

Service.



Self-Study Programme 300

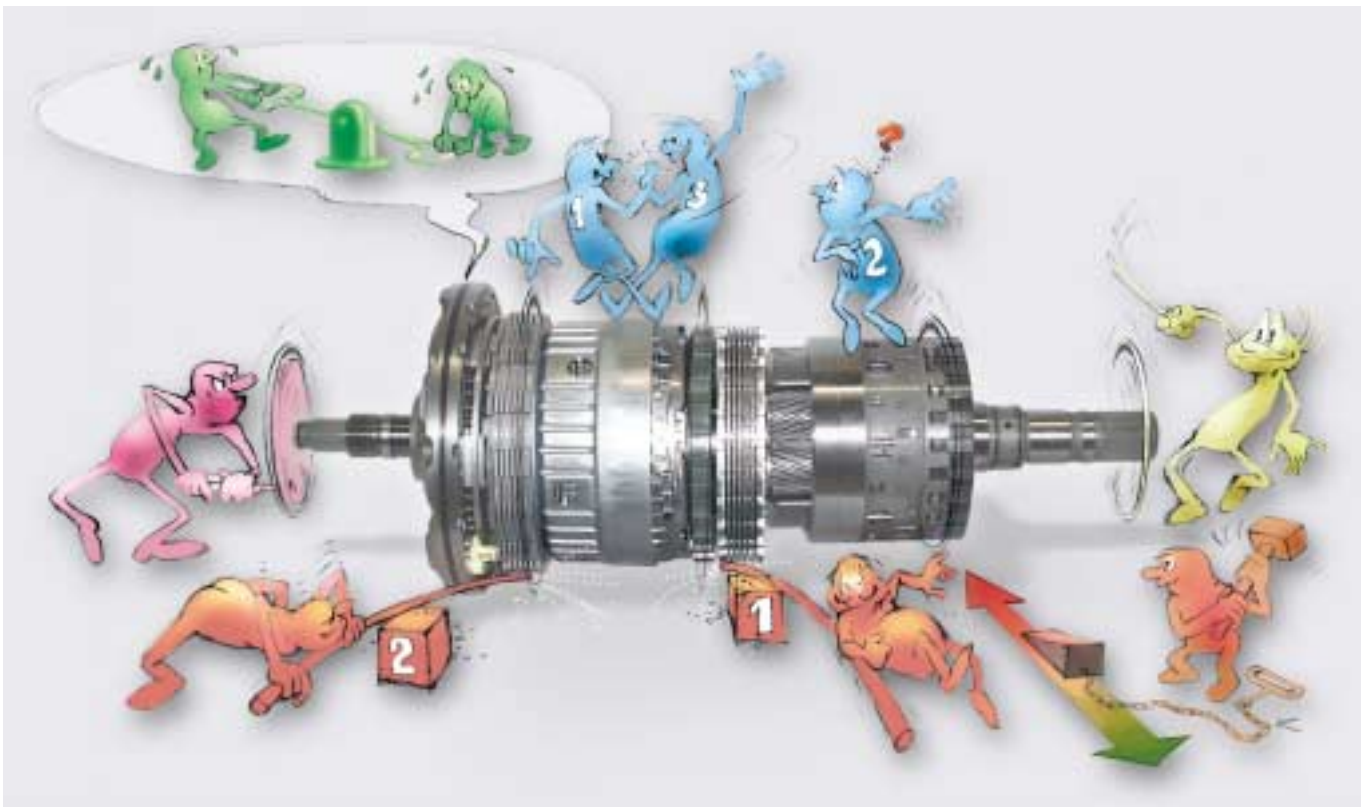
6-speed automatic transmission 09D

Design and function



Compared to the 5-speed automatic transmission, the 09D 6-speed automatic transmission provides:

- a reduction in fuel consumption,
- a reduction in exhaust emissions,
- improved acceleration values and
- a reduction in noise.



300_U2

This self-study programme provides you with the design and function of the new 6-speed automatic transmission which is installed in the Touareg.

NEW



**Caution
Note**

The Self-Study Programme describes the design and function of new developments! The contents are not updated.

Please always refer to the relevant service literature for up-to-date inspection, adjustment and repair instructions.



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Introduction

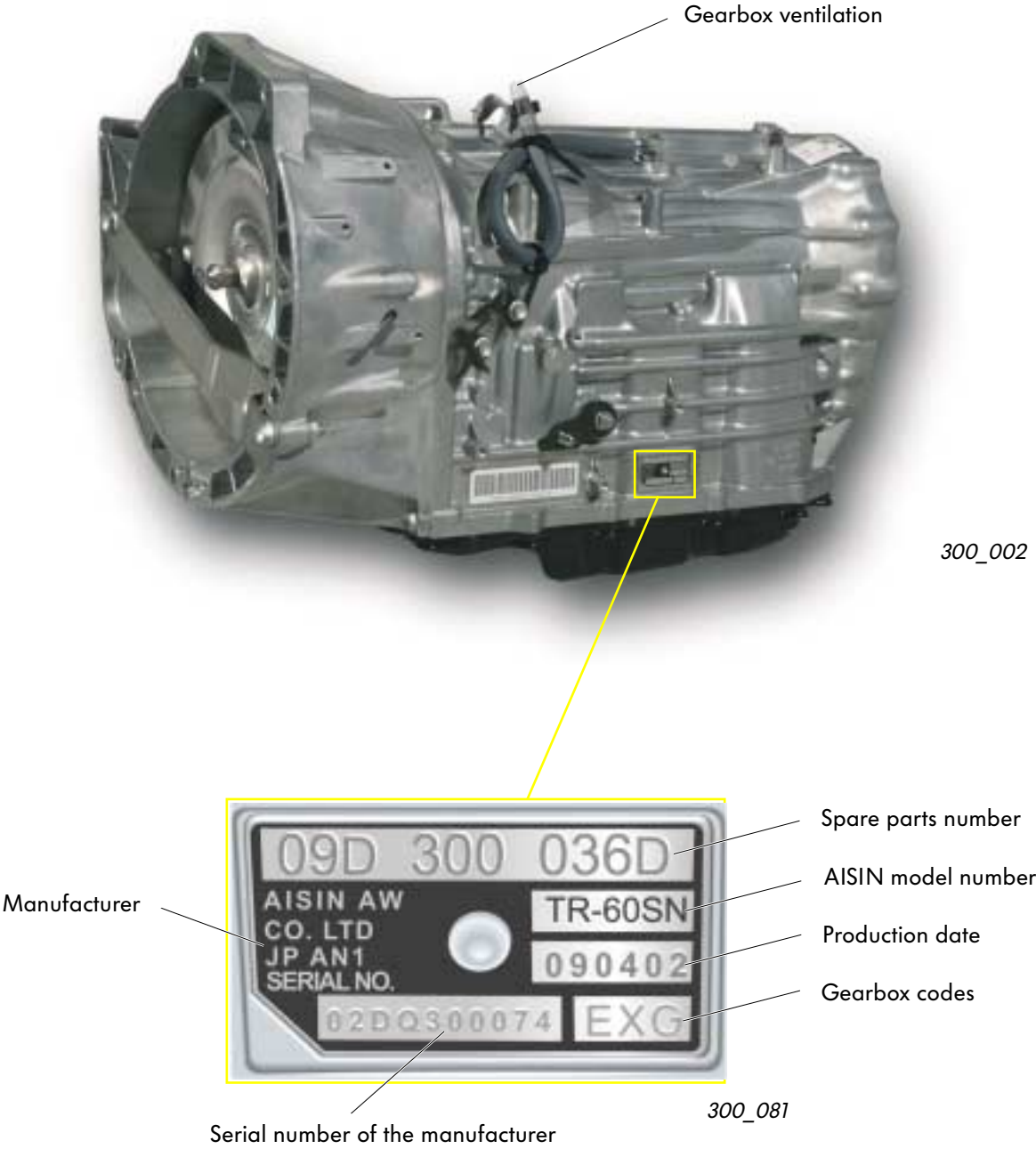


The 09D 6-speed automatic transmission

was developed at the famous Japanese manufacturer of automatic transmissions, AISIN Co., LTD, where it is manufactured.

