



Self-study Programme 309

6-speed Automatic Gearbox 09G/09K/09M



The 6-speed automatic gearbox from the Japanese manufacturer AISIN is used in the following Volkswagen vehicles:

Code	Maximum torque transfer	Vehicles
09G	250 Nm	Golf 2004/Touran/New Beetle
09K	400 Nm	Transporter 2004
09G	250 Nm	Passat 2005 planned
09M	450 Nm	Passat 2005 planned

The gearbox is adapted to the different engine types and vehicles as follows

- the number of disc pairs for clutches and brakes,
- adjustment of the ATF pressure applied to the clutches and brakes,
- the configuration of the gear pairs, planetary gear sets (e.g. 4 instead of 3 planetary gears), shafts and bearings,
- reinforcement of housing parts,
- the ratio of the axle drive and the intermediate drives,
- the size of the torque converter,
- the converter torque increase curve (conversion factor or converter amplification),
- the selector lever and
- the ignition key withdrawal lock.



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NEW



Important Note

The self-study programme shows the design and function of new developments.
The contents will not be updated.

For current testing, adjustment and repair instructions refer to the relevant service literature.

Contents



Introduction	4
Selector Lever	6
Gearbox Design	14
System Overview	38
Gearbox Control	40
Self-diagnosis	64
Service	65
Glossary	66
 Explanation of the <i>highlighted terms</i>	
Test Yourself	67



Introduction



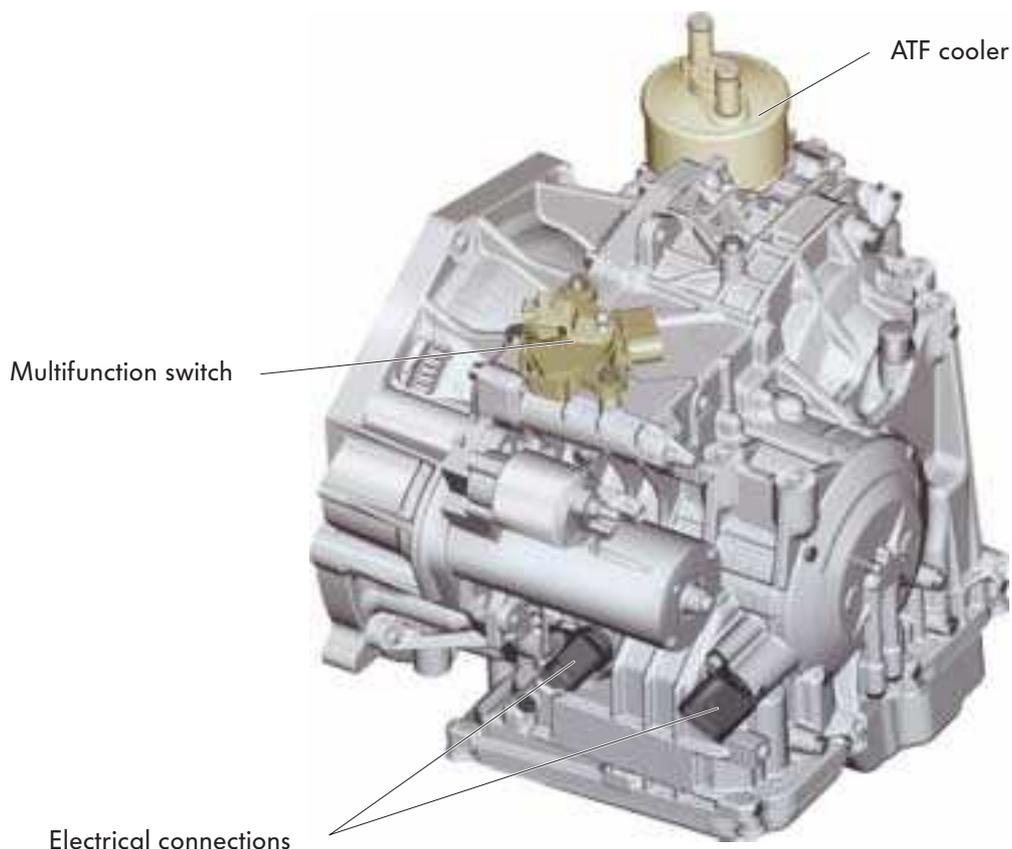
The 09G gearbox is developed and produced by the Japanese gearbox manufacturer AISIN AW CO., LTD. Volkswagen engineers have developed the gearbox in collaboration with AISIN and adapted it to Volkswagen vehicles.

This gearbox sets new standards for traverse-mounted stepped automatic transmissions in terms of dynamics and economy with its:

- low weight
- high overall spread
- compact gearbox dimensions
- high shifting speed
- smooth gear changes

The 6-speed automatic gearbox used in the Volkswagen Touareg, which has the code 09D, comes from the same manufacturer. Both automatic gearboxes from AISIN use a Lepelletier gear set concept.

The advantage of this Lepelletier gear set concept is its simple, space-saving and low-weight design. A simple planetary gear set has been combined with a Ravigneaux gear set. This creates a harmonious 6-speed ratio with just five shifting components.



S309_002



You will find information on the 09D automatic gearbox in self-study programme 300.

Technical Data



Manufacturer	AISIN AW CO., LTD. Japan		
Gearbox type	Electrohydraulically controlled 6-speed planetary gearbox (stepped automatic gearbox) with hydrodynamic torque converter and slip-regulated lock-up torque converter for front-wheel drive and transverse mounting		
Control	Hydraulic control unit in oil sump with external electronic control unit DSP dynamic shift program with separate sports program in "Position S" and the Tiptronic program for manual gear changes (optionally with steering wheel Tiptronic)		
Torque output	Up to 450 Nm depending on version		
Intermediate drive for codes GSY/GJZ	Number of teeth	$\frac{52}{49}$	= 1.061
Axle drive GSY	Number of teeth	$\frac{61}{15}$	= 4.067
Axle drive GJZ	Number of teeth	$\frac{58}{15}$	= 3.867
ATF specification	G 052 025 A2		
Filling quantity	7.0 litres (when new), filled for life		
Weight	approx. 82.5 kg		
Length	approx. 350 mm		
<i>Spread</i>	6.05		

Depending on the engine, the overall transmission ratio is configured as a 5+E gearbox or as a 6-speed gearbox.

The top speed is reached in fifth gear with the 5+E gearbox. The 6th gear is used to reduce the engine speed, improve driving comfort and lower fuel consumption.

The top speed is reached in sixth gear with the 6-speed configuration of the gearbox. The 6th gear is used for a shorter transmission ratio and increases the driving dynamics.

Selector lever

The selector lever design may vary from vehicle to vehicle.

However, it is operated in the same way and has the same functions in all of the vehicles featuring this automatic gearbox.

The steering wheel switches are optional and can also have different designs in the various models.

Selector Positions and Operation

P - Park

You need to turn the ignition on and put your foot on the brake pedal to move the selector from this position.

Furthermore you need to press the release button on the selector lever.

R - Reverse

You need to press the release button to select this gear.

N - Neutral

The gearbox is set to neutral in this position. If the selector level is kept in this position for a long period and the vehicle is travelling at less than 5 km/h, you will have to press the brake again to shift from this position.

D - Drive

The forward gears are selected automatically in this position.

S - Sport

You need to press the release button to select the "S" position. The gears are then selected automatically using a "sports" program that is stored in the control unit.

+ and -

The Tiptronic functions can be controlled in the right-hand selector gate and using the steering wheel switches.



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Design of Selector Lever in Golf 2004

The selector lever operates the multifunction switch via the gate change cable. In the multifunction switch, the mechanical movement of the change cable occurs in electrical signals according to the selector lever position. The electrical signals are sent to the automatic gearbox control unit via analogue cables.

Selector lever locked in position “P” switch F319

When the selector lever is set to the “P” position, the switch will send the signal – selector lever in “P” position – to the steering column electronics control unit.

The control unit requires this signal to operate the ignition key withdrawal lock.

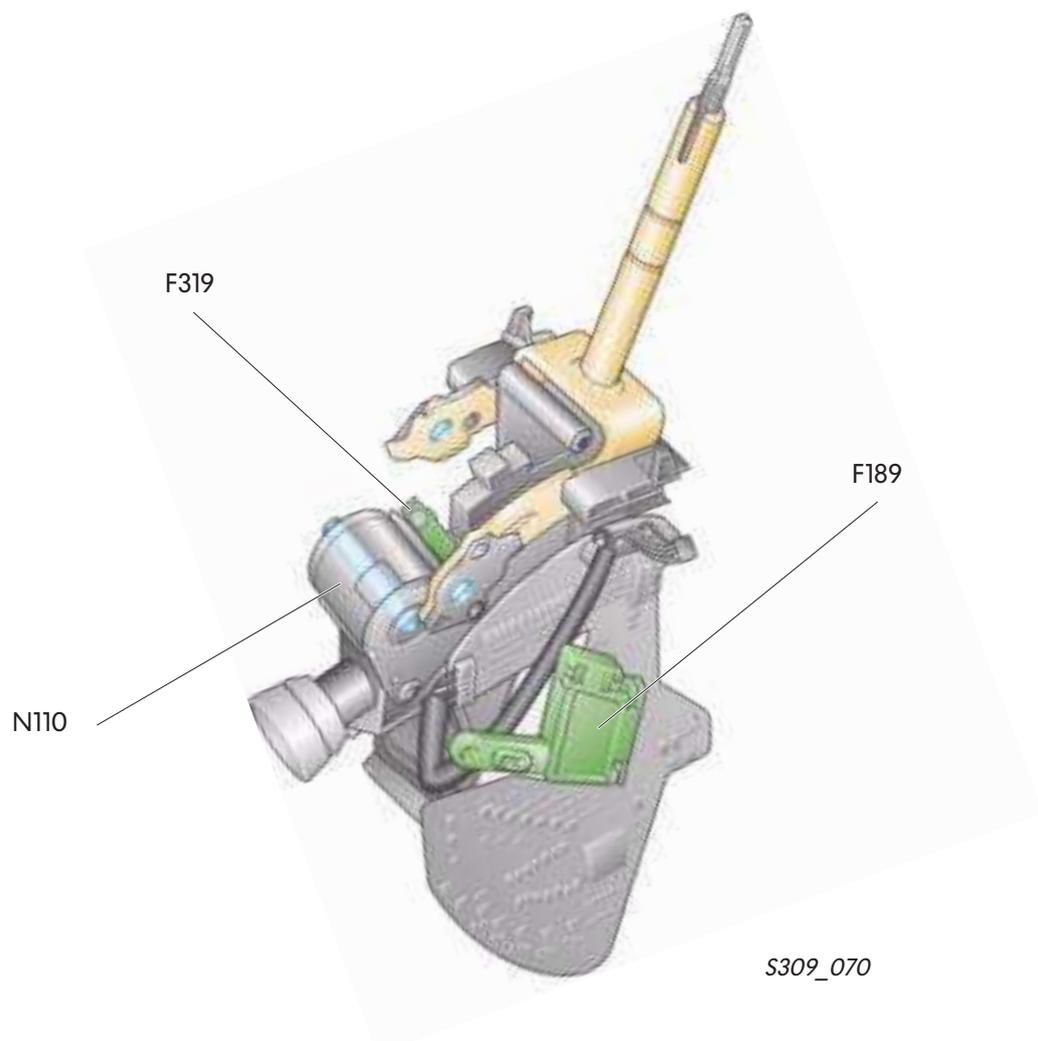
Selector lever lock solenoid N110

The selector lever lock solenoid magnet is controlled by the automatic gearbox control unit.

Tiptronic switch F189

The switch recognises the Tiptronic gate as well as Tip + and Tip –.

The signal is sent to the gearbox control unit via an analogue cable.



Selector Lever

Design of Selector Lever in Transporter 2004

The selector lever operates the selector lever cable that is connected to the multifunction switch on the gearbox. The multifunction switch signals the position of the selector lever to the automatic gearbox control unit.

Selector lever lock solenoid N110

The selector lever lock solenoid is controlled by the automatic gearbox control unit. The signal is sent to the solenoid via the gearshift indicator control unit J98.

Selector lever gate detector switch F257

If you move the selector lever into the Tiptronic gate, the selector lever will operate the selector lever gate detector switch.

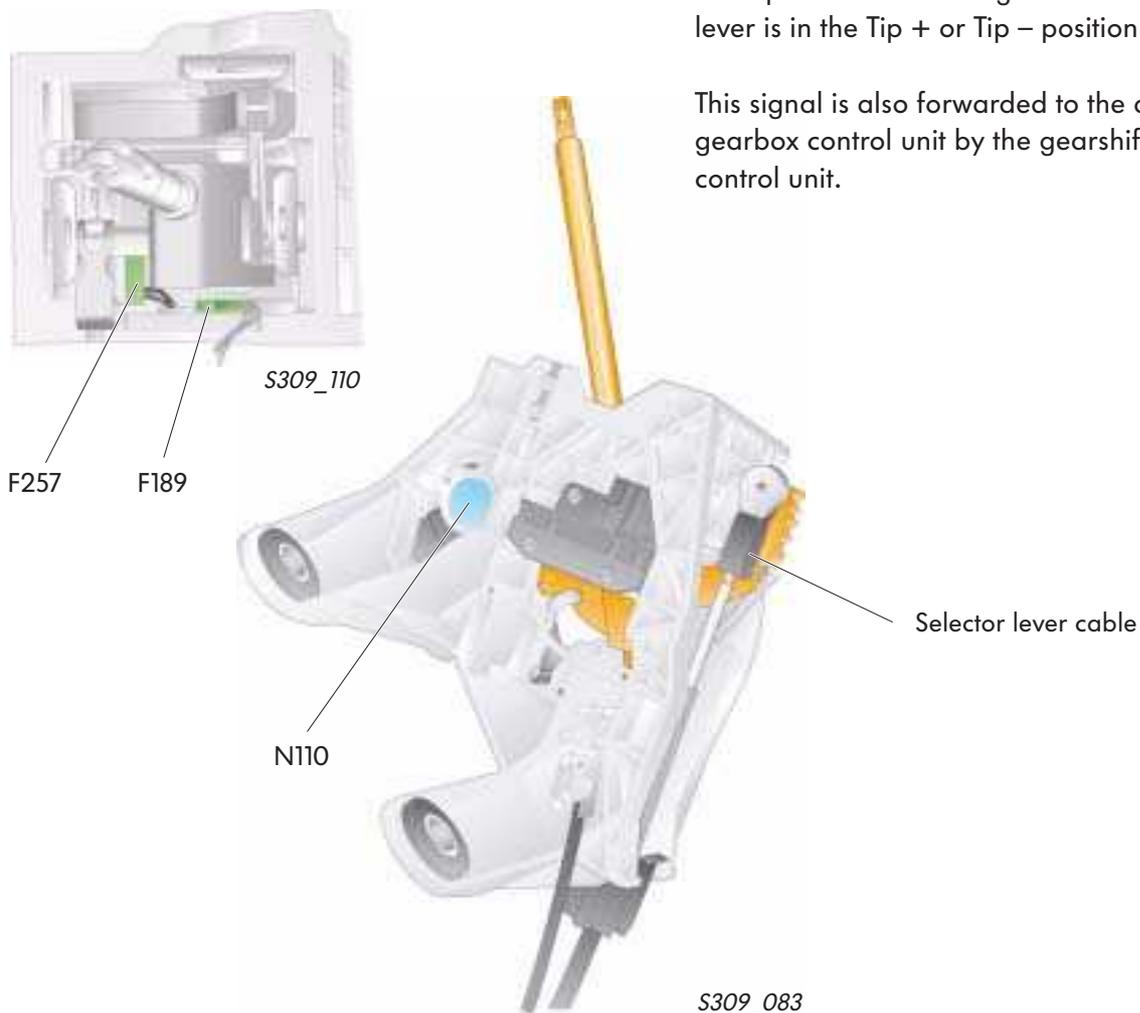
From the switch, the “selector lever in Tiptronic gate” signal is sent to the gearshift indicator control unit J98.

This forwards the signal to the automatic gearbox control unit.

Tiptronic switch F189

The Tiptronic switch recognises when the selector lever is in the Tip + or Tip – position.

This signal is also forwarded to the automatic gearbox control unit by the gearshift indicator control unit.

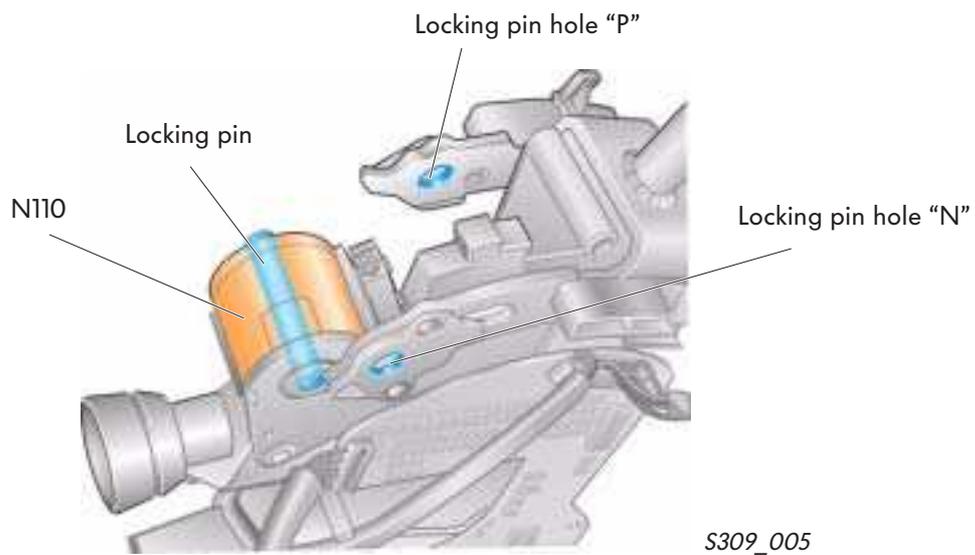


Selector lever lock

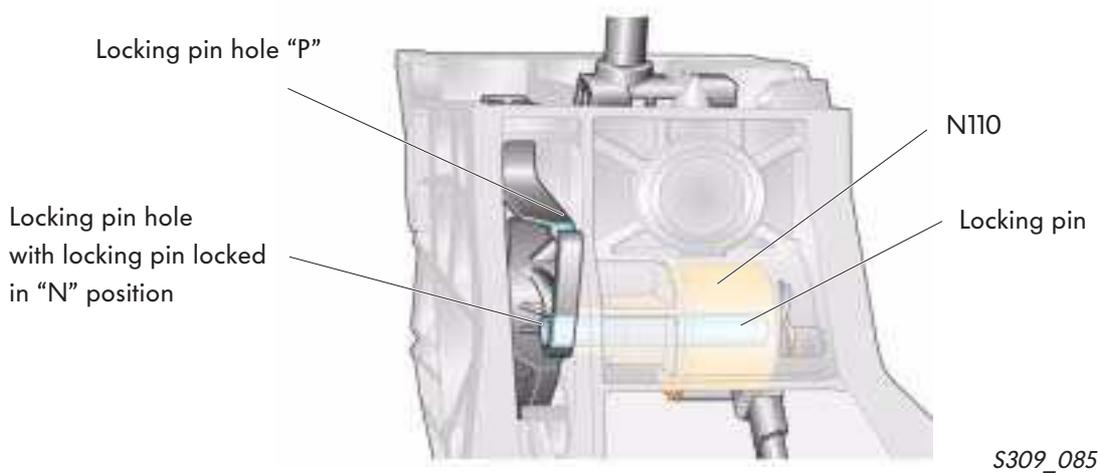
The selector lever lock prevents accidental selection of a gear while the engine is running. The selector lever lock solenoid N110 locks the selector lever in the positions "P" and "N". The lock is only released when you press the foot brake.



Selector lever lock in Golf 2004/Passat 2005



Selector lever lock in Transporter 2004



You will find further information on the design and function in self-study programme 308.

Selector Lever

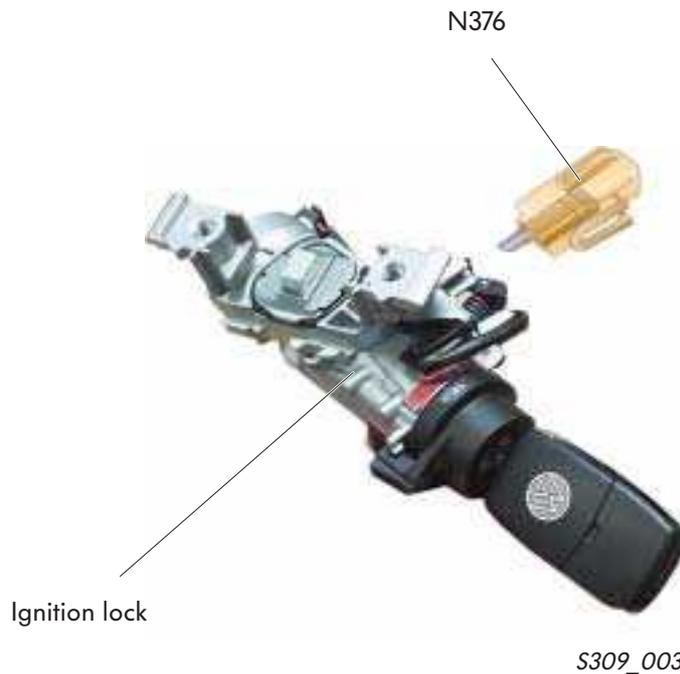
Ignition key withdrawal lock in Golf 2004

The ignition key withdrawal lock prevents the ignition key being turned back to the remove position when the parking lock is not engaged.

It works electro-mechanically and is controlled by the steering column electronics control unit J527.

The steering column electronics control unit recognises the position of the switch F319. If the switch is open, the selector lever is set to "P" and the ignition key withdrawal lock solenoid N376 is not powered.

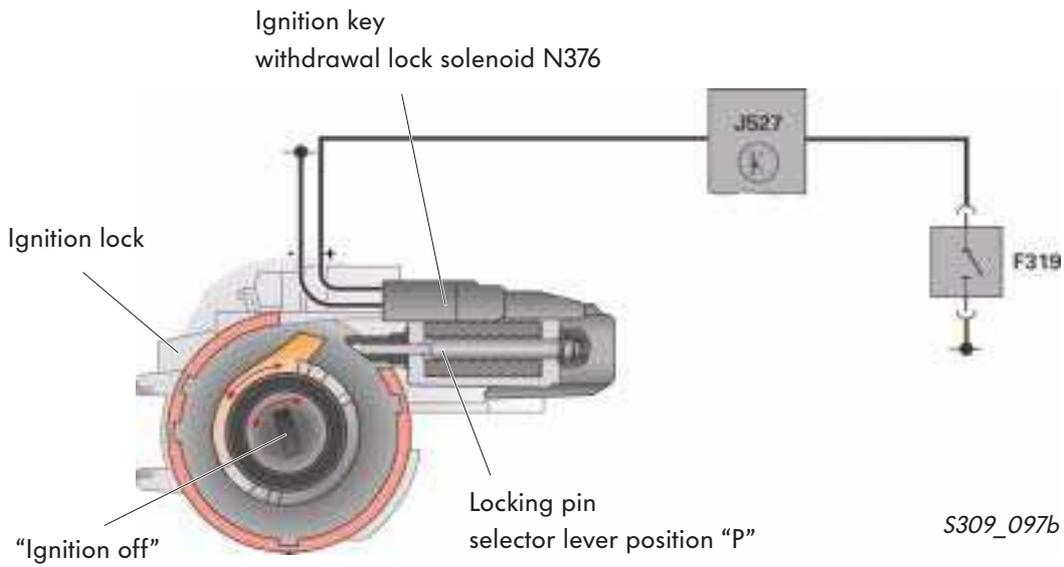
You can remove the ignition key.



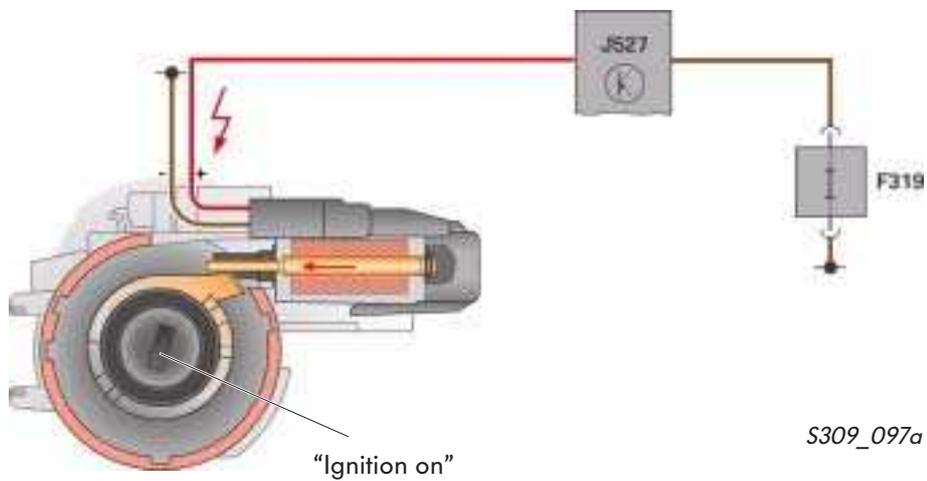
You will find more information on the design and function of the ignition lock in self-study programme 308.



