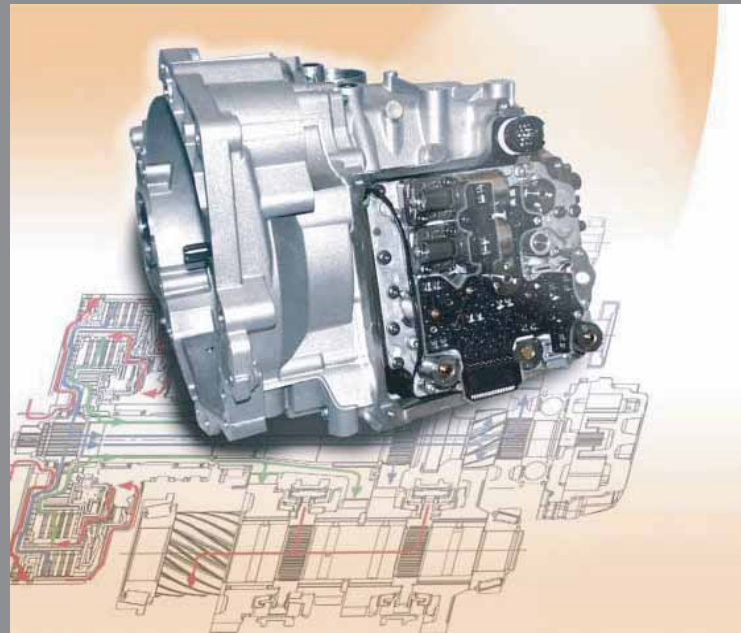


The 02E Direct Shift Gearbox Design and Function



Self-Study Program
Course Number 851403



Volkswagen of America, Inc.
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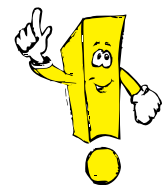
Always check Technical Bulletins and the Volkswagen Worldwide Repair Information System for information that may supersede any information included in this booklet.

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New!



Important/Note!



The Self-Study Program provides you with information regarding designs and functions.

The Self-Study Program is not a Repair Manual.

For maintenance and repair work, always refer to the current technical literature.

Introduction

The current transmission market in Europe is primarily manual transmissions. However, the markets in Japan and the United States use primarily automatic transmissions. Both of these transmissions have benefits and drawbacks.

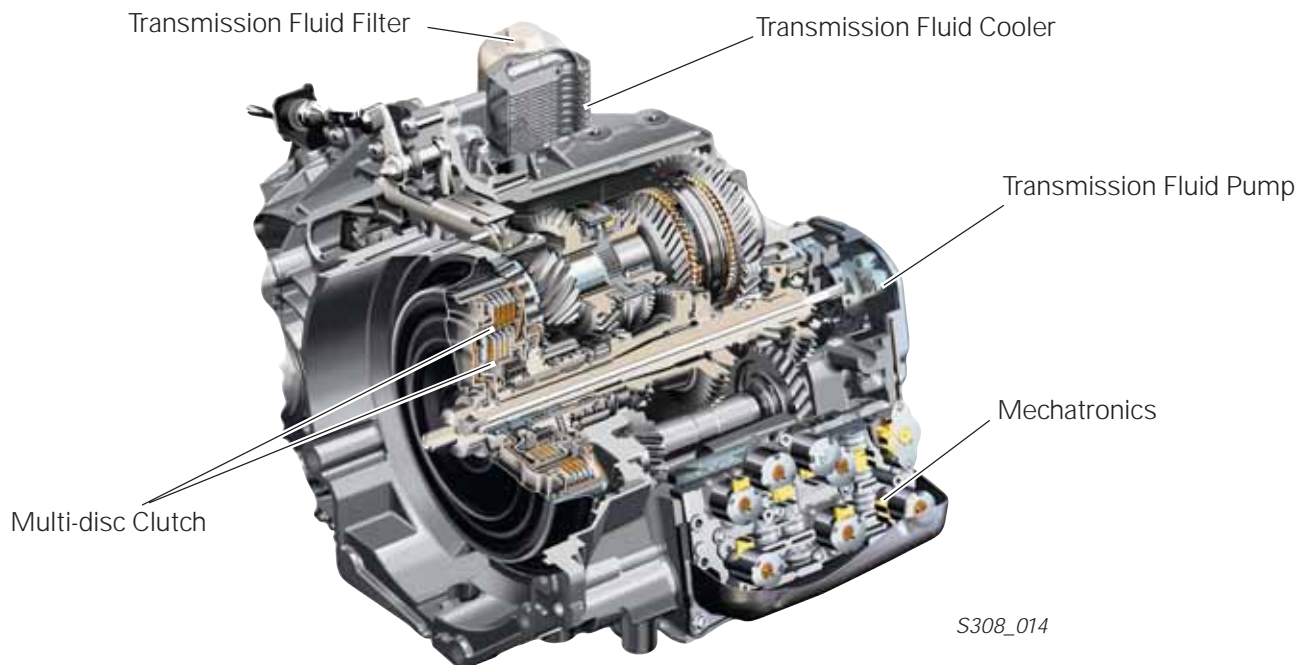
Manual transmission benefits:

- High efficiency
- Strength
- Driver control

Automatic transmission benefits:

- High comfort
- Ease of use

Based on this information, Volkswagen set out to design a transmission that combined the best characteristics of each of these transmissions. The result is the Direct Shift Gearbox (DSG).



The dual wet-clutch design and automatic shifting programs of this transmission will satisfy the automatic transmission driver's demands of high comfort and ease of use.

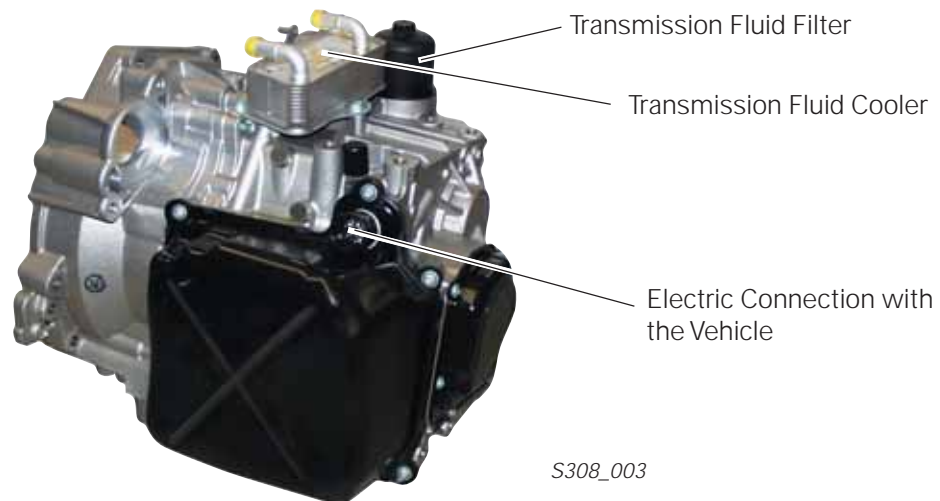
The fast and smooth shifting capabilities, which can be controlled by the driver, satisfy the manual transmission driver's demands.

Also, this transmission offers fuel consumption characteristics as low as most vehicles with manual transmissions.

Introduction

The Direct Shift Gearbox has the following features:

- Six forward gears and one reverse gear
- Normal driving program, "D"
- Sport shifting program, "S"
- Selector lever and steering wheel Tiptronic switches (optional)
- Mechatronics integrates electronic and electro-hydraulic controls into a single unit, located inside of the transmission
- Hillholder function: if a vehicle is brought to a stop by light braking, the clutch pressure rises and the vehicle remains motionless
- Creep regulation: permits "creeping" of the vehicle when the brake pedal is released and the accelerator pedal is not depressed
- Emergency running mode: when in emergency running mode, the vehicle can only be driven in either 1st and 3rd gears, or only in 2nd gear



Part number	DSG 02E (Direct Shift Gearbox)
Weight	About 207 lbs (94 kg) in front drive vehicles, 229 lbs (104 kg) in 4Motion vehicles
Torque	Maximal 258 lbs-ft (350 Nm) (engine dependent)
Clutch	Two wet multi-disc clutches
Gear ranges	Six forward gears, one reverse gear (all synchronized)
Operating mode	Automatic and Tiptronic mode
Fluid volume	1.9 gallons (7.2 liters Direct Shift Gearbox fluid G052 182)

Selector Lever

Operation

The selector lever operation is the same as in other automatic transmission vehicles. However, the Direct Shift Gearbox also offers the possibility of being shifted with Tiptronic. This can be activated either through the selector lever or by using the optional steering wheel buttons.

The selector lever controls the selector lever interlock and the ignition key interlock of the vehicles equipped with an automatic transmission. The interlock function operates the same as before, but the construction is different.

The selector lever positions are:

P - Park

To shift the selector lever out of this position, the ignition must be ON and the brake pedal must be depressed. In addition, the unlocking button must be depressed on the selector lever.

R - Reverse

To shift into Reverse, the unlocking button must be depressed.

N - Neutral

In this position, the transmission is idling.

If the selector lever remains in Neutral for an extended period of time, the brake pedal must once again be depressed to change the lever position.

D - Drive

This position allows for automatic shifting of forward gears.

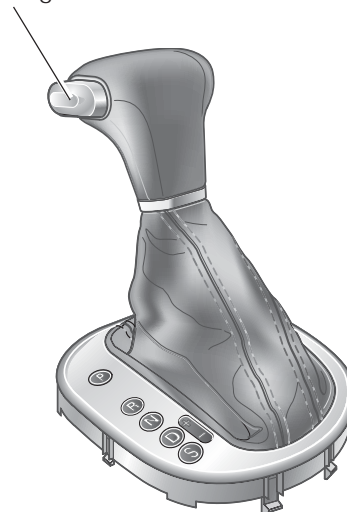
S - Sport

This position allows for automatic shifting of forward gears but will hold each of these gears until a higher RPM before shifting.

+ and -

The Tiptronic functions can be controlled in the right cover plate of the selector lever and can also be controlled with the steering wheel switches.

Unlocking Button



S308_004

Steering Wheel Switches



S308_063

Selector Lever

Selector Lever Design

The selector lever includes the following components:

Selector Lever Sensor System Control Module J587

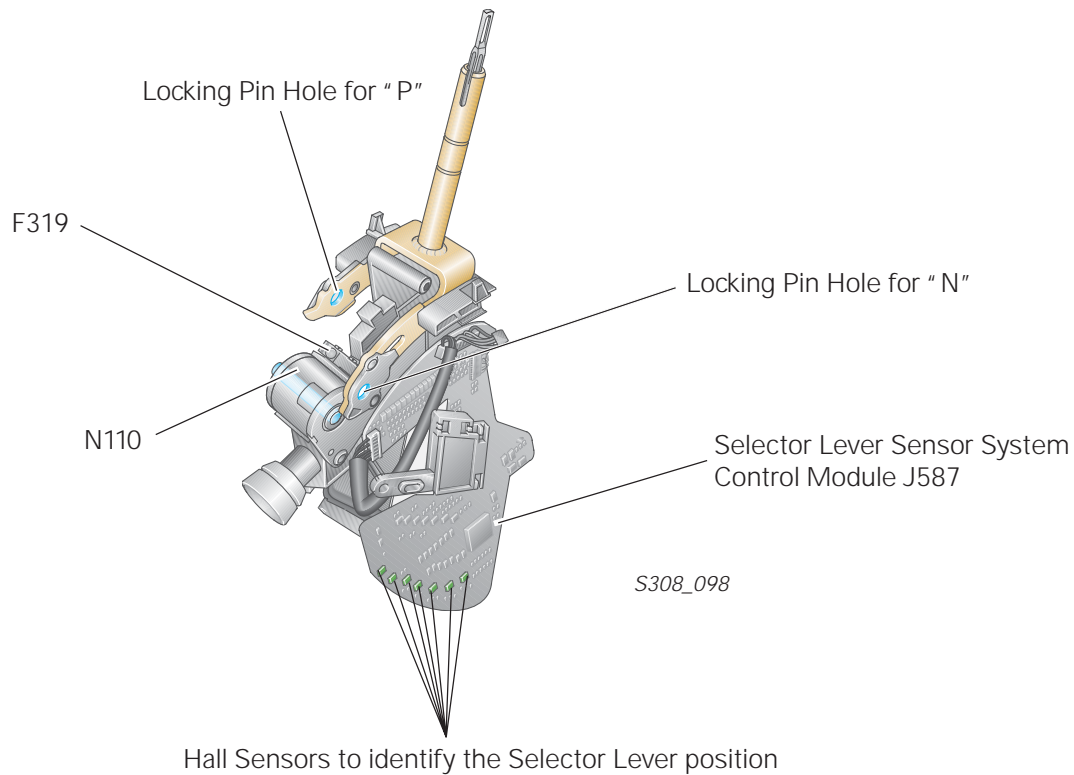
The Hall sensors in the selector lever input unit record the position of the selector lever and communicate this position to the Mechatronics via the CAN-Bus.

Shift Lock Solenoid N110

This solenoid locks the selector lever in the "P" and "N" positions. The solenoid is controlled by the Selector Lever Sensor System Control Module J587.

Selector Lever Park Position Interlock Switch F319

If the selector lever is in the "P" position, the switch sends the signal "Selector lever in "P" position" to the Steering Column Electronics System Control Module J527. The control module requires this signal to control the ignition key interlock.



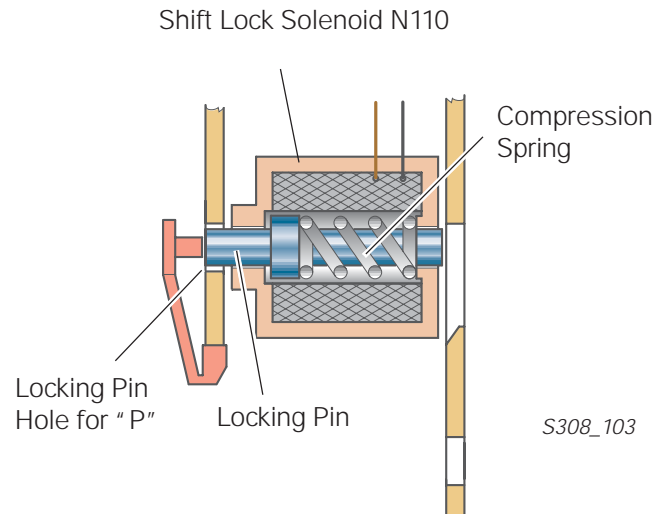
Selector Lever

Shift Lock Solenoid N110

The Shift Lock Solenoid N110 functions as follows:

Selector lever locked in "P":

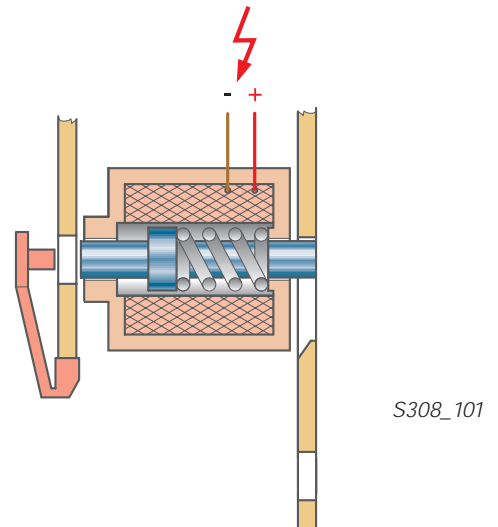
When the selector lever is in "P", the spring activated locking pin is in the locking pin hole "P". As a result, it prevents the accidental shifting of the selector lever.



Selector lever unlocked:

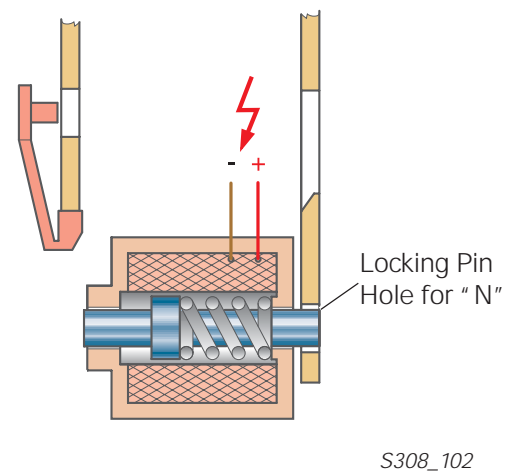
Once the ignition has been switched on and the brake pedal has been applied, the Selector Lever Sensor System Control Module J587 energizes the Shift Lock Solenoid N110. As a result, the locking pin is pulled out of the locking pin hole "P".

The selector lever can then be moved in other positions.

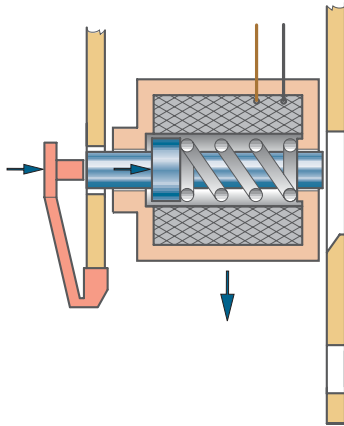


Selector lever locked in "N":

If the selector lever remains in the N position for more than 2 seconds, J587 will energize N110, allowing the locking pin to engage in the N locking pin hole. This prevents accidental shifting of the selector lever into a drive gear. This pin will be unlocked when the brake pedal is depressed.



Selector Lever



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Emergency release

In case of a power supply failure to the Shift Lock Solenoid N110, the selector lever can no longer be shifted because the shift lock "P" remains activated by spring tension.

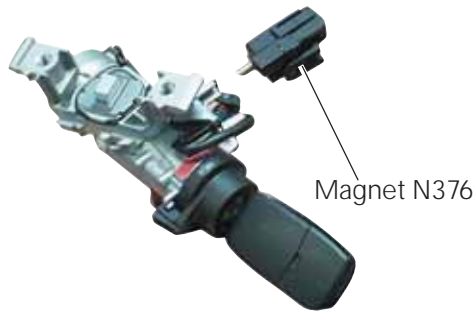
Apply mechanical pressure on the locking pin with a small object to disengage the shift lock. This releases the selector lever into the "N" position.

Selector Lever

Ignition key interlock

The ignition key interlock prevents the removal of the ignition key from the ignition assembly if the selector lever is not engaged and locked in the Park position.

It operates electromechanically and is controlled by the Steering Column Electronics System Control Module J527.



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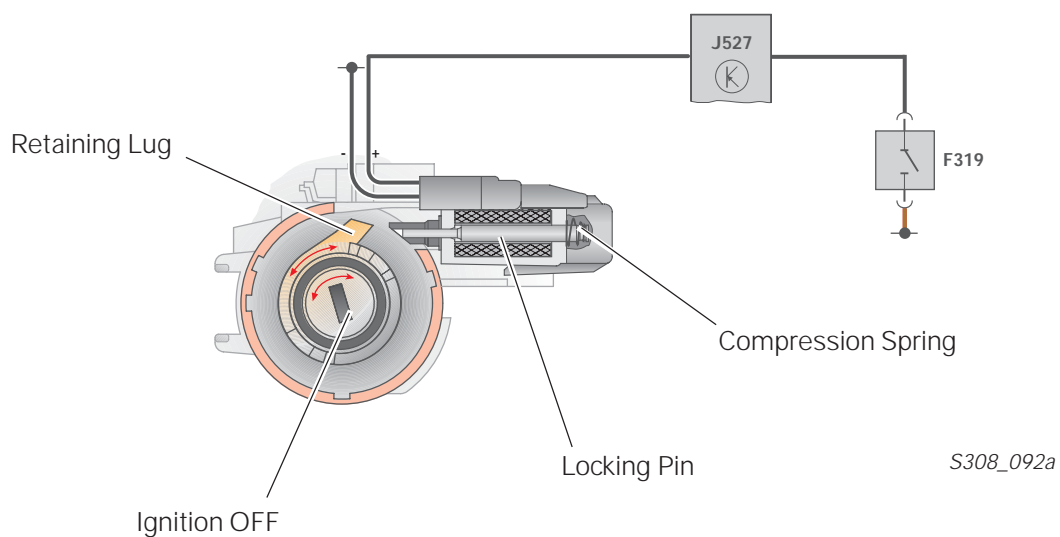
The interlock functions as follows:

Selector lever in "P"; ignition switched OFF.

If the selector lever is in "P", the Selector Lever Park Position Interlock Switch F319 is open.

The Steering Column Electronics System Control Module J527 recognizes that the switch is open. The Ignition Switch Key Lock Solenoid N376 is not energized.

The compression spring in the solenoid presses the locking pin into the disengaged position.



S308_092a

Selector Lever

The interlock functions as follows:

Selector lever in "D", the ignition is switched ON.