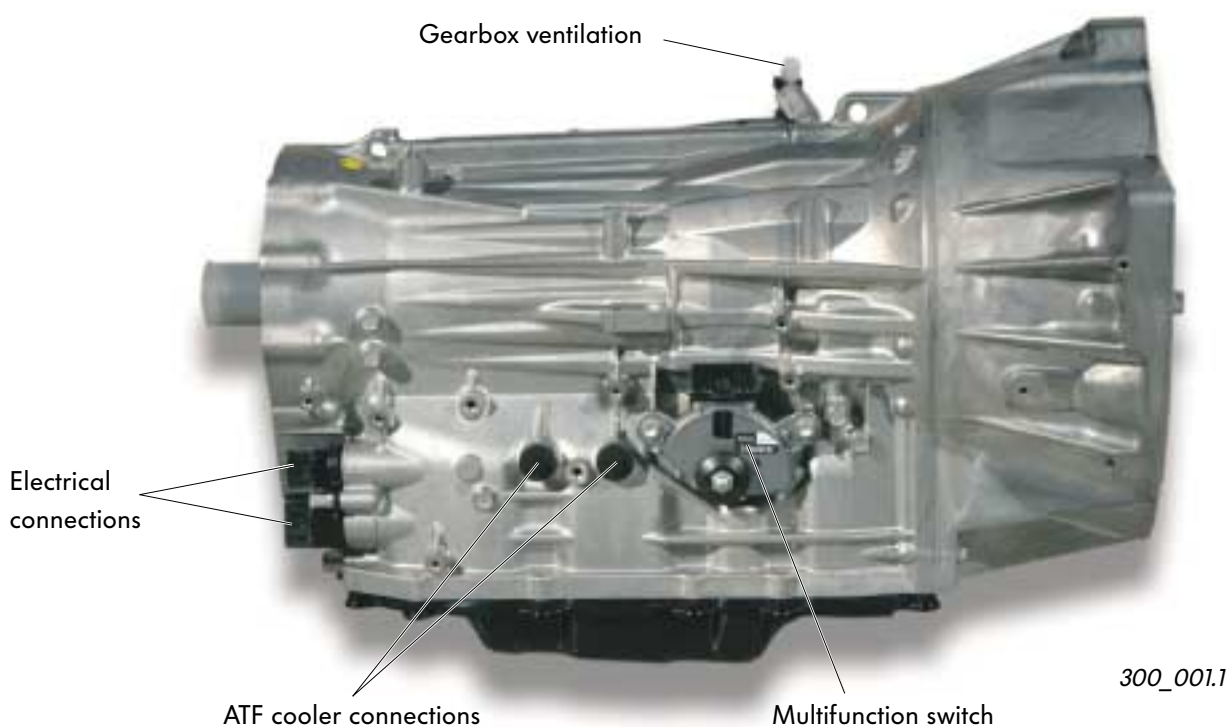
In the development of the control unit software, the years of experience that Volkswagen engineers have had with fuzzy logic-controlled driving programmes that depend on driving situations and hindrances has been a determining factor.

This 6-speed automatic transmission, which has a very compact construction, is being used for the first time in the Volkswagen Touareg.



Special gearbox features include:

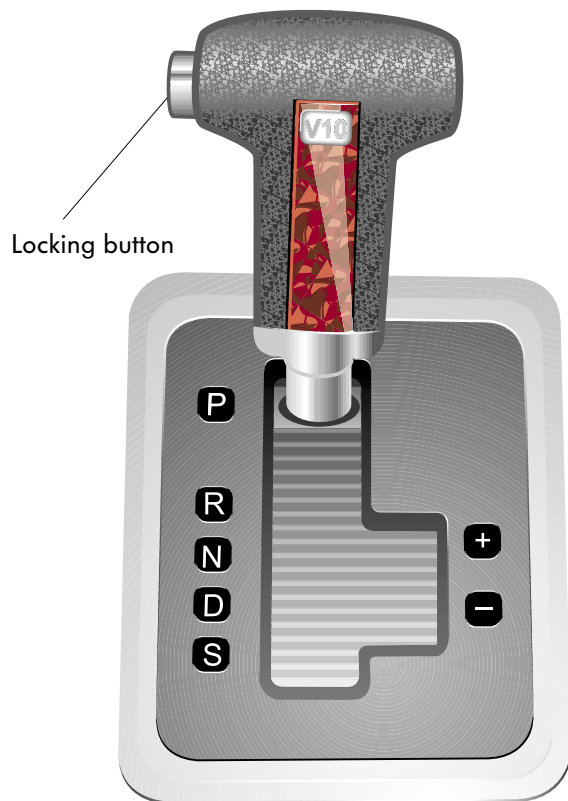
- fuzzy logic-controlled switching programmes that depend on driver and driving situations as well as switching programmes that depend on driving impedance
- a controlled converter bypass coupling
- lifetime ATF filling
- The hill-holder function secures the vehicle from rolling back and permits hills to be approached comfortably.
- selector lever and steering wheel Tiptronic switches



Technical data

Volkswagen designation		AG6 - 09D
Gearbox codes	with V10-TDI-engine with V6 engine	EXG EXL
ATF		Lifetime filling
ATF filling amount	with V10-TDI-engine with V6 engine	12 litres 9.6 litres
Maximum torque transmission		750 Nm
Weight	depending on engine including ATF	97 to 110 kg
Emergency run	in case of defective control unit	3rd gear and R gear

Selector lever



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The selector lever positions

P - Park

Before the selector lever can be moved out of the Park position, the ignition must be switched on. In addition, the foot brake and the locking button on the selector lever must be pressed.

R - Reverse

The locking button on the selector lever must be pressed to switch into reverse.

N - Neutral

The gearbox is idling in this position.

No power is being transmitted to the wheels.

If the selector lever is in this position for a long time, the foot brake must be pressed again to activate the lever.

D - Drive

In the Drive position, the forwards gears are switched automatically.

S - Sport

The control unit selects gears automatically according to a "sporty" switching characteristic curve.

The individual gears are extended further.

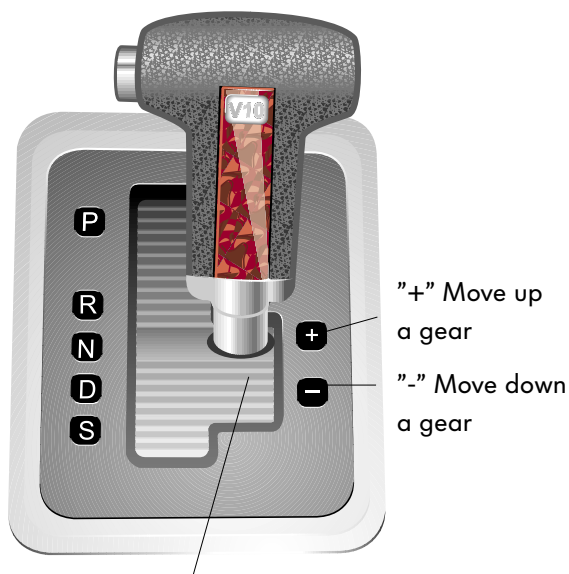


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Selector lever position and gear display in dash panel insert

After the ignition is switched on, the current selector lever position is displayed in the dash panel insert.

In positions "D" and "S", the gear selected in the gearbox is also displayed.



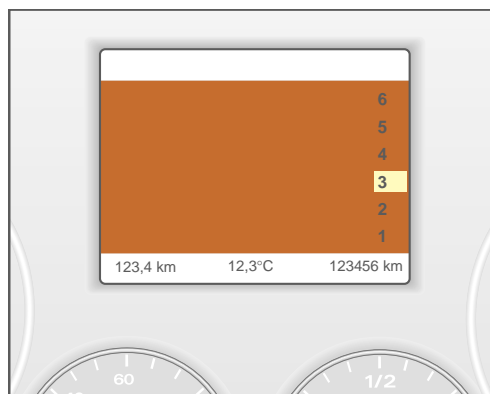
Tiptronic channel

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Steering wheel switches



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300_005

The Tiptronic

in the Touareg is available as a selector lever as well as a steering wheel switch.

