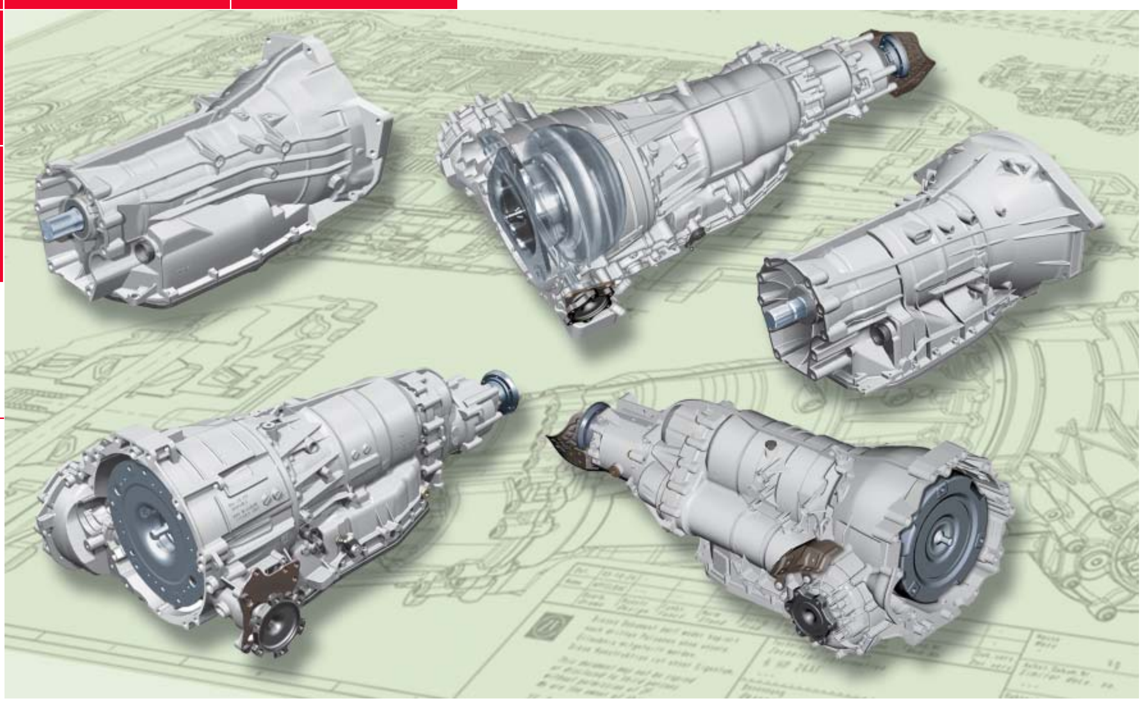
Service Training



6-speed automatic gearbox 09L / 0AT / 0B6 / 0BQ / 09E

Self-Study Programme 385

History of the 6-speed automatic gearbox by ZF - Getriebe GmbH at AUDI

Gearbox technology is currently going through a very creative phase. Numerous new gearbox concepts, such as the automated manual gearbox, the variable automatic gearbox and the dual-clutch gearbox, are now entering into competition with the conventional multi-step automatic gearbox.

The multi-step automatic gearbox is, however, still a highly effective means of torque conversion, particularly in combination with high-performance engines.
With recent developments in particular, e.g. the 0B6 gearbox, it is now possible to literally "feel" the performance of a multi-step automatic gearbox. Want to learn more? Then please turn to page 26 for more information.

This Self-Study Programme is dedicated to the 09E, 09L, 0AT, 0B6 and 0BQ 6-speed automatic gearboxes.
These gearboxes belong to the category of conventional multi-step automatic gearboxes having a torque converter.
They are based on the same design and functional features, and derive from the gearbox line of systems supplier ZF-Getriebe GmbH. The 09E gearbox was initially featured on the Audi A8 ´03 (type 4E).

The 09E gearbox has already been described in detail in SSPs 283 and 284. Both these booklets represent the basis of this Self-Study Programme.
Hence, where the technology is identical, reference is made to SSPs 283 and 284.

A section of this booklet is also dedicated to the 09E gearbox. It describes modifications and new features added to the 09E gearbox since launch.

385_001

2006
0AT
gearbox

The 0AT gearbox is used exclusively on the Audi Q7 (type 4L) (with 3.6 FSI engine) from model year ´07

2007/2008
0B6 gearbox

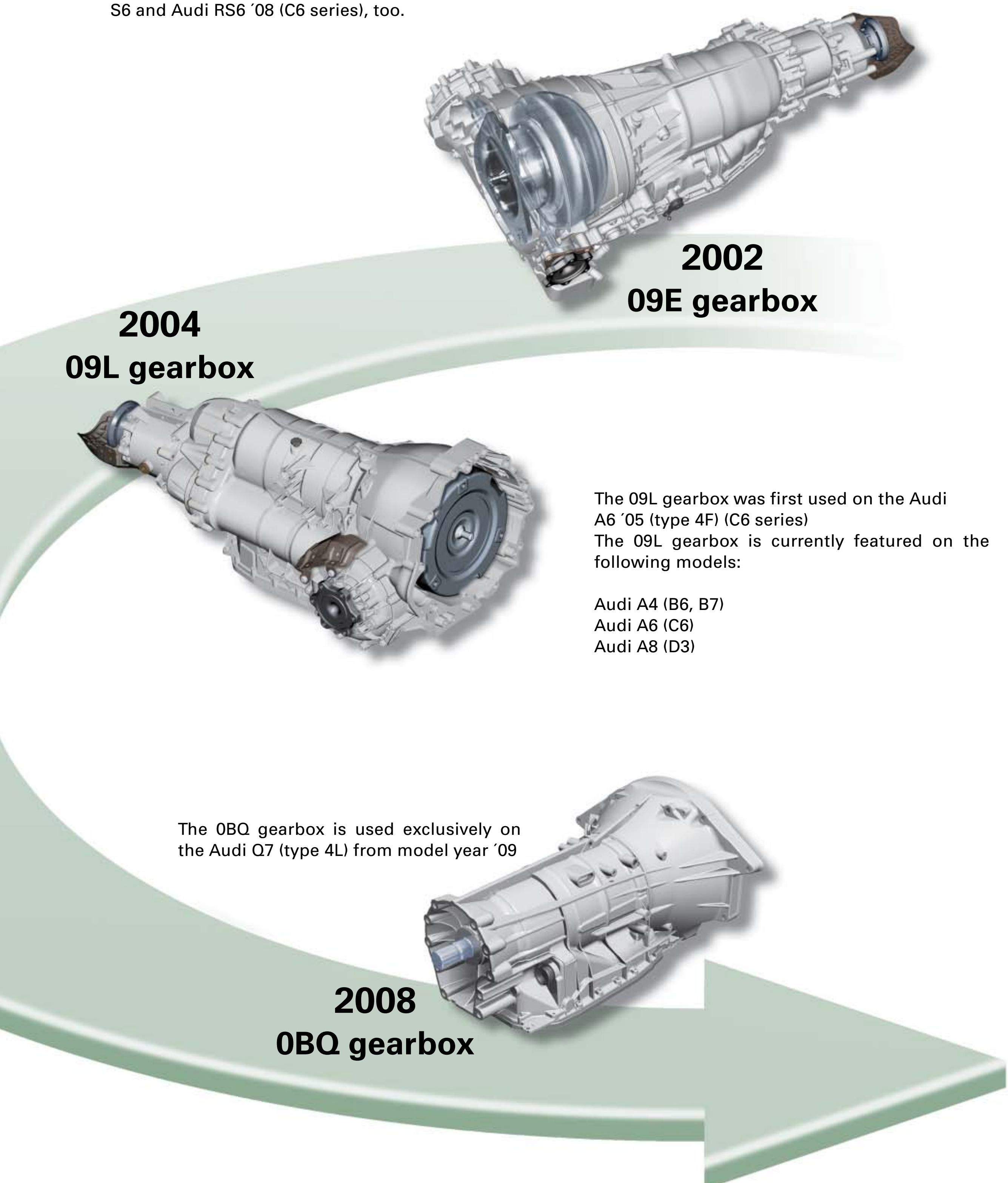
The 0B6 gearbox is used on the Audi A4 ´08 (type 8K), the Audi A5 ´08 (type 8T) (B8 series) and the US-spec Audi Q5

Initially, the 09E gearbox was exclusively designed for use on the Audi A8 ´03 (type 4E) (D3 series). A revised version of the gearbox was later used on the Audi S6 and Audi RS6 ´08 (C6 series), too.

The 09L gearbox was first used on the Audi A6 ´05 (type 4F) (C6 series)
The 09L gearbox is currently featured on the following models:

Audi A4 (B6, B7)
Audi A6 (C6)
Audi A8 (D3)

The 0BQ gearbox is used exclusively on the Audi Q7 (type 4L) from model year ´09



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Note

This Self-Study Programme describes the 09L, 0AT, 0B6 and 0BQ 6-speed automatic gearboxes.
The design of these gearboxes is based on the 09E gearbox. The 09E gearbox was the first 6-speed automatic gearbox of its kind to be used on an AUDI model, and is described in SSPs 283 and 284.
Hence, where the technology is identical, reference is made to SSPs 283 and 284.
Modifications and new features added to the 09E gearbox since launch are subsequently described.

09L, 0AT, 0B6, 0BQ and 09E gearboxes (general topics)

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Gearbox output speed sender G195	SSP 284 page 17
Gear sensor F125	SSP 284 page 20
Gearbox oil (ATF) temperature sender G93	SSP 284 page 21
tiptronic switch F189	refer to section on gearbox periphery
Key information	SSP 284 page 22
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Kick-down information	SSP 284 page 23
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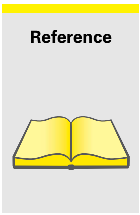
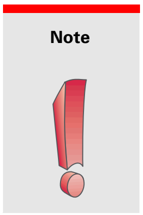
The Self-Study Programme teaches the design and function of new vehicle models, new automotive components or new technologies.

The Self-Study Programme is not a Repair Manual.
All values given herein are intended as a guideline only and refer to the software version valid at the time of preparation of the SSP.

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





Contents

09L gearbox

0AT gearbox

0B6 gearbox

0BQ gearbox

09E gearbox

Immobiliser

Gearbox adaption

Gearbox periphery

Overview

6-speed automatic gearboxes 09E, 09L, 0AT, 0B6 and 0BQ have the following features in common:

– Torque converter with lockup clutch

– M. Lepelletier planetary gearset concept (for 6 forward gears and 1 reverse gear using only 5 shift devices)

– Electro-hydraulic control by means of mechatronics integrated in the gearbox

– Ratio spread and gear ratio steps

– Used in combination with four-wheel drive only

– Dynamic Shift Program - DSP

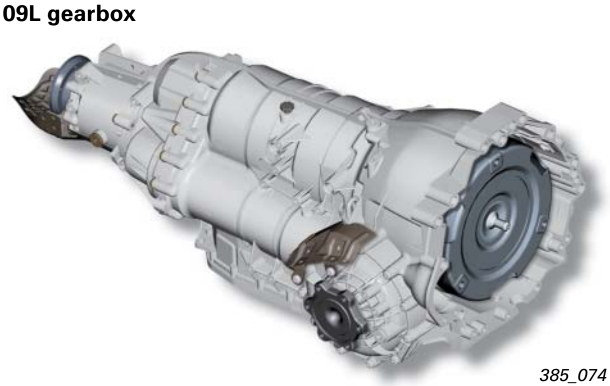
– tiptronic function and sport program

Developed / manufactured by
Service designation
ZF designation
AUDI designation
Gearbox type
Control unit
Engine type
Front-to- rear axle torque split
Weight incl. oil
Ratios
Ratio spread
Max. torque

09E gearbox

385_073

09L gearbox



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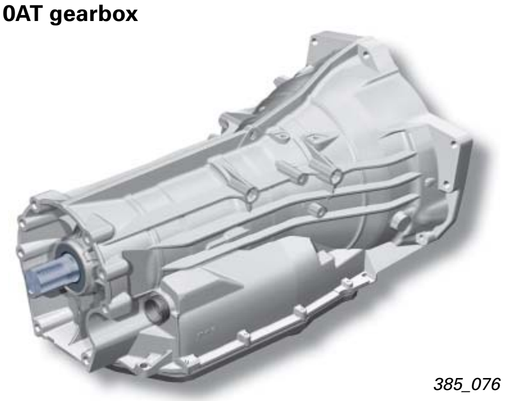
0AT gearbox



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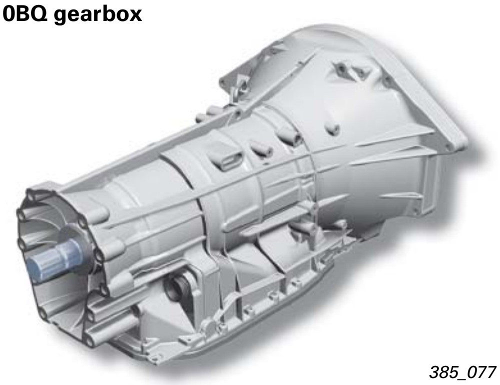
09E	09L	0AT	0B6	0BQ
ZF-Getriebe GmbH Saarbrücken				
09E	09L	0AT	06B	0BQ
6HP-26 A61	6HP-19A	6HP-19X	6HP-28AF	6HP-32X
AL600-6Q	AL420-6Q	AL420-6A	AL651-6Q	AL950-6A
- Electro-hydraulically controlled 6-speed planetary gearbox based on M. Lepelletier planetary gearset concept - Hydrodynamic torque converter with slip-controlled converter lockup clutch				
Mechatronics (integration of hydraulic control unit and electric control unit as a unit) Dynamic Shift Program with separate sport program "S" and "tiptronic" shift program for manual gear-shifting				
Longitudinally mounted gearbox and four-wheel drive, integrated centre differential and front axle drive on the upstream side of the torque converter	Longitudinally mounted gearbox and four-wheel drive, integrated centre differential and front axle drive	Longitudinally mounted gearbox and transfer case combination	Longitudinally mounted gearbox and four-wheel drive, integrated centre differential and front axle drive on the upstream side of the torque converter	Longitudinally mounted gearbox and transfer case combina-tion
Self-locking centre differential with dynamic torque split (in a basic ratio of 50/50 or 40/60 depend-ent on version, see page 13)		---------	Self-locking centre differential with 40/60 front-to-rear asymmetric-dynamic torque split	---------
136 kg - 143 kg	approx. 109 kg - 114 kg	approx. 76 kg	approx. 136 kg	approx. 103 kg
1st gear 4.171, **2nd gear** 2.340, **3rd gear** 1.521, **4th gear** 1.143, **5th gear** 0.867, **6th gear** 0.691, **reverse (R) gear** 3.403				
6.04				
to 700 Nm	**to 500 Nm**	**to 360 Nm**	**to 700 Nm**	**to 1000 Nm**

385_002

0B6 gearbox

385_075

0BQ gearbox



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The 09L gearbox ...

... replaces the previous 5-speed automatic gearboxes 01V and 01L up to an engine torque of 450 Nm.
Fundamentally, it differs from the 09E gearbox in that the latter has a lower torque capacity and uses lighter duty components.

The positioning of the front axle drive (differential) behind the torque converter was adopted from the previous models.

Compared to the previous 5-speed automatic gearbox, the 09L gearbox has the following advantages and improvements:

- Six gear ratio steps
- Wider overall ratio spread (ratio range)
- Higher torque capacity
- Weight reduction by approx. 14 kg (compared to 01V gearbox)
- Increased efficiency
- Improved shift quality
- Higher shifting speeds
- Improved DSP (Dynamic Shift Program)

Electro-hydraulic control

To increase shift speed, particularly when shifting down, the gearshift sequence was enhanced and other functions were developed in combination with the engine management system.

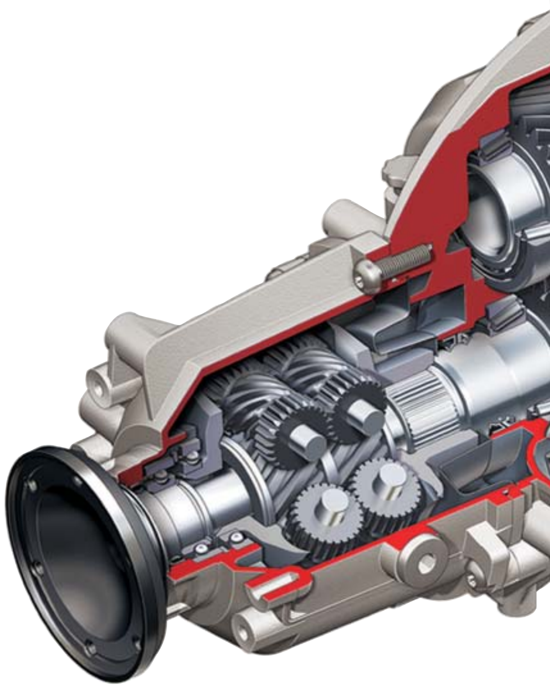
Multiple downshifts are grouped together, contributing to a marked gain in spontaneity. As a result of this modification, the next gearshift is prepared electrically and hydraulically while the first downshift is still in progress, so that it can subsequently be made without any delay.

Overrun downshifts can be shortened by approx. 50 % through the active application of intermediate throttle, in turn leading to a noticeable gain in agility.
This modification markedly improves the spontaneity of downshifts even under slight throttle.

Reference

With model year ´06 and later, specific adaptation values of the 6-speed automatic gearboxes 09E and 09L can be read and deleted using the diagnostic tester. These functions were available for the 0AT, 0B6 and 0BQ gearboxes since launch.
For more information, see page 54 ff.

With the launch of the Audi A6 Avant (model year ´05), the gearbox was integrated in the immobiliser for the first time. For more information, see page 52 ff.



Gear ratio

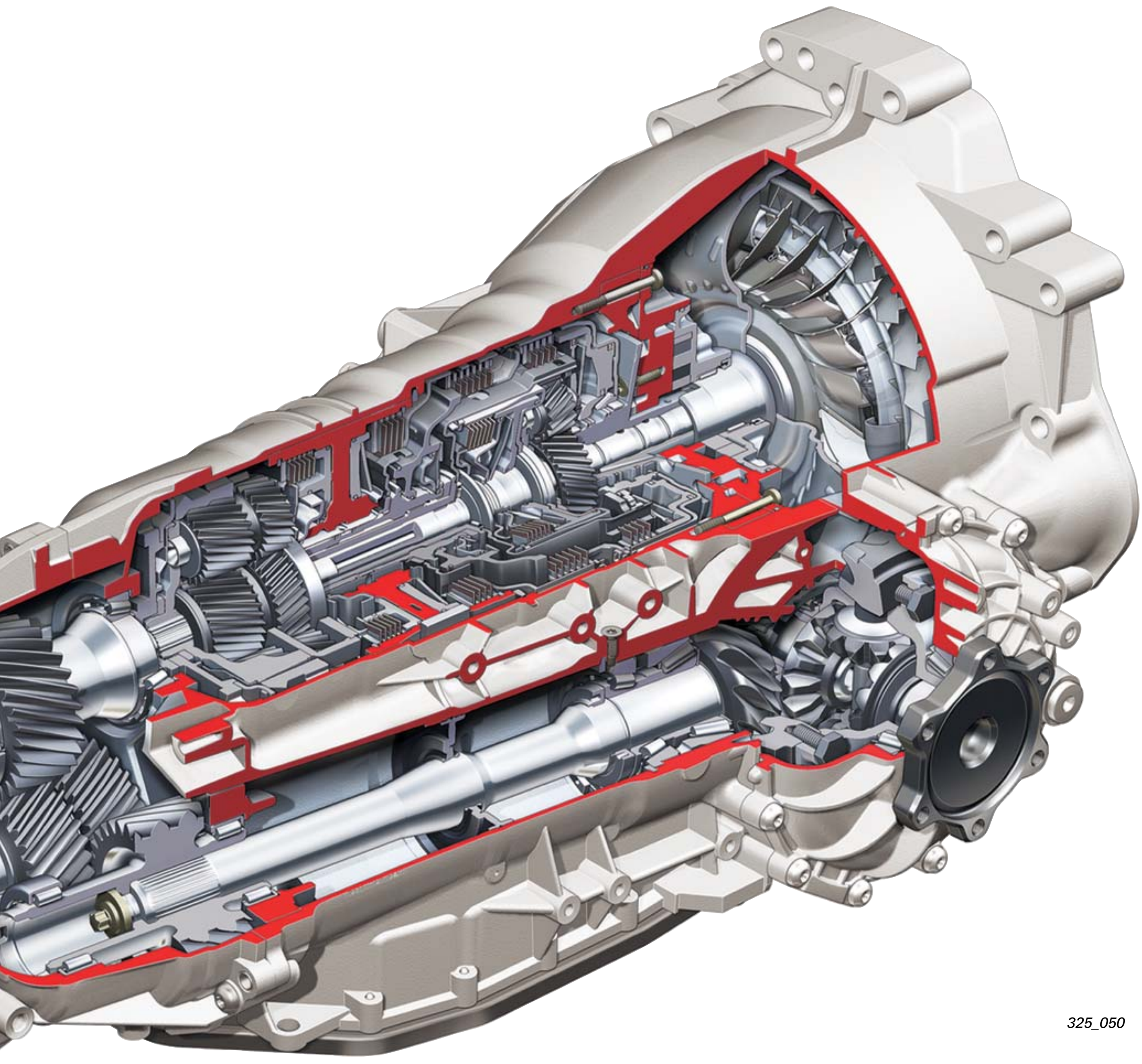
The ratio spread was increased by 22 % over the 01V gearbox.
This has largely been used to implement a smaller starting ratio for enhanced starting dynamics.

The higher ratio spread means, firstly, that more wheel torque is available for vehicle acceleration in the low gears and, secondly, that the vehicle can be run at lower engine speeds during motorway driving, which in turn means less noise and better fuel economy.

The basic gear ratio configuration for maximum speed is determined by the axle ratio, and is different for diesel engines and petrol engines.
In the case of diesel engines, top speed is achieved in 6th gear.
In the case of petrol engines, top speed is achieved in 5th gear.
Depending on engine power, maximum speed is achieved in 5th or 6th gear.

Comparison of the 09L and 01V gearbox ratios

	09L Gear ratio	01V Gear ratio
1st gear	4.171	3.665
2nd gear	2.340	1.999
3rd gear	1.521	1.407
4th gear	1.143	1.000
5th gear	0.867	0.742
6th gear	0.691	
Reverse (R)gear	3.403	4.096
Ratio spread	6.04	4.94



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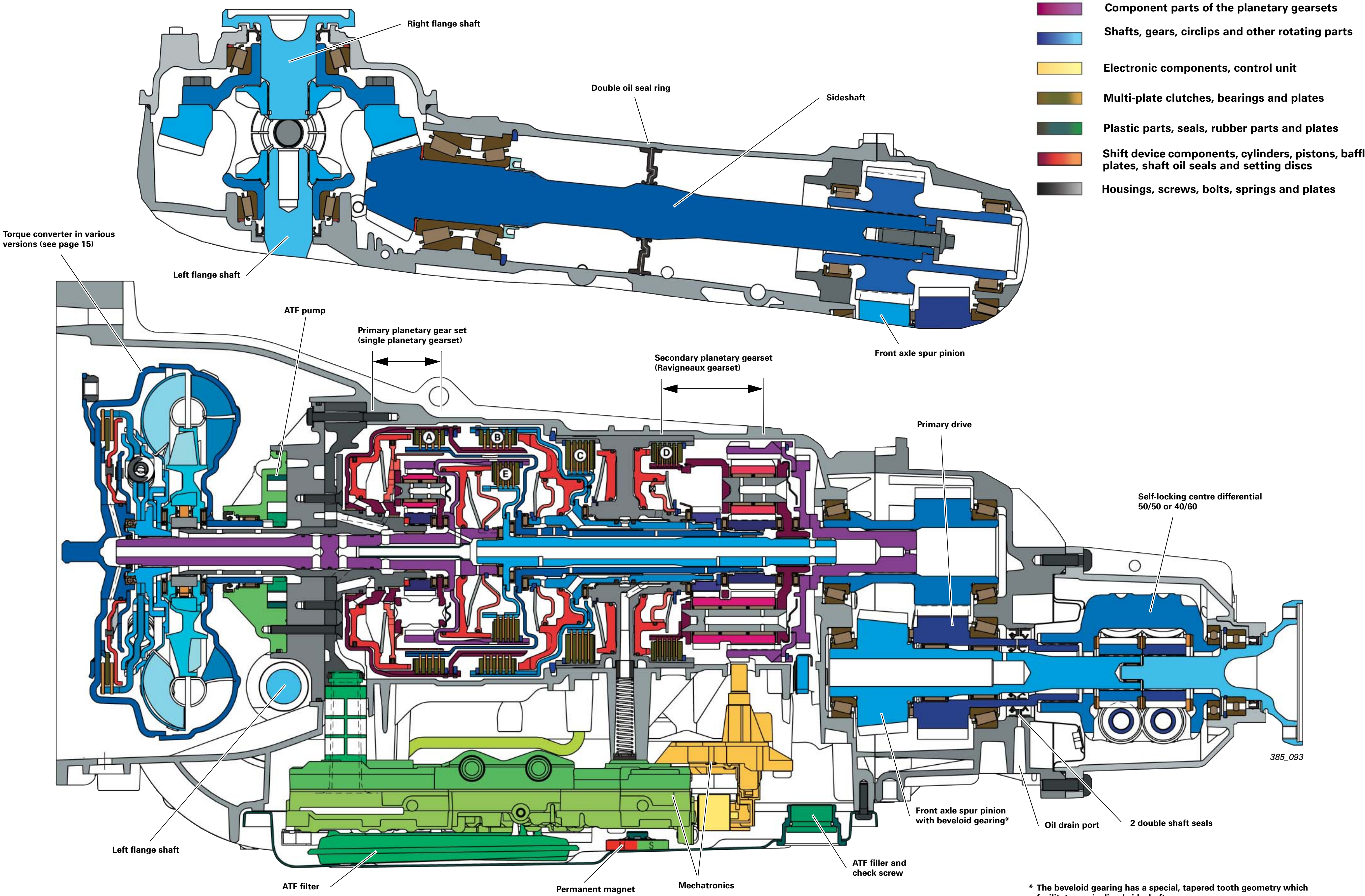
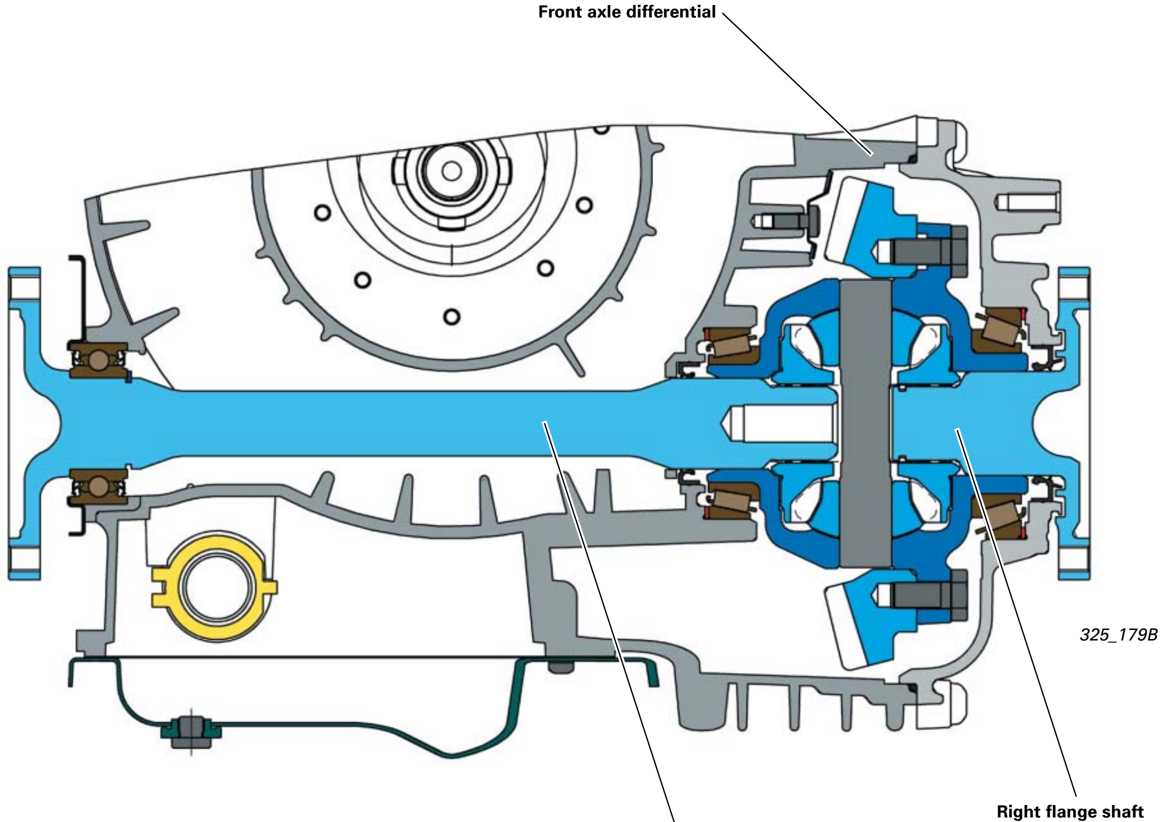
Sectional view of the 09L gearbox



* The beveloid gearing has a special, tapered tooth geometry which facilitates an inclined sideshaft.



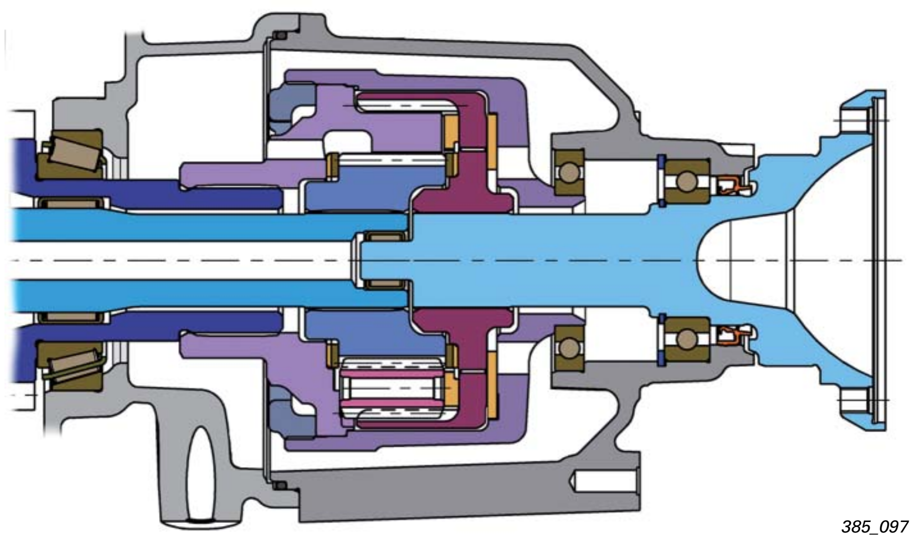
325_179B

Self-locking centre differential with 40/60 torque split

The new type C centre differential is installed on Audi A6 models from ´09. Type C is a self-locking centre differential with an asymmetric/dynamic torque split (in a basic ratio of 40/60 front to rear).
For a description of this centre differential, refer to SSP 363 (page 18 ff.).

This type of differential is also used with the 09E gearbox on the Audi S6 and Audi RS6.

For information on the self-locking 50/50 centre differential, refer to SSP 76.



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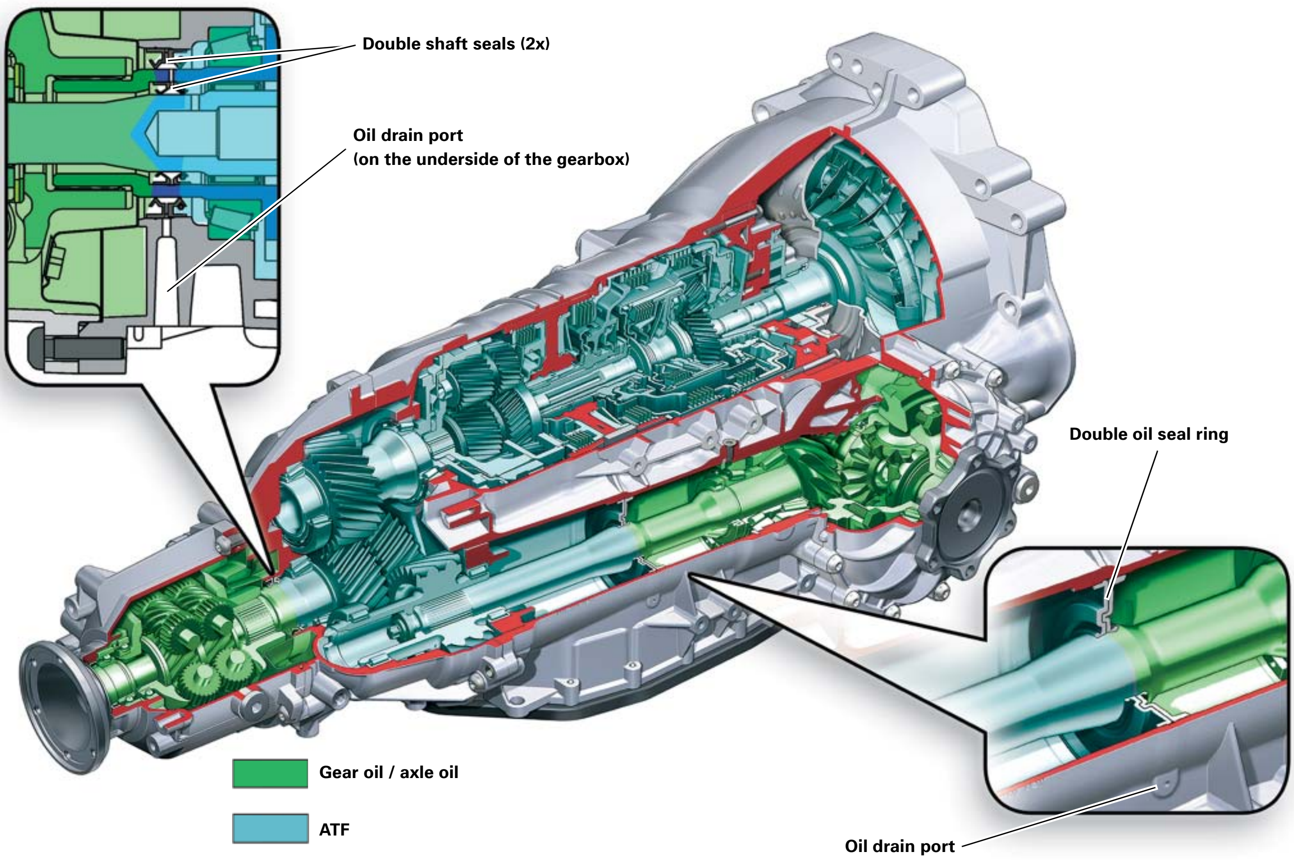
Oil supply and lubrication

The 09L gearbox has three separate oil supply systems carrying three different types of oil:

– One ATF oil supply for the planetary gearbox, the hydraulic control unit, and the torque converter *
– One oil supply for the transfer case (gear oil with STURACO**)
– One oil supply for the front axle drive (gear oil without STURACO**)



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Double shaft seals separate the different neighbouring oil chambers from each other. If the double shaft seals are leaking, oil will escape from the corresponding oil drain port.

Hydraulics (lubrication)

A marked reduction in the leakage within the hydraulic system, thanks mainly to the use of new pressure regulators, has made it possible to use a smaller oil pump. The oil pump in the 09L gearbox consumes only 50 % of the power of the oil pump in the 01V gearbox.

A lower-viscosity ATF is again used in the 09L gearbox (as in the 09E gearbox). This greatly reduces torque loss, especially
at low temperatures.

Both modifications provide not only better fuel efficiency, but also allow a higher maximum speed to be achieved.

*** Notes on the ATF:**

The 09L gearbox comes with two different ATF specifications. A new ATF was introduced at SOP in Feb. 2005.

**** Notes on the gear oil (axle oil):**

STURACO is an oil additive which is designed to reduce stress in the centre differential thereby enhancing ride comfort.

This oil additive is unsuitable for the front axle drive and, for this reason, must not be used here.

*/** Therefore, make sure that the ATF / gear oils and axle oils are correctly assigned in accordance with the part numbers specified in the Electronic Parts Catalogue (ETKA).

Torque converter

Different torque converters are used depending on engine type. They are matched to the various engine versions with their different performance specifications and characteristics. The torque converters are identified by means of code letters. The corresponding gearbox codes can be found in the Workshop Manual.

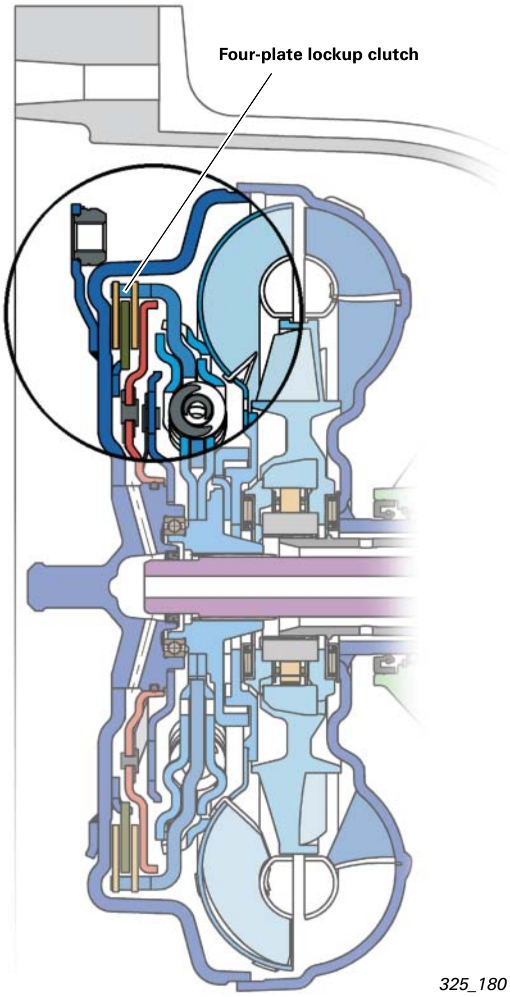
Special torque converter types:

When the lockup clutch is open, a torque converter is very effective at damping the torsional vibration produced by the engine.
This effect is deactivated when the lockup clutch is closed. To ensure sufficient vibration damping during this operating phase, the torque converters of the 09L gearbox have turbine torsion dampers (TTD converters) when used in combination with 4 and 6 cylinder engines.
V8 engines run more smoothly, so do not require this special type of torque converter. In this case, a torsion damper converter (TD converter) is used, or torsional vibration damping is dispensed with entirely.

In the case of the turbine torsion damper converter (TTD converter), the torsion damper is arranged downstream of the turbine.
The turbine therefore belongs of the primary mass and is decoupled from the input shaft.

In the case of the torsion damper converter (TD converter), the torsion damper is located on the upstream side of the turbine. The turbine belongs to the secondary mass and vibrates in sync with the input shaft.

Distributing the primary mass and secondary mass in this way ensures optimal vibration damping, depending on engine-gearbox combination.



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Torque converter lockup clutch

In the case of the 09L gearbox, the maximum permissible friction of the lockup clutch is increased by using four friction plates.

This allows controlled operation of the lockup clutch to be greatly extended, which in turn improves the overall efficiency of the powertrain.

To ensure the durability of the lockup clutch under load, the correct ATF is required. It was developed to meet exacting requirements.

Reference

Refer to the information and installation instructions given for the torque converter in SSP 367 (page 10 ff.) and in the Workshop Manual.

Notes on replacing the torque converter

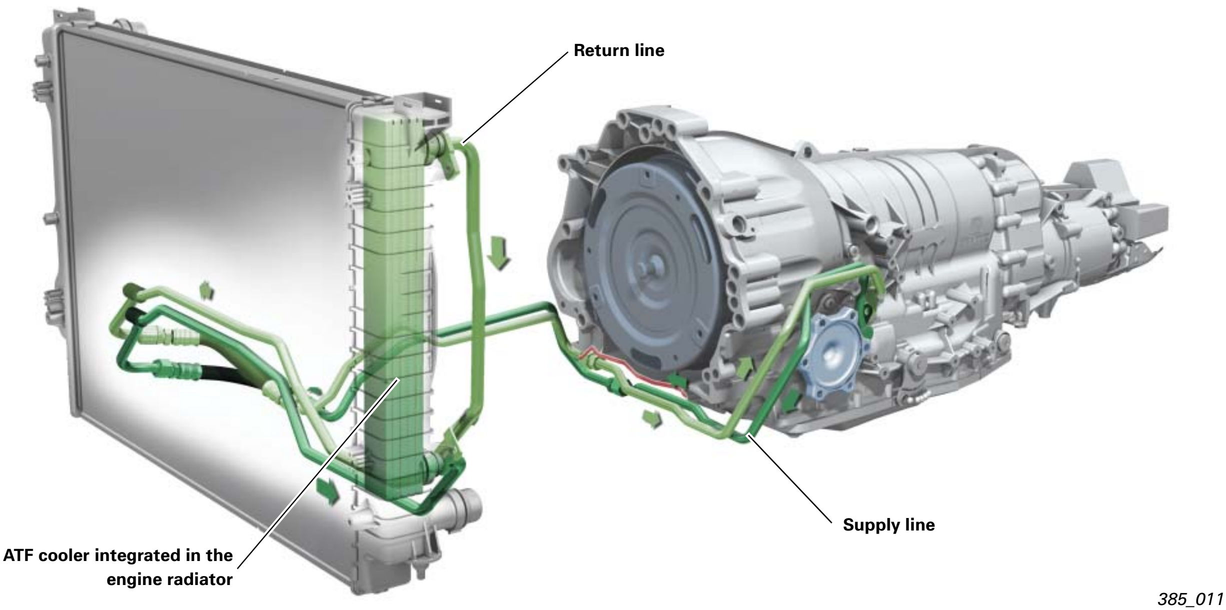
When replacing the torque converter or the gearbox, pay attention to correct assignment of the torque converter (refer to Workshop Manual, Identification codes, Assignment of engine-gearbox units).

ATF cooling

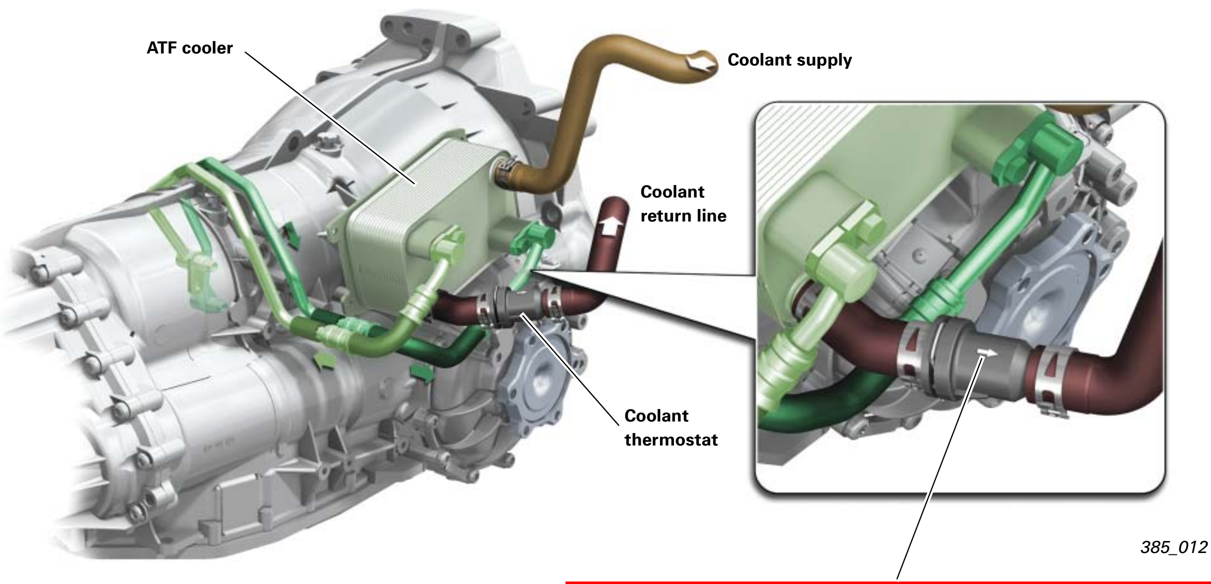
The ATF cooler is integrated in the engine radiator on the Audi A4 and Audi A6, and therefore is an integral part of the engine coolant system (standard version). It provides additional ATF heating during the warm-up phase of the engine. This allows the ATF to reach its operating temperature quickly.