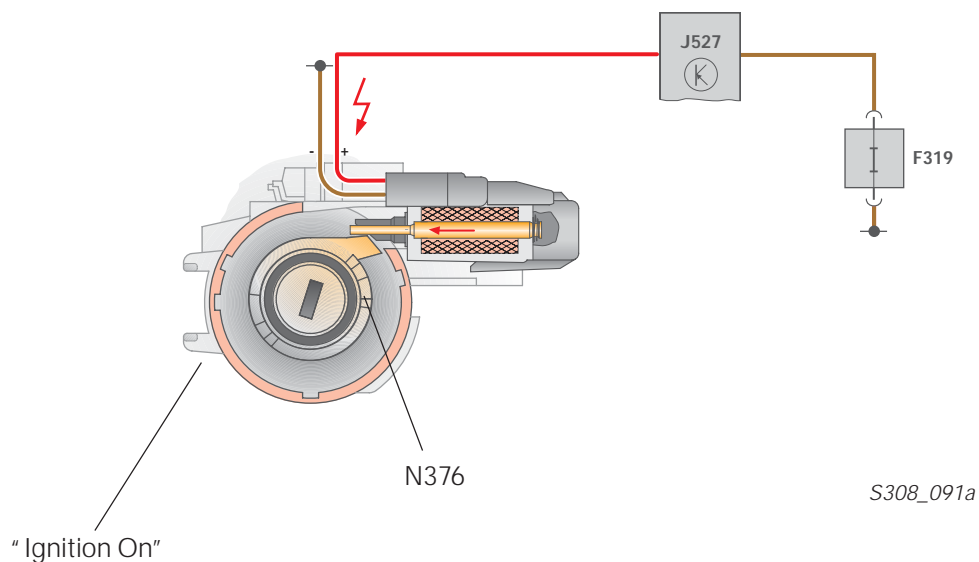
When the selector lever is in "D", the Selector Lever Park Position Interlock Switch F319 is closed.

The Steering Column Electronics System Control Module J527 energizes the Ignition Switch Key Lock Solenoid N376. The locking pin is pushed through the solenoids, against the strength of the compression spring, and into the lock position.

In the lock position, the locking pin prevents the ignition key from being turned back and removed.

Only when the selector lever is pushed in "P" will the Selector Lever Park Position Interlock Switch F319 open while the control module deactivates the solenoid.

The locking pin is then pulled back by the compression spring. The ignition key can be rotated and pulled out.



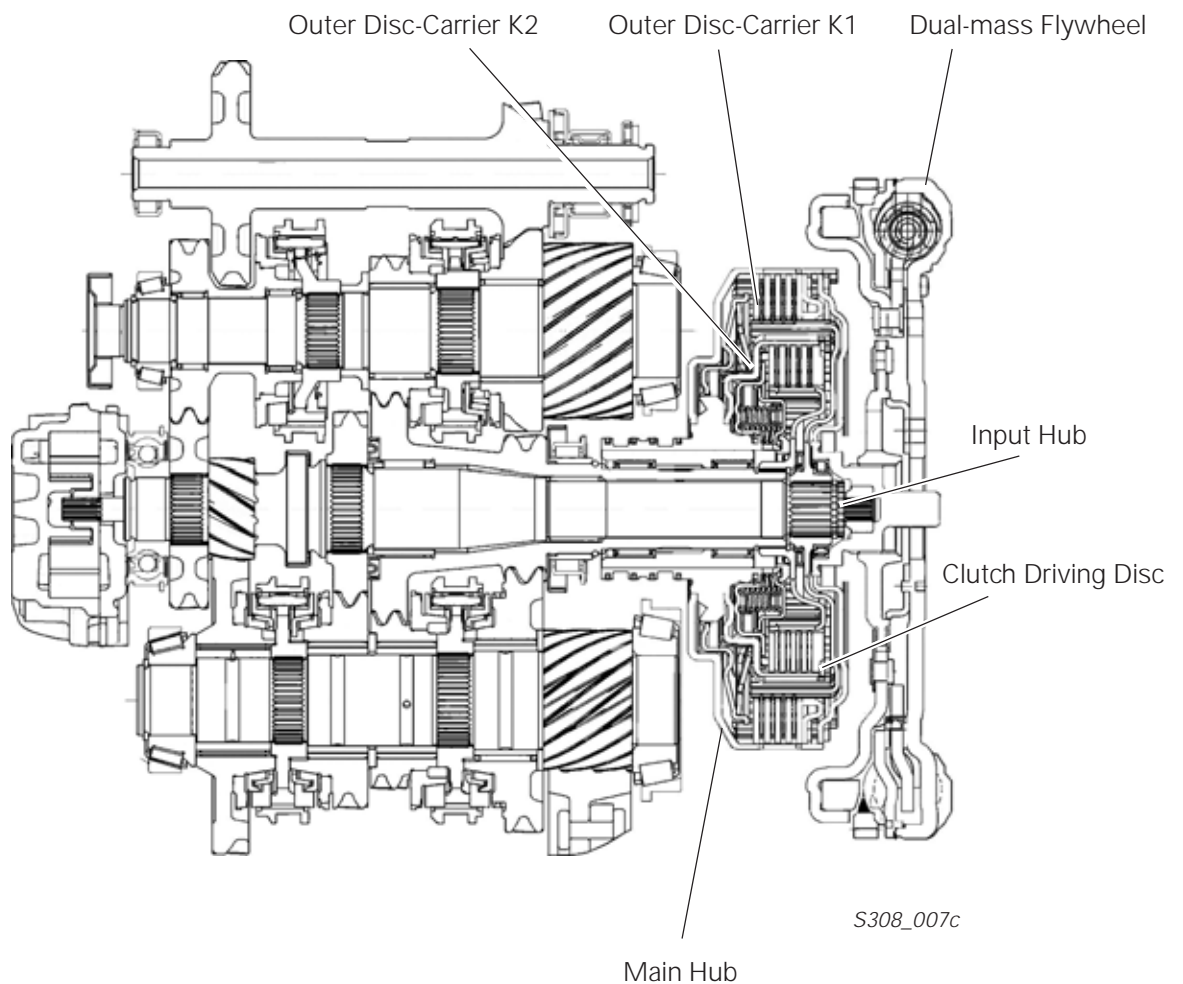
Direct Shift Gearbox Design

Basic Concept

The Direct Shift Gearbox is basically a manual transmission designed to operate like an automatic transmission. In place of a dry clutch, two wet clutches are used.

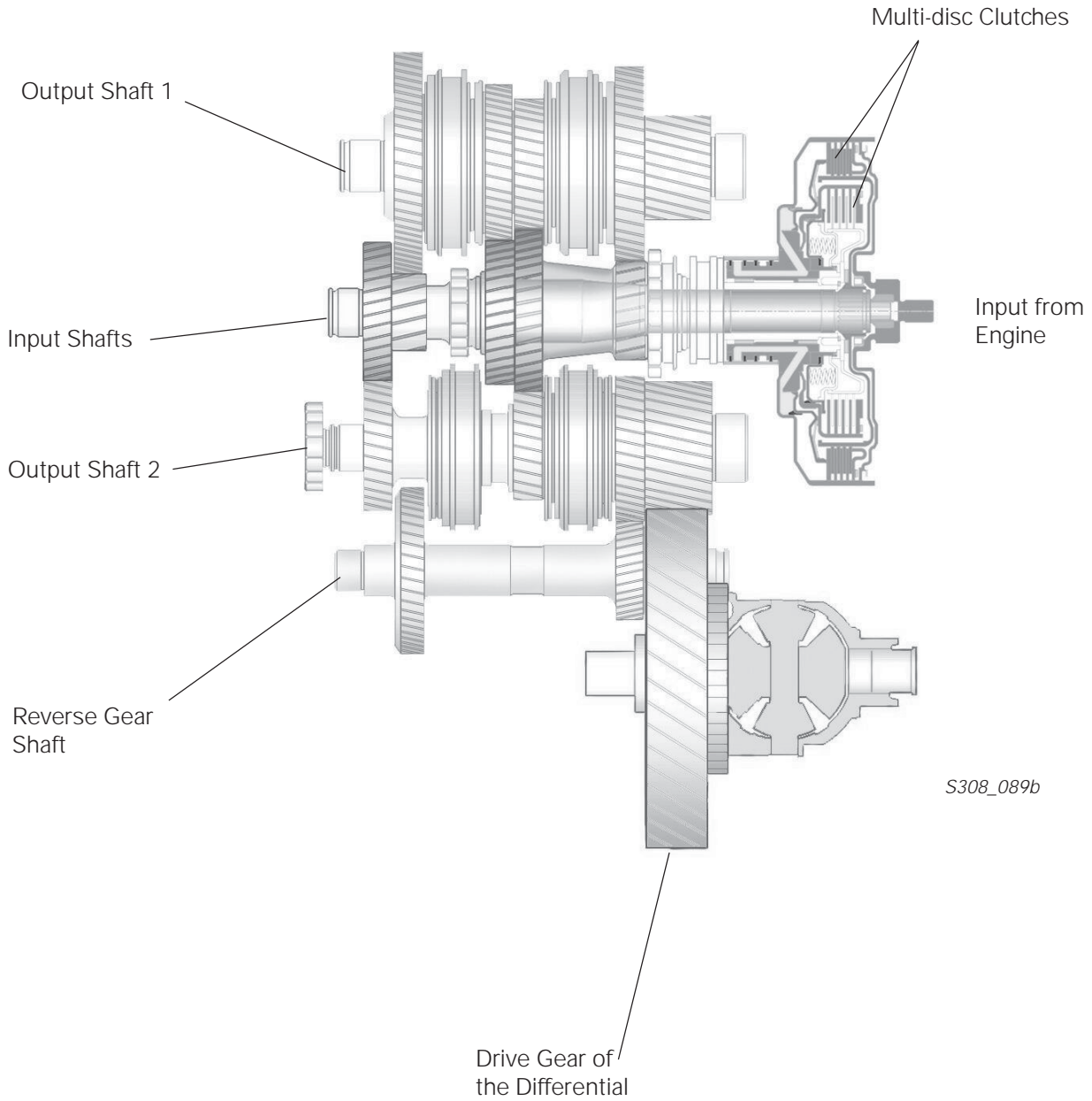
These wet clutches rotate in transmission fluid. The Mechatronics Control Module J743 controls clutch operation and gear selection.

Basically, the transmission is always engaged.



Direct Shift Gearbox Design

Direct Shift Gearbox Schematic diagram



Direct Shift Gearbox Design

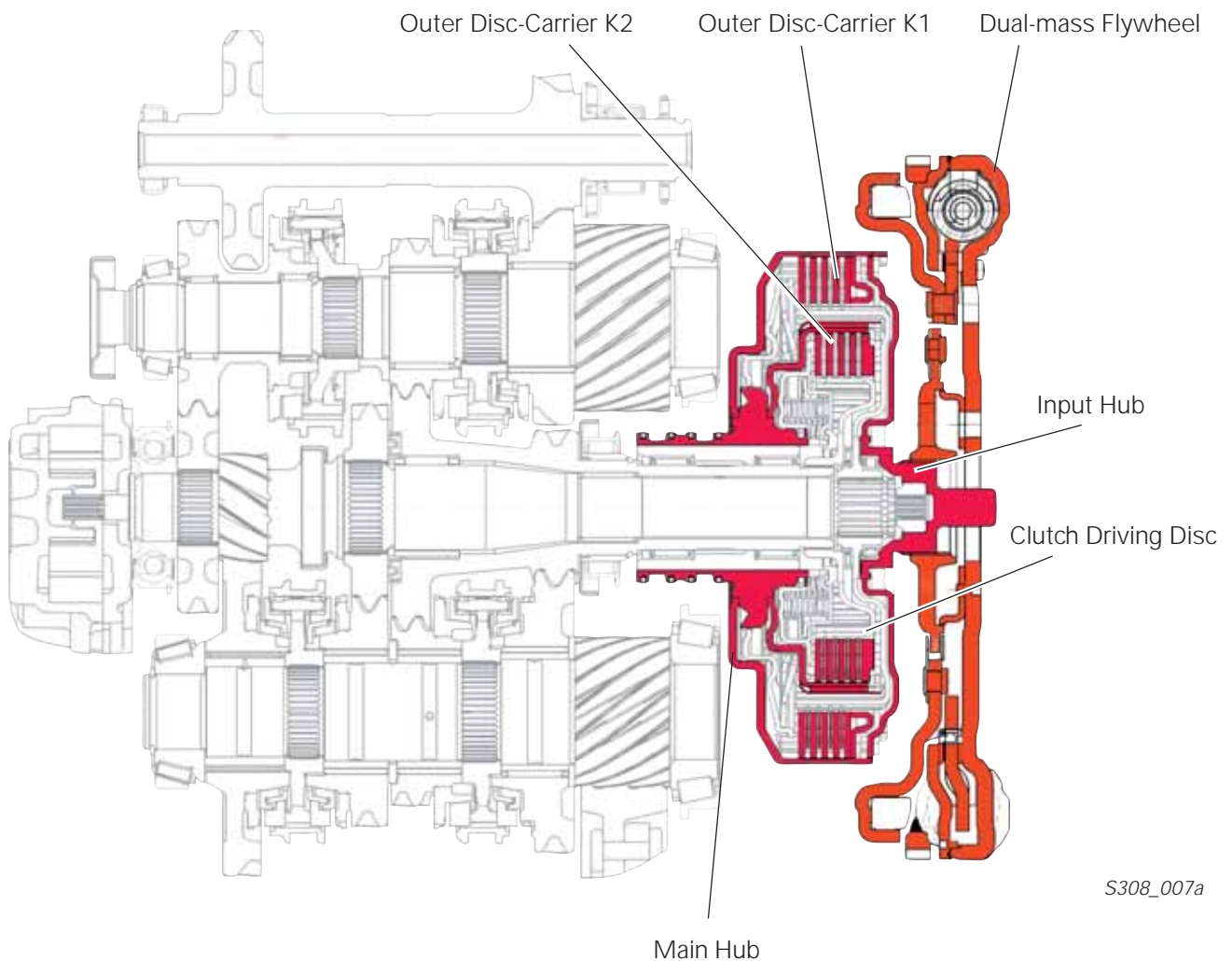
Torque Input

The torque is transferred from the crankshaft to the dual-mass flywheel. The splines of the dual-mass flywheel on the entry hub of the dual clutch transfer the torque to the driving disc of the multi-disc clutch.

The dual-mass flywheel transfers the torque to the input hub via splines.

Therefore, the following components turn at the same speed as the dual-mass flywheel and input hub:

- Clutch driving disc
- Main hub
- Outer disc-carrier K1
- Outer disc carrier K2



Direct Shift Gearbox Design

Multi-disc Clutches

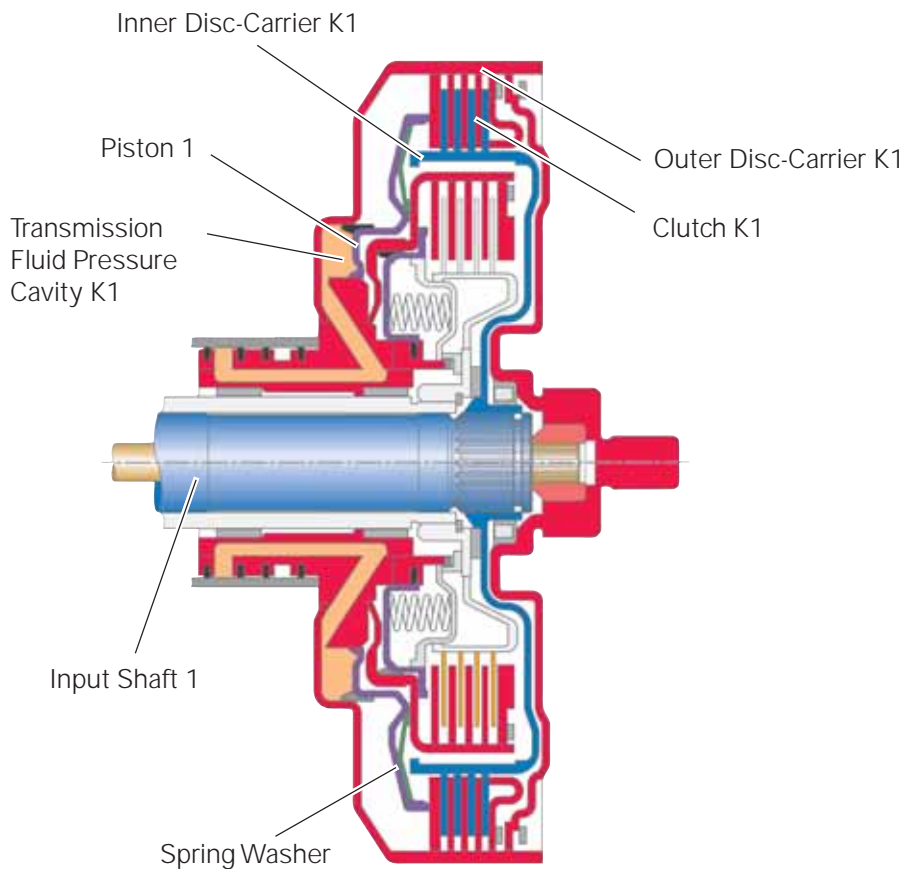
The torque is transferred into the respective clutch through the outer disc-carrier. By closing the clutch, the torque is transferred to the inner disc-carrier and then to the corresponding input shaft. There is always one multi-disc clutch activated in all drive gears.

Multi-disc clutch K1

Clutch K1 is the outer clutch and transfers the torque to Input Shaft 1 for 1st, 3rd, and 5th gears and Reverse.

Increasing the transmission fluid pressure in the clutch K1 fluid pressure cavity will close the clutch. As a result, piston 1 moves and presses the multi-discs of clutch K1 together. The torque is transferred to Input Shaft 1 by the multi-disc clutch.

When the clutch opens, the spring washer pushes piston 1 back into its initial position.



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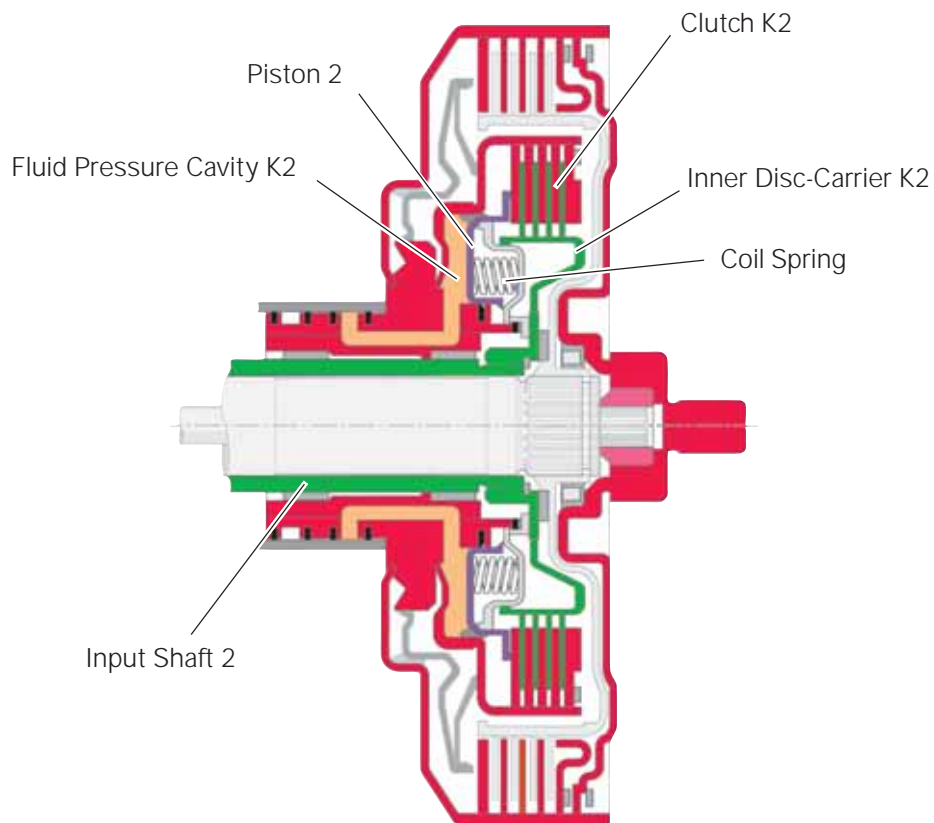
Direct Shift Gearbox Design

Multi-disc clutch K2

Clutch K2 is the inner clutch and transfers the torque to Input Shaft 2 for 2nd, 4th, and 6th gears.

Increasing the transmission fluid pressure in the clutch K2 fluid pressure cavity will close the clutch. The piston K2 closes the power flow to Input Shaft 2 through the multi-disc clutch.

When the clutch opens, the coil springs push piston 2 back into its initial position.

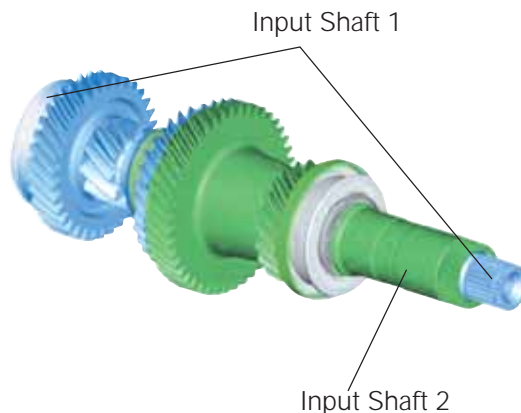


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Direct Shift Gearbox Design

Drive Shafts

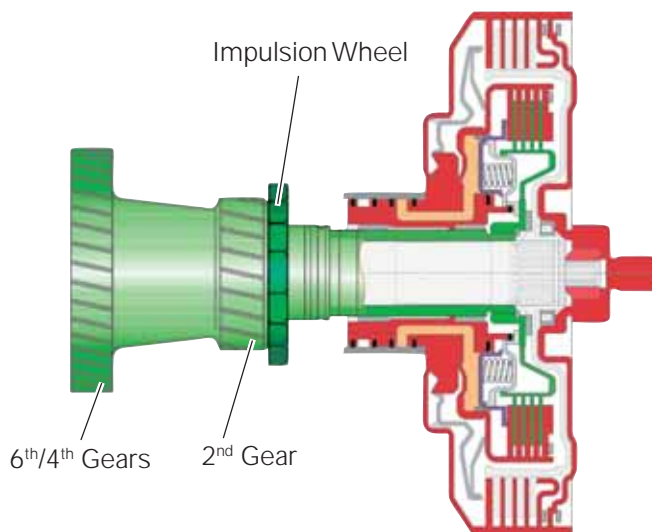
The engine torque is transferred to the input shafts by the multi-disc clutches K1 and K2.