Selector lever Tiptronic

The Tiptronic channel is reached by moving the selector lever to the right out of the "D" position. The control unit for the automatic gearbox thus enters the Tiptronic mode.

The driver can now actively select gears.

Steering wheel - Tiptronic switches

The steering wheel switches offer an optimal ergonomic actuation for gear selection.

Here you use:

- the switch on the right to move up a gear.
- and
- the switch on the left to move down a gear.

If the selector lever is in the "D" or "S" position when the steering wheel switches are pressed, the automatic transmission control moves into Tiptronic mode.

Control automatically reverts to the previously selected "D" or "S" programme if the steering wheel switches are not pressed again.

Gear display in the dash panel insert

The current gear is displayed in Tiptronic mode.



Selector lever

Selector lever lock and ignition key removal lock

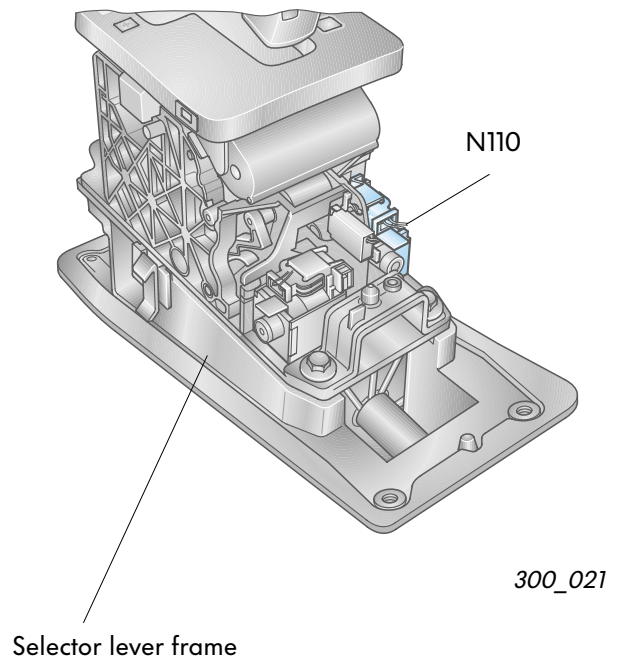
Magnet for selector lever lock N110

This is located in the front on the selector lever frame.

It prevents the actuation of the selector lever from the positions "P" and "N" when the brake is not being applied.

How it works

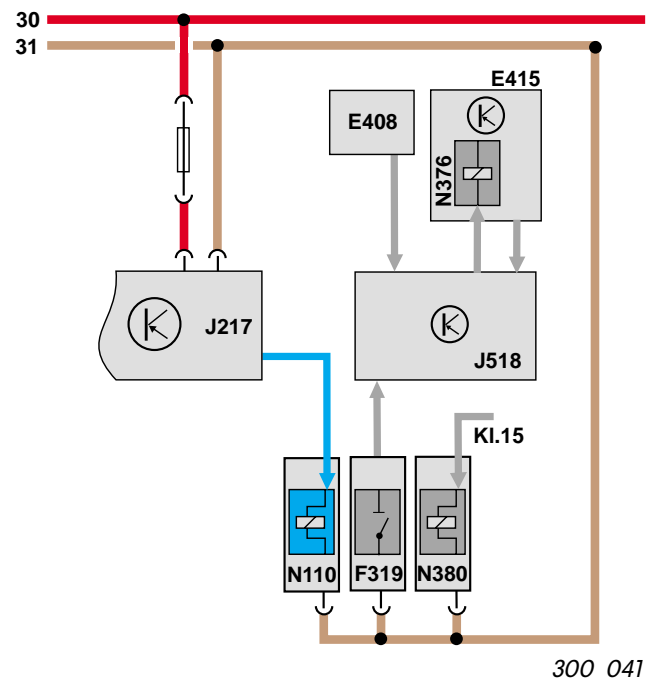
Once the ignition has been turned on, the magnet for the selector lever lock is put under current by the control unit for automatic transmission, thus blocking the selector lever. If the control unit receives the signal "brake applied" via the CAN data bus, it cuts off current to the magnet and the selector lever can be moved.



Effects of a signal drop-out

If one of these two signals fails or if the magnet is faulty, the selector lever can be moved out of "P" and "N" without applying the brake – assuming the ignition is turned on.

- E408 - button for starting/stopping the engine
- E415 - switch for access and start authorisation
- F319 - switch for selector lever locked in P
- J217 - control unit for automatic gearbox
- J518 - switch for access and start authorisation
- N110 - magnet for selector lever lock
- N376 - magnet for ignition key removal lock
- N380 - magnet for selector lever lock P



The magnet for selector lever lock "P" N380

is at the selector lever frame, as is the magnet for the selector lever lock.

It prevents the selector lever from moving out of the "P" position when the ignition is switched off. The ignition must be switched on to activate the lock button.

How it works

The magnet N380 is without power when the ignition is switched off, thus disabling the selector lever in the "P" position.

After the ignition is switched on, the magnet N380 receives power from terminal 15 and the lock is lifted.

The switch F319 signals to the access and start authorisation control device that the selector lever is in the "P" position.

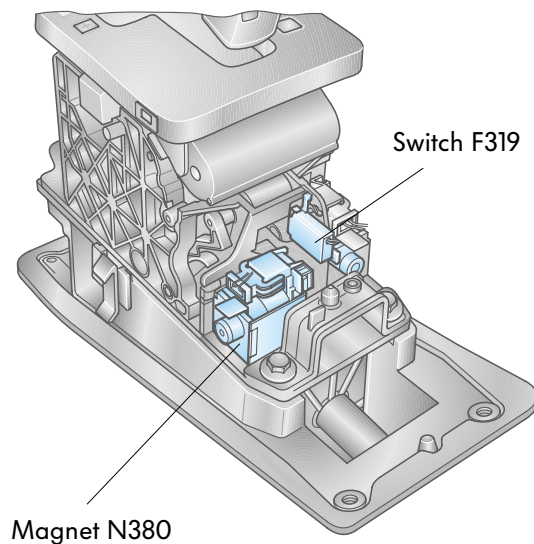
Effects of a signal drop-out

If one of the signals fails or the magnet for selector lever lock "P" is defective, then the selector lever cannot be moved out of the "P" position.

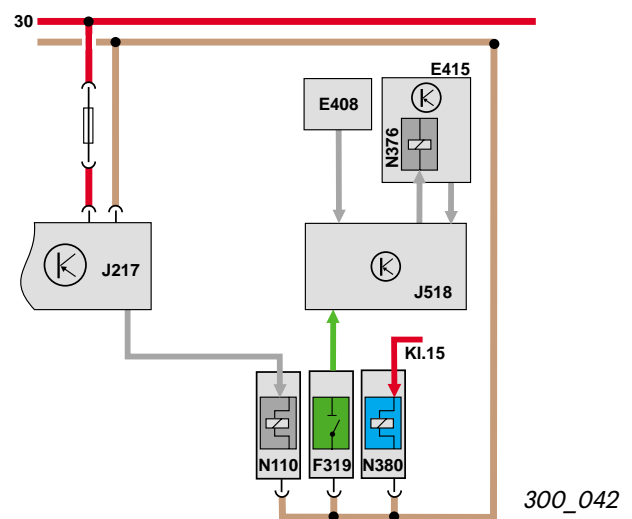
The disablement has to be manually unlocked for towing the vehicle.

For this purpose the centre console covering is to be removed and the magnet actuated by hand.

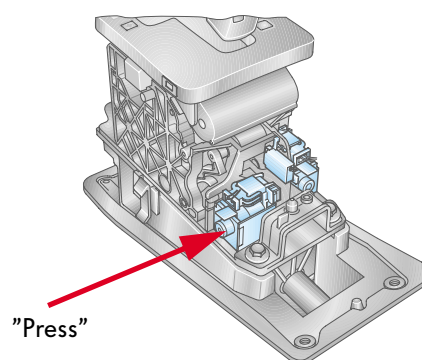
The selector lever has to be simultaneously moved out of the "P" position.



