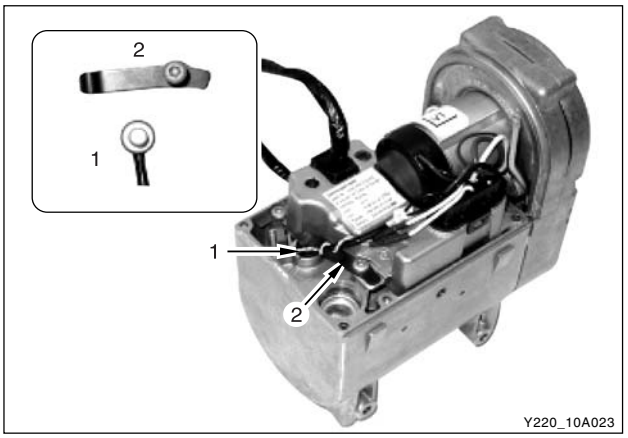
Jacket cover



- The O-rings are installed between jacket cover and two coolant hoses.
- The coolant hoses should be connected to right side.

1. Jacket
2. Jacket cover
3. Cable harness cover

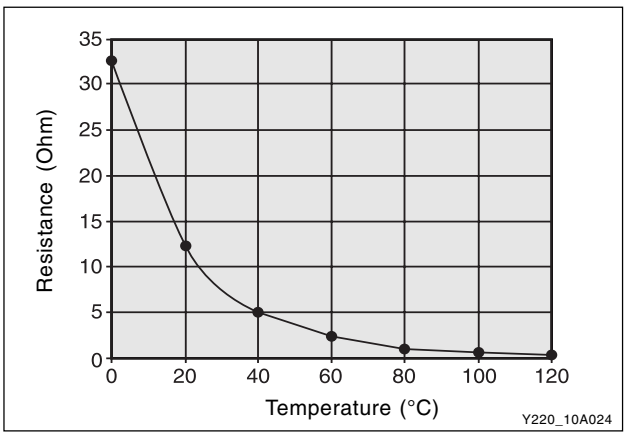
Control and overheating Sensor



The Control and overheating sensor and cable harness make up one component.

1. Control and overheating sensor
2. Pressure spring

Check control and overheating sensor

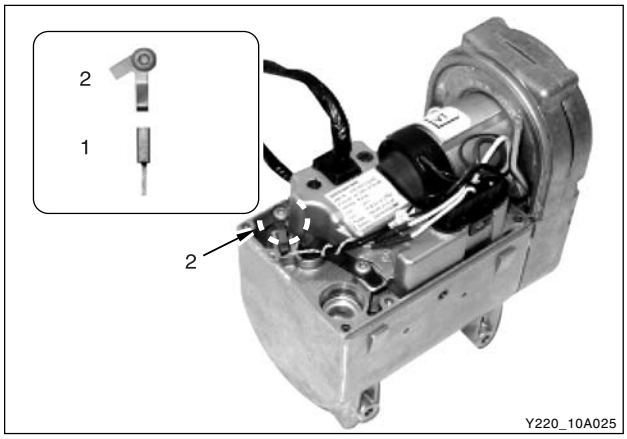


Check the control and overheating sensor with a digital multimeter. If the resistance according to the changes of flame sensor temperature is out of specified values, the flame sensor is defective.

Specifiedl value

Temperature [℃]	0	10	20	30	40	50	60	70	80	90	100	110	120
Resistance [Ω]	32.54	19.87	12.48	8.06	5.33	3.60	2.48	1.75	1.25	0.91	0.67	0.50	0.38
	±2.2	±1.0	±0.5	±0.4	±0.3	±0.25	±0.17	±0.13	±0.1	±0.08	±0.06	±0.05	±0.04

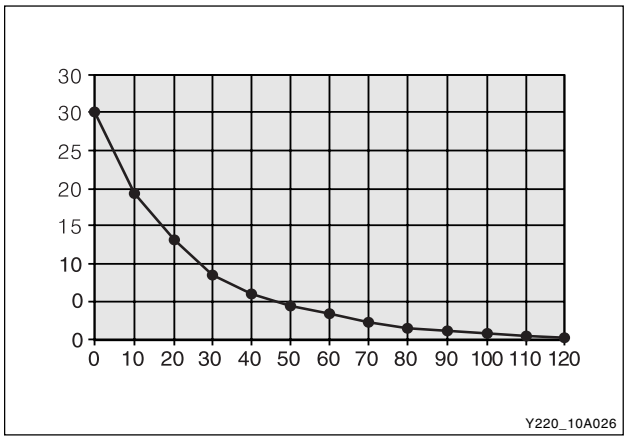
Surface sensor



The surface sensor and cable harness make up one component.

1. Surface sensor
2. Pressure spring

Check surface sensor

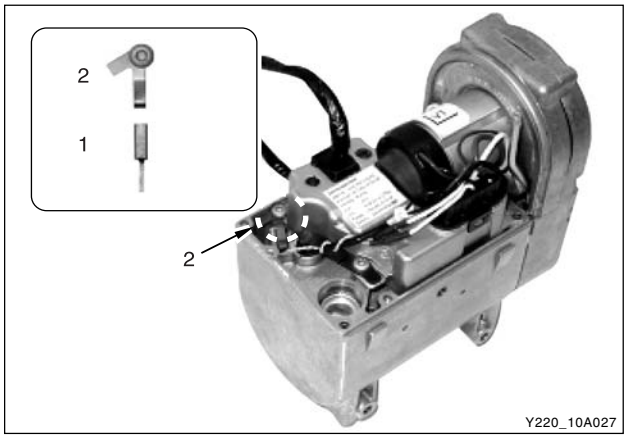


Check the surface sensor with a digital multimeter. If the resistance of flame sensor is out of specified values, the flame sensor is defective.

Specifiedl value

Temperature [℃]	0	10	20	30	40	50	60	70	80	90	100	110	120
Resistance [Ω]	30.00	19.53	13.03	8.90	6.20	4.41	3.19	2.34	1.75	1.32	1.02	0.79	0.62
	±0.13	±1.6	±1.89	±2.2	±2.4	±2.9	±3.19	±3.6	±3.92	±4.4	±4.78	±5.3	±5.70

Controller



The surface heater and cable harness make up one component.

1. Controller
2. Jacket
3. Combustion chamber housing
4. Screw

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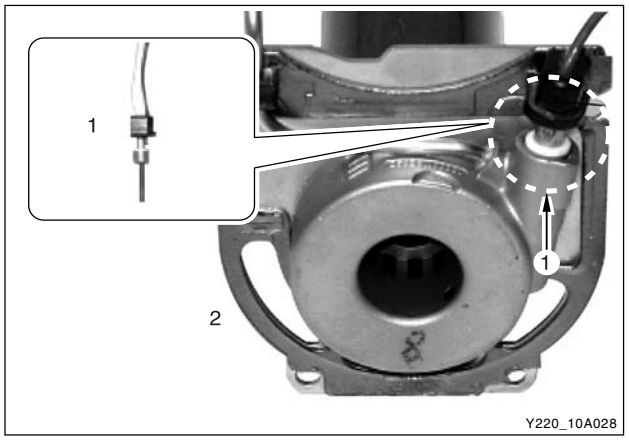
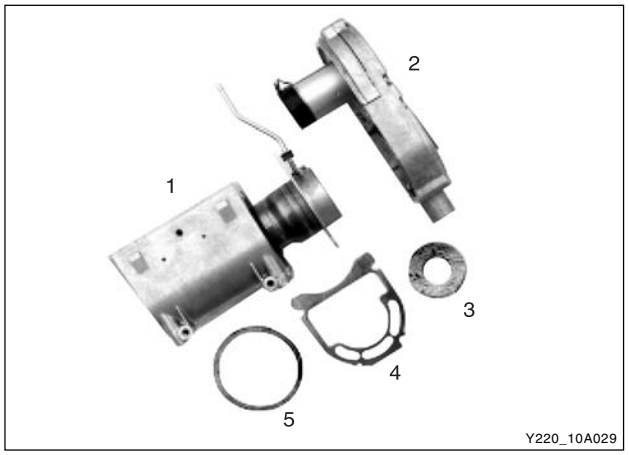
Glow plug



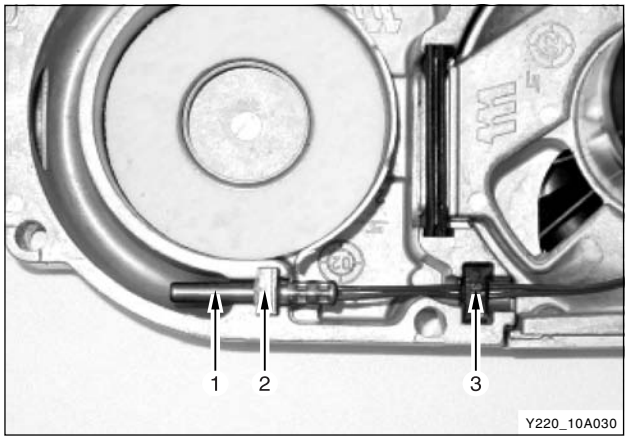
1. Glow plug
2. Combustion chamber with flame pipe

Combustion chamber housing



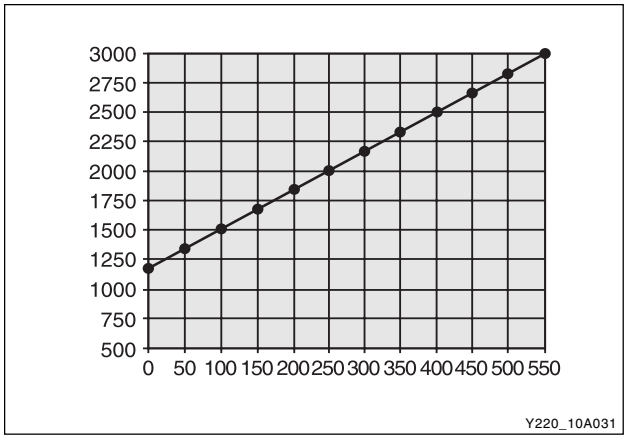
1. Jacket
2. Combustion chamber
3. Combustion chamber housing
4. Insulation washer
5. Seal - combustion chamber / combustion air fan
6. Seal - combustion chamber / heat exchanger

Flame sensor



1. Flame sensor
2. Graphite bush
3. Bush

Check flame sensor

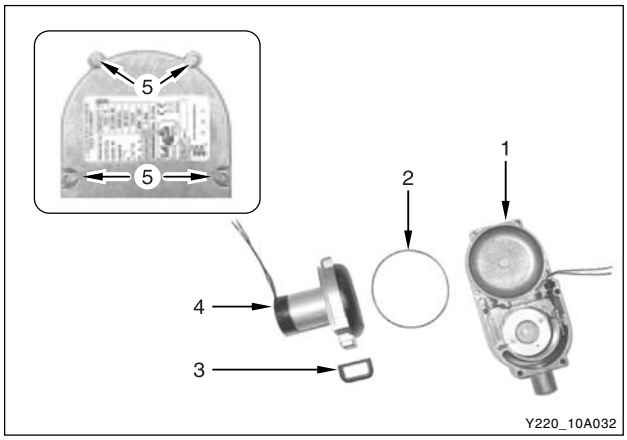


Check the surface sensor with a digital multimeter. If the resistance of flame sensor is out of specified values, the flame sensor is defective.

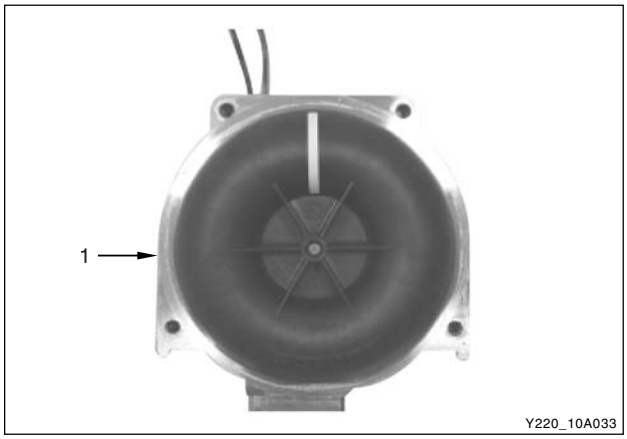
Specifiedl value

Temperature [℃]	0	10	20	30	50	80	90	100	130	150	200	250	300	350	400
Resistance [Ω]	1000	1022	1062	1097	1194	1309	1347	1385	1498	1573	1758	1941	2120	2297	2470
	±10	±10	±11	±11	±12	±13	±14	±15	±17	±20	±24	±28	±32	±36	±40

Combustion air fan



1. Combustion chamber
2. O-ring
3. Rubber seal
4. Combustion air fan



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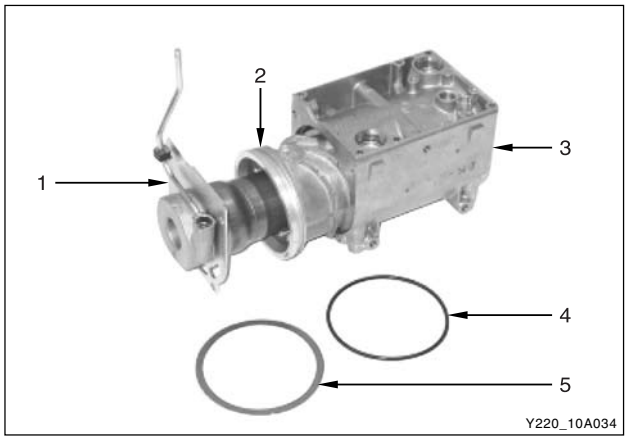
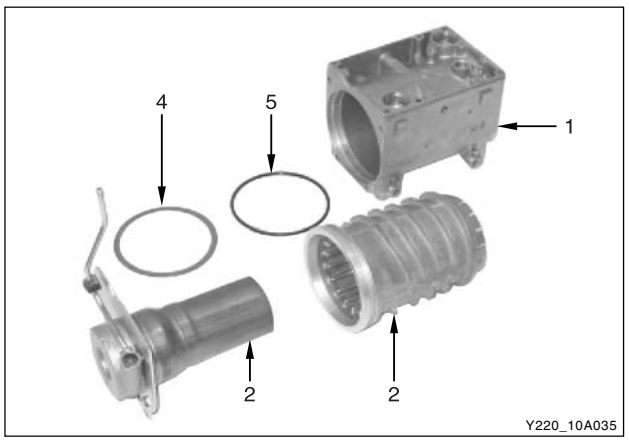
Combustion chamber



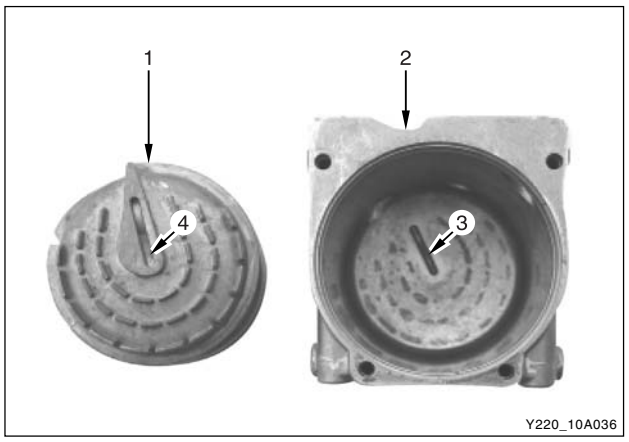
1. Combustion chamber
2. Heat exchanger
3. Jacket
4. O-ring
5. Seal - combustion chamber / heat exchanger

Heat exchanger



1. Jacket
2. Heat exchanger
3. Combustion chamber with flame tube
4. Seal - combustion chamber / heat exchanger
5. O-ring (for heat exchanger)

Heat exchanger



1. Heat exchanger
2. Jacket
3. Stopper
4. Groove (bottom of heat exchanger)

REMOVAL AND INSTALLATION

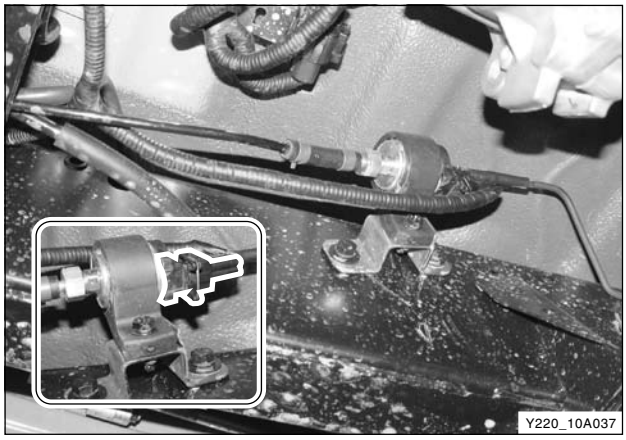
※ Preceding Work: Disconnection of negative battery cable

Notice

- ***This supplementary heater is a fuel burning type and improves the heating effect by increasing the engine coolant temperature.***
- ***This device is automatically operated by conditions of the coolant temperature and the ambient temperature.***
- ***In initial operating stage, the fuel pump generates the operating sound and the FFH heater produces white smoke for 10 to 20 seconds. These are normal states to fill the fuel into the FFH fuel line. Also, this white smoke may be produced immediately after replacing the FFH related fuel system.***

Fuel Pump - Removal and Installation

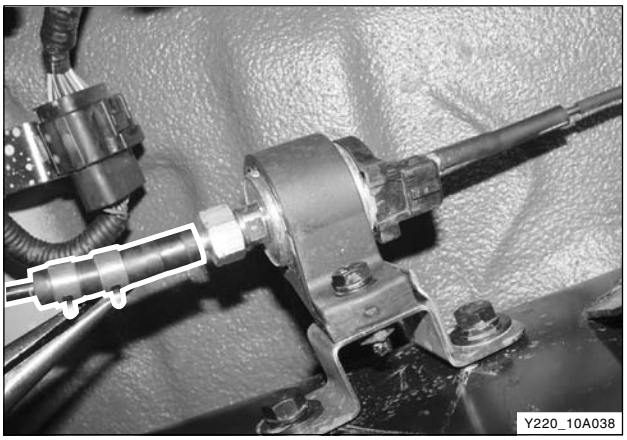
1. Lift up the vehicle and disconnect the fuel pump connector.



2. Remove the fuel supply hoses at both sides of fuel pump.

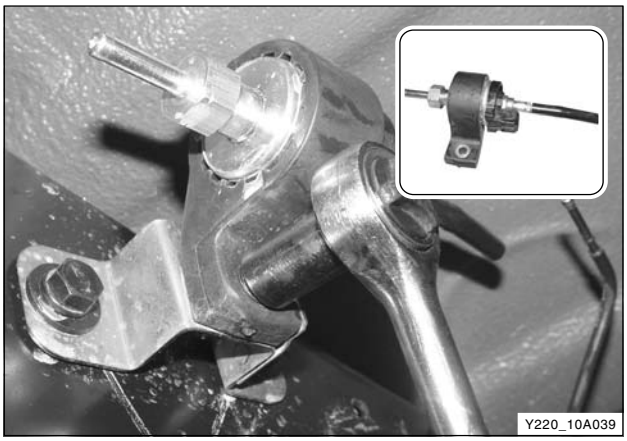
   Notice

   Plug the openings with sealing caps.



3. Unscrew the bracket bolt and remove the fuel pump.
4. Install in the reverse order of removal.

Tightening torque	10 ± 1.0 Nm



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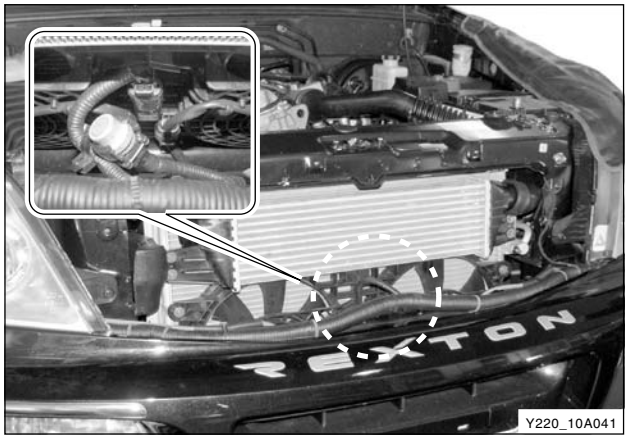
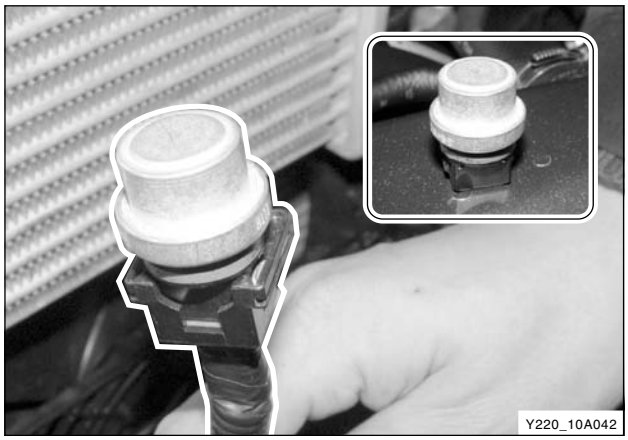
Ambient Temperature Switch - Removal and Installation

1. Remove the radiator grille.



2. Disconnect the ambient temperature switch connector behind the front bumper.

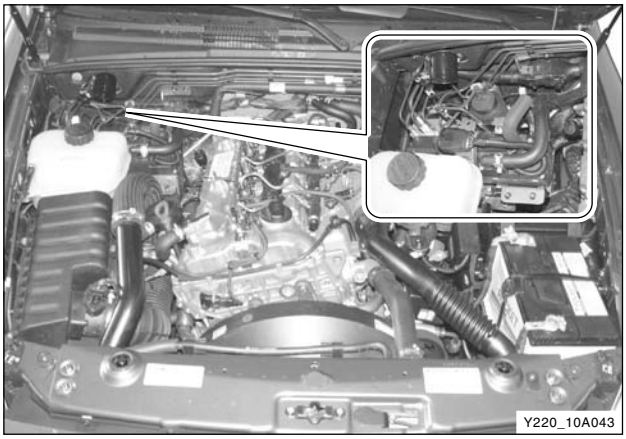


3. Remove the ambient temperature switch.

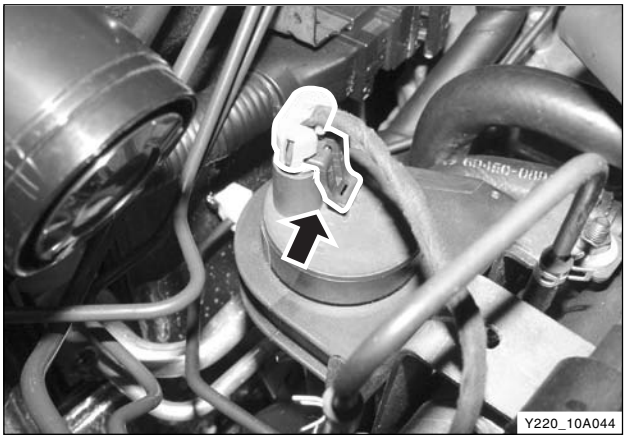
4. Install in the reverse order of removal.

FFH Unit - Removal and Installation

1. Open the engine hood.

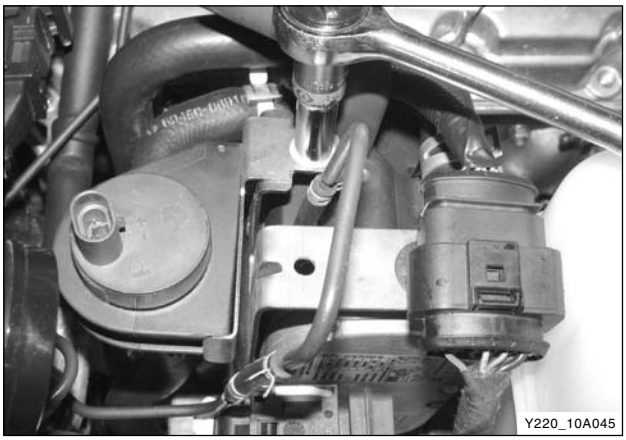


2. Disconnect the FFH coolant circulation pump connector.



3. Unscrew the bracket nut for coolant circulation pump.

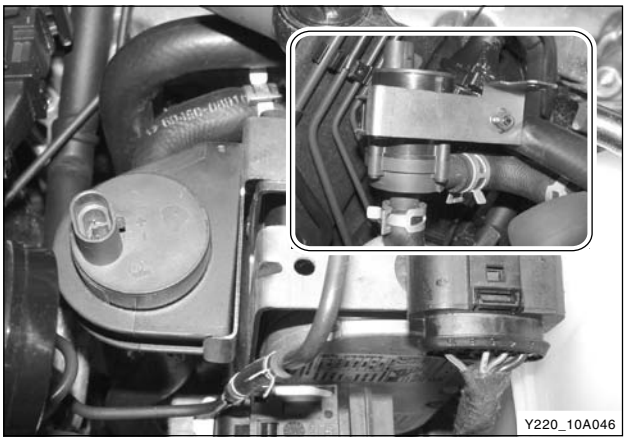
Tightening torque	10 ± 1.0 Nm

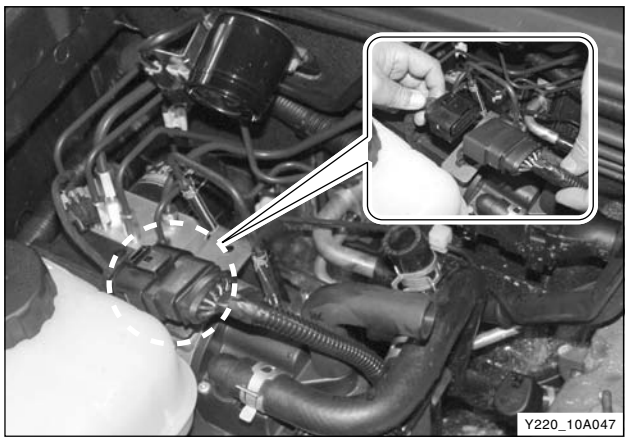


4. Release the clamps and remove the inlet and outlet hoses from coolant circulation pump.

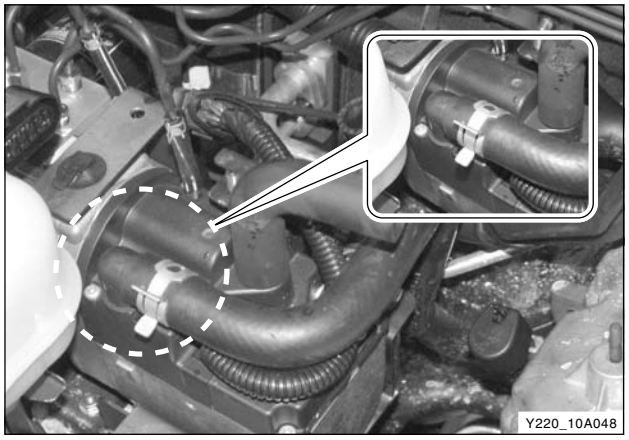
Notice

- ***Be careful not to splash the coolant to engine, painted surface and body.***
- ***The coolant hose is delivered as an assembly and the coolant hose bracket is installed to the transmission. When removing the hose, slightly lower the rear section of the transmission and pull out it through the clearance between engine and transmission.***





5. Disconnect the FFH connector.

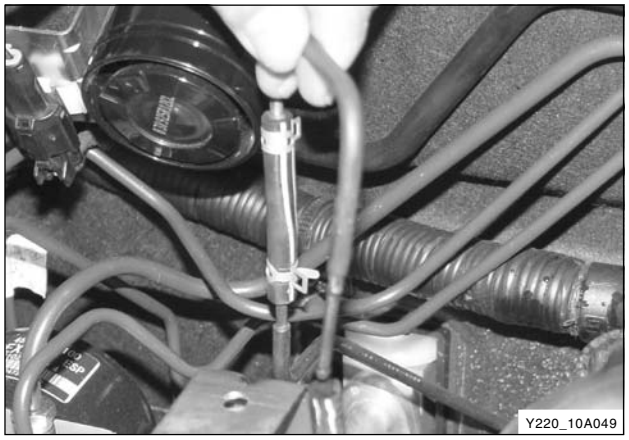


6. Remove the coolant outlet hose of FFH.

7. Remove the fuel supply hose.

Notice

Plug the opening with a sealing cap.



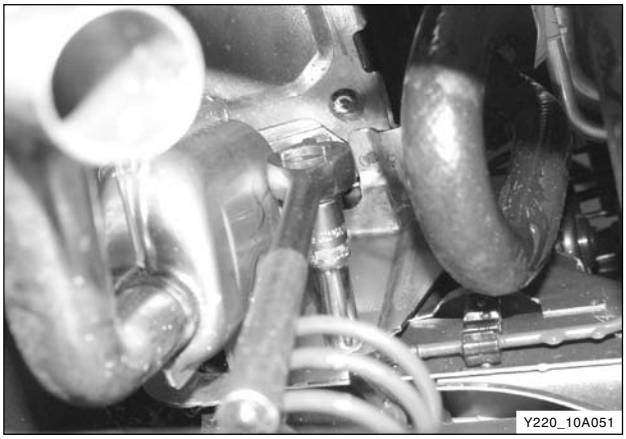
8. Remove the FFH mounting nuts.

Installation Notice

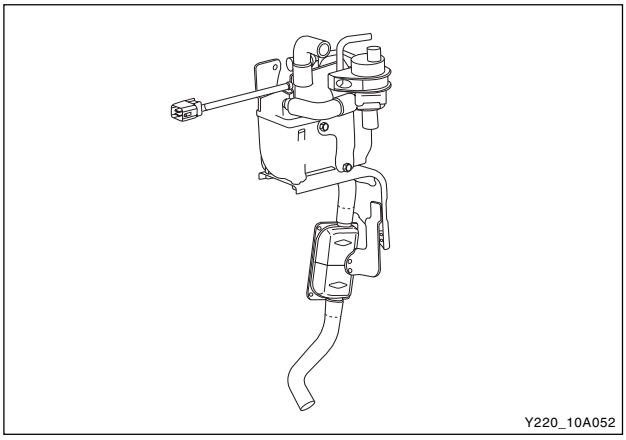
Tightening torque	10 ± 1.0 Nm

9. Remove the FFH silencer bracket bolts at both sides.

Tightening torque	10 ± 1.0 Nm



10. Remove the FFH unit.



11. Install in the reverse order of removal.

PTC SYSTEM

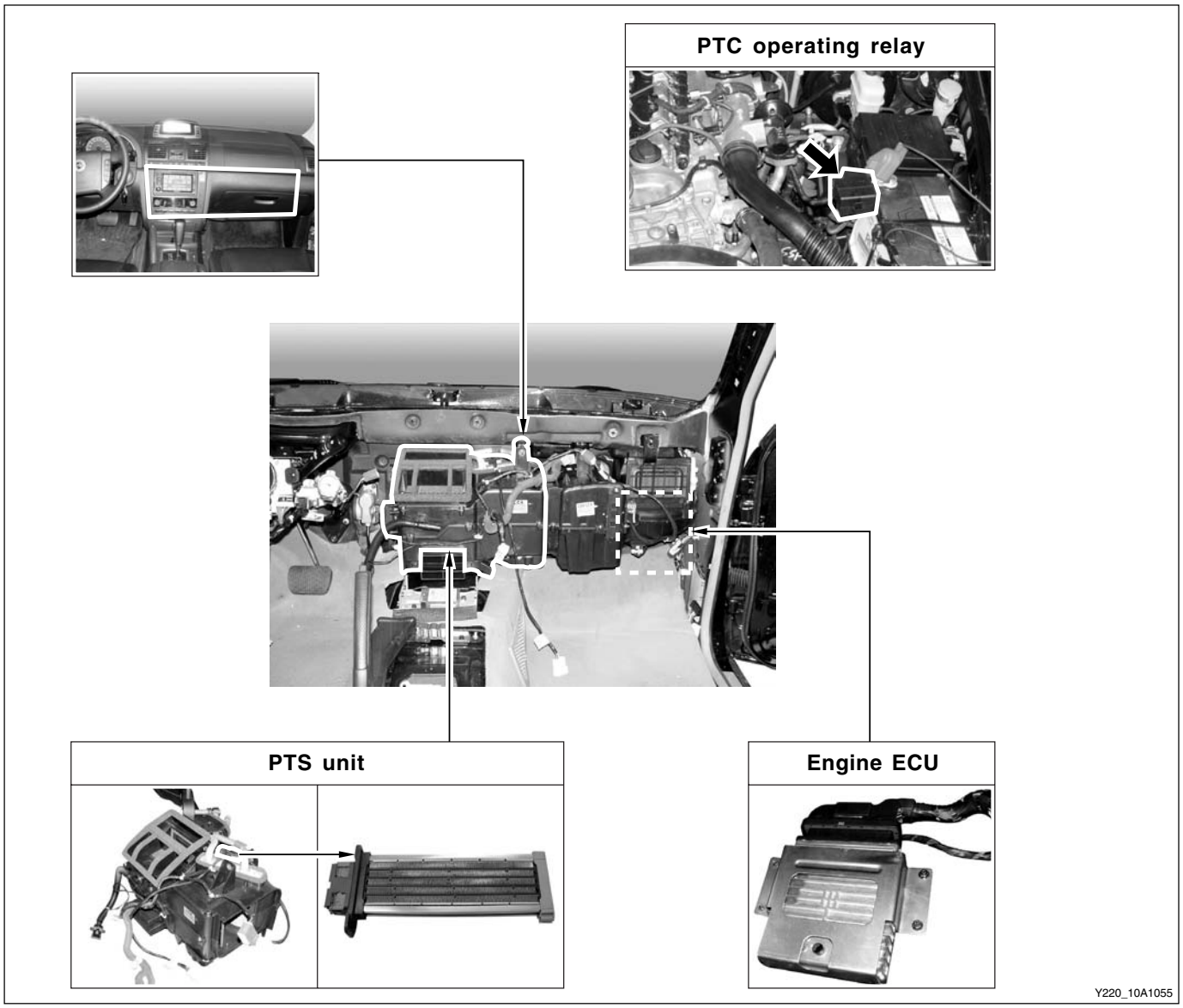
POSITIVE TEMPERATURE COEFFICIENT (PTC) SYSTEM

The supplementary electrical heater is installed in D27DT engine equipped vehicle as a basic equipment. The PTC system is operated by the measured temperature values at the coolant temperature sensor and the HFM sensor. This device improves the heating effect by increasing the temperature of flowing air into the passengers room. This system needs higher electric power than conventional system due to it heats the ceramic in PTC with the electricity. And, the alternator capacity has been largely increased (12 V ~ 75 A / 90 A to 12 V ~ 140 A).

Non-operational Condition

- During engine cranking
- Too low battery voltage (below 11 V)
- During preheating process of glow plugs

COMPONENTS LOCATOR



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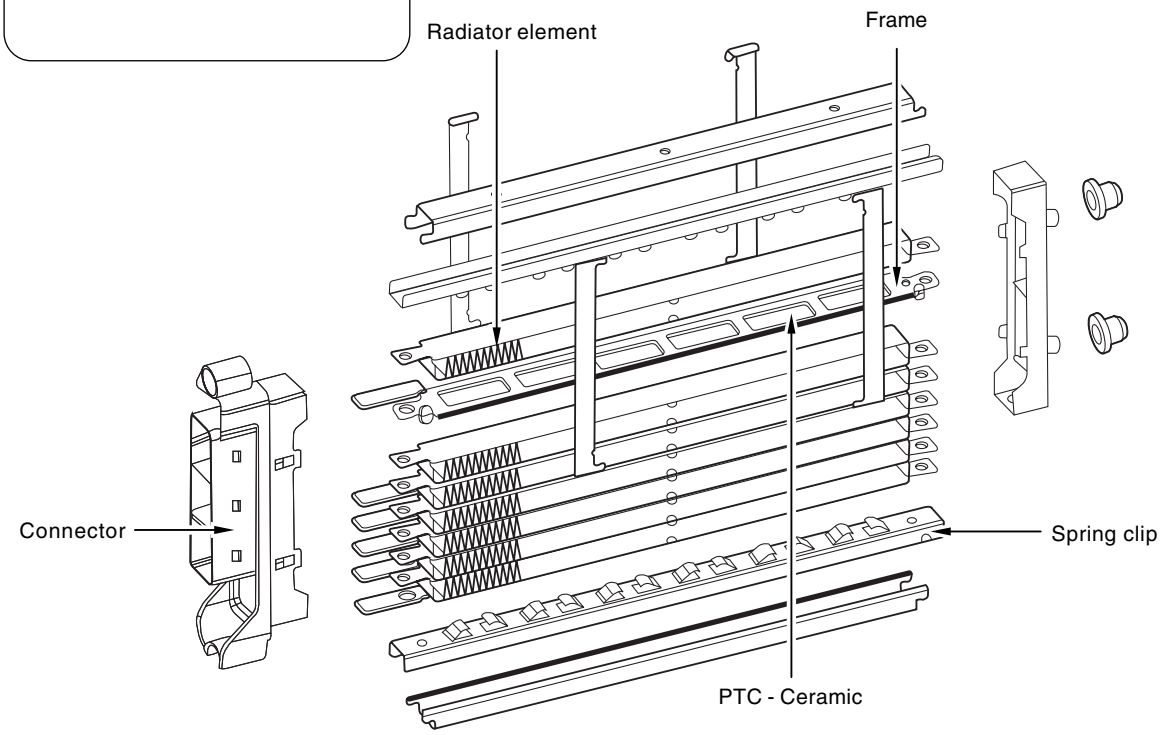
COMPONENTS



Y220_10A1053

CHARACTERISTICS OF PTC

	P.T.C Heater
Heating type	Air heating type
Heating efficiency	Excellent
Element	Ceramic PTC ($BaTio_3$)
Weight	approx. 500g
Durability	Excellent
Safety	Excellent
Advantages	- Stable output regardless of voltage changes - Block the overcurrent with switch effect of PTC element - High heating capacity in a moment - Excellent durability of heating element against high current

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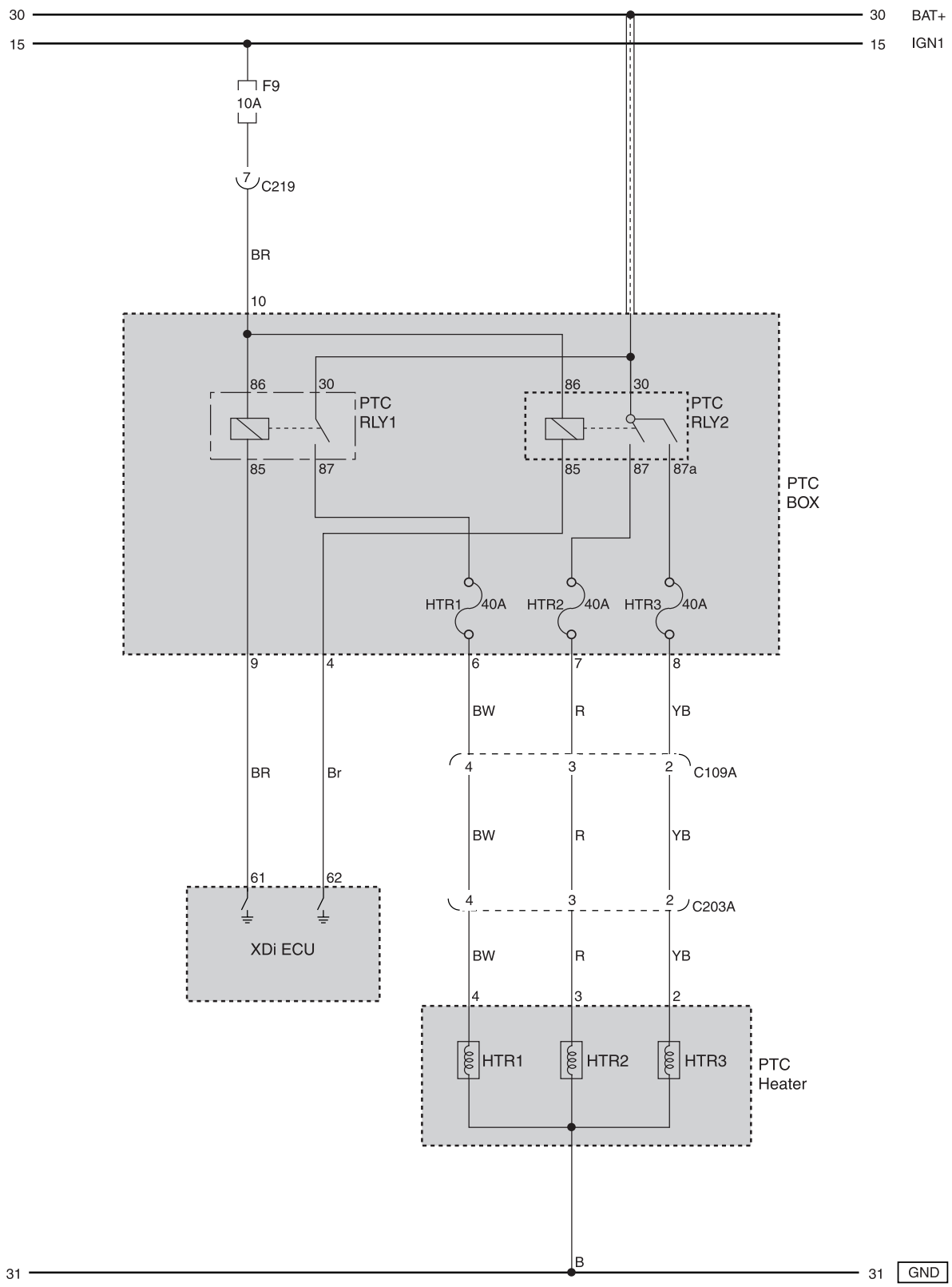
CIRCUIT DIAGRAM

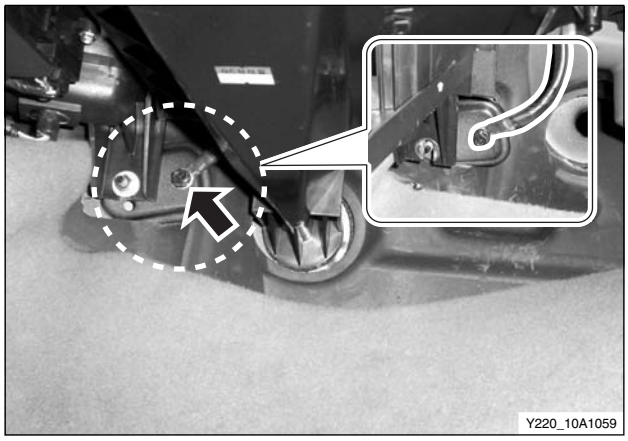


REMOVAL AND INSTALLATION

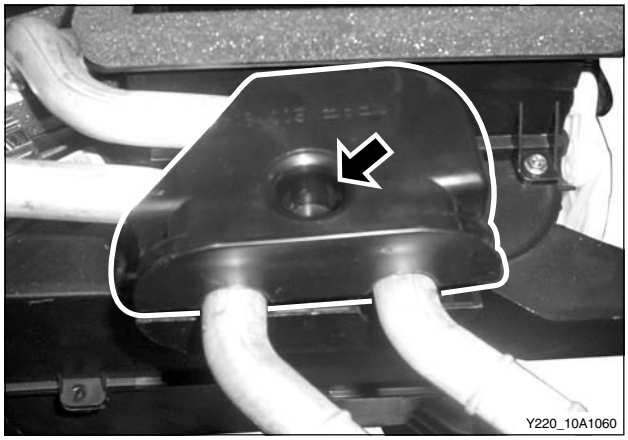
※ Preceding Works:
- Disconnection of negative battery cable
- Removal of instrument panel

1. Remove the heater hoses and air conditioner pipes from engine compartment panel and remove the heater assembly.

Remove the mounting nuts and PTC ground screw before removing the heater.



2. Remove the heater core pipe cover from the heater assembly.



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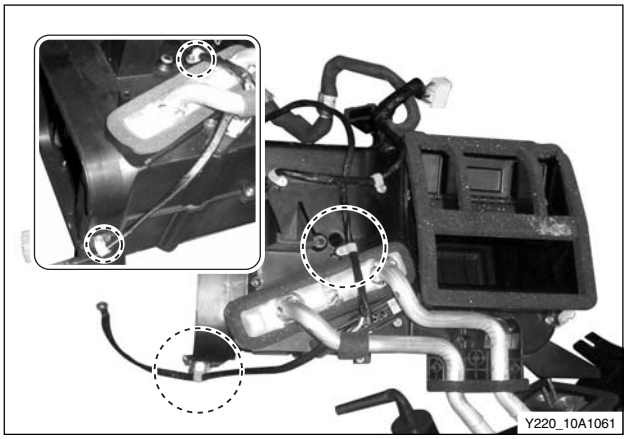
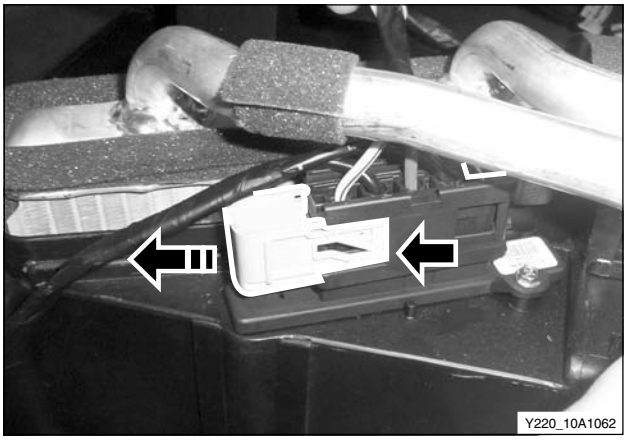
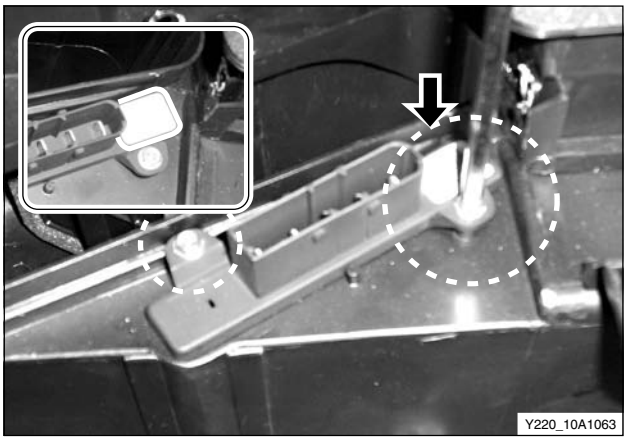


3. Remove the two PTC wiring harness bolts.
   - One at PTC ground cable
   - One at wiring harness (heater core side)



4. Remove the heater core.
5. Disconnect the PTC connector (slide lock type connector).
6. Remove the PTC wiring harness from the heater assembly.



7. Unscrew the bolts and remove the PTC.

Installation Notice

Make sure that the label attached surface is facing to driver seat when installing.

8. Install in the reverse order of removal.

SECTION 10B

HEATER & VENTILATION SYSTEM

Table of Contents

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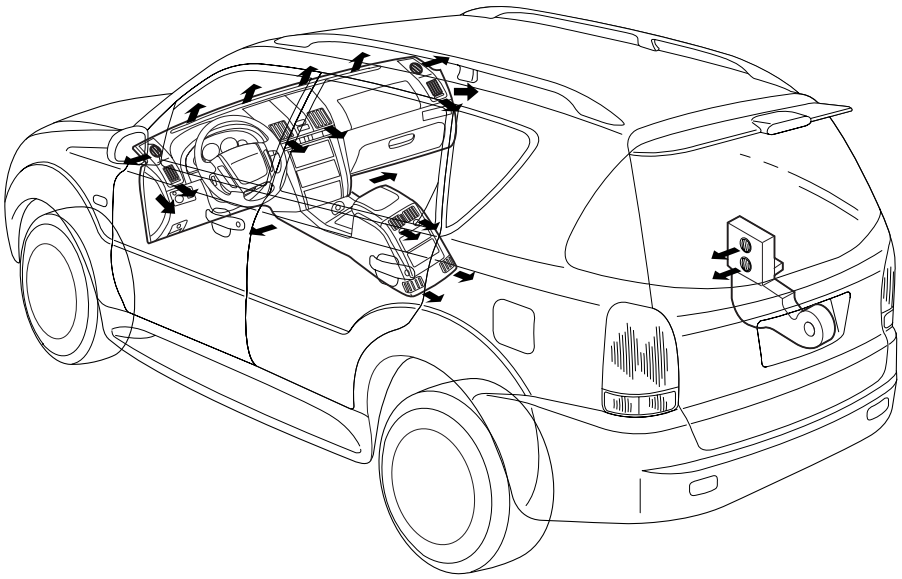
GENERAL INFORMATION

OVERVIEW

The heater system is designed to provide heating, ventilation, windshield defrosting. The heater and fan assembly regulates the air-flow from the air inlet for further processing and distribution. The heater core transfers the heat from the engine coolant to the inlet air.

The heater system consists of the heater hoses, heater module, blower motor and control system.

The control switch assembly installed on the instrument panel regulates the temperature, amount and flow direction of the air.



Y220_10B001

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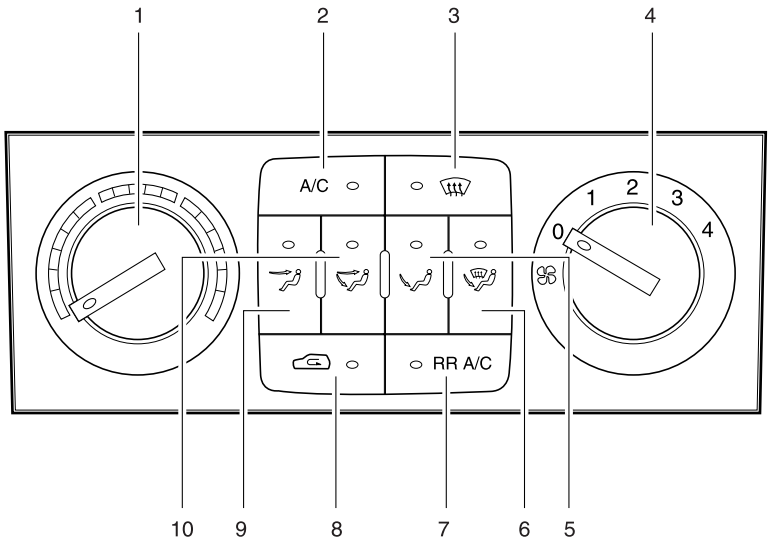
MANUAL AIR CONDITIONER

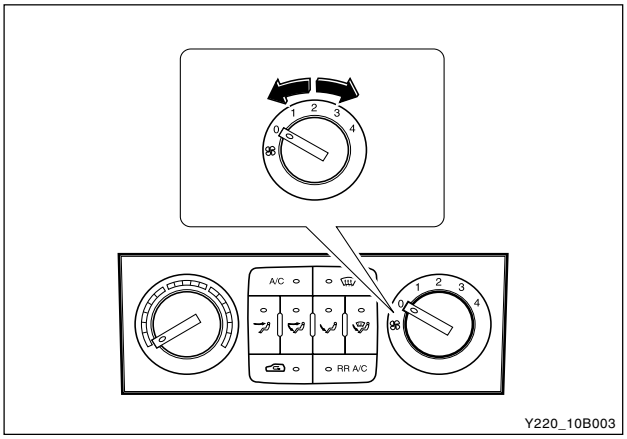


Y220_10B002

1. Temperature control switch
2. Air conditioner switch
3. Mode (defrost) switch
4. Fan speed control switch
5. Mode (foot) switch
6. Mode (defrost/foot) switch
7. Rear air conditioner switch
8. Air source selection switch
9. Mode (face) switch
10. Mode (face/foot) switch

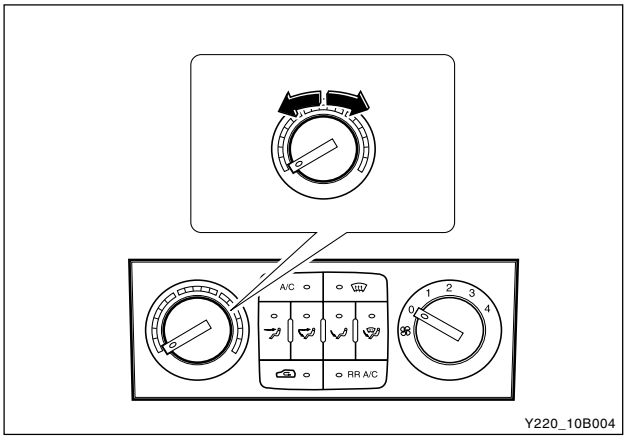
▶ Fan Speed Control Switch

The fan speed can be adjusted in 4 stages by this switch.



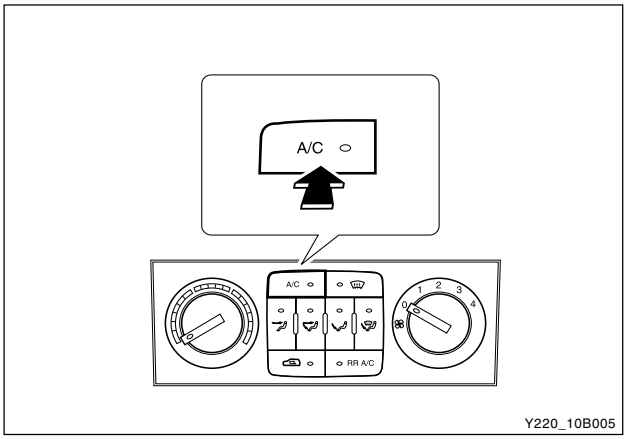
▶ Temperature Control Switch

This switch controls the temperature of the inlet air.



▶ Air Conditioner Switch

To turn on the air conditioner, press this switch while the fan speed control switch is not “0” position. To turn off, press it again.



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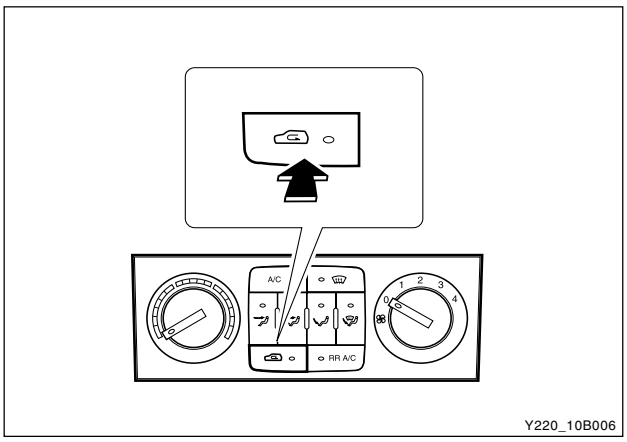


Y220_10B006

▶ Air Source Selection Switch (AMB Switch)

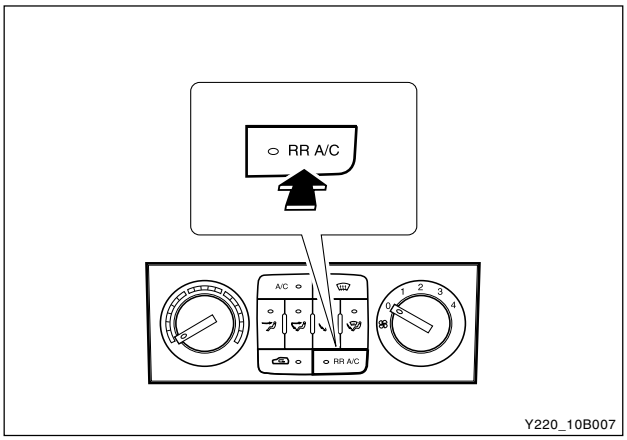
By pressing the switch, outside air intake mode and recirculation mode changes alternatively.

Notice

- ***In rainy or high humid condition, the difference between the outside air and the temperature of the windshield may cause the windows to fog, thereby restricting your view. This can lead to an accident which can damage your vehicle and cause personal injuries. In this case, push the AMB switch into ambient mode and press the defroster switch to remove the fog on the windshield.***

Notice

- ***Continued operation in the recirculation mode could cause interior to become stuffy and windows to fog up. Use recirculation mode in short period of time. And, it may cause a deadly intoxication if carbon monoxide has already flown into the passenger compartment. After paseed through the contaminated area, press the recirculation switch again to draw outside air into the passenger compartment.***
- ***Use the air recirculation mode only in short period of time.***
- ***When pressing the defroster switch in air recirculation mode, the air flow direction is automatically changed to the fresh air intake mode.***



Y220_10B007

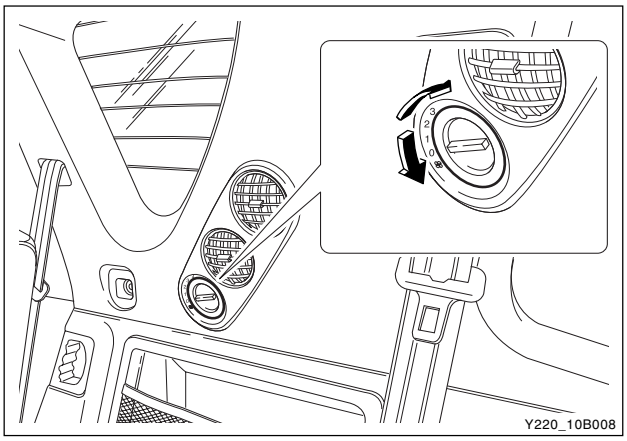
▶ Rear Air Conditioner Switch

Press the switch to operate the rear air conditioner.

Press the switch again to stop the rear air conditioner.

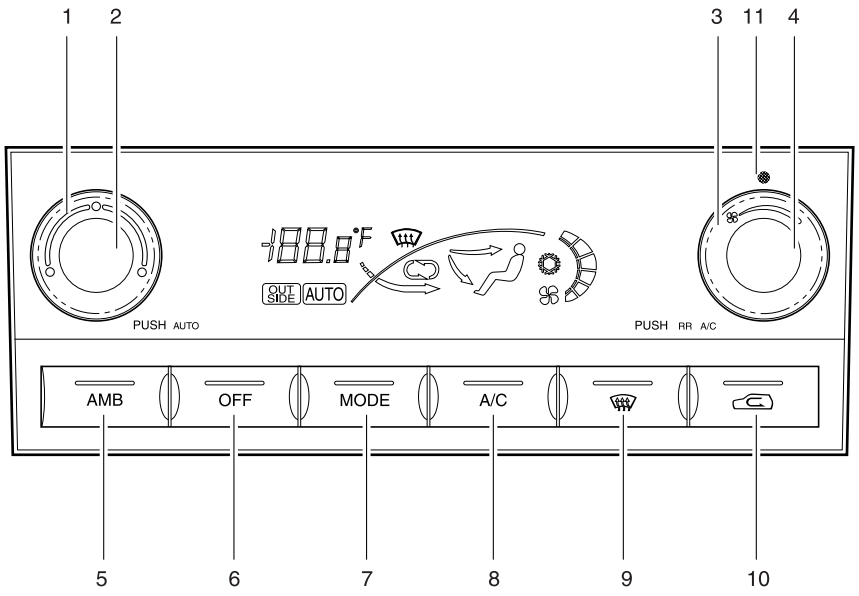
Operation

1. Turn on the front air conditioner switch and fan speed control switch.
2. Press the rear air conditioner switch.
3. Rotate the rear fan speed control switch to operate the rear air conditioner.


Y220_10B008

- When the switch is rotated, the fan speed will be controlled in 3 stages.
- With the separate airflow direction control lever, you can adjust the airflow direction.
- The rear air conditioner cannot operate without turning on the front air conditioner switch, front fan speed control switch and rear air conditioner switch even if the rear fan speed control switch is operated. However, the air comes in according to fan speed control switch position.
- The rear air conditioner doesn't provide heater function.

AUTOMATIC AIR CONDITIONER



Y220_10B009

1. Temperature control switch
2. AUTO switch
3. Fan speed control switch
4. Rear air conditioner switch
5. AMB switch
6. OFF switch
7. MODE switch
8. Air conditioner switch
9. Defrost switch
10. Air source selection switch
11. Rear air conditioning indicator

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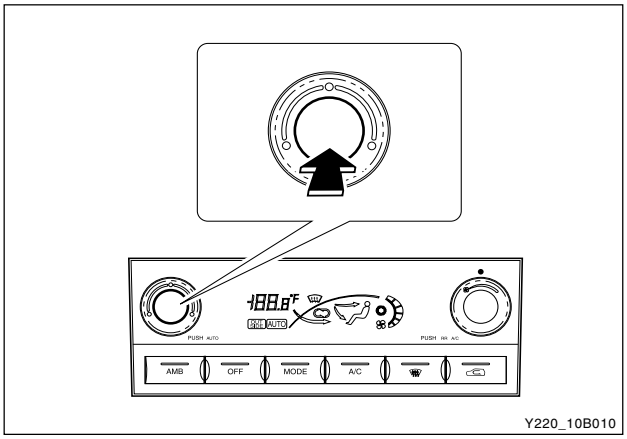
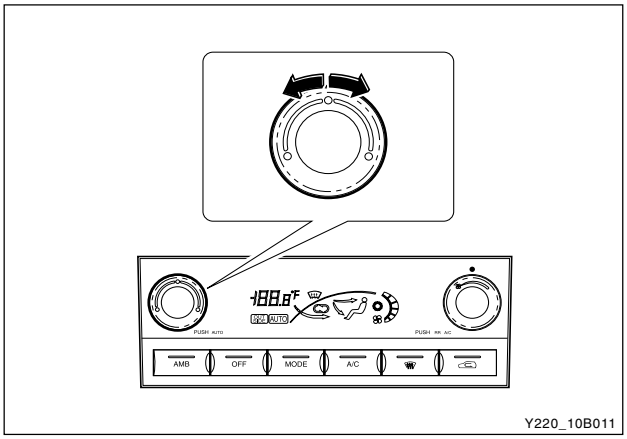


Y220_10B010

▶ Auto Switch

Press this switch to turn on the system. On the VFD, the AUTO indicator will be comes on. In 'AUTO' mode, the fan speed, air flow and air vent will be automatically controlled according to the preset temperature.

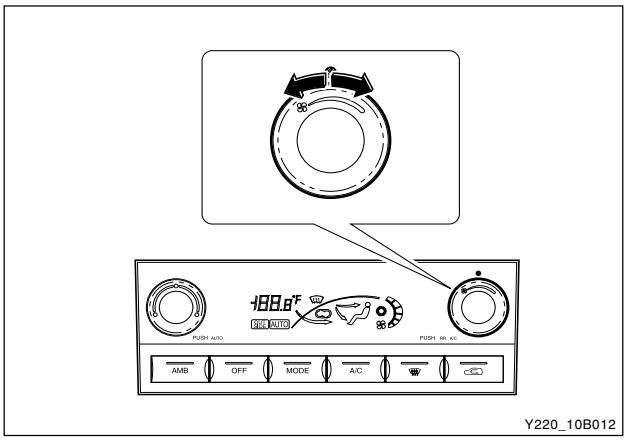


Y220_10B011

▶ Temperature Control Switch

The temperature can be adjusted between 18°C ~ 32°C.

- Turn the switch counterclockwise to lower the temperature by 0.5°C of decrement.
- Turn the switch clockwise to raise the temperature by 0.5°C of increment.



Y220_10B012

▶ Fan Speed Control Switch

The fan speed can be adjusted in 6 stages.

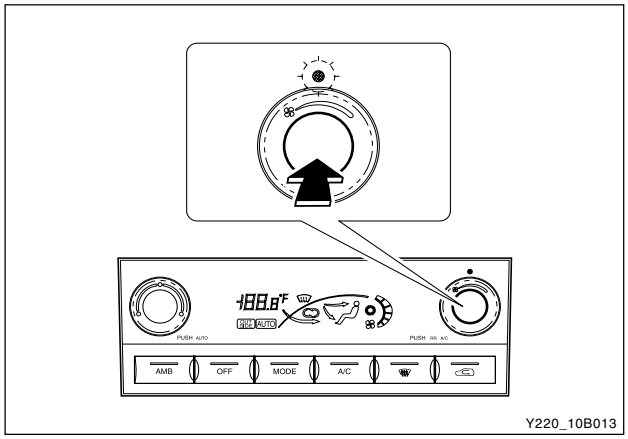
- Turn the switch counterclockwise to reduce the fan speed.
- Turn the switch clockwise to increase the fan speed.

  When the switch is operated, the fan speed shows up as bar and "AUTO" goes out.

Notice

- ***If the air conditioner switch is turned off, the air conditioner does not work even when the fan switch is operated. However, the air will flow due to fan operation.***
- ***To prevent battery discharge, do not run the fan for over extended period of time if the engine is not running.***

▶ Rear Air Conditioner Switch



Y220_10B013

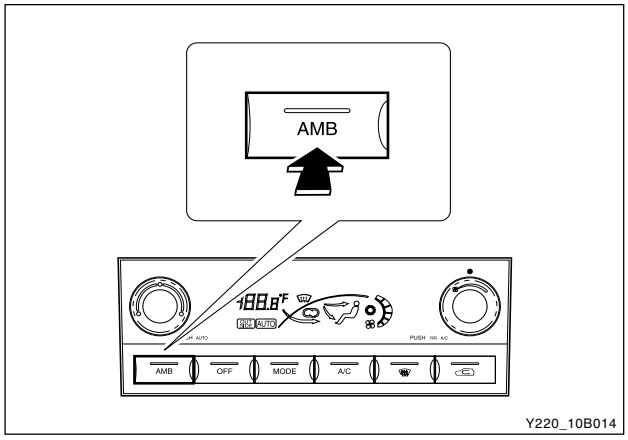
Press the switch to operate the rear air conditioner.

Press the switch again to stop the rear air conditioner.

Operation

1. Turn on the front air conditioner switch and fan speed control switch.
2. Press the rear air conditioner switch.
3. Rotate the rear fan speed control switch to operate the rear air conditioner.
   - When the switch is rotated, the fan speed will be controlled in 3 stages.
   - With the separate airflow direction control lever, you can adjust the airflow direction.
   - The rear air conditioner cannot operate without turning on the front air conditioner switch, front fan speed control switch and rear air conditioner switch even if the rear fan speed control switch is operated. However, the air comes in according to fan speed control switch position.
   - The rear air conditioner doesn't provide heater function.

▶ AMB Switch



Y220_10B014

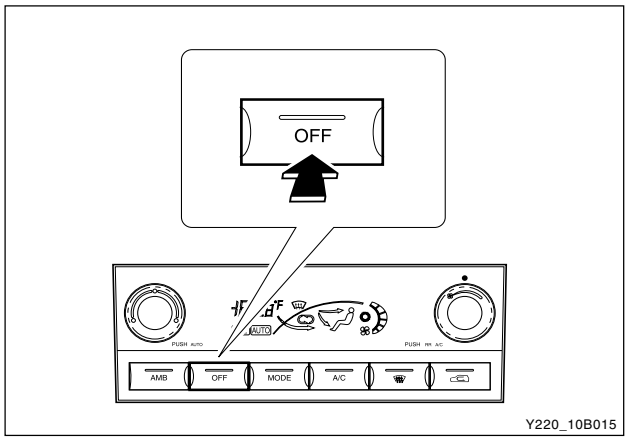
If pressing this switch, it will show you the ambient temperature for 5 seconds. It will be returned to its original display after displaying the temperature. On the VFD, the OUTSIDE indicator will be comes on.

If pressing the switch again during its ambient temperature display, it will be returned to its original display.

Notice

- ***The correct ambient temperature can be only while driving with over 20 km/h of speed. If the vehicle is stationary, the ambient temperature may not be correct due to ground heat or engine heat.***

▶ OFF Switch



Y220_10B015

If pressing this switch to turn off the air conditioning system and "AUTO" and fan speed is displayed on the VFD.

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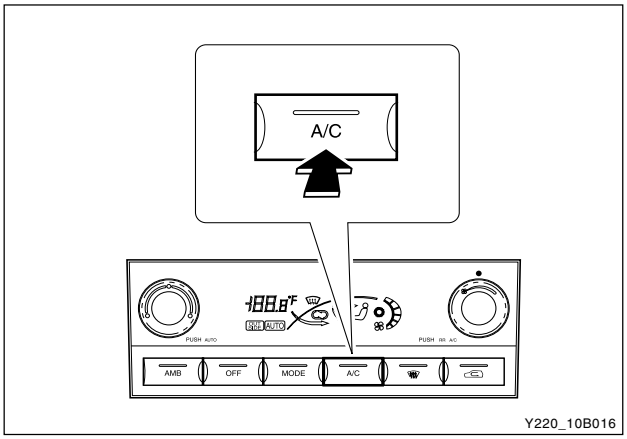


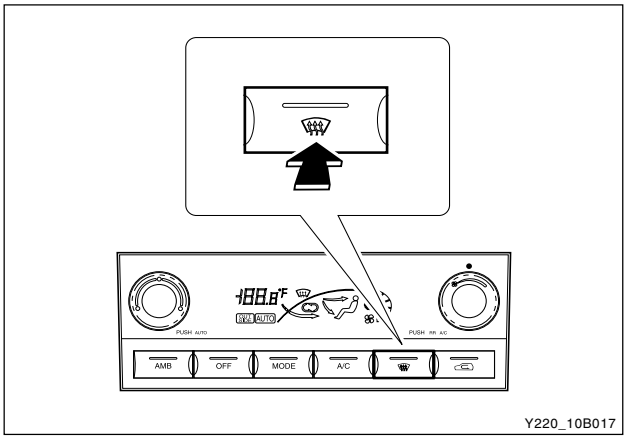
Y220_10B016

▶ Air Conditioner Switch

When pressing this switch, the indicator light (❄) comes on and the air conditioner starts to operate. When you press the switch again, the air conditioner stops operation and indicator goes out. AUTO indicator doesn't come on during the switch operation.

Notice

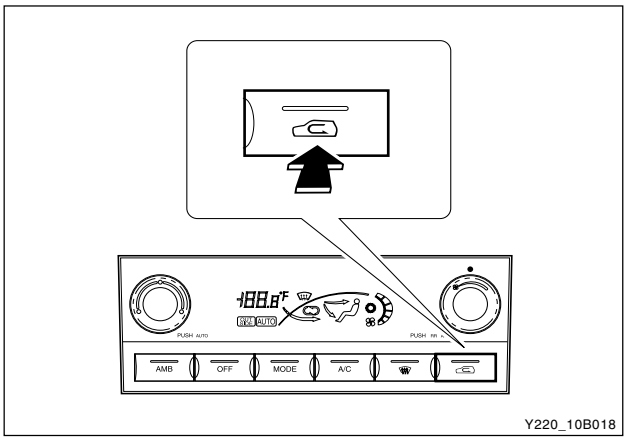
When the ambient temperature is extreme low, the air conditioner may not operate to protect the air conditioner system even the switch is pressed and the indicator came on.



Y220_10B017

▶ Defrost Switch

When pressing this switch, the airflow direction will be changed to windshield and door glasses, the air conditioner operates automatically and outside air comes in. At this moment, the indicator (⛆) comes on. When the defrosting is completed, press the switch to return to normal operations. When the switch is operated, the air conditioner indicator (❄) and fresh air intake mode indicator ( ) comes on. At this moment, AUTO indicator goes out.



Y220_10B018

▶ Air Source Selection Switch

By pressing the switch, outside air intake mode and recirculation mode changes alternatively. When the fresh air intake mode is selected, indicator ( ) comes on. Recirculation mode is selected ( ) indicator comes on. When the switch is operated, the AUTO indicator goes out.

Notice

- ***Press this switch when driving in dusty conditions or to avoid traffic or outside fumes, and when quick cooling or heating of the passenger area is required.***
- ***Continued operation in the recirculation mode could cause interior to become stuffy and windows to fog up. Use the recirculation mode in short period of time.***

Note

If pressing ( ) or (⛆) switch while the air source is recirculation mode, air source selection is automatically changed to outside air intake mode.

Notice

- ***In rainy or high humid condition, the difference between the outside air and the temperature of the windshield may cause the windows to fog, thereby restricting your view. This can lead to an accident which can damage your vehicle and cause personal injuries. In this case, select the fresh air intake mode with the recirculation switch and press the defroster switch to remove the fog on the windshield.***
- ***Continued operation in the recirculation mode could cause interior to become stuffy and windows to fog up. Use recirculation mode in short period of time. And, it may cause a deadly intoxication if carbon monoxide has already flown into the passenger compartment. After paseed through the contaminated area, press the recirculation switch again to draw outside air into the passenger compartment.***
- ***Use the air recirculation mode only in short period of time.***
- ***When pressing the defroster switch in air recirculation mode, the air flow direction is automatically changed to the fresh air intake mode.***

▶ Automatic Heating and Air Conditioning

- Press the AUTO switch to turn on the system and set the temperature with the temperature control switch. In 'AUTO' mode, the fan speed, air flow and air vent will be automatically controlled according to the preset temperature.

Note

- ***The AUTO indicator comes on in 'AUTO' mode.***
- ***The temperature can be adjusted between 18°C ~ 32°C by 0.5°C of increment or decrement.***

Notice

If not necessary, do not operate the temperature control switch after once set up. It may need longer time to reach the preset temperature.

* To turn off the "AUTO" air conditioning, press OFF Switch.

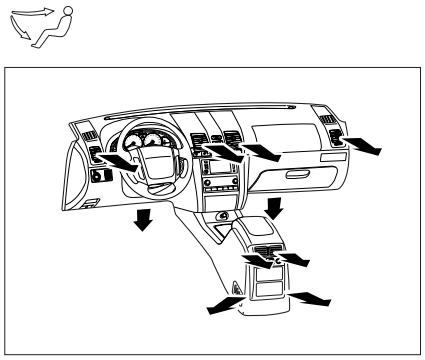
Note

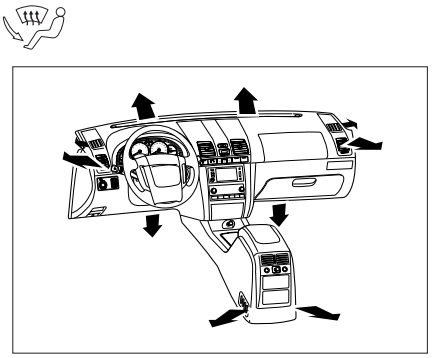
During the winter or summer, to prevent the direct blow of the cold or hot air, the fan speed will start from first stage or the air flow will be directed to defrost mode while the initial operation of air conditioner.

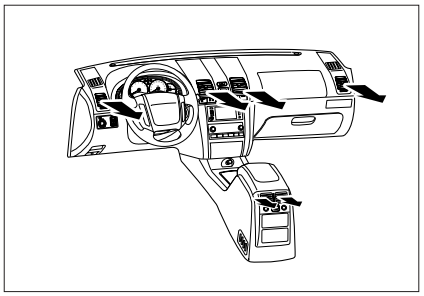
Notice

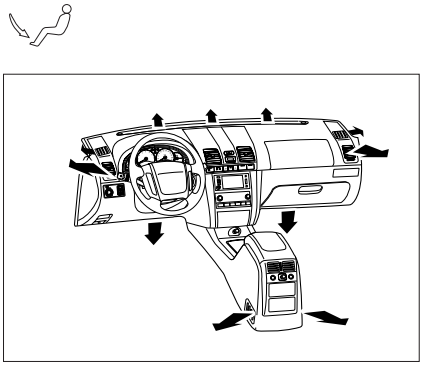
If the temperature indicator blinks during vehicle starting, there are defectives in the automatic air conditioner. In this case, operate the air conditioner manually and check it.

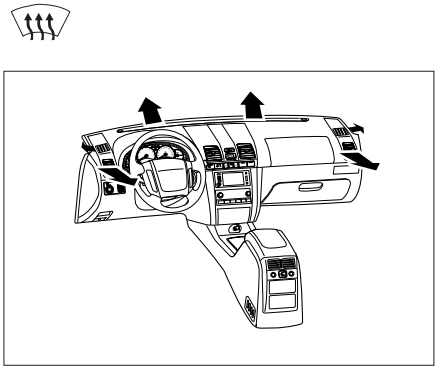
AIR FLOWS THROUGH VENTS (MODE SWITCH OPERATIONS)











Y220_10B019

SPECIFICATIONS

Blower motor	Max. Capacity	7.425 ~ 9.075 kcal/h
Heater core	Fin pitch	1.52 mm
	Size (L X H X W)	194.6 x180 x 35 mm
	Heating capacity	8,250 (Min. 4,700) kcal/h
Blower motor resistance	1st mode	3.25 Ω
	2nd mode	1.45 Ω
	3rd mode	0.35 Ω
	4th mode	0 Ω
Front A/C and heater unit	Type	Heater + Evaporator and blower (2 pieces)
	Heating capacity	Min. 4600 kcal/h (5.5 m^3/Min)
	Cooling capacity	Min. 4700 kcal/h (7.5 m^3/Min)
	Expansion valve	Block Type
	Input power	Max. 250 W
Rear cooler	Type	Evaporator and blower (only cooler)
	Cooling capacity	Min. 2700 kcal/h (5 m^3/Min)
	Expansion valve	ANGLE Type
	Input power	Max. 180 W

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AIR DISTRIBUTION

▶ Mode Door Motor

Location

Located at the left side of heater case.

Function

Controls the air outlet directions: Vent, Bi-level, Foot, Foot/ Def or Def mode.

▶ Air Source Door Motor

Location

Located at the upper right side of blower housing.

Function

Selects the air source by operating the air source door motor: Outside air intake and recirculation mode.

▶ Air Mix Door Motor

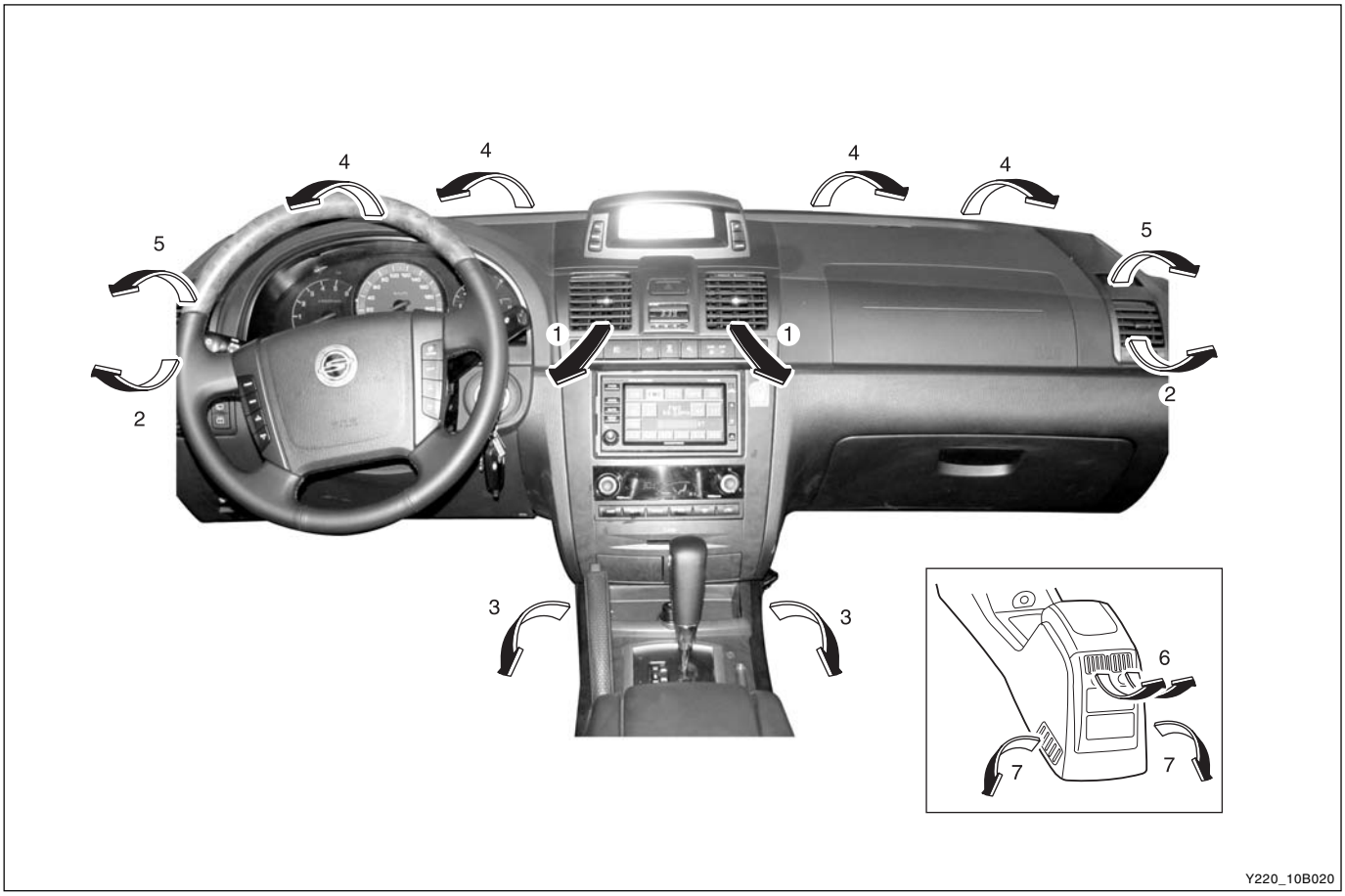
Location

Located at the bottom of heater housing

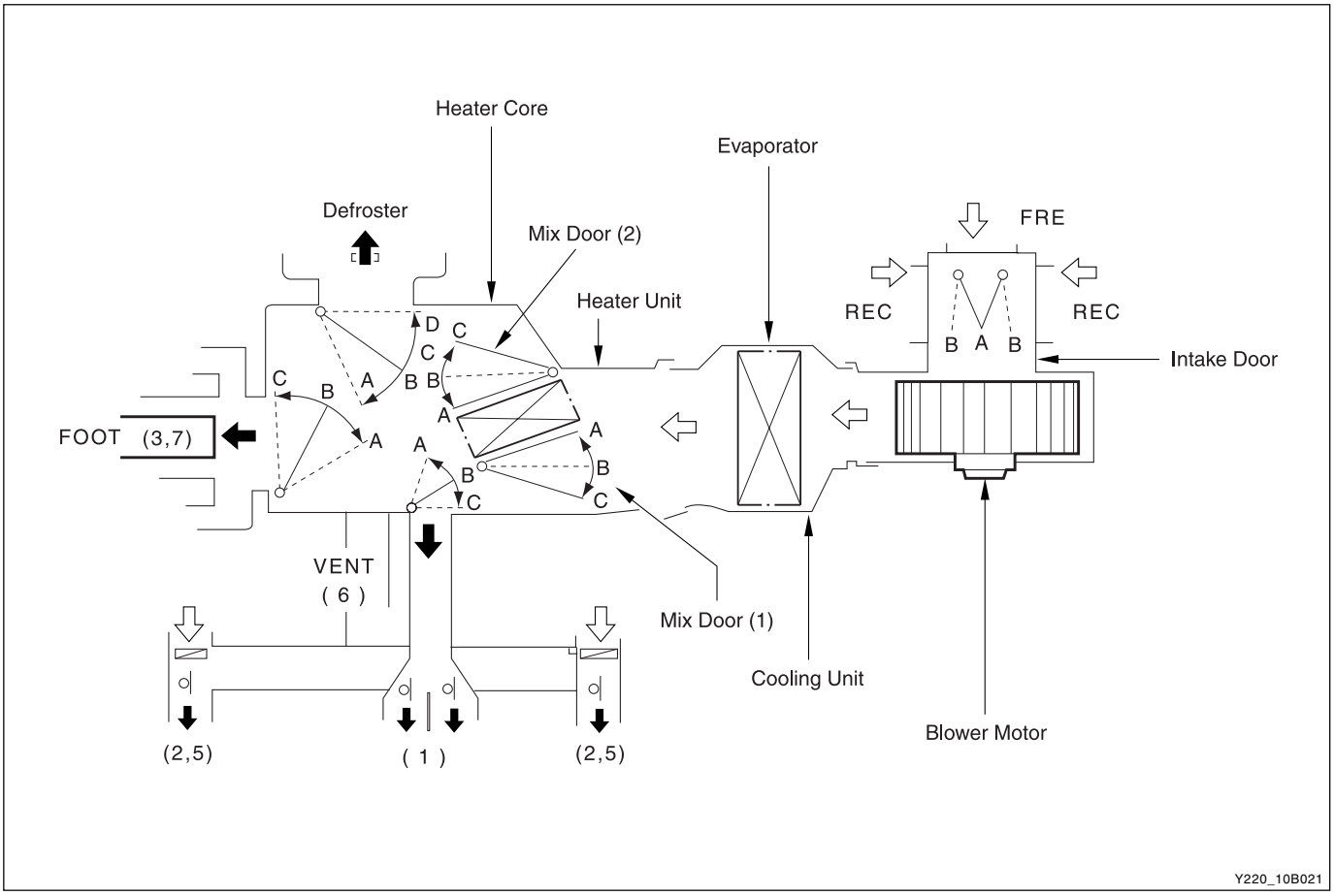
Function

Controls the outlet air temperature by opening an closing the damper.

▶ Air Flows



MODE		VENT	BI-LEVEL	FOOT	FOOT/DEF	DEF	Air Source Selection Switch		Temperature Control Switch
							REC	FRE	
Front	CENTER VENT (1)	A	B	-	-	-	-	-	-
	SIDE VENT (2)	A	B	B	B	B	-	-	-
	FOOT (3)	-	C	B	C	-	-	-	-
	DEFROSTER (4)	-	-	D	C	B	-	-	-
	SIDE DEF (5)	-	-	D	D	C	-	-	-
Rear	VENT* (6)	B	C	-	-	-	-	-	-
	FOOT (7)	-	C	B	D	-	-	-	-
INTAKE Door							(A) Recirculation	(B) Fresh air	-
AIR MIX Door							-	-	A B C



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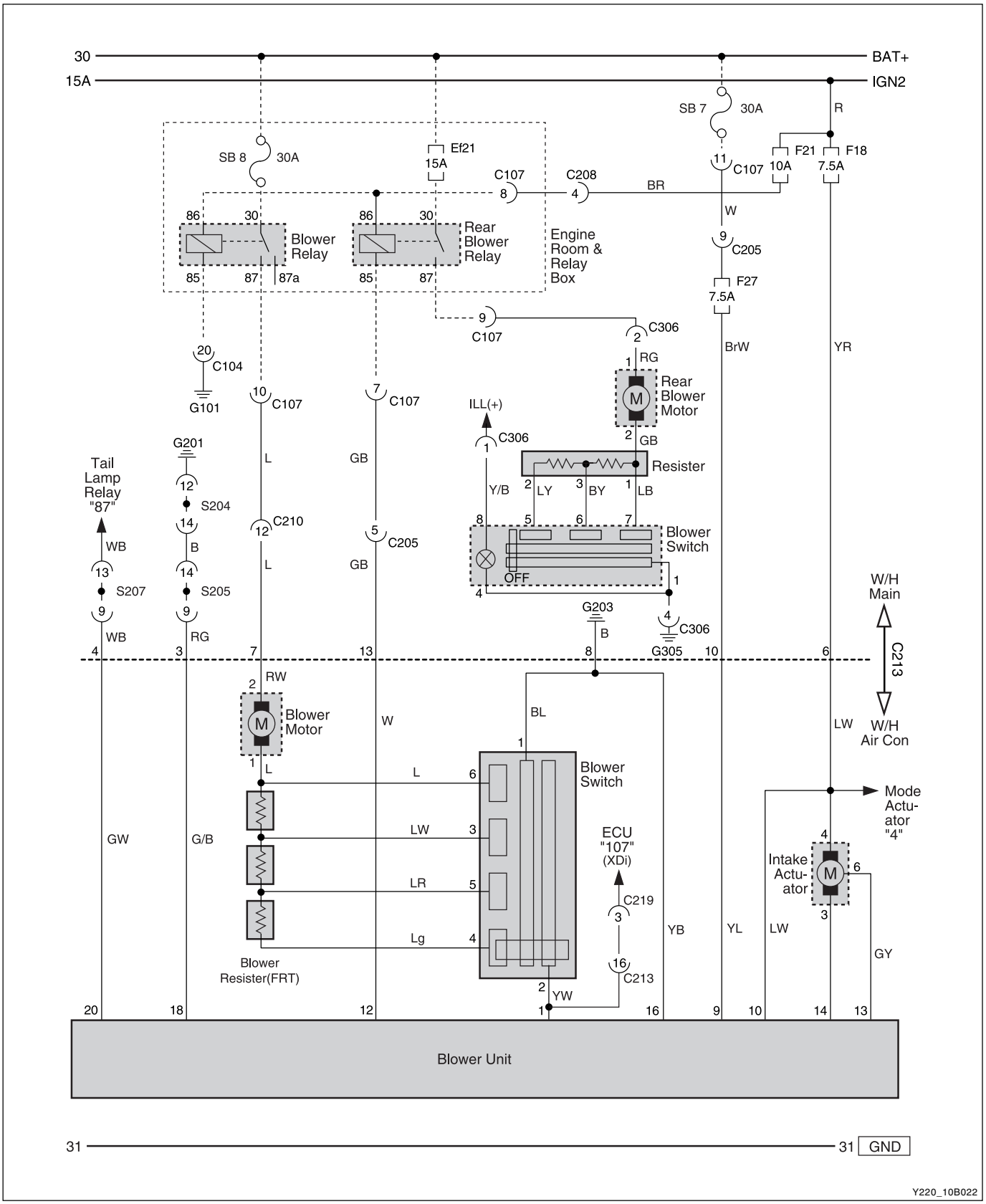
CIRCUIT DIAGRAM

▶ Blower Motor



TROUBLE DIAGNOSIS

INSUFFICIENT HEATING OR DEFROSTING

Step	Action	Yes	No
1	Check the coolant level, the serpentine accessory drive belt for tension or damage, coolant hoses for leaks or kinks, coolant reservoir cap. Is the repair complete?	System OK	Go to Step 2
2	1. Set the temperature control switch to full hot. 2. Set the blower motor switch on 4. 3. Turn the ignition ON. 4. Check for the airflow from the vent outlet. Is there a heavy airflow from the vent outlet?	Go to Step 4	Go to Step 3
3	Recheck the Heater system and then repair as needed. Does the system operate properly?	System OK	Go to Step 7
4	Check for change in the airflow at various blower speeds. Does the blower speed increase as the switch is turned from 1 to 4?	Go to Step 5	Go to “Blower Electrical”
5	With the engine idle, remove the coolant reservoir cap and watch the flow of the coolant. Is the coolant flow visible?	Go to Step 6	Go to Step 8
6	1. Check for a restriction in the cooling system, failed water pump impeller, faulty thermostat. 2. Make repairs to the cooling system, as needed. Is the repairs complete?	System OK	-
7	Check the airflow from the Defrost and vent outlets. Is there a heavy airflow from there?	System OK	Go to Step 9
8	1. Check the vehicle for cold air leaks at the Instrument panel, Heater case and Vents. 2. Repair and replace any leaks or obstructions. Are the repairs complete?	System OK	Go to Step 15
9	Set all the selection switches to Defrost. Is there a heavy airflow from any step?	Go to Step 10	Go to Step 11
10	Check the vent outlets and repair as needed. Is the repair complete?	System OK	-
11	Check for change in the airflow at various blower speeds and then repair as needed. Is the repair complete?	Go to Step 12	Go to “Blower Electrical”
12	Check for obstructions in the system at the blower inlet and repair as needed. Is the repair complete?	System OK	Go to Step 13
13	1. Set the blower motor switch on 4. 2. Slide the temperature control knob from full hot to full cold. 3. Listen for an airflow change. Does the airflow change?	Go to Step 14	Go to Step 19
14	1. Repair the temperature door travel, cables and linkage as required. 2. Verify the accuracy of the temperature controls at full hot. Is the repair complete?	System OK	-

INSUFFICIENT HEATING OR DEFROSTING (Cont'd)

Step	Action	Yes	No
15	1. Turn the ignition "LOCK". 2. Turn the temperature control knob to full cold, then rapidly to full hot. 3. Listen for the sound of the temperature door slam. Does the door slam?	Go to Step 16	Go to Step 20
16	1. Set the temperature switch to full hot. 2. Start the vehicle. 3. Check the temperature of the heater inlet and outlet hose by feel. Is the heater inlet hose hot and the heater outlet hose warm?	Go to Step 17	Go to Step 21
17	Inspection the heater inlet and outlet hose for proper installation. Are the heater inlet and outlet hose reserved?	Go to Step 18	Go to Step 22
18	1. Back flush the heater core. 2. Drain the cooling system. 3. Replace the coolant. 4. Warm the engine to an average operating temperature. 5. Feel the heater inlet and outlet hose. Is the heater inlet hose hot and outlet hose warm?	System OK	Go to Step 23
19	Check the system for any obstruction between blower, heater case and airflow delivery outlet and then repair or replace as required. Is the repair complete?	System OK	-
20	1. Repair the temperature door travel, cables and linkage as required. 2. Verify the accuracy of the temperature control at full hot and full cold, and then repair as required. Is the repair complete?	System OK	-
21	Check thermostat and then repair or replace as required. Is the repair complete?	System OK	-
22	Reinstall heater hose properly. Is the replace complete?	System OK	-
23	Replace heater core. Is the replace complete?	System OK	-

BLOWER ELECTRICAL

Step	Action	Yes	No
1	1. Disconnect the power connector from the blower motor. 2. Check the resistance between the 2 terminal of the blower motor connector and each step with the blower switch place each position. Is the resistance within the specified value?	Go to Step 2	Go to Step 3
2	Replace the blower motor. Is the repair complete?	System OK	-
3	Check the fuse SB7 (30 A) in the engine compartment fuse block. Is the fuse blown?	Go to Step 4	Go to Step 5
4	Replace the fuse. Is the repair complete?	System OK	-
5	1. Turn the ignition ON. 2. Use the short detector to locate the following possible short: From the fuse SB7 (30 A) in engine compartment fuse block to the blower motor. From the blower motor to the blower resister block. From the blower resister block to the blower speed switch. Is there any short in the above positions?	Go to Step 6	Go to Step 7
6	Repair any short. Is the repair complete?	System OK	-
7	1. Disconnect the power connector from the blower motor. 2. Use the test lamp to locate a possible short between the terminal 1 of the blower switch connectors and the terminals 6, 3, 5, 4 of the blower switch connectors sequentially. Does the test lamp light on at any terminal?	Go to Step 8	Go to Step 9
8	Replace the A/C controller switch. Is the repair complete?	System OK	-
9	Replace the blower resistor. Is the repair complete?	System OK	Go to Step 10
10	Check the ground of the blower motor and then repair as needed. Is the repair complete?	System OK	-

▶ Improper Air Delivery or No Mode Shift

This procedure provides a test of all functions of the heater/defroster unit.

1. Warm the vehicle and keep the engine running.
2. Perform the following diagnostic procedure.

Check		Action	
Check connection and the attachment of the door cable	Is the cable connected and retained properly?	Yes	Check the range of the door travel and the effort required to move it.
		No	Connect and attach the cable properly. Check the operation of the temperature control switch.
	Does the door operate properly?	Yes	If required, repair.
		No	Recheck the system using “Control setting/Correct Results” test.
	Is there a problem with the temperature control switch or wiring?	Yes	Repair or replace the temperature control switch or the cable.
		No	System OK
	Is the system OK after the repair complete?	Yes	Check the airflow from the defroster or the vent outlets.
		No	System OK
	Is the heavy airflow?	Yes	Switch the mode knob to defrost.
		No	Remove the heater outlet and then remove any obstructions in the heater outlet.
	Is the airflow proper?	Yes	Check the blower speed for change in the airflow as the control is turned 1 to 4.
		No	Repair or replace any obstructions at heater and air delivery case.
	Does the blower motor speed increase?	Yes	Go to “Blower Electrical”
		No	System OK
	Is the system OK after the repair complete?	Yes	Set the blower switch to 4th. Rotate the temperature control from full cold to full hot.
		No	Listen to an airflow change.
	Does the airflow change?	Yes	Repair or replace any obstruction between the blower and the system outlets.
		No	Check and repair the door adjustments, the cables, the linkage and the control.

▶ Too Much Heat

Check		Action	
Mode switch to the floor position	Is there too much heat when the mode switch is in the floor position?	Yes	Set the temperature control switch to defrost position.
		No	Set the mode switch to the vent position.
	Is the airflow proper?	Yes	Set the blower speed to 4th. Set the temperature control switch to full hot. Turn the ignition “ON”. Check the airflow and attachment at the foolr outlet.
		No	Check the door travel, the cables, the controls and the linkage for the defrost position and then repair or replace as needed.
	Is the heavy airflow?	Yes	Check the door travel, the cables, the controls and the linkage for the full hot, full cold position and then adjust as needed.
		No	Check for a change in the airflow at different blower speed. Check the change.
	Does the airflow change?	Yes	System OK
		No	Go to “Blower Electrical”
	Is the airflow proper?	Yes	Turn the ignition “OFF”. Turn the temperature control knob to full hot, then rapidly to full cold.
		No	Check the system case for leaks and check the floor outlet attachment.
	Can you hear the sound of the temperature door slam?	Yes	Adjust the vent door to vent mode.
		No	Check the door travel, the cables, the controls and the linkage for the full hot, full cold position and then adjust as needed.

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▶ Heater Controls

Check		Action	
Turn the temperature control switch	Is excessive effort required to move the control?	Yes	Check the cable for improper routing, kinks, wiring interference or other instrument panel interference.
		No	Set the blower switch to 4th. Repeat to turn the temperature control knob to full hot, then rapidly to full cold
	Does the control operate properly?	Yes	Remove the cable from any door that binds on the cable. Cycle the door manually. Check the door binding.
		No	Repair or replace the problem.
	Is there any door binding?	Yes	Check the door seal for proper installation.
		No	Check the control for binding.
	Does the control bind?	Yes	Reinstall the cable to the door. Repair the instrument panel interference with the cable.
		No	Remove the cable from the control. Check the control for binding.
	Does the control bind?	Yes	Replace the control switch.
		No	Replace the cable.
	Is excessive effort required to move the control?	Yes	Remove the cable from the control. Operate the control switch.
		No	System OK
	Does the control operate properly without any interference?	Yes	System OK
		No	Replace the control switch.
	Is the installation good condition?	Yes	Check a binding door for the shaft alignment, a bent shaft, a bent door or warped case and then repair as needed.
		No	Repair the door seal or replace as needed.

▶ Blower Noise

Check		Action	
Cycle through the blower speeds, the modes and the temperature settings in order to find the noise. - Close all of the doors and windows. - Turn the ignition "ON". - Set the blower switch to 4th. - Set the control switch to full hot position.	Is the blower noise constant at high blower speeds or certain modes, but absent at lower speeds or in other modes?	Yes	Remove any obstruction or foreign material of the duct. Check floor/defroster door seals. Repair or replace as needed.
		No	Check for the vibration from the blower motor and fan assembly at each blower speed by feeling the blower motor housing. Check for the foreign materials at the opening of the blower inlet.
	Did you find the excessive vibration and any foreign material?	Yes	Remove all foreign materials and repair or replace the blower motor and fan assembly.
		No	Set the blower switch to 4th. Check any noise from full hot to full cold temperature positions in the defroster, floor and vent modes.
	Is the noise constant?	Yes	Remove any obstruction or foreign material of the duct. Check the floor/defroster door seals. Repair or replace as needed.
		No	Check any noise in the floor mode.
	Is the noise constant?	Yes	Remove any obstruction or foreign material of the duct. Check the floor/defroster door seals. Repair or replace as needed.
		No	Check any noise in the vent mode.
	Is the noise constant?	Yes	Remove any obstruction or foreign material of the duct. Check the vent door seals. Repair or replace as needed.
	Is the blower noise constant at any modes but absent at all modes of temperature control lever?	Yes	Check the temperature door seals
		No	Check the system for obstructions, foreign materials between the fan and the temperature door and then repair or replace the fan as required.

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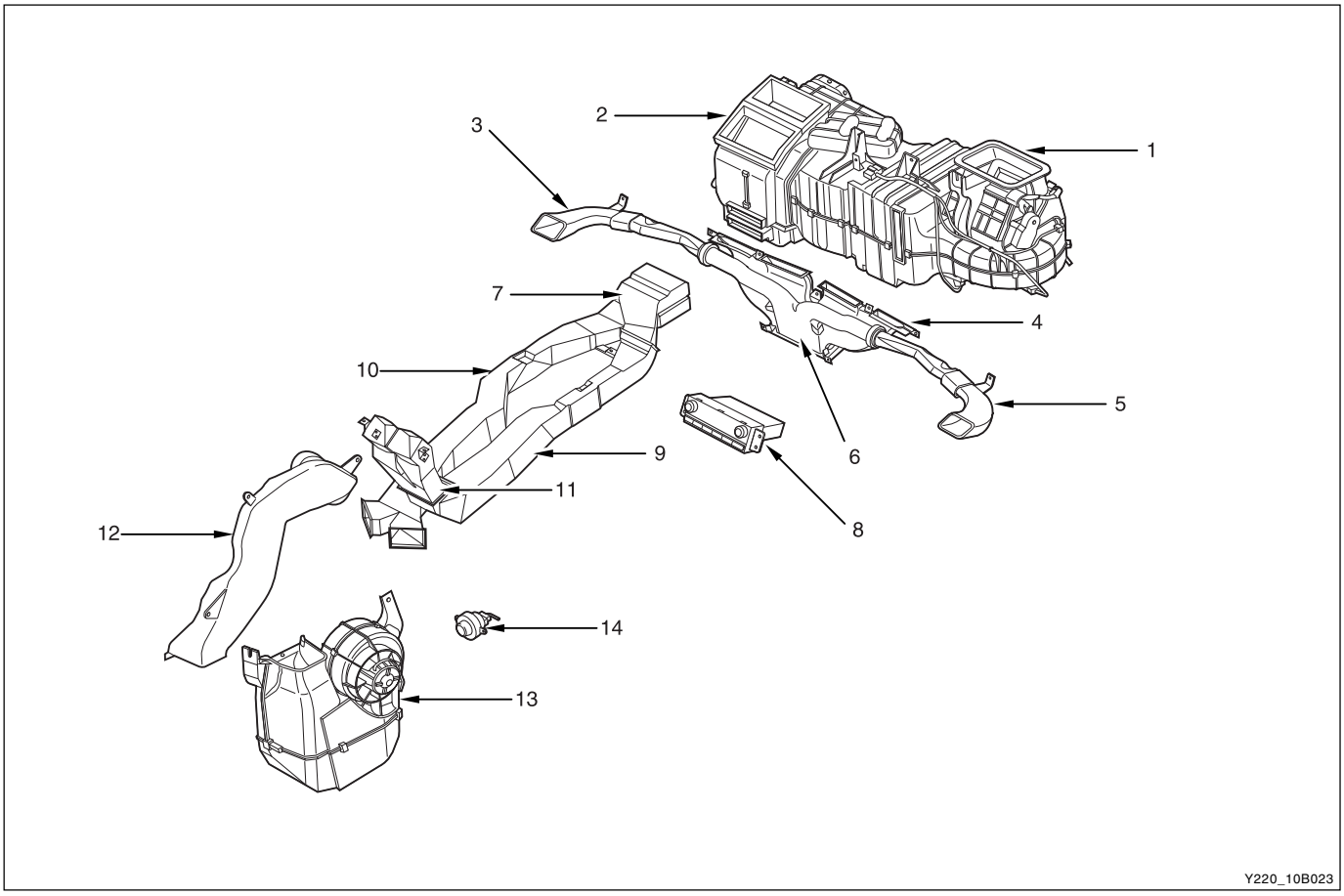
MAINTENANCE AND REPAIR

COMPONENTS LOCATOR

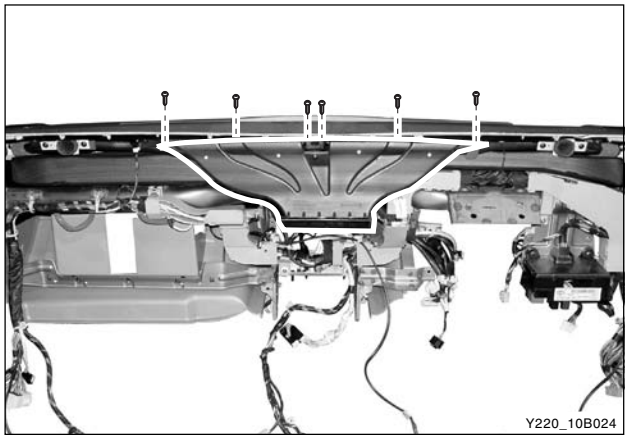


1. Blower and evaporator assembly
2. Heater assembly
3. Side defroster duct (LH)
4. Main defroster nozzle
5. Side defroster duct (RH)
6. Side defroster joint
7. Console front ventilation duct
8. A/C controller
9. Console middle ventilation duct
10. Console foot duct
11. Console rear ventilation duct
12. Rear cooler duct
13. Rear cooler assembly
14. Rear cooler controller

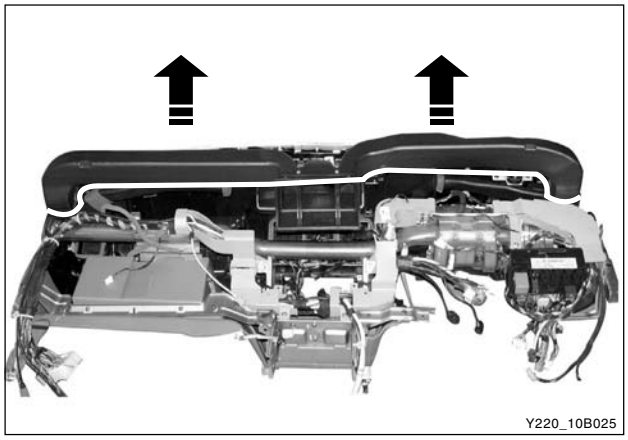
AIR DUCT ASSEMBLY

Removal and Installation

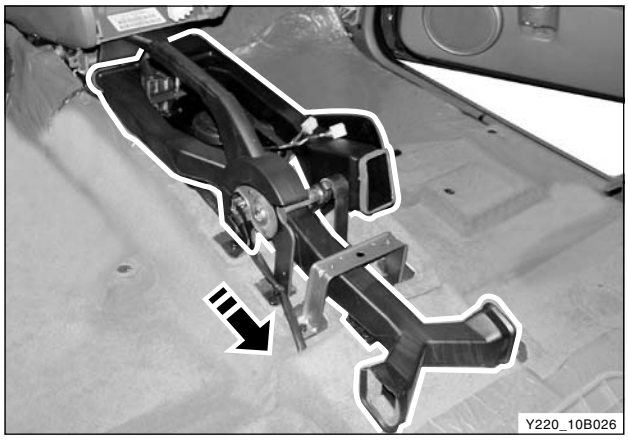
1. Remove the instrument assembly.
2. Unscrew the screws and remove the defrost nozzle assembly.



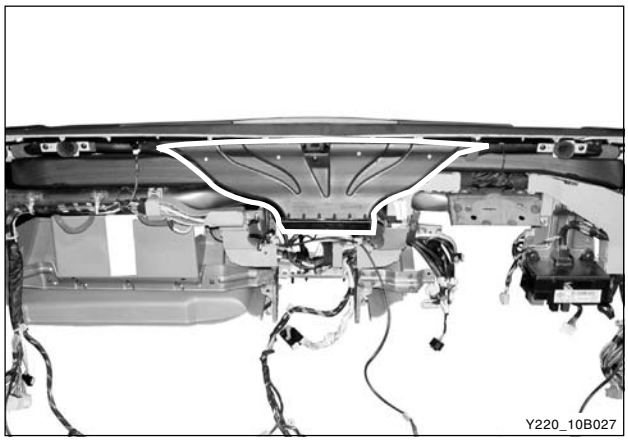
3. Remove the ventilation duct.



4. Remove the air distributor duct from console.
   - Remove the center console.
   - Remove the parking brake lever assembly.
   - Remove the intermediate duct bolts.
5. Remove the intermediate duct and lower duct.



6. Install in the reverse order of removal.
   - Install the nozzle and ventilation duct to the instrument panel.
   - Install the console duct with the air duct installed.



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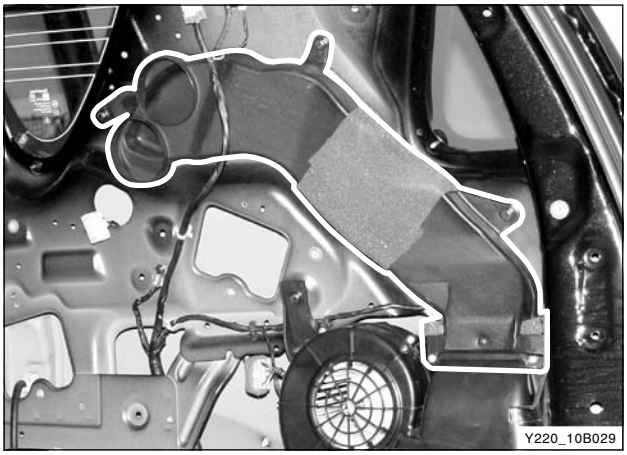


REAR COOLER DUCT

Removal and Installation

1. Remove the rear quarter inner panel.
2. Remove the tapping screws and screws from the duct.
3. Remove the duct.
4. Install in the reverse order of removal.

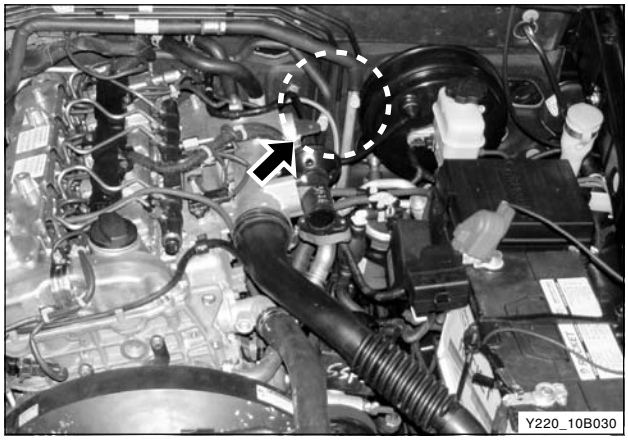
HEATER AND BLOWER MODULE ASSEMBLY

Removal and Installation

▶ Front Hoses

1. Remove the high and low pressure air conditioner pipes.

1-1. Discharge the refrigerant.



1-2. Unscrew the bolts for high and low pressure pipes.

Installation Notice

Tightening torque	10 ± 1.0 Nm

2. Remove the heater hoses.

2-1. Drain the coolant.

2-2. Remove the clip and push the inlet hose clamp around the fire wall rearward.

2-3. Loosen the hose and tube connections.

2-4. Remove the hose from the tube.

2-5. Remove the clip and push the heater inlet hose rearward.

2-6. Remove the heater inlet and outlet hoses.

2-7. Install in the reverse order of removal.

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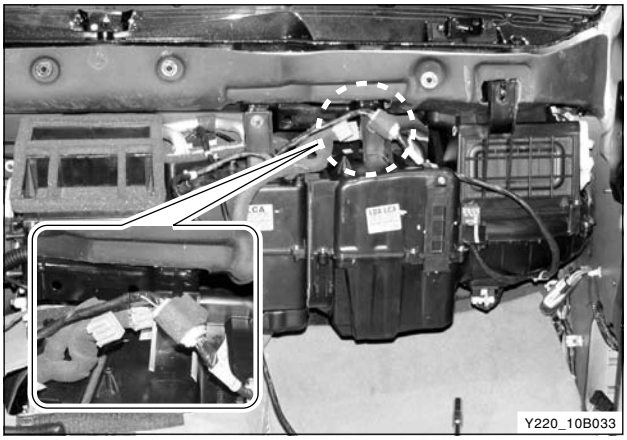
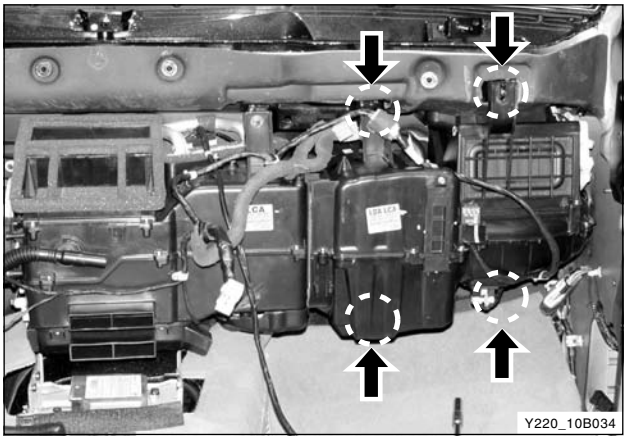


▶ Front Heater and Blower Module Assembly

1. Disconnect the blower connector and PTC connector.



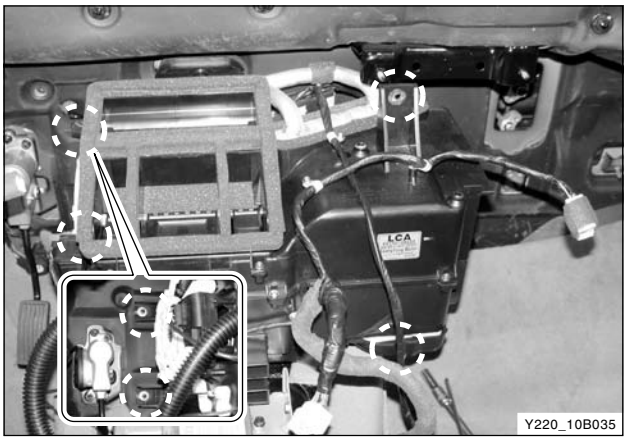
2. Unscrew the nuts and remove the blower module along with the evaporator.

Installation Notice

Tightening torque	10 ± 1.0 Nm

Notice

The air conditioner pipes should be removed before this operation.



3. Unscrew the bolts and remove the heater module assembly.

Notice

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

4. Install in the reverse order of removal.
   - Install the heater module.

Tightening torque	5 Nm

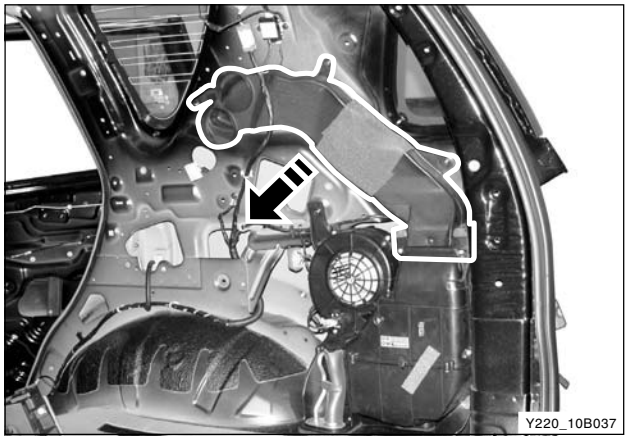
   - Install the blower module assembly.

Tightening torque	5 Nm

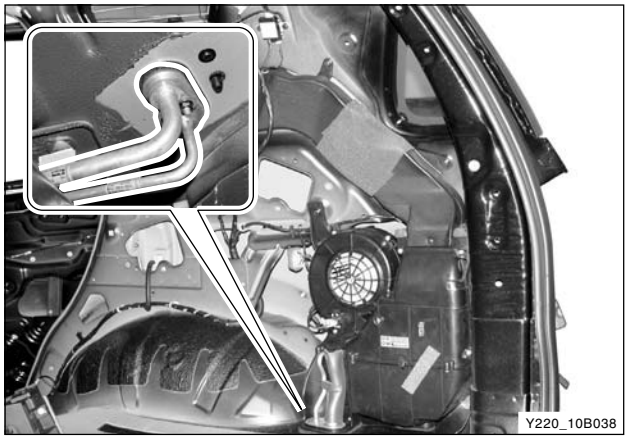
   - Connect the blower connector and install the heater hoses and air conditioner pipes.

▶ Rear Blower Motor Assembly

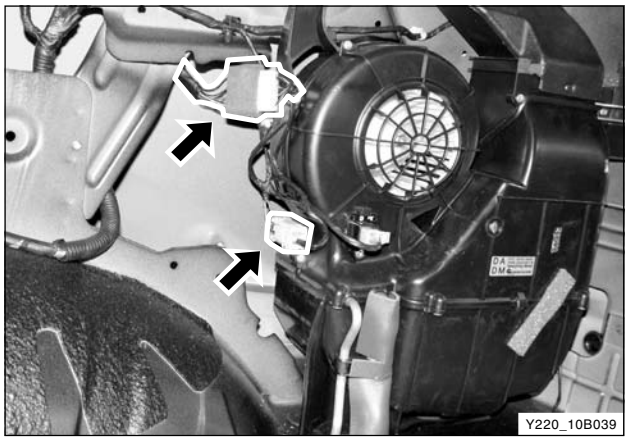
1. Discharge the refrigerant.
2. Remove the rear cooler duct.



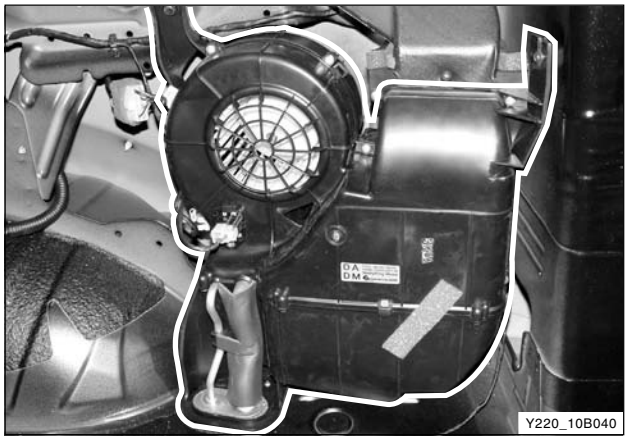
3. Remove the high and low pressure air conditioner pipes.



4. Disconnect the blower motor connector.



5. Unscrew the bolts and remove the blower motor assembly.
6. Install in the reverse order of removal.



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SECTION 10C

A/C SYSTEM

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A/C SYSTEM

DESCRIPTION AND OPERATION

COMPRESSOR SPECIFICATIONS

Engine	Model		Capacity (cc/rev)
Diesel (DI/IDI)	Sigle A/C	V5	9.8 ~ 151
	Dual A/C	KC83 (pulley ϕ120)	175.5
G23D	KC83 (pulley ϕ120)		175.5
G28D/G32D	KC83 (pulley ϕ120)		175.5

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REPAIR INSTRUCTIONS

▶ Precautions for Working with R-134a

- R-12 refrigerant and R-134a refrigerant are not compatible. These refrigerants must never be mixed, even in the smallest amounts. If the refrigerants are mixed, compressor failure is likely to occur.
- Use only specified lubricant for the R-134a A/C system and R-l34a components. If lubricant other than that specified is used, compressor failure is likely to occur.
- The specified R-134a lubricant rapidly absorbs moisture from the atmosphere.

The following handling precautions must be observed:

1. When removing refrigerant components from a vehicle, immediately cap (seal) the component to minimize the entry of moisture from the atmosphere.
2. When installing refrigerant components to a vehicle, do not remove the caps (unseal) until just before connecting the components. Connect all refrigerant loop components as quickly as possible to minimize the entry of moisture into system.
3. Only use the specified lubricant from a sealed container. Immediately reseal containers of lubricant. Without proper sealing, lubricant will become moisture saturated and should not be used.
4. Avoid breathing A/C refrigerant and lubricant vapor or mist. Exposure may irritate eyes, nose and throat. Use only approved recovery/recycling equipment to discharge R-134a refrigerant. If accidental system discharge occurs, ventilate work area before resuming service. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers.
5. Do not allow lubricant to come in contact with Styrofoam parts. Damage may result.

▶ General Refrigerant Precautions

- Do not release refrigerant into the air. Use approved recovery/recycling equipment to capture the refrigerant every time an air conditioning system is discharged.
- Always wear eye and hand protection (goggles and gloves) when working with any refrigerant or air conditioning system.
- Do not store or heat refrigerant containers above 52°C.
- Do not heat a refrigerant container with an open flame: if container warming is required place the bottom of the container in a warm pail of water.
- Do not intentionally drop, puncture, or incinerate refrigerant containers.
- Keep refrigerant away from open flames: poisonous gas will be produced if refrigerant burns.
- Refrigerant will displace oxygen, therefore be certain to work in well ventilated area to prevent suffocation.
- Do not introduce compressed air to any refrigerant container or refrigerant component.

▶ Handling O-Ring

1. Even though O-rings may look identical, it is extremely important that only recommended service replacement air conditioning O-rings be used, or excessive leakage of the refrigerant may occur.
2. Always O-ring and installation area should be kept clean. Any foreign material and dust may result in excessive refrigerant leakage.
3. Before installation, verify that both O-ring and fittings have not been nicked or deformed. Deformed or nicked parts must be replaced.
4. Failure to use the proper service replacement parts and procedures may result in excessive refrigerant leakage.

▶ Handling Refrigerant

1. Always work in a well-ventilated area.
2. If you have difficulty breathing, seek medical attention immediately. If refrigerant comes in contact with any part of your body, flush the exposed area with water. If a rush or pain develops seek medical attention.

▶ Handling of Refrigerant Lines and Fittings

1. Using too low or too high a torque when tightening a fitting can result in loose joints or deformed joint parts.
2. Back up the opposing fitting to prevent the distortion of the connecting lines or the components. Back up both the swaged fitting on the flexible hose connections and the coupling to which it is attached two wrenches to prevent turning the fitting and damaging the ground seat.

▶ Maintaining Chemical Stability In the Refrigeration System

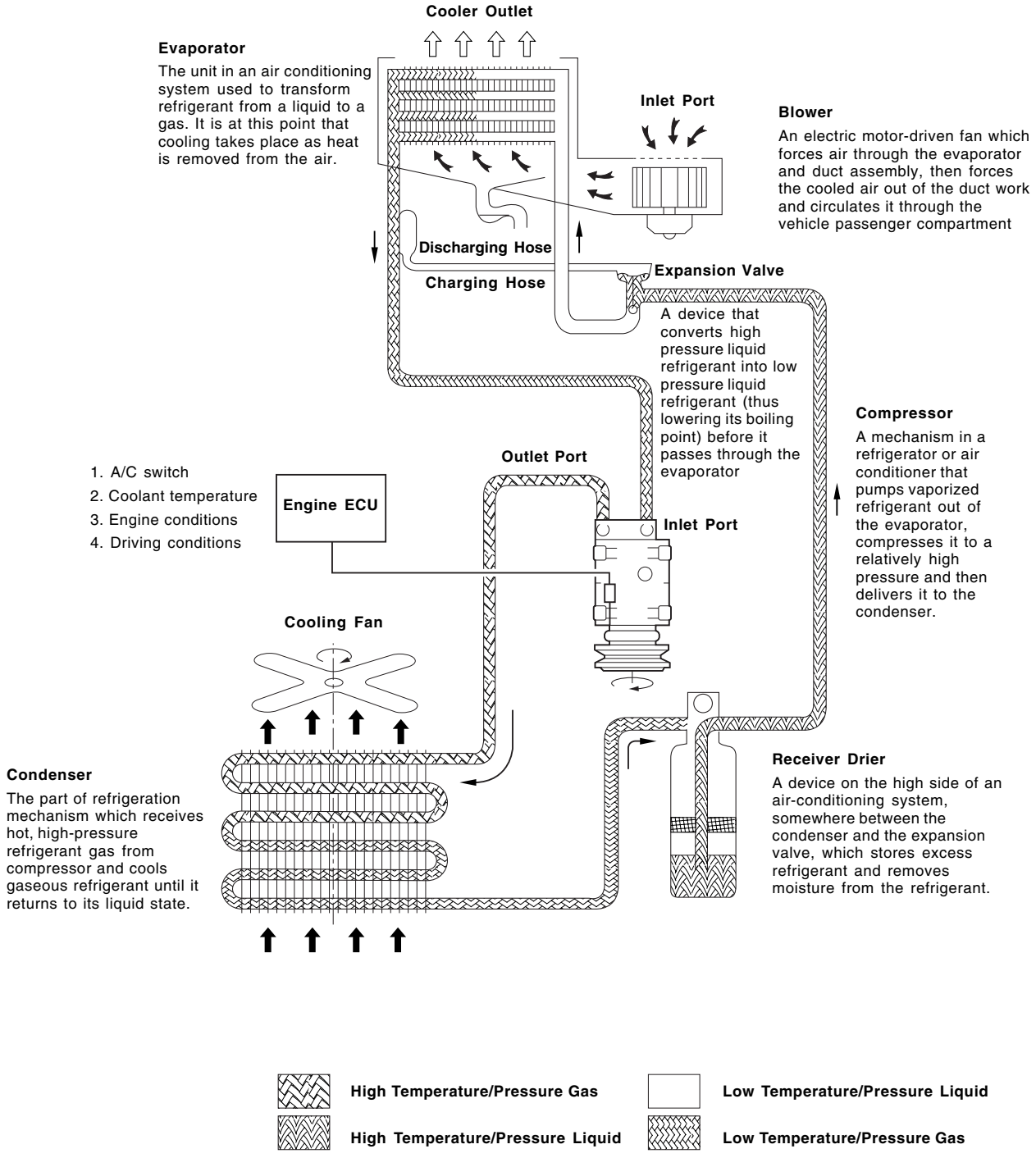
The efficient operation and life of the air conditioning system is dependent upon the chemical stability of the refrigeration system.

When foreign materials, such as dirt, air or moisture, contaminate the refrigeration system, they will change the stability of the refrigeration and the polyalkalene glycol (PAG) compressor oil. They will also affect the pressure-temperature relationship, reduce efficient operation and can possibly cause interior corrosion and abnormal wear of moving parts.

Observe the following practices to ensure chemical stability in the system:

1. Wipe away dirt or oil at and near any connection before opening that connection. This will reduce the chance of dirt entering the system.
2. Cap, plug or tape both sides of a connection as soon as possible after opening the connection. This will prevent the entry of dirt, foreign material and moisture.
3. Keep all tools clean and dry including the manifold gauge set and all replacement parts.
4. Use a clean and dry transfer device and container to add PAG refrigerant oil. This will ensure that the oil remains as moisture-free as possible.
5. When opening an A/C system, have everything needed to perform all operations ready. Do not leave the A/C system open any longer than necessary.
6. Evacuate and recharge any A/C system that has been opened.

SYSTEM OVERVIEW

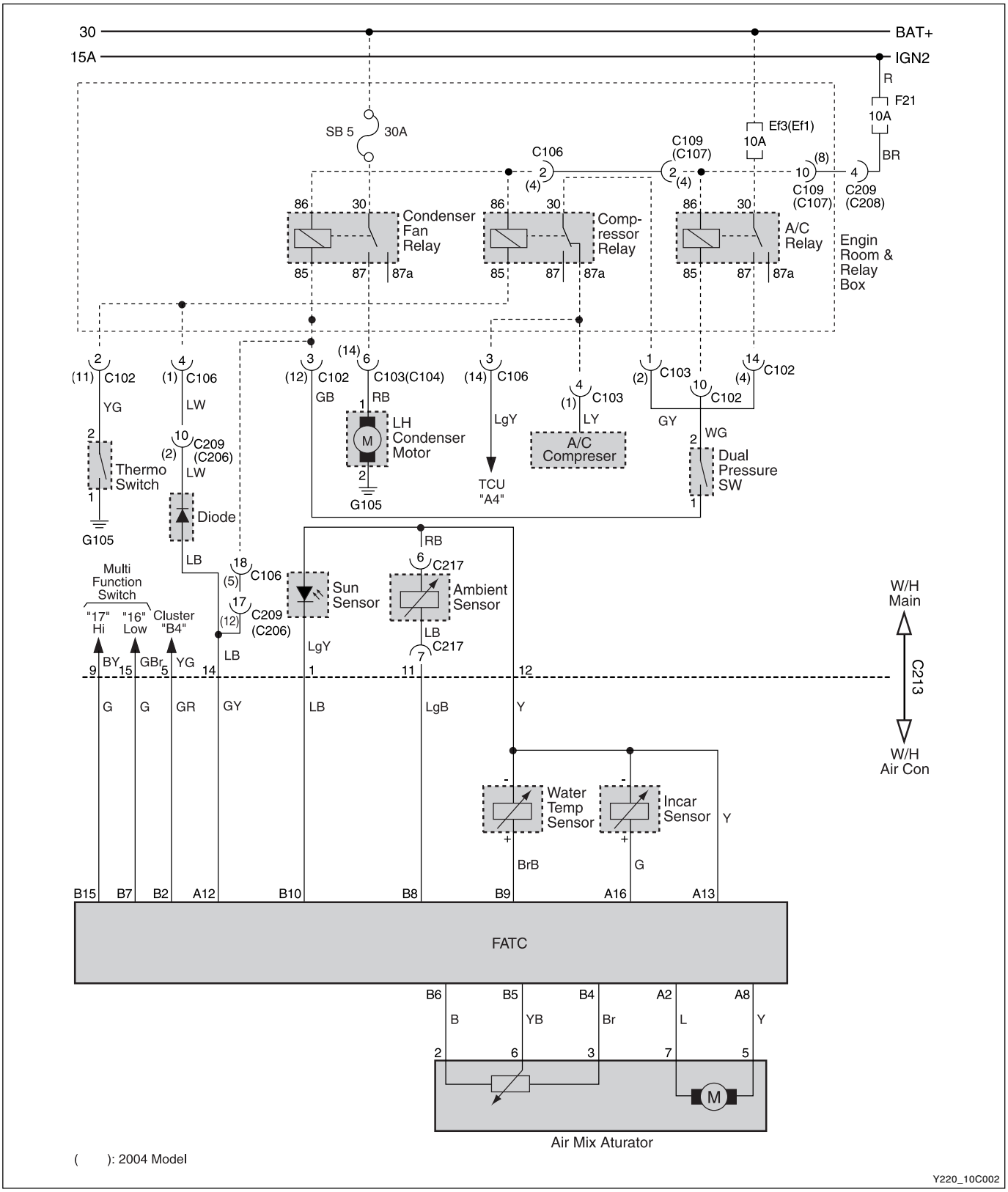


Y220_10C001

CIRCUIT DIAGRAM

▶ Automatic Air Conditioner

Air Mix Motor, Sensors (Sun, Ambient, Interior, Coolant Temperature)



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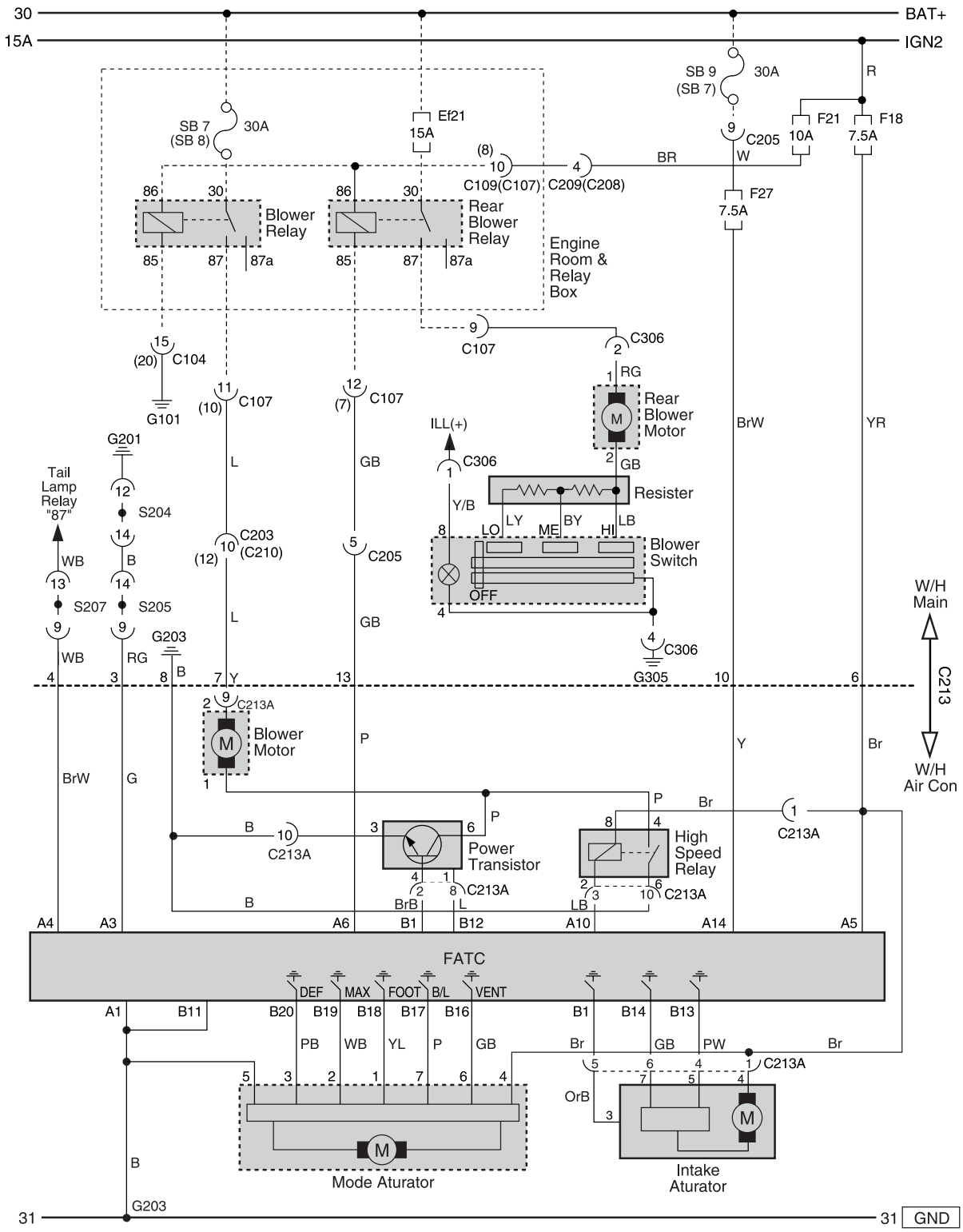
Motor (Mode, Interior/Ambient)



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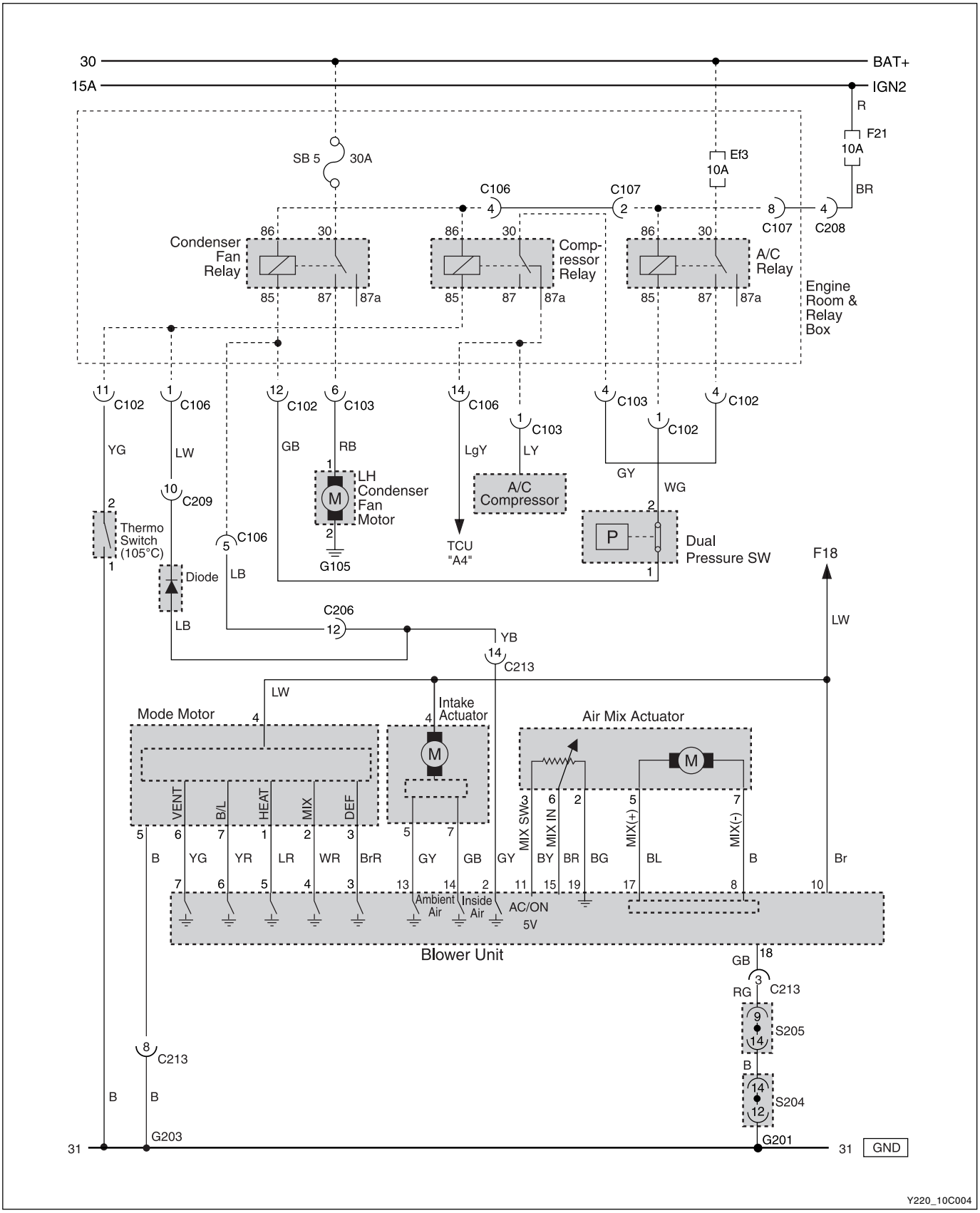
▶ Manual Air Conditioner

Power, A/C Compressor, Motors (Mode, Interior/Ambient, Air Mix)



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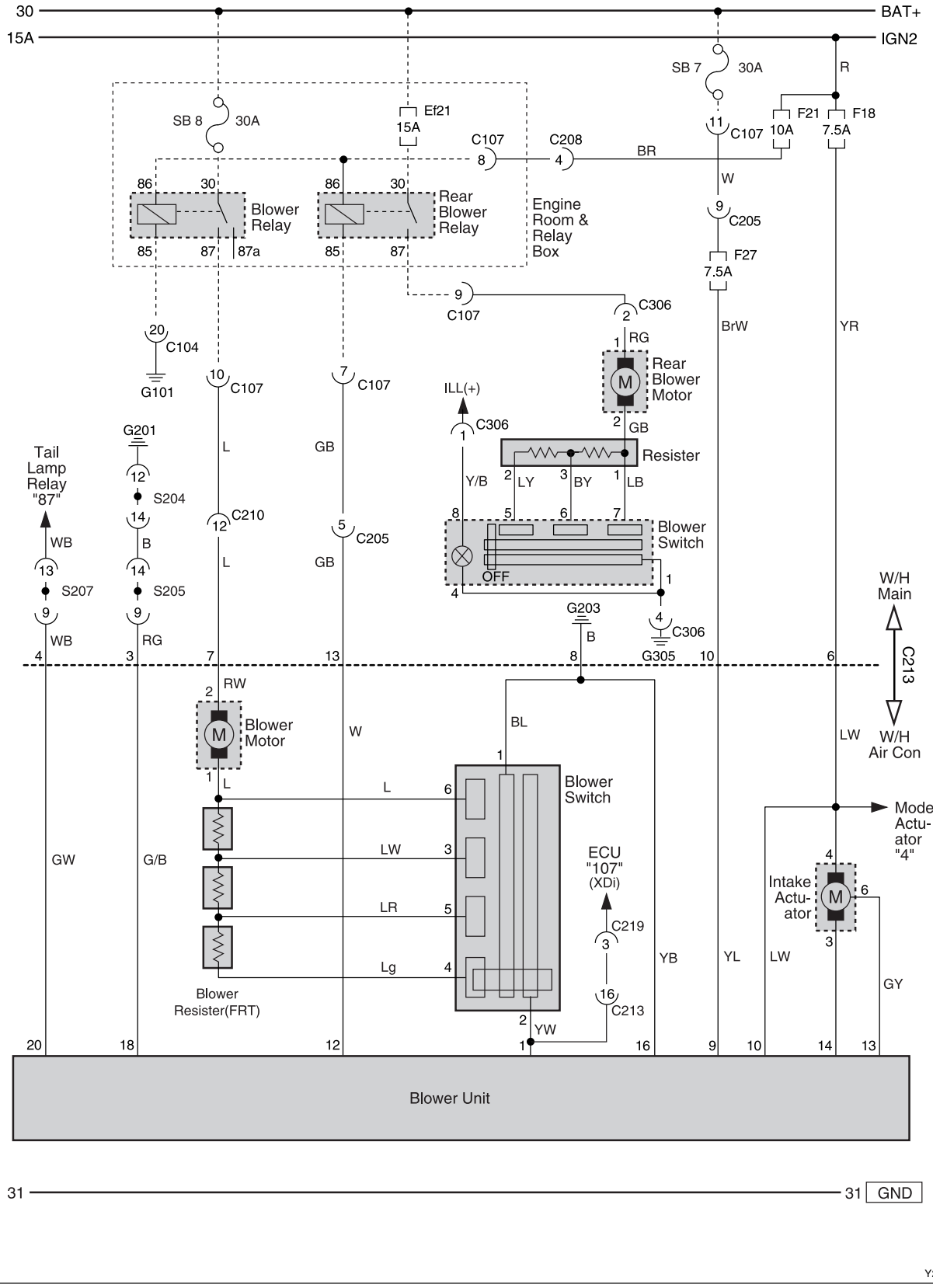
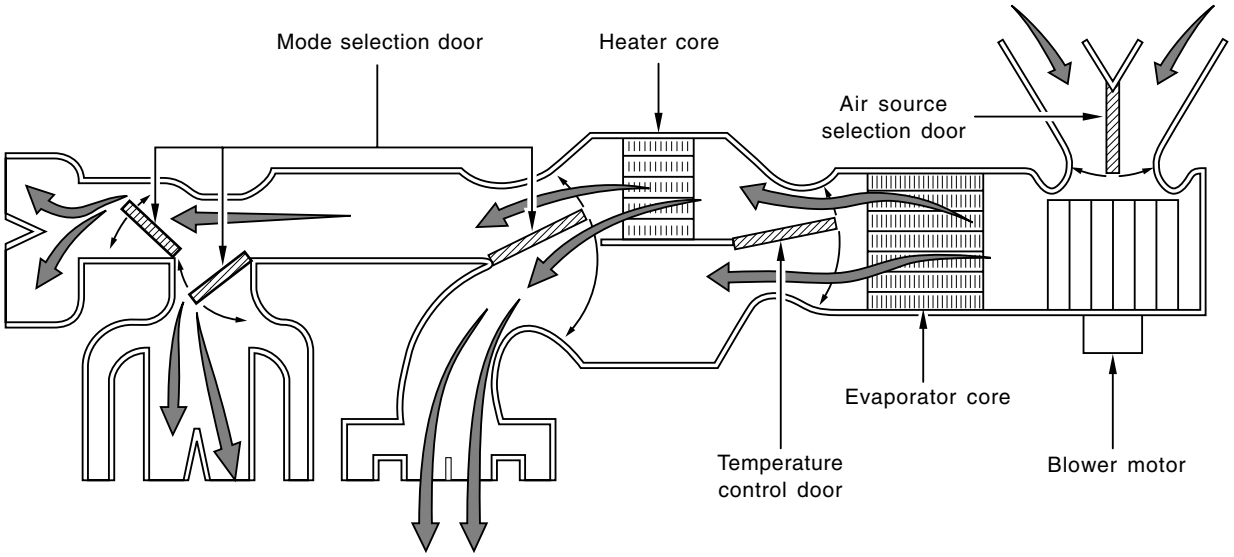
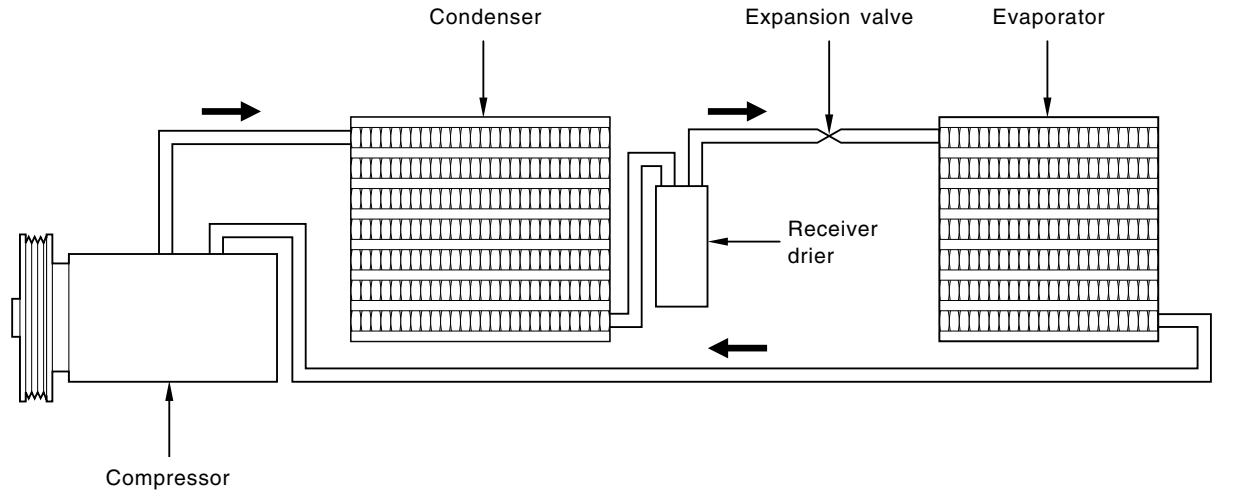
Blower Motor (Front, Rear)



▶ Air Flows



▶ Refrigerant Flows



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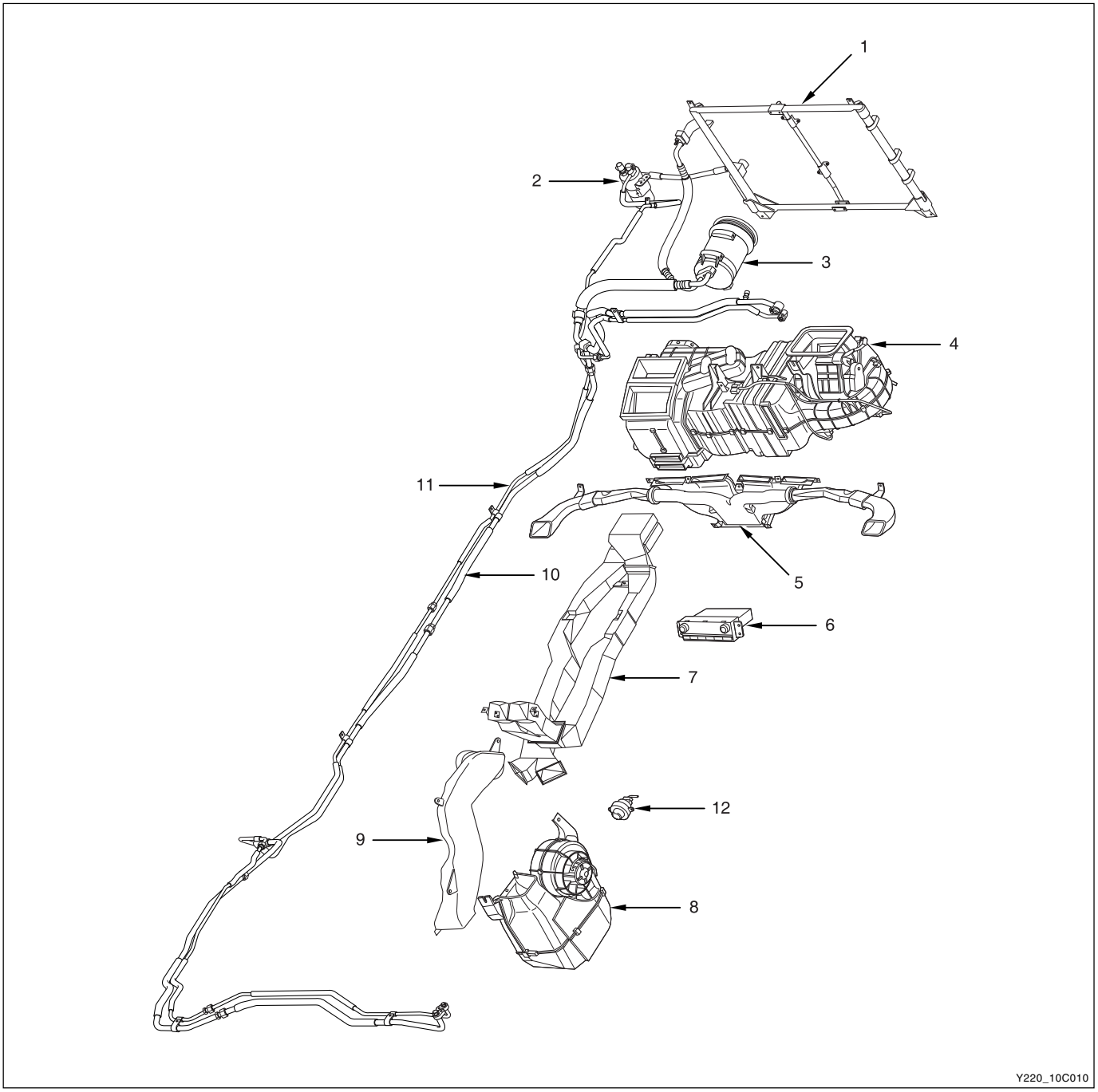
SYSTEM LAYOUT

▶ Components Locator



1. Condenser
2. Receiver drier
3. Compressor
4. Air conditioner/Heater (Blower) module
5. Defrost nozzle
6. Front air conditioner controller
7. Rear duct
8. Rear cooler assembly
9. Rear cooler duct
10. Suction rear pipe line
11. Liquid rear pipe line
12. Rear cooler controller

TROUBLE DIAGNOSIS

GENERAL DIAGNOSIS

Symptom		Cause	Action
Airflow not cold.	Magnetic clutch switch don't turn ON.	Check the fuse	Replace
		Check the A/C switch	Replace
		Check the triple switch (DSL: Dual switch)	Replace
		Check the thermo switch (GSL)	Replace
		Check the compressor relay	Replace
		Check the magnetic clutch	Replace
		Check the A/C control unit	Replace
	Insufficient refrigerant	Check the refrigerant capacity	Adding refrigerant
	Faulty receiver-drier	Check the receiver-drier	Replace
	Abnormal rotating of compressor	Check the drive belt's tension, slip of the compressor and clutch	Adjusting belt
	Abnormal compression of compressor	Check the compressor	Replace
	Faulty expansion valve	Check the expansion valve	Replace
Airflow is cold but insufficient.	Duct joint leak	Check the duct joint	Replace
	Evaporator frozen	Check the intake air temperature switch	Replace
	Faulty blower motor	Check the blower motor	Replace
	Blower 1th - 3th inoperative, 4th operative	Check the resistor, connector	Replace
Airflow is not continuous.	There is air in the refrigerant	Measure the pressure	Evacuating and charging refrigerant
	Faulty expansion valve	Check the expansion valve	Replace
Insufficient cooling.	Insufficient refrigerant	Check the refrigerant capacity	Adding refrigerant
	Faulty receiver-drier	Check the receiver-drier	Replace
	Faulty condenser	Check the fin's surface and crack of the tube, tank	Cleaning surface, replace
	Excessive refrigerant in the system	Check the refrigerant capacity (Verify the capacity higher than high pressure)	Recharging refrigerant
	Abnormal rotating of compressor	Check the drive belt's tension	Adjusting belt
	Insufficient compression of compressor	Check the compressor	Replace
	There is air in the unit.	Check the pressure	Evacuating and charging refrigerant
	Faulty expansion valve	Check the expansion valve	Replace

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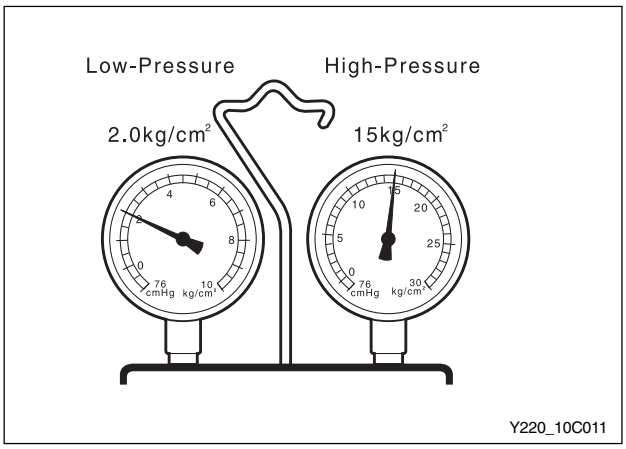
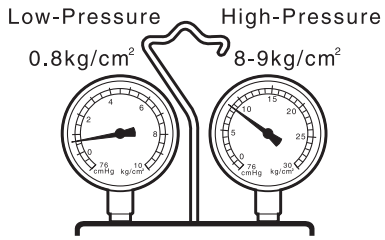
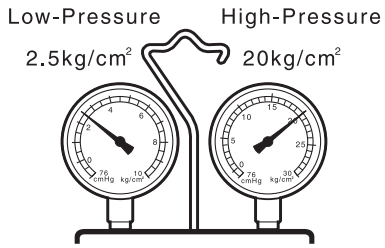
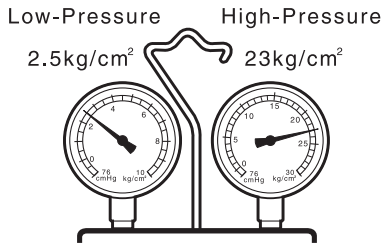
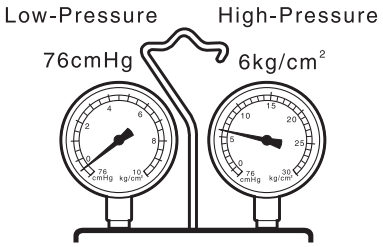
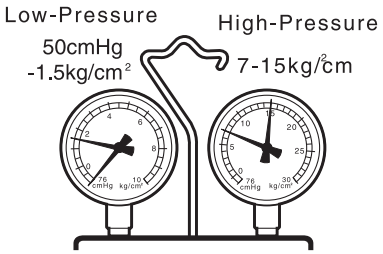
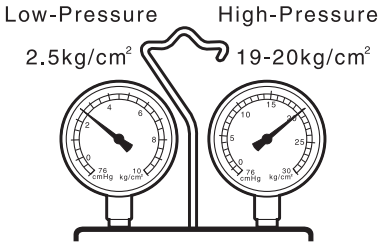
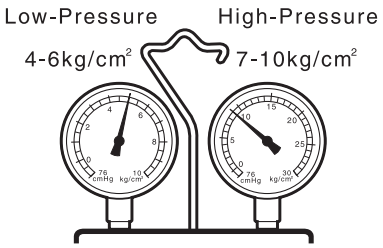
DIAGNOSIS USING THE MANIFOLD GAUGE



On normal operation during the cooling cycle, the manifold gauge must indicate approximately 1.5 ~ 2.0 kg/cm² at low pressure side and 14.5 ~ 15 kg/cm² at high pressure side, on condition that the temperature at the cooler inlet, 30°C ~ 35°C, 2,000 rpm of the engine rpm , full cold and maximum blower speed.

Symptom	Cause	Action
1. High and low pressure are abnormally low. 2. Air at cooler outlet is not cold.  Y220_10C012	• There is a gas leak in the cooling system.	• Check the oil leak, repair • Add the refrigerant
1. High and low pressure are abnormally high.  Y220_10C013	• Insufficient cooling and faulty condenser cooling by excessive refrigerant. • Belt is slipped	• Keep the specified amount of the refrigerant, Clean the condenser • Repair the belt
1. High and low pressure are abnormally high. 2. Connection at the low pressure is not cold.  Y220_10C014	• There is an air in the cooling system	• Clean and repair the receiver-drier • Check the oil contamination etc.

Symptom	Cause	Action
1. The low-pressure side indicates excessive high and high-pressure indicates excessive low. 2. There is a moisture in the connection of the receiver-drier and the front/back of the expansion valve.  Y220_10C015	• The dust and moisture etc. are frozen at the expansion valve • A gas leak in the heat reducer	• Repair the receiver-drier • Replace the expansion valve for the faulty heat reducer
1. The low-side pressure is high or normal intermittently.  Y220_10C016	• The mixed moisture is frozen at the expansion valve	• Repair the receiver-drier and perform the bleeding • Repair the receiver-drier
1. The low-pressure and high-pressure are excessive high. 2. There are a lot of moistures in the connection of the low-side pressure  Y220_10C017	• The faulty expansion valve, the improper installation of the heat reducer • Fail to control the flow rate	• Check the oil contamination etc.
1. The low-pressure is excessive high and high-pressure is excessive low.  Y220_10C018	• There is an oil leak in the compressor	• Replace the compressor

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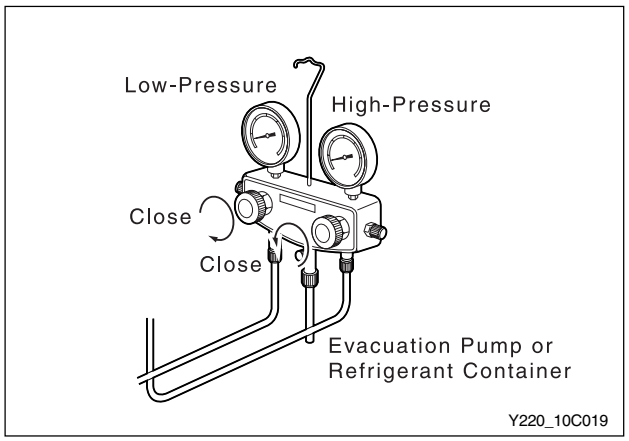
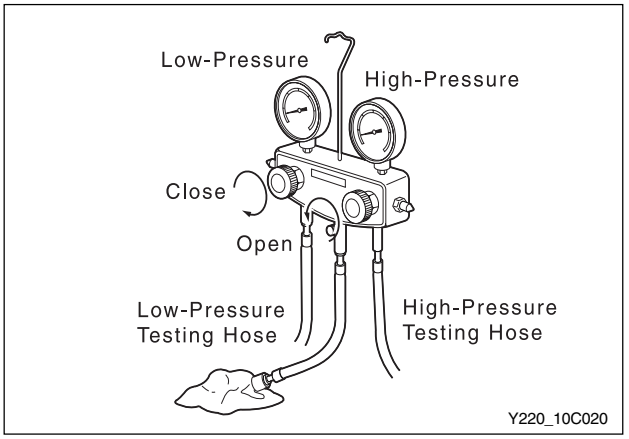
MAINTENANCE AND REPAIR



▶ Refrigerant Charging

Installation of manifold gauge

1. Close both high/low pressure hand valves of manifold gauge before installation of gauge to the charging valve.
2. Both high/low pressure hand valves of manifold gauge connect the appropriate charging valve. Tighten the hose nuts by hand.
   - High pressure hand valve → High pressure charging valve
   - Low pressure hand valve →Low pressure charging valve



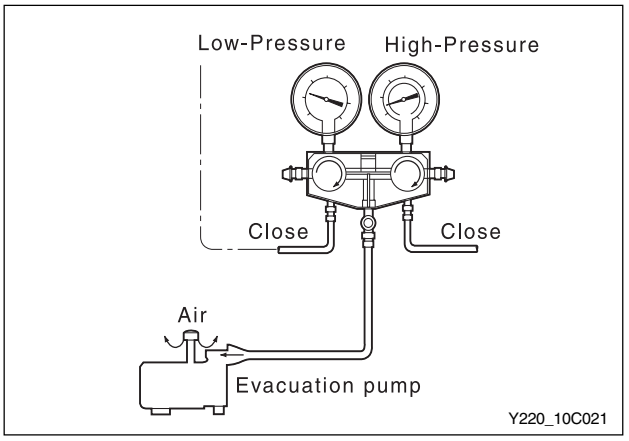
Discharging refrigerant

1. Connect the manifold gauge to the charging valve.
2. Place the free end of the center hose in a shop towel.
3. Slowly open the high pressure hand valve and discharge refrigerant.

   Notice

   If refrigerant is allowed to escape too fast, compressor oil will be drawn out of the system.

4. Check whether the shop towel gets wet in oil and if wet, close the hand valve.
5. After the high pressure gauge reading drops below 3.5 kg/cm^2, slowly open the low pressure valve.
6. When both high and low pressure gauges reading drops to 0 kg/cm^2, discharging is completed.



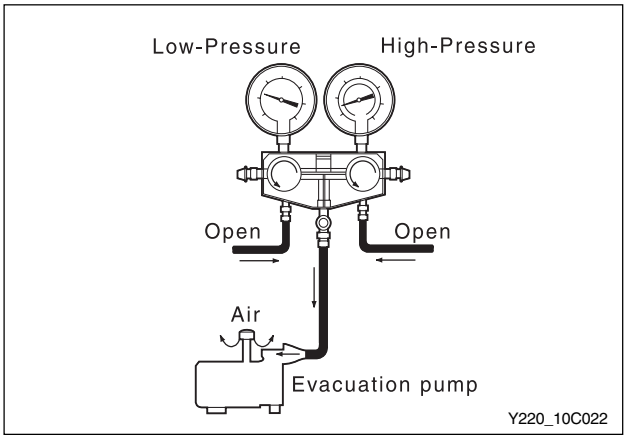
▶ Evacuating Refrigeration System

Notice

The evacuation process for the air conditioner system should be performed after discharing the refrigerant from the charging valve. This operation is for eliminating all the air and moisture in the system. Evacuate the system around for 15 minutes and the opened components during the service around for 30 minutes.

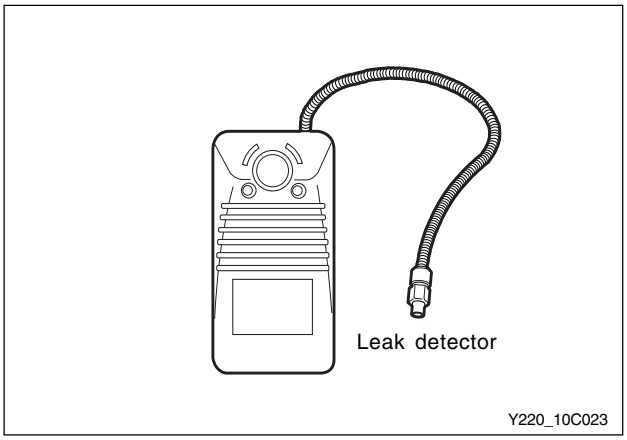
1. Make sure to turn off the engine.
2. Connect the manifold gauge set to the compressor gauge fitting and close both valves.
3. Make sure to discharge the refrigerant from the charging valve.
4. Connect the free end of the center hose to the intake port in the vacuum pump.

5. Operate the vacuum pump and open the high and low pressure valves.
6. Check whether the pointer in the low pressure gauge indicates below pressure of -0.96 kg/cm^2. If the pressure is not negative pressure, there may be a pressure leak in the charging valve. In this case, perform the leak test.
7. Operate the vacuum pump again.
8. Maintain the pointers in both manifold gauges at -0.96 kg/cm^2.
9. Maintain the pointer in the low pressure gauge at -0.96 kg/cm^2 for 15 minutes.
10. After 15 minutes, close both manifold pressure valves and stop the vacuum pump operation. Disconnect the hose from the vacuum pump. This is stand-by condition for charging.



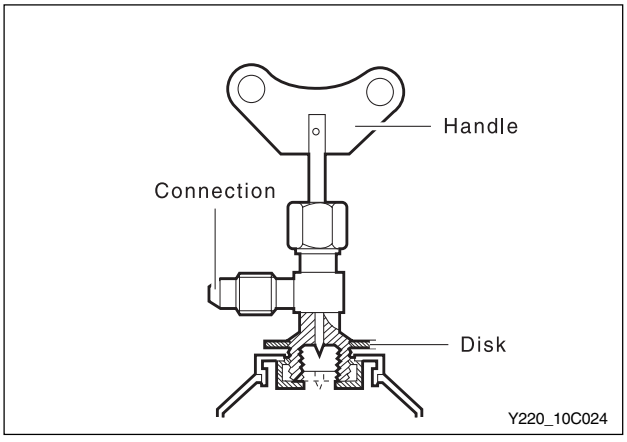
▶ Check for Refrigerant Leaks

1. Connect the center hose of the gauge to the refrigerant tank.
2. Open the high pressure valve of the gauge to charge with refrigerant gas.
3. Charge until the low pressure gauge reads 1.0 kg/cm^2 and close the valve.
4. Using a gas leak detector, check the system for leaks.
5. If any leak is found, replace O-ring or repair the faulty connection.



▶ How to Use the Tap Valve

1. Rotate the handle counterclockwise fully before connecting the valve to the refrigerant tank.
2. Rotate the disk counterclockwise fully.
3. Connect the center hose to the valve fitting and then rotate the disk clockwise fully by hand.
4. Rotate the handle clockwise to drill the sealed hole.
5. Remove the hose nut securing the center fitting of the manifold gauge and then tighten the nut again in a few seconds.



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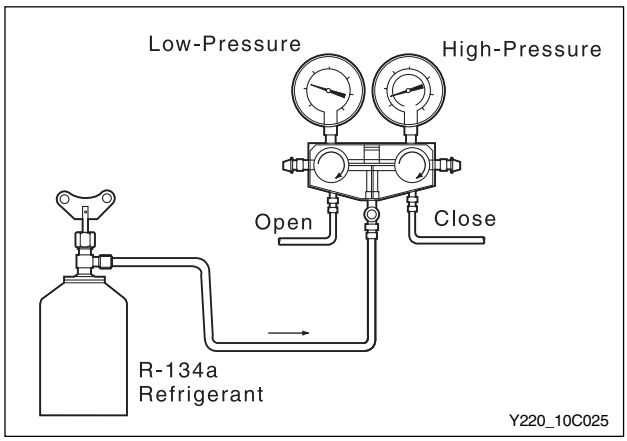
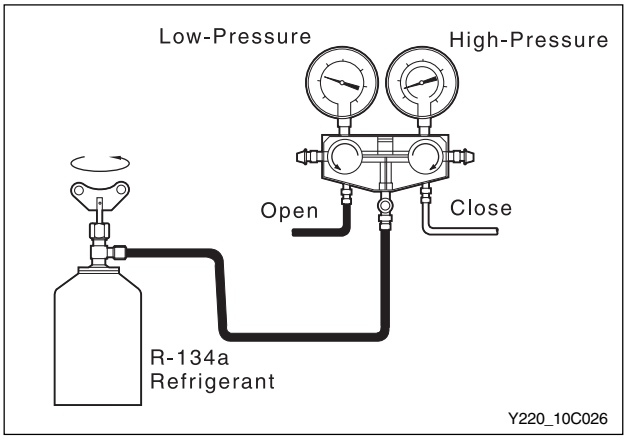
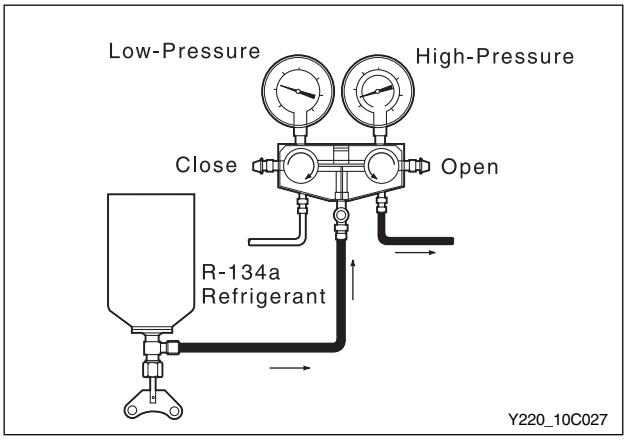






▶ Charging Refrigerant

Charging for gas

Notice

This operation is for charging the gas refrigerant into the charging valve through the low pressure side. At this time, if the refrigerant tank is upright on a flat floor, the gas refrigerant will flow into the charging valve.

1. Connect the tap valve to the refrigerant tank.
2. Open the low pressure and adjust the low-side reading below 4.2 kg/cm^2.
3. Place the refrigerant tank in the warm water (40°C) and keep the gas pressure in the refrigerant tank higher than the gas pressure in the charging valve.
4. Run the engine at high speed and operate A/C system.

Notice

Place the refrigerant tank on the flat floor to protect the liquid refrigerant from coming through the suction inlet resulting in the compressor's damage.

5. Charge the specified amount to the charging valve and close the low pressure valve.

Specified amount	Single: 850 ± 50 g
	Dual: 1200 ± 50 g

Notice

- ***If the charging speed is low, it's more efficient to place the refrigerant tank in the warm water (40°C). But the temperature should keep below (52°C) at any situation.***
- ***Be careful not to contact the heating device or material.***

Charging for liquid

This operation is for charging the liquid refrigerant into the empty system through the high pressure side. At this time, if the refrigerant tank is upside down, the liquid refrigerant will flow into the system.

Notice

- ***Do not operate when charging the system through the high-side rpessure.***
- ***Do not open the low pressure valve when charging the system by the liquid refrigerant.***

1. Tighten both high pressure and low pressure completely before evacuating the charging valve.
2. Connect the tap valve of the refrigerant tank.
3. Open the high pressure valve and turn the refrigerant tank upside down.
4. The discharging pressure increases when the charging valve charges excessively, so charge the charging valve to the specified amount with measuring the weight of the refrigerant before closing the high pressure valve.
5. Charge the specified amount of the refrigerant and then close the valve of the manifold gauge. Check the system for any leak.

Operation check

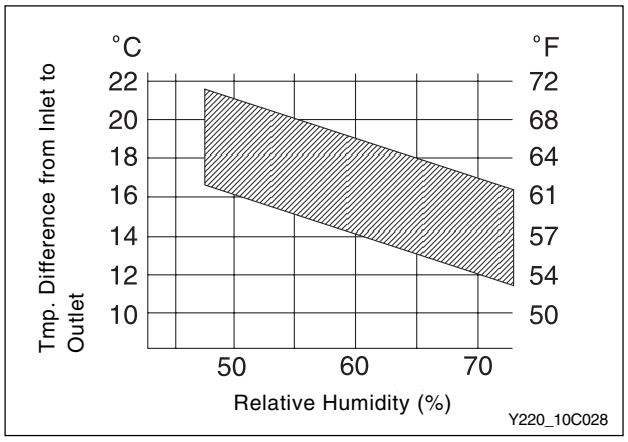
Notice

Operation Check is recommended before removing the manifold gauge.

1. Install the manifold gauge set.
2. Run the engine at 2,000 rpm and set the blower switch at 'HI' and A/C switch 'ON'. Set the temperature control lever at 'COOL'.
3. Keep opening all of the window and door.
4. Place a dry bulb thermometer to the front duct.
5. Place a psychrometer close to the inlet of the cooling unit.
6. Check the high pressure gauge reading within 14 ~ 16 kg/cm^2

   If the reading indicates high excessively, spray the water to the condenser.

   If the reading indicates low excessively, cover the condenser with the towel.
7. Check the temperature of air inlet within 25 ~ 35°C.
8. Calculate the relative humidity from the psychrometic graph comparing the wet/dry temperature at the air inlet.
9. Measure the wet/dry temperature at the cold air outlet and calculate the temperature difference of the dry bulb between the inlet and the outlet.
10. Check the cross point of the relative humidity and check the temperature difference between the black line. If the cross point is located between the black line, the cooling performance is normal.



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CHECK AND REPLACEMENT

COMPRESSOR OIL REPLACEMENT

▶ Before Oil Replacement

When any part is replaced or there are a lot of gas leaks in the A/C system, you should add the specified amount of the oil to keep the approval oil capacity because the oil for lubricating the compressor circulates through the A/C system during operating the compressor.

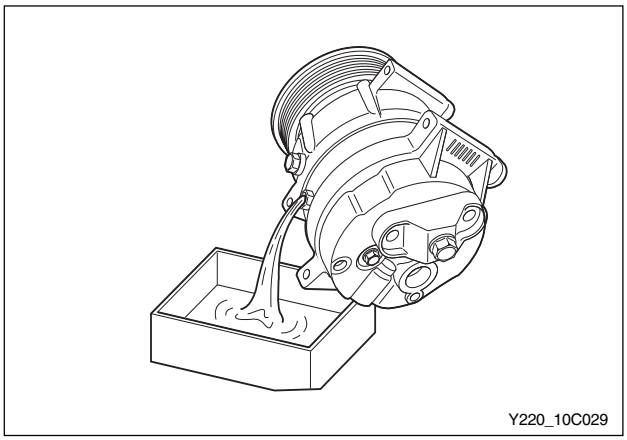
Total Oil Capacity	265 cc

Handling oil

- Be careful that moistures, dusts etc. must not flow into the oil.
- Do not mix with any other material.
- If the oil leaves outside for long time, it's possible to mix it with the moistures and so keep the oil sealed with a container.

Circulating oil

For checking or adjusting the oil level, set the control unit to full cold and max blower speed with keeping the engine run at idle for 20 ~ 30 minutes in order to circulate the oil through the compressor.


Y220_10C029

▶ Replacement of Oil

1. Perform the oil circulation and stop the engine. Remove the compressor on the vehicle.
2. Drain the oil at the position of the system line connection.

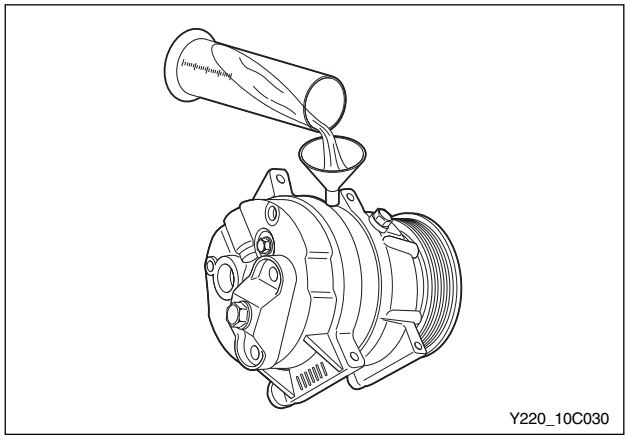
Notice

It may be difficult to discharge the oil when the compressor is cold. At this time warm the compressor (40 ~ 50°C) before discharging the oil.

3. Measure the amount of the discharged oil. If the the amount of the discharged oil is below 70 cc, it means the oil leak. Check the connections of the system and repair or replace as needed.
4. Check the oil contamination and add the oil or adjust the oil level.

Notice

For contaminating the oil by the dust or the foreign material, charge the refrigerant in the system and clean the receiver-drier.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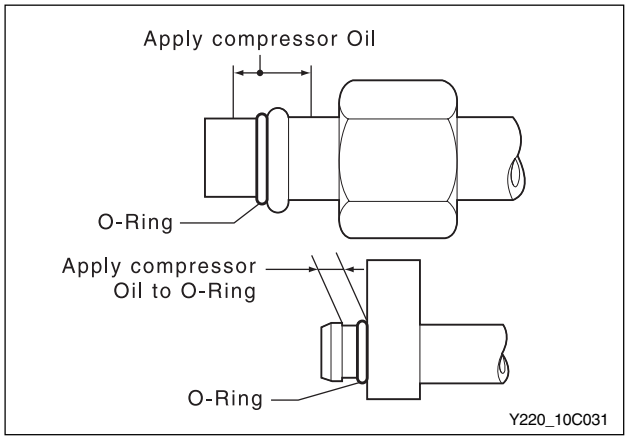
REPLACEMENT OF REFRIGERANT CONNECTION

1. When connecting a O-ring type, apply compressor oil to portions shown in illustration. Be careful not to apply oil to threaded portion.

Notice

Use the approval compressor oil.



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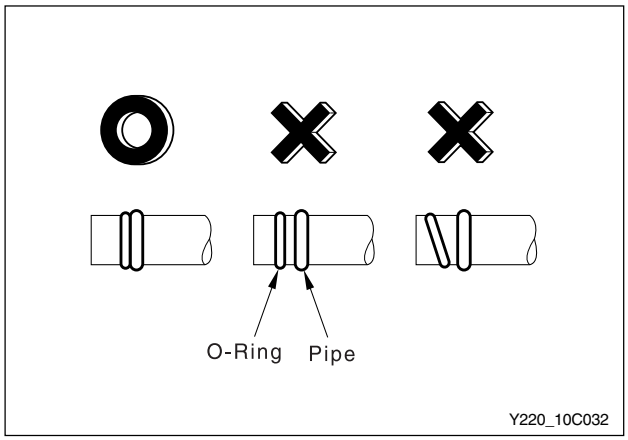
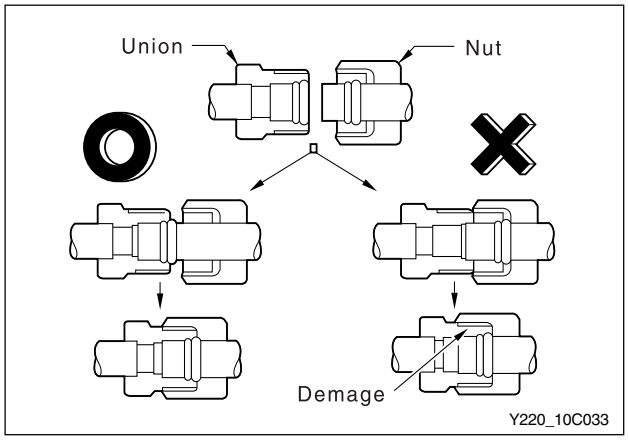
2. O-rings must be closely attached to inflated portion of pipe and always replace used O-rings.



Y220_10C032

3. After inserting the pipe to the union, tighten the nut by hand as much as possible and tighten the nut with the specified torque.



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REPLACEMENT OF AIR CONDITIONER FILTER

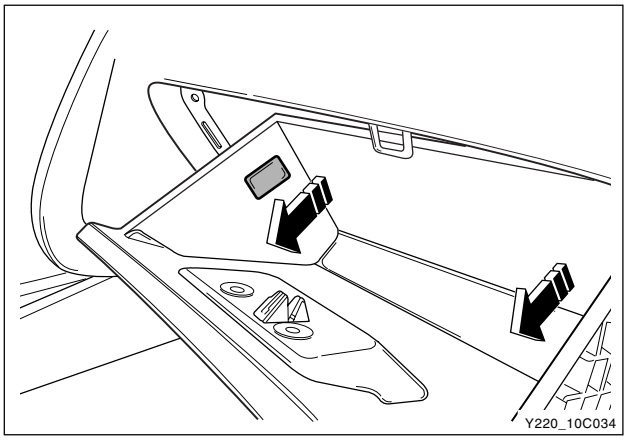
▶ Replacement of Air Conditioner Filter

Replace the air conditioner filter at every 10,000 km of driving. However, if the vehicle is operated under severe conditions such as dusty road, unpaved road, and excessive air conditioner and heater operation, shorten the replacement interval.

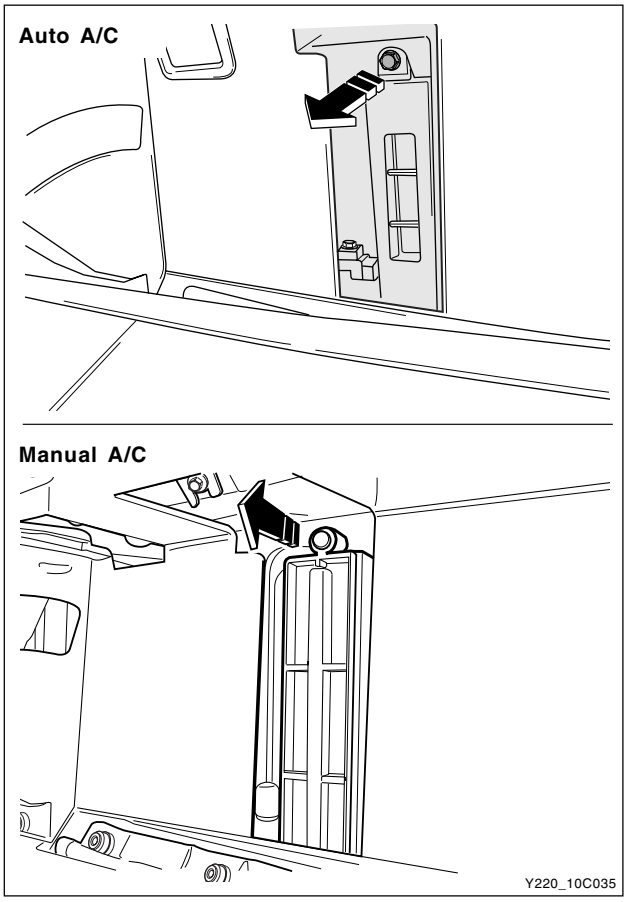
Notice

If the air conditioner filter is contaminated, cooling capacity is decreased and unpleasant odor is generated. Replace the air conditioner filter when

- ***Unpleasant odor is generated at first operation after long unused period.***
- ***Cooling and blowing capacity are decreased.***



1. Open the glove box and remove it from dash panel by pushing both holders to arrow directions.

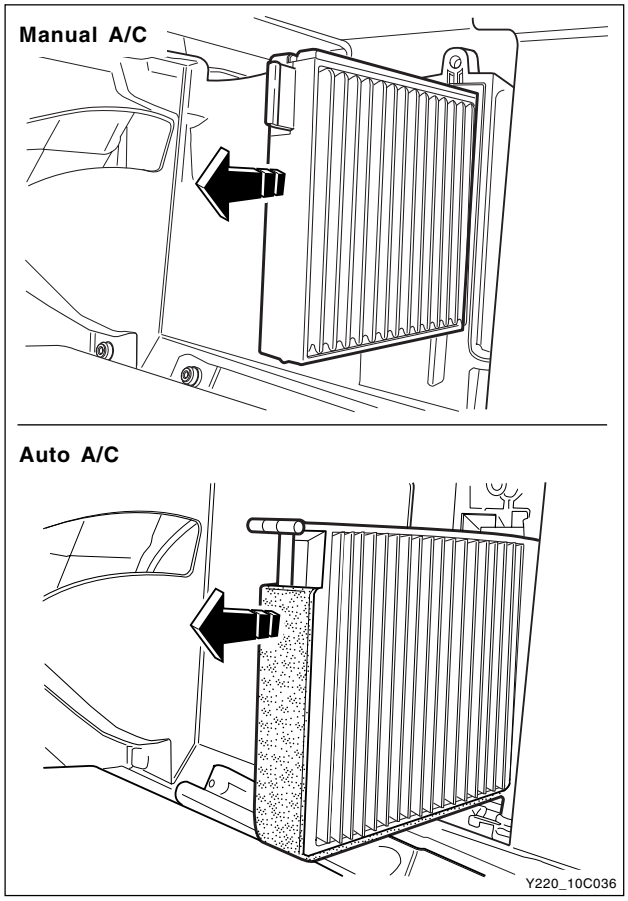


2. Unscrew the filter cover bolt inside glove box and remove the cover.

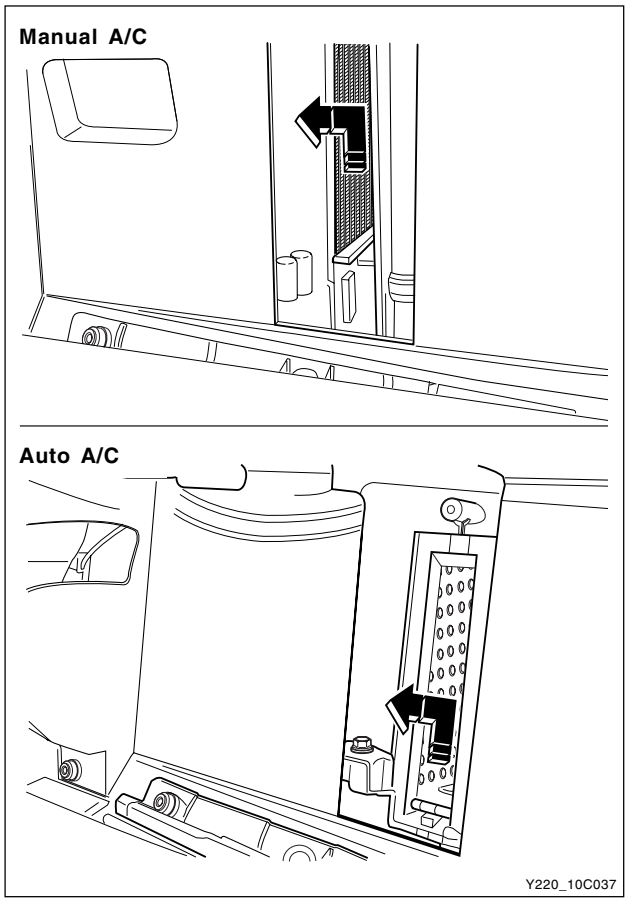
3. Pull in the primary air conditioner filter to remove it.

Notice

The manual A/C filter and the automatic A/C filter are not compatible.



4. Pull up and in the secondary air conditioner filter to remove it.
5. Install new air conditioner filters in the reverse order of removal.



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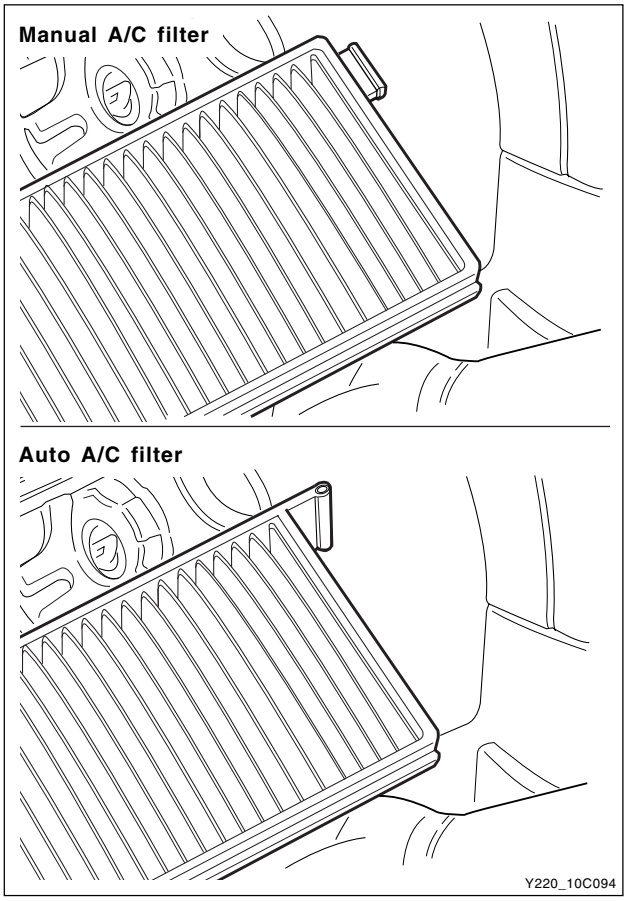
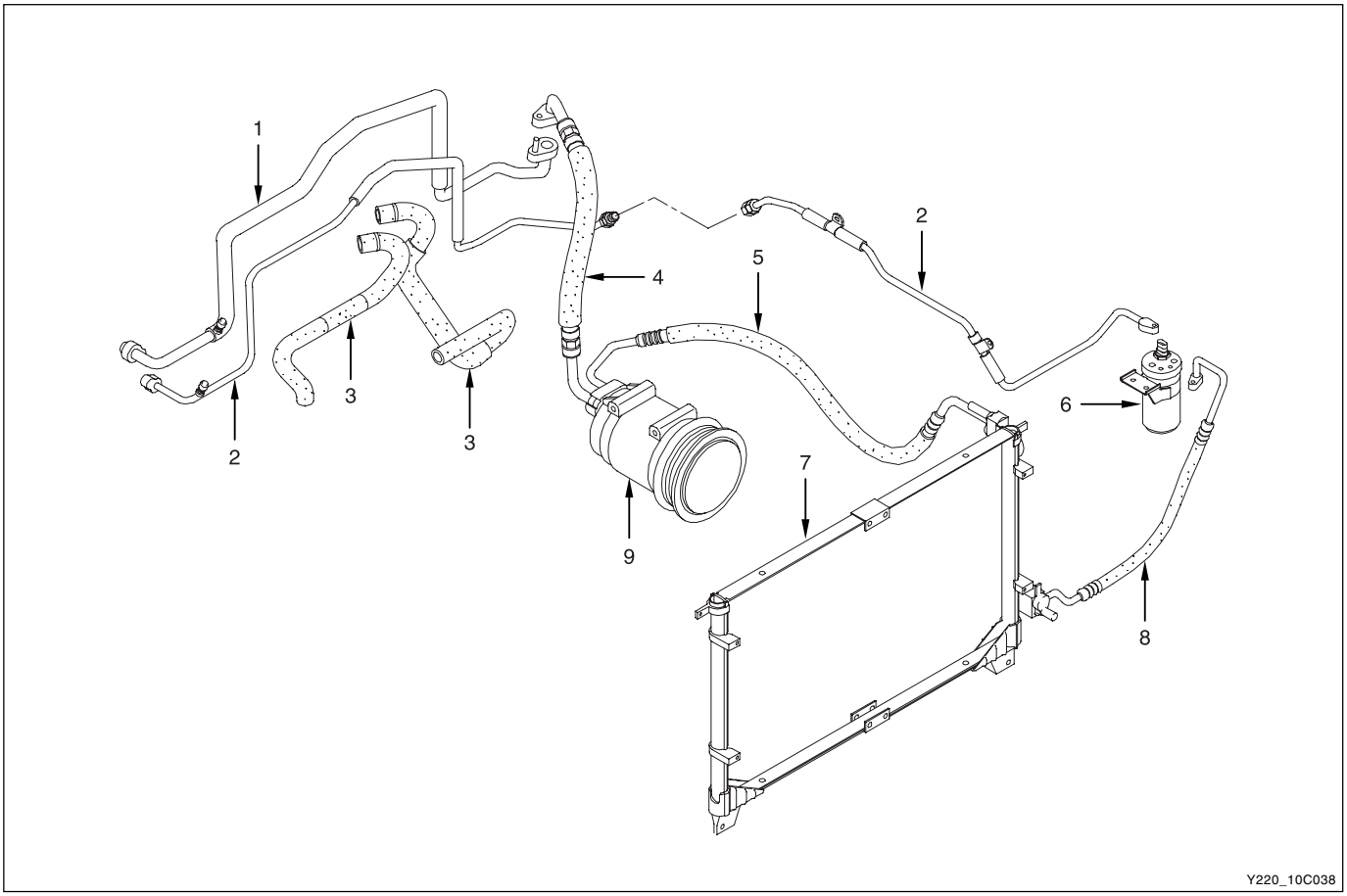


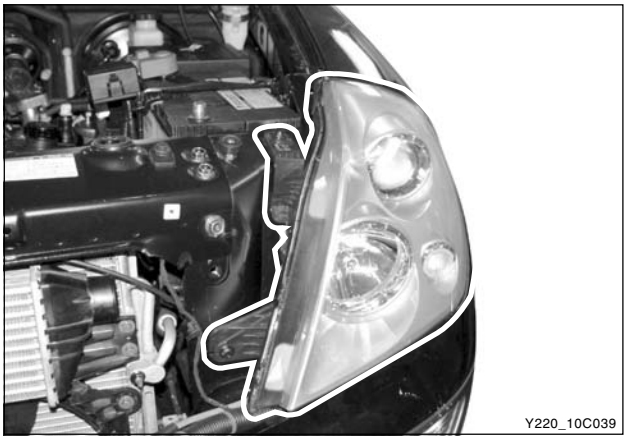
Notice

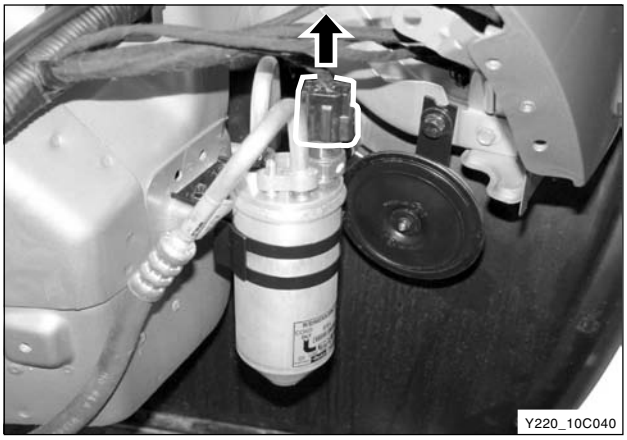
Replace both air conditioner filters at a time and pay attention to the installing direction.

REMOVAL AND INSTALLATION



1. Low pressure pipe
2. High pressure pipe
3. Heater hose
4. Low pressure hose and pipe
5. High pressure hose
6. Receiver drier
7. Condenser
8. Liquid hose
9. Compressor





Receiver Drier and Refrigerant Pressure - Removal and Installation

1. Discharge and recover the refrigerant from the air conditioner system.
2. Remove the headlamp assembly.
3. Disconnect the refrigerant pressure sensor connector.
4. Remove the receiver drier.
   - Remove the flange nuts.
   - Remove the O-ring.
   - Unscrew the bracket bolts and remove the receiver drier.
5. Install in the reverse order of removal.
6. Evacuate and recharge the air conditioner system.

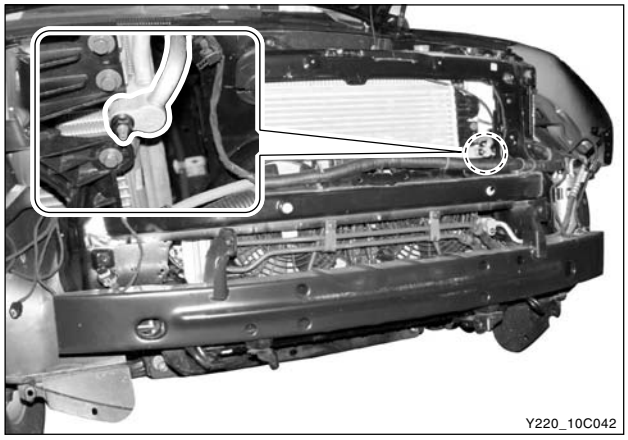
Notice

Never reuse the O-ring once removed.

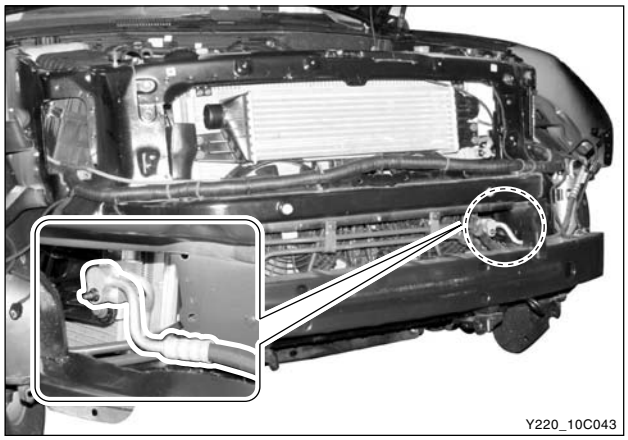
Condenser - Removal and Installation

1. Discharge and recover the refrigerant from the air conditioner system.
2. Remove the radiator grille and front bumper.

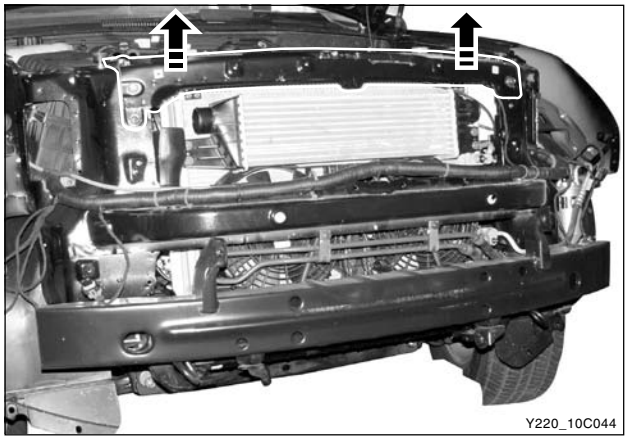
3. Remove the condenser inlet pipe with O-ring.



4. Remove the condenser outlet pipe (at front bottom side) with O-ring.



5. Remove the radiator grille plate.



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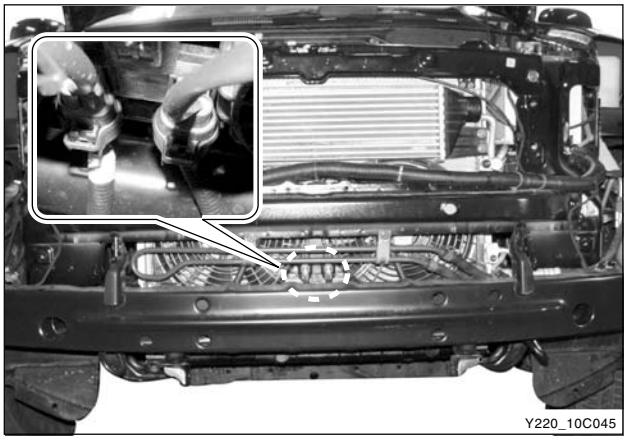
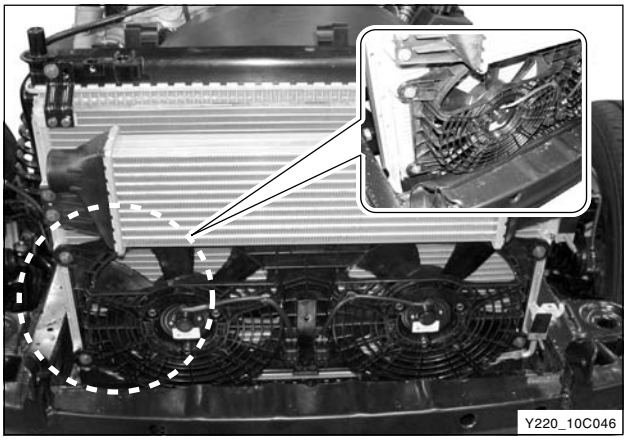
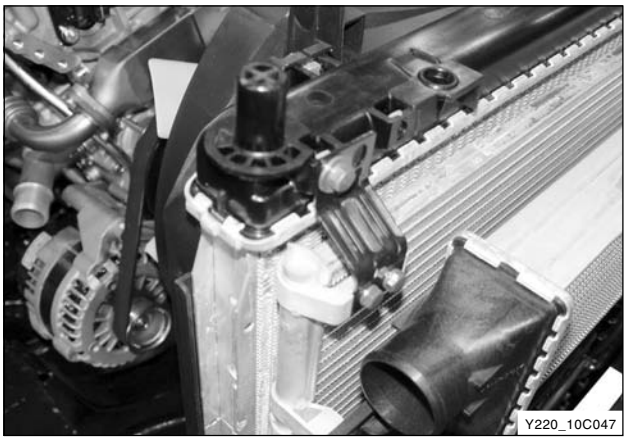


6. Disconnect the cooling fan (condenser) connector.



7. Unscrew the bolts and remove the cooling fan and intercooler from the condenser.



8. Unscrew the bolts and nuts and remove the condenser from the vehicle.

Notice

Replace the O-rings in the high and low pressure pipes with new ones.

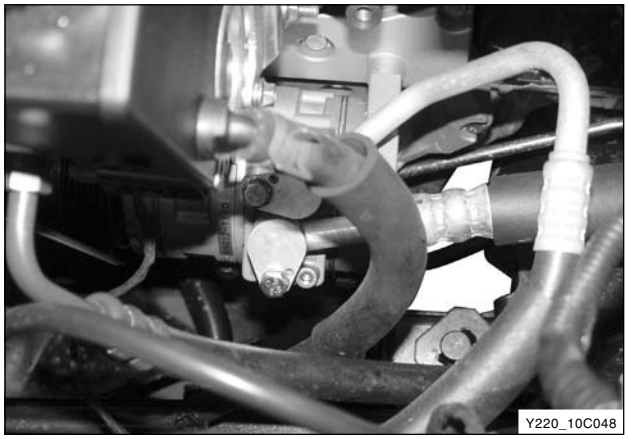
9. Install in the reverse order of removal.

Compressor - Removal and Installation

※ Preceding Works:

- Discharge and recover the air conditioning system
- Removal of fan belt

1. Remove the air conditioner hoses from the compressor.
   - Remove the air conditioner hose flange bolt.
   - Remove the hose.
   - Remove the two sealing washers.



2. Carefully lift up the vehicle with care.
3. Remove the skid plate.
4. Remove the compressor.
   - Disconnect the compressor connector.
   - Remove the three front bracket bolts.

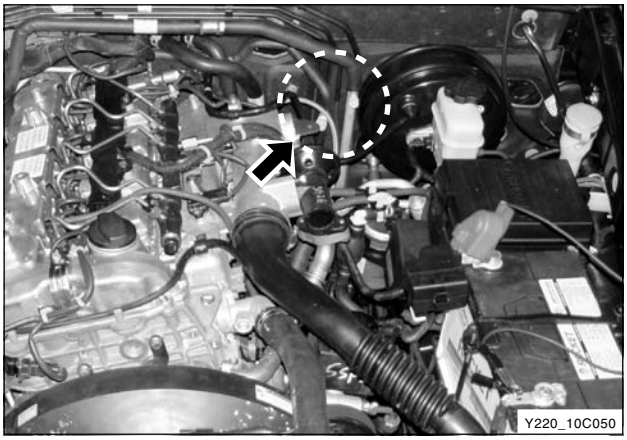
Notice

Never reuse the sealing washer once removed.

5. Install in the reverse order of removal.

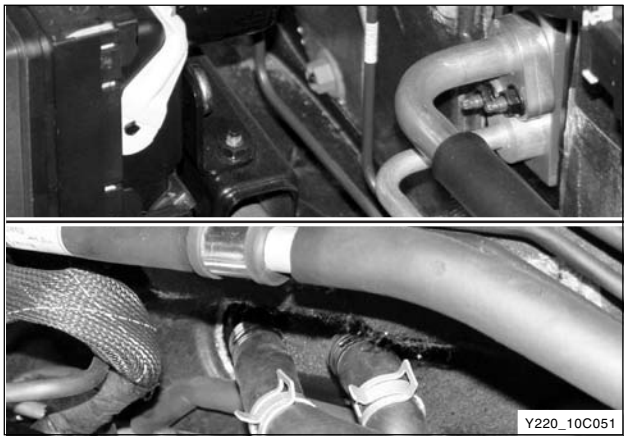
Notice

Evacuate and recharge the air conditioner system.



High and Low Pressure Lines - Removal and Installation

1. Discharge and recover the refrigerant from the air conditioner system.



2. Unscrew the flange nuts and remove the high and low pressure pipes.

3. Remove the high and low pressure pipes from the evaporator.

Notice

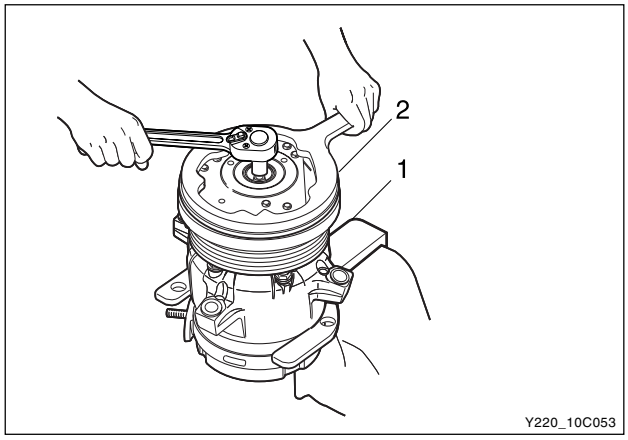
Never reuse the O-ring and washer once removed.

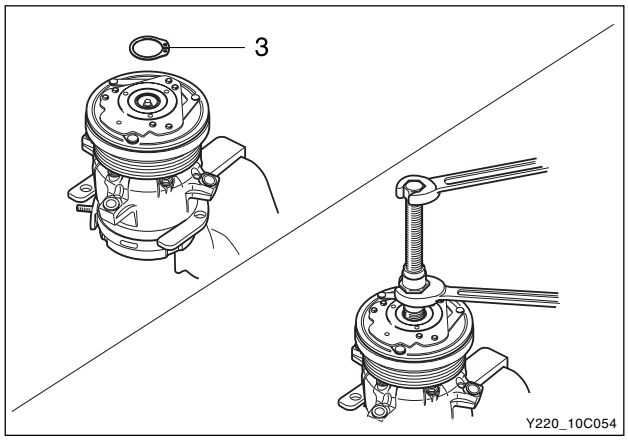
4. Install in the reverse order of removal.
5. Evacuate and recharge the air conditioner system.

DISASSEMBLY AND REASSEMBLY

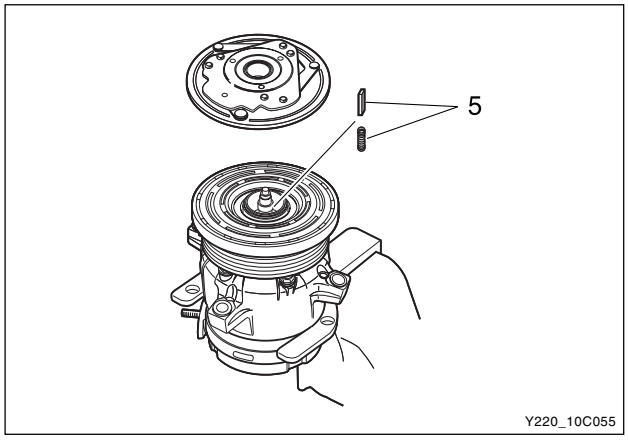
Compressor

1. Remove the compressor.
2. Remove the clutch driver.
   - Install the compressor holding fixture to the compressor and hold the compressor holding fixture using a bench vise.
   - Use the clutch hub holding tool to keep the clutch drive plate and the hub assembly from turning to remove the shaft nut.
   - Remove the snap ring using the ring plier.
   - Remove the clutch drive using the special tool.





   - Remove the clutch shaft key and spring.



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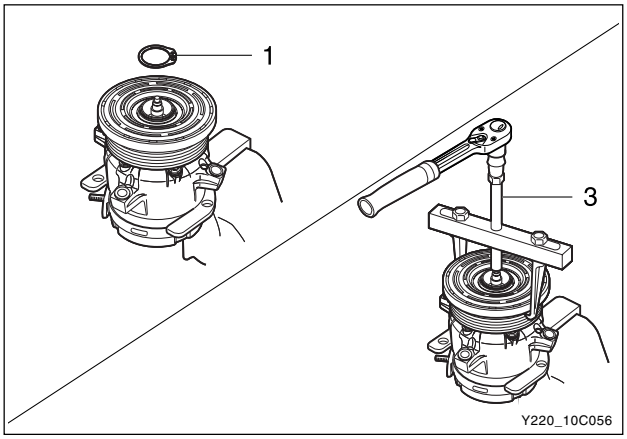
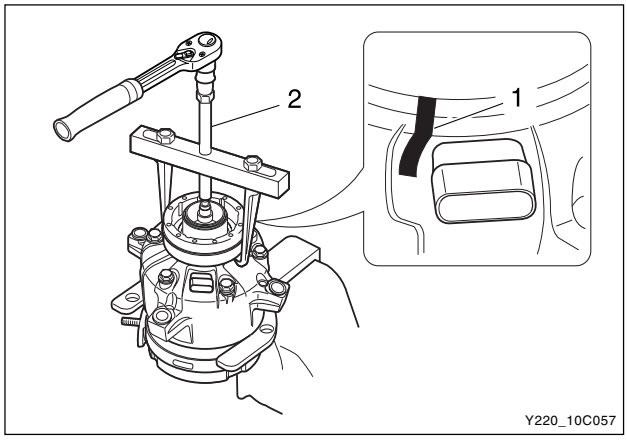
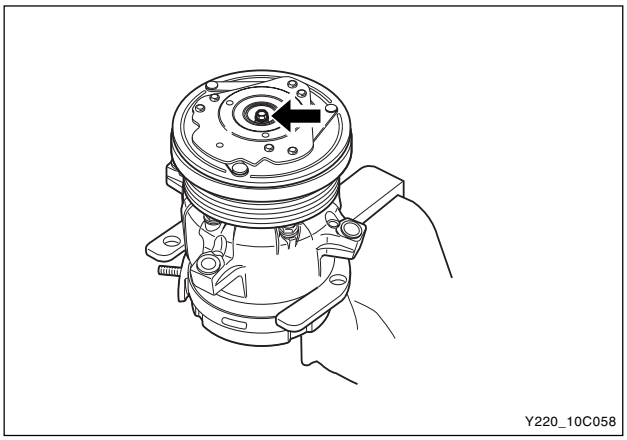


3. Remove the compressor pulley.
   - Remove the snap ring using the ring plier.
   - Remove the compressor pulley using the special tool.



4. Remove the clutch coil.
   - Mark the location of the clutch coil connector at the clutch housing.
   - Remove the clutch coil using the special tool.



5. Assembly in the reverse order of removal.

MANUAL AIR CONDITIONING SYSTEM

GENERAL INFORMATION

FUNCTION DESCRIPTION

▶ Compressor

All compressor are belt-driven from the engine crankshaft through the compressor clutch pulley. The compressor pulley rotates without driving the compressor shaft until an electromagnetic clutch coil is energized. When voltage is applied to energize the clutch coil, the clutch plate and hub assembly is drawn rearward toward the pulley. The magnetic force locks the clutch plate and pulley together as one unit to drive the compressor shaft.

As the compressor shaft driven, it compresses the low pressure refrigerant vapor from evaporator into high pressure, high temperature vapor. The refrigerant oil that is used to lubricate the compressor is carried with the refrigerant.

▶ Magnetic Clutch

The magnetic clutch is assembled in front of the compressor and controls to stop or operate the compressor.

The center piece is inserted to the compressor crankshaft and rotate the only the pulley when it doesn't operate the compressor. When the A/C switch is turned ON, the current flows into the wrapped coil of the stator and the stator is converted to the powerful electromagnet. Therefore, the compressor can rotate with the pulley together because the stator can pull the center piece tightly.

▶ V-5 Compressor-General

Description

Vehicle using the V5 compressor may have differences between installations in the mounting brackets, the drive system, the pulleys, the connections and the system capacities. Basic overhaul procedures are similar between the compressors used on different vehicles.

When serving the compressor, keep dirt and foreign material from getting on or into the compressor parts and the system. Clean tools and a clean work area are important for proper service. The compressor connections and outside of the compressor should be cleaned before performance of any on-vehicle repairs and before removal of the compressor. The parts must be kept clean at all times and any parts that are to be reassembled should be cleaned with trichloroethane, naphtha, stoddard solvent, kerosene or equivalent solvents and dried with dry air. Use only lint-free cloths to wipe the parts.

The operations described are based on bench overhaul with the compressor removed from the vehicle, except as noted. They have been prepared in the order of accessibility of the components. When a compressor is removed from the vehicle for servicing, the amount of oil remaining the compressor should be drained, measured and recorded. This should then be discarded and new polyalkaline glycol (PAG) refrigerant oil added to the compressor.

Note

The oil drain plug must be removed and the oil drained through the plug opening to insure complete draining of oil from the compressor.

▶ V-5 Compressor-Operation

The V5 is a variable displacement compressor that can match the automotive air conditioning demand under all conditions without cycling. The basic compressor mechanism is a variable angle wobble-plate with seven axially oriented cylinders. The center of the control of the compressor displacement is a billows-actuated control valve located in the rear head of the compressor that senses compressor suction pressure.

The wobble-plate angle and the compressor displacement are controlled by the crankcase suction pressure differential. When the A/C capacity demand is high, the suction pressure will be above the control point. The valve will maintain a bleed from crankcase to suction. With no crankcase suction pressure differential, the compressor will have maximum displacement.

When the A/C capacity demand is lower and the suction pressure reaches the control point, the valve will bleed discharge gas in the crankcase and close off a passage from the crankcase to suction plenum. The angle of the wobble-plate is controlled by a force balance of seven pistons. A slight elevation of the crankcase suction pressure differential creates total force on the piston resulting in a movement about the wobble-plate pivot pin that reduces the plate angle.

The compressor has a unique lubrication system. The crankcase suction bleed is routed through the rotating wobble-plate for lubrication of wobble-plate bearing.

The rotation acts as an oil separator that removes some of the oil from the crankcase where it can lubricate the compressor mechanism.

▶ Condenser Core

The condenser assembly in front of the radiator consists of coils, which carry the refrigerant and cooling fins that provide the rapid transfer of heat. The air passing through the condenser cools the high-pressure refrigerant vapor and causes it to condense it to condense into a liquid.

▶ Receiver-Drier

The sealed receiver-drier assembly is connected between the condenser and evaporator. It acts as a refrigerant storing container, receiving liquid and some vapor and refrigerant oil from the condenser.

At the bottom of the receiver-drier is the desiccant, which acts as drying agent for the moisture that may have entered the system. An oil bleed hole is located near the bottom of the receiver-drier outlet pipe to provide an oil return path to the compressor. The receiver drier is serviceable as an assembly.

▶ Expansion Valve

The expansion valve can fall in three different positions: open, closed or restricted.

An expansion valve that fails in open position will result in a noisy A/C compressor or no cooling. The cause can be a broken spring, a broken ball or excessive moisture in the A/C system. If the spring or the ball are found to be defective, replace the expansion valve. If excessive moisture is found in the A/C system recycle the refrigerant.

A restricted expansion valve will result in low suction pressure and no cooling. This may be caused by debris in the refrigerant system. If debris is believed to be the cause, recycle the refrigerant, replace the expansion valve and replace the receiver-drier.

▶ Evaporator

The evaporator is a device which cools and dehumidifies the air before it enters the vehicle. High pressure liquid refrigerant flows through the expansion tube (orifice) and becomes a low pressure gas in the evaporator. The heat in the air passing through the evaporator core is transferred to the cooler surface or the core, which cools the air.

As the process of heat transfer from the air the evaporator core surface is taking place, any moisture (humidity) in the air condenses on the outside surface of the evaporator core and is drained off as water.

▶ Pressure Relief Valve

The compressor is equipped with a pressure relies valve which is placed in the system as a safety factor. Under certain conditions, the refrigerant on the discharge side may exceed the designed operating pressure at approximately at 3,171 to 4,137 kPa
(460 to 600 psi) in an R-134a system. Conditions that might cause this valve to open, such as a defective pressure transducer, an inoperative cooling fan, etc., should be corrected. The refrigerant oil and the refrigerant should be replaced as necessary.

▶ Controller

The operation of the A/C system is controlled by the switches and knob on the control head. This console-mounted controller contains following control knobs.

Temperature control

- Actuates by cable.
- Raise the temperature of the air entering the vehicle by sliding to the right or the red portion of the knob.
- Varies the mix of the fresh air from outside the vehicle with the heated air from inside the vehicle to suit individual performance.

Mode control

- Actuates by cable.
- Regulates the air distribution between the windshield, the instrument panel and the floor vents.

Blower control

- Turn on to operate the blower motor at four speeds.
- Turn OFF to stop the blower.
- Operates completely independently from both the mode control knob and temperature control knob.
- Changes the fan speed in any mode and at any speed.

▶ A/C System Delay Relay

This relay controls the current to A/C system and instantly delays the A/C operation during starting the engine.

