The 0BZ 7-speed Dual Clutch S tronic Transmission in the 2017 R8

Self Study Program 950173

Audi Academy

Audi of America, LLC
Service Training
Created in the U.S.A.
Created 11/2016

Course Number 950173

Always check Technical Bulletins and the latest electronic service repair literature for information that may supersede any information included in this booklet.

Revision:11/2016

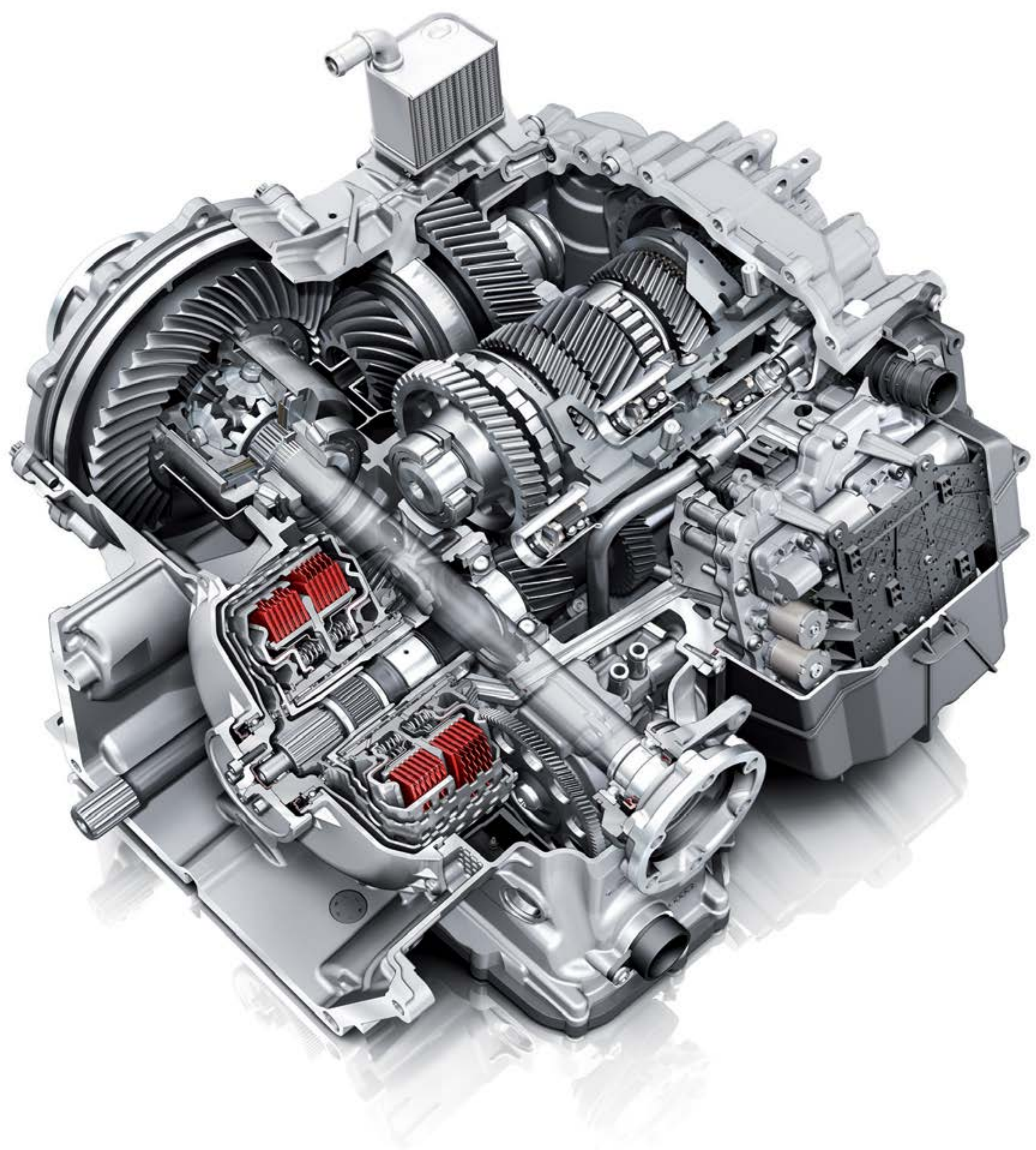
Note

Reference

The new 0BZ S tronic 7-speed dual clutch transmission is a truly sport-oriented gear box. Shifting occurs virtually without interrupting the power transmission.

The seven speeds provide a wide spread of ratios which reduce fuel consumption while retaining a close ratio configuration for better acceleration. It offers agility and easy gear shifting to meet customer expectations in terms of handling dynamics and driver convenience.

To review the basic functions of a dual clutch transmission with electro-hydraulic controls, please refer to eSelf-Study Program 951403, The 02E Direct Shift Gearbox, Design and Function.



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Learning objectives of this eSelf-Study Program:

After you have completed this eSelf-Study Program, you will be able to answer the following questions:

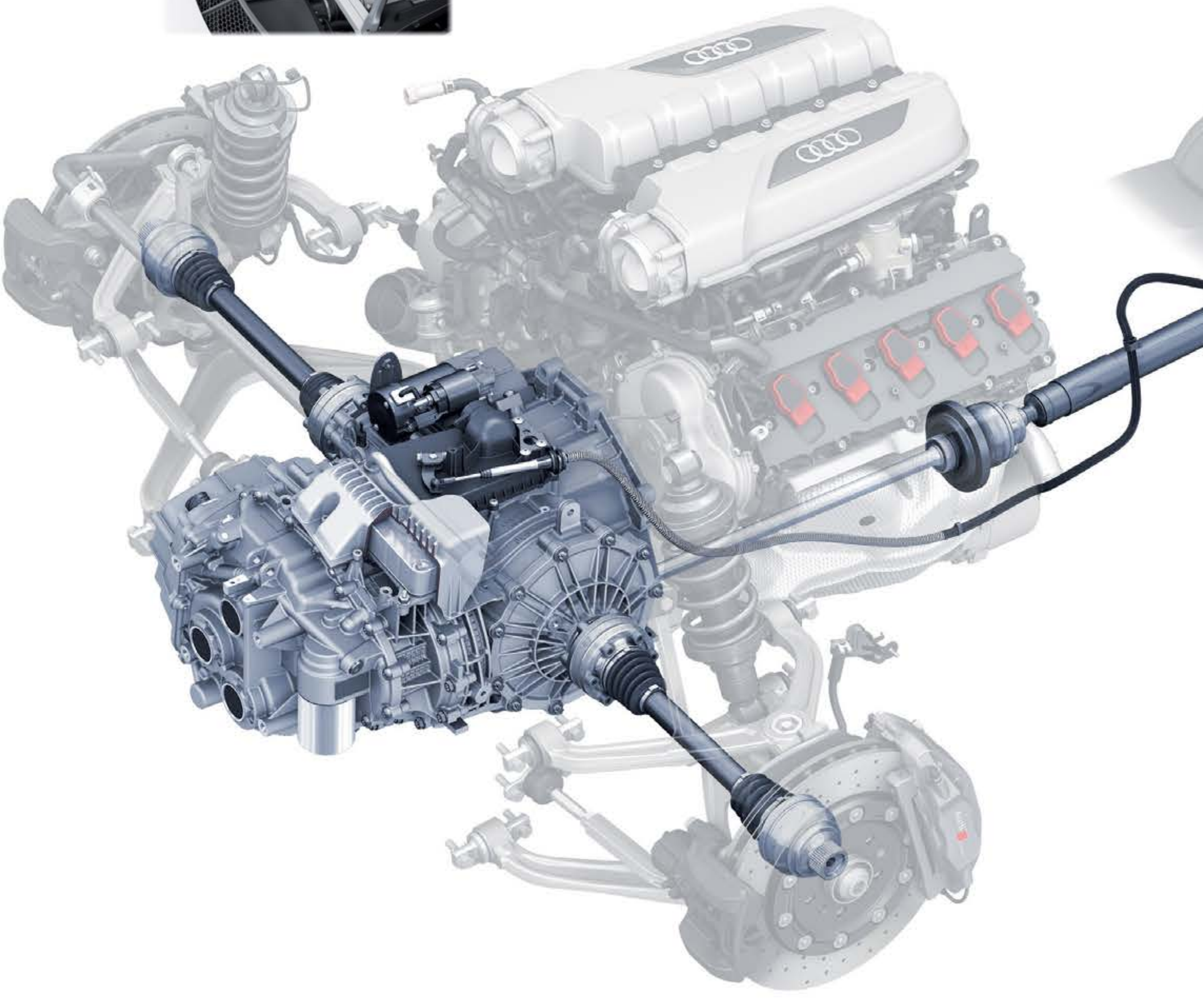
- What is the design of the 0BZ 7-speed dual clutch transmission?
- How does the 0BZ 7-speed dual clutch transmission function?
- How does the 0BZ 7-speed dual clutch transmission differ from the dual clutch transmission we are already familiar with?

Overview

The OBZ 7-speed dual clutch transmission is being offered for the first time in the North American market on the 2017 Audi R8.

The power to the front wheels on the 2017 R8 is via the new OD4 front final drive with an electro-hydraulic multi-plate clutch. For more information about this final drive, please refer to eSelf-Study Program 950163, Front Final Drive OD4 Design and Function.

The drive response and handling dynamics can be varied using Audi drive select to suit the driver's preference. See page 14.



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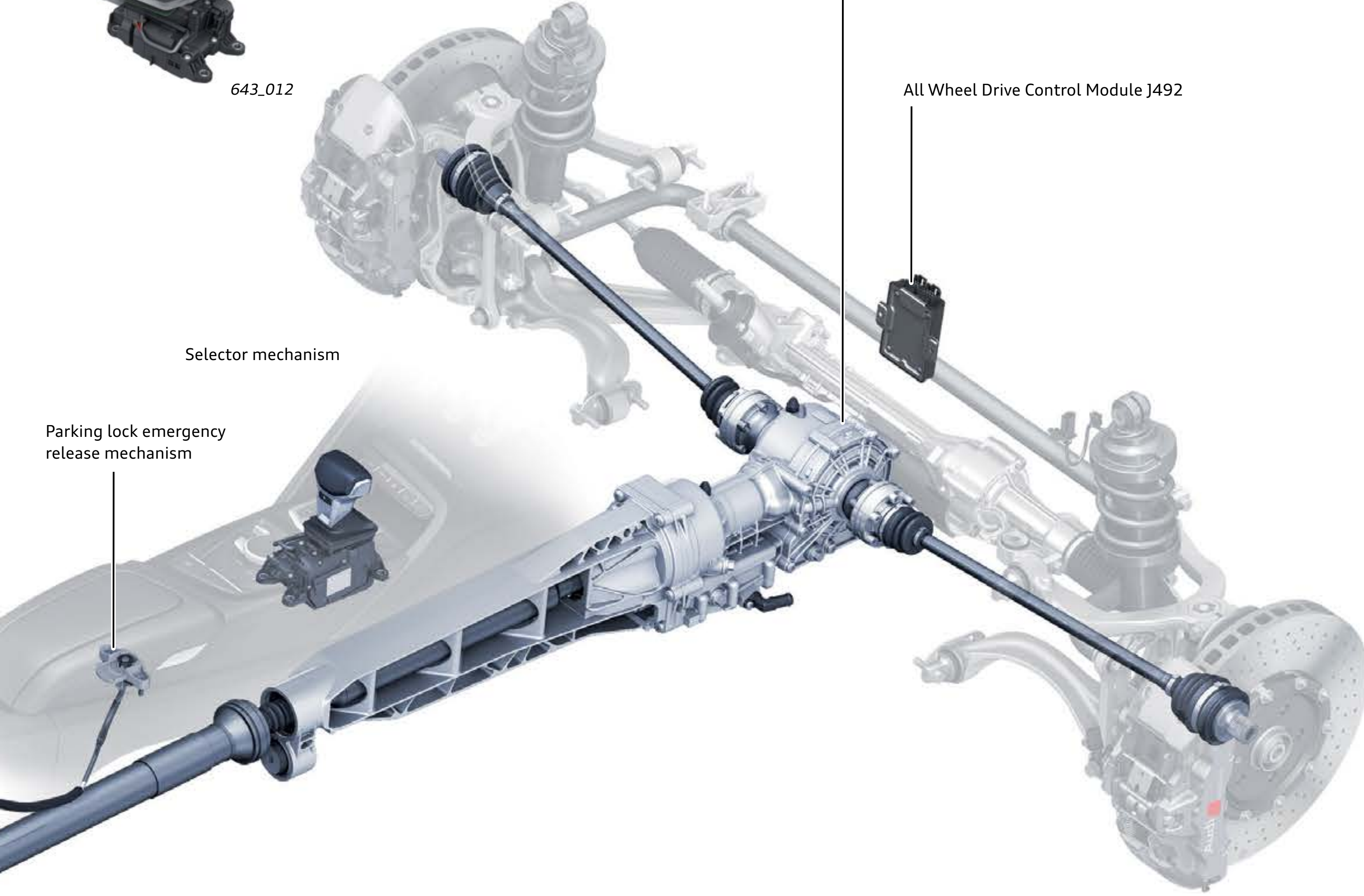

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Selector mechanism

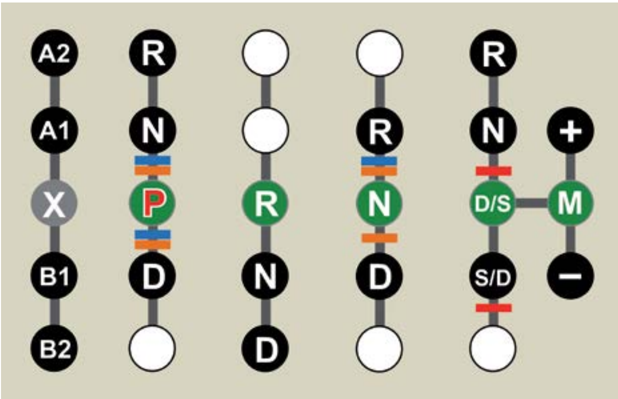
The Audi R8 uses the latest-generation Audi B and C series selector mechanism with full "shift-by-wire" functionality.

The operating concept is intuitive and is essentially identical to the familiar operating logic of other Audi automatic transmission models.

The parking lock is normally engaged and disengaged by the Auto-P function but can also be engaged by the driver using the P button. See page 12.

After every operation, the selector lever returns to the normal position of the automatic or tiptronic gate.

Shift schematic



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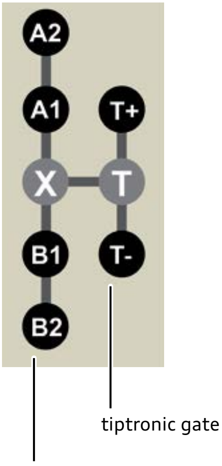
Basic shift schematic



Possible positions of the selector lever.

The following indications are displayed in the self-diagnosis sequence according to the selector lever position:

X - Normal position in automatic mode
T - Normal position in tiptronic mode

A1, A2, B1, B2, T+, and T- are the position indicators in the selector lever position shown in each case

643_010

○ Positions selectable without moving the selector

● Selectable drive positions

● Normal position of the selector lever and current drive position

▬ Software lock: cancelled by pressing the release button – E681

▬ Software lock: deactivate by pressing the foot brake[1)]

▬ Mechanical lock by Shift Lock Solenoid N110
– cancelled by pressing Selector Lever Release Button E681

Note: An acknowledgement tone sounds when drive position R is engaged.

Automatic gate

643_012

tiptronic gate

643_013

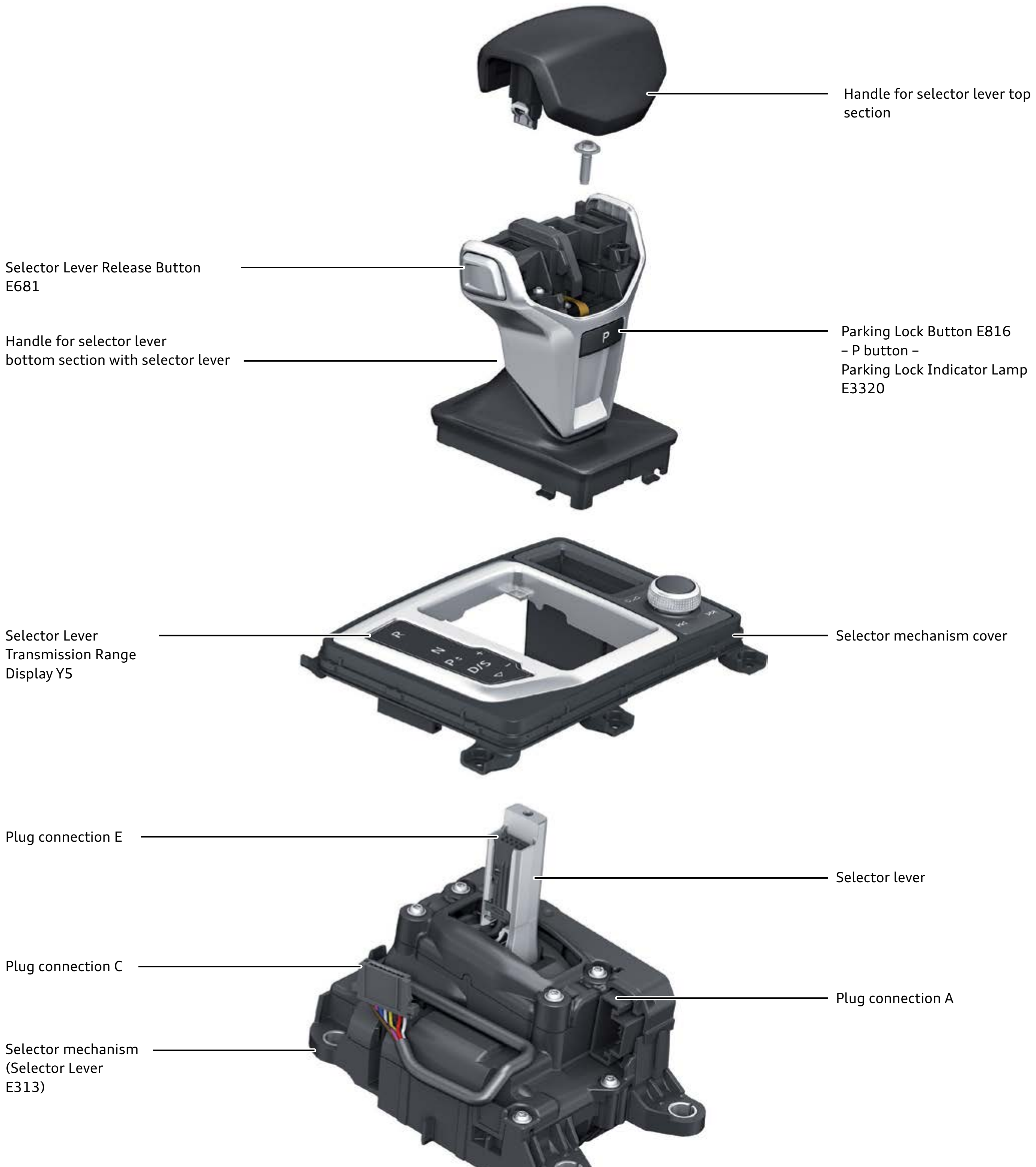
Speed-dependent transmission protection function

A change in driving direction from **D** to **R** and vice versa is only possible at speeds less than approximately 5 mph (8 km/h).

At vehicle speeds above 5 mph (8 km/h), the transmission safety function prevents the change.

[1)] The orange-colored software lock is activated in drive position **N** after about one second. This allows quick-changing of the drive position from **D** to **R** and vice versa without applying the brake. The makes it possible, to free a stuck vehicle by rocking it backwards and forwards and makes it easier to shift driving position when maneuvering.

Component overview



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Selector Lever Release Button E681

Button E681 is used for releasing the selector lever lock. It consists of two shift elements for reliability and diagnostics. In the event of a fault, it is considered actuated.
The locks marked red and blue (Fig. 643_011) are disabled and a DTC is recorded and then indicated on the instrument cluster. The selector can be moved out of positions **P** and **N** by pressing the foot brake.

Parking Lock Button E816

The P button is for manually engaging the parking lock. The parking lock can only be activated at vehicle speeds less than 0.5 mph (1 km/h). Button E816 has three shift elements for reliability and diagnostics. Its shift status is transferred to Selector Lever Sensor System Control Module J587 via two interfaces. In the event of a fault in E816, a message appears in the instrument cluster and the parking lock can only be engaged by the Auto-P function.

Selector Lever Sensor System Control Module J587

J587 forms a functional unit with Selector Lever Position Sensor G727 and Transverse Selector Lever Lock Sensor G868.

It is responsible for detecting the driver input, analyzing the button signals, communication with Gearbox Control Unit 1 J743, and all selector mechanism control and diagnosis functions. It has the Address Word 81.

J587 registers the positions of the selector lever as shown in Figure 643_010 (A2, A1, X, B1, B2, T+, T and T-) and the signals from the buttons E681 and E816, and passes them on to Gearbox Control Unit 1 J743 via the Drivetrain CAN.

Gearbox Control Unit 1 J743 determines the desired transmission setting and initiates the appropriate functional operations.

It reports back the current transmission setting to the selector lever sensor module, and then operates Shift Lock Solenoid N110, the LEDs for Selector Lever Transmission Range Display Y5 and Parking Lock Button K320.

When a transmission setting is selected, there is a brief delay before the relevant transmission setting symbol lights up.

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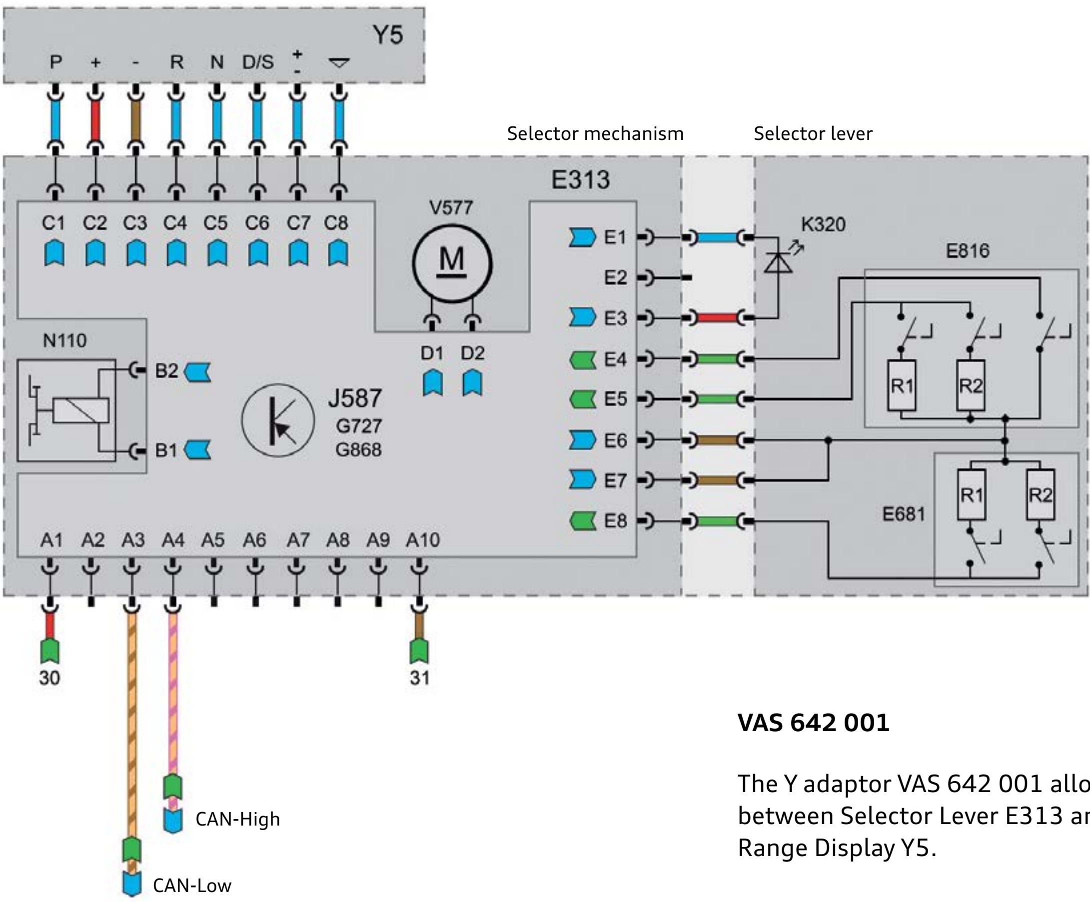
Selector Lever Sensor System Control Module J587
Address Word 81

Schematic diagram of selector mechanism



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VAS 642 001

The Y adaptor VAS 642 001 allows measurements to be taken between Selector Lever E313 and Selector Lever Transmission Range Display Y5.

Information

If there is a system fault with the selector mechanism, the transmission ranges **D** and **N** can be selected by simultaneously pressing the two tiptronic paddles when the vehicle is stationary and the brake applied. See page 13.

Selector Lever Position Sensor G727

J587 determines all selector lever positions by means of Selector Lever Position Sensor G727. G727 consists of two sensors – one sensor for the automatic gate and one sensor for the tiptronic gate.

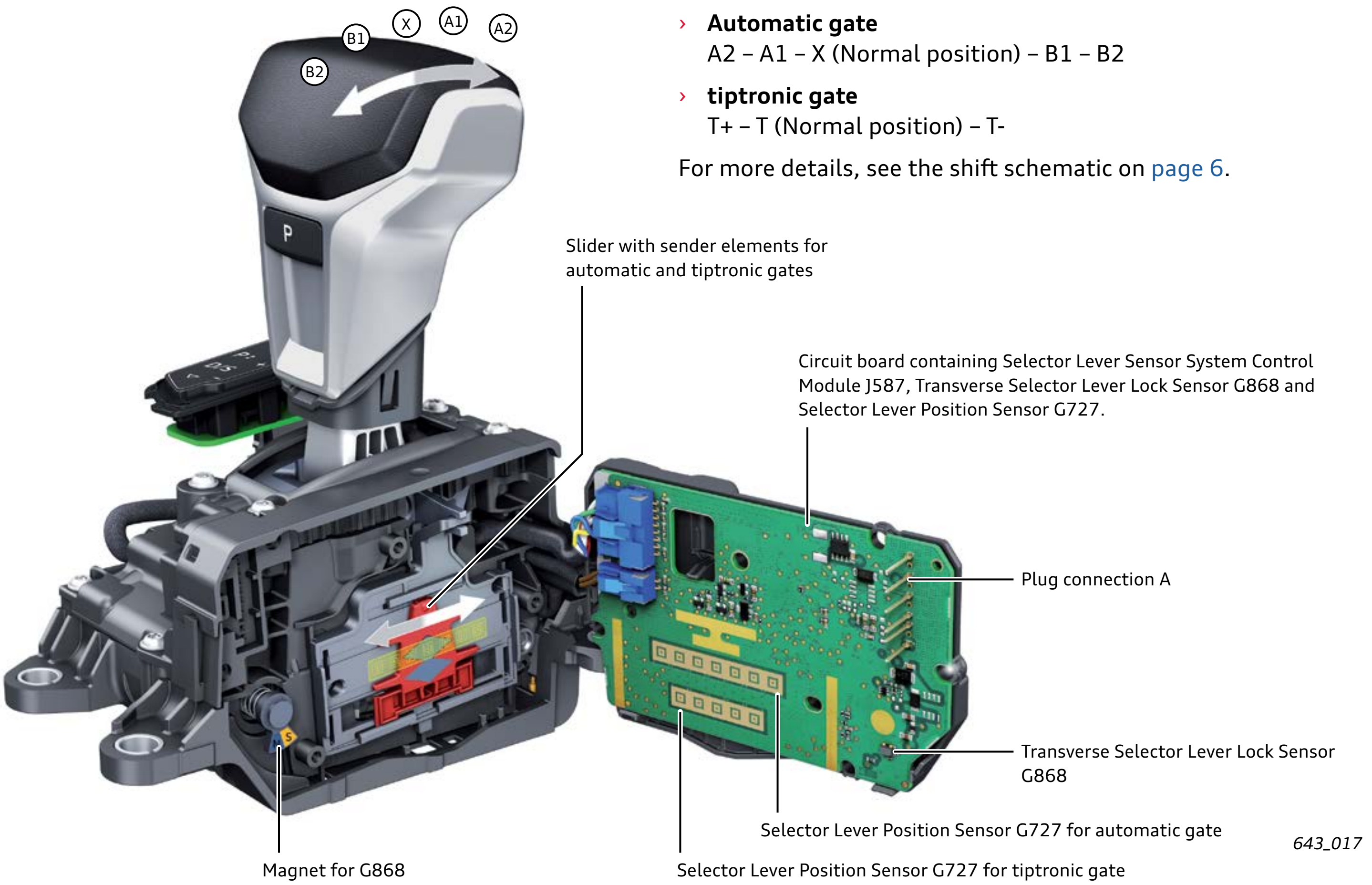
Selector lever in automatic gate

How selector lever positions are detected:

The longitudinal and transverse movements of the selector lever are transmitted to a slider with two diamond-shaped sender elements. The sender elements affect the magnetic flux in the sensor elements of G727 according to the movement of the selector lever. From the sensor signals, Selector Lever Sensor System Control Module J587 generates the following selector lever positions:

- **Automatic gate**
  A2 – A1 – X (Normal position) – B1 – B2
- **tiptronic gate**
  T+ – T (Normal position) – T-

For more details, see the shift schematic on page 6.