**Selector lever in park position,
the ignition is switched off**



**Selector lever in drive position,
the ignition is switched on**



Selector Lever

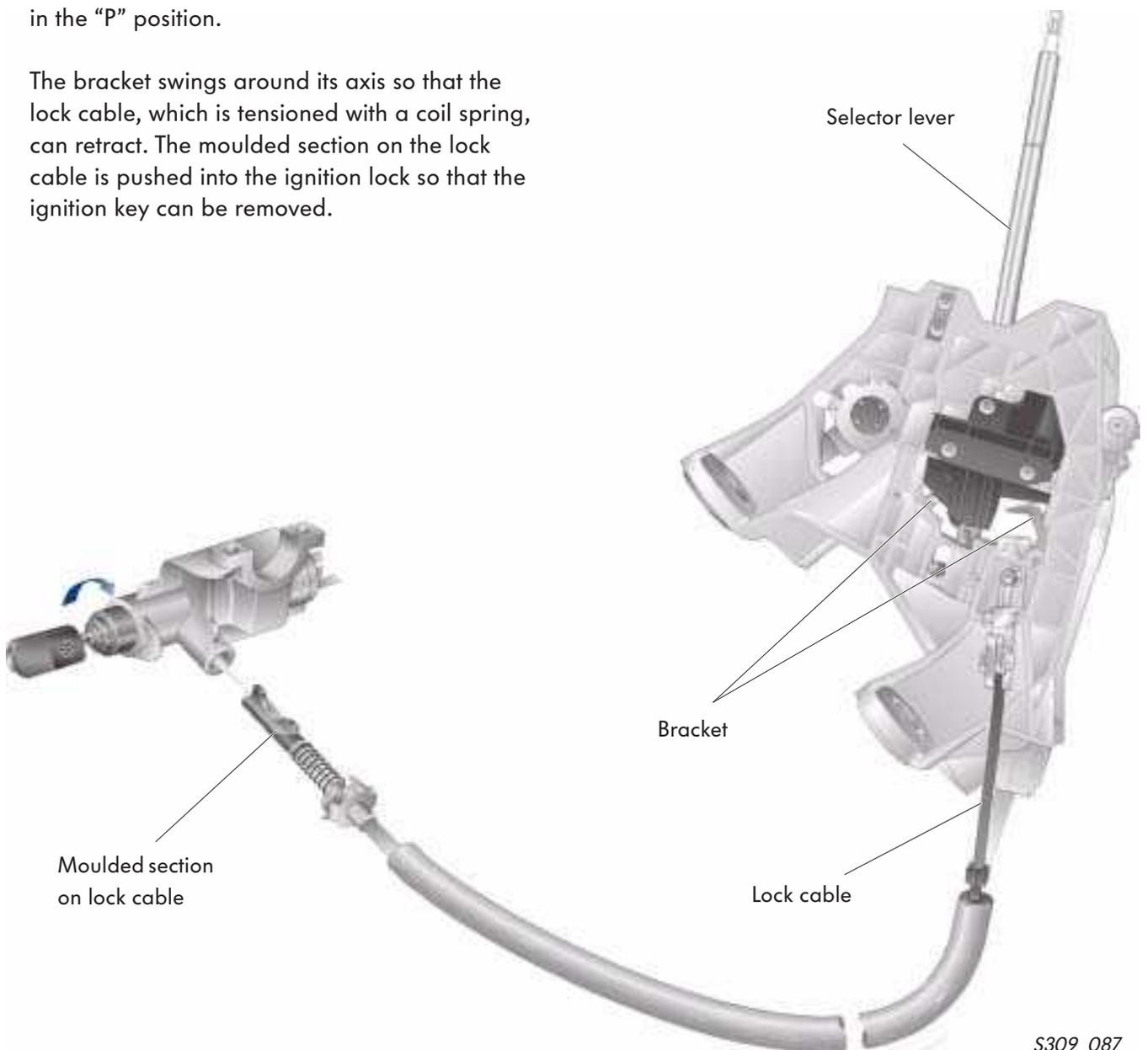
Ignition key withdrawal lock in Transporter 2004

In the Transporter 2004, the ignition key withdrawal lock is purely mechanical. The selector lever has a curved track with a recess on the bottom.

A bracket, which is connected to the lock cable for the ignition key withdrawal lock, is guided along this curved track and locks into the recess in the "P" position.

The bracket swings around its axis so that the lock cable, which is tensioned with a coil spring, can retract. The moulded section on the lock cable is pushed into the ignition lock so that the ignition key can be removed.

In all other positions, the moulded part is pushed into the lock so that the ignition key cannot be turned back to the remove position when the parking lock is not engaged.

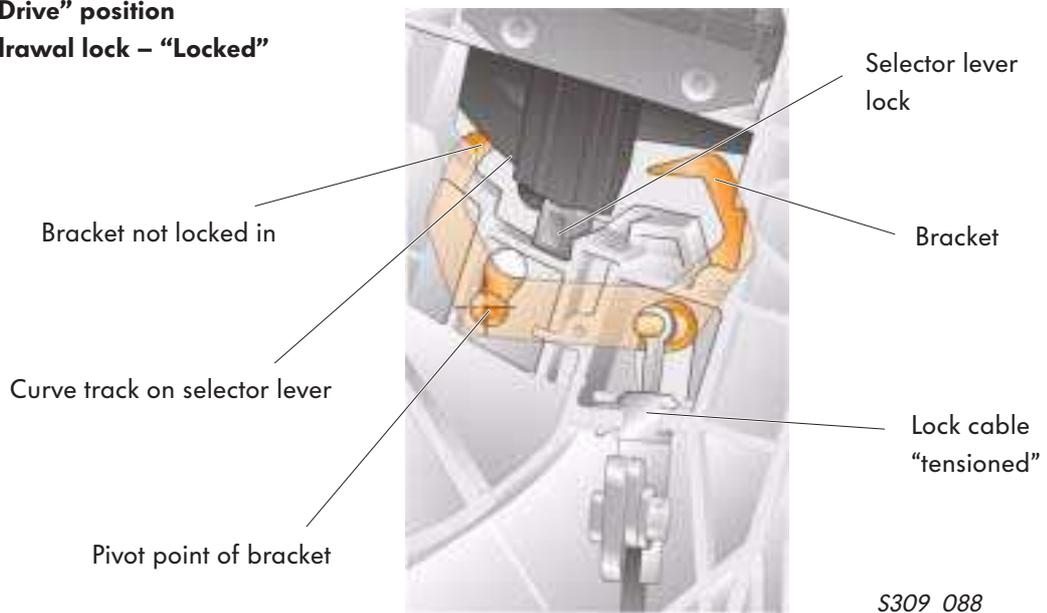


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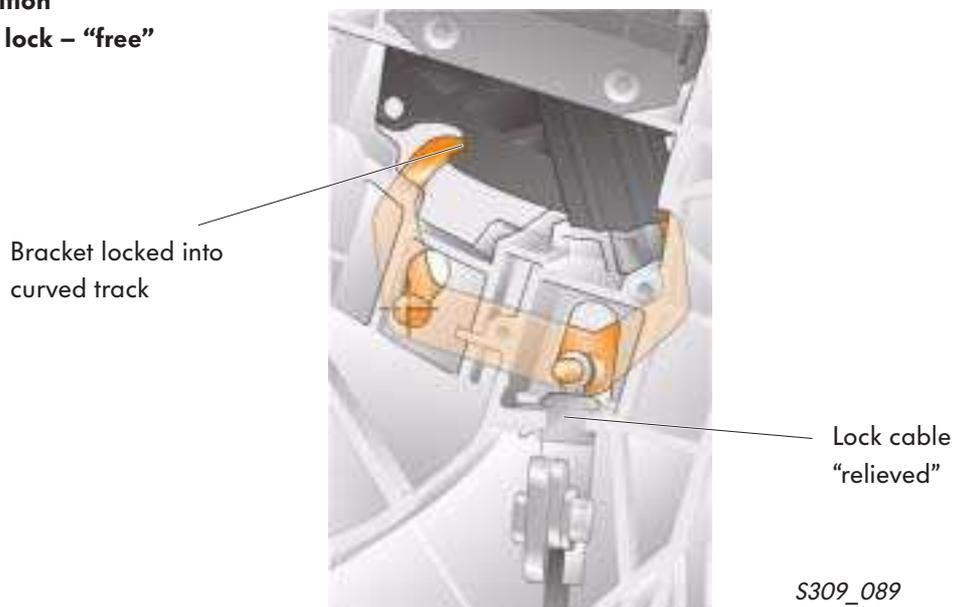


The release button on the selector lever lifts the pull rod when you move the lever. This allows the selector lever to be moved in the gate. When you release the button, the pull rod is locked into the new position again by the spring.

**Selector lever in “Drive” position
Ignition key withdrawal lock – “Locked”**



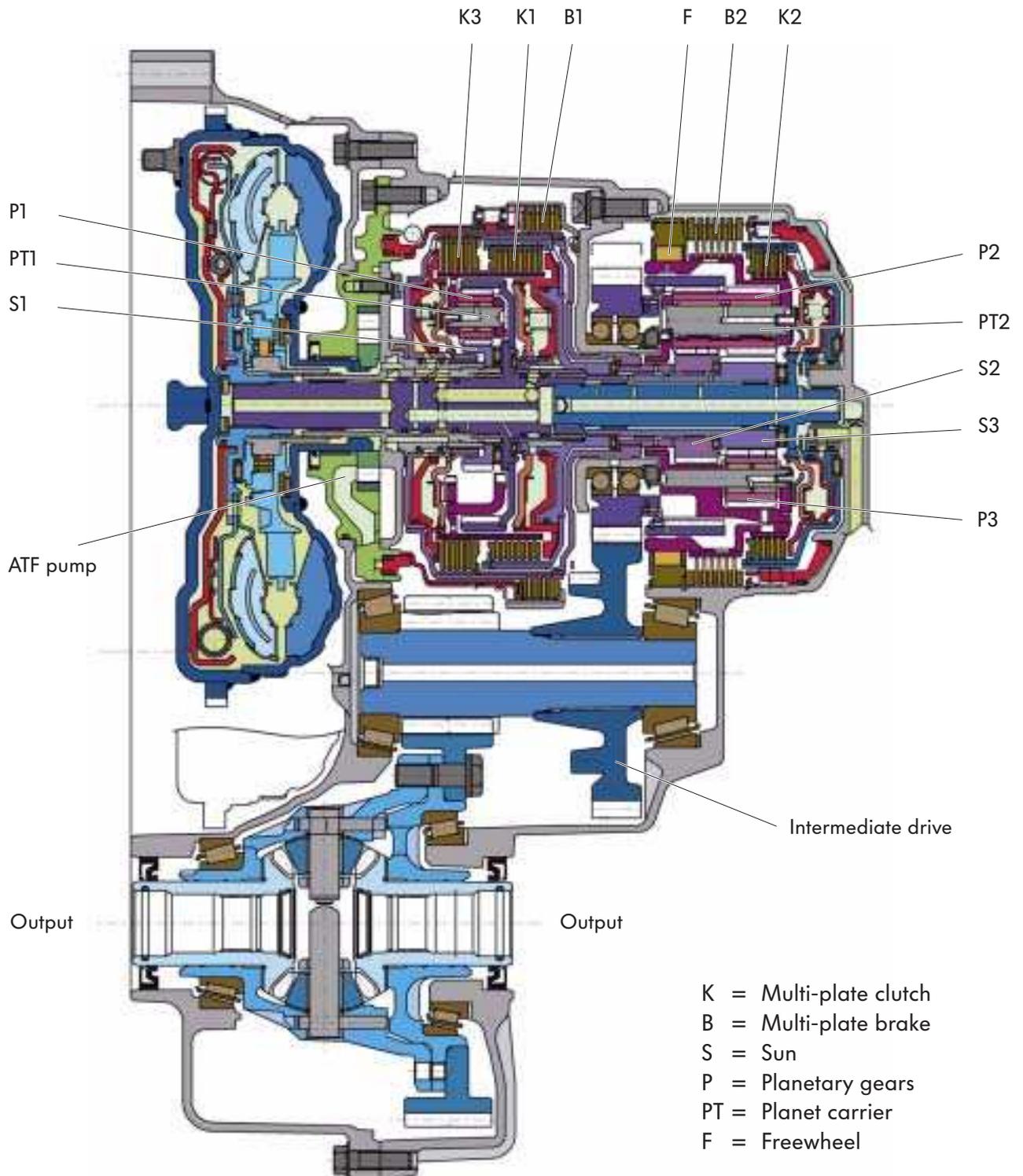
**Selector lever in “P” position
Ignition key withdrawal lock – “free”**



Gearbox Design

09G Gearbox Cross-section

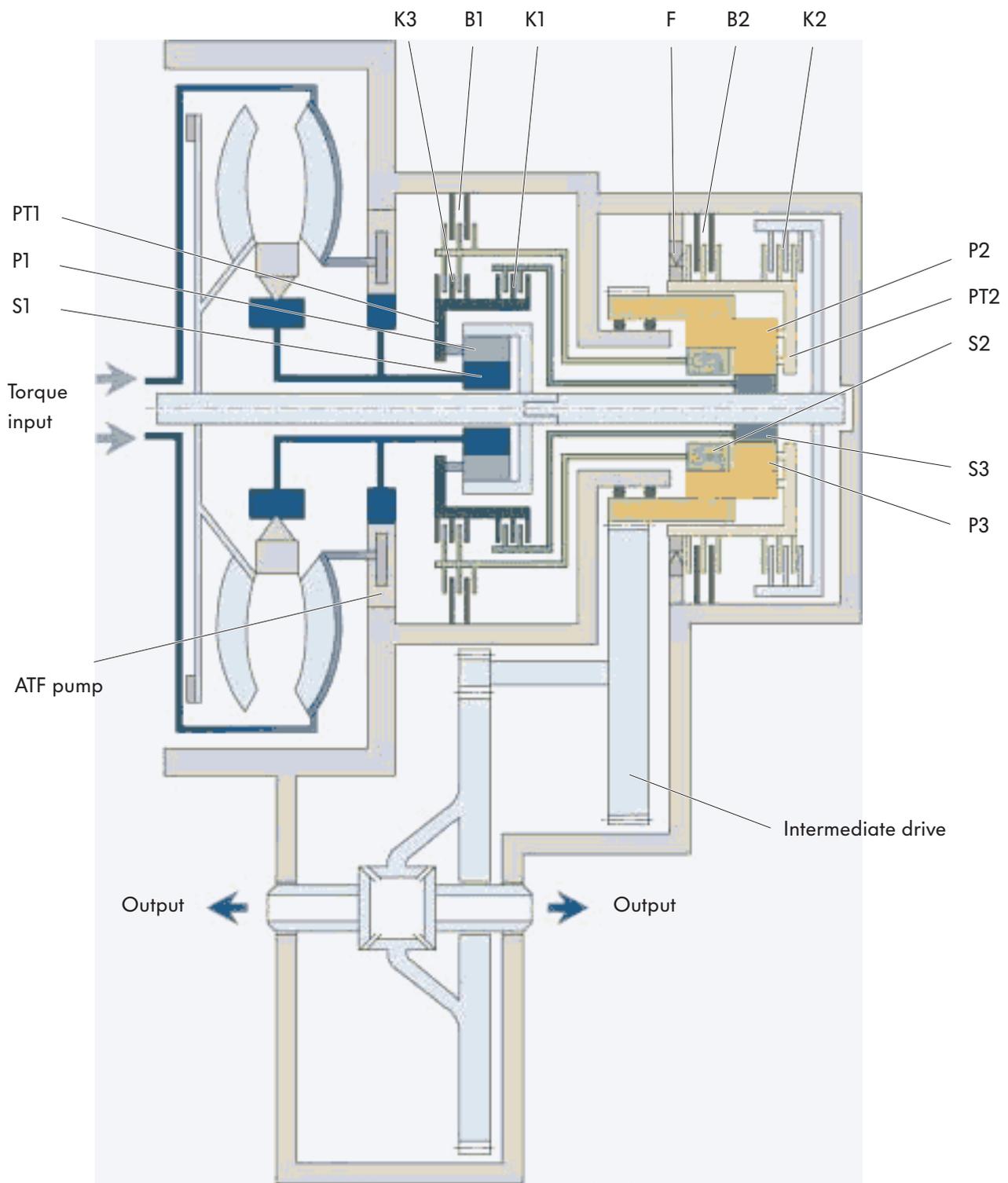
The following cross-section shows you the original structure and the original arrangement of the components in the gearbox.



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09G gearbox cross-section – Schematics

This diagram should simplify the explanation.

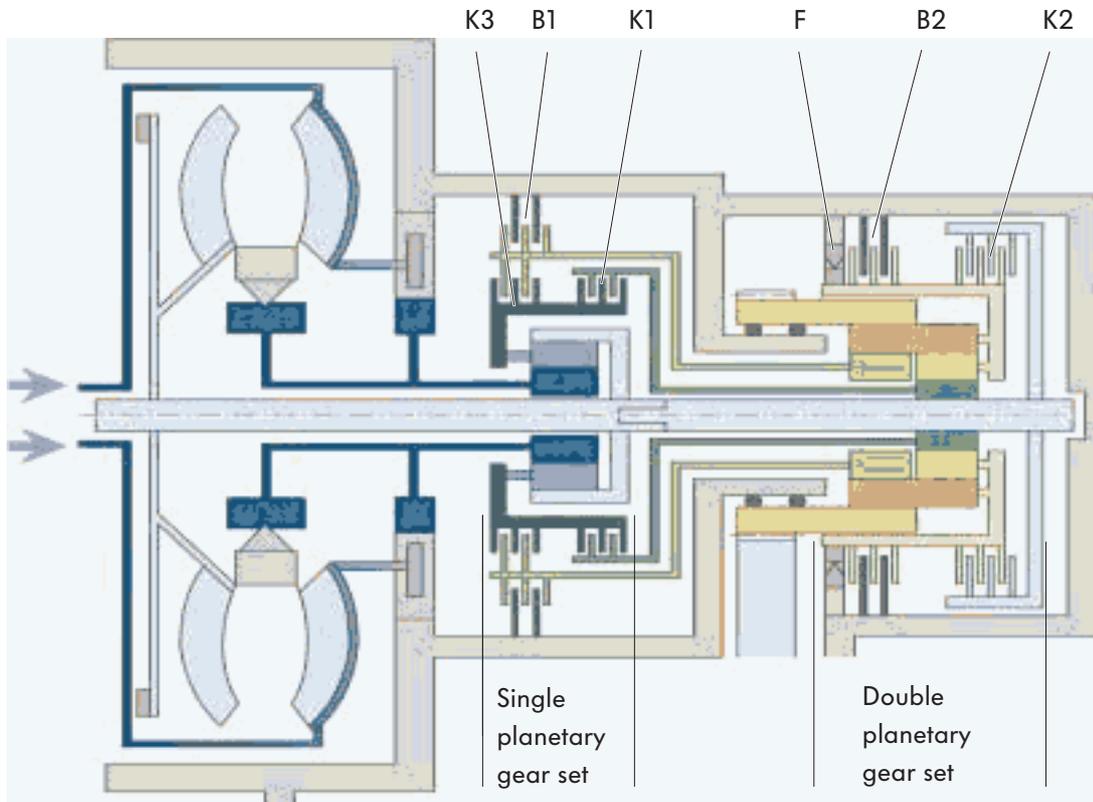


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Gearbox Design

Planetary gear/ shifting component



The planetary gear set uses a Lepelletier construction.

The engine torque is transmitted first to a single planetary gear set.

It is transferred from the single planetary gear set to a Ravigneaux double planetary gear set.

The multi-plate clutches K1 and K3 and the multi-plate brake B1 are on the single planetary gear set. The number of planetary gears depends on the torque transmission of the gearbox.

The multi-plate clutch K2 and the multi-plate brake B2 as well as the freewheel F are on the double planetary gear set.

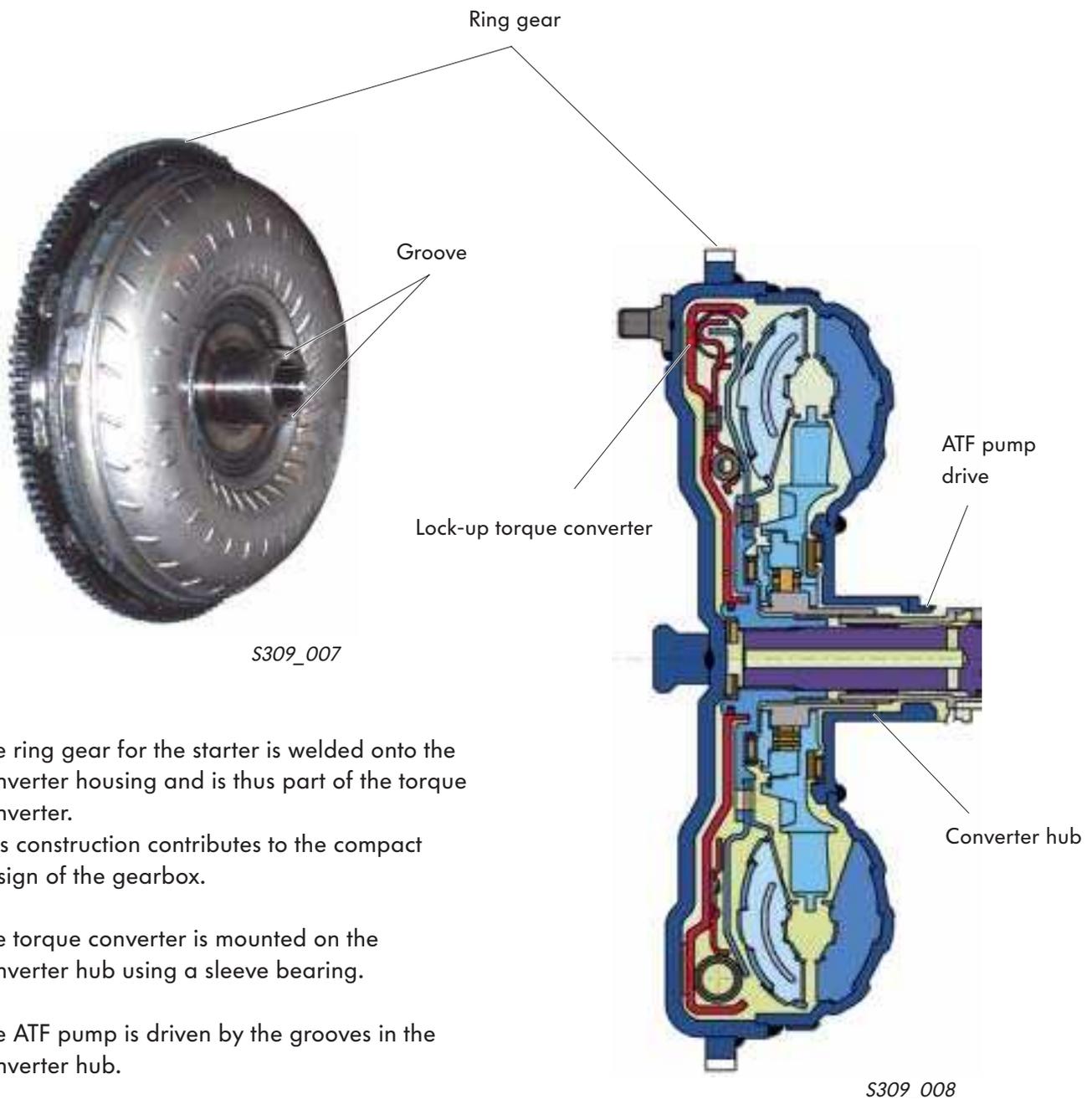
The clutches have a dynamic pressure compensation, which results in a control response that is not related to the engine speed. The clutches K1, K2 and K3 transmit the engine torque to the planetary gearbox. The brakes B1 and B2 as well as the freewheel lock against the gearbox housing.

All clutches and brakes are controlled indirectly by the electrical pressure control valves.

The freewheel F is a mechanical shifting component. It is arranged parallel to brake B2.

Torque Converter

The hydro-mechanical torque converter is used as a starting element and boosts the torque in the conversion range. A lock-up torque converter is integrated in the torque converter.



The ring gear for the starter is welded onto the converter housing and is thus part of the torque converter.

This construction contributes to the compact design of the gearbox.

The torque converter is mounted on the converter hub using a sleeve bearing.

The ATF pump is driven by the grooves in the converter hub.