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300_021

Selector lever

The magnet for ignition key removal lock N376

is located within the switch for access and start authorisation E415 and prevents the ignition key from being removed when the selector lever is in a driving position. The ignition key removal lock works electromechanically.

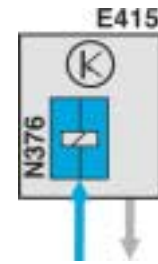
How it works

The magnet for the ignition key removal lock N376 contains two spring-loaded locking pins which engage into the inside tract of the inserted ignition key if the selector lever is not in the "P" position (N376 without power).

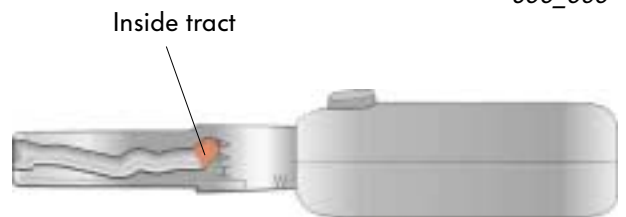
The ignition key cannot be withdrawn.

When the selector lever is in the 'P' position, a signal travels from the switch for the selector lever in "P" F319 to the access and start authorisation control unit J518. The control unit then sends current to the magnet for the ignition key removal lock N376. The locking pins are pulled out by the magnets and thus removed from the extended inside tract of the ignition key.

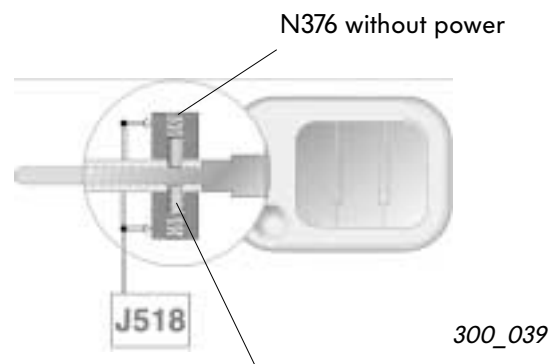
The ignition key can be withdrawn.



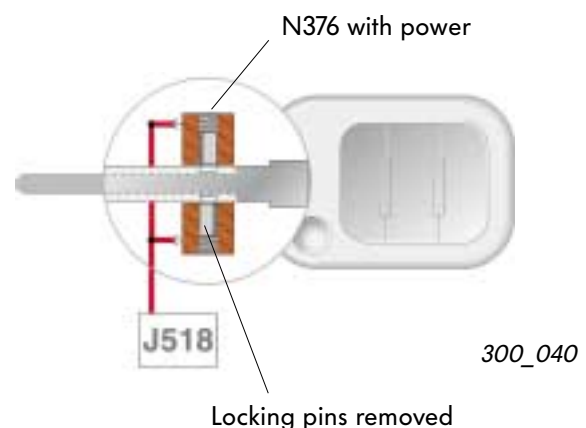
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300_038



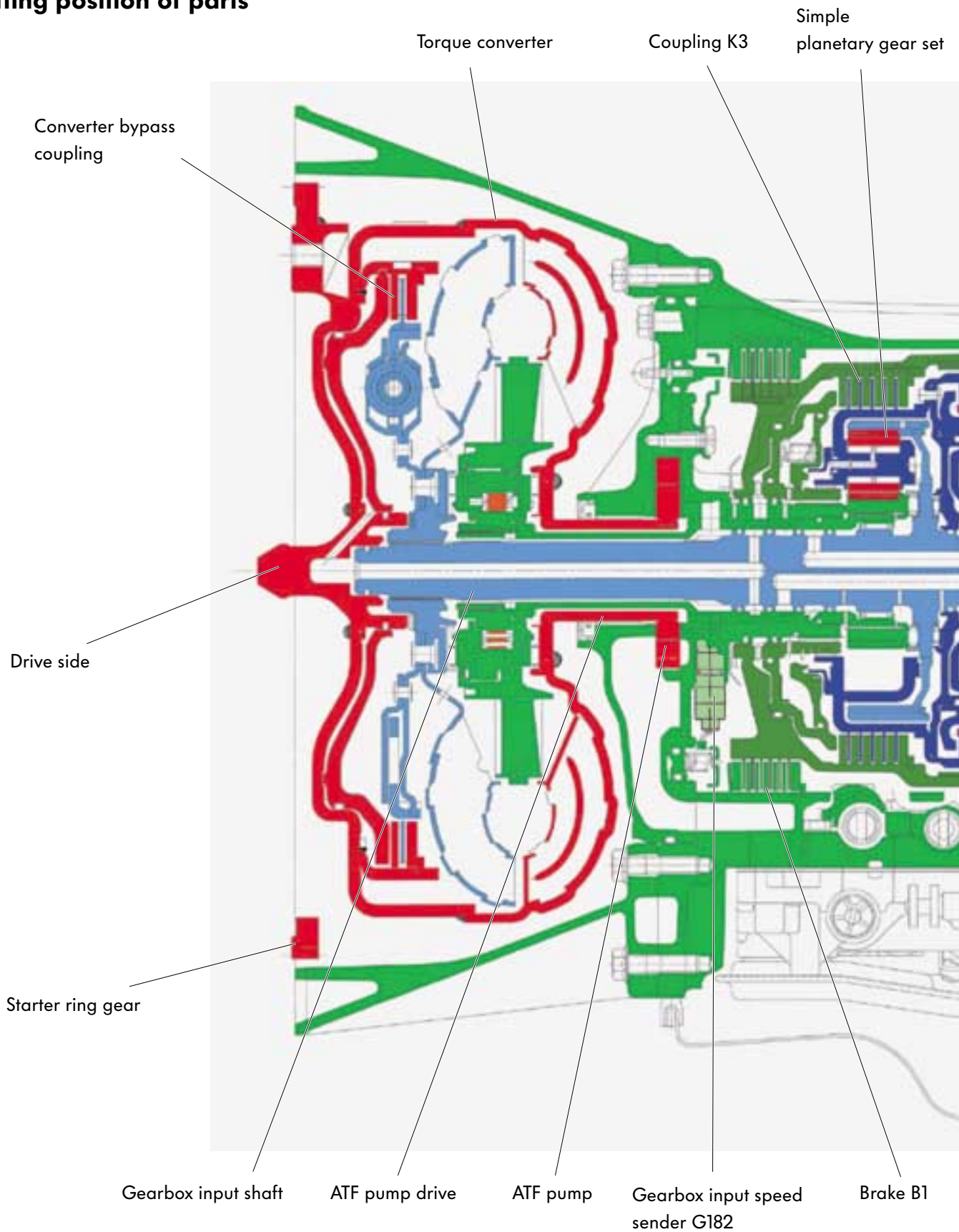
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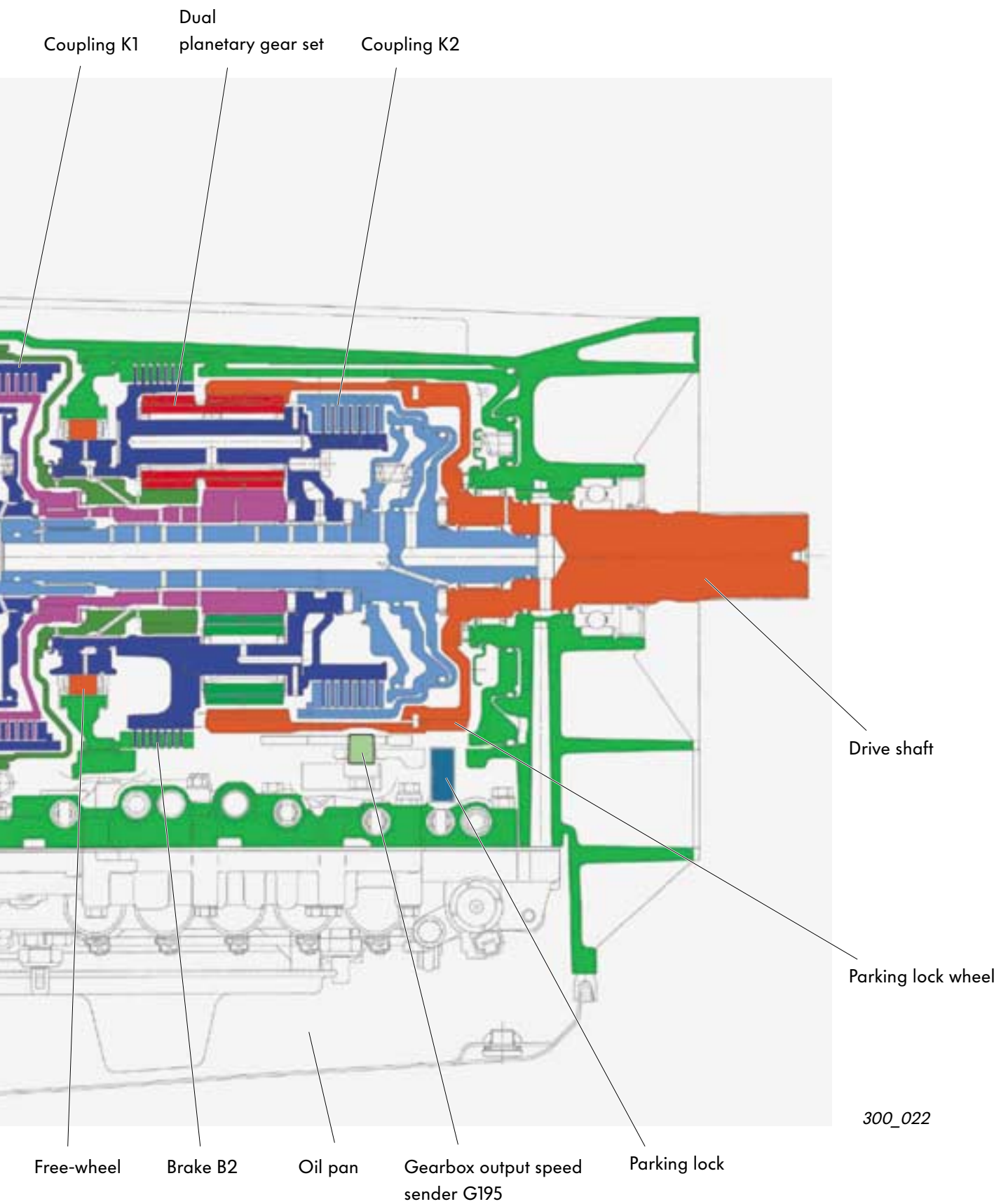


