SUBARU

QUALITY DRIVEN®

SERVICE

CERTIFIED SUBARU TECHNICIAN

Technicians Reference Booklet

2004 New Model Update

Module 913

MSA5P0301B

Technical Training

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Introduction

The 2004 Subaru model year marks the 35th anniversary by placing emphasis on high performance, lower emissions and improved safety. Turbo Chargers, Active Variable Valve Timing, Driver controlled Center Differential and Safety Brake pedal supports are only a few of the components and systems utilized on the 2004 line up that assist with making this launch of new vehicles the most powerful in Subaru's history.


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Impreza WRX STi

The WRX STi is a new high performance sedan added to the Impreza line up. This model is developed from the WRX with added features and performance.

The hood is all aluminum with an active hood scoop that directs air across a large intercooler and serves as a mount for the Intercooler water spray nozzles.


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The Rear Spoiler is larger than the WRX model and houses the 3rd stop light in the rear horizontal surface.

The tail lights are multi reflector type.


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The headlights are equipped with High Intensity Discharge for the low beams. The headlights are equipped with an adjustment motor that allows the driver to lower the physical location of the beam when ever illumination is offensive to other drivers.

Tire size is 225/45 ZR17 90W. These Bridgestone Potenza RE070 summer tires are standard equipment on all STi models.


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WRX STi is equipped with driver, front seat passenger and side airbags. The front seat belts are equipped with pretensioners. The front seats are not equipped with active head rests.

Labels on the driver side door jam are there to inform the operator that the vehicle is equipped with HID headlights and SRS side airbags. Also tire inflation and spare size are printed on a label.


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The combination meter is back lit to illuminate all gauges. Turning on the ignition illuminates the needles of all gauges and activates the warning lights to go through the light check cycle. The motors driving the gauges will move the needles to their maximum and then to the minimum.


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Next the gauges themselves illuminate, followed by the gauges moving to the correct levels as determined by their input sensors or signals. The STi emblem in the bottom center tachometer will also illuminate at this time.

The tachometer has an alarm that can be set to activate when the engine reaches the speed set by the driver. The alarm can flash the red light at the top center of the tachometer or flash the light and sound a chirp. This alarm will not affect engine operation and serves as a reminder to up shift only.

The alarm can be set with the ignition key on or with the engine running. The alarm cannot be set while the vehicle is moving. Setting of the alarm is accomplished by tuning on the ignition key, allow the gauges to move their normal running positions, turning the “Rev” control stalk clockwise, and releasing it. Next turn and hold the “Rev” control stalk until the tachometer needle reaches the desired setting.

The outside temperature gauge will switch to show the driver the RPM set (times 100). After releasing the control stalk the tachometer needle will remain steady and the RPM reading on the outside temperature gauge will blink twice followed by a blinking horizontal line. This horizontal line will blink three times unless the driver turns the control stalk counter clockwise. Turning the control stalk counter clockwise will activate the alarm to beep and flash the light when the set engine speed has been achieved. The alarm beep can be turned off by following the above steps but instead of a horizontal line flashing, the word “On” will be flashing. Turning the control stalk counter clockwise will turn the beep off.

Setting the alarm to “00” will completely turn it off. The minimum setting is 2000 RPM and maximum setting is “7000” RPM.

The outside temperature gauge will return to normal automatically.

The trip meter switches over to display the illumination control setting when the illumination setting of the combination meter is changed. The trip meter will return to normal automatically.

The WRX STi is equipped with semi automatic air conditioning. This system will attempt to maintain the set temperature when the automatic function is selected.

The new 6 speed manual transmission with reverse lock out is the only transmission available for the WRX STi.

Front suspension with aluminum front transverse link

Rear suspension with ball joint support on stabilizer bar link

Additional enhancements to the front and rear suspension include the use of an inverted strut. This type of configuration provides reduced body lean and assists with providing overall vehicle stability.

An engine undercover is equipped on the WRX STi. It must be removed to gain access to the oil filter.

The WRX STi is equipped with the new 2.5 liter DOHC turbo charged engine. This new engine develops 300 horse power @ 6000 RPM and 300 lb. Ft. @ 4000 RPM. The compression ratio is 8.2 to 1. The engine type is EJ 25.

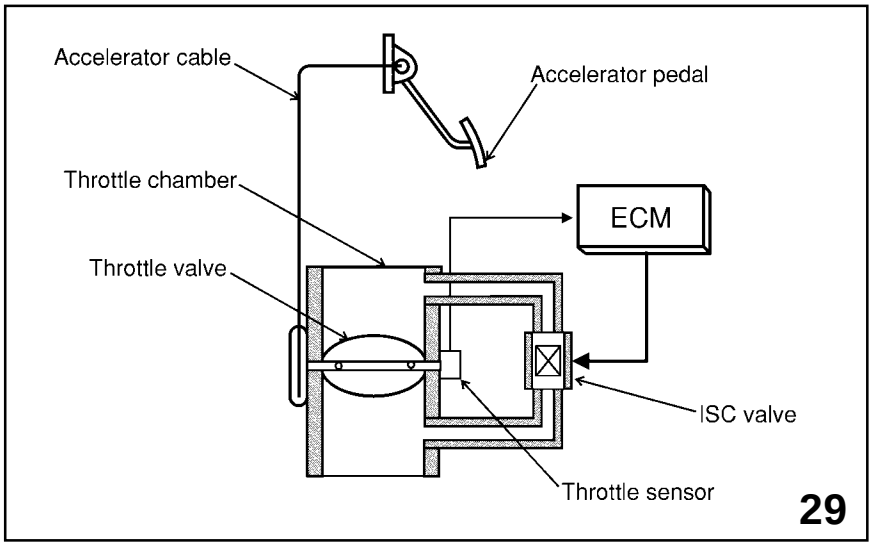
Electric Throttle Control System

Outline

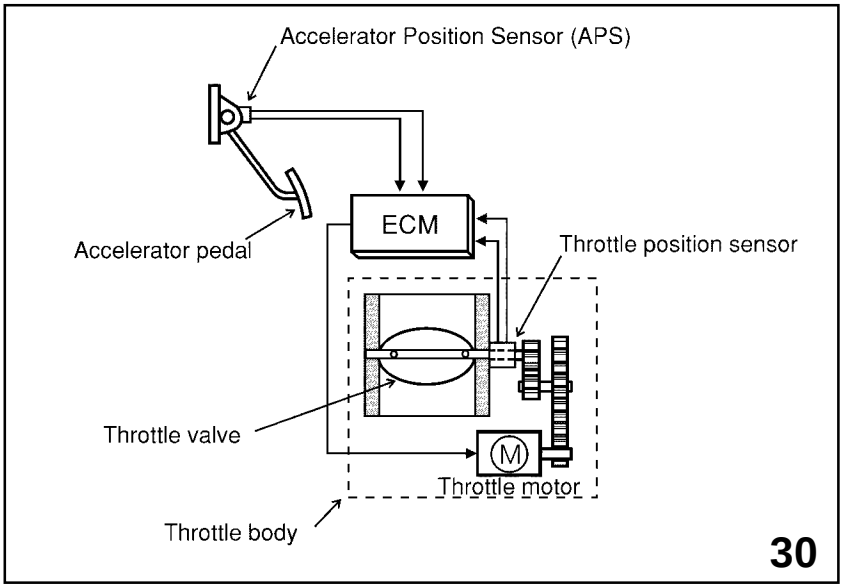
The Electric Throttle Control System dispenses with the accelerator cable that was used in the previous throttle system. Using electronic control that relies on various types of sensors and control modules provides a more fine-tuned control of the throttle system, including idle and cruise control functions.

In this system, since the opening and closing of the throttle valve is controlled by an ECM, the throttle valve opening/closing speed can be controlled during quick acceleration, without making it proportional to the speed at which the accelerator pedal is depressed. This enables the A/F mixture to be optimized, which results in a reduced amount of exhaust gas.

Current Throttle System



Electronic Throttle Control System

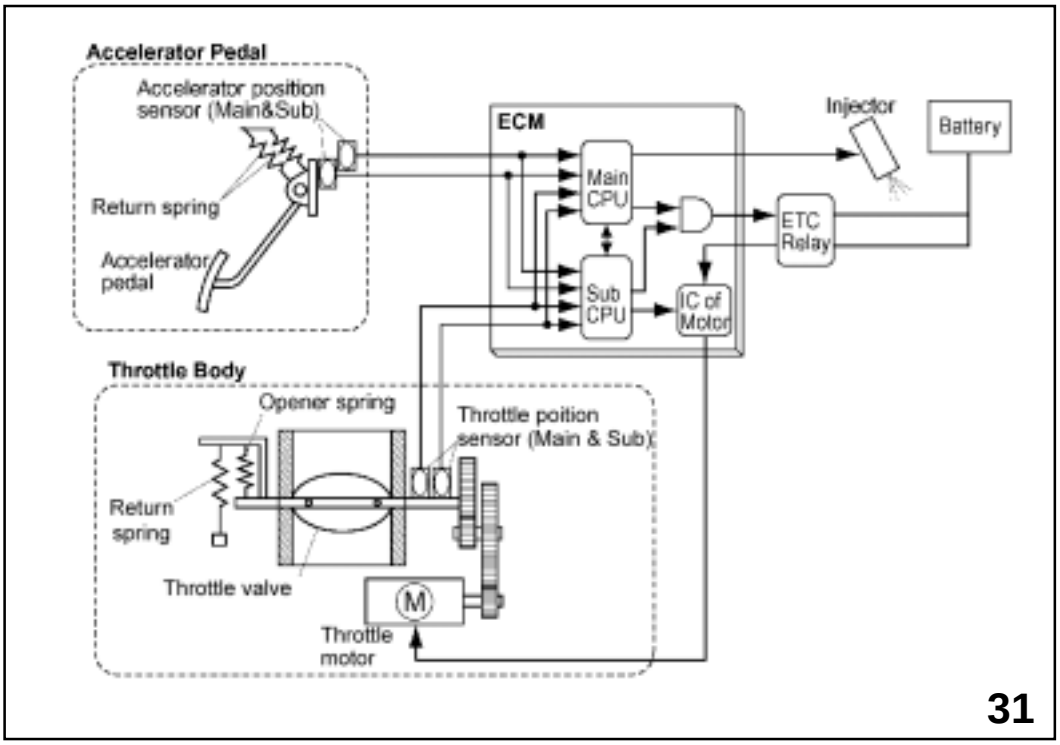


The accelerator position sensor and throttle position sensor are arranged in dual main and sub systems for improved reliability.

The ECM is equipped with two microcomputers, one for the main CPU for electronic control and the other for the sub CPU for the electronic throttle system.

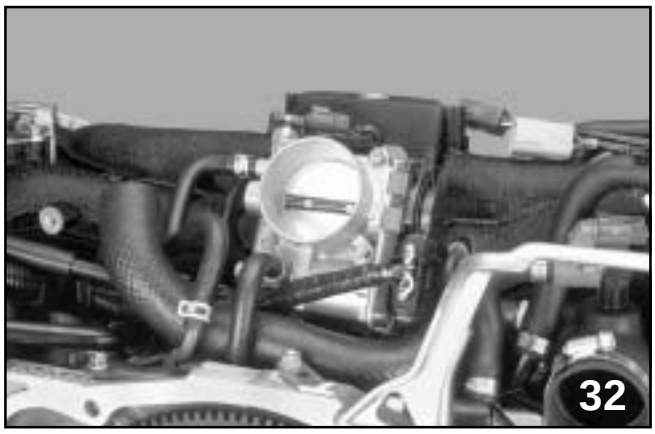
The main CPU computes the target throttle opening from the acceleration position sensor signal, while the sub CPU determines the difference between this target opening and the actual throttle opening, driving the throttle motor accordingly and controlling the throttle opening.

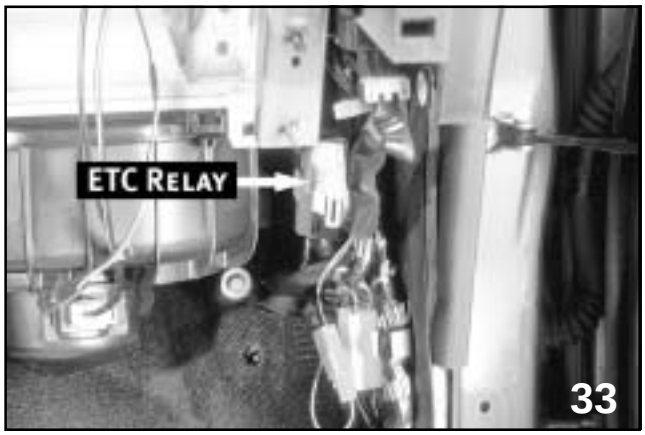
The two CPUs share sensor signals and constantly monitor each other to ensure that their computation results are correct.



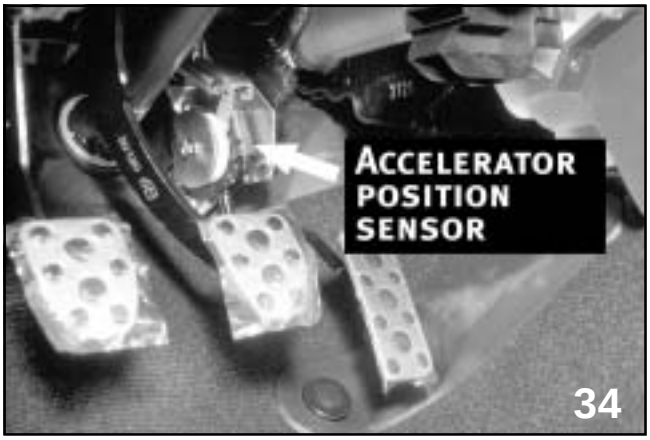
ETC Components

Throttle Body



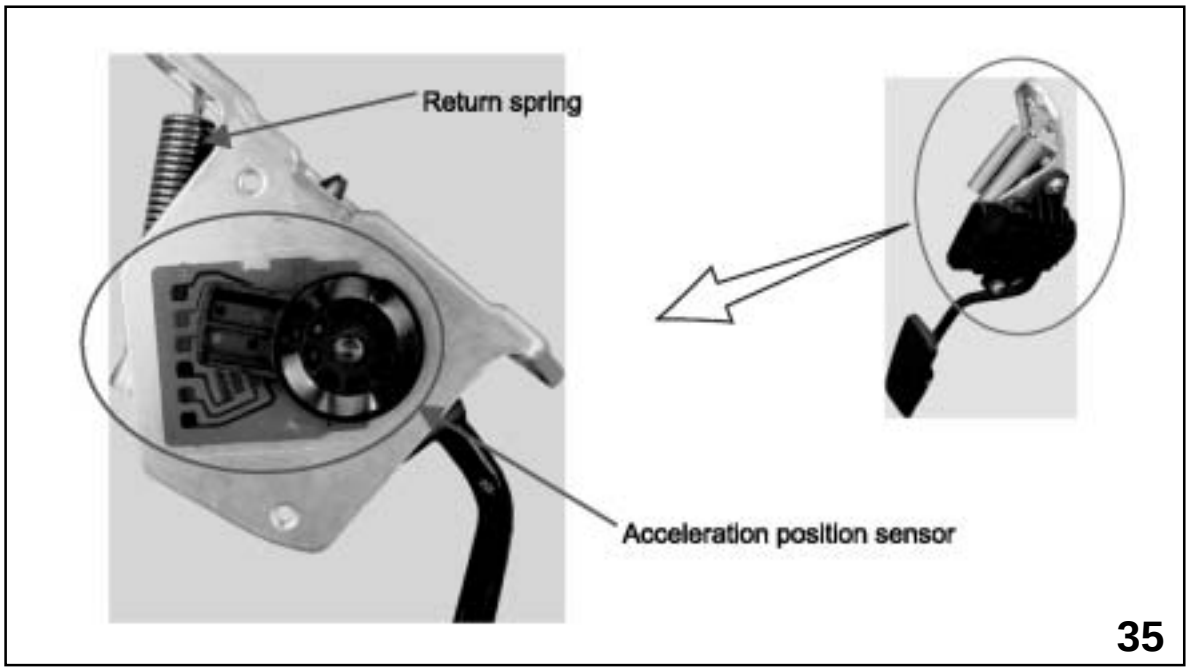


Accelerator Position Sensor



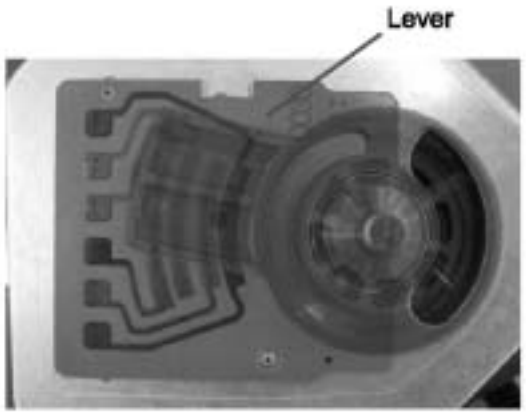
Construction

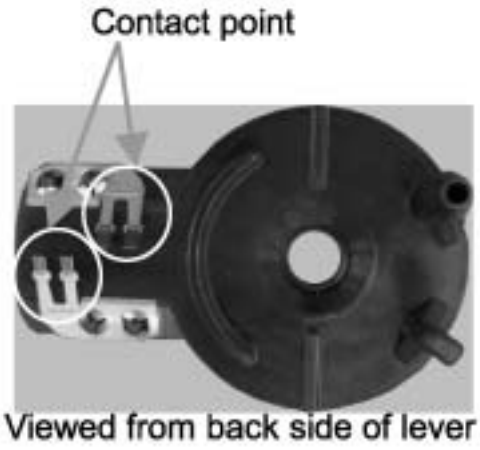
Accelerator Position Sensor



The acceleration position sensor, which is mounted directly on the accelerator pedal without the use of a link, detects the accelerator pedal travel.

The sensor uses two potentiometers (main and sub), forming a dual sensor signal system for improved reliability. When the driver depresses the accelerator pedal, a lever inside the sensor part rotates, moving the contact points on the rear of the lever and changes the voltage.


Lever


Contact point
Viewed from back side of lever

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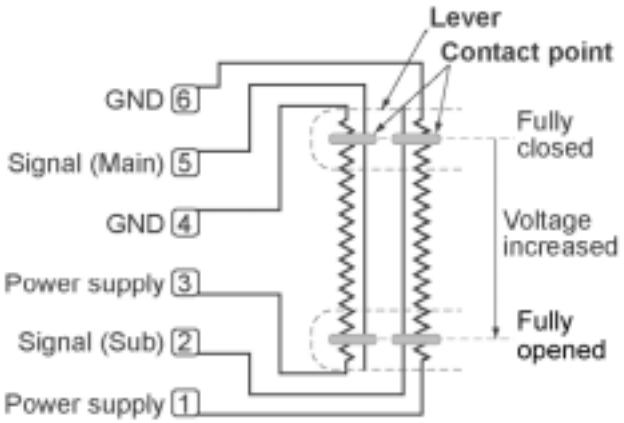
Lever
Contact point
GND 6
Signal (Main) 5
GND 4
Power supply 3
Signal (Sub) 2
Power supply 1
Fully closed
Voltage increased
Fully opened

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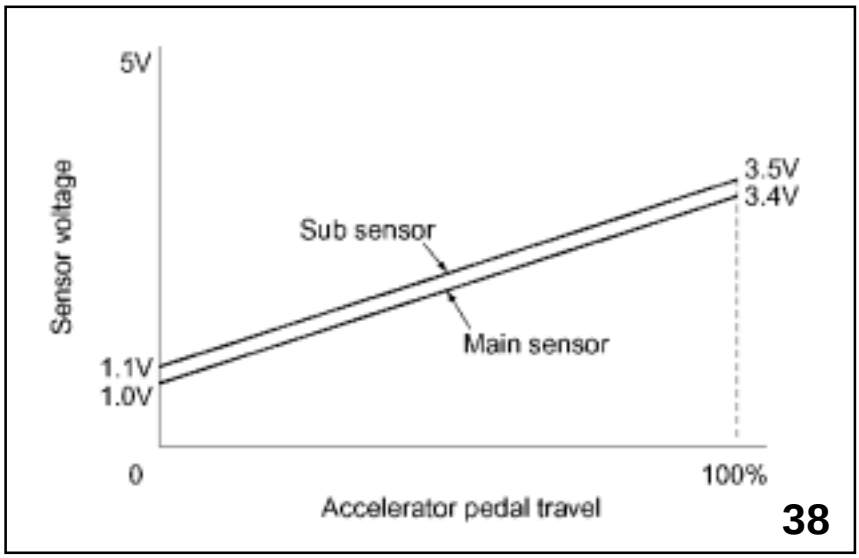
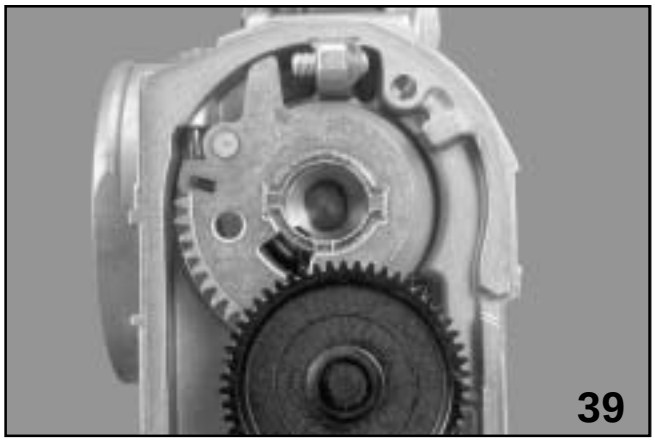
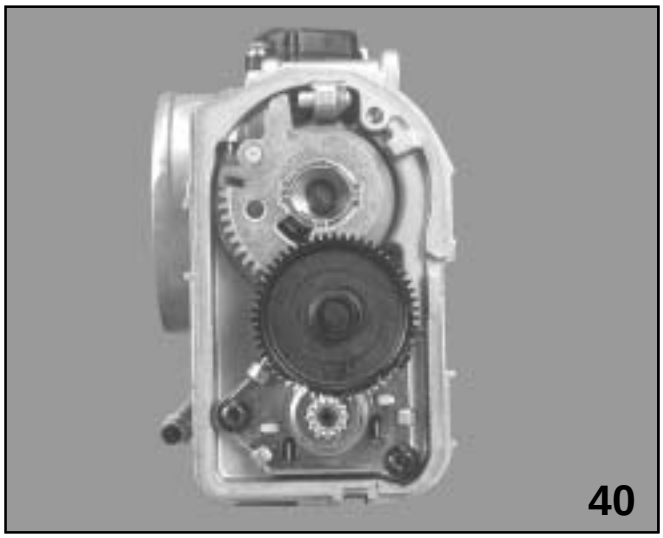


Both the main sensor and the sub sensor vary the voltage in proportion to the accelerator pedal travel. The voltage of the main sensor should be 1.0 volts when the accelerator is fully released and 3.4 volts when fully depressed. The sub sensor voltage range should be 1.1 volts with the pedal released and 3.5 volts fully depressed.

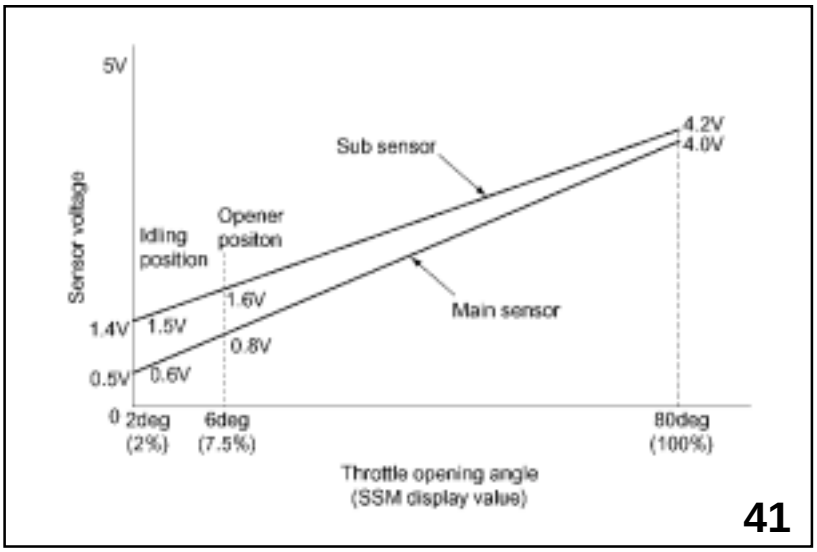




The throttle body is composed of the throttle valve, throttle position sensor, throttle motor, reduction gear, and the opener / return springs.

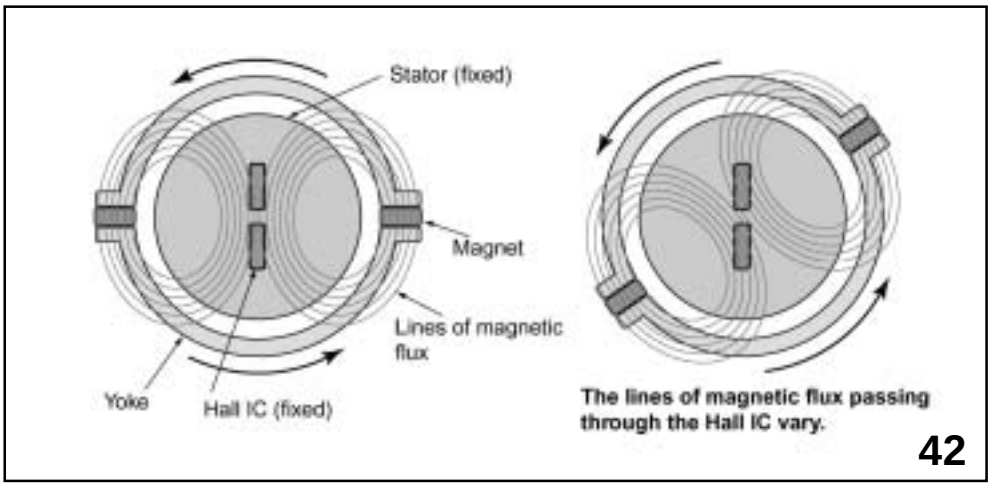
Throttle Position Sensor

The throttle position sensor has two built-in Hall ICs (main and sub) and the sensor signal is a dual system. The main and sub sensors output voltages at different rates of increase.



Valve Opening Detection Principle

The sensor part has two magnets integrated into gear set placed on the outside of a stator in which two Hall ICs (main and sub) are placed.



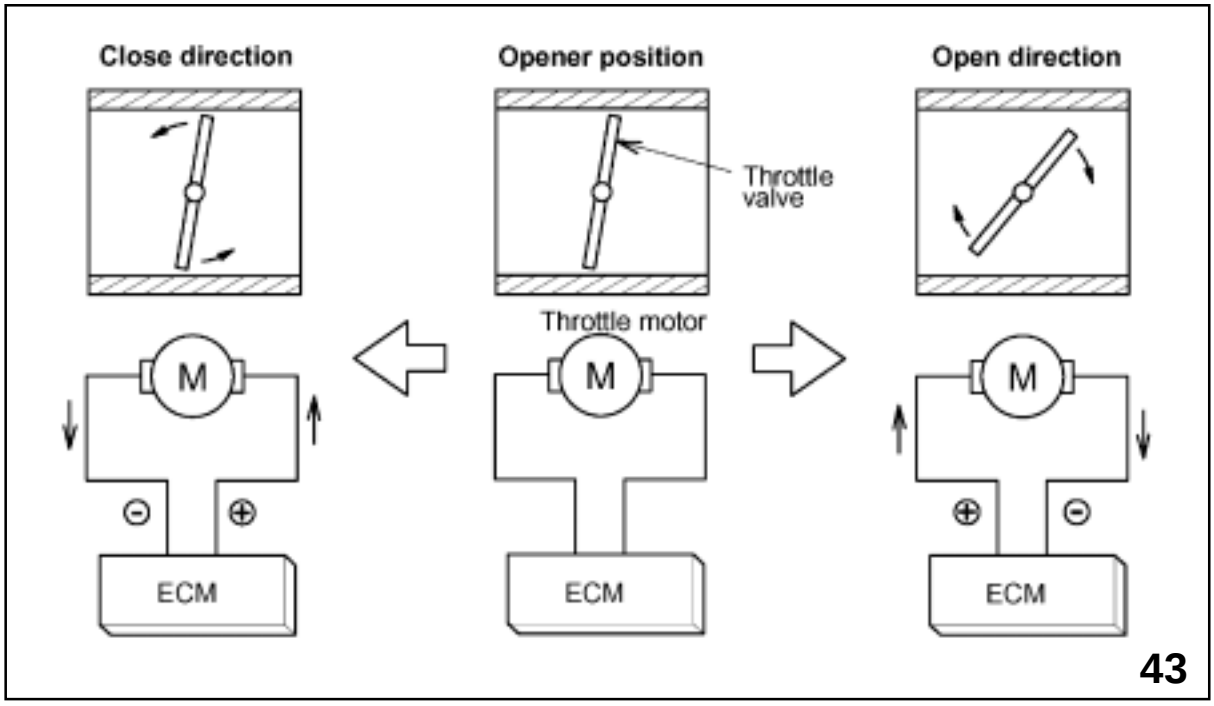
Since the magnet and gear are integrated, they rotate according to changes in the valve opening.

The Hall IC has the property of changing its output voltage according to changes in the number of lines of magnetic flux that pass through it. Therefore, the voltage output from the sensor changes according to the valve opening.

Throttle Motor

The throttle motor, which is driven according to the throttle valve opening determined by the ECM, opens and closes the throttle valve via a reduction gear.

The throttle valve opener position (valve is free with no spring force at work) is used as the reference point to control the throttle valve position in the closing direction and opening direction. Accordingly, the throttle motor controls the valve position by changing the direction of current (+, -) in the circuit in the closing direction and opening direction.

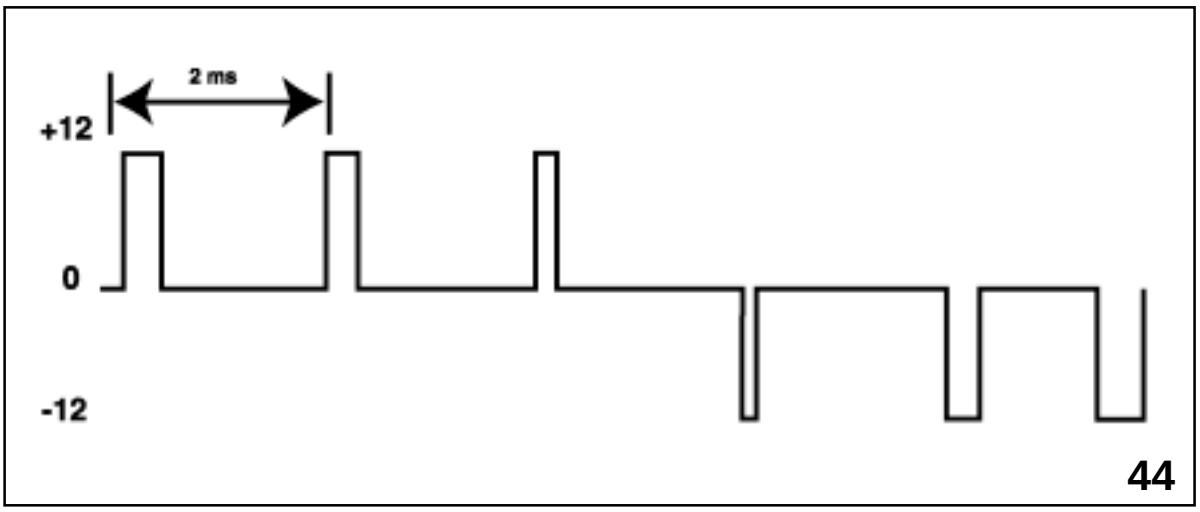


The valve opening/closing speed and the valve position are maintained by controlling the duty ratio. The duty ratio that maintains the valve position is determined by balancing the spring force of the return spring or the opener spring.

ETC Throttle

The ETC throttle body is equipped with two springs. An opener spring and a return spring. The return spring assists with closing the throttle body while the opener spring assists with moving the throttle away from idle. The balance point, the opening of the throttle controlled only by the tension of these two springs is about 1800-2000 RPM on a warm engine.

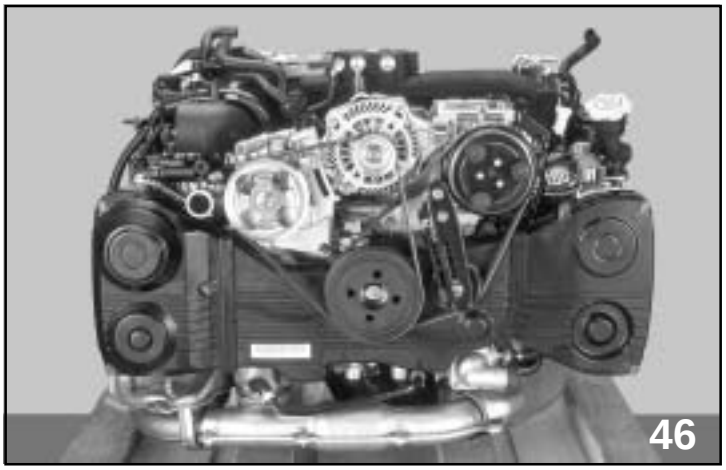
The throttle body is also equipped a motor that precisely controls the movement of the throttle plate by operating from a signal created in the ECM. This signal is positive or negative dependant on the need to increase throttle opening or decrease throttle opening.



