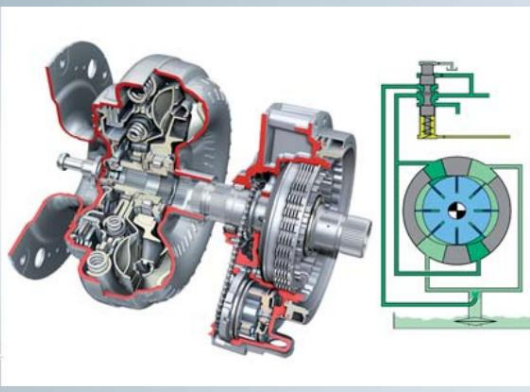
Self-study program 457



Audi A8 '10 Power Transmission

8-speed automatic transmission 0BK and 0BL
Rear axle drive 0BF and 0BE – sports differential

Audi
Service Training

The transmission world at Audi

Through innovative developments in the area of power transmission, such as the multitronic transmission or the dual-clutch transmission, Volkswagen and Audi have significantly changed the requirements profile for new, modern multi-stage automatic transmissions.

In addition to reducing fuel consumption, which has become extremely important due to the CO2 debate, dynamism and spontaneity are at the top of the list of requirements for sporty premium vehicles. This has already been taken into account with the use of the 2nd generation of 6-speed automatic transmissions from ZF Getriebe GmbH (see self-study program 385 for the 0B6 transmission).

Here, the vibration damping has been improved with the help of new torque converters, which enables a reduction in consumption and a more direct driving experience. With the help of the standstill decoupling, which reduces the absorption torque when stationary with the brake depressed, and the significant reduction in switching and reaction times, the comfortable torque converter automatics have been transformed into modern

Sports transmissions with high efficiency have been further developed.

"When developing the new automatic transmission, the focus was on further, significant reductions in consumption while simultaneously increasing performance - not the number of gears."
Dr. Michael Paul
Chief Technology Officer of ZF Friedrichshafen AG

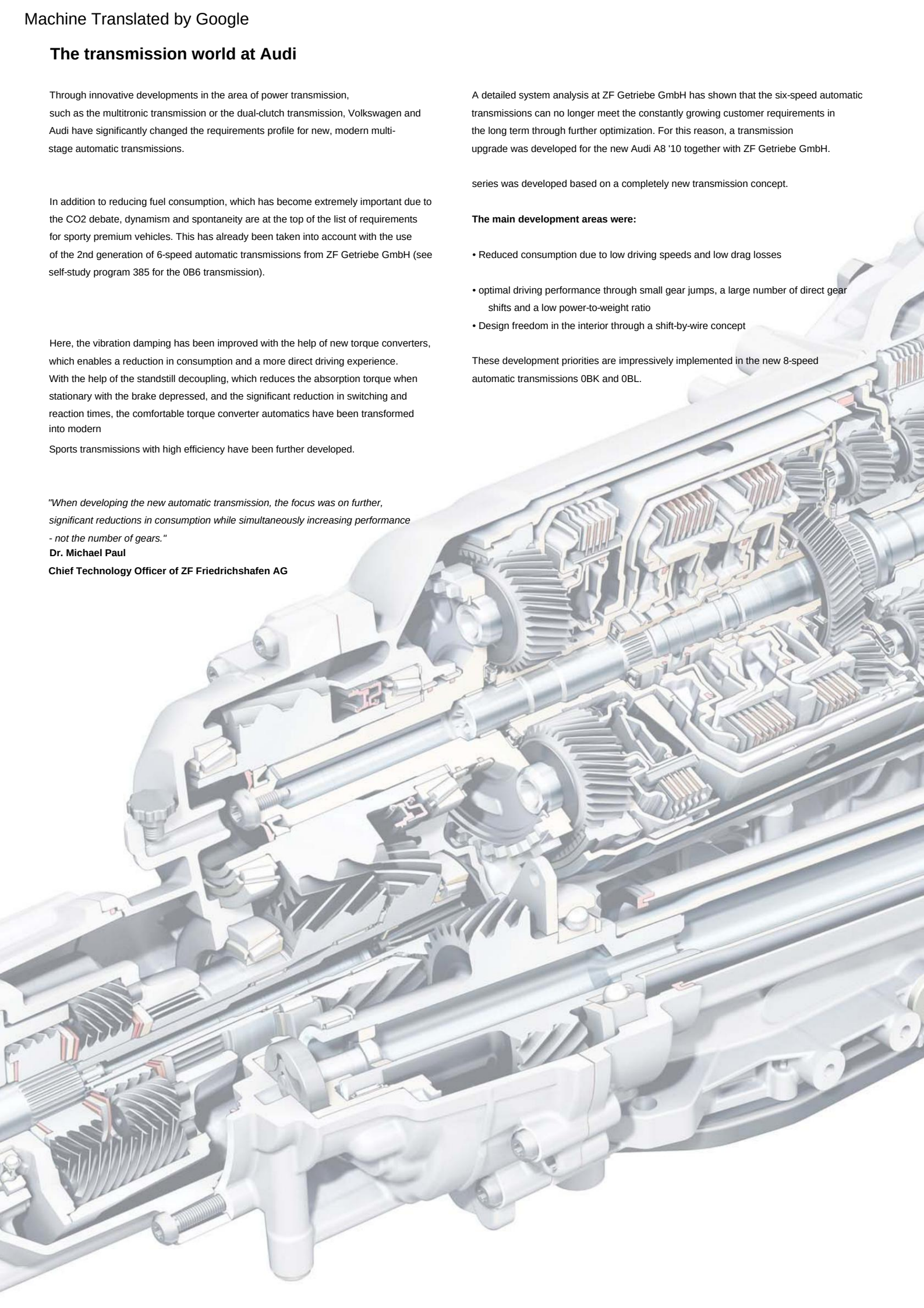
A detailed system analysis at ZF Getriebe GmbH has shown that the six-speed automatic transmissions can no longer meet the constantly growing customer requirements in the long term through further optimization. For this reason, a transmission upgrade was developed for the new Audi A8 '10 together with ZF Getriebe GmbH.

series was developed based on a completely new transmission concept.

The main development areas were:

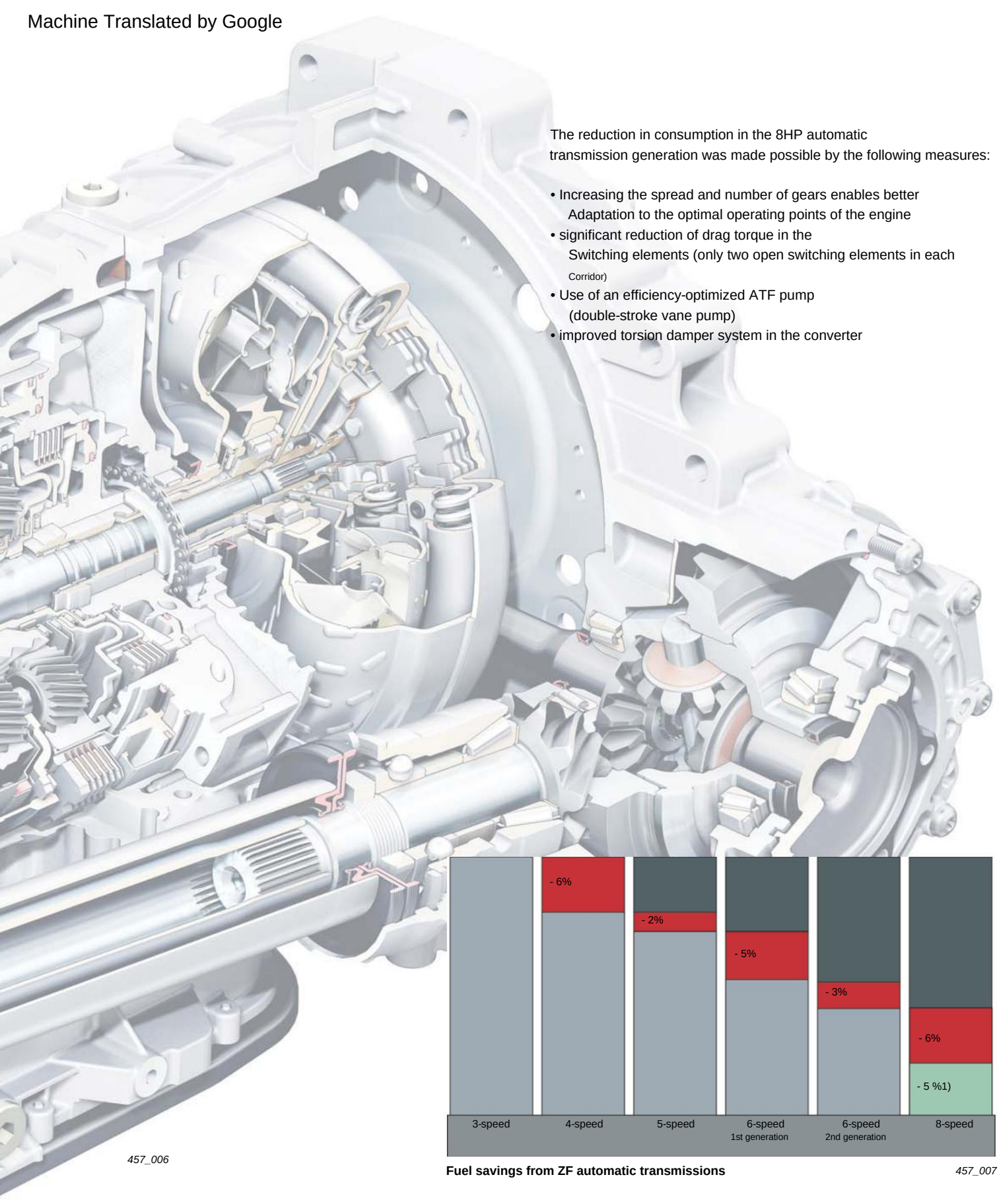
- Reduced consumption due to low driving speeds and low drag losses
- optimal driving performance through small gear jumps, a large number of direct gear shifts and a low power-to-weight ratio
- Design freedom in the interior through a shift-by-wire concept

These development priorities are impressively implemented in the new 8-speed automatic transmissions 0BK and 0BL.



The reduction in consumption in the 8HP automatic transmission generation was made possible by the following measures:

- Increasing the spread and number of gears enables better Adaptation to the optimal operating points of the engine
- significant reduction of drag torque in the Switching elements (only two open switching elements in each Corridor)
- Use of an efficiency-optimized ATF pump (double-stroke vane pump)
- improved torsion damper system in the converter



457_006

Fuel savings from ZF automatic transmissions

457_007

Another significant potential for reducing consumption is to avoid the idling consumption of the combustion engine when the vehicle is stationary. This has a very positive effect in city traffic.

To exploit this potential, the 3.0 V6 TDI engine is the first to use the start-stop function in combination with an automatic transmission. Further applications are in preparation.

[1)] Savings potential in start-stop operation determined by simulations in NEDC (New European Driving Cycle)

Table of contents

Power transmission in the Audi A8 '10

Shift-by-wire gearshift

8-speed automatic transmission 0BK/0BL

Rear axle drive 0BC/0BF/0BE

457_102

The 8-speed automatic transmissions 0BK and 0BL belong to the category of conventional stepped automatic transmissions with torque converter.
They have many design and

functional similarities with the 6-speed automatic transmissions already described in the self-study programs 283, 284 and 385.

These SSPs form the basis for SSP 457.
If the technology is the same, please refer to SSPs 283, 284 and 385.
It is therefore advisable to keep these three booklets handy.

Audi iTV training

You can find further information on the power transmission in the Audi A8 in the two Audi iTV broadcasts from September 2nd, 2010:

- **Audi A8 transmission part 1**
  Contents: gearshift, parking lock, auto-P function,
  Emergency release of the parking lock
- **Audi A8 transmission part 2**
  Contents: Special features of the new 8-speed automatic transmissions, oil systems and electro-hydraulic Control, working with the diagnostic tester, the plugged cardan shaft

• The self-study program provides the basics of the design and function of new vehicle models, new vehicle components or new technologies.
The self-study program is not a repair manual! The values given are only intended to facilitate understanding and refer to the software version valid at the time the SSP was created.
For maintenance and repair work, please be sure to use the latest technical literature.

Notice

reference

Power transmission in the Audi A8 '10

Overview of new features

The drive concept with the rearward-shifted engine position was already implemented in the Audi A8 '03. This made the Audi A8 '03 the pioneer of the drive concept that was continued in the B8 series.

developed concept, in which the front axle center was moved even further forward. This new unit or
Axle position is now also the basis for the Audi A8 '10.

A highlight is certainly the new 8-speed automatic transmission.
They open up a new dimension of
Driving dynamics, comfort and efficiency.

Together with the latest generation quattro drive, the highest level of driving dynamics is achieved. The Audi A8 '10 will be offered exclusively with quattro drive at market launch and beyond.

In order to be able to offer a particularly consumption-optimized vehicle in this vehicle class, a variant with front-wheel drive is planned.

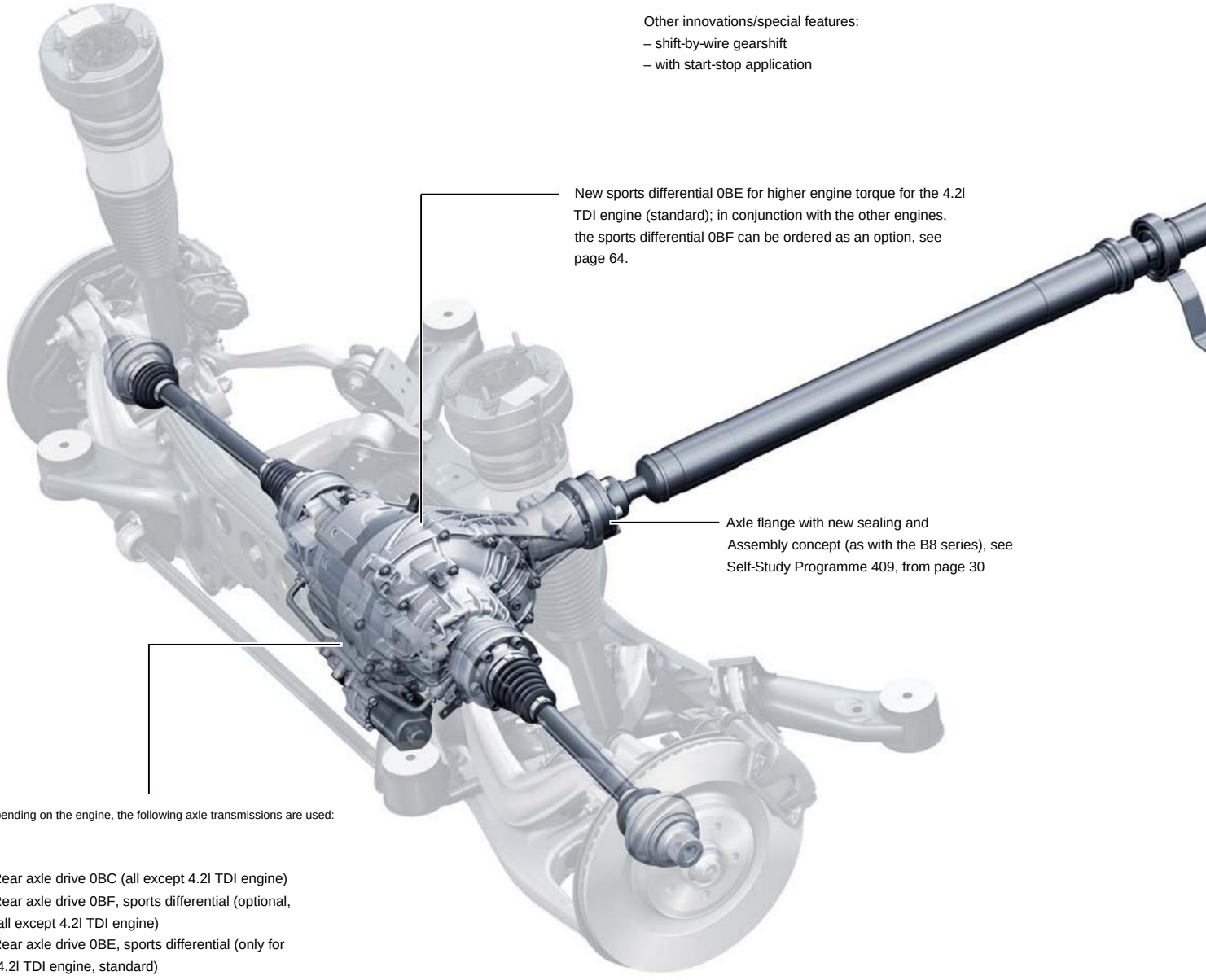
457_043

Two newly developed automatic transmissions:

8-speed automatic transmission 0BK for all engines except 4.2l TDI engine

8-speed automatic transmission 0BL (only for 4.2l TDI engine) – only with quattro drive

Other innovations/special features:
– shift-by-wire gearshift
– with start-stop application

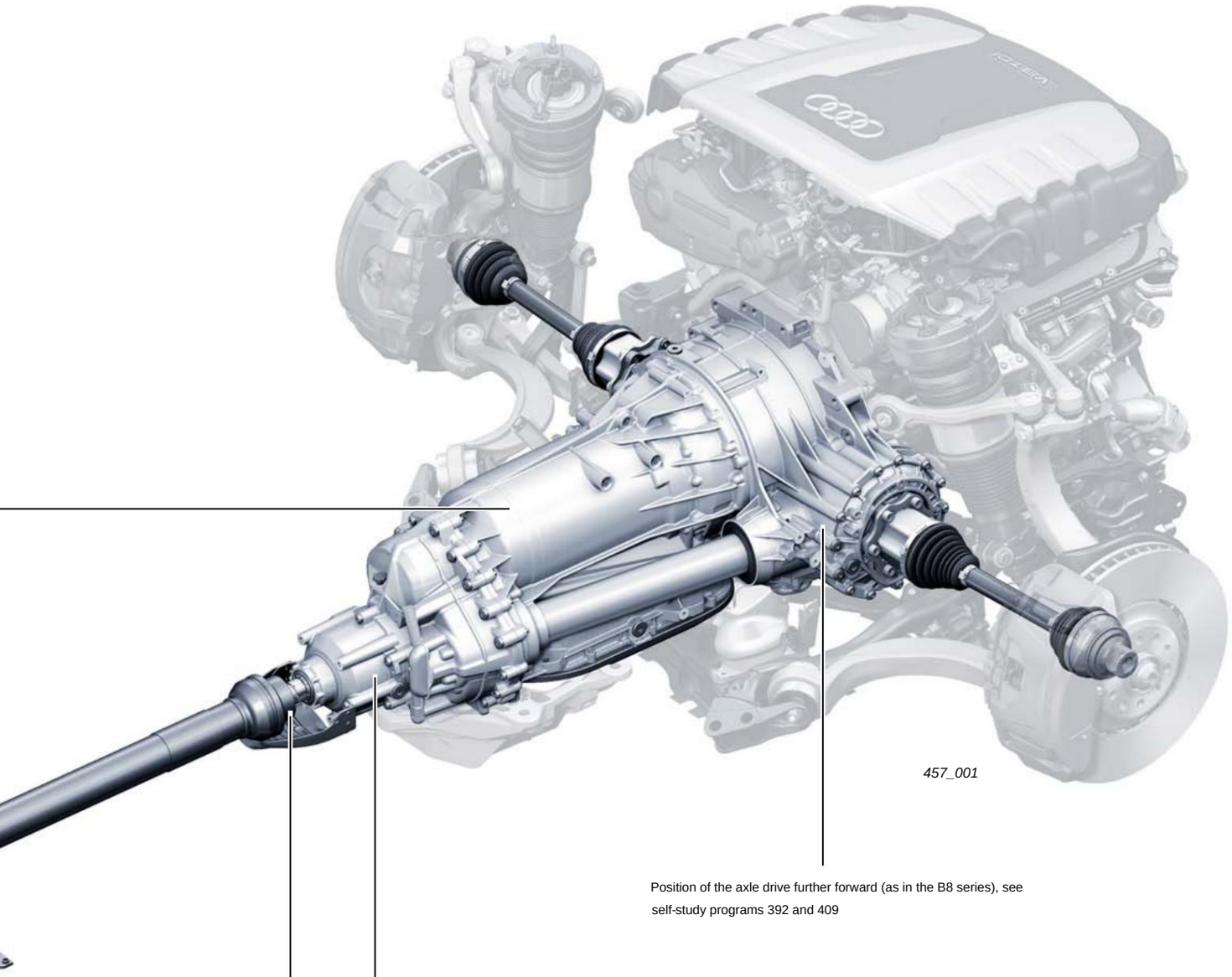


New sports differential 0BE for higher engine torque for the 4.2l TDI engine (standard); in conjunction with the other engines, the sports differential 0BF can be ordered as an option, see page 64.

Axle flange with new sealing and Assembly concept (as with the B8 series), see Self-Study Programme 409, from page 30

Depending on the engine, the following axle transmissions are used:

– Rear axle drive 0BC (all except 4.2l TDI engine)
– Rear axle drive 0BF, sports differential (optional, all except 4.2l TDI engine)
– Rear axle drive 0BE, sports differential (only for 4.2l TDI engine, standard)



457_001

Position of the axle drive further forward (as in the B8 series), see self-study programs 392 and 409

quattro with asymmetrical-dynamic torque distribution and wheel-selective torque control

Information on wheel-selective torque control can be found on page 66.

Plugged cardan shaft – significant weight reduction due to elimination of the screw flange connection, see page 23

reference

The drive concept of the Audi A8 '10 corresponds in some respects to that of the B8 series (Audi A4/A5). A great deal of information has already been published in the self-study programs 392 and 409, to which reference is made in this booklet.

In the Audi iTV broadcast on July 4, 2007, further special features on the subject of "Power transmission in the Audi A5" were presented. The information on the axle position also applies to the same extent to the Audi A8 '10 and provides basic knowledge on this subject.

Shift-by-wire gearshift

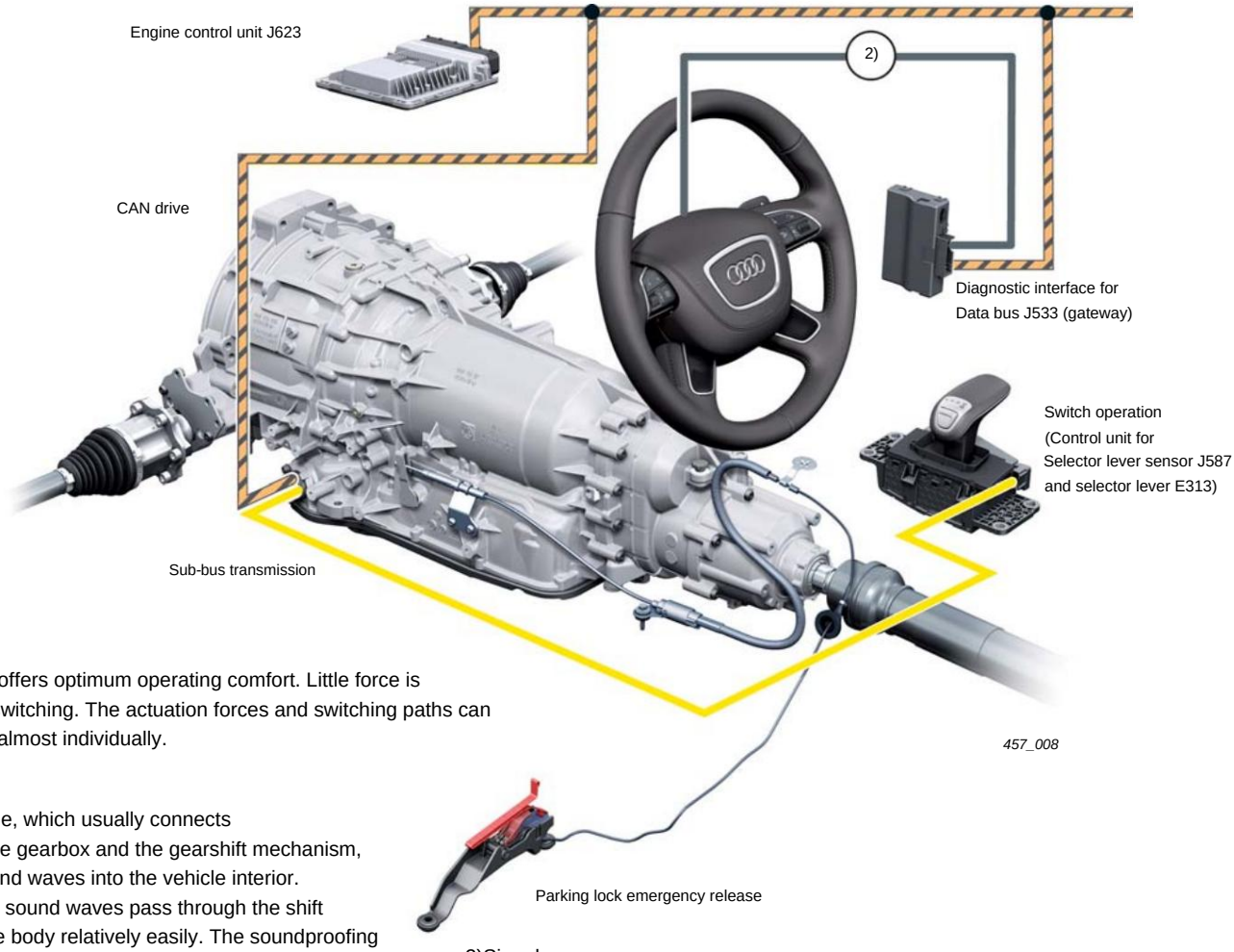
introduction

One innovation is the new operating and gearshift concept with shift-by-wire. Shift-by-wire, literally translated as "shifting via electrical cable", means something like "electrical shifting".
For the first time, shift-by-wire has been implemented 100% in the Audi A8 '10 - "full" shift-by-wire. This means:

- There is no mechanical connection between the selector lever and the gearbox
  Connection
- the operation is purely a driver request recording without mechanical fallback level
- the parking lock is operated electro-hydraulically; a mechanical
  The emergency release allows the parking lock to be unlocked in the event of a fault in order to be able to move the vehicle, see page 18

Advantages of the “full” shift-by-wire concept

- new options for the design of the gearshift mechanism, e.g. design, size, positioning in the vehicle and operating concept
- new comfort and safety functions can be implemented, e.g. automatic engagement of the parking lock
- Simplification of the assembly of gearshift and gearbox,
  No adjustment work required
- Improvement of the acoustics in the vehicle interior through
  Decoupling of gearshift and transmission1)



457_008

Shift-by-wire offers optimum operating comfort. Little force is required for switching. The actuation forces and switching paths can be designed almost individually.

1)A shift cable, which usually connects between the gearbox and the gearshift mechanism, directs sound waves into the vehicle interior. In addition, sound waves pass through the shift cable in the body relatively easily. The soundproofing measures are sometimes very complex and their effectiveness depends on the shift cable being laid without stress.

2)Signal curve:
M-button and touch switch E438/439 > Control unit for multifunction steering wheel J443 > via LIN bus > Control unit for steering column electronics J527 > via CAN comfort > Diagnostic interface for data bus J533 > via CAN-Drive > Gearbox control unit J217

tiptronic function

The tiptronic gate has been eliminated. Switching to tiptronic mode and back to automatic mode is done using the M button in the right-hand steering wheel spoke. The other functions of the tiptronic are as already known (tiptronic in D or S). The tiptronic in D or S can be activated or deactivated using coding or adaptation, see page 63. Switching from tiptronic mode to automatic mode also takes place when the selector lever is moved backwards. Gear shifting is done exclusively using the tip switches (paddles) on the steering wheel.

457_009

Features of the switch operation

The new design and operating concept of the gearshift mechanism is an innovation. The overview gives you an overview of the components, special features and innovations.

Integrated display unit for selector lever position (gear position) Y26.
It shows the currently selected gear (not the selector lever position).

Ergonomic selector lever in “yacht lever design” with various applications in leather or wood.

The “yacht lever” serves as a comfortable hand rest and improves the operation of the MMI input unit (the MMI is located in front of the gearshift in the Audi A8 '10).

Button for selector lever release E681 (electrical switch), replaces the previously known mechanical locking and unlocking mechanism to switch into or out of certain gears

to be able to switch.

Gear shifting without tiptronic shift gate, switching to tiptronic mode is done via the M button in the right-hand steering wheel spoke (see page 8), or for a limited time by pressing the tip switch (paddles) on the steering wheel in gear D or S (tiptronic in D or S). Depending on the model, the "tiptronic in D or S" function must be activated either in the coding or in the adaptation (or can also be deactivated), see page 63.

Intuitive operating logic with permanent return to the middle position.

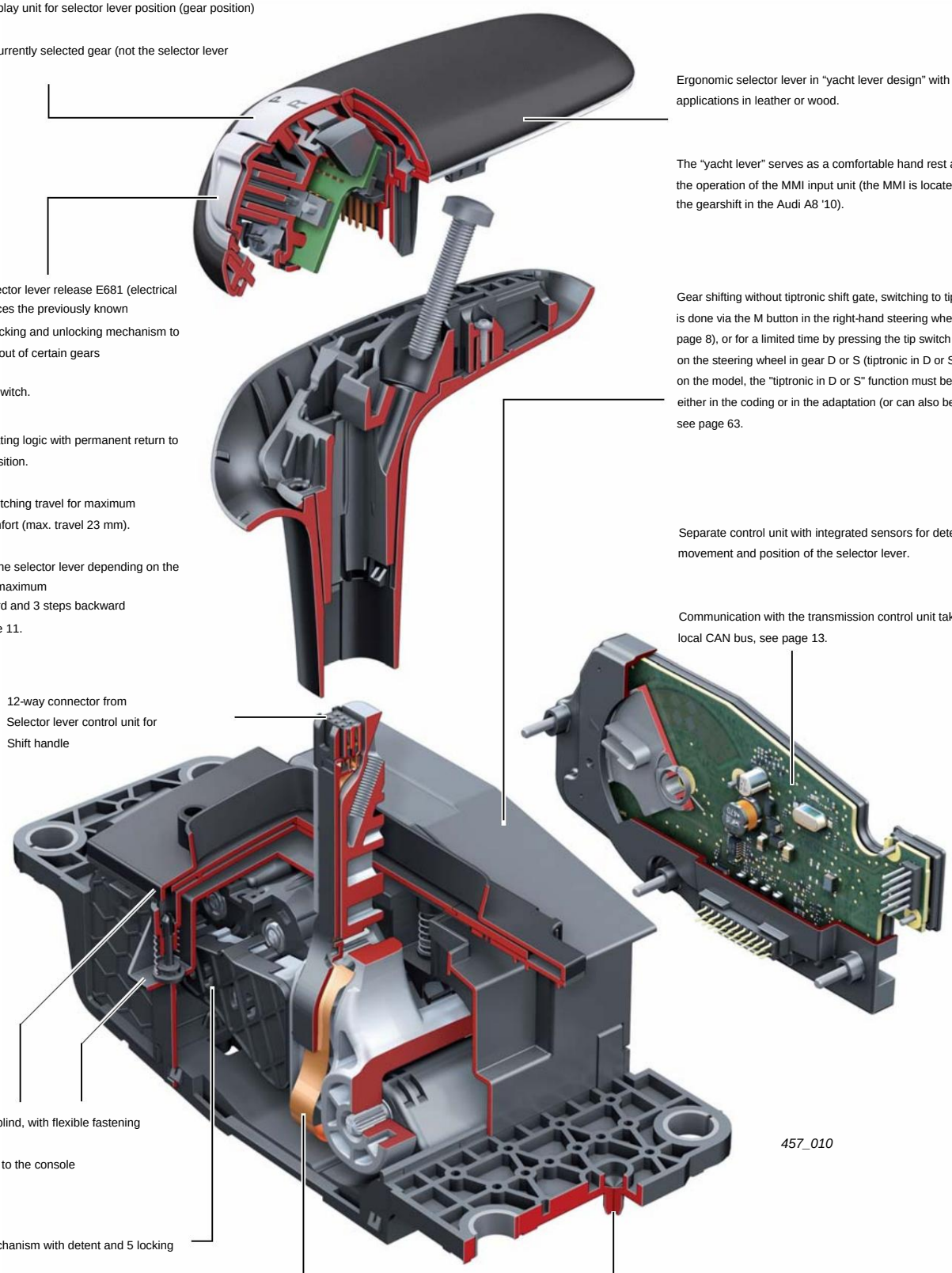
Very short switching travel for maximum operating comfort (max. travel 23 mm).

Separate control unit with integrated sensors for detecting the movement and position of the selector lever.

Deflection of the selector lever depending on the current gear, maximum
3 steps forward and 3 steps backward
rear, see page 11.

Communication with the transmission control unit takes place via local CAN bus, see page 13.

12-way connector from
Selector lever control unit for
Shift handle



457_010

Switch cover/blind, with flexible fastening for a
Self-centering to the console

Switching mechanism with detent and 5 locking magnets.
Instead of a gearshift gate, the

The degree of movement of the selector lever (forward or backward) is limited depending on the gear position by means of several locking magnets.
In addition, the selector lever lock in P and N is implemented with the locking magnets, see page 11.

Conductor foil

Easy installation of the switch actuator using centering pins on the housing.

If the switch mechanism does not fit despite centering, you can cut off the centering pins and align the switch mechanism within the hole clearance.

Operating concept

The gearshift mechanism of the Audi A8 '10 is not only visually striking, the new shift-by-wire gearshift mechanism is also an innovation in terms of operation and function.

The shift-by-wire concept allows the operation to be redesigned. What is new is that the selector lever no longer follows a shift gate depending on the selected gear, but always returns to the starting position (basic position) like a joystick.

This means that the selector lever position and the gear ratio or the function mode are not
are consistent.

An example: The gearbox is in park (P), but the selector lever is in its home position.

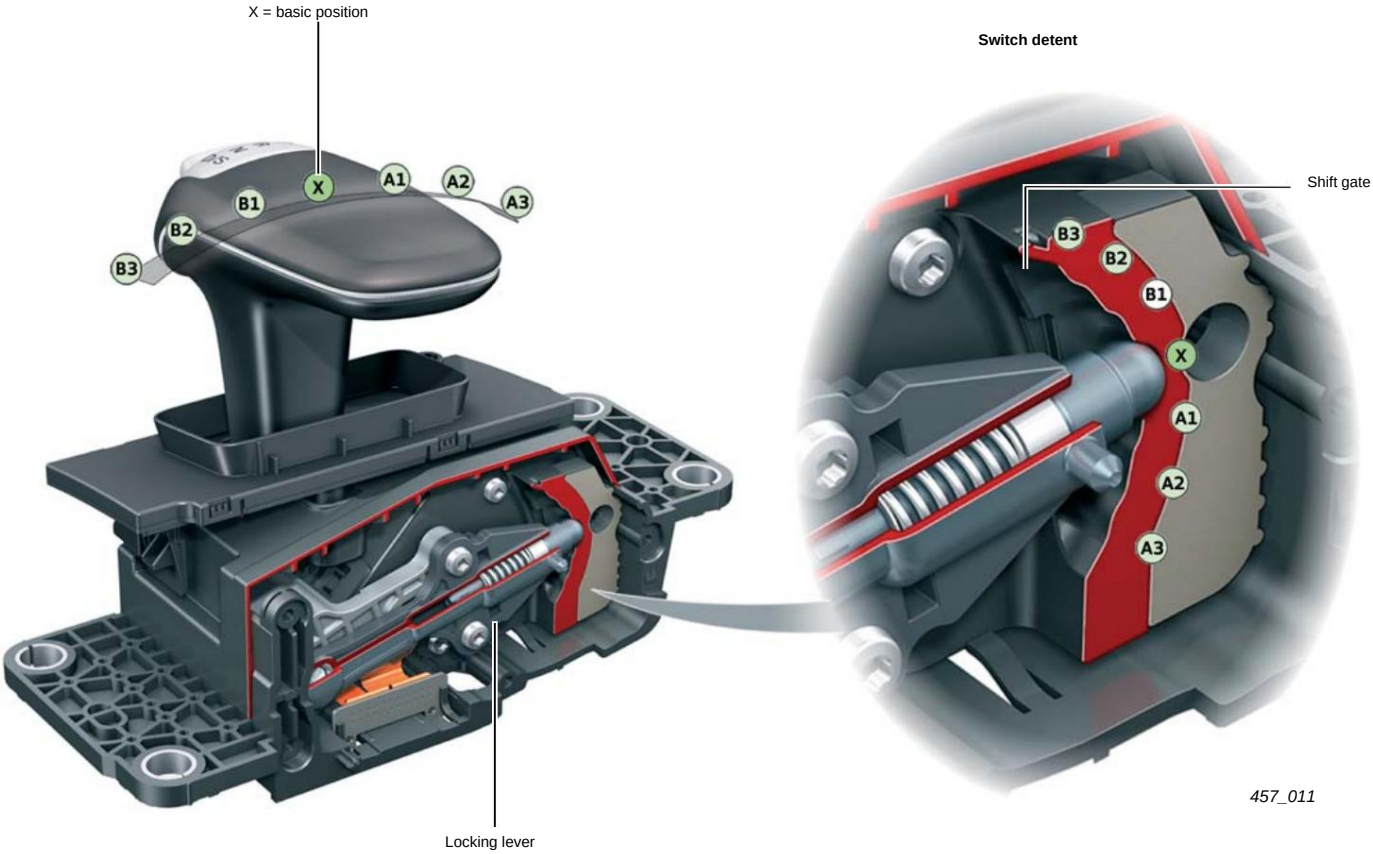
To avoid confusion between the terms selector lever position, gear position or function mode, we call this basic position “X”.

A logical operating concept was developed to ensure that the gearshift is comfortable and intuitive to use.
From the basic position “X”, the selector lever has three gears forward and three gears backward.

The locking mechanism ensures defined actuation forces and short, precisely defined shifting paths. Logical and intuitive operation is ensured by 5 locking magnets, each of which blocks illogical selector lever movements.

An example: If the transmission is in park, the selector lever is locked forwards, but it can be moved back a maximum of 3 steps, e.g. if the driver wants to switch from P to D (1st step P > R, 2nd step R > N, 3rd step N > D).

This corresponds to the operating logic of a conventional switching operation.



In the following circuits, the button or/and
To apply the brake:

P >	Button and brake
R > P	button
N > D	Brake1)
D/S > N key	
N > R	Button and brake1)

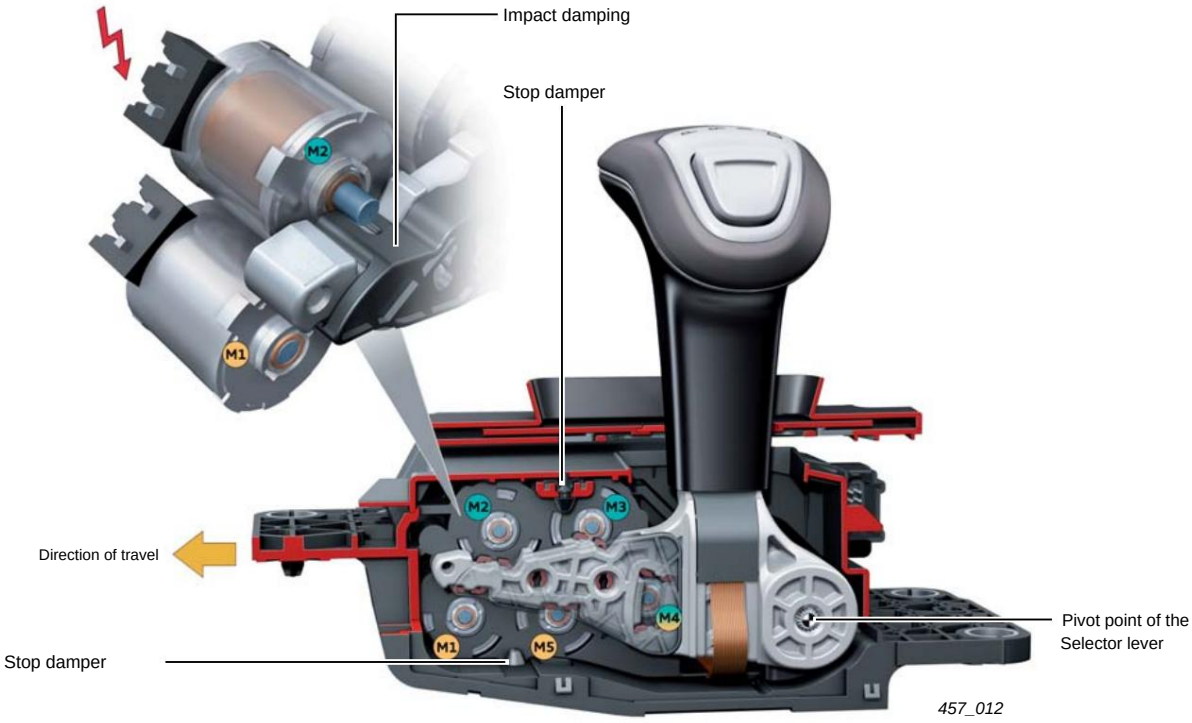
1) The N-lock only becomes active approximately 1 second after the gear position “N” is selected.