Different converter types are used to adapt the gearboxes to the characteristics of the different engines.

Gearbox Design

Lock-up Torque Converter

Design

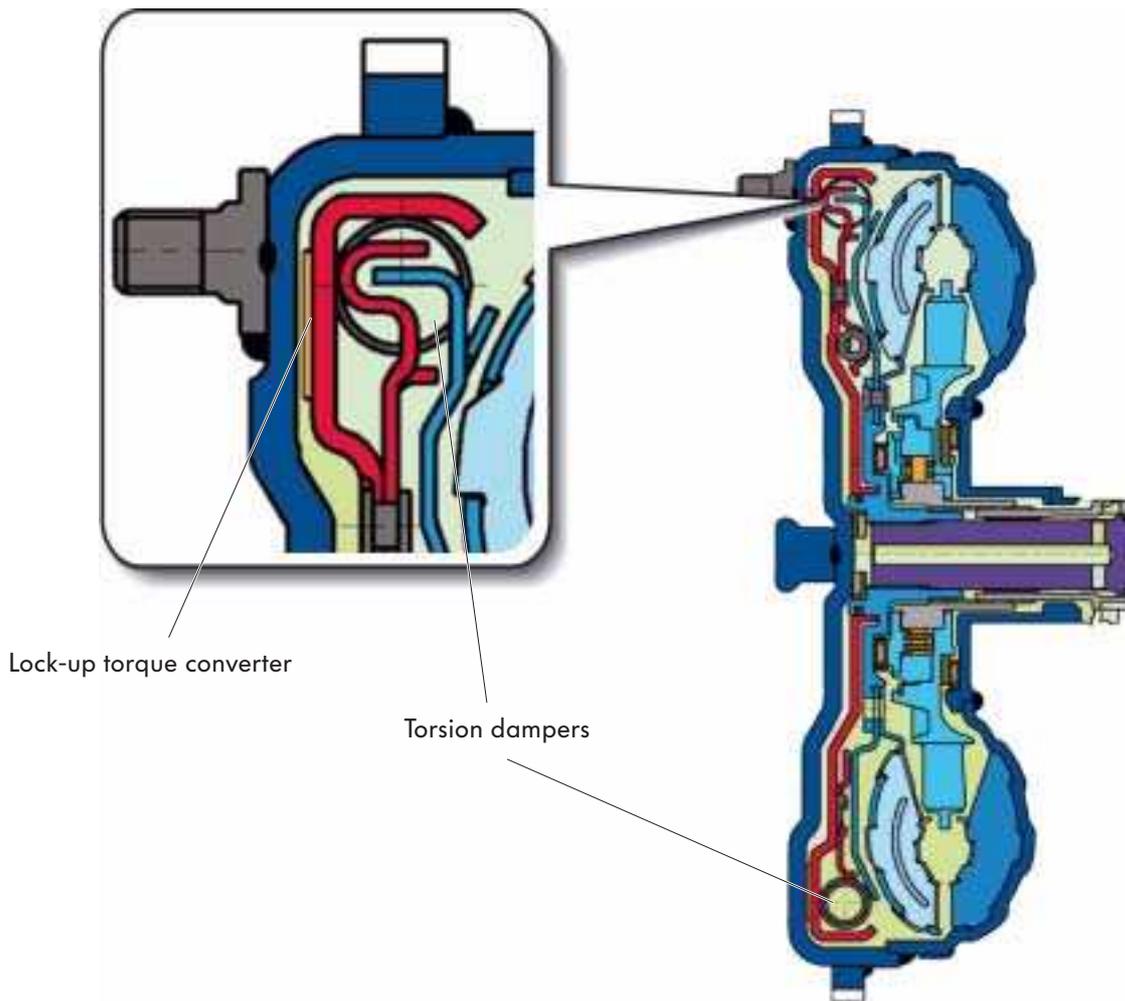
The torque converter has a lock-up torque converter with integrated torsion dampers.

The torsion dampers reduce the rotary vibration when the lock-up torque converter is closed. This allows the range in which the lock-up torque converter is closed to be expanded considerably.

We can basically distinguish between the modes:

- Lock-up torque converter - Open
- Lock-up torque converter - Regulated mode
- Lock-up torque converter - Closed

In normal driving mode, the lock-up torque converter can be closed in any gear.



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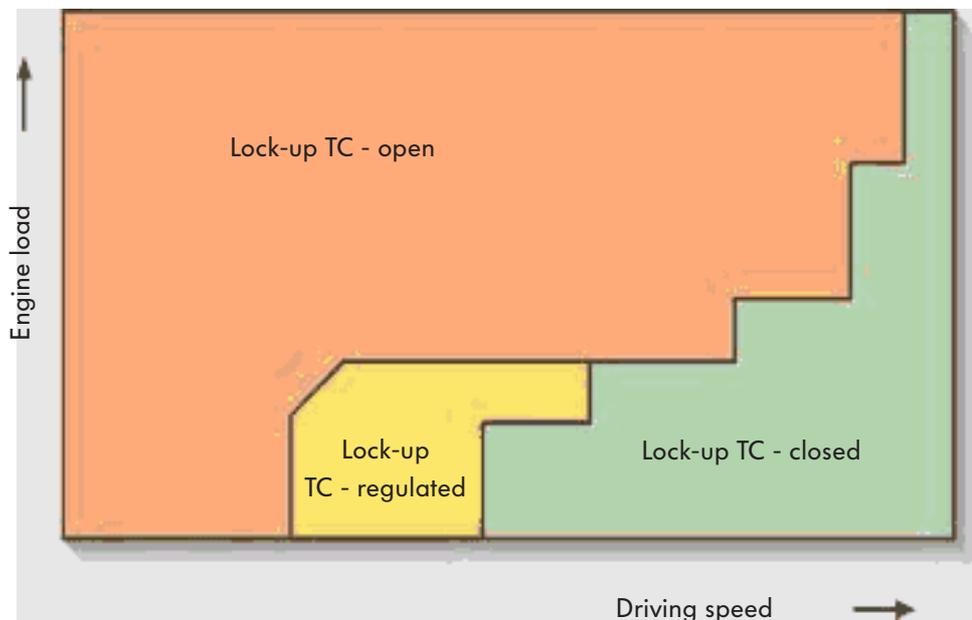
Operating ranges of lock-up torque converter

The lock-up torque converter is first regulated with slight slip depending on the gear, the engine load and the driving speed and is then closed completely.

In regulated operation, the fuel consumption is reduced compared with open mode and the driving comfort is increased compared with closed mode.



Lock-up torque converter – operating ranges in “D” (example)



S309_010

The lock-up torque converter is closed as soon as possible in Tiptronic mode and in the “S” program.

The direct positive engagement between the engine and gearbox underlines the sporty driving feel.

The lock-up torque converter is closed in 2nd gear in the hill program.

From an ATF temperature of 130 °C, the lock-up torque converter is no longer regulated, but instead closed early.

This reduces the thermal load on the ATF and allows it to cool.

Gearbox Design

ATF system/lubrication

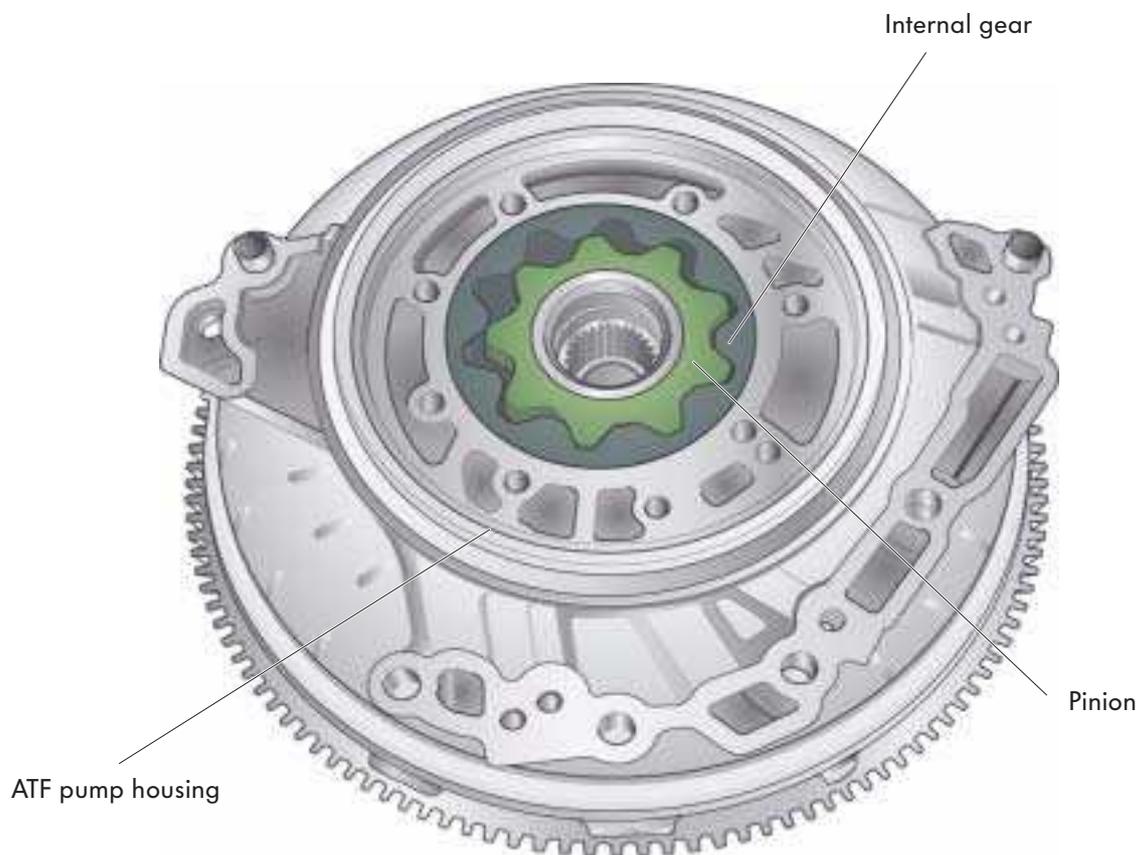
ATF (Automatic Transmission Fluid)

The high requirements regarding gearshift quality, functional safety and easy maintenance set high standards for the ATF.

The ATF has a decisive influence on the friction coefficient of the clutches and brakes.

The ATF was therefore also developed during the construction and testing of the gearbox. For this reason, you should only use ATF with the Volkswagen code G 052 025 for this gearbox. The right ATF is essential for perfect functioning of the gearbox.

The planetary gearbox, axle drive and differential share an ATF system.



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ATF pump

One of the most important components in automatic gearboxes is the ATF pump. The gearbox cannot work properly without a sufficient ATF supply.

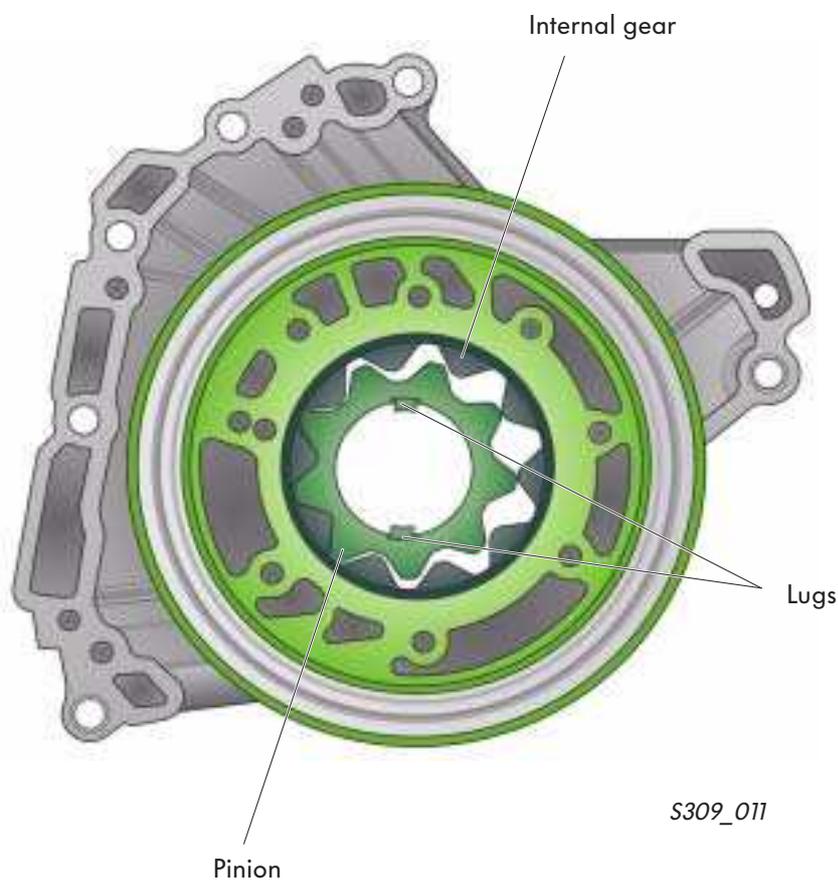
The ATF pump is an internal gear pump (duocentric pump).

The pump produces little friction and is lightweight.

It is driven directly by the engine (engine speed) via the converter housing and the converter hub. The pinion lugs fit into the two grooves of the converter hub. The converter hub mounted in the pump housing using a plain or needle bearing.



When the torque converter is assembled and before it is installed in the gearbox, it should be ensured that the ATF pump lugs fit properly into the converter hub.



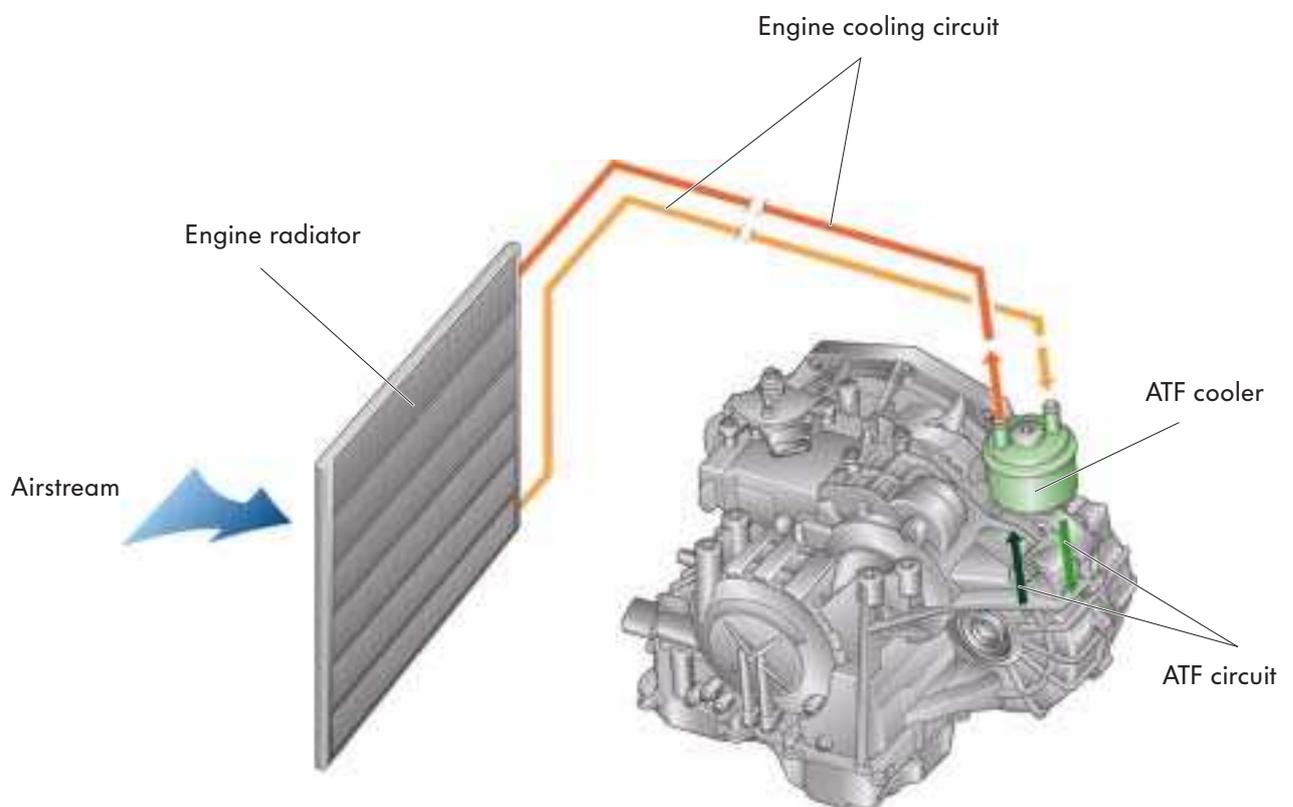
Gearbox Design

ATF cooling

The ATF is cooled by an ATF cooler that is mounted directly on the gearbox and is incorporated in the engine cooling circuit. The ATF circuit can therefore remain closed and no further ATF lines are required.



ATF cooling circuit in Golf 2004/Passat 2005 - Schematics



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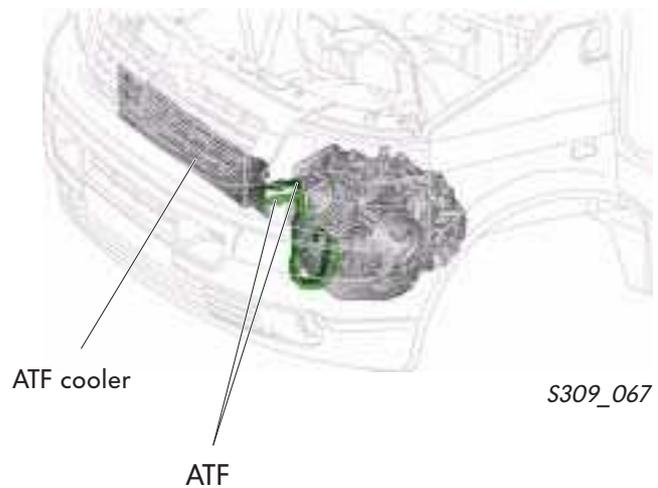
The “closed ATF system” does not need to be topped up nor does the ATF level have to be checked. There is no need to disconnect the ATF lines when the gearbox is removed or fitted.

ATF cooling circuit in Transporter 2004

In the Transporter 2004, the ATF cooler is fitted externally. The type and mounting position may differ depending on the engine.

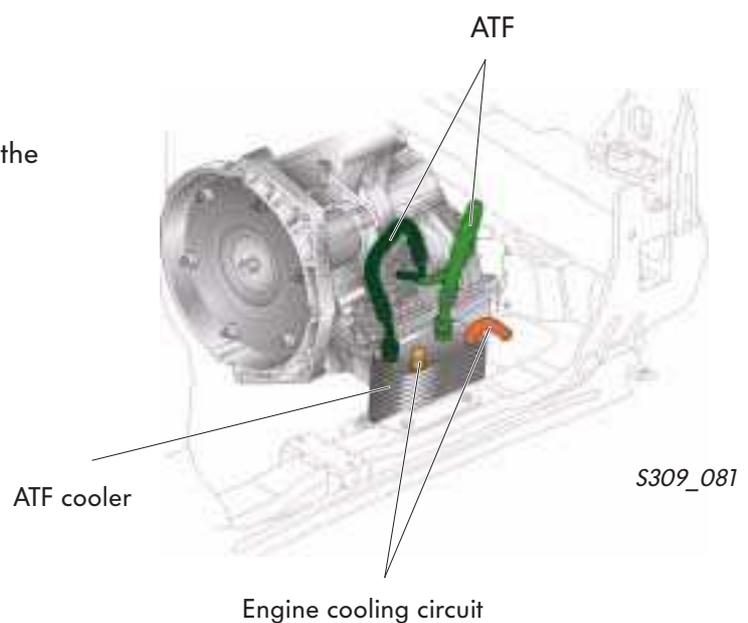
with 3.2l V6 engine

In the version with V6 engine, the ATF is cooled by an air-cooled ATF cooler, which is mounted separately in front of the engine radiator.



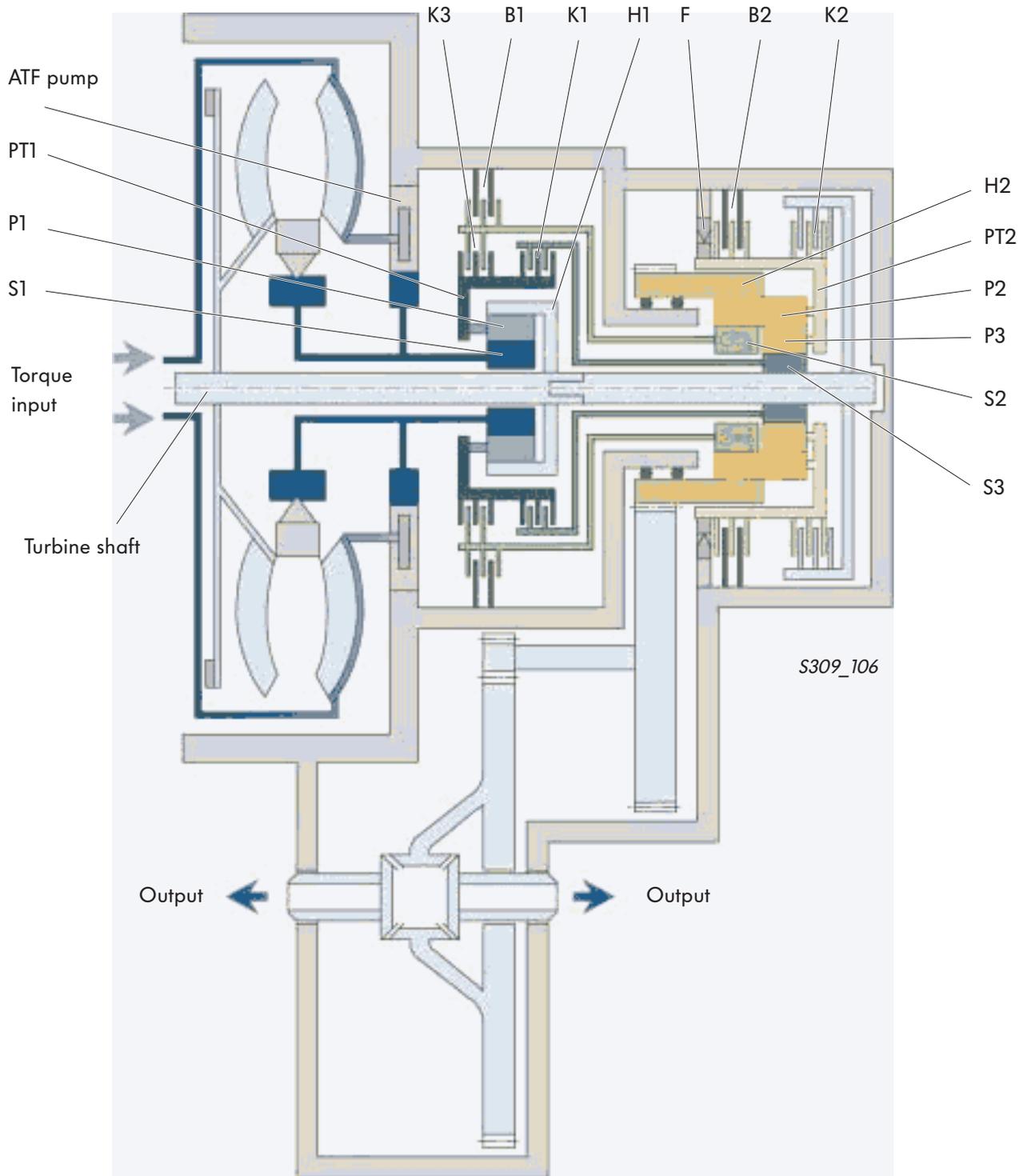
with 2.5l TDI engine

With the 2.5l TDI engine, a separate ATF cooler is installed that is incorporated in the engine cooling system.



Gearbox Design

Cross-section – Automatic gearbox



Single planetary gear set

Component:

Internal gear - H1
Planetary gears 1 - P1
Sun gear - S1
Planet carrier - PT1

Connected to:

Turbine shaft (drive)/clutch K2
Power transmission in planetary gear set
Fixed
Clutch K1/K3

Double planetary gear set

Component:

Internal gear - H2
Planetary gears long - P2
Planetary gears short - P3
Sun gear large - S2
Sun gear small - S3
Planet carrier - PT2

Connected to:

Output
Power transmission in planetary gear set
Power transmission in planetary gear set
Clutch K3/Brake B1
Clutch K1
Clutch K2/brake B2/freewheel F

Clutches, brakes, freewheel

Component:

Clutch - K1

Connected to:

Planet carrier PT1 (single planetary gear set) with the small sun gear S3 (secondary gear set)

Clutch - K2

Turbine shaft (drive) with planet carrier PT2 of the double planetary gear set

Clutch - K3

Planet carrier PT1 (single planetary gear set) with the large sun gear S2 (secondary gear set)

Brake - B1

holds the large sun gear S2 (secondary gear set) secure

Brake - B2

holds the planet carrier PT2 (secondary gear set)

Freewheel - F

holds the planet carrier PT2 (secondary gear set) secure against the drive rotation direction
used in 1st gear acceleration (no engine brake)



Gearbox Design

Parking lock

The parking lock stops the vehicle rolling when it is parked. It is mechanically operated with the selector lever via the selector lever cable, the selector shaft and a linkage with a cone and spring.