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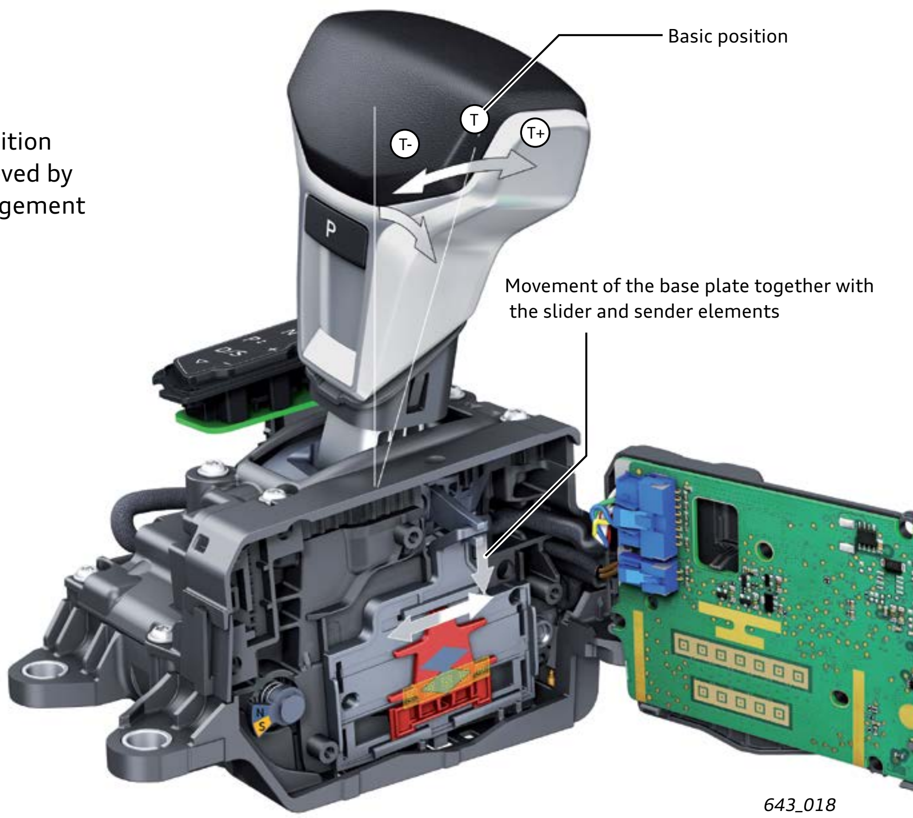
Selector lever in tiptronic gate

Restriction of the selector lever movement to one position forwards (T+) and one position backwards (T-) is achieved by means of the tiptronic gate track of the position engagement mechanism.

Key to schematic diagram of selector mechanism on page 6

E313 Selector Lever
E681 Selector Lever Release Button
E816 Parking Lock Button
G727 Selector Lever Position Sensor
G868 Transverse Selector Lever Lock Sensor
J587 Selector Lever Sensor System Control Module
K320 Parking Lock Indicator Lamp
N110 Shift Lock Solenoid
V577 Transverse Selector Lever Lock Motor
Y5 Selector Lever Transmission Range Display



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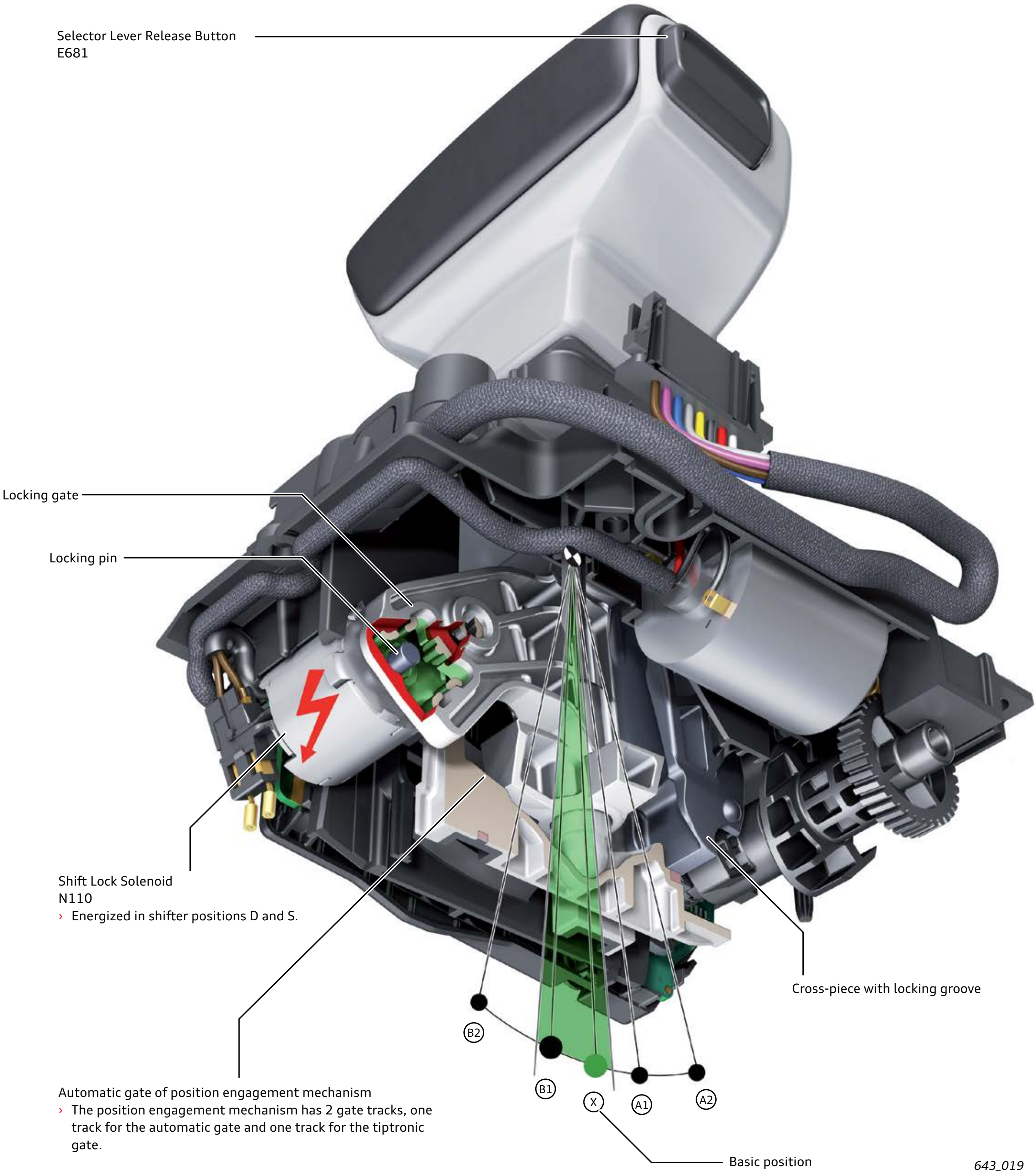
Selector lever longitudinal lock

In transmission setting **D/S**, Shift Lock Solenoid N110 is energized and the locking pin engages with the selector lever lock guide. The selector can now be moved back into position **B1** from the normal position in order to shift from **D** to **S** or from **S** to **D**.

When Selector Lever Release Button E681 is pressed, the power supply to N110 is disconnected and the lock is disengaged. To prevent unnecessary switching noises from N110, it remains energized when switching to the tiptronic gate. The lock preventing forward movement (A1) is inactive in the tiptronic gate, however, because the lock guide is tilted to the side it becomes ineffective.



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Selector lever transverse lock

To ensure that the selector lever cannot be inadvertently moved into the tiptronic gate, it is transversely locked in transmission settings **P**, **R** and **N**.

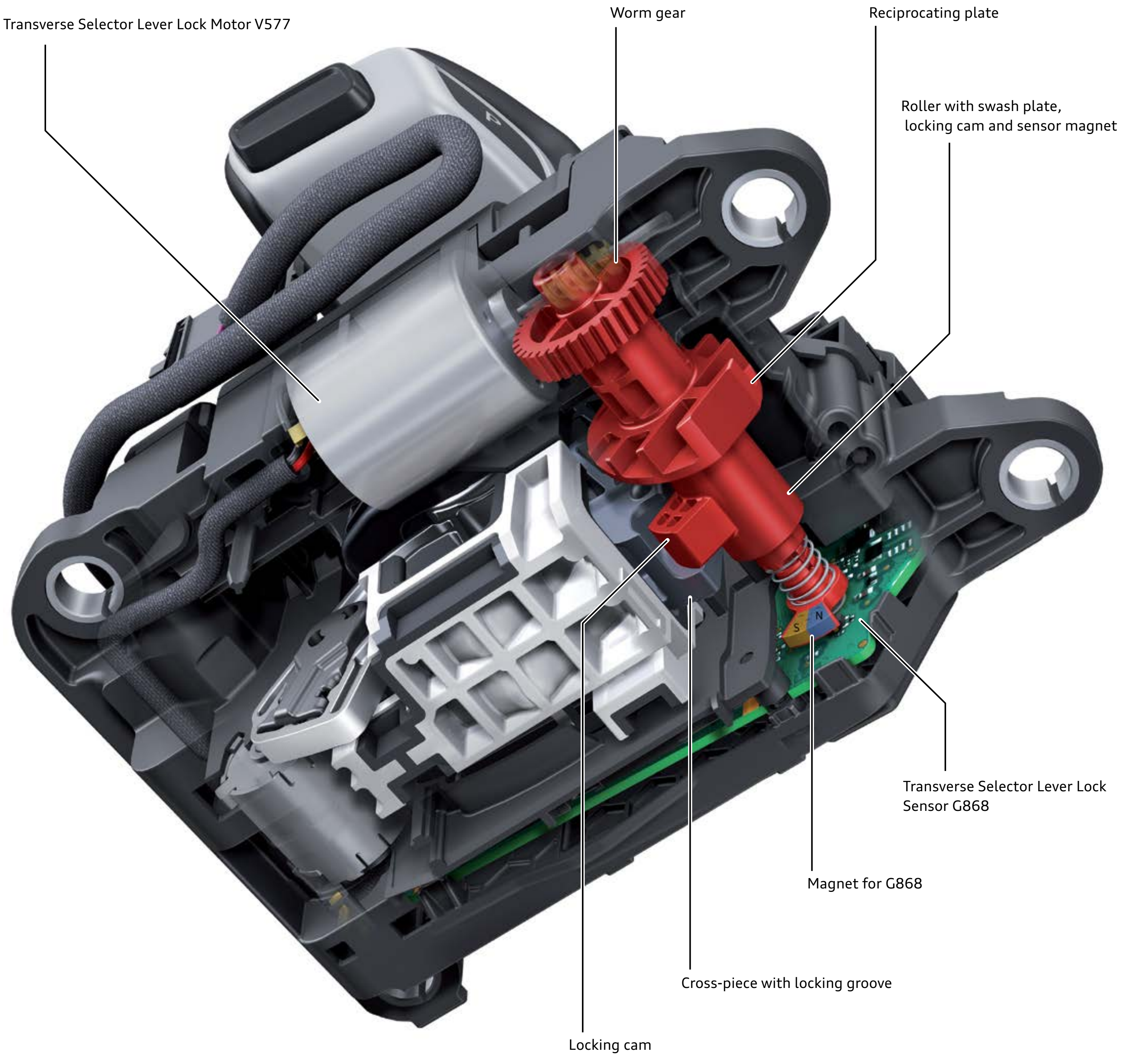
Selector lever transverse lock active

The selector lever is held in the cross-piece. When the transverse lock is active, the locking cam is positioned so that it engages in the locking groove of the cross-piece. When the locking cam is in that position, the selector lever cannot be moved into the tiptronic gate.

Transmission setting P/R/N – selector lever transverse lock active

Transverse Selector Lever Lock Sensor G868

G868 uses Hall-effect sensors and a sensor magnet that is located at the end of the roller. The sensor magnet affects the signal of G868 according to the rotational position of the roller. From that information Selector Lever Sensor System Control Module J587 determines the position of the roller and thus the status of the selector lever transverse lock.



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Selector lever transverse lock inactive

To be able to change to the tiptronic gate from transmission setting **D** or **S**, the selector lever transverse lock has to be deactivated.

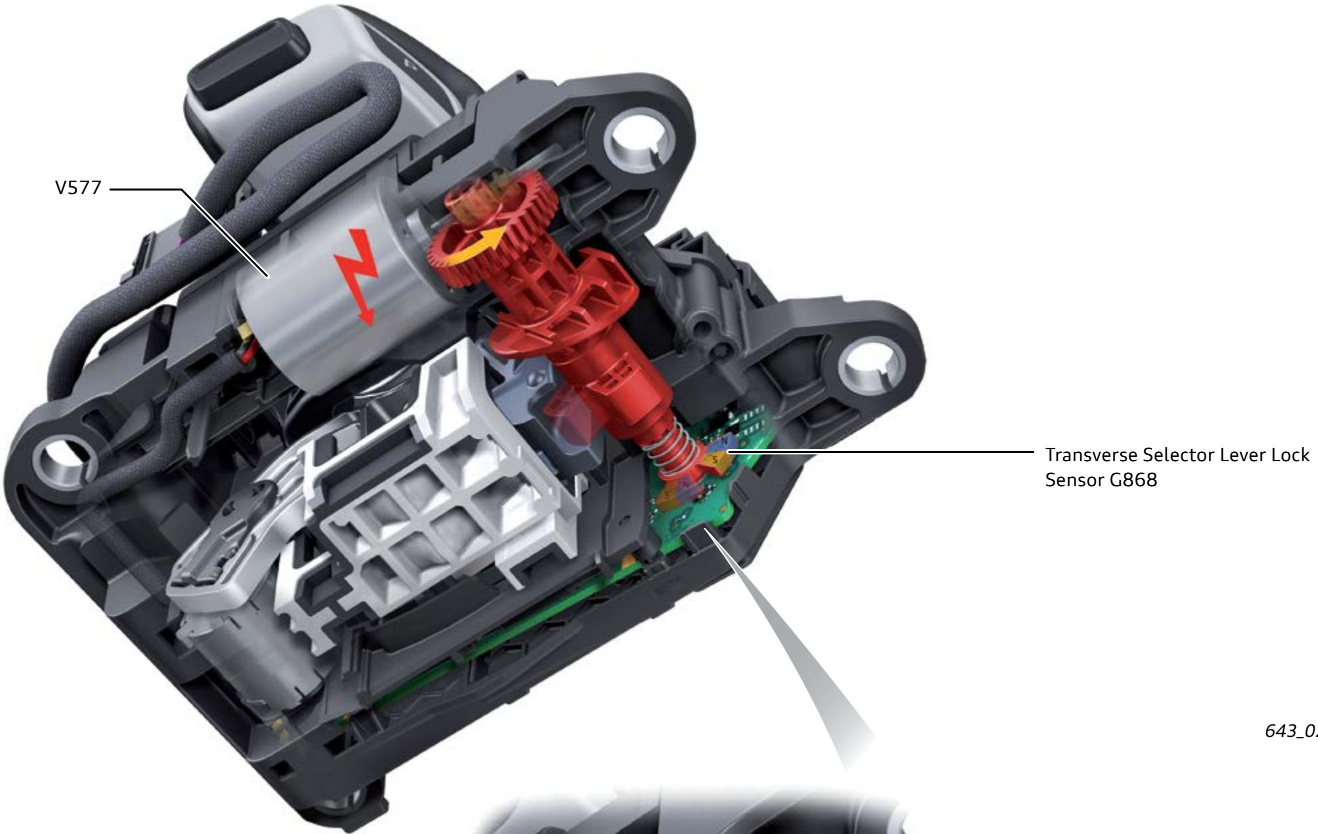
Transmission setting D/S – selector lever transverse lock inactive

Selector lever transverse lock cancelling function

① Transverse Selector Lever Lock Motor V577 is operated by Selector Lever Sensor System Control Module J587 until the locking cam is disengaged from the locking groove of the cross-piece.

② The cross-piece is then no longer locked and the selector lever can be shifted into the tiptronic gate.

①



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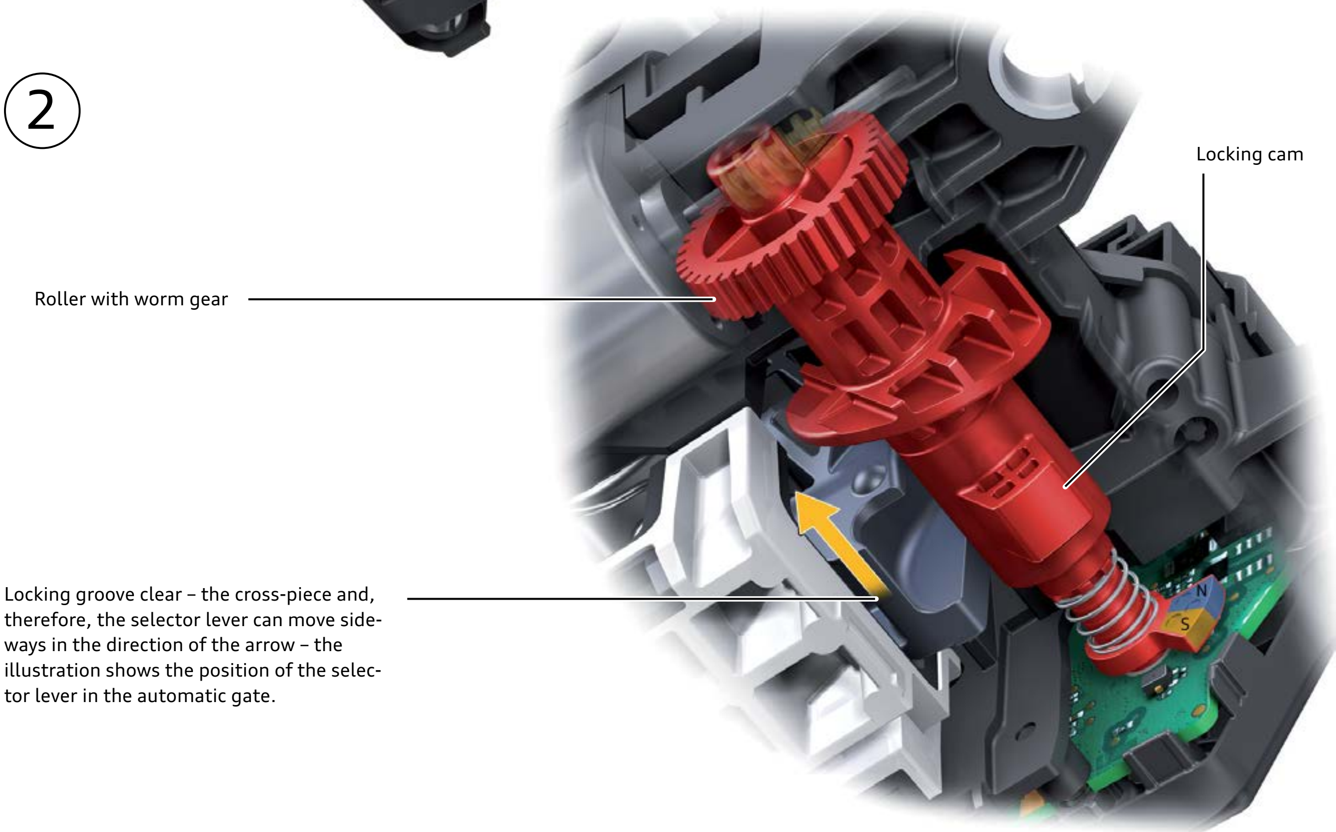
②



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From the position of the magnet, the selector lever sensor module detects (with the aid of the sensor G868) that the selector lever transverse lock is **not** active.

Selector lever transverse lock active

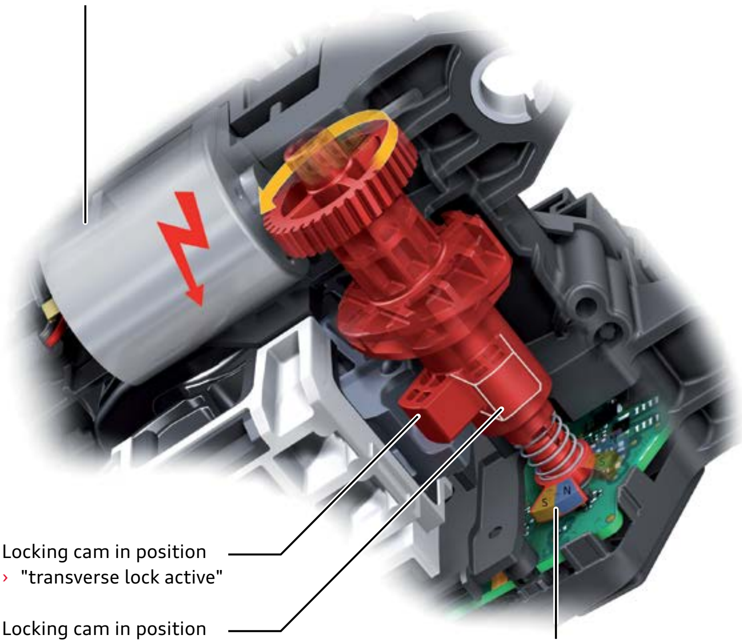
In transmission settings **P**, **R** and **N** the selector lever transverse lock is activated to prevent the selector lever unintentionally being shifted into the tiptronic gate..

To do so, Transverse Selector Lever Lock Motor V577 is operated by Selector Lever Sensor System Control Module J587 until the locking cam is engaged in the locking groove of the cross-piece. From the position of the magnet, J587 detects with the aid of G868 that the selector lever transverse lock is active.

Automatic resetting of the selector lever

If the selector lever is in the tiptronic gate when the ignition is switched off, it is automatically moved back into the automatic gate.

J587 determines whether the selector lever is in the tiptronic gate or the automatic gate with the aid of Selector Lever Position Sensor G727.



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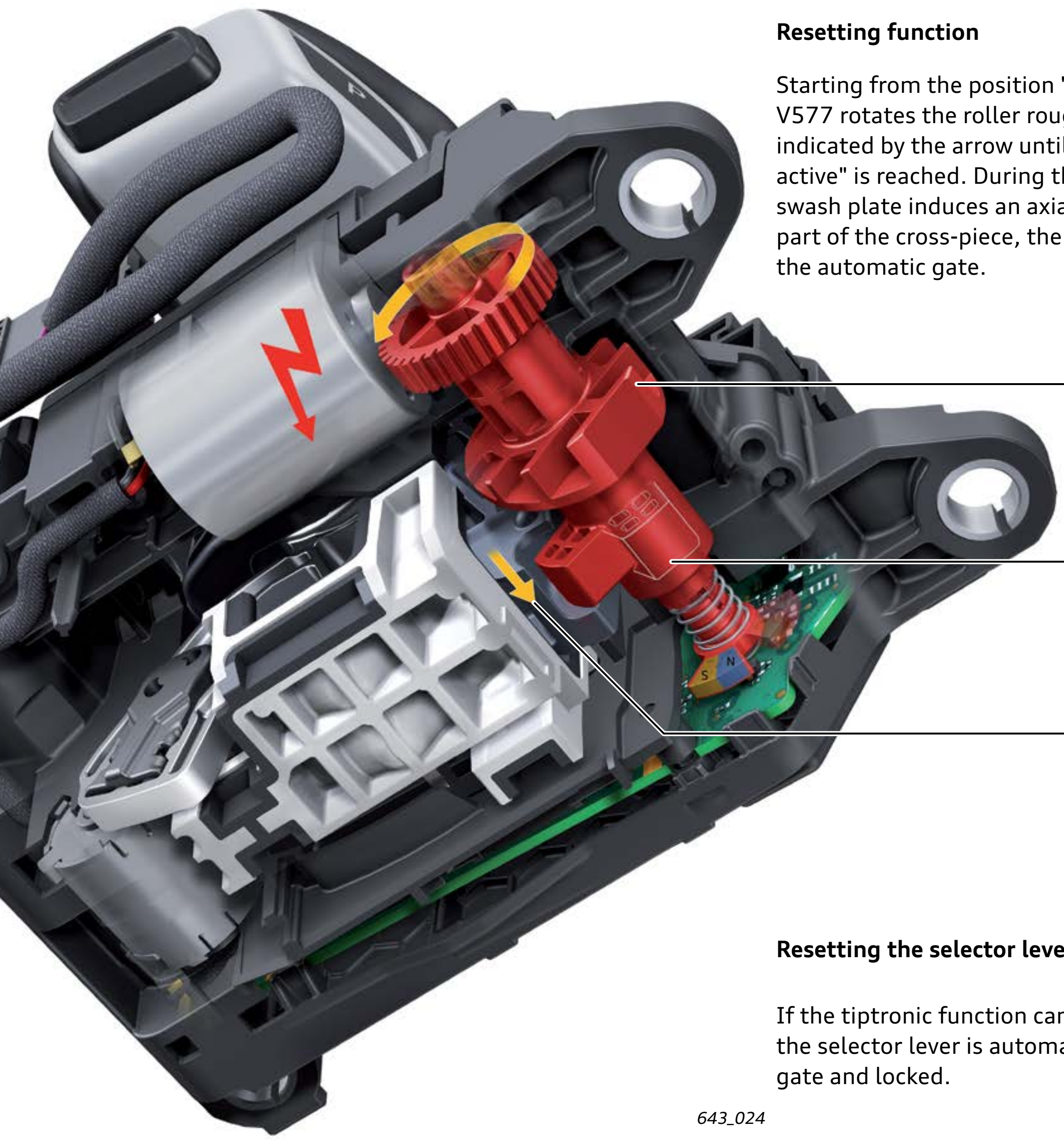
Resetting function

Starting from the position "transverse lock inactive", motor V577 rotates the roller roughly ¾ of a turn in the direction indicated by the arrow until the position "transverse lock active" is reached. During that rotational movement, the swash plate induces an axial movement (yellow arrow) on the part of the cross-piece, thereby returning the selector lever to the automatic gate.