Circuit diagram – function

As already mentioned, the shifting movements of the selector lever are limited by 5 locking magnets so that it provides logical and intuitive operation for the driver.

The locking magnets are controlled by the selector lever sensor control unit J587 according to the selected gear.

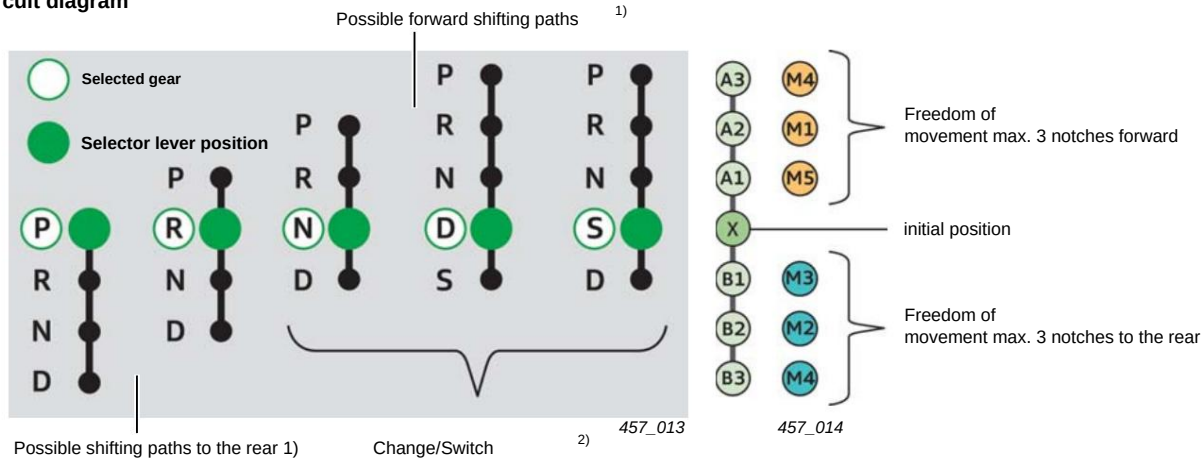
As before, the release button and/or the brake must be pressed in order to shift into or out of certain gears, e.g. when shifting out of "P" the button and the brake must be pressed.



M1 Magnet 1 for selector lever lock N496
M2 Magnet 2 for selector lever lock N497
M3 Magnet 3 for selector lever lock N498
M4 Magnet 4 for selector lever lock N499
M5 Magnet 5 for selector lever lock N500

M1 blocks the switching path to A2 and A3 (only A1 enabled)
M2 blocks the switching path to B2 and B3 (only B1 enabled)
M3 + M5 lock the selector lever in basic position X (with P-lock and N-lock)
M4 blocks switching path to A3 and B3 (A1, A2 and B1, B2 are released)
M5 + M3 lock the selector lever in basic position X (with P-lock + N-lock)

Circuit diagram



1) The speed levels can be changed either by repeatedly tapping one notch in the respective direction or by moving the selector lever up to three notches directly, as with the previously known operating logic.

2) The gear position S is selected from the gear position D. The change/ Switching from D to S or from S to D is done by switching to B1 (pull selector lever back 1 step).
If “dynamic” mode is set via “Audi drive select”, the gear position “S” is automatically engaged.

Selector lever sensor control unit J587

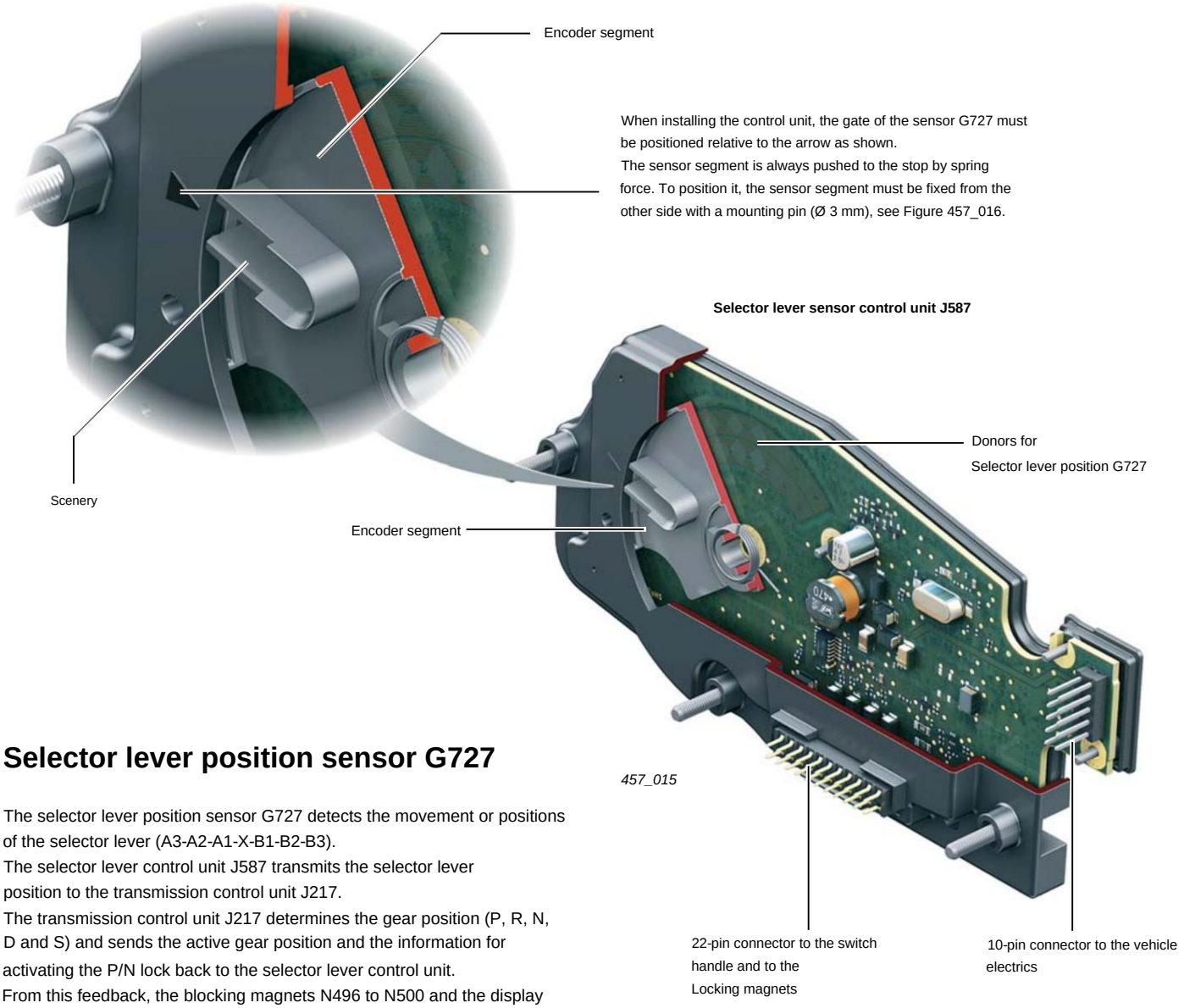
The selector lever sensor control unit J587 forms a functional unit together with the selector lever position sender G727.
This functional unit is responsible for detecting driver requests, evaluating signals, communicating with the transmission control unit J217, and for all control and diagnostic functions of the gearshift mechanism.

Features and special features at a glance:

- Address word 81
- Data protocol UDS
- separate CAN connection to the transmission control unit
- own event memory (maximum 8 entries)
- 24 measured values are available for diagnosis
- Actuator test (only in self-diagnosis)
- the control unit can be replaced separately
- no training/coding necessary
- Can be updated with the vehicle diagnostic tester

The selector lever sensor control unit J587 has the following Tasks:

- Determine the gearshift travel and the position of the selector lever (together with the G727), forwarding the sensor signal to the transmission control unit
- Selection and control of the 5 blocking magnets for the P/N lock and shift travel limitation according to the Gear level reported back to the transmission control unit
- Communication with the transmission control unit via separate CAN bus
- Signal processing of the selector lever release button E681 and forwarding of the information to the transmission control unit
- Control of the display unit Y26 according to the Gear level reported back to the transmission control unit



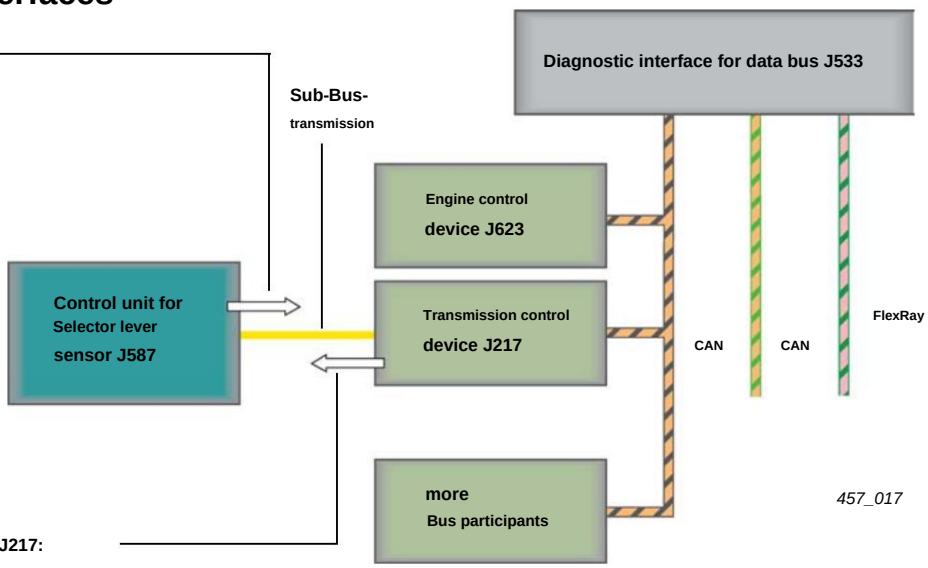
Selector lever position sensor G727

The selector lever position sensor G727 detects the movement or positions of the selector lever (A3-A2-A1-X-B1-B2-B3).
The selector lever control unit J587 transmits the selector lever position to the transmission control unit J217.
The transmission control unit J217 determines the gear position (P, R, N, D and S) and sends the active gear position and the information for activating the P/N lock back to the selector lever control unit.
From this feedback, the blocking magnets N496 to N500 and the display unit Y26 are controlled accordingly.
The speed signal and the brake signal, which are necessary for generating the P/N lock signal, are processed by the transmission control unit.

Functions, networking and interfaces

Information to the transmission control unit J217:

– Selector lever positions A3-A2-A1-X-B1-B2-B3
– Switching state of the selector lever release button E681
– Selector lever lock status
– Status event log



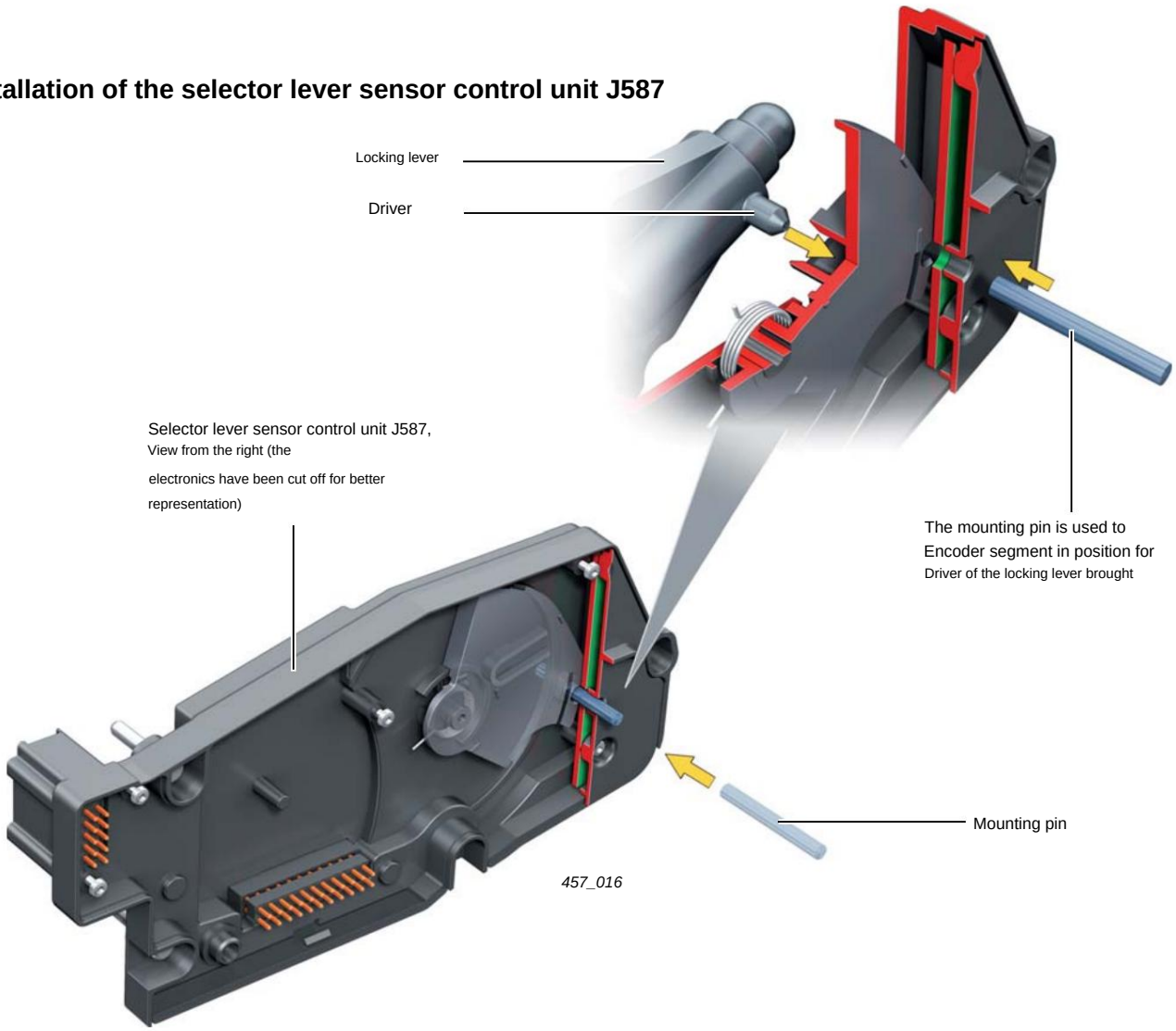
457_017

Information from the automatic transmission control unit J217:

– Information – Gear position (P, R, N, D, S)
The automatic transmission control unit J217 determines the gear positions from the “selector lever position information”.
The selector lever sensor control unit J587 uses this information to control the locking magnets and the display unit Y26
– Information – Activation and release of the selector lever lock (P/N lock)
The automatic transmission control unit J217 determines the release of the selector lever lock from the information “brake applied”, the speed signal and “button E681 pressed”.

The automatic transmission control unit J217 has a simple gateway function. The diagnostic services of the selector lever sensor control unit J587 are called up directly using the address word 81, but communication runs in the background via the Automatic transmission control unit J217.

Installation of the selector lever sensor control unit J587



457_016

Shift handle/button for selector lever release E681

The E681 button is used to unlock the selector lever. The unlocking is no longer done mechanically, but electrically.

To improve reliability, the button is designed as a circuit with two microswitches.

Both switches are monitored by the self-diagnosis system. If a switch is defective, an error message is displayed. As long as one switch is still working, the selector lever can still be operated.

457_018

Selector lever position display unit Y26

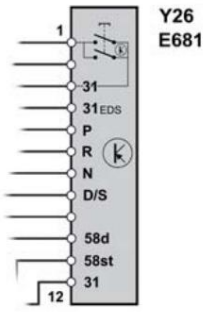
The display unit is integrated in the gearshift handle and shows the **current gear.** To provide better information to the driver, the

The gear position display (function lighting) is only switched off approx. 10 seconds after the ignition is turned OFF. The search lighting (see below) is switched on by the on-board power supply control unit J519.

In order to protect the electronics of the gearshift mechanism and the gearshift handle from overvoltage caused by electrostatic discharges, electrostatic discharges from the driver are diverted via a separate ground connection to the selector lever control unit, see terminal 31ESD in the functional diagram.

To dismantle the shift handle, the upper part of the handle must be unclipped and the fastening screw unscrewed.
When installing, make sure that the blind is not damaged. Make sure that the blind is correctly aligned.

Functional plan (excerpt)



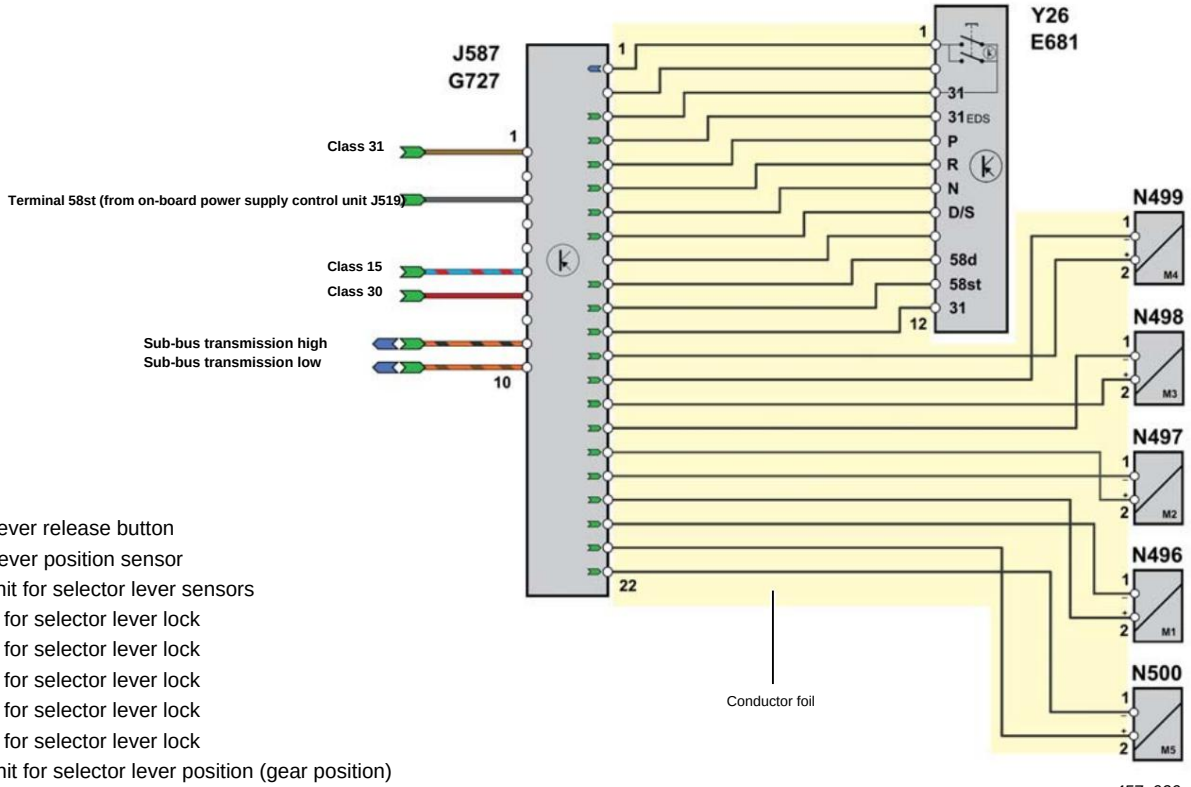
457_019

Legend for circuit diagram	
58st	**Search lighting** with defined dimming, all LEDs in the Y26 are controlled with low luminosity (so that the selector lever can be found even in the dark (without Kl. 15 and/or class 58d))
58d	**Dimming** of the LEDs for the function lighting (P, R, N, D/S). The dimming level is sent as information via data bus to the selector lever control unit, which in turn controls the display unit accordingly.
31ESD	Ground connection for dissipating electrostatic discharges
ESD	Electro Static Discharge

Notice

If the upper part of the shift handle is not inserted or not inserted correctly, all locking magnets are deactivated. This means that all selector lever positions can be switched. An error log entry and a warning message are displayed in the instrument cluster.

Function diagram – selector lever E313



457_020

E681	Selector lever release button
G727	Selector lever position sensor
J587	Control unit for selector lever sensors
N496	Magnet 1 for selector lever lock
N497	Magnet 2 for selector lever lock
N498	Magnet 3 for selector lever lock
N499	Magnet 4 for selector lever lock
N500	Magnet 5 for selector lever lock
Y26	Display unit for selector lever position (gear position)

Switch indicators

In total, the driver is informed about the driving positions and, if adjusted accordingly in the transmission control unit, about the current gear with three displays.

1. Display in the shift handle (Y26)
2. Permanent display in the instrument cluster (bottom center)
3. Pop-up window in the instrument cluster (centre)

Displays in the instrument cluster

457_079

Popup gearshift diagram display for 5 s when the selector lever or the unlock button is operated

Note that you can return to automatic mode by pulling the selector lever back (or
Press the M button on the steering wheel)

M = manual shifting (tiptronic mode)

The gear indicator in gear position “D” can be activated or deactivated using the vehicle diagnostic tester (adaptation function), see page 63.
In manual mode “M” (tiptronic mode) the current gear is always displayed.

shift-by-wire functions/operation

Auto-P function

(automatic parking lock)

The parking lock on the new Audi A8 '10 is operated electrohydraulically. This design allows the parking lock to be operated automatically, thus increasing operating comfort.

The function of the parking lock is described on page 48.
It is recommended that you first read the functional description of the parking lock so that you can better understand and empathize with the Auto-P function.

The Auto-P function automatically engages the parking lock without any action from the driver when the engine is switched off (either with the ignition key or with the START ENGINE STOP button).

The parking lock is automatically engaged when …

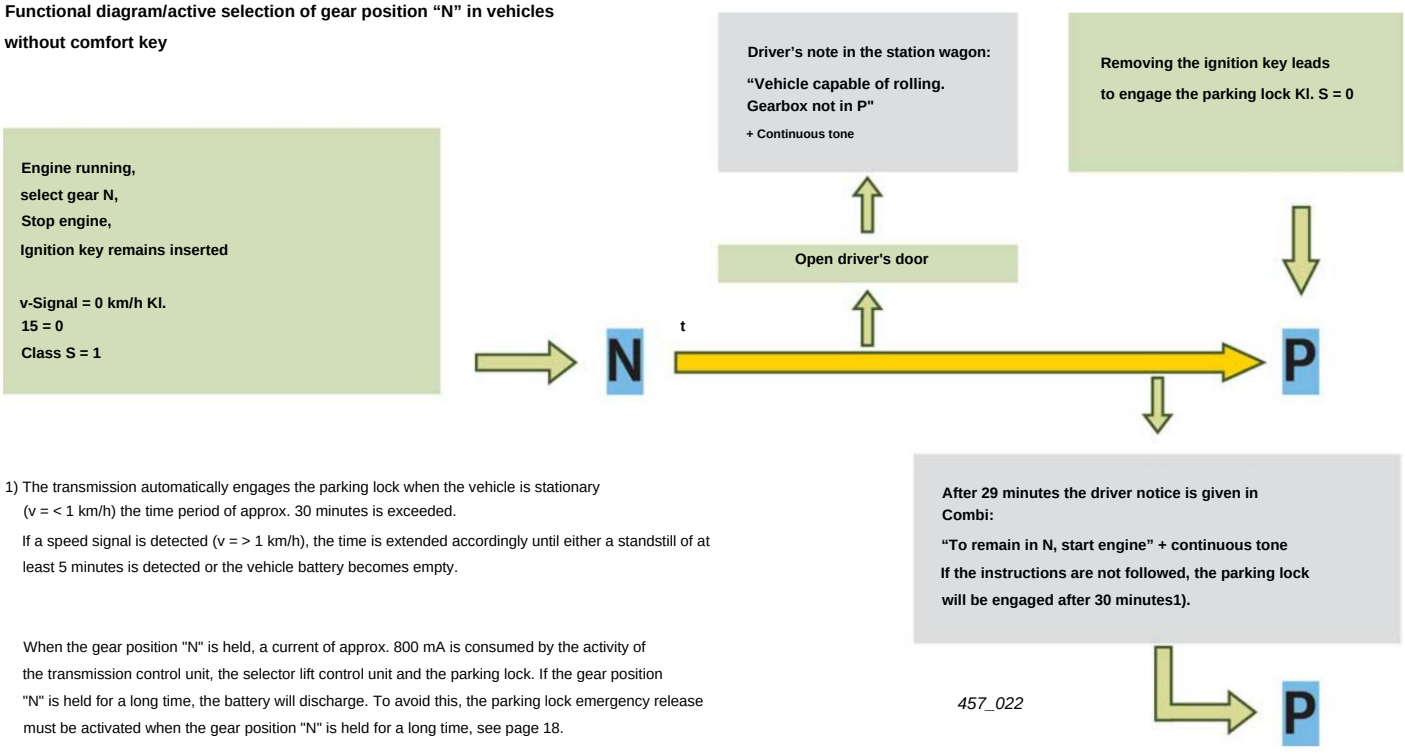
• the vehicle is stationary (speed < 1 km/h), • gear position D, S or R is active, • and the engine is switched off (terminal 15 off (0)).

To put the transmission into neutral, the “N” gear must be selected with the engine running or the emergency release of the parking lock must be activated.

Functional diagram/Auto-P function

457_021

Functional diagram/active selection of gear position “N” in vehicles without comfort key



457_022

1) The transmission automatically engages the parking lock when the vehicle is stationary (v = < 1 km/h) the time period of approx. 30 minutes is exceeded.
If a speed signal is detected (v = > 1 km/h), the time is extended accordingly until either a standstill of at least 5 minutes is detected or the vehicle battery becomes empty.

When the gear position "N" is held, a current of approx. 800 mA is consumed by the activity of the transmission control unit, the selector lift control unit and the parking lock. If the gear position "N" is held for a long time, the battery will discharge. To avoid this, the parking lock emergency release must be activated when the gear position "N" is held for a long time, see page 18.

Ways to put the transmission into neutral:

1. Select the gear position “N” using the gearshift control at engine running. There are certain differences to be noted between vehicles with and without the comfort key system, see the “Auto-P function” functional diagrams.

– Actively selecting the “N” gear is intended for short-term pushing, as the “N” gear is only **available for a limited time .** For example, when driving through a car wash or when the vehicle needs to be pushed within the workshop or garage.

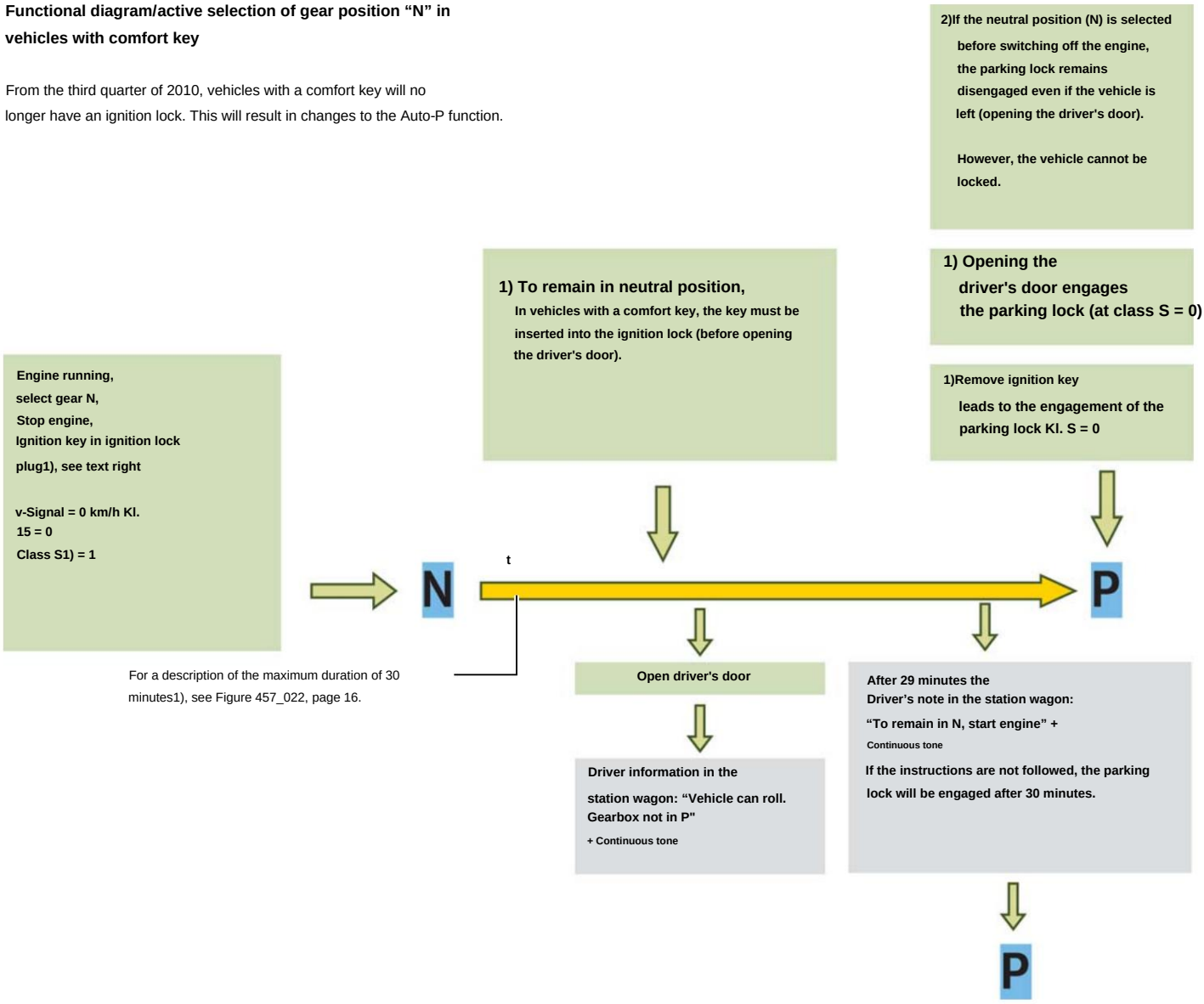
– When actively selecting gear position “N”, the transmission control unit and the selector lever control unit remain active (without terminal 15) and hold gear position “N” for up to 30 minutes when the vehicle is stationary1).

2. Engage gear position “N” using the emergency release.

– If the gear position “N” is to be used … … for a longer period of time, … … permanently, … … when the engine is not running … … or if there is a defect in the electro-hydraulic parking lock actuation … are inserted, the emergency release must be activated.
For example, if the vehicle needs to be towed or if the vehicle needs to be parked in neutral.

Functional diagram/active selection of gear position “N” in vehicles with comfort key

From the third quarter of 2010, vehicles with a comfort key will no longer have an ignition lock. This will result in changes to the Auto-P function.



457_023

Legend	
Class 15	Voltage at “ignition on” (1)
Class S	Detection of whether the ignition key is in Ignition lock is located (1) or not (0)
v-signal	Speed signal (from automatic transmission)
t	Time in neutral position
	Driver action/other conditions
	Action in the gearbox
	Display in the instrument cluster

1)Vehicles with comfort key **until** the 3rd quarter of 2010
2)Vehicles with comfort key **from** the 3rd quarter of 2010
A new comfort key system is used here.
The new comfort key system eliminates the ignition lock.

Important instructions

Note for vehicles without comfort key and vehicles with comfort key up to the 3rd quarter of 20102).
When using car washes with a towing system, the neutral position must be selected and the ignition key must remain inserted in the ignition lock so that the neutral position is maintained!

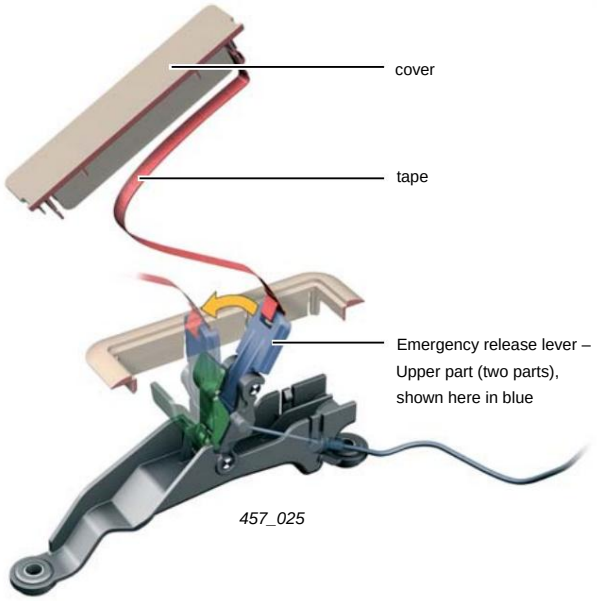
Note for all vehicles: When towing the vehicle or for longer periods of time during which the neutral position in the transmission must be established, the emergency release of the parking lock must be operated.
Do not forget to secure the vehicle against accidental rolling away using the parking brake, wheel chocks, etc. when you have selected the "N" gear or the emergency release of the parking lock is activated.

Emergency release of the parking lock

In normal operation, the parking lock is activated or released electrohydraulically. As already described on page 16, the engine must be running to unlock the parking lock and a sufficient power supply must be ensured to hold the neutral position (N-hold phase). In addition, the so-called N-hold phase is limited in time. For these reasons, 100% implementation of shift-by-wire (without selector lever cable) requires an emergency release for the parking lock. This is the only way the vehicle can be moved in certain situations.

The emergency release is used to temporarily unlock the Parking lock and must be activated in the following situations:

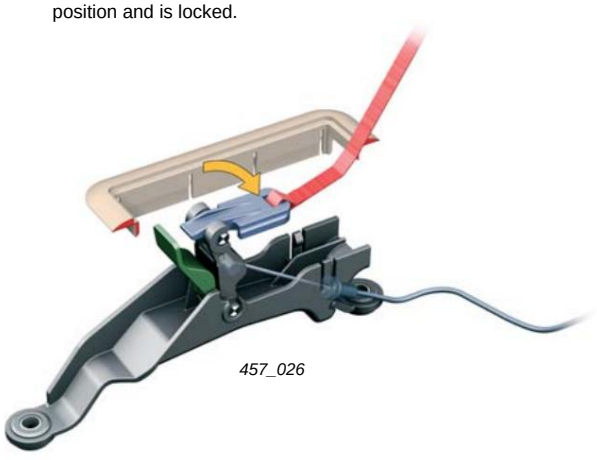
- if the vehicle is to be towed,
- if the parking lock cannot be released electro-hydraulically in the event of a malfunction,
- if the vehicle is to be maneuvered/moved when the on-board voltage is insufficient,
- when the engine is not running and the vehicle is being maneuvered/moved should be (e.g. in the workshop)
- After assembly work on the emergency release components, the emergency release must be checked (see note on the right side).



457_025

Unlock parking lock

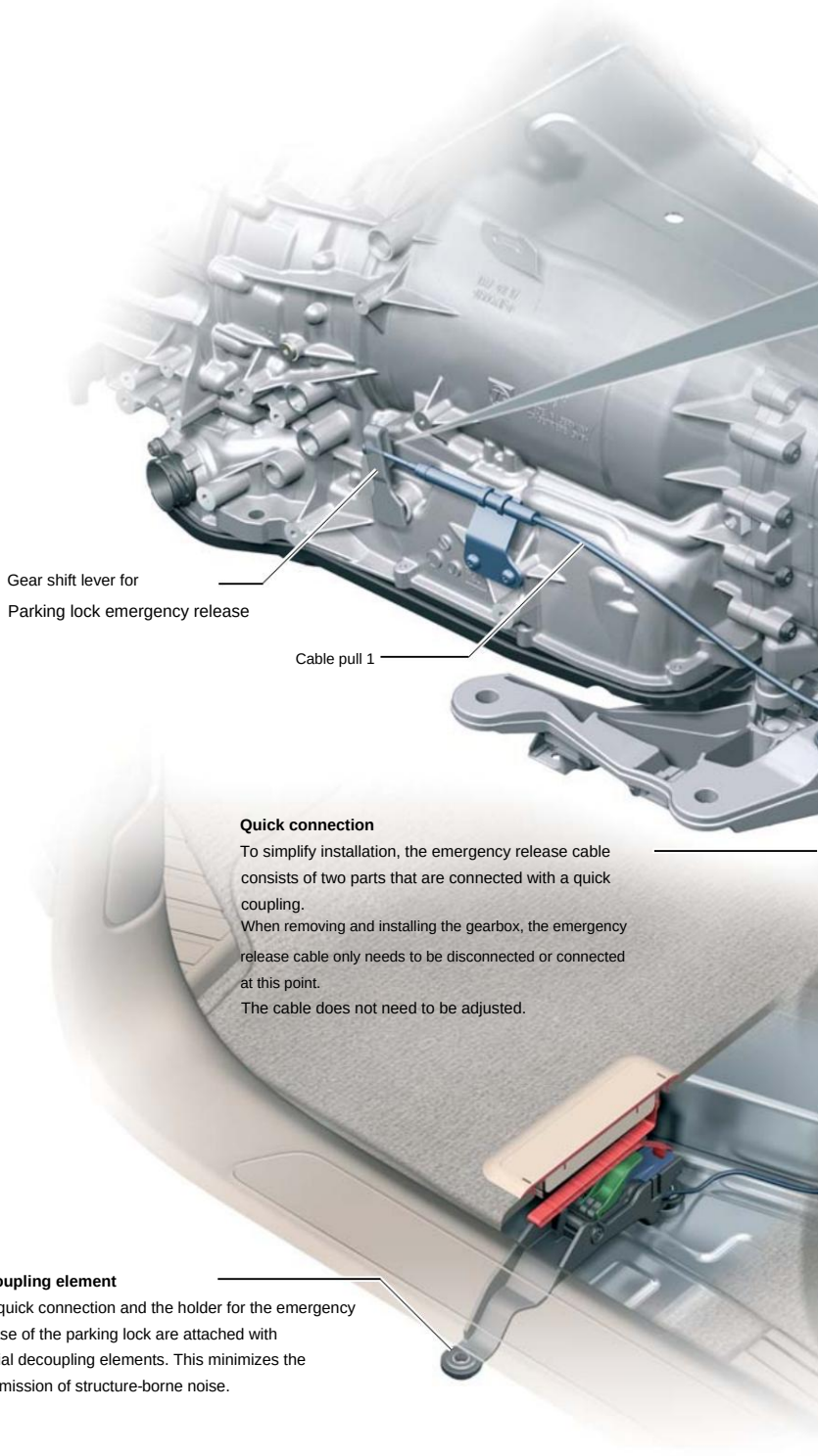
1. Remove the cover using the on-board tool. Use the strap to pull out the emergency release lever until it clicks into the vertical position and is locked.



457_026

2. The emergency release lever is in two parts.
   The upper part must be folded down so that the lever cannot be accidentally operated with the feet.

   The cover is designed in such a way that it cannot be installed in this condition; it is put aside.



Quick connection
To simplify installation, the emergency release cable consists of two parts that are connected with a quick coupling.
When removing and installing the gearbox, the emergency release cable only needs to be disconnected or connected at this point.
The cable does not need to be adjusted.

Decoupling element
The quick connection and the holder for the emergency release of the parking lock are attached with special decoupling elements. This minimizes the transmission of structure-borne noise.

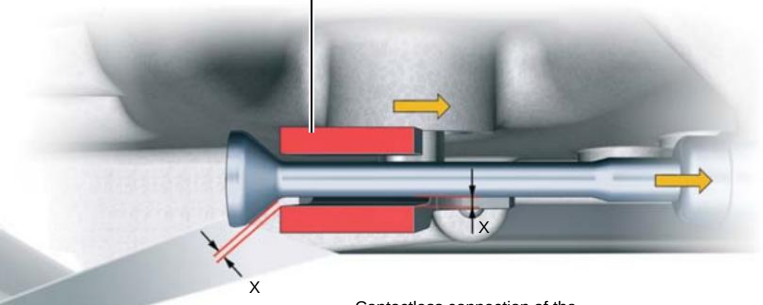
For comprehensive information on the parking lock, see page 16 (Auto-P function) and page 48 (Parking lock).

Further information on the emergency release of the parking lock can be found in the iTV broadcast - Audi A8 power transmission part 1 - from September 2nd, 2010.

When the emergency release of the parking lock is activated, the indicator light and the gear position display “N” light up in the instrument cluster. In addition, the driving message “Risk of rolling away!” appears.
P not possible. Please apply the parking brake."