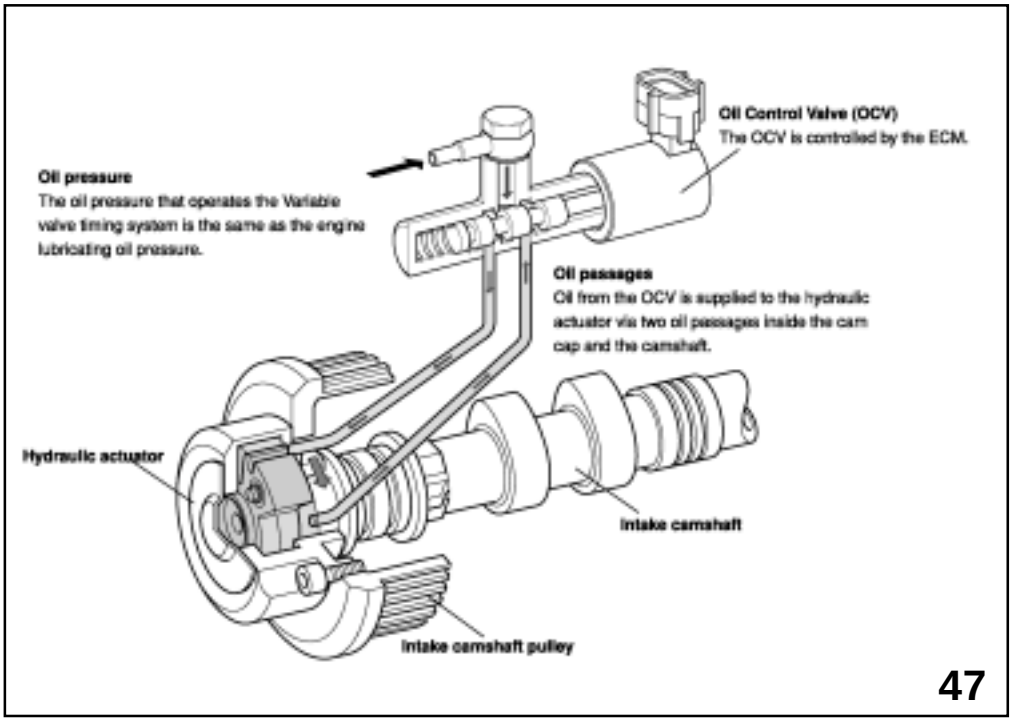
The duty ratio or on time of the signal determines how long the motor operates to increase or decrease throttle opening.

The ECM creates a high duty ratio with a positive signal to maintain normal idle speed. The duty ratio is reduced as the throttle is opened until the balance point is reached (reduces the current to the throttle body motor which is opposing the tension of the opener spring). Moving past the balance point requires that the polarity of the throttle body motor be reversed. The signal from the ECM is now negative with a small duty ratio. As the throttle is closed further the duty ratio is increased (increases the current to the throttle body motor which is opposing the tension of the return spring).

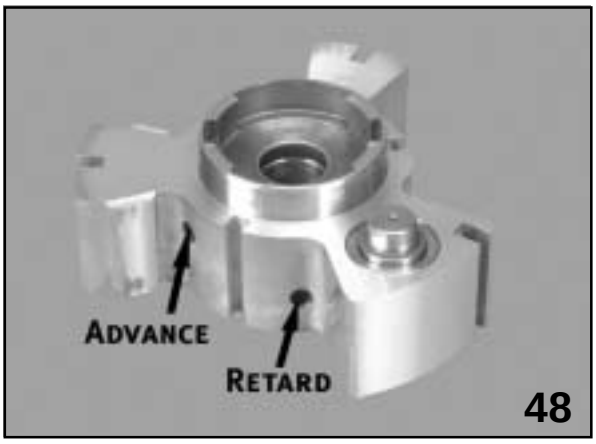
Variable Valve Timing System

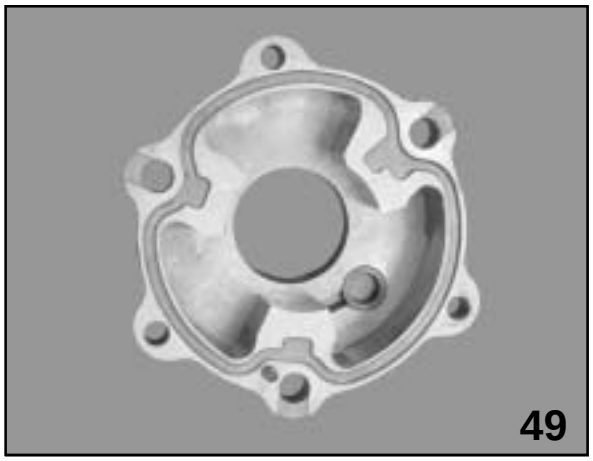


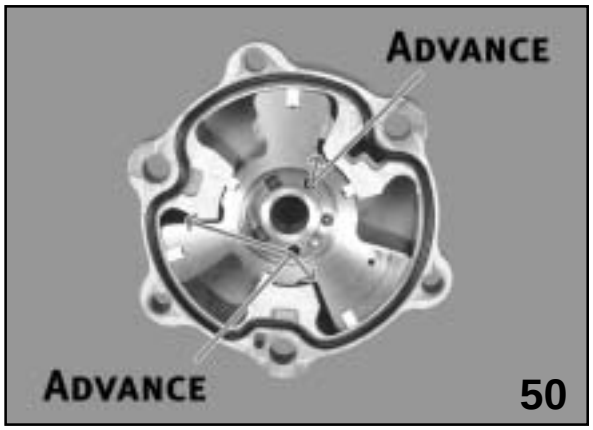
Variable valve timing functions to increase engine power output, improve fuel consumption and decrease exhaust emissions. These benefits are achieved by controlling the opening and closing time of the intake valves. The ECM monitors the engine operating condition and camshaft positions and controls the output duty ratio to oil control valves located on each cylinder head. The oil control valves in turn control the oil pressure to and from each intake camshaft sprocket. This allows the movement of the camshaft within the sprocket, controlling the opening and closing time of the intake valves.



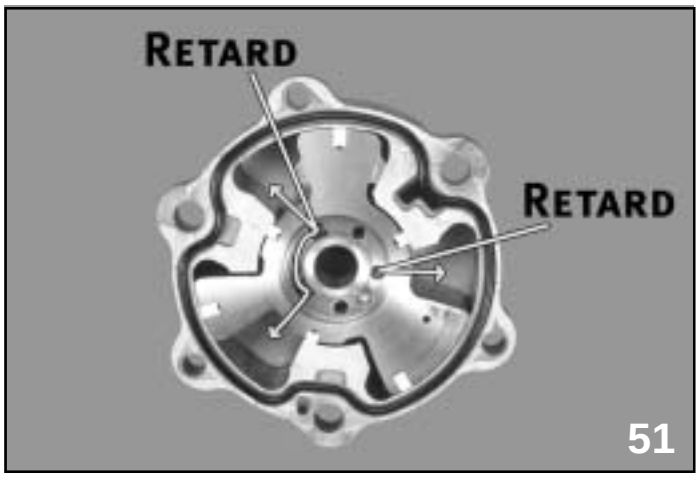
The intake camshaft sprocket is a non serviceable hydraulic actuator consisting of a set of sealing vanes, rotor and a fail-safe lock valve. The camshaft is secured to the rotor with a bolt. The position of the rotor within the camshaft sprocket forms advance and retard chambers. Changing the balance of oil pressure to these chambers moves the rotor to advance or retard the intake camshaft.

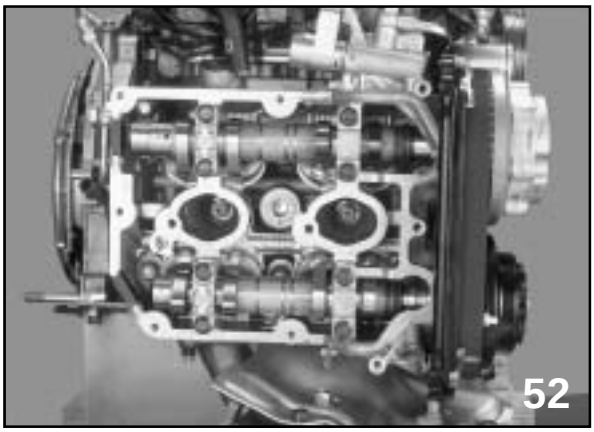


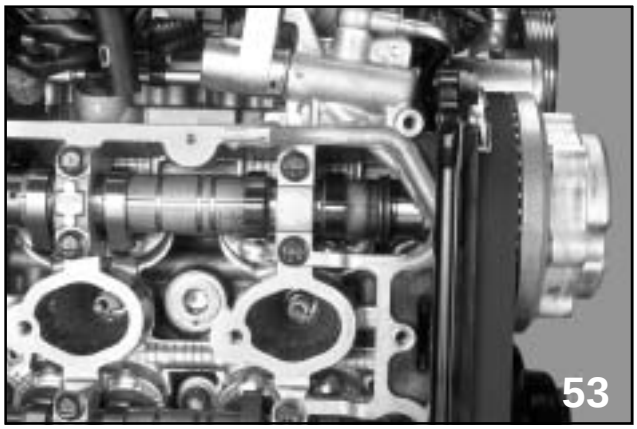




The fail-safe lock valve must operate to mechanically release the rotor from the sprocket before normal variable valve timing operation can begin. The fail-safe lock valve is unlocked by the oil pressure of the engine from the oil control valve when ever the camshaft is advanced and locked in place by the removal of pressure from the advance chamber and spring tension. The purpose of the valve is to allow the camshaft to operate in a preset fixed position in the event of a failure in the oil control valve or related hydraulic circuits. The camshaft position with the fail-safe lock valve seated is at full retard.

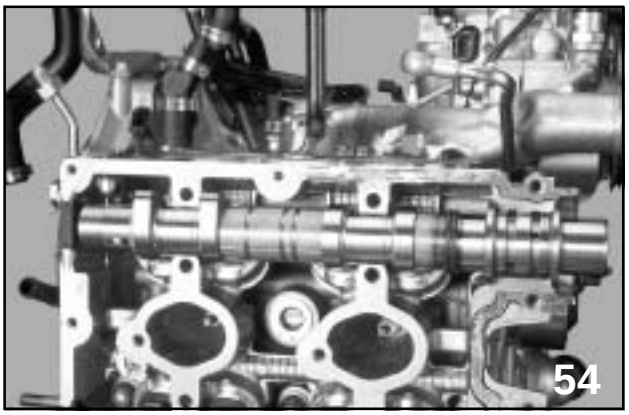


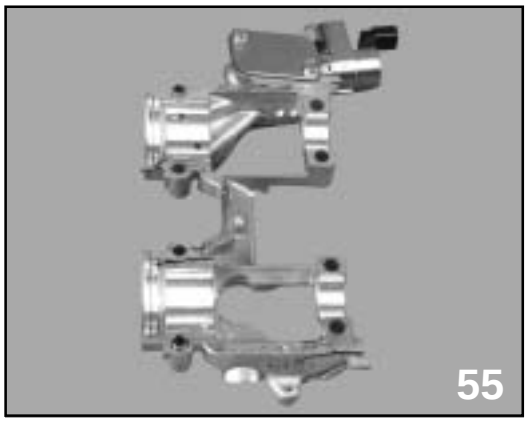




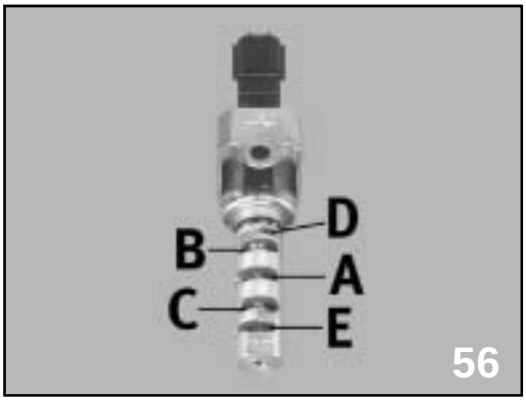
An oil control valve is located on each cylinder head, receiving a common duty ratio signal.

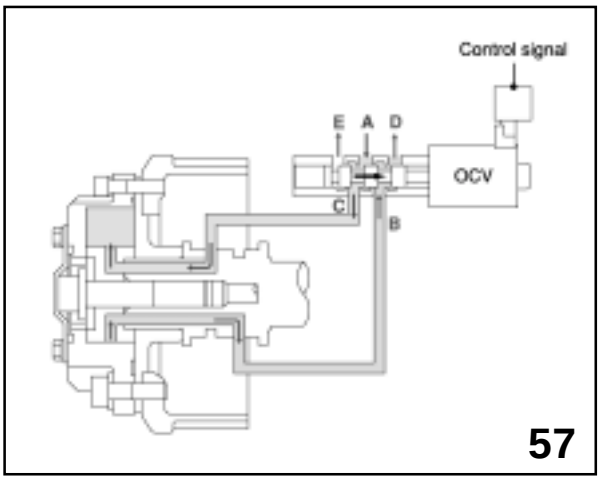
The oil control valve housing and the front camshaft saddle caps are incorporated into one unit.





Passageways in the oil control housing carry oil under pressure to and from the camshaft. The camshaft passageways then carry the oil to and from the camshaft sprocket. The forward passage way is for the advance chambers and the rear passage way is for the retard chambers.



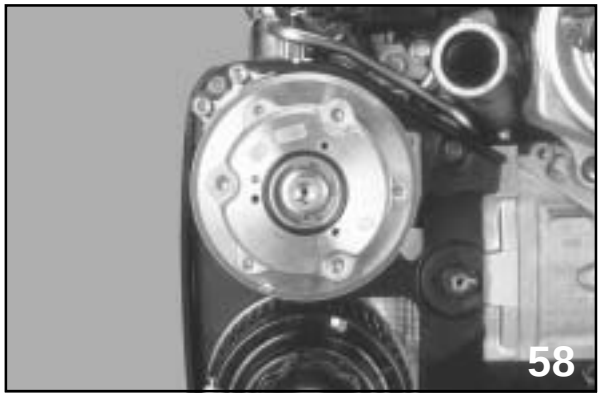


The oil control valve chamber A is oil pressure into the valve. Chamber B provides a passage from the camshaft sprocket to drain D during advance.

Chamber B also provides a passage way to the camshaft sprocket during retard.

Chamber C provides a passage way from the camshaft sprocket to drain E during retard.

Chamber C also provides a passage way to the camshaft sprocket during advance.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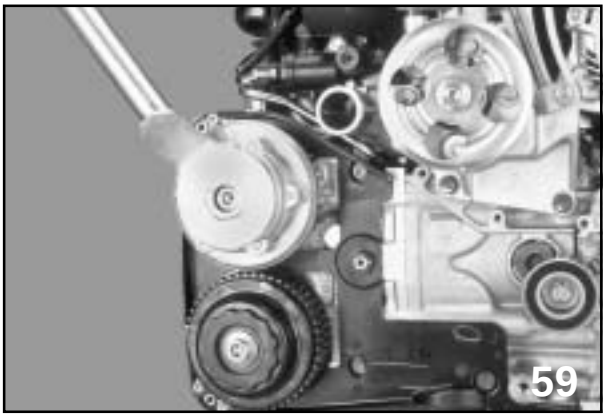
59

Access to the intake camshaft bolt is obtained after removing the end cap. The bolt is hollow to allow oil to enter the front of the camshaft sprocket to lubricate the area where the rotor and the camshaft sprocket rotate against each other. Be certain to properly position the o-ring when reinstalling the end cap.

Special tool 499977500 wrench is used to hold the camshaft sprocket while the bolt is being removed or installed.


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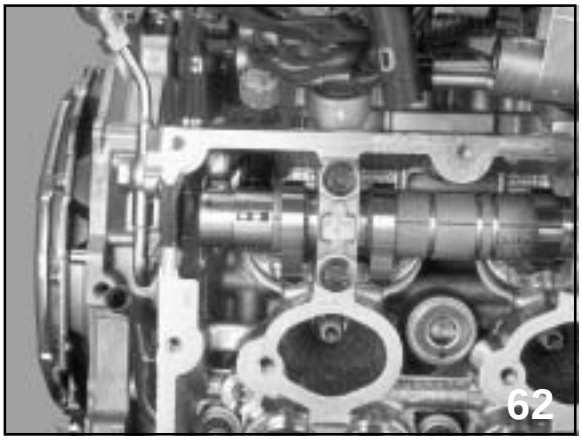
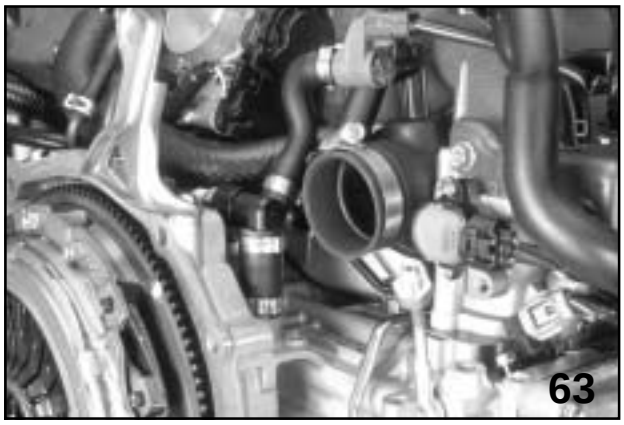
The shape of the wrench is made to match the shape made into the sprocket.

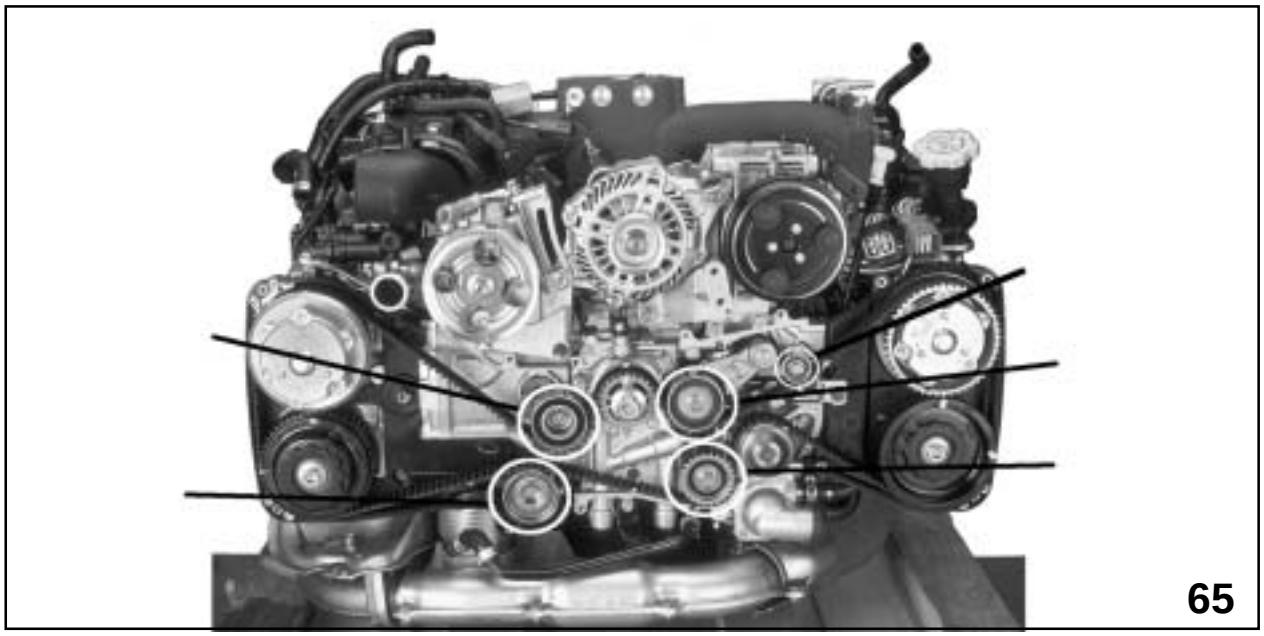
The intake camshaft bolt on each intake camshaft is hollow. Exhaust camshaft bolts are solid. Do not mix them up as the intake sprocket will be damaged from lack of lubrication.





A Hall effect camshaft sensor is used on the rear of each camshaft. These sensors are used to control the variable valve timing and to also provide camshaft information for ignition and fuel control.

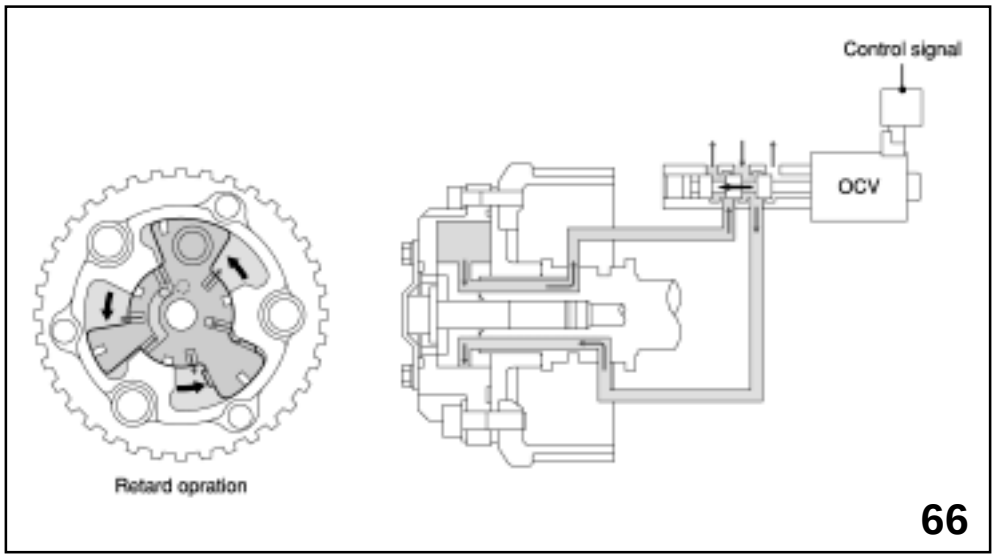
The oil supply for the passenger side oil control valve is shared with the turbo charger. The driver side oil control valve receives oil from a pipe from the front of the cylinder head.



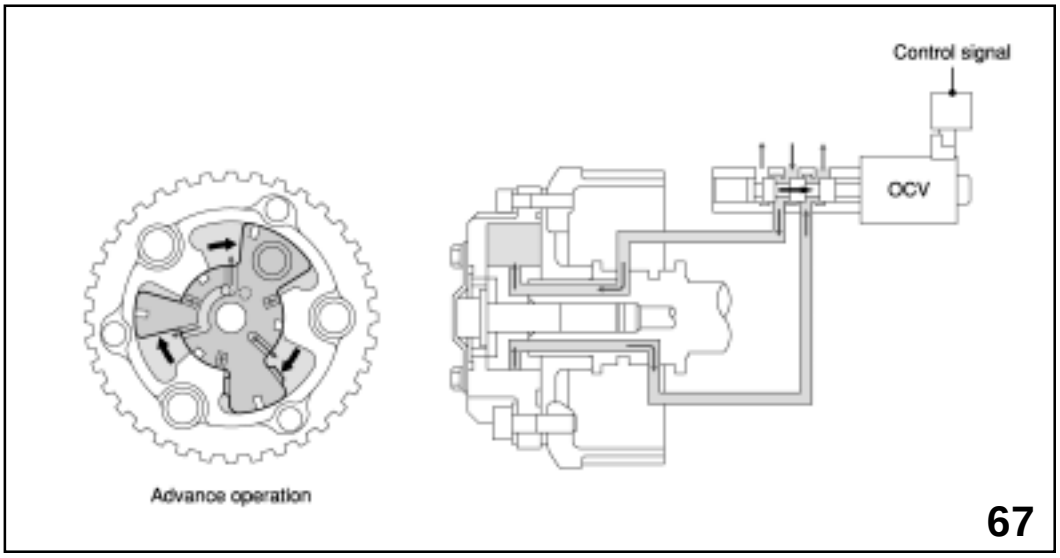
Proper timing belt configuration and pulley color identification.

Operation

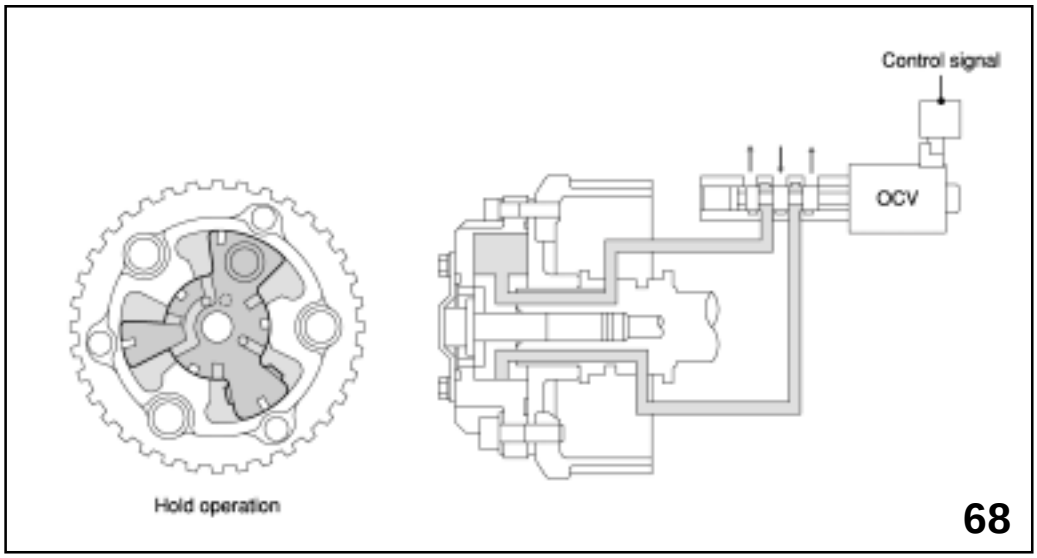
Variable Valve Timing



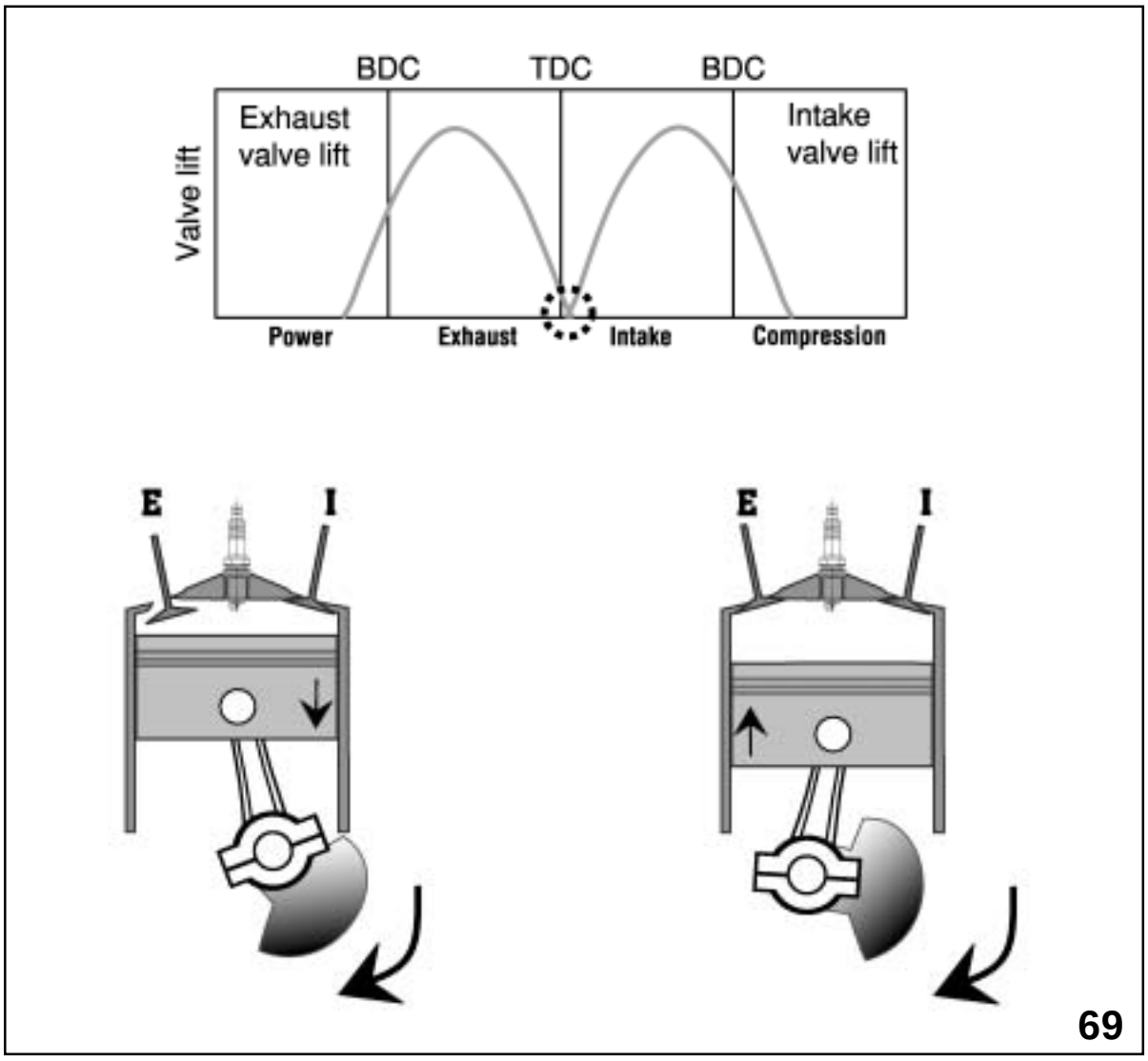
The oil control valve duty ratio during the time the camshaft is being retarded is low. This will affect the balance of pressure against the rotor to move the rotor in the opposite direction of engine rotation. This will retard the opening and closing of the intake valves as compared to the exhaust valves and crankshaft position.



The oil control valve duty ratio during the time the camshaft is being advanced is high. This will affect the balance of pressure against the rotor to rotate the rotor in the same direction of engine rotation. This will advance the opening and closing of the intake valves as compared to the exhaust valves and crankshaft position.



The oil control valve duty ratio during the time the camshaft is being held is a certain valve. The two ports connected to the hydraulic actuator are closed by the valve, sealing the oil in the retard and advance chambers. This will maintain the balance of pressure against the rotor so that the camshaft is neither advanced or retarded as compared to the exhaust valves and crankshaft position.