SPECIFICATIONS

Component			Description	
Compressor		Type	Variable Displacement	
		Model	Single	V-5 Compressor
			Dual	KC83
			Gasoline	KC83
		Displacement	Single	9.8 ~ 151 cc/rev
			Dual	175.5 cc/rev
			Gasoline	175.5 cc/rev
		Max. RPM	6,000 ~ 7,500 rpm	
Refrigerant		Type	R-134a	
		Capacity	Single	850 ± 50 g
			Dual	1200 ± 50 g
Oil		Type	Synthetic PAG Oil	
		Capacity	260 cc	
Receiver-drier		Material	Aluminum	
		Capacity	260 cc	
A/C condenser		Max. capacity	11,400 Kcal/h	
Evaporator		Size	263.0 x 228.6 x 88.9 mm	
		Capacity	6,500 Kcal/h	
A/C pressure sensor	High pressure	A/C ON/OFF	305/425 psi	
	Low pressure	A/C ON/OFF	39/30 psi	
A/C cutoff pressure		High pressure	32 Kgf/cm^2	
		Low pressure	4 Kgf/cm^2	

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TROUBLE DIAGNOSIS

INSUFFICIENT COOLING DIAGNOSIS

Step	Action	Yes	No
1	1. Check the A/C fuse. 2. Check the operation of the blower motor and cooling fan. 3. Check the accessory belt. 4. Check the A/C condenser for restricted air flow. 5. Check the engagement of the compressor clutch. 6. Check the discharge air temperature with the A/C turned ON. Are all above the operations normal?	System OK	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Connect the high/low pressure gauges. Are both pressures within the specified value?	Go to Step 4	Go to Step 3
3	1. If it's above the specified value, discharge the refrigerant. 2. If it's below the specified value, add 0.45kg (1 pound) of the refrigerant and repair any leaks as needed. 3. Recover, evacuate and recharge the A/C system. Is the repair complete?	System OK	-
4	1. Start the engine and allow it to run at idle. 2. Turn the A/C switch to ON. 3. Set the blower motor switch to 4th. 4. Set the temperature control lever to full cold. Does the A/C compressor clutch engage?	Go to Step 8	Go to Step 5
5	1. Turn the ignition to LOCK. 2. Check the open or short in the compressor wiring. Is there any open or short in the wiring?	Go to Step 6	Go to Step 7
6	Repair the faulty wiring as needed. Is the repair complete?	System OK	-
7	Replace the compressor clutch coil. Is the replacement complete?	System OK	-
8	Check for a knocking noise from the A/C compressor. Cycle the A/C compressor ON and OFF in order to verify the source of the noise. Do you hear a loud knocking noise?	Go to Step 9	Go to Step 10
9	1. Recover the A/C system refrigerant. 2. Replace the A/C compressor. 3. Evacuate and recharge the A/C system. 4. Check the A/C system for leaks. Is the compressor running normally?	System OK	-
10	1. Close all of the windows and doors. 2. Set the A/C switch to ON position. 3. Set the intake air control switch to "Fresh Air". 4. Set the blower motor switch to 4th. 5. Set the temperature control switch to full cold. 6. Keep it to run at idle for 5 minutes. 7. Check the temperature at the inlet/outlet of the evaporator. Is there a noticeable difference in the temperature of the evaporator inlet/outlet pipes?	Go to Step 11	Go to Step 13

INSUFFICIENT COOLING DIAGNOSIS (Cont'd)

Step	Action	Yes	No
11	1. Recover the A/C system refrigerant. 2. Replace the expansion valve as needed. 3. Evacuate and recharge the A/C system. 4. Check the A/C system for leaks. 5. Operate the A/C system. Is the discharge temperature normal?	Go to Step 13	Go to Step 12
12	1. Recover the refrigerant of the A/C system. 2. Evacuate and recharge the A/C system. 3. Check the A/C system for leaks. Does the A/C system operate normally?	System OK	-
13	Feel the liquid pipe between the condenser and the expansion valve. Is the pipe cold?	Go to Step 15	Go to Step 14
14	1. Repair any restriction in high pressure side. 2. Check the A/C system for leaks. Does the A/C system operate normally?	System OK	-
15	1. Run the engine at 3,000 rpm. 2. Close all of the windows and doors. 3. Set the A/C switch to ON. 4. Set the blower motor switch to 4th. 5. Set the temperature control switch to full cold. 6. Turn the A/C switch ON and OFF every 20 seconds for 3 minutes. 7. Measure the compressor high and low pressure. Are both pressures within the specified value?	Go to Step 17	Go to Step 16
16	Add the specified amount of the refrigerant to the A/C system. Is the amount within the specified value?	System OK	-
17	1. Turn the ignition to LOCK. 2. Set the A/C switch to OFF position. Can you turn the compressor clutch freely by hand?	Go to Step 18	Go to Step 19
18	1. Check the A/C system for leaks. 2. Repair any leaks as needed. 3. Evacuate and recharge the A/C system. Does the A/C system operate normally?	System OK	-
19	1. Recover the refrigerant of the A/C system. 2. Evacuate and recharge the A/C system. 3. Check the A/C system for leaks. 4. Replace the compressor as needed. Is the repair complete?	System OK	-

ABNORMAL REFRIGERANT PRESSURE

Step	Action	Yes	No
1	1. Verify whether airflow and excessive refrigerant. 2. Check any restriction at the condenser or radiator. 3. Check the condenser or cooling fan for proper operation. 4. Check any restriction of the refrigerant lines. Is the high-side refrigerant pressure high abnormally?	Go to Step 2	Go to Step 3
2	1. Recover, evacuate and recharge the A/C system according to the specified value. 2. Clean the condenser or radiator core. 3. Check the voltage, rpm, direction of the cooling fan. 4. Repair or replace the appropriate parts as needed. Is the high-side pressure within the specified value?	System OK	-
3	1. Check the amount of the refrigerant. 2. Check the internal faulty of the compressor. 3. Check the faulty of the expansion valve. 4. Check the moisture mix into the system. Is the high-side refrigerant pressure low abnormally?	Go to Step 4	Go to Step 5
4	1. Replace the compressor and the expansion valve as needed. 2. Recover, evacuate and recharge the A/C system according to the specified value. 3. Repair any leaks as needed. Is the repair complete?	System OK	-
5	1. Check the freezing/clogging of the expansion valve. 2. Check the clogging of the receiver-drier. 3. Check the amount of the refrigerant. Is the low-side refrigerant pressure low abnormally?	Go to Step 6	Go to Step 7
6	1. Clean the expansion valve and replace it as needed. 2. Replace the receiver-drier as needed. Is the repair complete?	System OK	-
7	1. Check the expansion valve and the compressor for any faulty. 2. Check the excessive amount of the refrigerant. Is the low-side refrigerant pressure high abnormally?	Go to Step 8	Go to Step 9
8	1. Replace the expansion valve and the compressor as needed. 2. Add the specified amount of the refrigerant. Is the repair complete?	System OK	-
9	1. Check the tightening condition of the refrigerant line coupling and bolts. 2. Check the faulty O-ring. 3. Check the faulty gasket or seal of the compressor. Is there any refrigerant leak?	Go to Step 10	System OK
10	1. Tighten the bolts. 2. Replace the faulty O-ring. 3. Replace the faulty compressor. Is the repair complete?	System OK	-

REMOVAL AND INSTALLATION

CONTROL SWITCH ASSEMBLY

1. Remove the center instrument panel.

2. Remove the air conditioner control switch screws.

3. Remove the control switch assembly from the instrument panel.

4. Install in the reverse order of removal.

Notice

Connect the connector and push the control switch until it stops.

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AUTOMATIC AIR CONDITIONER SYSTEM

GENERAL INFORMATION

OVERVIEW

THE V5 FULL AUTOMATIC TEMPERATURE CONTROL (FATC) SYSTEM

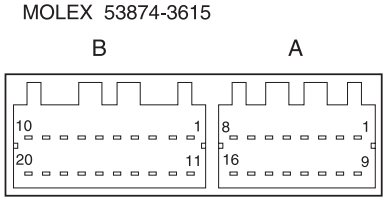
The full automatic temperature control (FATC) uses the integrated control panel as the driver's interface to the system. The FATC receives driver's input signal and various input signal from sensors and controls the actuators to maintain driver's desired room temperature.

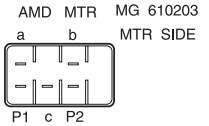
Vacuum Fluorescent Display panel provides system operating information for the driver. With the system in OFF mode, the outside temperature is displayed continuously.

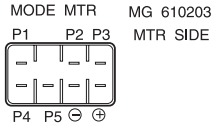
The driver may display the current temperature setting by selecting any mode except OFF or adjusting the temperature control.

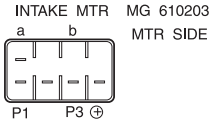
Also, it provides the convenience to the driver by indicating the ambient air temperature. If it occurs the faulty in the FATC system, the MICOM informs the driver or mechanics of the results of the self-diagnostic check and controls the system by

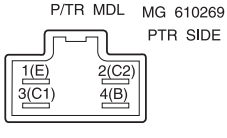
FATC CONTROL











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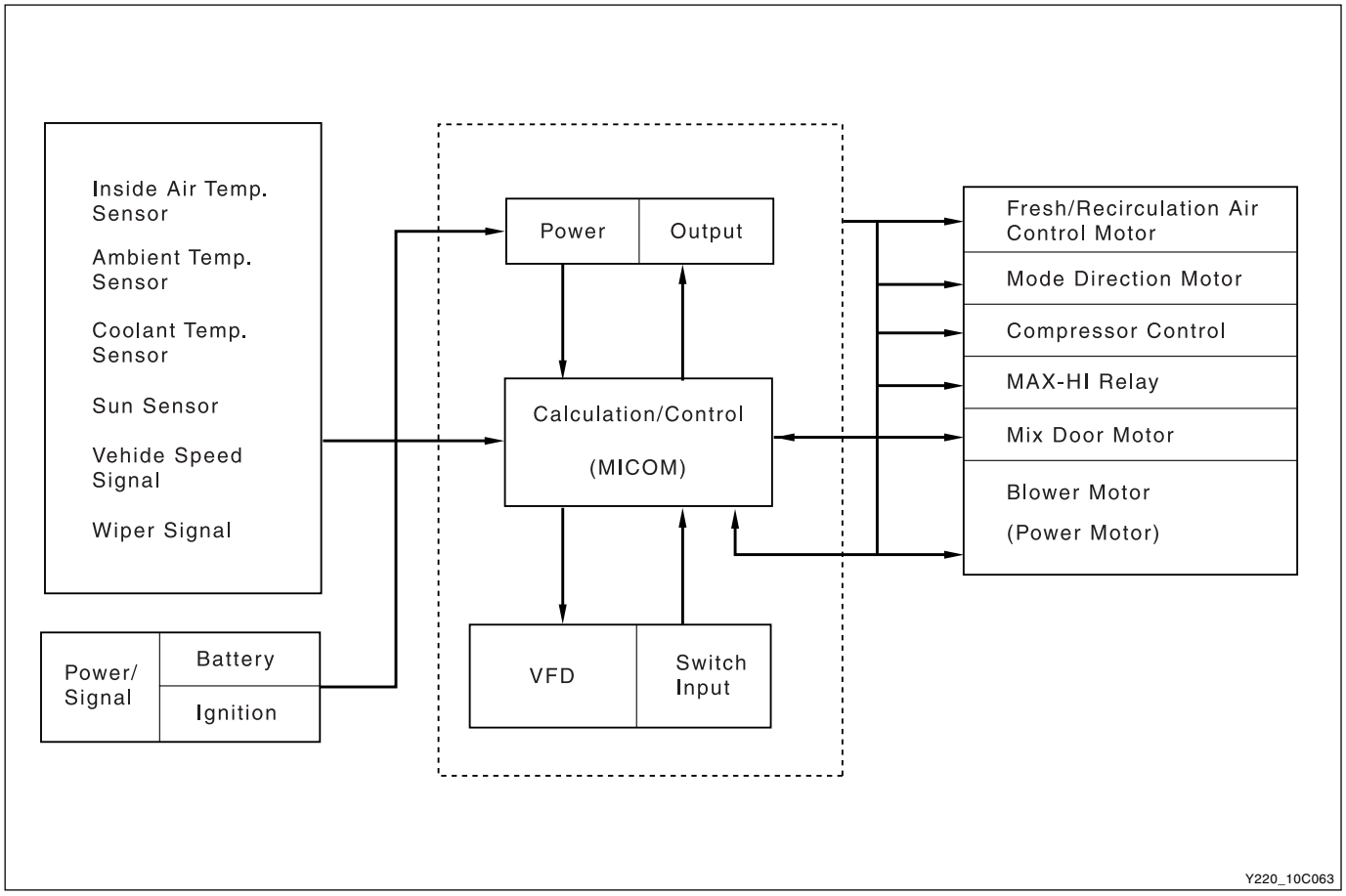
FATC INPUT/OUTPUT ROUTING DIAGRAM



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FATC SYSTEM CHARACTERISTIC

▶ Display Performance Enhancement

It allows VFD (Vacuum Fluorescent Display) to develop the effect of the visible.

▶ Airflow Control Enhancement

It allows MICOM to control the temperature and perform the control automatically of the heating operation, the cooling operation and the Mild operation. Also, MICOM enable to control the amount of the airflow and the direction of the vent outlet in order to keep the inside air fresh.

▶ Self-Diagnostic Circuit Check

The full automatic temperature control (FATC) air conditioning controller contains a self-diagnosis function to aid in finding any problem with the system. If the FATC detects some errors it will blink the temperature display screen for 5 seconds when the ignition switch is ON.

To enter the diagnostic mode, perform the following procedure.

1. Turn the ignition switch ON.
2. Set the temperature control to 26°C (79°F).
3. Within 3 seconds, push the AUTO and the OFF switches simultaneously, more than three times.
4. Check the diagnostic trouble code (DTC) in the temperature indicator screen blinks. If there are no diagnostic trouble code (DTC) set, the screen will display 00.
5. When the FATC controller indicates a DTC, proceed to the table for the DTC.
6. Push the OFF switch to return the controller to its normal function.

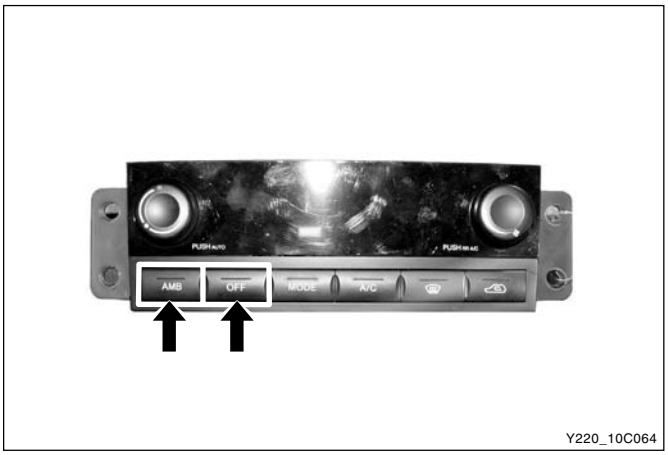
DTC	Description
0	Normal (No Error)
1	Inside Air Temperature Sensor Error
2	Ambient Air Temperature Sensor Error
3	Coolant Temperature Sensor Error
4	Air Mix Door Error
5	Sun Sensor Error
6	Power Transistor Error
7	High Blower Relay Error

Action taken when the faulty occurred

When any faulty is occurred in the automatic temperature control system, it's sign is informed to the driver by flashing the set temperature display for 5 seconds at initial starting.

How to verify faulty code

When the temperature is set to 26°C and then within 3 second, push the AMB switch and the OFF switch simultaneously at three times, the FATC controller temperature display indicates the faulty code after performing the self-diagnosis by MICOM.



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Condition for clearing the faulty code

1. When the vehicle restarts
2. When push the OFF switch after indicating the faulty code
3. When pass over 32 seconds after indicating the faulty code

Fault safety function

FATC air conditioner not only performs self-diagnosis but also has safety function against faults. If there is open or short in the sensors or potentiometer of temperature door some specific value will be substitute.

Error	Fault Safety Function
Inside air Sensor Error	25°C will be substituted as temperature of inside of vehicle.
Ambient Temperature Sensor Error	25°C will be substituted as ambient temperature.
Coolant Temperature Sensor Error	Sensor ON. 50°C will be substituted as coolant temperature.
Sun Sensor Error	Zero (0) will be substituted as sun load.

SYSTEM BASIC FUNCTION

▶ Set Temperature Control

When you set the setting temperature using the temperature control switch, the FATC receives the various input signals from sensors including the information of inside air temperature, ambient temperature, coolant temperature and sun loads etc.. The FATC uses this signals to control automatically the A/C compressor, the mode door, the I/A door, air mix door and blower motor etc.

▶ Airflow Control

For setting at Full AUTO, it is possible to control the blower motor operation both manually and automatically in order to adjust the airflow according to the set temperature.

▶ Manual Control

When you push the blower switch, you can control the blower motor manually and it increases or decreases each step by moving the switch to HI/LO. (with the ignition ON)

Step	Blower Voltage
1	4.5 V
2	6.0 V
3	7.5 V
4	9.0 V
5	11.0 V
6	Max Hi

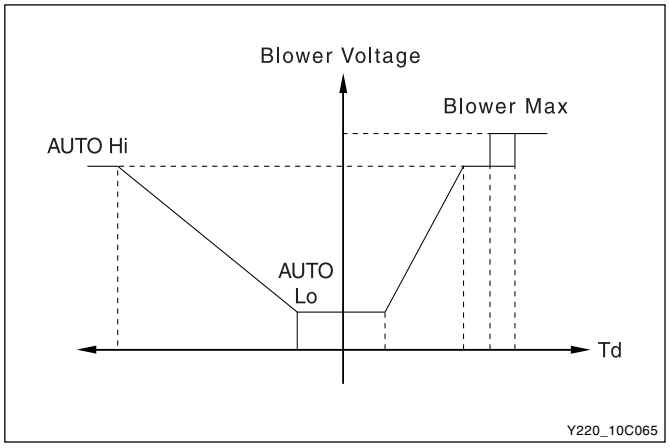
- The voltage of the blower motor may increase or decrease (0.5 V) according to power voltage.

▶ Automatic Control

Td value can be determined by the set temperature value and Td value is set to the target voltage of the blower motor simultaneously. The blower motor can shift without step.

Note

Td (Thermal Demand): Td value is the default for automatic control of the automatic temperature control and allows it to control the set temperature calculating the differences between inside air temperature and ambient temperature.



Blower Step	Blower Motor Voltage
1	4.0 ~ 5.5 V
2	5.5 ~ 7.5 V
3	7.5 ~ 8.5 V
4	8.5 ~ 9.5 V
5	9.5 ~ 10.5 V
6	10.5 ~ 13.5 V

▶ Vent Rate Control By Heating Operation

When the temperature of the engine coolant is low or it's difficult to obtain the desired hot air in winter, the system controls to prevent the cold airflow from the outlet due to the cold air give a negative effect to the heating performance.

Therefore vent step is fixed 1st on blower AUTO step until the coolant sensor detects above 20°C and also the blower step increases gradually according to going up the coolant temperature. When the coolant temperature goes up above 40°C, the heating operation stops.

▶ Vent Rate Control By Cooling Operation

When the air inside the resonance duct is hot in summer, after the system keeps the low vent rate (1st) operating for 5 seconds and discharges the hot air to the windshield side (Def Mode), the system starts to control normally in order to avoid for the passengers contacting the hot air.

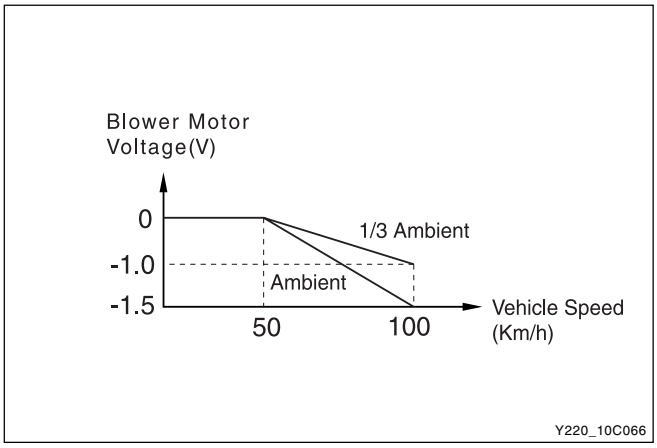
▶ Defroster Calibration

On the blower AUTO step, when the passenger sets to Defroster (Def), the system increases the blower voltage by 2 V for some intervals comparing AUTO voltage. But it is excluded the condition when the blower voltage is above 11.0 V. Also, the voltage increasing by defroster calibration is limited up to 10.5 V.

▶ Vehicle Speed Calibration

On the Ambient or the 1/3 Ambient and the blower AUTO, the blower decreases the voltage with the vehicle speed 100 Km/h such as 1.5 V for the Ambient, 1.0 V for the 1/3 Ambient.

But it is the exception for the blower max.



▶ Ambient Temperature Display

It indicates the ambient temperature as 0.5°C increment in the set temperature digit by ambient temperature sensor.

- When you push the AMB key it indicates the ambient temperature for 5 seconds and return back the set temperature.
- If you push the AMB key again during indicating in 5 seconds, it returns back.
- The ambient temperature sensor is securing in the front of radiator and may be influenced easily to the heat of the engine compartment in parking. Therefore the ambient temperature sensor indicates the ambient temperature accurately on the condition of above 40 km/h running.

▶ Delivery Condition

For the initial installation (the initial current draw), the initial mode follows;

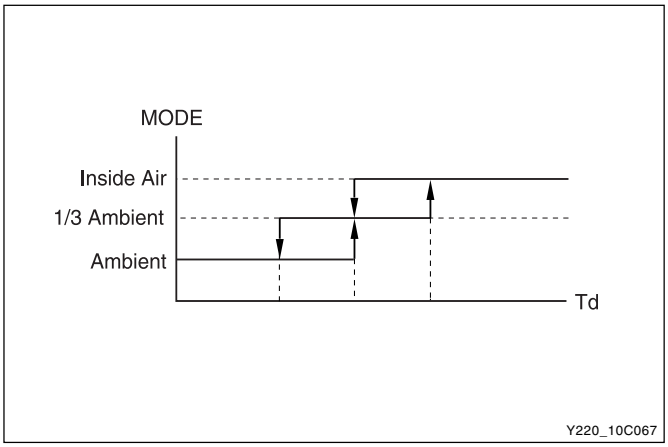
Actuator	Mode	Suction Air	A/C	Blower	Mix
Condition	FOOT/ DEF	FRESH	OFF	OFF	Td Basic Control

▶ Vent Inlet Control

Manual control

When you push the I/A control switch, you can control the I/A door manually and the I/A door changes between the recirculation air and the fresh air flow alternately by the control switch. For changing the fresh air step (FRE) to the recirculation air step (REC), the blower voltage decrease 15 % and for changing the recirculation air step (REC) to the fresh air step (FRE), the blower voltage return back.

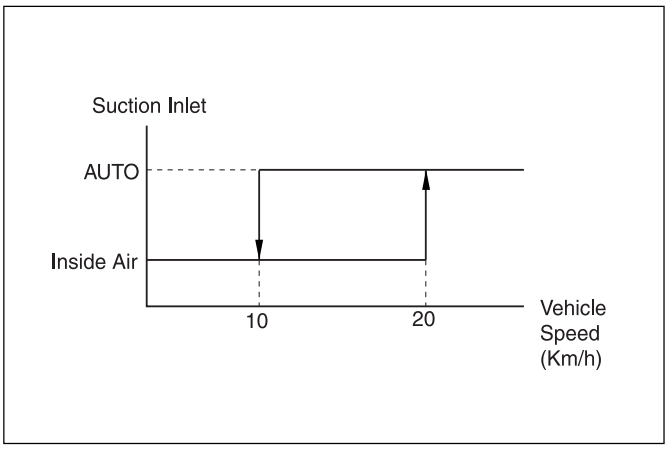
AUTO control



Control by the vehicle speed

The system controls the vent inlet according to the vehicle speed in order to prevent the exhaust gas of the preceding vehicle from flowing inside with the vehicle stopping or driving at low speed. The operation and control condition is following as;

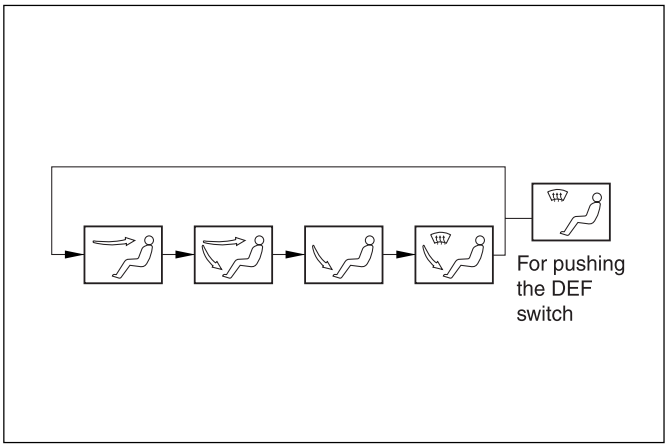
1. When the vent inlet mode is AUTO and the A/C "ON".
2. When the vehicle keeps to drive at below 10 km/h for 10 seconds and changes the REC mode at stop.
3. If 10 minutes passes after changing the REC mode, it returns back to the AUTO mode.



▶ Vent outlet Control

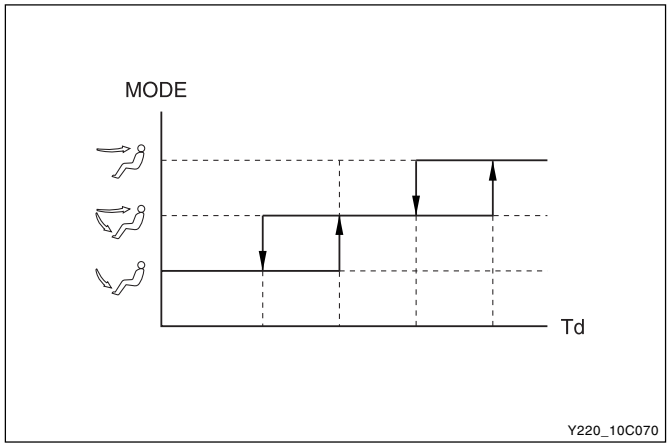
Manual control

For pushing the mode switch of AUTO temperature control, you can select four type of the vent outlets.



When you push the Def switch, it keeps to change to the defroster mode regardless of the sequence.

AUTO Control



▶ A/C Control

Manual control

When you pushed the A/C switch "ON" or the Def switch "ON", A/C starts to operate.

AUTO control

Basic Control: A/C "ON" has the priority for the initial operation.

▶ Full Cold/Hot Control

When you sets the set temperature to full cold (LO) or full hot (HI), the system controls the temperature to full cold or full hot regardless of sensor's detection. For LO, it becomes A/C "ON", front vent mode, recirculation air, max blower speed, air mix door close and for HI, A/C "OFF", floor vent mode, ambient mode, air mix door open.

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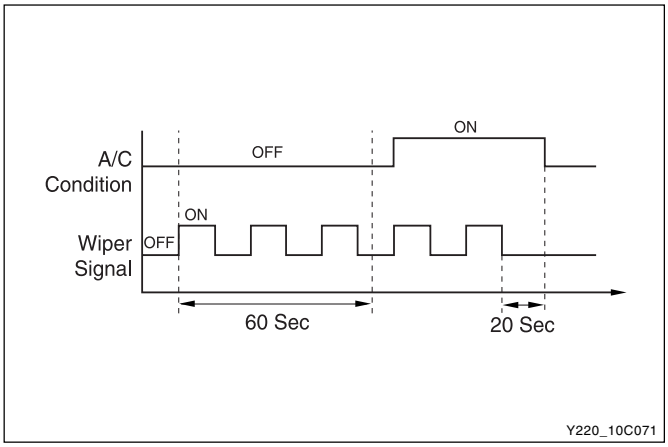
▶ Wiper Calibration Control

It is possible to generate the frost on the windshield in the rainy days. At this time, FATC controller allows the mode to change the AUTO defroster mode.

- Operation Condition: When the passenger operates the wiper on AUTO mode, the system controls the wiper on the A/C AUTO mode after sending the wiper signal and controlling the delay for 1 minutes.



▶ FATC Controller Illumination Control

When the tail lamp is “ON”, FATC Controller illumination lamp turns “ON”.

SYSTEM COMPONENTS - CONTROL

▶ Controller Assembly

The operation of the A/C system is controlled by the switched on the control head. This console-mounted controller consist of control knobs and a vacuum fluorescent display (VFD) indicating the status of the control settings selected.

▶ Sensors and Motors

- Inside air sensor, ambient sensor, coolant temperature and sun sensor
- Door mode motor, intake air control door motor, air mix door motor

▶ Inside Air Temperature Sensor

Inside air temperature sensor located in left side of full automatic temperature control (FATC) controller, is a sensor that detects the interior air temperature and a thermistor that decreases its resistance when temperature up and increases when temperature down. If there is open or short in the sensors, 25°C (77°F) will be substitute.

Inspection

When the inside air temperature sensor error displays, check the followings;

1. Remove the inside air temperature sensor and measure the resistance between the sensor connectors.
   (approximately 2.2 KW at 25°C) Replace the inside air temperature sensor when the resistance value is excessive low or high.
2. Replace the inside air temperature sensor for outside the specified value and check the followings for within the specified value;
3. Turn the ignition ON.
4. Measure the voltage between A13 and A16 terminal of the AUTO temperature control connector. (approximately 2.2 V at 25°C)
5. Verify the open circuit of the wiring harness when you can not measure the voltage value and replace the AUTO temperature control when it's normal.

▶ Ambient Air Temperature Sensor

Ambient air temperature sensor is a thermistor (NTC resistance) that decreases its resistance when temperature up and increases when temperature down and it detects ambient air temperature. If there is open or short in the sensors, 25°C (77°F) will be substitute. The sensor is located in the left back side of front bumper.

Inspection

When the ambient temperature sensor error displays, check the followings;

1. Remove the ambient temperature sensor and then measure the resistance between the sensor connectors.
   (approximately 2.2 KW at 25°C) Replace the ambient temperature sensor when the resistance value is excessive low or high.
2. Replace the ambient temperature sensor for outside the specified value and check the followings for within the specified value;
3. Turn the ignition ON.
4. Measure the voltage between A13 and B8 terminal of the AUTO temperature control connector. (approximately 2.2 V at 25°C)
5. Verify the open circuit of the wiring harness when you can not measure the voltage value and replace the AUTO temperature control when it's normal.

▶ Coolant Temperature Sensor

Coolant temperature sensor is a thermistor that decreases its resistance when temperature up and increases when temperature down. It detects coolant temperature to operate the blower speed at low when the coolant temperature is less than 50°C (122°F). If the coolant temperature sensor is open or short, 100°C (212°F) will be substitute.

Inspection

When the coolant temperature sensor error displays, check the followings;

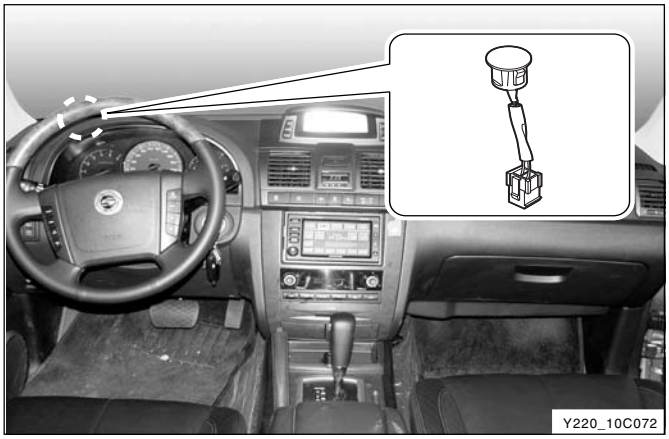
1. Measure the resistance between the sensor connectors. (approximately 2.2 KW at 25°C)
2. Replace the coolant temperature sensor for outside the specified value and check the followings for within the specified value;
3. Turn the ignition ON.
4. Measure the voltage between A13 and B9 terminal of the AUTO temperature control connector. (approximately 2.2 V at 25°C)
5. Verify the open circuit of the wiring harness when you can not measure the voltage value and replace the AUTO temperature control when it's normal.

▶ Sun Sensor

Sun sensor is a photo diode that detects lights. Resistance of the diode can be measured as current by using voltmeter according to increasing sun loads. If the sun sensor is error, no sun load will be substitute.

Photo diode

It is used to the circuit converting the sun light loads to the electric signals.



Inspection

When the sun sensor error displays, check the followings;

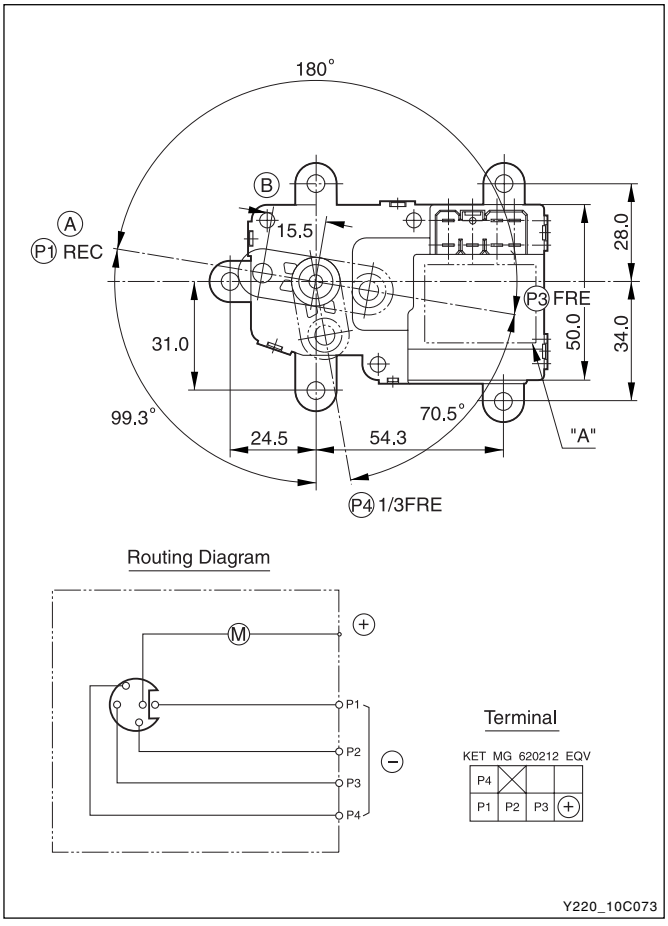
1. Remove the sensor to place it under the sun light and measure the current between the connector terminals.
2. Place the sun sensor under the shadow place and measure the current between the connector terminals. If the value is lower than the value under the sun light, it's normal.
3. Turn the ignition ON.
4. Measure the voltage between A13 and B10 terminal of the AUTO temperature control connector. (Sun light: 2.5 V, Shadow: 4.8 V)
5. Verify the open circuit of the wiring harness when you can not measure the voltage value and replace the AUTO temperature control when it's normal.

▶ Intake Control Door Motor

The mode motor set the I/A mode by the control signal of the AUTO temperature control.

When the mode displayed in the AUTO temperature control is different from the actual mode, check the followings;

- Turn the ignition ON.
- Measure the voltage between the (+) terminals at each mode and verify that changes from 0 V before the mode selection to 12 V after the mode selection.
- If the value is the specified value, check the open or short circuit.
- If the wiring is normal, replace the AUTO temperature control.
- If the voltage value is outside the specified value, replace the I/A mode motor.
- Check the motor operation connecting the (+) terminal to No.4 of the motor connector and connecting No.5 and No.7 to (-) terminal sequentially using 12 V power.



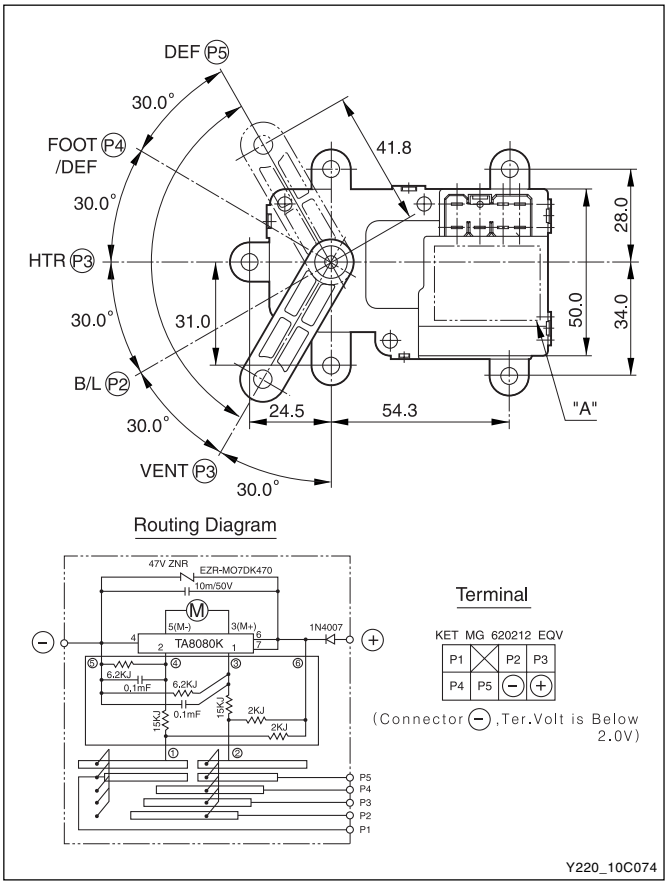
Inspection

When the vent inlet mode displayed in the AUTO temperature control is different from the actual mode, check the followings;

1. Turn the ignition ON.
2. Measure the voltage between positive terminal and negative terminal of the Mtr-Act, AI connector. (Specified value; 12 V)
3. Measure the voltage between P1, P2, P3 and (+) terminal. (If it changes from 0V before the mode selection to 12 V after the mode selection, it's normal)
4. If the value is outside the specified value, check the open or short circuit.
5. If the wiring is normal, replace the AUTO temperature control.
6. If the value is the specified value, replace the Mtr-Act, AI.
7. Check the motor operation connecting the (+) terminal to No.4 of the motor connector and connecting No.5 and No.7 to (-) terminal sequentially using 12 V power.

▶ Mode Control Motor

The control motor sets the mode of Vent, Bi-level, Foot, Foot/Def or Def by opening/closing the outlet damper at the outlet of Vent, Foot or Def according to control signal of the AUTO temperature control.



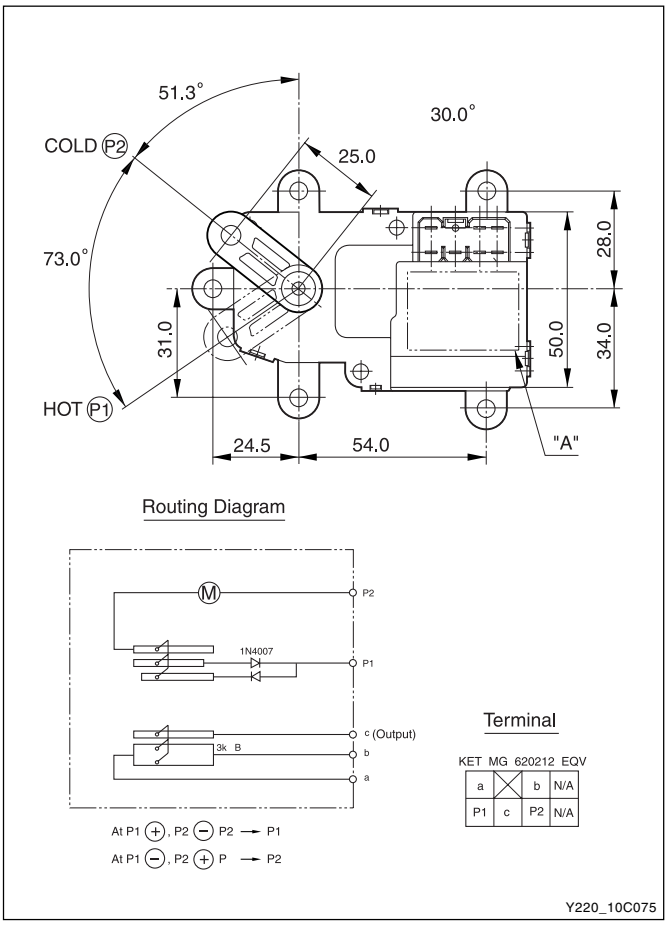
Inspection

When the vent inlet mode displayed in the AUTO temperature control is different from the actual mode, check the followings;

1. Turn the ignition ON.
2. Measure the voltage between P1 ~ P5 and (+) terminal. (If it changes from 0V before the mode selection to 12 V after the mode selection, it's normal)
3. If the value is outside the specified value, check the open or short circuit.
4. If the wiring is normal, replace the AUTO temperature control.
5. If the value is the specified value, replace the Mtr-Act, AI.
6. Check the motor operation connecting the (+) (-) terminal to the Mtr-Act mode and each terminal P1 ~ P5 to (-) terminal sequentially using 12 V power.

▶ Air Mix Door Motor

The air mix door motor is located on left side of heater module. The air mix door motor controls the exhaust air temperature by the signal of the FATC.



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Inspection

When the air mix door motor error displays, check the followings;

1. Turn the ignition ON.
2. Measure the voltage within P1, P2 terminals (specified value: 12 V) and a,b (specified value: 5).
3. If the value is outside the specified value, check the open or short circuit.
4. If the wiring is normal, replace the Mtr-Act, Temp.
5. If the (+) (-) terminal connects to P1 and P2 of the Mtr-Act, Temp alternately, the output by the each mode is following;

AMD	Mode	Bc Resistance
Cool	P1 (-), P2 (+)	Below 300 Ω
Hot	P1 (+), P2 (-)	Above 2.4 KΩ

▶ Power Transistor

Power transistor controls the blower airflow and it receives the airflow control signal from the AUTO temperature control in order to for blower motor to shift the speed without step by adding the current to the power transistor basic current.

Inspection

When the power transistor error displays, check the followings.

1. Turn the ignition ON.
2. Measure the voltage between blower connectors by changing the step from 1st to 6th.
3. The voltage value by each step is the followings; (specified value: 0.5)
4. If the value is outside the specified value, check the open or short circuit.

1st	2nd	3rd	4th	5th	6th
4.5 V	6.0 V	7.5 V	9.0 V	11.0 V	Relay Hi

5. When there is no problem in the wiring harness, replace the power transistor.

SPECIFICATIONS

Description			Specification
Compressor		Type	Variable Displacement
		Model	V-5 Compressor
		Displacement	9.8 ~ 151 cc/rev
		Max. RPM	6,000 ~ 6,500 rpm
Receiver-drier		Material	AL R/DRIER
		Capacity	210 cc
Refrigerant		Type	R-134a
		Capacity	750 ± 20 g
Oil		Type	Synthetic PAG Oil
		Capacity	220 cc
Condenser		Max. capacity	11,400 Kcal/h
A/C pressure sensor	High (gauge pressure)	A/C ON	305 psi
		A/C OFF	425 psi
	Low (gauge pressure)	A/C ON	39 psi
		A/C OFF	30 psi
Blower motor		Max. capacity	7,475 ~ 9,075 Kcal/h
Heater core		Fin pitch	1.52 mm
		Size	200.5 x 168.2 x 25.0 mm
		Capacity	8,250 Kcal/h

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TROUBLE DIAGNOSIS

GENERAL DIAGNOSIS

The full automatic temperature control (FATC) air conditioning controller contains a self-diagnosis function to aid in finding any problem with the system.

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If the FATC detects some errors it will blink the temperature display screen for 5 seconds when the ignition switch is ON.

When there are some errors in the automatic temperature control system without displaying the faulty code, perform the diagnostic test using the applicable table.

▶ General A/C Diagnosis

- Improper operations of FATC controller when the ignition switch is in “ON” position
- Improper operations of FATC controller illumination lamp when the ignition switch is in “ON” position
- Poor heating performance
- Poor cooling performance
- Improper operation of blower motor
- Improper operation of mode motor
- Improper operation of air source selection

▶ Insufficient Cooling Diagnosis

Step	Action	Yes	No
1	1. Check the A/C fuse. 2. Check the operation of the blower motor and cooling fan. 3. Check the accessory belt. 4. Check the A/C condenser for restricted air flow. 5. Check the engagement of the compressor clutch. 6. Check the discharge air temperature with the A/C turned ON. Are all above the operations normal?	System OK	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Connect the high/low pressure gauges. Are both pressures within the specified value?	Go to Step 4	Go to Step 3
3	1. If it's above the specified value, discharge the refrigerant. 2. If it's below the specified value, add 4.5 kg (1 pound) of the refrigerant and repair any leaks as needed. 3. Recover, evacuate and recharge the A/C system. Is the repair complete?	System OK	-
4	1. Start the engine and allow it to run at idle. 2. Turn the A/C switch to ON. 3. Set the blower motor switch to 4th. 4. Set the temperature control lever to full cold. Does the A/C compressor clutch engage?	Go to Step 8	Go to Step 5
5	1. Turn the ignition to LOCK. 2. Check the open or short in the compressor wiring. Is there any open or short in the wiring?	Go to Step 6	Go to Step 7
6	Repair the faulty wiring as needed. Is the repair complete?	System OK	-
7	Replace the compressor clutch coil. Is the replacement complete?	System OK	-
8	Check for a knocking noise from the A/C compressor. Cycle the A/C compressor ON and OFF in order to verify the source of the noise. Do you hear a loud knocking noise?	Go to Step 9	Go to Step 10
9	1. Recover the A/C system refrigerant. 2. Replace the A/C compressor. 3. Evacuate and recharge the A/C system. 4. Check the A/C system for leaks. Is the compressor running normally?	System OK	-
10	1. Close all of the windows and doors. 2. Set the A/C switch to ON position. 3. Set the intake air control switch to "Fresh Air". 4. Set the blower motor switch to 4th. 5. Set the temperature control switch to full cold. 6. Keep it to run at idle for 5 minutes. 7. Check the temperature at the inlet/outlet of the evaporator. Is there a noticeable difference in the temperature of the evaporator inlet/outlet pipes?	Go to Step 11	Go to Step 13

▶ Insufficient Cooling Diagnosis (Cont'd)

Step	Action	Yes	No
11	1. Recover the A/C system refrigerant. 2. Replace the expansion valve as needed. 3. Evacuate and recharge the A/C system. 4. Check the A/C system for leaks. 5. Operate the A/C system. Is the discharge temperature normal?	Go to Step 13	Go to Step 12
12	1. Recover the refrigerant of the A/C system. 2. Evacuate and recharge the A/C system. 3. Check the A/C system for leaks. Does the A/C system operate normally?	System OK	-
13	Feel the liquid pipe between the condenser and the expansion valve. Is the pipe cold?	Go to Step 15	Go to Step 14
14	1. Repair any restriction in high pressure side. 2. Check the A/C system for leaks. Does the A/C system operate normally?	System OK	-
15	1. Run the engine at 3,000 rpm. 2. Close all of the windows and doors. 3. Set the A/C switch to ON. 4. Set the blower motor switch to 4th. 5. Set the temperature control switch to full cold. 6. Turn the A/C switch ON and OFF every 20 seconds for 3 minutes. 7. Measure the compressor high and low pressure. Are both pressures within the specified value?	Go to Step 17	Go to Step 16
16	Add the specified amount of the refrigerant to the A/C system. Is the amount within the specified value?	System OK	-
17	1. Turn the ignition to LOCK. 2. Set the A/C switch to OFF position. Can you turn the compressor clutch freely by hand?	Go to Step 18	Go to Step 19
18	1. Check the A/C system for leaks. 2. Repair any leaks as needed. 3. Evacuate and recharge the A/C system. Does the A/C system operate normally?	System OK	-
19	1. Recover the refrigerant of the A/C system. 2. Evacuate and recharge the A/C system. 3. Check the A/C system for leaks. 4. Replace the compressor as needed. Is the repair complete?	System OK	-

▶ Full Automatic Temperature Control (FATC) Does Not Operate When The Ignition Is On

Step	Action	Yes	No
1	Check the fuse F18. Are the fuses blown?	Go to Step 3	Go to Step 2
2	Replace the fuse. Is the repair complete?	System OK	-
3	1. Remove the controller with connecting FATC wiring connector. 2. Turn the ignition switch to ON. 3. Measure the voltage between terminal A1 and A5 of the connectors Is the voltage within specified value?	Go to Step 15 11 ~ 14 V	Go to Step 4
4	Replace the controller. Is the repair complete?	System OK	-
5	Measure the voltage between terminal A5 of the connector and ground. Is the voltage within specified value?	Go to Step 6	Go to Step 7
6	Repair the faulty circuit between fuse F18 and terminal A5 of the FATC wiring connector. Is the repair complete?	System OK	-
7	Repair the faulty circuit between the ground G203 and terminal A1 of the ATC wiring connector. Is the repair complete?	System OK	-

▶ Controller Does Not Illuminate When Light Switch Is On

Step	Action	Yes	No
1	1. Remove the controller with connecting ATC wiring connector. 2. Turn the ignition switch to ON. 3. Measure the voltage between terminal A4 and A3 of the controller. Is the voltage within the specified value?	Go to Step 3 11 V ~ 14 V	Go to Step 2
2	Repair the wiring harness between splice 5206 and terminal A3 of the controller connector or between splice 5206 and terminal A4 of the controller connector. Is the repair complete?	System OK	-
3	Check the illumination bulb. Is the bulb burned out?	Go to Step 4	Go to Step 5
4	Check the illumination bulb. Is the repair complete?	System OK	-
5	Replace the controller. Is the repair complete?	System OK	-

▶ No Hot Air From Blower

Step	Action	Yes	No
1	Check the coolant level. Is the coolant level within the specified value?	Go to Step 3	Go to Step 2
2	Add coolant as needed. Is the repair complete?	System OK	-
3	1. Turn the ignition to ON. 2. Observe the temperature indication screen of the controller. Does the digit flash?	Go to Step 6	Go to Step 4
4	Observe the blower motor operation. Is the blower motor functioning at all?	Go to Step 5	Go to “Blower Motor Does Not Run At All”
5	Use the blower push switch to cycle the blower through its different speeds. Does the motor function at different speeds?	Go to Step 7	Go to “the Applicable Diagnostic Table”
6	Run a self diagnosis circuit check. Does the display indicate a defect code?	Go to Step 7	Go to “the Applicable Diagnostic Table”
7	Check the airflow of the ducts at each mode. Is the airflow normal?	Go to Step 9	Go to Step 8
8	Check inside the heater duct for obstructions and repair as needed. Is the repair complete?	System OK	-
9	Observe the air mix door motor while changing the temperature setting from LO to HI and then from HI to LO. Is the air mix door actuator functioning properly?	Go to Step 10	Go to “the Applicable Diagnostic Table”
10	Check the coolant hoses for leaks or kinks. Are the coolant hoses in good condition?	Go to Step 12	Go to Step 11
11	Replace the coolant hoses. Is the repair complete?	System OK	-
12	Check the coolant reservoir cap. Is the coolant tank cap in hood condition?	Go to Step 14	Go to Step 13
13	Replace the coolant reservoir cap. Is the repair complete?	System OK	-
14	1. Turn the A/C switch to ON. 2. Set the temperature control to full hot (HI). 3. Set the blower motor speed to full high. 4. Remove the coolant reservoir cap (all segments illuminated on the display). 5. Start the vehicle and run the engine at idles. 6. Watch for the flow of the coolant when the thermostat opens. Does the coolant flow normally?	Go to Step 16	Go to Step 15
15	1. Check for • faulty thermostat. • failed coolant pump impeller. • restriction in the cooling system. 2. Make repairs, as needed. Is the repair complete?	System OK	-

▶ No Hot Air From Blower (Cont'd)

Step	Action	Yes	No
16	Check the temperature of the heater inlet and outlet hoses by feel. Is the heater inlet hose hot and the outlet hose warm?	Go to Step 18	Go to Step 17
17	Back flush or replace the heater core. Is the repair complete?	System OK	-
18	Check the vehicle for cold air leaks the • Dash. • Heater cases. • Vents. Are any leaks found?	Go to Step 20	Go to Step 19
19	Repair any cold air leaks. Is the repair complete?	System OK	-
20	Check the coolant temperature sensor using the tests in "DTC Coolant Temperature Sensor Error." Is there a problem indicated in the sensor, the sensor wiring or the controller?	Go to Step 21	Go to Step 22
21	Repair, or replace the sensor, the wiring, or the controller as required. Is the repair complete?	System OK	-
22	Replace the controller. Is the repair complete?	System OK	-

▶ Blower Motor Does Not Run At All

Step	Action	Yes	No
1	1. Turn the ignition switch to ON. 2. Observe the temperature indication screen of the controller. Dose the digit on and off?	Go to "the Applicable Diagnostic Table"	Go to Step 2
2	Check the fuses. Are the fuses blown?	Go to Step 3	Go to Step 4
3	Replace the fuse. Is the repair complete?	System OK	-
4	1. Turn the ignition switch to ON. 2. Measure the voltage between ground and terminal 87 of blower relay. Is the voltage within the specified value?	Go to Step 7 11 ~ 14 V	Go to Step 5
5	1. Measure the voltage between ground and terminal 86 of blower relay. Is the voltage within the specified value?	Go to Step 9 11 ~ 14 V	Go to Step 6
6	1. Check the circuit between terminal 86 of the blower relay and fuse SB7 in the I/P fuse block. 2. Repair any problem found in the wiring or terminals at the relay socket or connectors. Is the repair complete?	System OK	-
7	1. Turn the ignition to OFF. 2. Disconnect the wiring connector of the blower motor. 3. Turn the ignition to ON. 4. Measure voltage between the wiring connector of the blower motor and ground. Is the voltage within the specified value?	Go to Step 14 11 ~ 14 V	Go to Step 8

▶ Blower Motor Does Not Run At All (Cont'd)

Step	Action	Yes	No
8	Repair the faulty circuit between the wiring connector of the blower relay, wiring, blower motor, connector C203, C107. Is the repair complete?	System OK	-
9	Measure voltage between terminal 30 of the blower relay and ground. Is the voltage within the specified value?	Go to Step 11 11 ~ 14 V	Go to Step 10
10	1. Repair the circuit between terminal 86 of the blower relay and fuse SB7 in the I/P fuse block. 2. Repair the wiring connector of the blower relay, wiring, blower motor, connector C203, C107. Is the repair complete?	System OK	-
11	1. Turn the ignition switch to OFF. 2. Using an ohmmeter, measure the resistance between terminal 85 of the blower relay and ground. Does the measured resistance indicate 0 Ω?	Go to Step 13	Go to Step 12
12	Repair the faulty circuit between terminal 85 of the blower relay, C104 and ground G101. Is the repair complete?	System OK	-
13	Replace the blower motor relay. Is the repair complete?	System OK	-
14	Measure the resistance of the blower motor. Does the measured resistance indicate 0.5 Ω?	Go to Step 15	Go to Step 16
15	Replace the blower motor. Is the repair complete?	System OK	-
16	Measure the open or short of the circuit between terminal 1 of the blower connector and terminal 30 of the blower high relay and terminal 6 of the power transistor. Is there any open or short circuit?	Go to Step 17	Go to Step 18
17	Repair the problem in the circuit. Is the repair complete?	System OK	-
18	Measure the resistance of the circuit from terminal 3 of the power transistor connector and ground. Does the measured resistance indicate 0 Ω?	Go to Step 19	Go to Step 20
19	Replace the controller. Is the repair complete?	System OK	-
20	1. Repair the faulty circuit from terminal 3 of the power transistor connector and terminal 87 of the high blower relay to ground. 2. Repair the faulty in the wiring, connector, C109, C209, C104 or ground G104. Is the repair complete?	System OK	-

▶ No Cool Air From Blower

Step	Action	Yes	No
1	1. Turn the ignition switch to ON. 2. Observe the temperature indication screen of the controller. Does the digit flash?	Go to Step 2	Go to Step 3
2	Run a self-diagnosis circuit check. Does the display indicate a defect code?	Go to "the Applicable Diagnostic Table"	Go to Step 4
3	Observe the blower motor operation. Is the blower motor functioning at all?	Go to Step 4	Go to "Blower Motor Does Not Run At All"
4	Use the blower push switch to cycle the blower through its different speeds. Does the motor function at different speeds?	Go to Step 5	Go to "the Applicable Diagnostic Table"
5	Check the airflow of the ducts at each mode. Is the airflow normal?	Go to Step 8	Go to Step 6
6	Check inside the heater duct for obstructions and repair as needed. Is the repair complete?	System OK	-
7	Observe the air mix door motor while changing the temperature setting from LO to HI and then from HI to LO. Is the air mix door actuator functioning properly?	Go to Step 8	Go to "the Applicable Diagnostic Table"
8	Perform the checks found in "Insufficient Cooling Diagnosis." Is the system operating normally now?	System OK	Go to Step 9
9	Place the controller in the AUTO mode. Is smoke taken into the intake port of the inside air sensor?	Go to Step 11	Go to Step 10
10	Replace the intake hose. Is the repair complete?	System OK	-
11	Check the each sensor and sensor wiring using the Diagnostic Table. Is there a problem indicated in the sensor, the sensor wiring or the controller?	Go to Step 12	Go to Step 13
12	Repair, or replace the sensor, the wiring, or the controller as required. Is the repair complete?	System OK	-
13	Replace the controller. Is the repair complete?	System OK	-

▶ Mode Controls Does Not Work

Step	Action	Yes	No
1	Measure the voltage between terminal 4 of the blower motor and mode door motor ground. Is the voltage within the specified value?	Go to Step 3 11 ~ 14 V	 Go to Step 2
2	Repair the connector and the circuit for any wiring or terminal problems. Is the repair complete?	System OK	-
3	1. Using the Motor Control Table, measure the voltages at the specified terminals of the specified motor connectors. 2. Change the mode settings and observe the voltage changes. Is the voltage within the specified value?	Go to Step 5	Go to Step 4
4	Repair or replace the wiring harness or the defective terminal. Is the repair complete?	System OK	-
5	1. Measure the voltages of the connector terminal. 2. Change the mode settings and observe the voltage changes. Is the voltage within the specified value?	Go to Step 7	Go to Step 6
6	Replace the fuel filter or the fuel line.	System OK	-
7	Check the connector at the controller. Is there a defective terminal?	Go to Step 8	Go to Step 9
8	Repair the terminal and replace as needed. Is the repair complete?	System OK	-
9	Replace the controller. Is the repair complete?	System OK	-

▶ Mode Controls Does Not Work

Step	Action	Yes	No
1	Measure the voltage between terminal 4 of the intake control door motor and ground. Is the voltage within the specified value?	Go to Step 3 11 ~ 14 V	 Go to Step 2
2	Repair the connector and the circuit for any wiring or terminal problems. Is the repair complete?	System OK	-
3	1. Measure the voltages at the specified terminals of the specified motor connectors. 2. Change the mode settings and observe the voltage changes Is the voltage within the specified value?	Go to Step 5	Go to Step 4
4	1. Repair the wiring harness or the defective terminal. 2. Replace the fuel filter or the fuel line as needed. Is the repair complete?	System OK	-
5	Check the connector at the controller. Is there a defective terminal?	Go to Step 6	Go to Step 7
6	Repair the terminal and replace as needed. Is the repair complete?	System OK	-
7	Replace the controller. Is the repair complete?	System OK	-

▶ Abnormal Refrigerant Pressure

Step	Action	Yes	No
1	1. Verify whether airflow and excessive refrigerant. 2. Check any restriction at the condenser or radiator. 3. Check the condenser or cooling fan for proper operation. 4. Check any restriction of the refrigerant lines. Is the high-side refrigerant pressure high abnormally?	Go to Step 2	Go to Step 3
2	1. Recover, evacuate and recharge the A/C system according to the specified value. 2. Clean the condenser or radiator core. 3. Check the voltage, rpm, direction of the cooling fan. 4. Repair or replace the applicable parts as needed. Is the high-side pressure within the specified value?	System OK	-
3	1. Check the amount of the refrigerant. 2. Check the internal faulty of the compressor. 3. Check the faulty of the expansion valve. 4. Check the moisture mix into the system. Is the high-side refrigerant pressure low abnormally?	Go to Step 4	Go to Step 5
4	1. Replace the compressor and the expansion valve as needed. 2. Recover, evacuate and recharge the A/C system according to the specified value. 3. Repair any leaks as needed. Is the repair complete?	System OK	-
5	1. Check the freezing/clogging of the expansion valve 2. Check the clogging of the receiver-drier. 3. Check the amount of the refrigerant. Is the low-side refrigerant pressure low abnormally?	Go to Step 6	Go to Step 7
6	1. Clean the expansion valve and replace it as needed. 2. Replace the receiver-drier as needed. Is the repair complete?	System OK	-
7	1. Check the expansion valve and the compressor for any faulty. 2. Check the excessive amount of the refrigerant. Is the low-side refrigerant pressure high abnormally?	Go to Step 8	Go to Step 9
8	1. Replace the expansion valve and the compressor as needed. 2. Add the specified amount of the refrigerant. Is the repair complete?	System OK	-
9	1. Check the tightening condition of the refrigerant line coupling and bolts. 2. Check the faulty O-ring. 3. Check the faulty gasket or seal of the compressor. Is there any refrigerant leak?	Go to Step 10	System OK
10	1. Tighten the bolts. 2. Replace the faulty O-ring. 3. Replace the faulty compressor. Is the repair complete?	System OK	-

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▶ Compressor Magnetic Clutch Does not Engage

Step	Action	Yes	No
1	1. Remove the controller with connecting the connector. 2. Turn the ignition switch to ON. 3. Set the A/C switch to ON. 4. Measure the voltage between the controller connector A12 (or all for GSL) and the ground. Is the voltage within the specified value?	Go to "Insufficient Cooling Diagnosis" 11 ~ 14 V	 Go to Step 2
2	Replace the defective motor. Is the repair complete?	System OK	-

▶ Inside Air Temperature Sensor Error

Step	Action	Yes	No
1	1. Put the smoke of the cigarette near the air inlet and verify that the smoke come into the air inlet properly. 2. Remove the controller with connecting the connector. 3. Turn the ignition switch to ON. 4. Measure the voltage between the connector terminals of the inside air sensor. Does the measured voltage indicate 2 ~ 3 V at 25 °C?	Go to Step 3	Go to Step 2
2	Repair the open or short of the wiring harness. Is the repair complete?	System OK	-
3	1. Remove the inside air temperature sensor. 2. Measure the resistance between the inside air sensor connector terminals. Does the measured resistance indicate 2.2 kΩ at 25 °C?	Go to Step 5	Go to Step 4
4	Replace the inside air sensor. Is the repair complete?	System OK	-
5	Replace the controller. Is the repair complete?	System OK	-

▶ Ambient Air Temperature Sensor Error

Step	Action	Yes	No
1	1. Remove the ambient air temperature sensor. 2. Measure the resistance between the ambient air temperature sensor connector terminals. Does the measured resistance indicate 2.2 kΩ at 25 °C?	Go to Step 3	Go to Step 2
2	Replace the ambient air temperature sensor. Is the repair complete?	System OK	-
3	1. Remove the controller with connecting the connector. 2. Turn the ignition switch to ON. 3. Measure the voltage between terminal B8 and connector A13. Does the measured voltage indicate 2.2 V at 25 °C?	Go to Step 5	Go to Step 4
4	Repair the open or short of the wiring harness. Is the repair complete?	System OK	-
5	Replace the controller. Is the repair complete?	System OK	-

▶ Coolant Temperature sensor Error

Step	Action	Yes	No
1	1. Disconnect the coolant temperature sensor connector from the FATC harness. 2. Measure the resistance between the coolant temperature sensor connector terminals.. Does the measured resistance indicate 2.2 kΩ at 25 °C?	Go to Step 3	Go to Step 2
2	Replace the coolant temperature sensor. Is the repair complete?	System OK	-
3	1. Remove the controller with connecting the connector. 2. Turn the ignition switch to ON. 3. Measure the voltage between terminal B9 and connector A13. Does the measured voltage indicate 2.2 V at 25 °C?	Go to Step 5	Go to Step 4
4	Repair the open or short of the wiring harness. Is the repair complete?	System OK	-
5	Replace the controller. Is the repair complete?	System OK	-

▶ Air Mix Door Error

Step	Action	Yes	No
1	1. Disconnect the I/P wiring harness connector form the air mix door motor. 2. Use an ohmmeter to measure the resistance between terminals 5 and 7 on the air mix door motor. Is the resistance within the specified value?	Go to step 3 open: ∞ short: 0 Ω	Go to Step 2
2	Replace the air mix door motor. Is the repair complete?	System OK	-
3	Use an ohmmeter to measure the resistance between terminals 2 and 3 on the air mix door motor. Does the measured resistance indicate approximately 3 kΩ?	Go to Step 5	Go to Step 4
4	Replace the air mix door motor. Is the repair complete?	System OK	-
5	Use an ohmmeter to measure the resistance between terminals 6 and 3, 6 and 2 on the air mix door motor. Does the measured resistance indicate approximately 3 kΩ?	Go to Step 7	Go to Step 6
6	Replace the air mix door motor. Is the repair complete?	System OK	-
7	Check the connector terminals at the air mix door motor and the wiring in the FATC harness. Is there a problem with any terminal on either the harness connector or the motor connector or the wiring?	Go to Step 9	Go to Step 8
8	1. Remove the FATC controller from the instrument panel. 2. Disconnect the harness connectors of the controller. 3. Examine the connector terminals on the harness connectors and the controller connectors and the harness wiring. Is there a problem with any of these connectors or the wiring?	Go to Step 9	Go to Step 10
9	Repair the problem found with a connector terminal or wiring. Is the repair complete?	System OK	-

Air Mix Door Error (Cont'd)

Step	Action	Yes	No
10	Check continuity in the harness between the controller connectors and the air mix door motor connector. Is there a problem with the wiring?	Go to Step 11	Go to Step 12
11	Repair the problem found with the wiring and replace as needed. Is the repair complete?	System OK	-
12	1. Reconnect the FATC harness connectors to the controller. 2. Reconnect the air mix door motor to the FATC harness. 3. Turn the ignition to ON. 4. Measure the voltage between ground and terminal B5 at the controller by backprobing the connector. Is the voltage within the specified value?	Go to Step 14 0 ~ 5 V	Go to Step 13
13	Repair the problem found between the controller connector wiring and air mix door connector wiring. Is the repair complete?	System OK	-
14	1. Set the temperature controller to LO. 2. Measure the voltage between ground and terminal A15 at the controller by backprobing the connector. (Specified voltage: 12 V) 3. Raise the temperature setting on the controller to HI and measure the voltage. (Turn to 0V) 4. Measure the voltage between ground and terminal A9 at the controller. (Specified voltage: 12 V) 5. Change the temperature setting on the controller to LO and measure the voltage. (0 V) Is the voltage within the specified value?	Go to Step 15	Go to Step 17
15	Recheck all wiring circuits between the controller and the air mix door motor with changing the temperature setting. Does the air mix door operate normally?	System OK	Go to Step 16
16	Replace the air mix door motor. Is the repair complete?	System OK	-
17	Recheck all wiring circuits between the controller and the air mix door motor. Is there a problem in the wiring or the connectors?	Go to Step 18	Go to Step 19
18	Repair the problem in the wiring between the FATC controller and the air mix door motor. Is the repair complete?	System OK	-
19	Recheck the air mix door motor. Is there a problem in the air mix door motor?	Go to Step 16	Go to Step 21
20	Replace the air mix door motor. Is the repair complete?	System OK	-
21	1. Install the components. 2. Perform the diagnostic test of the controller. Does the DTC reset?	Go to Step 16	System OK

▶ Sun Sensor Error

Step	Action	Yes	No
1	1. Disconnect the Sun sensor connector. 2. Place the sun sensor under the sun light and measure the current between the connector terminals. 3. Place the sun sensor under the shadow place and measure the current between the connector terminals. Is the measured current lower at the shadow place?	Go to Step 3	Go to Step 2
2	Replace the sun sensor. Is the repair complete?	System OK	-
3	1. Remove the controller with connecting the connectors. 2. Turn the ignition switch to ON. 3. Measure the voltage terminal A13 and B10 by backprobing the connectors. (Sun light: 2.5 V, Shadow: 4.8 V) Is the voltage equal to the specified value?	Go to Step 5	Go to Step 4
4	Repair open or short circuit. Is the repair complete?	System OK	-
5	Replace the FATC controller. Is the repair complete?	System OK	-

▶ Power Transistor Error

Step	Action	Yes	No
1	1. Remove the controller and disconnect the controller connector. 2. Disconnect power transistor connector. 3. Examine the open or short circuit between controller connector and power transistor connector. Is there a problem in the wiring or the connectors?	Go to Step 2	Go to Step 3
2	Repair the faulty wiring and replace as needed. Is the repair complete?	System OK	-
3	1. Reconnect power transistor connector and FATC connectors. 2. Turn the ignition switch to ON. 3. Measure the voltage between ground and terminal B12 of the FATC controller while changing the blower speed from 1 to 6 manually. 1st: 4.5 V 4th: 9.0 V 2rd: 6.0 V 5th: 11.0 V 3th: 7.5 V 6th: 12.5 V Is the resistance equal to the specified value?	Go to Step 5	Go to Step 4
4	Replace the power transistor. Is the repair complete?	System OK	-
5	Replace the FATC controller. Is the repair complete?	System OK	-

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▶ Max-High Relay Error

Step	Action	Yes	No
1	1. Remove the controller with connecting the connectors. 2. Turn the ignition switch to ON. 3. Set the blower speed for 5th speed manually. 4. Measure the voltage at terminal A10 and ground. Does the measured voltage indicate 0V?	Go to Step 3	Go to Step 2
2	Replace the FATC controller. Is the repair complete?	System OK	-
3	1. Check the wiring harness associated with blower high relay and terminals. 2. Repair any defects found. 3. Install the component. Is DTC retrieved as a current DTC?	Go to Step 4	System OK
4	Replace blower high relay. Is the repair complete?	System OK	-

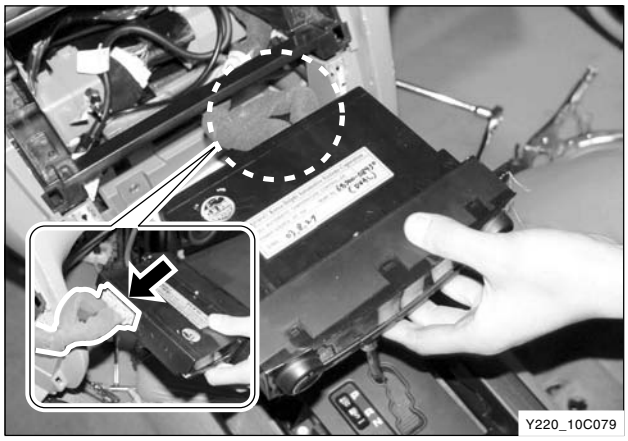
REMOVAL AND INSTALLATION

Control Switch Assembly

1. Remove the center instrument panel.

2. Remove the air conditioner switch assembly screws.

3. Disconnect the control switch assembly connector.



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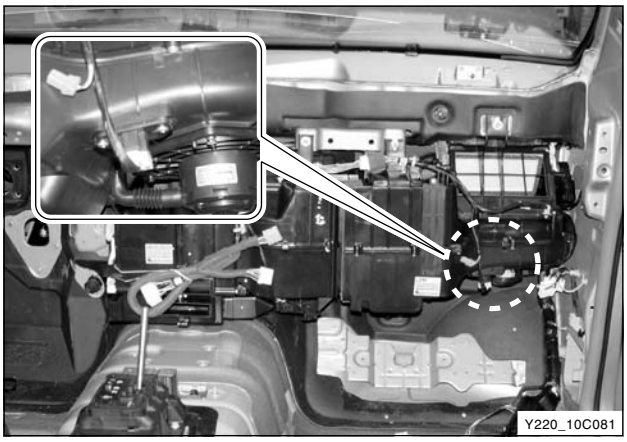
Y220_10C080

4. Remove the control switch assembly from the instrument panel.
5. Install in the reverse order of removal.

Notice

Connect the connector and push the control switch until it stops.


Y220_10C081

Blower Motor

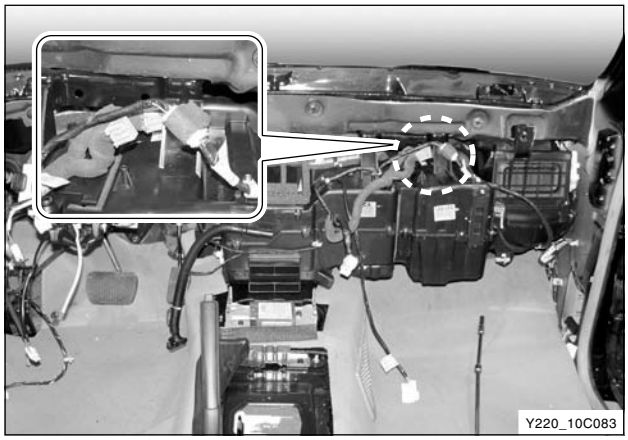
1. Remove the glove box and set aside the floor mat.
2. Disconnect the blower motor connector.


Y220_10C082

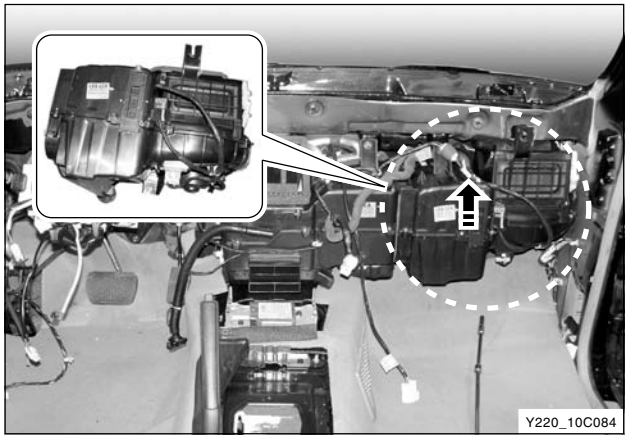
3. Unscrew the bolts and remove the blower motor assembly.
4. Install in the reverse order of removal.

High Speed Relay in Blower Motor

1. Disconnect the high speed relay connector from the blower motor.



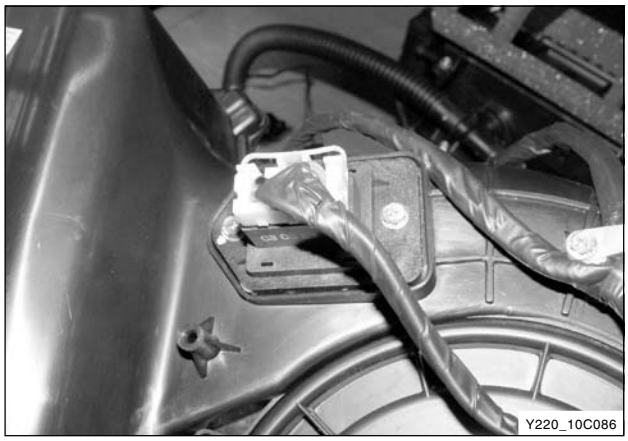
2. Unscrew the bolts and remove the relay.
3. Install in the reverse order of removal.



Power Transistor

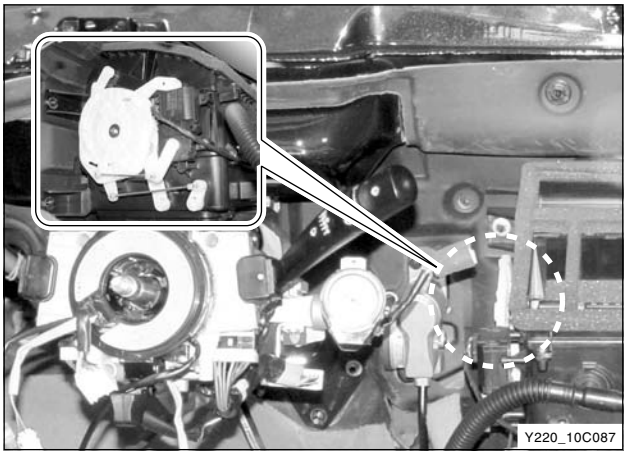
1. Disconnect the power transistor connector.
2. Remove the power transistor bolts.
3. Remove the power transistor assembly.

4. Install in the reverse order of removal.



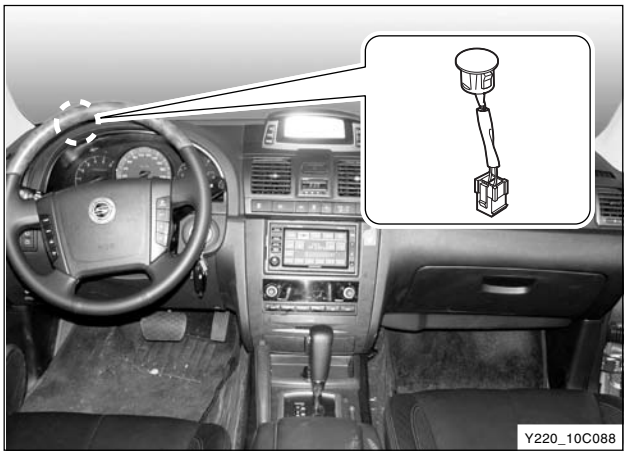
Intake Door Actuator

1. Disconnect the negative battery cable.
2. Remove the glove box.
3. Disconnect the intake door actuator connector.
4. Remove the screws at the mode control door actuator and heater/air distributor case.
5. Carefully remove the mode control door actuator.
6. Install in the reverse order of removal.



Mode Control Door Actuator

1. Disconnect the negative battery cable.
2. Remove the knee bolster.
3. Disconnect the mode control door actuator connector.
4. Remove the screws at the mode control door actuator and heater/air distributor case.
5. Carefully remove the mode control door actuator.
6. Install in the reverse order of removal.



Sun Sensor

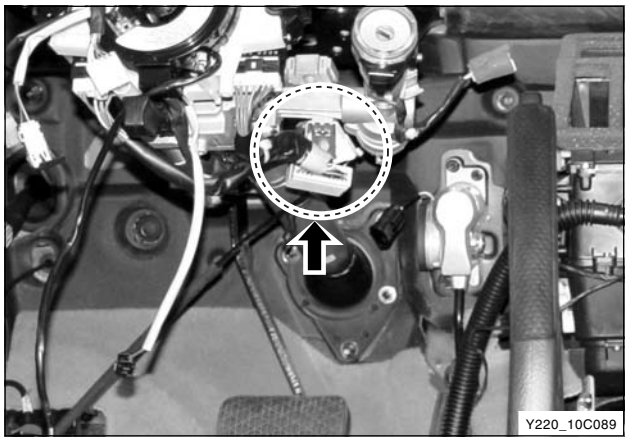
1. Disconnect the connect and remove the sun sensor from the instrument panel.
2. Install in the reverse order of removal.

Notice

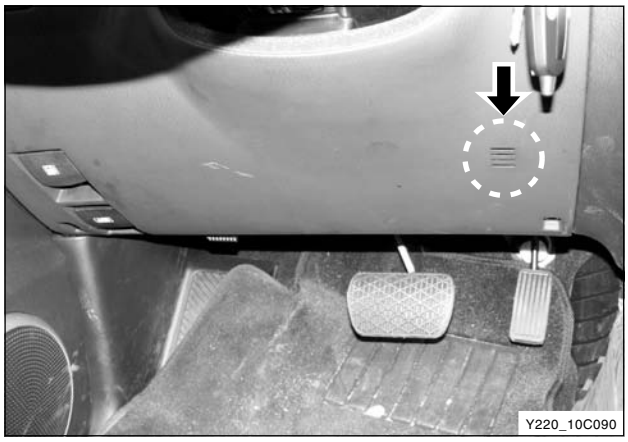
Be careful not to drop the disconnected wiring harness into the instrument panel when removing.

Inside Air Temperature Sensor

1. Remove the instrument panel.
2. Disconnect the connector and remove the inside air temperature sensor with tube.
3. Remove the inside air temperature sensor sub from the instrument panel.



4. Install in the reverse order of removal.



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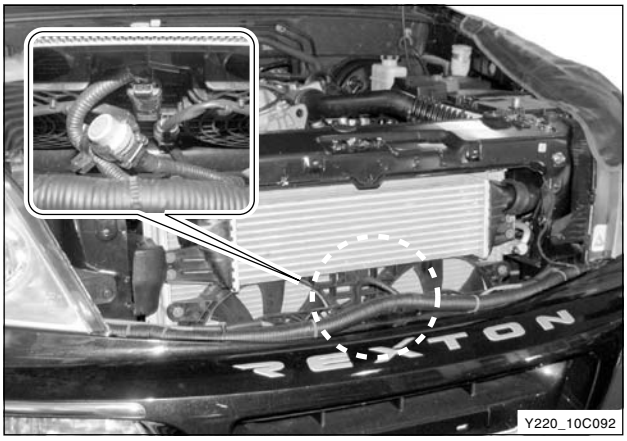
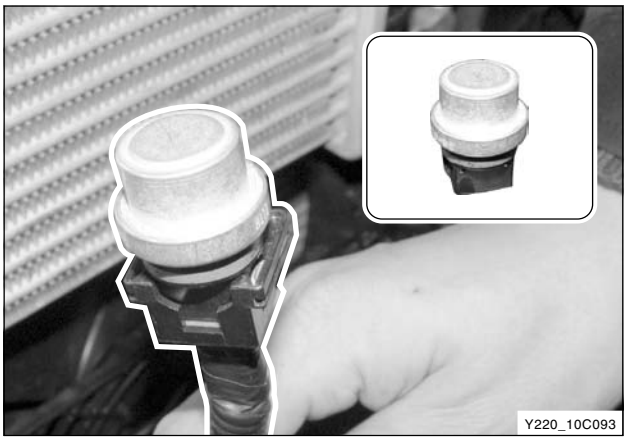
Ambient Air Temperature Switch

1. Remove the radiator grille.



2. Disconnect the ambient air temperature switch connector behind the front bumper.



3. Remove the ambient air temperature switch.
4. Install in the reverse order of removal.

Coolant Temperature Sensor

1. Disconnect the coolant temperature sensor connector from the heater core (left bottom of glove box) and remove the coolant temperature sensor.
2. Install in the reverse order of removal.

SECTION 11A

BODY

Table of Contents

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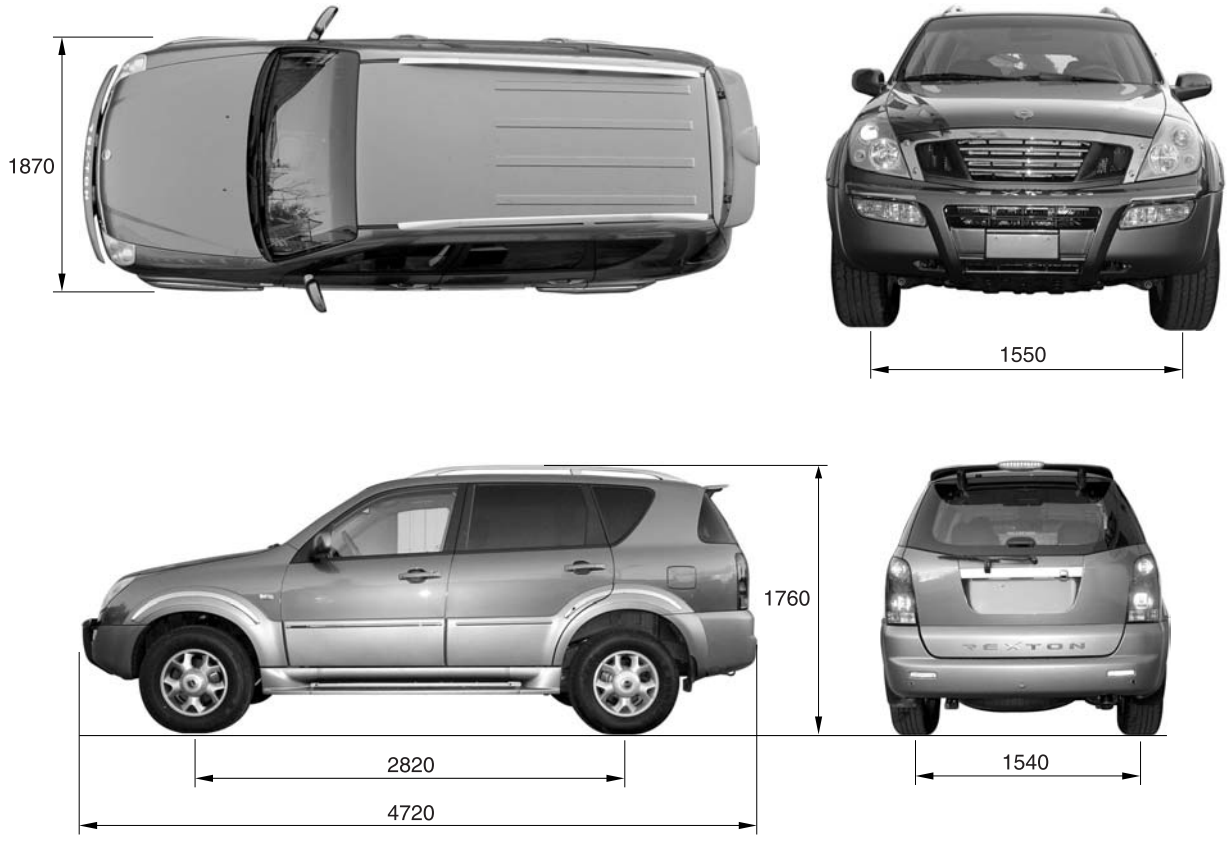
GENERAL INFORMATION

VEHICLE DIMENSION



Y220_11A050

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SPECIFICATIONS

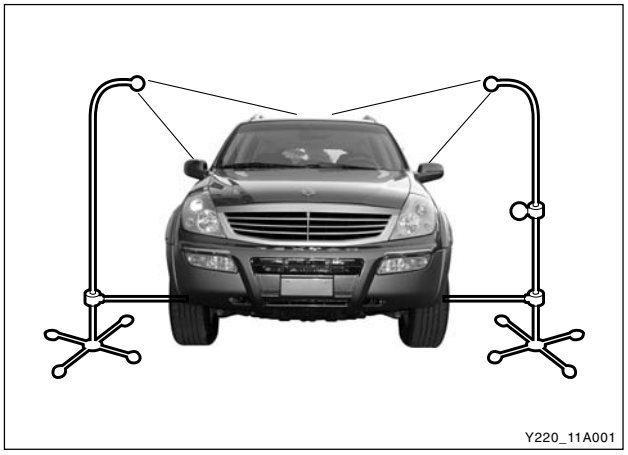
Description			Specification
Hood	Type		Gas lifter type
Front door	Structure		Frame door
	Regulator type		Wire-Drum type
	Locking device		Pin-Fork device
Rear door	Structure		Frame door
	Regulator type		Wire-Drum type
	Locking device		Pin-Fork device
Tailgate	Type		Gas lifter type
Thickness of glasses	Windshield		5 mm
	Front door		4.0 mm
	Rear door		4.0 mm
	Side quarter glass		4.0 mm
	Tailgate	Fixed type	4.0 mm
		Open type	5.0 mm
Requirements of leak tester stand	Nozzle type		Full-zet spray nozzle #1/2 GG-25 or nozzle with 60° angle
	Nozzle height		1,600 mm from ground
	Displacement		14 liter per minute
	Pressure		155 kPa (22.5 psi): at nozzle
	Location of test stand for windshield and A-pillar		From windshield corner center line: - downward: approx. 30° - rearward: approx 45°
	Location of test stand for B-pillar		From rear door center line: - downward: approx. 30° - rearward: approx 45°
	Location of test stand for tailgate and rear deck lid		At 60 mm from rear door corner: - downward: approx. 30° - rearward: approx 45°

WATERLEAK TEST

GENERAL INFORMATION

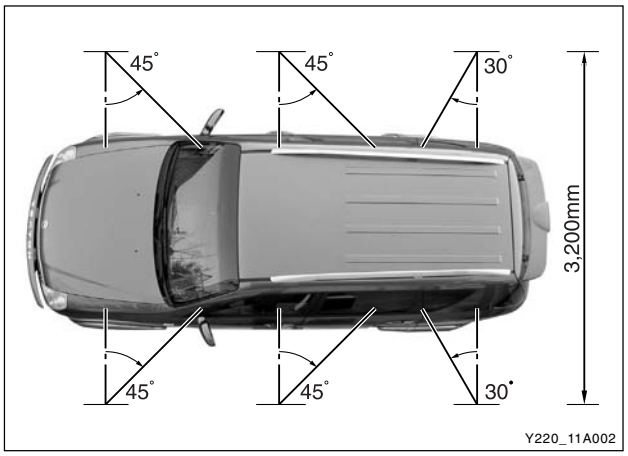
▶ Leak Test

1. Set up the waterleak test stands.
2. Perform the waterleak test.
3. If the local water pressure does not allow the required water pressure of 155 kPa (22.5 psi), move both stands closer to the vehicle so that the water spray overlaps.


Y220_11A001

▶ Spot Test

1. Perform the spot test with a water hose or an air hose.
2. Begin test by spraying the air or the water at the base of the suspected leak area. Continue spraying the air or the water upward until the leak is found.



Y220_11A002

▶ Water Hose Test

1. Place another service man inside the vehicle in order to detect the location of the leak.
2. Use a water hose without a nozzle.
3. Begin test by spraying the air or the water at the base of the suspected leak area. Continue spraying the air or the water upward until the leak is found.


Y220_11A003

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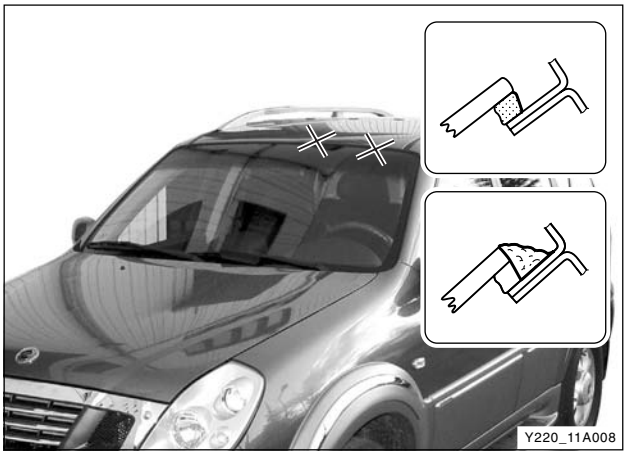
▶ Air Hose Test

1. Apply soapy water to the outside of the vehicle in the suspected leak area.
2. Blow air from inside the vehicle. The air pressure should not exceed 205 kPa (29.7 psi).
3. Determine the location of the leaks from the bubbles formed in the soapy water.

GENERAL REPAIR



▶ Waterleak Repair

Some waterleaks around the glass can be repaired without removing the glass.

Notice

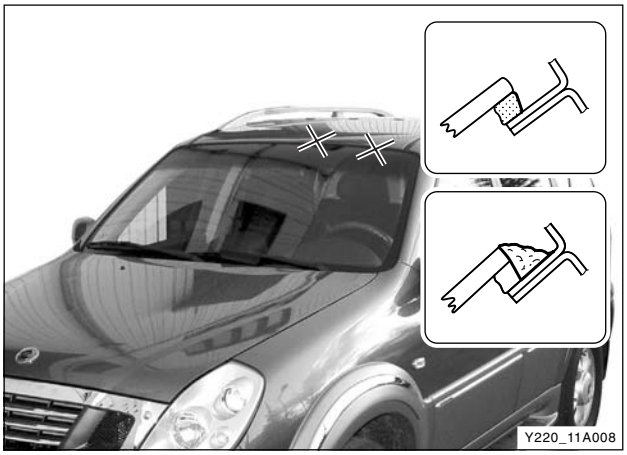
This type of repair may be used only for urethane-installed glass.

1. Remove the reveal molding in the area of the leak. It may be necessary to remove the garnish molding or the trim strip lace in order to locate the leak.
2. While spraying water over the leak area, carefully push the glass outward in order to determine the size of the leak.
3. Mark the location of the leak.
4. Use water to clean any dirt from the area. Dry the area with an air hose.
5. Using a sharp knife, trim off the uneven edges of the adhesive caulking material around the leak for a distance of 75 to 100 mm (3 to 4 inches) on both sides of the leak.
6. Using a sharp knife, trim off the uneven edges of the adhesive material around the leak 75 to 100 mm (3 to 4 inches) on both sides of the leak.
7. Prime the trimmed area with the primer.
8. Allow the primer to dry for 5 minutes.
9. Apply the adhesive over the leak and for a distance of 75 to 100 mm (3 to 4 inches) on both sides of the leak.
10. Immediately after applying the adhesive, use a flat stick or a similar tool to work the adhesive into the leak area and into the joint between the original material and the vehicle body in order to ensure a watertight seal.
11. Spray warm or hot water over the repaired area in order to determine if the leak was repaired. Do not run a heavy stream of water directly on the freshly-applied adhesive.
12. Install the trim strip lace if it was removed.
13. Install the garnish molding if it was removed.
14. Install the reveal molding.

▶ Air Hose Test

1. Apply soapy water to the outside of the vehicle in the suspected leak area.
2. Blow air from inside the vehicle. The air pressure should not exceed 205 kPa (29.7 psi).
3. Determine the location of the leaks from the bubbles formed in the soapy water.

GENERAL REPAIR



▶ Waterleak Repair

Some waterleaks around the glass can be repaired without removing the glass.

Notice

This type of repair may be used only for urethane-installed glass.

1. Remove the reveal molding in the area of the leak. It may be necessary to remove the garnish molding or the trim strip lace in order to locate the leak.
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4. Use water to clean any dirt from the area. Dry the area with an air hose.
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8. Allow the primer to dry for 5 minutes.
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11. Spray warm or hot water over the repaired area in order to determine if the leak was repaired. Do not run a heavy stream of water directly on the freshly-applied adhesive.
12. Install the trim strip lace if it was removed.
13. Install the garnish molding if it was removed.
14. Install the reveal molding.

Notice

After the completion of any waterleak repair, re-test the area using the watertest stands. Do not use localized testing procedures on the newly-repaired areas, as the repair material may dislodge under abnormal pressure.

15. Installation should follow the removal procedure in the reverse order.

▶ Windnoise Repair

Windnoise leak repairs are very similar to waterleak repairs. The actual procedure depends on the type of seal being repaired.

Leaks around the door opening weatherstrips do not always indicate a faulty weatherstrip. A door or window adjustment may resolve the condition.

▶ Squeak and Rattle Repair

Squeaks and rattles are caused by the unwanted move-ment between parts of a vehicle. There are three means to prevent squeaks or rattles.

- Attach the parts securely so that there is no relative motion during the operation of the vehicle.
- Separate the parts so that there is no contact during operation.
- Insulate the parts so that no squeaks or rattles occur with the movement of the parts. Low uniform friction surfaces can be used to eliminate “stick-slip” motion.

TROUBLE DIAGNOSIS

Symptom	Cause	Action
Rattle coming from the side rail	Check the brake lines.	• Tap lightly on the brake lines and listen for a rattle. • Install plastic tie straps to secure the brake lines tightly together.
Rattle under vehicle at higher rpm	Check for heat shield contact with the underbody.	• Raise the vehicle and perform a visual inspection. • Bend the heat shield slightly to gain clearance from the underbody.
Squeak from the front of the vehicle in cold weather	Check the front stabilizer shaft insulators.	• While the vehicle is cold, perform a test drive and achieve full front suspension travel by driving through a dip in the road. • Remove the insulators and wrap teflon tape around the stabilizer shaft. Reinstall the insulators over the tape.
Thump from rear of vehicle on bumps	Check for a properly secured spare tire in the rear compartment.	• Open the rear compartment and perform a visual inspection of the spare tire and the tools. • Tightly secure the spare tire and all tools. • Perform a road test to verify that the noise is elimi nated.
Glass knock coming from the rear of the vehicle when driving over bumps	Check for an out-of-adjustment hatchback latch.	• Test drive the vehicle in order to verify this condition. • Loosen the latch nuts and adjust the latch downward.
Rattle coming from door	Check the door lock solenoid.	• Remove the door trim panel and check if the solenoid is loose. • Tighten the solenoid bolts.
	Check for rattling electrical connectors inside the door trim panel.	• Tap on the trim panel and listen for a rattle. • Remove the trim panel and wrap foam padding around the connectors as required.
Squeak when operating doors	Check for a lack of lubrication of the door hinge pins.	• Operate the doors and listen for squeaks. • Lubricate the door hinge pins with light oil and coat with lithium grease.
Squeak coming from console when shifting manual transaxle (Condition occurs in cold weather with a cold engine)	Check the manual transaxle control lever lower boot.	• Move the control lever between gears and listen for squeaks. • Remove the floor console and replace the lower shift boot or apply talcum powder to the lower shift boot.
Buzz from the left side of instrument panel	Check for vibration of the fuse box cover against the instrument panel side trim.	• Tap on thecoverwith a fingerandlisten fora buzz. • Apply 6.35 mm (0.250 inch) by 25.4 mm (1.00 inch) felt pads to the side trim where the cover makes contact.
Squeak coming from instrument cluster trim plate	Check for rubbing of the cluster trim plate on the instrument panel.	• Test drive the vehicle in order to verify this condi-tion. • Remove the instrument cluster trim plate and install felt tape to the edges.

WATERLEAK DIAGNOSIS

The repair of waterleaks in the body requires proper testing and diagnosis. Repair waterleaks by adjusting the misaligned parts and using the proper repair materi-als. First, determine what conditions cause the leak. For example, the leak may occur only when the vehicle is parked on an incline, or water may appear only in the spare tire compartment. Second, test the area for the source of the leak using the following testing methods. If the general leak area is found, determine the exact entry point of the leak by using a water hose or an air hose. If the general leak area is not obvious, use the watertest stands to determine the area of the leak. It may be necessary to remove some interior trim panels or some parts in order to locate the leaks.

Notice

It is necessary to find the origin of all the leaks before making any repairs. Random repairs may stop the leak only temporarily and may make future repairs more difficult. Continue localized testing in the general area in order to ensure that all leaks are found.

▶ WINDNOISE DIAGNOSIS

Notice

An assistant should drive the vehicle while the technician checks for the location of the wind-noise, in order to prevent personal injury or vehicle damage.

A test drive in the vehicle is necessary to accurately determine the location of the windnoise. Often there is a primary leak and secondary leaks. Failure to repair all leaks will only reduce the windnoise, not eliminate it.

During the test drive the technician should bring the following items to aid in determining the location of the windnoise.

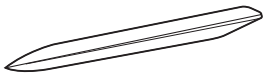
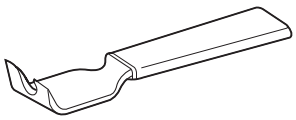
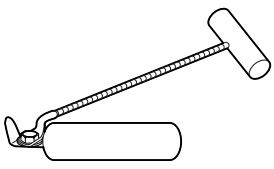
- A mechanics stethoscope or vacuum hose
- Masking tape
- Strip caulk
- A china marking pencil
- A screwdriver

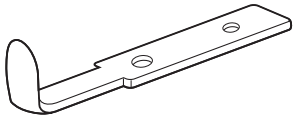
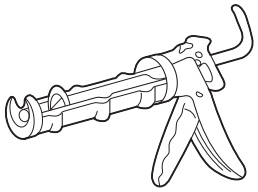
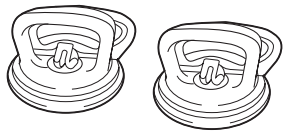
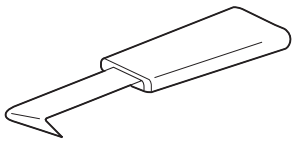
Perform the following steps in order to conduct the road test:

1. Choose a route that includes smooth straight streets that run in all four directions (north, south, east, and west).
2. Choose streets with little traffic or noise that would interfere with the test.
3. Drive the vehicle at the speeds at which the noise was noticed by the customer or until the noise is produced. Do not exceed legal speed limits.
4. The windnoise is external if any of the following conditions occur:
   - The windnoise is caused by the wind.
   - The windnoise can be heard with the door glass lowered and while the vehicle is being driven.
   - The windnoise is eliminated when tape is placed over various moldings and gaps.

5. Internal windnoise is air leaving the vehicle and should be repaired in the following manner.
   - In order to locate the leak, tape off the body lock pillar pressure relief valves. This will cause air pressure to build up inside the vehicle and enhance the windnoise.
   - Use a stethoscope or a vacuum hose to locate the leak.
   - Temporarily repair the leak with masking tape.
   - Continue testing in order to determine if the noise has been eliminated or if other leaks exist.
   - When all leaks have been found, return to the shop and make permanent repairs with the proper alignment techniques and sealing materials.

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
09793-21000 (W 99 31 007 0B) **Door hinge adjusting wrench**  Y220_11A010	Adjustment of door hinge
09800-21000 **Ornament remover**  Y220_11A012	Removal of door trim
0985-31000 **Headlining clip remover**  Y220_11A014	Removal of headlining clip
09861-3110 **Sealant cutter**  Y220_11A016	Cutting the sealant

Name and Part Number	Application
09861-31200 **Sealant cutter**  Y220_11A010	Cutting the sealant
09861-31300 **Sealant gun**  Y220_11A012	Applying the sealant
09861-31400 **Glass holder**  Y220_11A014	Carrying the glass
09861-31000 **Windshield molding remover**  Y220_11A016	Removal of windshield molding

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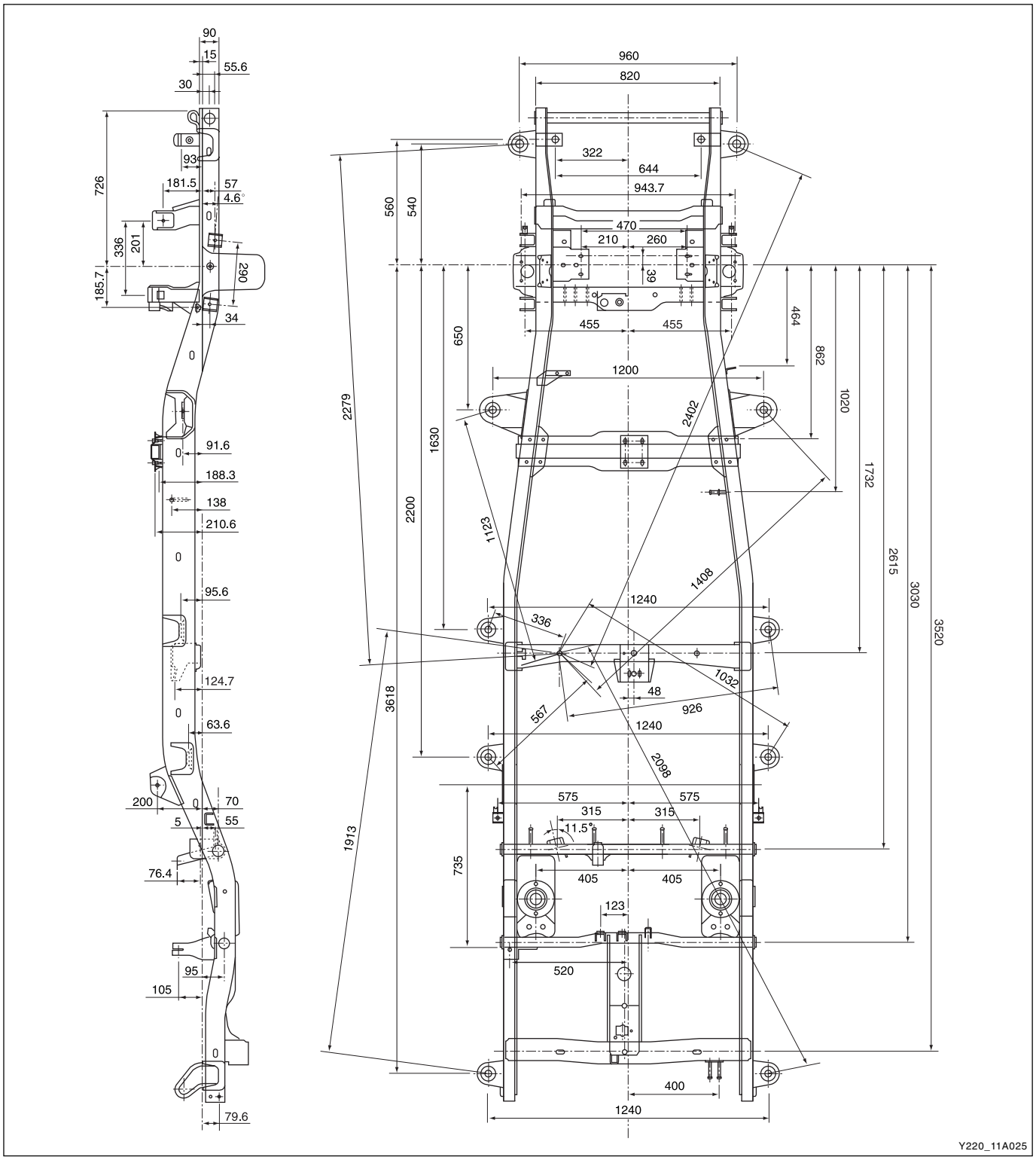
BODY DIMENSIONS

BODY DIMENSIONS

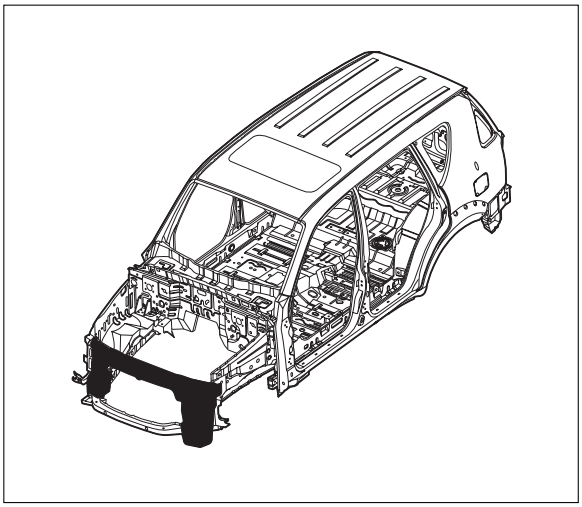
▶ Underbody (Frame)

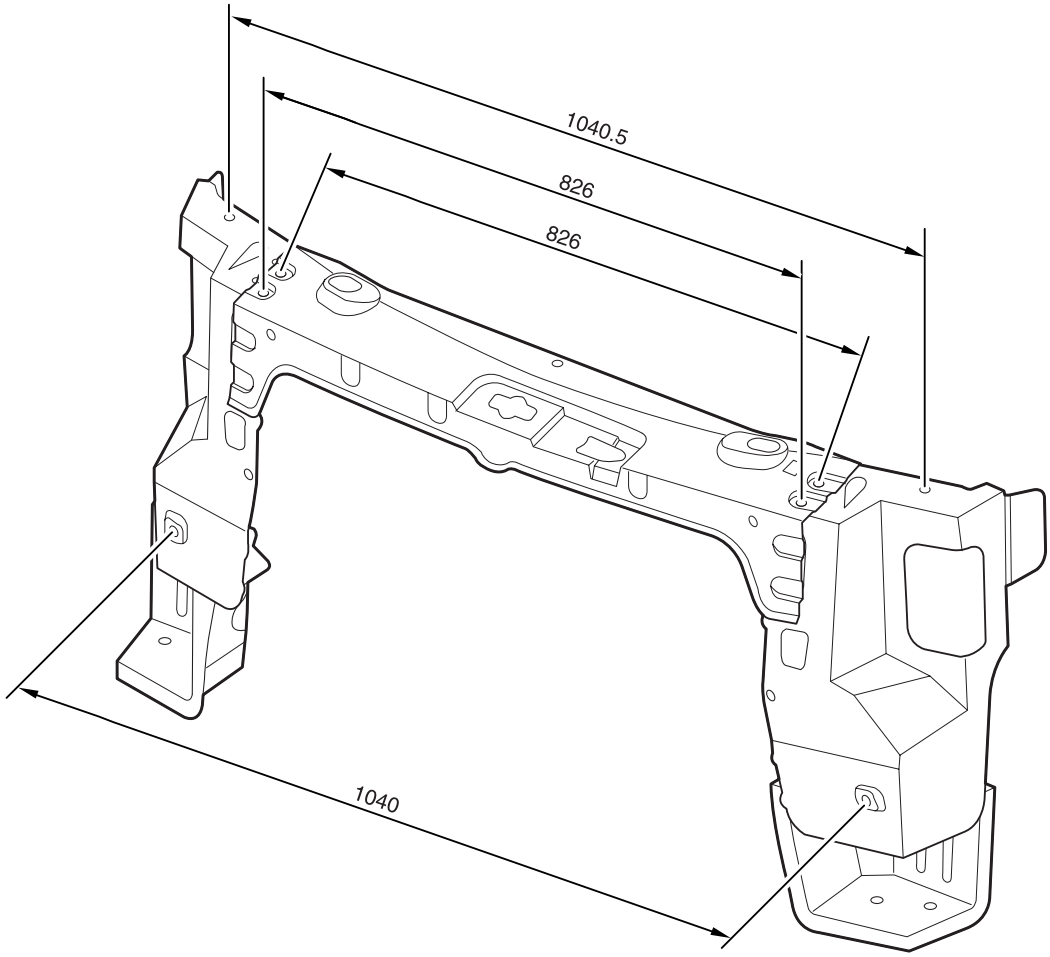
Unit: mm



FRAME

Unit: mm





Y220_11A026

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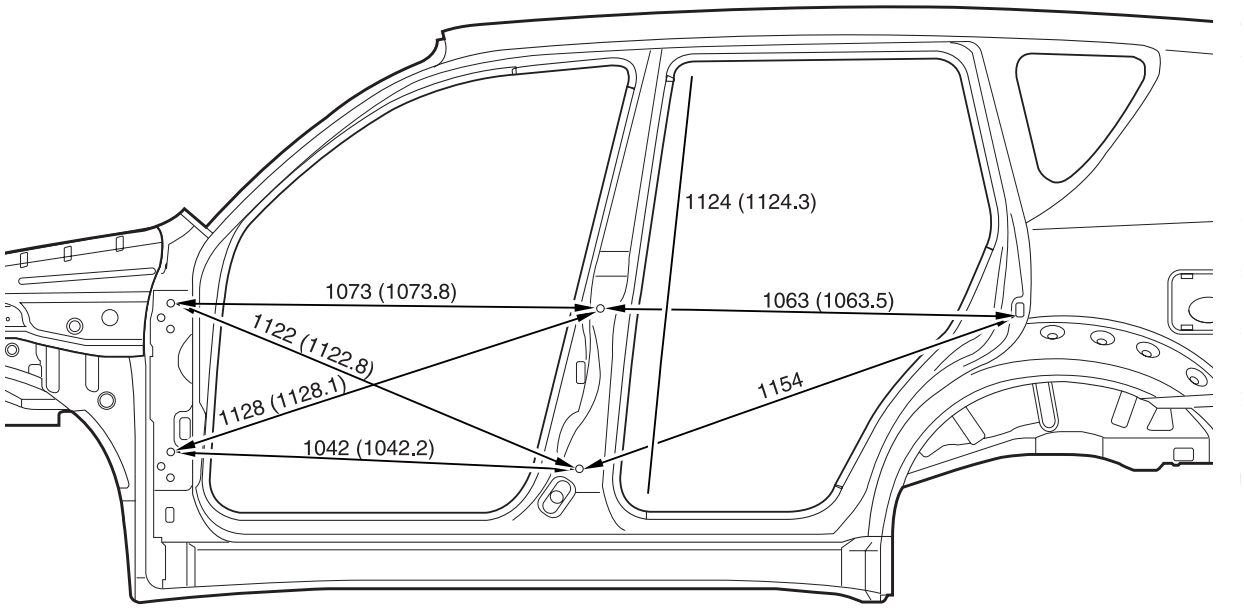
SIDE STRUCTURE COMPLETE

Unit: mm



Y220_11A027

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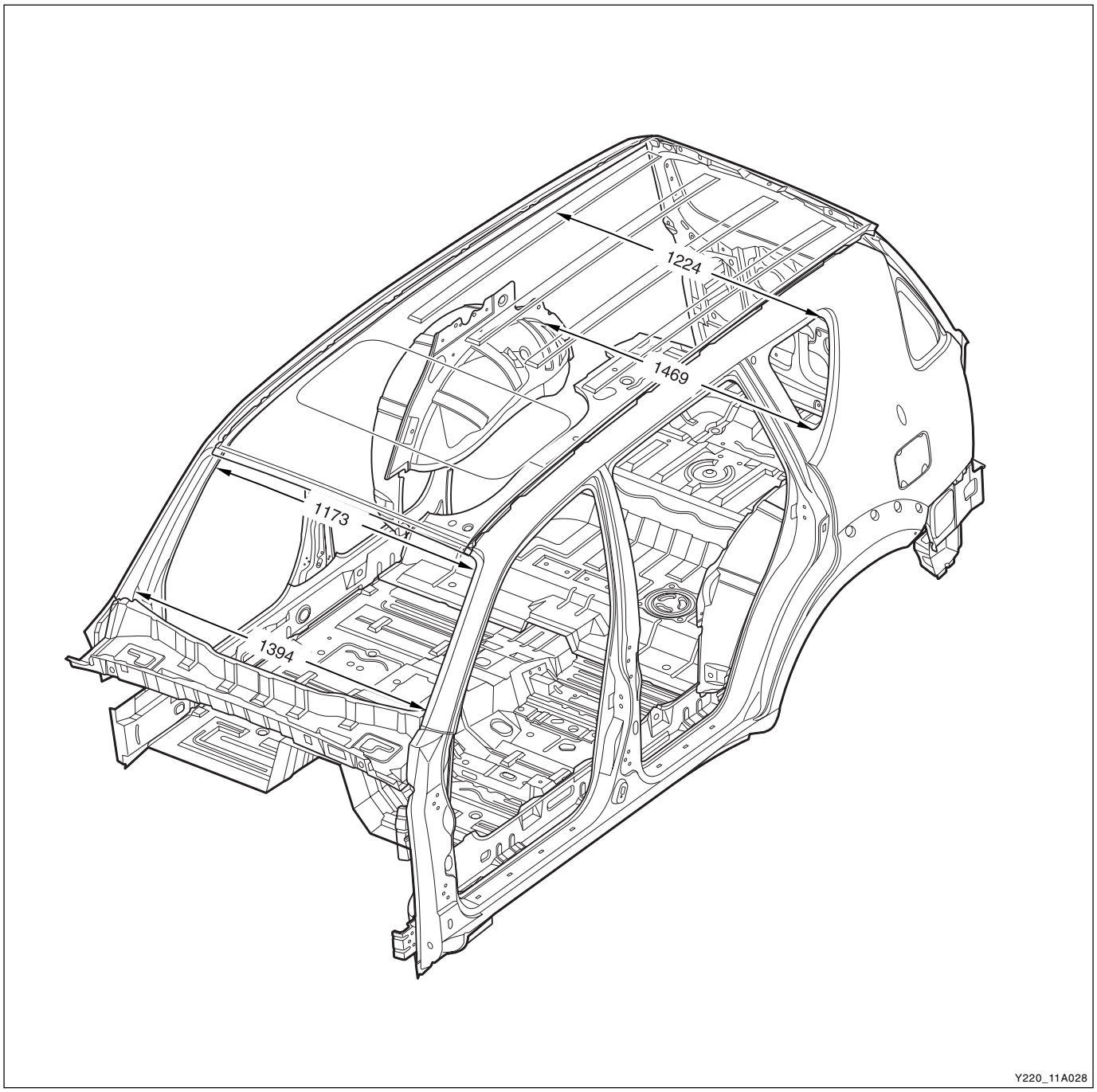
AFFECTED VIN	

Unit: mm



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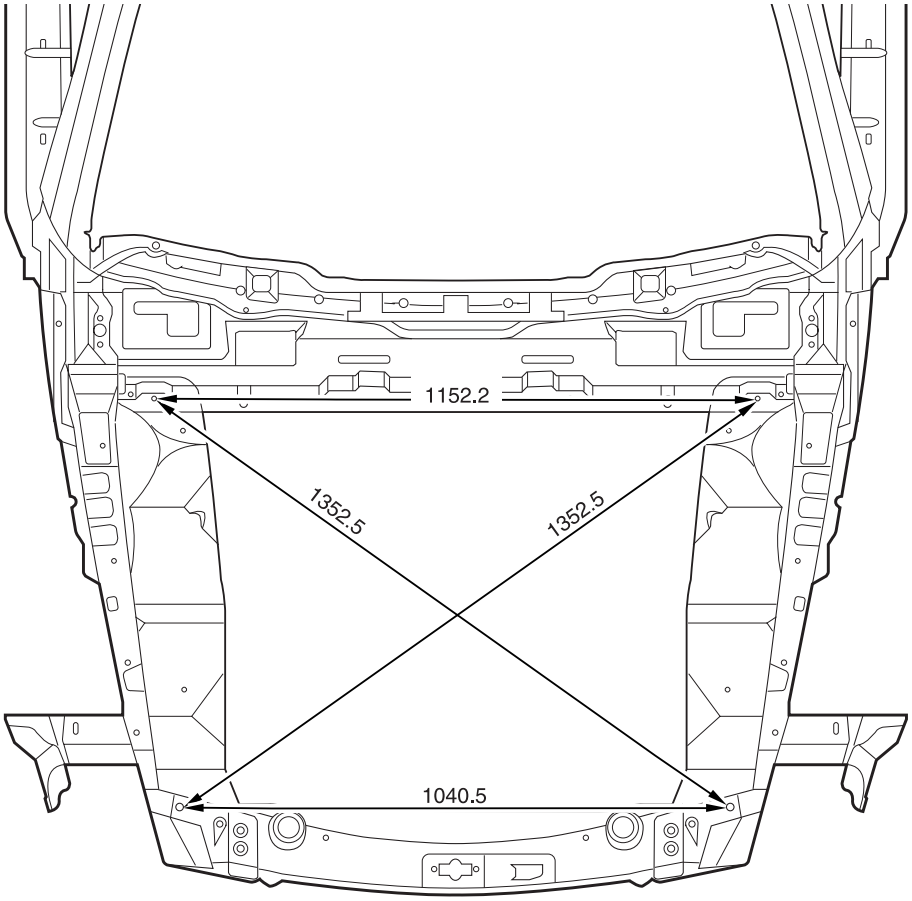
ENGINE COMPARTMENT

Unit: mm



Y220_11A029

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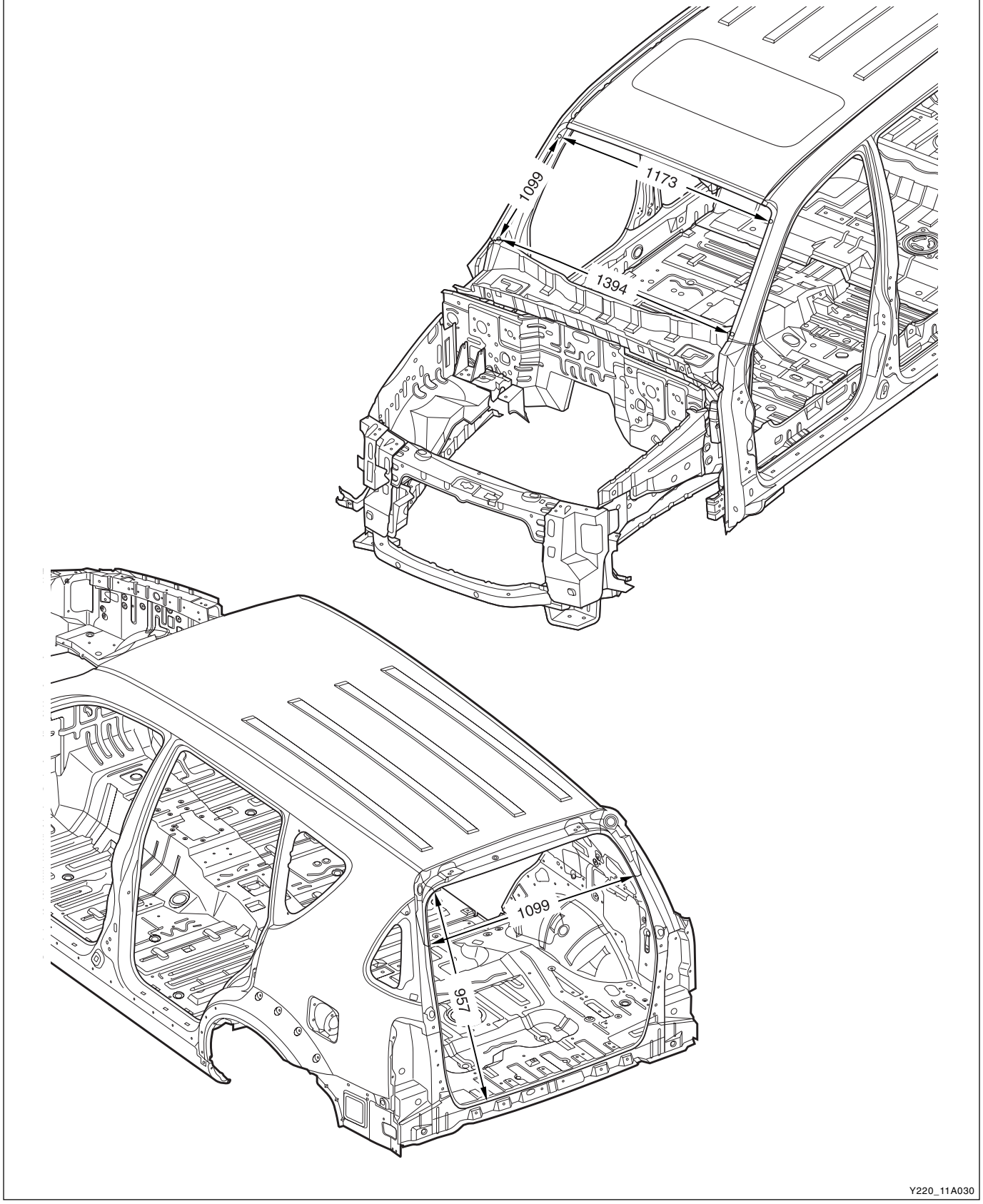
AFFECTED VIN	

WINDSHIELD AND TAILGATE GLASS

Unit: mm



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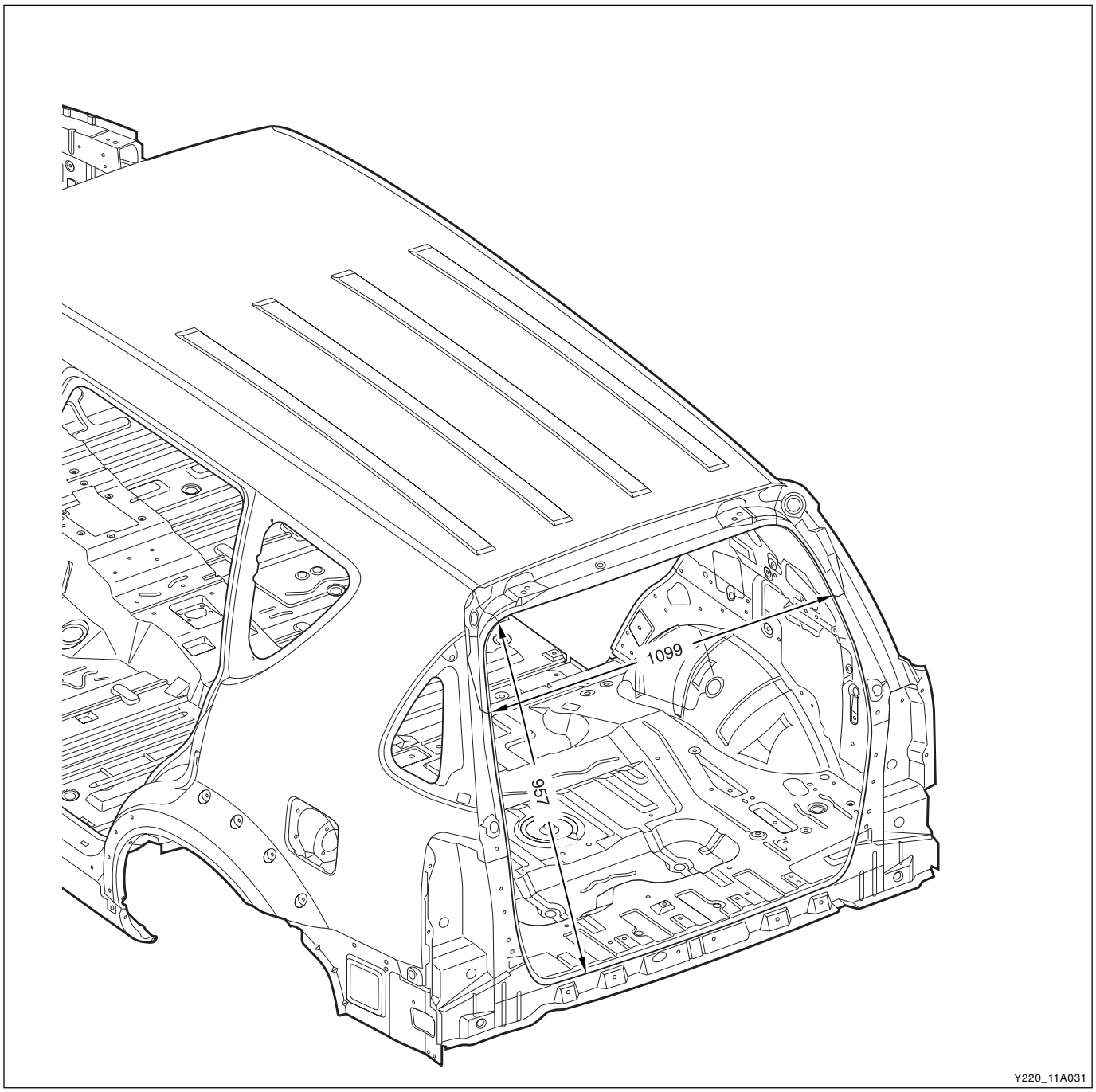
AFFECTED VIN	

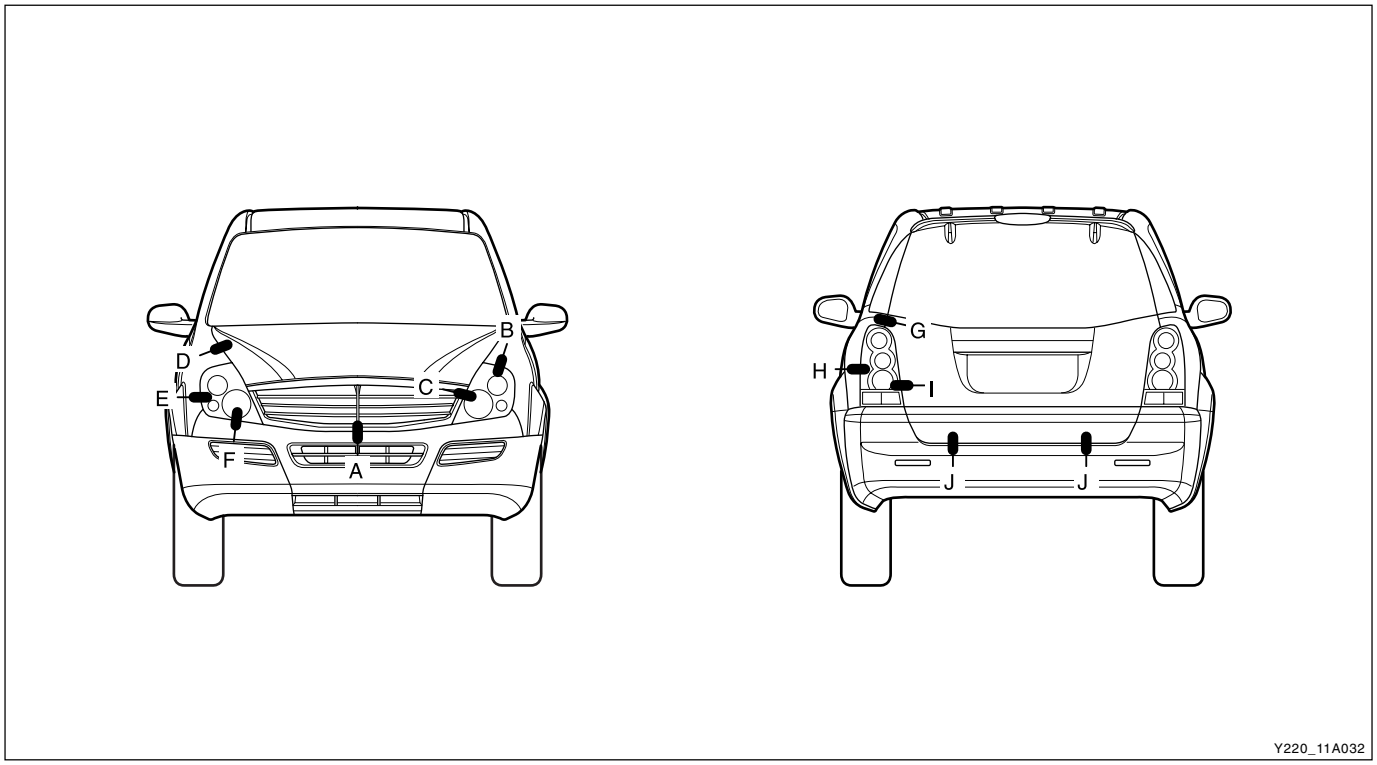
TAILGATE

Unit: mm



GAP CHART

Unit: mm



Dimension

Location	Value	Location	Value
A	$2.2\ ^{+1}_{-0.5}$	F	2.5
B	40	G	5.0 ± 0.5
C	3.0 ± 0.5	H	3.5
D	$4\ ^{+1}_{-0.5}$	I	4.9 ± 0.5
E	4.5 → 4.2 (Variable)	J	$5.7\ ^{+2}_{-0}$

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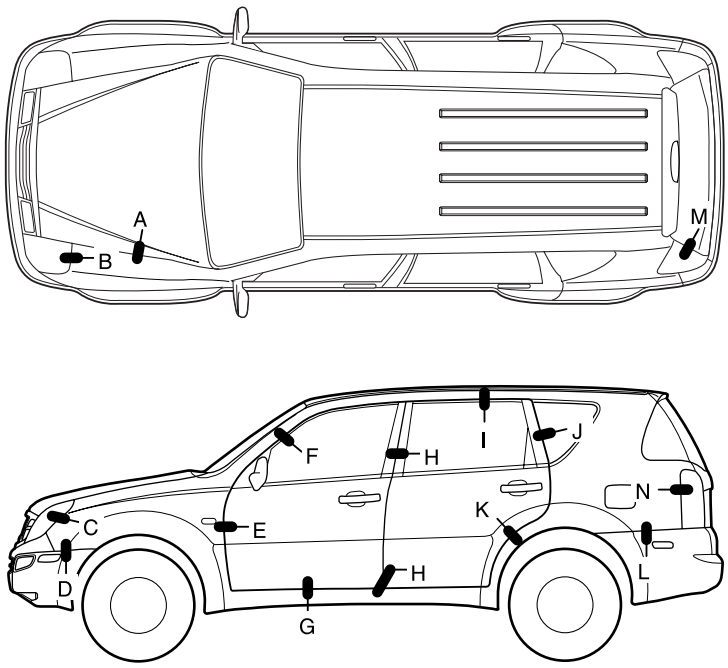
EFFECTIVE DATE	
AFFECTED VIN	

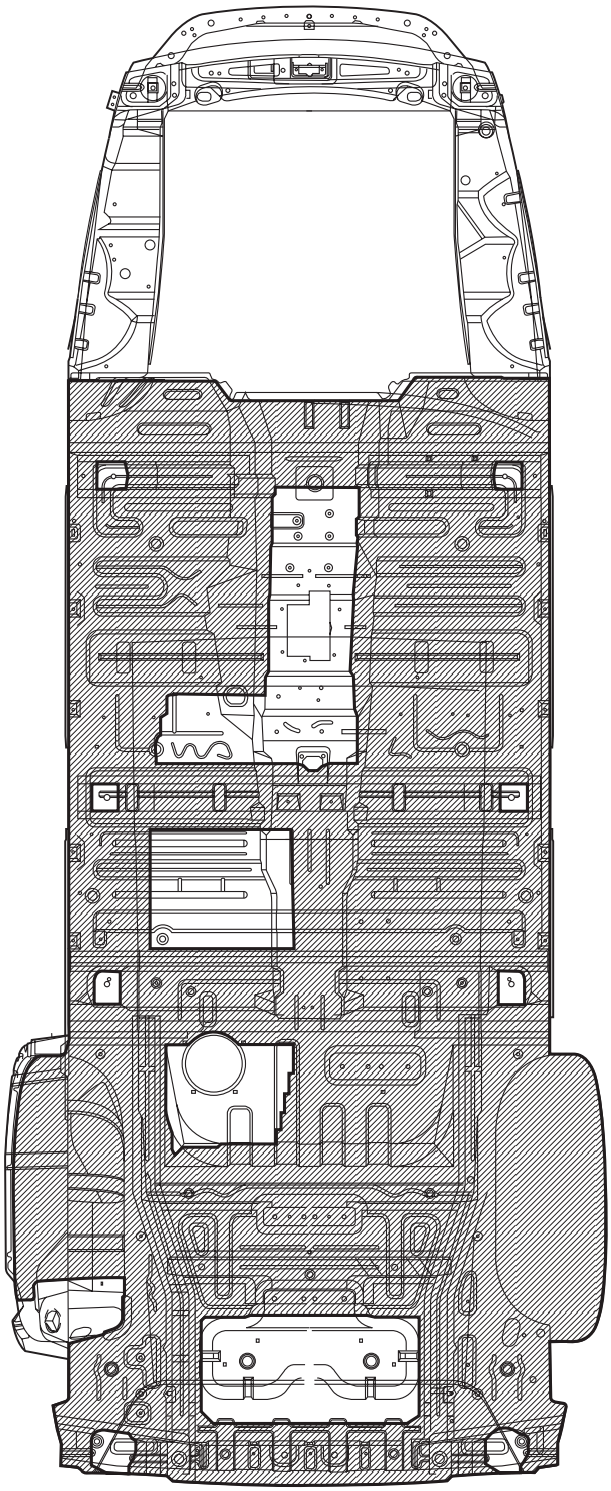
Unit: mm



Y220_11A033

Location	Value	Location	Value
A	$4^{+1}_{-0.5}$	H	4.5^{+1}_{-0}
B	4.0	I	↑
C	4.5 → 4.2 Variable	J	↑
D	$2.2^{+1}_{-0.5}$	K	↑
E	4.5^{+1}_{-0}	L	$2.2^{+1}_{-0.5}$
F	4.5^{+1}_{-0}	M	5.0 ± 0.5
G	6.5 ± 1	N	3.5

UNDERCOATING



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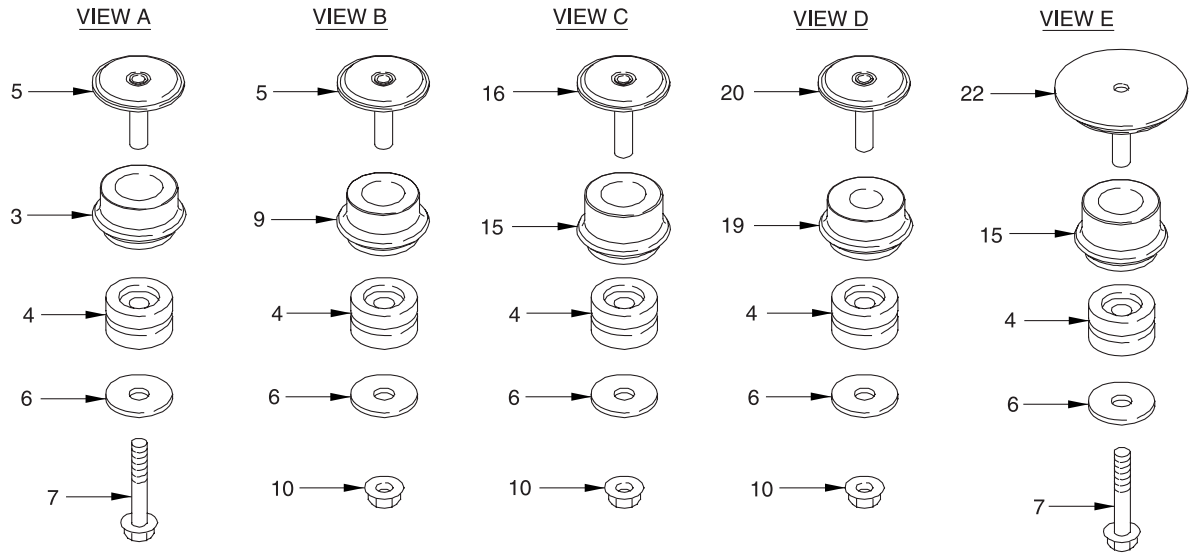
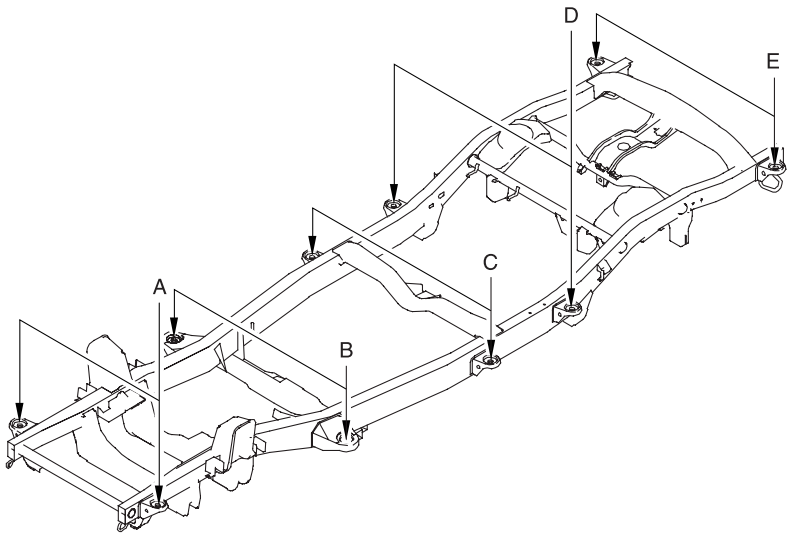
BODY MOUNTINGS

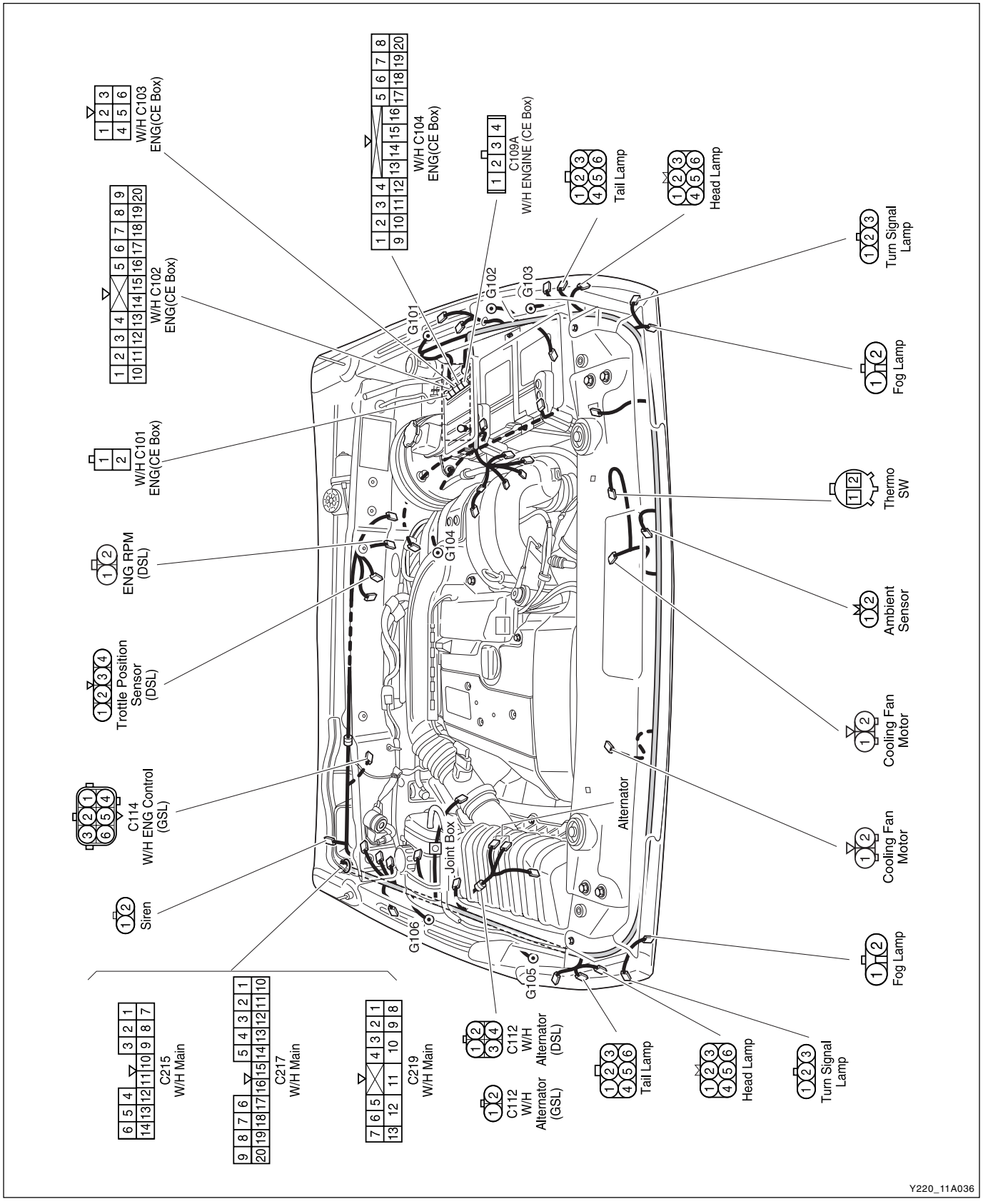




Y220_11A035

WIRING HARNESS (DI ENGINE EQUIPPED VEHICLE)

▶ Engine Compartment 1



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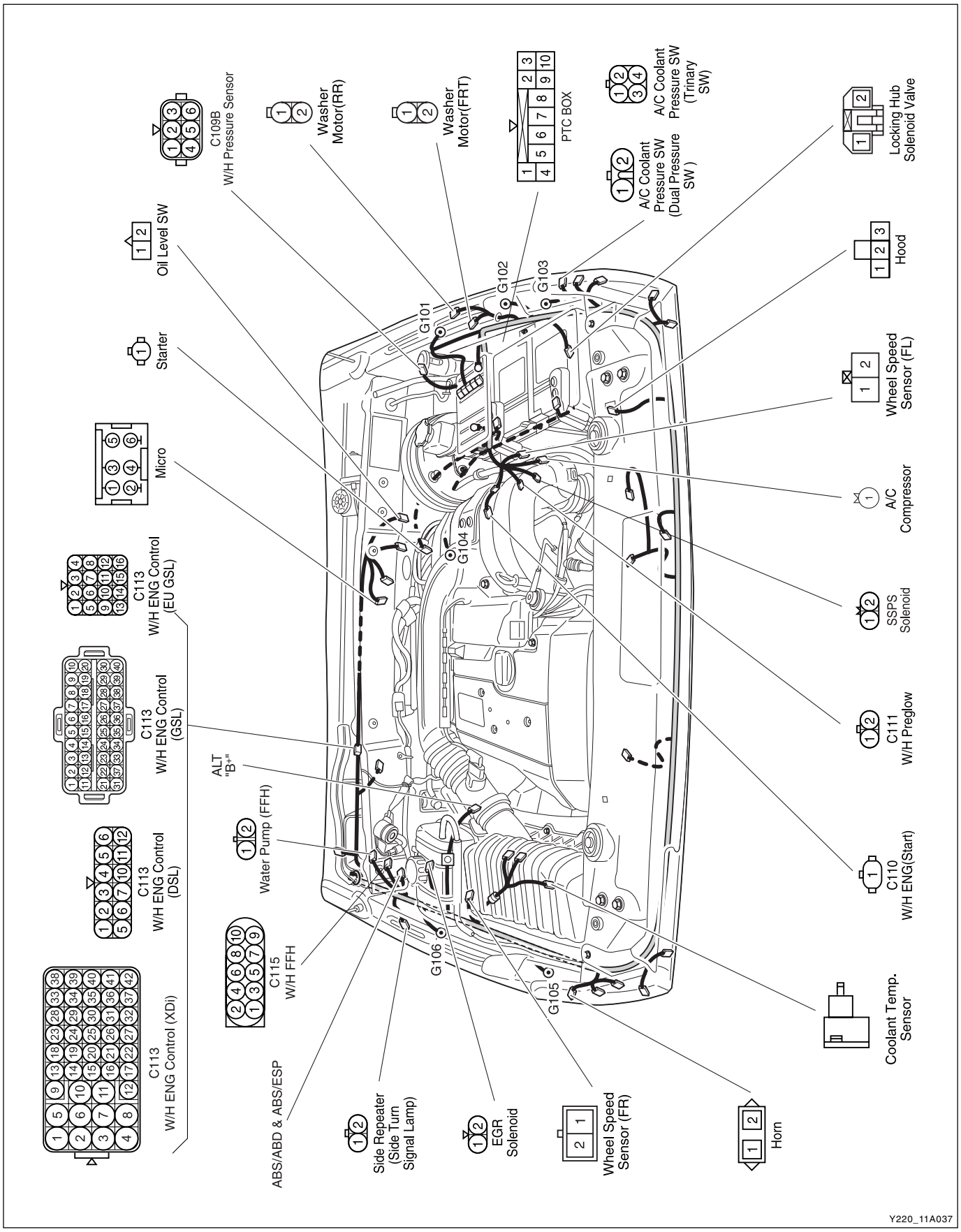
▶ Engine Compartment 2



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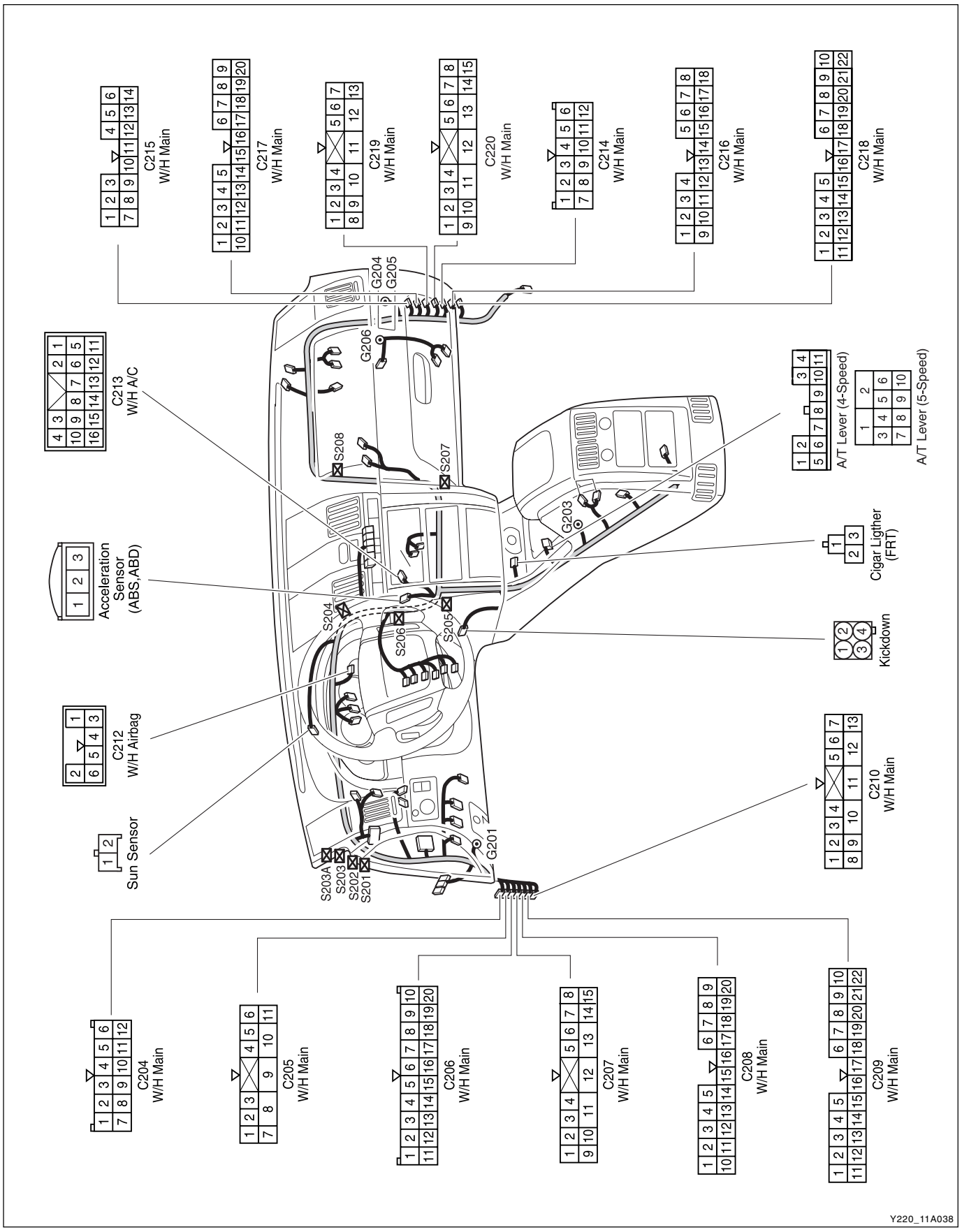
▶ Instrument 1



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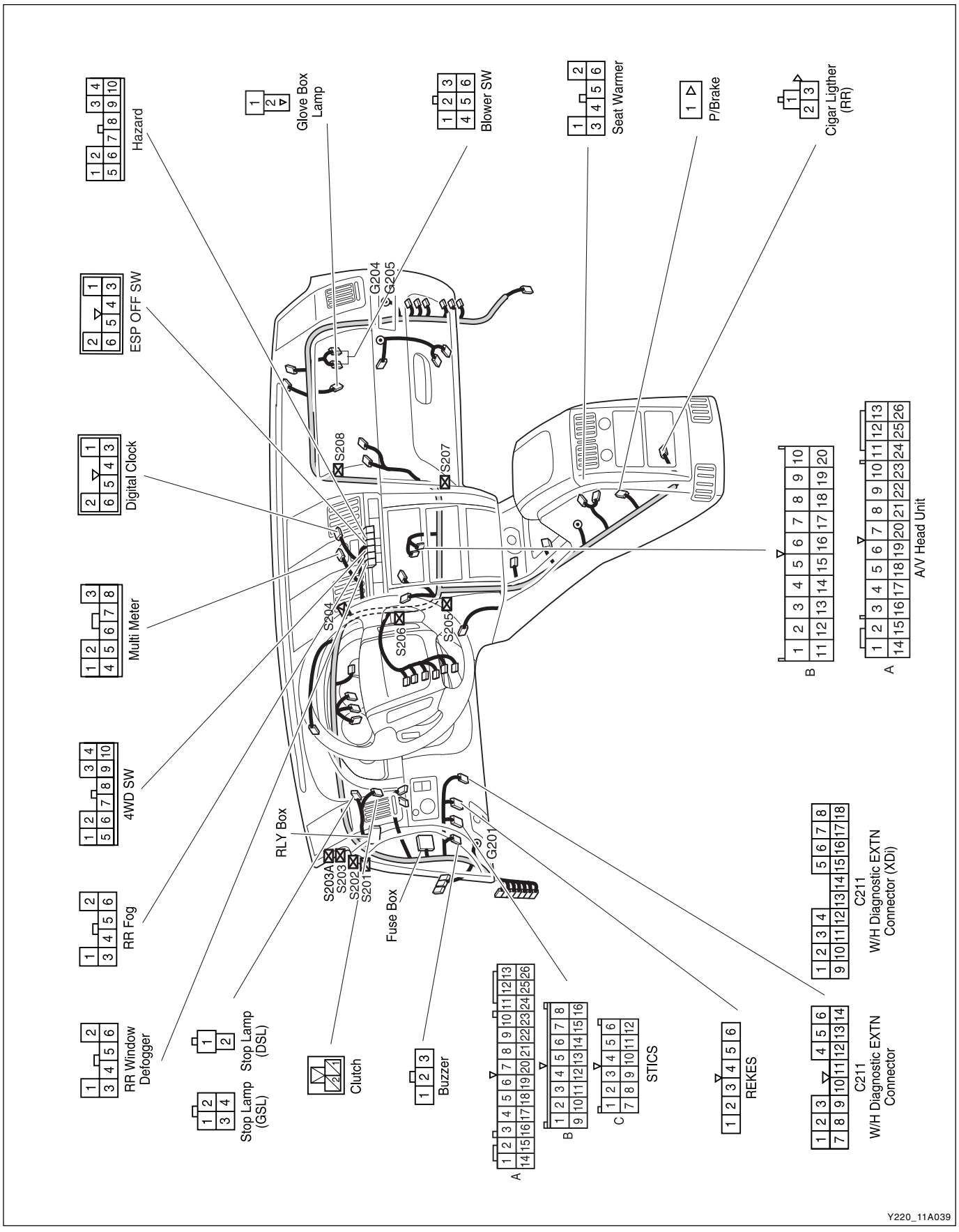
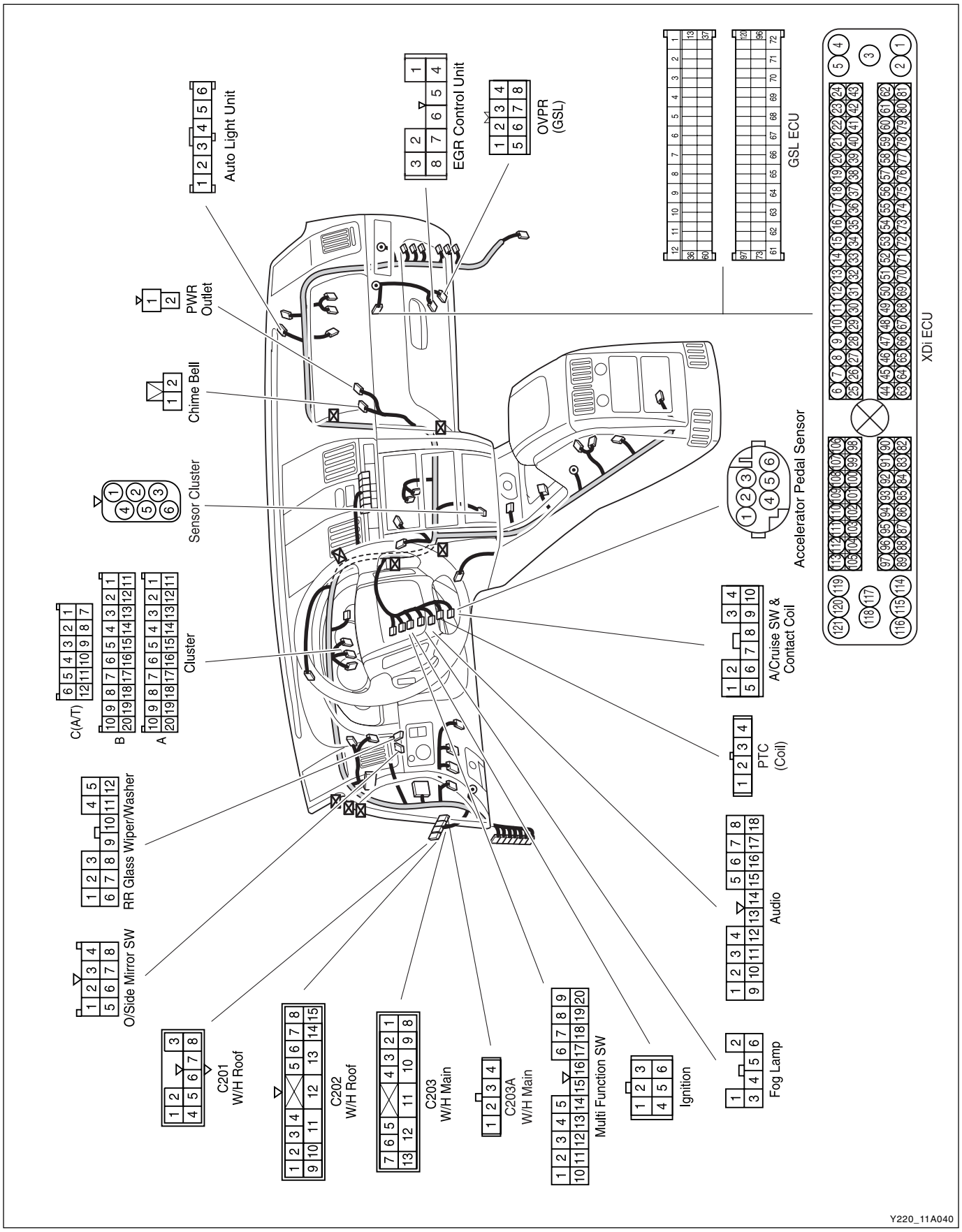
▶ Instrument 2



Y220_11A039

▶ Instrument 3



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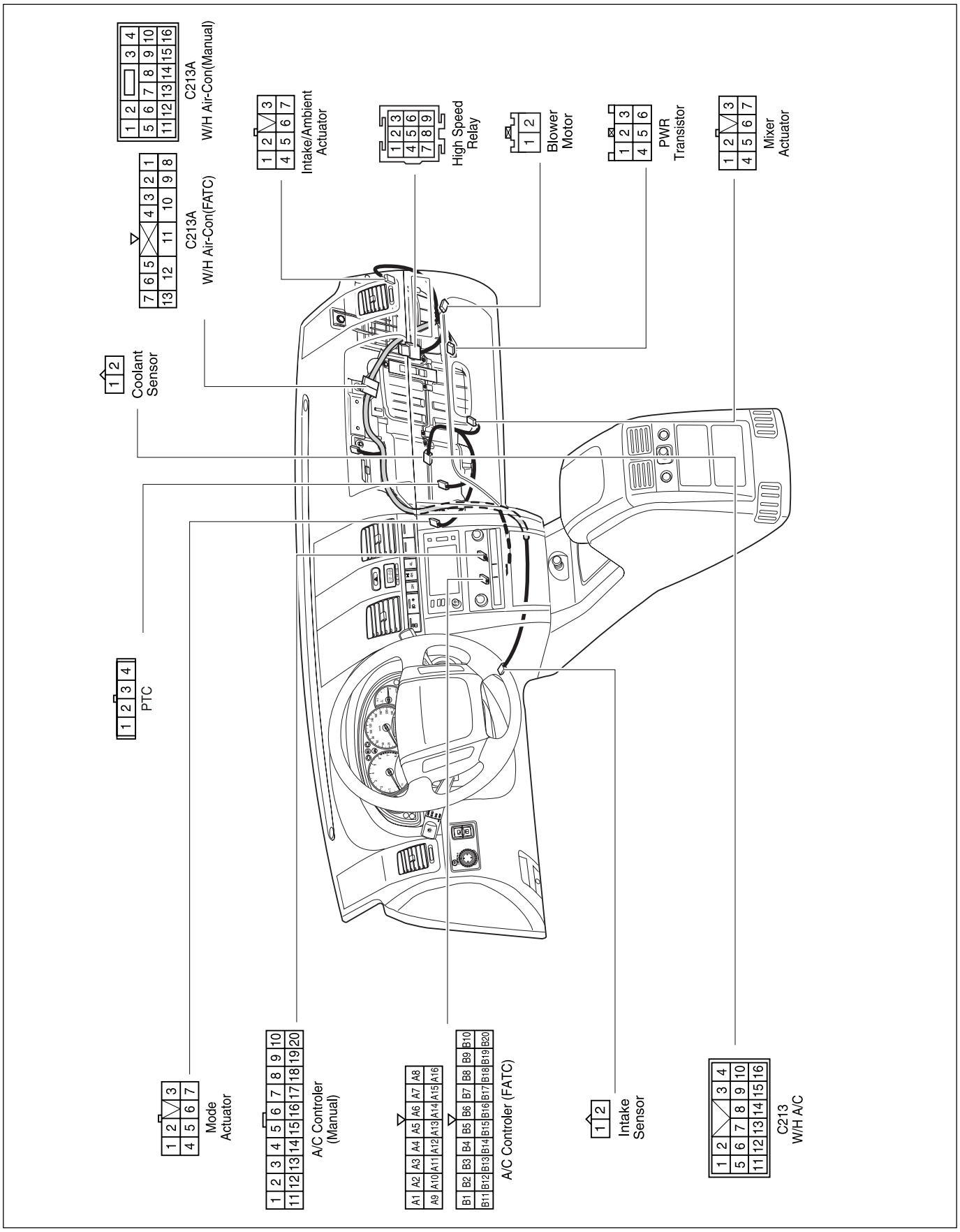
▶ Air Conditioner



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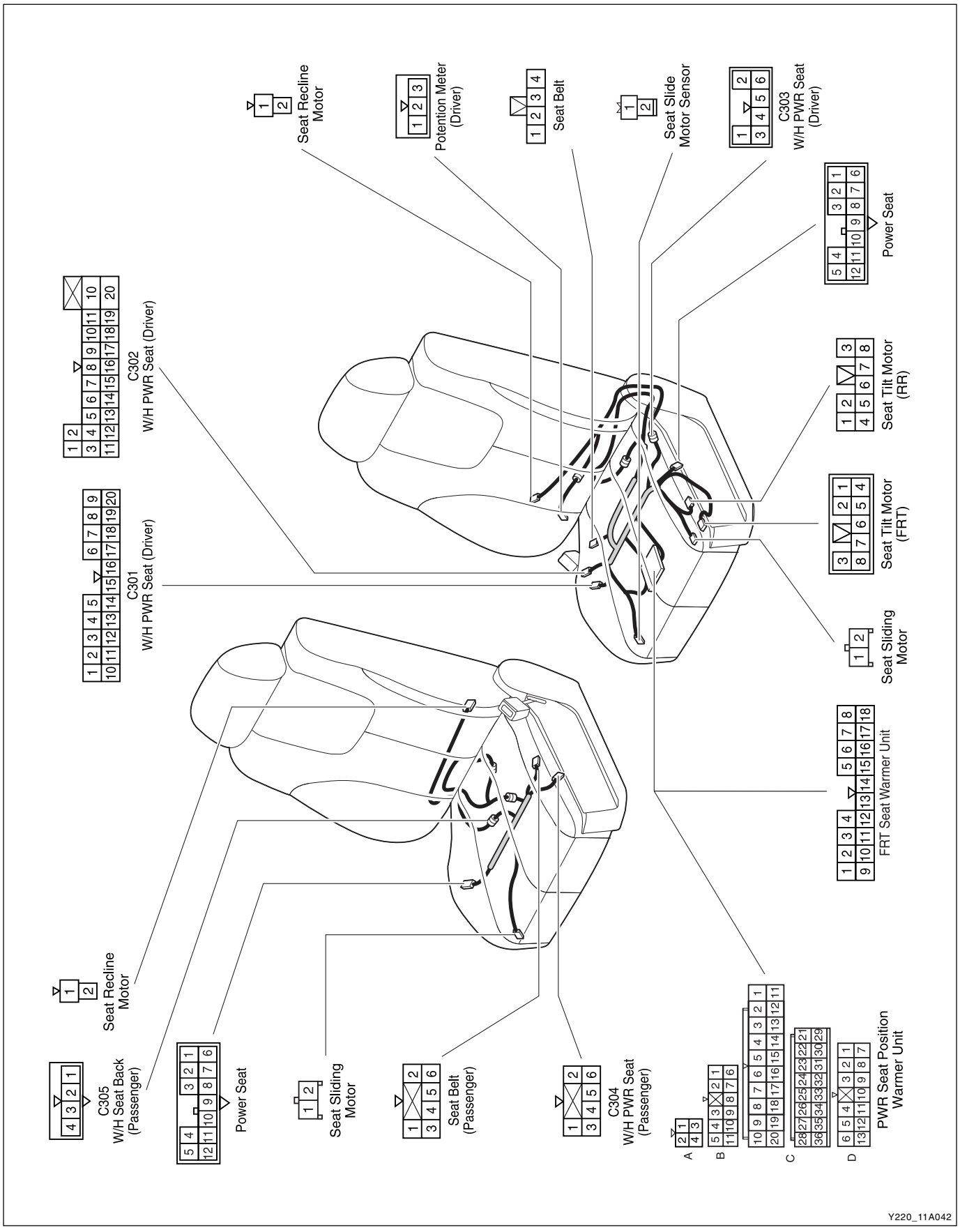
▶ Seat



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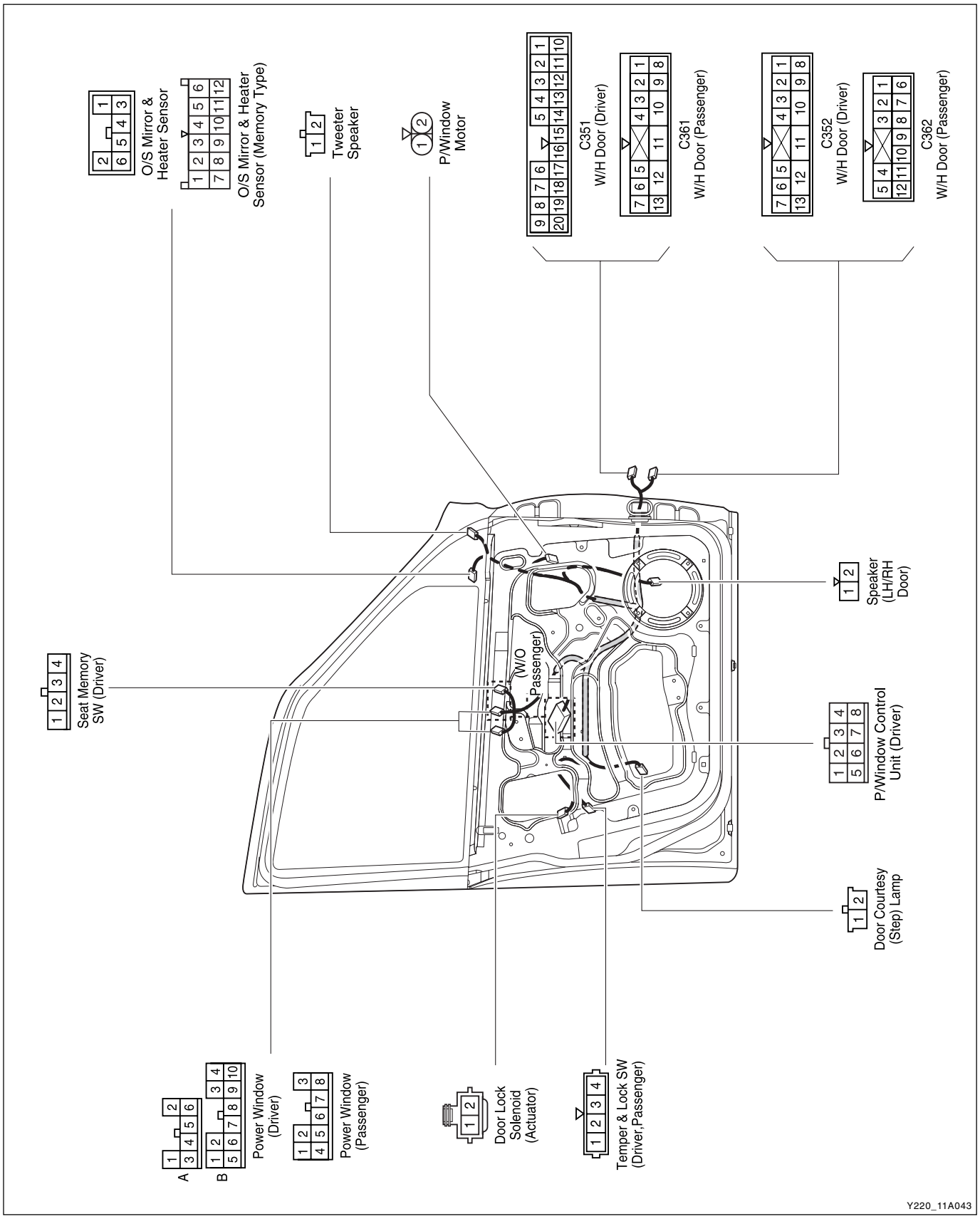
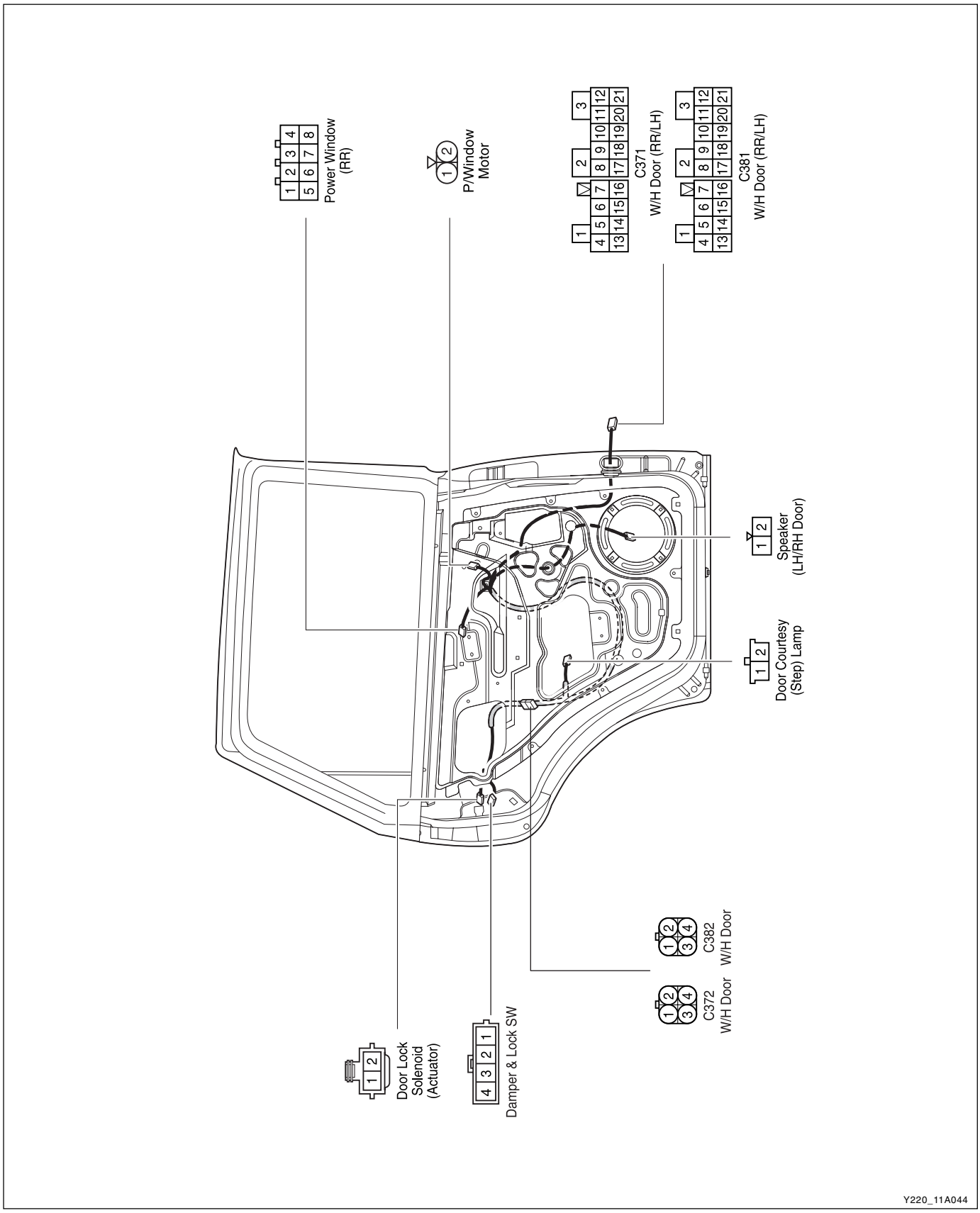
▶ Door

Front door



Rear door



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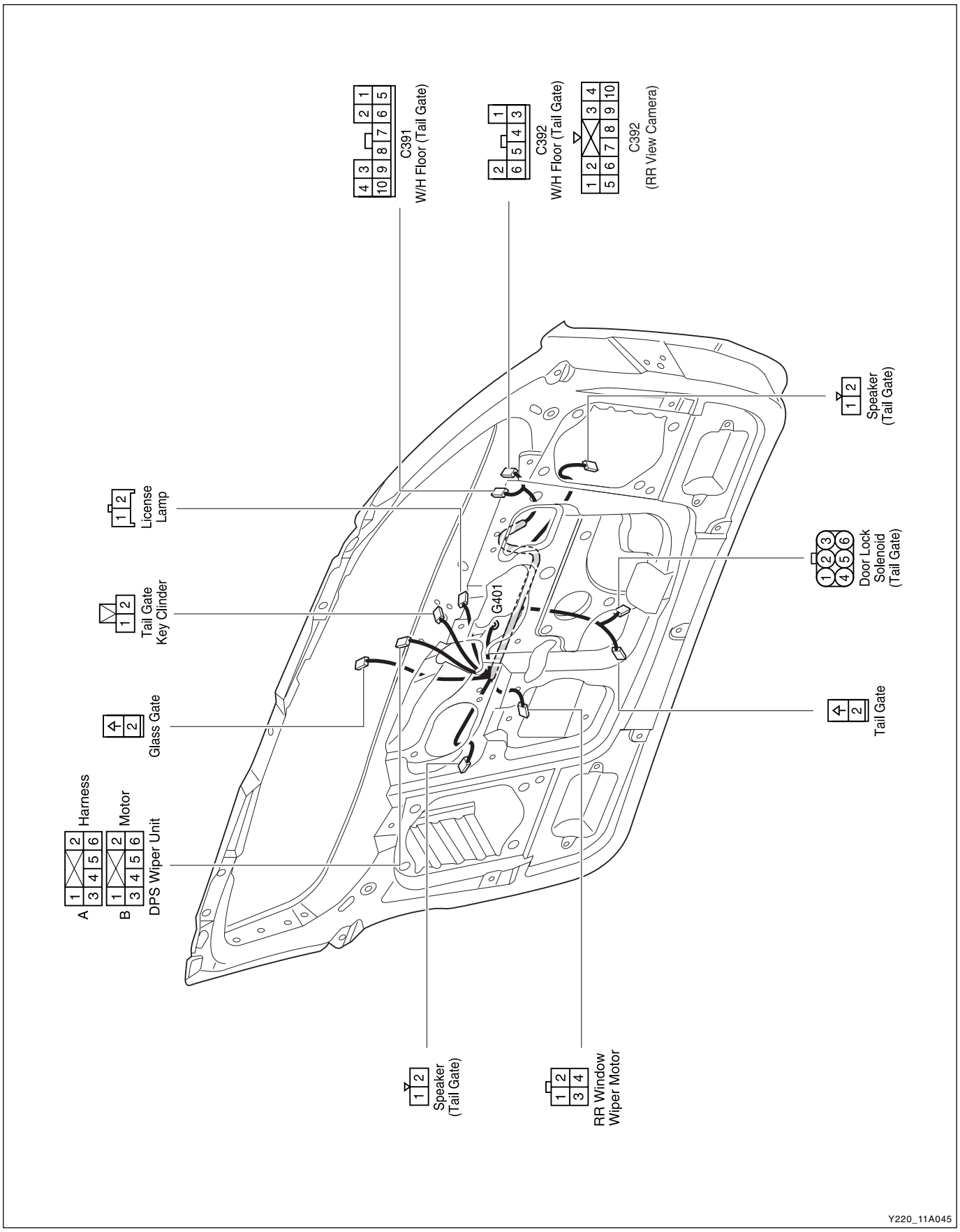
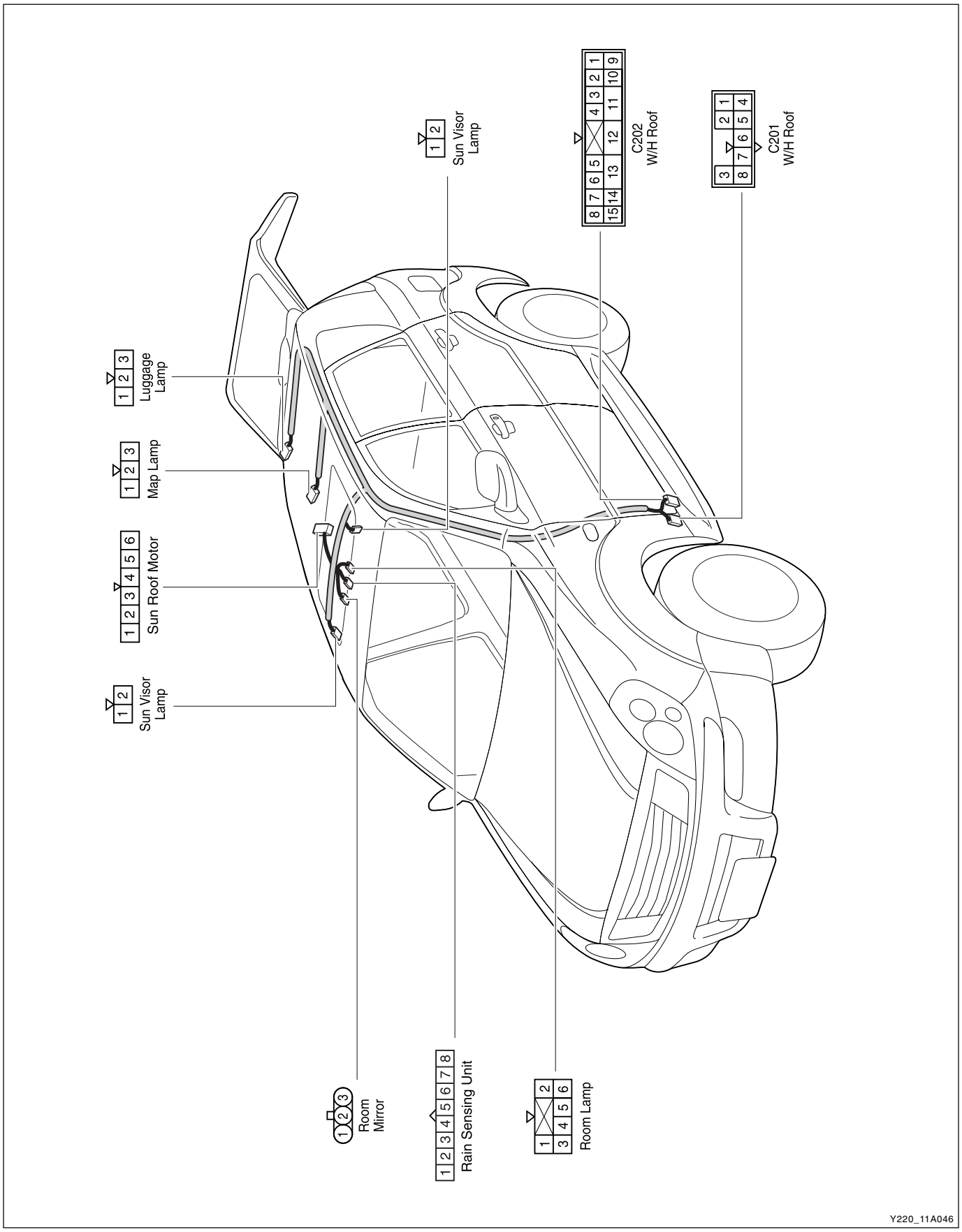
▶ Tailgate


C391
W/H Floor (Tail Gate)
C392
W/H Floor (Tail Gate)
C392
(RR View Camera)
Speaker
(Tail Gate)
License
Lamp
Door Lock
Solenoid
(Tail Gate)
Tail Gate
Key Clinder
G401
Glass Gate
Tail Gate
A
Harness
B
Motor
DPS Wiper Unit
Speaker
(Tail Gate)
RR Window
Wiper Motor
Y220_11A045

▶ Roof



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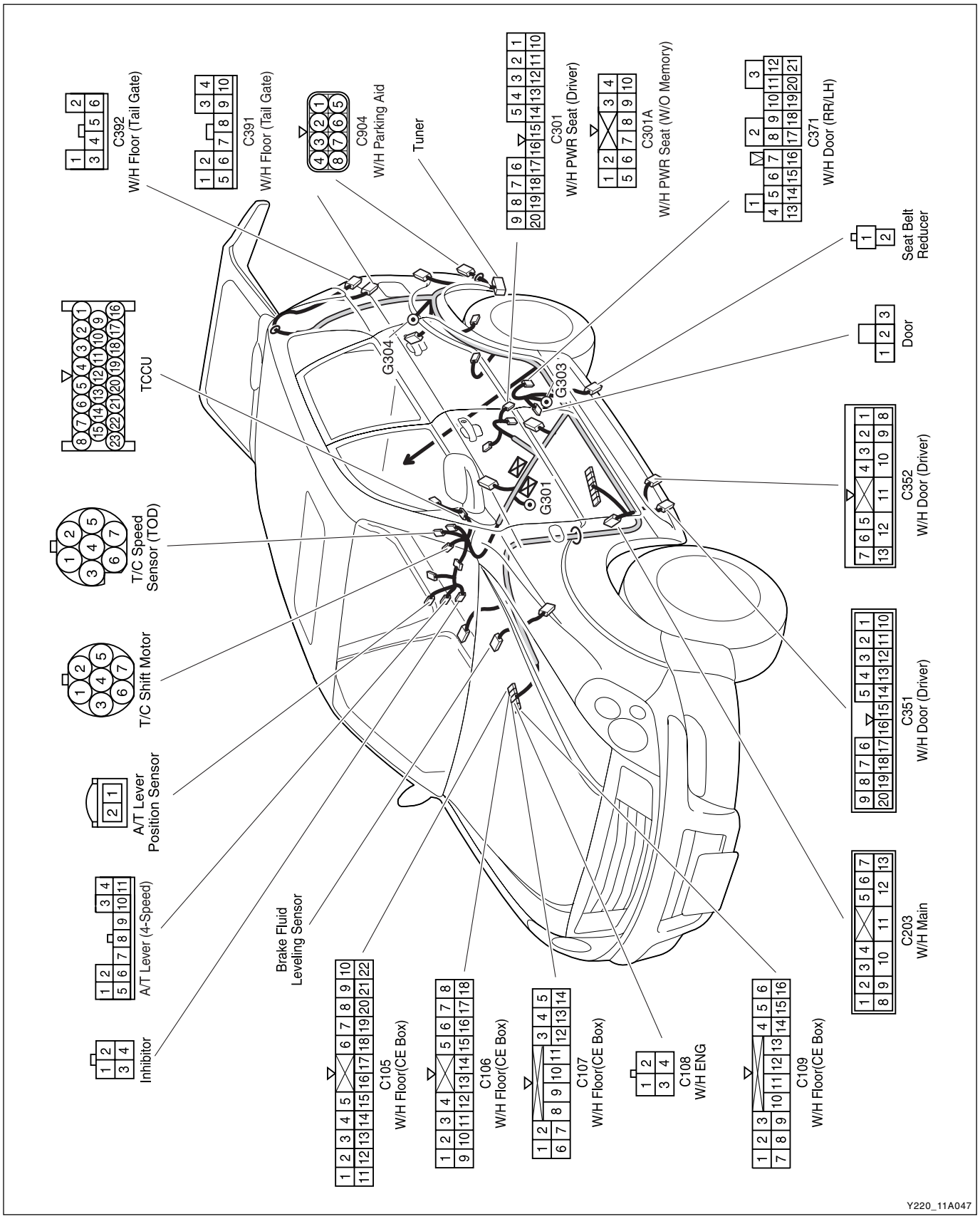
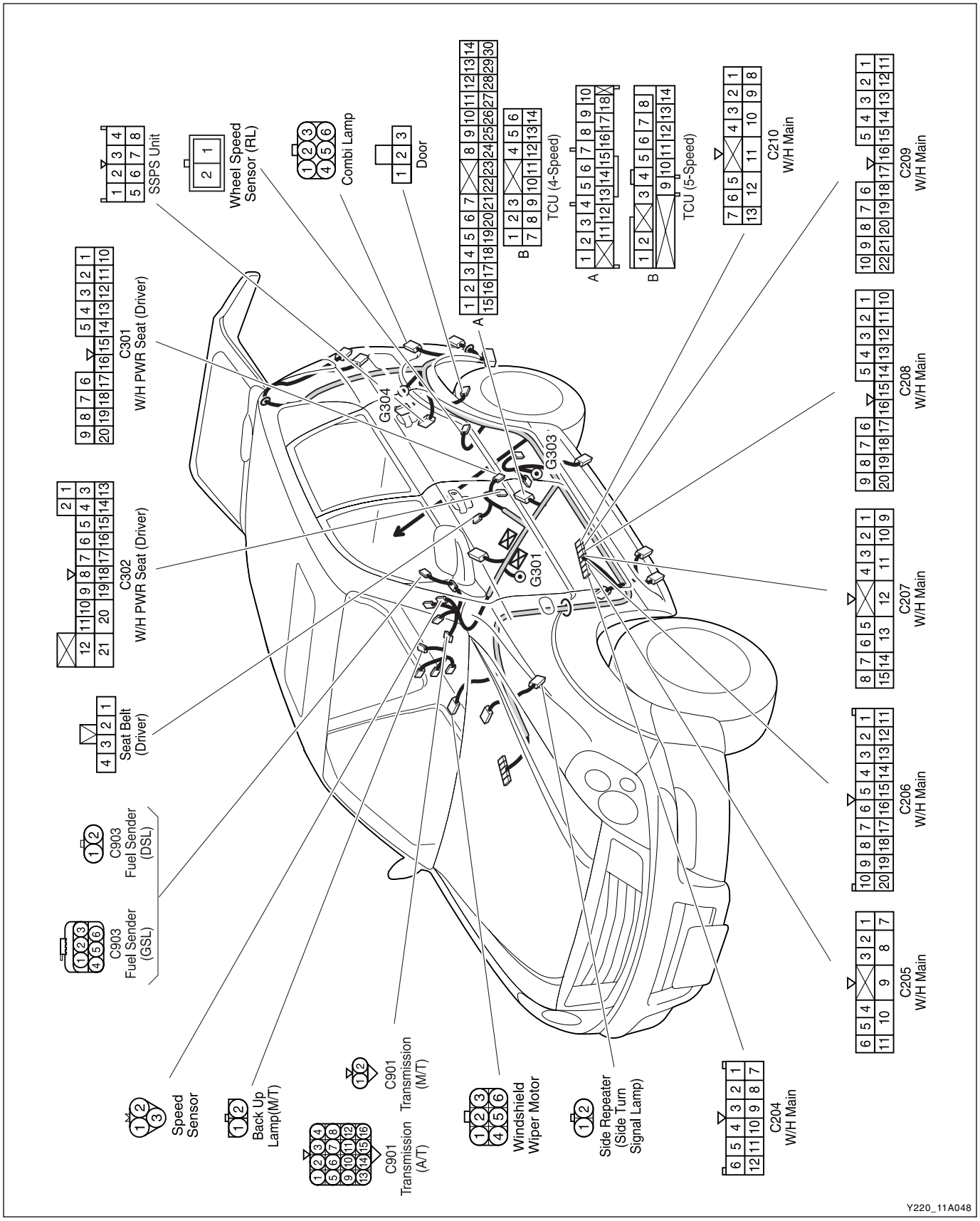
▶ Tailgate

Driver side 1



Driver side 2



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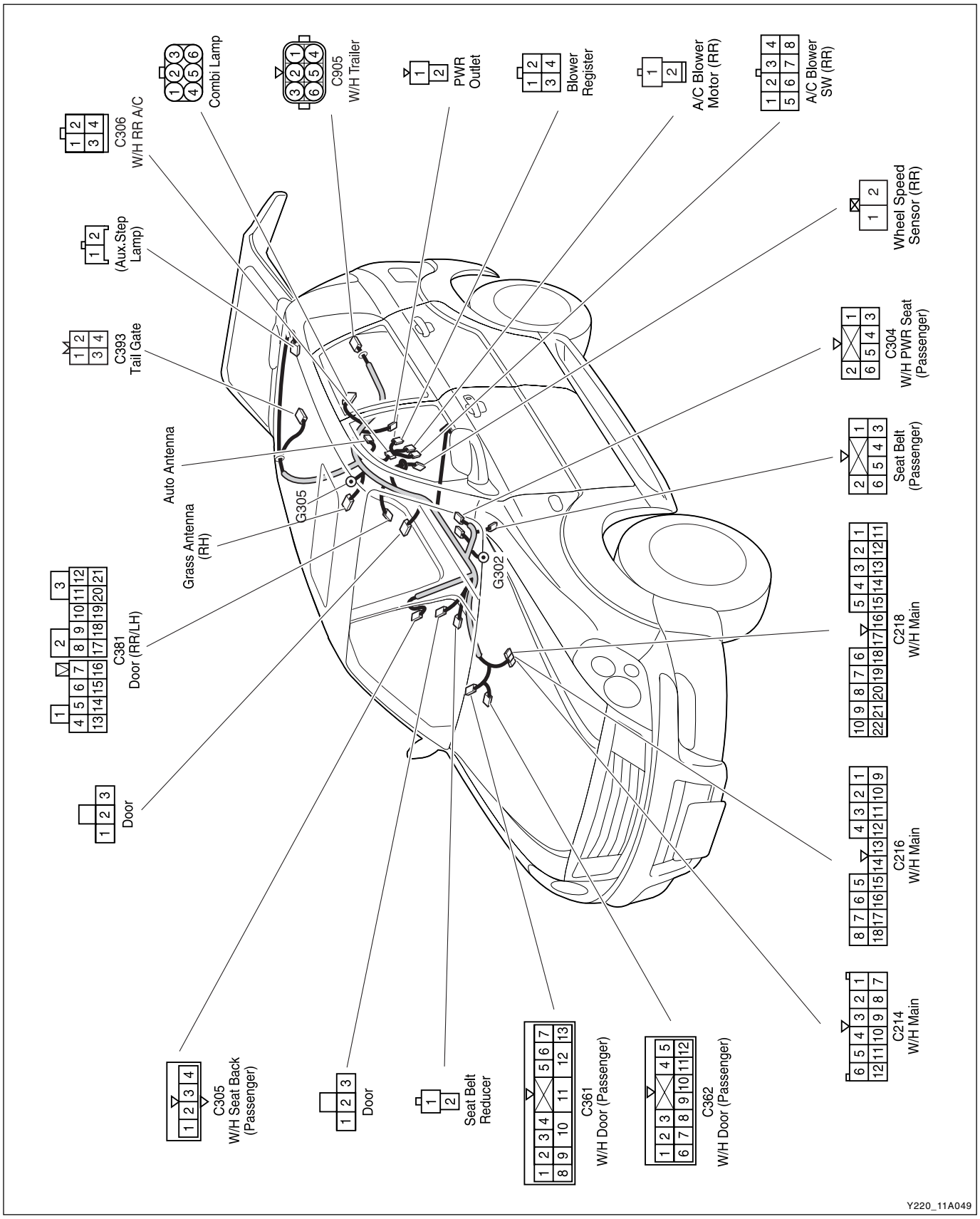
Passenger side



SECTION 11B

VEHICLE INTERIOR

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SEAT

Y220_11B001

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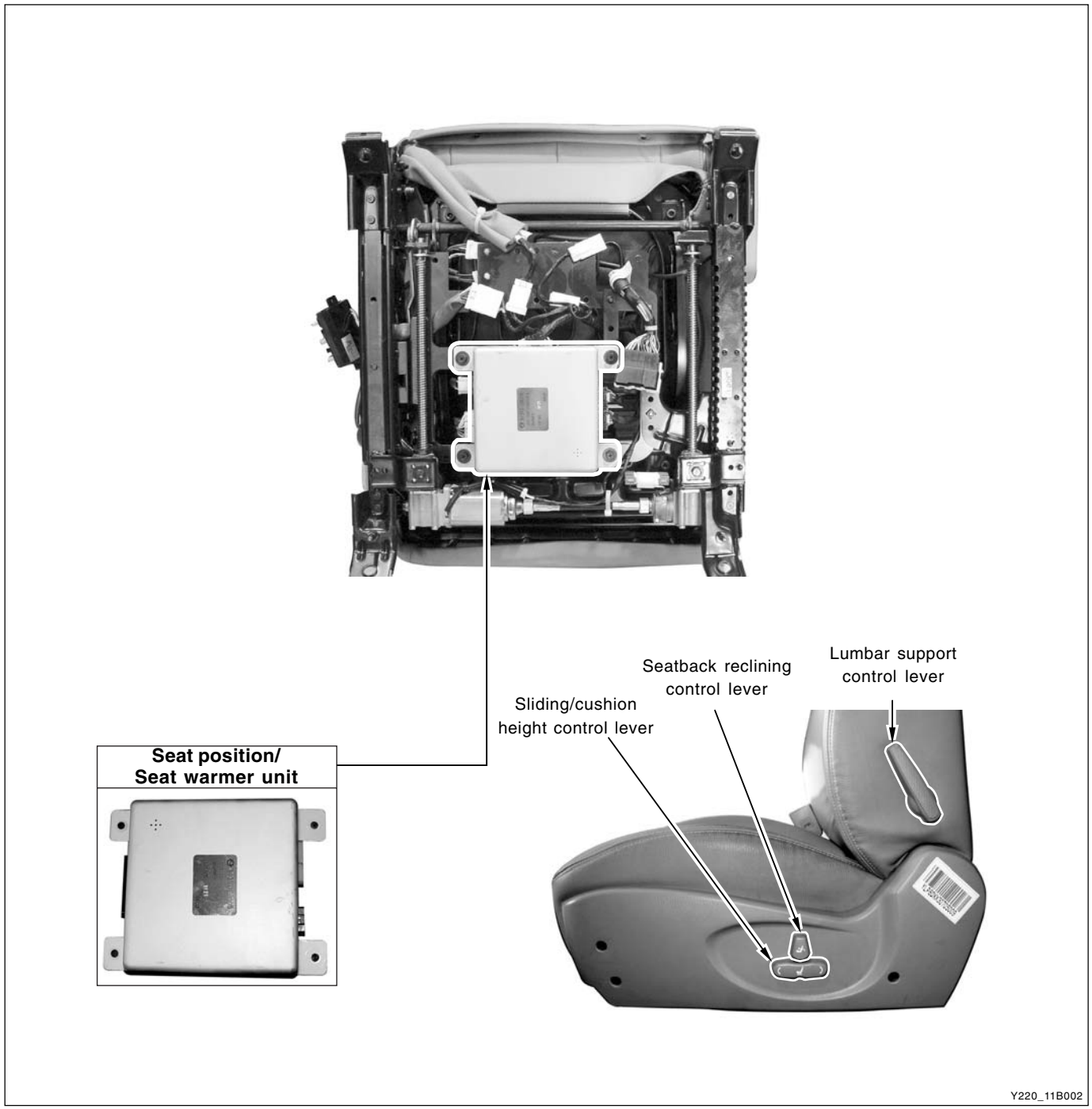
FUNCTION DESCRIPTION

▶ Seat Position/Seat Warmer Unit

This unit is installed under the driver's seat. It functions the manual operations and memory return of driver's seat and outside rearview mirror and. It also functions the outside rearview mirror folding and the seat warmer for driver's and passenger's seat.



▶ Specifications

Component	Description		Specification
Seat **Note:** Operated regardless of the ignition switch position	Operating voltage		DC 11 ~ 15 V
	Operating temperature range		-30°C ~ 80°C
	Seat moving speed (at 13.5 V)	Slide	20 ± 7 mm/sec
		Tilt	10.6 ± 5 mm/sec
		Height	7 ± 5 mm/sec
	Seat moving distance	Slide	228 ± 3 mm
		Recline	20° ↔ 0 ↔ 48°
		Lift	30 ± 3 mm
	Operating current (at 13.5 V)	Slide	below 7A
		Recline	below 7A
		Tilt and lift	below 8A
	Seat warmer switch	Rated load	DC 12 V / 1A
		Operating temperature range	40 ± 5°C
		Switch operating force	0.3 ~ 0.7 kgf
Outside rearview mirror	Up/Down angle		-8° ~ 8°
	Left/Right angle		-8° ~ 8°
	Folding angle		67° (available 30 seconds delayed operation after ignition “OFF”)

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▶ Seat Position Memory Switch

Seat position memory setting and operation

1. "SET" switch
2. "STOP" switch
3. Position (1, 2, 3) switch

Up to 3 different drivers, the memory setting of seat position is available. Each driver can set his/her own driver's seat and outside rearview mirrors positions and it will be stored in the computer. Even if someone have moved your seat and outside rearview mirrors, the memory positions will be recalled automatically by pressing the position button.

Storing memory settings

1. Place the selector lever in "P" (automatic transmission) or "N" (manual transmission) position, and apply the parking brake with the ignition switch "ON".
2. Adjust the driver's seat and outside rearview mirrors.
3. Press the "SET" button. Indicating light on the button will come on and beep sounds.
4. Within five seconds, press button you want among 1, 2 or 3 of the position buttons. Adjusted positions will be stored in the computer with "Beep" sound.

Notice

- ***Do not adjust seats while vehicle is moving.***
- ***Do not adjust seat and side mirror setting while vehicle is moving.***
- ***Never operate driver's seat and outside rearview mirror switch during memory setting, or the memory setting will be cancelled.***
- ***If you do not press a position switch within 5 seconds after pressing the "SET" switch, the memory setting will be cancelled.***
- ***The memory setting is available for up to 3 drivers.***

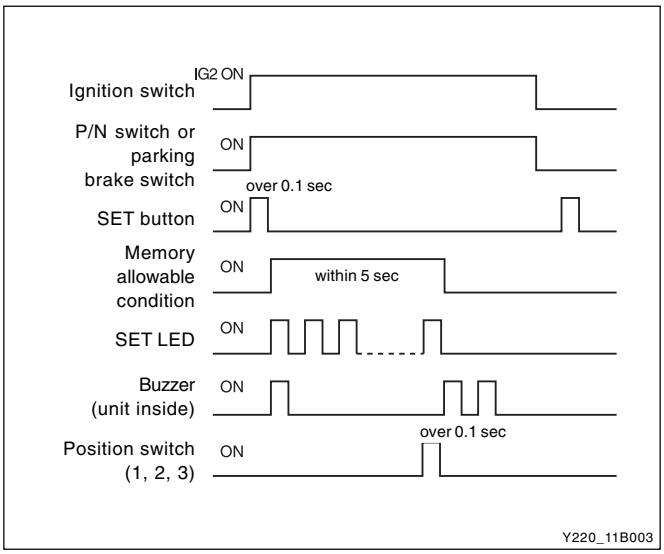
Operating memory settings

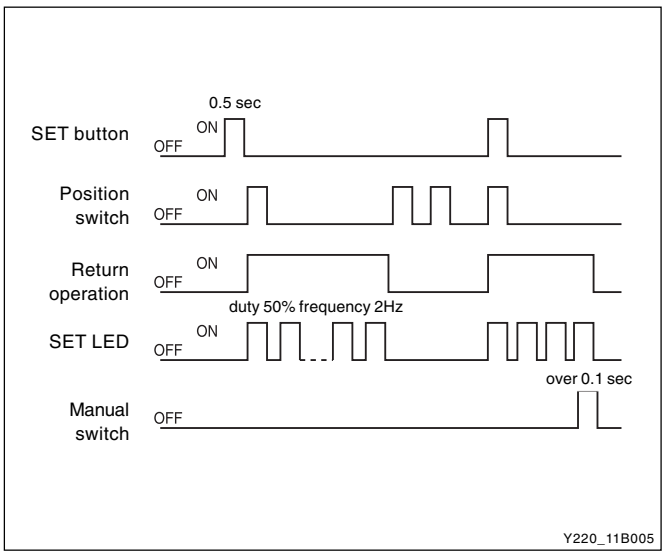
1. Place the selector lever in "P" (automatic transmission) or "N" (manual transmission) position, and apply the parking brake with the ignition switch "ON".
2. Keep the position button pushed (for more than 1.5 second) until driver's seat and outside rearview mirrors start to move.
3. If pressing the button, driver's seat and outside rearview mirrors will be recalled automatically to the memory positions.

Notice

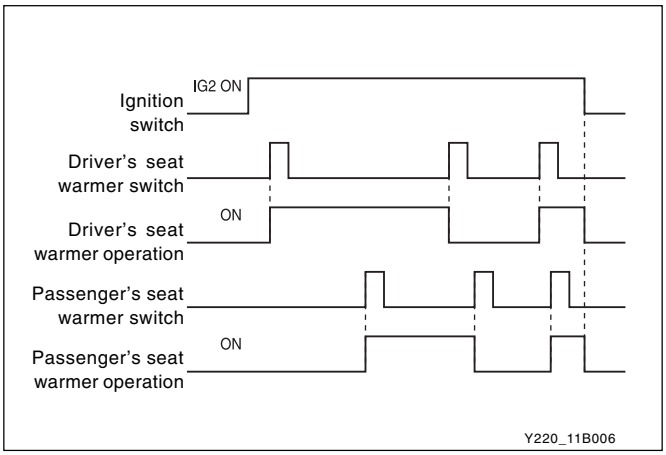
- ***To recall the memory positions, press the position switch for more than 1.5 seconds.***
- ***If you press "STOP" switch or operate a switch among the switches in order to adjust the driver's seat or outside rearview mirrors, recalling of the memory positions is immediately stopped.***

Memory operation





Seat warmer



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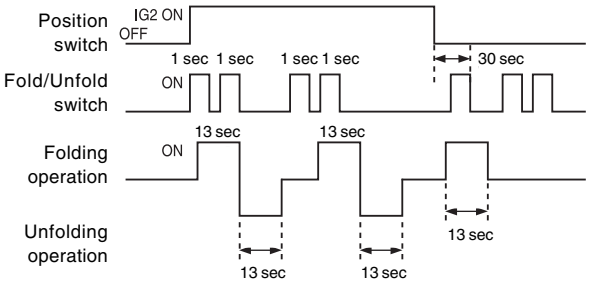
Outside rearview mirror folding/unfolding

Y220_11B008

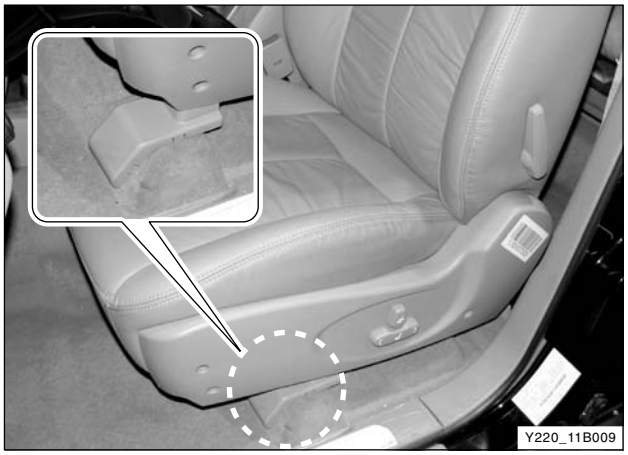


Y220_11B007

REMOVAL AND INSTALLATION

Front Seat

1. Remove three seat rail plastic caps.

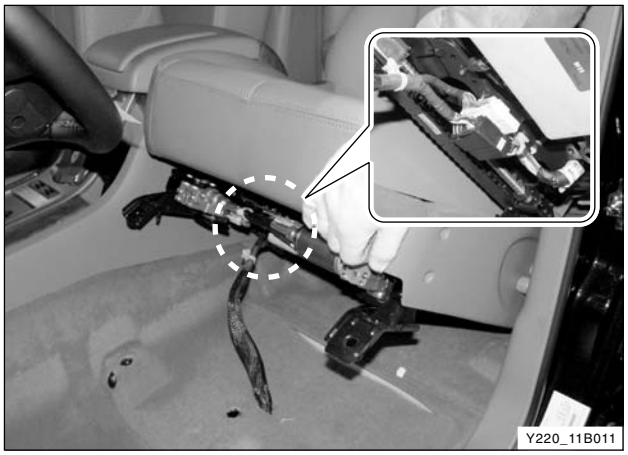


2. Remove the seat rail mounting bolts from both sides.

   Installation Notice

Tightening torque	35 ~ 55 Nm

3. Disconnect the floor wiring connectors and remove the front seat.
   - Connector locations
     - Driver side: basic 2, SAB 3
     - Passenger side: basic 1, SAB 2



4. Install in the reverse order of removal.

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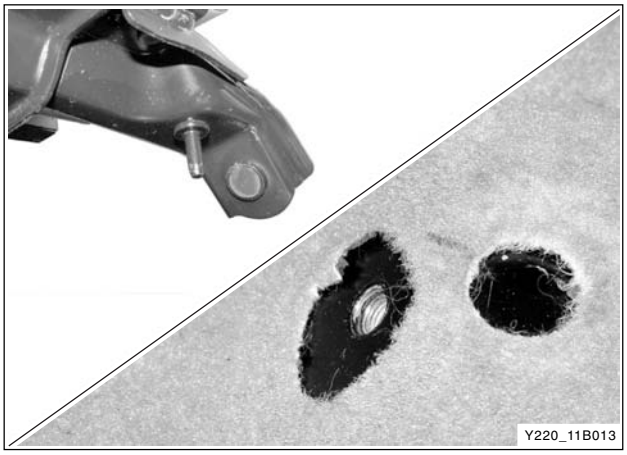


* Make sure to securely insert the seat pin into the body hole.

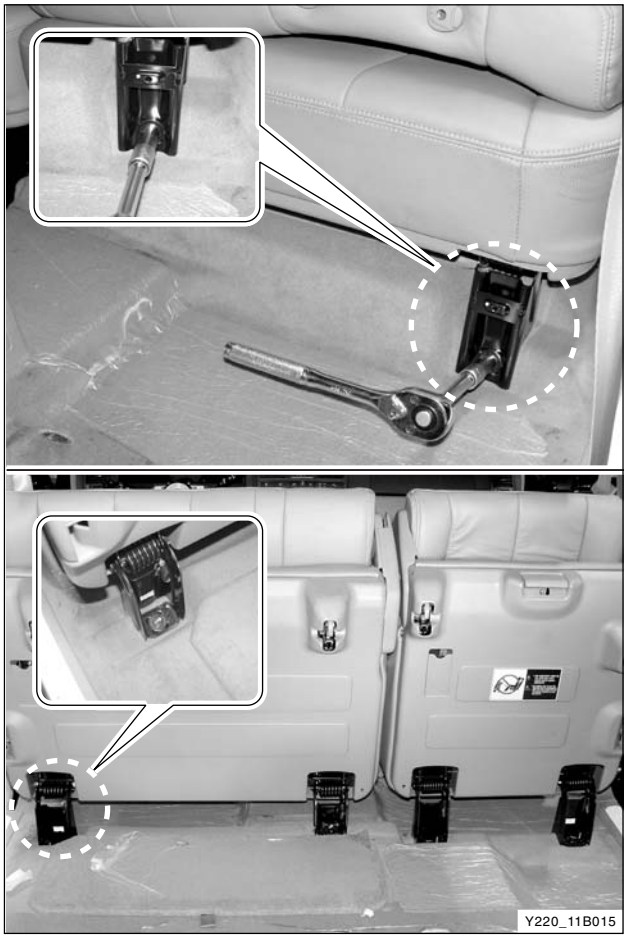
Second Seat

1. Unscrew the screws and remove the seat mounting cover.

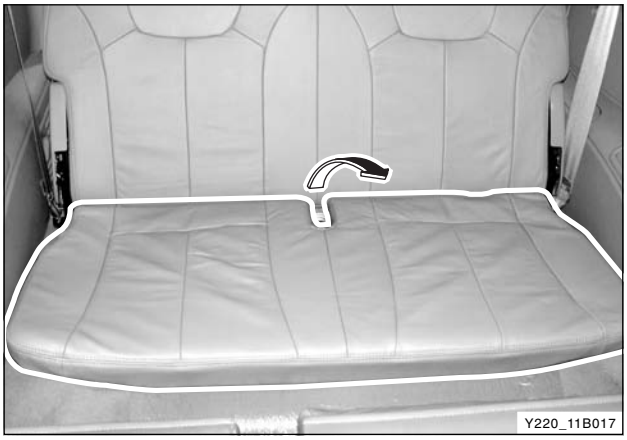
2. Unscrew the seat mounting bolts and remove the seat.

Installation Notice

Tightening torque	35 ~ 55 Nm

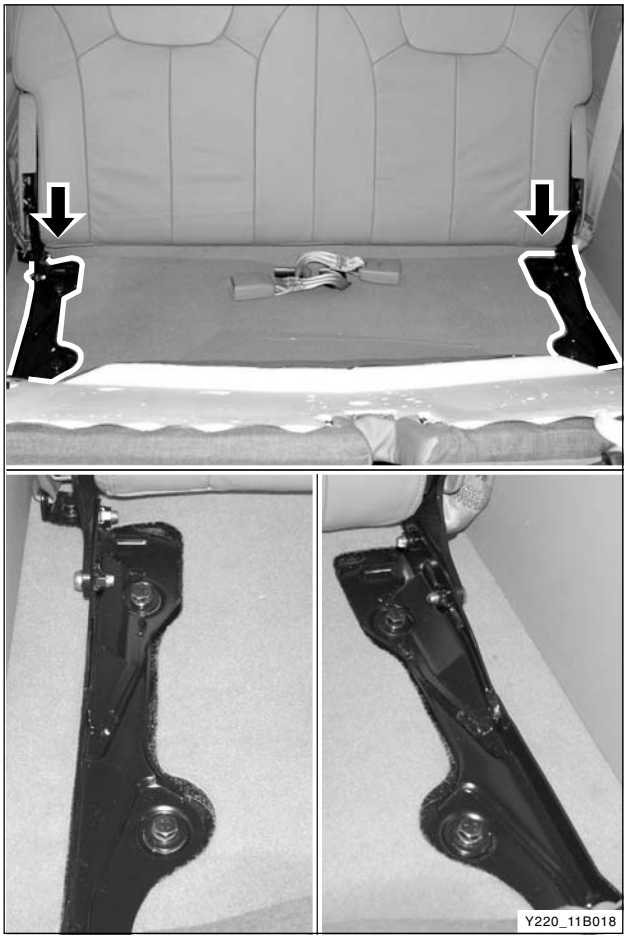


3. Install in the reverse order of removal.



Third Seat

1. Fold down the seatback of third seat.



2. Unscrew the mounting bolts from both sides and remove the seat.

   Installation Notice

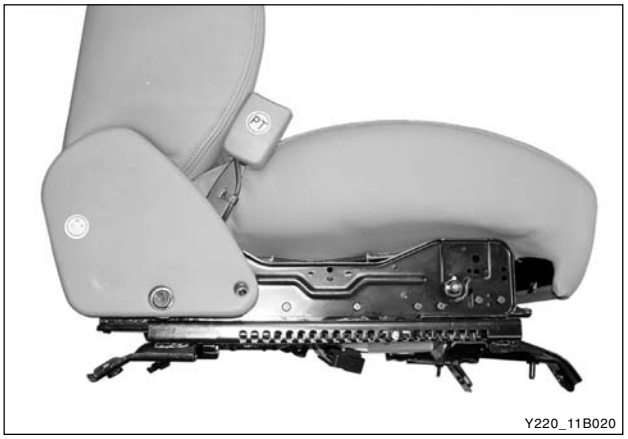
Tightening torque	35 ~ 55 Nm

3. Install in the reverse order of removal.

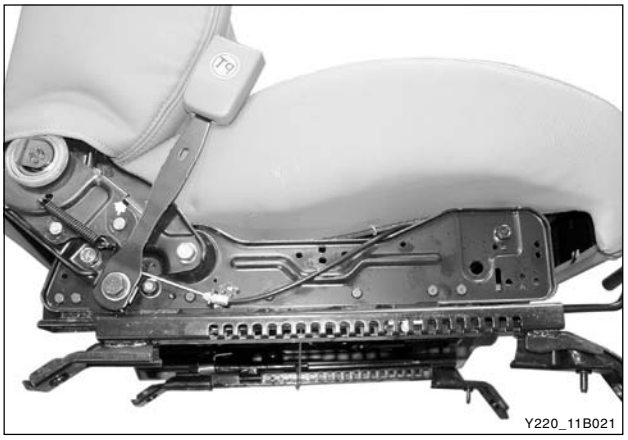
DISASSEMBLY AND REASSEMBLY

Driver's Seat

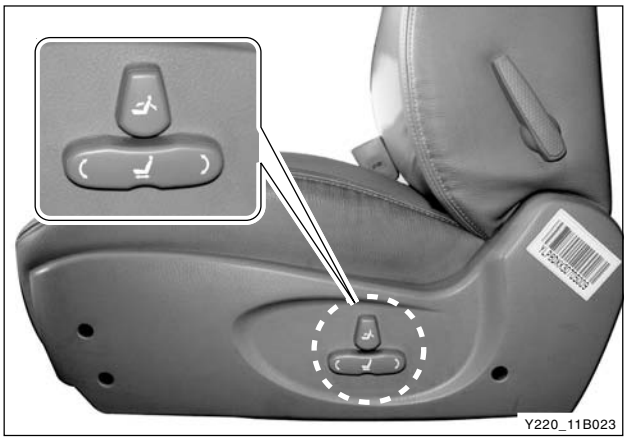
1. Unscrew the mounting screw on seat side cover (right side) and remove the cover.



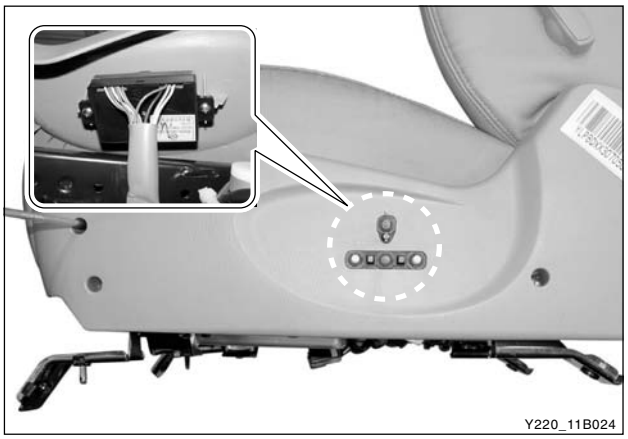
2. Remove the buckle assembly and the seat rail mounting bolts.



3. Remove the seat control lever from the seat side cover (left side).



4. Unscrew the mounting screws on the seat side cover (left side) and remove the cover. Unscrew the mounting screws and remove the seat control lever switch assembly.



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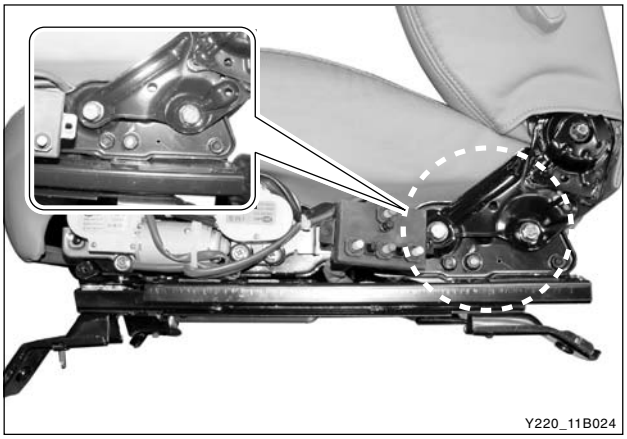
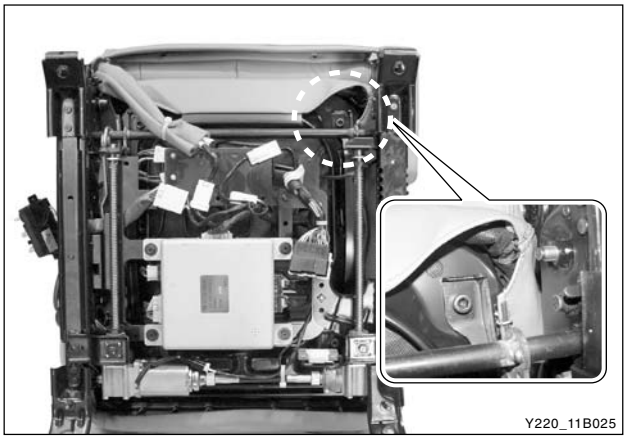


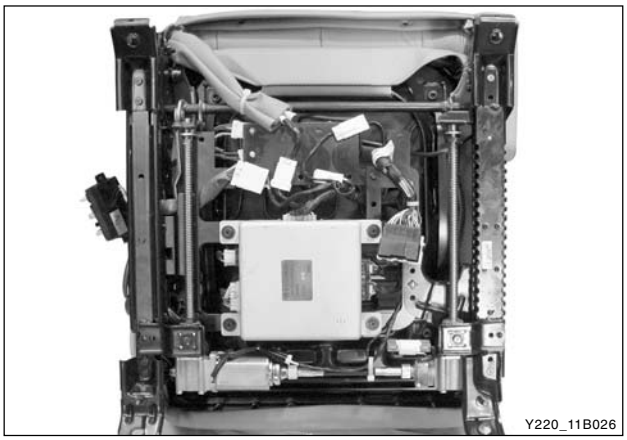
5. Unscrew the seat rail mounting bolts (10 mm x 2).

Installation Notice

Tightening torque	41.2 ~ 49 Nm



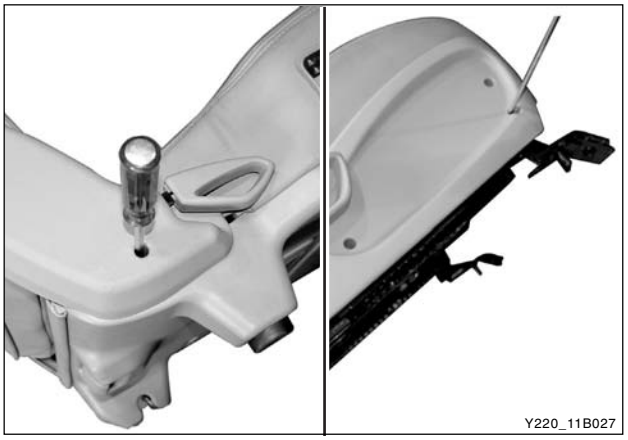
6. Unscrew the mounting bolts (hexagon, 4) in the seat rail and remove the seat cushion. If the seat warmer is installed, disconnect its connector.