300_040

Design of gearbox

Fitting position of parts





Design of gearbox

Introductory description of functions

The gearbox housing consists of an aluminium alloy.

The six forwards gears and the reverse gear are switched using a Lepelletier arrangement of the planetary gear sets.

To switch the gears,

- three multi-disc couplings,
- two multiple disc brakes and
- a free-wheel

are switched on or off using the electro-mechanic-hydraulic control unit in the control valve assembly.

The control unit for the automatic gearbox starts the switching of the gears and monitors the process for problems.

After the signals of the information senders (sensors), the actuators are activated.

Activation takes place depending on driver, driving situation and driving impedance switching programmes.

The gearbox is adapted to use with different engines (V10 or V6) in the Touareg using

- the number of installed disc pairs for the brakes and the couplings,
- the size of the torque converter and
- the geometric adaptation of the torque converter housing.

The transmissions of the individual gears remain the same for both engines.

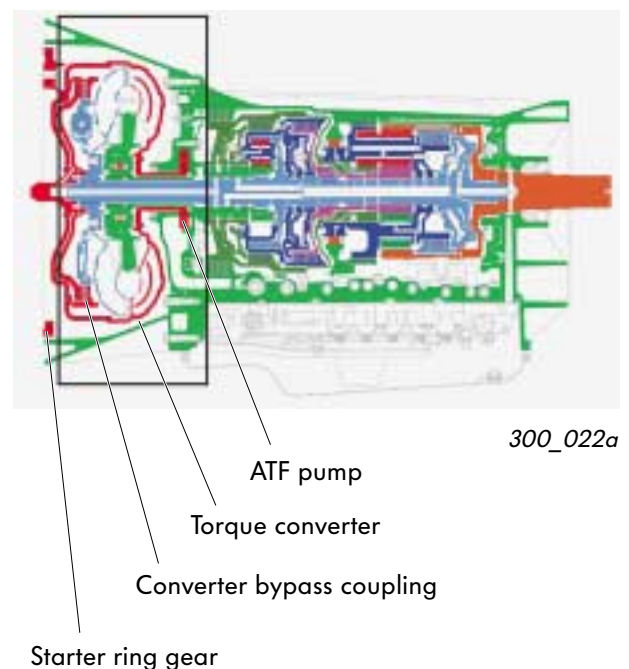
A transfer gearbox flanged onto the gearbox distributes the torque to the axle drives.

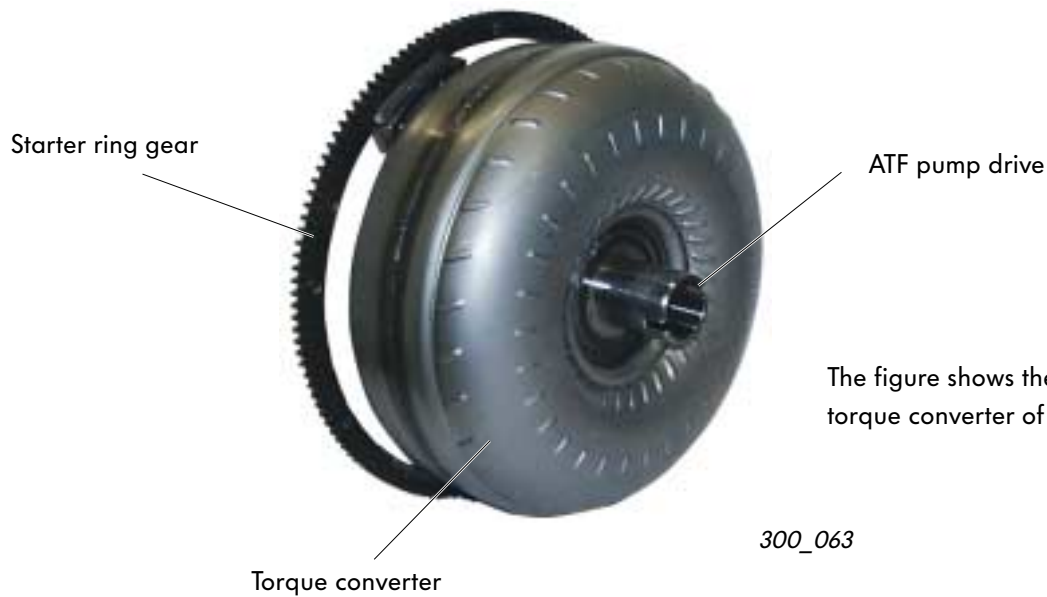
Torque converter with converter bypass coupling and ATF pump

The hydromechanical torque converter serves as a starting element and increases the torque in the transforming area.

It is equipped with a converter bypass coupling. Starting at an engine speed of 1000 rpm, the control unit for the automatic gearbox can close this coupling.

This transfers the engine torque directly to the drive input shaft.





The figure shows the torque converter of the V10-TDI.