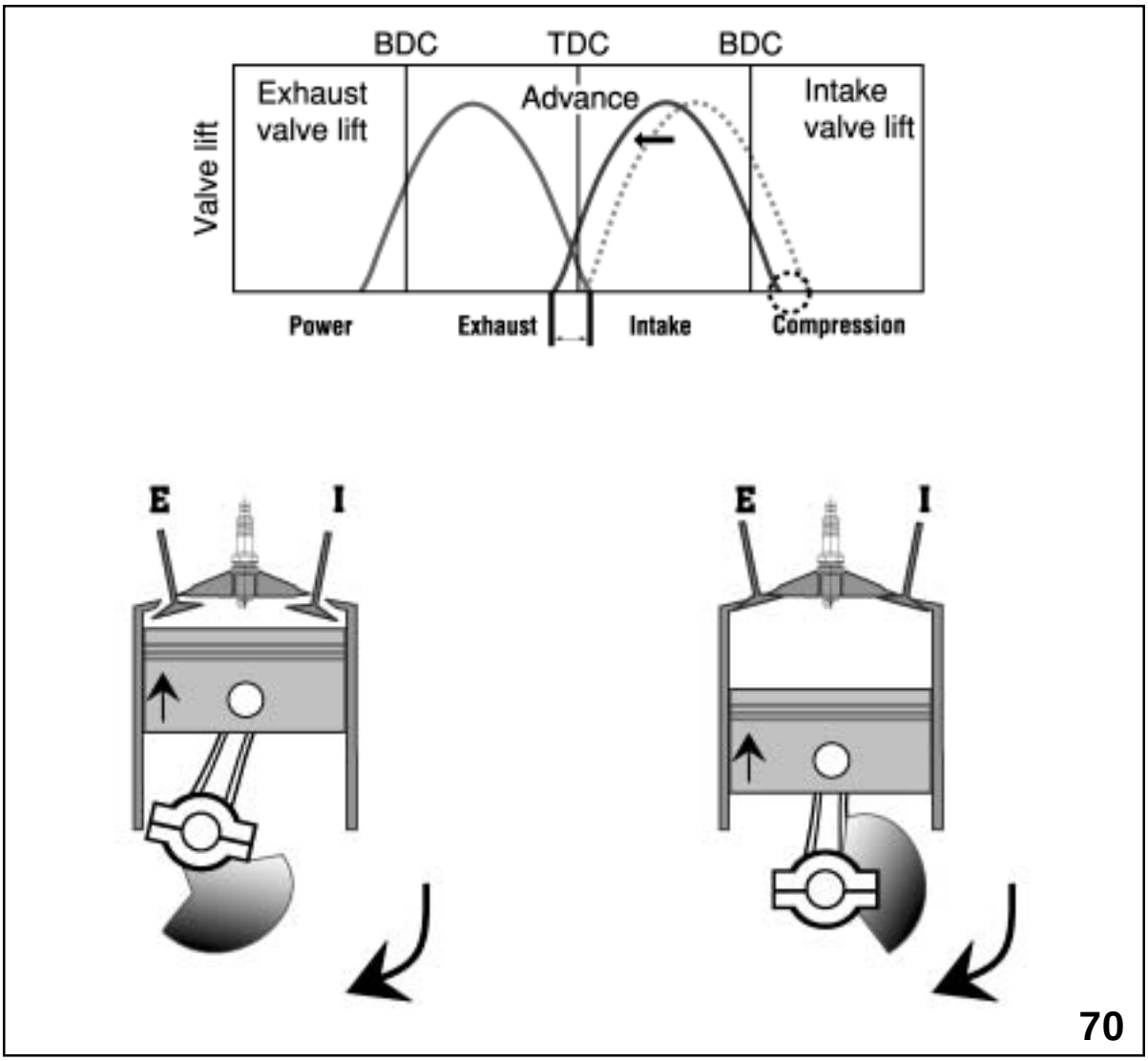


End of Exhaust stroke
Beginning of intake stroke

Moving up on compression stroke

At idle the intake valves are timed to open a few degrees after TDC of the exhaust stroke. This takes advantage of the large volume of negative pressure created by the exhaust stroke and the positive pressure consisting of air/ fuel mixture now more efficiently fills the cylinder. The exhaust valves will remain open a few degrees down on the intake stroke.

Air/Fuel mixture will continue to fill the cylinder until a few degrees up on the compression stroke, Minimizing the air that goes back into the intake manifold.

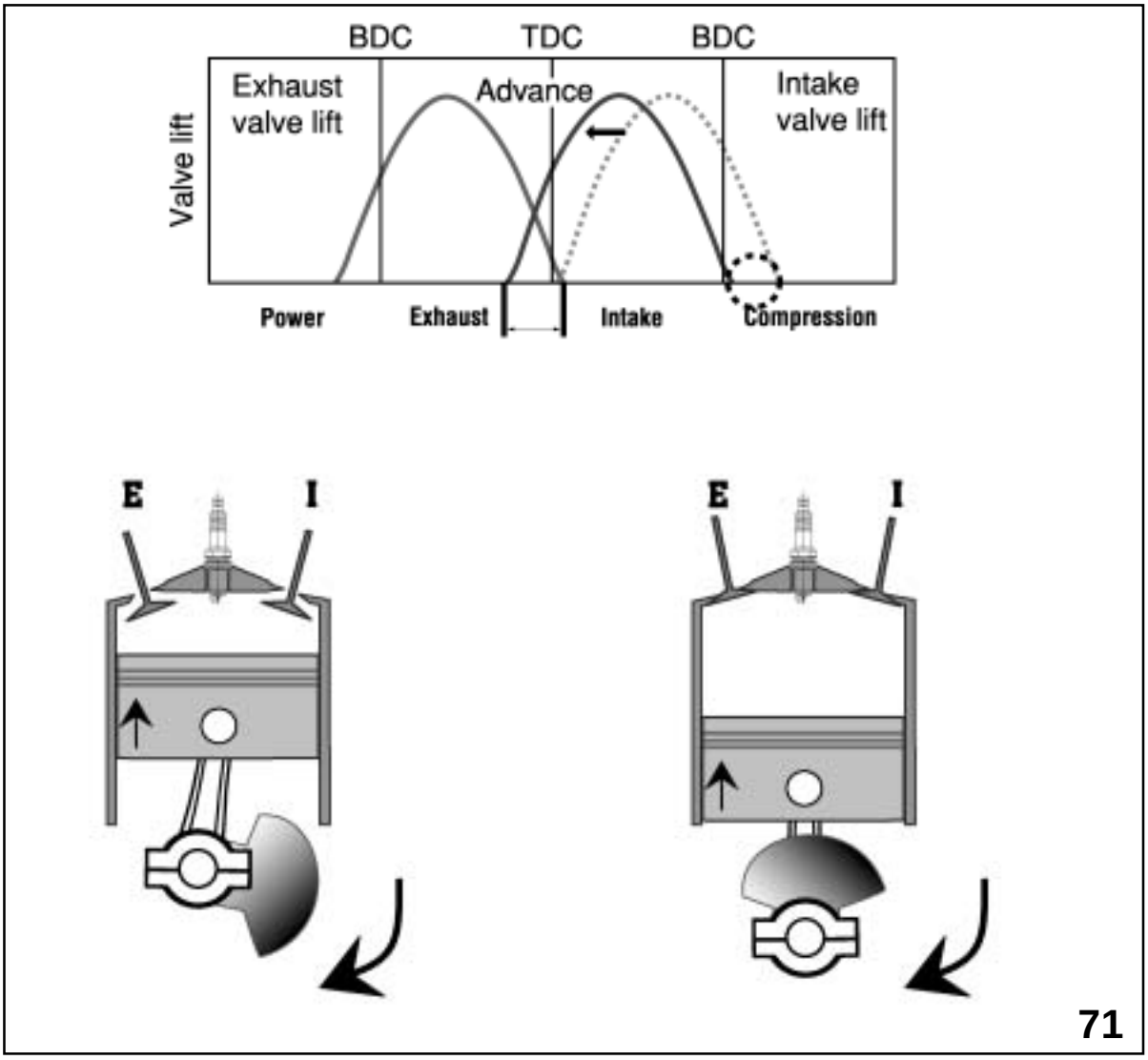


Near the end of exhaust *Moving up on compression stroke*

During small to medium engine load operating conditions the intake valves are opened sooner. This advanced setting allows some of the pressure created during the exhaust stroke to flow back into the intake manifold, creating and EGR effect.

This helps reduce the creation of Nox. As the engine load increases the pressure inside the manifold becomes higher than that of the cylinder on exhaust stroke, eliminating the EGR affect.

The intake valves are closed sooner on the compression stroke improving volumetric efficiency.

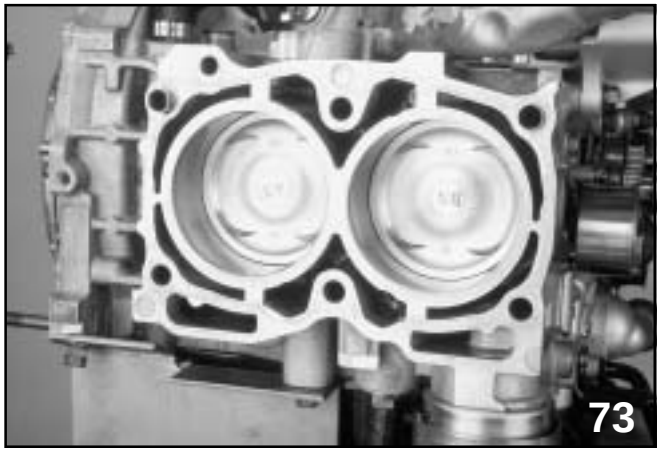


Moving up on exhaust stroke *Near the beginning of compression stroke*

During heavy engine load operating conditions the intake valves are opened sooner. This produces a scavenging effect to clear the cylinder of exhaust gas.

Closing the intake valves sooner on the compression stroke further increases the volumetric efficiency and assists with generating high engine power output.

Engine



The 2.5 liter DOHC turbo engine for the WRX STi is designed with a semi-closed type cylinder block. This provides stronger holding of the cylinder liners and improves the gas sealing characteristics between the cylinder block and cylinder head. The cylinder block itself has a cast in reinforcement above the number 5 main shaft journal that improves strength and noise control.

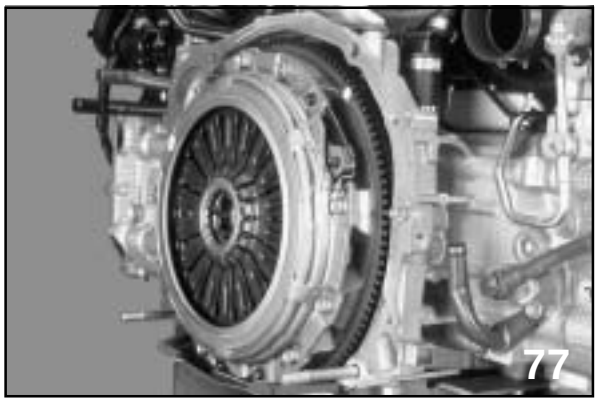
The exhaust valves are sodium filled to improve heat transfer. **Do not resurface exhaust valves. Dispose of discarded valves in accordance with regulations in your area**.
The intake valve is hollow to reduce reciprocating weight.

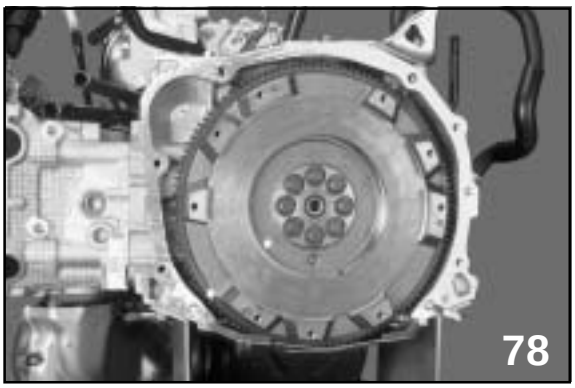
Valve clearance is adjusted by replacing the selective shim less valve lifter.

Spark plugs are made with an Iridium center electrode to improve performance.

Additional changes include reshaping of the oil pan, to prevent aeration on turns, and the shape of the piston top to control compression ratio.

The lower radiator cap contains only a pressure relief. The upper coolant system cap contains both a vacuum relief and a pressure relief. The lower radiator will open to pressure at 137+_14.7 kPa. The upper coolant system cap opens to pressure at 108+-15 kPa and under vacuum at -1.0 to -4.9kPa.

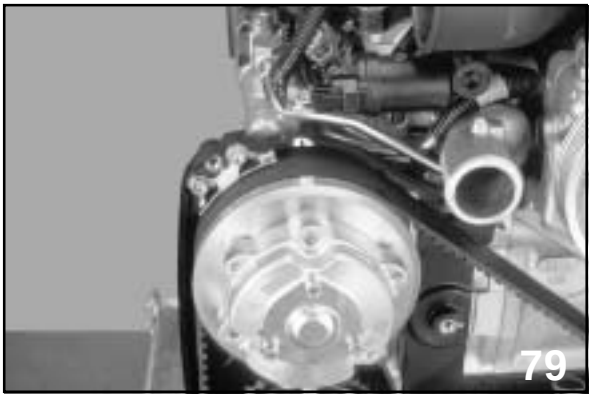




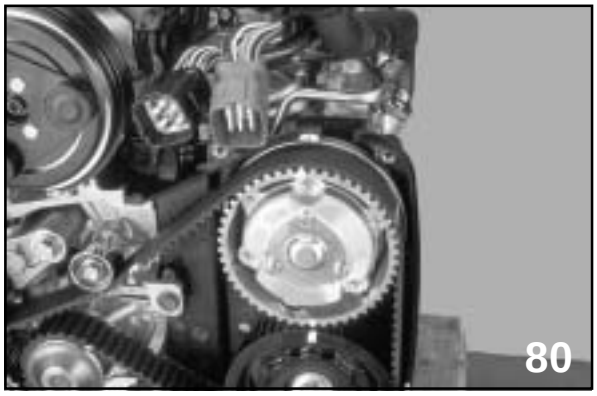
The flywheel is larger and lighter. The clutch is a hydraulic pull type with a clutch disc of 240 mm.

Position the two heavy marks of the flywheel and pressure plate at least 120 degrees apart upon reassembly.

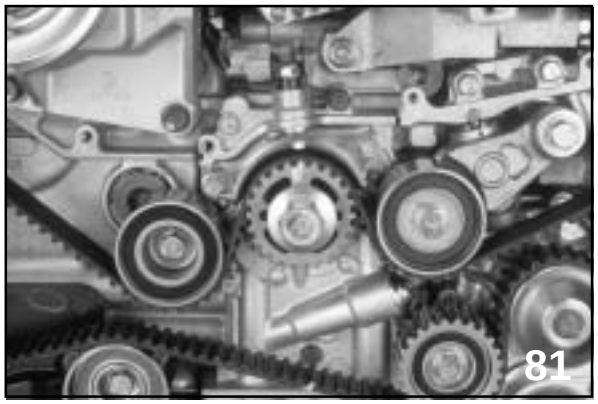
Timing Belt Timing Marks



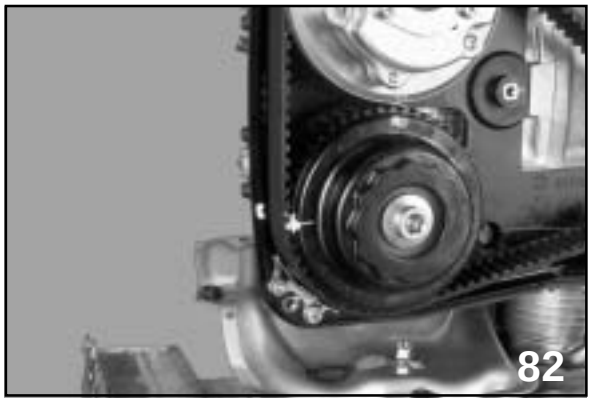
Passenger side intake camshaft



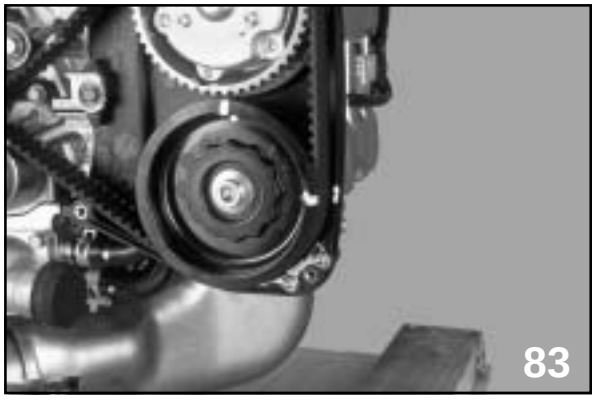
Driver side intake camshaft



Crank shaft



Passenger side exhaust camshaft



Driver side exhaust camshaft

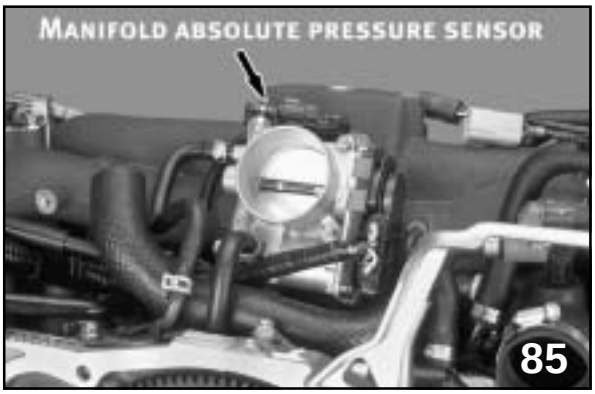
WRX STi Emission Control

Input signals

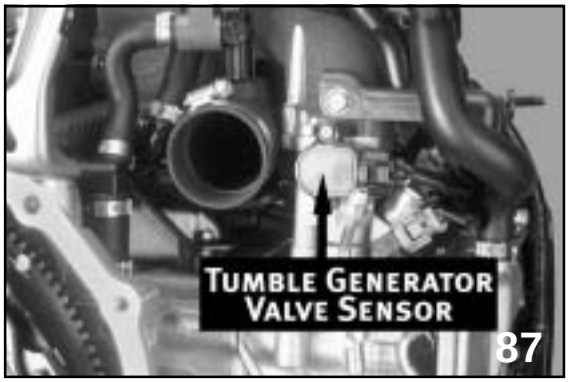
Manifold absolute pressure sensor
Mass Air Flow and Intake air temperature sensor
Throttle position sensor
Front oxygen sensor
Rear oxygen sensor
Tumble generator Valve Position Sensor
Crank shaft position sensor
Camshaft position sensor
Engine coolant temperature sensor
Knock Sensor
Vehicle speed sensor
Ignition switch
Starter Switch
Neutral position switch
Heater Circuit of front and rear oxygen sensors
A/C switch
Fuel level sensor
Fuel temperature sensor
Fuel tank pressure senor
Small light switch
Blower fan switch
Rear defogger switch

Output signals

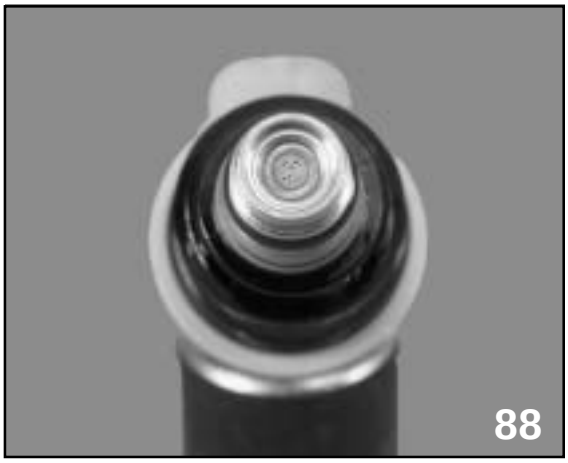
Fuel injectors
Ignition signal
Fuel pump control unit
A/C control relay
Radiator fan control relay
Waste gate control solenoid
Tumble generator valve actuator
Engine malfunction indicator light
Purge control solenoid
Pressure control solenoid valve
Drain valve
Power supply

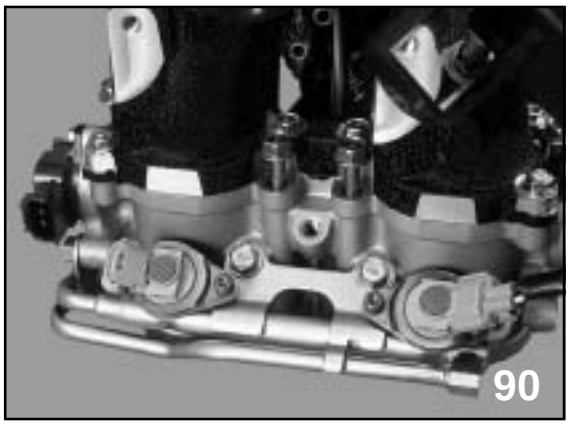

MANIFOLD ABSOLUTE PRESSURE SENSOR
85


MASS AIR FLOW
AND INTAKE AIR
TEMPERATURE SENSOR
86


TUMBLE GENERATOR
VALVE SENSOR
87

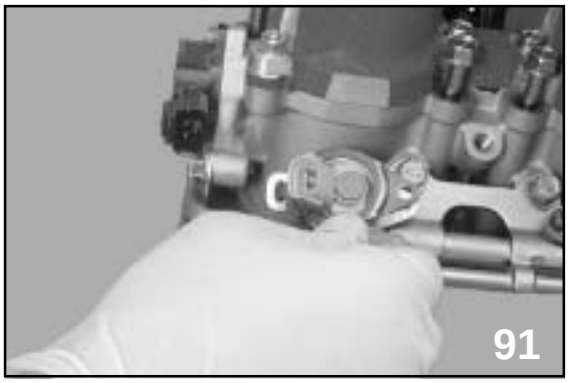
Fuel Injector





The injectors are classified as side feed type. The multi hole nozzle makes it possible for the injector to produce fine fuel particles which enhances the combustion efficiency and output performance of the engine.

The low profile shape of the injectors provides crash protection and eliminates the need for additional injector guards or covers.



The injectors are secured to the injector rail with a T-25 bolt and notched retaining ring.
Removal of the injector is accomplished by removing the bolt and lifting the retaining ring from the notch in the rail.

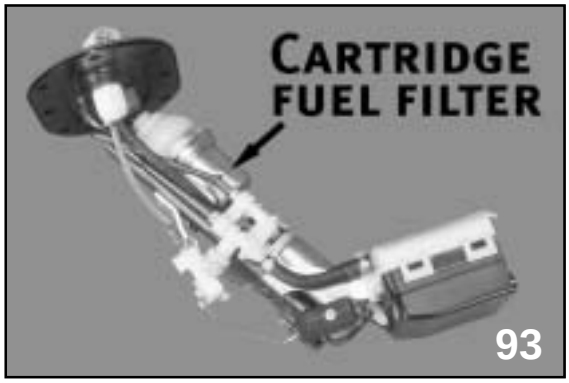
CAUTION: BE CERTAIN TO RELIEVE THE FUEL PRESSURE ACCORDING TO THE APPROPRIATE SERVICE MANUAL BEFORE REMOVING THE INJECTOR.

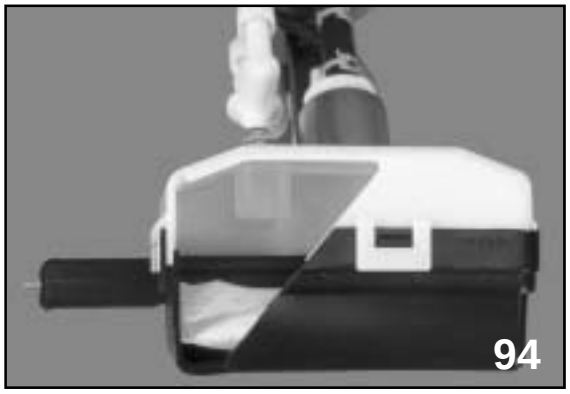
A Positive Crankcase Ventilation system connector is installed on the WRX STi. This connector is used to detect an open hose by simply opening the circuit from the ECM that monitors the connector. The electronic construction of the connector is a shorting loop built inside the connector. When the connector is moved away from its corresponding connector (carrying the PCV hose with it) the ECM detects the opening and triggers the Diagnostic Trouble code.

Fuel Pump

The fuel pump for the WRX STi is equipped with two filters. The mesh filter located at the inlet side of the pump can remove large particles from the fuel before it goes into the pump. The second filter is a cartridge type that filters the smaller particles from the fuel before the fuel is delivered to the injectors. This filter is recommended for replacement every 60,000 miles and according to the maintenance schedule.
Follow: The instructions provided in the appropriate service manual on pump and filter.

The mesh filter housing is designed to hold enough fuel to prevent aeration on turns during vehicle operation with lower fuel levels.





Intercooler Water Spray

The intercooler of the WRX STi is 470 mm by 168.5 mm. Air from the hood scoop is directed over and through the intercooler decreasing intake the air temperature. This allows for improved volumetric efficiency and more advanced ignition timing. To further increase efficiency of the intercooler an intercooler water spray has been added to the vehicle. A water spray nozzle is mounted to the bottom of the hood scoop that when activated sprays water in a pattern to cover the full width of the intercooler. This will assist with providing additional cooling of the intake air temperature as the water is pushed through the intercooler cooling fins by the air from the hood scoop.

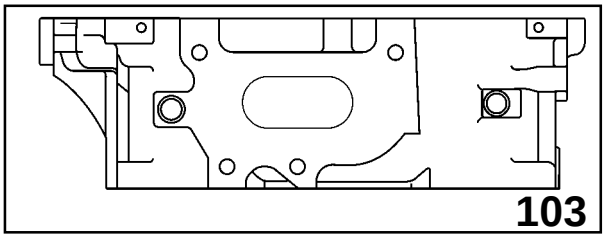
The I/C water spray button is mounted to the drivers left near the head light leveler control. When activated the button sends a signal to the I/C water spray timer. The timer is located on the A pillar post behind the glove box.

The timer will send a 2 second signal to the I/C water pump. The pump is located in the side of the I/C water tank, located in the trunk. The tank holds about one gallon of water. Do not fill the water tank more than 50% during times of low ambient temperature where freezing conditions are expected or damage to the tank will occur. A warning light on the combination meter will illuminate when the water level in the tank becomes low.

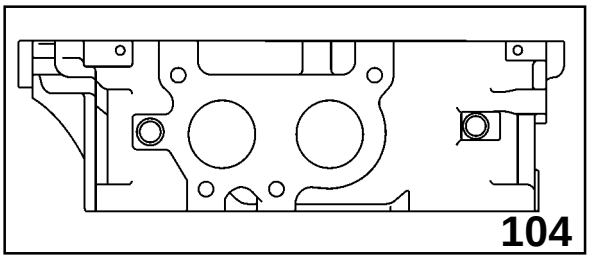
Partial Zero Emission Vehicle (PZEV)

A Partial Zero Emission Vehicle (PZEV) has been designed for sale in California, Maine, Massachusetts, New York and Vermont. The vehicle is equipped with a 2.5 NA engine with an Emission warranty for 15 years or 150,000 miles.

There are two major engine changes for the PZEV which are the design of the cylinder head and the pistons.

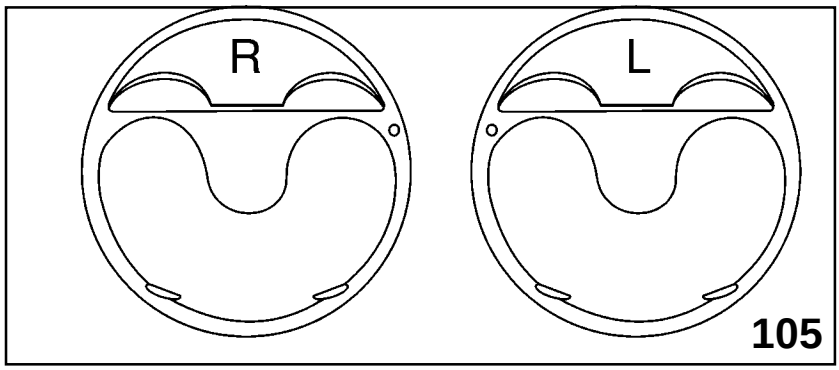


PZEV

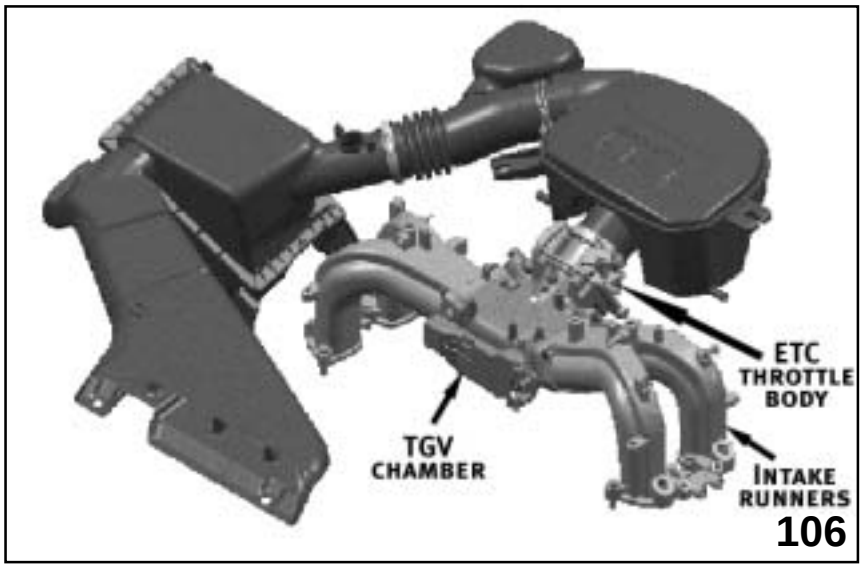


Federal

The cylinder head exhaust ports have been unified to a single port to promote faster warming of the catalyst.

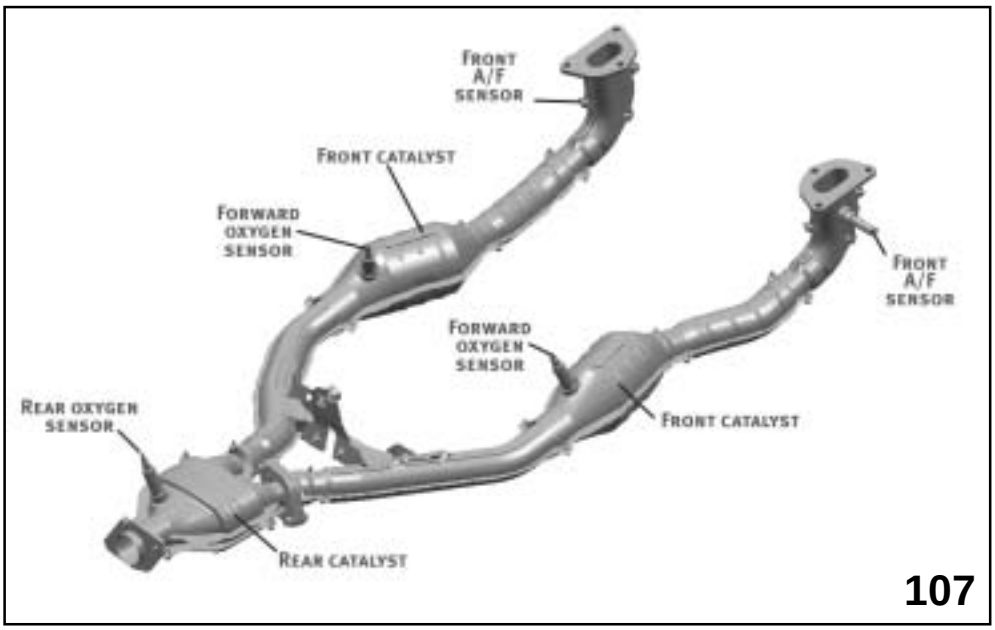


The piston design assists with better mixing of the air/fuel mixture before combustion.



The three piece intake manifold contains a center TGV chamber with intake runners bolted to each side. The TGV chamber contains all components of the TGV system. The motors and sensors can be serviced separately from the chamber.

The PZEV is equipped with ETC, which incorporates cruise control.



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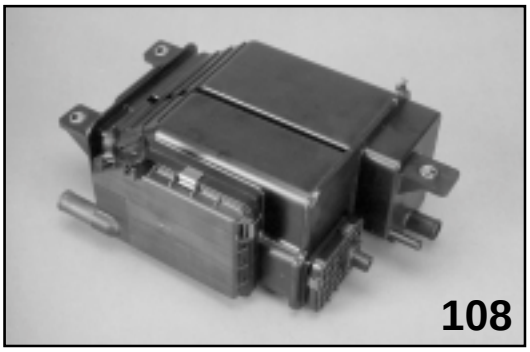
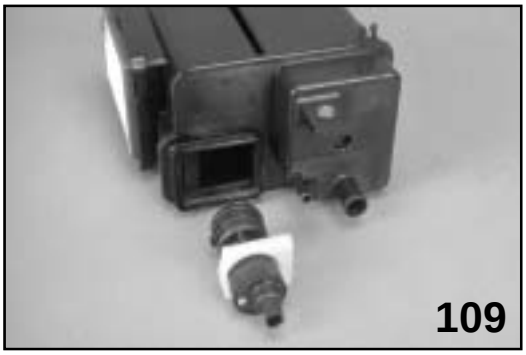
The exhaust system for the PZEV is equipped with an A/F sensors near the exhaust inlet on each side of the engine, two front catalysts, with an oxygen sensor at the rear of each catalyst and the rear catalyst. An oxygen sensor is located at the rear of the rear catalyst.

The front A/F sensors are used to produce main feed back for each side of the engine. Catalyst efficiency (front only) is judged from information from the front A/F and the forward Oxygen sensor for each catalyst.

The rear most Oxygen sensor monitors the total A/F feedback for proper operation.

A new evaporative cannister is installed with a built in drain valve, and filter.