S308_010

Input Shaft 2

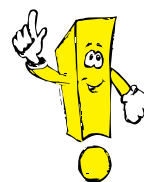
Input Shaft 2 is a hollow shaft and is coupled to the multi-disc K2 by external splines.



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The helical gear wheels for 6th, 4th and 2nd gears are on Input Shaft 2. A common gearwheel is used for 6th and 4th gears.

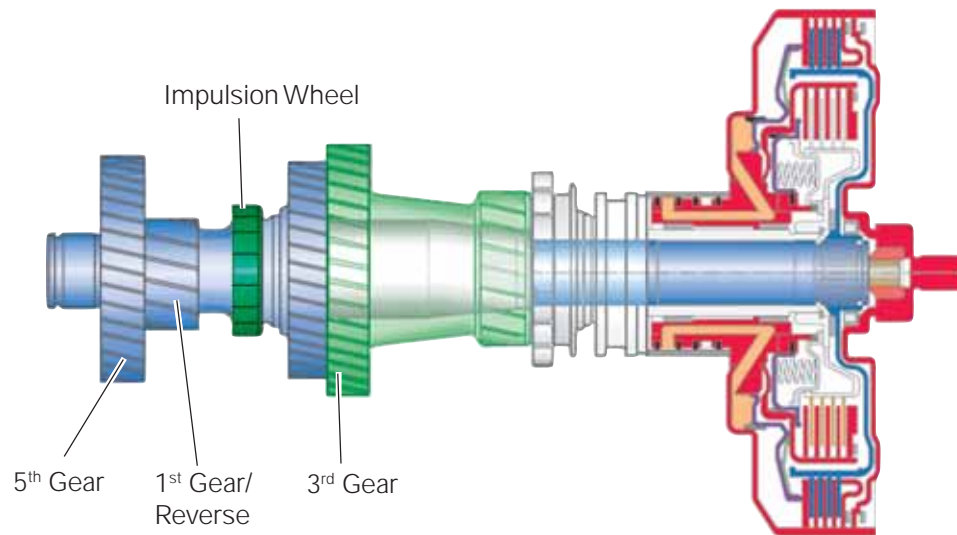
The Driveshaft 2 Speed Sensor G502 is located next to the second gear wheel. This sensor measures the speed of Input Shaft 2.



The Input Shafts may be referred to as Driveshafts in the repair information.

Direct Shift Gearbox Design

Input Shaft 1



S308_085

Input Shaft 1 rotates inside of Input Shaft 2, which is hollow. It is connected to the multi-disc clutch K1 by external splines.

The helical gear wheel for 5th gear, the common gear wheel for 1st gear and Reverse, and the gear wheel for 3rd gear are located in Input Shaft 1.

The Driveshaft 1 Speed Sensor G501 is located between 1st, Reverse and 3rd gear wheels. This sensor measures the speed of Input Shaft 1.



A strong magnet can destroy the impulsion wheels!

Direct Shift Gearbox Design

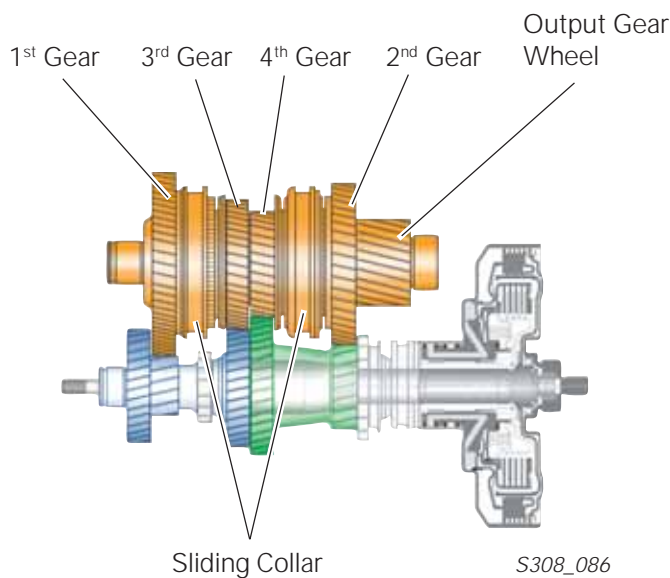
Output Shafts

Just as there are two input shafts, there are two output shafts in the Direct Shift Gearbox.

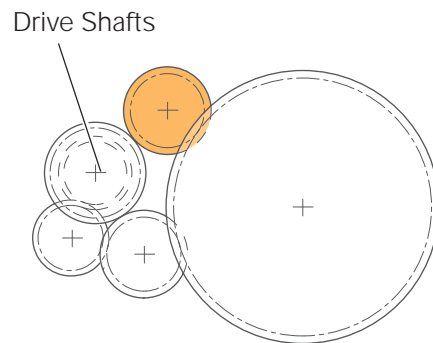
The overall length of the transmission was shortened by using a common gear wheel on the input shafts for 1st gear and Reverse, as well as a common gear wheel for 4th and 6th gears .

Output Shaft 1

Stretched representation



Mounting position in the transmission



The following are located on the Output Shaft 1:

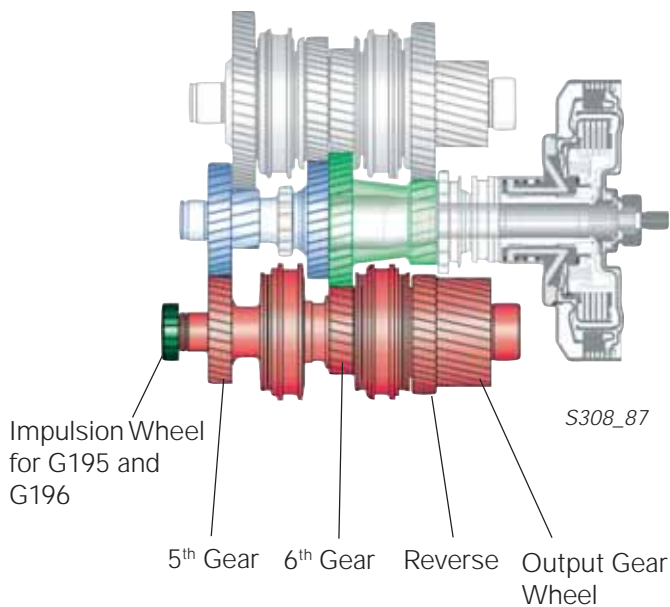
- The triple synchronized control wheels for 1st, 2nd and 3rd gears
- The single synchronized control wheel for 4th gear
- The output gear wheel for engaging the differential gear

The output shaft meshes in the gear wheel of the differential gear final drive.

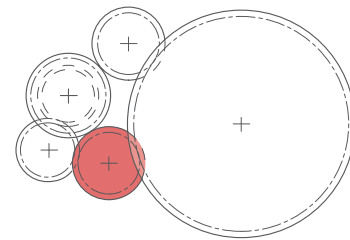
Direct Shift Gearbox Design

Output Shaft 2

Stretched representation



Mounting position in the transmission



The following are located on the Output Shaft 2:

- An impulsion wheel for the transmission output RPM
- The control wheels for 5th and 6th gears as well as the gear wheel of the reverse gear
- The output gear wheel for engaging the differential gear

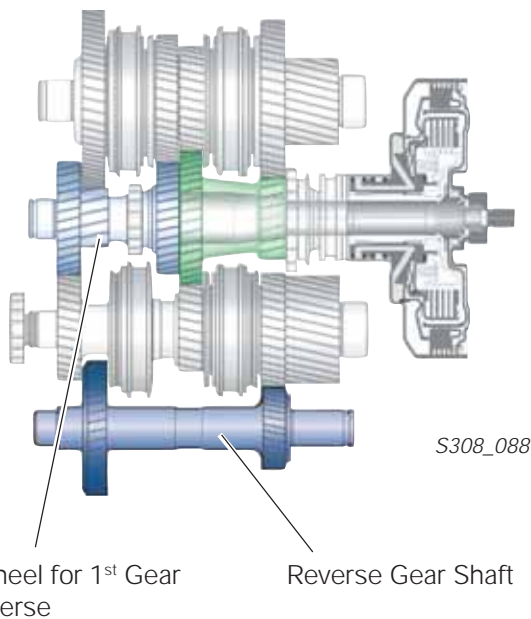
Both output shafts provide the torque to the differential gear through their output gear wheel.

Direct Shift Gearbox Design

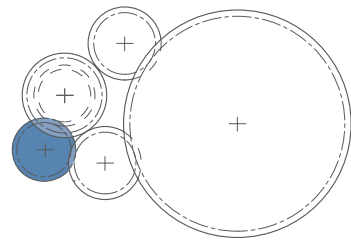
Reverse Gear Shaft

The Reverse Gear Shaft changes the direction of rotation of Output Shaft 2 and, as a result, changes also the direction of rotation of the gears for the final drive of the differential gear. It is meshed with the 1st gear and Reverse common gear wheel on Input Shaft 1, and with the Reverse control wheel on Output Shaft 2.

Stretched representation



Mounting position in the transmission



Direct Shift Gearbox Design

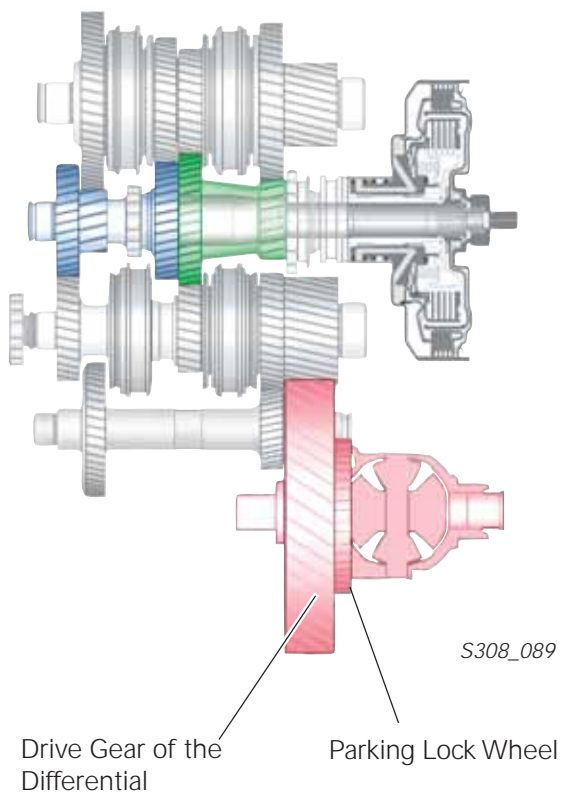
Differential Gear

Both output shafts transfer the torque to the differential drive gear.

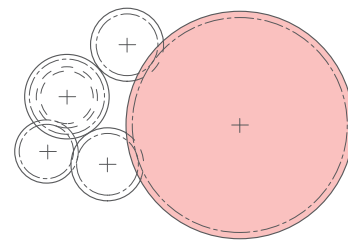
The differential gear transfers the torque through the drive train to the wheels.

The park position lock wheel is integrated into the differential gear.

Stretched representation



Mounting position in the transmission



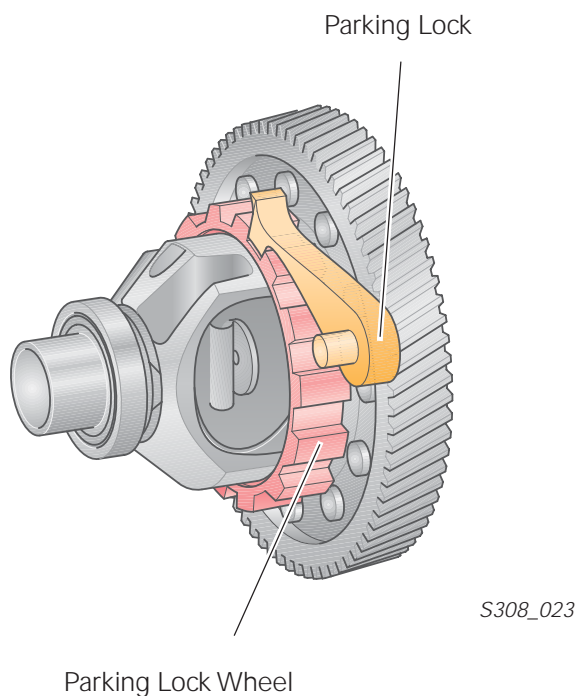
Direct Shift Gearbox Design

Parking Lock

A parking lock is built into the differential gear assembly to help ensure a complete stop of the vehicle and prevent the vehicle from unintentionally rolling away when the hand brake is not activated.

The parking lock is mechanically controlled by a connecting cable between the selector lever and the parking position lock lever in the transmission.

The only function of the connecting cable is to operate the parking lock.



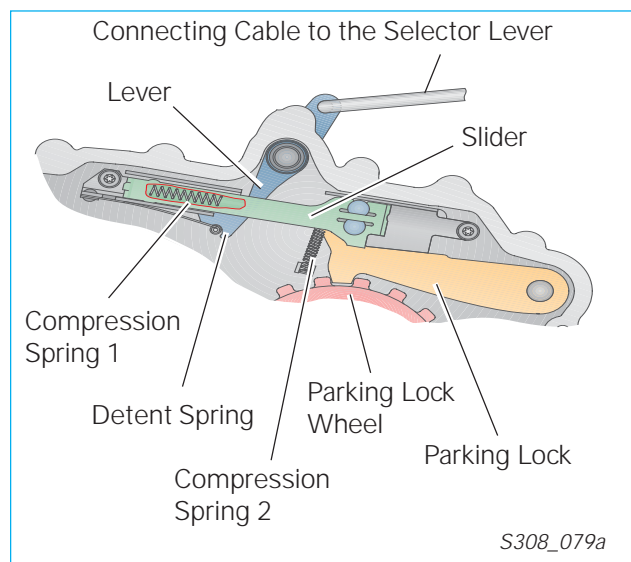
Function

The parking lock is engaged by shifting the selector lever in the "P" position. As a result, the parking lock engages into the teeth of the parking lock wheel.

A detent spring locks the lever in place and sets the parking lock in its position.

If the parking lock does not lock into a gap between the teeth of the parking lock wheel, the spring will be compressed. If the vehicle moves, the parking lock will lock into the next gap of the parking lock wheel.

The park position lock is disengaged by shifting the selector lever out of the "P" position. The slider is pushed back to the right into its initial position and the compression spring 2 pushes the parking lock out of the gap of the parking lock wheel.



Direct Shift Gearbox Design

Synchronization

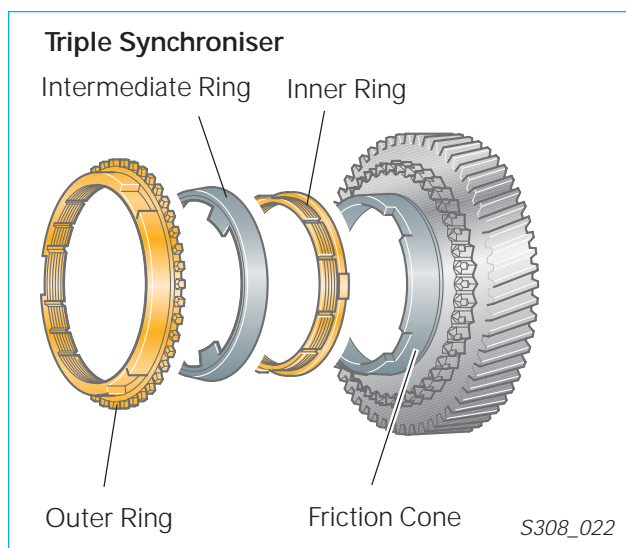
To change gears without interference or noise, the Direct Shift Gearbox uses synchronization on each gear.

The purpose of a synchronizer is to bring to the same speed the gears to be meshed and the selector sleeve. This allows for easy shifting.

The synchronizer rings are made of brass that is coated in molybdenum. The molybdenum allows for long life.

The triple synchronization is made of:

- An outer ring (synchronization ring)
- An intermediate ring
- An inner ring (2nd synchronization ring)
- The friction cone of the shifting gear wheel



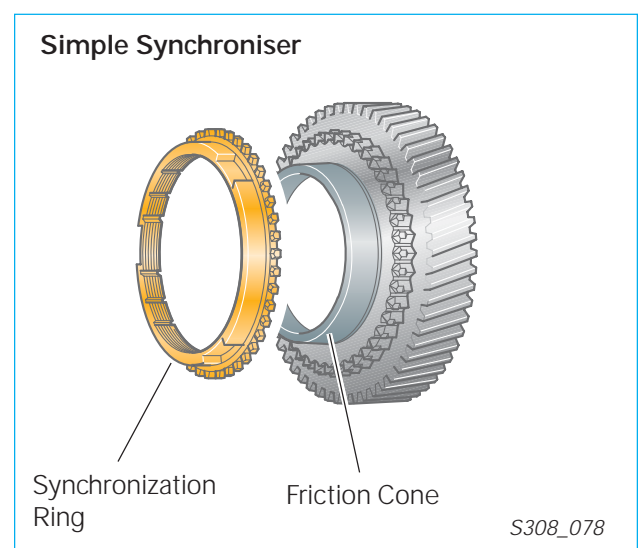
Gears 1, 2 and 3 are equipped with triple synchronization. This triple synchronization provides a larger heat transfer surface. The larger heat surface is needed because the rotation speed differences are higher in the lower gears.

Gears 4,5 and 6 have simple cone synchronization. Since the speed differences are not as high, the larger surface area of the triple synchronizers is not needed.

The reverse gear has a double-cone synchronization.

The simple synchronization is made of:

- The synchronizing ring
- The friction cone of the shifting gear wheel



Direct Shift Gearbox Design

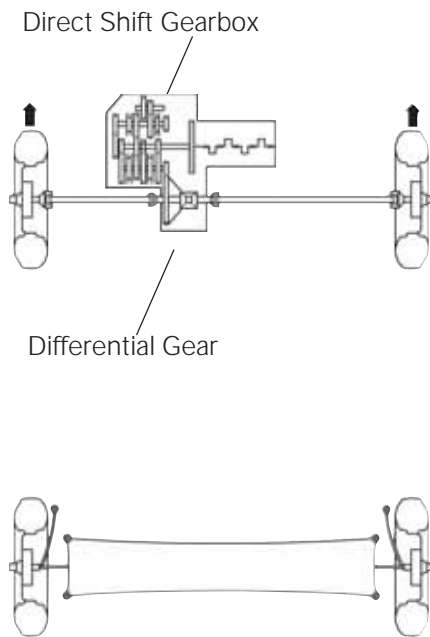
Torque Distribution

The engine torque is transferred from the dual-mass flywheel to the transmission.

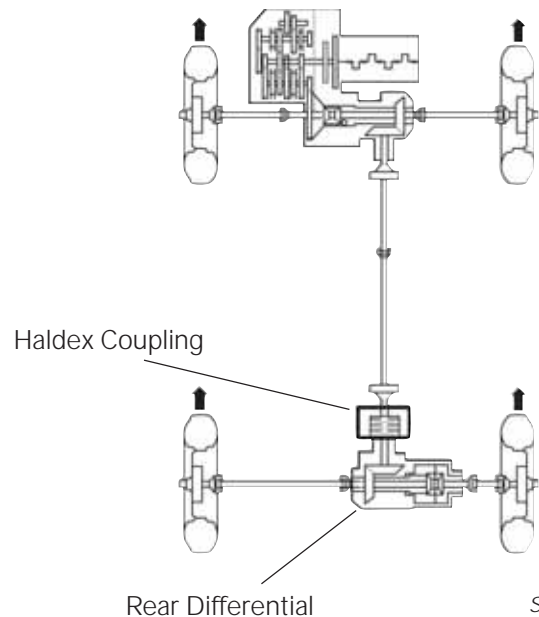
For front-wheel drive vehicles, this torque is transferred to a drive shaft on either side, which allows the wheels to turn.

For all-wheel drive vehicles, there are drive shafts for the front wheels and a drive shaft going to the rear differential to drive the rear wheels.

Vehicles equipped with the Direct Shift Gearbox have a Haldex coupling to distribute the torque to the rear wheels. When the Haldex coupling locks, torque is passed from the input shaft to the rear differential and out through the rear input shafts to the rear wheels.