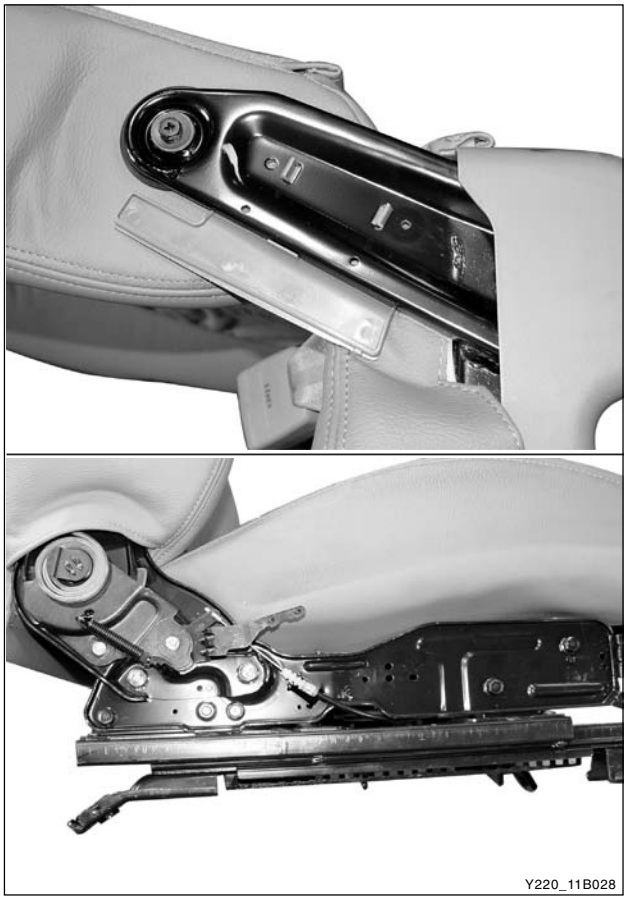
7. Install in the reverse order of removal.

Passenger' Seat/Second Seat (for 1 Person)

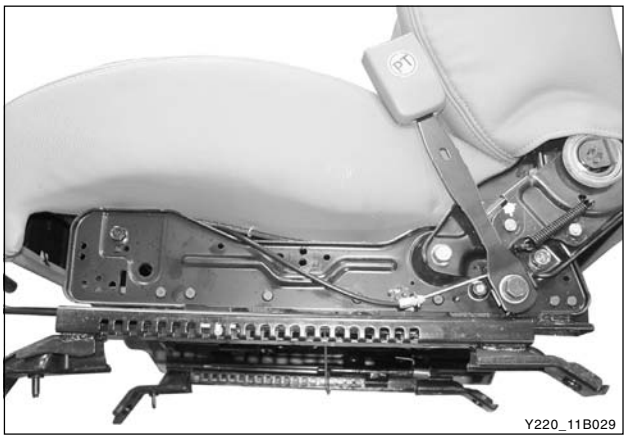
1. Remove the lever (right side) and cover.



2. Unscrew the seat cushion mounting bolts. Disconnect the seat cable from the second seat (for 1 person).



3. Remove the seat cover (left side). Unscrew the seat belt buckle mounting bolts and the seat rail mounting bolts and remove the seat cushion.



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4. Unscrew the mounting bolts and remove the seat rail.

Installation Notice

Tightening torque	41.2 ~ 49 Nm

5. Install in the reverse order of removal.

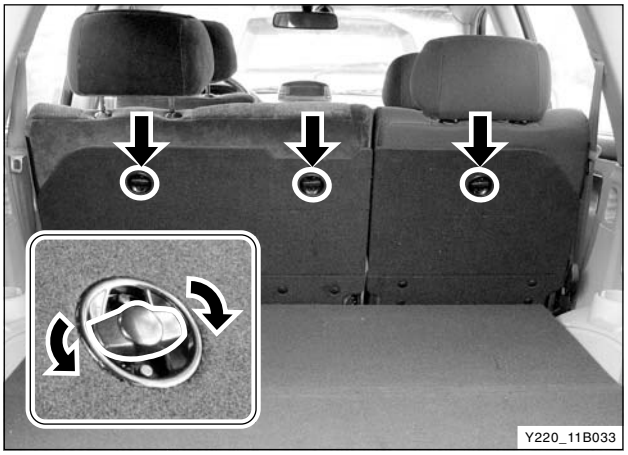
Second Seat (for 2 Persons)

1. Remove both side covers and the knob. Unscrew the cushion mounting bolts and remove the seat and cushion.

2. Install in the reverse order of removal.

Third Seat

1. Open the cover at seatback and unscrew the luggage pin mounting screw.



2. Unscrew the seat mounting bolts and the cushion mounting bolts from both sides and remove the seat.
3. Remove the side cover and remove the seat cushion.

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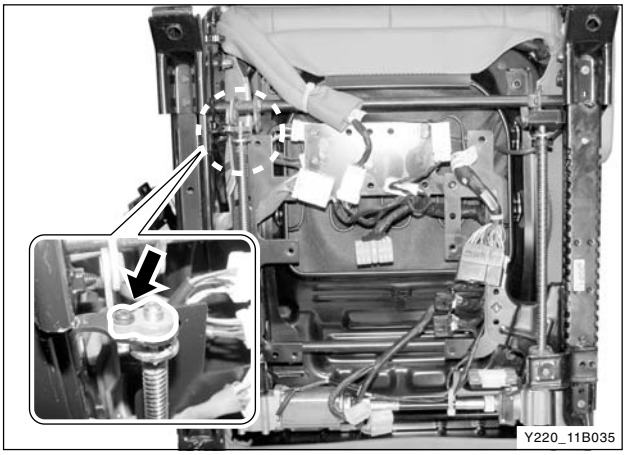
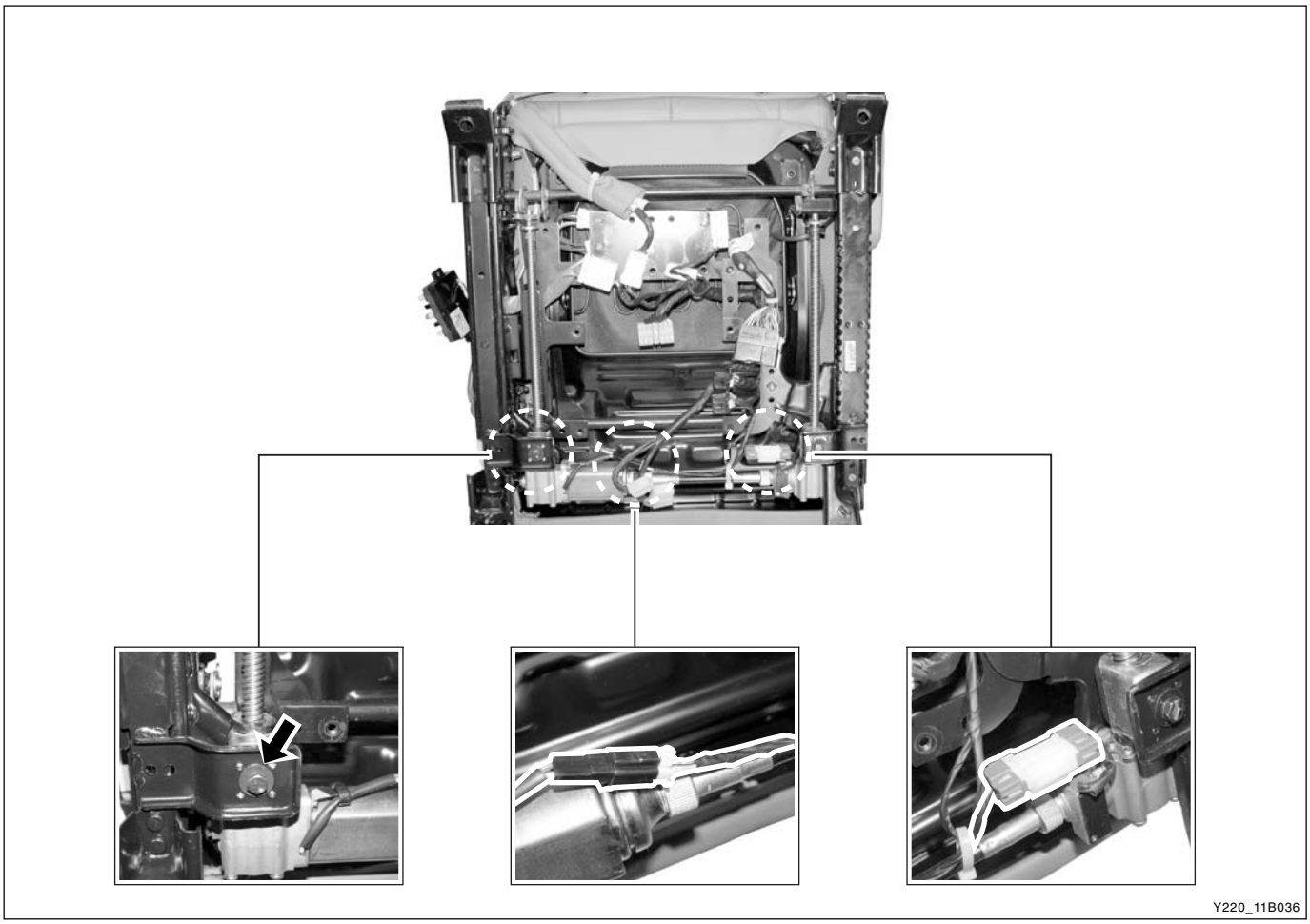
Replacing the seat motor from the seat guide rail

1. Unscrew the screw (arrow) and set aside the rotating wire.



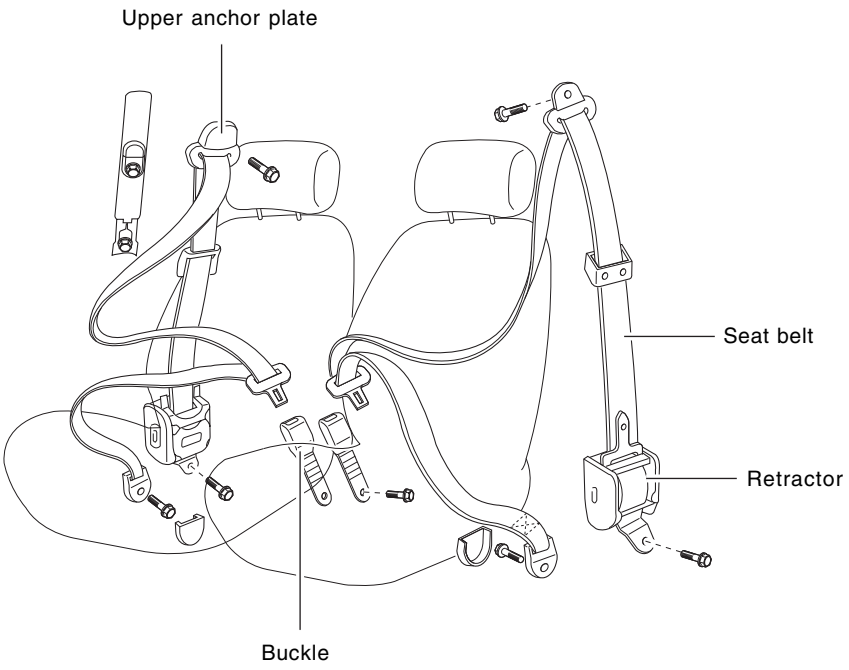
2. Unscrew the mounting nuts and remove the motor assembly.



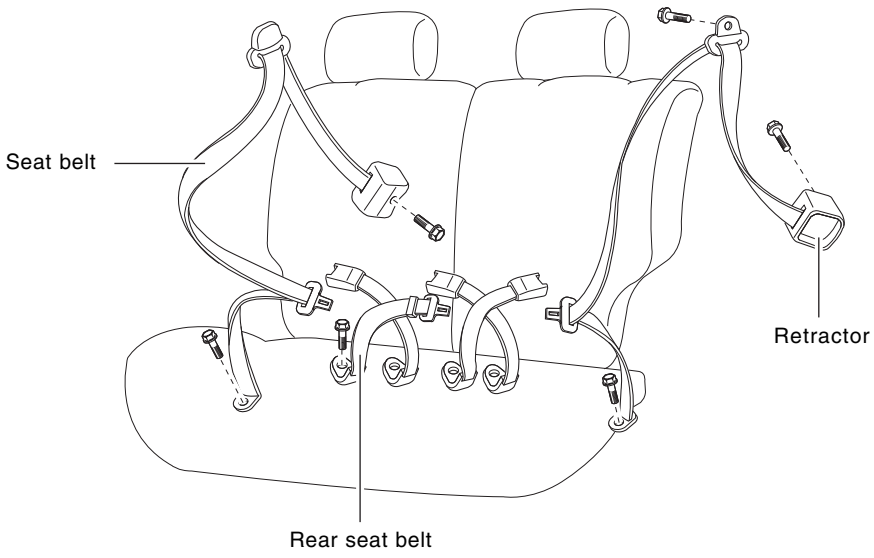
SEAT BELT

LAYOUT

[Front seat belt]



[Rear seat belt]



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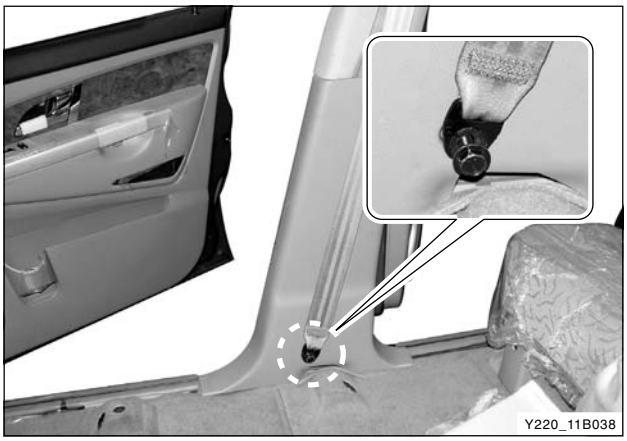
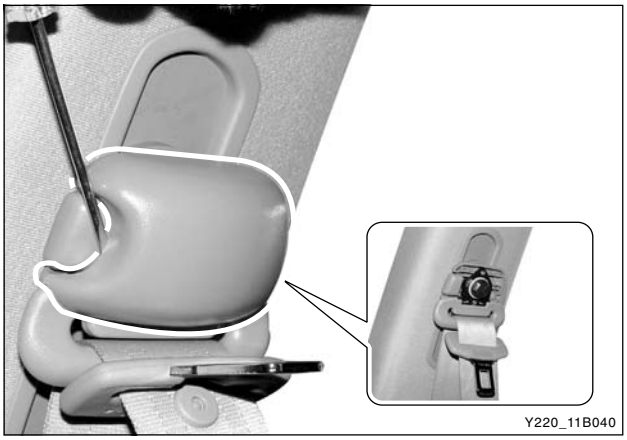
REMOVAL AND INSTALLATION

Front Seat Belt



1. Remove the front seat (driver's and passenger's).
2. Remove the lower mounting bolt.

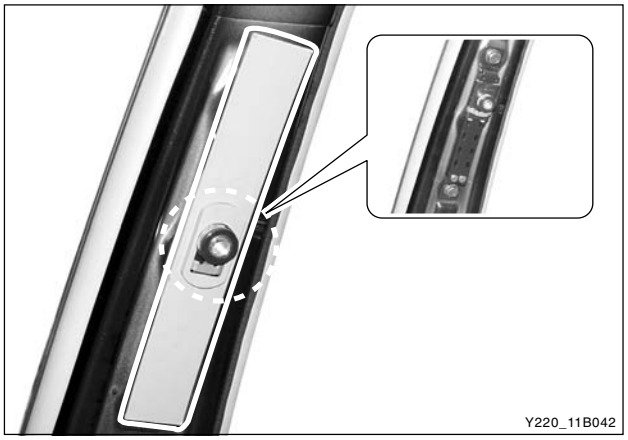
3. Remove the lower B-pillar trim.



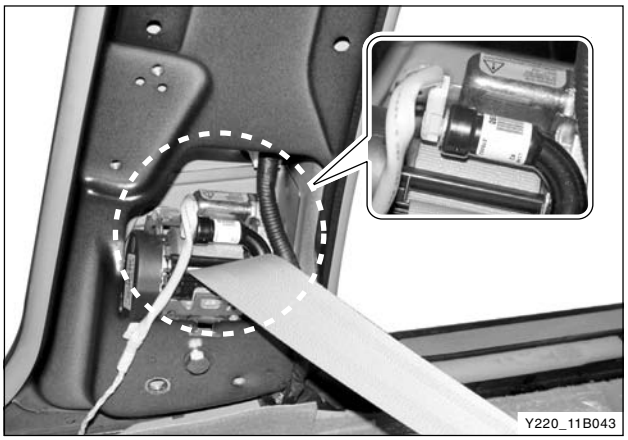
4. Remove the bolt cap and upper mounting bolt.

5. Take off the upper part of seat belt and remove the upper B-pillar trim.

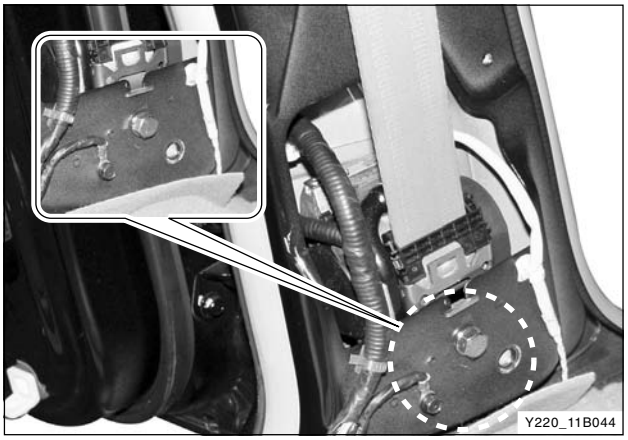
5-1. Unscrew the height adjuster bracket bolt and remove the adjuster assembly.



6. Disconnect the retractor connector from the front seat belt.



7. Unscrew the retractor mounting bolts and remove the seat belt assembly.



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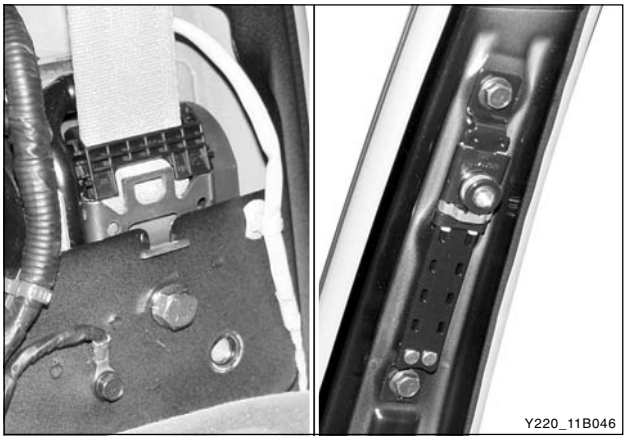
8. Remove the seat protection cover. Unscrew the mounting bolts and remove the seat belt buckle assembly.

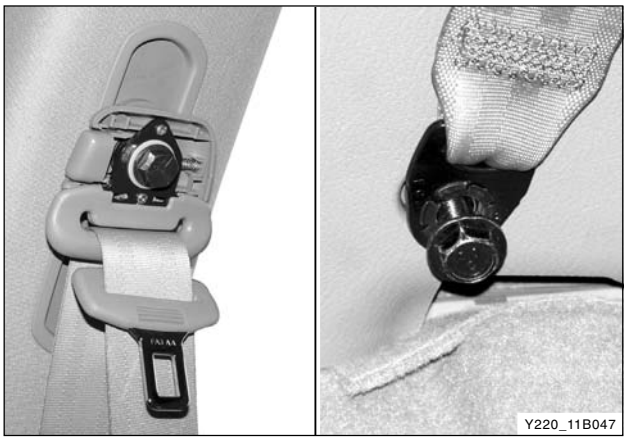


Installation

- Install in the reverse order of removal

1. Adjuster and retractor.

Adjustor mounting bolt	30 ~ 40 Nm
Retractor mounting bolt	30 ~ 45 Nm

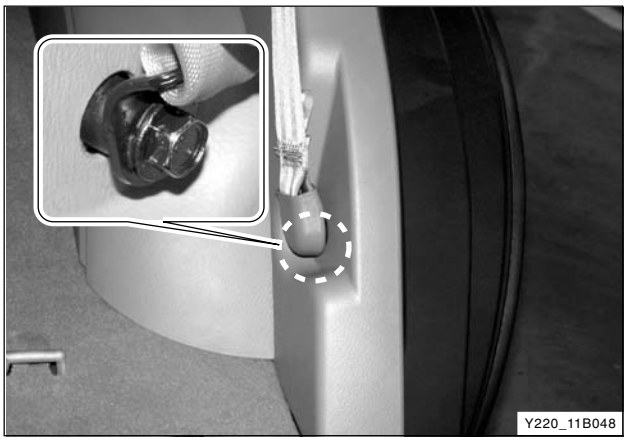


2. Seat belt

Upper mounting bolt	30 ~ 45 Nm
Lower mounting bolt	30 ~ 45 Nm

3. Seat belt buckle

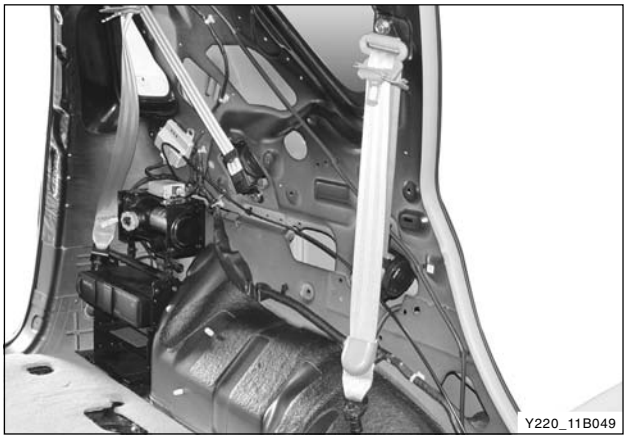
Tightening torque	30 ~ 45 Nm



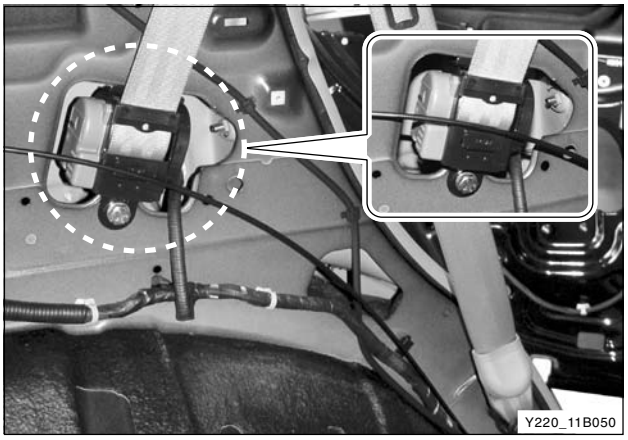
Second Seat Belt

1. Detach the cap and remove the lower mounting bolt.

2. Remove the lower quarter trim and upper quarter trim.

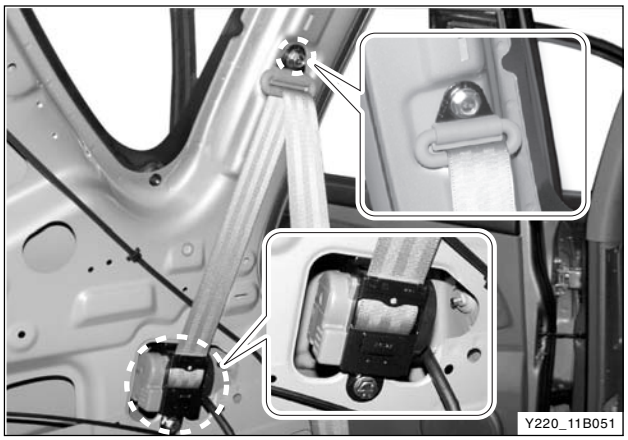


3. Remove the seat belt upper mounting bolt.
4. Unscrew the belt retractor bolts and screws and remove the seat belt assembly.



5. Install in the reverse order of removal.
   1) Belt retractor mounting bolt and upper mounting bolt

Retractor mounting bolt	30 ~ 45 Nm
Upper mounting bolt	30 ~ 45 Nm



   2) Lower mounting bolt

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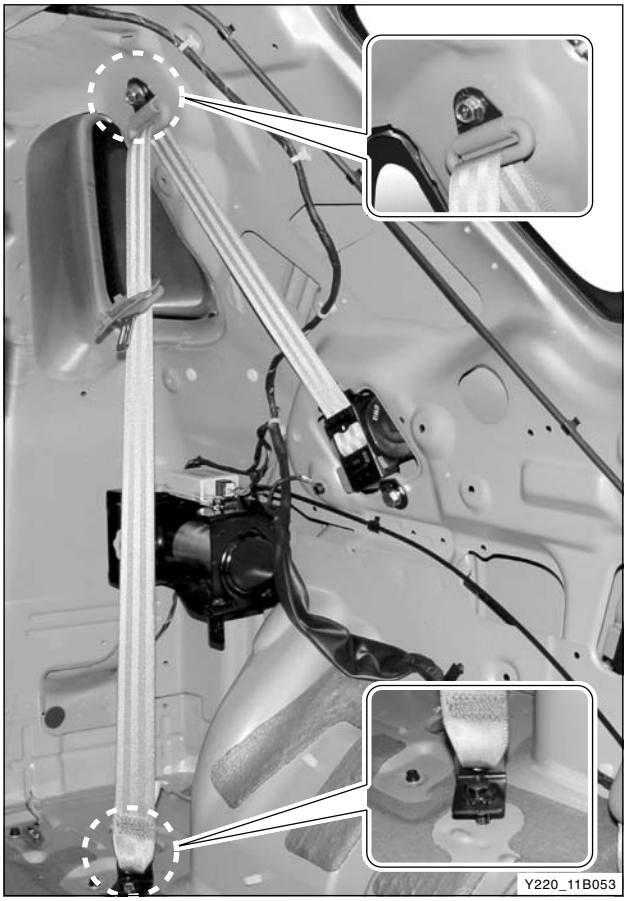
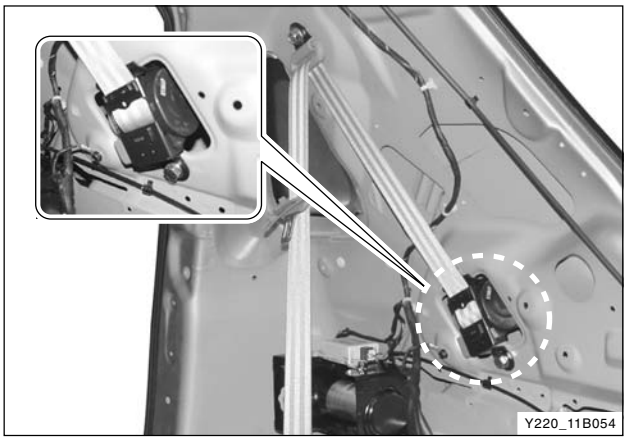


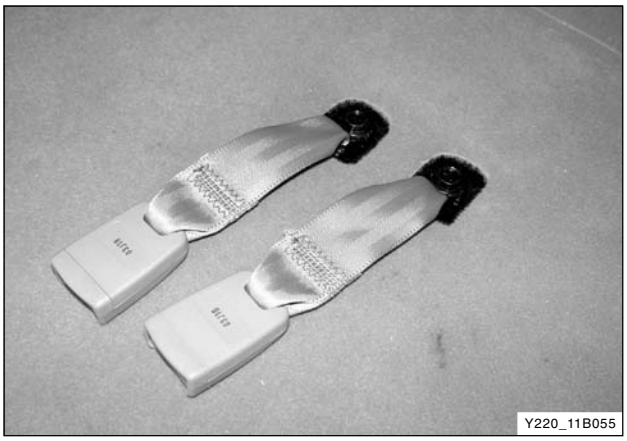
Third Seat Belt

※ Preceding works: 1. Removal of seat
2. Removal of lower and upper B-pillar

1. Remove the upper/lower mounting bolts.



2. Unscrew the retractor bolt and remove the seat belt assembly.



3. Remove the third seat. Unscrew the mounting bolts and remove the seat belt.
4. Install in the reverse order of removal.

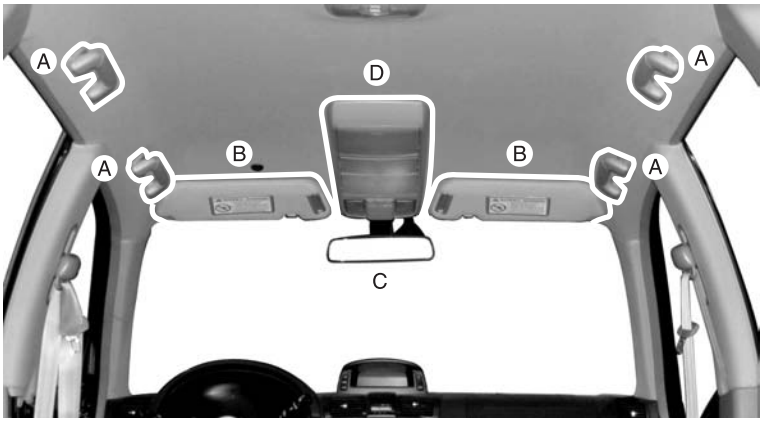
Upper bolt (1)	30 ~ 45 Nm
Lower bolt (2)	30 ~ 45 Nm
Retractor bolt (3)	30 ~ 45 Nm

CONVENIENT DEVICES

COMPONENTS LOCATOR

Hand grip (A)

Sun visor (B)



Overhead console (D)

Room mirror (C)

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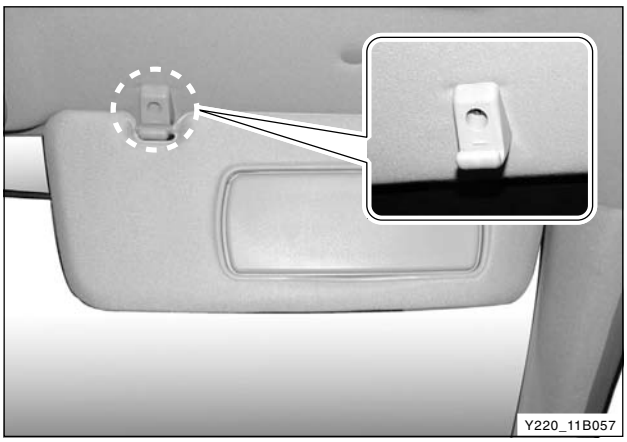
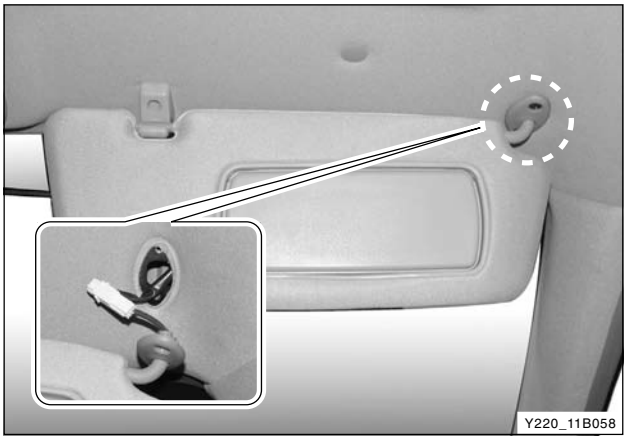
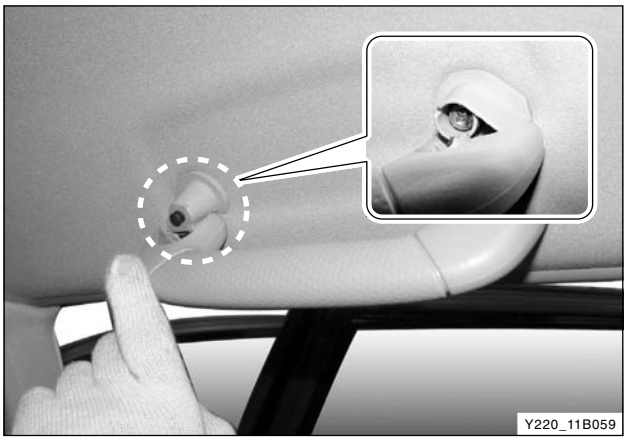


Sun Visor

1. Remove the sun visor hook.

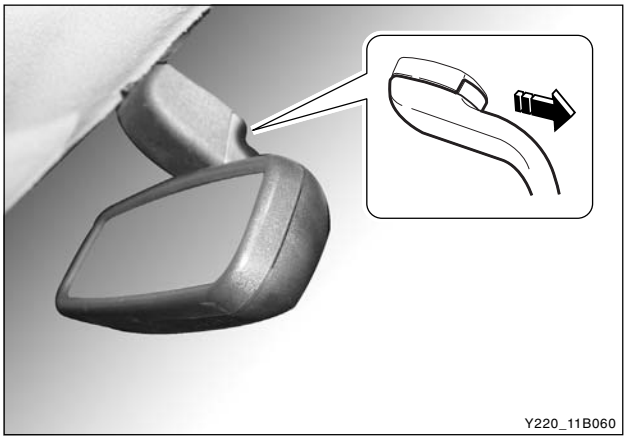


2. Unscrew bracket mounting screw and disconnect the vanity mirror connector.
3. Remove the sun visor.



Hand Grip

1. Flip down the hand grip and unscrew the screws.
2. Remove the hand grip.

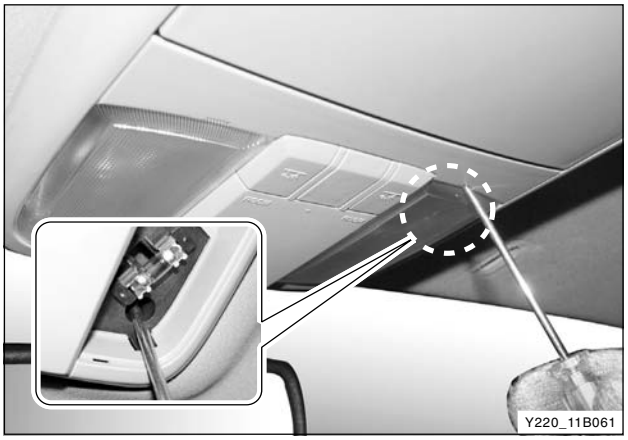


Room Mirror

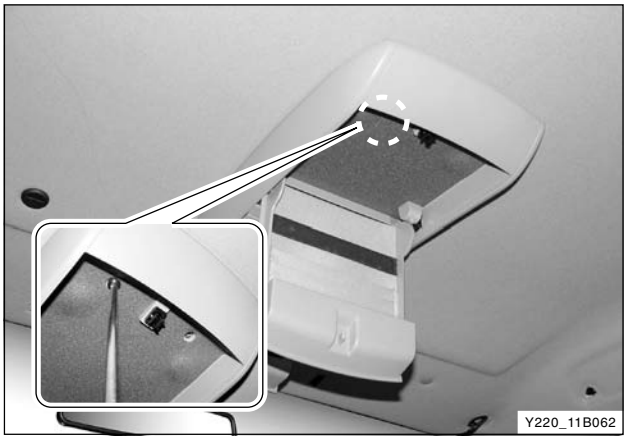
1. Remove the inside rearview mirror by pulling down (arrow direction) it.

Overhead Console

1. Open the front room lamp cover and remove the mounting screw.



2. Open the first console cover and remove the mounting screws.



3. Remove the overhead console.

Notice

Be careful not to lose the hooks.

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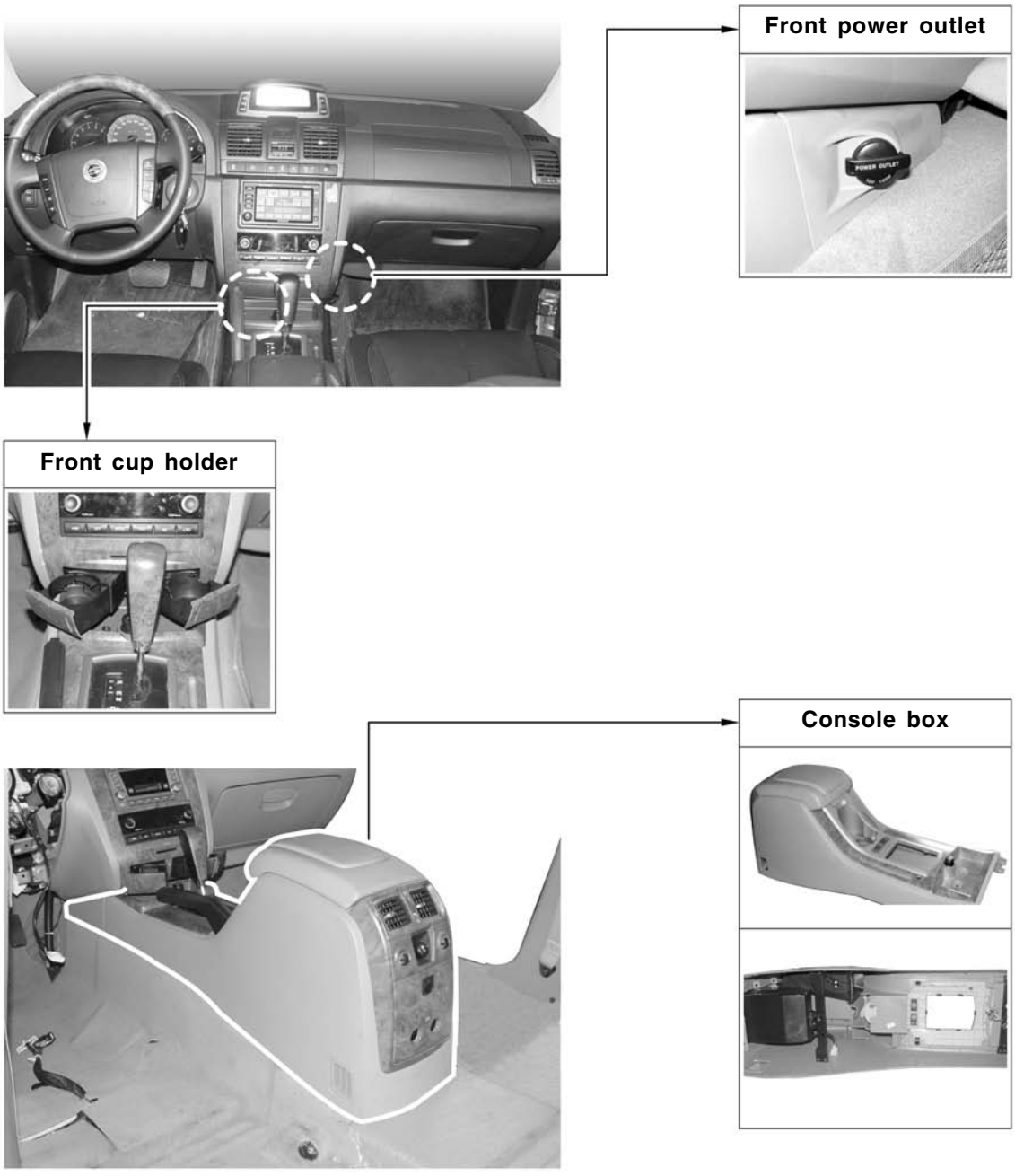
OTHER COMPONENTS



Cup Holder

1. Remove the center fascia lower panel.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2. Unscrew the mounting screws and remove the cup holder from the removed center fascia lower panel.


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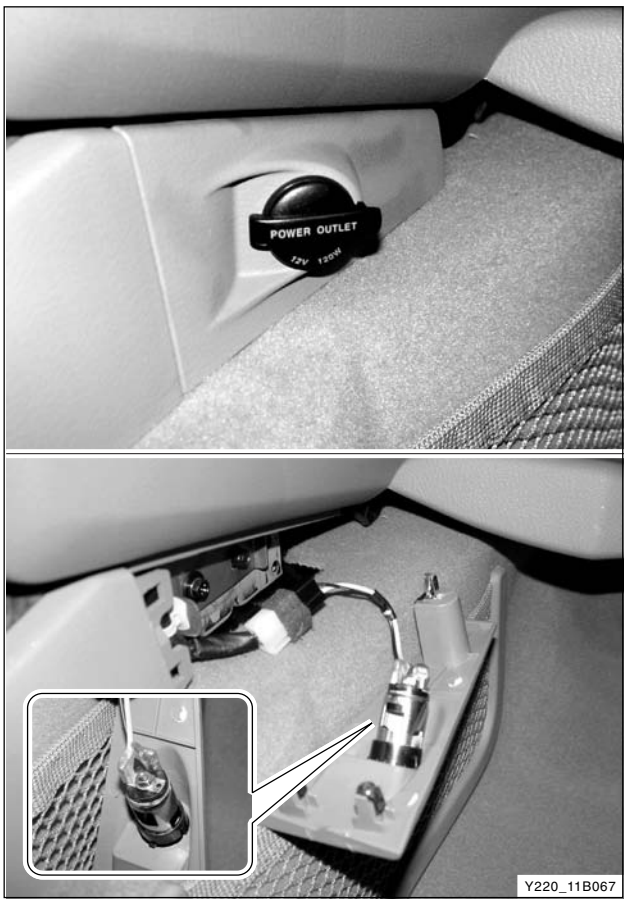
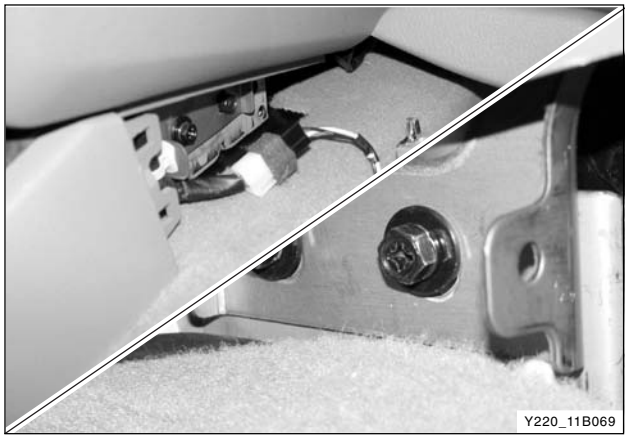


Front Power Outlet

1. Remove the power outlet bracket with cap in front of the front console.
2. Disconnect the power outlet connector and remove the power outlet from the bracket panel.

Center Console

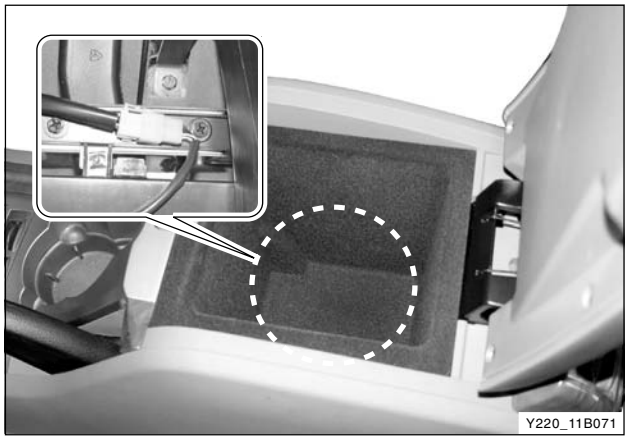
1. Remove the front panel in front of the center console.



2. Disconnect the power outlet connector and remove the console mounting bolts.

3. Remove the mounting screws in front of the cigarette lighter in front console.

4. Remove the console tray from the rear console, disconnect the inner connector and unscrew the mounting bolt.



5. Remove the air ventilation duct from the rear console side panel.

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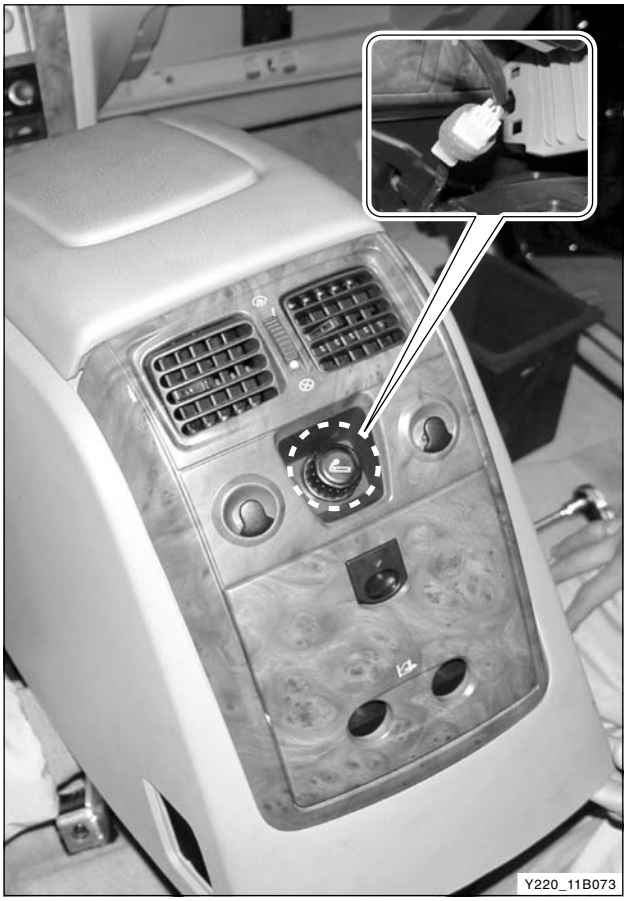


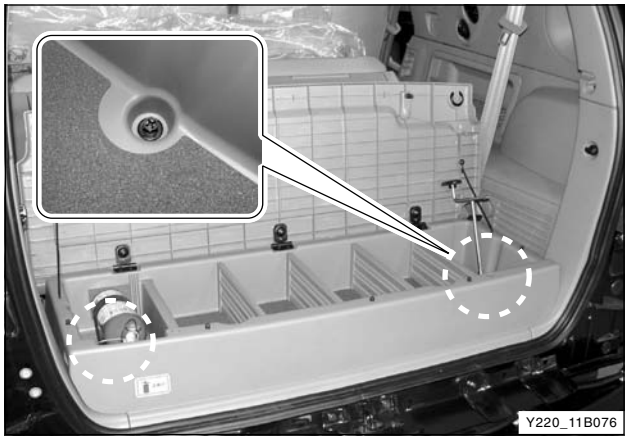
6. Place the parking brake lever to a proper position and lift up the console assembly to disconnect the cigarette lighter connector and seat warmer switch connector.

7. Remove the console assembly.
8. Install in the reverse order of removal.

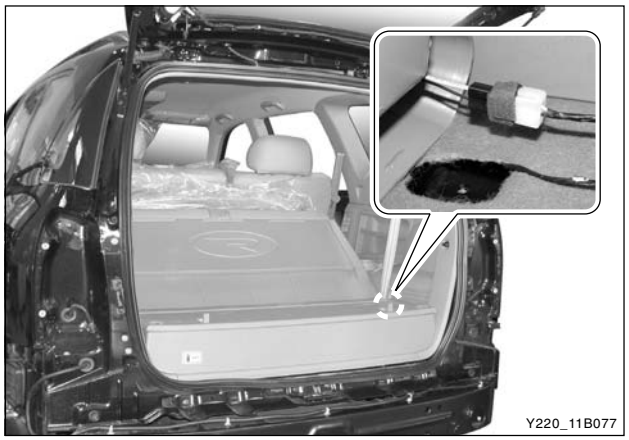
Multi-Purpose Box

1. Open the multi-purpose box cover.

2. Remove the mounting bolts at both sides.



3. Separate the lower section of opening weatherstrip.
4. Disconnect the power outlet connector in the multi-purpose box.



5. Remove the multi-purpose box.

6. Install in the reverse order of removal.

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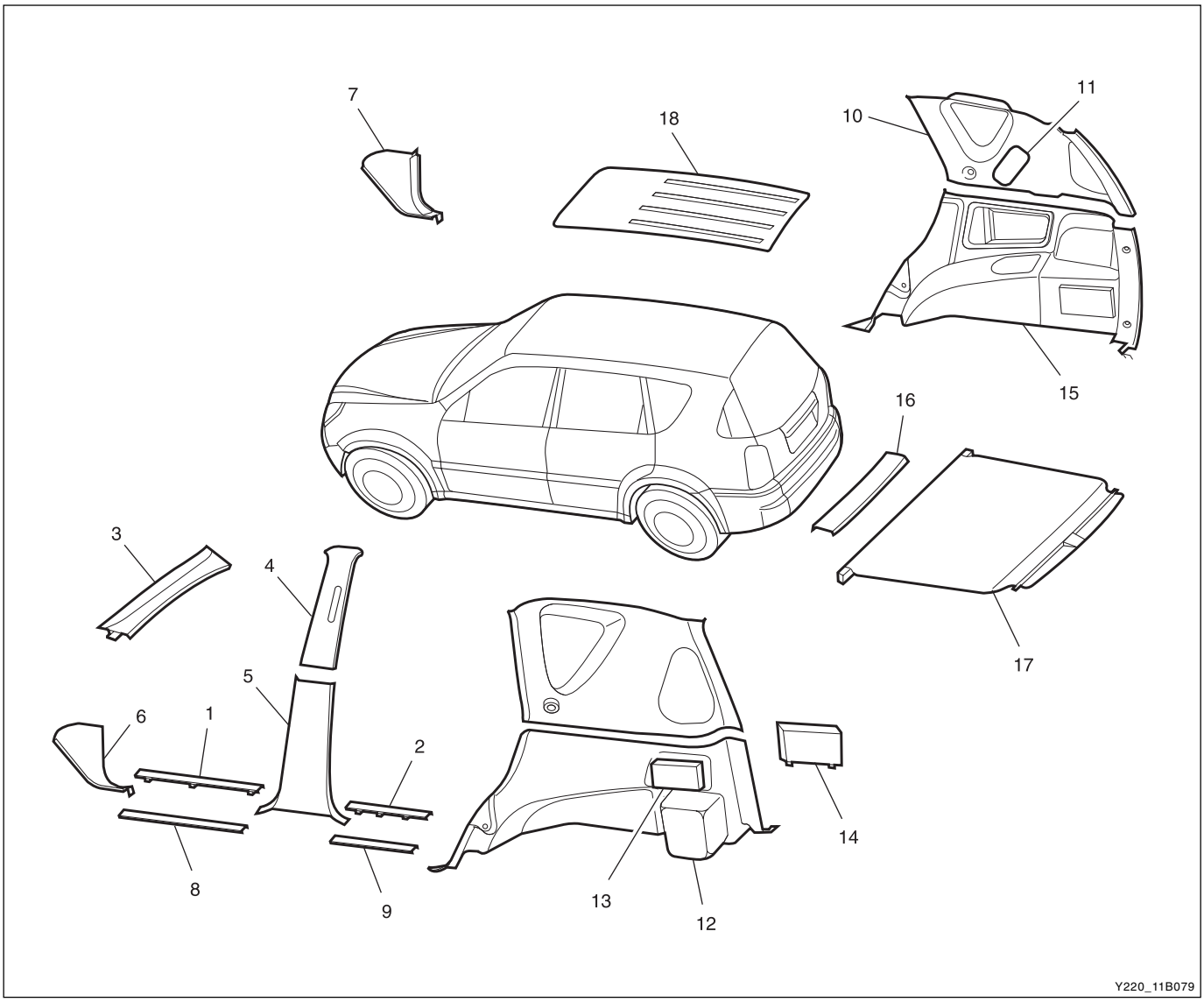
INTERIOR TRIM AND ROOF ASSEMBLY

※ Preceding work: Removal of seat



1. Front door scarf
2. Rear door scarf
3. A-pillar
4. Upper B-pillar
5. Lower B-pillar
6. Side cowl
7. Side cowl
8. Front outside step
9. Rear outside step
10. Upper quarter trim
11. Rear air conditioner fascia
12. Lower quarter trim
13. Jack cover
14. Lower quarter trim cover
15. Lower quarter trim
16. Rear transverse trim
17. Luggage compartment cover
18. Roof panel

REMOVAL AND INSTALLATION OF TRIM/ROOF

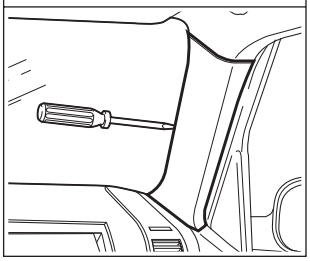
Note

Install in the reverse order of removal.

A-pillar trim

Upper B-pillar trim

Lower B-pillar trim



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A-Pillar Trim

Remove the A-pillar trim (4).

- Pull out the key from the panel key hole.

B-Pillar Trim

1. Unscrew the upper and lower mounting bolts from seat belt.
2. Remove the lower B-pillar trim.
3. Pull in the upper B-pillar trim and remove the trim cover from the panel. Remove the trim.

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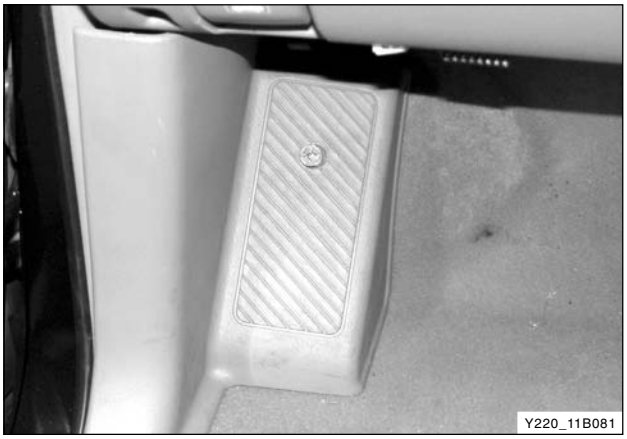


Side Cowl Trim

1. Unscrew the side cowl trim mounting bolts at step and door side.
2. Remove both side cowl trims.

Roof (Headlining)

1. Remove both sun visors.
2. Remove both upper trims.
3. Remove all hand grips.
4. Remove the room lamp, sun roof and door opening weatherstrip.
5. Unscrew the clip bolts and remove the headlining.

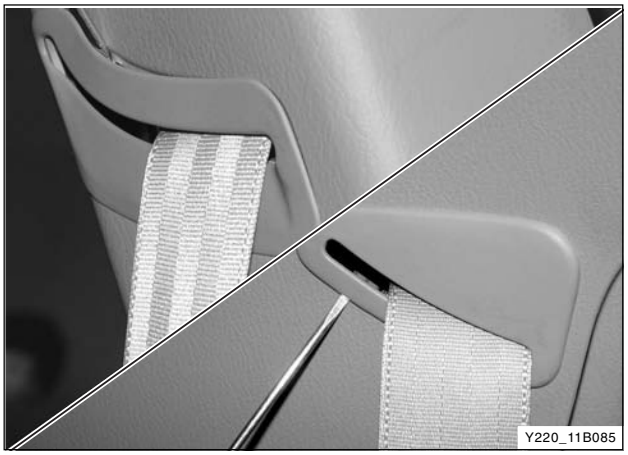
Lower Quarter Trim

1. Unscrew the lower mounting bolts for rear seat belt and third seat belt.

2. Unscrew the mounting screws and remove the lower quarter trim.

Upper Quarter Trim

1. Remove the upper seat belt cover for second and third seat belts.



2. Unscrew the mounting screws and remove the upper quarter trim.

Note

- ***For the rear air conditioner equipped vehicle, disconnect the air conditioner switch connector.***

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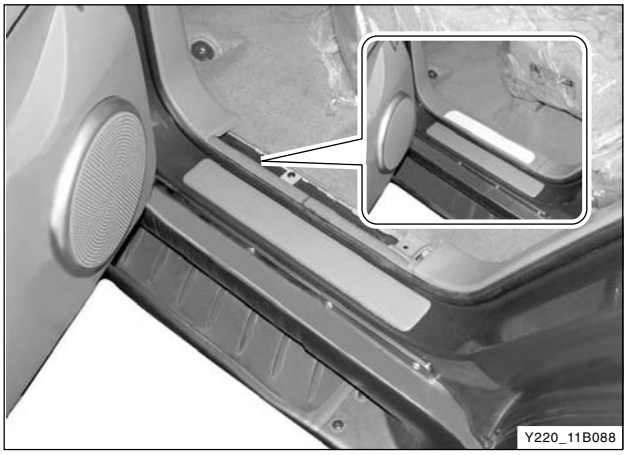
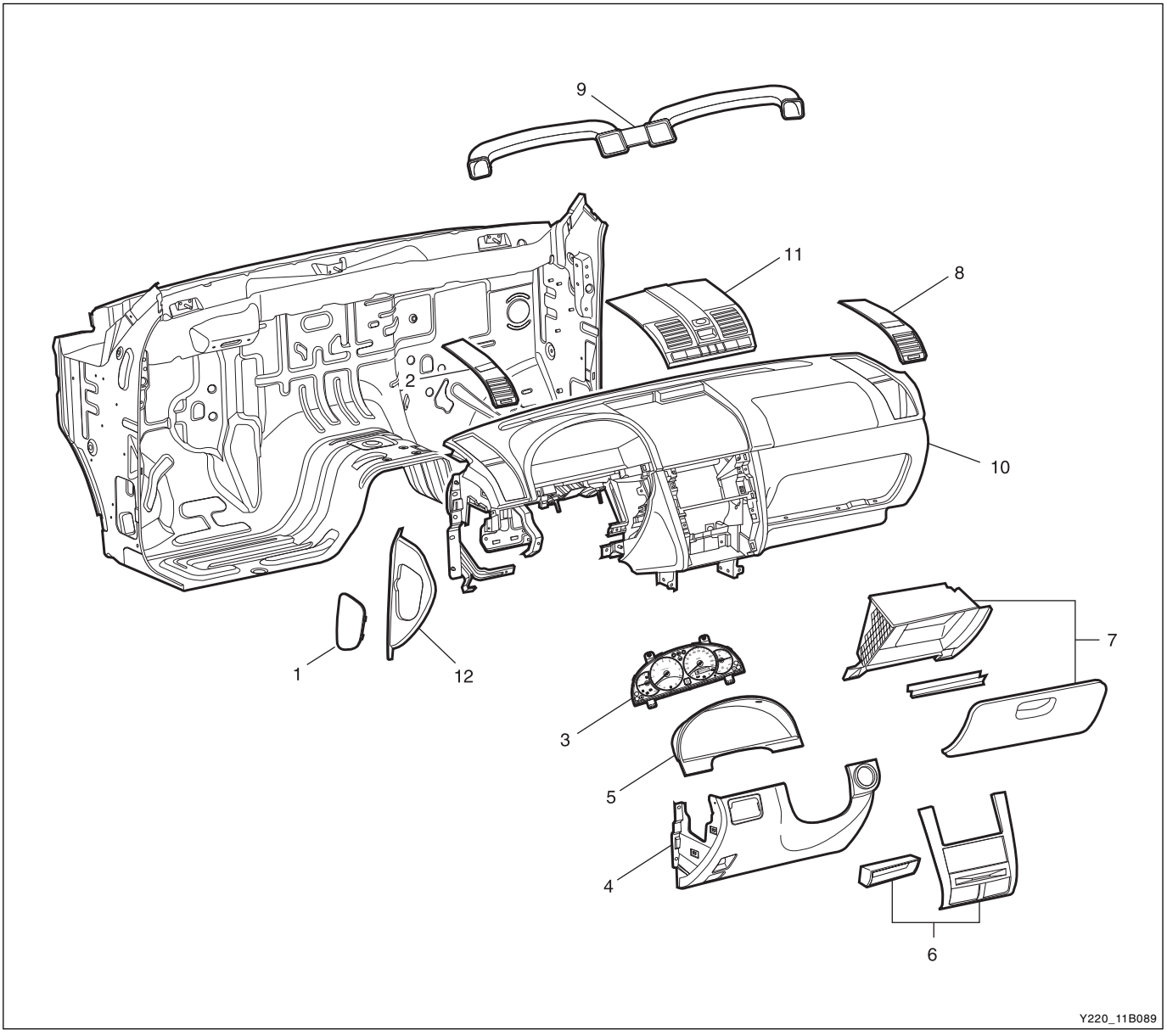


Door Scarf Trim

1. Remove the front and rear door scarf trims with a proper tool with flat and thin blade.

INSTRUMENT ASSEMBLY

※ Preceding works: 1. Disconnection of negative battery cable
2. Removal of front seat



1. Interior fuse box cover
2. Side fascia panel
3. Instrument cluster
4. Instrument lower main panel
5. Cluster fascia panel
6. Center fascia lower panel
7. Glove box
8. Side fascia panel
9. Duct
10. Instrument assembly
11. Center fascia upper panel
12. Side cover

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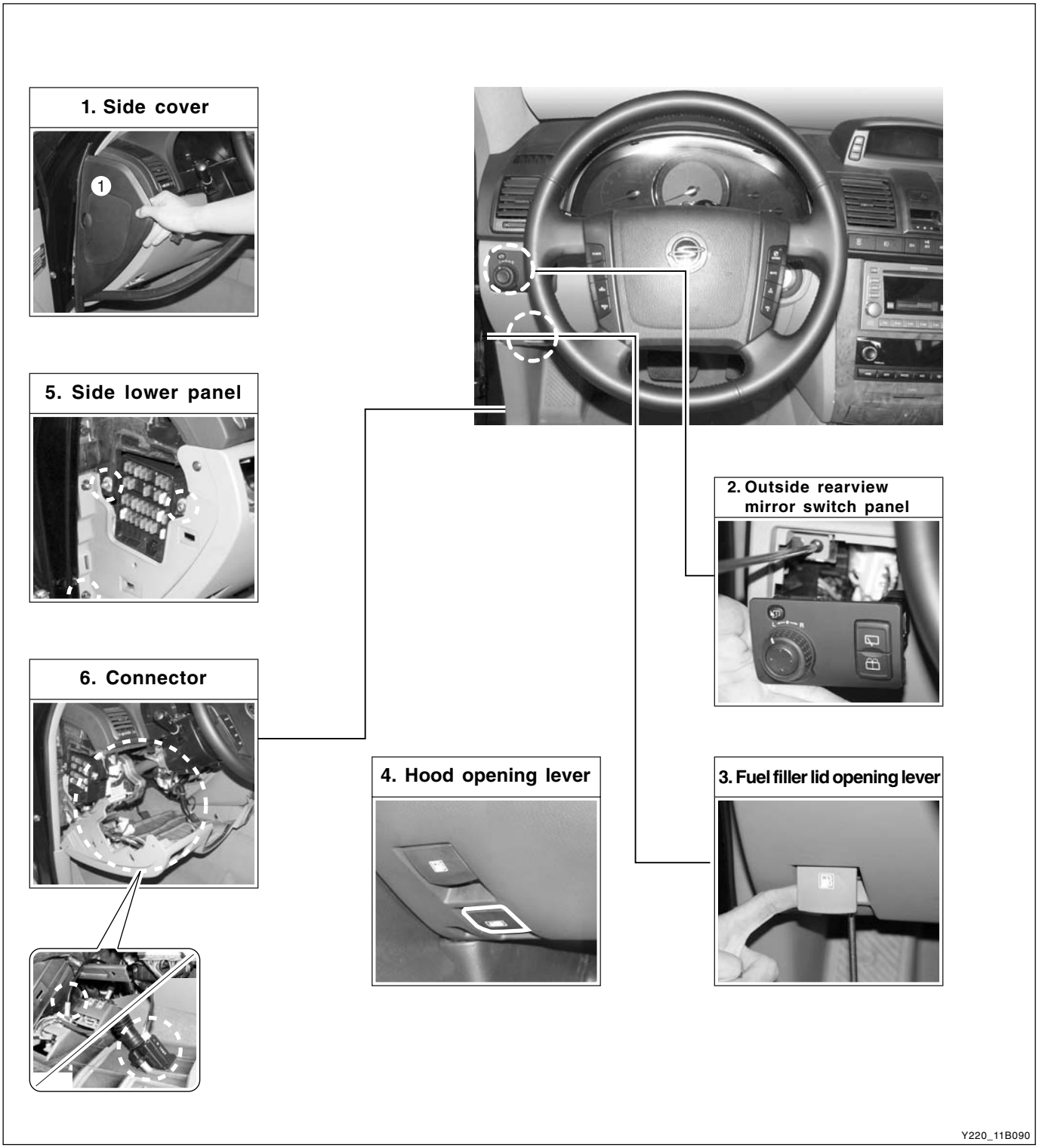
Removal and Installation



1. Remove the lower instrument panel at driver side.

1-1. Remove the interior fuse box cover, outside rearview mirror switch panel, fuel filler lid opening lever and hood opening lever.

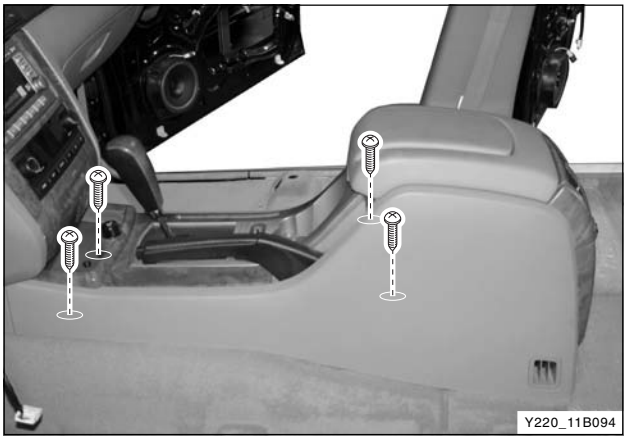
1-2. Unscrew the screws, disconnect the connectors and remove the lower panel.

2. Remove the lower panel under the steering wheel.

3. Disconnect the steering column connectors and the vacuum hose. Unscrew the bolts and remove the steering column shaft assembly.

4. Remove the center fascia panel, audio (1) and air conditioner controller assembly (2).

5. Remove the center console.



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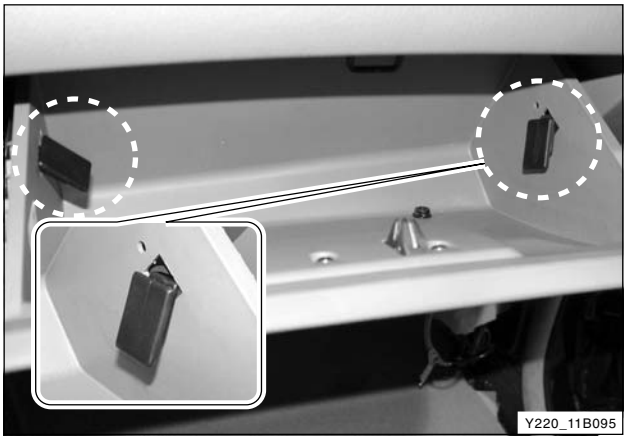
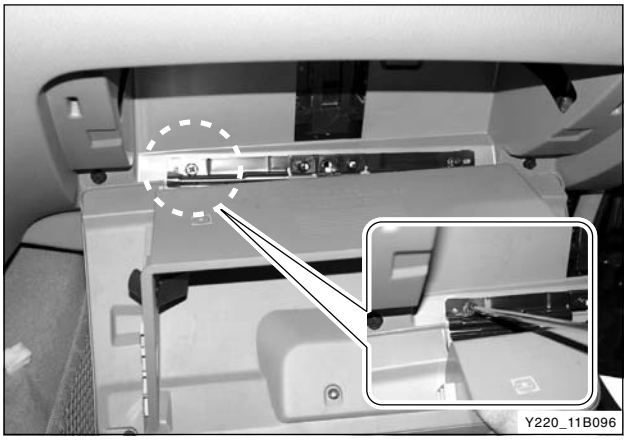


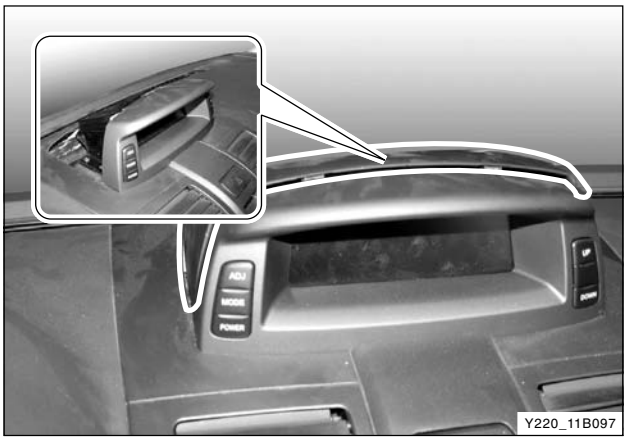
6. Remove the glove box.
   6-1. Un hook both ends of glove box from instrument panel.

Notice

To prevent damage to hook, do not apply excessive force.



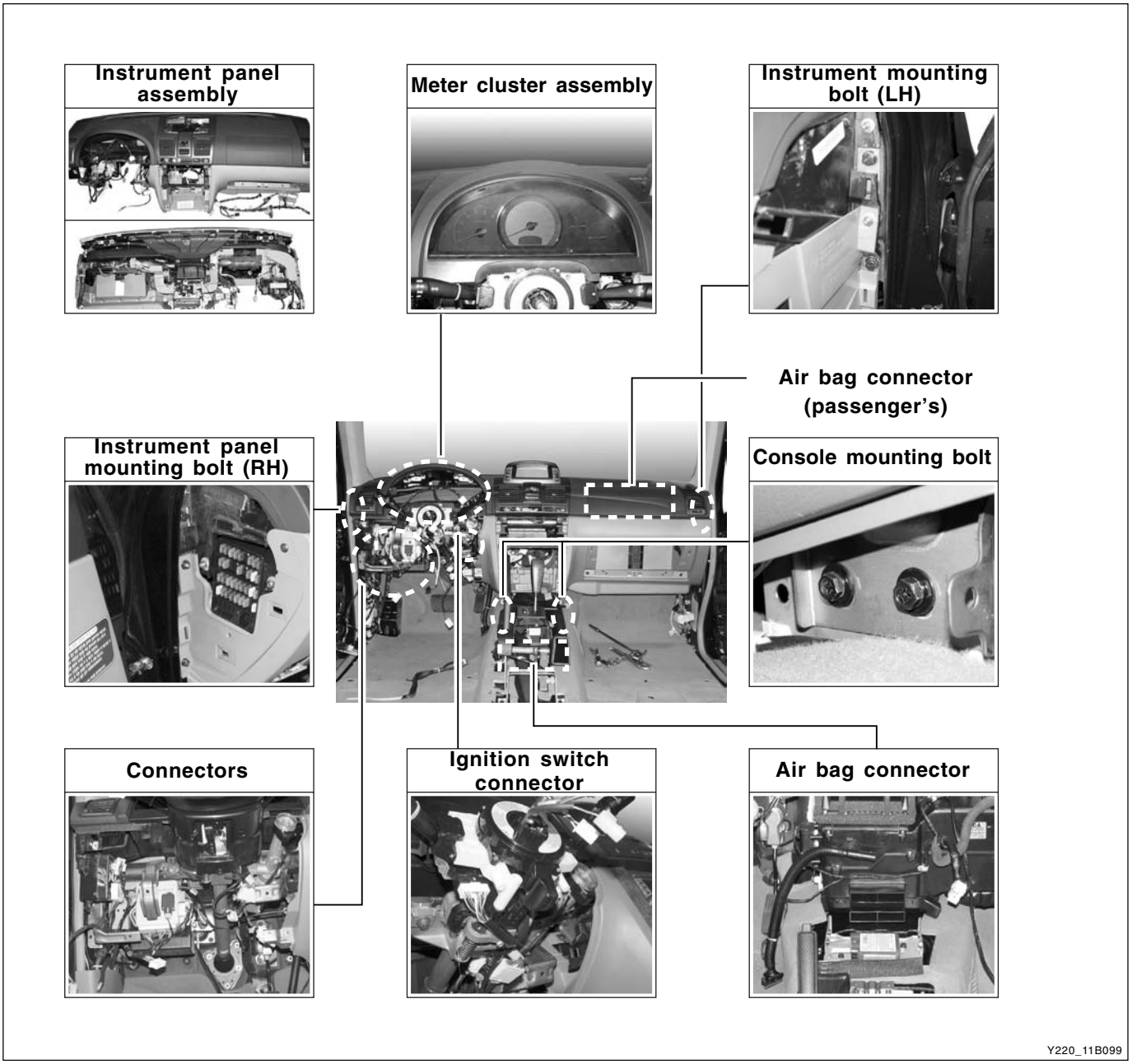
6-2. Fully open the glove box, unscrew the bracket mounting screws and remove the glove box.



7. Remove the multi-meter.
   7-1. Remove the top cover of multi-meter and unscrew the mounting screws.
   7-2. Disconnect the connector and remove the multi-meter.

8. Remove the switches from the instrument panel.

9. Remove the instrument panel.



Removal and Installation

1. Remove the meter cluster assembly.
2. Remove the multi-meter.
3. Disconnect the instrument connectors at both sides and the main harness connector connected to center console.
4. Unscrew the mounting bolts and nuts and remove the instrument panel assembly.
5. Install in the reverse order of removal.

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SECTION 11C

EXTERIOR

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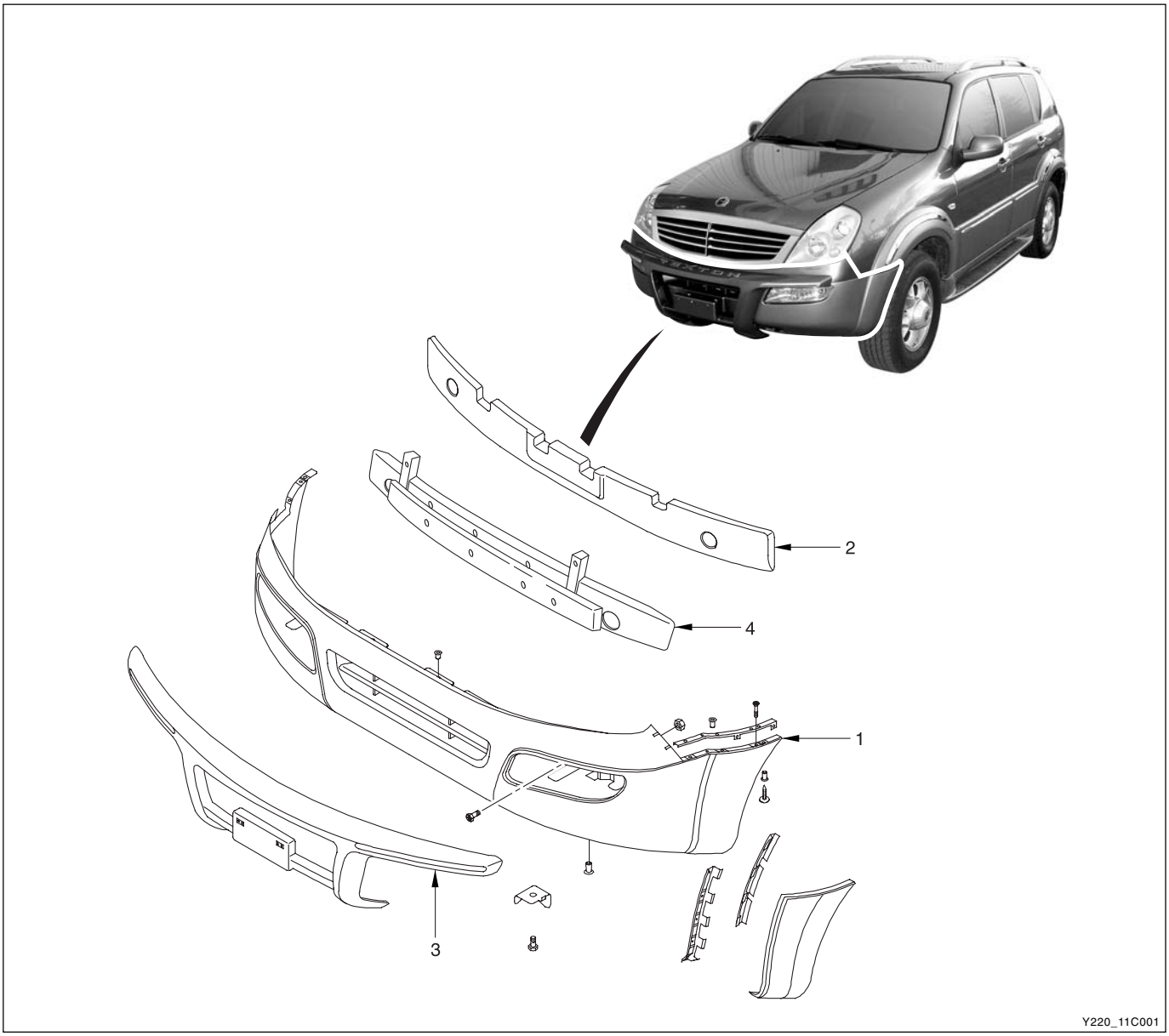
COMPONENTS LOCATOR

FRONT BUMPER



1. Front bumper fascia assembly
2. Energy absorber
3. Front nudge bar assembly
4. Bumper

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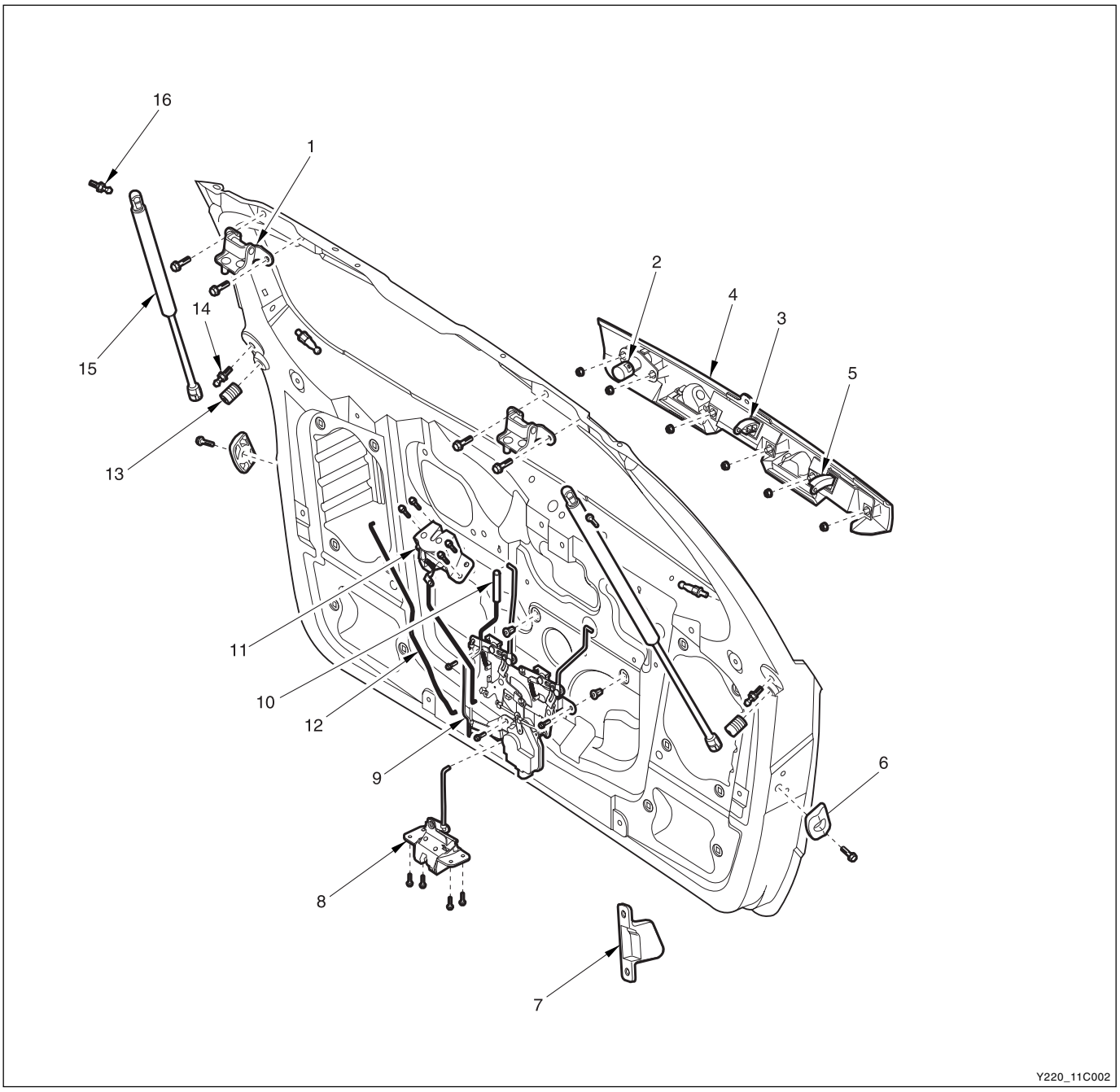
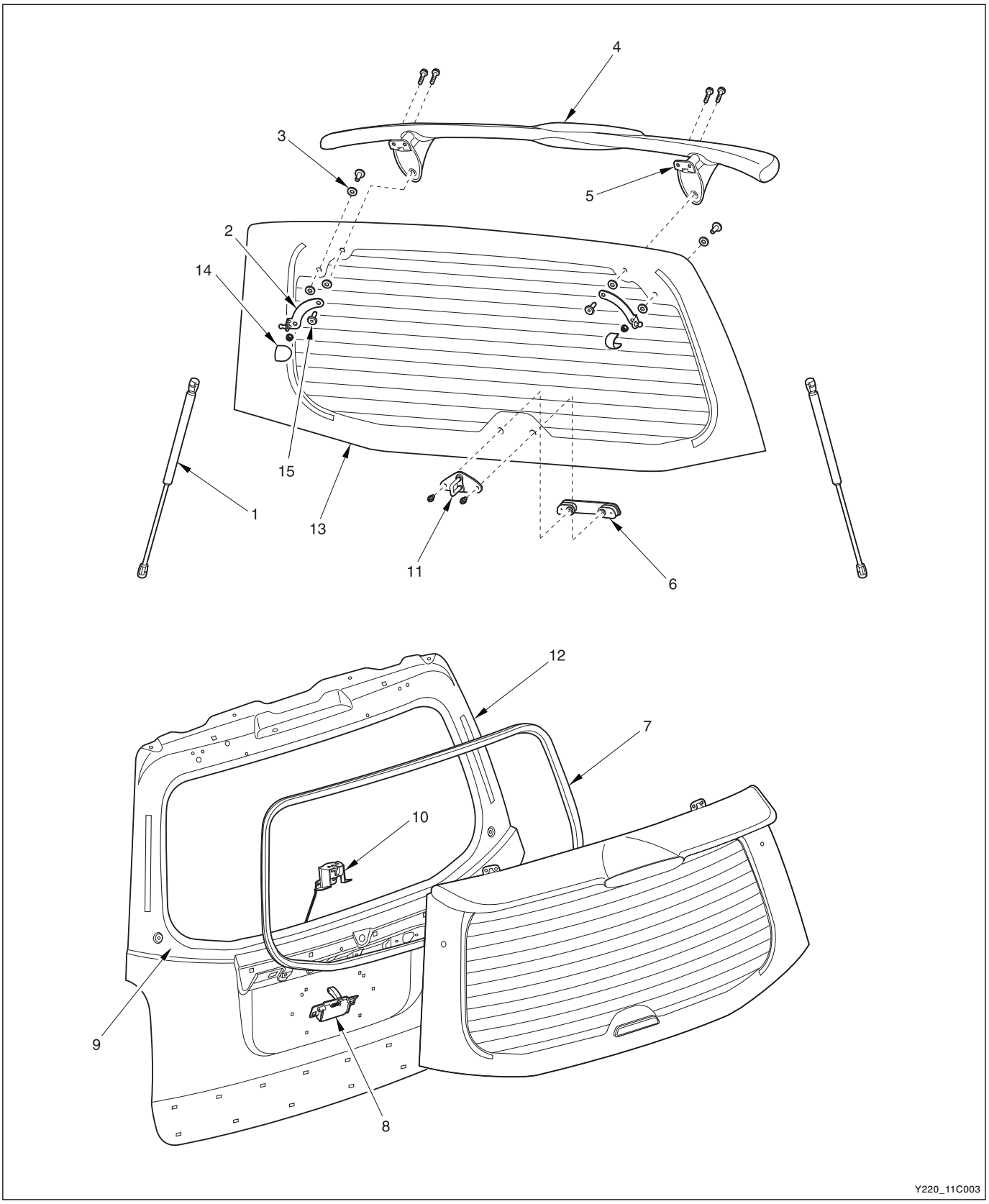
TAILGATE



1. Hinge
2. Key
3. Tailgate release handle
4. Garnish
5. Glass handle
6. Guide bumper
7. Body side garnish bumper
8. Tailgate latch
9. Door safety rod box crank
10. Safety knob
11. Glass opening latch
12. Key rod
13. Overslam bumper
14. Ball stud
15. Lifter
16. Ball stud

FLIP-UP SYSTEM



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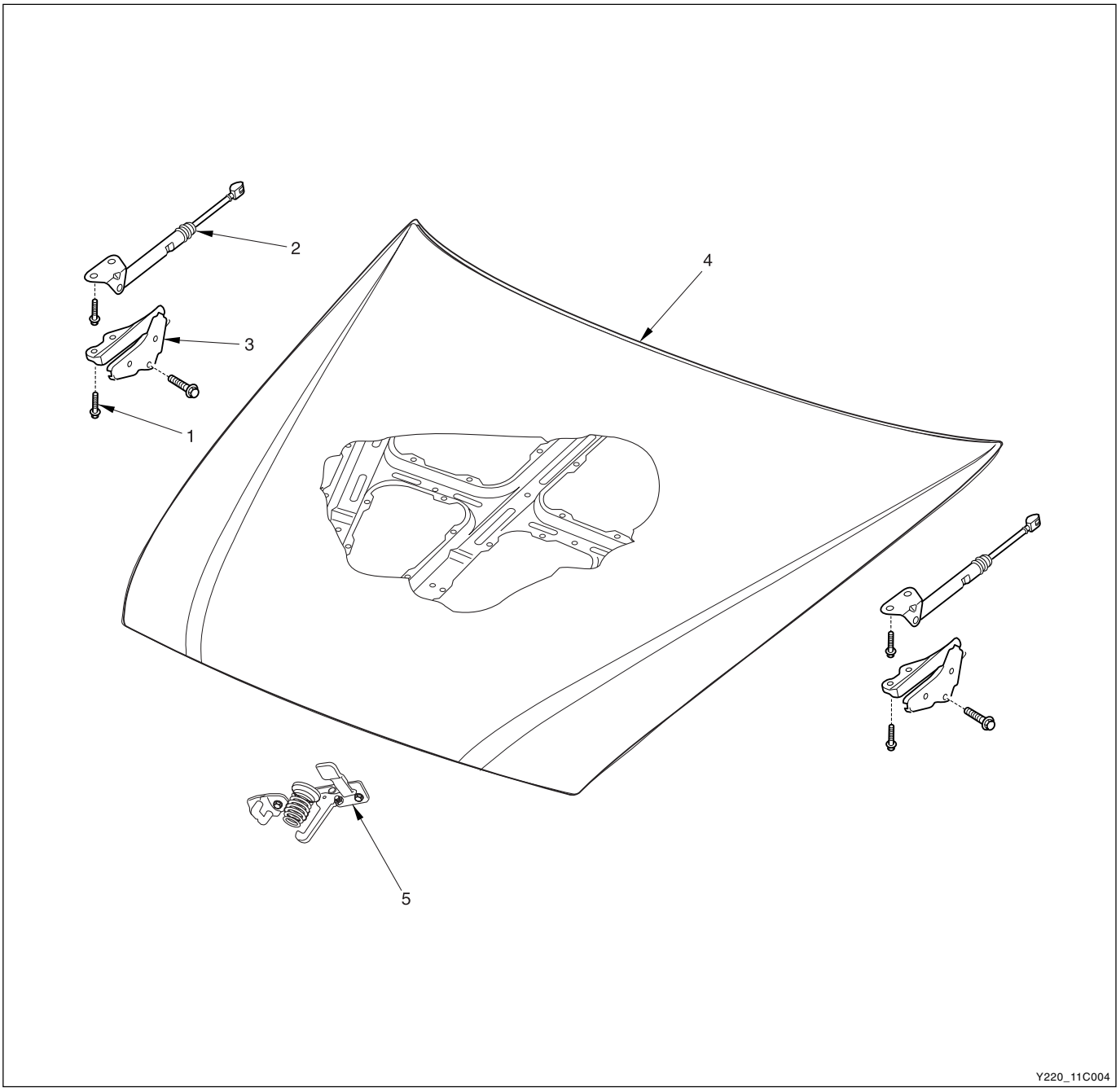
1. Glass lifter
2. Ball stud bracket
3. Bolt pad
4. Spoiler
5. Glass opening hinge
6. Glass handle
7. Glass weatherstrip
8. Glass release handle
9. Overslam bumper
10. Latch
11. Striker
12. Panel
13. Glass (Standard: 4.0 t, Flip-up: 5.0 t)
14. Ball stud bracket cover
15. Bolt

HOOD



1. Bolt
2. Shock absorber
3. Hood hinge
4. Hood
5. Hood striker

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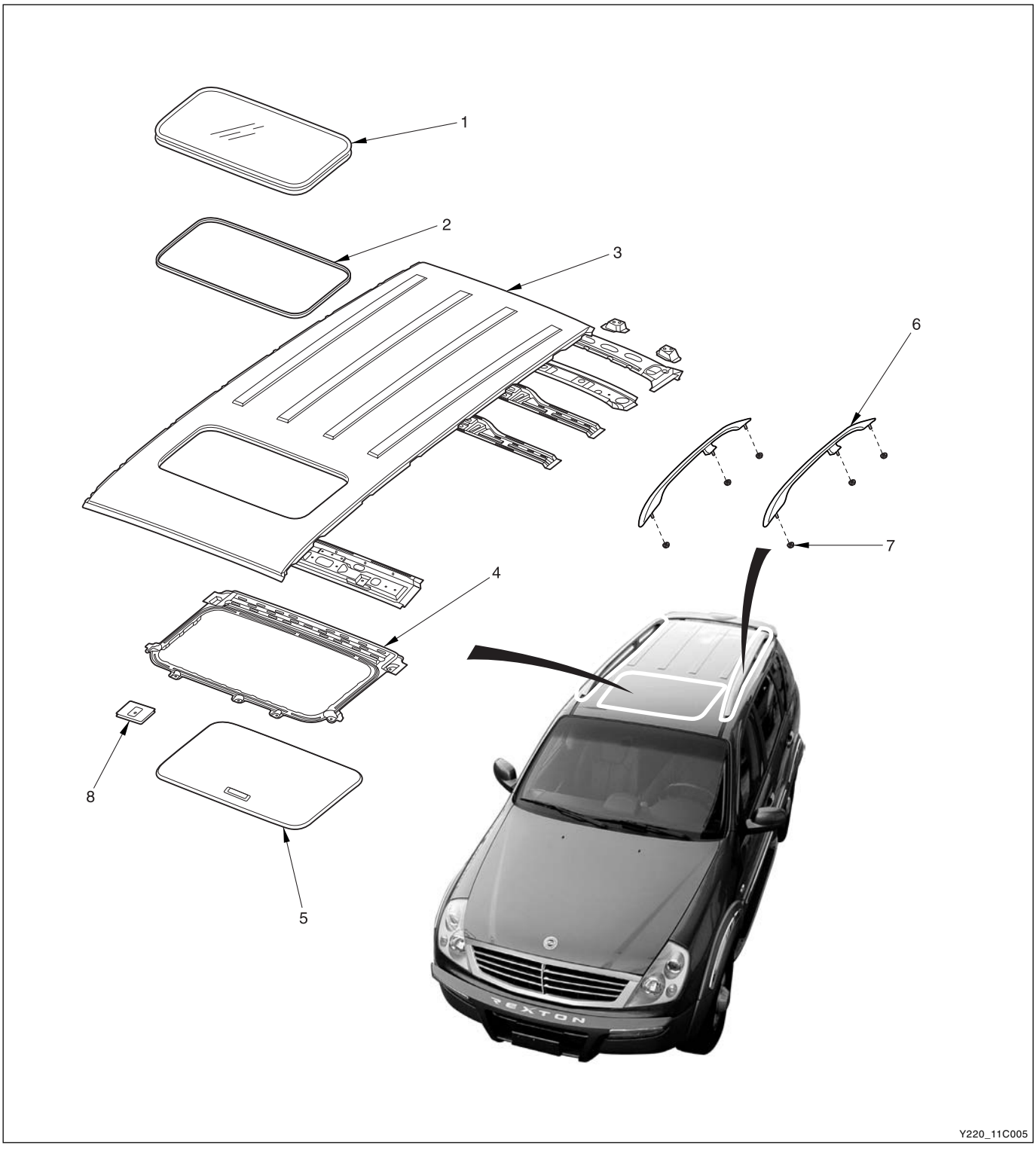
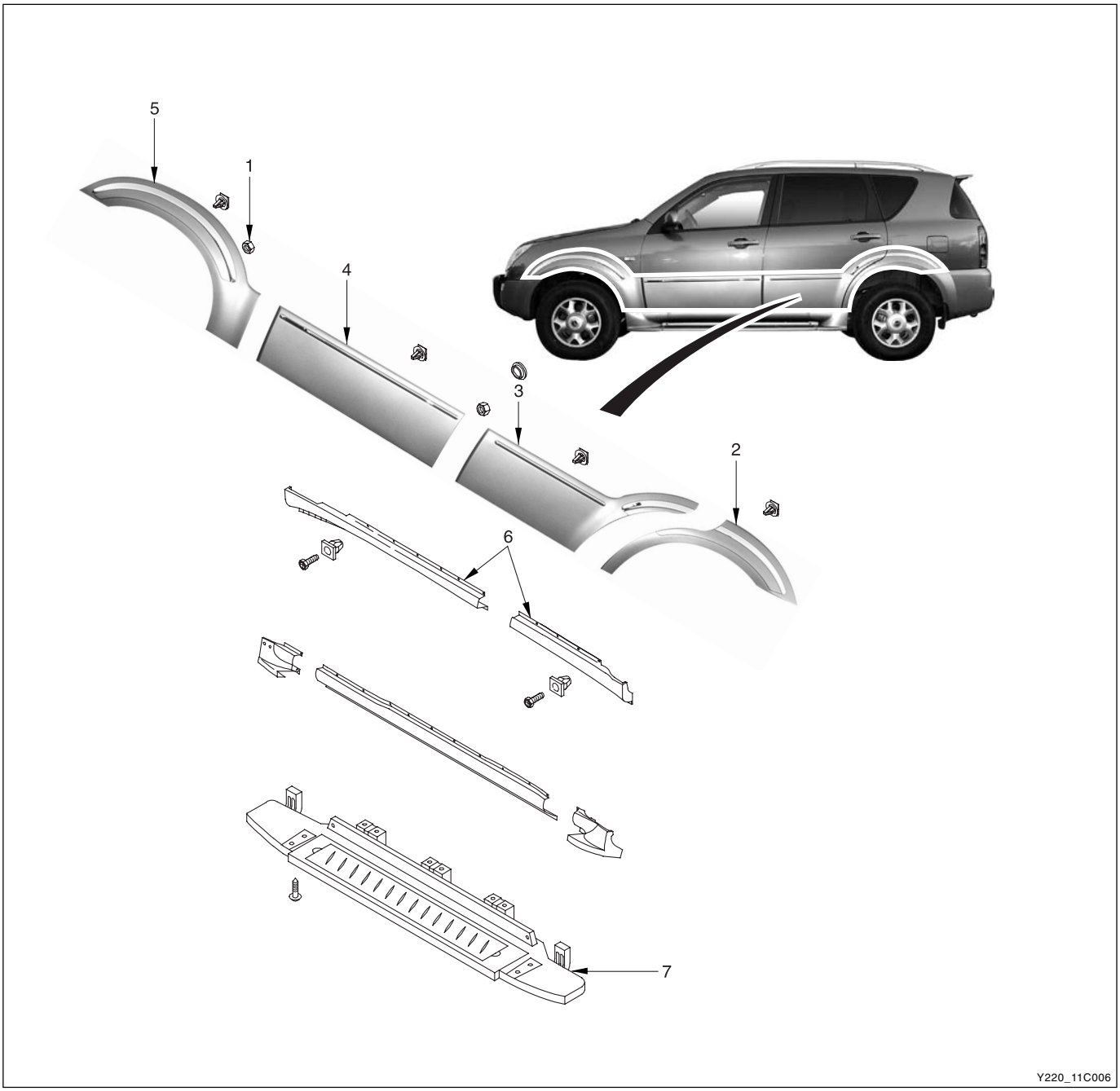
SUN ROOF AND ROOF RACK



1. Sun roof glass
2. Glass molding
3. Headlining assembly
4. Roof channel
5. Sun roof glass panel
6. Roof carrier
7. Nut
8. Motor/Relay box

MOLDING



1. Nut (M5)
2. Wheel arch rear molding
3. Rear door garnish
4. Front door garnish
5. Wheel arch front molding
6. Molding
7. Side step

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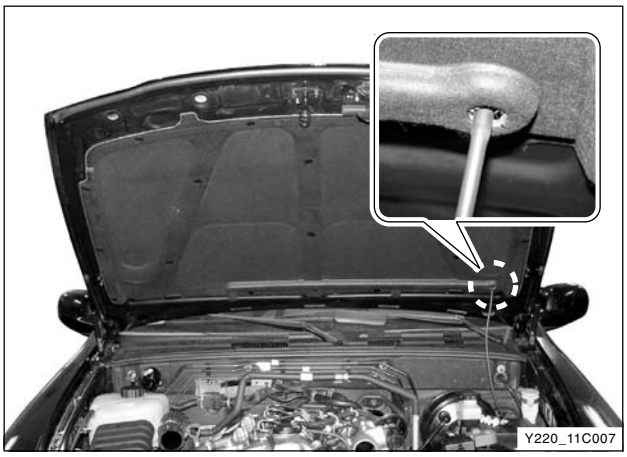
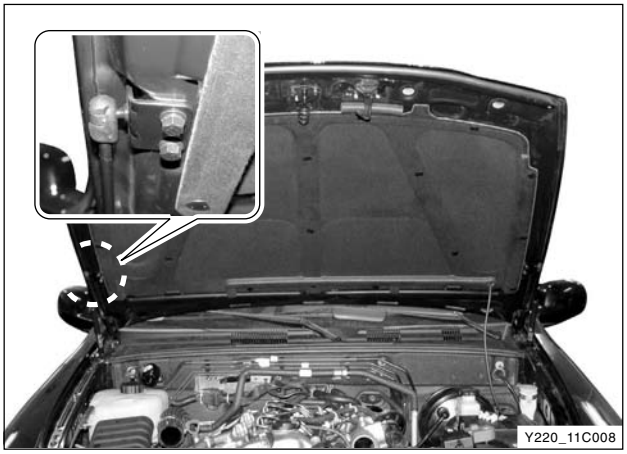
REMOVAL AND INSTALLATION



Hood Assembly

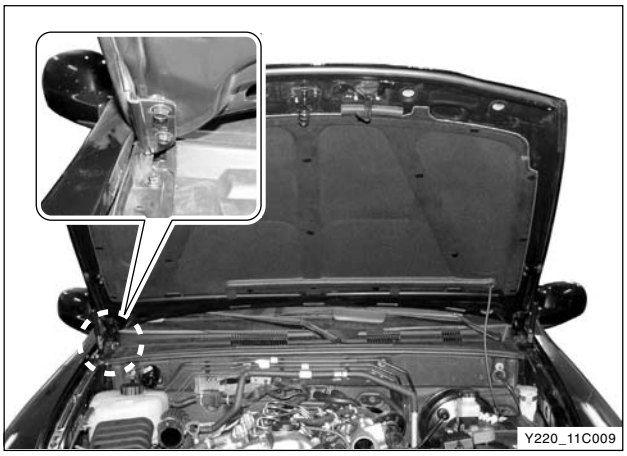
1. Disconnect the washer fluid hose.



2. Disengage the upper connection of shock absorber with a screwdriver.

Notice

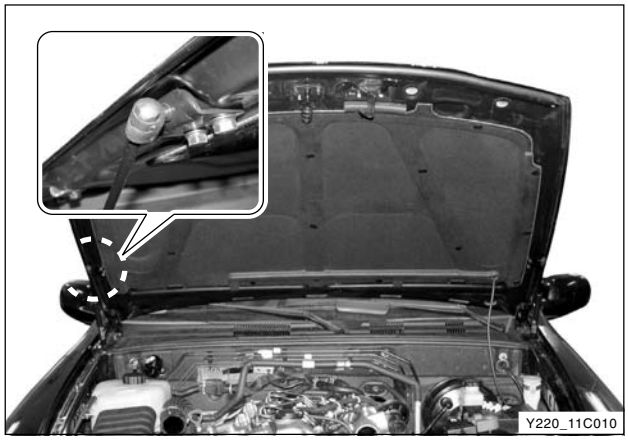
- ***It's not necessary to remove the shock absorber when removing only the hood.***
- ***If the shock absorber bracket has been removed, support the hood with additional tool to prevent it from closing.***



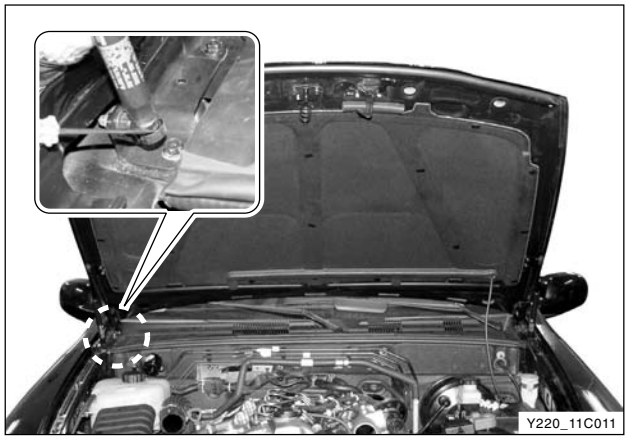
3. Unscrew the hood hinge mounting bolt and remove the hood.
4. Install in the reverse order of removal.

Hood Shock Absorber

1. Separate the upper connection of shock absorber with a screwdriver.

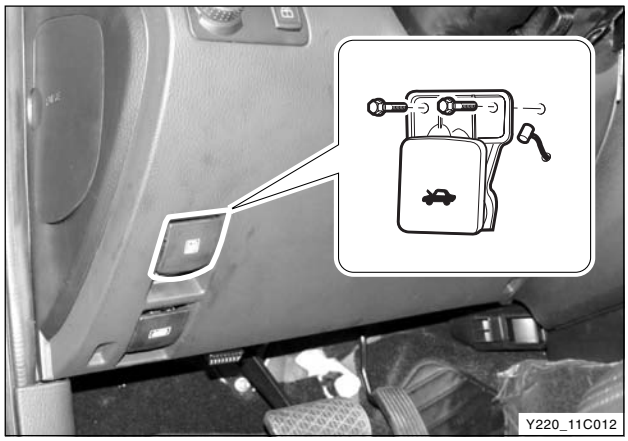


2. Separate the lower connection of shock absorber with a screwdriver.

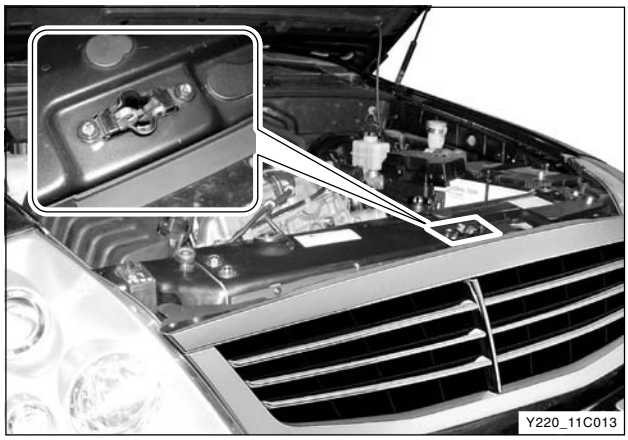


Hood Latch and Cable

1. Remove the hood latch and disengage the cable.



2. Unscrew the mounting bolts and remove the hood latch.



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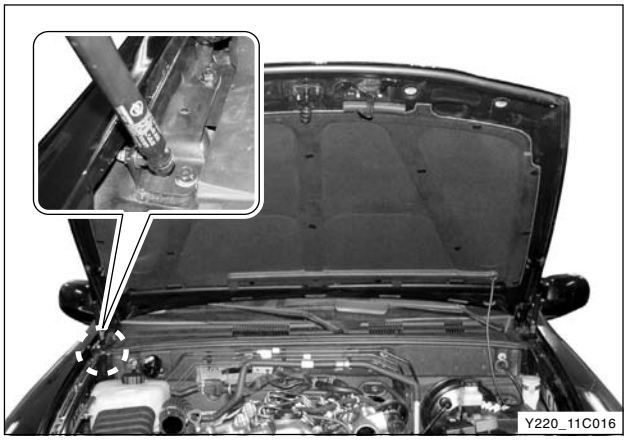
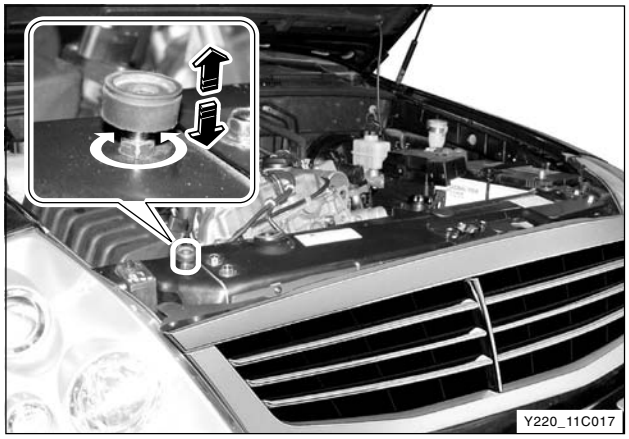
Hood Hinge Adjustment

1. Loosen the hood hinge mounting bolts.
2. Adjust the hood hinge to be securely seated.



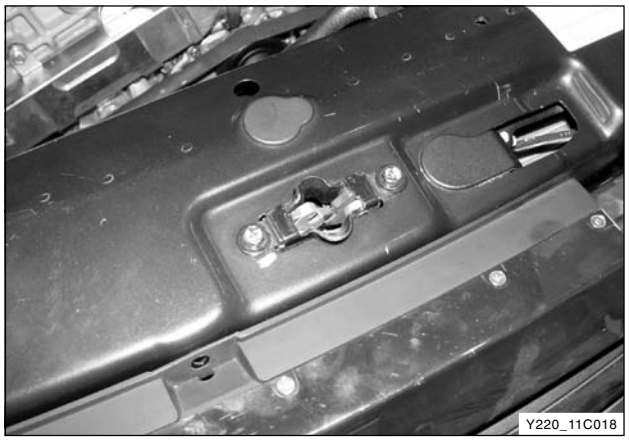
3. Adjust the height of hood arm end by using overslamp bumpers.



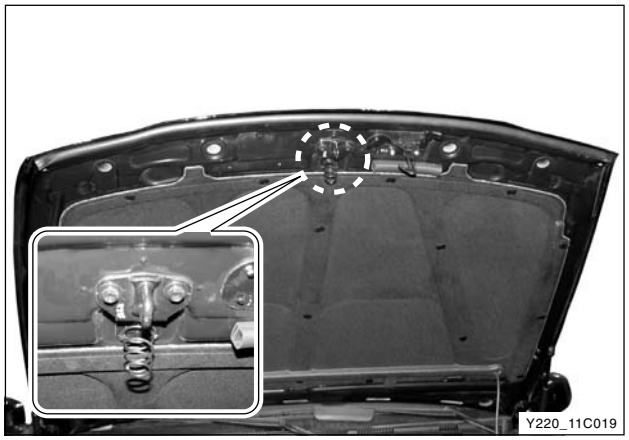
Hood Latch Adjustment

1. Install the hood latch at a correct location. Otherwise, it may cause the distortion or unbalance of hood.

Hood latch bolt	5 ~ 11 Nm



2. Loosen the hood latch bolts.
3. Adjust the striker to fit to hood latch.



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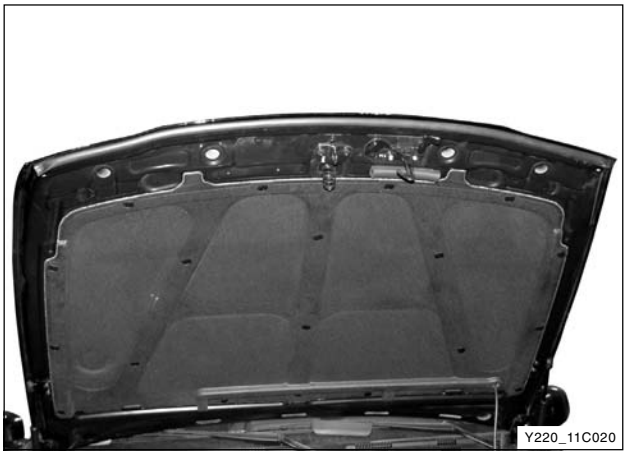


Replacement of Hood Insulation Pad

※ Preceding work: Disengagement of washer fluid hose

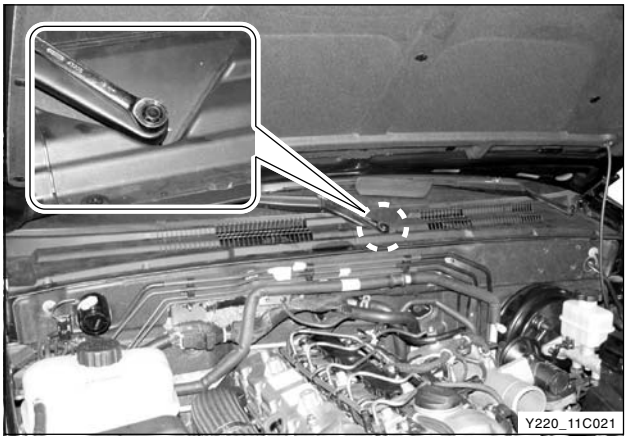
1. Unscrew the bolts and remove the insulation pad.

Cowl Grille

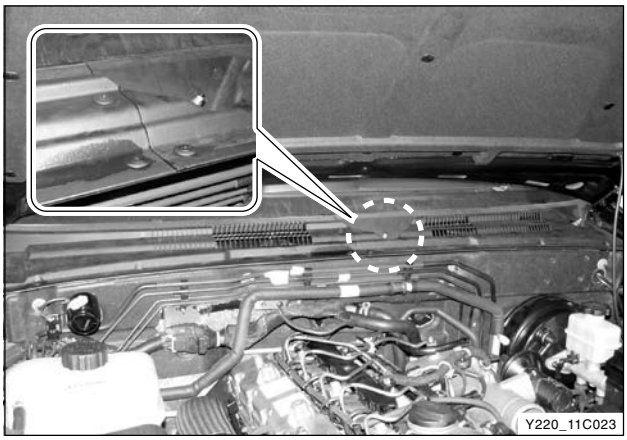
1. Remove the weatherstrip.

2. Unscrew both mounting nuts and remove the wiper arm.

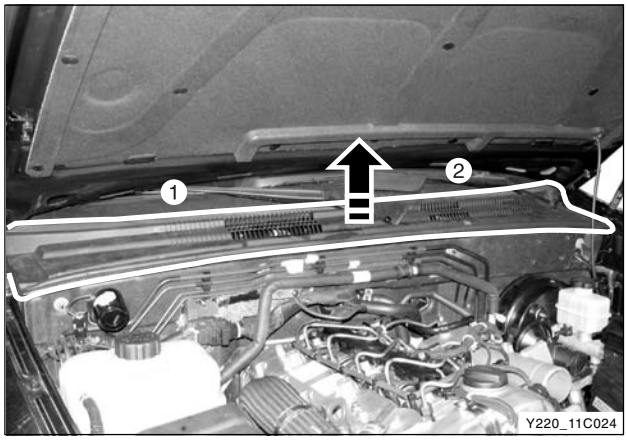
Tightening torque	14 ~ 17 Nm



3. Remove the cowl mounting clips.



4. Remove both cowls (remove the right cowl first).
5. Install in the reverse order of removal.



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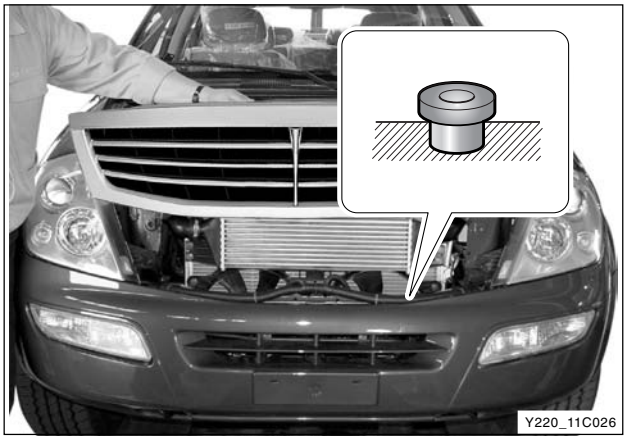
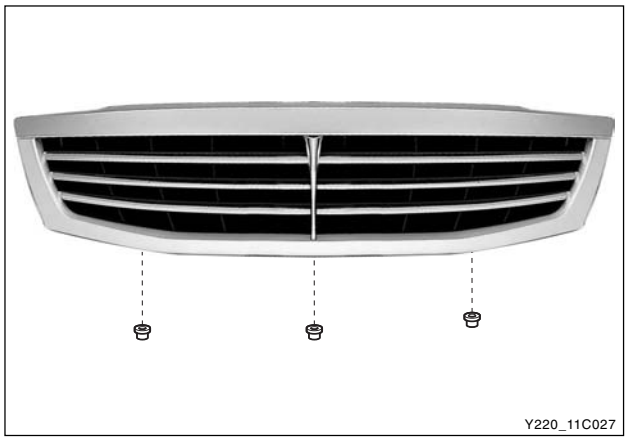
Radiator Grille

1. Remove the mounting screws and screw rivets from the radiator grille.



2. Remove the radiator grille and grille mounting rubber.



3. Install in the reverse order of removal.

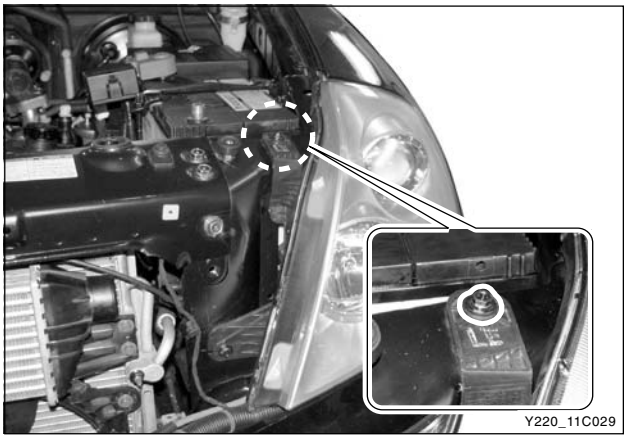
Notice

Check the mounting rubber and grille for damage.

Front Bumper Assembly

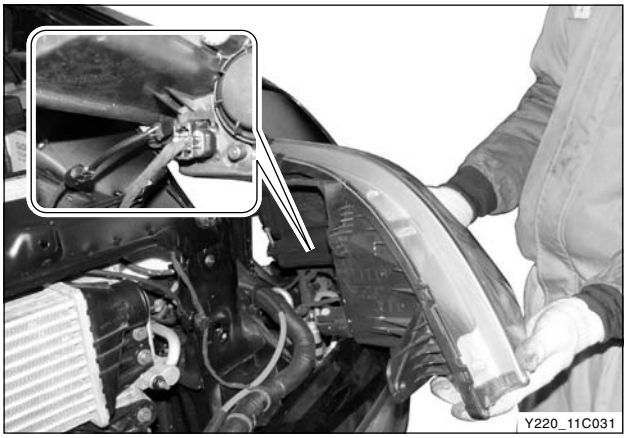
1. Remove the fasteners and screw rivets and remove the radiator grille assembly.

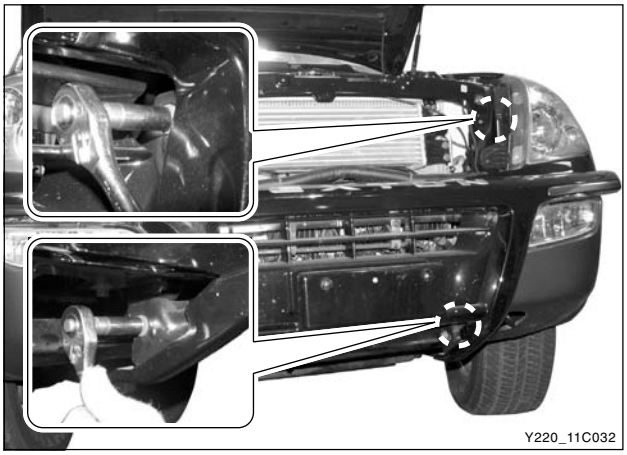
2. Remove the headlamp.
   1) Unscrew the headlamp mounting bolts.



   2) Unscrew the mounting bolt under the wheelhouse and remove the cover. Unscrew the mounting nut.

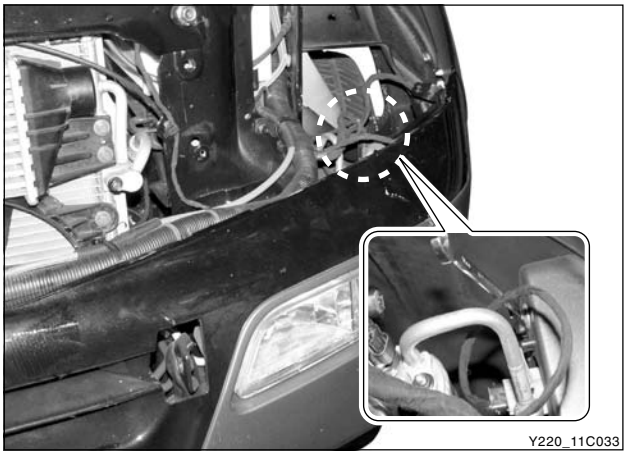
   3) Disconnect the headlamp connector.
   4) Remove the headlamp assembly.



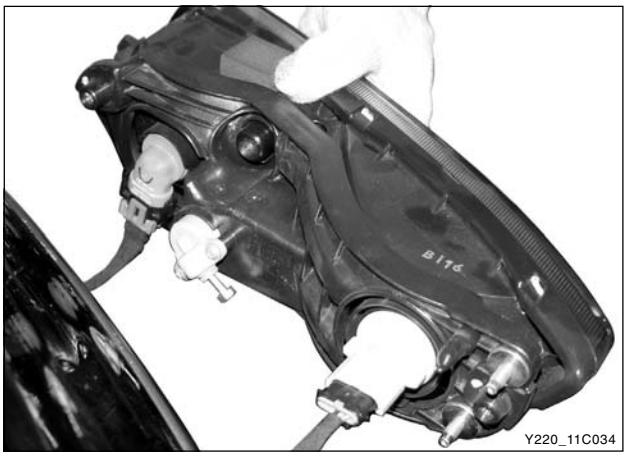


3. Unscrew the mounting bolts and remove the bumper guide from the bumper.
   - Unscrew the mounting bolts and remove the bumper guide support.

Tightening torque	16.8 ~ 31.2 Nm



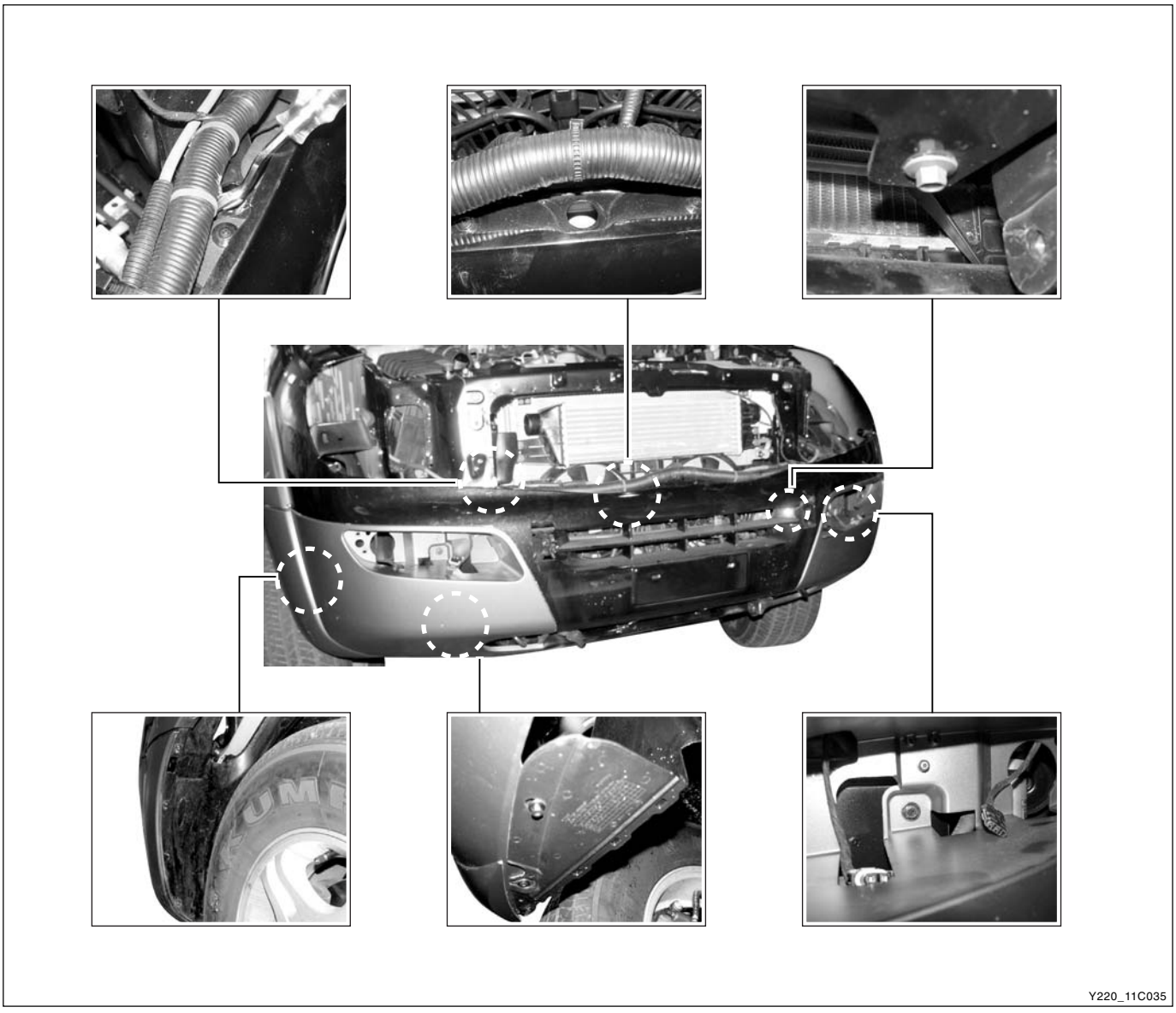
4. Remove the fog lamp.
   - Unscrew the nuts inside bumper fascia and disconnect the connectors.



5. Remove the bumper cover.

Installation Notice

Tightening torque	2.8 ~ 5.2 Nm

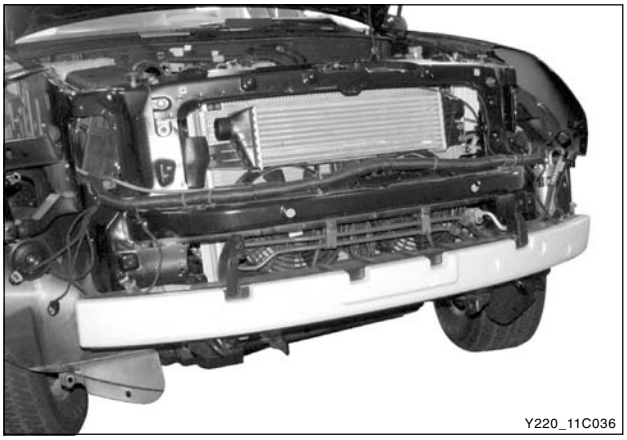


Y220_11C035

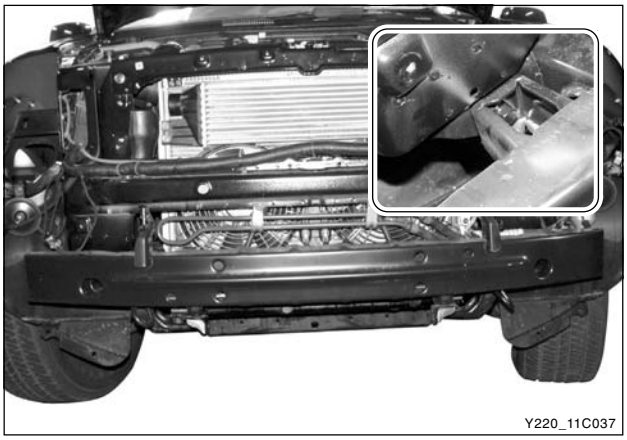
1) Remove the main wiring clip.
2) Remove the screw rivets on the bumper fascia.
3) Remove the bolts under the bumper fascia.
4) Remove the bumper fascia screws from the wheelhouse.
   - Side: 4
   - Lower: 1
5) Unscrew the center mounting bolts and remove the bumper fascia.

Installation Notice

Tightening torque	76 ~ 114 Nm


Y220_11C036

6. Remove the energy absorber.


Y220_11C037

7. Unscrew the mounting bolts and remove the bumper from the frame.

8. Install in the reverse order of removal.

Fender

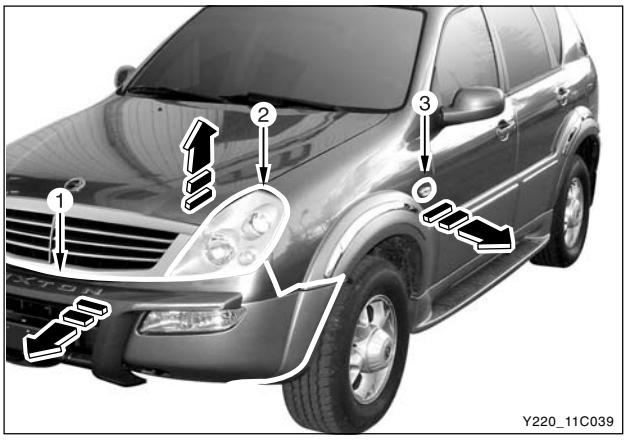
1. Lift up the vehicle very careful.

Notice

Inspect and adjust the abnormal clearance and steps before removing the fender (front door, hood, side outer seal, front bumper).

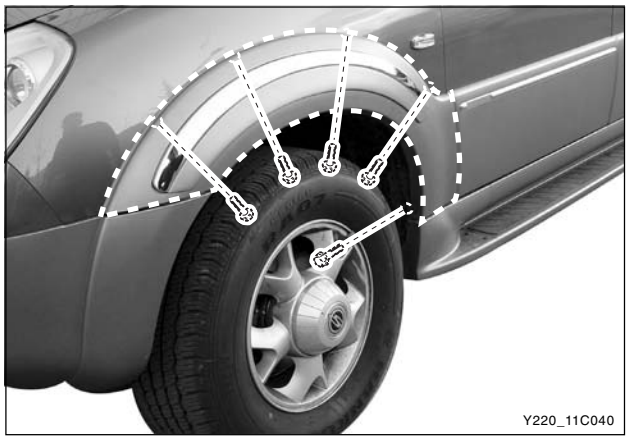

Y220_11C038

2. Remove the front bumper fascia (1), headlamp (2) and side turn signal lamp (3).



Y220_11C039

3. Remove the wheelhouse, mud guard and spring nut.


Y220_11C040

4. Remove the wheel arch garnish with a proper tool.

Notice

Be careful not to damage the body surface.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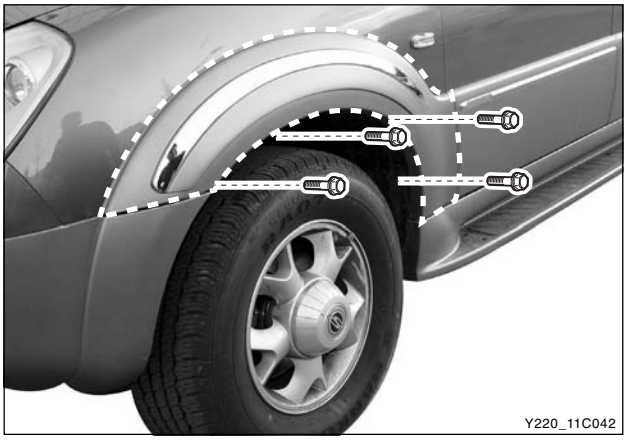
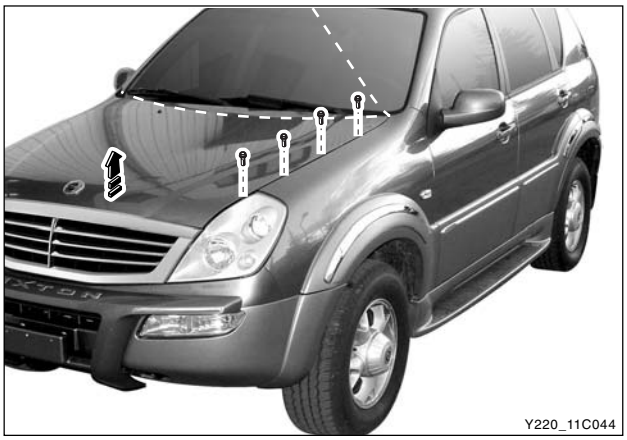


5. Remove the mounting bolts from the mud guard.
6. Open the door and remove the fender mounting bolt.

7. Remove the bumper fascia bolts.



8. Unscrew the rear hood hinge bolt and upper fender bolts and remove the fender.

9. Install in the reverse order of removal.
   Cautions during installation
   1) Paint the inside of fender and fender installation surface.
   2) Put the fender on the installation surface and temporarily tighten the front and rear hood bolts. Adjust the clearance and steps between door, hood and lamp.
   3) Apply the waterproof paint on the bolt connections and tighten them with the specified torque.

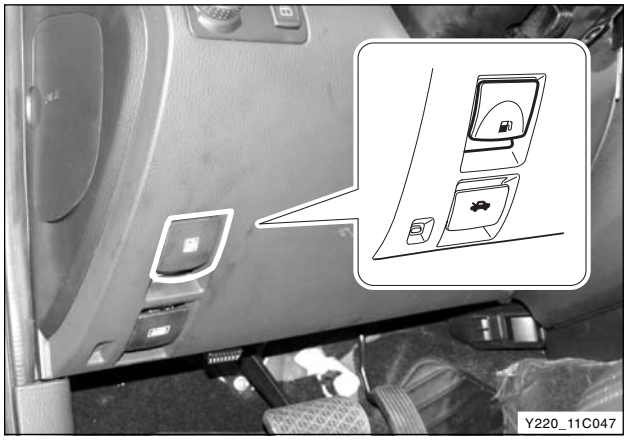
Tightening torque	6.9 ~ 8.8 Nm

   4) After painting, check the electric devices for connection and operation.

Fuel Filler Lid Opener

1. Open the fuel fill lid opener and remove the door bolts.

2. Disengage the fuel fill lid opening handle and cable at lower instrument panel.



3. Remove the fuel fill lid opener cable.
4. Install in the reverse order of removal.

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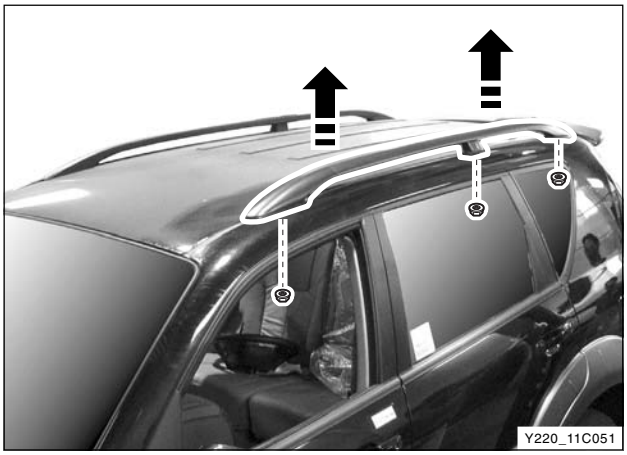


Roof Carrier

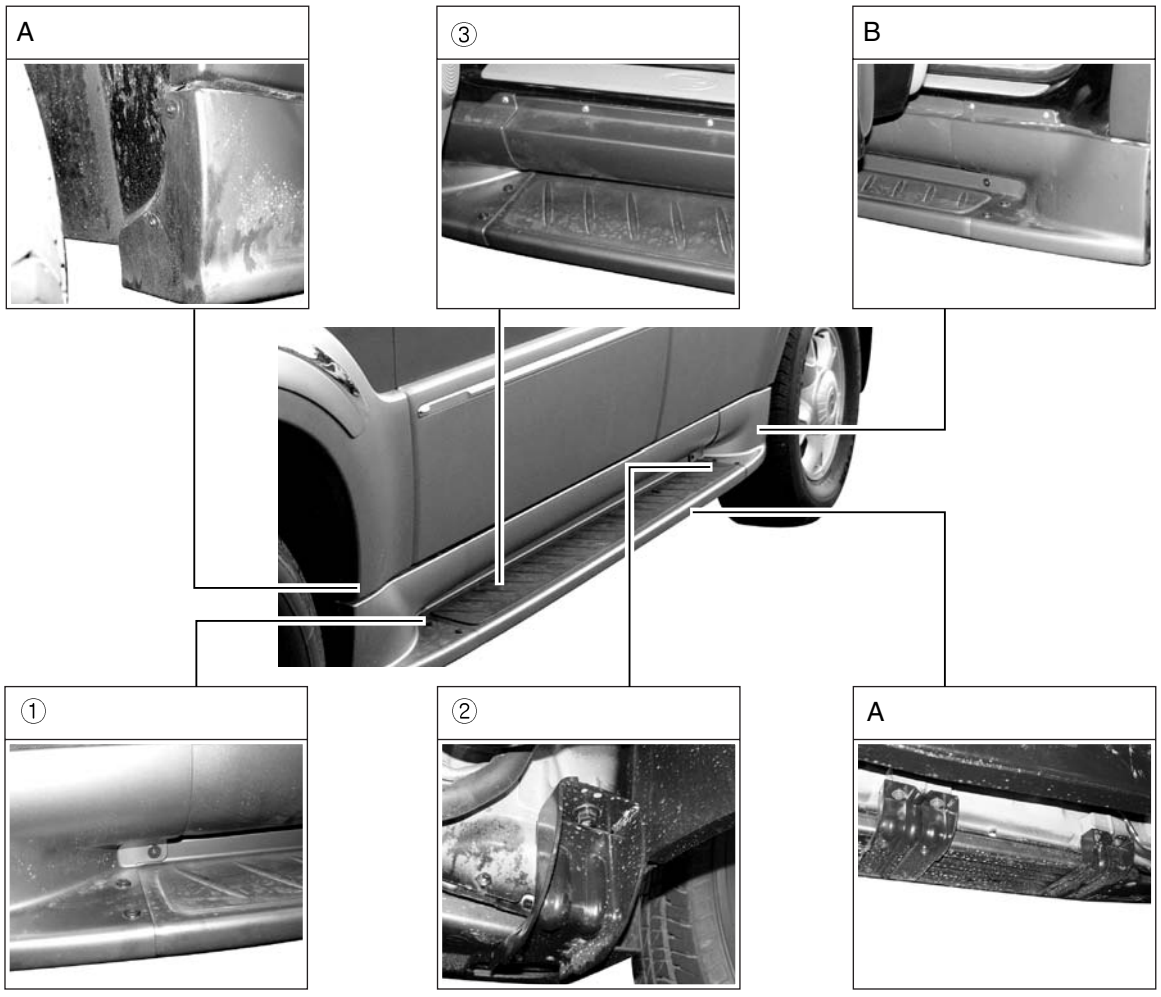
1. Remove the interior headlining.
2. Unscrew the nuts and remove the roof carrier assembly.
3. Install in the reverse order of removal.

Roof carrier nut	7 ~ 10 Nm

Notice

The capacity of roof carrier is approx. 45 kg. Do not overload and evenly distribute the load on the roof carrier.

Side Step



1. Unscrew the front and rear side step mounting screws (1, 3) .
2. Unscrew the step bar bolts (2, 4).
3. Unscrew the side step mounting bracket bolts (A, B).

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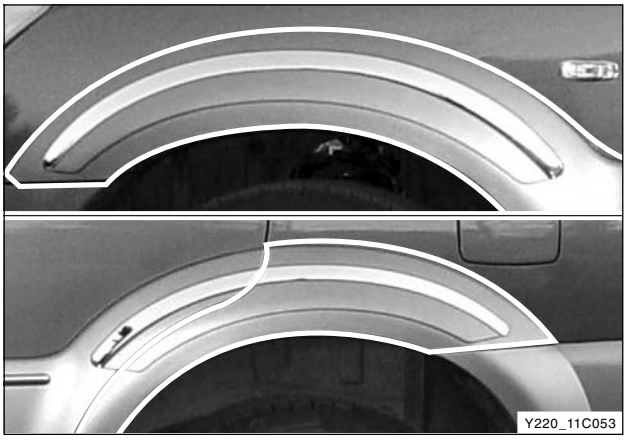
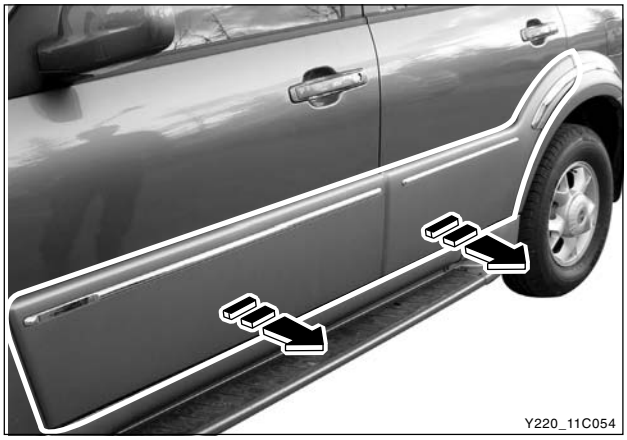


Side Molding/Wheelhouse Molding

1. Unscrew the front and rear mounting screws and remove the wheel house molding.



2. Remove the front and rear door moldings with a special tool.

Notice

Be careful not to damage the painted surface of body and moldings when removing the moldings.

3. Install in the reverse order of removal.

Notice

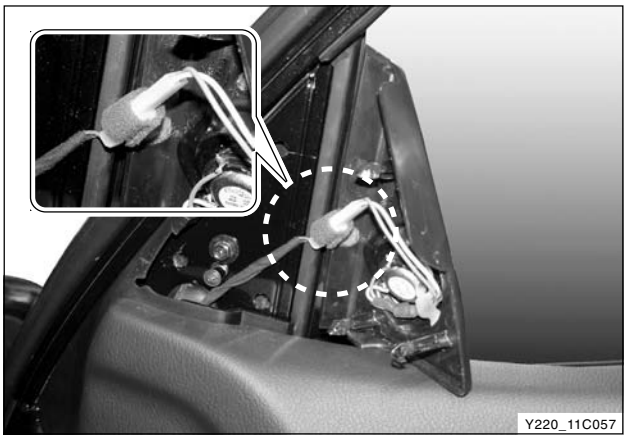
Make sure to avoid irregularities and gaps when installing the moldings.

Outside Rearview Mirror

1. Remove the front door interior trim cover.

2. Remove the outside rearview mirror inner cover.

3. Disconnect the tweeter speaker connector.



4. Disconnect the outside rearview mirror connector.

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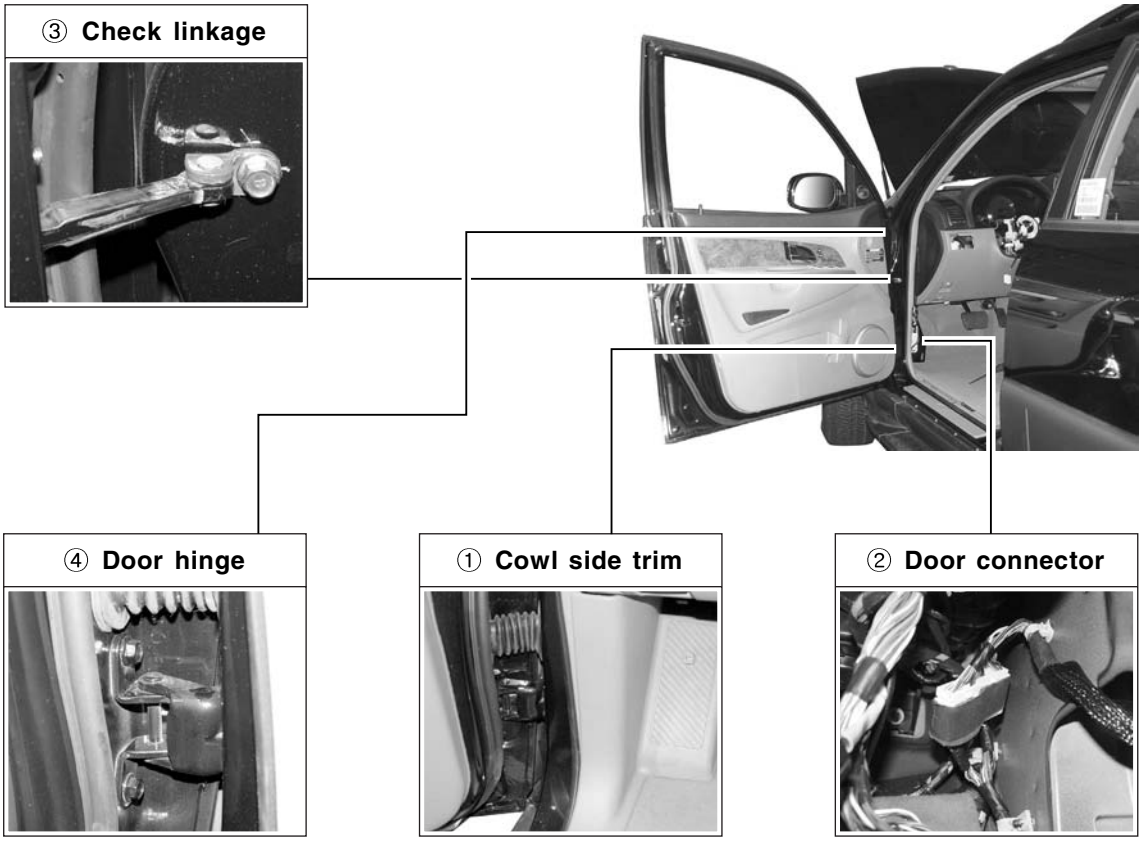
5. Unscrew the interior mounting bolts and screws.

6. Unscrew the lower mounting screws and remove the outside rearview mirror.

Front Door Assembly

※ Preceding work: Disconnection of negative battery cable



1. Remove the side cowl trim (1).
2. Disconnect the door connector (2).
3. Unscrew the check linkage bolt (3) at body side.
4. Unscrew the upper and lower door hinge bolts (4).
5. Remove the door assembly.
6. Install in the reverse order of removal.

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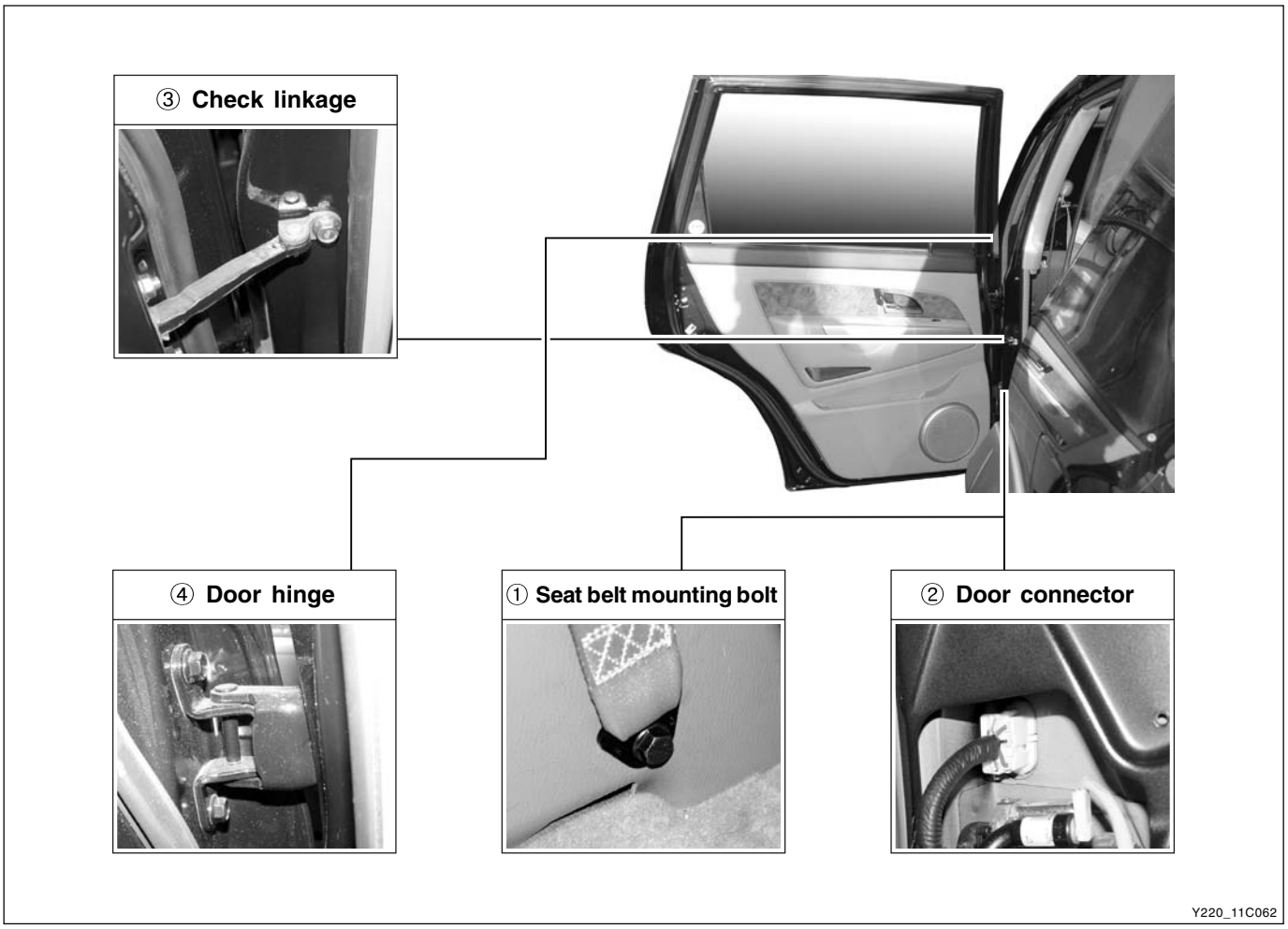
Rear Door

※ Preceding work: Disconnection of negative battery cable



1. Unscrew the seat belt mounting bolt (1) and remove the center panel.
2. Disconnect the door connector (2) at the center pillar.
3. Unscrew the check linkage bolt (3).
4. Unscrew the upper and lower door hinge bolts (4) and remove the door.
5. Install in the reverse order of removal.

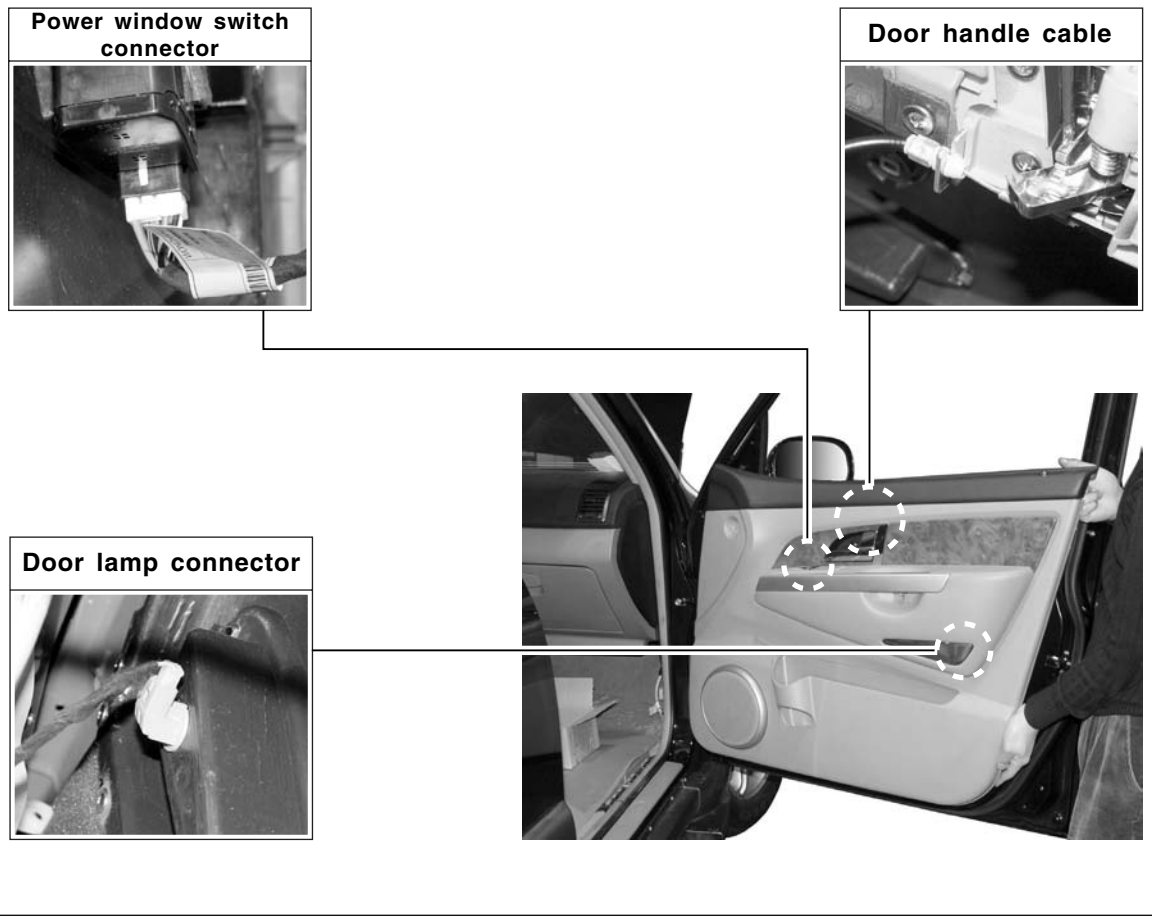
Door Trim

※ Preceding work: Disconnection of negative battery cable

1. Remove the screw rivets at the lower door trim.
2. Remove the door trim.


Y220_11C064

3. Disconnect the power window switch connector, door lamp connector and door handle cable.



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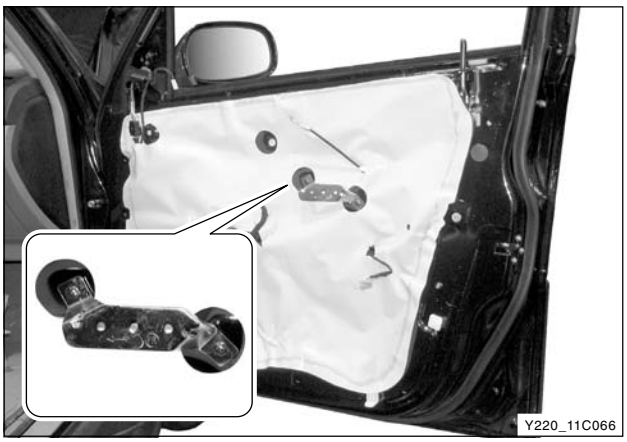
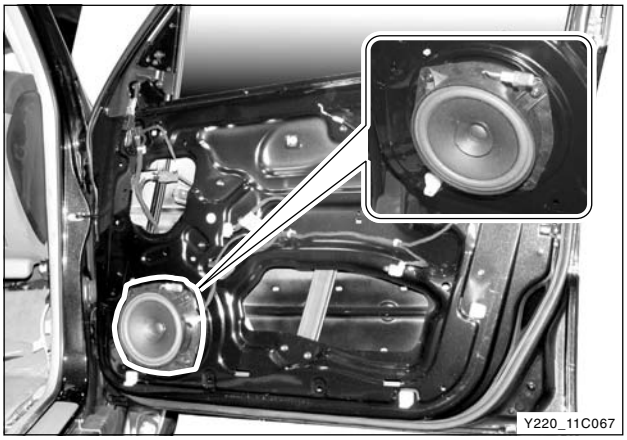


4. Remove the door handle mounting bracket and disconnect the door speaker connector. Then, remove the door trim seal.

Notice

Be careful not to damage the seal.



Door Speaker

※ Preceding work: Removal of door trim

1. Disconnect the door speaker connector and unscrew the mounting screws.
2. Remove the door speaker.

Window Regulator Assembly

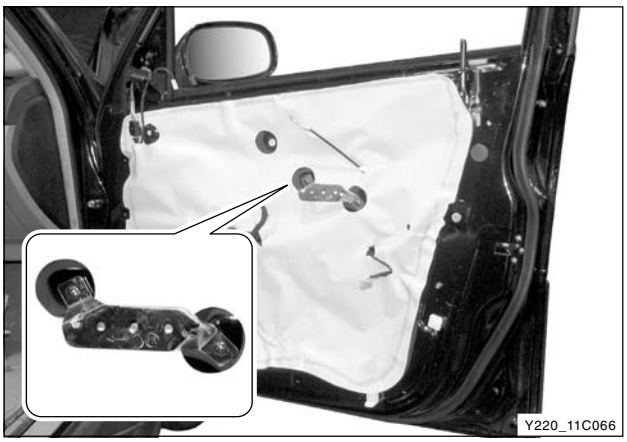
※ Preceding work: Removal of door trim

1. Disconnect the power window switch connector.

2. Unscrew the mounting nuts and remove the glass and regulator assembly.
3. Install in the reverse order of removal.

Notice

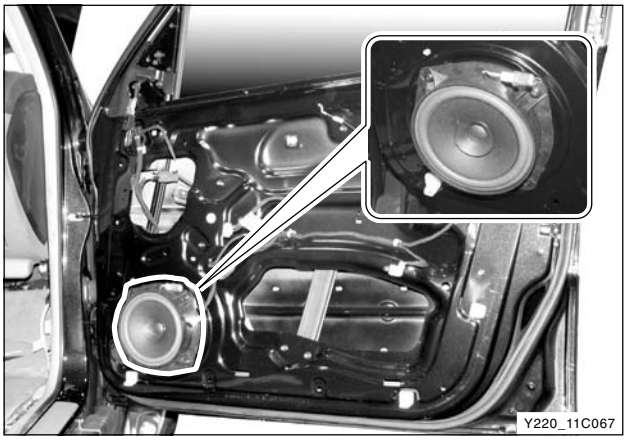
Apply the adhesive to install the door trim seal.



4. Remove the door handle mounting bracket and disconnect the door speaker connector. Then, remove the door trim seal.

Notice

Be careful not to damage the seal.



Door Speaker

※ Preceding work: Removal of door trim

1. Disconnect the door speaker connector and unscrew the mounting screws.
2. Remove the door speaker.

Window Regulator Assembly

※ Preceding work: Removal of door trim

1. Disconnect the power window switch connector.

2. Unscrew the mounting nuts and remove the glass and regulator assembly.
3. Install in the reverse order of removal.

Notice

Apply the adhesive to install the door trim seal.

Door Opening Weatherstrip

1. Remove the door checker.

2. Take off the upper weatherstrip from the rail.
3. Take off the lower weatherstrip while removing the clips. The weatherstrip and clips should be replaced with new ones once removed.

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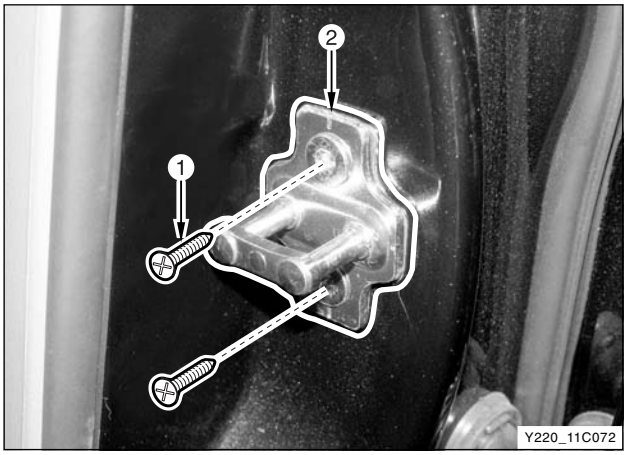
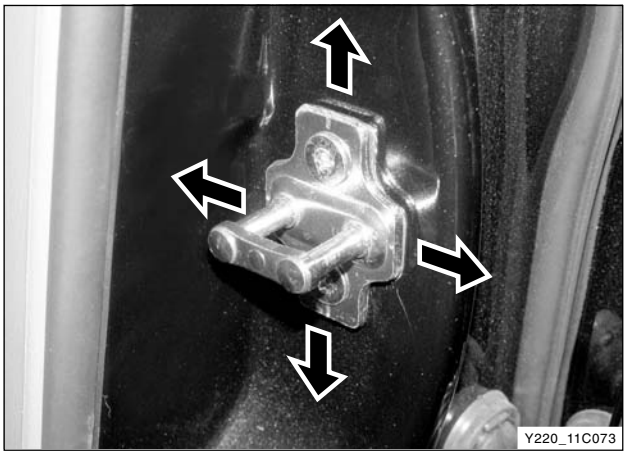


Door Lock Striker

1. Unscrew the screws and remove the door lock striker.
2. Install the door lock striker.
   - Temporarily install the door lock striker.
   - Adjust the location of door lock striker and fully tighten the screws.

Door lock striker screws	20 ~ 28 Nm



▶ Door Lock Striker Adjustment

Notice

The door lock striker is an important attaching part that can affect the performance of vital components and systems and can cause major repair expenses. If replacement becomes necessary, the door lock striker must be replaced by one with the same part number or with an equivalent part. Do not use a replacement part of lesser quality or of a substitute design. The specified torque values must be used during reassembly in order to ensure the proper retention of the part.

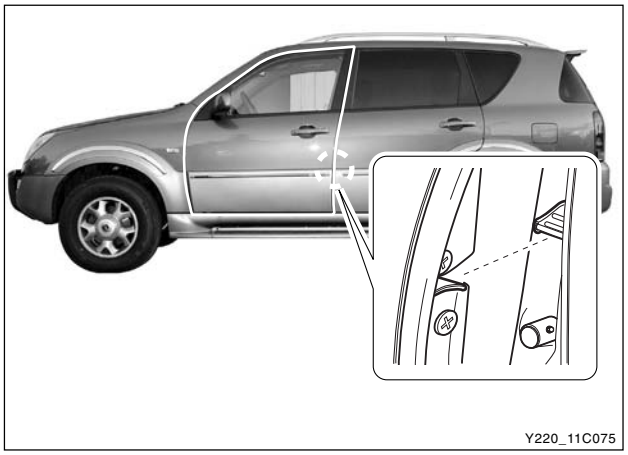
The door lock striker consists of a striker with two screws that are threaded into a tapped, floating cage plate located in the appropriate body pillar. This floating cage plate allows the striker to be easily adjusted in or out and up or down. The door is secured in the closed position when the door lock fork snaps over and engages the striker.

▶ Fore/Aft Adjustment

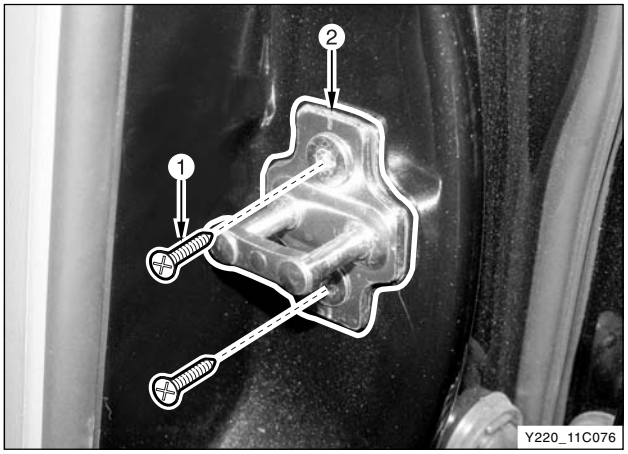
1. The door must be properly aligned.
2. Close the door until the lock fork contacts the striker.
3. Stand next to the door opening and move the door slowly in and out, just touching the striker each time.


Y220_11C074

4. The alignment of the lock fork and the striker can be easily seen. The lock fork should be perpendicular to and fall near the middle of the striker between the B-pillar and the end of the striker.


Y220_11C075

5. If a fore or aft adjustment is required, use the following steps:
   1) Remove the striker screws.
   2) Remove the spacer in order to move the striker toward the front of the vehicle.
   3) Add a 2 mm (0.8 inch) spacer in order to move the striker toward the front of the vehicle.
   4) Install the striker screws.
6. Perform the up/down or the in/out adjustment. Refer to “up/down or in/out Adjustment” in this section.



Y220_11C076

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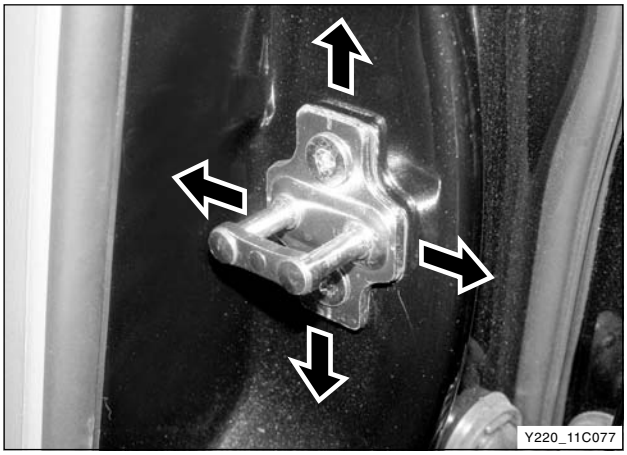


▶ Up/Down or In/Out Adjustment

An adjustment of the striker in the up/down or in/out directions may be necessary for a number of reasons:

- Vehicle frame damage as the result of a collision.
- Installation of new door weather stripping.
- Customer complaints of excessive wind noise.
- Difficulty in opening or closing the door.

In order to adjust the door striker in an up/down or in/out direction, perform the following procedure:

1. The door must be properly aligned.
2. Loosen the striker screws.
3. The floating cage plate can be moved slightly using the ends of the striker screws. Move the floating cage plate to the desired position.

Notice

It is important to use a flat-end rotary file in order not to damage the tapped floating cage plate. The striker screws and the tapped floating cage plate are important attaching parts that could affect the performance of vital components and systems.

4. If proper adjustment requires that the floating cage plate be moved more than is possible, use an electric hand drill and a 3/8-inch rotary file with a flat head in order to enlarge the body opening in the direction required.
5. Tighten the striker screws to the correct position.

Rear Bumper Assembly

Fascia

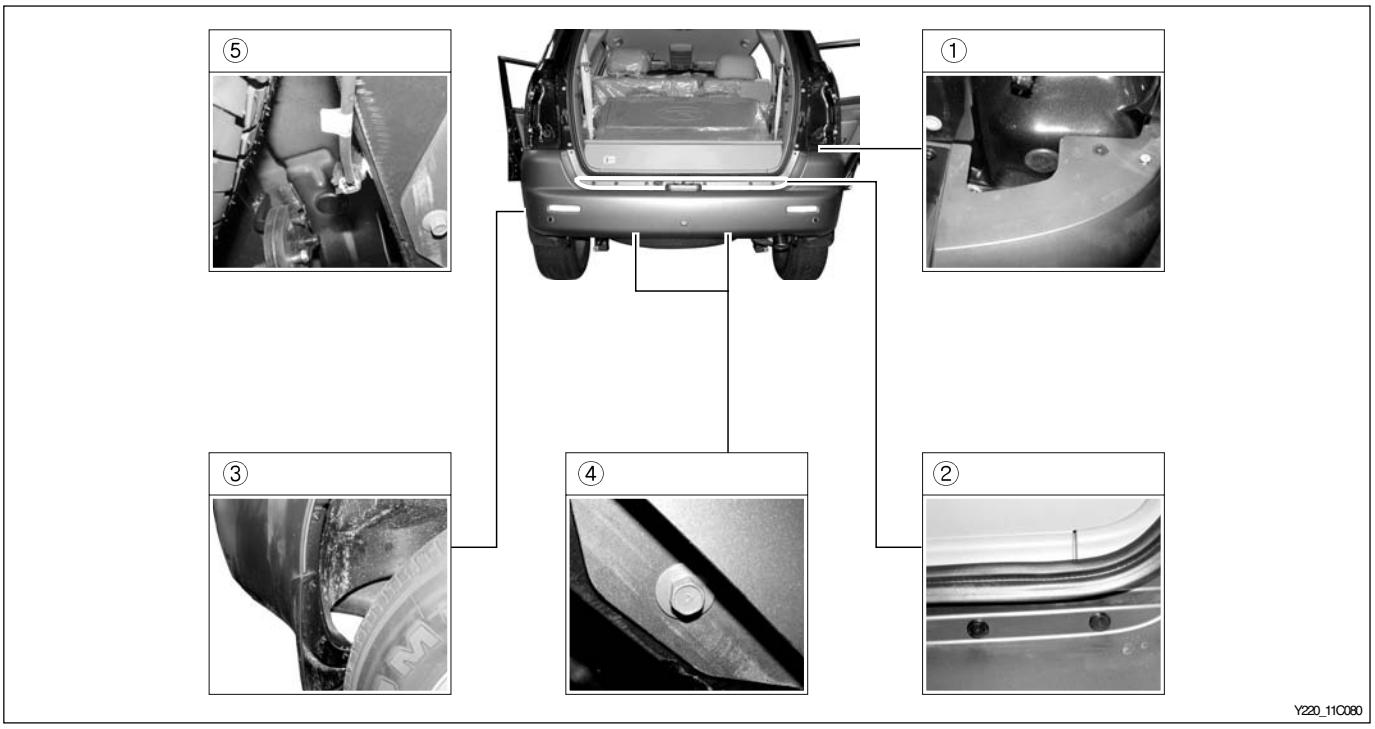
1. Unscrew the rear combination lamp mounting screws.

2. Disconnect the rear combination lamp connector and remove the rear combination lamp assembly.

3. Unscrew the mounting bolts and screws and remove the rear bumper fascia assembly.

Notice

Before removing the bumper fascia, disconnect the parking aid sensor connector.



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- Remove the screws around the combination lamp. (LH: 1, RH: 2)
- Remove the screws from the bumper. (LH: 1, RH: 1)
- Remove the screw rivets from the bumper fascia. (5 locations)
- Remove the bumper fascia mounting screws from the rear wheelhouse. (LH: 4, RH: 4)


Y220_11C081

4. Install in the reverse order of removal.


Y220_11C082

※ When installing, put the rear bumper on the hook on the ventilator.

Back Beam / Rear Bumper

1. Unscrew the rear bumper mounting bolts and remove the back beam assembly.

Tightening torque	41.6 ~ 62.4 Nm


Y220_11C083

2. Separate the parking aid sensor wiring harness and remove the mounting bolts.


Y220_11C084

3. Remove the rear bumper.


Y220_11C085

4. Install in the reverse order of removal.

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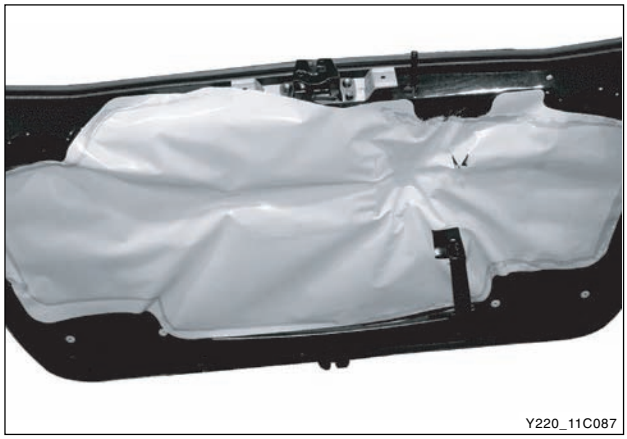
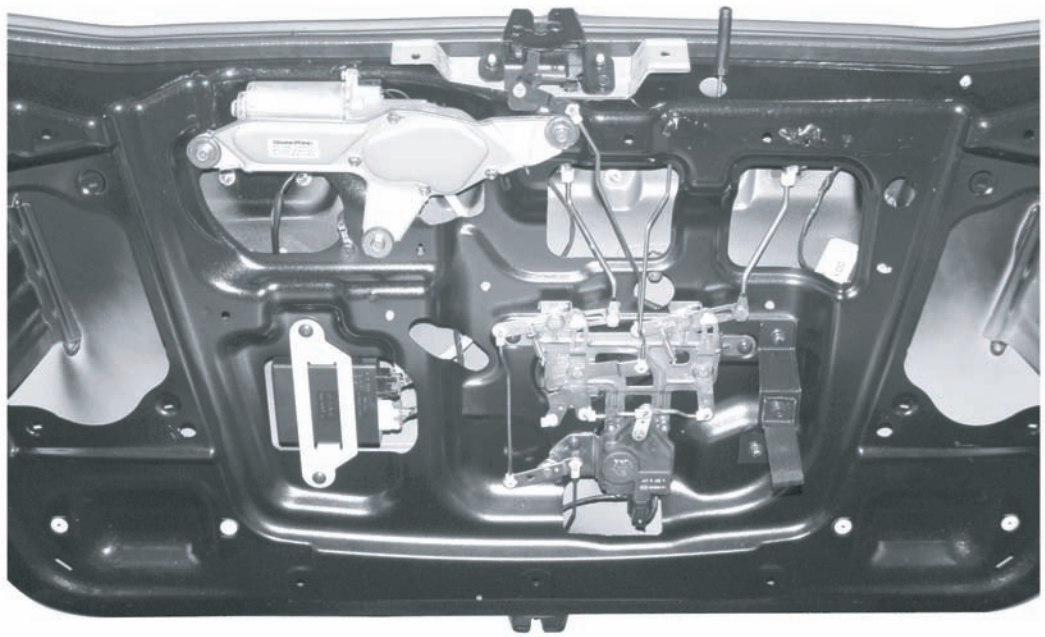
Y220_11C086

Tailgate Crank

1. Disconnect the negative battery cable.
2. Remove the tailgate inner panel trim cover.

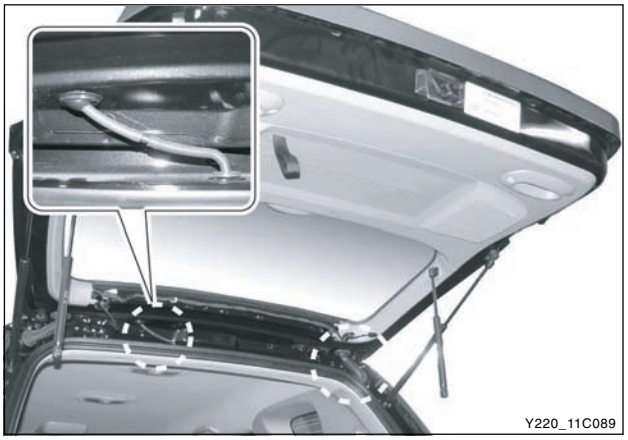

Y220_11C087

3. Remove the tailgate inner panel trim vinyl seal.
4. Disconnect the actuator wiring connector.
5. Unhook the outside handle rod and the glass handle rod.
6. Remove the safety rod.
7. Remove the tailgate glass latch rod.
8. Unscrew the mounting bolts and remove the crank assembly.
9. Install in the reverse order of removal.


Y220_11C088

Tailgate

1. Remove the grommets and disconnect the connectors. Disengage the washer fluid hose.

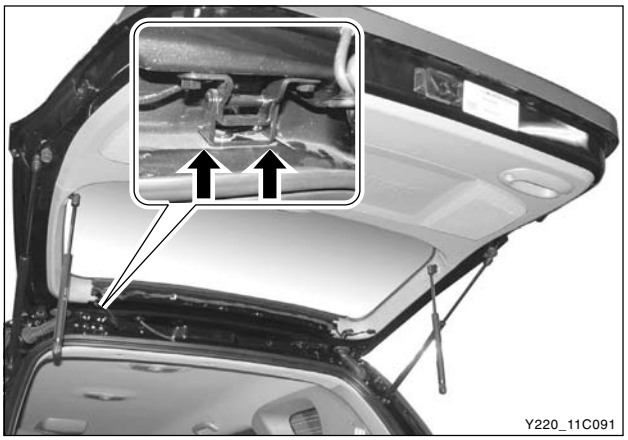


2. Spread out the clips (4 locations) with a proper tool and remove the gas lifters at both sides.

3. Unscrew the nuts and remove the tailgate with the interior headlining removed.

Notice

Let a person support the tailgate not to drop the tailgate down.



4. Install in the reverse order of removal.

Notice

The gas lifter is filled with the high pressurized nitrogen and oil. Make sure to remove the pressure before disposal.

Fully extend the gas lifter and put it on a level surface. Drill out a hole of 2 to 3 mm diameter to remove the pressurized gas and oil.

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Tailgate Glass

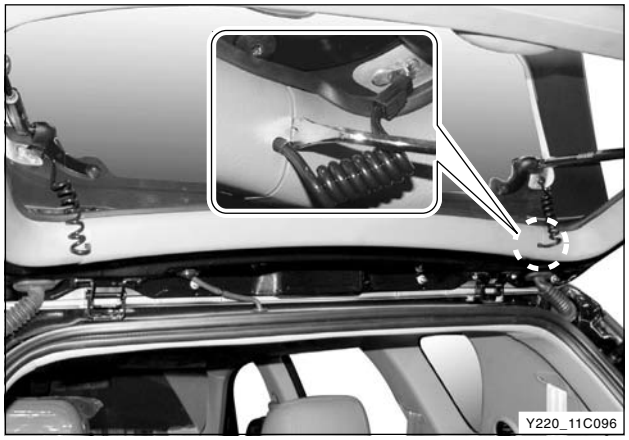
1. Remove the upper garnish.
2. Disconnect the rear defogger connectors on tailgate.

3. Spread out the clips (4 locations) with a proper tool and remove the shock absorbers at both sides.

4. Unscrew the hinge bolts at both sides and remove the glass from the tailgate.
5. Install in the reverse order of removal.

Tailgate Air Spoiler

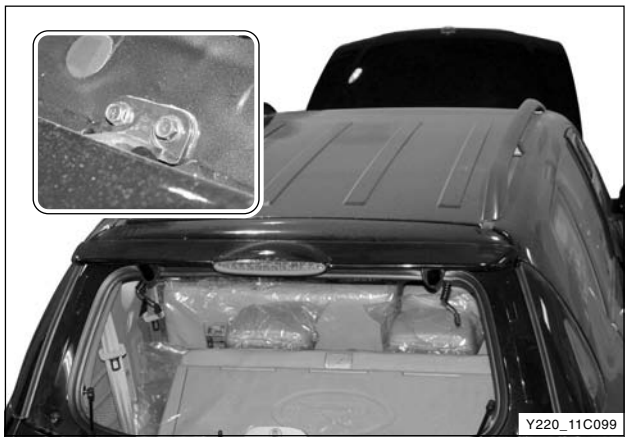
1. Remove the tailgate upper panel.



2. Unscrew the tailgate glass mounting screws at both sides.

3. Disconnect the high mounted stop lamp connector.

4. Unscrew the air spoiler bracket bolts.



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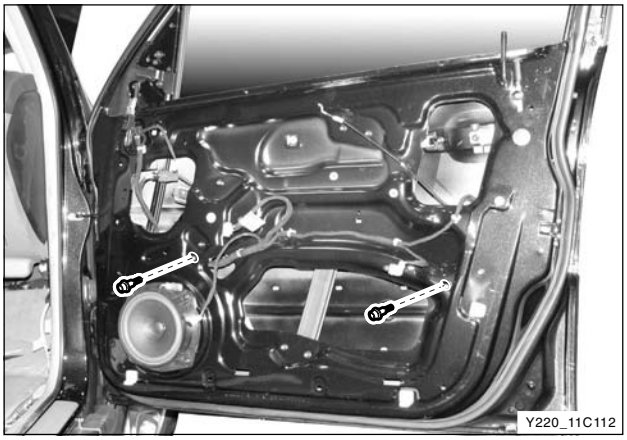
5. Remove the air spoiler assembly.

6. Install in the reverse order of removal.



Front Door Glass

※ Preceding work: Removal of door trim

1. Remove the door trim assembly and seal.

2. Remove the front door glass.
   1) Unscrew the glass mounting screws while the regulator carrier plate is at its location.
   2) Remove the glass

Installation Notice

Tightening torque	3 Nm

Notice

Make sure that the glass doesn't contact to the vehicle body. It may cause to damage the painted surface.

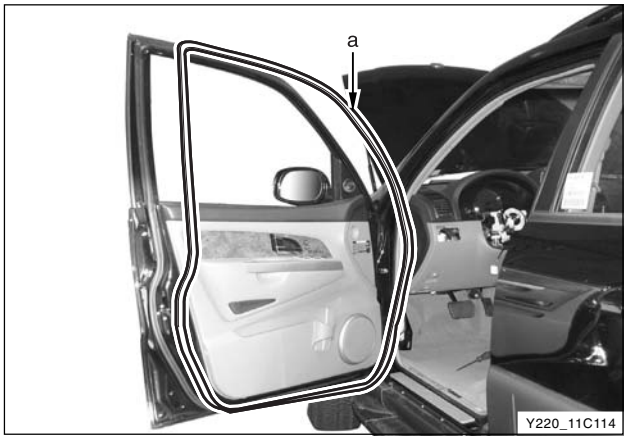
3. Install in the reverse order of removal.

Notice

Apply a small amount of soapy water to the contacting point of glass run and the glass with a brush to make the installation easier.

Front Door Glass Run and Regulator

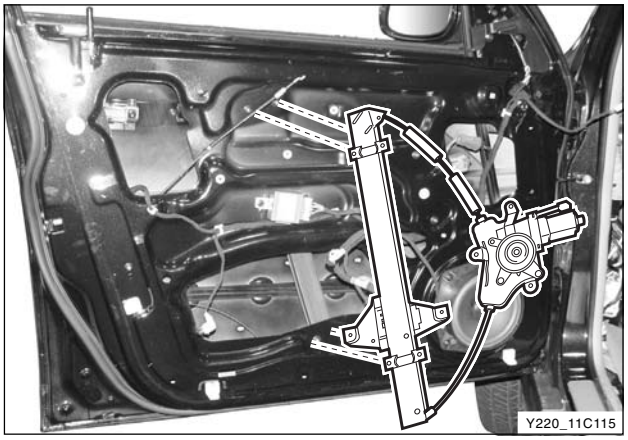
1. Remove the door trim, seal and glass.
2. Remove the door glass run from door.



3. Unscrew the door regulator mounting nuts and remove the power window motor connector.

   Installation Notice

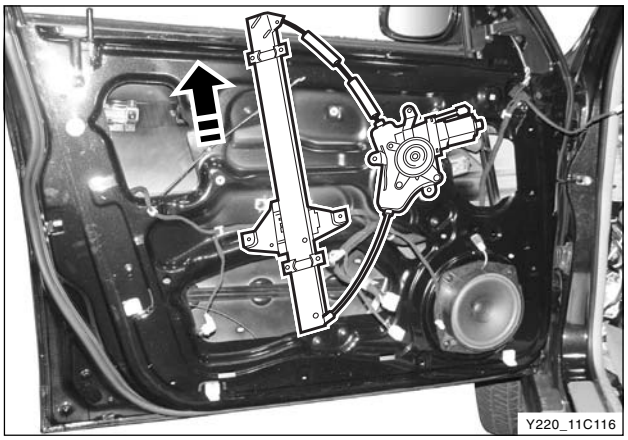
Tightening torque	8 Nm



4. Remove the door regulator assembly.

   Note

   The door glass run and the regulator assembly can be removed separately.



5. Apply a small amount of soapy water to the contacting point of glass run and the glass with a brush to make the installation easier.

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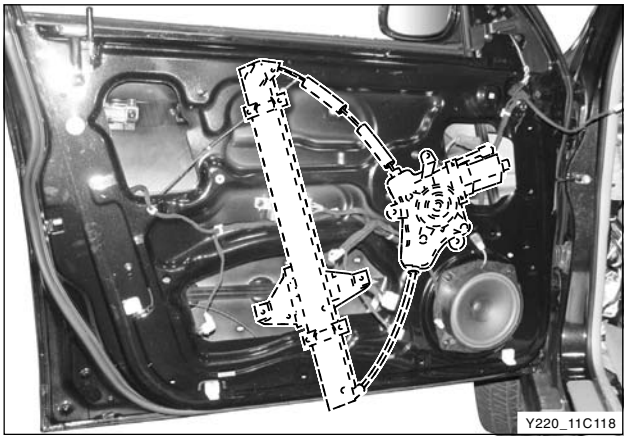
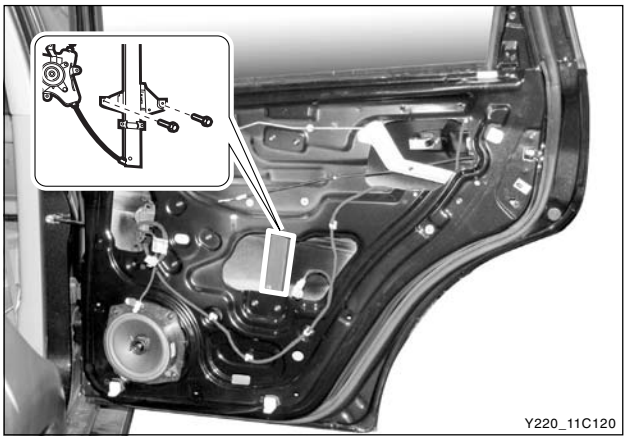


6. Install in the reverse order of removal.

Rear Window

1. Remove the external door weatherstrip.
2. Remove the front garnish from rear door.
3. Remove the door trim assembly and seal.



4. Remove the rear door glass.
   1) Lift up the carrier plate in regulator and remove the screws.

Tightening torque	3 Nm

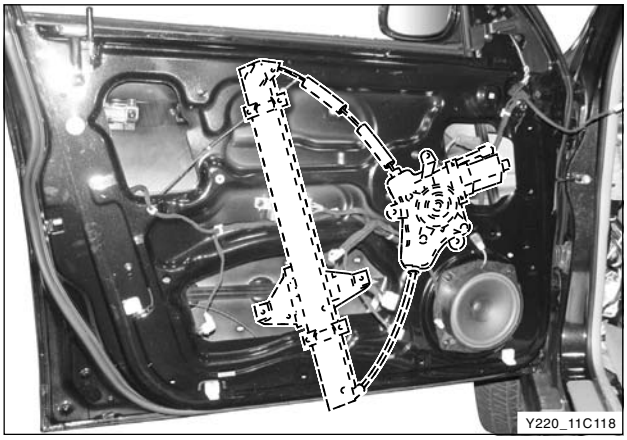
Notice

Make sure that the glass doesn't contact to the vehicle body. It may cause to damage the painted surface.

5. Install in the reverse order of removal.

Notice

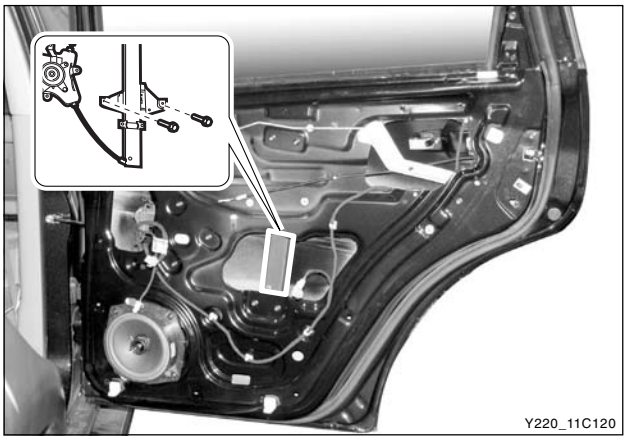
Apply a small amount of soapy water to the contacting point of glass run and the glass with a brush to make the installation easier.



6. Install in the reverse order of removal.

Rear Window

1. Remove the external door weatherstrip.
2. Remove the front garnish from rear door.
3. Remove the door trim assembly and seal.



4. Remove the rear door glass.
   1) Lift up the carrier plate in regulator and remove the screws.

Tightening torque	3 Nm

Notice

Make sure that the glass doesn't contact to the vehicle body. It may cause to damage the painted surface.

5. Install in the reverse order of removal.

Notice

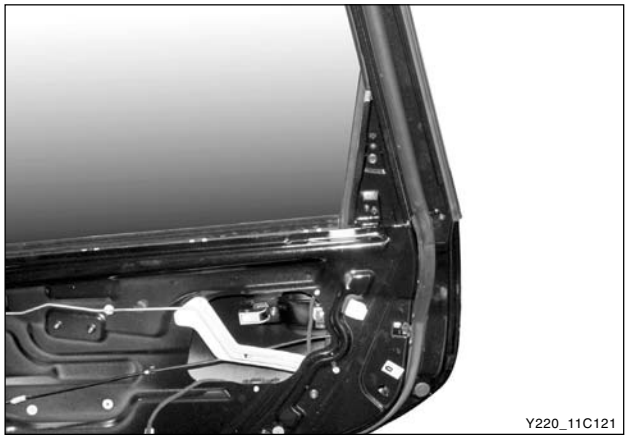
Apply a small amount of soapy water to the contacting point of glass run and the glass with a brush to make the installation easier.

Rear Glass Run / Regulator / Channel

1. Remove the door trim, seal and glass.
2. Remove the door glass run from door.

Notice

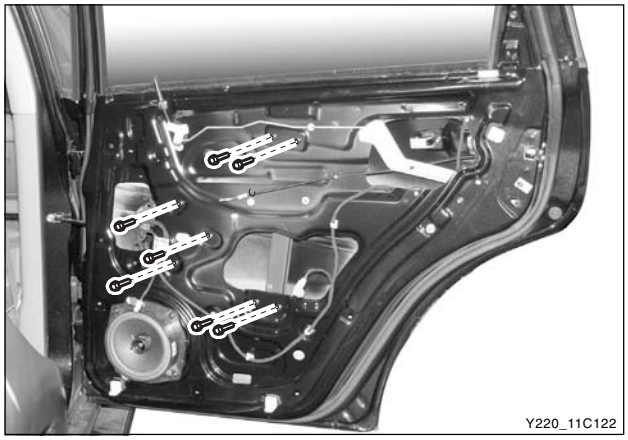
Apply a small amount of soapy water to the contacting point of glass run and the glass with a brush to make the installation easier.


Y220_11C121

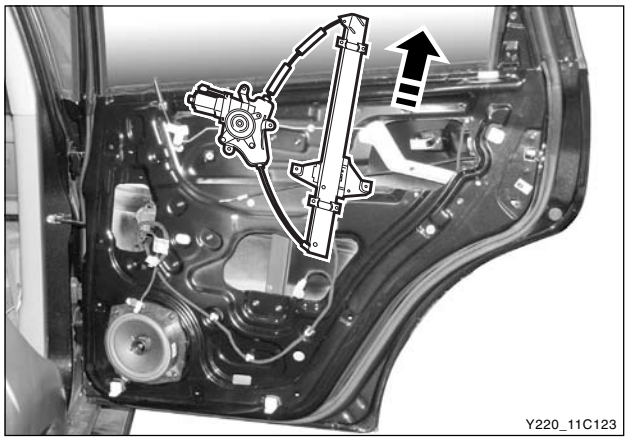
3. Remove the door regulator assembly.
   1) Disconnect the window motor connector.
   2) Unscrew the mounting nuts.

Installation Notice

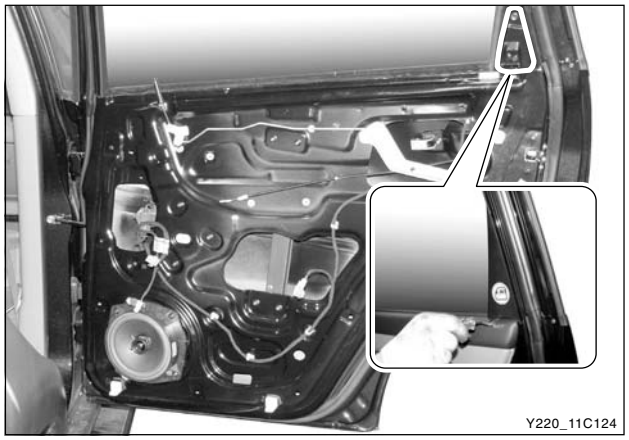
Tightening torque	8 Nm

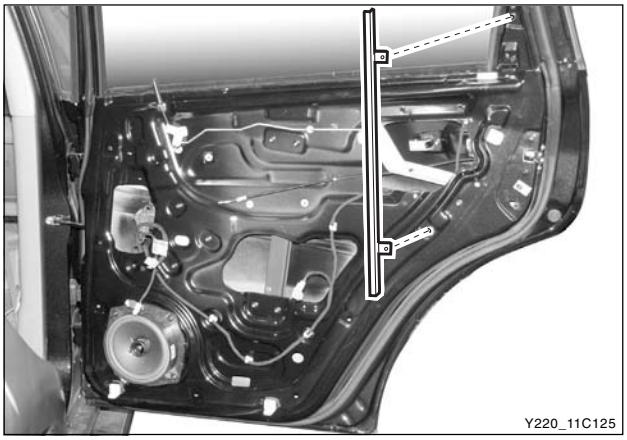

Y220_11C122

   3) Remove the window regulator.


Y220_11C123

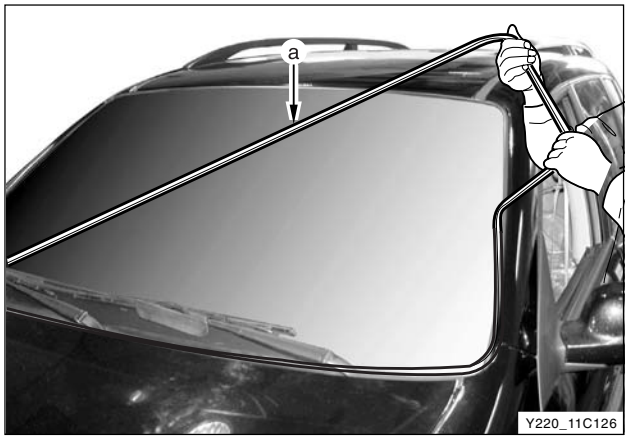
4. Remove the glass channel.
   1) Remove the inner panel from rear door.


Y220_11C124



2) Unscrew the mounting bolts and remove the glass channel.
3) Make sure to install the glass channel at correct location.

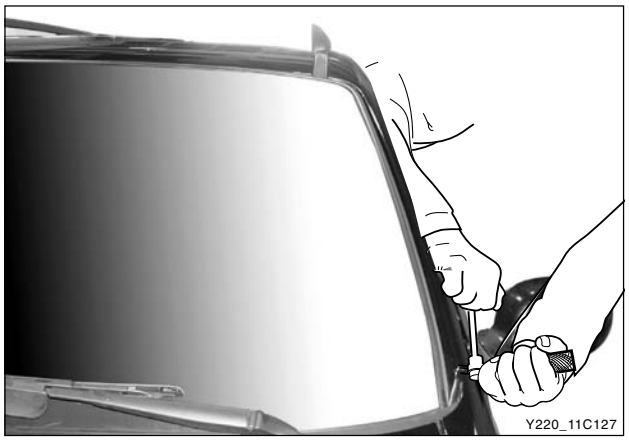
5. Install in the reverse order of removal.



Windshield

Removal

1. Remove the cowl grille.
2. Remove the inside rearview mirror.
3. Remove the weatherstrip (a) around the windshield.

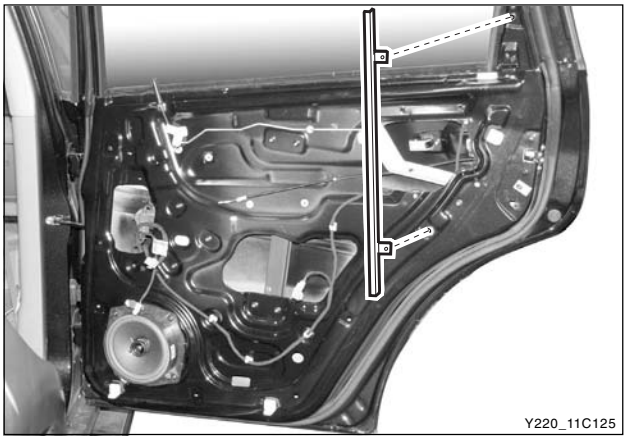


4. Cut the adhesive around the windshield with a special tool.

5. Remove the windshield.
6. Using a knife, remove the adhesive around the windshield and window frame.

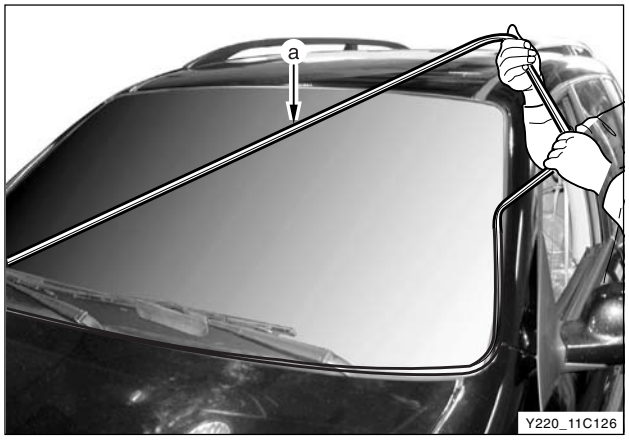
Note

To prevent the painted surface from damaging, do not remove the adhesive by 1 mm from the body surface.



2) Unscrew the mounting bolts and remove the glass channel.
3) Make sure to install the glass channel at correct location.

5. Install in the reverse order of removal.



Windshield

Removal

1. Remove the cowl grille.
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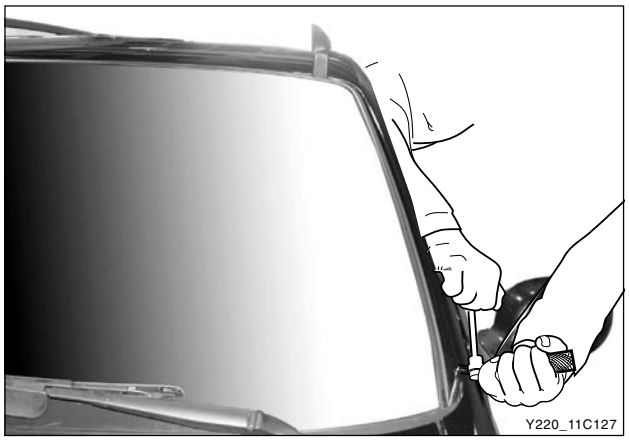
3. Remove the weatherstrip (a) around the windshield.



4. Cut the adhesive around the windshield with a special tool.

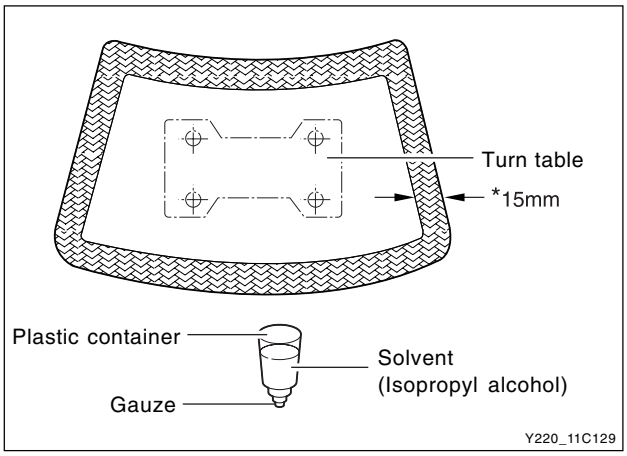
5. Remove the windshield.
6. Using a knife, remove the adhesive around the windshield and window frame.

Note

To prevent the painted surface from damaging, do not remove the adhesive by 1 mm from the body surface.

Installation

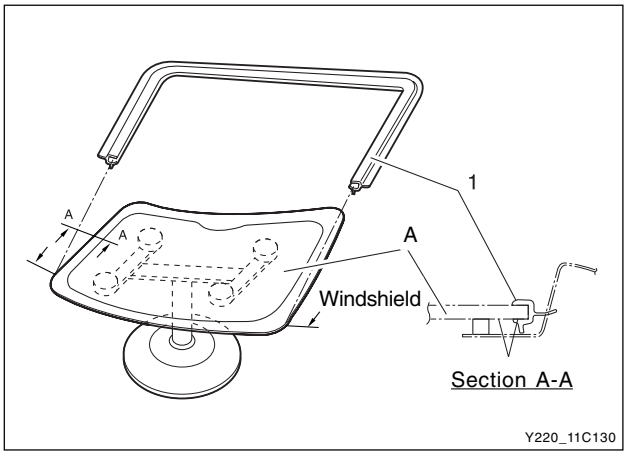
1. Thoroughly clean the adhesive primer applying area on windshield.
   1) Keep the width of 15 mm from the windshield end to cleaned area.
   2) The gauze that has been used over 20 times should be disposed.
   3) Fully dampen the gauze with a solution (isopropyl alcohol).
   4) Do not contact your fingers to the cleaned glass surface.
   5) Apply the adhesive primer around the fully dried glass.
   6) Make sure to thoroughly remove the foreign materials such as oil and dirt from the adhesive primer applying area.



2. Install new weatherstrip around the windshield.

   Notice

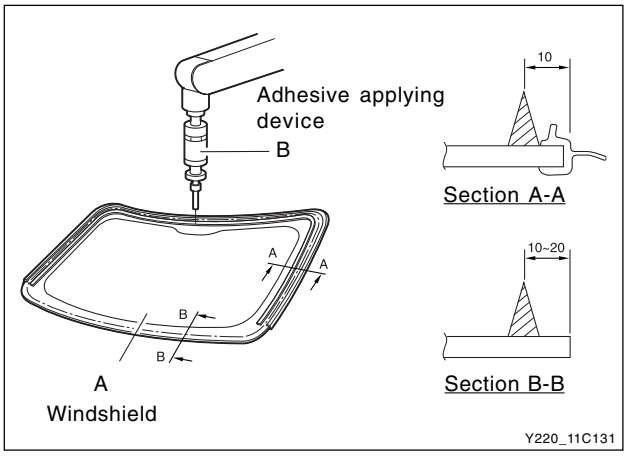
   The windshield should be installed within 5 minutes after applied the glass adhesive.



3. Apply the adhesive around the windshield.

   Notice

   - ***If the adhesive bead is not constant and the applied volume and height is not even, it may cause the waterleaks.***
   - ***Be careful not to contact the weatherstrip and glass dam when applying the adhesive with a nozzle.***



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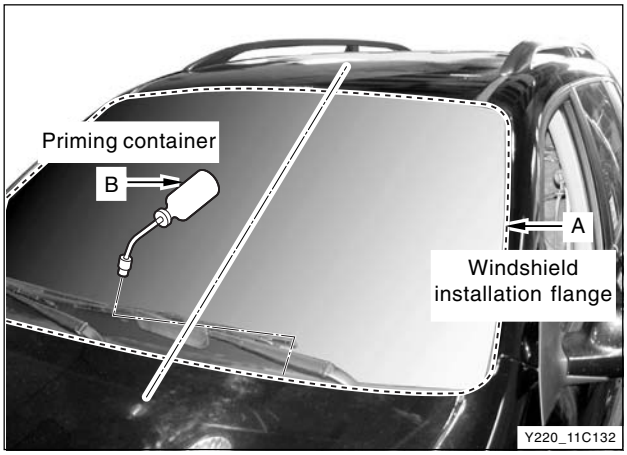
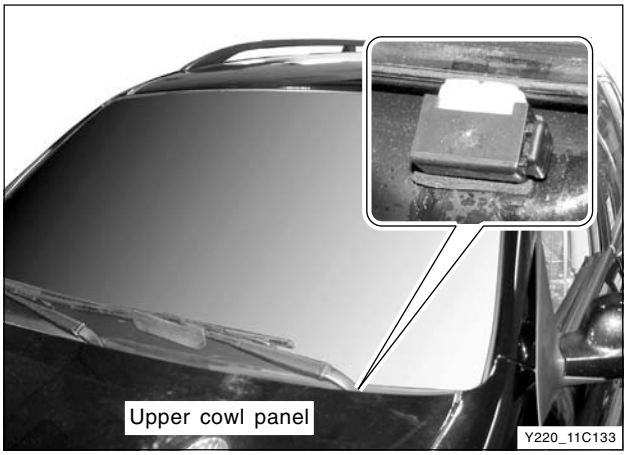
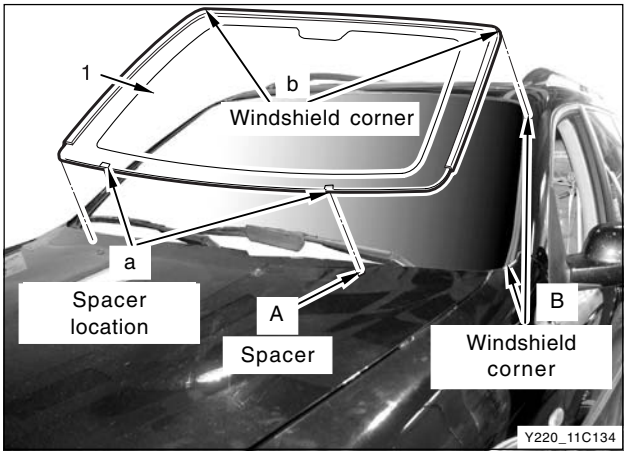


4. Clean the windshield installation flange.
   - The gauze that has been used over 20 times should be disposed.
   - Fully dampen the gauze with a solution (isopropyl alcohol).
   - Make sure to thoroughly remove the foreign materials such as oil and dirt from the adhesive primer applying area.
   - Apply the adhesive primer around the fully dried glass.
   - Usable period after applied: 3 minutes to 8 hours (reapply after 8 hours)
   - When contaminated by the primer: Clean the contaminants using a cloth with a cleaning solution such as the mixed agent of ethyl alcohol and ethyl acetate (50:50).
   - Dispose the out of available period primer (90 days).
   - Be careful not to flow down the primer. It may contaminate the vehicle body.



5. Insert the windshield spacer.
   - Insert it until it sounds “click” on the step.
   - No gap is accepted.

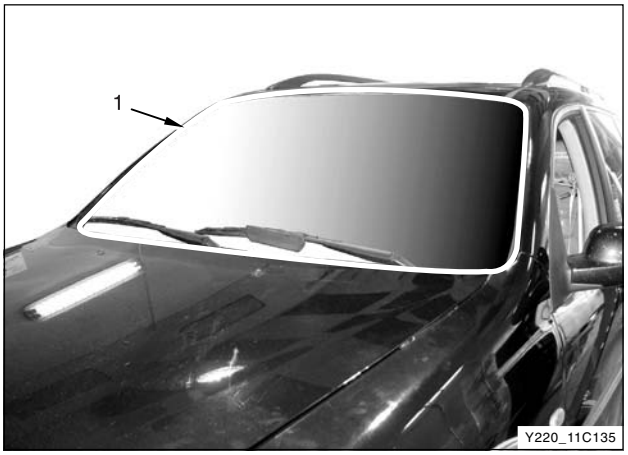


6. Install the windshield.

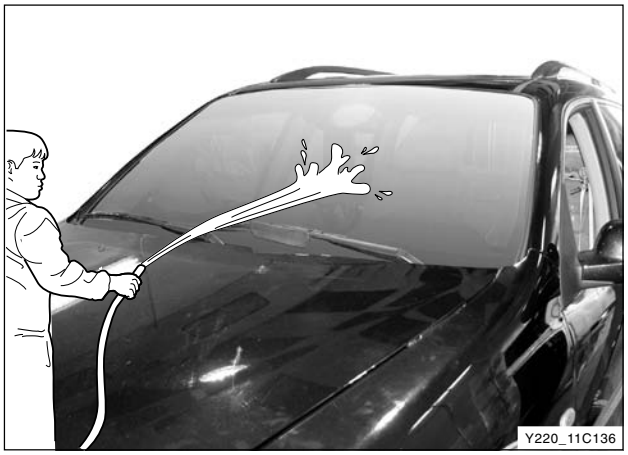
Note

If a clearance exists between weatherstrip and body around the glass corners (b), adjust it by using the spacers (A).

7. Attach the tape to windshield weatherstrip, windshield and windshield frame.
8. Let the adhesive dry for 24 hours.
9. Remove the tape.



10. Check for waterleaks by pouring water on the windshield. If a leak is found, dry the windshield and fill the area that leaks with adhesive. If the leak persists, remove the windshield and repeat the entire procedure.



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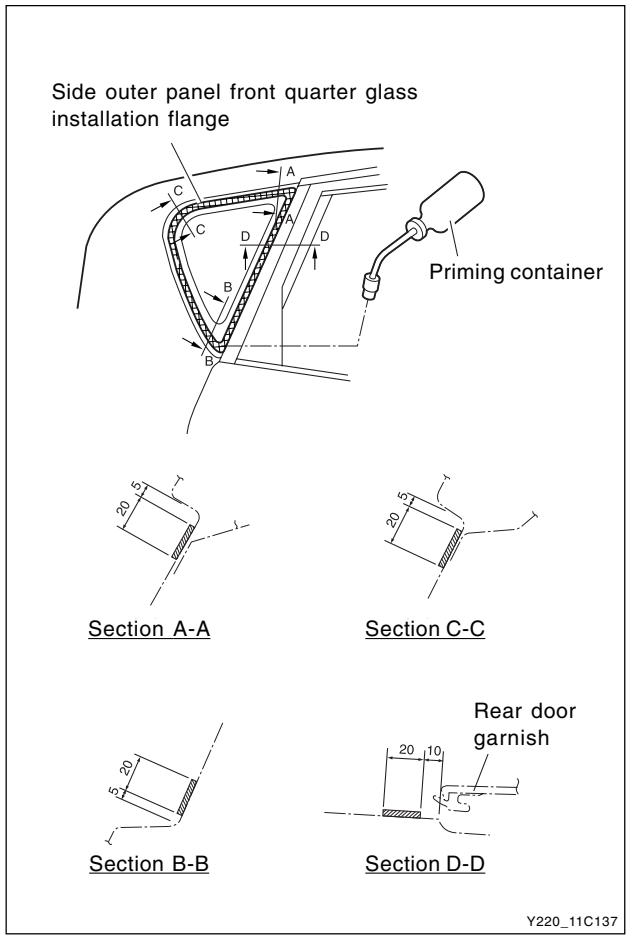
Front Quarter Glass

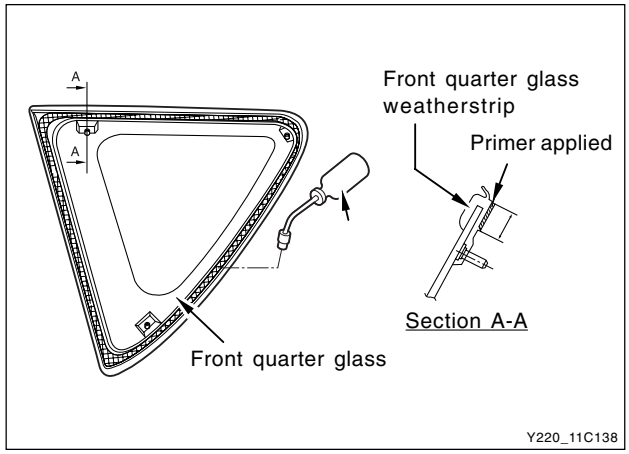
Removal

1. Unscrew the quarter glass mounting nuts and remove the glass weatherstrip cover.
2. Remove the quarter glass and remove the adhesive from the quarter glass and frame with a knife.



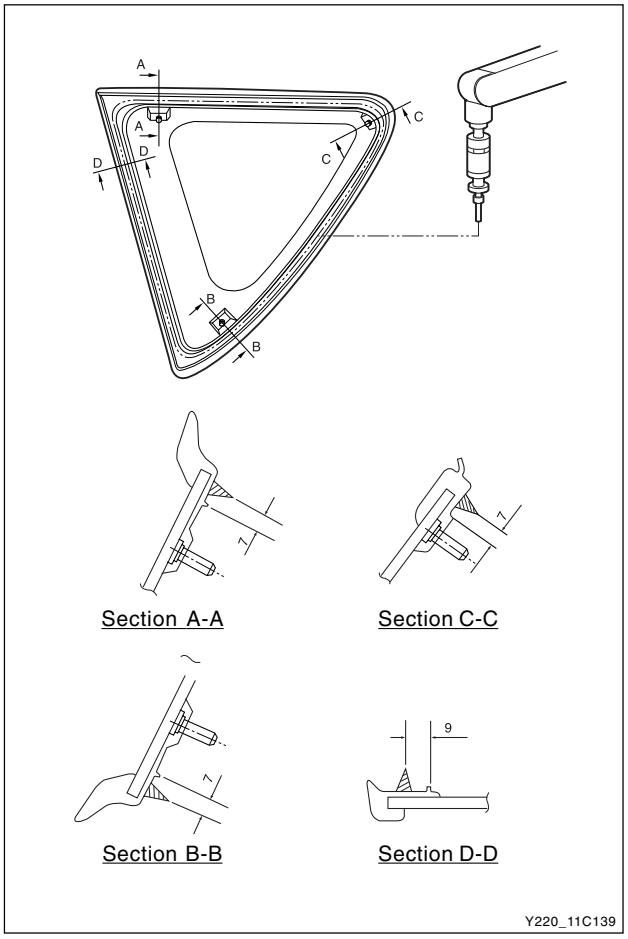
Installation

1. Thoroughly clean the body frame (glass installation area).
2. Apply the primer on the glass installation area with keeping the clearance as shown in the figure.

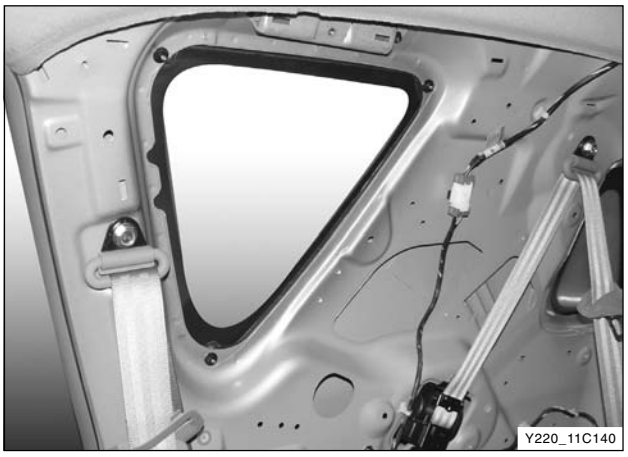


3. Apply the primer on the new quarter glass weatherstrip and install it.

4. Apply the adhesive to the glass with keeping the clearance as shown in the figure.



5. Install the front quarter glass to the body frame and tighten the bolts and nuts.



6. Check for waterleaks by pouring water on the glass.

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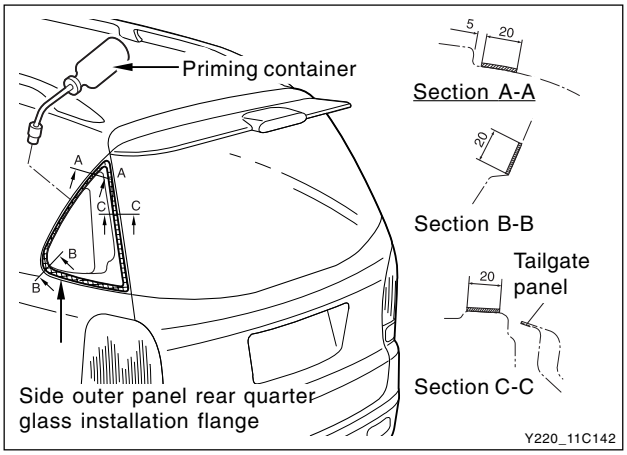
Rear Quarter Glass

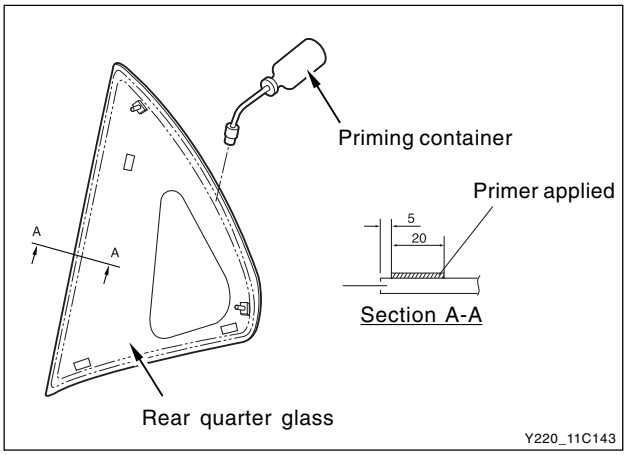
Removal

1. Remove the adhesive around the rear glass with a special tool.
2. Remove the rear quarter glass.



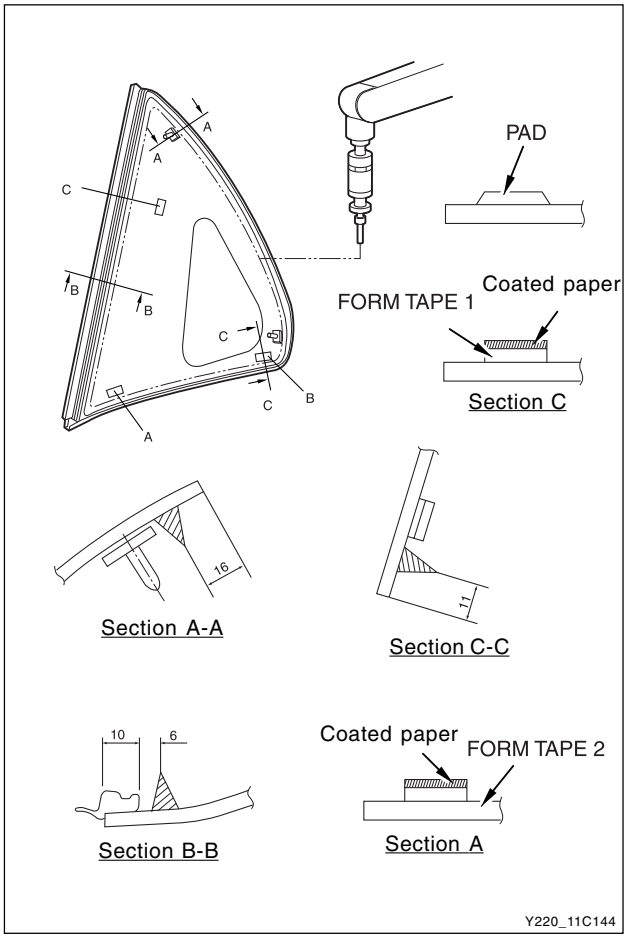
Installation

1. Thoroughly clean the body frame (glass installation area).
2. Apply the primer on the glass installation area with keeping the clearance as shown in the figure.

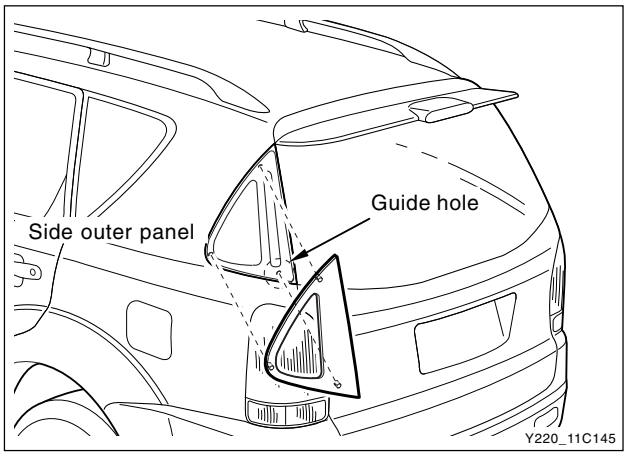


3. Apply the primer on the new quarter glass weatherstrip and install it.

4. Apply the adhesive to the rear quarter glass with keeping the clearance as shown in the figure.



5. Install the rear quarter glass to the body frame and tighten the bolts and nuts.
6. Check for waterleaks by pouring water on the glass.