108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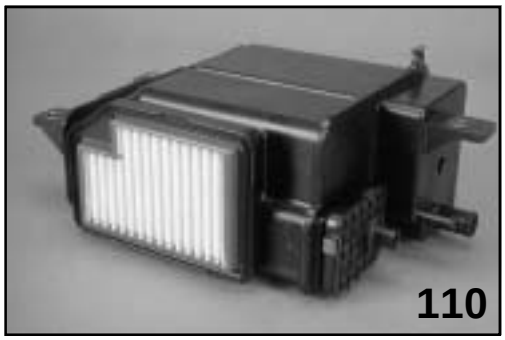
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6 Speed Manual Transmission

Outline

The new AWD 6 Speed manual transmission is equipped with the following features:

- 1st, 3rd, and reverse gears are equipped with a double synchronizer.
- 2nd gear is equipped with a triple synchronizer.
- Reverse gear is a constant-mesh type that ensures smooth shift lever operation, and a scissors gear is used in the reverse idler gear to reduce gear noise.
- A parallel-link type select return system is used to shorten the shift lever stroke.
- A slider ring is equipped below the shift knob to prevent accidental shifting into reverse gear.
- The lubricating system is equipped with an oil pump.
- A LSD front differential Cam type
- The center differential is Driver Controlled Center Differential (DCCD)

Specification

Specification table

Type			6-forward speeds and 1 reverse
Transmission gear ratio		1st	3.636
		2nd	2.375
		3rd	1.761
		4th	1.346
		5th	1.062
		6th	0.842
		Reverse	3.545
Front reduction gear	Final	Type of gear	Hypoid
		Gear ratio	3.900
Rear reduction gear	Transfer	Type of gear	Helical
		Gear ratio	1.000
	Final	Type of gear	Hypoid
		Gear ratio	3.900
Front differential			Cam Type
Center differential			DCCD
Transmission gear oil			GL-5
Transmission gear oil capacity			4.1ℓ

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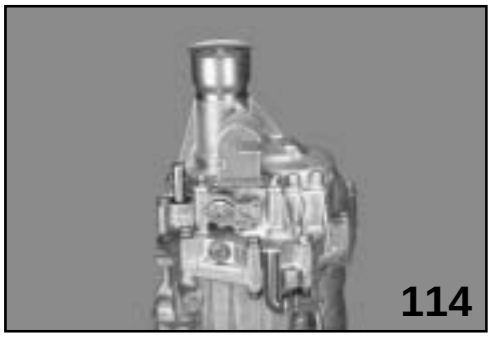
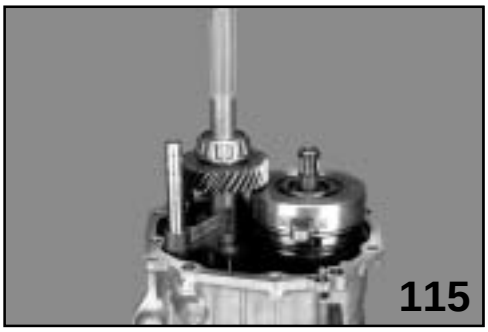
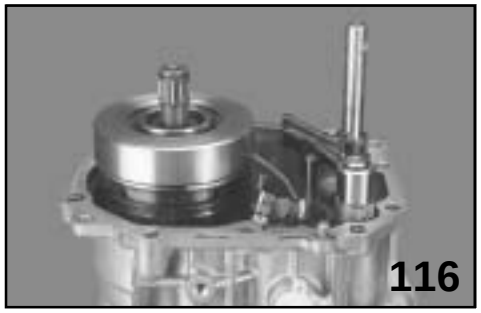
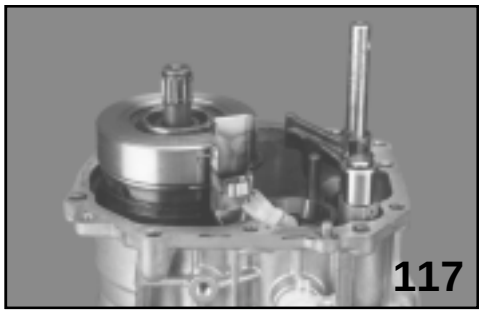
Transmission Overview Construction



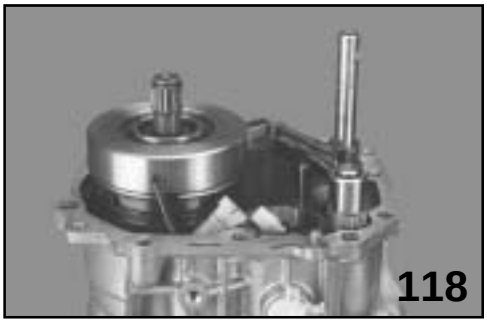


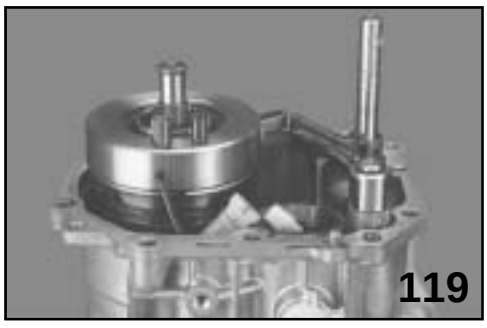
1. Remove the bolts securing the extension case to the transmission main case. Separate the extension case with care from the transmission main case.
2. Note the location of the exposed components.



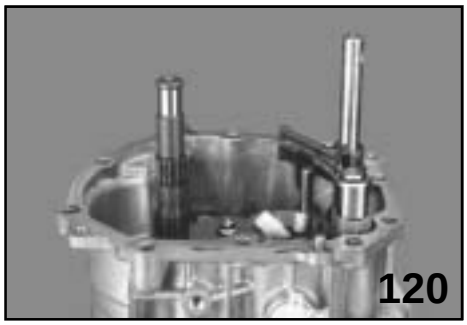


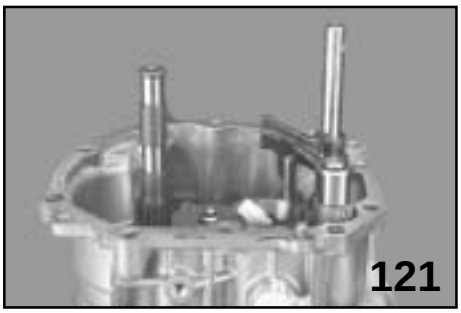
3. Remove the transfer driven gear assembly by lifting the assembly by hand.
4. Pull upward on the oil guide and position the connector so that it can be disconnected. Remove the oil guide and disconnect the connector of the Drive controlled center differential.



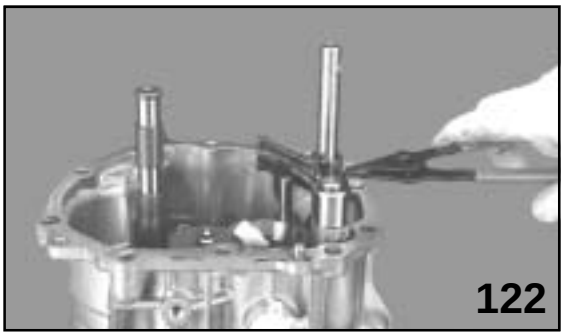


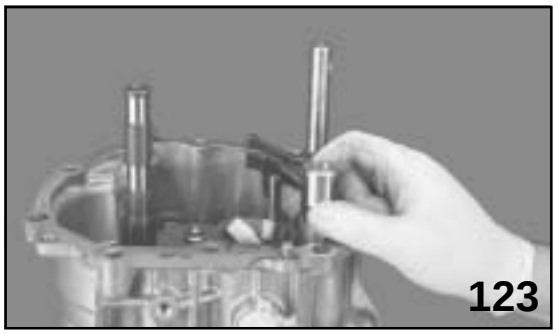
5. Separate the upper split bearing and maintain the orientation of the bearing so that it can be returned to its original position during reassembly.
6. Lift the driver controlled center differential from the pinion shaft.



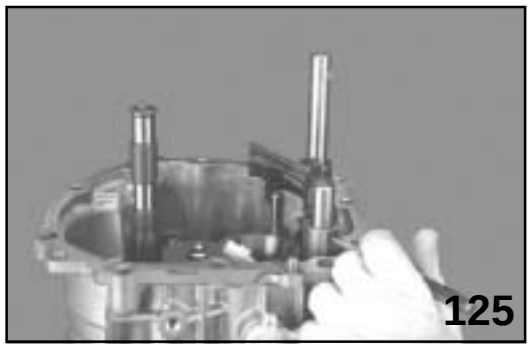


7. Separate the lower split bearing and maintain the orientation of the bearing so that it can be returned to its original position during reassembly.





8. Remove the snap ring from the striker rod.
9. Remove the striker rod support noting the shape and fit.



10. Spread the neutral set spring and remove from the striker rod.
11. Remove the drift pin from the selector arm number 2.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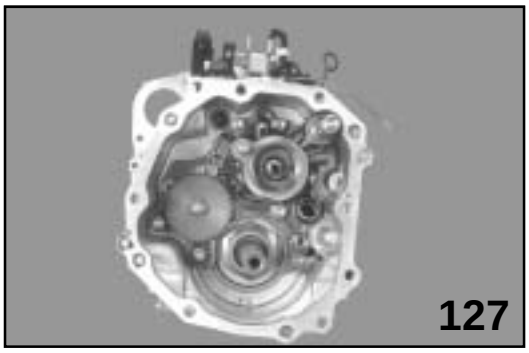
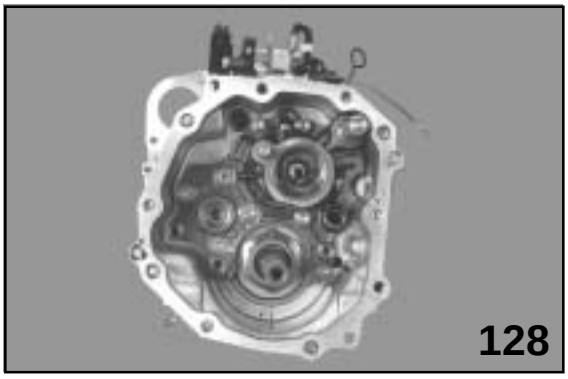
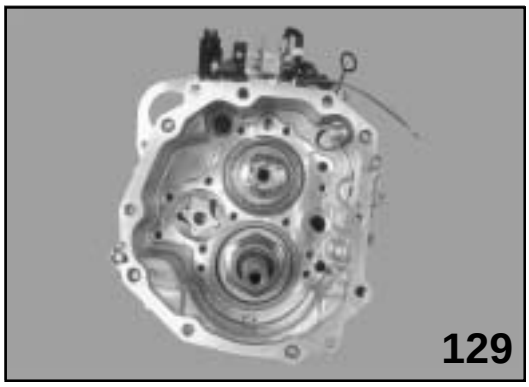
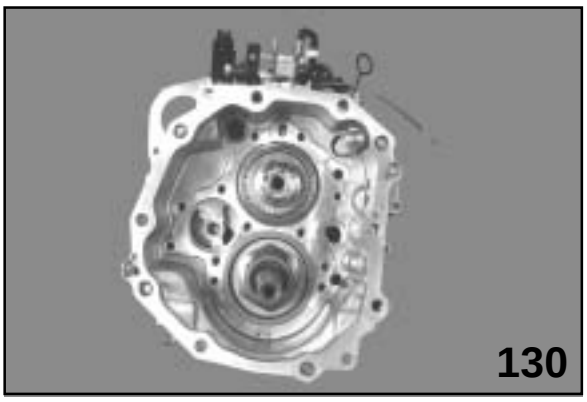

127

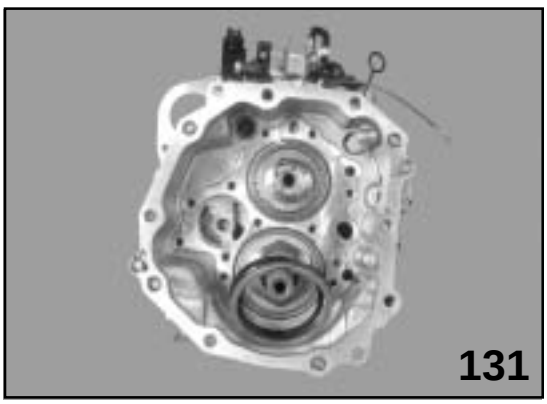
12. Hold selector arm number one and selector arm number two together and remove in one motion.
13. Remove the bolts securing the oil pump cover and holder plate.


128

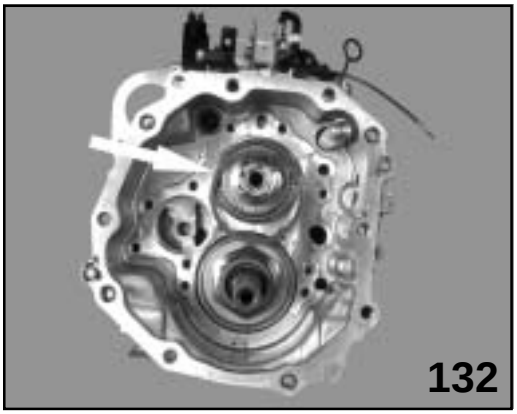

129

14. Remove the oil pump driven gear and holder plate.
15. Remove the oil pump cover.


130

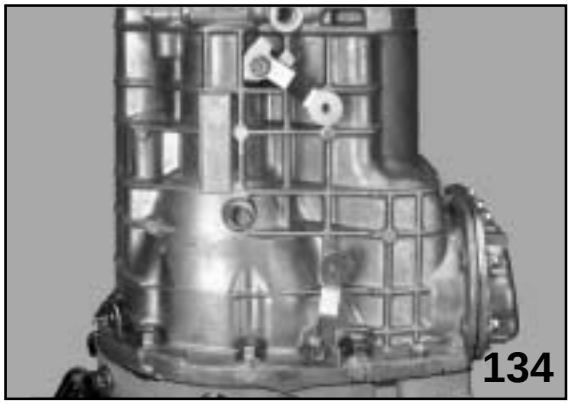

131

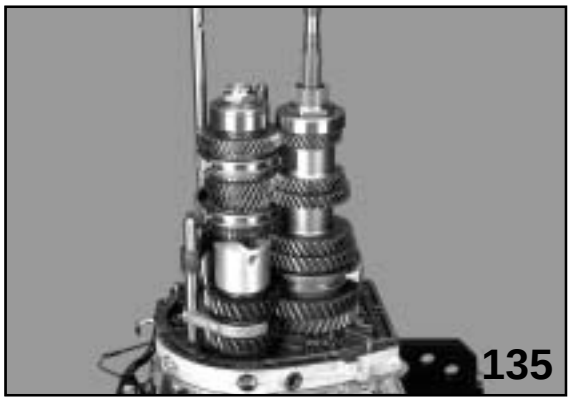
16. Remove the oil pump inner and outer rotor.
17. Remove the shim and collar from the top of the pinion shaft.


132


133

18. Remove the snap ring from the main shaft bearing.
19. Remove the two bolts securing the vent hose bracket and remove the bracket.
20. Remove the two pilot bolts.

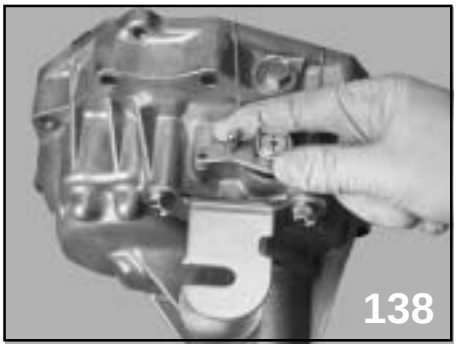

134


135

21. Remove the reverse idler holder mounting bolt.
22. Remove the bolts securing the transmission main case to the differential adapter plate.

Reverse Lock Out


137

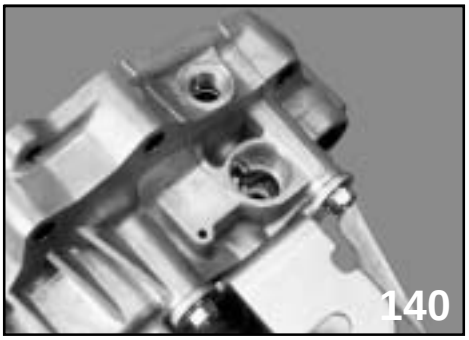

138

The reverse check system equipped on the new 6 speed manual transmission prevents the accidental attempt to shift into reverse while selecting 6th gear.

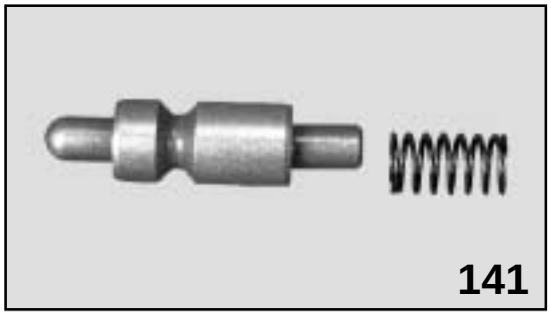
Normal shifting into reverse requires the motion of pulling up on a reverse slider while making the shift to reverse.

When the reverse check cable is activated the reverse check lever is pulled towards the rear of the transmission.


139


140

The reverse check shaft, which is secured to the reverse check lever, will rotate at this time and position a notch in line with a plunger.


141


142

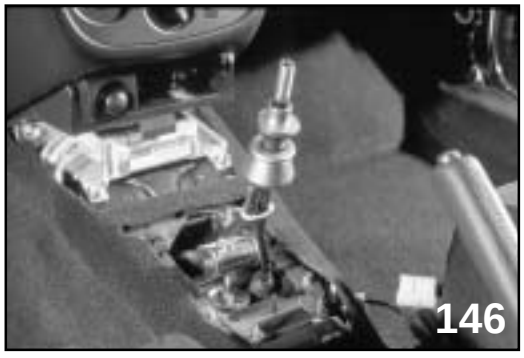
This provides the plunger with a space to move into when the spring loaded reverse check plug is forced up by the number one selector arm.


143


144

In the event the reverse check cable fails, the spring loaded reverse check lever will move towards the front of the transmission and expose a fail safe notch in line with the plunger. At that time no reverse lock out would be provided.


145


146

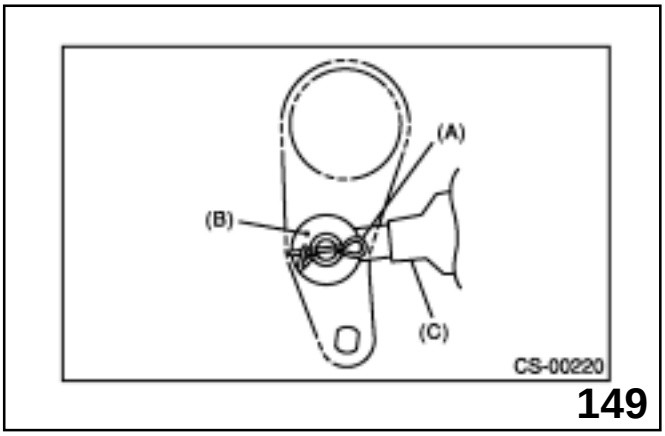
The reverse check cable is routed into the passenger compartment through a grommet next to the shifter linkage.

The reverse check cable must be removed from under the vehicle. Turn the shift knob counter clockwise until the knob is removed form the threaded end of the reverse check cable housing.

Remove the spring pin from the reverse slider then remove the reverse slider, cover, and spring cut and remove the band clip.

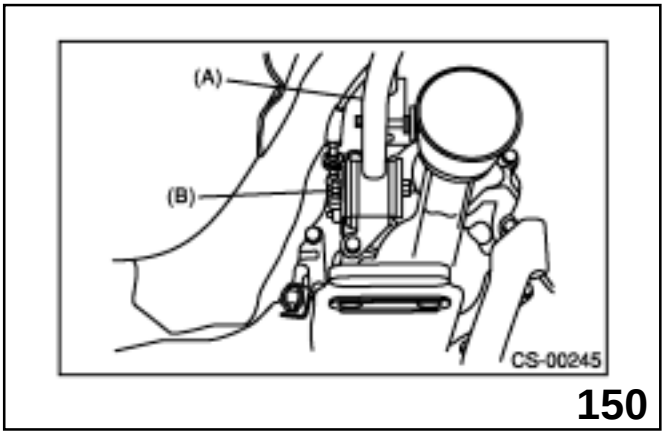

147


148



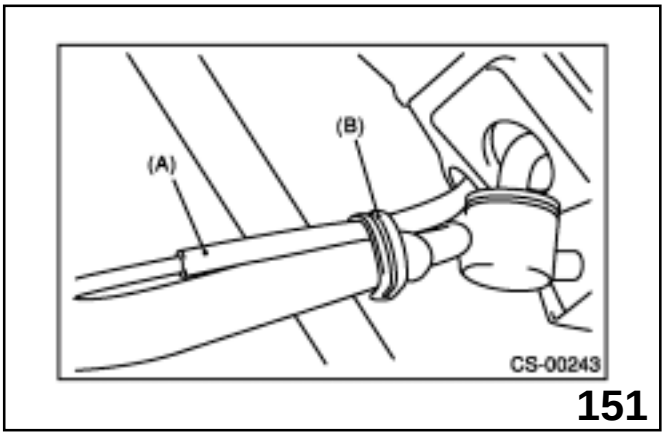
149

Raise the vehicle and remove the rear exhaust pipe and muffler.
Remove the cross member.
Remove the snap pin and washer.



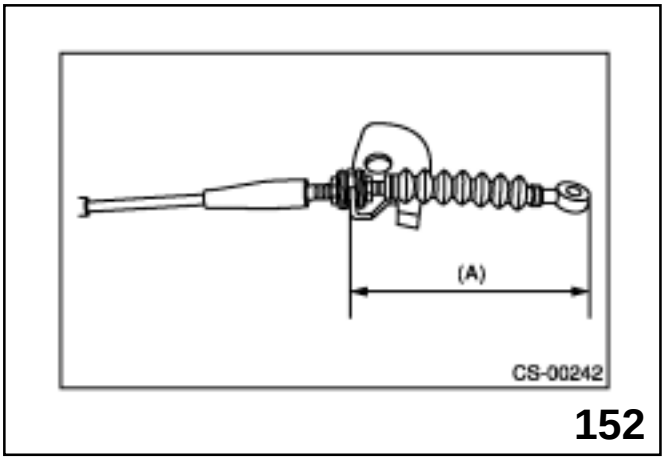
150

Move the transmission to the right side and remove the stay bolt.
CAUTION: FAILURE TO MOVE TRANSMISSION TO THE RIGHT WILL RESULT IN DAMAGE TO THE VEHICLE BODY.



151

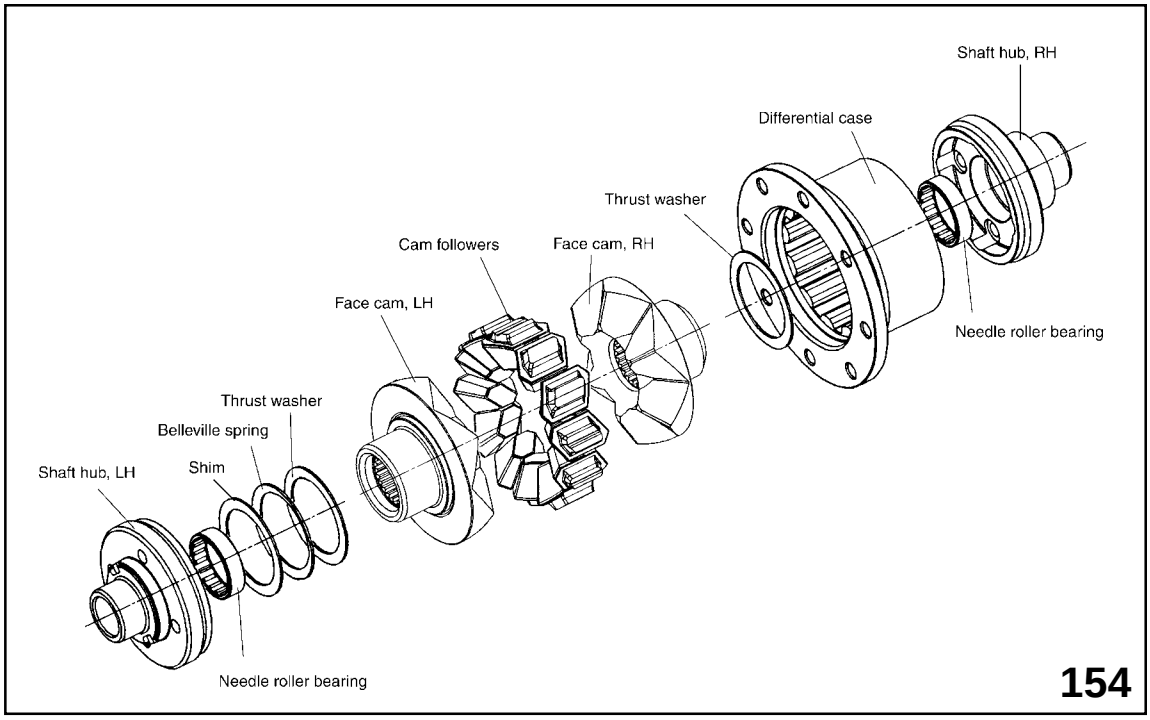
Remove the stay clip from the cable.
Remove the cable by pulling from the vehicle underside.



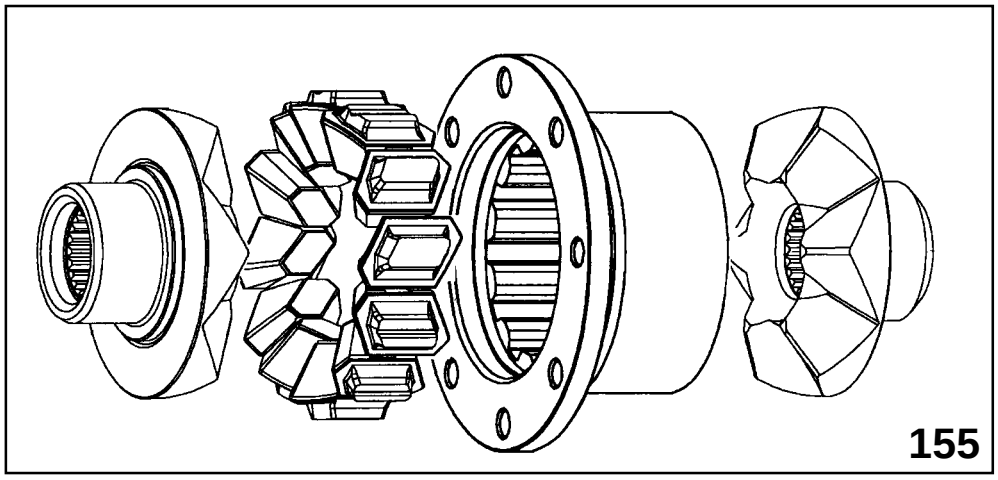
152

Adjust this length to 3.31 inches (84mm) before installing new cable.

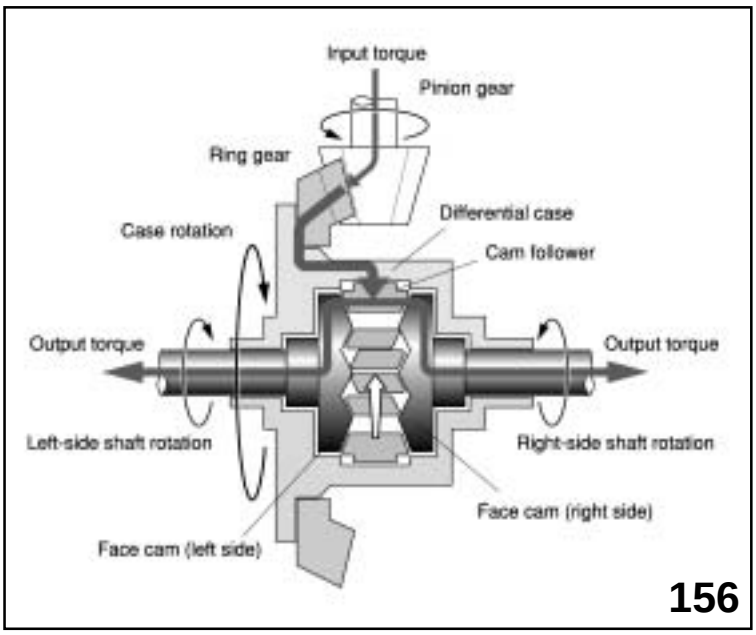
Front Differential



The WRX STi front differential is a cam type limited slip differential. It is a sealed unit and must be replaced as an assembly. The main components of the differential are a differential case, cam followers and two face cams. The bottom side of the cam followers is shaped to fit into slots made into the inner diameter of the differential case. These slots allow the cam followers to slide left and right as well as deliver power from the differential case to the left and right face cams. The top side of the cam followers are shaped to work with the shape provided to the cam followers.

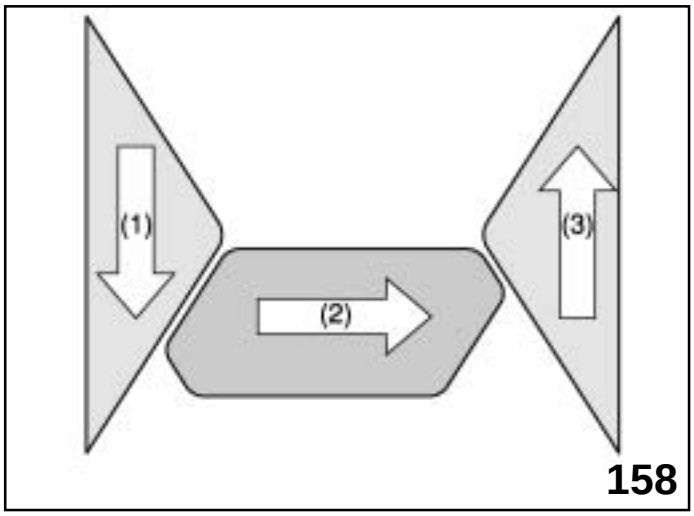


The cam followers have two different cam shapes (the shapes of the surfaces in contact with the face cams), which are alternately arranged. Because of this design, the left and right face cams each have 6 teeth.

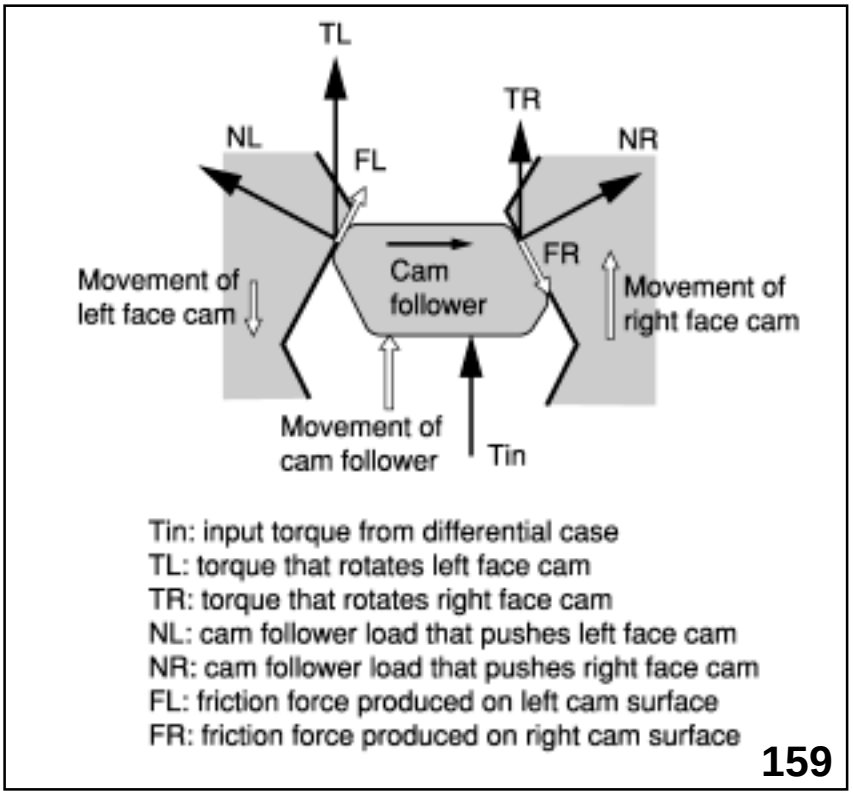


Operation

When the vehicle is driving on a level, uniform road surface, the left and right wheels are turning at the same speed, so there is no difference in the rotational speed of the left and right face cams. The drive force transmitted from the drive pinion gear to the ring gear is transmitted to the 12 cam followers via the slots on the inside of the differential case. The drive force is uniformly transmitted to the left and right face cams by the cam followers in contact with the left and right face cams. This causes all the cam followers and the left and right face cams to rotate together as a single unit.