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Direct Shift Gearbox Design

Transmission Power Flow

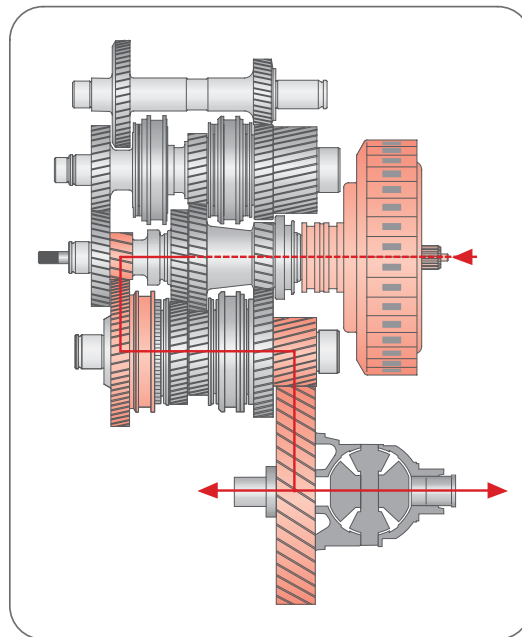
The engine torque is transferred to the transmission either through clutch K1 or K2. Each of these clutches drives a separate shaft.

- Input Shaft 1 is driven by the K1 clutch
- Input Shaft 2 is driven by the K2 clutch

There are two additional shafts needed to transfer the power to the differential:

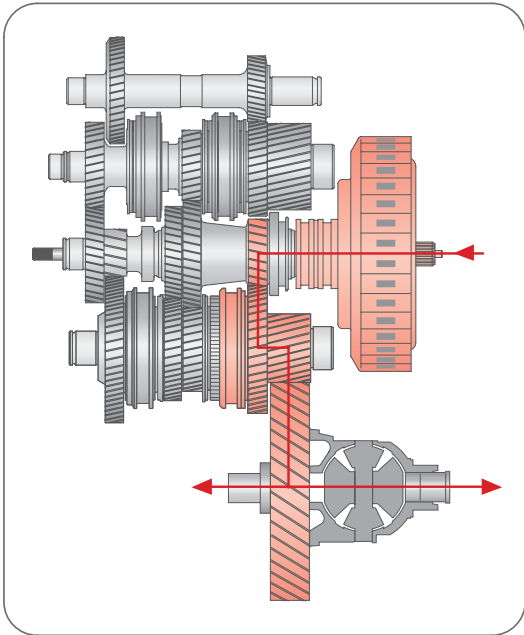
- Output shaft 1 for gears 1, 2, 3, and 4
- Output shaft 2 for gears 5, 6 and Reverse

1st Gear
K1 Clutch
Input Shaft 1
Output Shaft 1
Differential



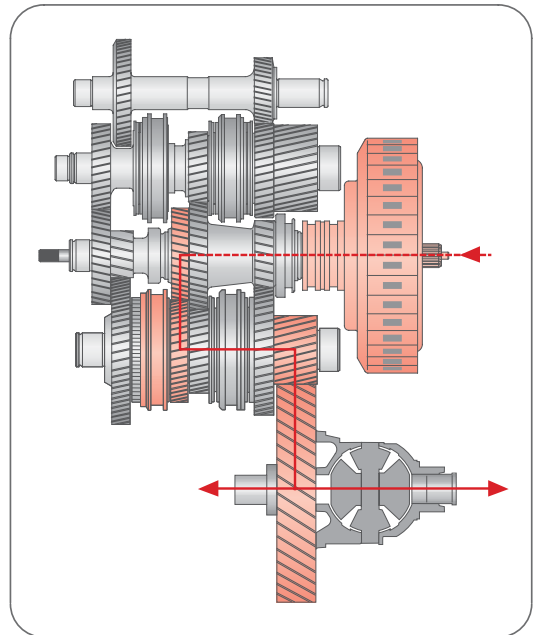
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Direct Shift Gearbox Design



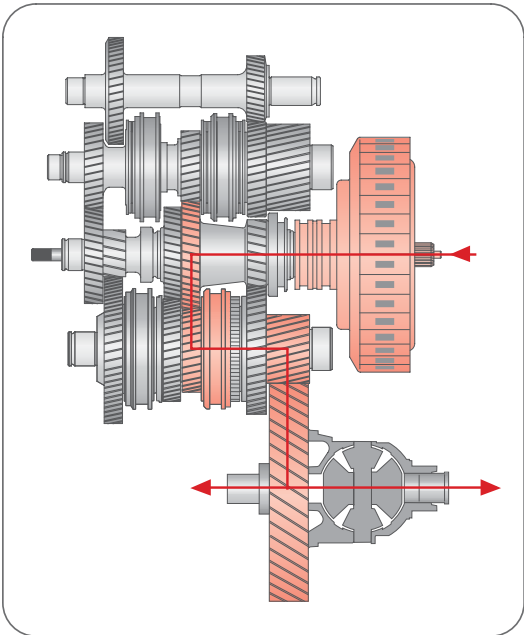
2nd Gear
K2 Clutch
Input Shaft 2
Output Shaft 1
Differential

S308_055_2



3rd Gear
K1 Clutch
Input Shaft 1
Output Shaft 1
Differential

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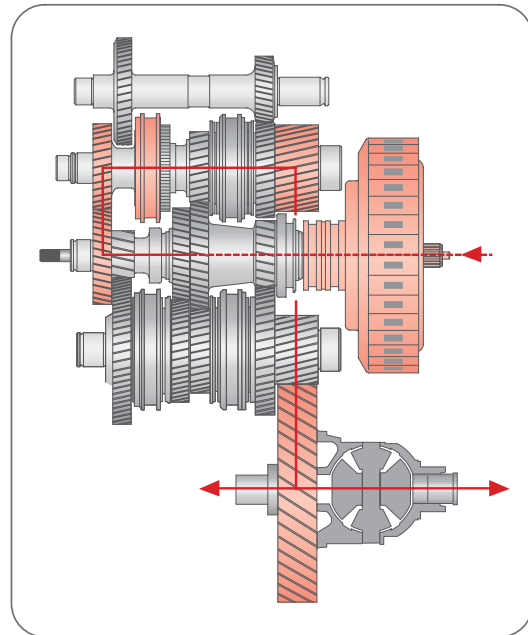


4th Gear
K2 Clutch
Input Shaft 2
Output Shaft 1
Differential

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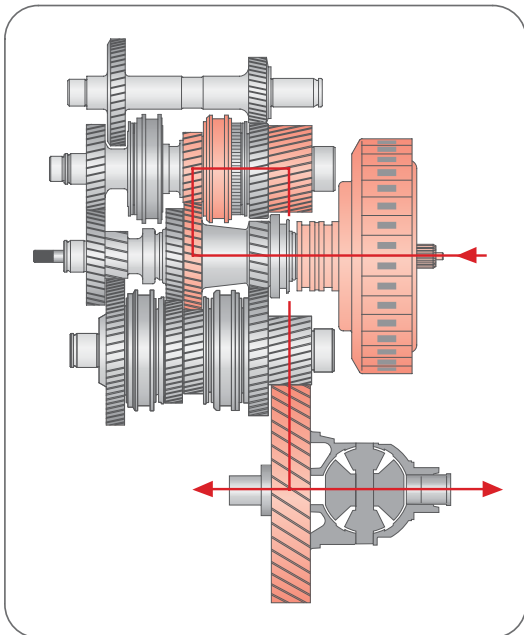
Direct Shift Gearbox Design

5th Gear
 K1 Clutch
 Input Shaft 1
 Output Shaft 2
 Differential



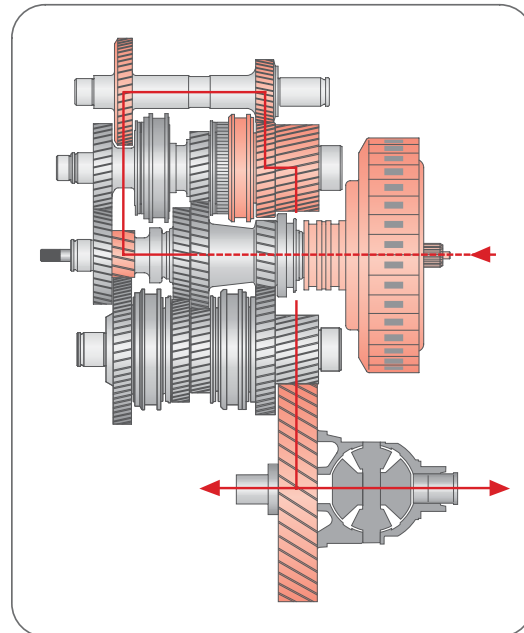
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6th Gear
 K2 Clutch
 Input Shaft 2
 Output Shaft 2
 Differential



S308_055_6

Reverse
 K1 Clutch
 Input Shaft 1
 Reverse Gear Shaft
 Output Shaft 2
 Differential



S308_055_R

The change of rotation direction for Reverse is performed through the reverse gear shaft.

Mechatronics Module

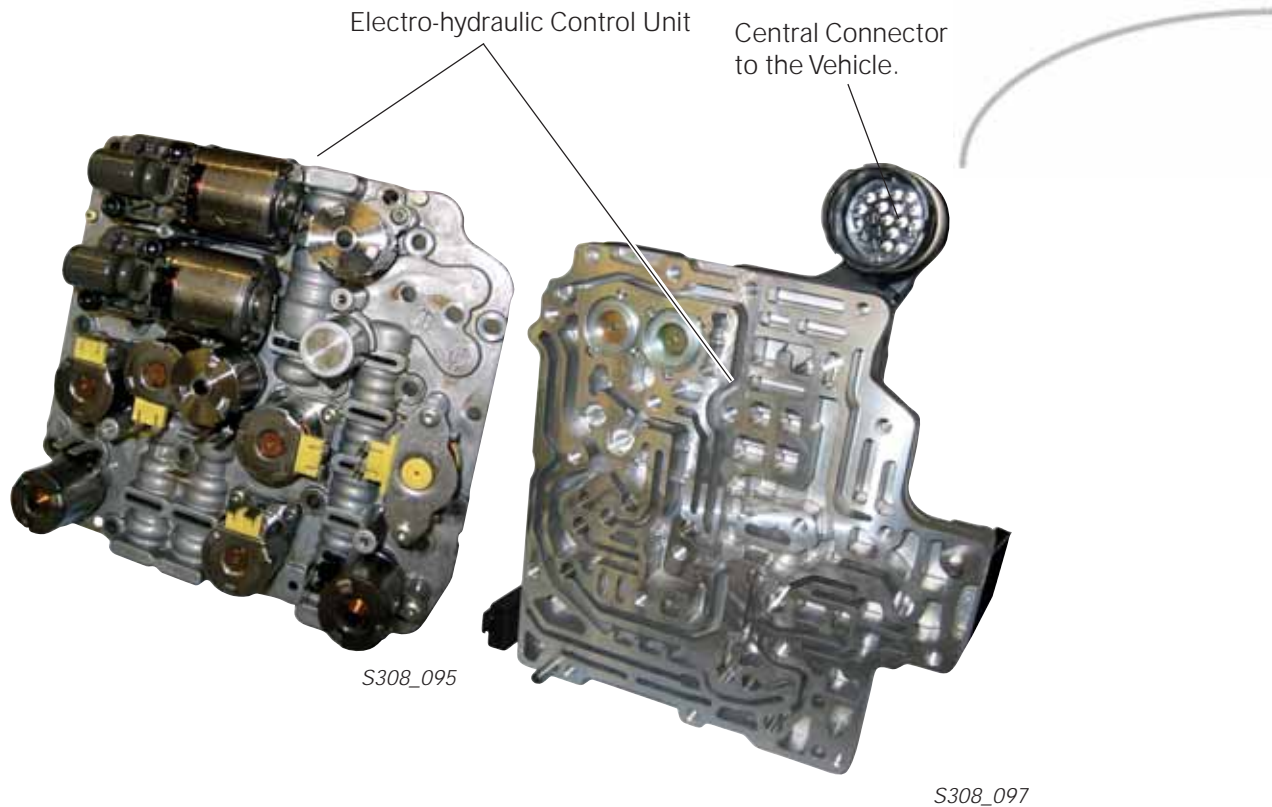
Mechatronics

The Mechatronics assembly is located inside of the transmission and immersed in transmission fluid. This assembly is made up of both the transmission control module and electro-hydraulic controls.

The Mechatronics is the central control module of the transmission. All sensor signals from the transmission and other relevant areas of the vehicle are sent to the Mechatronics assembly. As a result, the Mechatronics assembly can monitor the operation of the transmission and regulate output correctly.

Twelve sensors are located within the Mechatronics assembly. These sensors regulate eight hydraulic gear actuators, six pressure modulation valves, five control valves and the pressure and cooling of both clutches.

The Mechatronics assembly can adapt to learn the positions of the clutches, the positions of the gear actuators for each specific gear and the main transmission fluid pressure.



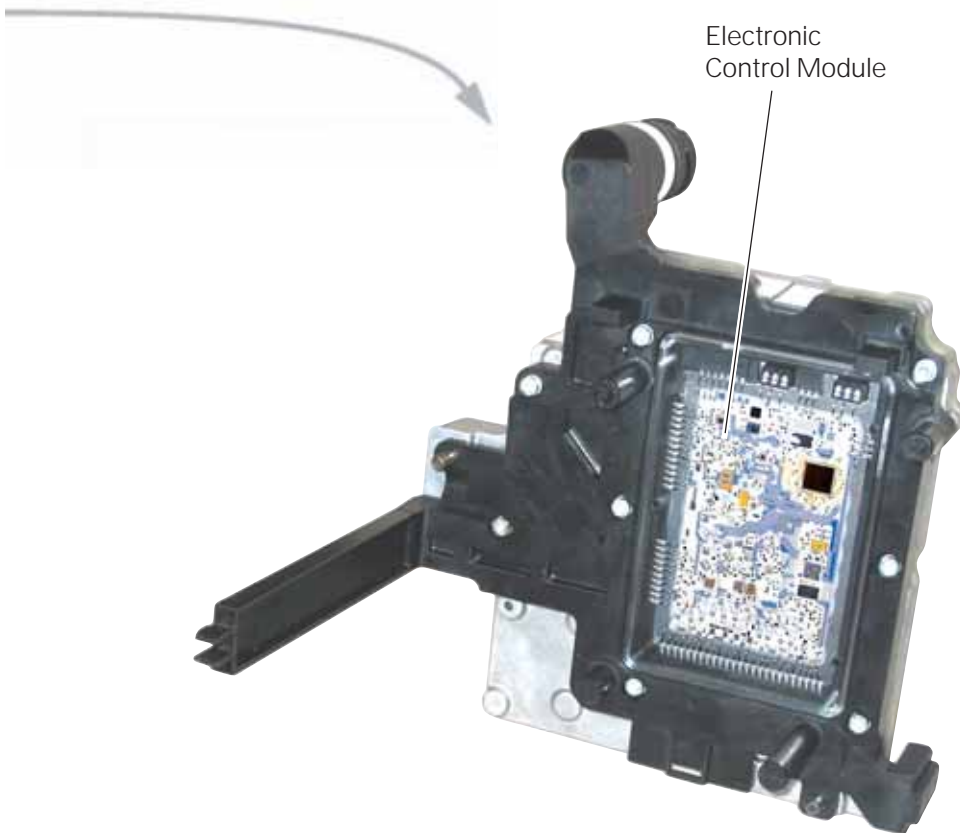
Mechatronics Module

The benefits of this assembly are:

- Integrated sensors
- Actuators located directly on the Mechatronics assembly
- All interaction with the rest of the vehicle is done through a single connector

These features reduce the number of connectors and wires, providing better electrical reliability and lower weight.

However, this also means that the transmission control module electronics are exposed to higher thermal and mechanical loads. The Mechatronics assembly has been engineered to easily withstand these conditions.



S308_096

Electro-hydraulic Control Unit

Electro-hydraulic Control Unit

The electro hydraulic control unit is integrated to the Mechatronics module.

All the solenoid valves, pressure control valves, the hydraulic slider and the multiplexer are located inside the control unit.

N88 – Solenoid Valve 1 (Gear actuating valve)

N89 – Solenoid Valve 2 (Gear actuating valve)

N90 – Solenoid Valve 3 (Gear actuating valve)

N91 – Solenoid Valve 4 (Gear actuating valve)

N92 – Solenoid Valve 5 (Multiplexer valve)

N215 – Pressure Control Valve 1 (Clutch valve K1)

N216 – Pressure Control Valve 2 (Clutch valve K2)

A pressure relief valve is located outside of the hydraulic module. This valve prevents high internal pressures that can damage the hydraulic valves.

N217 – Pressure Control Valve 3 (Main pressure valve)

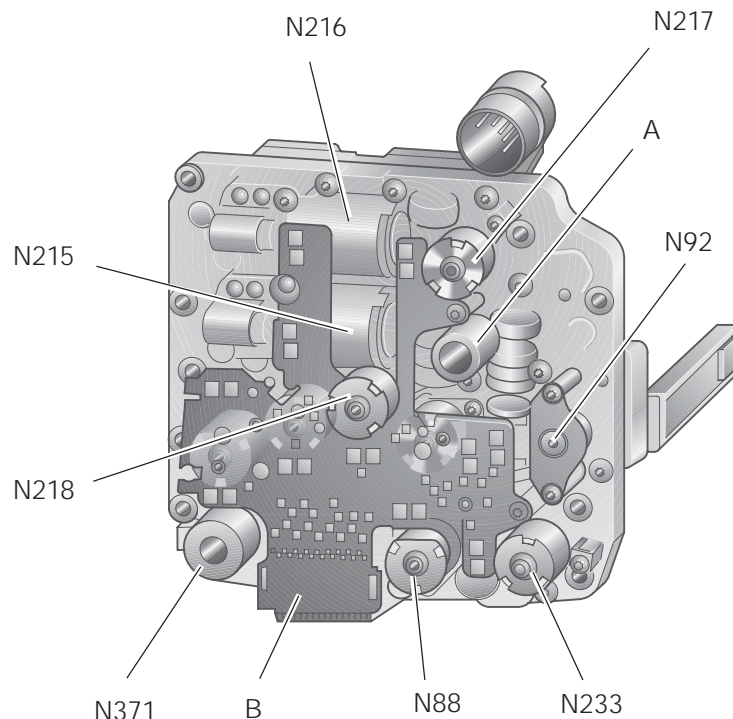
N218 – Pressure Control Valve 4 (Coolant valve)

N233 – Pressure Control Valve 5 (Safety valve 1)

N371 – Pressure control valve 6 (Safety valve 2)

A – Pressure Relief Valve

B – Printed Circuit Board



S308_033

Electro-hydraulic Control Unit

Valves have different shifting characteristics according to their function. The two function types are:

- “Yes/No” control valves
- Modulation valves

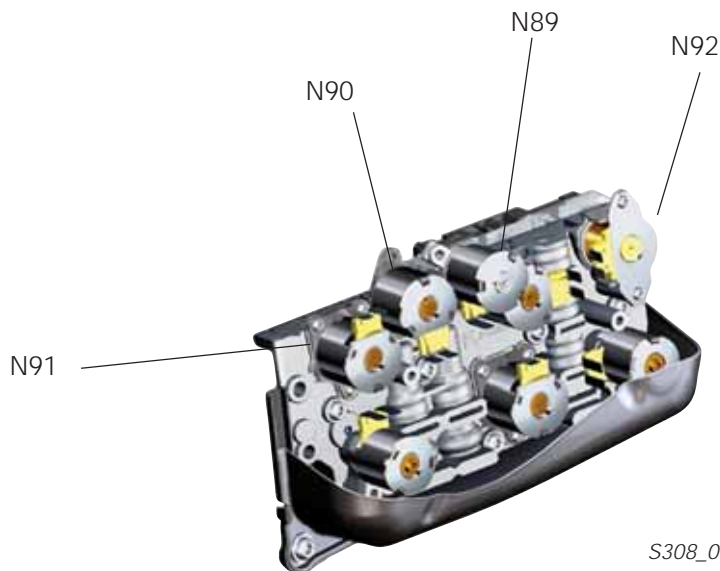
The “Yes/No” control valve type includes:

- The gear selector valves and
- The multiplexer valve

The Modulation valve type includes:

- The main pressure valve
- The cooling fluid valve
- The clutch valves
- The safety valve

The gear actuator valves N89, N90 and N91 can be seen by removing the printed circuit board.