Indicator light

Gear shift lever for
Parking lock emergency release



Contactless connection of the
Emergency release cable
X = Circumferential clearance (play)
(only in non-actuated state)

Reduction of structure-borne sound transmission

A special feature is the connection of the emergency release cable to the gearshift lever. The end of the emergency release cable is fitted with a rigid rod and a conical nipple. The rod is guided through the gearshift lever with almost no play and without contact. As long as the emergency release is not activated, the rod and the gearshift lever do not touch. This largely prevents the transmission of structure-borne noise from the gearbox to the cable and thus into the vehicle interior.

Emergency release cable

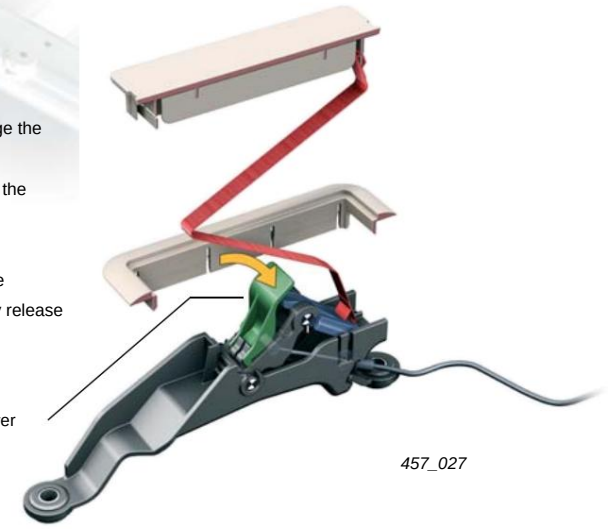
The illustration shows the emergency release on a left-hand drive vehicle; on a right-hand drive vehicle, the emergency release is on the right-hand side.

Cable pull 2

Lock the parking lock

The release lever (shown here in green) is used to release the emergency release lever's locking mechanism in order to re-engage the parking lock. To do this, gently press the release lever and the emergency release lever together while releasing the pressure on the emergency release lever. Then push the two levers back into the

Press the cover into the home position until it clicks into place. The cover is designed so that it can only be fitted when the emergency release lever is folded in.



457_024

457_027

Notice

Do not forget to secure the vehicle against accidental rolling away by other means (with the parking brake, wheel chocks, etc.) when you have selected the "N" gear or the emergency release of the parking lock is activated.

After removing and installing the gearbox or after assembling components of the emergency release, a functional test must be carried out in accordance with the repair manual!

8-speed automatic transmission 0BK/0BL

introduction

The 0BK gearbox and the 0BL gearbox are the first representatives

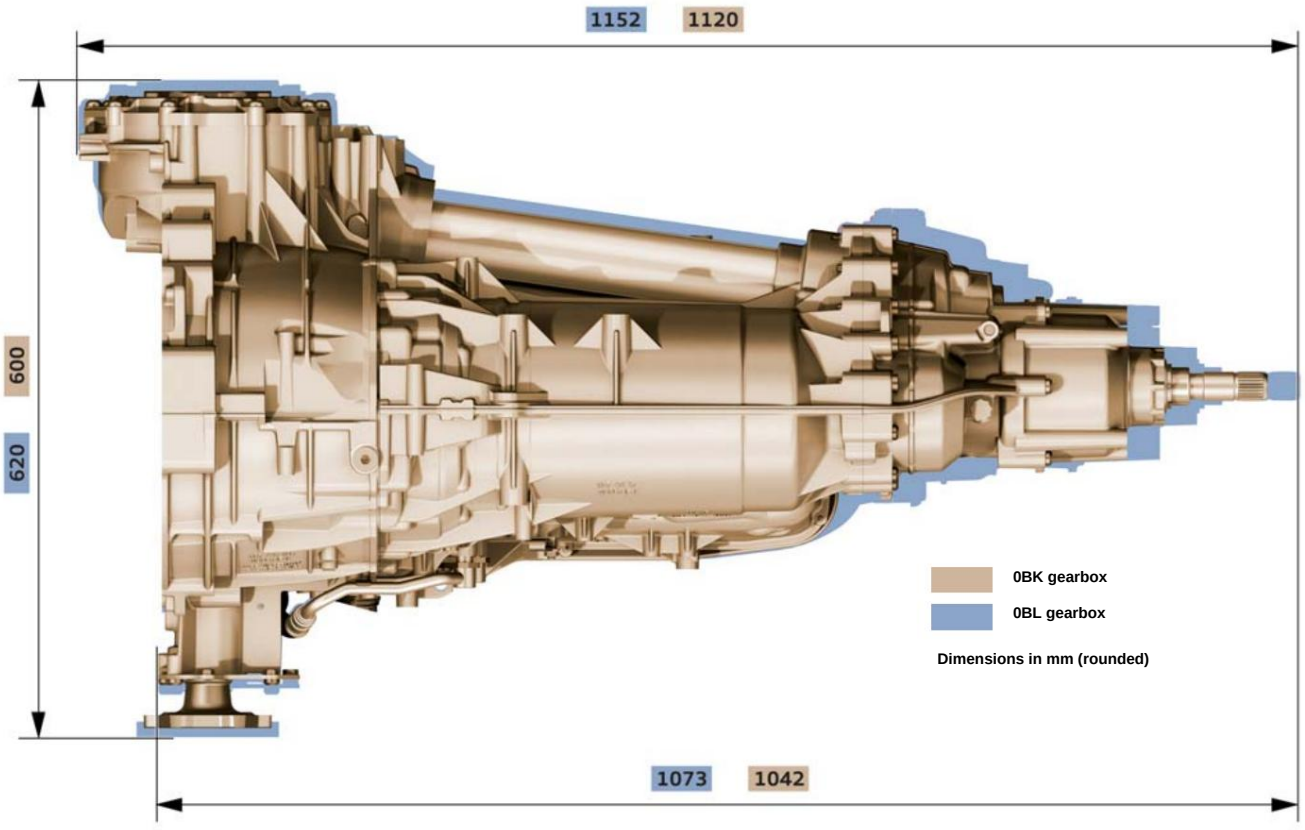
the latest 8-speed automatic transmission generation.
Common features are:

- Differential in front of the torque converter
- the 8 forward gears and the reverse gear are equipped with a
  Planetary gear set concept consisting of 4 planetary gear sets and 5 switching elements
- minimized drag losses, as three switching elements are closed in each gear
- Mechatronics for “shift-by-wire” with electro-hydraulic
  Parking lock
- 8 gears with a spread of 7 allow small gear jumps, a powerful starting ratio and
  at higher
  Speeds a low engine speed level
- ATF oil supply by means of a vane pump, driven
  from a chain
- Lubrication of the transfer case with oil pump
- Standstill decoupling when the vehicle is stationary and the engine is idling

0BK gearbox

0BL gearbox

Dimensions in comparison



457_004

457_002

457_003

Technical data

	0BK gearbox	0BL gearbox
Developer/Manufacturer	ZF Transmission GmbH Saarbrücken	
Designation in service	0BK	0BL
Designation at ZF 8HP-55AF		8HP-90AF
Designation at Audi AL551-8Q		AL951-8Q
Gearbox type	electro-hydraulically controlled 8-speed planetary gearbox with hydrodynamic Torque converter with slip-controlled torque converter lock-up clutch	
steering	• Mechatronics (integration of the hydraulic control unit and the electronic Control to one unit) • dynamic gearshift program with separate sports program “S” and gearshift program “tiptronic” for manual gear changes • Shift-by-wire operation with electro-hydraulic parking lock function	
design type	• Transmission for longitudinal installation and all-wheel drive • Axle drive/front axle in front of the torque converter	
Power distribution	Self-locking center differential with asymmetric-dynamic Moment distribution	
Weight including oil	141kg – 146kg1)	
Translation2)	1st gear: 4.71; 2nd gear: 3.14; 3rd gear: 2.11; 4th gear: 1.67; 5th gear: 1.29; 6th gear: 1.00; 7th gear: 0.84; 8th gear: 0.67; Reverse gear: 3.32	
Spread	7.03	7.03
maximum Torque	up to 700 Nm1)	up to 1000 Nm1)

1) depending on engine

2) The ratios of the individual gears are the same for all transmission variants. The adaptation to the characteristics and performance of the various engines is achieved by different ratios of the:

- Primary drive,
- the spur gear to the front axle and
- the front and rear axle drive.

Likewise, certain country-specific requirements influence the overall translation.

Depending on the engine and country, the top speed is reached in 6th or 7th gear. In the USA, where the maximum speed is limited to 210 km/h (Vmax), the Vmax can even be reached in 8th gear.

The gear to which the vehicle shifts up in S mode also depends on the engine and country. The sport program is usually programmed so that the vehicle only shifts up to the gear in which the maximum speed is reached the quickest. Different requirements apply in some countries.

Here is a small overview of the most important engine and country variants:

- With 3.0 TDI engine and 4.2 TDI engine, in gear S only up to the 7th gear engaged. Vmax in 7th gear
- With 4.2 FSI engine (all countries except USA) in gear S only up to 6th gear is engaged. Vmax in 6th gear or under certain circumstances in 7th gear. In the USA, when the vehicle is at full throttle and Vmax is reached, the vehicle is shifted to 8th gear (gear position D or S). With kick-down in gear position D or S, 6th gear remains engaged when Vmax is reached.
- With 3.0 TFSI engine (all countries except USA and Korea), gear shifting in S mode is only possible up to 7th gear (in USA and Korea up to 8th gear)
- With 6.3 FSI engine (all countries except USA) in gear S only up to switched to 7th gear. Vmax in 7th gear
  In the USA, when the vehicle is at full load and the top speed is reached, the vehicle shifts up to 8th gear (gear position D or S).
  With kick-down in gear D or S, the Vmax remains the same when the 6th gear engaged.

The gearboxes 0BK and 0BL are hardly distinguishable from the outside.

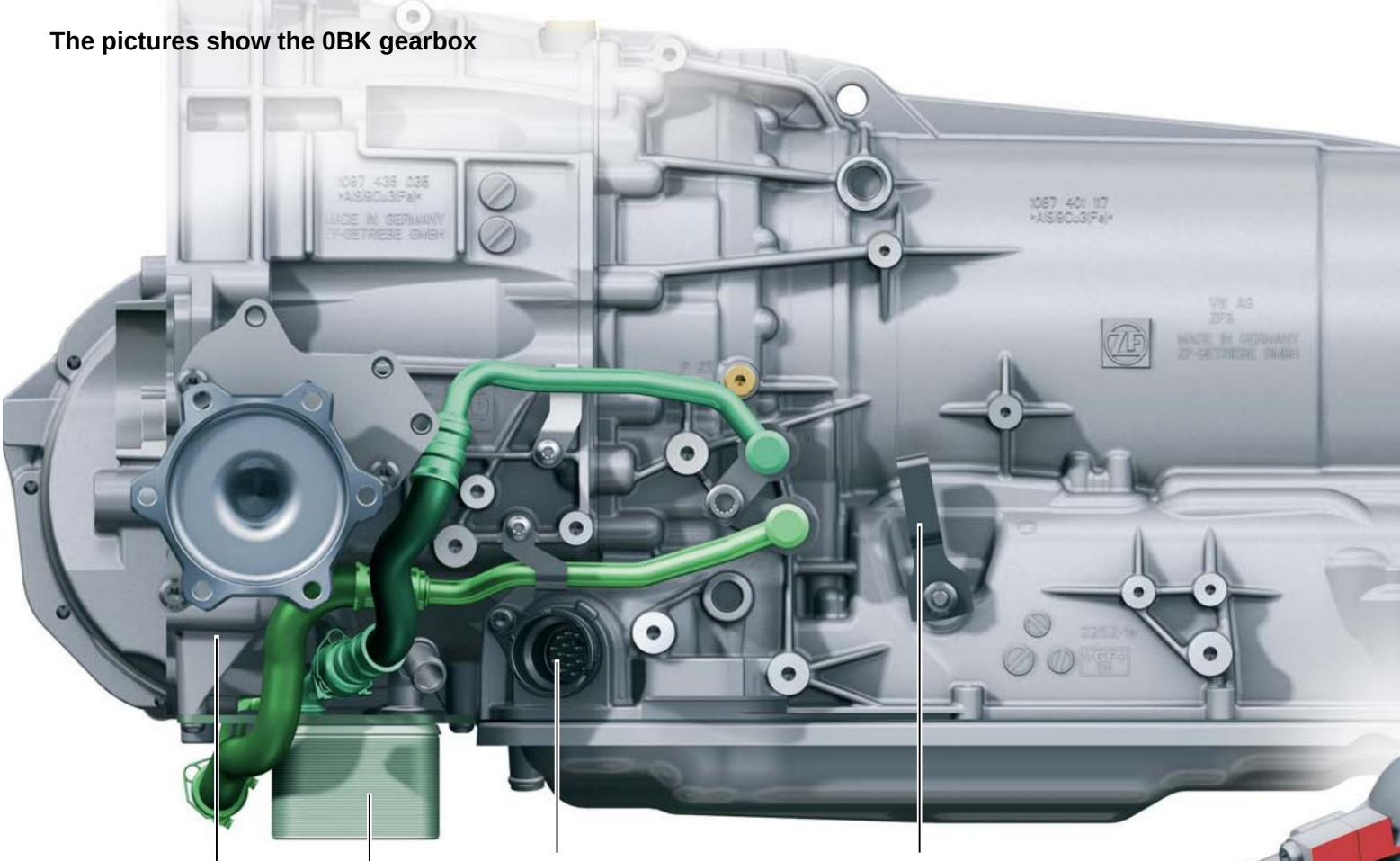
Due to the design of the 0BL gearbox for a torque of up to 1000 Nm, most of the components of the

0BL gearbox is dimensioned accordingly larger.

This also applies to the external dimensions of the gearbox, which is shown in Figure 457_004 on page 20.

Special features and similarities at a glance

The pictures show the 0BK gearbox

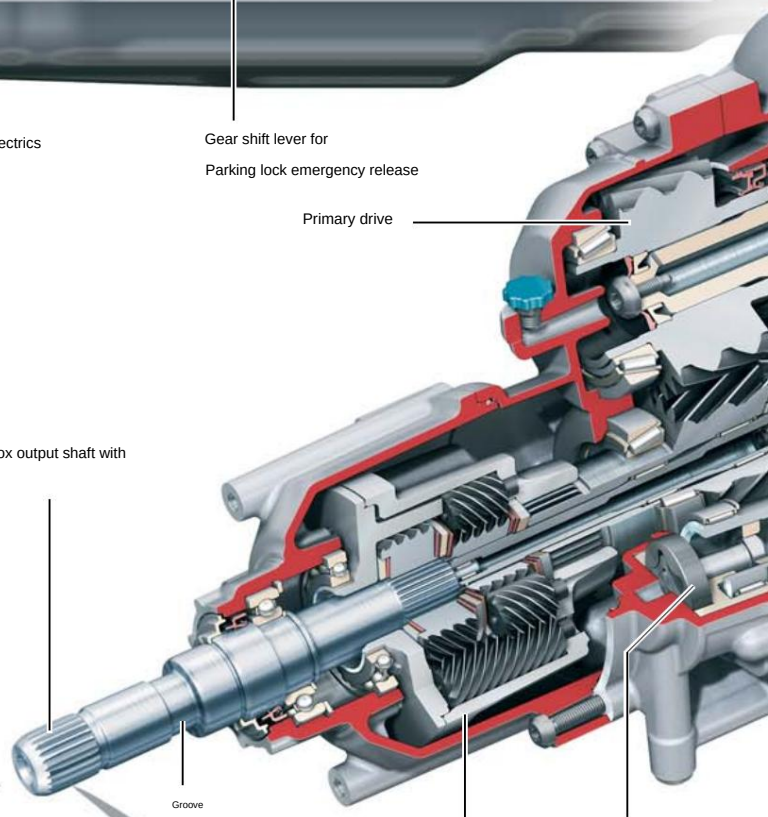


Plug connection to the vehicle electrics

Gear shift lever for
Parking lock emergency release

ATF cooler (heat exchanger) mounted
on the gearbox

The type plate is located under the
Flange shaft (visible from below)



Primary drive

Gearbox output shaft with
spline

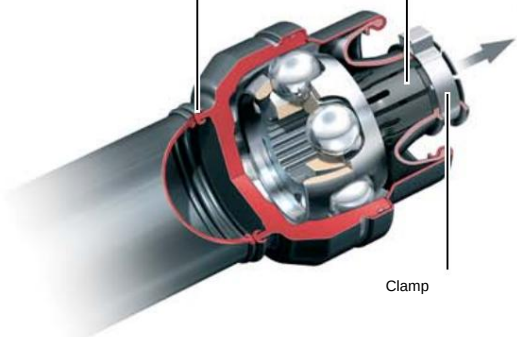
plugged cardan shaft

Spring sleeve

Groove

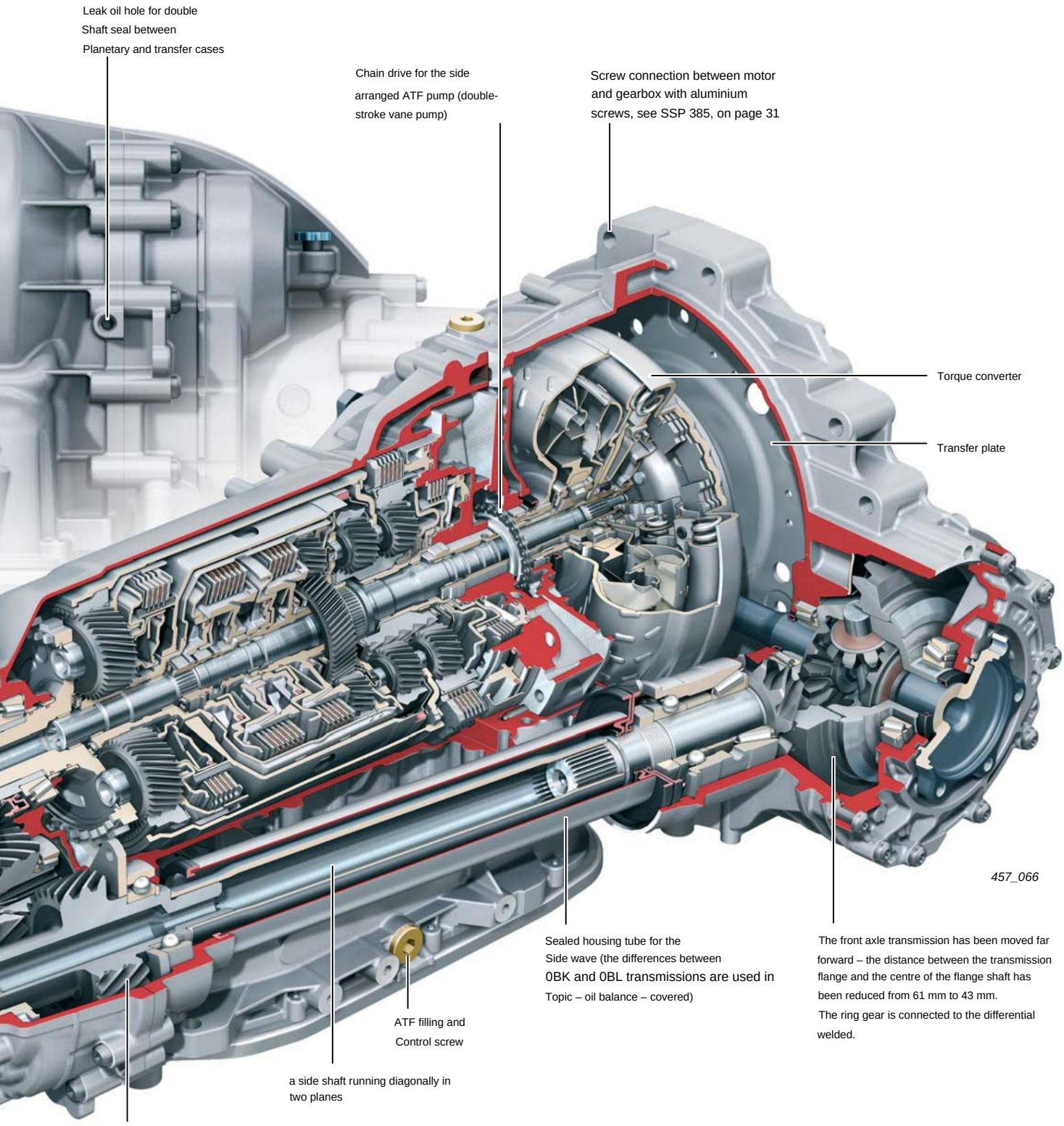
Center differential

Oil pump for transfer case,
see page 37



Clamp

The joint is part of the cardan shaft and can
cannot be replaced separately. The rubber sleeve can be replaced
using a special tool.



Plugged cardan shaft

A new, innovative connection for the cardan shaft is used for the first time. The cardan shaft is plugged onto the gearbox output shaft and locked into a groove using a spring sleeve. The axial securing of the connection is ensured by the clamping force of the clamp. The new plug connection achieves a weight reduction of 0.6 kg. The new plug connection will gradually be adopted for all gearboxes as further development progresses.

Center differential

The 0BK/0BL transmission uses a self-locking center differential with asymmetrical-dynamic torque distribution. The design and function are comparable to the version installed in the 0B2 and 0B5 transmissions, see SSP 429 from page 22.

One innovation is the wheel-selective torque control, see page 66.

Torque converter

The parameters (e.g. dimensions and conversion factor) of the torque converter and the converter clutch are adapted to the respective engine. In order to effectively dampen the torsional vibrations of the engine, different torsional damper systems are used depending on the engine. Turbine torsional dampers (in all engines except 3.0 V6 TDI) and two-damper converters (ZDW, only 3.0l V6 TDI engine) are used.

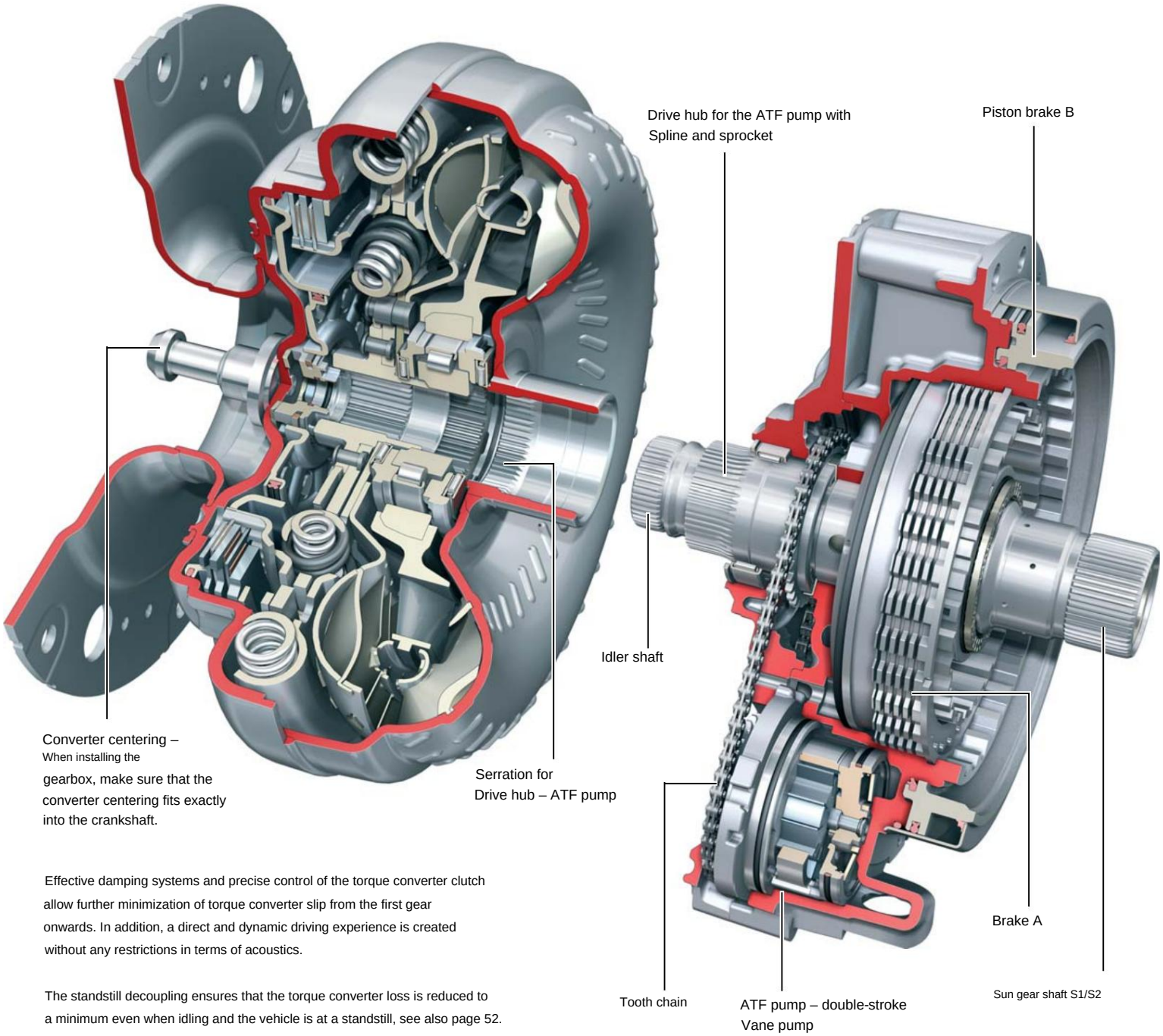
For more information about torque converters, see SSP 283 and 385.

The torque converters on 0BK and 0BL transmissions are so-called "three-line converter". This means that the turbine chamber is supplied via two lines and the converter clutch is controlled via a separate line (third line). The converter clutch is closed and opened independently and decoupled from the turbine chamber.

This design brings advantages in the control of the converter clutch.

The pressure of the converter clutch is controlled via the pressure control valve 6 N371 (see page 43) and the associated hydraulic control valves.

The figure shows a two-damper converter (ZDW).



Effective damping systems and precise control of the torque converter clutch allow further minimization of torque converter slip from the first gear onwards. In addition, a direct and dynamic driving experience is created without any restrictions in terms of acoustics.

The standstill decoupling ensures that the torque converter loss is reduced to a minimum even when idling and the vehicle is at a standstill, see also page 52.

These measures have resulted in a significant reduction in fuel consumption compared to the previous 6-speed transmissions.

ATF supply/ATF pump

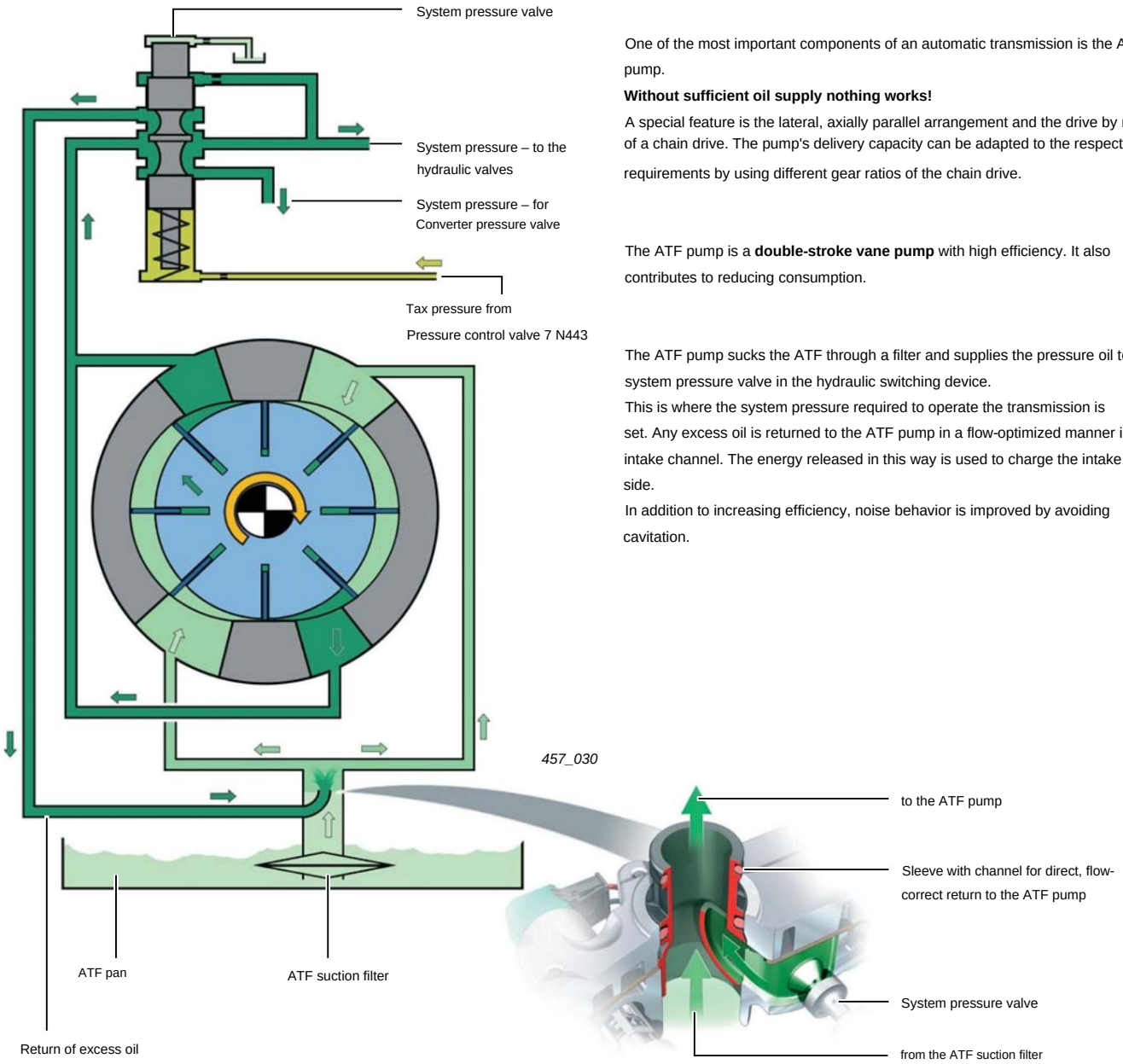
One of the most important components of an automatic transmission is the ATF pump.

Without sufficient oil supply nothing works!

A special feature is the lateral, axially parallel arrangement and the drive by means of a chain drive. The pump's delivery capacity can be adapted to the respective requirements by using different gear ratios of the chain drive.

The ATF pump is a **double-stroke vane pump** with high efficiency. It also contributes to reducing consumption.

The ATF pump sucks the ATF through a filter and supplies the pressure oil to the system pressure valve in the hydraulic switching device.
This is where the system pressure required to operate the transmission is set. Any excess oil is returned to the ATF pump in a flow-optimized manner into the intake channel. The energy released in this way is used to charge the intake side.
In addition to increasing efficiency, noise behavior is improved by avoiding cavitation.



ATF (Automatic Transmission Fluid)

The ATF is a “high-tech product”! The high requirements regarding shifting quality, functional reliability and freedom from maintenance (lifetime filling) place the highest demands on the ATF.
The ATF has a decisive influence on the friction coefficient of the clutches and brakes. This is why the ATF is already developed during the design and testing phase.

Always make sure that the correct ATF is used and ensure the necessary cleanliness and purity!

The ATF pump is mounted in the gearbox as an assembly, the so-called “oil supply”. The assembly includes:

- Pump housing
- ATF pump drive hub
- Chain drive of the ATF pump
- ATF pump
- Brake housing A
- Brake A
- Pistons and piston chambers of brake B
- Idler shaft (fixed)

Another new feature is the power transmission from the converter housing to the drive hub of the ATF pump via a spline. Here too, when installing the converter, it is important to ensure that the converter and the drive hub are fully fitted together.

Attention: When installing the converter, be sure to pay attention to the installation dimensions!

Planetary gear

The 8 forward gears and the reverse gear are generated by a corresponding connection of four simple single-web planetary gear sets. The two front gear sets have a common sun gear. The output always occurs via the planet carrier of the 4th gear set.

Switching elements

Only 5 switching elements switch 8 gears!

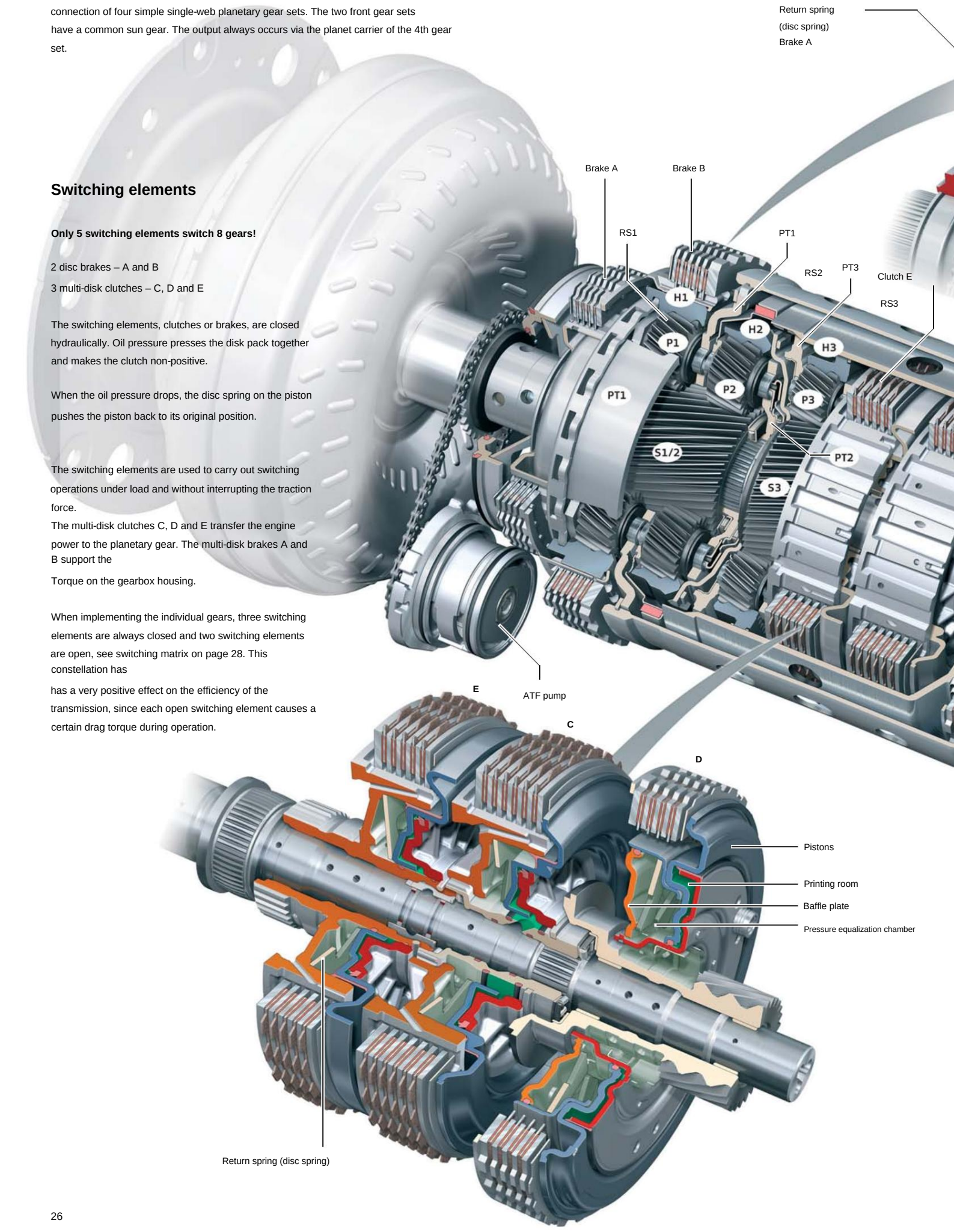
2 disc brakes – A and B
3 multi-disk clutches – C, D and E

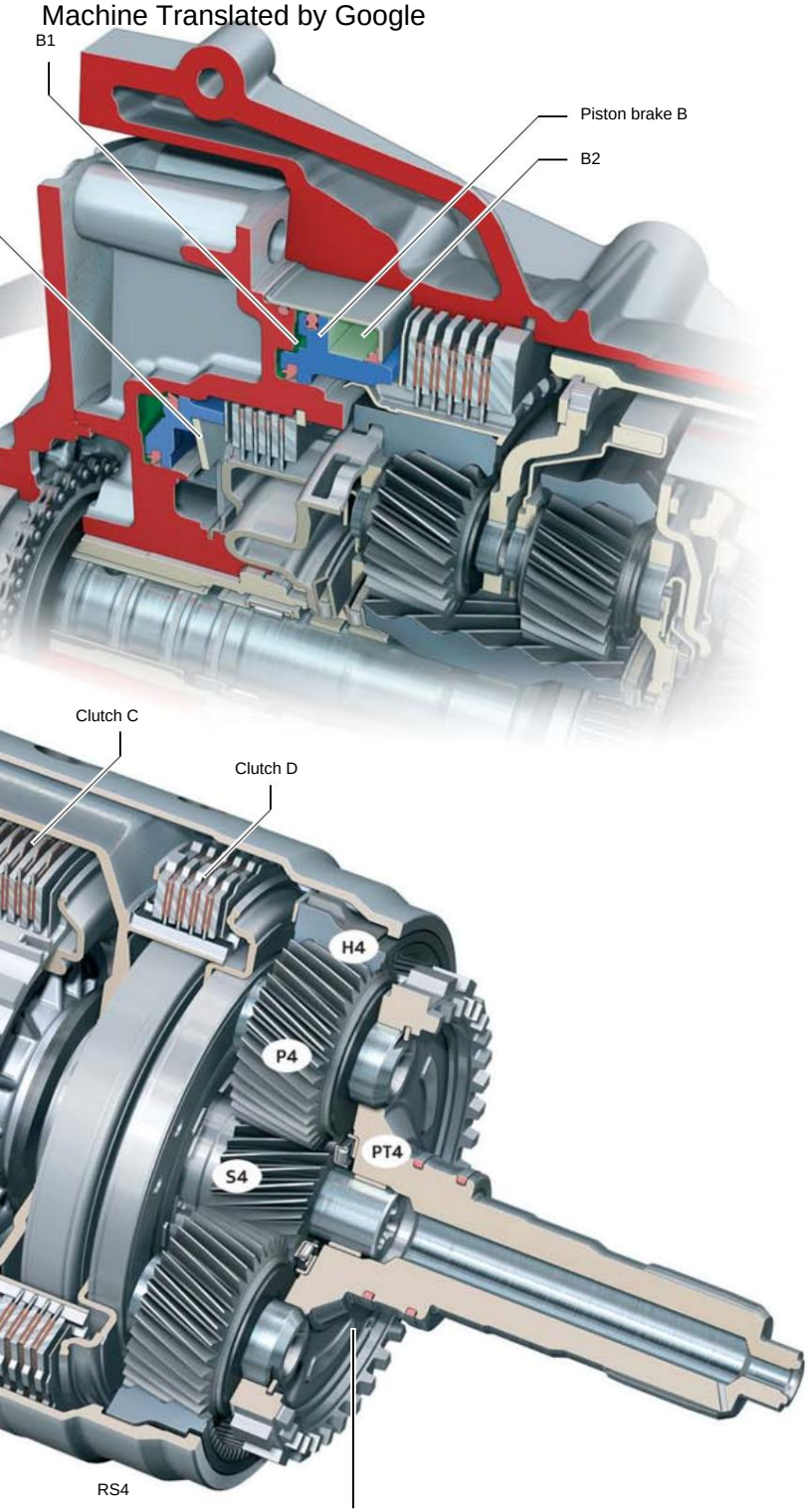
The switching elements, clutches or brakes, are closed hydraulically. Oil pressure presses the disk pack together and makes the clutch non-positive.

When the oil pressure drops, the disc spring on the piston pushes the piston back to its original position.

The switching elements are used to carry out switching operations under load and without interrupting the traction force.
The multi-disk clutches C, D and E transfer the engine power to the planetary gear. The multi-disk brakes A and B support the
Torque on the gearbox housing.

When implementing the individual gears, three switching elements are always closed and two switching elements are open, see switching matrix on page 28. This constellation has
has a very positive effect on the efficiency of the transmission, since each open switching element causes a certain drag torque during operation.





The planet carrier PT4 also forms the
Transmission output shaft, the parking lock gear and the sensor wheel for the transmission sensor
output speed G195

457_032

To provide a clearer representation of the shifting elements and the planetary gear sets, some parts are not shown (e.g. the outer disk carriers of the shifting elements).

Brakes

Brake B has a special design. The piston

Brake B has no return spring. This task is performed by a second piston chamber, piston chamber B2.

The brake B has a piston chamber (cylinder) on both sides, piston chamber B1 and piston chamber B2.

The piston chamber B1 is used to close the brake and the

Piston chamber B2 takes on the role of a return spring (opening the brake). The control of brake B is designed in such a way that when the brake is vented in piston chamber B2, a residual oil pressure

remains, which pushes the piston back to its rest position.