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Resetting the selector lever in emergency mode

If the tiptronic function cannot be performed due to a fault, the selector lever is automatically returned to the automatic gate and locked.

Transmission functions

Auto-P function

The parking lock is operated electro-hydraulically. See page 38. This allows Gearbox Control Module 1 to automatically operate the parking lock, thereby enhancing operating comfort.

The Auto-P function engages the parking lock automatically (P-ON position) if the following conditions are satisfied:

- Vehicle is stationary – vehicle speed less than 0.6 mph (1 km/h).
- One of the transmission settings **D**, **S**, **R** or **M** is active.
- The engine is switched off – Terminal 15 is off.

On the 2017 Audi R8, the parking lock can also be engaged by the driver by pressing the P button, provided that the vehicle speed is less than 0.6 mph (1 km/h).

The parking lock is disengaged automatically (P-OFF position) if the engine is running and one of the transmission settings **D**, **S**, **R**, **N** or **M** is selected.

Tip-shifting in D/S

Manual gear shifts can be executed at any time using the shift paddles on the steering wheel (steering wheel tiptronic controls) in transmission setting **D/S**. Once the steering wheel tiptronic controls have been used, the transmission remains permanently in manual mode (tiptronic mode).

There are two possible ways of returning to automatic mode:

- Pull the selector lever back one position (position B1).
- Move the selector lever into the tiptronic gate and back into the automatic gate.

Activating transmission setting N
(holding P-OFF setting)

To be able to move the vehicle without the parking lock for a limited amount of time, for example, in a car wash, automatic engagement of the parking lock can be prevented.

A condition for this is that the selector mechanism, the P button and the transmission are working properly.

To activate P-OFF, transmission setting **N** must be selected while the engine is running and then the engine switched off[1)]. When the ignition is turned off, engagement of the parking lock is suppressed for a period of 20 minutes. After 19 minutes the following message is displayed in the instrument cluster: “Start engine to remain in N.” along with a warning tone. If this instruction is not followed, the parking lock engages after 20 minutes and the system shuts down.

If a speed signal greater than 0.6 mph (1 km/h) is detected during this time, the period is extended according to the driving time of the vehicle until the system detects that the vehicle has been stationary for at least five minutes.

While the vehicle is stationary with the transmission in P-OFF, power is consumed by the activity of the control modules, bus network operation and the holding solenoid. If the vehicle is stationary for an extended period of time, the battery may become discharged to the extent that the parking lock automatically engages. Therefore, if it is necessary to keep the transmission in P-OFF for an extended period, the parking lock emergency release should be actuated.

More information on "Holding transmission setting P-OFF" can be found on page 37.

On the 2017 R8 (100% keyless) the vehicle cannot be locked while P-OFF is active.

Launch control program

The Launch Control Program regulates the maximum acceleration of the vehicle from a standing start. Please refer to the Owner's Manual for instructions on how to use it and follow the guidance provided.

The Launch Control Program in the Audi R8 has a particularly sporty setup. In addition, forced up-shifts are performed in tiptronic mode. Refer to page 14.

Notes

When pulling away with Launch Control active, all vehicle components are heavily stressed. As a result, greater wear may occur.

The number of Launch Control starts performed can be read in the Measuring values.

Special features of the 2017 R8

Steering wheel tiptronic

The following functions can be selected using the shift paddles on the steering wheel of the 2017 R8.

- If both shift paddles are operated simultaneously while the engine is running, driving position **N** is selected (both moving and when the vehicle is stationary).
- When the vehicle is stationary, the driver can shift from the transmission settings **P**, **R** and **N** to **M1** by operating the Tip+ shift paddle with the brake applied.
- Press-and-hold function: if the driver presses and holds the Tip+ shift paddle while the vehicle is moving, the transmission changes up to the highest possible gear, for example, from 3rd to 5th gear. If the driver presses and holds the Tip– shift paddle, the transmission changes down to the lowest possible gear, for example, from 7th to 3rd gear.
- If a system malfunction occurs in the selector mechanism, the driver can select driving position **D** with the Tip+ shift paddle when the vehicle is stationary and with the brake pressed. **N** can be selected by actuating both shift paddles simultaneously. R (reverse gear) is not available.

643_025

These additional functions of the tiptronic shift paddles are made possible by the use of redundant backup systems for communicating the shift commands from the shift paddles The shift commands are sent via CAN data bus to Gearbox Control Unit 1 J743 and also by two separate signal lines to Automatic Transmission Control Module 2 J1006. See also schematic diagram on page 72. The information is then, in turn, sent on by CAN data bus to J743.

Audi drive select – transmission settings

The 2017 Audi R8 is equipped with Audi drive select. That means, depending on the vehicle equipment, the driver can experience the performance capabilities and dynamic handling characteristics of different vehicle systems.

In addition to the familiar Audi drive select modes – **comfort**, **auto**, **dynamic** and **individual** – the 2017 R8 has a **performance** mode. Within performance mode itself there are three sub-modes – **snow**, **wet** and **dry**. Those setups allow the handling systems to be better adapted to the road surface conditions. The Audi drive select handling system utilizes the electronic stability control (ESC) system in performance mode.

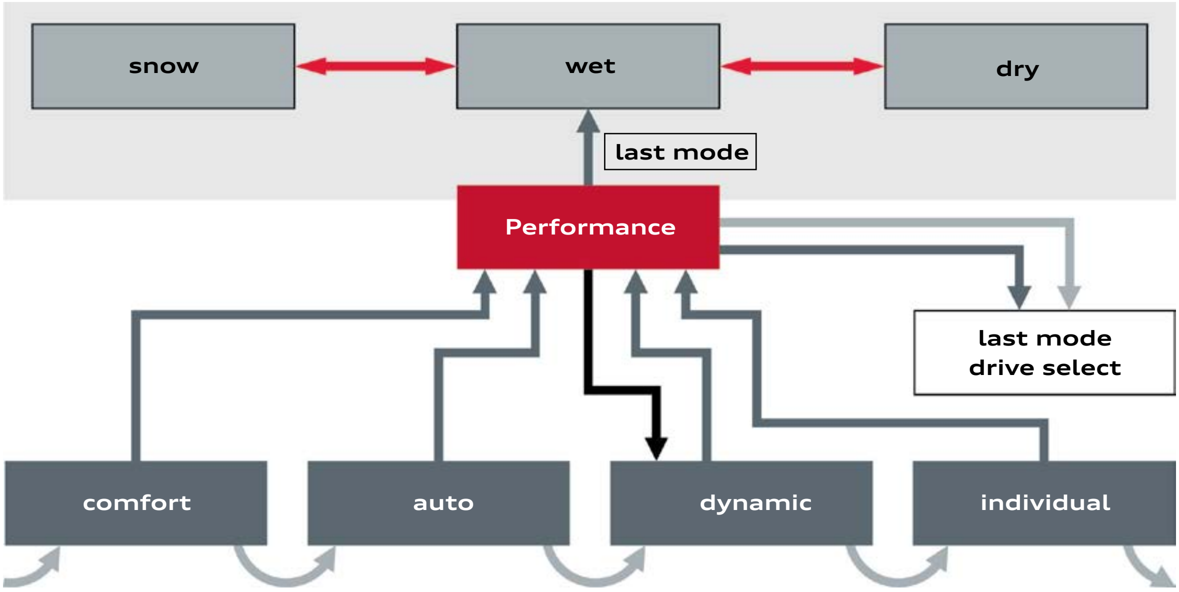
Basic information about Audi drive select on the Audi R8 can be found in eSelf-Study Program 990363, The 2017 Audi R8 Introduction. It explains how the transmission control system reacts to the various Audi drive select modes.

The comfort, auto and dynamic modes

comfort and **auto** modes are identical regarding transmission setup. The shift points and the gear shifts are comfort-oriented.

In **dynamic** mode the sport program **S** is selected in the gearbox. In the sport program the shift points are at higher engine speeds and shift times are reduced. This makes for better power delivery and more noticeable gear shifts.

The overview on page 15 shows the effects of the various Audi drive select modes on the transmission setup.



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Key:

Performance button

Performance button adjusting ring

Audi drive select button/MMI turn-and-press knob

Terminal 15 changeover

Performance mode

Performance mode is standard on the V10 **plus** and optional on the V10. In performance mode, the transmission setup is very sporty. That means that the transmission works to maximize power delivery from the engine; comfort plays a secondary role. Gear shifts are performed at very high engine speeds, gear changes are very fast and distinctly perceptible. Performance mode can only be activated and operated using the Performance button the steering wheel. The Performance button allows the driver to activate or deactivate performance mode directly and in any Audi drive select mode.

Information

The following applies to vehicles for the North America region and all other countries from model year '17 on: If performance mode is selected, Gearbox Control Unit 1 switches to tiptronic mode **MS+** and automatic mode is not available.

! Please note that the stabilization functions of the ESC and traction control systems are limited when performance mode is activated. You should only activate performance mode if you have the necessary driving skills and the traffic conditions permit. There is a danger of skidding and losing control!

Performance button

The Performance button is a touch switch with an adjusting ring. The adjusting ring is used to select the **snow**, **wet** and **dry** modes. Those modes have no effect on the setup of the transmission.

643_027

Overview of transmission setups available with Audi drive select

Audi drive select modes / Transmission setups and functions	comfort		auto		dynamic = sport program		performance No distinction is made between dry, wet and snow
Driving position[1]	D	M	D	M	S	MS	MS+
Shift characteristics	normal	–	normal	–	sporty	–	–
Automatic upshifting in M mode	–	Yes	–	Yes	–	No	No
Downshift during-kickdown in M mode	–	Yes	–	Yes	–	No	No
Modified accelerator map, increased idling and driveaway speed	normal				sporty		super sporty
Launch control program	No		No		Yes – with forced up-shift to **M** and with the most high-performance shift sequence and fastest gear changes		
Blipping the throttle during downshift	No	Yes	No	Yes	Yes		
Shift sequence/shift time	A	C	A	C	B	C	D
Return to automatic mode after actuating the tiptronic shift paddles	No	–	No	–	No	–	–
Engine start/stop mode	Yes				No		

Key to shift sequences/shift times:

A Comfort-orientated overlapping gear shift with engine torque intervention
B Shift-time-orientated overlapping gear shift with maximum engine torque intervention
C Fast overlapping gear shift with maximum engine torque intervention – specially adapted for tiptronic operation
D Fastest possible overlapping gear shift with maximum engine torque intervention and utilisation of engine inertial torque during up-shifts

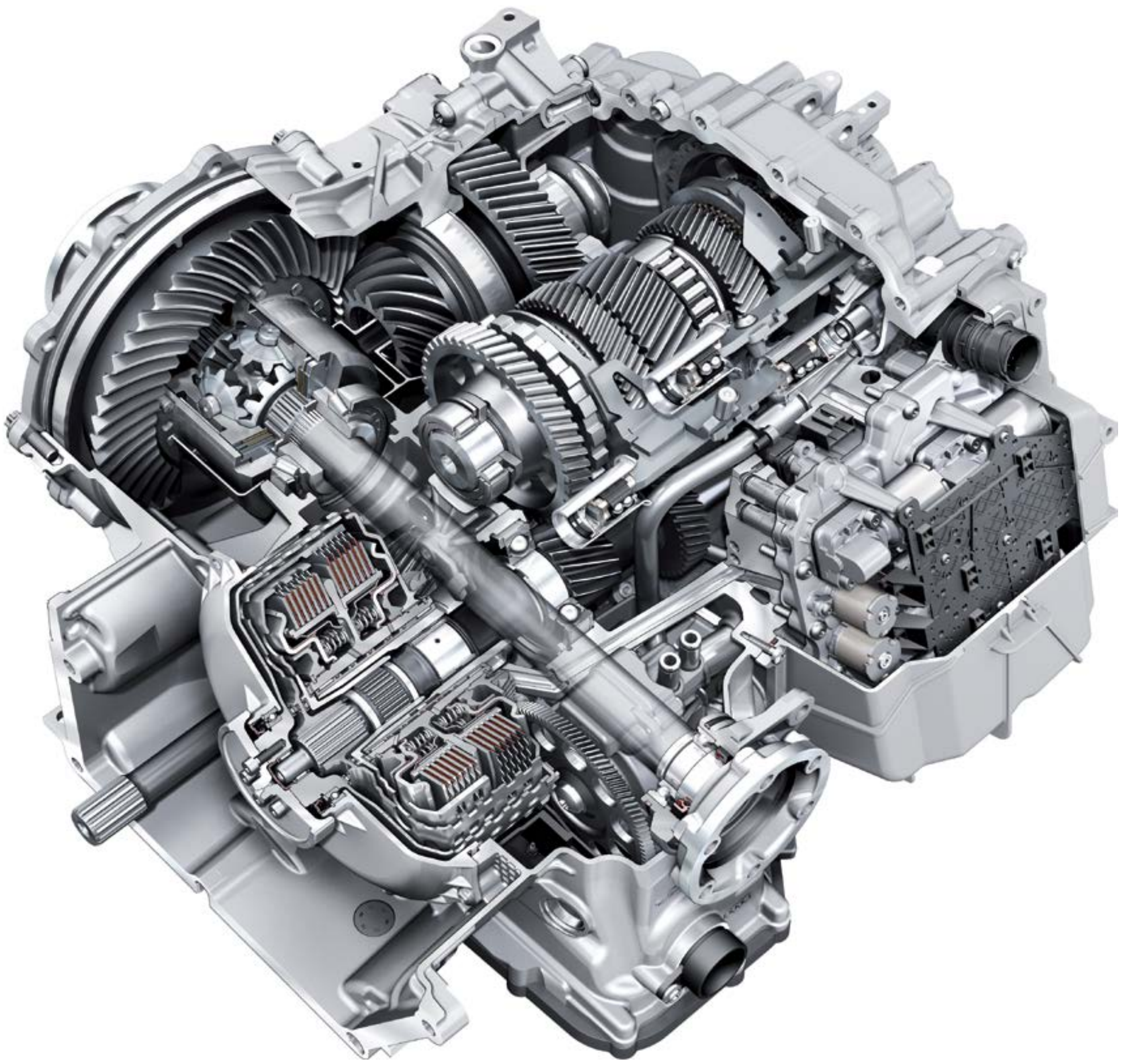
[1] The transmission setting is determined by the selector lever setting (**D**, **S**, or **M**) in combination with the choice of Audi drive select mode. **M** means: tiptronic Manual shift program, **MS** means: tiptronic Manual Sport shift program , **MS+** means: Manual Sport Plus shift program.

Gearbox assemblies

Specifications

Designations	Manufacturer Service Sales	DL800-7A 7-speed dual clutch gearbox 0BZ S tronic
Development/production	Audi AG Ingolstadt/VW plant Kassel	
Gearbox type	Full synchromesh 3-shaft sliding-collar variable-speed gearbox with 7 forward gears and one reverse gear, electro-hydraulically operated for mid-engine concept, with differential lock in the rear final drive and PTO shaft for direct power transmission to the front final drive	
Dual clutch	Two wet-type multi-plate clutches in an in-line configuration, electro-hydraulically operated and oil-cooled	
Control system	Mechatronic unit plus 2 additional electro-hydraulic modules (parking lock module and auxiliary hydraulics module) – shift-by-wire actuation with electro-hydraulically operated parking lock (park by wire), Two control module concept for park-by-wire technology and separate clutch cooling for clutches K1 and K2. Automatic mode with various shift programs and tiptronic program for manual gear-shifting.	
Ratio configuration	› 6+E configuration on the V10 (the 7th gear is a high ratio designed for fuel economy) › 7 speed configuration on V10 plus	
Weight	311 lb (141 kg) including ATF and dual-mass flywheel	

Overview and features



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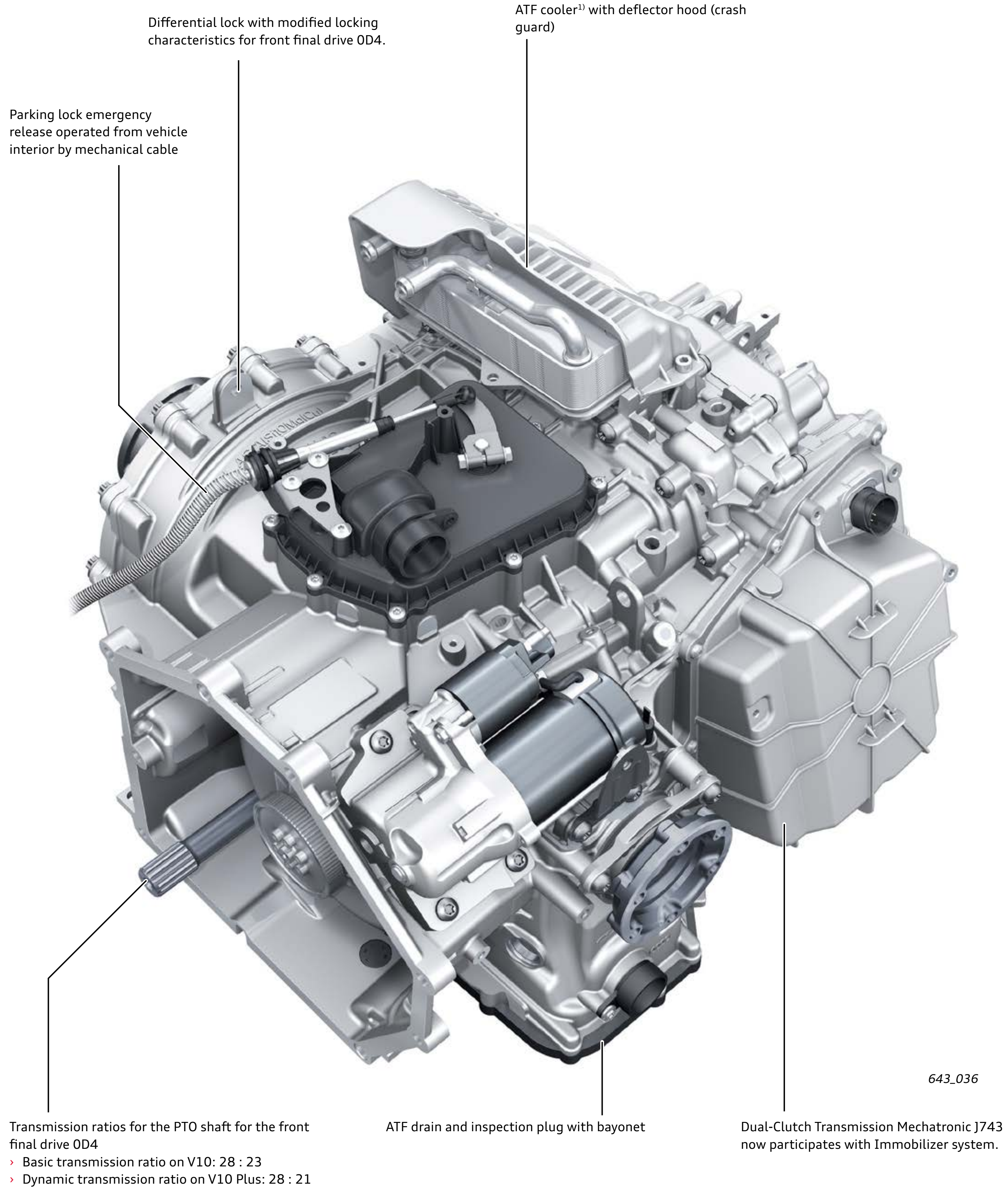
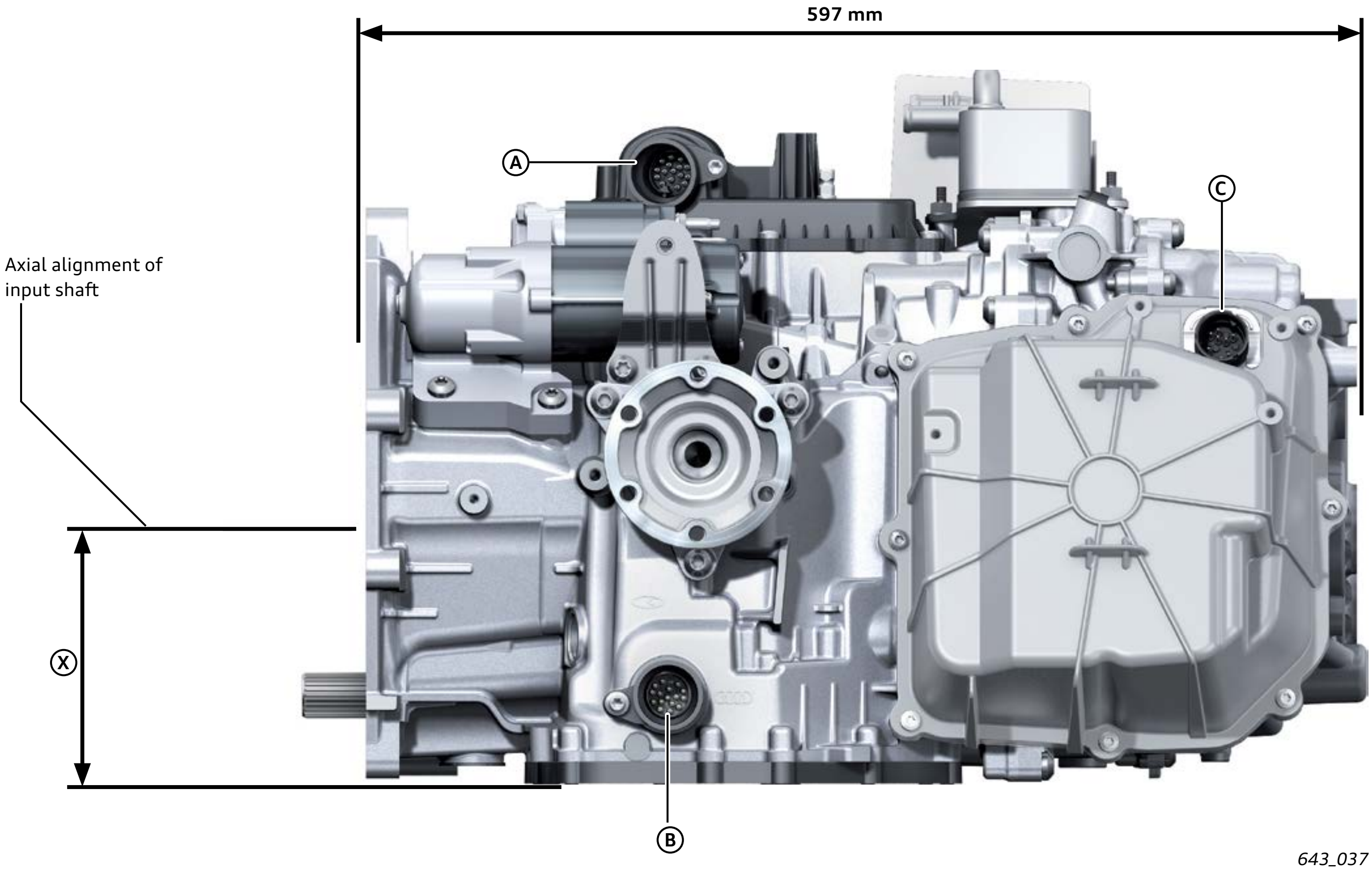


[1] The overall cooling concept on the 2017 Audi R8 has been redesigned and substantially improved so that no additional ATF cooler (air/oil heat exchanger) is required by either engine variant.



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Ⓐ Electrical connection of Parking Lock Module T16a

Ⓑ Electrical connection of Auxiliary Hydraulic Module T16b

Ⓒ Electrical connector T16c for Dual-Clutch Transmission Mechatronic J743

Ⓧ Installation space requirement from axis of transmission input shaft (= crankshaft axis) to bottom of transmission

The 0BZ was developed specially for the new MSS platform[1]. That platform requires a transmission with a short installed length.

Those requirements were essentially achieved by means of the following design features:

- Compact dual clutch with directly adjacent clutches.
- Positioning of the Mechatronic module on the side of the transmission.
- 3-shaft gear-set configuration.
- Positioning of the rear final drive and the PTO shaft for the front final drive.

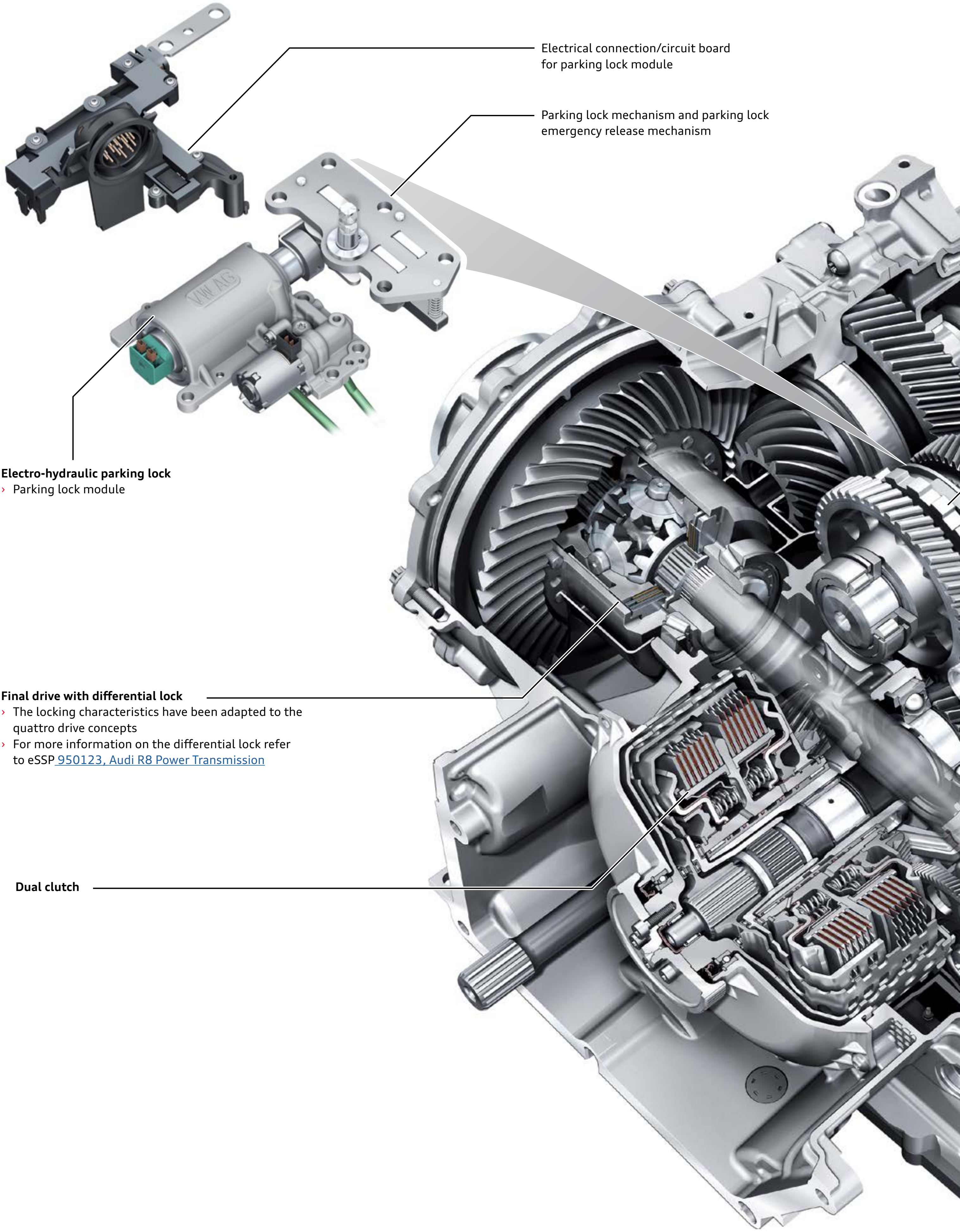
With an installed length shorter than 23.6 in (600 mm), the 0BZ transmission is more than 5.9 in (150 mm) shorter than the R tronic.