Transmission Lubrication System

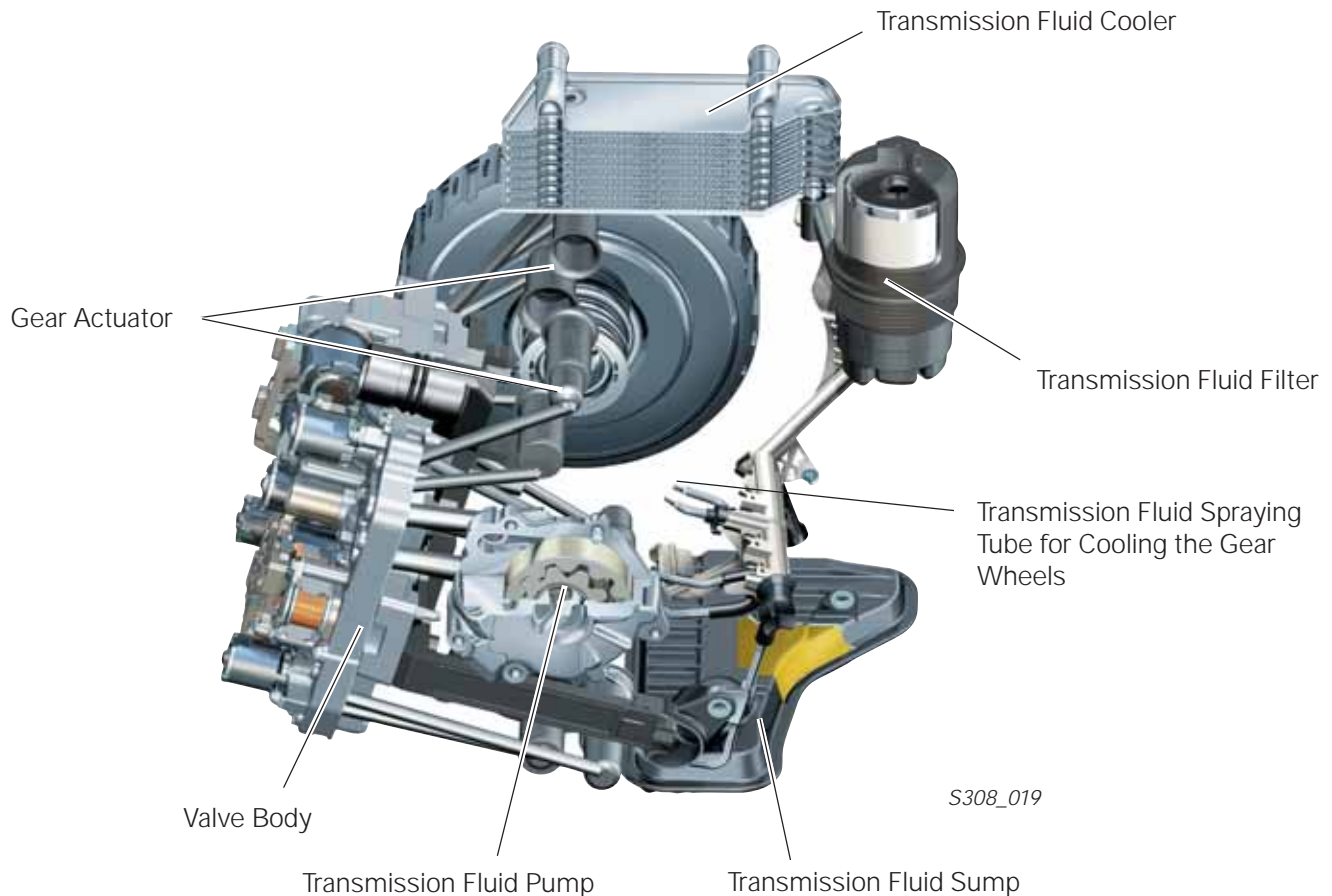
Transmission Fluid System

The DSG transmission has a fluid capacity of 7.2 liters. This fluid must meet the following requirements:

- Ensure clutch regulation and hydraulic control
- Have a stable viscosity through the entire temperature range
- Withstand and lubricate the dual-clutch, wheels, shafts, bearings and synchronizer rings under high mechanical loads

- No foam
- Allow for smooth operation of all valves
- Allow for correct operation of the dual-clutch and gear control piston

A separate transmission fluid cooler prevents the transmission fluid temperature from rising above 135°C (275°F). This cooler uses engine coolant to reduce temperature.



Transmission Lubrication System

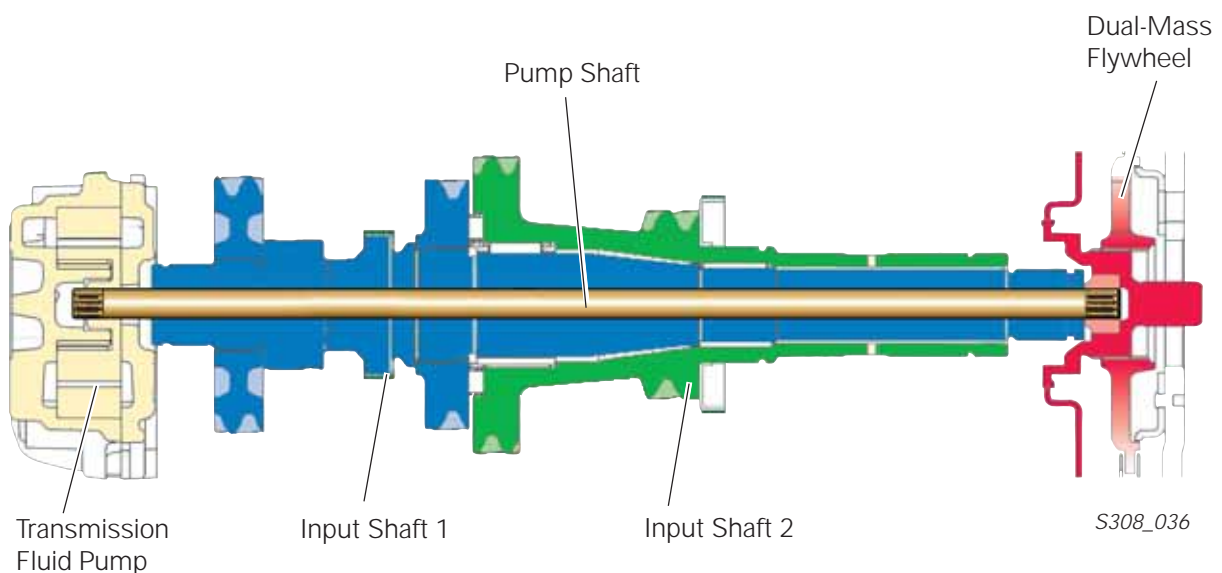
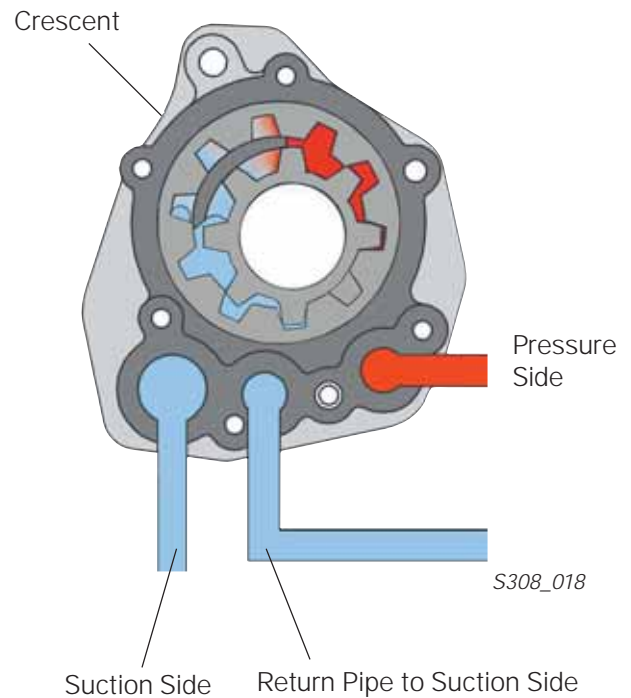
Transmission Fluid Pump

A crescent shaped pump draws the transmission fluid and produces the main pressure required for the hydraulic parts to operate. It produces up to 26.4 gal/min (100 l/min) and a maximum pressure of 20 bar (290 psi).

The transmission fluid pump supplies fluid for:

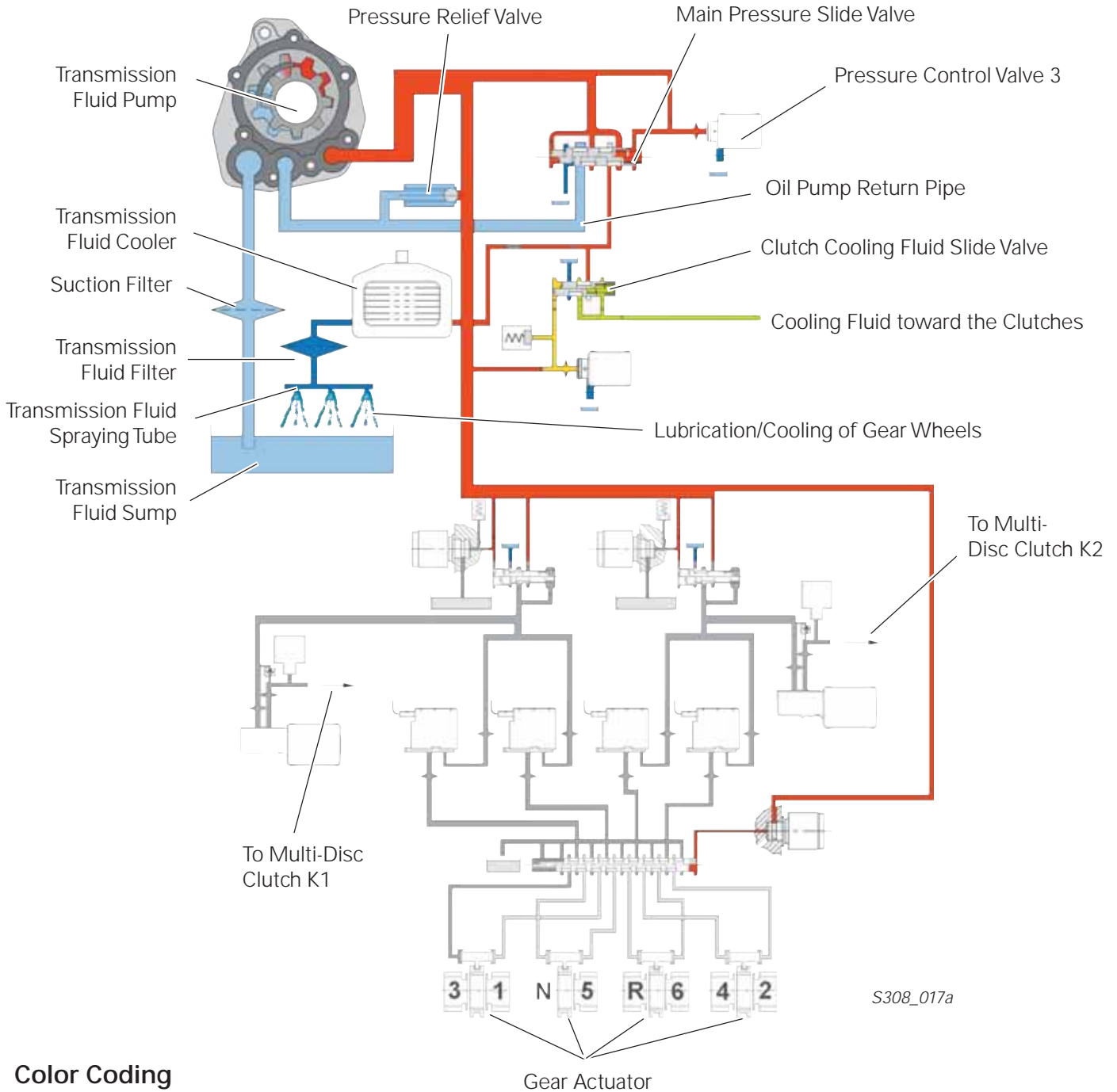
- The multi-disc clutches
- The clutch cooling
- The gear shift hydraulic pressure
- The gear wheel lubrication

The transmission fluid pump is driven by the pump shaft rotating at engine RPM. This pump shaft is a third shaft located inside Input Shaft 1, which rotates within Input Shaft 2.



Transmission Lubrication System

Schematic Diagram



S308_017a

Color Coding

- Regulated pressure, work pressure
- Uncontrolled pressure
- Controlled pressure, clutch cooling
- Transmission fluid sump return circuit

Transmission Lubrication System

Transmission Lubrication System Description

The transmission pump draws the transmission fluid from the sump, through the filter, pressurizes it and sends it to the main pressure slider valve.

The Main Pressure Valve N217 controls the main pressure slider valve. This regulates fluid pressure inside of the transmission.

A transmission fluid channel from the main pressure slider valve directs extra fluid back to the transmission pump suction side.

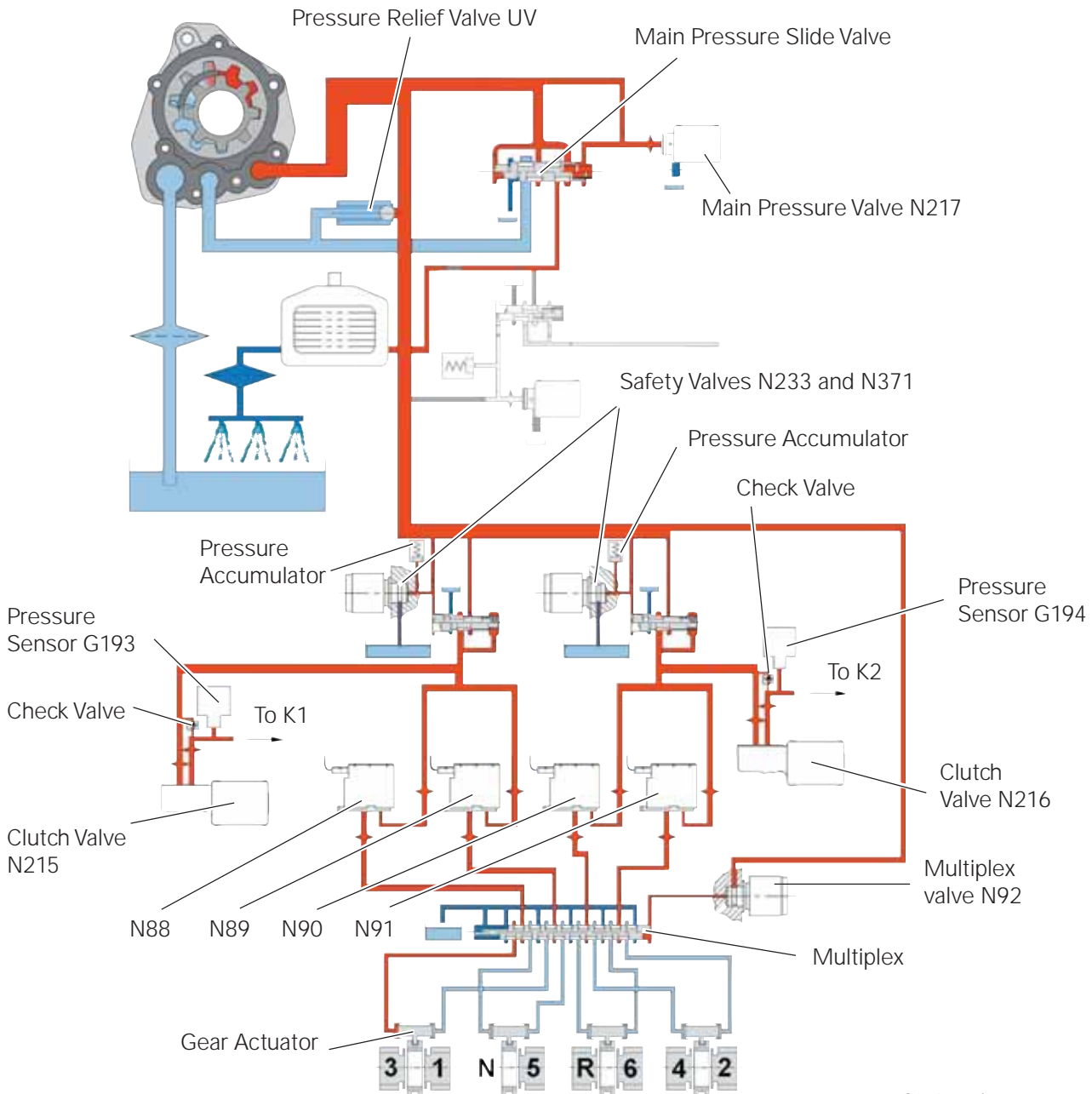
Pressurized fluid from the main pressure slider valve branches off into two channels. One channel directs the fluid to the transmission fluid cooler, cooling the fluid and returning it to the sump. The other channel directs the fluid to the clutch cooling fluid slide valve.

Other features of the fluid circuit:

- The transmission fluid cooler is in the engine cooling circuit and uses engine coolant to control temperature
- The transmission fluid filter is located outside of the transmission housing
- The pressure relief valve limits the fluid pressure to 32 bar (464 psi)
- The individual gears are lubricated by fluid spray from directional nozzles

Transmission Lubrication System

Schematic Diagram of Hydraulic Elements in the Transmission Lubrication System



S308_017b

Color Coding

- Regulated pressure, work pressure
- Transmission fluid sump return circuit
- Uncontrolled pressure

Transmission Lubrication System

Electro-hydraulic Control of the Transmission Fluid System.

Pressure Control Valve 3 for Automatic Transmission N217

The Pressure Control Valve 3 for Automatic Transmission N217 controls the main pressure valve. This controls the main pressure for all of the transmission components including:

- Pressure Control Valve 1 N215
- Pressure Control Valve 2 N216
- Clutch K1
- Clutch K2
- Solenoid Valve 1 N88
- Solenoid Valve 2 N89
- Solenoid Valve 3 N90
- Solenoid Valve 4 N91

In addition to controlling the main supply pressure, N217 also controls:

- The transmission fluid return through the transmission fluid cooler, transmission fluid filter and spray nozzle
- Transmission fluid pump return circuit

Multiplexer valve

Solenoid Valve 5, N92, operates the multiplexer in the transmission. The multiplexer is a slide valve that allows four solenoid valves to have the control of eight solenoid valves.

The multiplexer has two positions, home and work. The default position is the home position and it is held in that position by a spring when N92 is not energized. In this position, gears 1,3,6 and Reverse can be selected.

When N92 is energized, pressure is applied to the multiplexer and the spring is compressed. In the work position, gears 2,4,5, and Neutral can be selected. Also, in the work position, the multiplexer spring is compressed.

Safety valve

A safety valve for clutches K1 (N233) and K2 (N371) allows a quicker opening of the respective clutch. This is necessary when the actual clutch pressure is above the rated pressure.

Pressure sensors G193 and G194

Pressure sensors G193 and G194 control the clutch pressure of clutches K1 and K2.

A pressure relief valve prevents an increase of the main pressure that could result from a defective main pressure slide valve.

Transmission Lubrication System

Clutch Cooling Lubrication System

The mechanical friction in the multi-disc clutches increases the temperature of the dual clutch.

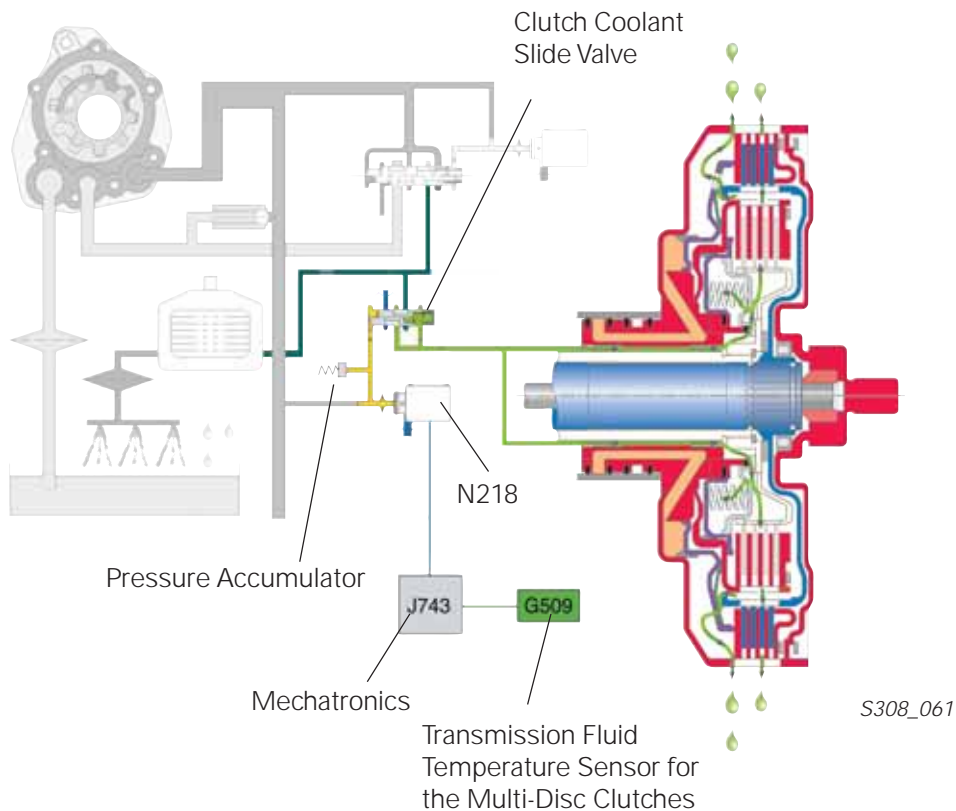
To cool down the clutches, the transmission fluid circulation system includes a separate clutch cooling system.

The coolant slide valve and the Pressure Control Valve 4 N218 (clutch cooling valve) belong to the clutch cooling system.

The multi-plate clutches oil temperature sensor G509 measures the fluid temperature directly at the multi-disc clutches' fluid discharge.

Depending on the measured temperature, the pressure control valve either increases or reduces the fluid pressure to the clutch cooling fluid slide valve. The clutch coolant slide valve opens or closes the fluid pressure for the fluid channel to the multi-disc clutches.