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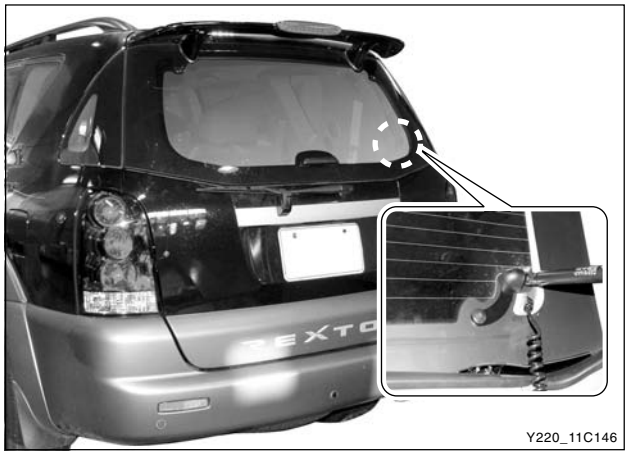
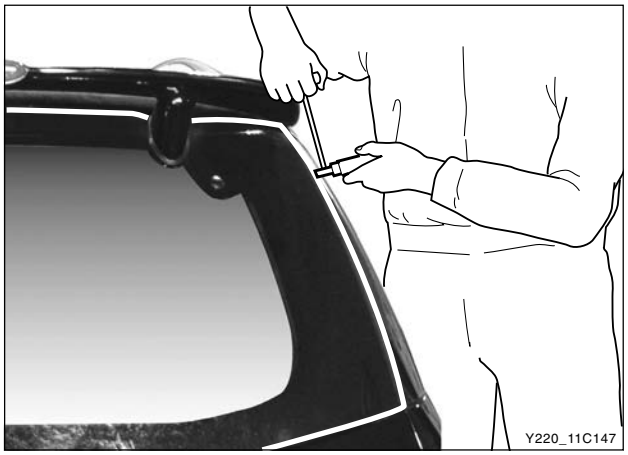


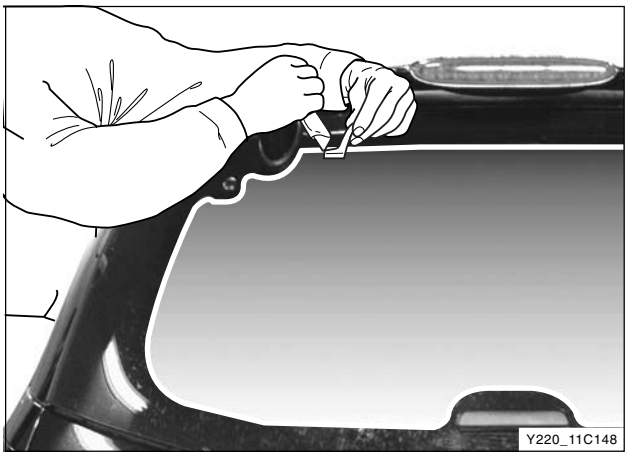
Tailgate Glass

Removal

1. Disconnect the negative battery cable.
2. Disconnect the rear defogger connector from the tailgate glass.



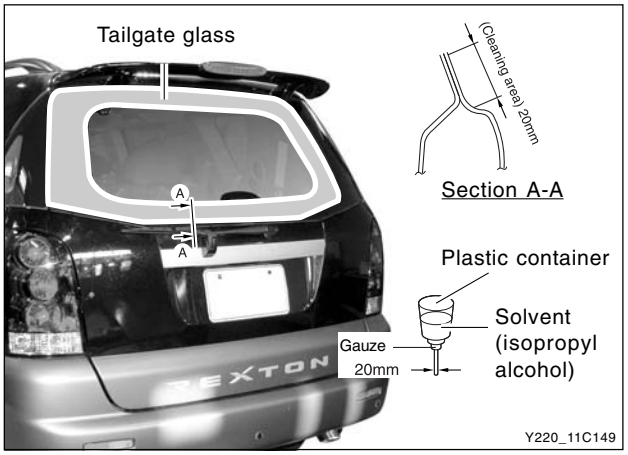
3. Remove the adhesive around the tailgate glass with a special tool.



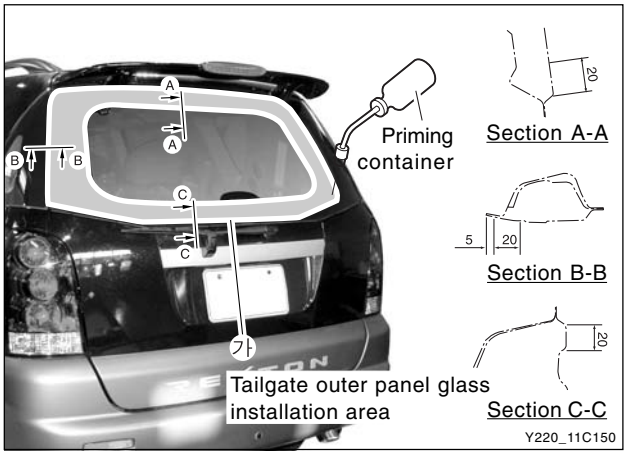
4. Remove the tailgate glass.
5. Remove the adhesive around the tailgate glass and frame with a knife.

Installation

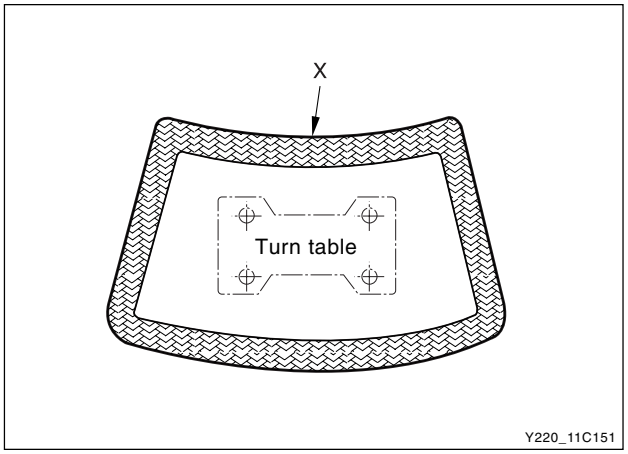
1. Clean the tailgate outer panel.
   - The gauze that has been used over 20 times should be disposed.
   - Fully dampen the gauze with a solution (isopropyl alcohol).
   - Do not contact your fingers to the cleaned glass surface.
   - Apply the adhesive primer around the fully dried glass.
   - Make sure to thoroughly remove the foreign materials such as oil and dirt from the adhesive primer applying area.



2. Apply the glass primer.
   - Store the glass primer in the refrigerator before using.
   - Completely mix the primer before using (over 10 minutes, no deposit).
   - Use the primer within 2 hours after opening the package.
   - Even though it is sealed again after opening, it should be used within 24 hours.
   - Distribute the primer evenly.
   - Usable period after applied: 3 minutes to 8 hours (reapply after 8 hours)
   - When contaminated by the primer: Clean the contaminants using a cloth with a cleaning solution such as the mixed agent of ethyl alcohol and ethyl acetate (50:50).
   - Be careful not to flow down the primer. It may contaminate the vehicle body.



3. Clean the tailgate glass.
   - Keep the width of 15 mm from the windshield end to cleaned area.
   - The gauze that has been used over 20 times should be disposed.
   - Fully dampen the gauze with a solution (isopropyl alcohol).
   - Do not contact your fingers to the cleaned glass surface.
   - Apply the adhesive primer around the fully dried glass.
   - Make sure to thoroughly remove the foreign materials such as oil and dirt from the adhesive primer applying area.



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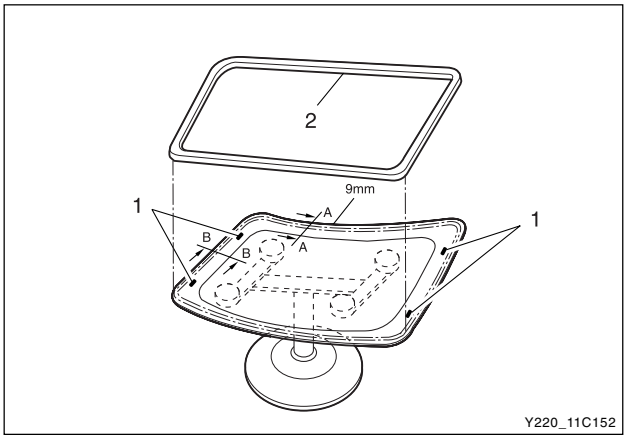
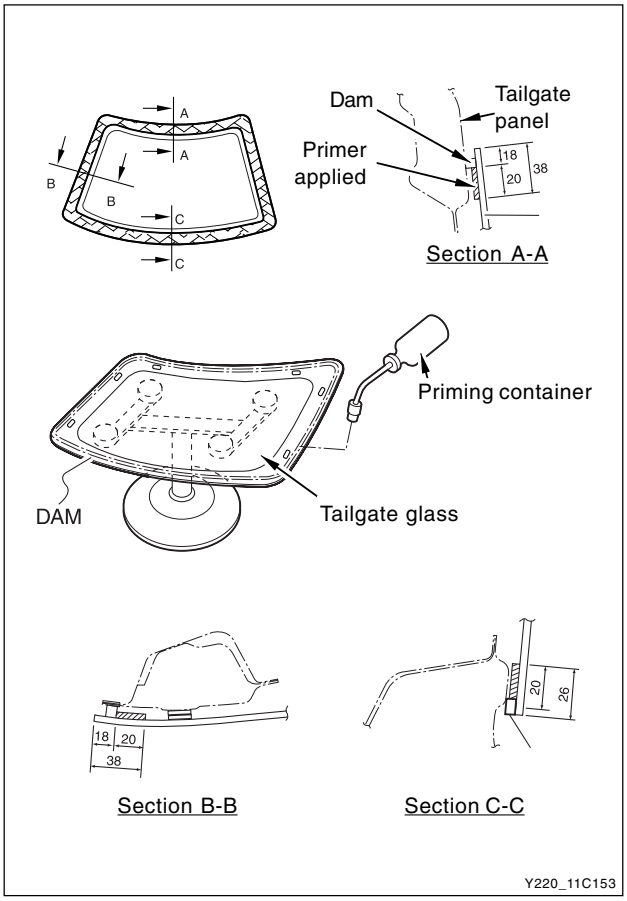
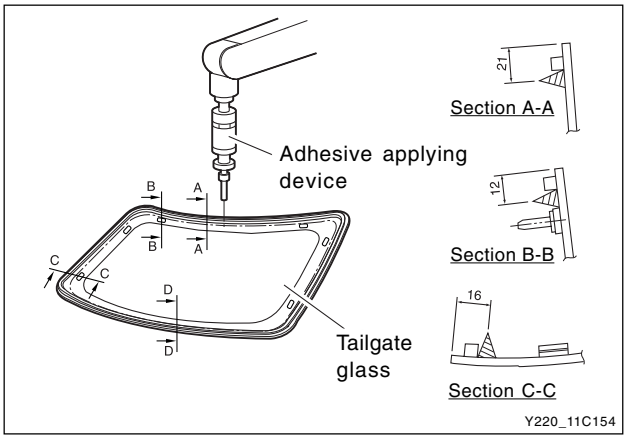


4. Attach the dual-lock (1) to the tailgate glass and install the glass dam.

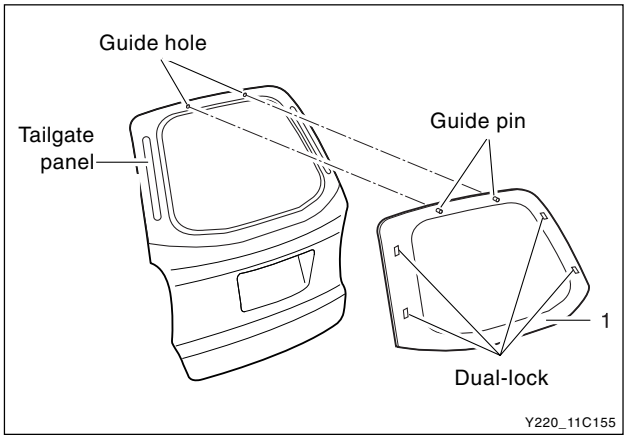


5. Apply the primer to the tailgate glass.
   - Completely mix the primer before using (over 10 minutes, no deposit).
   - Be careful not to flow down the primer. It may contaminate the vehicle body.
   - Curing time after applied: 1 minutes to 24 hours (reapply after 24 hours)
   - Do not use the primer with deposit or floating matters.
   - Dispose the out of available period primer (90 days).
   - Distribute the primer evenly on the glass surface.



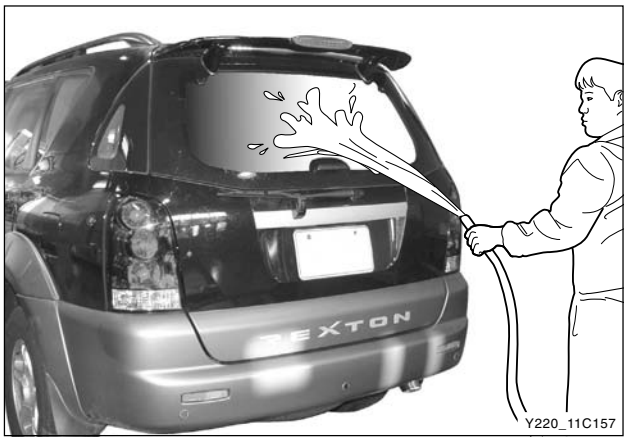
6. Apply the glass adhesive to the tailgate glass.
   - Turn over the tailgate glass and start to apply the glass adhesive at 200 mm from the right bottom corner.
   - If the adhesive bead is not constant and the applied volume and height is not even, it may cause the waterleaks.

7. Install the tailgate glass with a compressor within 5 minutes after applying the glass adhesive.
   - Put the adhesive tapes at the tailgate, the upper corners (2 locations) and the arm side after installing the tailgate glass.



8. Attach the tape to the tailgate glass and the tailgate glass frame.
9. Let the adhesive dry for 24 hours.
10. Remove the tape (a).

11. Check for waterleaks by pouring water on the tailgate glass. If a leak is found, dry the tailgate glass and fill the area that leaks with adhesive. If the leak persists, remove the tailgate and repeat the entire procedure.
12. Connect the rear defogger connector.
13. Connect the negative battery cable.



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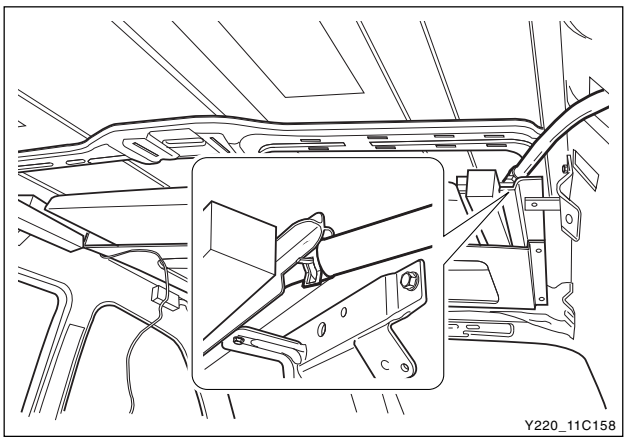
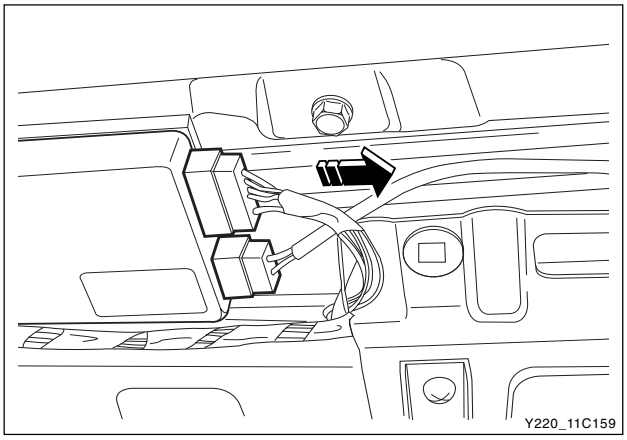
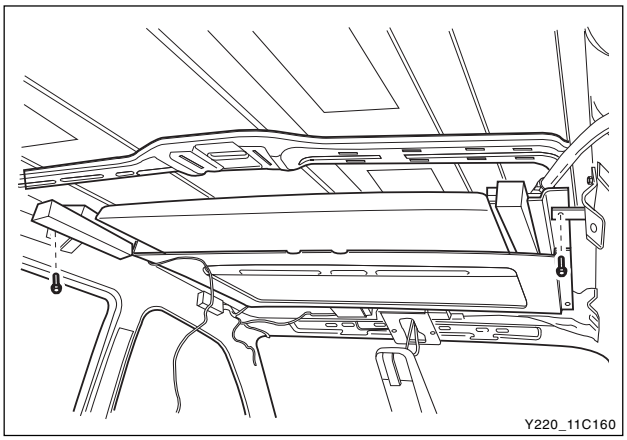


Sun Roof

1. Remove the headlining, room lamps and sun visors.
2. Remove the hose clips at each corner (4 locations) on the sun roof drain hose. Disconnect the drain hose while gently pulling it.



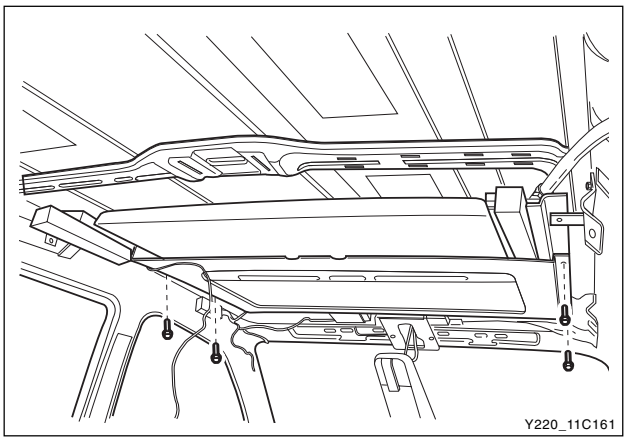
3. Disconnect the power connector in the relay box.



4. Remove the sun roof bracket.

   Installation Notice

Tightening torque	25 ~ 35 Nm



5. Unscrew the mounting bolts and remove the sun roof assembly.

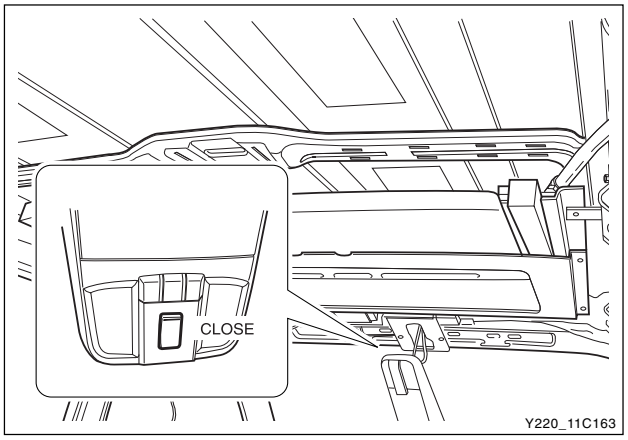
   Installation Notice

Tightening torque	25 ~ 35 Nm

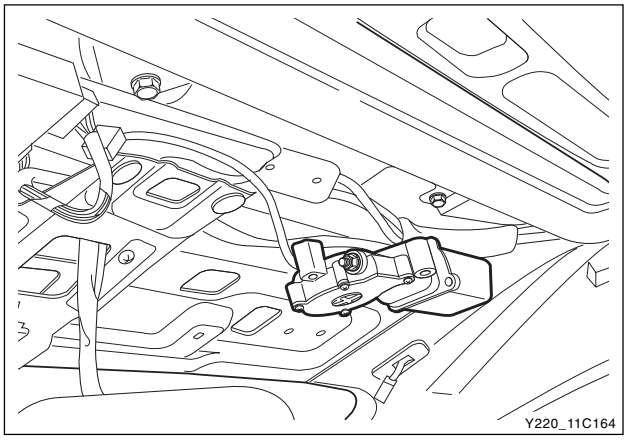
6. Install in the reverse order of removal.

Motor and Relay Box

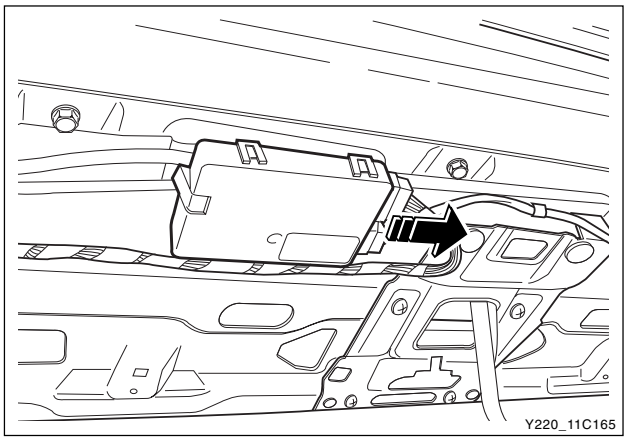
1. Close the sun roof.
2. Remove the headlining, room lamps and sun visors.
3. Cut out the tie-wrap in the relay box.



4. Disconnect the motor connector and remove the bolts and motor assembly.



5. Disconnect the power connector in the relay box.
6. Unscrew the mounting bolts and remove the relay box from the front beam.



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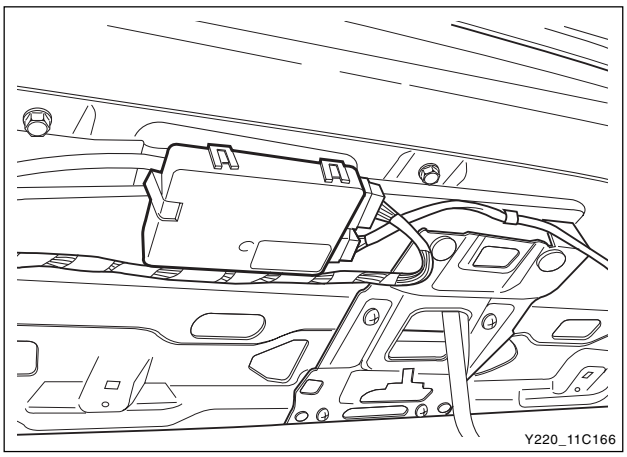
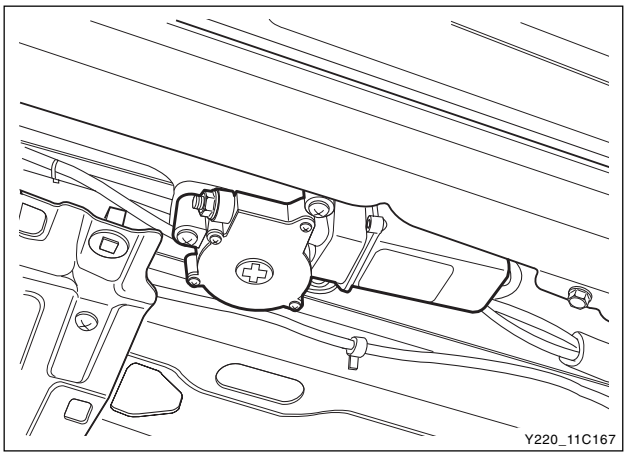




7. Install in the reverse order of removal.
   1) Keep the glass panel closed (normal close position).
   2) Check if the motor is at “Normal Close” position.
      - Normal Close Position: The motor stop position when turning off the system by the switch.
   3) Install the motor.

      The motor is engaged into the bolt hole in the locating bracket.
   4) Install the motor mounting bolts.

      Installation Notice

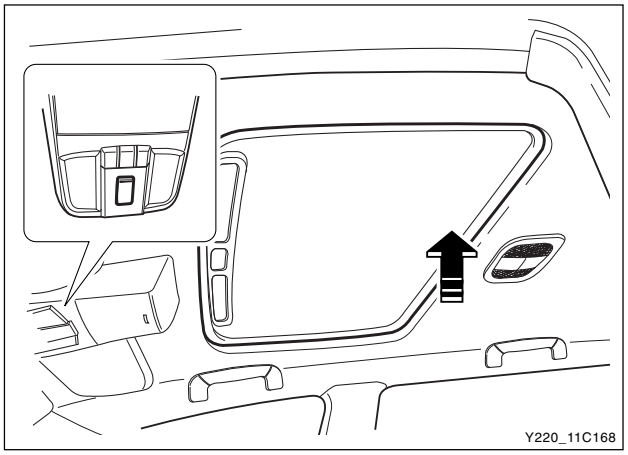
Tightening torque	3 Nm

   5) Hook the relay box on the front beam.
   6) Fasten the relay box with the tie-wrap.
   7) Check the sun roof operations.

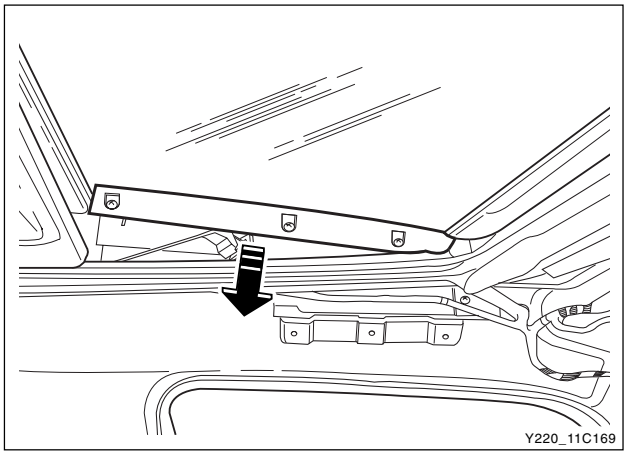
Glass Panel

Removal

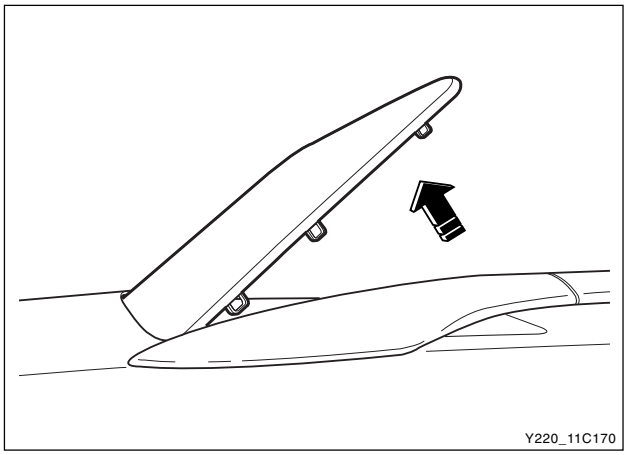
1. Tilt the sun roof.



2. Remove the side inner cover.
3. Remove the glass mounting bolts.



4. Pull out the glass panel.



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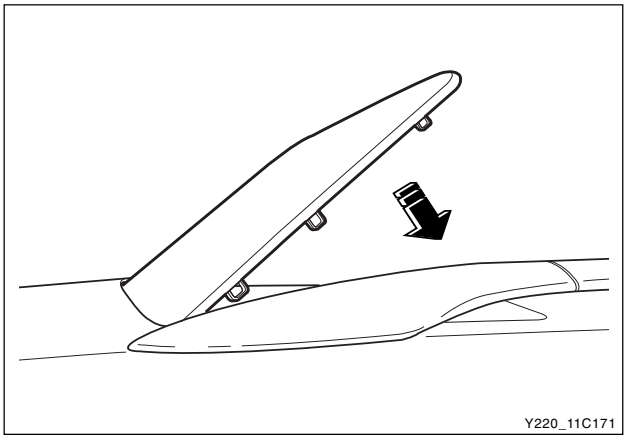
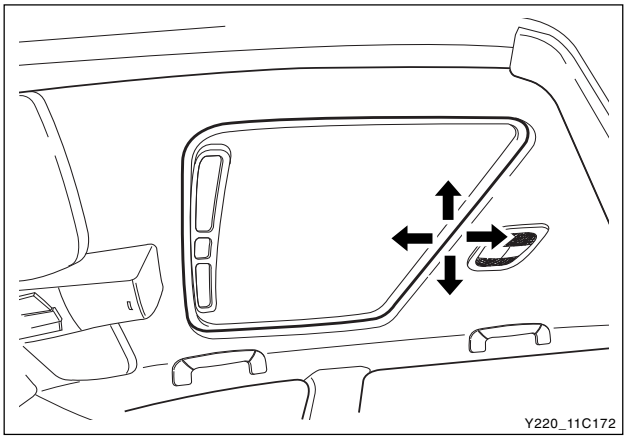


Installation

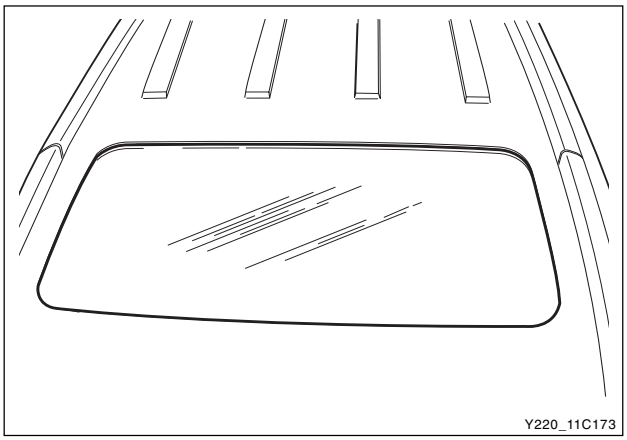
1. Install the glass panel inside of cover-on panel (check the bolt tightening locations from inside the vehicle)

   NOTICE

   Make sure the marking on the glass faces rearward.



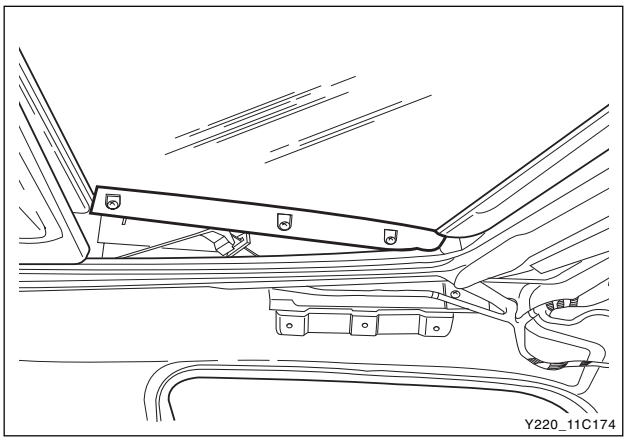
2. Temporarily tighten the mounting bolts.
3. Slowly close the sun roof by using the sun roof switch. The sun roof should be operated smoothly.



4. Adjust the sun roof height. The front level of the glass should be same with the vehicle body and the rear level of it should be higher 1 mm than the vehicle body. Tighten the bolts.

Tightening torque	5 Nm

5. Check the operations of sun roof.



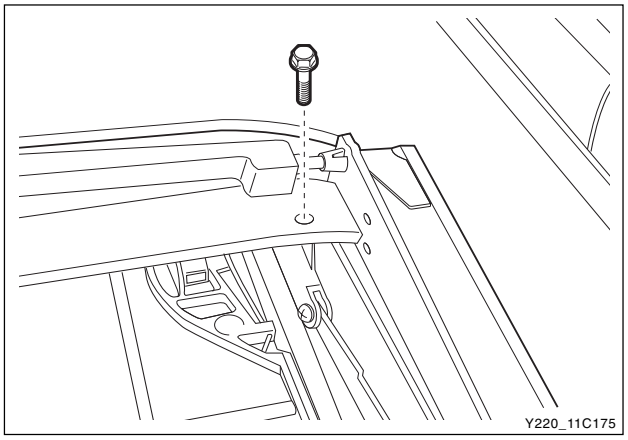
6. Tilt the glass by using the sun roof switch.
7. Install the side covers at both sides.

   Check the installations of side inner cover and the side outer cover. Check the abnormal noise and functions while operating the sun roof.

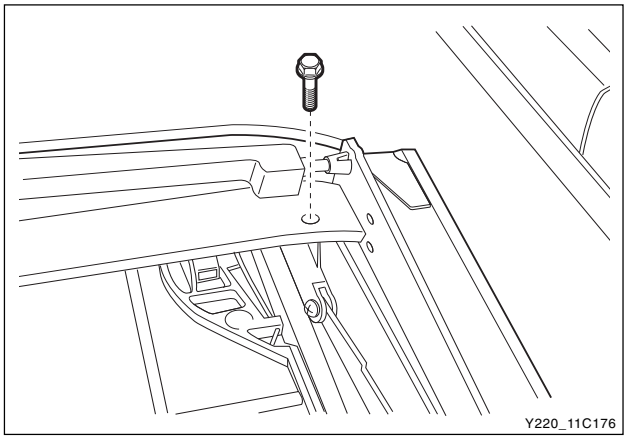
Sun Shade

Removal

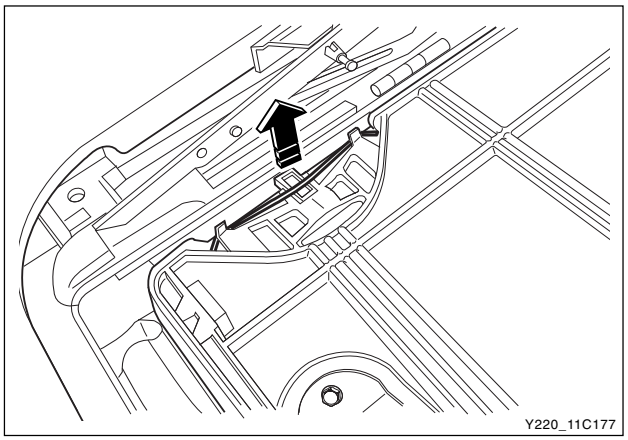
1. Remove the glass panel.



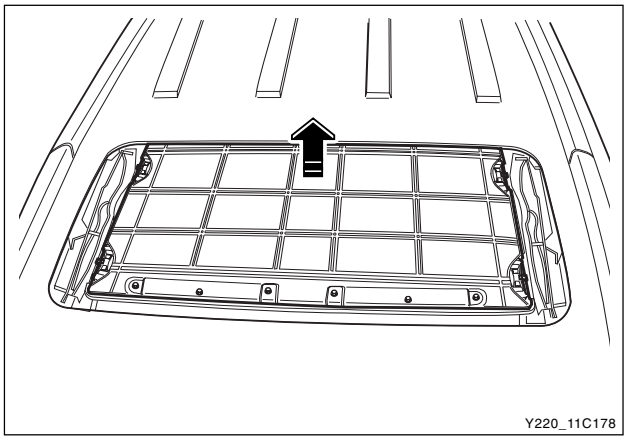
2. Unscrew the mounting bolts and remove the drain channel by pushing the plastic hook.



3. Close the sun shade panel and remove the slide blocks (4 locations) from the guide rail with a flat blade screwdriver.



4. Remove the sun shade panel.



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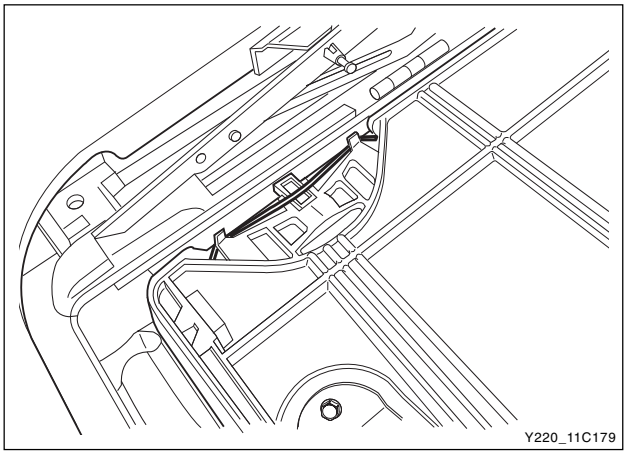
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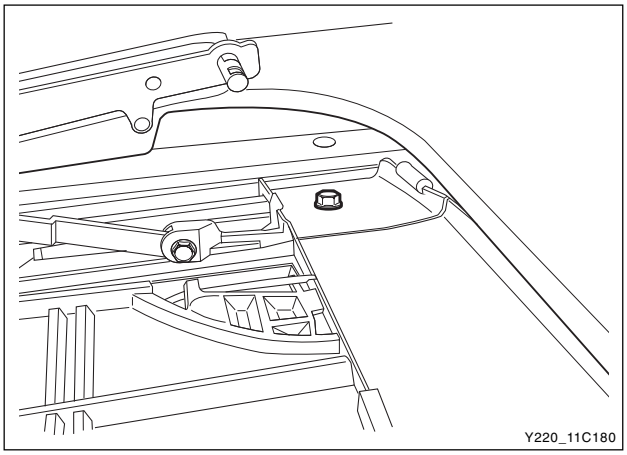
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Installation

1. Put the sun shade on the guide rail.
2. Install the slide blocks into the guide rail on sun shade panel with a flat blade screwdriver.
3. Insert the drain channel into the roof and hook the rear drain channel, then press the front hook.

Tightening torque	12 Nm

4. Check the operations of sun shade panel (functions/ vibration/noise/interference)
5. Install the glass panel.

SECTION 12

AIRBAG SYSTEM

Table of Contents

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GENERAL DESCRIPTION AND OPERATION

GENERAL PRECAUTIONS

When the ignition is switched ON, the supplemental inflatable restraints (SIR) warning lamp must blink at six times for 6 seconds and then turn off.

There is a fault in the airbag system if the warning lamp does not turn OFF or the warning lamp illuminates while the vehicle is in operation. If the warning lamp indicates there is a fault in the airbag system, assume that the SIR system may not be functional.

Notice

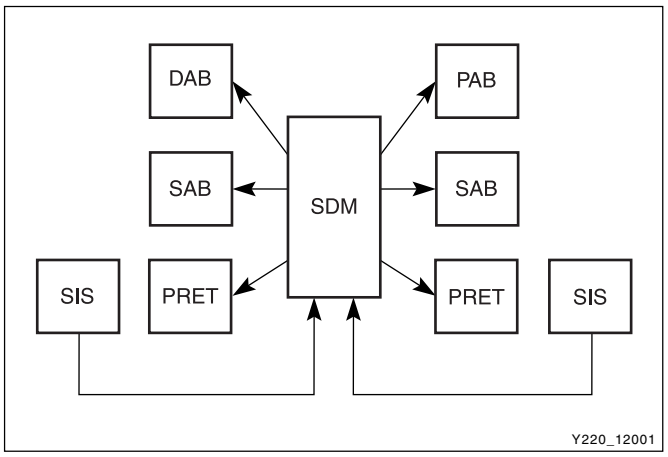
Failure to follow all service procedures in the correct sequence can cause the airbag system to deploy unexpectedly and possibly cause a serious injury.

- ***Only trained personnel at franchised SsangYong dealers and authorized SsangYong service dealerships may service the airbag system.***
- ***Never attempt to disassemble, repair or reuse the following component;***
  - ***Airbag modules***
  - ***Clock spring***
  - ***Sensing and diagnostic module***
  - ***Wiring harness***
- ***When repairing SIR component, follow the service notice;***
  - ***Inspect any SIR part before it is installed.***
  - ***Use only new parts.***
  - ***Do not install used SIR parts from other vehicles.***
  - ***Do not install any part that has been dropped or that has dents, cracks or other defects.***
- ***Before testing, disconnect the negative battery cable. Wait one minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.***

▶ SIR System

SIR system consists of 6-Loop (DAB, PAB, 2*SAB, 2*PRET) fully and the block diagram is as shown below.

On this diagram, SDM sends the output signal to DAB, PAB, 2*SAB, 2*PRET and receives the input of side impact from 2*SIS (Side Impact Seasor).



Abbreviation

1	SDM	Sensing and Diagnostic Module
2	DAB	Driver-side Airbag Module
3	PAB	Passenger-side Airbag Module
4	SAB	Side Airbag Module (Driver, Passenger)
5	PRET	Seatbelt Pretensioner (Driver, Passenger)
6	SIS	Side Impact Sensor (Driver, Passenger)

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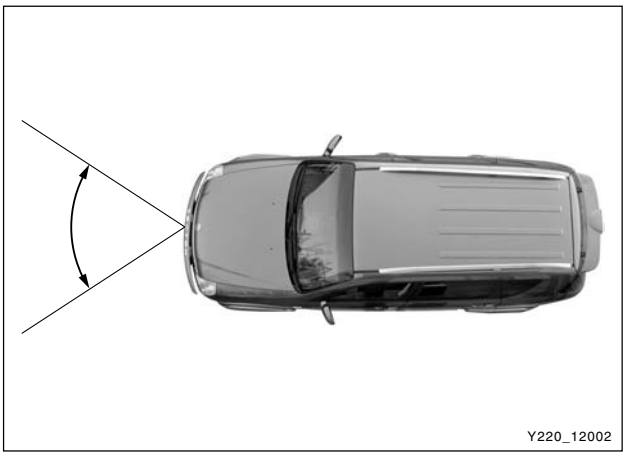
CAUTIONS WITH THE AIR BAG

▶ Side Airbag Operation



The air bag inflates when:

- Vetical side impact is over 25 km/h of vehicle speed

The air bag does not inflate when:

- Impact speed is very low
- Rear impact

The air bag seldom inflates when:

- Oblique impact (diagonal direction)
- Impact at engine compartment or trunk
- Partial impact at side of the front seat such as telegraph pole
- Vertical impact against a motorcycle
- Rollover

▶ Front Airbag Operation (Driver's and Passenger's)

The air bag inflates when:

- Frontal impact against a solid concrete wall at over 25 km/h or near-frontal impact within 30 degrees from the center of the vehicle at both corners

The air bag can inflate when:

- Underbody impact from the road surface; impact against the curb at a very high speed; dropping impact onto the road surface with a large angle

The air bag does not inflate when:

- Rollover, side impact or rear impact

The air bag seldom inflates when:

- Oblique impact, rollover
- Weak impact in which the sensor is unable to detect (under the inflation requirements)
- Impact against narrow objects such as a telegraph pole or a tree
- The vehicle falls into a drainage or a puddle
- The front of the vehicle crashes into high impact point vehicle such as a truck
- Impact on the hood by falling stones
- The air bag warning lamp is on

Warnings for Airbag

- ***Do not diagnose the circuit with a circuit tester. Do not attempt to modify any air bag components including the steering wheel, air bag mounting area, and harness.***
- ***Do not impact any air bag components including the steering wheel, air bag mounting area, and harness by hand or tools. You may get injured by sudden deployment.***
- ***The air bag components will be very hot after deployment. Do not touch them.***
- ***Once the air bag system is triggered, the triggered air bag assembly should be removed from the vehicle and replaced with new one.***
- ***The air bag contains explosive materials, so contact Ssangyong Dealer or Ssangyong Authorized Service Operation when trashing or replacing it.***
- ***Incorrect air bag inspection can be dangerous and cause injuries. The air bag system must be disposed only by Ssangyong Dealer or Ssangyong Authorized Service Operation.***
- ***Replace the steering wheel with only Ssangyong genuine part.***
- ***When the engine starts, the air bag warning lamp comes on for a system check. It goes out after 3 to 7 seconds when the system is normal. If this warning lamp stays ON, then the system may be defective. Have the air bag system checked immediately by Ssangyong Dealer or Ssangyong Authorized Service Operation.***
- ***The seat belt and air the bags are the most effective when you are sitting well back and upright in the seat.***
- ***A child restraint system must not be placed on the front seat. The infant or child can be severely injured by an air bag inflation in case of an accident.***
- ***Do not carry your child on your lap while driving. You cannot resist against the impact pressure in an accident. The child could be crushed between you and the parts of the vehicle.***
- ***Do not place any objects on the air bag inflation location. You may get injured by those objects during deployment.***
- ***Do not attach any objects such as a sticker, scent bottle, or phone holder on the steering wheel pad and to the dashboard.***
- ***Do not put the seat cover on the front seatbacks. It may interfere with the side air bag inflation.***
- ***When sitting in the rear seat, do not hold onto the seatback of the front seat. If the side air bag inflates, the occupant may get seriously injured.***
- ***Do not lean on the door. When the side air bag inflates, the occupant may get seriously injured.***
- ***Do not place any objects such as an umbrella or a bag between the side air bag and the door. Do not place the part of your body near the side air bag. You may obstruct the side air bag or get injured by the inflation impact.***
- ***Do not slam the front doors. It may lead to an unintended inflation of the side air bag.***
- ***Do not move your seat too close to the steering wheel or dashboard. If you lower your head, the air bag can hit your head during inflation and can cause severe injury or even death.***
- ***Hold only the outer rim of the steering so that the air bag can inflate without any hinderances.***
- ***Do not place your face or chest near the steering wheel and dashboard. Also, do not allow anyone to place their hands, leg or face on the dashboard. 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.***
- ***When the air bag inflates, it makes a loud noise and smoke. However, the smoke is a non-toxic nitrogen gas.***
- ***When the air bag is deployed, non-toxic gas will come out. This gas may cause skin, eyes or nose irritation. Wash it out with cold and clean water and consult the doctor if irritation continues.***
- ***When any repairs are needed for the steering wheel, or when an accident occured without the air bag deployment, have the air bag system checked by Ssangyong Dealer or Ssangyong Authorized Service Operation.***
- ***The windshield glass may be broken when the passenger's air bag is deployed.***
- ***The air bag deployment can cause abrasion on your hands and face.***

▶ Airbag Module Discard

Airbag module deployment (inside vehicle)

Deploy the airbag before disposing of them. If a vehicle to be scraped, the airbag may be deployed inside the vehicle.

- Before deploying the airbags, remove all loose objects from the airbag's expansion area.
- Deploy the airbags with the vehicle doors closed and the side windows open.
- Deploy the airbags only in an evacuated area. Service personnel who must be present during the deployment should be at least 10 meters (33 feet) in front of the vehicle.
- Do not connect the voltage source until after having completed all other preparations for the deployment of the airbags.
- Allow a deployed airbag module or pretensioner to cool for at least 30 minutes before handling.
- If the deployment fails, disconnect the voltage source and wait 5 minutes before approaching the vehicle.

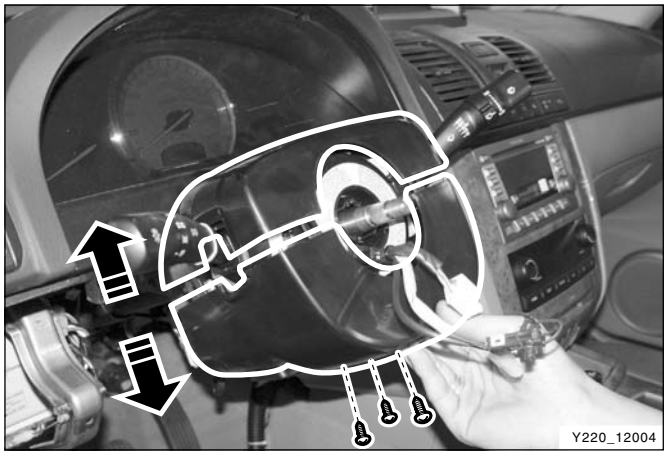
▶ Airbag Module Discard (Driver)

1. Disconnect the battery cable and place the vehicle battery at least 10 meters (33 feet) away from the airbag module.

   Notice

   If the airbags are not disconnected, service cannot begin until one minute has passed after disconnecting power to the SDM. If the airbags are disconnected, service can begin immediately without waiting for one-minute time period to expire. Failure to temporarily disable the SRS during service result in unexpected deployment, personal injury and otherwise unneeded SRS repair.

2. Remove the lower cover of the steering column.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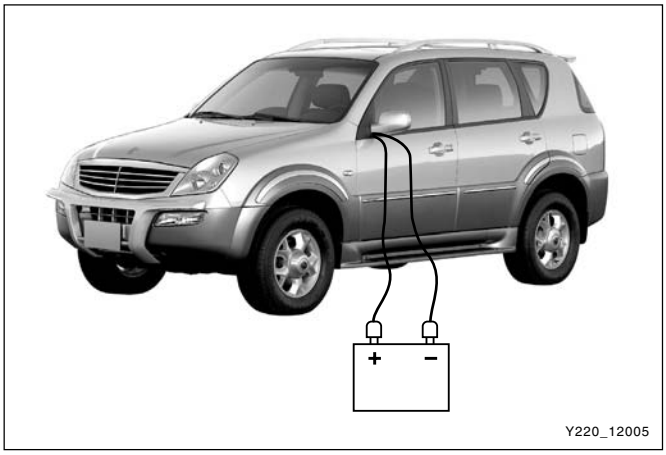
3. Cut two wires between the airbag and the contact coil.
4. Strip 13 mm (0.5 inch) of the insulation from the end of the wires leading to the contact coil.
5. Use two additional wires, each at least 10 meters (33 feet) long, to reach from the deployment battery to the airbag module.
6. Strip 13 mm (0.5 inch) of the insulation from the ends of these two additional wires.
7. Twist the two wires together at one end.
8. Place the twisted ends of the two wires near the deployment battery. Do not connect the wires to the battery at this time.
9. Using the free ends of the 10 meters (33 feet) wires leading to the airbag module, make two splices, one at each wires from the airbag module.
10. Wrap the splices with insulating tape.
11. Now that the free ends of the 10 meters (33 feet) wires are spliced to the airbag module wires and the ends that are twisted together are near the deployment battery, clear the area.
12. Untwist the wires that near the deployment battery.



Y220_12005

13. Touch one wire to the positive battery terminal and touch the other wire to the negative battery terminal. The airbag module will deploy.
14. Refer to "DEPLOYED AIRBAG MODULE DISPOSAL PROCEDURE" in this section.

Airbag module discard (passenger)

The passenger airbag deployment is the same procedure of the driver's. Remove the glove box instead of the contact coil and cut two passenger airbag wires.

Refer to "AIRBAG MODULE DISCARD (DRIVER)" in this section for more information.

Airbag module deployment (outside vehicle)

Deploy airbag modules in following situations:

- If the airbag module is removed in the discarded vehicle.
- If the airbag module is replaced due to any fault.
- If an airbag module is damaged during transfer, storage or servicing.

Observe following precaution if the airbag is deployed:

- Deploy the airbags only in an evacuated area. Service mechanics should be at least 10 meters (33 feet).
- Do not connect the voltage source until after having completed all other preparations for the deployment of the airbags.
- Allow a deployed airbag module or pretensioner to cool for at least 30 minutes before handling.
- If the deployment fails, disconnect the voltage source and wait 5 minutes before approaching the vehicle.

1. Position the airbag module face up, on flat ground outdoors, at least 10 meters (33 feet) from any obstacle or people.
2. Place a vehicle battery at least 10 meters (33 feet) away from the airbag module.
3. Deploy the airbag module using the deployment tool. If you do not have deployment tool, cut the two additional wires to the airbag module and strip 13 mm (0.5 inch) of the insulation from the end of the wires leading to the airbag module.
4. Refer to "DEPLOYED AIRBAG MODULE DISPOSAL PROCEDURE" in this section.

▶ Deployed Airbag Module Disposal Procedure

After deployment, a powdery residue may be on the surface of the airbag. The powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and by-products of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a by-product of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate also known as baking soda}. Therefore, it is unlikely that sodium hydroxide will be present after deployment. Wear gloves and eye protection during the disposal procedure.

After deployment, the metal surfaces of the airbag module will be hot. In order to avoid the risk of an injury or a fire, do not place the deployed airbag module near any flammable objects, and allow the airbag module to cool for 30 minutes before handling. Deploy an airbag or pretensioner before disposing of it.

This includes those in a whole vehicle being scrapped. If the vehicle is still within the warranty period contact the SsangYong regional service manager for approval or special instructions before deploying an airbag module or pretensioner.

FUNCTION DESCRIPTION

▶ Back (Cushion)

- The airbag system performance is influenced on the cushion size, shape and position.
- The cushion strength is a important parameter on the impact absorb effect.
- Therefore, the control of the airbag performance depends on cushion size, shape, inflator characteristic and vent hole size for the gas discharge.
- The cushion's material and folding function to control the cushion deployment direction and the performance to protect passenger's face.

▶ Module Cover/Housing

- It is a type of a container that includes the cushion and the inflator.
- The module housing functions to deliver the reaction force between the body structure and the airbag (The airbag reaction is absorbed generally to the steering wheel or instrument panel).
- The module cover must be considered in a viewpoint of protection between exterior, internal units and cushion. Also the module cover should be designed not to cause any personal injury for deployment.

▶ Inflator

- The inflator is a type of the direct gas generated device.
- The inflator with initial low pressure provides negative restraint effect regarding passengers moving and time.

  On the contrary, the inflator with initial high pressure allows other components of the airbag to make a excessive impact resulting in any personal injury.

  Thus, the inflator output must be optimized according to the characteristic of the vehicle and passenger moving.
- The discharge gas has no toxicity or inflammability and also it is the important parameter to control the high temperature for gas firing.

▶ Airbag Module

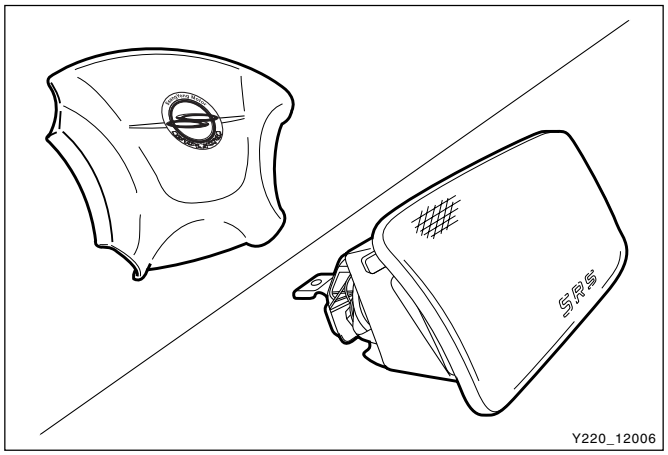
The driver airbag module is under the center pad of the steering wheel.

The passenger airbag module is installed in the instrument panel at passenger side.

The driver and passenger side airbag is inside each seat.

Notice

Do not disassemble the airbag module because unintentional deployment of the airbags resulting from any damage or interference of the module can cause injury.



▶ SDM (Sensing and Diagnostic Module)

1. The airbag system consists of the module section (driver, passenger and side), seat belt section and SDM.
2. The SDM has no user-serviceable parts and monitors the system components continuously. The SDM also records any faults which are discovered.
3. The SDM allows the fault codes to be retrieved with a scan tool and illuminates a warning lamp that alerts the driver to any faults.

The SDM located on floor beneath the floor console assembly. The SDM performs the following functions:

- Impact decision processor function.
- Determine the airbag deployment through the impact signal of the accelerometer sensor and the safety sensor.

- Malfunction detection and recording any faults that are detected.

  Monitor the supplemental restrain system electrical components and set a diagnostic trouble code when malfunction is detected.
- Display airbag fault codes

  Display airbag fault codes and system status information when connected to a scan tool.
- Self-diagnosis function

  Illuminate the AIRBAG indicator to alert the driver to any fault.
- Power supply function

  Provide a reserve power source to deploy the airbags and pretensioners if an accident has disabled the normal power source.

▶ Acceleromenter Sensor

The accelerometer sensor electronically represents the acceleration or deceleration of the vehicle during a frontal impact.

In this electronic representation, the electrical signal is proportional to the acceleration or deceleration of the vehicle.

▶ Safety Sensor

The safety sensor is safety device made up of a dual-contact, electro-mechanical switch that:

1. Acts independently of the electronic components.
2. Connects the acceleration sensor in series in order to make up for the weak points in the current electronic sensor.

▶ Micro Controller

This device receives the impact signal from the sensor for vehicle impact and identifies whether the current condition is necessary for airbag deployment or not. And then the controller sends the specified currents to the airbag ignition circuit as needed.

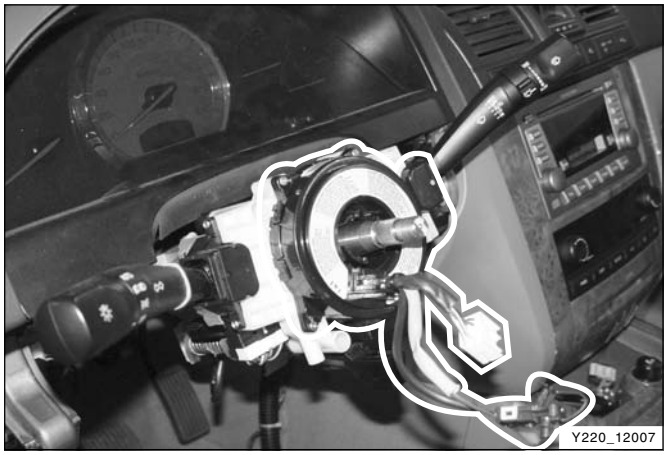
This device always monitors the airbag system in conduction with the diagnostic circuit. When it is detected any problem, it illuminates the airbag warning indicator to inform driver of the fault and stores the fault information.

▶ Contact Coil

The contact coil is installed between the steering wheel and the steering column and contains a coil that enables to contact electrically between the airbag wiring harness, the driver airbag module and the horn switch.

Notice

Turning the steering wheel more than three and one-quarter turns may damage the clock spring. The contact coil should never be disassembled and must be replaced if the airbag have been deployed.



Notice

Turn the label of the clock spring clockwise to lock and turn the label of the clock spring counterclockwise approximately 2.9 ± 0.2 turns to the neutral positions with the front wheels ahead.

Align the pointed marks " ▸ ◂ ".

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▶ Airbag Warning Lamp

The instrument cluster contains an airbag warning indicator bulb to verify the operation of the AIRBAG indicator and sensing and diagnostic module (SDM).

The SDM performs a turn-on test when the ignition is turned ON. The SDM flashes the AIRBAG indicator seven tomes by supplying an intermittent ground to the indicator lamp circuit. After flashing seven times, the AIRBAG indicator will turn off if no more malfunctions have been detected.

Warning Lamp Status	Fault Contents
Flash seven times within 7 seconds and then turn off	System OK
Warning lamp stays ON	System fault
	Internal SDM fault
No turn on	Power supply circuit open and fuse open
	Warning lamp circuit open
	SDM fault

▶ Wiring Harness Connectors

If the sensing and diagnostic module (SDM) electrical connector is not attached properly, a built in shorting bar will connect the wire from airbag warning lamp with the SDM ground wire. This turns on the AIRBAG indicator.

To prevent deployment during servicing, additional shorting bars are located in following locations:

- Driver airbag module connector
- Passenger airbag module connector
- Driver and passenger side airbag module connector
- SDM wiring harness connector
- Contact coil connector to airbag wiring harness

The shorting bar is only a backup safety device. Always disable the supplemental restraints system (SRS) before beginning any service procedure.

▶ Belt Pretensioner

The belt pretensioner enables to retract the driver and the passenger seat belt webbing to reduce any personal impact when accounted a frontal collision.

FRONT AIR BAG

▶ General Description

- The frontal airbag system is a safety device used in conjunction with the seat belts.

  The airbag does not replace the function of the seat belt. The driver and the passengers must always fasten their seat belts and adjust them for a proper fit.

  The front seat airbag is designed to protect the driver and the front seat passenger in the event of a significant frontal impact to the vehicle.
- The driver airbag is installed on the steering wheel and the passenger airbag is in the instrument panel.

▶ Airbag Components

Cover

It is a part of the airbag steering section and is made by injection molding.

Door assembly

It is a part of the airbag steering and is made by plastic injection molding.

Cushion

- Cushion is made mainly of nylon 66 material.
- It is made by assembling various panel pieces and sometimes, some surfaces of these panel pieces handled by coating. The coating material is used as silicon rubber generally.

Inflator

- The inflator generates gas to fill the cushion with it. There are two type of ALL-PYRO TECHNIC TYPE and HYBRID TYPE according to gas generated type.
- Now, the driver airbag uses the “all-pyro technic type” and the passenger airbag uses both “all-pyro technic type” and “hybrid type”.
- The inflator has the ignitor at one side of the inflator.

  The ignitor receives a electrical signal from the sensor and ignites powders continuously.

Housing

It is a part of airbag steel plate structure.

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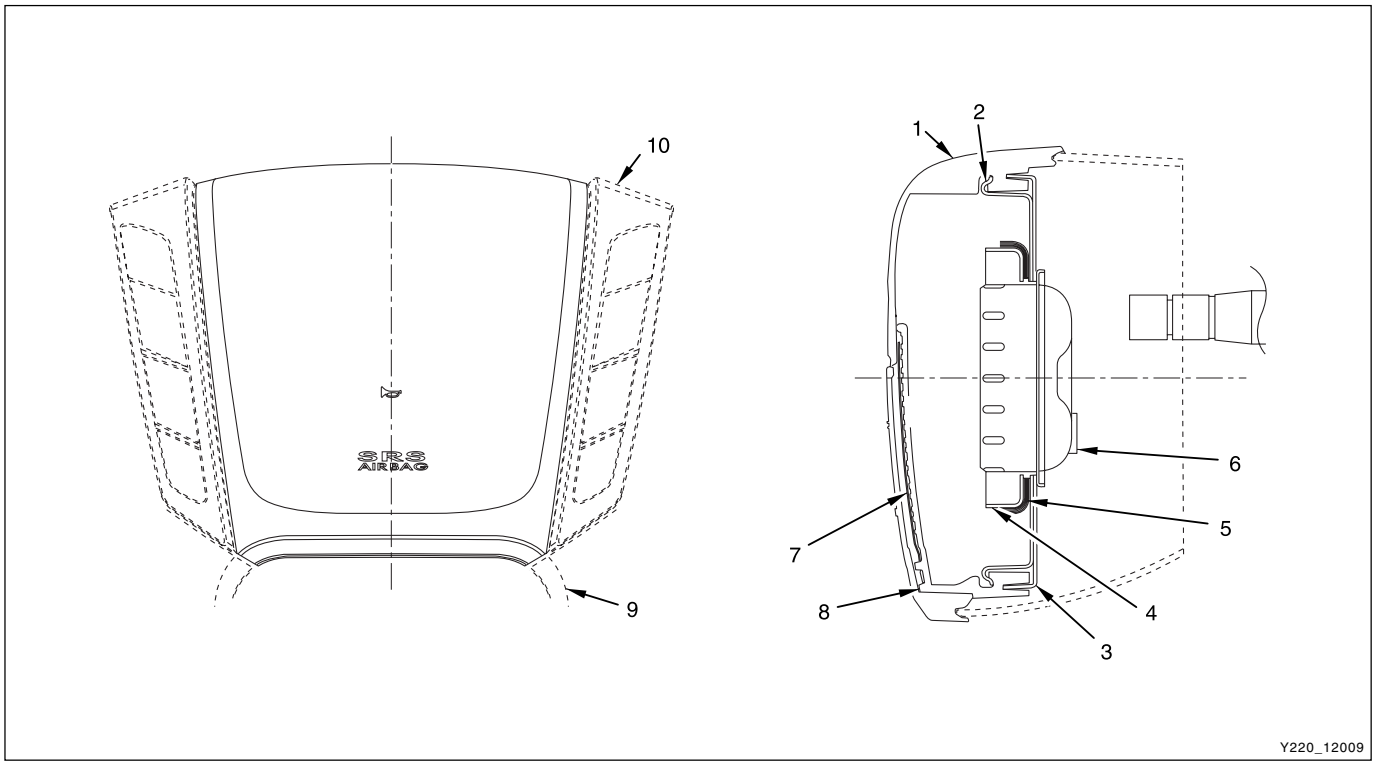
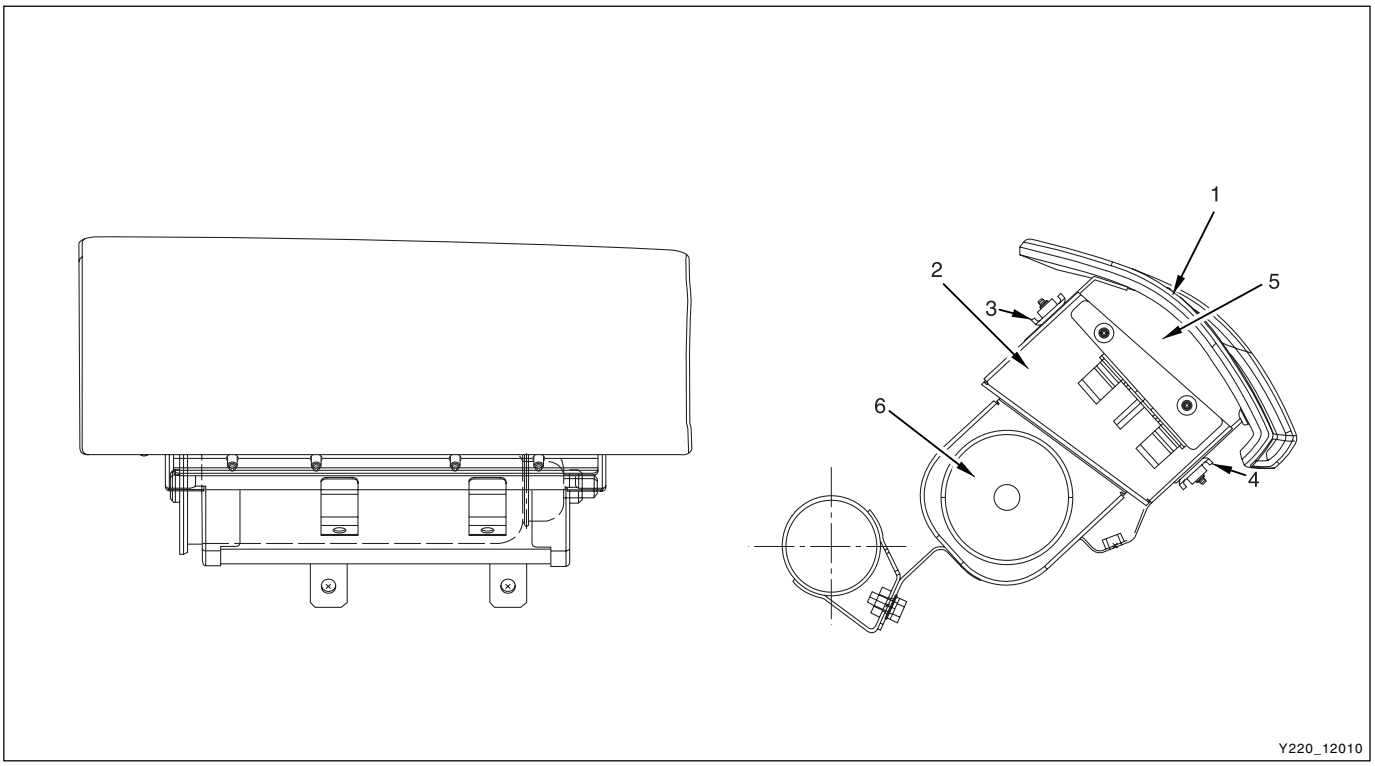
▶ Frontal Airbag Cross Sectional View

Driver airbag assembly



1. Cover
2. Carrier
3. Retainer cover assembly
4. Retainer cushion assembly
5. Cushion assembly
6. Inflator assembly
7. Membrane switch assembly
8. Reaction plate
9. Steering wheel
10. Remote control switch

Passenger airbag assembly



1. Cover assembly
2. Housing assembly
3. Upper door retainer
4. Lower door retainer
5. Cushion assembly
6. Inflator assembly

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SIDE AIR BAG

The side airbag receives each of the side airbag sensor signal to deploy the airbag when the vehicle crashes at side impact. The side airbag module is installed inside the seat. When the airbag is deployed, replace the deployed front seat assembly.

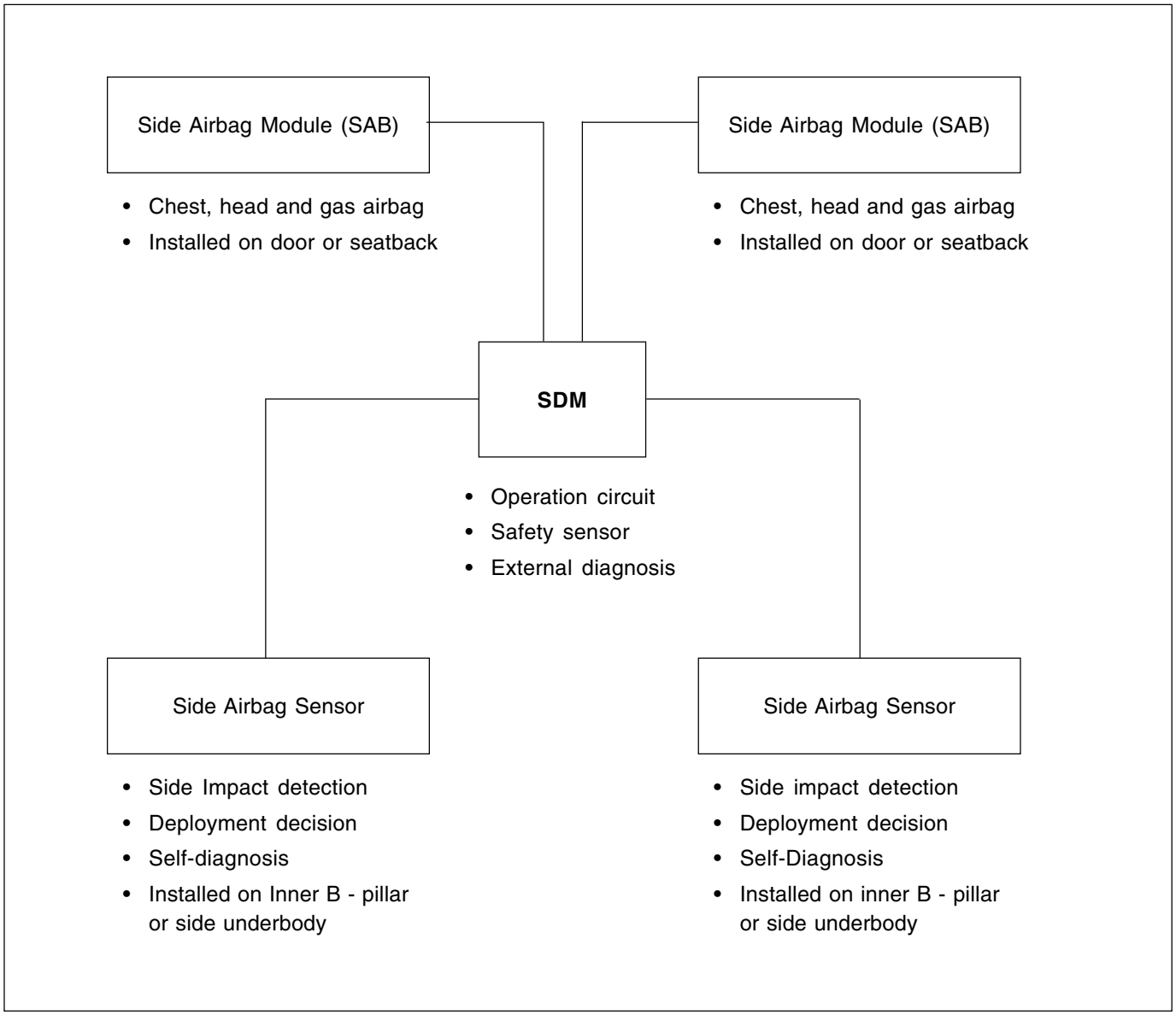
▶ System Structure

Related System

1. Vehicle Structure and B/W
2. Seat System
3. Seat Belt System
4. Door Trim and Door Structure
5. B - Pillar Trim and Structure
6. Airbag Wiring Harness

Components

1. Side Airbag Module (LH/RH)
2. Side Airbag Sensor (LH/RH)
3. SDM (Common use the SDM for frontal airbag)

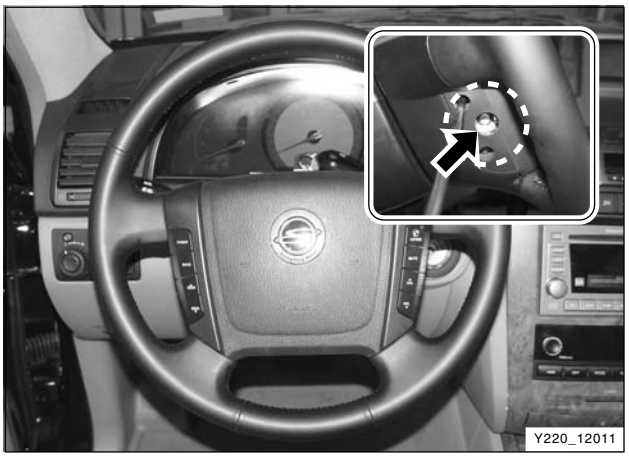


MAINTENANCE AND REPAIR

DRIVER'S AIR BAG MODULE

Removal and Installation

1. Disconnect the negative battery cable.
2. Place the steering wheel to straight ahead direction.
3. Remove the driver's air bag module bolts.



4. Disconnect the air bag module connector and the horn connector and remove the air bag module.

5. Install in the reverse order of removal. Make sure to connect each connector and tighten the bolts with the specified tightening torque.

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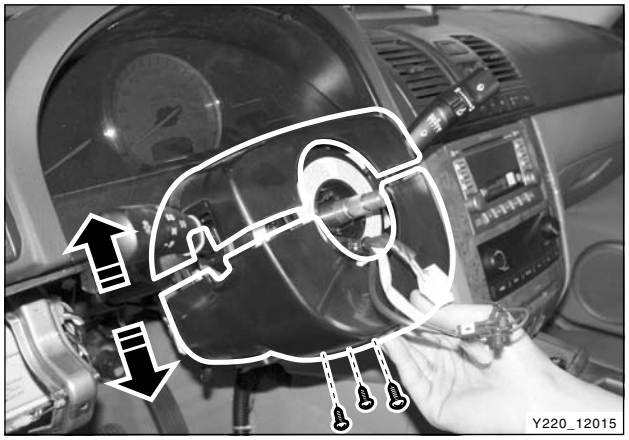
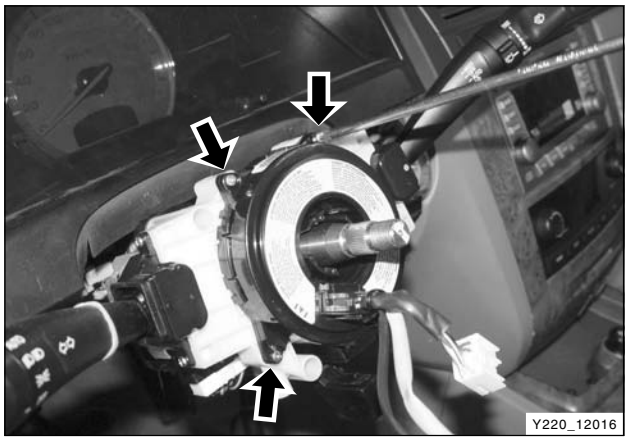
CONTACT COIL

Removal and Installation

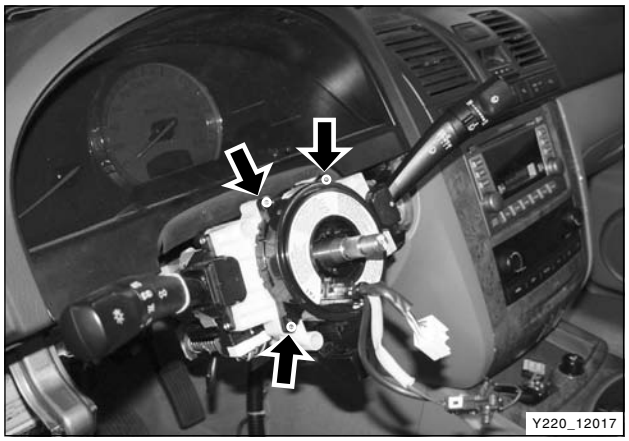
1. Remove the steering wheel and lower instrument panel in front of driver's seat.



2. Remove the upper and lower steering column covers.



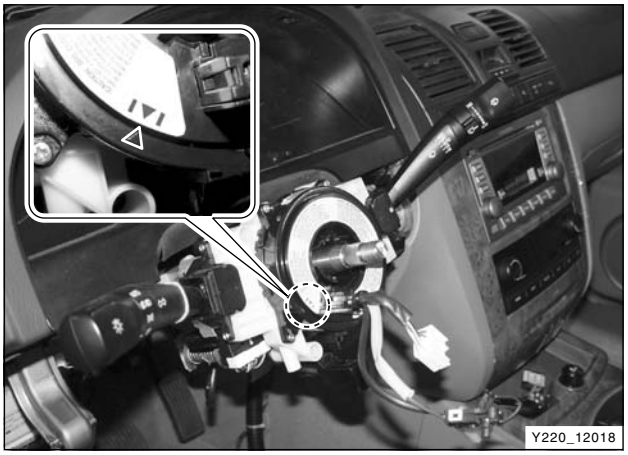
3. Separate the connecting contact from the contact coil, unscrew the contact coil mounting screw, and remove the contact coil assembly.



4. Install in the reverse order of removal. Make sure to tighten the screws with the specified tightening torque.

Contact coil screw	3 Nm

5. Place the contact coil at the center position.



Notice

If the contact coil is not properly aligned, the steering wheel may not be able to rotate completely during a turning. Restricted turning ability may cause the vehicle to crash. Improper alignment of the contact coil also may make the SIR system inoperative, preventing the air bags from deploying during a crash.

Notice

Turn the contact coil clockwise until it stops and turn it counterclockwise approx. 2.9 ± 0.2 turns to align the " ▸ ◂ " marks.

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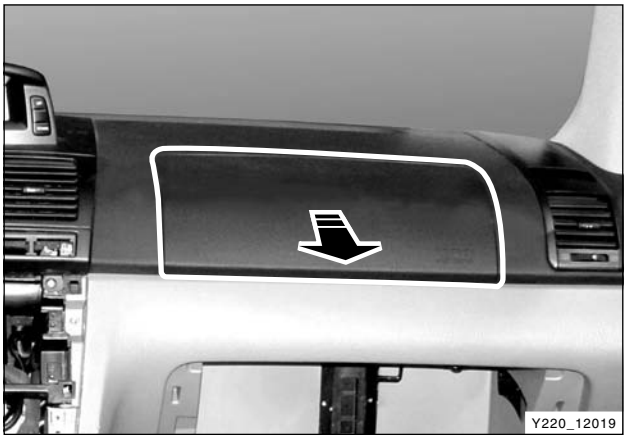
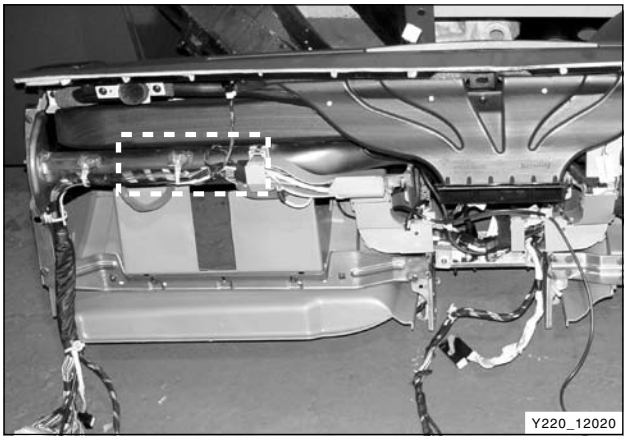
AFFECTED VIN	





PASSENGER'S AIR BAG MODULE

Removal and Installation

1. Disconnect the negative battery cable.
2. Remove the instrument assembly.
3. Remove the air duct from the removed instrument assembly.
4. Remove the passenger's air bag module.
5. Install in the reverse order of removal.

BELT PRETENSIONER

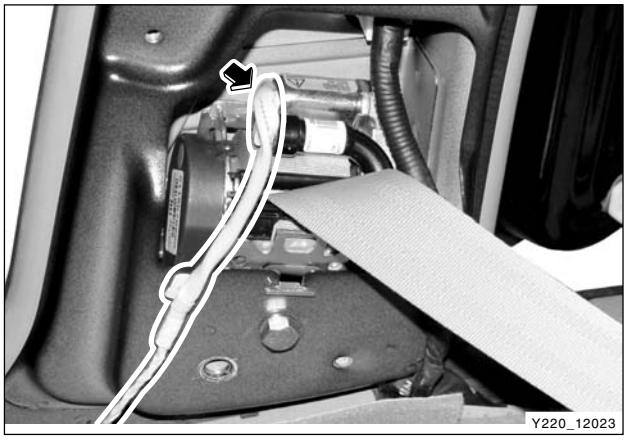
Removal and Installation

Notice

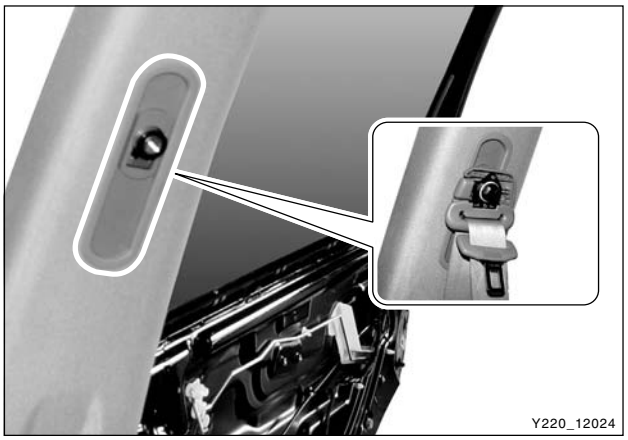
1. ***Disconnect the negative battery cable and place the ignition switch at "OFF".***
2. ***Perform the preceding works before start this operation.***

1. Remove the seat belt mounting bolts and B-pillar lower trim assembly.

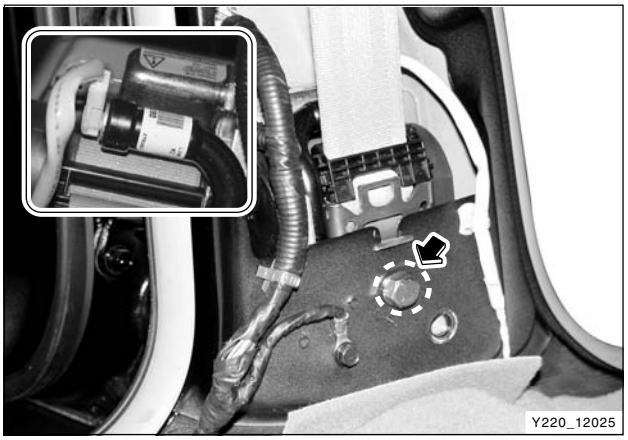
2. Disconnect the air bag connector.



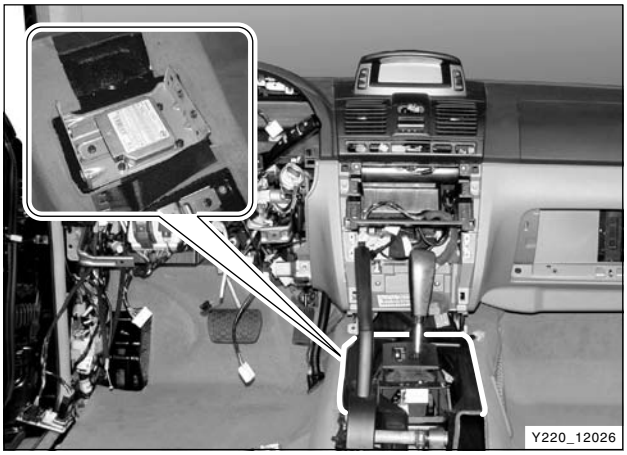
3. Unscrew the belt pretensioner bolt and the seat belt upper bolt and remove the seat belt assembly.

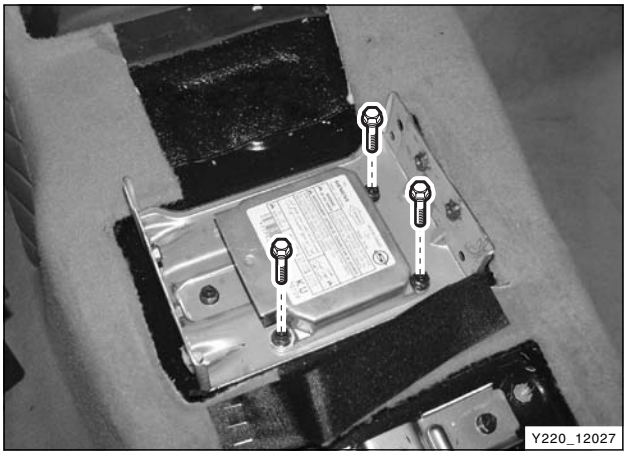


4. Install in the reverse order of removal. Make sure to tighten the pretensioner bolt with the specified tightening torque.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	





AIR BAG CONTROL MODULE (SDM)

Removal and Installation

1. Disconnect the negative battery cable.
2. Remove the instrument center panel and console panel.
3. Disconnect the SDM connector.
4. Unscrew the bolts and remove the SDM assembly.
5. Install in the reverse order of removal.

TROUBLE DIAGNOSIS

GENERAL DIAGNOSIS

▶ Warning Lamp Check

As soon as the opening voltage is applied to the sensing and diagnostic module (SDM) ignition input, the SDM activates the warning lamp for a bulb check. The SDM allows the lamp to blink at seven times for 7 seconds and then turn off.

During the bulb check, the SDM is not ready to detect a crash or deploy the supplemental inflatable restraints.

▶ Fault Indication

The sensing and diagnostic module records the system's faults in two categories:

- Active Fault
  Current detected faults and the "C" appears the first digit of the fault code on the scan tool display (example: "C16").
- History Fault
  These faults that were detected in the past, but are no longer active. The "H" appears the first digit of the fault code on the scan tool display (example: "H17").

Diagnosis by using warning lamp

- The warning lamp flashes for 7 seconds at seven times and turn off : Normal Status - There is not any history or current fault code.
- The indicator turns on for 7 seconds and then turn off : Normal Status - A fault has been detected previously but now there is not any more of the same detected fault. Clear the fault using the scan tool.
- The indicator turns on for 7 seconds and turns off for 1 second and then turn on again: Abnormal Status - It has detected a current fault or has been occurred same fault more than five times, or has been occurred more than five types of faults. Perform the diagnosis using the scan tool.
- Warning lamp stays ON: Connection fault between the SDM wiring harness connector and the SDM connector, or the airbag wiring harness fault.
- No the indicator turn ON: Power supply malfunction, indicator circuit open, bulb fault, SDM internal defect.

Diagnosis by using scan tool

- Check the fault code by connecting the diagnostic (ALDL) connector.
- Receive serial data from terminal 9 of the ALDL connector.
- Receive the ground signal from terminal 4 or 5 of the ALDL connector.

▶ Clearing Fault Codes

When the sensing and diagnostic module (SDM) receives the "CODE ERASE" command from the scan tool, the SDM:

- Clears the entire fault memory.
- Turns OFF the warning lamp.
- When it is removed the scan tool after clearing the fault code, the SDM rechecks the airbag system to detect the SDM's fault.

External fault

Service personnel can reset the SDM and turn OFF the warning lamp if the fault is an external fault.

Internal fault

An internal fault of the SDM or a CRASH RECORDED fault code cannot be reset.

In the case of an internal fault of the SDM or a CRASH RECORDED fault code, the SDM must be replaced.

▶ Microprocessor-Independent Lamp Activation

If the sensing and diagnostic module (SDM) electrical connector is not properly attached, the SDM cannot function and cannot control the warning lamp.

If this fault is present, the warning lamp will operate independently from the SDM through the use of shorting bars that are built into the SDM connector.

Notice

Do not measure the resistance of the airbag module because the multimeter's battery may deploy the air bag causing any personal injury.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DIAGNOSIS

Possible Cause		Action	
Ignition "ON" Check warning lamp on I/P	Does the warning lamp blink at seven times for 7 seconds and then turn off?	Yes	System OK
		No	Connect the scan tool to diagnostic connector (ALDL). Select the fault code display menu and clear code menu.
	Does the fault code display on the scan tool display?	Yes	Perform "Diagnostic System Check".
		No	Check any fuse open. Replace fuse.
	Is there any open in fuse?	Yes	Disconnect wiring connector.
		No	Check any wiring short between fuse and wiring connector.
	Is there any short in fuse?	Yes	Repair wiring.
		No	Disconnect SDM wiring connector. Check wiring short between connector terminal and SDM connector terminal.
	Is there any short in wiring?	Yes	Replace airbag wiring.
		No	Check any open between ALDL connector No.4, No.5 terminal and ground.
	Is there any open in wiring?	Yes	Repair wiring
		No	Ignition "ON" Measure voltage at the cigar lighter socket.
	Does the voltage indicate 11 ~ 14 V?	Yes	Check any open or short between ALDL connector terminal and wiring connector terminal.
		No	Repair the wiring of the cigar lighter socket.
	Is there any open or short in wiring?	Yes	Repair wiring
		No	Check any open or short between SDM connector terminal and wiring connector terminal.
	Is there any open or short in wiring?	Yes	Replace the airbag wiring.
		No	Replace the SDM.

DIAGNOSTIC TROUBLE CODES

Code	Fault Contents	Check
01h	Driver airbag circuit, resistance too high	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
02h	Driver airbag circuit, resistance too low	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
03h	Driver airbag circuit, short to ground	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
04h	Driver airbag circuit, short to battery voltage	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
05h	Passenger airbag circuit, resistance too high	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
06h	Passenger airbag circuit, resistance too low	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
07h	Passenger airbag circuit, short to ground	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
08h	Passenger airbag circuit, short to battery voltage	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
09h	Driver pretensioner circuit, resistance too high	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.
0Ah	Driver pretensioner circuit, resistance too low	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.
0Bh	Driver pretensioner circuit, short to ground	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.
0Ch	Driver pretensioner circuit, short to battery voltage	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.

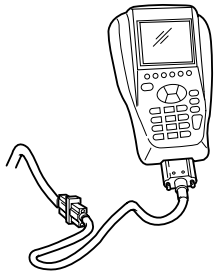
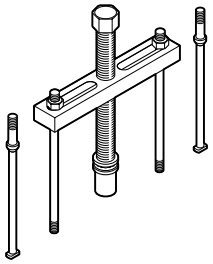
Code	Fault Contents	Check
0Dh	Passenger pretensioner circuit, resistance too high	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
0Eh	Passenger pretensioner circuit, resistance too low	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
0Fh	Passenger pretensioner circuit, short to ground	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
10h	Passenger pretensioner circuit, short to battery voltage	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
34h	Driver side airbag circuit, resistance too high	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
35h	Driver side airbag circuit, resistance too low	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
36h	Driver side airbag circuit, short to ground	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
37h	Driver side airbag circuit, short to battery voltage	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
38h	Passenger side airbag circuit, resistance too high	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
39h	Passenger side airbag circuit, resistance too low	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
3Ah	Passenger side airbag circuit, short to ground	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
3Bh	Passenger side airbag circuit, short to battery voltage	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
50h	Driver side airbag sensor, open/short to battery voltage	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.
51h	Passenger side airbag circuit, short to ground	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.

Code	Fault Contents	Check
52h	Communication malfunction of the driver side airbag	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.
53h	Internal fault of the driver side airbag sensor	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.
54h	Passenger side airbag sensor, open/short to battery voltage	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
55h	Passenger side airbag sensor, short to ground	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
56h	Communication malfunction of the passenger side airbag	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
57h	Internal fault of the passenger side airbag sensor	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
17h	Battery voltage too high	Check generator output voltage. Check the battery voltage. Check the bending of the airbag terminal.
18h	Battery voltage too low	Check generator output voltage. Check the battery voltage. Check the bending of the airbag terminal.
1Eh	SDM internal fault (Initialization fault)	Replace the SDM.
1Fh	SDM internal fault	Replace the SDM.

Notice

- ***Use only the scan tool to check the airbag module and the sensing and diagnostic module (SDM). Never measure the resistance of an airbag module with an ohmmeter. An ohmmeter's battery can deploy the airbag and cause injury.***
- ***Before testing, disconnect the negative battery cable. Wait 1 minute for the SDM capacitor to discharge. The capacitor supplies reserve power to deploy the airbags, even if the battery is disconnected. Unintentional deployment of the airbags can cause injury.***
- ***Do not attempt to repair the supplemental inflatable restraints (SIR) wiring harness. An SIR repair can create a high-resistance connection which can keep the airbags from deploying when needed, resulting in injury.***

SPECIAL TOOLS AND EQUIPMENT

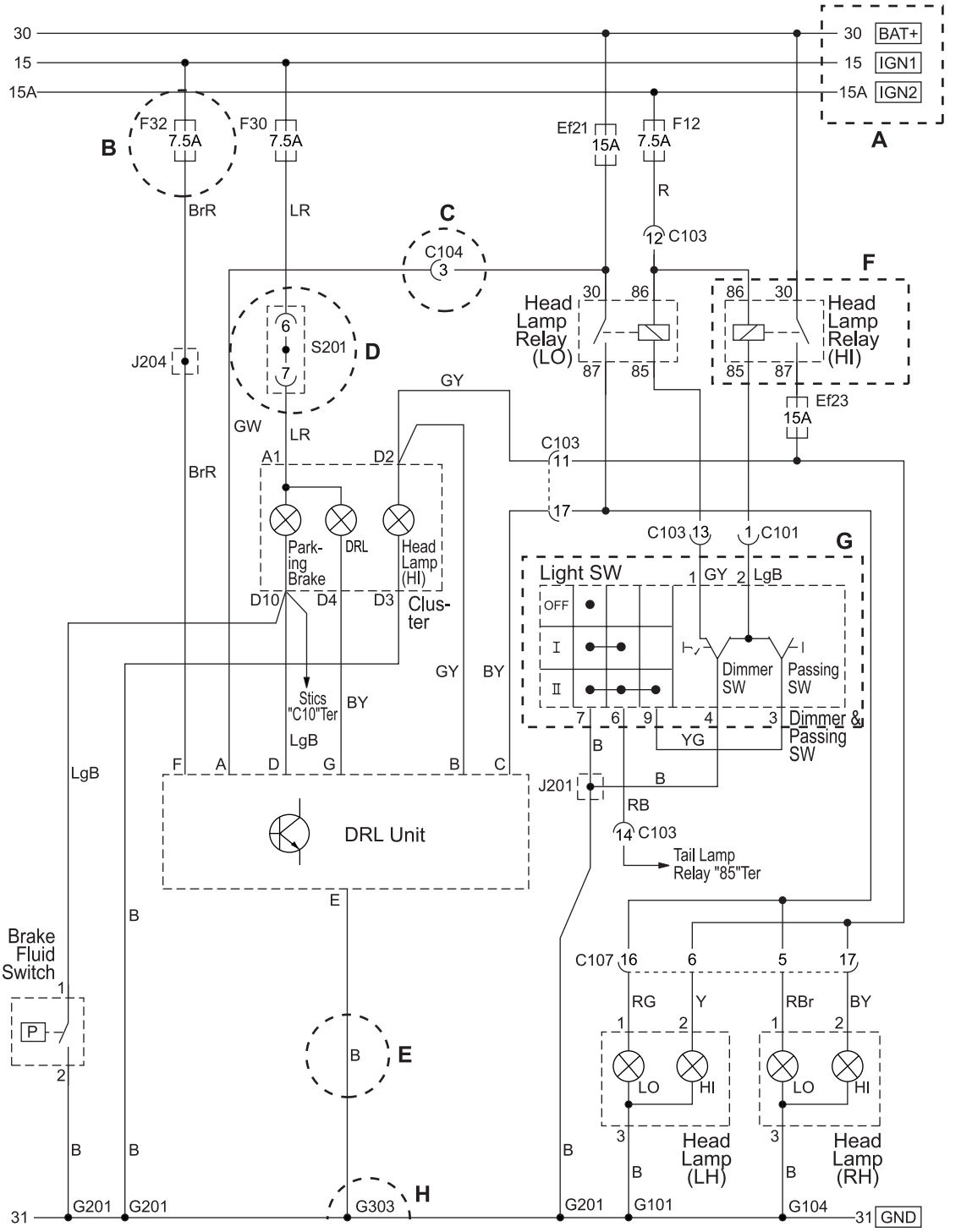
Name and Part Number	
Scanner	**Wheel wrench**
 Y220_12029	 Y220_12031

SECTION 1

HOW TO USE ELECTRICAL WIRING DIAGRAM

TABLE OF CONTENTS

1. HOW TO READ ELECTRICAL WIRING DIAGRAM



1) CONTENTS OF ELECTRICAL WIRING DIAGRAM (CIRCUIT)

Position	Explanation
A	- Upper horizontal lines : Power supply lines - Power supply lines : 30, 15, 15A, 15C, 58
B	- Ef20 or F2 : Fuse Number • Ef20 : Fuse No #20 in engine room compartment • F2 : Fuse No #2 in passenger room compartment
C	- Connector (C101 ~ C402) • Connector No C203 terminal No1 * Refer to Major Connector Position (Section 2)
D	- S201 : Splice pack (S101 ~ S302) * Refer to Major Splice Pack Position (Section2)
E	- Wiring Harness Color * Refer to Wiring Harness Color Abbreviation
F	- Internal circuit of component (Relay) (Component Name and Terminal Number)
G	- Internal circuit of component (Switch) (Component Name, Terminal Number and Connecting Wiring Circuit)
H	- Lower horizontal line : Ground line • Ground position (G101 ~ G401) • B : Body Ground * Refer to Major Ground Position (Section2)

2. CIRCUIT IDENTIFICATION SYMBOL

Identification Symbol	Meaning
C	Connector
D	Diode
Ef	Fuse in engine room fuse & relay box
F	Fuse in passenger room fuse box
G	Ground
S	Splice pack (Junction connector)

3. FUNCTION OF POWER SUPPLY LINE (NUMBER)

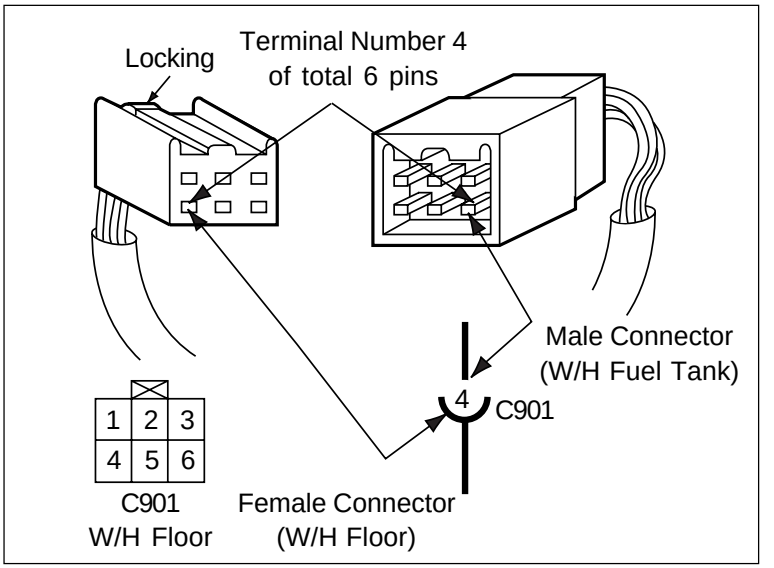
Power supply No.	Power supply condition
15	Battery Voltage (B+) supply in Ignition Switch “ON” and “ST” (IGN 1)
15A	Battery Voltage (B+) supply in Ignition Switch “ON” (IGN 2)
15C	Battery Voltage (B+) supply in Ignition Switch “ON” and “ACC”
30	Battery Voltage (B+) supply directly regardless of Ignition Switch
31	Ground connected to battery (-)
58	Battery Voltage (B+) supply in Head Lamp Switch 1st and 2nd step (Illumination circuit)

4. 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
Or	Orange	**B**	Black
Lg	Light Green		

5. HOW TO CHECK TERMINAL NUMBER OF CONNECTOR

- Terminal number is given based on Female Terminal Connector
  ex) Terminal Number 4 of C901 connection



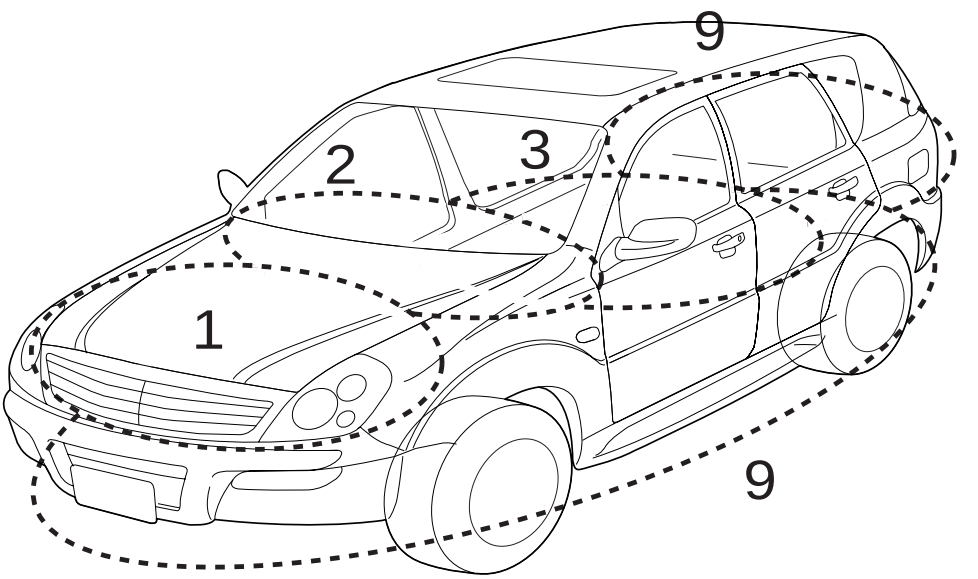
6. PART LOCATION ACCORDING TO PART NUMBER

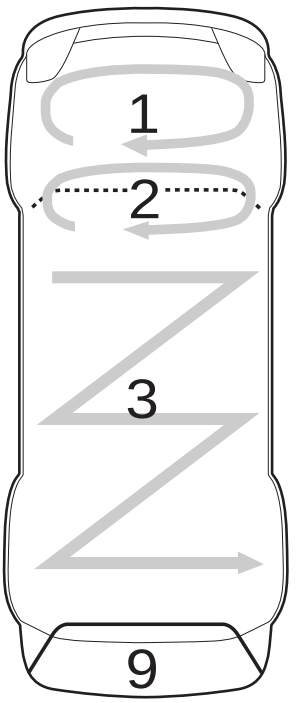
Ex.) **C 1 0 2**

• C : Symbol character for connector

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 : Part location number





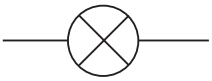
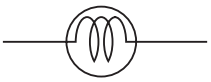
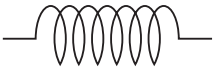
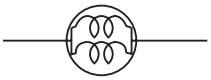
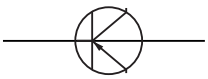
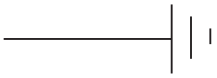
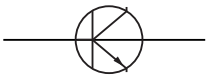
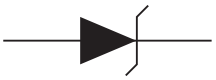
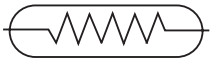
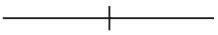
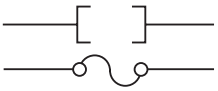
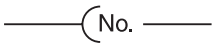
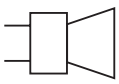
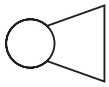
• Part number according to locating section

Part Number	Location
□1□□	Engine compartment
□2□□	Instrument panel
□3□□	Passenger compartment, Tailgate
□9□□	Underbody

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

• 02 : Part number

7. 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	
Photo Diode		Amperemeter	
Light Emitting Diode		Switch	
Battery		Thermistor	
Disconnected Wire		Junction Point	
Fuse		Fusible Link	
Motor		Connector	
Speaker		Horn	

8. ABBREVIATIONS

Classification	Abbreviations	Full words
A	A/BAG	Air Bag
	A/CLNR	Air Cleaner
	A/CON (A/C)	Air Conditioner
	A/DUCT	Air Duct
	A/T	Auto Transmission
	ABD	Automatic Brake Differential
	ABS	Anti-lock Braking System
	AC	Alternating Current
	ACC	Accessory
	ACCEL	Accelerator
	ACS	Auto Cruise System
	ACTR (ACT)	Actuator
	ALT	Alternator
	AMP	Ampere
	ANT	Antenna
	ASR	Anti Slip Regulator
	ASSY	Assembly
	ATC	Automatic Temperature Controller
	ATDC	After Top Dead Center
	AUX	Auxiliary
	AVR	Automatic Voltage Regulator
B	BATT	Battery
	B/UP	Back Up
	B/DR	Back Door
	B/WDW	Back Window
	BDC	Bottom Dead Center
	BIW	Body in White
	BTDC	Before Top Dead Center
C	COMP	Compressor
	C/FAN	Condenser Fan
	CONN	Connector
	C/LIGHTER	Cigar Lighter
	CRU	Cruise
	C/PAD	Crash Pad
	CANI	Canister
	CB	Contact Breaker
	CBL	Cable
	CC	Catalystic Converter

Classification	Abbreviations	Full words
C	CD-I	Compact Disk - Interactive
	CLG	Cooling
	CLH	Clutch
	CONT	Control
	CONV	Converter
	CPLG	Coupling
	CRS	Child Restraint System
	CTR	Center
D	DSL	Diesel
	DR	Door
	DN	Down
	D/CTSY	Door Courtesy
	D/SW	Dimmer Switch
	DC	Direct Current
	DEFOG	Defogger
	DIAPH	Diaphragm
	DYN	Dynamo
	DWG	Drawing
	DRV	Driver
	D/P SW	Dual Pressure Switch
E	ENG	Engine
	ECU	Electronic Control Unit
	EGR	Exhaust Gas Recirculation System
	ESC	Engine Spark Control
	ESIMS	Electronic Steering & Inside Mirror Control System
	EXTR	Exterior
F	FRM	Frame
	FWD	Forward
	FL	Front Left
	FR	Front Right
	F/PUMP (F/P)	Fuel Pump
	F/LEVEL'G	Fluid Leveling
	FRT	Front
	F/LINK	Fusible Link
	F/BOX	Fuse Box
	F/DR	Front Door
	F/FLR	Front Floor
	F/SEAT	Front Seat

Classification	Abbreviations	Full words
F	F/TIME	Full Time
	F/C	Fuel Cut
	FLEX	Flecible
	FLR	Floor
	FLTR	Filter
	FM	Frequency Modulation
	FO	Firing Order
G	GND	Ground
	GSL	Gasoline
	GL/BOX (G/BOX)	Glove Box
H	HARN	Harness
	HTG	Heating
	HTR	Heater
	H/LP (H/LAMP)	Head Lamp
	HI/LH (RH)	High Beam/Left Hand (Right Hand)
	HFM	Hot Film Air Flow Meter
	HI	High
I	INTLK	Interlock
	INTR	Interior
	IGN (IGN1, IGN2)	Ignition
	IND	Indicator
	INT	Intermittent
J	JNT	Joint
K	K/DOWN	Kick Down
L	LHD	Left Hand Drive
	LP	Lamp
	LH	Left Hand
	LO	Low
M	MTR	Motor
	M/T	Manual Transmission
N	N/C	Normal Close
	N/O	Normal Open
O	O/PRESS	Oil Pressure
	O/PUMP	Oil Pump
	O/S MIRROR	Out Side Mirror
	OVPR	Over Voltage Protection Relay
P	POS LP	Position Lamp
	PTC	Potentio Temperature Contol

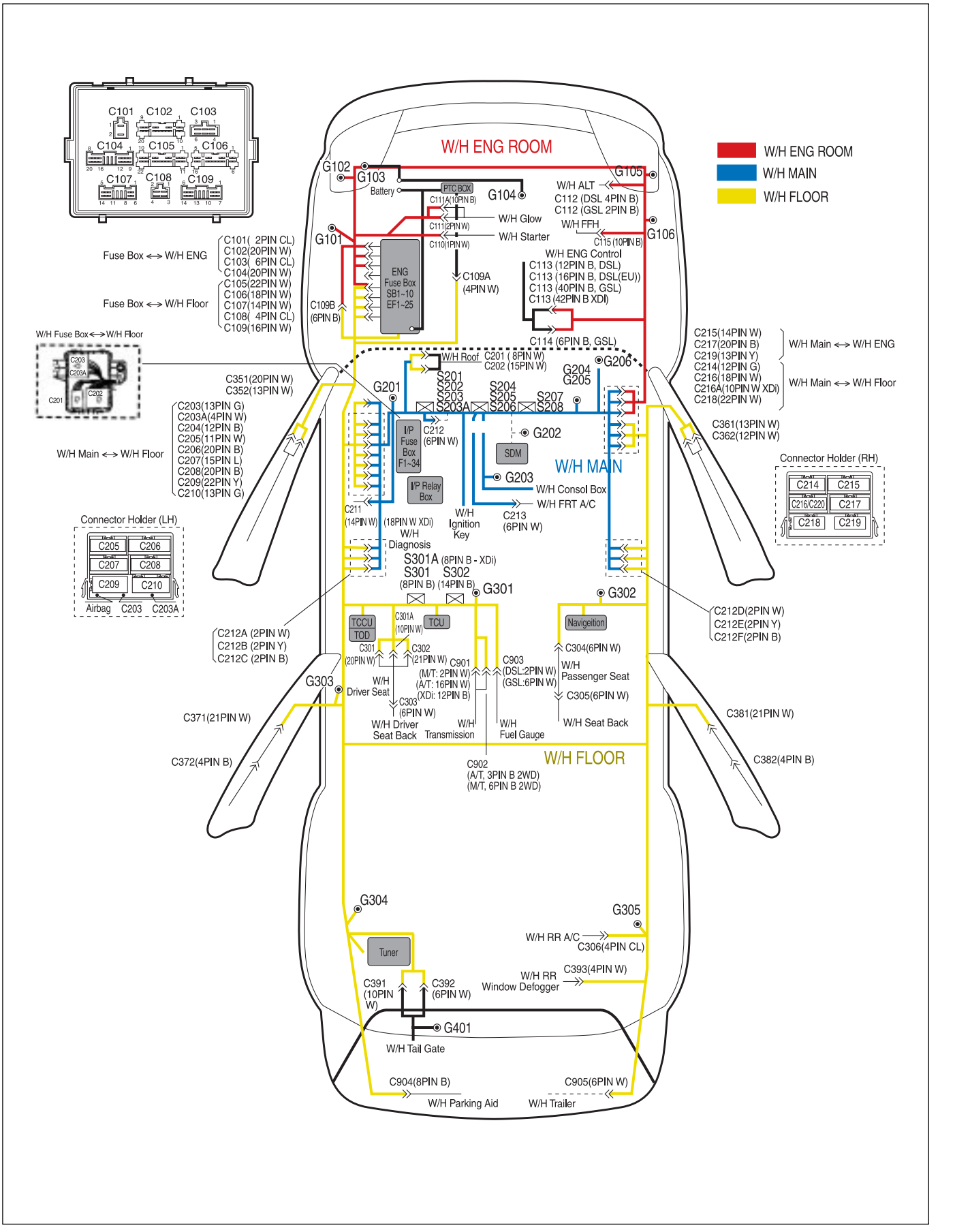
Classification	Abbreviations	Full words
P	PLA	Pneumatic Idle Speed Increase
	P/ANT	Power Antenna
	POS	Position
	P/WDW	Power Window
	PBR	Potentio Balance Resistor
R	REKES	Remote Keyless Entry System
	RHD	Right Hand Drive
	RLY	Relay
	RH	Right hand
	RR	Rear
	RHEO	Rheostat
S	S & E MODE	Standard & Exonomy Mode
	S/M	Speed Meter
	SPK	Speaker
	SW	Switch
	S/LP	Stop Lamp
	S/BELT	Seat Belt
	SIG	Signal
	SLD (SOL)	Solenoid
	S/ROOF	Sun Roof
	STICS	Super Time & Alarm Intergrated Control
T	TCU	Transmission Contol Unit
	TEMP	Temperature
	T/LP	Tail Lamp
	T/SIG	Turn Signal
	TCS	Traction Control System
	TCCU	Transfer Case Control Unit
	T/C	Transfer Case
	T/GATE	Tail Gate
U	U/D	Up/Down
W	W/SHLD	Windshield
	W/WHSHER	Windshield Washer
	W/WPR	Windshield Wiper
	WDW	Window
	WHL	Wheel
	WPR	Wiper
	WIR'G	Wiring
	WSS	Wheel Speed Sensor

SECTION 2

POSITION OF CONNECTORS AND GROUNDS

TABLE OF CONTENTS

1. POSITION OF CONNECTOR, GROUND & SPLICE PACK



2. CONNECTOR, GROUND & SPLICE PACK INFORMATION

1) CONNECTOR

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (2Pin, Colorless)	Engine Room Fuse Box (A) - Engine	Engine Room Fuse Box	
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C103 (6Pin, Colorless)	Engine Room Fuse Box (C) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C109A (4Pin, White)	Engine - PTC BOX	Engine Room Fuse Box	XDi
C109B (6Pin, Black)	Engine - ABS/ESP Pressure Sensor	Engine Room Fuse Box (RH)	XDi
C110 (1Pin, Gray)	Engine - Starter “ST”	FRT Pre-Heating Unit	
C111 (2Pin, Black)	Engine - Pre-Heating	RR Pre-Heating Unit	DSL
C111A (10Pin, Black)	Engine - W/H EGR	FRT Pre-Heating Unit	CLUSTER
C112 (4Pin, Black)	Engine - Alternator	Under the Coolant Reserve Tank	DSL
C112 (2Pin, Black)	Engine - Alternator	Under the Coolant Reserve Tank	GSL
C113 (12Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	DSL
C113 (40Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	GSL
C113 (16Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	DSL (EU)
C113 (42Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	XDi
C114 (6Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	GSL
C115 (10Pin, Black)	Engine - FFH Control	Under the Coolant Reserve Tank	XDi
C201 (8Pin, White)	Main - Roof	Under the I/P Fuse Box	
C202 (15Pin, White)	Main - Roof	Under the I/P Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C203A (4Pin, White)	Main - Floor (LH)	Under the I/P Fuse Box	XDi
C204 (12Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	A/T
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C211 (14Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	
C211 (18Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	XDi
C212 (6Pin, White)	Main - Air-Bag	Behind the Cluster (Inside Dash PNL)	

Connector Number (Pin Number, Color)	Connecting Wiring	Connector Position	Remark
C212A (2Pin, White)	Floor - W/H Air-Bag	Inside Driver Side Cowl PNL	Side Air-Bag
C212B (2Pin, Yellow)	Floor - W/H Air-Bag	Inside Driver Side Cowl PNL	Side Air-Bag
C212C (2Pin, Black)	Floor - W/H Air-Bag	Inside Driver Side Cowl PNL	Freetensioner
C212D (2Pin, White)	Floor - W/H Air-Bag	Inside Co-Driver Side Cowl PNL	Side Air-Bag
C212E (2Pin, Yellow)	Floor - W/H Air-Bag	Inside Co-Driver Side Cowl PNL	Side Air-Bag
C212F (2Pin, Black)	Floor - W/H Air-Bag	Inside Co-Driver Side Cowl PNL	Freetensioner
C213 (16Pin, White)	Main - Air-Con	Inside Dash PNL	
C213A (13Pin, White)	W/H Air Bag - W/H Blower	Inside Dash PNL	XDi
C213B (2Pin, White)	Main - Kick Down SW	Acceleration Pedal (RH)	AUTO
C214 (12Pin, Black)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C215 (14Pin, White)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	ABS, ABD
C216 (18Pin, White)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C216 (10Pin, White)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C217 (20Pin, Black)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C220 (15Pin, Blue)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	XDi
C301 (20Pin, White)	Floor - Driver Seat	Under the Driver Seat	Power Seat
C301A (10Pin, White)	Floor - Driver Seat	Under the Driver Seat	Seat Warmer
C302 (21Pin, White)	Floor - Driver Seat	Under the Driver Seat	Power Seat
C303 (6Pin, White)	Driver Seat - Seat Back	Under the Driver Seat	Power Seat
C304 (6Pin, White)	Floor - Co-Driver Seat	Under the Co-Driver Seat	Power Seat
C305 (4Pin, White)	Co-Driver Seat - Seat Back	Under the Co-Driver Seat	Power Seat
C306 (4Pin, Colorless)	Floor - RR Air Con	Right Side 3rd Seat	A/C
C351 (20Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C352 (13Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C353 (13Pin, White)	Driver Door - Door Extention	Inside Driver Side Cowl PNL	
C361 (13Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
C362 (12Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
C371 (21Pin, White)	Floor - RR Left Door	Under Left “B” Filler	
C372 (4Pin, Black)	RR LH Door - Door Extention	Inside RR LH Door PNL	
C381 (21Pin, White)	Floor - RR Right Door	Under Right “B” Filler	
C382 (4Pin, Black)	RR RH Door - Door Extention	Inside RR RH Door PNL	
C391 (10Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
C392 (6Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
C392 (10Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
C393 (10Pin, White)	Floor - RR Defogger	Inside the Upper the Tail Gate	

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C901 (16Pin, Black)	Floor - T/M	Left the T/C (Under the Floor)	A/T
C901 (2Pin, Black)	Floor - T/M	Left the T/C (Under the Floor)	M/T
C901 (12Pin, Black)	Floor - T/M	Left the T/C (Under the Floor)	XDi
C902 (6Pin, Black)	Floor - T/M	Under the T/C (Under the Floor)	M/T 2WD
C902 (3Pin, Black)	Floor - T/M	Under the T/C (Under the Floor)	A/T 2WD
C903 (6Pin, Black)	Floor - Fuel Sender	Left the T/C (Under the Floor)	GSL
C903 (2Pin, Black)	Floor - Fuel Sender	Left the T/C (Under the Floor)	DSL
C904 (8Pin, Black)	Floor - Parking Aid	Inside the Left RR Bumper	Parking Aid
C905 (6Pin, White)	Floor - Trailer	Inside the Left RR Bumper	

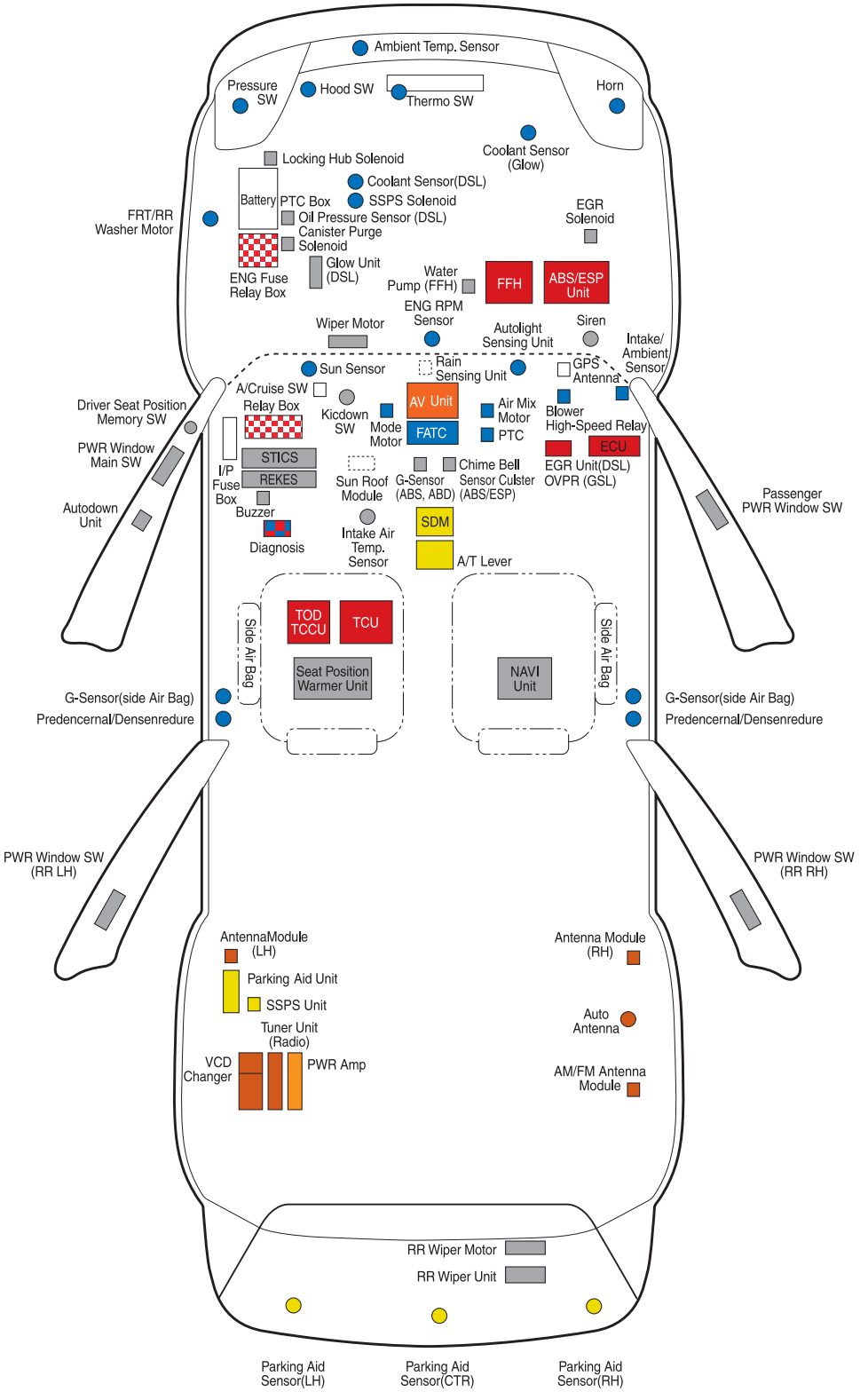
2) SPLICE PACK

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
S101 (7Pin, -)	OVPR “6” - Injector	Inside the C113, C114	GSL
S102 (4Pin, -)	OVPR “8” - IGN Coil	Inside the Injector “6”	GSL
S103 (4Pin, -)	OVPR “2” - HFM/CPS	Inside the C113, C114	GSL
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S203 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S203A (14Pin, Black)	W/H Main	Behind the Left FATC	XDi
S204 (14Pin, Black)	W/H Main	Behind the Left FATC	GND
S205 (14Pin, Black)	W/H Main	Behind the Left FATC	GND
S206 (14Pin, Black)	W/H Main	Behind the Left FATC	
S207 (14Pin, Black)	W/H Main	Behind the Right FATC	Tail Lamp
S208 (14Pin, Black)	W/H Main	Behind the Right FATC	
S301 (8Pin, Black)	W/H Floor	Under Driver Seat	CAN (GSL)
S301A (8Pin, Black)	W/H Floor	Under Driver Seat	XDi
S302 (14Pin, Black)	W/H Floor	Under Driver Seat	

3) GROUND

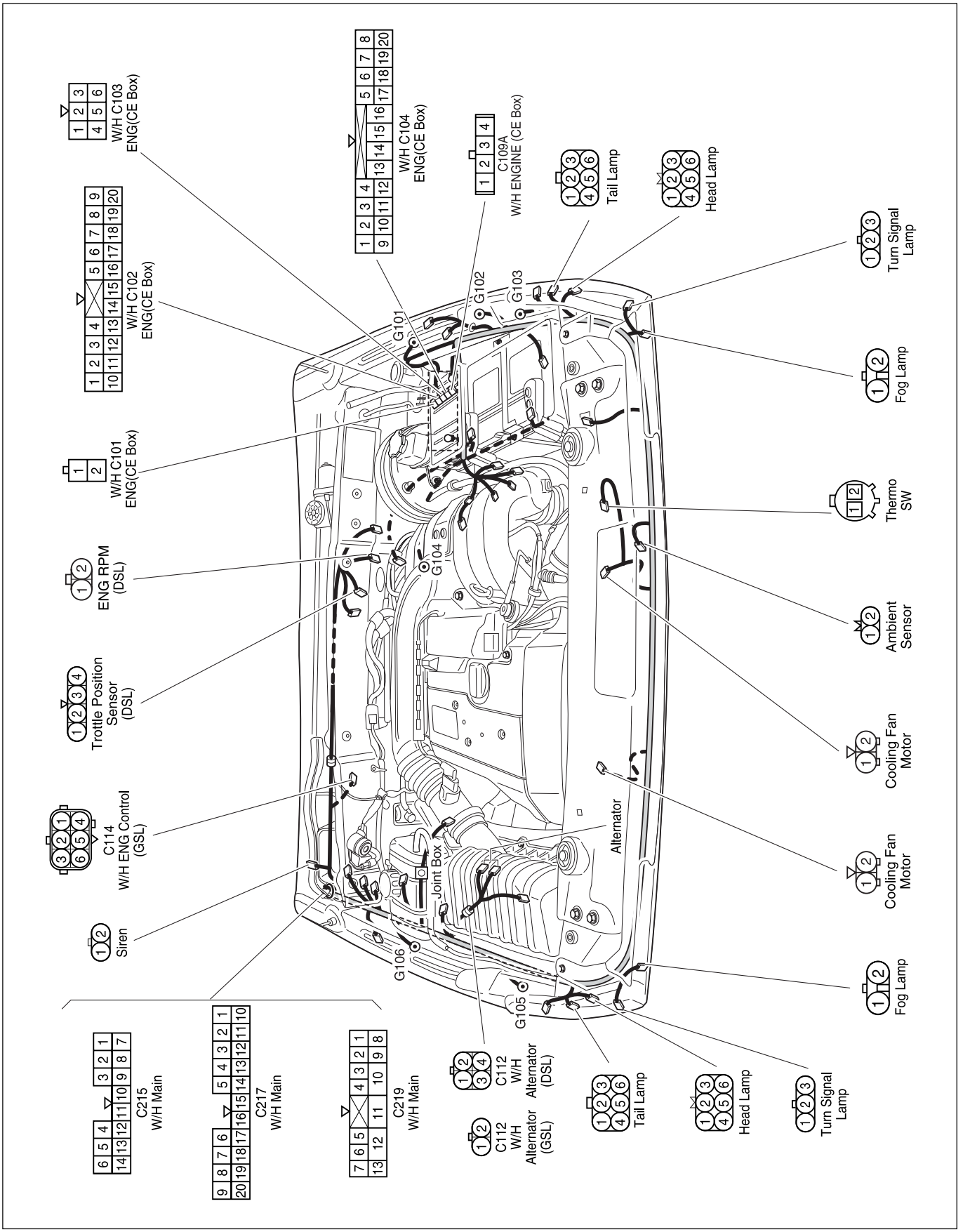
Connector Number	Connecting Wiring Harness	Connector Position	Remark
G101	W/H Engine	Center the Engine Room Fuse Box	
G102	W/H Engine	Center BATT	
G103	W/H Engine	Behind the Left Head Lamp	
G104	W/H Engine	Beside the Engine Mounting Bracket	
G105	W/H Engine	Behine the Right Head Lamp	
G106	W/H Engine	Beside the Engine Coolant Reserve Tank	ABS, ABD
G201	W/H Main	Inside Driver Side Cowl PNL	
G202	W/H Main	Beside the SDM	
G203	W/H Main	Under the Seat Heating SW	W/H Air Bag
G204	W/H Main	Inside Co-Driver Side Cowl PNL	
G205	W/H Main	Inside Co-Driver Side Cowl PNL	GSL
G206	W/H Main	Under Co-Driver Dash PNL	DSL
G301	W/H Floor	Under Driver Seat	ECU GND
G302	W/H Floor	Under Driver Seat	
G303	W/H Floor	Under the Left “B” Filler	
G304	W/H Floor	Behind the Quarter Grass #1	
G305	W/H Floor	Behind the Quarter Grass #1	
G401	W/H Tail Gate	Center the Tail Gate	
G402	W/H Tail Gate	Lift the Tail Gate	
G403	W/H Tail Gate	Right the Tail Gate	

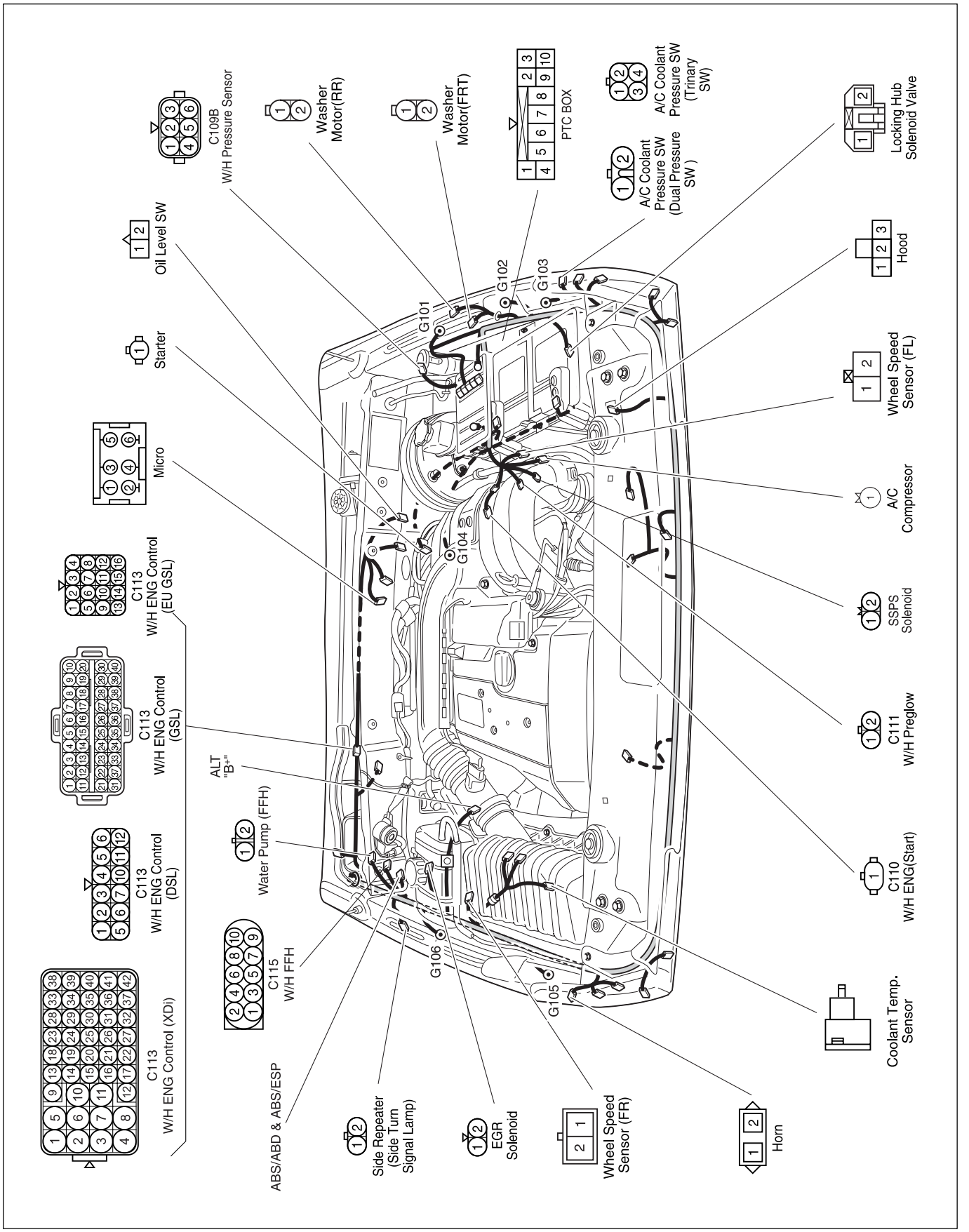
3. COMPONENTS LOCATION



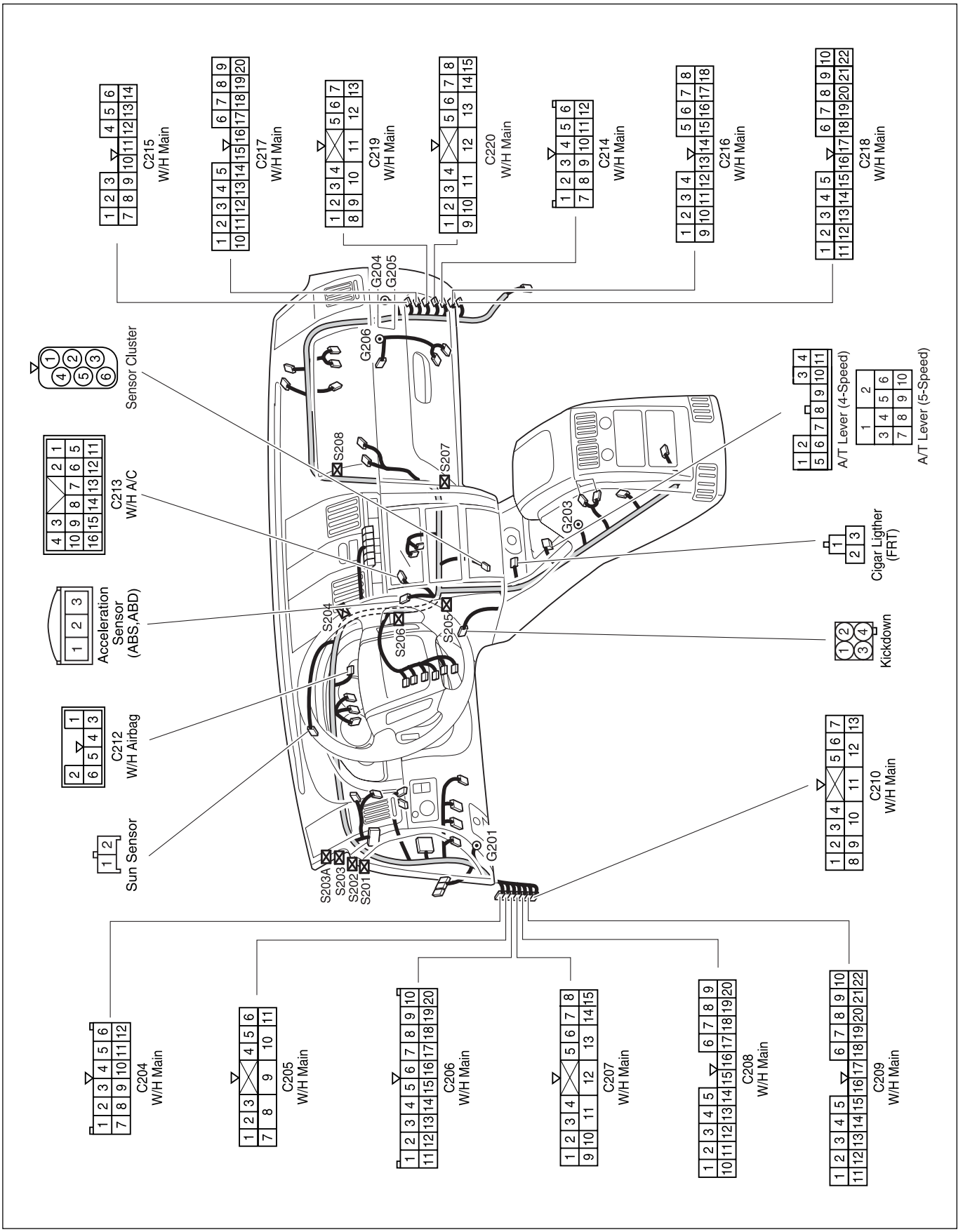
4. WIRING HARNESS, CONNECTOR & GROUND LOCATION

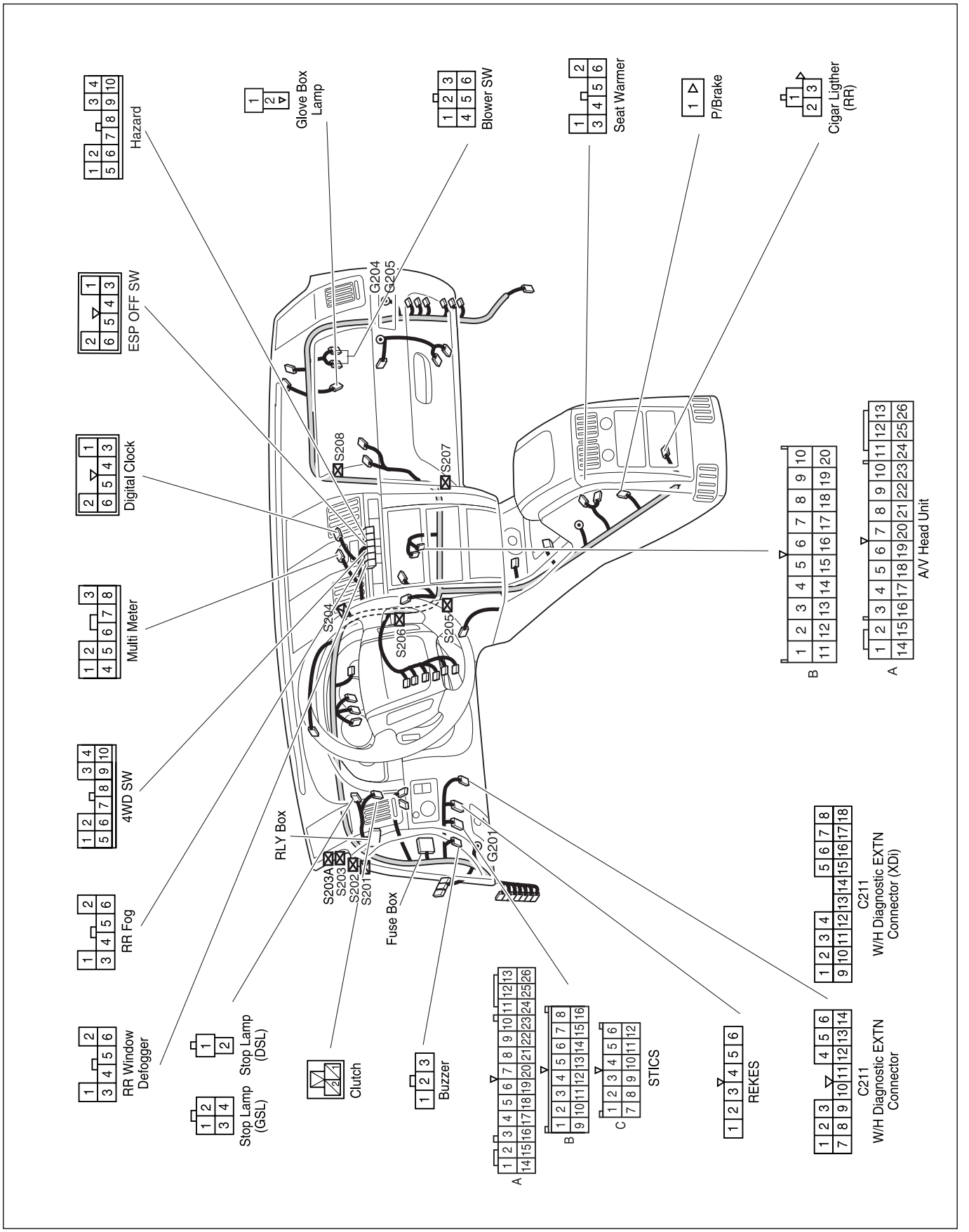
1) W/H ENGINE ROOM

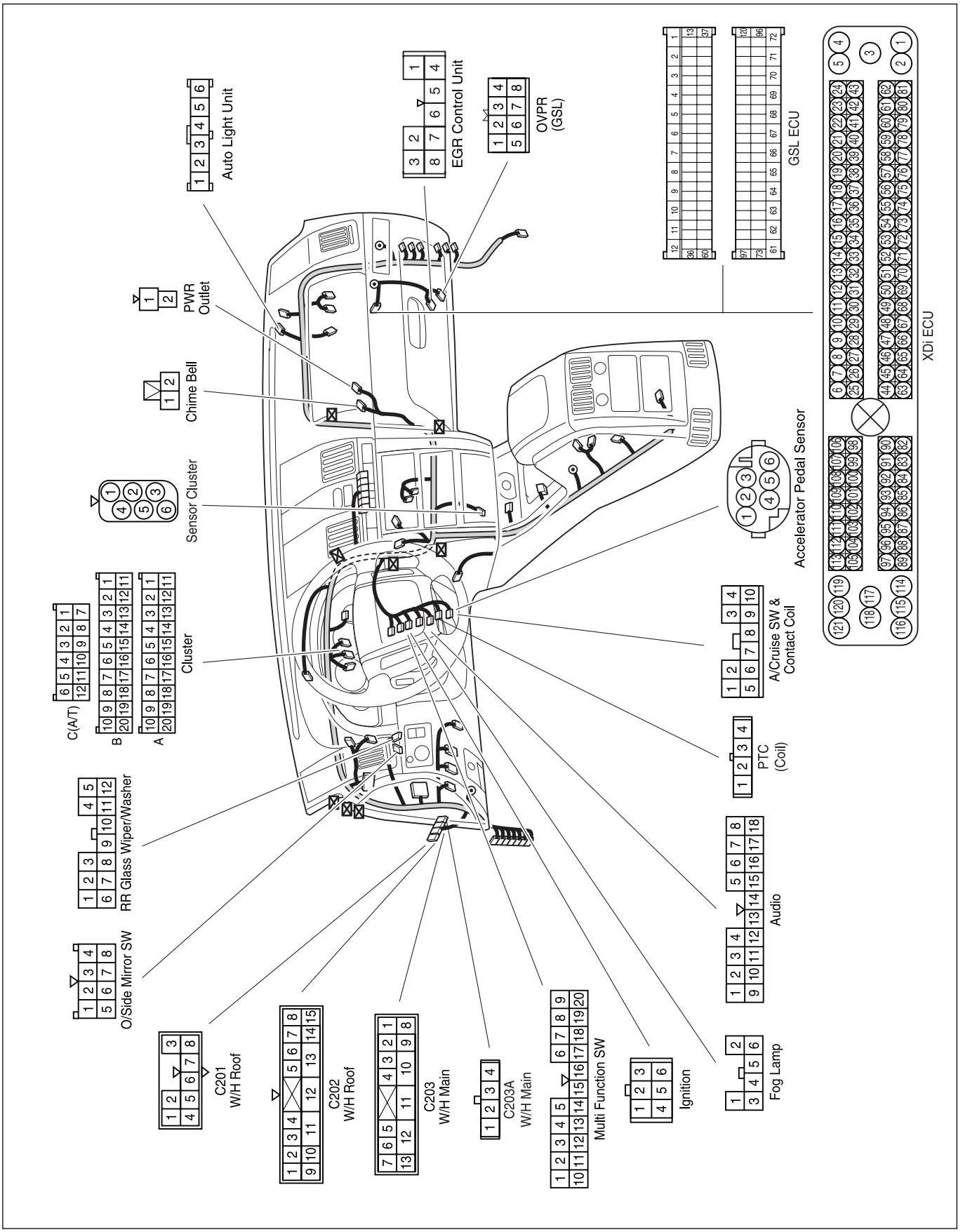



C113
W/H ENG Control (XDi)
C113
W/H ENG Control
(DSL)
C113
W/H ENG Control
(GSL)
C113
W/H ENG Control
(EU GSL)
C115
W/H FFH
C109B
W/H Pressure Sensor
Oil Level SW
Starter
Micro
ALT
"B+"
Water Pump (FFH)
ABS/ABD & ABS/ESP
Side Repeater
(Side Turn
Signal Lamp)
EGR
Solenoid
Wheel Speed
Sensor (FR)
Horn
Coolant Temp.
Sensor
C110
W/H ENG(Start)
C111
W/H Preglow
SSPS
Solenoid
A/C
Compressor
Wheel Speed
Sensor (FL)
Hood
Locking Hub
Solenoid Valve
A/C Coolant
Pressure SW
(Trinary
SW)
A/C Coolant
Pressure SW
(Dual Pressure
SW)
PTC BOX
Washer
Motor(FRT)
Washer
Motor(RR)
G101
G102
G103
G104
G105
G106

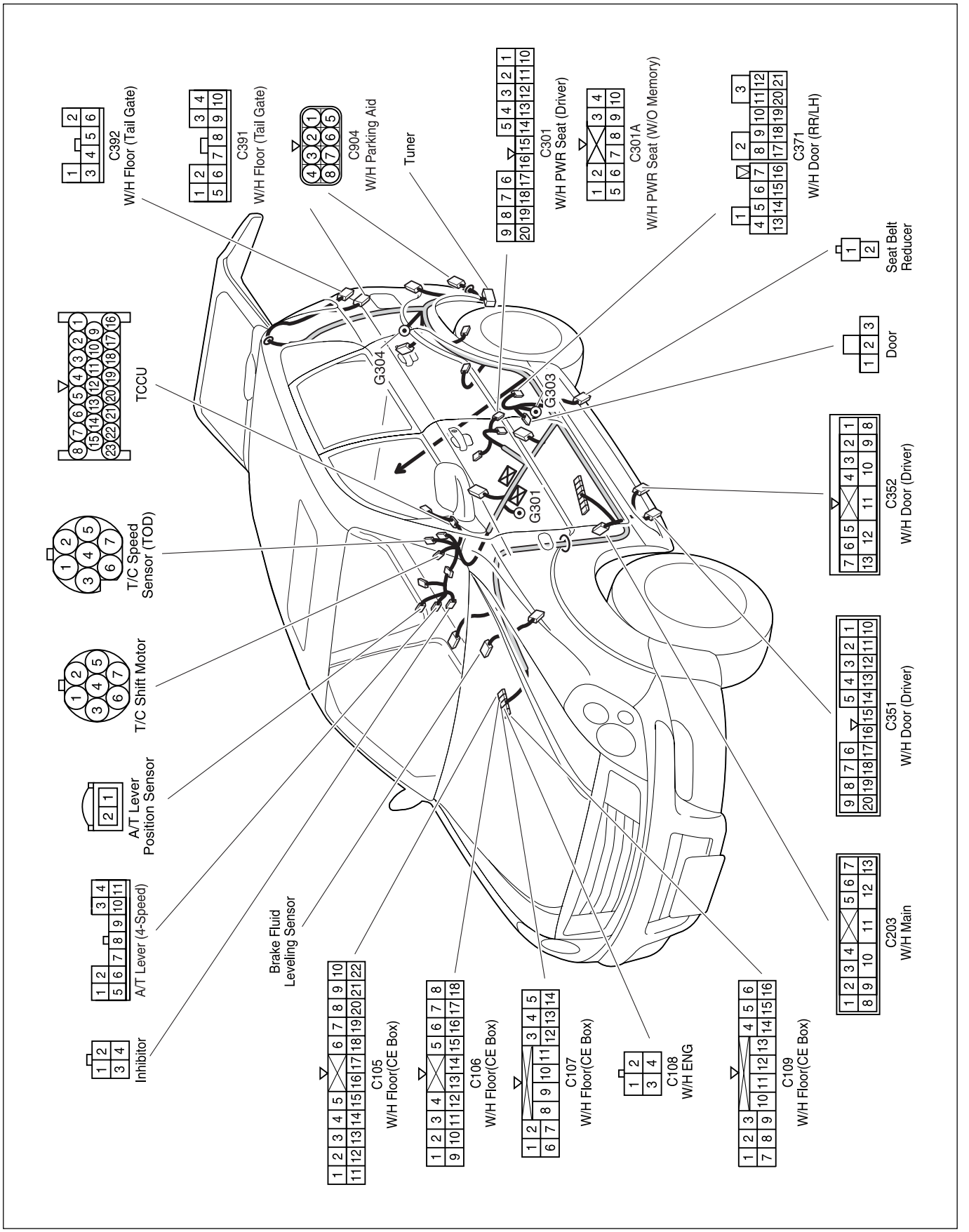
2) W/H MAIN

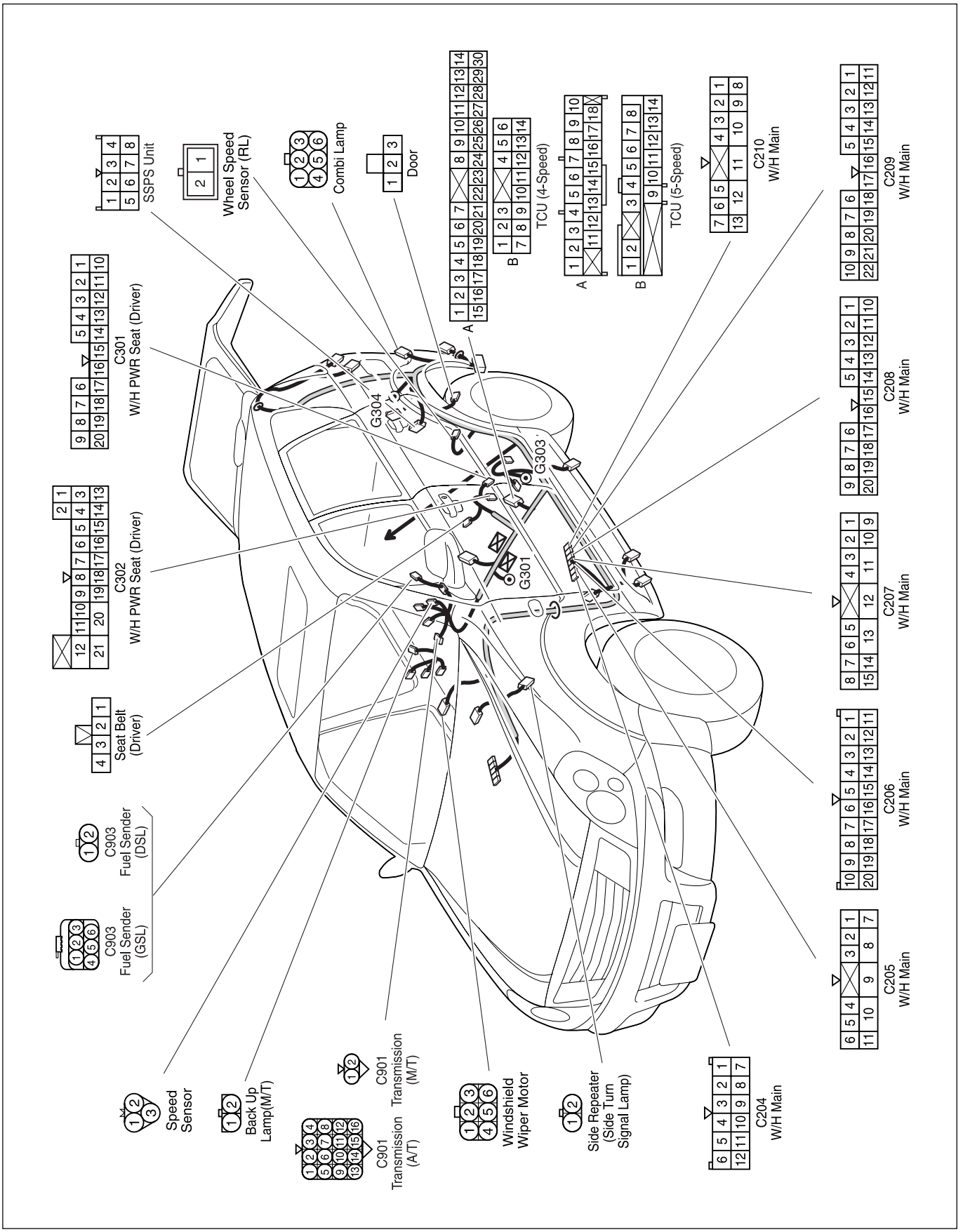

C215 W/H Main
C217 W/H Main
C219 W/H Main
C220 W/H Main
C214 W/H Main
C216 W/H Main
C218 W/H Main
G204
G205
G206
Sensor Cluster
C213 W/H A/C
S208
S207
G203
A/T Lever (4-Speed)
A/T Lever (5-Speed)
Cigar Ligther (FRT)
Acceleration Sensor (ABS,ABD)
S204
S206
S205
Kickdown
C212 W/H Airbag
C210 W/H Main
Sun Sensor
S203A
S203
S202
S201
G201
C204 W/H Main
C205 W/H Main
C206 W/H Main
C207 W/H Main
C208 W/H Main
C209 W/H Main


Hazard
Glove Box Lamp
Blower SW
Seat Warmer
P/Brake
Cigar Ligther (RR)
ESP OFF SW
Digital Clock
Multi Meter
4WD SW
RR Fog
RR Window Defogger
Stop Lamp (GSL)
Stop Lamp (DSL)
Clutch
Buzzer
STICS
REKES
C211 W/H Diagnostic EXTN Connector
C211 W/H Diagnostic EXTN Connector (XDi)
A/V Head Unit
RLY Box
Fuse Box
G201
G204
G205
S201
S202
S203
S203A
S204
S205
S206
S207
S208

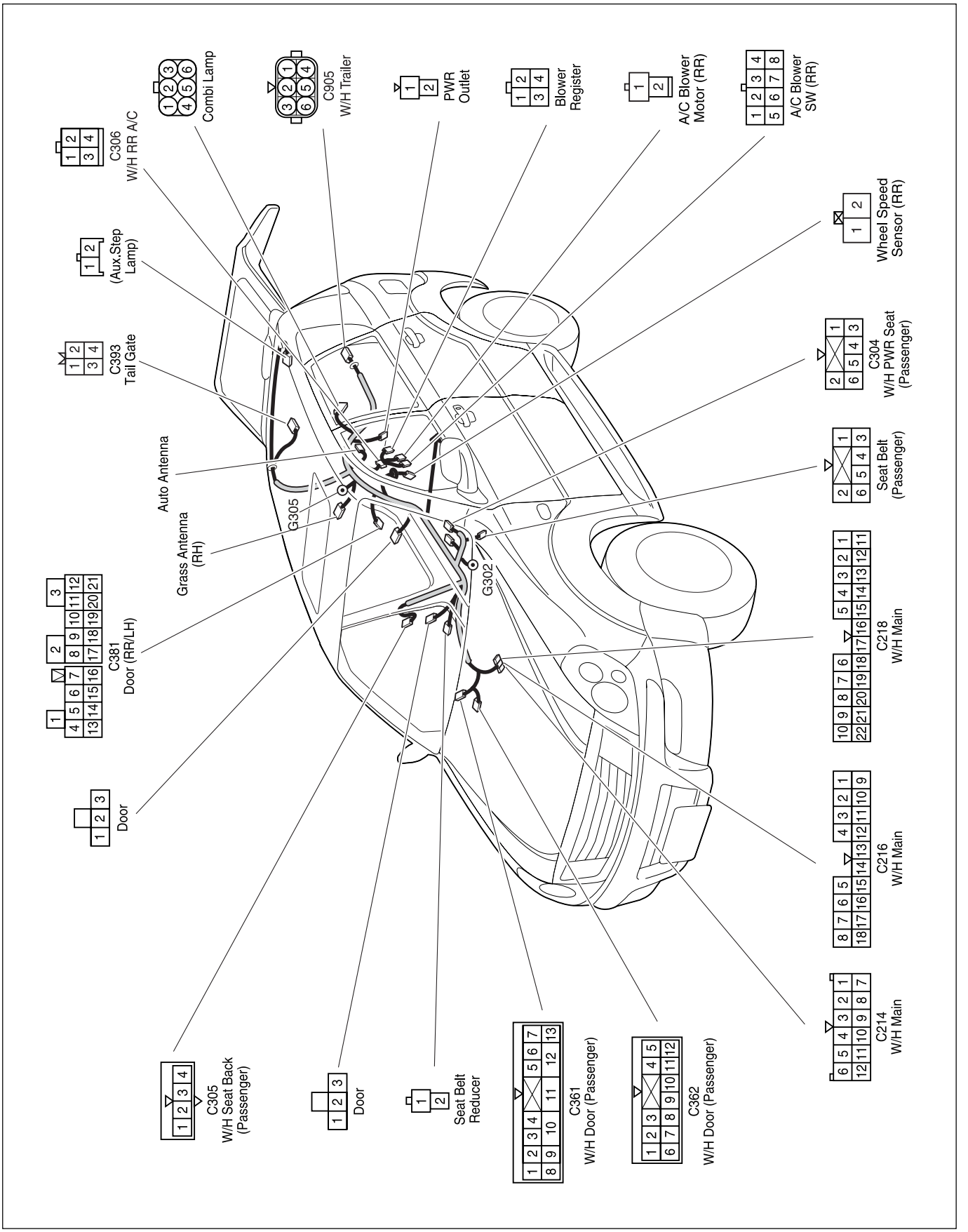

Auto Light Unit
EGR Control Unit
OVPR (GSL)
PWR Outlet
Chime Bell
Sensor Cluster
Cluster
C(A/T)
B
A
RR Glass Wiper/Washer
O/Side Mirror SW
C201 W/H Roof
C202 W/H Roof
C203 W/H Main
C203A W/H Main
Multi Function SW
Ignition
Fog Lamp
Audio
PTC (Coil)
A/Cruise SW & Contact Coil
Accelerator Pedal Sensor
GSL ECU
XDi ECU

3) W/H FLOOR (LH)

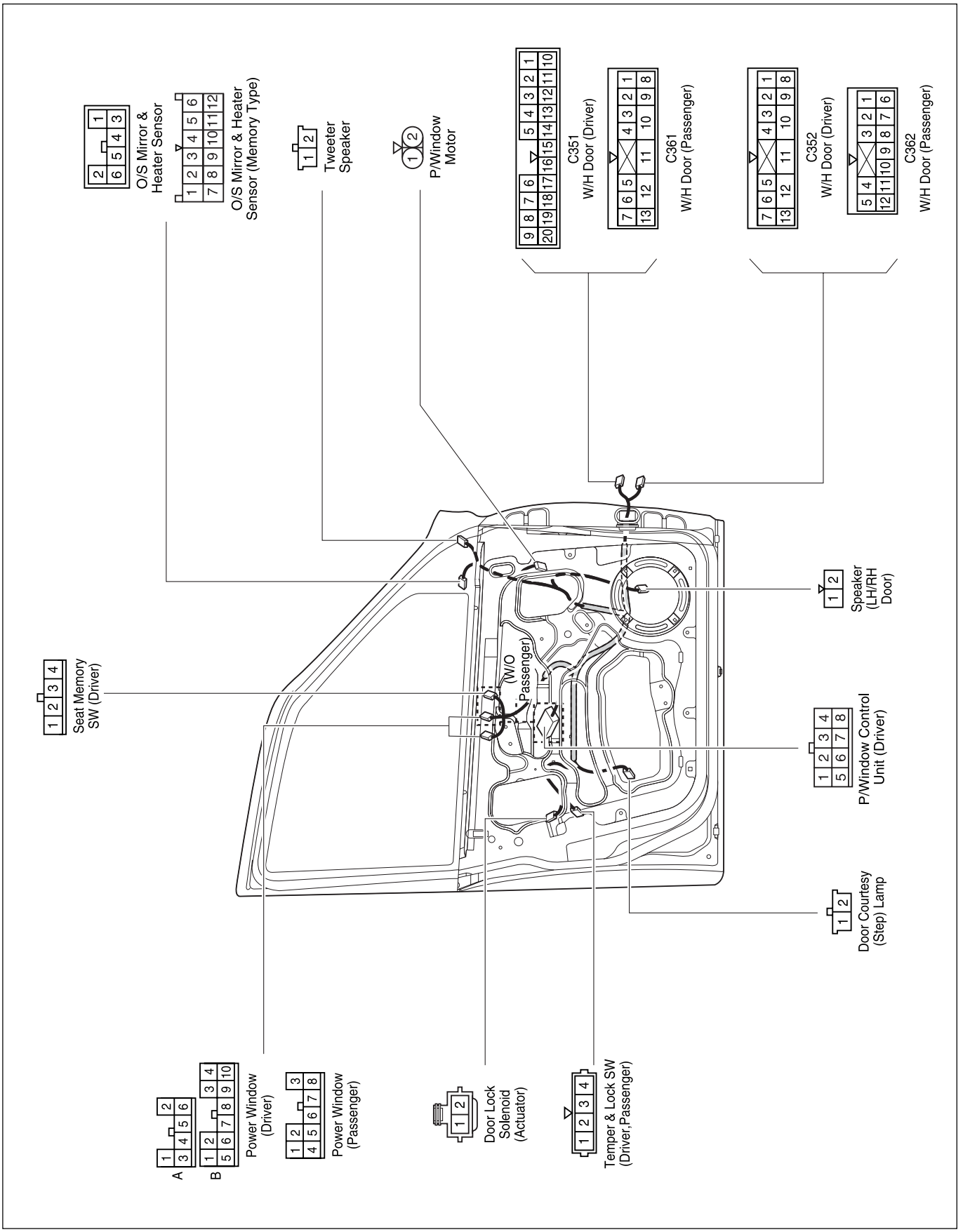

C392
W/H Floor (Tail Gate)
C391
W/H Floor (Tail Gate)
C904
W/H Parking Aid
Tuner
C301
W/H PWR Seat (Driver)
C301A
W/H PWR Seat (W/O Memory)
C371
W/H Door (RR/LH)
Seat Belt
Reducer
Door
TCCU
T/C Speed
Sensor (TOD)
T/C Shift Motor
A/T Lever
Position Sensor
A/T Lever (4-Speed)
Inhibitor
Brake Fluid
Leveling Sensor
G304
G303
G301
C352
W/H Door (Driver)
C351
W/H Door (Driver)
C203
W/H Main
C105
W/H Floor(CE Box)
C106
W/H Floor(CE Box)
C107
W/H Floor(CE Box)
C108
W/H ENG
C109
W/H Floor(CE Box)


SSPS Unit
Wheel Speed Sensor (RL)
Combi Lamp
Door
C301 W/H PWR Seat (Driver)
C302 W/H PWR Seat (Driver)
Seat Belt (Driver)
C903 Fuel Sender (DSL)
C903 Fuel Sender (GSL)
Speed Sensor
Back Up Lamp(M/T)
C901 Transmission (A/T)
C901 Transmission (M/T)
Windshield Wiper Motor
Side Repeater (Side Turn Signal Lamp)
C204 W/H Main
C205 W/H Main
C206 W/H Main
C207 W/H Main
C208 W/H Main
C209 W/H Main
C210 W/H Main
TCU (4-Speed)
TCU (5-Speed)
G301
G303
G304

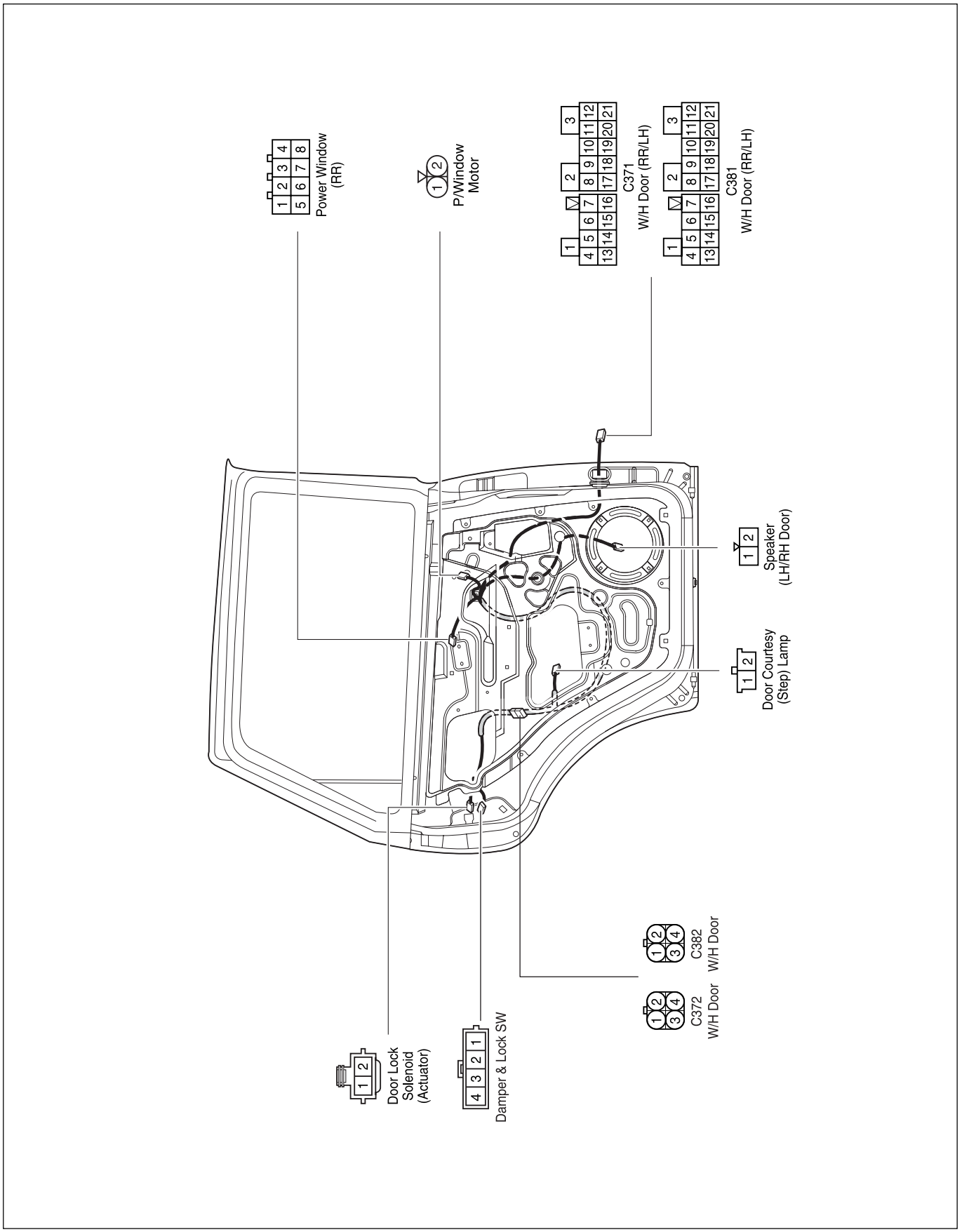
4) W/H FLOOR (RH)


C306
W/H RR A/C
Combi Lamp
C905
W/H Trailer
PWR
Outlet
Blower
Register
A/C Blower
Motor (RR)
A/C Blower
SW (RR)
(Aux.Step
Lamp)
C393
Tail Gate
Auto Antenna
Grass Antenna
(RH)
G305
G302
Wheel Speed
Sensor (RR)
C304
W/H PWR Seat
(Passenger)
Seat Belt
(Passenger)
C381
Door (RR/LH)
C218
W/H Main
Door
C216
W/H Main
C214
W/H Main
C305
W/H Seat Back
(Passenger)
Door
Seat Belt
Reducer
C361
W/H Door (Passenger)
C362
W/H Door (Passenger)

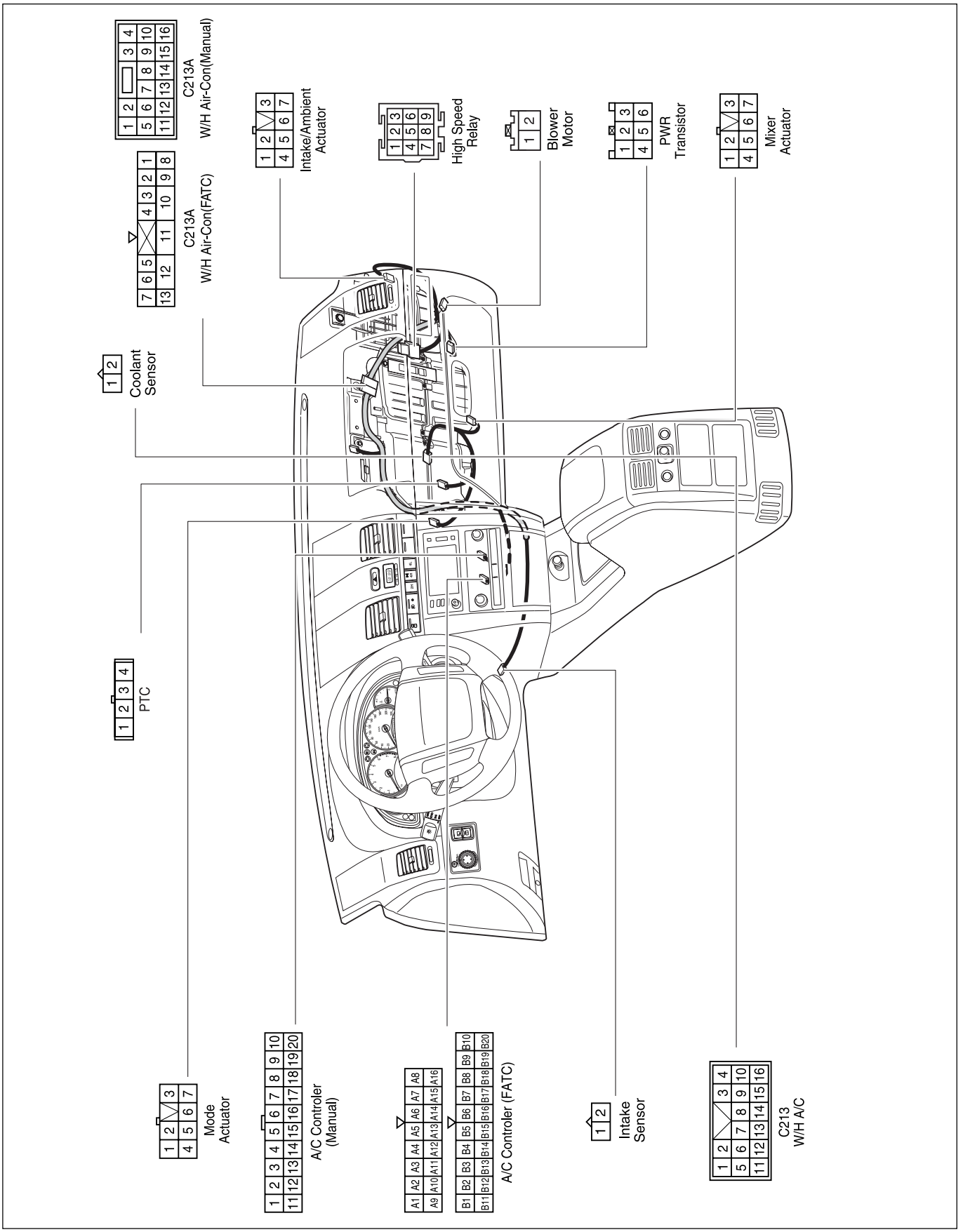
5) W/H DOOR (LH/RH)



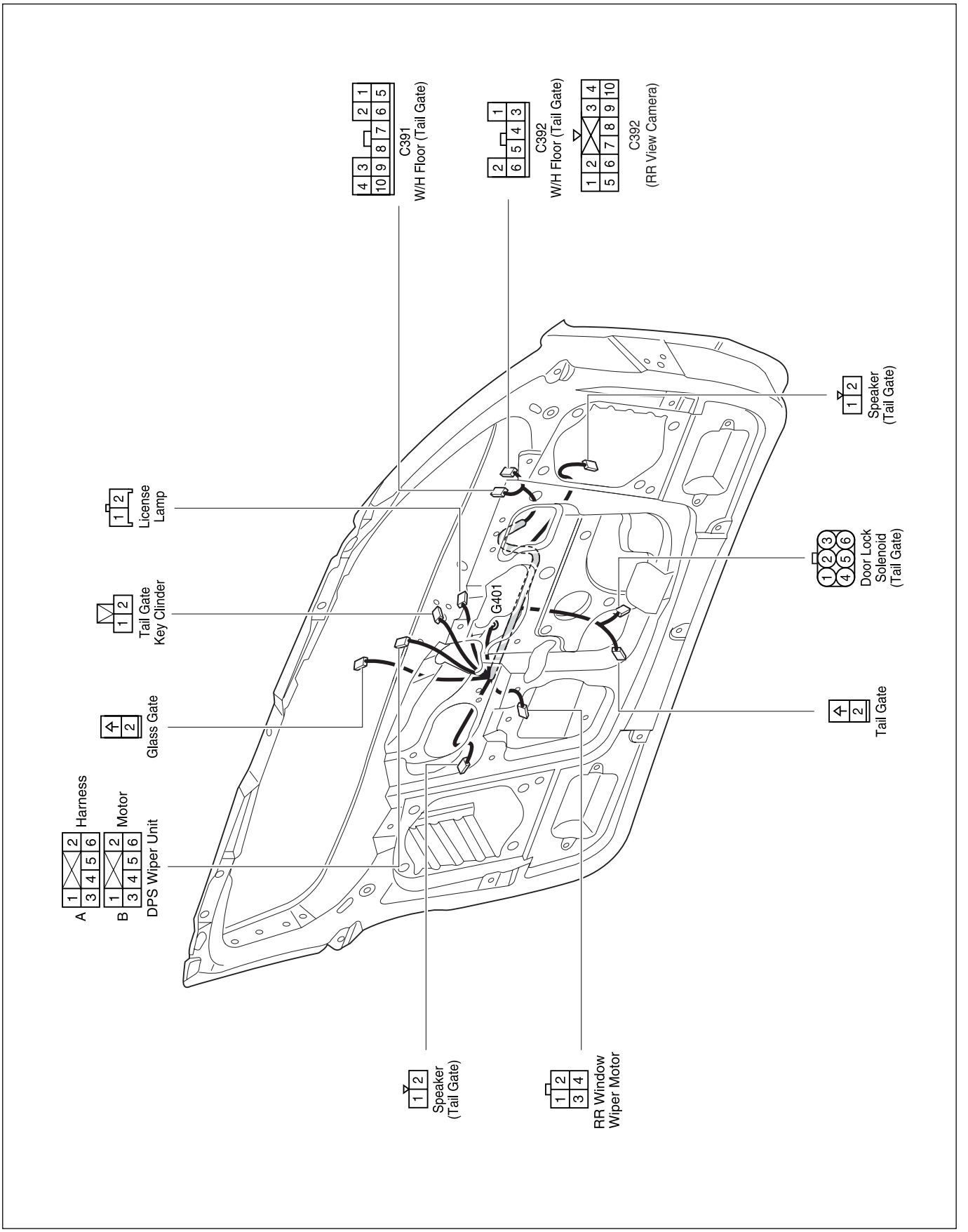
6) W/H RR DOOR


Power Window (RR)
P/Window Motor
C371 W/H Door (RR/LH)
C381 W/H Door (RR/LH)
Speaker (LH/RH Door)
Door Courtesy (Step) Lamp
C382 W/H Door
C372 W/H Door
Door Lock Solenoid (Actuator)
Damper & Lock SW

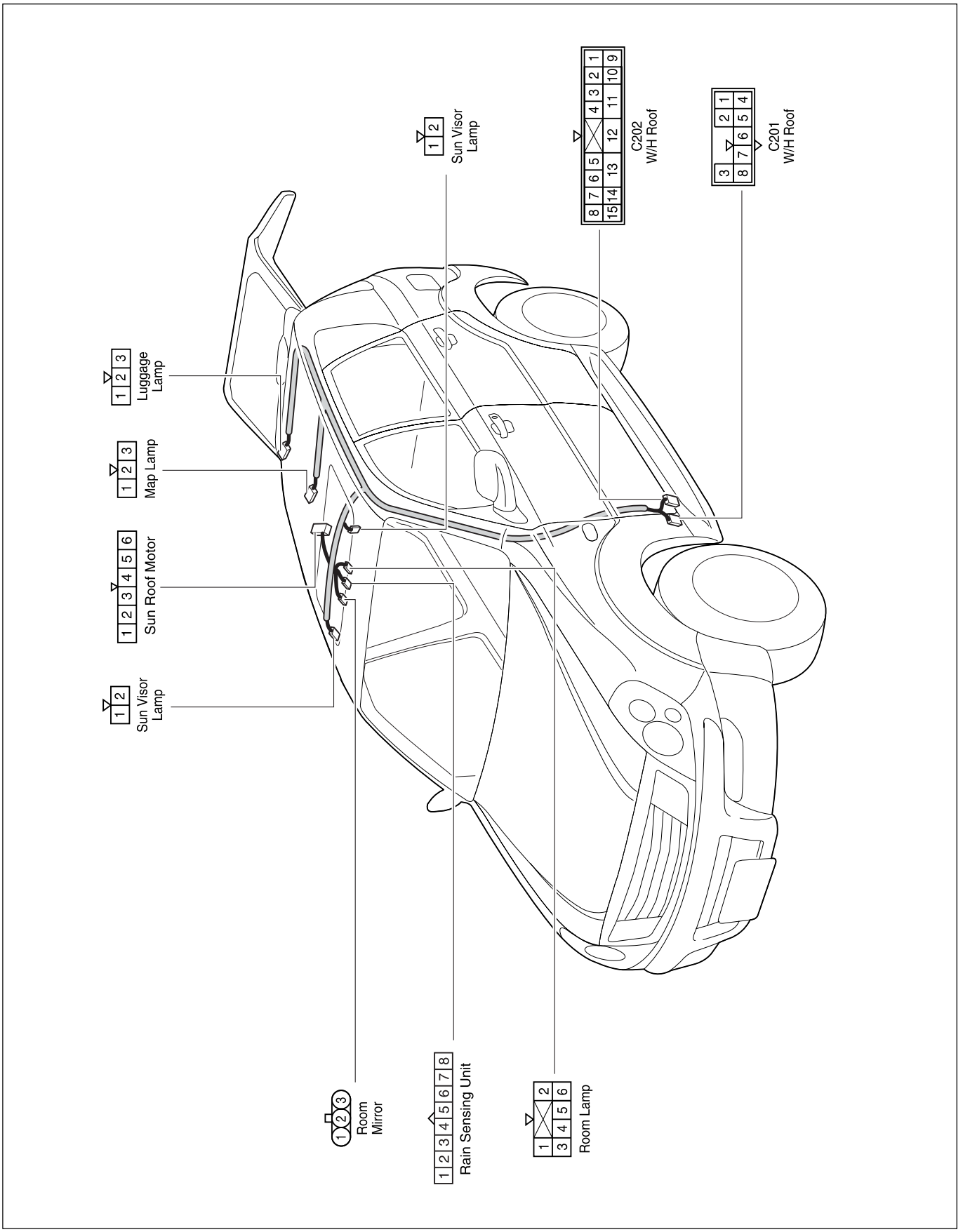
7) W/H AIR-CON


C213A
W/H Air-Con(Manual)
C213A
W/H Air-Con(FATC)
Intake/Ambient
Actuator
High Speed
Relay
Blower
Motor
PWR
Transistor
Mixer
Actuator
Coolant
Sensor
PTC
Mode
Actuator
A/C Controler
(Manual)
A/C Controler (FATC)
Intake
Sensor
C213
W/H A/C

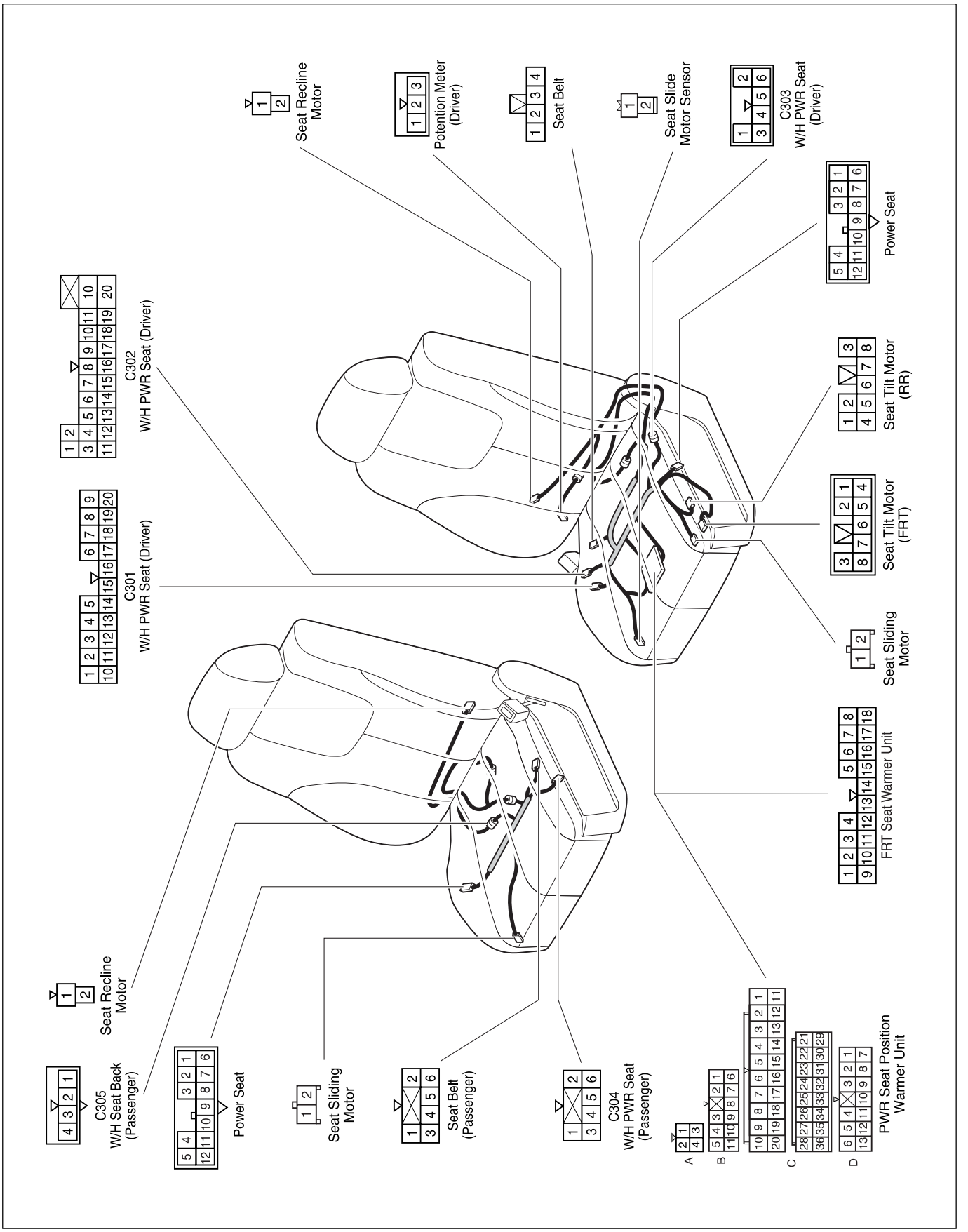
8) W/H TAIL GATE



9) W/H ROOF

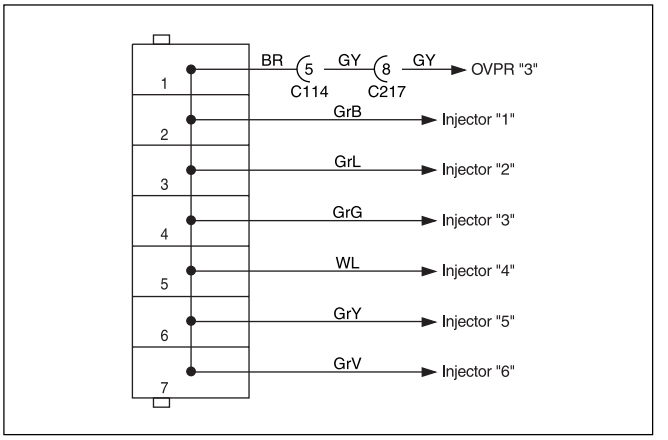

Luggage Lamp
Map Lamp
Sun Roof Motor
Sun Visor Lamp
Sun Visor Lamp
C202 W/H Roof
C201 W/H Roof
Room Mirror
Rain Sensing Unit
Room Lamp

10) W/H SEAT

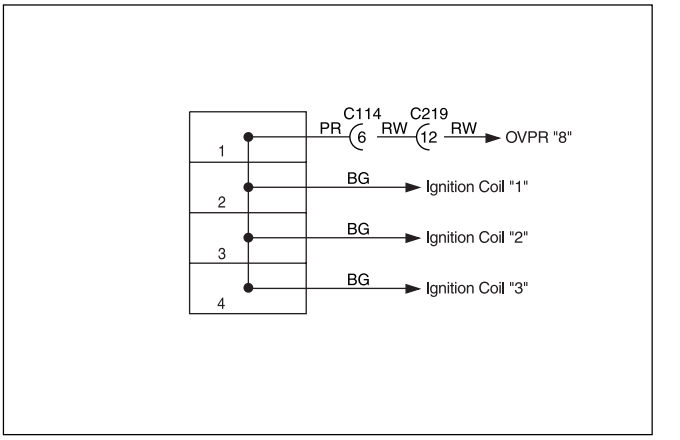

Seat Recline Motor
Potention Meter (Driver)
Seat Belt
Seat Slide Motor Sensor
C303 W/H PWR Seat (Driver)
Power Seat
C302 W/H PWR Seat (Driver)
Seat Tilt Motor (RR)
C301 W/H PWR Seat (Driver)
Seat Tilt Motor (FRT)
Seat Sliding Motor
FRT Seat Warmer Unit
Seat Recline Motor
C305 W/H Seat Back (Passenger)
Power Seat
Seat Sliding Motor
Seat Belt (Passenger)
C304 W/H PWR Seat (Passenger)
PWR Seat Position Warmer Unit

11) SPLICE PACK

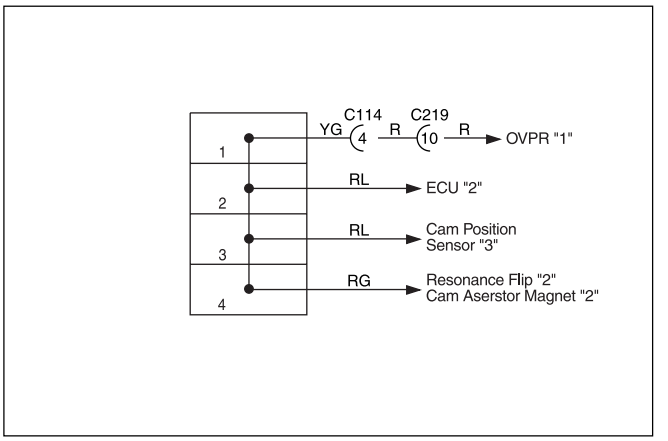
• **S101**



• **S102**

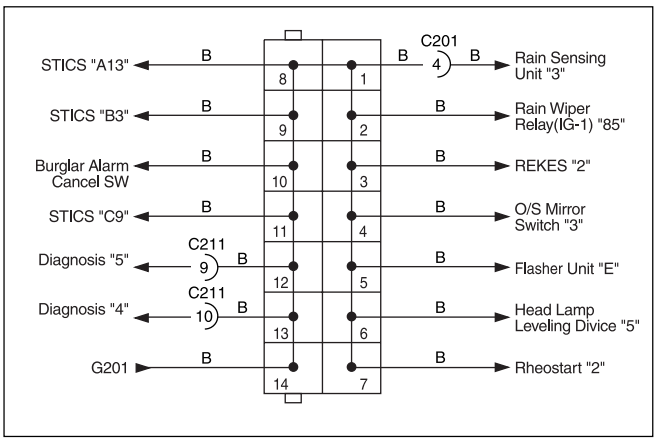


• **S103**

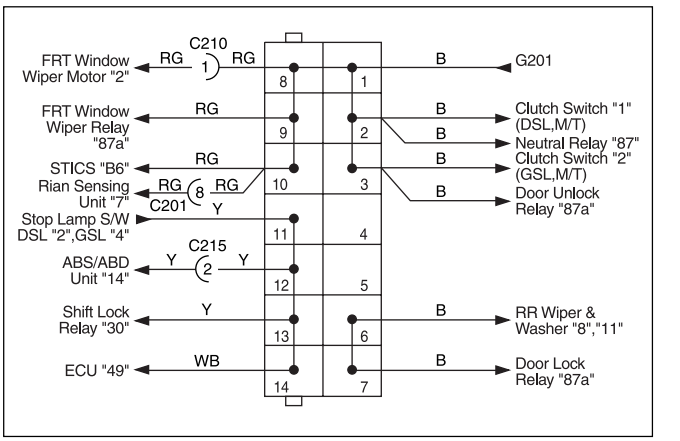


(1) ~ 2002 MODEL

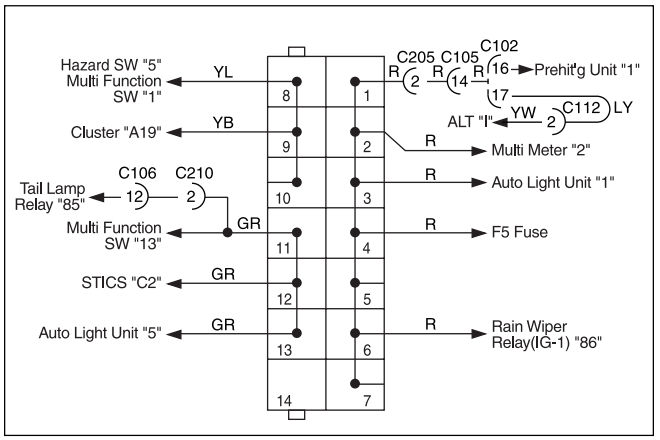
• **S201**



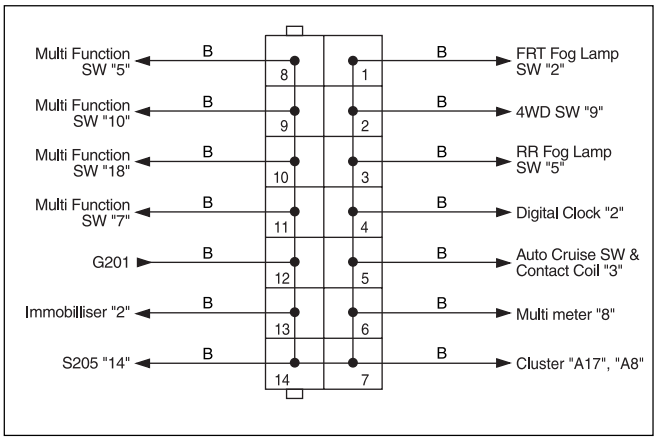
• **S202**



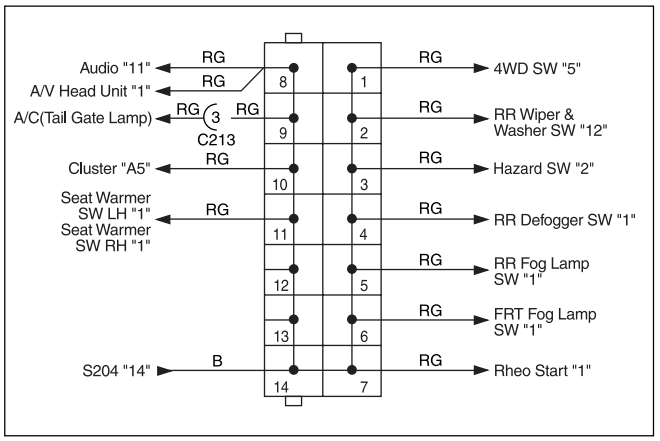
• S203



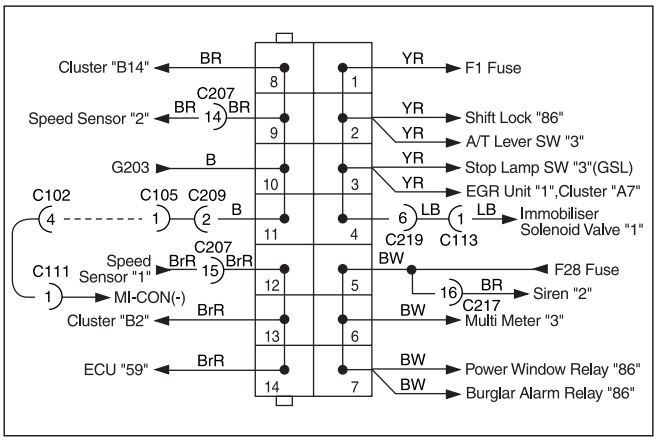
• S204



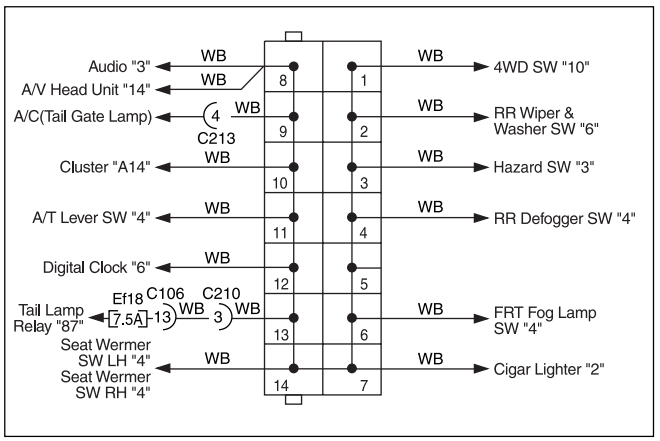
• S205



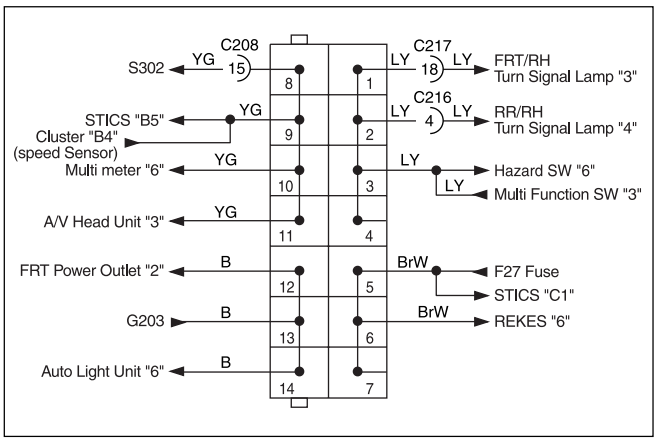
• S206



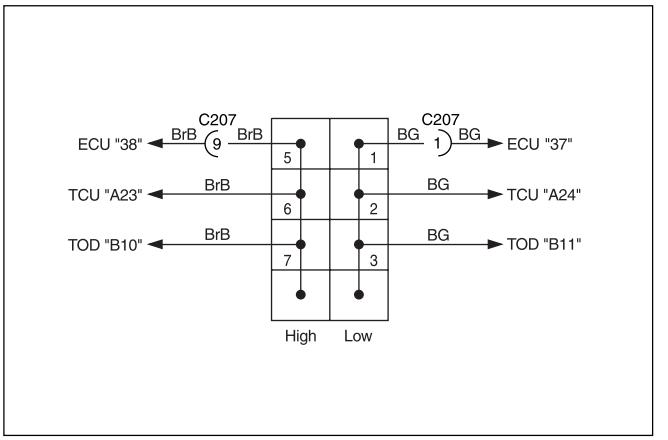
• S207



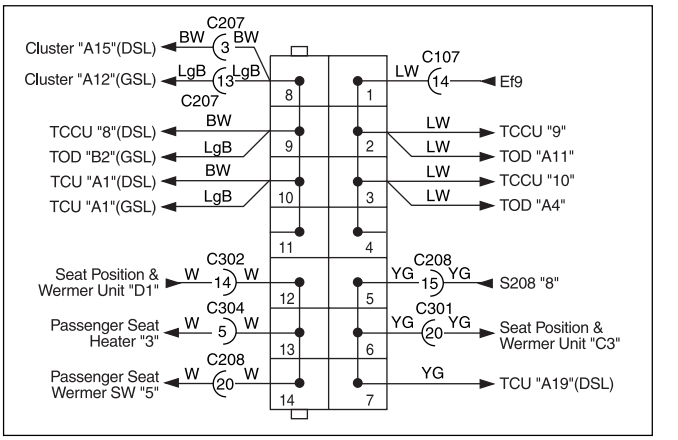
• S208



• **S301**

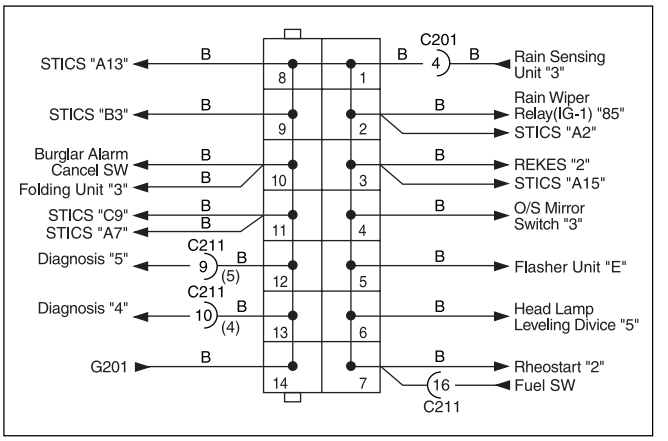


• **S302**

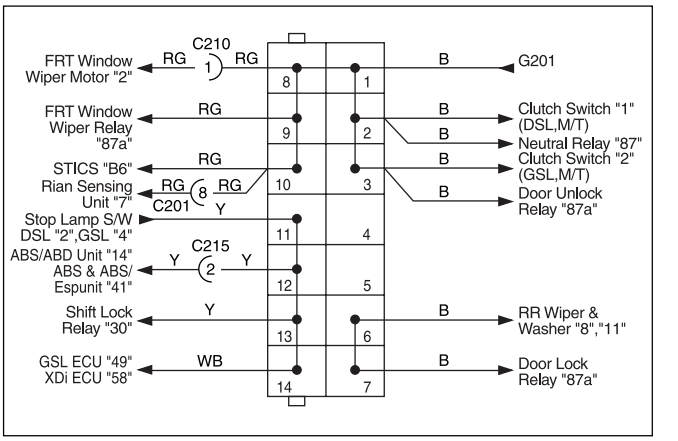


(2) 2003 MODEL ~

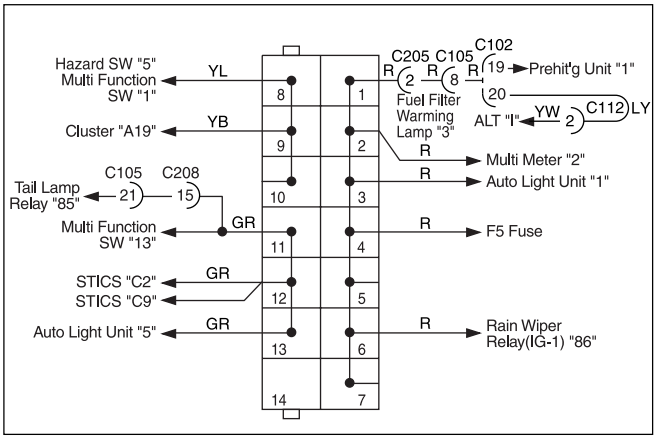
• **S201**



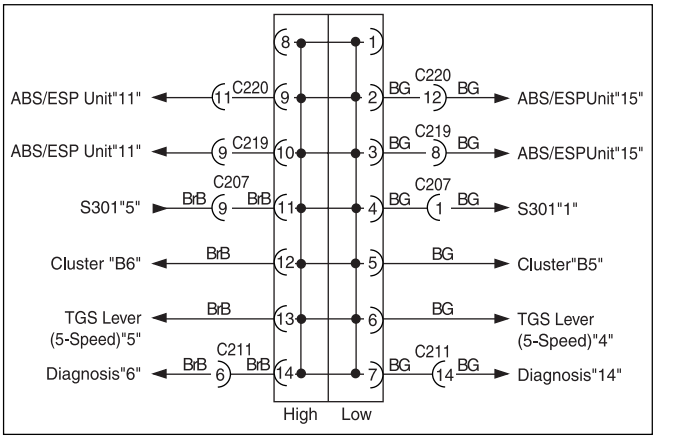
• **S202**



• **S203**

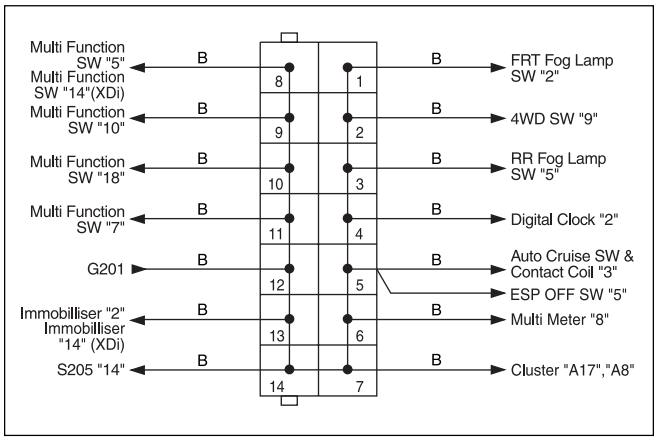


• **S203A**

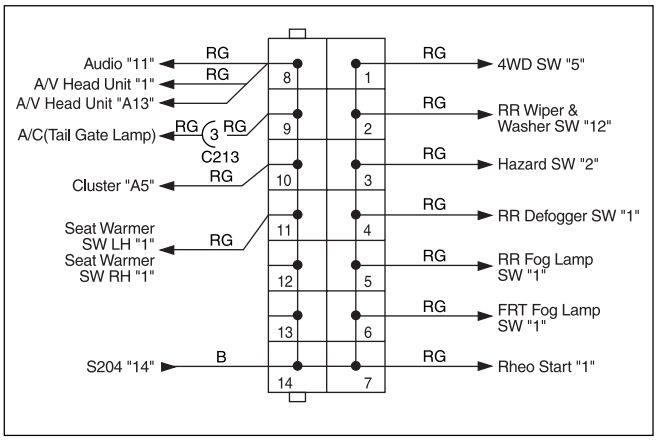


( ): XDi Only

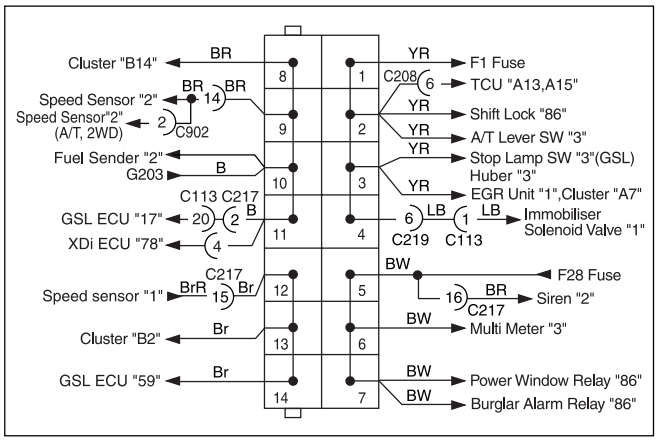
• S204



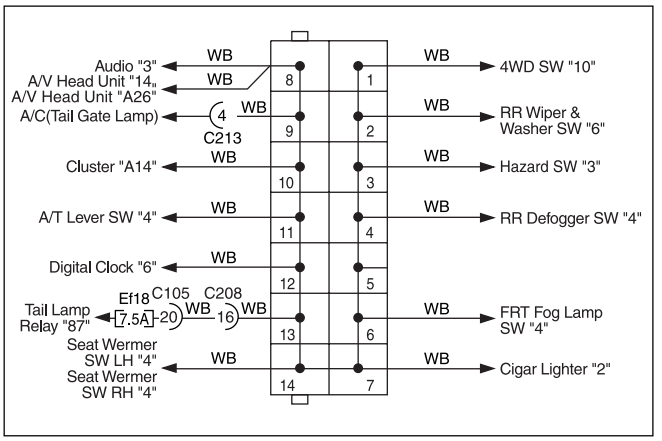
• S205



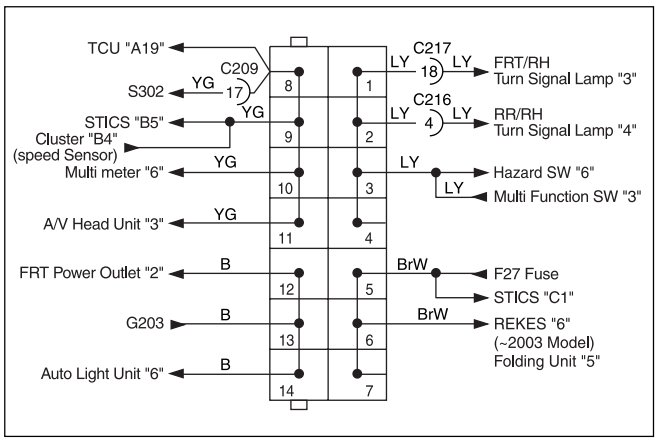
• S206



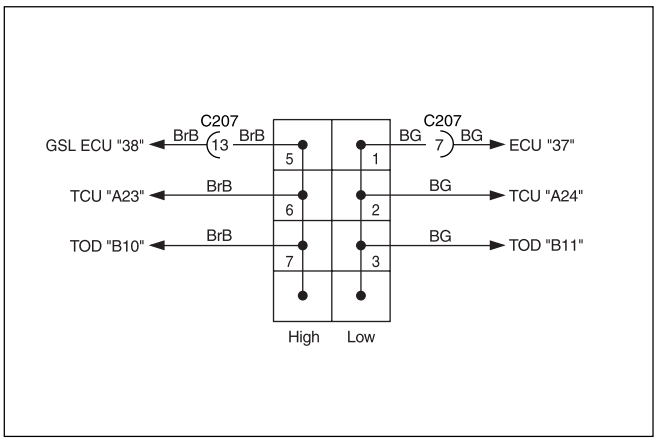
• S207



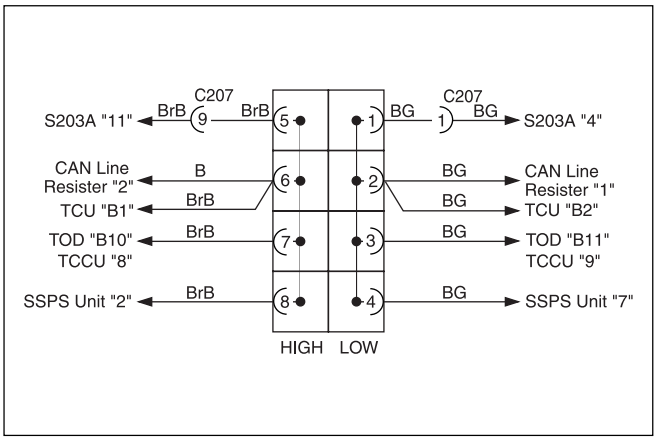
• S208



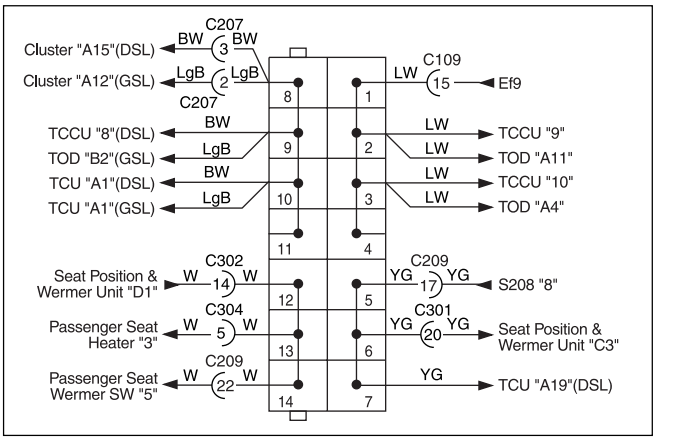
• S301



• S301A


C207
S203A "11"
BrB
9
BrB
5
1
BG
C207
1
BG
S203A "4"
CAN Line
Resister "2"
B
6
2
BG
CAN Line
Resister "1"
TCU "B1"
BrB
BG
TCU "B2"
TOD "B10"
TCCU "8"
BrB
7
3
BG
TOD "B11"
TCCU "9"
SSPS Unit "2"
BrB
8
4
BG
SSPS Unit "7"
HIGH
LOW

• S302


C207
Cluster "A15"(DSL)
BW
3
BW
Cluster "A12"(GSL)
LgB
2
LgB
C207
8
1
C109
LW
15
Ef9
TCCU "8"(DSL)
BW
TOD "B2"(GSL)
LgB
9
2
LW
TCCU "9"
LW
TOD "A11"
TCU "A1"(DSL)
BW
LW
TCCU "10"
TCU "A1"(GSL)
LgB
10
3
LW
TOD "A4"
11
4
C302
Seat Position &
Wermer Unit "D1"
W
14
W
C209
YG
17
YG
S208 "8"
12
5
C304
C301
Passenger Seat
Heater "3"
W
5
W
YG
20
YG
Seat Position &
Wermer Unit "C3"
13
6
C209
Passenger Seat
Wermer SW "5"
W
22
W
YG
TCU "A19"(DSL)
14
7

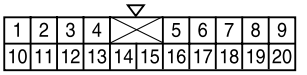
5. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

1) C101 ~ C115

1

C101
W/H ENG(CE Box)

2

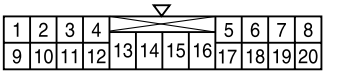


C102
W/H ENG(CE Box)

3

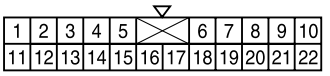
C103
W/H ENG(CE Box)

4



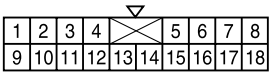
C104
W/H ENG(CE Box)

5



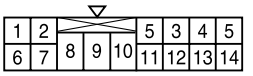
C105
W/H Floor(CE Box)

6



C106
W/H Floor(CE Box)

7

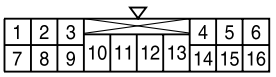


C107
W/H Floor(CE Box)

8

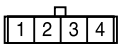
C108
W/H Floor(CE Box)

9



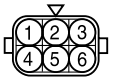
C109
W/H Floor(CE Box)

10



C109A
W/H ENG (CE Box)

11



C109B
W/H Pressure Sensor

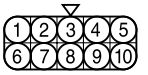
12

C110
W/H ENG(Starter)

13

C111
W/H Preglow

14



C111A
W/H EGR

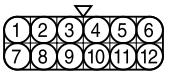
14

C112
W/H Alternator
(GSL)

15

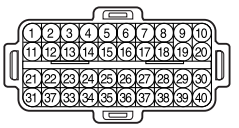
C112
W/H Alternator
(DSL)

16



C113
W/H ENG Control
(DSL)

17

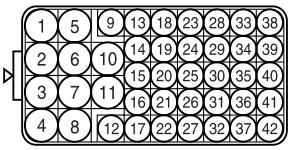


C113
W/H ENG Control
(GSL)

18

C113
W/H ENG Control
(EU GSL)

19

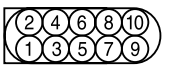


C113
W/H ENG Control(XDi)

20

C114
W/H ENG Control
(GSL)

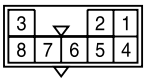
21



C115
W/H FFH

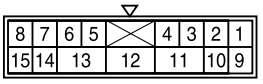
2) C201 ~ C220

22



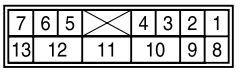
C201
W/H Roof

23



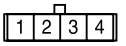
C202
W/H Roof

24



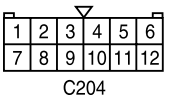
C203
W/H Main

25



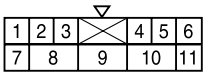
C203A
W/H Main

26



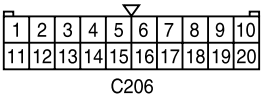
C204
W/H Main

27



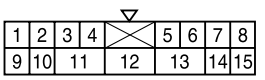
C205
W/H Main

28



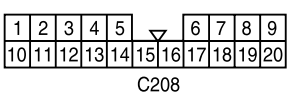
C206
W/H Main

29

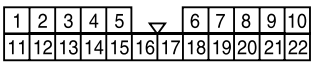


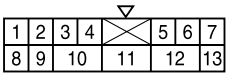
C207
W/H Main

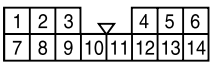
30

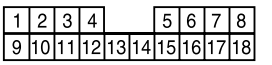


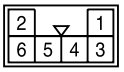
C208
W/H Main

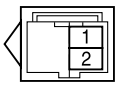
31

C209
W/H Main

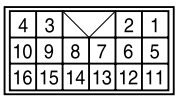
32

C210
W/H Main

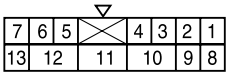
33

C211
W/H Diagnosis EXTN
Connector

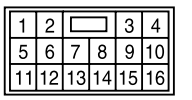
34

C211
Diagnosis(XDi)

35

C212
W/H Airbag

36

C212A~F
W/H Air-Bag

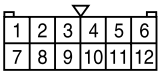
37

C213
W/H Air-Con

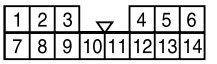
38

C213A
W/H A/C(FATC)

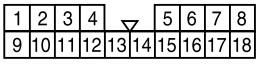
39

C213A
W/H A/C(Manual)

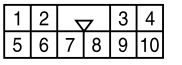
40

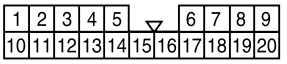
C213B
Kick Down
SW

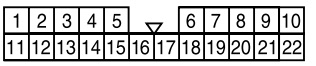
41

C214
W/H Main

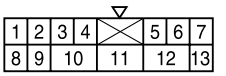
42

C215
W/H Main

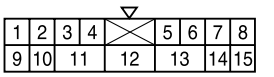
43

C216
W/H Main

44

C216
W/H Main

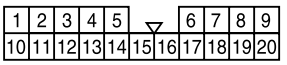
45

C217
W/H Main

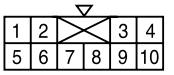
46

C218
W/H Main

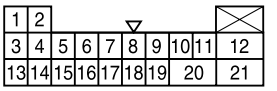
47

C219
W/H Main

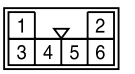
48

C220
W/H Main

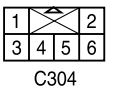
3) C301 ~ C905

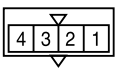
49

C301
W/H PWR Seat (Driver)

50

C301A
W/H Warmmer Seat
(W/O Memory)

51

C302
W/H PWR Seat (Driver)

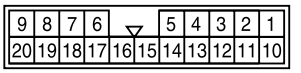
52

C303
W/H PWR Seat
(Driver)

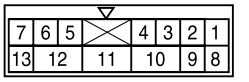
53

C304
W/H PWR Seat
(Passenger)

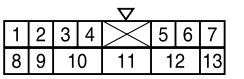
54

C305
W/H Seat Back
(Passenger)

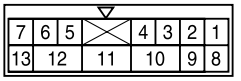
55

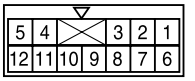
C306
W/H RR Air-Con

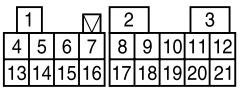
56

C351
W/H Door (Driver)

57

C352
W/H Door (Driver)

58

C353
W/H Door (Driver)

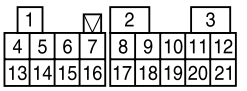
59

C361
W/H Door (Passenger)

60

C362
W/H Door (Passenger)

61

C371
W/H Door (RR/LH)

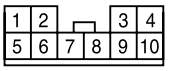
62

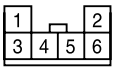
C372
W/H Door

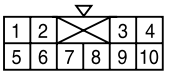
63

C381
W/H Door (RR/LH)

64

C382
W/H Door

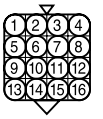
65

C391
W/H Floor (Tail Gate)

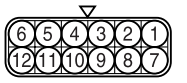
66

C392
W/H Floor (Tail Gate)

67

C392
W/H Tail Gate

68

C393
W/H Tail Gate

69

C901
W/H Transmission(A/T)

70

C901
W/H Transmission(A/T)

71

C901
W/H Transmission
(M/T)

72

C902
W/H Transmission
(A/T 2WD)

73

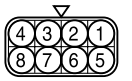
C902
W/H Transmission
(M/T 2WD)

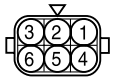
74

C903
W/H Fuel Sender
(GSL)

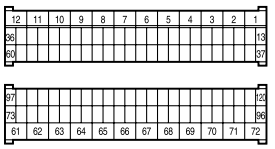
75

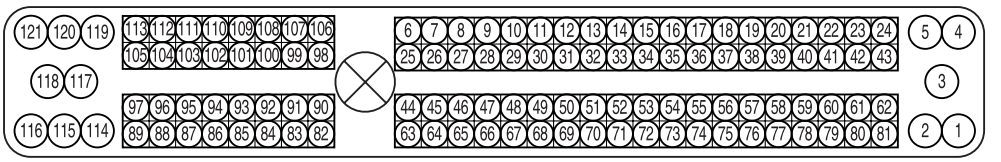
C903
W/H Fuel Sender
(DSL)