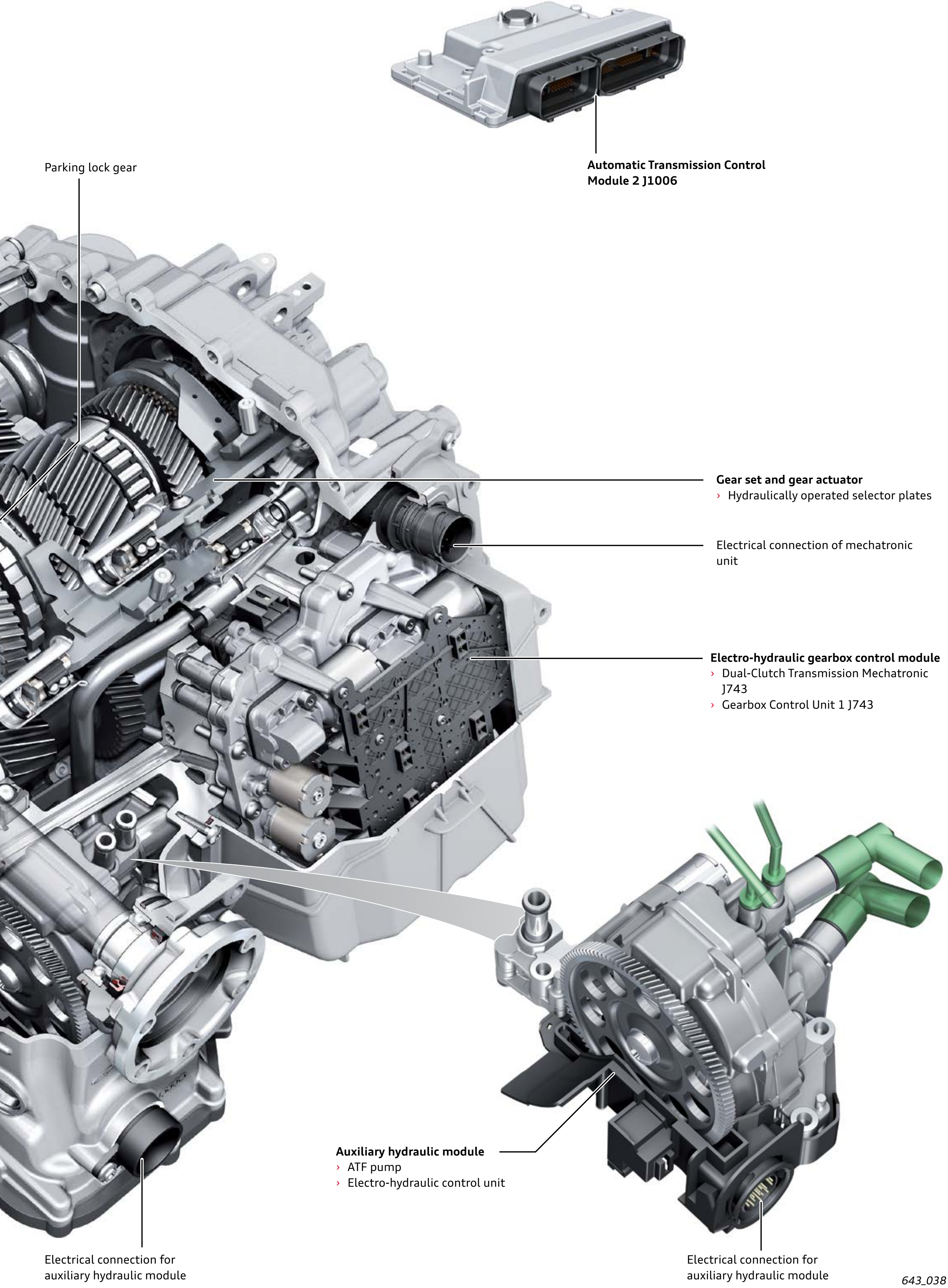
Together with the engine's dry-sump lubrication system, it achieves sufficient ground clearance at the same time as providing a low center of gravity for the vehicle while keeping within the baseline limit.

The 0BZ 7-speed dual clutch gearbox is perfectly suited for the new MSS platform[1] with mid-engine configuration and quattro drive. That platform is the basis for the 2017 Audi R8 and the Lamborghini Huracán.

[1] MSS = Modular Super Sports-car

Component overview




Automatic Transmission Control Module 2 J1006
Parking lock gear
Gear set and gear actuator
› Hydraulically operated selector plates
Electrical connection of mechatronic unit
Electro-hydraulic gearbox control module
› Dual-Clutch Transmission Mechatronic J743
› Gearbox Control Unit 1 J743
Auxiliary hydraulic module
› ATF pump
› Electro-hydraulic control unit
Electrical connection for auxiliary hydraulic module
Electrical connection for auxiliary hydraulic module

643_038

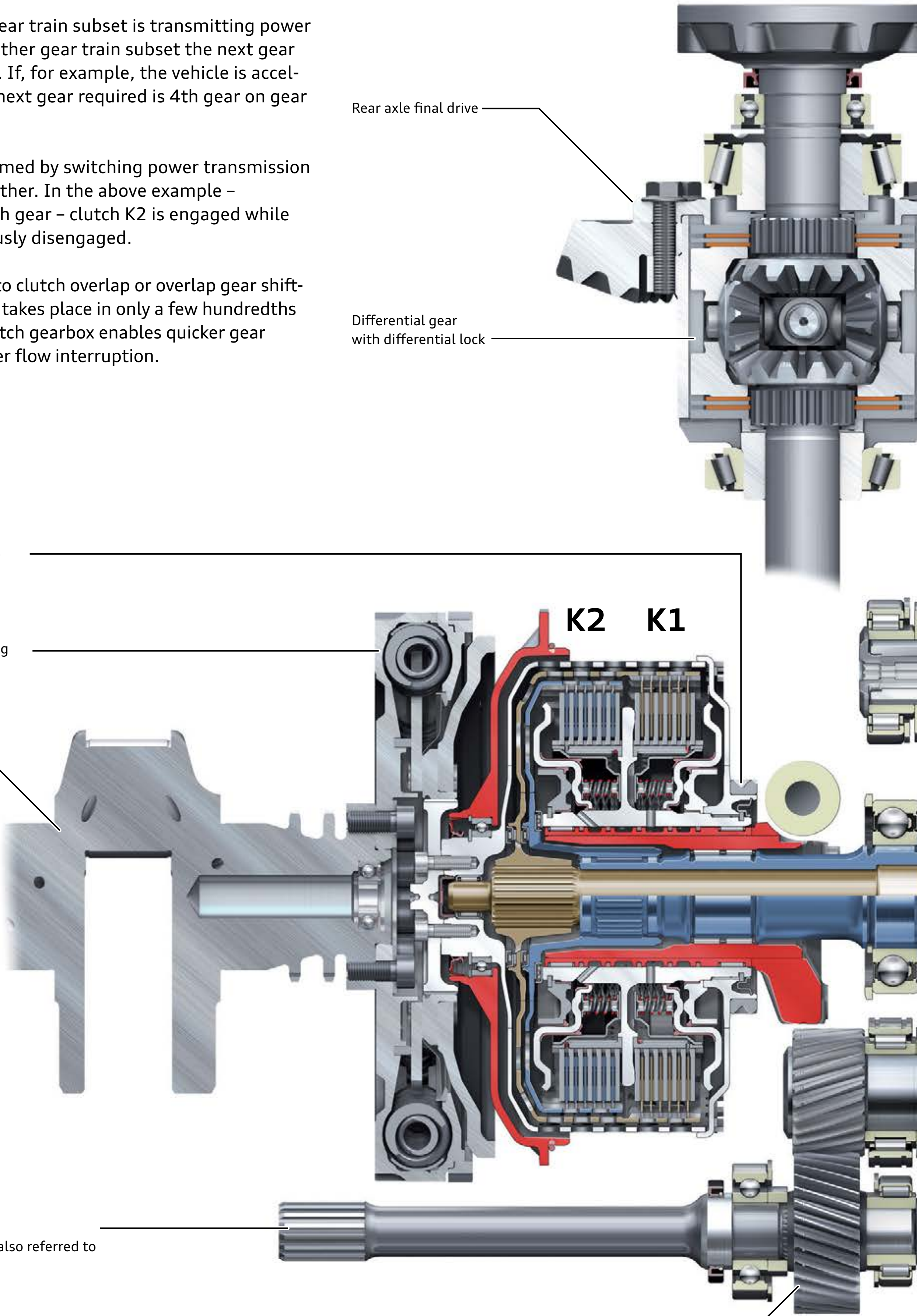
Gear set/gear train configuration

A dual clutch transmission consists of two gear train subsets and two associated clutches - K1 and K2. Gear train subset 1 carries the uneven gears 1, 3, 5, 7 and gear train subset 2 the even gears 2, 4, 6 and reverse.

In operation, only one gear train subset is transmitting power at a time, while on the other gear train subset the next gear required is pre-engaged. If, for example, the vehicle is accelerating in 3rd gear, the next gear required is 4th gear on gear train subset 2.

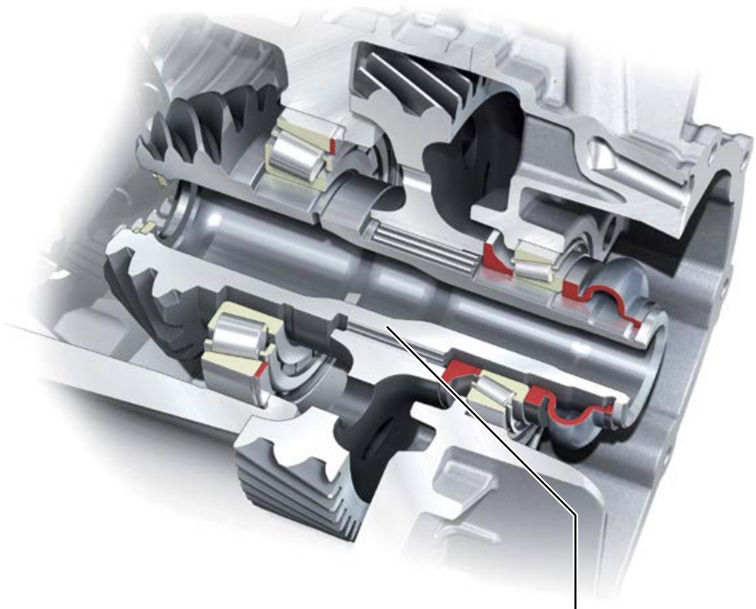
Gear changes are performed by switching power transmission from one clutch to the other. In the above example – changing from 3rd to 4th gear – clutch K2 is engaged while clutch K1 is simultaneously disengaged.

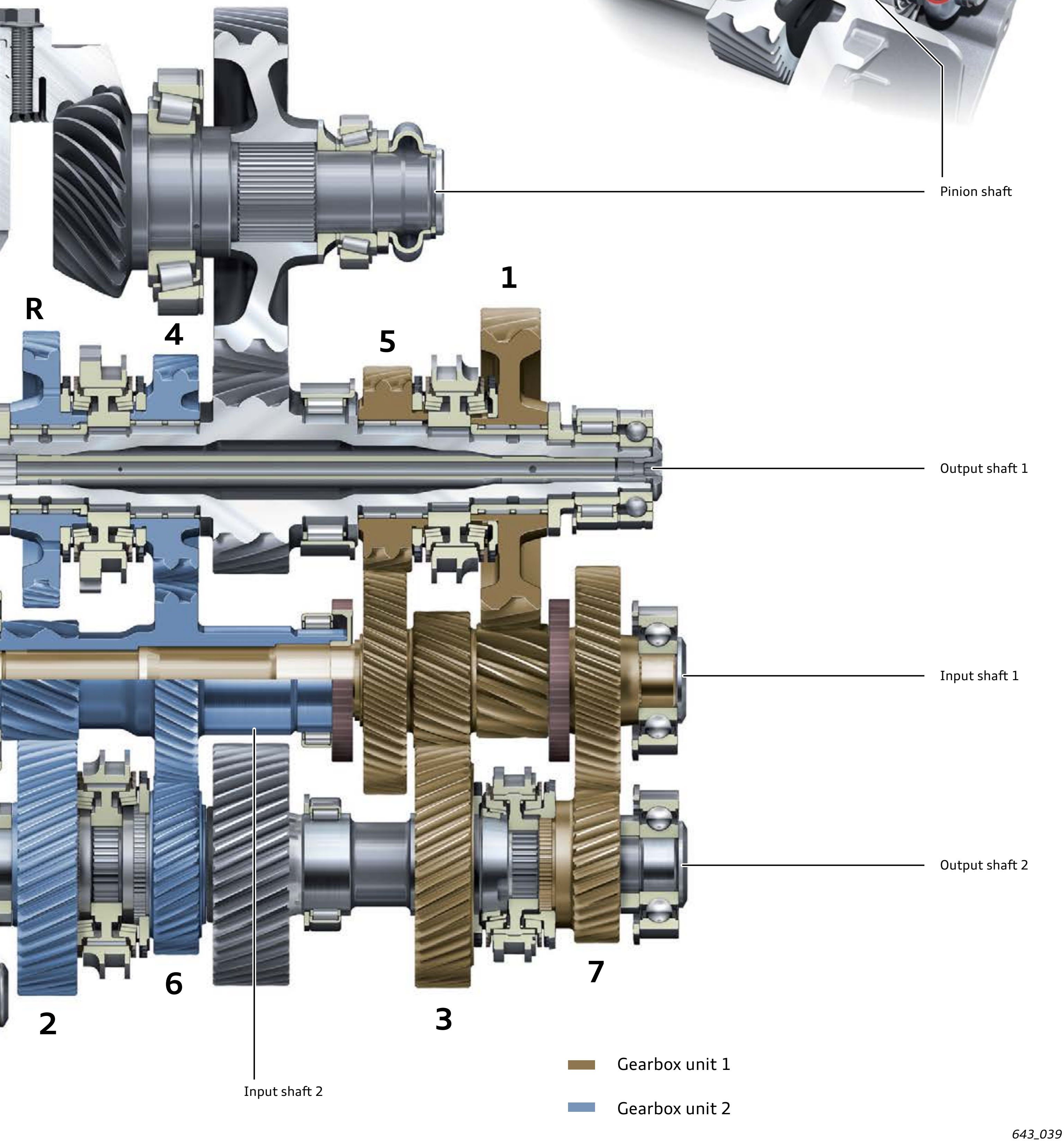
That process is referred to clutch overlap or overlap gear shifting. The entire sequence takes place in only a few hundredths of a second. The dual clutch gearbox enables quicker gear shifts which reduce power flow interruption.



The rear final drive uses bevel gears without hypoid offset. That means that the sliding forces between the meshing teeth are smaller than with bevel gears with hypoid offset. This design enables the use of a common oil system using low-viscosity ATF for all functional transmission subassemblies.

The differential has a differential lock design carried over from the R tronic. More detailed information on the differential lock can be found in eSSP 950123, Audi R8 Power Transmission. The locking characteristics have been adapted to suit the all-wheel drive concept of the 2017 R8.





Dual clutch

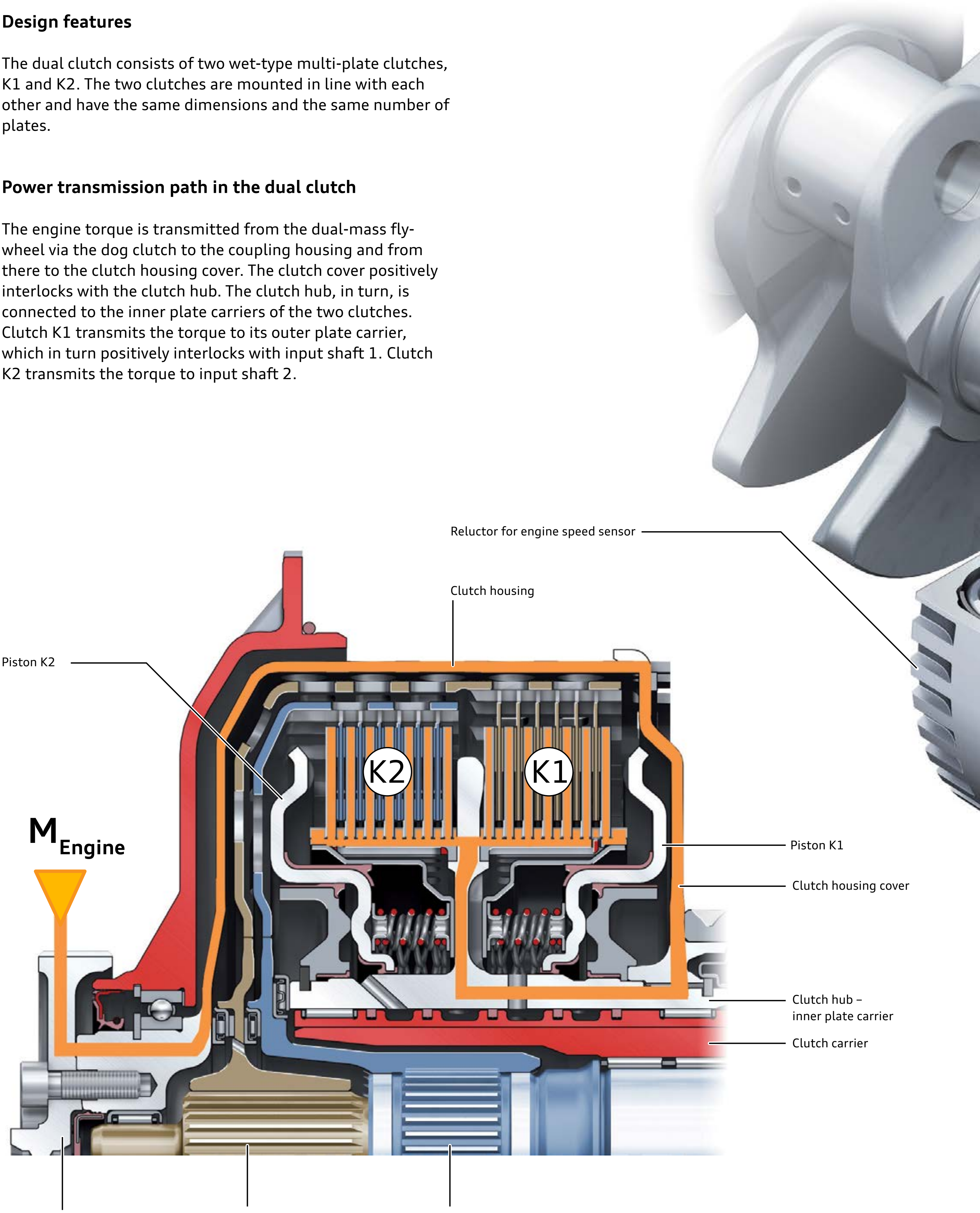
The dual clutch is the central functional component of the dual clutch transmission. It transmits the torque to the relevant gear train subset.

Design features

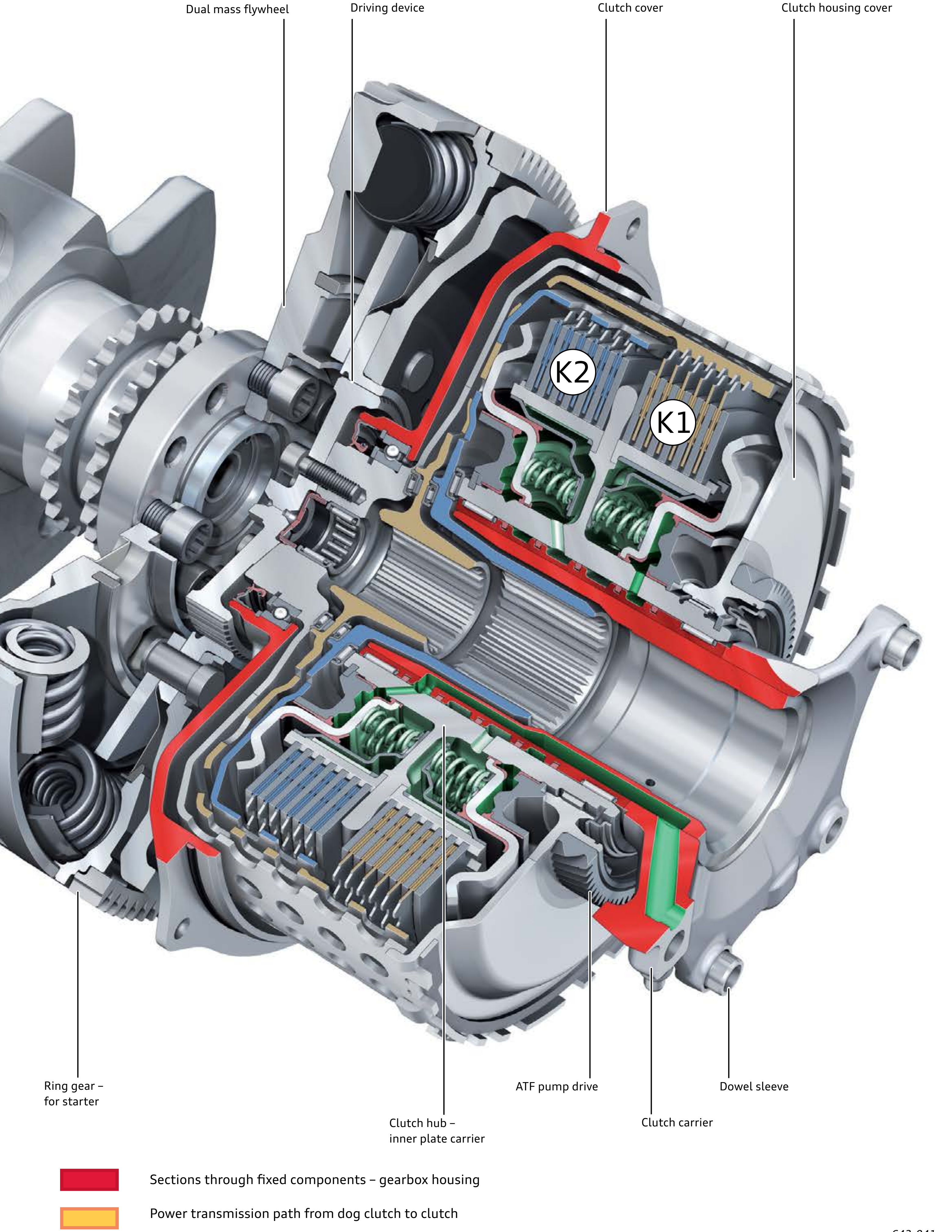
The dual clutch consists of two wet-type multi-plate clutches, K1 and K2. The two clutches are mounted in line with each other and have the same dimensions and the same number of plates.

Power transmission path in the dual clutch

The engine torque is transmitted from the dual-mass flywheel via the dog clutch to the coupling housing and from there to the clutch housing cover. The clutch cover positively interlocks with the clutch hub. The clutch hub, in turn, is connected to the inner plate carriers of the two clutches. Clutch K1 transmits the torque to its outer plate carrier, which in turn positively interlocks with input shaft 1. Clutch K2 transmits the torque to input shaft 2.



643_040


Dual mass flywheel
Driving device
Clutch cover
Clutch housing cover
K2
K1
Ring gear – for starter
Clutch hub – inner plate carrier
ATF pump drive
Clutch carrier
Dowel sleeve
Sections through fixed components – gearbox housing
Power transmission path from dog clutch to clutch

643_041

Dual clutch oil system

The oil entire oil system for the dual clutch is supplied via the clutch carrier by means of a rotational feed system.

The dual clutch is mounted on the clutch carrier by two needle roller bearings. See Figure 643_041 on page 25.
The clutches are supplied with the control pressure (clutch pressure), cooling oil and centrifugal oil for dynamic pressure equalization via four oil channels. Five Torlon rings form the rotary seals for the four oil channels.

In order to counterbalance the effect of dynamic pressure build-up with increasing rotational speed, each of the clutches has a pressure equalization chamber (centrifugal oil chamber).

The following functions are associated with the dual clutch:

- Clutch control.
- Dynamic pressure equalization.
- Start-up.
- Power flow reversal.
- Clutch cooling.
- Clutch control at standstill (creep control).
- Overload protection.
- Safety shut-off.
- Microslip control.
- Clutch adaptation.

Basic information about those functions is provided in eSSP 951403, The 02E Direct Shift Gearbox, Design and Function.

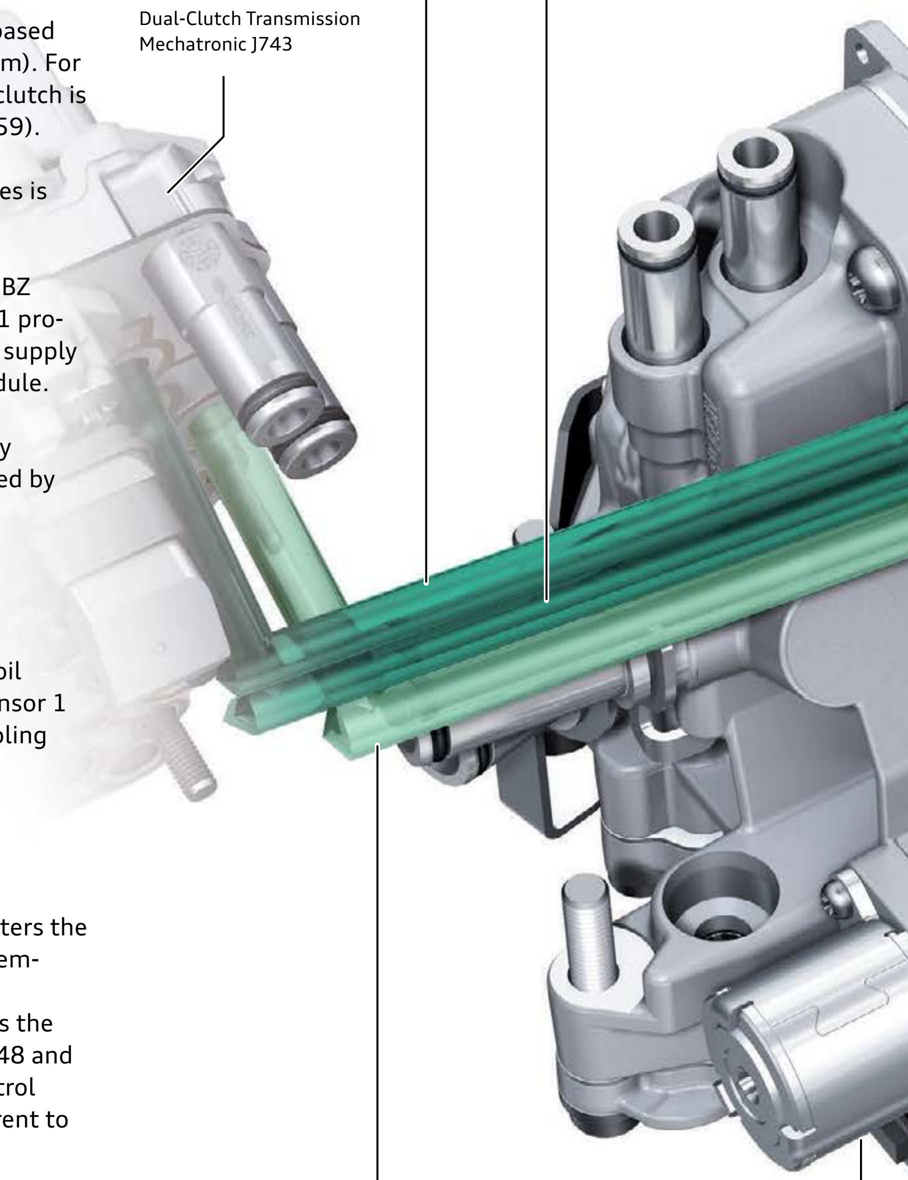
Clutch cooling

Each of the two clutches has a separate and demand-based cooling and lubrication oil supply (clutch cooling system). For that purpose, the centrifugal oil temperature of each clutch is detected by a separate temperature sensor (G658/G659).