The maximum cooling fluid flow is 20 liters per minute. The maximum cooling fluid pressure is 2 bar (29 psi).



Transmission Lubrication System

Shifting Gears

Gear shifting is based on manual transmission gearshift forks. Each fork shifts 2 gears.

The operation of the gearshift forks is performed hydraulically in the Direct Shift Gearbox, instead of with a cam mechanism like the one used in common manual transmissions.

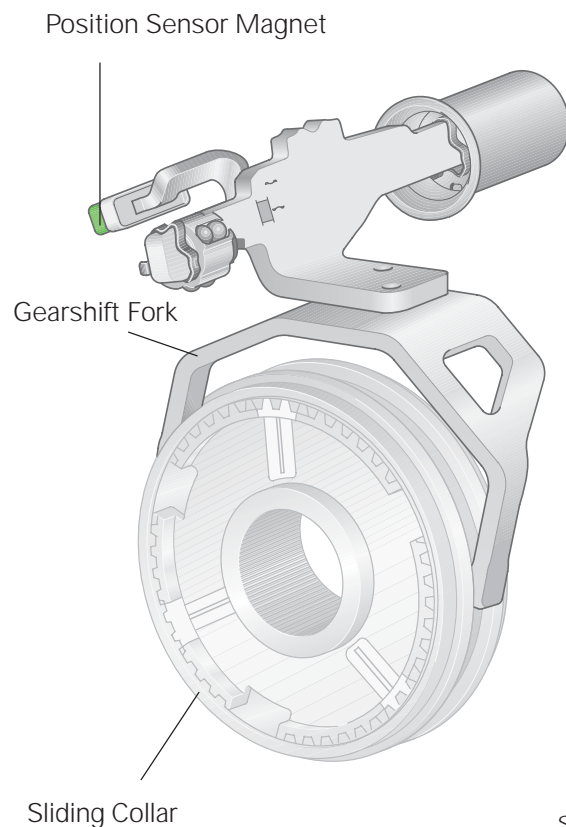
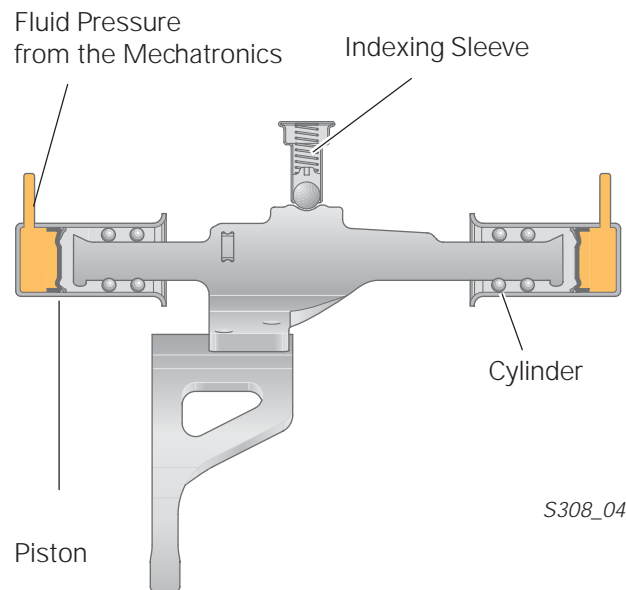
The gearshift forks are set in cylinder ball bearings, for smooth operation.

To shift a gear, the Mechatronics fluid is sent to the left cylinder. Since the right cylinder pressure is open, the gearshift fork moves and activates the selector sleeve. As a result, the gear is engaged.

Once the gear is engaged, the gearshift fork pressure is switched off. The gear is stopped by a detent in the shift tooth system and by the indexing socket of the gearshift fork.

When the gearshift fork is not activated, it is held in the neutral position by a detent in the transmission housing.

On each gearshift fork, there is a permanent magnet. With this magnet, the position sensor in the Mechatronics can identify the exact position of the individual gearshift forks.



System Overview

Sensors

Multi-Plate Clutch Oil Temperature Sensor G509

Sensor for Transmission RPM G182

Senders for Transmission Output RPM G195 and G196

Driveshaft 1 Speed Sensor G501 and Driveshaft 2 Speed Sensor G502

Sender 1 G193 and Sender 2 G194 for Hydraulic Pressure, Automatic Transmission

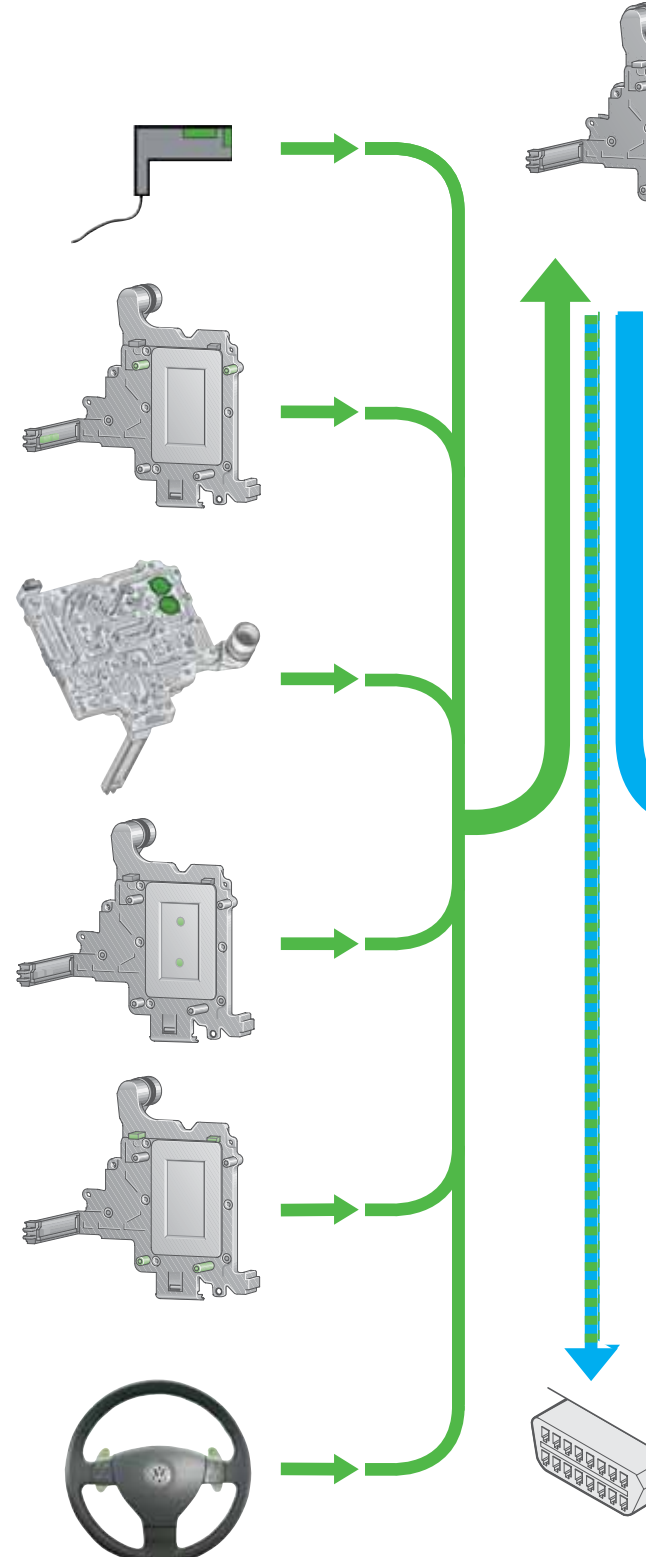
Transmission Fluid Temperature Sensor G93

Temperature Sensor (in Control Module) G510

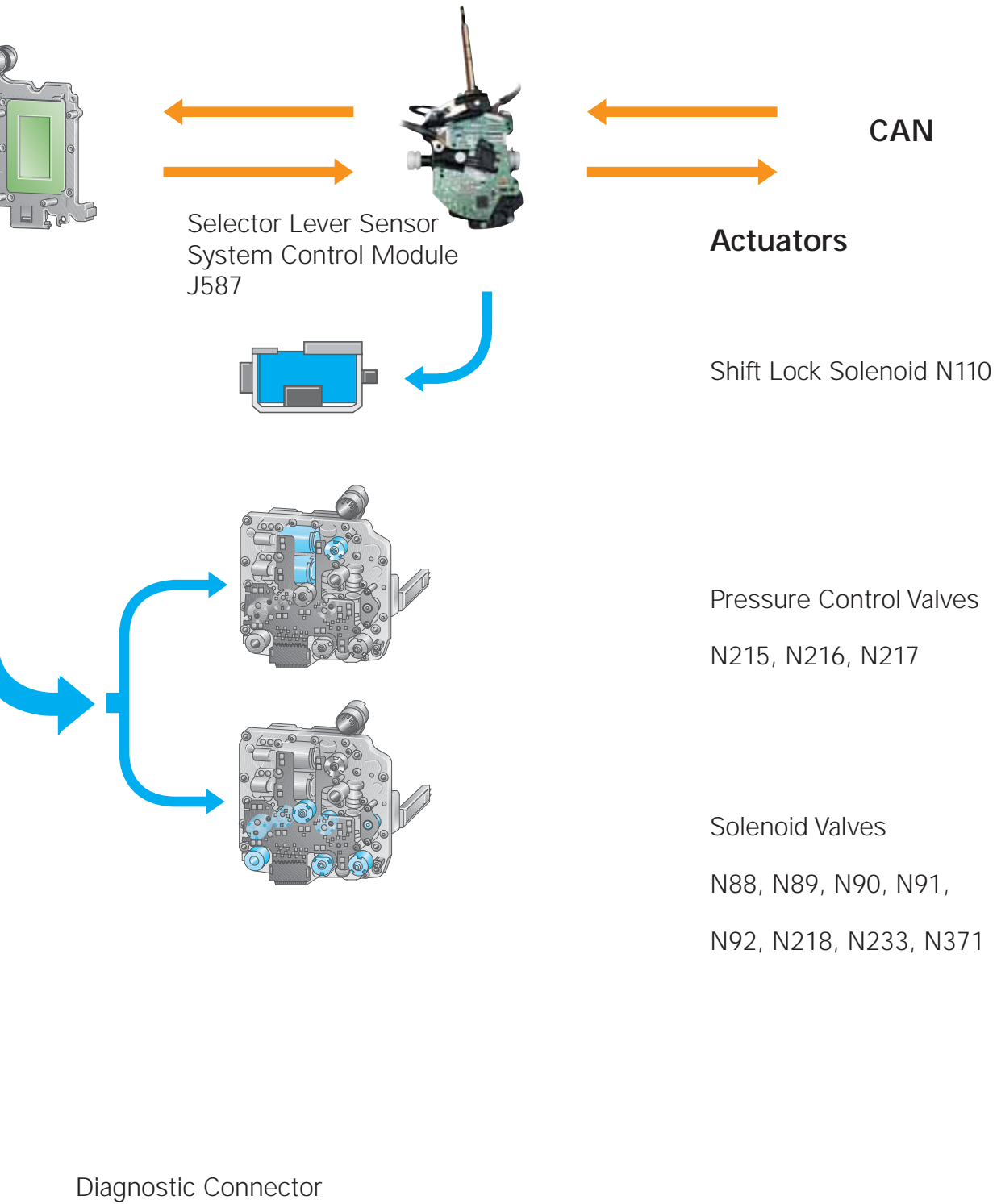
Gear Position Distance Sensors 1 to 4, G487, G488, G489, G490

Tiptronic Buttons (on the Steering Wheel) E438 and E439

Direct Shift Gearbox (DSG) Mechatronics J743



System Overview



S308_024

Sensors

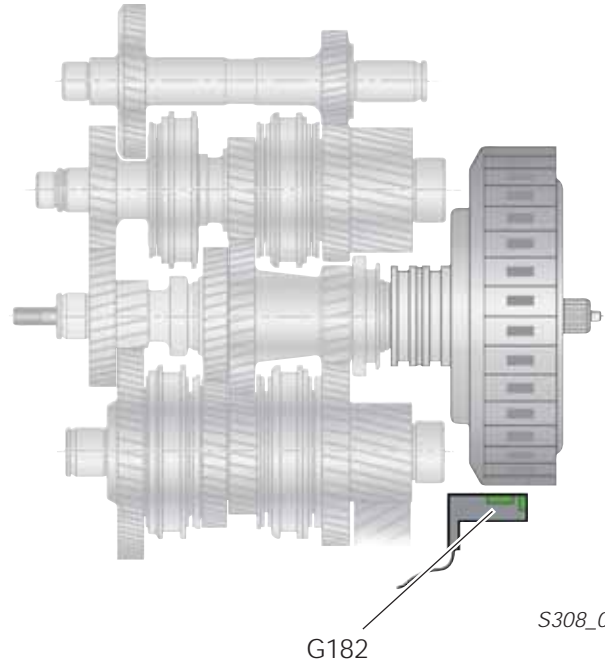
Sensor for Transmission RPM G182

The sensor for transmission RPM is positioned inside the transmission housing.

It electronically senses the outside of the double coupling and records the input transmission RPM.

The transmission input RPM is identical to the engine RPM.

G182 is a Hall sensor that is integrated with the Multi-plate Clutch Oil Temperature Sensor G509. Electrical wires connect both sensors to the Mechatronics.



Signal utilization

The transmission input RPM signal is used to calculate the multi-disc clutches slip. For this calculation, the control module also uses the signals from sensors G501 and G502. With the calculated slip rate, the control module can regulate correctly the opening and closing of the clutches.

Effect of signal failure

In case of signal failure, the control module uses the engine RPM from the CAN as a replacement signal.

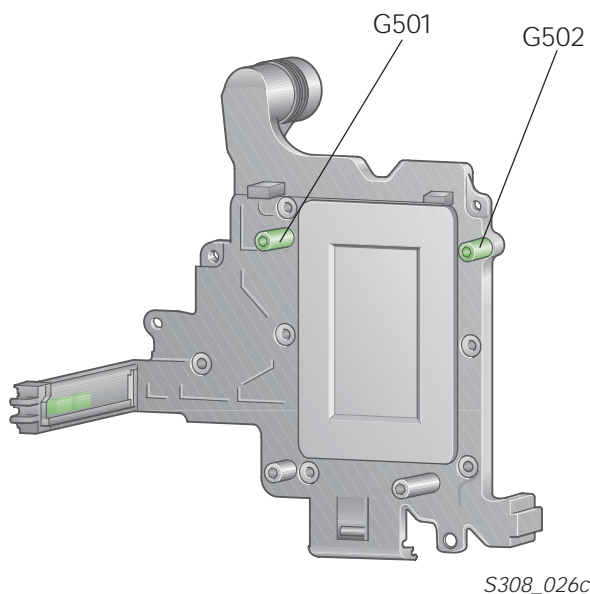
Driveshaft 1 Speed Sensor G501 and Driveshaft 2 Speed Sensor G502

The two sensors located in the Mechatronics unit are Hall effect sensors.

Sensor G501 records the RPM of Input Shaft 1.

Sensor G502 records the RPM of Input Shaft 2.

To identify the shaft RPM, each sensor detects an impulsion wheel installed on the respective shaft. The impulsion wheel is made of sheet metal. A coat of rubber-metal is deposited on the sheet metal. This coat constitutes a ring of small magnets with North and South poles. There is an air gap between each magnet.



A strong magnet will destroy the impulsion wheel.

Signal utilization

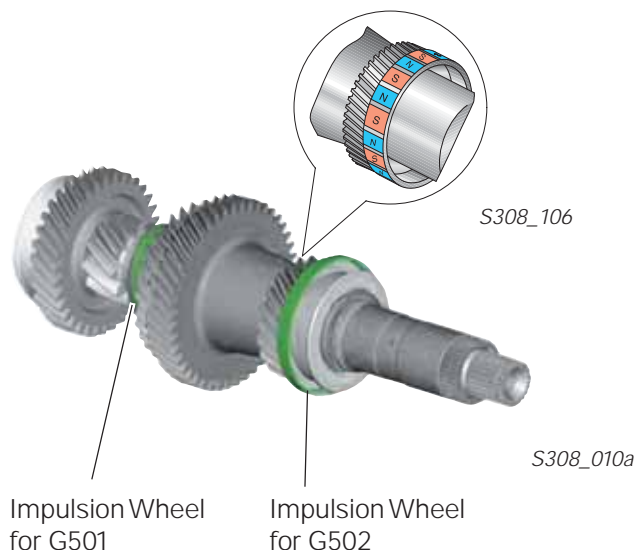
When this signal is compared to the transmission input RPM signal, the control module calculates the output RPM of the multi-disc clutches K1 and K2, and can identify the clutch slippage. Once the slippage is known, the control module regulates the opening and closing of the clutches. This signal is also used to monitor the currently selected gear in the transmission. By comparing this signal to the output RPM sensor signal, the control module can verify that the correct gear is engaged.

Effect of signal failure

In case of a signal failure, the affected transmission circuit is closed.

In case of sensor G501 failure, it is only possible to drive in 2nd gear.

In case of sensor G502 failure, it is only possible to drive in 1st and 3rd gear.



Sensors

Sender 1 for Transmission Output RPM G195 and Sender 2 for Transmission Output RPM G196

The sensors G195 and G196 are located in the Mechatronics and are permanently mounted on the control module.

Like all other RPM sensors in this transmission, these sensors are Hall effect sensors. Both sense the same impulsion wheel on Output Shaft 2.

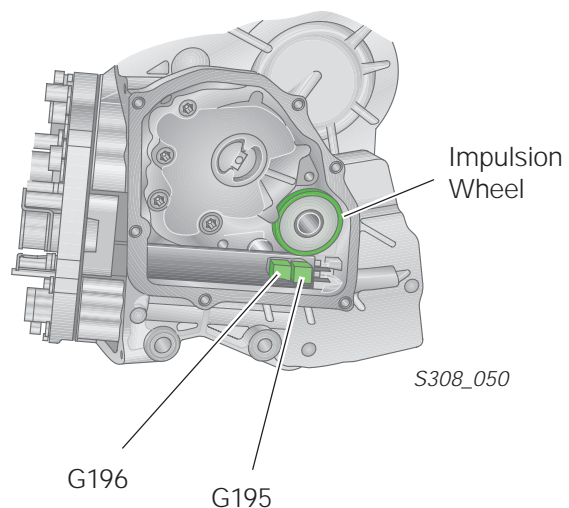
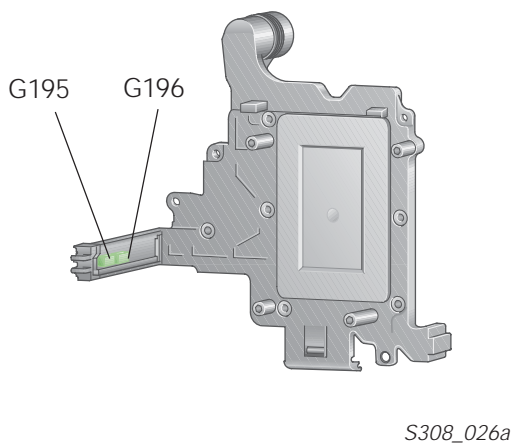
The two sensors are placed next to each other and are protected by a housing. As a result, two opposite signals are generated. If the signal of sensor G195 is "high", the signal of sensor G196 is "low".

Signal utilization

With the detailed signals, the control module can identify the vehicle speed and the direction of travel. The direction of travel is identified by comparing the signals against each other. When a modification of travel direction occurs, the signals come in opposite order in the control module.

Effect of signal failure

In case of signal failure, the control module uses the vehicle speed signal and the travel direction signal from the ABS control module.



Sender 1 G193 and Sender 2 G194 for Hydraulic Pressure, Automatic Transmission

The pressure sensors G193 and G194 are located in the electro-hydraulic control unit of the Mechatronics.

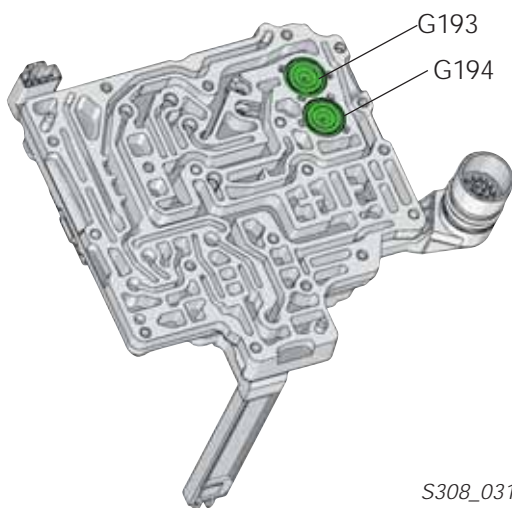
The same pressure that acts on the multi-disc clutch K1 acts on Sender 1 G193. The multi-disc clutch K2 pressure acts on Sender 2 G194.

Signal utilization

With these signals, the Mechatronics electronic control module can identify the hydraulic pressure acting on the respective multi-disc clutch. Precise hydraulic pressure is required for the control module to regulate the multi-disc clutches.

Effect of signal failure

In case of failure of the pressure signal, or if the pressure does not build up, the corresponding transmission circuit is closed. The transmission can only be operated in 1st and 3rd gear, or in 2nd gear.