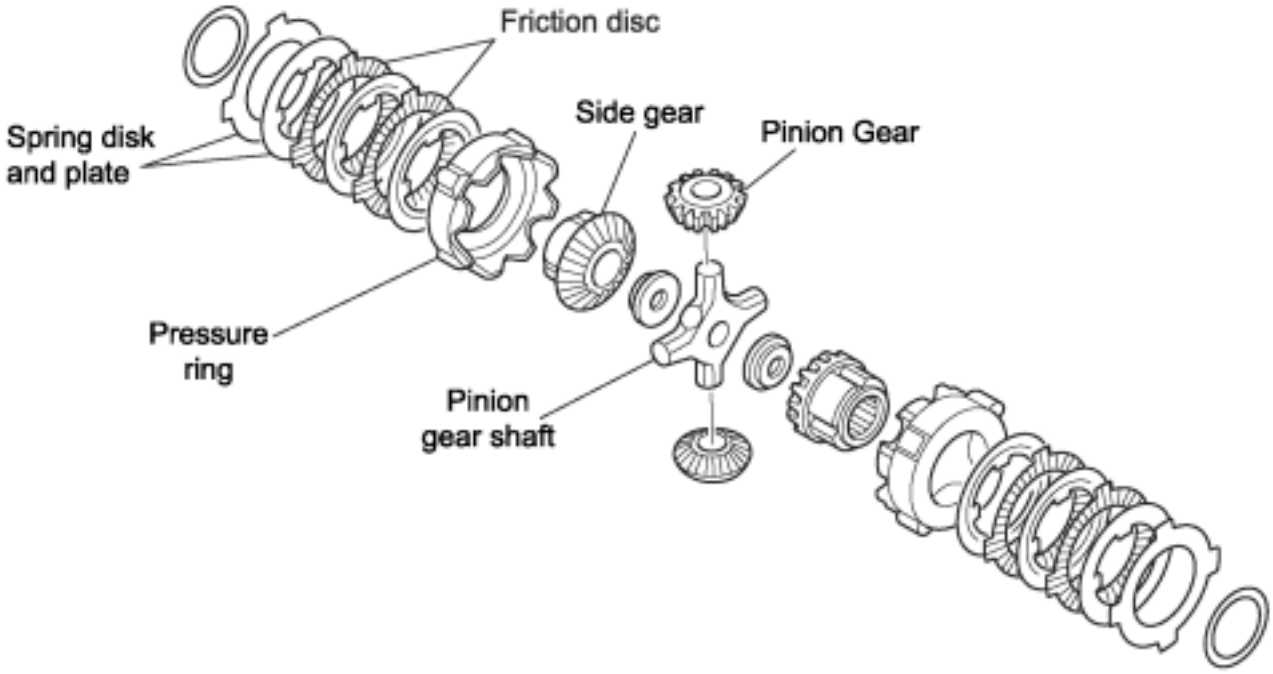


When a vehicle turns, producing a difference in rotational speed between the left and right wheels, there is a shift in the relative position of the left and right face cams. When the left face cam moves downward the cam followers are pushed by the left face cam to the right. This pushes the right face cam upward. As a result the upward movement of the right face cam is equal to the downward movement of the left face cam. This operation between the left and right face cams and the cam followers in contact them occurs continuously absorbing the difference in rotational speed between the left and right wheels produced by the turning vehicle.



The limited slip function is created by the friction between the cam followers and the face cams. When the relative position of the left and right face cams change the cam followers start to move producing forces on the face cams. At the same time frictional forces which counteract the movement of the left and right face cams are produced. Additionally the friction created between the cam followers and the slots in the differential case and the friction between the face cams and the differential case enhance the LSD effect.

Rear Differential



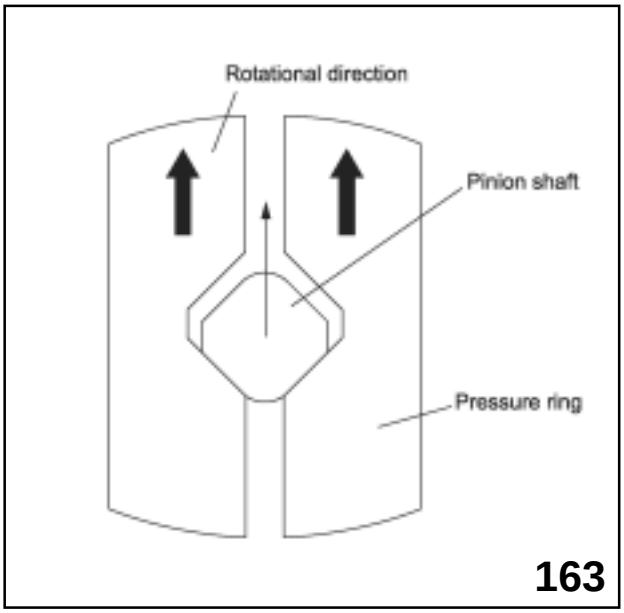
The rear differential of the WRX STi is equipped with a Mechanical Type Limited Slip Differential. The rear differential is non serviceable and must be replaced as an assembly. The Limited Slip Differential functions by slowing down the rear wheel with reduced or low traction and transfers that power to the wheel with traction.

Another feature of the Mechanical Type Limited Slip Differential is the ability to lock the rear differential into a 50% left and 50% right power split of the rear wheels under very high engine output conditions.

Mechanical Type Limited Slip Differential operation is accomplished through the mechanical application of a set friction plates that are splined to the differential side gears and the differential case. The friction plates are applied by a set of pressure rings, one for each side of the differential, which are acted upon by the pinion gear shaft.

The pressure rings are splined to and rotate with differential carrier, but the pressure rings can move in and out. The force required to move them out is determined by the spring tension from a set of spring disks and plates, one set for each side of the differential. It is also this spring force that assists with returning the pressure rings back to the static position.

The outward movement of the pressure rings pushes on and applies the friction plates. The degree of friction plate application is determined by how much outward movement is applied from the pressure rings.



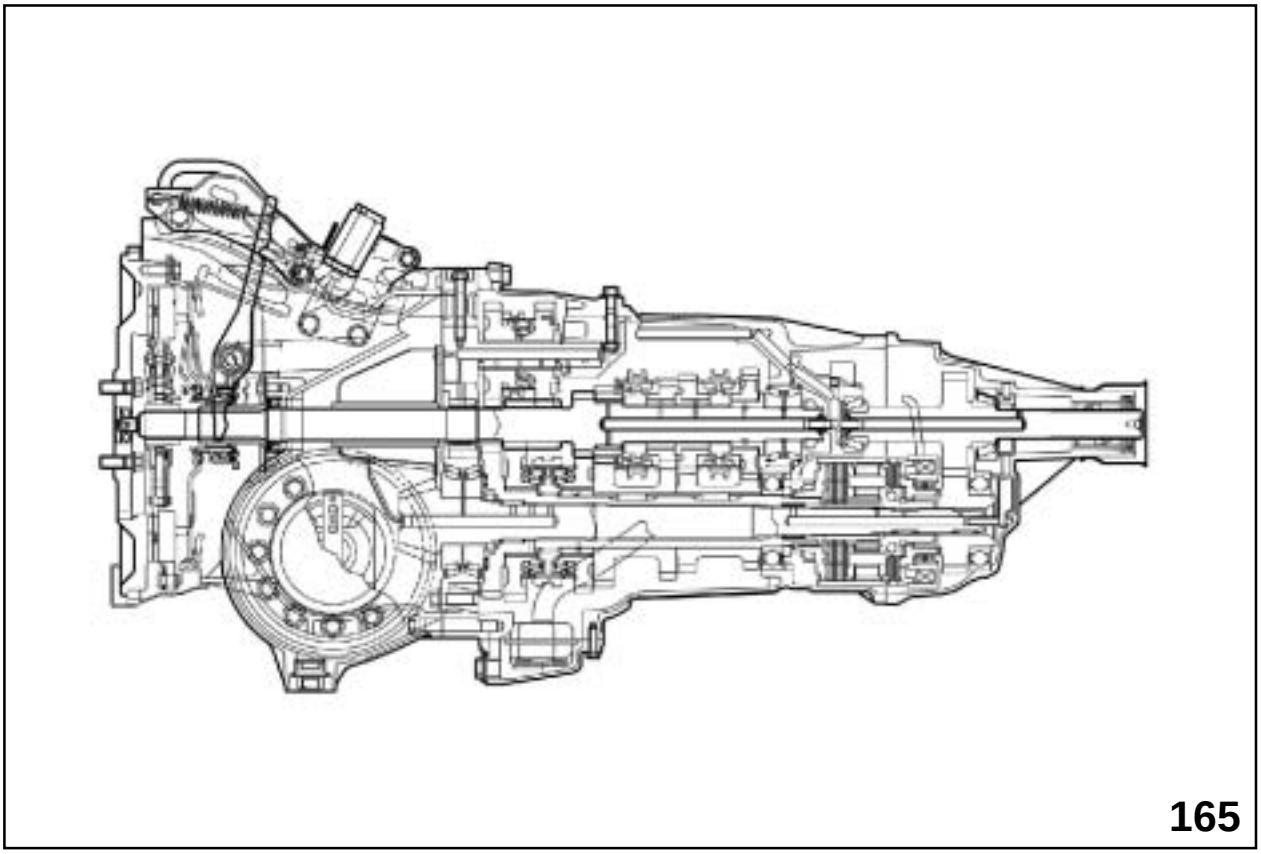
The force that moves the pressure rings outward is generated by the pinion gear shaft. The static position of the pinion gear shaft is in the center of a space created by the pressure rings as they surround the pinion and side gears.

Power from the differential carrier is delivered to the pressure rings and depending on the amount of force created by the movement of the pressure rings into the pinion gear shaft, pulls the pinion gear shaft in the direction of forward movement or uses the pinion gear shaft to split or move the pressure rings outward.

This will apply the friction plates and allow the power to flow partially into the side gears and partially through the differential pinion gears to the side gears and finally to the rear wheels. Higher degrees of friction plate application result in the power flowing from the differential carrier straight to the side gears and to the rear wheels.

Driver Control Central Difference (DCCD)

Outline



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The DCCD system is comprised of sensors, switches, DCCD central models and planetary gear type center differential with built-in LSD clutch.

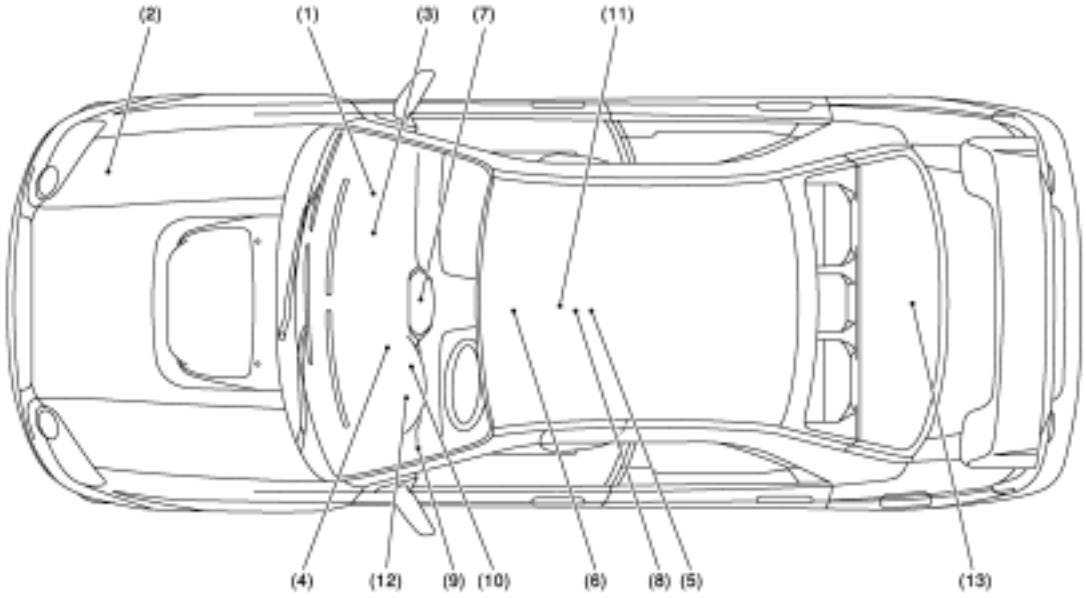
By varying the LSD clutch engagement torque from 0% to 100%, the DCCD control module can vary the drive torque distribution to the front wheels from 35:65 to 50:50 (direct 4WD condition), using the planetary gear type center differential.

Utilizing the DCCD control module to suitably control the drive torque distribution to the front wheels according to the driving conditions, the system improves the running performance over rough roads and reduces tight cornering phenomenon.

Also, the driver can control the LSD clutch engagement torque by adjusting the DCCD control dial equipped beside the parking brake. (Manual Mode)

In the event of a system malfunction, a fail-safe control is activated to release the LSD clutch.

System layout



(1) Engine control module (ECM)
(2) ABS control module & hydraulic control unit (ABSCM & H/U)
(3) Driver's control center differential control module
(4) Accelerator position sensor
(5) Lateral G sensor
(6) Center differential control dial
(7) Center differential
(8) Manual mode switch
(9) Driver's control center differential relay
(10) Driver's control center differential indicator (driver's control center differential diagnostic indicator)
(11) Parking brake switch
(12) Brake Light switch
(13) Rear differential oil temperature switch

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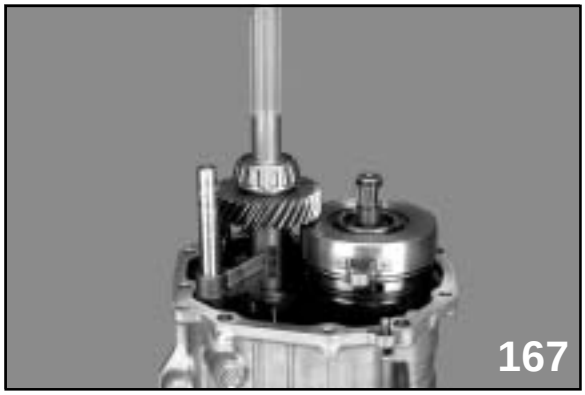
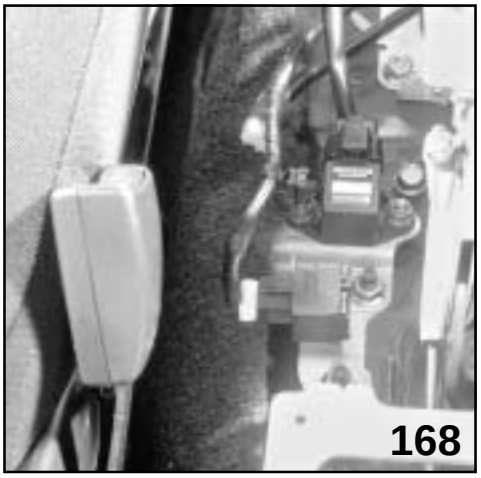
Center Differential



The center differential is comprised of the planetary type differential, LSD clutch, pilot clutch, DCCD coil assembly, and other parts. The DCCD coil assembly (electromagnet) is controlled by the DCCD control module duty drive signal, which sets up a magnetic force that the coil assembly uses to vary the LSD clutch engagement force.

Lateral G Sensor



This sensor detects the lateral acceleration of a vehicle while it is cornering. The DCCD control module determines the vehicle cornering conditions based on signals from this sensor and controls the LSD clutch engagement torque accordingly, improving stability when a vehicle is cornering.

Manual Mode

The Manual Mode selector switch toggles between Manual Mode and Auto Mode each time it is pressed.

NOTE: WHEN THE ENGINE IS STARTED AUTO MODE IS ALWAYS SELECTED. EVEN IF MANUAL MODE IS SET WHEN THE IGNITION IS TURNED OFF, AUTO MODE WILL AUTOMATICALLY BE SELECTED THE NEXT TIME THE ENGINE IS STARTED.

DCCD Control Dial

By operating this dial, the driver can adjust the LSD clutch engagement torque to any desired setting. The DCCD control dial setting will be displayed in the DCCD indicator in the instrument panel when Manual Mode is selected with the Manual Mode switch.

Oil Temperature Switch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This is the temperature switch that is mounted on the rear of the rear differential case. This switch detects the temperature of the lubricating oil inside the case, and it is activated when the oil temperature reaches approximately 150°C. When this happens, a warning light in the instrument panel is illuminated and at the same time an abnormal signal is sent to the DCCD control module.

DCCD Indicator

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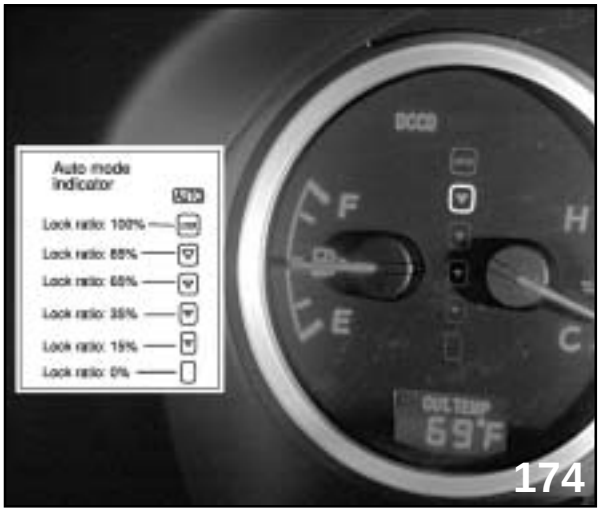

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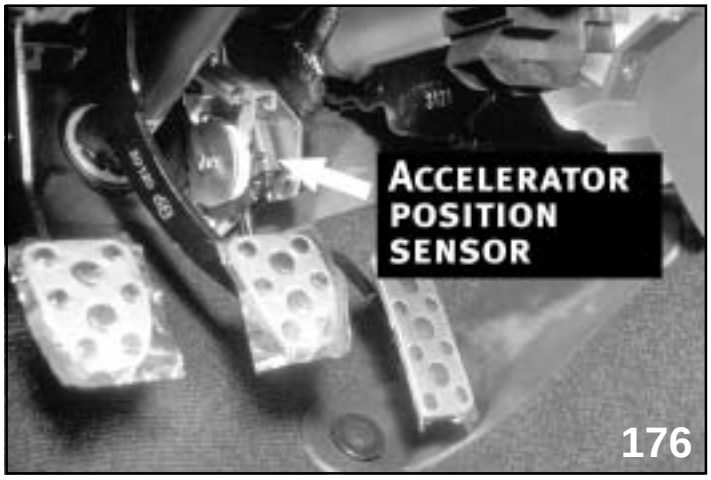
In Auto Mode the top DCCD indicator light is illuminated, informing the driver that Auto Mode is activated. In Manual Mode the DCCD control dial setting is displayed.

When trouble occurs, the bottom DCCD indicator light flashes, warning the driver that trouble has occurred. By operating the DCCD control dial and the parking brake lever according to a predetermined procedure, the service technician can read the trouble code stored in the DCCD control module memory from the flashing pattern of the indicator light.

Accelerator Position Sensor



This sensor detects the position of the accelerator pedal as it is depressed by the driver.

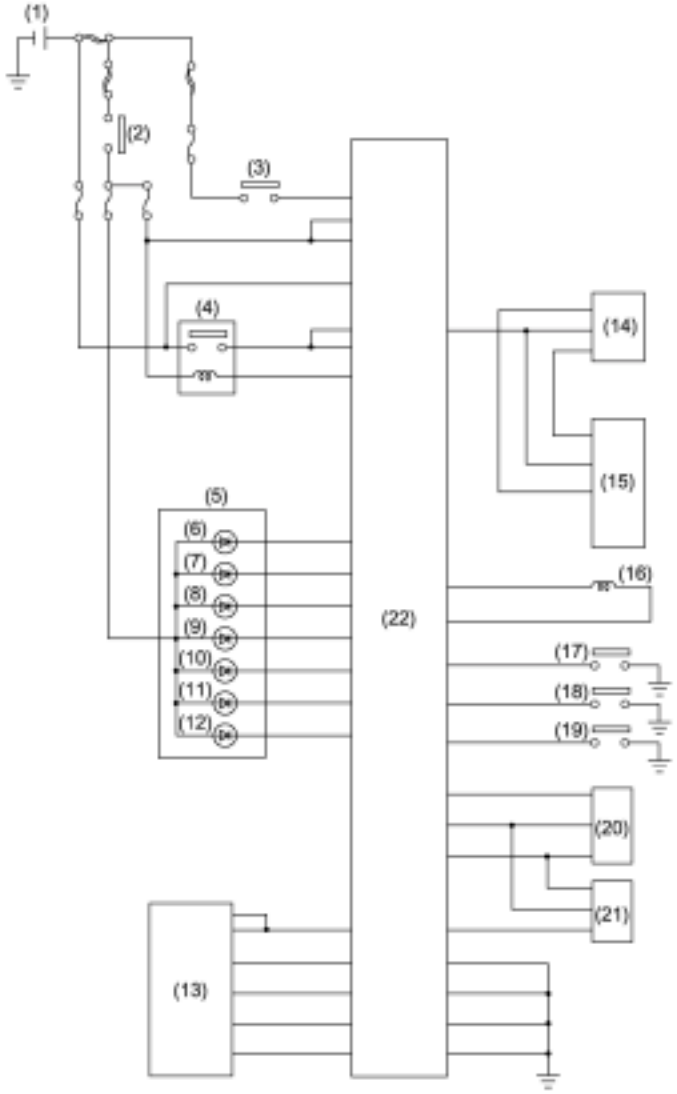
Stop Light Switch

Mounted on the brake pedal bracket, this switch is activated when the driver operates the brake pedal.

Hand Brake Switch

This switch is mounted at the bottom of the parking brake lever and is activated when the driver operates the parking brake lever.

System Circuit



(1) Battery
(2) Ignition relay
(3) Stop light switch
(4) Driver-controllable center differntial relay
(5) Combination meter
(6) Driver-controllable center differential indicator light (0% locked)
(7) Driver-controllable center differential indicator light (15% locked)
(8) Driver-controllable center differential indicator light (35% locked)
(9) Driver-controllable center differential indicator light (65% locked)
(10) Driver-controllable center differential indicator light (85% locked)
(11) Driver-controllable center differential indicator light (100% locked)
(12) Indicator light
(13) ABSCU & HU
(14) Throttle position sensor
(15) Engine control unit
(16) Driver-cotrollable center differential
(17) Parking brake switch
(18) Manual mode switch
(19) Rear differential oil temperature switch
(20) Control dial
(21) Lateral G sensor
(22) Driver-controllable center differential control unit

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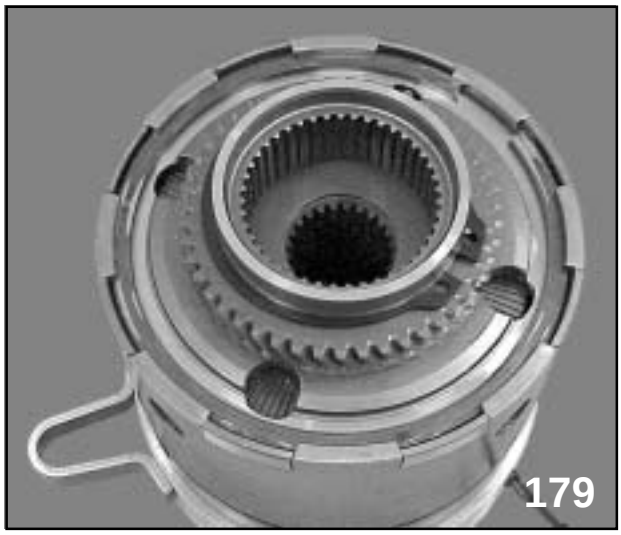
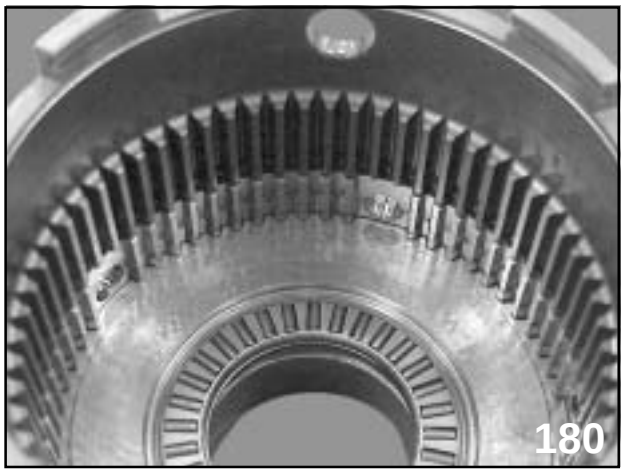
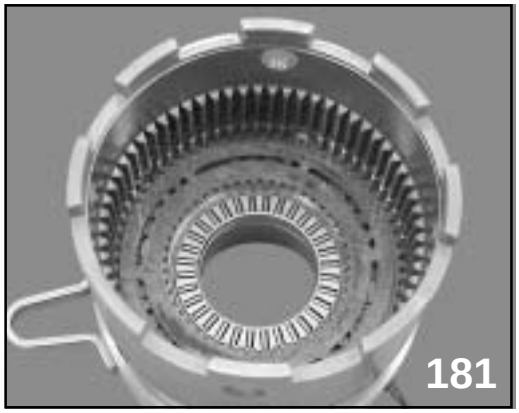
The following 4 pages explaining the DCCD are for general information only. Do not disassemble the DCCD center differential as it is not serviceable.

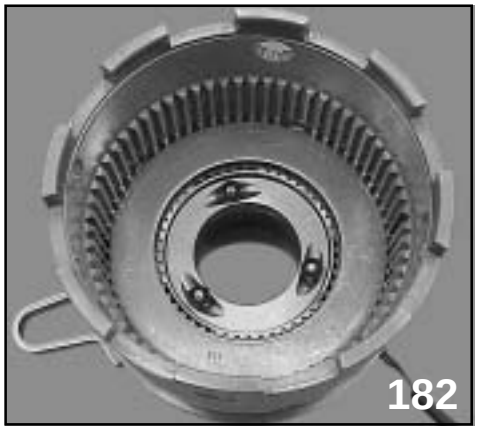


1. Controlled with chopper voltage signal (300 to 2 K HZ).
   Maximum current use is 4 amps.



2. The electronic coil is press fitted to the differential case.
   The lower splines are for the placement of the pilot clutch plates.
   The upper teeth are for delivering power to the planet gears of the planetary assembly.


181


182

3. The needle bearing provides a support for the pilot clutch hub.

The inner splines of the pilot clutch plates engage with the pilot clutch hub.
The armature is located on top of the pilot clutch plates to apply pressure, engaging the pilot clutch hub to the differential case.
The three metal balls are used to push up on the planetary assembly.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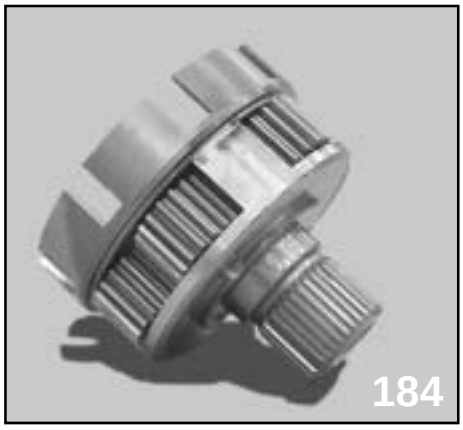
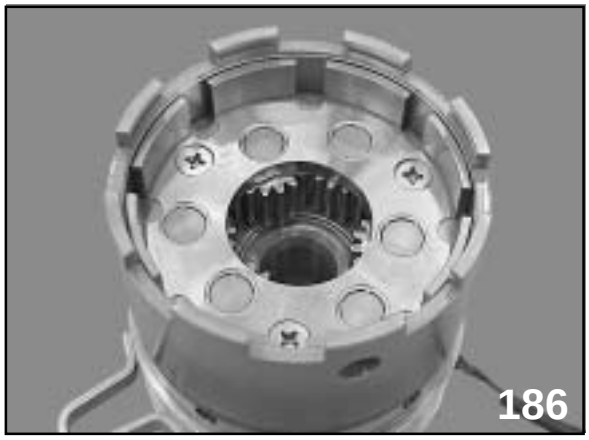
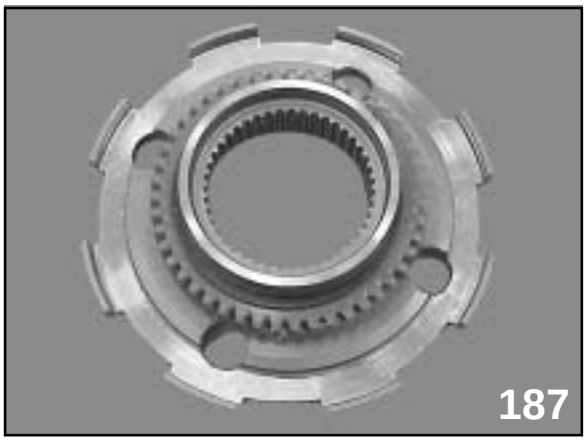
4. The top of the planetary assembly houses the LSD clutch which is used to control the speed of the sun gear and planetary carrier.


184


185

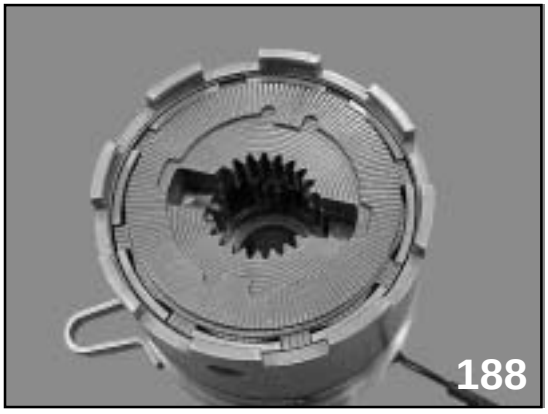
5. The splines at the bottom of the planetary assembly are used to secure the transfer drive gear.

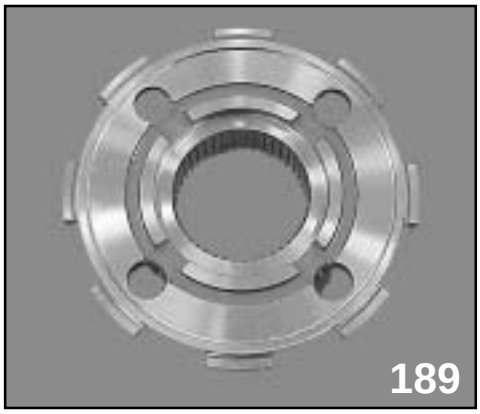




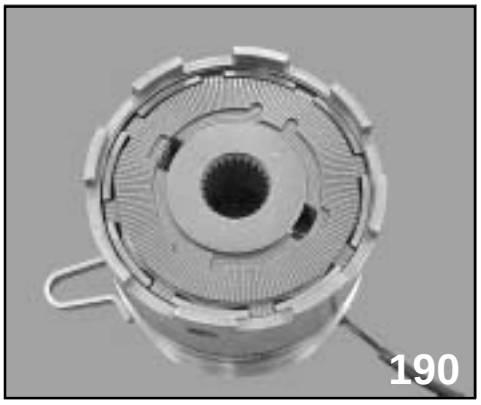
6. Power flows into the differential case to the planet gears. Power then splits, the planetary carrier driven by the planet gears power the rear wheels. The sun gear, powered by the planet gears powers the front wheels.

The speed of the sun compared to the speed of the planetary carrier determines the power split of the front and rear wheels.





7. The limited slip differential clutch is used to hold the sun gear and push down on the planetary carrier. This braking action changes the output distribution of power.