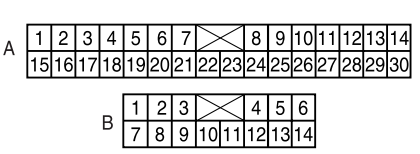
76

C904
W/H Parking Aid

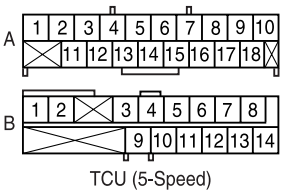
77

C905
W/H Trailer

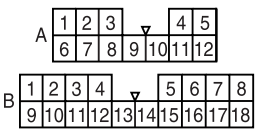
4) CONTROL UNIT

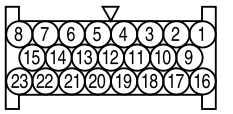
78

ECU

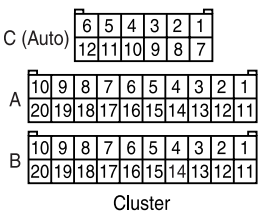
79

XDi ECU

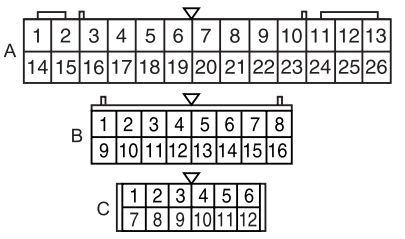
80

TCU (4-Speed)

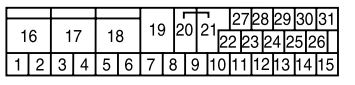
81

TCU (5-Speed)

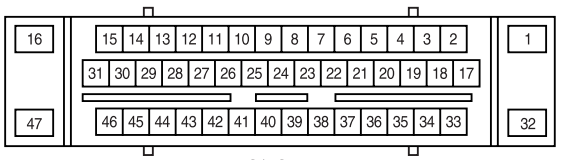
82

TOD

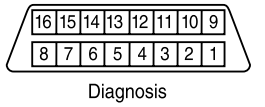
83

TCCU (Old)

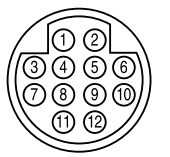
84

Cluster

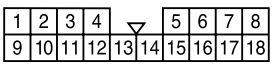
85

STICS

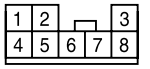
86

ECBM (ABS/ABD)

87

ABS/ESP Unit

88

Diagnosis

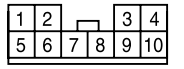
89

Transmission (A/T)

90

Audio

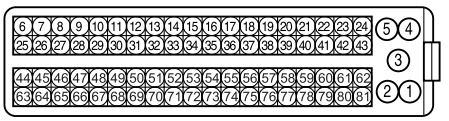
91

Multi Meter

92

REKES

93

A/Cruise SW &
Contact Coil

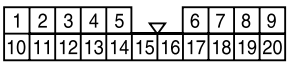
94



Huber EGR

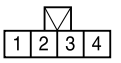
5) SW (SWITCH)

95



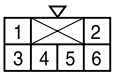
Multi Function

96



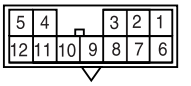
Seat Belt (Driver)

97



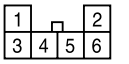
Seat Belt (Passenger)

98



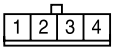
Power Seat SW

99



Seat Warmer

100



Seat Memory (Driver)

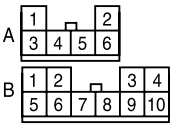
101

Stop Lamp (GSL)

102

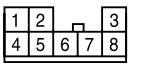
Stop Lamp (DSL)

103



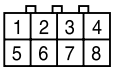
Power Window (Driver)

104



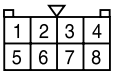
Power Window (Passenger)

105



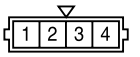
Power Window (RR)

106



Power O/S Mirror

107



Temper & Lock SW (Driver,Passenger)

108

Tail Gate

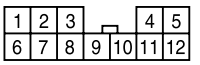
109

Tail Gate Key Clinder

110

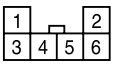
Glass Gate

111



RR Grass Wiper/Washer

112



RR Defogger

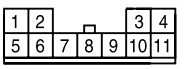
113

Back Up Lamp (M/T)

114

Inhibitor (A/T)

115



A/T Lever

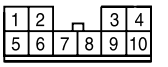
116

Clutch (M/T)

117

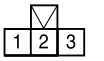
Kickdown

118



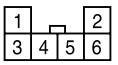
4WD SW

119



Key Reminder

120

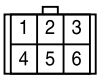


Fog Lamp

121

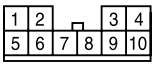
Hood

122



Ignition

123

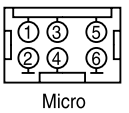


Hazard

124

P/Brake

125



Micro

126

Door

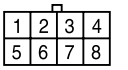
127

A/C Coolant Pressure SW (Duel Pressure SW)

128

A/C Coolant Pressure SW (Trinary SW)

129



A/C Blower SW (RR)

130


Blower SW

131

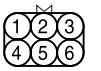

Thermo SW
(DSL)

132

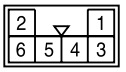

Oil Level

133

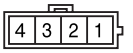

Start SW

134


Head Lamp Level'g
Derice SW

135


ESP OFF SW

136


Damper & Lock SW

6) LAMP

137

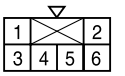

Glove Box
Lamp

138


Sun Visor
Lamp

139


Luggage
Lamp

140


Room Lamp

141


Door Courtesy
(Step) Lamp

142

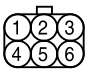

Position
Lamp

143

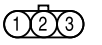

Map Lamp

144


Head Lamp

145


Tail Lamp &
Combi Lamp

146


Turn Signal
Lamp

147


Side Repeater
(Side Turn
Signal Lamp)

148


Stop Lamp

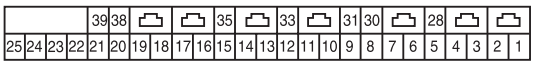
149


Fog Lamp

150


License
Lamp

7) AIR BAG

151


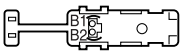
SDM

152


Driver
Airbag

153


Passenger
Airbag

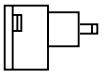
154


Airbag Contact Coil
(Steering Side)

155

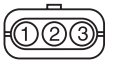

Airbag
Contact Coil
(Column Side)

8) SENSOR

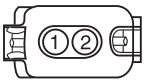
156

Coolant Temp. Sensor

157

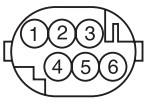

Coolant Temp. Sensor

158


Cam Shaft Position Sensor

159


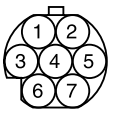
Crank Position Sensor

160


Accelerator Pedal Sensor

161


A/T Lever Position Sensor

162


T/C Speed Sensor

163


Wheel Speed Sensor (FRT)

164

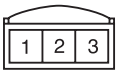

Wheel Speed Sensor (RR)

165

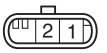
Seat Slide Motor Sensor

166


Vehicle Speed Sensor

167


Acceleration Sensor (ABS, ABD)

168


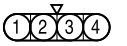
Acceleration ("G"-Sensor)

169

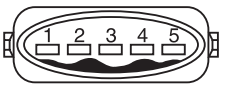

ENG RPM

170


O2 Sensor (GSL)

171


Trottle Position Sensor (DSL)

172


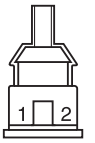
Air Flow Sensor

173


Ambient Sensor

174


Sun Sensor

175


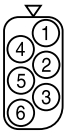
Knock Sensor

176

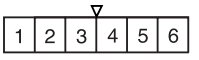

Intake Sensor

177


Coolant Sensor

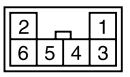
178


Sensor Cluster

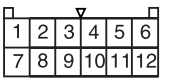
179


Steering Wheel Angle Sensor

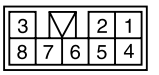
9) MOTOR

180


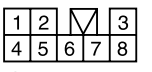
O/S Mirror & Heater Sensor

181


O/S Mirror & Heater Sensor (Memory Type)

182


Seat Tilt Motor (FRT)

183


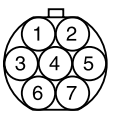
Seat Tilt Motor (RR)

184


Seat Recline Motor

185


Seat Sliding Motor

186


T/C Shift Motor

187


T/C Motor

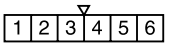
188


FRT Glass Wiper Motor

189


RR Glass Wiper Motor

10) UNIT

190


Sun Roof Motor

191


Washer Motor

192


A/C Blower Motor (RR)

193

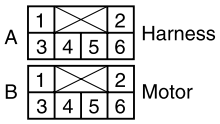

Blower Motor

194

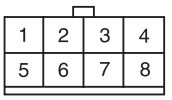

Cooling Fan Motor

195

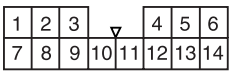

P/Window Motor

196


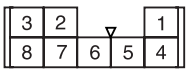
DPS Wiper Unit

197


P/Window Control Unit (Driver)

198


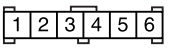
Parking Aid Unit

199


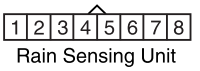
EGR Control Unit

200

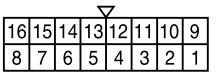

Pre Glow Unit

201


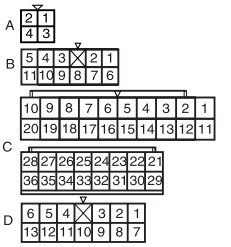
Auto Light Unit

202


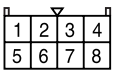
Rain Sensing Unit

203


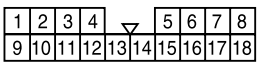
Immobilizer Unit (DSL)

204


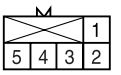
PWR Seat Position Warmer Unit

205


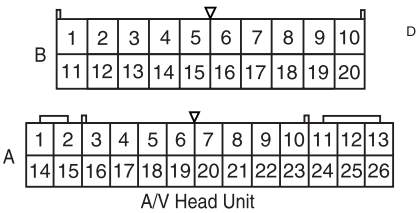
SSPS Unit

206


FRT Seat Warmer Unit

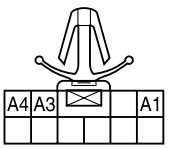
207


Folding Unit

208


A/V Head Unit

11) COIL/SOLENOID

209


Horn/Audio Contact Coil (Column Side)

210


Horn Contact (Steering)

211


Audio Contact (Steering)

212

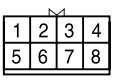
Ignition Coil

213


Door Lock Solenoid (Actuator)

214


Door Lock Solenoid (Tail Gate)

215


OVPR (GSL)

216


EGR Solenoid

217


Locking Hub Solenoid Valve

218


Canister Purge Valve

219


SSPS Solenoid

12) OTHERS

220

Speaker (FRT/RR Door)

221

Speaker (Tail Gate)

222

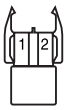
Tweeter Speaker

223

Cigar Ligther (RR)

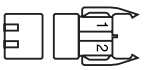
224

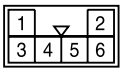
Cigar Ligther (FRT)

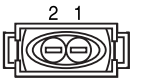
225

Camshaft Actuater

226

Seat Belt Reducer

227

Resonance Flap

228

Digital Clock

229

Injector (E28, E32 M/T)

230

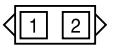
Injector (E32 A/T)

230

PWR Antenna

231

Buzzer

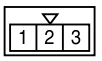
232

Horn

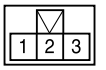
233

PWR Outlet

234

Parking Aid

235

Potention Meter (Driver)

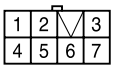
236

Seat Heater

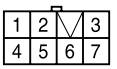
237

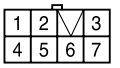
Room Mirror

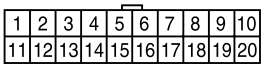
238

Throttle Valve Actuator

239

Mixer Actuator

240

Mode Actuator

241

Intake/Ambient Actuator

242

A/C Controler (Manual)

243

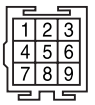
Blower Resister

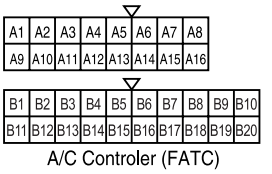
244

A/C Blower Resister (RR)

245

PWR Transistor

246

High Speed Relay

247

A/C Controler (FATC)

248

A/C Compressor

249

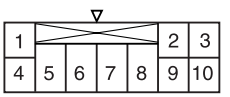
Siren

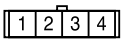
250

Chime Bell

251

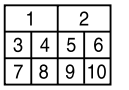
Seat Belt Pretenisiner

252

PTC BOX

253

PTC (Coil)

254

Water Pump (FFH)

255

A/T Lever (5-Speed)

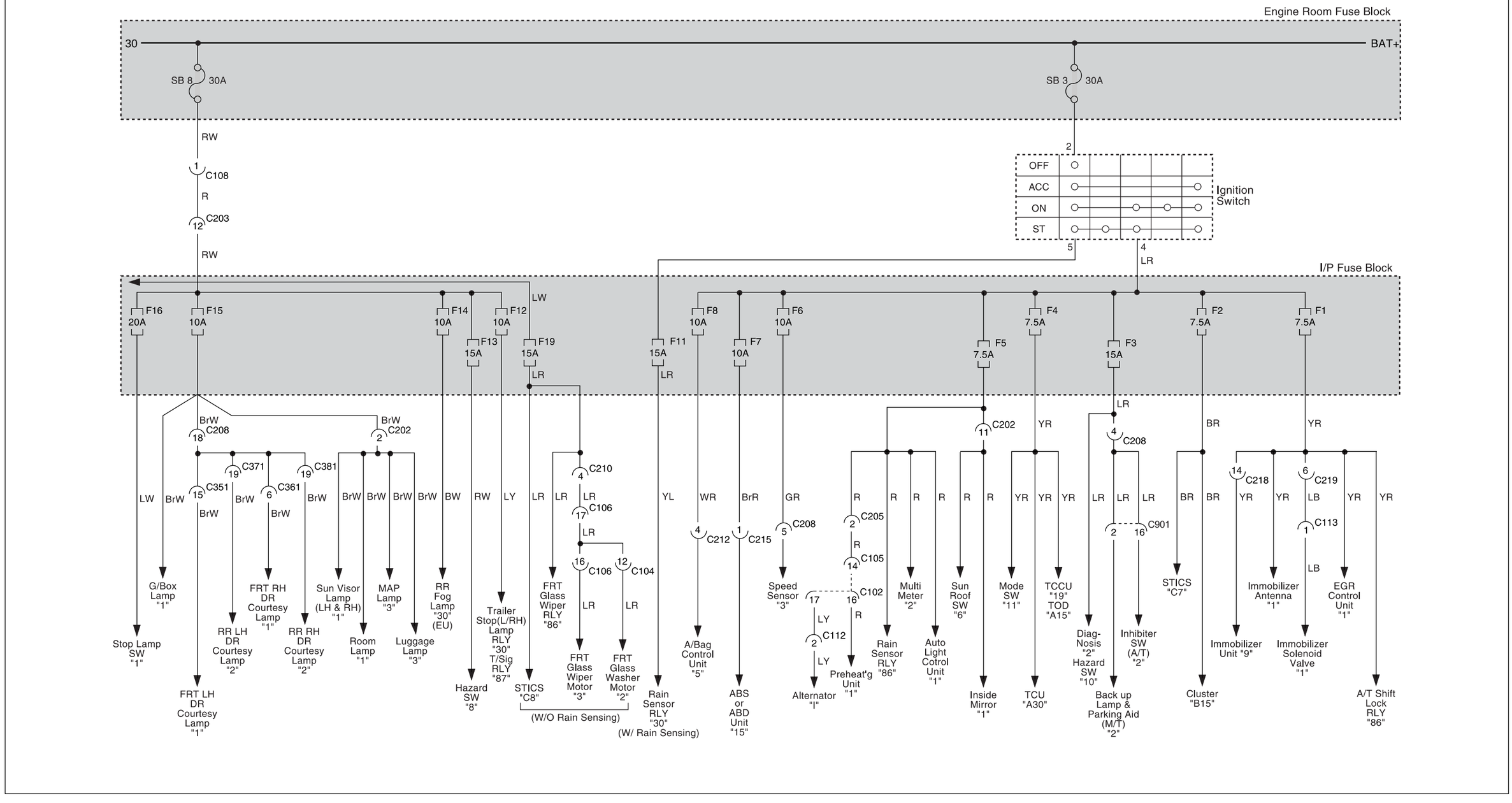
SECTION 3

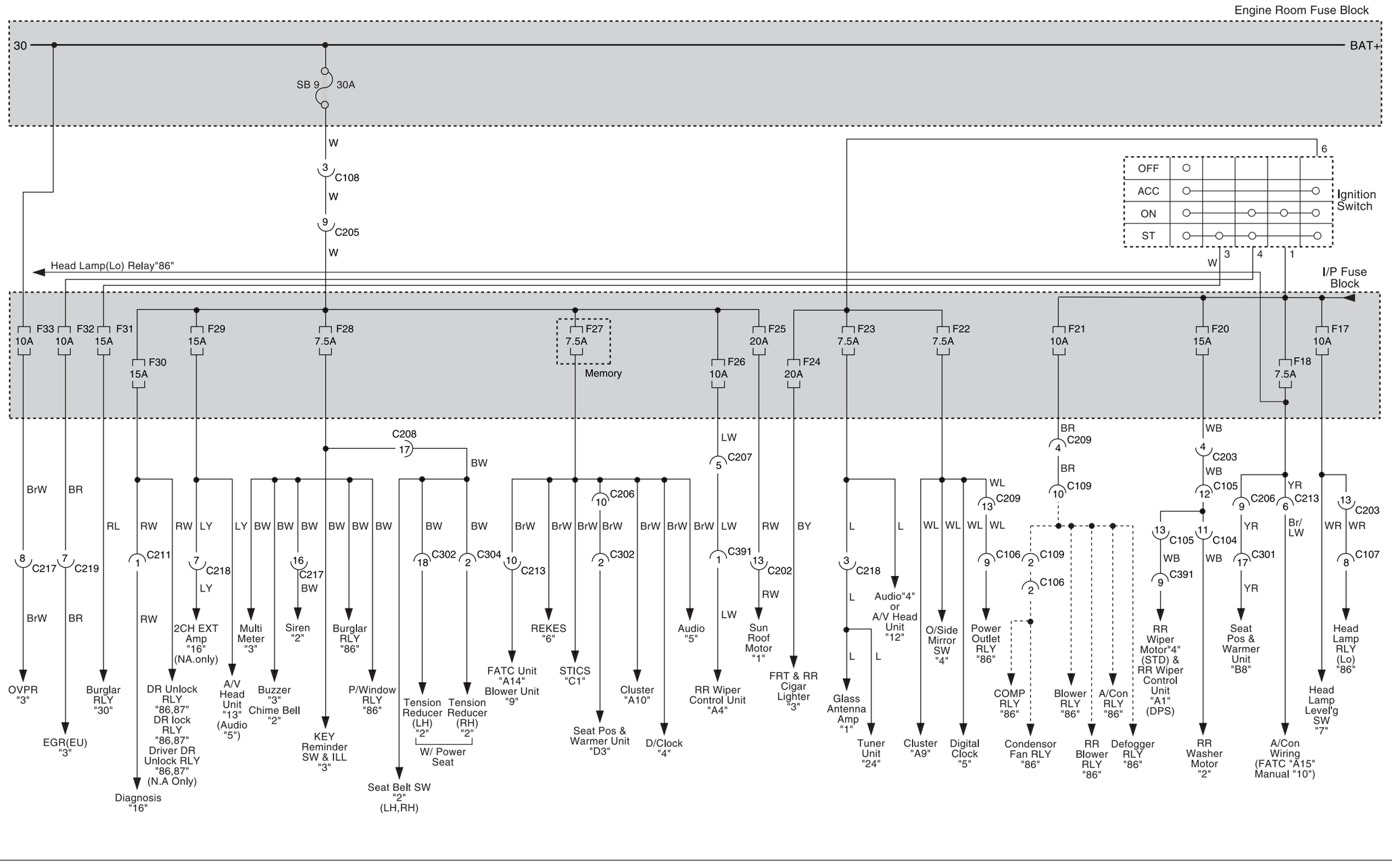
WIRING DIAGRAM FOR POWER SUPPLIES

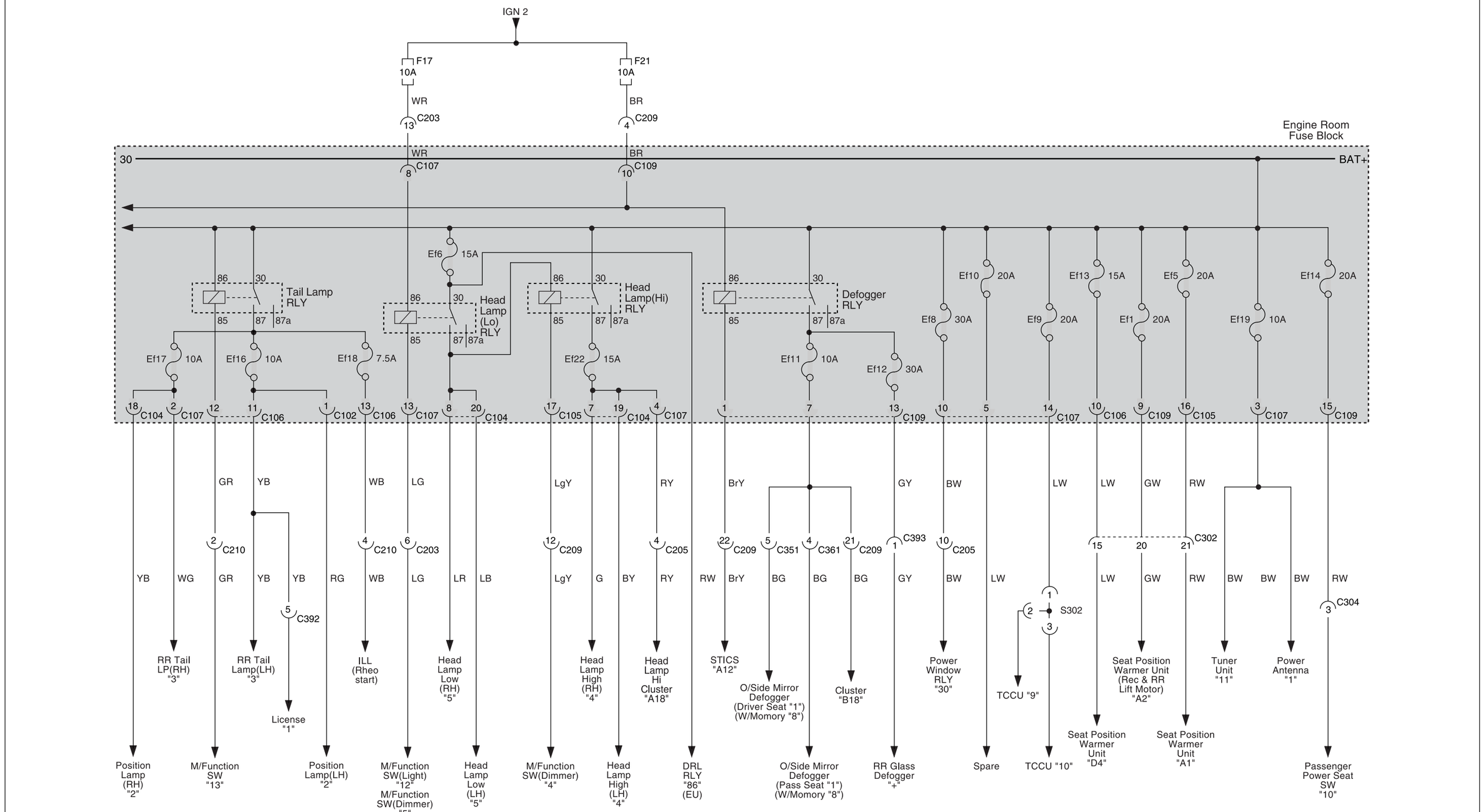
TABLE OF CONTENTS

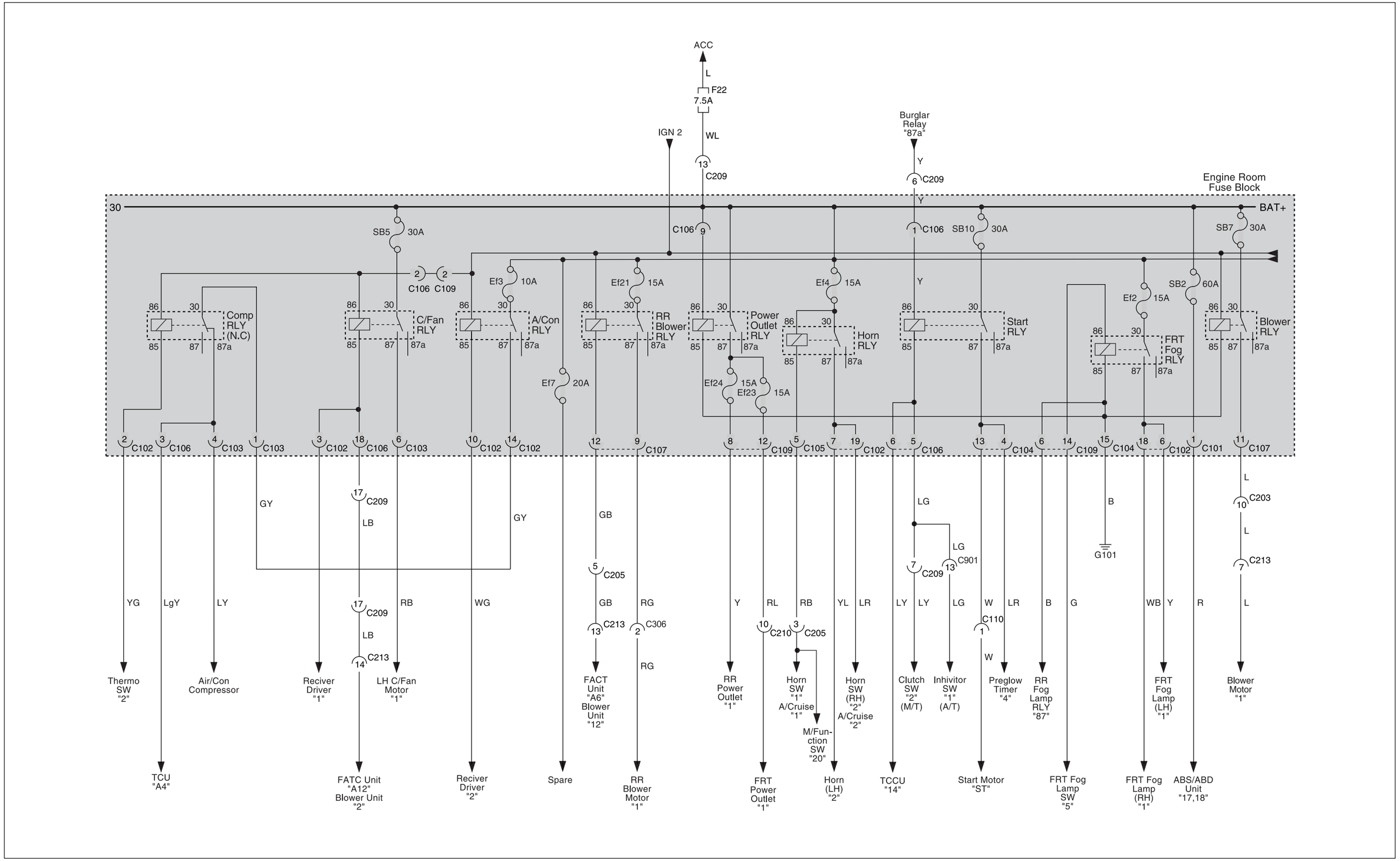
1. POWER WIRING DIAGRAM (DSL)

1) ~ 2002 MODEL

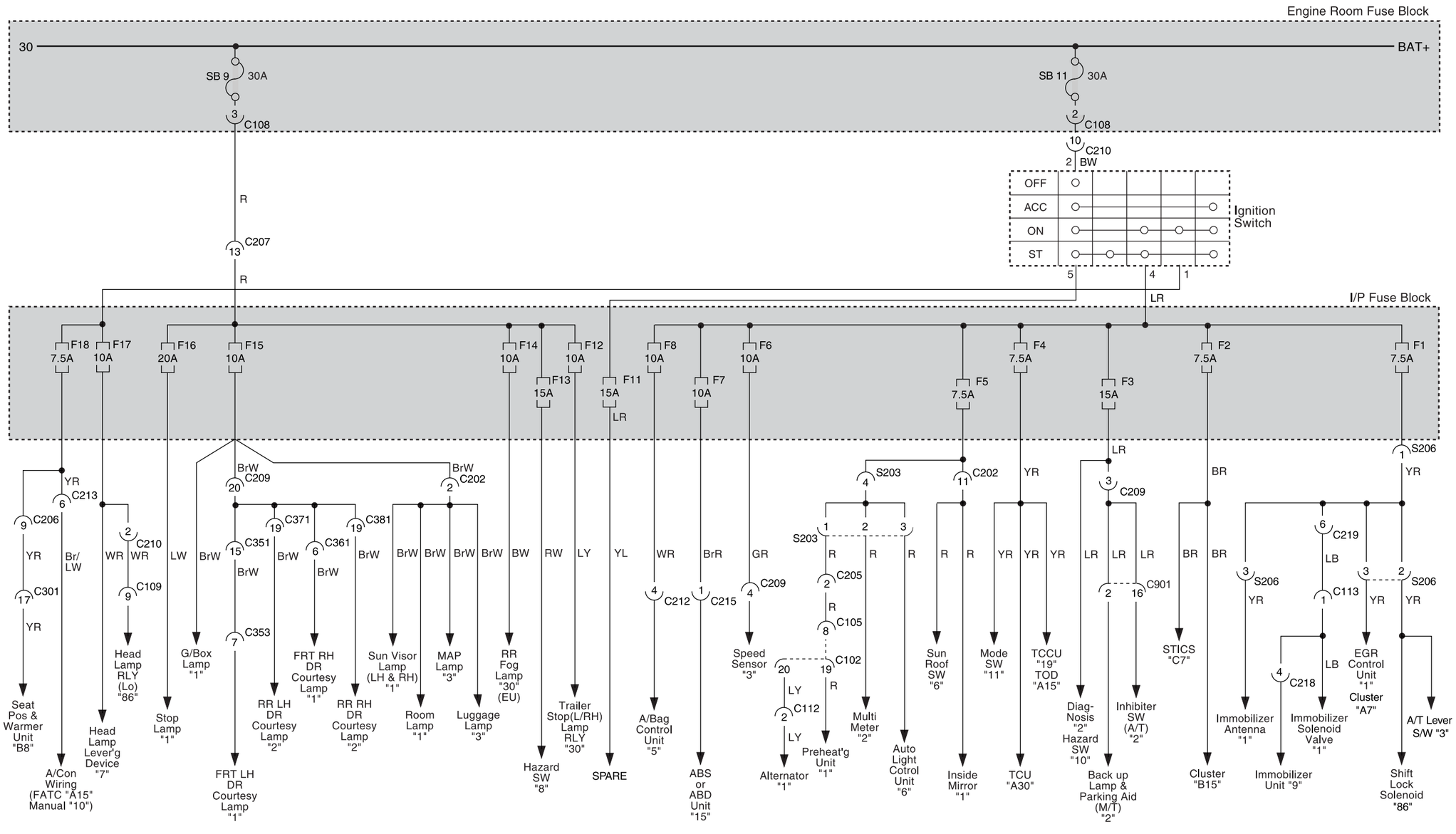


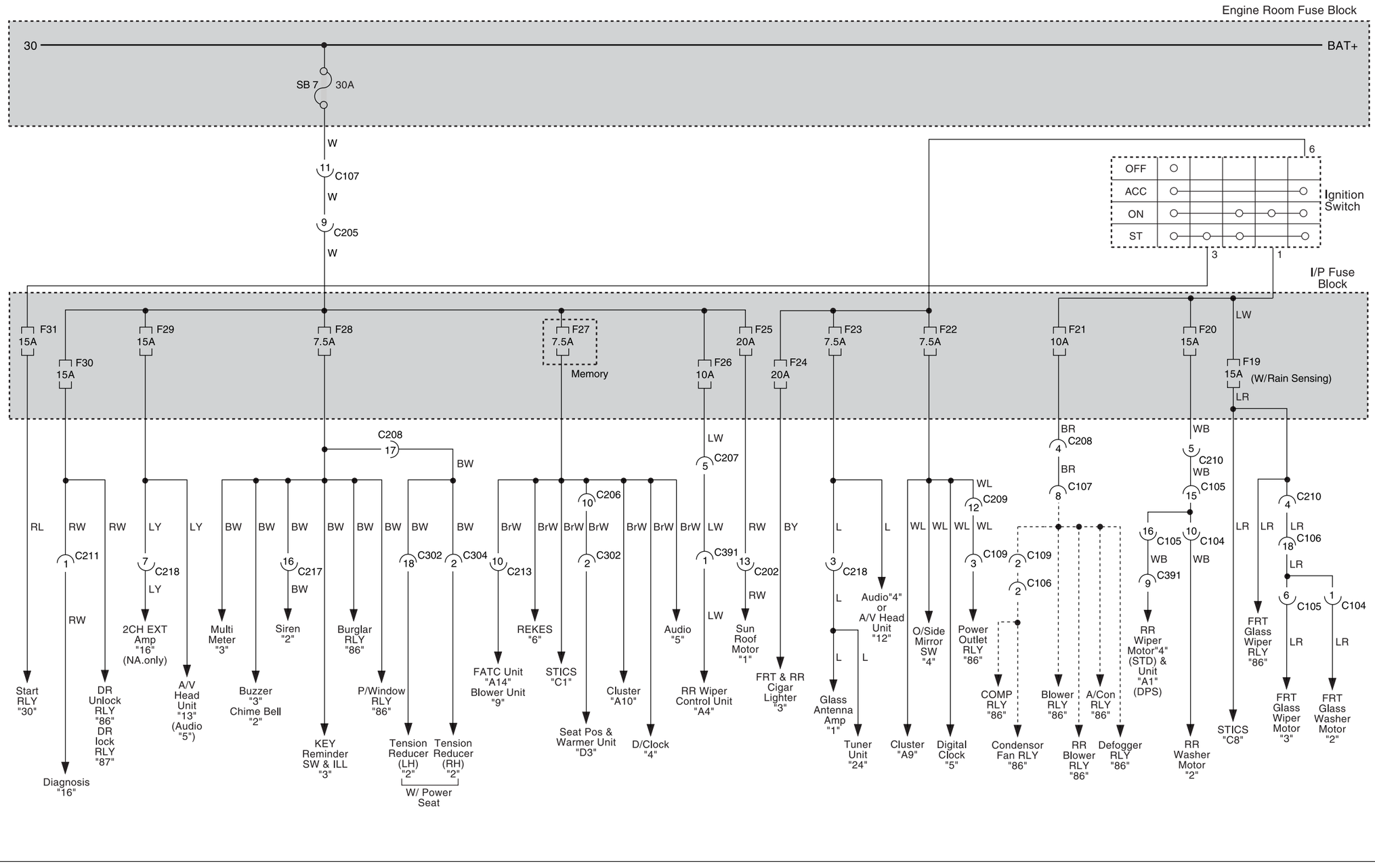

Engine Room Fuse Block
30
BAT+
SB 9
30A
W
3
C108
W
9
C205
W
6
OFF
ACC
ON
ST
Ignition Switch
W
3
4
1
Head Lamp(Lo) Relay"86"
I/P Fuse Block
F33 10A
F32 10A
F31 15A
F30 15A
F29 15A
F28 7.5A
F27 7.5A
Memory
F26 10A
F25 20A
F24 20A
F23 7.5A
F22 7.5A
F21 10A
F20 15A
F18 7.5A
F17 10A
C208
17
BW
LW
C207
5
BR
C209
4
BR
C109
10
WB
4
C203
WB
C105
12
YR
C206
9
YR
C213
6
Br/LW
13
C203
WR WR
C107
8
BrW
BR
RL
RW
RW
LY
LY
BW
BW
BW
BW
BW
BW
BrW
BrW
BrW
BrW
BrW
BrW
LW
RW
BY
L
L
WL
WL
WL
WL
8
C217
7
C219
1
C211
7
C218
16
C217
BW
10
C213
10
C206
2
C302
1
C391
13
C202
RW
3
C218
L
13
C105
11
C104
WB
9
C391
17
C301
YR
C302
18
C302
2
C304
WL
13
C209
9
C106
2
C109
2
C106
Audio"4" or A/V Head Unit "12"
O/Side Mirror SW "4"
Power Outlet RLY "86"
OVPR "3"
EGR(EU) "3"
Burglar RLY "30"
DR Unlock RLY "86,87" DR lock RLY "86,87" Driver DR Unlock RLY "86,87" (N.A Only)
Diagnosis "16"
2CH EXT Amp "16" (NA.only)
A/V Head Unit "13" (Audio "5")
Multi Meter "3"
Buzzer "3"
Chime Bell "2"
Siren "2"
KEY Reminder SW & ILL "3"
Burglar RLY "86"
P/Window RLY "86"
Seat Belt SW "2" (LH,RH)
Tension Reducer (LH) "2"
Tension Reducer (RH) "2"
W/ Power Seat
FATC Unit "A14" Blower Unit "9"
REKES "6"
STICS "C1"
Seat Pos & Warmer Unit "D3"
Cluster "A10"
D/Clock "4"
Audio "5"
RR Wiper Control Unit "A4"
Sun Roof Motor "1"
FRT & RR Cigar Lighter "3"
Glass Antenna Amp "1"
Tuner Unit "24"
Cluster "A9"
Digital Clock "5"
COMP RLY "86"
Condensor Fan RLY "86"
Blower RLY "86"
A/Con RLY "86"
Defogger RLY "86"
RR Wiper Motor"4" (STD) & RR Wiper Control Unit "A1" (DPS)
RR Washer Motor "2"
Seat Pos & Warmer Unit "B8"
A/Con Wiring (FATC "A15" Manual "10")
Head Lamp Level'g SW "7"
Head Lamp RLY (Lo) "86"

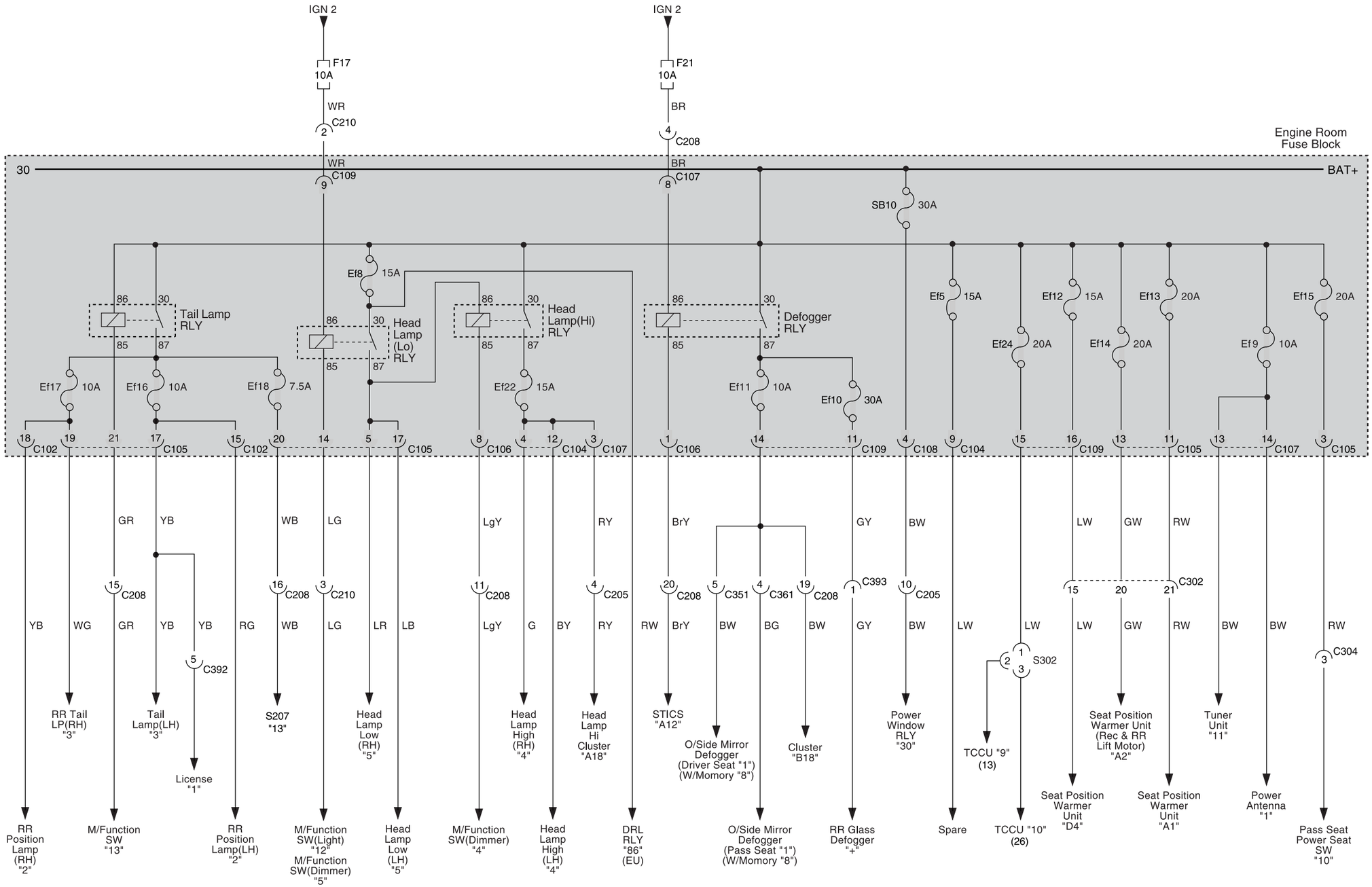

IGN 2
F17
10A
WR
C203
13
F21
10A
BR
C209
4
Engine Room
Fuse Block
30
BAT+
WR
C107
8
BR
C109
10
Ef6 15A
86 30 Tail Lamp RLY 85 87 87a
86 30 Head Lamp (Lo) RLY 85 87 87a
86 30 Head Lamp(Hi) RLY 85 87 87a
86 30 Defogger RLY 85 87 87a
Ef17 10A
Ef16 10A
Ef18 7.5A
Ef22 15A
Ef11 10A
Ef12 30A
Ef8 30A
Ef10 20A
Ef9 20A
Ef13 15A
Ef1 20A
Ef5 20A
Ef19 10A
Ef14 20A
18 C104
2 C107
12 11 C106
1 C102
13 C106
13 C107
8 20 C104
17 C105
7 19 C104
4 C107
1 7 13 C109
10 5
14 C107
10 C106
9 C109
16 C105
3 C107
15 C109
GR
YB
WB
LG
LgY
RY
BrY
GY
BW
LW
LW
GW
RW
2 C210
4 C210
6 C203
12 C209
4 C205
22 C209
5 C351
4 C361
21 C209
1 C393
10 C205
1 2 3 S302
15 20 21 C302
BW
BW
BW
RW
3 C304
YB
WG
GR
YB
YB
RG
WB
LG
LR
LB
LgY
G
BY
RY
RW
BrY
BG
BG
BG
GY
BW
LW
LW
GW
RW
5 C392
Position Lamp (RH) "2"
RR Tail LP(RH) "3"
M/Function SW "13"
RR Tail Lamp(LH) "3"
License "1"
Position Lamp(LH) "2"
ILL (Rheo start)
M/Function SW(Light) "12"
M/Function SW(Dimmer) "5"
Head Lamp Low (RH) "5"
Head Lamp Low (LH) "5"
M/Function SW(Dimmer) "4"
Head Lamp High (RH) "4"
Head Lamp High (LH) "4"
Head Lamp Hi Cluster "A18"
DRL RLY "86" (EU)
STICS "A12"
O/Side Mirror Defogger (Driver Seat "1") (W/Momory "8")
O/Side Mirror Defogger (Pass Seat "1") (W/Momory "8")
Cluster "B18"
RR Glass Defogger "+"
Power Window RLY "30"
Spare
TCCU "9"
TCCU "10"
Seat Position Warmer Unit (Rec & RR Lift Motor) "A2"
Seat Position Warmer Unit "D4"
Seat Position Warmer Unit "A1"
Tuner Unit "11"
Power Antenna "1"
Passenger Power Seat SW "10"

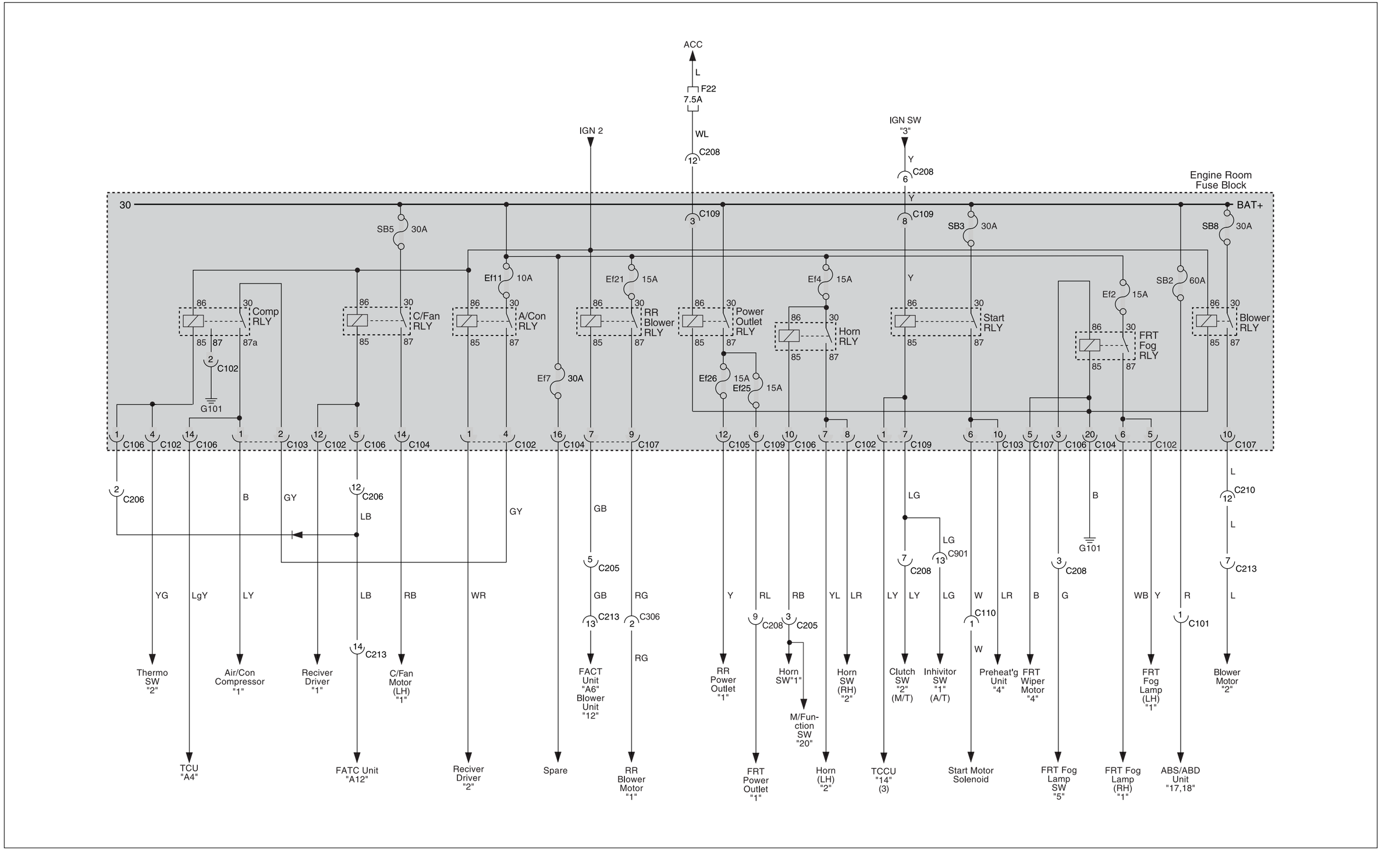

ACC
L
F22
7.5A
IGN 2
WL
13
C209
Burglar Relay "87a"
Y
6
C209
Engine Room Fuse Block
30
BAT+
SB5 30A
C106 9
1 C106
SB10 30A
SB7 30A
2 C106 2 C109
Ef3 10A
Ef21 15A
Ef4 15A
SB2 60A
Ef2 15A
Comp RLY (N.C)
C/Fan RLY
A/Con RLY
RR Blower RLY
Power Outlet RLY
Horn RLY
Start RLY
FRT Fog RLY
Blower RLY
Ef7 20A
Ef24 15A
Ef23 15A
2 C102
3 C106
4 C103
1 C103
3 C102
18 C106
6 C103
10 C102
14 C102
12 9 C107
8 12 C109
5 C105
7 19 C102
6 5 C106
13 4 C104
6 14 C109
15 C104
18 6 C102
1 C101
11 C107
GY
17 C209
LB
GB
5 C205
L
10 C203
L
7 C213
L
YG
LgY
LY
RB
WG
RG
Y
RL
RB
YL
LR
LY
LY
LG
W
LR
B
G
WB
Y
R
10 C210
3 C205
7 C209
13 C901
LG
1 C110
W
G101
B
Thermo SW "2"
Air/Con Compressor
Reciver Driver "1"
LH C/Fan Motor "1"
FACT Unit "A6" Blower Unit "12"
RR Power Outlet "1"
Horn SW "1" A/Cruise "1"
M/Fun-ction SW "20"
Horn SW (RH) "2" A/Cruise "2"
Clutch SW "2" (M/T)
Inhivitor SW "1" (A/T)
Preglow Timer "4"
RR Fog Lamp RLY "87"
FRT Fog Lamp (LH) "1"
Blower Motor "1"
TCU "A4"
FATC Unit "A12" Blower Unit "2"
Reciver Driver "2"
Spare
RR Blower Motor "1"
FRT Power Outlet "1"
Horn (LH) "2"
TCCU "14"
Start Motor "ST"
FRT Fog Lamp SW "5"
FRT Fog Lamp (RH) "1"
ABS/ABD Unit "17,18"

2) 2003 MODEL


Engine Room Fuse Block
30
BAT+
SB 9
30A
3
C108
SB 11
30A
2
C108
10
C210
2
BW
OFF
ACC
ON
ST
Ignition Switch
5
4
1
R
C207
13
R
LR
I/P Fuse Block
F18
7.5A
F17
10A
F16
20A
F15
10A
F14
10A
F13
15A
F12
10A
F11
15A
LR
F8
10A
F7
10A
F6
10A
F5
7.5A
F4
7.5A
F3
15A
F2
7.5A
F1
7.5A
YR
C213
6
9
C206
YR
17
C301
YR
Br/
LW
2
C210
WR
WR
9
C109
LW
BrW
20
C209
BrW
C202
2
19
C371
19
C381
15
C351
BrW
6
C361
BrW
7
C353
BrW
BrW
BrW
BrW
BrW
BW
RW
LY
YL
WR
4
C212
1
C215
BrR
GR
4
C209
S203
4
1
2
3
S203
R
R
R
2
C205
R
8
C105
C102
20
19
R
LY
2
C112
LY
11
C202
YR
3
C209
LR
LR
LR
2
16
C901
BR
BR
1
S206
YR
6
C219
LB
3
S206
YR
4
C218
3
2
S206
YR
1
C113
LB
YR
Seat Pos & Warmer Unit "B8"
A/Con Wiring (FATC "A15" Manual "10")
Head Lamp Lever'g Device "7"
Head Lamp RLY (Lo) "86"
Stop Lamp "1"
G/Box Lamp "1"
FRT LH DR Courtesy Lamp "1"
RR LH DR Courtesy Lamp "2"
FRT RH DR Courtesy Lamp "1"
RR RH DR Courtesy Lamp "2"
Sun Visor Lamp (LH & RH) "1"
Room Lamp "1"
MAP Lamp "3"
Luggage Lamp "3"
RR Fog Lamp "30" (EU)
Hazard SW "8"
Trailer Stop(L/RH) Lamp RLY "30"
SPARE
A/Bag Control Unit "5"
ABS or ABD Unit "15"
Speed Sensor "3"
Alternator "1"
Preheat'g Unit "1"
Multi Meter "2"
Auto Light Cotrol Unit "6"
Sun Roof SW "6"
Inside Mirror "1"
Mode SW "11"
TCU "A30"
TCCU "19" TOD "A15"
Diag-Nosis "2"
Hazard SW "10"
Back up Lamp & Parking Aid (M/T) "2"
Inhibiter SW (A/T) "2"
STICS "C7"
Cluster "B15"
Immobilizer Antenna "1"
Immobilizer Unit "9"
Immobilizer Solenoid Valve "1"
EGR Control Unit "1"
Cluster "A7"
Shift Lock Solenoid "86"
A/T Lever S/W "3"


Engine Room Fuse Block
30
BAT+
SB 7
30A
W
11
C107
W
9
C205
W
6
OFF
ACC
ON
ST
Ignition Switch
3
1
I/P Fuse Block
F31 15A
F30 15A
F29 15A
F28 7.5A
F27 7.5A
Memory
F26 10A
F25 20A
F24 20A
F23 7.5A
F22 7.5A
F21 10A
F20 15A
F19 15A
(W/Rain Sensing)
LW
LR
C208
17
BW
C207
5
LW
C206
10
C211
1
RW
C218
7
LY
C217
16
BW
C302
18
C304
2
C213
10
C391
1
C202
13
RW
C218
3
C209
12
WL
C109
3
C109
2
C106
2
C208
4
BR
C107
8
BR
C210
4
LR
C106
18
LR
C105
6
C104
1
C105
16
C210
5
WB
C105
15
C104
10
WB
C391
9
RL
RW
RW
LY
LY
BW
BW
BW
BW
BW
BW
BW
BW
BrW
BrW
BrW
BrW
BrW
BrW
BrW
LW
RW
BY
L
L
WL
WL
WL
WL
BR
WB
WB
LR
LR
LR
LR
Start RLY "30"
Diagnosis "16"
DR Unlock RLY "86" DR lock RLY "87"
2CH EXT Amp "16" (NA.only)
A/V Head Unit "13" (Audio "5")
Multi Meter "3"
Buzzer "3" Chime Bell "2"
Siren "2"
Burglar RLY "86"
P/Window RLY "86"
KEY Reminder SW & ILL "3"
Tension Reducer (LH) "2"
Tension Reducer (RH) "2"
W/ Power Seat
FATC Unit "A14" Blower Unit "9"
REKES "6"
STICS "C1"
Seat Pos & Warmer Unit "D3"
Cluster "A10"
D/Clock "4"
Audio "5"
RR Wiper Control Unit "A4"
Sun Roof Motor "1"
FRT & RR Cigar Lighter "3"
Glass Antenna Amp "1"
Tuner Unit "24"
Audio"4" or A/V Head Unit "12"
Cluster "A9"
O/Side Mirror SW "4"
Digital Clock "5"
Power Outlet RLY "86"
COMP RLY "86"
Condensor Fan RLY "86"
Blower RLY "86"
RR Blower RLY "86"
A/Con RLY "86"
Defogger RLY "86"
RR Wiper Motor"4" (STD) & Unit "A1" (DPS)
RR Washer Motor "2"
STICS "C8"
FRT Glass Wiper RLY "86"
FRT Glass Wiper Motor "3"
FRT Glass Washer Motor "2"

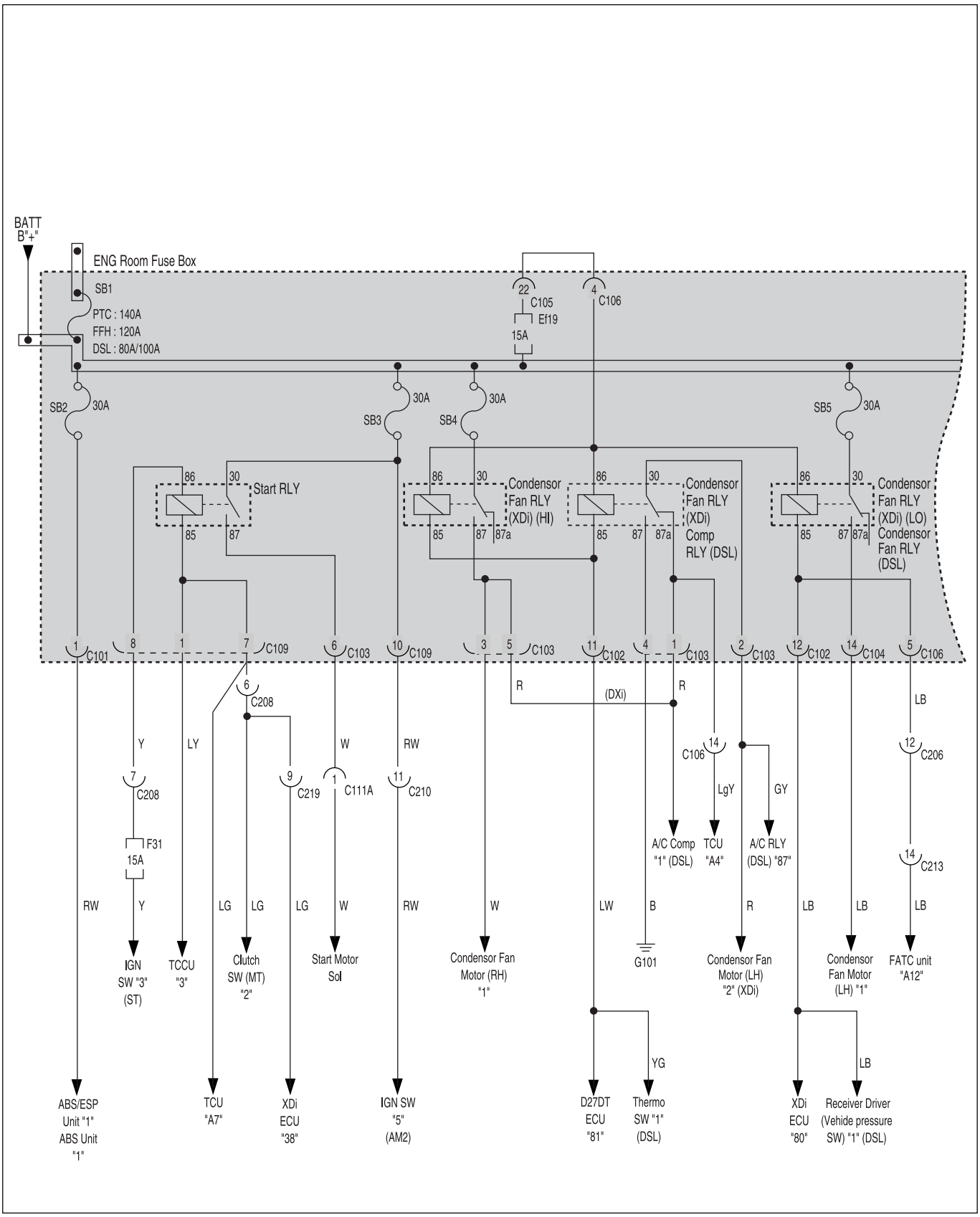

IGN 2
F17
10A
WR
C210
2
IGN 2
F21
10A
BR
4
C208
Engine Room
Fuse Block
30
WR
C109
9
BR
C107
8
BAT+
SB10
30A
Ef8
15A
Tail Lamp
RLY
Head
Lamp
(Lo)
RLY
Head
Lamp(Hi)
RLY
Defogger
RLY
86
30
85
87
Ef17
10A
Ef16
10A
Ef18
7.5A
Ef22
15A
Ef11
10A
Ef10
30A
Ef5
15A
Ef12
15A
Ef13
20A
Ef15
20A
Ef24
20A
Ef14
20A
Ef9
10A
18 C102
19 C102
21
17 C105
15 C102
20
14
5
17 C105
8 C106
4
12
3 C107
1 C106
14
11 C109
4 C108
9 C104
15
16 C109
13
11 C105
13
14 C107
3 C105
YB
WG
GR
YB
YB
RG
WB
LG
LR
LB
LgY
G
BY
RY
RW
BrY
BW
BG
BW
GY
BW
LW
LW
LW
GW
RW
BW
BW
RW
15 C208
16 C208
3 C210
11 C208
4 C205
20 C208
5 C351
4 C361
19 C208
1 C393
10 C205
5 C392
1
2
3 S302
15
20
21 C302
3 C304
RR Tail
LP(RH)
"3"
Tail
Lamp(LH)
"3"
License
"1"
S207
"13"
Head
Lamp
Low
(RH)
"5"
Head
Lamp
High
(RH)
"4"
Head
Lamp
Hi
Cluster
"A18"
STICS
"A12"
O/Side Mirror
Defogger
(Driver Seat "1")
(W/Momory "8")
Cluster
"B18"
Power
Window
RLY
"30"
TCCU "9"
(13)
Seat Position
Warmer Unit
(Rec & RR
Lift Motor)
"A2"
Tuner
Unit
"11"
Power
Antenna
"1"
Pass Seat
Power Seat
SW
"10"
RR
Position
Lamp
(RH)
"2"
M/Function
SW
"13"
RR
Position
Lamp(LH)
"2"
M/Function
SW(Light)
"12"
M/Function
SW(Dimmer)
"5"
Head
Lamp
Low
(LH)
"5"
M/Function
SW(Dimmer)
"4"
Head
Lamp
High
(LH)
"4"
DRL
RLY
"86"
(EU)
O/Side Mirror
Defogger
(Pass Seat "1")
(W/Momory "8")
RR Glass
Defogger
"+"
Spare
TCCU "10"
(26)
Seat Position
Warmer
Unit
"D4"
Seat Position
Warmer
Unit
"A1"


ACC
L
F22
7.5A
WL
C208
12
IGN 2
IGN SW
"3"
Y
C208
6
Engine Room
Fuse Block
30
BAT+
SB5 30A
C109
3
C109
8
SB3 30A
SB8 30A
SB2 60A
Ef11 10A
Ef21 15A
Ef4 15A
Ef2 15A
Comp
RLY
C/Fan
RLY
A/Con
RLY
RR
Blower
RLY
Power
Outlet
RLY
Horn
RLY
Start
RLY
FRT
Fog
RLY
Blower
RLY
86
85
87
30
87a
C102
G101
Ef7 30A
Ef26 15A
Ef25 15A
C106
C102
C106
C103
C102
C106
C104
C102
C104
C107
C105
C109
C106
C102
C109
C103
C107
C106
C104
C102
C107
C206
C206
C213
C205
C213
C306
C208
C205
C208
C901
C110
C101
C210
C213
B
GY
LB
RB
WR
GB
RG
RG
Y
RL
RB
YL
LR
LY
LY
LG
W
LR
B
G
WB
Y
R
L
L
L
YG
LgY
LY
W
Thermo
SW
"2"
TCU
"A4"
Air/Con
Compressor
"1"
Reciver
Driver
"1"
FATC Unit
"A12"
C/Fan
Motor
(LH)
"1"
Reciver
Driver
"2"
Spare
FACT
Unit
"A6"
Blower
Unit
"12"
RR
Blower
Motor
"1"
RR
Power
Outlet
"1"
FRT
Power
Outlet
"1"
Horn
SW"1"
M/Fun-
ction
SW
"20"
Horn
(LH)
"2"
Horn
SW
(RH)
"2"
TCCU
"14"
(3)
Clutch
SW
"2"
(M/T)
Inhivitor
SW
"1"
(A/T)
Start Motor
Solenoid
Preheat'g
Unit
"4"
FRT
Wiper
Motor
"4"
FRT Fog
Lamp
SW
"5"
FRT Fog
Lamp
(RH)
"1"
FRT
Fog
Lamp
(LH)
"1"
ABS/ABD
Unit
"17,18"
Blower
Motor
"2"

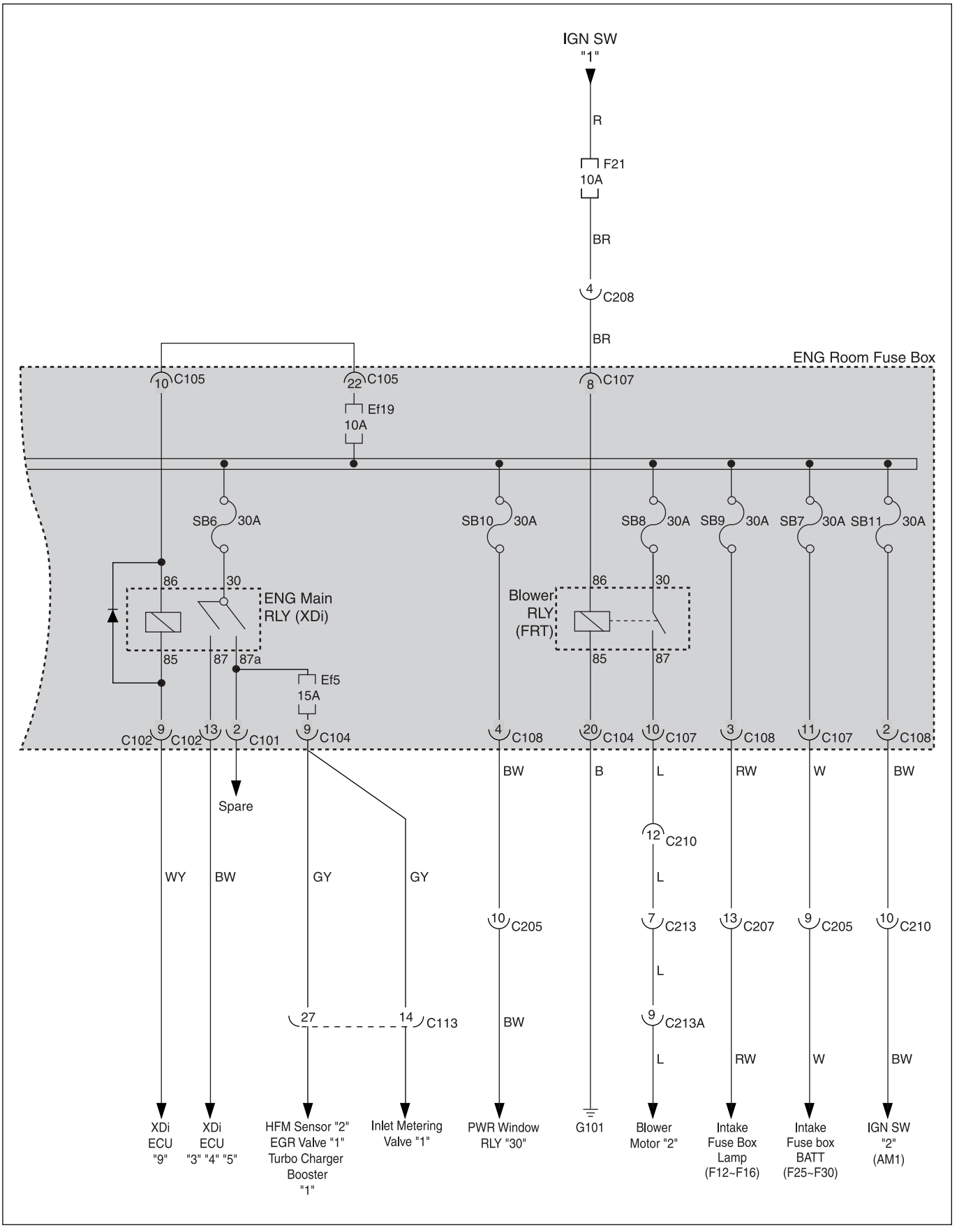
3. POWER WIRING DIAGRAM (XDi, 2003 MODEL ~)

1) ENG ROOM & FUSE BOX

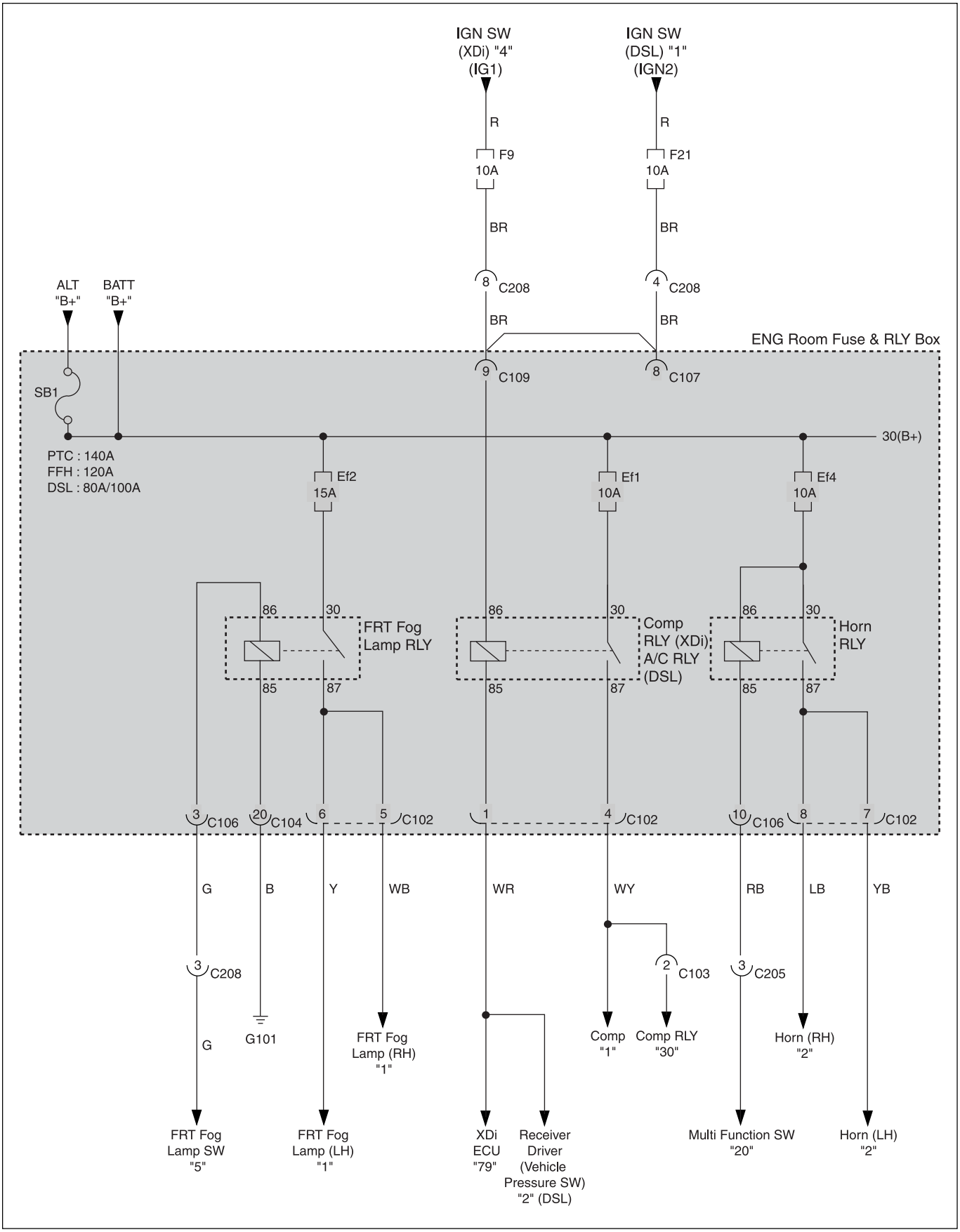
(1) SB1 ~ SB5



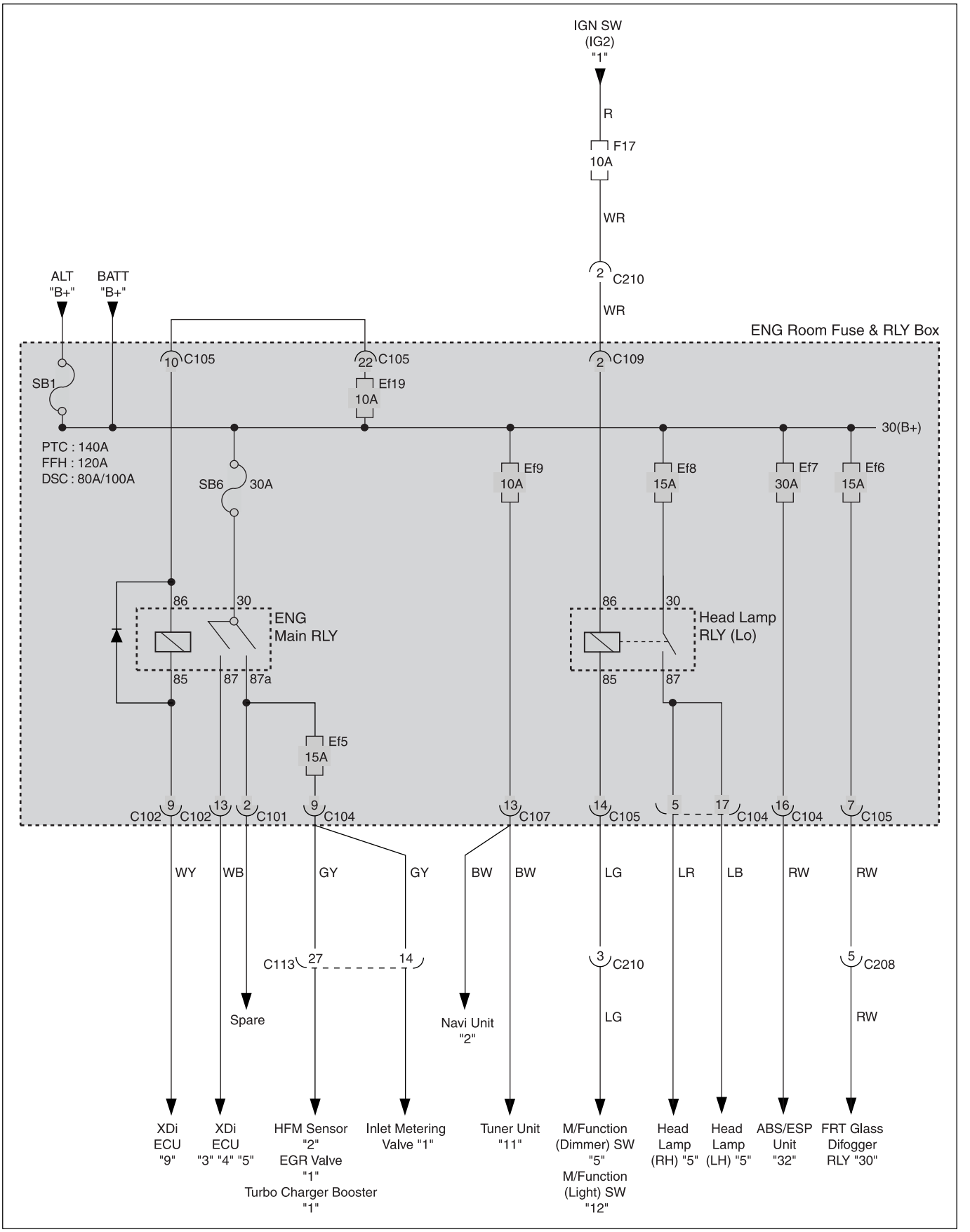
(2) SB6 ~ SB11


IGN SW
"1"
R
F21
10A
BR
4
C208
BR
ENG Room Fuse Box
10
C105
22
C105
8
C107
Ef19
10A
SB6
30A
SB10
30A
SB8
30A
SB9
30A
SB7
30A
SB11
30A
86
30
ENG Main
RLY (XDi)
85
87
87a
Ef5
15A
Blower
RLY
(FRT)
86
30
85
87
C102
9
C102
13
2
C101
9
C104
4
C108
20
C104
10
C107
3
C108
11
C107
2
C108
Spare
BW
B
L
RW
W
BW
12
C210
WY
BW
GY
GY
L
10
C205
7
C213
13
C207
9
C205
10
C210
L
27
14
C113
BW
9
C213A
L
RW
W
BW
XDi
ECU
"9"
XDi
ECU
"3" "4" "5"
HFM Sensor "2"
EGR Valve "1"
Turbo Charger
Booster
"1"
Inlet Metering
Valve "1"
PWR Window
RLY "30"
G101
Blower
Motor "2"
Intake
Fuse Box
Lamp
(F12~F16)
Intake
Fuse box
BATT
(F25~F30)
IGN SW
"2"
(AM1)

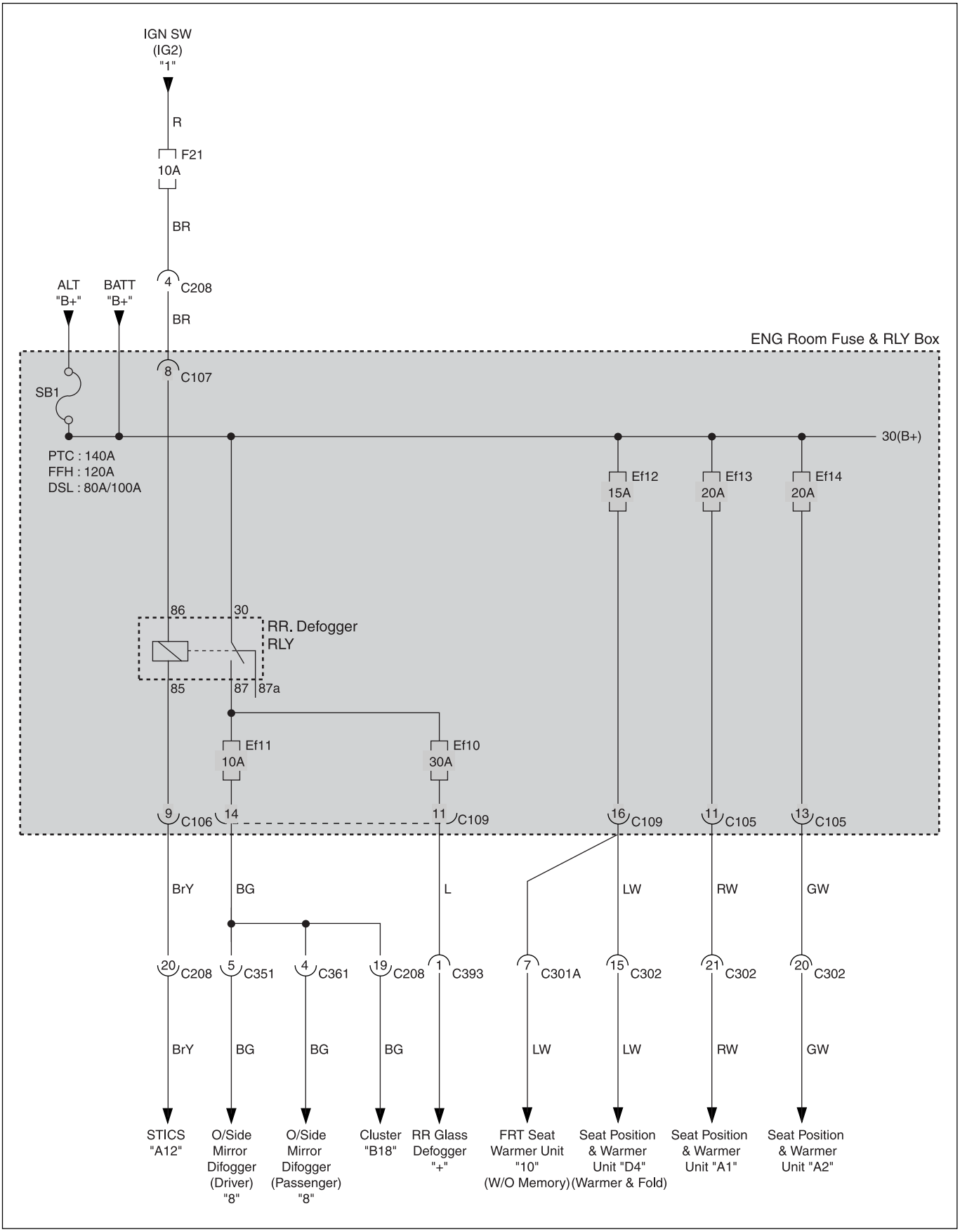
(3) Ef1 ~ Ef4


IGN SW
(XDi) "4"
(IG1)
IGN SW
(DSL) "1"
(IGN2)
R
F9
10A
F21
10A
BR
8 C208
4 C208
ALT
"B+"
BATT
"B+"
ENG Room Fuse & RLY Box
9 C109
8 C107
SB1
30(B+)
PTC : 140A
FFH : 120A
DSL : 80A/100A
Ef2
15A
Ef1
10A
Ef4
10A
86
30
85
87
FRT Fog
Lamp RLY
Comp
RLY (XDi);
A/C RLY
(DSL)
Horn
RLY
3 C106
20 C104
6
5 C102
1
4 C102
10 C106
8
7 C102
G
B
Y
WB
WR
WY
RB
LB
YB
3 C208
2 C103
3 C205
G101
FRT Fog
Lamp (RH)
"1"
Comp
"1"
Comp RLY
"30"
Horn (RH)
"2"
FRT Fog
Lamp SW
"5"
FRT Fog
Lamp (LH)
"1"
XDi
ECU
"79"
Receiver
Driver
(Vehicle
Pressure SW)
"2" (DSL)
Multi Function SW
"20"
Horn (LH)
"2"

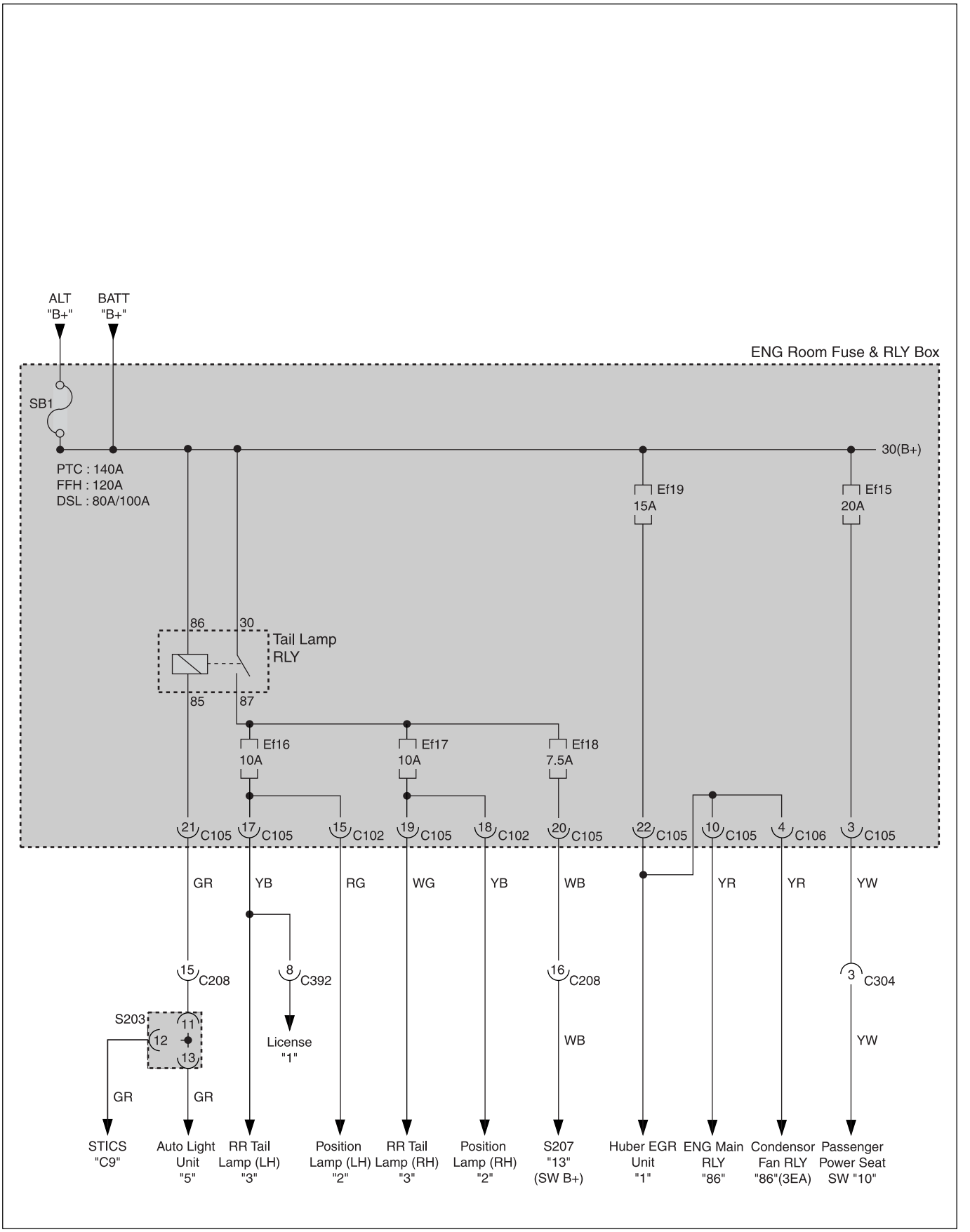
(4) Ef5 ~ Ef9


IGN SW
(IG2)
"1"
R
F17
10A
WR
2
C210
WR
ALT
"B+"
BATT
"B+"
ENG Room Fuse & RLY Box
10
C105
22
C105
2
C109
SB1
Ef19
10A
30(B+)
PTC : 140A
FFH : 120A
DSC : 80A/100A
SB6
30A
Ef9
10A
Ef8
15A
Ef7
30A
Ef6
15A
86
30
ENG
Main RLY
85
87
87a
86
30
Head Lamp
RLY (Lo)
85
87
Ef5
15A
9
C102
13
C102
2
C101
9
C104
13
C107
14
C105
5
17
C104
16
C104
7
C105
WY
WB
GY
GY
BW
BW
LG
LR
LB
RW
RW
C113
27
14
3
C210
5
C208
LG
RW
Spare
Navi Unit
"2"
XDi
ECU
"9"
XDi
ECU
"3" "4" "5"
HFM Sensor
"2"
EGR Valve
"1"
Turbo Charger Booster
"1"
Inlet Metering
Valve "1"
Tuner Unit
"11"
M/Function
(Dimmer) SW
"5"
M/Function
(Light) SW
"12"
Head
Lamp
(RH) "5"
Head
Lamp
(LH) "5"
ABS/ESP
Unit
"32"
FRT Glass
Difogger
RLY "30"

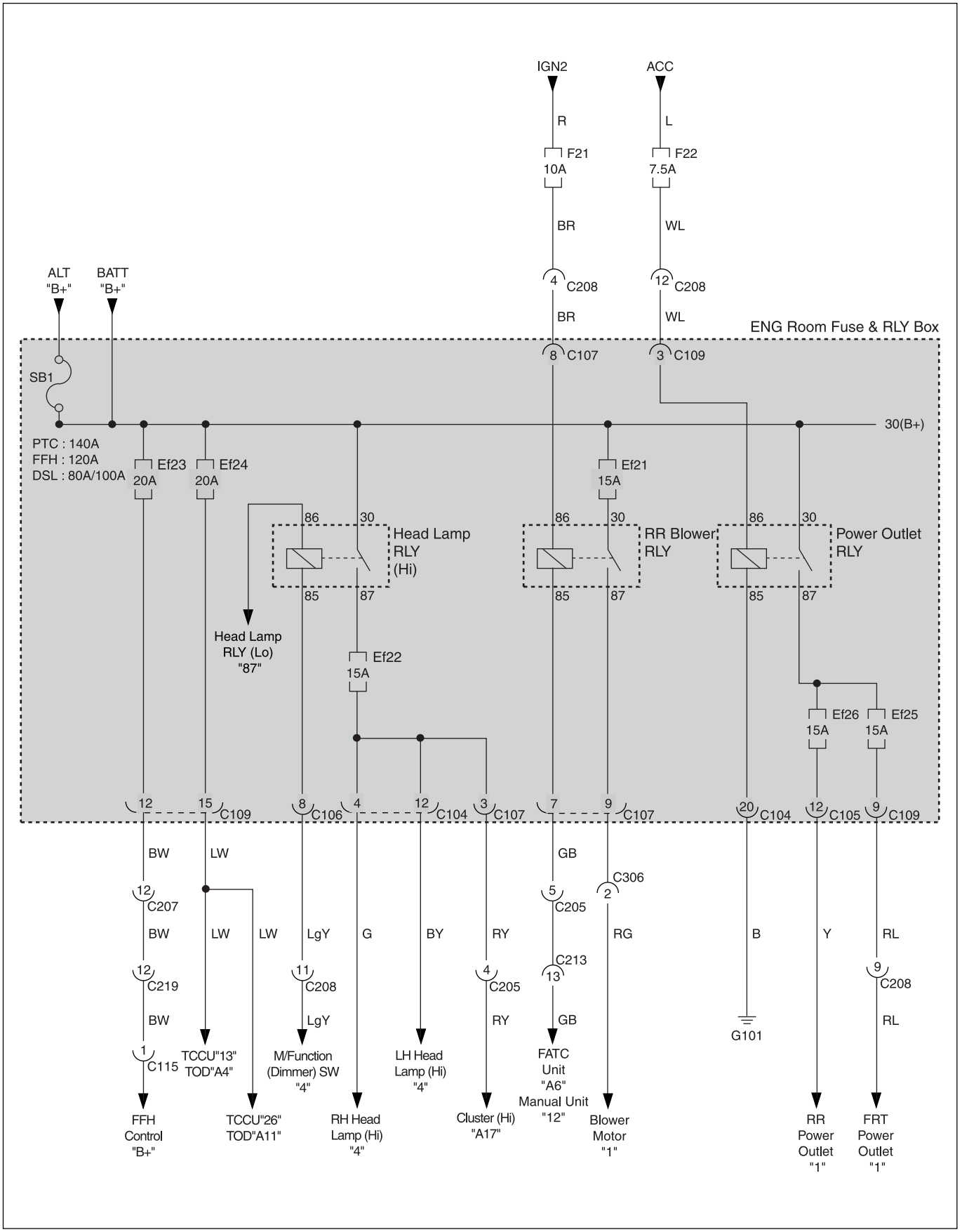
(5) Ef10 ~ Ef14


IGN SW
(IG2)
"1"
R
F21
10A
BR
4
C208
ALT
"B+"
BATT
"B+"
BR
ENG Room Fuse & RLY Box
8
C107
SB1
PTC : 140A
FFH : 120A
DSL : 80A/100A
30(B+)
Ef12
15A
Ef13
20A
Ef14
20A
86
30
RR. Defogger
RLY
85
87
87a
Ef11
10A
Ef10
30A
9
C106
14
11
C109
16
C109
11
C105
13
C105
BrY
BG
L
LW
RW
GW
20
C208
5
C351
4
C361
19
C208
1
C393
7
C301A
15
C302
21
C302
20
C302
BrY
BG
BG
BG
LW
LW
RW
GW
STICS
"A12"
O/Side
Mirror
Difogger
(Driver)
"8"
O/Side
Mirror
Difogger
(Passenger)
"8"
Cluster
"B18"
RR Glass
Defogger
"+"
FRT Seat
Warmer Unit
"10"
(W/O Memory)
Seat Position
& Warmer
Unit "D4"
(Warmer & Fold)
Seat Position
& Warmer
Unit "A1"
Seat Position
& Warmer
Unit "A2"

(6) Ef15 ~ Ef20

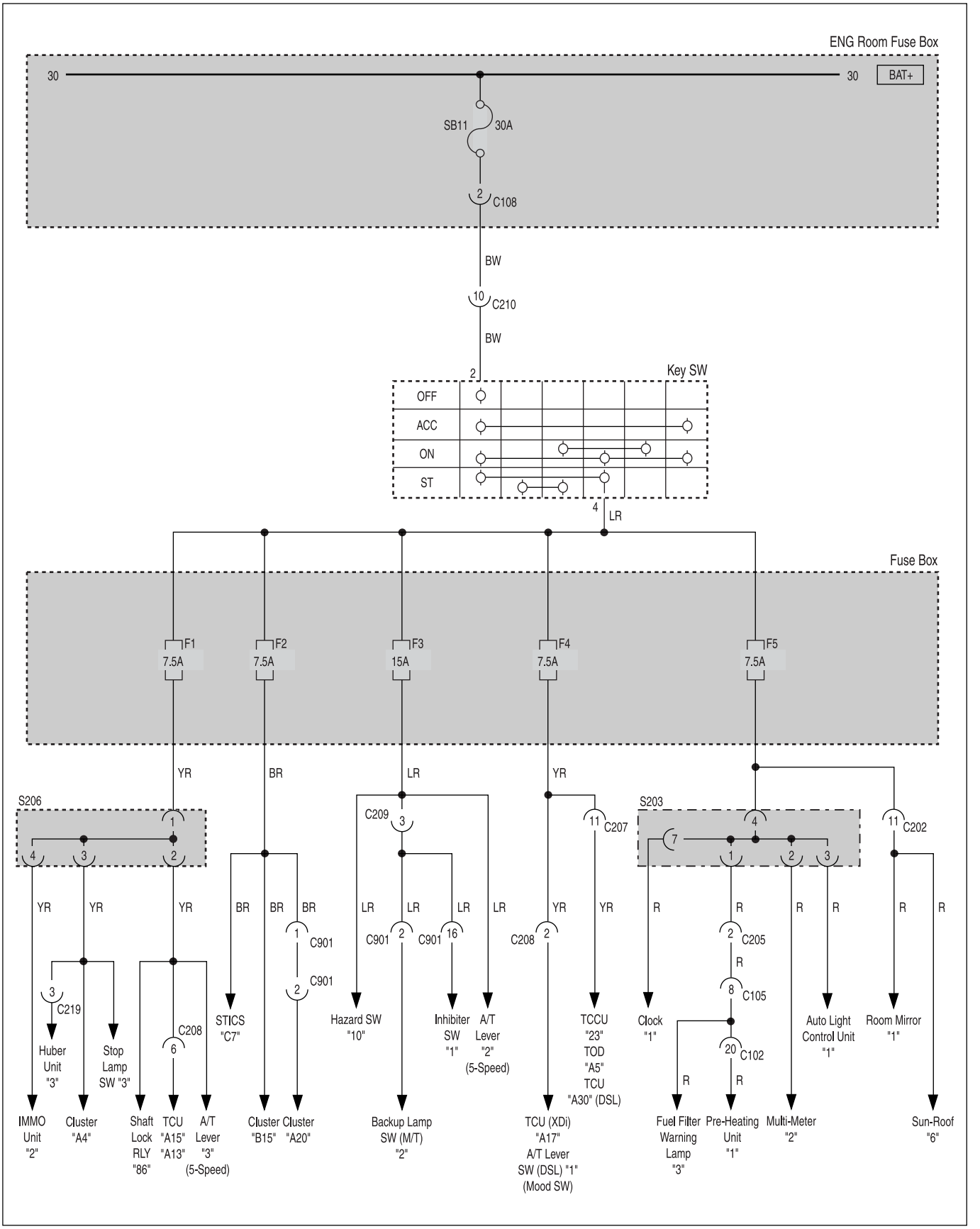

ALT
"B+"
BATT
"B+"
ENG Room Fuse & RLY Box
SB1
PTC : 140A
FFH : 120A
DSL : 80A/100A
30(B+)
Ef19
15A
Ef15
20A
86
30
Tail Lamp
RLY
85
87
Ef16
10A
Ef17
10A
Ef18
7.5A
21 C105
17 C105
15 C102
19 C105
18 C102
20 C105
22 C105
10 C105
4 C106
3 C105
GR
YB
RG
WG
YB
WB
YR
YR
YW
15 C208
8 C392
16 C208
3 C304
S203
11
12
13
License
"1"
WB
YW
GR
GR
STICS
"C9"
Auto Light
Unit
"5"
RR Tail
Lamp (LH)
"3"
Position
Lamp (LH)
"2"
RR Tail
Lamp (RH)
"3"
Position
Lamp (RH)
"2"
S207
"13"
(SW B+)
Huber EGR
Unit
"1"
ENG Main
RLY
"86"
Condensor
Fan RLY
"86"(3EA)
Passenger
Power Seat
SW "10"

(7) Ef21 ~ Ef26

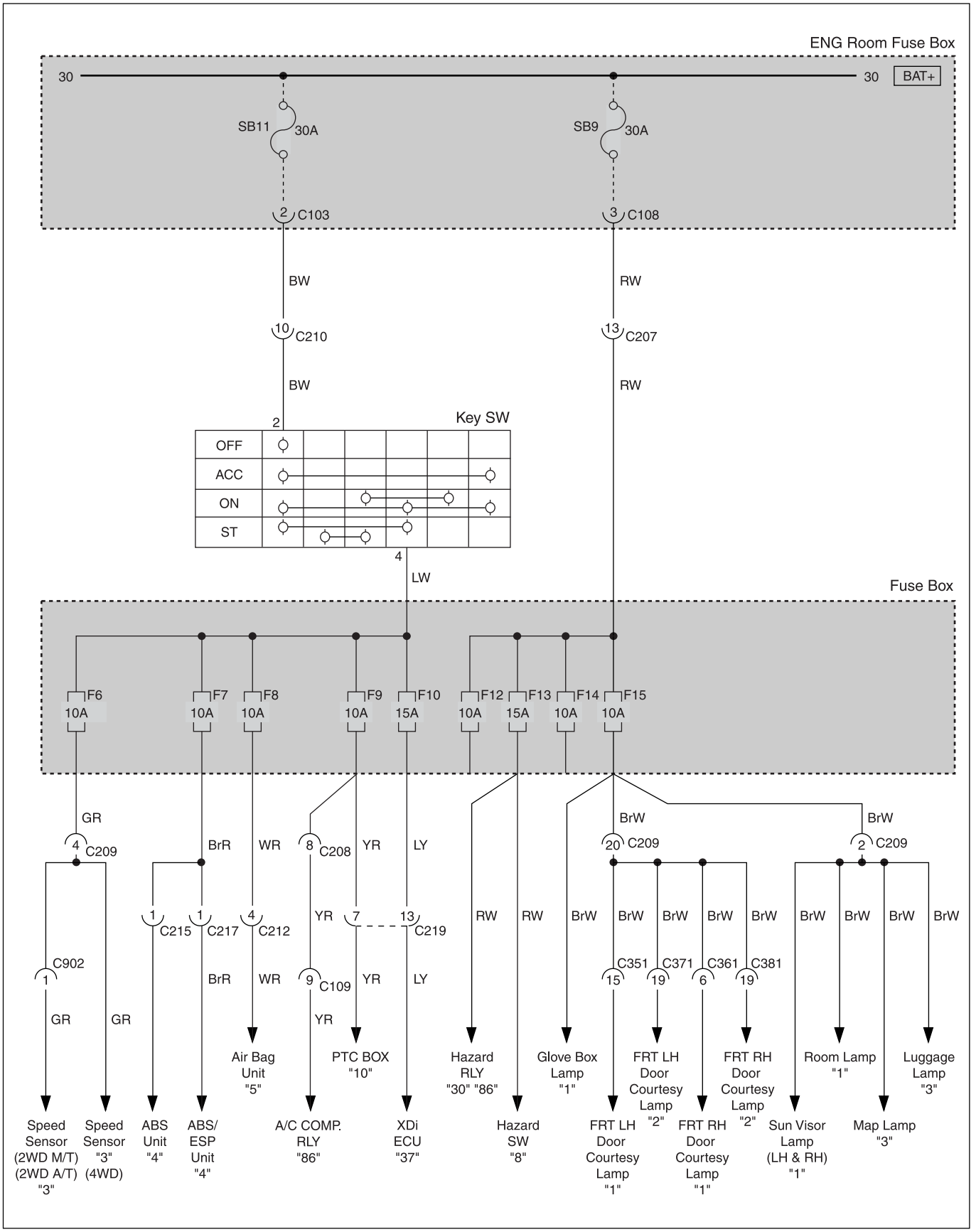

IGN2
ACC
R
L
F21
10A
F22
7.5A
BR
WL
4 C208
12 C208
BR
WL
ENG Room Fuse & RLY Box
8 C107
3 C109
ALT
"B+"
BATT
"B+"
SB1
30(B+)
PTC : 140A
FFH : 120A
DSL : 80A/100A
Ef23
20A
Ef24
20A
Ef21
15A
86
30
85
87
Head Lamp
RLY
(Hi)
RR Blower
RLY
Power Outlet
RLY
Head Lamp
RLY (Lo)
"87"
Ef22
15A
Ef26
15A
Ef25
15A
12
15
C109
8
C106
4
12
C104
3
C107
7
9
C107
20
C104
12
C105
9
C109
BW
LW
GB
C306
12
C207
5
C205
2
BW
LW
LW
LgY
G
BY
RY
RG
B
Y
RL
C213
12
C219
11
C208
4
C205
13
9
C208
BW
LgY
RY
GB
RL
1
C115
TCCU"13"
TOD"A4"
M/Function
(Dimmer) SW
"4"
LH Head
Lamp (Hi)
"4"
FATC
Unit
"A6"
Manual Unit
"12"
G101
FFH
Control
"B+"
TCCU"26"
TOD"A11"
RH Head
Lamp (Hi)
"4"
Cluster (Hi)
"A17"
Blower
Motor
"1"
RR
Power
Outlet
"1"
FRT
Power
Outlet
"1"

2) FUSE BOX

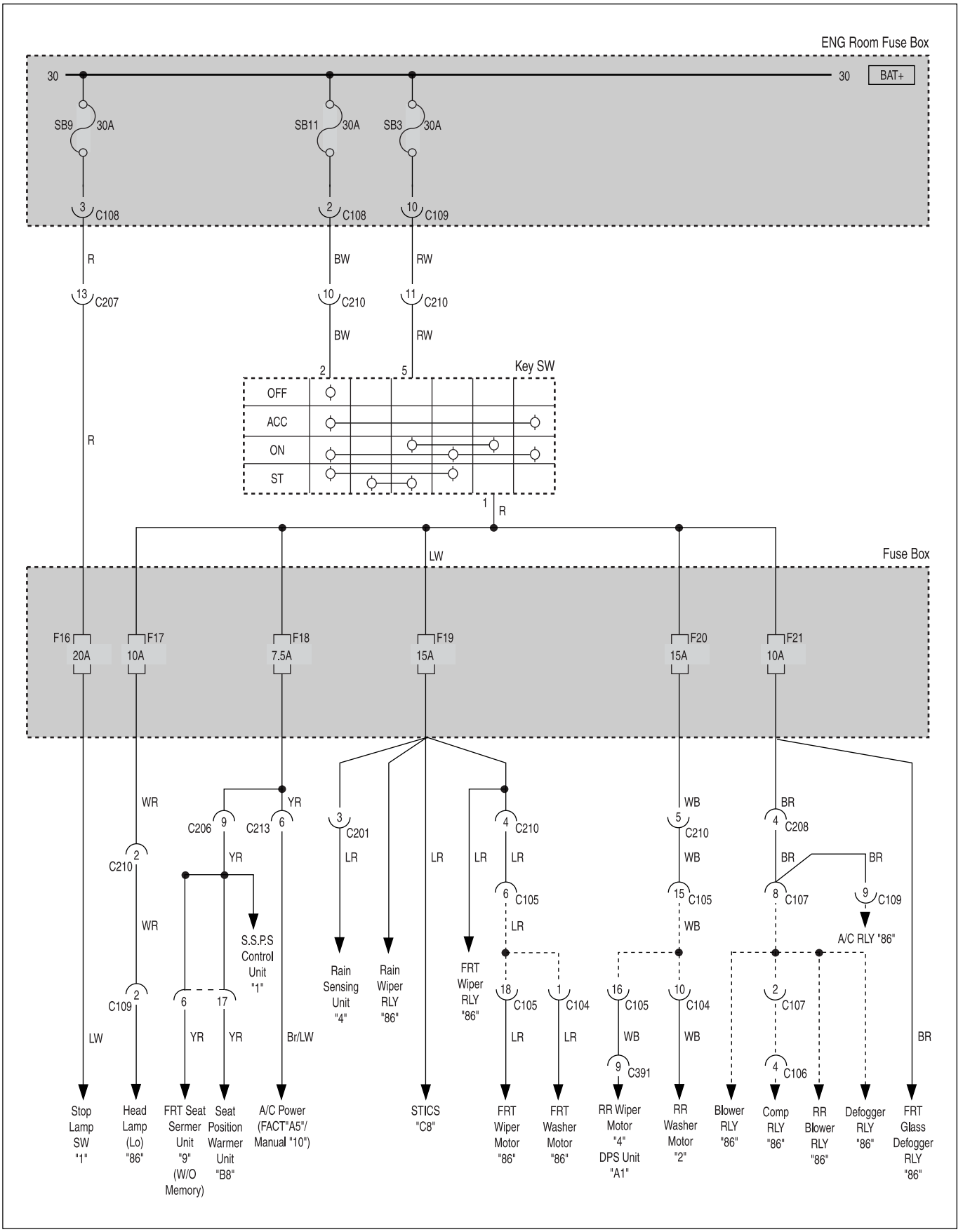
(1) F1 ~ F5



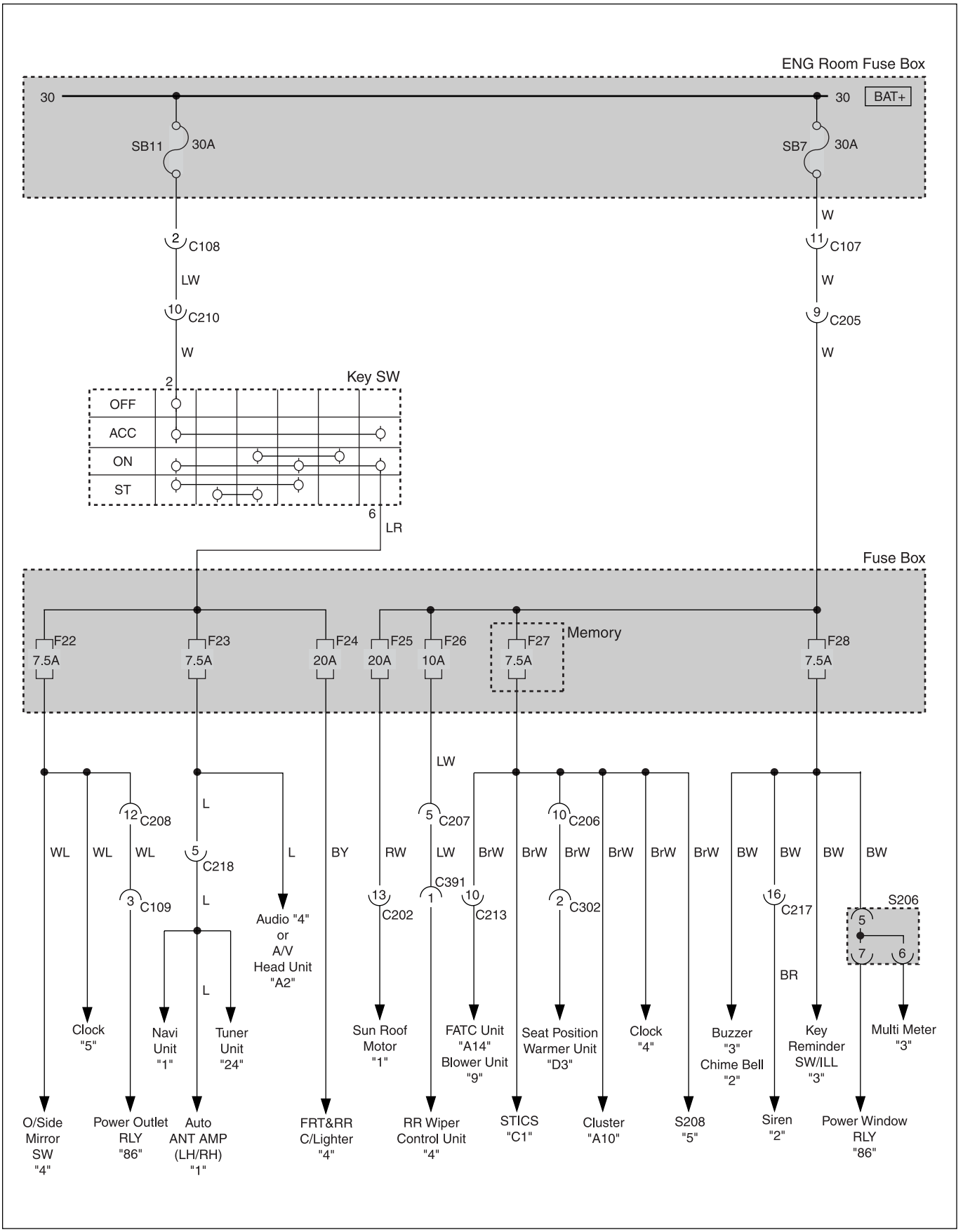
(2) F6 ~ F15


ENG Room Fuse Box
30
30
BAT+
SB11
30A
SB9
30A
2 C103
3 C108
BW
RW
10 C210
13 C207
BW
RW
2
Key SW
OFF
ACC
ON
ST
4
LW
Fuse Box
F6 10A
F7 10A
F8 10A
F9 10A
F10 15A
F12 10A
F13 15A
F14 10A
F15 10A
GR
4 C209
BrR
WR
8 C208
YR
LY
BrW
20 C209
BrW
2 C209
1 C215
1 C217
4 C212
YR
7
13 C219
RW
RW
BrW
BrW
BrW
BrW
BrW
BrW
BrW
BrW
BrW
C902
1
BrR
WR
9 C109
YR
LY
C351 15
C371 19
C361 6
C381 19
GR
GR
YR
Air Bag Unit "5"
PTC BOX "10"
Hazard RLY "30" "86"
Glove Box Lamp "1"
FRT LH Door Courtesy Lamp "2"
FRT RH Door Courtesy Lamp "2"
Room Lamp "1"
Luggage Lamp "3"
Speed Sensor (2WD M/T) (2WD A/T) "3"
Speed Sensor "3" (4WD)
ABS Unit "4"
ABS/ ESP Unit "4"
A/C COMP. RLY "86"
XDi ECU "37"
Hazard SW "8"
FRT LH Door Courtesy Lamp "1"
FRT RH Door Courtesy Lamp "1"
Sun Visor Lamp (LH & RH) "1"
Map Lamp "3"

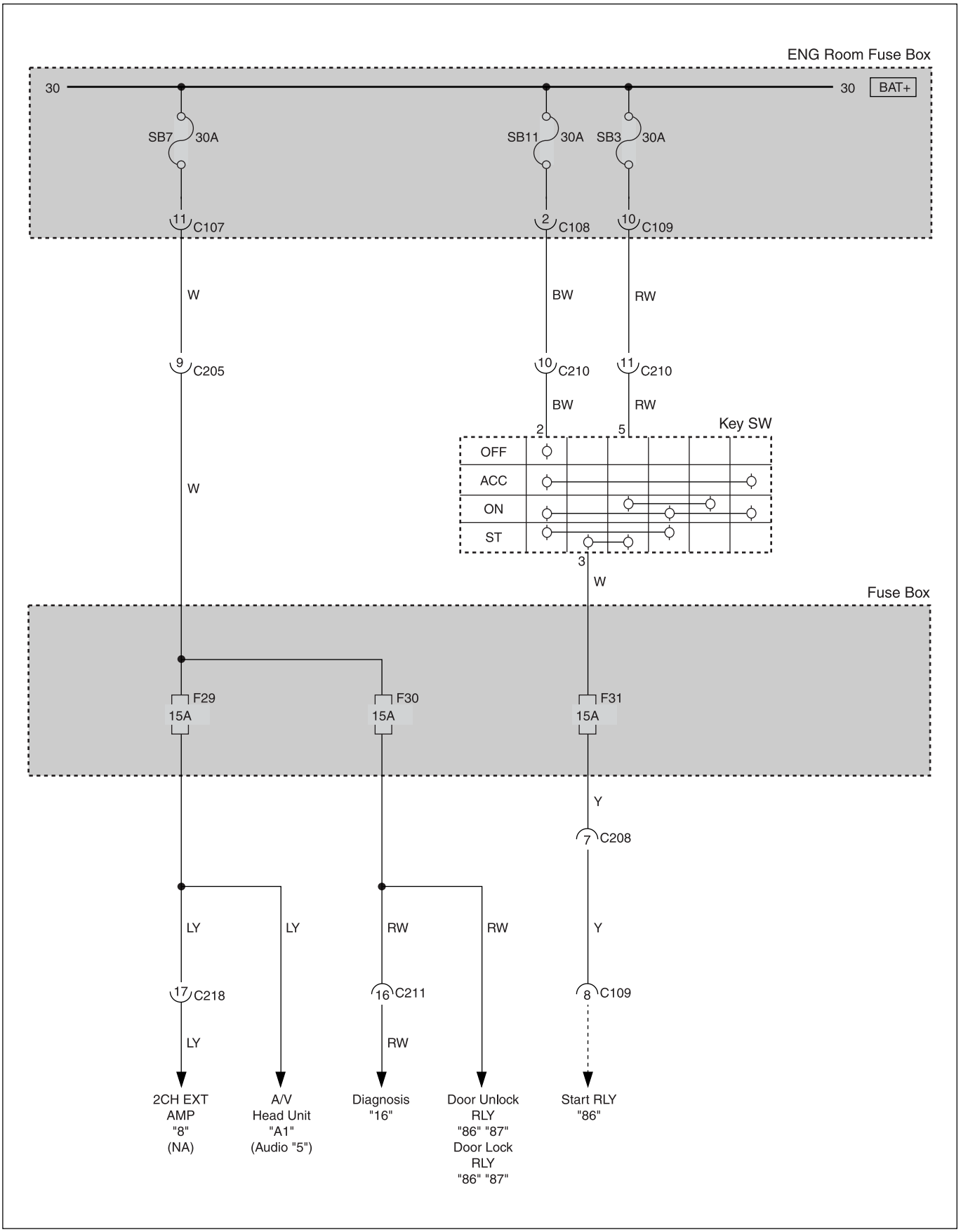
(3) F16 ~ F21


ENG Room Fuse Box
30
BAT+
SB9 30A
SB11 30A
SB3 30A
C108
C108
C109
R
BW
RW
C207
C210
C210
Key SW
OFF
ACC
ON
ST
R
Fuse Box
LW
F16 20A
F17 10A
F18 7.5A
F19 15A
F20 15A
F21 10A
WR
YR
WB
BR
C206
C213
C201
C210
C210
C208
C107
C109
C105
C105
C107
C109
A/C RLY "86"
S.S.P.S Control Unit "1"
Rain Sensing Unit "4"
Rain Wiper RLY "86"
FRT Wiper RLY "86"
C105
C104
C105
C104
C107
C106
C391
LW
YR
YR
Br/LW
LR
LR
LR
LR
WB
WB
BR
Stop Lamp SW "1"
Head Lamp (Lo) "86"
FRT Seat Sermer Unit "9" (W/O Memory)
Seat Position Warmer Unit "B8"
A/C Power (FACT"A5"/ Manual "10")
STICS "C8"
FRT Wiper Motor "86"
FRT Washer Motor "86"
RR Wiper Motor "4" DPS Unit "A1"
RR Washer Motor "2"
Blower RLY "86"
Comp RLY "86"
RR Blower RLY "86"
Defogger RLY "86"
FRT Glass Defogger RLY "86"

(4) F22 ~ F28

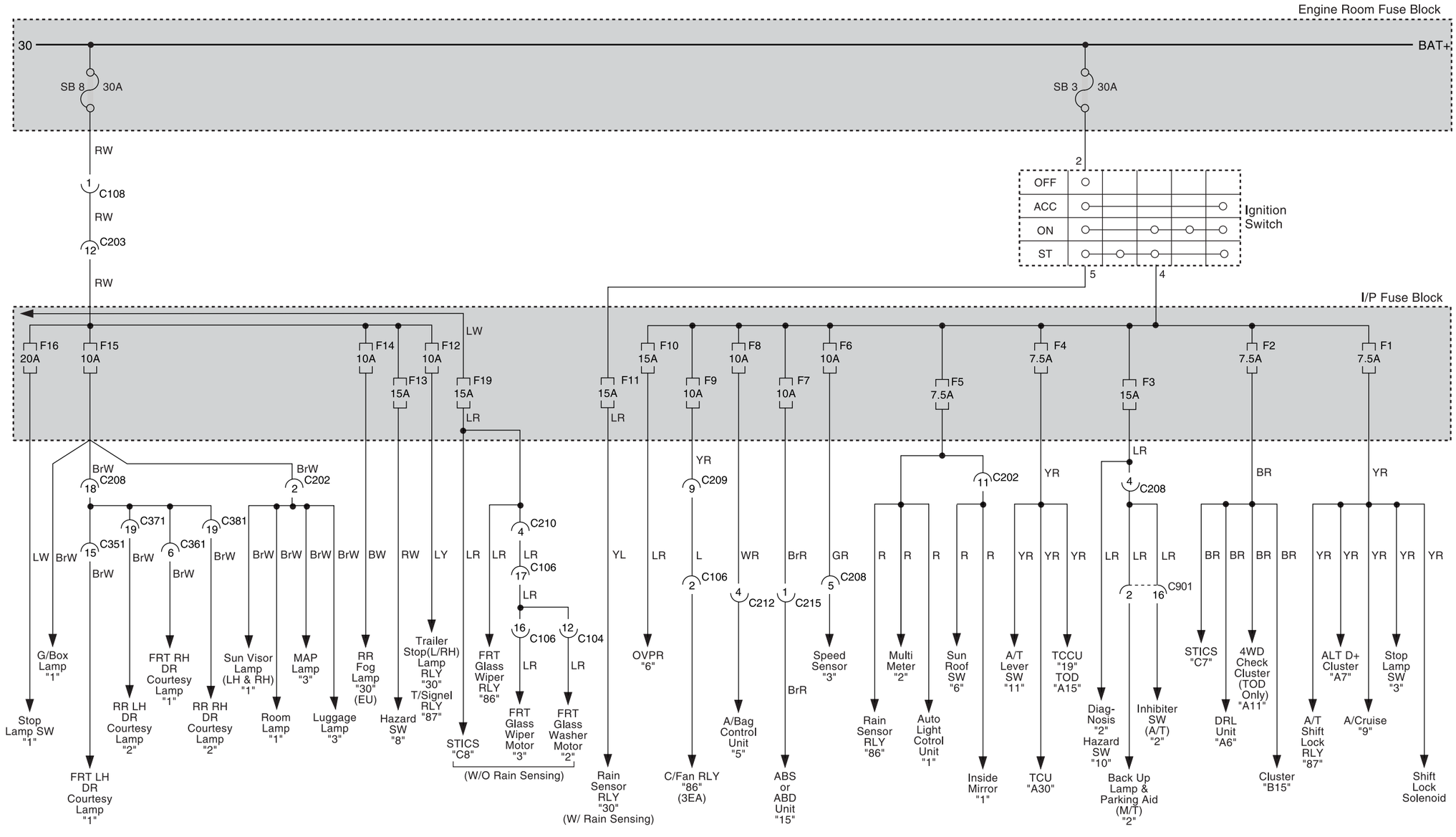

ENG Room Fuse Box
30
30
BAT+
SB11
30A
SB7
30A
W
2
C108
11
C107
LW
W
10
C210
9
C205
W
W
Key SW
2
OFF
ACC
ON
ST
6
LR
Fuse Box
F22
7.5A
F23
7.5A
F24
20A
F25
20A
F26
10A
F27
7.5A
Memory
F28
7.5A
LW
12
C208
L
5
C207
10
C206
WL
WL
WL
5
C218
L
BY
RW
LW
BrW
BrW
BrW
BrW
BrW
BrW
BW
BW
BW
BW
C391
3
C109
L
13
C202
1
10
C213
2
C302
16
C217
S206
5
7
6
BR
Audio "4"
or
A/V
Head Unit
"A2"
L
Clock
"5"
Navi
Unit
"1"
Tuner
Unit
"24"
Sun Roof
Motor
"1"
FATC Unit
"A14"
Blower Unit
"9"
Seat Position
Warmer Unit
"D3"
Clock
"4"
Buzzer
"3"
Chime Bell
"2"
Key
Reminder
SW/ILL
"3"
Multi Meter
"3"
O/Side
Mirror
SW
"4"
Power Outlet
RLY
"86"
Auto
ANT AMP
(LH/RH)
"1"
FRT&RR
C/Lighter
"4"
RR Wiper
Control Unit
"4"
STICS
"C1"
Cluster
"A10"
S208
"5"
Siren
"2"
Power Window
RLY
"86"

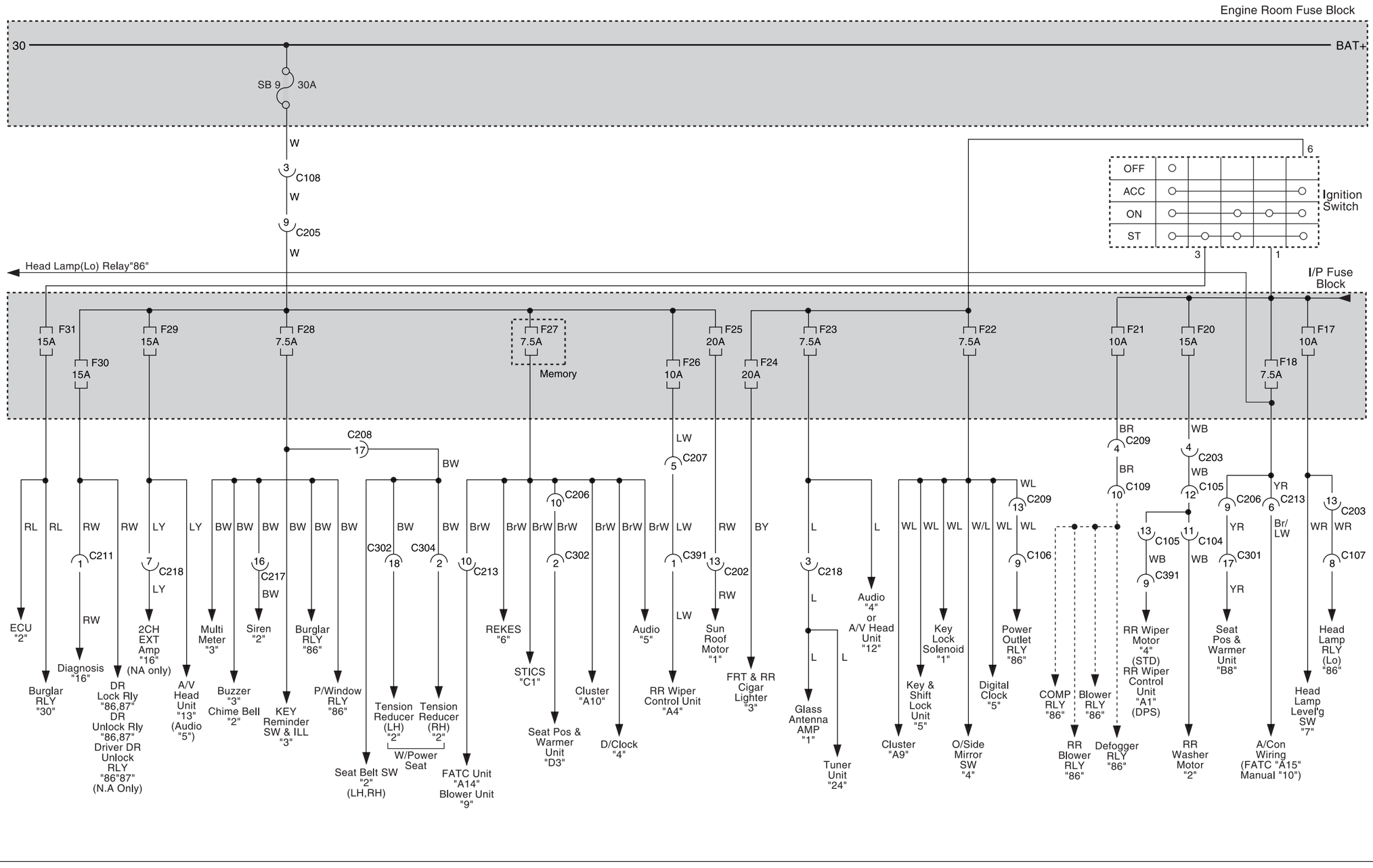
(5) F29 ~ F31

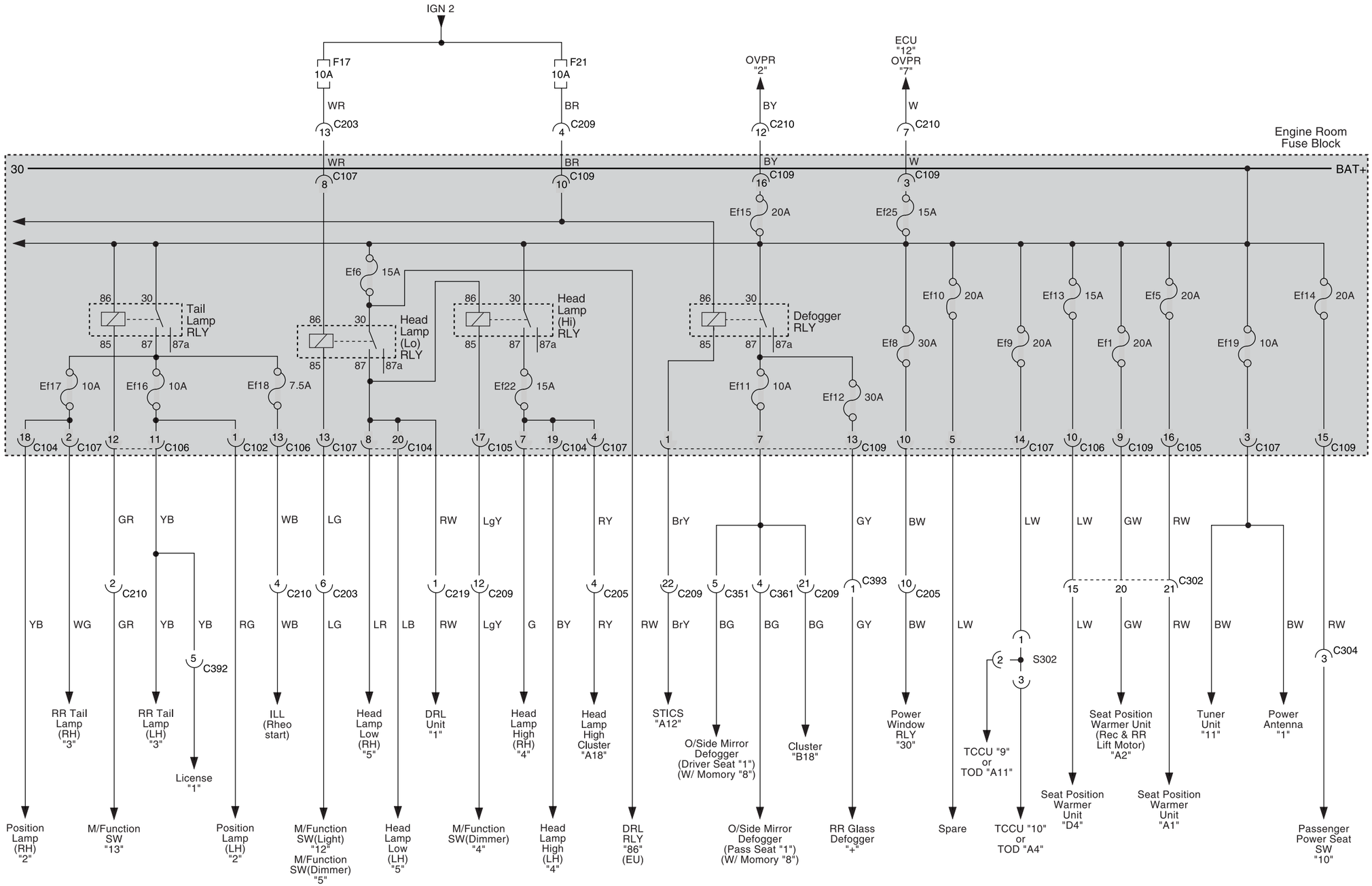

ENG Room Fuse Box
30
30
BAT+
SB7
30A
SB11
30A
SB3
30A
11
C107
2
C108
10
C109
W
BW
RW
9
C205
10
C210
11
C210
BW
RW
2
5
Key SW
OFF
ACC
ON
ST
3
W
W
Fuse Box
F29
15A
F30
15A
F31
15A
Y
7
C208
LY
LY
RW
RW
Y
17
C218
16
C211
8
C109
LY
RW
2CH EXT AMP "8" (NA)
A/V Head Unit "A1" (Audio "5")
Diagnosis "16"
Door Unlock RLY "86" "87" Door Lock RLY "86" "87"
Start RLY "86"

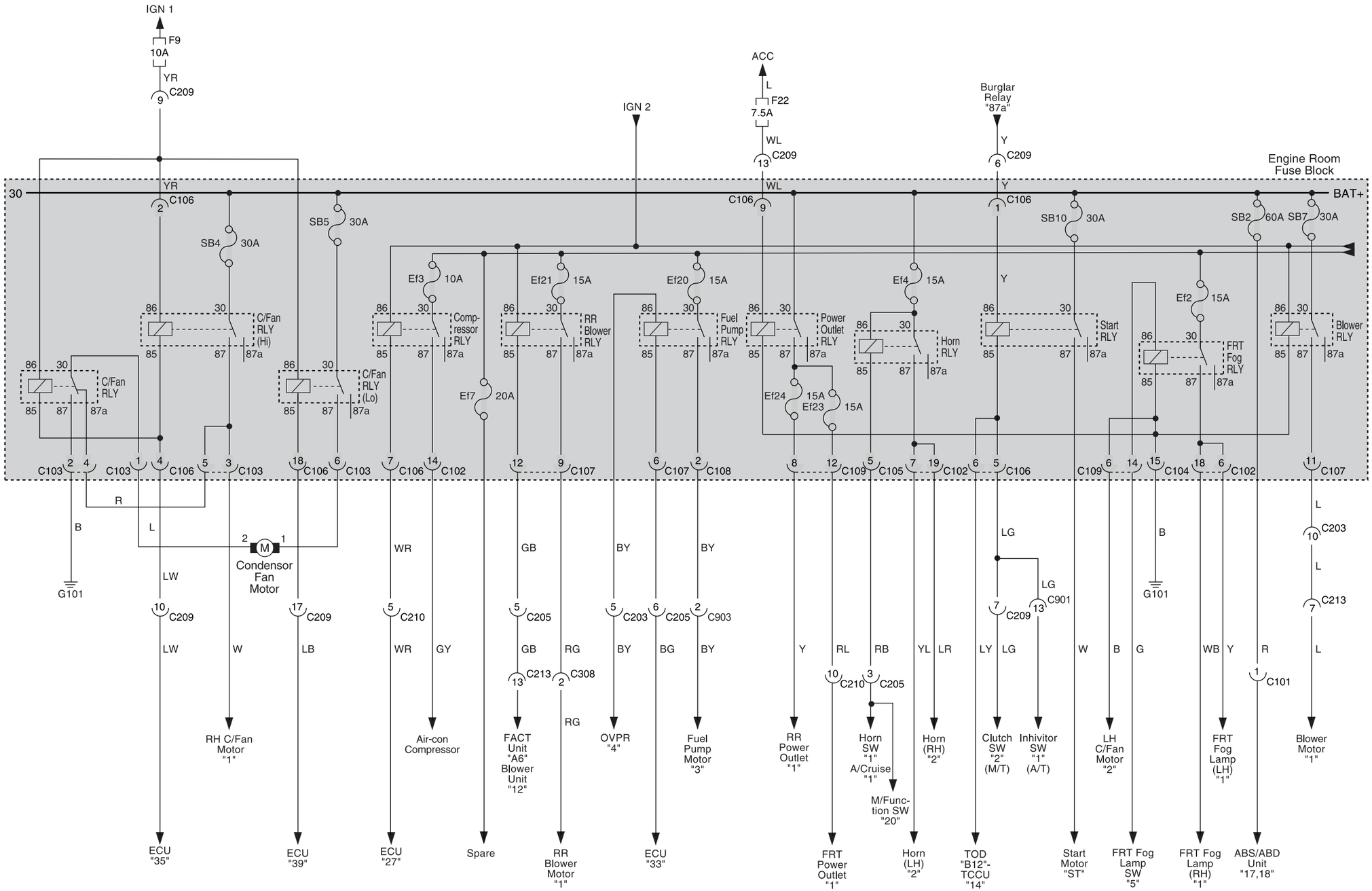
2. POWER WIRING DIAGRAM (GSL)

1) ~ 2002 MODEL

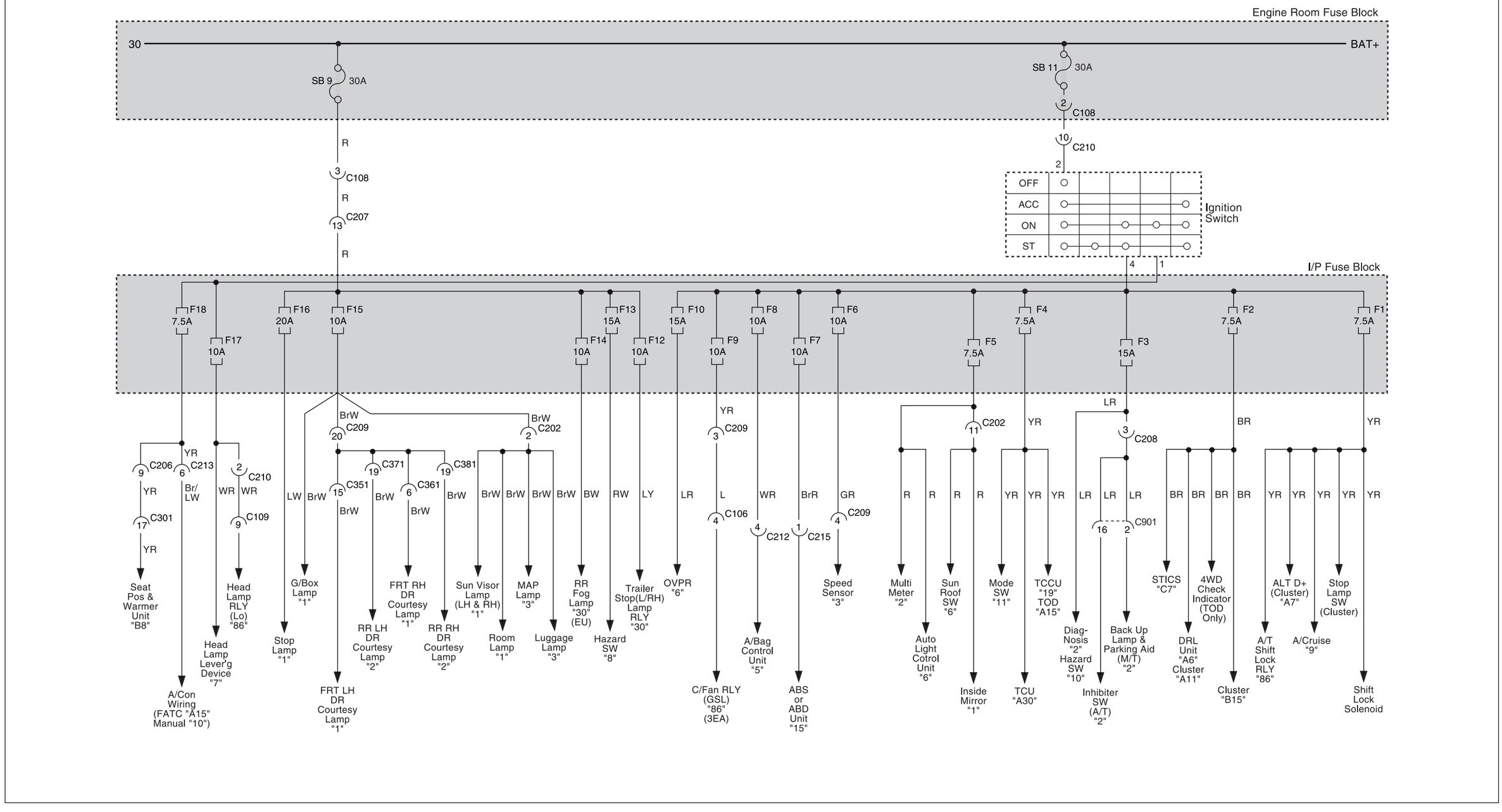


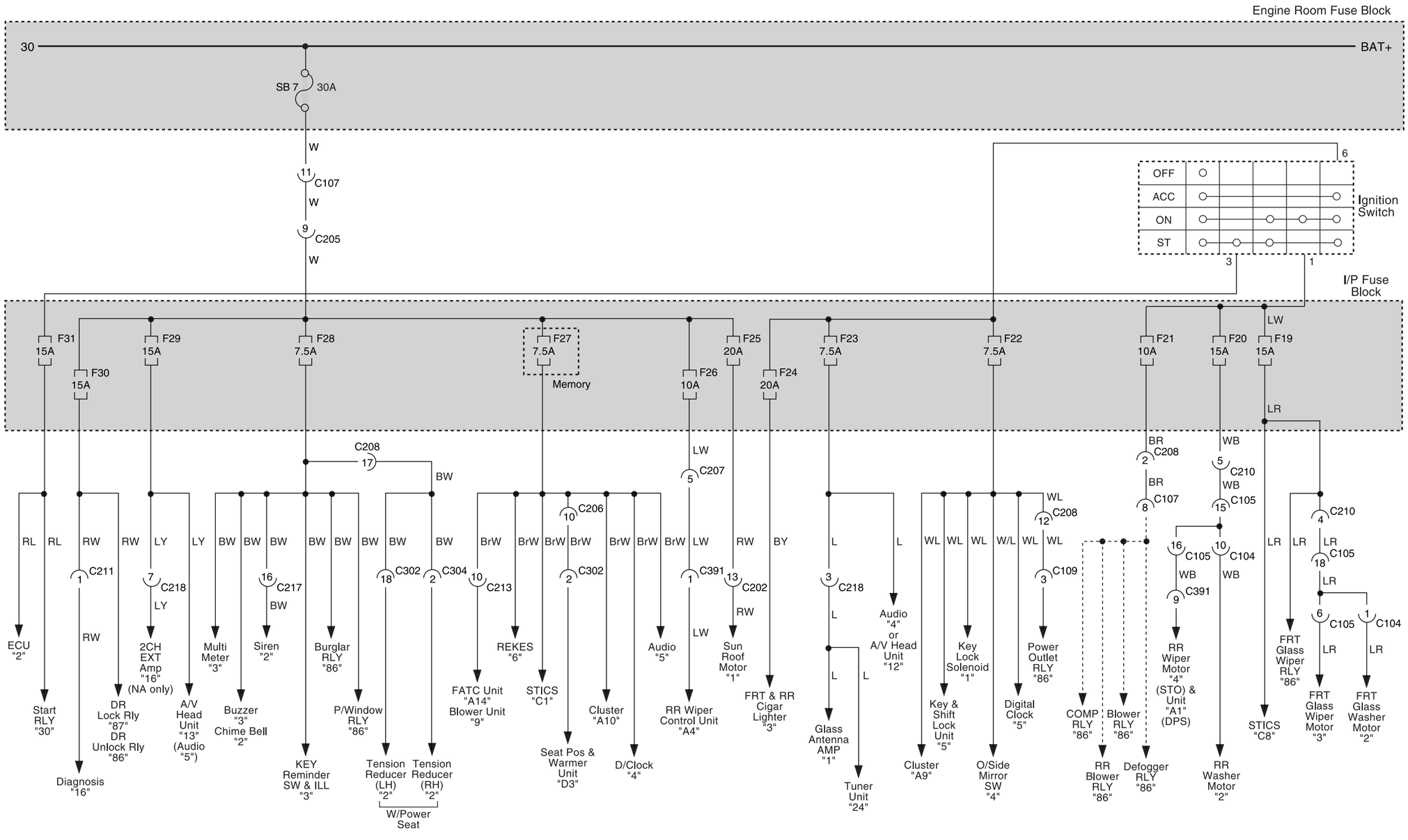

Engine Room Fuse Block
30
BAT+
SB 9
30A
W
3
C108
W
9
C205
W
Head Lamp(Lo) Relay"86"
6
OFF
ACC
ON
ST
Ignition Switch
3
1
I/P Fuse Block
F31 15A
F30 15A
F29 15A
F28 7.5A
F27 7.5A
Memory
F26 10A
F25 20A
F24 20A
F23 7.5A
F22 7.5A
F21 10A
F20 15A
F18 7.5A
F17 10A
C208
17
BW
LW
C207
5
RL
RW
LY
BW
BrW
LW
RW
BY
L
WL
W/L
WB
BR
YR
Br/LW
WR
ECU "2"
Burglar RLY "30"
C211
Diagnosis "16"
DR Lock Rly "86,87" DR Unlock Rly "86,87" Driver DR Unlock RLY "86"87" (N.A Only)
7
C218
2CH EXT Amp "16" (NA only)
A/V Head Unit "13" (Audio "5")
Multi Meter "3"
Buzzer "3" Chime Bell "2"
16
C217
Siren "2"
KEY Reminder SW & ILL "3"
Burglar RLY "86"
P/Window RLY "86"
C302
18
C304
2
Tension Reducer (LH) "2"
Tension Reducer (RH) "2"
W/Power Seat
Seat Belt SW "2" (LH,RH)
10
C213
FATC Unit "A14" Blower Unit "9"
REKES "6"
STICS "C1"
C206
10
C302
2
Seat Pos & Warmer Unit "D3"
Cluster "A10"
D/Clock "4"
Audio "5"
1
C391
RR Wiper Control Unit "A4"
13
C202
Sun Roof Motor "1"
FRT & RR Cigar Lighter "3"
3
C218
Glass Antenna AMP "1"
Tuner Unit "24"
Audio "4" or A/V Head Unit "12"
Cluster "A9"
Key & Shift Lock Unit "5"
Key Lock Solenoid "1"
O/Side Mirror SW "4"
C209
13
Digital Clock "5"
Power Outlet RLY "86"
C106
9
COMP RLY "86"
RR Blower RLY "86"
Blower RLY "86"
Defogger RLY "86"
4
C209
10
C109
4
C203
12
C105
13
C105
WB
C391
9
RR Wiper Motor "4" (STD) RR Wiper Control Unit "A1" (DPS)
11
C104
RR Washer Motor "2"
9
C206
17
C301
Seat Pos & Warmer Unit "B8"
6
C213
A/Con Wiring (FATC "A15" Manual "10")
13
C203
8
C107
Head Lamp RLY (Lo) "86"
Head Lamp Level'g SW "7"

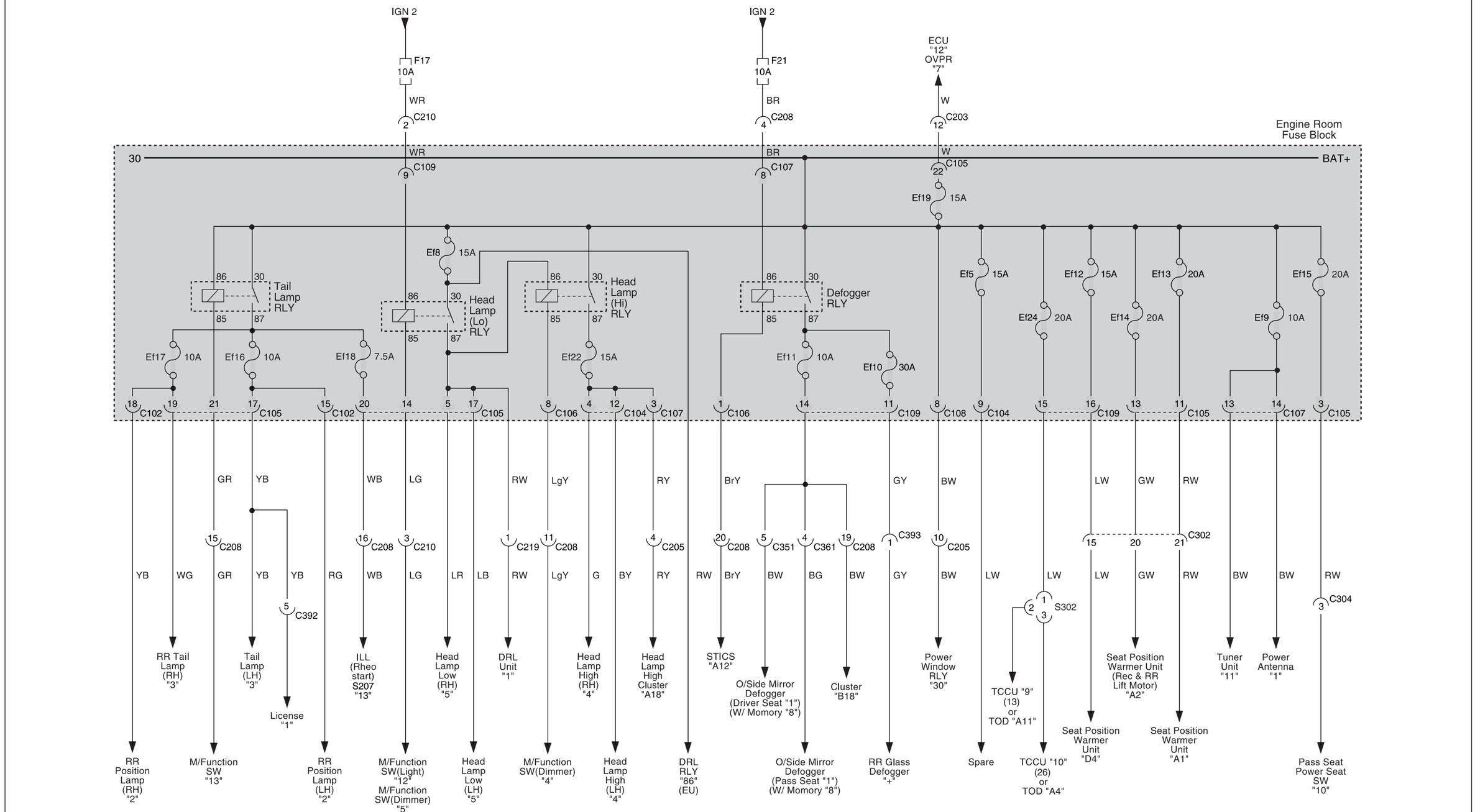

IGN 2
F17
10A
WR
C203
13
F21
10A
BR
C209
4
OVPR
"2"
BY
C210
12
ECU
"12"
OVPR
"7"
W
C210
7
Engine Room
Fuse Block
30
BAT+
WR
C107
8
BR
C109
10
BY
C109
16
W
C109
3
Ef15 20A
Ef25 15A
Ef6 15A
Tail
Lamp
RLY
Head
Lamp
(Lo)
RLY
Head
Lamp
(Hi)
RLY
Defogger
RLY
86
30
85
87
87a
Ef17 10A
Ef16 10A
Ef18 7.5A
Ef22 15A
Ef11 10A
Ef12 30A
Ef10 20A
Ef8 30A
Ef13 15A
Ef9 20A
Ef5 20A
Ef1 20A
Ef19 10A
Ef14 20A
C104
C107
C106
C102
C105
C109
C302
C303
C304
C392
C203
C205
C209
C210
C219
C351
C361
C393
S302
YB
WG
GR
RG
WB
LG
LR
LB
RW
LgY
G
BY
RY
BrY
BG
GY
BW
LW
GW
RW
RR Tail
Lamp
(RH)
"3"
RR Tail
Lamp
(LH)
"3"
License
"1"
ILL
(Rheo
start)
Head
Lamp
Low
(RH)
"5"
DRL
Unit
"1"
Head
Lamp
High
(RH)
"4"
Head
Lamp
High
Cluster
"A18"
STICS
"A12"
O/Side Mirror
Defogger
(Driver Seat "1")
(W/ Momory "8")
Cluster
"B18"
Power
Window
RLY
"30"
Spare
TCCU "9"
or
TOD "A11"
TCCU "10"
or
TOD "A4"
Seat Position
Warmer Unit
(Rec & RR
Lift Motor)
"A2"
Seat Position
Warmer
Unit
"D4"
Seat Position
Warmer
Unit
"A1"
Tuner
Unit
"11"
Power
Antenna
"1"
Passenger
Power Seat
SW
"10"
Position
Lamp
(RH)
"2"
M/Function
SW
"13"
Position
Lamp
(LH)
"2"
M/Function
SW(Light)
"12"
M/Function
SW(Dimmer)
"5"
Head
Lamp
Low
(LH)
"5"
M/Function
SW(Dimmer)
"4"
Head
Lamp
High
(LH)
"4"
DRL
RLY
"86"
(EU)
O/Side Mirror
Defogger
(Pass Seat "1")
(W/ Momory "8")
RR Glass
Defogger
"+"

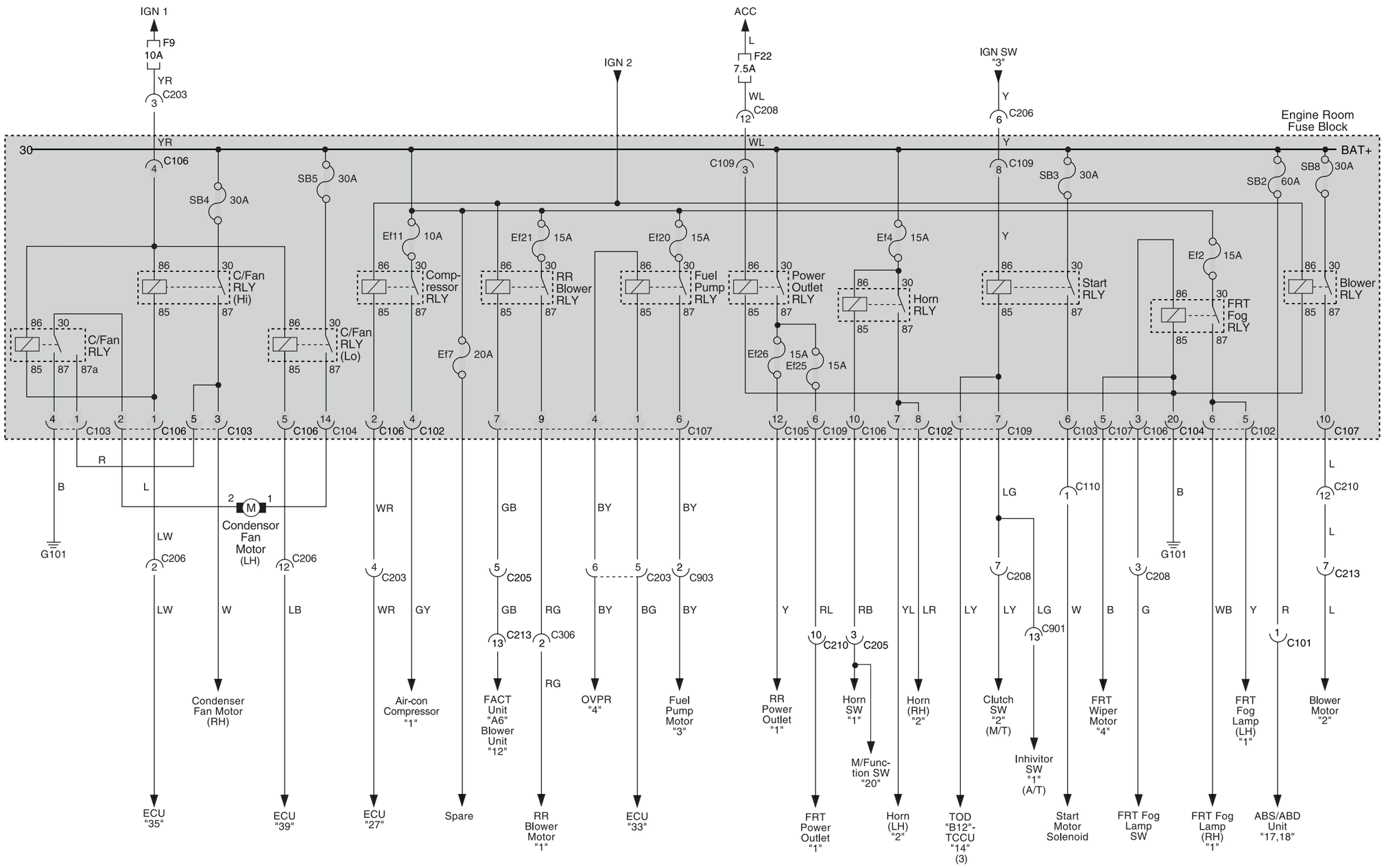

IGN 1
F9
10A
YR
C209
9
IGN 2
ACC
L
F22
7.5A
WL
C209
13
Burglar Relay "87a"
Y
C209
6
Engine Room Fuse Block
30
BAT+
YR
C106
2
WL
C106
9
Y
C106
1
SB4 30A
SB5 30A
SB10 30A
SB2 60A
SB7 30A
Ef3 10A
Ef21 15A
Ef20 15A
Ef4 15A
Ef2 15A
Ef7 20A
Ef24 15A
Ef23 15A
C/Fan RLY
C/Fan RLY (Hi)
C/Fan RLY (Lo)
Comp-ressor RLY
RR Blower RLY
Fuel Pump RLY
Power Outlet RLY
Horn RLY
Start RLY
FRT Fog RLY
Blower RLY
86
85
87
87a
30
C103 2 4
C103 1 4
C106 5 3
C103
C106 18 6
C103
C106 7 14
C102
12 9
C107
6 2
C107
C108
8 12
C109
5
C105
7 19
C102
6 5
C106
C109 6 14
15
C104
18 6
C102
11
C107
B
L
R
LW
W
LB
WR
GY
GB
RG
BY
BG
LG
Y
RL
RB
YL
LR
LY
WB
G
G101
Condensor Fan Motor
2
M
1
10
C209
17
C209
5
C210
5
C205
13
C213
2
C308
5
C203
6
C205
2
C903
7
C209
13
C901
10
C210
3
C205
1
C101
10
C203
7
C213
RH C/Fan Motor "1"
Air-con Compressor
FACT Unit "A6" Blower Unit "12"
OVPR "4"
Fuel Pump Motor "3"
RR Power Outlet "1"
Horn SW "1" A/Cruise "1"
M/Func-tion SW "20"
Horn (RH) "2"
Clutch SW "2" (M/T)
Inhivitor SW "1" (A/T)
LH C/Fan Motor "2"
FRT Fog Lamp (LH) "1"
Blower Motor "1"
ECU "35"
ECU "39"
ECU "27"
Spare
RR Blower Motor "1"
ECU "33"
FRT Power Outlet "1"
Horn (LH) "2"
TOD "B12"-TCCU "14"
Start Motor "ST"
FRT Fog Lamp SW "5"
FRT Fog Lamp (RH) "1"
ABS/ABD Unit "17,18"

2) 2003 MODEL


Engine Room Fuse Block
30
BAT+
SB 9
30A
SB 11
30A
2
C108
10
C210
2
R
3
C108
R
C207
13
R
OFF
ACC
ON
ST
Ignition Switch
4
1
I/P Fuse Block
F18
7.5A
F17
10A
F16
20A
F15
10A
F14
10A
F13
15A
F12
10A
F10
15A
F9
10A
F8
10A
F7
10A
F6
10A
F5
7.5A
F4
7.5A
F3
15A
F2
7.5A
F1
7.5A
YR
C206
9
6
C213
2
C210
YR
Br/
LW
WR
WR
C301
17
C109
9
YR
Seat
Pos &
Warmer
Unit
"B8"
Head
Lamp
RLY
(Lo)
"86"
Head
Lamp
Lever'g
Device
"7"
A/Con
Wiring
(FATC "A15"
Manual "10")
BrW
C209
20
BrW
C202
2
LW
BrW
C371
19
C381
19
C351
15
C361
6
BrW
BrW
BrW
BrW
BrW
BrW
BrW
BW
RW
LY
LR
G/Box
Lamp
"1"
Stop
Lamp
"1"
FRT LH
DR
Courtesy
Lamp
"1"
RR LH
DR
Courtesy
Lamp
"2"
FRT RH
DR
Courtesy
Lamp
"1"
RR RH
DR
Courtesy
Lamp
"2"
Sun Visor
Lamp
(LH & RH)
"1"
Room
Lamp
"1"
MAP
Lamp
"3"
Luggage
Lamp
"3"
RR
Fog
Lamp
"30"
(EU)
Hazard
SW
"8"
Trailer
Stop(L/RH)
Lamp
RLY
"30"
OVPR
"6"
YR
C209
3
L
C106
4
WR
4
C212
BrR
1
C215
GR
C209
4
C/Fan RLY
(GSL)
"86"
(3EA)
A/Bag
Control
Unit
"5"
ABS
or
ABD
Unit
"15"
Speed
Sensor
"3"
R
R
C202
11
R
R
YR
YR
YR
LR
3
C208
LR
LR
LR
C901
16
2
BR
BR
BR
BR
YR
YR
YR
YR
YR
Multi
Meter
"2"
Auto
Light
Cotrol
Unit
"6"
Sun
Roof
SW
"6"
Inside
Mirror
"1"
Mode
SW
"11"
TCU
"A30"
TCCU
"19"
TOD
"A15"
Diag-
Nosis
"2"
Hazard
SW
"10"
Inhibiter
SW
(A/T)
"2"
Back Up
Lamp &
Parking Aid
(M/T)
"2"
STICS
"C7"
DRL
Unit
"A6"
Cluster
"A11"
4WD
Check
Indicator
(TOD
Only)
Cluster
"B15"
A/T
Shift
Lock
RLY
"86"
ALT D+
(Cluster)
"A7"
A/Cruise
"9"
Stop
Lamp
SW
(Cluster)
Shift
Lock
Solenoid


Engine Room Fuse Block
30
BAT+
SB 7
30A
W
11
C107
W
9
C205
W
6
OFF
ACC
ON
ST
Ignition Switch
3
1
I/P Fuse Block
F31 15A
F30 15A
F29 15A
F28 7.5A
F27 7.5A
Memory
F26 10A
F25 20A
F24 20A
F23 7.5A
F22 7.5A
F21 10A
F20 15A
F19 15A
LW
LR
C208 17
BW
LW
C207 5
C206 10
C208 2
BR
C208 12
WL
C210 5
WB
C210 4
LR
C105 18
LR
C105 6
LR
C104 1
LR
C105 16
WB
C391 9
C105 15
WB
C104 10
WB
C211 1
RW
C218 7
LY
C217 16
BW
C302 18
C304 2
BW
C213 10
BrW
C302 2
C391 1
LW
C202 13
RW
C218 3
L
C109 3
WL
C107 8
BR
RL
RW
LY
BW
BrW
L
WL
W/L
ECU "2"
Start RLY "30"
Diagnosis "16"
DR Lock Rly "87" DR Unlock Rly "86"
2CH EXT Amp "16" (NA only)
A/V Head Unit "13" (Audio "5")
Multi Meter "3"
Buzzer "3" Chime Bell "2"
Siren "2"
KEY Reminder SW & ILL "3"
Burglar RLY "86"
P/Window RLY "86"
Tension Reducer (LH) "2"
Tension Reducer (RH) "2"
W/Power Seat
FATC Unit "A14" Blower Unit "9"
REKES "6"
STICS "C1"
Seat Pos & Warmer Unit "D3"
Cluster "A10"
D/Clock "4"
Audio "5"
RR Wiper Control Unit "A4"
Sun Roof Motor "1"
FRT & RR Cigar Lighter "3"
Glass Antenna AMP "1"
Tuner Unit "24"
Audio "4" or A/V Head Unit "12"
Cluster "A9"
Key & Shift Lock Unit "5"
Key Lock Solenoid "1"
O/Side Mirror SW "4"
Digital Clock "5"
Power Outlet RLY "86"
COMP RLY "86"
RR Blower RLY "86"
Blower RLY "86"
Defogger RLY "86"
RR Wiper Motor "4" (STO) & Unit "A1" (DPS)
RR Washer Motor "2"
STICS "C8"
FRT Glass Wiper RLY "86"
FRT Glass Wiper Motor "3"
FRT Glass Washer Motor "2"

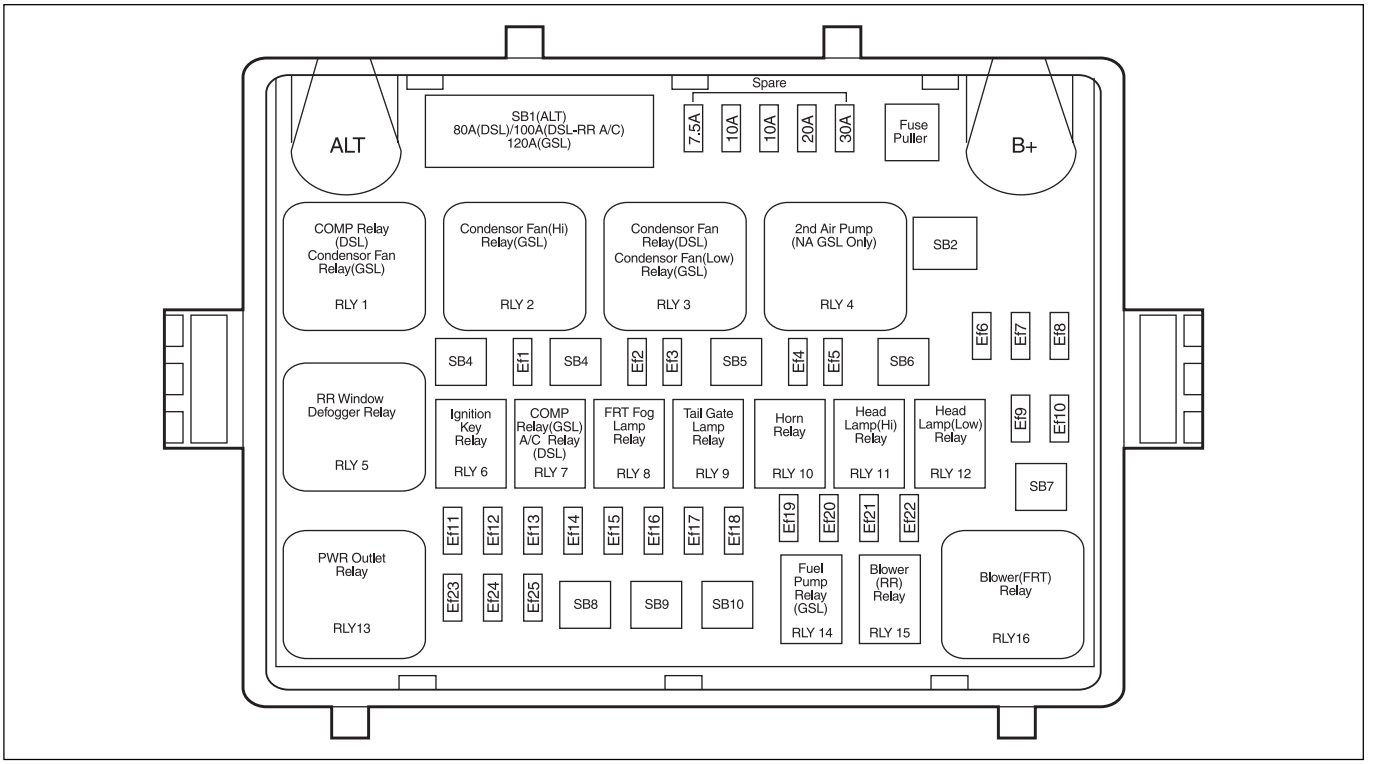

IGN 2
F17
10A
WR
C210
2
IGN 2
F21
10A
BR
C208
4
ECU
"12"
OVPR
"7"
W
C203
12
Engine Room
Fuse Block
30
WR
C109
9
BR
C107
8
W
C105
22
BAT+
Ef19 15A
Ef8 15A
Tail
Lamp
RLY
Head
Lamp
(Lo)
RLY
Head
Lamp
(Hi)
RLY
Defogger
RLY
86
85
87
Ef17 10A
Ef16 10A
Ef18 7.5A
Ef22 15A
Ef11 10A
Ef10 30A
Ef5 15A
Ef12 15A
Ef13 20A
Ef15 20A
Ef24 20A
Ef14 20A
Ef9 10A
18 C102
19 C102
21
17 C105
15 C102
20
14
5
17 C105
8 C106
4
12
3 C107
1 C106
14
11 C109
8 C108
9 C104
15
16 C109
13
11 C105
13
14 C107
3 C105
YB
WG
GR
YB
YB
RG
WB
LG
LR
LB
RW
LgY
G
BY
RY
RW
BrY
BW
BG
BW
GY
BW
LW
LW
LW
GW
RW
BW
BW
RW
15 C208
16 C208
3 C210
1 C219
11 C208
4 C205
20 C208
5 C351
4 C361
19 C208
1 C393
10 C205
5 C392
1
2
3 S302
15
20
21 C302
3 C304
RR Tail
Lamp
(RH)
"3"
Tail
Lamp
(LH)
"3"
License
"1"
ILL
(Rheo
start)
S207
"13"
Head
Lamp
Low
(RH)
"5"
DRL
Unit
"1"
Head
Lamp
High
(RH)
"4"
Head
Lamp
High
Cluster
"A18"
STICS
"A12"
O/Side Mirror
Defogger
(Driver Seat "1")
(W/ Momory "8")
Cluster
"B18"
Power
Window
RLY
"30"
TCCU "9"
(13)
or
TOD "A11"
Seat Position
Warmer Unit
(Rec & RR
Lift Motor)
"A2"
Tuner
Unit
"11"
Power
Antenna
"1"
RR
Position
Lamp
(RH)
"2"
M/Function
SW
"13"
RR
Position
Lamp
(LH)
"2"
M/Function
SW(Light)
"12"
M/Function
SW(Dimmer)
"5"
Head
Lamp
Low
(LH)
"5"
M/Function
SW(Dimmer)
"4"
Head
Lamp
High
(LH)
"4"
DRL
RLY
"86"
(EU)
O/Side Mirror
Defogger
(Pass Seat "1")
(W/ Momory "8")
RR Glass
Defogger
"+"
Spare
TCCU "10"
(26)
or
TOD "A4"
Seat Position
Warmer
Unit
"D4"
Seat Position
Warmer
Unit
"A1"
Pass Seat
Power Seat
SW
"10"


IGN 1
F9
10A
YR
C203
3
IGN 2
ACC
L
F22
7.5A
WL
C208
12
IGN SW
"3"
Y
C206
6
Engine Room
Fuse Block
30
YR
C106
4
WL
C109
3
Y
C109
8
BAT+
SB5 30A
SB4 30A
SB3 30A
SB2 60A
SB8 30A
Ef11 10A
Ef21 15A
Ef20 15A
Ef4 15A
Ef2 15A
Ef7 20A
Ef26 15A
Ef25 15A
C/Fan RLY (Hi)
C/Fan RLY
C/Fan RLY (Lo)
Comp-ressor RLY
RR Blower RLY
Fuel Pump RLY
Power Outlet RLY
Horn RLY
Start RLY
FRT Fog RLY
Blower RLY
86
85
87
87a
30
C103
C106
C104
C102
C105
C107
C110
C901
C210
C213
C306
C205
C203
C903
C208
C101
R
B
L
LW
W
LB
WR
GY
GB
RG
BY
BG
Y
RL
RB
YL
LR
LY
LG
WB
G101
Condensor Fan Motor (LH)
Condenser Fan Motor (RH)
Air-con Compressor "1"
FACT Unit "A6" Blower Unit "12"
OVPR "4"
Fuel Pump Motor "3"
RR Power Outlet "1"
Horn SW "1"
M/Func-tion SW "20"
Horn (RH) "2"
Clutch SW "2" (M/T)
Inhivitor SW "1" (A/T)
FRT Wiper Motor "4"
Blower Motor "2"
FRT Power Outlet "1"
Horn (LH) "2"
TOD "B12"-TCCU "14" (3)
Start Motor Solenoid
FRT Fog Lamp SW
FRT Fog Lamp (RH) "1"
FRT Fog Lamp (LH) "1"
ABS/ABD Unit "17,18"
ECU "35"
ECU "39"
ECU "27"
Spare
RR Blower Motor "1"
ECU "33"

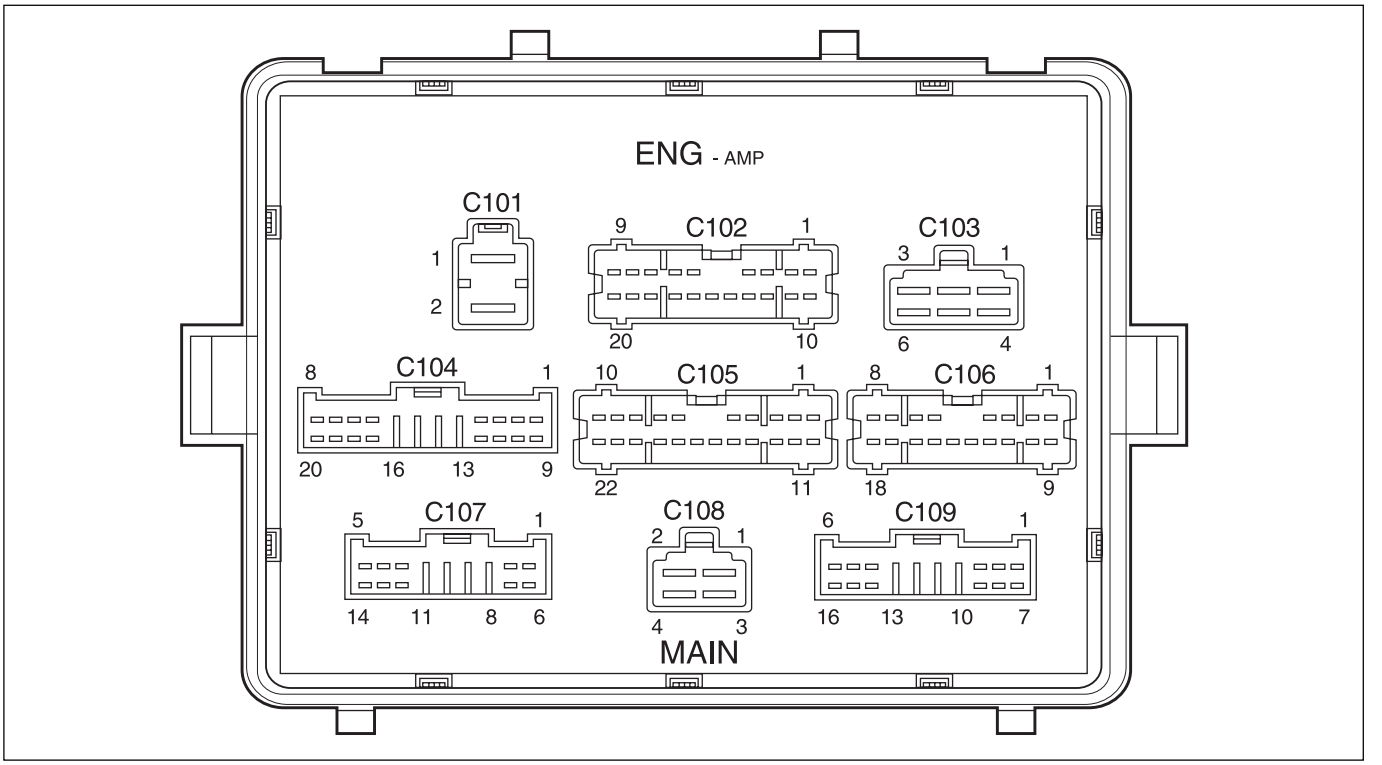
1. ENGINE ROOM FUSE & REALY BLOCK

1) ~ 2002 MODEL

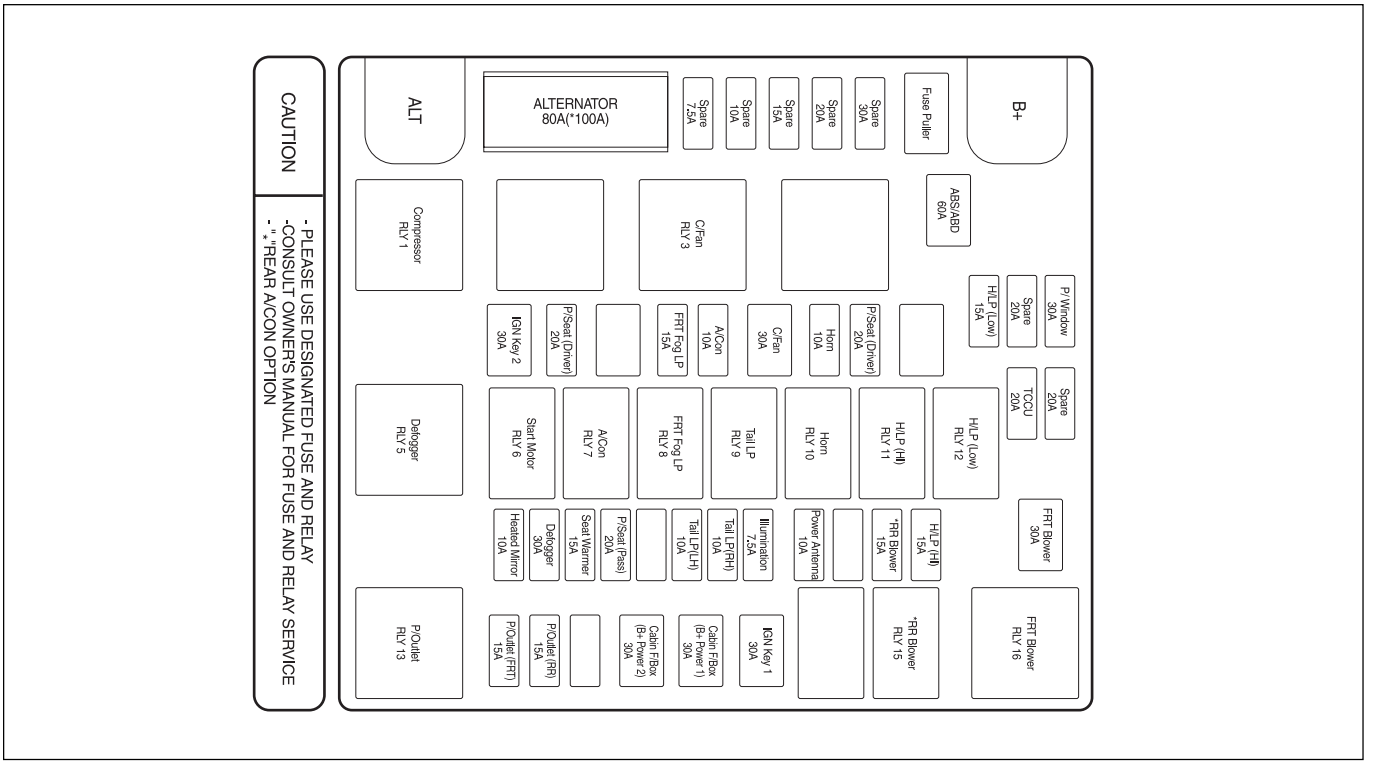
(1) FRONT



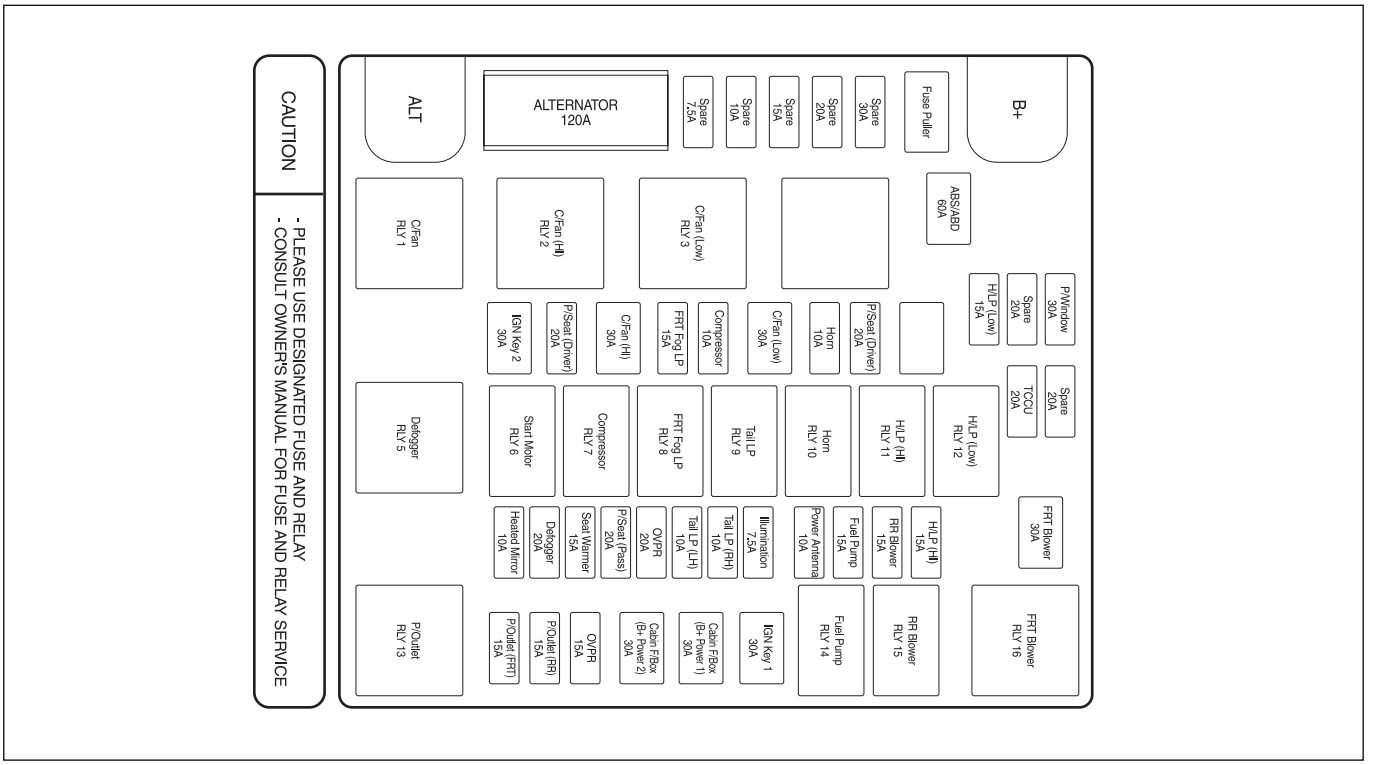
(2) REAR



(3) FRONT (DSL)



(4) FRONT (GSL)



(5) USAGE OF FUSE IN ENGINE ROOM FUSE BOX

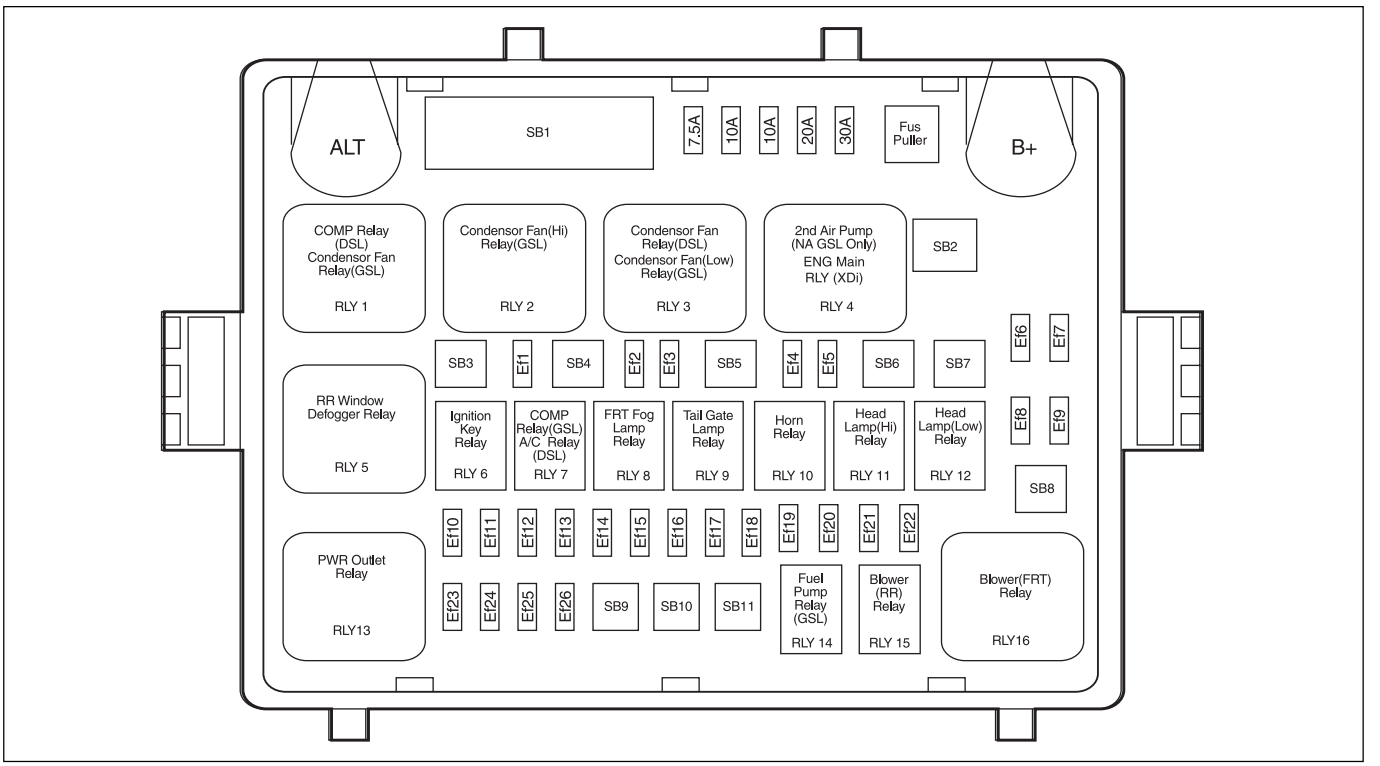
Fuse NO.	Capacity	Usage	Fuse NO.	Capacity	Usage
Ef1	20A	Power Seat (Driver)	Ef19	10A	Power Antenna.
Ef2	15A	FRT Fog Lamp	Ef20	15A	Fuel Pump (GSL)
Ef3	10A	A/C Comp. (GSL)	Ef21	15A	RR Blower
Ef4	10A	Horn	Ef22	15A	Head Lamp (HI)
Ef5	20A	Power Seat (Driver)	Ef23	15A	Power Outlet (FRT)
Ef6	15A	Head Lamp (Low)	Ef24	15A	Power Outlet (RR)
Ef7	20A	Spare	Ef25	15A	OVPR (GSL)
Ef8	30A	Power Window	SB1	80A/100A/120A	Alternator
Ef9	20A	TCCU/TOD (GSL)	SB2	60A	ABS/ABD
Ef10	20A	Spare	SB3	30A	IGN Key “2”
Ef11	10A	Heated Mirror	SB4	30A	C/Fan (HI) - GSL
Ef12	30A	Defogger	SB5	30A	C/Fan (DSL), C/Fan (LOW) - DSL
Ef13	15A	Seat Warmer	SB6	50A	2nd Air Pump
Ef14	20A	Power Seat (Passenger)	SB7	30A	FRT Blower
Ef15	20A	OVPR (GSL)	SB8	30A	Cabin F/Box “B+” - 2
Ef16	10A	Tail Lamp (LH)	SB9	30A	Cabin F/Box “B+” - 1
Ef17	10A	Tail Lamp (RH)	SB10	30A	IGN Key “1”
Ef18	7.5A	Illumination			

(6) CONNECTOR

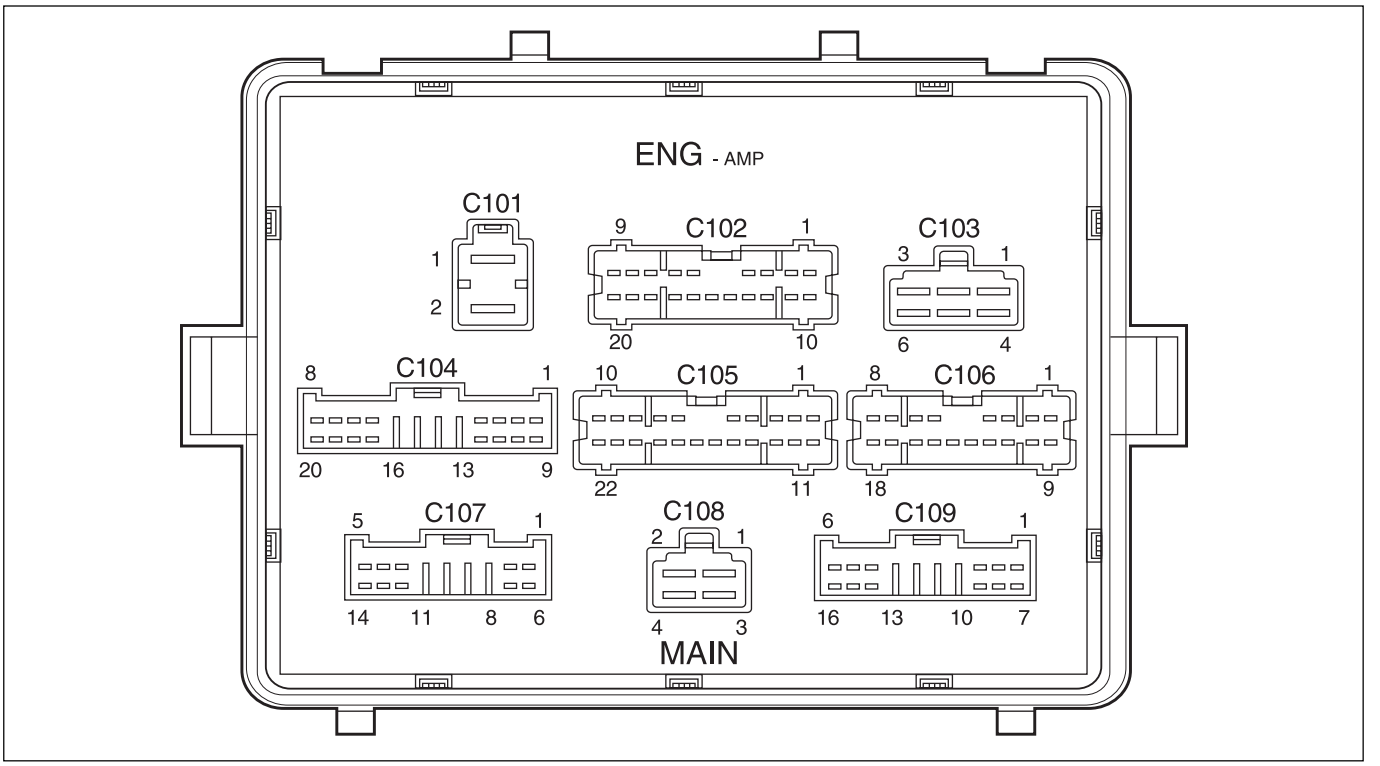
Position	Connector NO.	Pin NO.	Connector Color
A	C101	2	Black
B	C102	20	White
C	C103	6	Colorless
D	C104	20	White
E	C105	22	White
F	C106	18	White
J	C107	14	White
K	C108	4	Colorless
M	C109	16	White

2) 2003 MODEL (W/ XDi) ~

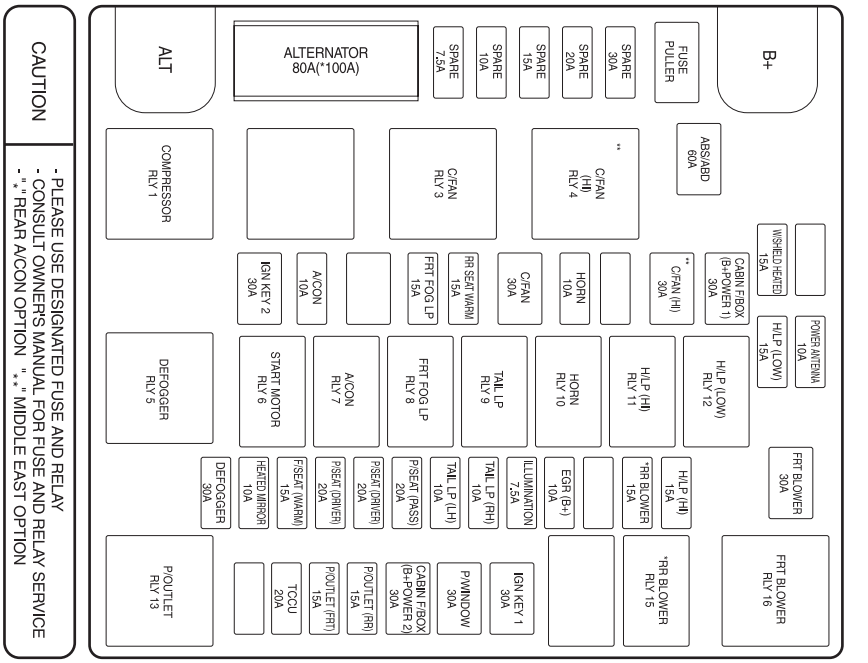
(1) FRONT



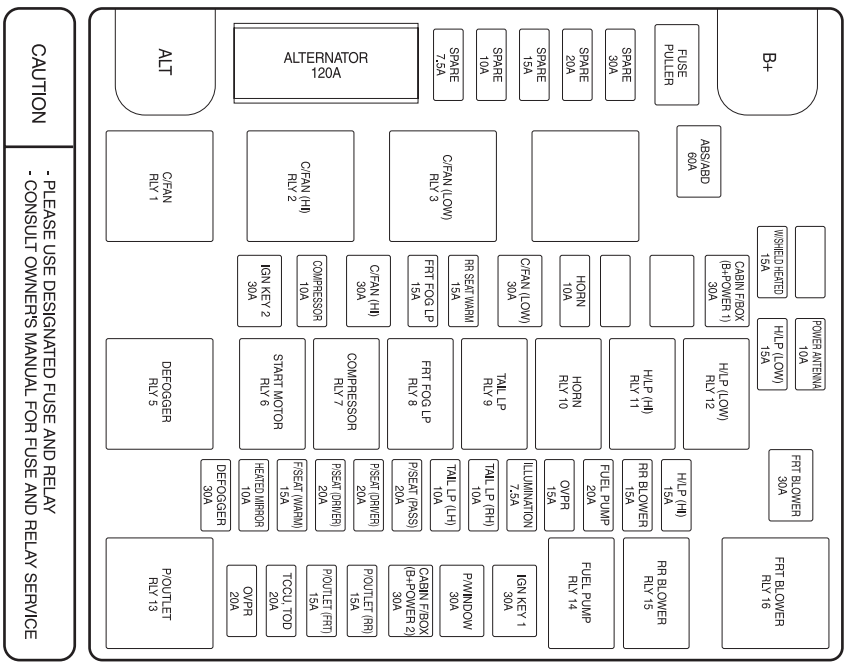
(2) REAR



(3) FRONT (DSL)



(4) FRONT (GSL)



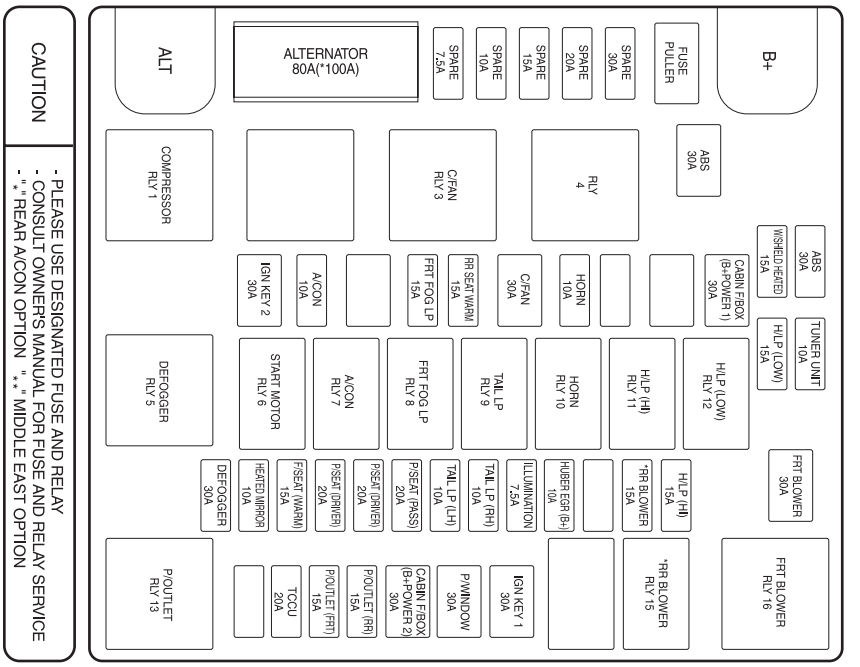
(5) USAGE OF FUSE IN ENGINE ROOM FUSE BOX

Fuse NO.	Capacity	Usage	Fuse NO.	Capacity	Usage
SB1	80A/100A/120A	Generator	Ef9	10A	PWR Antenna/Tuner Unit
SB2	60A	ABS/ABD	Ef10	30A	RR Glass Defogger
SB3	30A	IGN KEY “2”	Ef11	10A	Mirror Defogger
SB4	30A	Condenser Fan (High)-GSL	Ef12	15A	Seat Warmer
SB5	30A	Condenser Fan (Low)	Ef13	20A	Seat Position Warmer Unit (Slide & FRT Lift Motor)
SB6	50A				
SB7	30A	Fuse Box “BATT-1”	Ef14	20A	Seat Position Warmer Unit (Recline & RR Lift Motor)
SB8	30A	Blower (FRT)			
SB9	30A	Fuse Box “B+”-2	Ef15	20A	Passenger PWR Seat
SB10	30A	PWR Window	Ef16	10A	Tail Lamp (LH)
SB11	30A	IGN KEY “1”	Ef17	10A	Tail Lamp (RH)
Ef1	20A	A/C Compressor (GSL)	Ef18	7.5A	Illumination
Ef2	15A	Fog Lamp (FRT)	Ef19	15A	OVPR (GSL) 7
Ef3	15A	RR Seat Heater Unit	Ef20	20A	Fuel Pump (GSL)
Ef4	10A	Horn	Ef21	15A	RR Blower
Ef5	15A	Spare	Ef22	15A	Head Lamp (High)
Ef6	15A	Window Shield Glass	Ef23	20A	OVPR (GSL) 2
Ef7	30A	Spare	Ef24	20A	TCCU/TOD (GSL)
Ef8	15A	Head Lamp (Low)	Ef25	15A	PWR Outlet (FRT)
			Ef26	15A	PWR Outlet (RR)

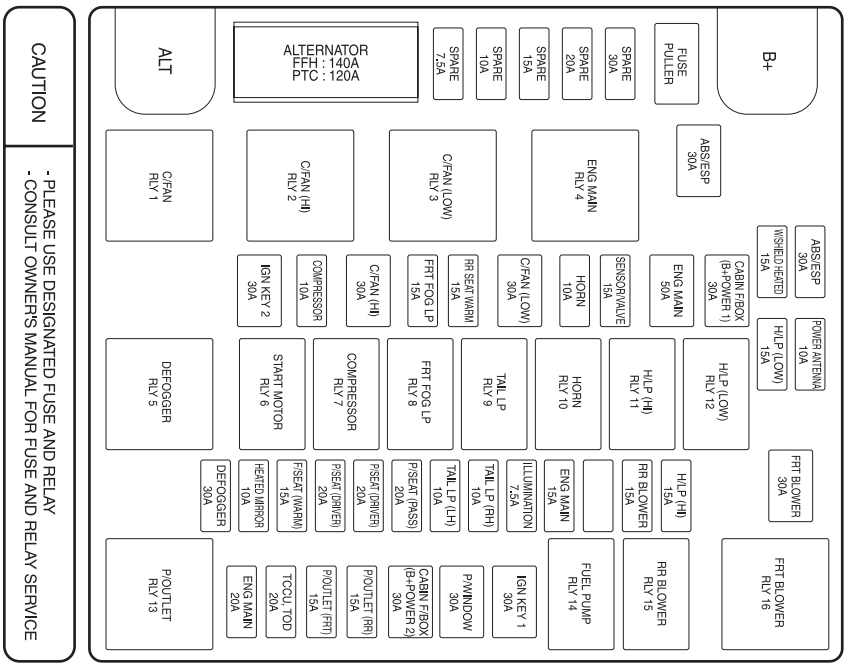
(6) CONNECTOR

Position	Connector NO	Pin NO	Connector Color
A	C101	2	Black
B	C102	20	White
C	C103	6	Colorless
D	C104	20	White
E	C105	22	White
F	C106	18	White
J	C107	14	White
K	C108	4	Colorless
M	C109	16	White

(7) FRONT (TI)



(8) FRONT (XDi)



(9) USAGE OF FUSE IN ENGINE ROOM FUSE BOX

Fuse NO.	Capacity	Usage	Fuse NO.	Capacity	Usage
SB1	80A/100A/120A	Generator	Ef9	10A	Tuner Unit
SB2	60A	ABS, ABS/ESP	Ef10	30A	RR Glass Defogger
SB3	30A	IGN KEY “2”, Start RLY	Ef11	10A	Mirror Defogger
SB4	30A	Condenser Fan (High)	Ef12	15A	Seat Warmer
SB5	30A	Condenser Fan (Low), Condenser Fan	Ef13	20A	Seat Position Warmer Unit (Slide & FRT Lift Motor)
SB6	50A	ENG MAIN RLY			
SB7	30A	Fuse Box “BATT-1”	Ef14	20A	Seat Position Warmer Unit (Recline & RR Lift Motor)
SB8	30A	Blower (FRT)			
SB9	30A	Fuse Box “B+”-2	Ef15	20A	Passenger PWR Seat
SB10	30A	PWR Window	Ef16	10A	Tail Lamp (LH)
SB11	30A	IGN KEY “1”	Ef17	10A	Tail Lamp (RH)
Ef1	20A	A/C Compressor, (XDi) A/C RLY	Ef18	7.5A	Illumination
Ef2	15A	Fog Lamp (FRT)	Ef19	15A	ENG Main RLY(XDi), Huber EGR
Ef3	15A	RR Seat Heater Unit	Ef20	15A	
Ef4	10A	Horn	Ef21	15A	RR Blower
Ef5	15A	EGR, HFM Sensor	Ef22	15A	Head Lamp (High)
Ef6	15A	Window Shield Glass	Ef23	20A	ENG Main RLY(XDi)
Ef7	30A	ABS, ABS/ESP	Ef24	20A	TCCU/TOD
Ef8	15A	Head Lamp (Low)	Ef25	15A	PWR Outlet (FRT)
			Ef26	15A	PWR Outlet (RR)

(10)CONNECTOR

Position	Connector NO	Pin NO	Connector Color
A	C101	2	Black
B	C102	20	White
C	C103	6	Colorless
D	C104	20	White
E	C105	22	White
F	C106	18	White
J	C107	14	White
K	C108	4	Colorless
M	C109	16	White

SECTION 4

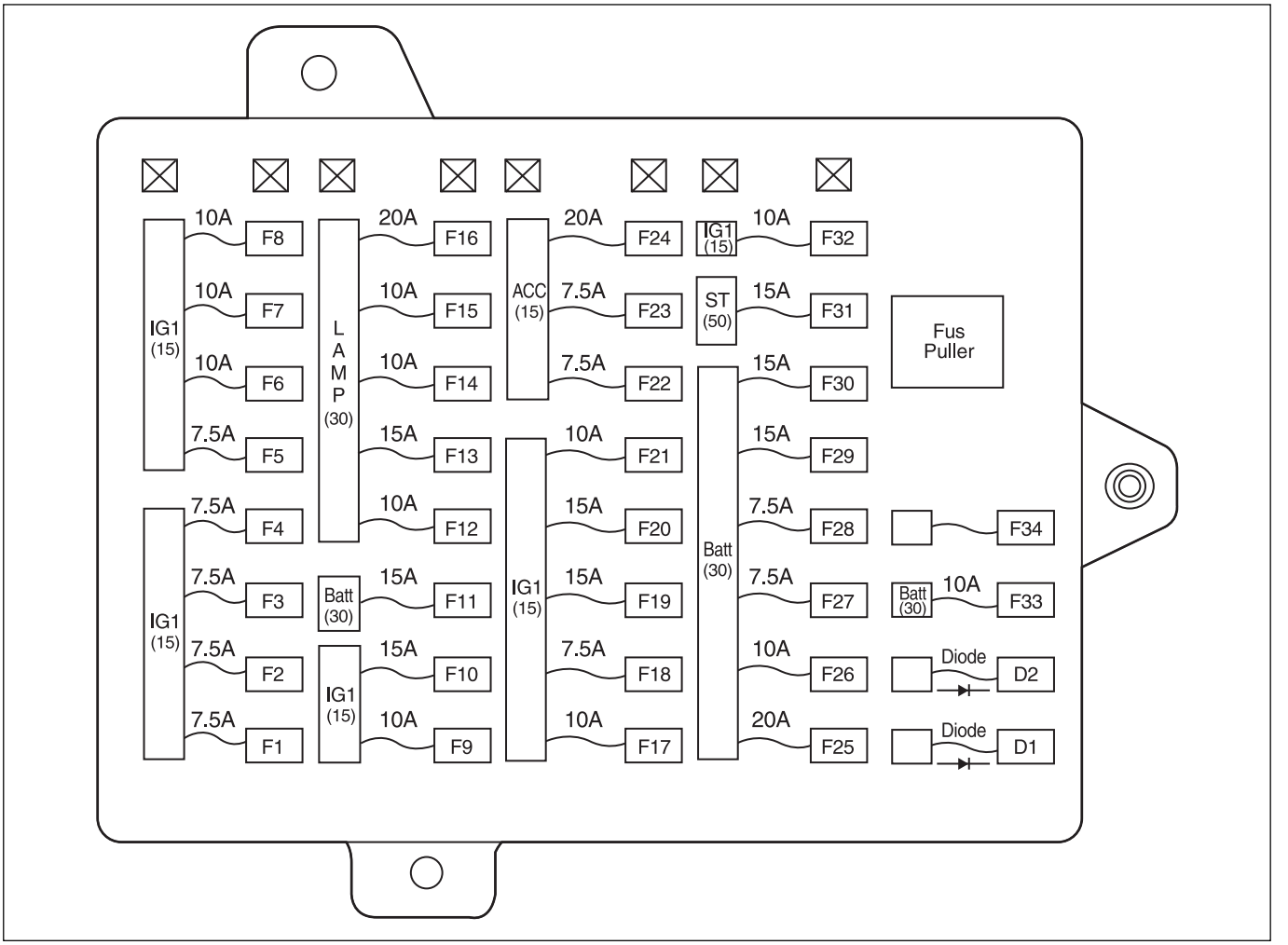
USAGE AND CAPACITY OF FUSES IN FUSE BLOCK

TABLE OF CONTENTS

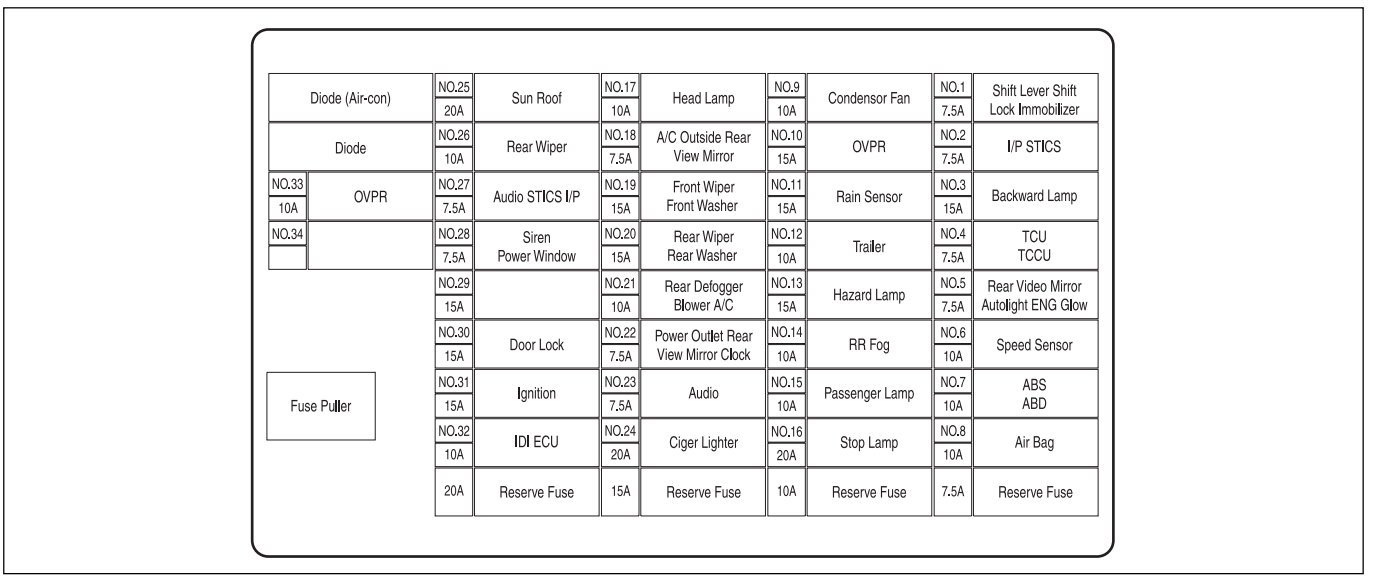
2. I.P FUSE & RELAY BOX

1) ~ 2002 MODEL

(1) FUSE BOX

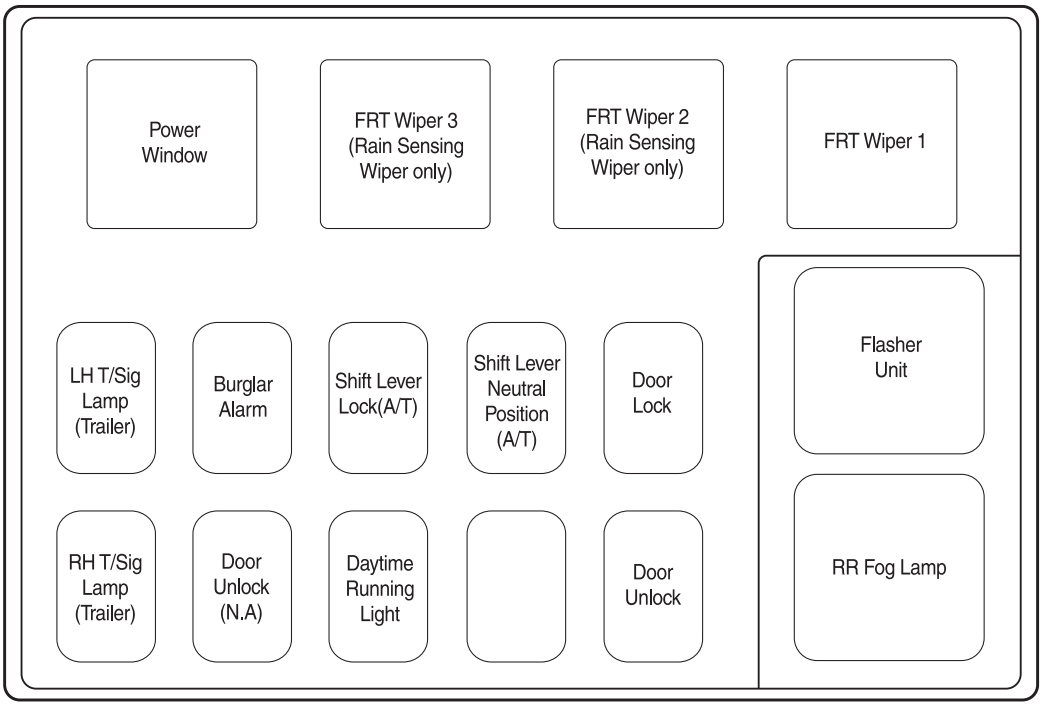


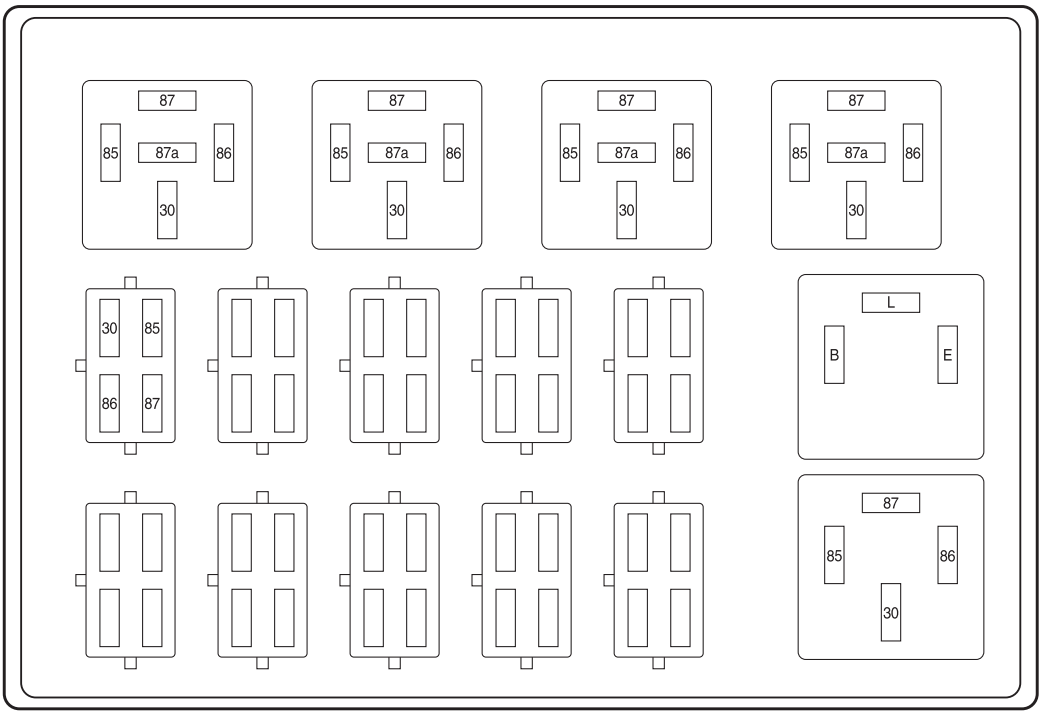
(2) POWER SUPPLY



Diode (Air-con)	NO.25 20A	Sun Roof	NO.17 10A	Head Lamp	NO.9 10A	Condensor Fan	NO.1 7.5A	Shift Lever Shift Lock Immobilizer
Diode	NO.26 10A	Rear Wiper	NO.18 7.5A	A/C Outside Rear View Mirror	NO.10 15A	OVPR	NO.2 7.5A	I/P STICS
NO.33 10A	OVPR	NO.27 7.5A	Audio STICS I/P	NO.19 15A	Front Wiper Front Washer	NO.11 15A	Rain Sensor	NO.3 15A	Backward Lamp
NO.34		NO.28 7.5A	Siren Power Window	NO.20 15A	Rear Wiper Rear Washer	NO.12 10A	Trailer	NO.4 7.5A	TCU TCCU
		NO.29 15A		NO.21 10A	Rear Defogger Blower A/C	NO.13 15A	Hazard Lamp	NO.5 7.5A	Rear Video Mirror Autolight ENG Glow
		NO.30 15A	Door Lock	NO.22 7.5A	Power Outlet Rear View Mirror Clock	NO.14 10A	RR Fog	NO.6 10A	Speed Sensor
Fuse Puller		NO.31 15A	Ignition	NO.23 7.5A	Audio	NO.15 10A	Passenger Lamp	NO.7 10A	ABS ABD
		NO.32 10A	IDI ECU	NO.24 20A	Ciger Lighter	NO.16 20A	Stop Lamp	NO.8 10A	Air Bag
		20A	Reserve Fuse	15A	Reserve Fuse	10A	Reserve Fuse	7.5A	Reserve Fuse

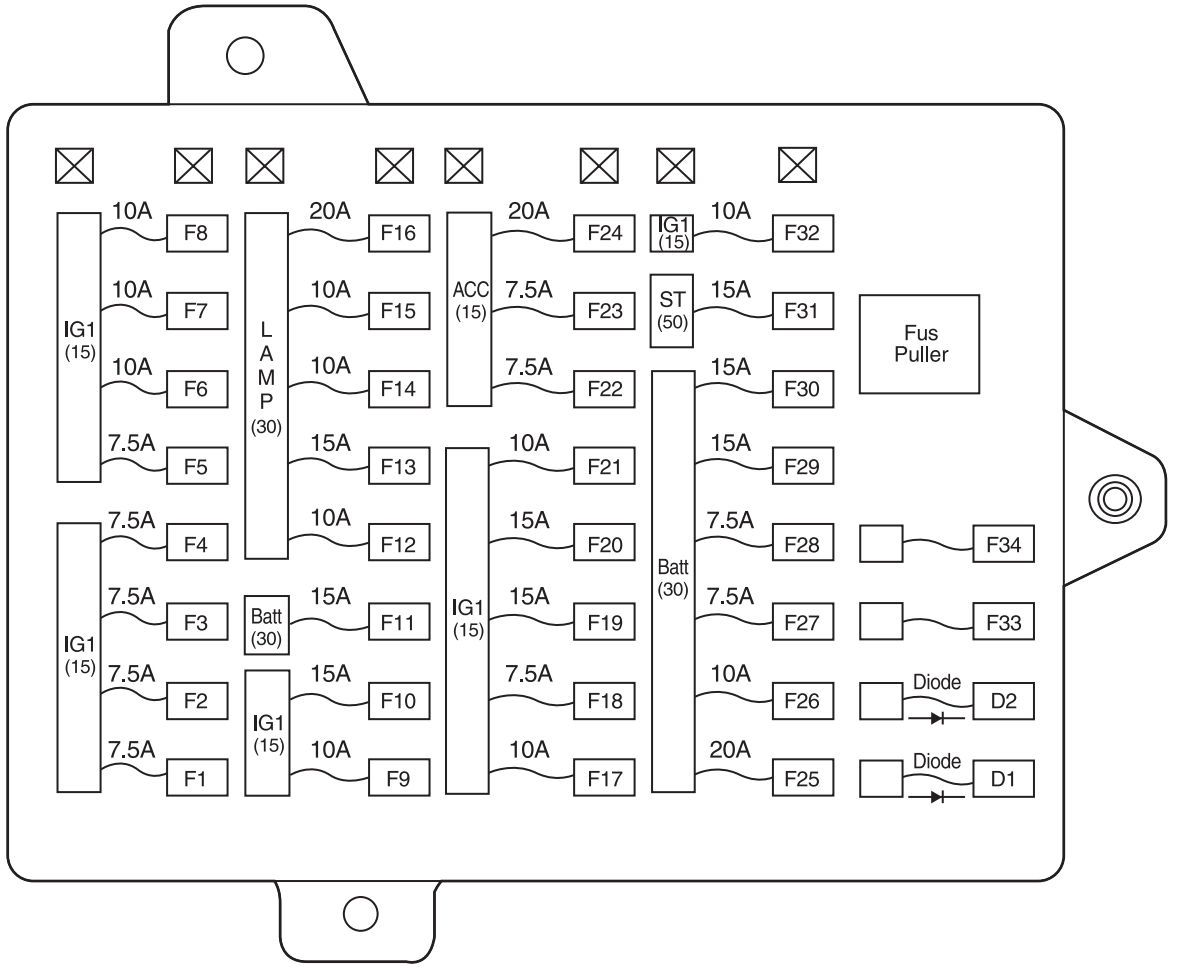
(3) RELAY


Power Window
FRT Wiper 3 (Rain Sensing Wiper only)
FRT Wiper 2 (Rain Sensing Wiper only)
FRT Wiper 1
LH T/Sig Lamp (Trailer)
Burglar Alarm
Shift Lever Lock(A/T)
Shift Lever Neutral Position (A/T)
Door Lock
Flasher Unit
RH T/Sig Lamp (Trailer)
Door Unlock (N.A)
Daytime Running Light
Door Unlock
RR Fog Lamp