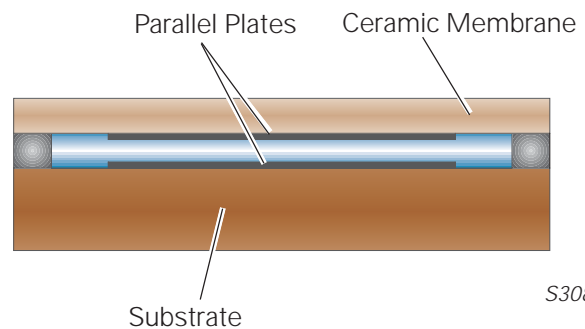


S308_031

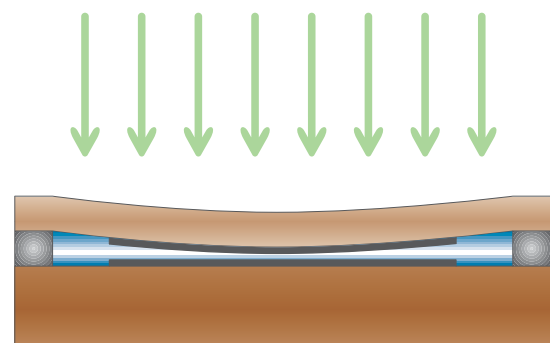
Pressure sensor function

The pressure sensor consists of a pair of electrically conductive parallel plates. The upper plate is mounted on a ceramic membrane, which is deflected according to the pressure variation. The other plate is rigidly coupled to a ceramic substrate. This substrate does not react to the pressure variation.

The upper membrane is bent according to the pressure variations, and the distance between the plates varies accordingly. As a result, a reliable signal is produced as a function of the transmission fluid pressure.



S308_107



S308_108

Sensors

Multi-plate Clutch Oil Temperature Sensor G509

The Multi-Plate Clutch Oil Temperature Sensor G509 is integrated with the Sensor for Transmission RPM G182. It measures the temperature of the transmission fluid leaving the multi-disc clutches. The multi-disc clutches generate more heat than any other component in the transmission, and the transmission fluid leaving them must be monitored accurately.

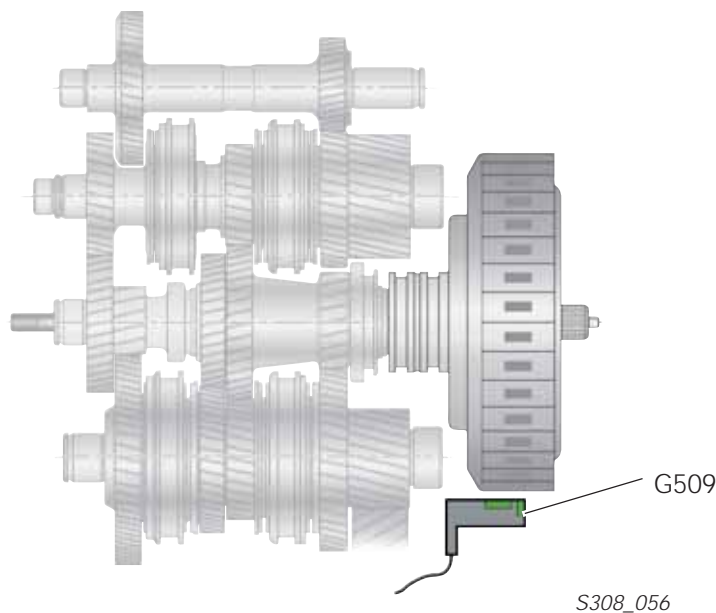
This sensor is built so that it can measure the temperature very quickly and very precisely. It can record temperatures from -55°C to $+180^{\circ}\text{C}$ (-67°F to 356°F).

Signal utilization

With the signals from temperature sensor G509, the control module regulates the amount of clutch cooling fluid and initiates other measurements to protect the transmission.

Effect of signal failure

In case of signal failure, the control module uses the signals from sensors G93 and G510 as replacement signals.



Transmission Fluid Temperature Sensor G93 and Control Module Temperature Sensor G510

Sensors G93 and G510 are integrated into the Mechatronics unit, which is surrounded by transmission fluid. Excessive heat in the transmission fluid can damage the Mechatronics.

These two sensors measure the temperature of the Mechatronics and the fluid surrounding it. As a result, transmission fluid temperature increases can be detected early enough to prevent a rapid increase in the Mechatronics temperature.

Signal utilization

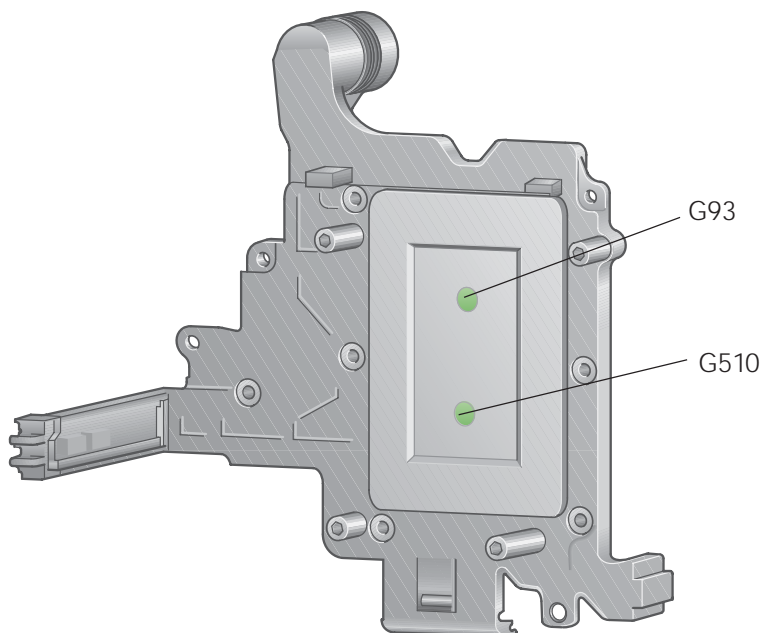
Both sensor signals are used to measure the Mechatronics temperature.

In addition, based on the sensor signals, a warm-up control program is started.

Both sensors are used to check each other.

Effect of signal failure

When temperature reaches 138°C (280°F), the Mechatronics initiates a reduction in engine torque. At temperatures above 145°C (293°F), the multi-disc clutches are no longer provided with fluid pressure and the clutches open.



S308_026d

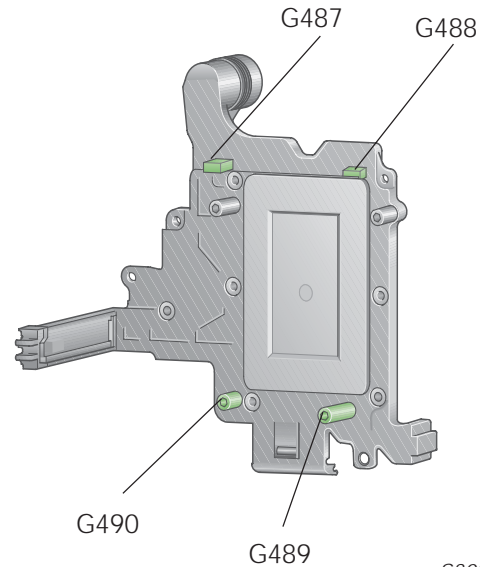
Sensors

Gear Position Distance Sensors 1 to 4 G487, G488, G489, G490

These Hall effect position sensors are located in the Mechatronics. Along with the magnets and the gearshift forks, they produce a signal allowing the control module to know the position of the gear actuator.

Each position sensor monitors the position of a gear actuator/gearshift fork, which allows a decision between two gears :

- G487 for gears 1/3
- G488 for gears 2/4
- G489 for gears 6/R
- G490 for gears 5/N



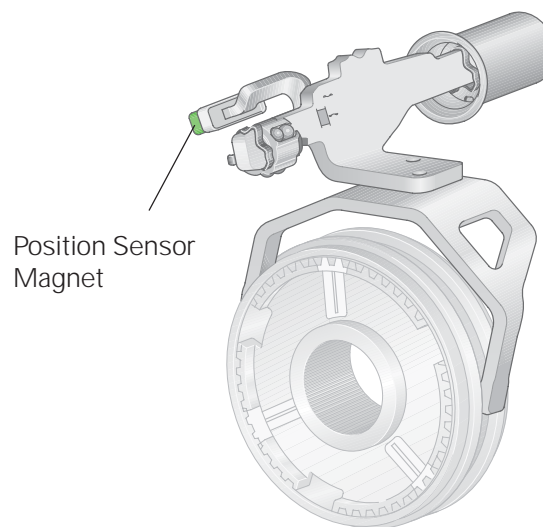
S308_025

Signal utilization

Once it has received the exact position, the control module lets the gear actuator use the transmission fluid pressure to shift gears.

Effect of signal failure

If a position sensor fails to provide a signal, the affected transmission circuit is closed. The gears in the affected transmission circuit can no longer be used.



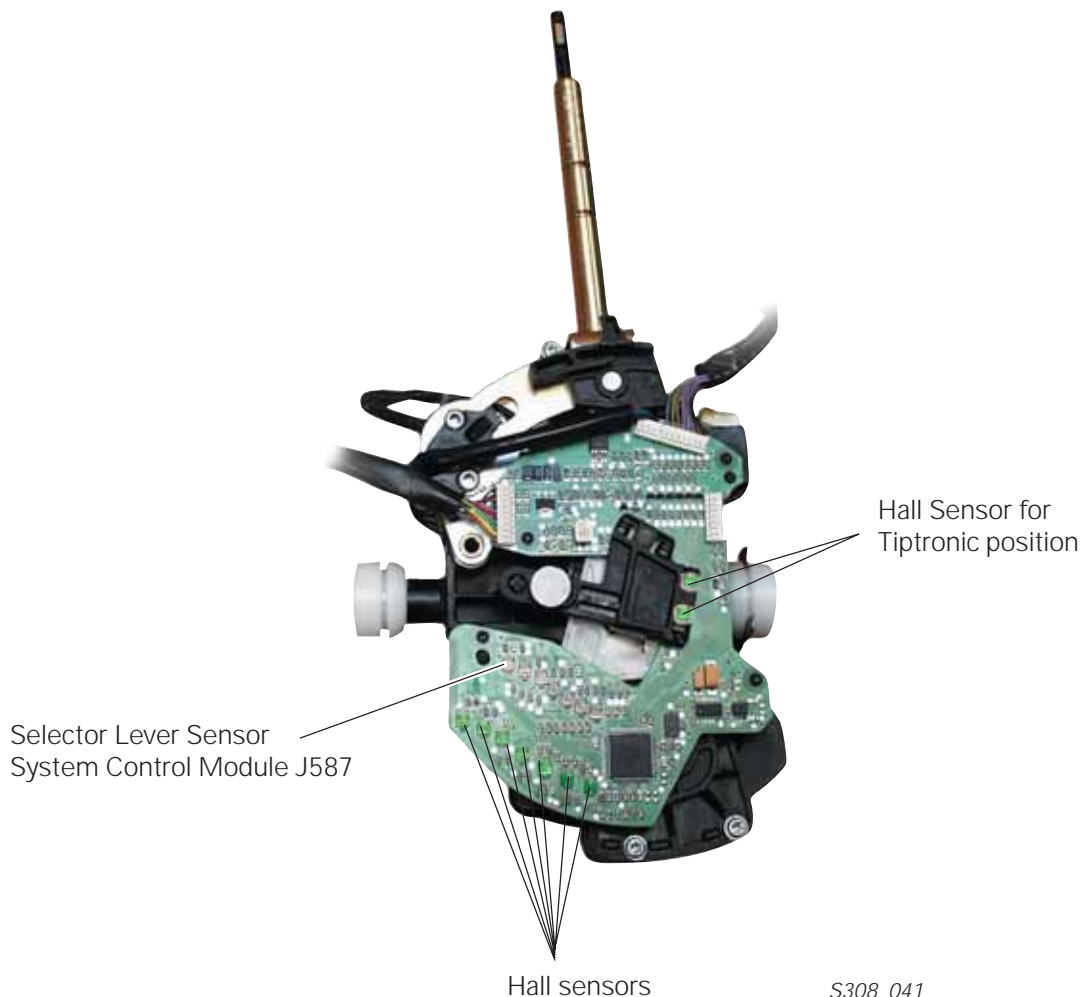
S308_048

Selector Lever Sensor System Control Module J587

The Selector Lever Sensor System Control Module J587 is integrated in the selector lever. It functions simultaneously as a control module and as two separate sensors. As a control module, it works to control the solenoid for the selector lever interlock. The selector lever lighting is integrated.

At the same time, it contains a Hall effect sensor to recognize the position of the selector lever and a Hall effect sensor to recognize the Tiptronic controls.

The signals for selector lever position and for Tiptronic are sent to the Mechatronics and to the control module for application of the shift table.



S308_041

Actuators

Pressure Control Valve 3 N217 (Main Pressure Valve)

The Pressure Control Valve 3 N217 is located in the electro-hydraulic control unit of the Mechatronics. It is a modulation valve. The main pressure in the Mechatronics hydraulic system is regulated by this valve.

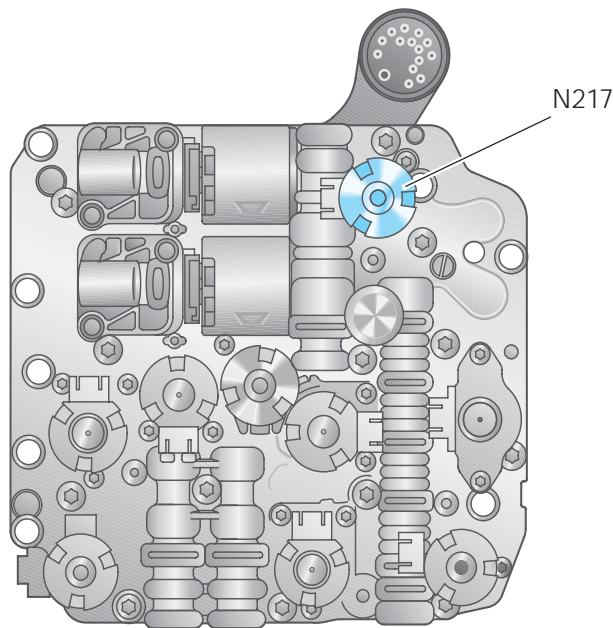
The most important factor in computing main pressure is clutch pressure, which depends on engine torque.

Engine temperature and engine speed are used to correct the main pressure.

The control module continually adjusts the main pressure based on current conditions.

Effect of signal failure

If the pressure control valve is defective, the maximum main pressure will be used. As a result, fuel consumption may increase and gearshifts may become harsh.



S308_054_1

Pressure Control Valve 1 N215 and Pressure Control Valve 2 N216 (Clutch Valves)

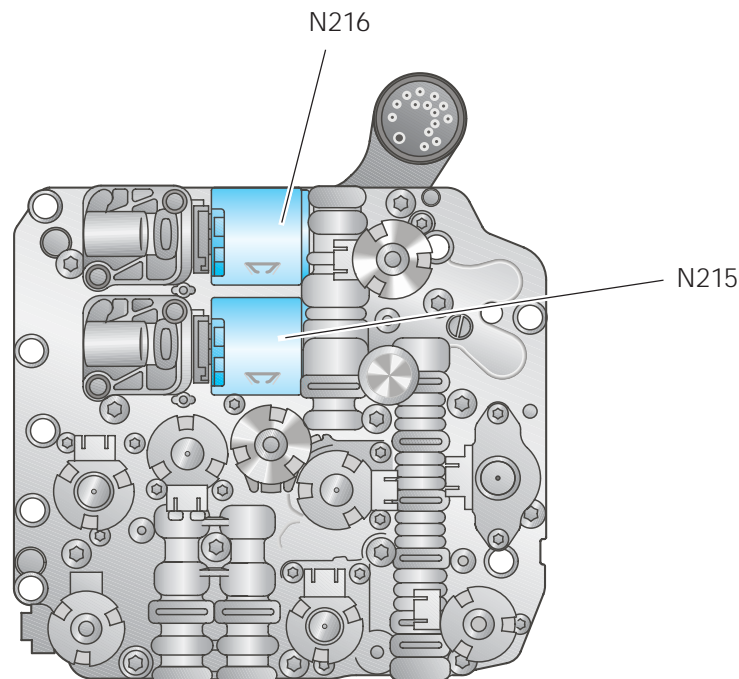
The Pressure Control Valves N215 and N216 are located in the electro-hydraulic control unit of the Mechatronics.

They are modulation valves and produce the control pressure for the multi-disc clutches – Pressure Control Valve N215 for multi-disc clutch K1 and Pressure Control Valve N216 for multi-disc clutch K2.

Engine torque is the basis for the computation of clutch pressure. The control module adjusts clutch pressure based on the actual friction coefficient of the multi-disc clutches.

Effect of signal failure

In case of failure of a pressure control valve, the corresponding transmission circuit is closed. This failure will be displayed in the instrument panel insert.



S308_054_4

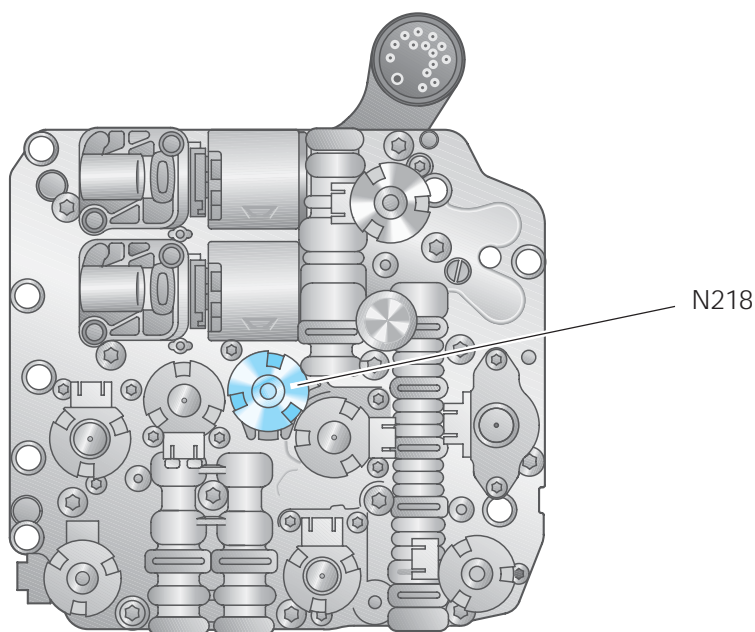
Actuators

Pressure Control Valve 4 N218 (Coolant Valve)

The Pressure Control Valve N218 is located in the electro-hydraulic control unit. It is a modulation valve and controls a hydraulic slide valve to regulate the volume of clutch cooling fluid. To control the valve, the control module uses the signal from the Multi-Plate Clutch Oil Temperature Sensor G509.

Effect of signal failure

If the pressure control valve cannot be actuated, the maximum cooling fluid volume flows through the multi-disc clutches. In case of low outside temperature, this could result in problems shifting gears as well as a higher fuel consumption.



S308_054_2

Solenoid Valves 1 N88, 2 N89, 3 N90 and 4 N91 (Gear Actuator Valves)

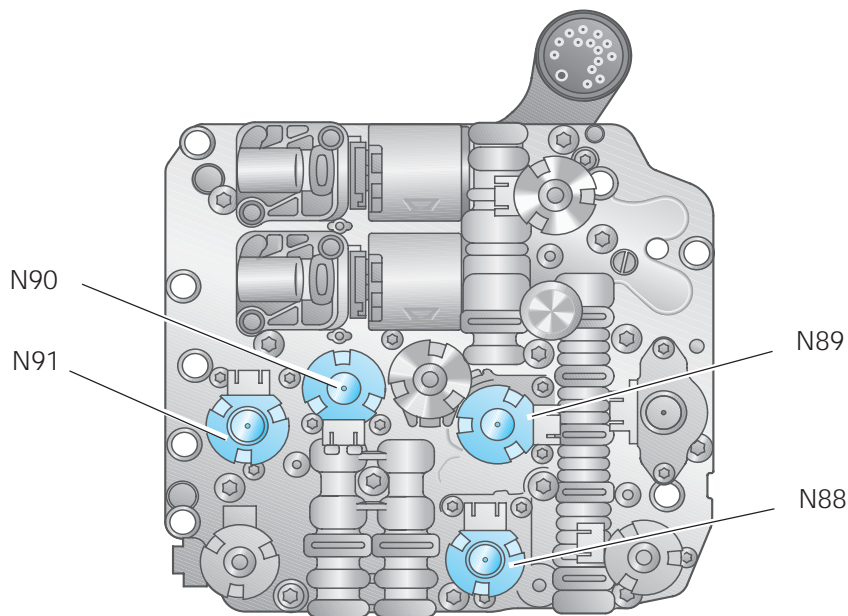
The four solenoid valves are located in the electro-hydraulic control unit of the Mechatronics. These are ON/OFF valves. They regulate all fluid pressure of the multiplexer slide valves for the gear actuators.

When de-energized, the solenoid valves are closed and no fluid pressure is provided to the gear actuators.