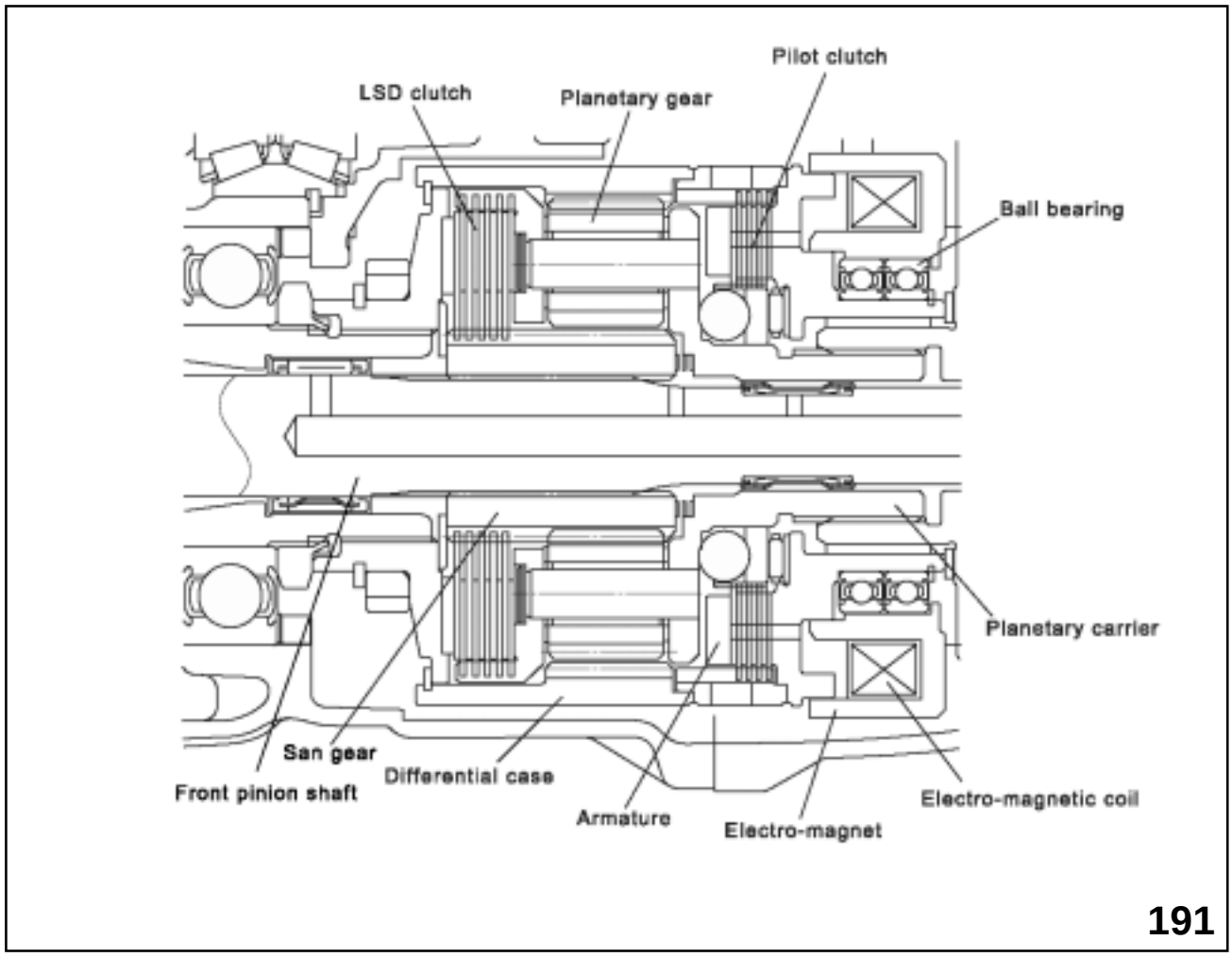


8. Case with sun gear installed.

No current applied to the DCCD coil results in a power split of 35% to the front wheels and 65% to the rear wheels.
The more current is applied to the coil, the faster the transfer rate changes towards a 50% front and 50% rear.
The armature pulls down on the pilot clutch in proportion to the amount of current applied to the coil. This results in the pilot clutch hub partially or fully rotating with the differential case.
The differential carrier, rotating in the same direction as the pilot clutch hub is now used as reference of the rear wheel power output. When the planetary carrier rotates faster than the pilot clutch hub the alignment of the three balls to the recesses in the bottom of the planetary carrier changes. This will force the planetary carrier to move into the LSD clutch, slowing down the sun gear and planet carrier. The resulting action removes power from the rear wheels and redirects it to the front wheels.
Power split is determined by the difference in rotation of the sun gear and planetary carrier and the difference in rotation of differential case to the planet gears. If the planetary carrier slows down or stops rotating the power from the differential case passes straight through the planetary assemble as if the planetary assembly was part of the case.

The center differential consists of a planetary gear type differential mechanism, a pilot clutch that is engaged by the DCCD coil assembly, and an LSD clutch placed between the planetary gear unit sun gear and the planetary carrier.

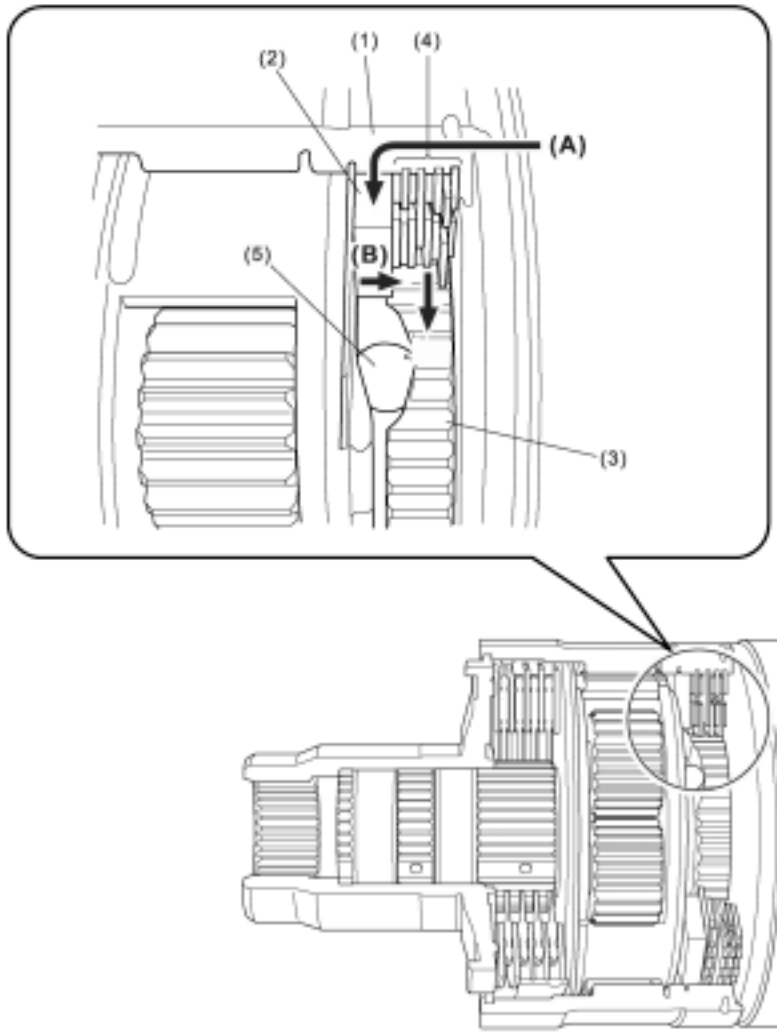
The planetary gear unit sun gear is connected to the front drive pinion shaft, which turns the front wheels, and the planetary carrier is connected to the transfer drive gear, which turns the rear wheels. When the LSD clutch is released, the center differential distributes the drive torque to the front and rear wheels in a 35:65 proportion.



Three steel balls are equipped between the pilot clutch hub and planetary carrier inside the center differential case. These steel balls are mounted in hollows in the clutch hub and planetary carrier, and they work to widen the clearance between these parts when their relative position changes. In this explanatory note, the clutch hub hollow is referred to as cam 1 and the planetary carrier hollow as cam 2.

When current flows through the electromagnetic coils, magnetism is generated at components in the following sequence: electromagnet, differential case, armature (A). The armature is moved to the right (B) by this magnetism causing the pilot clutch to engage, and a magnetic field is formed in the area from the electromagnet, differential case, armature, and to the pilot clutch.

The pilot clutch locks the differential case side and cam 1 side together, thus the rotational speed of the cam 1 and differential case are synchronized. The engagement of the pilot clutch is controlled by adjusting the current flowing through the electromagnetic coils.



(1) Differential case
(2) Armature
(3) Cam 1
(4) Pilot clutch
(5) Steel ball

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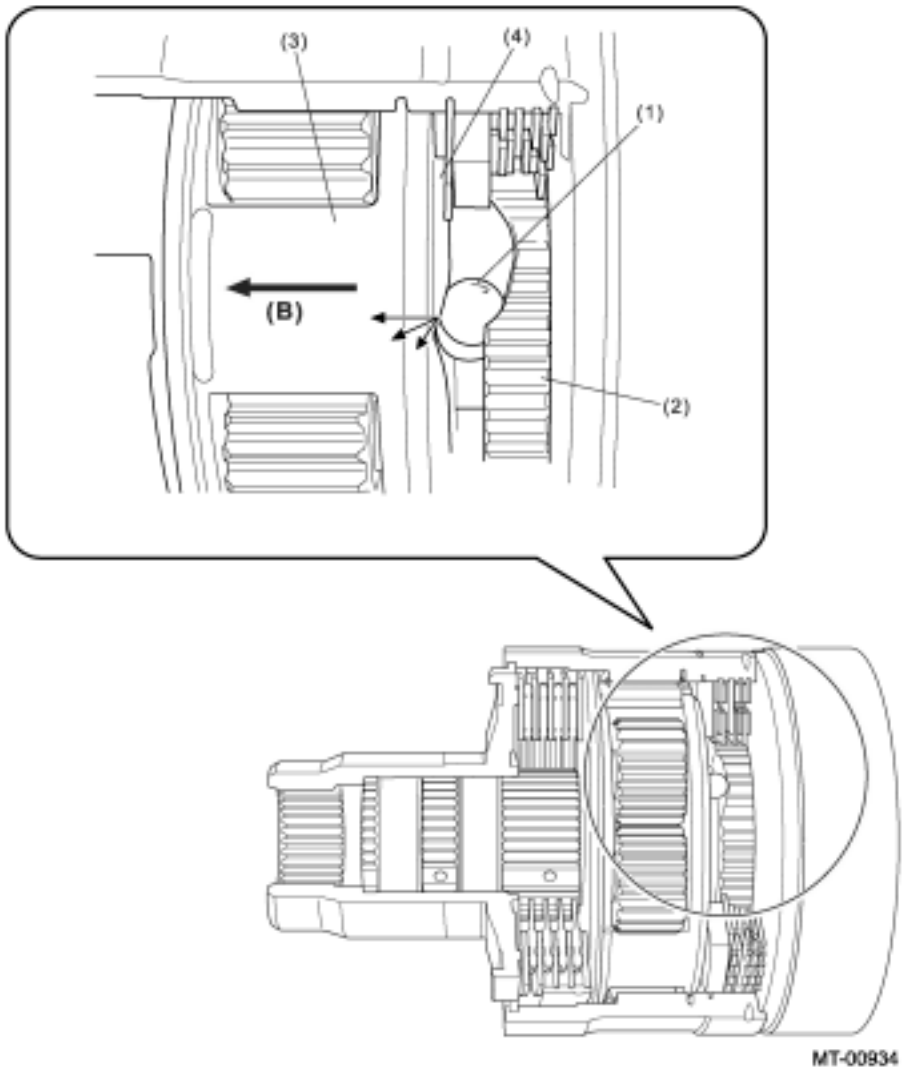
When a speed difference occurs, a force (B) pushing the cam 2 to the left is generated at the steel balls sandwiched between cam 1 and cam 2, pushing the planetary carrier to the left.



(1) Steel ball
(2) Cam 1
(3) Planetary carrier
(4) Cam 2

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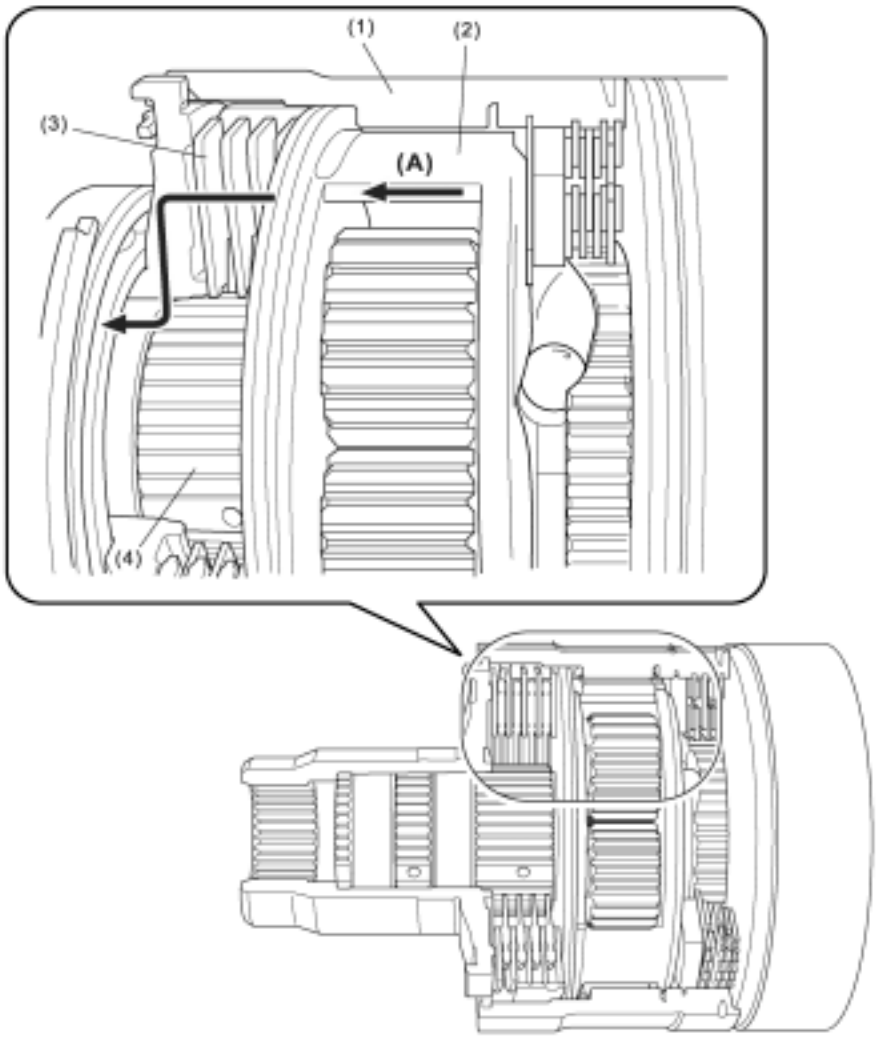
The planetary gears and the sun gear together to generate a differential action restriction torque.



(1) Differential case
(2) Planetary carrier
(3) Main clutch
(4) Sun gear

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DCCD System Operation

The DCCD system has two modes: Manual Mode and Auto Mode. In Manual Mode, operation of the DCCD control dial (to whatever setting the driver wants) is given priority, and the LSD clutch engagement torque is increased or decreased accordingly. In Auto Mode, on the other hand, the LSD clutch is automatically controlled according to various input signals, such as, the lateral G sensor input signal (turn status signal) and the wheel speed sensor input signal.

The most fundamental control in the DCCD system is the throttle-response engagement-torque control. This control increases or decreases the LSD clutch engagement torque according to the driver's operation of the accelerator pedal (accelerator position sensor signal). (The basic control theory is the same as that of the VTD transfer system.)

Besides the throttle-response engagement-torque control, the DCCD system also executes the following controls.

CONTROL	AUTO MODE	MANUAL MODE
Throttle-response engagement-toque control	○	○
ABS actuation signal input control	○	○
Brake switch signal input control	○	○
Parking brake signal input control	○	○
Tight cornering control	○	○
Slip control	○	X
Cornering control	○	X
DCCD control dial control	X	○
Fail-safe control	○	○
Rear differential oil temperature control	○	○

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X means not available

ABS Actuation Signal Input Control

Once the ABS Actuation signal has been input into the DCCD control module from the ABS CM & H/U, the DCCD control module decreases the LSD clutch engagement torque.

(Purpose: To reduce the number of factors that will disturb the ABS control.)

Brake Switch Signal Input Control

Once the brake switch signal has been input into the DCCD control module, the module reduces the LSD clutch engagement torque.

(Purpose: To prevent delays in the start of the ABS control and prepare the system for when all the wheels slow down simultaneously.)

Parking Brake Signal Input Control

Once the parking brake switch signal has been input into the DCCD control module, the module releases the LSD clutch.

(Purpose: To enable the vehicle to drift when the rear wheels lock by the operation of parking brake lever.)

Tight Cornering Control

In order to prevent the tight cornering phenomenon, this control determines the vehicle driving conditions from the left and right wheel speed ratios and the vehicle speed, and reduces the LSD clutch engagement torque accordingly.

Slip Control

This control determines the amount of slip for each wheel, based on signals from all four wheels speed sensors, and corrects the LSD clutch engagement torque according to the amount of slip.

Cornering Control

In order to improve stability when a vehicle is cornering, this control determines the cornering conditions on the basis of the throttle position sensor signal, lateral G sensor signal, all four wheel speed sensor signals, and other signals, and optimally controls the LSD clutch engagement torque.

Control Based on Lateral G Sensor Signal

In the DCCD system, the purpose of control based on the lateral G sensor signal is to improve the road handling characteristics of a vehicle. Accordingly, the philosophy behind this control is different than that of the Vehicle Dynamic Control System (which works to maintain vehicle stability when the tires lose their grip).

The DCCD control module varies the LSD clutch engagement conditions as described below, according to the lateral G sensor signal (vehicle cornering conditions). This distributes the drive torque to the front and rear wheels in suitable proportions, according to the cornering conditions.

If the lateral G force is large

LSD clutch engagement strength is reduced —> Drive torque distribution to rear wheels increases —> Pushing force of rear wheels increases —> Vehicle cornering performance is given priority.

If the lateral G force is small

LSD clutch engagement strength is increased —> Drive torque distribution to front wheels increases —> Pushing force of all wheels is equal —> Vehicle acceleration performance is given priority.

Control Based on Accelerator Position Sensor Signal

When the LSD clutch is released completely, 35% of the drive torque is distributed to the front wheels and 65% to the rear wheels. When the LSD clutch operates and distributes 45% of the drive torque to the front wheels and 55% to the rear wheels, it takes 10% of the drive torque from the rear wheels and transfers it to the front wheels.

When the drive torque input into the center differential from the engine increases, the LSD clutch engagement strength must increase to maintain the 45% drive torque distribution to the front wheels and 55% to the rear wheels. Consequently, when the throttle opening is large (the drive torque generated by the engine is large), the LSD clutch engagement strength increases.

Control Based on Wheel Speed Sensors

The difference in speed of the left and right wheels is determined on the basis of signals from four wheel speed sensors. The LSD clutch engagement strength is reduced in order to prevent the tight cornering phenomenon, which occurs in low-speed situations such as when a vehicle is being put into a garage.

DCCD Control Dial Control

The LSD clutch engagement torque increases or decreases according to the DCCD control dial setting selected by the driver. (Manual mode)

Fail-safe Control

When the DCCD control module detects any trouble in the system, it illuminates the bottom DCCD indicator light to inform the driver that trouble has occurred.

When a major malfunction related to the DCCD coil assembly occurs, the DCCD control module will turn the DCCD coil assembly off and fully release the LSD clutch. The DCCD control module will preserve as much of the system operation as it can, provided that the malfunction does not involve a sensor or other critical part.

Rear Differential Oil Temperature Control

If the rear differential oil temperature rises abnormally (to approximately 150°C) because of continued hard driving or for any other reason, the rear differential oil temperature switch will turn on and the rear differential oil temperature warning light in the combination meter will come on. At the same time, the DCCD control module will reduce the LSD clutch engagement torque. (Normal control will automatically be restored once the oil temperature drops.)

LSD Clutch Engagement Torque Control Applied to Cornering Vehicle by DCCD System

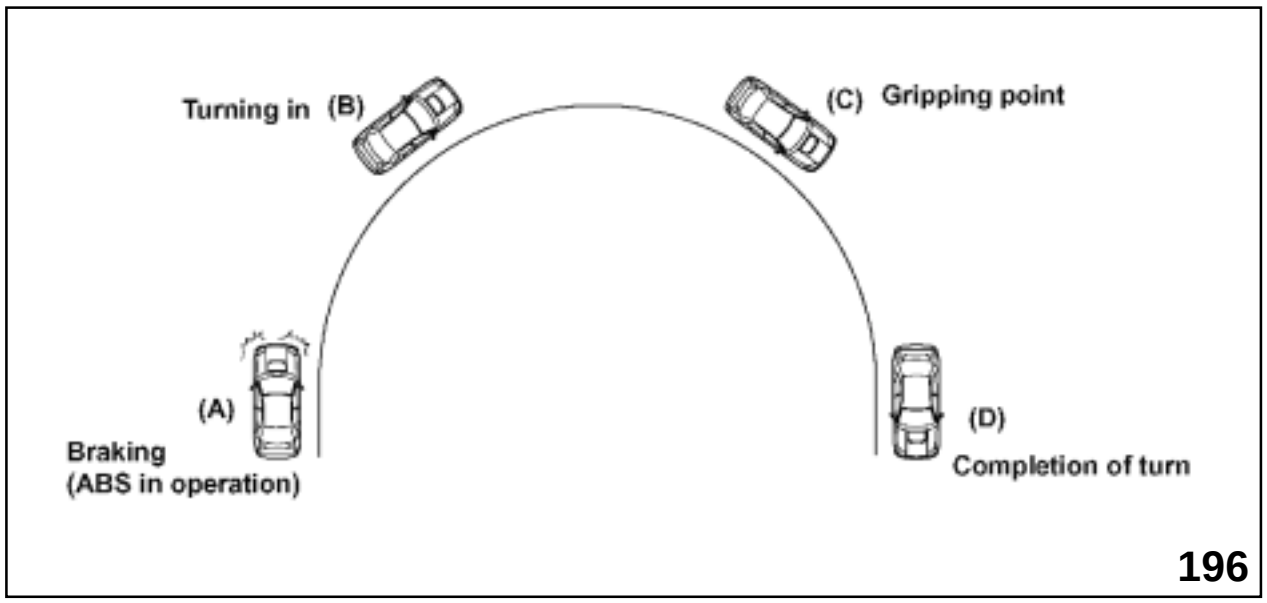
Let's consider the LSD clutch conditions at points A, B, C, and D, using slow-in quick-out cornering as a model.

A: The vehicle is decelerating and has not yet started to turn. Since the brake pedal is depressed and the ABS is working, the system is operating under ABS actuation signal input control conditions and the LSD clutch is practically released.

B: The vehicle is starting to corner, generating a lateral G force. Since the accelerator pedal is not depressed, the system gives cornering performance priority, so the LSD clutch engages weakly.

C: The vehicle has passed the top of the curve and is starting to accelerate. Although the lateral G force is large, the accelerator pedal is depressed, so the LSD clutch engagement strength is increased proportionally to the increasing engine driving force.

D: The vehicle has finished cornering and is traveling straight ahead. Since the lateral G force is small, the system gives priority to acceleration performance, so the LSD clutch engages strongly, approaching direct 4WD conditions.


Turning in (B)
(C) Gripping point
(A)
Braking
(ABS in operation)
(D)
Completion of turn
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Diagnostics

How To Read the Trouble Code

(1) Engage the parking brake.

(2) Turn the ignition switch to the ON position.

(3) Set the DCCD control dial to the MIN or MAX position.

(4) Fully depress the accelerator pedal.

(5) Turn the DCCD control dial from MIN to MAX and back to MIN, and repeat 10 times.

If no trouble code has been recorded

The bottom indicator light repeatedly flashes at approximately 2Hz.

If a trouble code has been recorded

The trouble code is read from the flashing pattern of the bottom indicator light.

The Bottom DCCD indicator light flashes the code corresponding to faulty part.

The long segment (1.2 sec on) indicates a “ten”, and the short segment (0.2 sec on) signifies a “one”.

D-Check Procedure

(1) Engage the parking brake.
(2) Set the DCCD control dial to the MIN position.
(3) Start the engine.
(4) Set the DCCD control dial to the MAX position.
(5) Release the parking brake.
(6) Set the DCCD control dial to the MIN position.
(7) Engage the parking brake.
(8) Repeat steps 4 to 7 twice within 30 seconds.

NOTE: THE INDICATOR WILL DISPLAY THE TROUBLE CODE FOR A WHEEL SPEED SENSOR MALFUNCTION.

(9) Operate the parking brake.
(10) Operate the brake pedal.
(11) Operate the Manual Mode switch.
(12) Operate the DCCD control dial and then set it to the MAX position and wait 3 seconds.
(13) Drive the vehicle (above 15km/h for at least 5 seconds) and check the ON/OFF status of the bottom indicator light.

If no trouble code has been recorded

The bottom indicator light repeatedly flashes at approximately 2Hz.

If a trouble code has been recorded

The trouble code is read from the flashing pattern of the bottom indicator light.

NOTE: AFTER THE TROUBLE HAS BEEN REPAIRED, IF A DIAGNOSTIC CHECK IS EXECUTED AND THE SAME TROUBLE IS FOUND NOT TO RECUR, THE RECORDED TROUBLE CODE WILL BE ERASED FROM THE SYSTEM MEMORY THE NEXT TIME THE IGNITION SWITCH IS TURNED ON.

NOTE: ONLY SEVEN TROUBLE CODES STORED IN THE MEMORY APPLY TO TROUBLE DETECTED BY THE DCCD CONTROL MODULE. THESE ARE: CODES 11, 12, 13, 14, 21, 22, AND 23. THE DCCD MODULE WILL CAUSE THE BOTTOM INDICATOR LIGHT TO FLASH AND WARN THE DRIVER OF TROUBLE ONLY WHEN ONE OF THESE SEVEN CODES IS DETECTED.

THERE ARE NO TROUBLE CODES RELATED TO THE REAR DIFFERENTIAL OIL TEMPERATURE SWITCH. IF FOR ANY REASON THE REAR DIFFERENTIAL OIL TEMPERATURE RISES ABNORMALLY AND ACTIVATES THE TEMPERATURE SWITCH, THE REAR DIFFERENTIAL OIL TEMPERATURE WARNING LIGHT IN THE COMBINATION METER WILL COME ON TO WARN THE DRIVER THAT THE OIL TEMPERATURE IS TOO HIGH. AT THE SAME TIME, THE DCCD CONTROL MODULE WILL START THE BOTTOM INDICATOR LIGHT FLASHING. NEVERTHELESS, THE DCCD CONTROL MODULE HAS NO TROUBLE CODES RELATED TO THIS PROBLEM. (NORMAL CONTROL WILL AUTOMATICALLY BE RESTORED ONCE THE OIL TEMPERATURE DROPS.)

Component Parts Test

Lateral G sensor

Measure the sensor output voltage with the sensor connector disconnected.

Between connector terminal No. 1(+) and connector No. 2(-)

In horizontal position: 2.3 - 2.7V

Inclined 90° to the right: 3.5 - 4.1V

Inclined 90° to the left: 0.8 - 1.5V

DCCD coil assembly

Measure the coil resistance.

Resistance value: 1.0 - 2.0 ohms

Check the DCCD control module drive voltage (duty signal).

Voltage value: 6.0 - 7.0V

Semi-Automatic Air Conditioning


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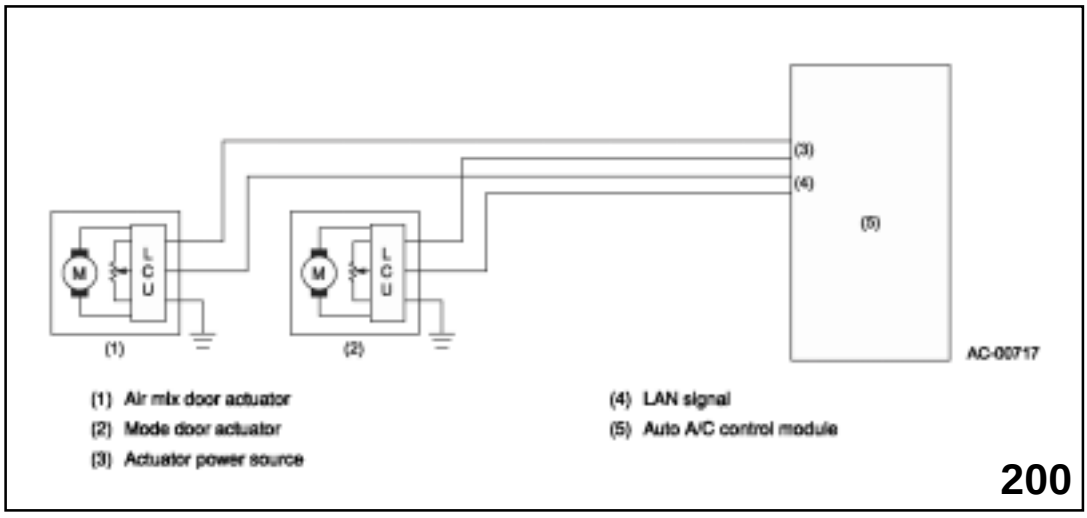
The WRX STi is equipped with Semi-Automatic Air conditioning. This system, in Automatic mode, will adjust the air temperature and air flow rate automatically to the selected temperature. The range is 65° to 85 degrees Fahrenheit. (20° to 30° C.)
The lower setting commands the system to go to full cold and the highest setting commands the system to go to full hot.

The mode or air flow direction, compressor operation (except defrost) and recirculation must be set by the driver.



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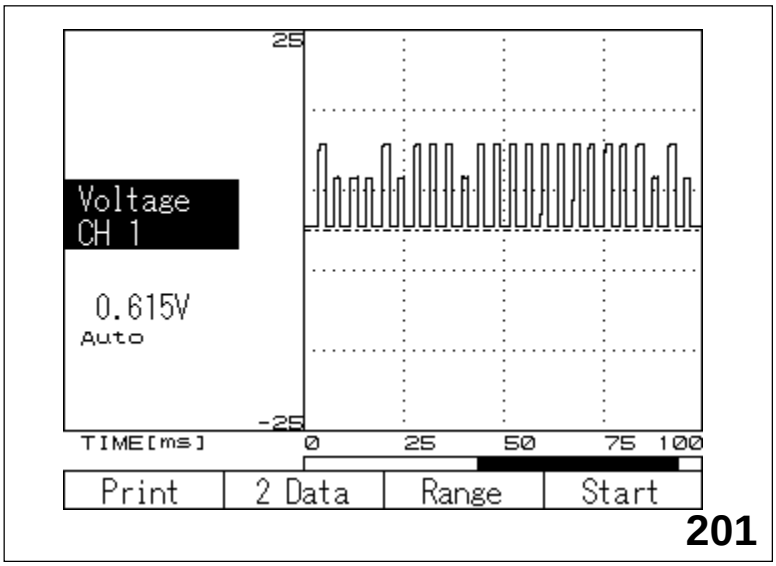
The air mix door actuator and the mode door actuator have their own local control units (LCUs). This allows communication and control through a single wire by using local area network technology (LAN).

When each LCU receives a signal (LAN) from the auto A/C control unit a corresponding door will move to a target location which is monitored by a sensor inside the actuator. The sensor will send a signal to the LCU and the LCU will then send a signal to the auto A/C control unit that the door has reached its target.

An on board diagnostic is built into the auto A/C control unit that allows all components of the system to be electrically or physically checked. Refer to the appropriate service manual for step by step procedures.



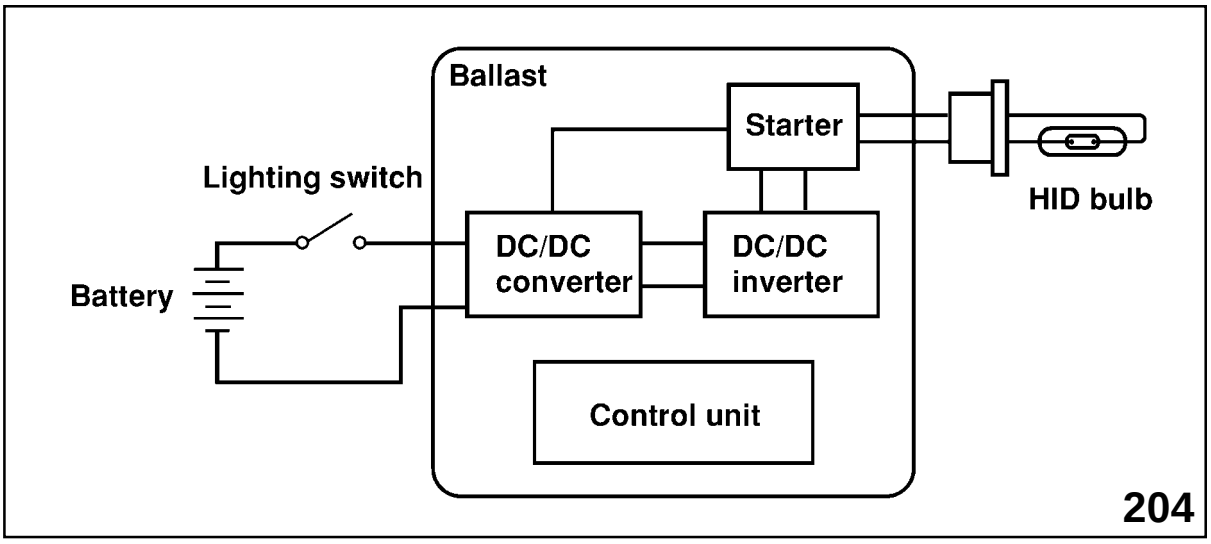
Example: LAN Signal

High Intensity Discharge Headlights

WRX STi is equipped with a High Intensity and Discharge (HID) low beam headlight system. The high beam headlights are halogen. The vehicle is not equipped with day time running lights.

High intensity and discharge (HID) headlights work by applying a high electrical charge between two electrodes which are surrounded by a gas (Xenon) in sealed glass tube. The gas emits light as it is heated and electrical current passes through it.

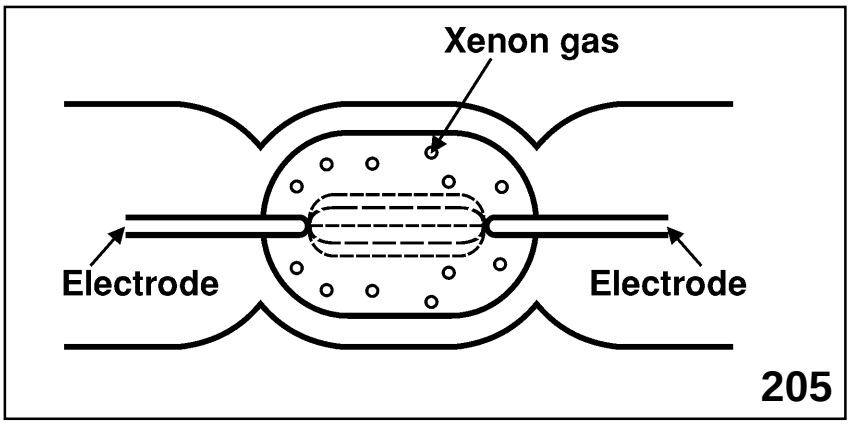
WARNING: THE HID HEADLIGHTS GENERATE HIGH HEAT AND REQUIRE HIGH VOLTAGES TO FUNCTION. EXTREME CARE SHOULD BE TAKEN TO PREVENT INJURY.