Brake B is operated with slip when the vehicle is stationary, see page 52. Brake B has been dimensioned accordingly so that it can withstand the demands of stationary operation over the long term. In addition, it is specifically cooled when activated via the hydraulic switching device.

Brake A is equipped with a return spring.

Legend of the planetary gear	
RS1 (2, 3, 4)	Planetary gear set 1 (2, 3, 4)
PT1 (2, 3, 4)	Planetary gear carrier 1 (2, 3, 4)
S1 (2, 3, 4)	Sun gear of planetary gear set 1 (2, 3, 4)
P1 (2, 3, 4)	Planetary gears from planetary gear set 1 (2, 3, 4)
H1 (2, 3, 4)	Ring gear of planetary gear set 1 (2, 3, 4)

Couplings

The clutches E, C and D are balanced in terms of dynamic pressure. This means that in order to avoid a speed-dependent pressure build-up in the clutch, the clutch piston is pressurized with oil on both sides. This balancing is achieved by a second piston chamber, the pressure compensation chamber.

In clutch D, the pressure equalization chamber is created by means of a baffle plate, in clutches C and E the plate carrier forms the partition. The oil supply to the pressure equalization chamber is pressure-free via lubrication channels.

Advantages of dynamic pressure equalization are:

- safe opening and closing of the clutch in all Speed ranges
- improved shifting comfort

reference

The function of the switching elements and the dynamic pressure compensation is described in detail in SSP 283 and SSP 367.

Circuit diagram/circuit matrix

All circuits from 1 > 8 and from 8 > 1 are overlapping
Circuits, i.e. during a circuit the one
Clutch must remain capable of transmitting with a reduced main pressure until the corresponding other clutch can take over the torque, see SSP 283,

Page 52.

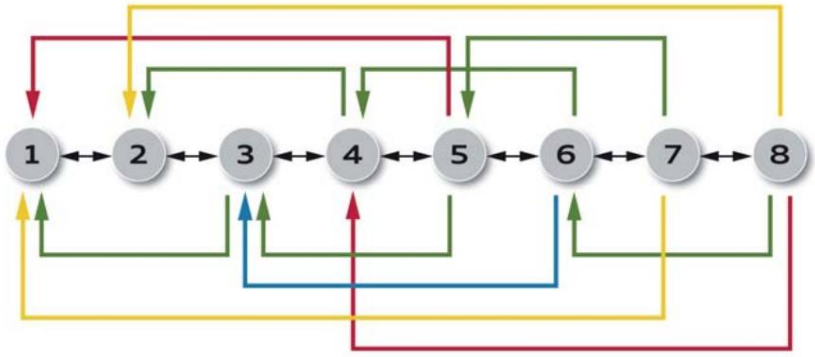
For gear shifts that are not or cannot be carried out directly (e.g. 7 > 3), the larger gear steps (direct shift) are always carried out first and then the simple downshift(s), see examples.

Circuit diagram

(possible direct connections)

Note on the examples:
The circuit diagram shows the technically feasible switching options.
yellow 6-speed step (direct shift) red 4-speed step (direct shift) 3-speed step (direct shift) 2-speed step (direct shift)
blue
green

In examples 1 and 2, the variations that are not currently used are highlighted in gray.



457_053

Example 1: Circuit 8 > 2:
- 8-7-6-5-4-3-2
- 8-6-5-4-3-2
- 8-4-3-2
- 8-4-2
- 8-2

Example 2: Circuit 7 > 3:
- 7-6-5-4-3
- 7-5-4-3
- 7-6-3
- 7-5-3

Example 3: Circuit 6 > 3:
- 6-5-4-3
- 6-4-3
- 6-3

Switch matrix

	Switching elements/pressure control valves/solenoid valves							
	A EDS-A N215	B EDS B N216	C EDS-C N217	D EDS-D N218	E EDS-E N233	MV Pos N510	EDS-Sys N443	EDS-WK N371
Parking lock	1	1	1	0	0	0	X	0
Neutral	1	1	1	0	0	1	X	0
R-gear	1	1	1	1	0	1	X	0
1st gear	1	1[1)]	0	0	0	1	X	X
2nd gear	1	1	1	0	1	1	X	X
3rd gear	0	1	0	0	1	1	X	X
4th gear	0	1	1	1	1	1	X	X
5th gear	0	1	0	1	0	1	X	X
6th gear	0	0	0	1	1	1	X	X
7th gear	1	0	0	1	0	1	X	X
8th gear	1	0	1	1	1	1	X	X

457_054

Clutch closed

Brake closed

Pressure control valves/solenoid valve

1 active
0 not active (a low base Control current is always present) active –
X control current depends on the Operating status

1) During standstill decoupling operation, brake B is open except for a small residual torque, see page 52.

EDS Electric pressure control valve (pressure control valve)
MV solenoid valve

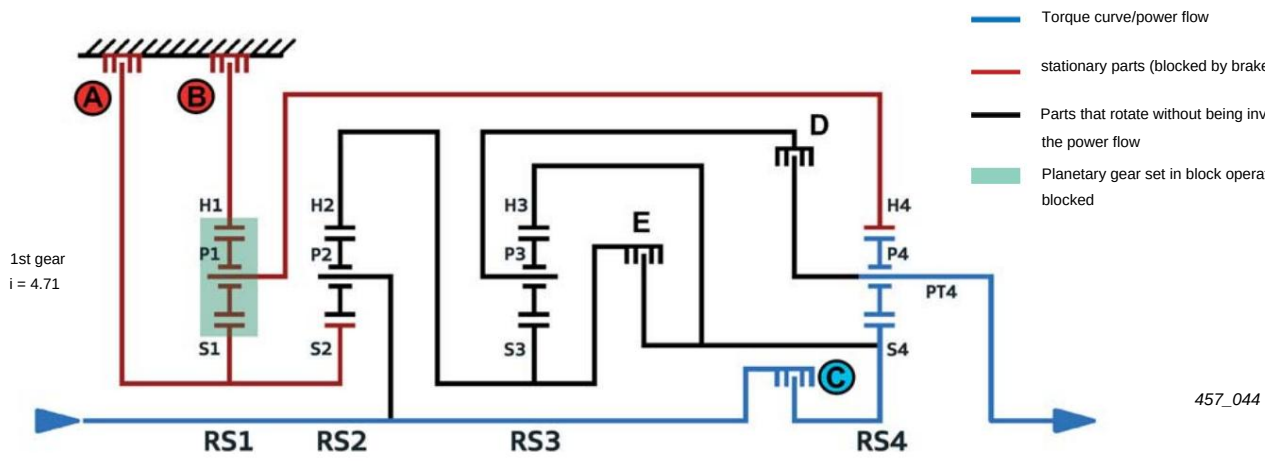
For further information please visit
Topic: Mechatronics on page 42.

Legend for planetary gear – gear description/torque curve (see also picture on page 26)	
RS1 (2, 3, 4)	Planetary gear set 1 (2, 3, 4)
PT1 (2, 3, 4)	Planetary gear carrier 1 (2, 3, 4)
S1 (2, 3, 4)	Sun gear of planetary gear set 1 (2, 3, 4)
P1 (2, 3, 4)	Planetary gears from planetary gear set 1 (2, 3, 4)
H1 (2, 3, 4)	Ring gear of planetary gear set 1 (2, 3, 4)

reference

Further explanations of the schematic representation of the planetary gear and the torque curve can be found in Self-Study Programme 283 on page 55.

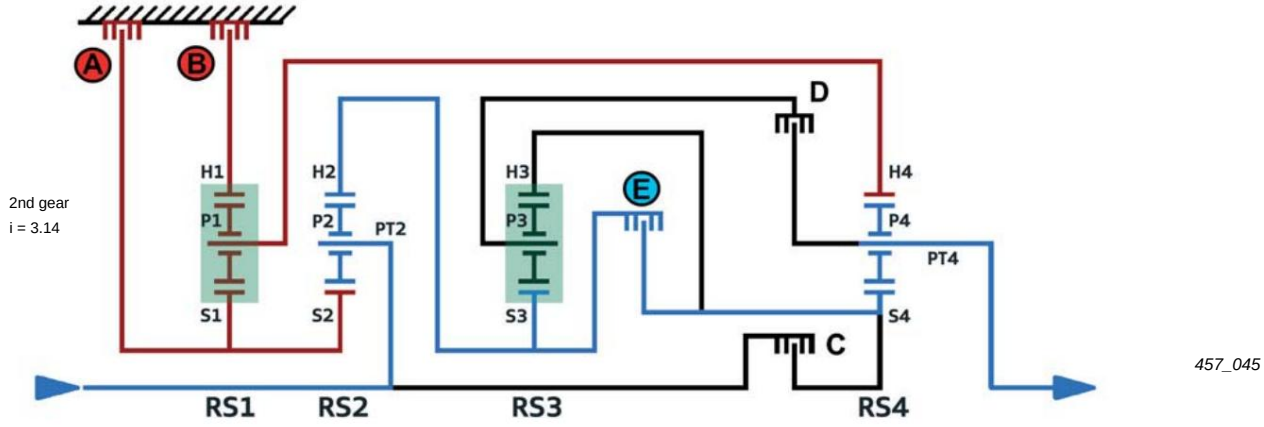
Gear description – torque curve



457_044

Power flow in 1st gear – activated switching elements: A, B, C

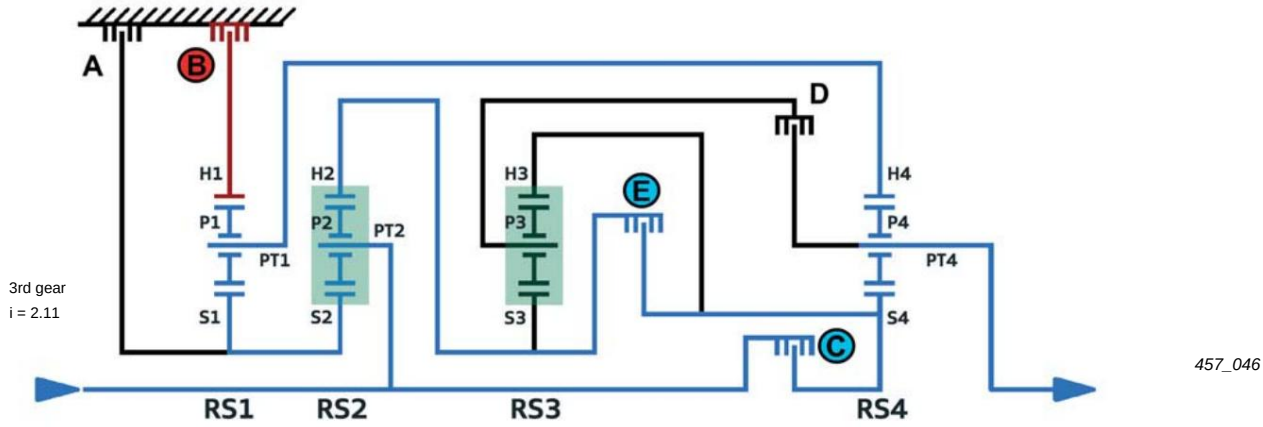
turbine shaft > clutch C > S4 > P4 > PT4 (> output shaft > transfer case ...)



457_045

Power flow in 2nd gear – activated switching elements: A, B, E

turbine shaft > PT2 > P2 > H2 > clutch E > S4 > P4 > PT4 (> output shaft > transfer case ...)



457_046

Power flow in 3rd gear – activated switching elements: B, E, C 1.

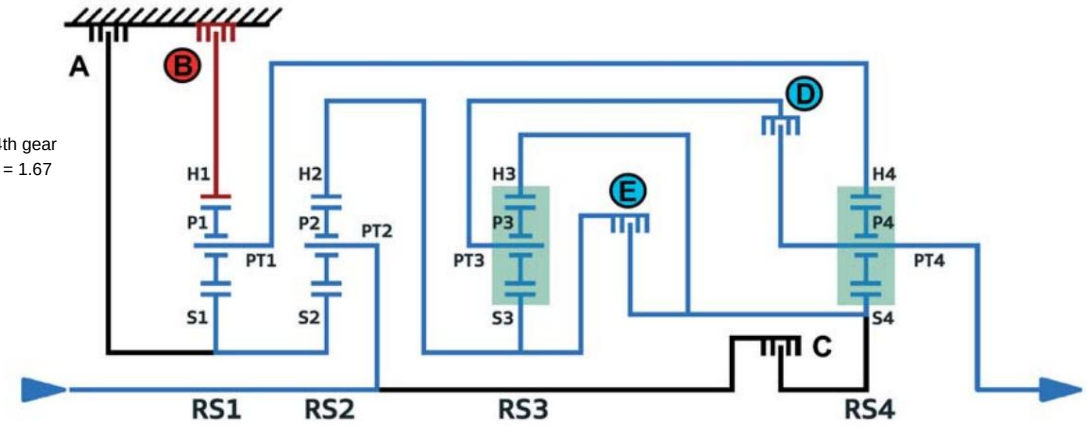
Turbine shaft > clutch C > S4 > P4 > PT4 (> output shaft > transfer case ...)

2. Clutch C > Clutch E > H2 > P2 (RS2 is in block operation because H2 and PT2 are connected via clutch C and E)

3. Turbine shaft > PT2 > S2 (PT2 block operation) > S1 > P1 > PT1 > H4

The connection of PT1 to H4 causes a corresponding gear ratio in the RS4 (compare with power flow in 1st gear)

4th gear
i = 1.67

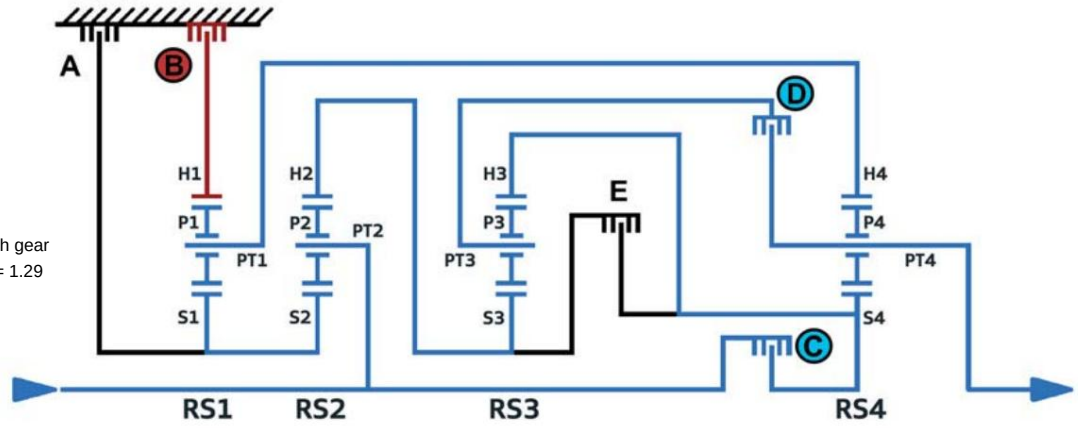


457_047

Power flow in 4th gear – activated shift elements: B, E, D

1. Clutch E causes block operation in RS3, and clutch D and the block operation of RS3 cause block operation in RS4 (wheel sets 3 and 4 rotate at the same speed = output speed)
2. Turbine shaft > PT2 > P2 > S2/S1 > P1 > PT1 > H4 > P4 > PT4 (= output shaft > transfer case …)

5th gear
i = 1.29

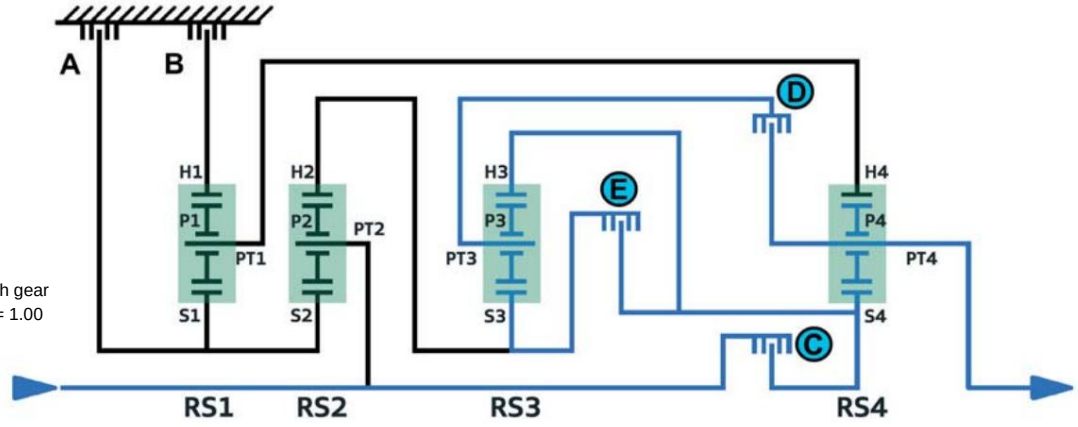


457_048

Power flow in 5th gear – activated switching elements:

B, C, D 1. Turbine shaft > clutch C > S4 + H3 (PT2, H2 and S4 = turbine speed)
2. The clutch D connects the PT3 with the PT4 (= output shaft)
3. Turbine shaft > PT2 > P2 > S2/S1 > P1 > PT1 > H4 > this results in a speed ratio between S4 (= turbine speed) and H4 with corresponding speed on PT4 (= output shaft > transfer case …)

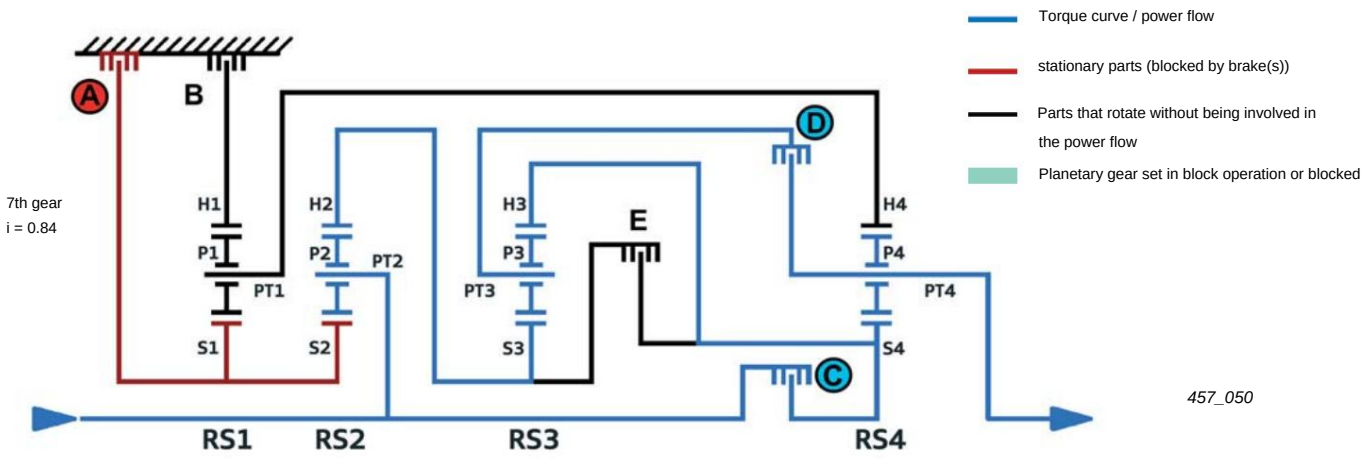
6th gear
i = 1.00



457_049

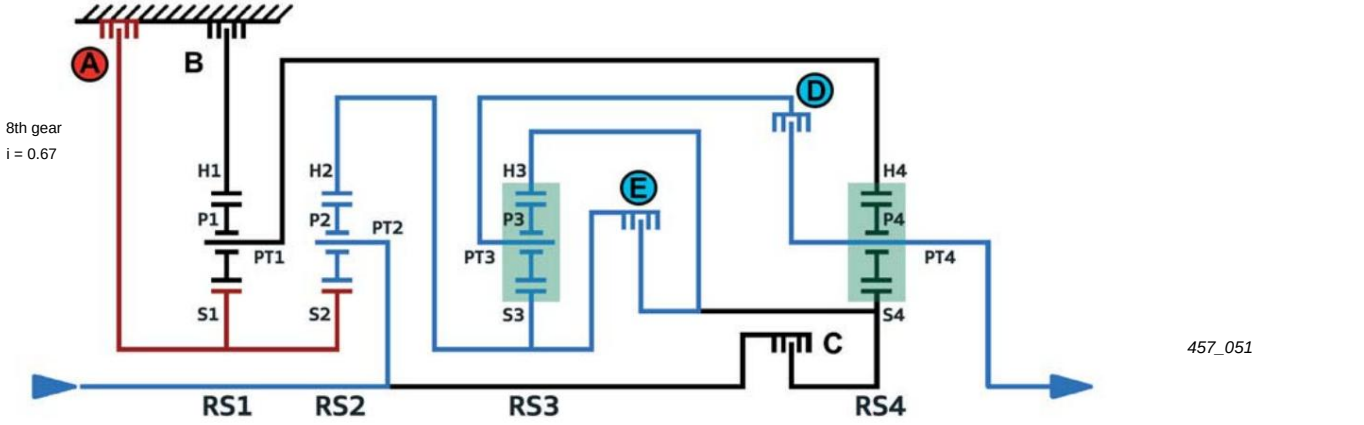
Power flow in 6th gear – activated shift elements: C, D, E

The clutches E and D enable block operation in the RS3 and RS4.
The torque is introduced into the planetary gear via clutch C.
The entire planetary gear rotates at turbine speed (block operation).



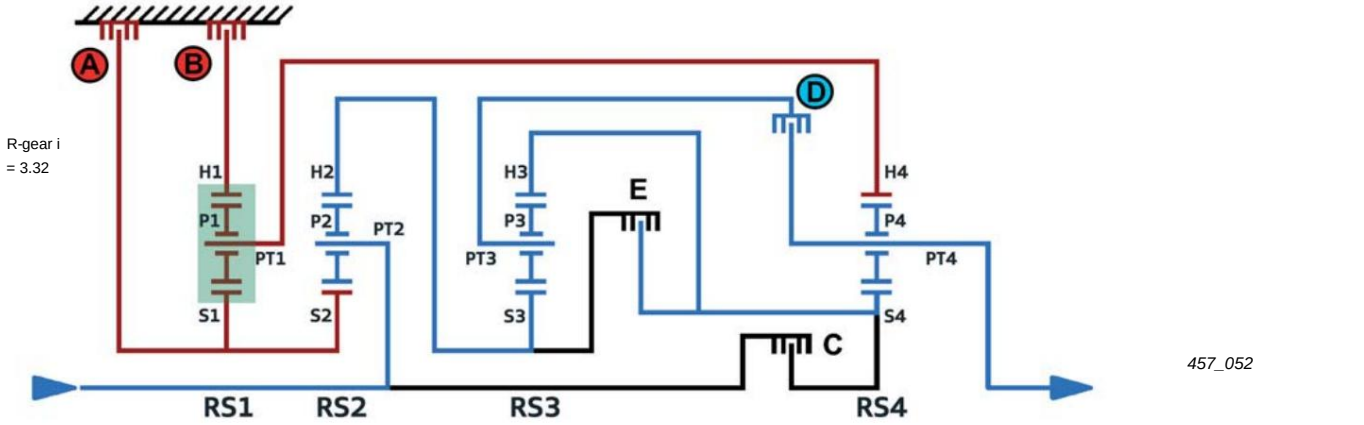
457_050

Power flow in 7th gear – activated switching elements: A,
C, D 1. Turbine shaft > clutch C > S4 + H3 (= turbine speed)
2. Turbine shaft > PT2 > P2 > H2 > S3 > P3 > PT3 > clutch D > PT4 (= output shaft > transfer case …}
The clutch D connects the PT3 with the PT4 (= output shaft)



457_051

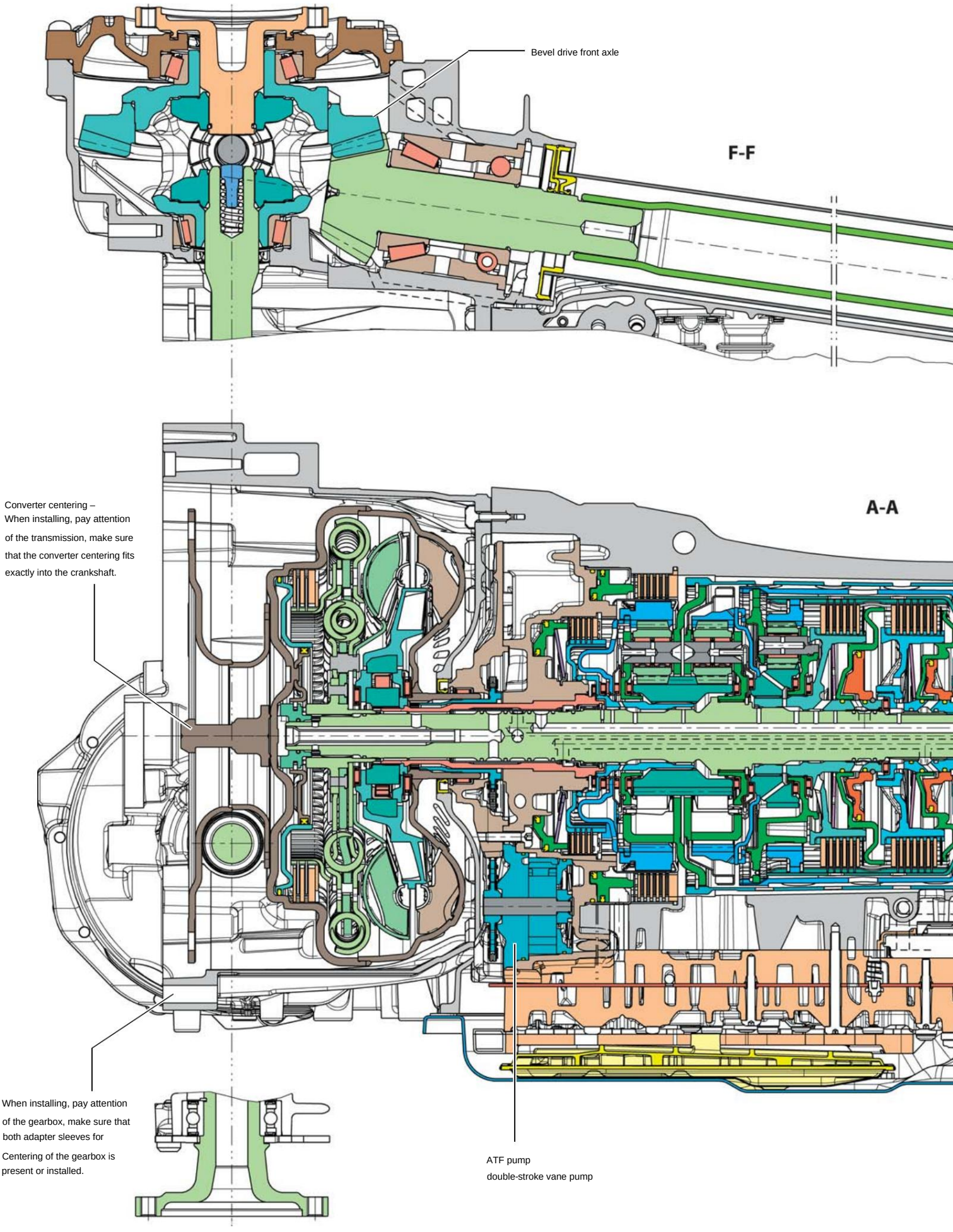
Power flow in 8th gear – activated switching elements: A,
E, D 1. Clutch E causes the RS3 to operate in block
mode 2. Turbine shaft > PT2 > P2 > H2 > RS3 (block mode) > clutch D > PT4 (= output shaft > transfer case …)
The clutch D connects the PT3 with the PT4 (= output shaft)

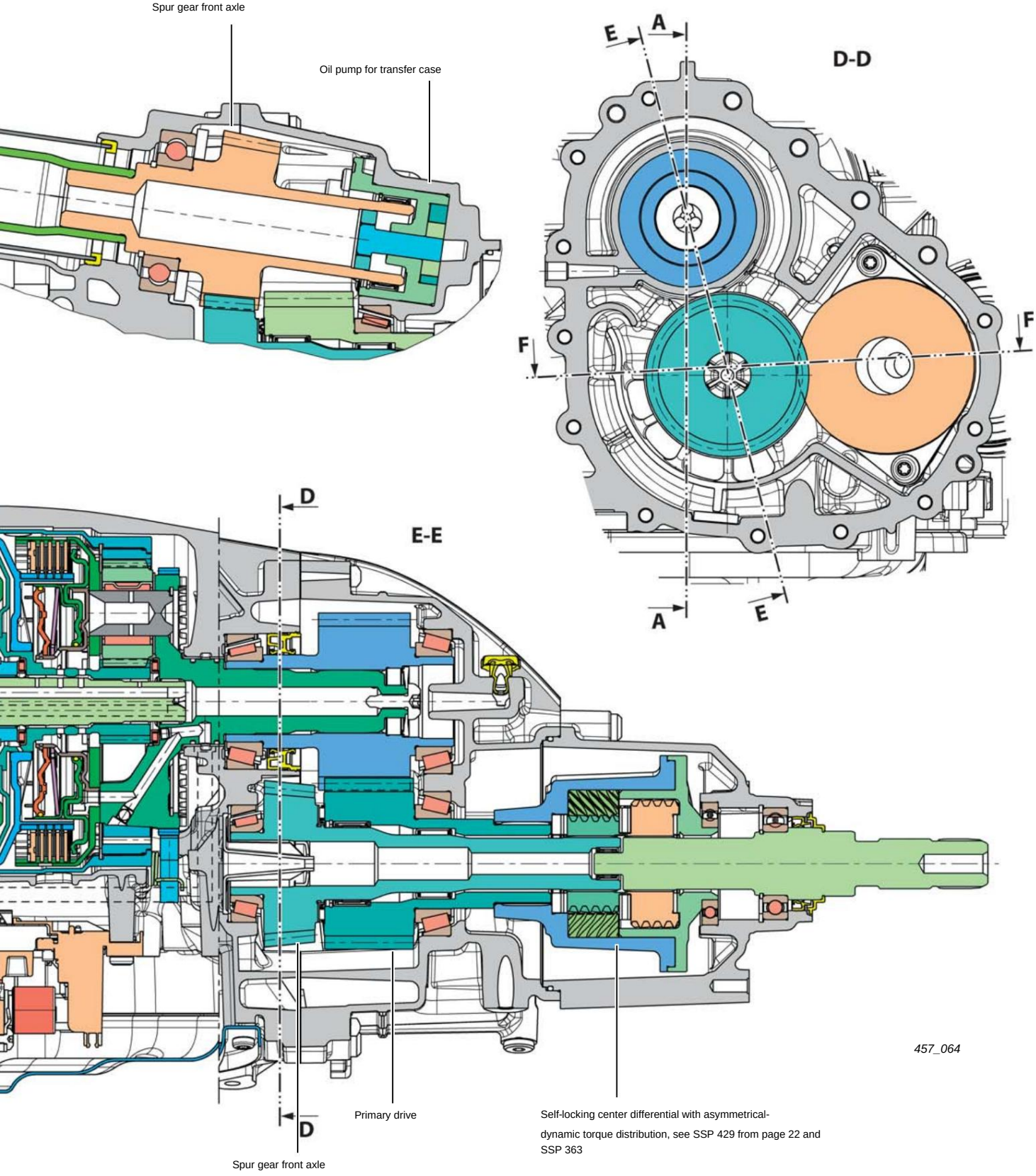


457_052

Power flow in reverse gear – activated switching elements:
A, B, D 1. The clutch D connects the PT3 with the PT4 (= output shaft)
2. Turbine shaft > PT2 > P2 > H2 > S3 > P3 > PT3 > clutch D > PT4 (= output shaft > transfer case ...)
The H3 is firmly connected to the S4. The S4 drives the P4 against the direction of motor rotation.
The P4 rolls on the fixed H4 and rotates the PT4 with the specified gear ratio against the direction of engine rotation.

Gearbox section 0BK gearbox





Oil supply/lubrication/sealing in the 0BK gearbox

With the 0BK transmission, there are two oil supply systems
Variants:

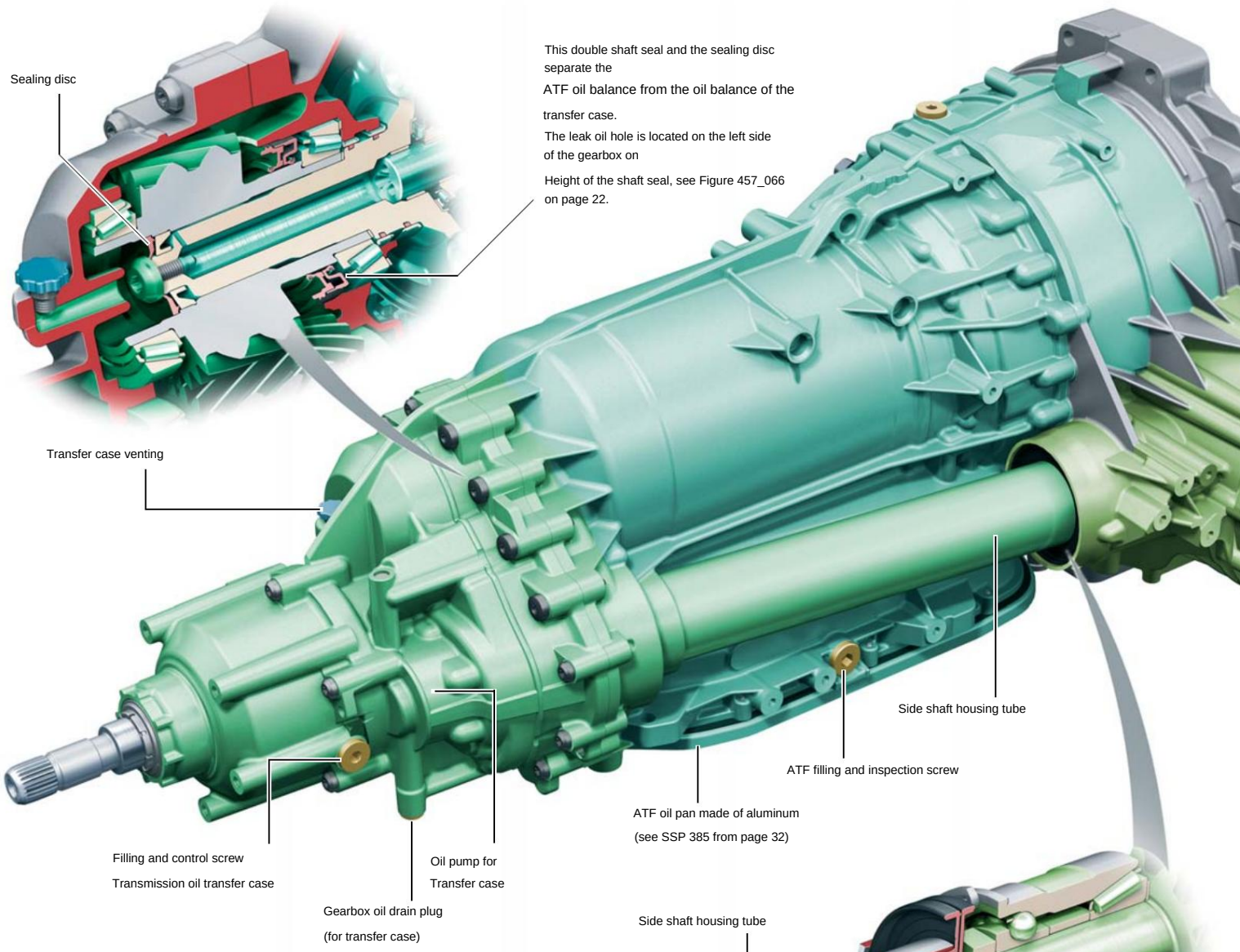
1. Separate oil budgets

The oil chambers (oil reservoirs) of the transfer case and front axle transmission are separate. The transmission has a total of three separate oil reservoirs (oil chambers) with different types of oil:

ATF oil supply for the planetary gear, hydraulic control and torque converter

Oil supply for the transfer case (gearbox oil with STURACO1))

Oil supply for the front axle drive (gearbox oil without STURACO1))

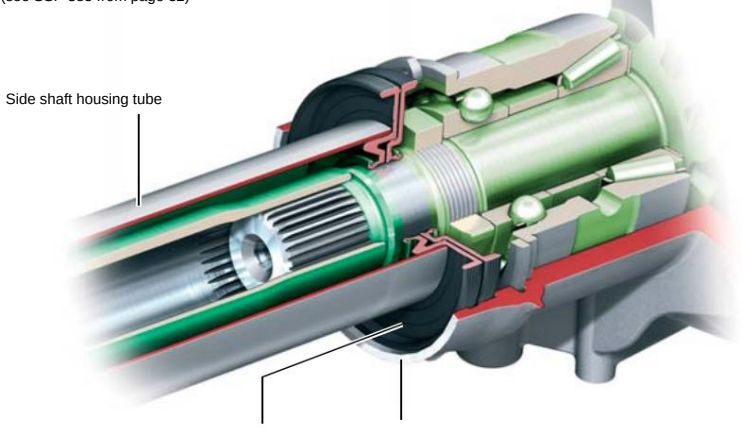


The oil supply in the ATF oil system is ensured by a highly efficient vane pump, see the topic ATF pump on page 25.

The oil pump for transfer cases ensures targeted and reliable lubrication of all bearings and gears in the transfer case. This design enables highly efficient lubrication with a minimum oil level. Splash losses are significantly reduced and foaming of the

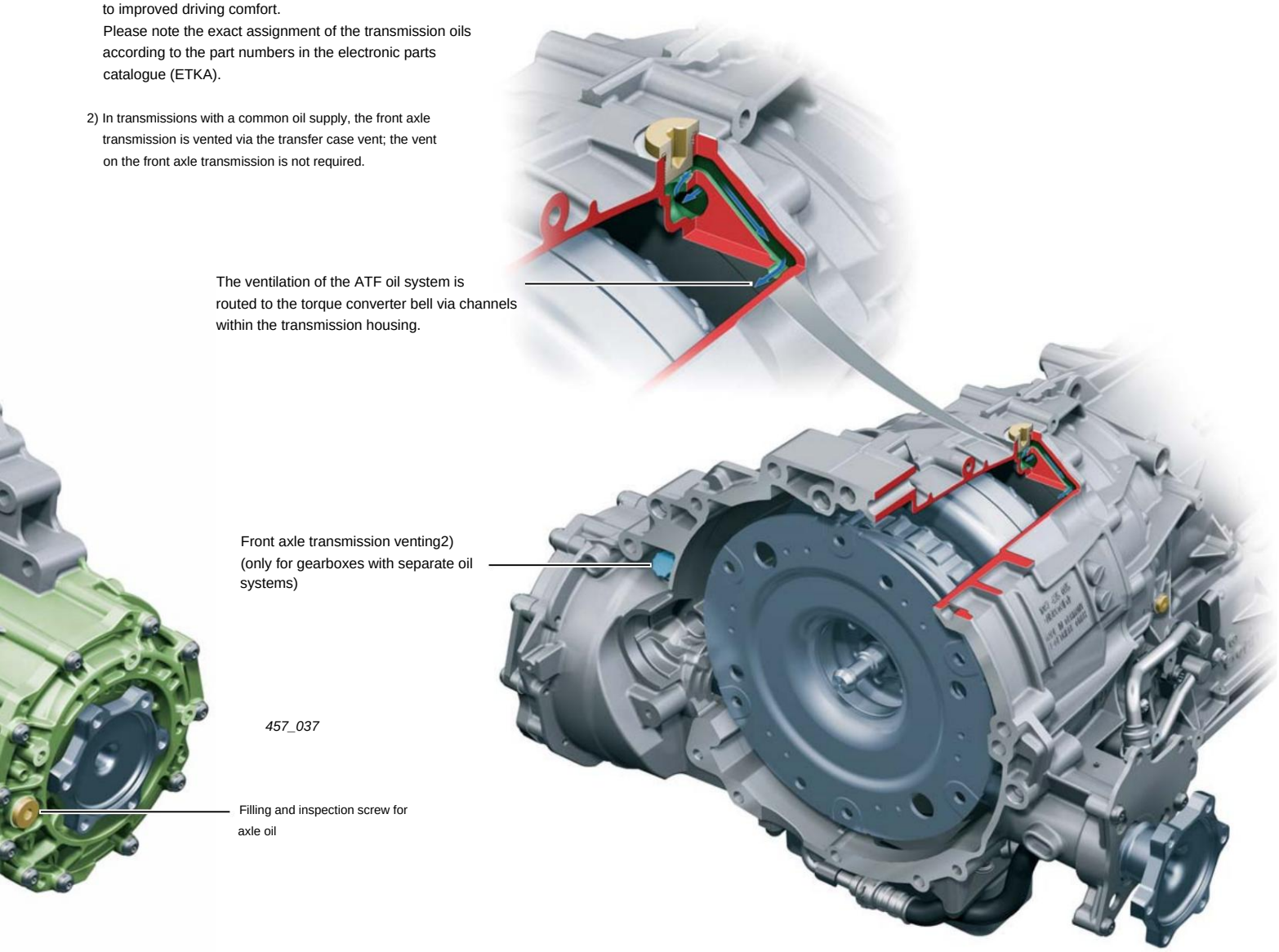
Oil is minimized.