- Solenoid Valve 1 N88 controls the fluid pressure to shift the 1st and 5th gears
- Solenoid Valve 2 N89 controls the fluid pressure to shift 3rd gear and Neutral
- Solenoid Valve 3 N90 controls the fluid pressure to shift 2nd and 6th gears
- Solenoid Valve 4 N91 controls the fluid pressure to shift 4th gear and Reverse

Effect of signal failure

In case of failure of a solenoid valve, the corresponding transmission circuit, containing the corresponding gear actuator, will be closed. The vehicle can only be driven in 1st and 3rd gears, or only in 2nd gear.



S308_054_13

Actuators

Solenoid Valve 5 N92 (Multiplexer Valve)

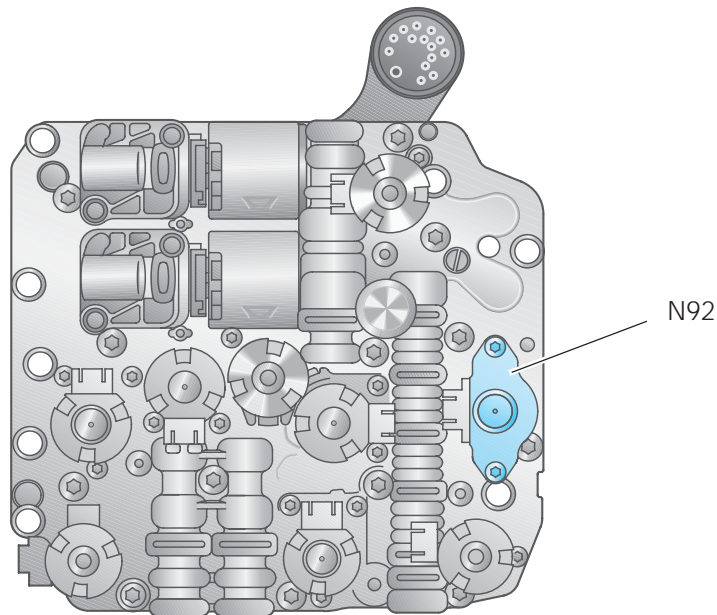
The Solenoid Valve 5 N92 is located in the Mechatronics electro-hydraulic control unit. It controls the multiplexer in the hydraulic control unit.

When the solenoid valve is activated, gears 2, 4 and 6 can be shifted. When the solenoid valve is deactivated, gears 1, 3, 5, and Reverse can be shifted.

Effect of signal failure

The multiplexer slide valve remains in its resting position. It can no longer be activated by fluid pressure.

Incorrect gear shifting may occur. It is also possible that the vehicle will not engage any gear.



S308_054_11

Pressure Regulating Valve 5 N233 and Pressure Regulating Valve 6 N371 (Safety Valves)

Pressure Regulating Valves N233 and N371 are housed in the Mechatronics hydraulic module. They are modulation valves. They regulate the safety valves inside the Mechatronics valve body.

In case of a safety related failure in a transmission circuit, the safety valve cuts the hydraulic pressure of the corresponding transmission circuit.

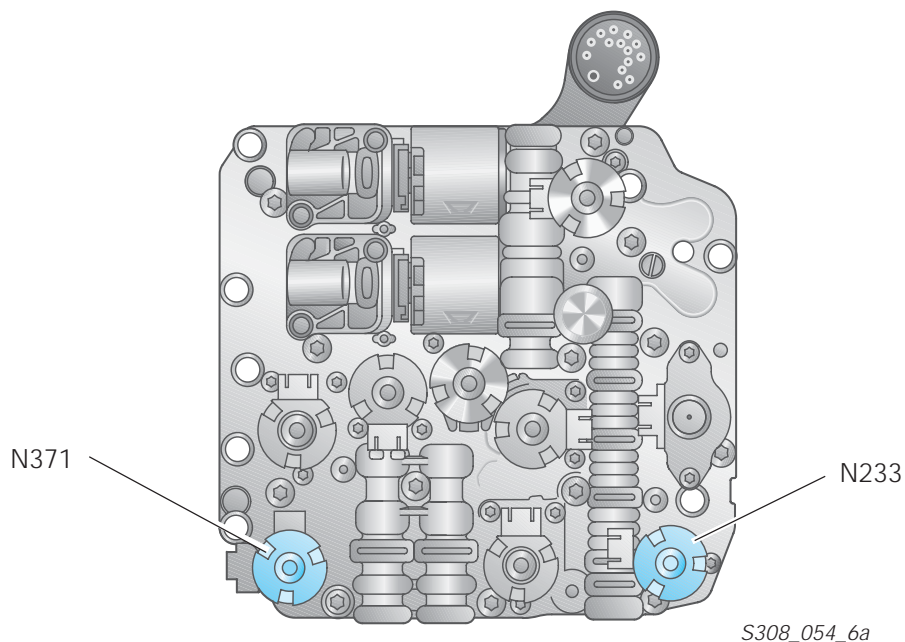
Pressure Regulating Valve 5 N233 controls the safety slide valve in transmission circuit 1. Pressure Regulating Valve 6 N371 controls the safety slide valve in transmission circuit 2.

Effect of signal failure

In case of failure of a pressure control valve, it is no longer possible to shift any gear in the corresponding transmission circuit.

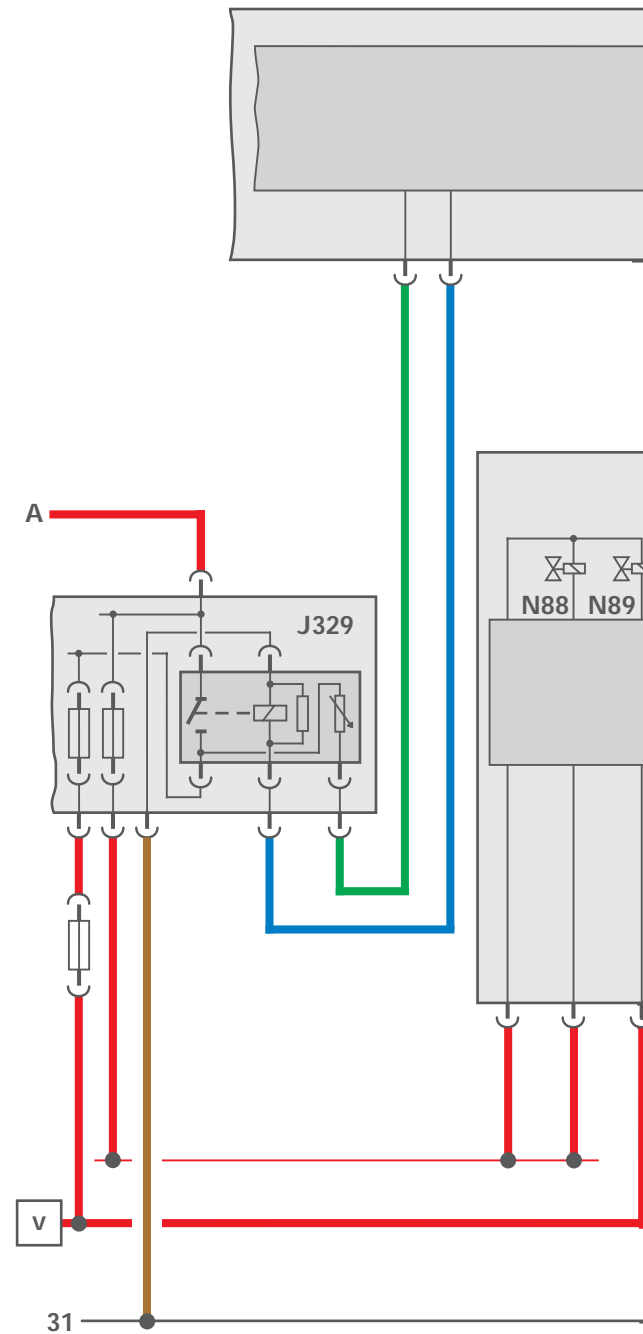
If transmission circuit 1 shuts down, it is only possible to drive in 2nd gear.

If transmission circuit 2 shuts down, it is only possible to drive in 1st or 3rd gear.

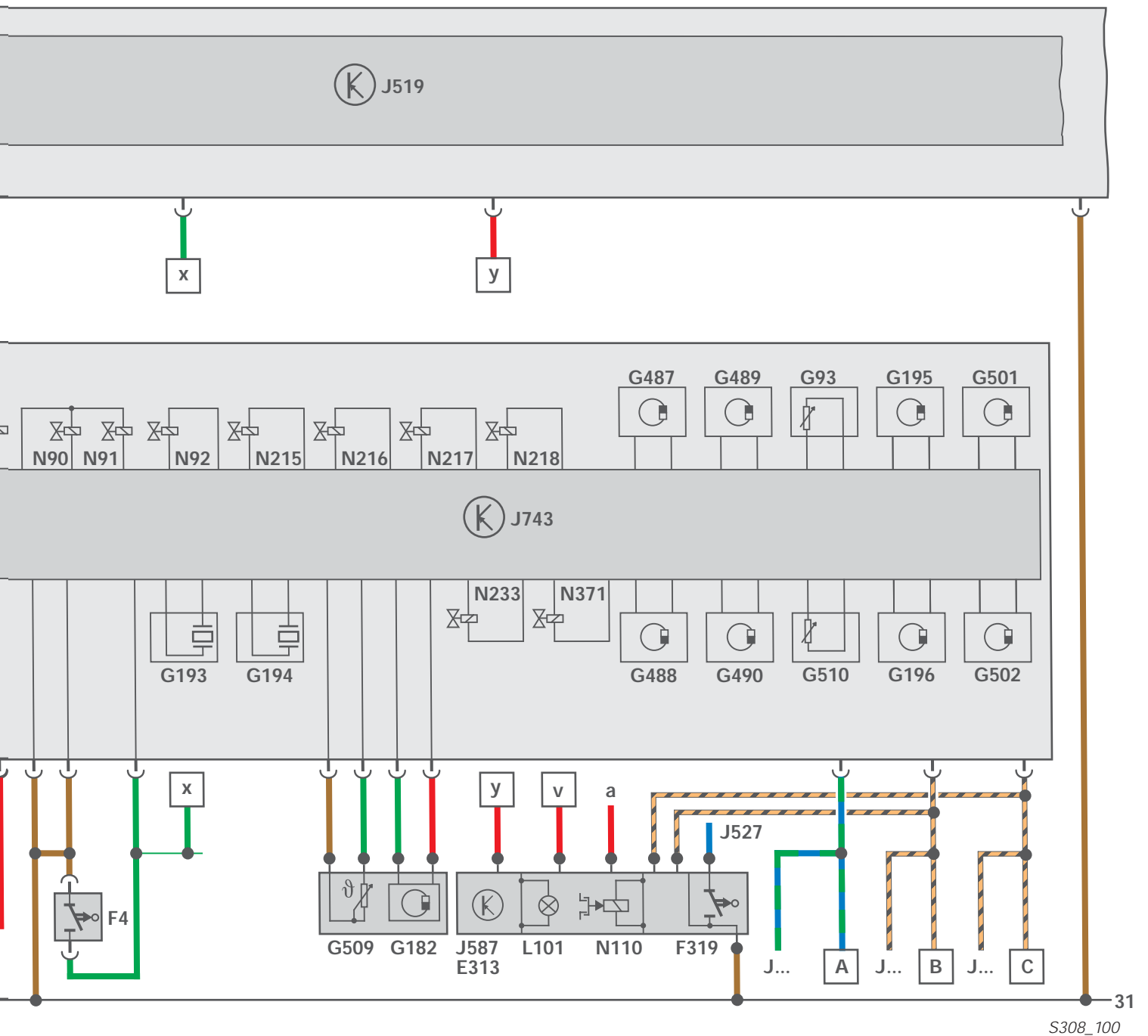


Functional Diagram

- A – Battery
- E313 – Selector Lever
- F4 – Back-up Light Switch
- F319 – Selector Lever Park Position Lock Switch
- G93 – Transmission Fluid Temperature Sensor
- G182 – Sensor for Transmission RPM
- G193 – Sender 1 for Hydraulic Pressure
- G194 – Sender 2 for Hydraulic Pressure
- G195 – Sender for Transmission Output RPM
- G196 – Sender 2 for Transmission Output RPM
- G487 – Gear Position Distance Sensor 1
- G488 – Gear Position Distance Sensor 2
- G489 – Gear Position Distance Sensor 3
- G490 – Gear Position Distance Sensor 4
- G501 – Driveshaft 1 Speed Sensor
- G502 – Driveshaft 2 Speed Sensor
- G509 – Multi-plate Clutch Oil Temperature Sensor
- G510 – Temperature Sensor (in Control Module)
- J... – Engine control module
- J329 – Voltage Supply Terminal 15 (B+) Relay
- J519 – Vehicle Electrical System Control Module
- J527 – Steering Column Electronic Systems Control Module
- J587 – Selector Lever Sensor System Control Module
- J743 – Direct Shift Gearbox (DSG) Mechatronics
- N88 – Solenoid Valve 1
- N89 – Solenoid Valve 2
- N90 – Solenoid Valve 3
- N91 – Solenoid Valve 4
- N92 – Solenoid Valve 5
- N110 – Shift Lock Solenoid
- N215 – Pressure Control Valve 1 for Automatic Transmission
- N216 – Pressure Control Valve 2 for Automatic Transmission
- N217 – Pressure Control Valve 3 for Automatic Transmission
- N218 – Pressure Control Valve 4 for Automatic Transmission
- N233 – Pressure Control Valve 5 for Automatic Transmission
- N371 – Pressure Control Valve 6 for Automatic Transmission



Functional Diagram



- a – Terminal 30 over safety switch SC21
- A** – K-Wire
- B** – CAN Drivetrain high
- C** – CAN Drivetrain low

CAN-Databus-Links

CAN-Databus-Links

The schematic below shows the Mechatronics links for the Direct Shift Gearbox in the CAN Databus structure of the vehicle.

J104 – ABS Control module with EDL

J248 – Diesel Direct Fuel Injection (DFI) Engine Control Module

J285 – Control Module with Indicator Unit in the Instrument Panel Insert

J519 – Vehicle Electrical System Control Module

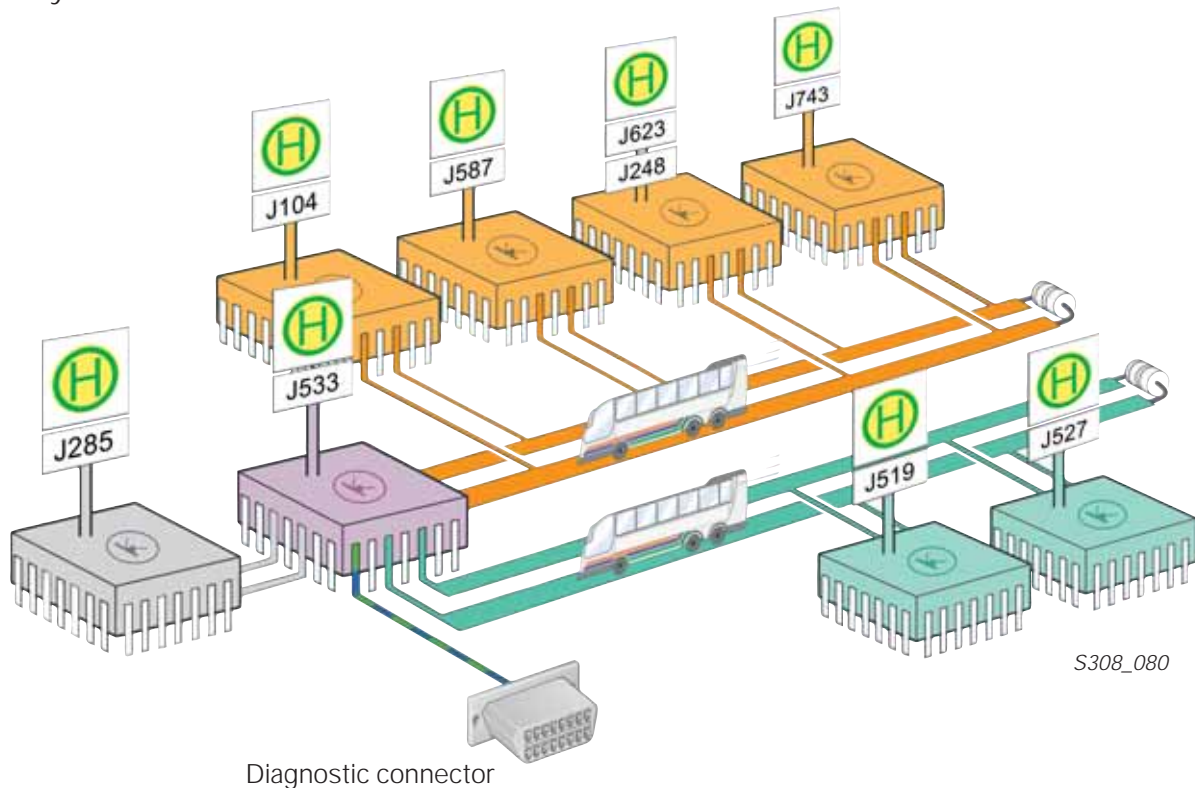
J527 – Steering Column Electronic Systems Control Module

J533 – Data Bus On-Board Diagnostic Interface

J587 – Selector Lever Sensor System Control Module

J623 – Engine Control Module (ECM)

J743 – Direct Shift Gearbox (DSG) Mechatronics



 CAN-Data bus "Drivetrain"

 CAN-Data bus "Comfort"

Diagnostic

The vehicle diagnostic, test, and information system VAS 5051 provides the following operating modes:

- Guided Fault Finding
- Guided Functions

“Guided Fault Finding” operating mode

In the “Guided Fault Finding” mode, the Direct Shift Gearbox defines a test plan using sensors, actuators, and the Mechatronics.

Sensors:

- G93 – Transmission Fluid Temperature Sensor
- G182 – Sensor for Transmission RPM
- G193 – Sensor 1 for Hydraulic Pressure
- G194 – Sensor 2 for Hydraulic Pressure
- G195 – Sender for Transmission Output RPM
- G196 – Sender 2 for Transmission Output RPM
- G487 – Gear Position Distance Sensor 1
- G488 – Gear Position Distance Sensor 2
- G489 – Gear Position Distance Sensor 3
- G490 – Gear Position Distance Sensor 4
- G501 – Driveshaft 1 Speed Sensor
- G502 – Driveshaft 2 Speed Sensor
- G509 – Multi-Plate Clutch Oil Temperature Sensor
- G510 – Temperature Sensor (in Control Module)

Actuators:

- N88 – Solenoid Valve 1
- N89 – Solenoid Valve 2
- N90 – Solenoid Valve 3
- N91 – Solenoid Valve 4
- N92 – Solenoid Valve 5
- N110 – Shift Lock Solenoid
- N215 – Pressure Control Valve 1
- N216 – Pressure Control Valve 2
- N217 – Pressure Control Valve 3
- N218 – Pressure Control Valve 4
- N233 – Pressure Control Valve 5
- N371 – Pressure Control Valve 6

Mechatronics:

- J743 – Mechatronics gear monitoring
- J743 – Mechatronics shifting monitoring
- J743 – Mechatronics power supply voltage

“Guided Functions” operating mode

In the “Guided Functions” operating mode, the Direct Shift Gearbox executes a test plan to test the oil levels.



Pay attention to the instructions in VAS 5051 when testing sensors and actuators.

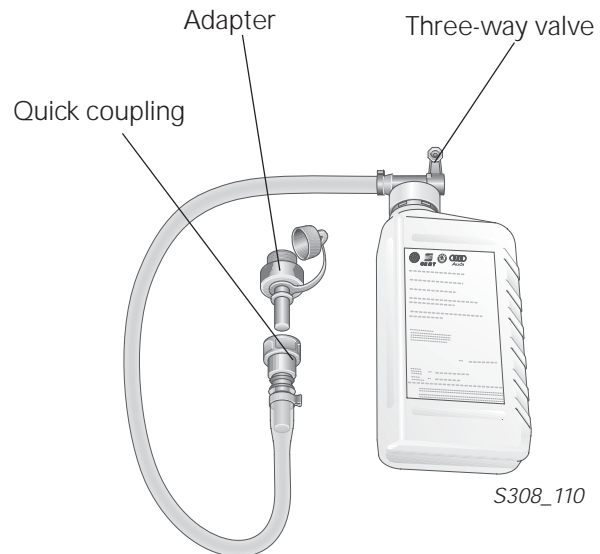
Service

Special Tools

A new special tool, the VAS 6252, has been created to check and adjust the fluid level of the Direct Shift Gearbox.

This tool has a quick release coupling to easily control the fluid level.

A three-way valve on the fluid bottle connection allows for easy replacement of the bottle.



Be careful not to mix different types of transmission fluids. Poor operation or internal damage can result.

Notes

Knowledge Assessment

An on-line Knowledge Assessment (exam) is available for this Self-Study Program.

The Knowledge Assessment may or may not be required for Certification.

You can find this Knowledge Assessment at:

www.vvwebservice.com

From the [vvwebservice.com](http://www.vvwebservice.com) Homepage, do the following:

- Click on the Certification tab
- Type the course number in the Search box
- Click "Go!" and wait until the screen refreshes
- Click "Start" to begin the Assessment

For Assistance, please call:

Certification Program Headquarters

**1 – 877 – CU4 – CERT
(1 – 877 – 284 – 2378)**

(8:00 a.m. to 8:00 p.m. EST)

Or, E-Mail:

Comments@VWCertification.com

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