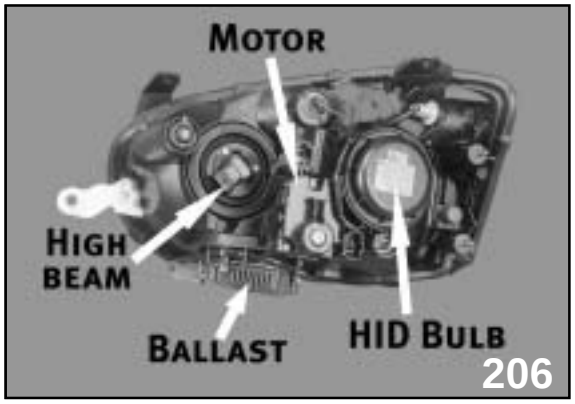
The illumination portion of the headlight assembly for the HID consists of a ballast and HID bulb.

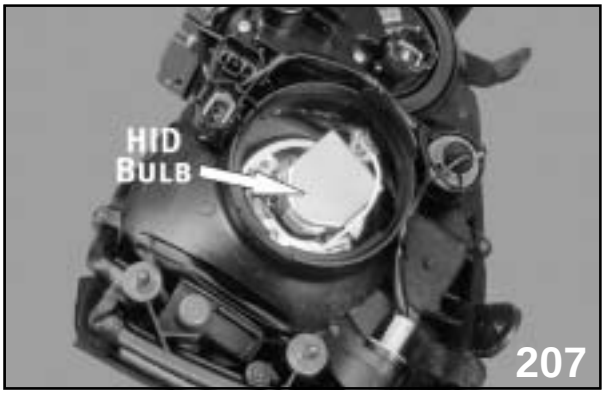
The ballast contains a DC/DC converter, DC/AC converter, starter and control unit. The DC/DC converter raises 12 volts DC to 85 volts DC. The DC/AC converter changes the 85 volts DC to 85 volts AC.

NOTE: HID BULBS CONTAIN MERCURY. FOLLOW LOCAL REGULATIONS FOR PROPER DISPOSAL.



When the HID is turned on the voltage required to begin operating is much higher than an HID already on. The starter generates 23,000 volts AC. The voltage will drop to 85 volts AC as the HID warms and light is generated.





CAUTION: DO NOT DISASSEMBLE THE BALLAST, BULB SOCKET HARNESS OR BALLAST HARNESS.

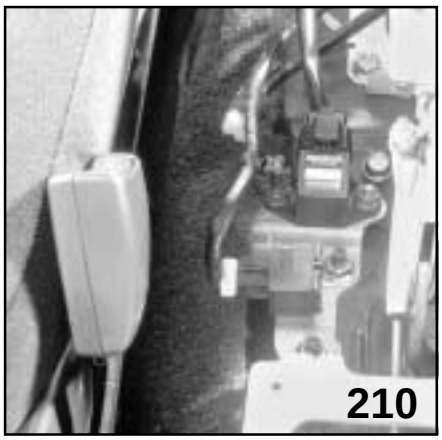
DO NOT DISCONNECT THE HEADLIGHT ASSEMBLE WITH THE LIGHTS ON.

The headlight assembly is equipped with a motor that is controlled by the driver to lower the headlights, both high and low beam. The switch allows the headlights to be lowered in 3 steps. Step 3 is the lowest setting. The purpose of the head light leveler switch is to allow the driver to lower the headlights if the illumination becomes an objection to on coming traffic.

Brakes

The 2004 WRX STi is equipped with Super Sports ABS. This system incorporates the proportioning control of Electronic Brake Distribution (EBD) and Anti Lock Brakes (ABS) with new logic that allows current ABS components to perform new tasks. EBD, introduced with last year's new Forester, controls the brake fluid pressure to the rear wheels by using wheel speed differences between the front and rear wheels. The Super Sports ABS logic assists with providing enhanced cornering control while the brake is being applied. Previous model years' ABS was designed with Select Low Control, this would control both rear wheels at the same time any time either rear wheel began to lock up. Super Sports ABS will, under the right conditions, individually control the rear wheels. This allows the brake force to the rear wheel on the outside of the turn to continue braking while the inside wheel receives anti lock control.

* Other components include wheel speed sensors, brake switch, refer to the appropriate service manual for system layout.



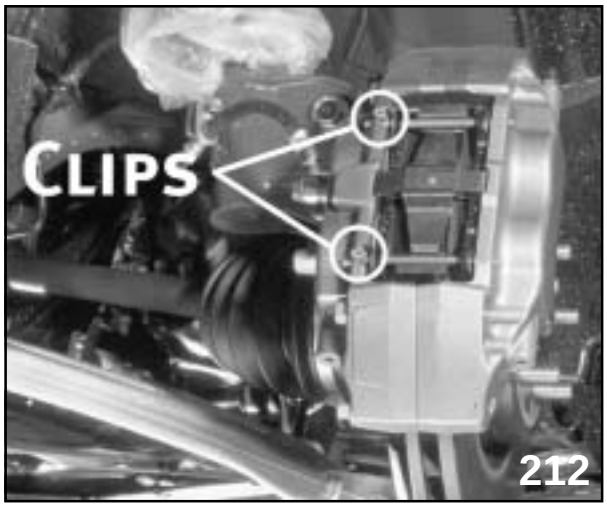
The lateral and longitudinal G sensors

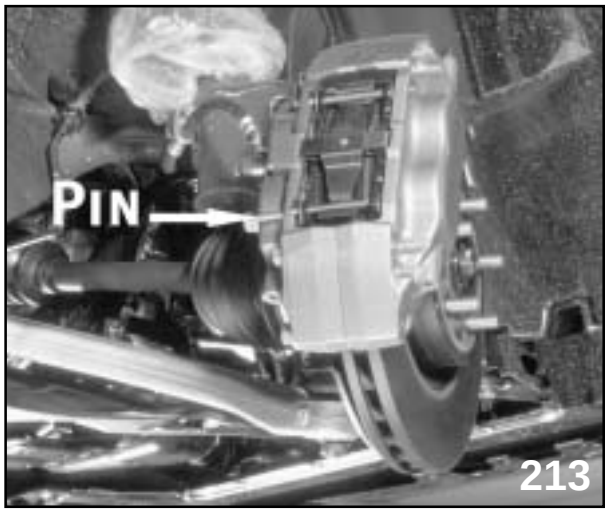
Hydraulic control unit

The WRX STi is equipped with Brembo brake calipers and pads. These high performance brakes apply direct braking force from both sides of the brake caliper. Each side of the brake caliper is provided a brake fluid bleeder. Follow the directions provided in the appropriate service manual to bleed the air from the brake system when ever service work to the hydraulics is performed.

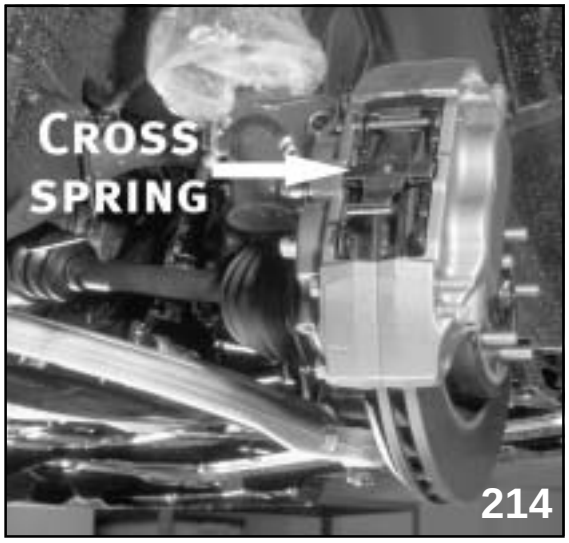
NOTE: NEVER SEPARATE THE BRAKE CALIPER HALVES

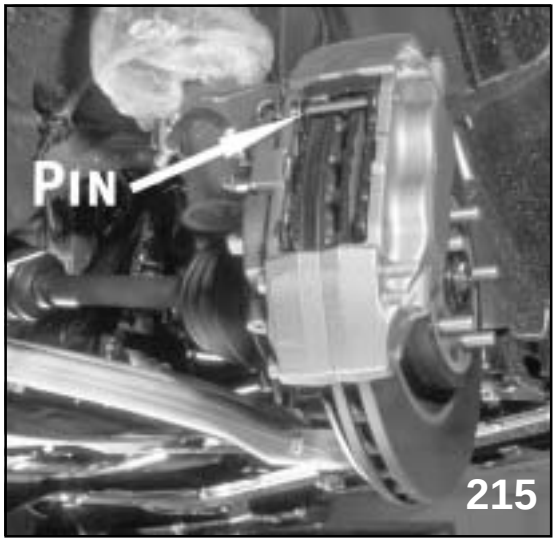
The front is equipped with Brembo 4 piston calipers. The front brake rotor is 12.6 in diameter with a minimum thickness of 28mm.





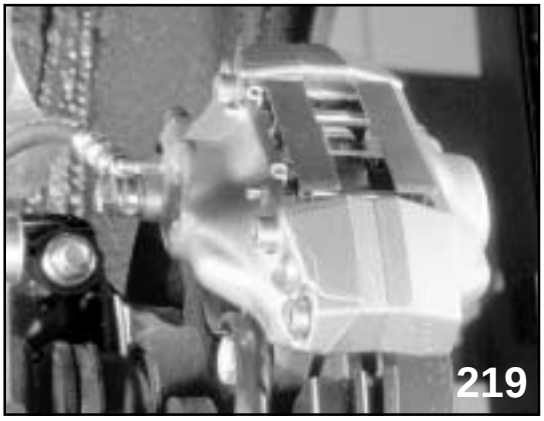
Replacing the break pads is accomplished by first removing the clips from end of the pad pins. Remove the lower pad pin.



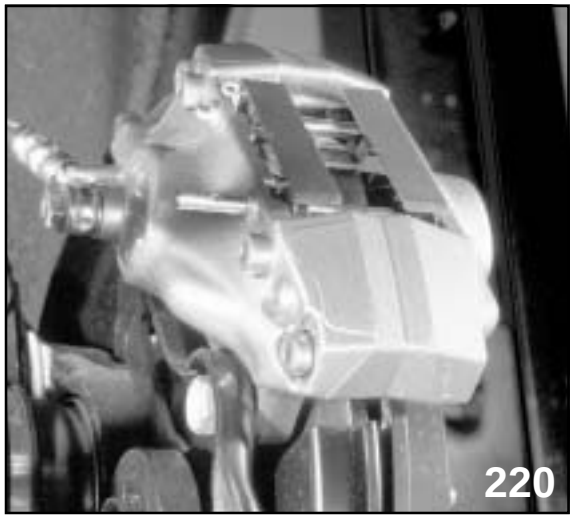


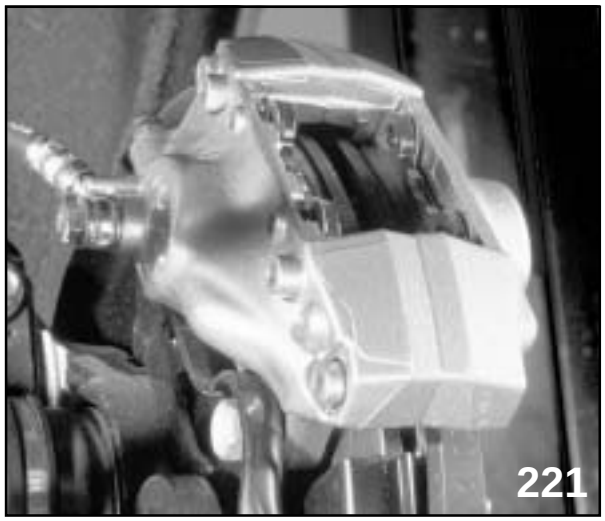
Next remove the cross spring. Then remove the upper pad pin.

Pull the pads out slightly and use the pads to push the pistons back inside the caliper.

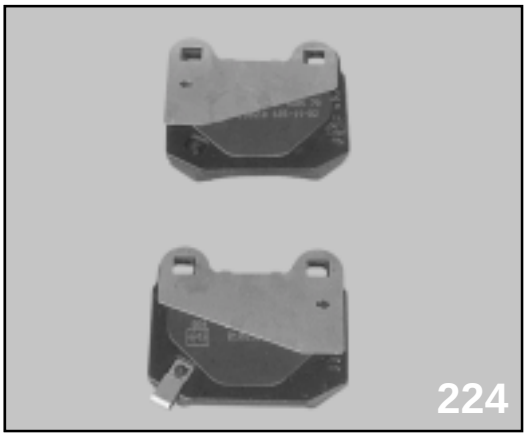


The rear of the vehicle is equipped with Brembo 2 piston calipers. The rear brake rotor is 12.3 in diameter with a minimum thickness of 18mm.





Remove the clips and pad pins, followed by the cross spring .
Pull the pads out slightly and use the pads to push the pistons back inside the caliper.



Front brake pads

Rear brake pads

Arrows point in the direction of forward rotation.

Impreza

Model Line

Sedan

Impreza 2.5 RS (SOHC 2.5 Liter)
Impreza WRX (DOHC 2.0 Liter)
Impreza WRX STi (DOHC 2.5 Liter)

Sport Wagon

Impreza 2.5 TS (SOHC 2.5 Liter)
Impreza WRX (DOHC 2.0 Liter)
Impreza Outback Sport (SOHO 2.5 Liter)

The intake manifold for the 2.5 RS, 2.5 TS and Outback sport is made from resin composite material. **Do not over tighten bolts.**

Brakes

The WRX STi model comes standard with a performance Brembo brand 4-wheel disc brake system.

This system utilizes 12.7 inch ventilated front discs with four-piston fixed calipers. The rear brakes use 12.3 inch ventilated discs with dual-piston fixed calipers. The WRX STi model comes standard with a Super Sport Anti-lock Breaking System (ABS). This ABS system incorporates Electronic Brake-force Distribution (EBD) and vehicle stability logic.

4-wheel disc brakes are standard on all 2.5 TS and Outback Sport models. Electronic Brake-force Distribution (EBD) is standard on all Impreza models.

Wheels

The WRX STi models, with a DG option package, have standard multi-spoke BBS brand 17 inch gold aluminum-alloy wheels with 225/45 ZR17 90W Bridgestone Potenza RE070 summer tires.

The WRX STi models, with a HG option package, have standard multi-spoke BBS brand 17 inch gun metal gray aluminum-alloy wheels with 225/45 ZR17 90W Bridgestone Potenza RE070 summer tires.

Front view

The front of all models have been redesigned. The hood, fenders, headlights, grille and bumper have been restyled providing a more refined sportier image. All WRX models have a larger hood scoop.

Roof view

A power glass moonroof, with tilt up and internal retract ventilation, is standard on all WRX Sedan models with a AP option package.

Rear view

The combination lights and bumper have been redesigned for all models providing a more refined sportier image.

Key lock cylinders

The gate lock cylinder has been deleted on all Sport Wagon models. This is to improve the security of the vehicle.

Rear glass

The rear glass is a lightweight design for the WRX STi model. This lightweight design is to reduce overall vehicle weight and increase performance.

Trunk spoiler

A large rectangular trunk spoiler is standard on the WRX STi model. A rear trunk spoiler, the same as the 2003 model year spoiler, is standard on all WRX Sedan models with a ZP option package.

Rear gate

The rear gate has an internal release lever behind an access plug in the trim panel on all wagon models.

Rear seat

The rear seat fold-down center armrest with trunk pass-through has been deleted on the WRX STi model.

Steering Wheel

A three-spoke STi brand steering wheel designed by the Subaru World Rally Team (SWRT) is standard on the WRX STi model. The steering wheel is black leather-wrapped with Red upper stitching and black lower stitching.

On the WRX models the MOMO emblem on the steering wheel has changed from yellow to red.

Head restraints

Active front seat head restraints are standard on 2.5 RS, 2.5 TS and Outback Sport. The active head restraint system helps reduce whiplash injury to the front seat occupants in a frontal collision.

Supplemental restraint system

Front seat head / chest side-impact air bags (SRS) are standard on all WRX and WRX STi models.

Pedals

A collapsible pedal system is standard on all models. The collapsible pedal frame helps reduce injury to the driver in a frontal collision.

Audio

The audio face plate has a silver metallic finish on the 2.5 TS and Outback Sport models.

The audio face plate has a dark gray metallic finish on the 2.5 RS and WRX models.

The audio unit and speakers have been deleted as a standard equipment on the WRX STi model. A blank cover plate will be installed in the audio unit position. As accessory audio unit will be available for this model.

An in-glass antenna is standard on all models.

All-weather package

The all-weather package is standard on all WRX Sedan models with a ZP option package and consists of the following features:

Heated Exterior Mirrors

Dual Mode Heated Front Seats

Windshield Wiper De-Icer

Cruise control

A cruise control engaged light located in the instrument cluster is standard on all models.

Door locks

A central power door lock switch is standard on all models. This switch is located in the center console.

Fog lights

Projector beam halogen foglights are standard on WRX and Outback Sport models.

Instrument cluster

2.5 TS and Outback Sport
The standard instrument cluster has a dark blue base plate. The gauges have white indicators, red illuminating needles and black trim rings. The speedometer is located in the center part of the instrument cluster and the tachometer is located on the right side of the instrument cluster.

2.5 RS
The sport instrument cluster has a dark blue base plate. The gauges have white indicators, red illuminating needles and silver trim rings. The speedometer is located on the center part of the instrument cluster and the tachometer is located on the right side of the instrument cluster.

WRX
The sport instrument cluster has a black base plate. The gauges have white indicators, red illuminating needles and silver trim rings. The tachometer is located in the center part of the instrument cluster and the speedometer is located on the right side of the instrument cluster.

Power moonroof
A power glass moonroof, with tilt up and internal retract ventilation, is standard on all WRX Sedan models with a ZP option package.

Remote keyless entry system
A remote keyless entry system is standard on all models. This system incorporates a new answer back electronic chirp to confirm mode operation.

Forester

Model Line

Forester 2.5 X
Forester 2.5 XS
Forester 2.5 XS with Premium Package
Forester 2.5 XS with Premium Package and Leather-Trimmed Upholstery
Forester 2.5 XT
Forester 2.5 XT with Premium Package and Leather-Trimmed Upholstery

New Model

Two new Forester turbo models have been added to the model line-up:

Forester 2.5 XT model:
This turbo model is an upgrade in performance from the Forester 2.5 XS model and comes standard with a monotone body color. The optional power moonroof is not available on this model.

Forester 2.5 XT with Premium Package and Leather-Trimmed Upholstery model:
This turbo model is a upgrade from the 2.5 XS with Premium Package and Leather-trimmed Upholstery model.

Engine

The Forester 2.5 XT models come standard with a 2.5 liter intercooled turbocharged double overhead cam horizontally opposed 4-cylinder boxer engine.

Engine Specifications

DOHC: 2.5-Liter
Turbocharged
Maximum boost pressure: 600 mmHg (11.6 PSI)
intercooled
Horsepower: 210-HP @ 5600 RPM
Torque: 235-LB.-FT. @ 3600 RPM
Compression Ratio: 8.2:1
Engine Type: EJ25

Intake

Active Valve Control System (AVCS) is standard on the Forester 2.5 XT models.

The intake manifold on the Forester 2.5 XT models incorporate Tumble Generator Valves (TGV) located above the fuel injectors.

The Forester 2.5 XT models are equipped with Electronic Throttle Control (ETC).

Transmission

The Forester 2.5 XT with Premium Package comes standard with a direct control automatic transmission. The remaining Forester models are equipped with an AWD 5 speed manual transmission.

Wheel

New design 16' aluminum-alloy wheels are standard on all Forester 2.5 XT models.
215/60 R16 94HR raised black wall tires are standard on all Forester 2.5 XT models.

Color

All Forester 2.5 XT models have a monotone body color.

Front view

All Forester 2.5XT models have a functional hood scoop for directing cool air to the intercooler.

Pedals

All 2004 Forester models are equipped with a safety brake pedal system that is designed to yield during a serious frontal impact.

Audio system

An AM/FM/WB stereo with 6-disc in-dash CD changer and upgraded speakers are standard on all Forester 2.5 XS and 2.5XT models. A 6 speaker audio system is standard on all Forester 2.5 XS models. This system includes 4 door speakers and 2 front door tweeter speakers. A 7 speaker audio system is standard on all Forester 2.5 XT models. This system includes 4 door speakers, 2 front door tweeter speakers and a rear sub-woofer speaker.

BAJA

Model Line

Baja Sport (RH)
Baja (TG)
Baja Turbo (TH)

The Baja Turbo is equipped with the same 2.5 liter turbo charged engine and fuel system as the Forester XT.

An AWD 5 speed manual transmission is standard. Direct AT with Variable Torque Distribution (VTD) is available as an option.

The hood is equipped with a low profile hood scoop that directs air over the intercooler. A flexible roof mount antennae with amplifier is used with the audio system to improve radio reception.

Direct Control 4-EAT

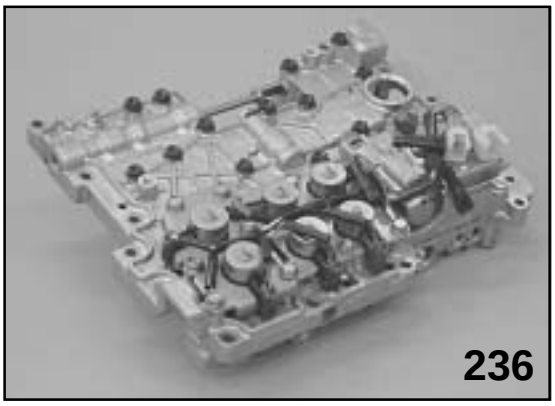
Outline

The Direct control 4EAT has been introduced to further improve the control and feel of forward gear shifting. This new design focuses only on the controlling elements of the transmission. The internal construction of the 4EAT remains the same as the previous model year. There are no accumulators in the new design. Their functions have been replaced with more precise control of the solenoid valves.

The following is brief explanation of construction and features on the new transmission.

- Accuracy of the hydraulic control is improved by the employment of a new hydraulic valve body assembly.
- The transfer control valve located at the rear end of transmission is relocated inside of hydraulic valve body assembly.
- A hall element sensor is used for the rear wheel speed sensor in order to improve detecting accuracy.

*** Reverse inhibit control method is changed to select lever locking method from hydraulic control method in the reverse inhibit circuit.**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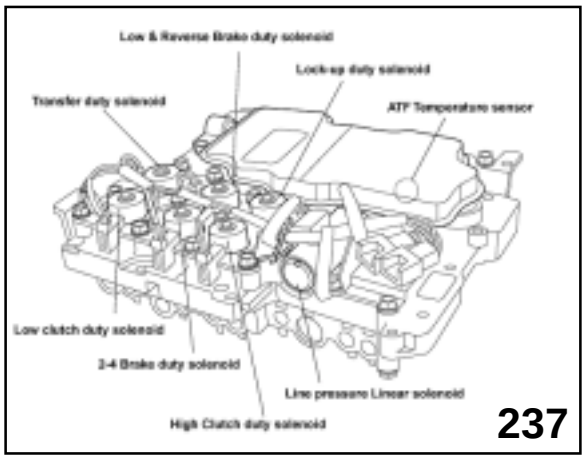

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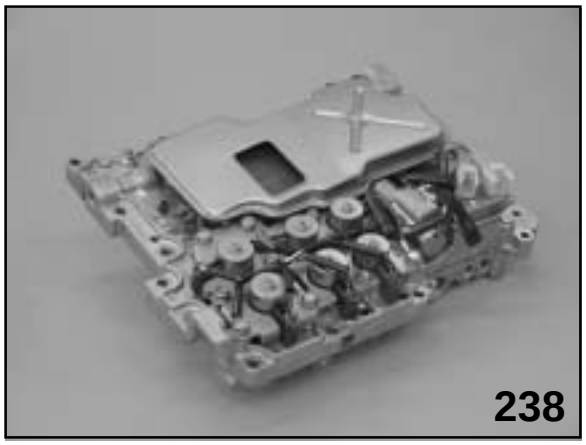
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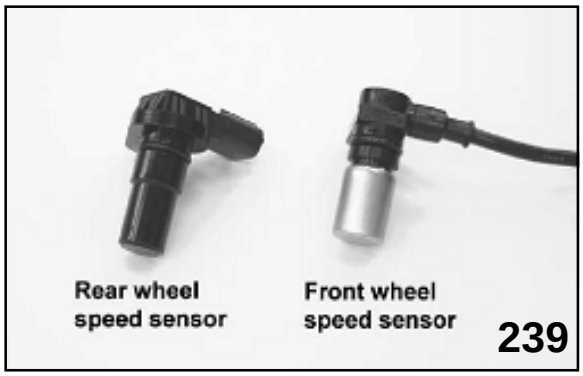
Control Valve Assembly

The new valve body assembly consists of a two-piece structure compared to the previous three-piece structure. It has seven solenoid valves and one ATF temperature sensor.

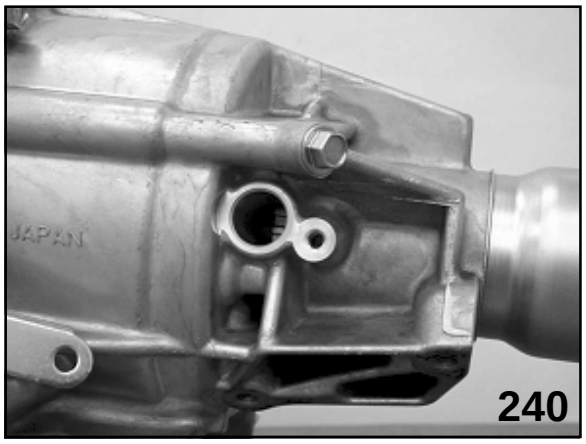
***NOTE:** VALVE BODY AND SOLENOIDS ARE NOT SERVICEABLE.*

Rear wheel speed sensor



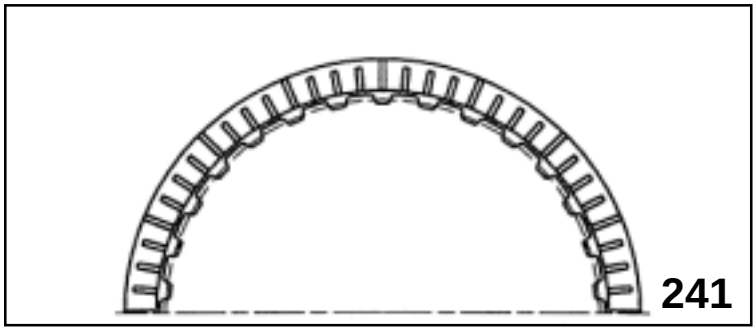
A Hall element sensor is used for rear wheel speed sensor. The Shape of the extension case where the sensor is installed has been modified according to the sensor change.

Transmission case



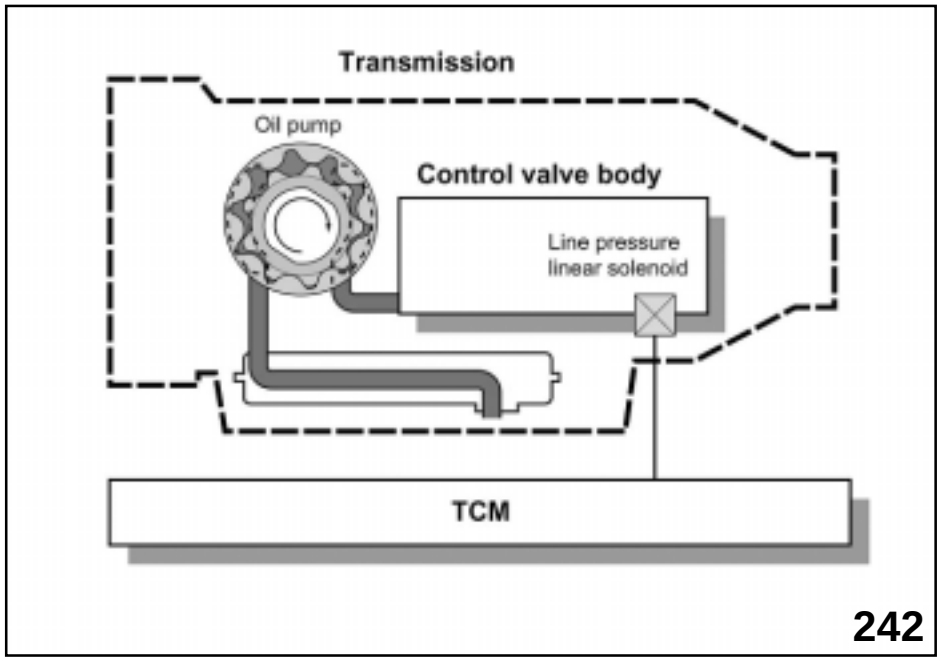
The Transfer control valve located at the rear end of transmission has been relocated inside of valve body assembly. According to this modification, the contour of the rear end of transmission case is changed.

Clutch plate face



Loss-reduction type clutch plates are used to improve clutch release. They are incorporated into 2-4 brake, reverse clutch and low clutch.

Line pressure control

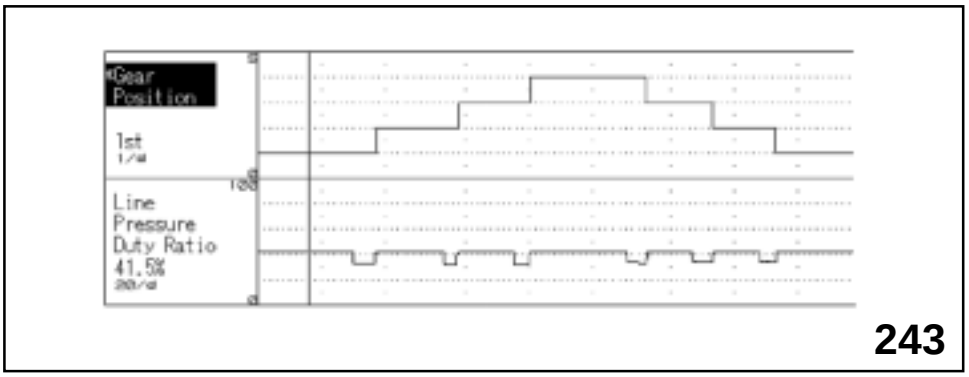


The TCM judges driving condition of the vehicle from signals such as throttle opening angle, vehicle speed, gear position and so on, and controls the line pressure linear solenoid so as to become optimum line pressure at that time. The linear solenoid driving signal sent from TCM is 300Hz duty signal. The TCM performs the following line pressure control.

Normal control

Line pressure is controlled according to the throttle opening angle, vehicle speed, and select lever position.

Line Pressure Control at Gear shifting



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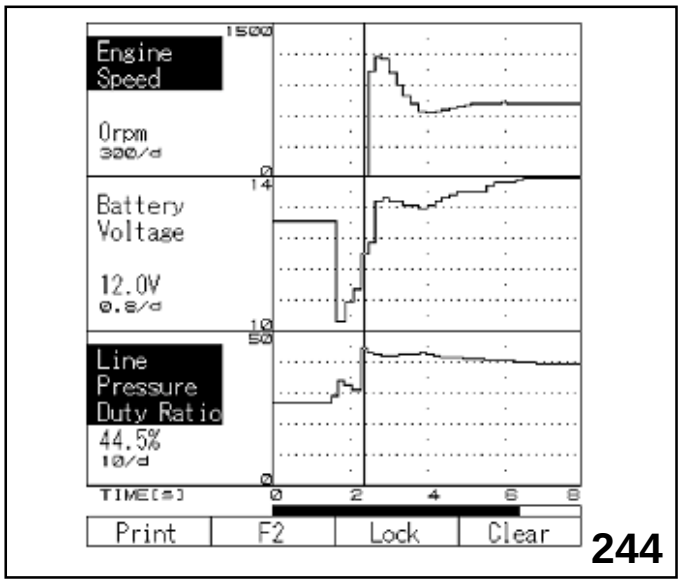
Line pressure is controlled in order to reduce shift shock at gear shifting.