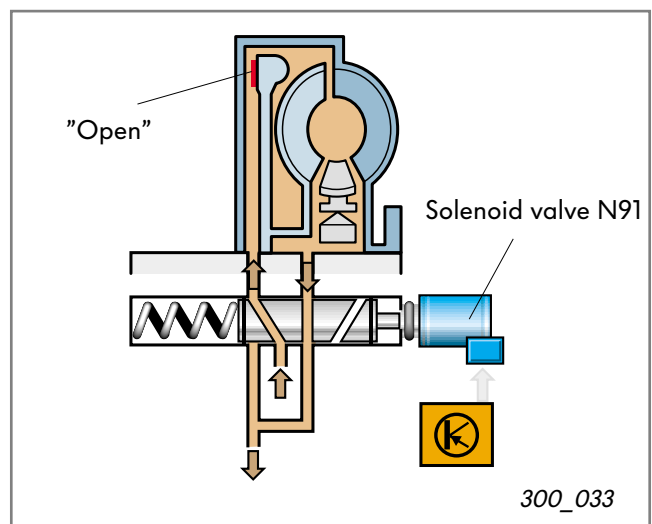
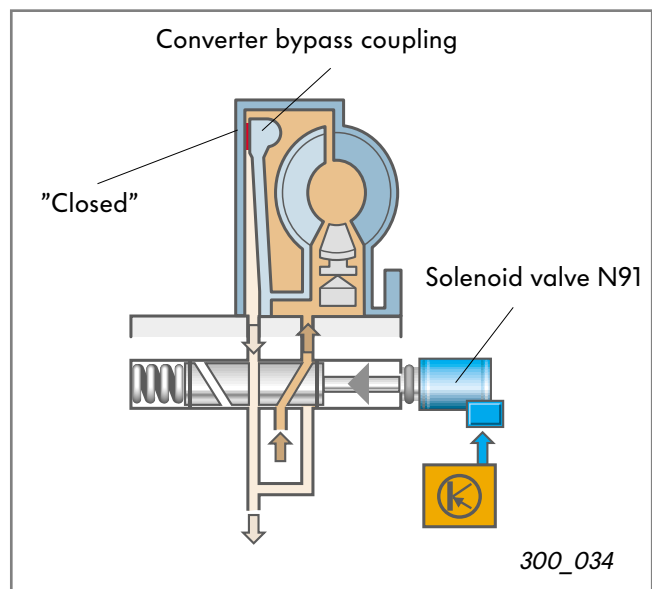
Converter bypass coupling

Function

The control unit for the automatic gearbox controls the solenoid valve N91. The solenoid valve opens or closes the converter bypass coupling depending on the engine's speed and torque.

If the converter bypass coupling is to be closed, the solenoid valve opens the oil reservoir upstream of the converter bypass coupling. As a result, the oil pressure in this reservoir decreases; the oil pressure downstream of the converter bypass coupling closes the converter bypass coupling.

When the solenoid valve N91 closes the oil flow again, the pressure upstream of the converter bypass coupling builds up again and the converter bypass coupling opens.



Design of gearbox

The ATF pump

is a gear pump and is driven by the ATF pump drive (pump gear shaft) of the torque converter.

It suctions the ATF from the oil pan of the gearbox through the oil sieve.

The ATF pump generates the working pressure for:

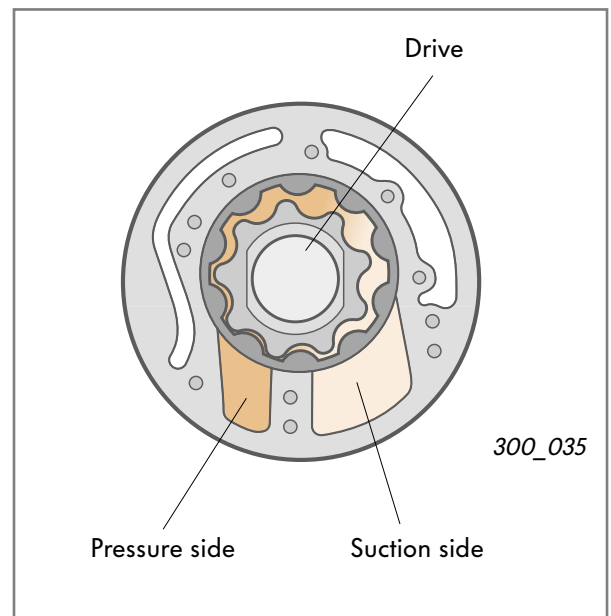
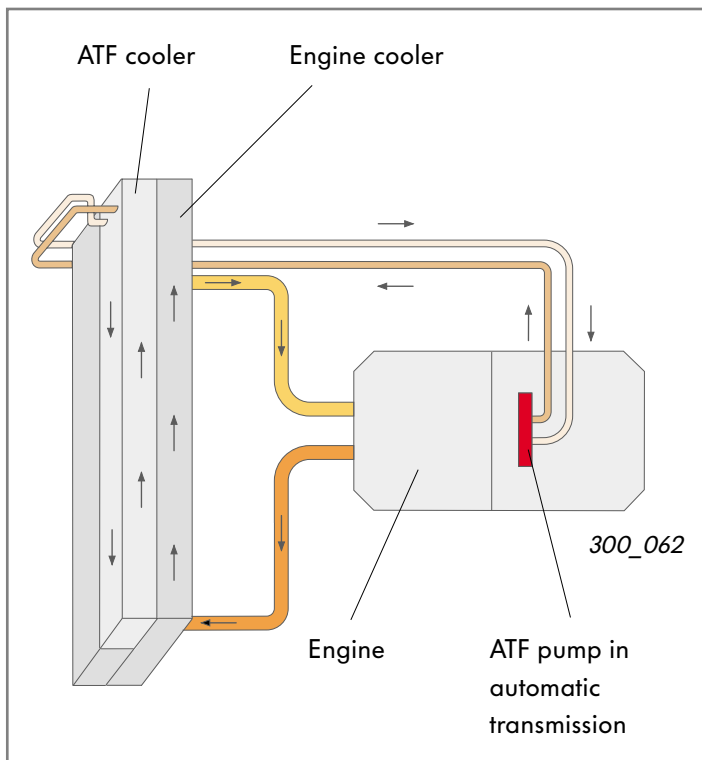
- the multi-disc couplings and multiple disc brakes,
- the lubrication circulation system and
- the coolant circulation system.

The ATF is cooled in a cooler.

This cooler is located in front of the engine cooler (as seen in the driving direction).



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The Lepelletier arrangement

is based on a simple planetary gear set and a subsequent dual planetary gear set according to Ravigneaux.

Lepelletier's brilliant idea was to drive

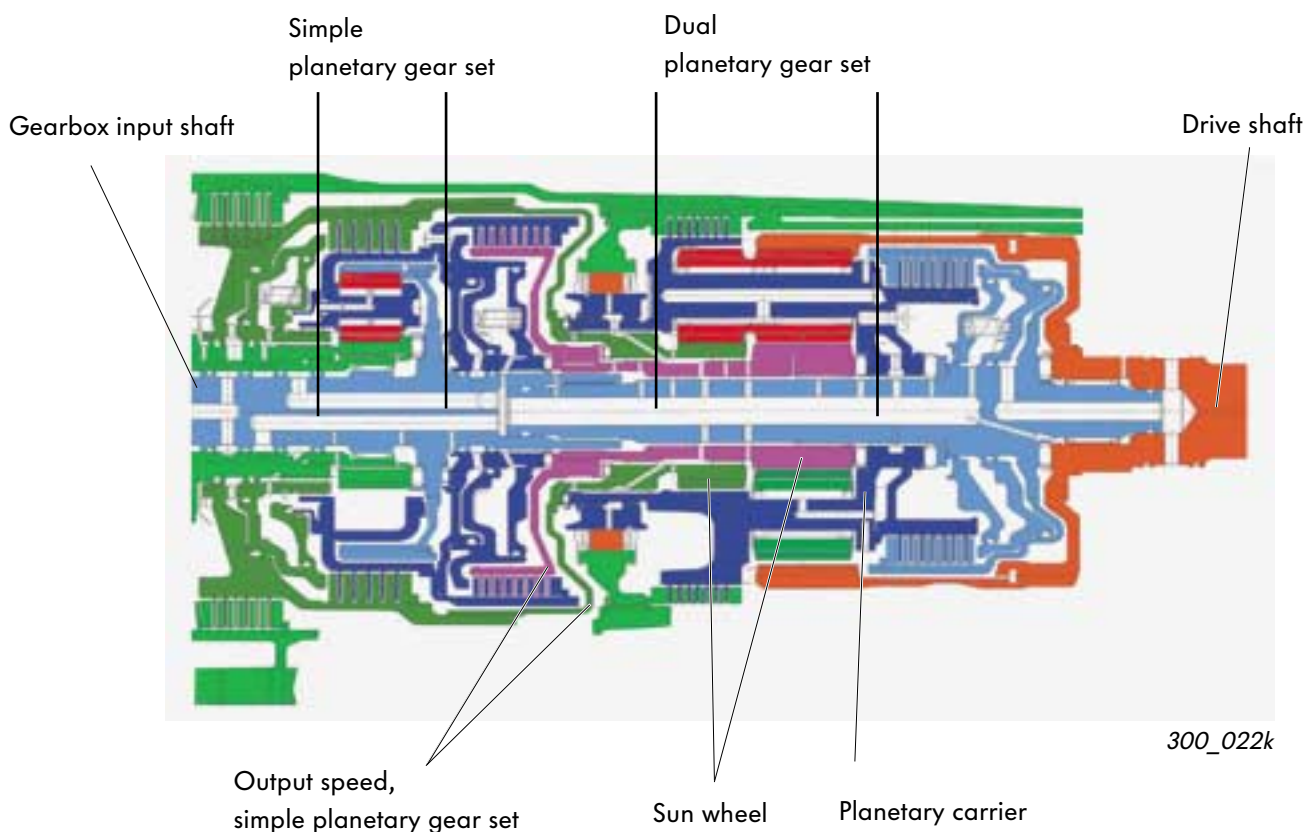
the sun wheels and the planetary carriers of the dual planetary gear set at different speeds. Due to these different input speeds in the dual planetary gear set, the potential transmission doubles compared to a five-gear automatic gearbox to ten gears minus one gear.