The parking lock gear is part of the driven gear wheel on the intermediate shaft. It is also used as a sender wheel for the gearbox output speed sender G195.

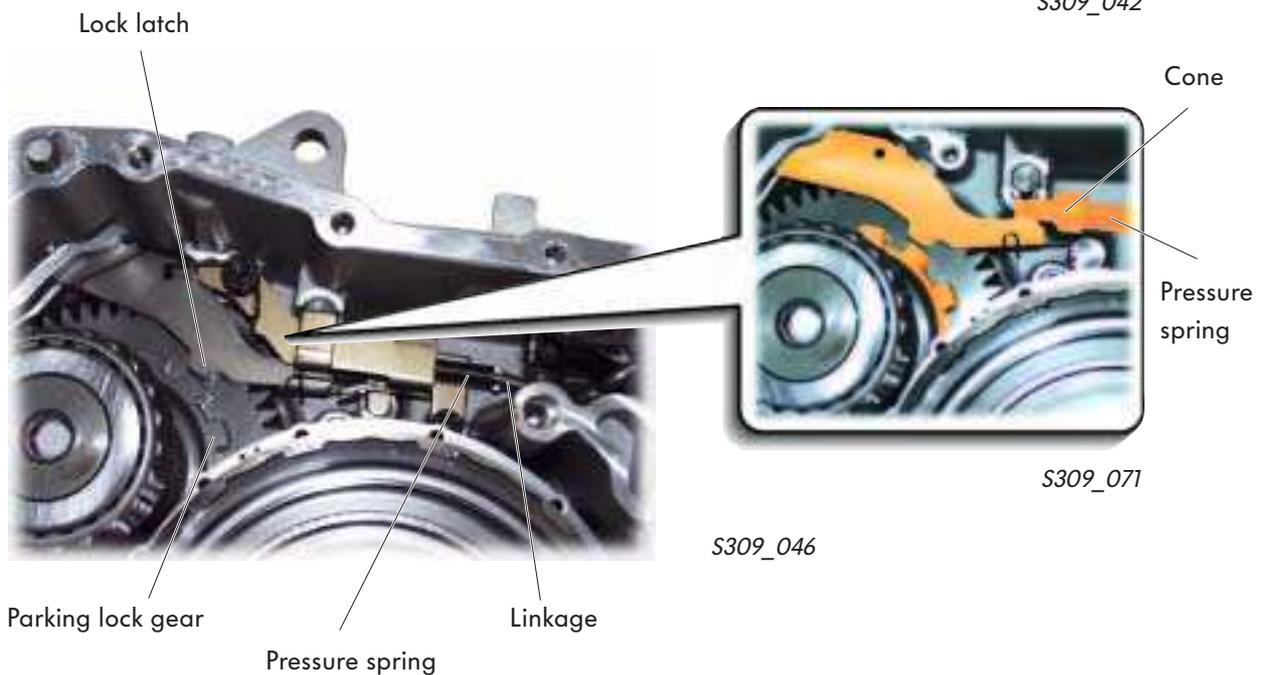
The latch that locks into the parking lock gear teeth thus blocks the axle drive. The wheels are balanced when the axle is raised on both sides.

It is therefore not possible to prevent the vehicle rolling when the front axle is raised on one side (e.g. when you change a wheel with the supplied jack). The hand brake has to be set.

To reduce wear on the selector lever cable and make the selector lever easier to use, the hand brake should be applied on steep slopes before you move the selector lever to the "P" position. This therefore prevents tension between the latch and the parking lock gear. When you drive away, you will first have to move the selector lever out of the "P" position and then release the hand brake.



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S309_071

Hydraulic Control

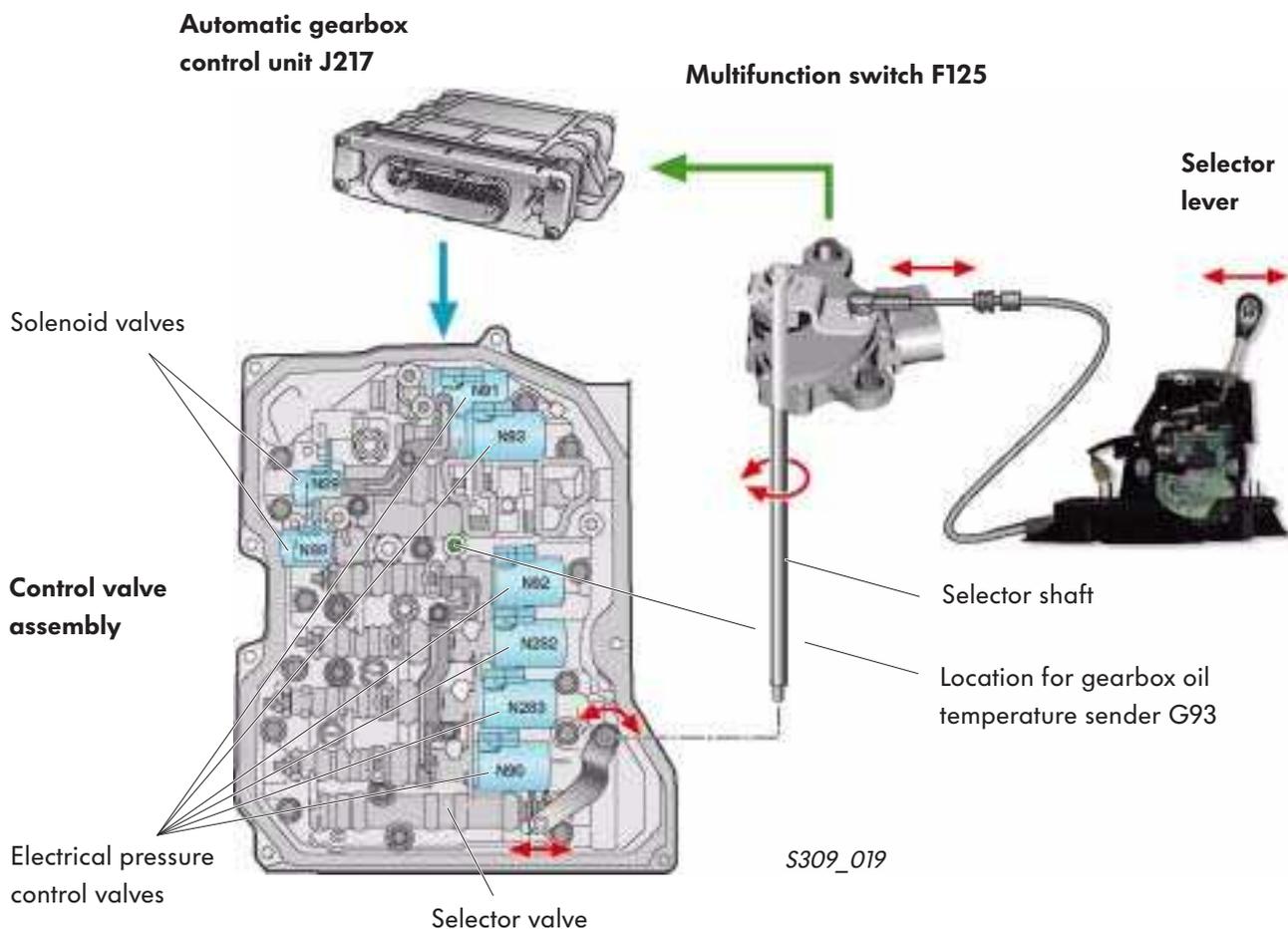
Control valve assembly

The clutches and brakes (shifting components) are controlled by the control valve assembly using hydraulic valves. These control valves are operated by solenoid valves that, in turn, are controlled by the automatic gearbox control unit.

In addition to the shifting components, the control valve assembly controls the lock-up torque converter and the ATF pressures in the gearbox (e.g. main pressure, control pressure, converter pressure and lubrication pressure).

The control valve assembly is made up of the following components:

- the mechanically operated selector valve
- the hydraulically operated solenoid valves
- six electrically operated pressure control valves
- the gearbox oil temperature sender



Gearbox Design

Solenoid Valves

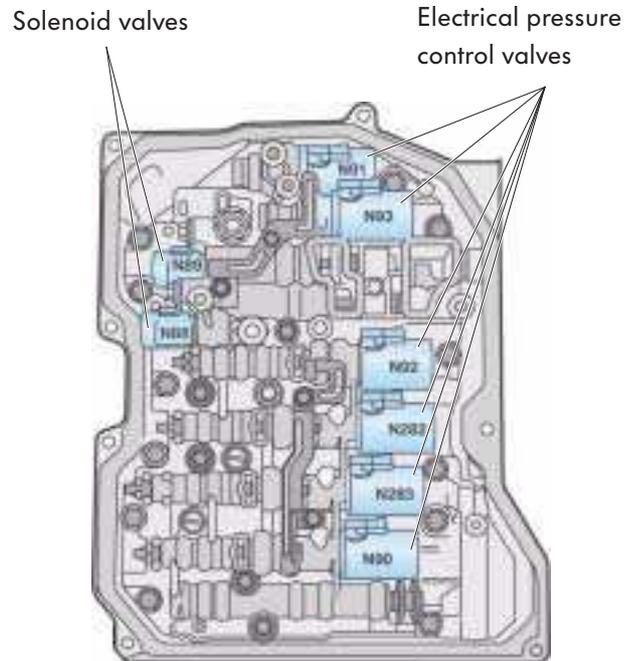
The solenoid valves can be either switching solenoid valves with two switch positions (on/off) or electrical pressure control valves (modulation valves).

The switching solenoid valves (N88/N89) are so-called on/off valves.

They control hydraulic valves with ATF pressure and open or close an ATF channel.

The electrical pressure control valves turn an electrical current into a proportional hydraulic control pressure.

Two types of pressure control valve are used.



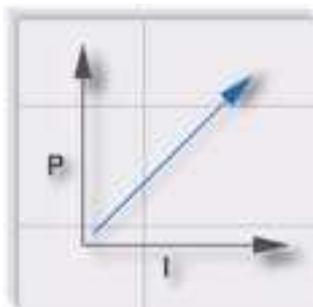
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Electrical pressure control valves

Pressure control valves with rising characteristic curve

increase the control pressure (P) as the control current rises (I)

No current – no control pressure (0 mA = 0 bar).



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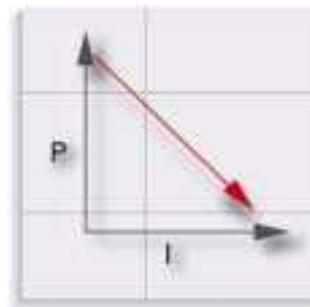
Pressure control valve with rising characteristic curve N90 and N91

Electrical pressure control valves

Pressure control valves with falling characteristic curve

reduce the pressure as the control current rises

No current – max. control pressure



S309_072

Pressure control valve with falling characteristic curve N92, N93, N282 and N283

Function assignment of solenoid valves

N90 controls the clutch K3,
 N91 controls the lock-up torque converter,
 N92 controls the clutch K1,
 N93 controls the main pressure/system pressure,
 N282 controls clutch K2 and
 N283 controls the brake B1.

Solenoid valves N88 and N89 are used to select gears 4 to 6 and are temporarily and alternately triggered (powered) during the gear changes.

The solenoid valves N88 and N89 also control the brake B2 in 1st gear – Tiptronic mode (for the engine brake).



Assignments of multi-plate clutches and brakes to gears

Gear	Component					
	K1	K2	K3	B1	B2	F
1st gear	X				*	X
2nd gear	X			X		
3rd gear	X		X			
4th gear	X	X				
5th gear		X	X			
6th gear		X		X		
Reverse			X		X	

* The “engine brake”

The braking effect caused by the engine being “pushed” in certain driving situations – like steep downhill slopes – is achieved by selecting 1st gear in Tiptronic mode.

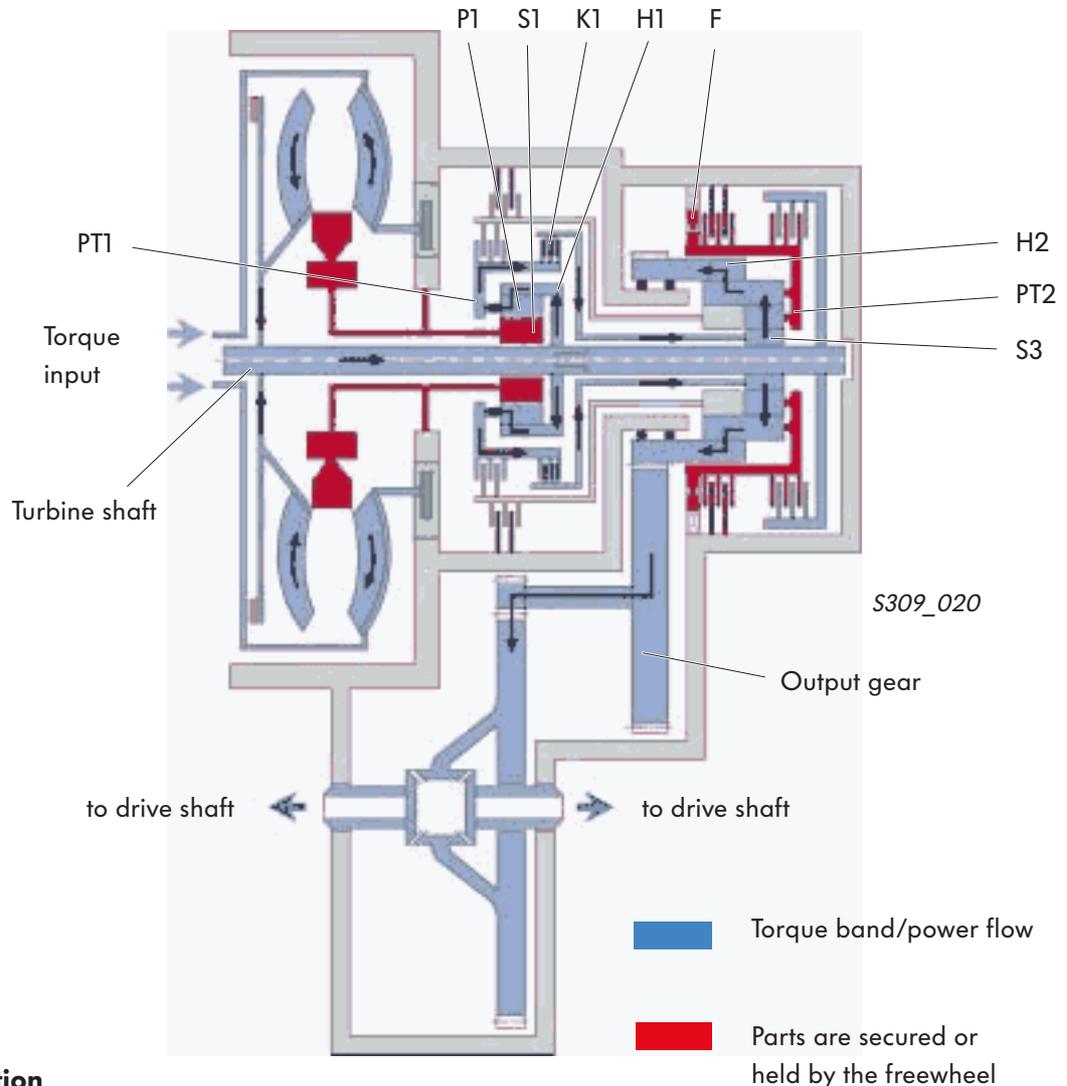
The multi-plate brake B2 is only closed in 1st gear in Tiptronic mode.

Gearbox Design

Torque Band

1st gear

Ratio 4.148
Code GSY/GJZ



Gear description

Clutch K1 - Freewheel F

The turbine shaft drives the internal gear H1 of the single planetary gear set. The internal gear drives the planetary gears P1 that mesh into the fixed sun gear S1. This drives the planetary carrier PT1.

Clutch K1 is closed. This transfers the torque to the sun gear S3 on the double planetary gear set.

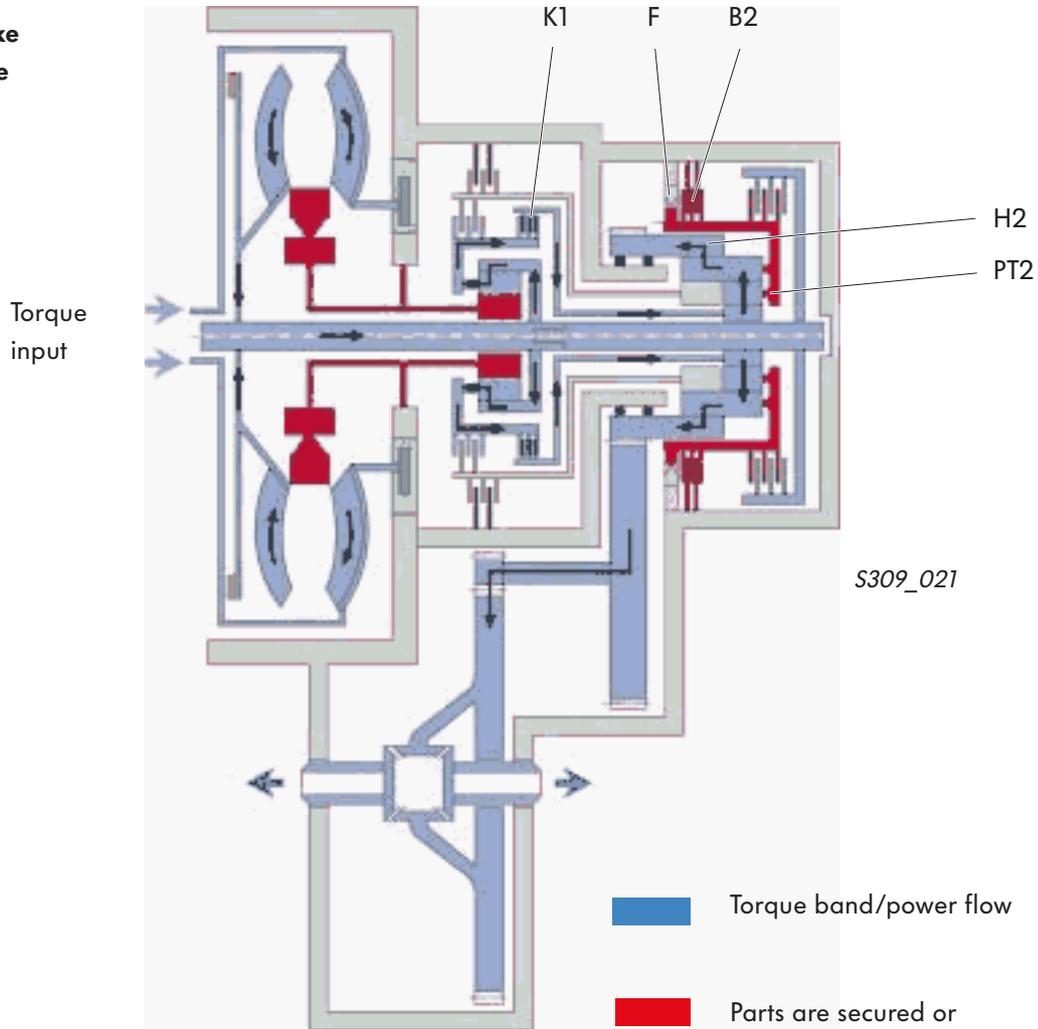
The long planetary gears transfer the torque to the internal gear H2. The internal gear is connected directly to the output gear. The planetary carrier PT2 rests on the freewheel F.

As the first gear is selected with the help of the freewheel F, the power transmission in is stopped in 1st gear pushing mode. The wheels drive in pushing mode.

The freewheel F turns against its locking direction (in freewheel direction) and the engine braking effect cannot be used.

**1st gear
with engine brake
in Tiptronic mode**

Ratio 4.148
Code GSY/GJZ



Gear description

Clutch K1 - brake B2

The engine braking effect in 1st gear can be used in special driving situations – e.g. on steep slopes – by selecting 1st gear in Tiptronic mode (brake B2 closed).

The torque band corresponds with the procedure described for 1st gear.

The engine brake effect is only possible in 1st gear when the brake B2 is closed.

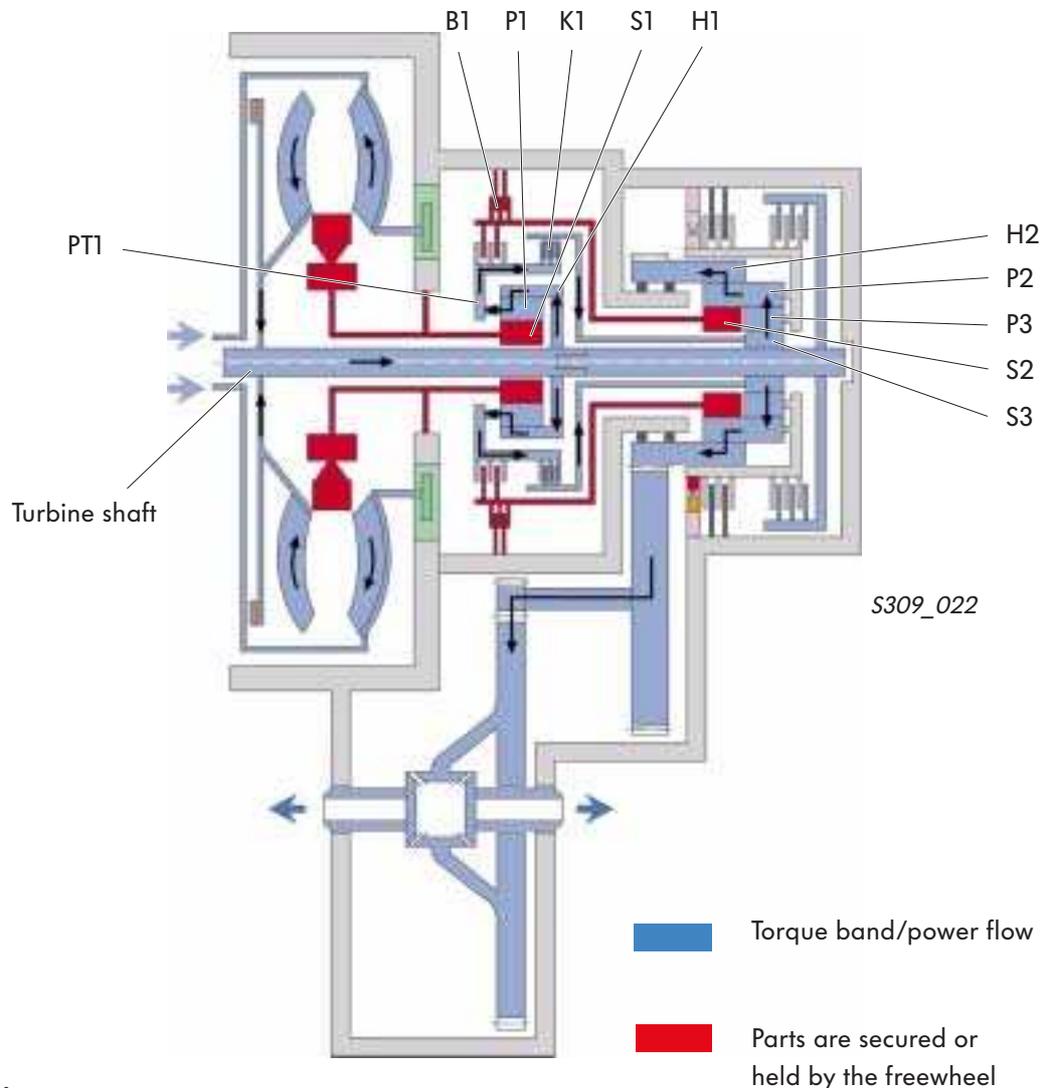
The brake B2 blocks the planetary carrier PT2 like the freewheel F. In contrast to the freewheel F, the brake B2 holds the planetary carrier PT2 in both directions. This is needed for the reverse gear and for using the engine braking effect in 1st gear.



Gearbox Design

2nd gear

Ratio 2.370
Code GSY/GJZ



Gear description

Clutch K1 - brake B1

The turbine shaft drives the internal gear H1 of the single planetary gear set. The internal gear drives the planetary gears P1 that mesh into the fixed sun gear S1. This drives the planetary carrier PT1.

The clutch K1 connects the planetary carrier PT1 with the sun gear S3 and transmits the torque to the double planetary gear set.