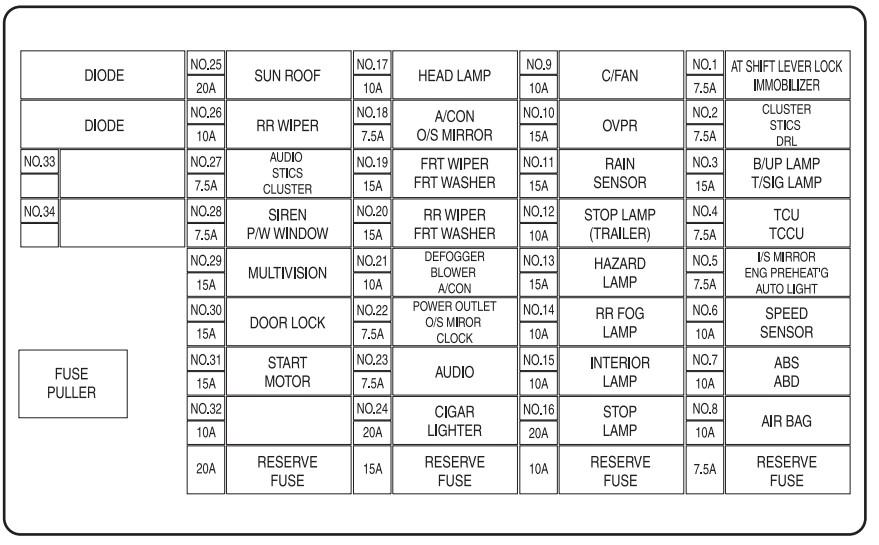

87
85
87a
86
30
L
B
E

2) 2003 MODEL ~

(1) FUSE BOX



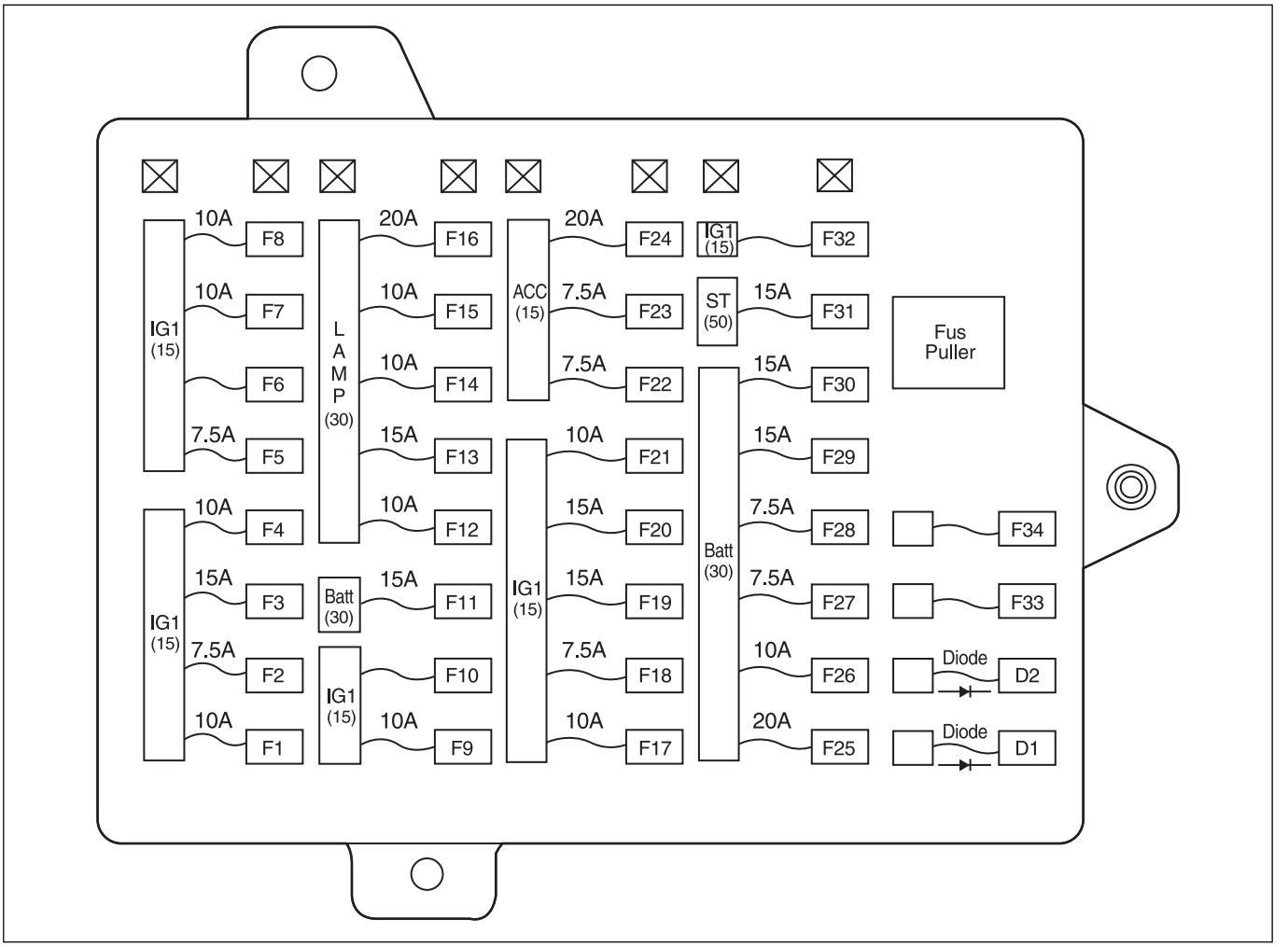
(2) POWER SUPPLY



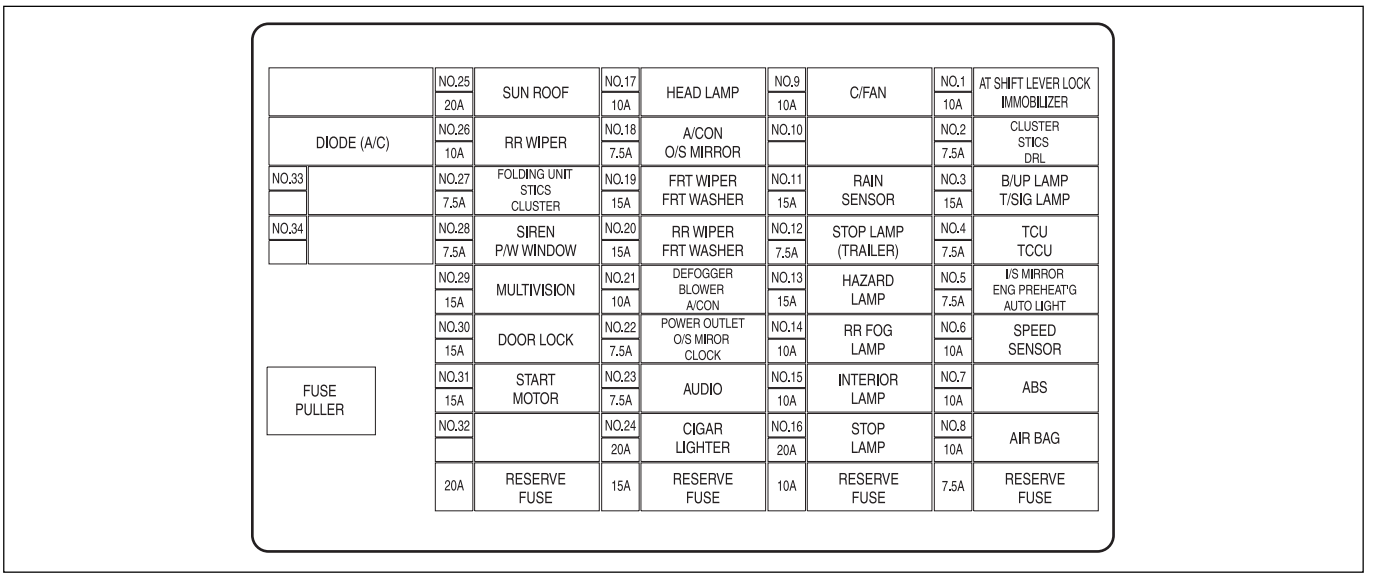
DIODE	NO.25 20A	SUN ROOF	NO.17 10A	HEAD LAMP	NO.9 10A	C/FAN	NO.1 7.5A	AT SHIFT LEVER LOCK IMMOBILIZER
DIODE	NO.26 10A	RR WIPER	NO.18 7.5A	A/CON O/S MIRROR	NO.10 15A	OVPR	NO.2 7.5A	CLUSTER STICS DRL
NO.33	NO.27 7.5A	AUDIO STICS CLUSTER	NO.19 15A	FRT WIPER FRT WASHER	NO.11 15A	RAIN SENSOR	NO.3 15A	B/UP LAMP T/SIG LAMP
NO.34	NO.28 7.5A	SIREN P/W WINDOW	NO.20 15A	RR WIPER FRT WASHER	NO.12 10A	STOP LAMP (TRAILER)	NO.4 7.5A	TCU TCCU
	NO.29 15A	MULTIVISION	NO.21 10A	DEFOGGER BLOWER A/CON	NO.13 15A	HAZARD LAMP	NO.5 7.5A	I/S MIRROR ENG PREHEAT'G AUTO LIGHT
	NO.30 15A	DOOR LOCK	NO.22 7.5A	POWER OUTLET O/S MIROR CLOCK	NO.14 10A	RR FOG LAMP	NO.6 10A	SPEED SENSOR
FUSE PULLER	NO.31 15A	START MOTOR	NO.23 7.5A	AUDIO	NO.15 10A	INTERIOR LAMP	NO.7 10A	ABS ABD
	NO.32 10A		NO.24 20A	CIGAR LIGHTER	NO.16 20A	STOP LAMP	NO.8 10A	AIR BAG
	20A	RESERVE FUSE	15A	RESERVE FUSE	10A	RESERVE FUSE	7.5A	RESERVE FUSE

3) TI

(1) FUSE BOX



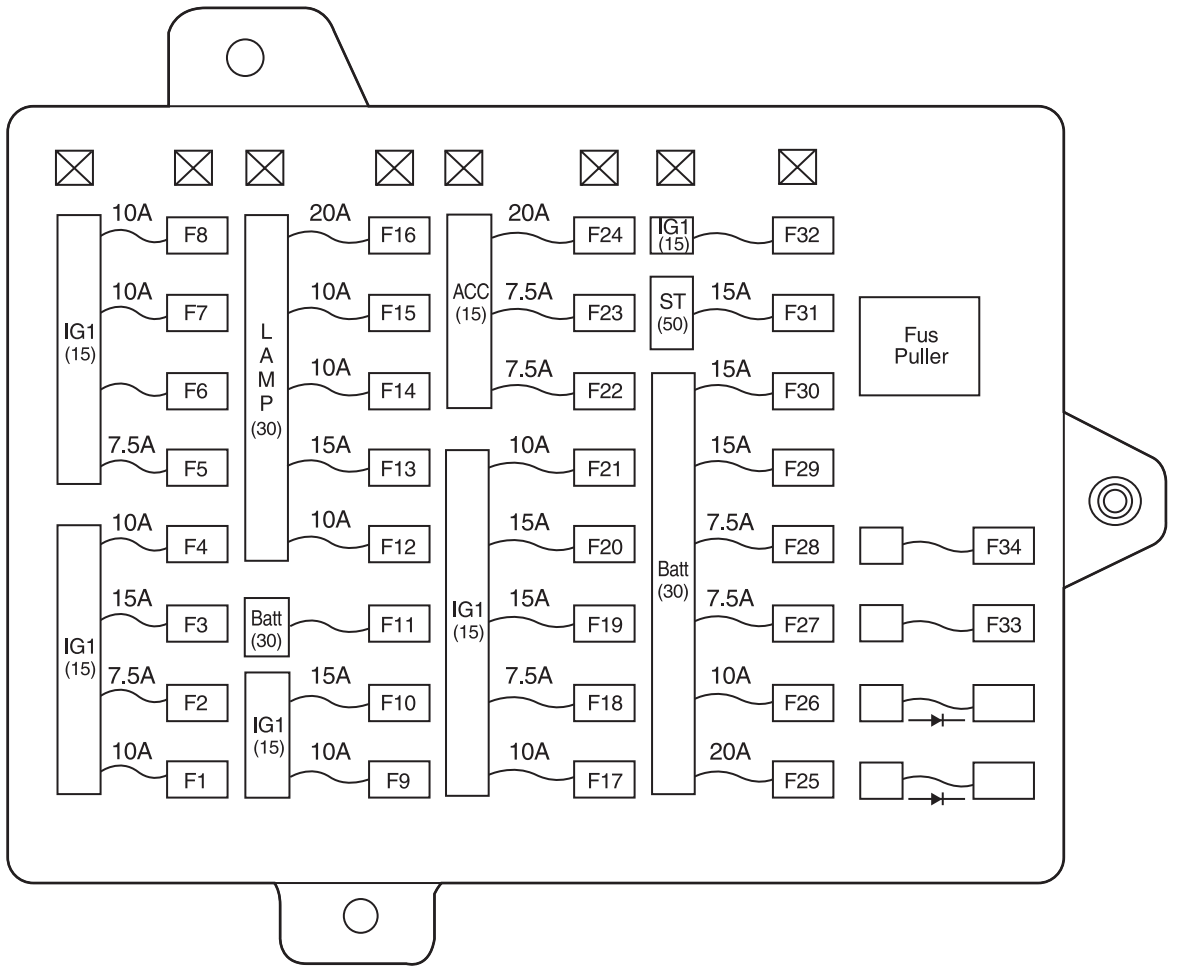
(2) POWER SUPPLY



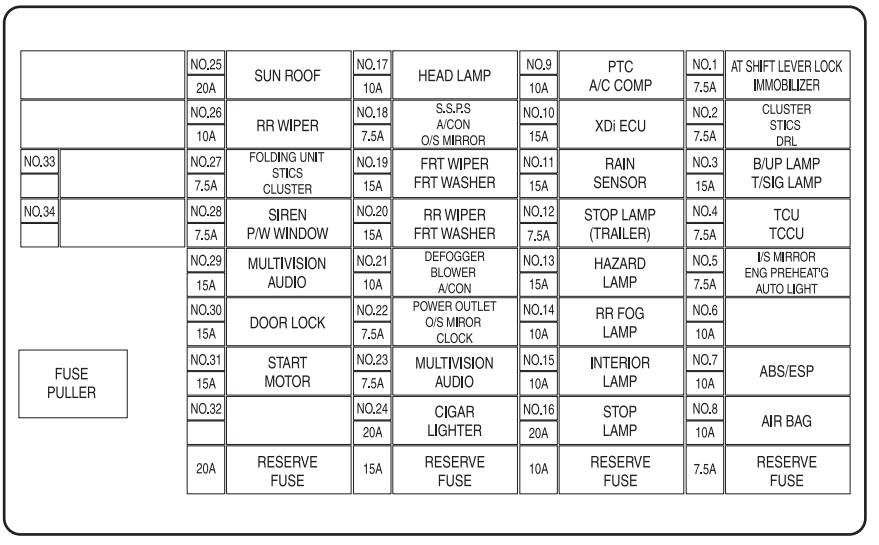
		NO.25 20A	SUN ROOF	NO.17 10A	HEAD LAMP	NO.9 10A	C/FAN	NO.1 10A	AT SHIFT LEVER LOCK IMMOBILIZER
DIODE (A/C)		NO.26 10A	RR WIPER	NO.18 7.5A	A/CON O/S MIRROR	NO.10		NO.2 7.5A	CLUSTER STICS DRL
NO.33		NO.27 7.5A	FOLDING UNIT STICS CLUSTER	NO.19 15A	FRT WIPER FRT WASHER	NO.11 15A	RAIN SENSOR	NO.3 15A	B/UP LAMP T/SIG LAMP
NO.34		NO.28 7.5A	SIREN P/W WINDOW	NO.20 15A	RR WIPER FRT WASHER	NO.12 7.5A	STOP LAMP (TRAILER)	NO.4 7.5A	TCU TCCU
		NO.29 15A	MULTIVISION	NO.21 10A	DEFOGGER BLOWER A/CON	NO.13 15A	HAZARD LAMP	NO.5 7.5A	I/S MIRROR ENG PREHEAT'G AUTO LIGHT
		NO.30 15A	DOOR LOCK	NO.22 7.5A	POWER OUTLET O/S MIROR CLOCK	NO.14 10A	RR FOG LAMP	NO.6 10A	SPEED SENSOR
FUSE PULLER		NO.31 15A	START MOTOR	NO.23 7.5A	AUDIO	NO.15 10A	INTERIOR LAMP	NO.7 10A	ABS
		NO.32		NO.24 20A	CIGAR LIGHTER	NO.16 20A	STOP LAMP	NO.8 10A	AIR BAG
		20A	RESERVE FUSE	15A	RESERVE FUSE	10A	RESERVE FUSE	7.5A	RESERVE FUSE

4) XDi

(1) FUSE BOX

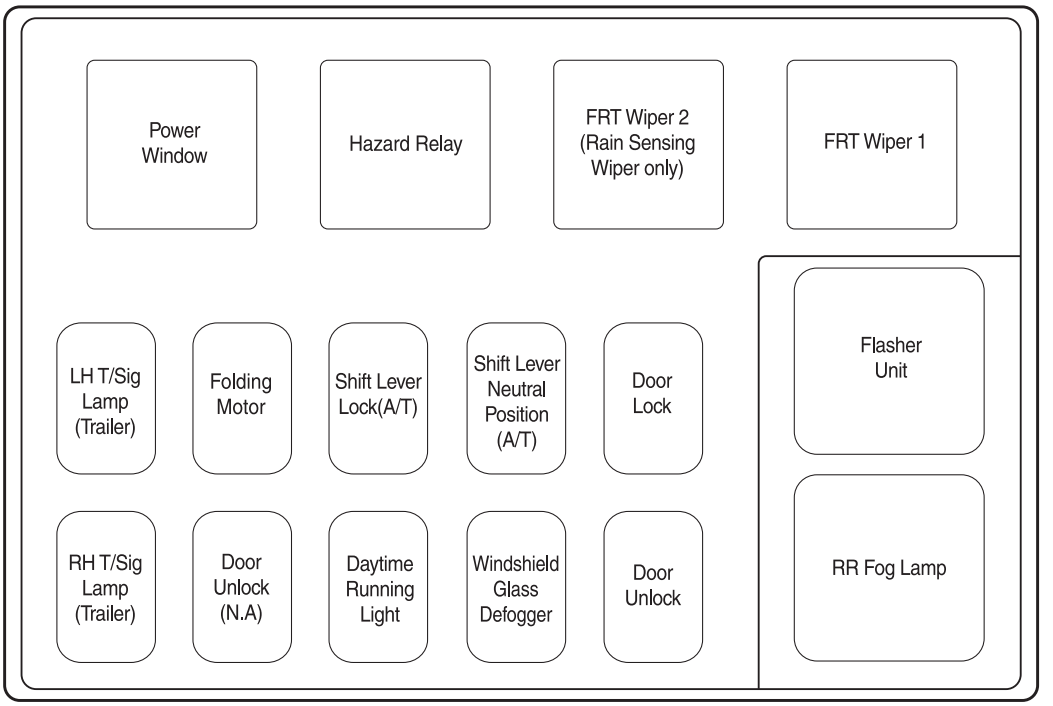


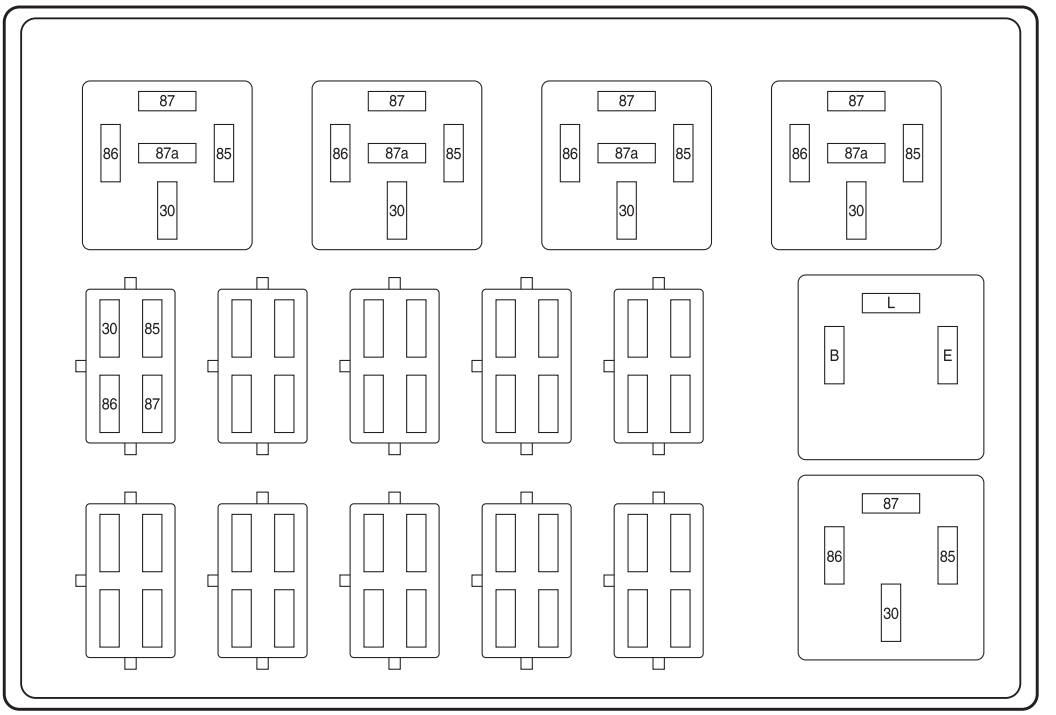
(2) POWER SUPPLY



		NO.25 20A	SUN ROOF	NO.17 10A	HEAD LAMP	NO.9 10A	PTC A/C COMP	NO.1 7.5A	AT SHIFT LEVER LOCK IMMOBILIZER
		NO.26 10A	RR WIPER	NO.18 7.5A	S.S.P.S A/CON O/S MIRROR	NO.10 15A	XDi ECU	NO.2 7.5A	CLUSTER STICS DRL
NO.33		NO.27 7.5A	FOLDING UNIT STICS CLUSTER	NO.19 15A	FRT WIPER FRT WASHER	NO.11 15A	RAIN SENSOR	NO.3 15A	B/UP LAMP T/SIG LAMP
NO.34		NO.28 7.5A	SIREN P/W WINDOW	NO.20 15A	RR WIPER FRT WASHER	NO.12 7.5A	STOP LAMP (TRAILER)	NO.4 7.5A	TCU TCCU
		NO.29 15A	MULTIVISION AUDIO	NO.21 10A	DEFOGGER BLOWER A/CON	NO.13 15A	HAZARD LAMP	NO.5 7.5A	I/S MIRROR ENG PREHEAT'G AUTO LIGHT
		NO.30 15A	DOOR LOCK	NO.22 7.5A	POWER OUTLET O/S MIROR CLOCK	NO.14 10A	RR FOG LAMP	NO.6 10A	
FUSE PULLER		NO.31 15A	START MOTOR	NO.23 7.5A	MULTIVISION AUDIO	NO.15 10A	INTERIOR LAMP	NO.7 10A	ABS/ESP
		NO.32		NO.24 20A	CIGAR LIGHTER	NO.16 20A	STOP LAMP	NO.8 10A	AIR BAG
		20A	RESERVE FUSE	15A	RESERVE FUSE	10A	RESERVE FUSE	7.5A	RESERVE FUSE

(3) RELAY


Power Window
Hazard Relay
FRT Wiper 2 (Rain Sensing Wiper only)
FRT Wiper 1
Flasher Unit
LH T/Sig Lamp (Trailer)
Folding Motor
Shift Lever Lock(A/T)
Shift Lever Neutral Position (A/T)
Door Lock
RR Fog Lamp
RH T/Sig Lamp (Trailer)
Door Unlock (N.A)
Daytime Running Light
Windshield Glass Defogger
Door Unlock


87
86
87a
85
30
L
B
E

SECTION 5

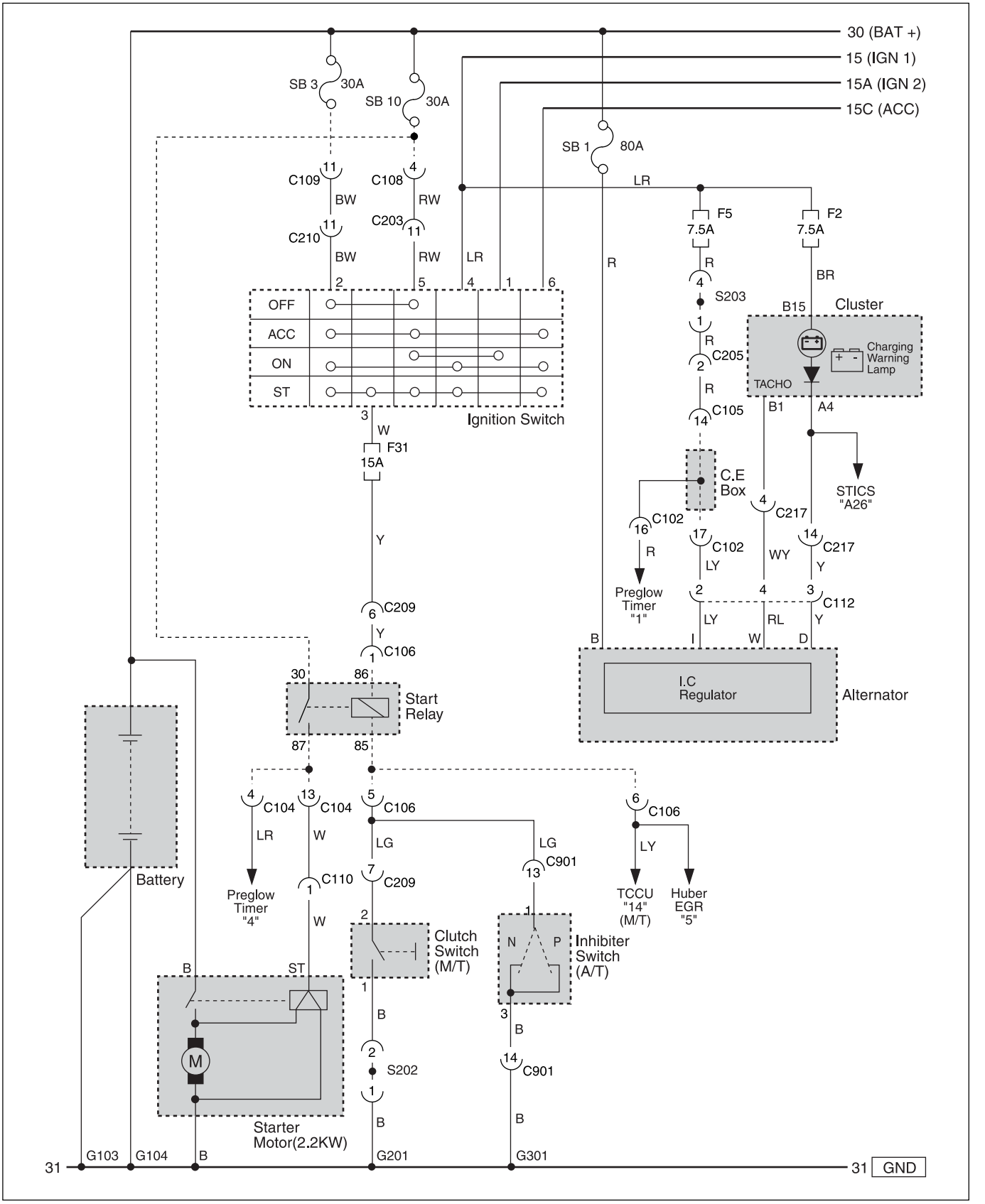
ELECTRICAL WIRING DIAGRAMS

TABLE OF CONTENTS

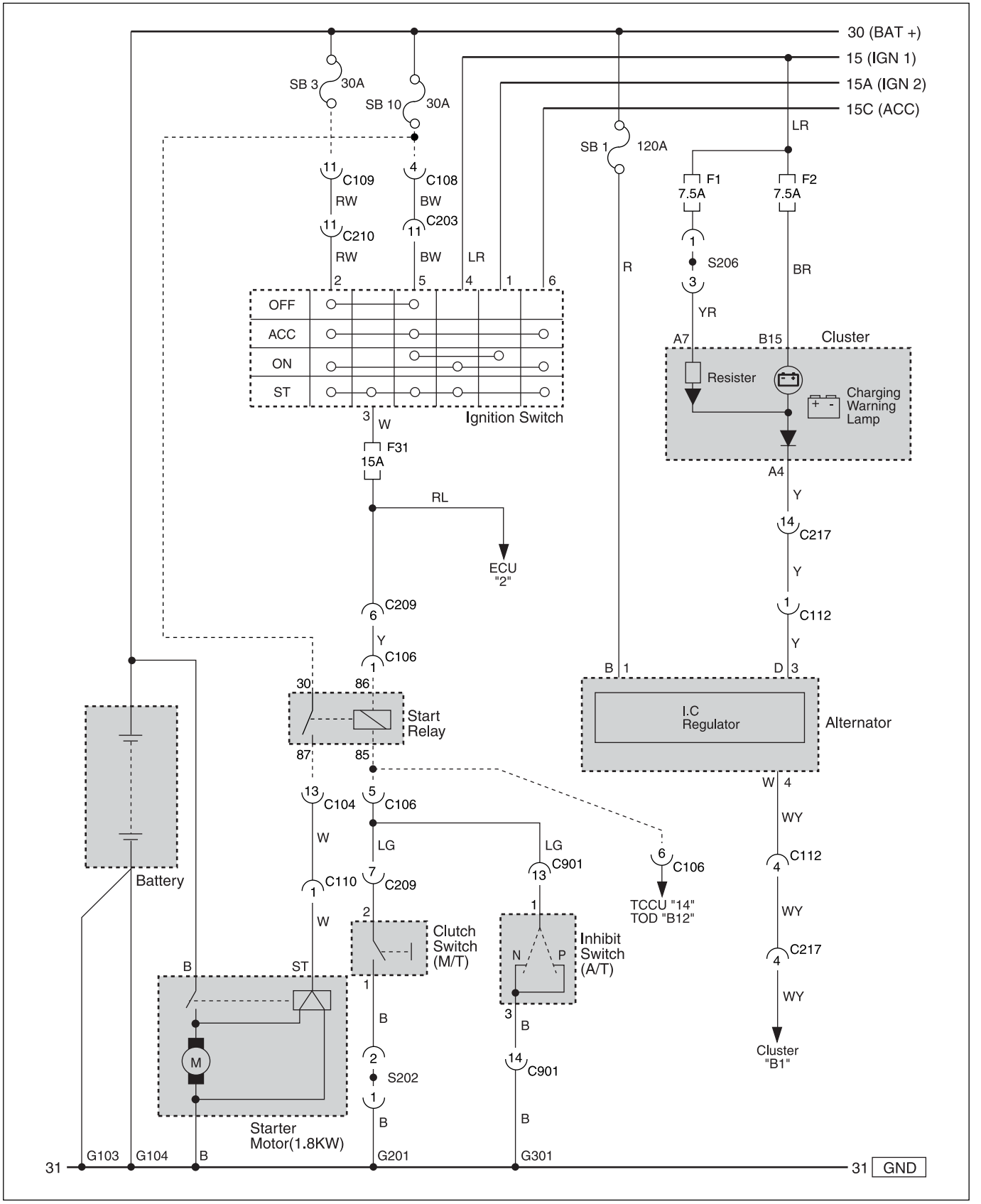
1. STARTING & CHARGING

1) ~ 2002 MODEL

(1) DIESEL (M/T, A/T)

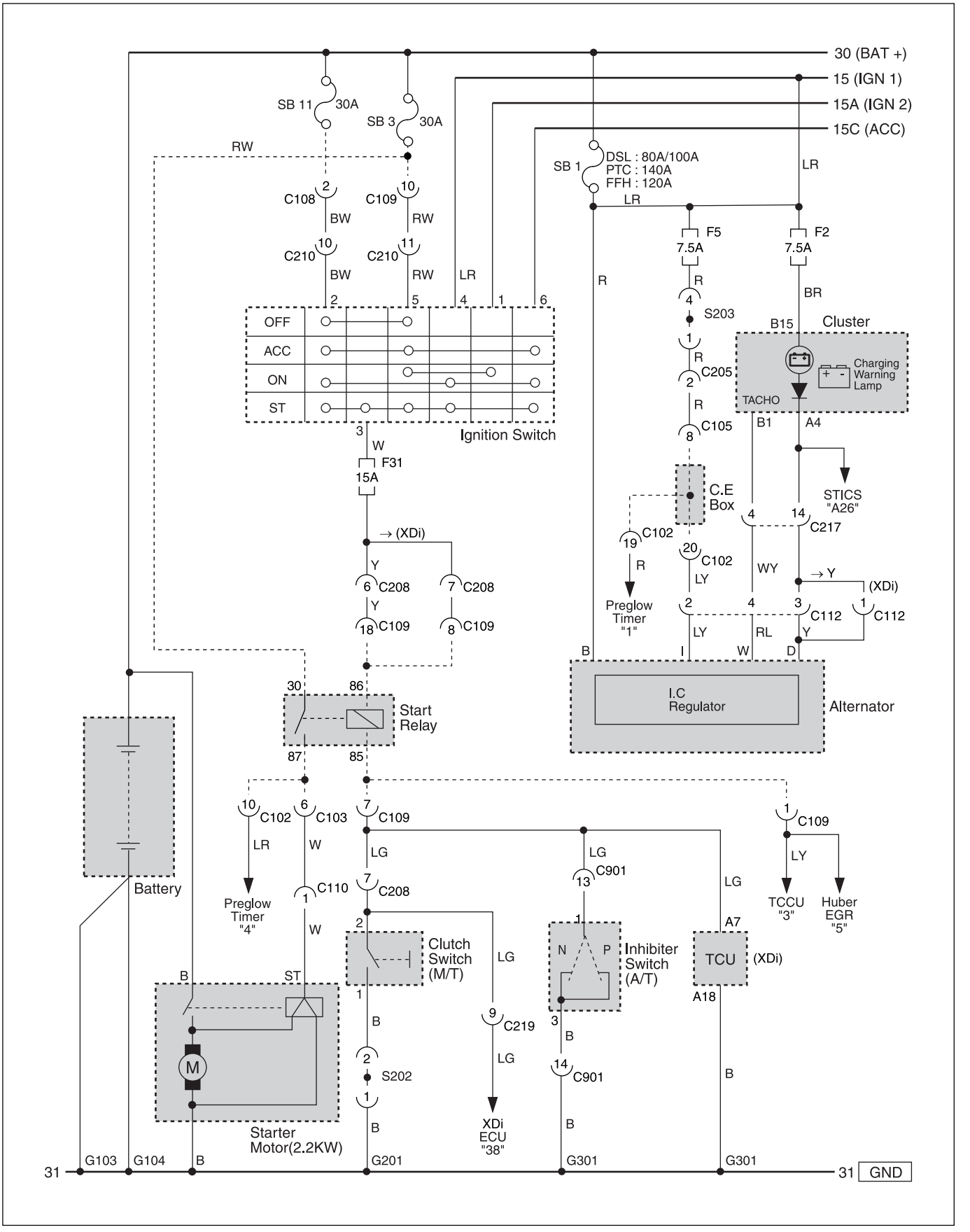


(2) GASOLINE (M/T, A/T)

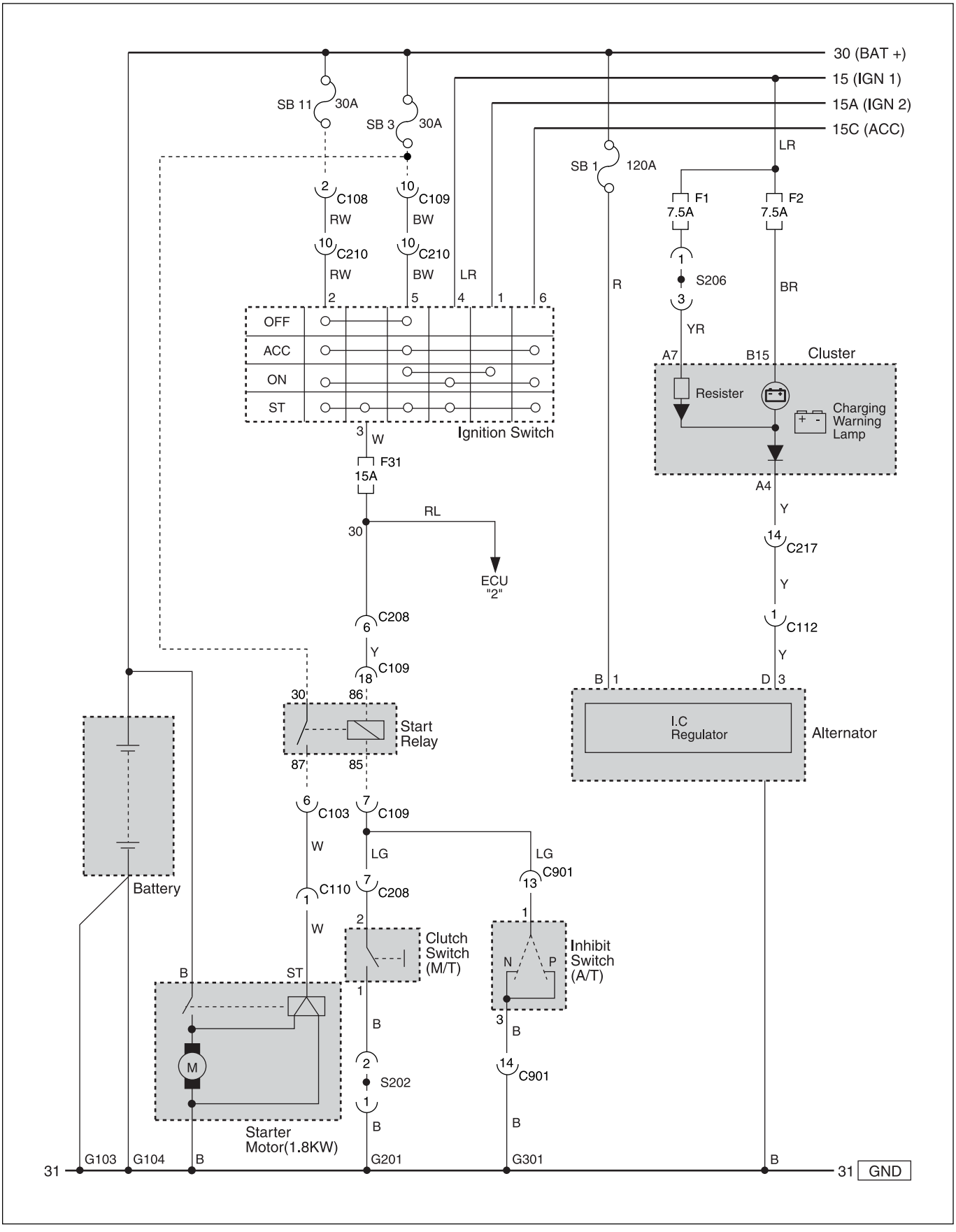


2) 2003 MODEL (W/ XDi) ~

(1) DIESEL (M/T, A/T)



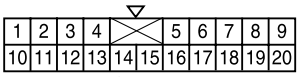
(2) GASOLINE (M/T, A/T)



A. CONNECTOR INFORMATION

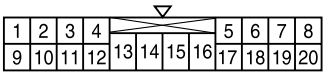
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C103 (6Pin, Colorless)	Engine Room Fuse Box (C) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C110 (1Pin, Gray)	Engine - Starter “ST”	FRT Pre-Heating Unit	
C112 (4Pin, Black)	Engine - Alternator	Under the Coolant Reserve Tank	DSL
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C217 (20Pin, Black)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C901 (16Pin, White)	Floor - T/M	Left the T/C (Under the Floor)	A/T
C901 (2Pin, White)	Floor - T/M	Left the T/C (Under the Floor)	M/T
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S203 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S206 (14Pin, Black)	W/H Main	Behind the Left the FATC	
G103	W/H Engine	Behind the Left Head Lamp	
G104	W/H Engine	Beside the Engine Mounting Bracket	
G201	W/H Main	Inside Driver Side Cowl PNL	
G301	W/H Floor	Under Driver Seat	ECU GND

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

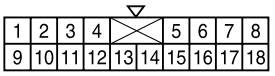


C102
W/H ENG(CE Box)

C103
W/H ENG(CE Box)

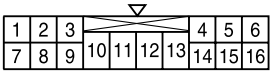


C104
W/H ENG(CE Box)



C106
W/H Floor(CE Box)

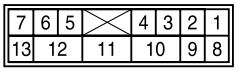
C108
W/H Floor(CE Box)



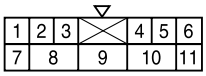
C109
W/H Floor(CE Box)

C110
W/H ENG(Starter)

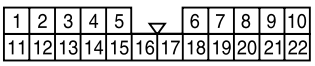
C112
W/H Alternator
(GSL)



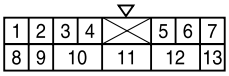
C203
W/H Main



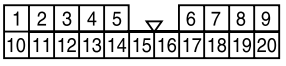
C205
W/H Main



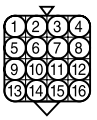
C209
W/H Main



C210
W/H Main

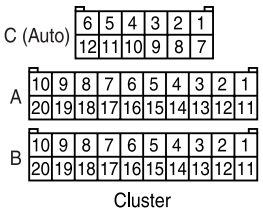


C217
W/H Main

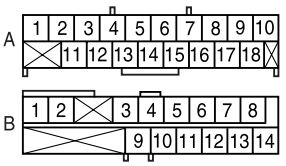


C901
W/H Transmission (A/T)

C901
W/H Transmission
(M/T)



Cluster

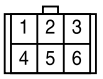


TCU(5-Speed)

Stop Lamp
(GSL)

Inhibitor
(A/T)

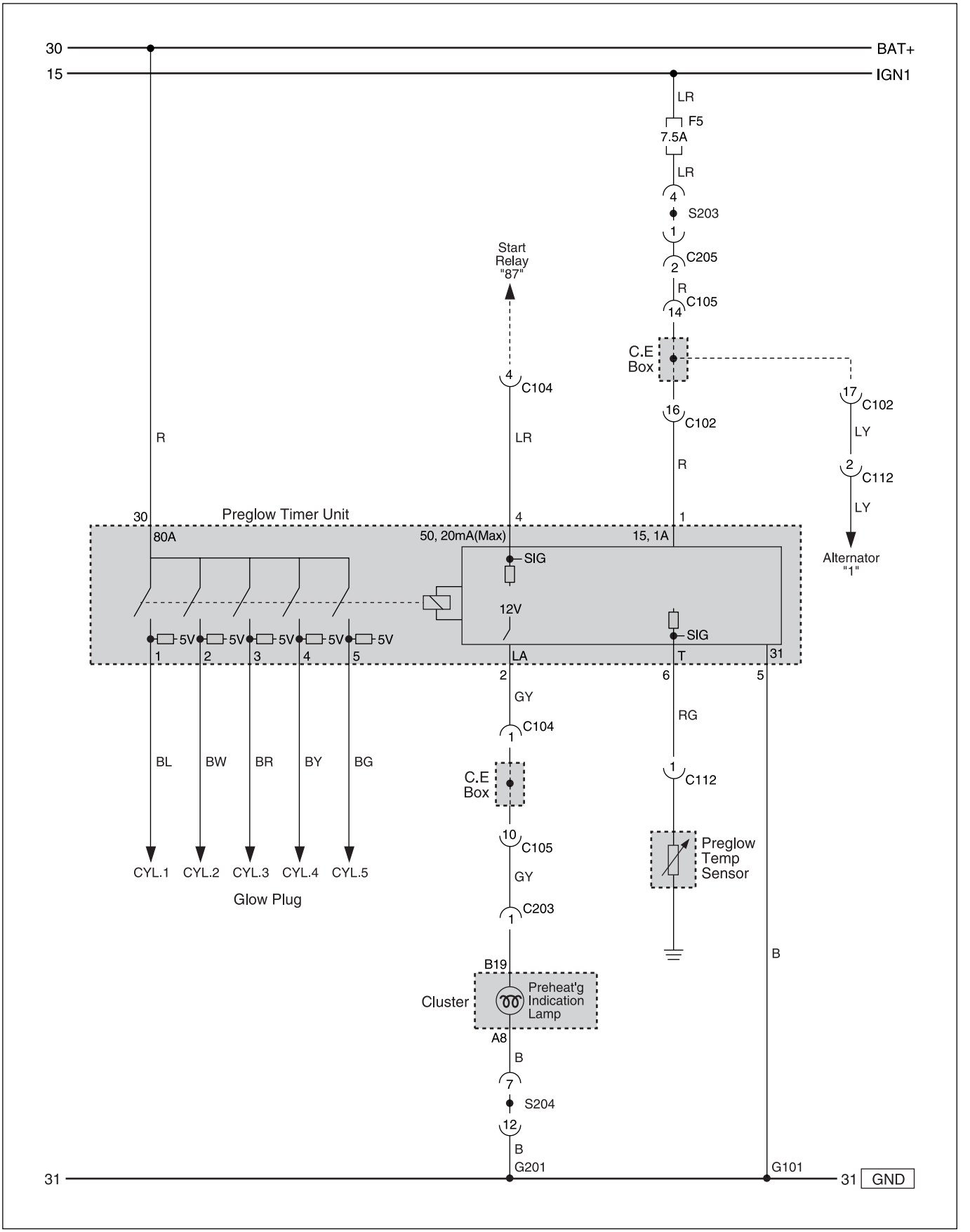
Clutch
(M/T)



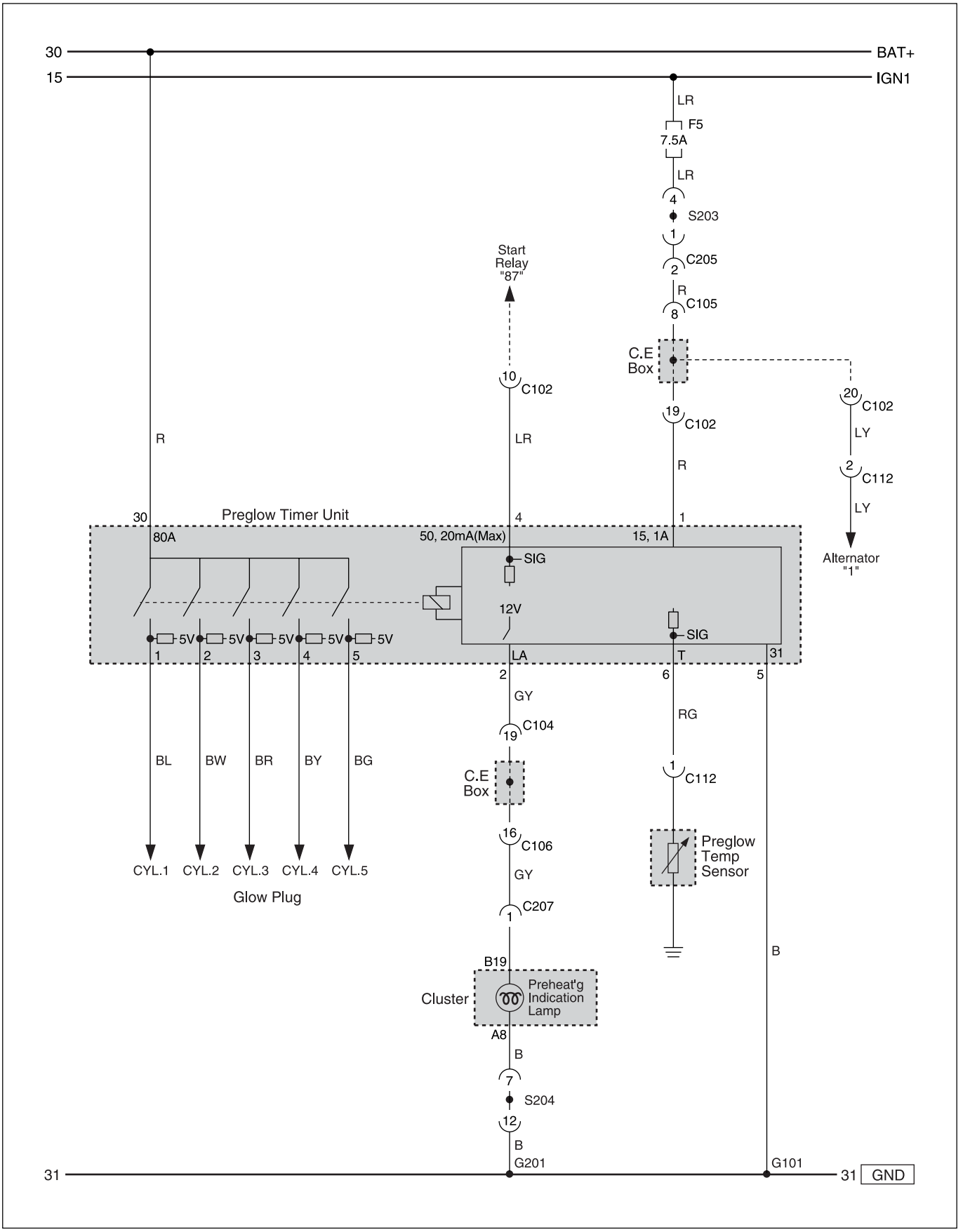
Ignition

2. PREHEATING UNIT CIRCUIT

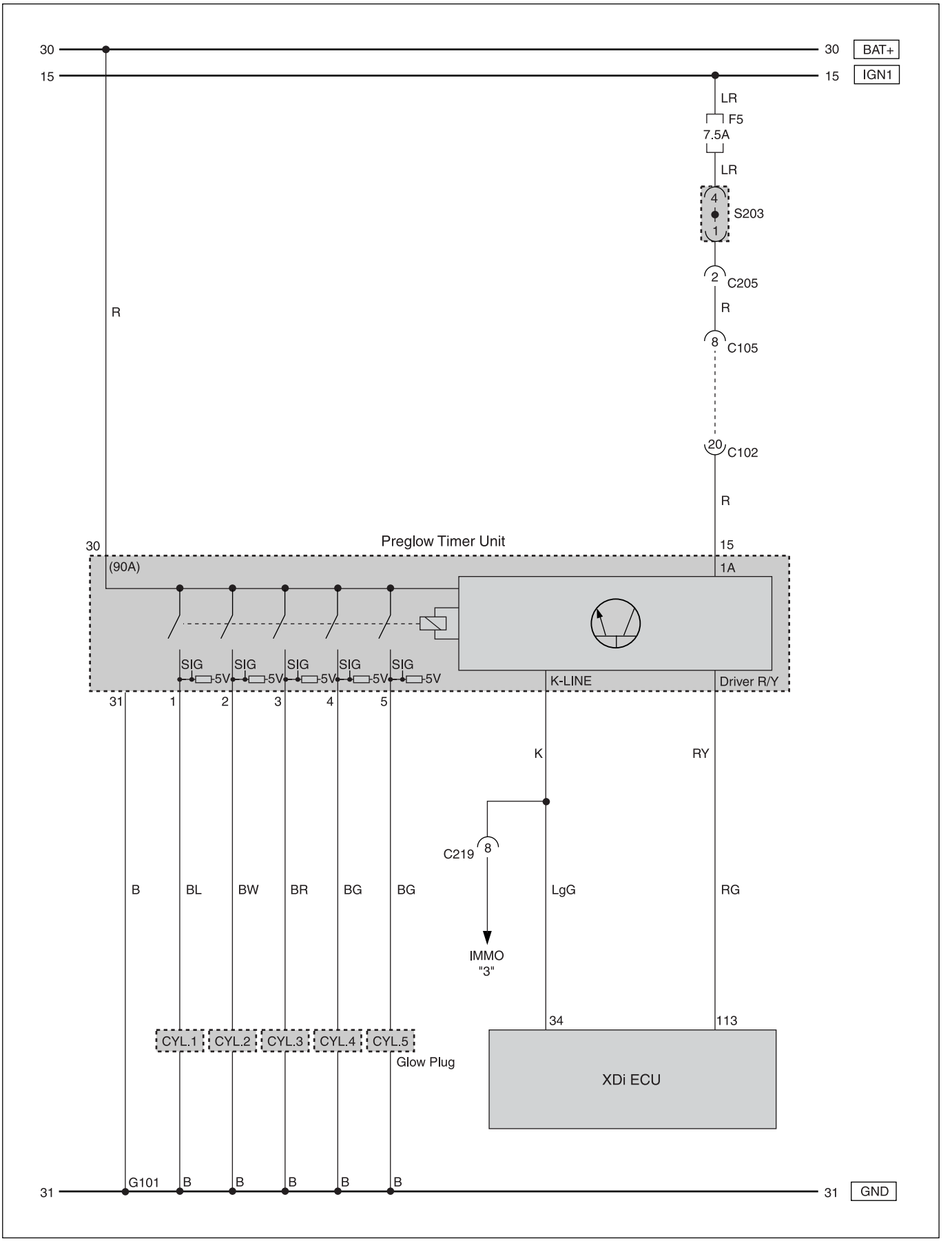
1) ~ 2002 MODEL



2) 2003 MODEL ~


30
BAT+
15
IGN1
LR
F5
7.5A
LR
4
S203
1
C205
2
R
C105
8
C.E
Box
Start
Relay
"87"
10
C102
LR
19
C102
R
20
C102
LY
2
C112
LY
Alternator
"1"
R
30
Preglow Timer Unit
80A
4
50, 20mA(Max)
1
15, 1A
SIG
12V
SIG
5V
5V
5V
5V
5V
1
2
3
4
5
LA
T
31
2
6
5
GY
RG
19
C104
1
C112
BL
BW
BR
BY
BG
C.E
Box
16
C106
GY
C207
1
Preglow
Temp
Sensor
CYL.1
CYL.2
CYL.3
CYL.4
CYL.5
Glow Plug
B
B19
Cluster
Preheat'g
Indication
Lamp
A8
B
7
S204
12
B
G201
G101
31
31
GND

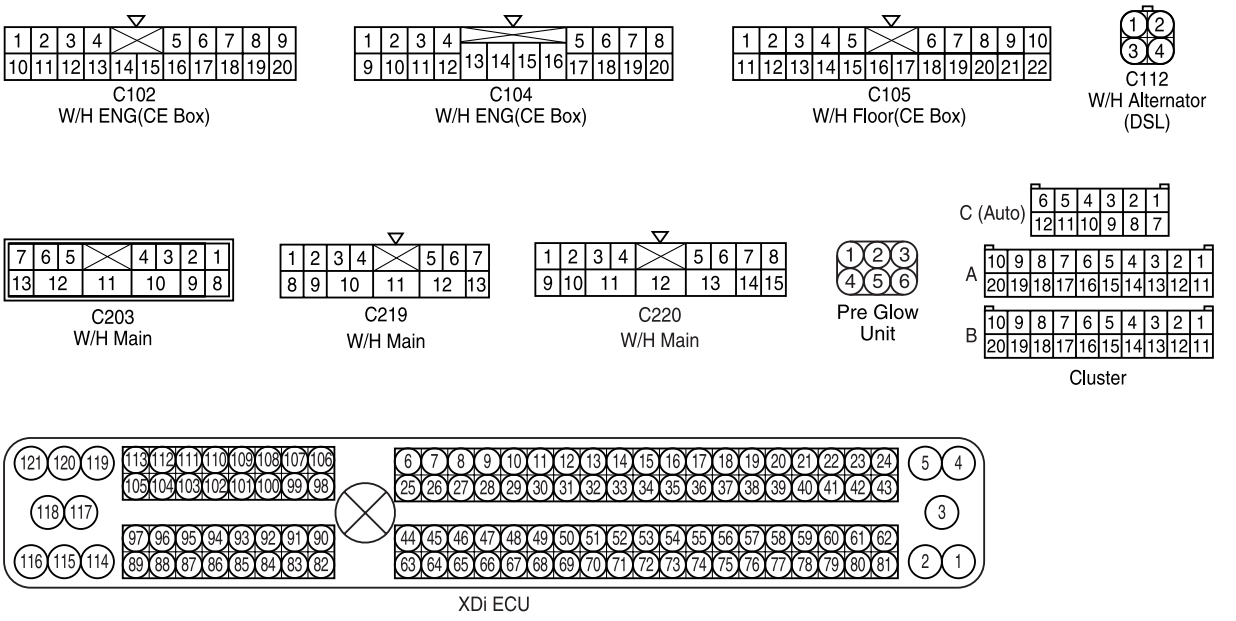
3) XDi


30
15
30
BAT+
15
IGN1
LR
F5
7.5A
LR
4
S203
1
2
C205
R
8
C105
R
20
C102
R
30
Preglow Timer Unit
15
(90A)
1A
SIG
5V
SIG
5V
SIG
5V
SIG
5V
SIG
5V
K-LINE
Driver R/Y
31
1
2
3
4
5
K
RY
C219
8
B
BL
BW
BR
BG
BG
LgG
RG
IMMO
"3"
34
113
CYL.1
CYL.2
CYL.3
CYL.4
CYL.5
Glow Plug
XDi ECU
31
G101
B
B
B
B
B
31
GND

A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C112 (4Pin, Black)	Engine - Alternator	Under the Coolant Reserve Tank	DSL
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C220 (15Pin, Blue)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	XDi
S203 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	
G101	W/H Engine	Center the Engine Room Fuse Box	
G102	W/H Engine	Center BATT	

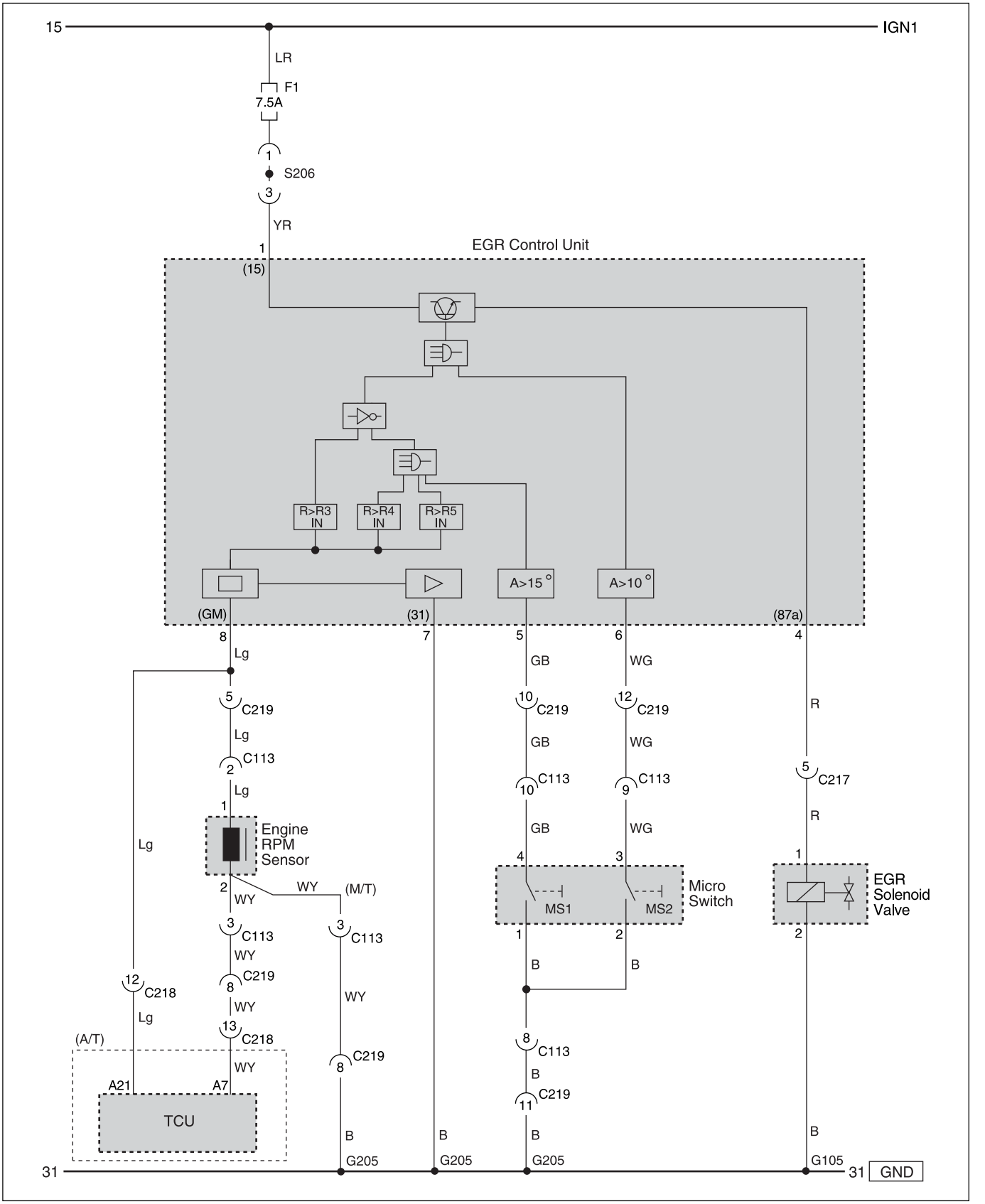
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



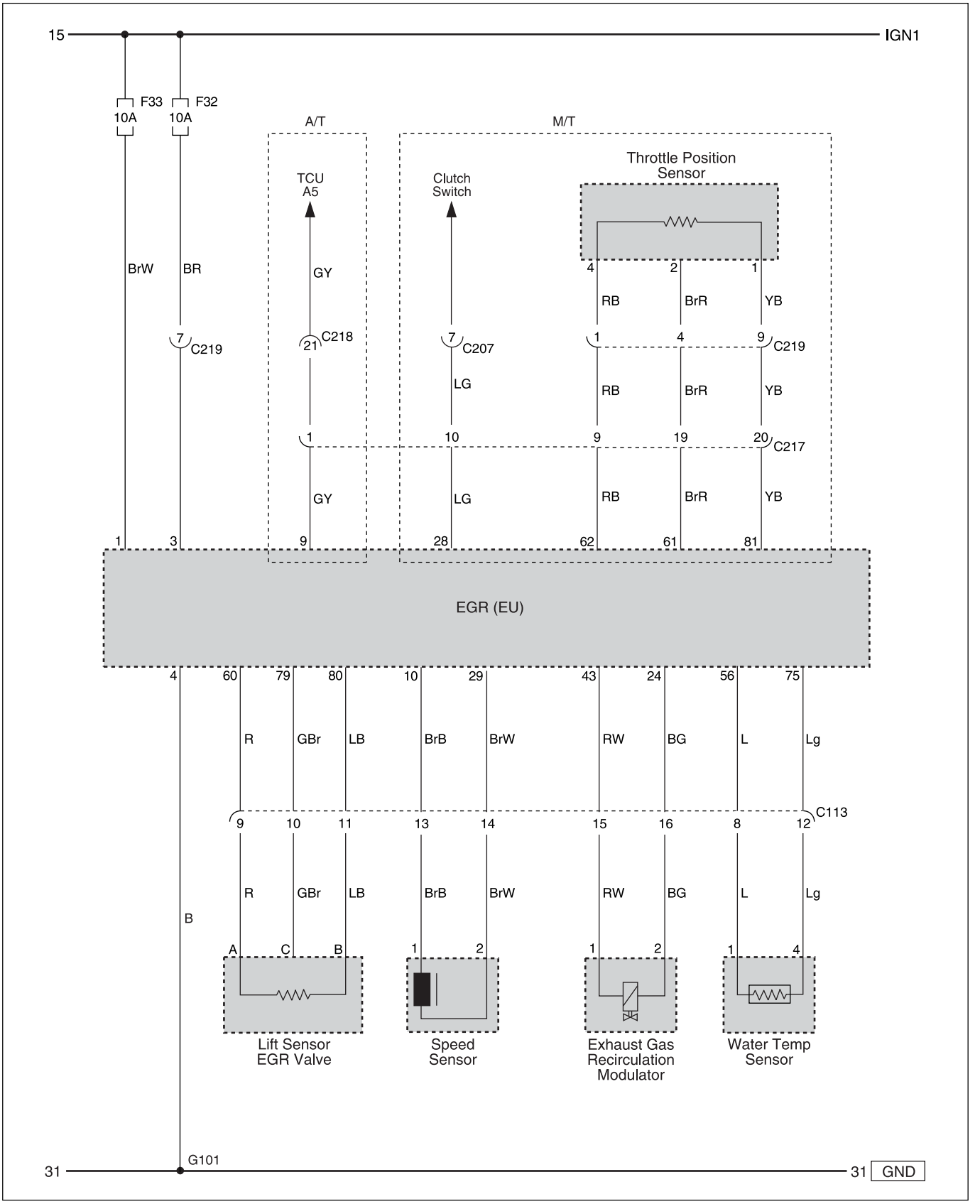
3. EGR (EXHAUST GAS RECIRCULATION) CONTROL CIRCUIT (DSL)

1) ~ 2002 MODEL

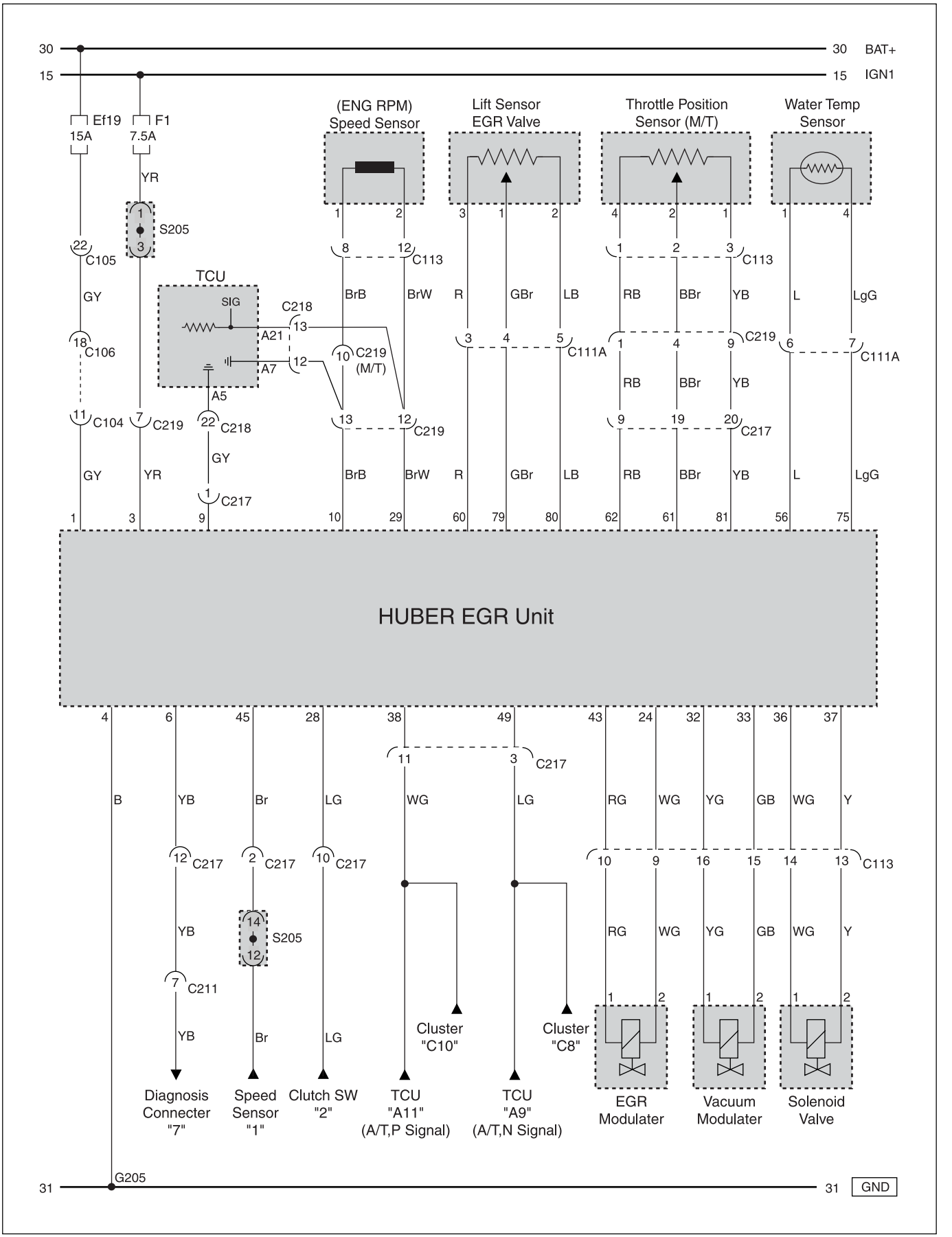
(1) GENERAL



(2) EURO


15
IGN1
F33
10A
F32
10A
A/T
M/T
TCU
A5
Clutch
Switch
Throttle Position
Sensor
BrW
BR
GY
LG
RB
BrR
YB
C219
C218
C207
C217
EGR (EU)
R
GBr
LB
BrB
BrW
RW
BG
L
Lg
C113
B
Lift Sensor
EGR Valve
Speed
Sensor
Exhaust Gas
Recirculation
Modulator
Water Temp
Sensor
G101
31
GND

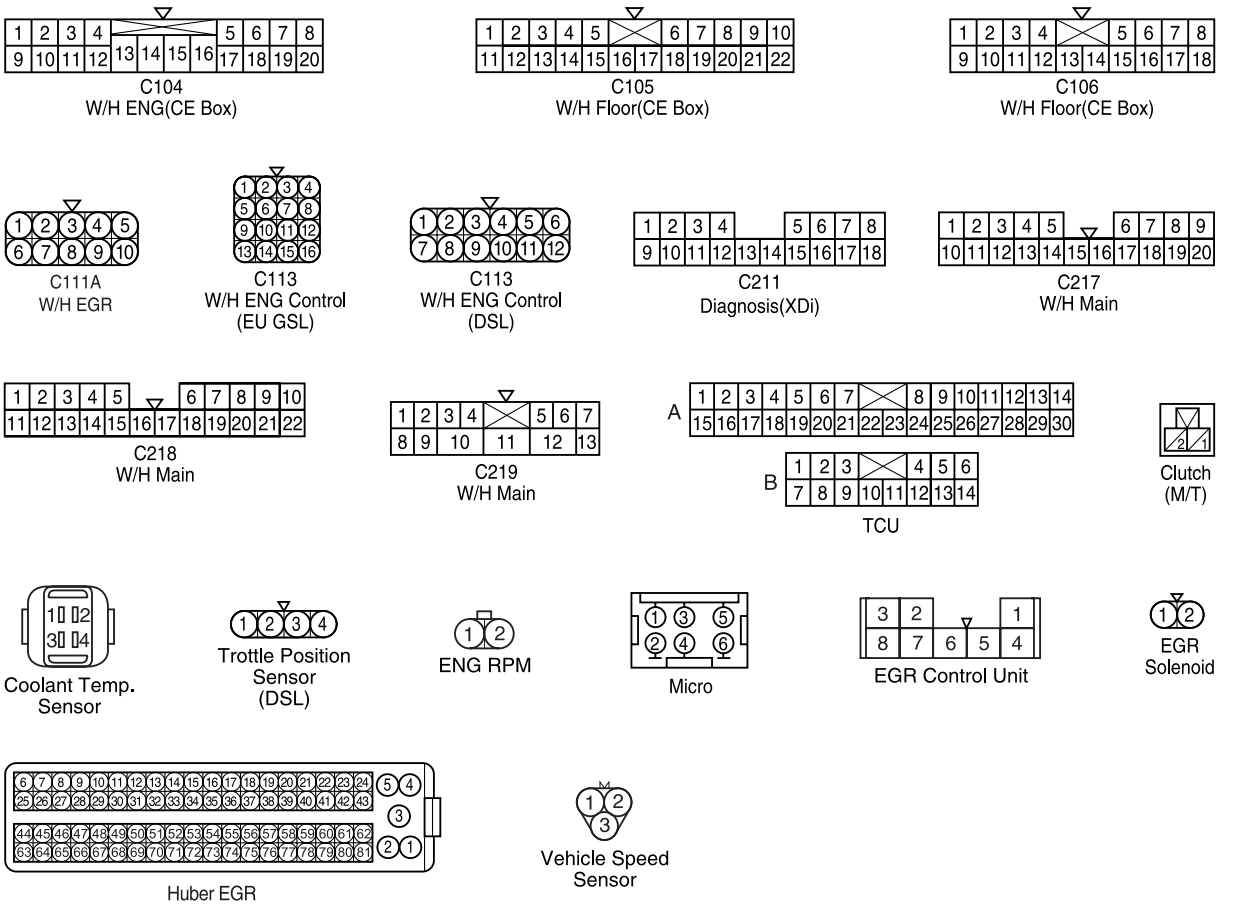
2) HUBER EGR


30
15
30 BAT+
15 IGN1
Ef19
15A
F1
7.5A
YR
S205
C105
GY
C106
TCU
SIG
A21
A7
A5
C218
C104
C219
C217
GY
YR
(ENG RPM)
Speed Sensor
Lift Sensor
EGR Valve
Throttle Position
Sensor (M/T)
Water Temp
Sensor
C113
BrB
BrW
C219
(M/T)
R
GBr
LB
C111A
RB
BBr
YB
L
LgG
HUBER EGR Unit
B
YB
Br
LG
WG
LG
RG
WG
YG
GB
WG
Y
C211
Diagnosis
Connecter
"7"
Speed
Sensor
"1"
Clutch SW
"2"
TCU
"A11"
(A/T,P Signal)
TCU
"A9"
(A/T,N Signal)
Cluster
"C10"
Cluster
"C8"
EGR
Modulater
Vacuum
Modulater
Solenoid
Valve
G205
31
31 GND

A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C111A (10Pin, Black)	Engine - W/H EGR	FRT Pre-Heating Unit	CLUSTER
C113 (12Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	DSL
C113 (16Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	DSL (EU)
C211 (18Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	XDi
C217(20Pin, Black)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
G101	W/H Engine	Center the Engine Room Fuse Box	
G105	W/H Engine	Behine the Right Head Lamp	
G205	W/H Main	Inside Co-Driver Side Cowl PNL	GSL
S205 (14Pin, Black)	W/H Main	Behind the Left FATC	GND

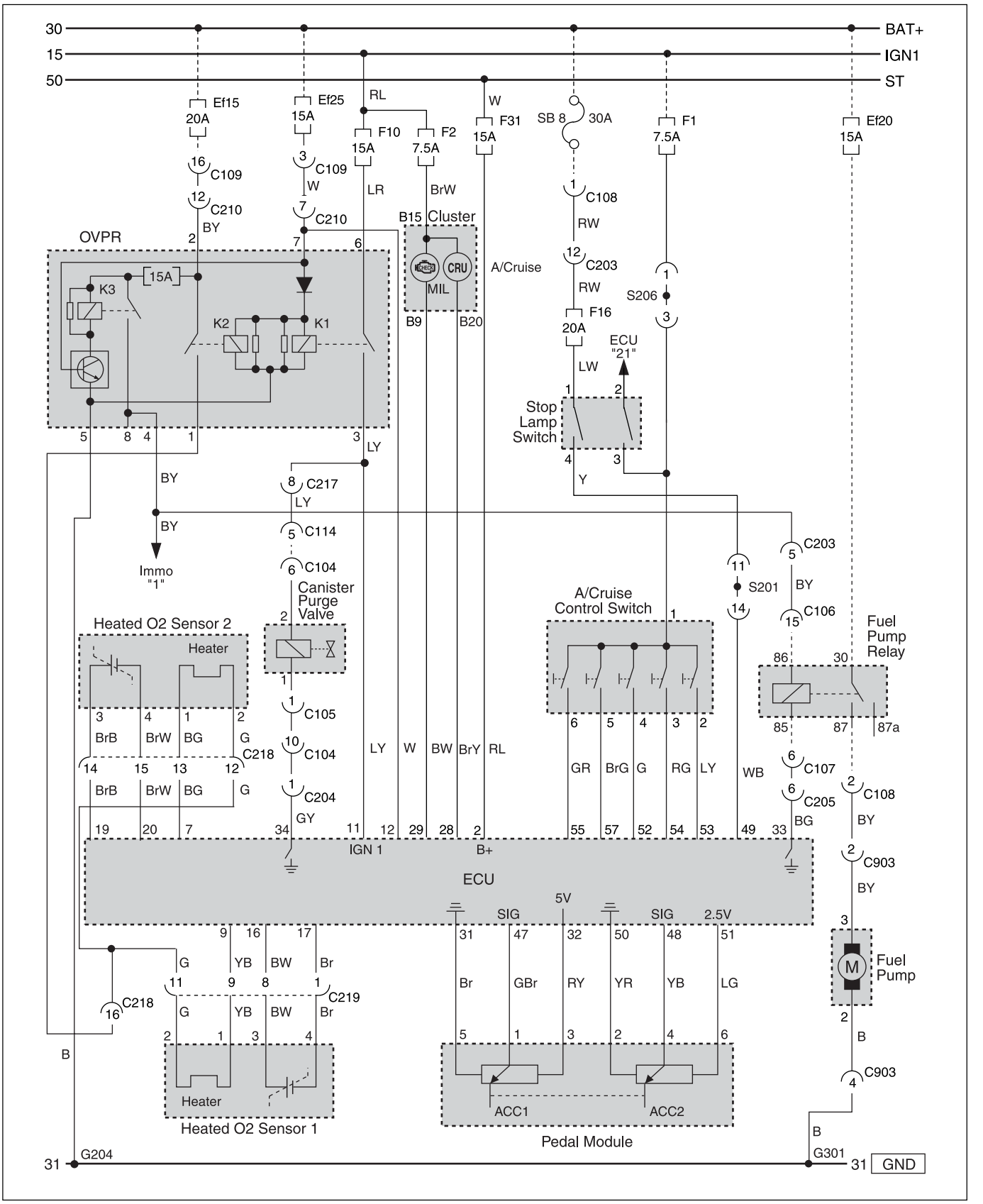
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



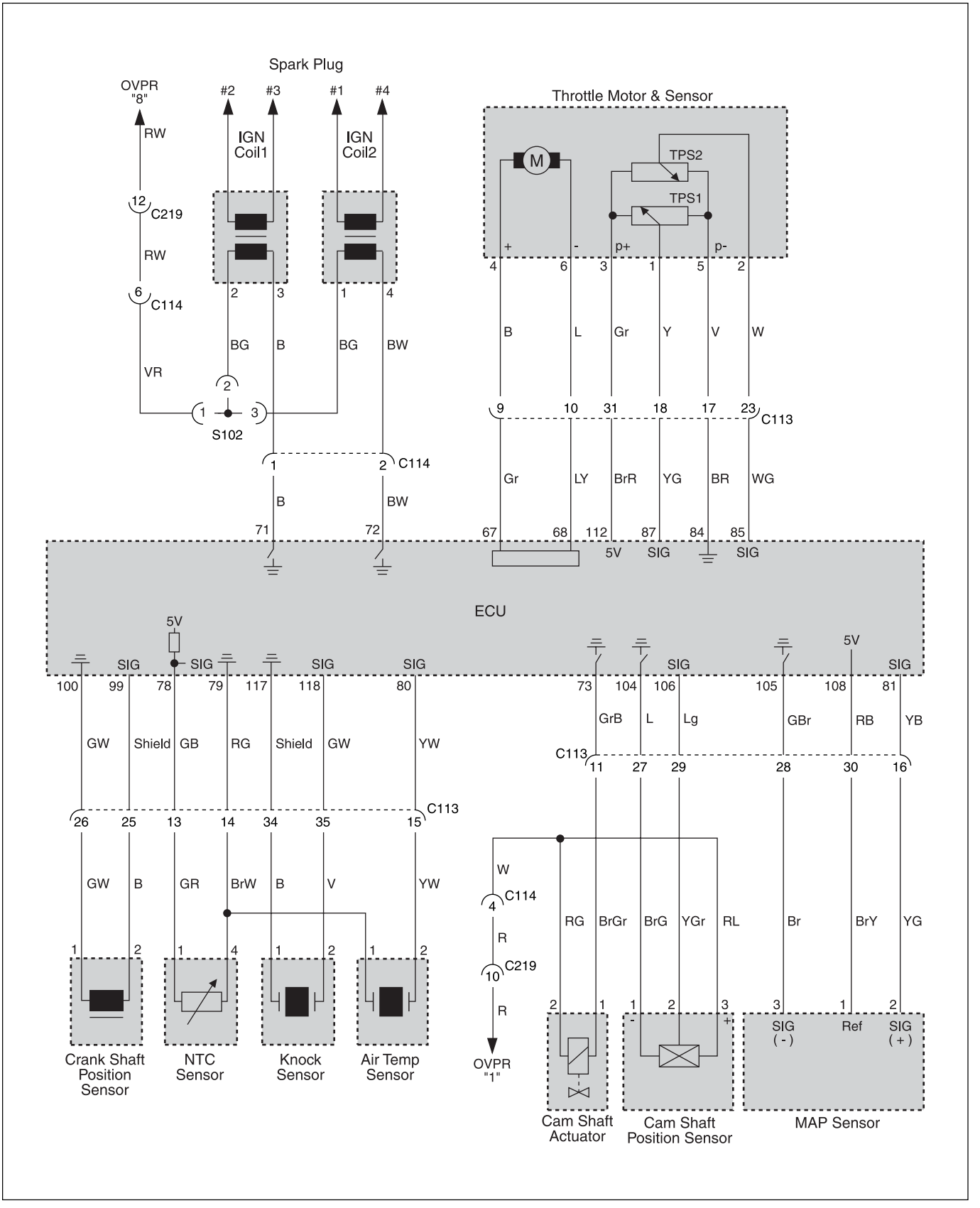
4. ECU (ELECTRONIC CONTROL UNIT) (E23)

1) ~ 2002 MODEL

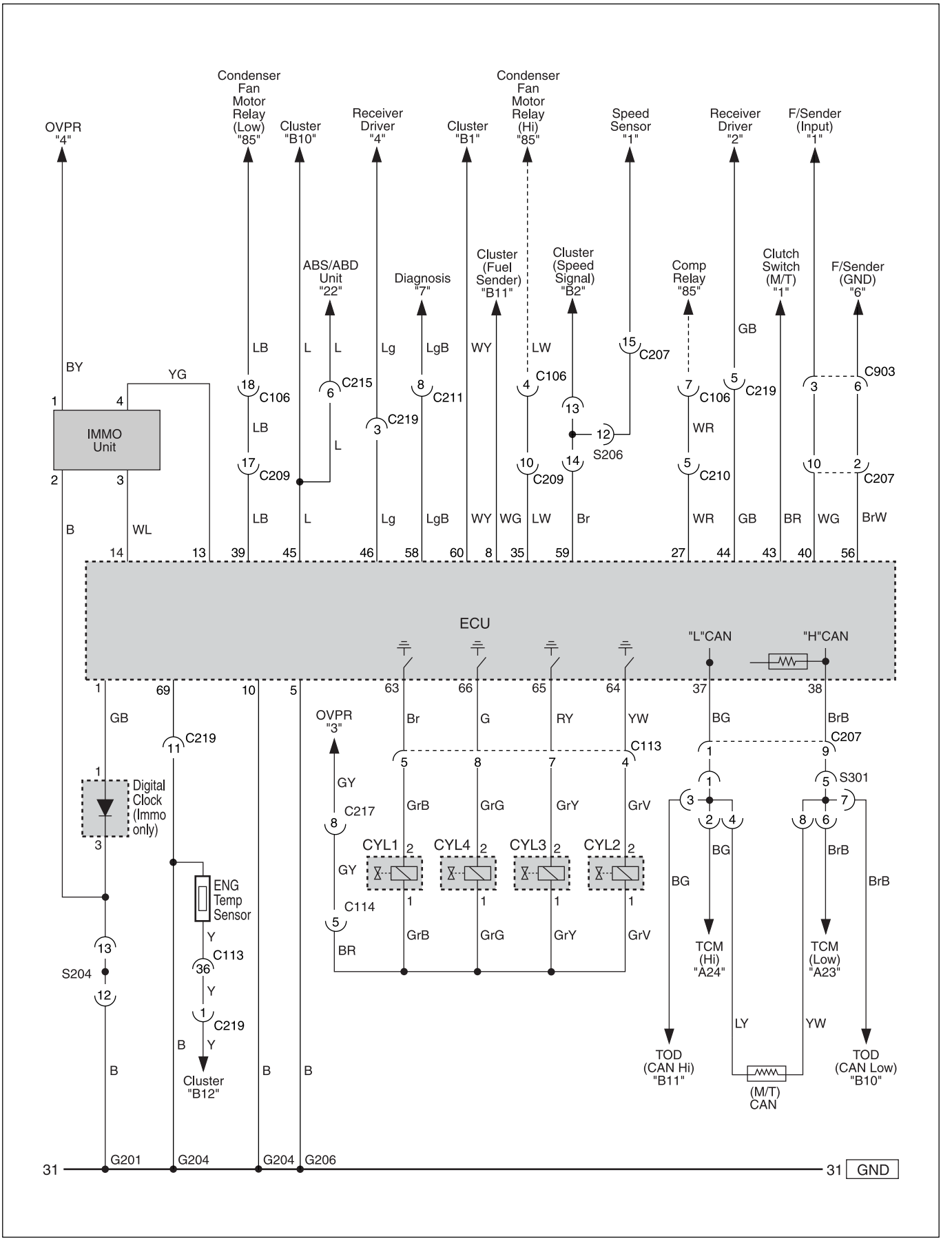
(1) OVPR, FUEL PUMP, CANISTER PURGE VALVE, O_2 SENSOR, PEDAL MODULE CIRCUIT



(2) SPARK PLUG, SENSOR (CAM SHAFT POSITION, MAP, NTC, CRANK SHAFT POSITION, THROTTLE MOTOR, AIR TEMP, KNOCK), CAM SHIFT ACTUATOR CIRCUIT



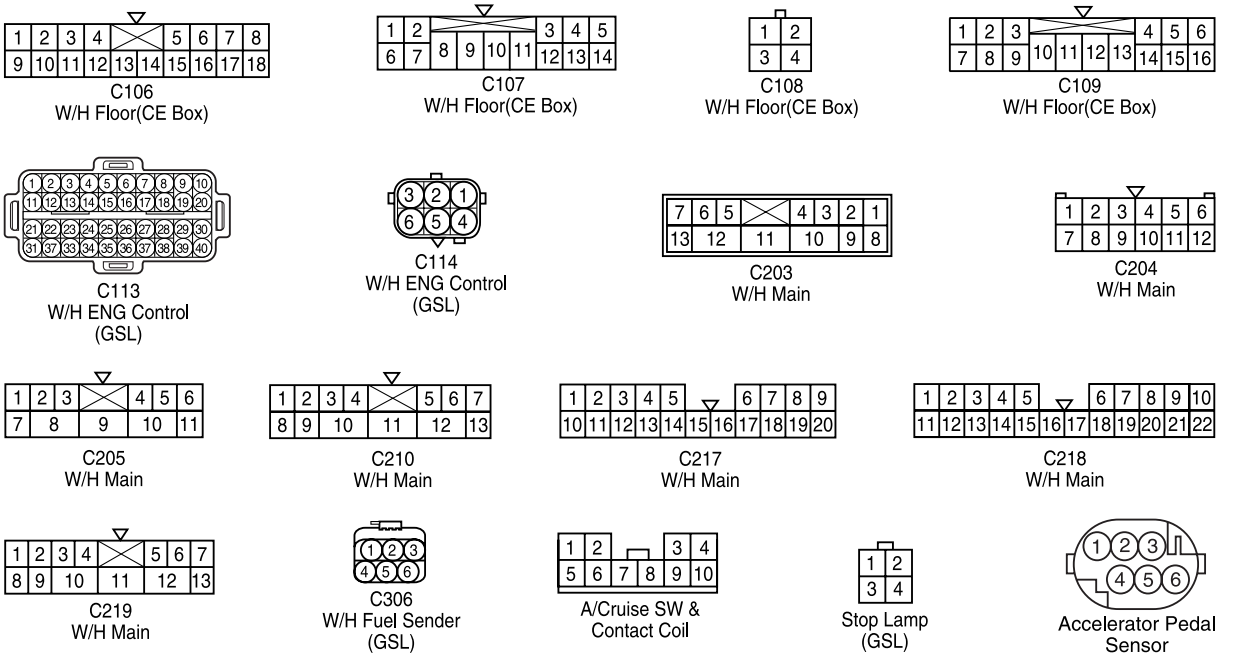
(3) DIGITAL CLOCK, ENG TEMP SENSOR, IMMOBILIZER CIRCUIT



A. CONNECTOR INFORMATION

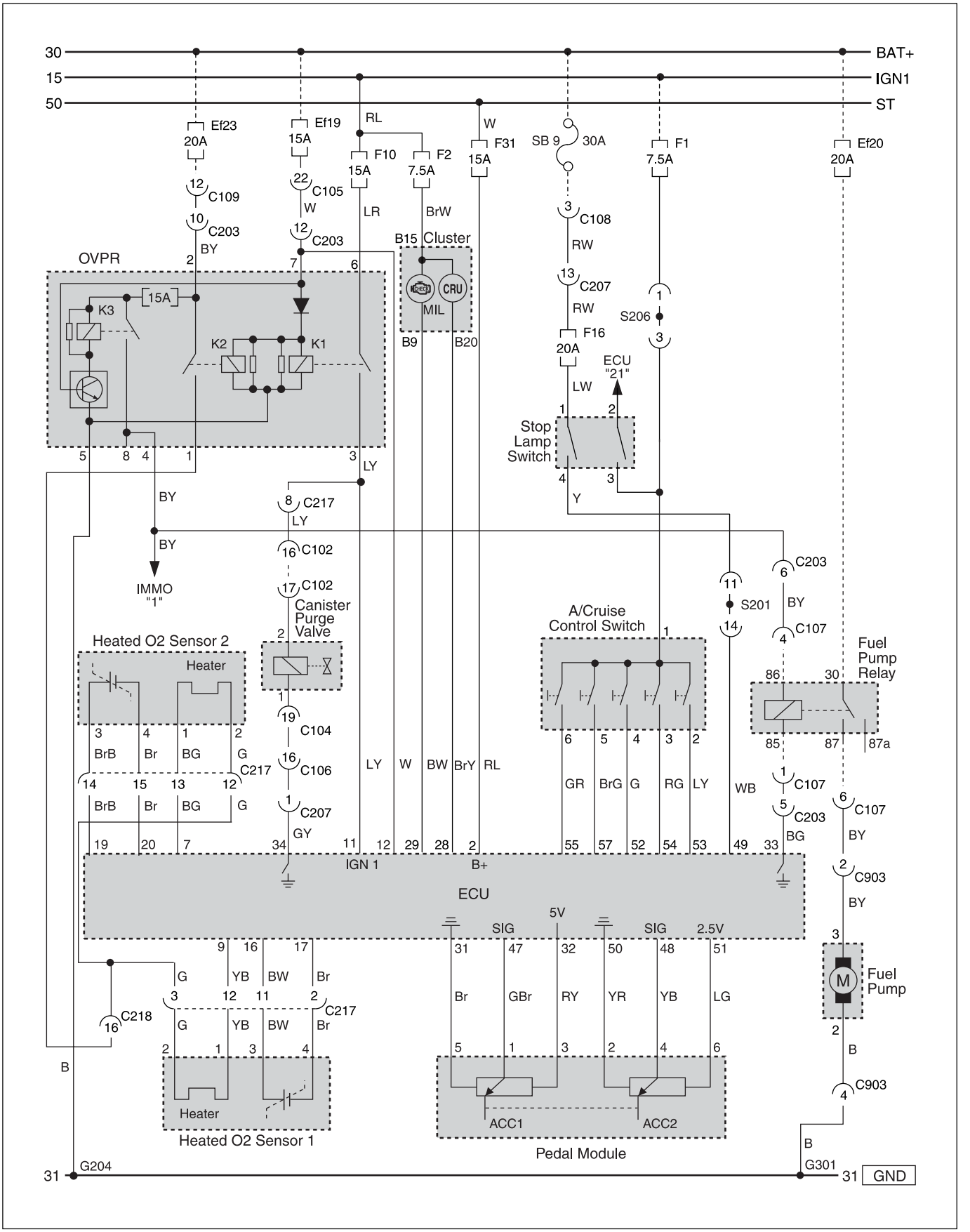
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C113 (40Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	GSL
C114 (6Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	GSL
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C204 (12Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	A/T
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Engine - Main (RH)	Inside Driver Side Cowl PNL	
C217 (20Pin, Black)	Floor - T/M	Inside Co-Driver Side Cowl PNL	
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C306 (6Pin, Black)	Floor - Fuel Sender	Left the T/C (Under the Floor)	GSL
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
S206 (14Pin, Black)	W/H Main	Behind the Left the FATC	
G204	W/H Main	Inside Co-Driver Side Cowl PNL	
G301	W/H Floor	Under Driver Seat	ECU GND

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

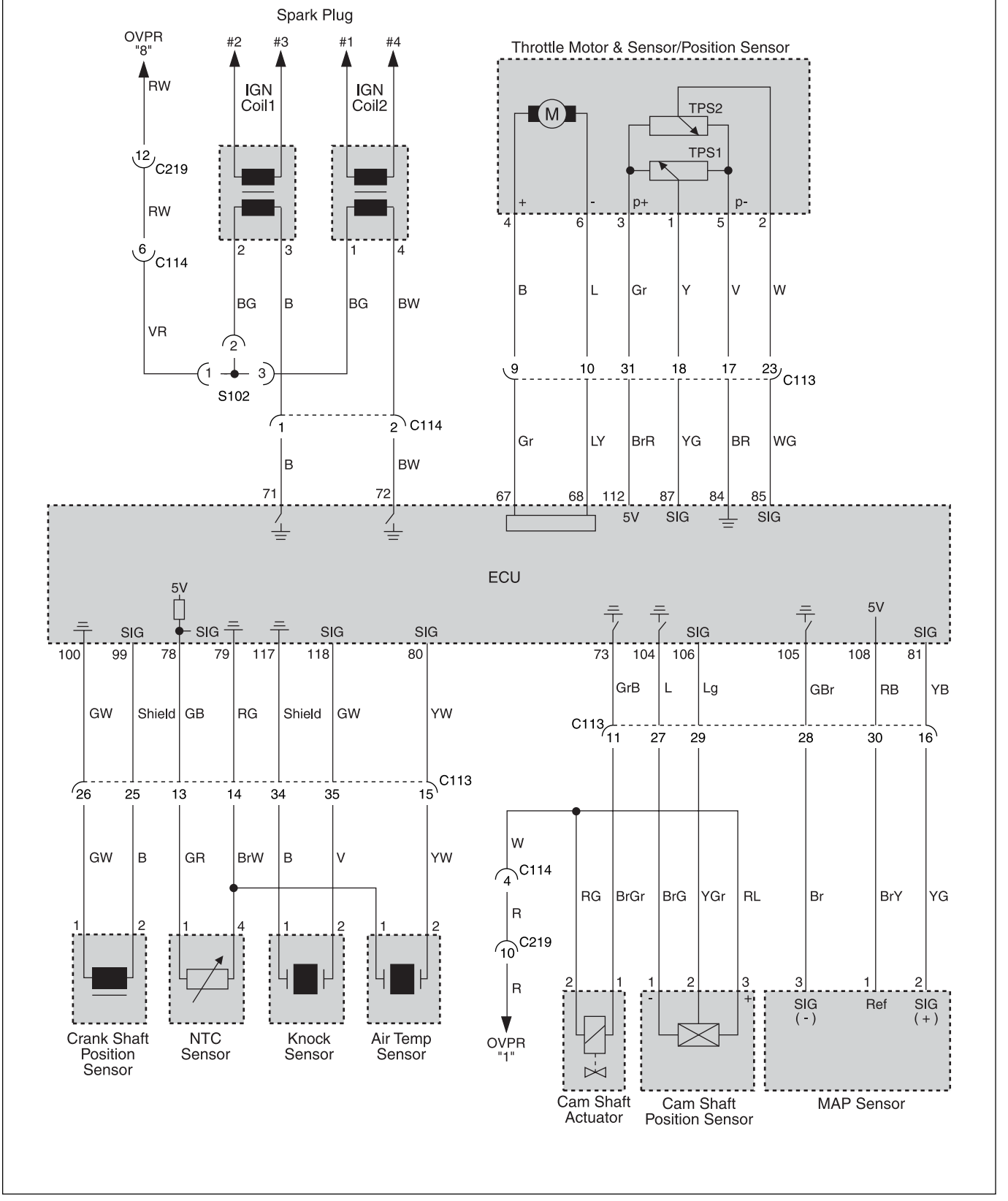


2) 2003 MODEL ~

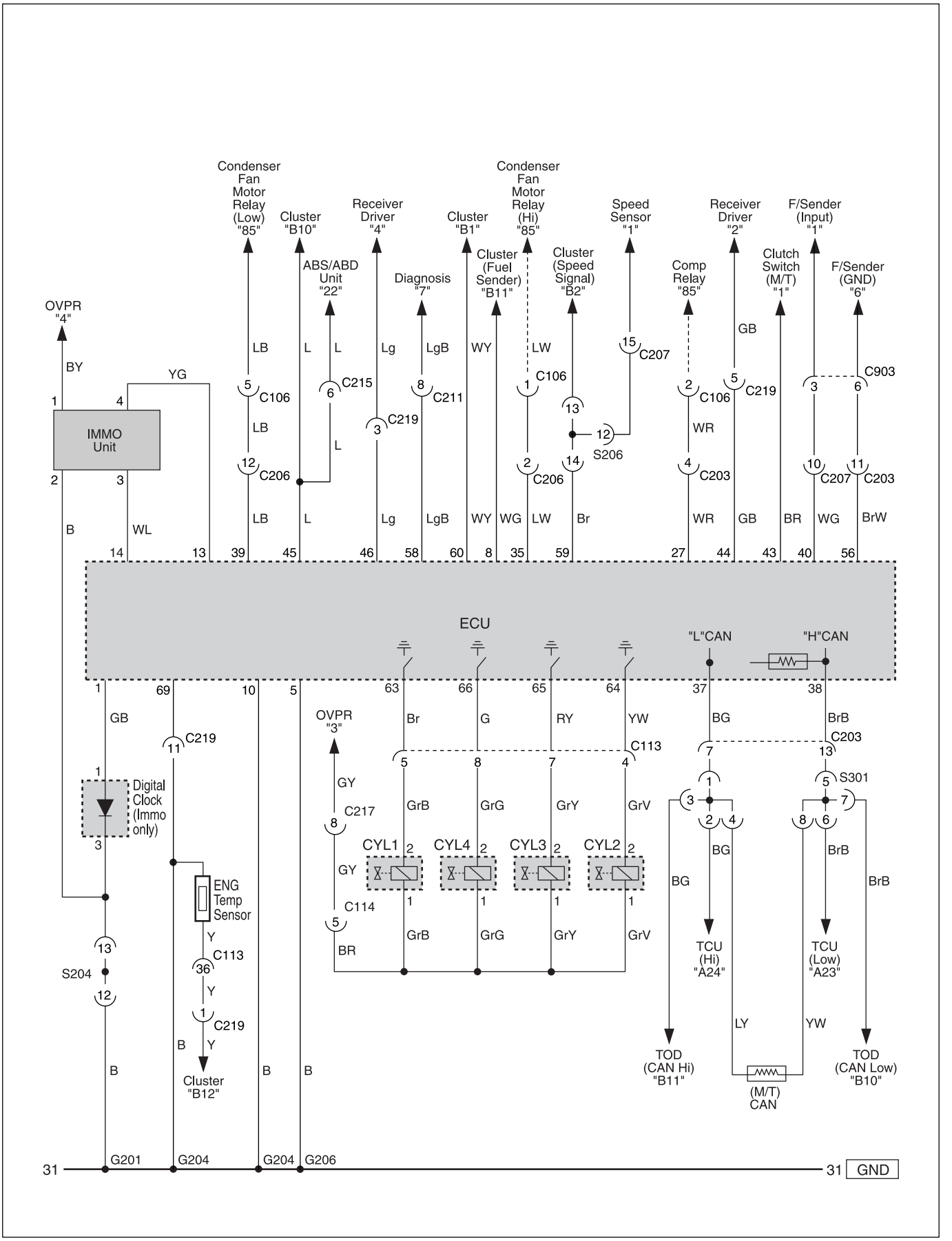
(1) OVPR, FUEL PUMP, CANISTER PURGE VALVE, O_2 SENSOR, PEDAL MODULE CIRCUIT



(2) SPARK PLUG, SENSOR (CAM SHAFT POSITION, MAP, NTC, CRANK SHAFT POSITION, THROTTLE MOTOR, AIR TEMP, KNOCK), CAM SHIFT ACTUATOR CIRCUIT



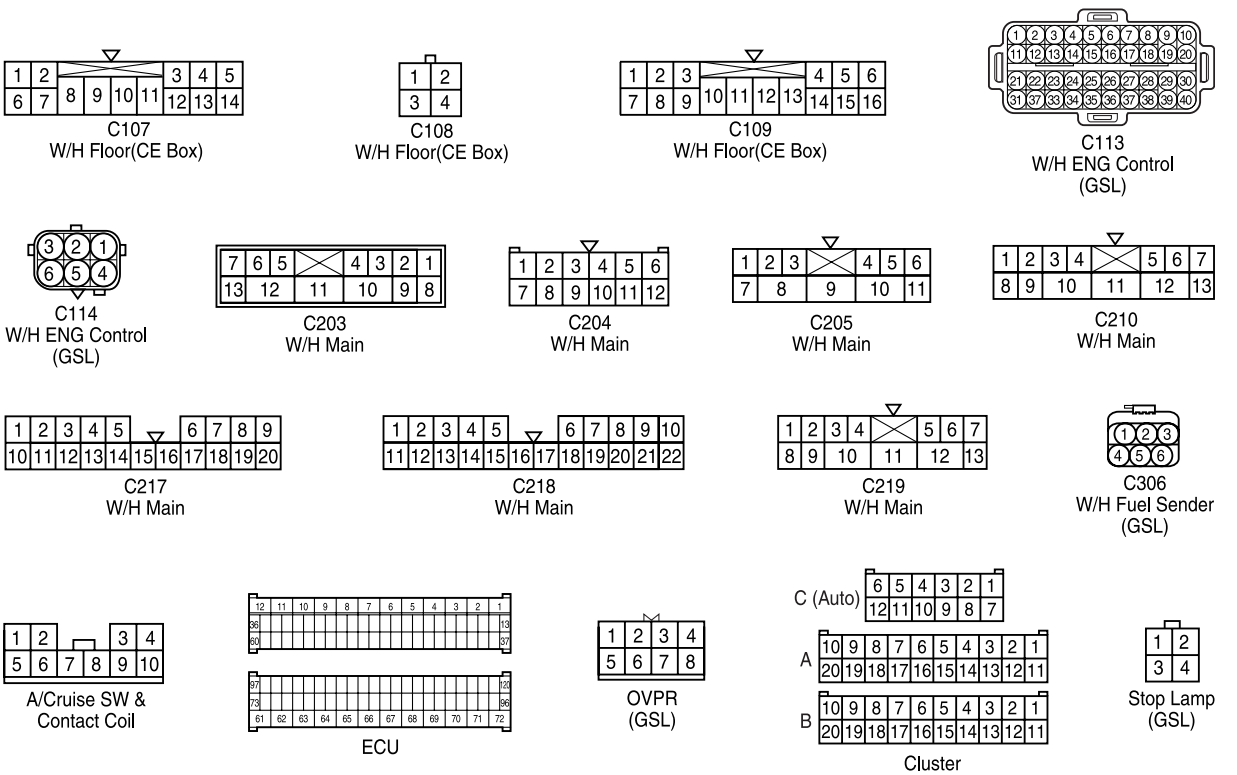
(3) DIGITAL CLOCK, ENG TEMP SENSOR, IMMOBILIZER CIRCUIT



A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C204 (12Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	A/T
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Engine - Main (RH)	Inside Driver Side Cowl PNL	
C217 (20Pin, Black)	Floor - T/M	Inside Co-Driver Side Cowl PNL	
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C306 (6Pin, Black)	Floor - Fuel Sender	Left the T/C (Under the Floor)	GSL
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
S206 (14Pin, Black)	W/H Main	Behind the Left the FATC	
G204	W/H Main	Inside Co-Driver Side Cowl PNL	
G301	W/H Floor	Under Driver Seat	ECU GND

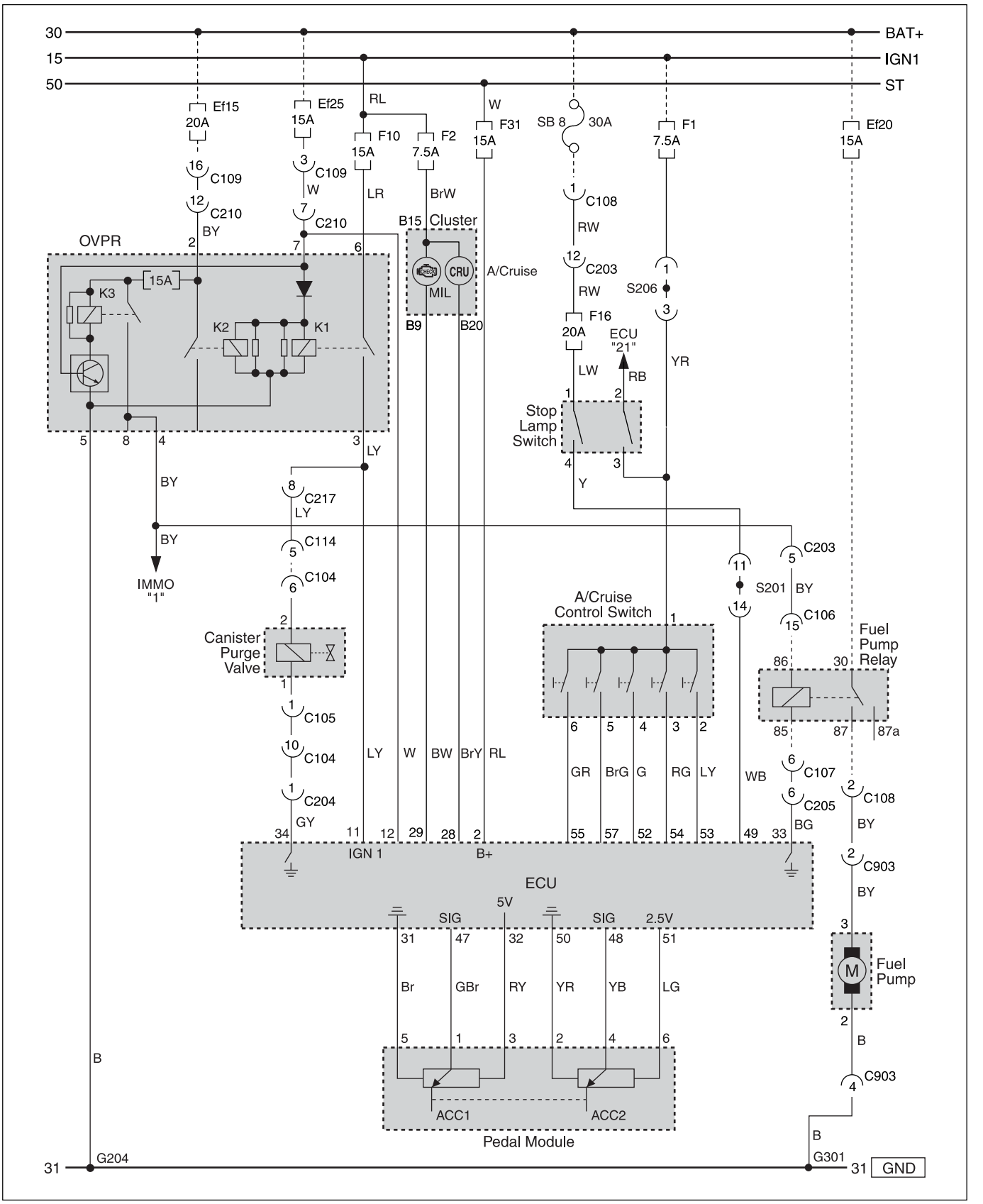
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



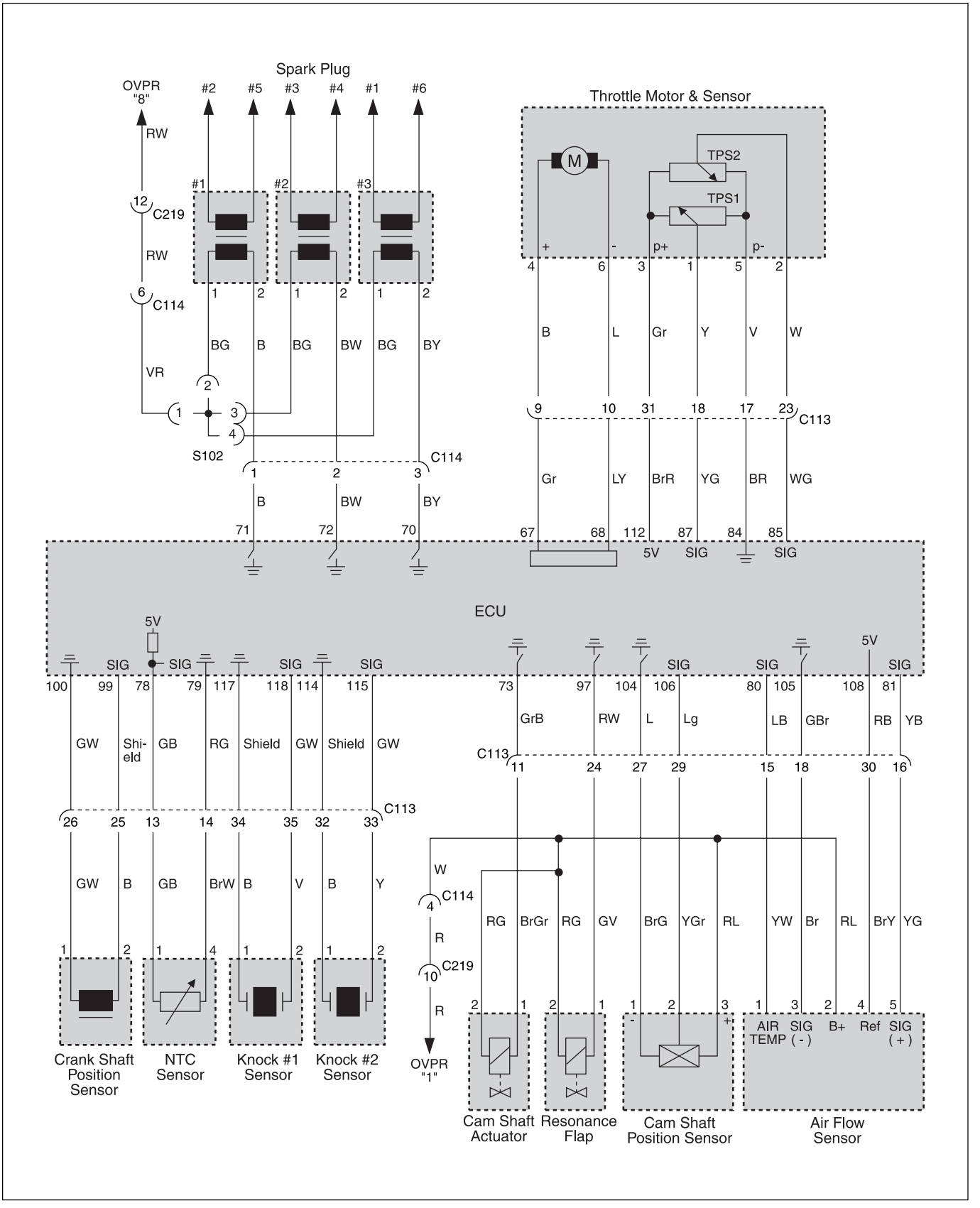
5. ECU (ELECTRONIC CONTROL UNIT) (E28, E32)

1) ~ 2002 MODEL

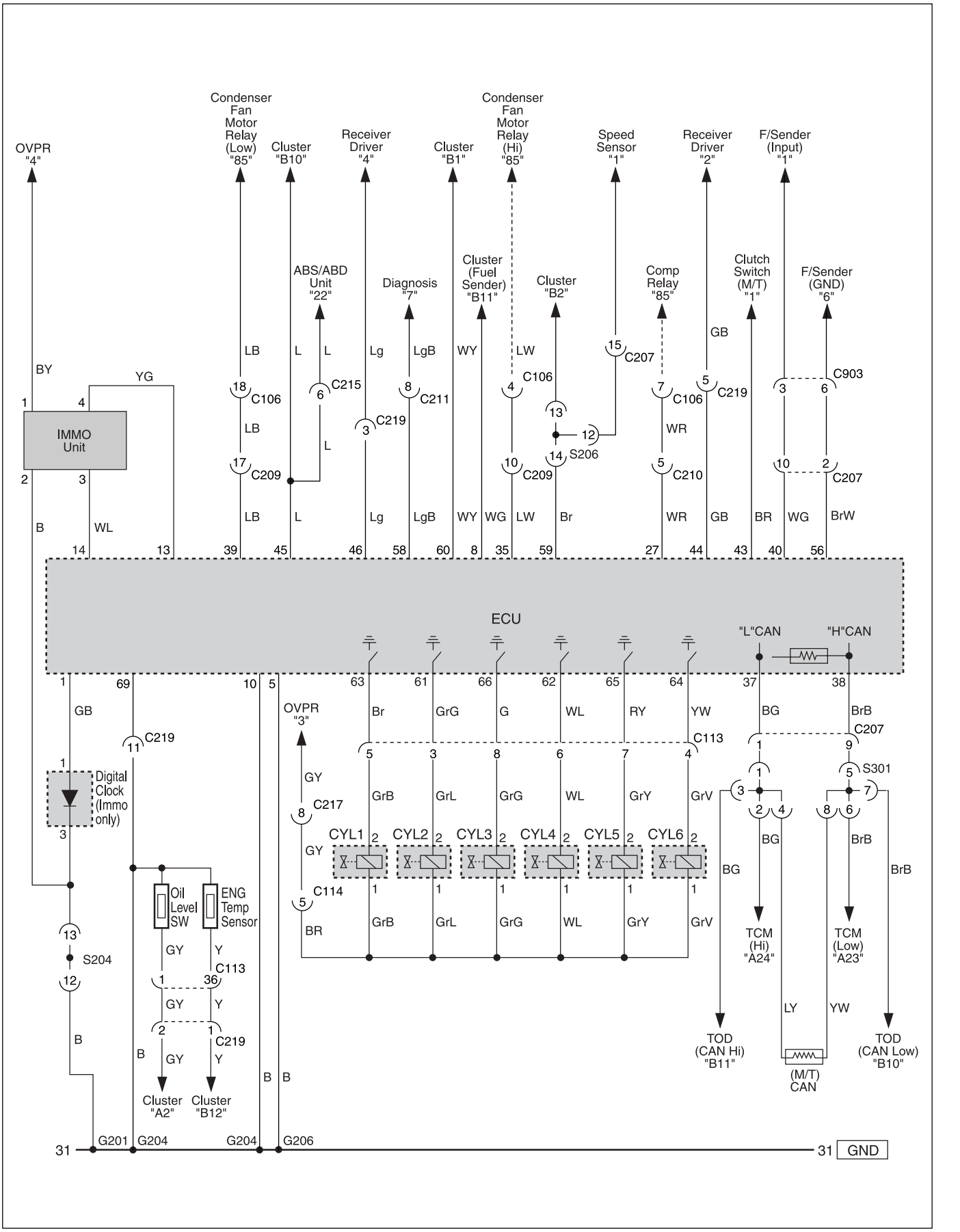
(1) OVPR, FUEL PUMP, CANISTER PURGE VALVE, PEDAL MODULE CIRCUIT



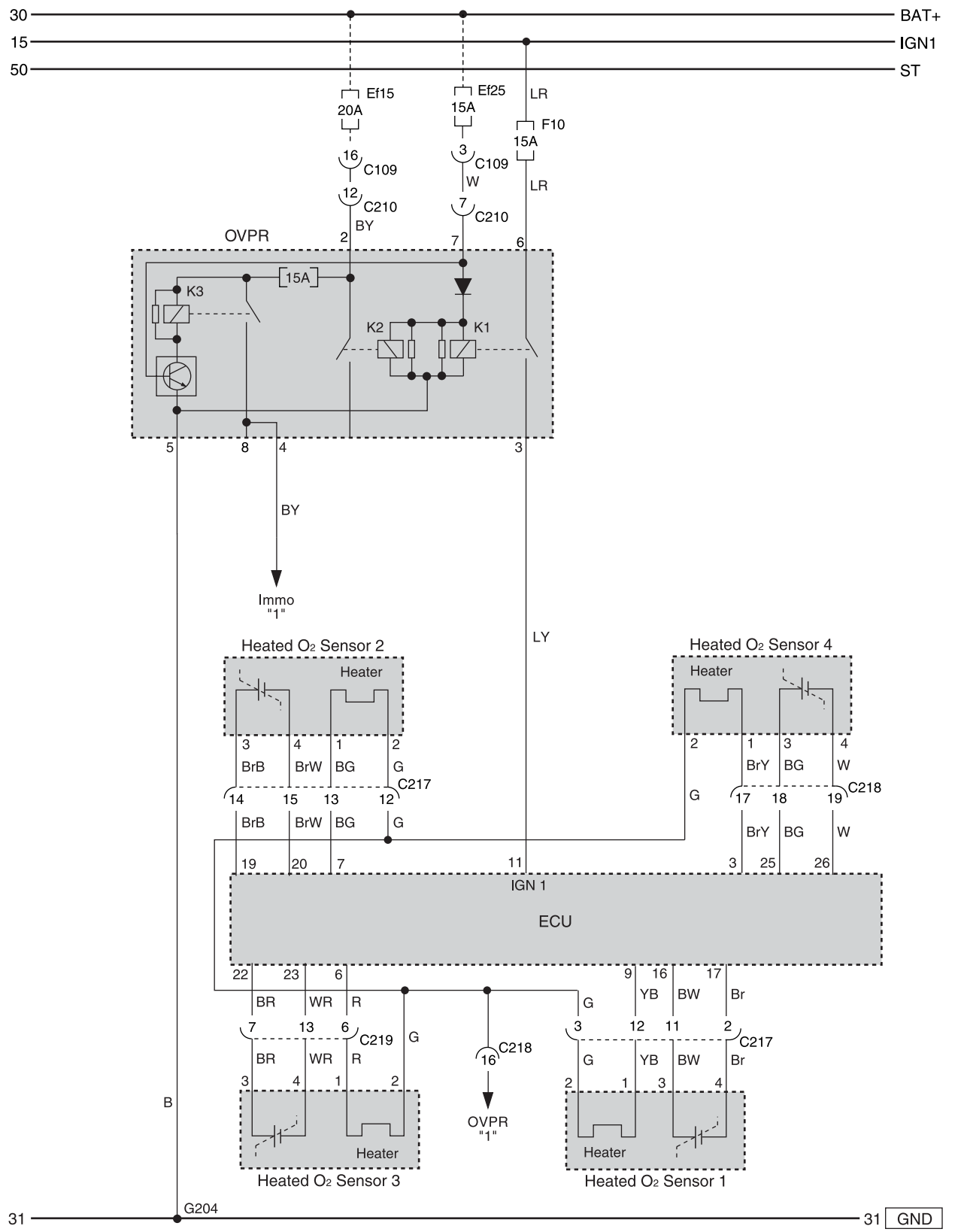
(2) SPARK PLUG, SENSOR (CAM SHAFT POSITION, NTC, CRANK SHAFT POSITION, THROTTLE MOTOR & SENSOR, KNOCK), CAM SHIFT ACTUATOR, RESONANCE FLAP CIRCUIT



(3) DIGITAL CLOCK, ENG TEMP SENSOR, IMMOBILIZER CIRCUIT



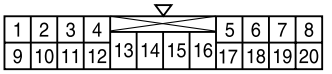
(4) O_2 SENSOR

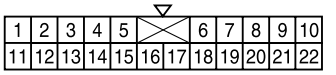

30
15
50
BAT+
IGN1
ST
Ef15
20A
Ef25
15A
LR
F10
15A
16
C109
3
C109
W
LR
12
C210
BY
7
C210
OVPR
2
7
6
15A
K3
K2
K1
5
8
4
3
BY
Immo
"1"
LY
Heated O2 Sensor 2
Heater
3
4
1
2
BrB
BrW
BG
G
C217
14
15
13
12
BrB
BrW
BG
G
19
20
7
11
Heated O2 Sensor 4
Heater
2
1
3
4
BrY
BG
W
C218
G
17
18
19
BrY
BG
W
3
25
26
IGN 1
ECU
22
23
6
9
16
17
BR
WR
R
G
YB
BW
Br
7
13
6
C219
G
3
12
11
2
C217
BR
WR
R
C218
16
G
YB
BW
Br
3
4
1
2
2
1
3
4
B
OVPR
"1"
Heater
Heater
Heated O2 Sensor 3
Heated O2 Sensor 1
31
G204
31
GND

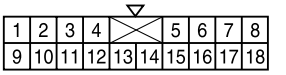
A. CONNECTOR INFORMATION

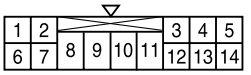
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C113 (40Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	GSL
C114 (6Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	GSL
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C204 (12Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	A/T
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Engine - Main (RH)	Inside Driver Side Cowl PNL	
C217 (20Pin, Black)	Floor - T/M	Inside Co-Driver Side Cowl PNL	
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C306 (6Pin, Black)	Floor - Fuel Sender	Left the T/C (Under the Floor)	GSL
S101 (7Pin, -)	OVPR “6” - Injector	Inside the C113, C114	GSL
S102 (4Pin, -)	OVPR “8” - IGN Coil	Inside the Injector “6”	GSL
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
S206 (14Pin, Black)	W/H Main	Behind the Left the FATC	
G204	W/H Main	Inside Co-Driver Side Cowl PNL	
G301	W/H Floor	Under Driver Seat	ECU GND

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

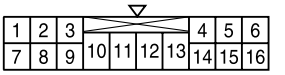

C104
W/H ENG(CE Box)

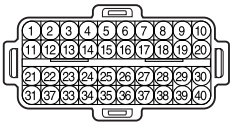

C105
W/H Floor(CE Box)


C106
W/H Floor(CE Box)

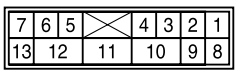

C107
W/H Floor(CE Box)

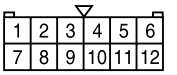

C108
W/H Floor(CE Box)

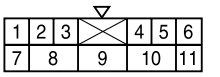

C109
W/H Floor(CE Box)

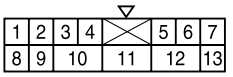

C113
W/H ENG Control
(GSL)

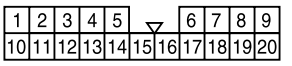

C114
W/H ENG Control
(GSL)

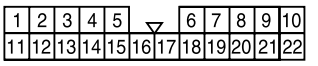

C203
W/H Main

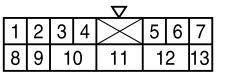

C204
W/H Main


C205
W/H Main

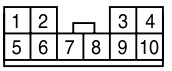

C210
W/H Main

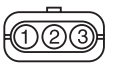

C217
W/H Main

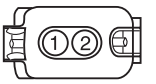

C218
W/H Main

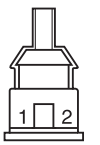

C219
W/H Main


C306
W/H Fuel Sender
(GSL)

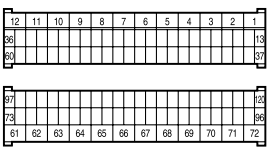

A/Cruise SW &
Contact Coil

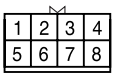

Cam Shaft
Position Sensor

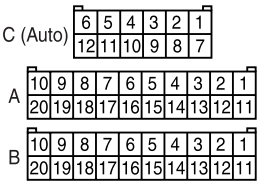

Crank Position
Sensor

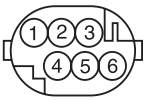

Knock Sensor


Coolant Temp.
Sensor


ECU


OVPR
(GSL)

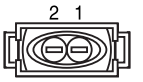

Cluster

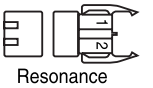

Accelerator Pedal
Sensor

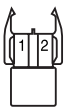

O2 Sensor
(GSL)


Ignition Coil

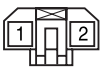

Canister
Purge Valve


Injector


Resonance
Flap

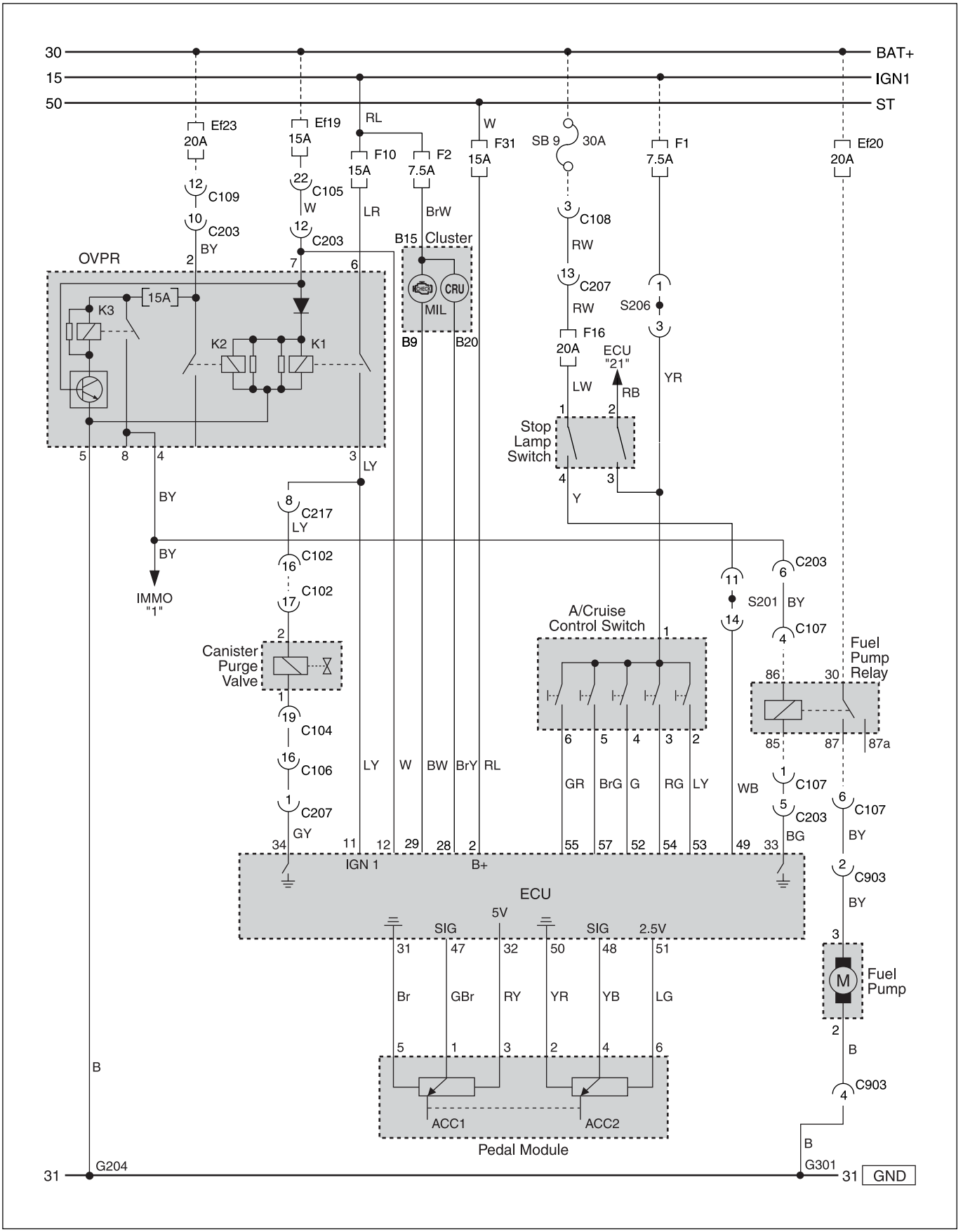

Camshaft
Actuater


Throttle Valve
Actuator

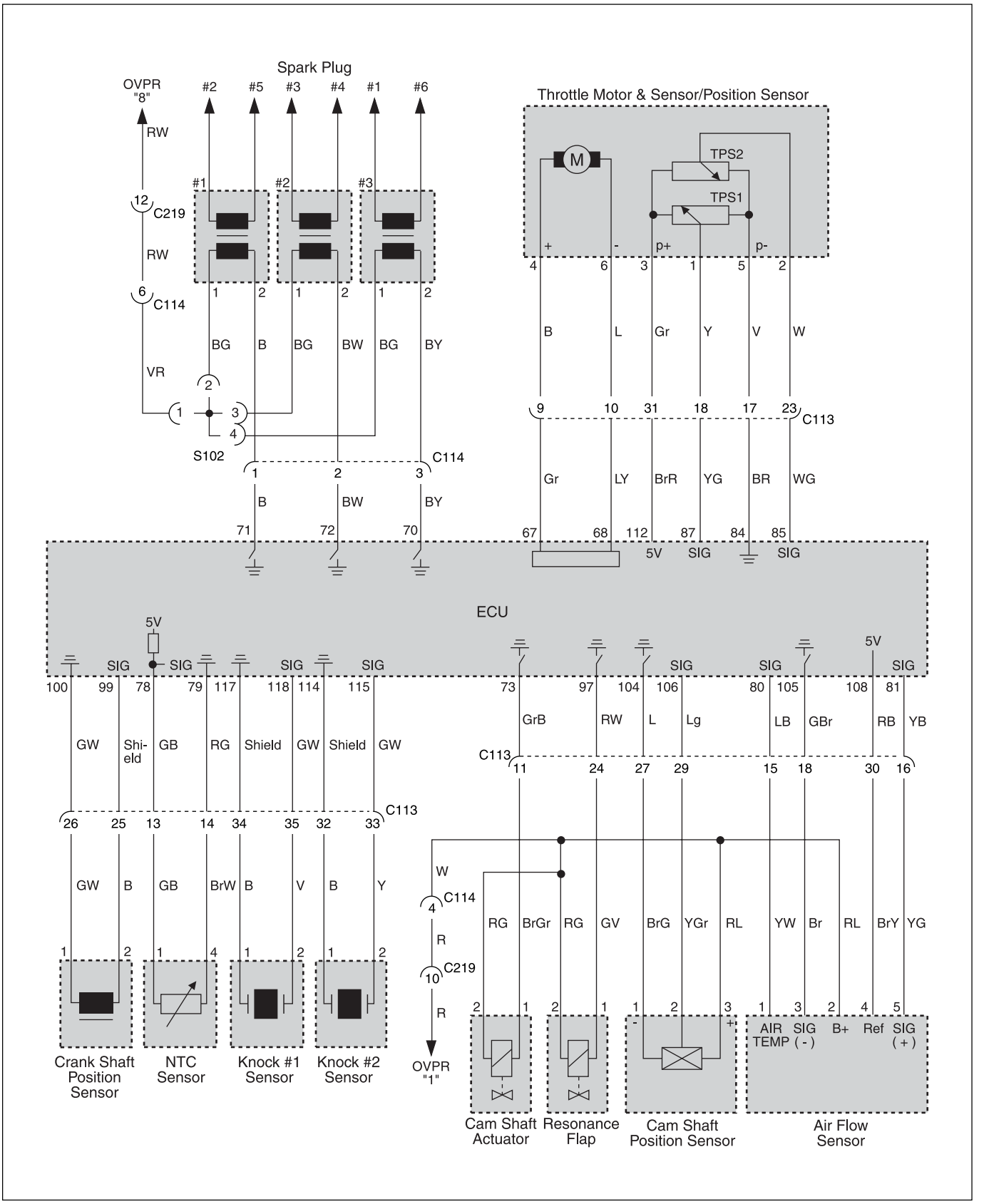

Locking Hub
Solenoid Valve

2) 2003 MODEL ~

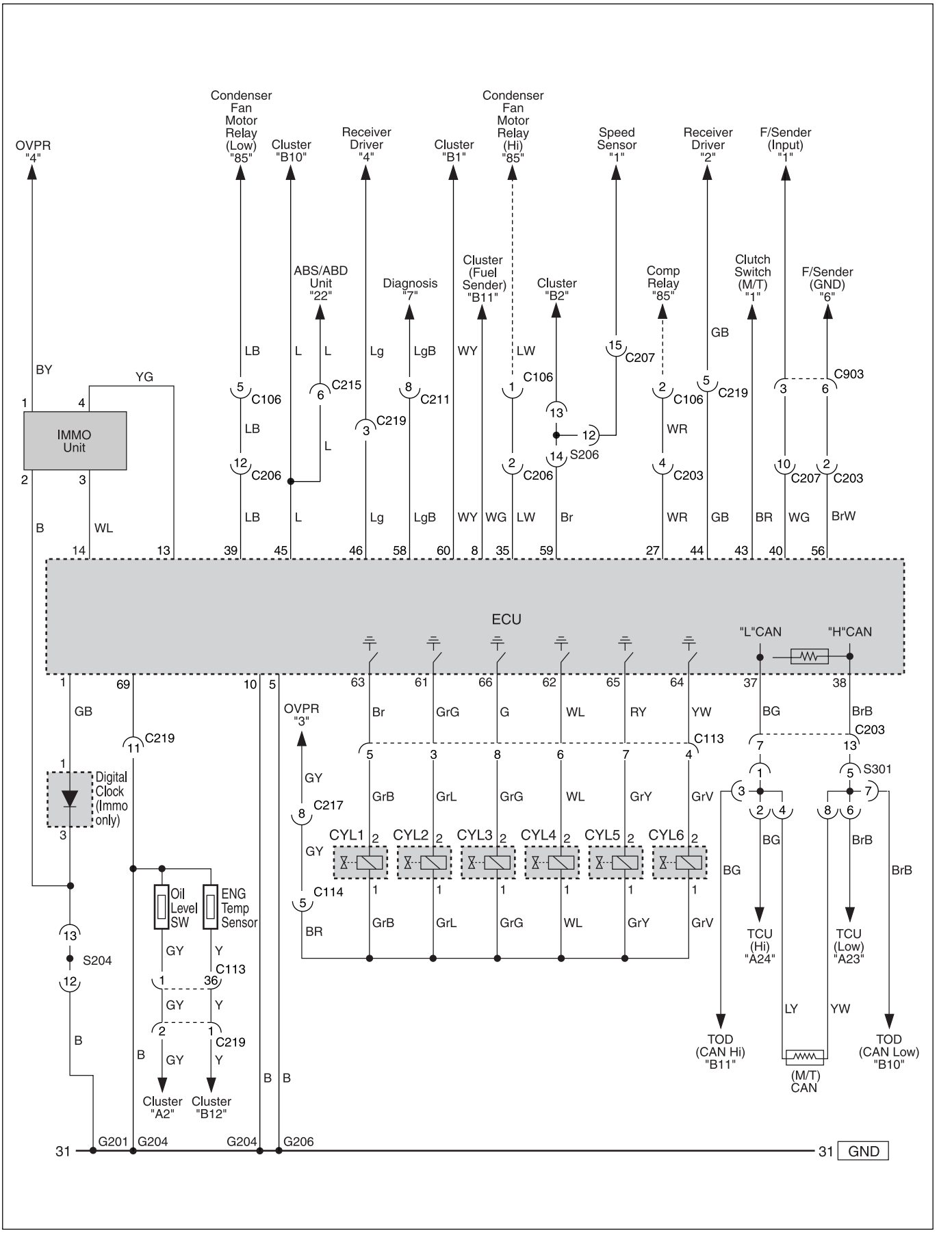
(1) OVPR, FUEL PUMP, CANISTER PURGE VALVE, PEDAL MODULE CIRCUIT



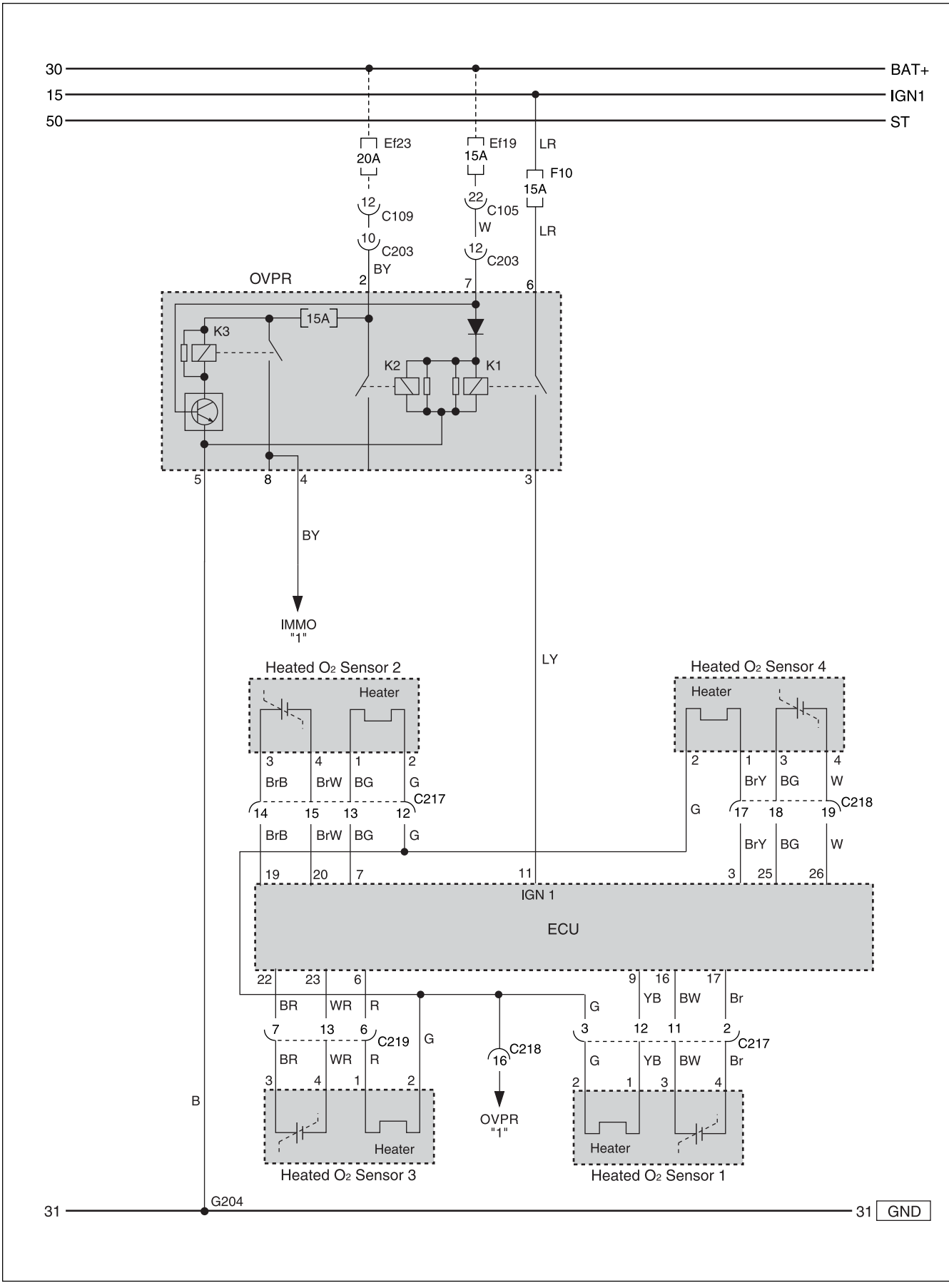
(2) SPARK PLUG, SENSOR(CAM SHAFT POSITION, NTC, CRANK SHAFT POSITION, THROTTLE MOTOR & SENSOR, KNOCK), CAM SHIFT ACTUATOR, RESONANCE FLAP CIRCUIT



(3) DIGITAL CLOCK, ENG TEMP SENSOR, IMMOBILIZER CIRCUIT



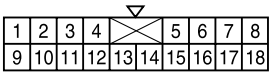
(4) O_2 SENSOR

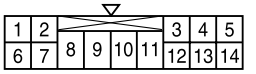

30
15
50
BAT+
IGN1
ST
Ef23
20A
Ef19
15A
LR
F10
15A
12
C109
22
C105
W
LR
10
C203
BY
12
C203
OVPR
2
7
6
15A
K3
K2
K1
5
8
4
3
BY
IMMO
"1"
LY
Heated O2 Sensor 2
Heater
Heated O2 Sensor 4
Heater
3
4
1
2
BrB
BrW
BG
G
C217
14
15
13
12
BrB
BrW
BG
G
2
1
3
4
BrY
BG
W
C218
G
17
18
19
BrY
BG
W
19
20
7
11
3
25
26
IGN 1
ECU
22
23
6
BR
WR
R
9
16
17
YB
BW
Br
G
7
13
6
C219
G
BR
WR
R
3
4
1
2
Heater
Heated O2 Sensor 3
C218
16
OVPR
"1"
3
12
11
2
C217
G
YB
BW
Br
2
1
3
4
Heater
Heated O2 Sensor 1
B
31
G204
31
GND

A. CONNECTOR INFORMATION

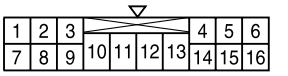
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C113 (40Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	GSL
C114 (6Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	GSL
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C204 (12Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	A/T
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Engine - Main (RH)	Inside Driver Side Cowl PNL	
C211 (14Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	
C215 (14Pin, White)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	ABS, ABD
C217 (20Pin, Black)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C903 (2Pin, White)	Floor - Fuel Sender	Left the T/C (Under the Floor)	DSL
S102 (4Pin, -)	OVPR “8” - IGN Coil	Inside the Injector “6”	GSL
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
S206 (14Pin, Black)	W/H Main	Behind the Left the FATC	
S301 (8Pin, Black)	W/H Floor	Under Driver Seat	CAN (GSL)
G204	W/H Main	Inside Co-Driver Side Cowl PNL	
G301	W/H Floor	Under Driver Seat	ECU GND

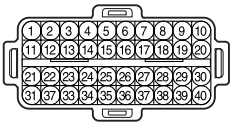
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

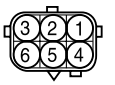

C106
W/H Floor(CE Box)

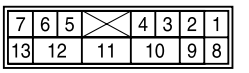

C107
W/H Floor(CE Box)

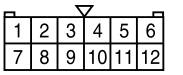

C108
W/H Floor(CE Box)

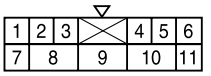

C109
W/H Floor(CE Box)

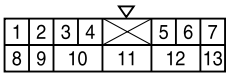

C113
W/H ENG Control
(GSL)

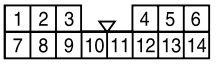

C114
W/H ENG Control
(GSL)

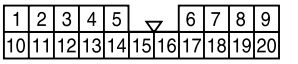

C203
W/H Main

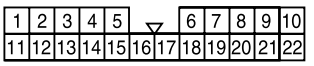

C204
W/H Main

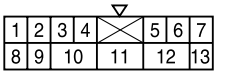

C205
W/H Main


C210
W/H Main

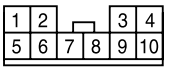

C211
W/H Diagnosis EXTN
Connector


C217
W/H Main


C218
W/H Main

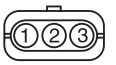

C219
W/H Main

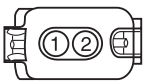

C903
W/H Fuel Sender
(GSL)

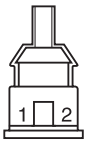

A/Cruise SW &
Contact Coil


Throttle Valve
Actuator


Clutch
(M/T)


Cam Shaft
Position Sensor

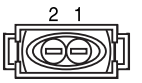

Crank Position
Sensor


Knock Sensor

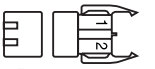

Coolant Temp.
Sensor

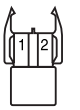

Ignition Coil


Canister
Purge Valve

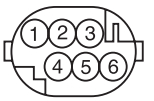

Injector
(E28, E32 M/T)


Injector
(E32 A/T)

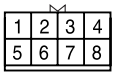

Resonance
Flap

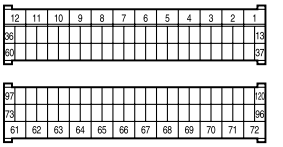

Camshaft
Actuater


Stop Lamp
(GSL)


Accelerator Pedal
Sensor

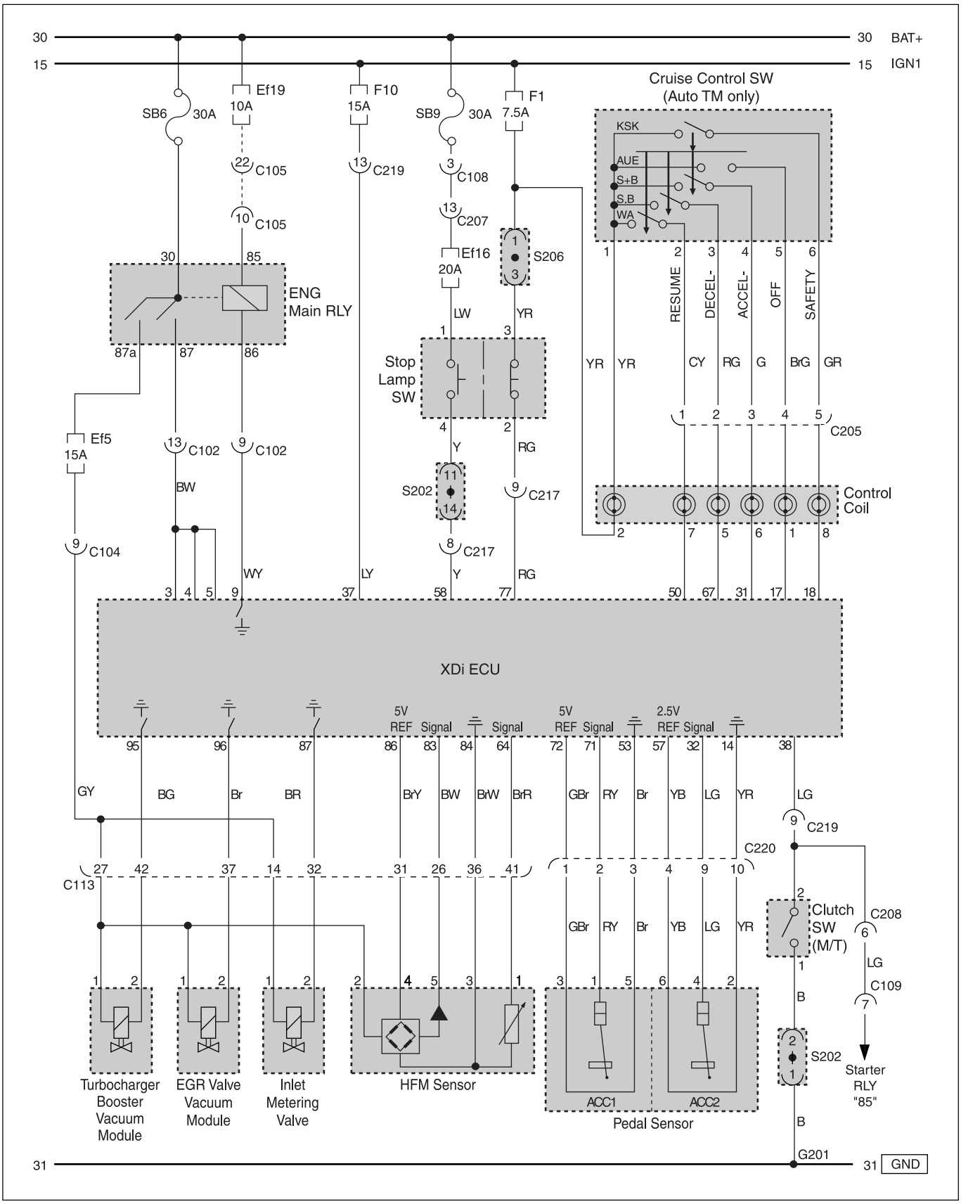

O2 Sensor
(GSL)


OVPR
(GSL)

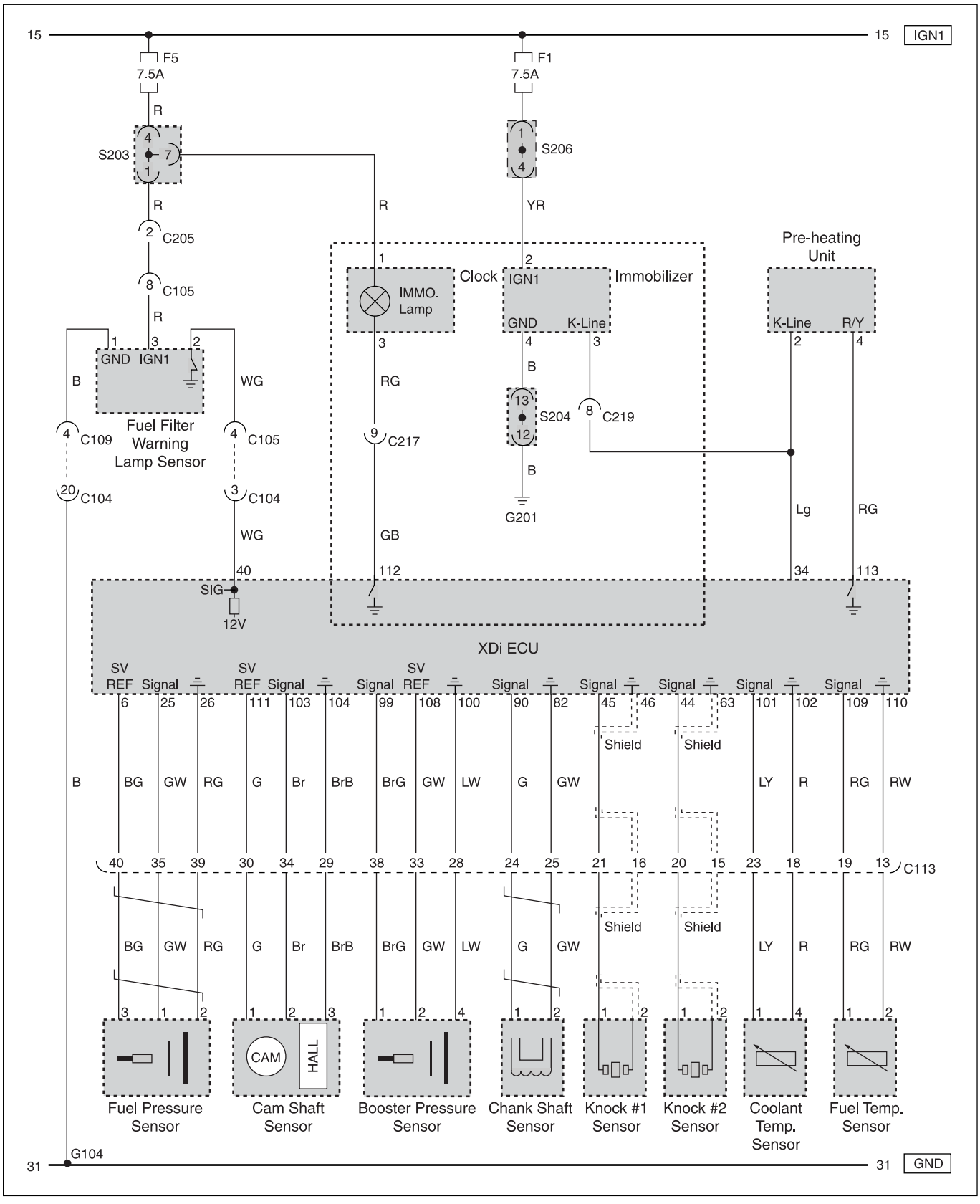

ECU

6. ECU(XDi)

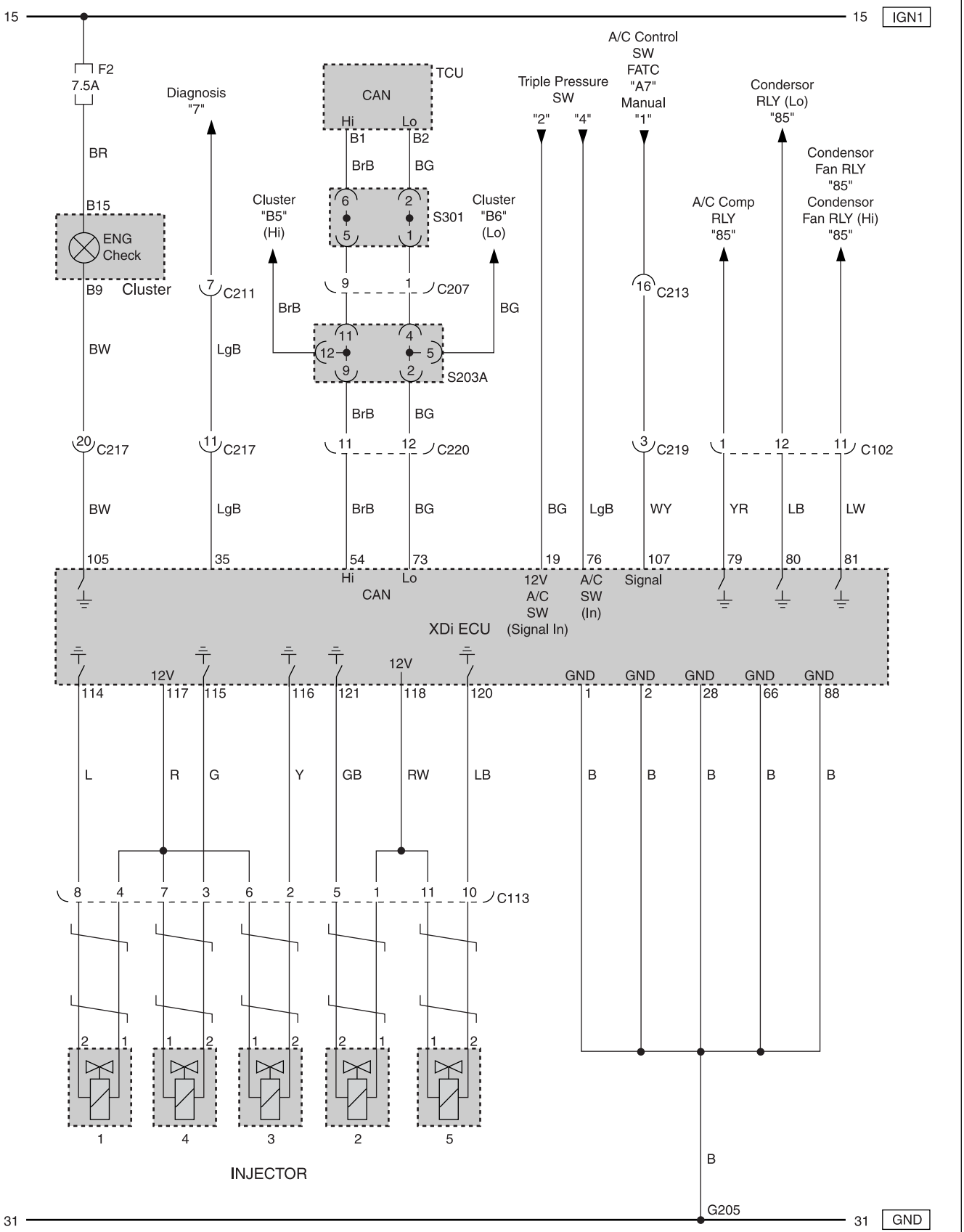
1) ENG MAIN RLY, PEDAL MODULE, HFM SENSOR, VALVE (TURBO CHANGER BOOSTER, EGR VACUUM MODULE, INLETMETERING VALVE)



2) FUEL FILTER WARNING LAMP, IMMOBILIZER, SENSOR (FUEL PRESSURE, CAM SHAFT, BOOSTER PRESSURE, CRANK SHAFT, KNOCK, WATER PUMP, FUEL TEMP)



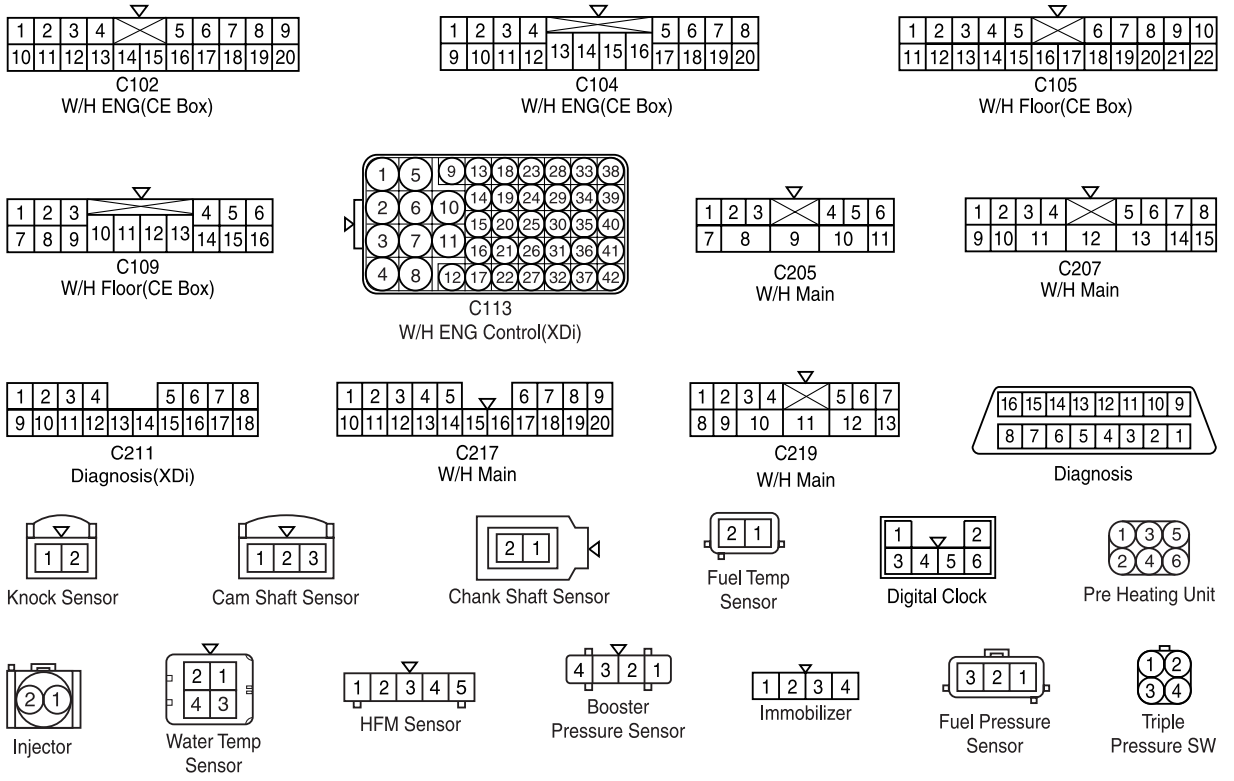
3) INJECTOR, CAN LINE



A. CONNECTOR INFORMATION

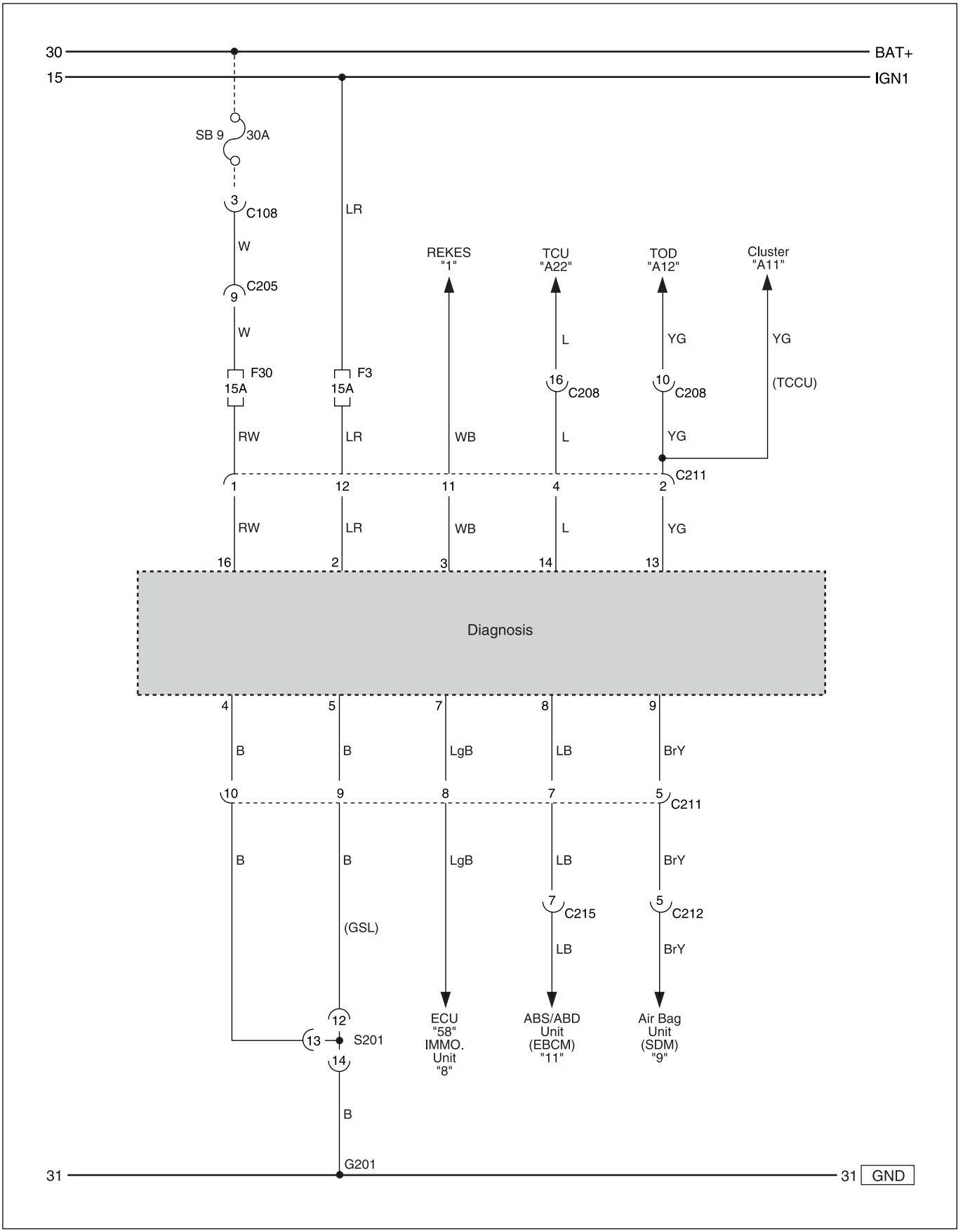
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C113 (42Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	XDi
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C217 (20Pin, Black)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	XDi
S203 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S205 (14Pin, Black)	W/H Main	Behind the Left FATC	GND
G101	W/H Engine	Center the Engine Room Fuse Box	
G201	W/H Main	Inside Driver Side Cowl PNL	
G205	W/H Main	Inside Co-Driver Side Cowl PNL	GSL

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

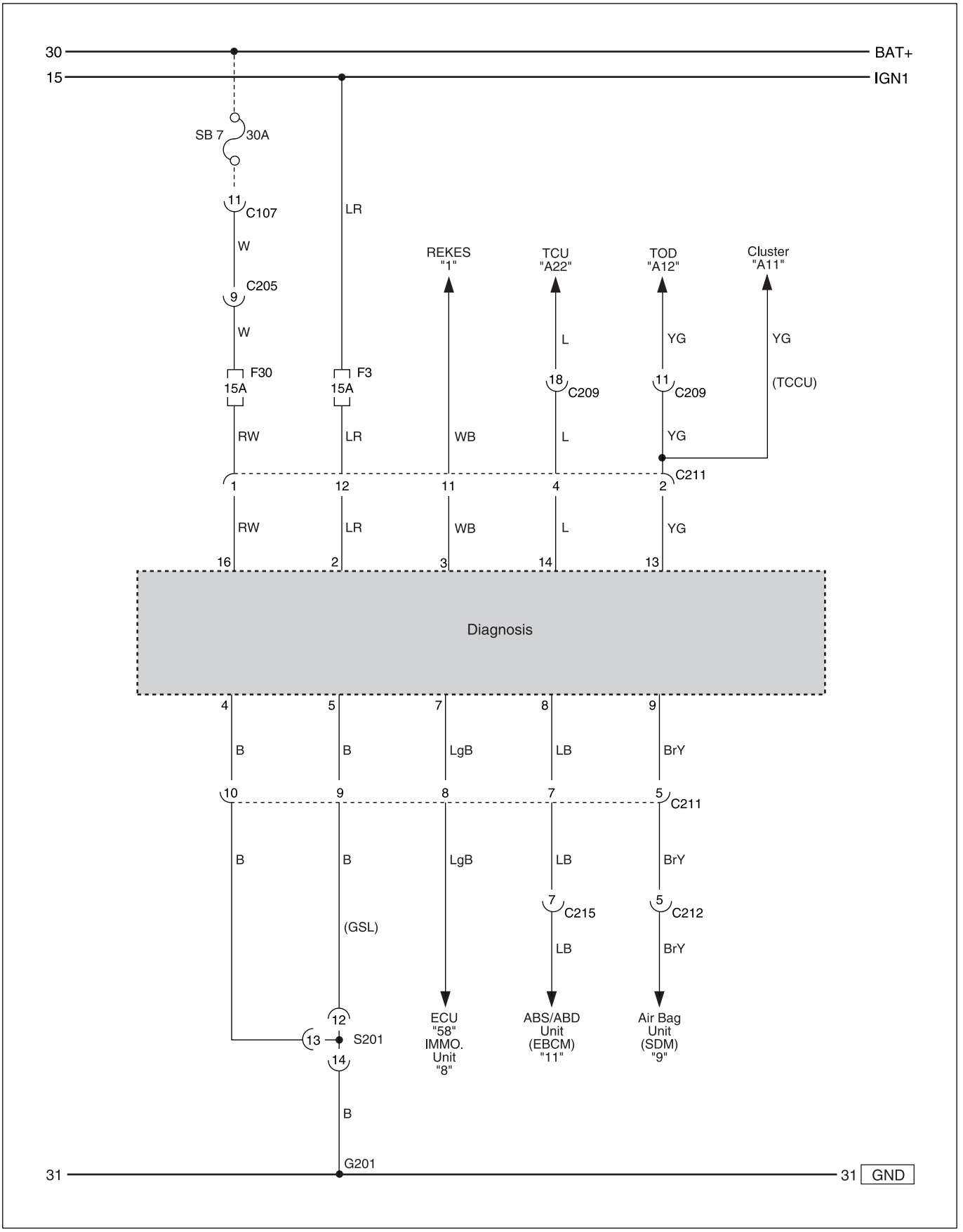


7. DIAGNOSIS CIRCUIT

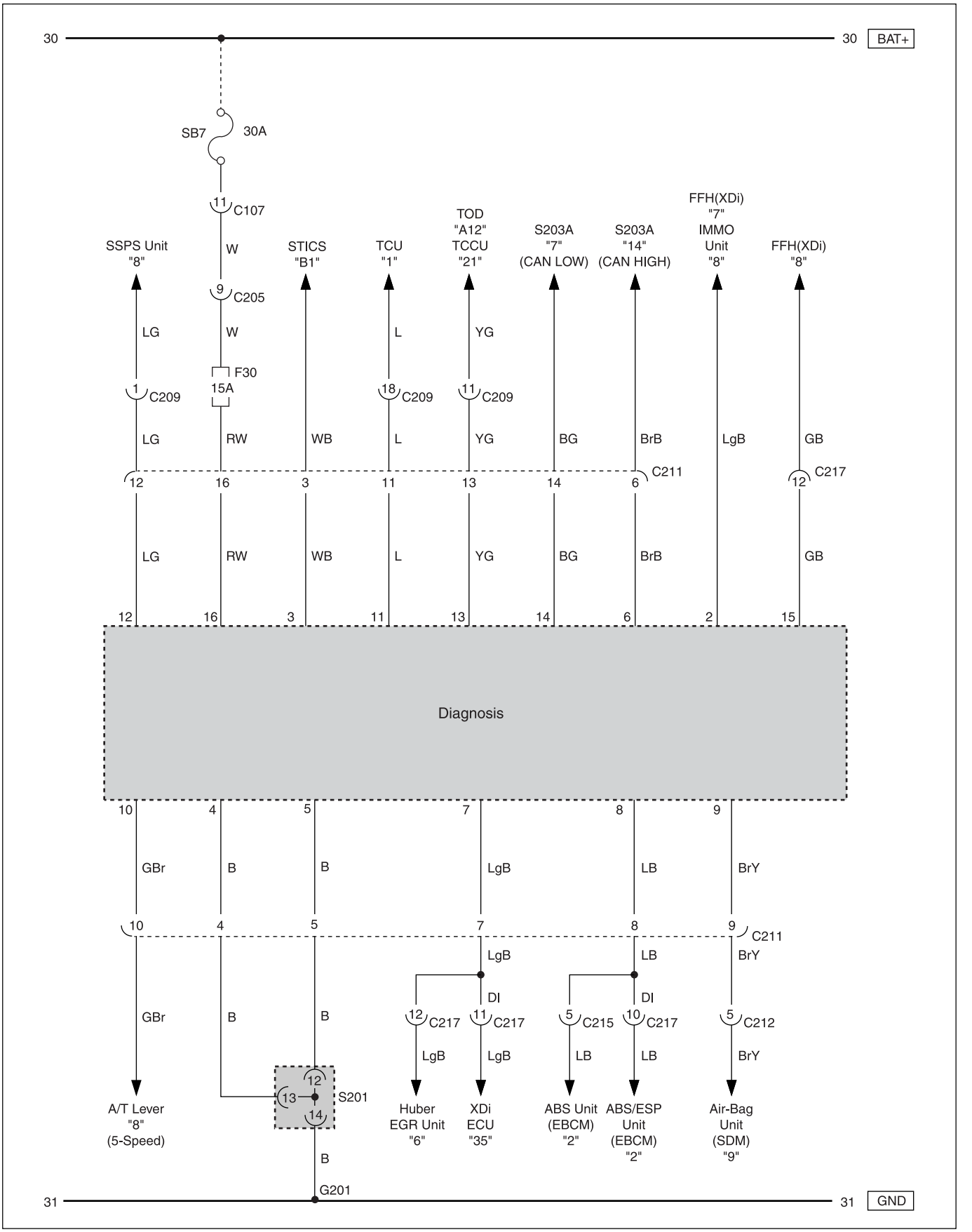
1) ~ 2002 MODEL



2) 2003 MODEL ~


30
BAT+
15
IGN1
SB 7
30A
11
C107
W
9
C205
W
F30
15A
F3
15A
LR
REKES
"1"
TCU
"A22"
TOD
"A12"
Cluster
"A11"
L
YG
YG
18
C209
11
C209
(TCCU)
RW
LR
WB
L
YG
C211
1
12
11
4
2
RW
LR
WB
L
YG
16
2
3
14
13
Diagnosis
4
5
7
8
9
B
B
LgB
LB
BrY
10
9
8
7
5
C211
B
B
LgB
LB
BrY
(GSL)
7
C215
5
C212
LB
BrY
12
13
S201
14
ECU
"58"
IMMO.
Unit
"8"
ABS/ABD
Unit
(EBCM)
"11"
Air Bag
Unit
(SDM)
"9"
B
G201
31
31
GND

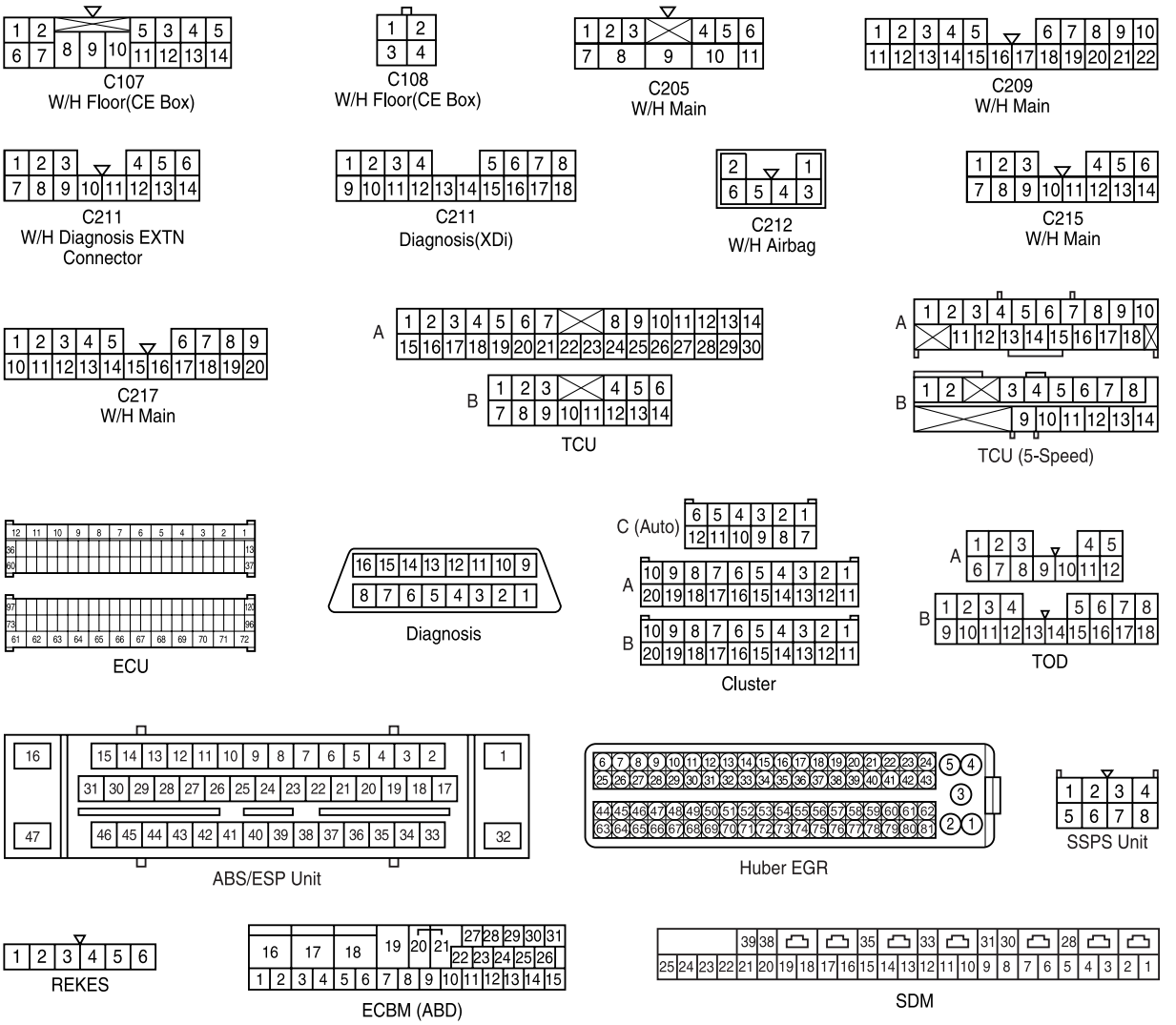
3) XDi


30
30 BAT+
SB7
30A
11 C107
W
9 C205
F30
15A
SSPS Unit "8"
STICS "B1"
TCU "1"
TOD "A12" TCCU "21"
S203A "7" (CAN LOW)
S203A "14" (CAN HIGH)
FFH(XDi) "7" IMMO Unit "8"
FFH(XDi) "8"
LG
W
L
YG
1 C209
18 C209
11 C209
LG
RW
WB
L
YG
BG
BrB
LgB
GB
C211
C217
12 16 3 11 13 14 6 2 15
Diagnosis
10 4 5 7 8 9
GBr
B
B
LgB
LB
BrY
DI
12 C217
11 C217
5 C215
10 C217
5 C212
LgB
LB
BrY
12
13
14
S201
A/T Lever "8" (5-Speed)
Huber EGR Unit "6"
XDi ECU "35"
ABS Unit (EBCM) "2"
ABS/ESP Unit (EBCM) "2"
Air-Bag Unit (SDM) "9"
G201
31
31 GND

A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C211 (18Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	XDi
C212 (6Pin, White)	Main - Air-Bag	Behind the Cluster (Inside Dash PNL)	
C215 (14Pin, White)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	ABS, ABD
C217 (20Pin, Black)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
G201	W/H Main	Inside Driver Side Cowl PNL	

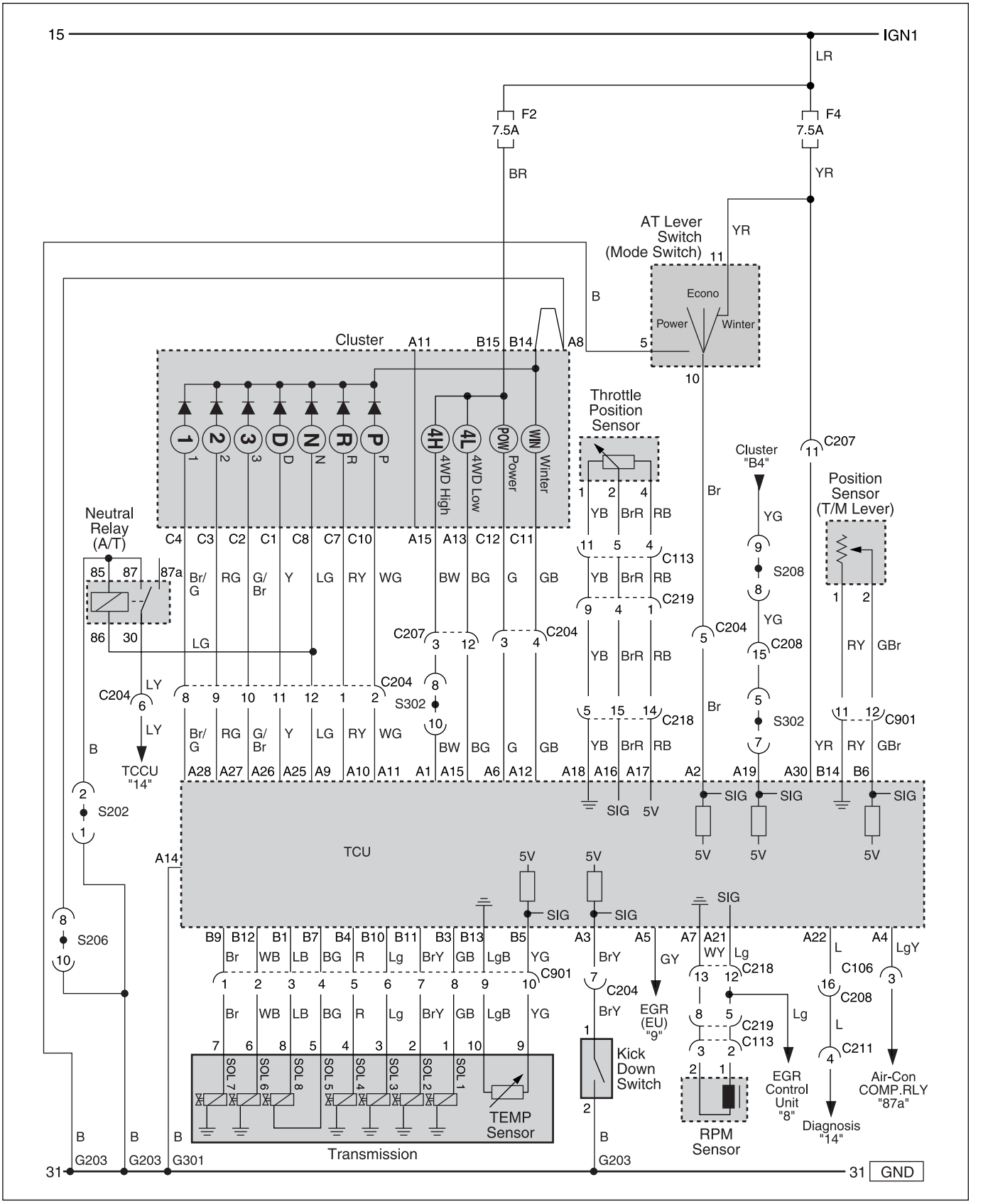
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



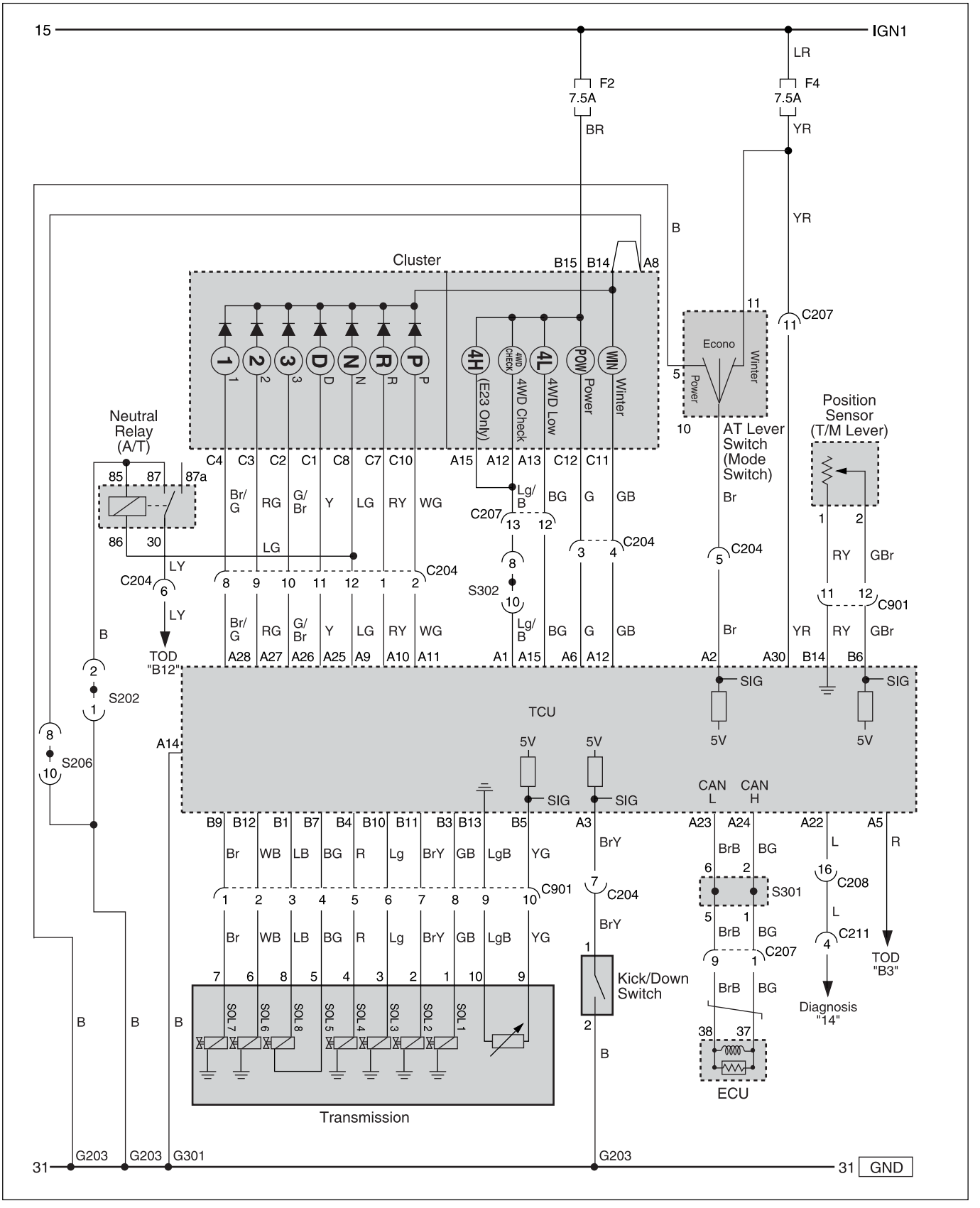
8. TCU (TRANSMISSION CONTROL UNIT) (4-SPEED)

1) ~ 2002 MODEL

(1) DSL

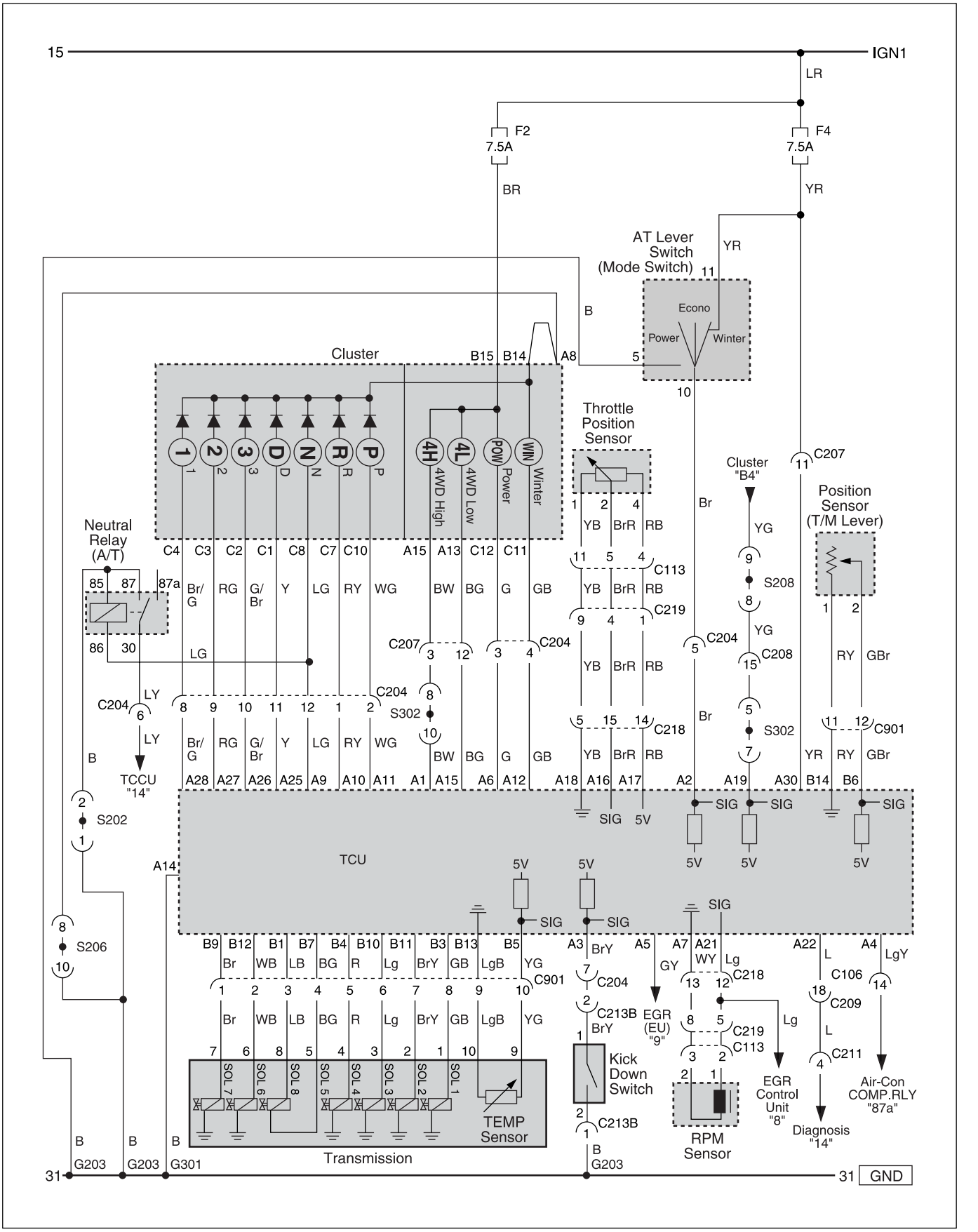


(2) GSL

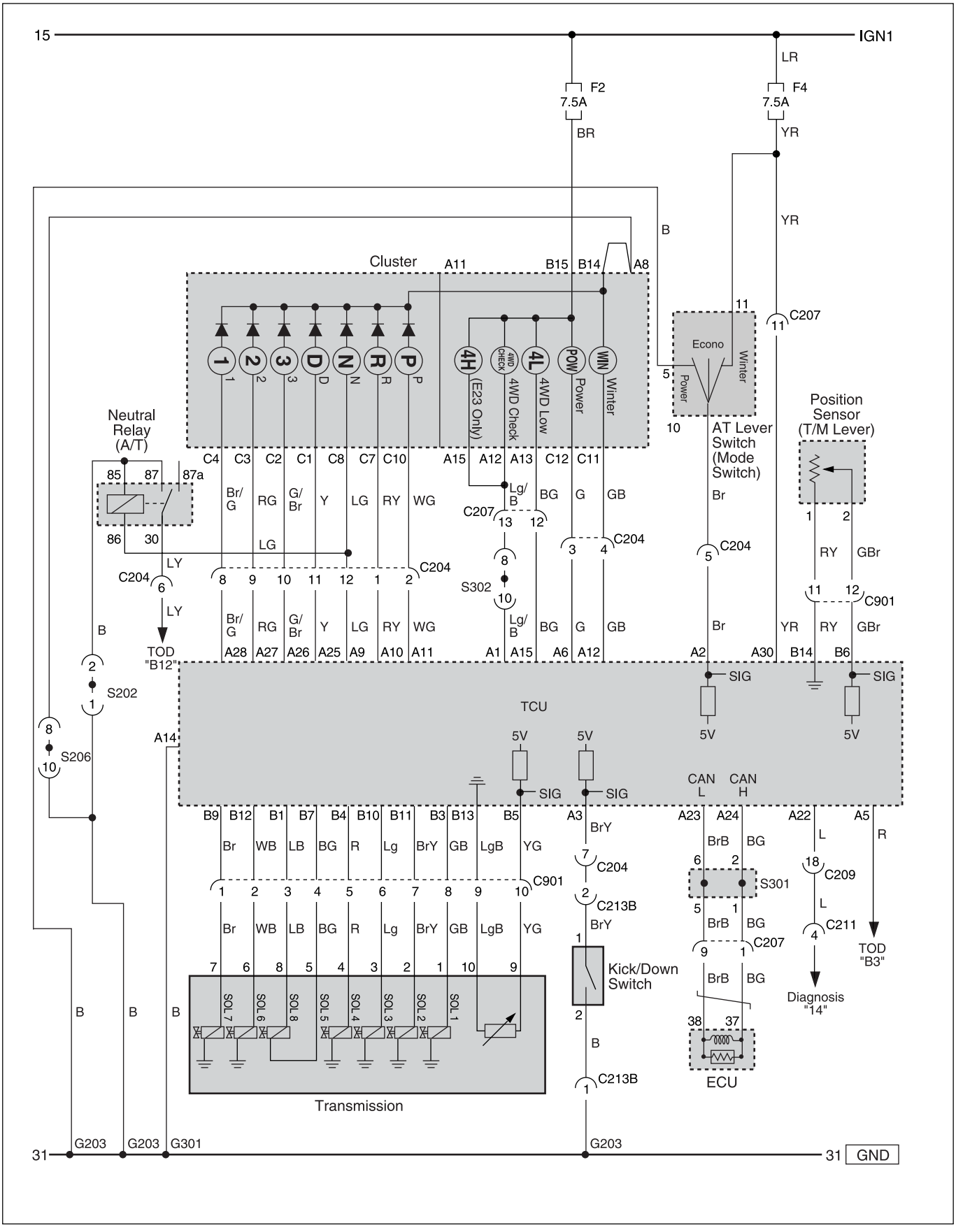

15
IGN1
LR
F2
7.5A
F4
7.5A
BR
YR
B
YR
Cluster
B15 B14 A8
1 2 3 D N R P
4H (E23 Only)
4WD CHECK
4L
POW
WIN
4WD Check
4WD Low
Power
Winter
11
C207
11
Econo
Power
Winter
5
10
AT Lever Switch (Mode Switch)
Position Sensor (T/M Lever)
Neutral Relay (A/T)
85 87 87a
86 30
C4 C3 C2 C1 C8 C7 C10
A15 A12 A13 C12 C11
Br/G RG G/Br Y LG RY WG
Lg/B BG G GB
C207 13 12
C204 3 4
C204 5
Br
1 2
RY GBr
LG
LY
C204 6
C204 8 9 10 11 12 1 2
8
S302
10
C901 11 12
LY
Br/G RG G/Br Y LG RY WG
Lg/B BG G GB
Br YR RY GBr
B
TOD "B12"
A28 A27 A26 A25 A9 A10 A11
A1 A15 A6 A12
A2 A30 B14 B6
2
S202
1
SIG
SIG
8
S206
10
TCU
A14
5V 5V
5V 5V
SIG SIG
CAN L
CAN H
B9 B12 B1 B7 B4 B10 B11 B3 B13 B5 A3
A23 A24 A22 A5
Br WB LB BG R Lg BrY GB LgB YG
BrY
BrB BG
L R
6 2
S301
16
C208
1 2 3 4 5 6 7 8 9 10 C901
7
C204
5 1
L
BrY
BrB BG
C211
4
1
9 1
C207
TOD "B3"
Kick/Down Switch
BrB BG
Diagnosis "14"
7 6 8 5 4 3 2 1 10 9
SOL 7 SOL 6 SOL 8 SOL 5 SOL 4 SOL 3 SOL 2 SOL 1
2
38 37
B
ECU
Transmission
B B B
31 G203 G203 G301
G203
31 GND

2) 2003 MODEL ~

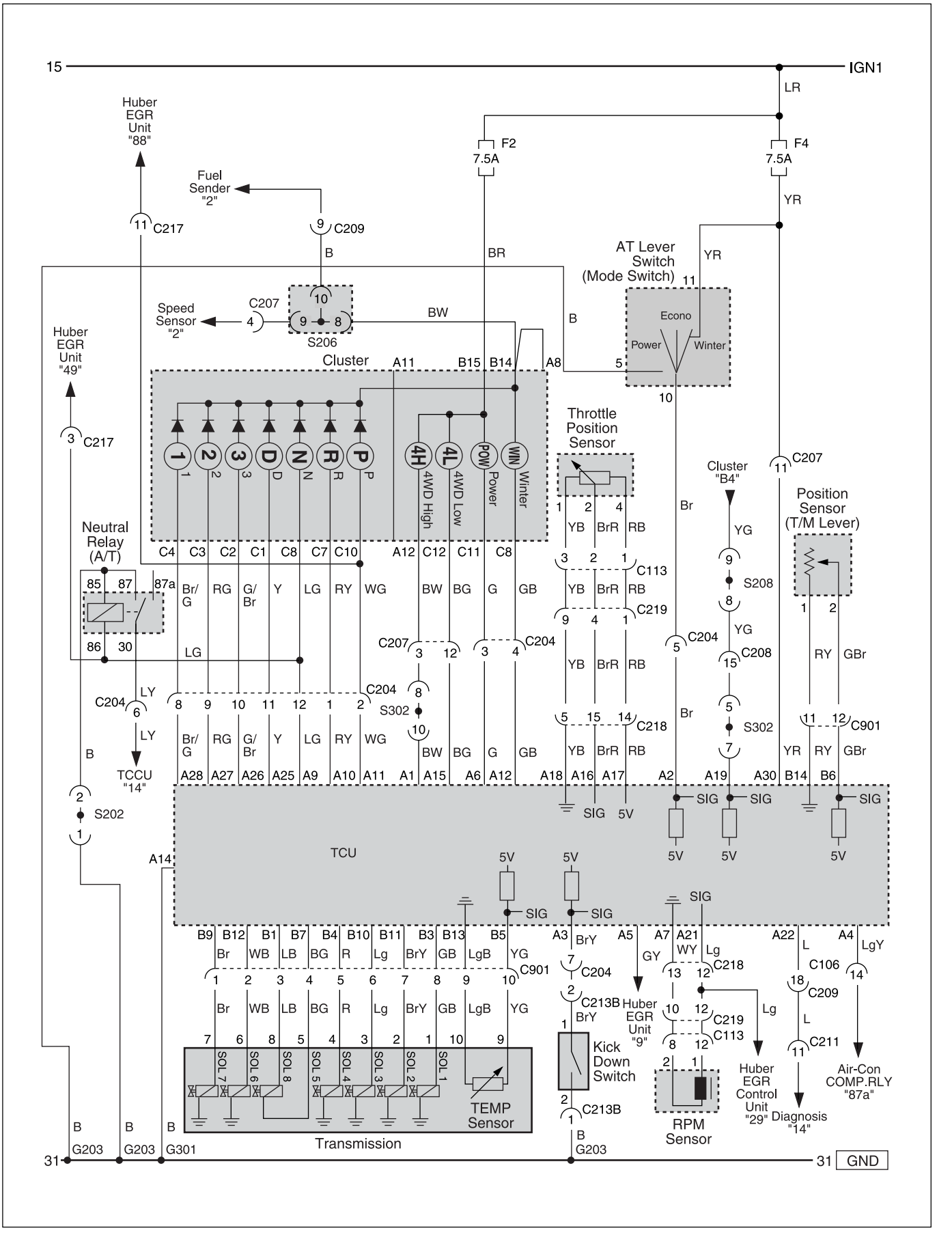
(1) DSL



(2) GSL


15
IGN1
LR
F2
7.5A
F4
7.5A
BR
YR
YR
B
Cluster
A11
B15
B14
A8
1
2
3
D
N
R
P
4H
(E23 Only)
4WD CHECK
4WD Check
4L
4WD Low
POW
Power
WIN
Winter
11
C207
11
Econo
Winter
5
Power
10
AT Lever Switch (Mode Switch)
Position Sensor (T/M Lever)
Neutral Relay (A/T)
85
87
87a
86
30
C4
C3
C2
C1
C8
C7
C10
A15
A12
A13
C12
C11
Br/G
RG
G/Br
Y
LG
RY
WG
Lg/B
BG
G
GB
C207
13
12
C204
3
4
LG
LY
C204
6
8
9
10
11
12
1
2
C204
8
S302
10
Br
C204
5
1
2
RY
GBr
LY
TOD "B12"
A28
A27
A26
A25
A9
A10
A11
A1
A15
A6
A12
A2
A30
B14
B6
11
12
C901
RY
GBr
B
2
S202
1
SIG
SIG
8
S206
10
TCU
A14
5V
5V
5V
5V
SIG
SIG
CAN L
CAN H
B9
B12
B1
B7
B4
B10
B11
B3
B13
B5
A3
A23
A24
A22
A5
Br
WB
LB
BG
R
Lg
BrY
GB
LgB
YG
BrY
BrB
BG
L
R
1
2
3
4
5
6
7
8
9
10
C901
7
C204
6
2
S301
18
C209
2
C213B
BrY
5
1
L
1
7
6
8
5
4
3
2
1
10
9
Kick/Down Switch
BrB
BG
C207
9
1
4
C211
TOD "B3"
SOL 7
SOL 6
SOL 8
SOL 5
SOL 4
SOL 3
SOL 2
SOL 1
2
B
BrB
BG
Diagnosis "14"
38
37
B
B
B
C213B
1
ECU
Transmission
31
G203
G203
G301
G203
31
GND

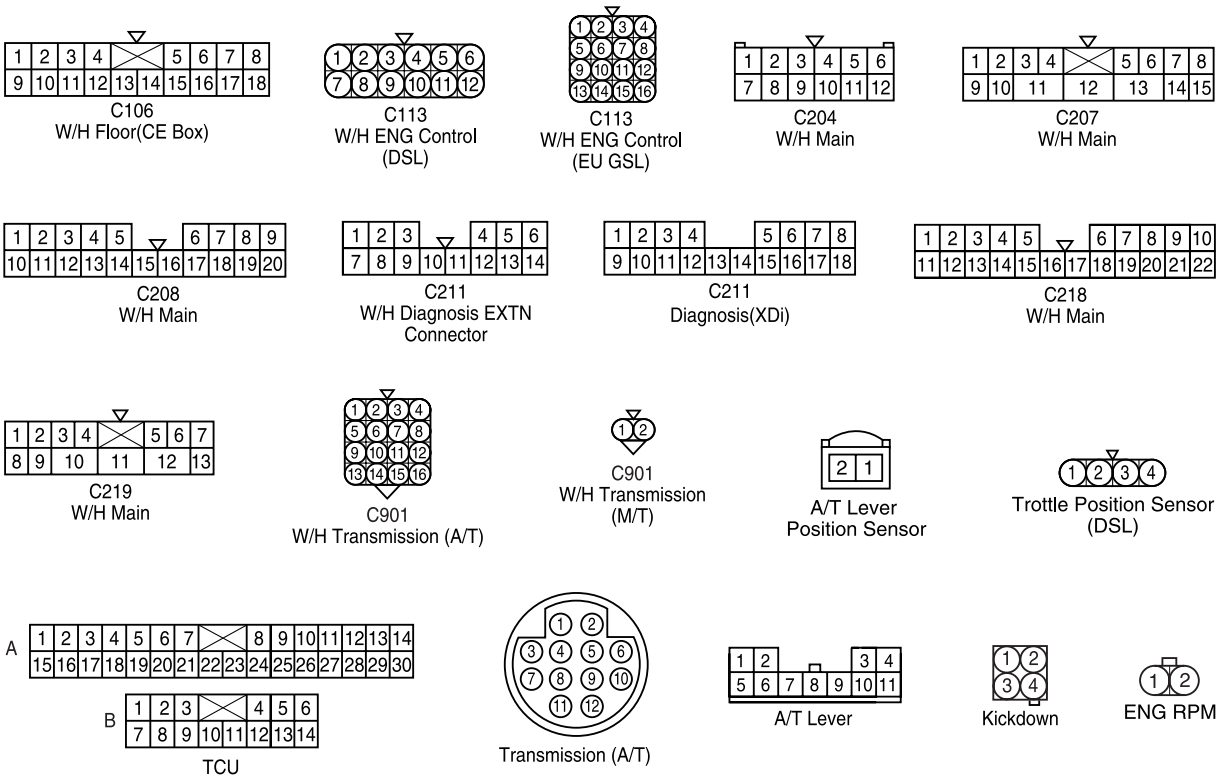
3) 2004 MODEL (DSL)



A. CONNECTOR INFORMATION

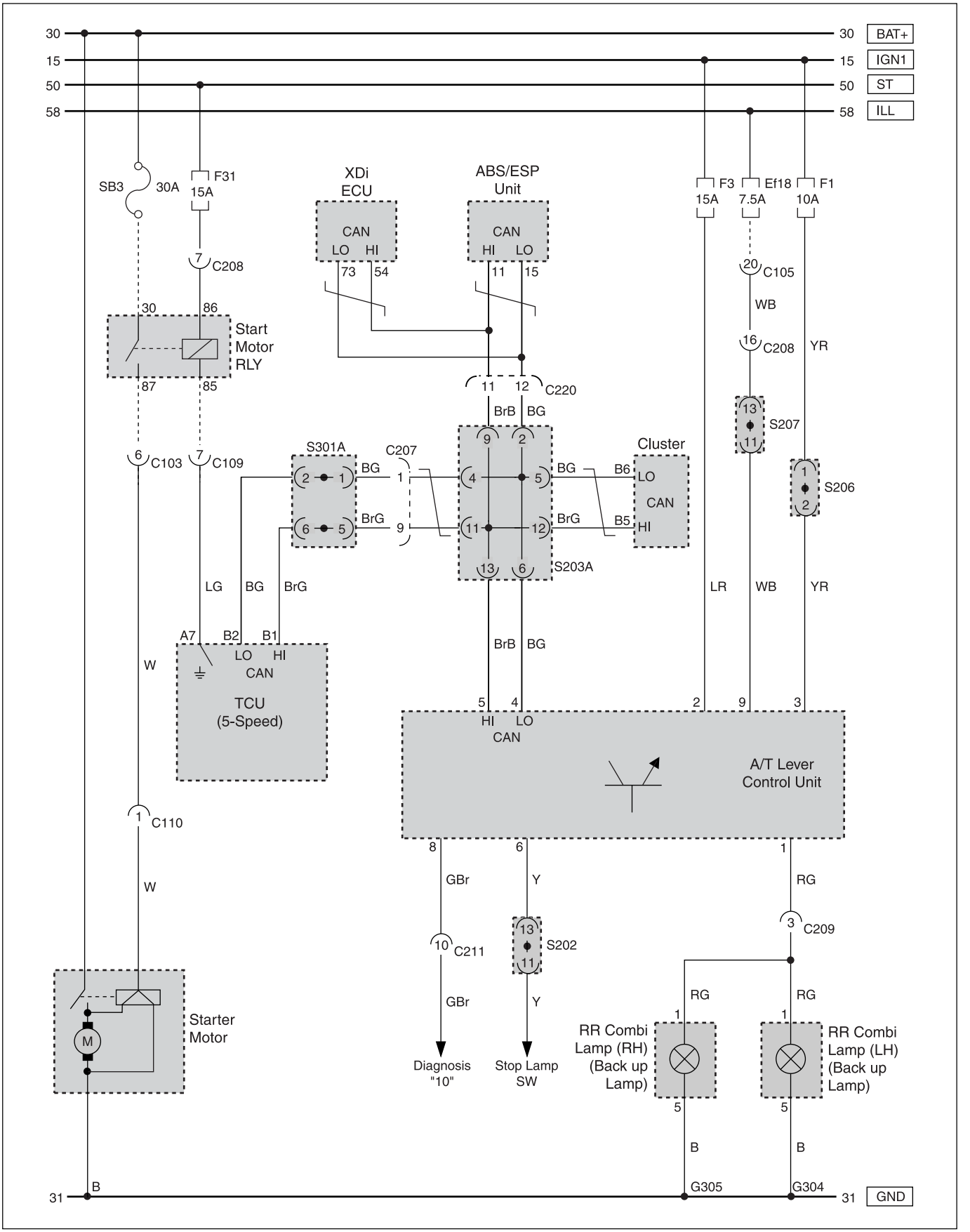
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C113 (12Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	DSL
C113 (16Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	DSL (EU)
C204 (12Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	A/T
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C211 (14Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C901 (16Pin, White)	Floor - T/M	Left the T/C (Under the Floor)	A/T
C901 (2Pin, White)	Floor - T/M	Left the T/C (Under the Floor)	M/T
S202 (14Pin, Black)	W/H Main	Upper the I/P Realy Box	
S208 (14Pin, Black)	W/H Main	Behind the Right the FATC	
G201	W/H Main	Inside Driver Side Cowl PNL	
G203	W/H Main	Under the Seat Heating SW	W/H Air Bag
G301	W/H Floor	Under Driver Seatz	ECU GND

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



9. TCU (5-SPEED)

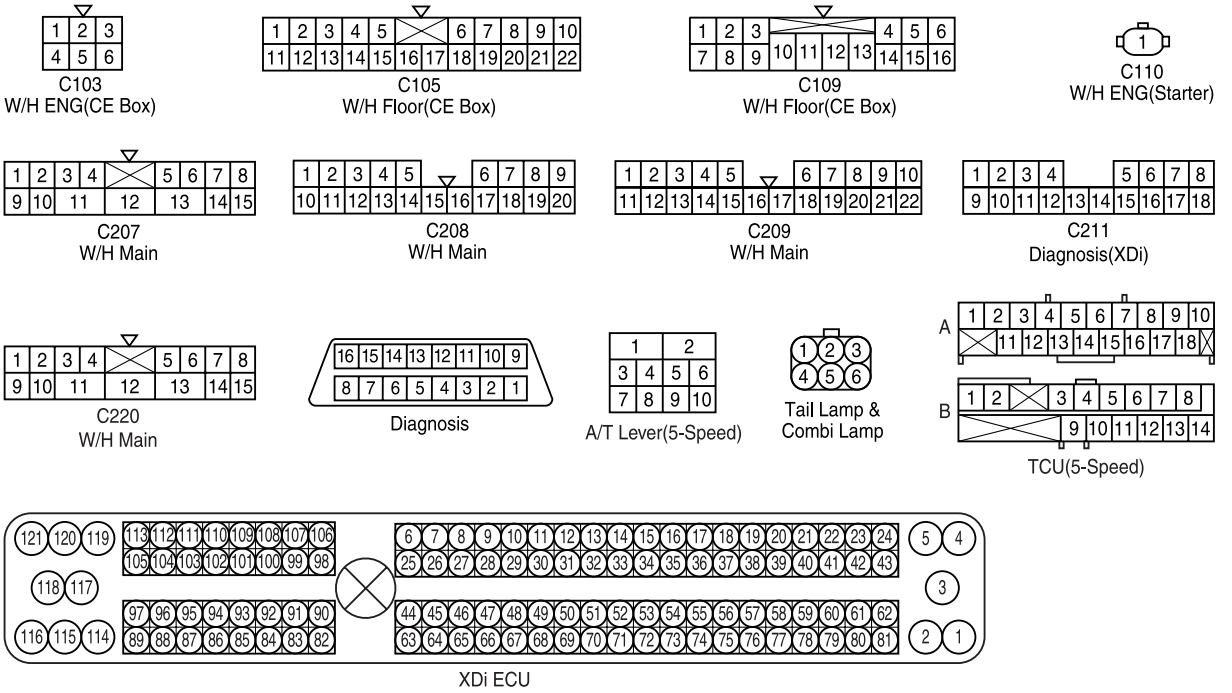
1) START MOTOR, A/T LEVER, CAN LINE



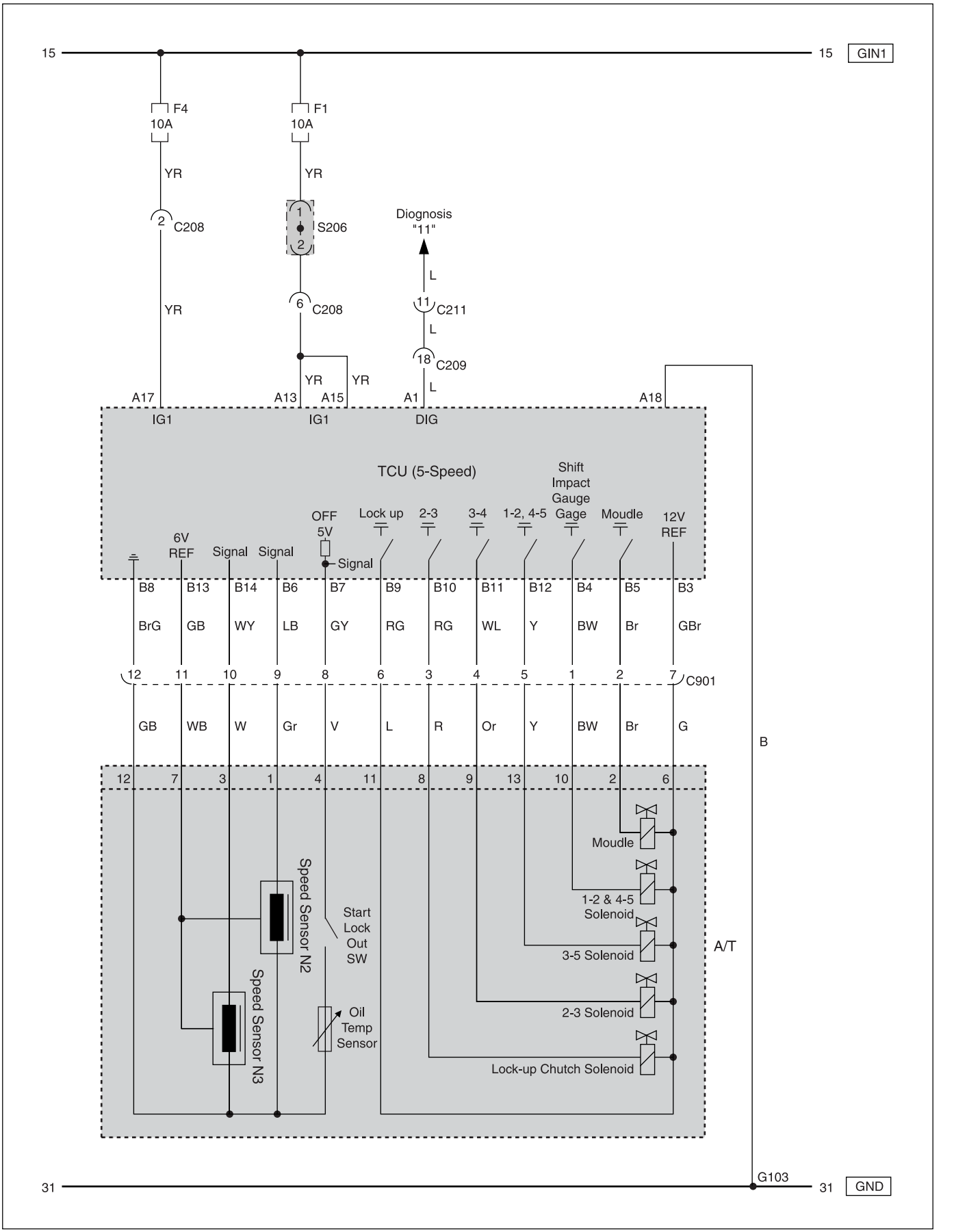
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (6Pin, Colorless)	Engine Room Fuse Box (C) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C110 (1Pin, Gray)	Engine - Starter “ST”	FRT Pre-Heating Unit	
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C211 (18Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	XDi
C220 (15Pin, Blue)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	XDi
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	XDi
S203A (14Pin, Black)	W/H Main	Behind the Left FATC	
S206 (14Pin, Black)	W/H Main	Behind the Left FATC	
S207 (14Pin, Black)	W/H Main	Behind the Right FATC	Tail Lamp
S301 (8Pin, Black)	W/H Floor	Under Driver Seat	CAN (GSL)
G304	W/H Floor	Behind the Quarter Grass #1	
G305	W/H Floor	Behind the Quarter Grass #1	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



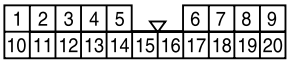
2) SOLENOID OIL TEMP SENSOR, SPEED SENSOR



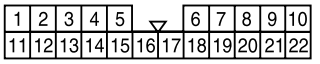
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C211 (18Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	XDi
C901 (12Pin, White)	Floor - T/M	Left the T/C (Under the Floor)	XDi
S207 (14Pin, Black)	W/H Main	Behind the Right FATC	Tail Lamp
G103	W/H Engine	Behind the Left Head Lamp	

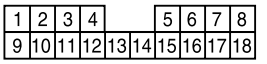
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



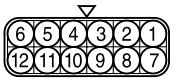
C208
W/H Main



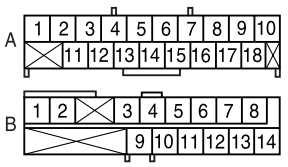
C209
W/H Main



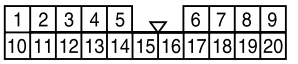
C211
Diagnosis(XDi)



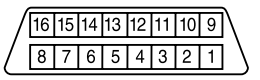
C901
Transmission (A/T)



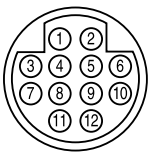
TCU(5-Speed)



Multi Function



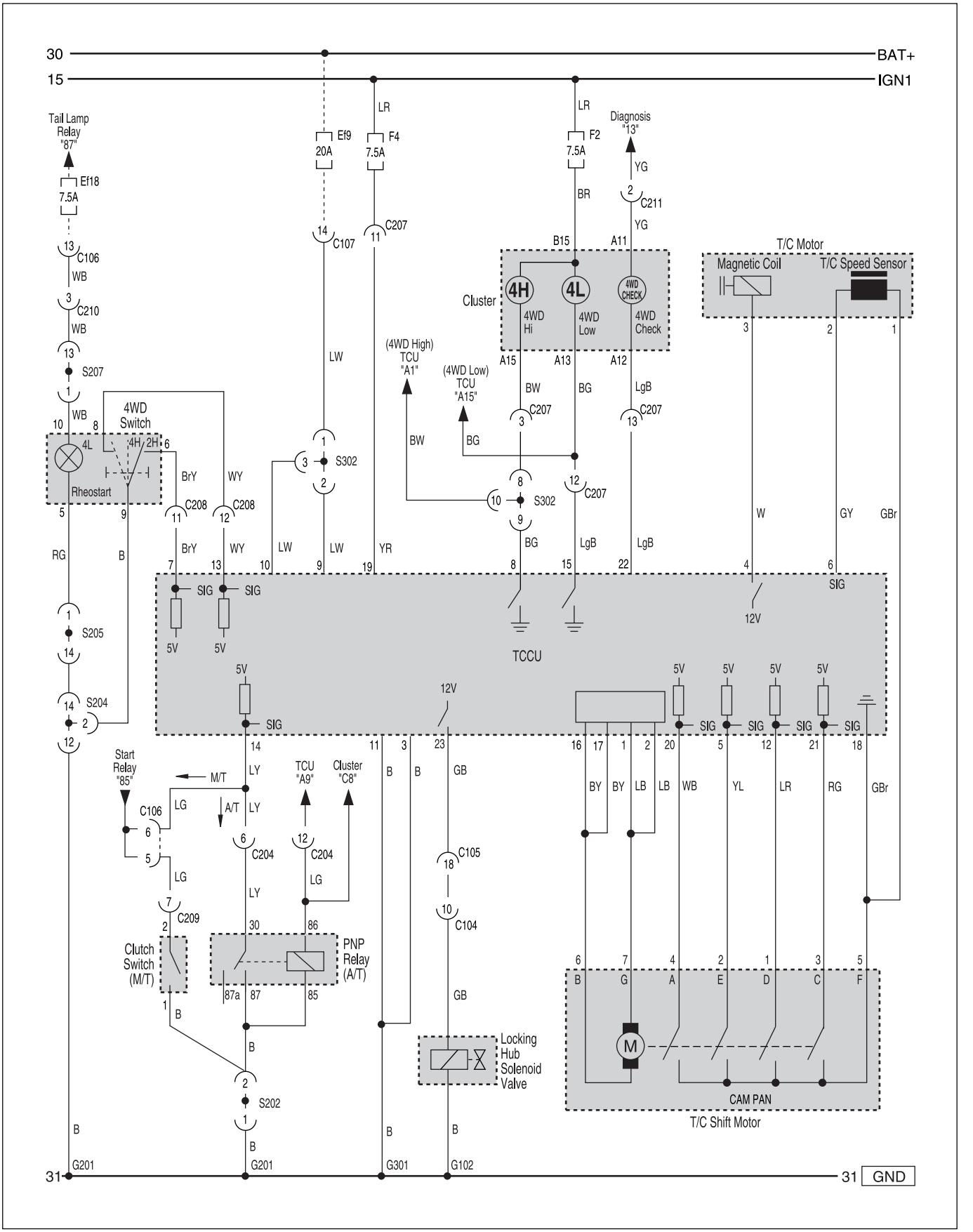
Diagnosis



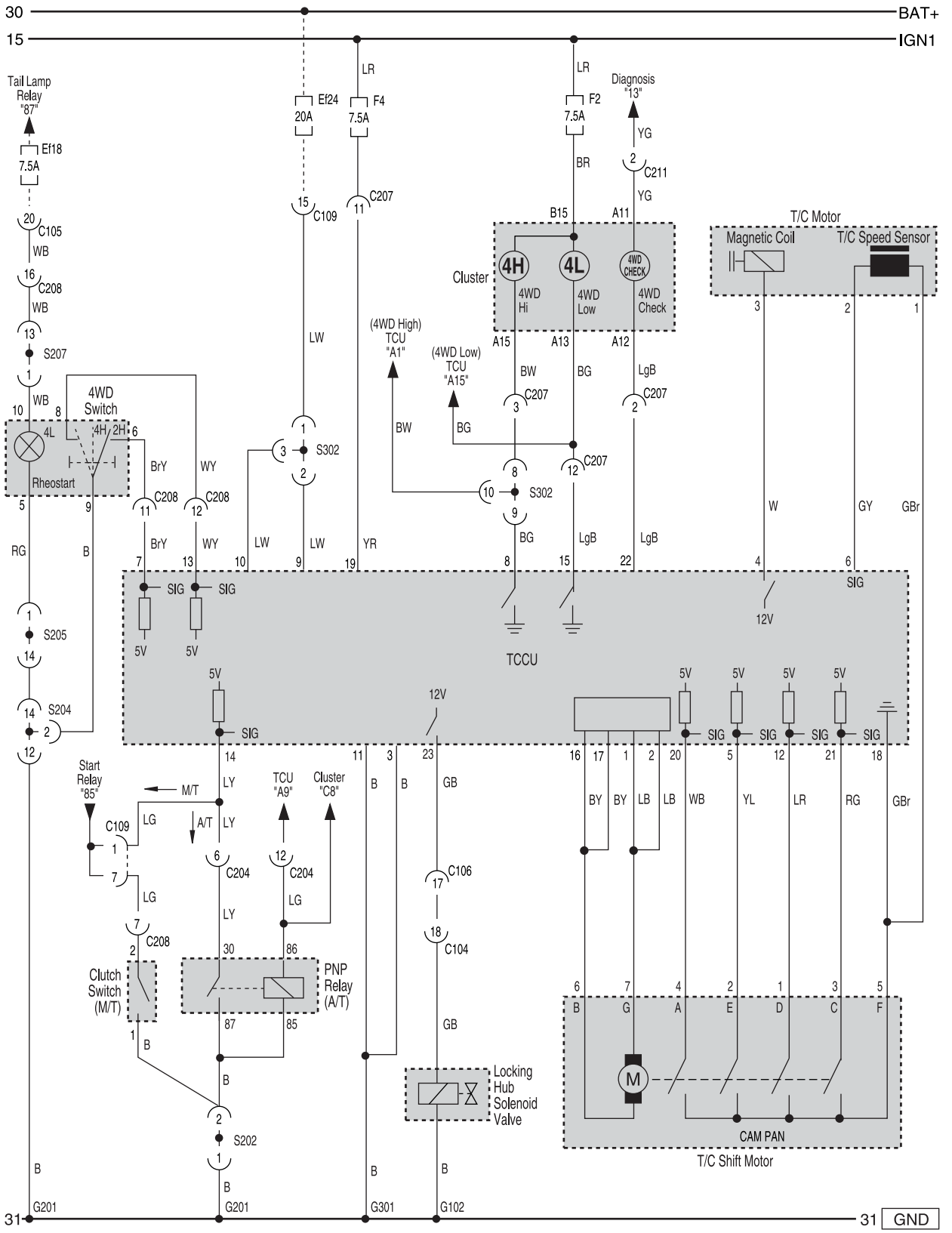
Transmission (A/T)