The ATF cooler on the Audi A8 is the integrated in the engine cooling system as a separate component. To shorten the warm-up phase of the engine, the ATF cooling system is controlled in a temperature dependent manner. A coolant thermostat in the ATF cooling system opens the coolant system when the coolant temperature exceeds approx. 80°C.

ATF cooling system in the Audi A4/A6 (standard version)



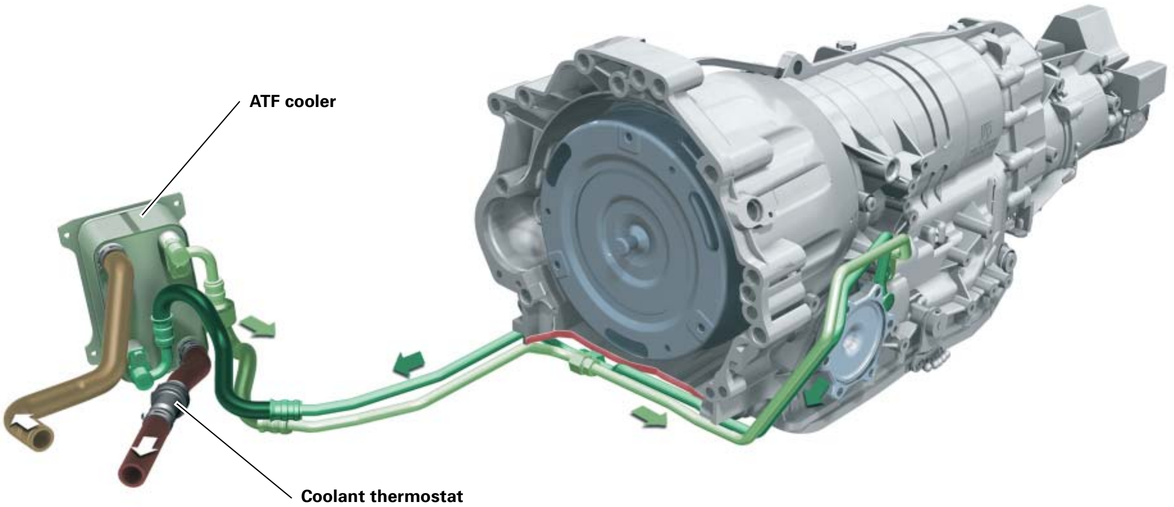
ATF cooling system of the Audi A8 - V6 3.0l TDI



Note

Pay attention to installation of the coolant thermostat in the correct position (arrow). If the thermostat is installed in the wrong position, it will not be able to regulate the coolant temperature.

ATF cooling system of the Audi A8 - V6 and V8 petrol engine



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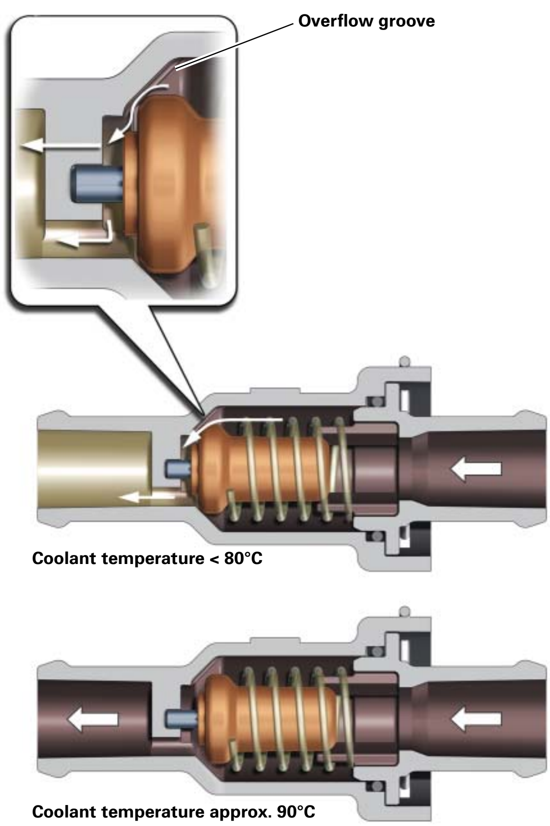
Note

Please note that impurities in the ATF (e.g. abrasion, chips, emulsions) will disperse and deposit throughout the ATF cooling system. The ATF cooler and the ATF lines must, therefore, be flushed thoroughly after repairing the gearbox and before installing a new gearbox.
To flush the individual components, the lines most be disconnected from the radiator. Make sure that all impurities are removed. If in doubt, components such as the ATF cooler must be replaced. Residual impurities can lead to complaints and/or cause gearbox damage.

Coolant thermostat

An expanding wax thermostat with an integrated bypass (bypass thermostat) is used as a coolant regulator.
An overflow groove on the valve seat acts as a bypass, resulting in a very low but continuous coolant flow. A continuous through-flow is necessary to heat the thermostat, thus allowing the temperature to be regulated.
The coolant thermostat is integrated in the coolant return line of the ATF cooler.



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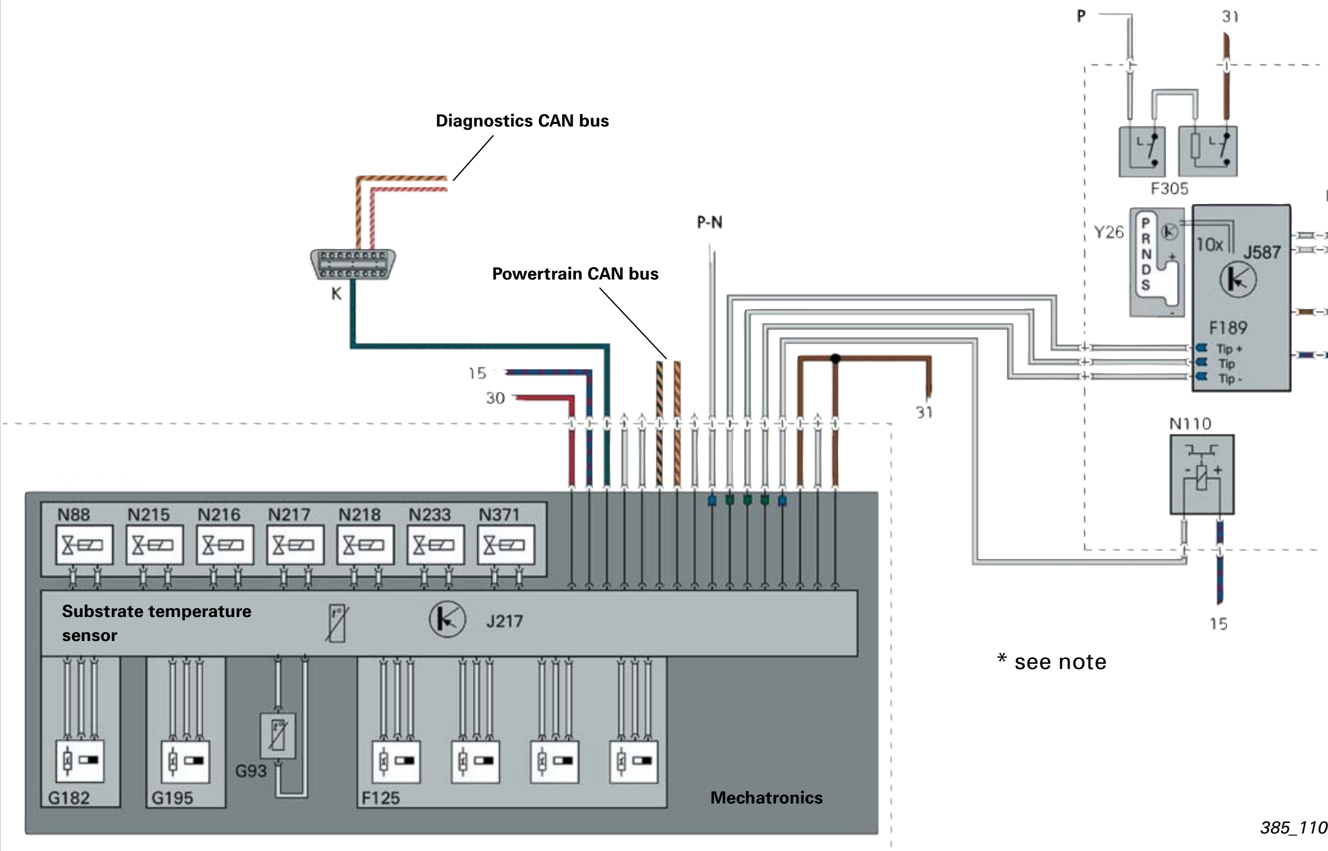
Note

As the overflow groove is relatively small in size (approx. 2 mm x 0.7 mm), impurities in the cooling system may clog it. If this occurs, the temperature regulation system will not function because heat transfer to the thermostat will be disrupted (no coolant circulation).

If complaints are made regarding excessively high ATF temperature, then the oil supply and the cooling circuit leading to the ATF cooler and the coolant thermostat must be checked.

Function diagram (general*)



Legend

F125 Gear sensor
F189 tiptronic switch
F305 Gear selector position P switch

G93 Gearbox oil (ATF) temperature sender
G182 Gearbox input speed sender
G195 Gearbox output speed sender

J217 Automatic gearbox control unit
J587 Selector lever sensors control unit

N88 Solenoid valve 1 (not with 0B6 gearbox)
N110 Selector lever lock solenoid
N215 Electrical pressure control valve -1-
N216 Electrical pressure control valve -2-
N217 Electrical pressure control valve -3-
N218 Electrical pressure control valve -4-
N233 Electrical pressure control valve -5-
N371 Electrical pressure control valve -6-
N443 Electrical pressure control valve -7- (with 0B6 gearbox only (in lieu of N88))

Y26 Selector lever position indicator unit

P P-signal to entry and start authorization switch E415 (for ignition key removal lock function)

P-N P/N signal to entry and start authorization control unit J518 (for start control function)

K Bidirectional diagnostic line (K-wire)

*** General notes on the function diagram**

The same function diagram of the mechatronics applies to gearboxes 09E, 09L, 0AT and 0BQ. The function diagram of the mechatronics in the 0B6 gearbox differs only in that 7 electrical pressure control valves are used and there is no solenoid valve N88. The gearshift mechanisms differ according to vehicle type and model year. For more information, see page 74 ff.

Dynamic Shift Program - DSP

To accentuate the sporty character of Audi vehicles, the driving strategy was refined.

In both D and S modes, different shift programs are implemented in dependence on accelerator gradients, vehicle acceleration and transverse acceleration. The result is that unwanted up-shifts are suppressed during sporty driving, e.g. while cornering.

The initial drive-away process is evaluated so that the gearbox can adapt very quickly to different shift characteristics both in D and S mode, in turn allowing even faster adaption of the gearbox to driver type.

To fulfill the comfort requirements of Audi customers, different clutch set-ups were implemented for selector positions D, S and tiptronic. In Sport and tiptronic mode, a more spontaneous shift map is selected, resulting in reduced shift times.

In D mode, the emphasis is on comfort, so shift times are slightly longer.

Mechatronics

As already described on page 10, the mechatronics were revised and improved with the rollout of the 09L gearbox.

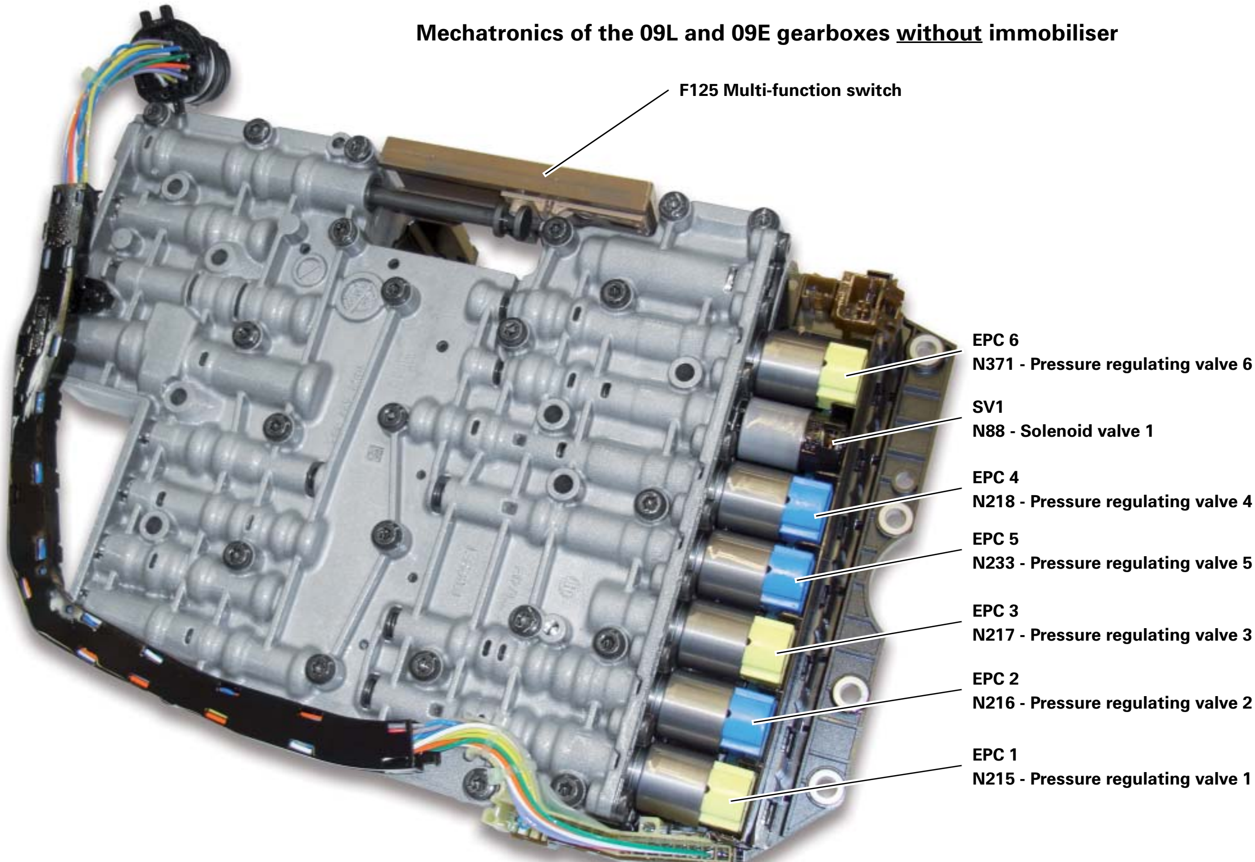
A major modification is the integration of the immobiliser into the gearbox control unit (see page 52). To this end, adjustments to the electronic and hydraulic control units were necessary.

The only physical difference between a mechatronics system with or without immobiliser is the way the electrical pressure valves (EPC) are configured.

These modifications have also been adopted for the 09E gearbox.

All 0AT and 0BQ gearboxes have a mechatronics with integrated immobiliser.

Mechatronics of the 09L and 09E gearboxes <u>without</u> immobiliser



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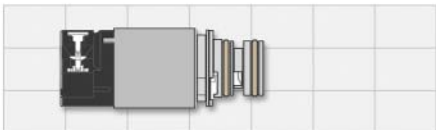
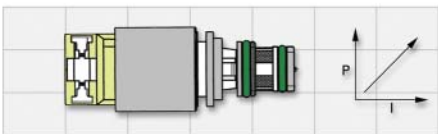
SV1



N88 is an electrically actuated solenoid valve. It is a so-called 3/2 - way valve, i.e. it has 3 terminals and 2 switch positions (open / closed, or on / off).

The N88 is activated by the gearbox control unit and serves to switch the hydraulic valves.

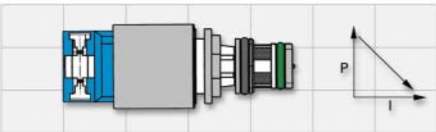
EPC 1, 3 and 6
(* plus EPC 2 and 4 with immobiliser)



Pressure range	**0 to 4.6 bar**
Operating voltage	**12 V**
Resistance at 20°C	**5.05 ohms**
Rising characteristic curve	

EPC 1 (N215) Clutch valve, clutch A
EPC 3 (N217) Clutch valve, brake C
EPC 6 (N371) Lockup clutch

EPC 2, 4 and 5 (only EPC 5 with immobiliser)**



Pressure range	**4.6 to 0 bar**
Operating voltage	**12 V**
Resistance at 20°C	**5.05 ohms**
Falling characteristic curve	

***EPC 2 (N216) Clutch valve, clutch B**
***EPC 4 (N218) Clutch valve, brake D and clutch E**

****EPC 5 (N233) System pressure regulation**

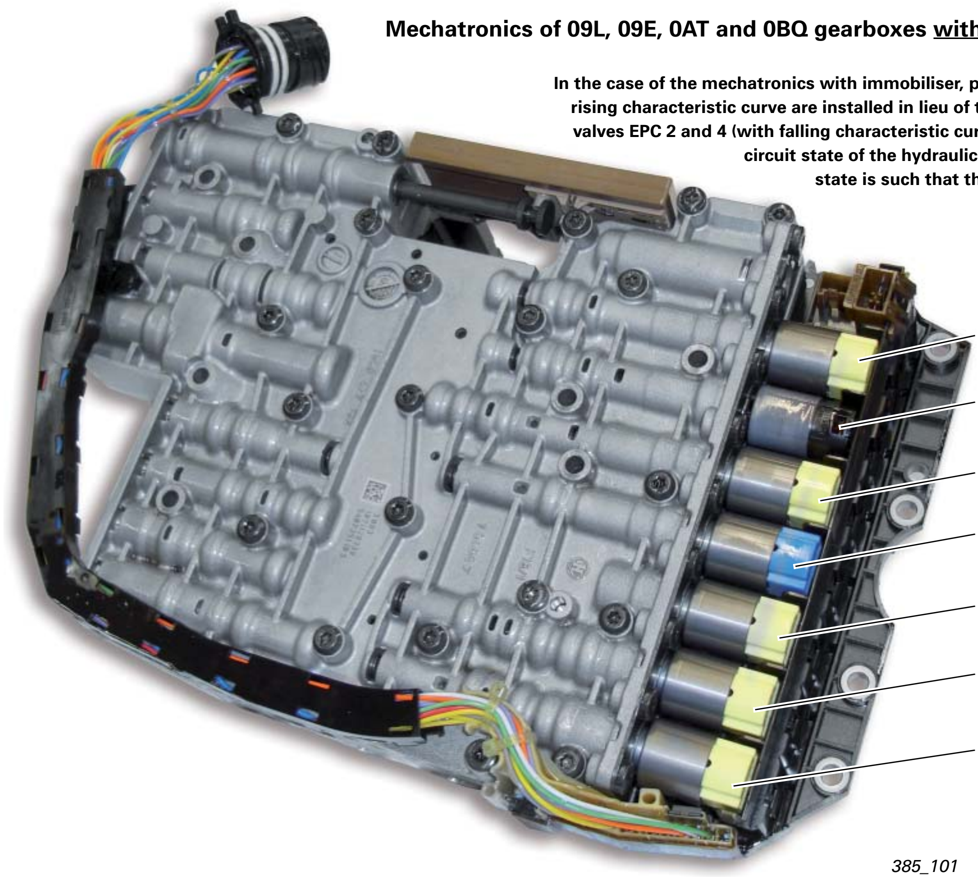
P = pressure
I = current

385_107

Valves with a rising characteristic curve for the mechatronics system with immobiliser

Mechatronics of 09L, 09E, 0AT and 0BQ gearboxes <u>with</u> immobiliser

In the case of the mechatronics with immobiliser, pressure regulating valves with a rising characteristic curve are installed in lieu of the previous pressure regulating valves EPC 2 and 4 (with falling characteristic curve). Consequently, the hydraulic circuit state of the hydraulic control unit in the de-energised state is such that the shift devices cannot establish positive engagement.



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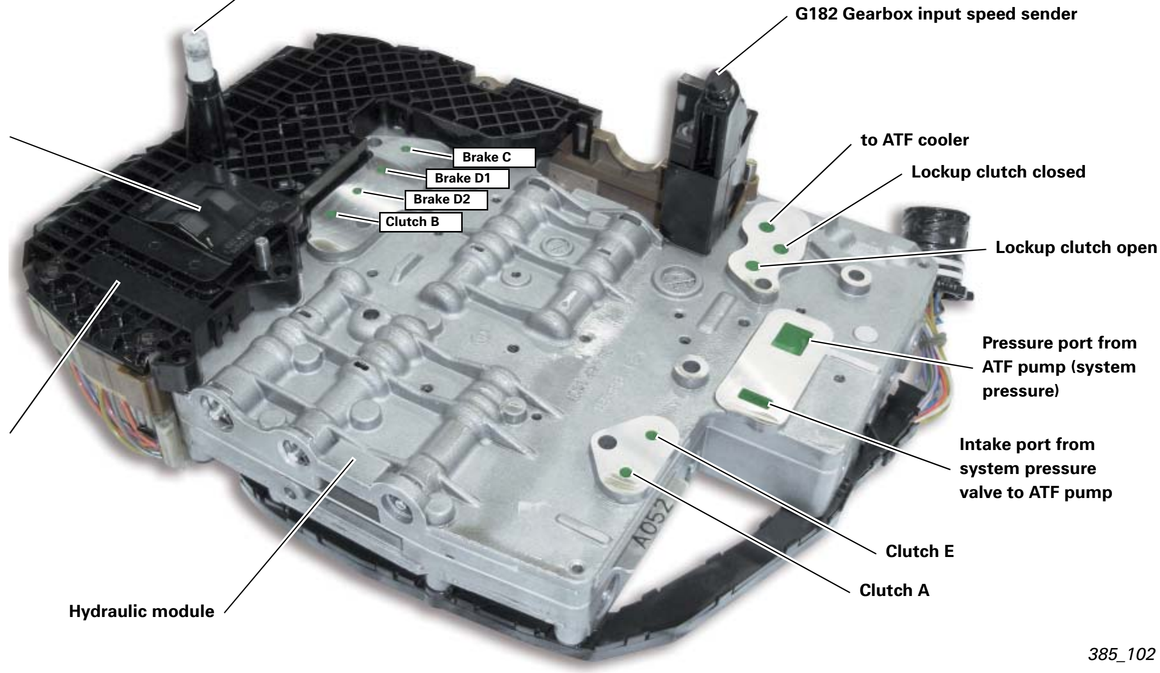
Mechatronics of 09L, 09E, 0AT and 0BQ gearboxes with or without immobiliser

Components and hydraulic interfaces



385_102

Note

A gearbox integrated in the immobiliser has no hydraulic-mechanical limp-home function. See page 52.

Reference

For more information about the mechatronics and the sensors / actuators, refer to SSP 284.

The 0AT gearbox...

... is a derivative of the 09L gearbox. It was developed specially for the Audi Q7, and is initially earmarked for the 3.6L FSI engine.
The 0AT gearbox was designed as an independent component. This means that the front axle gearbox and transfer case are not integrated in the gearbox, as is otherwise usual with Audi models having a quattro powertrain and longitudinally mounted gearbox.

Power is transmitted to the front and rear axles via the 0AQ transfer case with self-locking centre differential and asymmetric/dynamic torque split.

Special features for off-road use

– A special low-level ATF intake point and high ATF capacity ensure oil intake during off-road use. See page 23

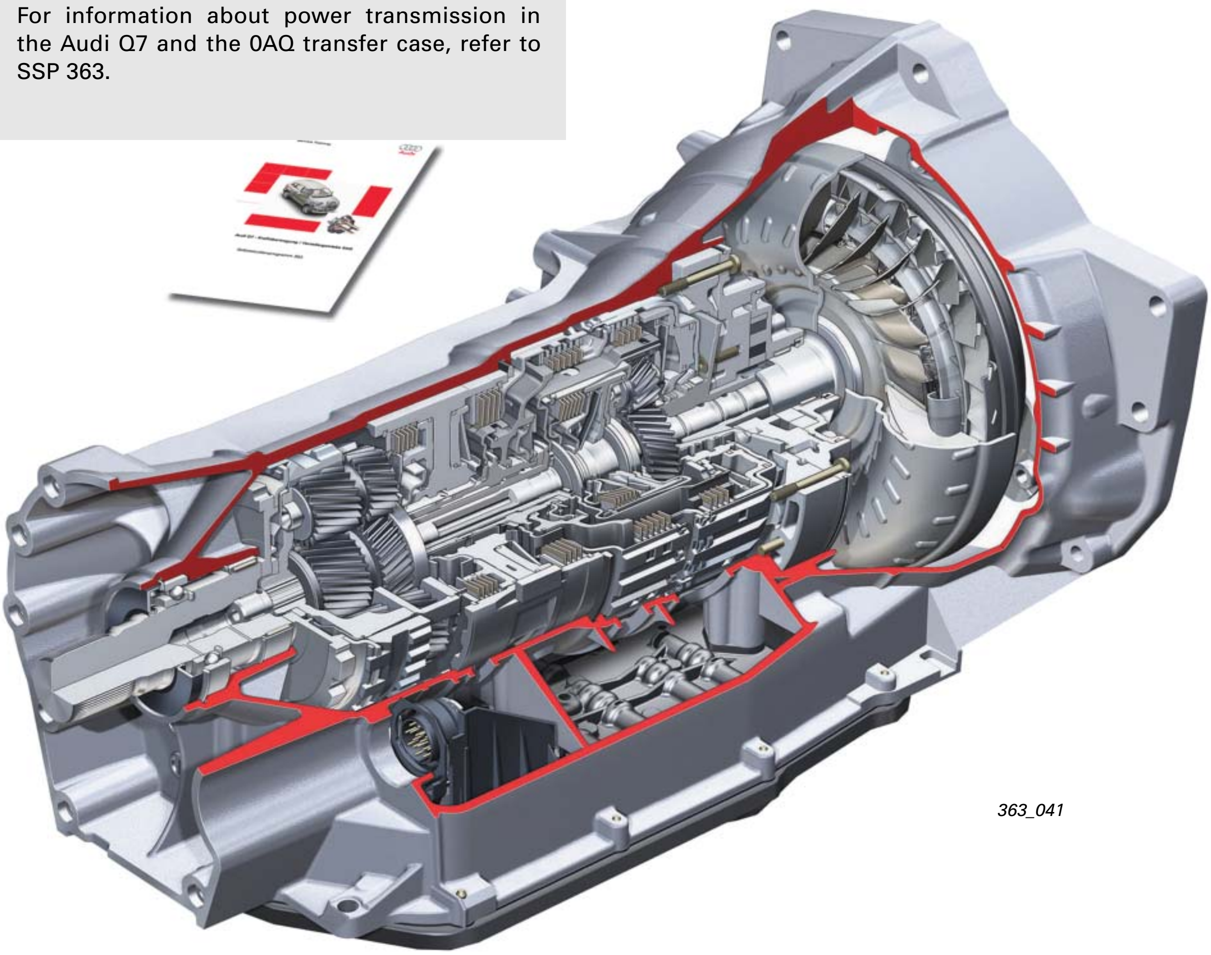
– A high-capacity ATF cooler keeps the ATF temperature at a safe level. See page 24

– The elevated gearbox breather hose prevents the ingress of water into the gearbox even under adverse conditions.

– A large capacity torque converter with a lockup clutch reduces heat build-up in the ATF and allows power to be transmitted directly.

Reference

For information about power transmission in the Audi Q7 and the 0AQ transfer case, refer to SSP 363.



363_041

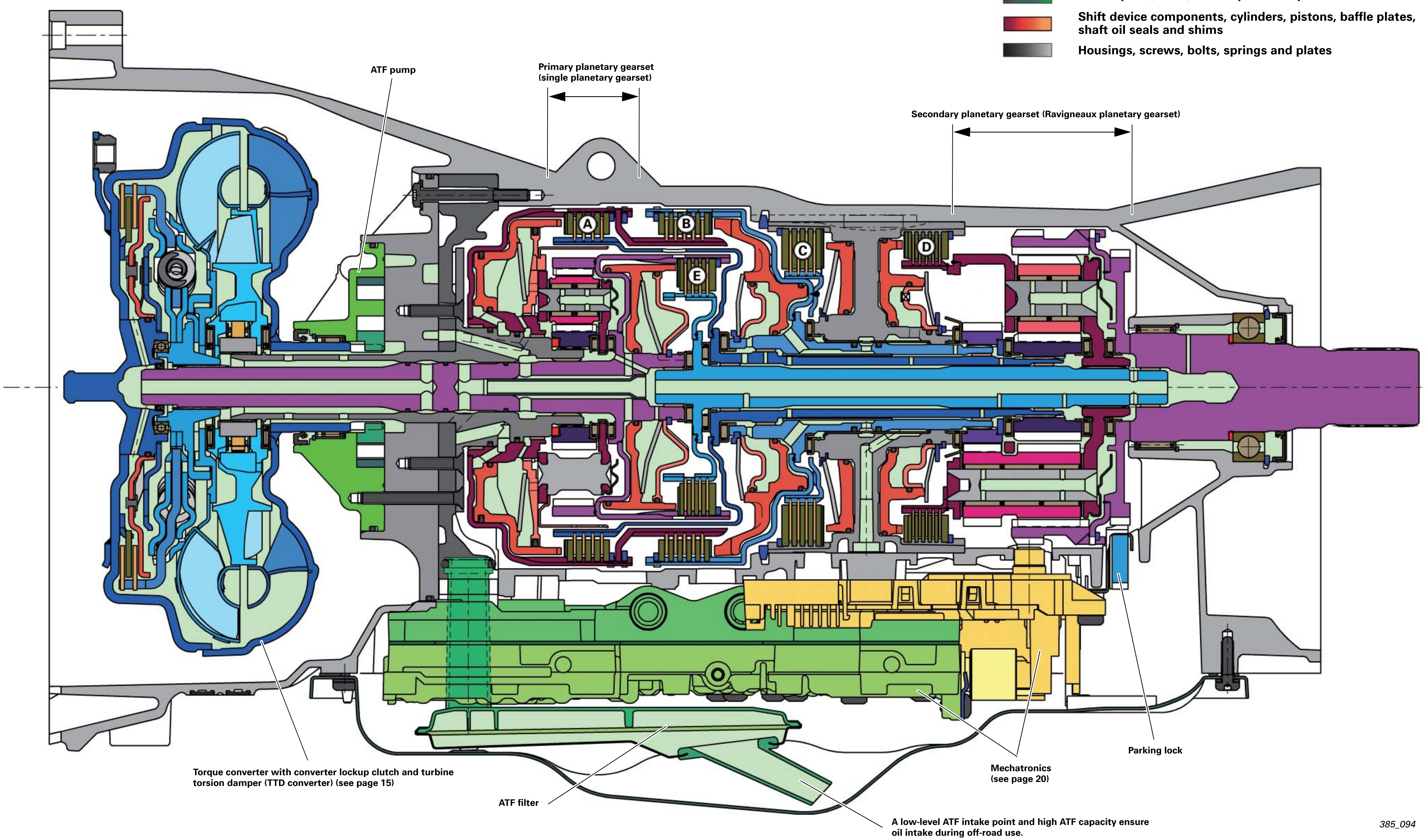
Reference

The 0AT gearbox is integrated in the immobiliser system. For more information, see page 52 ff.

With 6-speed automatic gearbox 0AT, it is possible to read certain gearbox adaption values using the diagnostic tester and to delete adaption values. For more information, see page 54 ff.

Sectional view of the 0AT gearbox

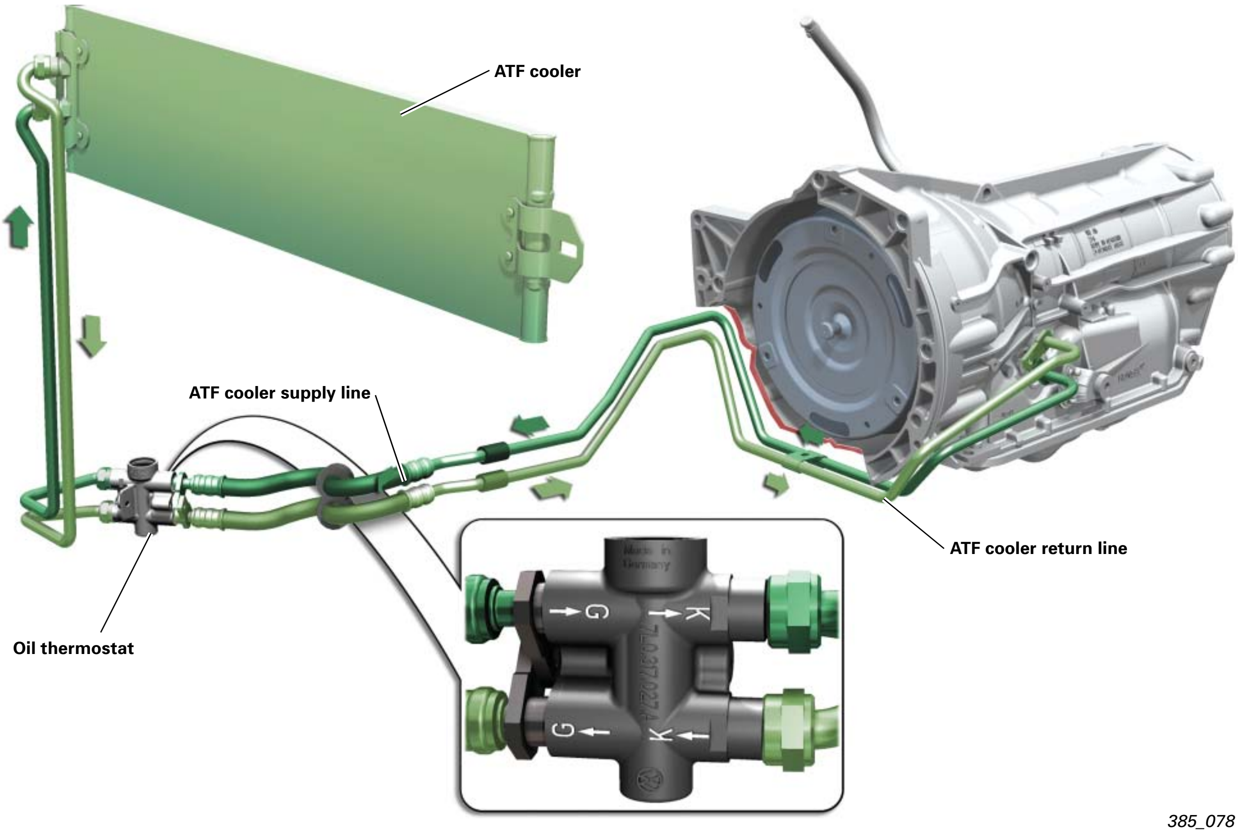
- Hydraulic parts, hydraulic control unit and ATF carrying parts
- Component parts of the planetary gearsets
- Shafts, gears, circlips and other rotating parts
- Electronic components, control unit
- Multi-plate clutches, bearings and plates
- Plastic parts, seals, rubber parts and plates
- Shift device components, cylinders, pistons, baffle plates, shaft oil seals and shims
- Housings, screws, bolts, springs and plates



385_094

ATF cooling system (in the Audi Q7)

To shorten the gearbox warm-up phase, the ATF cooling system is controlled by a thermostat.
In the Q7, an oil-air heat exchanger is used as an ATF cooler.
The ATF cooler is placed in front of both the radiator and air conditioning compressor, when viewed in the direction of travel.



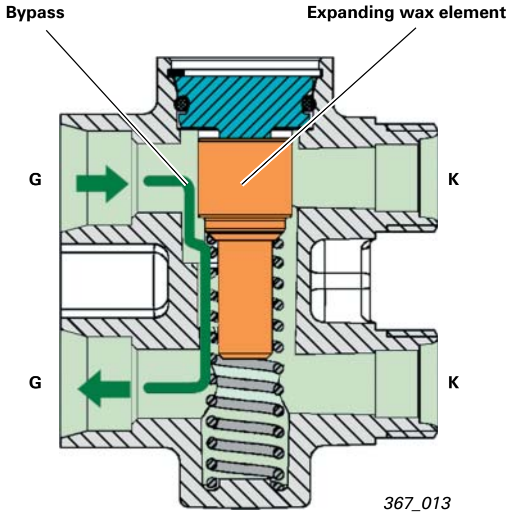
385_078

Oil thermostat

The thermostat is integrated in the supply and return lines of the ATF cooling system.
Use is made of an expanding wax thermostat with integrated bypass (bypass thermostat).

Note

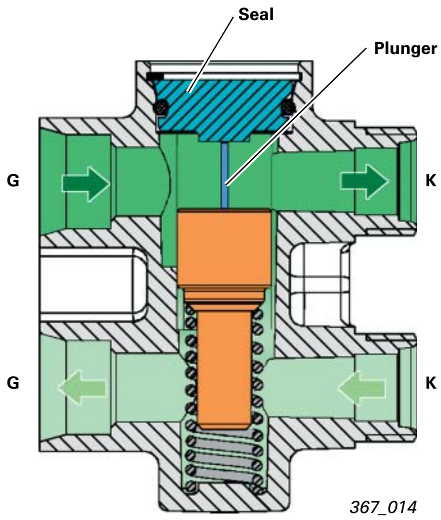
Please note that impurities in the ATF (e.g. abrasion, chips, emulsions) will disperse and deposit throughout the ATF cooling system. The ATF cooler and the ATF lines must, therefore, be flushed thoroughly after repairing the gearbox and before installing a new gearbox.
For this purpose, the lines must be disconnected from the thermostat and the cooler in order to flush the individual components.
Make sure that all impurities are removed.
If in doubt, components such as the ATF cooler or thermostat must be replaced.
Residual impurities can lead to complaints and/or cause gearbox damage.



G = to or from gearbox
K = to or from cooler

Thermostat closed

The expanding wax element also acts as the thermostat slide valve and regulates ATF supply to the cooler. In the closed state, a small fraction of the ATF flows through the bypass thereby heating the expanding wax element.
At a temperature of approx. 75°C, the plunger of the expanding wax element begins to push downwards against the force of the spring, thereby opening the inlet to the cooler (see figure below).



Thermostat open

At a temperature of approx. 90°C or higher, the thermostat is fully open.

Note

If the cooling system is opened (draining the ATF cooler) during repairs, the ATF must be heated to a temperature of at least 90°C by carrying out a test drive in order to set the ATF level correctly.
This ensures that the ATF cooler is filled. The ATF level must be set after the ATF has cooled down to the normal test temperature (refer to Workshop Manual).

Note

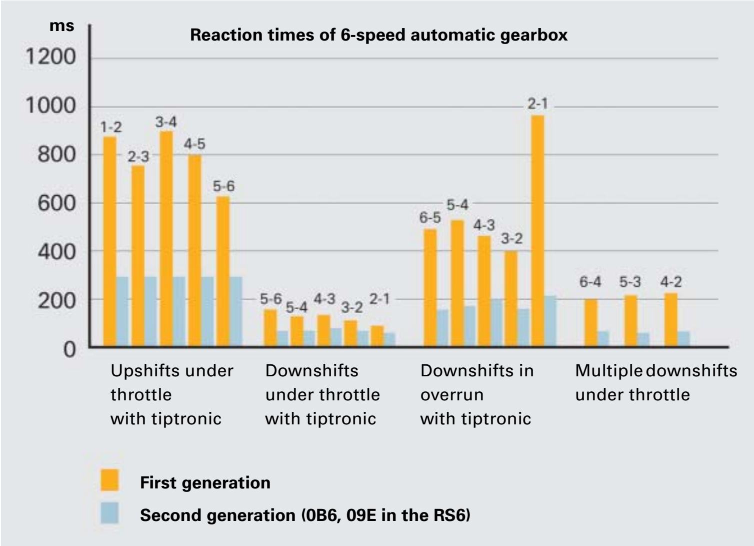
Contaminants can clog the thermostat bypass, causing the thermostat to malfunction or be disabled. This can result in overheating of the gearbox! During normal vehicle operation at an ambient temperature of 25°C, the ATF temperature barely exceeds 110°C.

The 0B6 gearbox ...

... is a derivative of the new second generation 6-speed automatic gearbox series by ZF-Getriebe GmbH.

This so-called second generation gearbox is notable in particular for its extremely short reaction times. Shift dynamics were improved by about 50 %, which significantly enhances driving dynamics.

The diagram (Fig. 385_017) illustrates the reduction in the reaction times of various shift mechanisms compared to the first generation of the 6-speed automatic gearbox.
The new hydraulic system and the electronic control unit allow, for the first time, multiple downshifts to be carried out without any loss of time.



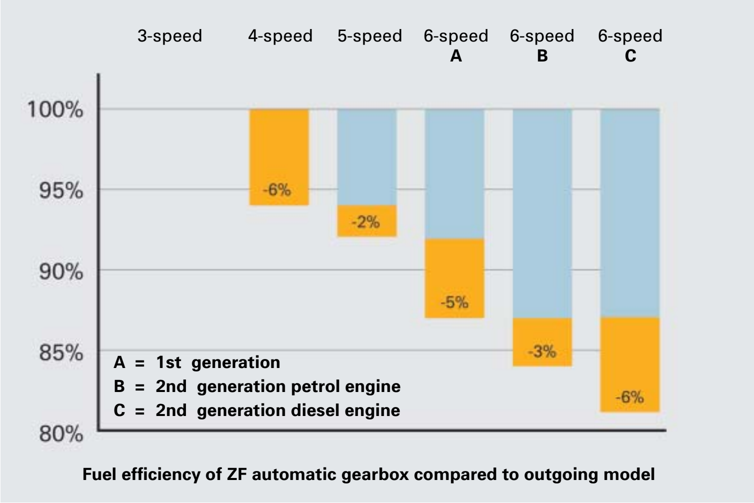
385_017

The torque converter with turbine torsion damper for petrol engines and the dual-damper converter for diesel engines allow the lockup clutch to close earlier. This, in turn, enhances fuel efficiency and provides a more direct, sporty driving feel.

The standstill decoupling feature also enhances fuel efficiency and ride comfort. See page 36

Compared to the previous model, this gearbox saves 3 % fuel in combination with petrol engines and as much as 6 % in combination with diesel engines.

The diagram (Fig. 385_018) shows the improvements in terms of fuel efficiency from the 3-speed automatic gearbox up to the current second generation 6-speed automatic gearbox.



385_018

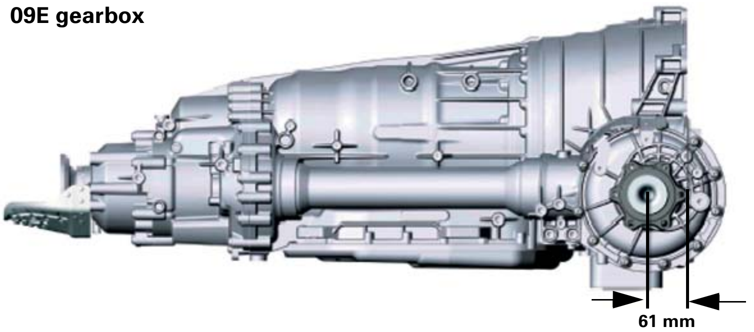
The 0B6 gearbox was developed for the model series incorporating the new engine-gearbox and axle configuration.

The new engine-gearbox configuration is achieved by moving the front axle drive (differential) in front of the torque converter. The Audi A5 Coupé and the Audi A4 B8 (types 8T and 8K) are the first models to benefit from the advantages of this radical modification.

The design of the 0B6 gearbox is based on that of the 09E gearbox, where the front axle drive is already positioned in front of the torque converter.
The distance between the engine/gearbox flange and the centreline of the flange shaft was reduced to 61 mm.
In the case of the 0B6 gearbox, this distance has shrunk still further to 43 mm.

Furthermore, the flange shaft was moved up 30 mm to make space for the steering gear.