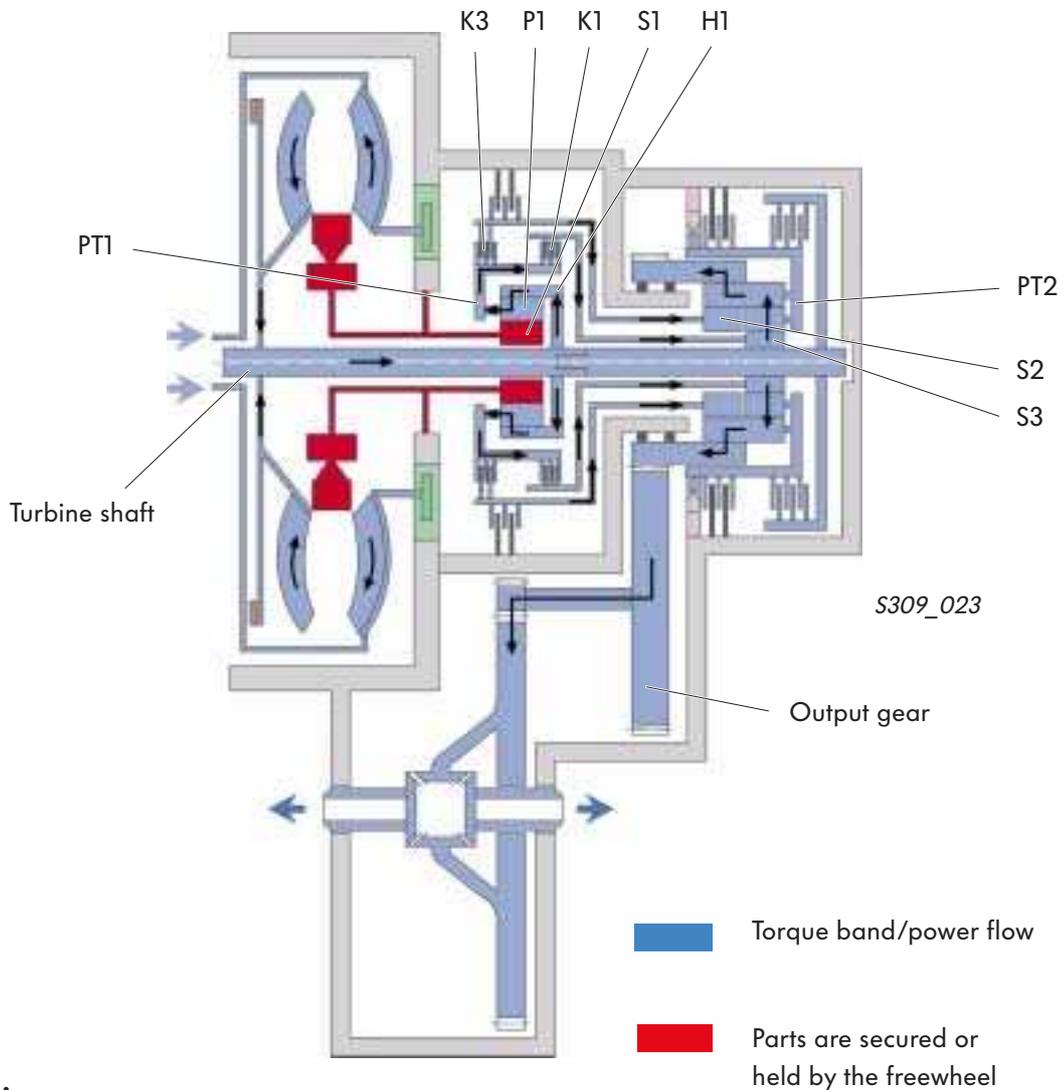
The brake B1 blocks the large sun gear S2. The torque is transmitted from sun gear S3 to the short planetary gears P3 and from there to the long planetary gears P2.

The long planetary gears P2 roll on the fixed sun gear S2 and drive the internal gear H2.

3rd gear

Ratio 1.556

Code GSY/GJZ



Gear description

Clutch K1 - clutch K3

The turbine shaft drives the internal gear H1 of the single planetary gear set. The internal gear drives the planetary gears P1 that mesh into the fixed sun gear S1. This drives the planetary carrier PT1.

The clutch K1 connects the planetary carrier PT1 with the sun gear S3 and transmits the torque to the double planetary gear set.

The clutch K3 also transmits the torque from the double planetary gear set to the sun wheel S2. Closing the two clutches K1 and K3, blocks the double planetary gear set. The torque is now transferred directly from the planetary gear set to the output gear.

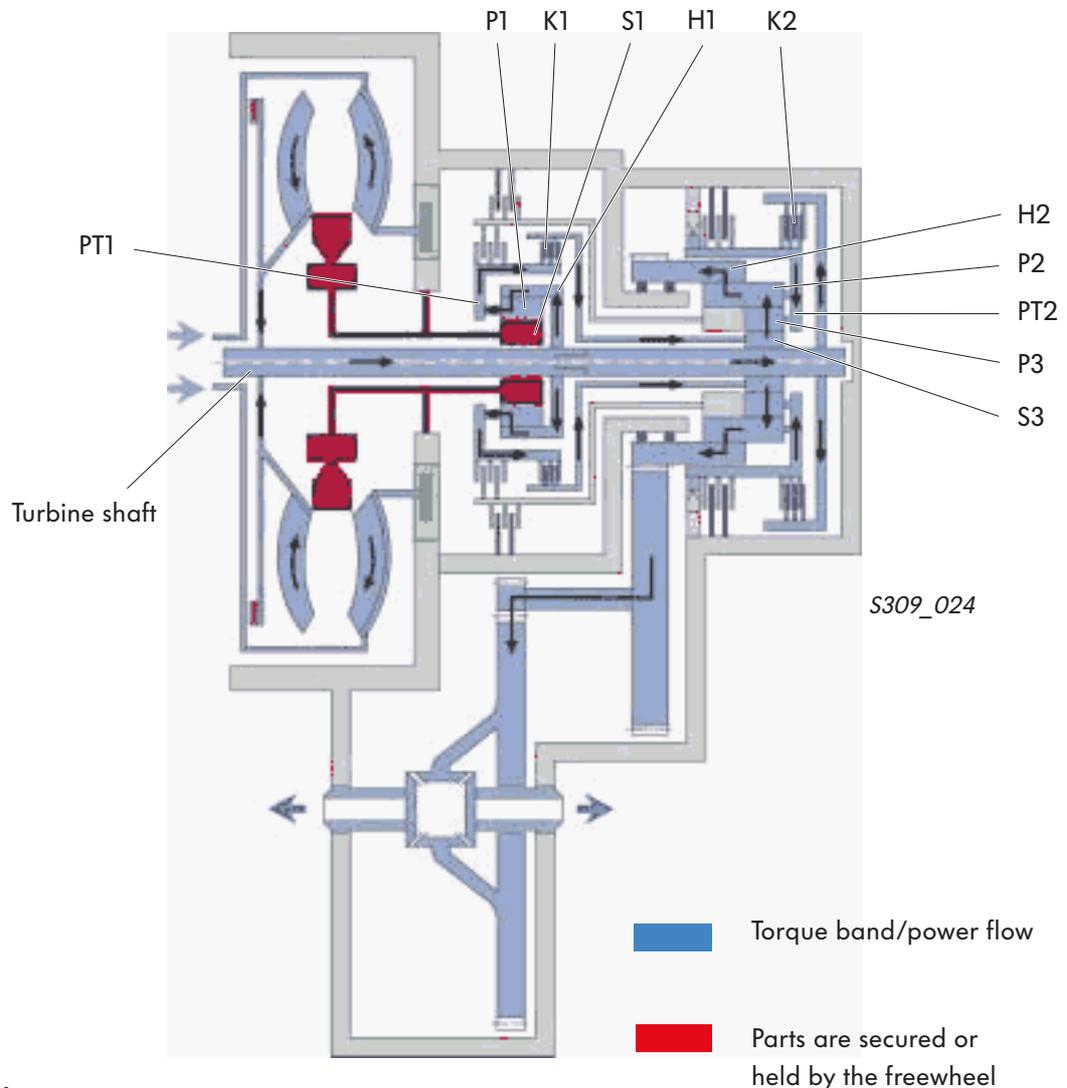


Gearbox Design

4 th gear

Ratio 1.155

Code GSY/GJZ



Gear description

Clutch K1 - clutch K2

The turbine shaft drives the internal gear H1 of the single planetary gear set and the outer disk carrier of clutch K2.

The internal gear drives the planetary gears P1 that mesh into the fixed sun gear S1. This drives the planetary carrier PT1.

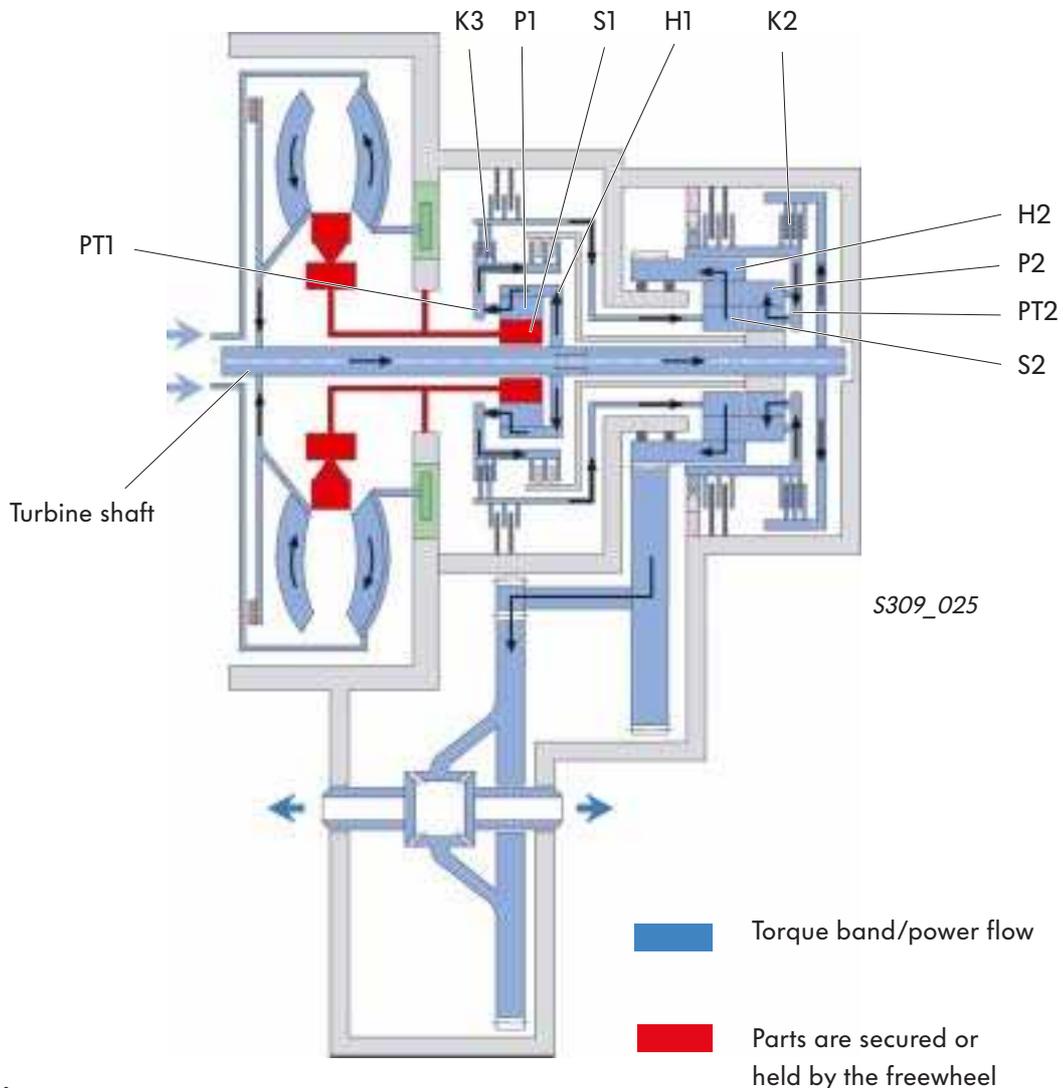
The clutch K1 connects the planetary carrier PT1 with the sun gear S3 and transmits the torque to the double planetary gear set. The clutch K2 connects the turbine shaft to the planetary carrier PT2 and also transmits the torque to the double planetary gear set.

The long planetary gears P2, which mesh with the short planetary gears P3, drive the internal gear H2 with the planetary carrier PT2.

5th gear

Ratio 0.859

Code GSY/GJZ



Gear description

Clutch K2 - clutch K3

The turbine shaft drives the internal gear H1 of the single planetary gear set and the outer disk carrier of clutch K2.

The internal gear drives the planetary gears P1 that mesh into the fixed sun gear S1. This drives the planetary carrier PT1.

The clutch K3 connects the planetary carrier PT1 with the sun gear S2 and transmits the torque to the double planetary gear set.

The clutch K2 connects the turbine shaft to the planetary carrier on the double planetary gear set and also transmits the torque to the double planetary gear set.

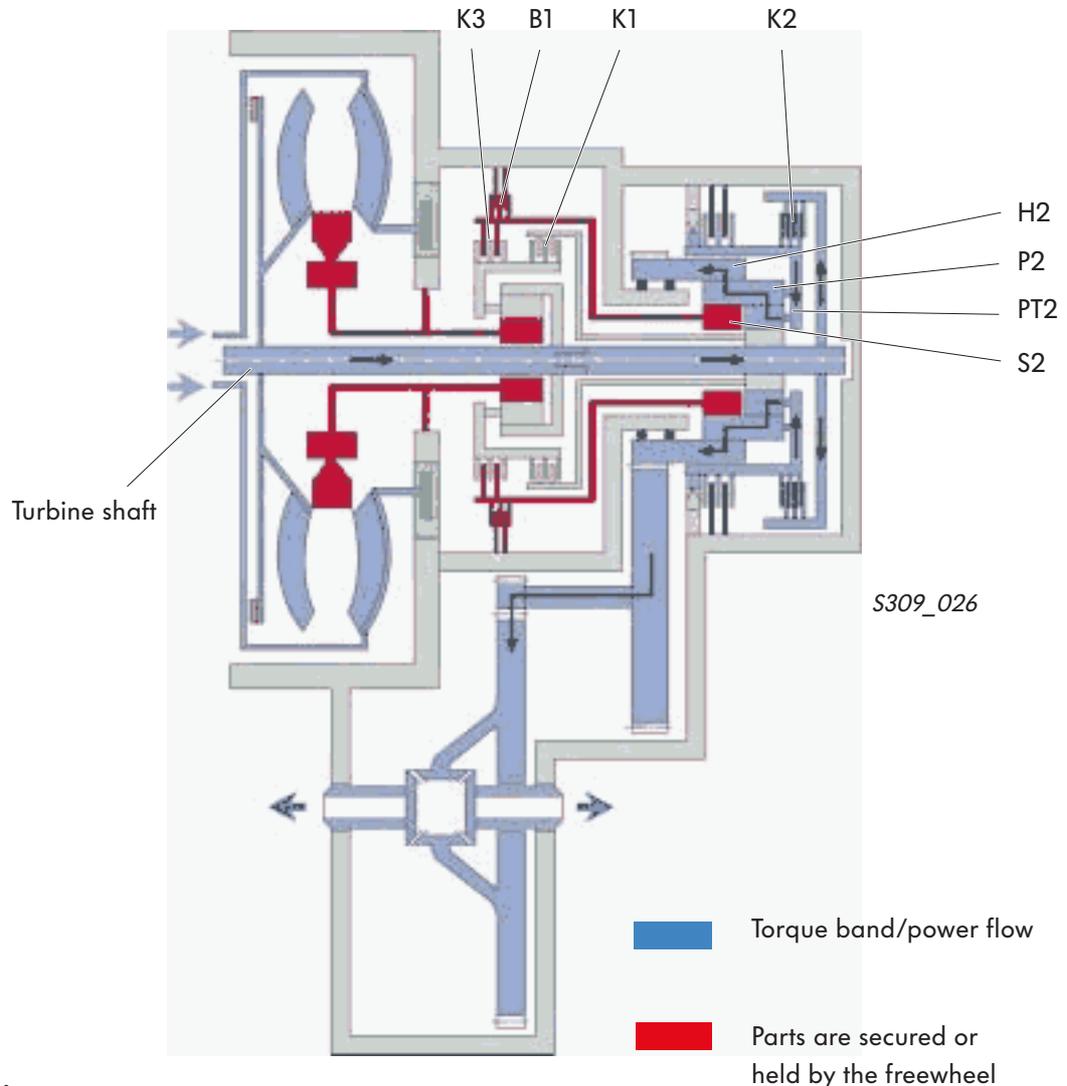
The long planetary gears P2 drive the internal gear H2 with the planetary carrier PT2 and the sun gear S2.



Gearbox Design

6th gear

Ratio 0.686
Code GSY/GJZ



Gear description

Clutch K2 - brake B1

The brake B1 blocks the sun gear S2.

The clutch K2 connects the turbine shaft to the planetary carrier on the double planetary gear set and transmits the torque to the double planetary gear set.

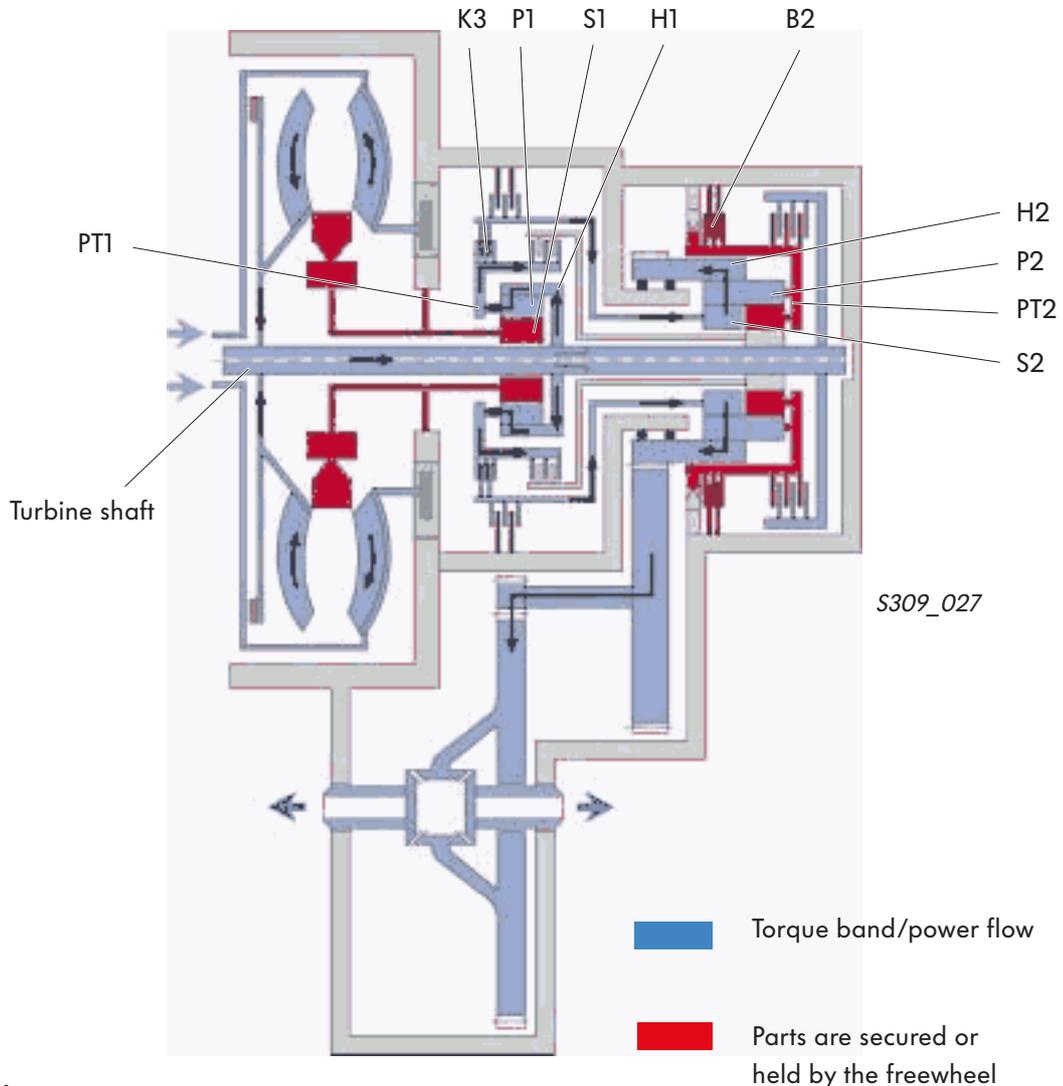
The long planetary gears P2 mesh into the fixed sun gear S2 and drive the internal gear H2.

The clutches K1 and K3 are opened. The planetary gear set is not involved in the power transmission.

Reverse

Ratio 3.394

Code GSY/GJZ



Gear description

Clutch K3 - brake B2

The turbine shaft drives the internal gear H1 of the single planetary gear set. The internal gear drives the planetary gears P1 that mesh into the fixed sun gear S1. This drives the planetary carrier PT1.

The clutch K3 connects the planetary carrier PT1 with the sun gear S2 and transmits the torque to the double planetary gear set.

In the double planetary gear set, the brake B2 blocks the planetary carrier PT2. The torque is transferred from the sun gear S2 to the long planetary gears P2.

Held by the planetary carrier PT2, the torque is transferred to the internal gear H2, which is connected to the output shaft.

The internal gear is driven against the engine rotation direction.