10. TCCU (TRANSFERCASE CONTROL UNIT)

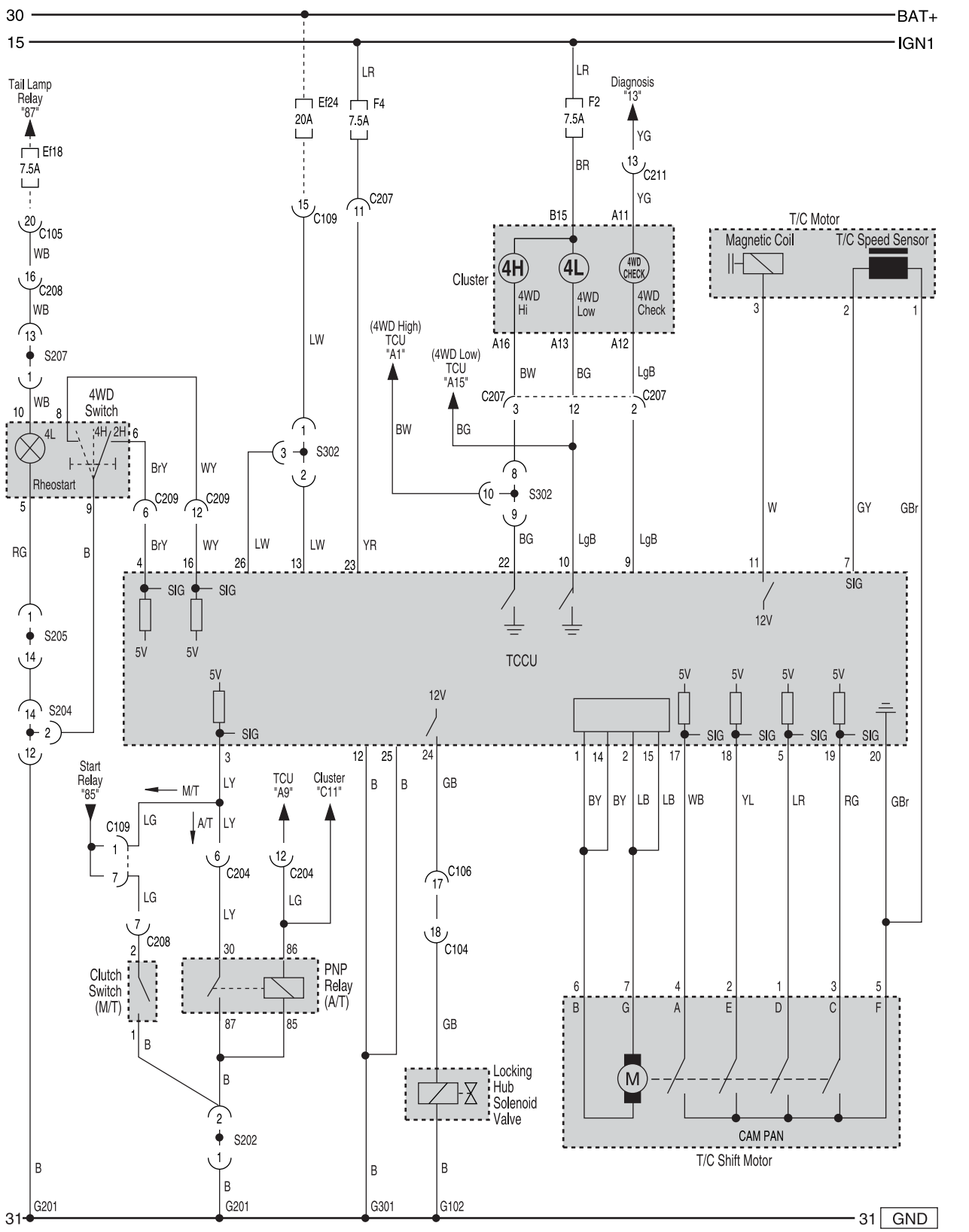
1) ~ 2002 MODEL



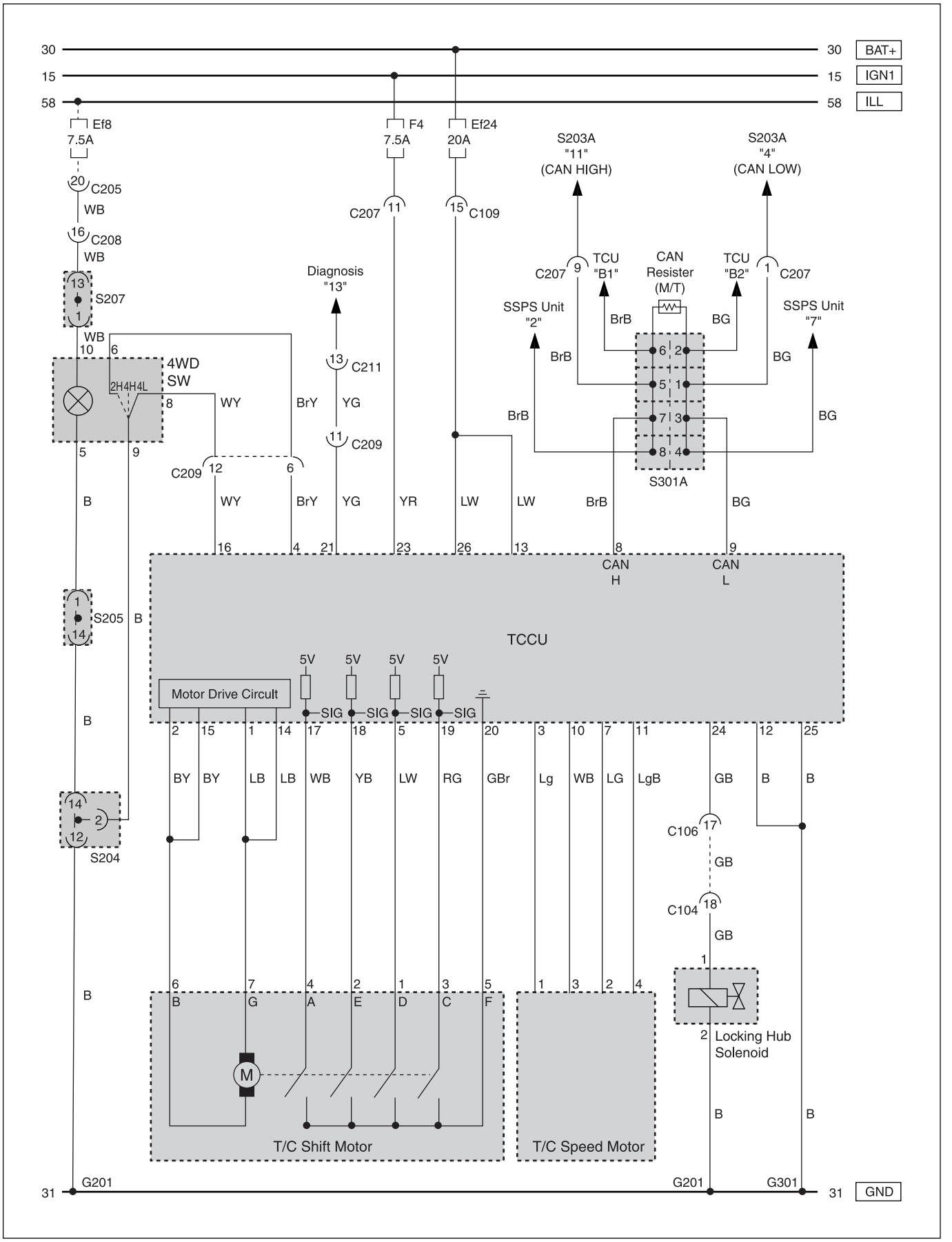
2) 2003 MODEL


30
BAT+
15
IGN1
Tail Lamp Relay "87"
Ef18 7.5A
Ef24 20A
F4 7.5A
F2 7.5A
Diagnosis "13"
C105
C208
C109
C207
C211
WB
LW
LR
BR
YG
B15
A11
Cluster
4H
4L
4WD CHECK
4WD Hi
4WD Low
4WD Check
A15
A13
A12
T/C Motor
Magnetic Coil
T/C Speed Sensor
(4WD High) TCU "A1"
(4WD Low) TCU "A15"
BW
BG
LgB
S207
S205
S204
S302
4WD Switch
4L
4H/2H
Rheostart
BrY
WY
RG
B
W
GY
GBr
SIG
5V
12V
TCCU
Start Relay "85"
M/T
A/T
LY
LG
TCU "A9"
Cluster "C8"
C204
C106
C104
Clutch Switch (M/T)
PNP Relay (A/T)
GB
Locking Hub Solenoid Valve
S202
BY
LB
WB
YL
LR
RG
GBr
CAM PAN
T/C Shift Motor
G201
G301
G102
31
GND

3) 2004 MODEL ~


30
BAT+
15
IGN1
Tail Lamp Relay "87"
Ef18
7.5A
Ef24
20A
F4
7.5A
F2
7.5A
Diagnosis "13"
C105
C208
C109
C207
C211
Cluster
4H
4L
4WD CHECK
4WD Hi
4WD Low
4WD Check
T/C Motor
Magnetic Coil
T/C Speed Sensor
S207
4WD Switch
Rheostart
S302
(4WD High) TCU "A1"
(4WD Low) TCU "A15"
C209
S205
S204
TCCU
12V
5V
SIG
Start Relay "85"
M/T
A/T
TCU "A9"
Cluster "C11"
C204
C106
C104
Clutch Switch (M/T)
PNP Relay (A/T)
Locking Hub Solenoid Valve
S202
T/C Shift Motor
CAM PAN
G201
G301
G102
31
GND

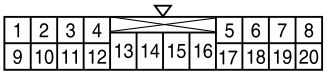
4) XDi


30
15
58
BAT+
IGN1
ILL
Ef8
7.5A
F4
7.5A
Ef24
20A
S203A
"11"
(CAN HIGH)
S203A
"4"
(CAN LOW)
C205
WB
C208
WB
S207
C207
C109
Diagnosis
"13"
C211
C209
TCU
"B1"
CAN
Resister
(M/T)
TCU
"B2"
SSPS Unit
"2"
SSPS Unit
"7"
4WD
SW
2H4H4L
S301A
WY
BrY
YG
YR
LW
BrB
BG
CAN
H
CAN
L
TCCU
Motor Drive Circuit
5V
SIG
BY
LB
WB
YB
RG
GBr
Lg
LG
LgB
GB
S205
S204
C106
C104
Locking Hub
Solenoid
T/C Shift Motor
T/C Speed Motor
G201
G301
GND

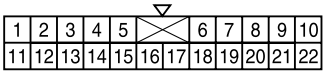
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C204 (12Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	A/T
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Engine - Main (RH)	Inside Driver Side Cowl PNL	
C211 (14Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	
C211 (18Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	XDi
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S205 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S207 (14Pin, Black)	W/H Main	Behind the Right the FATC	Tail Lamp
G102	W/H Engine	Center BATT	
G201	W/H Main	Inside Driver Side Cowl PNL	
G203	W/H Main	Under the Seat Heating SW	W/H Air Bag
G301	W/H Floor	Under Driver Seat	ECU GND

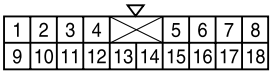
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



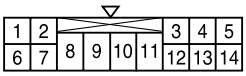
C104
W/H ENG(CE Box)



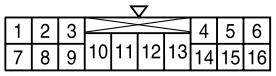
C105
W/H Floor(CE Box)



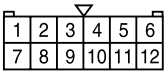
C106
W/H Floor(CE Box)



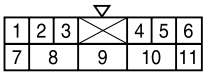
C107
W/H Floor(CE Box)



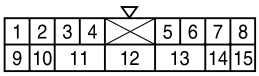
C109
W/H Floor(CE Box)



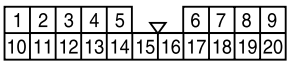
C204
W/H Main



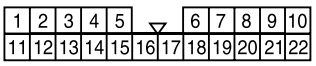
C205
W/H Main



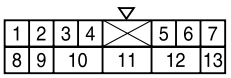
C207
W/H Main



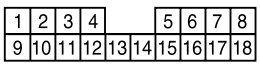
C208
W/H Main



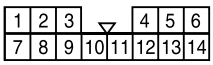
C209
W/H Main



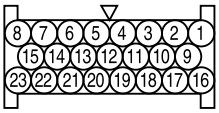
C210
W/H Main



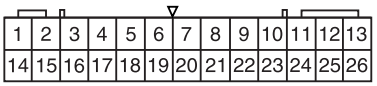
C211
Diagnosis(XDi)



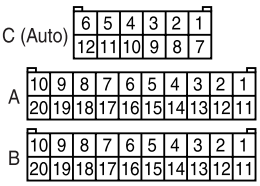
C211
W/H Diagnosis EXTN
Connector



TCCU

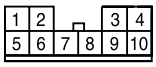


TCCU

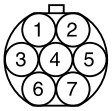


Cluster

Clutch
(M/T)

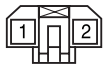


4WD SW



T/C Shift Motor

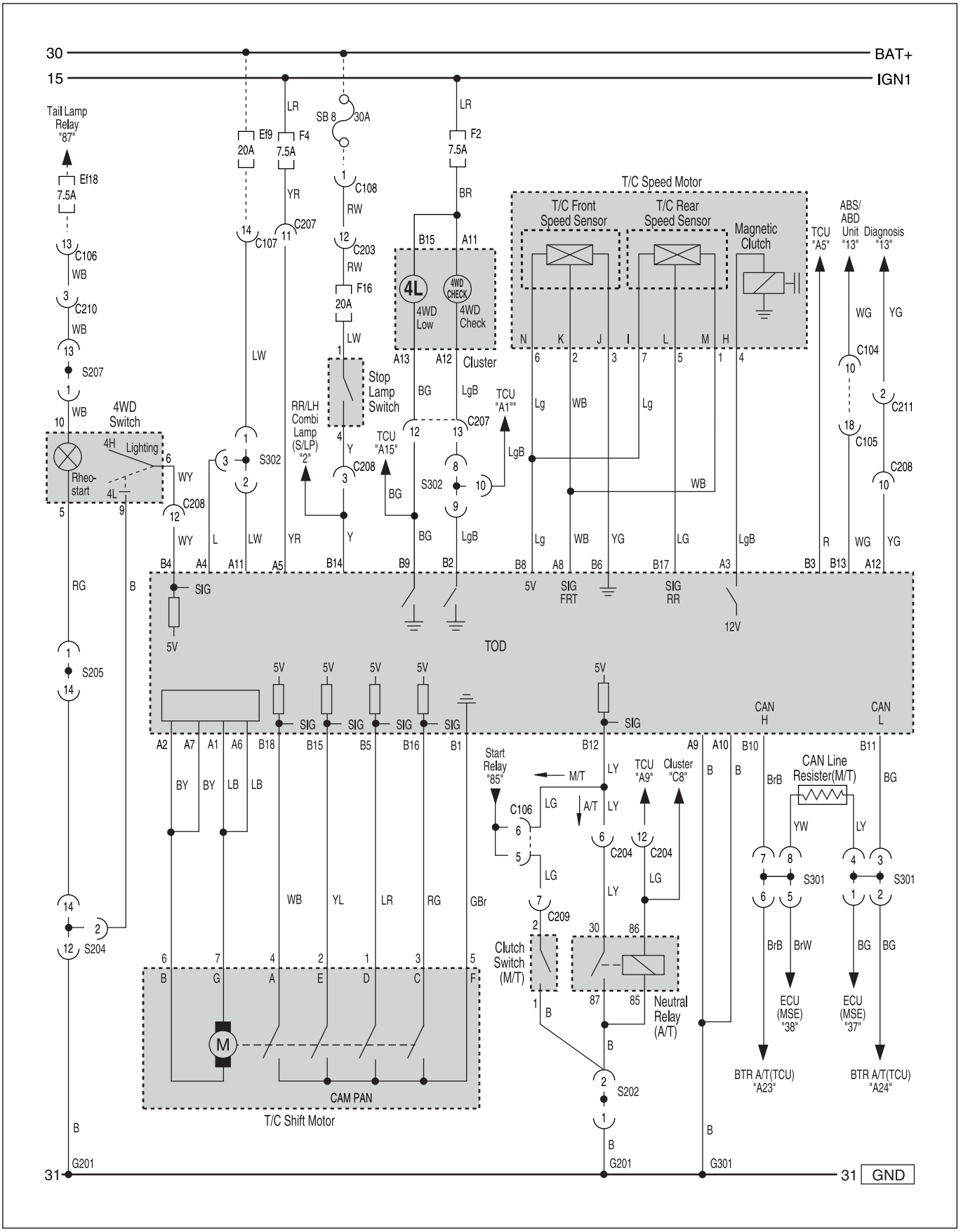
T/C Motor



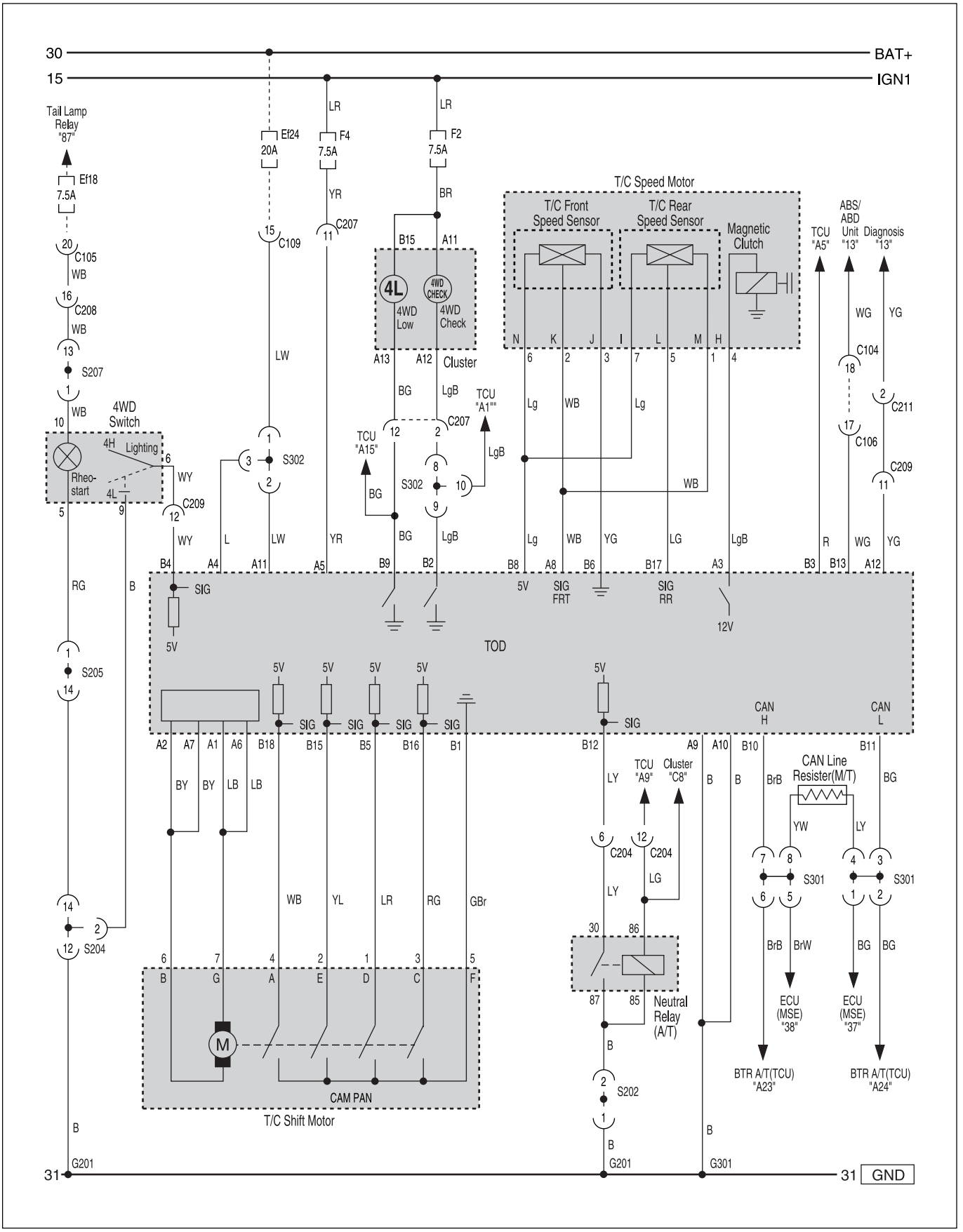
Locking Hub
Solenoid Valve

11. TOD(TORQUE ON DEMAND)

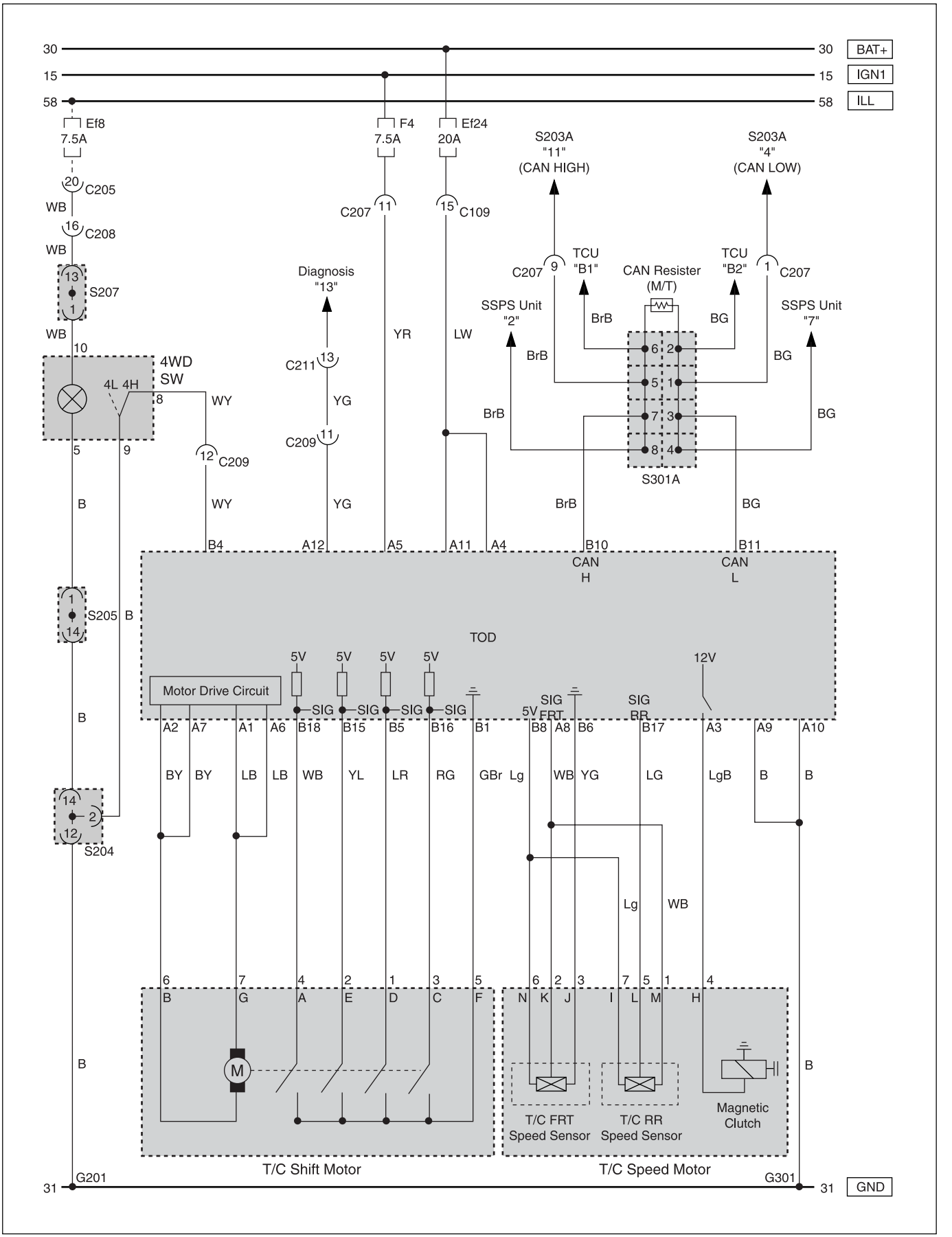
1) ~ 2002 MODEL



2) 2003 MODEL ~


30
BAT+
15
IGN1
Tail Lamp Relay "87"
Ef18
7.5A
20
C105
WB
16
C208
WB
13
S207
1
WB
10
4WD Switch
4H
Lighting
6
WY
Rheo-start
4L
9
5
C209
12
WY
RG
B
1
S205
14
14
2
12
S204
B
G201
31
Ef24
20A
15
C109
LW
1
3
S302
2
LR
F4
7.5A
YR
11
C207
LR
F2
7.5A
BR
B15
A11
4L
4WD Low
4WD CHECK
4WD Check
A13
A12
Cluster
BG
LgB
C207
12
2
TCU "A15"
TCU "A1""
LgB
8
S302
10
BG
9
T/C Speed Motor
T/C Front Speed Sensor
T/C Rear Speed Sensor
Magnetic Clutch
N
K
J
I
L
M
H
6
2
3
7
5
1
4
Lg
WB
Lg
WB
YG
LG
LgB
TCU "A5"
ABS/ ABD Unit "13"
Diagnosis "13"
WG
YG
C104
18
17
C106
2
C211
C209
11
R
WG
YG
B4
A4
A11
A5
B9
B2
B8
A8
B6
B17
A3
B3
B13
A12
SIG
5V
TOD
5V
SIG FRT
SIG RR
12V
5V
5V
5V
5V
SIG
SIG
SIG
SIG
SIG
5V
SIG
A2
A7
A1
A6
B18
B15
B5
B16
B1
B12
A9
A10
B10
B11
CAN H
CAN L
BY
BY
LB
LB
WB
YL
LR
RG
GBr
LY
TCU "A9"
Cluster "C8"
B
B
BrB
CAN Line Resister(M/T)
BG
YW
LY
C204
C204
LG
LY
6
12
7
8
4
3
S301
S301
6
5
1
2
30
86
BrB
BrW
BG
BG
87
85
Neutral Relay (A/T)
ECU (MSE) "38"
ECU (MSE) "37"
6
7
4
2
1
3
5
B
G
A
E
D
C
F
M
CAM PAN
T/C Shift Motor
B
2
S202
1
B
G201
B
G301
BTR A/T(TCU) "A23"
BTR A/T(TCU) "A24"
31
GND

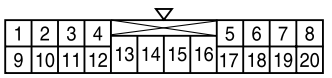
3) XDi


30
15
58
BAT+
IGN1
ILL
Ef8
7.5A
F4
7.5A
Ef24
20A
S203A
"11"
(CAN HIGH)
S203A
"4"
(CAN LOW)
C205
C208
S207
C207
C109
TCU
"B1"
TCU
"B2"
CAN Resister
(M/T)
SSPS Unit
"2"
SSPS Unit
"7"
Diagnosis
"13"
4WD
SW
4L 4H
C209
C211
S301A
S205
S204
TOD
Motor Drive Circuit
5V
SIG
12V
CAN
H
CAN
L
T/C Shift Motor
T/C Speed Motor
T/C FRT
Speed Sensor
T/C RR
Speed Sensor
Magnetic
Clutch
G201
G301
GND

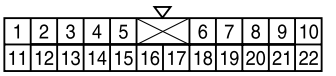
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C204 (12Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	A/T
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C211 (14Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	
C211 (18Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	XDi
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S205 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S207 (14Pin, Black)	W/H Main	Behind the Right the FATC	Tail Lamp
S301 (8Pin, Black)	W/H Floor	Under Driver Seat	CAN (GSL)
G201	W/H Main	Inside Driver Side Cowl PNL	
G301	W/H Floor	Under Driver Seat	ECU GND

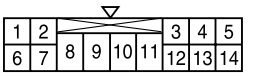
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



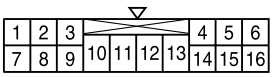
C104
W/H ENG(CE Box)



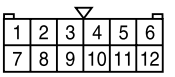
C105
W/H Floor(CE Box)



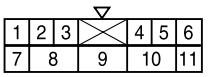
C107
W/H Floor(CE Box)



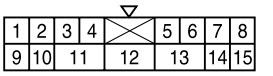
C109
W/H Floor(CE Box)



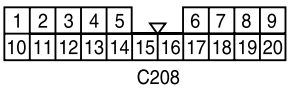
C204
W/H Main



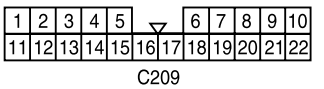
C205
W/H Main



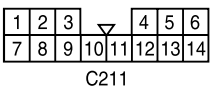
C207
W/H Main



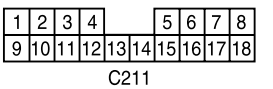
C208
W/H Main



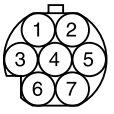
C209
W/H Main



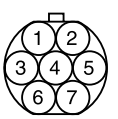
C211
W/H Diagnosis EXTN
Connector



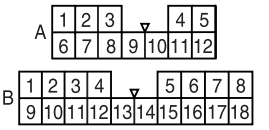
C211
Diagnosis(XDi)



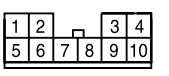
T/C Speed
Sensor



T/C Shift Motor



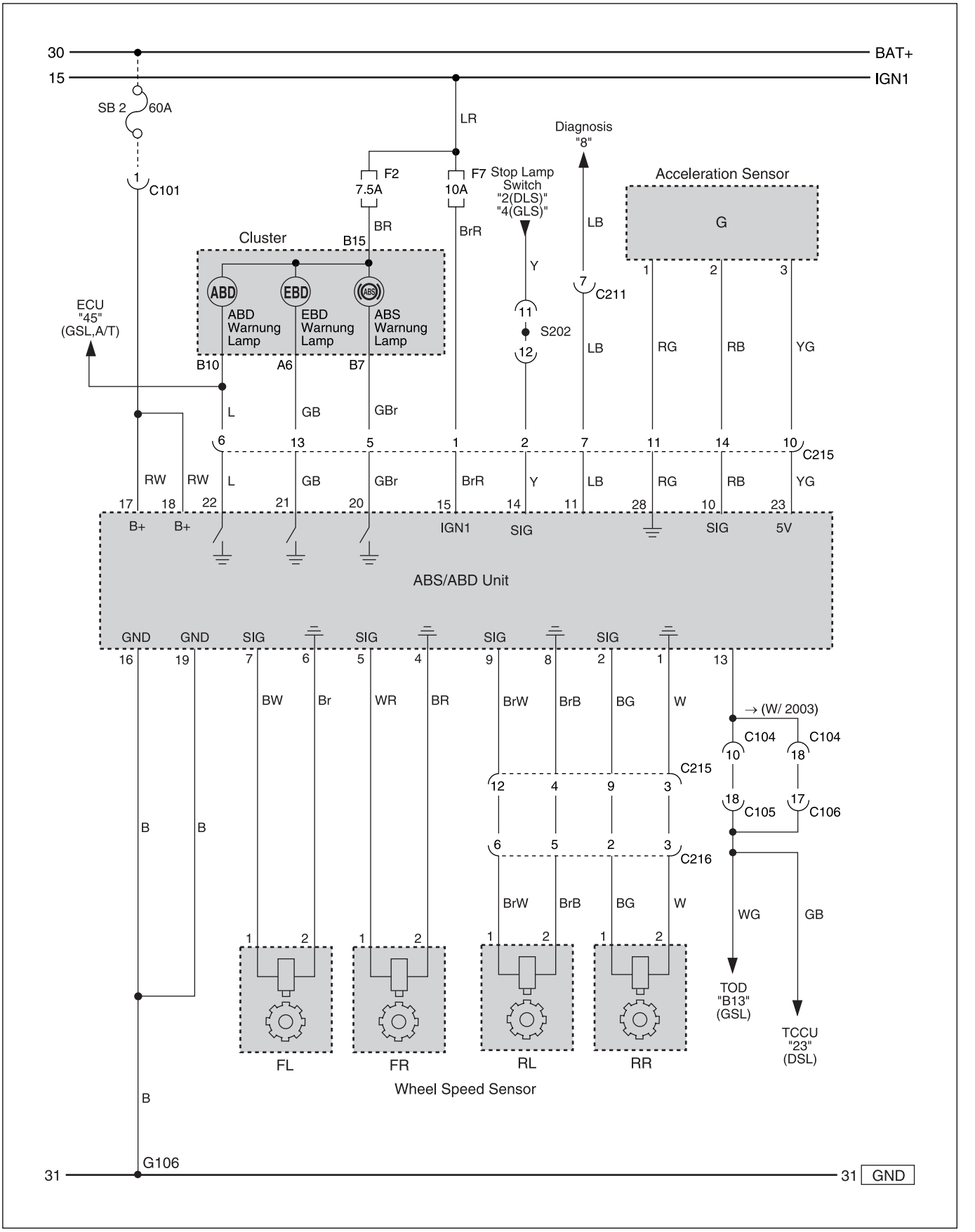
TOD



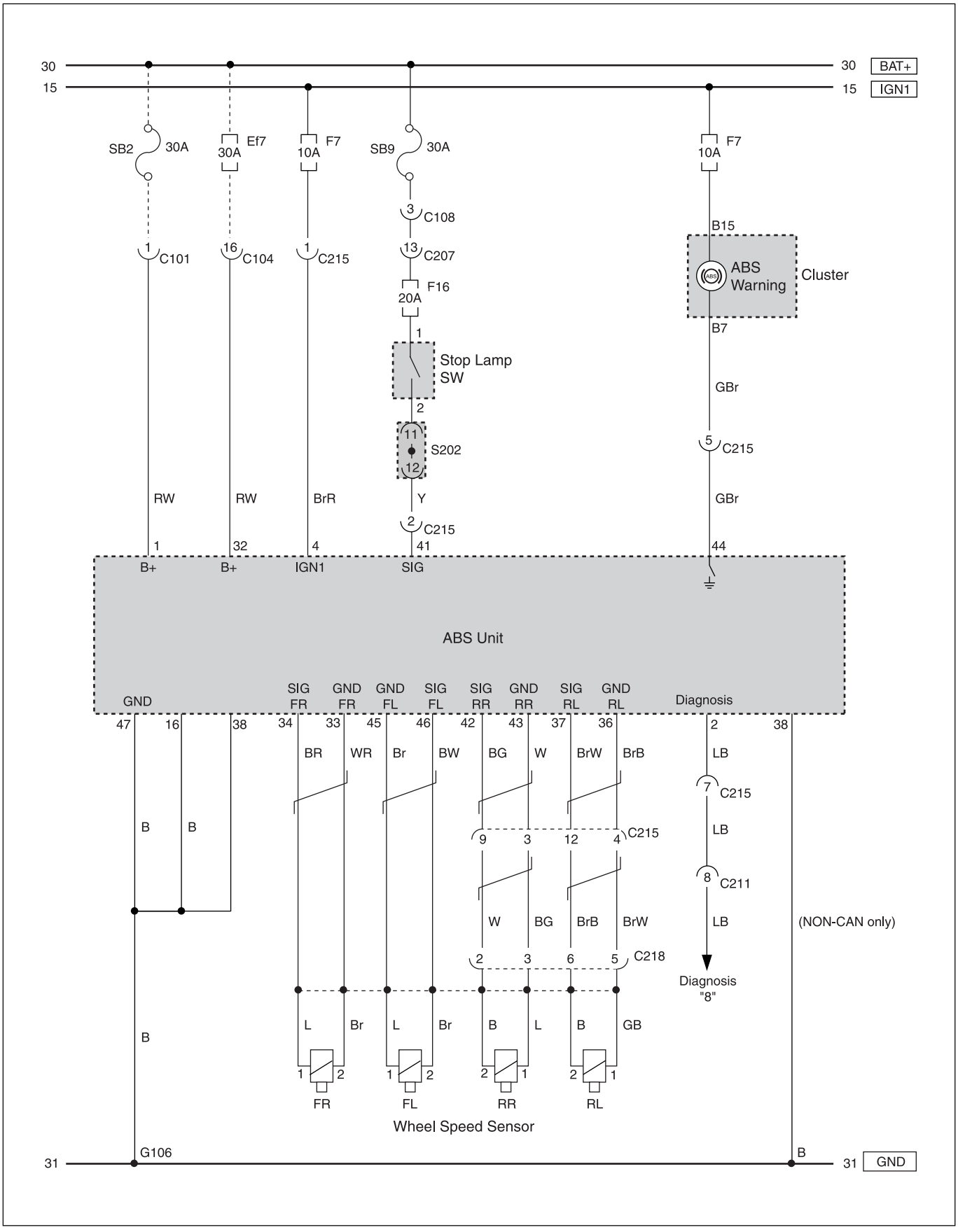
4WD SW

12. BRAKE SYSTEM

1) ABS & ABS/ABD 5.3 II

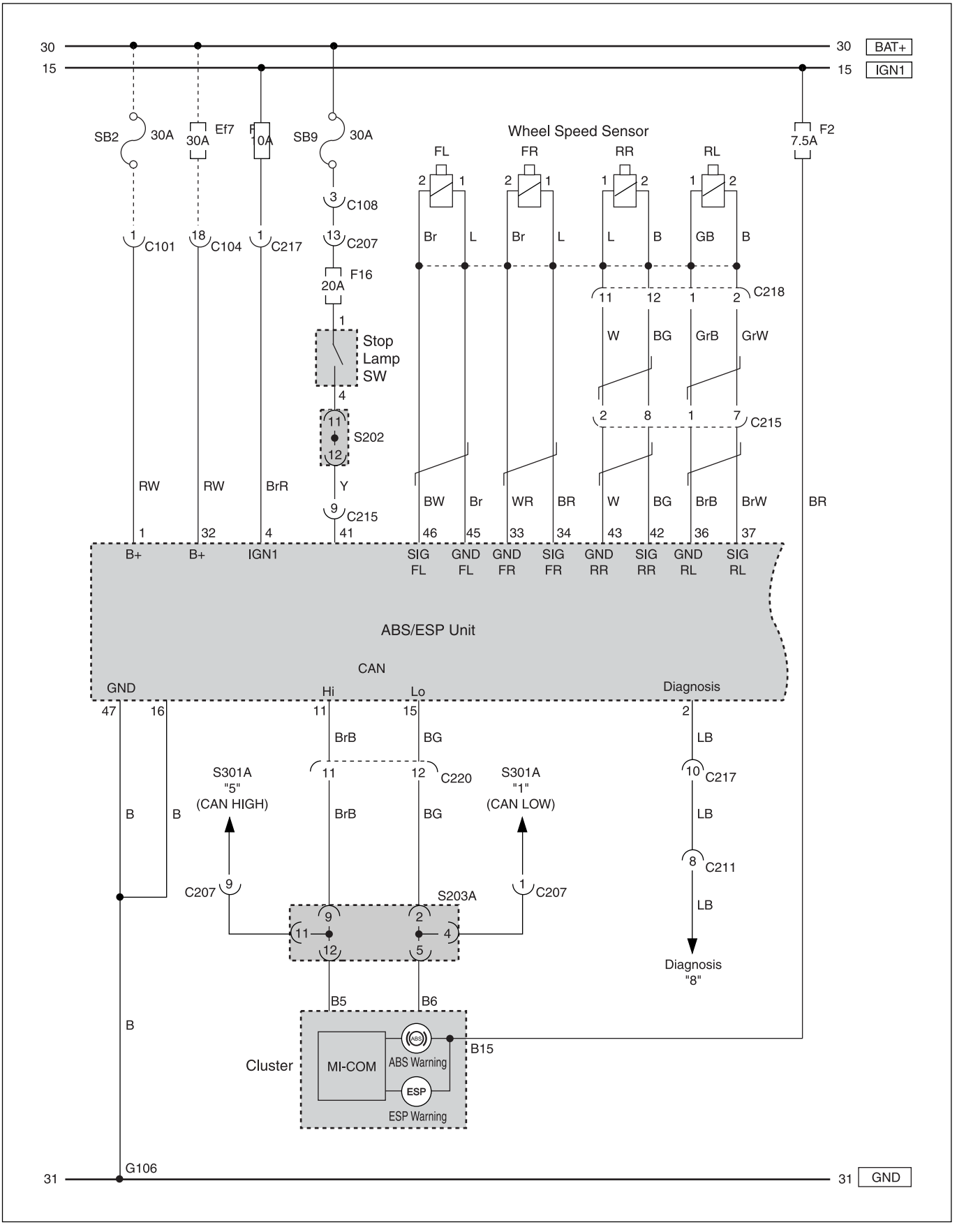


2) ABS(TEVES)

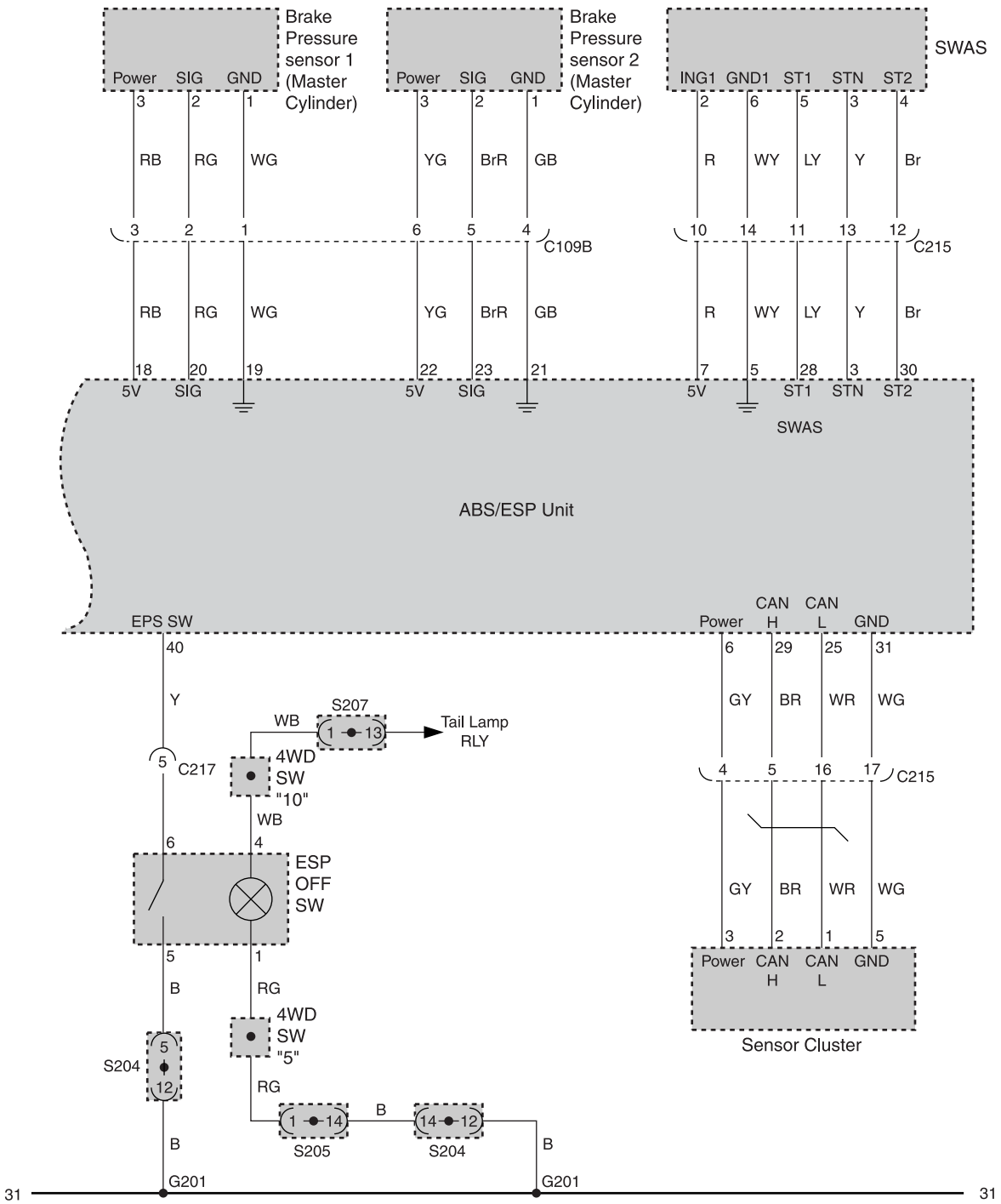

30
15
30 BAT+
15 IGN1
SB2 30A
Ef7 30A
F7 10A
SB9 30A
F7 10A
C101
C104
C215
C108
C207
F16 20A
B15
ABS Warning
Cluster
B7
Stop Lamp SW
GBr
S202
C215
RW
RW
BrR
Y
GBr
B+
B+
IGN1
SIG
ABS Unit
GND
SIG FR
GND FR
GND FL
SIG FL
SIG RR
GND RR
SIG RL
GND RL
Diagnosis
BR
WR
Br
BW
BG
W
BrW
BrB
LB
C215
W
BG
BrB
BrW
C218
LB
C211
LB
(NON-CAN only)
Diagnosis "8"
L
Br
B
L
FR
FL
RR
RL
Wheel Speed Sensor
G106
GND

3) ABS/ESP(TEVES)

(1) WHEEL SPEED SENSOR, STOP LAMP SW, DIAGNOSIS, WARNING LAMP



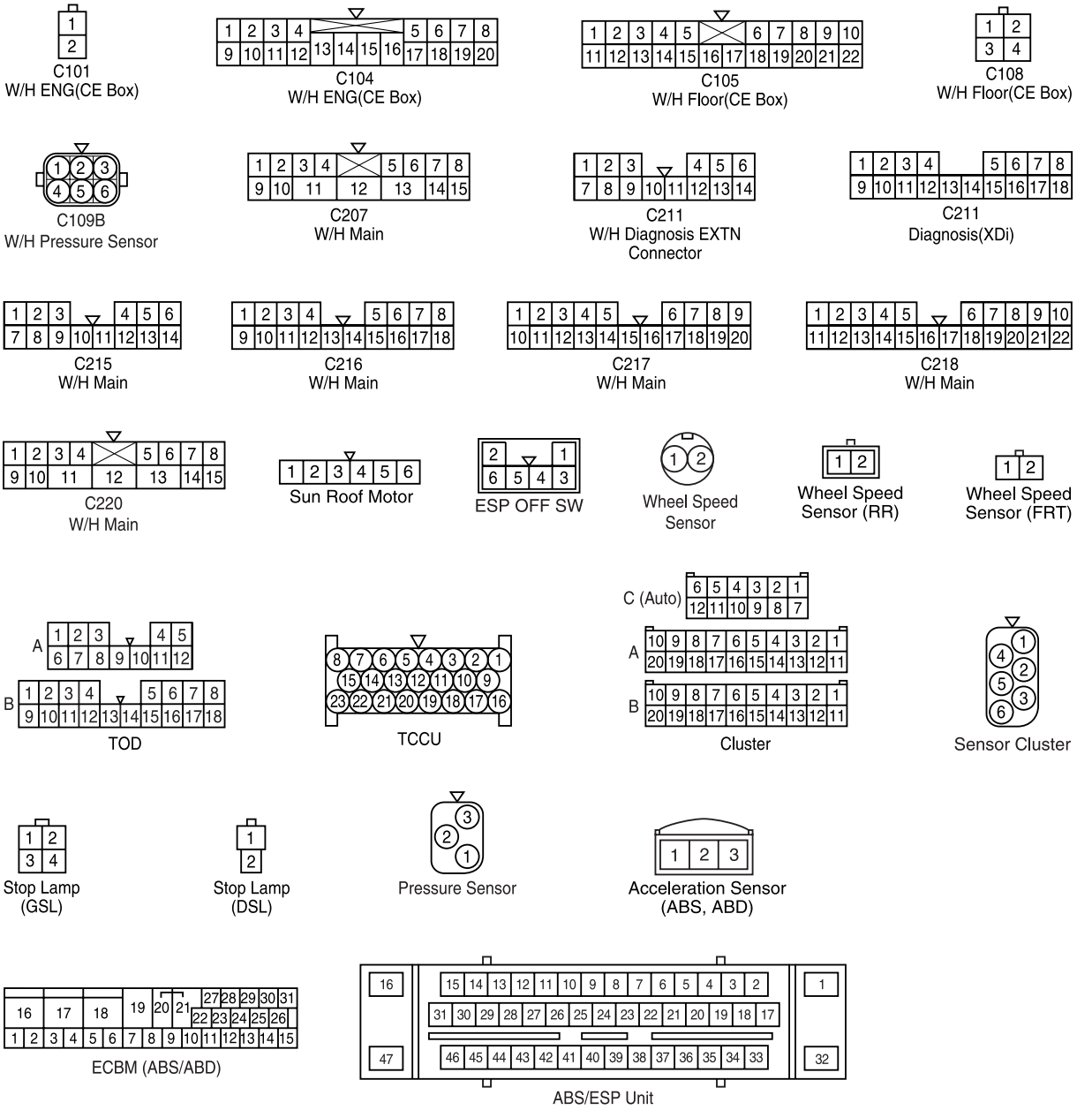
(2) BRAKE PRESSURE SENSOR, SWAS, SENSOR CLUSTER, ESP OFF SW



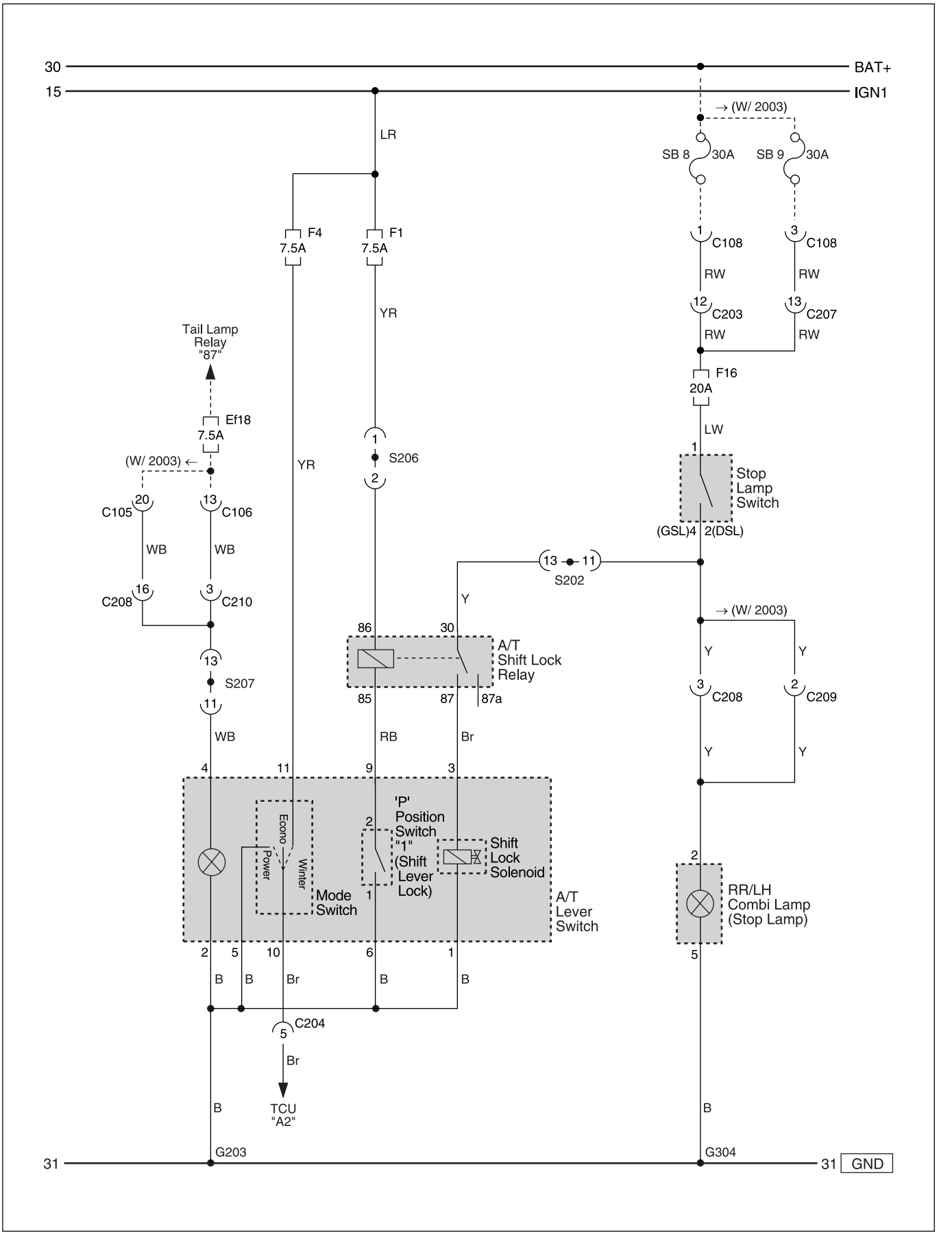
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (2Pin, Colorless)	Engine Room Fuse Box (A) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C109B (6Pin, Black)	Engine - ABS/ESP Pressure Sensor	Engine Room Fuse Box	XDi
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C211 (14Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	
C215 (14Pin, White)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	ABS, ABD
C216 (18Pin, White)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C217 (20Pin, Black)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C220 (15Pin, Blue)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	XDi
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S204 (14Pin, Black)	W/H Main	Behind the Left FATC	GND
S205 (14Pin, Black)	W/H Main	Behind the Left FATC	GND
G103	W/H Engine	Behind the Left Head Lamp	
G106	W/H Engine	Beside the Engine Coolant Reserve Tank	ABS, ABD

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



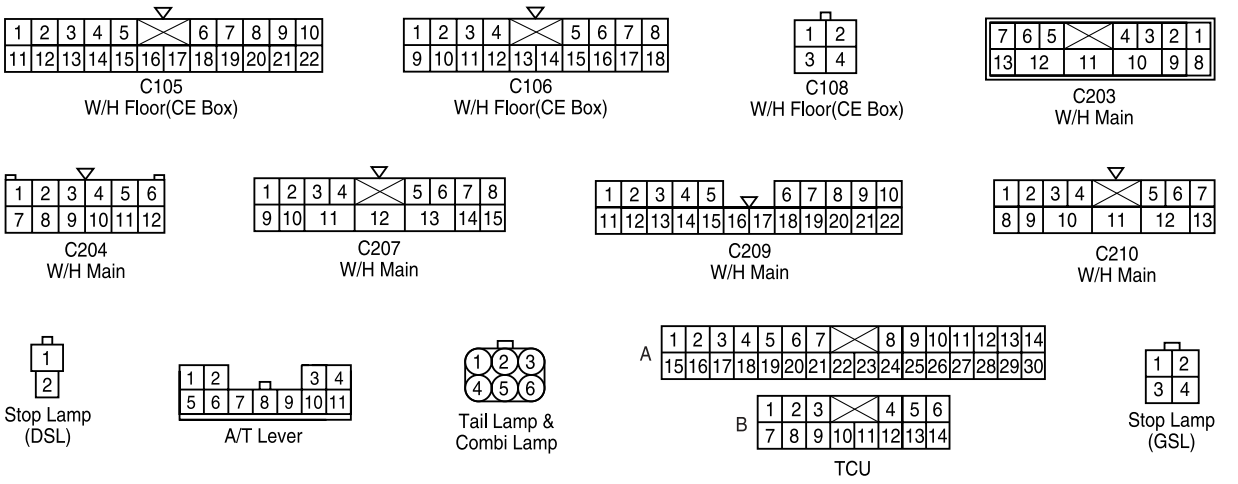
13. A/T SHIFT LOCK CIRCUIT



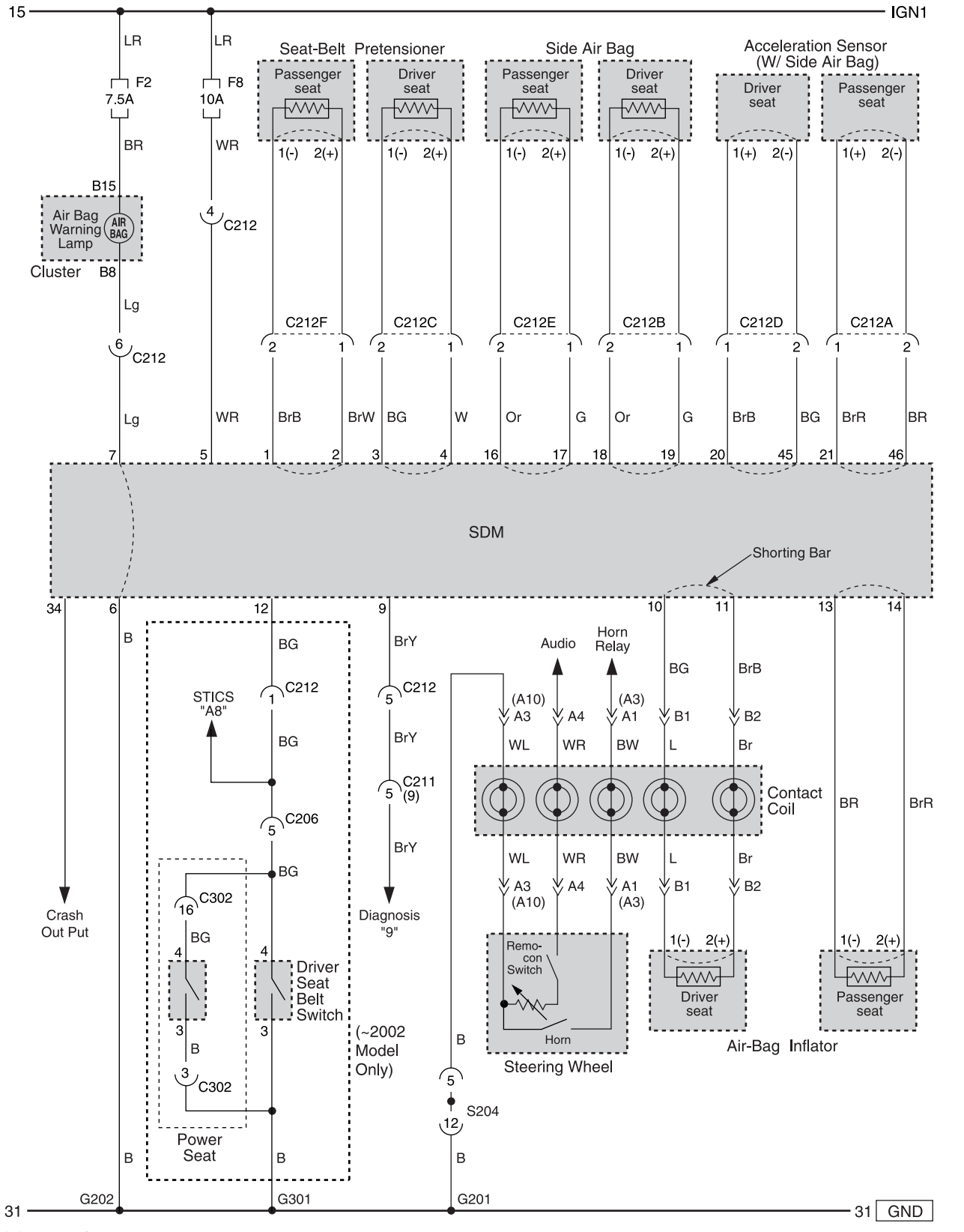
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C204 (12Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	A/T
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S206 (14Pin, Black)	W/H Main	Behind the Left the FATC	
G203	W/H Main	Upper the Seat Heating SW	
G304	W/H Floor	Behind the Quarter Grass #1	W/H Air Bag

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



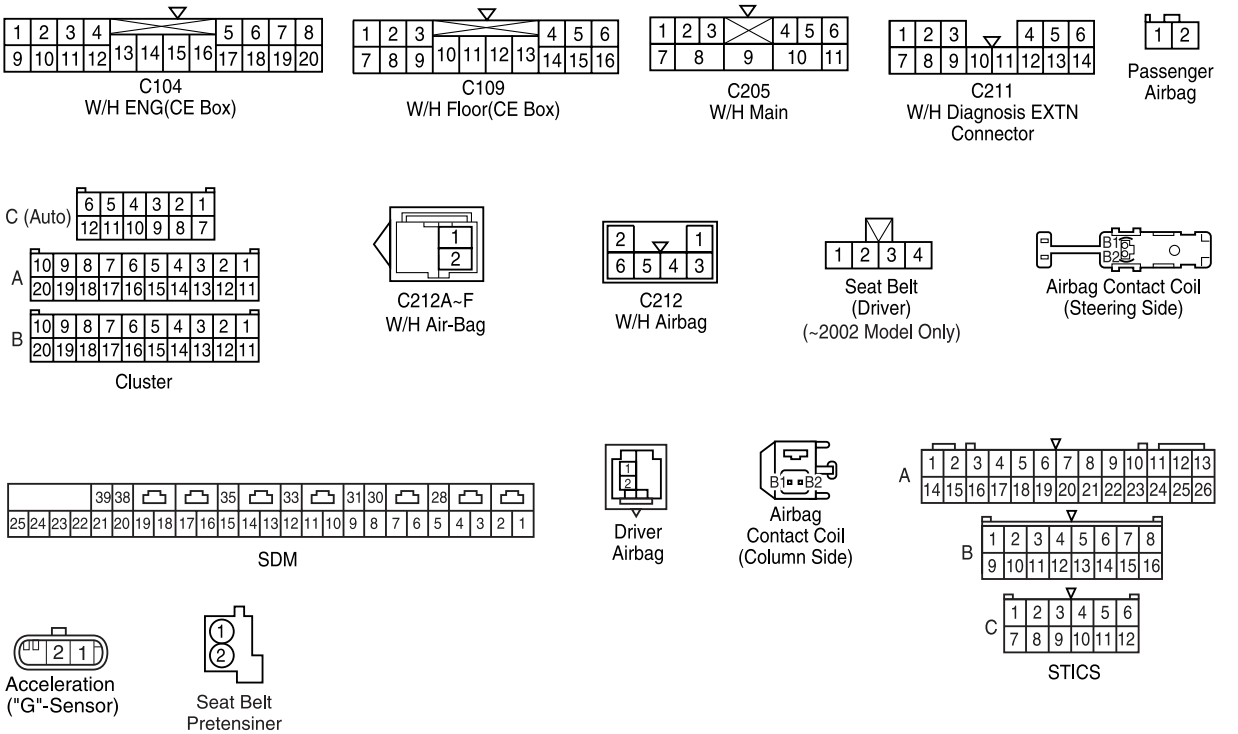
14. AIR BAG & SIDE AIR-BAG CIRCUIT



A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C211 (14Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	
C212 (6Pin, White)	Main - Air-Bag	Behind the Cluster (Inside Dash PNL)	
C212A (2Pin, White)	Floor - W/H Air-Bag	Inside Driver Side Cowl PNL	Side Air-Bag
C212B (2Pin, Yellow)	Floor - W/H Air-Bag	Inside Driver Side Cowl PNL	Side Air-Bag
C212C (2Pin, Black)	Floor - W/H Air-Bag	Inside Driver Side Cowl PNL	Freetensioner
C212D (2Pin, White)	Floor - W/H Air-Bag	Inside Co-Driver Side Cowl PNL	Side Air-Bag
C212E (2Pin, Yellow)	Floor - W/H Air-Bag	Inside Co-Driver Side Cowl PNL	Side Air-Bag
C212F (2Pin, Black)	Floor - W/H Air-Bag	Inside Co-Driver Side Cowl PNL	Freetensioner
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
G101	W/H Engine	Center the Engine Room Fuse Box	
G202	W/H Main	Beside the SDM	
G301	W/H Floor	Under Driver Seat	ECU GND

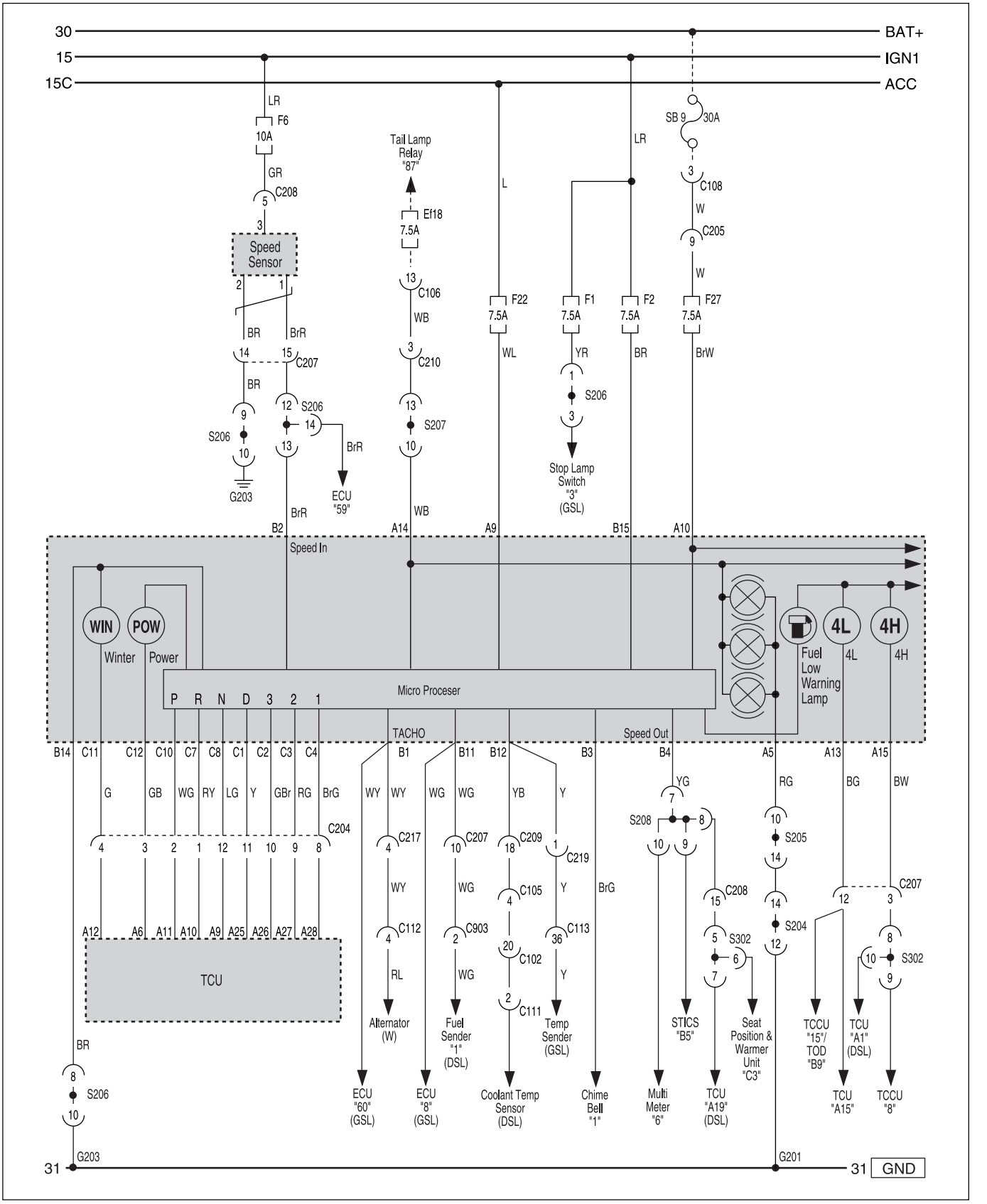
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



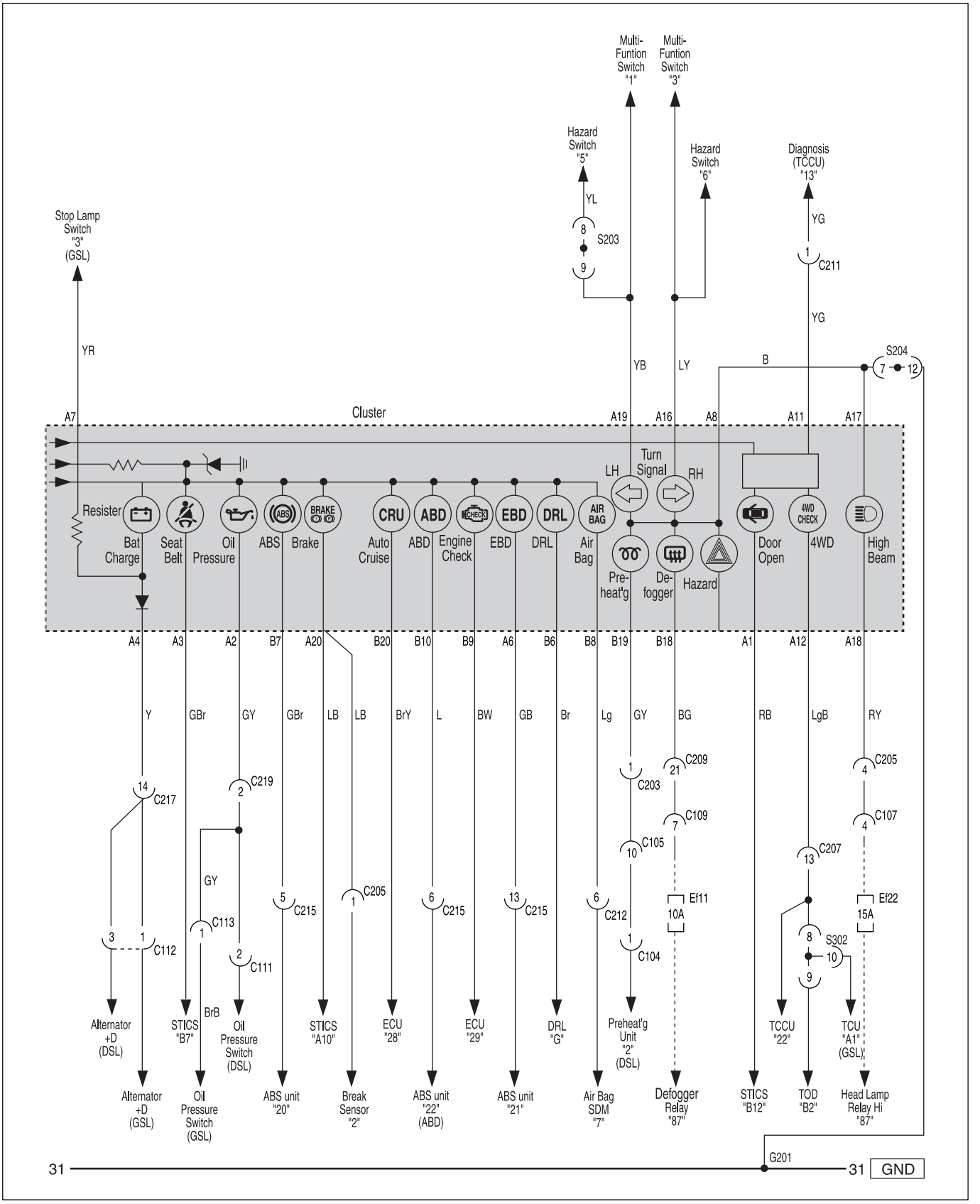
15. CLUSTER

1) ~ 2002 MODEL

(1) POWER SUPPLY, GROUND, LAMP (FUEL LOW WARNING, 4H, 4L) CIRCUIT

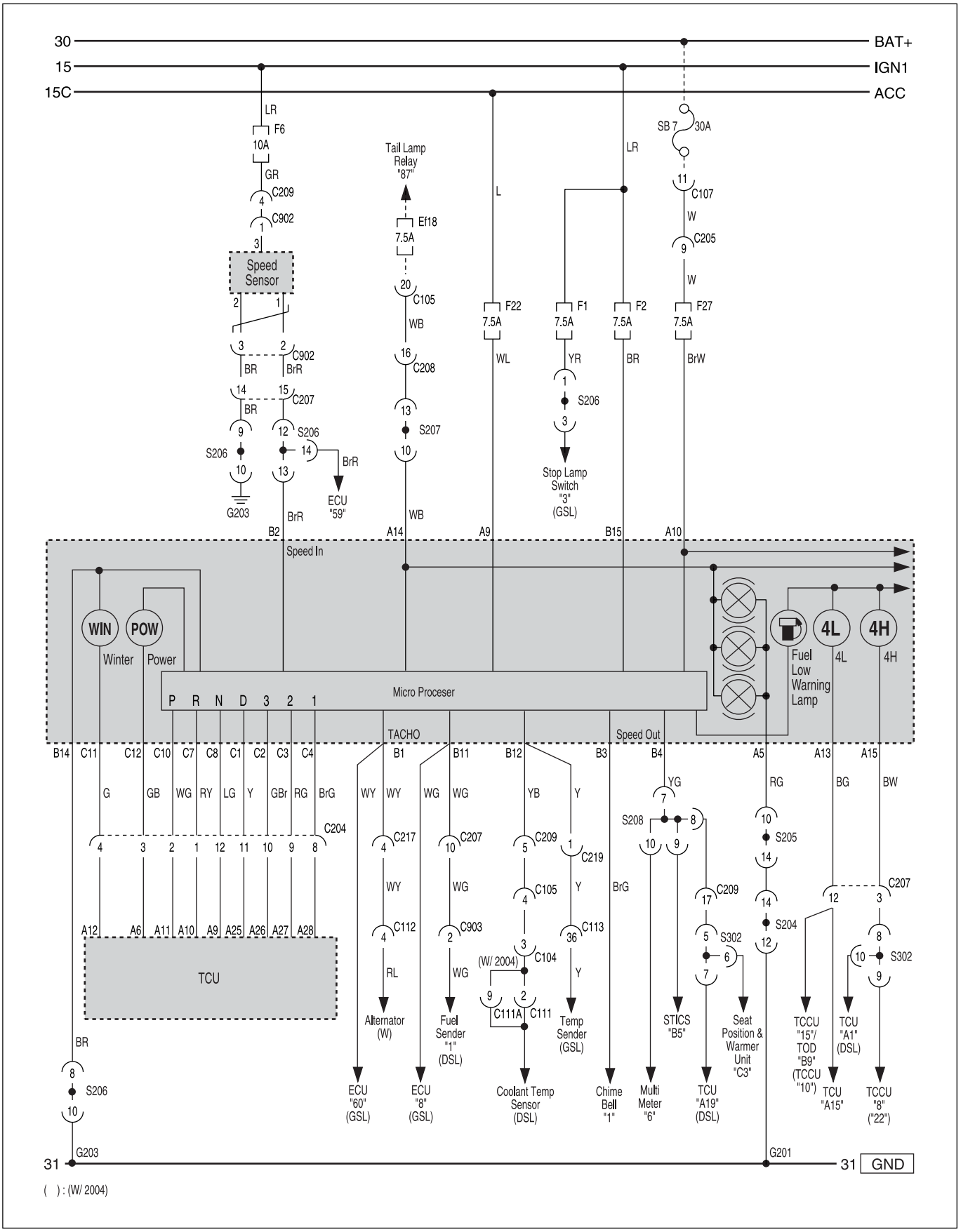


(2) WARNING LAMP, DEFOGGER CIRCUIT

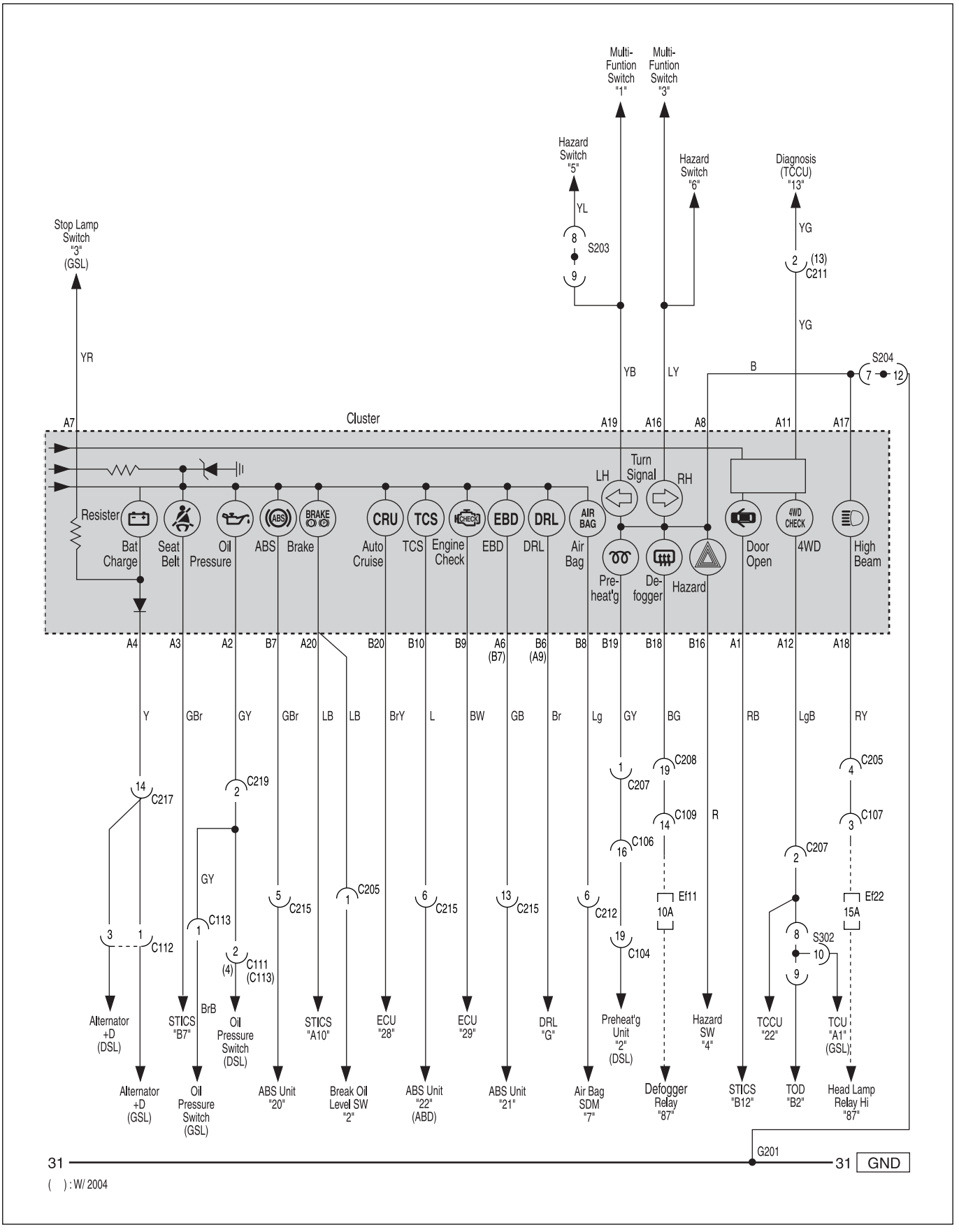


2) 2003 MODEL ~

(1) POWER SUPPLY, GROUND, LAMP (FUEL LOW WARNING, 4H, 4L) CIRCUIT

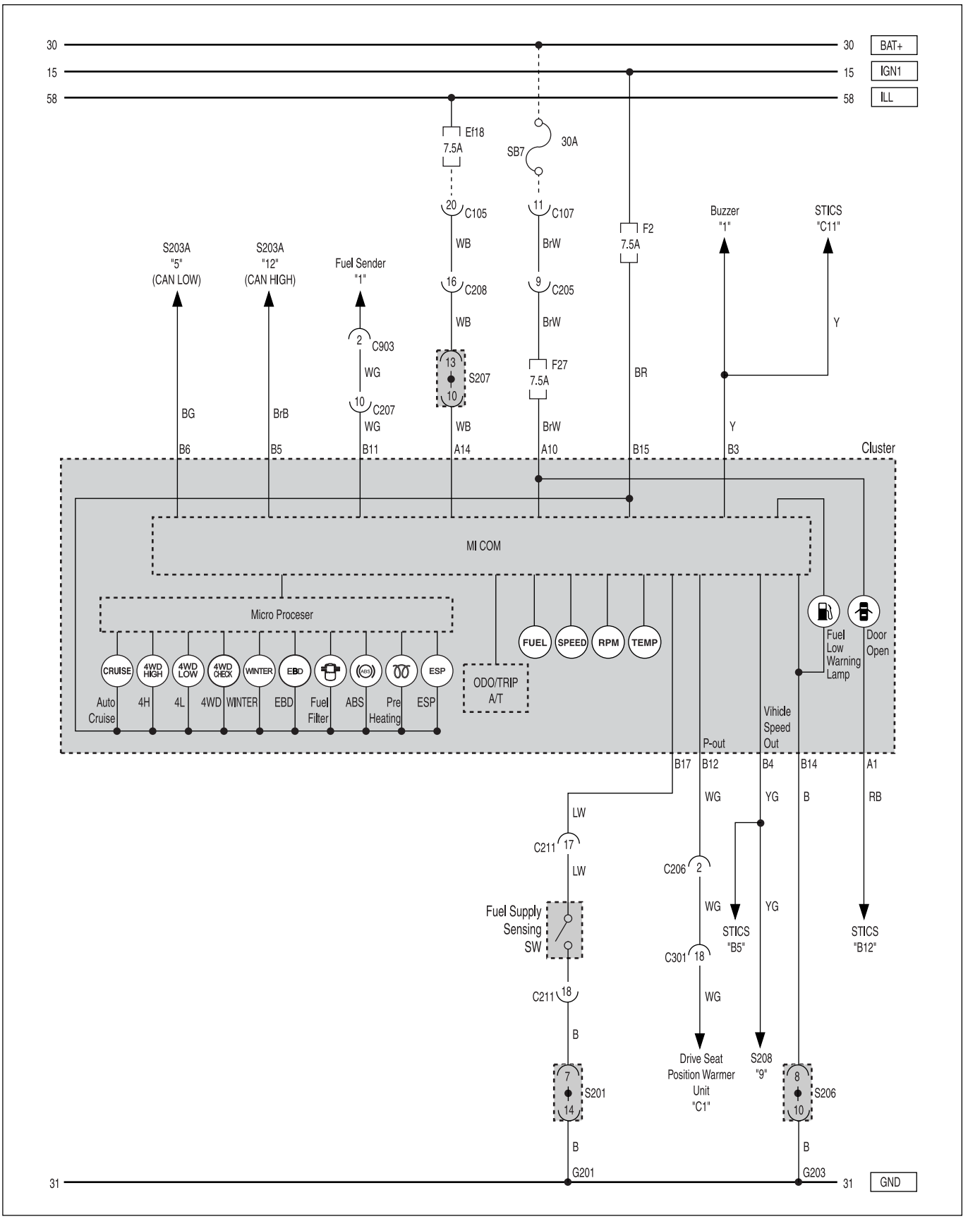


(2) WARNING LAMP, DEFOGGER CIRCUIT

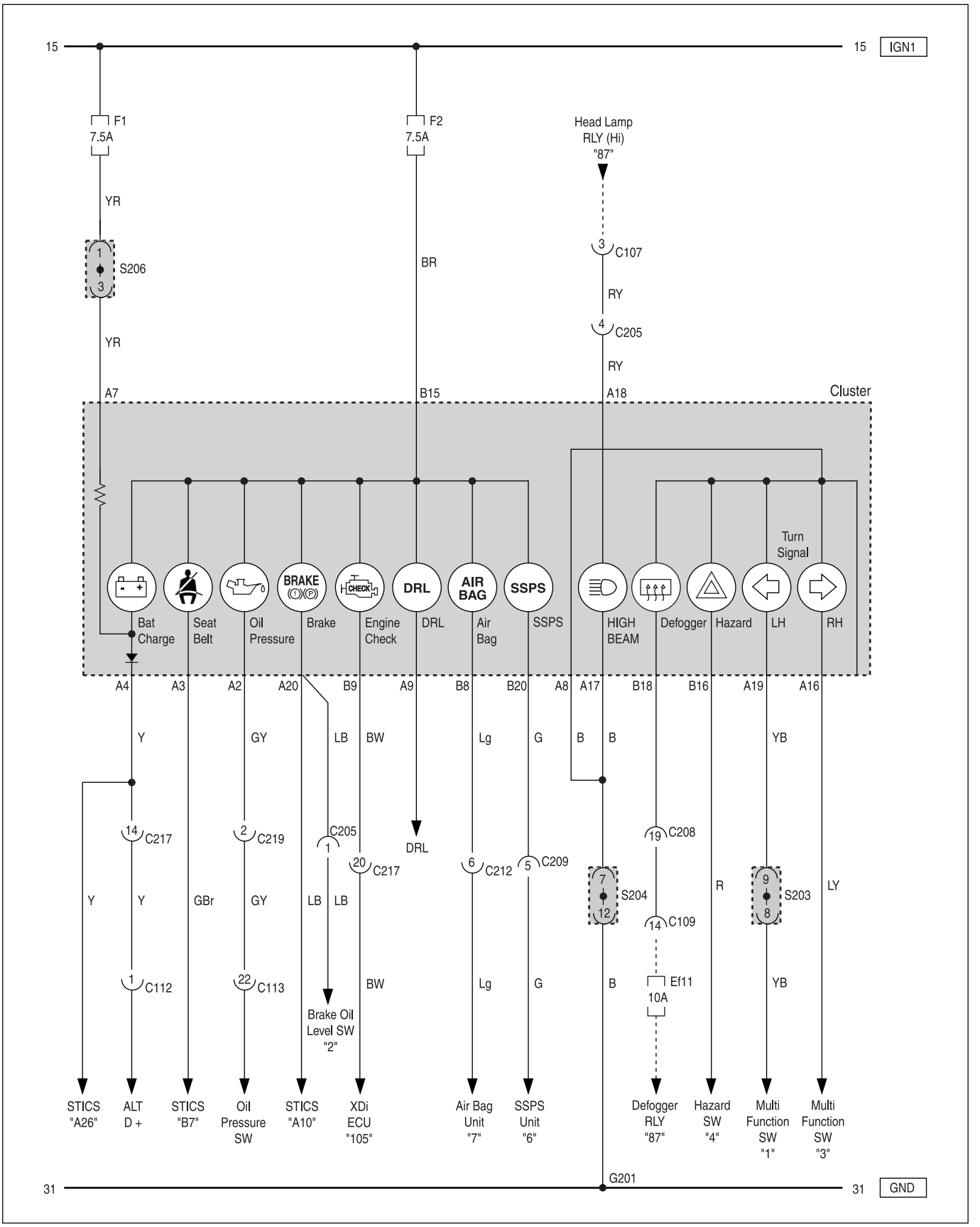


3) XDi

(1) GAUGE(SPEED, RPM, FUEL, TEMP), WARNING(FUEL, DR OPEN, FUEL FILTER, ABS/ ESP)



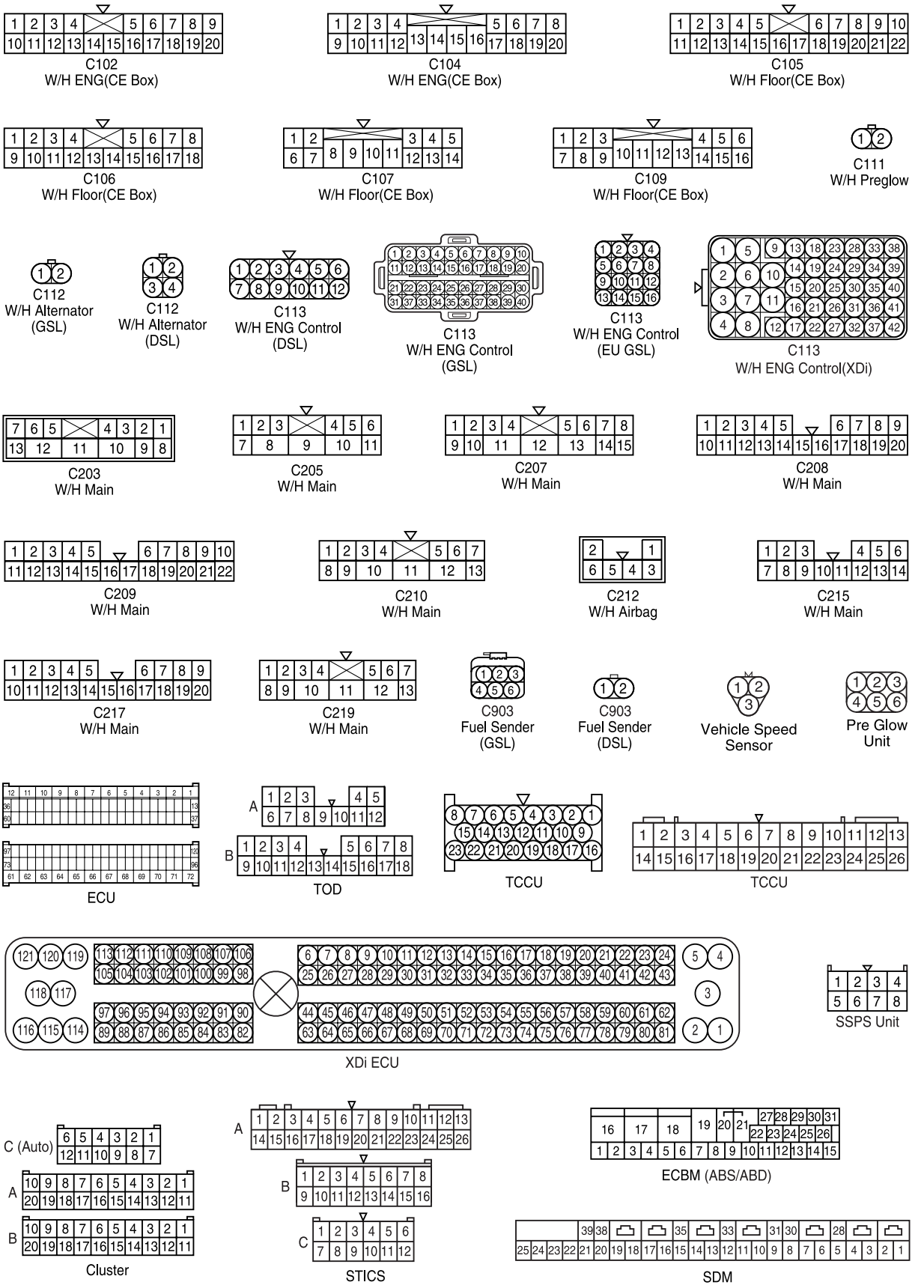
(2) WARNING(BAT CHANGE OIL, BRAKE, EGR CHECK, AIR BAG, SSPS, SEAT BELT), TURN SIGNAL DEFOGGER



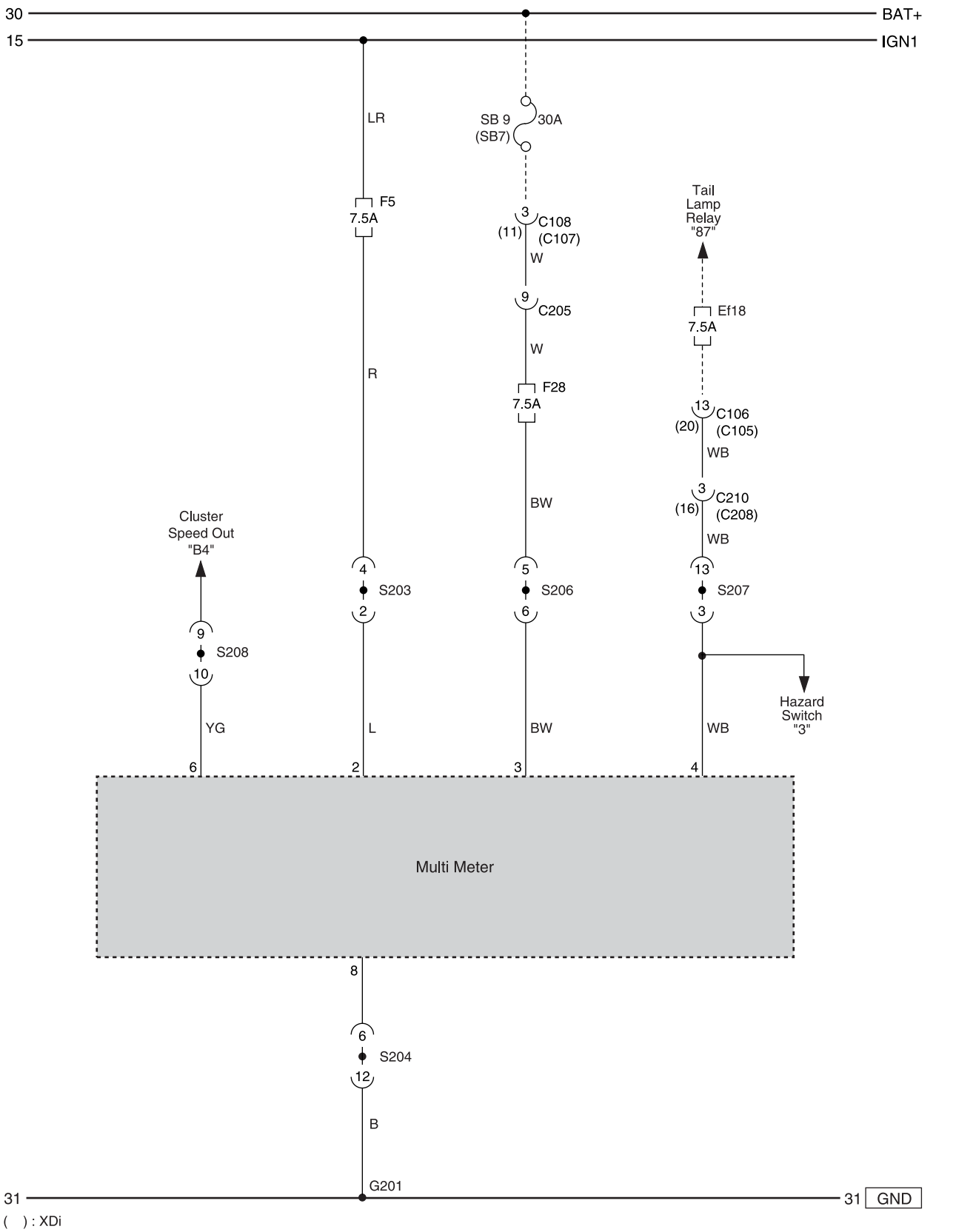
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C111 (2Pin, Black)	Engine - Pre-Heating	RR Pre-Heating Unit	DSL
C112 (4Pin, Black)	Engine - Alternator	Under the Coolant Reserve Tank	DSL
C112 (2Pin, Black)	Engine - Alternator	Under the Coolant Reserve Tank	GSL
C113 (12Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	DSL
C113 (40Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	GSL
C113 (42Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	XDi
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C211 (18Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	XDi
C212 (6Pin, White)	Main - Air-Bag	Behind the Cluster (Inside Dash PNL)	
C215 (14Pin, White)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	ABS, ABD
C217 (20Pin, Black)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C903 (6Pin, White)	Floor - Fuel Sender	Left the T/C (Under the Floor)	GSL
C903 (2Pin, White)	Floor - Fuel Sender	Left the T/C (Under the Floor)	DSL
S203 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S205 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S206 (14Pin, Black)	W/H Main	Behind the Left the FATC	
S207 (14Pin, Black)	W/H Main	Behind the Right the FATC	Tail Lamp
S208 (14Pin, Black)	W/H Main	Behind the Right the FATC	
S302 (14Pin, Black)	W/H Floor	Under Driver Seat	
G201	W/H Main	Inside Driver Side Cowl PNL	
G203	W/H Main	Under the Seat Heating SW	W/H Air Bag

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



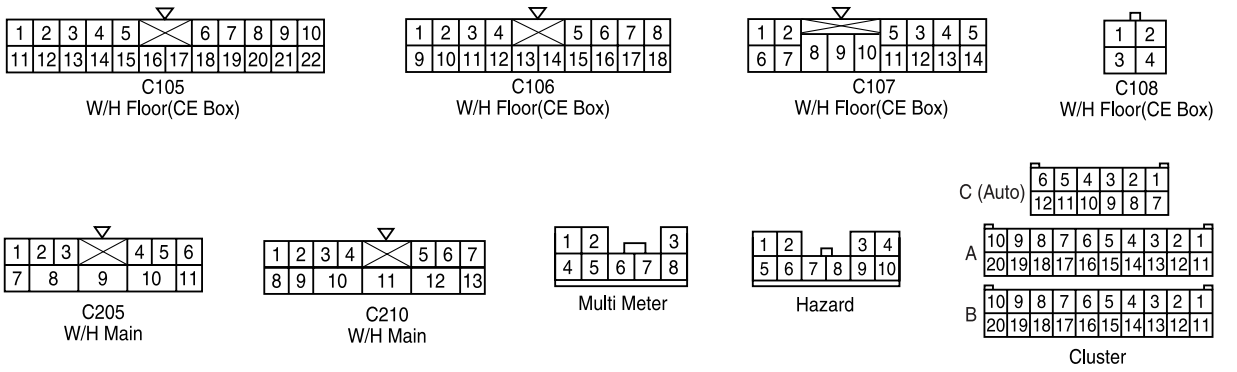
16. MULTI METER CIRCUIT



A. CONNECTOR INFORMATION

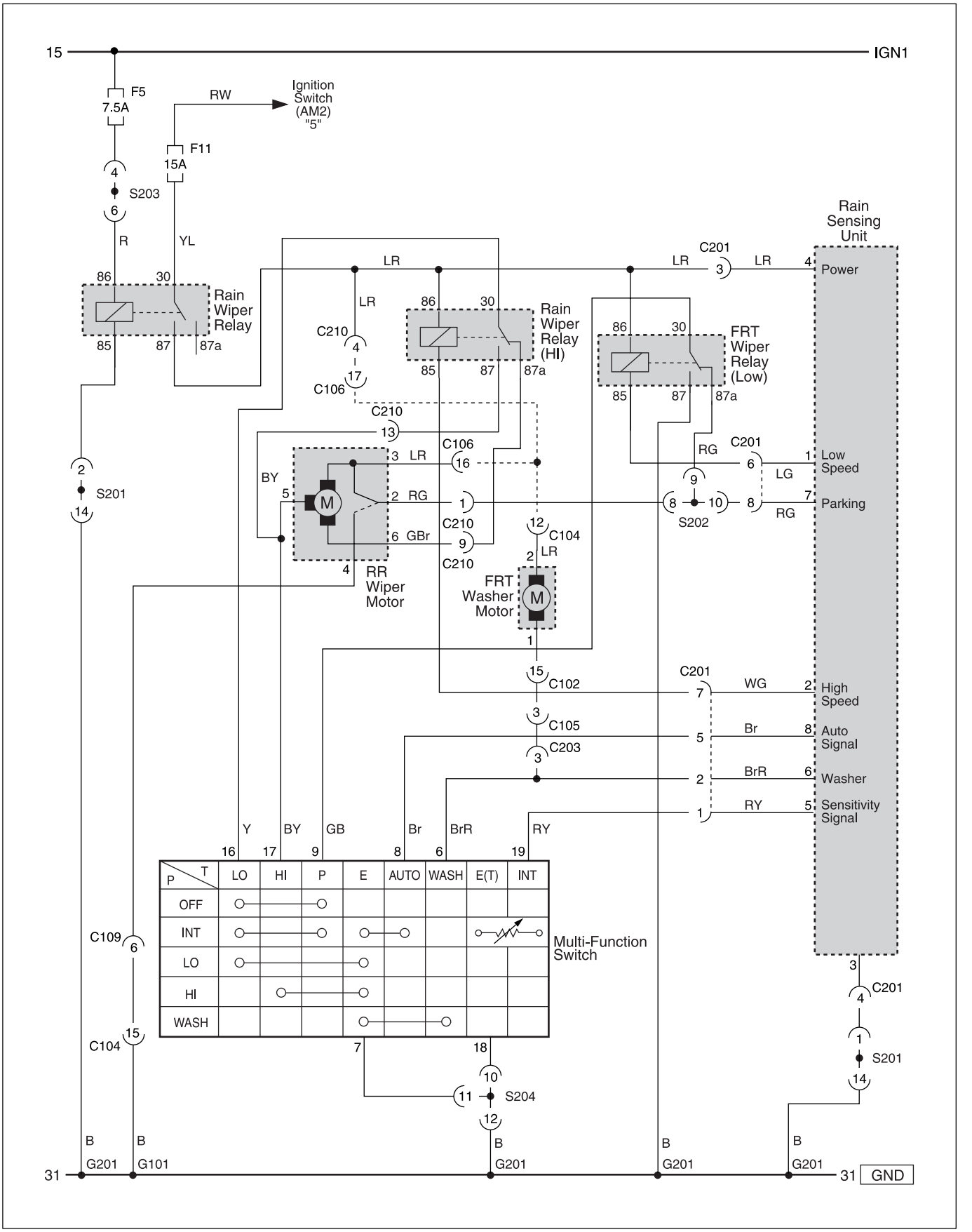
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
S203 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S206 (14Pin, Black)	W/H Main	Behind the Left the FATC	
S207 (14Pin, Black)	W/H Main	Behind the Right the FATC	Tail Lamp
S208 (14Pin, Black)	W/H Main	Behind the Right the FATC	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



17. RAIN SENSING WIPER CIRCUIT

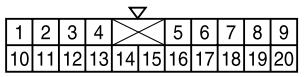
1) ~ 2002 MODEL



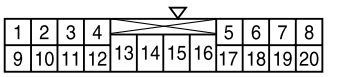
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C201 (8Pin, White)	Main - Roof	Under the I/P Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C210 (13Pin, Green)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S203 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
G101	W/H Engine	Center the Engine Room Fuse Box	
G201	W/H Main	Inside Driver Side Cowl PNL	

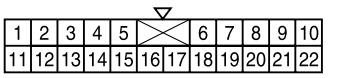
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



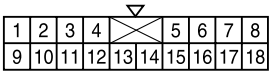
C102
W/H ENG(CE Box)



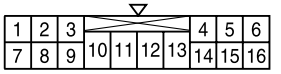
C104
W/H ENG(CE Box)



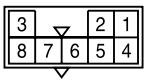
C105
W/H Floor(CE Box)



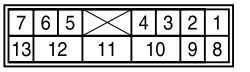
C106
W/H Floor(CE Box)



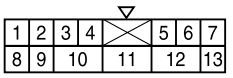
C109
W/H Floor(CE Box)



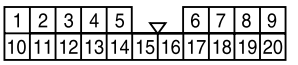
C201
W/H Roof



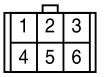
C203
W/H Main



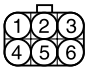
C210
W/H Main



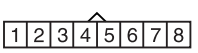
Multi Function



Ignition



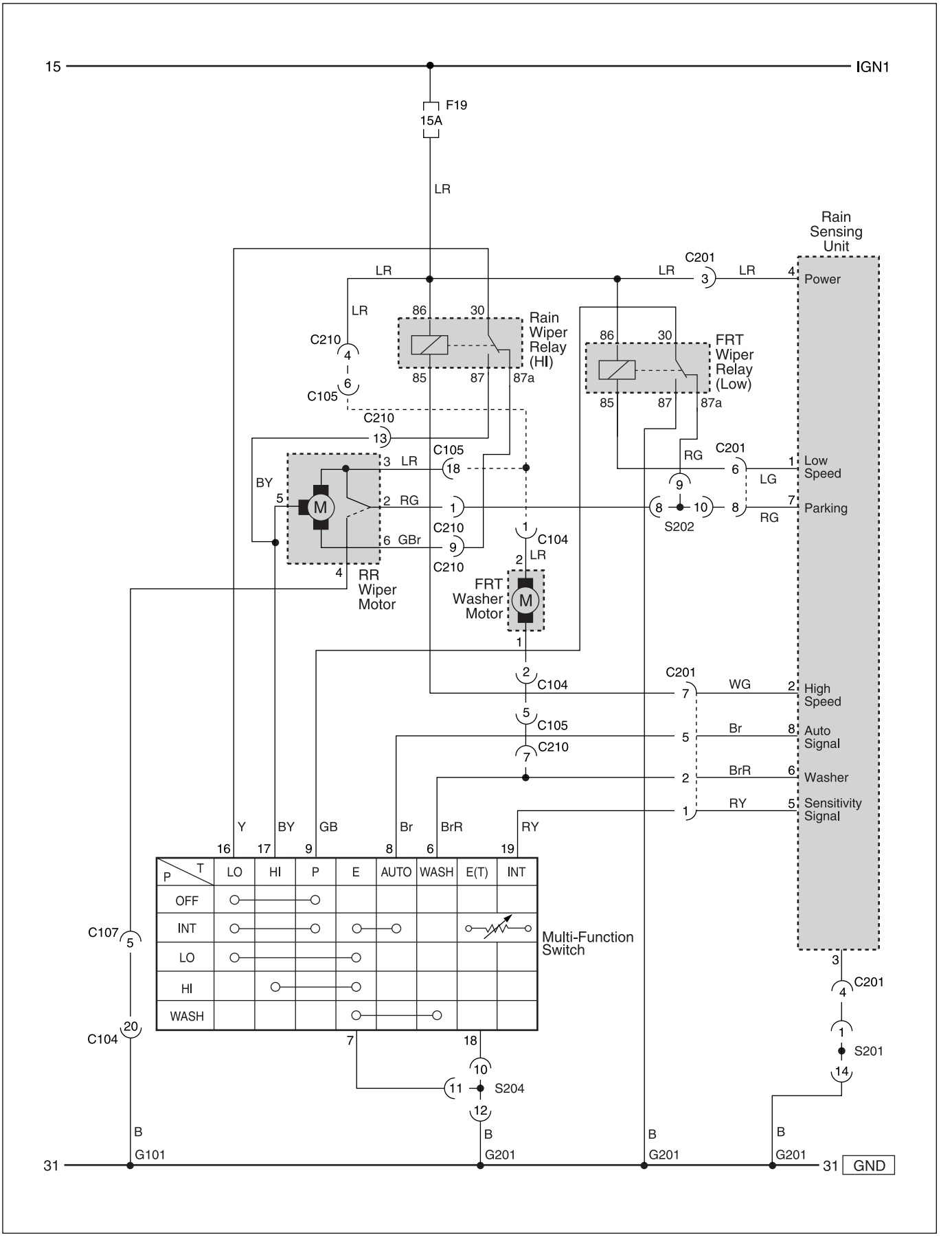
FRT Glass
Wiper Motor



Rain Sensing Unit

Washer
Motor

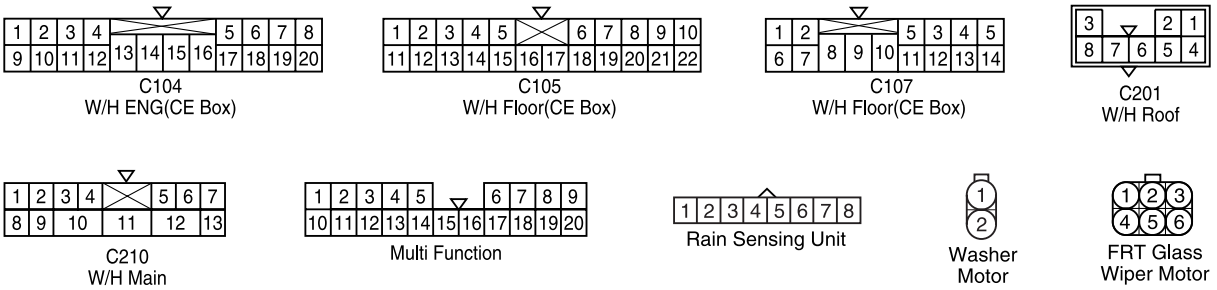
2) XDi, 2003 MODEL ~



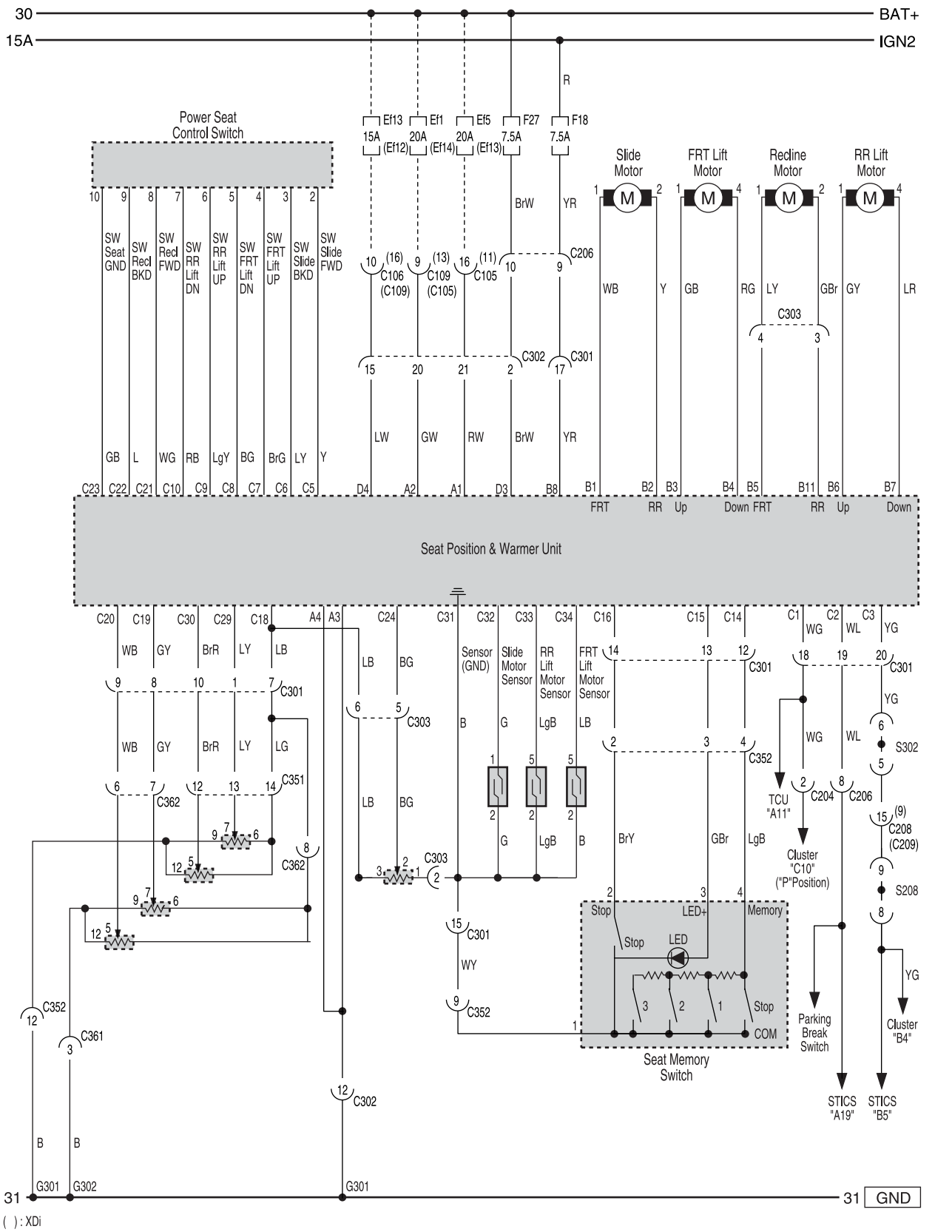
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C201 (8Pin, White)	Main - Roof	Under the I/P Fuse Box	
C210 (13Pin, Green)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S203 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
G101	W/H Engine	Center the Engine Room Fuse Box	
G201	W/H Main	Inside Driver Side Cowl PNL	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



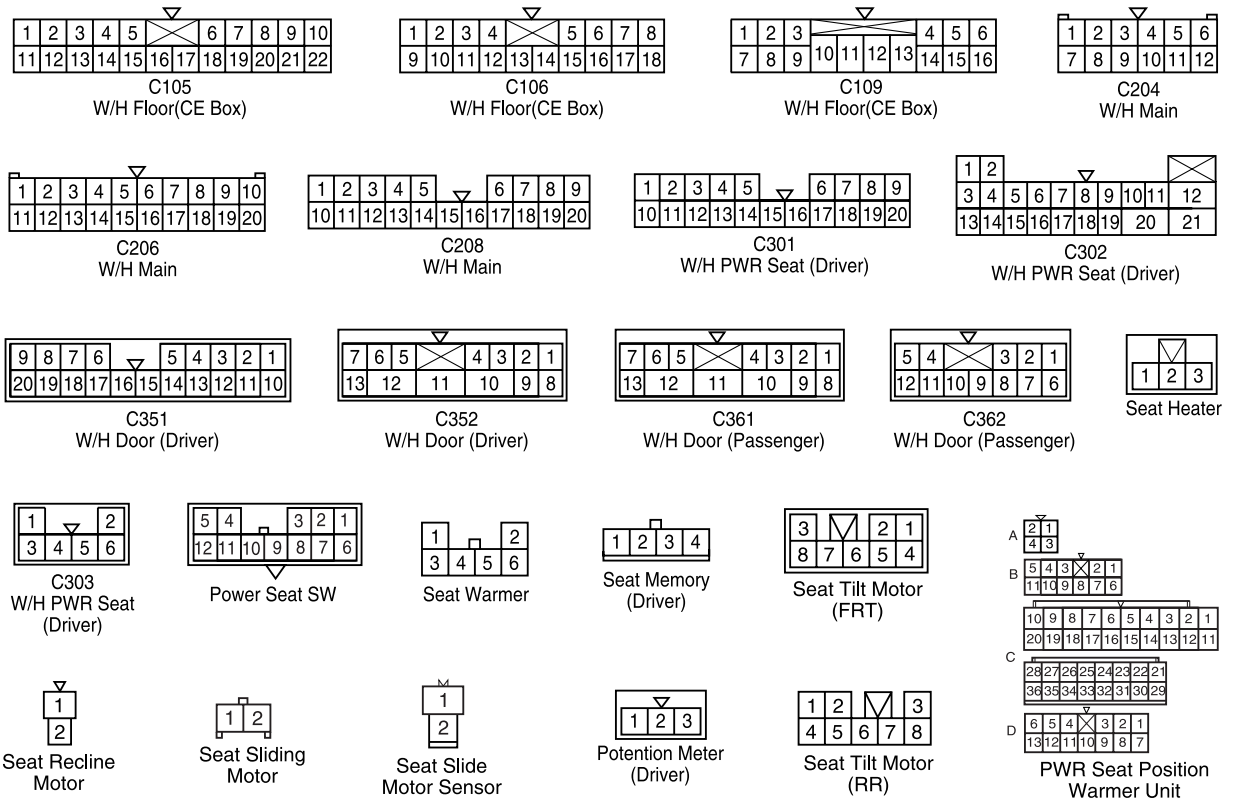
18. POWER SEAT CIRCUIT



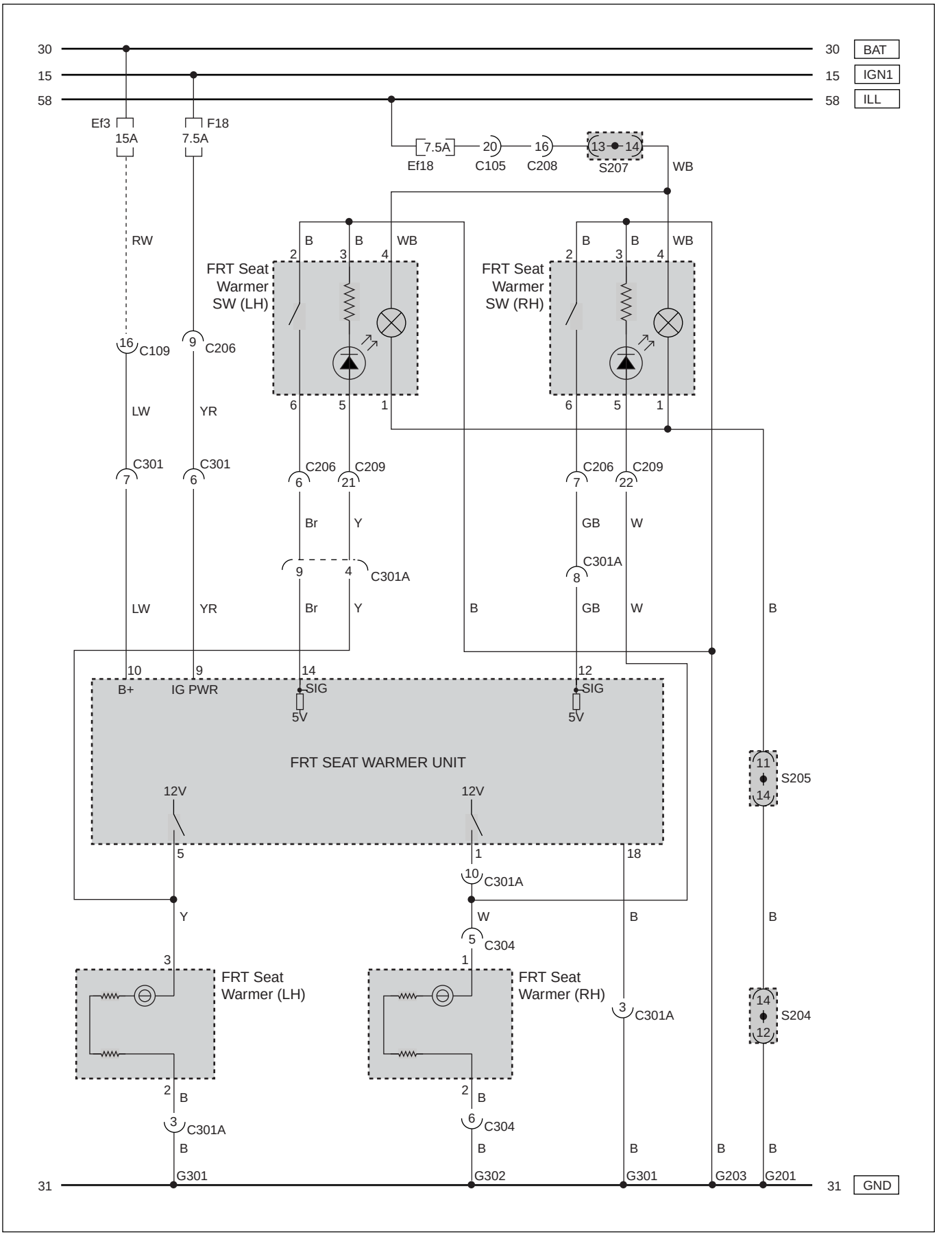
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C204 (12Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	A/T
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C301 (20Pin, White)	Floor - Driver Seat	Under the Driver Seat	Power Seat
C302 (21Pin, White)	Floor - Driver Seat	Under the Driver Seat	Power Seat
C303 (6Pin, White)	Driver Seat - Seat Back	Under the Driver Seat	Power Seat
C351 (20Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C352 (13Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C361 (13Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
C362 (12Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
S208 (14Pin, Black)	W/H Main	Behind the Right the FATC	
S302 (14Pin, Black)	W/H Floor	Under Driver Seat	
G301	W/H Floor	Under Driver Seat	ECU GND
G302	W/H Floor	Under Driver Seat	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



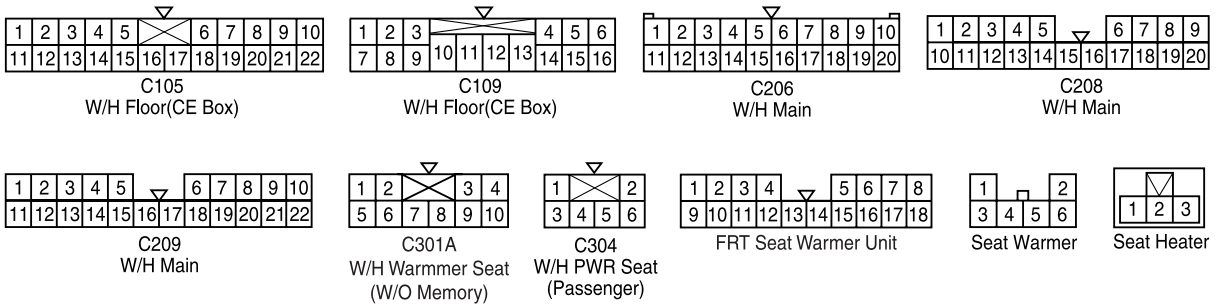
19. FRT SEAT WARMER(W/O MEMORY)



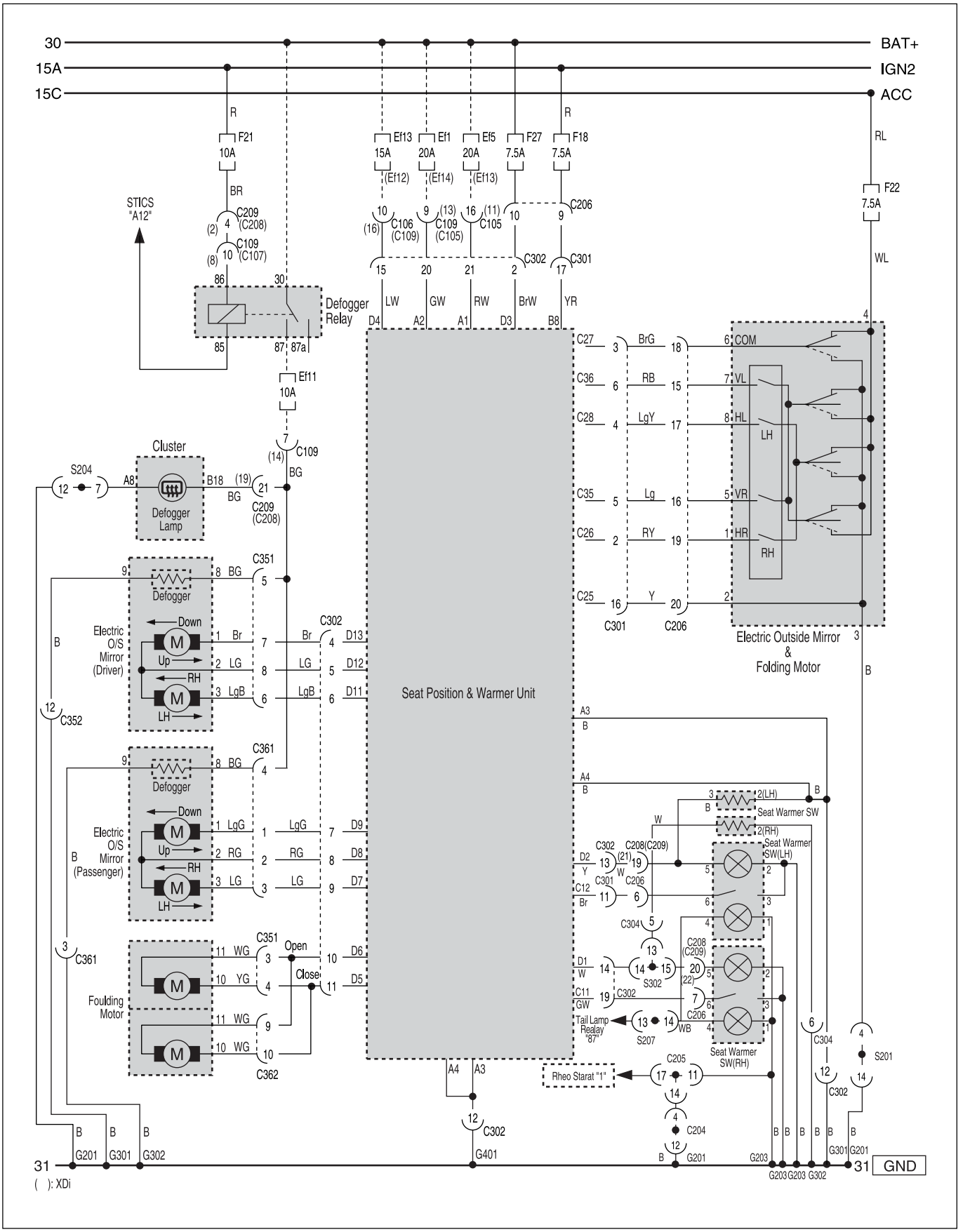
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C204 (12Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	A/T
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C301A (10Pin, White)	Floor - Driver Seat	Under the Driver Seat	Seat Warner
C304 (6Pin, White)	Floor - Co-Driver Seat	Under the Co-Driver Seat	Power Seat
S205 (14Pin, Black)	W/H Main	Behind the Left FATC	GND
S206 (14Pin, Black)	W/H Main	Behind the Left FATC	
S208 (14Pin, Black)	W/H Main	Behind the Right FATC	
G201	W/H Main	Inside Driver Side Cowl PNL	
G203	W/H Main	Under the Seat Heating SW	W/H Air Bag
G301	W/H Floor	Under Driver Seat	ECU GND
G302	W/H Floor	Under Driver Seat	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



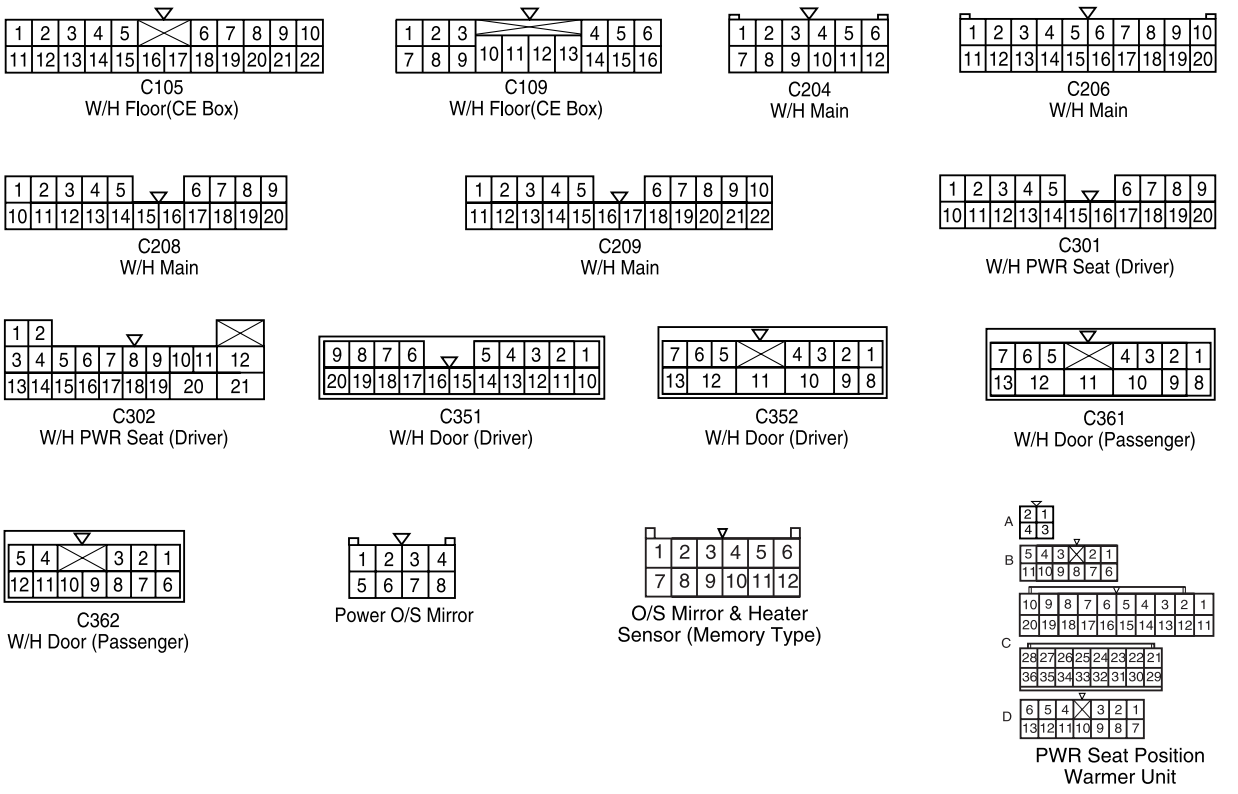
20. POWER O/SIDE MIRROR, DEFOGGER SEAT WARMER CIRCUIT (W/ MEMORY)



A. CONNECTOR INFORMATION

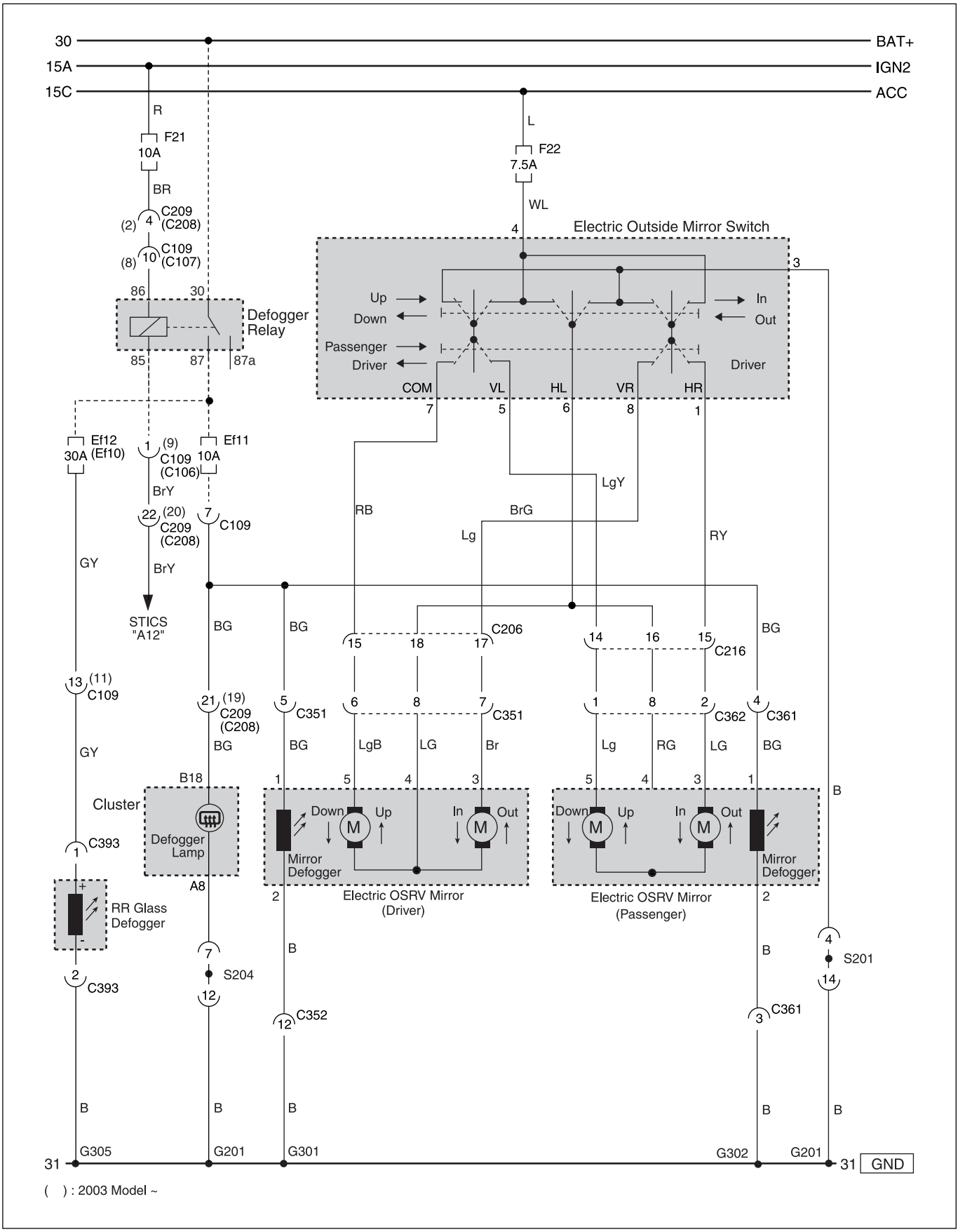
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C204 (12Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	A/T
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C301 (20Pin, White)	Floor - Driver Seat	Under the Driver Seat	Power Seat
C302 (21Pin, White)	Floor - Driver Seat	Under the Driver Seat	Power Seat
C351 (20Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C352 (13Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C362 (12Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S302 (14Pin, Black)	W/H Floor	Under Driver Seat	
G201	W/H Main	Inside Driver Side Cowl PNL	
G301	W/H Floor	Under Driver Seat	ECU GND
G401	W/H Floor	Center the Tail Gate	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



21. POWER O/SIDE MIRROR, DEFOGGER CIRCUIT (W/O MEMORY)

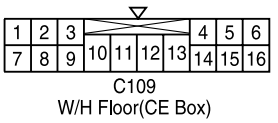
1) ~ 2002 MODEL



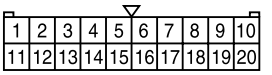
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C216 (18Pin, White)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C351 (20Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C352 (13Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C362 (12Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
C393 (4Pin, White)	Floor - RR Defogger	Inside the Upper the Tail Gate	
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
G201	W/H Main	Inside Driver Side Cowl PNL	
G301	W/H Floor	Under Driver Seat	ECU GND
G302	W/H Floor	Under Driver Seat	
G305	W/H Floor	Behind the Quter Grass #1	

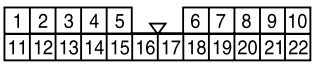
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



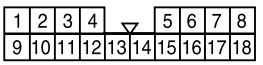
C109
W/H Floor(CE Box)



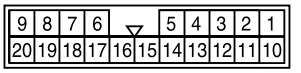
C206
W/H Main



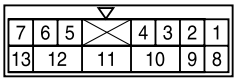
C209
W/H Main



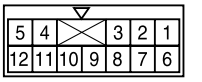
C216
W/H Main



C351
W/H Door (Driver)

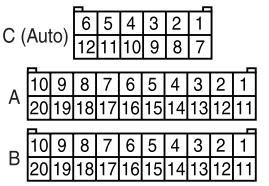


C352
W/H Door (Driver)

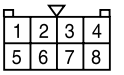


C362
W/H Door (Passenger)

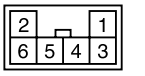
C393
W/H Tail Gate



Cluster

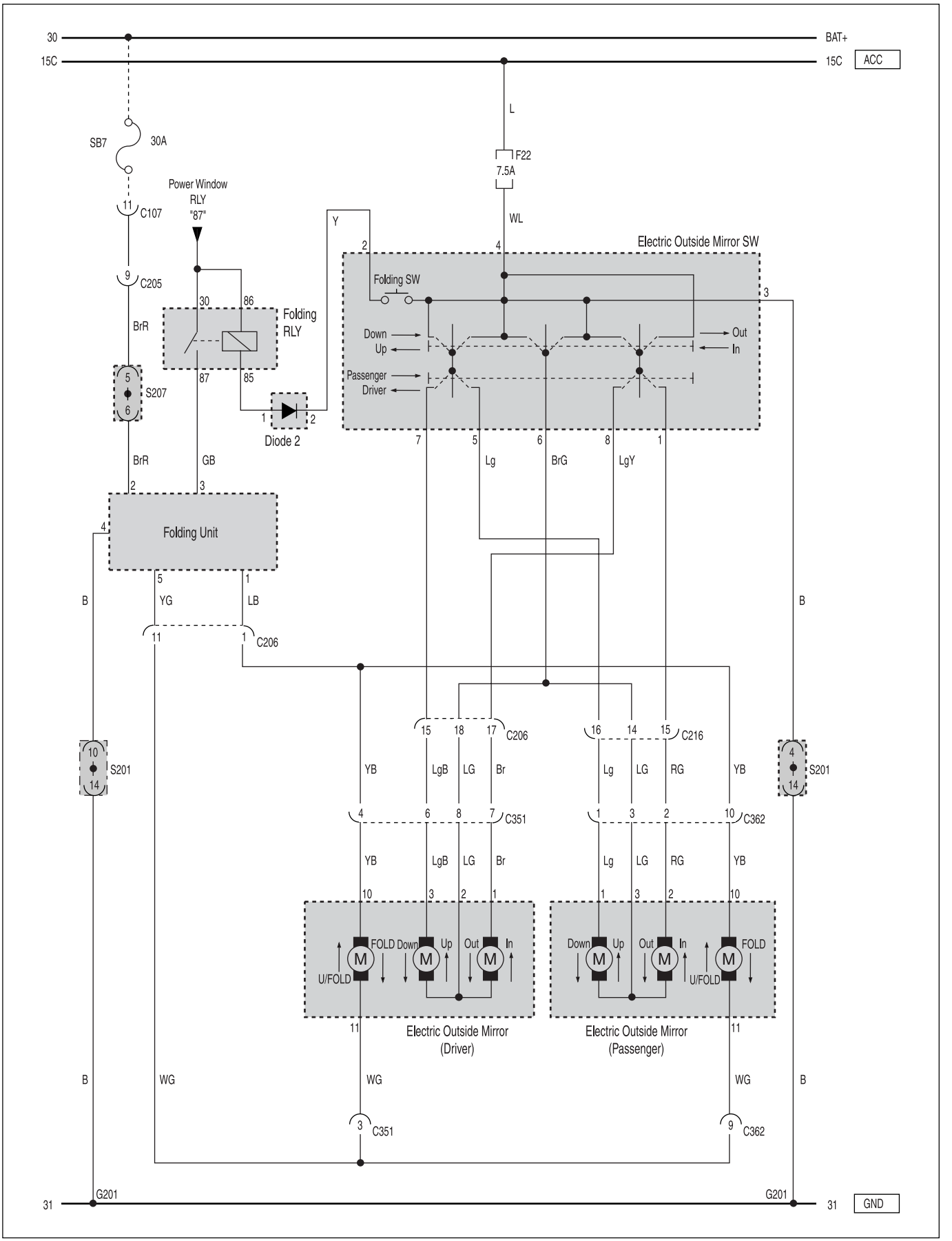


Power O/S Mirror



O/S Mirror &
Heater Sensor

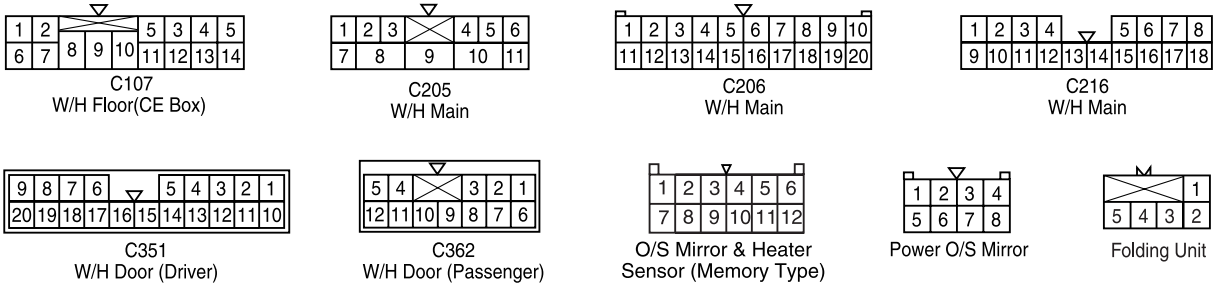
2) XDi


30
BAT+
15C
15C
ACC
SB7
30A
L
F22
7.5A
Power Window
RLY
"87"
11
C107
Y
WL
2
4
Electric Outside Mirror SW
9
C205
Folding SW
3
30
86
Folding
RLY
BrR
Down
Up
Out
In
5
S207
87
85
Passenger
Driver
6
1
2
Diode 2
7
5
6
8
1
BrR
GB
Lg
BrG
LgY
2
3
Folding Unit
4
5
1
B
YG
LB
B
11
1
C206
15
18
17
C206
16
14
15
C216
10
S201
14
4
S201
14
YB
LgB
LG
Br
Lg
LG
RG
YB
4
6
8
7
C351
1
3
2
10
C362
YB
LgB
LG
Br
Lg
LG
RG
YB
10
3
2
1
1
3
2
10
FOLD
Down
Up
Out
In
Down
Up
Out
In
FOLD
M
M
M
M
M
M
U/FOLD
U/FOLD
11
Electric Outside Mirror
(Driver)
Electric Outside Mirror
(Passenger)
11
B
WG
WG
WG
B
3
C351
9
C362
G201
G201
31
31
GND

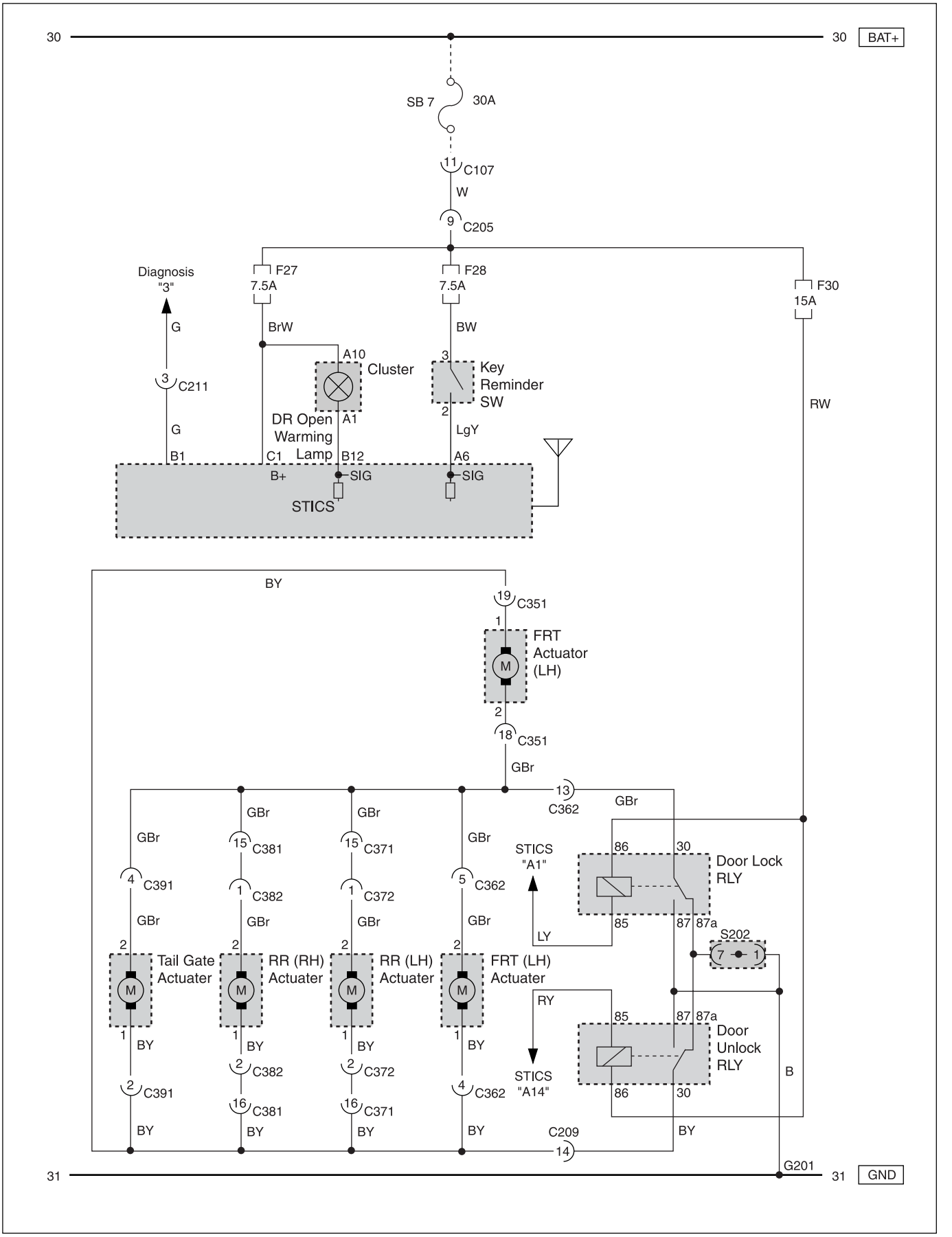
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C216 (18Pin, White)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C351 (20Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C362 (12Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
S208 (14Pin, Black)	W/H Main	Behind the Right FATC	
G201	W/H Main	Inside Driver Side Cowl PNL	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



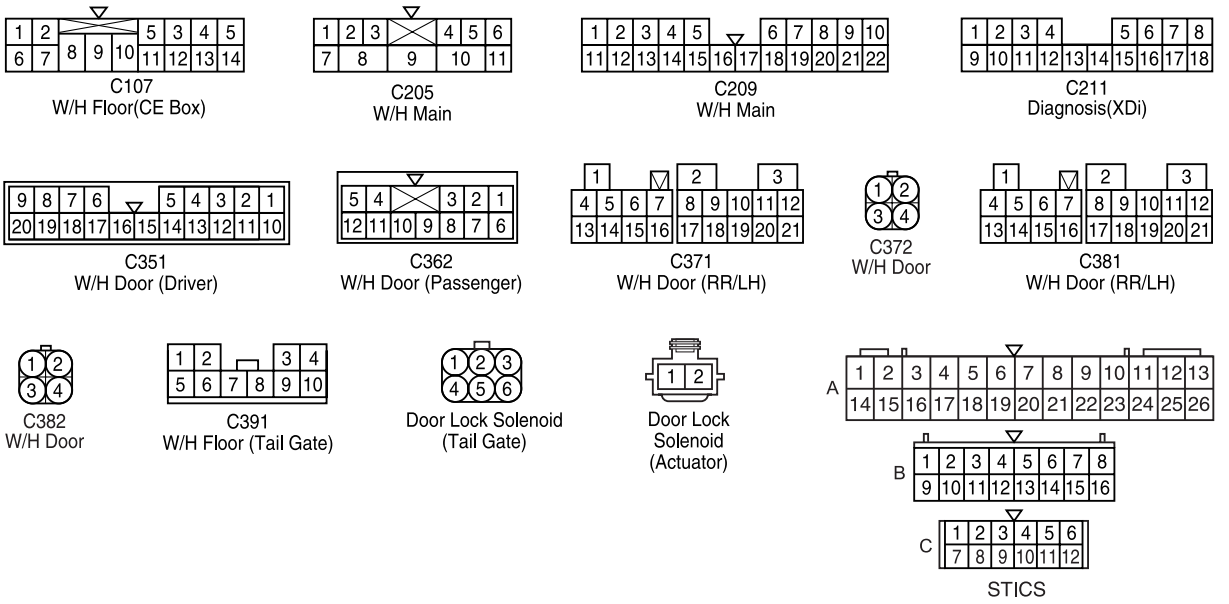
22. CENTRAL DOOR LOCKING SYSTEM



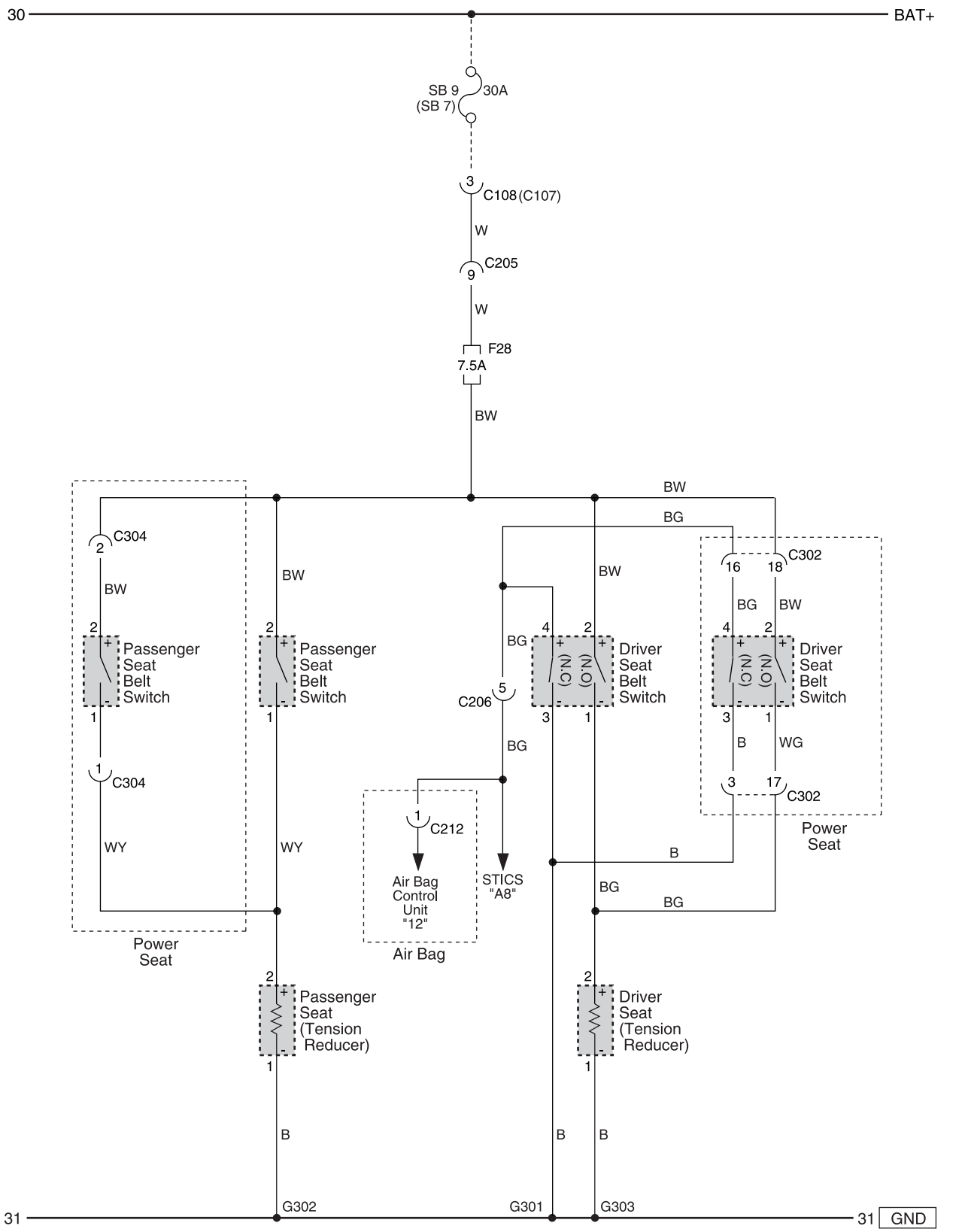
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C211 (18Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	XDi
C351 (20Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C362 (12Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	
C371 (21Pin, White)	Floor - RR Left Door	Under Left “B” Filler	
C372 (4Pin, Black)	RR LH Door - Door Extention	In Side RR LH Door PNL	
C381 (21Pin, White)	Floor - RR Right Door	Under Right “B” Filler	
C382 (4Pin, Black)	RR RH Door - Door Extention	Inside RR RH Door PNL	
C391 (10Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
G201	W/H Main	Inside Driver Side Cowl PNL	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



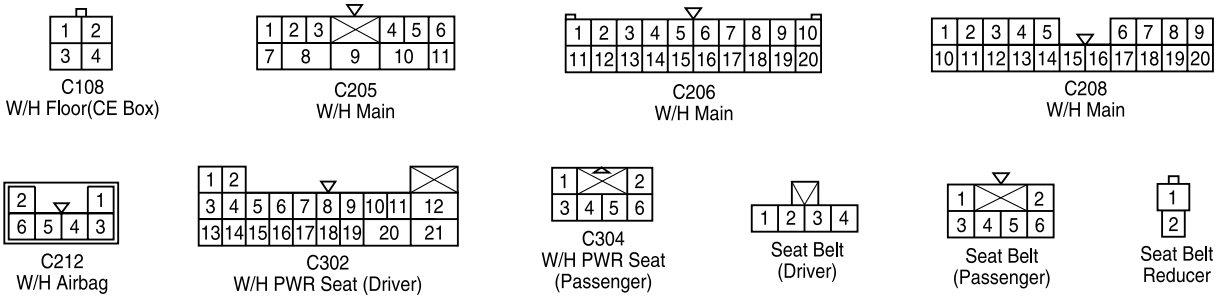
23. SEAT BELT, TENSION REDUCER CIRCUIT (2002 MODEL ONLY)



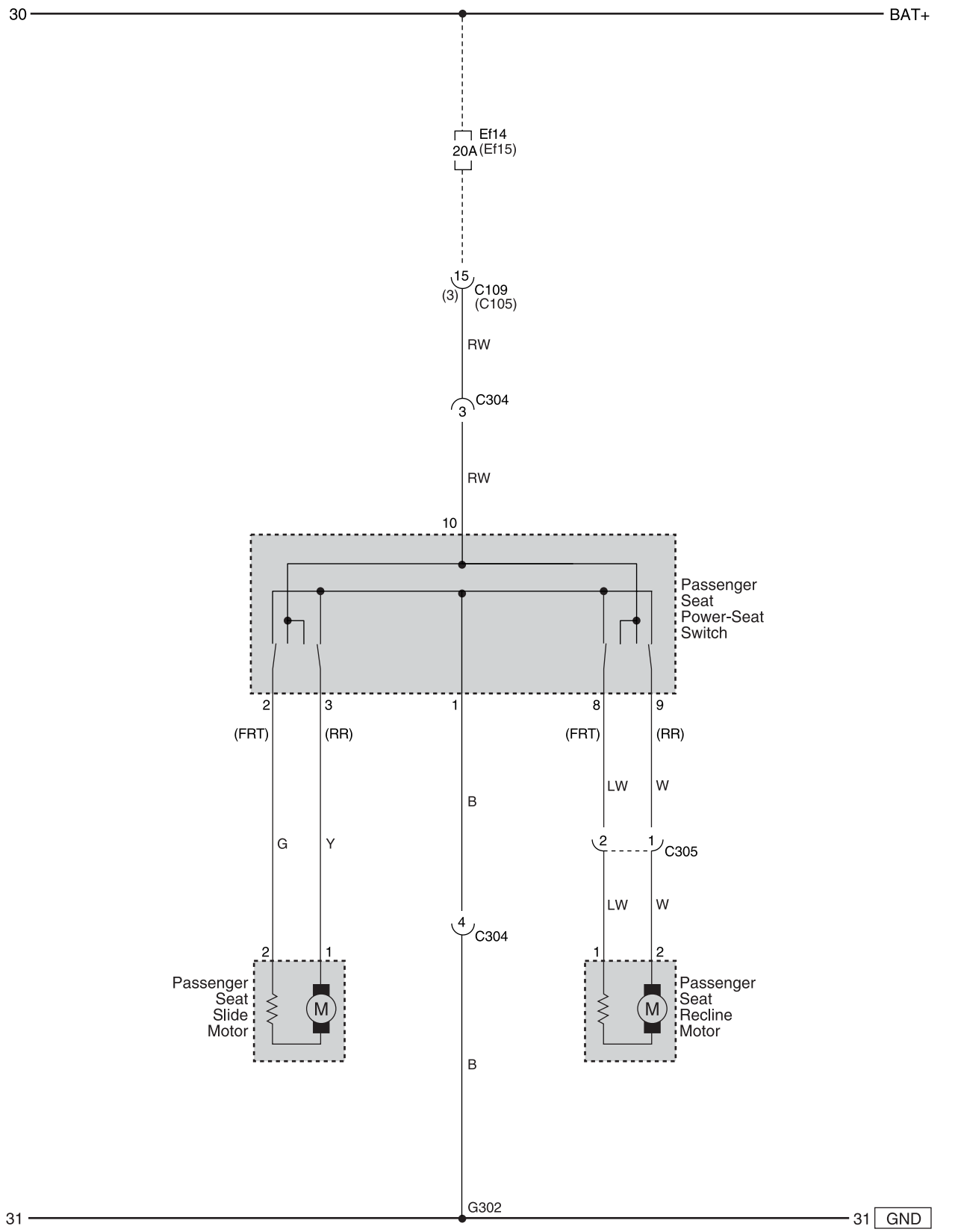
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C212 (6Pin, White)	Main - Air-Bag	Behind the Cluster (Inside Dash PNL)	
C302 (21Pin, White)	Floor - Driver Seat	Under the Driver Seat	Power Seat
C304 (6Pin, White)	Floor - Co-Driver Seat	Under the Co-Driver Seat	Power Seat
G301	W/H Floor	Under Driver Seat	ECU GND
G302	W/H Floor	Under Driver Seat	
G303	W/H Floor	Under the Left “B” Filler	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



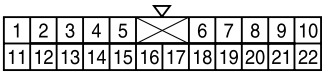
24. PASSENGER POWER SEAT CIRCUIT



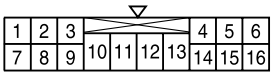
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C304 (6Pin, White)	Floor - Co-Driver Seat	Under the Co-Driver Seat	Power Seat
C305 (4Pin, White)	Co-Driver Seat - Seat Back	Under the Co-Driver Seat	Power Seat
G302	W/H Floor	Under Driver Seat	

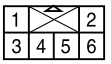
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



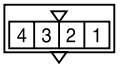
C105
W/H Floor(CE Box)



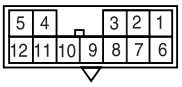
C109
W/H Floor(CE Box)



C304
W/H PWR Seat
(Passenger)



C305
W/H Seat Back
(Passenger)



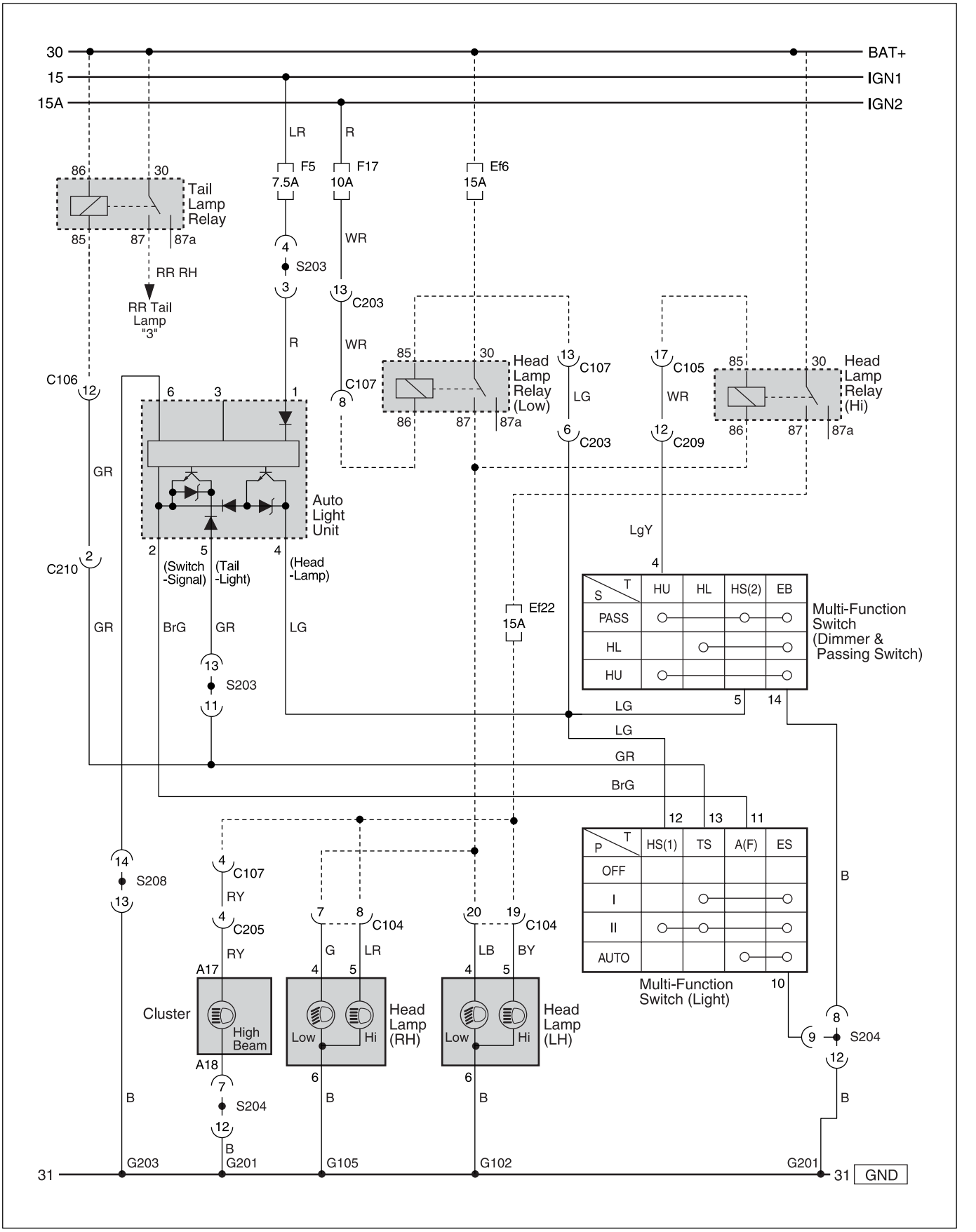
Power Seat SW

Seat Recline
Motor

Seat Sliding
Motor

25. AUTO LIGHT CONTROL CIRCUIT

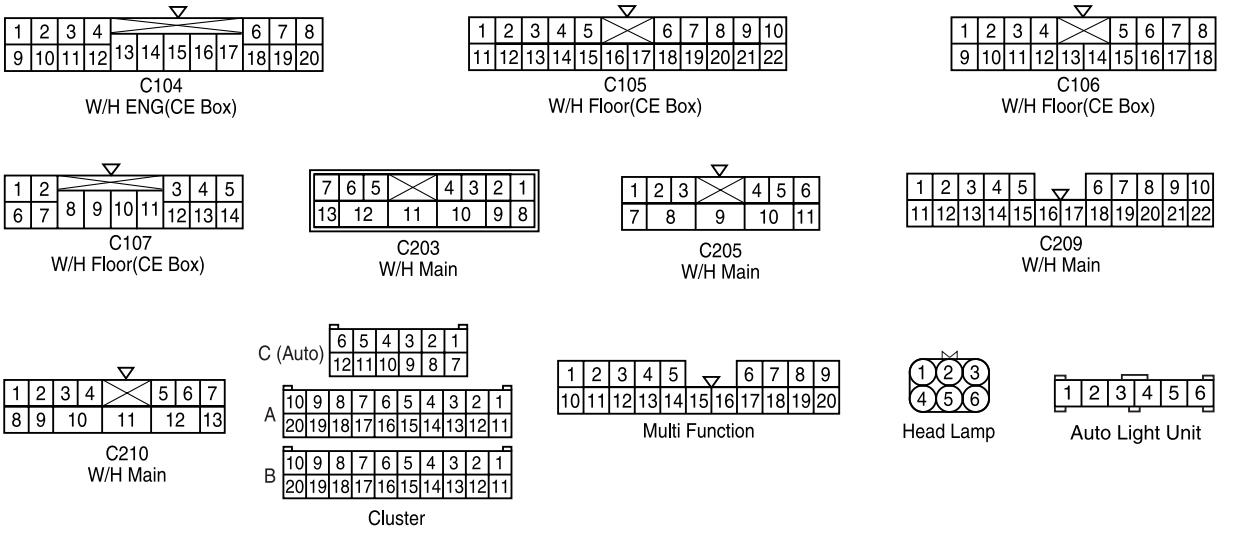
1) ~ 2002 MODEL



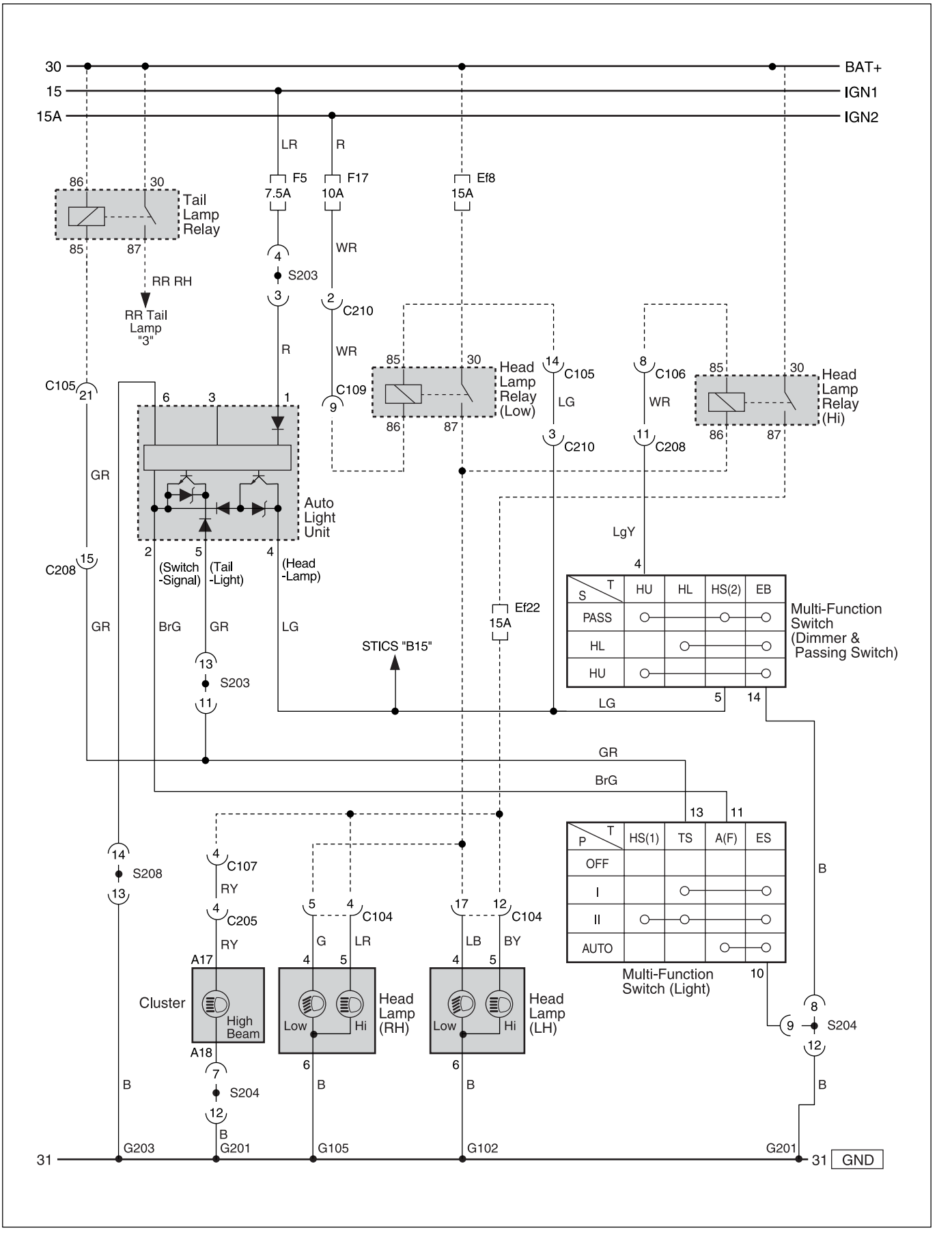
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Engine - Main (RH)	Inside Driver Side Cowl PNL	
S203 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S208 (14Pin, Black)	W/H Main	Behind the Right the FATC	
G102	W/H Engine	Center BATT	
G105	W/H Engine	Behine the Right Head Lamp	
G201	W/H Main	Inside Driver Side Cowl PNL	
G203	W/H Main	Under the Seat Heating SW	W/H Air Bag

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



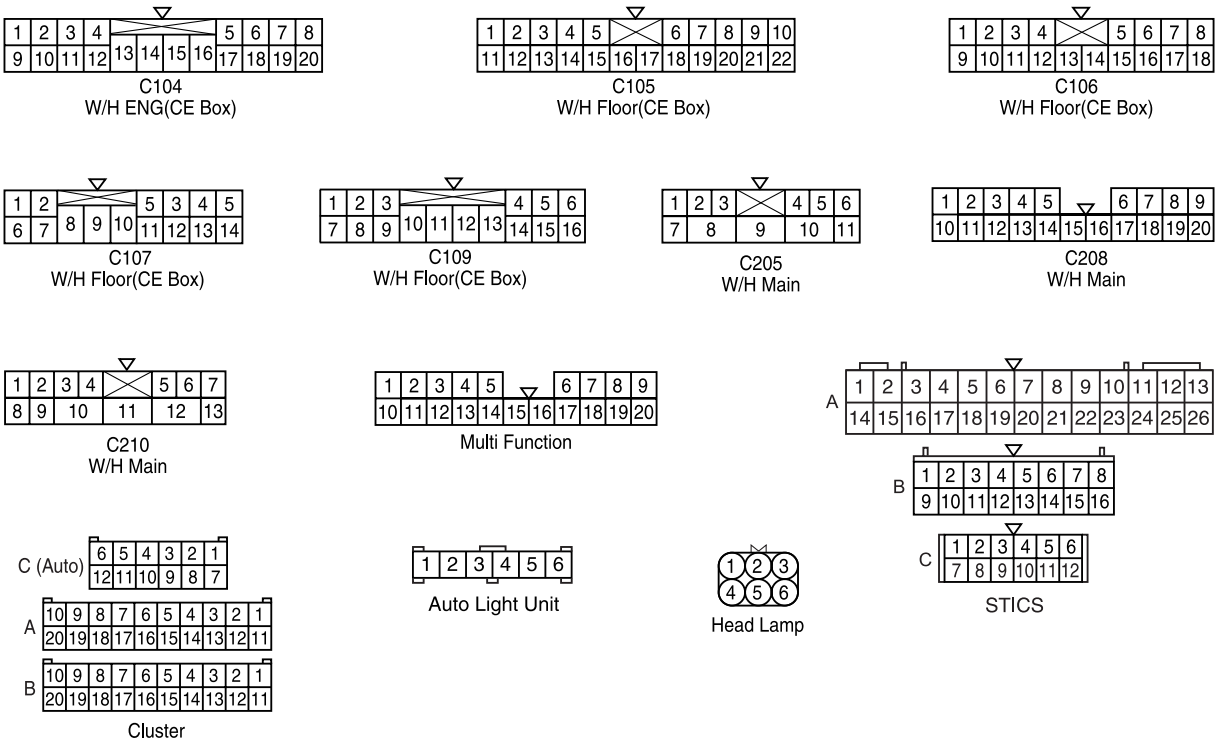
2) XDi


30
15
15A
BAT+
IGN1
IGN2
Tail Lamp Relay
86
30
85
87
RR RH
RR Tail Lamp "3"
LR
R
F5
7.5A
F17
10A
Ef8
15A
WR
S203
C210
C109
Head Lamp Relay (Low)
Head Lamp Relay (Hi)
C105
C106
C208
LG
LgY
Auto Light Unit
(Switch -Signal)
(Tail -Light)
(Head -Lamp)
GR
BrG
Ef22
STICS "B15"
Multi-Function Switch (Dimmer & Passing Switch)
S
T
HU
HL
HS(2)
EB
PASS
Multi-Function Switch (Light)
P
HS(1)
TS
A(F)
ES
OFF
I
II
AUTO
S208
C107
RY
C205
C104
G
LB
BY
Cluster
High Beam
Low
Hi
Head Lamp (RH)
Head Lamp (LH)
A17
A18
S204
B
G203
G201
G105
G102
31
GND

A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Engine - Main (RH)	Inside Driver Side Cowl PNL	
S203 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S208 (14Pin, Black)	W/H Main	Behind the Right the FATC	
G102	W/H Engine	Center BATT	
G103	W/H Engine	Behind the Left Head Lamp	
G105	W/H Engine	Behine the Right Head Lamp	
G201	W/H Main	Inside Driver Side Cowl PNL	

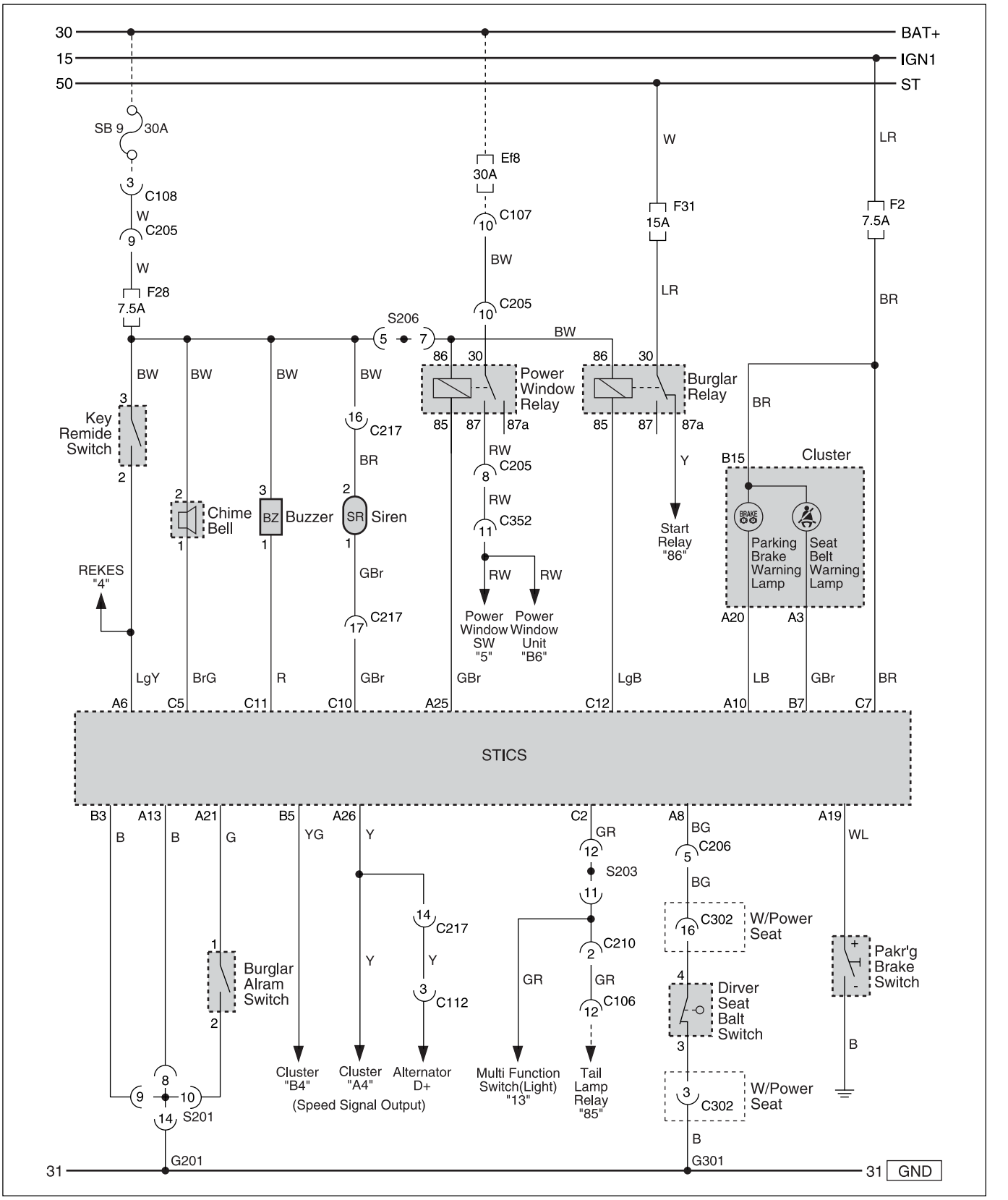
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



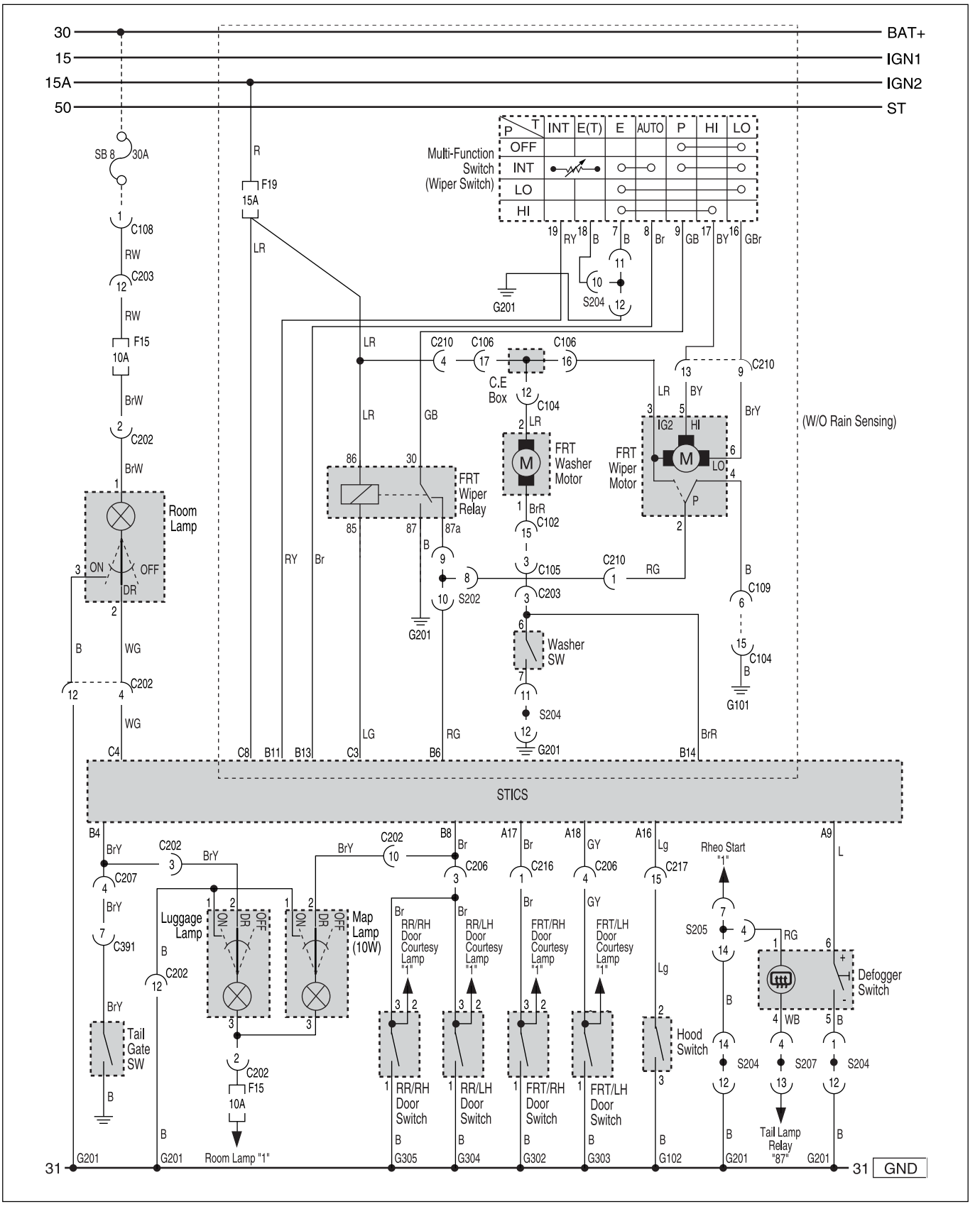
26. STICS

1) ~ 2002 MODEL

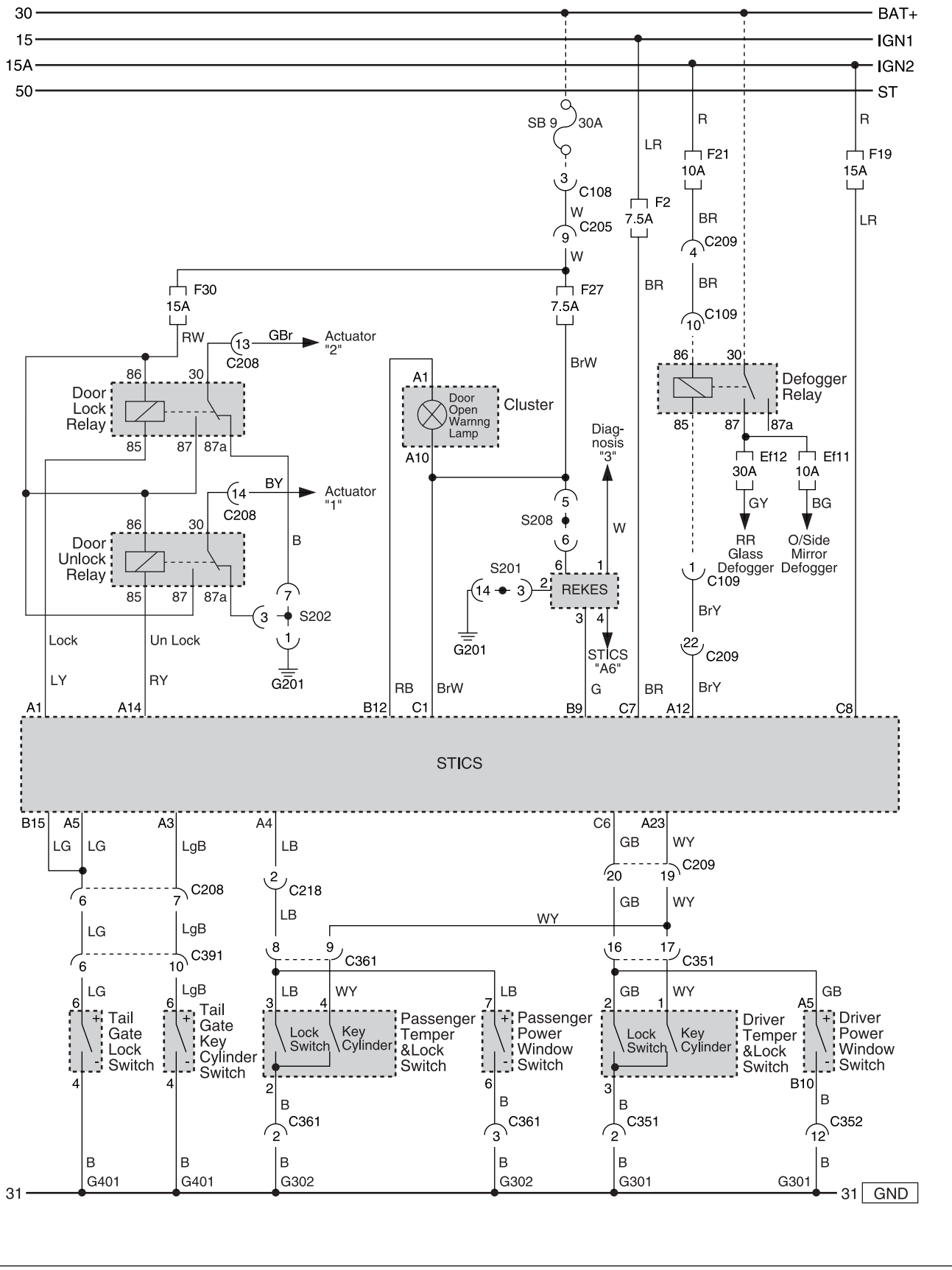
(1) POWER SUPPLY, GND, CHIME BELL, BUZZER, WARNING LAMP (PARKING BRAKE, SEAT BELT) CIRCUIT



(2) FRT WIPER, DR SWITCH, LAMP (ROOM, MAP) CIRCUIT



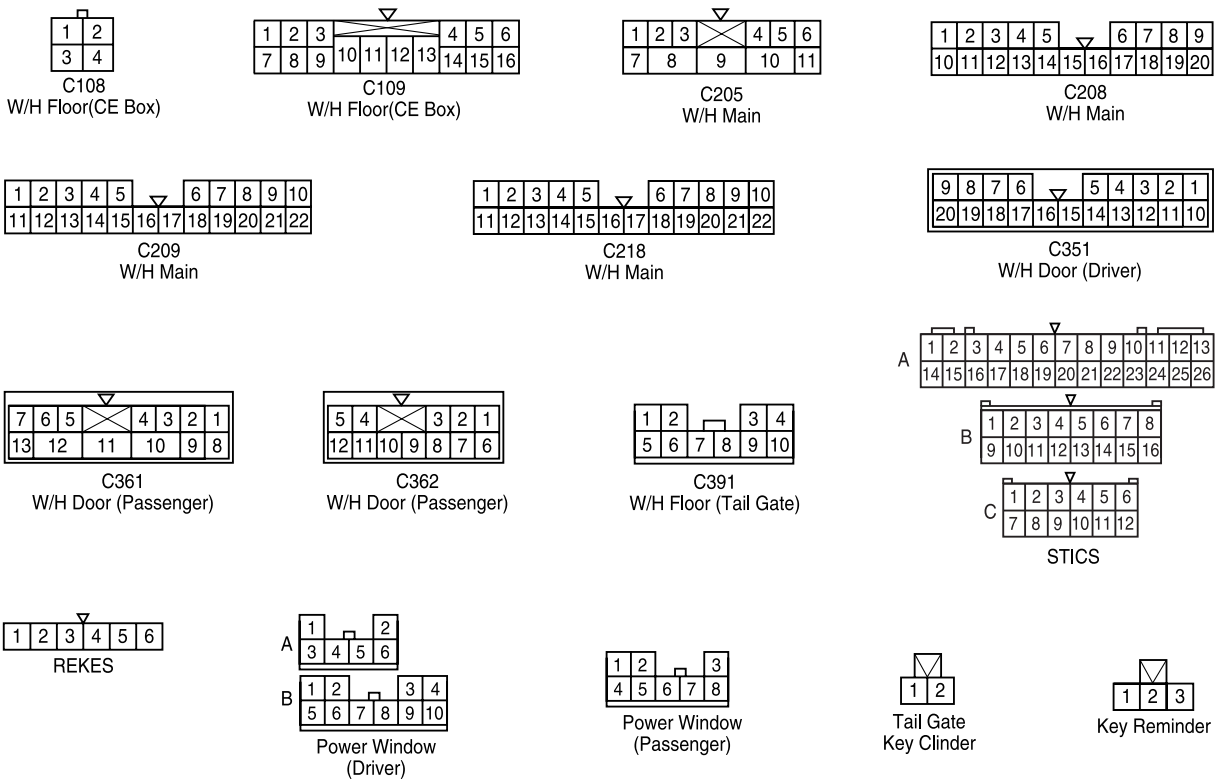
(3) DR LOCK, DEFOGGER, POWER WINDOW CIRCUIT



A. CONNECTOR INFORMATION

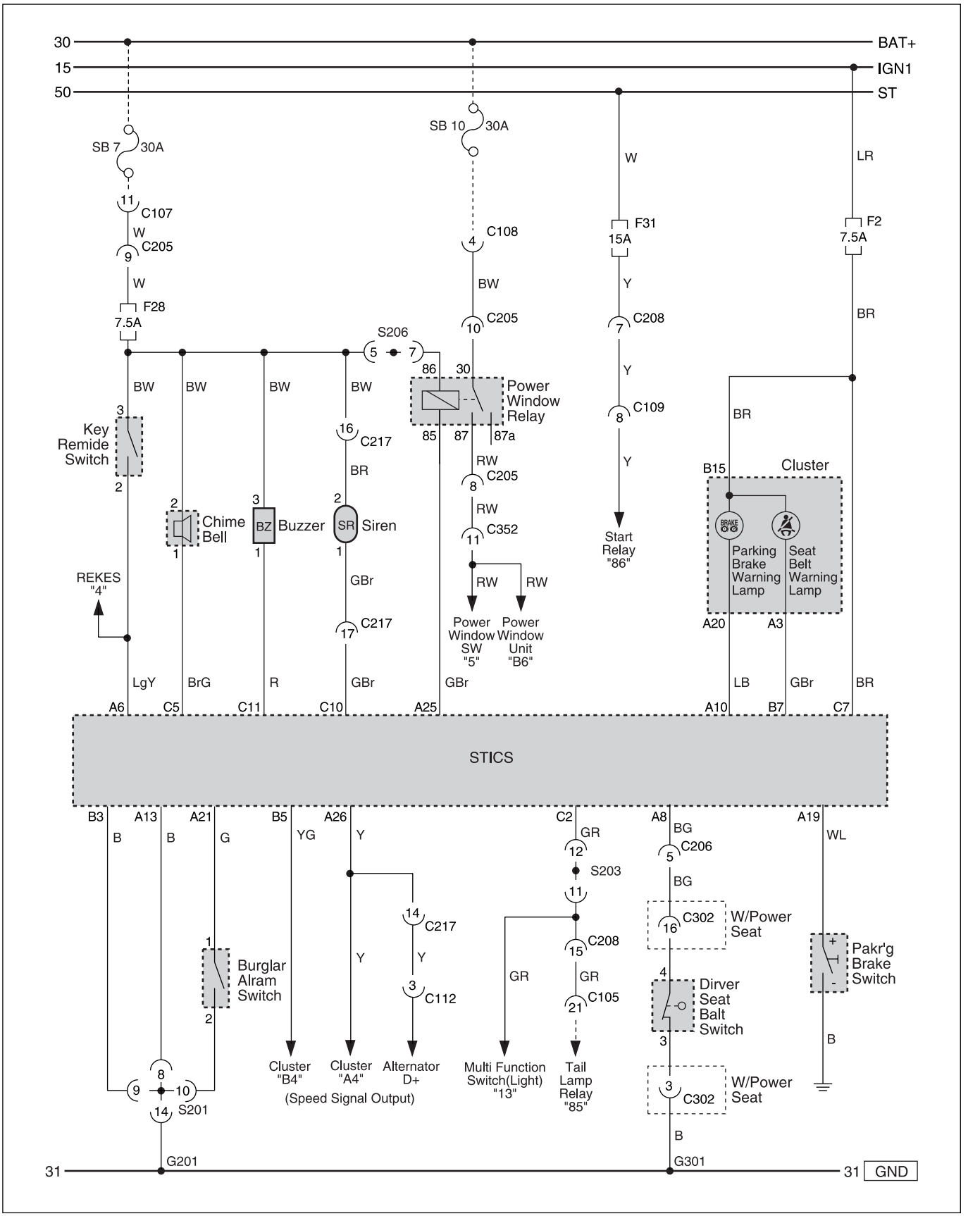
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C351 (20Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C361 (13Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
C362 (12Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
C391 (10Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S208 (14Pin, Black)	W/H Main	Behind the Right the FATC	
G201	W/H Main	Center BATT	
G301	W/H Floor	Under Driver Seat	ECU GND
G302	W/H Floor	Under Driver Seat	
G401	W/H Floor	Center the Tail Gate	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

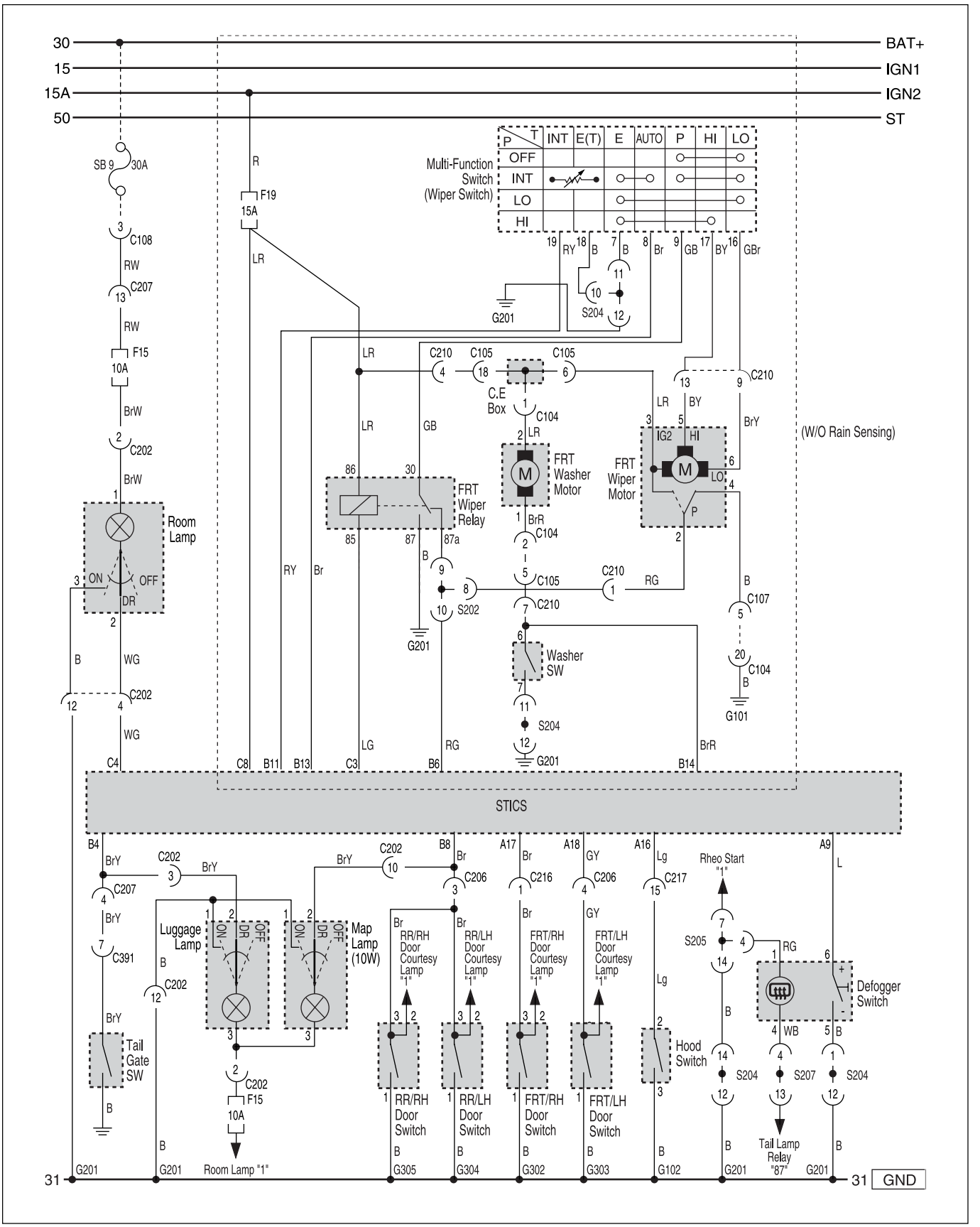


2) 2003 MODEL

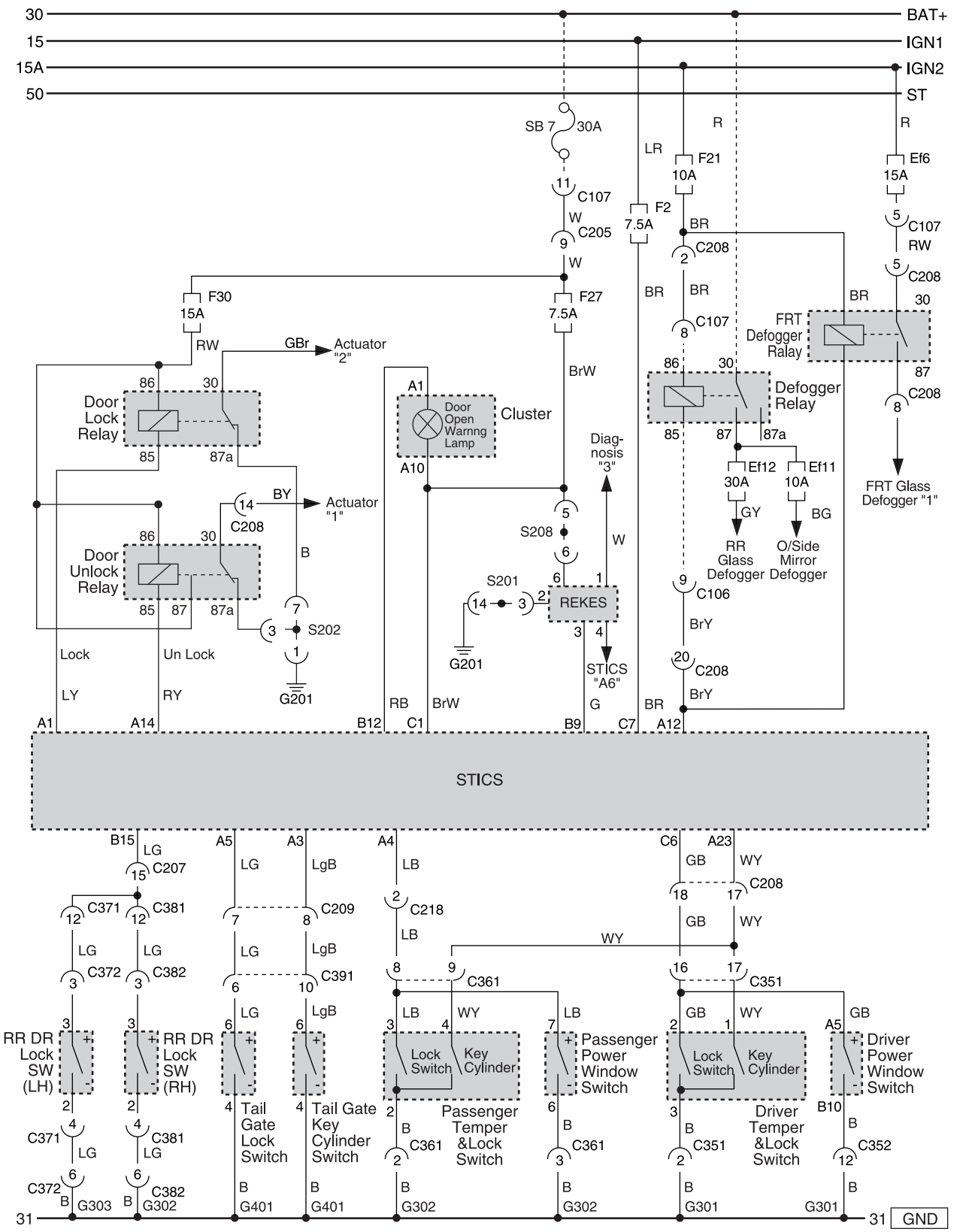
(1) POWER SUPPLY, GND, CHIME BELL, BUZZER, WARNING LAMP (PARKING BRAKE, SEAT BELT) CIRCUIT



(2) FRT WIPER, DR SWITCH, LAMP (ROOM, MAP) CIRCUIT



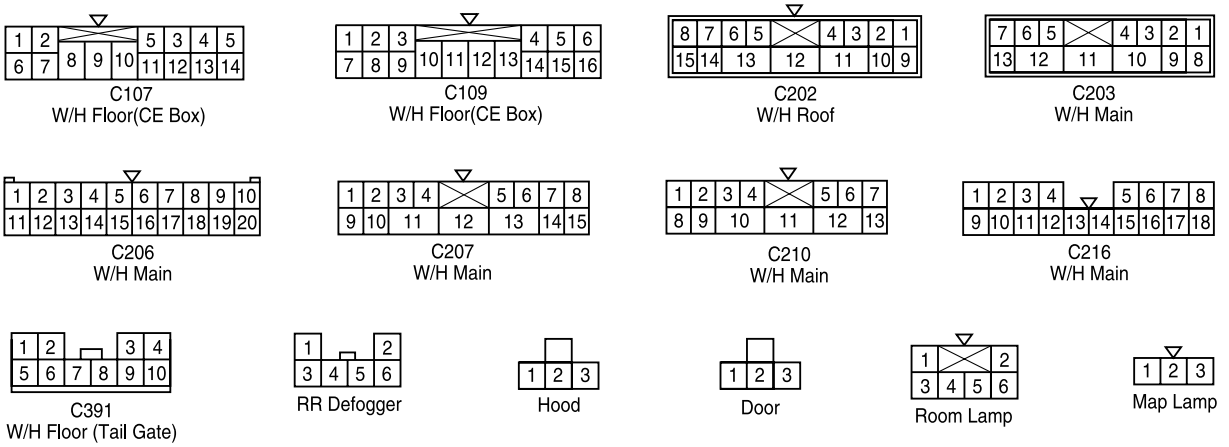
(3) DR LOCK, DEFOGGER, POWER WINDOW CIRCUIT



A. CONNECTOR INFORMATION

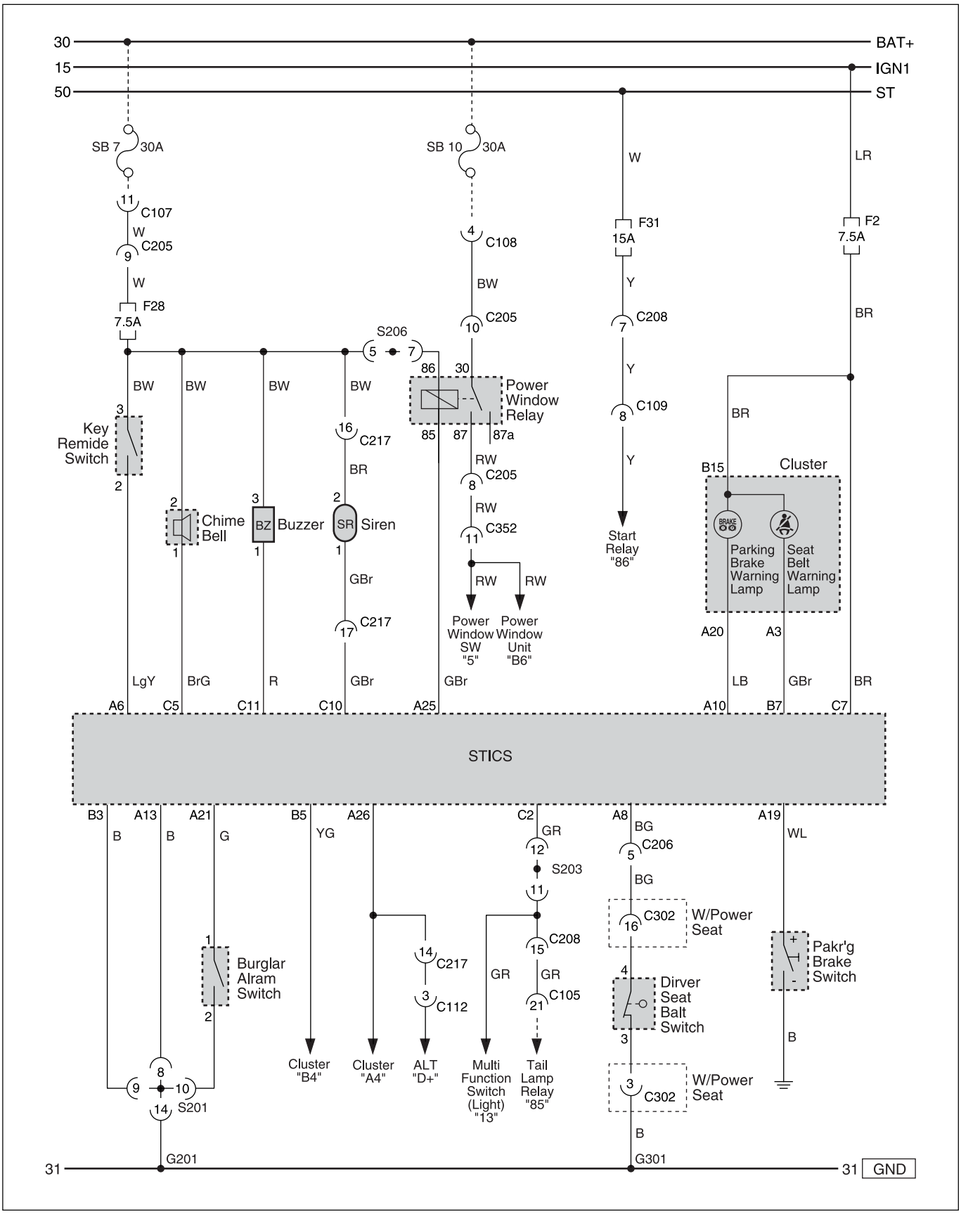
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C109 (14Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C202 (15Pin, White)	Main - Roof	Under the I/P Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Engine - Main (RH)	Inside Driver Side Cowl PNL	
C216 (18Pin, White)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C217 (20Pin, Black)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C391 (10Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S205 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S207 (14Pin, Black)	W/H Main	Behind the Right the FATC	Tail Lamp
G102	W/H Engine	Center BATT	
G201	W/H Main	Inside Driver Side Cowl PNL	
G302	W/H Floor	Under Driver Seat	
G303	W/H Floor	Under the Left “B” Filler	
G304	W/H Floor	Behind the Quarter Grass #1	
G305	W/H Floor	Behind the Quarter Grass #1	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

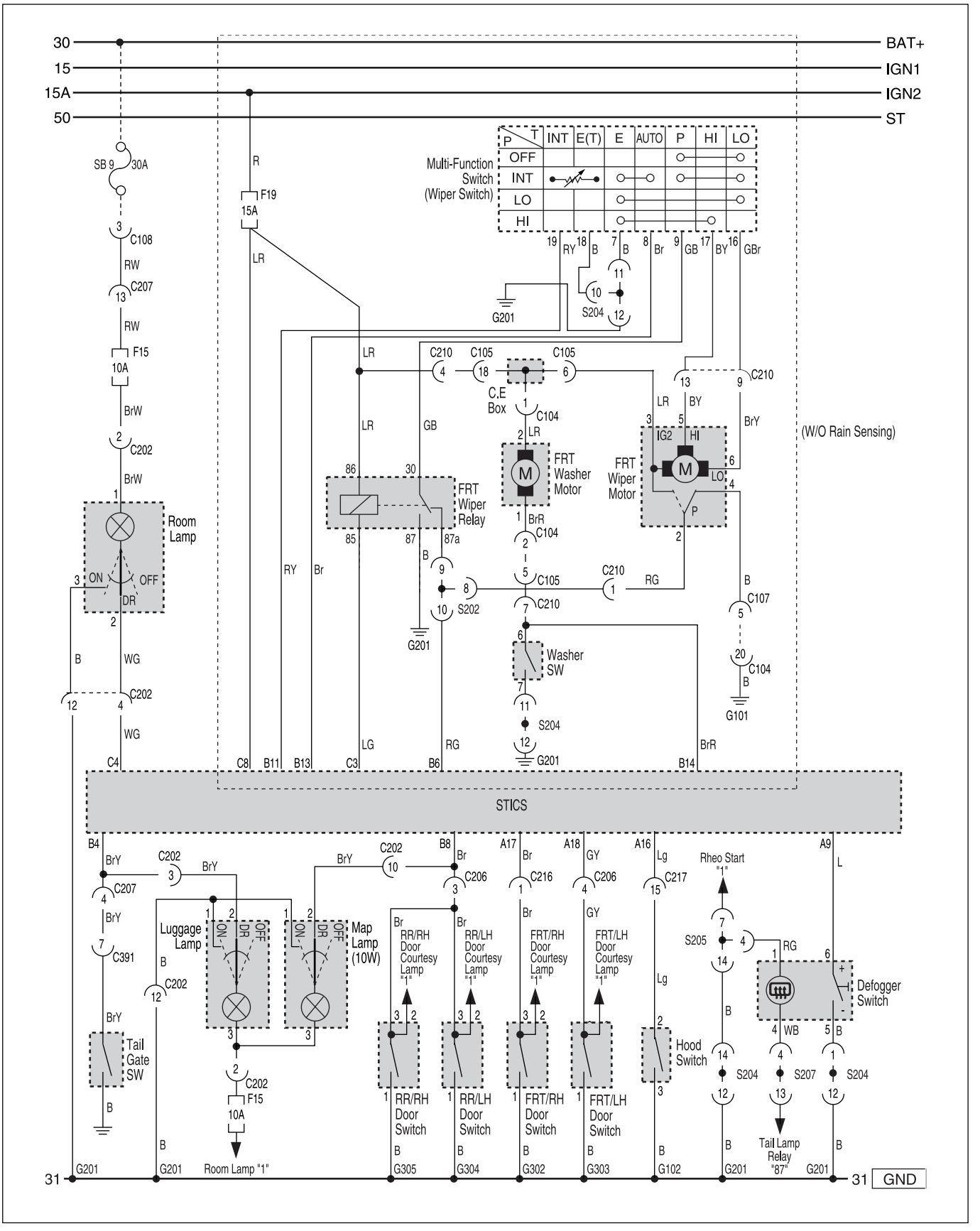


3) XDi

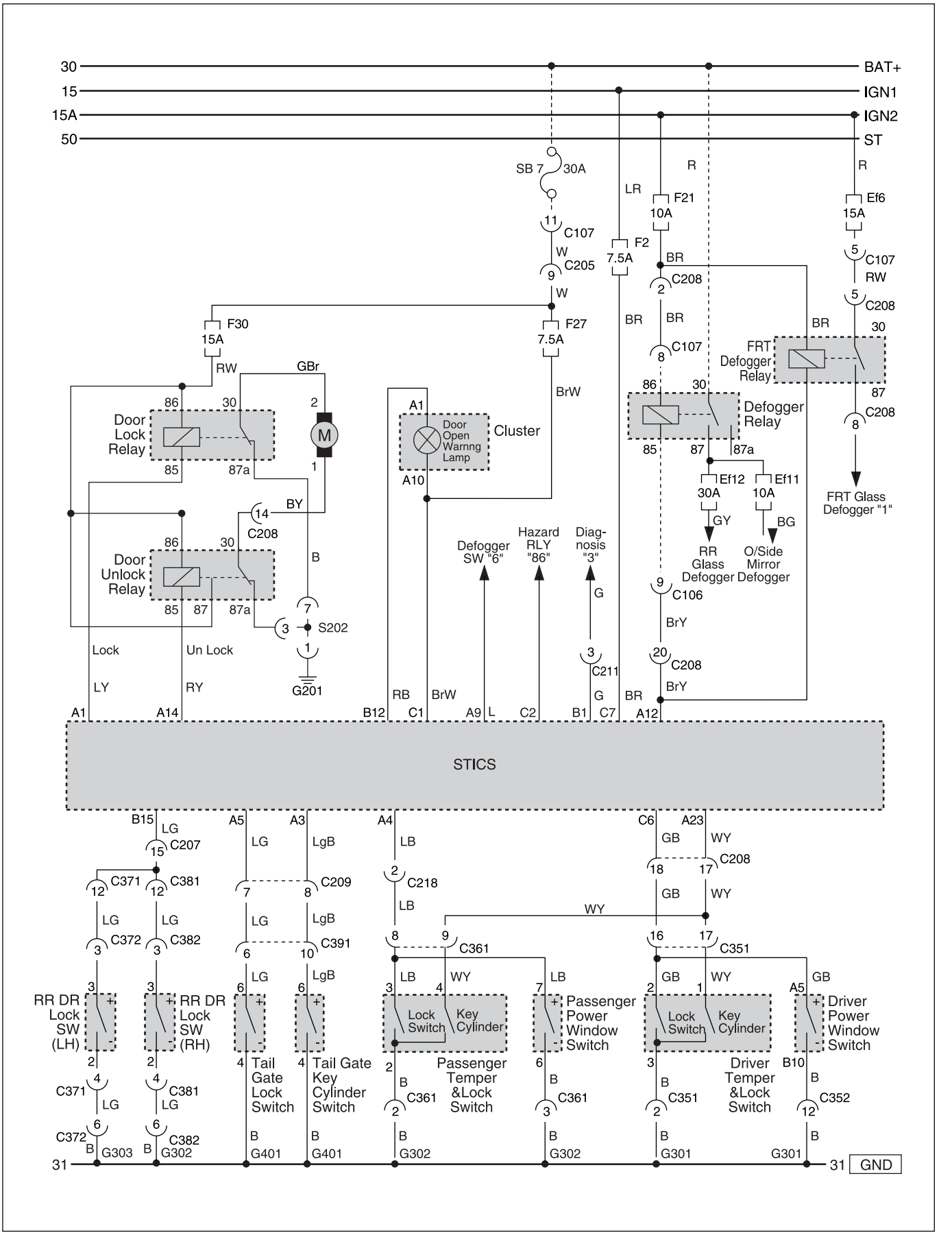
(1) POWER SUPPLY, GND, CHIME BELL, BUZZER, WARNING LAMP (PARKING BRAKE, SEAT BELT) CIRCUIT