09E gearbox

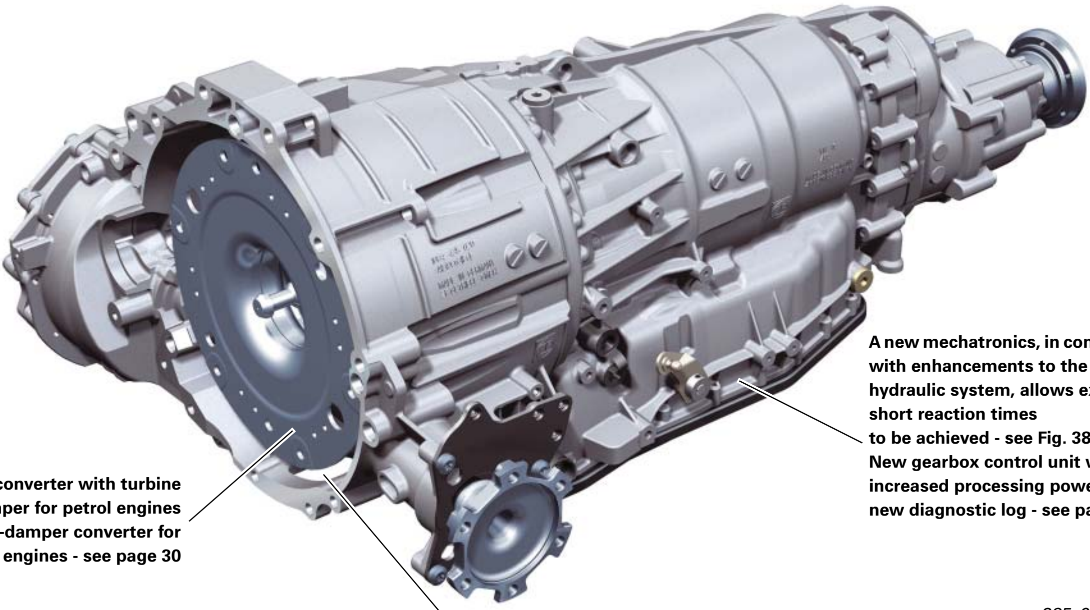


385_016

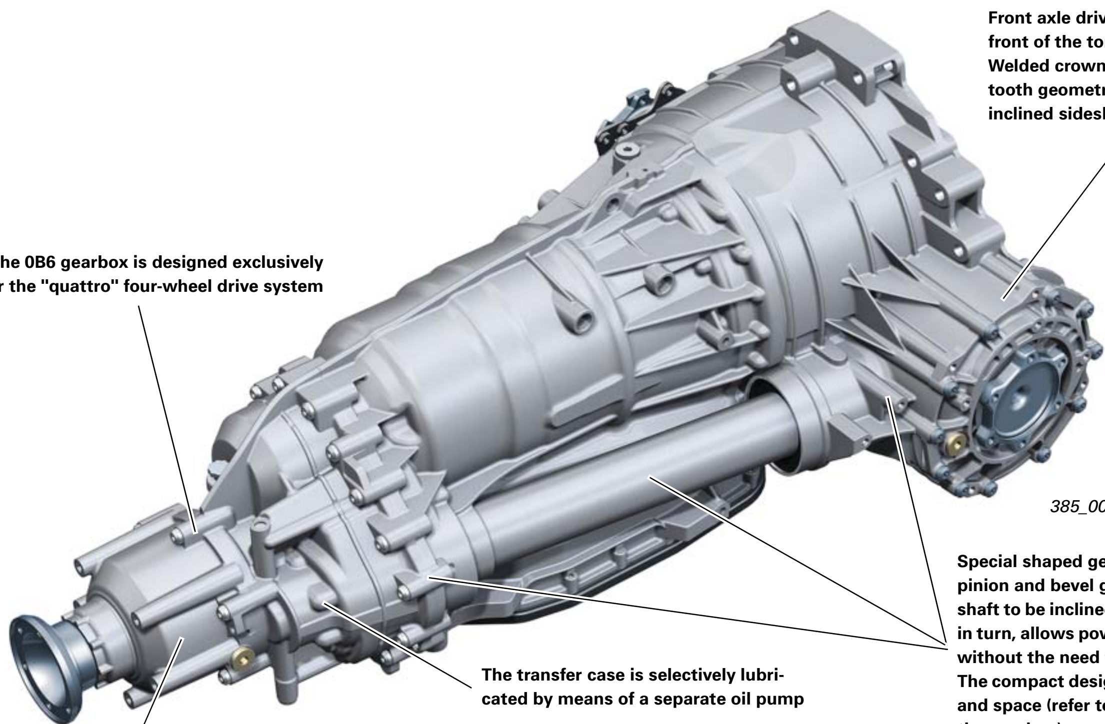
0B6 gearbox

385_019

Special features at a glance



385_006

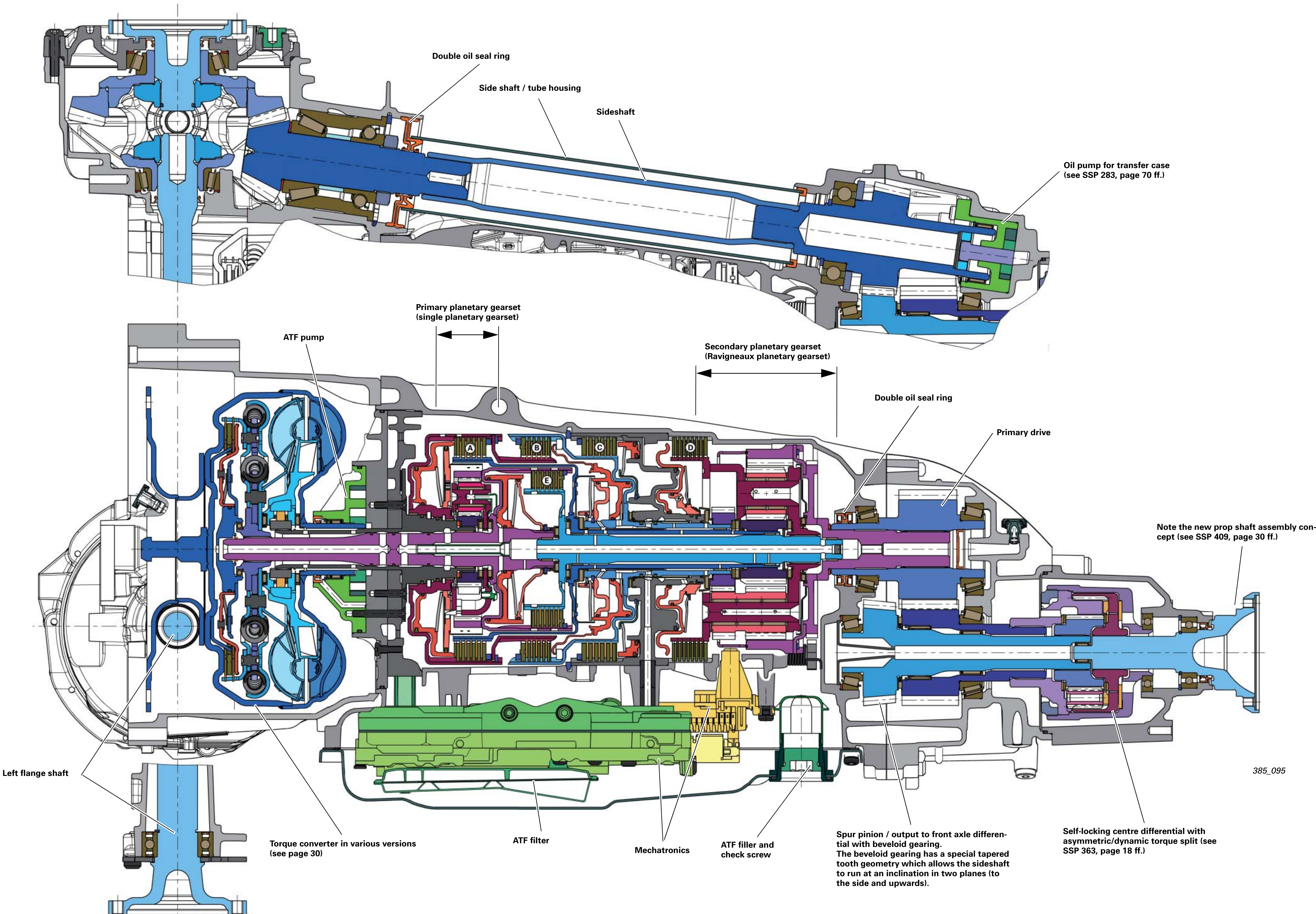


385_007

Reference

For background information and details of the advantages of the new engine-gearbox and axle configuration, refer to SSP 392 (page 30 ff.) and SSP 409 (page 24 ff.).
For information on the axle configuration, refer to SSP 283 (page 10 ff.).

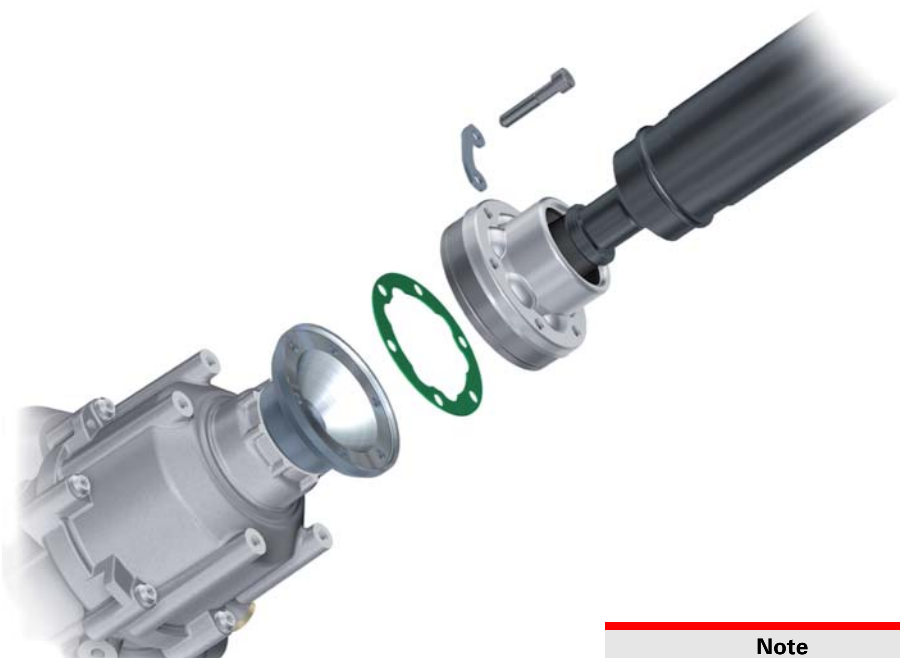
Sectional view of the 0B6 gearbox



- Hydraulic parts, hydraulic control unit and ATF carrying parts
- Component parts of the planetary gearsets
- Shafts, gears, circlips and other rotating parts
- Electronic components, control unit
- Multi-plate clutches, bearings and plates
- Plastic parts, seals, rubber parts and plates
- Shift device components, cylinders, pistons, baffle plates, shaft oil seals and shims
- Housings, screws, bolts, springs and plates

Note

The new positioning of the final drive / differential means some changes to the existing repair procedures. Please refer to the information and instructions given in the Workshop Manual.



409_144

Note

A new prop shaft sealing and assembly concept was introduced to the B8 series (A4, A5 and Q5). Refer to the description in SSP 409 (page 30 ff.).
Please refer to the information and instructions given in the Workshop Manual.

Torque converter

Torsional vibration of the engine is now damped even more effectively through the use of optimised torsion damper systems. This shortens the duration of the converter slip phase while driving, which, in turn, improves fuel efficiency by up to 6 % (in the case of diesel engines) over the first generation of the six-speed multi-step automatic gearbox.

Torque converters with turbine torsion dampers (TTD converters) are used with petrol engines. For more information, see page 15.

So-called dual-damper converters are used with diesel engines.

Dual-damper converter

This relatively new design is notable for broadband vibration damping, in addition to permitting very early closing of the lockup clutch - even in diesel engines. Controlled operation of the lockup clutch is reduced to a minimum. This, in turn, means better fuel economy while imparting a direct and responsive driving feel. Furthermore, the lockup clutch and the ATF are conserved.

As the name already implies, the dual-damper converter has two torsion dampers. Both torsion dampers are arranged in-line, i.e. one behind the other in the direction of power flow, and have different damping characteristics. This enables them to dampen torsional vibration across a wider range of engine speeds. The lockup clutch can therefore be closed at even lower engine speeds than was previously the case.

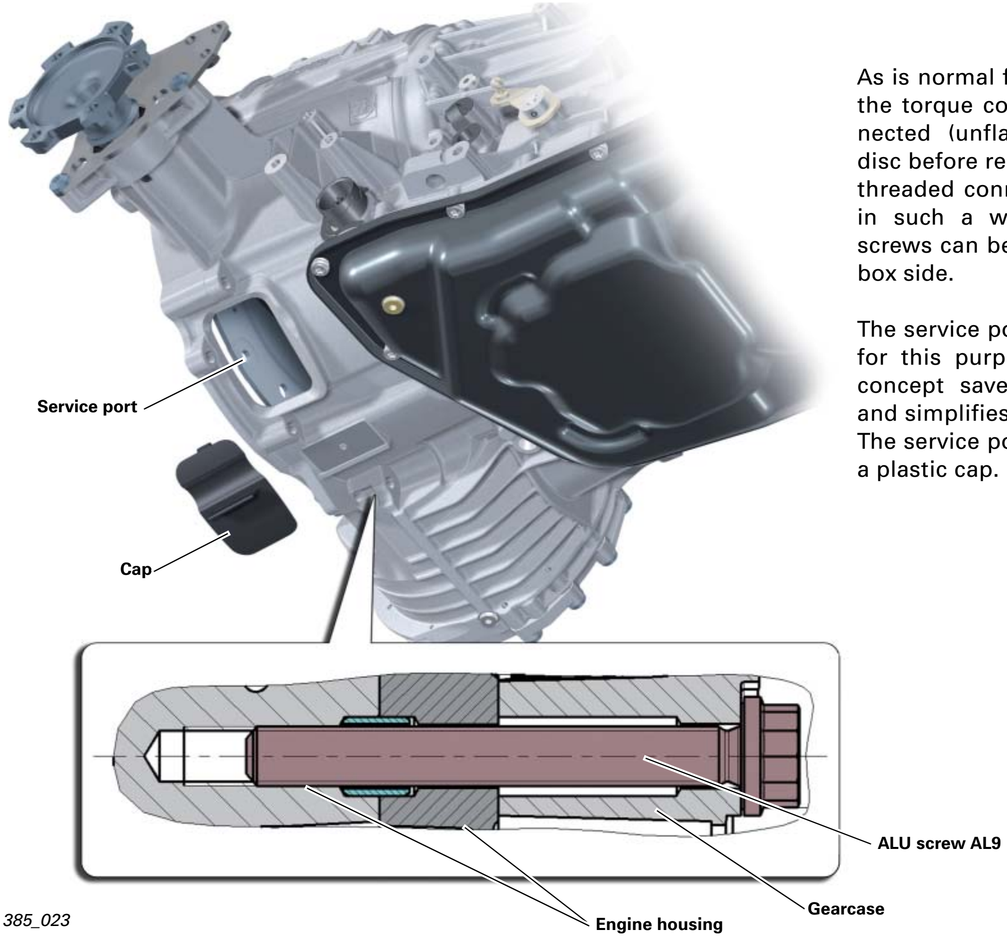
385_021

385_022

Reference

Refer to the information and installation instructions given for the torque converter in SSP 367 (page 10 ff.) and in the Workshop Manual.

Service port



385_023

As is normal for automatic gearboxes, the torque converter must be disconnected (unflanged) from the clutch disc before removing the gearbox. The threaded connection is now designed in such a way that the (converter) screws can be inserted from the gearbox side.

The service port provides good access for this purpose. The new assembly concept saves removing the starter and simplifies assembly work.
The service port is sealed by means of a plastic cap.

ALUMINIUM screws

Use of aluminium throughout the vehicle and in the 0B6 gearbox helps to reduce kerb weight. For this reason, ALUMINIUM screws are increasingly being used. ALU screws are very well suited to threaded connections, where the connecting parts or components are also made of aluminium.

Since the connecting components and screws are made of aluminium, all parts of the threaded connection are subject the same degree of thermal expansion. That means that the tensile stress on the screw remains constant even under heating. This permits the use of ALU screws with the same diameter as the previous steel screws.

In addition to a special corrosion-proofing, aluminium screws have a special anti-friction coating which ensures that the thread does not seize when tightening and loosening a screw.

Normally, ALU screws are tightened using the "torque-rotation angle tightening method" and must always be replaced after use.

ALUMINIUM screws are used in the following parts of the 0B6 gearbox:

Threaded connection between engine and gearbox

Threaded connection of ATF pan (see page 33)

Several threaded connections of the gearcase

Threaded connection between engine and gearbox

A special feature is that the engine and gearbox are bolted by means of ALUMINIUM screws. The "torque-rotation angle tightening method" is used for tightening the ALU screws.
ALU screws may be reused once only. This means that a new ALU screw may be used twice in total. If an ALU screw is reused (e.g. after removing and installing the gearbox), then it must be indelibly marked with an "X" on its end face. Refer to Workshop Manual.

Oil supply / sealing

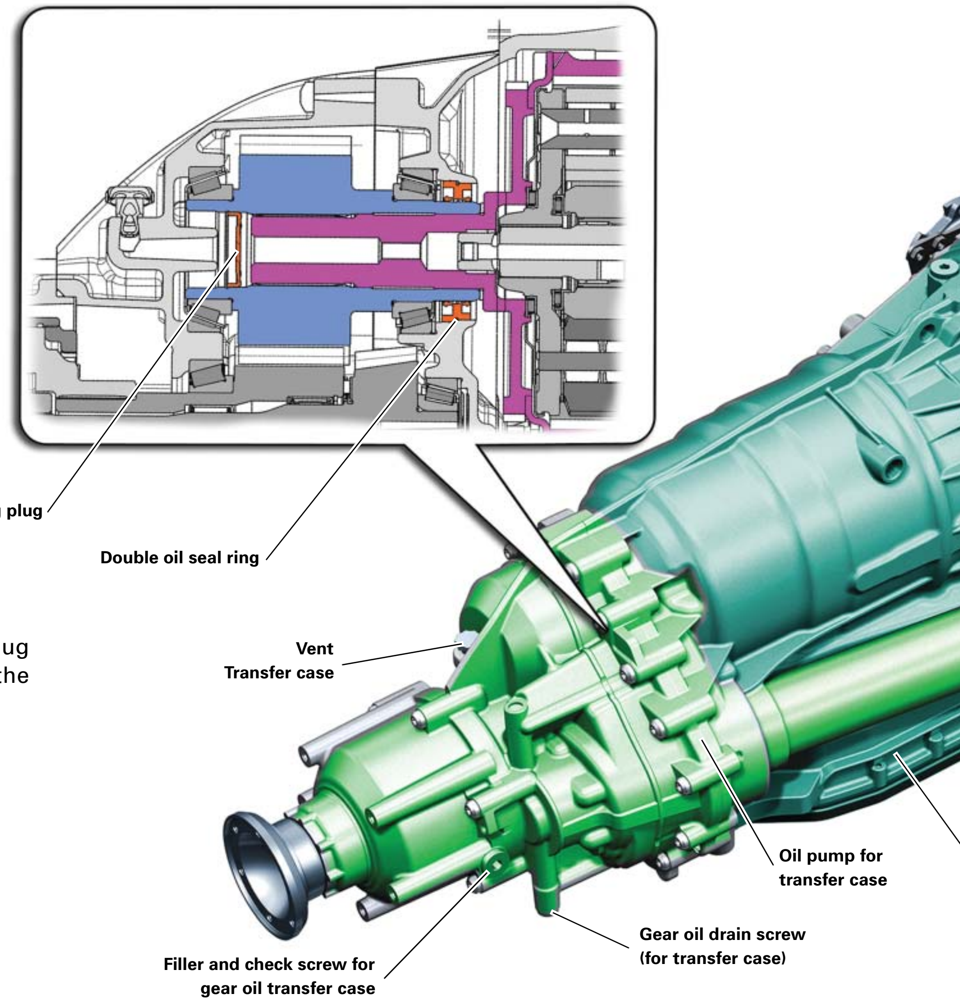
The 0B5 gearbox has three separate oil supplies with three different types of oil:

- One ATF oil supply for the planetary gearbox, the hydraulic control unit, and the torque converter
- One oil supply for the front axle drive (gear oil **without** STURACO*)
- One oil supply for the transfer case (gear oil **with** STURACO*)

* STURACO is an oil additive which reduces stress in the centre differential and thereby enhances ride comfort.

This oil additive is **not** suitable for the front axle drive and, for this reason, must not be used here.

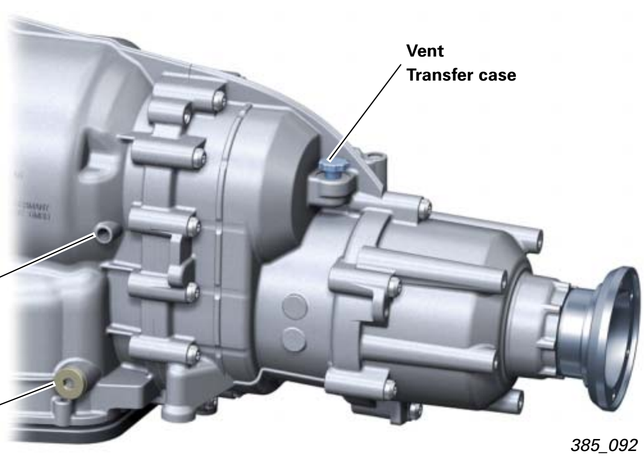
Therefore, make sure that the gear oils are correctly assigned in accordance with the part numbers specified in the Electronic Parts Catalogue (ETKA).



A double shaft seal and a sealing plug separate the ATF system off from the transfer case oil supply.

ATF cooling

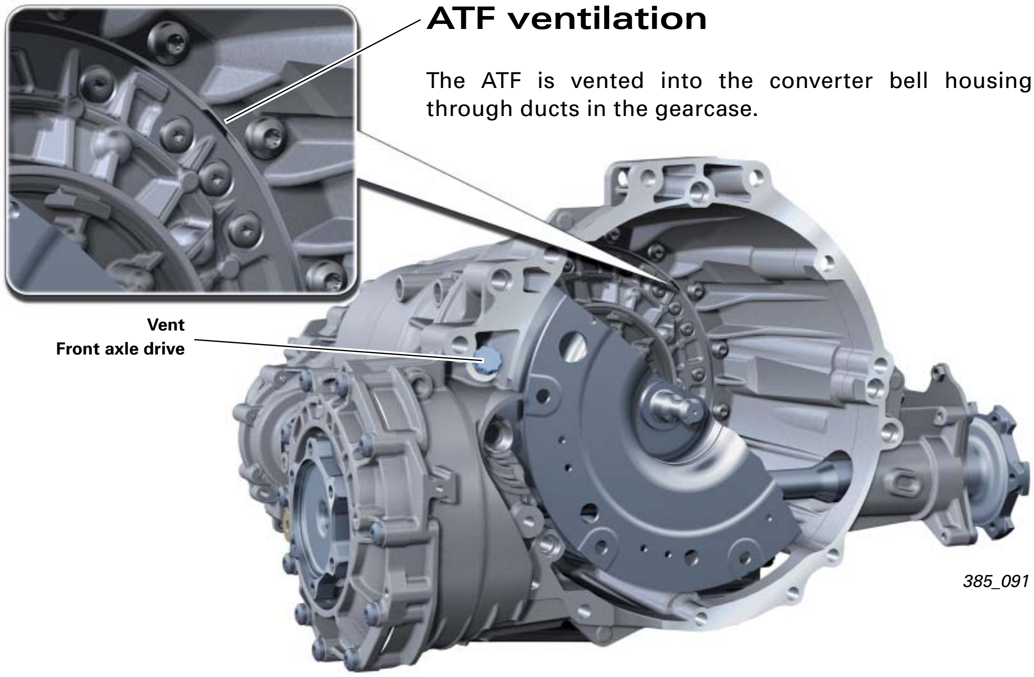
The ATF in the 0B5 gearbox of the B8 series is cooled by means of a heat exchanger (ATF cooler) integrated in the radiator.
Identical to concept shown in Fig. 385_011 on page 16.



385_092

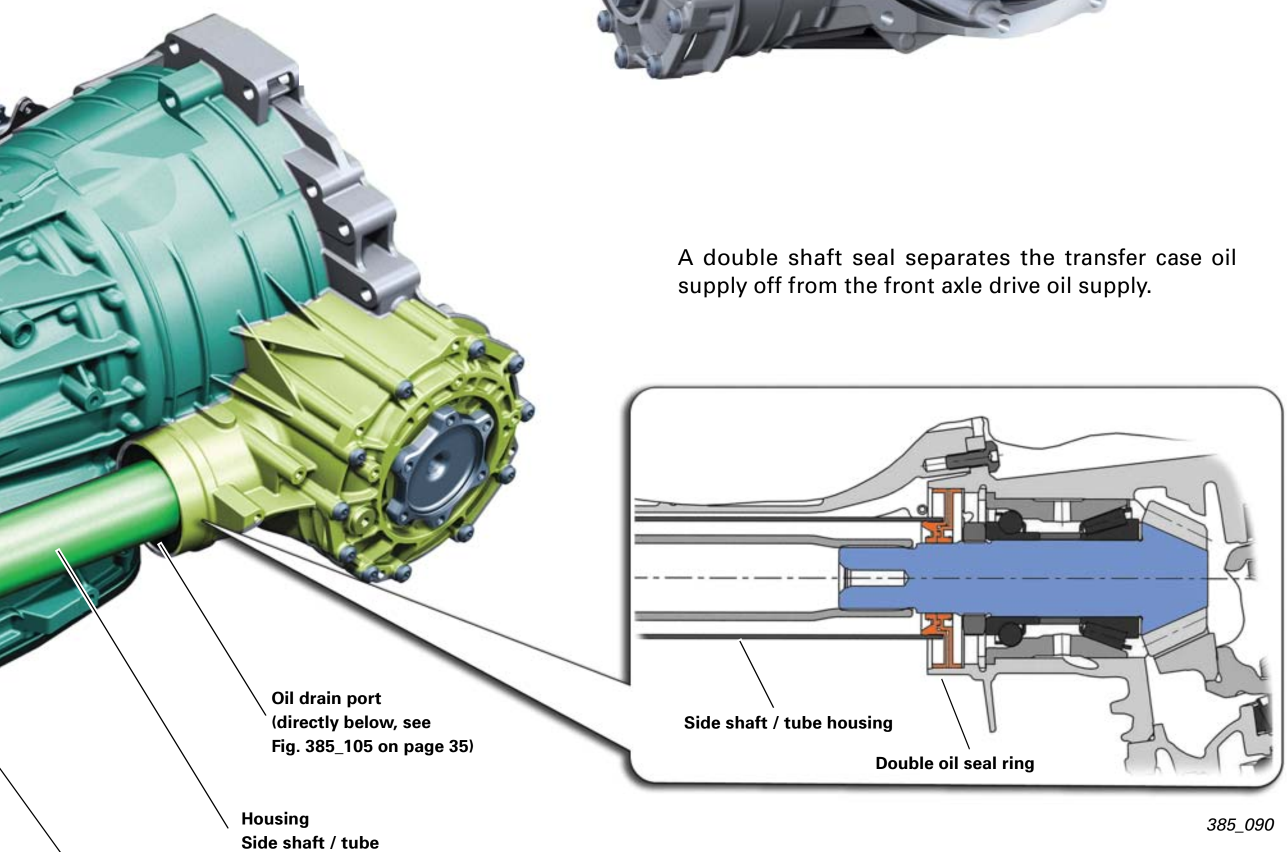
ATF ventilation

The ATF is vented into the converter bell housing through ducts in the gearcase.



385_091

A double shaft seal separates the transfer case oil supply off from the front axle drive oil supply.



385_090

ATF pan

The ATF pan of the 0B6 gearbox is made of aluminium and sealed by means of a metal-elastomer gasket. This gasket consists of an aluminium substrate layered with a vulcanised rubber lip seal (elastomer).

The advantage of the metal-elastomer gasket is that it exhibits no subsidence, and therefore provides a durable seal.
The metal-elastomer gasket must be positioned exactly using four guide bolts (special tool) in order to ensure effective sealing. The ATF pan is fastened using ALU screws. These screws must be tightened in a defined sequence and using the torque-rotation angle tightening method. Follow the instructions given in the Workshop Manual.

Mechatronics

The electro-hydraulic control unit (mechatronics) was radically revised for the 0B6 gearbox. This, in combination with improvements to the entire hydraulic system, has enabled extremely short reaction times to be achieved. The shift dynamics of the 0B6 gearbox therefore set new standards for multi-step automatic gearboxes (see page 26).

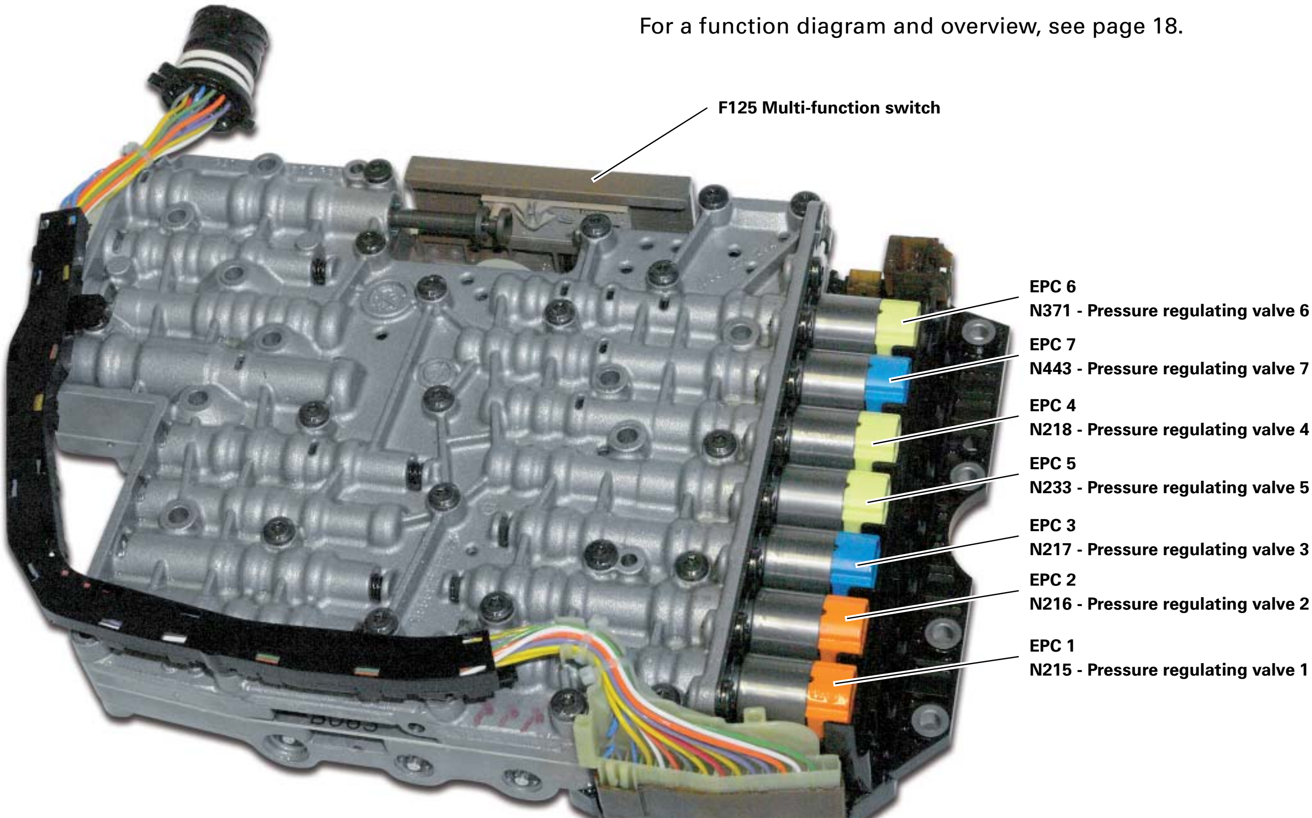
The new mechatronics are identifiable by the new, orange coloured pressure regulating valves.

Only pressure regulating valves are used for control purposes. Each clutch / brake is now assigned to its own pressure regulating valve.

The mechatronics are integrated in the immobiliser system, which means no hydro-mechanical limp-home function (see page 52).

For more information about the mechatronics and sensors / actuators, refer to SSP 284.

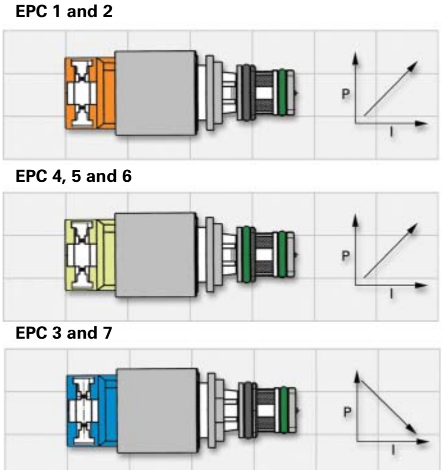
For a function diagram and overview, see page 18.



EPC = electrical pressure control valve

385_103

Function assignments of the electrical pressure regulating valves



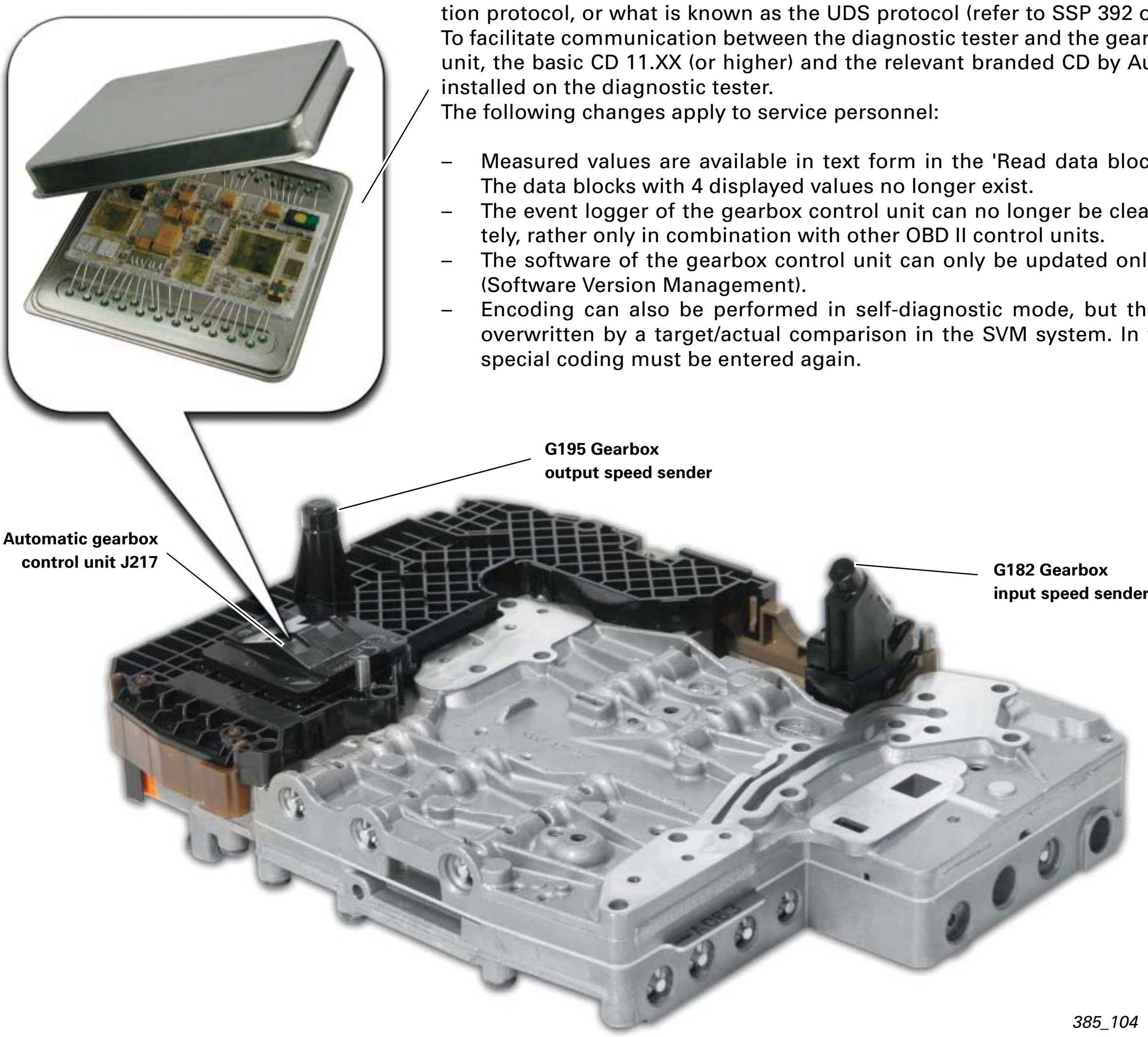
EPC 1 and 2		
Pressure range	**0 to 4.7 bar**	**EPC 1 (N215) Clutch valve, clutch A**
Operating voltage	**12 V**	**EPC 2 (N216) Lockup clutch**
Resistance at 20°C	**5.05 ohms**	
Characteristic curve	**rising**	
EPC 4, 5 and 6		
Pressure range	**0 to 4.6 bar**	**EPC 4 (N218) Clutch valve, clutch E**
Operating voltage	**12 V**	**EPC 5 (N233) Clutch valve, brake C**
Resistance at 20°C	**5.05 ohms**	**EPC 6 (N371) Clutch valve, brake D**
Characteristic curve	**rising**	
EPC 3 and 7		
Pressure range	**4.6 to 0 bar**	**EPC 3 (N217) Clutch valve, clutch B**
Operating voltage	**12 V**	**EPC 7 (N443) System pressure regulation**
Resistance at 20°C	**5.05 ohms**	
Characteristic curve	**falling**	

385_029

P = pressure
I = current

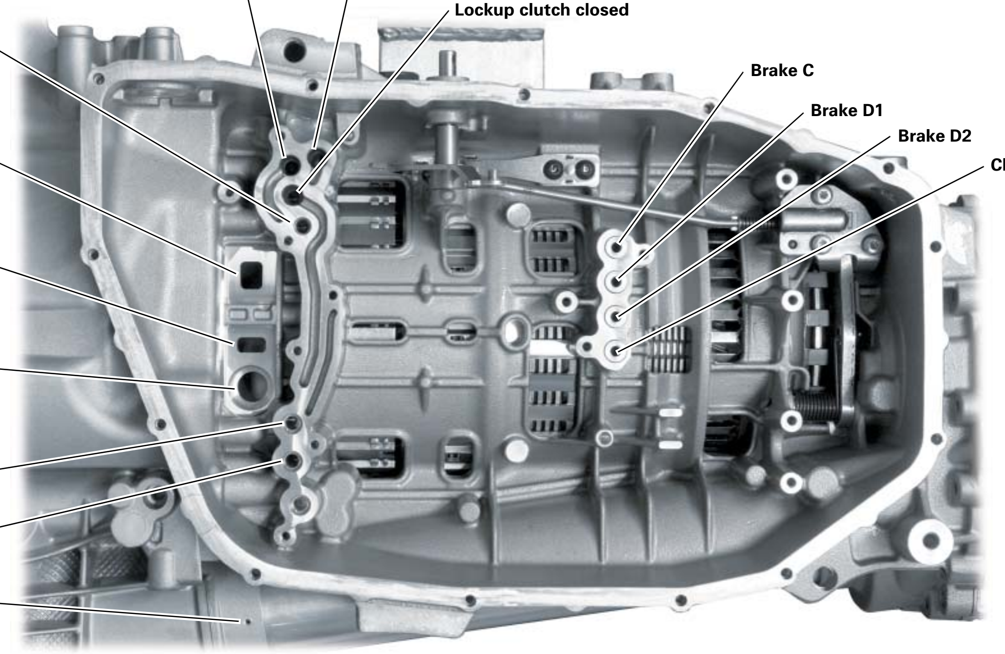
In addition to the modifications to the hydraulics, use is made of a new control unit generation with higher processing capacity and a new diagnostic communication protocol, or what is known as the UDS protocol (refer to SSP 392 on page 90). To facilitate communication between the diagnostic tester and the gearbox control unit, the basic CD 11.XX (or higher) and the relevant branded CD by Audi must be installed on the diagnostic tester.
The following changes apply to service personnel:

– Measured values are available in text form in the 'Read data block' function. The data blocks with 4 displayed values no longer exist.
– The event logger of the gearbox control unit can no longer be cleared separately, rather only in combination with other OBD II control units.
– The software of the gearbox control unit can only be updated online by SVM (Software Version Management).
– Encoding can also be performed in self-diagnostic mode, but the coding is overwritten by a target/actual comparison in the SVM system. In this case, a special coding must be entered again.



385_104

Hydraulic interfaces of 0B6 gearbox



385_105

Standstill decoupling feature

When the vehicle is at a standstill (engine idling) and in gear, the torque converter transmits a defined amount of torque. This causes the vehicle to move away ("creep") on releasing the brake. When the brake is applied, this "converter torque" results in a loss of power. The engine has to increase the idling torque in order to maintain a constant idling speed. This also increases fuel consumption. Other drawbacks are that the engine runs more loudly and produces more vibration, and the driver has to apply a certain amount of pressure to the brake pedal in order to keep the vehicle stationary. In both these instances, comfort is compromised.

The 0B6 gearbox therefore has a standstill decoupling feature which reduces torque converter loss when the engine is idling (when the vehicle is stationary) and the vehicle is in gear.

The standstill decoupling feature has the following advantages:

– Ride comfort is better because engine idles more smoothly and less pressure has to be applied to the brake when at a standstill.
– Fuel efficiency is better (by approx. 15 %) when the engine is idling and the vehicle is in gear.

How the standstill decoupling feature works

When **standstill decoupling is inactive**, slip between engine speed and turbine speed is 100 %. This means that the engine is running at idling speed and the turbine shaft is at a standstill. The turbine shaft runs at gearbox input speed.

When **standstill decoupling is activated**, slip is set to a defined speed between engine input speed and gearbox input speed by the controlled opening of clutch A. Both engine speed (= converter input speed) and gearbox input speed are taken into account. At the same time, the slip in the converter is reduced by up to 90 %** (engine/gearbox unit is at operating temperature). Only a small amount of torque is applied to the planetary gearbox. Due to the reduced load, the engine runs more smoothly and consumes less fuel.

If "driving away" is detected (due to the driver releasing the brake or depressing the accelerator), clutch A is closed quickly in order to re-establish "normal" engagement for power transmission.

Clutch A operates in slip mode while standstill decoupling is active. It is not opened completely to allow the vehicle to pull away with a minimum of delay and load reversal.

To handle the extra load caused by slip operation, clutch A is rated to withstand this amount of slip even in continuous duty.

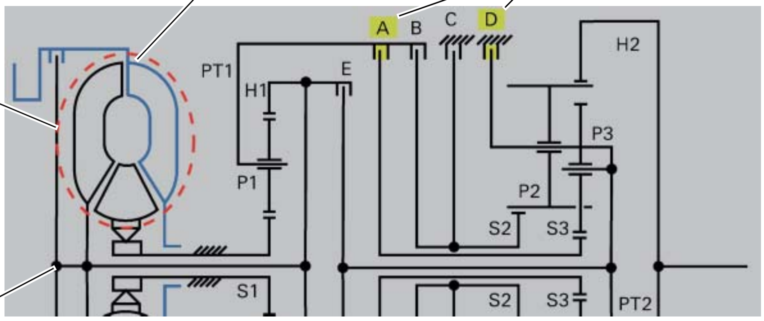
Standstill decoupling inactive

Read data block	
Measured value	**Result**
Gearbox output speed	0.00 rpm
Gearbox input speed	0.00 rpm
Engine speed	823.00 rpm
Selected gear	D
Lockup clutch slip	-819 rpm
Gearbox oil temperature	83°C
Status of brake signals / brake light switch	not applied

385_071

The standstill decoupling feature can be checked in this way (apply the handbrake so that the vehicle does not begin to roll).

Standstill decoupling inactive *



385_070

* Example: Audi A4 2.0 TFSI engine

The following conditions must be met in order to **activate the standstill decoupling feature**:

- ATF temperature between 20°C*** and 110°C
- Selector in position D, S or tiptronic
- Vehicle speed 0 kph
- Accelerator not depressed
- Brake applied
- Defined brake pressure
- Engine idling

*** Temperature range can vary from engine to engine.

Special conditions which deactivate or suppress the **standstill decoupling feature**:

- Trailer operation detected
- Audi hold assist active
- Detection of a gradient greater than 4° (approx. 7 %)

The standstill decoupling feature was not available from market launch of the 0B6 gearbox. The following list indicates when the standstill decoupling feature was rolled out:

3.2 FSI engine from model year 09
4.2 FSI engine from model year 09
2.0 TFSI engine from market launch
3.0 TDI engine from market launch

Behaviour on gradients (possibility of rollback on releasing the brake) is unchanged. Holding the vehicle without brake application is still dependent on idle converter torque, gradient and kerb weight.