Engine start control



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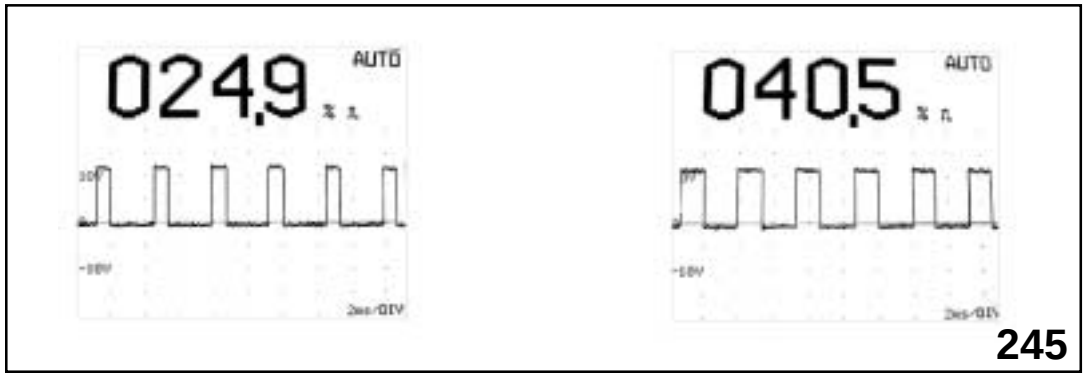
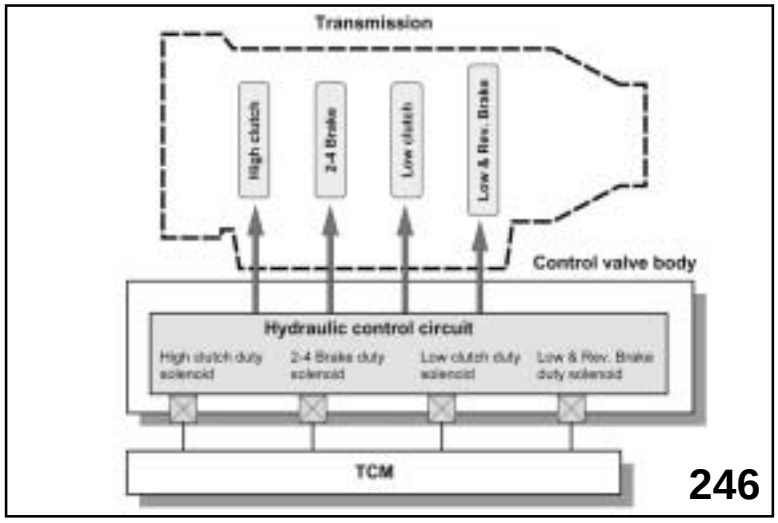
Line pressure is fixed at the minimum pressure for reducing starter motor loads at the engine starting.

Linear solenoid driving signal of TCM



Waveform for linear solenoid

Gear shift control



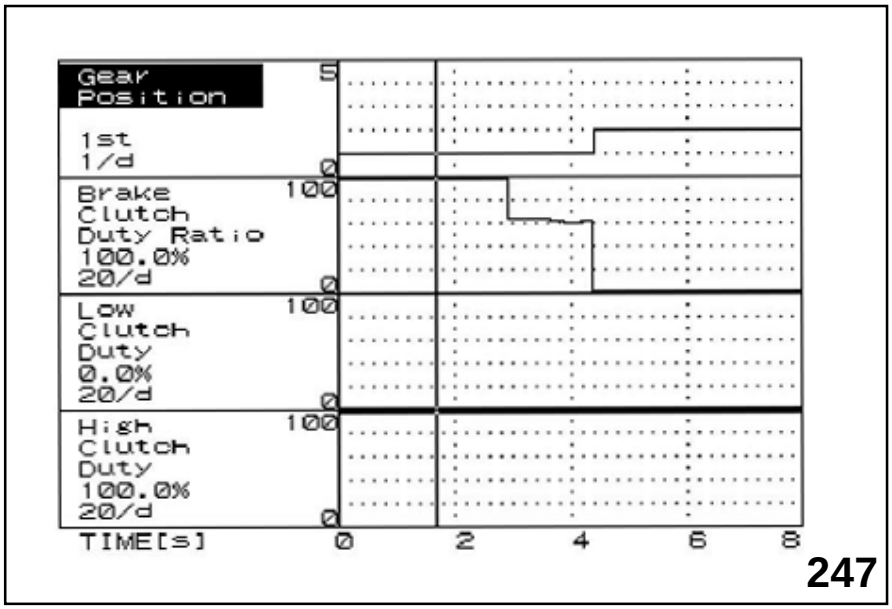
The manual valve and 4 duty solenoid valves, H/C, L/C, 2-4B, and Low & Rev. Brake are involved to carry out gear-shifting.
These solenoid valves control engagement and disengagement of Low clutch, 2-4 Brake, High clutch, and Low & Rev. Brake that are gear-shifting members assembled inside of the transmission, and 1st through 4th gear-shifting is carried out.
Also, these solenoid valves work under a duty control signal and adjust oil pressure variation smoothly when gear-shifting. The accumulators used for previous 4EAT are discontinued by this modification.

NOTE: THE REVERSE SHIFT DOES NOT USE ANY SOLENOID VALVE. OIL PRESSURE FROM THE MANUAL VALVE ENGAGES BOTH REVERSE CLUTCH AND LOW & REV. BRAKE FOR REVERSE SHIFT.

TCM performs the following hydraulic control.

Basic control

Gear shifting is carried out according to the gearshift map in response to throttle opening angle signal and vehicle speed signal.



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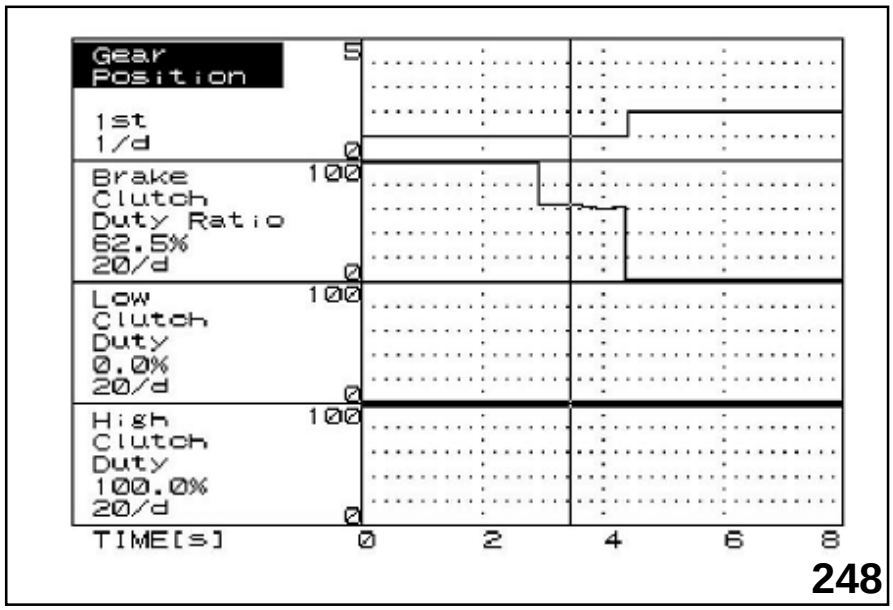

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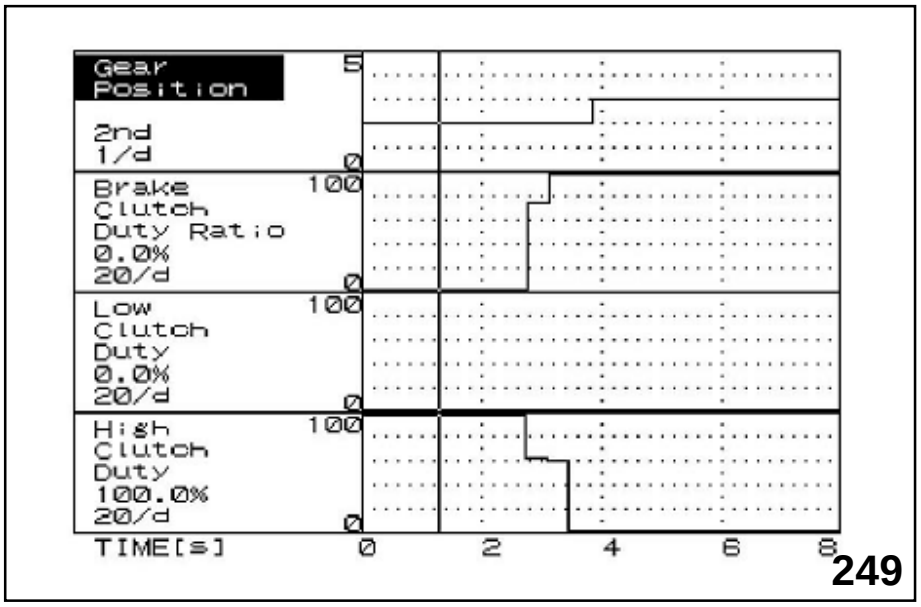
Condition of solenoid valve during gear shifting from 1st to 2nd



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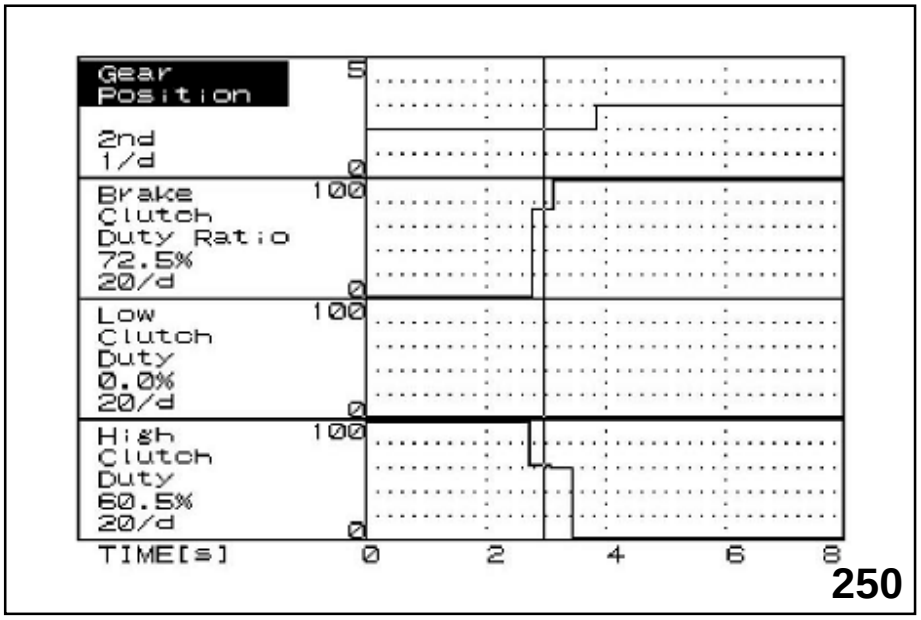

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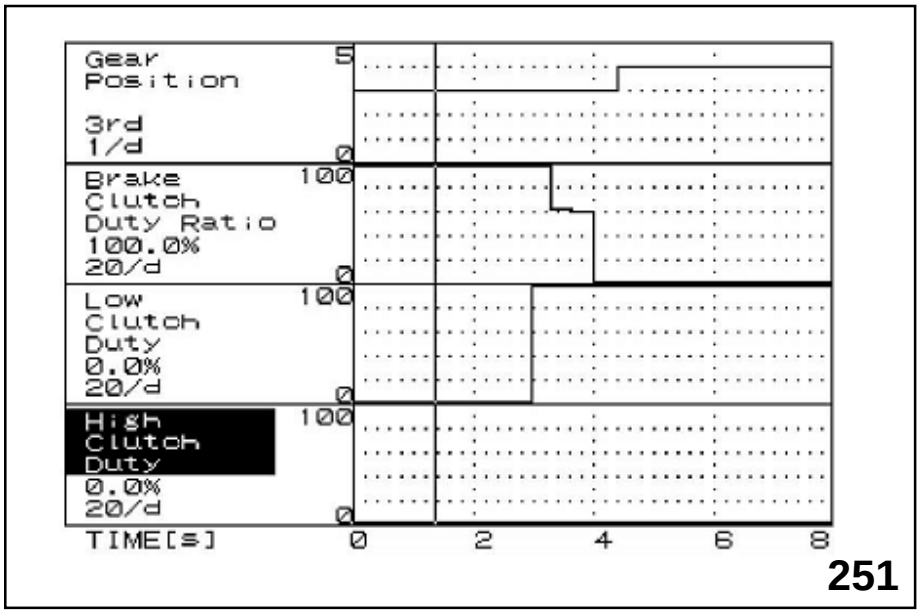
Condition of solenoid valve during gear shifting from 2nd to 3rd



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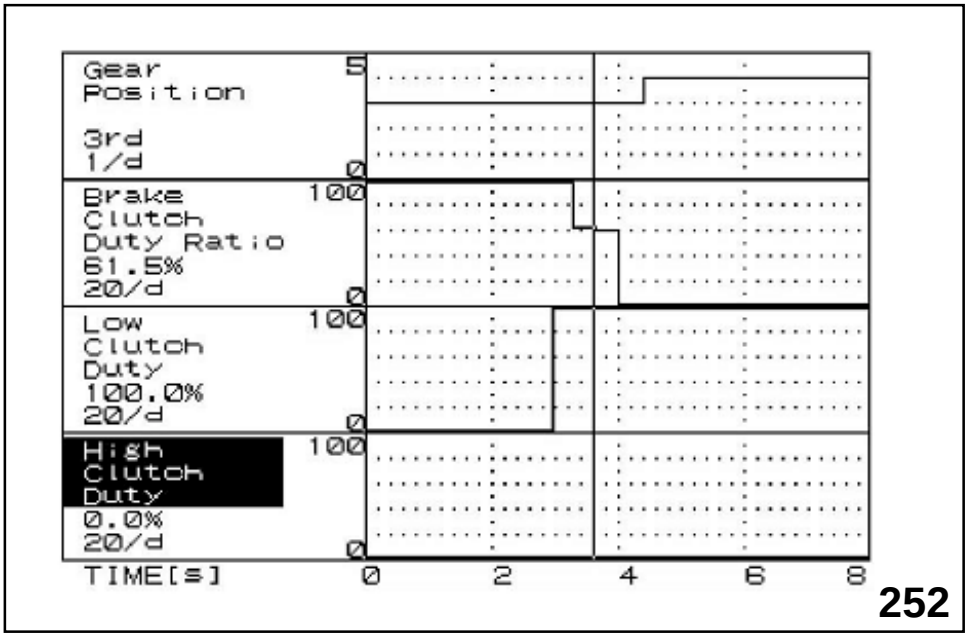

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Condition of solenoid valve during gear shifting from 3rd to 4th

ABS in-operation control

When TCM receives ABS operating signal and brake switch ON signal, TCM fixes, in response to the vehicle speed, transmission gear to the one so as to the ABS system can work maximum effect.

Low temperature ATF control

TCM does not allow shifting to the 4th gear when ATF temperature is lower than the predetermined temperature. (about - 10° C and lower)

Hold mode control

TCM performs starting control from 2nd gear when select lever is in the 2nd range.

Engine torque control during gearshift

Control that makes engaging and disengaging of clutch and brake smoothly is carried out with reducing engine torque temporary for a gear shifting.

TCM transmits cooperate control signal to ECM at the start of gear shifting. ECM makes engine torque reduced temporary according to the received signal.

Uphill and down hill control

TCM fixes the gear position to 3rd speed during uphill driving in order to avoid frequent gear shifting between 3rd speed and 4th speed. Also, TCM shifts the gear down to 3rd speed when brake switch is ON during downhill driving at about 80 km/h.

Learning control

Shift shock is apt to occur when a transmission becomes old by reason of a change on standing and/or wear of clutch plates and brake plates, deterioration of ATF and so on.
Learning control reduces shift shock caused by a change of standing.
TCM measures a gear shifting motion time based on the signals from turbine speed sensor, rear wheel speed sensor, engine revolution, ATF temperature and throttle opening* during gear shifting of transmission, and is comparing it with criterion time memorized in the memory. Stable gearshift feeling can be maintained for a long time with adjusting an oil pressure added to the clutches and brakes based on the comparison result.

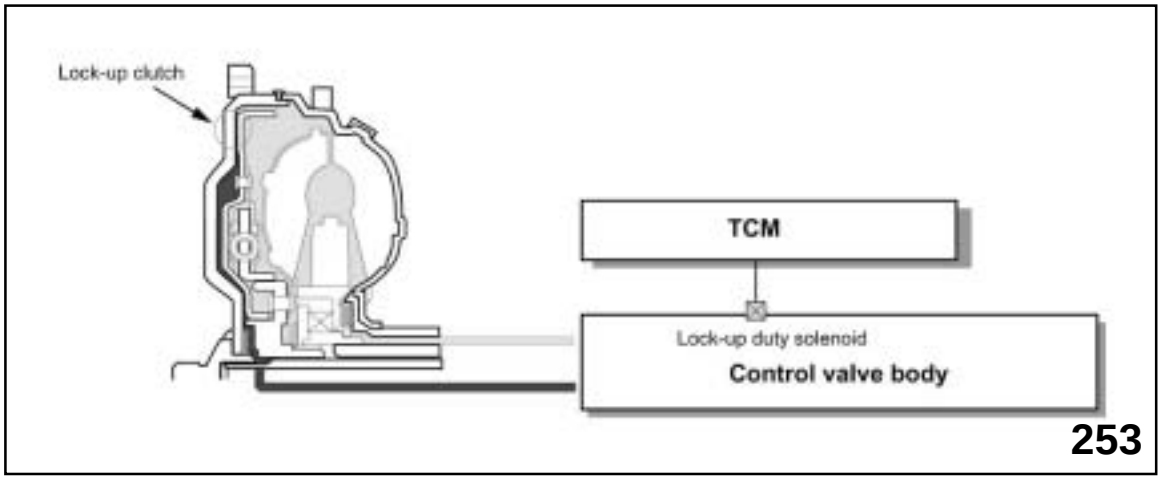
***** Engine revolution signal and throttle opening signals are sending by ECM.

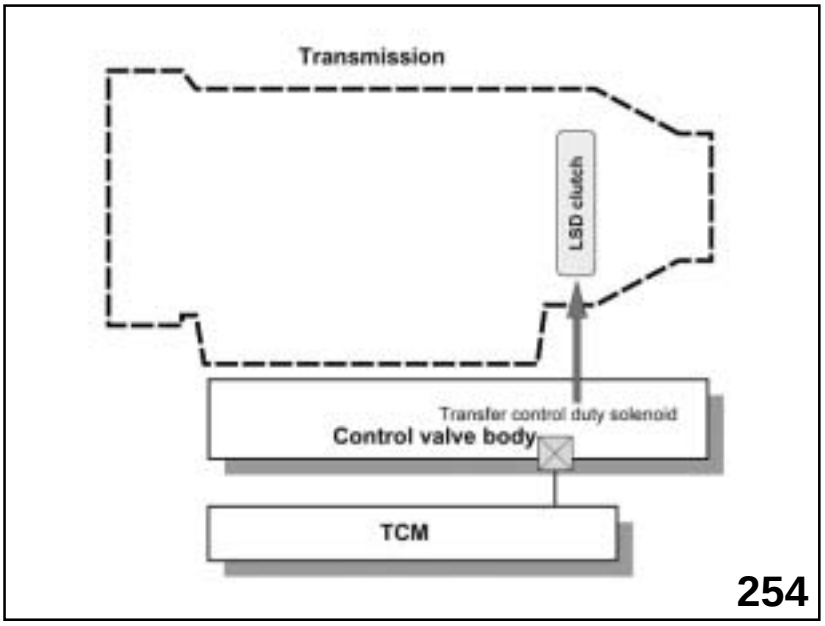
Lock-up clutch control

Lock-up control operates beyond a certain vehicle speed with 4th gear driving. TCM is carrying out smooth lock-up control in order to reduce engaging and disengaging shocks of lock-up clutch.

Smooth lock-up control

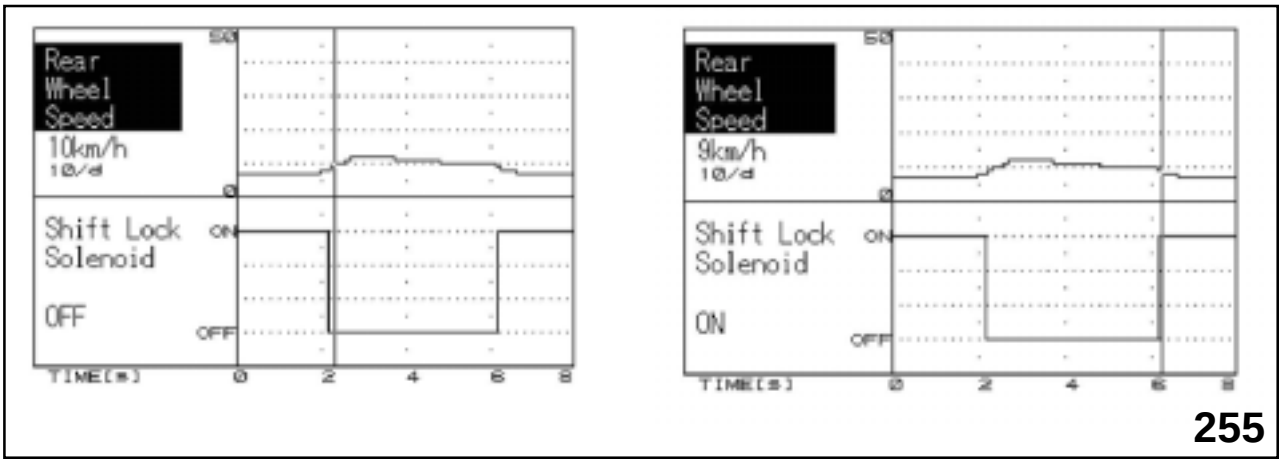
When vehicle-driving conditions meet the term of lock-up engagement, TCM increases duty ratio of lock-up duty solenoid driving signal gradually, and has lock-up clutch engaged slowly. This process prevents a shock of lock-up clutch engagement.





Transfer control valve and duty solenoid mounted at the rear end of transmission case of the previous 4-EAT are assembled in the hydraulic control valve assembly in the Direct control 4-EAT.

Reverse shifting control



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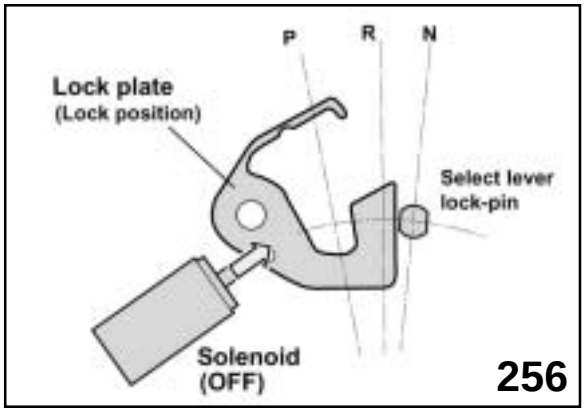
This control works to block gear shifting into R range with select lever at and over a certain vehicle speed during forward driving.

Reverse inhibit control system of previous 4-EAT has the structure that hydraulic circuit in the hydraulic control valve assembly works to prevent gearshift into the reverse position when a driver tries to shift into R range beyond a certain forward driving speed.

On the direct 4-EAT system, the system is modified to prevent the movement of select lever to R range beyond a certain forward driving speed.

Prevention of the select lever movement to R range is carried out with lock plate assembled at the bottom of the select lever. Since shift lock solenoid is OFF when a vehicle speed is beyond about 10 km/h in forward direction, lock plate moves to lock position, and select lever movement to R range from D range is blocked.

NOTE: WHEN IGNITION SWITCH IS OFF WITH THE RANGE OTHER THAN P, SHIFT LOCK SOLENOID IS TURNED ON BY TCM FOR ABOUT 30 SECONDS AND SELECT LEVER MOVEMENT TO P BECOMES POSSIBLE.



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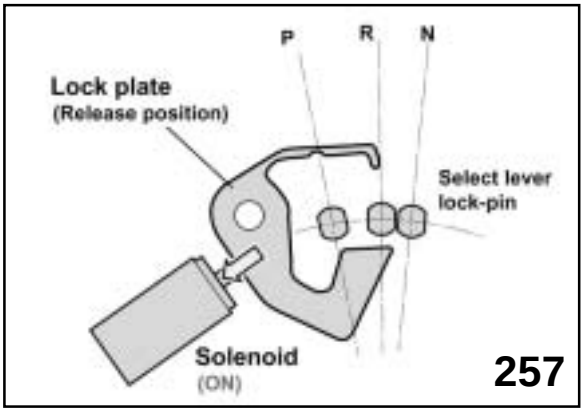

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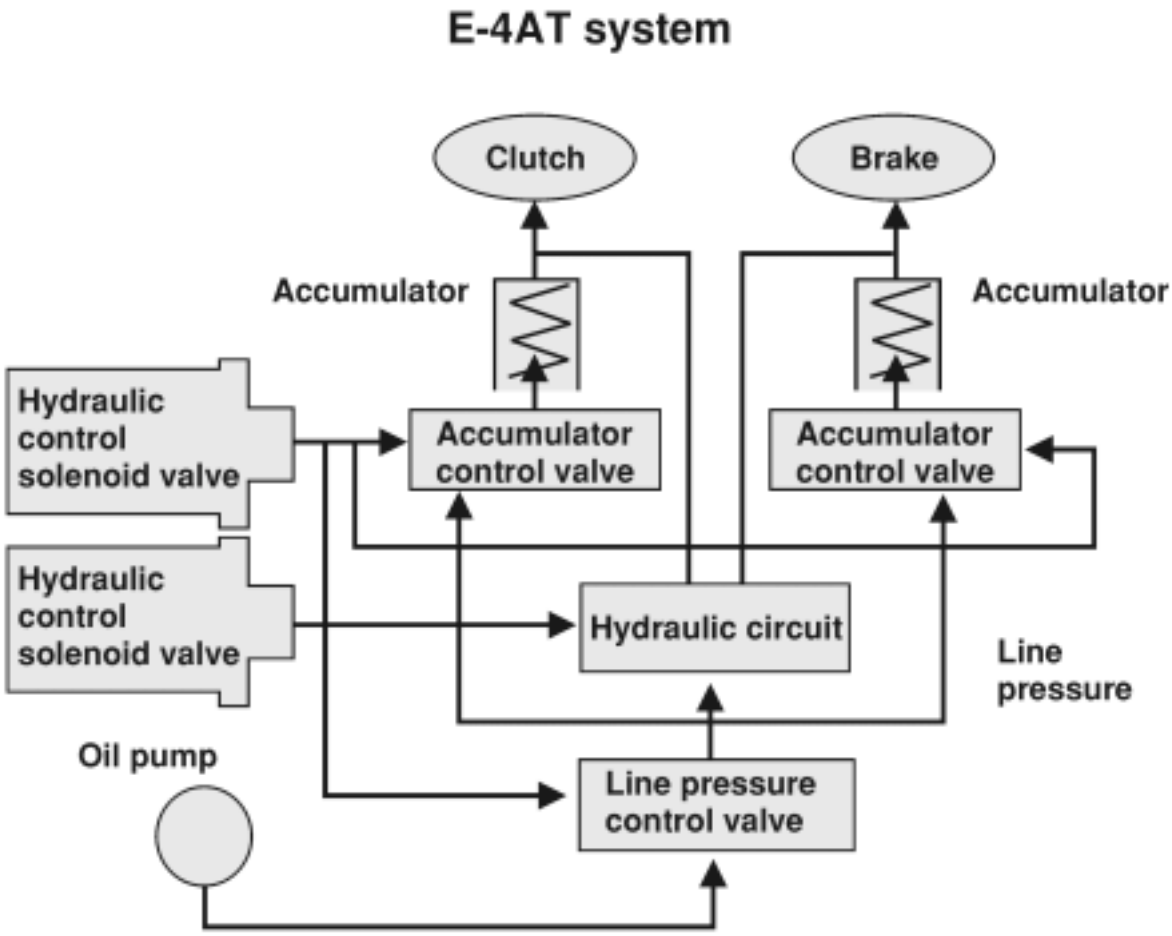
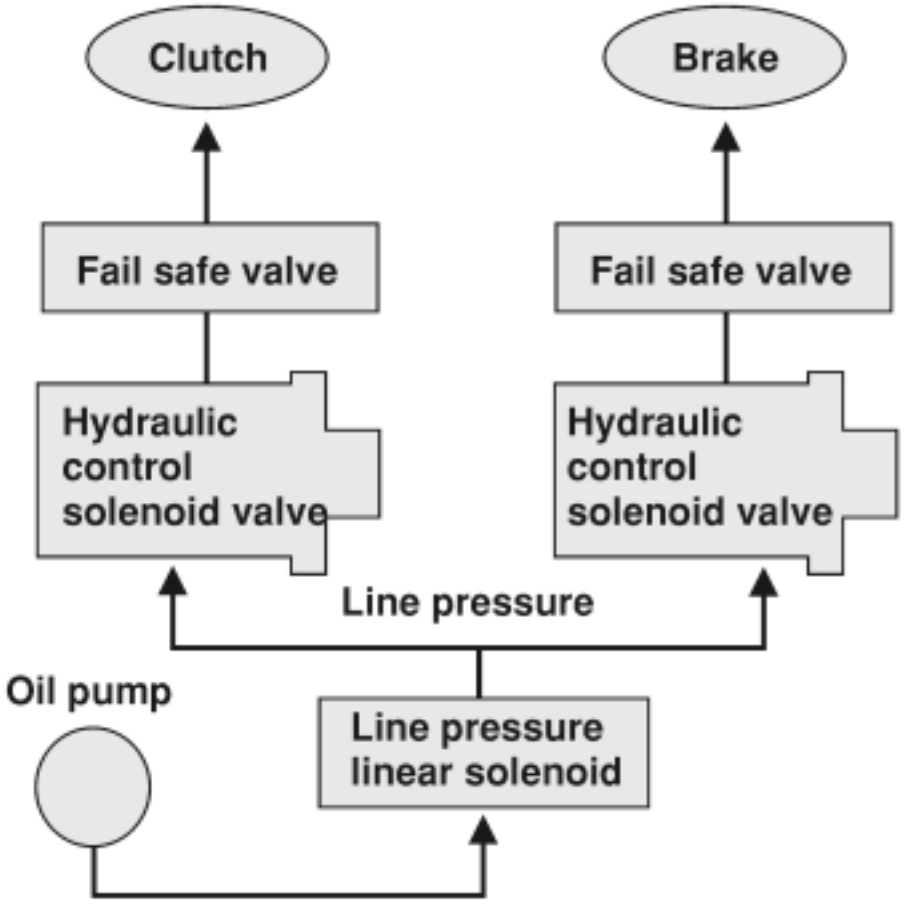
Fail safe function

Direct control E-4AT

Speed Sensor	When TCM detects a failure in a circuit (open or short?), Front wheel sensor supports rear wheel sensor. (Turbine speed sensor supports front wheel speed sensor further.) Impossible case of support: Transmission gear position is fixed to 3rd speed.
Turbine speed sensor	When TCM detects a failure in a circuit (open or short?), Vehicle speed sensor supports Turbine Sensor.
Throttle position sensor	When TCM detects a failure by the communication with ECM (open or short?), The certain fixed value is used fot the control.
Inhibitor switch	Multiple signals from inhibitor switch input into TCM simultaneously, TCM selects shift range by the following order of priority. D.3.2.1.N, P
Line pressure linear solenoid	When TCM detects open or short in a circuit, TCM makes the solenoid OFF. In result, lock-up mechanism is fixed to disengaged condition.
Lock-up duty solenoid	When TCM detects open or short in a circuit, TCM makes the solenoid OFF. In result, lock-up mechanism is fixedto disengaged condition.
Transfer duty solenoid	When TCM detects open or short in a circuit, TCM makes the solenoid OFF. In result, lock-up mechanism is fixed at o and transfer becomes FWD.
2-4 Brake duty solenoid	When TCM detects open in a circuit, TCM fix the gear at 2nd position. When TCM detects battery short in a circuit, TCM fix the gear at 3rd position.
Low clutch duty solenoid	When TCM detects open in a circuit, TCM fix the gear at 3rd position. When TCM detects battery short in a circuit, TCM fix the gear at 4th position.
High clutch duty solenoid	When TCM detects open in a circuit, TCM fix the gear at 3rd position. When TCM detects battery short in a circuit, TCM fix the gear at 2nd position.
Low & Reverse duty solenoid	When TCM detects open in a circuit, TCM fix the gear at 1 range-1st postion. When TCM detects battery short in a circuit, TCM shift the gear as usual (1st-4th), but 1 range-1st is not available.


E-4AT system
Clutch
Brake
Accumulator
Accumulator
Hydraulic control solenoid valve
Accumulator control valve
Accumulator control valve
Hydraulic control solenoid valve
Hydraulic circuit
Line pressure
Oil pump
Line pressure control valve

Direct E-4AT system



NOTES

NOTES

NOTES


CERTIFIED
SUBARU
TECHNICIAN


AUTOMOTIVE
Youth
Educational
Systems
YES
PROUD PARTNER