System Overview

Using the Golf 2004 as an example

Sensors

Gearbox input speed sender G182

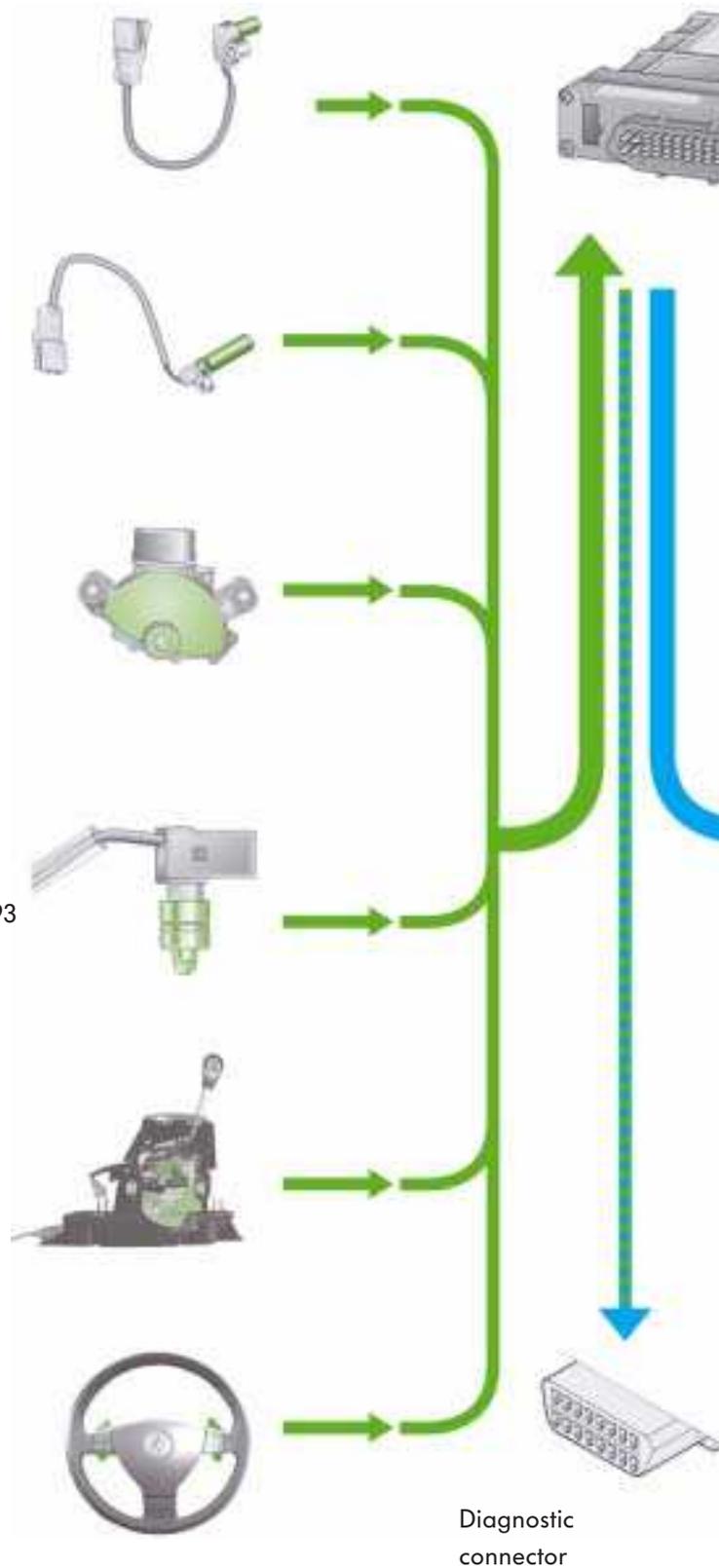
Gearbox output speed sender G195

Multifunction switch F125

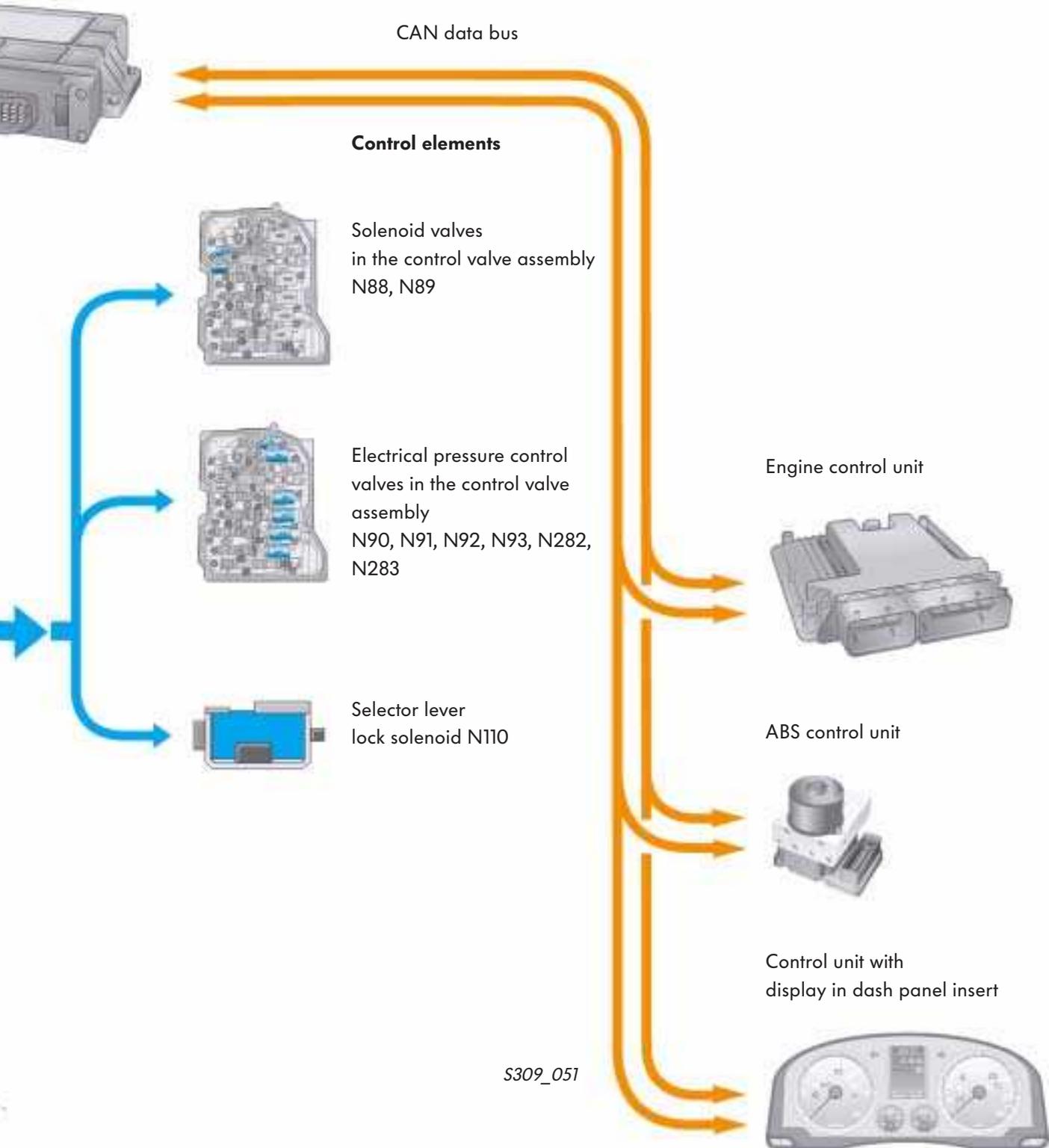
Gearbox oil temperature sender G93

Tiptronic switch F189

Tiptronic switch in steering wheel E438 and E439



Automatic gearbox control unit J217



Gearbox control

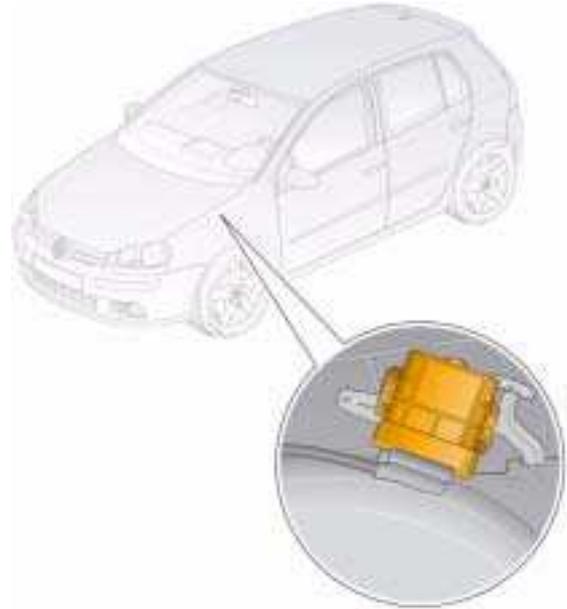
Automatic gearbox control unit J217

A 52-pole connector is used for the connection between the vehicle and the control unit. The VAS adapter cable 1598/48 is available for static and dynamic measurements in the system.

The control unit is produced by ASIN AW Japan.

The updates can be programmed with the VAS 5051.

Location in Golf 2004 under the front left wheel housing



S309_094

Automatic gearbox control unit J217



S309_028

Location in Transporter 2004 in the E-box behind the left headlight



S309_096

Dynamic Shift Program DSP

This automatic gearbox uses the latest generation of the DSP dynamic shift program.

The driving condition, for example, the driving resistance (e.g. hill), the route profile (e.g. curve) and the driver type (driving style) are evaluated.

The basic parameters for calculating the gear selection have essentially not changed compared with previous automatic gearboxes. Since the gearbox control unit is been networked with an increasing number of vehicle systems (for example, the engine, ESP and steering angle sender), a larger amount of information is available to determine the current driving conditions and the driving style in more detail.



“S” Sport program

When the selector lever is set to “S”, the driver is provided with a performance-based shifting program.

If the electronic control unit contains the “S” selector lever position information, the gear change curves are shifted to higher engine speeds. This leads to an increase in the driving dynamics.

In “S” position, the DSP also ensures adaptation to the driver (driver type assessment) and driving situations.

The “S” program has the following special features:

- If the selector lever is set to “S” during driving with a constant accelerator position, the gearbox will shift down a gear.
- To achieve a more direct driving reaction to the accelerator movements, the lock-up torque converter is closed.

If 6th gear is configured as an E gear in the overall gearbox ratio, only gears 1 to 5 will be used.

Gearbox Control

Emergency Mode

If faults/malfunctions occur that lead to mechanical emergency mode, only the 3rd gear will be selected for driving ranges that normally use gears 1 to 3.

If the gearbox is already in 4th, 5th or 6th gear, the current gear will be kept until you move the selector lever to the neutral position or turn off the engine.

The next time you pull away or start the engine, the 3rd gear will be selected in the “D” or “S” position.



Reserve gear is available (the R gear lock is not active).



S309_039

The maximum system pressure is controlled, maximum switching pressure is applied to the shifting components. There are hard jolts when the gear is selected.

The lock-up torque converter remains open.

Towing

When the vehicle is towed, the ATF pump is not driven so the rotating components are not lubricated.

To avoid serious damage to the gearbox, the following conditions must be observed:

- The selector lever must be in the “N” position.
- The towing speed may not exceed 50 km/h.
- The vehicle may not be towed further than 50 km.

If the battery has been disconnected or is flat, you will have to use the selector lever emergency release to move the selector from “P” to “N” in the Golf or Touran.

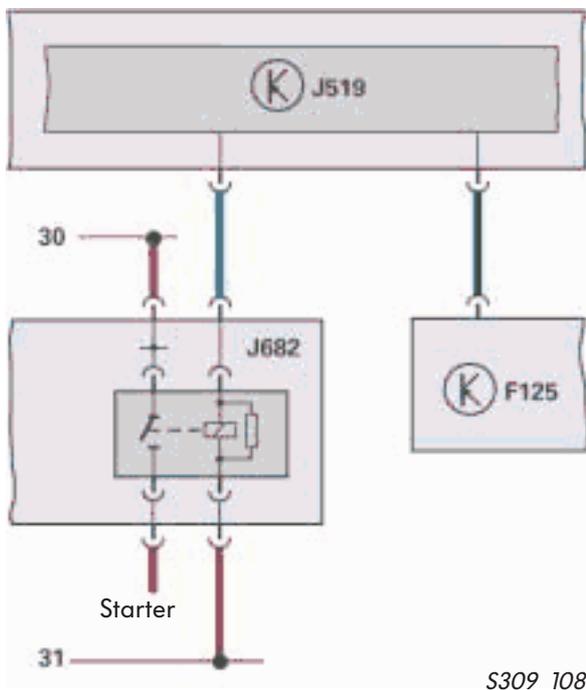
Starter Inhibitor, Reversing Light

The starter inhibitor (control of terminal 50 for starter) and the reversing light control functions are controlled by the onboard supply control unit J519. The starter inhibitor prevents the engine being started when the selector lever is in a gear position.

Engine Start - Golf 2004

When the selector lever is in the “P” or “N” positions, the onboard supply control unit receives a signal from the multifunction switch F125.

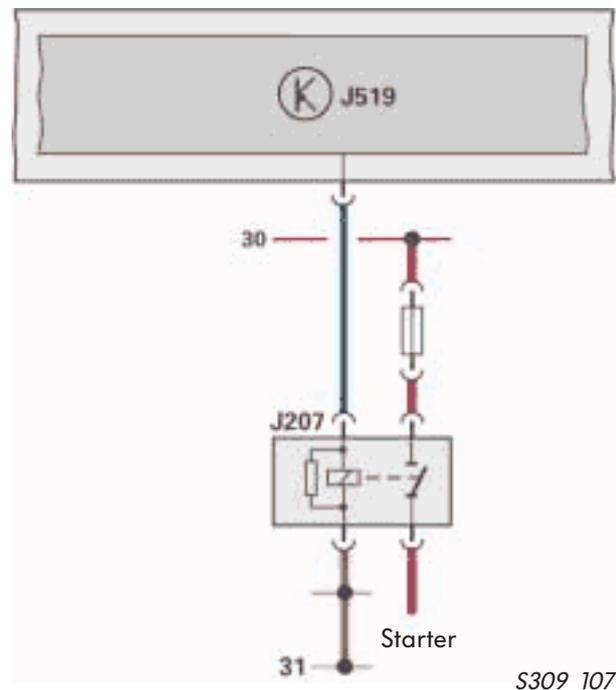
After the signal, the onboard supply control unit activates the voltage supply relay terminal 50 J682. The relay closes and supplies voltage to terminal 50 of the starter.



S309_108

Engine Start - Transporter 2004

In the Transporter 2004, the onboard supply control unit triggers the starter inhibitor relay J207 in the selector lever positions “P” And “N”. The starter inhibitor relay supplies power to terminal 50 of the starter.



S309_107

Reversing light

The information “reverse gear” is first transferred from the multifunction switch F125 to the automatic gearbox control unit J217. The automatic gearbox control unit J217 sets this information on the CAN drive. Using the data bus diagnostic interface J533, the information is sent to the onboard supply control unit J519 that activates the reversing lights via CAN convenience.



Gearbox Control

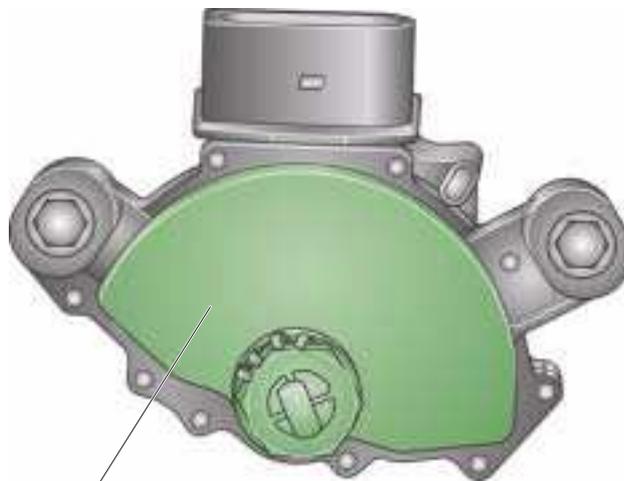
Sensors

Multifunction switch F125

The multifunction switch is connected to the selector lever via the selector lever cable. It converts the mechanical movement of the selector lever into electrical signals and forwards them to the automatic gearbox control unit J217.



S309_075

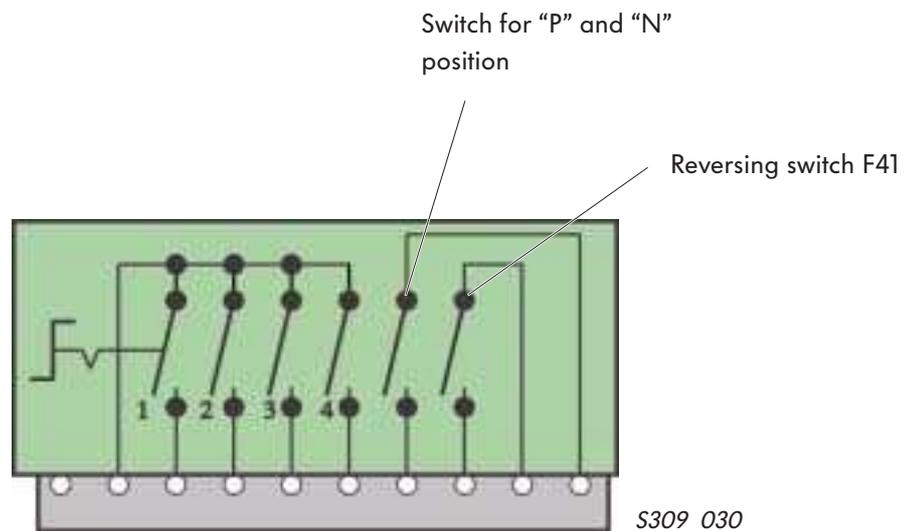


S309_029

Multifunction switch F125

The multifunction switch is a mechanical multiple switch with 6 sliding contacts:

- 4 switches for selector value position
- 1 switch for “P” and “N” position for start control
- 1 reversing switch F41



Signal use

The control unit initiates the automatic shifting programs depending on the position of the multifunction switch and controls the following functions:

- Starter inhibitor
- Reversing lights
- Selector lever lock P/N

The control unit sets the current selector lever position on the CAN BUS so other control units can use it.

Effects of signal failure

As long as you can distinguish between forward and reverse gears, there is no effect on the shifting programs.

If the reverse gear signal is faulty, the gearbox will switch to emergency mode.



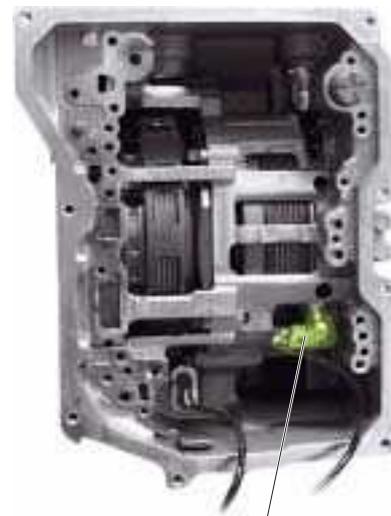
The multi-function switch needs to be set if

- it has been replaced.
- a new gearbox has been installed.
- the gearshift indicator in dash panel insert is not working properly.

Gearbox Control

Gearbox input speed sender G182

The G182 measures the gearbox input speed on the outside plate carrier of clutch K2. It works according to the Hall principle.



Signal use

The electronic gearbox control requires the exact input speed for the following functions:

- Control, adaptation and monitoring of the gear changes
- Regulation and monitoring of the lock-up torque converter
- Diagnosis of the shifting components and evaluation of engine speed and gearbox output speed

Effects of signal failure

The lock-up torque converter is closed without slippage. The engine speed is used as a substitute speed.

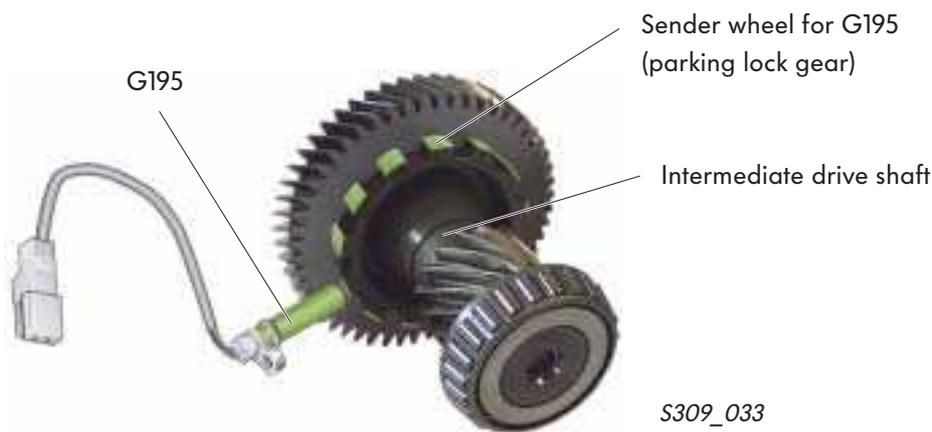
Gearbox output speed sender G195

The G195 measures the gearbox output speed on the parking lock gear. It works according to the Hall principle.

The parking lock gear is part of the driven gear wheel on the intermediate shaft. Due to the ratio between the output planetary gearbox and intermediate shaft, both speeds have a particular relationship. The control unit calculates the actual gearbox output speed using the programmed speed ratio.



S309_098



S309_033

Signal use

One of the most important signals for the electronic gearbox control is the gearbox output speed. It has a defined relationship to the vehicle speed and is needed for the following functions:

- Selection of the shift points
- DSP dynamic shift program (e.g. driving condition assessment)
- Diagnosis of the shifting components and evaluation of engine and turbine speed

Effects of signal failure

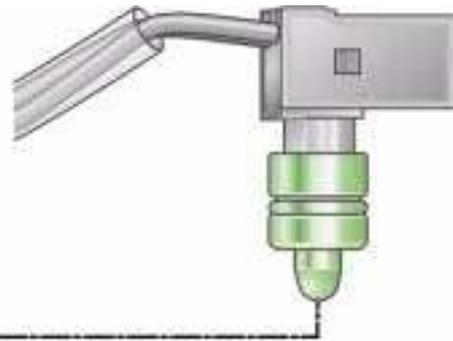
The speed signal of the ABS control unit is used as a substitute speed.

Gearbox Control

Gearbox oil temperature sender G93

The gearbox oil temperature sender G93 is located inside the control valve assembly in the ATF. It measures the ATF temperature and signals it to the gearbox control unit.

The G93 is in the control valve assembly and is secured with a mounting plate. It is part of the wiring harness and works as an NTC resistor. (NTC - Negative Temperature Coefficient)



S309_053

Signal use

The ATF temperature is required for the following functions:

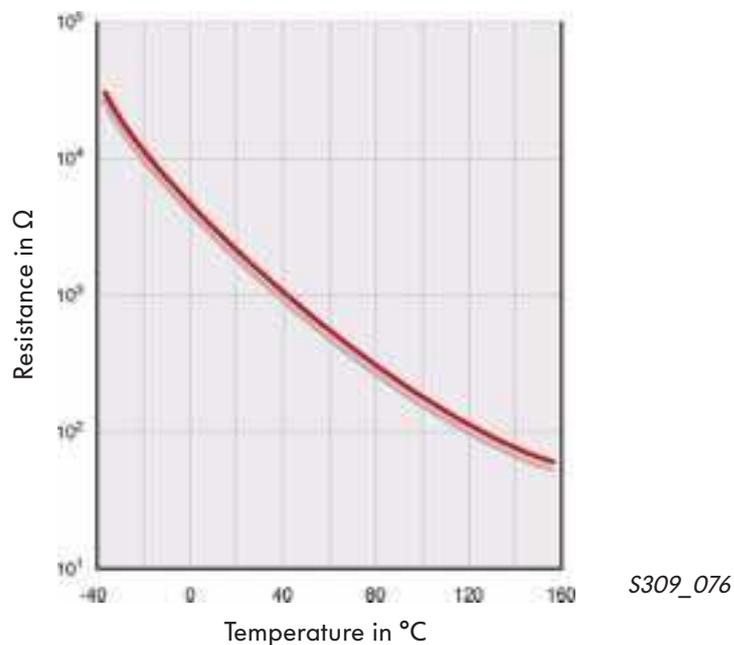
- to adjust the shift pressures (system pressure) as well as the pressure build-up and reduction during gearshifts
- to activate or deactivate temperature-dependent functions (warm-up program, lock-up torque converter etc.)
- for activating gearbox protection measures if the ATF temperature is too high (hot mode)

Effects of signal failure

- A substitute value is formed from the engine temperature and the operating time.
- no lock-up torque converter regulated mode (only open or closed)
- no adaptation of the shifting pressure (which normally leads to harder shifts)

G93 NTC resistor characteristic curve

The electrical resistance falls as the temperature rises.



Gearbox measures

To avoid gearbox overheating, countermeasures are taken when defined ATF temperatures are exceeded:

Countermeasure 1 (approx. 127 $^{\circ}\text{C}$):

The shifting curves are adjusted to higher engine speeds using the DSP function.
The lock-up torque converter is closed earlier and is no longer regulated.

Countermeasure 2 (approx. 150 $^{\circ}\text{C}$):

The engine torque is reduced.

Gearbox Control

Tiptronic switch F189

The Tiptronic switch is located in the circuit board on the selector lever.

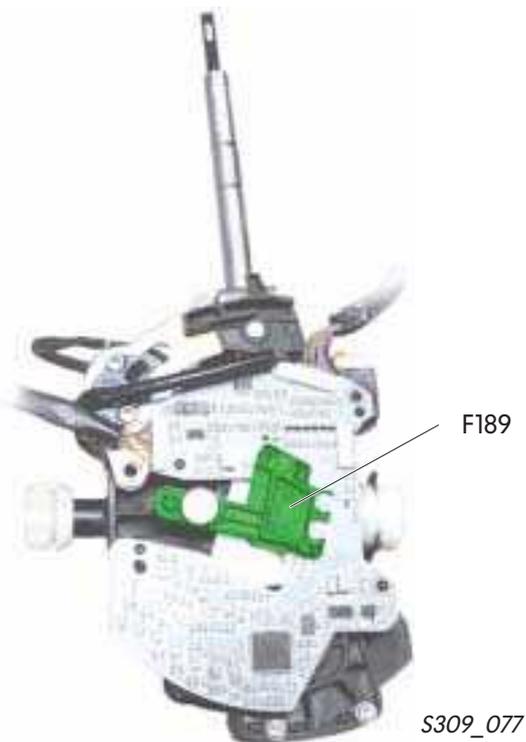
The selector lever positions

- Selector lever in the Tiptronic gate,
- Tip + and
- Tip -

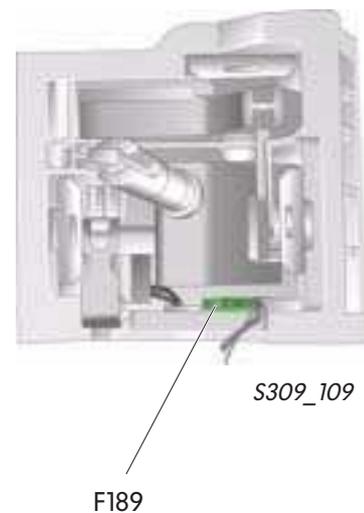
are recognised by Hall sensors (Golf 2004/Touran) or micro switches (Transporter 2004). The signals are sent to the gearbox control unit via an analogue cable.



In the Golf 2004



In the Transporter 2004



Signal use

After the signal is received from the Tiptronic switch, the control unit shifts a gear up or down accordingly.

Effects of signal failure

If the switch fails or a cable is faulty, Tiptronic mode can no longer be used.

Tiptronic switch F438 and F439

The switches are to the right and left of the steering wheel. You can shift up and down by pressing the switches.

The shift signals go directly to the automatic gearbox control unit.

Signal use

In Tiptronic mode, you can also change gear with these switches.

If you press the Tiptronic switches on the steering wheel in automatic mode, the gearbox control unit will switch to Tiptronic mode.

If you do not press the Tiptronic switches on the steering wheel, the gearbox control unit will automatically return to automatic mode after a set time*.

Effects of signal failure

If the signal fails, you will not be able to use the Tiptronic functions with the steering wheel switches.

Tiptronic shifting strategy

- automatic shift up when maximum speed reached
- automatic shift down when speed falls below minimum speed
- kick-down gear change
- start in 2nd gear by selecting 2nd gear before pulling away
- prevention of shift up or shift down

* Timer



S309_048



Gearbox Control

Accelerator position sender G79 and Accelerator position sender 2 G185

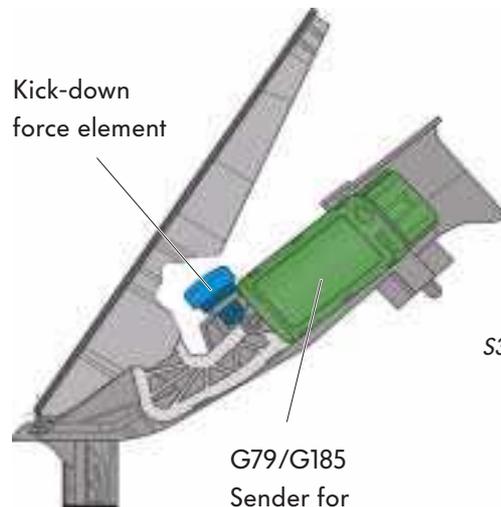
The senders are in a accelerator module on the pedal cluster.

Kick-down information

A separate switch is not used for the kick-down information. There is a force element on the accelerator pedal instead of a stop (as used in manual cars). The force element provides a “mechanical pressure point” that conveys the kick-down feel to the driver. When the driver uses the kick-down, the full-load voltage value of the accelerator position senders G79 and G185 is exceeded.

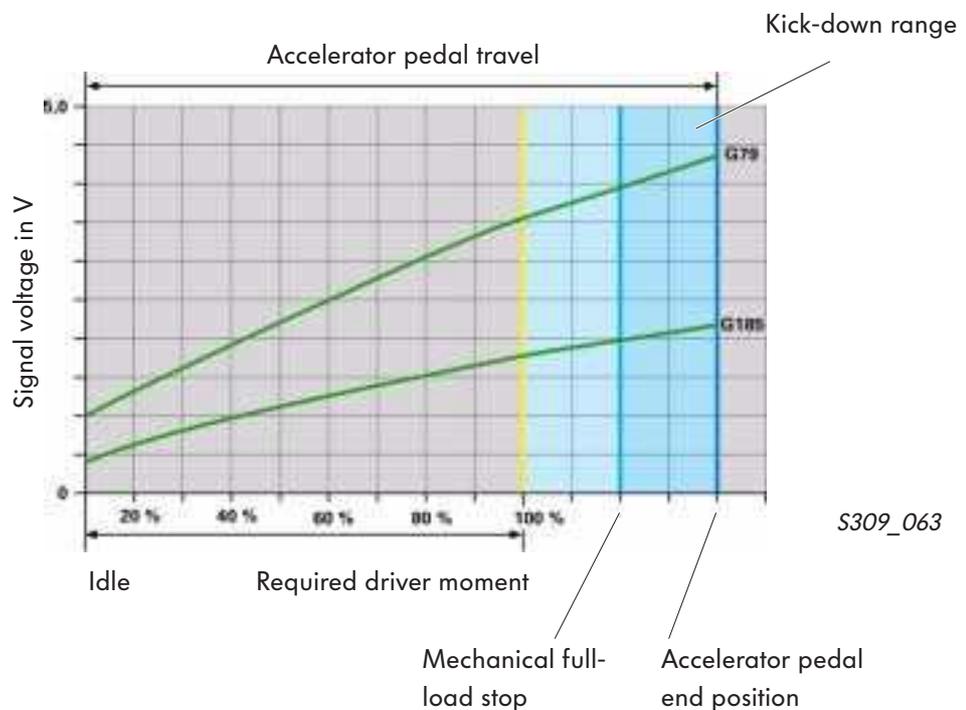
If a defined voltage value is reached in the engine control unit, this is interpreted as a kick-down by the engine control unit and is sent to the gearbox control unit via CAN drive. The kick-down shift point can only be tested using a diagnosis tester.

Accelerator pedal



S309_038

G79/G185
Sender for
accelerator position



S309_063



Two accelerator position senders are used for reasons of safety.

Control elements

Solenoid valves are used as electrohydraulic shifting components in the electronically controlled automatic gearbox. There are switching solenoid valves (on/off valves) and electrical pressure control valves (called modulator valves).

Solenoid valves

Solenoid valve 1 - N88

The solenoid valve works as an on/off solenoid valve and opens or closes an ATF channel.

When the solenoid valve is open, the gears 4 to 6 can be selected.

The solenoid valve also improves the shift transfer from 5th to 6th gear. The solenoid valve closed when no power is supplied.

Effect of signal or control element failure

Gears 4 to 6 can no longer be selected.

Solenoid valve 2 - N89

The solenoid valve works as an on/off solenoid valve and opens or closes an ATF channel.

When the solenoid valves opens, the ATF pressure on the lock-up torque converter is increased.

When the solenoid valves N88 and N89 are opened at the same time, the brake B2 closes and, in Tiptronic 1st gear mode, the “engine brake” is active.

The valve is closed when no power is supplied.

Effects of signal failure

If the signal to the solenoid valve N89 fails, the maximum ATF pressure can no longer be applied to the lock-up torque converter. You cannot drive with the “engine brake”.

Control valve assembly



S309_054



Gearbox Control

Electrical pressure control valves

Solenoid valve 3 - N90

The solenoid valve controls the ATF pressure on the multi-plate clutch K1.

The solenoid valve is closed when no power is supplied.

In this switching state, the maximum ATF pressure is applied to the clutch.

Effects of signal failure

If the solenoid valve is faulty or cannot be activated, the gearshifts from gears 1 to 4 may be harder.



S309_056

Solenoid 4 - N91

The solenoid valve controls the ATF pressure on the lock-up torque converter.

When no power is supplied to the solenoid valve N91, the lock-up torque converter is open.

Effects of signal failure

The lock-up torque converter is not closed.



S309_057



Solenoid valve 5 - N92

The solenoid valve controls the ATF pressure on the multi-plate clutch K3.

The solenoid valve is closed when no power is supplied.

In this switching state, the maximum ATF pressure is applied to the clutch.

Effects of signal failure

If the solenoid valve is faulty or there is an error in the electrical circuit, the gears 3, 5 and R can be hard to shift.



S309_058



Solenoid valve 6 - N93

The solenoid valve regulates the ATF main pressure in the gearbox depending on the engine torque.

The solenoid valve closes when there is no power and the gearbox works with maximum ATF pressure.

Effects of signal failure

When the solenoid valve is faulty or there is a fault in the circuit, all gear shifts could be harder.



S309_059

Gearbox Control

Solenoid valve 9 - N282

The solenoid valve controls the ATF pressure on the multi-plate clutch K2.

The solenoid valve is closed when no power is supplied.

In this state, the clutch is closed with maximum pressure.

Effects of signal failure

When the solenoid valve is faulty or there is a fault in the circuit, shifts between gears 4 to 6 could be harder.



S309_060

Solenoid valve 10 - N283

The solenoid valve controls the ATF pressure on the multi-plate brake B1.

The solenoid valve closes depending on the current applied.

The brake is closed with maximum ATF pressure.

Effects of signal failure

If the solenoid valve is faulty or there is an error in the electrical circuit, the gears 2 and 6 can be hard to shift.



S309_061

Selector lever lock solenoid N110

The magnet is in the selector level base.

It is an electromagnet and stop the selector lever being moved from the “P” and “N” positions when the ignition is switched on.

You need to press pedal before you move the selector lever from these positions.

Golf/Touran

The selector lever is locked in the “P” position and in the “N” position when power is supplied to the magnets.

Effects of signal failure

The selector lever is locked when there power supply fails.

The emergency release needs to be used.

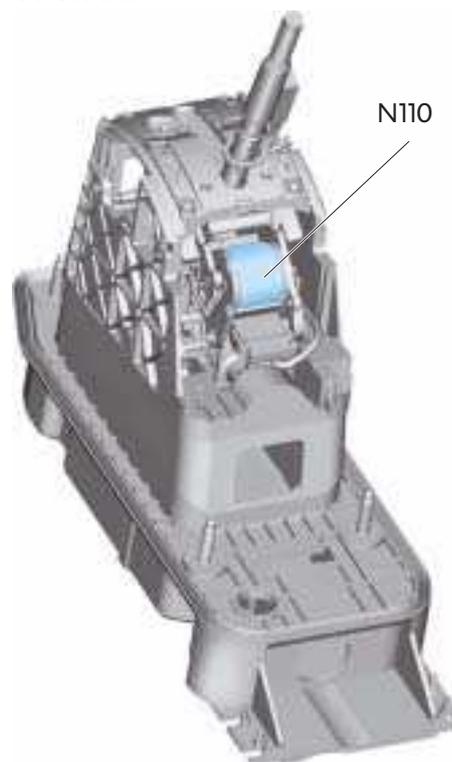
Transporter 2004

The selector lever is locked in the “P” and “N” position when the magnets are powered.

Effects of signal failure

If the power fails, the selector lever can be moved without you pressing the brake.

Selector lever base



S309_006

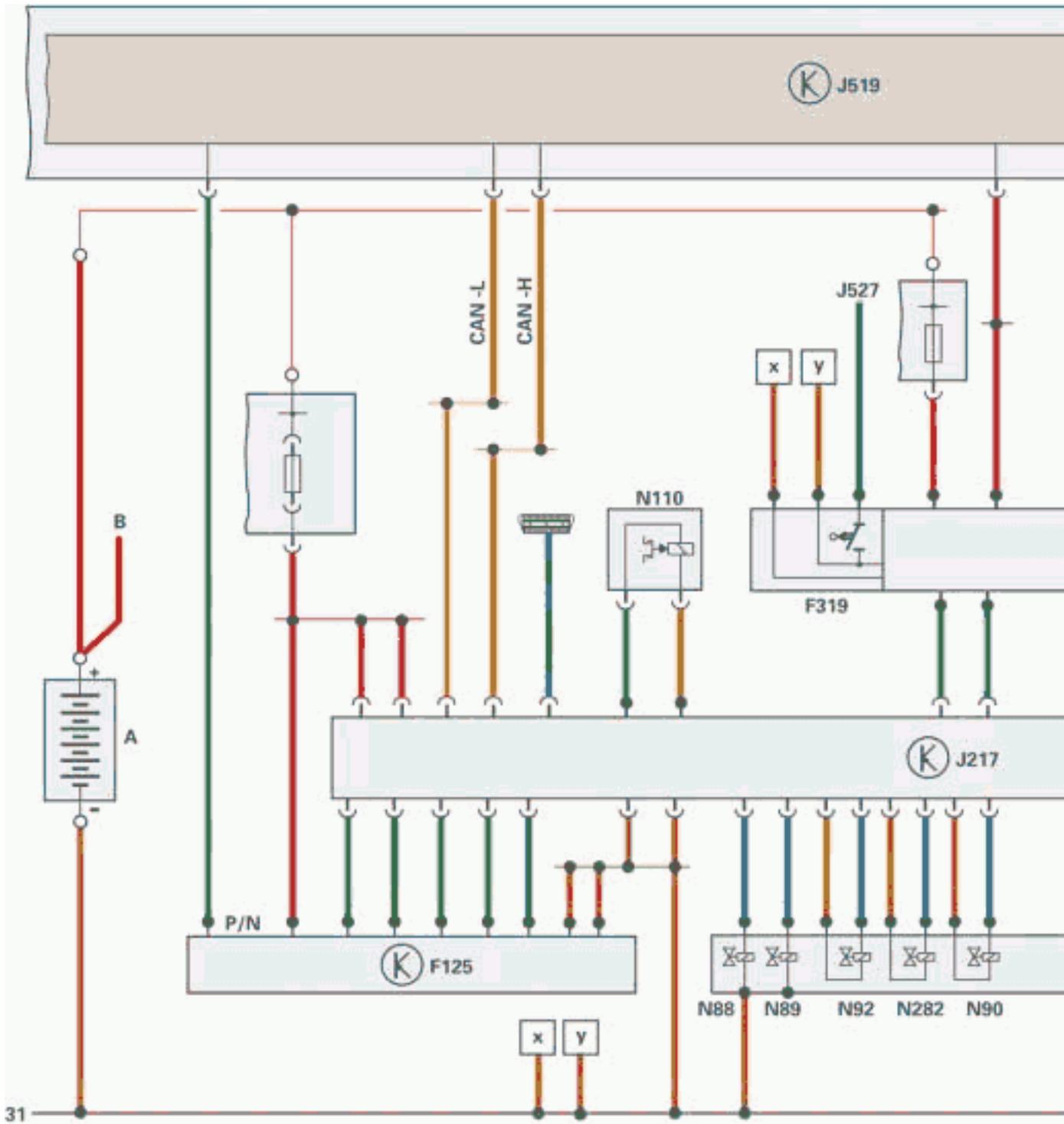


You will find further information on the design and function in self-study programme 308.

Gearbox Control

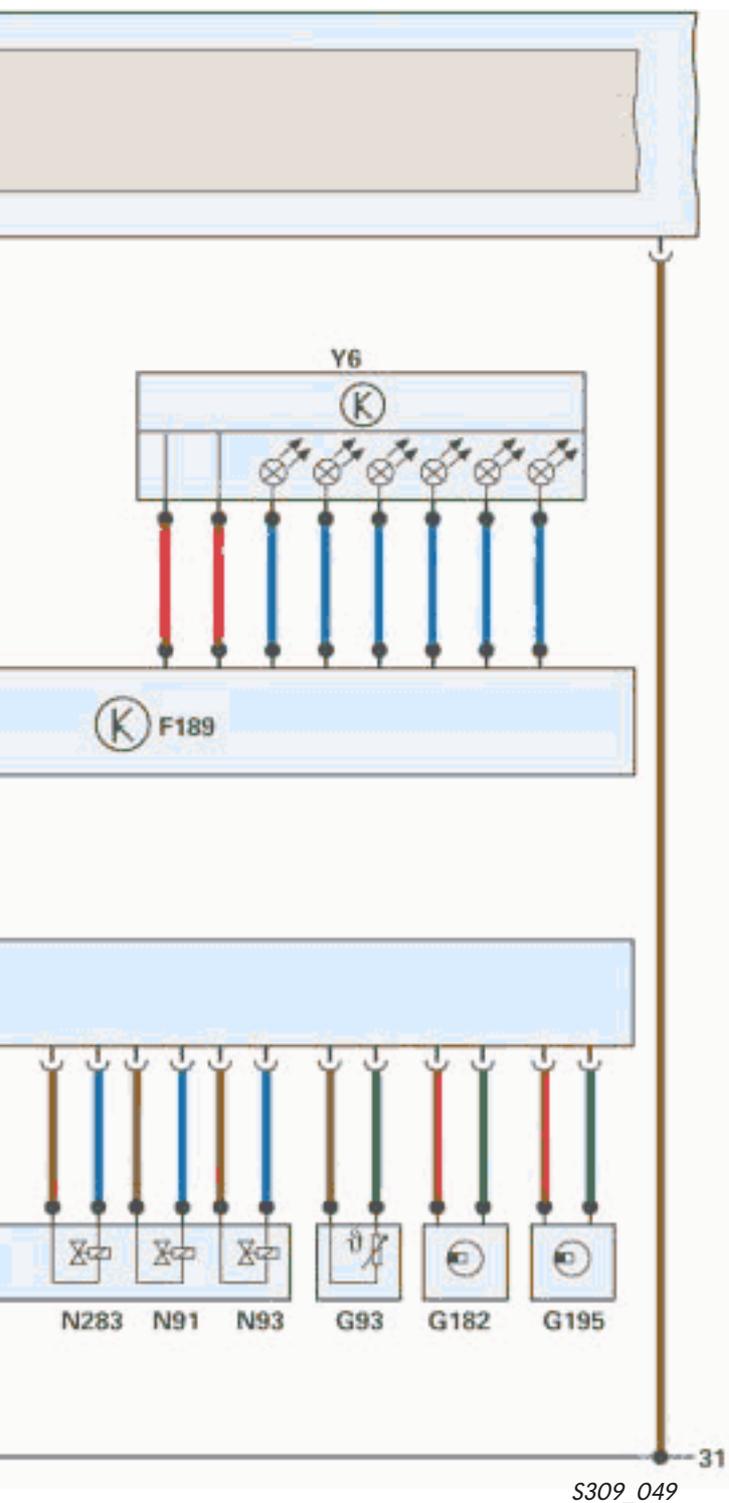
Functional Diagram

Using the Golf 2004 as an example



Colour code/legend

- | | | | |
|--|------------------|---------------------------------------|----------------|
| █ | = input | █ | = positive |
| █ | = output signal | █ | = earth |
| █ | = bi-directional | █ | = CAN data bus |



Diagnosis connector

Components

- | | |
|------|--|
| A | Battery |
| B | Starter |
| F125 | Multifunction switch |
| F189 | Tiptronic switch |
| F319 | Selector lever locked in position "P" switch |
| G93 | Gearbox oil temperature sender |
| G182 | Gearbox input speed sender |
| G195 | Gearbox output speed sender |
| J217 | Automatic gearbox control unit |
| J519 | Onboard supply control unit |
| J527 | Steering column electronics control unit |
| N88 | Solenoid valve 1 |
| N89 | Solenoid valve 2 |
| N90 | Solenoid valve 3 |
| N91 | Solenoid valve 4 |
| N92 | Solenoid valve 5 |
| N93 | Solenoid valve 6 |
| N110 | Selector lever lock solenoid |
| N282 | Solenoid valve 9 |
| N283 | Solenoid valve 10 |
| Y6 | Selector lever position display |

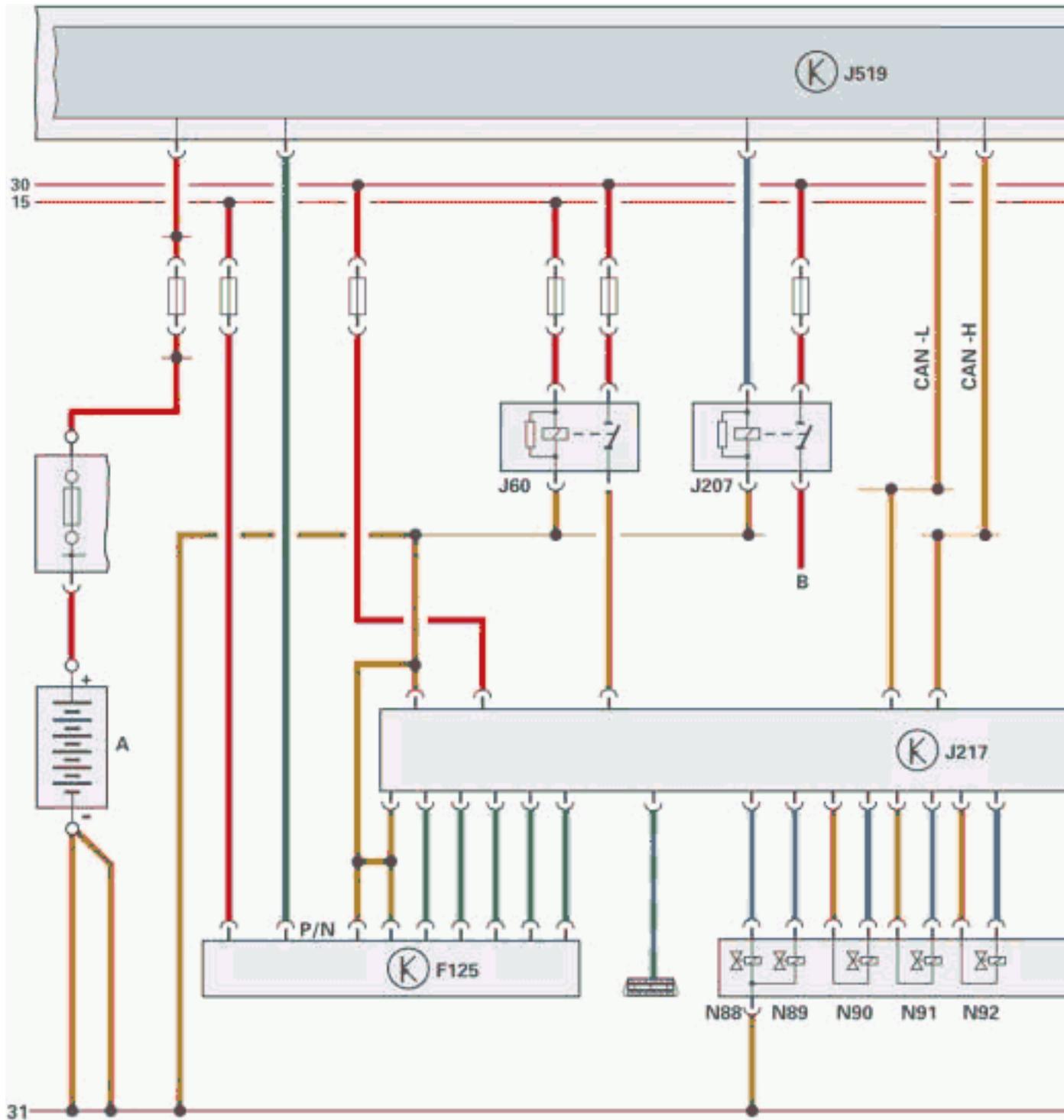


Other signals

- | | |
|-------|-------------------|
| CAN-H | CAN data bus high |
| CAN-L | CAN data bus low |

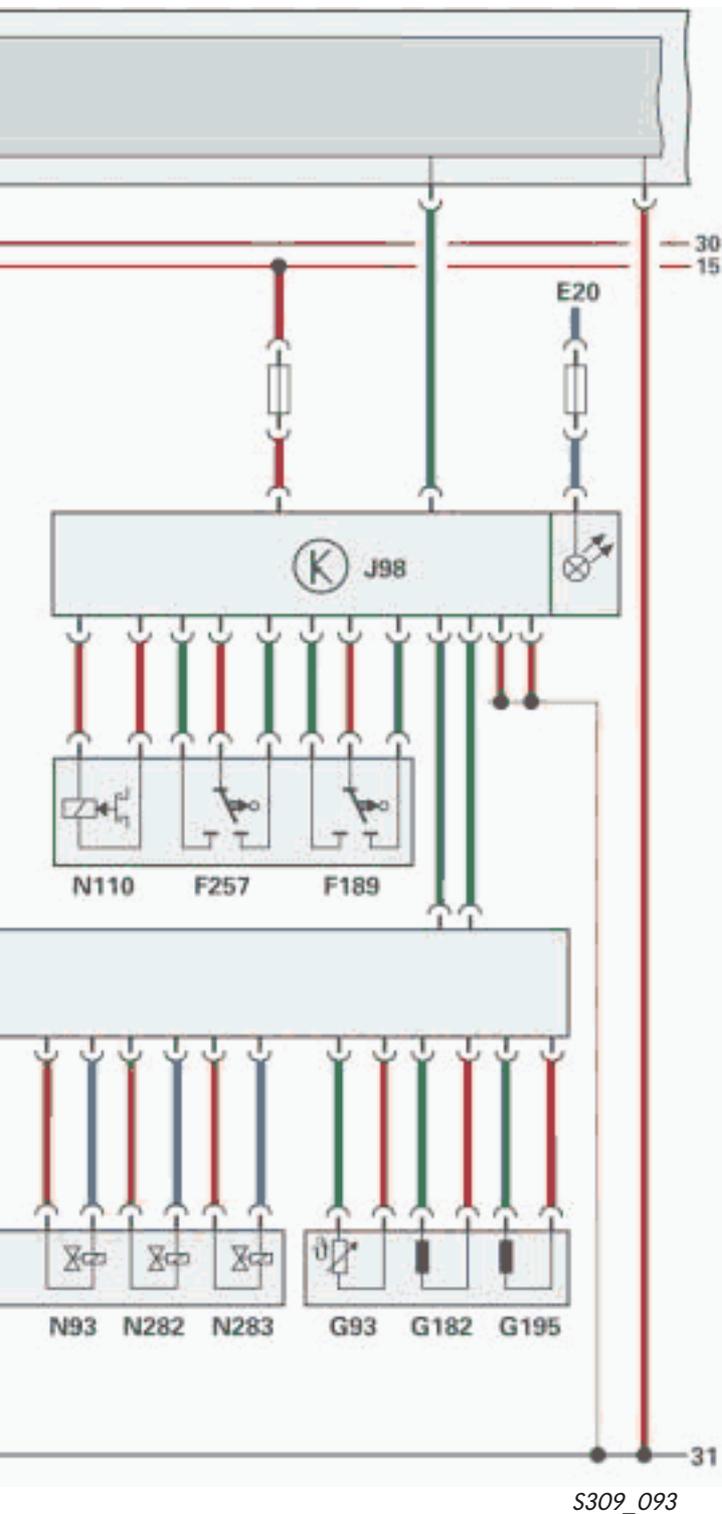
Gearbox Control

Using the Transporter 2004 as an example



Colour code/legend

- | | | | |
|--|------------------|---------------------------------------|----------------|
| █ | = input | █ | = positive |
| █ | = output signal | █ | = earth |
| █ | = bi-directional | █ | = CAN data bus |