The supply of oil for cooling and lubricating the clutches is provided via the centrifugal oil chambers.

A special feature of the clutch cooling system on the 0BZ transmission is that the cooling oil supply for clutch K1 provided by the Mechatronic module while the cooling oil supply for clutch K2 is provided by the auxiliary hydraulic module.

The clutch cooling system for clutch K2 is controlled by Clutch Cooling Valve 2 N488. Which in turn is controlled by Automatic Transmission Control Module 2 J1006.



Clutch cooling system for clutch K1

Gearbox Control Unit 1 J743 registers the centrifugal oil temperature of clutch K1 from Clutch Temperature Sensor 1 G658 and calculates the control current for Clutch Cooling Valve 1 N447.

Clutch cooling system for clutch K2

Automatic Transmission Control Module 2 J1006 registers the centrifugal oil temperature of clutch K2 from Clutch Temperature Sensor 2 G659 and sends the information to Gearbox Control Unit 1 as a CAN message. It calculates the required control current for Clutch Cooling Valve 2 N448 and send that information to Automatic Transmission Control Module 2 J1006. J1006 then applies the specified current to N448.

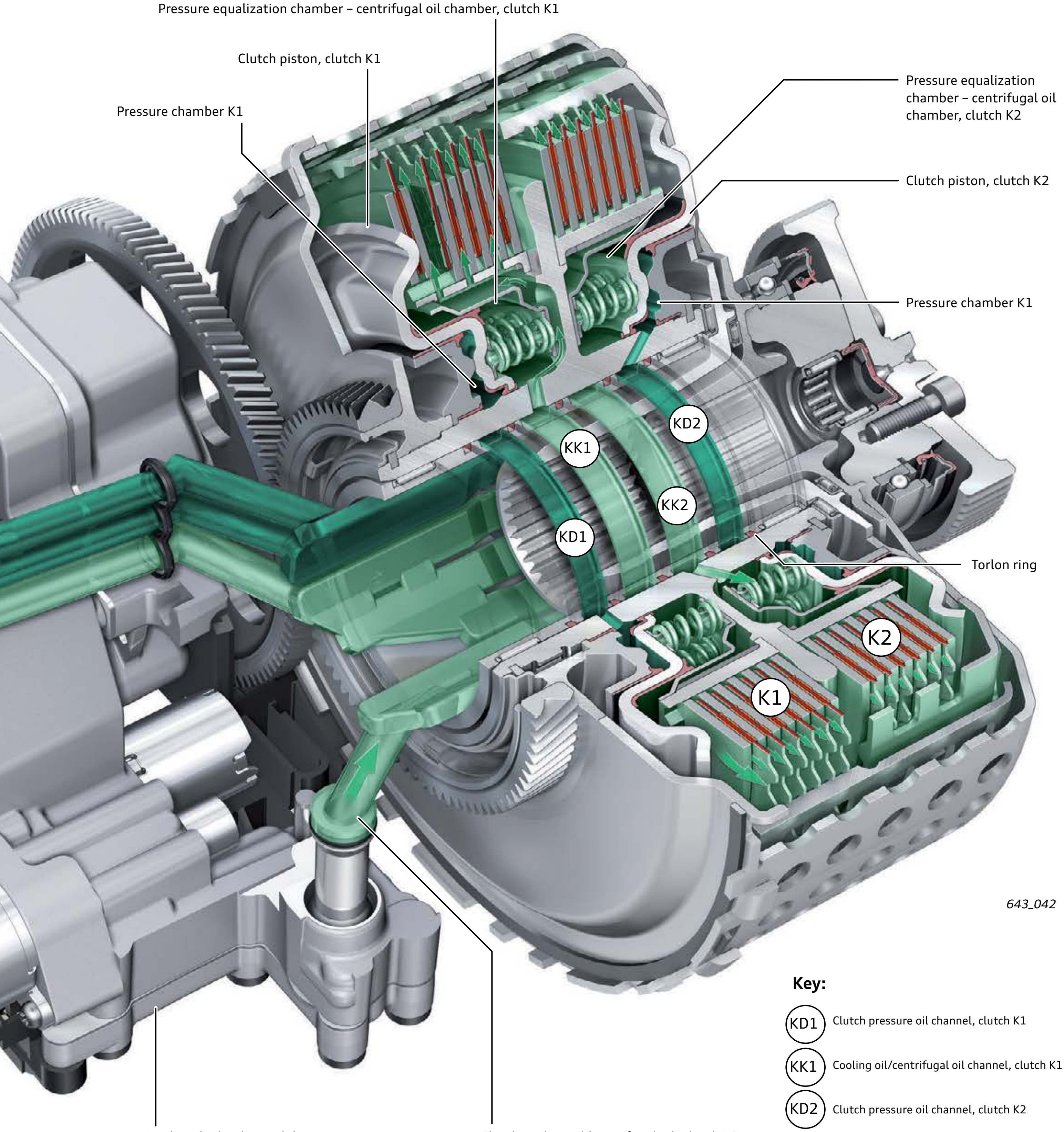
Clutch monitoring

The clutch pressure of the two clutches is continuously monitored by Gearbox Control Unit 1 J743. If the pressure deviates from the specified clutch pressure, the clutch concerned is de-pressurized by means of a safety cut-out. Refer to page 60.

The temperature of the two clutches is continuously monitored by J743 and J1006.

Two temperature sensors, G658 and G659, are used to calculate the clutch temperature and controlling clutch cooling.

If a centrifugal oil temperature of around approximately 338 °F (170 °C) is exceeded, the instrument cluster displays the warning "*Gearbox too hot. Please adjust driving style.*" and a corresponding DTC is registered in the control module.



643_042

Key:

KD1 Clutch pressure oil channel, clutch K1

KK1 Cooling oil/centrifugal oil channel, clutch K1

KD2 Clutch pressure oil channel, clutch K2

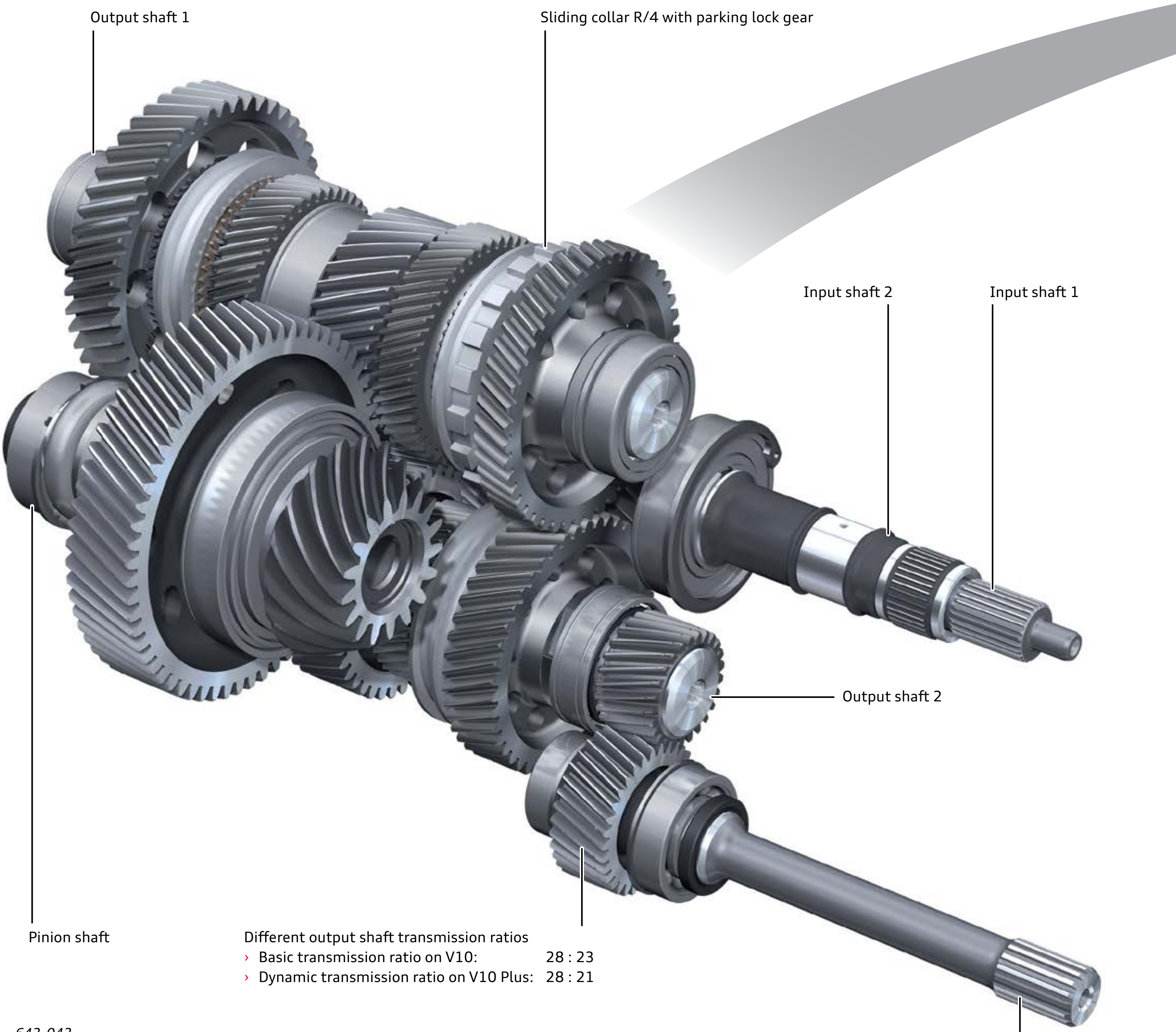
KK2 Cooling oil/centrifugal oil channel, clutch K2

Gear train and gear set

Special features

The gear set of the 0BZ transmission has the following special features:

- Reverse gear is implemented without a separate reverse drive gear or reverse shaft.
- The parking lock gear is combined with the sliding collar of gear set R/4 in a single unit.
- There is a separate output shaft for driving the front wheels.



643_043

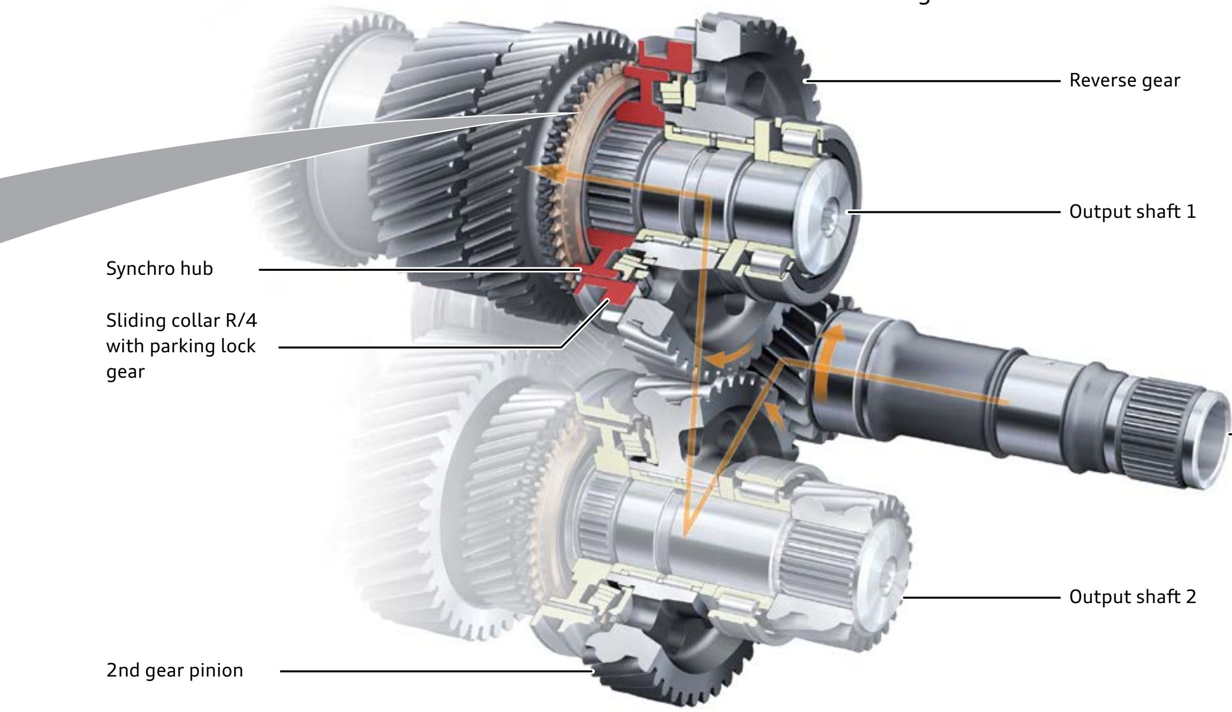
Figure 643_045 opposite shows how the two output shafts 1 and 2, the pinion shaft and the PTO shaft for the front final drive are permanently engaged.

Disengage

The parking lock gear is located on the sliding collar of gear set R/4. The sliding collar, the synchromesh hub and output shaft 1 are locked together rotationally. When the parking lock is engaged, output shaft 1 is locked.

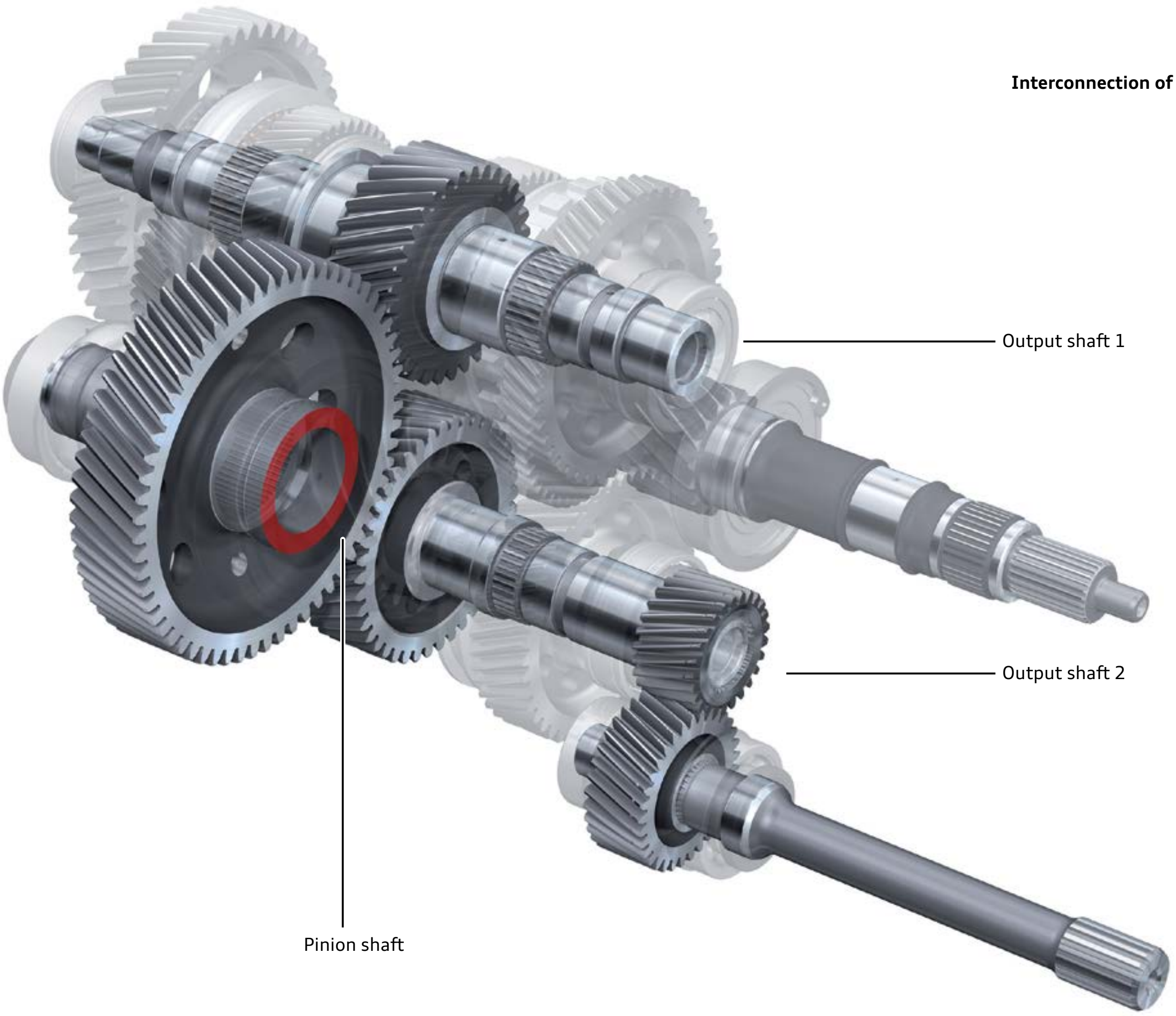
Reverse gear

The reversal of rotation direction for reverse gear is achieved by means of the synchronizer gear for 2nd gear. The synchronizer gears for 2nd and reverse gears are permanently engaged. In reverse gear, the torque is transmitted from input shaft 2 via the idling synchronizer gear for 2nd gear to the synchronizer gear for reverse gear. The direction of rotation of output shaft 1 is opposite to what it is in the forward gears.



643_044

Interconnection of the shafts



643_045

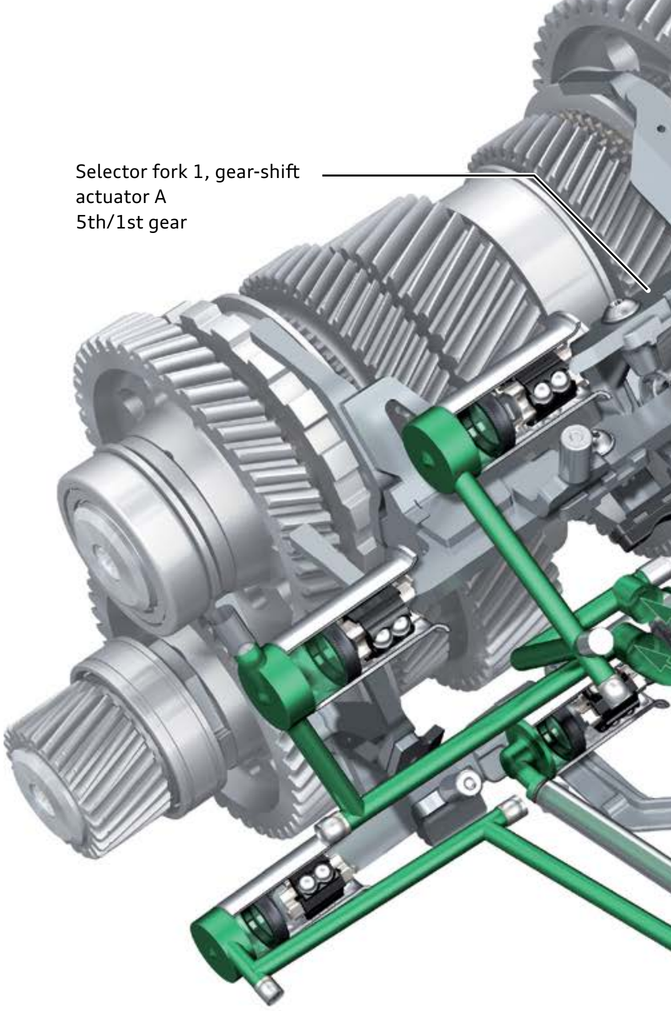
Gear shifting and gear-shift actuators

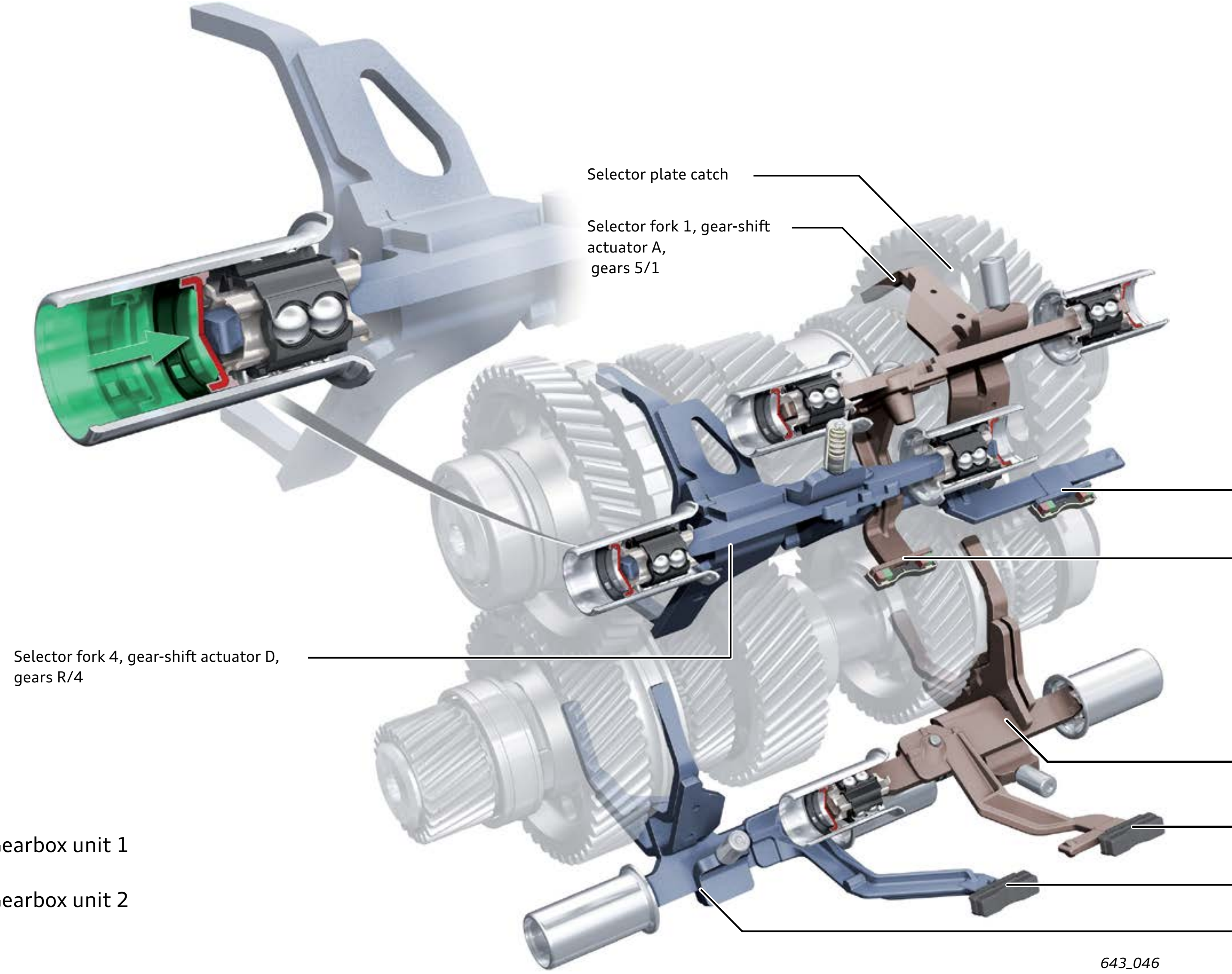
Gear changing is performed by means of four hydraulically operated selector forks referred to as gear-shift actuators.

Each gear-shift actuator consists of a selector fork with a selector plate at each end of which is a single-action hydraulic cylinder. On the selector plate there is also a bracket holding sensor magnets and a catch.

Pressure is applied to the hydraulic cylinders so that they move the selector forks to the left or right (gear engaged), depending on the gear to be selected, or to the center position (neutral position). Once the gear/neutral position is engaged, the hydraulic cylinders are de-pressurized. The gears are kept engaged by the undercut of the dog teeth and the catches on the selector plates. In neutral position, the selector plates are held in the center position by the catches. The sliding collars also have a catch for the neutral position.

When the vehicle is stationary, 1st gear is always engaged on gear train subset 1. On gear train subset 2, 2nd or reverse gear may be engaged depending on the preceding driving scenario. If the vehicle is braked to a standstill after travelling forwards, 2nd gear remains engaged. Reverse gear is not engaged until transmission setting **R** is selected or if the engine is switched on again after being switched off and transmission setting **D** or **R** is selected. If, for example, the engine is switched off immediately after backing up, reverse gear remains engaged.





Gearbox unit 1

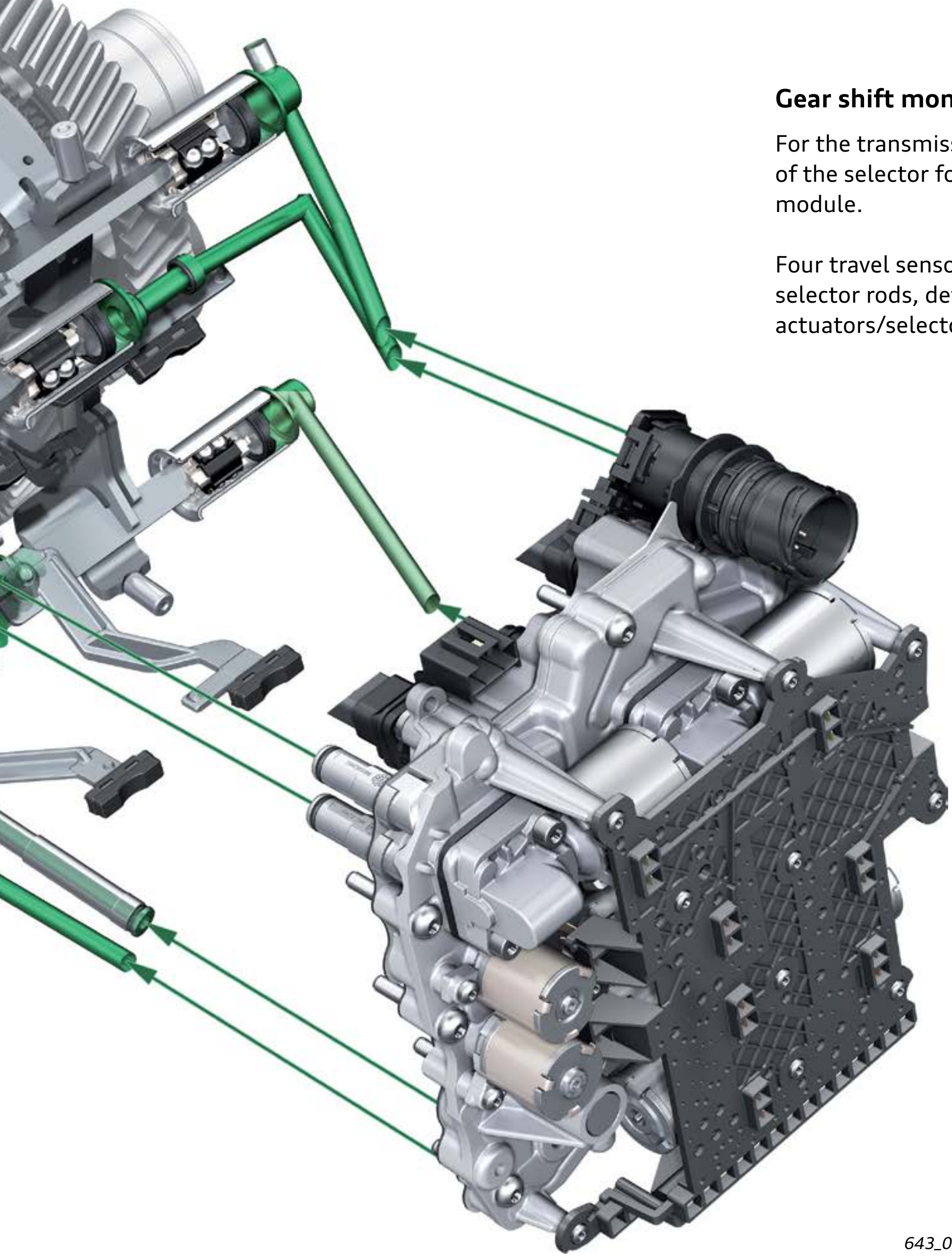
Gearbox unit 2

643_046

Gear shift monitoring

For the transmission to function perfectly, the exact positions of the selector forks must be known by transmission control module.

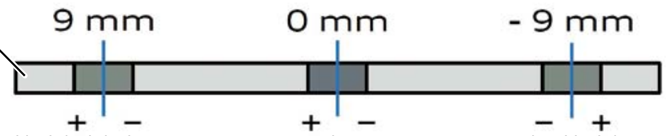
Four travel sensors, aided by sensor magnets attached to the selector rods, define the positions of the relevant gear shift actuators/selector forks. Refer to page 68.



643_047

The measurements taken – actual positions of gear-shift actuator A (B/C/D) – show the gear-shift travel in millimetres. Refer to page 68.

Travel of gear-shift actuator



3rd/4th/5th/6th gear engaged

Neutral position

1st/2nd/7th/Reverse gear engaged

643_102

Sensor magnet for Gear Position Distance Sensor 4 G490[1] for gear-shift actuator D for gears R/4

Sensor magnet for Gear Position Distance Sensor 1 G487[1] for gear-shift actuator A for gears 5/1

Selector fork 3/gear-shift actuator C, gears 3/7

Sensor magnet for Gear Position Distance Sensor 3 G489[1] for gear-shift actuator C for gears 3/7

Sensor magnet for Gear Position Distance Sensor 2 G488[1] for gear-shift actuator B for gears 2/6

Selector fork 2/gear-shift actuator B, gears 2/6

In the event of malfunctions or invalid shift positions, the gear train subset concerned is hydraulically disabled by means of the safety cut-out. Refer to page 60.

Due to manufacturing tolerances, the limit positions and synchronization points of each gear have to be learned by Dual-Clutch Transmission Mechatronic J743. This can be done via the VAS Scan Tool.

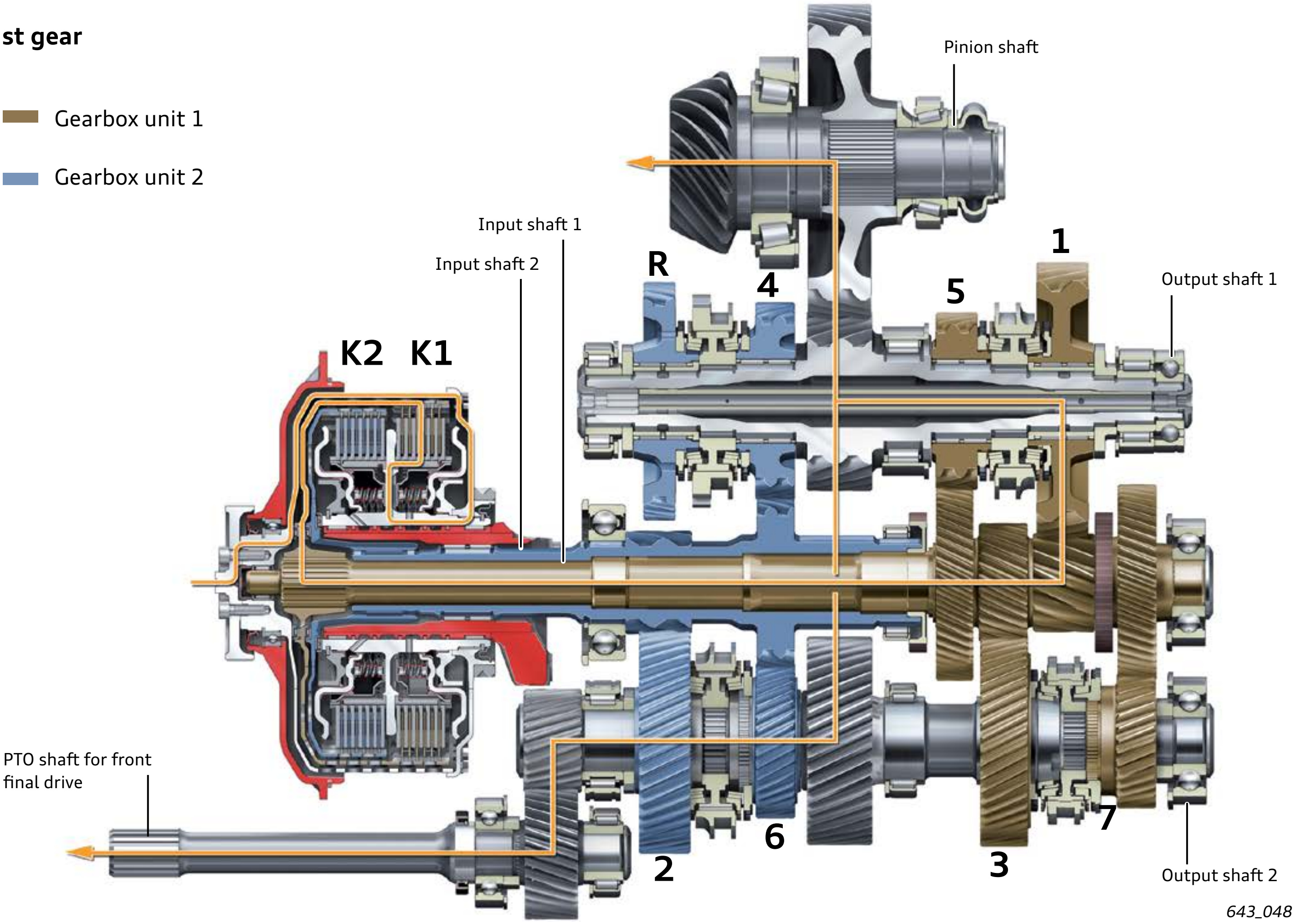
[1] See also page 68.