The sun wheels of the dual planetary gear set are driven with the transmitted output speed of the simple planetary gear set.

The planetary carriers of the dual planetary gear set are driven with the gearbox input speed.

As a result, the sun wheels and the planetary carriers have different speeds.

In this automatic gearbox, six forwards and one reverse gear bring Lepelletier's brilliant idea to life.



Design of gearbox

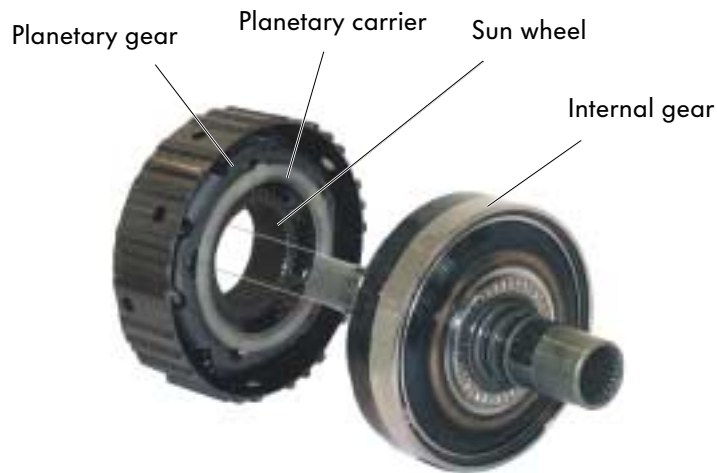
The simple planetary gear set

consists of:

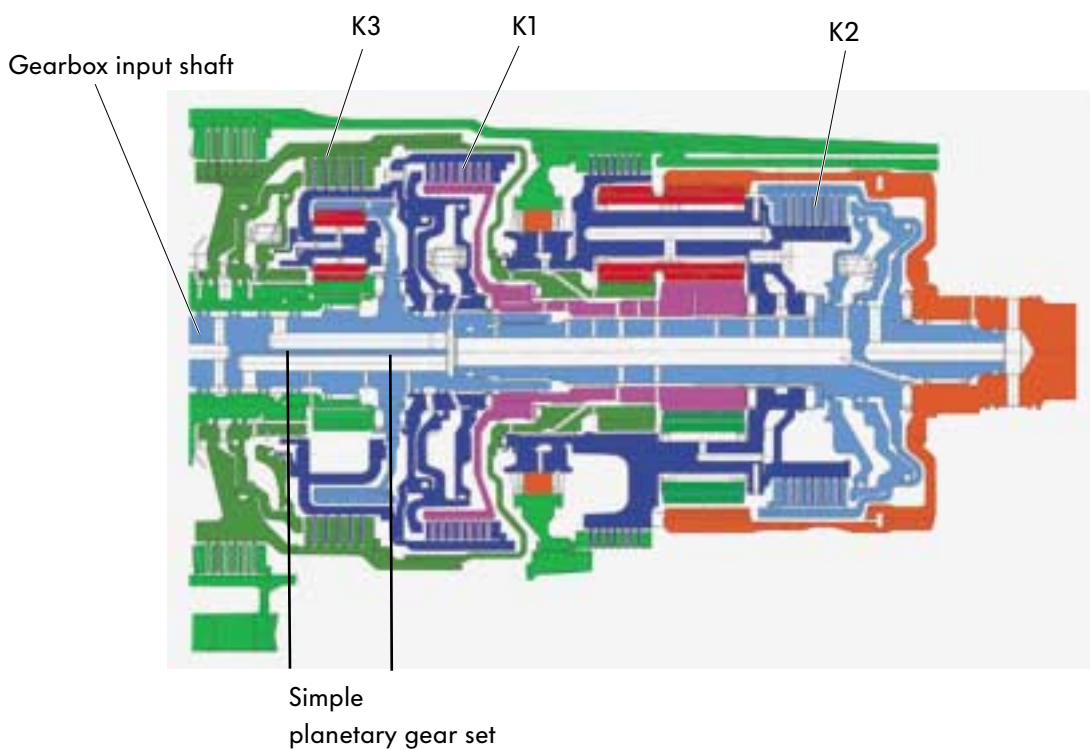
- a sun wheel,
- an internal gear and
- 5 planetary wheels with V10-TDI engine and 3 planetary wheels with V6 engine, which are
- guided by the planetary carriers.

The input torque is guided through the simple planetary gear set on two paths:

- from the gearbox input shaft without transmission via the coupling K2 on the planetary carrier of the dual planetary gear set and
- through the simple planetary gear set with transmission to couplings K1 and K3.