(2) FRT WIPER, DR SWITCH, LAMP (ROOM, MAP) CIRCUIT



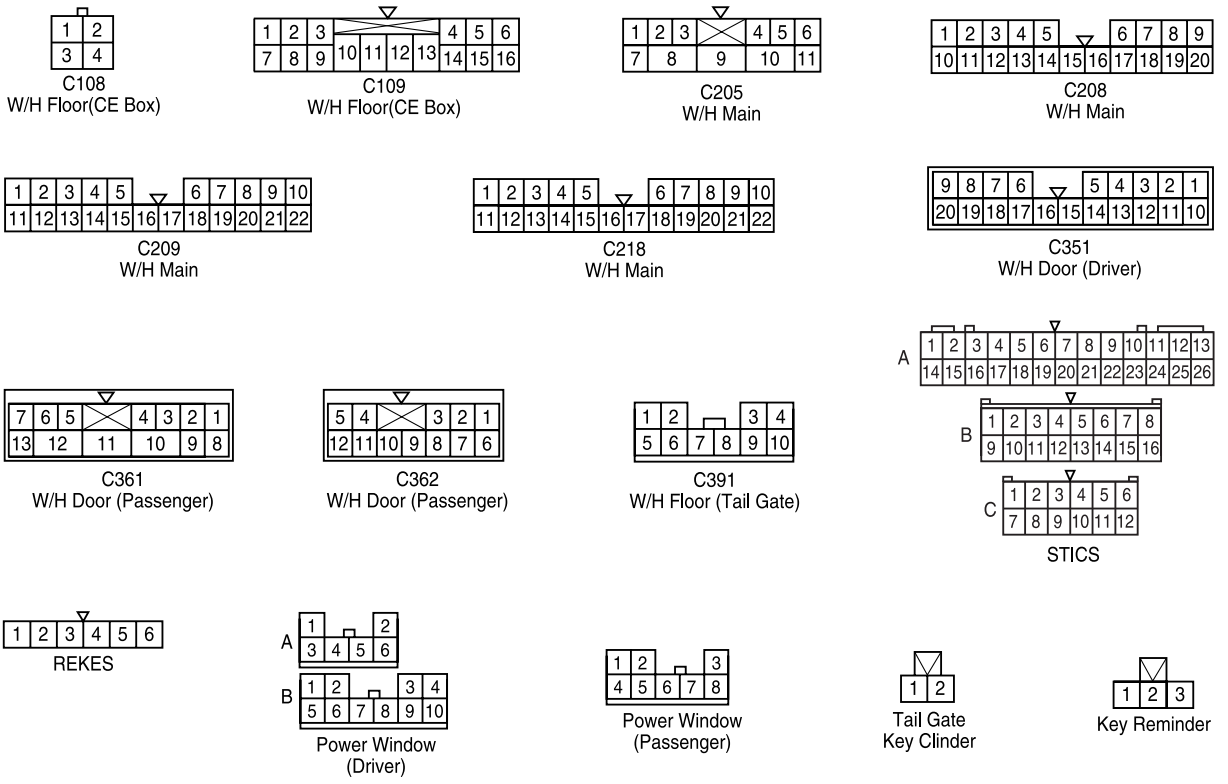
(3) DR LOCK, DEFOGGER, POWER WINDOW CIRCUIT



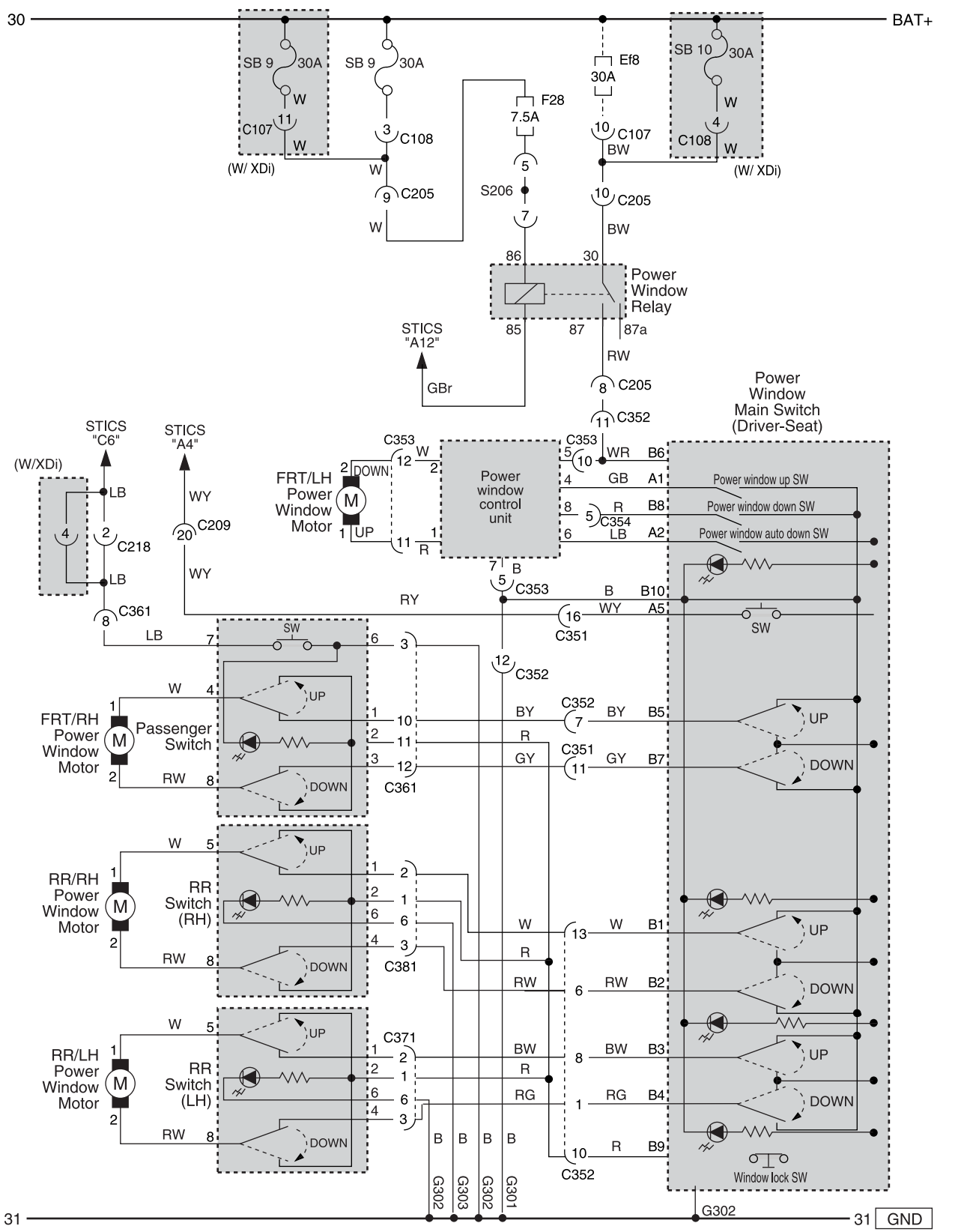
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C351 (20Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C361 (13Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
C362 (12Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
C391 (10Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S208 (14Pin, Black)	W/H Main	Behind the Right the FATC	
G201	W/H Main	Center BATT	
G301	W/H Floor	Under Driver Seat	ECU GND
G302	W/H Floor	Under Driver Seat	
G401	W/H Floor	Center the Tail Gate	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



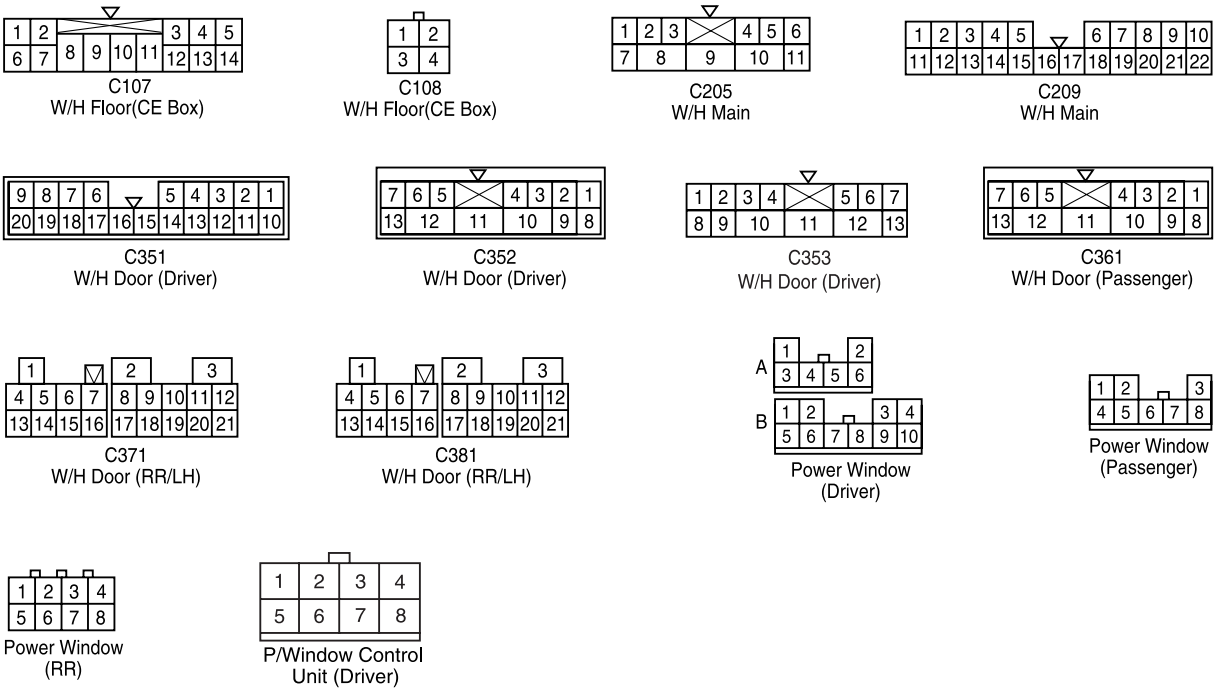
27. POWER WINDOW CIRCUIT



A. CONNECTOR INFORMATION

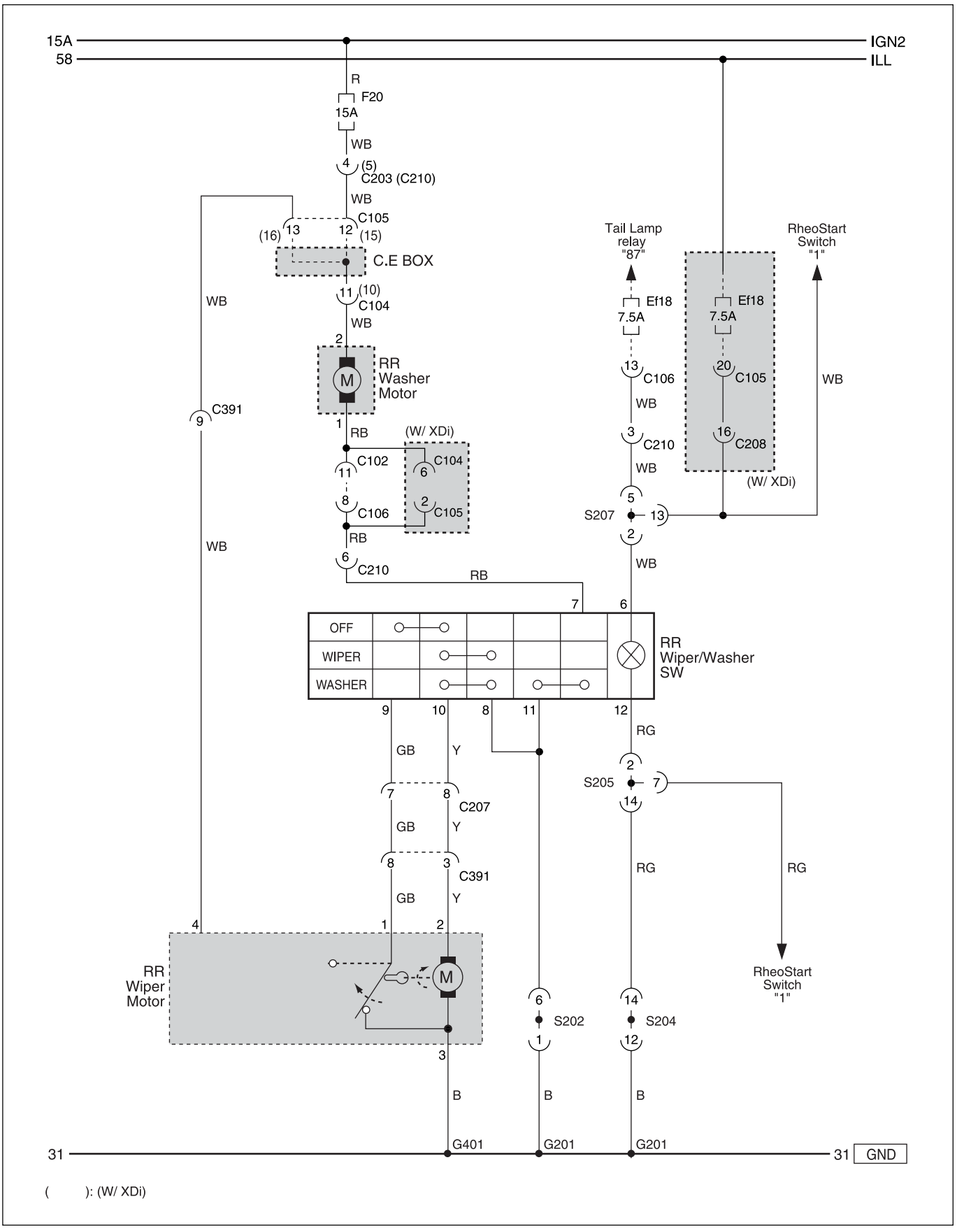
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C351 (20Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C352 (13Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C353 (13Pin, White)	Driver Door - Door Extention	Inside Driver Side Cowl PNL	
C361 (13Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
C371 (21Pin, White)	Floor - RR Left Door	Under Left “B” Filler	
C381 (21Pin, White)	Floor - RR Right Door	Under Right “B” Filler	
S206 (14Pin, Black)	W/H Main	Behind the Left the FATC	
G301	W/H Floor	Under Driver Seat	ECU GND
G302	W/H Floor	Under Driver Seat	
G303	W/H Floor	Under the Left “B” Filler	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

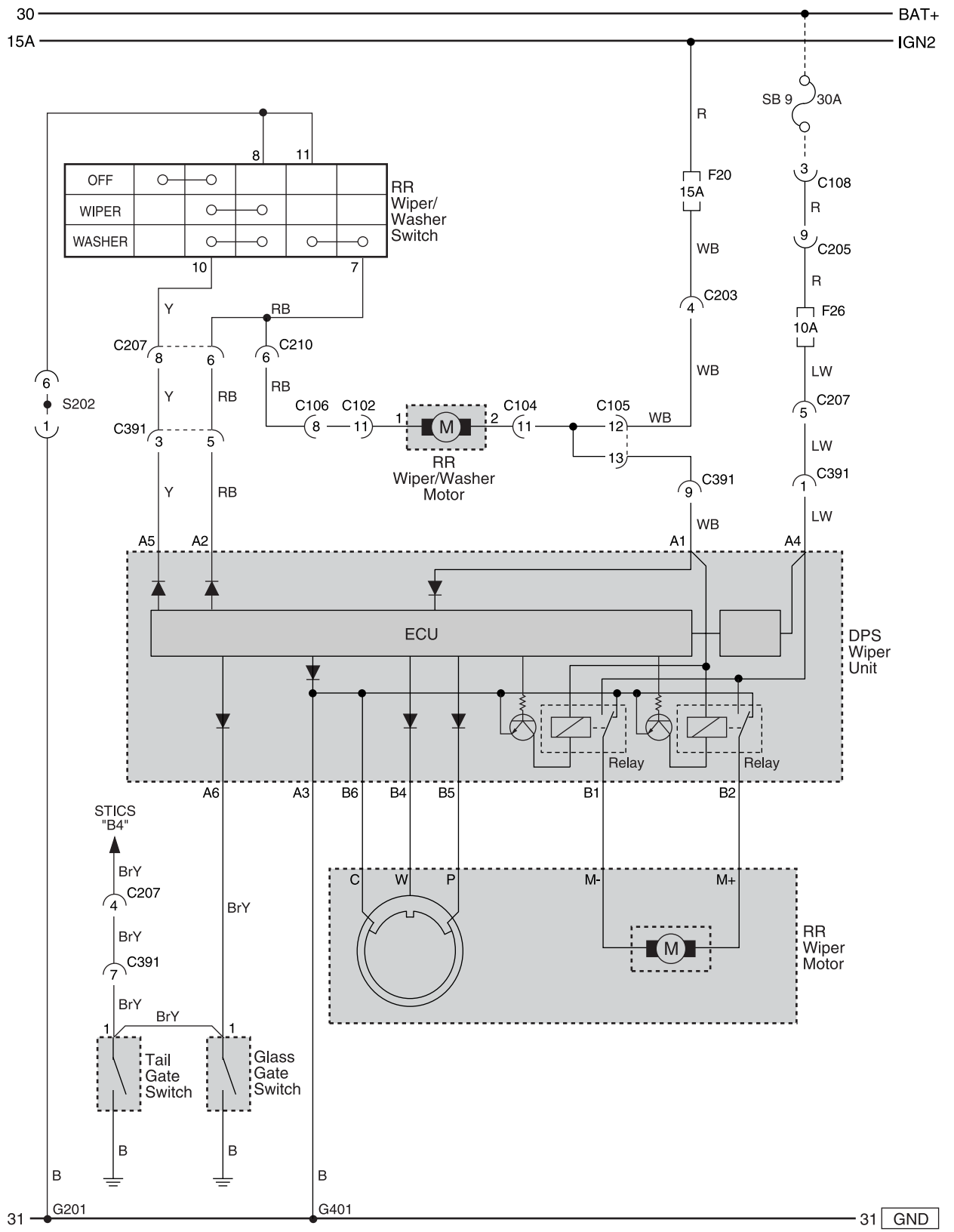


28. REAR GLASS WIPER & WASHER CIRCUIT

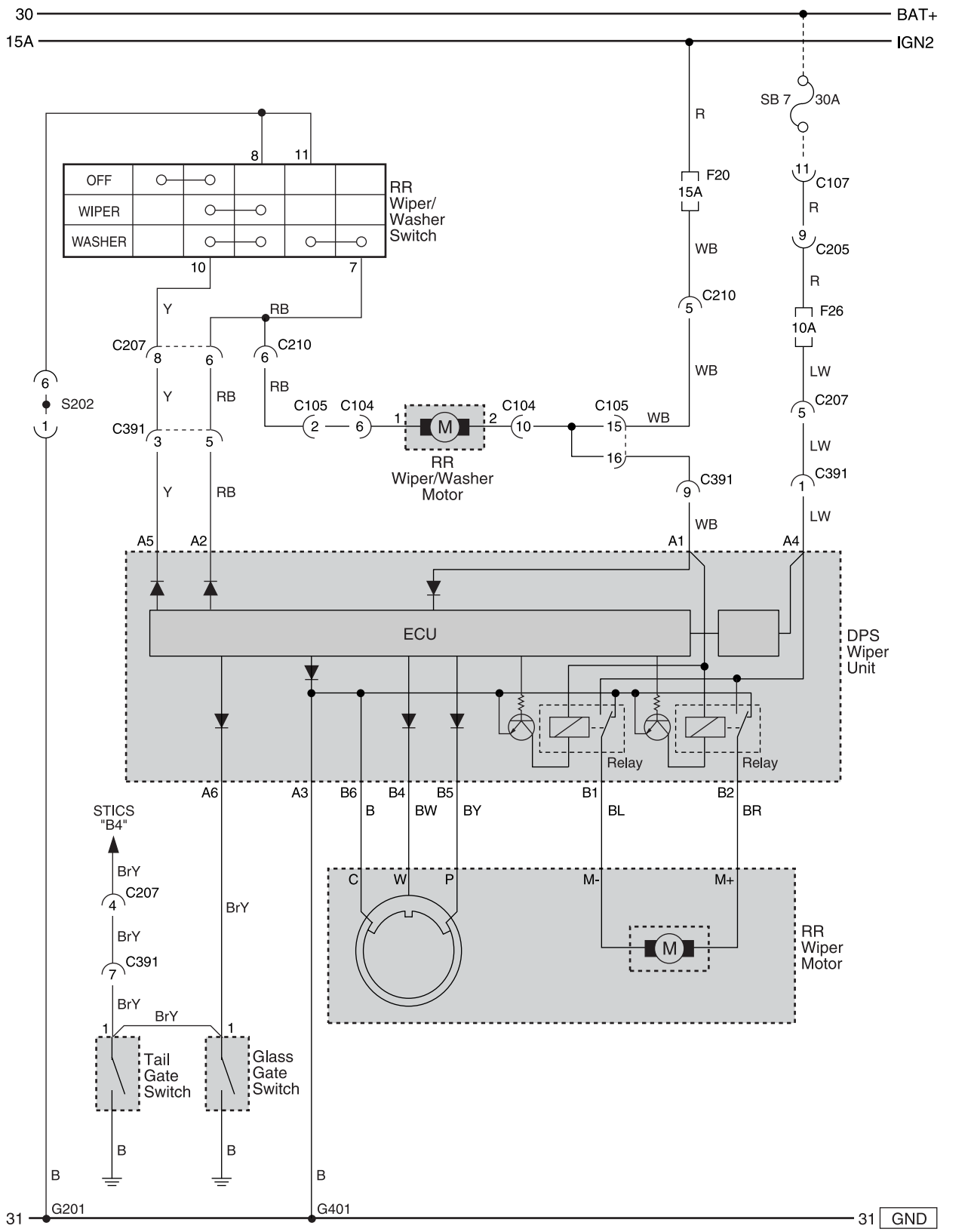
1) REAR GLASS WIPER & WASHER (W/O FLIP UP GLASS)



2) REAR GLASS DPS WIPER & WASHER (W/ FLIP UP GLASS)



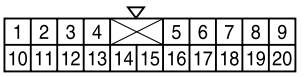
3) REAR GLASS DPS WIPER & WASHER (W/ FLIP UP GLASS) (XDi)



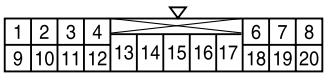
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Engine - Main (RH)	Inside Driver Side Cowl PNL	
C391 (10Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
G201	W/H Main	Inside Driver Side Cowl PNL	
G401	W/H Floor	Center the Tail Gate	

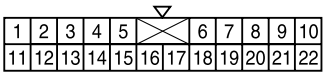
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



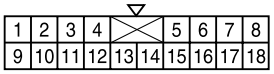
C102
W/H ENG(CE Box)



C104
W/H ENG(CE Box)

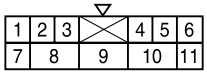


C105
W/H Floor(CE Box)

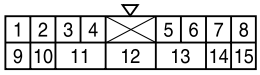


C106
W/H Floor(CE Box)

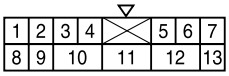
C108
W/H Floor(CE Box)



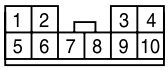
C205
W/H Main



C207
W/H Main



C210
W/H Main

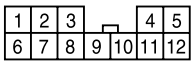


C391
W/H Floor (Tail Gate)

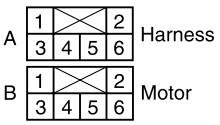
Tail Gate

Glass
Gate

Washer
Motor

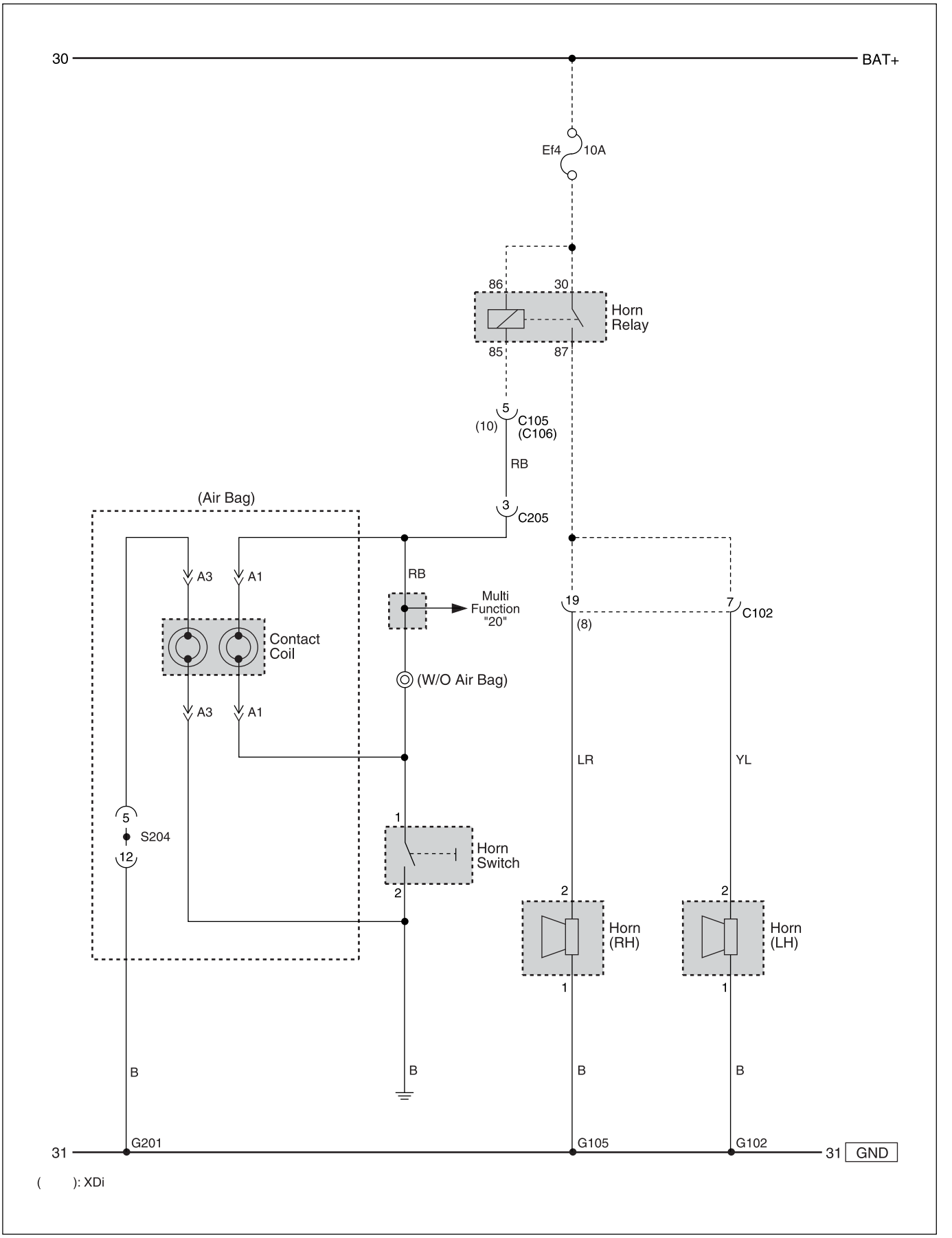


RR Grass
Wiper/Washer



DPS Wiper Unit

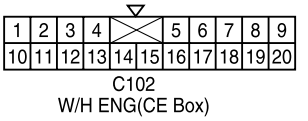
29. HORN CIRCUIT



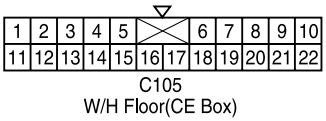
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
G102	W/H Engine	Center BATT	
G105	W/H Engine	Behind the Right Head Lamp	
G201	W/H Main	Inside Driver Side Cowl PNL	

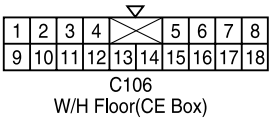
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



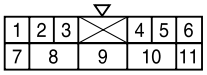
C102
W/H ENG(CE Box)



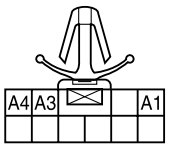
C105
W/H Floor(CE Box)



C106
W/H Floor(CE Box)



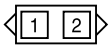
C205
W/H Main



Horn/Audio
Contact Coil
(Colum Side)

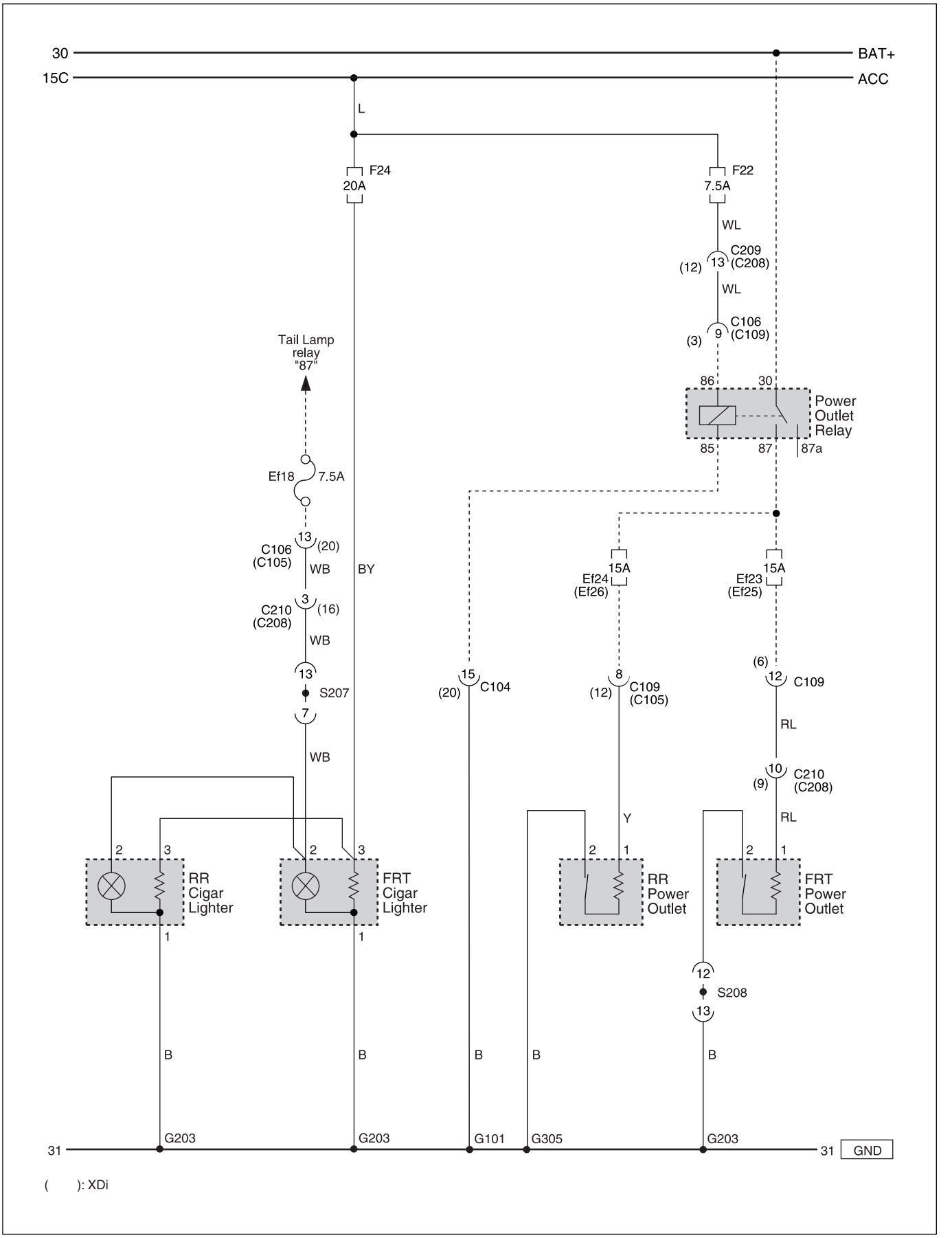
Horn Contact
(Steering)

Audio Contact
(Steering)



Horn

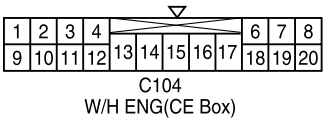
30. CIGAR LIGHTER CIRCUIT



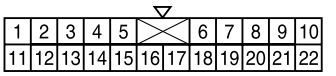
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Engine - Main (RH)	Inside Driver Side Cowl PNL	
S207 (14Pin, Black)	W/H Main	Behind the Right the FATC	Tail Lamp
S208 (14Pin, Black)	W/H Main	Behind the Right the FATC	
G101	W/H Engine	Center the Engine Room Fuse Box	
G203	W/H Engine	Under the Seat Heating SW	W/H Air Bag
G305	W/H Floor	Behind the Quarter Grass #1	

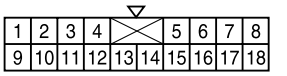
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



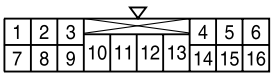
C104
W/H ENG(CE Box)



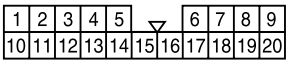
C105
W/H Floor(CE Box)



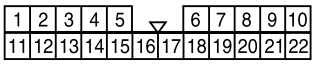
C106
W/H Floor(CE Box)



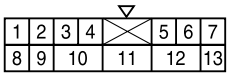
C109
W/H Floor(CE Box)



C208
W/H Main



C209
W/H Main



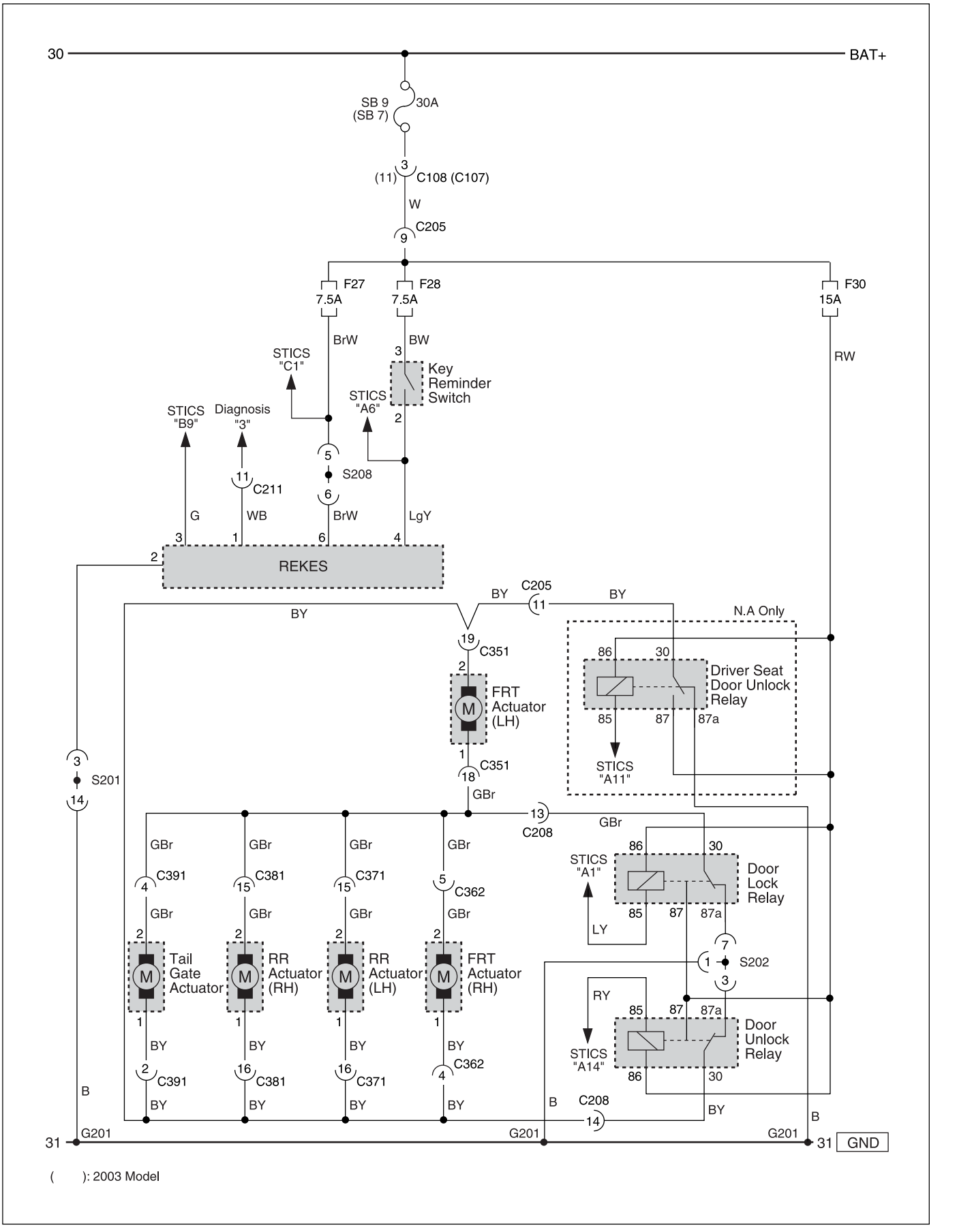
C210
W/H Main

Cigar Ligther
(FRT)

Cigar Ligther
(RR)

PWR
Outlet

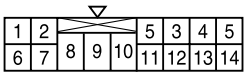
31. REKES CIRCUIT (~ 2003 MODEL)



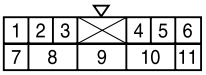
A. CONNECTOR INFORMATION

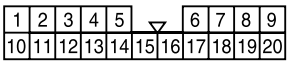
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C351 (20Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C362 (12Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
C371 (21Pin, White)	Floor - RR Left Door	Under Left “B” Filler	
C381 (21Pin, White)	Floor - RR Right Door	Under Right “B” Filler	
C391 (10Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S208 (14Pin, Black)	W/H Main	Behind the Right the FATC	
G201	W/H Main	Inside Driver Side Cowl PNL	

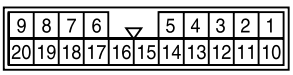
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

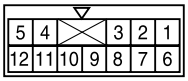

C107
W/H Floor(CE Box)

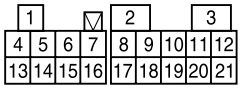

C108
W/H Floor(CE Box)

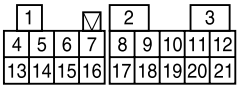

C205
W/H Main

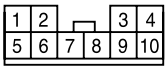

C208
W/H Main

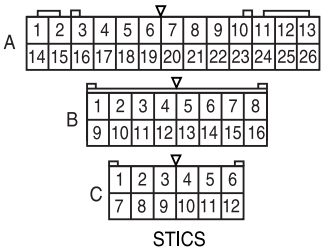

C351
W/H Door (Driver)

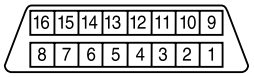

C362
W/H Door (Passenger)

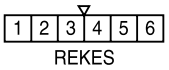

C371
W/H Door (RR/LH)


C381
W/H Door (RR/LH)


C391
W/H Floor (Tail Gate)


STICS


Diagnosis


REKES

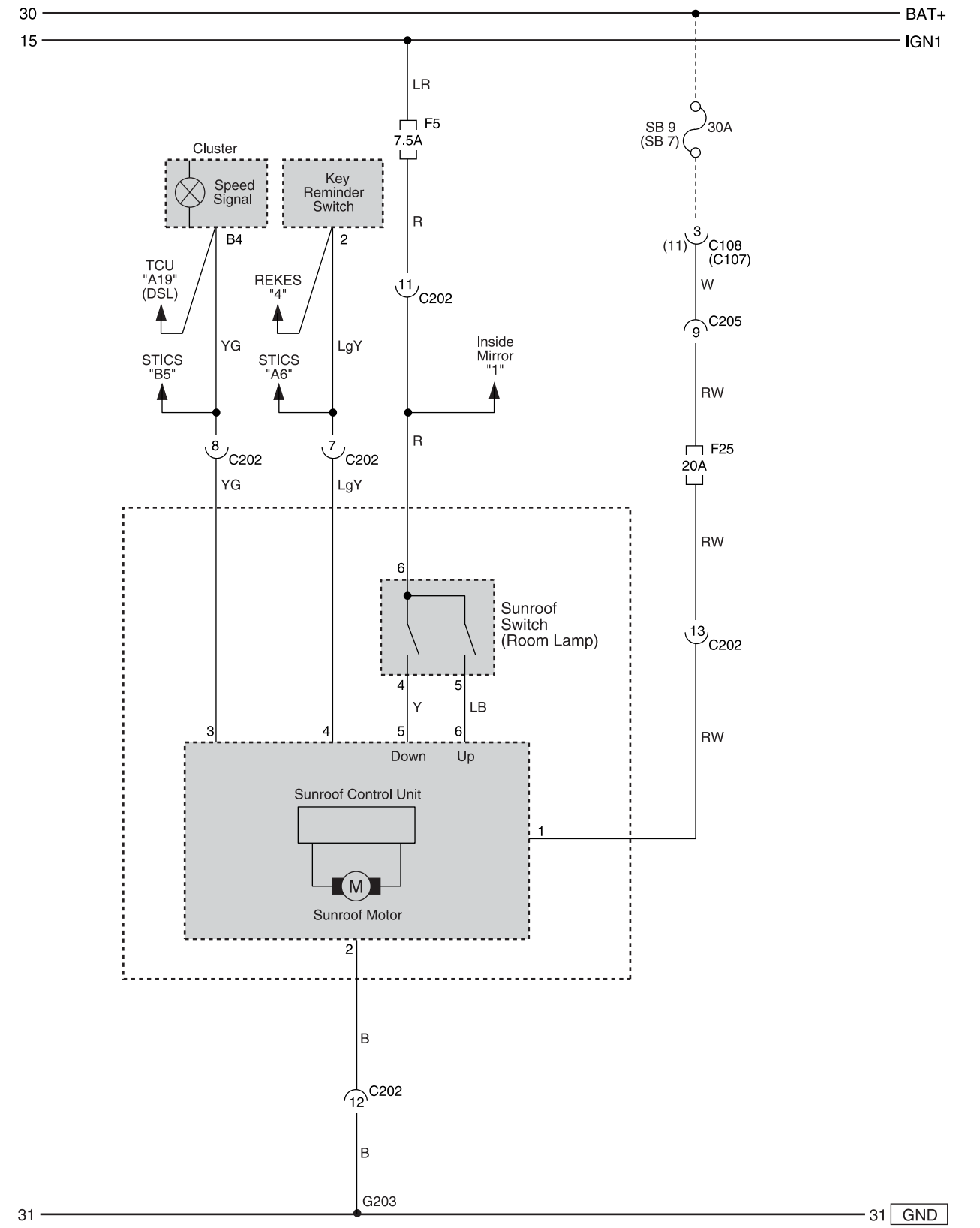

Key Reminder


Hood


Door Lock
Solenoid
(Actuator)


Door Lock Solenoid
(Tail Gate)

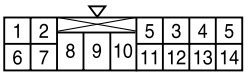
32. SUN ROOF CIRCUIT



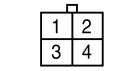
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C202 (15Pin, White)	Main - Roof	Under the I/P Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
G201	W/H Main	Inside Driver Side Cowl PNL	

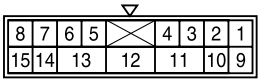
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



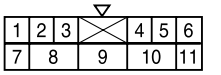
C107
W/H Floor(CE Box)



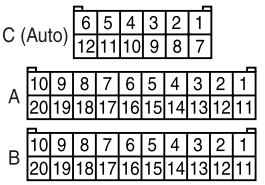
C108
W/H Floor(CE Box)



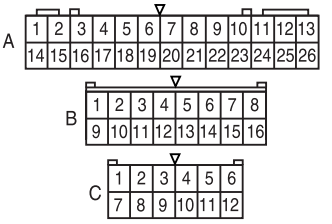
C202
W/H Roof



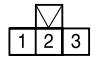
C205
W/H Main



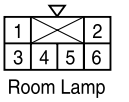
Cluster



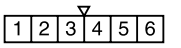
STICS



Key Reminder

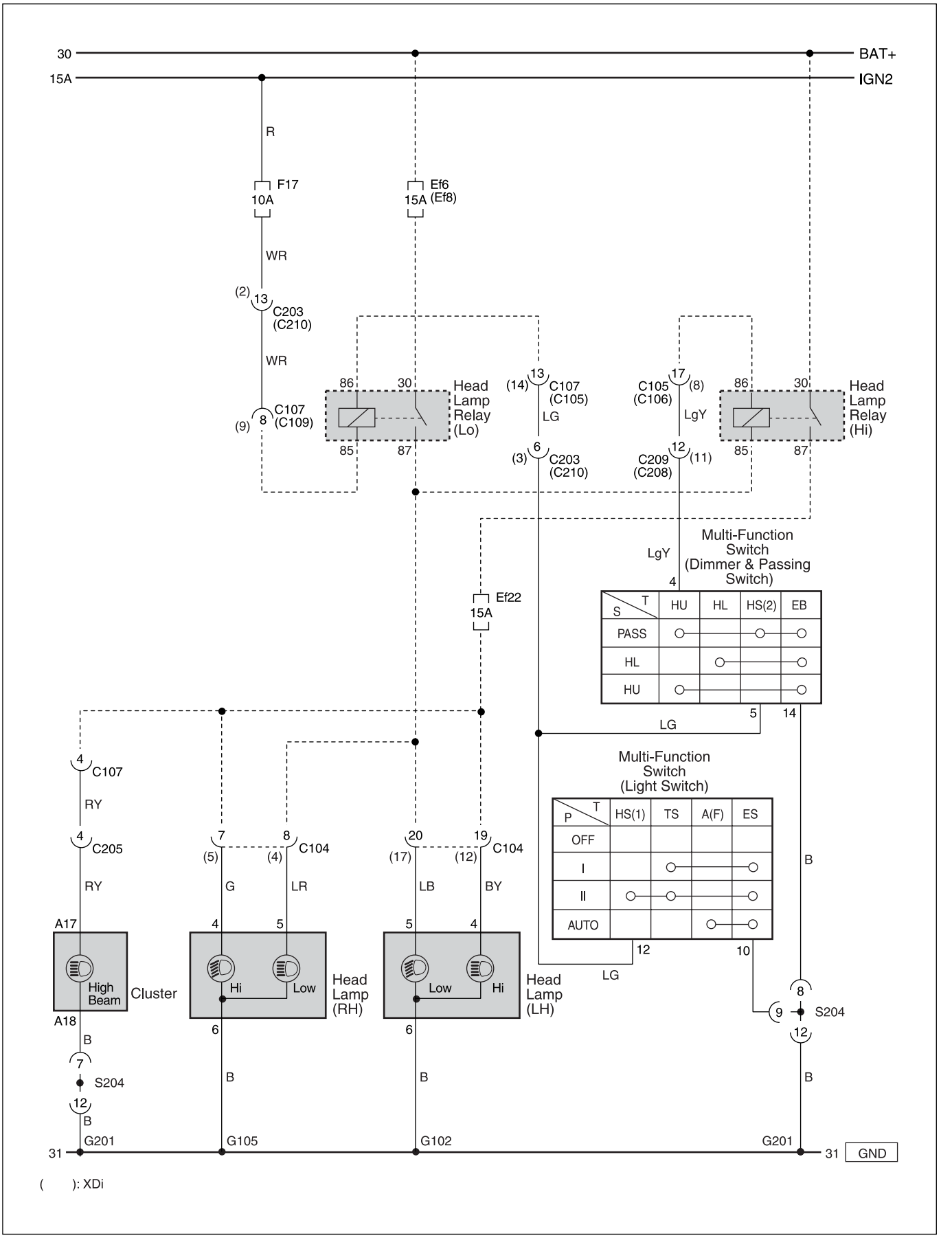


Room Lamp



Sun Roof Motor

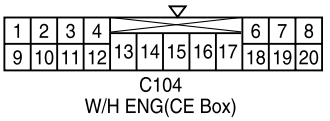
33. HEAD LAMP CIRCUIT



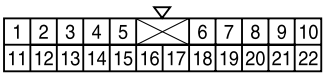
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	GND
C210 (13Pin, Green)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	
G102	W/H Engine	Center BATT	
G105	W/H Engine	Behine the Right Head Lamp	
G201	W/H Main	Inside Driver Side Cowl PNL	

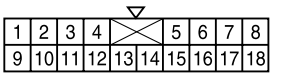
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



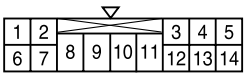
C104
W/H ENG(CE Box)



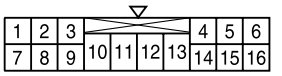
C105
W/H Floor(CE Box)



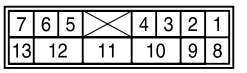
C106
W/H Floor(CE Box)



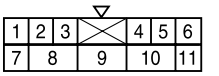
C107
W/H Floor(CE Box)



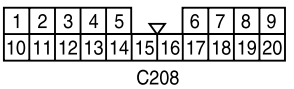
C109
W/H Floor(CE Box)



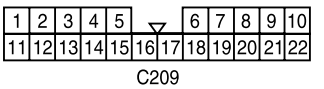
C203
W/H Main



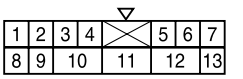
C205
W/H Main



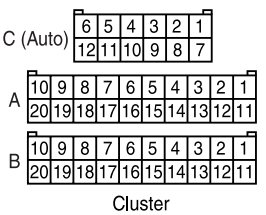
C208
W/H Main



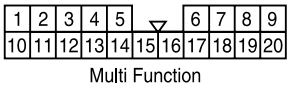
C209
W/H Main



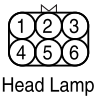
C210
W/H Main



Cluster

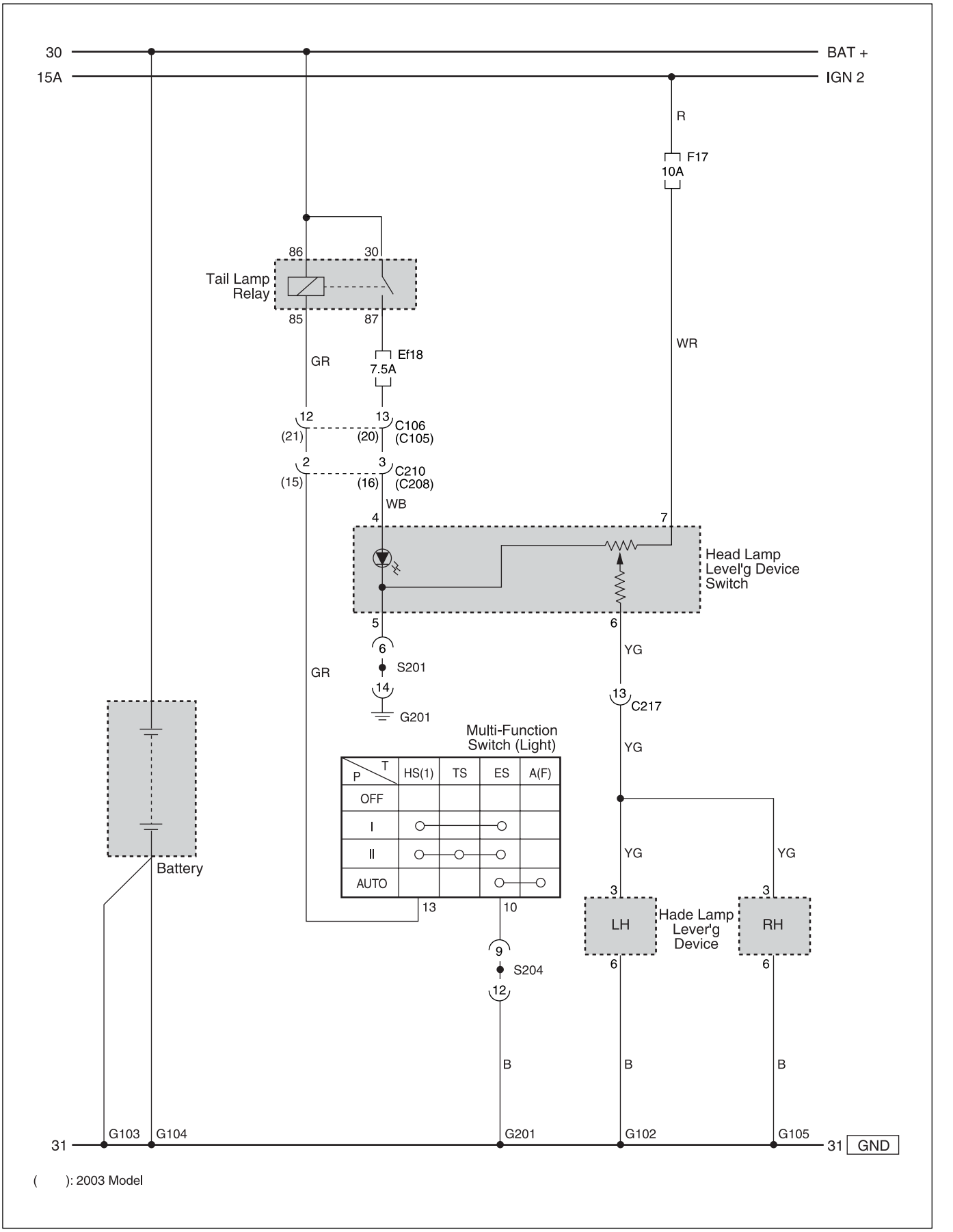


Multi Function



Head Lamp

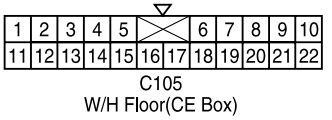
34. HEAD LAMP LEVELING DEVICE CIRCUIT



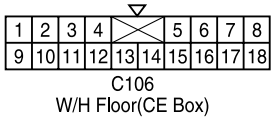
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C217 (20Pin, Black)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
G102	W/H Engine	Center BATT	
G105	W/H Engine	Behine the Right Head Lamp	
G201	W/H Main	Inside Driver Side Cowl PNL	GND

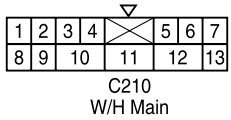
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



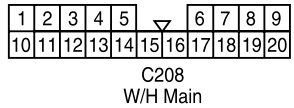
C105
W/H Floor(CE Box)



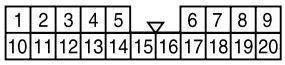
C106
W/H Floor(CE Box)



C210
W/H Main



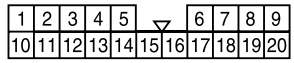
C208
W/H Main



C217
W/H Main

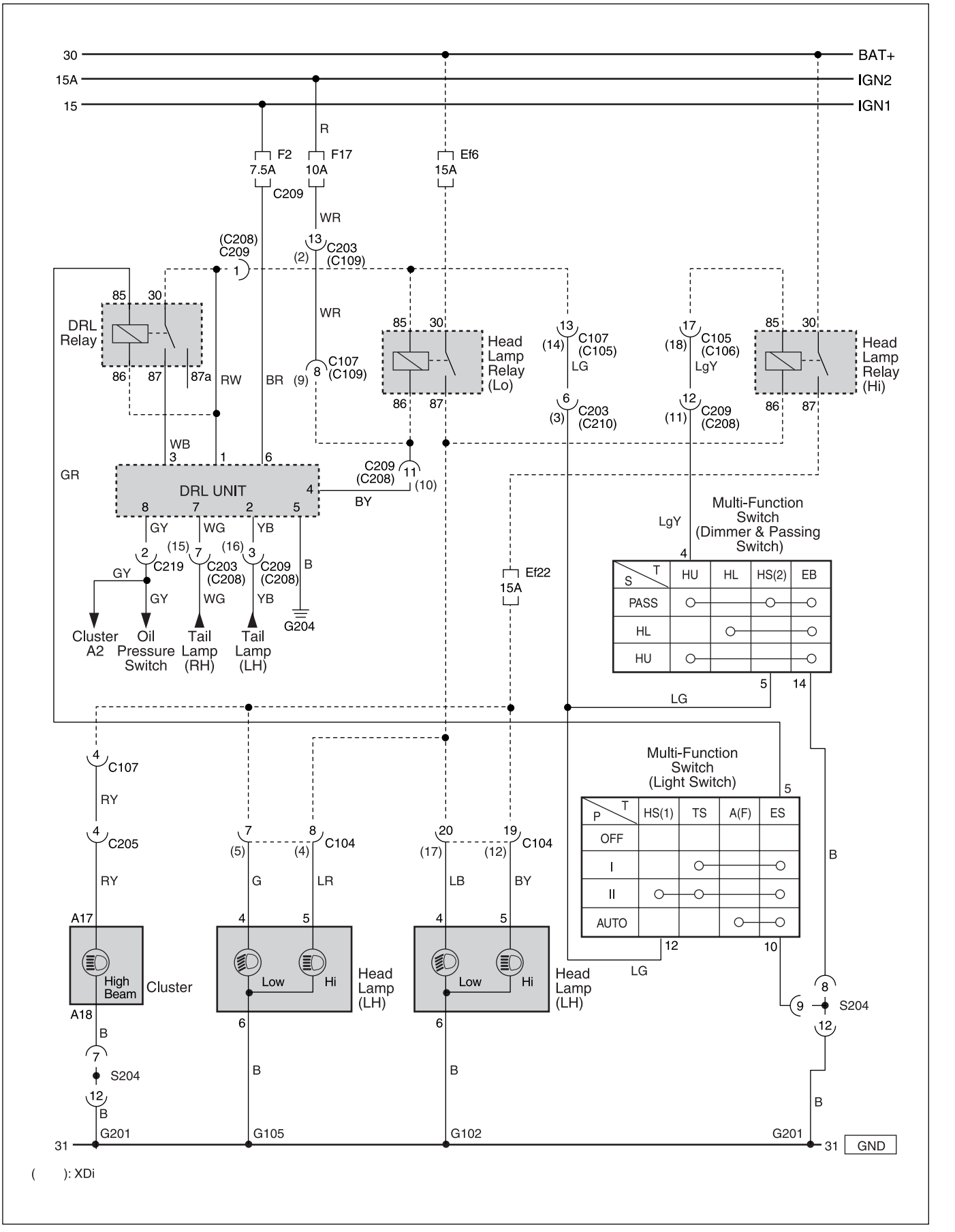
Luggage
Lamp

Head Lamp Level'g
Device SW



Multi Function

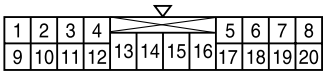
35. DRL (DAY TIME RUNNING LIGHT) UNIT (EU)



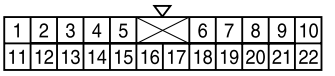
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
G102	W/H Engine	Center BATT	
G105	W/H Engine	Behine the Right Head Lamp	
G201	W/H Main	Inside Driver Side Cowl PNL	
G204	W/H Main	Inside Co-Driver Side Cowl PNL	

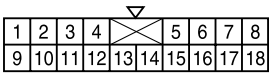
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



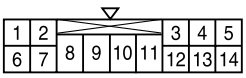
C104
W/H ENG(CE Box)



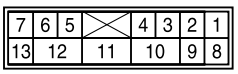
C105
W/H Floor(CE Box)



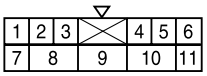
C106
W/H Floor(CE Box)



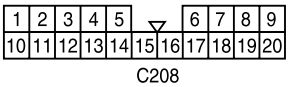
C107
W/H Floor(CE Box)



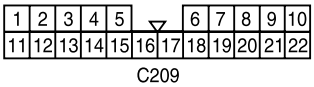
C203
W/H Main



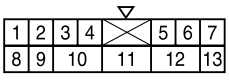
C205
W/H Main



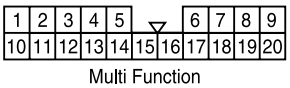
C208
W/H Main



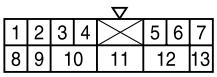
C209
W/H Main



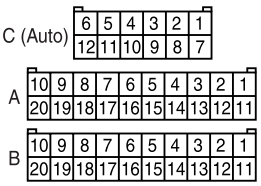
C210
W/H Main



Multi Function



C219
W/H Main

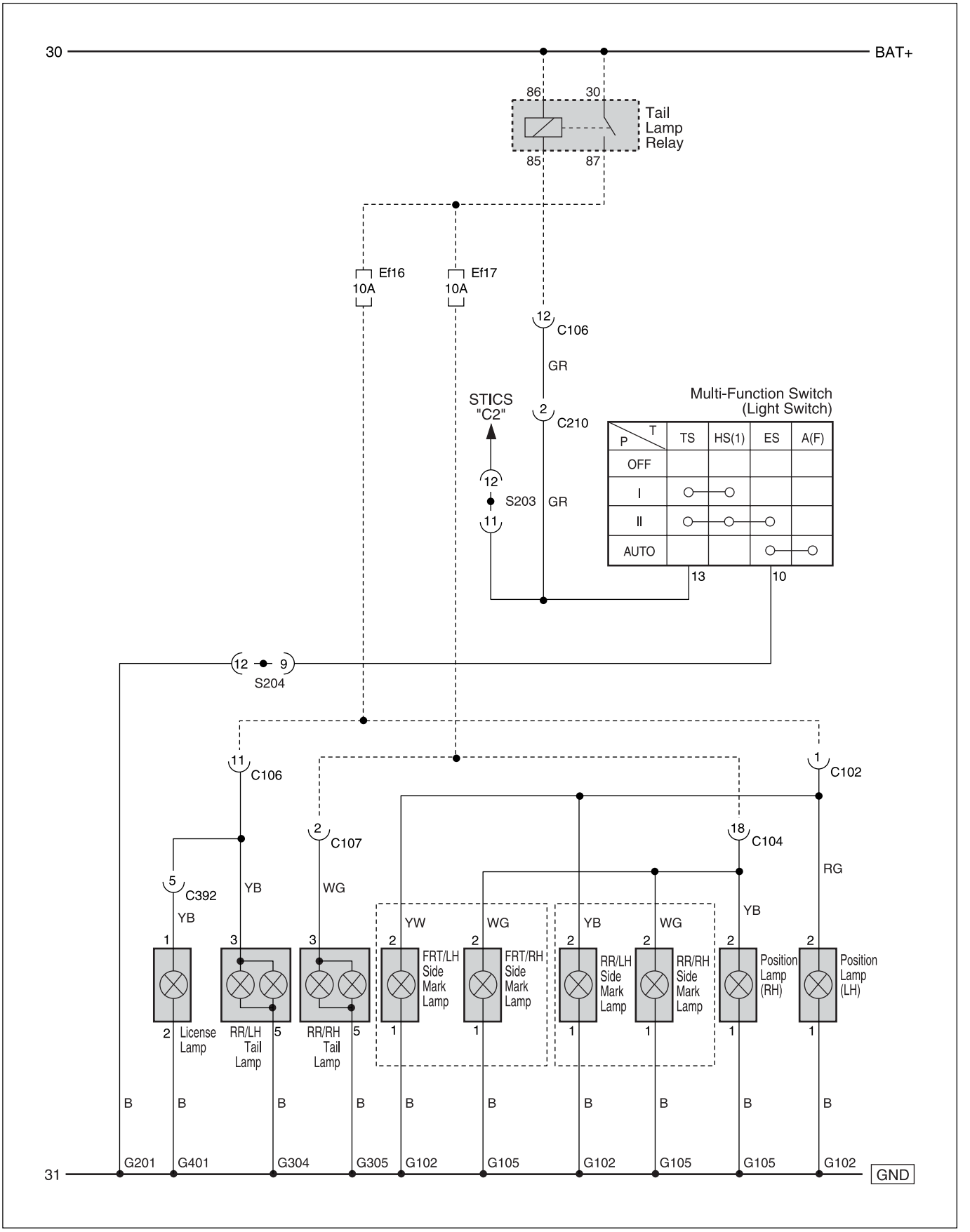


Cluster

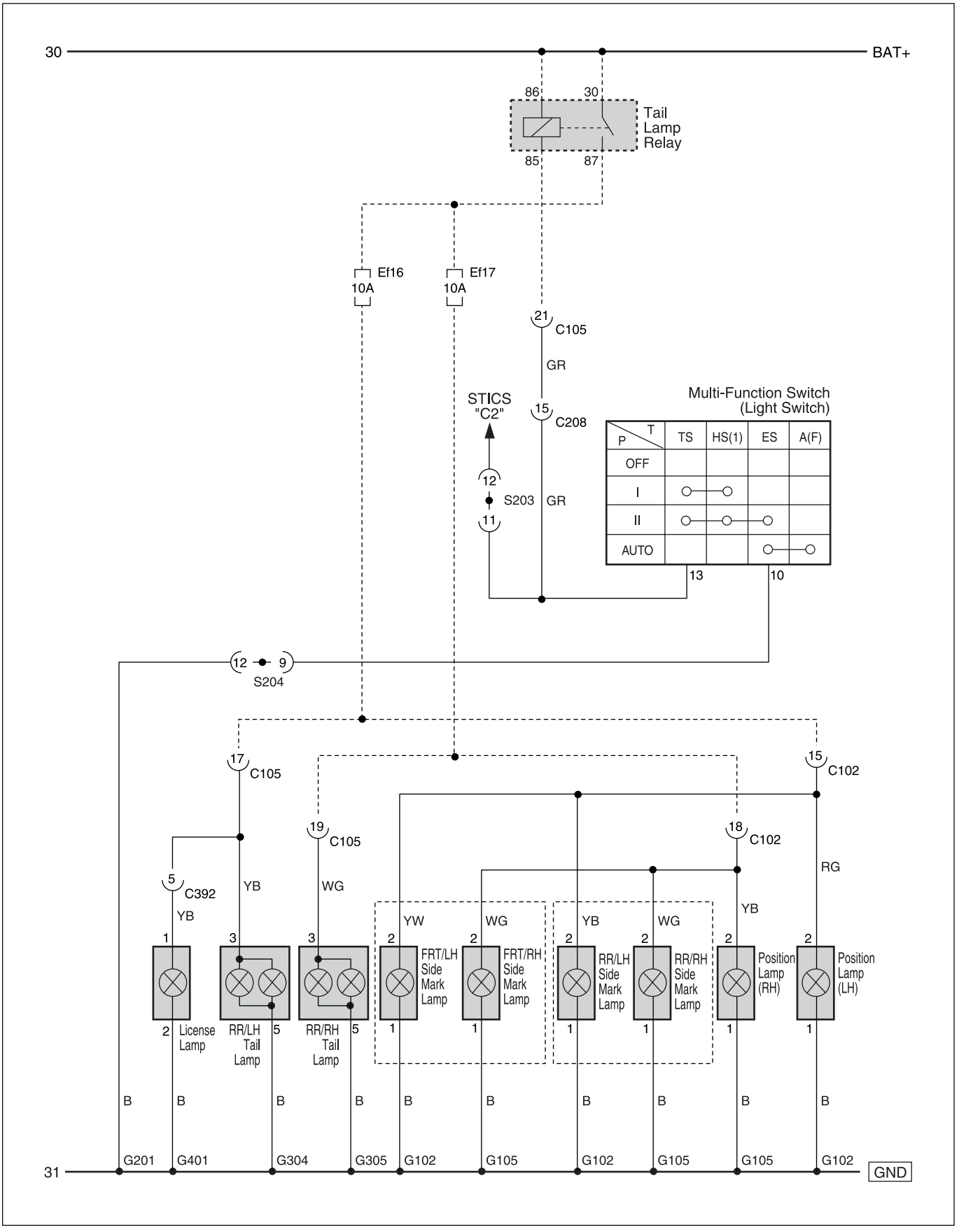
Head Lamp

36. TAIL LAMP CIRCUIT

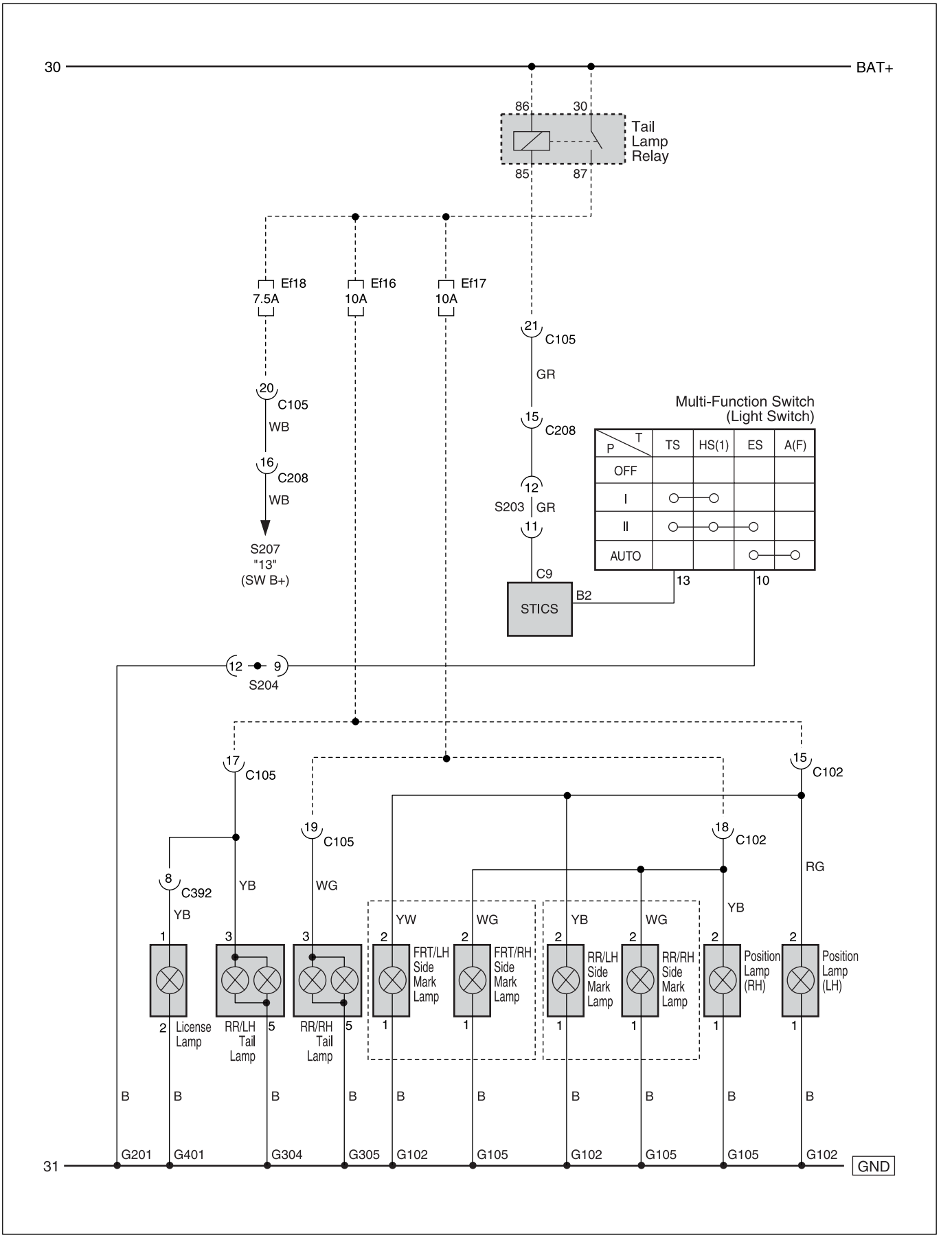
1) ~ 2002 MODEL



2) 2003 MODEL


30
BAT+
86
30
Tail Lamp Relay
85
87
Ef16
10A
Ef17
10A
21
C105
GR
STICS "C2"
15
C208
Multi-Function Switch (Light Switch)
T
P
TS
HS(1)
ES
A(F)
OFF
I
II
AUTO
12
S203
GR
11
13
10
12
9
S204
17
C105
19
C105
15
C102
18
C102
5
C392
YB
YB
WG
RG
YB
YW
WG
YB
WG
YB
1
3
3
2
2
2
2
2
2
FRT/LH Side Mark Lamp
FRT/RH Side Mark Lamp
RR/LH Side Mark Lamp
RR/RH Side Mark Lamp
Position Lamp (RH)
Position Lamp (LH)
2
License Lamp
RR/LH Tail Lamp
5
RR/RH Tail Lamp
5
1
1
1
1
1
1
B
B
B
B
B
B
B
B
B
B
31
G201
G401
G304
G305
G102
G105
G102
G105
G105
G102
GND

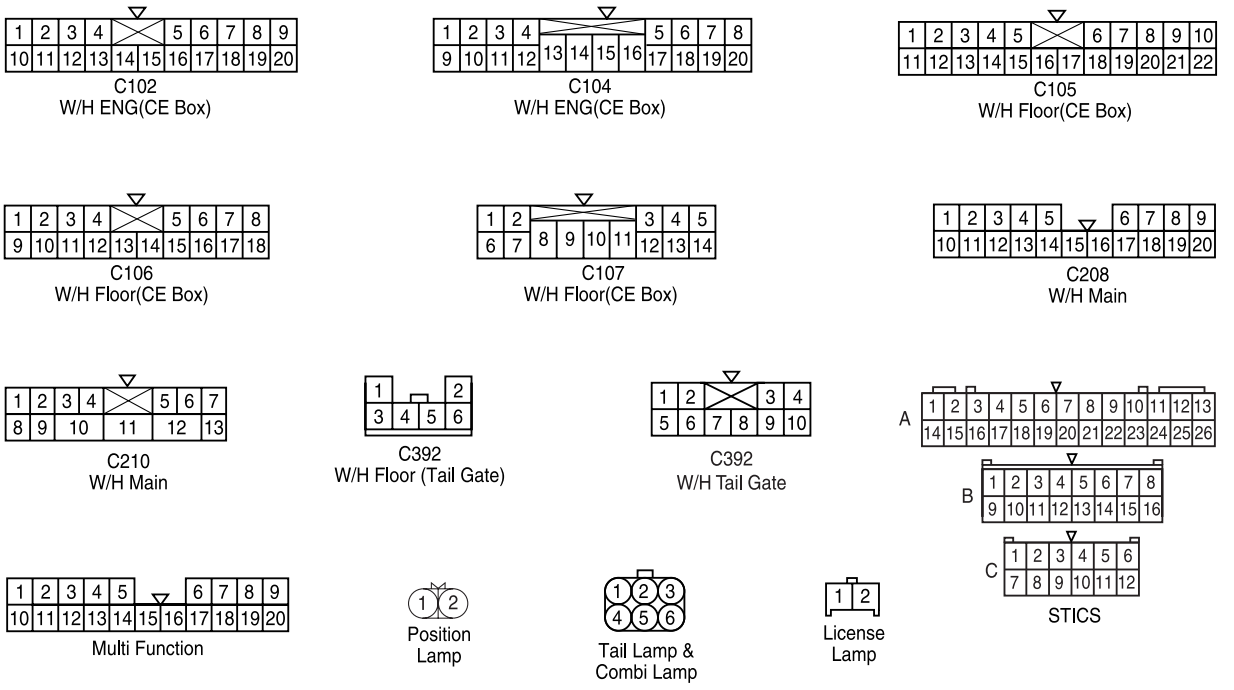
3) XDi


30
BAT+
86
30
Tail Lamp Relay
85
87
Ef18 7.5A
Ef16 10A
Ef17 10A
21 C105
GR
20 C105
WB
15 C208
16 C208
WB
S207 "13" (SW B+)
12 S203 GR
11
C9
STICS
B2
Multi-Function Switch (Light Switch)
T
P
TS
HS(1)
ES
A(F)
OFF
I
II
AUTO
13
10
12 9 S204
17 C105
19 C105
15 C102
18 C102
RG
8 C392
YB
YB
WG
YB
YW
WG
YB
WG
YB
1
3
3
2
2
2
2
2
2
2
2
License Lamp
RR/LH Tail Lamp
5
RR/RH Tail Lamp
5
FRT/LH Side Mark Lamp
FRT/RH Side Mark Lamp
RR/LH Side Mark Lamp
RR/RH Side Mark Lamp
Position Lamp (RH)
Position Lamp (LH)
B
G201
G401
G304
G305
G102
G105
G102
G105
G105
G102
31
GND

A. CONNECTOR INFORMATION

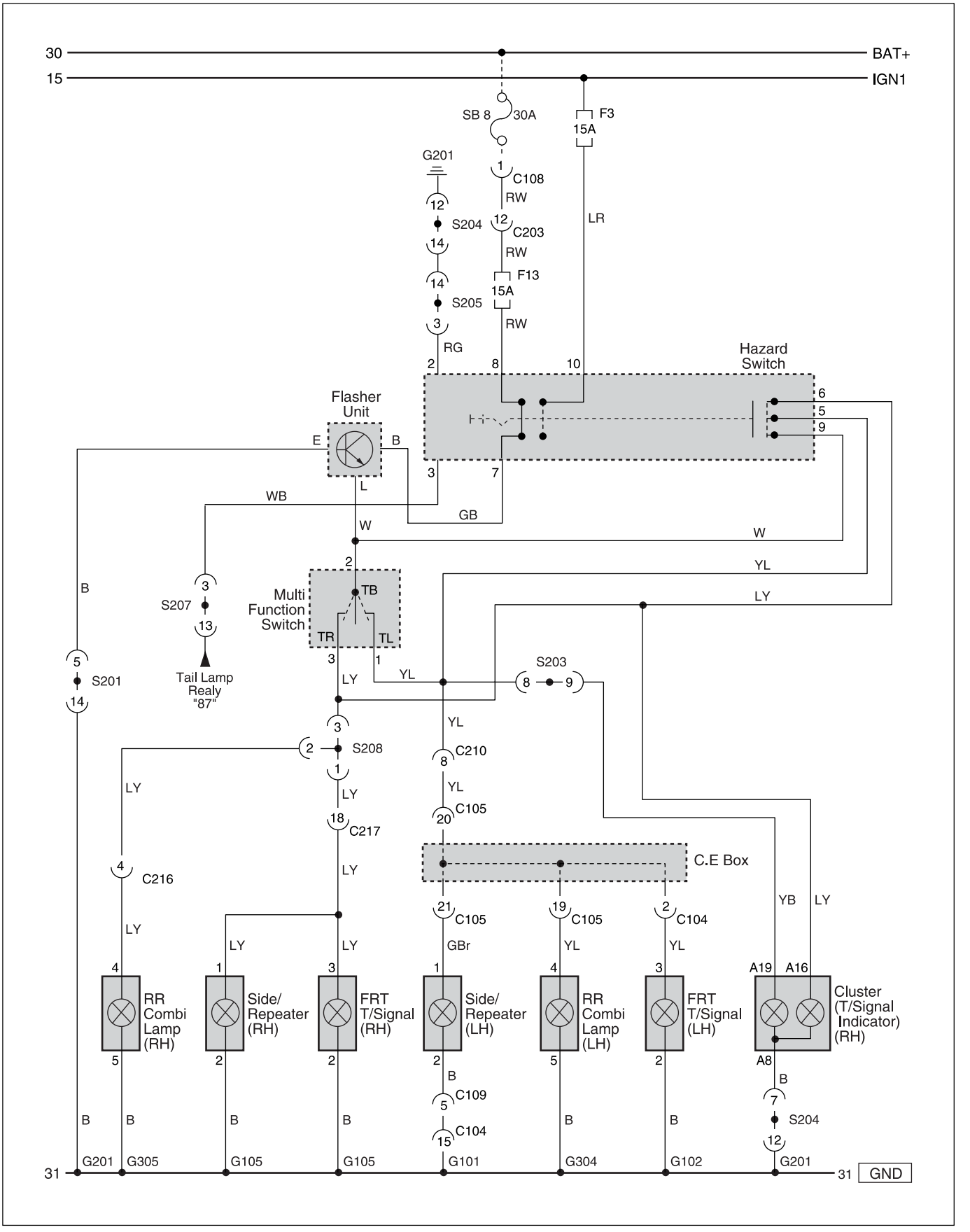
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Engine - Main (RH)	Inside Driver Side Cowl PNL	
C392 (6Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
C392 (10Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
S203 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S207 (14Pin, Black)	W/H Main	Behind the Right the FATC	Tail Lamp
G102	W/H Engine	Center BATT	
G105	W/H Engine	Behine the Right Gead Lamp	
G201	W/H Main	Inside Driver Side Cowl PNL	
G304	W/H Floor	Behind the Quarter Grass #1	
G305	W/H Floor	Behind the Quarter Grass #1	
G401	W/H Floor	Center the Tail Gate	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

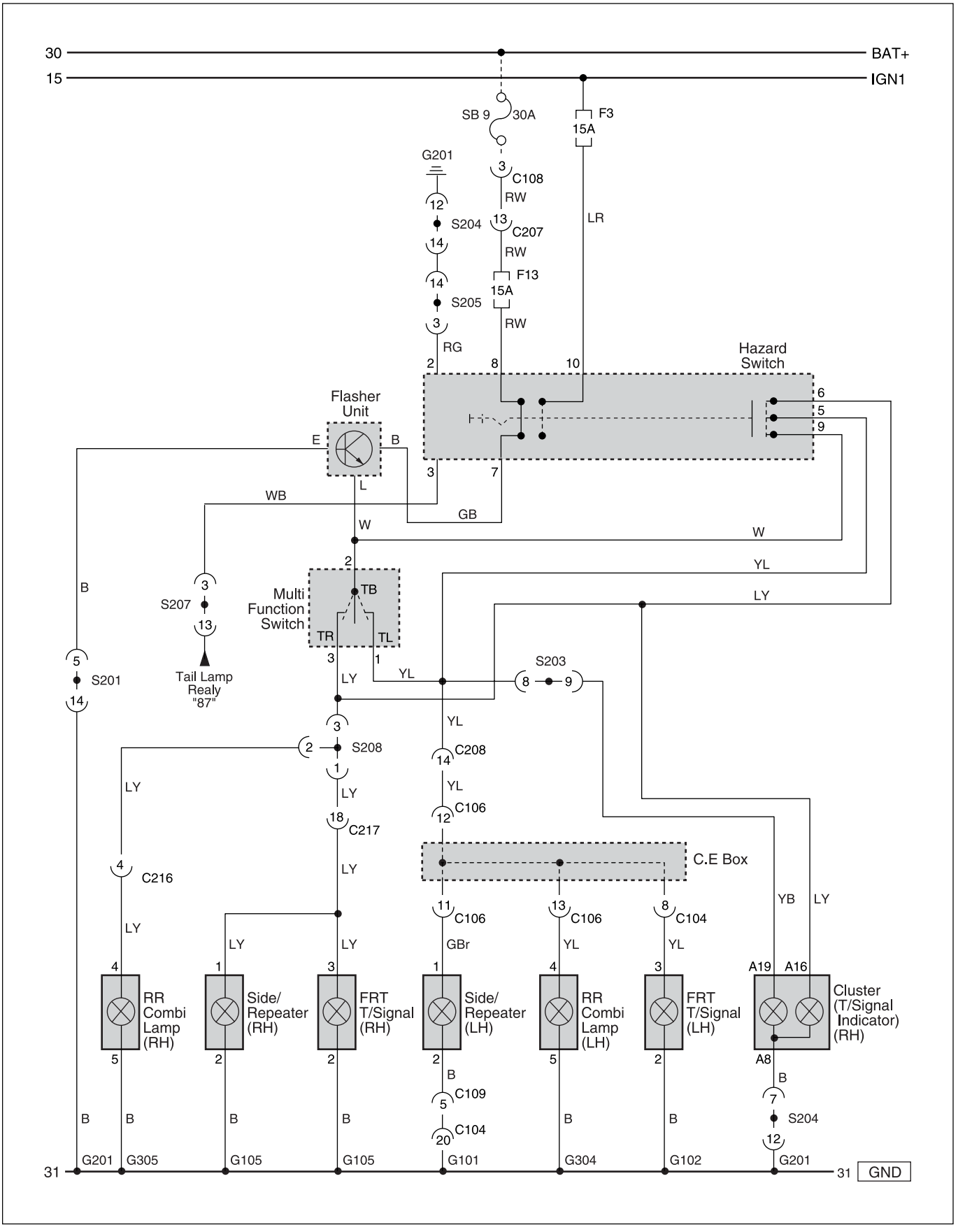


37. TURN SIGNAL & HAZARD LAMP CIRCUIT

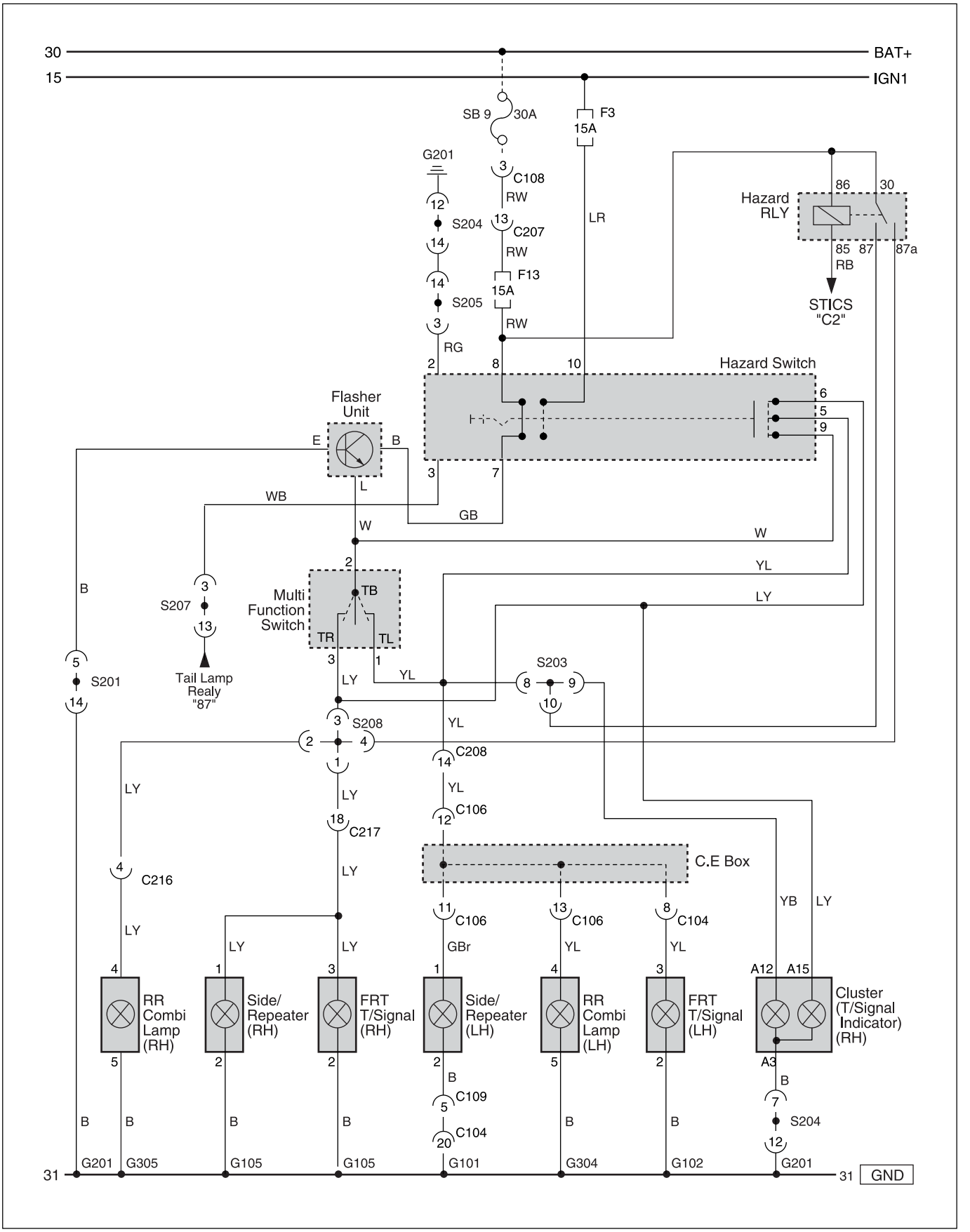
1) ~ 2002 MODEL



2) 2003 MODEL


30
BAT+
15
IGN1
SB 9
30A
F3
15A
G201
C108
RW
S204
C207
LR
F13
S205
RG
Hazard Switch
Flasher Unit
E
B
L
WB
GB
W
YL
LY
S207
Tail Lamp Realy "87"
Multi Function Switch
TB
TR
TL
S201
S203
S208
C208
C216
C217
C106
C.E Box
C104
YB
RR Combi Lamp (RH)
Side/ Repeater (RH)
FRT T/Signal (RH)
Side/ Repeater (LH)
RR Combi Lamp (LH)
FRT T/Signal (LH)
Cluster (T/Signal Indicator) (RH)
C109
S204
G201
G305
G105
G101
G304
G102
31
GND

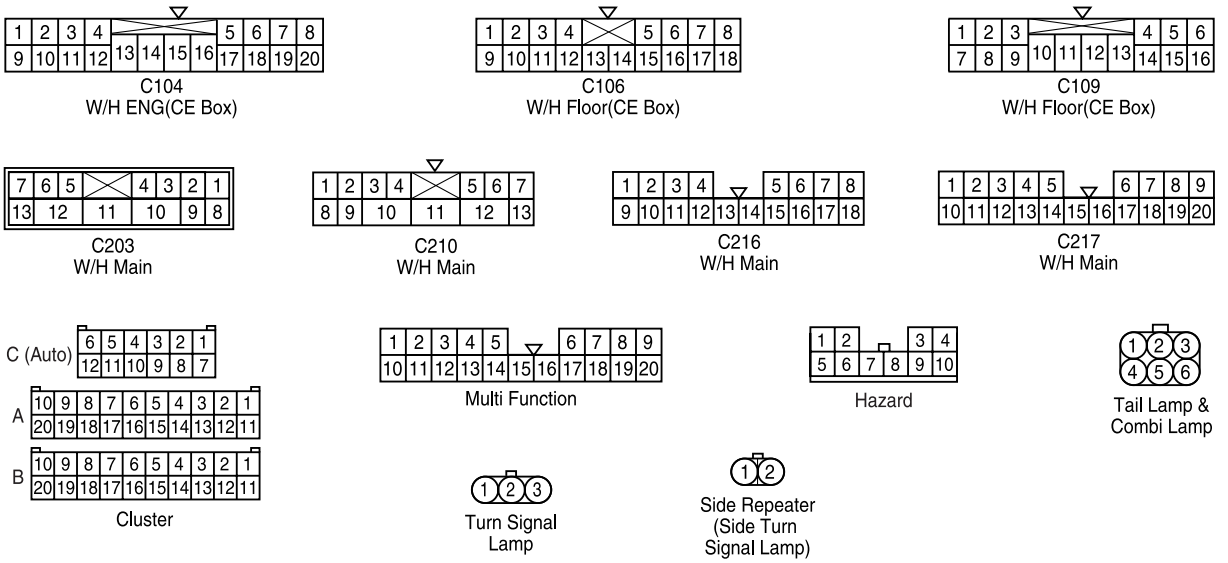
3) XDi


30
BAT+
15
IGN1
SB 9
30A
F3
15A
G201
C108
RW
S204
C207
RW
F13
15A
S205
RW
LR
RG
Hazard RLY
86
30
85
87
87a
RB
STICS "C2"
Hazard Switch
Flasher Unit
E
B
L
WB
GB
W
YL
LY
S207
Tail Lamp Realy "87"
Multi Function Switch
TB
TR
TL
S201
S203
S208
C208
C106
C217
C216
C.E Box
YB
C104
C109
RR Combi Lamp (RH)
Side/ Repeater (RH)
FRT T/Signal (RH)
Side/ Repeater (LH)
RR Combi Lamp (LH)
FRT T/Signal (LH)
Cluster (T/Signal Indicator) (RH)
GBr
G201
G305
G105
G105
G101
G304
G102
G201
31
GND

A. CONNECTOR INFORMATION

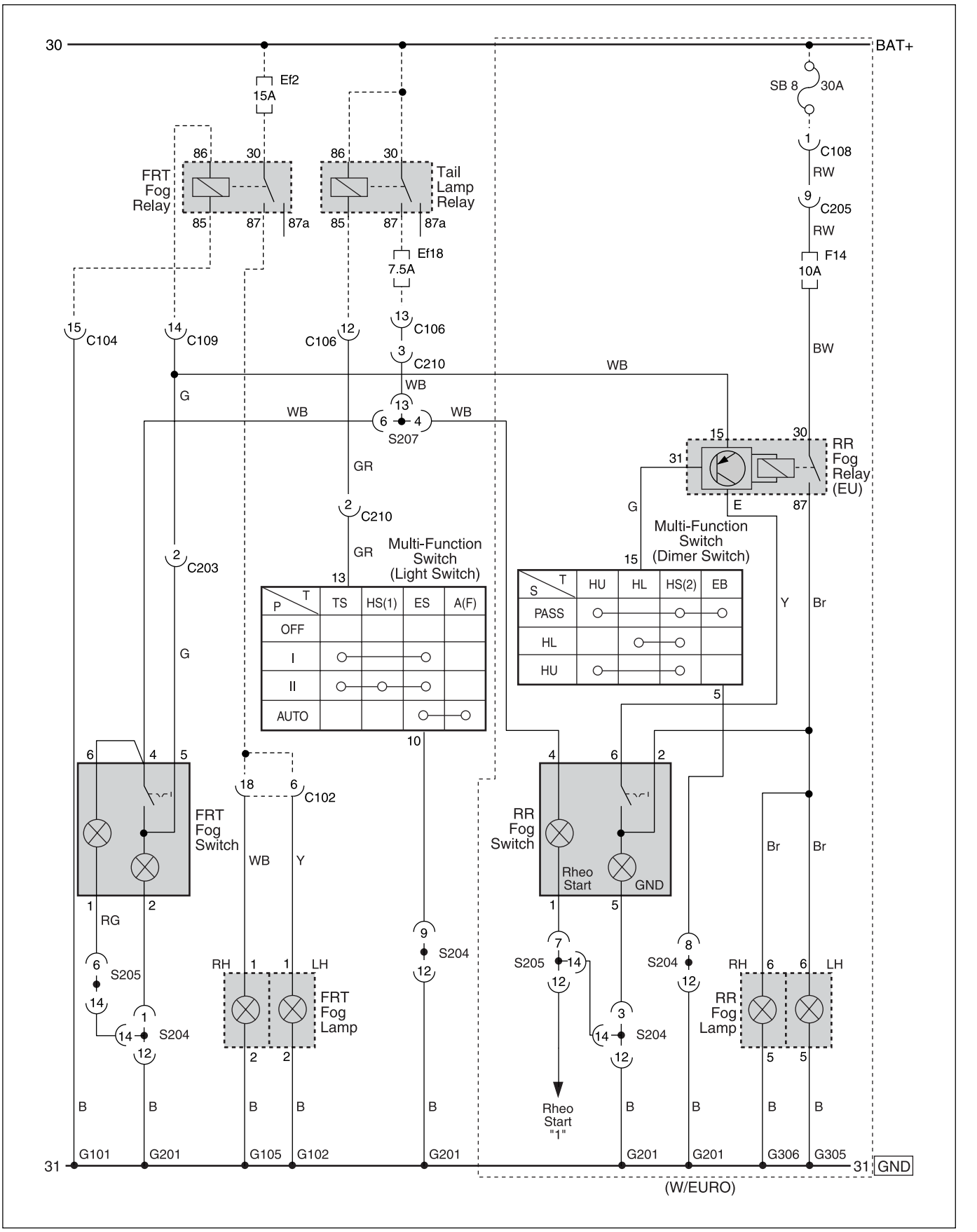
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C210 (13Pin, Green)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C216 (18Pin, White)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
S201 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	GND
S203 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S205 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S207 (14Pin, Black)	W/H Main	Behind the Right the FATC	Tail Lamp
S208 (14Pin, Black)	W/H Main	Behind the Right the FATC	
G101	W/H Engine	Center the Engine Room Fuse Box	
G102	W/H Engine	Center BATT	
G105	W/H Engine	Behine the Right Gead Lamp	
G201	W/H Main	Inside Driver Side Cowl PNL	
G304	W/H Floor	Behind the Quarter Grass #1	
G305	W/H Floor	Behind the Quarter Grass #1	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



38. FOG LAMP CIRCUIT

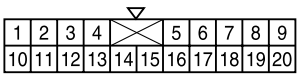
1) ~ 2002 MODEL



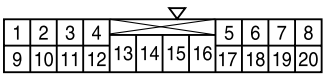
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C109 (14Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C210 (13Pin, Green)	Engine - Main (RH)	Inside Driver Side Cowl PNL	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S207 (14Pin, Black)	W/H Main	Behind the Right the FATC	Tail Lamp
G101	W/H Engine	Center the Engine Room Fuse Box	
G102	W/H Engine	Center BATT	
G105	W/H Engine	Behine the Right Head Lamp	
G201	W/H Main	Inside Driver Side Cowl PNL	

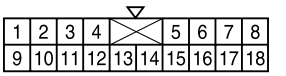
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



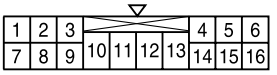
C102
W/H ENG(CE Box)



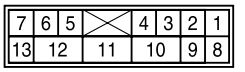
C104
W/H ENG(CE Box)



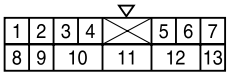
C106
W/H Floor(CE Box)



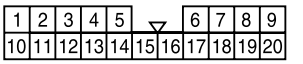
C109
W/H Floor(CE Box)



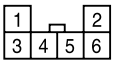
C203
W/H Main



C210
W/H Main



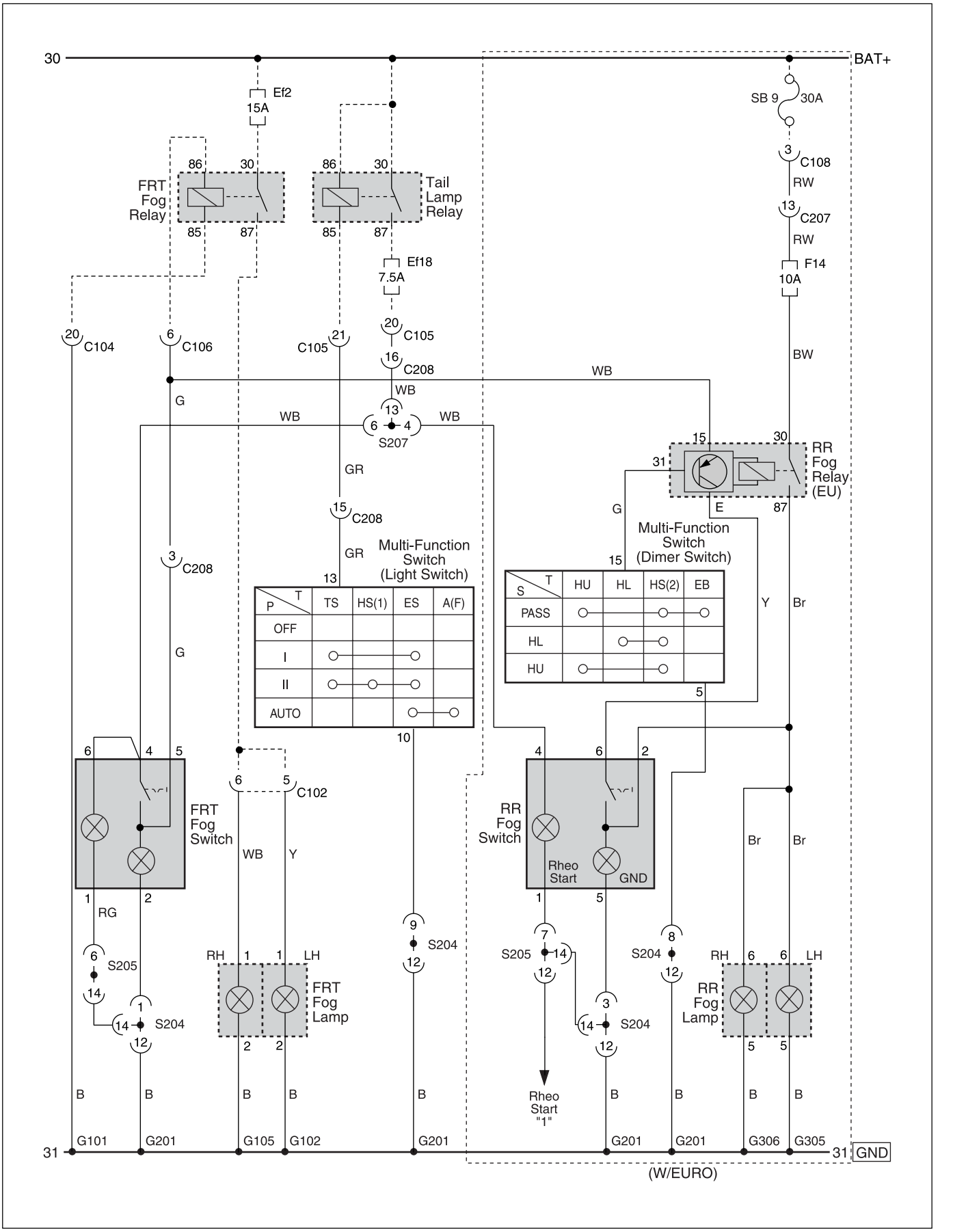
Multi Function



Fog Lamp
(FRT)

Fog Lamp
(RR)

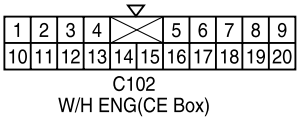
2) XDi


30
BAT+
Ef2
15A
SB 9
30A
C108
RW
C207
RW
F14
10A
FRT Fog Relay
Tail Lamp Relay
Ef18
7.5A
C104
C106
C105
C208
BW
WB
G
S207
GR
Multi-Function Switch (Light Switch)
Multi-Function Switch (Dimer Switch)
RR Fog Relay (EU)
T
P
TS
HS(1)
ES
A(F)
OFF
I
II
AUTO
S
HU
HL
HS(2)
EB
PASS
Y
Br
FRT Fog Switch
RR Fog Switch
Rheo Start
GND
C102
RG
S205
S204
FRT Fog Lamp
RR Fog Lamp
RH
LH
B
G101
G201
G105
G102
Rheo Start "1"
G306
G305
31
GND
(W/EURO)

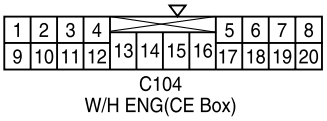
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C109 (14Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C210 (13Pin, Green)	Engine - Main (RH)	Inside Driver Side Cowl PNL	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S207 (14Pin, Black)	W/H Main	Behind the Right the FATC	Tail Lamp
G101	W/H Engine	Center the Engine Room Fuse Box	
G102	W/H Engine	Center BATT	
G105	W/H Engine	Behine the Right Head Lamp	
G201	W/H Main	Inside Driver Side Cowl PNL	

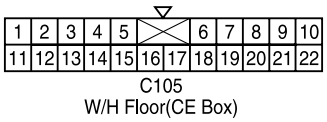
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



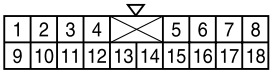
C102
W/H ENG(CE Box)



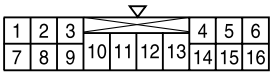
C104
W/H ENG(CE Box)



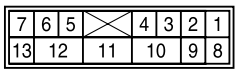
C105
W/H Floor(CE Box)



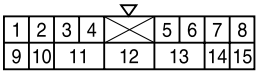
C106
W/H Floor(CE Box)



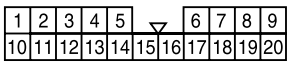
C109
W/H Floor(CE Box)



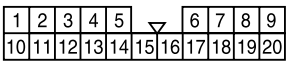
C203
W/H Main



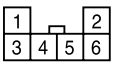
C207
W/H Main



C208
W/H Main



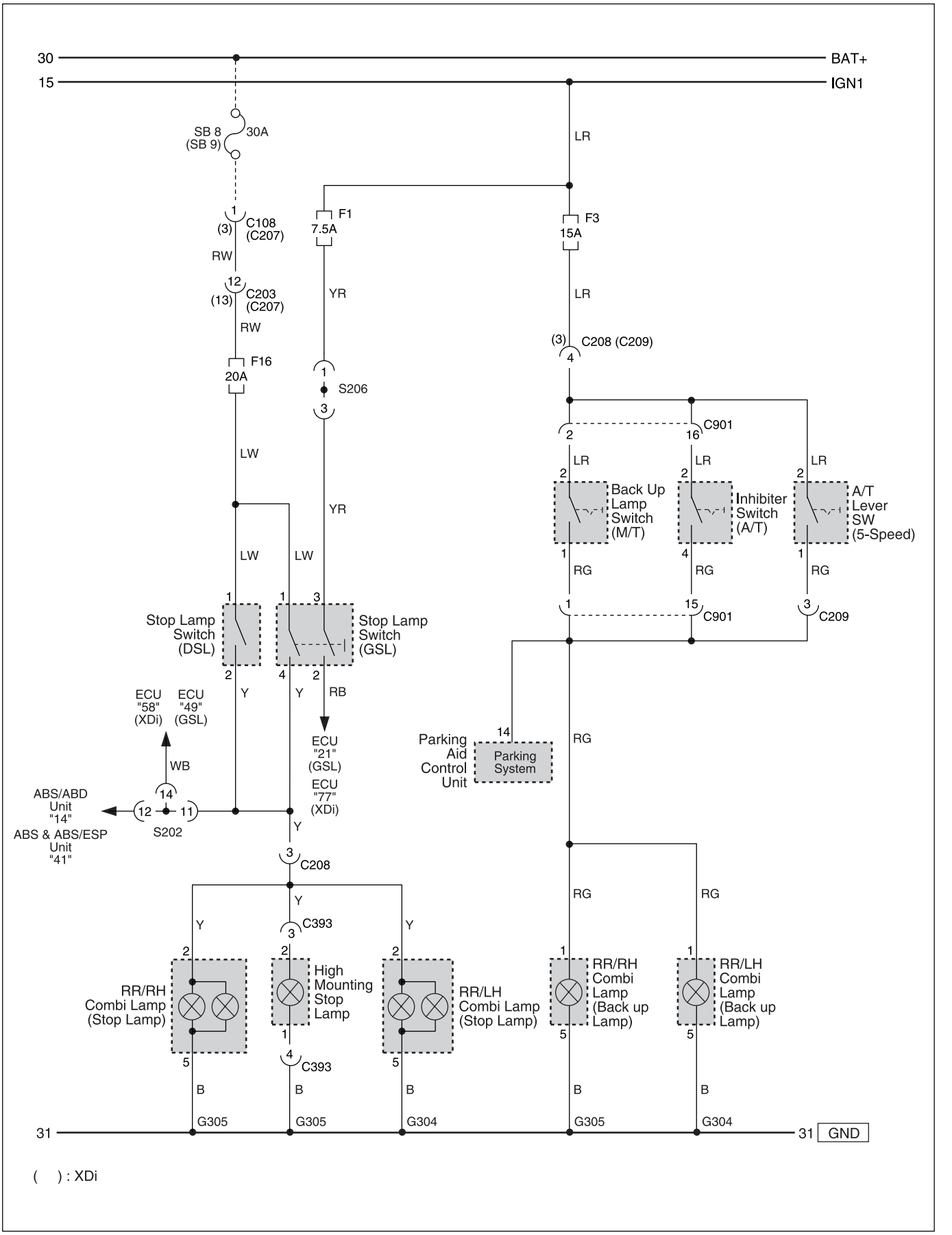
Multi Function



Fog Lamp
(FRT)

Fog Lamp
(RR)

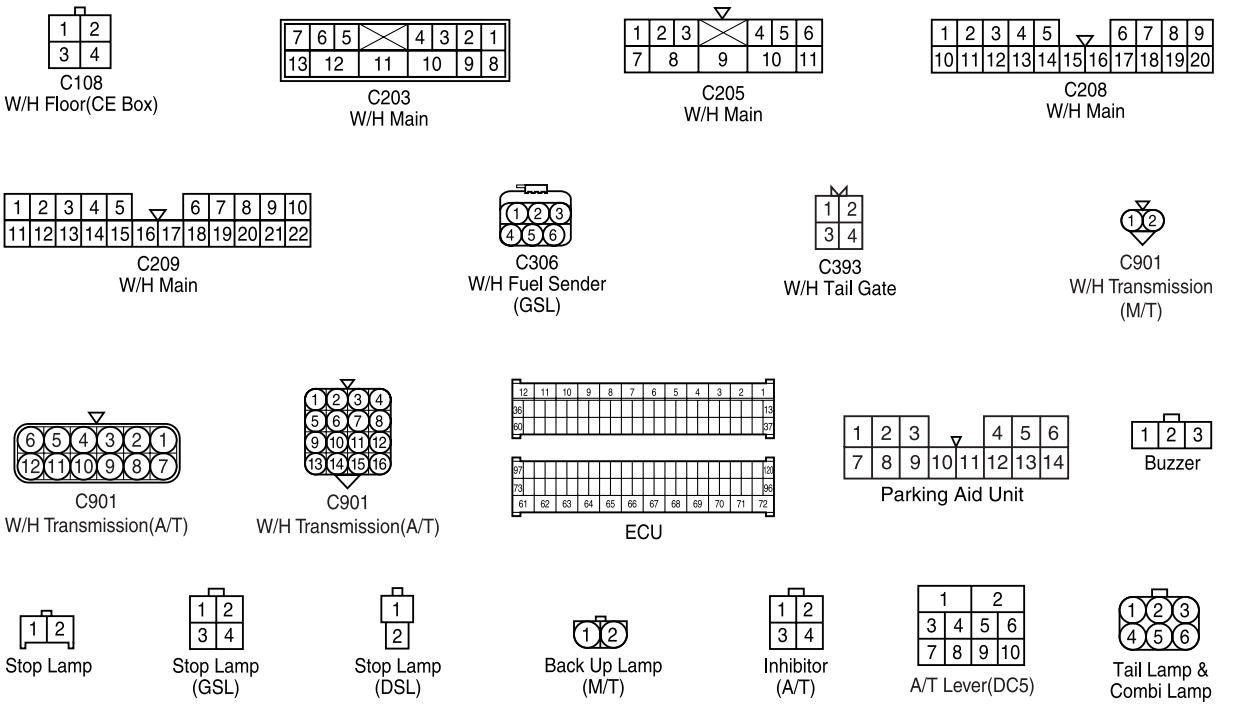
39. STOP & BACK UP LAMP CIRCUIT



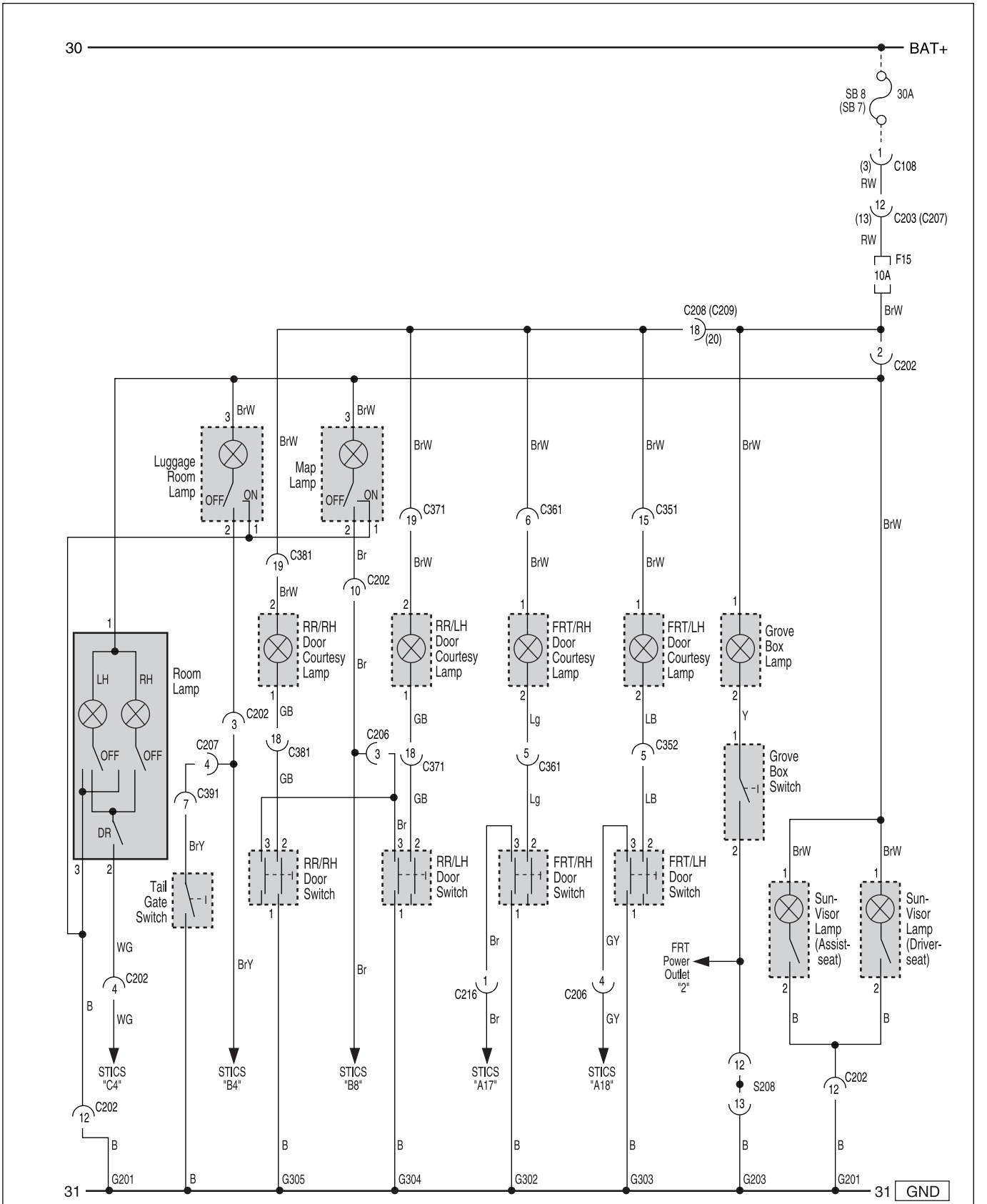
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	EEngine Room Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C901 (2Pin, White)	Floor - T/M	Left the T/C (Under the Floor)	M/T
C901 (12Pin, White)	Floor - T/M	Left the T/C (Under the Floor)	XDi
C393 (4Pin, White)	Floor - RR Defogger	Inside the Upper the Tail Gate	
S202 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
S206 (14Pin, Black)	W/H Main	Behind the Left the FATC	
G304	W/H Floor	Behind the Quarter Grass #1	
G305	W/H Floor	Behind the Quarter Grass #1	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



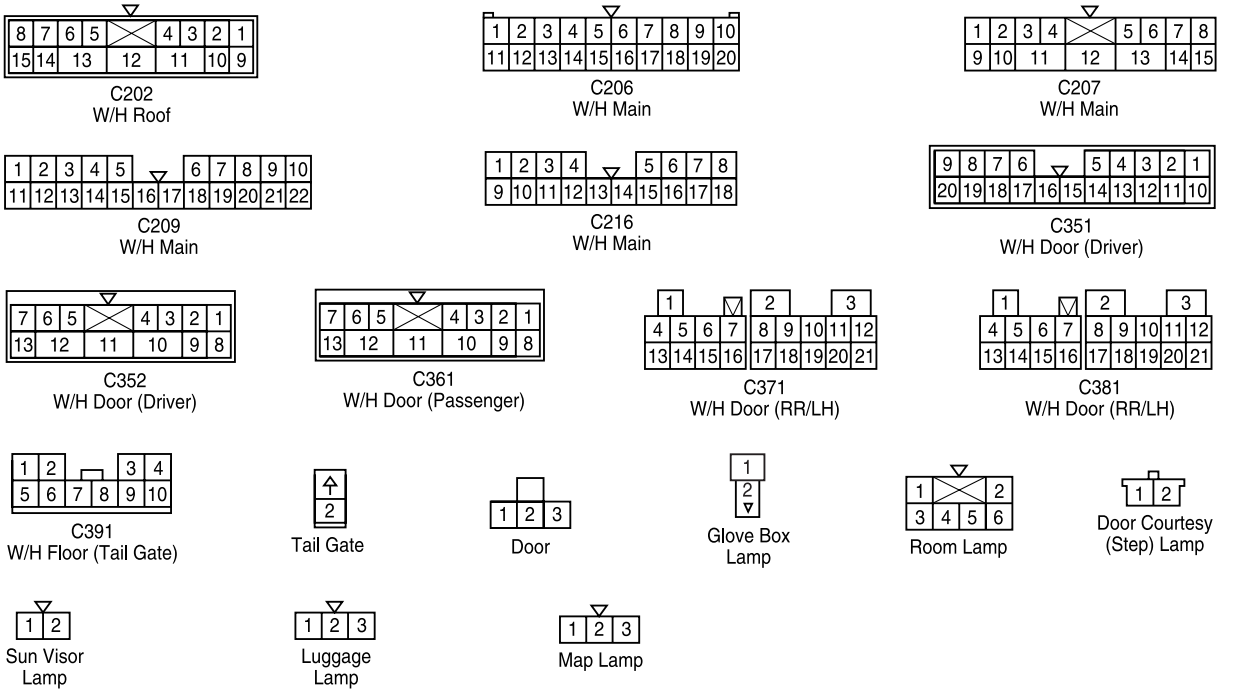
40. INTERIOR LAMP CIRCUIT



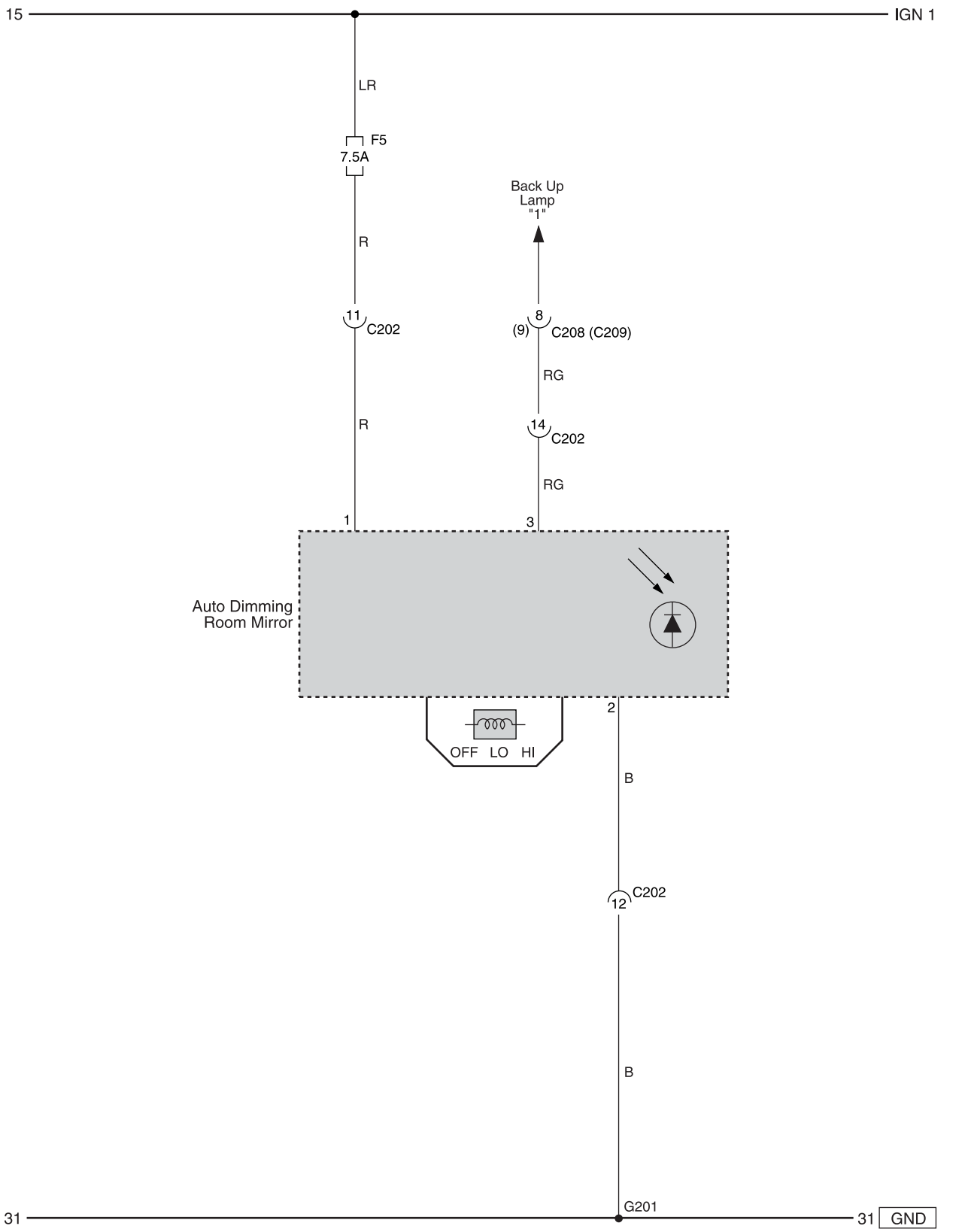
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C202 (15Pin, White)	Main - Roof	Under the I/P Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C216 (18Pin, White)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C351 (20Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C352 (13Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C361 (13Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
C371 (21Pin, White)	Floor - RR Left Door	Under Left “B” Filler	
C381 (21Pin, White)	Floor - RR Right Door	Under Right “B” Filler	
C391 (10Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
S203 (14Pin, Black)	W/H Main	Upper the I/P Relay Box	
G201	W/H Main	Inside Driver Side Cowl PNL	
G203	W/H Main	Under the Seat Heating SW	W/H Air Bag
G302	W/H Floor	Under Driver Seat	
G303	W/H Floor	Under the Left “B” Filler	
G304	W/H Floor	Behind the Quarter Grass #1	
G305	W/H Floor	Behind the Quarter Grass #1	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



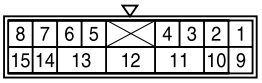
41. AUTO DIMMING ROOM MIRROR CIRCUIT



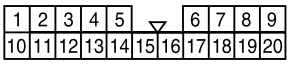
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C202 (15Pin, White)	Main - Roof	Under the I/P Fuse Box	
C205 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
G201	W/H Main	Inside Driver Side Cowl PNL	

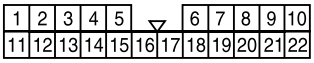
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



C202
W/H Roof



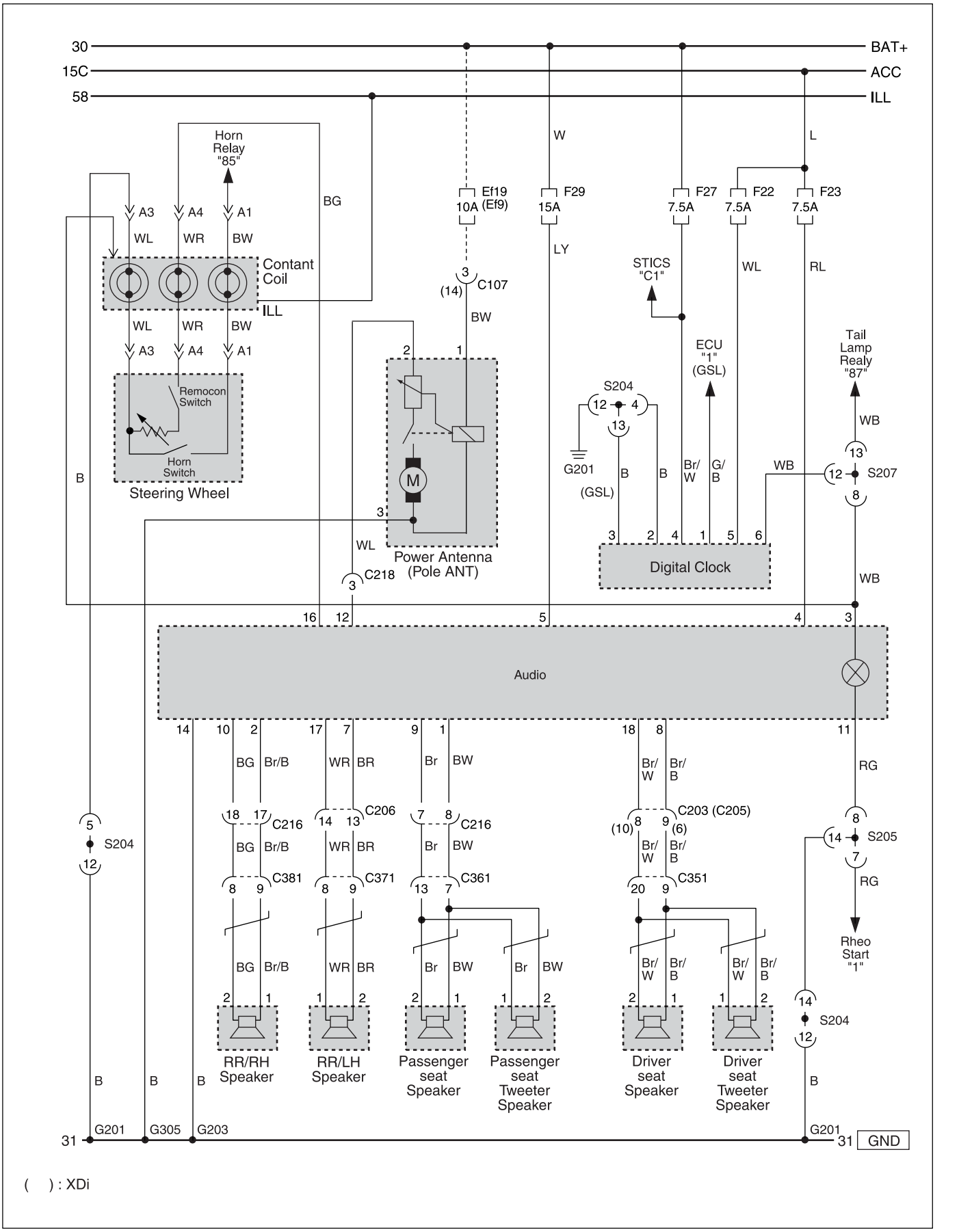
C208
W/H Main



C209
W/H Main

Room
Mirror

42. AUDIO, DIGITAL CIOCK CIRCUIT

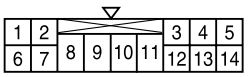


( ) : XDi

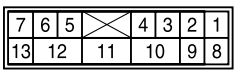
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C216 (18Pin, White)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C351 (20Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C361 (13Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
C371 (21Pin, White)	Floor - RR Left Door	Under Left “B” Filler	
C381 (21Pin, White)	Floor - RR Right Door	Under Right “B” Filler	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S205 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S207 (14Pin, Black)	W/H Main	Behind the Right the FATC	Tail Lamp
G201	W/H Main	Inside Driver Side Cowl PNL	
G203	W/H Main	Under the Seat Heating SW	W/H Air Bag
G305	W/H Floor	Behind the Quarter Grass #1	

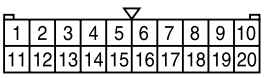
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



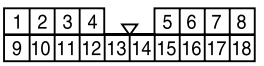
C107
W/H Floor(CE Box)



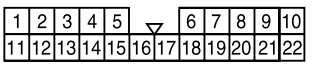
C203
W/H Main



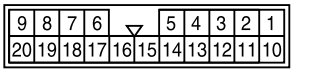
C206
W/H Main



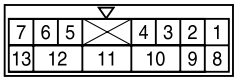
C216
W/H Main



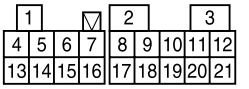
C218
W/H Main



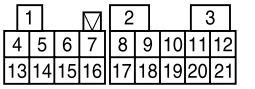
C351
W/H Door (Driver)



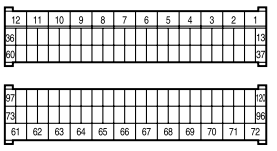
C361
W/H Door (Passenger)



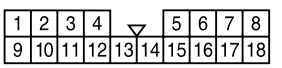
C371
W/H Door (RR/LH)



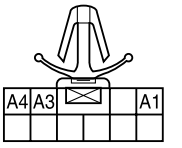
C381
W/H Door (RR/LH)



ECU



Audio



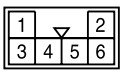
Horn/Audio
Contact Coil
(Column Side)

Audio Contact
(Steering)

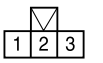
Speaker
(FRT/RR
Door)

Speaker
(Tail Gate)

Tweeter
Speaker



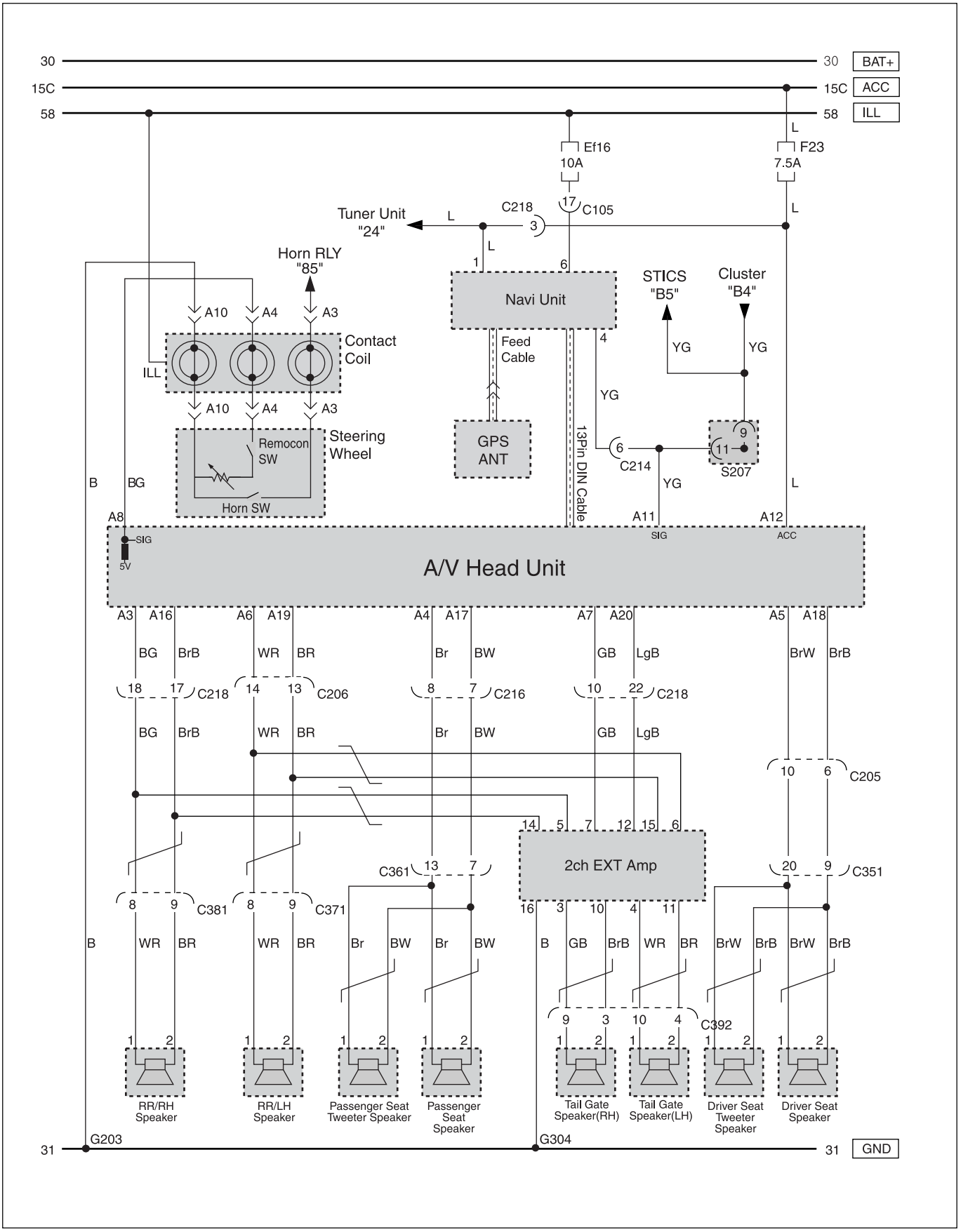
Digital Clock



PWR
Antenna

43. AUDIO(MULTI VISION)

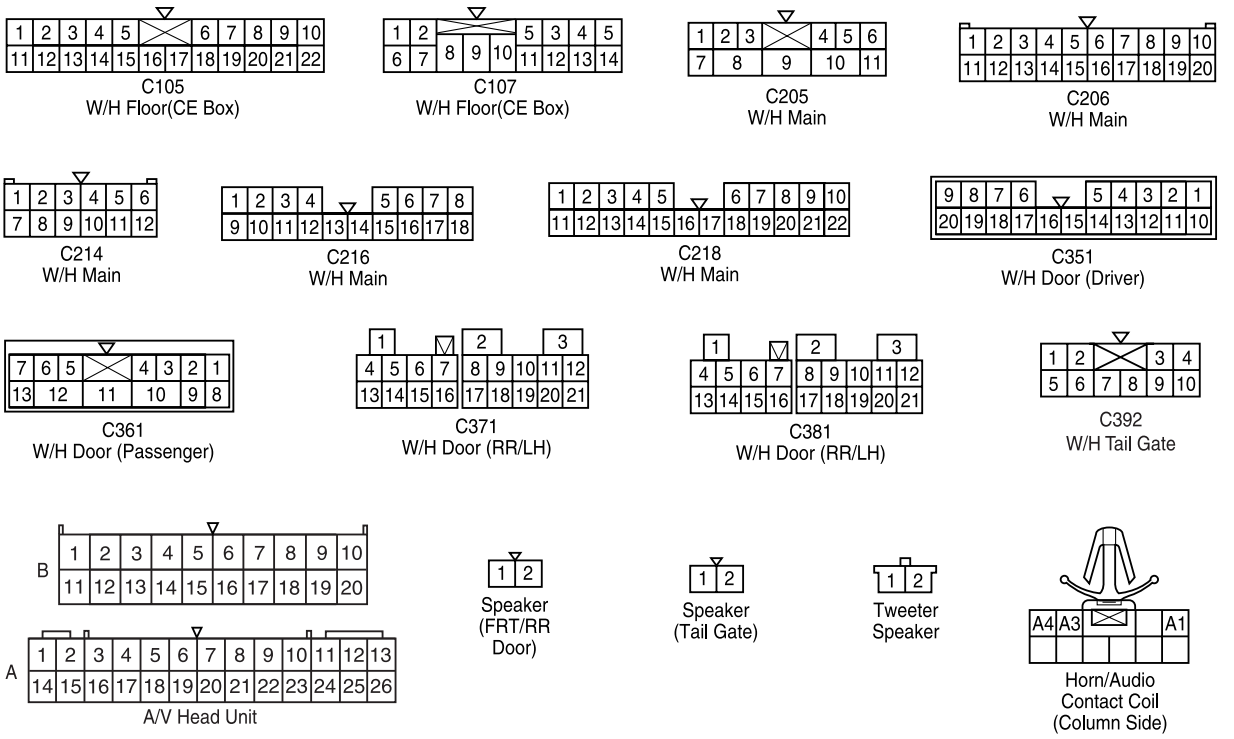
1) HEAD UNIT, 2CH EXT AMP, REMOCON, NAVI UNIT, GPS



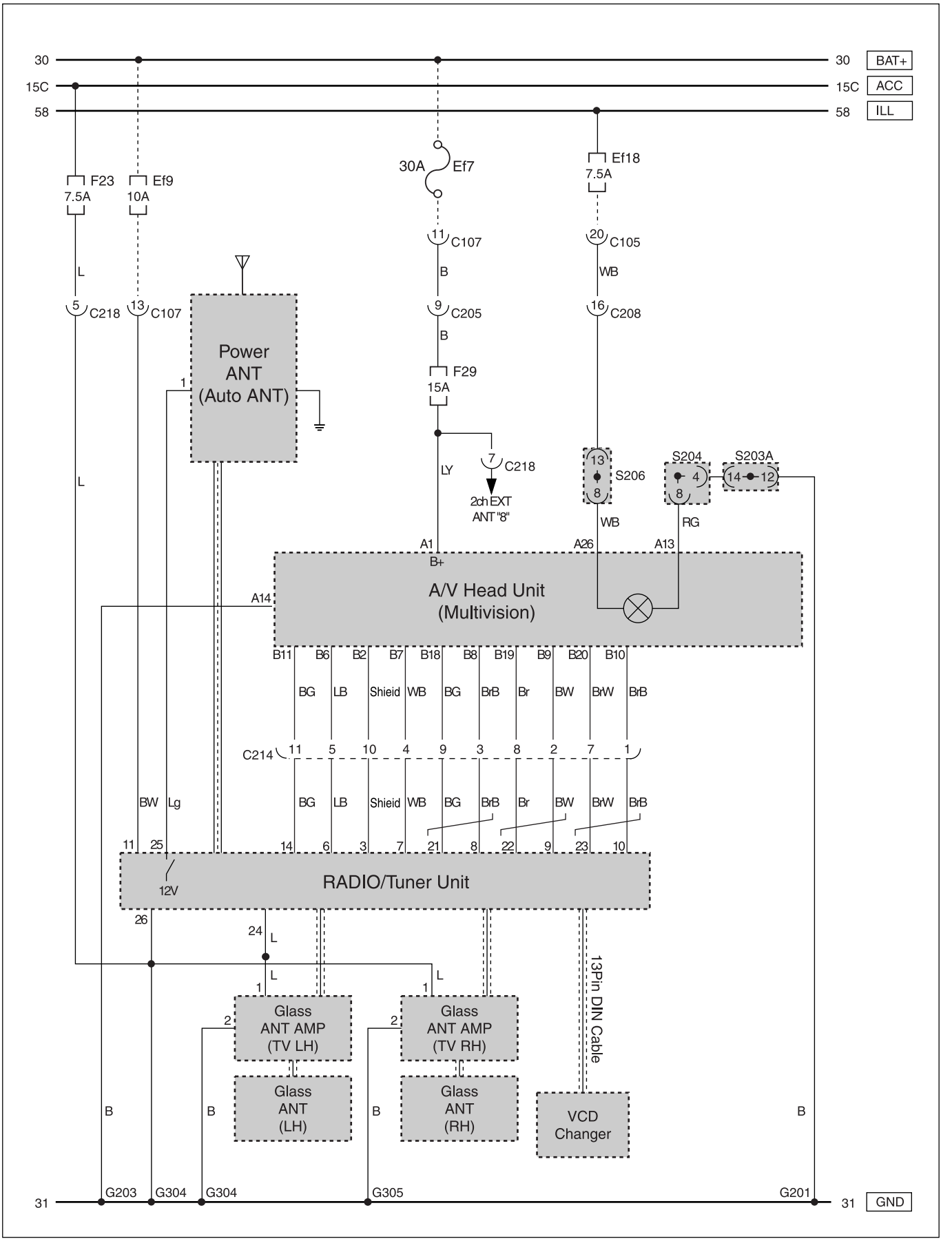
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C214 (12Pin, Black)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C216 (18Pin, White)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C351 (20Pin, White)	Floor - Driver Door	Inside Driver Side Cowl PNL	Behinel Conn Holder
C361 (13Pin, White)	Floor - Co-Driver Door	Inside Co-Driver Side Cowl PNL	Behinel Conn Holder
C371 (21Pin, White)	Floor - RR Left Door	Under Left “B” Filler	
C381 (21Pin, White)	Floor - RR Right Door	Under Right “B” Filler	
C392 (6Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
S207 (14Pin, Black)	W/H Main	Behind the Right FATC	Tail Lamp
G203	W/H Main	Under the Seat Heating SW	W/H Air Bag
G304	W/H Floor	Behind the Quarter Grass #1	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



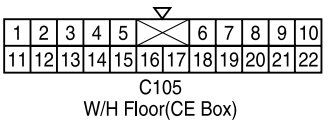
2) HEAD UNIT, TUNER UNIT, VCD CHANGER



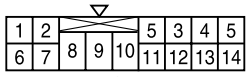
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C214 (12Pin, Black)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C392 (10Pin, White)	Floor - Tail Gate	Inside the Left Side Cover the Tail Gate	
S204 (14Pin, Black)	W/H Main	Behind the Left FATC	GND
S205 (14Pin, Black)	W/H Main	Behind the Left FATC	GND
S207 (14Pin, Black)	W/H Main	Behind the Right FATC	Tail Lamp
G201	W/H Main	Inside Driver Side Cowl PNL	
G202	W/H Main	Beside the SDM	
G203	W/H Main	Under the Seat Heating SW	W/H Air Bag
G304	W/H Floor	Behind the Quarter Grass #1	
G305	W/H Floor	Behind the Quarter Grass #1	

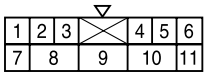
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



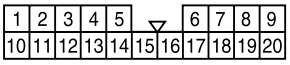
C105
W/H Floor(CE Box)



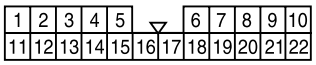
C107
W/H Floor(CE Box)



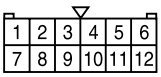
C205
W/H Main



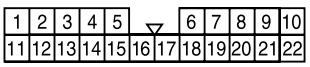
C208
W/H Main



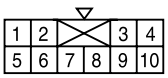
C209
W/H Main



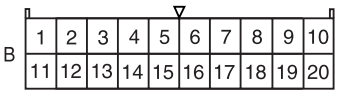
C214
W/H Main

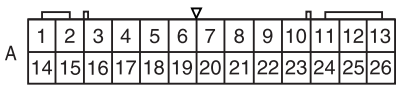


C218
W/H Main



C392
W/H Tail Gate



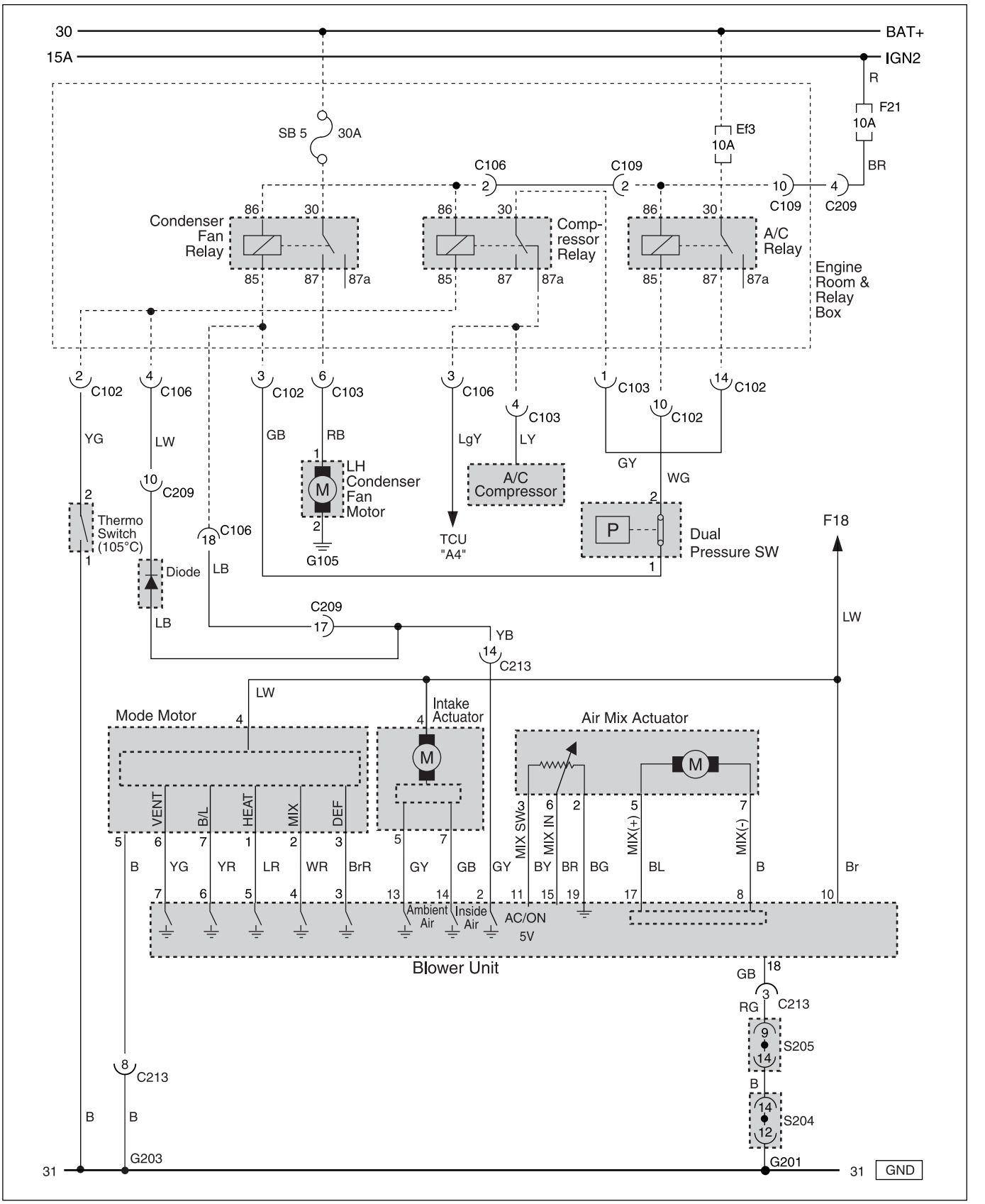


A/V Head Unit

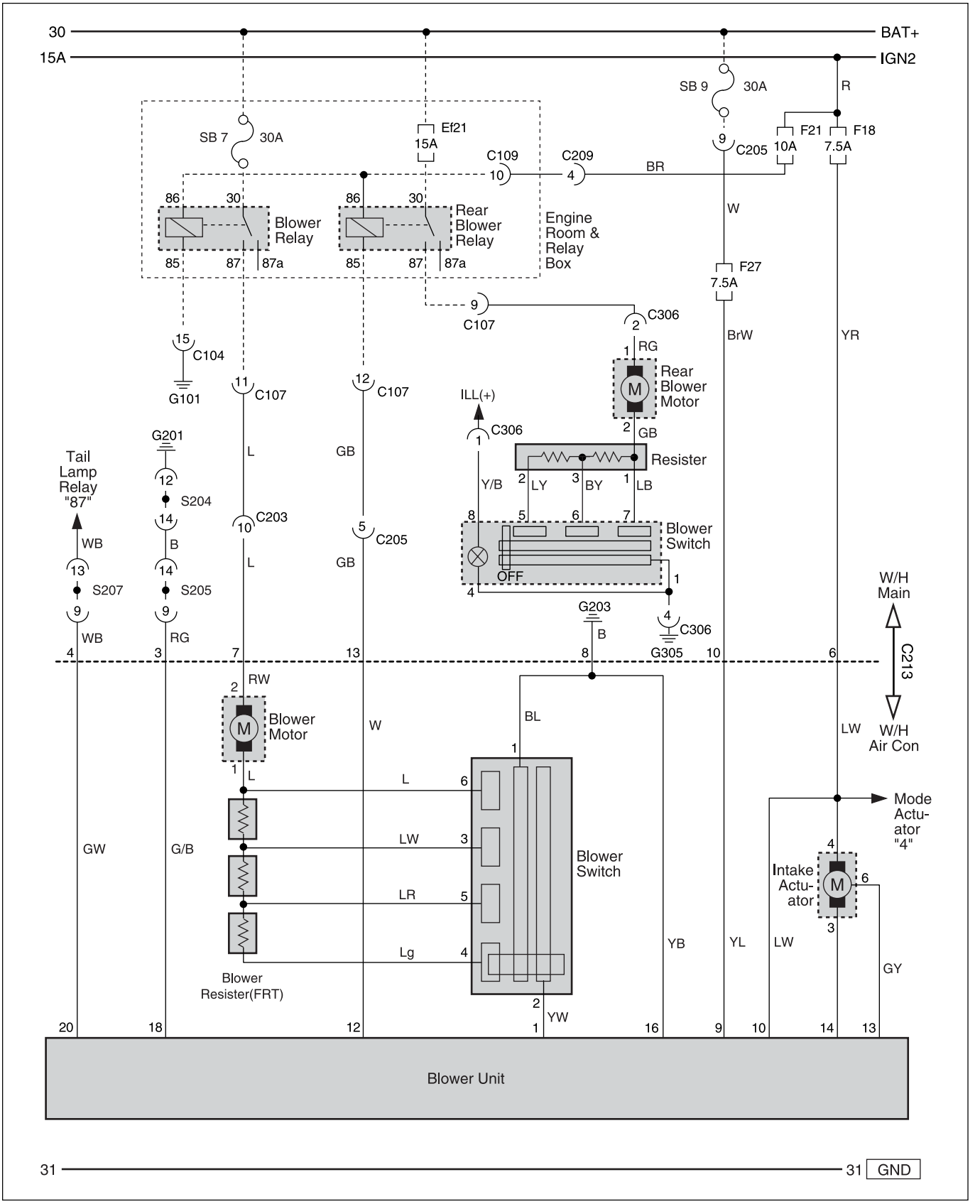
44. AIR-CON (MANUAL, DSL)

1) ~ 2002 MODEL

(1) ACTUATOR (MODE, AIR MIX), BLOWER UNIT CIRCUIT

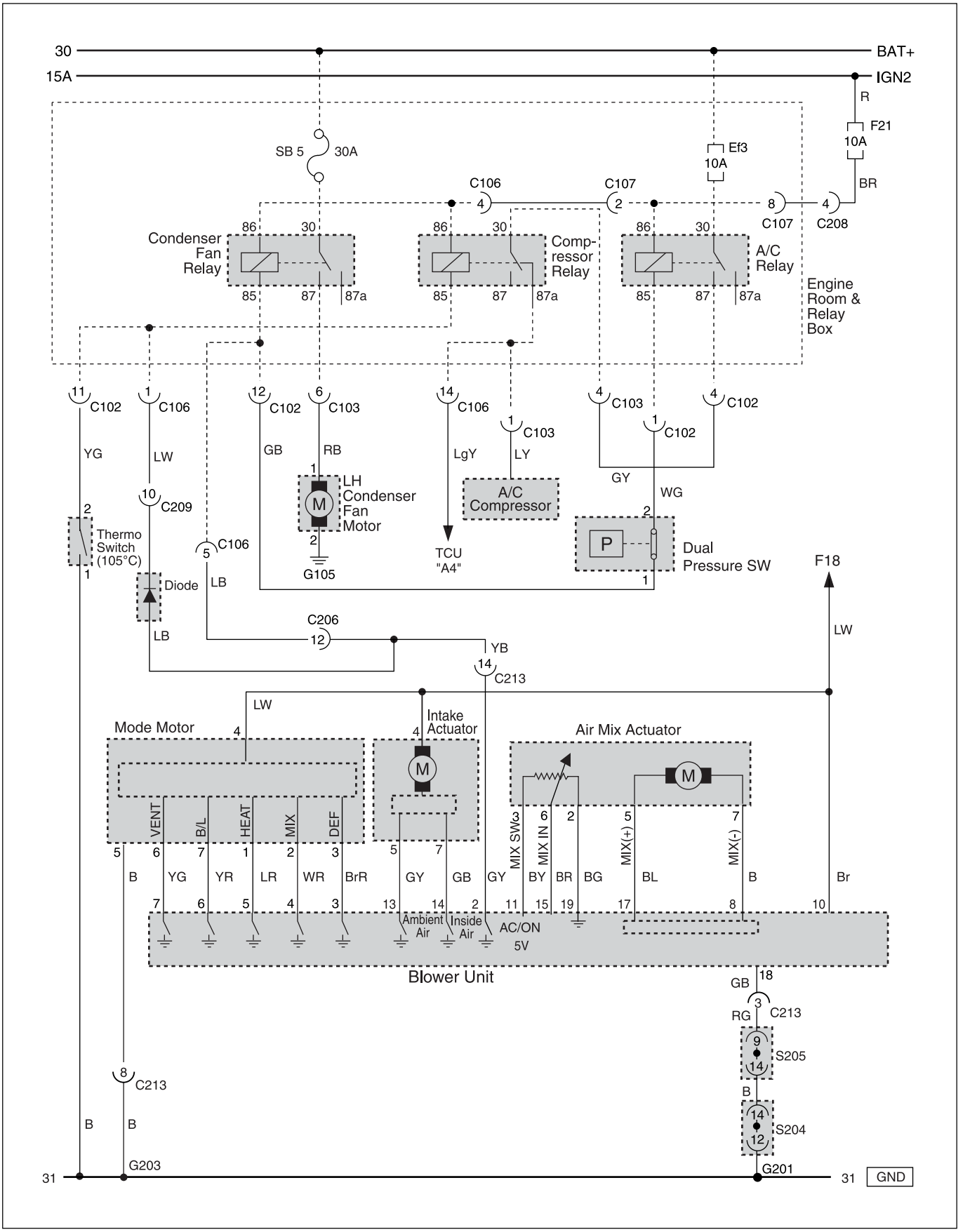


(2) INTAKE MOTOR, BLOWER MOTOR CIRCUIT

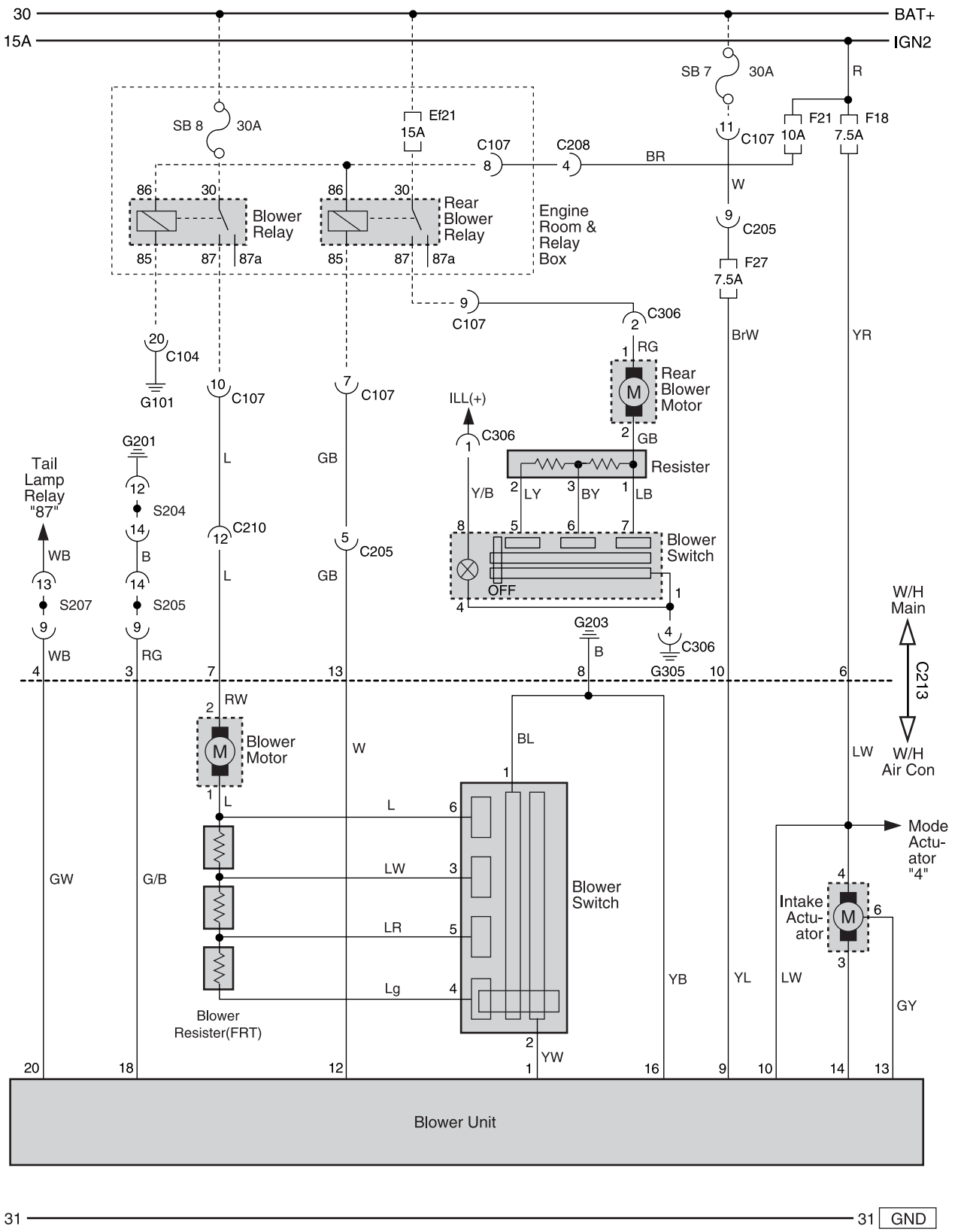


2) 2004 MODEL ~

(1) ACTUATOR (MODE, AIR MIX), BLOWER UNIT CIRCUIT

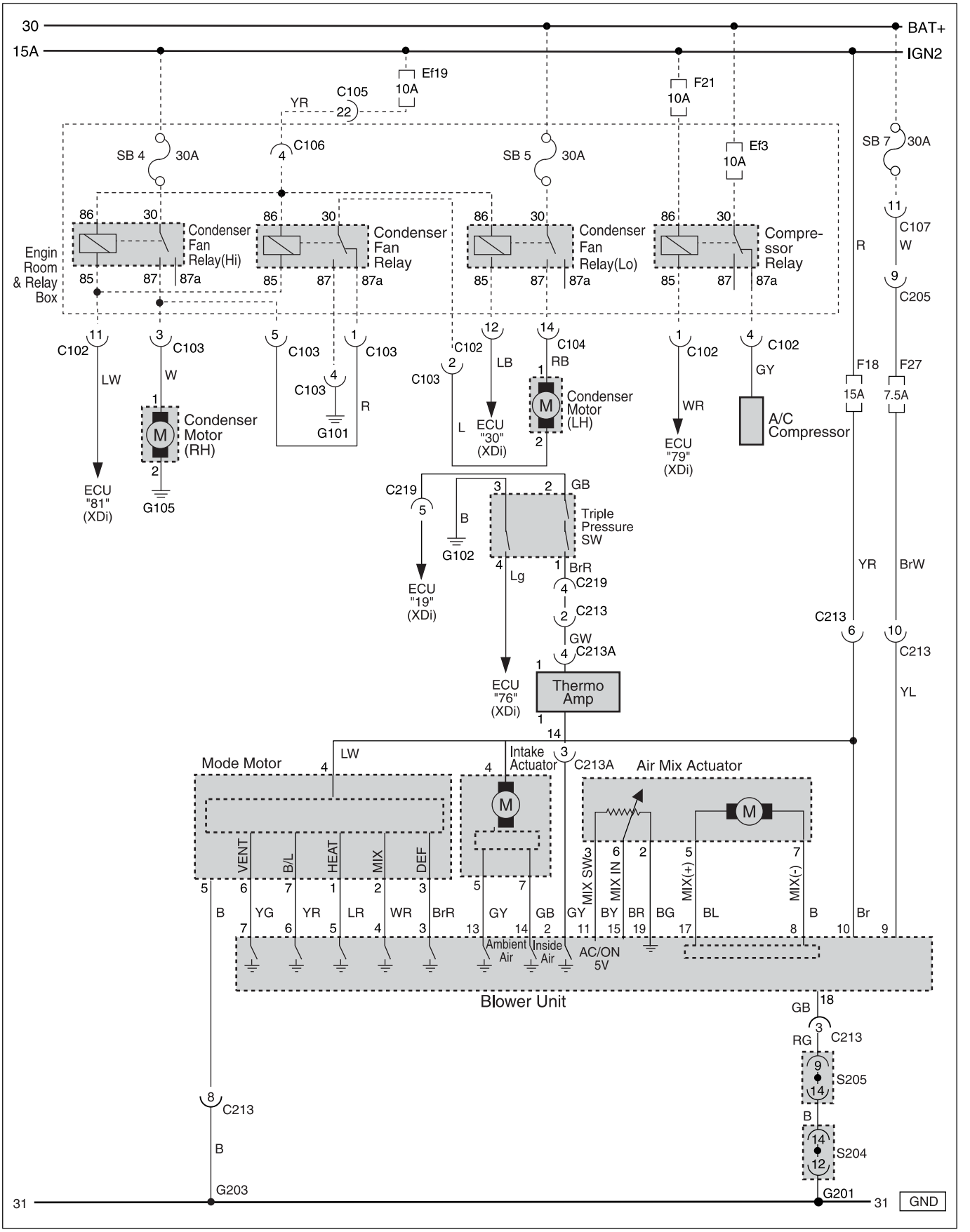


(2) INTAKE MOTOR, BLOWER MOTOR CIRCUIT

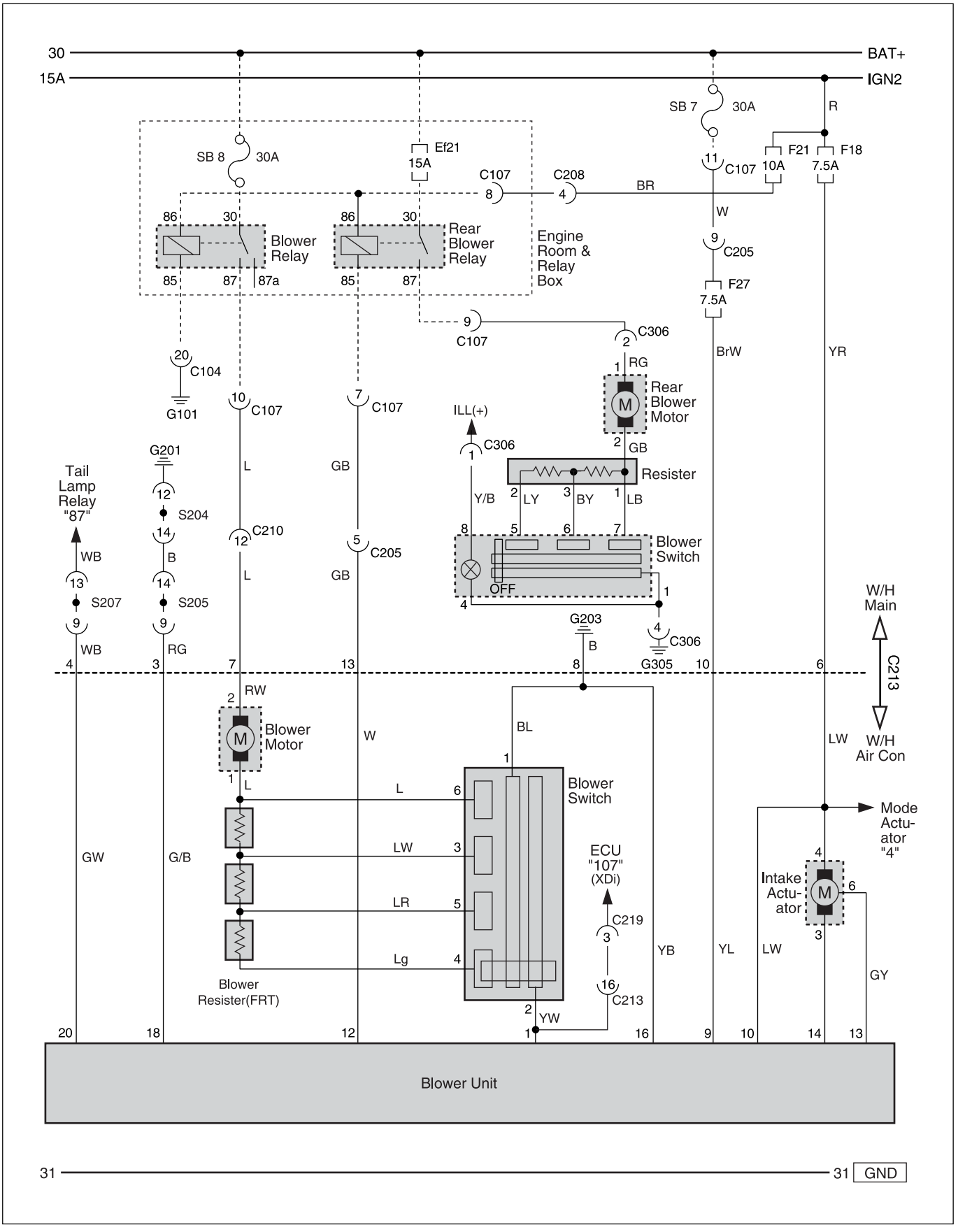


3) XDi

(1) ACTUATOR (MODE, AIR MIX), BLOWER UNIT CIRCUIT



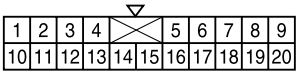
(2) INTAKE MOTOR, BLOWER MOTOR CIRCUIT



A. CONNECTOR INFORMATION

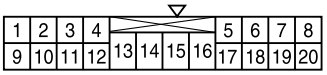
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C103 (6Pin, Colorless)	Engine Room Fuse Box (C) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C213 (16Pin, White)	Main - Air-Con	Inside Dash PNL	
C213A (13Pin, White)	W/H Air Bag - W/H Blower	Inside Dash PNL	XDi
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C306 (4Pin, Colorless)	Floor - RR Air Con	Right Side 3rd Seat	A/C
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S205 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S207 (14Pin, Black)	W/H Main	Behind the Right the FATC	Tail Lamp
G101	W/H Engine	Center the Engine Room Fuse Box	
G105	W/H Engine	Behine the Right Head Lamp	
G201	W/H Main	Inside Driver Side Cowl PNL	
G203	W/H Main	Under the Seat Heating SW	W/H Air Bag

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

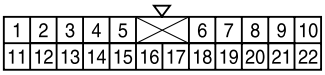


C102
W/H ENG(CE Box)

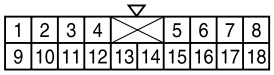
C103
W/H ENG(CE Box)



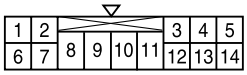
C104
W/H ENG(CE Box)



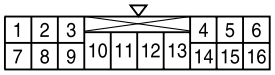
C105
W/H Floor(CE Box)



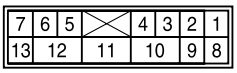
C106
W/H Floor(CE Box)



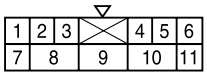
C107
W/H Floor(CE Box)



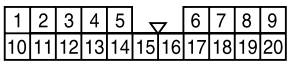
C109
W/H Floor(CE Box)



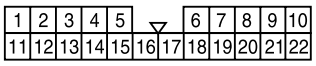
C203
W/H Main



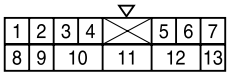
C205
W/H Main



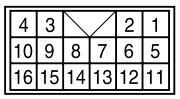
C208
W/H Main



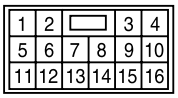
C209
W/H Main



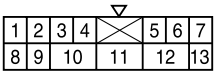
C210
W/H Main



C213
W/H Air-Con

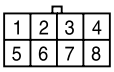


C213A
W/H A/C(Manual)



C219
W/H Main

C306
W/H RR Air-Con



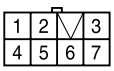
A/C Blower
SW (RR)

Blower SW

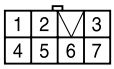
Thermo SW
(DSL)

A/C Blower
Motor (RR)

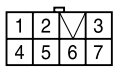
Cooling Fan
Motor



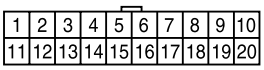
Mixer
Actuator



Mode
Actuator



Intake/Ambient
Actuator

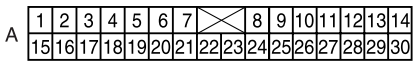


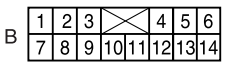
A/C Controler
(Manual)

Blower
Resister

A/C Blower
Resister (RR)

A/C
Compressor





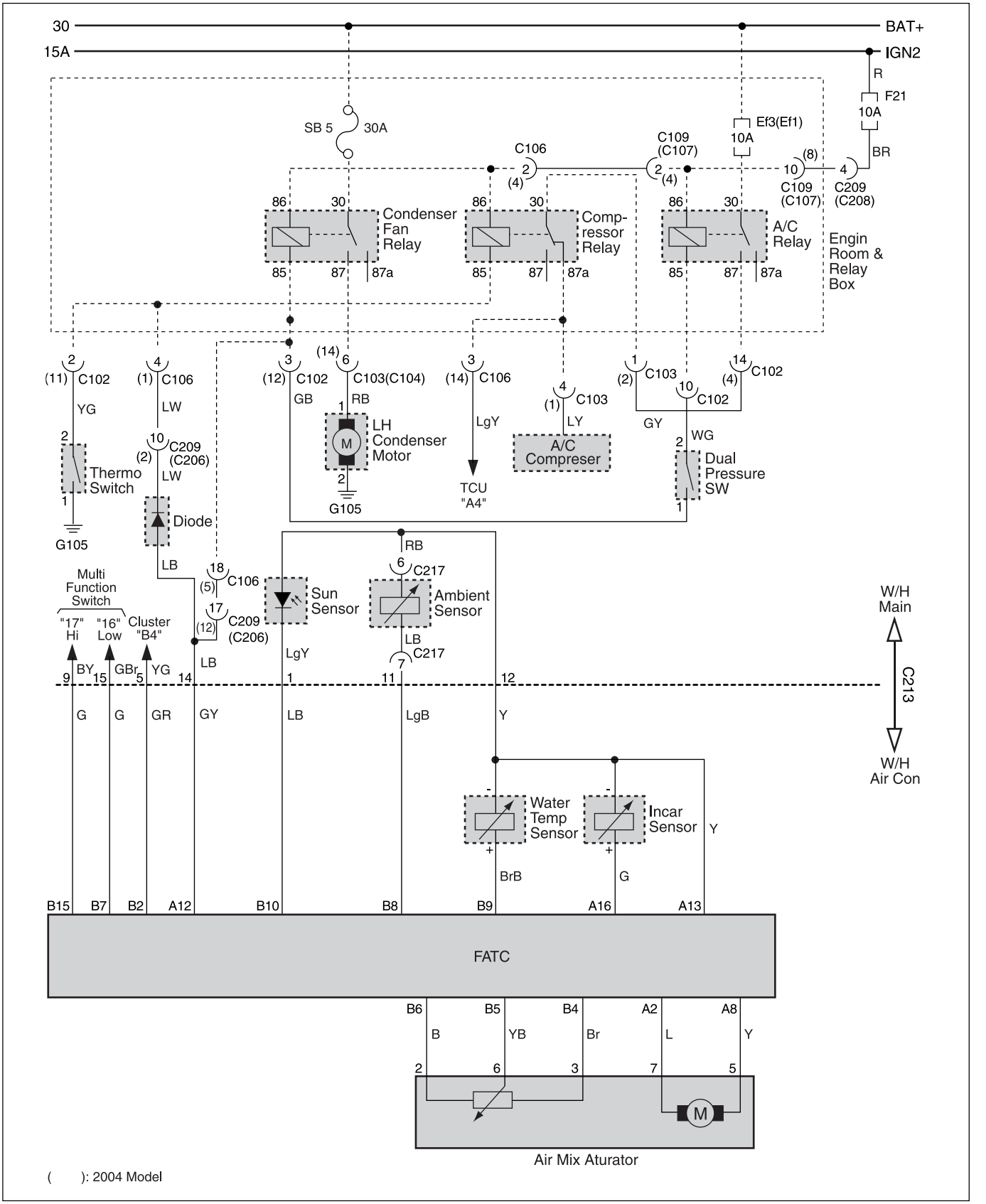
TCU

A/C Coolant
Pressure SW
(Duel Pressure
SW)

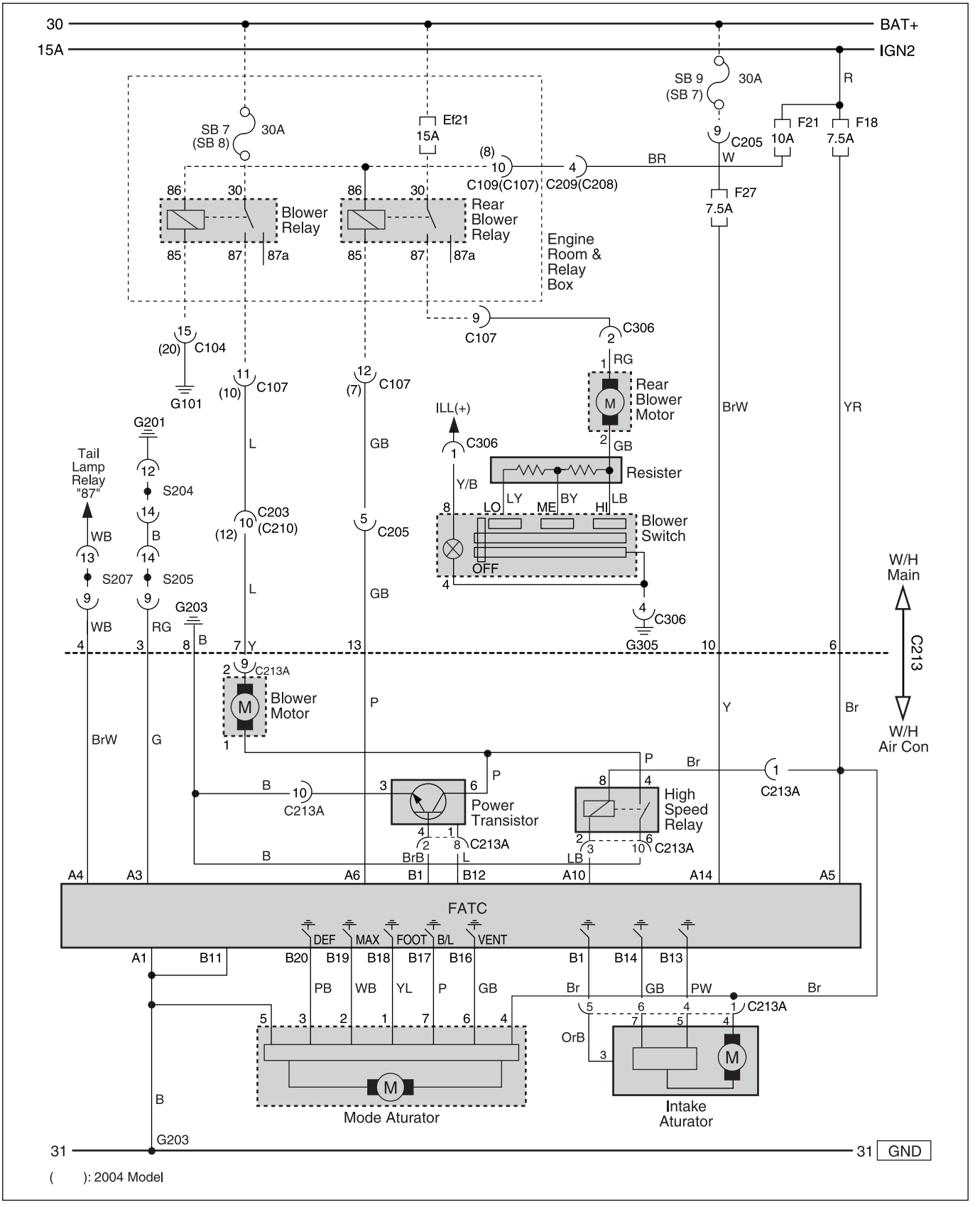
45. FATC (FULL AUTO TEMPERATURE CONTROL) CIRCUIT

1) DIESEL

(1) AIR MIX ACTUCTOR, SENSOR (SUN, AMBIENT, INCAR, WATER TEMP) CIRCUIT

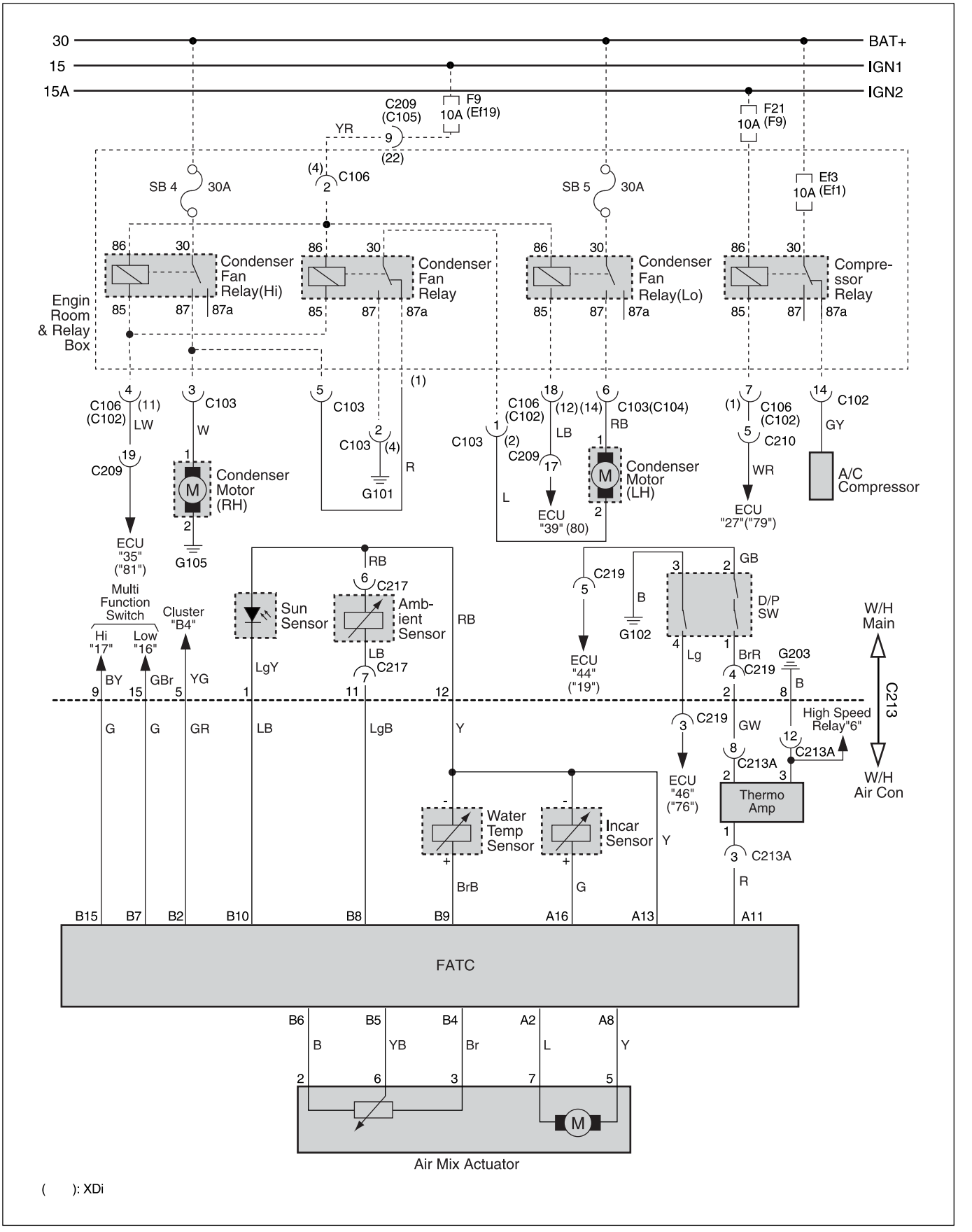


(2) ACTURATOR (MODE, INTAKE) CIRCUIT

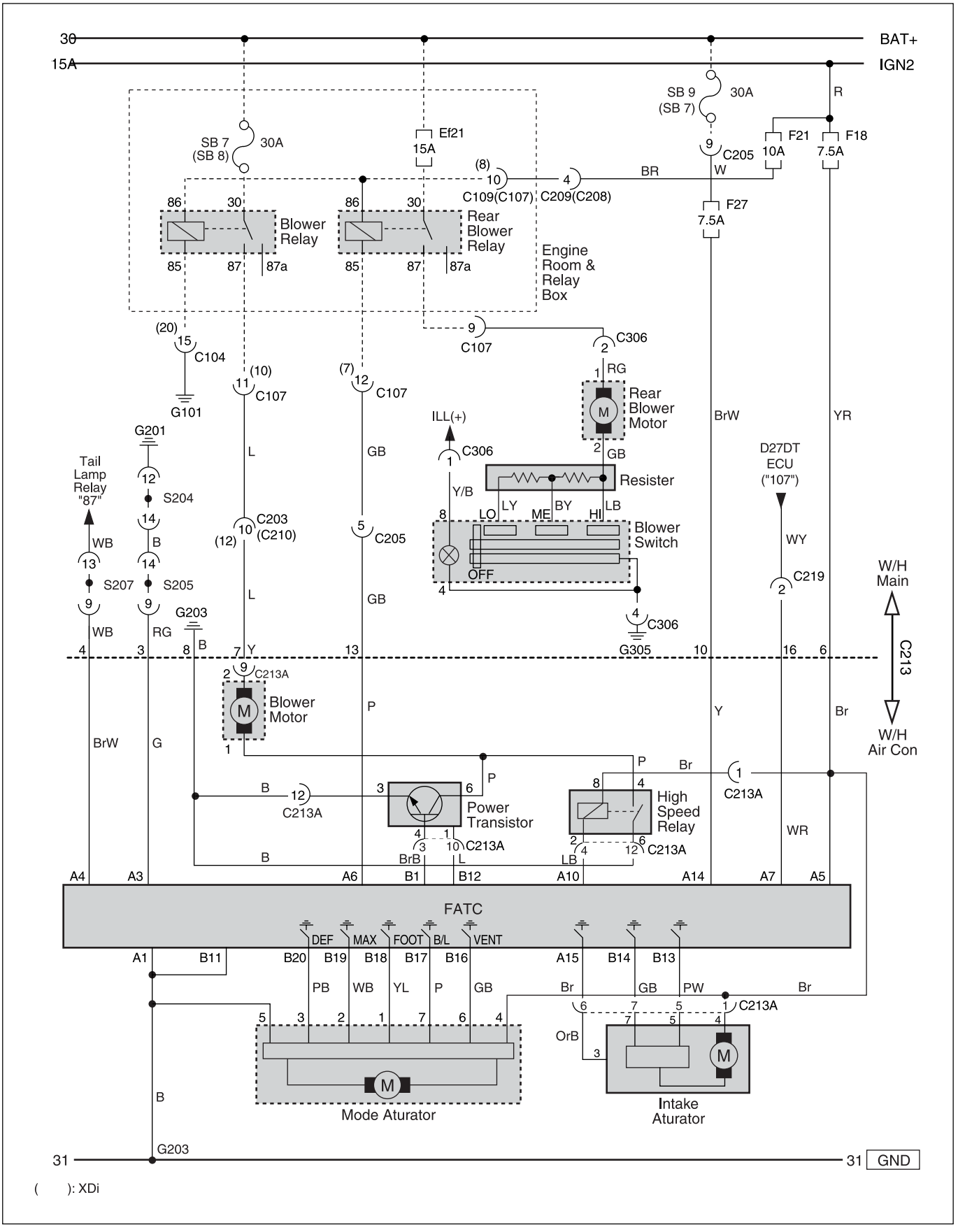


2) GASOLINE & XDi

(1) AIR MIX ACTUCTOR, SENSOR (SUN, AMBIENT, INCAR, WATER TEMP) CIRCUIT



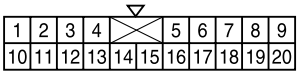
(2) ACTURATOR (MODE, INTAKE) CIRCUIT



A. CONNECTOR INFORMATION

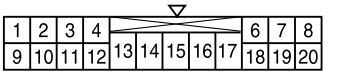
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (20Pin, White)	Engine Room Fuse Box (B) - Engine	Engine Room Fuse Box	
C103 (6Pin, Colorless)	Engine Room Fuse Box (C) - Engine	Engine Room Fuse Box	
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C210 (13Pin, Green)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C213 (16Pin, White)	Main - Air-Con	Inside Dash PNL	
C213A (13Pin, White)	W/H Air Bag - W/H Blower	Inside Dash PNL	XDi
C217 (20Pin, Black)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C306 (4Pin, Colorless)	Floor - RR Air-Con	Right Side 3rd Seat	A/C
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S205 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S207 (14Pin, Black)	W/H Main	Behind the Right the FATC	Tail Lamp
G101	W/H Engine	Center the Engine Room Fuse Box	
G105	W/H Engine	Behine the Right Head Lamp	
G201	W/H Main	Inside Driver Side Cowl PNL	
G203	W/H Main	Under the Seat Heating SW	W/H Air Bag
G305	W/H Floor	Behind the Quarter Grass #1	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

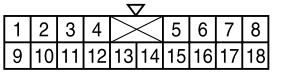


C102
W/H ENG(CE Box)

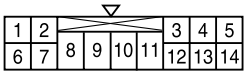
C103
W/H ENG(CE Box)



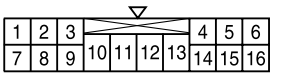
C104
W/H ENG(CE Box)



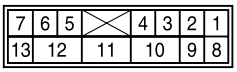
C106
W/H Floor(CE Box)



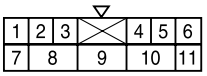
C107
W/H Floor(CE Box)



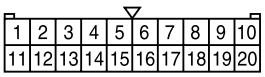
C109
W/H Floor(CE Box)



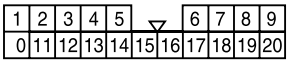
C203
W/H Main



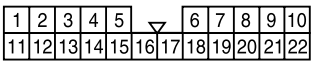
C205
W/H Main



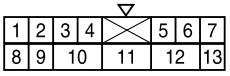
C206
W/H Main



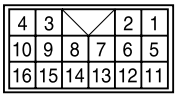
C208
W/H Main



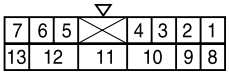
C209
W/H Main



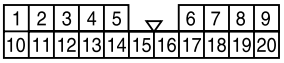
C210
W/H Main



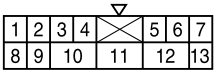
C213
W/H Air-Con



C213A
W/H A/C(FATC)

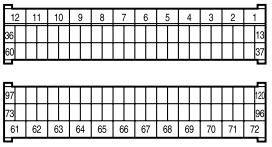


C217
W/H Main



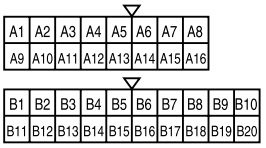
C219
W/H Main

C306
W/H RR Air-Con

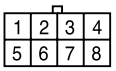


ECU

A/C Coolant
Pressure SW
(Trinary SW)



A/C Controler (FATC)



A/C Blower
SW (RR)

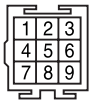
Ambient
Sensor

Sun Sensor

Intake
Sensor

Coolant
Sensor

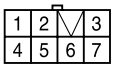
A/C Blower
Motor (RR)



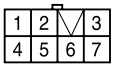
High Speed
Relay

Blower
Motor

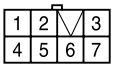
Cooling Fan
Motor



Mixer
Actuator



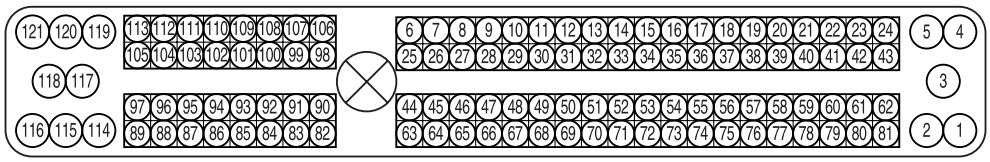
Mode
Actuator



Intake/Ambient
Actuator

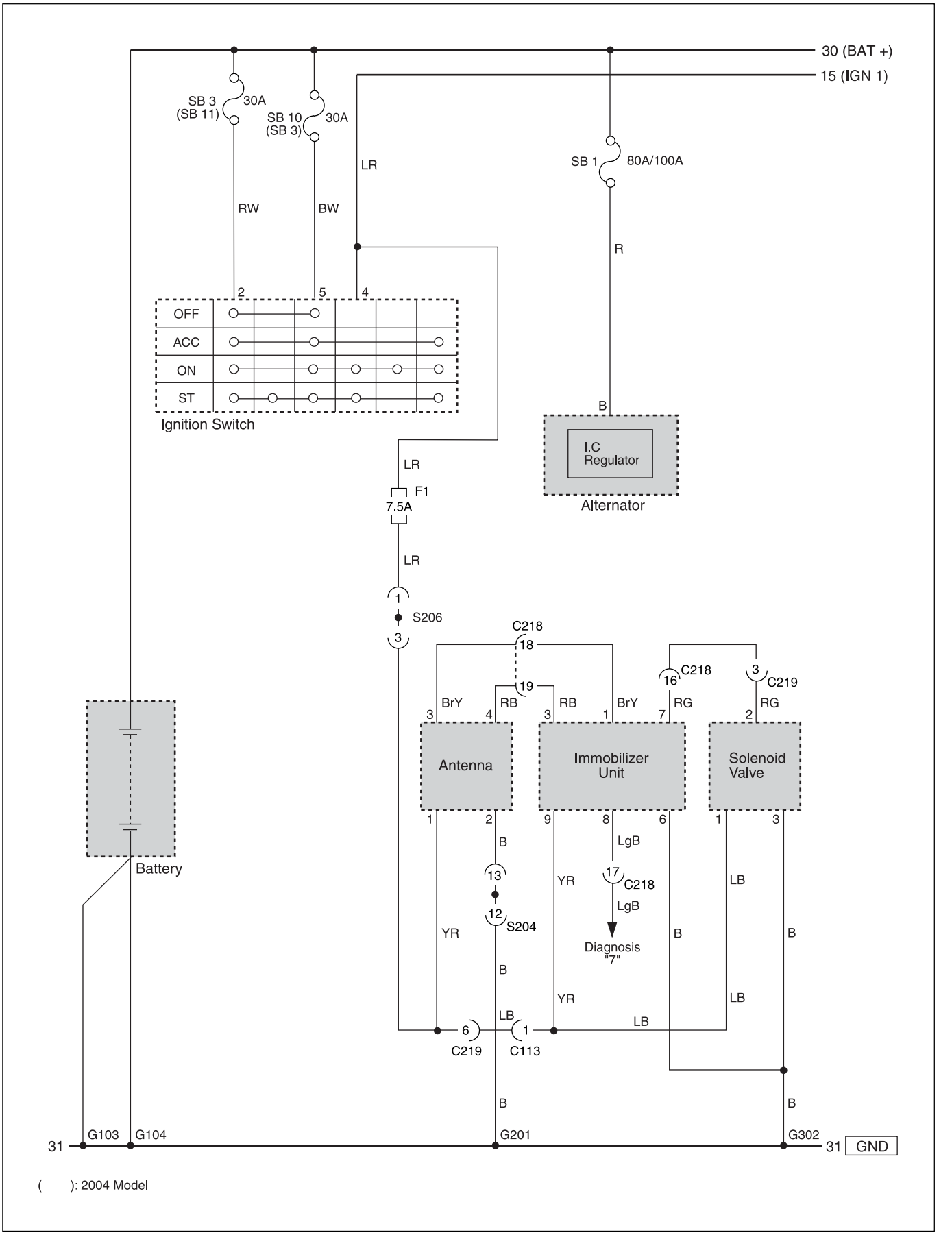
A/C Blower
Register (RR)

PWR
Transistor



XDi ECU

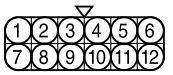
46. IMMOBILIZER (DSL)



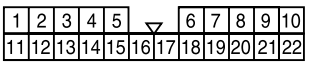
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C113 (12Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	DSL
C218 (22Pin, Yellow)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
S204 (14Pin, Black)	W/H Main	Behind the Left the FATC	GND
S206 (14Pin, Black)	W/H Main	Behind the Left the FATC	
G201	W/H Main	Inside Driver Side Cowl PNL	
G302	W/H Floor	Under Driver Seat	

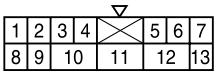
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



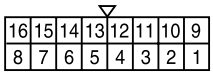
C113
W/H ENG Control
(DSL)



C218
W/H Main

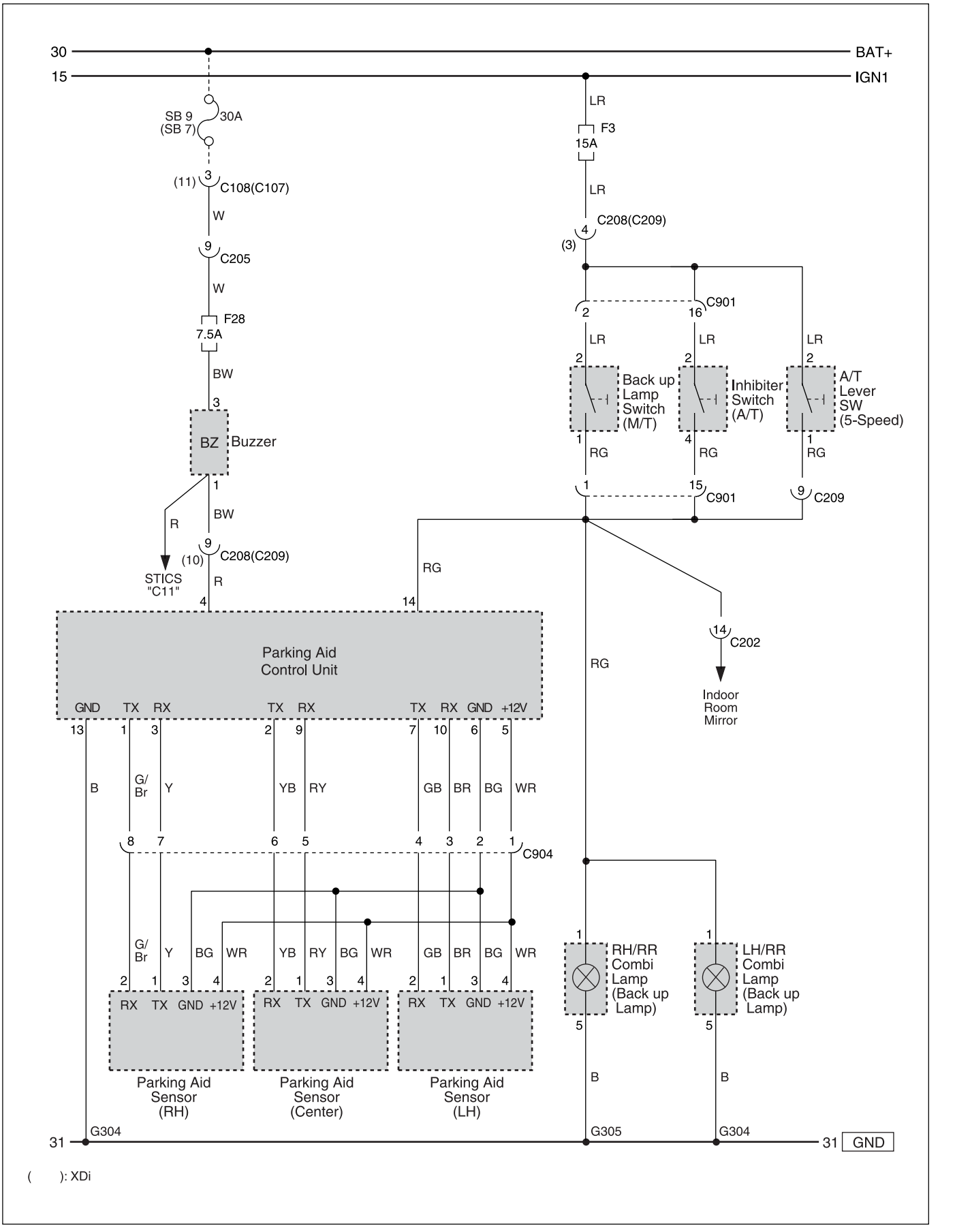


C219
W/H Main



Immobilizer Unit (DSL)

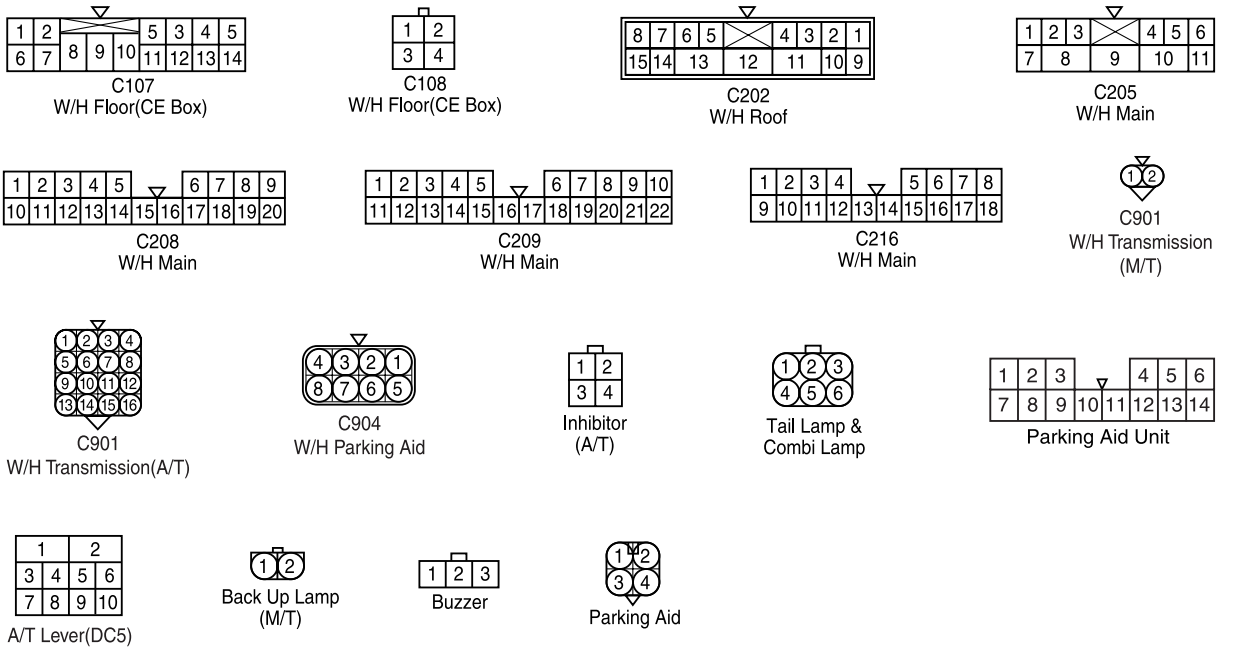
47. PARKING AID CIRCUIT



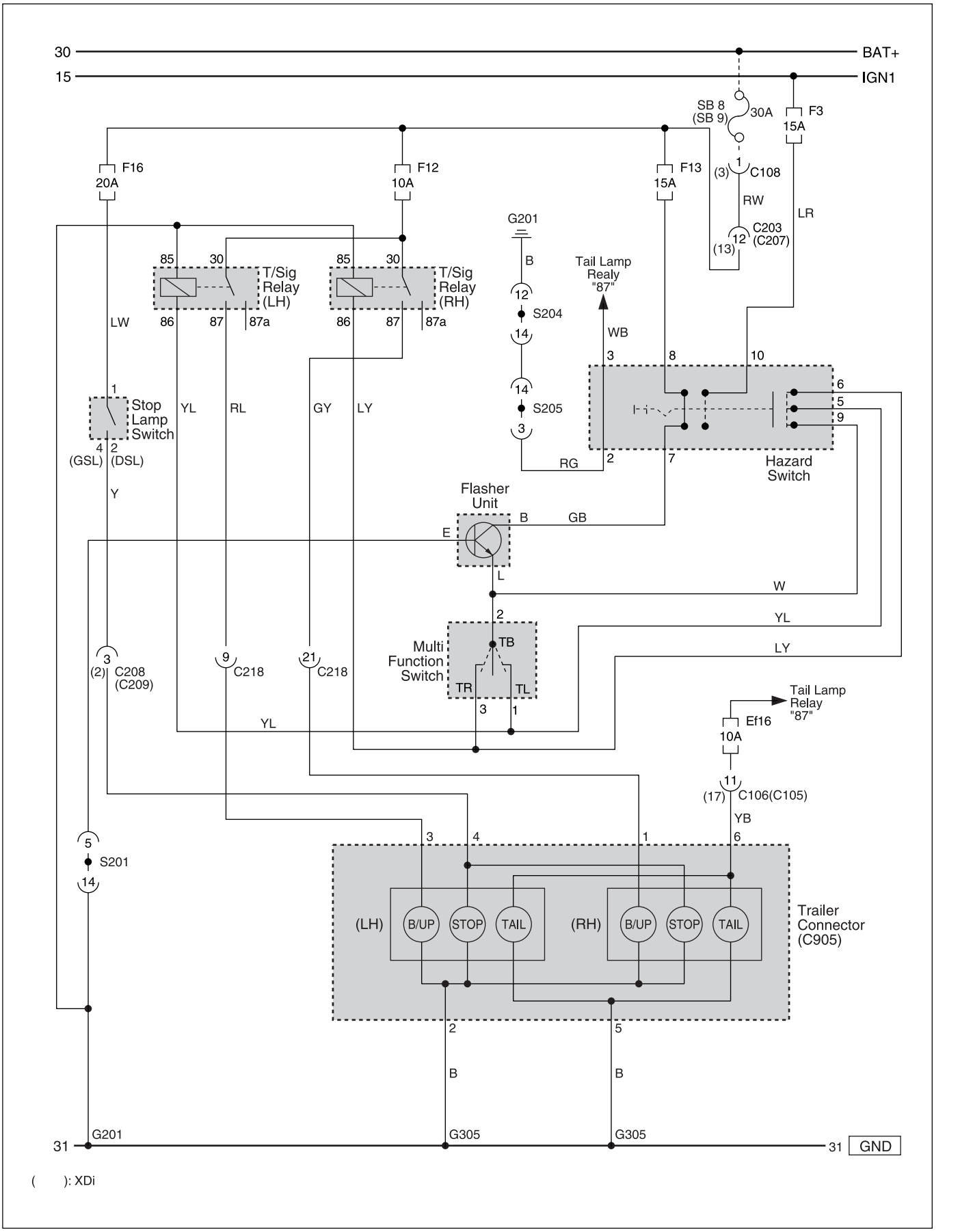
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C107 (14Pin, White)	Engine Room Fuse Box (J) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C202 (15Pin, White)	Main - Roof	Under the I/P Fuse Box	
C205 (11Pin, White)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C216 (18Pin, White)	Main - Floor (RH)	Inside Co-Driver Side Cowl PNL	
C901 (16Pin, White)	Floor - T/M	Left the T/C (Under the Floor)	A/T
C901 (2Pin, White)	Floor - T/M	Left the T/C (Under the Floor)	M/T
C904 (8Pin, White)	Floor - Parking Aid	Inside the Left RR Bumper	Parking Aid
G304	W/H Floor	Behind the Quarter Grass #1	
G305	W/H Floor	Behind the Quarter Grass #1	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



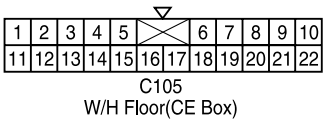
48. TRAILER CONNECTOR CIRCUIT



A. CONNECTOR INFORMATION

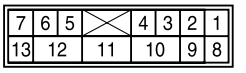
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C105 (22Pin, White)	Engine Room Fuse Box (E) - Engine	Engine Room Fuse Box	
C108 (4Pin, Colorless)	Engine Room Fuse Box (K) - Engine	Engine Room Fuse Box	
C203 (13Pin, Green)	Main - Floor (LH)	Under the I/P Fuse Box	
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C208 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C218 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C905 (6Pin, White)	Floor - Trailer	Inside the Left RR Bumper	
G305	W/H Floor	Behind the Quarter Grass #1	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

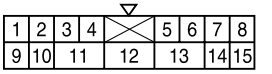


C105
W/H Floor(CE Box)

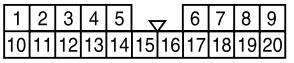
C108
W/H Floor(CE Box)



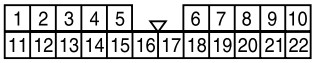
C203
W/H Main



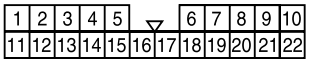
C207
W/H Main



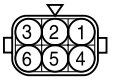
C208
W/H Main



C209
W/H Main



C218
W/H Main

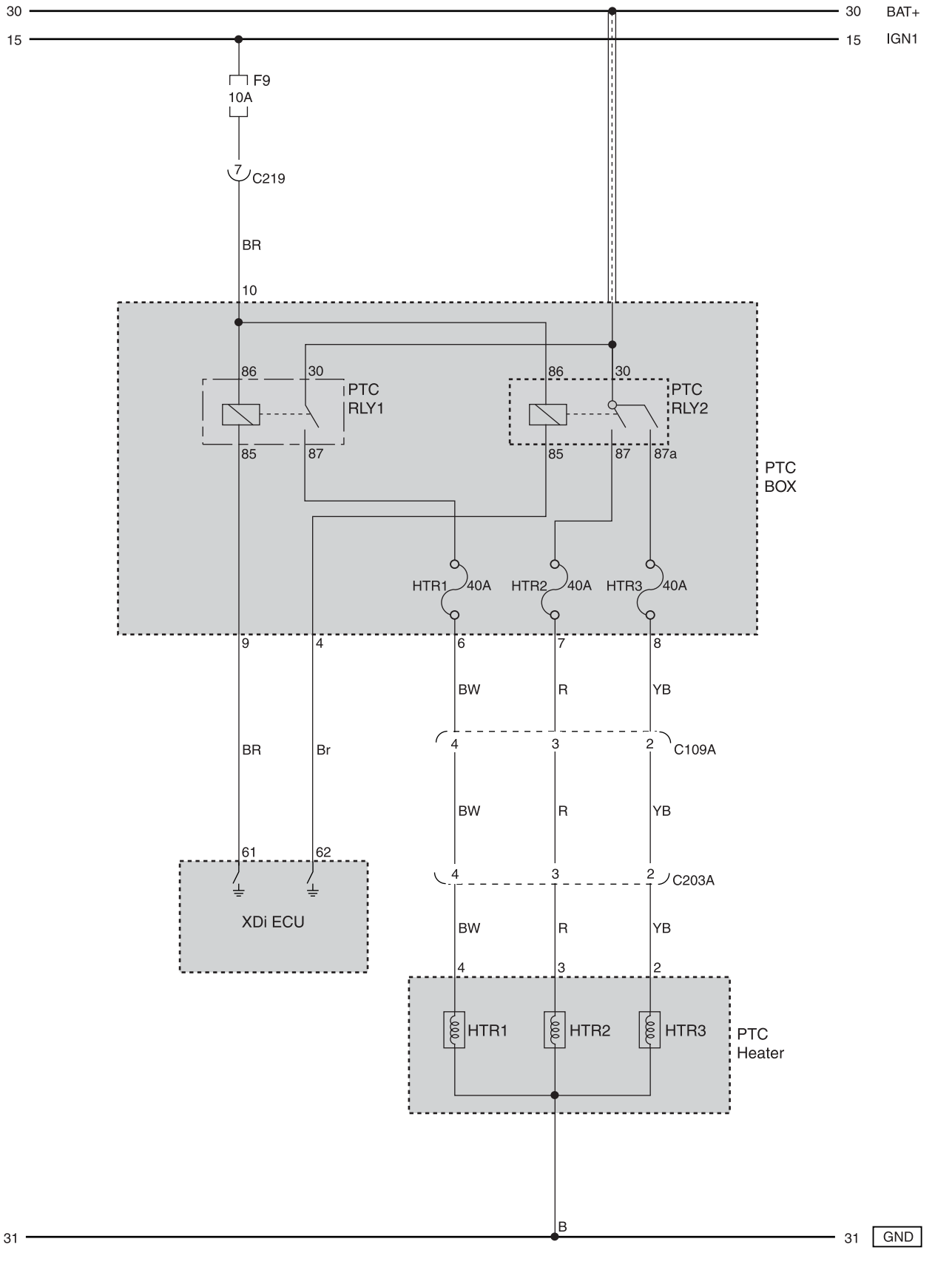


C905
W/H Trailer

Stop Lamp
(GSL)

Stop Lamp
(DSL)

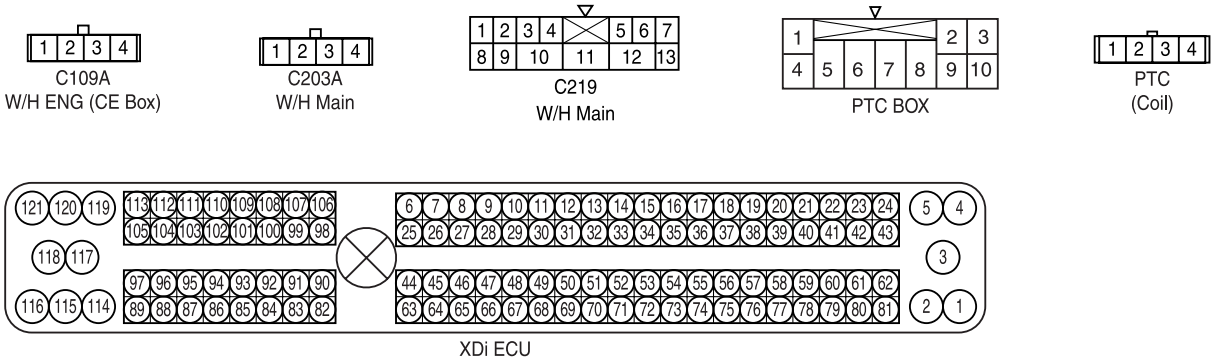
49. P.T.C HEATER(POSITIVE TEMPERATURE COEFFICIENT)



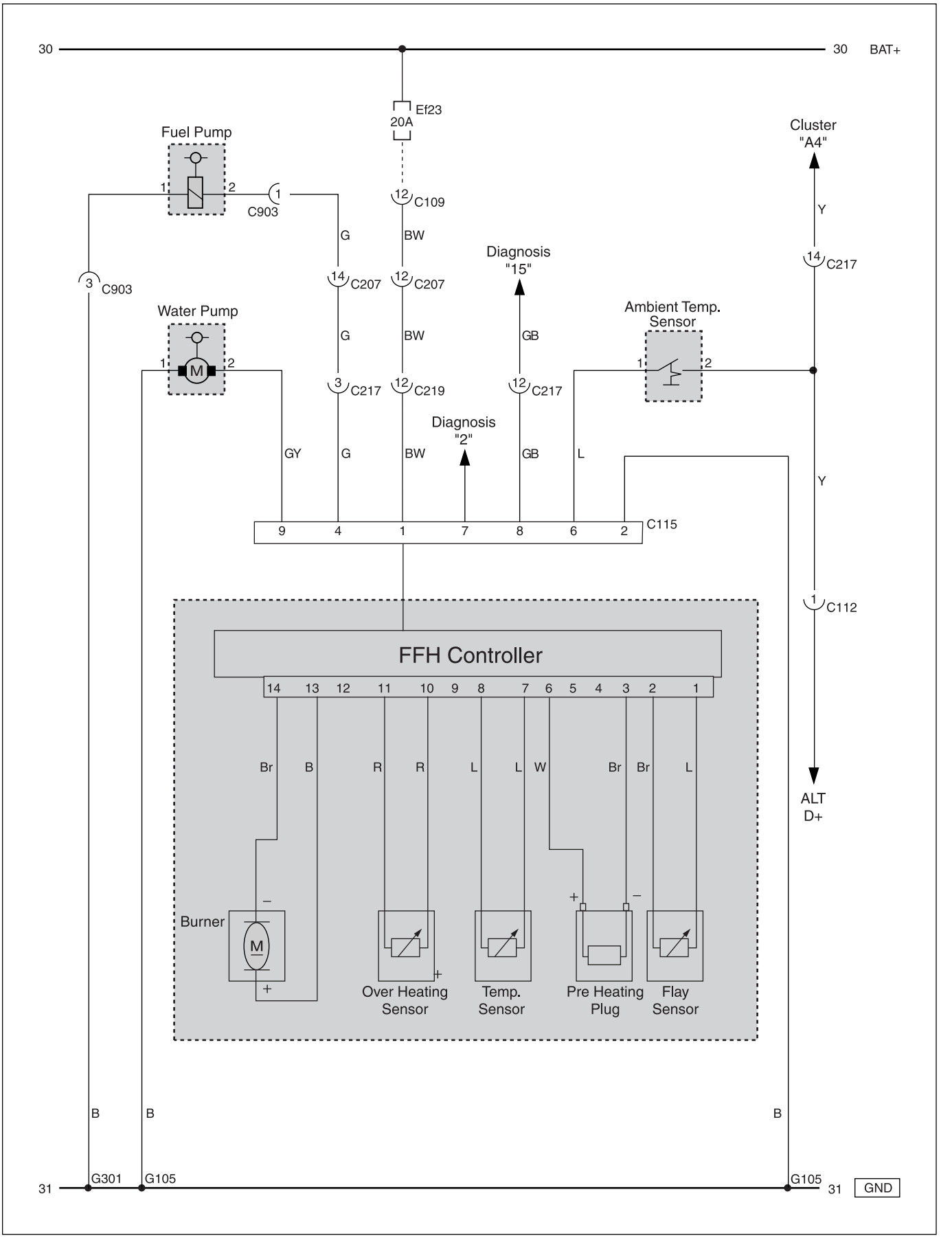
A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C110 (1Pin, Gray)	Engine - Starter “ST”	FRT Pre-Heating Unit	
C204 (12Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	A/T
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



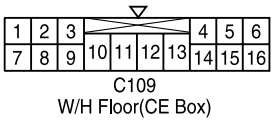
50. F.F.H (FUEL FIRED HEATER)



A. CONNECTOR INFORMATION

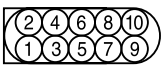
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C109 (16Pin, White)	Engine Room Fuse Box (M) - Engine	Engine Room Fuse Box	
C112 (2Pin, Black)	Engine - Alternator	Under the Coolant Reserve Tank	GSL
C114 (6Pin, Black)	Engine - Engine Control	Right Engine Room Dash PNL	GSL
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C217 (20Pin, Black)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C219 (13Pin, Green)	Engine - Main (RH)	Inside Co-Driver Side Cowl PNL	
C902 (6Pin, White)	Floor - T/M	Under the T/C (Under the Floor)	M/T 2WD
G105	W/H Engine	Behine the Right Head Lamp	
G301	W/H Floor	Under Driver Seat	ECU GND

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

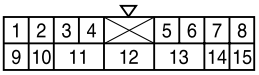


C109
W/H Floor(CE Box)

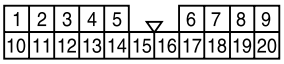
C112
W/H Alternator
(GSL)



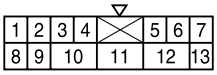
C115
W/H FFH



C207
W/H Main



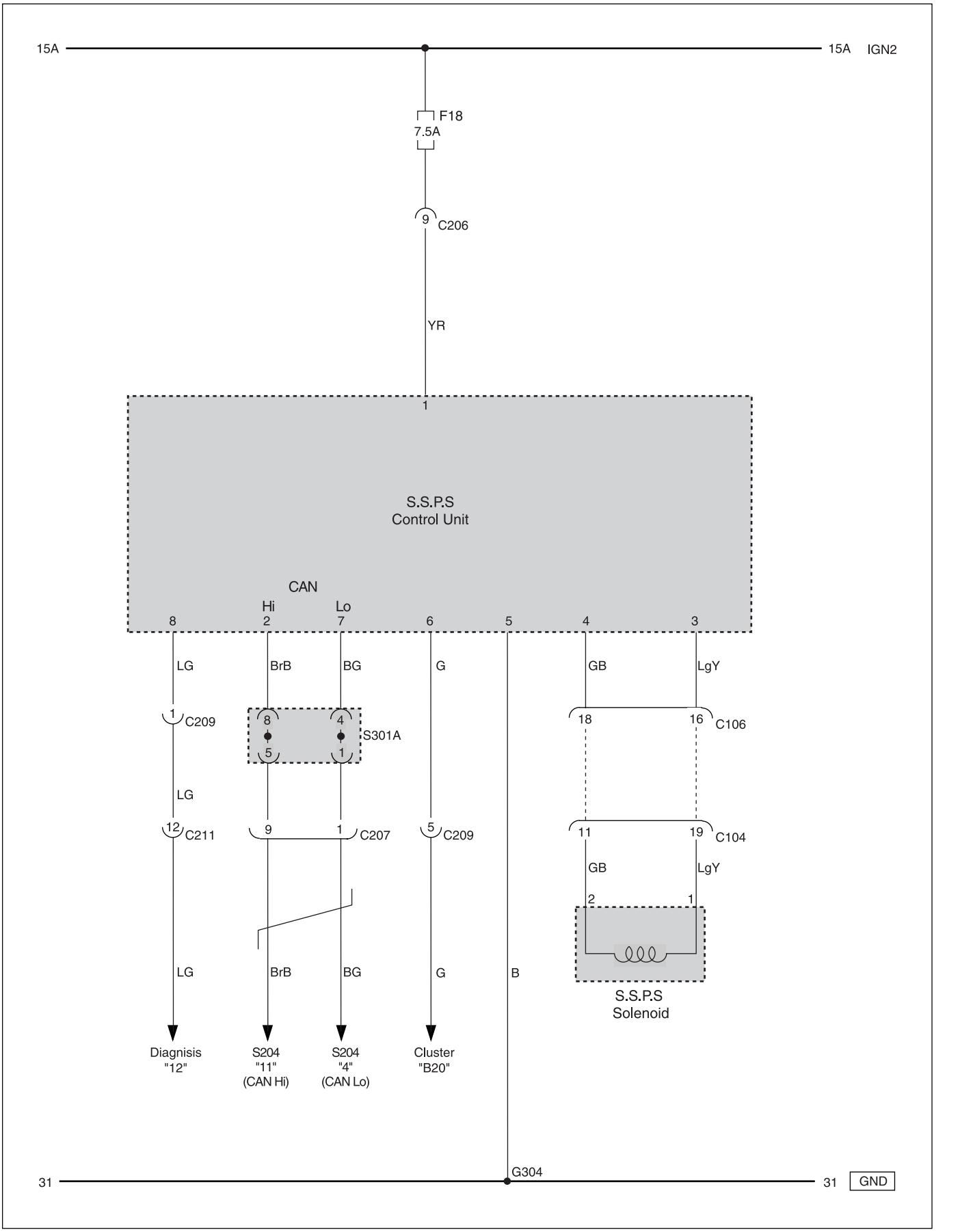
C217
W/H Main



C219
W/H Main

Water Pump
(FFH)

51. S.S.P.S


15A
15A IGN2
F18
7.5A
9 C206
YR
1
S.S.P.S
Control Unit
CAN
Hi
Lo
8
2
7
6
5
4
3
LG
BrB
BG
G
GB
LgY
1 C209
8
4
5
1
S301A
18
16 C106
LG
12 C211
9
1 C207
5 C209
11
19 C104
GB
LgY
2
1
LG
BrB
BG
G
B
S.S.P.S
Solenoid
Diagnisis
"12"
S204
"11"
(CAN Hi)
S204
"4"
(CAN Lo)
Cluster
"B20"
G304
31
31
GND

A. CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (20Pin, White)	Engine Room Fuse Box (D) - Engine	Engine Room Fuse Box	
C106 (18Pin, White)	Engine Room Fuse Box (F) - Engine	Engine Room Fuse Box	
C206 (20Pin, Black)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C207 (15Pin, Blue)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C209 (22Pin, Yellow)	Main - Floor (LH)	Inside Driver Side Cowl PNL	
C211 (18Pin, White)	Main - Diagnosis Connector	Upper the Diagnosis	XDi
S301A (8Pin, Black)	W/H Floor	Under Driver Seat	CAN (GSL)
G304	W/H Floor	Behind the Quarter Grass #1	

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION