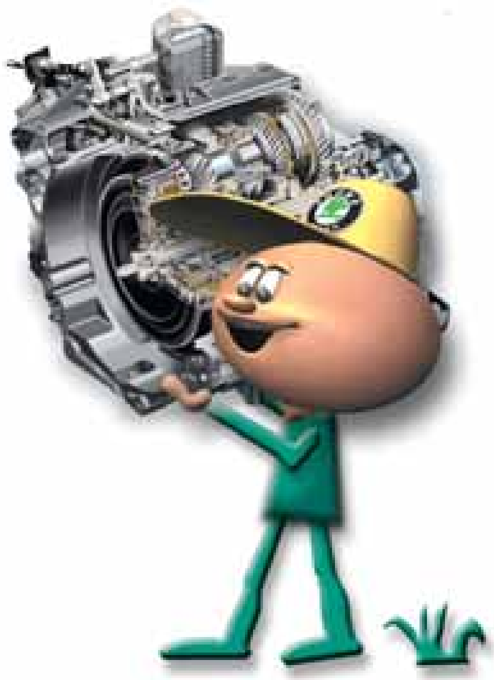


The automatic gearbox DSG* is available in the new **Škoda**Octavia, designated as Direct Shift Gearbox - abbreviated DSG.
It can function in two operating modes:

– fully automatically or
– with the manual gear selection – the so-called Tiptronic

The automatic gearbox DSG combines the advantages of the manually shiftable gearbox and the classical automatic gearbox in a successful way while at the same time suppressing their disadvantages.

Shifting occurs fast, completely smooth and soft, without any jolting. It lasts only three to four hundredth seconds.
The power transmission from the engine to the wheels is not interrupted when shifting. The gearbox shifts into a sporty shifting mode only at a higher speed and thus makes it possible to fully use the power potential of the engine. It shifts beforehand in the economic driving mode. Thus the fuel consumption is kept at a low level.

* **D**irect **S**hift **G**earbox

Contents

You will find notes on inspection and maintenance, setting and repair instructions in the Workshop Manual.

Introduction

Technical highlights

The manual shift gearboxes dominate in Europe in the current gearbox world, meanwhile the automatic gearboxes are primarily available in the USA and Japan.
Both kinds of gearboxes have specific advantages and disadvantages.

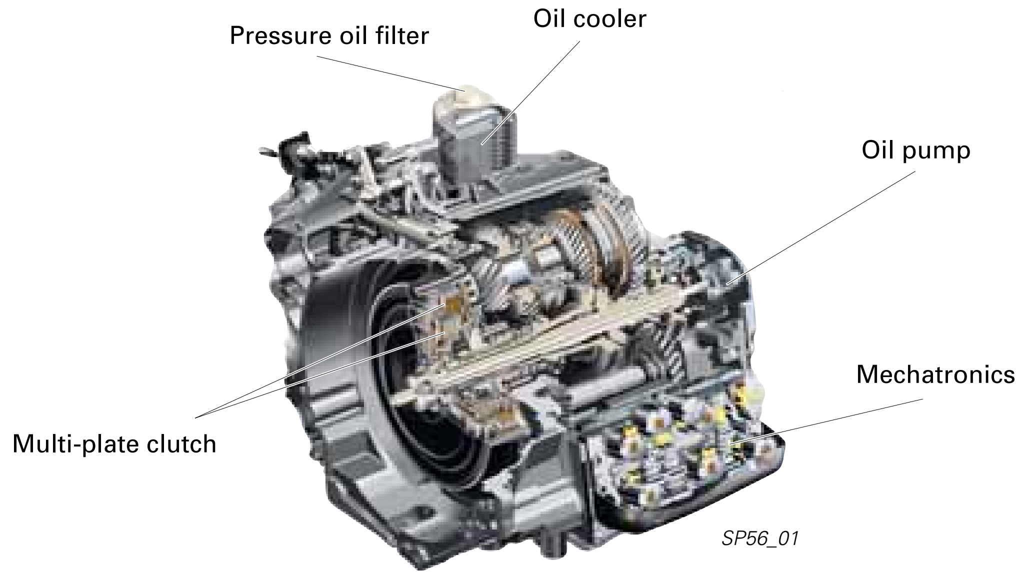
The advantages of a manual shift gearbox are among others.

- a high degree of efficiency as well as
- robustness and sportyness.

An advantage of an automatic gearbox is among others.

- high convenience, particularly when changing the gears (without interruption of the traction force).

Before this background Volkswagen set itself the goal to unite the advantages of both gearbox worlds in a completely new gearbox generation, the automatic gearbox DSG.



Based on its conception with two multi-plate clutches and different automatic shift programs, it fulfils the high requirements for comfort from the drivers of vehicles with automatic gearbox.

Beyond this it offers pure driving fun to the drivers of vehicles with manual shift gearbox through direct influence and very fast, jerk-free shifts.

At the same time the fuel consumption is equal to the one of economical vehicles with manual shift gearbox.

Characteristics for the automatic gearbox DSG are:

- six forward gears and one reverse gear
- normal driving program „D“, sport driving program „S“
- direct shifting with the selector lever - Tiptronic
- Mechatronics, electronic and electrohydraulical control unit form a unit and are accommodated in the gearbox
- Hillholder function - rolls the vehicle while stationary with easily operated brake, the clutch pressure is increased and the vehicle is stationary
- Creep control - makes "creeping" of the vehicle possible without operating the driving pedal, for example when parking
- due to the design it can only be driven in the 1st or 3rd gear or only in the 2nd gear in

  the emergency operation programme depending on the occuring fault

SP56_02

Selector lever

Actuation

The selector lever is operated in the same way as on a vehicle with automatic gearbox.
The automatic gearbox DSG offers also the possibility of shifting with Tiptronic.

The selector lever is available, as for vehicles with automatic gearbox, via selector lever locks and ignition key removal locks.
The function of the locks has remained the same. The design is new.

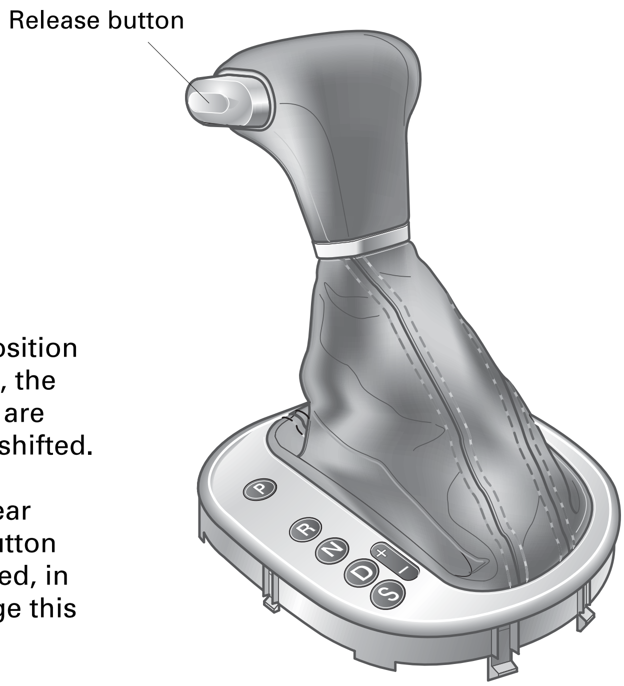
The selector lever positions are:

P – **P**arking
For moving the selector lever from this position, the ignition must be"on" and the foot brake must be applied.
In addition, the release button on the selector lever must be pressed.

N – **N**eutral position
In this position the gearbox is in idle.
If the selector lever is in this position for a longer period, the foot brake must be applied when leaving this position.

D – **D**rive
In this lever position (Drive = Fahrt), the forward gears are automatically shifted.

R – **R**everse gear
The release button must be pressed, in order to engage this gear.



SP50_03

S – **S**port
The automatic gear selection is performed according to a "sporty" characteristic, which is stored in the control unit for automatic gearbox.

+ and **–**
Tiptronic functions can be carried out in the right selector lever gate.

Structure of the selector lever

Selector lever sensor control unit J587

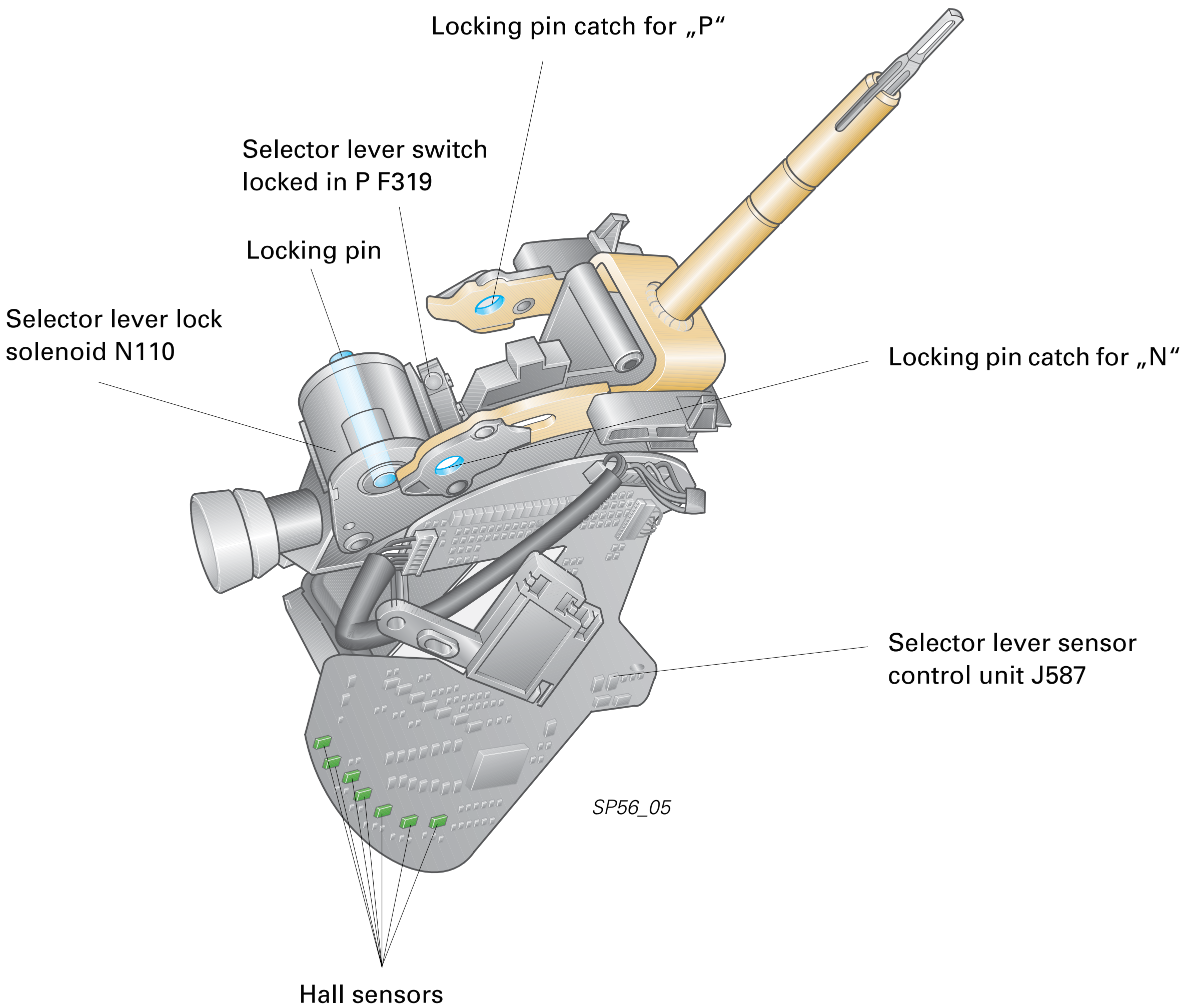
Hall sensors in the selector lever support detect the position of the selector lever and make these available via the CAN bus of the mechatronics.

Selector lever lock solenoid N110

Through the solenoid, the selector lever is locked in the positions „**P**“ and „**N**“. The selector lever lock solenoid N110 is actuated by the selector lever sensor control unit J587.

Selector lever switch locked in P F319

If the selector lever is in the position „**P**“, the selector lever switch locked in P F319 sends the signal - selector lever in position „**P**“ to the steering column electronics control unit J527. The steering column electronics control unit needs this signal for the actuation of the ignition key removal lock.



SP56_05

Selector lever

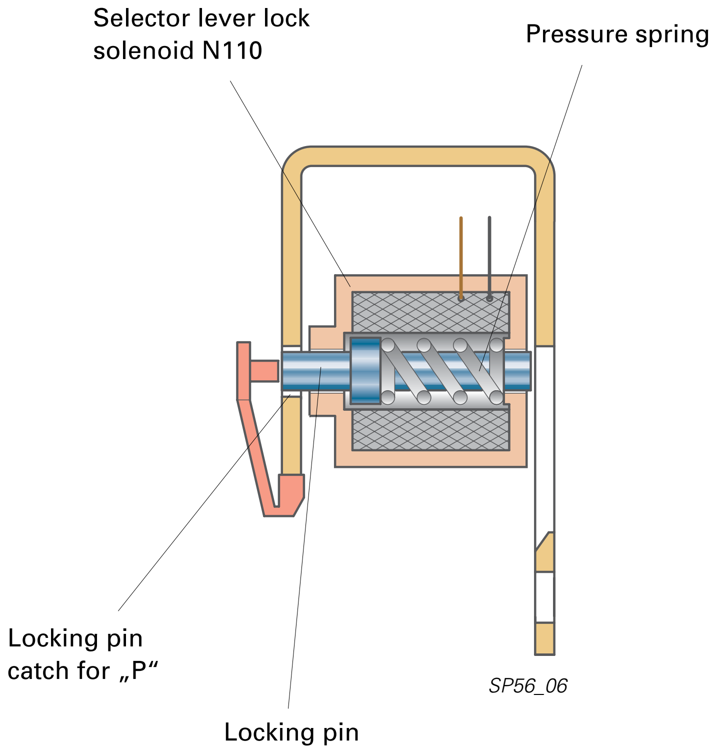
Selector lever lock solenoid N110

It functions as follows:

Selector lever position „P“ locked

The selector lever lock solenoid N110 is de-energized, the locking pin latches into the locking pin catch for „P“ by means of the spring force.

The selector lever is locked.

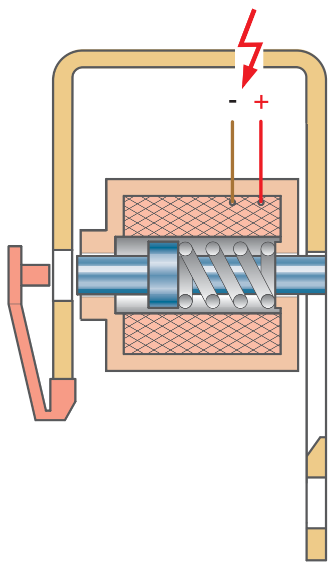


SP56_06

Selector lever position „P“ unlocked

The selector lever lock solenoid N110 is energized by the selector lever sensor control unit J587. The locking pin is pulled against the spring force from the locking pin catch for „P“.

The selector lever lock is removed.



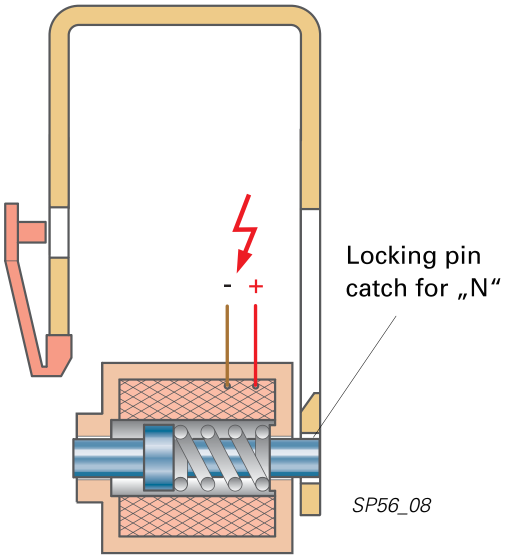
SP56_07

Selector lever position „N“

If the selector lever with “ignition ON” is in the position "N" for longer than 2 seconds, the selector lever lock solenoid N110 is energized by the selector lever sensor control unit J587. The locking pin is pressed against the spring force into the locking pin catch for „N“.

The selector lever is locked.

As of a speed of approx. 5 km/h, the N lock is no longer activated.

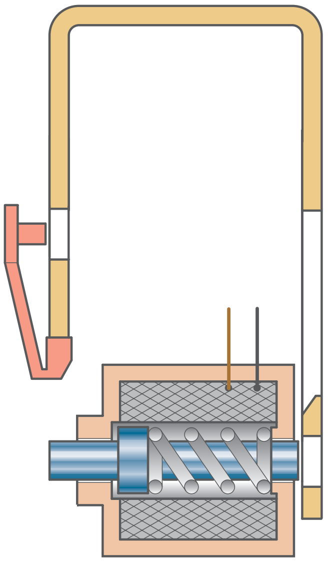


SP56_08

Selector lever position „N“ unlocked

By actuating the foot brake and/or when "ignition off" the selector lever lock solenoid N110 is de-energized. The locking pin is pulled by the spring force out of the locking pin catch for „N“.

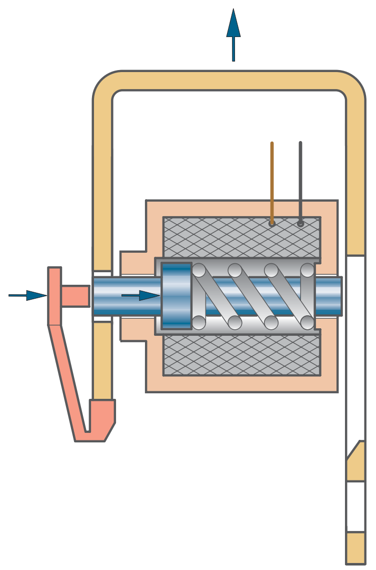
The selector lever lock is removed.



SP56_09

Emergency release

The access to the emergency release mechanism is possible after the removal of the console cover.
By actuating the emergency release, the locking pin of the selector lever lock solenoid N110 is pressed against the spring force out of the locking pin catch for „P“.
The selector lever can be moved out of the position „P“.



SP56_77

Selector lever

Ignition key removal lock

The ignition key removal lock prevents a turning back of the ignition key in the removal position when parking position is engaged.

functions electromechanically and is actuated by the steering column electronics control unit J527.

SP56_10

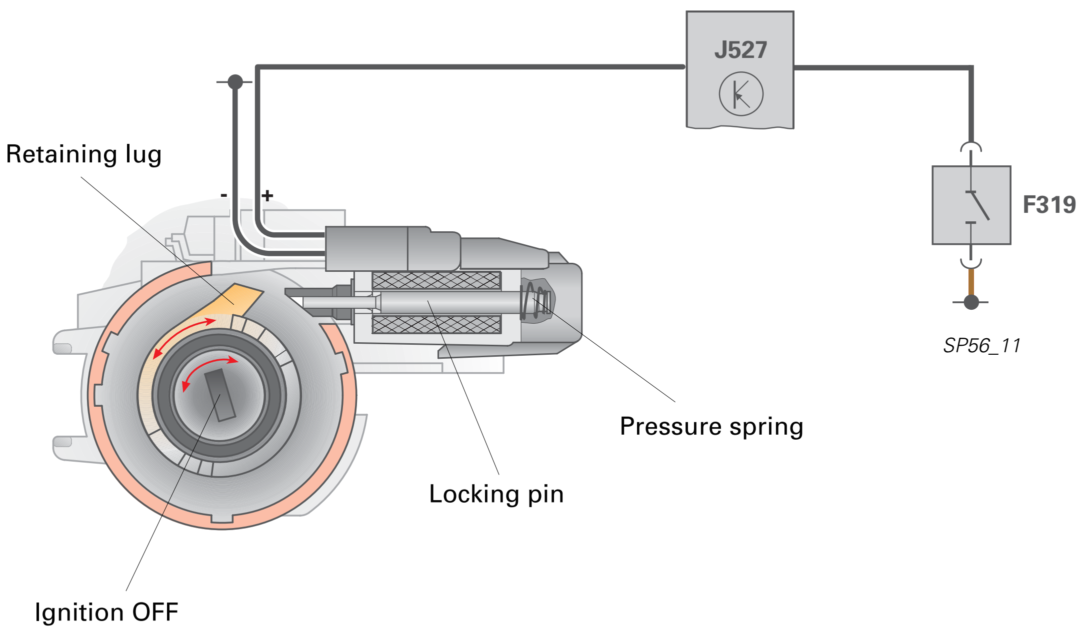
It functions as follows

Selector lever in „Park position“, the ignition is switched off.

If the selector lever is in the park position, the selector lever switch locked in P F319 is opened.
The steering column electronics control unit J527 detects the opened switch.

The ignition key removal lock solenoid N376 is not energized.

The pressure spring in the solenoid presses the locking pin into the loose position.



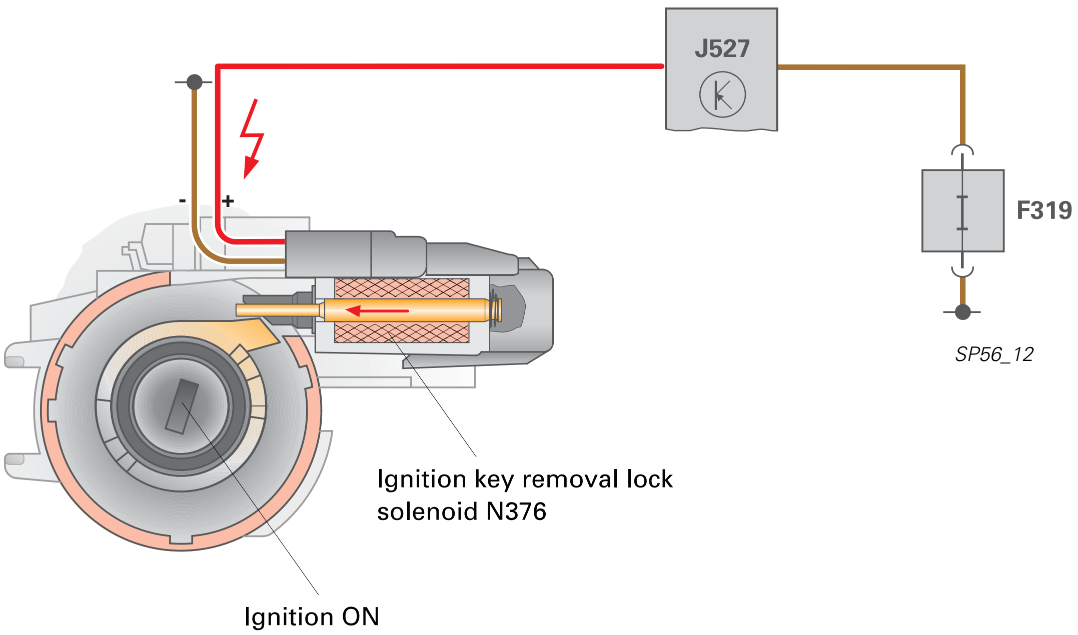
SP56_11

Selector lever in „Drive position“,
the ignition is switched on.

In the drive position of the selector lever, the selector lever switch locked in P F319 is closed.

The steering column electronics control unit J527 energizes the ignition key removal lock solenoid N376.

The locking pin is pushed by the solenoid, against the force of the pressure spring, into the locking position.
In the locking position the locking pin prevents that the ignition key can be turned back and removed.



SP56_12

Only if the selector lever is pushed into the park position, the selector lever switch locked in P F319 opens and the steering column electronics control unit J527 shifts the ignition key removal lock solenoid N376 de-energized.

Thereupon the locking pin is pressed back by the pressure spring. The ignition key continues to turn and can be pulled out.

Structure of DSG

Basic principle

The automatic gearbox DSG consists in principle of two partial gearboxes independent from each other.

Each partial gearbox is designed functionally like a manual shift gearbox. A multi-plate clutch is assigned to each partial gearbox.

Both multi-plate clutches run with DSG oil. They are regulated, opened and closed by the mechatronics depending on the shift gear.

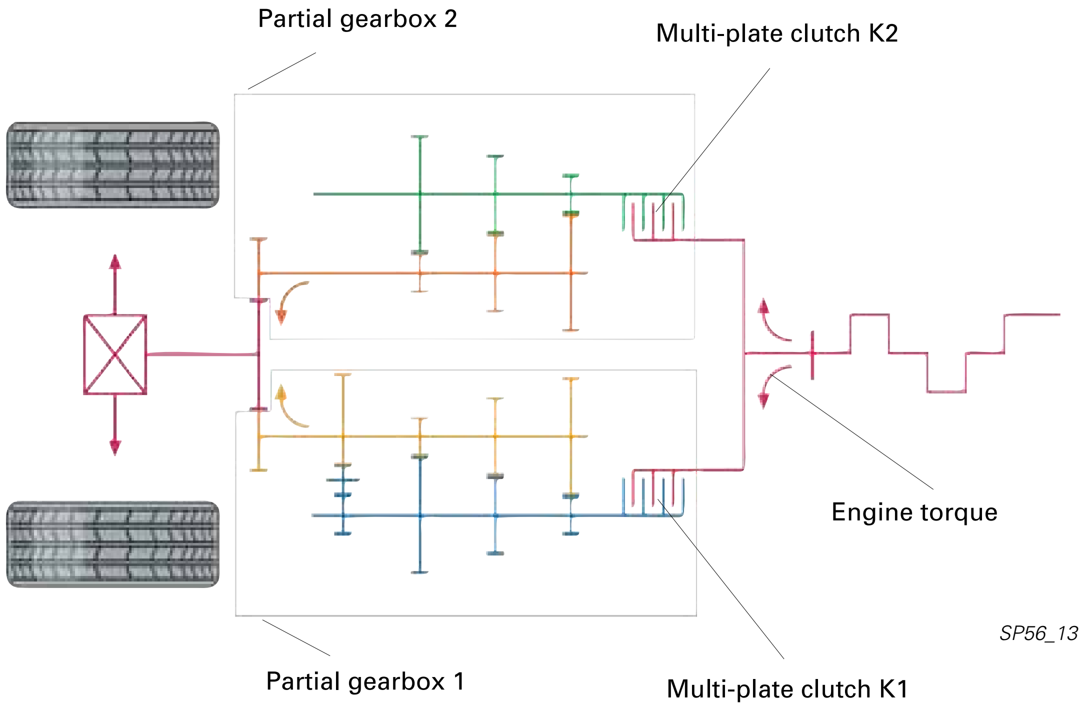
The 1st, 3rd, 5th gear and the reverse gear are shifted via the multi-plate clutch K1.

The 2nd, 4th and 6th gear are shifted via the multi-plate clutch K2.

In principle one partial gearbox is always actuated and in the other partial gearbox the next gear is already shifted, but the clutch for this gear is still open.

A conventional synchronization and gearshift unit of a gearbox is assigned to each gear.

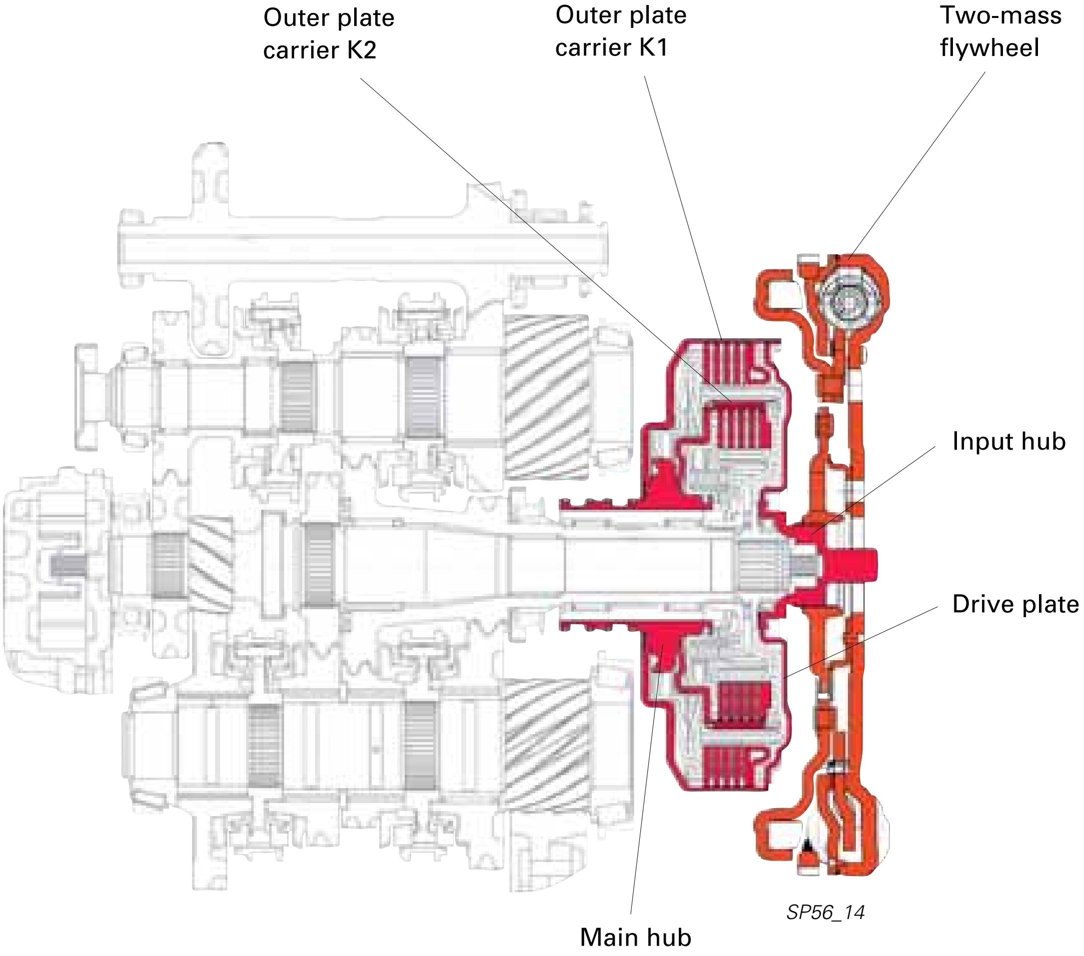
Principle representation



Torque input

The torque reaches from the crankshaft to the two-mass flywheel. The plug serration of the two-mass flywheel on the input hub of the multi-plate clutch transfers the torque to the drive plate of the multi-plate clutch.

This is connected by the outer plate carrier of the clutch K1 with the main hub of the multi-plate clutch.
The outer plate carrier of the clutch K2 is also powerfully connected with the main hub.



Structure of DSG

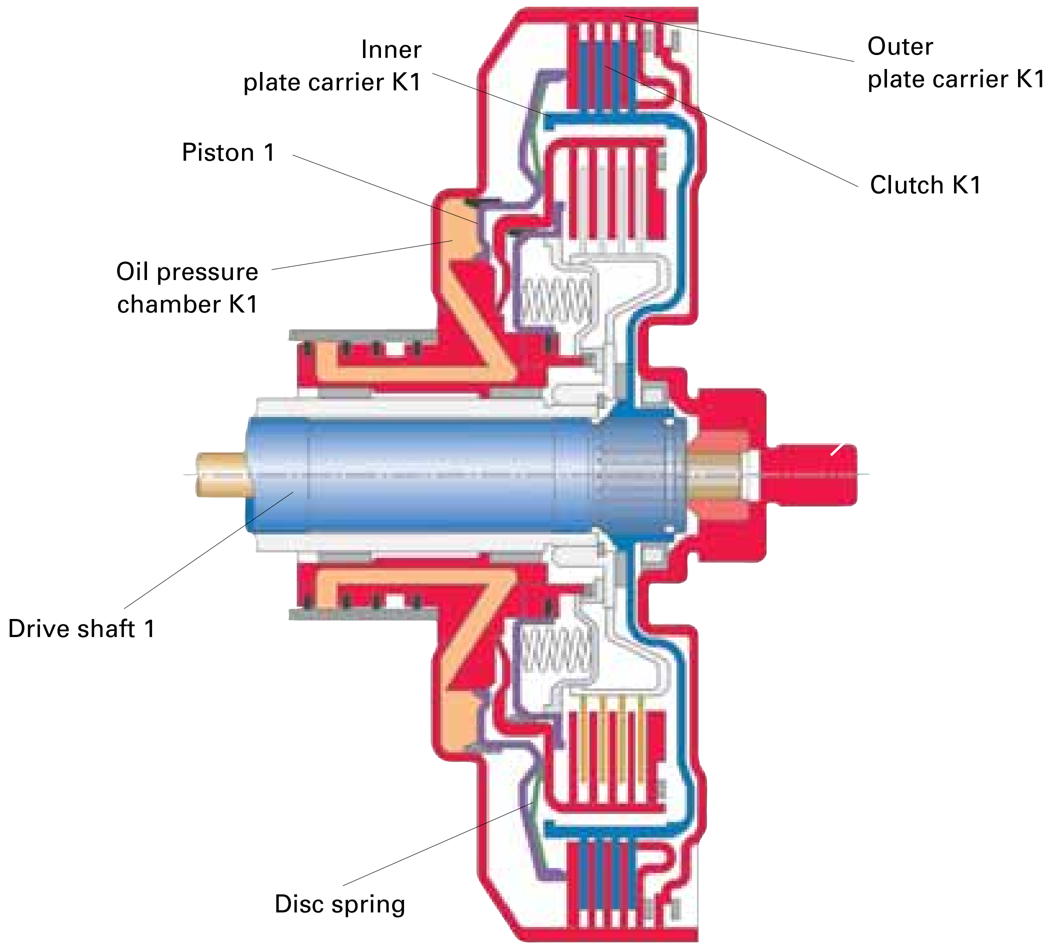
Multi-plate clutches

The torque is inserted into the respective clutch through the outer plate carrier. By closing the clutch, the torque is passed on to the inner plate carrier and then to the appropriate drive shaft. Always one multi-plate clutch is actuated.

Multi-plate clutch K1

The clutch K1 is a multi-plate clutch. It is the outer clutch and transfers the torque to the drive shaft 1 for the 1st 3rd, 5th gear and the reverse gear.
For closing the clutch, the oil is pressed into the oil pressure chamber of the clutch K1.

Thus the piston 1 shifts and presses the plate package of the clutch K1 together. The torque will be transfered via the plate package of the inner plate carrier to the drive shaft 1.
When opening the clutch, the disc spring presses the piston 1 again back into the initial position.

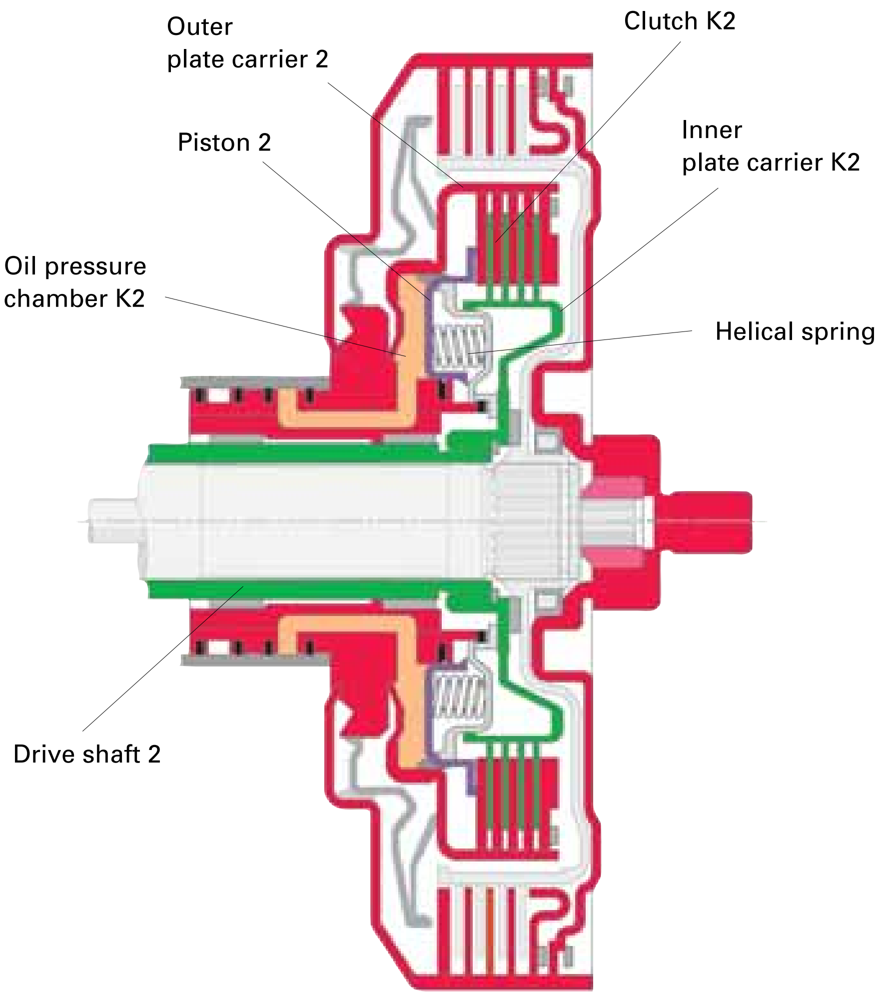


SP56_15

Multi-plate clutch K2

The clutch K2 is a multi-plate clutch. It is the inner clutch and transfers the torque to the drive shaft 2 for the 2nd, 4th and 6th gear. For closing the clutch, the oil is pressed into the oil pressure chamber K2. The piston K2 closes thereupon the power flux via the plate package to the drive shaft 2.

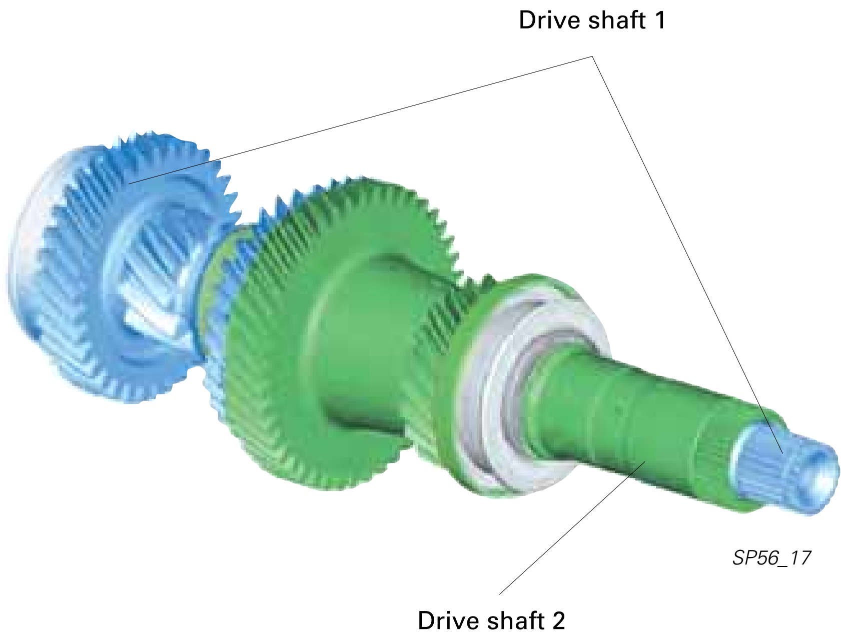
The helical springs press the piston 2 back into the initial position when opening the clutch.



SP56_16

Drive shafts

The torque of the engine is passed on from the multi-plate clutch K1 or K2 to the relevant drive shaft.



SP56_17

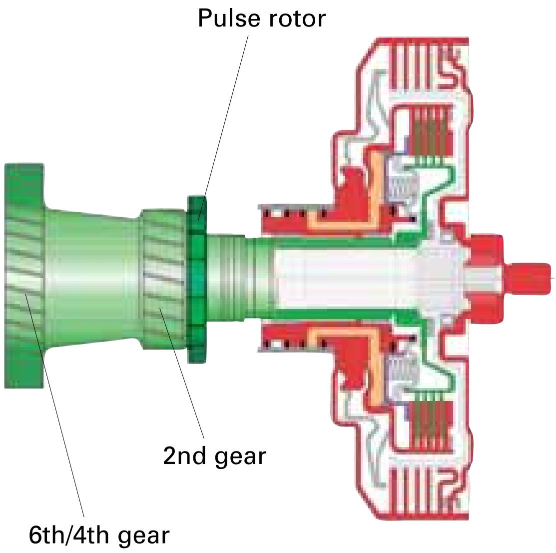
Drive shaft 2

The drive shaft 2 is illustrated through the fitting position of the drive shaft 1.

The drive shaft 2 is hollow drilled and connected through a plug serration to the multi-plate clutch K2.

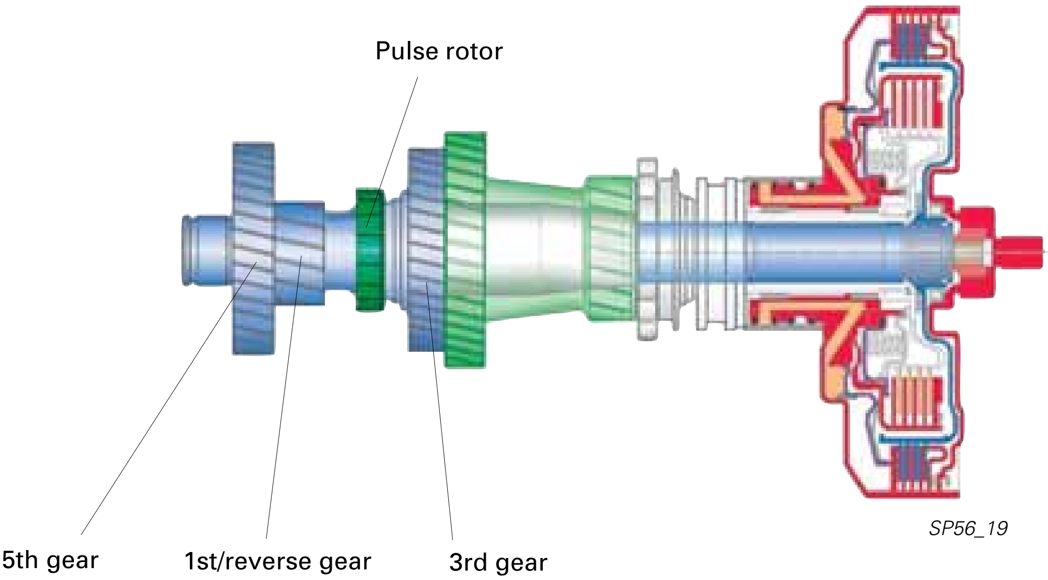
The helical gearings for the 6th, 4th and 2nd gear are seated on the drive shaft 2. A common gear is used for the 6th and 4th gear.

A pulse rotor for the rpm drive shaft sender 2 G502 is located next to the gear for the 2nd gear, in order to detect the speed of this drive shaft.



SP56_18

Drive shaft 1



The drive shaft 1 operates through the hollow drilled drive shaft 2. It is connected through a plug serration to the multi-plate clutch K1. The helical gearings for the 5th gear, the common gear for the 1st and the reverse gear as well as the 3rd gear are seated on the drive shaft 1.

A pulse rotor for the rpm drive shaft sender 1 G501 is located between the gear for 1st/ reverse gear and the 3rd gear, in order to detect the speed of this drive shaft.

Note:
A stronger solenoid can destroy the pulse rotor!

Structure of DSG

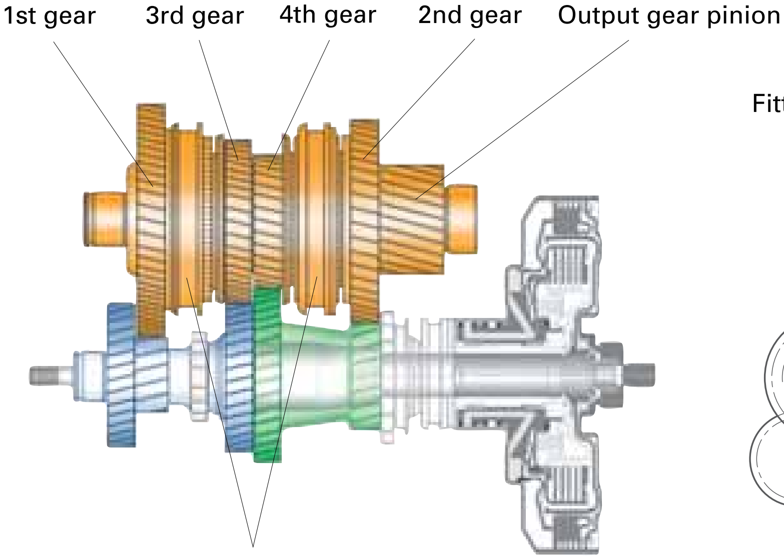
Drive shafts

According to the two drive shafts there are also two output shafts in the automatic gearbox DSG.

By means of the common use of the gears for the 1st gear and the reverse gear as well as for the 4th and 6th gear on the drive shafts the overall length of the gearbox could be minimized.

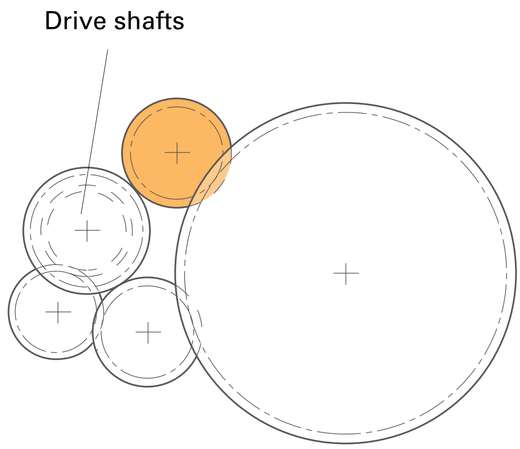
Drive shaft 1

stretched illustration



SP56_20

Fitting position in the gearbox



SP56_21

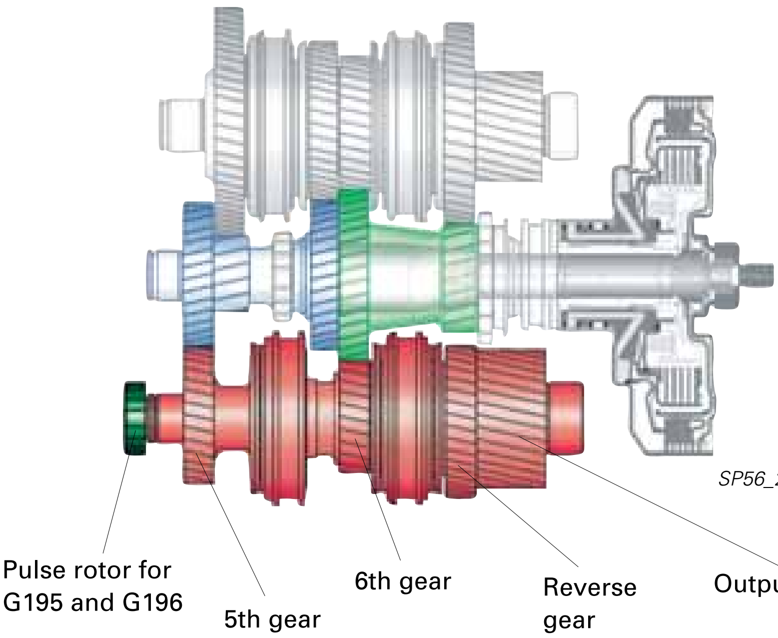
On the output shaft 1 are

- the triple synchronized sliding gears for the 1st, 2nd and 3rd gear
- the simple synchronized sliding gear for the 4th gear and
- the output gear pinion for engaging into the differential gear.

The output shaft grips into the gear pinion for the final drive of the differential gear.

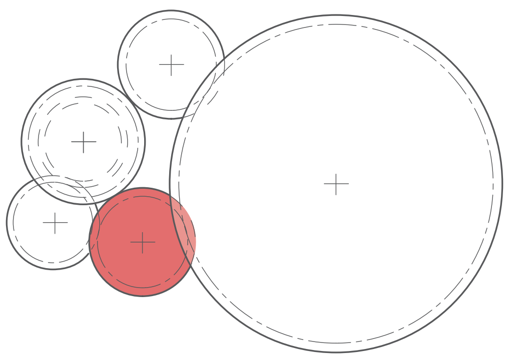
Drive shaft 2

stretched illustration



SP56_22

Fitting position in the gearbox



SP56_23

On the output shaft 2 are

- a pulse rotor for the gearbox output speed
- the gearshifts of the 5th, 6th gear and the gear of the reverse gear
- the output gear pinion for engaging into the differential gear.

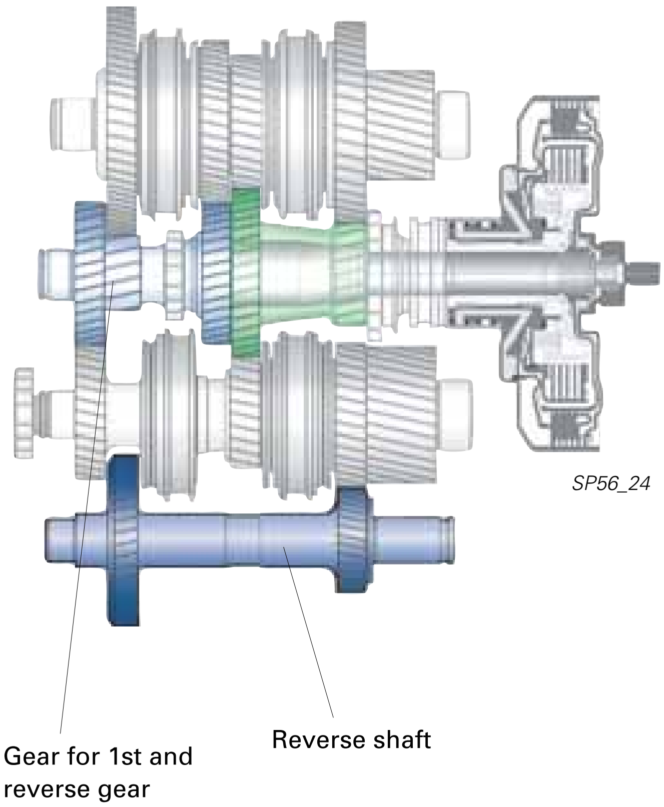
Both output shafts pass on the torque via their output gear pinion to the differential gear.

Structure of DSG

Reverse shaft

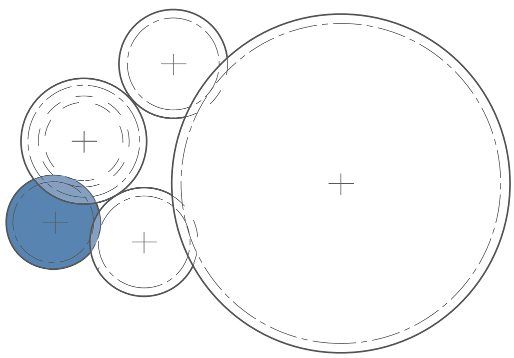
The reverse shaft changes the direction of rotation of the output shaft 2 and therefore also the one of the gear pinion for the final drive of the differential gear. It comes with the common gear for the 1st gear and the reverse gear on the drive shaft 1 and with the sliding gear for the reverse gear on the output shaft 2.

Stretched illustration



SP56_24

Fitting position in the gearbox


SP56_25

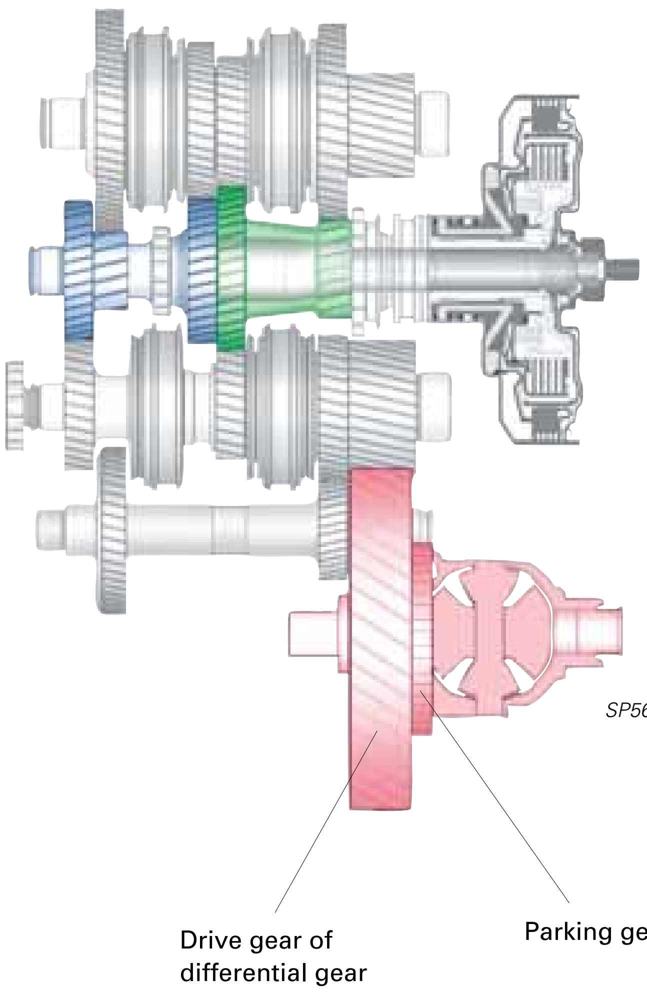
Differential gear

Both output shafts are in constant contact with the drive wheel of the differential gear and thus transfer the torque.

The differential gear transfers the torque via the drive shafts onto the wheels.

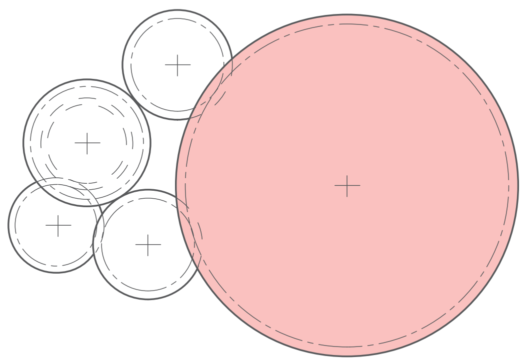
The parking gear is integrated into the differential gear.

Stretched illustration



SP56_26

Fitting position in the gearbox

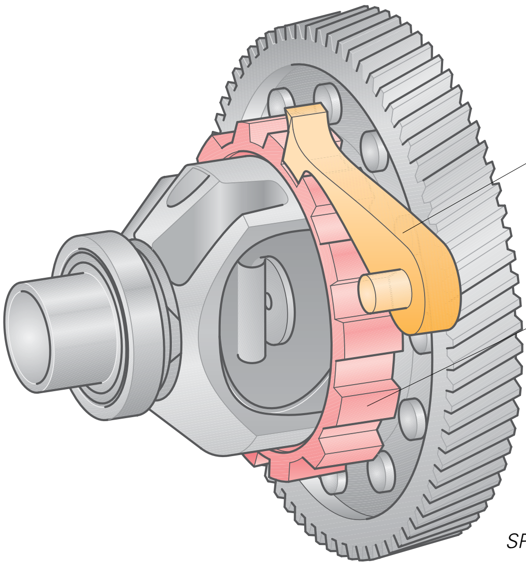


SP56_27

Parking position

For safe stationary positioning of the vehicle and against inadvertent moving off when the hand-brake is not applied, a parking position is integrated into the axle differential gear.

The insertion of the catch is performed purely mechanically via a control cable between the selector lever and the lever for the parking position at the gearbox.
The control cable is used exclusively for operating the parking position.



SP56_28

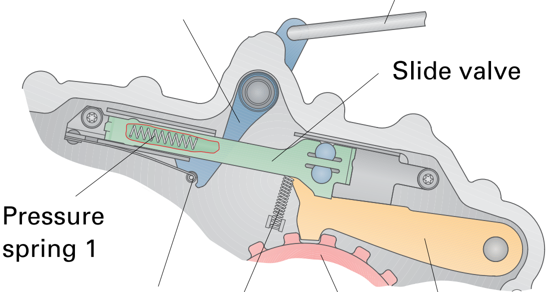
It functions as follows:

By moving the selector lever into the position „P“, the parking position is engaged. Thus, the catch grips into the teeth of the parking gear.

The latch spring locks into the lever and fixes the catch in its position.

If the catch touches a tooth of the parking gear, the pressure spring 1 is tensioned.
If the vehicle moves, the catch is pressed by the relaxing pressure spring 1 into the next gap of the parking gear.

By operating the selector lever from the position „P“, the parking position is released. The slide valve is pushed back into the initial position to the right and the pressure spring 2 presses the catch out of the gap of the parking gear.



SP56_29

Synchronization

For engaging a gear, the shift collar must be pushed onto the shift serration of the sliding gear.
It is the task of the synchronization to establish synchronization between the gears to be shifted and the shift collar.

Basis of the synchronization are molybdenum-coated brass synchronizers.

The 1st, 2nd and 3rd gear are equipped with a triple synchronization.
In relation to a single synchronization with only one friction cone, a clearly increased friction surface is available.
The synchronization power increases, because a larger heat transfer surface is present.

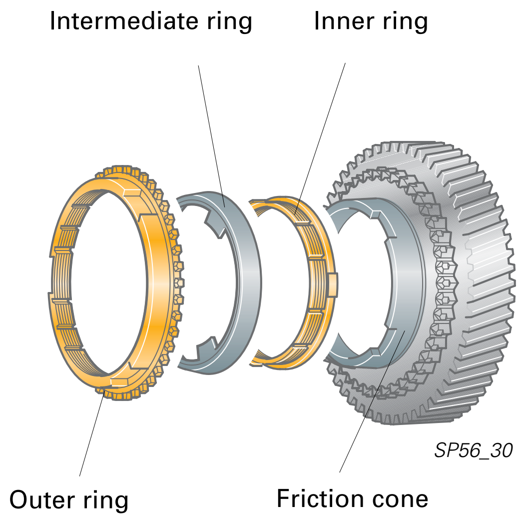
The adjustment of the large differences in rpm between the different sliding gears in the lower gears takes place faster. Engaging the gears can take place with less forces.

The 4th, 5th and 6th gear have a single synchronization. Here the differences in rpm are not so great when shifting. Therefore the rpm adjustment takes place faster. No demanding effort for the synchronization is needed.

The reverse gear has a double cone synchronization.

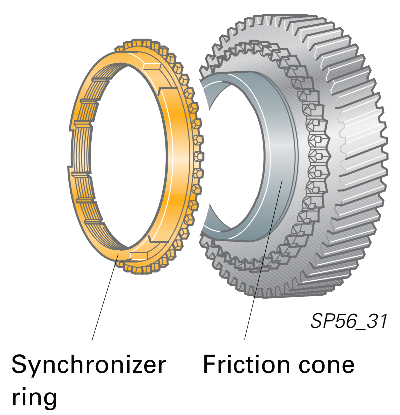
The triple syncronization consists of

- an outer ring (1st synchronizer ring),
- an intermediate ring,
- an inner ring (2nd synchronizer ring) and
- the friction cone on the sliding gear/gear.



The single syncronization consists of

- the synchronizer ring and
- the friction cone of the sliding gear/gear.



Structure of DSG

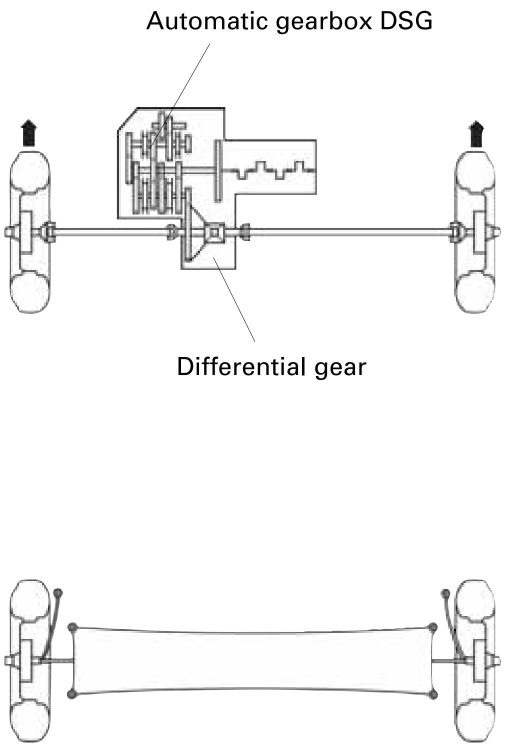
Torque transfer in the vehicle

The torque of the engine will be transferred via the two-mass flywheel onto the automatic gearbox DSG.

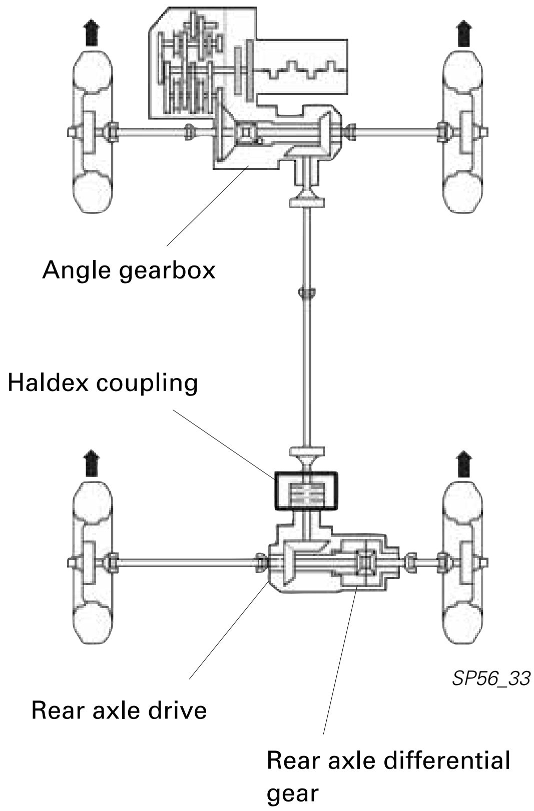
For the front final drive, the drive shafts transfer the torque to the front wheels.

For vehicles of other company brands with all-wheel drive, the torque is passed on via an additional angle gearbox and a propshaft to the rear axle.

The propshaft transfers the torque to the Haldex coupling.
A differential gear for the rear axle is integrated into the rear final drive.



SP56_32



SP56_33

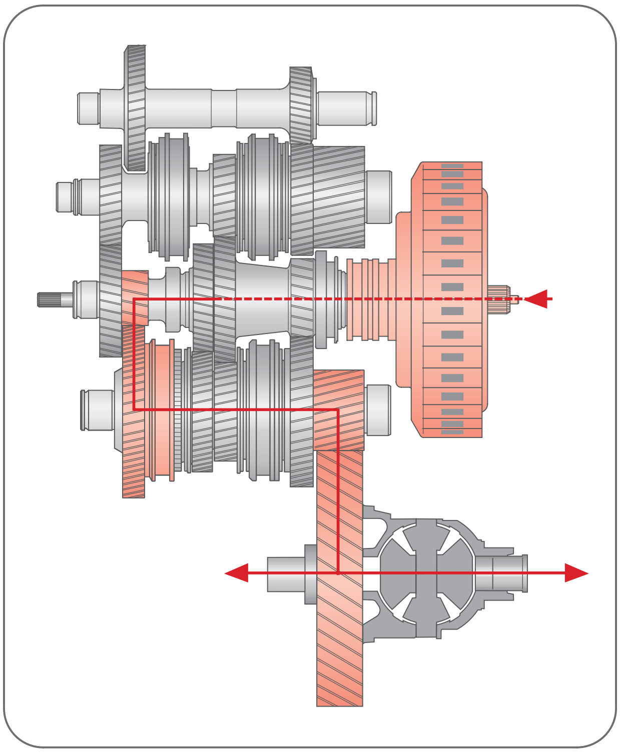
Power flow in the gears

The torque transmission in the gearbox takes place either on the outer clutch K1 or on the inner clutch K2.
Each clutch drives one drive shaft.
The drive shaft 1 (inner) is driven by the clutch K1 and the drive shaft 2 (outer) by the clutch K2.

The passing on of the power transmission to the differential gear is performed by

– the output shaft 1 for the 1st, 2nd, 3rd, 4th gear and
– the output shaft 2 for the 5th, 6th gear and the reverse gear.

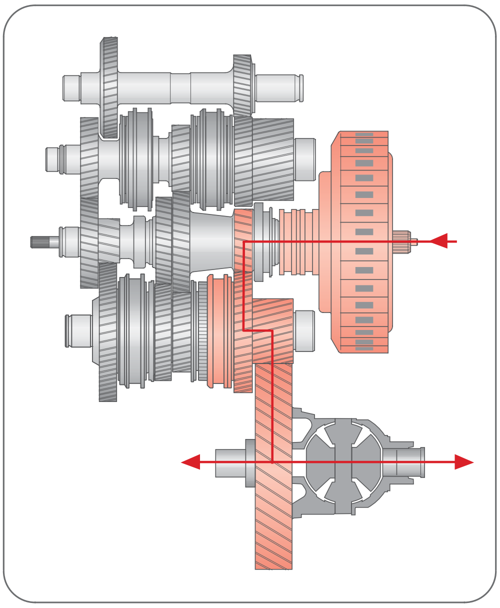
1st gear
Clutch K1
Drive shaft 1
Drive shaft 1
Differential gear



SP56_34

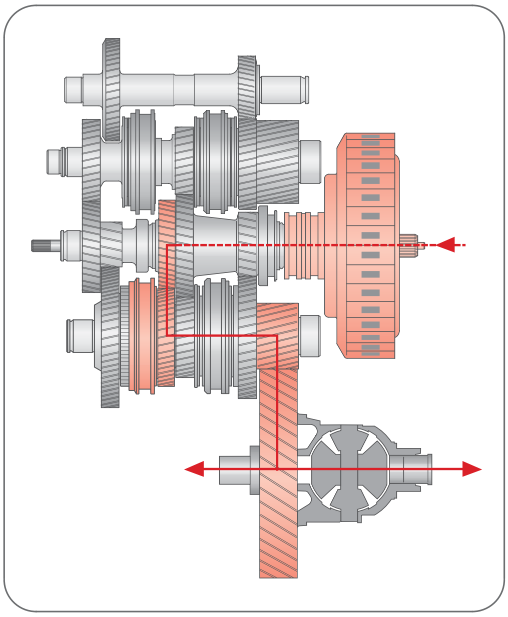
Note:
For improved understanding, the illustration of the power flow is performed schematically in a "stretched" illustration.

Structure of DSG



SP56_35

2nd gear
Clutch K2
Drive shaft 2
Drive shaft 1
Differential gear



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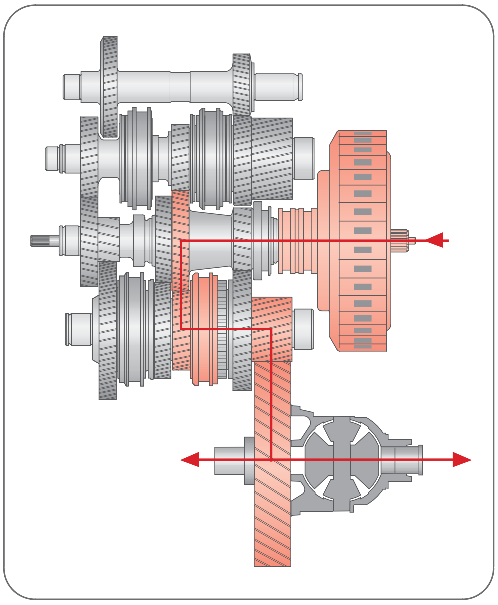
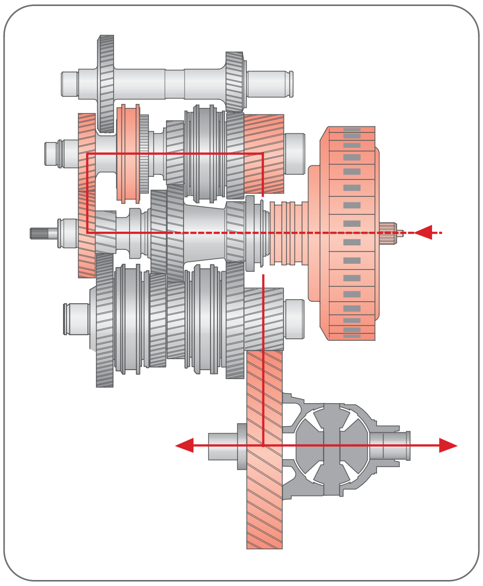
3rd gear
Clutch K1
Drive shaft 1
Drive shaft 1
Differential gear



SP56_37

4th gear
Clutch K2
Drive shaft 2
Drive shaft 1
Differential gear



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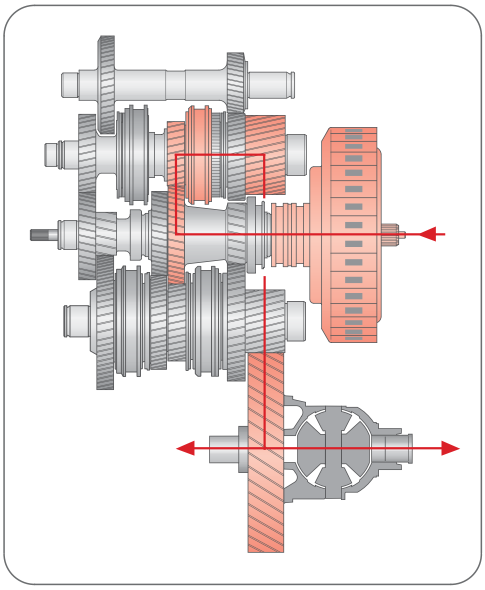
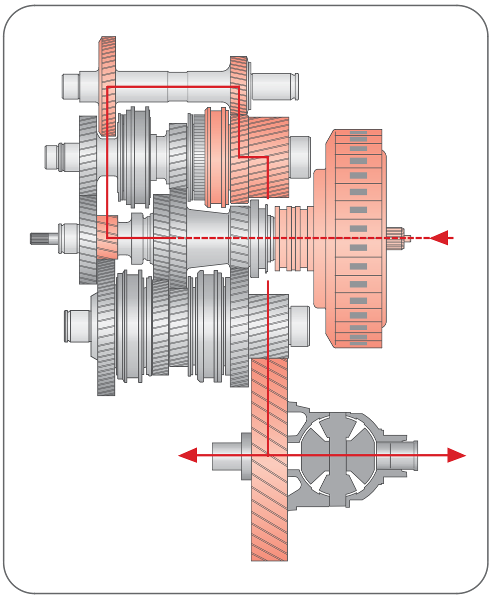
5th gear
Clutch K1
Drive shaft 1
Drive shaft 2
Differential gear



SP56_39

6th gear
Clutch K2
Drive shaft 2
Drive shaft 2
Differential gear



SP56_40

Reverse gear
Clutch K1
Drive shaft 1
Reverse shaft
Drive shaft 2
Differential gear

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

Mechatronic module

Mechatronics

The mechatronics is accommodated in the gearbox, rinsed around with DSG oil. It consists of an electronic control unit and an electrohydraulical control unit.

The mechatronics is the central control unit of the gearbox. All sensor signals and all signals of other control units run together in it and all actions are introduced and supervised by it.

There are twelve sensors in this compact unit. Only two sensors are assigned outside the mechatronics.

It controls or regulates hydraulically eight gear actuators via six pressure modulation valves and five switch valves as well as the pressure and the cooling oil flow of both clutches.

The control unit of the mechatronics learns (adapted) the positions of the clutches, the positions of the gear actuators with engaged gear and the main pressure.

SP56_41

SP56_42

The advantages of this compact unit are:

- The biggest part of the sensors is integrated.
- The electrical actuators are located directly at the mechatronics.
- Necessary electrical interfaces on vehicle side are performed by a central plug.

This measure reduces the number of plug connections and wiring. That means a larger electrical reliability and a lower weight.

In addition, it means highest thermal and mechanical stresses for the control unit. Possible temperatures from –40 °C to +150 °C as well as occuring mechanical oscillations up to $33g_n$ must not impair the driveability.

g_n = Standard acceleration

g_n = 9.806 65 m/s^2
In technical calculations usually sufficient approximate value 9.81 m/s^2.

SP56_43

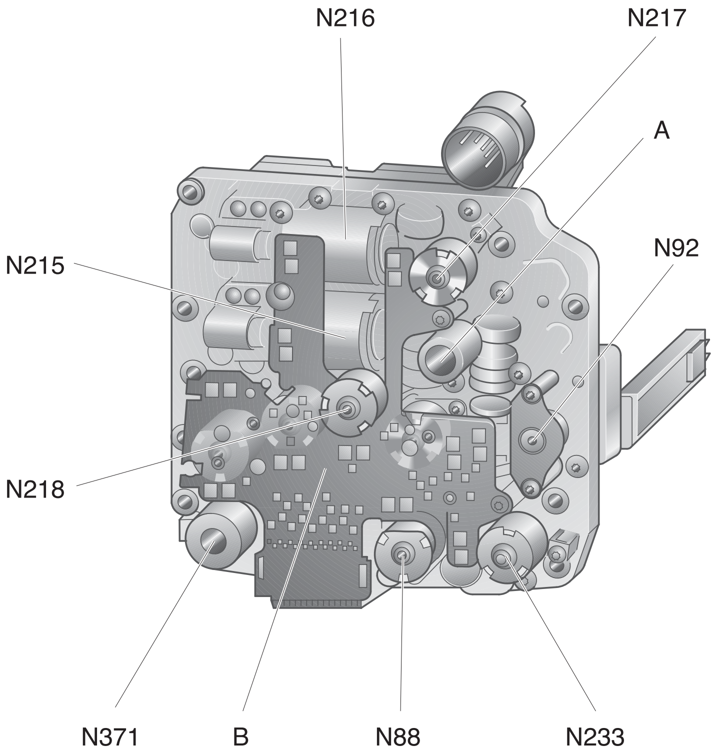
Electrohydraulic control unit

The electrohydraulical control unit is integrated in the mechatronic module.
In the control unit there are all solenoid valves, pressure control valves as well as the hydraulic slide valves and the multiplexer *(multiplier)*.

N88	- Solenoid valve 1	(gear actuator valve)
N89	- Solenoid valve 2	(gear actuator valve)
N90	- Solenoid valve 3	(gear actuator valve)
N91	- Solenoid valve 4	(gear actuator valve)
N92	- Solenoid valve 5	(multiplexer valve)
N215	- Pressure control valve 1 for autom. gearbox	(clutch valve K1)
N216	- Pressure control valve 2 for autom. gearbox	(clutch valve K2)

In addition, there is a pressure relief valve on the hydraulic module. It prevents inadmissible increase of pressure to values, which could lead to damage on the hydraulic slide valve.

N217	- Pressure control valve 3 for autom. gearbox	(main pressure valve)
N218	- Pressure control valve 4 for autom. gearbox	(cooling oil valve)
N233	- Pressure control valve 5 for autom. gearbox	(safety valve 1)
N371	- Pressure control valve 6 for autom. gearbox	(safety valve 2)
A	- Pressure relief valve	
B	- Conductor plate	



SP56_44

They have different shift characteristics depending upon the function of the valves. It is differentiated between

- ,,Yes/No“ switching valves and
- Modulation valves.

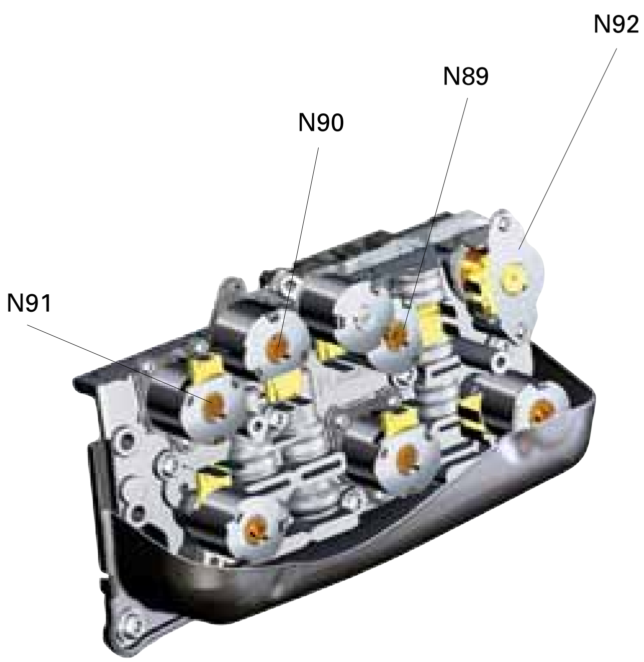
To the „Yes/No“ switching valves belong

- the gear actuator valves and
- the multiplexer valve.

To the modulation valves belong

- the main pressure valve
- the cooling oil valve
- the clutch valves and
- the safety valves.

After removing the conductor plate the valves N89, N90 and N91 for the gear actuator are visible.



SP56_45

Oil circulation

Oil circulation

The DSG has a common oil circulation system for all gearbox functions.
Altogether there is in this circulation system 7.2 l direct shift gearbox oil (DSG oil).

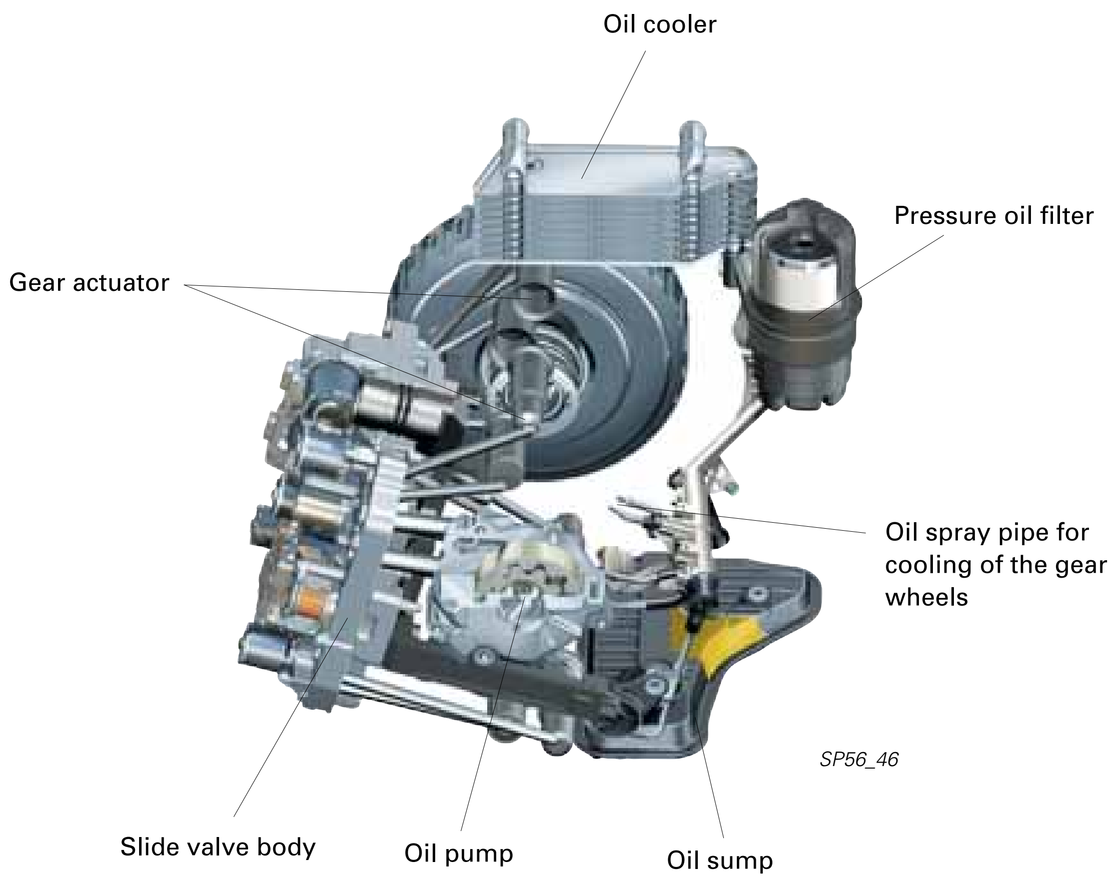
The oil must comply to the following requirements:

– Safety of the clutch regulation and the hydraulic control
– Stable viscosity in the entire temperature range
– Resisting high mechanical stresses
– No permissible foaming

The tasks of this oil are:

– Lubrication/cooling
  • of the multiple clutch,
  • the wheels, shafts, bearings and
  • the synchronization
– Actuation
  • of the multiple clutch and,
  • the gear actuator piston

The oil cooler through which the engine coolant flows, prevents that the oil temperature increases above 135 °C.

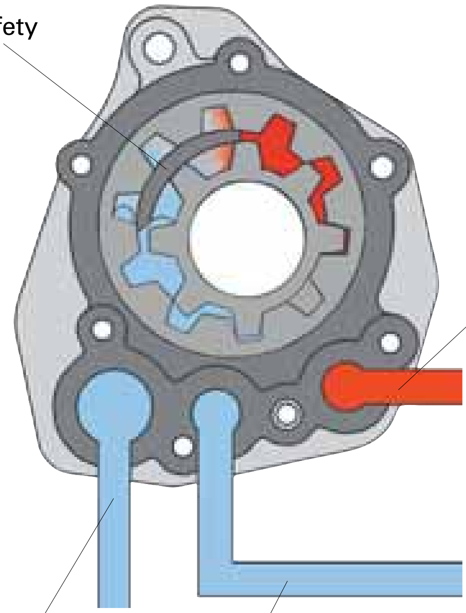


Oil pump

A safety cell pump suctions the DSG oil and produces the oil pressure, which is necessary for the operation of the hydraulic components. It enables a maximum output of 100 l/min. and a main pressure of 2 MPa.

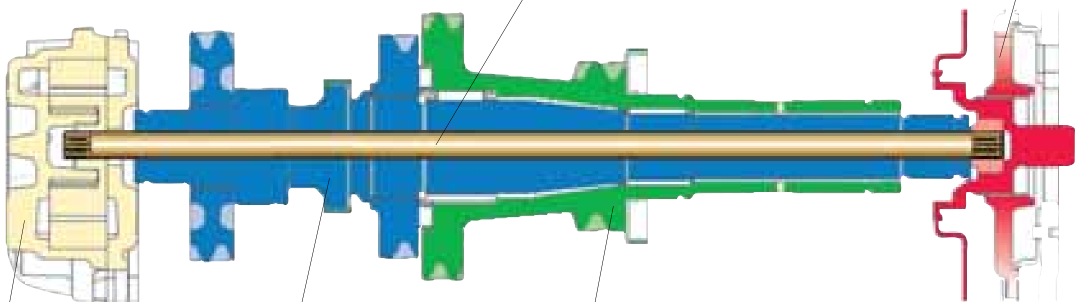
The oil pump supplies

- the multi-plate clutches,
- the clutch cooling,
- the shift hydraulics and
- the gear pinion lubrication.



SP56_47

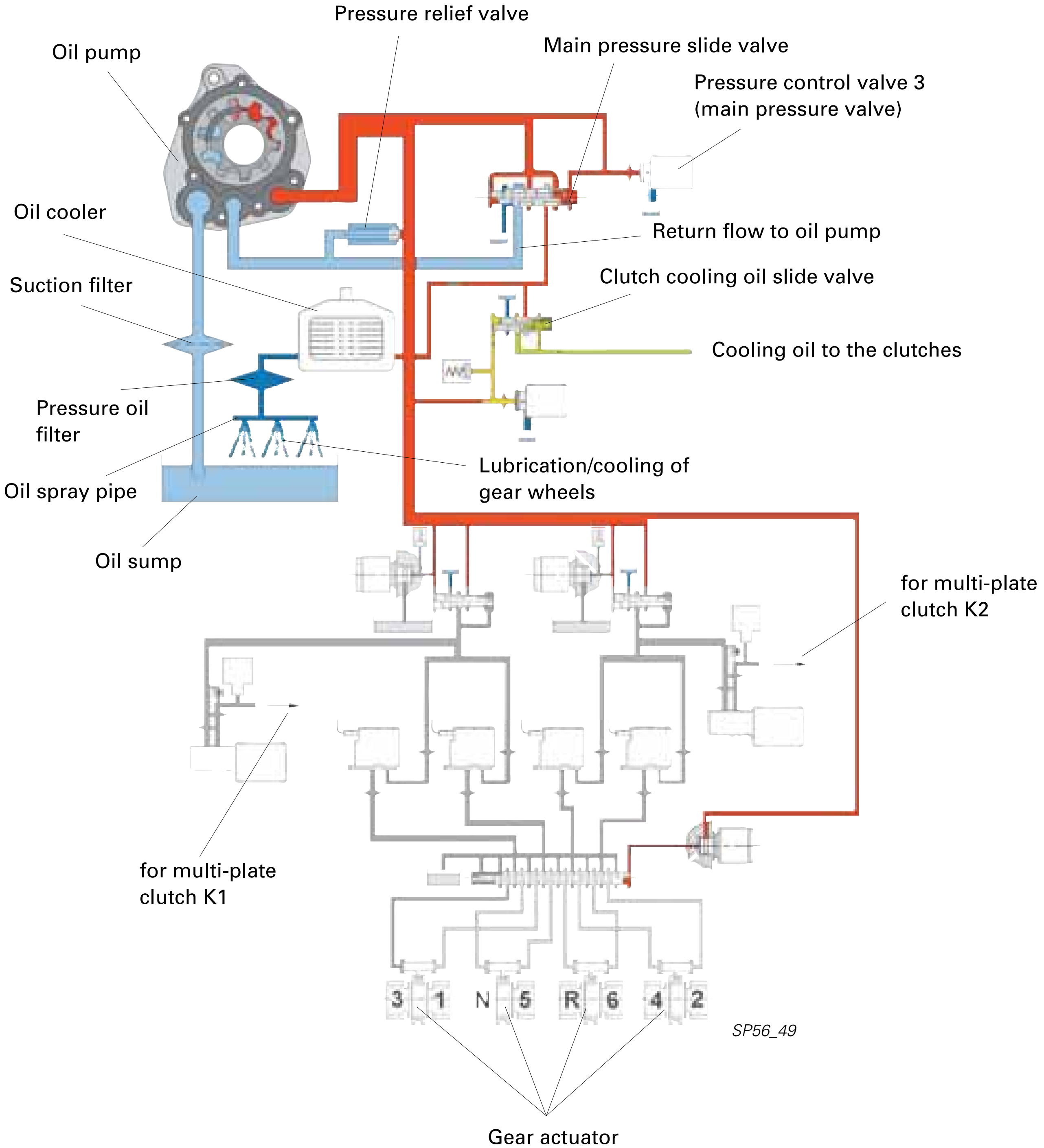
The drive of the oil pump is performed via the pump shaft running at engine speed.
This pump shaft is the third shaft within both drive shafts 1 and 2 inserted into one another.



SP56_48

Oil circulation

Oil circulation system diagram



Colour legend

controlled pressure, work pressure, main pressure

Return flow in the oil sump

uncontrolled pressure

controlled pressure, clutch cooling

Description of the oil circulation system

The oil pump suctions the oil via the suction filter from the oil sump and delivers it under pressure to the main pressure slide valve.

The main pressure slide valve is controlled by the pressure control valve 3 - the main pressure control valve -.
The main pressure valve regulates the work pressure in the automatic gearbox DSG.

Under the main pressure slide valve, an oil channel returns to the suction side of the pump.

The other oil channel is divided.

A channel leads to the oil cooler and then via the pressure oil filter back into the oil sump.

The other channel leads the oil flow to the clutch cooling oil slide valve.

The work pressure regulated by the pressure control valve 3 is used by the gearbox for the operation of the multi-plate clutches and for shifting the gears.

The oil cooler is integrated into the cooling circuit of the engine.

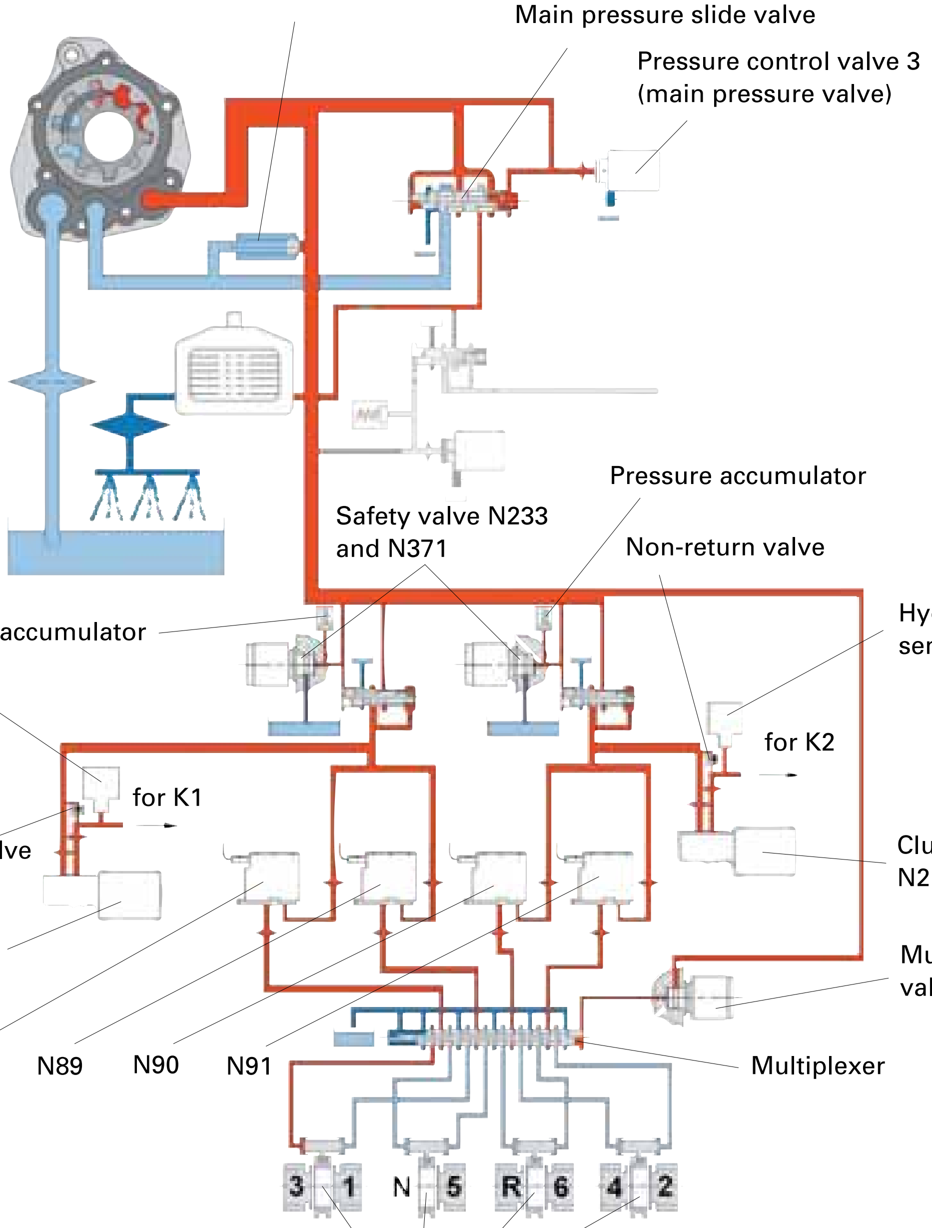
The pressure oil filter is located outside the gearbox housing.

The pressure relief valve ensures that the oil pressure does not rise above 3.2 MPa.

The oil reaches the gear wheels directly through the oil spray pipe.

Oil circulation

Hydraulic elements in the oil circulation system



SP56_50

Colour legend

controlled pressure, work pressure, main pressure

uncontrolled pressure

Return flow in the oil sump

Electrohydraulic control of the oil circulation system

Pressure valve 3 for automatic gearbox N217 (main pressure valve)

It is actuated by the electronic control unit and controls the main pressure slide valve.

Thus, the work pressure in the hydraulic system of the automatic gearbox DSG is regulated.

Through the main pressure valve the oil currents for

- the oil return flow through the oil cooler/ pressure filter/oil spray pipe and
- the return flow to the oil pump

are actuated.

The work pressure opens the two clutch valves N215 and N216 and closes the clutches K1 and K2 and the four gear actuator valves N88, N89, N90 and N91 for engaging the gears.

Multiplexer valve N92

It operates the multiplexer. The multiplexer (multiplier) enables the controlling of the eight gear actuator cylinders with only four solenoid valves.

The multiplexer is pressed through a spring into its basic position.

In the basic position, the 1st, 3rd, 6th gear and reverse gear can be shifted.

If the multiplexer valve N92 is energized, oil pressure reaches the multiplexer and it is pressed against the spring force into the work position.

The 2nd, 4th, 5th and neutral gear can be shifted.

Safety valves

One safety valve each for clutch K1 (N233) and clutch K2 (N371) enables a fast opening for the respective clutch. This is necessary, if their actual clutch pressure is above the specified value.

Hydraulic pressure sender G193 and G194

The hydraulic pressure senders G193 and G194 control the clutch pressure of the clutches K1 and K2.

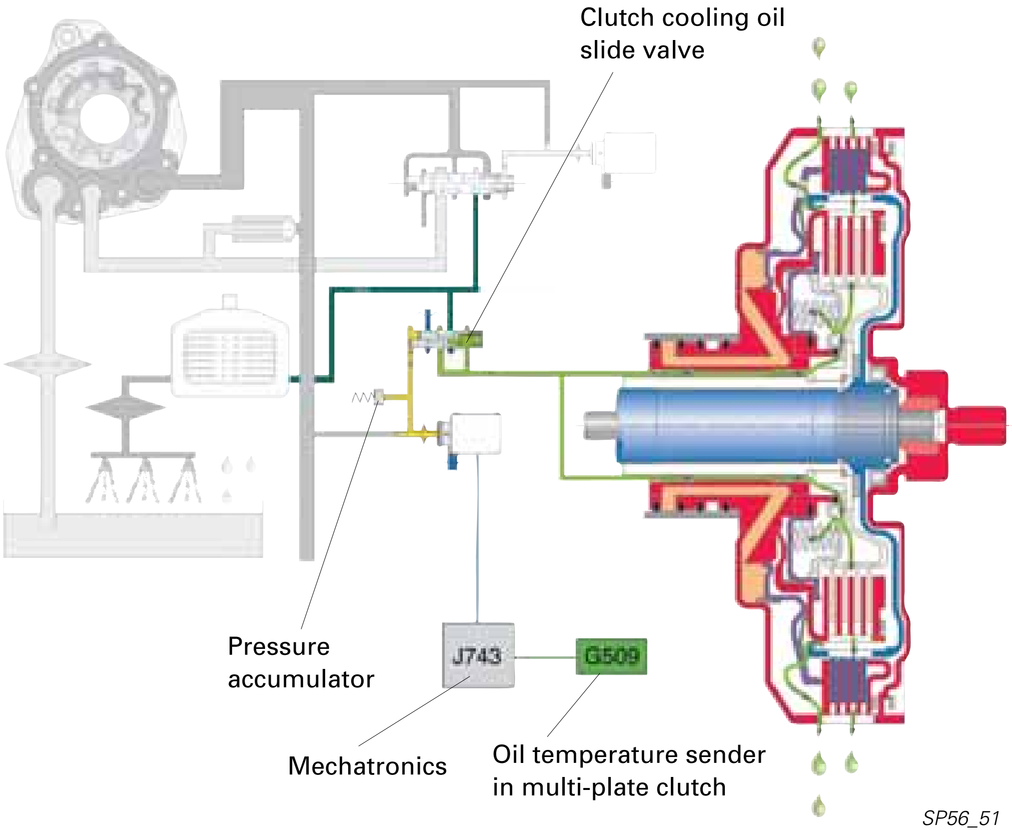
A pressure relief valve prevents a too strong increase of the operating pressure on a defective main pressure slide valve.

Oil circulation

Clutch cooling oil system

The temperature of the multiple clutch increases through the mechanical friction in the multi-plate clutches.
The multi-plate clutches must be cooled down so that this does not overheat.

There is a separate clutch cooling oil circulation system within the oil circulation system for the cooling of the clutches.
A cooling oil slide valve and pressure control valve 4 N218 (clutch cooling oil valve) belong to the cooling oil circulation system.



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It functions as follows:

The oil temperature sender in multi-plate clutch G509 measures the oil temperature directly at the oil leakage of the multi-plate clutches.

Depending on the measured temperature, the control unit actuates the pressure control valve.

The pressure control valve increases or reduces, depending on the measured temperature, the oil pressure on the clutch cooling oil slide valve.
The cooling oil slide valve opens or closes the oil channel to the multi-plate clutches depending on the oil pressure.

The maximum cooling oil quantiy is 20 ltr./per minute. The maximum cooling oil pressure is 0.2 MPa.

Shifting the gears

Shifting the gears is performed by shift forks in the same way as on conventional manual gearboxes. 2 gears are shifted by each shift fork.

The actuation of the shift forks is performed on the automatic gearbox DSG hydraulically and not through the shifts rods as on the conventional manual gearbox.

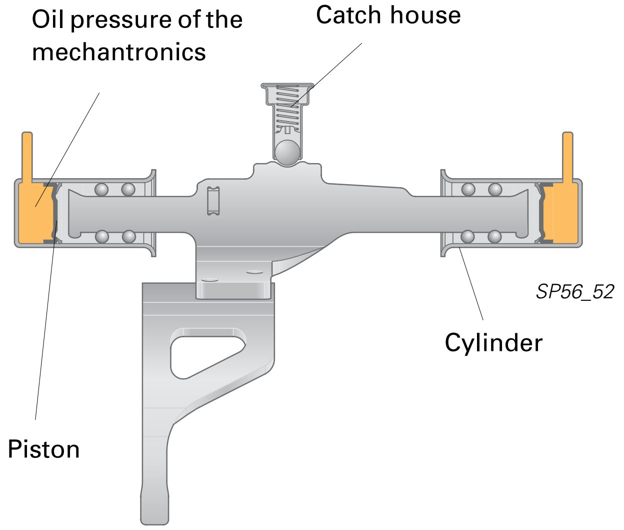
The shift forks run on ball bearings in one cylinder.

For shifting, oil is lead from the mechantroncis into the left cylinder. Since the right cylinder is pressureless, the shift fork shifts and operates the sliding sleeve. Thus, the gear is engaged.

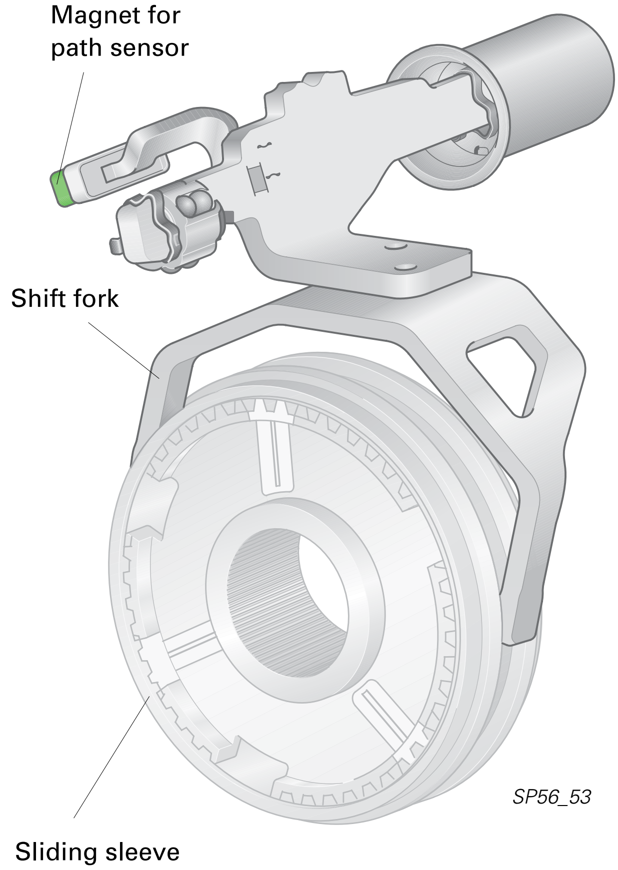
If the gear is engaged, the shift fork is shifted pressureless.
The gears maintain the shift serration and the catch mechanism on the shift fork through the after-body.