Standstill decoupling activated

Read data block

Measured value	Result	Result	Result	Result
Gearbox output speed	0.00 rpm	0.00 rpm	0.00 rpm	0.00 rpm
Gearbox input speed	737.00 rpm	733.00 rpm	595.00 rpm	582.00 rpm
Engine speed	824.00 rpm	817.00 rpm	749.00 rpm	746.00 rpm
Selected gear	D	D	D	D
Lockup clutch slip	-80 rpm **	-84 rpm **	-157 rpm **	-177 rpm **
Gearbox oil temperature	82°C **	57°C **	34°C **	28°C **
Status of brake signals / brake light switch	applied	applied	applied	applied

** Torque converter slip is set according to ATF temperature. The speed differential is greater at low ATF temperatures than at high ATF temperatures.

385_069

Reference

For an explanation of the gearbox schematic, refer to SSP 283 (page 55 ff.).

Standstill decoupling activated *

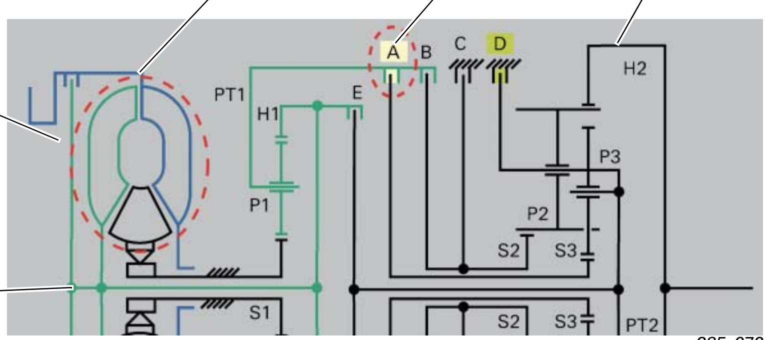
Torque converter housing / pump gear (engine idling speed 824 rpm*)

Clutch A in slip mode (approx. 485 rpm* speed differential)

All black coloured parts are stationary.

10 % slip in converter

Turbine shaft / gearbox input shaft operating at 737 rpm resulting in a difference of approx. 80 rpm ** to engine idling speed (lockup clutch slip)



385_072

*** Example: Audi A4 2.0 TFSI engine**

The 0BQ gearbox ...

... is a derivative of the 6HP-32 series by ZF GmbH. Within the Group, a four-wheel drive version with the designation 09F (6HP-32A) was already in use on the VW Phaeton.
It was specially adapted for use on the Audi Q7 with V12 6.0 TDI engine. The 0BQ gearbox is designed as an independent component. This means that front axle gearboxes and transfer cases are not integrated in the gearbox, as is otherwise normal on Audi models with a quattro powertrain and longitudinally mounted gearbox.

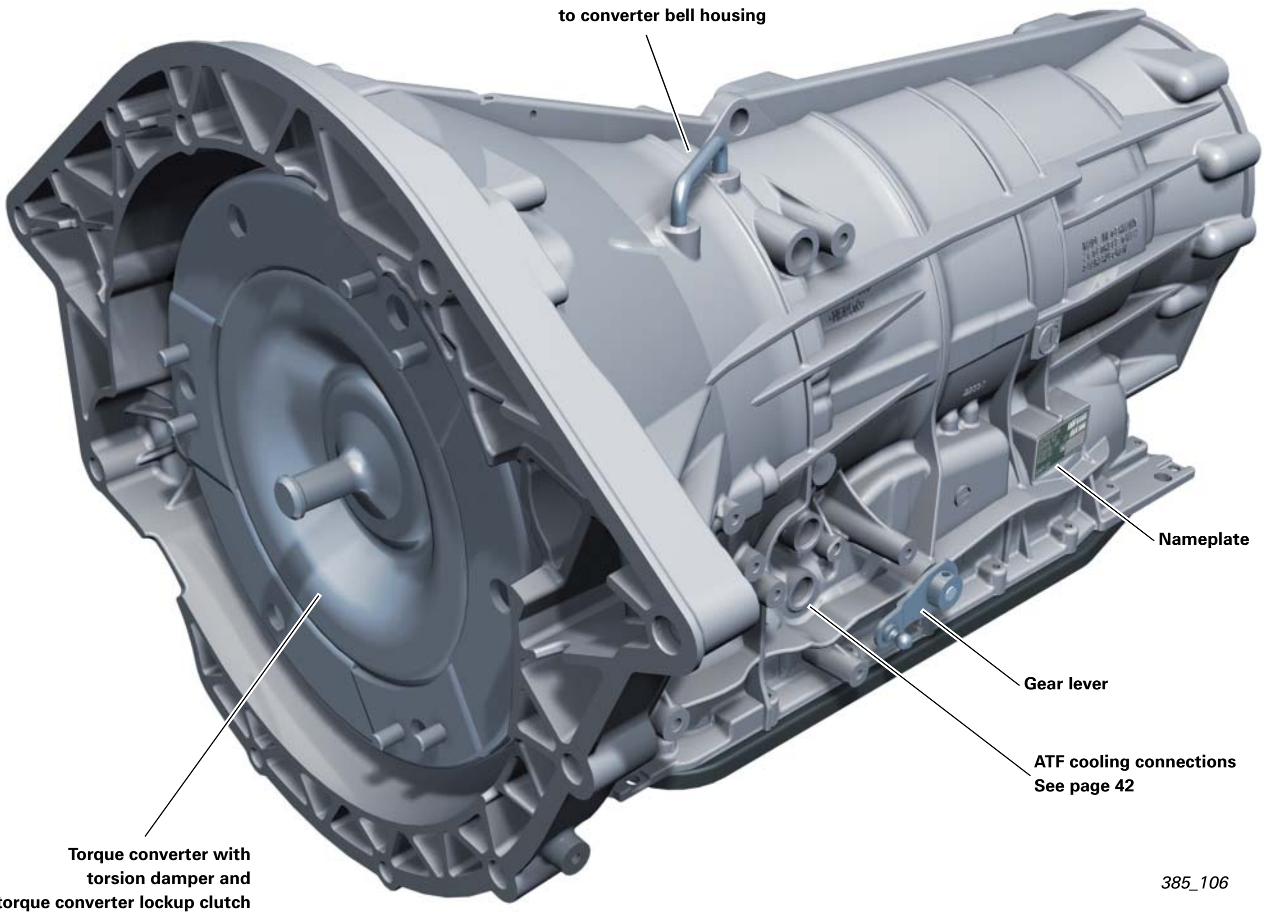
Reference

For information about power transmission in the Audi Q7 and the 0AQ transfer case, refer to SSP 363.

Power is transmitted to the front and rear axles through the 0AQ transfer case with self-locking centre differential and asymmetric/dynamic torque split.

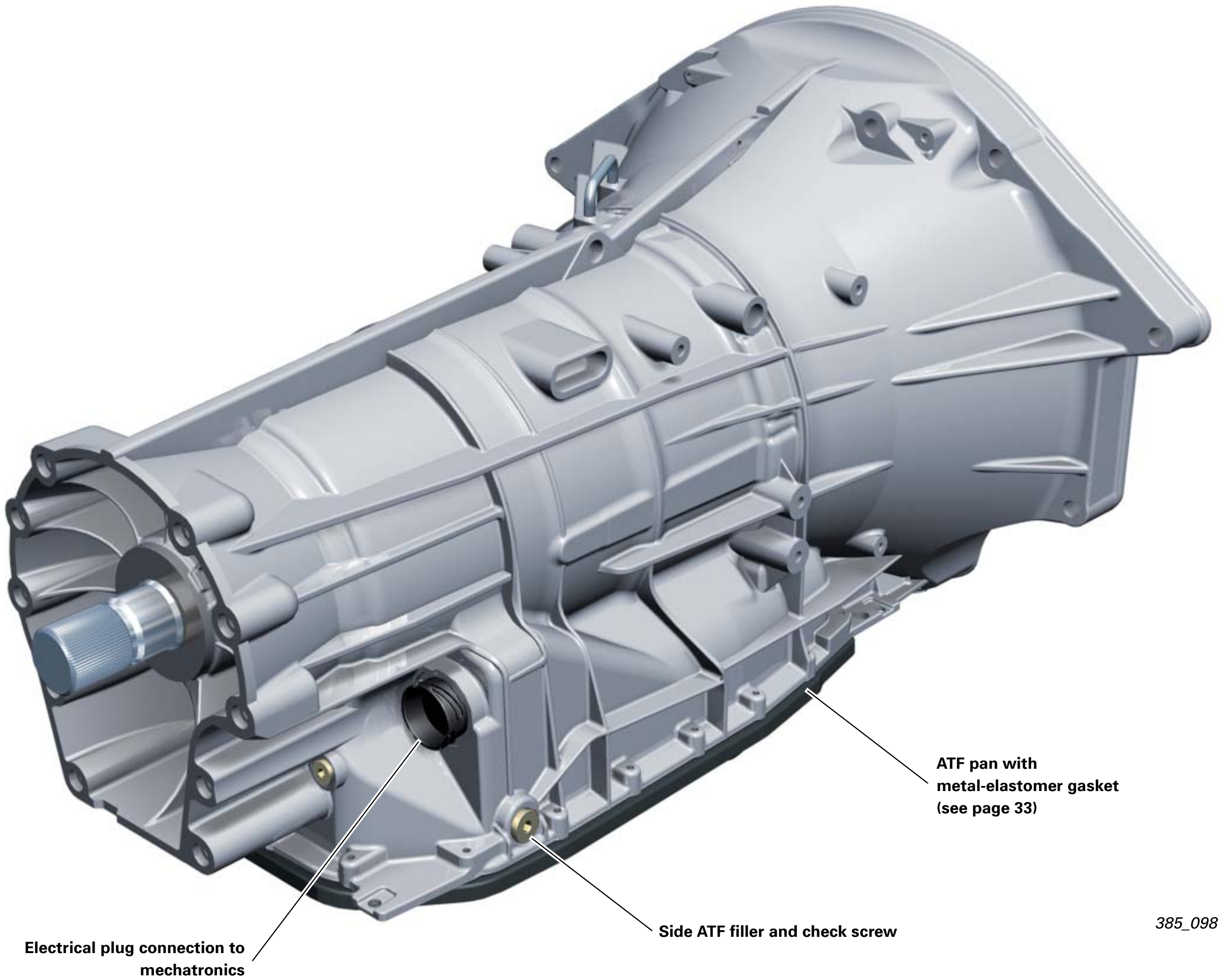
With a torque capacity of 1000 Nm, the 0BQ gearbox is the most powerful in this series.

See page 8 for specifications



385_106

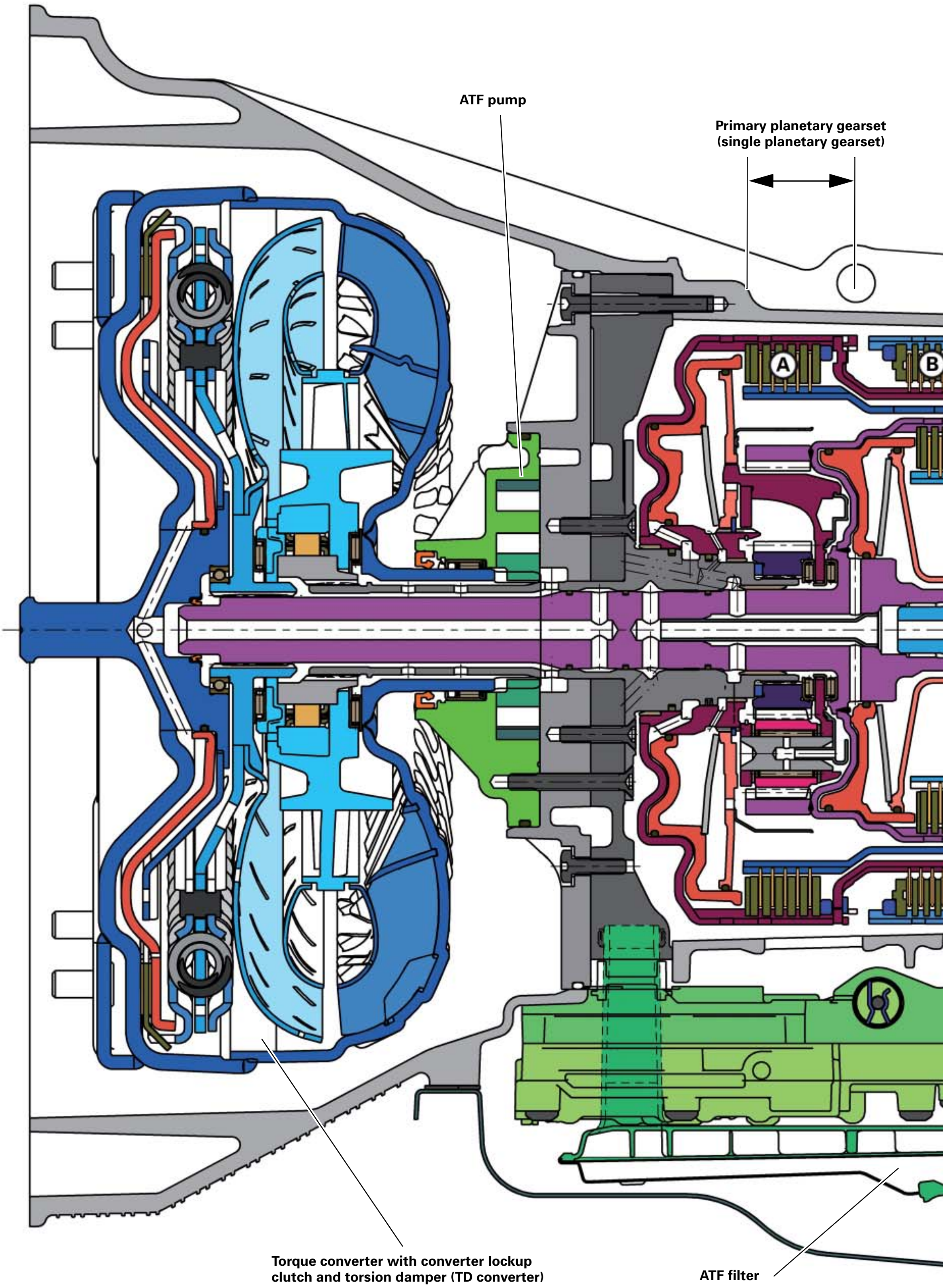
The 0B6 gearbox is integrated in the immobiliser system. For more information, see page 52 ff.



385_098

In the case of the six-speed automatic gearbox 0BQ, it is possible to read and delete specific gearbox adaption values using the diagnostic tester.
For more information, see page 54 ff.

Sectional view of the 0BQ gearbox



Hydraulic parts, hydraulic control unit and ATF carrying parts

Component parts of the planetary gearsets

Shafts, gears, circlips and other rotating parts

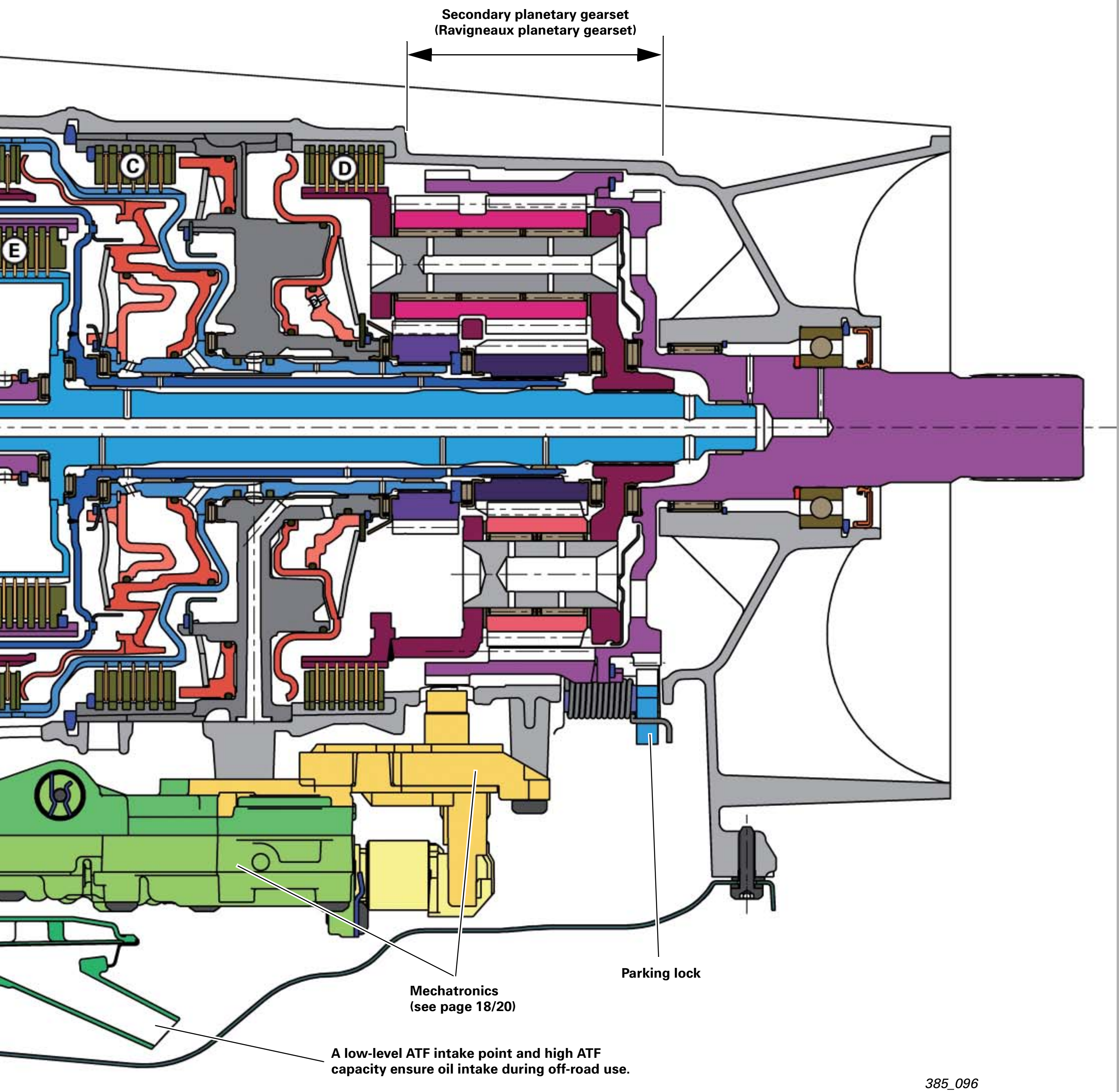
Electronic components, control unit

Multi-plate clutches, bearings and plates

Plastic parts, seals, rubber parts and plates

Shift device components, cylinders, pistons, baffle plates, shaft oil seals and shims

Housings, screws, bolts, springs and plates



385_096

ATF cooling

The gearbox cooling system of the Audi Q7 with 6.0 V12 TDI engine has to meet special requirements due to the high engine output. ATF temperature must be kept at a safe level even under extreme conditions of use.

The following two driving scenarios show why:

Scenario 1: When driving at low speed under high engine load (e.g. when climbing), there is little headwind.

Scenario 2: When driving at maximum speed, the headwind is very strong.

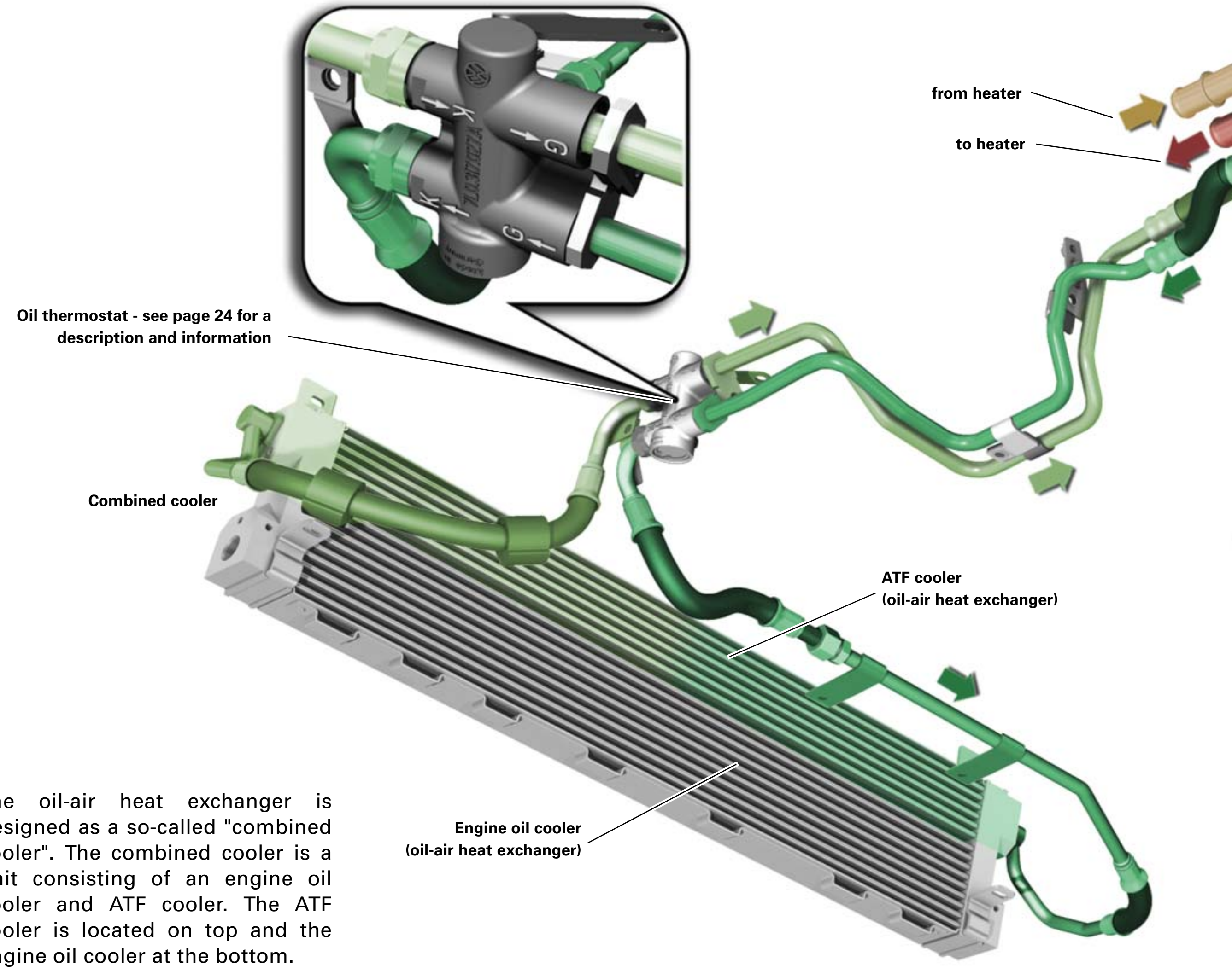
To meet these requirements, the ATF cooling system is equipped with an **oil-coolant heat exchanger** and an **oil-air heat exchanger**.

In scenario 1 the oil-coolant heat exchanger ensures sufficient cooling of the ATF. ATF temperature is controlled by the engine cooling system. In this scenario the engine cooling system has enough reserve capacity to cool the ATF, too. Since there is little headwind and the oil-air heat exchanger is out of the radiator fan airflow, not enough heat can be extracted from the engine cooling system through the oil-air heat exchanger.

In scenario 2 there is a strong headwind and the ATF can be efficiently cooled by through the oil-air heat exchanger. In this scenario the engine produces a large amount of heat and, accordingly, the engine cooling system has to operate at full capacity. Use of the oil-air heat exchanger reduces the load on the engine cooling system.

The ATF coolers are connected in series.

ATF cooling system (Audi Q7 V12 TDI with 0BQ gearbox)

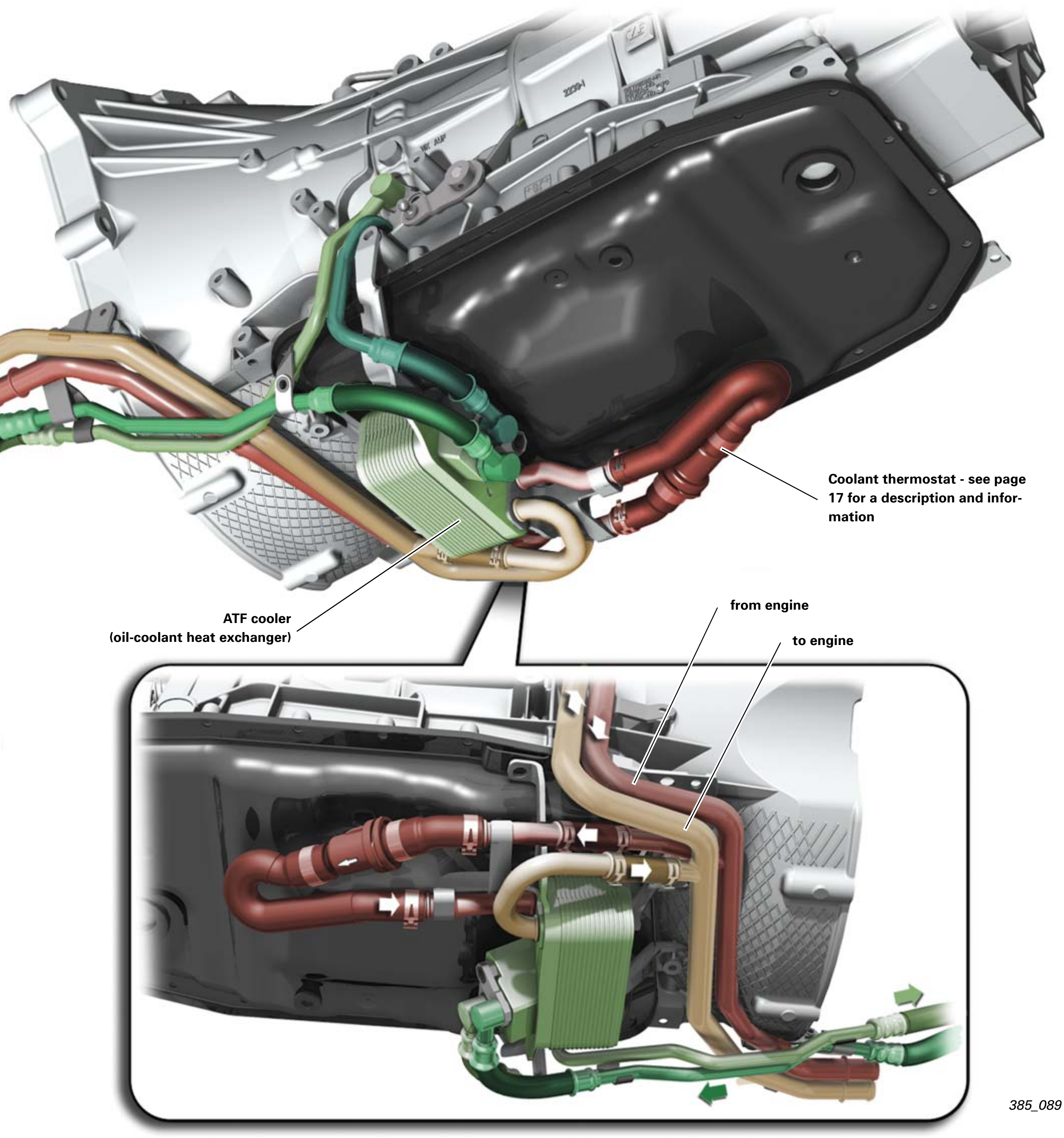


The oil-air heat exchanger is designed as a so-called "combined cooler". The combined cooler is a unit consisting of an engine oil cooler and ATF cooler. The ATF cooler is located on top and the engine oil cooler at the bottom.

ATF thermostat

To shorten the engine warm-up phase, the ATF cooling system is regulated by two thermostats. One thermostat is integrated in the coolant circuit leading to the oil-coolant heat exchanger and regulates the flow of coolant to the heat exchanger. A description of how this thermostat works is given on page 17.

The second thermostat is an oil thermostat, which is integrated in the supply and return lines of the oil-air heat exchanger. It regulates the ATF through-flow in the cooler. A description of how this thermostat works is given on page 24.



View from bottom right

Modifications / new features of 09E gearbox

Since its market launch, many modifications and new features have been incorporated into the 09E gearbox. Based on Self-Study Programmes 283, 284 and this Self-Study Programme, the main modifications and new features are explained below.

Deletion of standstill decoupling feature

The standstill decoupling feature described on page 30 of Self-Study Programme 284 was deleted after only a short time. The reason is that it was causing complaints from customers about delayed drive-away.

Deletion of shut-off valve N82

The shut-off valve N82 described on page 44 of Self-Study Programme 283 was replaced by a simpler and more reliable coolant thermostat. The new coolant thermostat is a so-called bypass thermostat and was gradually replaced on all engine versions. The coolant thermostat is described on page 17 and in the sections presenting the various gearbox cooling systems.

Gearbox ventilation

The vents of the various oil supplies were modified at the introduction of the common oil supply. For information see page 46.

Immobiliser in gearbox control unit

The 09E gearbox was integrated in the immobiliser from model year 2006. For detailed information, see page 52 ff.

Gearbox adaption
Reading, evaluating and deleting adaption values

From model year 2006, it is possible to read and delete adaption values of the 09E gearbox using the diagnostic tester. For detailed information, see page 54 ff.

385_003

Mechatronics

Many changes, such as the immobiliser, reading and deleting adaption values, and various improvements to the shift control system, could only be effected by modifying the mechatronics (see page 20).

Special features of the Audi S6

As regards the gearbox cooling system, refer to the table on the next page.

The S6 (like the RS6) has a new self-locking centre differential with a 40/60 asymmetric/dynamic torque split, see page 51.

Special features of the Audi RS6

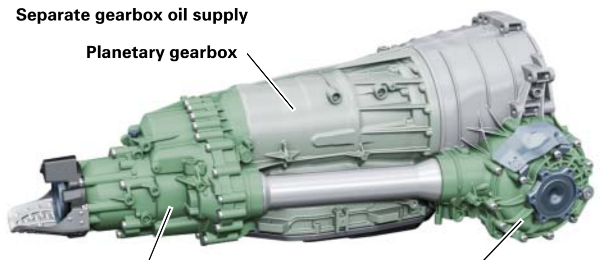
See table on next page and page 50.

The S6 has a new self-locking centre differential with a 40/60 asymmetric/dynamic torque split, see page 51.

Gearbox cooling - common / separate gearbox oil supply

Since the market launch of the 09E gearbox, increasingly larger and more powerful engines have been added. This has placed increasing demands on the gearbox cooling system. In addition to the reinforcement of the ATF cooling system, the oil in the transfer case and front axle drive has to be cooled. For this purpose, the separate oil supplies of the transfer case and the final drive were combined to create a **common oil supply**.

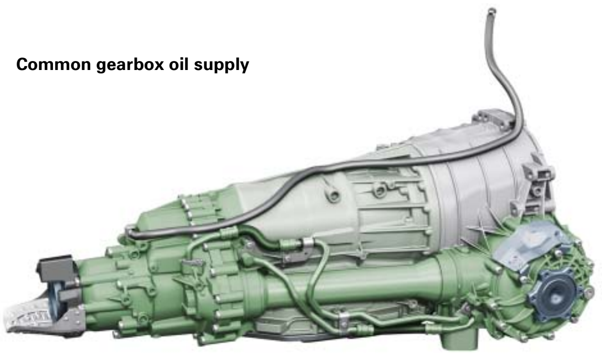
Separate gearbox oil supply



385_080

The oil chambers (oil supplies) of the transfer case and front axle differential are separate. The gearbox has, in total, three oil supplies: the planetary gearbox (ATF), the transfer case (axle oil) and the front axle differential (axle oil).

Common gearbox oil supply



385_079

Gear oil (axle oil)
ATF
without oil

The oil chambers (oil supplies) of the transfer case and front axle differential are interconnected. The gearbox has, in total, two oil supplies: the planetary gearbox (ATF) and the common oil system (axle oil).

Note

There are different ATFs and axle oils. Always make sure that they are assigned correctly according to the engine and gearbox codes specified in the parts catalogue.

Versions - gearbox oil supply / gearbox cooling system

		Gearbox oil supply		Gearbox cooling system	
Model	**Engine**	**Separate oil supply**	**Common oil supply**	**ATF cooling system**	**Axle oil cooling system (gearbox oil cooling)**
A6 S6	V10 FSI 5.2l		X	with coolant thermostat integrated in the engine cooling circuit	with axle oil cooler or with connecting tube, depending on gearbox code
A6 RS6	V10 TFSI 5.0l		X	with coolant thermostat, separate radiator and independent electrical coolant pump	with axle oil cooler
A8	V8 MPI/FSI 3.7l/4.2l	X		First without, later with coolant thermostat	without
A8	V8 TDI 4.0l/4.2l	X		with coolant thermostat integrated in the engine cooling circuit	without
A8 S8	V10 FSI 5.2l		X	with coolant thermostat integrated in the engine cooling circuit	with axle oil cooler or with connecting tube, depending on gearbox code
A8	W12 6.0l		X	with coolant thermostat integrated in the engine cooling circuit	with axle oil cooler or with connecting tube, depending on gearbox code

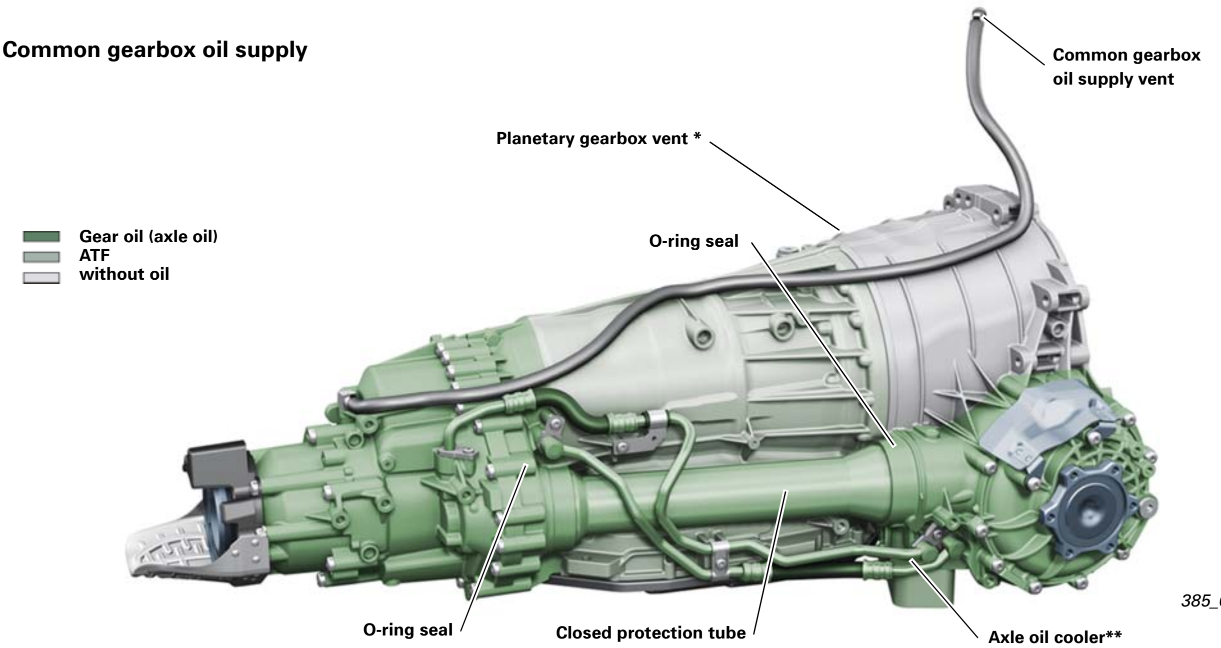
Common gearbox oil supply - design

cf. Fig. 385_079a (common gearbox oil supply) with Fig. 385_080a (separate gearbox oil supply).
The two shaft oil seals, which normally seal the transfer case and the front axle differential off from the side-shaft, are no longer used. The sideshaft protection tube is closed and sealed off from the housing using O-rings.

Both oil supplies are interconnected in this way. The common gearbox oil supply is vented through a hose-pipe which leads into the engine bay from the transfer case. The front axle differential no longer has a separate vent.

* The planetary gearbox (ATF oil system) is vented through ducts in the gearcases into the converter bell housing, and is not visible from the exterior.
This new feature has also been adopted for the gearbox with separate gearbox oil supply.

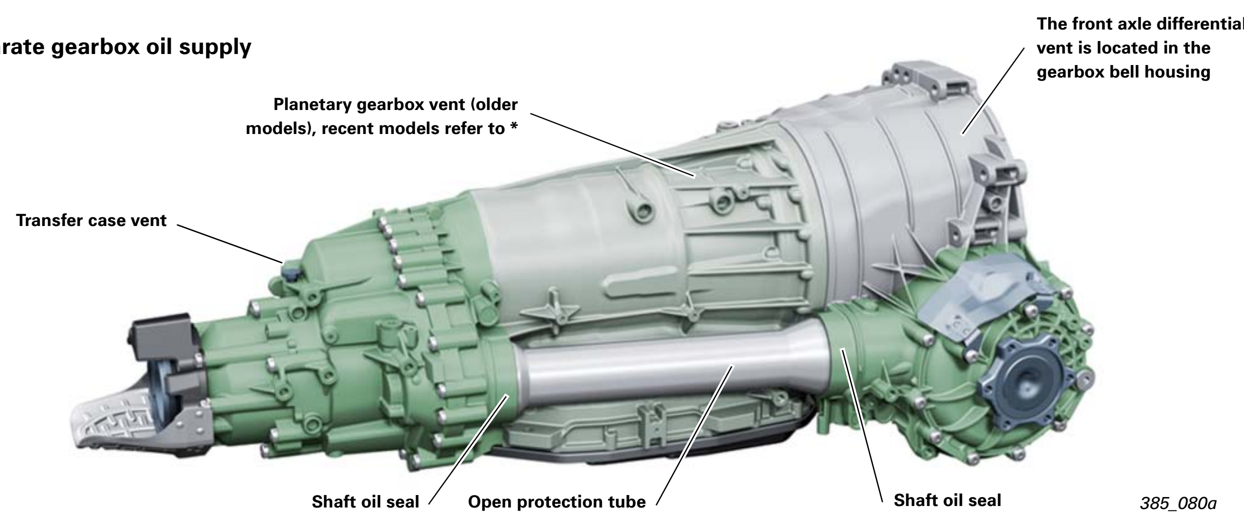
Common gearbox oil supply



385_079a

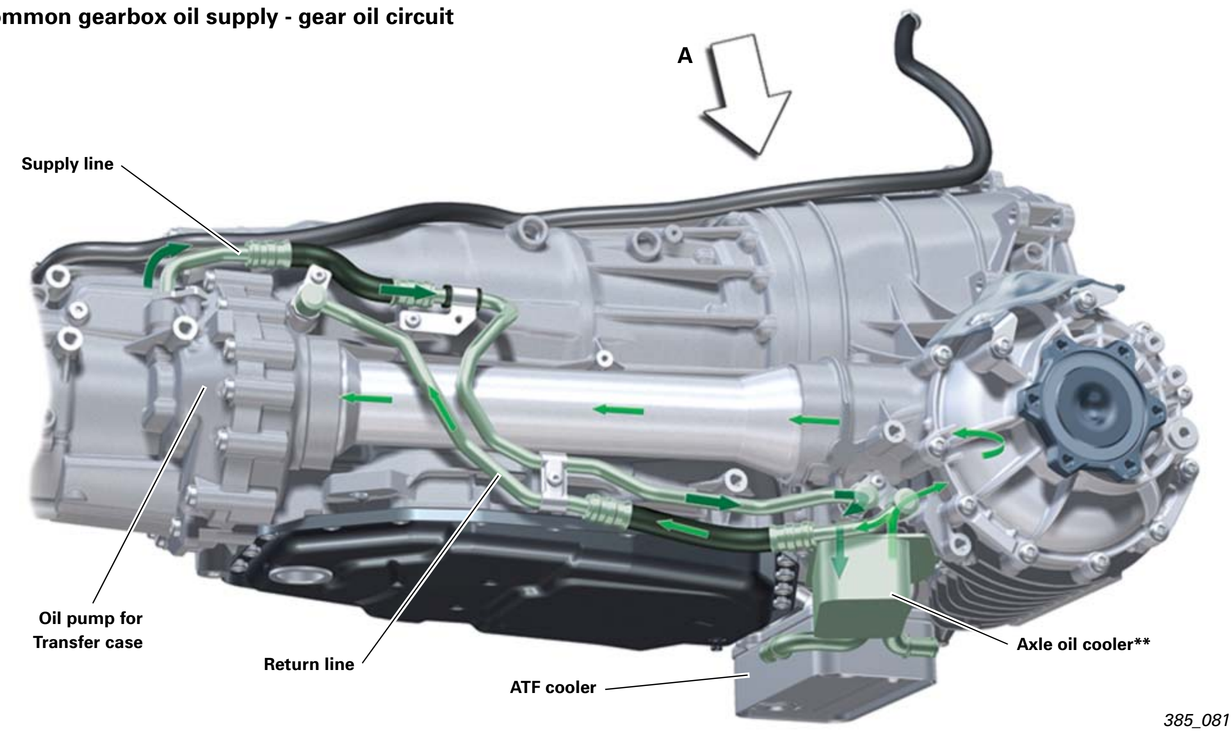
** Depending on engine type and model combination, the common gearbox oil supply is also available without an oil cooler. See next page and table on page 45.

Separate gearbox oil supply



385_080a

Common gearbox oil supply - gear oil circuit



385_081

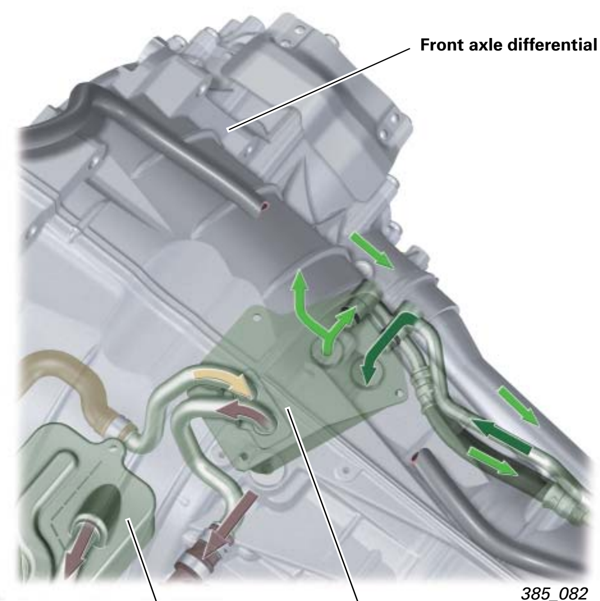
Gear oil circuit - function

The oil conveyed by the oil pump flows into the axle oil cooler (supply). A fraction of the cooled oil is branched into the front axle differential on the upstream side of the return line while the remainder is cooled through the return line to the transfer case. The oil flowing into the front axle differential is recirculated through the protection tube.

Reference

The oil circulation system within the transfer case is otherwise as described in SSP 283 (page 69 ff.).

View A



385_082

Note

The common gearbox oil supply necessitates a special procedure for filler and checking the gear oil in the front axle differential and transfer case. Depending on the driving situation, different gear oil levels can occur. The oil level must therefore **always be checked in two places**.
Follow the instructions given in the Workshop Manual.

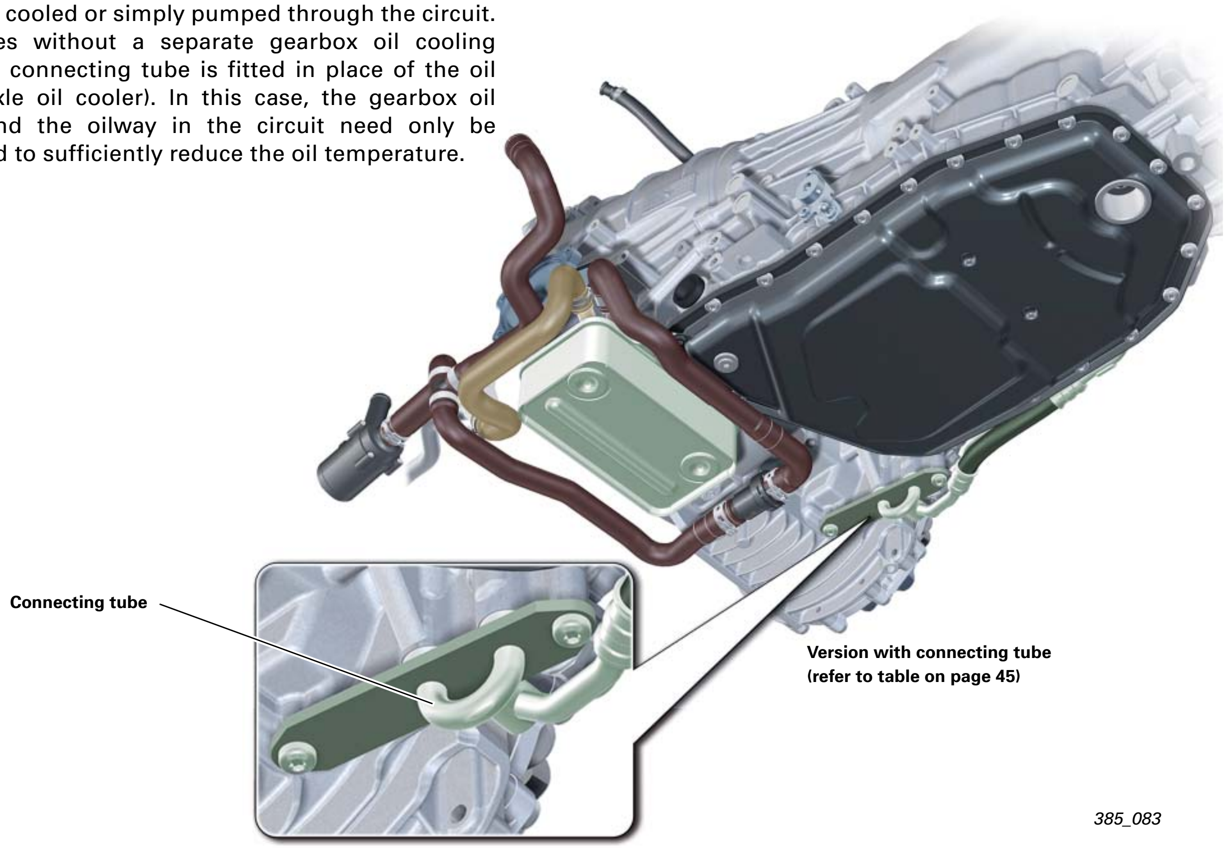
After carrying out repairs that involve draining the axle oil cooler, it must be ensured that the axle oil cooler is filled with oil before checking the oil level. Since the transfer case oil pump is only driven while the vehicle is being driven, a certain distance must always be covered in order to fill the axle oil cooler.

Note

Also refer to the notes on contamination of the oil cooler in the event of gearbox damage on page 17.

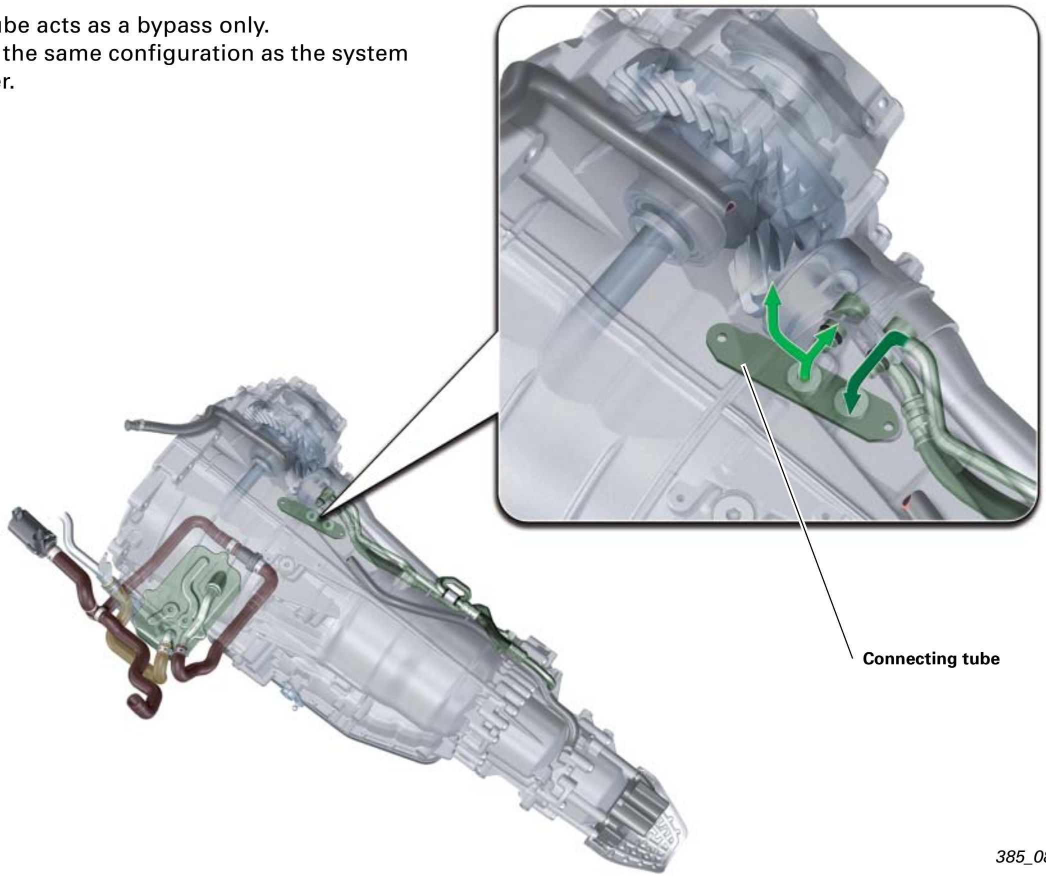
Common gearbox oil supply - without oil cooler

Depending on engine type and model combination, the gear oil is cooled or simply pumped through the circuit. In vehicles without a separate gearbox oil cooling system, a connecting tube is fitted in place of the oil cooler (axle oil cooler). In this case, the gearbox oil supply and the oilway in the circuit need only be connected to sufficiently reduce the oil temperature.



385_083

The connecting tube acts as a bypass only.
The oil circuit has the same configuration as the system with axle oil cooler.



385_084

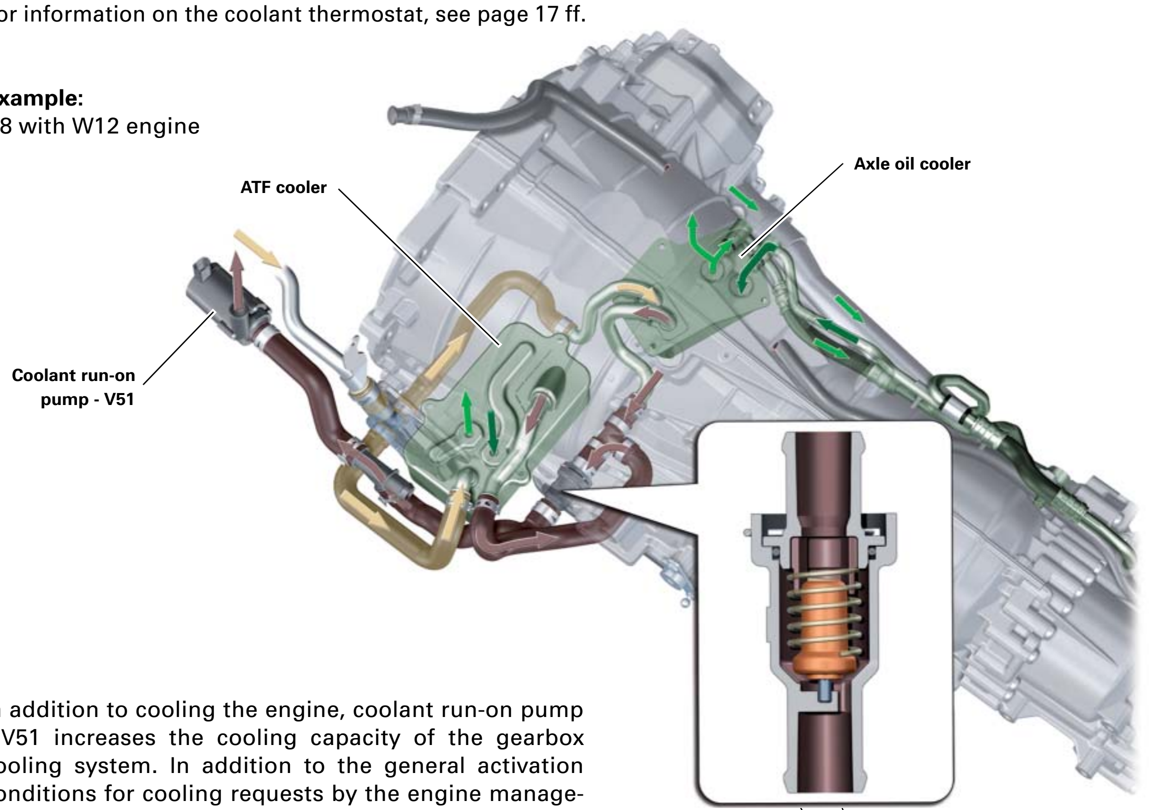
Gearbox cooling - water circuit

The ATF and axle oil cooler are both connected in parallel with the engine cooling circuit. To shorten the engine warm-up phase, a coolant thermostat that begins to open at a coolant temperature of 80°C or higher is integrated in the common return line.
For information on the coolant thermostat, see page 17 ff.

Note

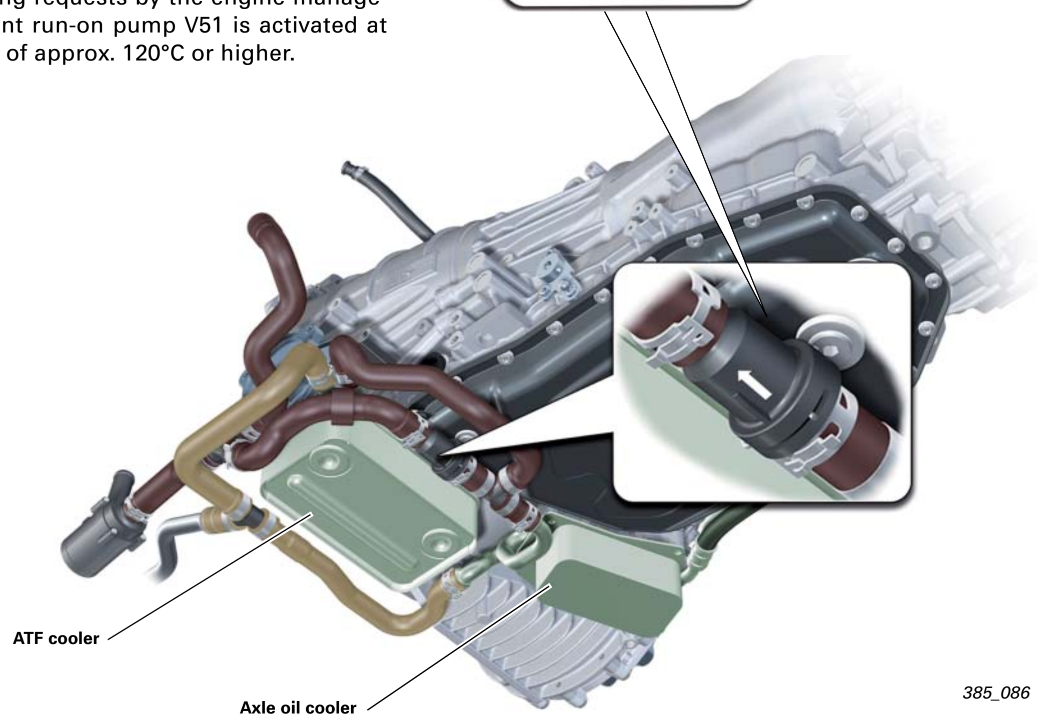
The coolant thermostat (bypass thermostat) replaces the electric shut-off valve initially used (refer to SSP 283 (page 44).

Example:
A8 with W12 engine



385_085

In addition to cooling the engine, coolant run-on pump - V51 increases the cooling capacity of the gearbox cooling system. In addition to the general activation conditions for cooling requests by the engine management system, coolant run-on pump V51 is activated at an ATF temperature of approx. 120°C or higher.



385_086

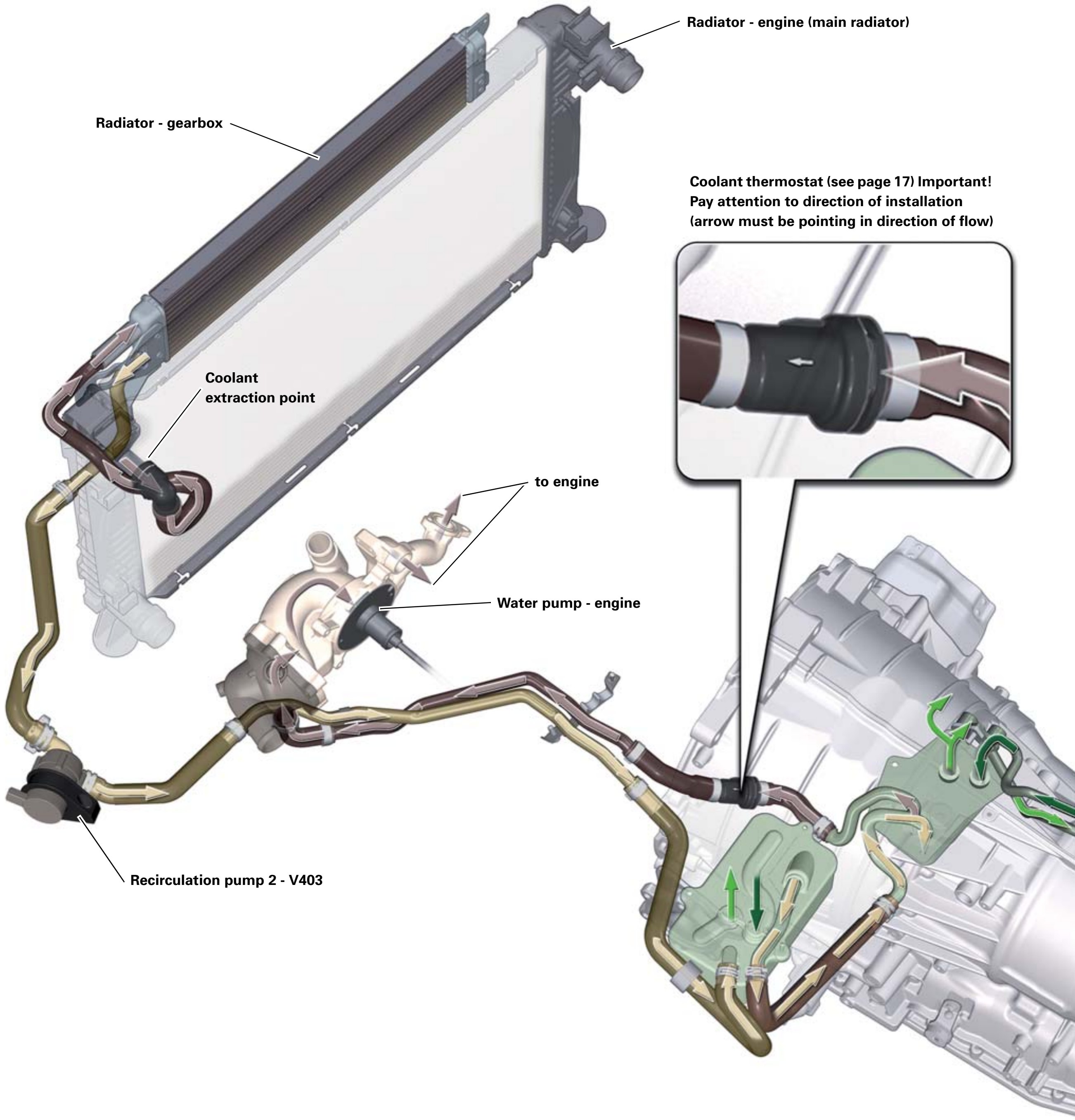
Note

Pay attention to installation of the coolant thermostat in the correct position (arrow). If the thermostat is installed in the wrong position, it will not be able to regulate the coolant temperature properly.

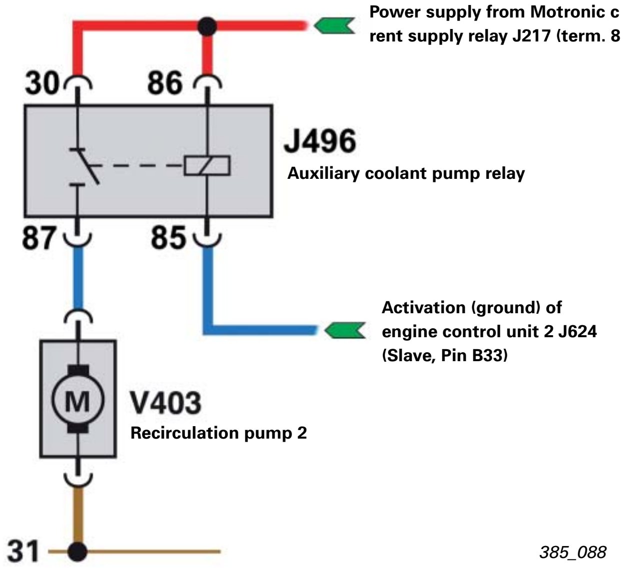
Special features of the Audi RS6

The combination of the 09E gearbox with the 5.0l V10 TFSI engine on the Audi RS 6 (type 4F) called for special modifications with regard to the gearbox cooling system. In addition to cooling the ATF, the oil is cooled by the transfer box and front axle differential (axle oil).
Refer to "Common gearbox oil supply" on page 45.

The gear oils are cooled by an independent water cooling circuit with a separate radiator and electrical water pump (recirculation pump 2 - V403).



The gearbox cooling circuit is connected in parallel with the engine cooling circuit. The ATF cooler and the axle oil cooler are arranged in-line with one another. To shorten the engine warm-up phase, a coolant thermostat that begins to open at a coolant temperature of 80°C or higher is integrated in the return line. For information on the coolant thermostat, see page 17 ff.
To increase cooling capacity, recirculation pump 2 - V403 is activated when an ATF temperature of approx. 110°C is exceeded. This pump backs up the engine-driven water pump and increases the coolant flow rate.



385_088

Activation of recirculation pump 2 - V403

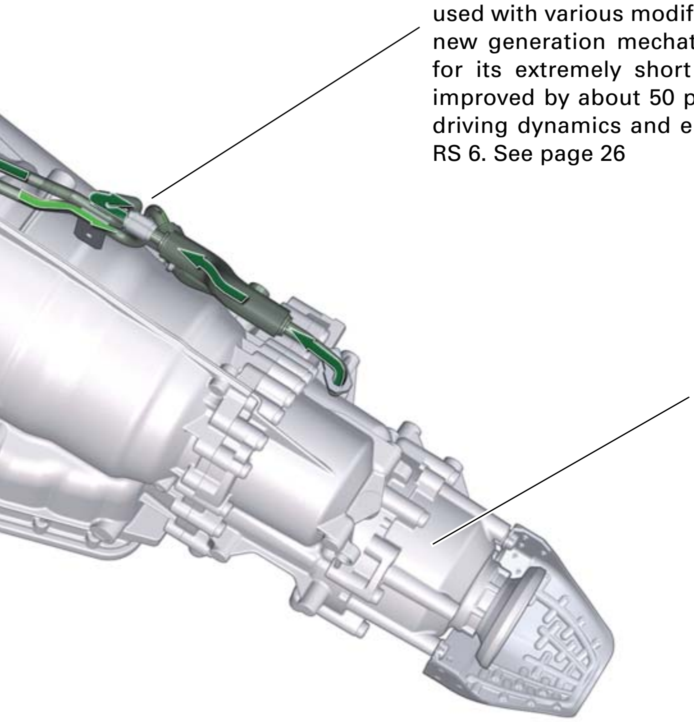
Recirculation pump 2 is activated by relay J496. Engine control unit 2 (slave) controls relay J496 by applying earth potential in dependence on the ATF temperature.

Pump ON ⟹ ATF temperature approx. 110°C
Pump OFF ⟹ ATF temperature approx. 95°C

To prevent the pump from seizing under regular short-distance use (pump switch-on temperature is not reached), the pump is briefly activated after every cold start. The control current circuit of relay J496 is checked by the self-diagnostics of the engine control unit 2 and any detected faults are diagnosed. The working circuit, i.e. direct activation of the pump, or a faulty pump cannot be diagnosed by the engine control unit.
There is **no** measured value for the activation of pump V403. This has to be checked using conventional methods (acoustic/visual inspection, voltage test, etc.).

Gearbox control unit - mechatronics
The gearbox control of the 09E gearbox was updated specially for the Audi RS 6. The second generation mechatronics system (technology adopted from the 0B6 gearbox of the B8 series) is used with various modifications to the gearbox hydraulics. This new generation mechatronics system is notable in particular for its extremely short reaction times. Shift dynamics were improved by about 50 percent, in turn significantly enhancing driving dynamics and emphasising the sportiness of the Audi RS 6. See page 26

Power transmission - centre differential
The sporty character of the Audi RS6 is emphasised by using a self-locking centre differential with a 40/60 front-to-rear asymmetric/dynamic torque split. For information on this centre differential, refer to SSP 363 (page 18 ff.).
See also sectional view of the 09L gearbox on page 13.



385_087

Immobiliser in gearbox control unit

The automatic gearbox has been integrated in the immobiliser system since the launch of the A6 Avant at SOP* in wk** 02/05. These modifications were initially made to the 6-speed automatic gearbox 09L and multitronic 01J.
The notchback versions of the A6 and A8 with 09E, 09L and 01J gearboxes were subsequently rolled out at SOP in wk 22/05 (model year ´06).

The 0AT, 0B6, 0BQ and 0AW gearboxes have been integrated in the immobiliser system since SOP.

All aforementioned gearbox versions all have an integrated control unit (mechatronics). The relatively inaccessible (and hence secure) installation location and the dependency on the gearbox control unit for positive engagement represent an ideal basis for implementation of the immobiliser.

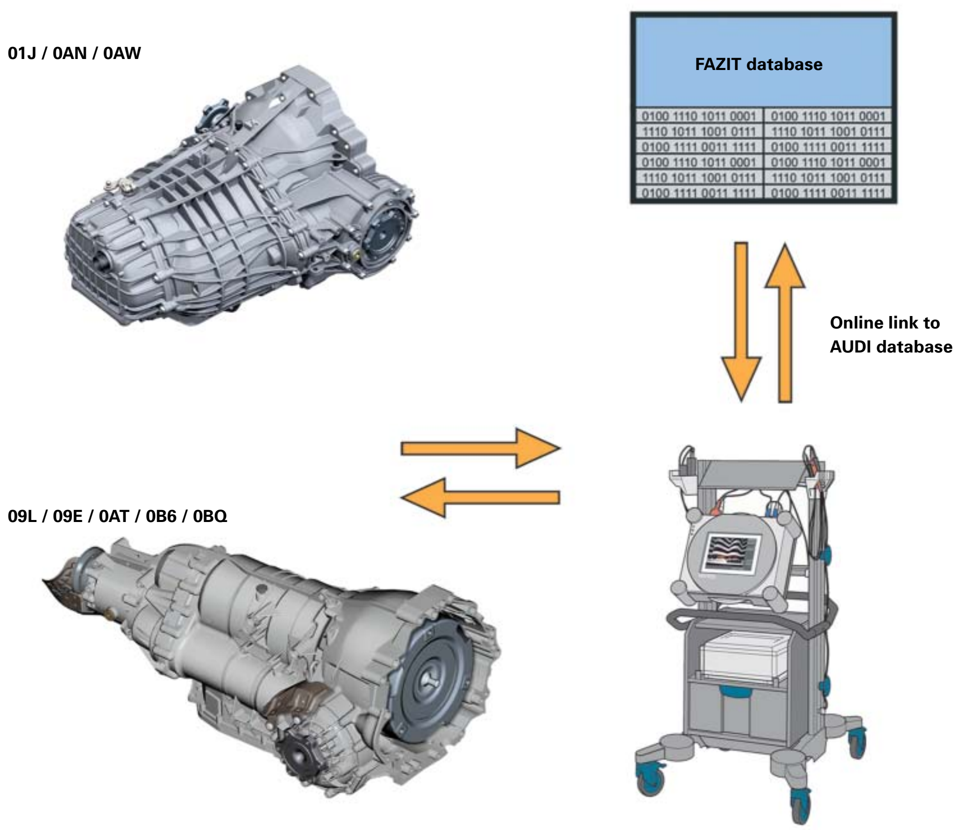
*SOP = start of production
**wk = week

Note

In the following vehicle versions (and older), the automatic gearbox is **not** integrated in the immobiliser system:

Audi A3
Audi TT / TTR
Audi A4 (the B6 and B7 series)
Audi Cabrio (the B6 and B7 series)
Audi Q7 with 09D gearbox

As at March ´08



385_034

01J, 0AN and 0AW gearbox (multitronic)

The multitronic generally does not have a mechanical limp-home function. The modifications with regard to the immobiliser apply only to the software and electronic components of the gearbox control unit.

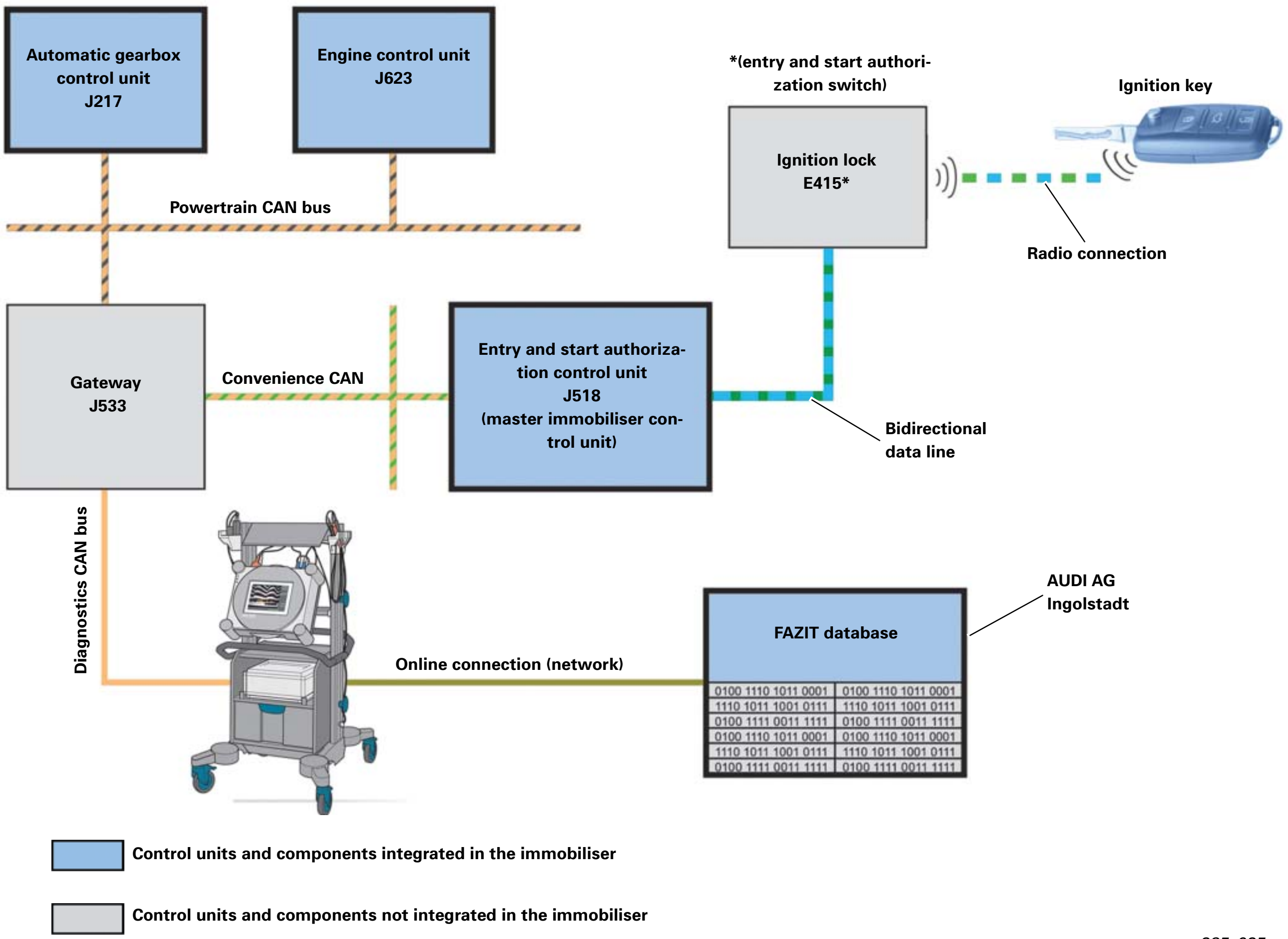
09E, 09L gearbox

In addition to the changes to the control unit's software and hardware, the hydraulic control unit was modified so that no drive is transmitted in the deenergised condition. For this purpose, the characteristic curve of several electrical pressure control valves was inverted.
For more information, refer to "Mechatronics" of the 09L gearbox on page 21.

Due to the integration of the automatic gearbox in the immobiliser, several modifications and special features were added:

- The gearbox control unit has to be adapted to the immobiliser. For this purpose, the menu option "J217 Gearbox control unit, activate immobiliser" is available in "Guided Fault Finding".
- Gearboxes integrated in the immobiliser system do not have a mechanical limp-home function.
- The gearbox control unit or the mechatronics can only be interchanged on the vehicle type for which the control unit was initially adapted (e.g. type 4F to type 4F).
- Unadapted gearbox control units (e.g. new parts) have a limp-home function which permits vehicle speeds of up to approx. 25 kph. When this limp-home speed is reached, engine torque is reduced accordingly. This limp-home function simplifies handling by service personnel since even a vehicle with an unadapted gearbox control unit can be driven into the workshop and manoeuvred.

Overview of participating components (example: Audi A6 ´05)



385_035

Reference

For information on the immobiliser and the FAZIT database, refer to SSP 294 and the SSPs relating to the various vehicle models (e.g. SSP 326 Audi A6 `05 - Electrical System)

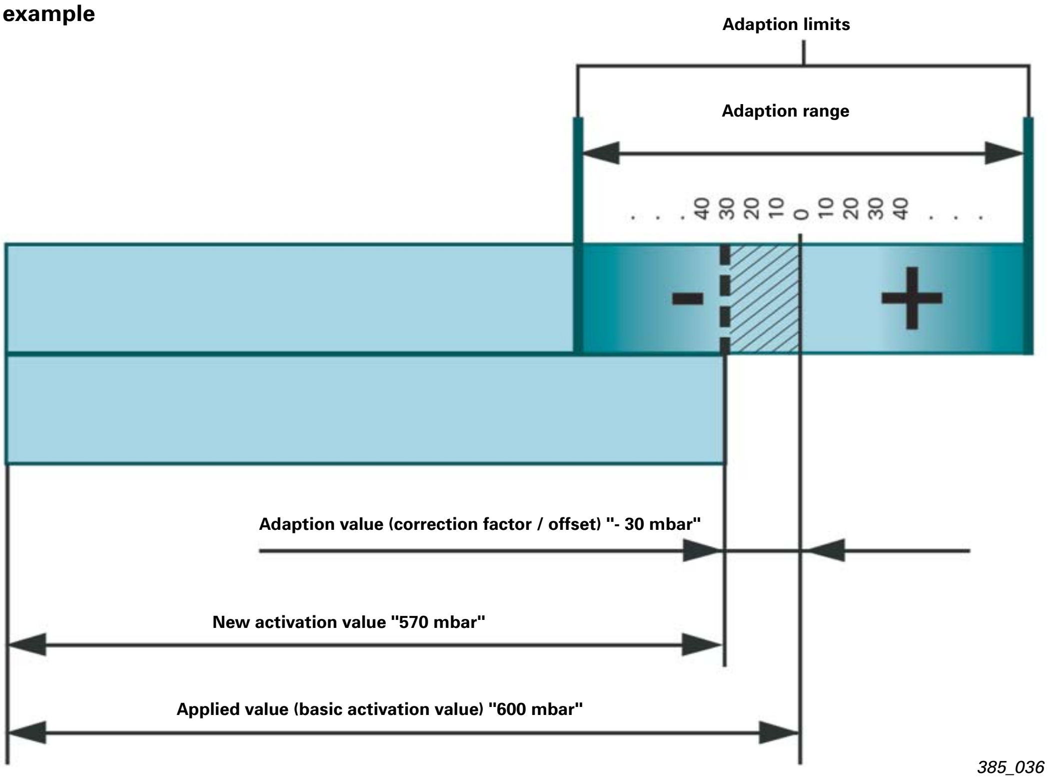
Introduction/basics

In addition to the design, precision control of the shift elements is of key importance to achieving consistently high shift quality. To maintain a high standard of shift quality throughout the service life of the gearbox, it is necessary to continuously adapt various open and closed-loop control parameters, as well as saving the acquired adaption values. These adjustments and this teach-in process are collectively referred to as "adaption".

The aim of gearbox adaption is to compensate for production tolerances in gearbox components and the modifications they undergo during the service life of the gearbox.

Adaption values are corrective values (so-called offsets) which are either added to or subtracted from the default values (applied values) permanently stored in the gearbox control unit.

Adaption example



385_036

This figure shows the principle of adaption. In this example, it was ascertained by adaption that the value permanently stored in the control unit (applied value) is too high.

The ascertained correction factor is now subtracted from the applied value. The result is a new value, which is used to activate the clutch.

Note

Gearbox adaption is a very complex topic, and is becoming increasingly important in view of the rising comfort requirements. For this reason, this topic will be dealt with in detail in the relevant expert training course.

Mechanical and hydraulic influencing factors

The shift elements are actuated hydraulically. For this purpose, the characteristics of the electrical and mechanical control valves have to be taken into account. It is necessary to overcome resistance caused by mechanical friction within the components and the pressure of the piston resetting springs. Moreover, attention must be paid to filling all ducts, lines and cylinder chambers, as well as clutch clearance. All of these are factors influencing the gearshift sequence. To these must be added the parameters of the individual shift devices upon which clutch torque (**M_K**) is dependent.

Parameters of the shift devices

- Type
- Contact pressure (clutch pressure)
- Coefficient of friction

The **type** determines the average friction face diameter (**d_m**) and the number of friction faces (**n**). The type is defined by design and therefore is constant.

The **contact pressure** (**F_N**) is regulated by the clutch pressure. The clutch pressure is a variable parameter which is used to control clutch torque.

The **coefficient of friction** (**μ**) is a parameter that changes continuously during operation of the vehicle and throughout its service life. The coefficient of friction is a variable parameter and is dependent upon the following influencing factors:

- The friction plates (material, specification, quality, ageing and wear)
- The ATF (specification, quality, ageing and wear)
- ATF temperature
- Clutch temperature
- Clutch slip

To be able to control or regulate the clutches consistently easily in any operating condition and throughout their useful life, in addition to the aforementioned influencing factors, it is necessary in particular to compensate for the change in the coefficient of friction.

One of the focal points is the clutch pressure, as these changes can be compensated by adapting the clutch pressure.

Clutch pressure

There is a defined ratio between the clutch pressure and the control current of the electrical pressure control valve (EPC valve).

The clutch-pressure-to-control-current ratio is, by design, determined by the characteristic curves of the EPC valve and the hydraulic control valves (slide valves) on the downstream side.

Note:
The EPC valve produces the necessary control pressure by applying a defined control current. This control pressure acts upon a slide valve, which in turn produces the pressure required to activate the clutch (clutch pressure). The clutch pressure, in turn, produces a clutch torque.

To control the clutch torque with constant precision, the gearbox control unit has to be continuously adapted to the control-current-to-clutch-torque ratio.

Clutch torque derives from the engine torque (information supplied by the engine control unit) and is determined from a defined amount of clutch slip by means of the gearbox input speed sender G182.

Note

To transmit a defined amount of clutch torque, a defined ratio must always exist between the parameters of contact pressure, coefficient of friction and type.
The adjacent formula illustrates this basic relationship:

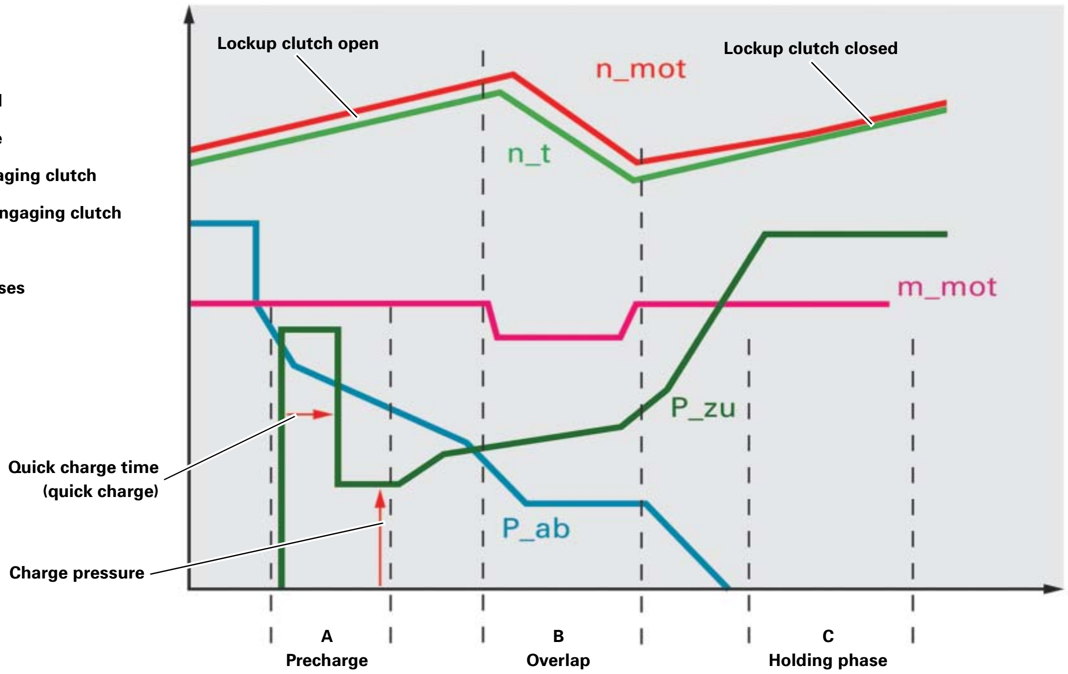
$$\underbrace{M_k}_{\text{Clutch torque}} = \underbrace{F_N}_{\text{Contact pressure}} \cdot \underbrace{\mu}_{\text{Coefficient of friction}} \cdot \underbrace{d_m \cdot n}_{\text{Type}}$$

385_037

Upshift sequence under throttle

Legend

n_mot = engine speed
n_t = turbine speed
m_mot = engine torque
P_zu = pressure engaging clutch
P_ab = pressure disengaging clutch
t = time
A, B, C = adaption phases



385_038

The gearshift sequence

To understand the adaption process better, it is important to know how the basic shift control process works. Take for example a typical upshift under throttle.

The upshift under throttle shown in Fig. 385_038 is applicable to all gears. It is what is known as an overlap shift.

Overlap shift means that the power transmitting clutch maintains a torque at a reduced pressure until the engaging torque accepts the torque.

To make the gearshift sequence as comfortable as possible, and to conserve the clutches, engine torque is reduced during the overlap phase and the lockup clutch is opened.
Fig. 385_038 shows the three phases (A, B and C) during which adaption processes take place.

A During the precharge phase, the quick charge time and the charge pressure are adapted

B During the overlap phase, the shift pressure is adapted

C During the holding phase, the holding pressure is adapted

Glossary:

The **precharge** prepares the clutch for the next gearshift, and is of key importance to achieving high shift quality.
The precharge comprises the quick charge time and the charge pressure, and eliminates clutch play and a certain degree of elasticity in the shift devices. This permits defined clutch engagement and increases the spontaneity of gearshifts.

The **quick charge time** (quick charge) is the first stage of the gearshift. During the quick charge time, a high pressure is applied briefly (for approx. 100 - 150 ms) to the shift devices directly before the actual gearshift, in order to fill the hydraulic ports and the clutch cylinder as quickly as possible.

The charge pressure is the pressure that is required to compress the clutch plate assembly so that the clutch just makes contact, but still does not transmit an appreciable amount of torque. The purpose of the charge pressure is to "preload" the clutch to the extent that it can immediately accept torque when the pressure subsequently increases. The charge pressure is the basis for all other pressures in the gearshift sequence. The correct charge pressure is particularly important for shifting gear at low engine load.

The **shift pressure** is the pressure acting during the overlap phase (slip phase).

The **holding pressure** is the pressure necessary to keep the clutch safely closed.

Adaption of the precharge cycle ...

... (charge pressure and quick charge time) adapts clutch play and clutch resistance until the clutch assembly makes contact, but still does not transmit an appreciable amount of torque.

... can be tested and assessed using the diagnostic tester - see page 60 ff.

... is performed by what is known as pulse adaption - see page 68.

Adaption of the shift pressure ...

... is based on an analysis of the change in gearbox input speed (engine speed gradient) during the gearshift. Example: During an excessively harsh gearshift (uncomfortable gearshift), the engine speed drops too quickly (steep engine speed gradient). The adaption program detects this condition from the engine speed gradients and reduces the clutch pressure by a defined amount (adaption value) during the next gearshift. This type of adaption is mainly carried out during the quick adaption cycle. See page 70.

Adaption of the holding pressure ...

... is generally based on calculations made using the values determined during the charge pressure and shift pressure adaption.

Note:
The shift and holding pressure adaptions cannot be read out using the diagnostic testers. They are therefore not dealt with in any further detail. However, these adaptions are also deleted when the adaption values are deleted.

Depending on the type of adaption and the shift device to be adapted, different driving and operating conditions must be present. For this purpose, so-called adaption conditions are defined for each adaption cycle.

An adaption cycle can only be performed if the defined adaption conditions are met.

Here is an overview of the criteria which must be taken into account during the adaption cycle*:

– The temperature of the ATF must lie within a defined range.

– Defined gear or gearshift.

– The engine load must lie within a defined range. A very low engine load or low accelerator position is normally necessary.

– No entries in the fault memory of the gearbox control unit.

– A defined vehicle operating state must exist (e.g. under throttle or overrun, constant vehicle operation, vehicle at standstill with engine idling, etc.).

– Good road conditions, as good a road surface as possible, no large uphill or downhill gradients, as level a route as possible.

* For detailed information on the adaption conditions, refer to the descriptions of the individual adaptions.

Note

If the adaption conditions are not brought about, e.g. because the driver always operates the vehicle outside the adaption conditions, the gearbox will be unable to adapt sufficiently.
Inadequate adaption can lead to complaints about shift quality. This can affect, for example, only a specific gearshift sequence, or various gearshifts.
The adaption cycle has a relatively large influence on gearshifts at low engine load, during overrun downshifts and overrun upshifts.

What is special about the adaption process

A gearbox does not enter a defined adaption condition until it has been in use for an extended period of time.
Another characteristic of the adaption process is that the readiness for adaption decreases with increasing adaption frequency. This means that the adaption frequency will be very high if a gearbox has undergone only a small number of adaptions (e.g. low mileage vehicle) or if adaption values have been deleted. On the other hand, if a gearbox that has already undergone a large number of adaptions (e.g. high mileage vehicle), the adaption intervals will be longer.
Refer to "Adaption cycles" on page 71.

Reading, evaluating and deleting adaption values

With model year ´06 and later, adaption values of the 6-speed automatic gearboxes 09E and 09L can be read and deleted using the diagnostic tester. This is generally possible with gearboxes 0AT, 0B6 and 0BQ, as they were launched after model year ´06.

In following sections, you will learn about and gain a better understanding of the gearbox adaption processes:

Reading, evaluating and deleting adaption values

Effect of adaption values

Adaption principles

Adaption conditions

Adaption cycles

Adaption limits / interpretation

Adaption drive

385_065

Note

In vehicles up to and including model year ´05, adaption values cannot be read out or deleted. In these vehicles, to be able to at least delete the adaption values, the gearbox control unit software must be updated. If no software update is available, please contact Product Support (per DISS notification). If you are unable to obtain suitable software through these channels, then the mechatronics must be replaced. When new mechatronics are installed, the existing adaption values are always deleted.

Adaption values are written to a permanent memory. Adaption values will not be deleted if the gearbox control unit has a separate power supply.

When is it necessary to read, evaluate or delete adaption values and carry out an adaption run?

- Following complaints about gearshift comfort
- After repair work has been done on the gearbox (for example, after replacing or adjusting clutches or replacing parts involved in the activation or actuation of clutches)
- After replacing the gearbox
- After replacing the ATF
- After replacing the mechatronics
- After a software update
- After engine repairs (e.g. replacement of the air mass meter)

Note

Before deleting adaption values, make sure that the existing adaption values are evaluated and documented. The previous adaption values can provide pointers as to the condition of individual clutches, and can be of great use in deciding what further action is necessary. **Documenting adaption values makes it easier to identify the cause of the complaint.**

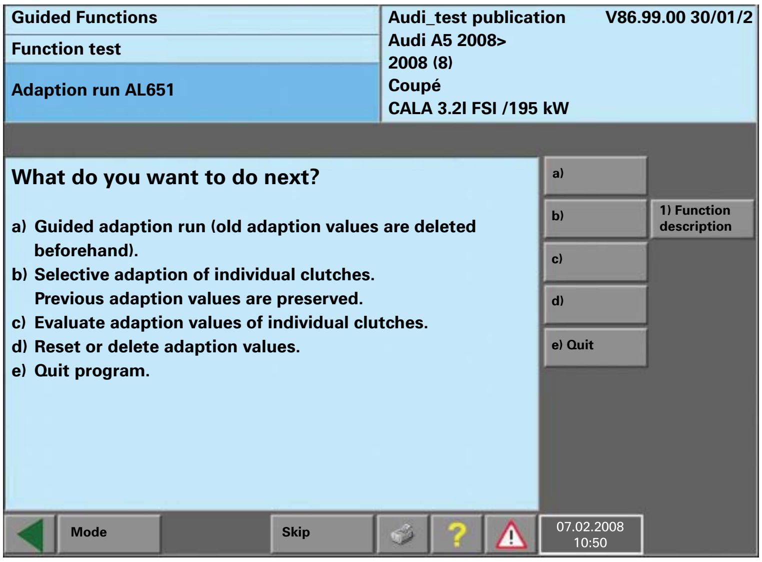
After deleting the adaption values, an adaption run must be performed using the "Guided Functions or Fault Finding" function. If the adaption run cannot be performed for any particular reason, an extensive test drive must always be carried out.
Make sure that the adaption conditions (see page 67 ff.) are observed and that the quality of each gearshift is assessed. If certain gearshifts are irregular, the corresponding shift devices can be adapted selectively.
You can use the shift logic on page 60 to identify the shift devices affected.

Reading adaption values

There are two ways to read adaption values:

1 In "Guided Functions / Fault Finding", select "Adaption run" under "Select function or component " - "J217 Automatic gearbox control unit, functions".

2 In the "Vehicle self-diagnostics". See next page



385_039

Brief description of functions a), b), c) and d):

Function a)
covers the automatically guided procedure from the read-out of adaption values to complete adaption of the gearbox.
The following functions are performed:

– The previous adaption values are saved to the diagnostic log

– The adaption values are deleted

Driving instructions are now given so that you can carry out a complete adaption run step by step. The object of these instructions is to bring about the vehicle operating states necessary to meet the adaption conditions.
See page 67 ff.
If necessary, the same vehicle operating state must be repeated several times. As soon as the maximum repetition rate is achieved or the clutch has adapted once, the next program step is started. To check your results, the adaption values are displayed and documented after each program step. If clutches have not been adapted at least once after all program steps have been completed, the program step can now be repeated for the clutch in question. By the end of the program, each clutch adaption should have been performed at least once. The shift quality of the gearbox should then be checked.
See page 72.

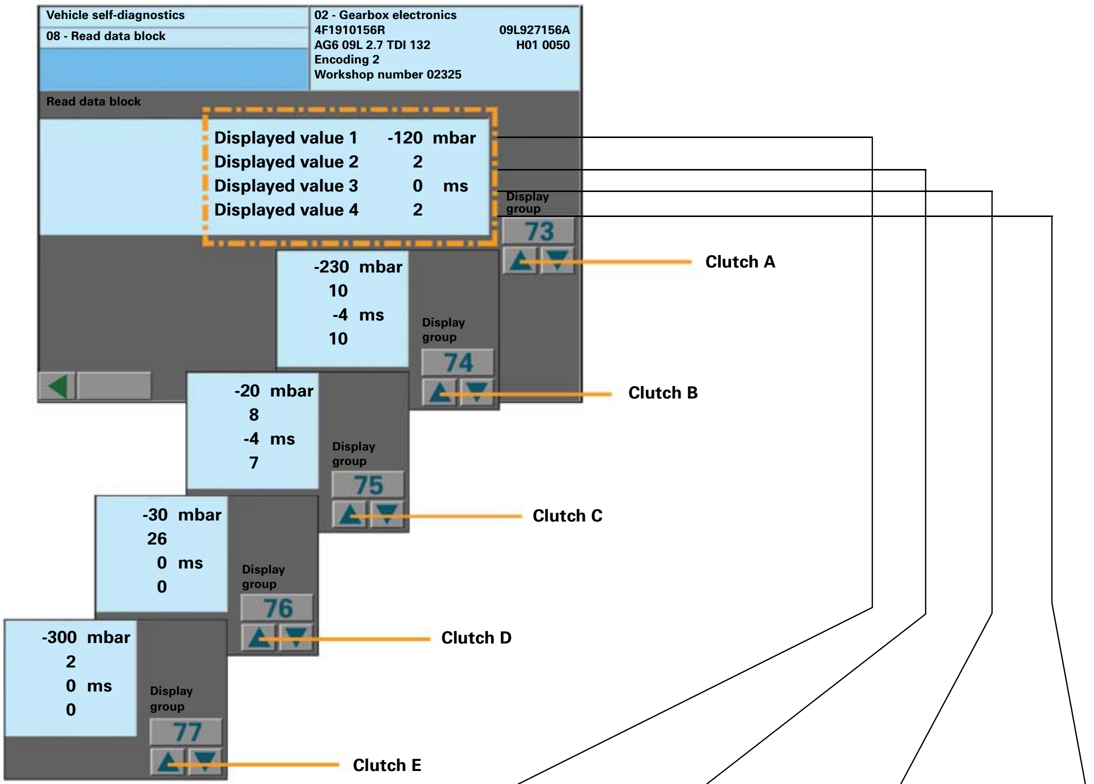
Function b)
can be used for selective adaption of a specific clutch without deleting the previous adaption values. This function is advantageous when, for instance, an irregular (harsh) gearshift can be attributed to an insufficiently adapted clutch. This entails analysing the adaption values (particularly the adaption count) and looking at the shift logic to see what shift devices are affected by the irregular gearshift.
Refer to "Interpreting adaption values" on page 62 and the example on page 61.

Function c)
can be used to assess the precharge adaption values.
See page 57.

Function d)
can be used to delete adaption values. In this case, the previous adaption values are not documented.
Refer to the note on page 58.

Reading adaption values in the self-diagnostics of gearboxes 09E, 09L, 0AT and 0BQ

The precharge adaption values are displayed in data blocks (DB) 73 to 77.



385_040

Data block	Shift device	Displayed value 1	Displayed value 2	Displayed value 3	Displayed value 4
73	A	Adaption value Charge pressure in mbar	Count Adaption cycles Charge pressure	Adaption value Quick charge time in ms	Count Adaption cycles Quick charge time
74	B				
75	C				
76	D	Adaption value Charge pressure in mbar	Count Adaption cycles Charge pressure	No adaption* (value remains at 0)	No adaption* (value remains at 0)
77	E				

* The quick charge time is also adapted for the 0B6 gearbox and the 09E gearbox in the RS6.

385_041

Shift logic of the 09E, 09L, 0AT, 0B6 and 0BQ gearboxes

The adjacent shift logic shows which shift devices are involved and are not involved in each of the gears or gearshifts.

	Shift logic				
Shift device	A	B	C	D	E
P/N					
Reverse (R) gear					
1st gear					
2nd gear					
3rd gear					
4th gear					
5th gear					
6th gear					

385_042

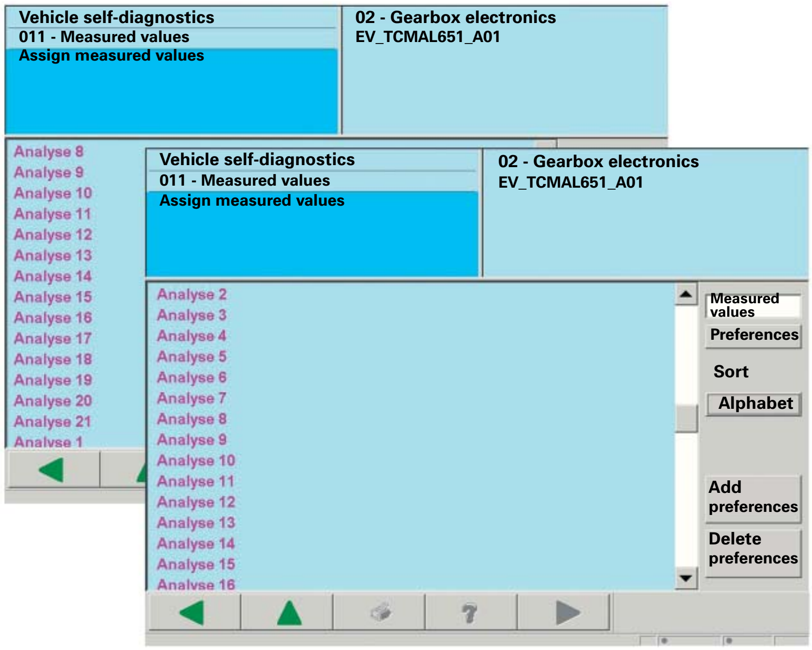
Shift device - clutches

Shift device - brakes

Reading adaption values in the self-diagnostics of the 0B6 gearbox

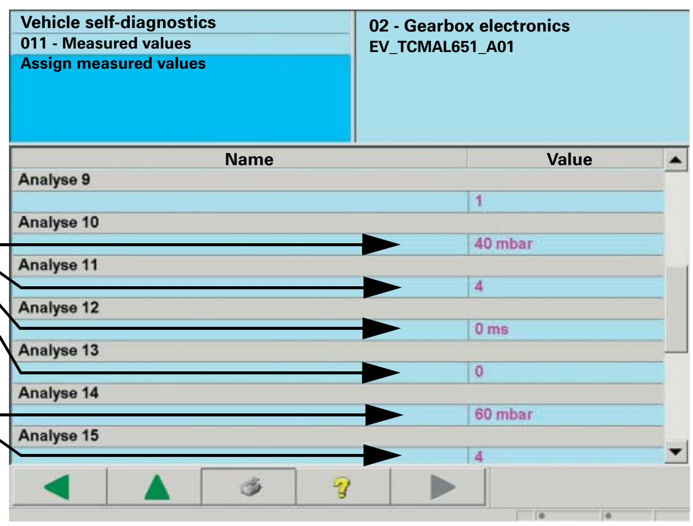
A new data and diagnostic log was implemented for the 0B6 gearbox. The previous data blocks and numberings were deleted. In exchange, measured values are now available individually, and are listed as full text in alphabetical order. The required measured values can then be selected in a specific manner.

The adaption values are referred as the "analysis". The following list shows the assignments of the individual adaption values.



385_043

Analysis	2-5	**Clutch A**	
	2	Adaption value	Charge pressure (mbar)
	3	Count	Charge pressure
	4	Adaption value	Quick charge time (ms)
	5	Count	Quick charge time
Analysis	6-9	**Clutch B**	
	6	Adaption value	Charge pressure (mbar)
	7	Count	Charge pressure
	8	Adaption value	Quick charge time (ms)
	9	Count	Quick charge time
Analysis	10-13	**Clutch C**	
	10	Adaption value	Charge pressure (mbar)
	11	Count	Charge pressure
	12	Adaption value	Quick charge time (ms)
	13	Count	Quick charge time
Analysis	14-17	**Clutch D**	
	14	Adaption value	Charge pressure (mbar)
	15	Count	Charge pressure
	16	Adaption value	Quick charge time (ms)
	17	Count	Quick charge time
Analysis	18-21	**Clutch E**	
	18	Adaption value	Charge pressure (mbar)
	19	Count	Charge pressure
	20	Adaption value	Quick charge time (ms)
	21	Count	Quick charge time



385_048

Example of how the shift logic is used:

A customer complains about an uncomfortable downshift. During the test drive, you determine that it is the 3-2 downshift under throttle. From the shift logic table, you can see that during the 3-2 downshift clutch B opens and brake C closes (overlap shift). Now evaluate the adaption values of shift devices B and C. This cause of the problem could, for example, be insufficient adaption of brake C (indicated by low adaption count). see next page.
Note: the engaging torque/brake is usually the cause of the trouble.
To stay with this example: Now readapt the shift device by deleting the adaption values and subsequently carrying out an adaption run. This could be sufficient to remedy the complaint. Another possibility is to carry out an adaption run specifically for the shift device in question (without deleting the adaption values).

Gearbox adaption

Interpreting the adaption values

When evaluating the adaption values, special attention must be given to the number of adaption cycles (count). A count of 0 or a low count indicates that the clutch in question has possibly not been sufficiently adapted.
If, for instance, a clutch has not been sufficiently adapted and is involved in the faulty gearshift (refer to shift logic), then the reason for the complaint is very probably insufficient adaption of the clutch in question.

The cause of an insufficient adaption is usually the driver's driving profile. If the driver's driving style is performance-oriented or if the driving profile is very unfavourable due to the ambient conditions, no or little adaption takes place because the adaption conditions (see page 67 ff.) are not met.

The following unfavourable conditions are possible causes:

- Hilly terrain (few level roads)
- Continuous "stop and go" traffic (traffic jam)

Adaption limits

The adaption limits given in the table are examples only. Basically, no generalisations can be made regarding adaption limits because they can vary considerably depending on gearbox version (different gearbox codes).

Shift device	Adaption limits Charge pressure	Adaption limits Quick charge time
A	approx. - 400 mbar to +350 mbar	approx. - 40 ms to 120
B	approx. - 400 mbar to +350 mbar	approx. - 60 ms to 100
C	approx. - 400 mbar to +350 mbar	approx. - 50 ms to 120
D	approx. - 300 mbar to +200 mbar	approx. - 300 ms to +200
E	approx. - 300 mbar to +300 mbar	------

Exceeding adaption limits can be detrimental to shift quality. As long as no complaints are made regarding shift quality, no action need be taken. On the other hand, high adaption values are normal for some gearbox versions.

If in doubt or if major discrepancies occur, seek the advice of a specialist. In such cases, please contact Product Support providing detailed gearbox data.

The following circumstances can lead to irregular adaption values:

- Heavy wear of the shift devices (e)
- Leakage in the shift device or in the supply lines (e)
- Mechanical components of the shift device are faulty or have not been correctly installed (e)
- The AFT is contaminated, needs to be changed (degraded), or the gearbox is not filled with the correct ATF (a)
- Adaption values are near the limit (often without explanation) (e)’
- Errors in software, or faults in hardware or application (e)

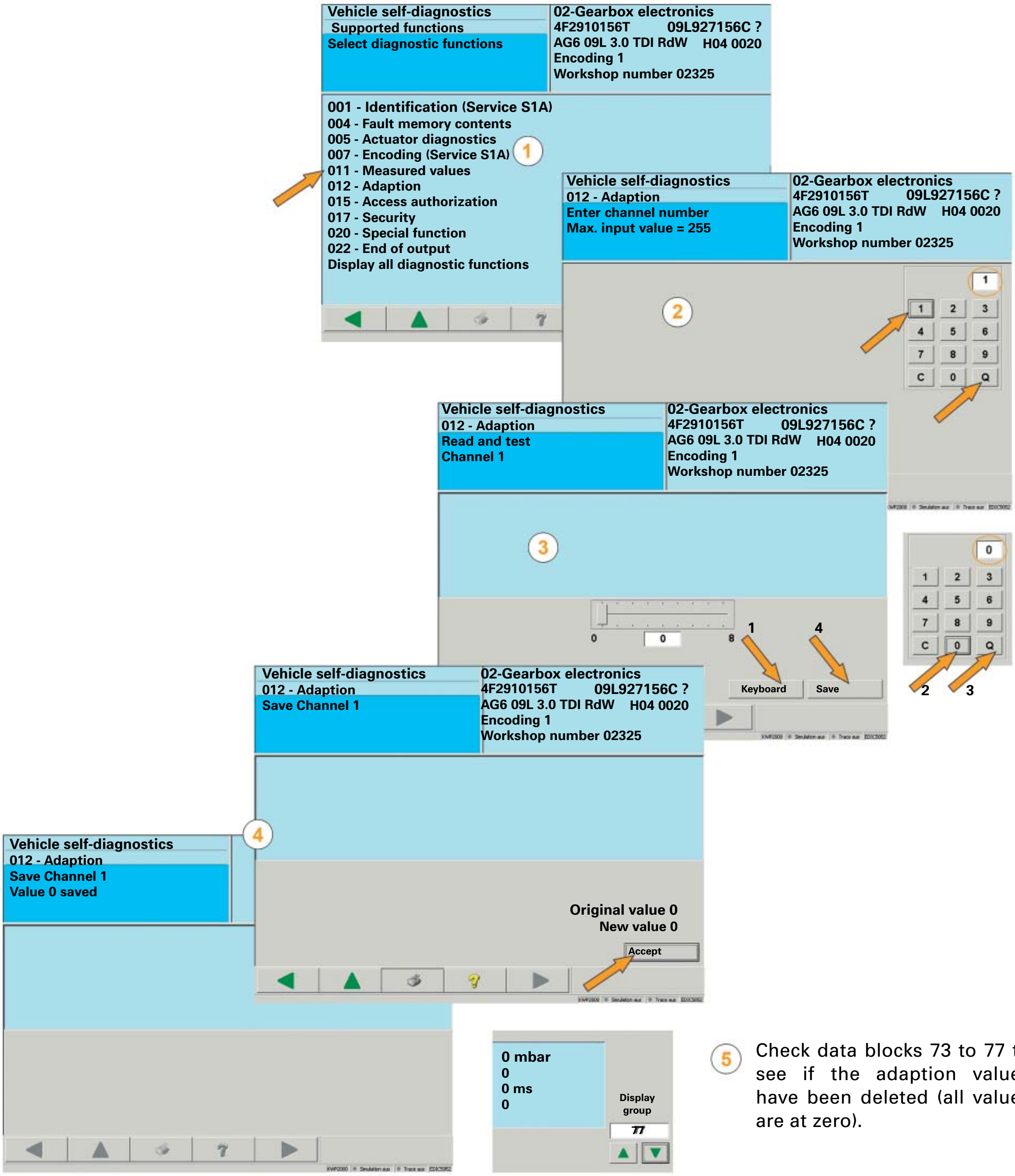
(e) = applies to individual clutch only
(a) = applies to possibly all or multiple clutches

Deleting adaption values in the self-diagnostics of gearboxes 09E, 09L, 0AT and 0BQ

Normally, adaption values can be deleted using the "Guided Functions or Fault Finding" function.

If, however, this function is unavailable for any particular reason, you can take the steps shown below.

Refer to the notes on page 58



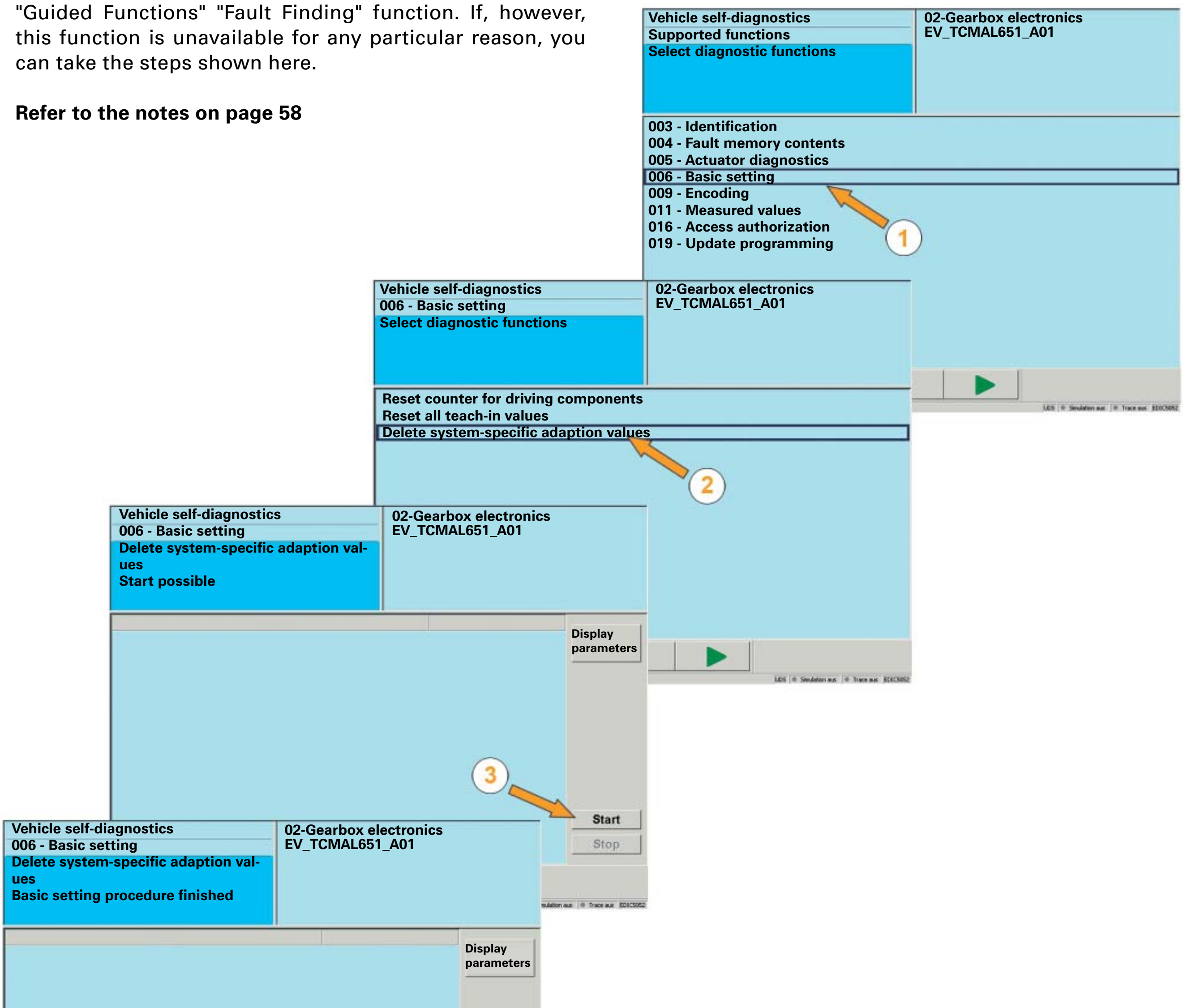
Check data blocks 73 to 77 to see if the adaption values have been deleted (all values are at zero).

385_066

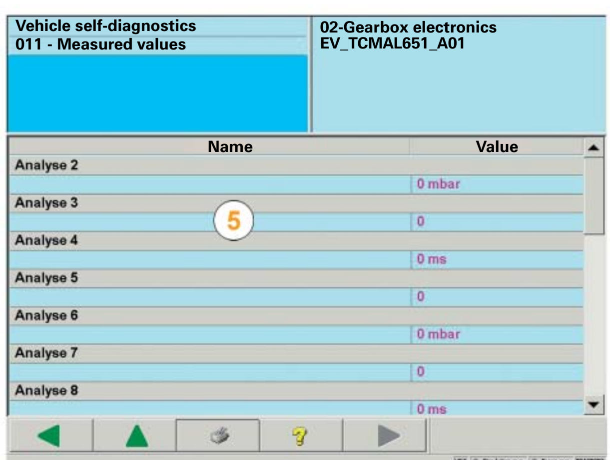
Deleting adaption values in the self-diagnostics of the 0B6 gearbox

On the basis of the new data and diagnostic log (see page 35), the procedure for deleting adaption values of the 0B6 gearbox is explained below.
Normally, adaption values can be deleted using the "Guided Functions" "Fault Finding" function. If, however, this function is unavailable for any particular reason, you can take the steps shown here.

Refer to the notes on page 58



Check the measured values in Analysis 2-21 to see if the adaption values were deleted (all values are zero).



385_067

Adaption procedure

The following adaption modes are used:

– Shift adaption (during up and downshifts)

– Slip adaption (vehicle at standstill and engine idling)

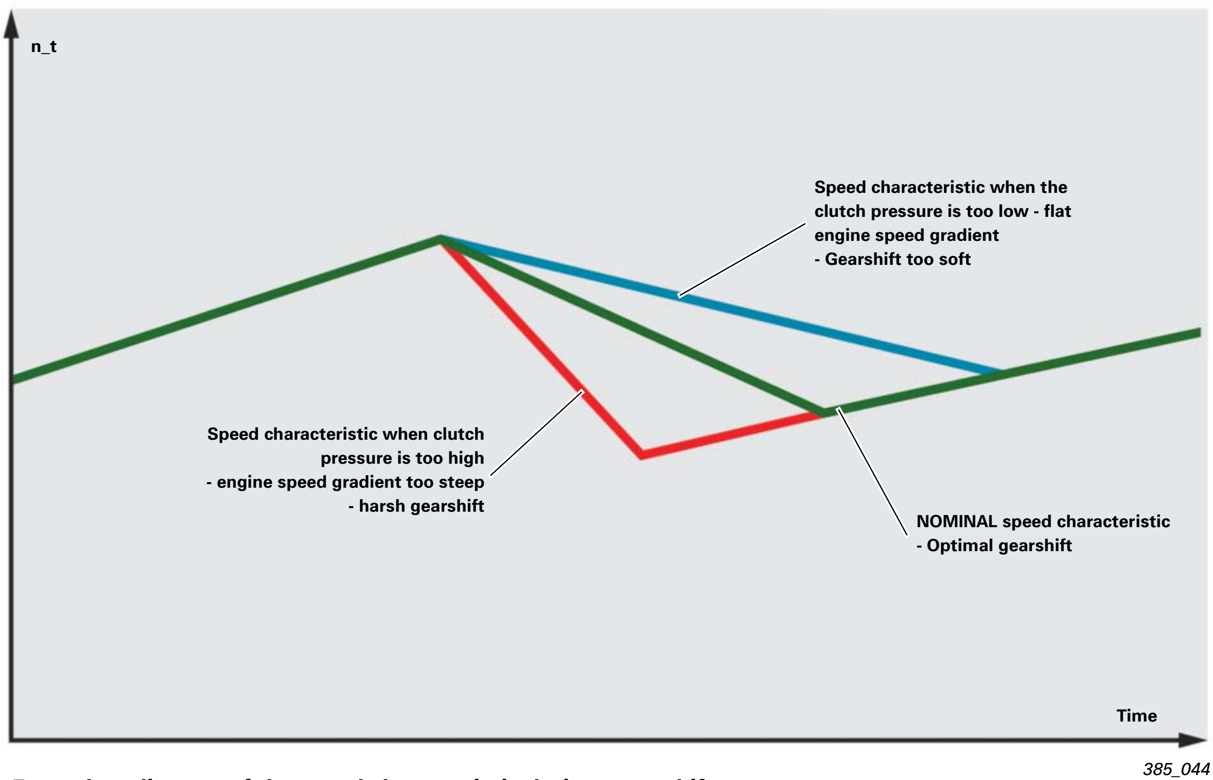
– Pulse adaption (outside gearshift mechanism)

Shift adaption ...

... is based on an analysis of the change in gearbox input speed (engine speed gradient) during the gearshift.

Example:
During an excessively harsh gearshift (uncomfortable gearshift), the engine speed drops too quickly (steep engine speed gradient).
The adaption program detects this condition from the engine speed gradients and reduces the clutch pressure by a defined amount (adaption value) during the next gearshift.

This adaption process is mainly carried out during the quick adaption cycle. Refer to Quick adaption - Start adaption on page 70.



Exemplary diagram of the speed characteristic during an upshift to illustrate the shift adaption process

Slip adaption ...

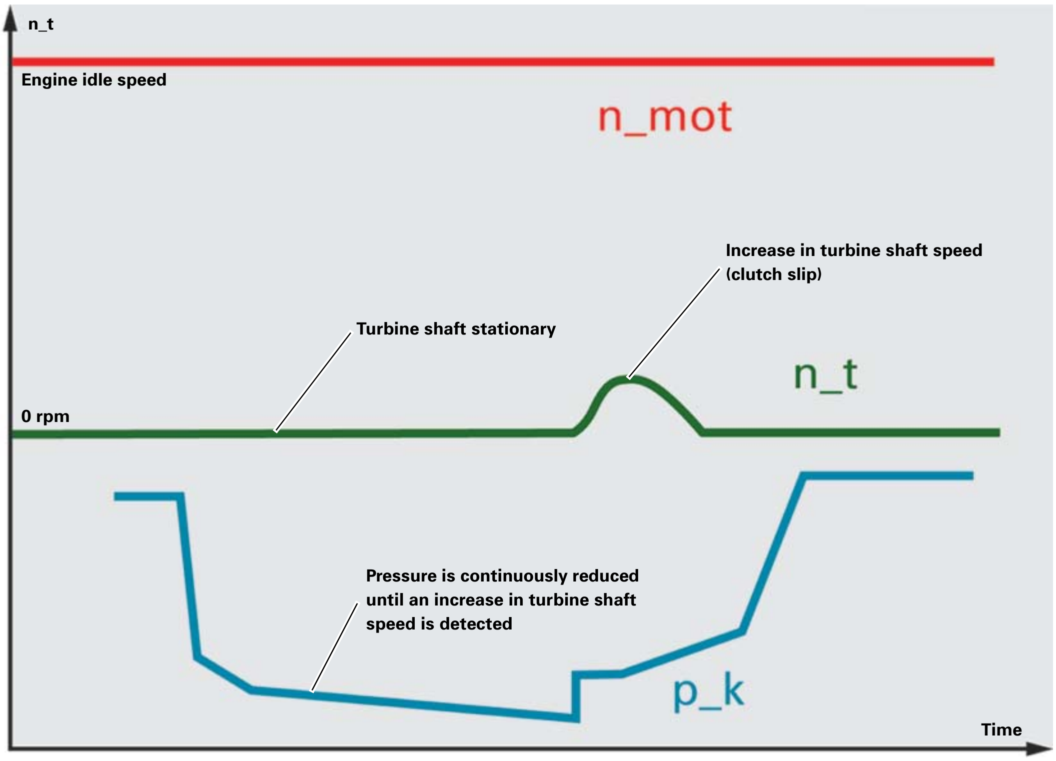
... is applied only to clutch D for technical reasons.

If the adaption conditions have been met, clutch D is opened to allow a defined amount of clutch slip and closed again. Clutch slip can be determined exactly from the turbine speed (n_t) by the gearbox input speed sender G182.

There is a defined relationship between the control current, clutch pressure and clutch torque, which are used for calculating the adaption value.

Conditions for slip adaption of clutch D:

- ATF temperature between 75°C and 100°C
- Engine idle
- Gear selector in D
- Brake applied
- Vehicle stationary (no vehicle speed detected for > 6 seconds)
- No fault entries in fault memory



385_045

n_mot = engine speed
n_t = turbine speed
p_k = clutch pressure (clutch D)

Gearbox adaption

Pulse adaption ...

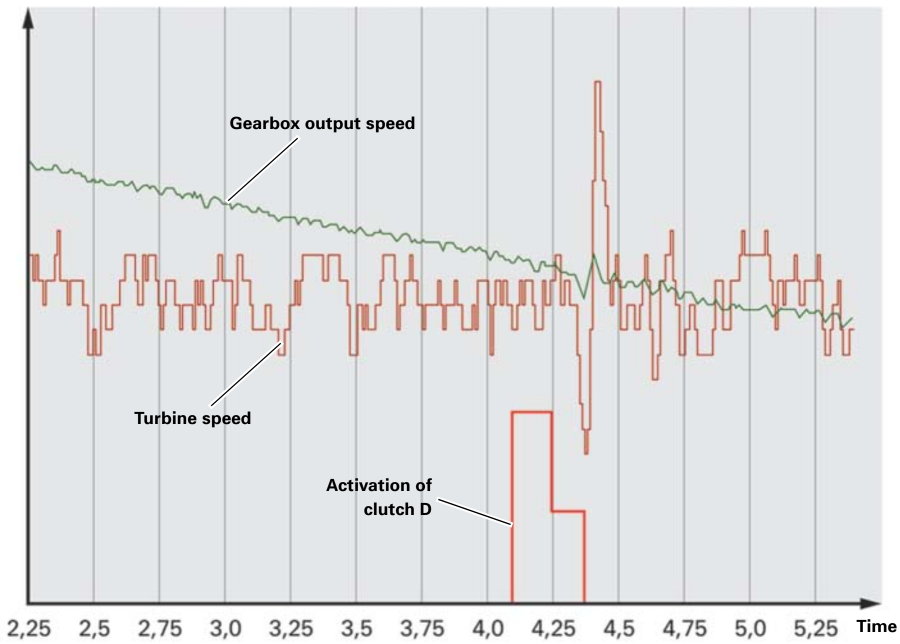
... is a modern adaption method and provides the very high level of precision necessary to achieve excellent shift quality.

During the pulse adaption process, shift devices **currently not involved in power flow** (inactive) are adapted. This occurs in a defined vehicle operating state (see table).
If the adaption conditions for pulse adaption are met, the shift device to be adapted is activated in a pulsating (rhythmic) fashion with continuously increasing pressure, i.e. longer quick charge time, until a very small amount of torque is transmitted.

This induces slight stress within the gearbox, which is detected by the turbine speed and the gearbox output speed. There is a defined relationship between the control current, clutch pressure and clutch torque, which are used for calculating the adaption value.

Specific adaption conditions have to be met so that pulse adaption can be performed:

- ATF-Temperatur min. 70°C (max 95°)
- guter Fahrbahnbelag
- keine Einträge im Fehlerspeicher
- definierter Gang (siehe Tabelle)
- definiertes Motormoment (siehe Tabelle)
- definierter Motordrehzahlbereich (siehe Tabelle)



385_046

Note

All adaption processes take place in the background and normally go unnoticed by the driver. In isolated cases, attentive drivers may notice and complain about irregularities.
Normally, the complaint is barely reproducible, occurs rarely and has a minimal effect on ride comfort.

Example: Overview of the adaption processes

The adaption process and the adaption conditions are defined for almost every gearbox version. The table serves only to illustrate the complexity of this topic. During the guided adaption run and during the selective adaption of individual clutches, the driving instructions are selected such that most of the adaption conditions are met. In isolated cases, however, it can occur that a shift device is not adapted despite an extensive adaption run.

In this case, check the "General boundary conditions". These include: Is a good road surface available? Does the brake light switch work? Are faults stored in the gearbox control unit?

Table Adaption procedure - adaption conditions **

Shift device	09L gearbox		09E gearbox	0B6 gearbox
	Audi A4 3.2 FSI	Audi A6 3.0 TDI	Audi A8 6.0 MPI	All engines As at 02/2008
A Data block 73	5th gear overrun Engine torque -110 Nm to -25 Nm Turbine speed 1100 - 2000 rpm	5th gear overrun Engine torque -100 Nm to -53 Nm Turbine speed* 1400 - 3000 rpm	5-4 downshift Engine torque -30 Nm to 8 Nm Turbine speed* 550 - 1100 rpm	5th gear overrun Engine torque -140 Nm to -25 Nm Turbine speed* 1300 - 2200 rpm
B*** Data block 74	6th gear under throttle Engine torque 50 Nm to 130 Nm Turbine speed* 1600 - 2800 rpm	6th gear under throttle Engine torque 35 Nm to 200 Nm Turbine speed* 1100 - 3000 rpm	6-5 downshift Engine torque -30 Nm to 8 Nm Turbine speed* 550 - 1200 rpm	6th gear until throttle Engine torque 50 Nm to 140 Nm Turbine speed* 1500 - 2700 rpm
C*** Data block 75	5th gear under throttle Engine torque 60 Nm to 120 Nm Turbine speed* 1500 - 2800 rpm	5th gear under throttle Engine torque 35 Nm to 200 Nm Turbine speed* 1100 - 3000 rpm	5th gear under throttle Engine torque 40 Nm to 120 Nm Turbine speed* 1200 - 2500 rpm	5th gear under throttle Engine torque 40 Nm to 120 Nm Turbine speed* 1500 - 2700 rpm
D Data block 76	See description of slip adaption process	See description of slip adaption process	See description of slip adaption process	See description of slip adaption process
E*** Data block 77	3rd gear under throttle Engine torque 35 Nm to 80 Nm Turbine speed* 1100 - 2300 rpm	Is not adapted	3rd gear under throttle Engine torque 40 Nm to 100 Nm Turbine speed* 1300 - 2500 rpm	3rd gear under throttle Engine torque 40 Nm to 90 Nm Turbine speed* 1400 - 2500 rpm

385_047

Shift adaption

Pulse adaption

Slip adaption

* Turbine speed = gearbox input speed (from G182)

** Also refer to the "General boundary conditions". For more information, see description of relevant adaption process.

*** Refer to "Quick adaption - start adaption" on page 70

Quick adaption - start adaption

To complete the teach-in process as quickly as possible, the first charge pressure adaptions are adapted by shift adaption for clutches B, C and E. This process is referred to as a quick adaption or start adaption.

An ATF temperature of only approx. 40°C must be achieved for these initial adaptions. The other adaption conditions are more generous.

Quick adaption produces quick adaption results, but the level of precision is not sufficient to meet the special requirements regarding gearshift comfort. It is a rough adaption process only, and is designed to configure the gearbox for acceptable shift quality as quickly as possible.

After several quick adaptions have been made, the clutches are subsequently adapted more exactly by pulse adaption.

The quick adaption feature was first introduced to the 09L gearbox from model year ´06, where it was confined to clutch C. Shortly after that, a quick adaption feature was also adopted for the 09E gearbox.

Clutches B and E from model year ´07 (SOP week 22/06) are initially adapted by a quick adaption before pulse adaption is activated.

Conditions for quick adaption:

Clutch C

- ATF temperature > 40°C
- During the 1>2 upshift
- Engine torque 60 Nm - 100 Nm (gradually accelerating)
- Max. turbine speed approx. 2100 rpm
- Gear selector in D

Clutch B

- ATF temperature > 40°C
- During the 2>3 upshift
- Engine torque 80 Nm - 120 Nm (gradually accelerating)
- Max. turbine speed approx. 2100 rpm
- Gear selector in D

Clutch E

As with clutch B, but during the 3>4 upshift

The quick adaption takes place concurrently with the other adaption processes. This means that the adaption commences as soon as one of the adaption conditions is fulfilled.

Adaption cycles

Adaption is a continuous process and active at all times. Nevertheless, there are differences between the individual adaption processes.

- Adaption is continuously active during the gearshift (shift adaption), except the quick adaption.
- Pulse adaption has a gearshift and adaption counter for each clutch. Adaption frequency is reduced in dependence on shift frequency by means of a frequency characteristic. This means that, on commencement of adaption, an attempt is always made to adapt the gearbox if the adaption conditions are fulfilled. After several successfully completed adaptions, the gearbox is only adapted at specific intervals in dependence on the frequency characteristic. These intervals become increasingly longer with increasing mileage. In the case of high mileage vehicles, therefore, several thousand gearshifts can take place between adaption cycles.
- Slip adaption functions in much the same way as pulse adaption.
- In the case of the quick adaption, up to four adaptions are performed during the gearshift under eased adaption conditions. The other adaptions are made by means of pulse adaption.

Slip and quick adaption likewise have separate gearshift and adaption cycle counters for each clutch.

Here is a practical example:

After a mileage of 100 000 km, the gasket of the ATF pan is replaced and the gearbox is filled with fresh ATF. The fresh ATF alters the friction coefficient of the clutches, which in turn affects gear-shifting. The adaption program has adapted the clutch control parameters to the frictional characteristics of the old ATF. Due to the vehicle's high mileage, the adaption cycles are already very long.

The gearbox cannot adapt to the new ATF within an acceptable period of time. This impairs shift quality and reduces the useful life of the clutches. In this case, the adaption values have to be deleted and an adaption run carried out.

The adaption run

To give an overview of the instructions for the adaption run, here is a summary of the adaption run from "Guided Fault Finding / Functions". Find a route on which you can comply with the required driving profiles.

A complete adaption run should always be carried out before adapting individual clutches. This is generally the quickest way to adapt the gearbox. The adaption step is aborted (ended) as soon as the relevant clutch has been adapted at least once or the maximum repetition rate is reached.

Note

Make sure that the road is in good condition. If the road is very uneven, no adaption will be carried out or a running adaption cycle will be aborted.

Conclusion of the adaption run:

An analysis of shift quality is obligatory. Check and assess the shift quality in all gears when the vehicle is stationary and travelling. If necessary, you can separately readapt affected clutch(es) using the menu option "Selective adaption of individual clutches" (see Shift logic).

You should also use this menu option if clutches have not yet been adapted.

As a rule, do not hand over to the customer a vehicle on which one or more clutches have not been adapted.

In part 1 (ATF temperature 40°C or higher), the quick adaption cycles of clutches B, C and E are excited.	**Sequence of part 1** Accelerate the vehicle from a standing start through selector positions D to 4th gear using very little torque (approx. 100 Nm of torque). After this, allow the vehicle to coast down to 40 kph without applying the brake, and then gradually brake to a standstill. Wait 5 seconds when the vehicle is stationary. Repeat this part up to 3 times, or continue with part 2 if clutches B, C and E were adapted at least once.
In part 2 (ATF temperature 70°C or higher), the pulse adaption cycles of clutches B and C are excited.	**Sequence of part 2** Drive 3-4 km using approx. 100 Nm of torque in tiptronic 5th gear (manual) within the engine speed range of 1600-2800 rpm. Subsequently, accelerate the vehicle and continue for another 3-4 km in tiptronic 6th gear (manual) at 1600-2800 rpm.
In part 3, the pulse adaptions of clutches A and C are excited.	**Sequence of part 3** Drive the vehicle for 1 minute in tiptronic 5th gear (manual) at between 1400 and 2100 rpm, and then allow the engine speed to drop to 1400 rpm (overrun mode). Repeat this part up to 3 times, or continue with part 4 if clutches A and C were adapted at least once.
In part 4, the pulse adaption of clutch E and the slip adaption of clutch D are excited (if they have not already been adapted).	**Sequence of part 4** Drive the vehicle for 1 minute in tiptronic 3rd gear (manual) using 60 Nm of torque within the engine speed range of 1400 and 2100 rpm, and then slowly brake at a standstill. Wait 5 seconds when the vehicle is stationary. Repeat this part up to 3 times, or end the guided adaption run if clutches D and E were adapted at least once.

Introduction

The gearbox periphery to which we refer is basically the gearshift mechanism. It represents the link between the driver and the gearbox.

In all of the gearboxes shown herein, a mechanical connection can be established between the selector lever and the hydraulic control unit (gear selector valve) and the parking lock by means of the selector lever cable.

For information on operation and general notes, refer to SSP 283 and the vehicle's Owner's Manual.

Series	Model series	Type	from model year
B6	Audi A4	8E	2001 (8E_000001)
B7	Audi A4	8E	2005 (8E_400001)
B8	Audi A4	8K	2008
B8	Audi A5	8T	2008
B8	Audi A5 Cabrio	8F	2009
--	Audi Q5	8R199	2009
C6	Audi A6	4F	2005
--	Audi Q7	4L	2007
D3	Audi A8	4E	2003 see SSP 283 / 284

The following design features and functions relating to the gearshift mechanism will be explained below:

- Shift lock* (P lock, P/N lock)
- Ignition key removal lock
- Emergency release
- tiptronic switch
- Selector lever position display

*** In the case of the shift lock, a basic distinction is made between two functions:**

P lock ... locks the selector lever in position P after the ignition key is removed from the ignition lock.
The P lock operates mechanically.

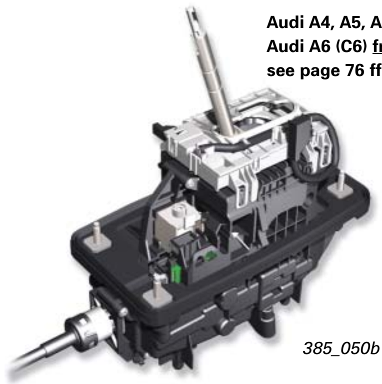
P/N lock ... locks the selector lever in positions P and N when driving or when the ignition is "on". The P/N lock is actuated by shift lock solenoid N110.

Overview of gearshift mechanisms

Audi A4 (B7) new
(see below)

385_050a

Audi A4, A5, A5 Cabrio (B8) and Q5
Audi A6 (C6) from 11.2005
see page 76 ff.



385_050b

Audi A8
Refer to SSP 283 / 284

385_108

Audi A6 (C6) to 11.2005
see page 88 ff.

385_050c

Audi Q7
See page 88 ff.

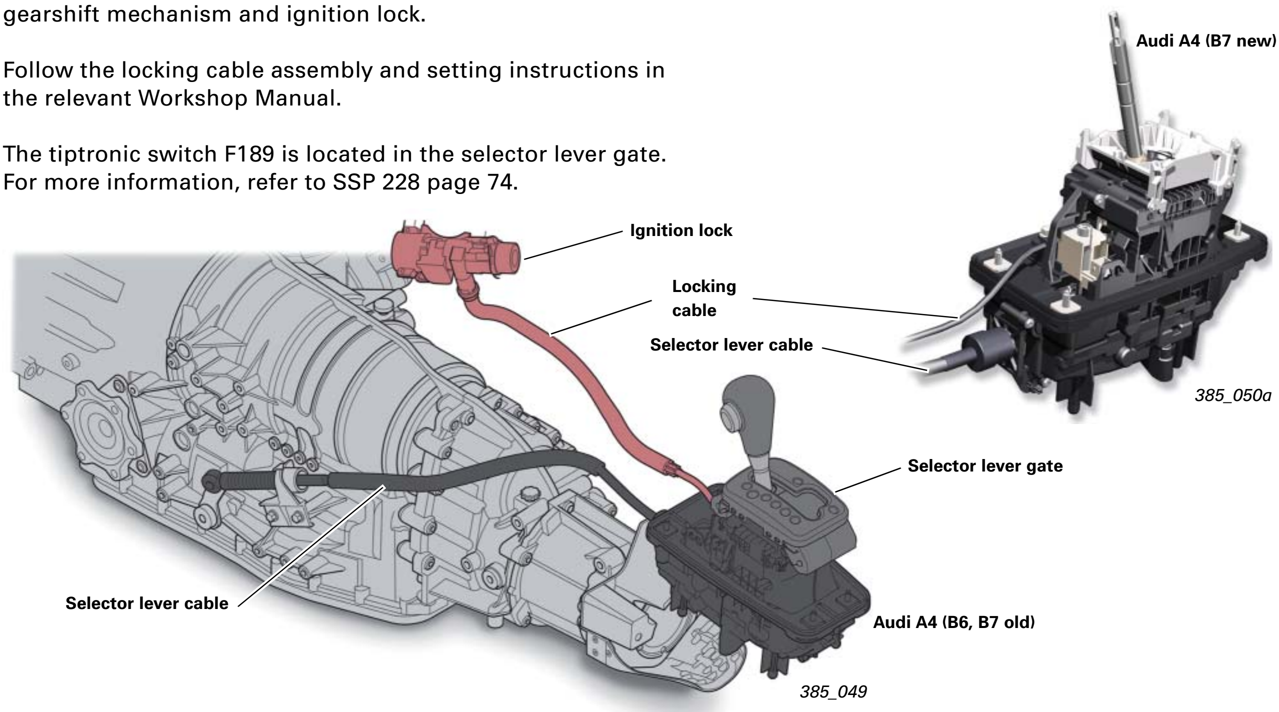
385_050d

Gearshift mechanism of Audi A4 - Audi Cabrio (type B6_B7 old / new)

The B6 and B7 series have a conventional gearshift mechanism with a mechanically controlled P lock and ignition key removal lock. A cable pull (locking cable) is used to control these functions, and makes the connection between the gearshift mechanism and ignition lock.

Follow the locking cable assembly and setting instructions in the relevant Workshop Manual.

The tiptronic switch F189 is located in the selector lever gate. For more information, refer to SSP 228 page 74.



385_049

A new gearshift mechanism was introduced in the Audi A4 type B7 from week 47/07. Its basic design is identical to the gearshift mechanism of the B8 series (see next page). Similarly, the P lock and the ignition key removal lock are mechanically actuated by a cable pull.

Gearshift mechanism of Audi A4 / A5 (B8)*

The B8 series has an "electronic ignition lock" and an electrical steering column lock.

The locking cable is no longer used to link the gearshift mechanism to the ignition lock (the previous mechanical link). For this reason, the design and function of the ignition key removal lock and the shift locks have changed radically.

Reliable recognition of selector lever position P is a basic requirement for removal of the ignition key. For this purpose, gear selector position P switch - F305 is integrated in the gearshift mechanism.

The gearshift mechanism in the B8 was previously phased in for the Audi A6 from mid model year ´06 on (from build date 11.2005). The B and C series now have a harmonised gearshift mechanism.

The key features of this gearshift mechanism are:

– Longitudinally split housing (no provision has been made for dismantling, i.e. this not necessary to carry out regular repair work).

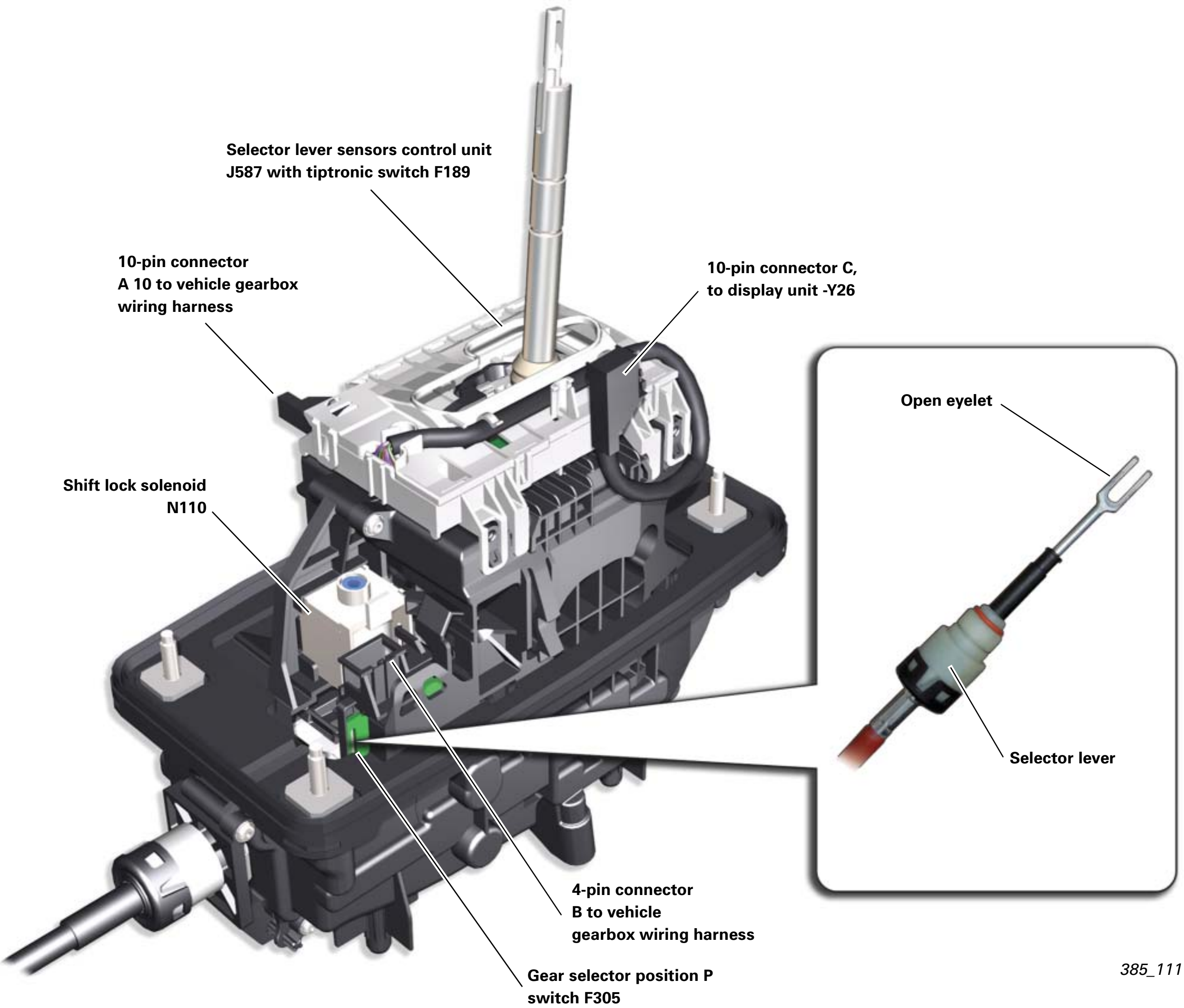
– The gear selector position P switch - F305 and the shift lock solenoid N110 are a unit. It can be removed very easily, and without the need for further assembly work on the gearshift mechanism.

– Simple removal, assembly and setting of the selector lever cable.

Selector lever cable with an open eyelet*

There is no need for laborious assembly work on the gearshift mechanism when removing and assembling the cable pull. The selector lever cable can easily be adjusted at the eyelet from inside the vehicle. Refer to Workshop Manual.

* **Note:** The topics marked by an asterisk also apply to the Audi A6 (C6) from build date 11.2005.



385_111

Audi drive select

An innovation featured on n the B8 series for the first time is the optional Audi drive select system. Audi drive select allows different vehicle set-ups to be configured by the driver. The sport program of the automatic gearbox is set to DYNAMIC driving mode. Vehicles with the "Audi drive select" package do not have the selector lever position "S" (Sport). Vehicles without Audi drive select have, as before, a shift gate with the selector lever position "S" for activating the sport program.

Note

For more information on the Audi drive select system, please refer to SSP 409 page 56 ff.

409_151

Ignition key removal lock

Reliable recognition of selector lever position P is a basic requirement for removal of the ignition key. This is the task of the selector lever position P switch - F305. For this purpose, switch F305 sends a signal to the convenience system central control unit J393.

To enable the ignition key, J393 in turn activates a solenoid in the ignition lock module E415.

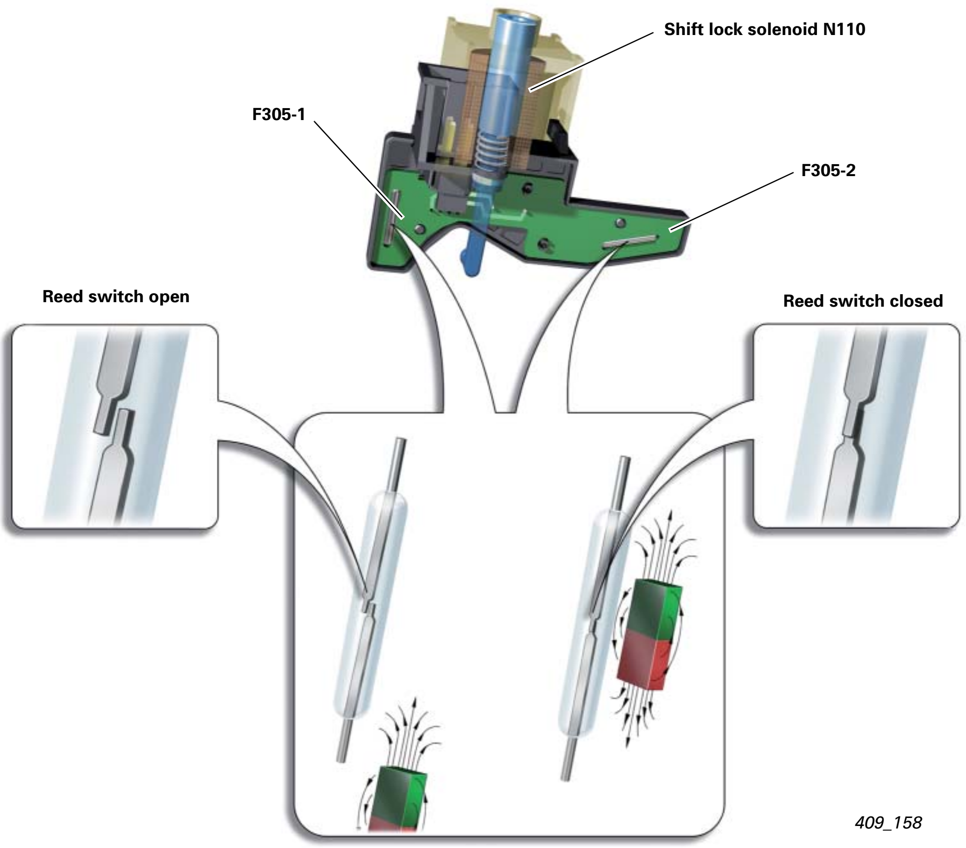
Note

The function and design of the ignition key removal lock are described in SSP 393 (page 26 ff.).

Gear selector position P switch F305*

Switch F305 comprises two reed switches which are connected in series with a resistor. Both switches must be closed so that a ground signal reaches the convenience system central control unit J393.

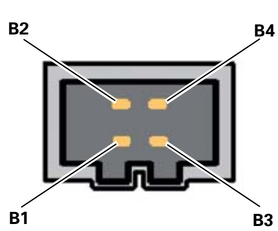
Switch F305 is checked by the self-diagnostics of control unit J393. The series connected resistor can be used for detecting ground faults.
In addition, a check for plausibility is made using the information provided by the multi-function switch F125 (per CAN information exchange).



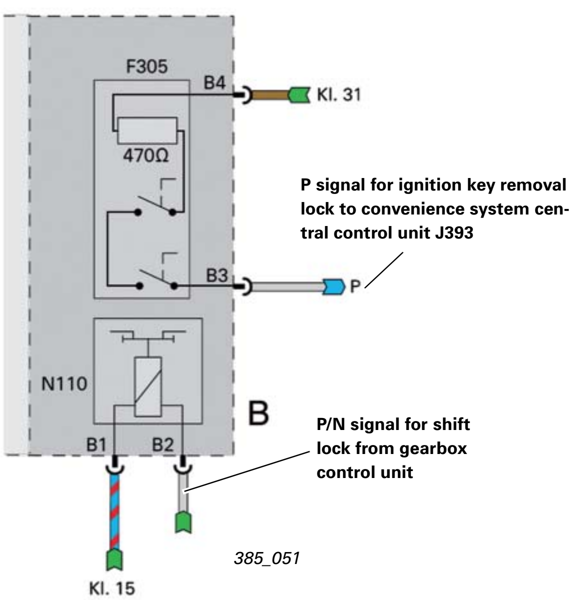
409_158

Function and design*

Reed switches are actuated by the field generated by an external permanent magnet located in selector lever position "P" directly above the Reed switches on the gate or on the lock lever.
See also Fig. 409_161 and Fig. 409_162.



409_157



385_051

*** Refer to note on page 76**

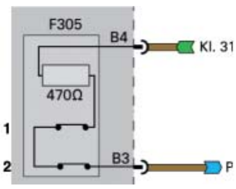
Shift lock (P lock and P/N lock)*

Basically, a distinction is made between two different types of shift lock: the P/N lock which is engaged during vehicle operation and when the ignition is "on", and the P lock which is engaged when the selector lever is in the "P" position and the ignition key is removed from the ignition lock.

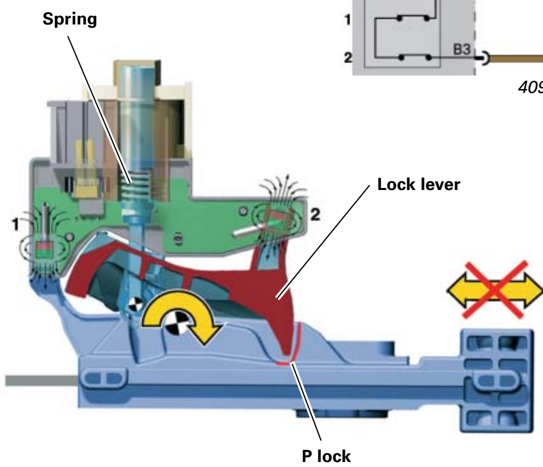
The locking mechanism is designed to permit locking both when N110 is energised (in position "N") and de-energised (in position "P").

Shift lock "P"and P signal for ignition key removal lock*

When the selector lever is moved into the "P" position, the permanent magnet 1 of the gate is in front of Reed switch 1 (switch closed). As soon as the lock lever is in its original position (N110 not activated), permanent magnet 2 is also in front of reed contact switch 2. Both switches are now closed and deliver the signal to deactivate the ignition key removal lock.



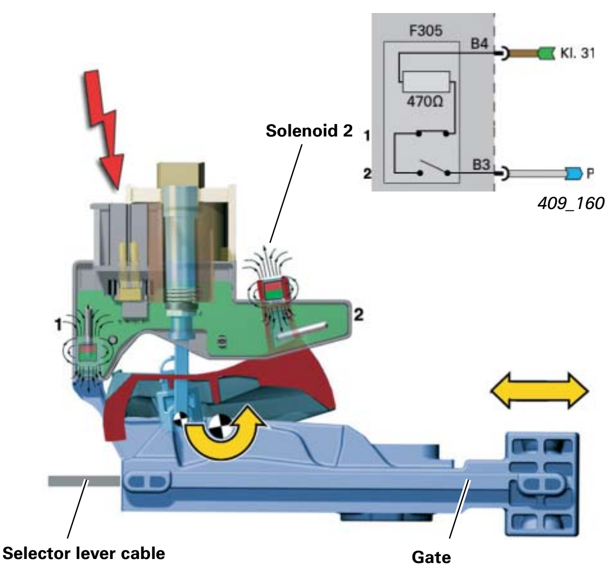
409_162



409_161

Ignition ON (or OFF)

- Selector lever position "P"
- **Brake not applied**
- N110 de-energised
- Gate or selector lever locked



409_160

409_159

Ignition ON

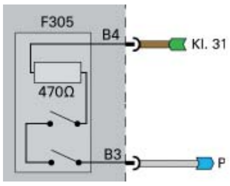
- Selector lever position "P"
- **Brake applied**
- N110 energised
- Gate or selector lever released

*** See note of page 76**

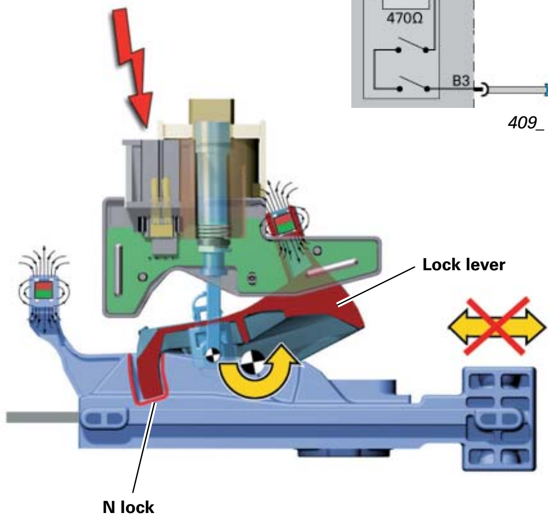
Shift lock "N"*

Ignition ON

- Selector lever position "N"
- **Brake not applied**
- N110 de-energised
- Gate or selector lever locked



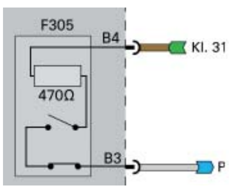
409_164



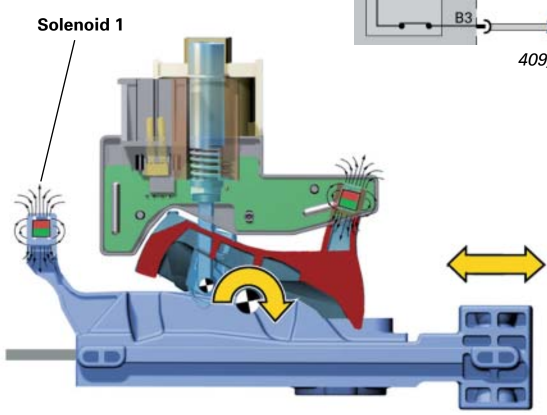
409_163

Ignition ON (or OFF)

- Selector lever position "N"
- **Brake applied**
- N110 energised
- Gate or selector lever released



409_166



409_165

Note

Switch F305 can easily be tested using the diagnostic tester or an ohmmeter. As mentioned already, F305 can easily be replaced if faulty.
However, please note the following: If the distance between the permanent magnet and its reed switch is too great, or if a permanent magnet is missing (for example, because it has dropped out of its mounting), then F305 will not generate a shift signal. In this case, the gearshift mechanism must be replaced.

* Refer to note on page 76

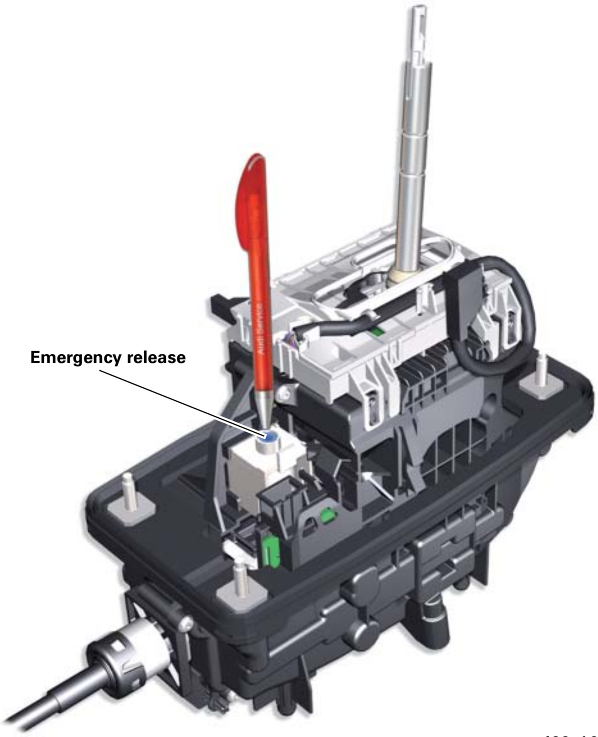
Emergency release*

Since the P lock is released only when solenoid N110 is activated, the selector lever remains locked in position "P" after a malfunction (e.g. flat battery, solenoid N110 not working, etc.).

To be able to move the vehicle in such a situation, an emergency release procedure must be carried out.

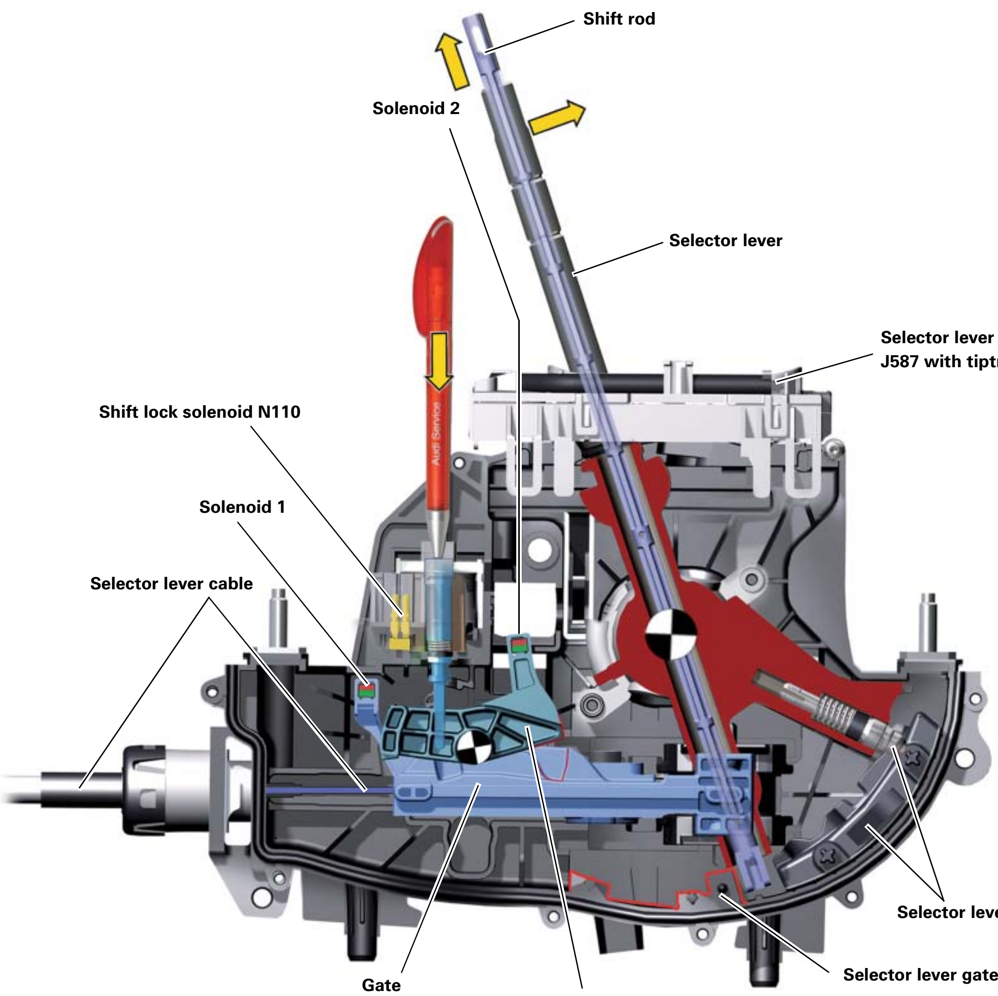
The emergency release mechanism can be accessed by removing the ashtray insert and the trim clip behind it.

Solenoid N110 can be actuated and the lock lever released using, for example, a ball-point pen. At the same time, the button on the selector lever must be pressed and the selector lever pulled back.



409_167

Actuation of the emergency release mechanism*



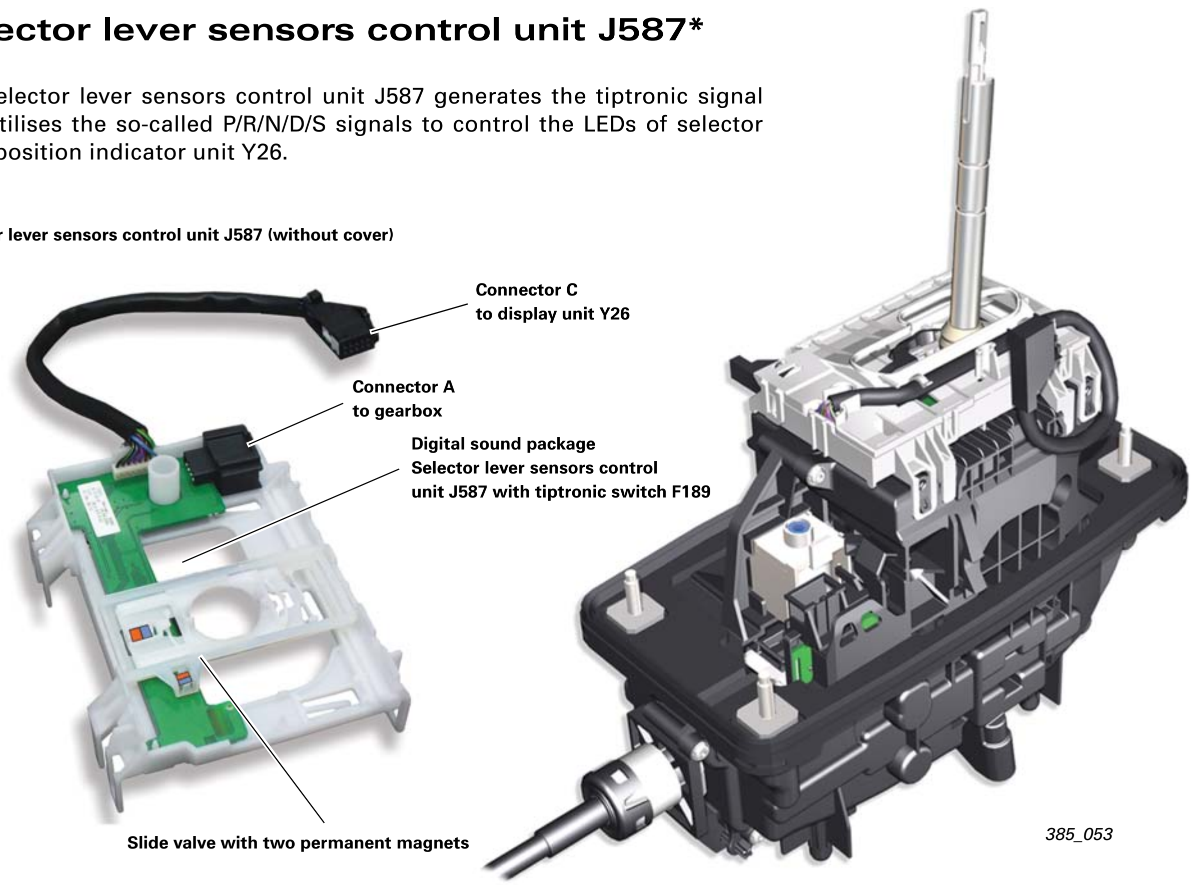
409_168

*** Refer to note on page 76**

Selector lever sensors control unit J587*

The selector lever sensors control unit J587 generates the tiptronic signal and utilises the so-called P/R/N/D/S signals to control the LEDs of selector lever position indicator unit Y26.

Selector lever sensors control unit J587 (without cover)

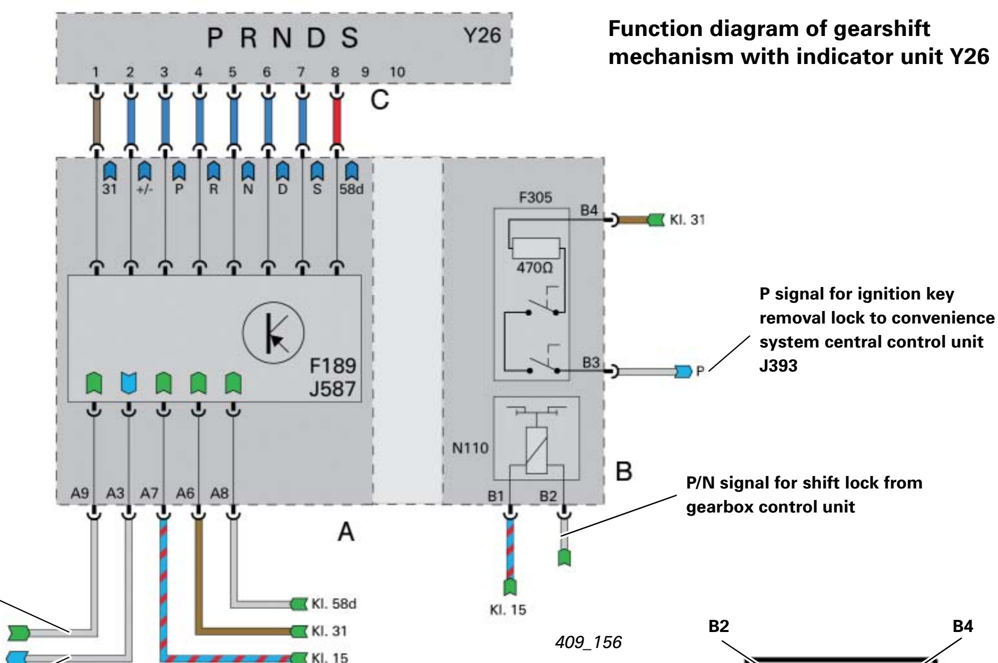


385_053

Pin assignments
Connector C

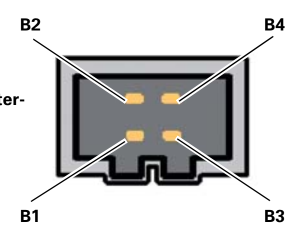
Pin 1	Term. 31
Pin 2	LEDs+/-
Pin 3	LEDP
Pin 4	LEDR
Pin 5	LEDN
Pin 6	LEDD
Pin 7	LEDS
Pin 9	----
Pin 8	Term. 58d
Pin 10	----

Function diagram of gearshift mechanism with indicator unit Y26



409_156

Coding of connector B (at terminal N110/F305)



409_157

A = 10-pin connector to vehicle gearbox wiring harness / gearbox
B = 4-pin connector to vehicle gearbox wiring harness / gearbox
C = 10-pin connector to indicator unit Y26

*** Refer to note on page 76**

P/R/N/D/S signal*

Information on selector lever positions P/R/N/D/S is supplied to the gearbox control unit by multi-function switch F125. The gearbox control unit utilises this information to generate a square-wave signal with a different low-level time,
the so-called P/R/N/D/S signal. With this signal, a defined duty cycle (low to high level time ratio)
is assigned to each selector lever position (see DSO images).

As explained, the selector lever sensors control unit J587 uses the P/R/N/D/S signal to activate indicator unit Y26. The selector lever sensors control unit recognises from the duty cycle which LED it has to activate.

DSO images of the P/R/N/D/S signals

DSO port:

- Black probe tipPin 6*
- Red probe tipPin 9**

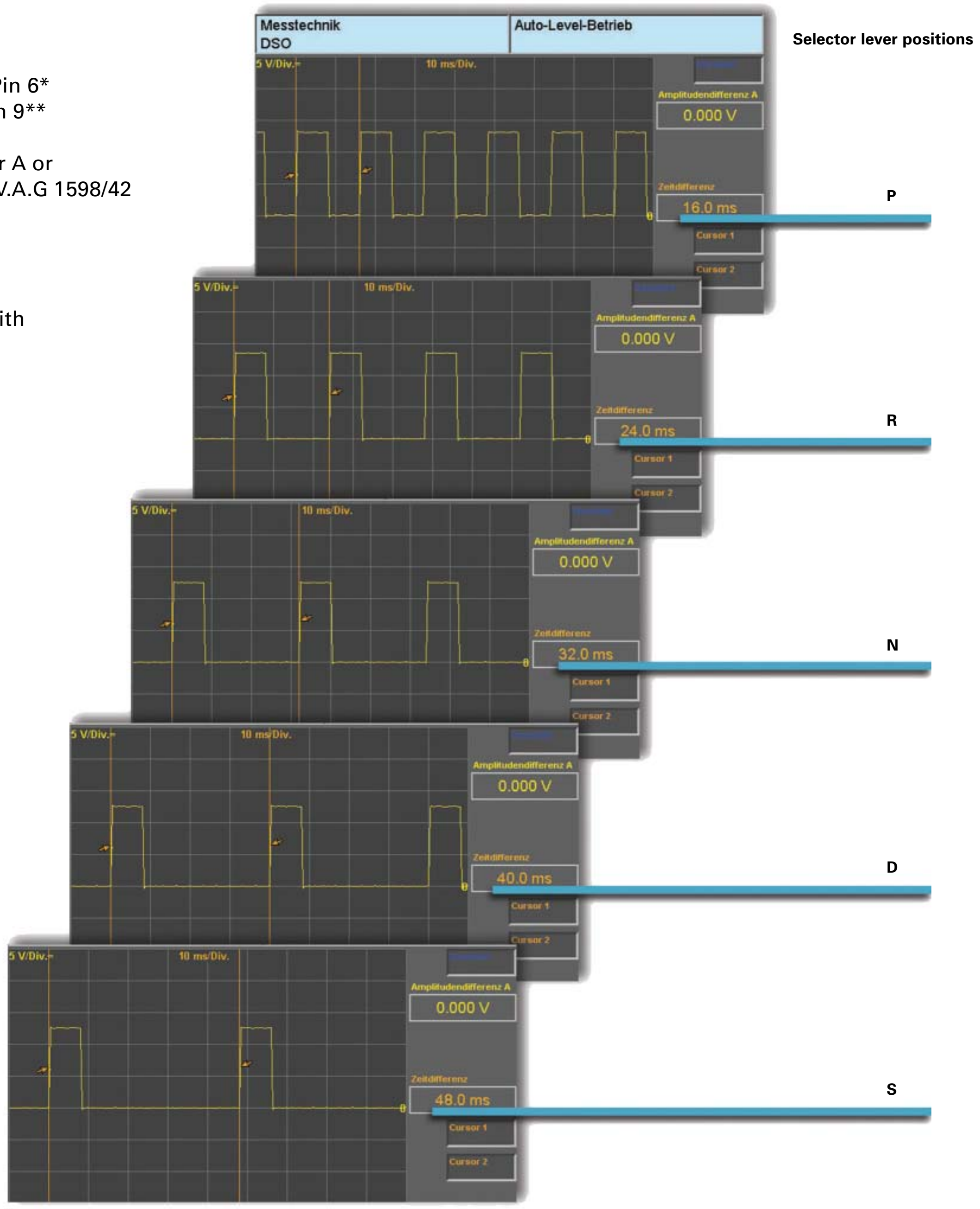
** Pin on connector A or
on test adaptor V.A.G 1598/42

Test equipment:

- V.A.G 1598/54 with
- V.A.G 1598/42
- VAS 5051

Test conditions:

- Ignition "ON"



367_006

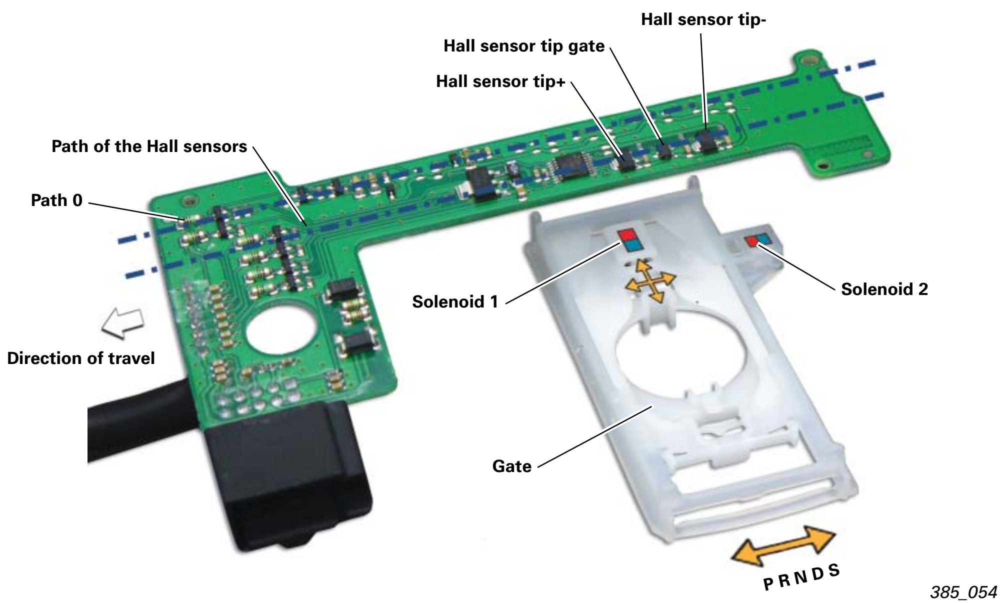
* **Refer to note on page 76**

tiptronic switch F189*

The tiptronic information "selector lever in tiptronic gate", "selector lever in tip+" or "selector lever in tip-" is supplied by tiptronic switch F189. F189 comprises three Hall sensors and is integrated in the selector lever sensors control unit J587. Depending on selector lever position, two permanent magnets act on the Hall sensors thereby altering their circuit state.

The selector lever sensors control unit J587 generates from this information a so-called "tiptronic signal" and makes a continuous diagnosis of the F189.
The tiptronic signal is, in turn, diagnosed by the gearbox control unit.

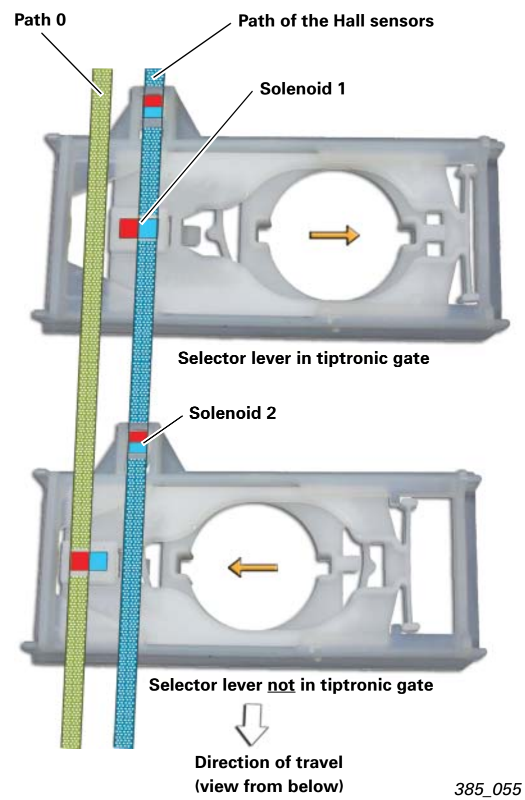
Selector lever sensors control unit J587 with slide valve (view from below)



385_054

Diagnosis of the Hall sensors:

Solenoid 1 serves to detect the tiptronic positions, and is only in the "path of the Hall sensors" when the selector lever is in the tiptronic position.
Solenoid 2 is used for the diagnosis of F189, even when the vehicle is not in tiptronic mode.
Solenoid 2 is always in the "path of the Hall sensors" but positioned further back so that it acts only on the Hall sensors in R and N. Whenever the vehicle is driven (when the selector lever is moved from P into D), the three Hall sensors are "actuated" and checked for functioning. The gearbox control unit knows that when the gear selector lever is in position P, R or N, the gearbox is not in tiptronic mode but in "Diagnostic Mode".
In this way, the selector lever sensors make a continuous diagnosis of F189, even when the selector lever is not in the tiptronic gate or being actuated.
This comprehensive diagnosis is necessary for safety reasons. The tiptronic Mode is a key function relevant to safety, since unwanted unshifts (e.g. when the driver wants to utilise the engine braking effect when driving downhill by selecting a low gear) can only be prevented by using the tiptronic function. By comparison: On older vehicles (e.g. Audi A4 / B4 / B5), upshifting was inhibited in selector lever positions 4, 3 and 2.



385_055

* Refer to note on page 76

tiptronic signal*

From the signals supplied by the Hall sensors, the selector lever sensors control unit J587 generates a square-wave signal with a different low level time, the so-called tiptronic signal. Refer to function diagram on page 82.
The tiptronic signal is transmitted to the gearbox control unit via a separate wire.

A defined duty cycle is assigned to each gear selector lever position (see DSO images).
The gearbox control unit diagnoses a missing or faulty tiptronic signal and creates a corresponding fault entry.

Effects of a malfunctioning F189 or faulty tiptronic signal

The driver is alerted to a malfunctioning F189 or faulty tiptronic signal by the fault indicator (inverted selector lever position display) (not available on B8 series models). On B8 series models, faults are indicated by the DIS (Driver Information System, refer to Owner's Manual). The tiptronic function is available via steering wheel tiptronic only.

Fault indication (inverted static)

385_063

DSO images of the tiptronic signal

DSO port:

– Black probe tipPin 6**
– Red probe tipPin 3**

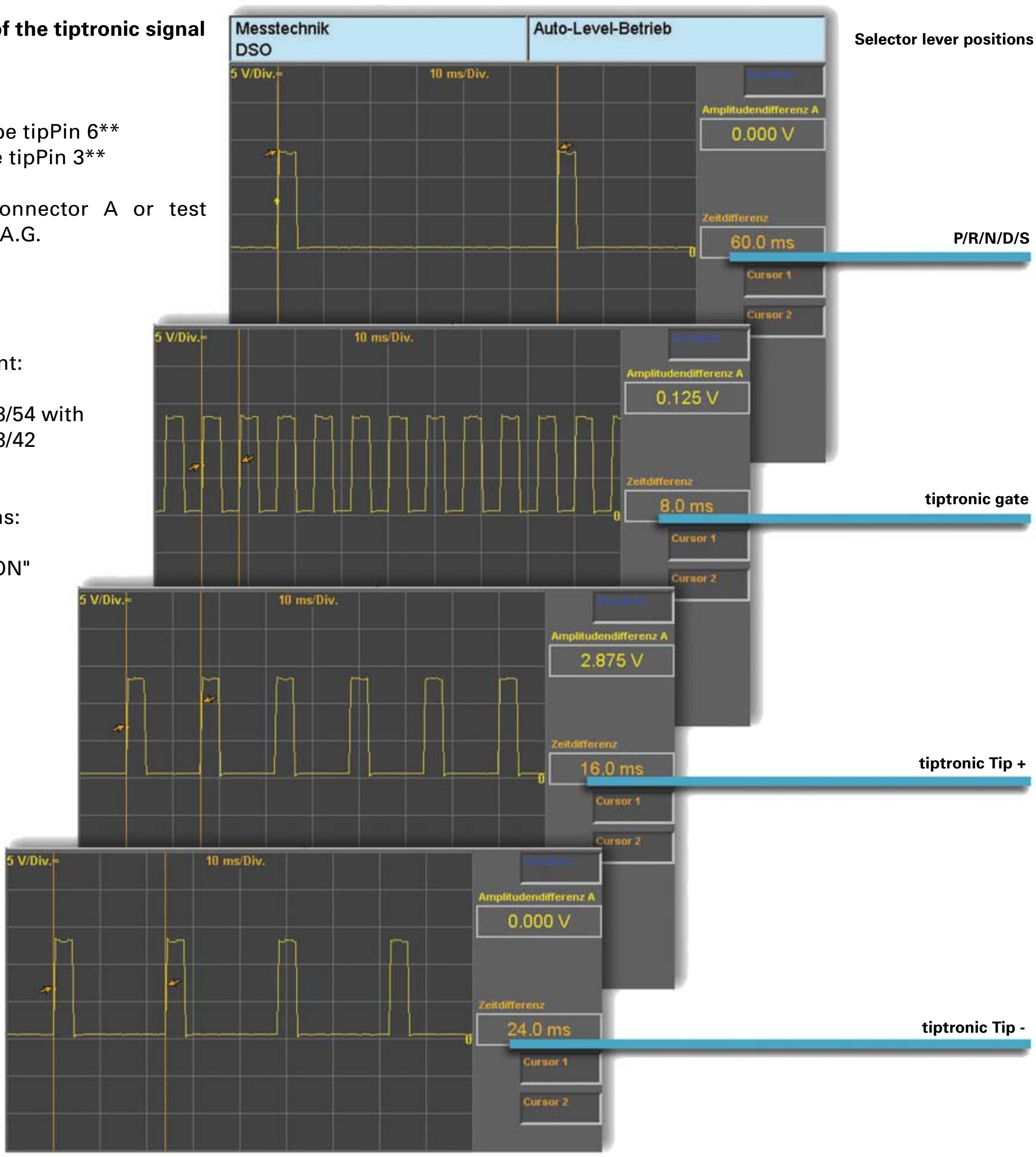
** Pin on connector A or test adapter V.A.G. 1598/42

Test equipment:

– V.A.G 1598/54 with
– V.A.G 1598/42
– VAS 5051

Test conditions:

– Ignition "ON"



367_007

*** Refer to note on page 76**

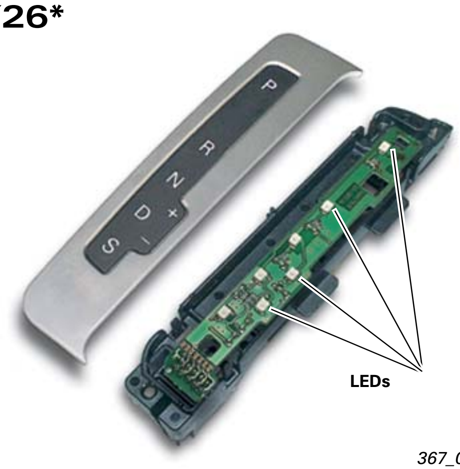
Selector lever position indicator unit Y26*

The display unit is supplied with voltage and ground via the selector lever sensors control unit J587. A separate LED, which is activated by J587 according to the selector lever position, is assigned to each selector lever position.