This design was first used in the 09E gearbox and differs only slightly in the 0BK gearbox. The functionality is described in more detail in SSP 283 from page 70.



1) STURACO is an oil additive that prevents excessive
Reduces tension in the center differential, thus contributing to improved driving comfort.
Please note the exact assignment of the transmission oils according to the part numbers in the electronic parts catalogue (ETKA).

2) In transmissions with a common oil supply, the front axle transmission is vented via the transfer case vent; the vent on the front axle transmission is not required.



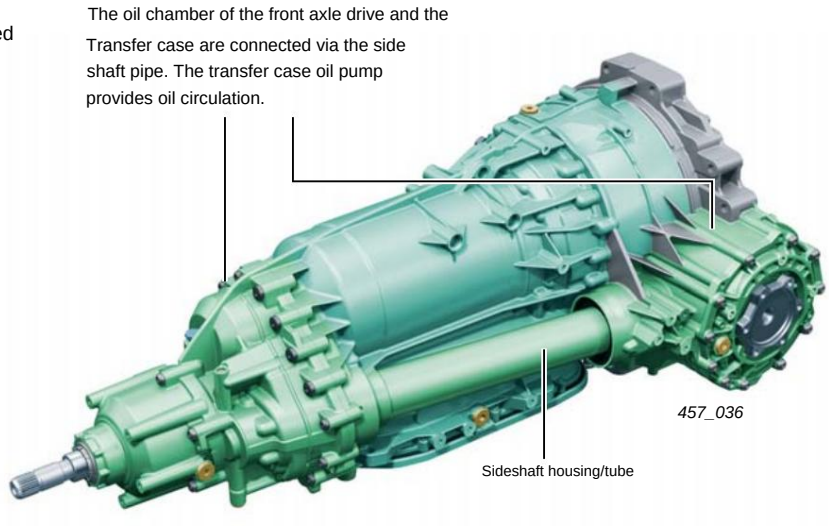
2. Common oil budget

To improve cooling of the front axle transmission, the oil chambers (oil systems) of the transfer case and front axle transmission are connected and form a common oil system. The transmission has a total of two oil systems with two different types of oil:

- ATF oil supply for the planetary gear, the hydraulic control and the torque converter
- An oil supply for the transfer case and the Front axle transmission (gearbox oil with STURACO1))

The 0BK transmission with a shared oil supply is only used in conjunction with very powerful engines (4.0 V8 TFSI and 6.3 W12 FSI).

If required (depending on performance and country), these transmissions can also be equipped with a transmission oil cooler be equipped.



Further information and advice on shared oil management can be found on page 36.

Oil supply/lubrication/sealing in the 0BL gearbox

The 0BL transmission basically has only two oil systems, one oil system with ATF and one oil system with transmission oil (axle oil).

ATF oil supply for the planetary gear, hydraulic control and torque converter

Gear oil supply for the transfer case and the front axle transmission (gear oil with STURACO1))

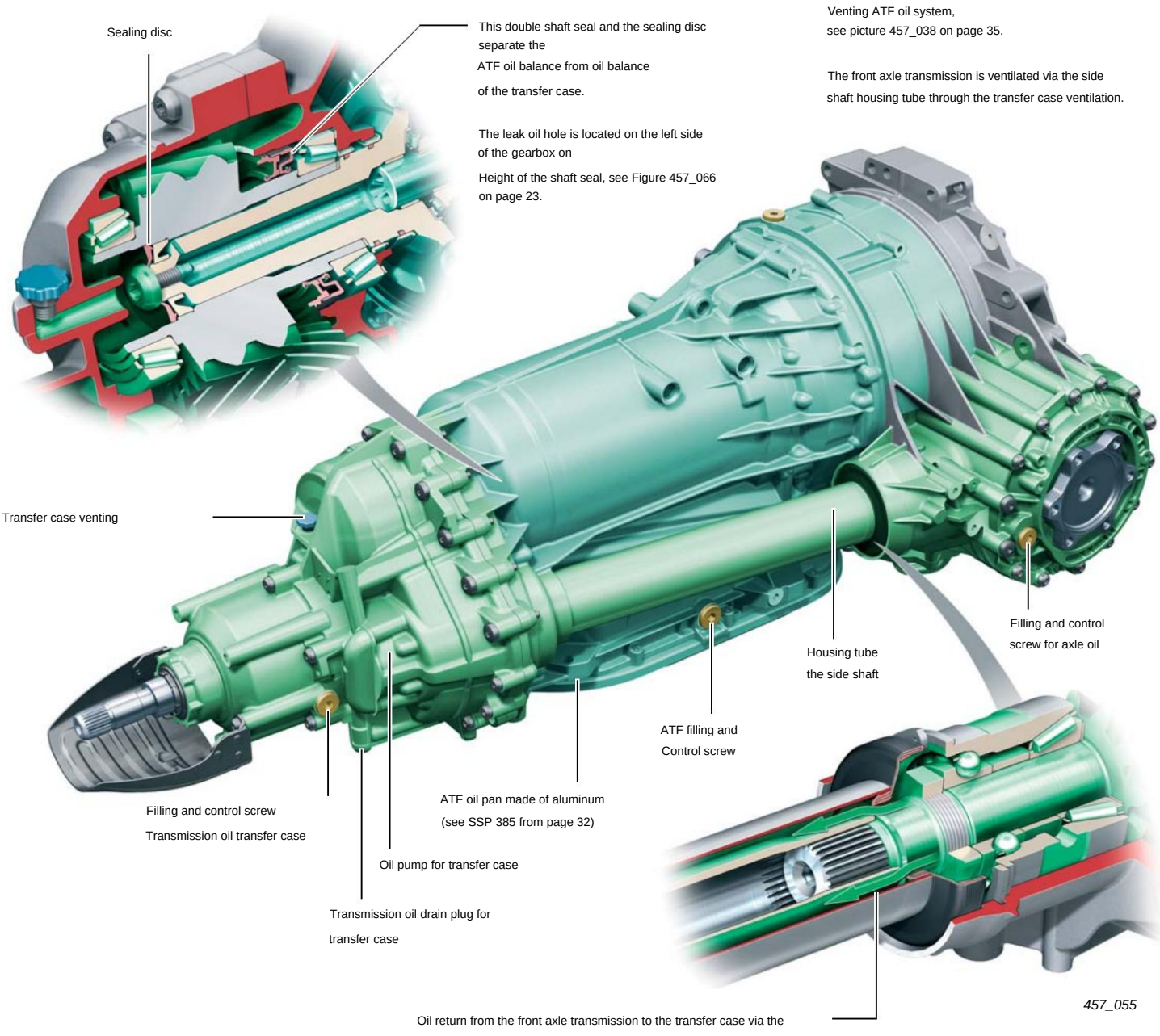
The oil supply in the **ATF oil system** is ensured by a highly efficient vane pump, see the topic ATF pump on page 25.

Gearbox oil supply (common oil supply)

For better cooling of the front axle transmission, the oil chambers (oil reservoirs) of the transfer case and front axle transmission are connected and form a common oil reservoir.

The oil pump in the transfer case ensures efficient and reliable lubrication of the transfer case and supplies cooler transmission oil to the front axle drive.

This design was first used in the 09E gearbox and differs only slightly in the 0BL gearbox. The functionality is described in more detail in SSP 283 from page 70.



Notice

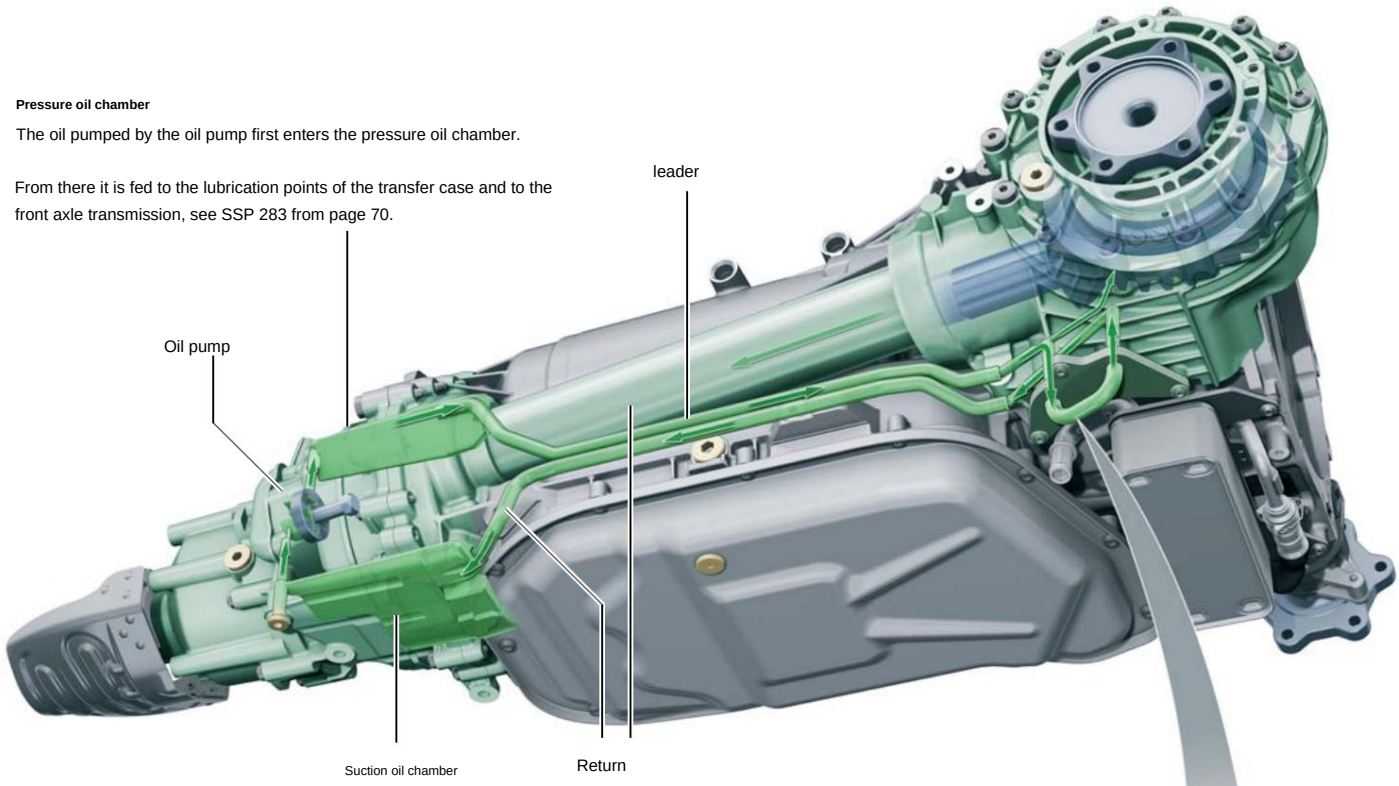
The shared oil supply requires a special procedure for filling and checking the transmission oil in the front axle and transfer case. Depending on the driving situation, different levels may prevail.
When checking the oil level, the oil level must therefore always be adjusted at both control points.
Please note the repair manual!

Common oil supply – transmission oil circuit

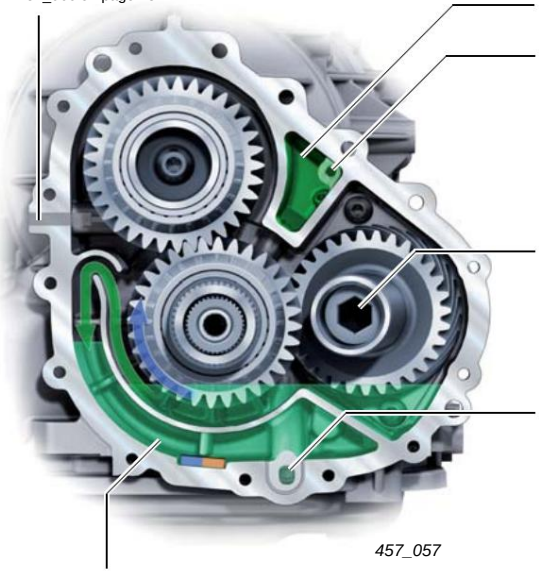
Pressure oil chamber

The oil pumped by the oil pump first enters the pressure oil chamber.

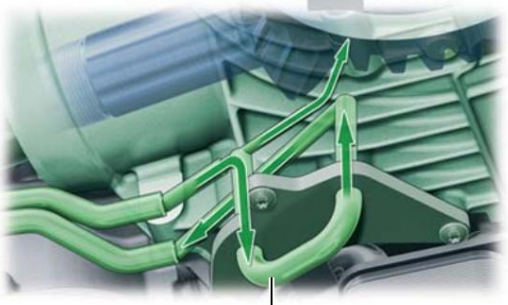
From there it is fed to the lubrication points of the transfer case and to the front axle transmission, see SSP 283 from page 70.



For the location of the leakage oil hole, see Figure 457_066 on page 23



457_057



457_056

Connecting pipe

For the current engine, additional cooling of the transmission oil is not necessary.

In order to keep the temperature level low enough, it is sufficient to combine the two oil systems (distribution and front axle transmission) and to guide the oil in the circuit.

Therefore, instead of a transmission oil cooler, a Connecting pipe installed.

Transmission oil circuit – function

The oil pump is driven by the side shaft and only runs when the vehicle is moving (see gearbox section 457_064 on page 32 and 457_066 on page 23). The suction oil chamber is intelligently separated from the rest of the oil chamber of the transfer case. The oil is thrown into the suction oil chamber by the gear of the intermediate drive. There it collects, calms down and cools down before it is sucked in by the oil pump and pumped into the pressure oil chamber. From the pressure oil chamber, the oil is distributed specifically to the bearings and gears of the transfer case. Part of the oil is fed to the front axle transmission via a channel (feed line).

Part of this oil is then fed into the front axle transmission, while the other part is fed back to the suction oil chamber via the connecting pipe. From there it is pumped back into the circuit.

The oil fed into the front axle transmission is returned via the housing tube of the sideshaft, see Figure 457_055.
The oil transports heat from the front axle transmission to the transfer case. There, the oil temperature is reduced because the transfer case is not subjected to such a high thermal load.

Innovative Thermal Management (ITM)

The transmission cooling is part of the innovative thermal management – called ITM for short.

The aim of the innovative thermal management is to reduce fuel consumption by shortening the warm-up phase of the engine and transmission.

The “heat manager” – a newly developed software module in the engine control unit – ensures optimal distribution of the heat generated by the engine within the engine cooling circuits (engine heating), to the air conditioning system (interior heating) and to the transmission (transmission heating).

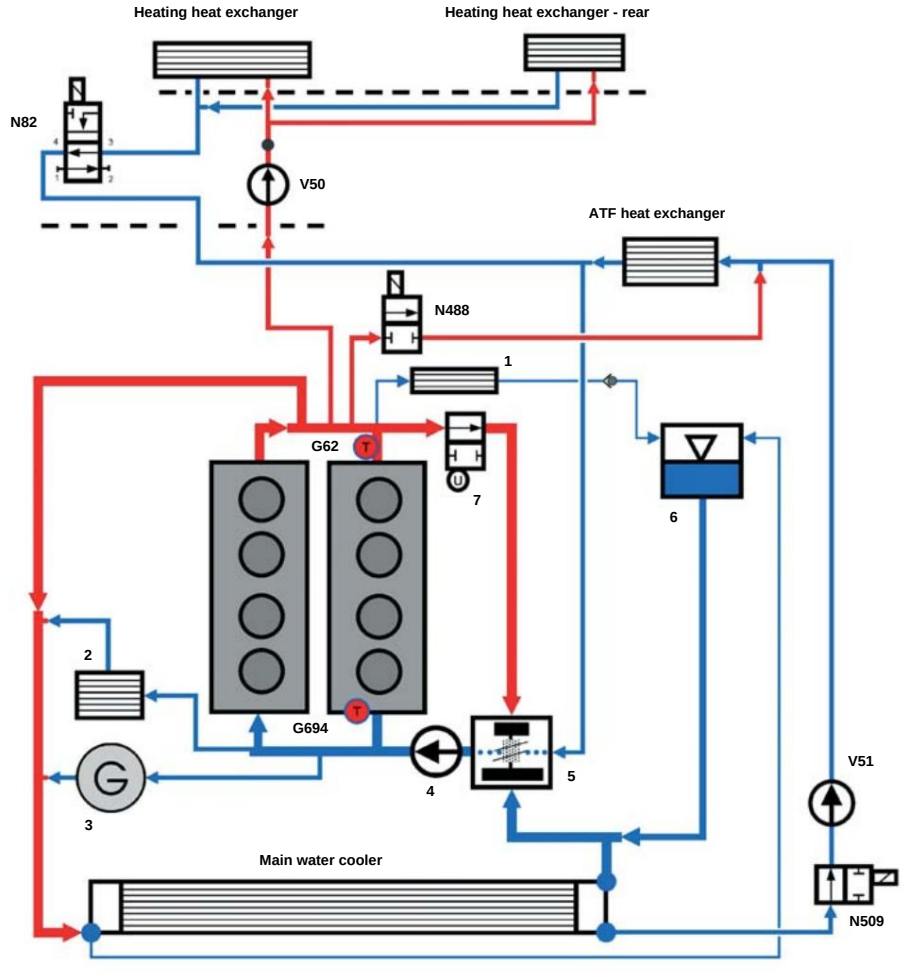
The air conditioning and transmission control units report their heat requirements to the engine control unit via CAN bus. This information is then weighted and prioritized together with the engine heat requirements and the control signals for the ITM components (valves and regulators) are generated.

At this point, the function and design of the gearbox heating and cooling in conjunction with the 4.2l V8 FSI engine are discussed as an example. Other engine combinations differ, see ATF cooling 0BL - gearbox (4.2l V8 TDI engine) on page 40.

Further information on the ITM's engine scope can be found in SSP 456.

Gearbox heating/cooling – V8 FSI engine

Functional diagram – coolant circuit Audi A8 '10 with 4.2l V8 FSI engine and 0BK transmission



457_040

G62 Coolant temperature sensor
G694 Temperature sensor for engine temperature control
N82 Coolant shut-off valve (controlled by the Climatronic J255)
N488 Transmission coolant valve (controlled by engine control unit J623)
N509 Gearbox cooling valve (controlled by gearbox control unit J217)
V50 pump for coolant circulation (controlled by the Climatronic J255)
V511) Coolant after-run pump (controlled by engine control unit J623)

1 Heating for crankcase ventilation
2 Heat exchanger for engine oil cooling
3 generator
4 Coolant pump
5 Coolant temperature controller (F265 thermostat for map-controlled Engine cooling)
6 Coolant expansion tank
7 Coolant shut-off valve (controlled by vacuum) is controlled by the cylinder head coolant valve N489, which in turn is controlled by the Engine control unit J623 is controlled

1) the V51 works with ATF cooling and cooling after-run

Gearbox heating function

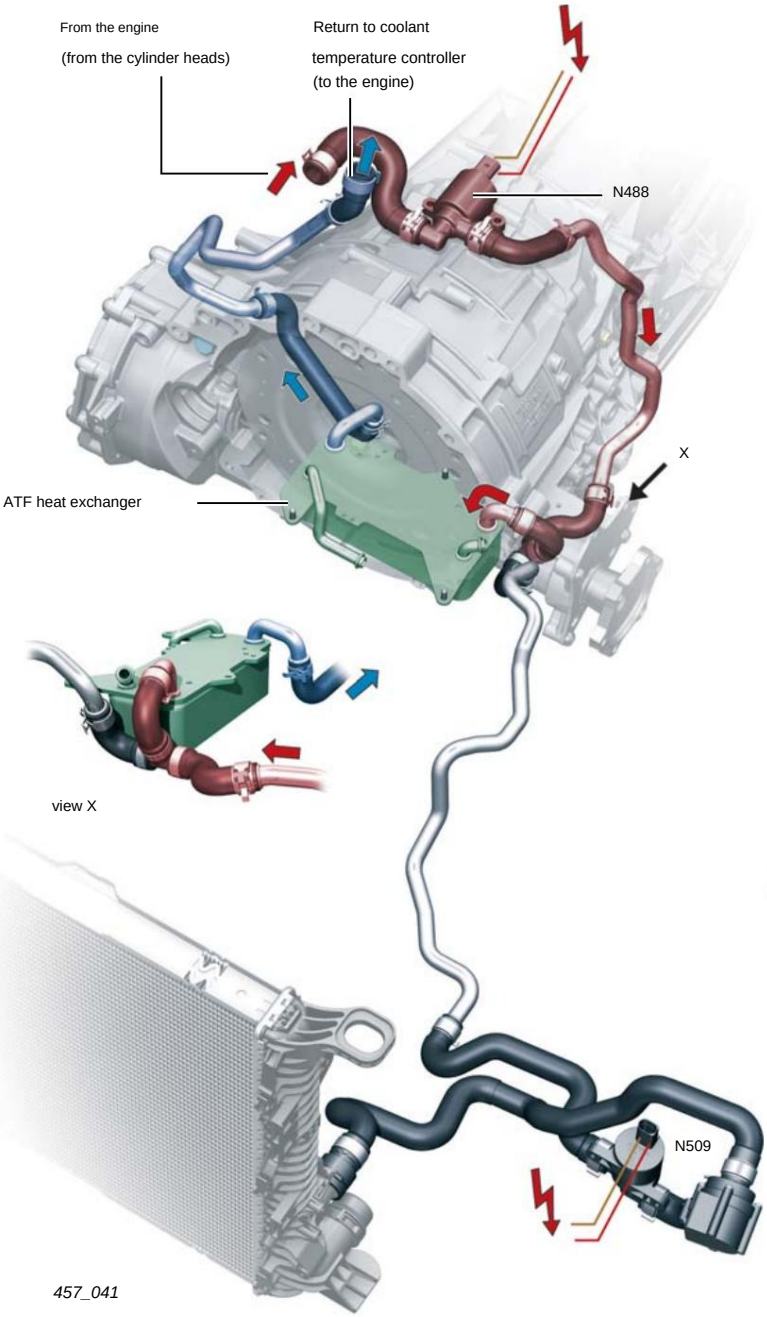
(Figure 357_041)

Initial situation – engine/gearbox cold

The transmission control unit reports its heat requirement to the engine control unit1) (the ATF should warm up as quickly as possible). First, the engine tries to heat up as quickly as possible. The solenoid valves N509 (energized) and N488 (deenergized) are closed.

Only when the engine has reached a defined target temperature is the N488 opened (energized). Warm coolant now flows from the cylinder heads to the ATF heat exchanger. The ATF is heated up.

1) The heat requirement of the air conditioning system (heating the interior) has the highest priority. Heating the engine and transmission are secondary in this case.



457_041

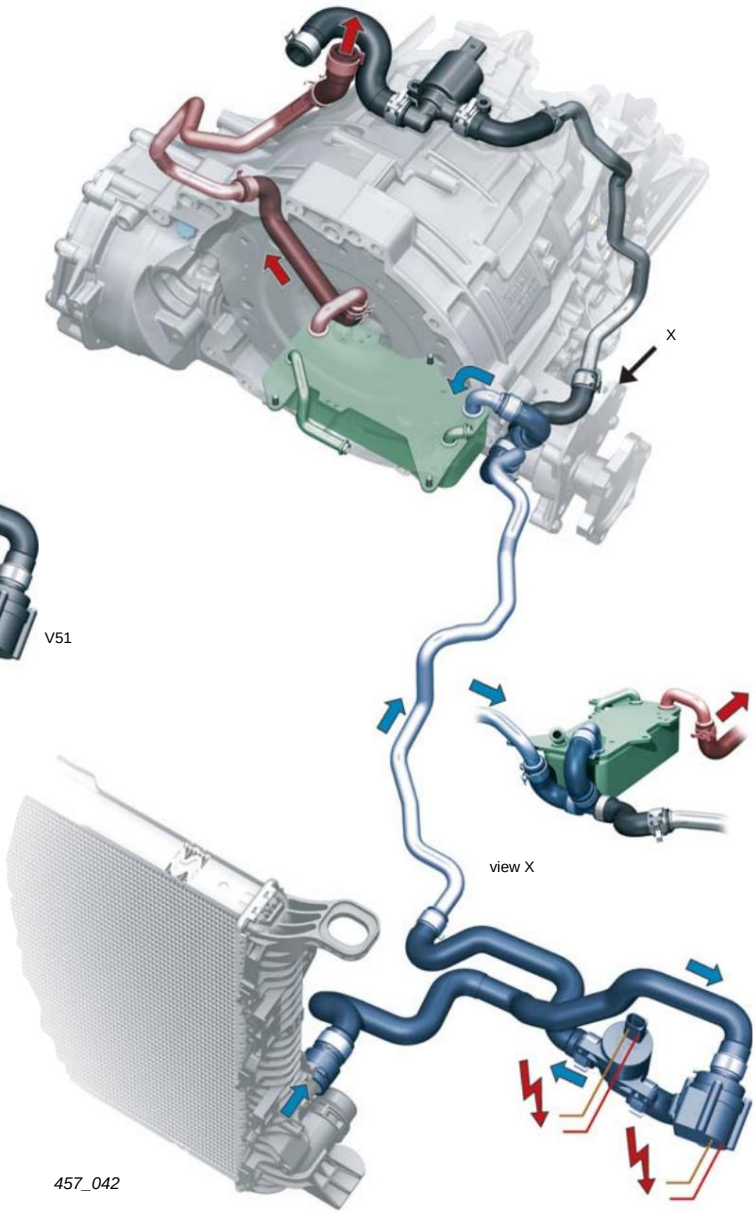
Gearbox cooling function

(Figure 357_042)

Initial situation – engine/gearbox at operating temperature

Once the ATF temperature reaches a defined level, the transmission heating phase ends and the N488 is closed (switched off). If the ATF temperature continues to rise, the N509 is opened **(de-energized)** and cooled coolant flows from the main water cooler to the ATF heat exchanger.

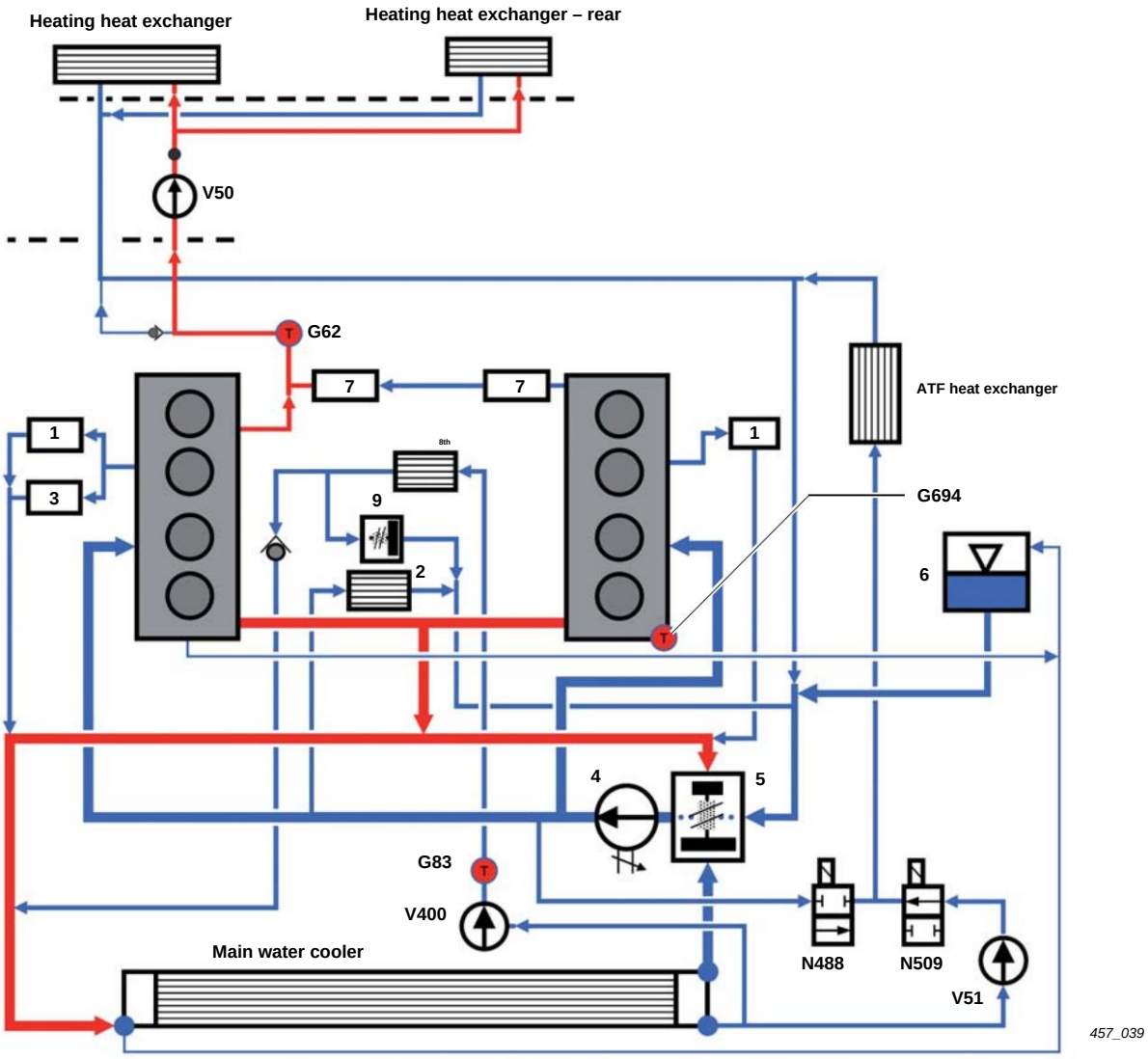
If the ATF temperature rises to 96 °C, pump V51 is switched on to increase the cooling capacity.



457_042

Gearbox heating/cooling – V8 TDI engine

**Functional diagram – coolant circuit Audi A8 '10
with 4.2l V8 TDI engine and 0BL transmission**

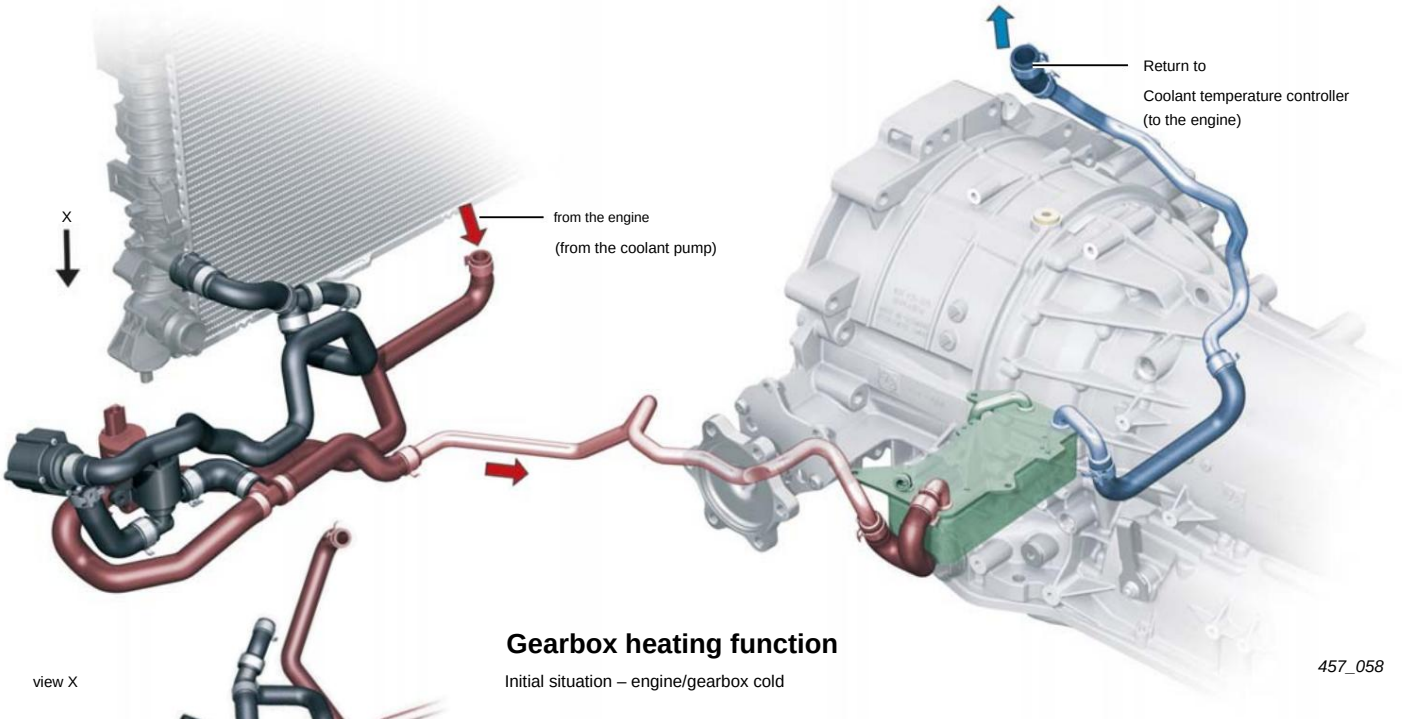


G62 Coolant temperature sensor
G83 Coolant temperature sensor at radiator outlet
G694 Temperature sensor for engine temperature control
N488 Transmission coolant valve (controlled by engine control unit J623)
N509 Gearbox cooling valve (controlled by gearbox control unit J217)
V50 pump for coolant circulation (controlled by the Climatronic J255)
V511) Coolant after-run pump (controlled by engine control unit J623)
V400 pump for exhaust gas recirculation cooler

1 Exhaust turbocharger
2 Heat exchanger for engine oil cooling
3 generator
4 Switchable coolant pump – controlled by vacuum (from N492
Solenoid valve for coolant circuit, controlled by the engine control unit J623)
5 Coolant temperature controller (with F265 thermostat for map-controlled
Engine cooling)
6 Coolant expansion tank
7 Valve for exhaust gas recirculation cylinder bank 1/2
8 Exhaust gas recirculation cooler
9 Coolant regulator for exhaust gas recirculation

1) the V51 works with ATF cooling and cooling after-run

2) applies to page 41 – The heat requirement of the air conditioning system (heating the interior) has the highest priority.
Heating the engine and transmission are secondary in this case.



Gearbox heating function

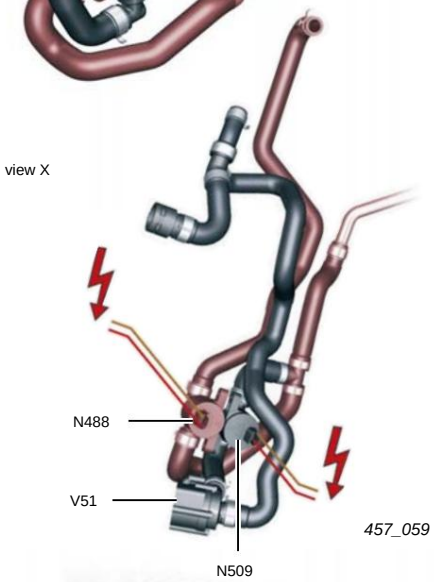
Initial situation – engine/gearbox cold

457_058

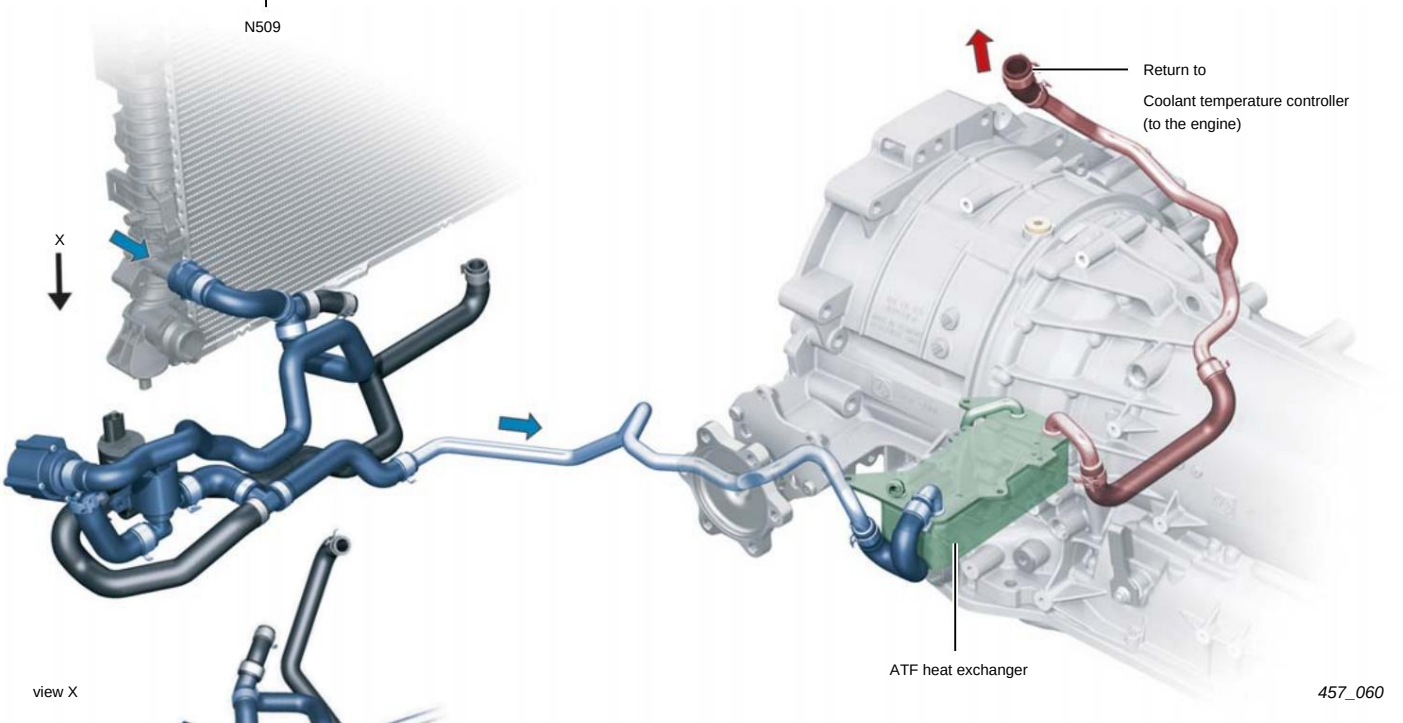
The transmission control unit reports its heat requirement2) to the engine control unit (the ATF should warm up as quickly as possible).

First, the engine tries to heat up as quickly as possible. The solenoid valves N509 (energized) and N488 (not energized) are closed and the coolant pump 4 (Figure 457_039) is switched off (hidden).

Only when the engine has reached a defined target temperature is the coolant pump 4 (Figure 457_039) switched on and the N488 opened (energized). Now warm coolant flows from the coolant temperature regulator and the coolant pump via the N488 to the ATF heat exchanger. The ATF is heated up.



457_059



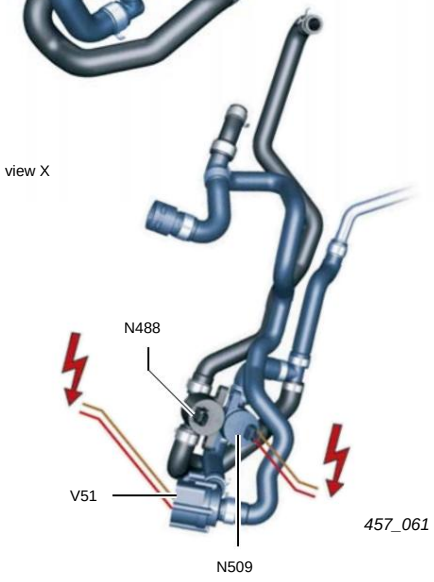
Gearbox cooling function

Initial situation – engine/gearbox at operating temperature

457_060

The transmission heating phase ends when the ATF temperature reaches a defined level. First, the N488 is closed (switched off). If the ATF temperature continues to rise, the N509 is opened (switched off) and cooled coolant flows from the main water cooler to the ATF heat exchanger.

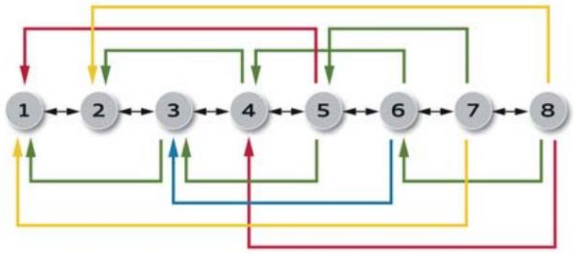
If the ATF temperature rises to approx. 96 °C, pump V51 is switched on to increase cooling performance.



457_061

Mechatronics – electrohydraulic control

The increase in the number of gears has drastically increased the complexity of clutch control. For example, an 8-2 downshift can be carried out in many different ways.
The shift diagram shows the variety of possible shift sequences.



457_053

The shift program determines the appropriate shift sequence depending on the driver's action, driving situation and driving program.
The aim is to achieve a direct connection if possible, see page 28.

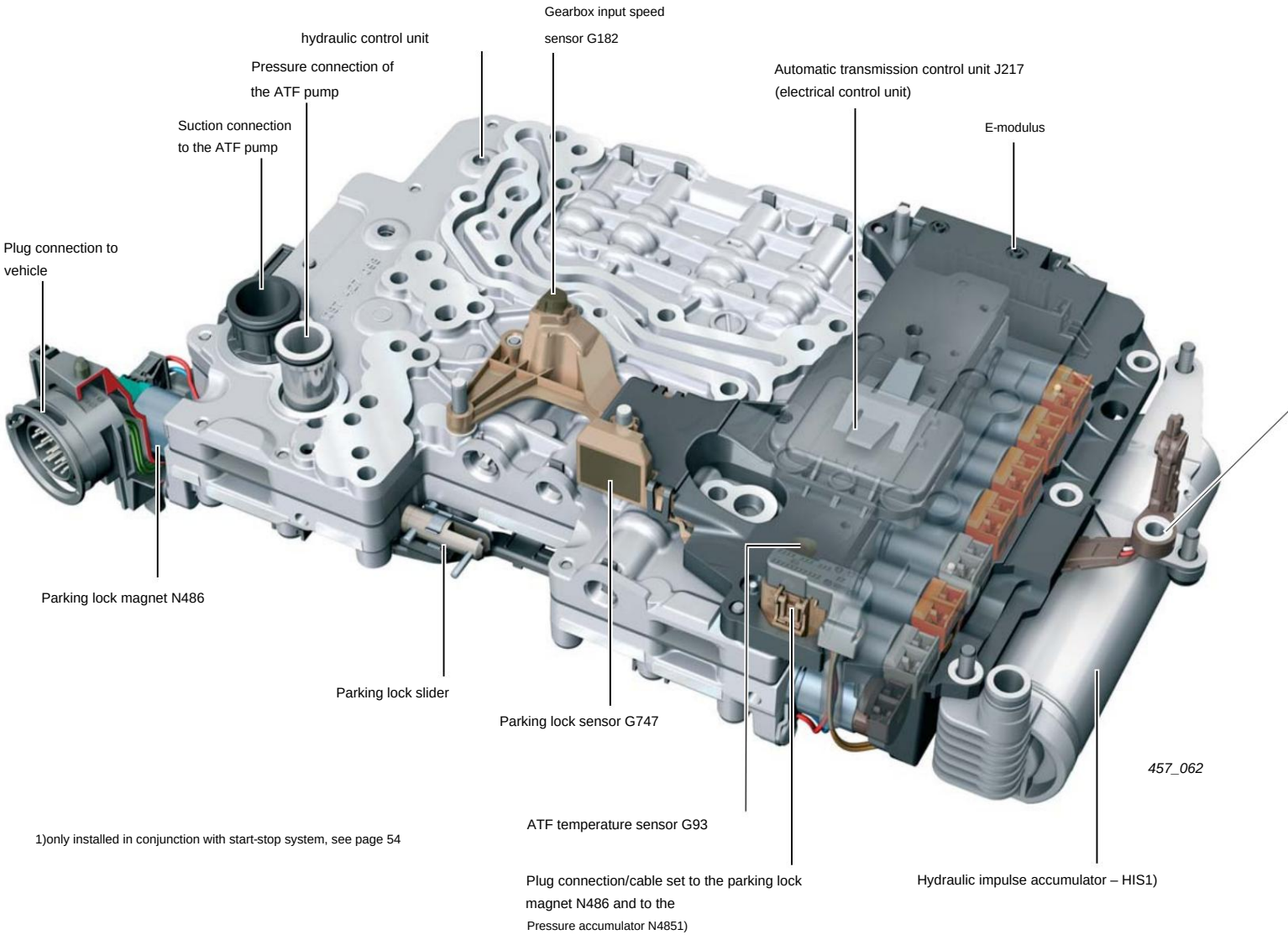
A key innovation to improve gear selection is the inclusion of route data from the navigation system.
This additional information, which allows a view of the route ahead, makes it possible to develop a predictive shifting strategy with appropriate gear selection.

See “Navigation data-based gear selection” starting on page 58.

The standstill decoupling, to minimize the torque loss when stationary (e.g. traffic lights) was already implemented in the 0B6-
Transmission introduced (see SSP 385). Through consistent further development of the hardware and software, the stand-alone decoupling in the 0BK and 0BL transmission can set new standards in terms of comfort and consumption, see page 52

The electrical control unit has been fundamentally revised so that the mechatronics can carry out these tasks with very high dynamics. The hydraulic control unit and the transmission mechanics must implement the electrical commands quickly. Here, too, the switching dynamics and control quality have been further improved through component optimization.

Mechatronics (E26/6)

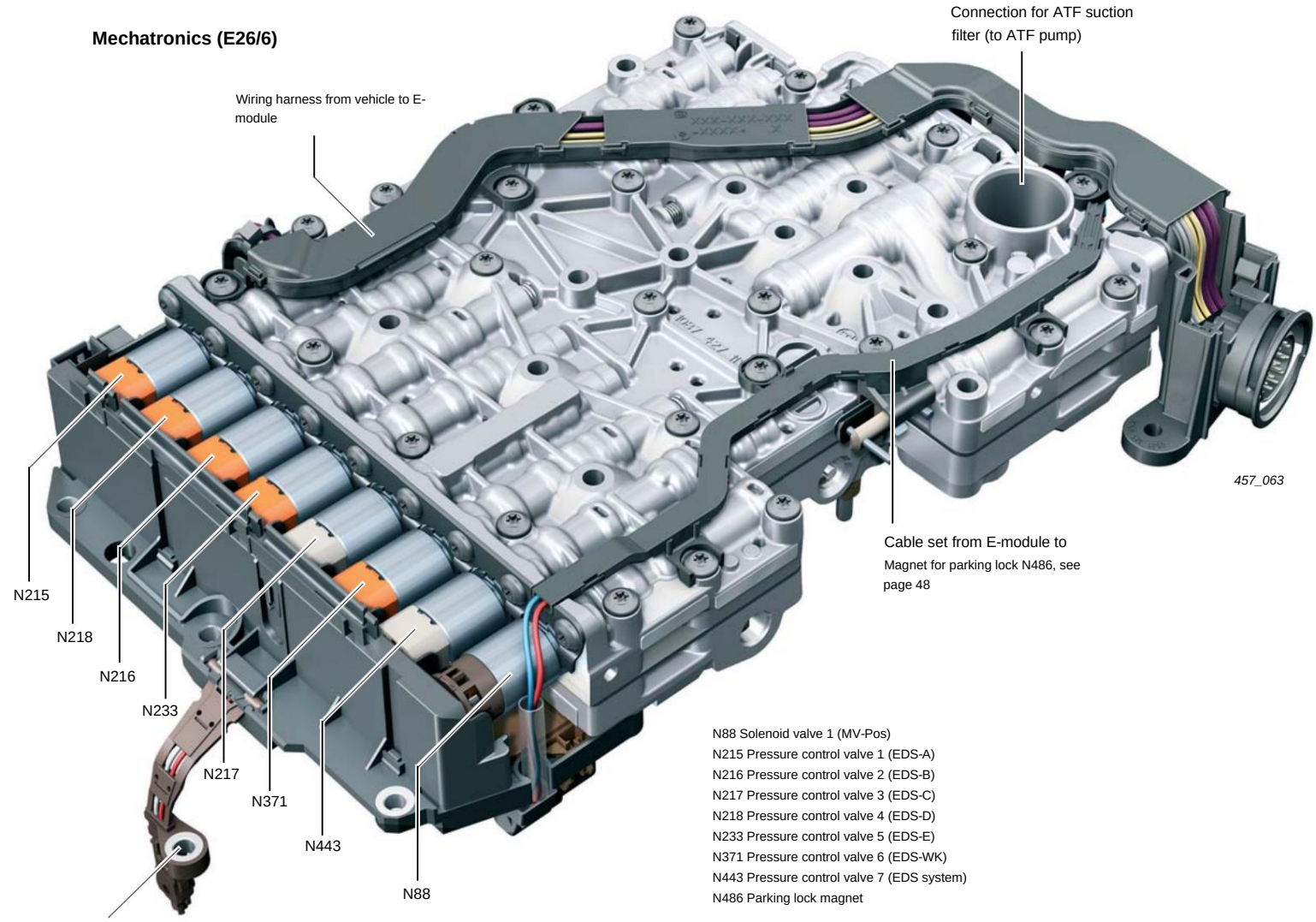


457_062

1)only installed in conjunction with start-stop system, see page 54

Particular attention must be paid to protecting the electronics against electrostatic discharge. Observe the specifications and instructions in SSP 284 (page 6) and in the repair manual.

Mechatronics (E26/6)



N88 Solenoid valve 1 (MV-Pos)
N215 Pressure control valve 1 (EDS-A)
N216 Pressure control valve 2 (EDS-B)
N217 Pressure control valve 3 (EDS-C)
N218 Pressure control valve 4 (EDS-D)
N233 Pressure control valve 5 (EDS-E)
N371 Pressure control valve 6 (EDS-WK)
N443 Pressure control valve 7 (EDS system)
N486 Parking lock magnet

In order to achieve high switching dynamics and to be able to implement a wide range of switching sequences, each switching element is assigned its own electrical pressure control valve (EDS).

Mechatronics/control unit for Automatic transmission J217

The mechatronics are integrated into the immobilizer system, which means there is no hydraulic-mechanical emergency running, see SSP 385 from page 52.

Due to the high demands and complexity of the self-diagnosis, the diagnostic data description according to the ASAM/ODX standard, which was first used by Audi in the 0B6 transmission, was also adopted for the 0BK and 0BL transmissions, see SSP 385 on page 35.

Renewing mechatronics

When replacing the mechatronics, make sure that the control unit and electronic components are not damaged by electrostatic discharge.

After a transmission software update or after renewing the mechatronics, the following points must be checked or carried out:

- Control unit coding (see page 62)
- Adjusting the gear display (see page 62)
- Adaptation of the switching elements (see page 53)

reference

Basic information and notes on mechatronics and sensors can be found in the Self-study programs 284 and 385.

Mechatronics – Actuators

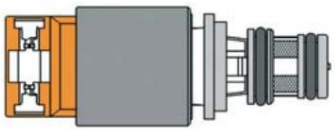
Pressure control valves, also known as EDS (electric pressure control valves), convert a control current into a hydraulic control pressure. They are controlled by the transmission control unit and control the hydraulic valves (sliders) belonging to the switching elements.

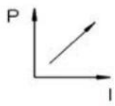
There are two types installed:

- EDS with rising characteristic curve – currentless – no control pressure (0 mA = 0 bar)
- EDS with falling characteristic curve – currentless – maximum control pressure (0 mA = approx. 5 bar)

Pressure control valves – solenoid valves

Pressure control valves 1, 2, 4, 5, 6 (orange)



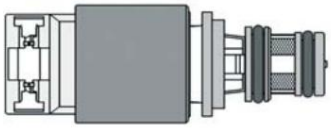


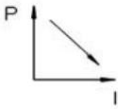
Print area	0 to 4.7 bar
Operating voltage	12V
Resistance at 20 °C	5.05 Ohm
Characteristic curve	increasing

457_067

1	N215 Pressure control valve 1 – brake A
2	N216 Pressure control valve 2 – brake B
4	N218 Pressure control valve 4 – clutch D
5	N233 Pressure control valve 5 – clutch E
6	N371 Pressure control valve 6 – torque converter clutch

Pressure control valves 3, 7 (white)



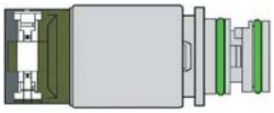


Print range	4.7 to 0 bar
Operating voltage	12V
Resistance at 20 °C	5.05 Ohm
curve	falling

457_068

3	N217 Pressure control valve 3 – clutch C
7	N443 Pressure control valve 7 – system pressure

Solenoid valve 1 – N88 (black/brown)



Operating voltage	< 16V
Starting voltage	> 6V
Dropout voltage	< 5V
Resistance at 20 °C	11 Ohm +/- 2 Ohm

457_069

The N88 is an electrically switched solenoid valve.
It is a so-called 3/2 valve, i.e. 3 connections and 2 switching positions (open/closed or on/off).

The N88 is controlled by the transmission control unit and controls the position valve and parking lock valve. The position valve replaces the previous selector valve for gear shifts with selector lever cable. The position valve switches the system pressure to the individual controls of the clutches and brakes.

The parking lock valve controls the system pressure to the parking lock slide. The parking lock slide replaces the previous task of the selector lever cable to operate the parking lock.
The parking lock slider is responsible for disengaging the parking lock, see topic – Parking lock from page 48.

Switch matrix

	Switching elements/pressure control valves/solenoid valves							
	A EDS-A N215	B EDS B N216	C EDS-C N217	D EDS-D N218	E EDS-E N233	MV Pos N510	EDS-Sys N443	
Parking lock	1	1	1	0	0	0	X	0
Neutral	1	1	1	0	0	1	X	0
R-gear	1	1	1	1	0	1	X	0
1st gear	1	1[1)]	0	0	0	1	X	X
2nd gear	1	1	1	0	1	1	X	X
3rd gear	0	1	0	0	1	1	X	X
4th gear	0	1	1	1	1	1	X	X
5th gear	0	1	0	1	0	1	X	X
6th gear	0	0	0	1	1	1	X	X
7th gear	1	0	0	1	0	1	X	X
8th gear	1	0	1	1	1	1	X	X

457_070

Clutch closed

Brake closed

Pressure control valves/solenoid valve

1	active
0	not active (a minor reason – Control current is always present)
X	active – control current depends on the Operating status

1) The brake B is opened in standstill decoupling mode except for a small residual torque, see page 52.

EDS Electric pressure control valve (pressure control valve)

MV solenoid valve

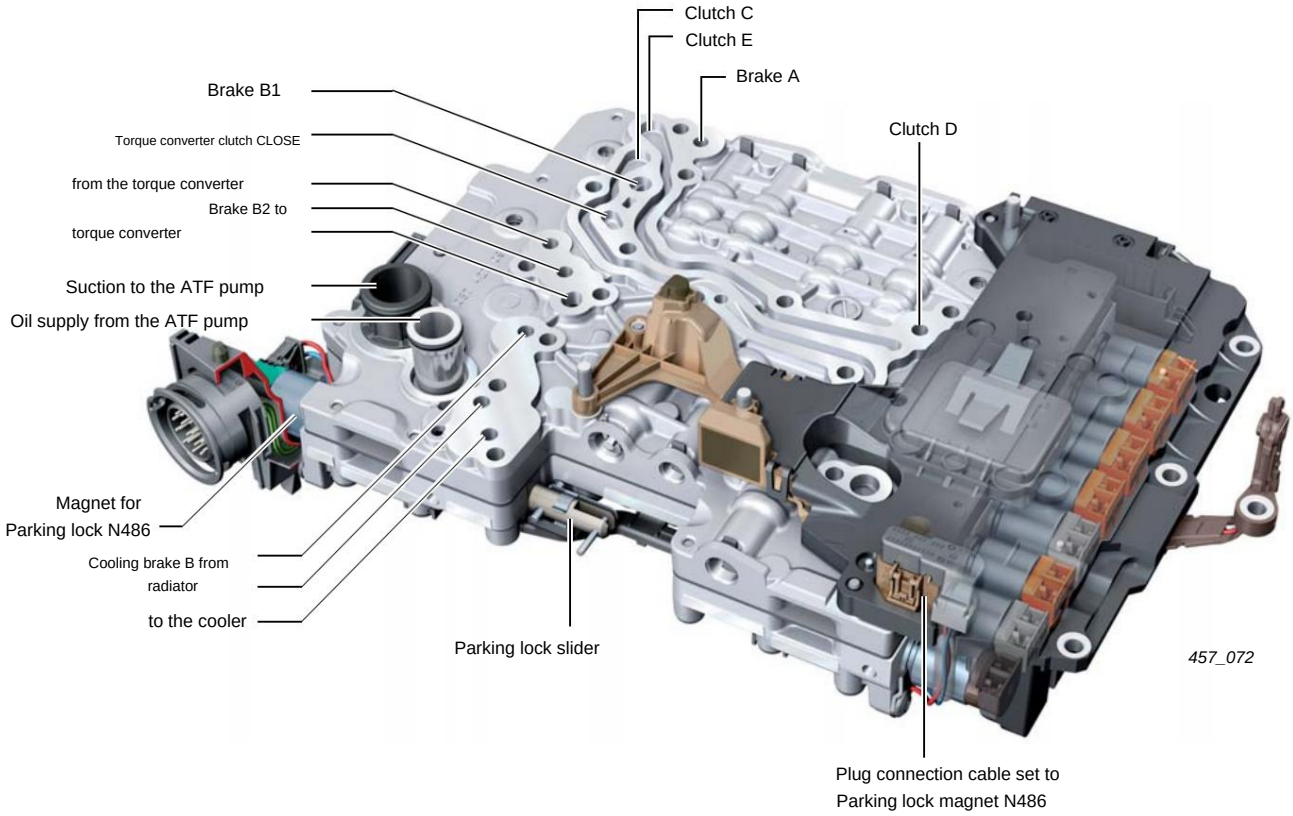
Parking lock magnet – N486 (green)

457_071

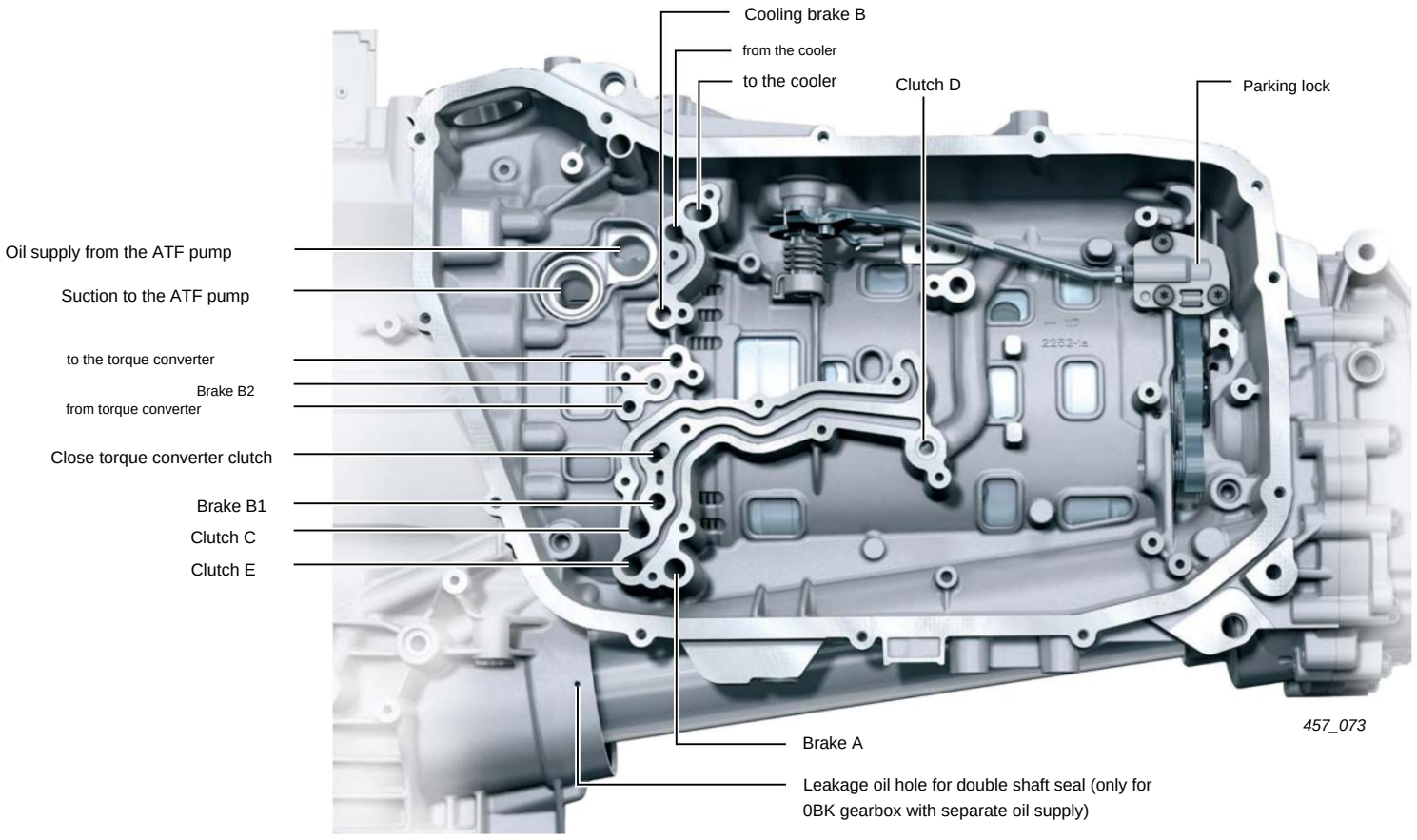
Operating voltage < 16V
Starting voltage > 8V
Resistance at 20 °C 25 Ohm +/- 2 Ohm

The parking lock magnet N486 is used to hold the parking lock slide in the “parking lock disengaged” position, see topic – Parking lock from page 48.

Hydraulic interfaces



457_072



457_073

Temperature monitoring of J217

Due to the integration of the electronics in the gearbox (surrounded by the ATF), monitoring the control unit temperature and thus also the ATF temperature is of great importance.

High temperatures have a decisive influence on the service life and functionality of electronic components.

Temperatures above 120 °C affect the service life of the control unit's electronic components. Above 150 °C, damage to the components and thus malfunctions of the entire system can no longer be ruled out.

To protect against overheating, countermeasures are initiated when defined temperature thresholds are exceeded.
The DSP (dynamic switching program) has its own programs for this purpose (see SSP 284, page 41 Hotmode programs).

In order to measure the temperature of the microprocessor (main computer of the J217) as accurately as possible, a so-called substrate temperature sensor is integrated in the substrate1) of the semiconductor components.

1) "Substrate" refers to the carrier ceramic of the semiconductor components or the microprocessor. The substrate temperature sensor is located directly in the substrate next to the microprocessor and measures its temperature directly on site.

Hot mode

The hot mode is divided into 3 levels:

1st stage > 124 °C substrate temperature (126 °C ATF temperature, G93)
With the help of the DSP function, the switching points are shifted to higher speeds. The operating range in which the converter clutch is closed is expanded.

2nd stage > 139 °C substrate temperature (141 °C ATF temperature, G93)
The engine torque is significantly reduced depending on the further temperature increase.

3rd stage > 145 °C substrate temperature (147 °C ATF temperature, G93)
To protect the control unit from overheating (which can lead to malfunctions and component damage), the power supply to the solenoid valves is switched off. The transmission loses traction. An error is stored in the event log.

All temperature specifications refer to the valid software version at the time the SSP was created. The temperature specifications may differ for other software versions.

Monitoring of the oil temperature collective

At regular intervals, the control unit J217 uses the transmission oil temperature sensor G93 to check the range of the current transmission temperature. The values determined are saved. The thermal load on the transmission over its running time can be determined by appropriate evaluation. This is referred to as an oil temperature collective2).

The oil temperature collective is used by the manufacturer to analyze component damage to the E-module of the mechatronics.

2) Collective is an arbitrarily large total unit of measured values or This refers to counter data, which enables statistical evaluation through weighting and appropriate assessment.

Mechatronics – Sensors

The speed sensors G182, G195 and the parking lock sensor G747 are designed as Hall sensors.

Information on the parking lock sensor G747 can be found on page 51.

Further information on the speed sensors and the ATF temperature sensor G93 can be found in SSP 283 from page 16.

More information about how Hall sensors work can be found in SSP 268 from page 34.

The sensors G93, G182, G195, and G747 are part of the E-module. The E-module cannot be replaced separately. If one of the above components is defective, the entire mechatronics must be replaced.

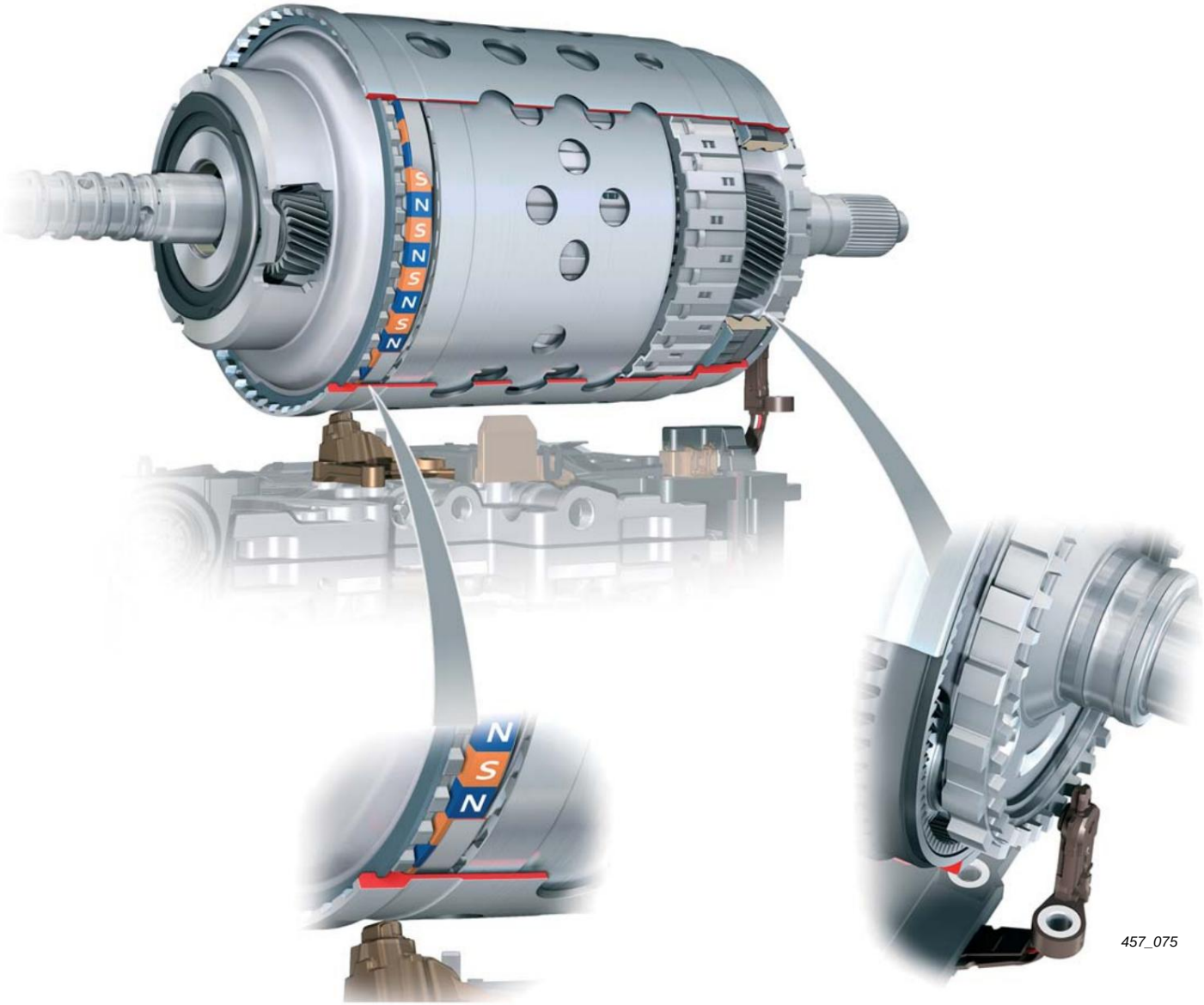
Gearbox input speed sensor G182
Gearbox output speed sensor G195

Deviating from the information in SSP 268, the donor for transmission input speed G182 a sensor wheel with magnetic ring. The sensor wheel is connected to the planet carrier 2. The G182 detects the speed of the planet carrier of the 2nd planetary gear set (PT2). The planet carrier 2 is positively connected to the turbine shaft.

(Turbine input speed = gearbox input speed).

Above the magnetic ring sensor wheel is the cylinder that connects the planet carrier 1 to the ring gear 4. The cylinder is made of a high-strength aluminum alloy. The material is therefore non-magnetic and the magnetic fields of the magnetic ring act through the cylinder onto the sensor G182. However, metal chips on the sensor wheel can limit or hinder the effect of the sensor wheel.

The gearbox input speed sensor G182 and the gearbox output speed sensor G195 are so-called intelligent sensors. They detect the direction of rotation and adapt to a change in the magnetic field strength and adapt to tolerances of the air gap between the sensor and the sensor wheel.



457_075

Gearbox input speed sensor G182

Gearbox output speed sensor G195

Parking lock

The parking lock on the new Audi A8 '10 is operated electrohydraulically. The parking lock is controlled by the mechatronics. The control is carried out either on request by the driver using the gearshift control or by means of the Auto-P function, see page 16. The mechanism of the parking lock in the gearbox is derived from the previous mechanics.
The parking lock is engaged by spring force and is designed electro-hydraulically and secured electromagnetically.

The three functional steps of inserting, removing and holding are carried out by the following components:

1. Engaging the parking lock:

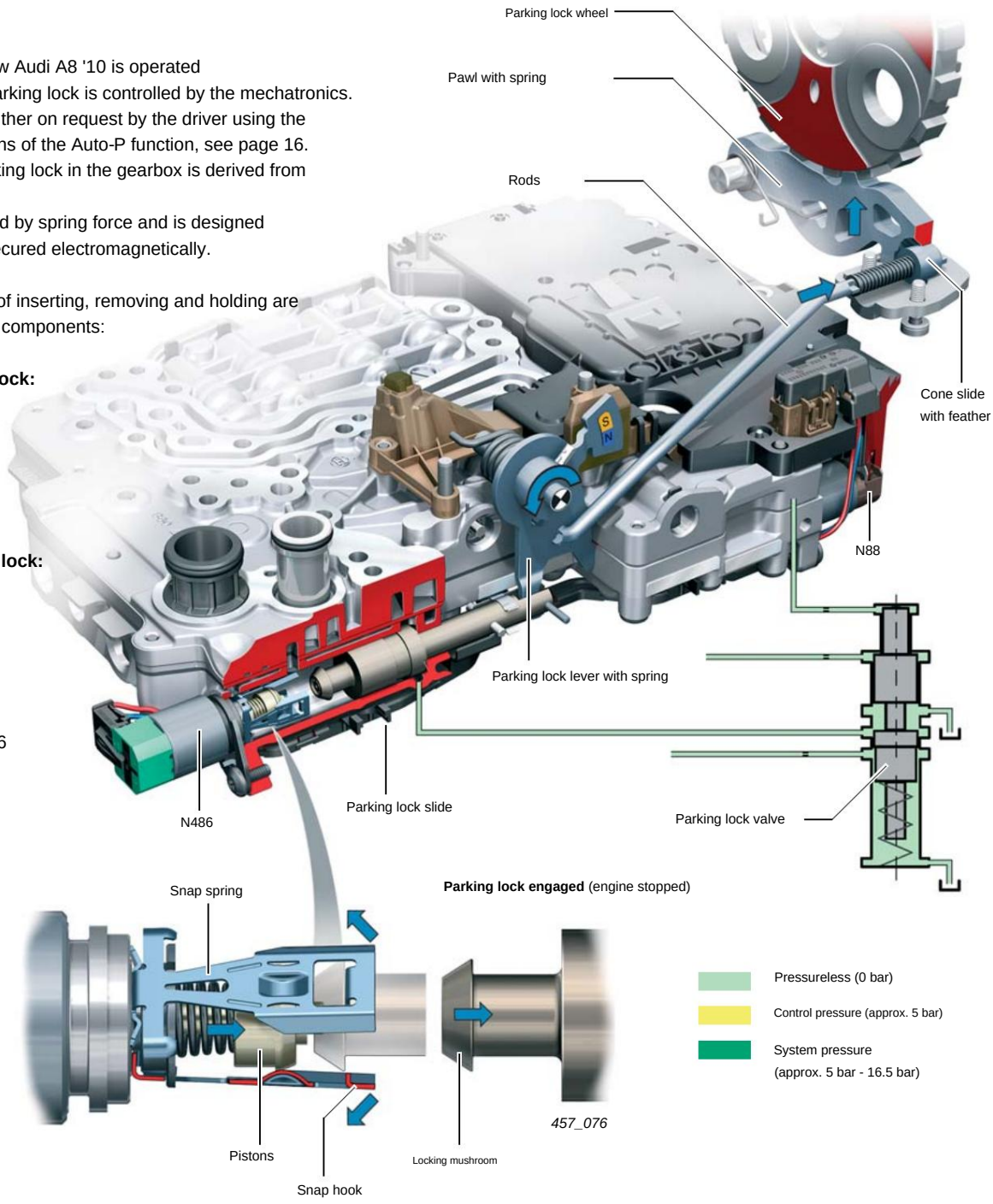
• Parking lock spring • Parking lock lever • Rod
• Cone slide with spring
• Locking pawl

2. Laying out the parking lock:

• Solenoid valve N88
• Parking lock valve
• Parking lock slide

3. Holding the deployed parking lock:

• Parking lock magnet N486



Parking lock – function

Engage parking lock

If the solenoid valve N88 and the magnet N486 are de-energized, the parking lock is engaged (e.g. when the engine is switched off or when gear position P is selected, see Auto-P function on page 16). The parking lock valve goes into its basic position, the cylinder chamber of the parking lock slide is depressurized and empties.

When the magnet N486 is de-energized, the piston of the N486 pushes the snap springs apart. The snap hooks release the locking mushroom and thus the parking lock slide.

The spring of the parking lock lever presses the pawl into the parking lock wheel. The parking lock is engaged.

Lay out parking lock

Basically, the parking lock is disengaged via the electro-hydraulic control of the parking lock slide. The hydraulic force is many times greater than the spring force of the spring on the parking lock lever. The necessary hydraulic pressure is generated by the ATF pump.

Note: The engine must be running to disengage the parking lock! When the engine is not running, the parking lock can be disengaged using the parking lock emergency release (see topic – Parking lock emergency release from page 18).

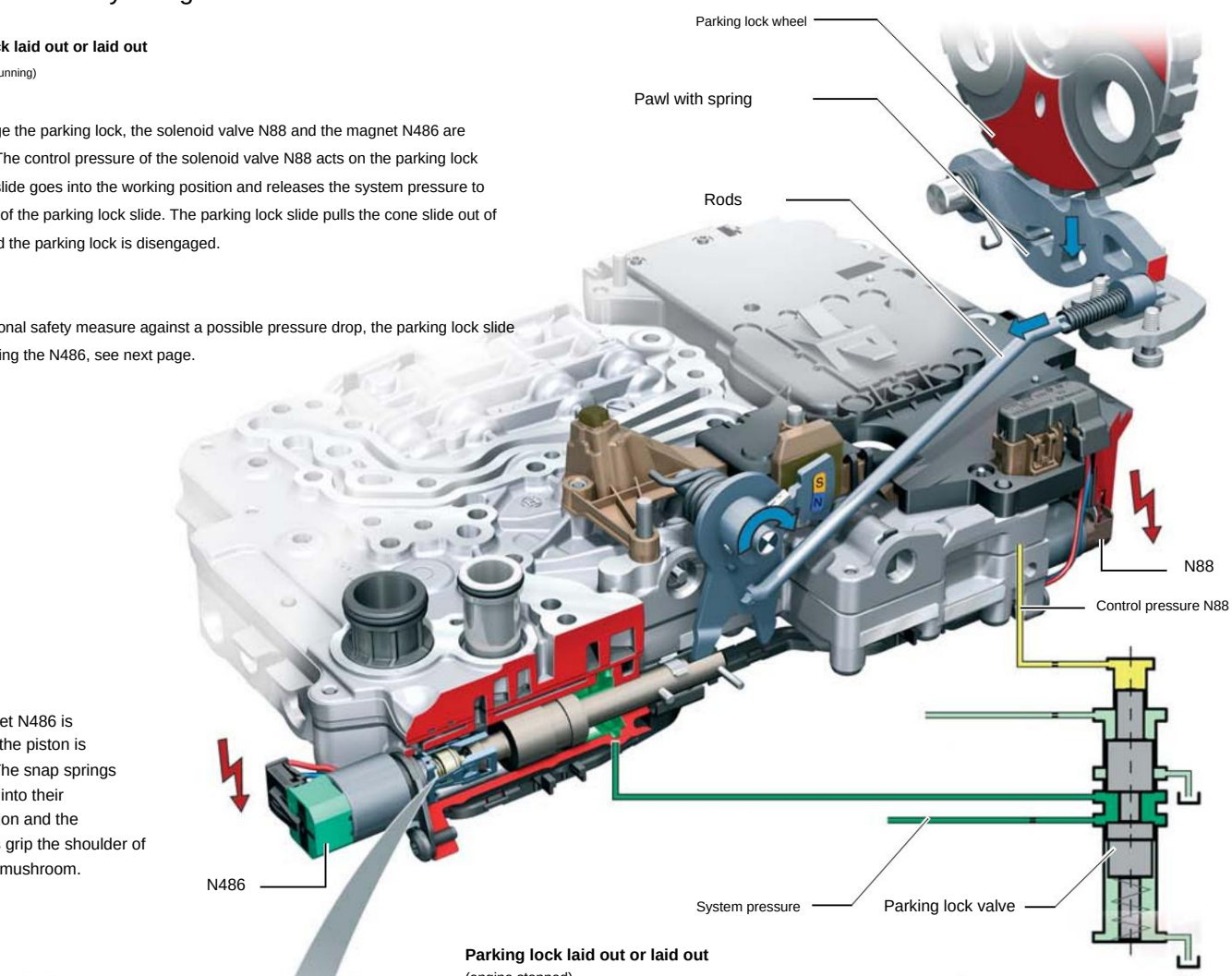
Parking lock laid out or laid out

(The engine is running)

To disengage the parking lock, the solenoid valve N88 and the magnet N486 are energized. The control pressure of the solenoid valve N88 acts on the parking lock valve. The slide goes into the working position and releases the system pressure to the cylinder of the parking lock slide. The parking lock slide pulls the cone slide out of the pawl and the parking lock is disengaged.

As an additional safety measure against a possible pressure drop, the parking lock slide is locked using the N486, see next page.

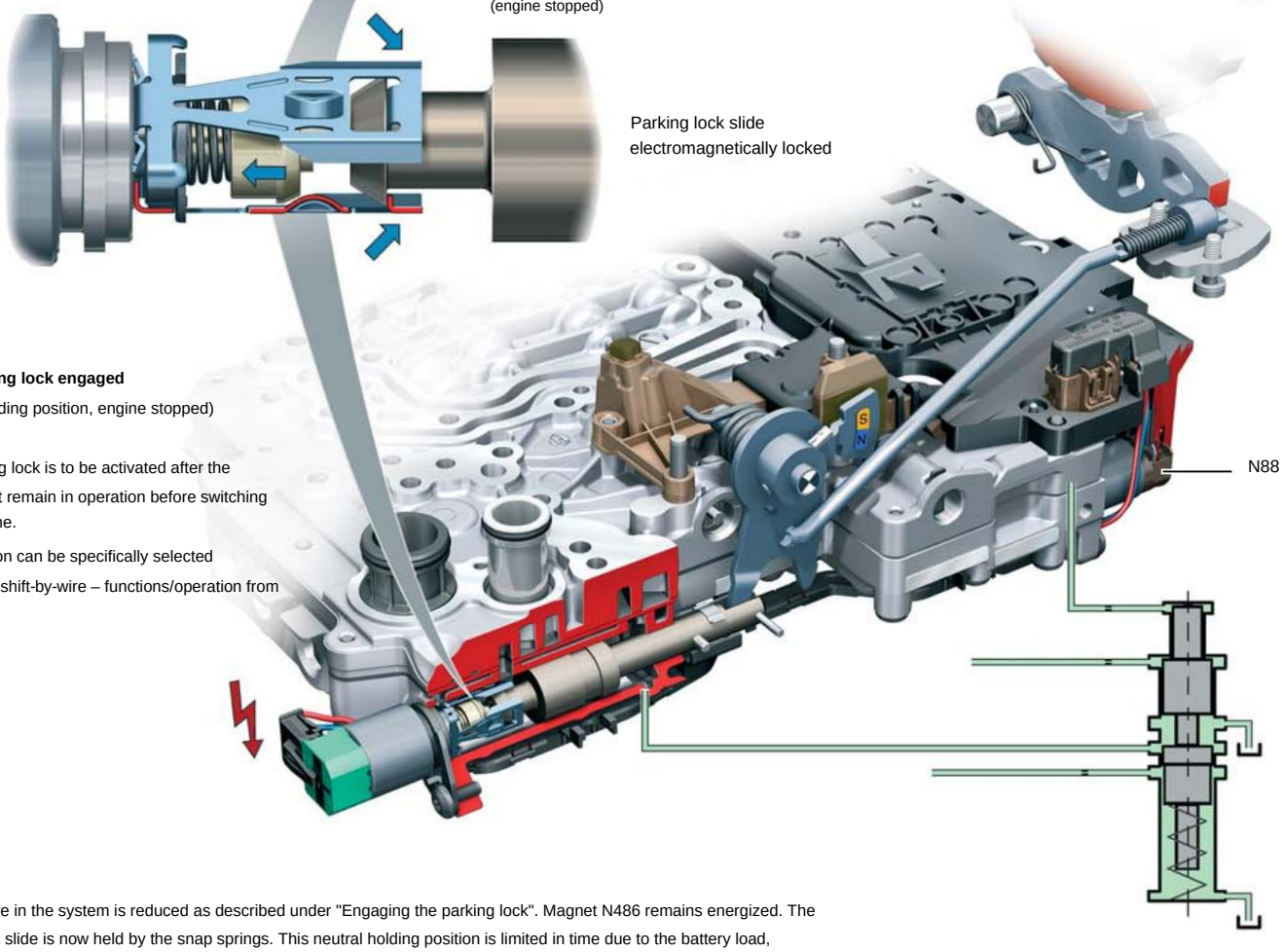
If the magnet N486 is energized, the piston is retracted. The snap springs now spring into their home position and the snap hooks grip the shoulder of the locking mushroom.



Parking lock laid out or laid out

(engine stopped)

Parking lock slide electromagnetically locked



Keep parking lock engaged

(Neutral holding position, engine stopped)

If the parking lock is to be activated after the engine must remain in operation before switching off the engine.

the N position can be specifically selected (see topic – shift-by-wire – functions/operation from page 16).

The pressure in the system is reduced as described under "Engaging the parking lock". Magnet N486 remains energized. The parking lock slide is now held by the snap springs. This neutral holding position is limited in time due to the battery load, see topic - shift-by-wire - functions/operation from page 16.

457_077

Parking lock – emergency functions

The parking lock emergency functions are designed to prevent the parking lock from being accidentally engaged while driving in the event of a fault. The following three situations are protected:

1. Failure of solenoid valve N88 or insufficient oil pressure

• the cylinder chamber of the parking lock slide is depressurized • the parking lock slide is still electro-
mechanically locked

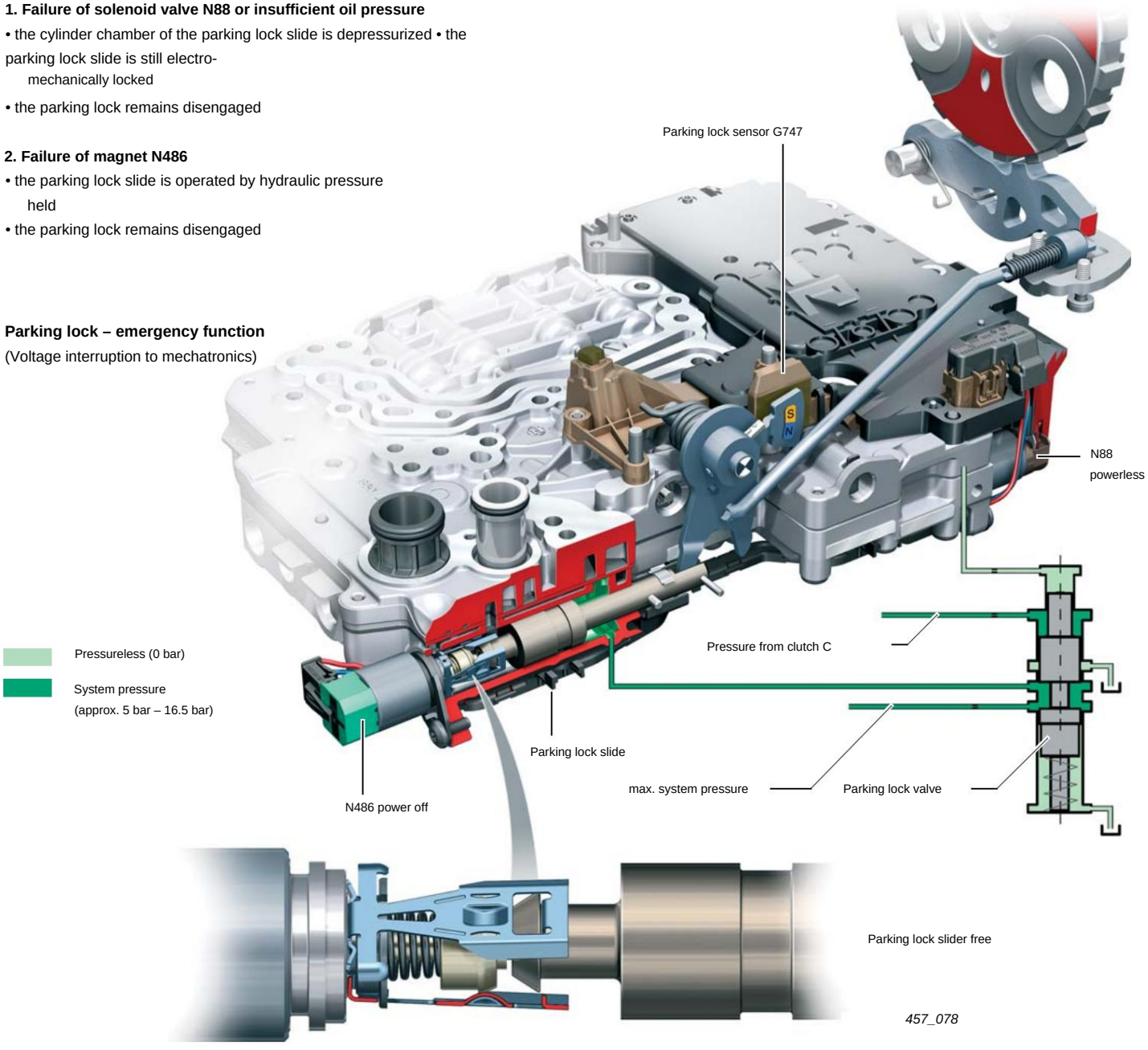
• the parking lock remains disengaged

2. Failure of magnet N486

• the parking lock slide is operated by hydraulic pressure
held

• the parking lock remains disengaged

Parking lock – emergency function
(Voltage interruption to mechatronics)



3. Voltage interruption to mechatronics (while driving)

If the voltage to the mechatronics is interrupted while driving, all electrically controlled functions of the transmission fail. The transmission then has no power transmission.

As long as the engine is running, the ATF pump provides the system pressure. The system pressure is switched to clutch C using a hydraulic emergency running circuit. The parking lock valve is connected to the pressure channel for clutch C. The clutch pressure C acts on the ring surface of the valve piston.

The parking lock valve is pushed into the working position against the spring force and system pressure reaches the cylinder chamber of the parking lock slide. The parking lock remains disengaged.

If the engine is switched off, the pressure in the system drops and the parking lock is engaged by the force of the spring on the parking lock lever. The emergency running circuit is designed so that when the engine is started again, clutch C and thus the parking lock system remain pressureless. The parking lock remains engaged.

Parking lock sensor G747

The position of the parking lock is monitored by the transmission control unit using a sensor, the parking lock sender G747.

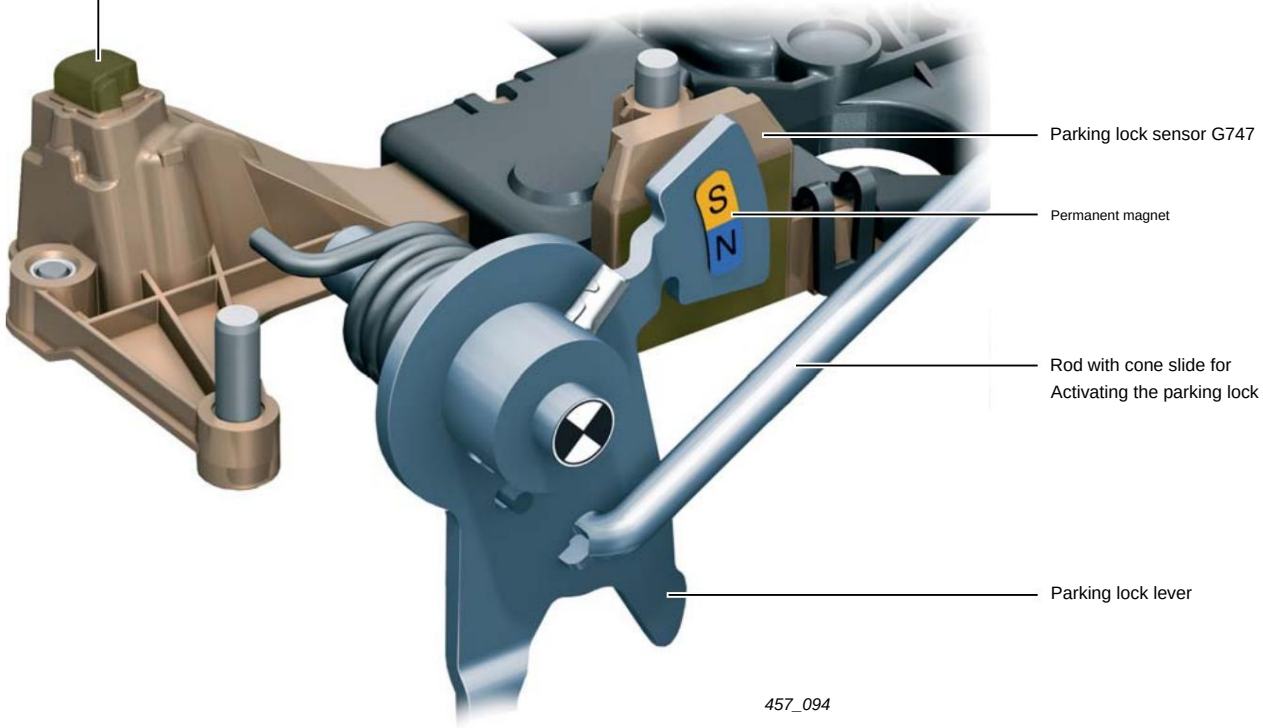
The G747 consists of two Hall sensors. The Hall sensors are switched by a permanent magnet on the parking lock lever.

The P sensor detects/recognizes the positions: P engaged —> intermediate position —> P **not** engaged.

The intermediate position does not normally exist in operation and is defined as an error after a defined filter time.

The parking lock sensor G747 has the following tasks:

1. Monitoring the correct functioning of the parking lock
2. Start release in P (the sensor signal is converted directly by the transmission control unit into the P/N signal
3. Display in the instrument cluster “Gearbox in position P”
4. Display in the instrument cluster when the parking lock is activated Emergency release



457_094

In case of failure or error (e.g. intermediate position) of the G747, the following measures/effects apply:

- Error message in the instrument cluster
- maximum system pressure is set (this ensures that the parking lock slide can work with maximum force)
- No indication in the instrument cluster that the parking lock is engaged (even if it is engaged).

Note on point 3, page 50:
In order for the emergency running circuit described under point 3 to work, clutch C or clutch E must first be activated. This is the case with one of the eight forward gears, see also the shift matrix on page 28.

If there is a voltage interruption while the vehicle is in gear R or N, the parking lock is engaged unless one of the two clutches has been activated beforehand as described above.

Functions – Stand decoupling

The standstill decoupling enables a significant reduction in consumption in city traffic. This is achieved by decoupling the torque loss from the converter when the engine is idling, in forward gear, when the vehicle is stationary and the brake is depressed. The engine idling torque is reduced to a minimum when stopping at traffic lights, for example. In addition to the fuel consumption benefits when the engine is idling, the acoustics and driving comfort are improved. Because the engine can run with less load, it runs more smoothly and quietly. The reduction to a small residual torque reduces the brake pedal force to a minimum.

The standstill decoupling on the 0BK and 0BL transmissions is achieved by opening the brake B. By opening the brake B the supporting torque on the ring gear 1 is removed. The force connection is diverted to brake B.

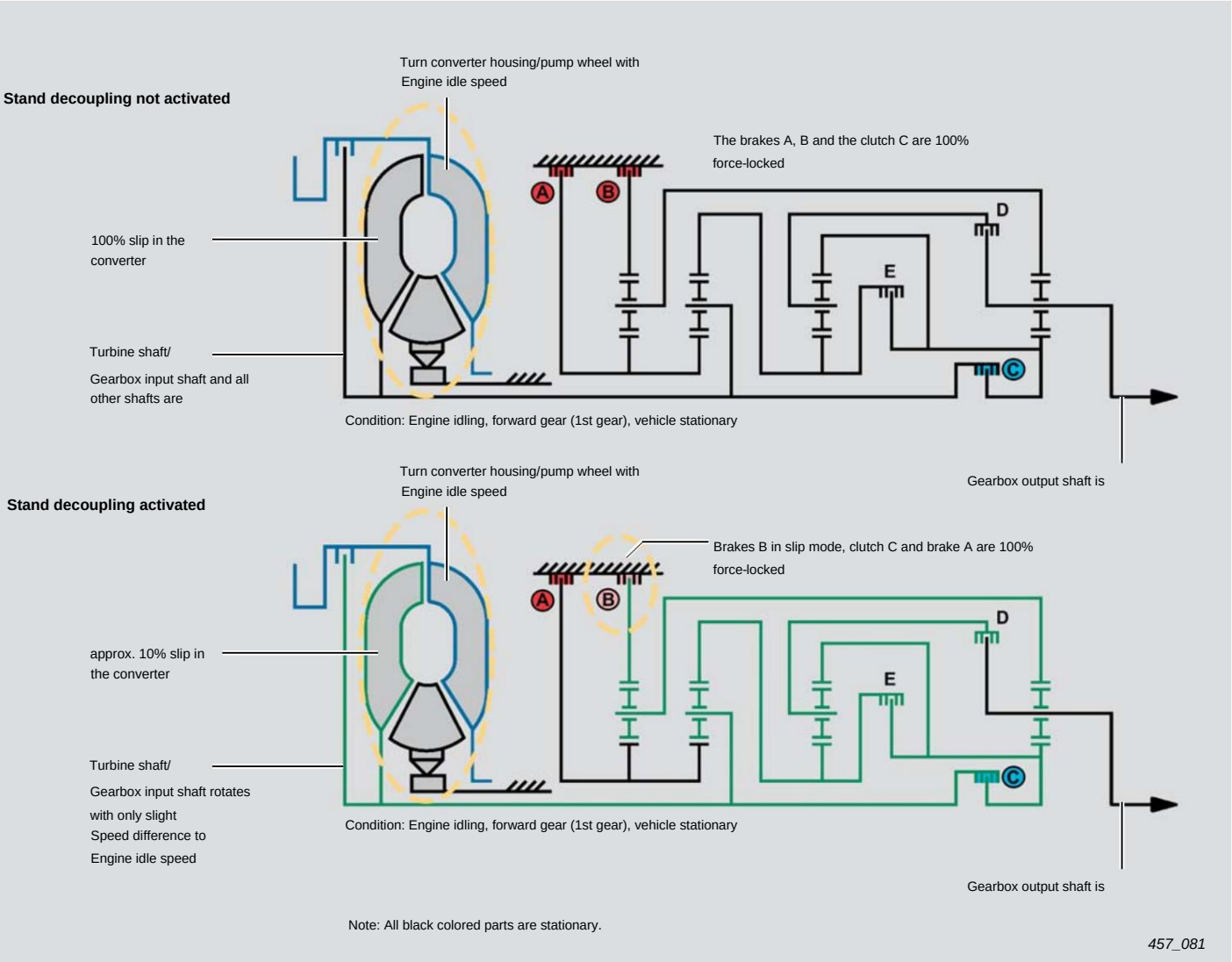
Brake B is operated with slip during standstill decoupling operation. Brake B has been dimensioned accordingly so that it can withstand the demands over the long term. In addition, it is specifically cooled via the hydraulic switching device when activated.

The standstill decoupling was introduced in a first generation of the 0B6 transmission (see SSP 385). Through consistent further development of the hardware and software, the standstill decoupling of the 2nd generation (in the 0BK and 0BL transmissions) can set new standards in terms of comfort and consumption.

In addition to reducing the converter residual torque, the response when closing the traction connection has also been improved.

The stand decoupling can be activated or deactivated by coding, see page 62.

The idle decoupling is also communicated under the name NIC (neutral idle control).



reference

The function of the stationary decoupling is described in detail in SSP 385 from page 36. Except for minor changes to the values shown, this description is also valid for the 0BK and 0BL transmissions.

Functions – Gearbox adaptation

The gearbox adaptation is described in detail in SSP 385 from page 54 and also applies to the 0BK and 0BL gearboxes. The 0BK and 0BL gearboxes have the new data and diagnostic protocol that was already used in the 0B6 gearbox, see SSP 385, page 35 and SSP 392, page 90. Therefore, pages 61 and 64 are relevant for the 0BK and 0BL gearboxes when it comes to reading/deleting adaptation values.

In order to ensure good shifting quality, it is necessary that the 5 shifting elements (brake A, B, and clutches C, D, E) are adapted accordingly.

For example, the adaptation values are deleted after a software update.
In this case, an adaptation drive must be carried out using the vehicle diagnostic tester. The process is precisely specified in the guided function or guided troubleshooting and is self-explanatory.

Deviating from the contents of SSP 385, the adaptation procedures and adaptation conditions are listed below as an overview for the 0BK and 0BL gearboxes.

The following adaptation procedures are used:

- Shift adaptation (during an upshift or downshift)
  The switching adaptation is mainly used for quick adaptation (start adaptation).

- Slip path adaptation

- Pulse adaptation (continuous adaptation of the switching elements)

Quick adaptation – switching adaptation (from 40 °C ATF temperature)2)

Brake A 6 —> 7 Circuit1)
Brake B 6 —> 5 coasting circuit
Clutch C 2 —> 3 gearshift1)
Clutch D 3 —> 4 gearshift1)
Clutch E 1 —> 2 and 5 —> 6 circuit1)

Rapid adaptation – slip path adaptation

(from 40 °C ATF temperature)2)

In stationary decoupling operation, an additional adaptation of brake B takes place by means of the slip path adaptation.
This adaptation takes about 7 seconds.

The quick adaptations and the pulse adaptations run in parallel. This means that depending on which conditions are met first, the corresponding adaptation is carried out – but as mentioned, the rapid adaptation is carried out a maximum of four times.

Pulse adaptation

(ATF temperature 50 °C – 110 °C)2)

Brake A — 6th gear-traction load: 80 – 180 Nm, turbine speed 1200 – 2100 1/min (Filling pressure/quick filling time)

Brake B — 7th gear-traction load: 80 – 180 Nm, turbine speed 1200 – 2100 1/min (only quick filling time, the filling pressure of brake B is increased during coasting circuit 6 —> 5 adapted)

Clutch C 4th gear-pull load: 30 – 100 Nm, turbine speed 1200 – 1700 rpm (filling pressure/quick filling time)

Clutch D 3rd gear-pull load: 30 – 100 Nm, turbine speed 1200 – 1700 rpm (filling pressure/quick filling time)

Clutch E 7th gear-pull load: 80 – 180 Nm, turbine speed 1200 – 2100 rpm (filling pressure/quick filling time)

Result of adaptation

The assessment of the switching quality is mandatory. The number of adaptations can be checked in the corresponding measured value (e.g. analysis 3 for the filling pressure adaptation of brake A). The counter readings should each have reached a value of at least 3. If necessary, individual switching elements can be adapted separately.

In principle, no vehicle should be handed over to the customer in which one or more switching elements are not adapted.

1) During upshifts, the shift elements can be adapted four times using the shift adaptation at a load of up to 150 Nm.

2) The “general boundary conditions” must also be observed in any case. Information on this can be found in SSP 385 in the description of the respective adaptation procedure.

Functions – Start-Stop system

For the first time, the V6 3.0 TDI features the start-stop function in conjunction with an automatic transmission.

The start-stop function presents a particular challenge for the automatic transmission. Start-stop operation requires an extremely short start and acceleration readiness time. To avoid any noticeable acceleration delay, the engine and automatic transmission must be ready to accelerate after approximately 350 ms.

An automatic transmission without appropriate design or measures on the oil supply cannot meet this requirement.

The problem with start-stop operation:

When the engine is switched off, the oil supply to the gearbox is disabled. The shift elements of the respective gear open and the power transmission is interrupted. When starting the engine,
the power transmission and thus the readiness to start
be restored. For the 8-speed automatic transmission, this means that three switching elements must be closed (see switching matrix).

The volume of oil pumped by the ATF pump during engine start-up is not sufficient to pressurize the switching elements within the required time and to establish sufficient traction.

In principle, the ATF pump could be designed to meet this requirement. However, such a pump would cause completely unacceptable losses even at low engine speeds.

Hydraulic Impulse Accumulator – HIS

457_082

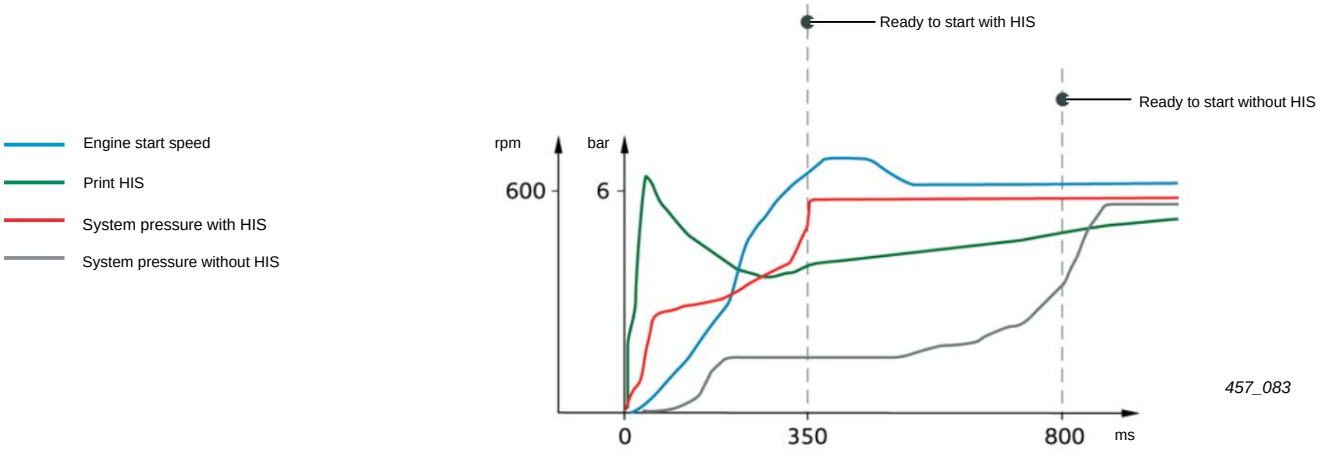
The hydraulic impulse accumulator has a usable volume of approx. 100 cm3.

The solution – the hydraulic impulse accumulator (HIS)

A highly efficient solution to this problem is achieved with the so-called “hydraulic impulse storage” (HIS).

The HIS is a special oil volume storage device with an electro-mechanical locking unit.

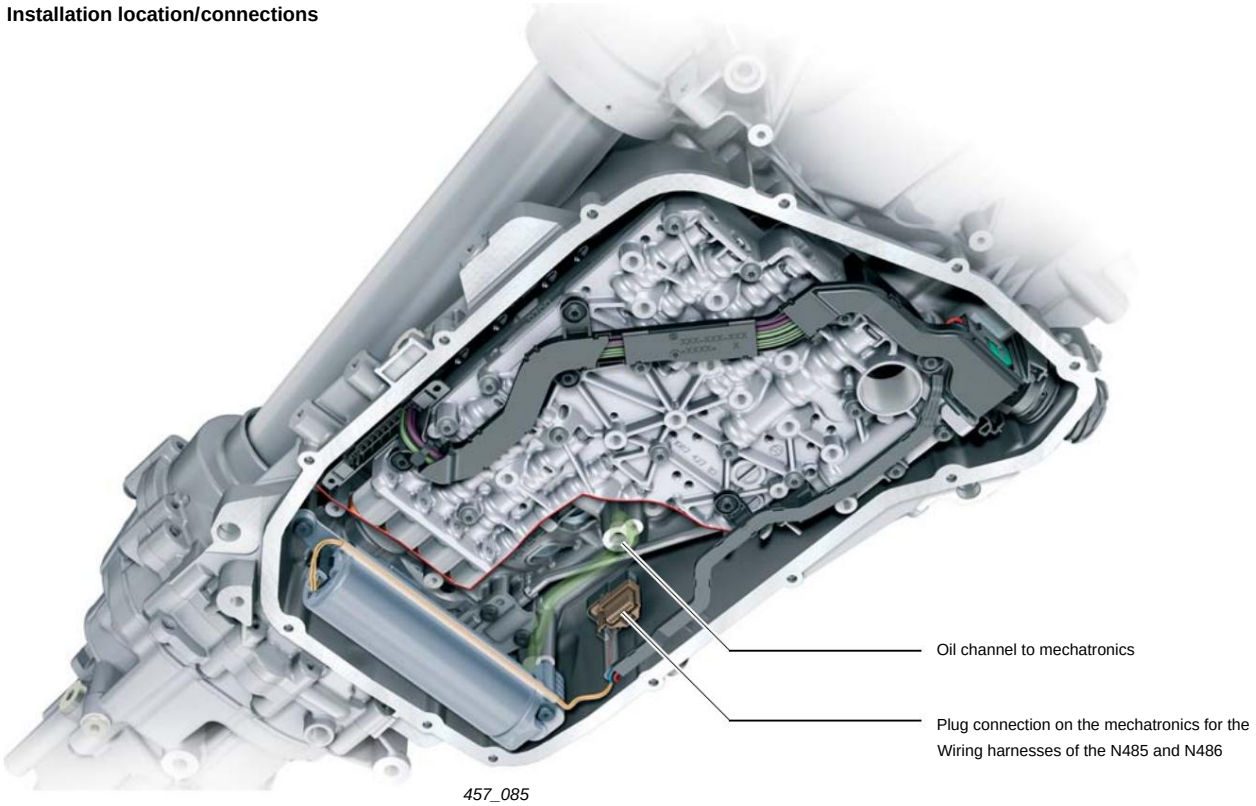
It is used to provide a transferable pressure for the switching elements in fractions of a second. With the
HIS achieves the required start-up time of approx. 350 ms in an ingenious way.



457_083

Comparison of start-up readiness with and without hydraulic impulse storage – HIS

Installation location/connections



457_085

The HIS is installed below the oil level. The piston spring accumulator cannot therefore run dry and always remains full when charged.

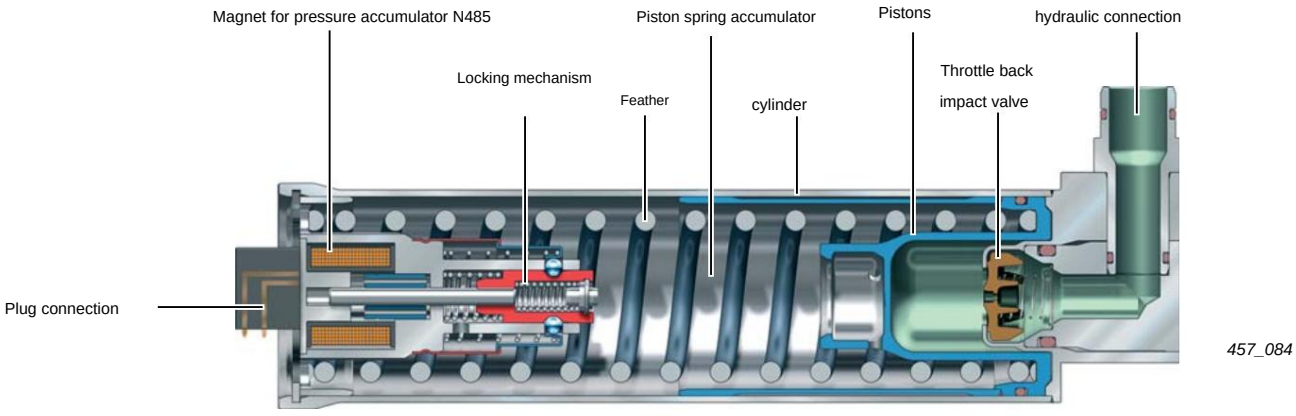
Layout and function

The HIS consists of the piston spring accumulator system, an electromechanical locking unit (magnet for pressure accumulator N485) and a throttle check valve. The piston spring accumulator consists of a piston, cylinder and steel spring.
The magnet N485 has the task of keeping the piston in the preloaded state (N485 energized).

The piston spring accumulator is "charged" when the engine is running. When starting, the magnet N485 is de-energized and the stored oil volume is pressed into the hydraulic control system by spring force (discharged).

As a result, the switching elements are already subjected to oil pressure when the ATF pump starts to pump.
The HIS supports the ATF pump and ensures lightning-fast pressure build-up.

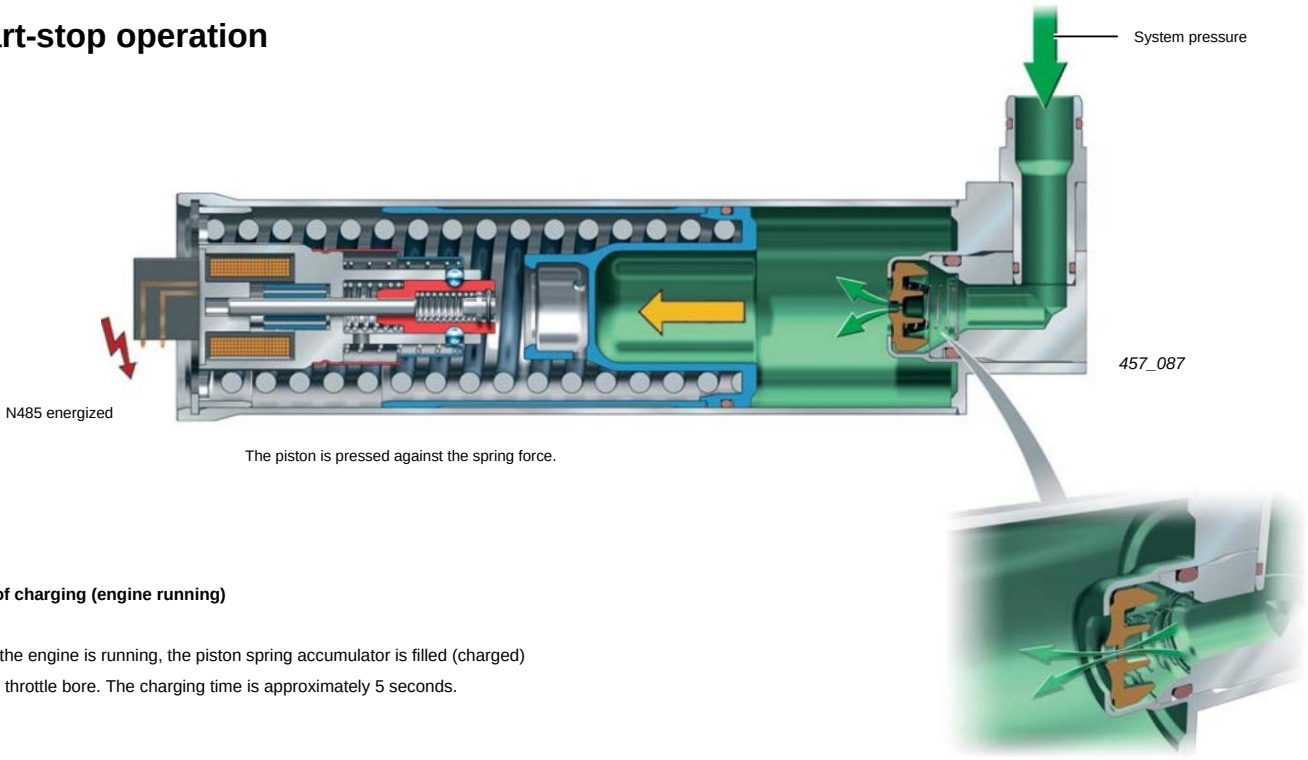
The pressure build-up by the HIS and the ATF pump overlap at the point when the pump delivers sufficient pressure. At this point, the charging process of the piston accumulator begins. To ensure that further pressure build-up is not disrupted by the charging process, the supply to the piston spring accumulator is throttled. This task is performed by the throttle check valve. The charging time is nevertheless very short at around 5 seconds (at 20 °C) and does not affect the start-stop operation.



457_084

Hydraulic impulse accumulator in empty state

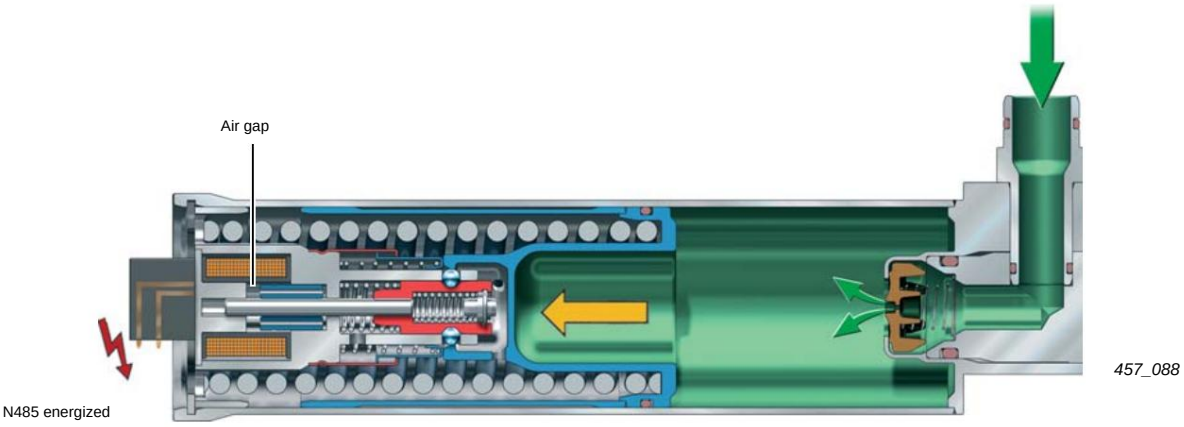
Start-stop operation



The piston is pressed against the spring force.

Start of charging (engine running)

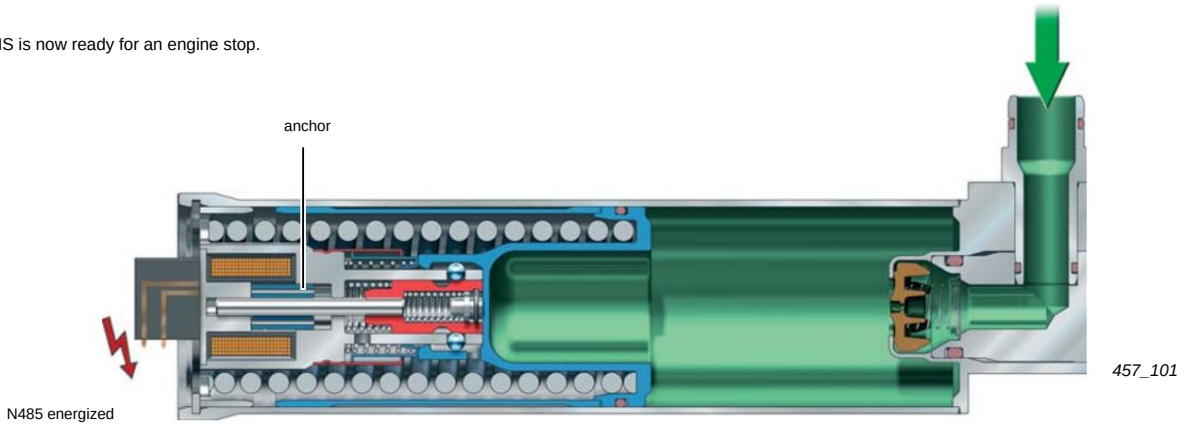
When the engine is running, the piston spring accumulator is filled (charged) via the throttle bore. The charging time is approximately 5 seconds.



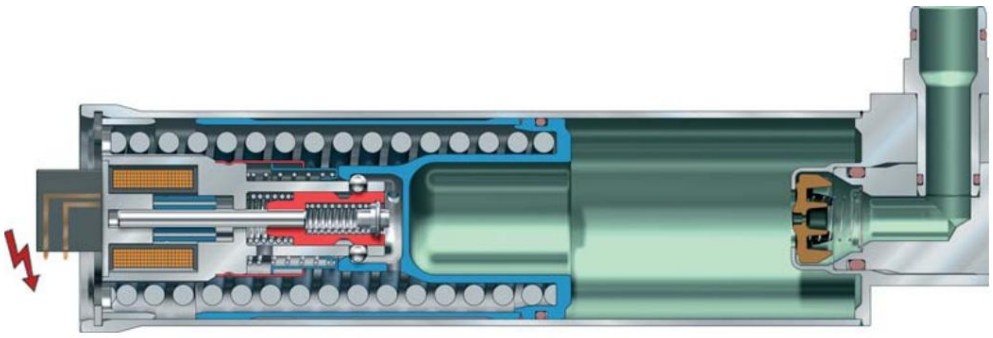
The piston overrides the ball locking mechanism.

When loading, the piston is pushed all the way to the left. The armature of the holding magnet is pushed into its final position required for locking and the air gap is overcome1). The balls are pushed out for locking and the magnet N485 can now hold the armature so that the piston remains locked.

The HIS is now ready for an engine stop.



HIS fully charged, piston is at the stop



457_089

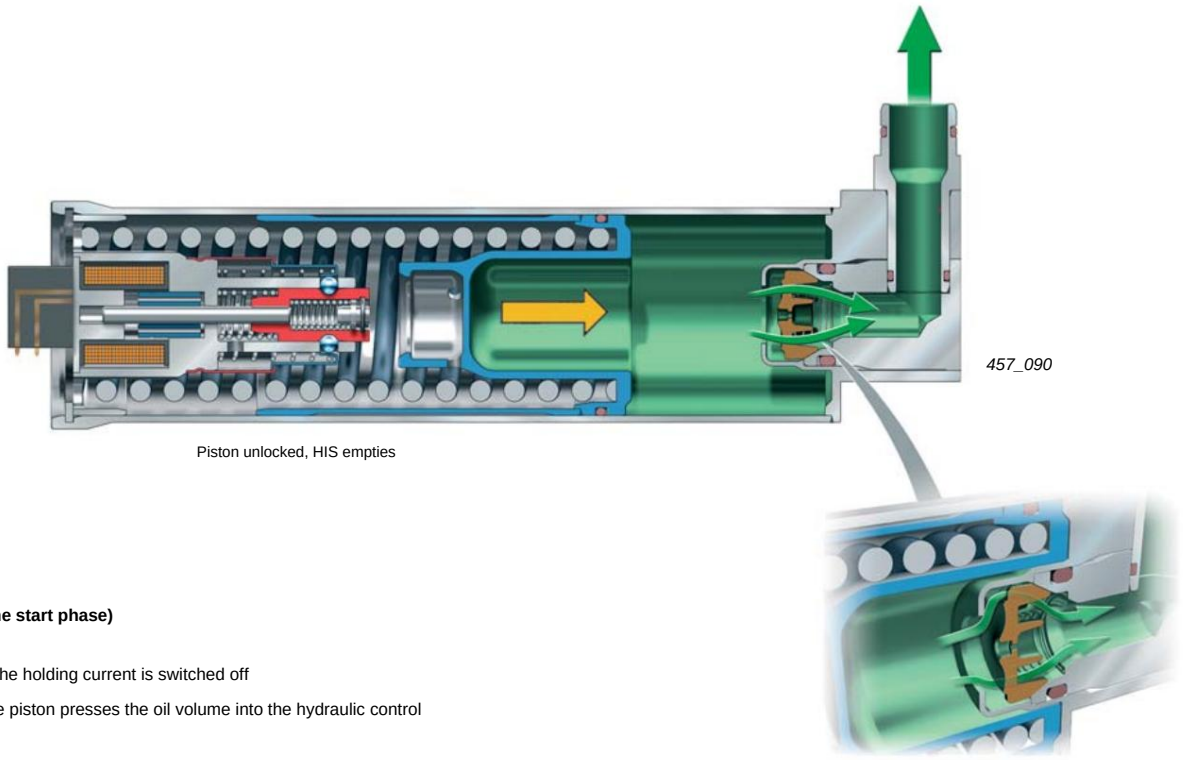
N485 energized

HIS fully loaded, piston locked

HIS is loaded (engine stopped)

When the engine is switched off, the system pressure and the pressure in the HIS drop. The oil volume in the HIS is depressurized.