If the shift fork is not actuated, it is held by a catch mechanism in the neutral position, arranged in the gearbox housing.

On each shift fork is a permanent magnet. The path sensors detects through the permanent magnets the exact position of the individual shift forks in the mechatronics.



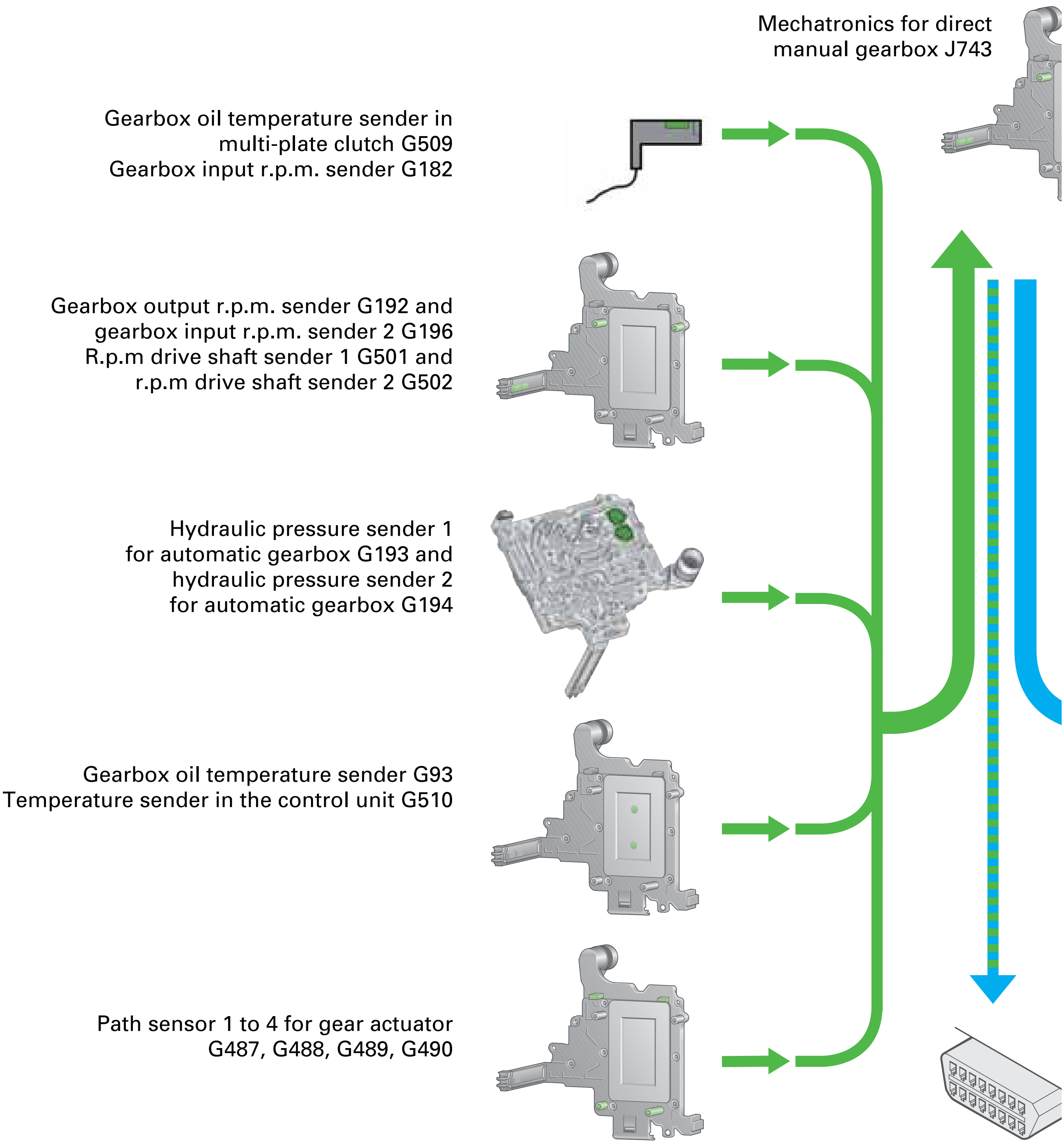
SP56_52



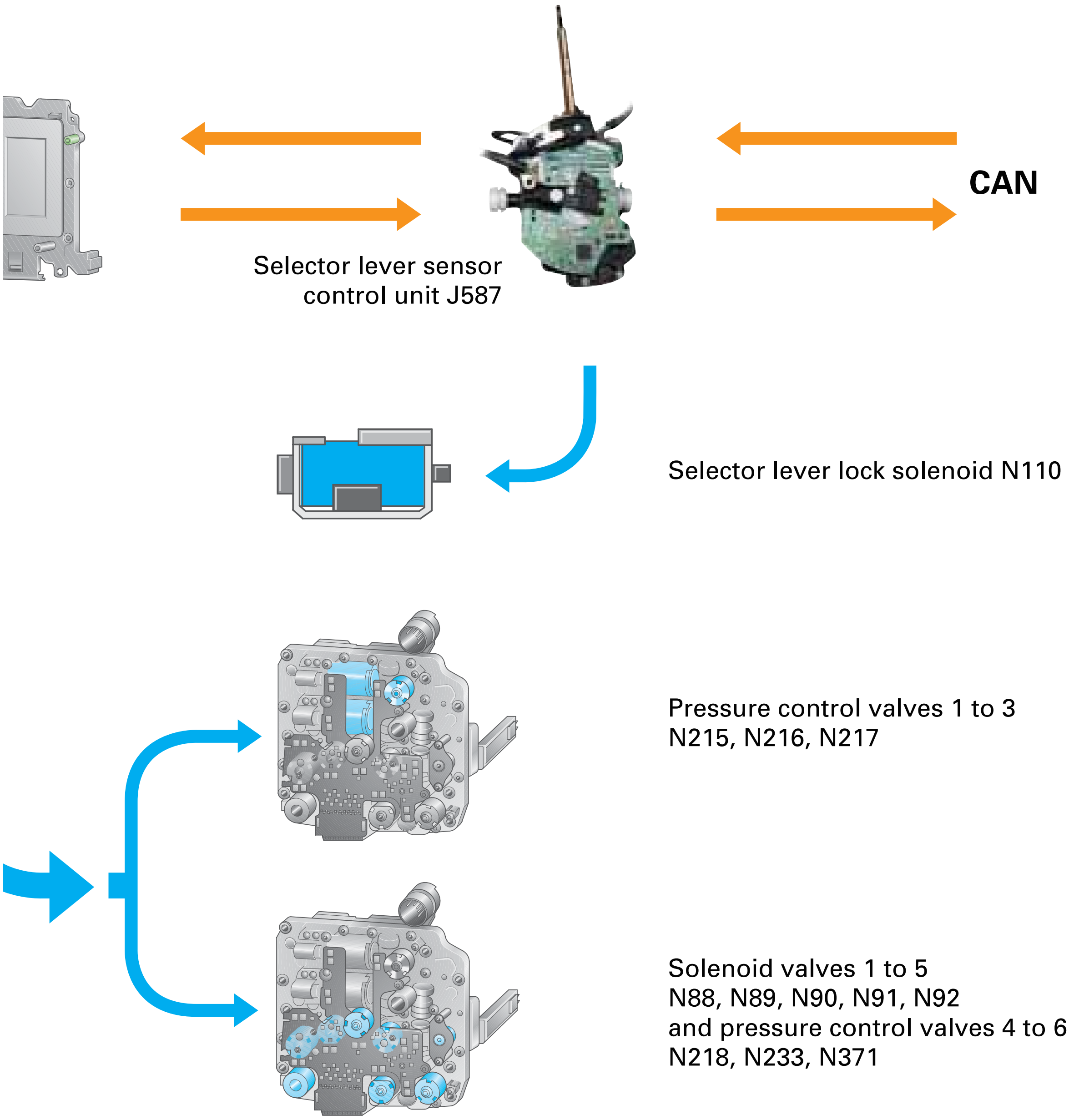
SP56_53

System overview

Sensors



Actuators



SP56_54

Diagnostic connection

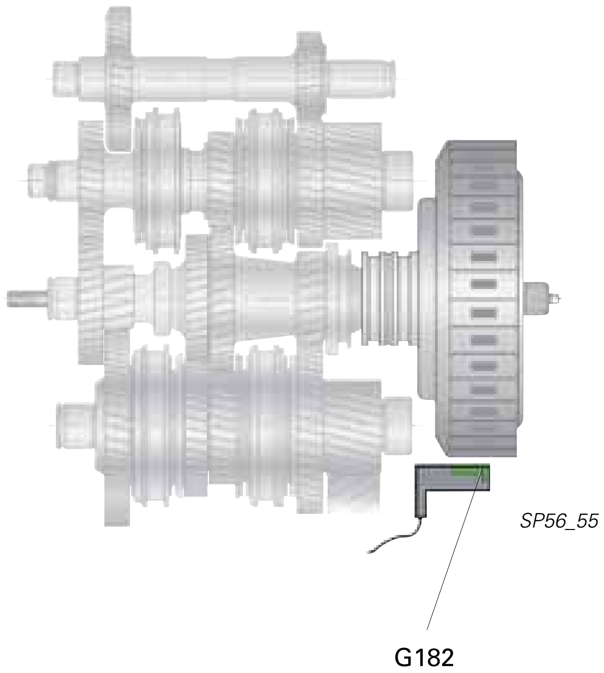
Gearbox input r.p.m. sender G182

The gearbox input rpm sender is inserted into the gearbox housing.

It scans electronically the exterior of the multiple clutch and detects the gearbox input rpm.

The gearbox input rpm sender is identical to the engine speed.

The rpm sender functions according to the Hall principle.
Sender G509 is also located in the housing of this sender.
Both senders are connected via electrical lines to the mechatronics.



Use of signal

The signal of the gearbox input r.p.m is a value for the calculation of the slip of the multi-plate clutches.
For this calculation the control unit still needs the signals of the sender G501 and G502.
Based on the clutch slip, the control unit can actuate more accurately the opening and closing of the clutches.

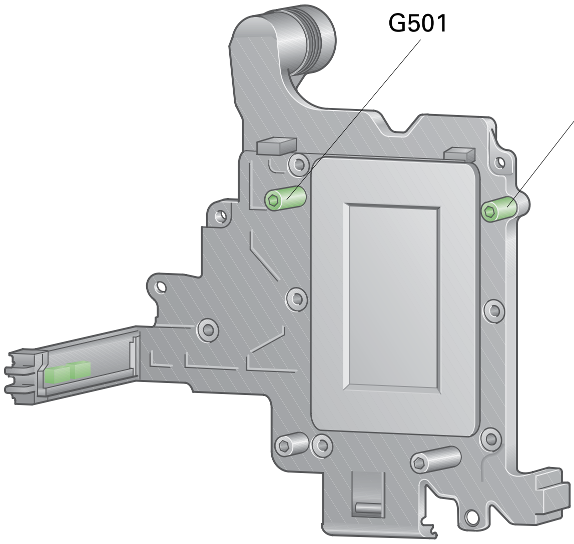
Effects of signal failure

In case of failure of the signal, the control unit uses the engine speed of CAN as replacement signal.

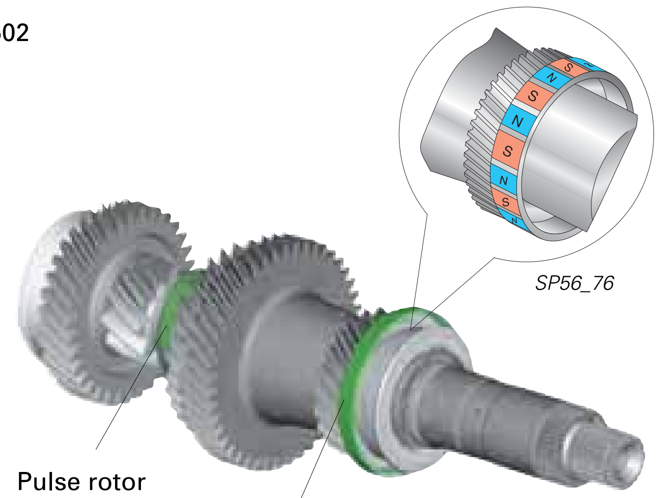
R.p.m drive shaft sender 1 G501 and r.p.m drive shaft sender 2 G502

Both senders are located on the mechatronics. The sender 1 G501 detects the speed of the drive shaft 1.
The sender 2 G502 detects the speed of the drive shaft 2.
Both senders are Hall senders.

For the detection of the rpm, each sender touches a pulse rotor on its shaft.
The pulse rotor consists of a panel.
A rubber metal layer is applied onto this panel. This layer forms circulating small magnets with north and south pole.
There is an air gap between the individual magnets.



SP56_56



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SP56_57

Use of signal

In combination with the signal of the gearbox input rpm, the control unit calculates the output speeds of the multi-plate clutches K1 and K2 and detects the slip of the clutches.
On the basis of the slip, the control unit recognizes the opening and the closing condition of the clutches.
Furthermore, the signal is used as a check of the shifted gear.
In combination with the signals of the gearbox input rpm sender, the control unit detects whether the correct gear is shifted.

Effects of signal failure

If one of the signals fails, then the related gearbox area is switched off.
If the sender G501 fails, it can only be driven in the 2nd gear.
If the sender G502 fails, it can only be driven in the 1st and 3rd gear.

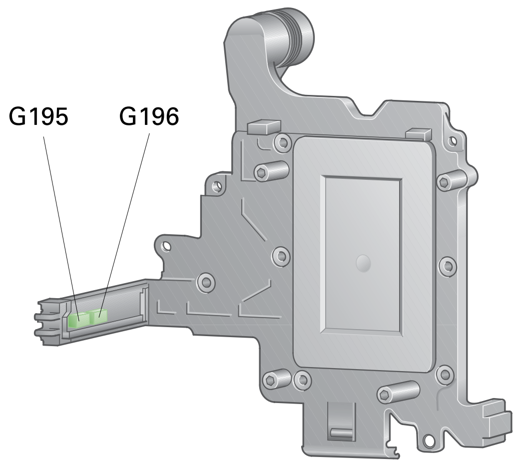
Note:
The pulse rotors must not be stored close to powerful magnets.

Sensors

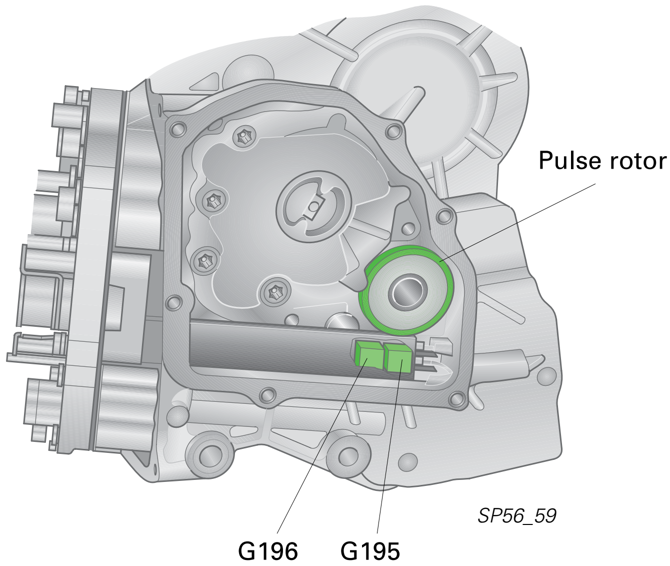
Gearbox output r.p.m. sender G195 and gearbox input r.p.m. sender 2 G196

Both senders are located on the mechantronics and are inseparably connected to the control unit.
They are Hall senders as all the other speed senders in this gearbox.
They touch both the same pulse rotor on the output shaft 2.

Both senders are accomodated offset against each other in one housing.
This results in two signals offset against each other.
If the signal of the sender G195 is „high“, then the signal of the sender G196 is still „low“.



SP56_58



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Use of signal

Based on the detailed signals, the control unit detects the driving speed and the driving direction.
The driving direction is detected by the signals which are offset against each other.
During a change of direction, the signals arrive in reverse order in the control unit.

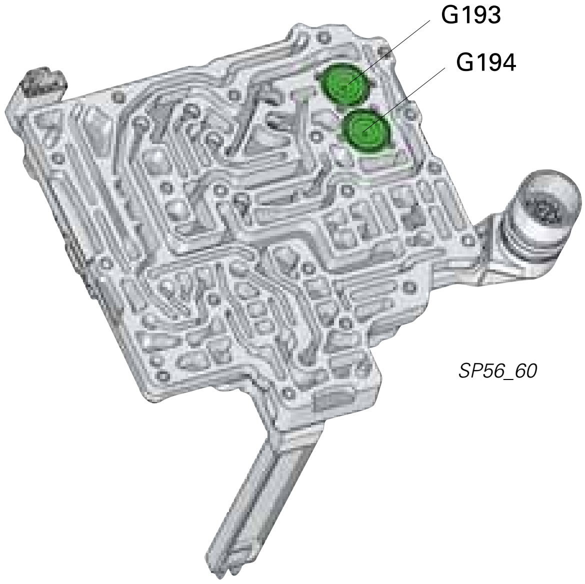
Effects of signal failure

In case of failure of the signals, the control unit uses the driving speed and the direction of travel signal of the ABS control unit.

Hydraulic pressure sender 1 for automatic gearbox G193 and hydraulic pressure sender 2 for automatic gearbox G194

Both hydraulic pressure senders are located in the electrohydraulical control unit of the mechatronics.

The same pressure is exerted on the hydraulic sender 1 G193 as on the multi-plate clutch K1. The pressure of the multi-plate clutch K2 is exerted on the hydraulic sender 2 G194.



SP56_60

Function of the hydraulic pressure sender

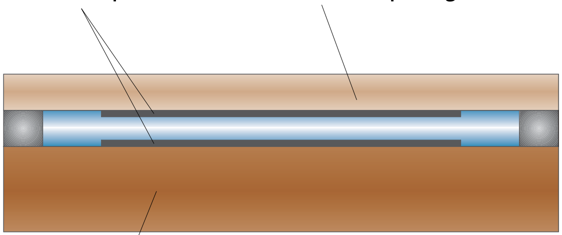
The hydraulic pressure sender consists of a pair of parallel, electrical conducting plates.
The upper plate is fastened to a ceramic diaphragm, which bends according to the pressure changes.
The other plate is rigidly connected with a ceramic substrate. This does not react to pressure changes.
As soon as the pressure changes, the diaphragm bends and therefore also the upper plate.
The distance between the plates changes.
Thus, a reliable signal as a function of the oil pressure is produced.

Use of signal

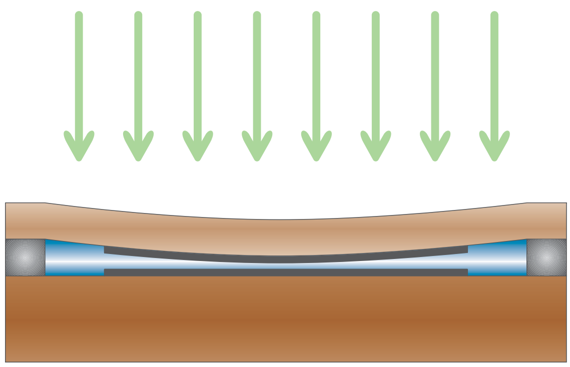
On the basis of these signals, the electronic control unit of the mechatronics detects the hydraulic pressure, which affects the respective multi-plate clutch.
The control unit needs the accurate hydraulic pressure for the regulation of the multi-plate clutch.

Effects of signal failure

If a pressure signal fails or if no pressure is built up, the appropriate branch of gearbox is switched off.
The vehicle can only be driven in the 1st and/or 3rd gear or in 2nd gear.



SP56_61



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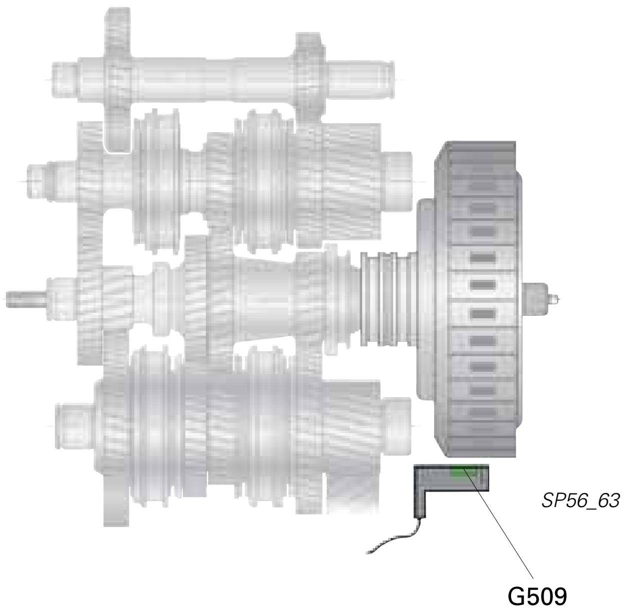
Gearbox oil temperature sender in multi-plate clutch G509

The sender G509 is located in the housing of the gearbox input rpm sender G182.
It measures the temperature of the DSG oil flowing out of the multi-plate clutches.
As the oil in the multi-plate clutches is strongly thermally stressed, it has at this point the highest temperature in the gearbox.

This sender is designed in such a way that it can measure the temperatures very fast and accurately.
It functions in the temperature range from –55 °C to +180 °C.



Use of signal

According to the signals of the oil temperature sender G509, the control unit controls the clutch cooling oil quantity and introduces further measures for the protection of the gearbox.

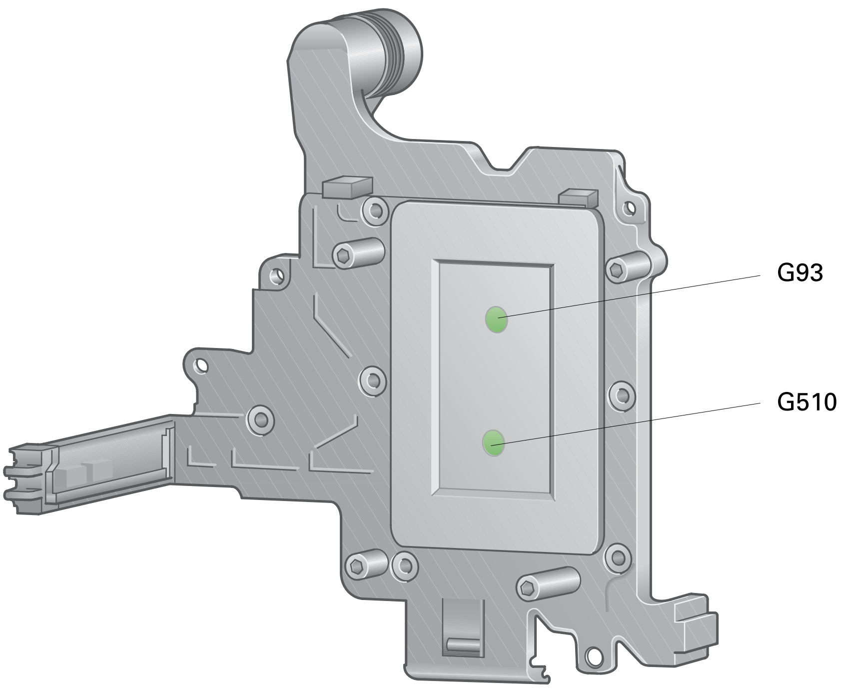
Effects of signal failure

In case of signal failure, the control unit takes the signals of the sender G93 and G510 as replacement signal.

Gearbox oil temperature sender G93 and temperature sender in the control unit G510

Both senders are assigned directly to the mechatronics.
The mechatronics is constantly rinsed by the DSG oil and thereby warmed up.
Strong heating can impair the functions of the electronics.

Both senders measure the temperature directly in the endangered components. Thus, oil temperature lowering measures can be introduced early and a too strong heating of the mechatronics can be avoided.



SP56_64

Use of signal

The signals of both senders are used for checking the mechatronics temperature.
In addition, a warm-up switching program is started based on the sender signals.
Both senders mutually check each other.

Effects of signal failure

For gearbox oil temperatures as of 138 °C the mechatronics arranges a reduction of the engine torque.
For temperatures over 145 °C the multi-plate clutches are no longer supplied with oil pressure and they open.

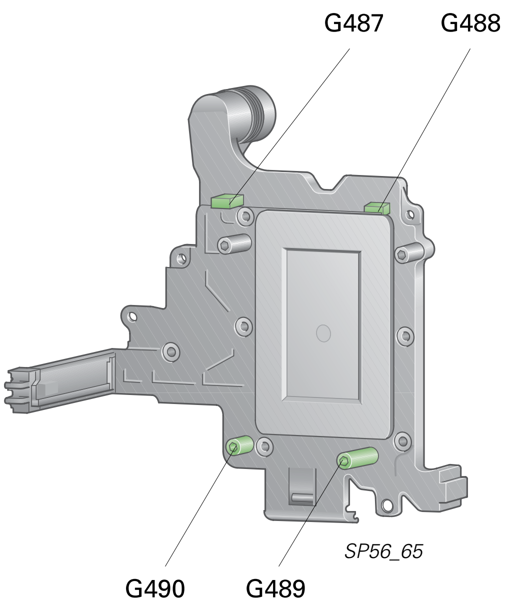
Sensors

Path sensors 1 to 4 G487, G488, G489, G490 for gear actuator

The path sensors are located in the mechatroncis. They are Hall senders.
In combination with the solenoids at the shift forks they generate a signal, from which the control unit detects the positions of the gear actuators.

Each path sensor supervises the position of a gear actuator /shift fork, with which can be selected between two gears

- G487 for the 1st/3rd gear,
- G488 for the 2nd/4th gear,
- G489 for the 6th/Reverse gear and
- G490 for the 5th/Neutral gear.



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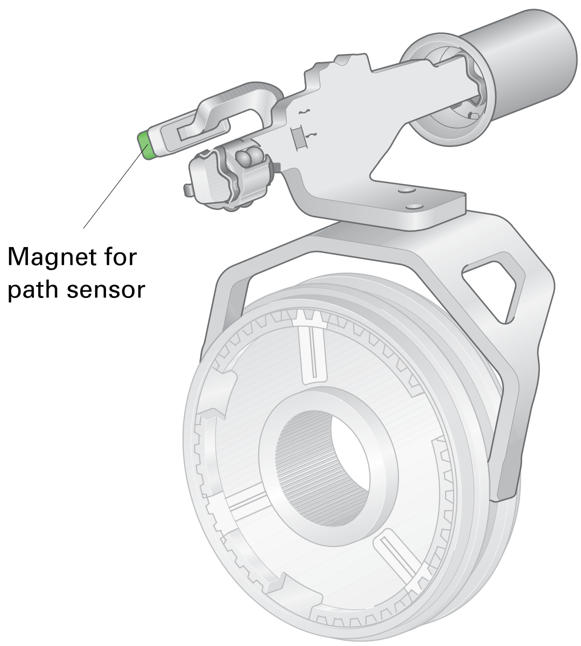


SP56_66

Use of signal

On the basis of the exact position, the control unit pressurizes the gear actuators for shifting the gears with oil pressure.

Effects of signal failure

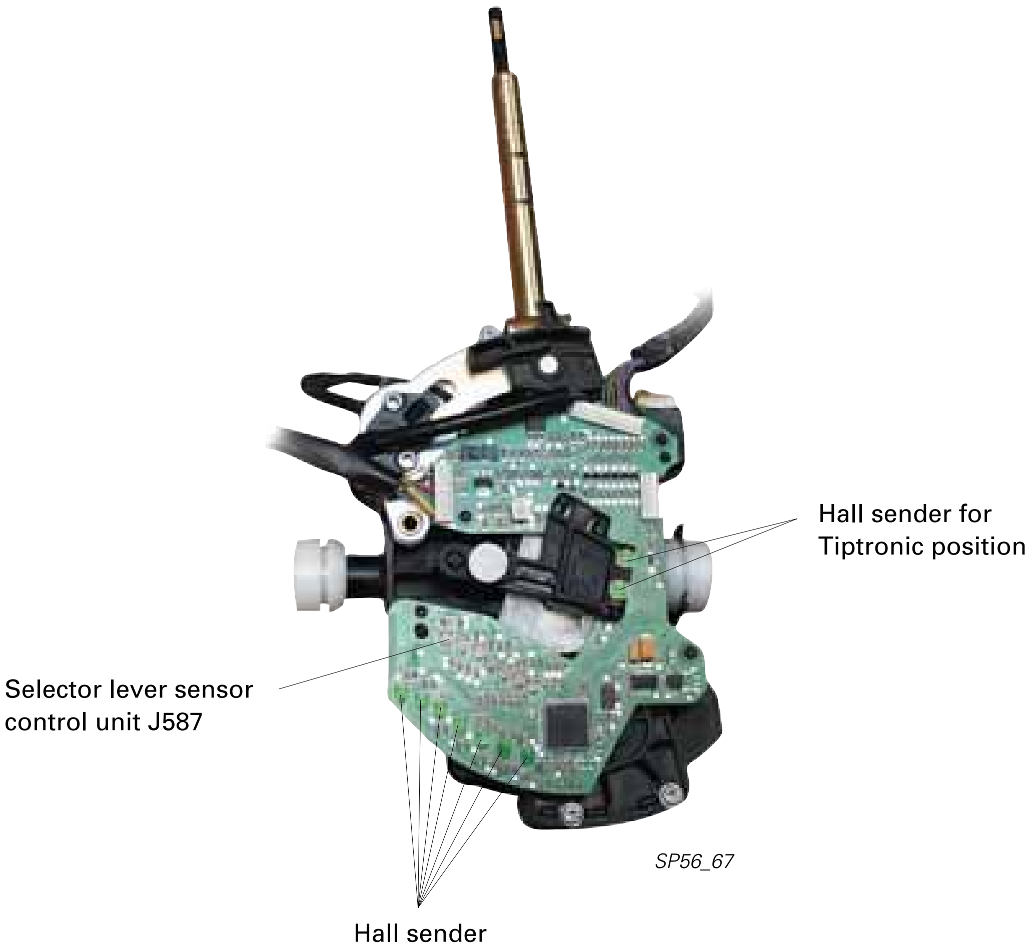
If a path sensor signal fails, the related gearbox area is switched off.
The gears of the related gearbox area can no longer be driven.

Selector lever sensor control unit J587

The selector lever sensor control unit is integrated into the selector lever.
It functions simultaneously as a control unit and as a sensor.
The control of the selector lever lock solenoids is performed via the control unit.
The selector lever scale lighting is integrated into the cover.

At the same time the hall senders for detecting the selector lever position and the hall senders for Tiptronic detection are accommodated in it.

The signals of the selector lever position and the signals of the Tiptronic are transmitted via the CAN bus to the mechatronics and to the control unit for dash panel insert.

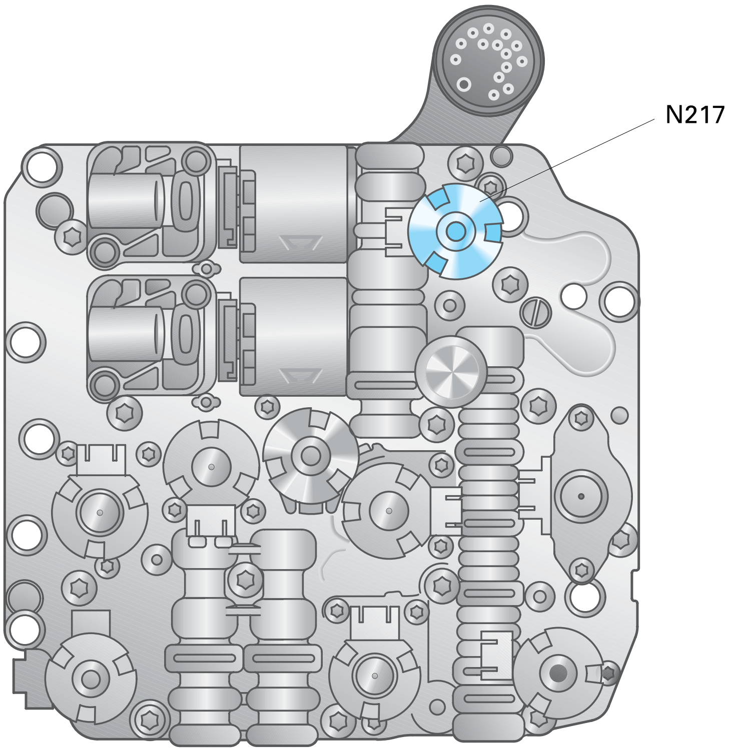


Actuators

Pressure valve 3 for automatic gearbox N217 (main pressure valve)

The pressure control valve 3 for automatic gearbox is located in the electrohydraulical control unit of the mechatronics.
It is a modulation valve.
The main pressure in the hydraulic system of the mechatronics is regulated by this valve.
The main factor for the calculation of the main pressure is the current clutch pressure, which is dependent on the engine torque.

The engine temperature and the engine speed are used for the correction of the main pressure.
The control unit constantly adapts the main pressure to the current situation.



SP56_68

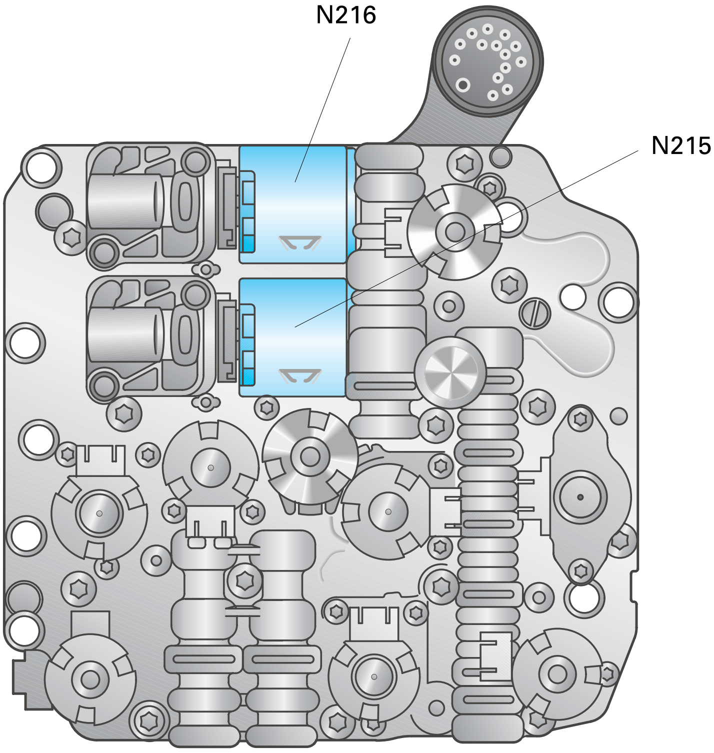
Effects of failure

If the pressure valve fails, the maximum main pressure is used.
Thus, the fuel consumption can increase and when shifting noises can occur.

Pressure control valve 1 for automatic gearbox N215 and pressure control valve 2 for automatic gearbox N216 (clutch valves)

The pressure control valves N215 and N216 are mounted in the electrohydraulical control unit of the mechatronics.
They are modulation valves and generate the control pressure for the multi-plate clutches - the pressure control valve 1 N215 for the multi-plate clutch K1 and the pressure control valve 2 N216 for the multi-plate clutch K2.

Basis for the calculation of the clutch pressure is the current engine torque.
The control unit adapts the clutch pressure to the current friction value of the multi-plate clutches.



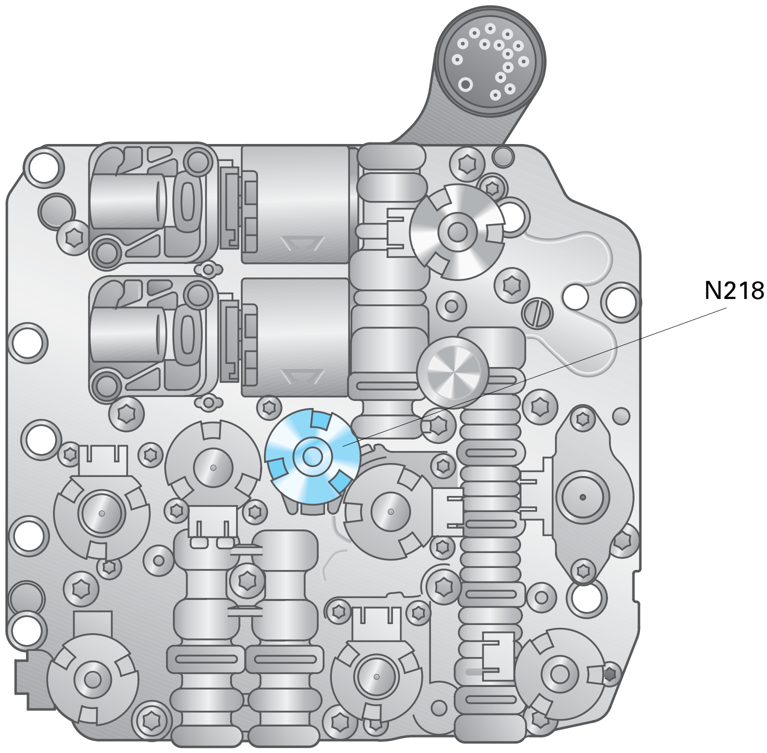
SP56_69

Effects of failure

If a pressure control valve signal fails, the related gearbox area is switched off. This fault is indicated in the dash panel insert.

Pressure control valve 4 N218 (cooling oil valve)

The pressure control valve N218 is located in the electrohydraulical control unit. It is a modulation valve and controls the clutch cooling oil quantity via a hydraulic slide valve. The control unit uses the signal of the oil temperature sender in the multi-plate clutch G509 to control the valve.



SP56_70

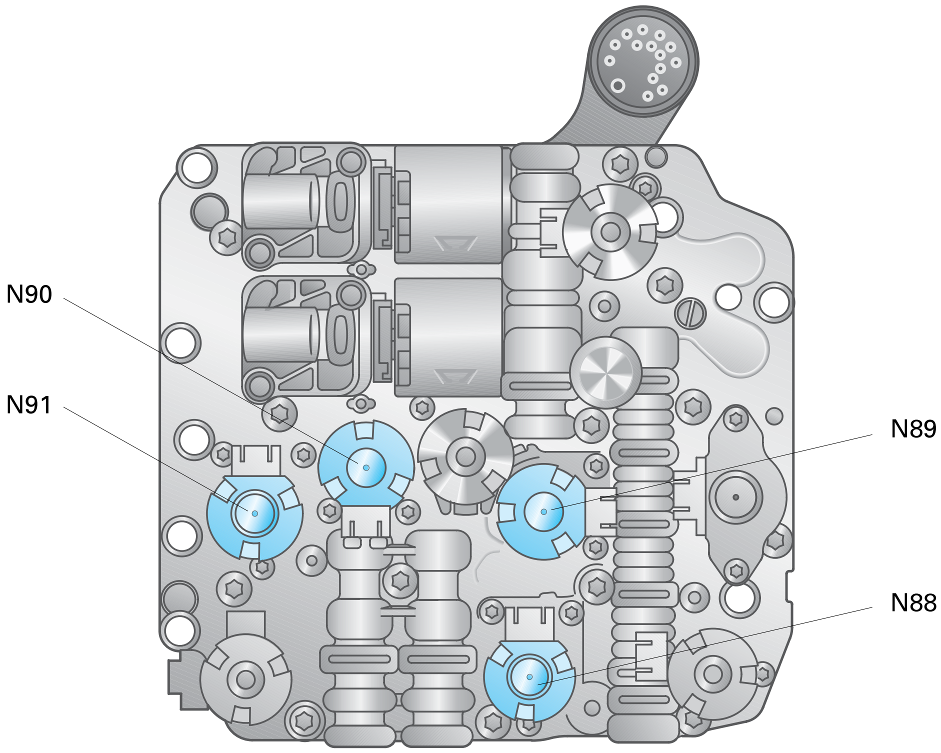
Effects of failure

If the pressure control valve cannot be actuated, the maximum cooling oil quantity flows through the multi-plate clutches.
At low outside temperatures it can lead to problems when shifting the gears and to an increased fuel consumption.

Solenoid valves 1 N88, 2 N89, 3 N90 and 4 N91 (gear actuator valves)

All four solenoid valves are located in the electrohydraulical control unit of the mechatronics. They are "Yes/No" valves. They control all oil pressures via the multiplexer slide valve to the gear actuators. If de-energized, the solenoid valves are closed, no oil pressure reaches the gear actuators.

- Solenoid valve 1 N88 controls the oil pressure for shifting the 1st and 5th gear.
- Solenoid valve 2 N89 controls the oil pressure for shifting the 3rd and the neutral gear.
- Solenoid valve 3 N90 controls the oil pressure for shifting the 2nd and the 6th gear.
- Solenoid valve 4 N91 controls the oil pressure for shifting the 4th and the reverse gear.



SP56_71

Effects of failure

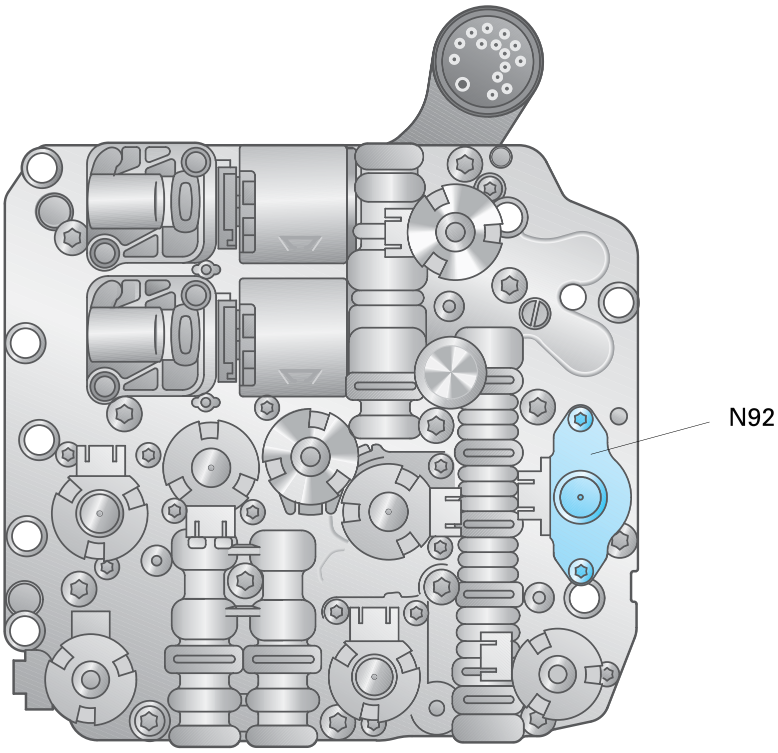
If a solenoid valve fails, the corresponding gearbox branch, in which the gear actuator is located, is switched off.
The vehicle can only be driven in the 1st and/ or 3rd or in the 2nd gear.

Actuators

Solenoid valve 5 N92 (multiplexer valve)

The solenoid valve 5 N92 is located in the electrohydraulical control unit of the mechatronics.
It controls the multiplexer in the hydraulical control unit.

If the solenoid valve is actuated, the 2nd, 4th and 6th gear are shifted.
If the solenoid valve is de-energized, the 1st and/or 3rd or 5th and reverse gear can be shifted.



SP56_72

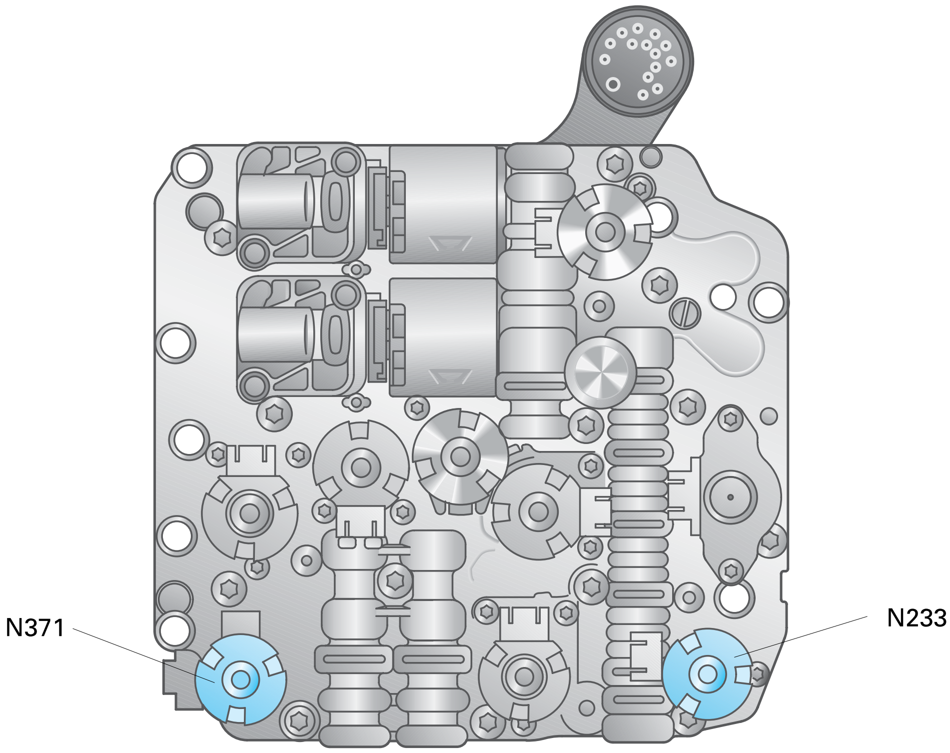
Effects of failure

If the multiplexer valve fails, it remains de-energized in the basic position.
It can no longer be actuated by the oil pressure.
False gears can be shifted.
The standing still of the vehicle is also possible.

Pressure control valve 5 N233 and pressure control valve 6 N371 (safety valves)

The pressure control valves N233 and N371 are accommodated in the hydraulic module of the mechatronics.
They are modulation valves.
They control the safety slide valve in the slide valve of the mechatronics.
The safety slide valves shift the respective gearbox area hydraulically pressureless in the case of a safety-relevant error in the gearbox branch.

The pressure control valve 5 N233 controls the safety slide valve in the 1st gearbox branch.
The pressure control valve 6 N371 controls the safety slide valve in the 2nd gearbox branch.



SP56_73

Effects of failure

If a pressure control valve fails, there can no longer be any gear shifted into the corresponding gearbox branch.
If the gearbox area 1 fails, it can only be driven in the 2nd gear.
If the gearbox area 2 fails, it can only be driven in the 1st or 3rd gear.

Function diagram

Components

A Battery

E313 Selector lever

F319 Selector lever switch locked in P

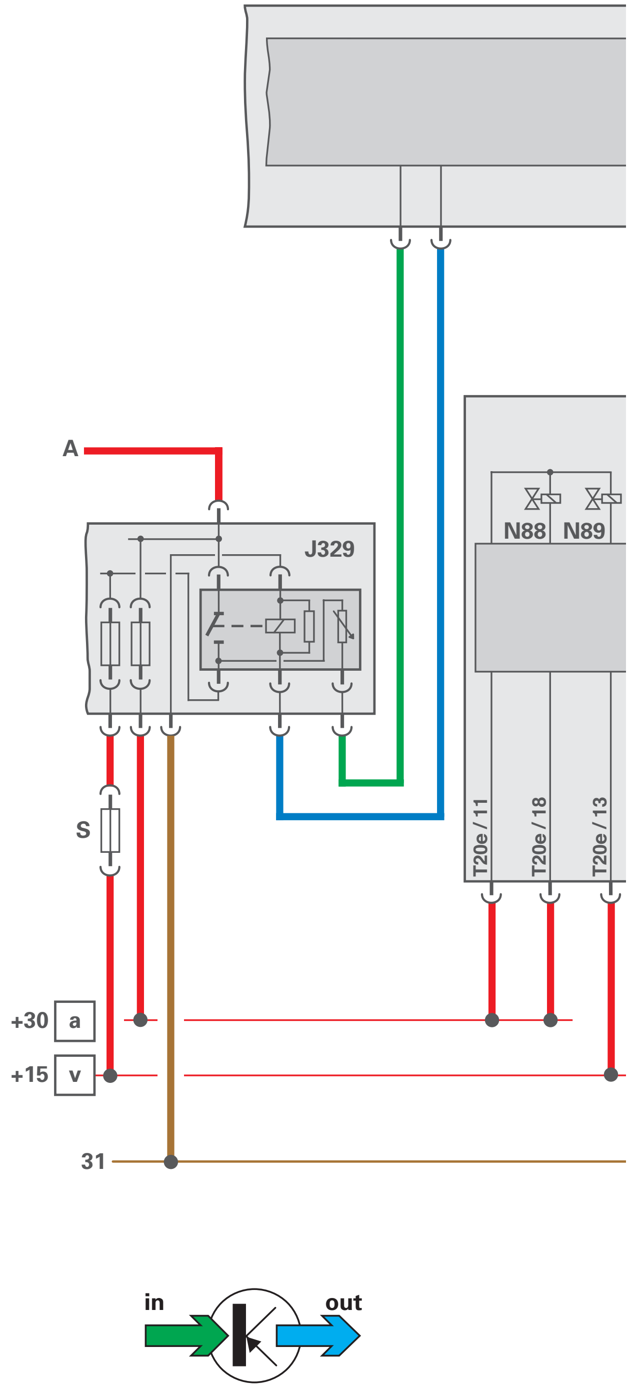
G93 Gearbox oil temperature sender
G182 Gearbox input rpm sender
G193 Hydraulic pressure sender 1 for automatic gearbox
G194 Hydraulic pressure sender 2 for automatic gearbox
G195 Gearbox output rpm sender
G196 Gearbox output rpm 2 sender
G487 Path sensor 1 for gear actuator
G488 Path sensor 2 for gear actuator
G489 Path sensor 3 for gear actuator
G490 Path sensor 4 for gear actuator
G501 R.P.M drive shaft sender 1
G502 R.P.M drive shaft sender 2
G509 Oil temperature sender in multi-plate clutch
G510 Temperature sender in the control unit

J... Engine control unit
J329 Voltage supply relay of terminal 15
J519 Onboard supply control unit
J527 Steering column electronics control unit
J587 Selector lever sensor control unit
J743 Direct shift gearbox mechatronics

L101 Lamp for selector lever scale lighting

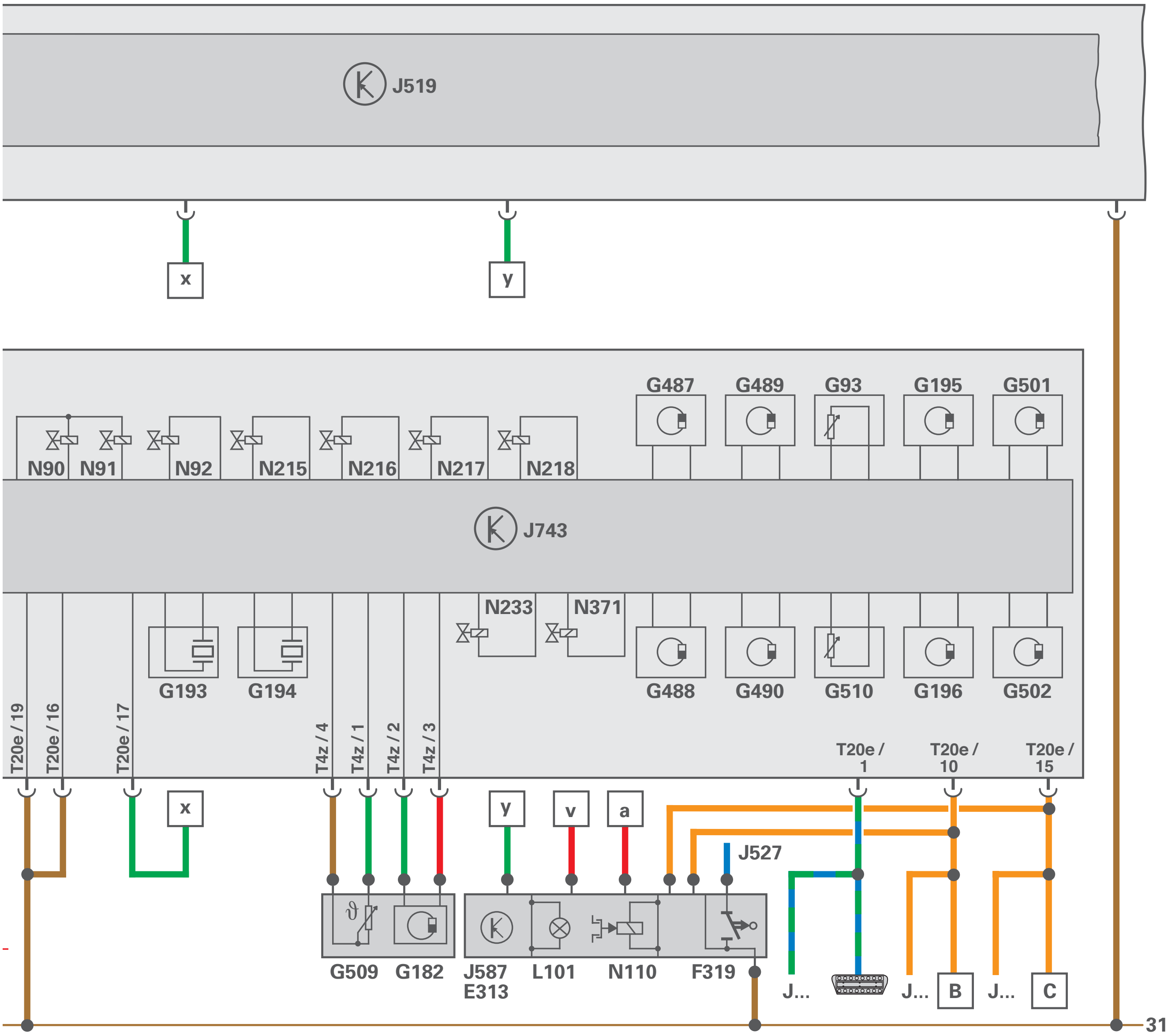
N88 Solenoid valve 1
N89 Solenoid valve 2
N90 Solenoid valve 3
N91 Solenoid valve 4
N92 Solenoid valve 5
N110 Selector lever lock solenoid
N215 Pressure control valve 1 for automatic gearbox
N216 Pressure control valve 2 for automatic gearbox
N217 Pressure control valve 3 for automatic gearbox
N218 Pressure control valve 4 for automatic gearbox
N233 Pressure control valve 5 for automatic gearbox
N371 Pressure control valve 6 for automatic gearbox

S... Fuse



a - Terminal 30

B - CANCAN bus drive high
C - CAN bus drive low



SP56_74

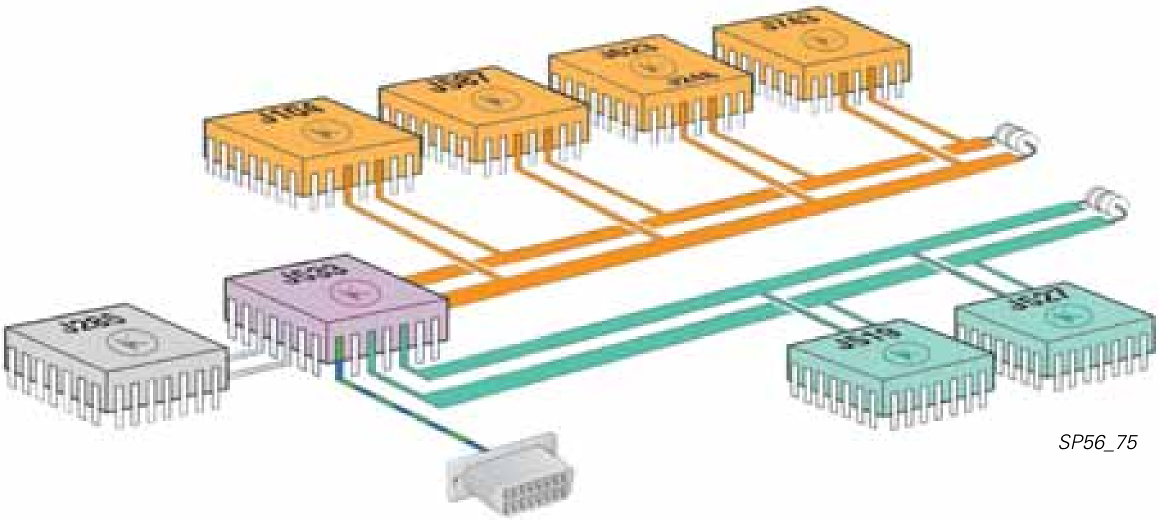
Input signal	CAN bus
Output signal	Bidirectional
Supply voltage	Diagnostic connection
Earth	

GB

CAN databus linkage

The pattern represented below shows symbolically the integration of the mechatronics for direct shift gearbox into the CAN databus structure of the vehicle.

J104 - ABS control unit with EDL
J248 - Diesel direct injection system control unit
J285 - Dash panel insert control unit
J519 - Onboard supply control unit
J527 - Steering column electronics control unit
J533 - Databus diagnostic interface
J587 - Selector lever sensor control unit
J623 - Engine control unit
J743 - Direct shift gearbox mechatronics



Diagnostic connection

CAN data bus "Drive"

CAN data bus "Convenience"

Diagnosis

Via vehicle diagnosis, measuring and information system VAS 5051, the modes of operation

- Targeted Fault Finding and
- Targeted Functions

are available to you.

Mode of operation „Targeted Fault Finding“

In the „Targeted Fault Finding“ of the automatic gearbox DSG there is a test plan with which you can test the following sensors, actuators and the mechatronics in operation. Please observe the notes in the VAS 5051 when testing the sensors and actuators.

Sensors:

G93 - Gearbox oil temperature sender
G182 - Gearbox input rpm sender
G193 - Hydraulic pressure sender 1 for automatic gearbox
G194 - Hydraulic pressure sender 2 for automatic gearbox
G195 - Gearbox output rpm sender 1
G196 - Gearbox output rpm sender 2
G487 - Path sensor 1 for gear actuator
G488 - Path sensor 2 for gear actuator
G489 - Path sensor 3 for gear actuator
G490 - Path sensor 4 for gear actuator
G501 - R.P.M drive shaft sender 1
G502 - R.P.M drive shaft sender 2
G509 - Oil temperature sender in multi-plate clutch
G510 - Temperature sender in the control unit

Actuators:

N88 - Solenoid valve 1
N89 - Solenoid valve 2
N90 - Solenoid valve 3
N91 - Solenoid valve 4
N92 - Solenoid valve 5
N110 - Selector lever 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

Mechatronics defective
J743 - Mechatronics gear monitoring
J743 - Mechatronics shift monitoring
J743 - Mechatronics supply voltage

Operation mode „Targeted Fault Finding“

In the mode of operation „Targeted Fault Finding“ of the automatic gearbox there is a test plan for testing the oil level.