Power transmission path in gearboxes

1st gear

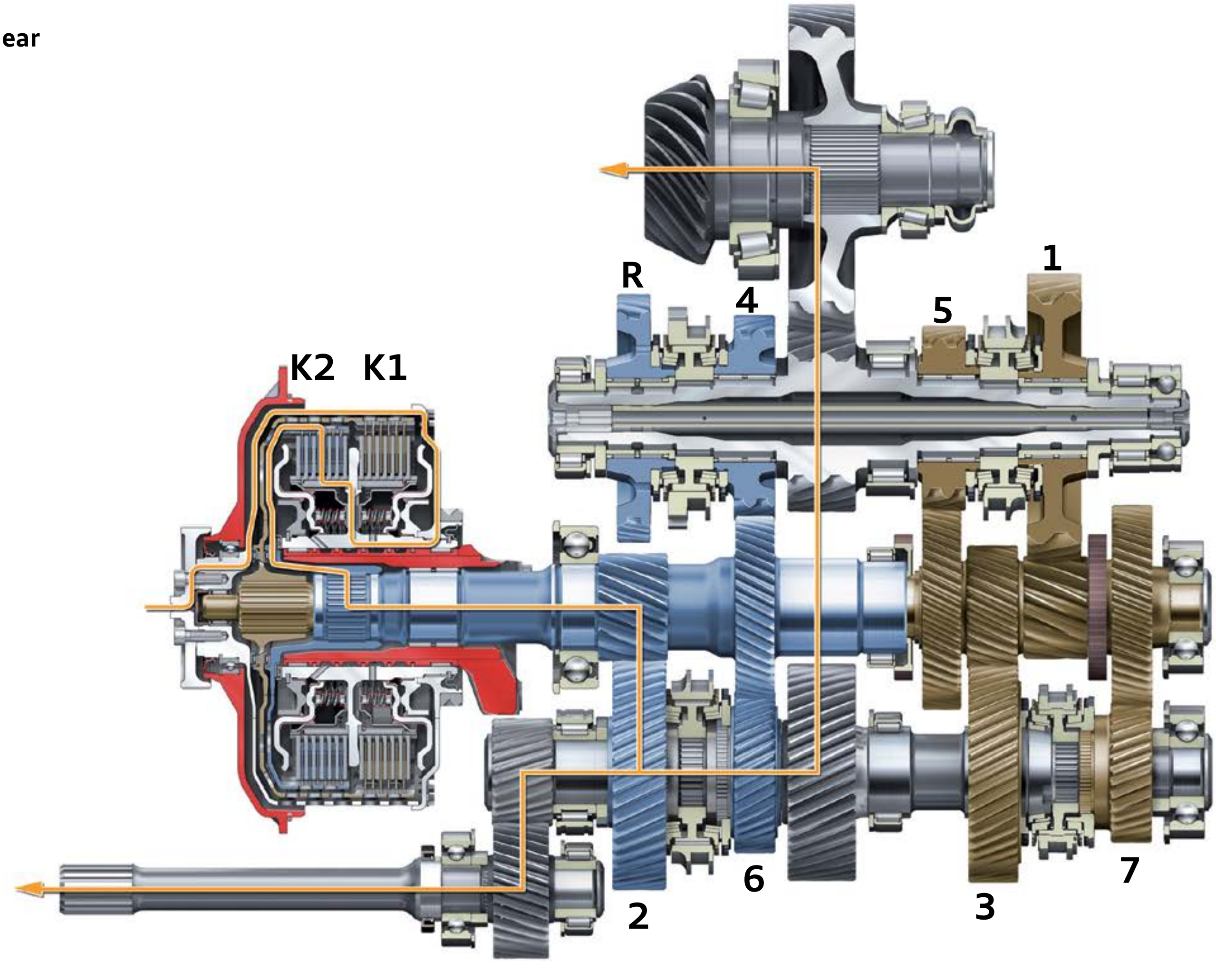
Gearbox unit 1

Gearbox unit 2



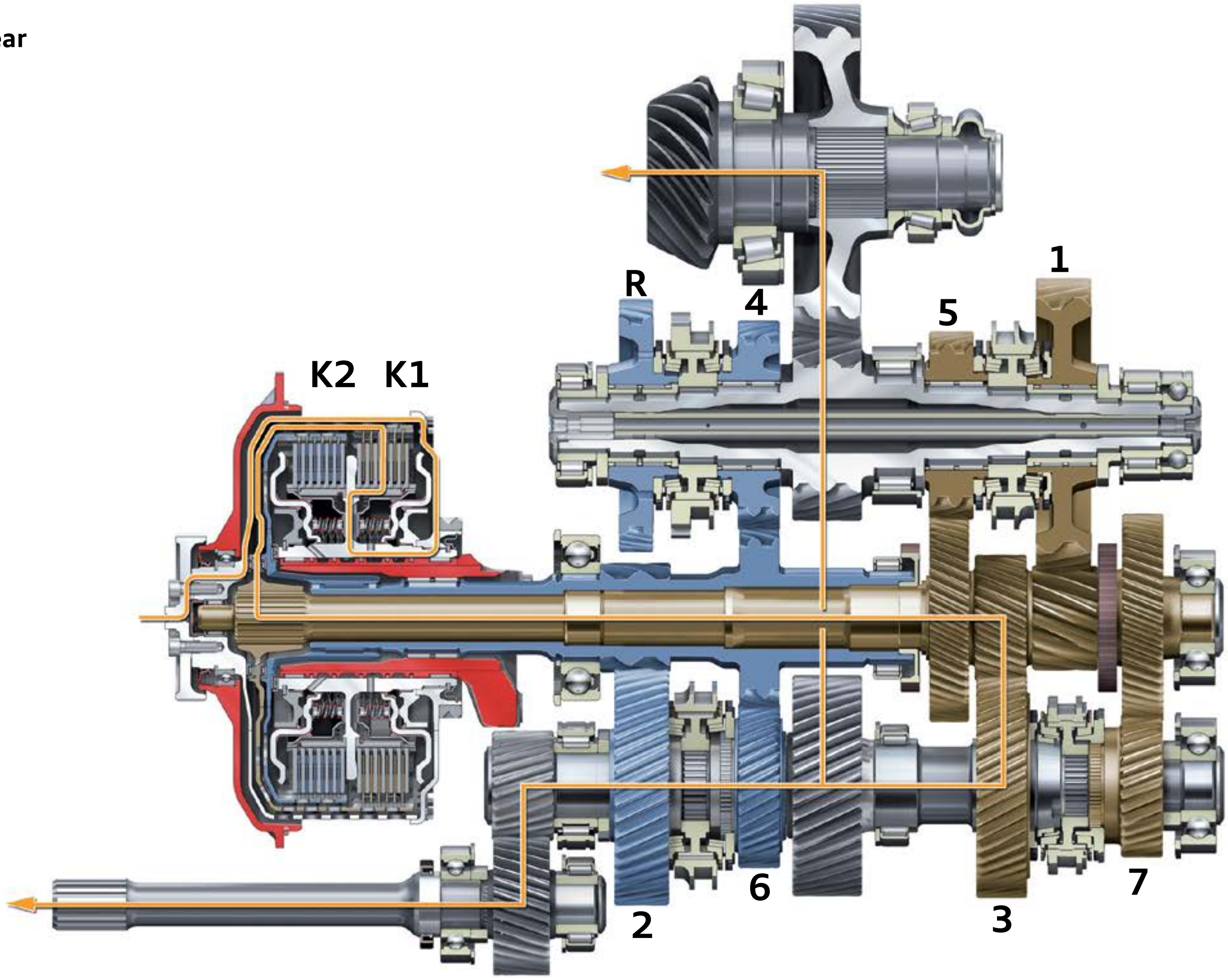
643_048

2nd gear



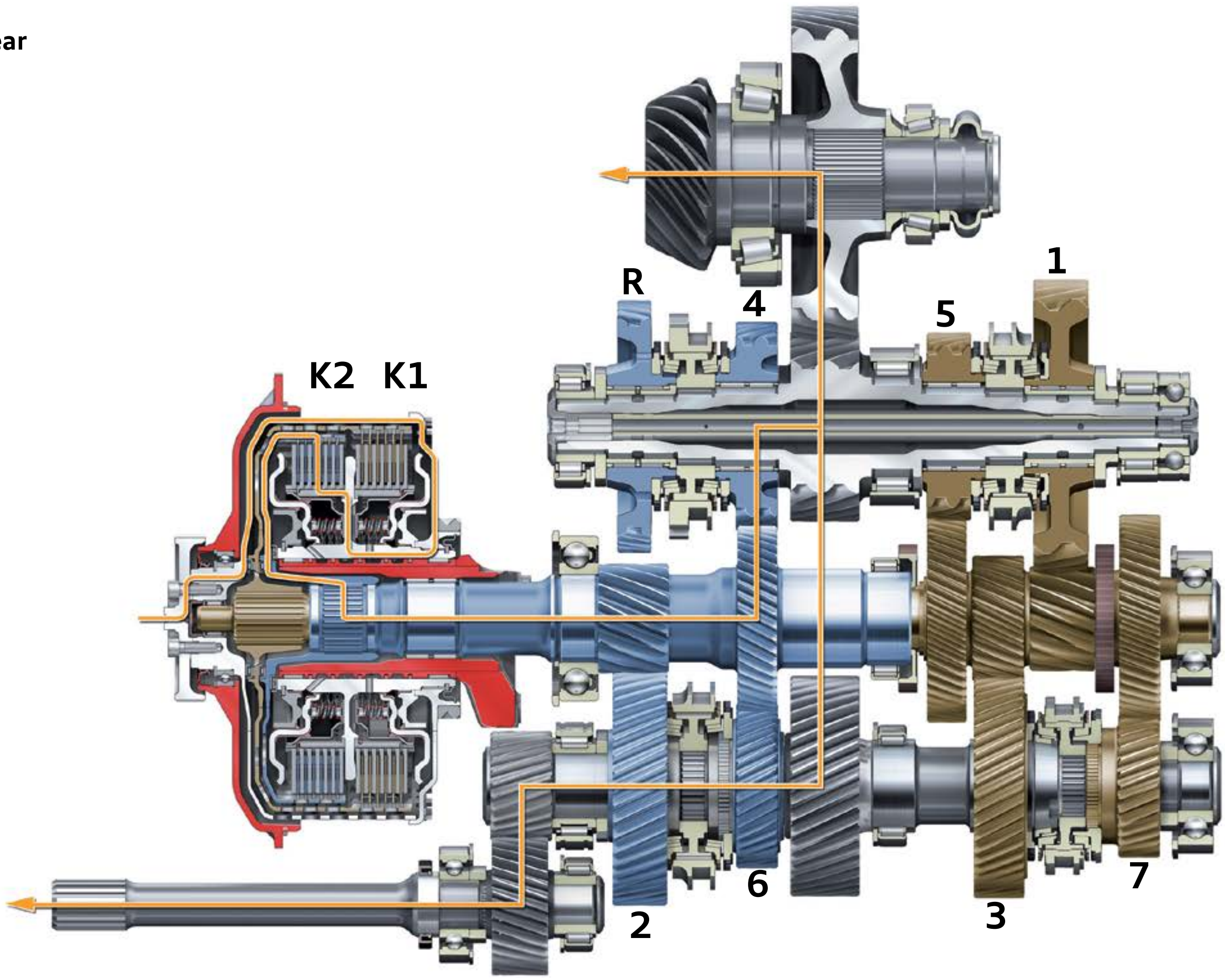
643_049

3rd gear



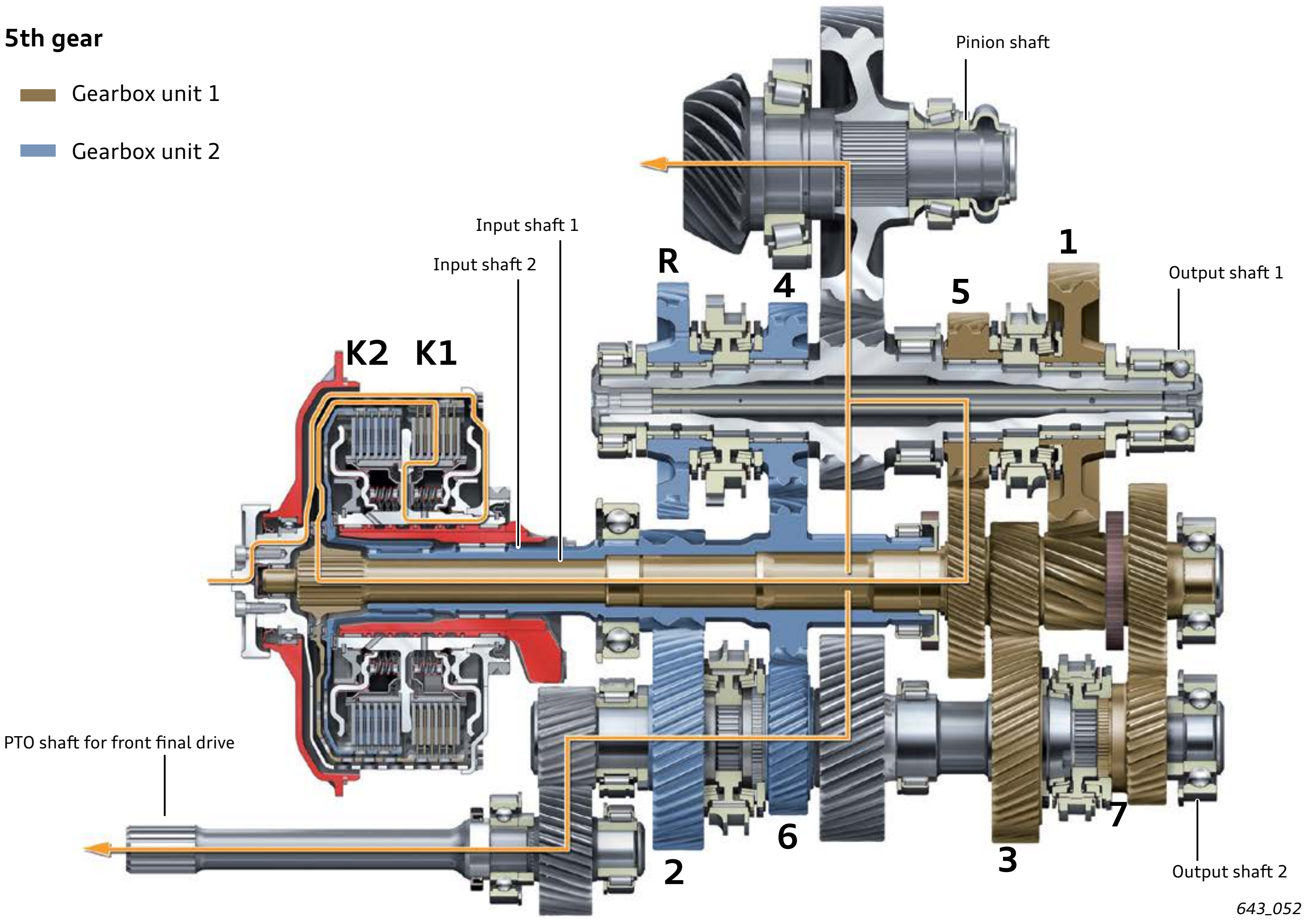
643_050

4th gear



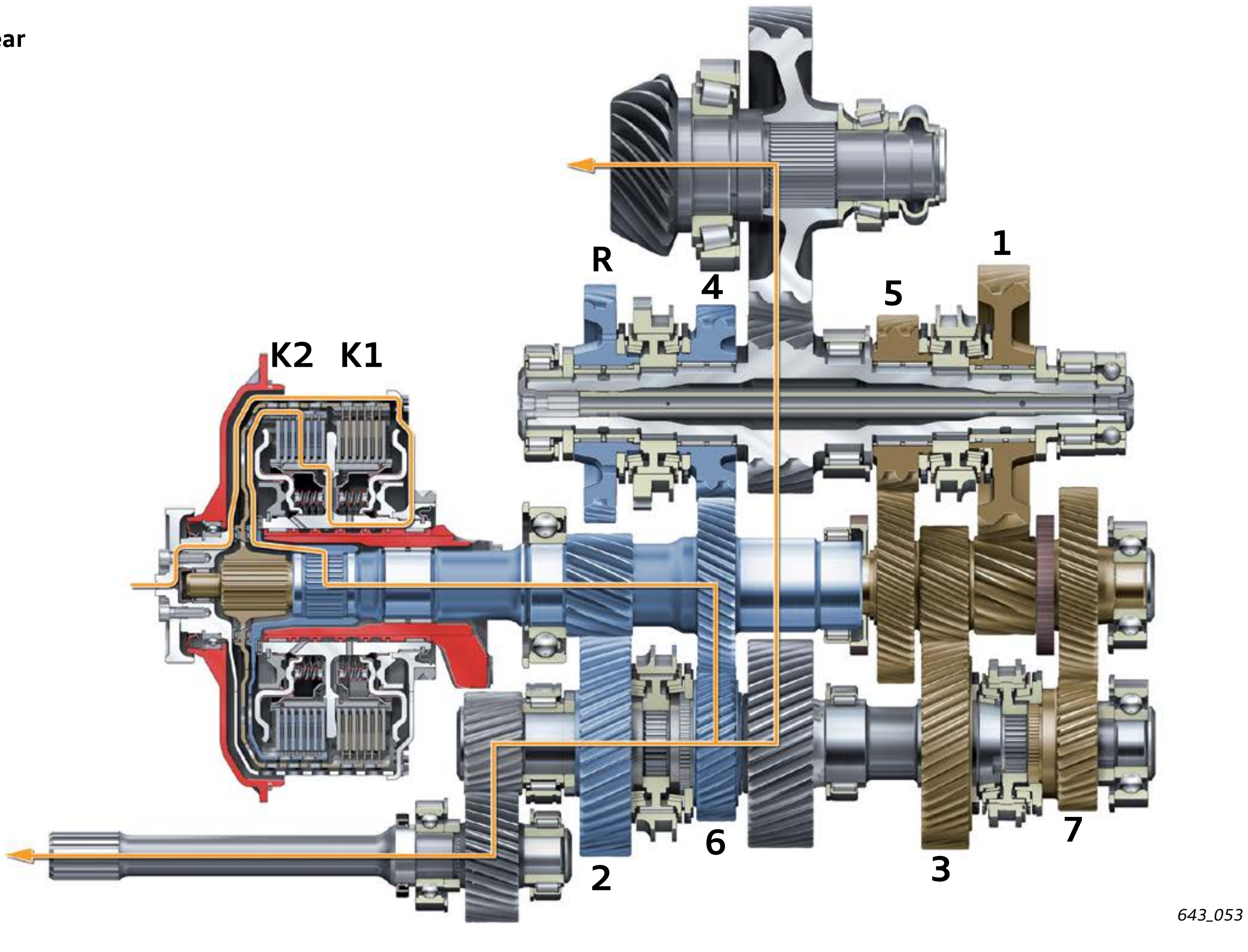
643_051

5th gear



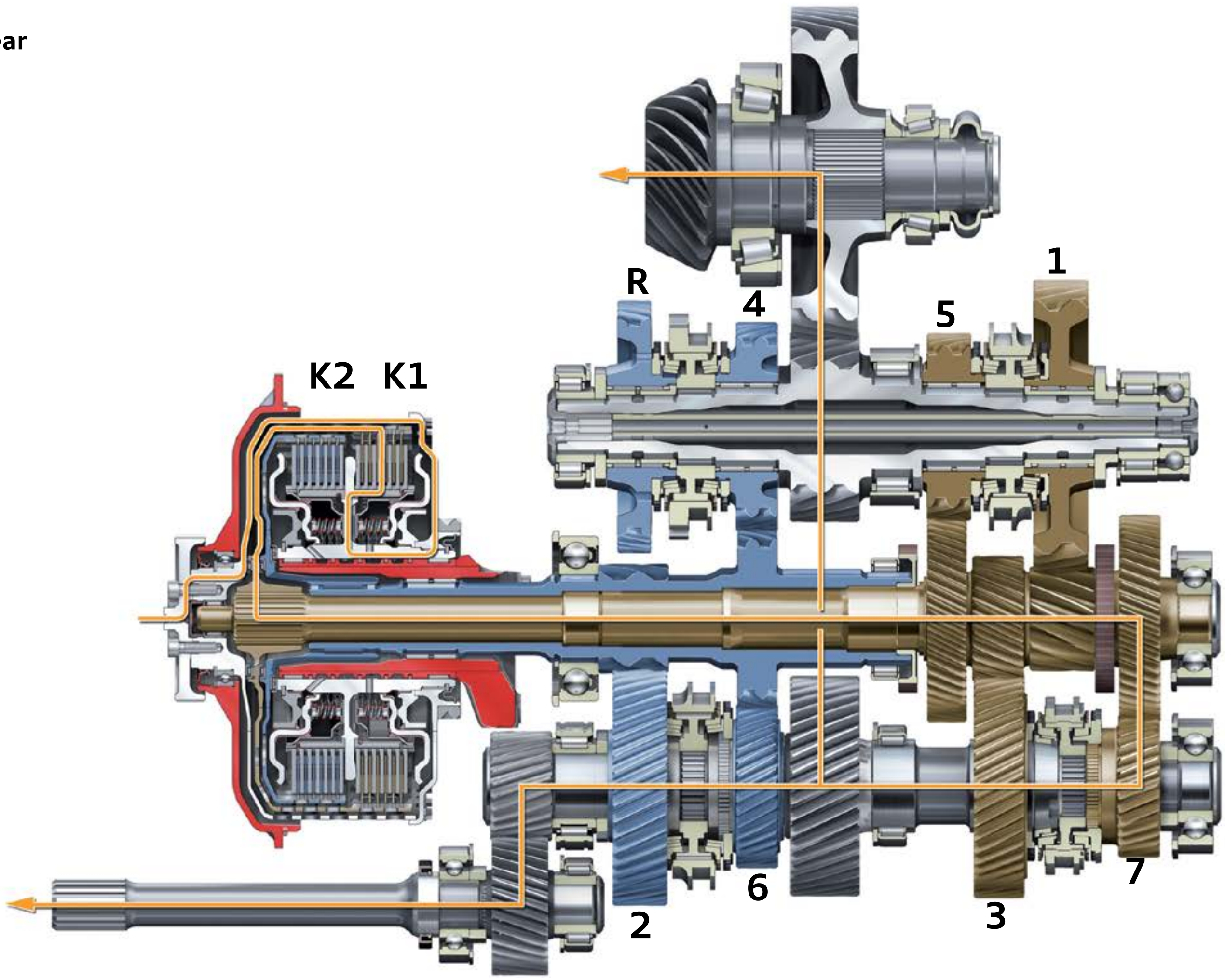
643_052

6th gear



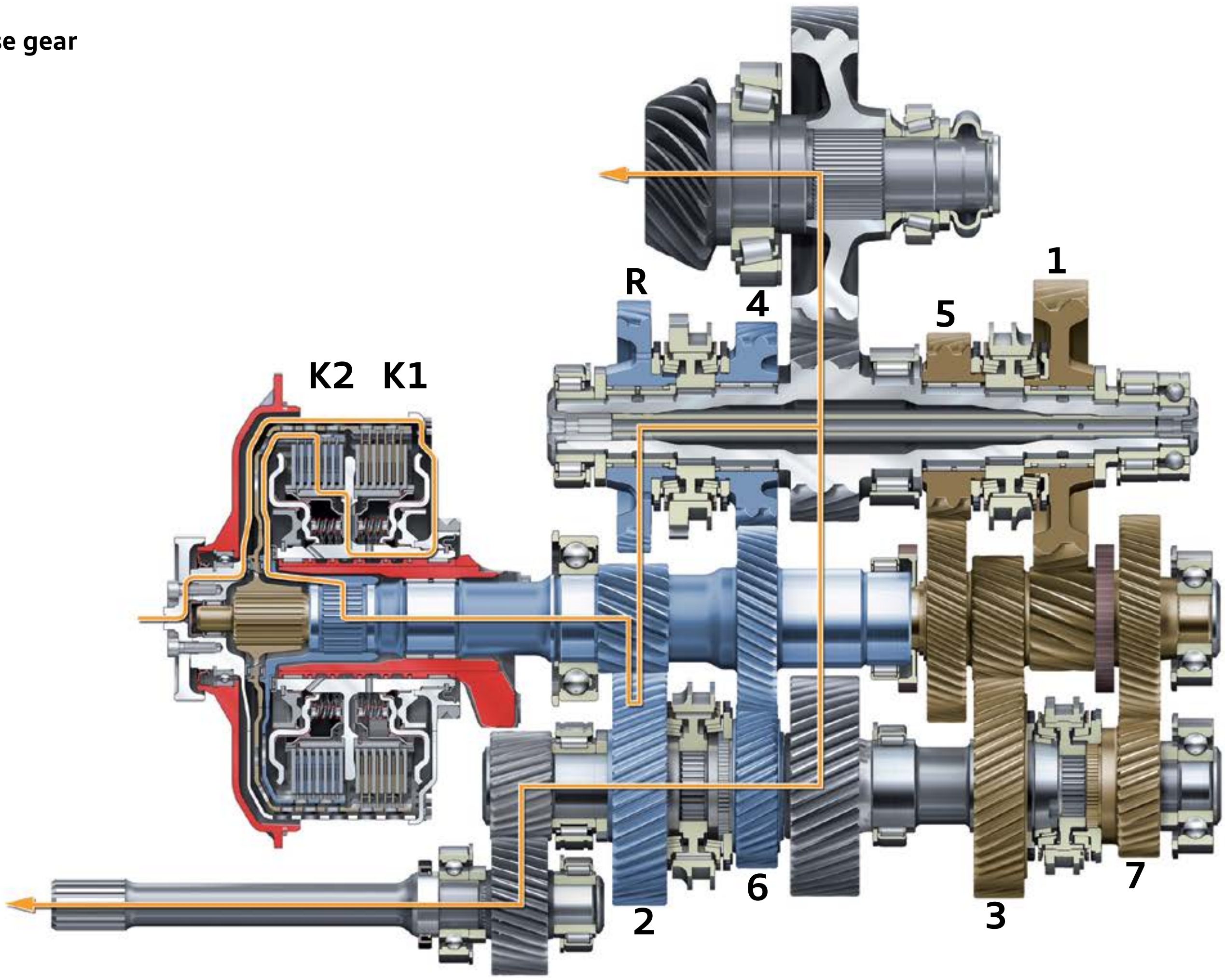
643_053

7th gear



643_054

Reverse gear



643_055

Parking lock – mechanical function

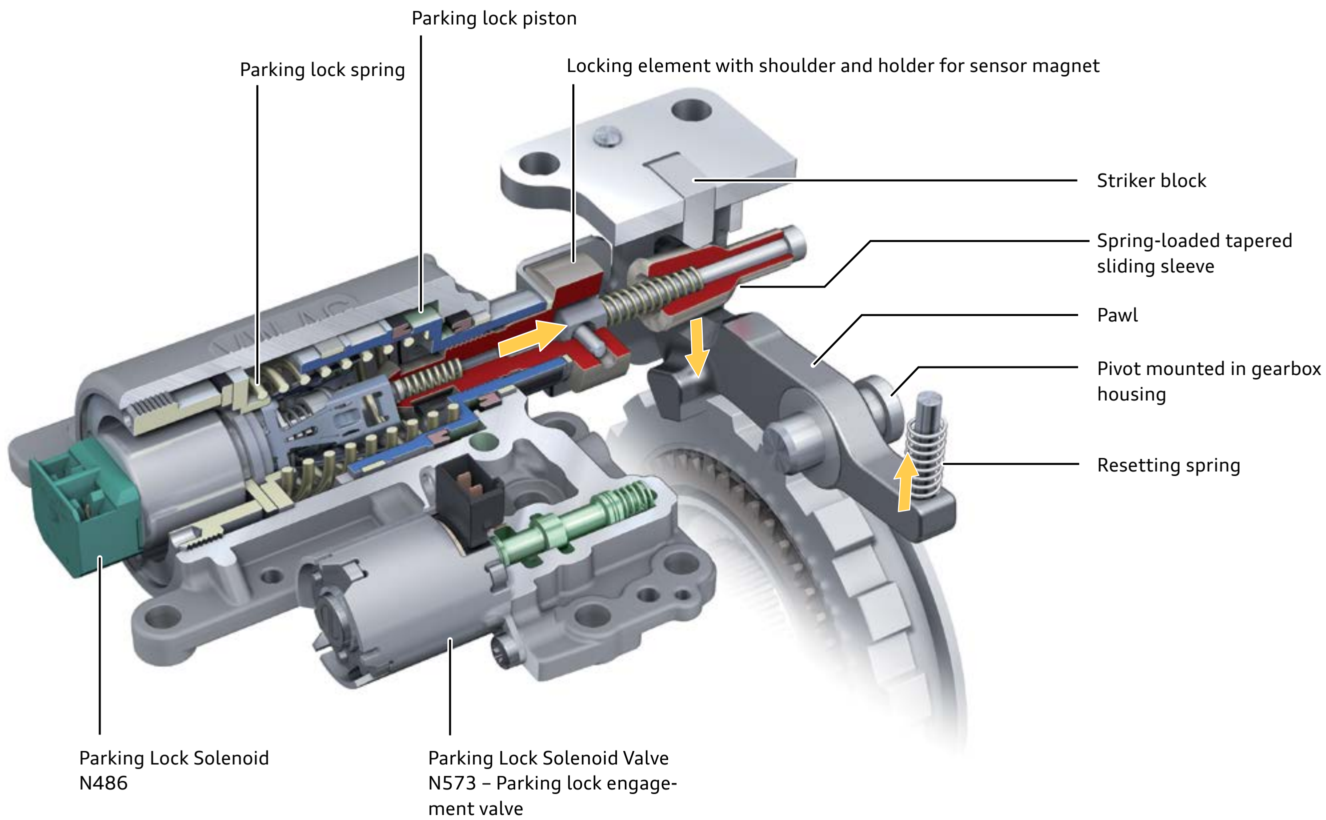
Because there is never any drive gear engaged when the engine is not running (both clutches K1 and K2 are not engaged), the OBZ transmission requires a parking lock.

The parking lock consists of a parking lock gear and a locking pawl that is actuated by a spring loaded, tapered sliding sleeve.

Unique to the OBZ transmission, is that the parking lock gear is not located on the gearbox output shaft, as is normally the case, but instead is integrated in sliding collar R/4. See page 29.

Engaging the parking lock – P-ON

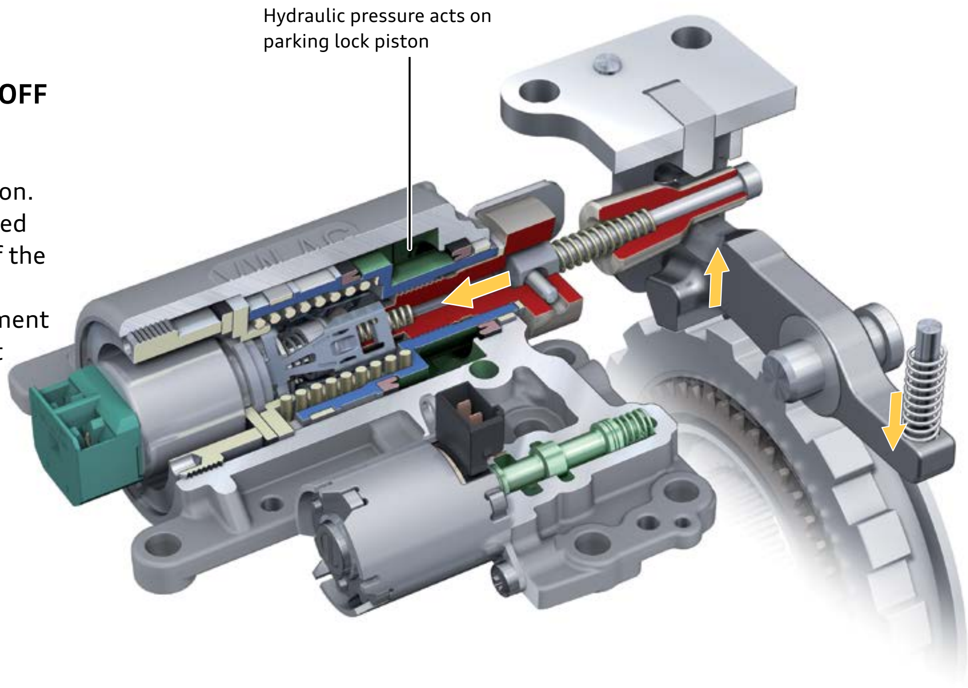
The parking lock is engaged by the force of the parking lock spring. The parking lock spring forces the parking lock piston together with arrester element and tapered sliding sleeve between the bracing plate and the locking pawl. As a result, the locking pawl is pressed against the parking lock gear. The claw engages in the teeth of the parking lock gear and locks it in position.



643_078

Disengaging the parking lock – P-OFF

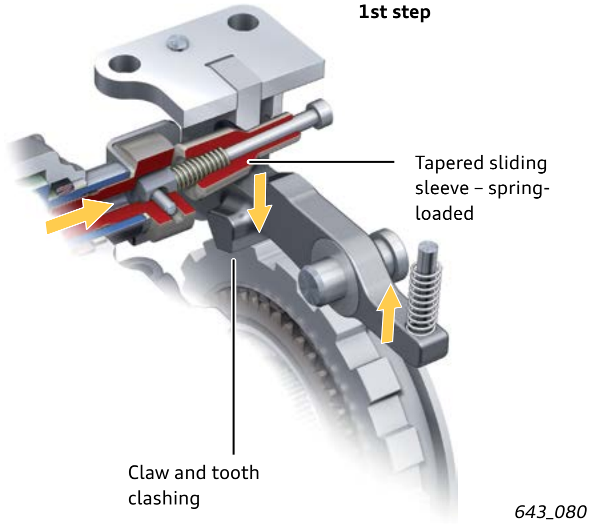
The parking lock is disengaged by the hydraulic force of the parking lock piston. The parking lock piston pulls the tapered sliding sleeve back against the force of the parking lock spring. The return spring forces the locking pawl out of engagement with the gear teeth and holds it in that position.



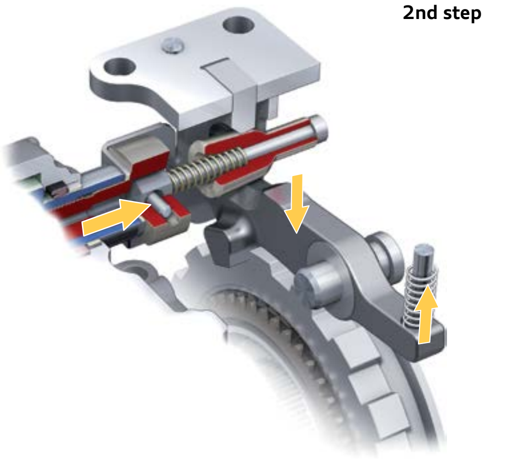
643_079

Engaging the parking lock if pawl and gear do not mesh

1. If the claw of the locking pawl clashes with a tooth of the parking lock gear, the tapered sliding sleeve is still forced between the bracing plate and the locking pawl by the preloaded spring force. The tapered sleeve is spring-loaded and presses the locking pawl against the tooth of the parking lock gear.



643_080



643_081

2. As soon as the vehicle rolls a little and the parking lock gear rotates slightly, the locking pawl snaps into engagement with the parking lock gear because the tapered sleeve is preloaded by the force of the spring. The parking lock is engaged.

Holding the parking lock in position P-OFF with Parking Lock Solenoid N486

A - Keeping parking lock disengaged

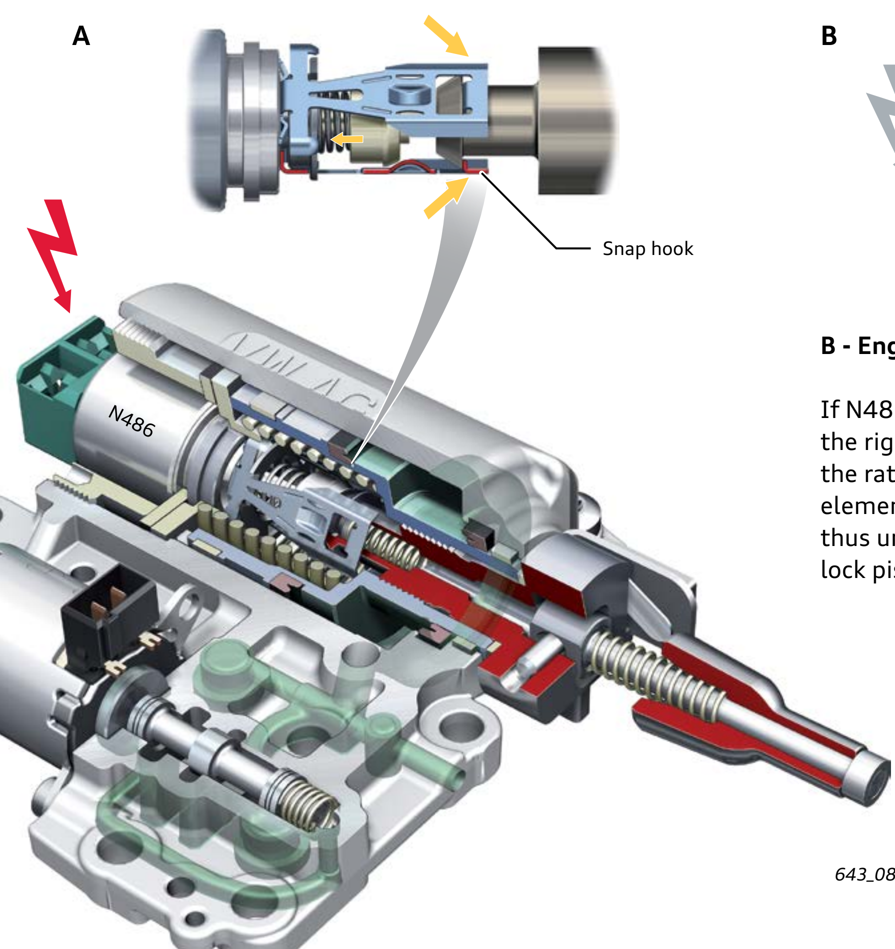
If the parking lock needs to remain disengaged after the engine is switched off, the parking lock piston has to be held in the P-OFF position by the Parking Lock Solenoid N486.

To hold the lock in position P-OFF, N486 remains energized after the engine is switched off. That means that the armature of N486 remains pulled in against the force of the spring (Figure A).

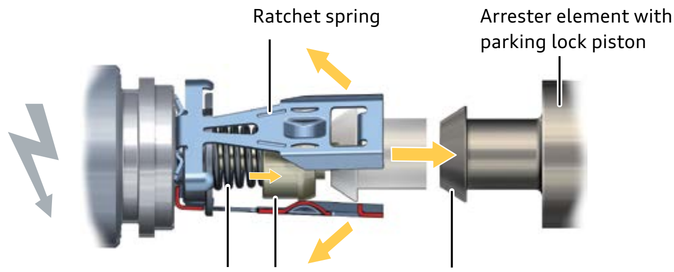
In that position, the 3 ratchet springs of N486 engage with the locking tip of the arrester element and so lock the parking piston in the P-OFF position.

More information on activating the transmission setting P-OFF can be found on page 12.

A



B



B - Engaging the parking lock

If N486 is de-energized, the armature of N486 moves out (to the right) under the force of the armature spring. As a result, the ratchet springs are forced apart and release the arrester element of the parking lock piston. The parking lock piston is thus unlocked and the parking lock spring forces the parking lock piston into the P-ON position.

643_082

Parking lock – electro-hydraulic function

Normal position – Parking lock ON – Engine OFF

The following circuit diagram shows the system in pressurized and depressurized condition.

The spring in the parking lock piston ensures that the parking lock is engaged.

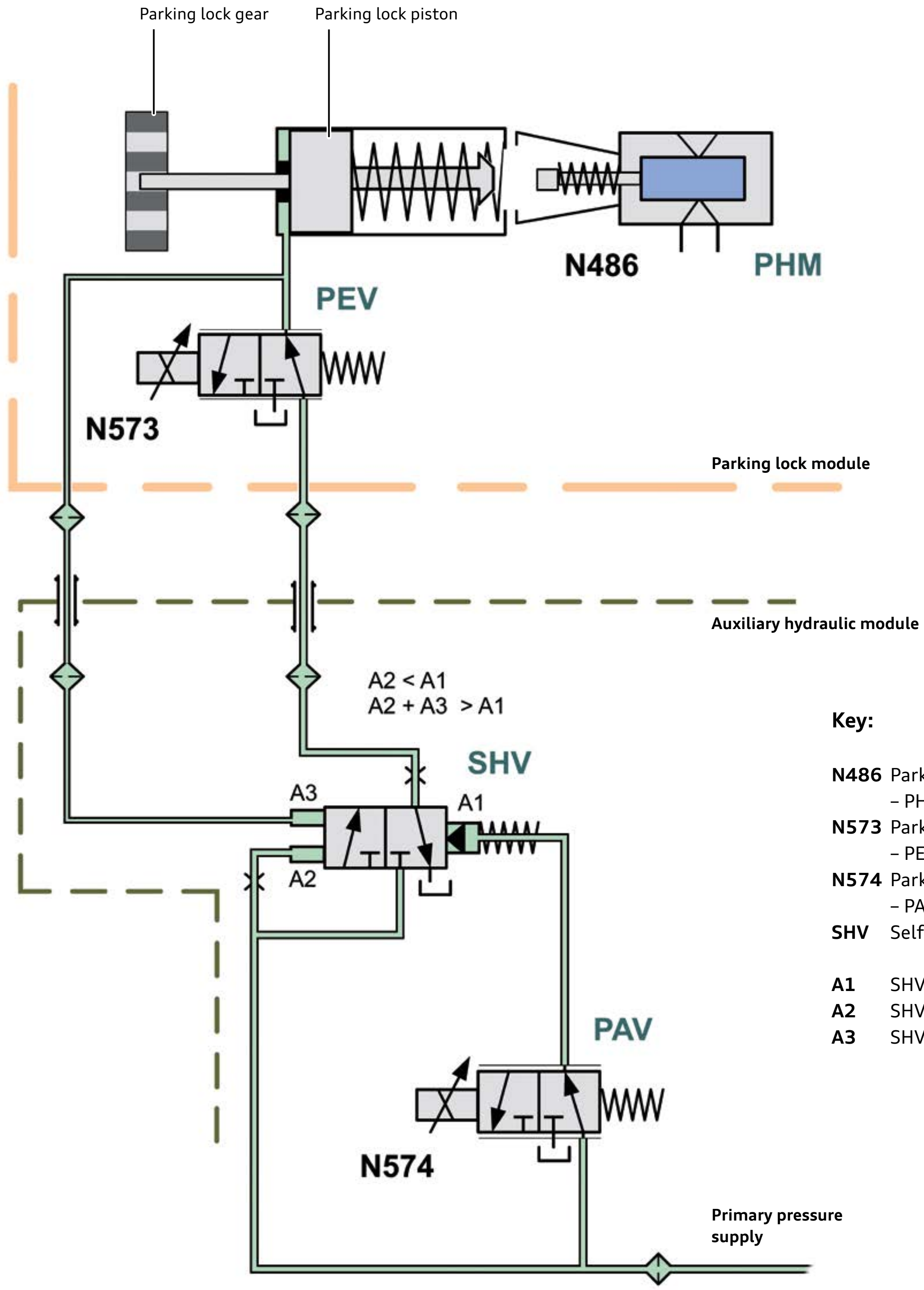
A hydraulic circuit with spring-loaded self-holding valve (SHV) and an additional holding solenoid (N486) for the P-OFF position make sure that the parking lock cannot be unintentionally engaged when the vehicle is moving.

WhenParking Lock Solenoid Valve 2 N574 and Parking Lock Solenoid N486 are de-energized, the parking lock always remains engaged. In that circuit setting, the pressure line of the parking lock piston has an open connection to the sump via the self-holding valve (SHV) and is not pressurized.

The basic principle is:

When it has no oil pressure and power supply, the parking lock is always engaged (parking lock PN).

Solenoid valve N574 is only briefly operated. The self-holding valve retains whichever switching condition is initiated.



Key:

N486 Parking Lock Solenoid
– PHM – Parking lock holding solenoid
N573 Parking Lock Solenoid Valve
– PEV – Parking lock engagement valve
N574 Parking Lock Solenoid Valve 2
– PAV – Parking lock disengagement valve
SHV Self-holding valve

A1 SHV piston face A1
A2 SHV piston face A2
A3 SHV piston face A3

643_083

Parking lock ON – engine running

Even if the primary pressure is present when the engine is running, the self-holding valve remains in its normal position and keeps connection between the parking lock piston pressure line and the sump open and, therefore, depressurized. When P-ON is active, N573 remains energized until the engine is switched off.

That means the connection between the parking lock piston and the sump is open. This prevents unintentional pressure build up that would result from the disengagement of the parking lock.

The self-holding valve, SHV

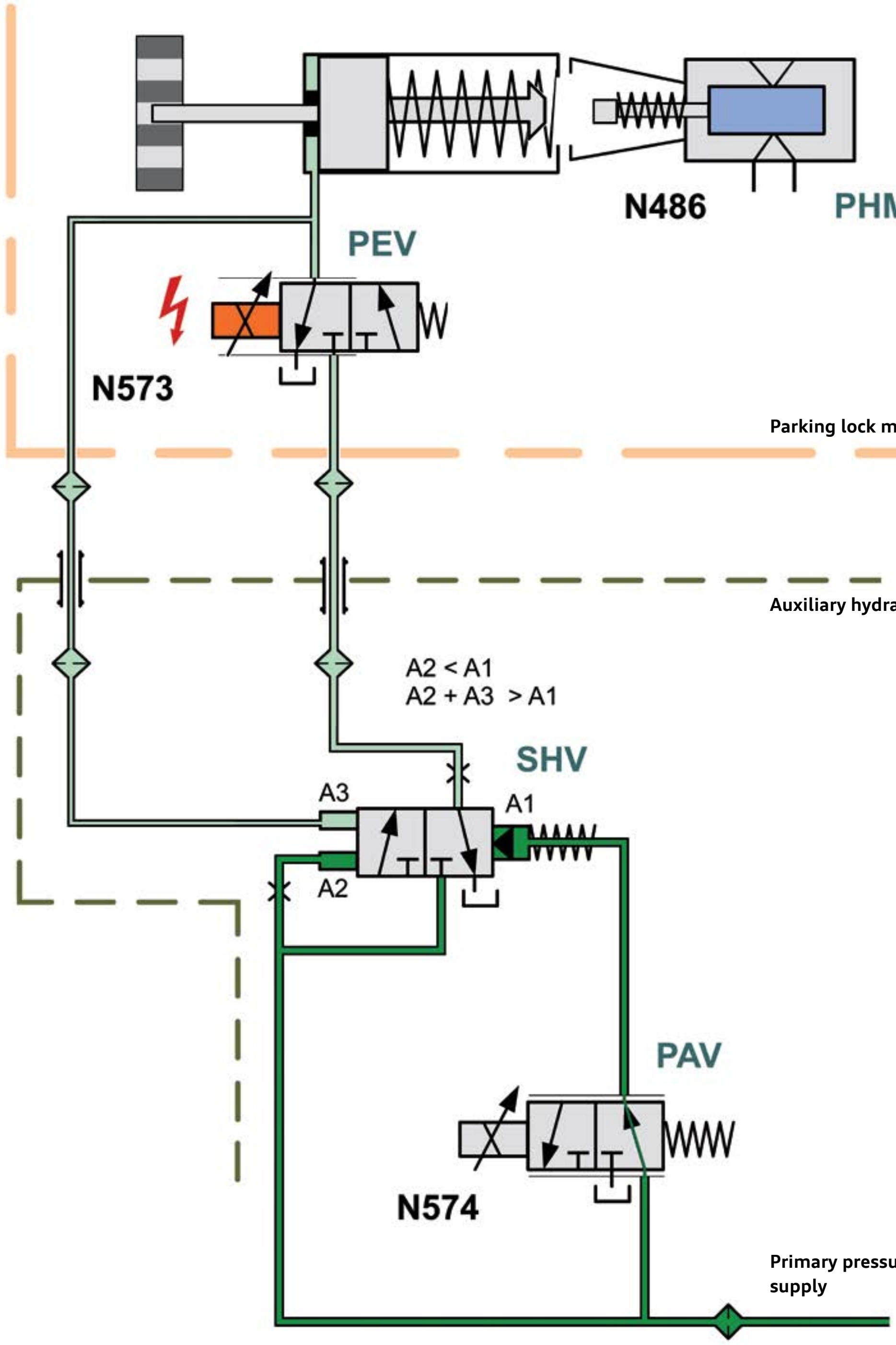
The SHV has a spring-loaded valve with 3 different-sized piston faces – faces A1, A2 and A3. Depending on the switching position of the solenoid valves N573 and N574, either the primary pressure (equal pressure) or no pressure is acting on those faces. Since the same pressure acts on all the piston faces, different forces result and enable the valve to be moved to the desired setting.