Components

A	Battery
B	Starter
E20	Switches and instruments illumination regulator
F125	Multifunction switch
F189	Tiptronic switch
F257	Selector lever gate detector switch
G93	Gearbox oil temperature sender
G182	Gearbox input speed sender
G195	Gearbox output speed sender
J60	Automatic gearbox relay
J98	Gearshift indicator control unit
J207	Starter inhibitor relay
J217	Automatic gearbox control unit
J519	Onboard supply control unit
N88	Solenoid valve 1
N89	Solenoid valve 2
N90	Solenoid valve 3
N91	Solenoid valve 4
N92	Solenoid valve 5
N93	Solenoid valve 6
N110	Selector lever lock solenoid
N282	Solenoid valve 9
N283	Solenoid valve 10



Diagnosis connector

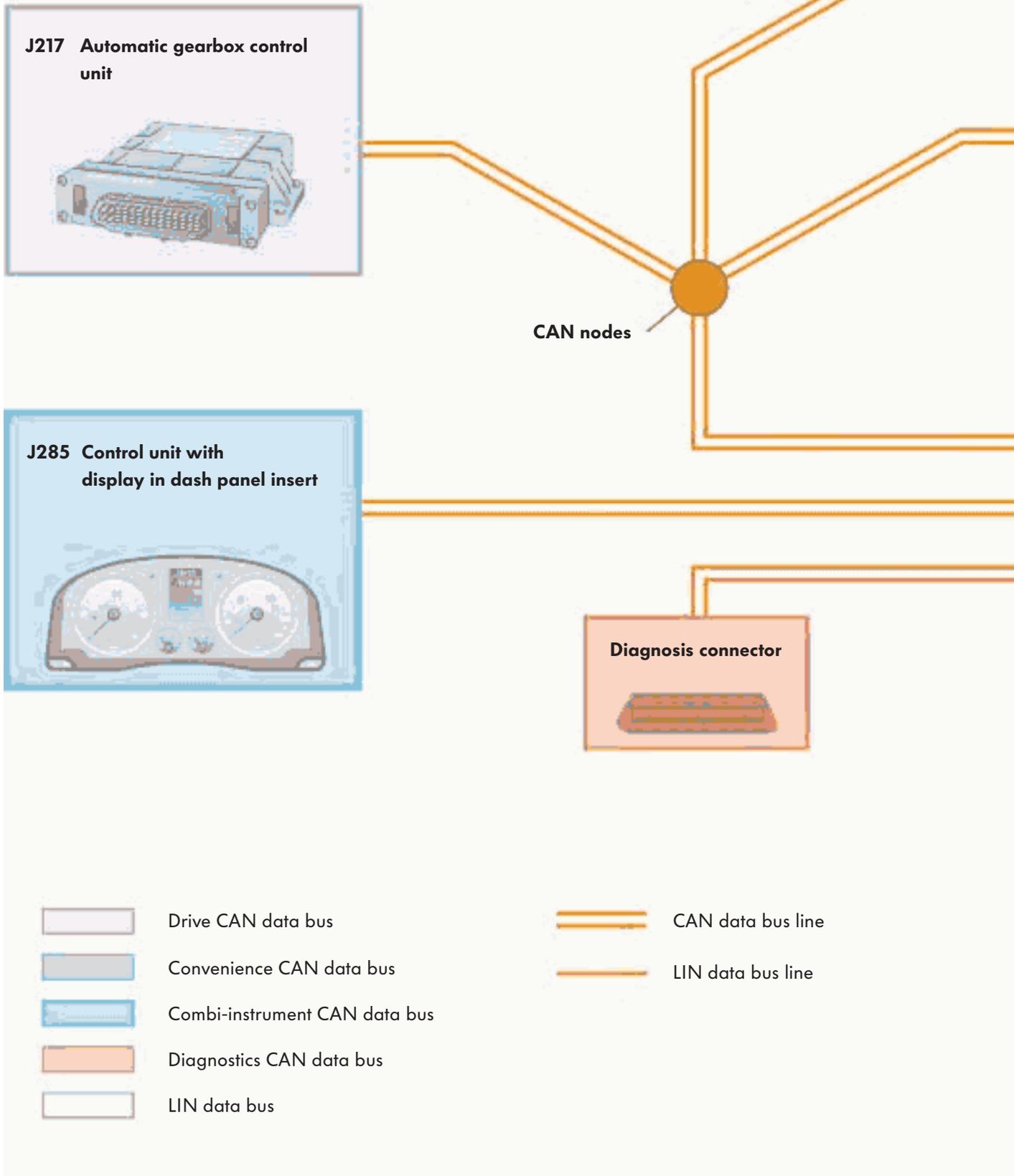
Other signals

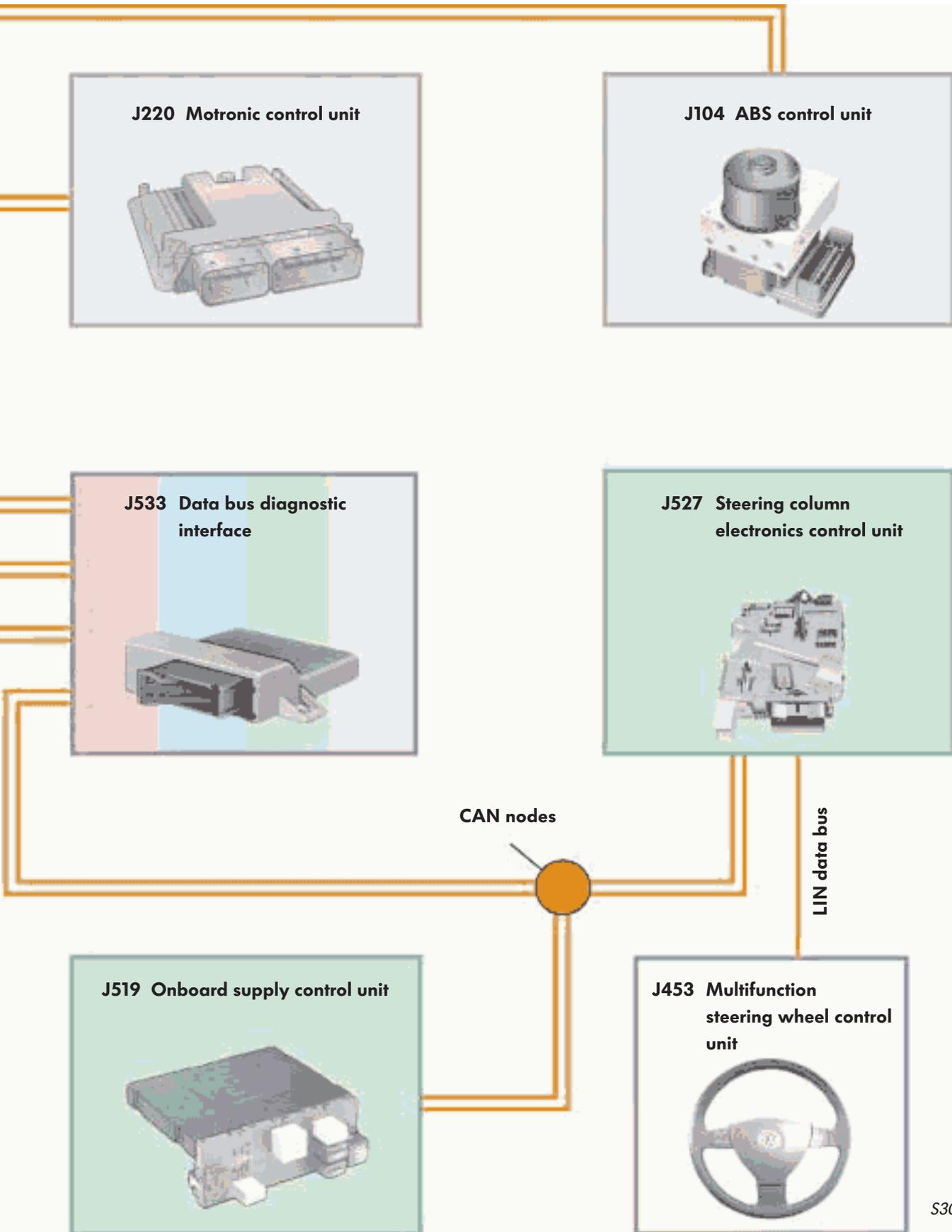
CAN-H	CAN data bus high
CAN-L	CAN data bus low

Gearbox Control

CAN Data Bus Connections

Using the Golf 2004 as an example





S309_040

Self-diagnosis

Diagnosis

The VAS 5051 vehicle diagnosis, measuring and information system and the VAS 5052 vehicle diagnosis and service information system are available for diagnosis purposes.

The VAS 5051 vehicle diagnosis, measuring and information system has the following operating modes:

- Guided fault finding
- Guided functions
- Vehicle self-diagnosis
- OBD (on-board diagnosis)
- Measuring technology

The **“Guided Fault Finding”** operating mode checks all control units installed in the vehicle for fault entries and automatically compiles a system test plan from the results.

In conjunction with ELSA information, for example, the circuit diagrams or repair guides, this mode guides you directly to the cause of the fault.

In addition, you also have the option of compiling your own test plan.

The function and component selection records the tests you select in the test plan. You can then work through the tests in any order during the diagnosis procedure.

The **“Vehicle self-diagnosis”** mode can still be used, but there is no further ELSA information available.

VAS 5051



S309_065

VAS 5052



S309_066

The **“Guided Functions”** mode is new. In this way, without a complete vehicle system test, you can quickly access general service functions, for example, adapting vehicle keys.

It is used from the basis CD V06.00.00 and the Volkswagen brand CD V06.42.00.



The VAS 5052 also has the **“Guided Fault Finding”** and **“Guided Functions”** operating modes.

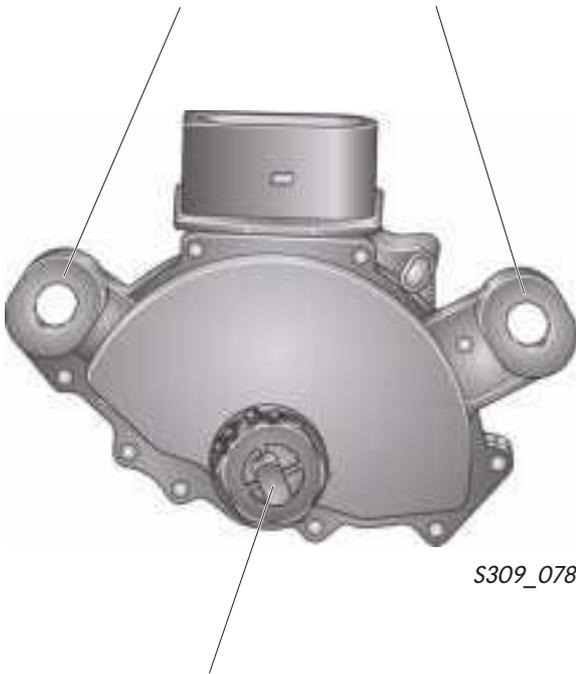


For more detailed information on the procedure and guided fault finding, please refer to chapter 7 of the VAS 5051 operating manual.

Special tools

Setting – Multifunction switch F125

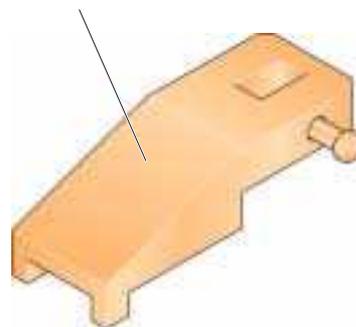
Secured with slots for fine adjustments



S309_078

The setting nut for the contact lever should not be loosened

Setting gauge
T10173



S309_079



Glossary

Terms

Spread Spread, in the context of gearboxes, is the “transmission bandwidth” of a gearbox. The spread is the ratio figure between the transmission in first gear and sixth gear (top gear). You obtain the spread value by dividing the ratio of the 1st gear with that of the top gear (here 6th gear).

Using the 09G gearbox as an example:

i	1st gear	4.148	
i	6th gear	0.686	$4.148 : 0.686 = 6.05$ (value rounded up)

The advantages of a large spread are:

In addition to a high starting ratio – for a high level of traction – a low final ratio can be achieved. The latter reduces the engine speed, which in turn allows you to reduce the noise level and fuel consumption.

A high spread requires a corresponding number of gears so that the speed differences do not become too large when gears are changed (gear jumps).

During gearshifts, the engine should not enter speed ranges with a low torque that makes acceleration difficult.

Tiptronic Shift strategy The car normally pulls away in 1st gear. You can start in 2nd gear by shifting up to 2nd gear before pulling away (with steering wheel Tiptronic switches or selector lever). This makes pulling away with low roadfriction values less difficult, e.g. on winter roads.

In addition to the possibility of changing gear manually the Tiptronic function is needed if you want to use the engine braking effect. As there are no 4, 3, 2 positions (new selector indicator plate with the “D” and “S” positions), you have to prevent the gearbox shifting up by selecting the Tiptronic function (move selector lever to Tiptronic gate) .



Which answers are correct?

One, several or all answers could be correct.

1. Which gear set concept is used in this automatic gearbox?

- a) The Wilson gear set concept.
- b) The Ravigneaux gear set concept.
- c) The Lepelletier gear set concept.

2. Which statement on the ignition key withdrawal lock is correct?

- a) It prevents accidental movement of the selector lever to the "P" position.
- b) It prevents you removing the ignition key when the parking lock is not engaged.
- c) It works electromechanically in the Golf and Passat.

3. How many multi-plate clutches and multi-plate brakes ensure that this automatic gearbox works perfectly?

- a) 3 multi-plate clutches and 2 multi-plate brakes
- b) 2 multi-plate clutches and 3 multi-plate brakes
- c) 3 multi-plate clutches and 3 multi-plate brakes

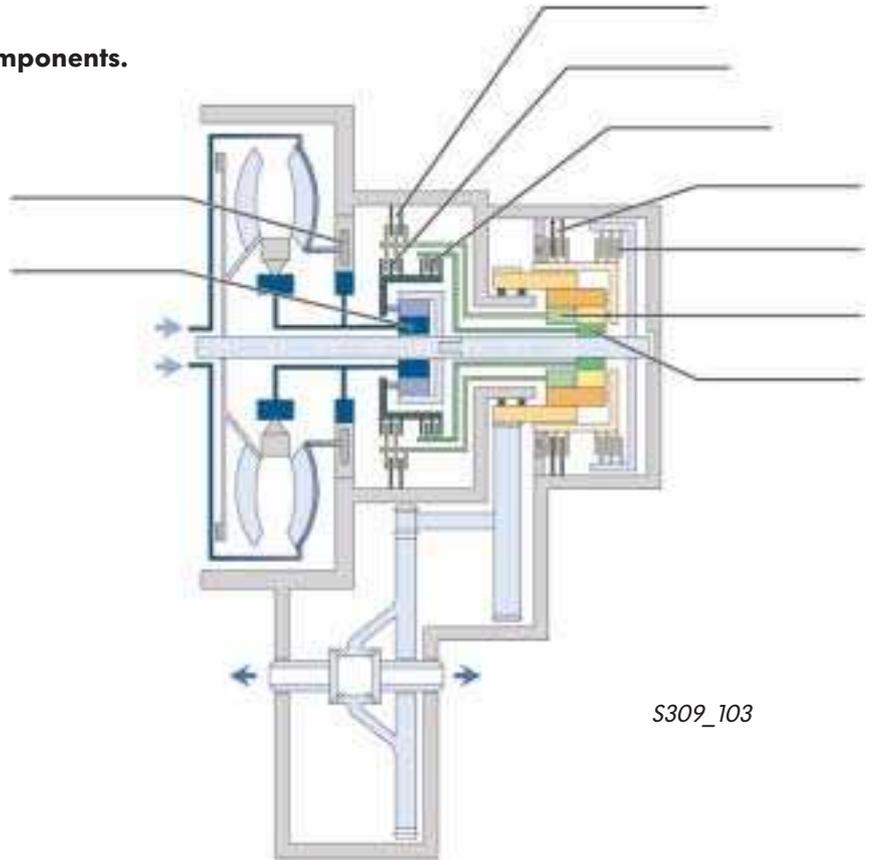
4. Which statement on the ATF is correct?

- a) Any ATF can be used.
- b) The ATF has a decisive influence on the frictional value of the clutches.
- c) It was developed during development and testing of the gearbox.



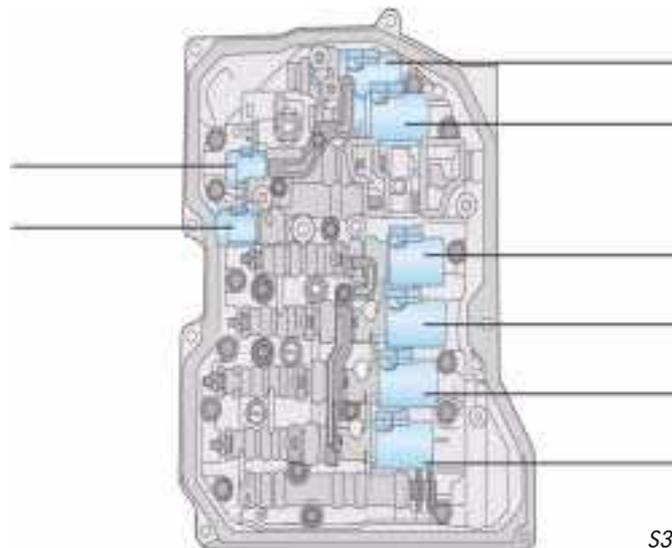
Test Yourself

5. Please name the following components.



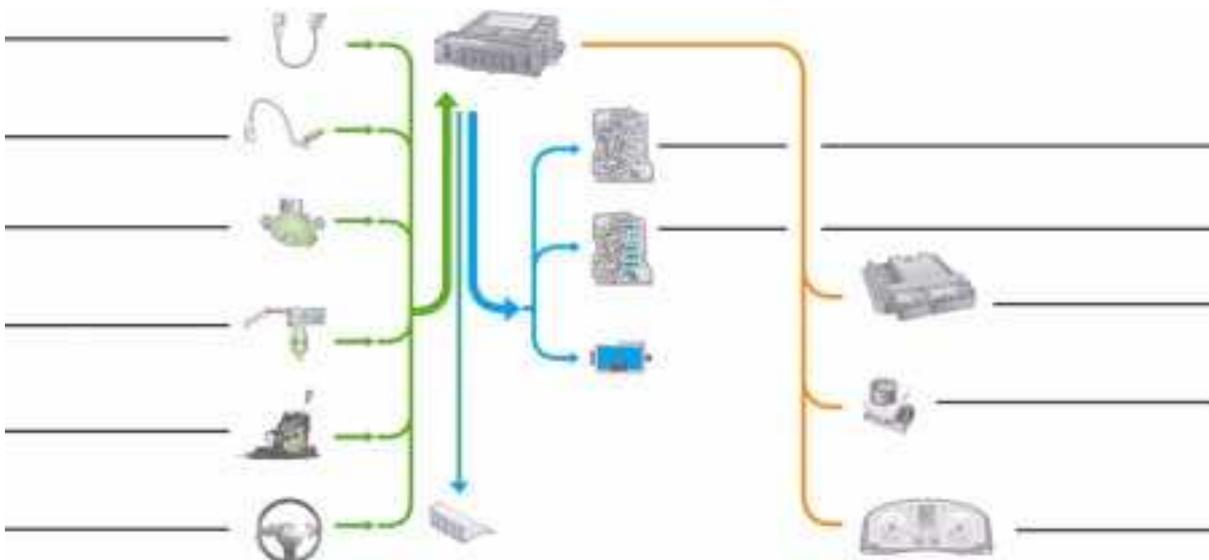
S309_103

6. Please name the components distinguishing between on/off valves and modulationvalves.



S309_104

7. Please name the following components.



S309_105

8. Which control units does the automatic gearbox control unit J217 communicate with via the CAN data bus?

.....
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.....
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.....
.....
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.....



Test Yourself

9. Which control unit controls the starter inhibitor?

- a) The automatic gearbox control unit.
- b) The onboard supply control unit.
- c) The steering column electronics control unit.

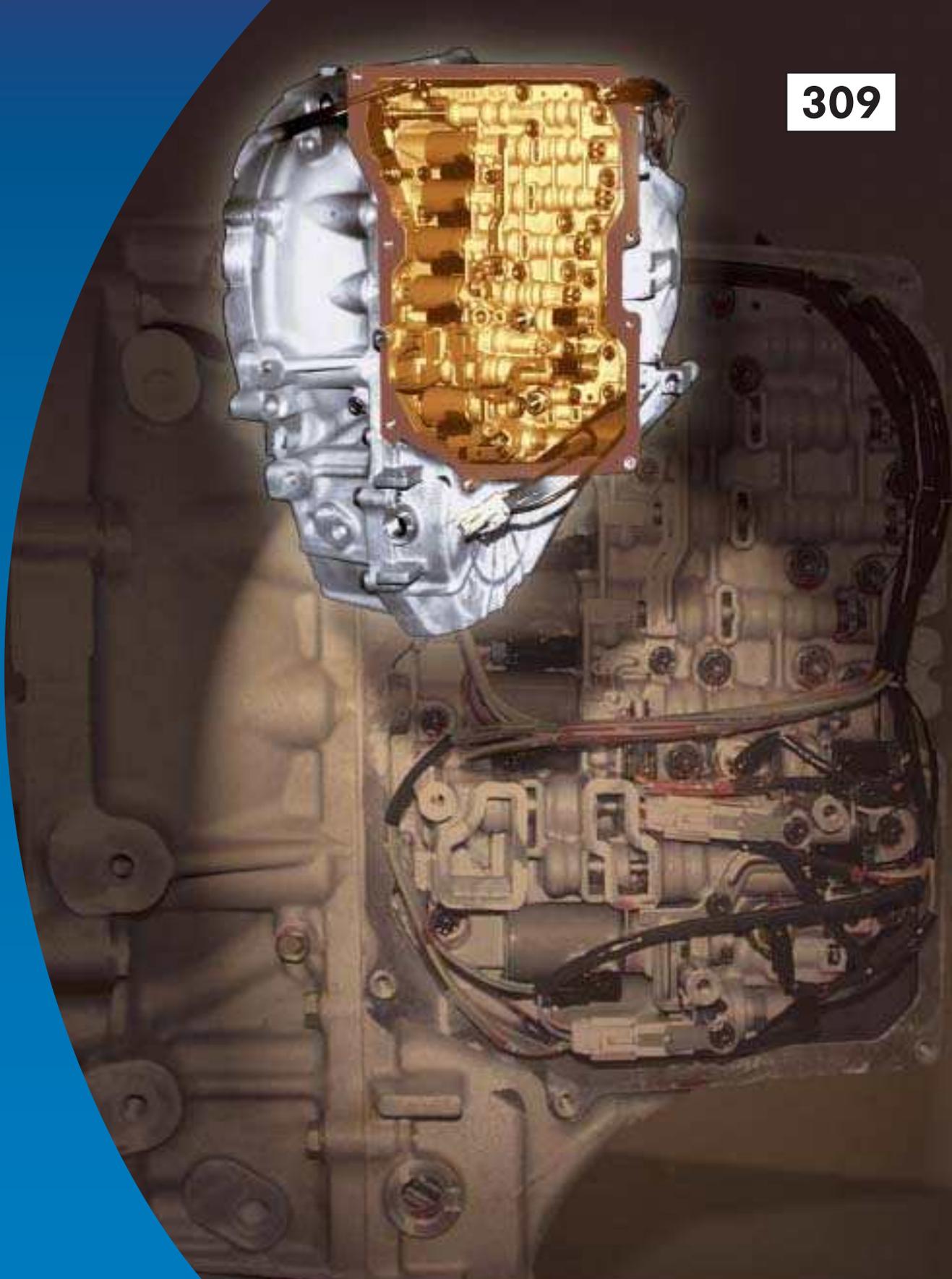
10. Which component informs the gearbox control unit that the selector lever is in the “P” position?

- a) The multifunction switch.
- b) The selector lever position sender J471.
- c) The switch F319.



1. c; 2. b, c; 3. a; 4. b, c; 5. see p 24 and 25; 6. see p 28; 7. see p 38 and 39; 8. see page 62 and 63; 9. b; 10. a - Transporter, c - Golf

Answers:



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✿ This paper was manufacturer from pulp that
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