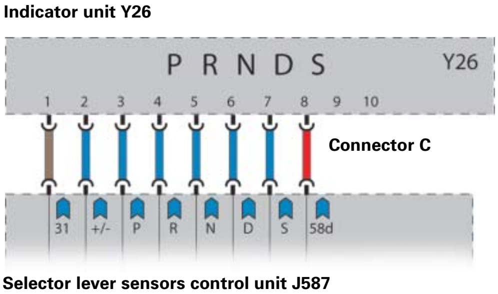
The LEDs are activated in two ways:

1 The basic brightness level of the LEDs is varied by adjusting the pulse width of the PWM signal of terminal 58d (dimming). For example, a large pulse width (e.g. 90 %) results in a high basic brightness level. See DSO image 1.

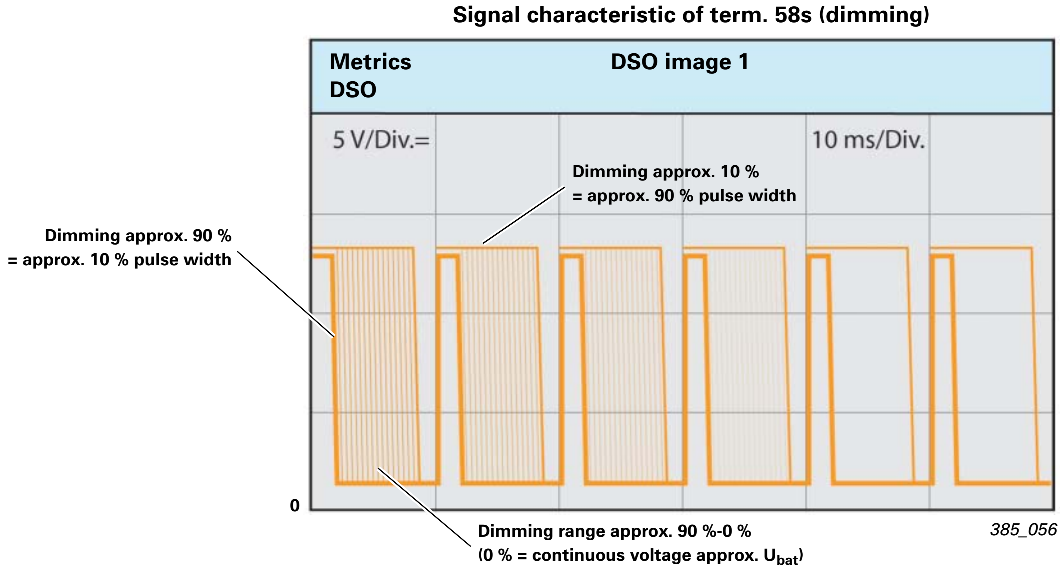
2 Each selector lever position is highlighted by the difference in potential of the PWM signal pulse voltage. This means the LED indicating the current selector lever position is activated with a higher voltage (it glows more brightly) than the other LEDs. See DSO image 2.



367_003



367_112



385_056

Connecting DSO image 1:

– Black probe tipPin C1
– Red probe tipPin C8

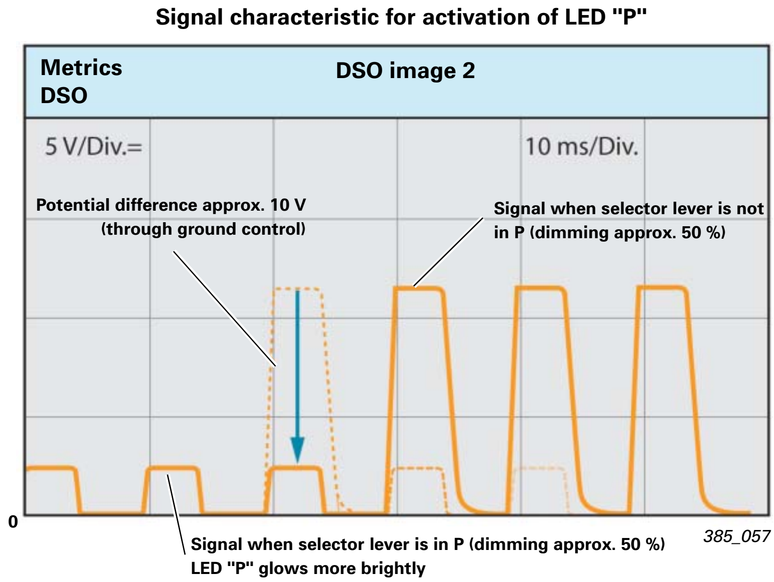
Connecting DSO image 2:

– Black probe tip C1
– Red probe tip C3 (e.g. for LED "P")

Test equipment: V.A.G 1598/54 with V.A.G 1598/42

Test conditions: Ignition "ON"

*** Refer to note on page 76**



385_057

Gearshift mechanism of Audi A6* (4F) and Audi Q7** (4L)

The Audi A6 (type 4F) and the Audi Q7 (type 4L) have an "electronic ignition lock" and an electrical steering column lock. The locking cable is no longer used to link the gearshift mechanism to the ignition lock (the previous mechanical link). For this reason, the design and function of the ignition key removal lock and the shift locks have changed radically.

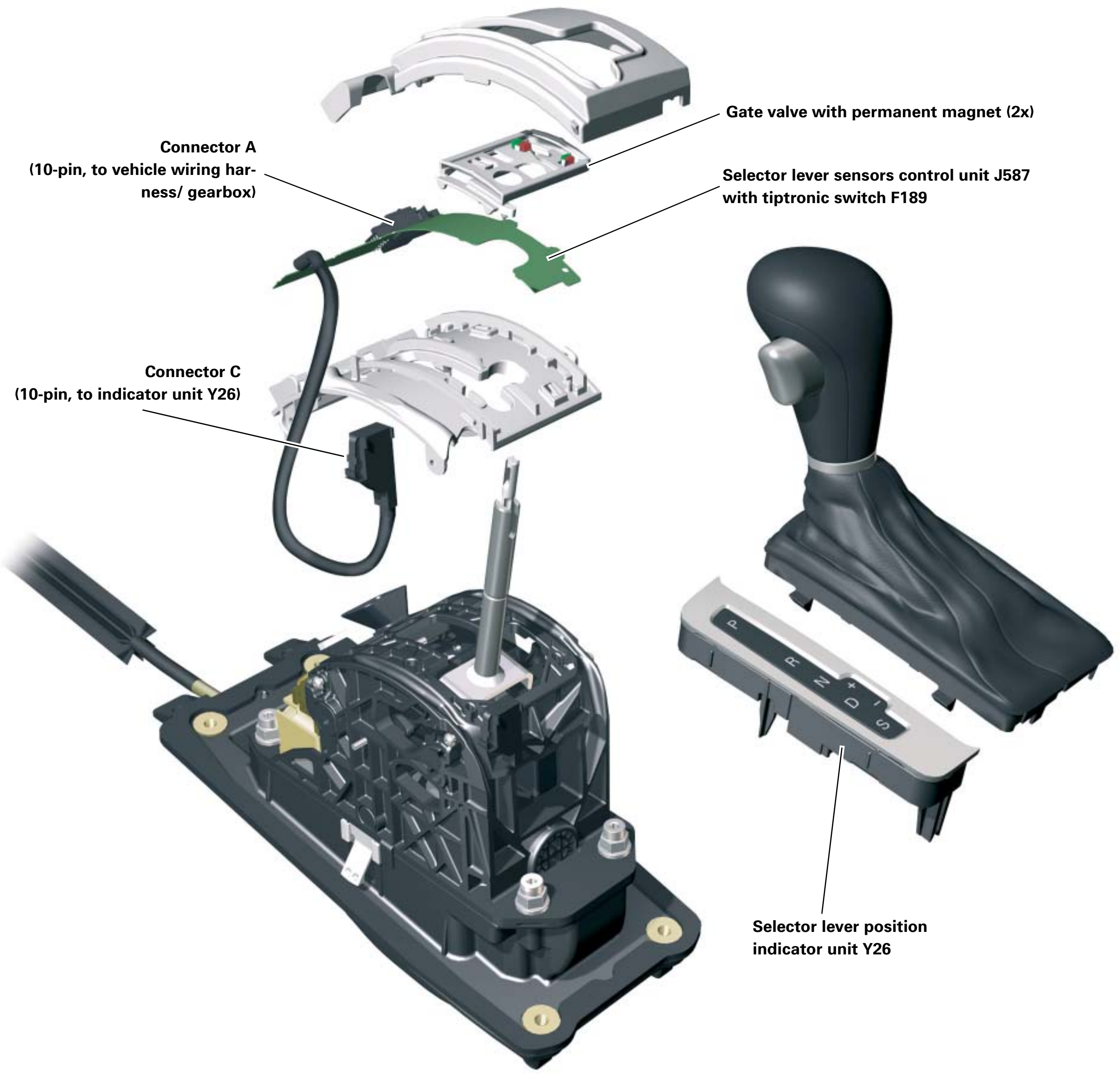
The gearshift mechanism is responsible for the following functions:

Mechanical functions

- Actuation of the parking lock
- Actuation of the hydraulic control unit selector valve
- Actuation of the multi-function switch on the gearbox
- P/N lock and P lock (shift lock)

Electrical functions:

- Control of the P/N lock (see page 90)
- Ignition key removal lock (see page 93)
- Activation of the selector lever position indicator unit (see pages 92, 94 and 95)
- tiptronic function (see pages 94 and 95)



367_101

*** Audi A6 <u>to</u> 11.2005**
**** Audi Q7 - refer to SSP 367 (page 60 ff.).**

The design and function of the gearshift mechanisms on the Audi Q7 and Audi A6 to 11.2005 are largely identical.

Basically, there are two differences:

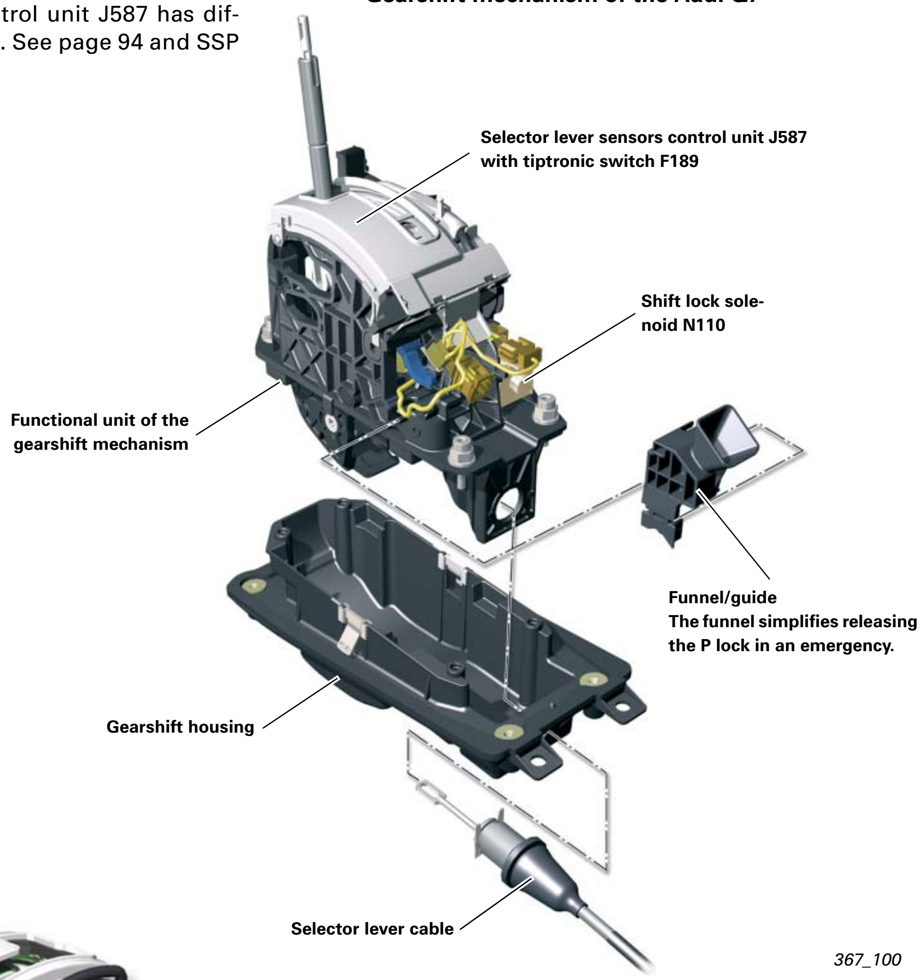
1 In the case of the Audi Q7, the functional unit can be removed from inside the vehicle. This reduces repair time considerably (e.g. when replacing microswitch F305). The Q7 gearshift mechanism can be replaced by exchanging the functional unit only. The old connector housing remains in the vehicle and is reused.

2 The selector lever sensors control unit J587 has different input and output signals. See page 94 and SSP 367 (page 66).

Note

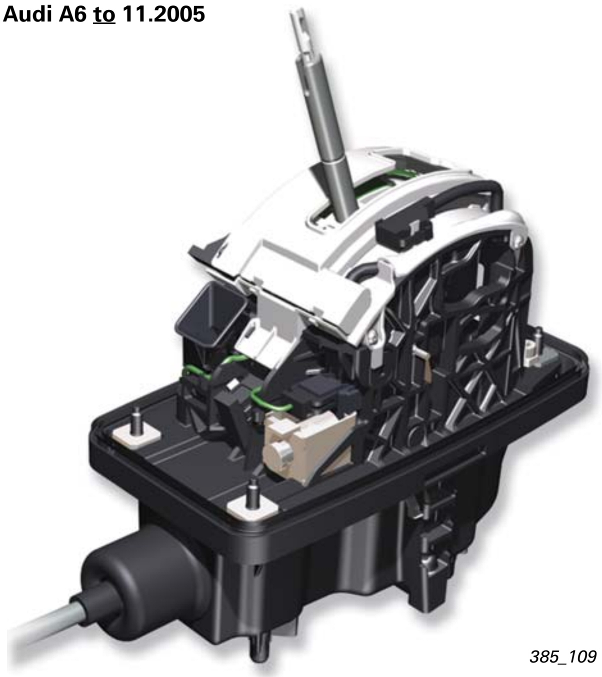
A new gearshift mechanism was phased in on the Audi A6 from 11.2005.
It is a so-called standard gearshift mechanism, which harmonises the C and B model series.
For a description of this gearshift mechanism, see page 76 ff.

Gearshift mechanism of the Audi Q7



367_100

Gearshift mechanism of the Audi A6 to 11.2005



385_109

Reference

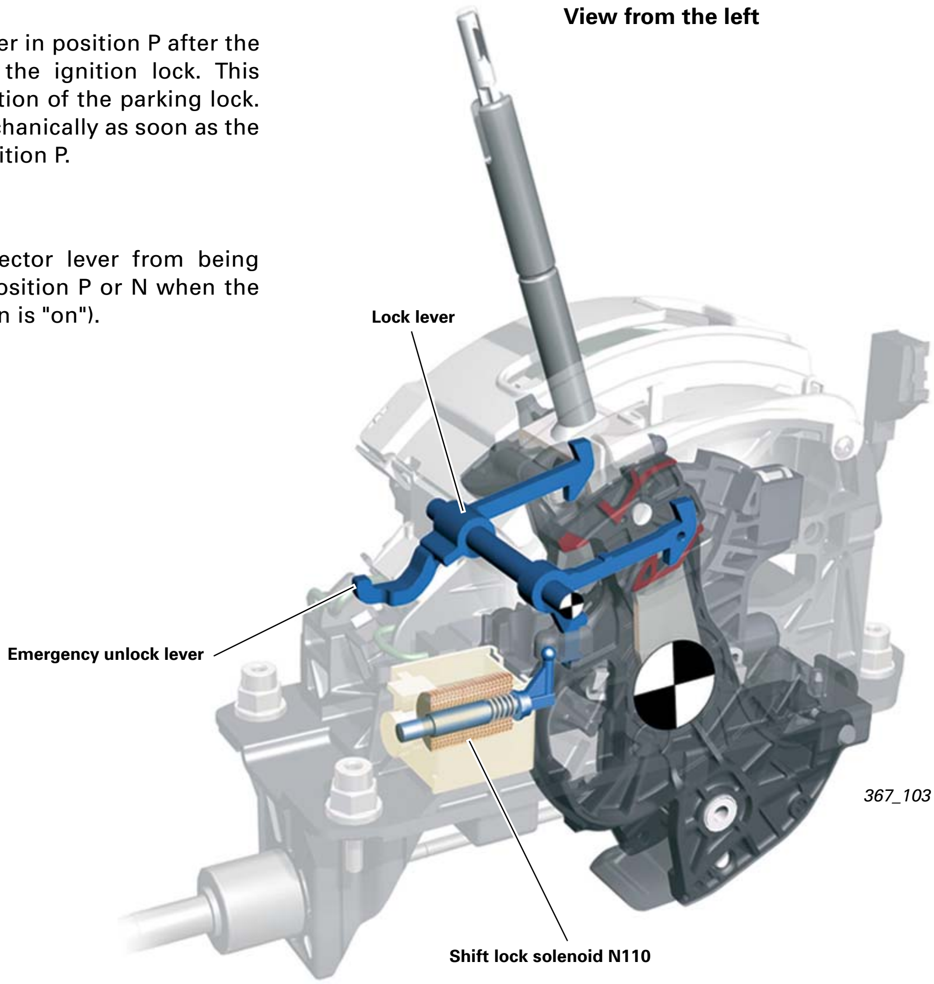
Please refer to the Audi iTV broadcast of 28.03.2007, "Gearshift Mechanisms of the Automatic Gearbox".

Shift locks (P lock and P/N lock)

The P-lock locks the selector lever in position P after the ignition key is removed from the ignition lock. This prevents unauthorized deactivation of the parking lock. The P lock operates entirely mechanically as soon as the selector lever is shifted into position P.

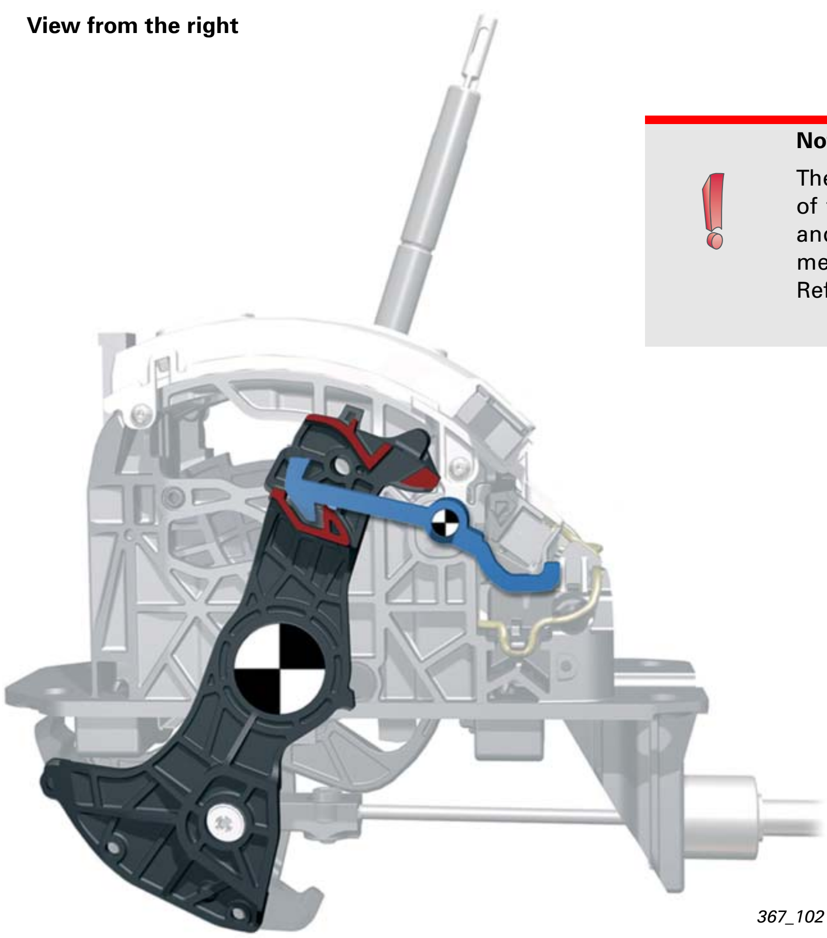
The P/N lock prevents the selector lever from being unintentionally moved out of position P or N when the engine is running (or the ignition is "on").

View from the left



367_103

View from the right



367_102

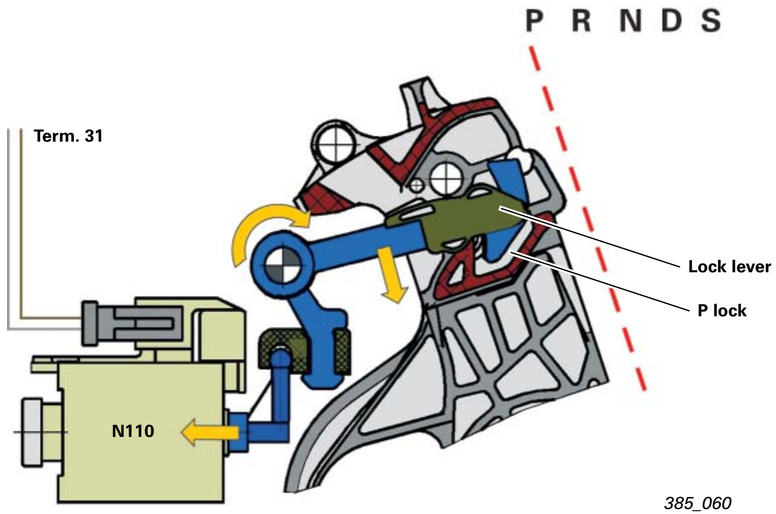
Note

The figures show the gearshift mechanism of the Audi Q7. In terms of its basic design and function, it is identical to the gearshift mechanism on the Audi A6 to 11.2005.
Refer to SSP 325 (page 71 ff.).

Shift lock in selector lever position "P"

Locking of the selector lever in lever position "P" is ensured by automatic locking of the lock lever in this position.
When solenoid N110 is de-energised, the stop lever automatically drops into the P lock, under the action of gravity and assisted by a spring in solenoid N110, as soon as the selector lever is moved into position "P".

To unlock the selector lever, solenoid N110 is energised and the solenoid pushes the lock lever out of position P (when the ignition is "on" and the brake applied).
In the event of a fault or power failure, the selector lever remains locked. An emergency release mechanism is available for this purpose. Refer to "Emergency release".

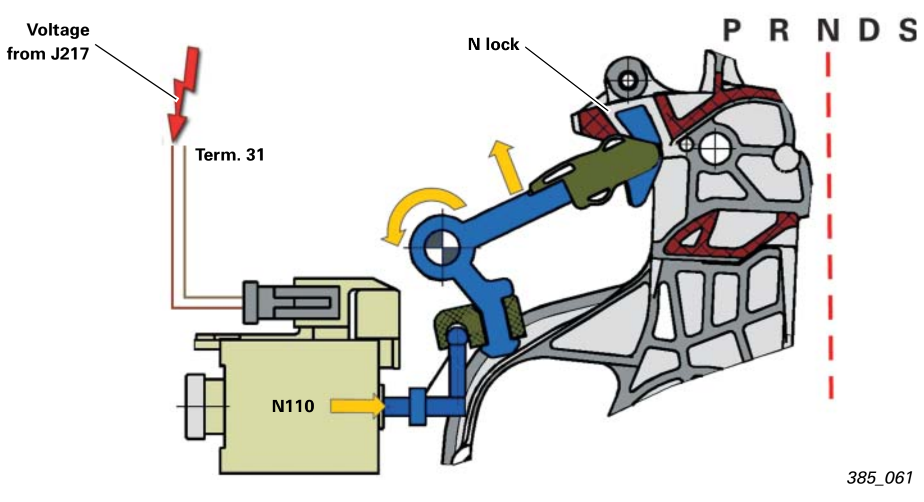


385_060

Shift lock in selector lever position "N"

Shifting the selector lever into position "N" activates solenoid N110, which in turn pushes the upper catch on the stop lever into the N lock and locks the selector lever.

To unlock the selector lever, solenoid N110 is de-energised and the lock lever drops down, releasing the selector lever (ignition ON, brake applied, or only ignition OFF).



385_061

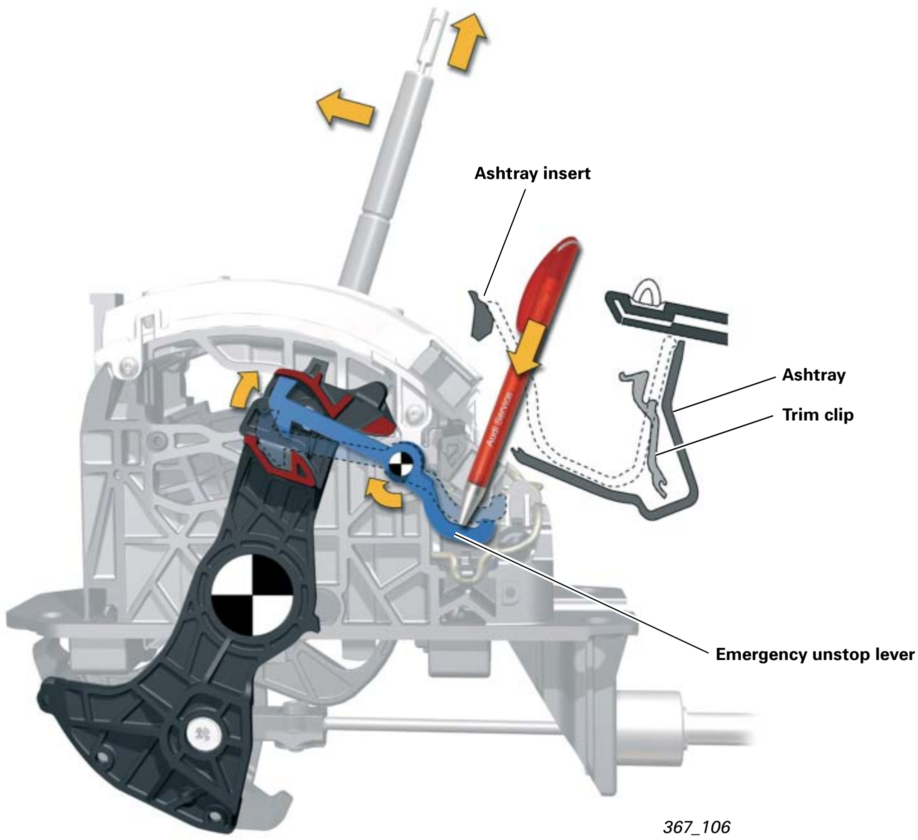
Emergency release of the P lock on the Audi A6* and Audi Q7

As the P lock is released only when solenoid N110 is activated, the selector lever remains locked in position "P" after a malfunction (e.g. flat battery, solenoid N110 not working, etc.).

An emergency unlocking lever on the left-hand side of the lock lever allows the vehicle to be moved in such a situation.

The emergency release mechanism can be accessed by removing the ashtray insert and the trim clip behind it.

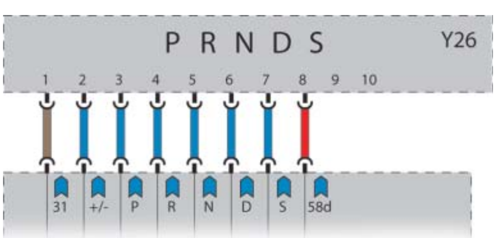
The lock lever can be unlocked by pressing down the emergency unlocking lever (e.g. using a ball point pen). At the same time, the button on the selector lever must be pushed and the selector lever pulled back.



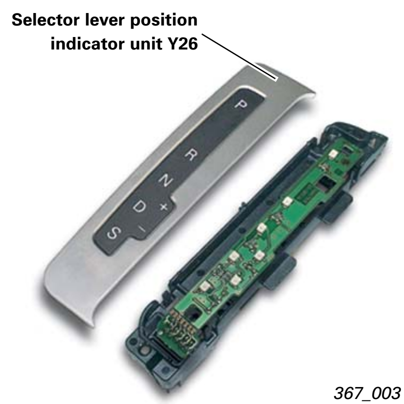
367_106

Selector lever position indicator unit Y26

The LEDs on the display unit are supplied with electrical power by the selector lever sensors control unit J587 and is activated according to the selector lever position.



367_112



367_003

Reference

For more information see page 86.

*** Audi A6 to 11.2005**

Ignition key removal lock on the Audi A6 and Audi Q7

The ignition key removal lock is activated automatically by means of a mechanical locking mechanism integrated in the entry and start authorization switch E415.

The ignition key removal lock is unlocked electromechanically by brief activation of the ignition key removal lock solenoid N376. For this purpose, switch E415 requires information on selector lever position "P".

The information on selector lever position "P" is supplied by the two mechanical microswitches F305. These switches are connected in series and form a unit.

In selector lever position "P", both switches are closed and deliver a ground signal directly to E415.

If the ignition is turned off, solenoid N376 is briefly energised by E415, after which an unlocking mechanism deactivates the ignition key lock.

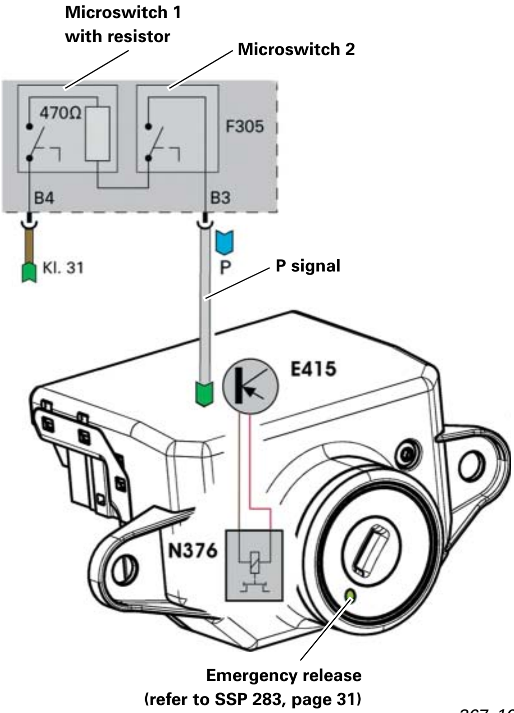
For safety reasons, two microswitches are used:

Microswitch **1** is not closed until the selector lever button is released in selector lever position "P" (button not pressed).

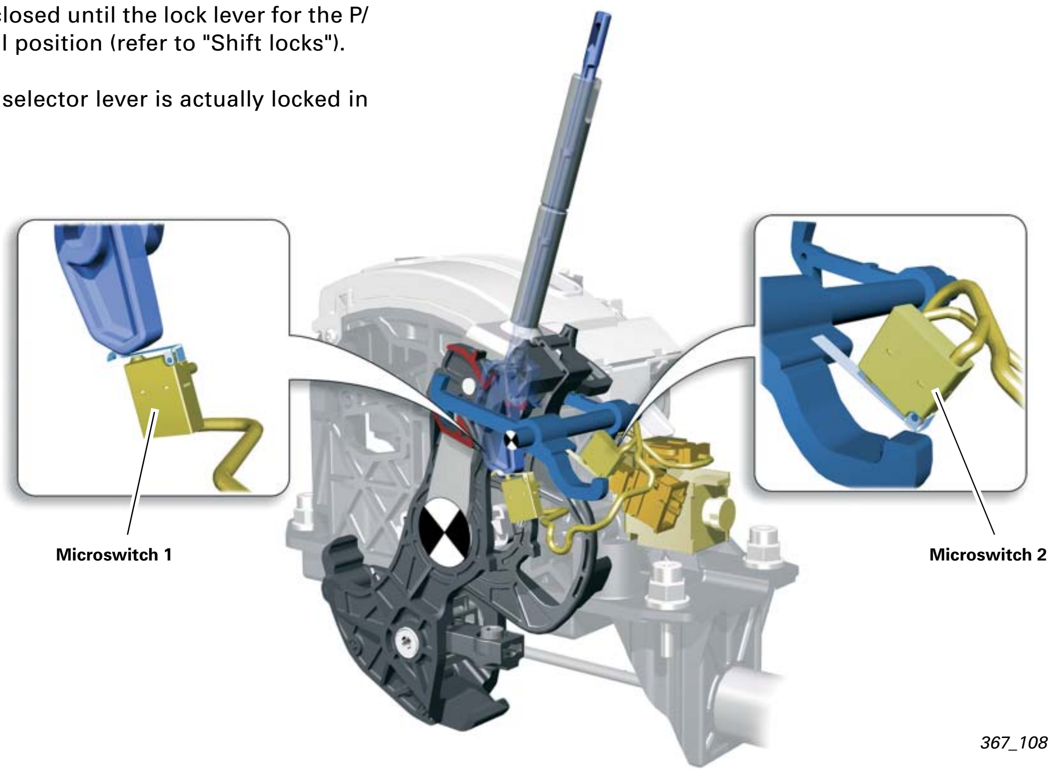
The series-connected resistor allows the signal line to be diagnosed.

Microswitch **2** is not closed until the lock lever for the P/N lock is in its original position (refer to "Shift locks").

It indicates when the selector lever is actually locked in position "P".



367_107



367_108

Reference

The basic functions of the ignition key removal lock are described in SSP 283 (page 28 ff.).

Selector lever sensors control unit J587 of the Audi A6 to 11.2005

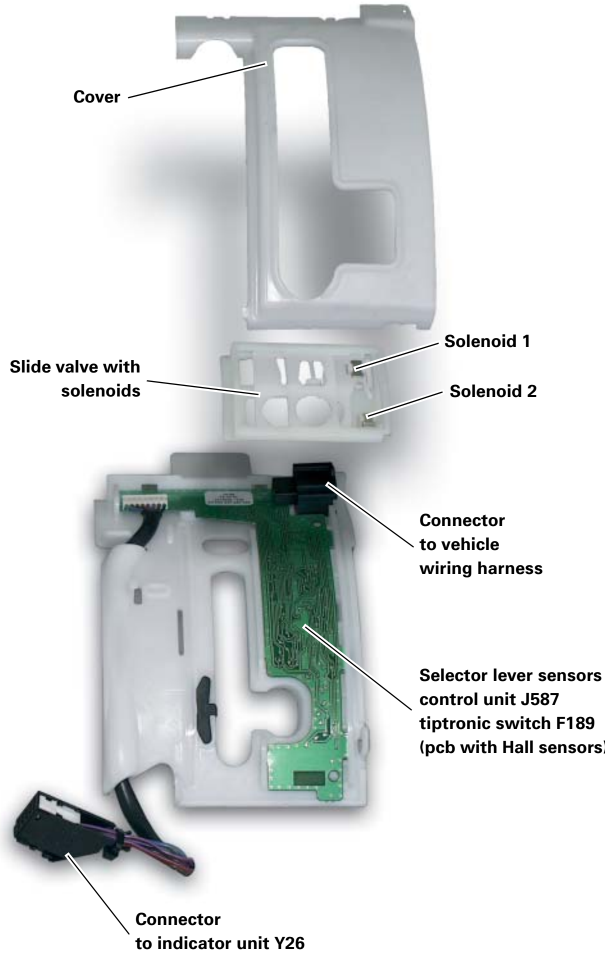
The selector lever sensors control unit J587 has the following tasks:

1 The following is a description of how selector lever positions P/R/N/D/S are monitored, and how the selector lever position indicator unit Y26 is activated:

- Five Hall sensors monitor selector lever positions P/R/N/D/S (see Fig. 385_062). J587 controls indicator unit Y26 according to the selector lever position. See Fig. 385_062
- Solenoid 1 acts on the Hall sensors for positions P, R, N and D.
- Solenoid 2 acts on the Hall sensor for position S, and is used to diagnose the Hall sensors for tiptronic (F189) when the selector lever is shifted between positions P and N. See page 84.

2 In tiptronic mode, the selector lever positions are monitored as follows:

- Three Hall sensors monitor the selector lever positions in tiptronic mode. J587 generates the tiptronic function signals (switch F189) for the gearbox control unit.
- Solenoid 1 acts on the Hall sensors for tiptronic (F189). see next page.

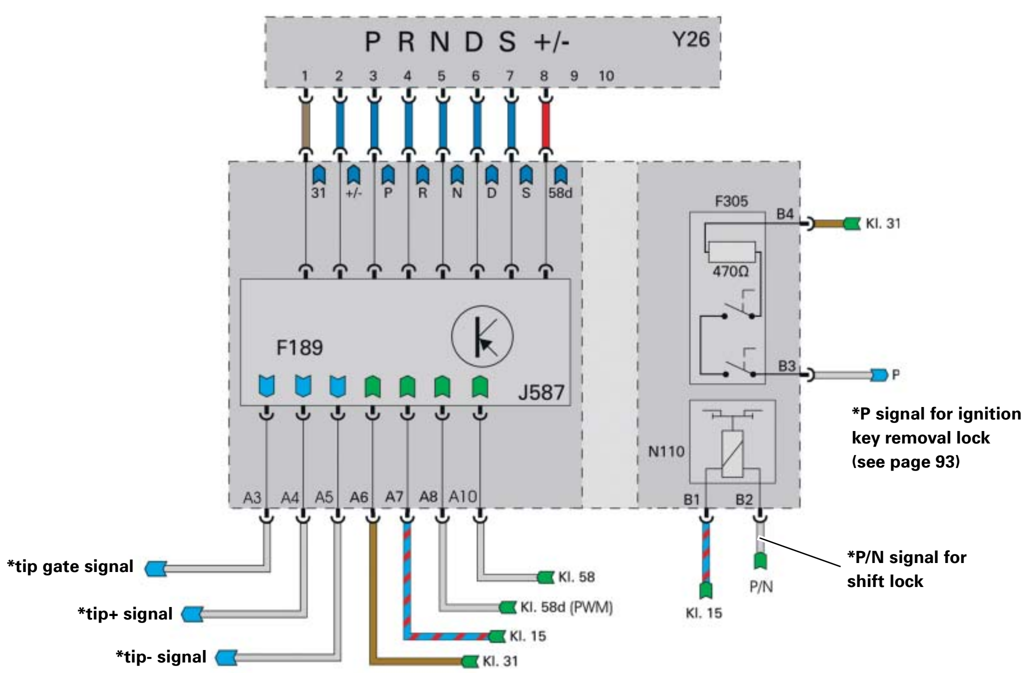


325_088

Reference

For information on the selector lever sensors on the Audi Q7, refer to SSP 367 (page 66 ff.).

Function diagram of the gearshift mechanism with display unit on Audi A6 models to 11.2005



* Signals to and from the gearbox control unit

385_059

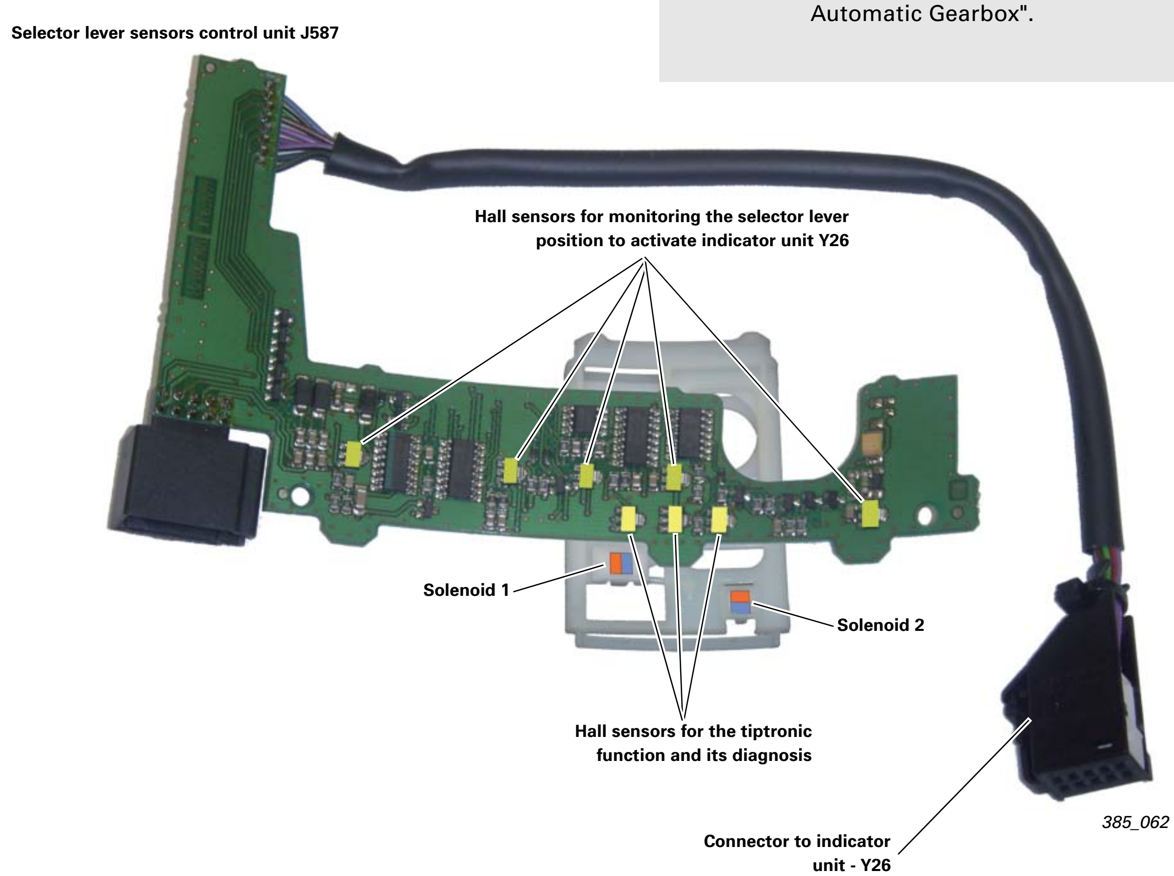
tiptronic switch F189 - Audi A6 to 11.2005

The tiptronic information "selector lever in tiptronic gate", "selector lever in tip+" or "selector lever in tip-" is supplied by tiptronic switch F189. F189 comprises three Hall sensors and is integrated in the selector lever sensors control unit J587. Depending on the selector lever position, two permanent magnets act on the Hall sensors thereby altering their circuit state.

The selector lever sensors control unit J587 generates a PWM signal from the circuit states of each of the Hall sensors and makes a continuous diagnosis of the Hall sensors.
See page 84 "Diagnosis of the Hall sensors"

Reference

Please refer to the Audi iTV broadcast of 28.03.2007, "Gearshift Mechanisms of the Automatic Gearbox".



385_062

Display unit of Audi A6 to 11.2005

The display unit is supplied with electrical power by the selector lever sensors control unit J587 and is activated according to the selector lever position. See page 86

367_003

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