The piston is now held by the ball locking mechanism.



457_090

N485 de-energized

Piston unlocked, HIS empties

HIS is discharged (engine start phase)

When starting the motor, the holding current is switched off

the piston is unlocked. The piston presses the oil volume into the hydraulic control to the switching elements.

The throttle check valve opens and releases a large cross-section.

1) The magnetic field generated by magnet N485 is not able to pull the armature against the spring force. Only when the piston pushes the armature all the way to the left until it stops (Figure 457_101) can the magnetic force hold the armature independently.

Functions – Navigation data-based gear selection

One innovation to improve the gear selection strategy is the inclusion of route data from the navigation system.

In the Audi A8 '10, the navigation system provides extensive information about the route ahead.
The transmission control uses information about the geometry of curves ahead (curvature, curve length, etc.) and whether you are driving inside or outside built-up areas.

This forecast of the route ahead makes it possible to significantly reduce the frequency of gear changes, for example when cornering. Another goal is to calculate the "ideal gear" when cornering or accelerating out of a corner.

In addition to increasing driving comfort through fewer gear changes, driving dynamics are also improved because the “ideal gear” is already present when accelerating out of a curve.

This innovation complements the previously known dynamic gearshift program DSP in a consistent and sensible way. The frequency of gearshifts is significantly reduced, especially when driving economically, because unnecessary upshifts before bends are prevented.

Navigation data-based gear selection is one of a series of functions of “navigation data-based vehicle assistance”. Further information on this topic can be found in SSP 456.

In specialist circles, this topic is communicated using the term “PSD” (predictive route data, predictive = predictable).

The following functions are provided by Transmission control unit executed:

Predictive upshift prevention before a curve

When the load is reduced (you take your foot off the accelerator) before the bend, the DSP shift program normally performs an upshift. A predictive assessment of the curve and knowledge of the distance to the relevant bend enable unwanted upshifts to be suppressed. Depending on the driving situation and the further course of the route, the gear is held or an appropriate gear is engaged, see page 60.

Active downshifting before/in the curve

When braking before a curve, a predictive
Calculation of the cornering speed limit and the “ideal” gear, an active downshift to the appropriate gear before the bend (and not only during the bend), see page 60.

Gradual upshifting when exiting the curve

The aim of this function is to avoid multiple upshifts after a bend.
Depending on the sportiness factor, the gears are held longer to avoid unwanted upshifts that follow one another too quickly, see

Page 60.

Limiting/reducing the driver type rating within built-up areas

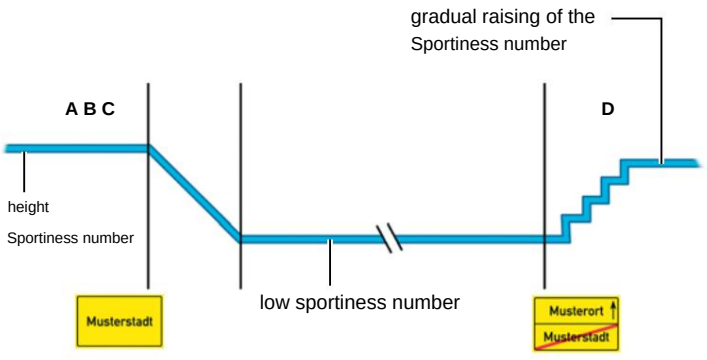
If you drive very sportily outside built-up areas, the DSP reacts accordingly and the driver type assessment calculates a high sportiness number.

This in turn leads to undesirably high gear shift speeds when entering a built-up area, as reducing the sportiness number normally takes a certain amount of time.

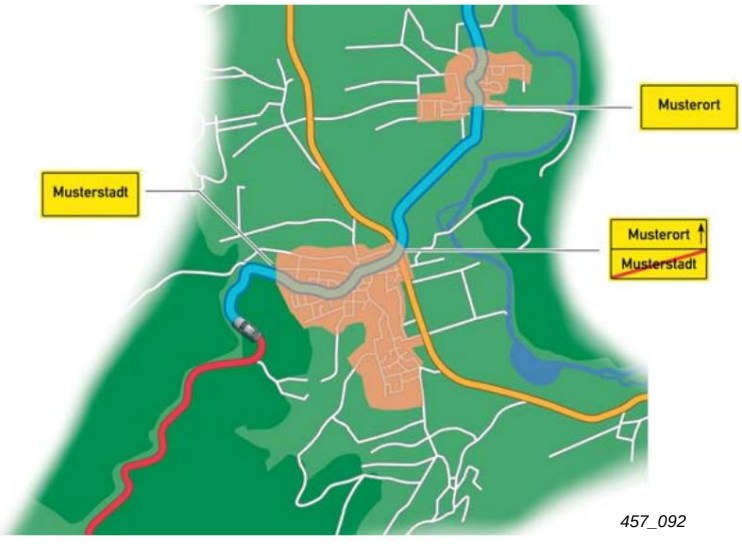
Knowing that the vehicle is entering a built-up area leads to a rapid reduction in the sportiness number. This prevents undesirably high engine speeds within a

town avoided.

Limiting/reducing the driver type rating within closed Places



457_093



457_092

A Driving outside the urban area with high sportiness rating
B Reaching the local area and quickly reducing the
Sportiness number (approx. 7 s)
C Driving within the urban area with reduced sporting
ity number
D Exit from the town area. Removal of the restriction of
Sportiness and increasing sportiness depending on driving style

Possibilities of navigation-based Gear selection

There are various requirements for the accuracy of the correct gear selection. On the one hand, the quality of the route data is crucial. On the other hand, it is important to consider how reliably the route ahead or the predetermined route corresponds to the route actually driven (reliably recognized route, probable route).

Quality of route data

The route data is not 100% reliable. This is because the data accuracy is not 100%. For example, the curvature of the curves (curve radius, vertex, distances) are sometimes not specified precisely enough. Another factor is the timeliness of the data.

This means that the route has changed over time and no longer corresponds to the available route data.

Certainly identified route – probable route

The navigation data-based gear selection weighs up how reliably the actual route can be predicted. A distinction is made between a "reliably recognized route" and a "probable route".

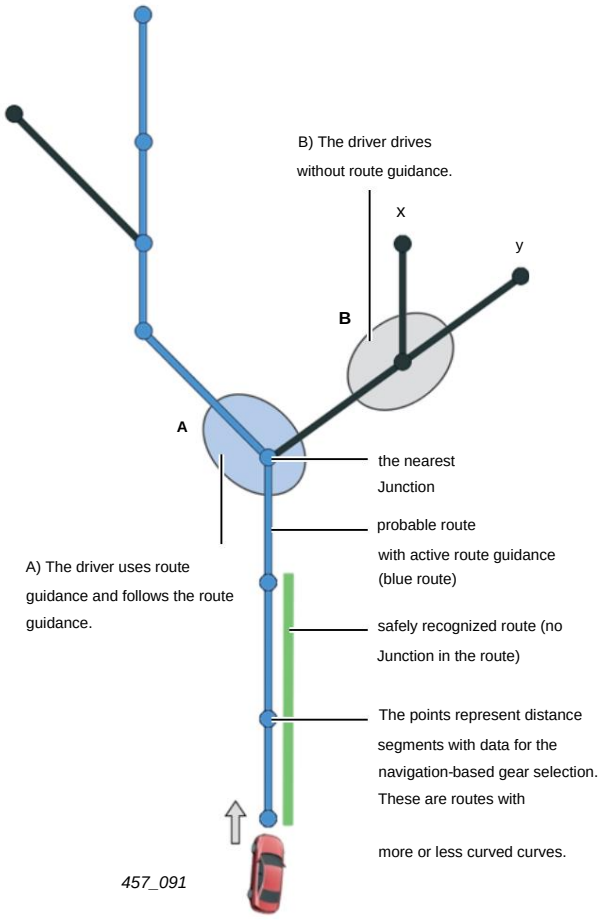
In principle, the navigation data-based gear selection works even if route guidance is not activated. However, active route guidance improves the function of the navigation data-based gear selection.

A **route that has been reliably identified** is characterized by the fact that there is no possibility of turning off in the section. The route is therefore clear and the calculation of the gear selection corresponds to the bends ahead.

A **probable route** is characterized by the fact that there are further route options in the foreseeable area (e.g. a branch).

When route guidance is active, a route is marked out that the driver is very likely to take. The route guidance then consists of sections with a reliably recognized route and a probable route.

Schematic representation of the predictable route area with active route guidance, "predictable route tree"



to A) in picture 457_091

If **route guidance is active,** the route guidance route specified by the navigation system becomes a "probable route". In this case, gear selection is made using the route data for the route guidance route. When route guidance is active, it is not guaranteed that the driver will follow the route guidance precisely. For this reason, active downshifts only occur when the brake is applied with sufficient force.

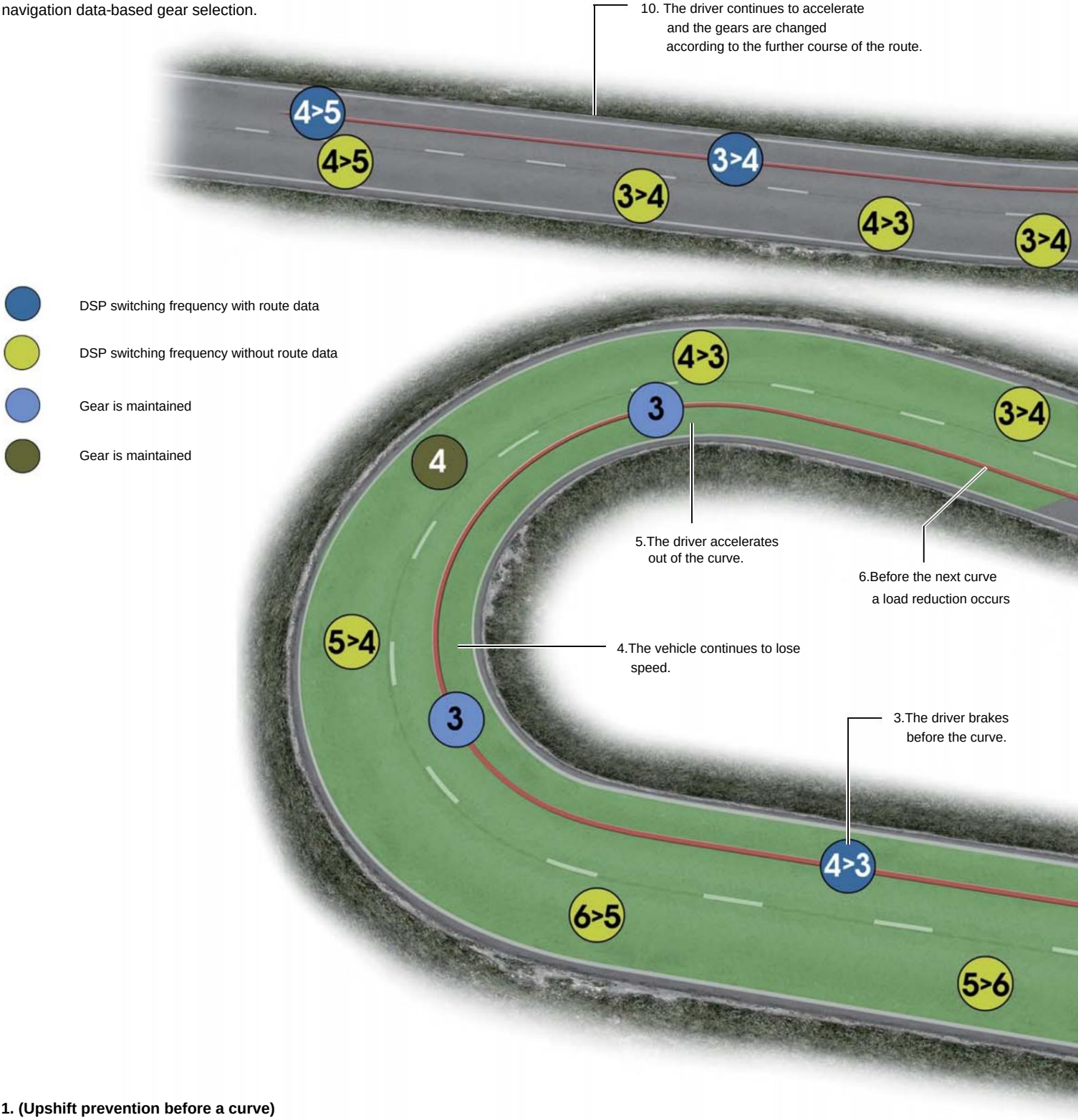
to B) in picture 457_091

If **route guidance is not active,** the junctions on the route are taken into account. In this case, the gear selection is made according to the route with the greatest possible curve (or a straight line). This means that if the driver turns in direction x, the gear selection is made as if the driver were driving in direction y.

Navigation data-based gear selection – functional example

The functions and the driving situation are illustrated using an example route. The gear selection and

Shift frequency compared with a vehicle with and without navigation data-based gear selection.



1. (Upshift prevention before a curve)
The transmission control unit has detected a curve ahead and its course and can use this to calculate the “optimal gear selection”. Unnecessary gear shifts are thus suppressed.

2. (Keep gear)
The transmission control unit holds the gear because the following curve has already been recognized and an upshift would not make sense (upshift prevention).

To 3 - 5. (active downshifting, holding gear)
The cornering speed limit and the "ideal gear" (in this case 3rd gear) have already been calculated. If the brakes are applied accordingly, 3rd gear is engaged before the corner. This gear can be maintained during the cornering and is available as the ideal gear for accelerating out of the corner.

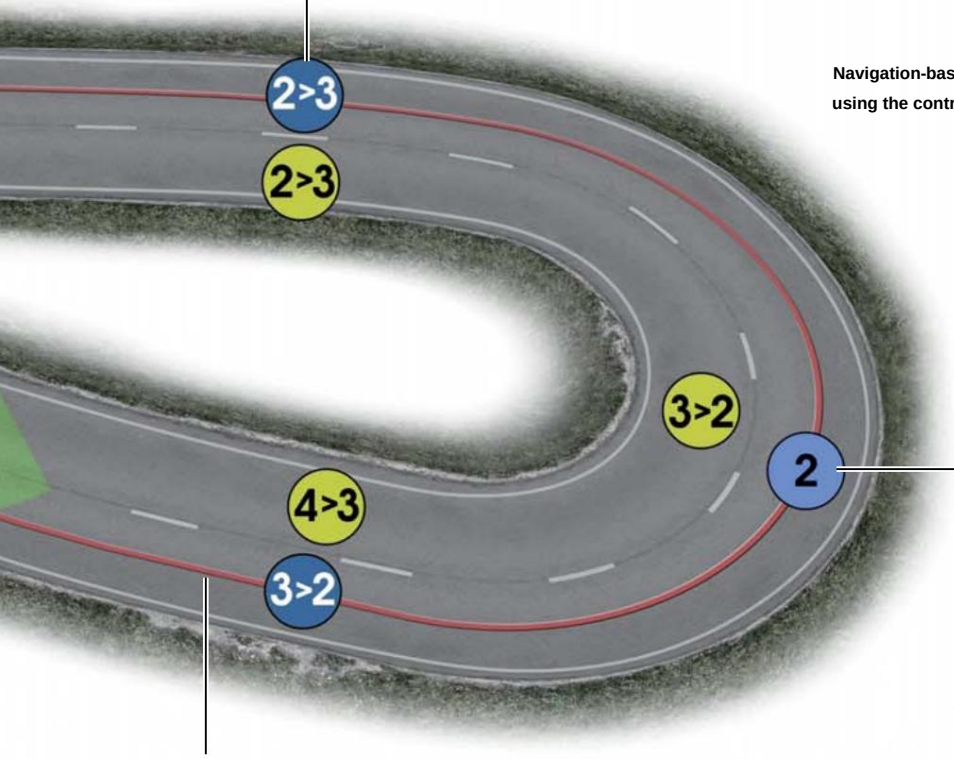
To 10. (Stepped upshift)

The transmission control unit detects a longer straight stretch of road. This prevents the gears from shifting up too quickly.
This prevents unwanted downshifts when accelerating.

9.The driver accelerates out of the curve.

Navigation-based gear selection is currently only available in Europe.

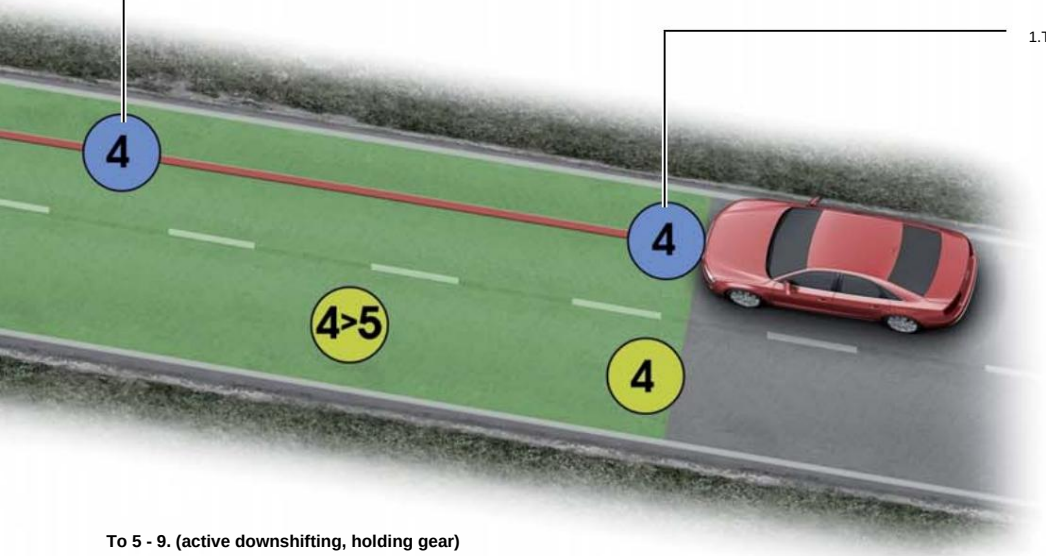
Navigation-based gear selection can be activated or deactivated using the control unit coding, see page 63.



8.The driver drives through the curve with low Acceleration.

7.The driver brakes before the curve.

2.The curve comes closer, the driver continues to ease off the accelerator until the vehicle is in coasting mode.



1.The starting situation is a winding road: After a bend, the driver drives to the next bend until

accelerates into 4th gear. The driver sees that a right-hand bend is coming and takes his foot off the accelerator (reduce the load).

457_103

To 5 - 9. (active downshifting, holding gear)

Knowing that another, even tighter curve is immediately ahead prevents you from upshifting on the straight section of the track.

The next curve is much tighter, and the driving speed at which the curve can be taken is correspondingly lower.

The transmission control unit now calculates 2nd gear as the ideal gear and shifts back into this gear before the bend. An unwanted downshift directly in the bend is prevented.
This gear can be maintained throughout the curve and is already available as an ideal gear for accelerating out of the curve.

Functions – Indicators/Warnings

System malfunctions or protective functions of the transmission are indicated in the instrument cluster by means of an indicator lamp (transmission fault symbol) and a corresponding driver information text. The following warnings and information notices may be displayed.

Display 1

symbol		This display appears when there are errors that the driver may not notice because the transmission control unit can use a corresponding substitute signal (substitute program). There are no or only minor functional restrictions. The warning is intended to encourage the driver to visit a specialist workshop at the next opportunity.
text	**Transmission: system malfunction. further drive possible**	

Display 2

symbol		When this display appears, the transmission has activated an emergency drive program that holds the gear until either the gear is switched to neutral or the engine is turned off. After the gear is re-engaged or the engine is restarted, the vehicle will no longer drive.
text	**Transmission: system malfunction. Continue driving in Germany until engine off is still possible**	

Display 3

symbol		This display indicates a system fault where the transmission can only shift certain gears or not at all (a defined gear is held). Driving can be very limited (e.g. no starting on inclines, limited acceleration or speed).
text	**Transmission: system malfunction. Further travel only possible to a limited extent**	

Display 4

symbol		This display indicates a system fault where the transmission can only shift certain gears or not at all (a defined gear is held). Driving can be very limited (e.g. no starting on inclines). Reversing is not possible because the transmission cannot shift into reverse.
text	**Transmission: system malfunction. Further travel is only possible to a limited extent. No reverse gear**	

Display 5

symbol		This driver message appears when the parking lock emergency release is activated. In addition, the neutral position “N” is displayed.
text	**Danger of rolling away! P not possible. Please apply the parking brake.**	

Display 6

symbol	without symbol **(with warning tone)**	This driver message appears together with a warning tone if the transmission position P is not engaged after the ignition is switched off.
text	**Vehicle can roll. Gearbox not in P.**	

Functions – Special features for adaptive cruise control (ACC) operation

In order to provide the greatest possible starting comfort in ACC mode, the vehicle only shifts down to 2nd gear when stopping.
The vehicle then starts off in second gear. This makes the starting process smoother and eliminates the need for gear changes.

From a defined gradient, the vehicle shifts down to 1st gear. The vehicle then starts off in 1st gear so that the full traction power is available.

Functions – Coding automatic transmission control unit J217

The following functions can be switched on or off in the transmission control unit by coding:

1st position Country/variant coding 2nd position* Standstill decoupling	1 = RdW, 2 = USA 1 = active, 0 = not active
3rd position* Forced upshift before engine speed cut-off	1 = active, 0 = not active
4th position* tiptronic function in D/S 5th position not used	1 = active, 0 = not active
6. Position** navigation data based Gear selection	1 = active, 0 = not active

6-digit coding: **XXXXXX**
6. 5. 4. 3. 2. 1.

Note: The control unit must be coding via the software version management.

Conversion from coding variants to adaptation functions

* As of MY2012, the following functions for gearboxes 0BK and 0BL have been switched from coding to adaptation:

Coding 2nd position: Stand decoupling (see SSP 385, p. 36)
Adjustment: “neutral_idle_control”
Coding 3rd position: Forced upshift before engine speed cut-off
Adjustment: “enforced_shift_up”
Coding 4th position: tiptronic function in D/S (see SSP 283, p. 23)
Adjustment: “tiptroic_switch_in_steeing_wheel”

** The coding variant “navigation data-based gear selection” (6th position) was converted to an adaptation function immediately after the market launch (adaptation: “Route data” predictive route data).

Note: Once the adjustment functions have been made, they remain unchanged during a software update. If the mechatronics are renewed, the adjustments may need to be readjusted if they are to deviate from the factory settings.

Functions – Adjust gear display

Using the adjustment in the transmission control unit, you can select whether the current gear should be displayed in the instrument cluster in addition to gears D and S. In tiptronic mode, the gear display is always active.

The gear indicator can be switched on or off separately for gears D and S. The gear indicator is activated on vehicles for the RdW markets. The gear indicator is deactivated on vehicles for the US market. After replacing the mechatronics or after a software update, it is necessary to check whether the gear indicator is correctly adjusted.

Functions – emergency and replacement programs

The 0BK and 0BL gearboxes do not have a hydraulic-mechanical emergency running function. This means that there is no drive without a power supply, see page 43. The emergency running and backup programs have been updated to reflect the latest technical possibilities, which ensures a high level of operational readiness in the event of a fault.

tow away

If a vehicle with a 0BK or 0BL transmission needs to be towed, the usual Audi restrictions for automatic transmissions must be observed:

- Activate the parking lock emergency release
- The towing speed must not exceed 50 km/h.
- The maximum towing distance must not exceed 50 km.
- The vehicle must not be towed with the front or rear axle raised.

Reason:
When the engine is stopped, the oil pump is not driven and certain parts in the gearbox are not lubricated. Failure to comply with the towing conditions can therefore result in serious gearbox damage.

Note: Please note the further descriptions and instructions on towing and towing in the operating instructions.

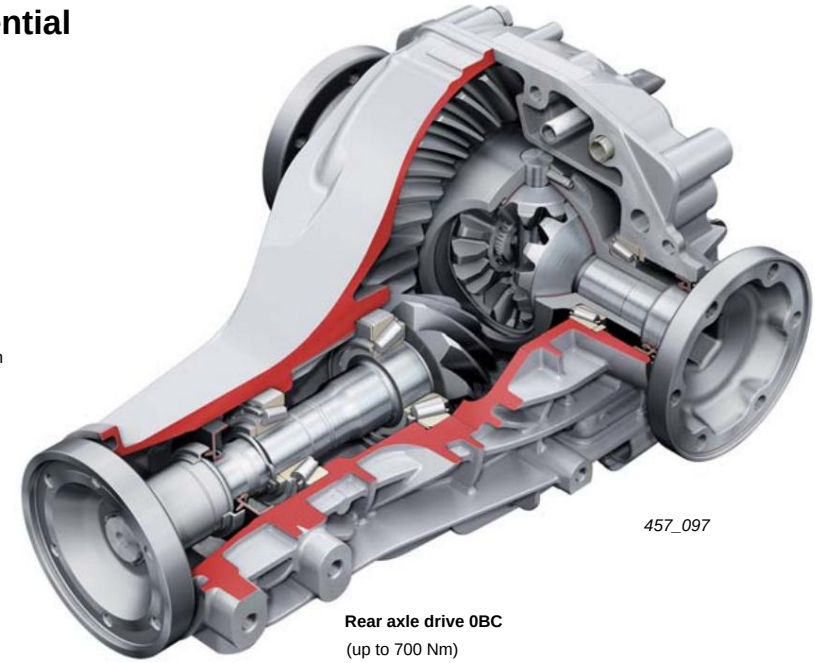
Important NOTE
In order to permanently release the parking lock when towing the vehicle, the emergency release of the parking lock must be activated. If this is not observed, the parking lock can be engaged while driving. The parking lock cannot engage at speeds over 7 km/h (for mechanical reasons), but will be mechanically damaged, see page 50.

Rear axle drive 0BC/0BF/0BE

Conventional rear axle drive/sport differential

All engines except the 4.2l TDI engine and the S models have the conventional 0BC rear axle transmission as standard. The 0BF sports differential, which was first used in the Audi S4 in early 2009, is available as an option.

Vehicles with a 4.2l TDI engine are equipped with a sports differential 0BE as standard. The main innovation in the sports differential is the connection of the all-wheel drive control unit J492 to the FlexRay data bus. This enables a significant increase in performance in all aspects of control. The J492 receives the relevant current information on vehicle dynamics from the sensor electronics control unit J849 via the FlexRay data bus, see SSP 458 and SSP 459.



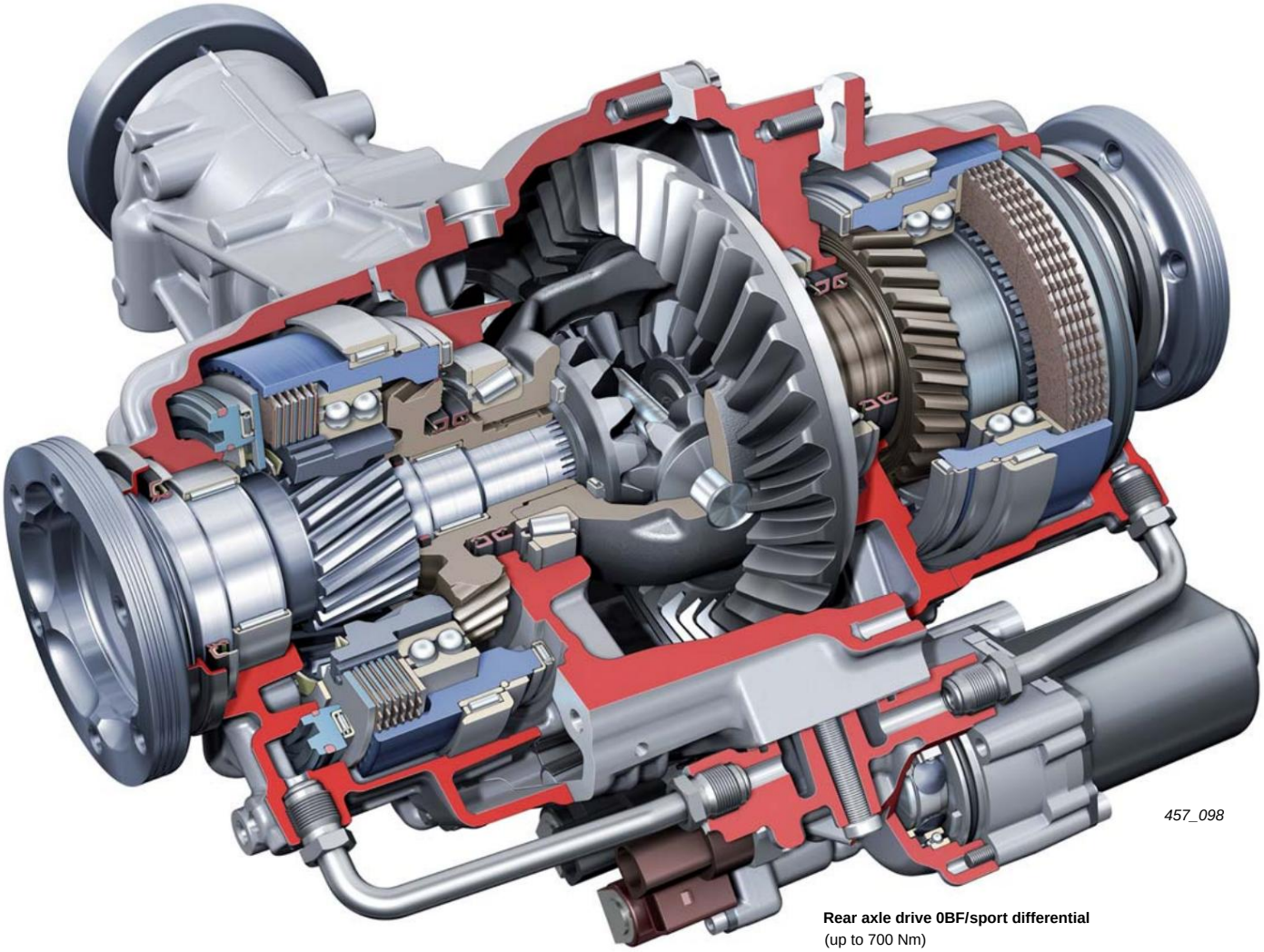
457_097

Rear axle drive 0BC
(up to 700 Nm)

Sports differential with traction function

From the production date week 32/2010, the sport differential in the Audi A8 '10 will be enhanced with a special traction function. Additional drive torque is directed to the wheel with the higher traction capability. This means that if the left rear wheel spins, the drive torque of the right (stationary) wheel is increased by controlling the right superposition unit. The traction function is only activated at a driving speed of around 15 km/h and therefore does not provide any starting aid.

The function improves driving dynamics when road friction values vary greatly because the power is shifted to where it can be effective. An EDS braking intervention, which results in a loss of power, is not necessary in this situation.



457_098

Rear axle drive 0BF/sport differential
(up to 700 Nm)

Rear axle drive 0BE/sport differential

The new 0BE sports differential is used with the 4.2l TDI engine. The sports differential corresponds to the 0BF sports differential in terms of function and structure. The left and right superposition units and the electro-hydraulic control have also been adopted from the 0BF.

In order to cope with the high torque of the 4.2l TDI engine (800 Nm), the components of the drive train, crown wheel, pinion, differential, bearings and all housing parts are dimensioned accordingly larger. This makes the 0BE gearbox around 45 mm wider than the 0BF gearbox.

Audi iTV training

You can find information about the sports differential in the following four Audi iTV programs:

Audi quattro with sports differential 0BF Part 1
Content: Mode of operation, driving dynamics with sports differential
Operation, mode of operation and function

Audi quattro with sports differential 0BF Part 2
Contents: Construction and function
Oil management and electro-hydraulic control

Audi quattro with sports differential 0BF Part 3
Contents: Repairs to the sports differential

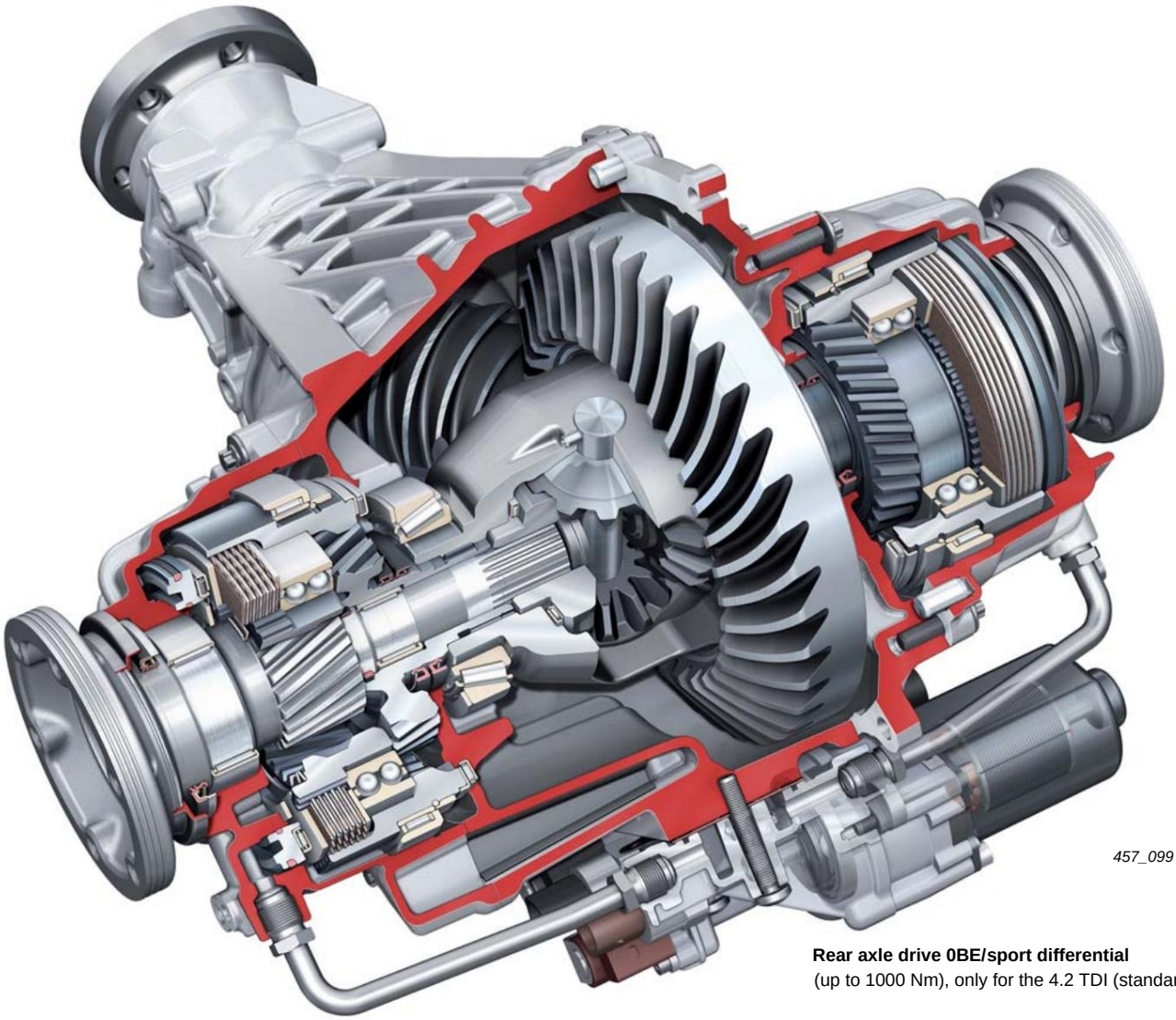
Audi quattro with sports differential 0BF Part 4
Contents: Working and testing with the vehicle diagnostic tester

In addition to the four programs, you can find further information in the answers to the frequently asked questions for each program.

If the depth of repair is expanded accordingly, further shipments will be created.

Notice

Detailed information on the sports differential can be found in the self-study program 476 Rear axle drive 0BF/0BE - sports differential.



457_099

Rear axle drive 0BE/sport differential
(up to 1000 Nm), only for the 4.2 TDI (standard)

Wheel-selective torque control

From the third quarter of 2010, the Audi A8 '10 will be equipped with the new "wheel-selective torque control".

The wheel-selective torque control is an extension of the well-known EDL function (electronic differential lock). In contrast to the EDL control, the electronic differential lock is active when cornering and intervenes before critical wheel slip occurs.

For this purpose, the control system calculates the relief of the inside wheels and the load on the outside wheels when cornering. This calculation is based primarily on the measured values from the steering angle and lateral acceleration sensors. The ESP control unit uses this to determine the optimum brake pressure for the inside wheels.

Wheel-selective torque control - mode of operation/function

When cornering, a support torque is built up on the inside wheels by targeted braking interventions. This transfers additional drive torque to the outside wheels

Traction in curves is significantly improved. The vehicle reaches higher cornering speeds and has precise and accurate handling. Agility when turning into curves and during steering maneuvers is also significantly improved.

sert.

As already mentioned, the system reacts to the change in wheel load and not to wheel slip. The required brake pressure is relatively low at 5 - 15 bar, which only places a small load on the brake and protects the material.

The wheel-selective torque control enables driving dynamics at the highest level while at the same time ensuring low system complexity and high driving comfort.

Vehicles with the standard rear axle drive 0BC have **wheel-selective torque control** on the front and rear axles.
In vehicles with a sports differential, the wheel-selective torque control only affects the front axle.

Basics

The driving physics are basically such that the maximum transferable drive torque increases with increasing lateral acceleration at the outer wheels of the curve, while it decreases by approximately the same amount at the inner wheels.

The reason for this is the effect of centrifugal force, which acts on the vehicle's center of gravity and whose line of action runs to the outside of the curve. A so-called rolling moment is created on the vehicle, which is supported by the wheels. This rolling moment reduces the wheel load on the inside wheels and increases the wheel load on the outside wheels. As a result, the inside wheels can only transmit lower torques than the outside wheels.

The open axle differentials distribute the drive torque in the Ratio 1:1 on both wheels of one axle. So takes the maximum times the torque that can be transmitted to the wheel driven on the inside of the curve, only an equally large torque can be transmitted to the wheel driven on the outside of the curve - even though the greater wheel load effective there would allow a significantly higher drive torque.

If the drive torque at the inside wheel breaks off, the entire drive torque in the drive train breaks down.

Self-study programs for the Audi A8 '10

This self-study program summarizes all important information on the power transmission of the Audi A8 '10.
Further information on the Audi A8 '10 can be found in the following self-study programs.

SSP 456 Audi A8 '10

- Bodywork
- Passive/Active Safety
- Engine
- Landing gear
- Electrics/Air Conditioning/Infotainment

Order number: A10.5S00.60.00

SSP 458 Audi A8 '10 Chassis

- Front axle/rear axle
- adaptive air suspension
- Dynamic steering
- Brake system

Order number: A10.5S00.62.00

457_104

457_105

SSP 459 Audi A8 '10 On-board network and networking

- Topology
- FlexRay
- Lighting system
- LED headlights

Order number: A10.5S00.63.00

457_106

SSP 460 Audi A8 '10 comfort electronics and Audi tracking assistant

- Control unit in the dashboard insert J285
- Comfort control unit J393
- Ambient lighting
- Audi tracking assistant

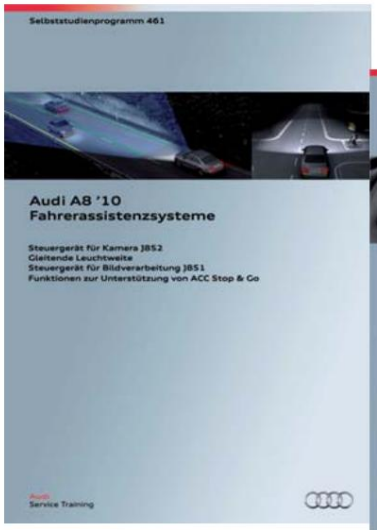
Order number: A10.5S00.64.00

457_107

SSP 461 Audi A8 '10 Driver Assistance Systems

- New image processing system
- Control unit for camera J852
- Adjustable beam range with navigation support
- Image processing control unit J851
- Functions of the image processing system for ACC Stop & Go

Order number: A10.5S00.65.00

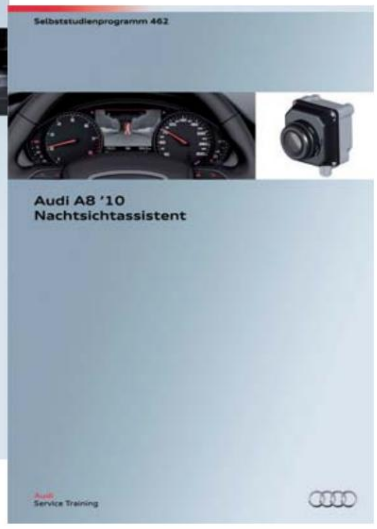


457_108

SSP 462 Audi A8 '10 Night Vision Assistant

- Night vision assistant function
- Operation and display of the system
- System components
- System overview
- Diagnostic scope and system calibration

Order number: A10.5S00.66.00



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