300_072



300_022k

The dual planetary gear set,

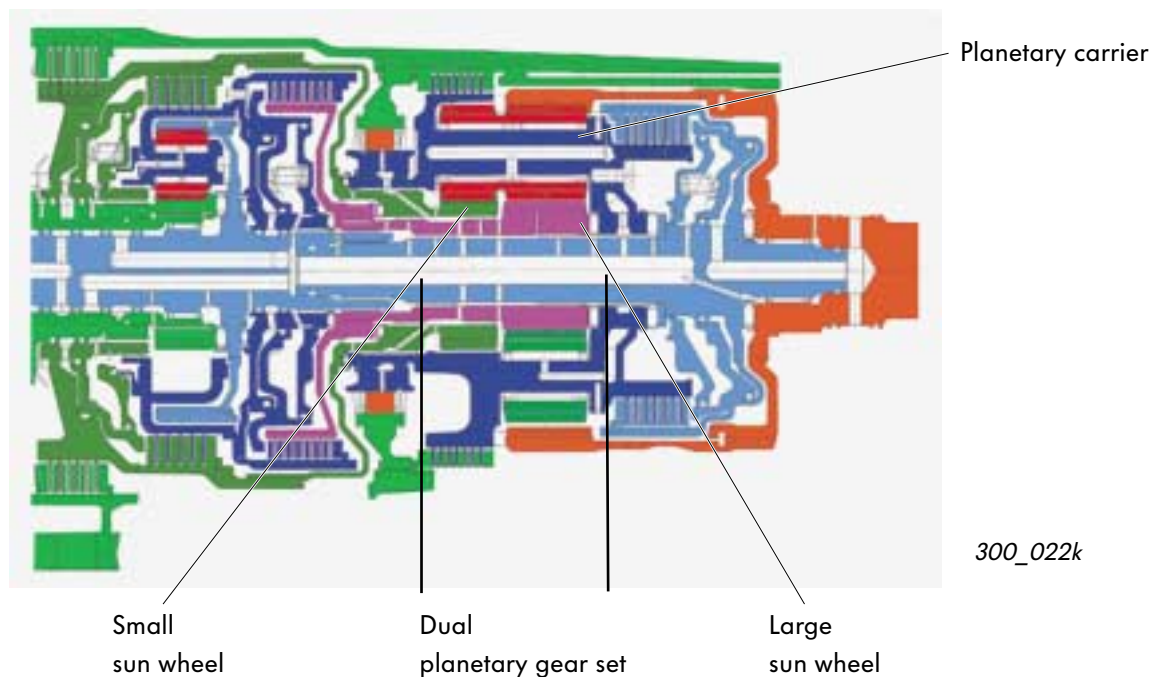
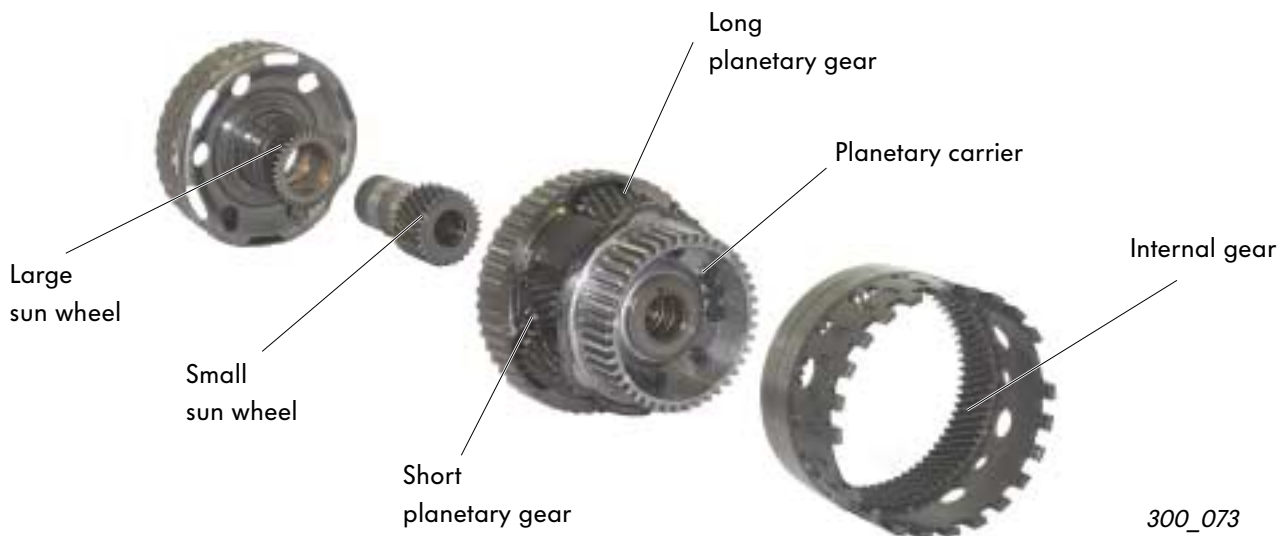
also known as the Ravigneaux planetary gear set, consists of:

- an internal gear
- a planetary carrier
- two sun wheels with different diameters and
- short and long planetary wheels.

The multi-disc coupling K1 provides the connection between the internal gear of the simple planetary gear set and the large sun wheel of the dual planetary gear set.

The multi-disc coupling K3 provides the connection between the planetary carrier of the simple planetary gear set and the small sun wheel of the dual planetary gear set.

The multi-disc coupling K2 provides the connection between the transmission input shaft and the planetary carriers of the dual planetary gear set.



Design of gearbox

The multi-disc couplings

drive the two sun wheels and the planetary carriers of the dual planetary gear set when they are closed.

Depending on the gear to be switched, they are placed under ATF pressure by the control unit for the automatic gearbox via a solenoid valve in the control valve assembly; this closes them. Each multi-disc coupling is supplied with ATF pressure by another solenoid valve. The number of installed disc pairs per coupling varies with the maximum torque that can be transmitted.

The multi-disc coupling K1

is closed in gears 1 to 4 and is controlled by the solenoid valve N90.

It is compensated for centrifugal pressure.

In the V10-TDI, for example, seven multi-disc pairs are installed.

The multi-disc coupling K2

is closed in gears 4 to 6.

It is controlled by the solenoid valve N282.

It is compensated for centrifugal pressure.

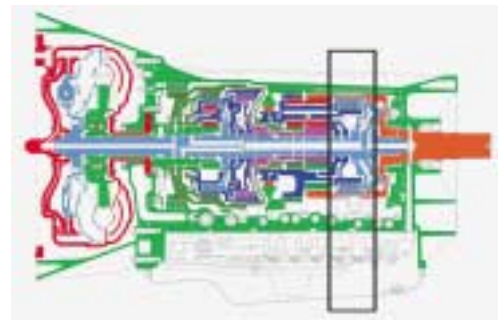
In the V10-TDI, for example, seven multi-disc pairs are installed.



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300_065



300_022d



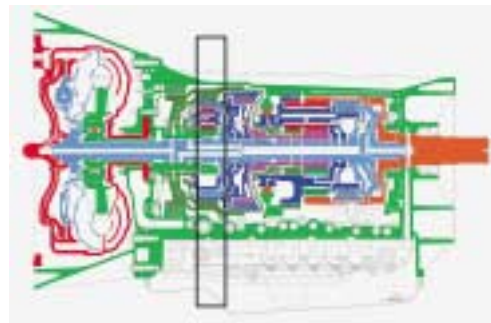
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The multi-disc coupling K3

is controlled by the solenoid valve N92 and is closed in gears 3, 5 and R.

It is compensated for centrifugal pressure.

In the V10-TDI, for example, five multi-disc pairs are installed.



300_022c



Multi-disc
pairs

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Information regarding the design and function of couplings that are compensated for centrifugal pressure can be found in SSP 172.

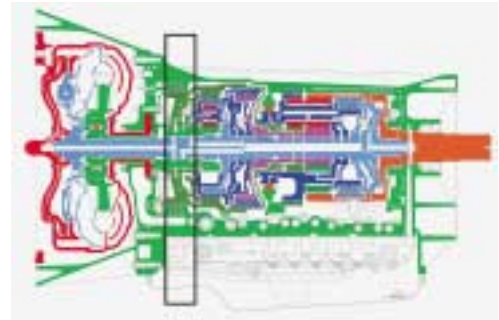
Design of gearbox

The multiple disc brakes

secure parts of the planetary gear sets when they are closed.

To do this, they are submitted to ATF pressure by the control unit for the automatic gearbox via a solenoid valve or via the manual slider.

The multiple disc brakes are supported on the gearbox housing by their exterior discs.



300_022b

The multiple disc brake B1

brakes the small sun wheel of the dual planetary gear set.

It is closed in gears 2 to 6 and is controlled by the solenoid valve N283.

In the V10-TDI, for example, six multi-disc pairs are installed.



300_069

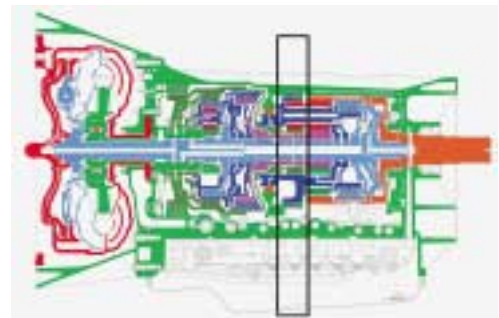
The multiple disc brake B2

brakes the planetary carriers of the dual planetary gear set.

It is controlled without a solenoid valve using the selector lever via the manual slider.

It is closed in Reverse and, in the Tiptronic mode, in 1st gear.

In the V10-TDI, for example, seven multi-disc pairs are installed.



300_022f



300_069