The following relationships apply to the piston faces:

1. Face A2 is smaller than face A1.
2. Faces A2 and A3 combined are larger than face A1.

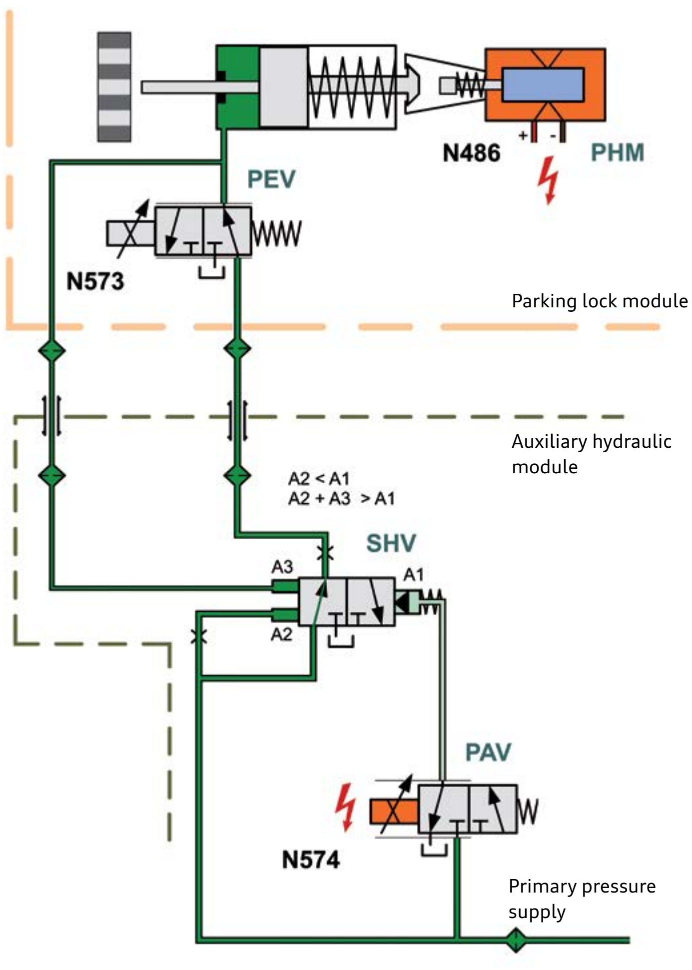
A larger face (A) = Greater force

In the situation illustrated in Figure 643_084 – primary pressure applied to A2 and A1 – the SHV remains in the left-hand position because the force acting on piston face A1 is greater than that on A2.



643_084

Disengaging the parking lock and holding the P-OFF setting



643_085

To disengage the parking lock, primary pressure is applied to the packing lock piston. The hydraulic force is many times greater than the force of the parking lock spring, so the parking lock piston is forced back together with the tapered sleeve. The return spring of the locking pawl lifts the pawl out of engagement with the parking lock gear and so releases the parking lock. See Figure 643_079 on page 36.

Electro-hydraulic function

Step 1

Parking Lock Solenoid Valve N573 has to be de-energized. By operating Parking Lock Solenoid Valve 2 N574 the control line for piston A1 is connected to the sump and de-pressurized. Initially, pressure is only applied to piston face A2, causing the self-holding valve, SHV, to switch over to the right. At that point, the primary pressure is connected through to the parking lock piston via N573 and the parking lock is disengaged.

At the same time, the primary pressure is directed to piston A3 via a control line. The primary pressure is then acting on both piston faces A2 and A3. At the same time as the valves N573 (OFF) and N574 (ON) are switched over, Parking Lock Solenoid N486 is also energized.

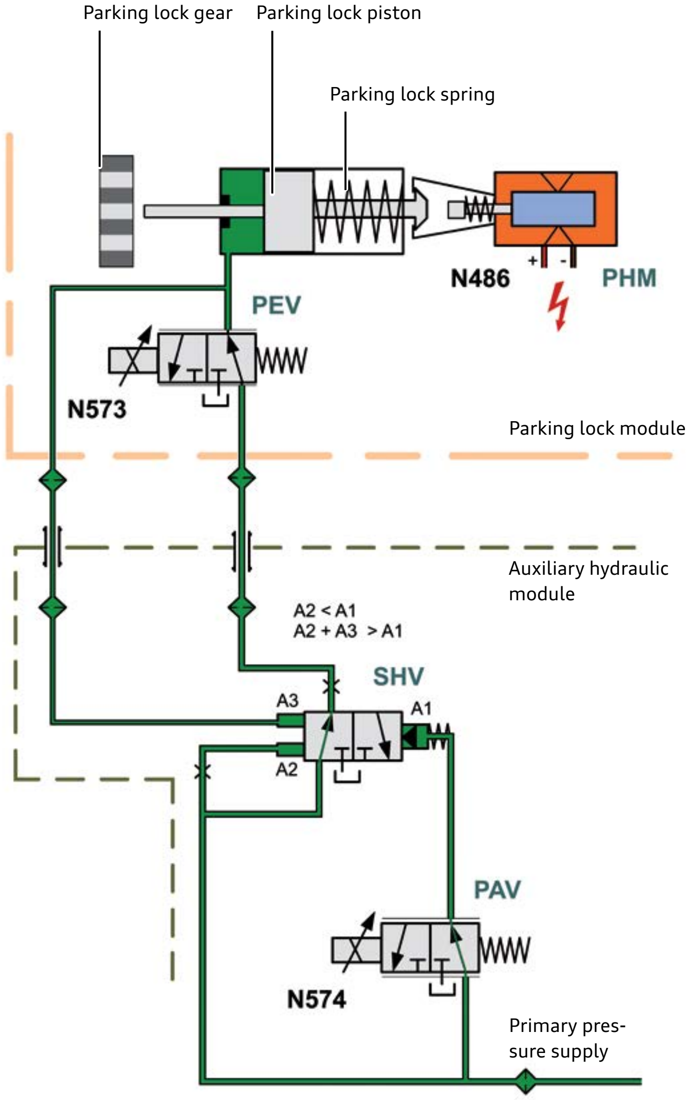
Step 2

As soon as the position P-OFF is definitely detected (signal from G747 plus short delay), N574 is de-energized. N574 is then back in its normal position and applies primary pressure to piston face A1. The switching condition of the SHV remains unchanged, however, because the forces acting on A2 and A3 are greater than the force on A1 (self-holding function).

Primary pressure is acting on the parking lock piston and holds the parking lock in the position P-OFF.

The energized Parking Lock Solenoid N486 acts as an additional safeguard against unwanted engagement of the parking lock while the vehicle is being driven.

If, for example, the ATF supply were to fail (for example, because of the engine stopping) while the vehicle is moving, the parking lock would be engaged. In such a scenario, Parking Lock Solenoid N486 prevents the parking lock engaging and so protects the parking lock (and the transmission) from damage. Refer to Figure 643_089.



643_086

Holding the position P-OFF in transmission setting N.

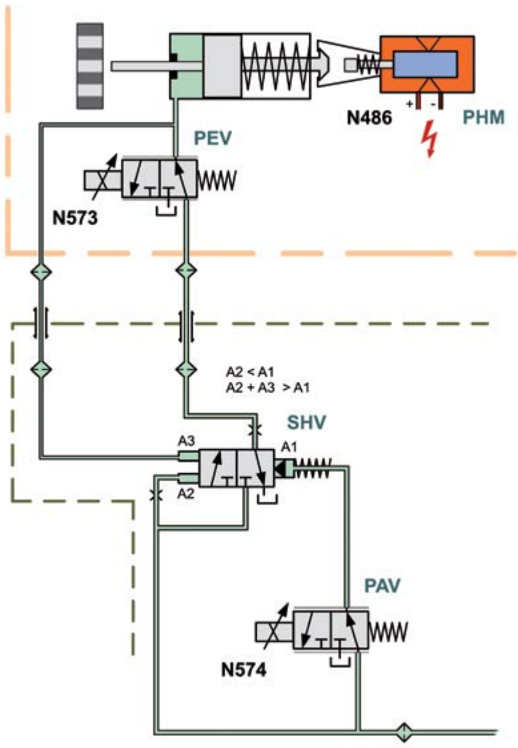
To prevent the parking lock being engaged when the engine is switched off, transmission setting **N** must be selected while the engine is running. If the engine is switched off with the transmission in **N**, N486 remains energized. The Parking Lock Solenoid N486 then keeps the parking lock piston in the P-OFF position.

More information on the subject can be found on page 12 and page 37.

Key:

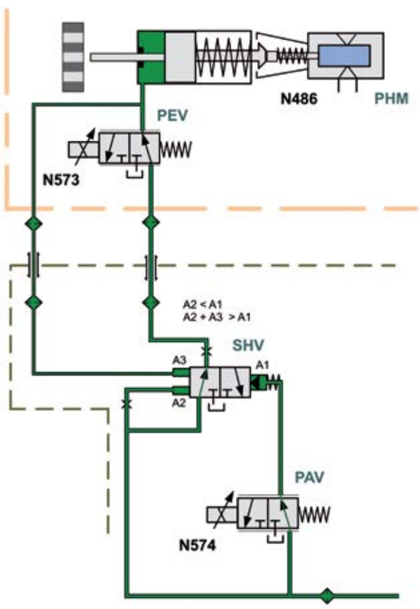
N486 Parking Lock Solenoid
– PHM – Parking lock holding solenoid
N573 Parking Lock Solenoid Valve
– PEV – Parking lock engagement valve
N574 Parking Lock Solenoid Valve 2
– PAV – Parking lock disengagement valve
SHV Self-holding valve

A1 SHV piston face A1
A2 SHV piston face A2
A3 SHV piston face A3



643_089

Engaging the parking lock – parking lock ON



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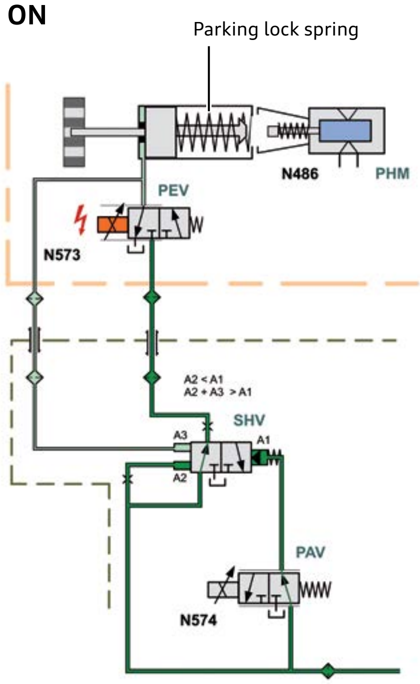

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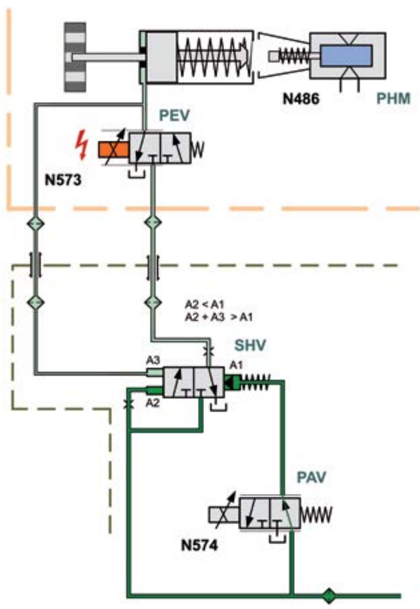


643_084

Step 1

To engage the parking lock, N486 must first be switched off.

Step 2

At the same time, N573 is energized.

That connects the pressure line for the parking lock piston **and** the control line for piston A3 to the sump, thereby de-pressurizing them. The parking lock is engaged by the force of the parking lock spring.

Step 3

As primary pressure is acting on piston face A3, the self-holding valve, SHV, switches over to the left into its normal position.

The entire pressure line for the parking lock piston is then connected through to the sump and thus de-pressurized.

N573 is not switched off until the engine is switched off. Refer to page 38.

In normal operation, the parking lock is electro-hydraulically actuated. To enable electro-hydraulic disengagement of the parking lock, the engine must be running to generate sufficient ATF pressure. And to hold the parking lock in the OFF position, there must also be sufficient ATF pressure or an adequate power supply to Parking Lock Solenoid N486.

The emergency release mechanism serves to disengage the parking lock and hold it in the P-OFF position if the electro-hydraulic function fails or if it is necessary to hold the P-OFF position for an extended period.

The emergency release mechanism of the parking lock must be actuated in the following situations:

- In general, when recovering or maneuvering the vehicle.
- If the parking lock cannot be released electro-hydraulically due to a malfunction.
- If the vehicle cannot be maneuvered or moved due to insufficient onboard voltage.
- If the engine is not running and it is necessary to maneuver or move the vehicle, for example, in the workshop.
- For function testing after carrying out assembly work on components of the emergency release mechanism. See Note.

! After removing and installing the transmission or carrying out assembly work on components of the emergency release mechanism, a function test must be performed as described in the workshop manual.

Parking lock emergency release

The parking lock is emergency-released from inside the vehicle by means of a cable pull. The special socket tool and the screwdriver are included in the vehicle tool kit.

Operating the parking lock emergency release (position P-OFF)

Follow the instructions on the page opposite.

Warning! Before actuating the emergency release device of the parking lock, the vehicle must be secured to prevent it from rolling away.

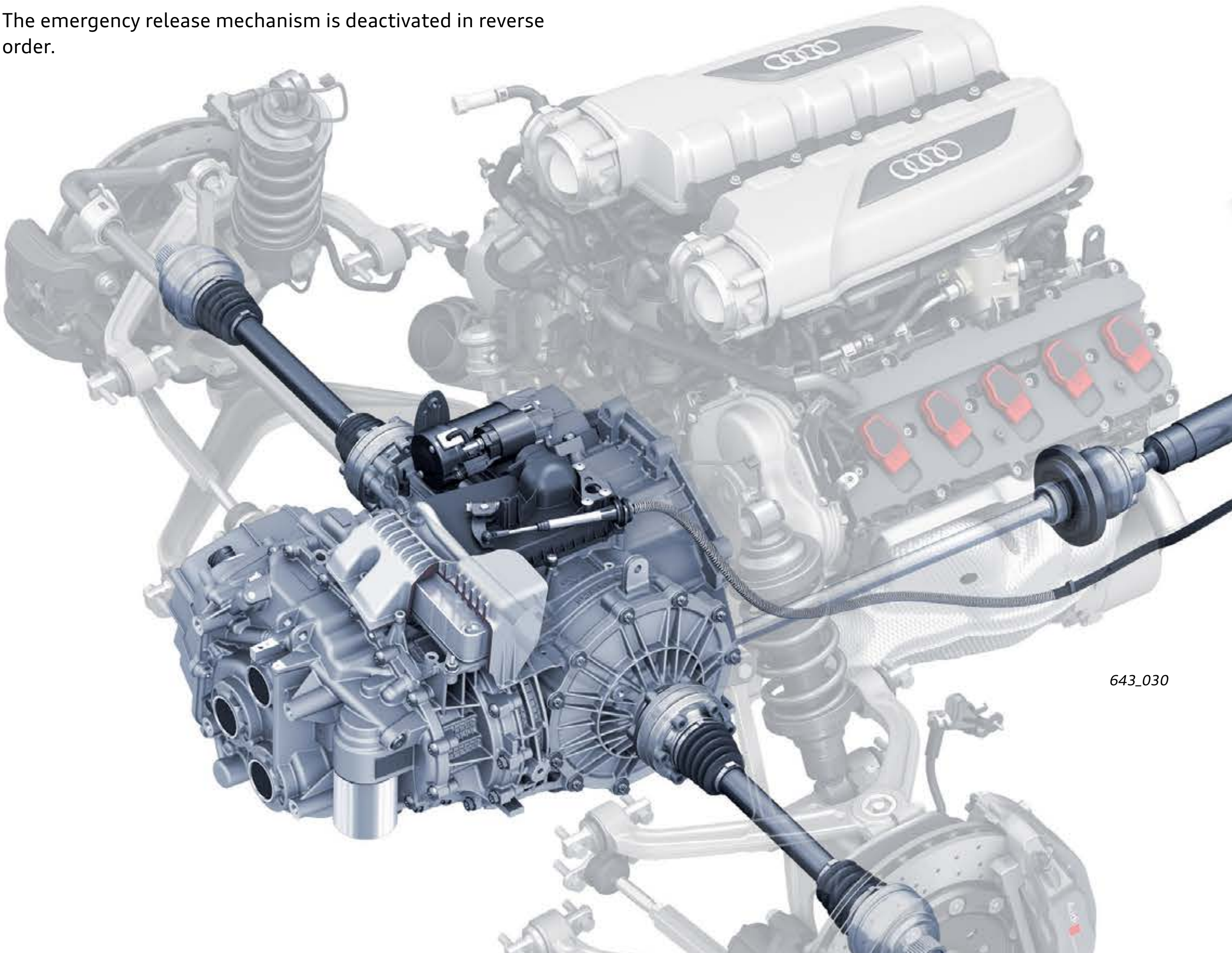
Indications on the instrument cluster

When the parking lock emergency release device is actuated, the yellow gearbox warning lamp and the gear drive position indicator **N** light up in the instrument cluster. In addition, information on the instrument cluster indicates that the parking lock cannot be engaged, there is a risk of the vehicle rolling away, and the parking brake should be applied.

643_029

Deactivating the emergency release (P-ON position)

The emergency release mechanism is deactivated in reverse order.



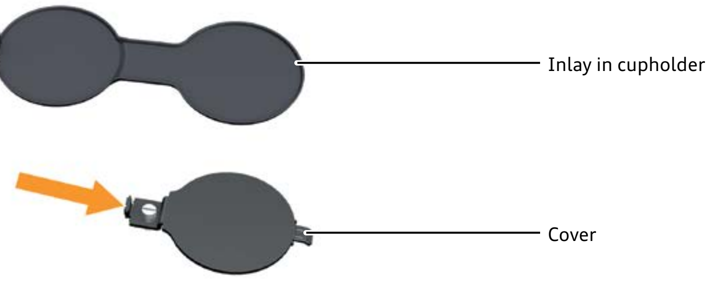
643_030

Operation

1. Remove inlay from cupholder.

2. Remove the cover with a screwdriver. Remove the screw, push the release tab (arrow) and take out the cover.

3. Fold the socket wrench as shown and insert it into the actuating mechanism.



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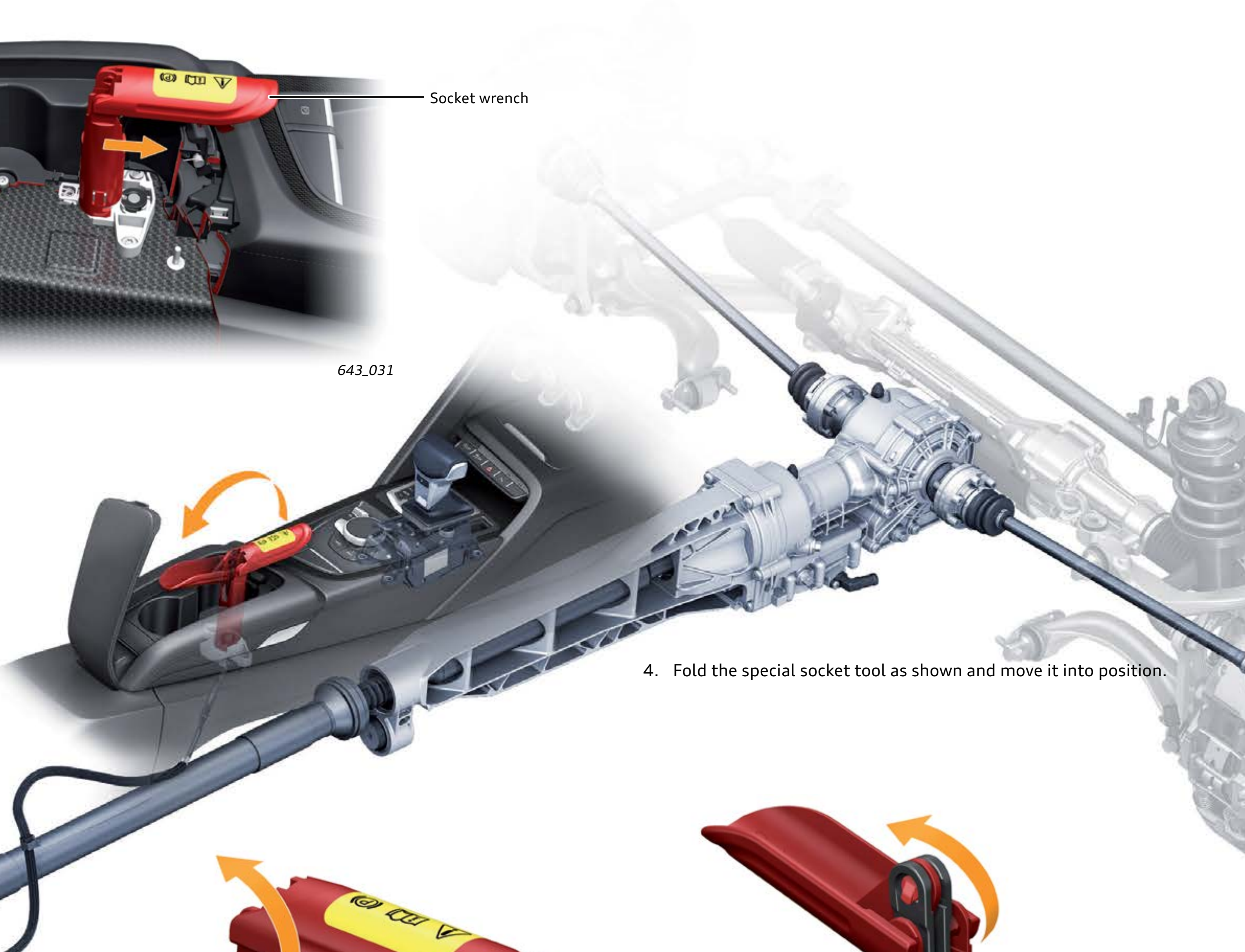


4. Fold the special socket tool as shown and move it into position.

643_032

643_033

Oil system and ATF supply

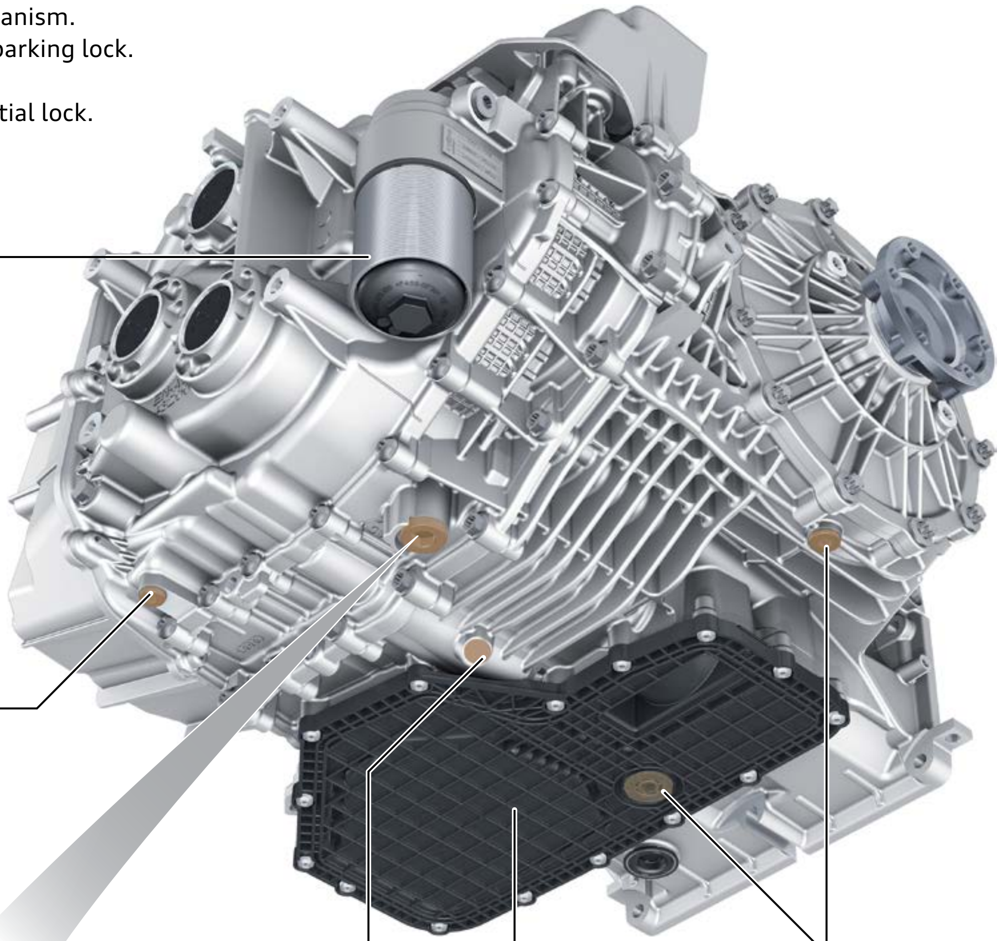
The 0BZ transmission has a common ATF oil system for all functional sub-assemblies and oil chambers of the gearbox. The Mechatronic module has its own oil chamber in which its own oil level is established. See page 48.

The following functional sub-assemblies are supplied and/or controlled, lubricated and cooled with ATF.

- Mechatronic module.
- Dual clutch.
- Hydraulic selector mechanism.
- Hydraulically operated parking lock.
- Gear set (gear train).
- Final drive with differential lock.

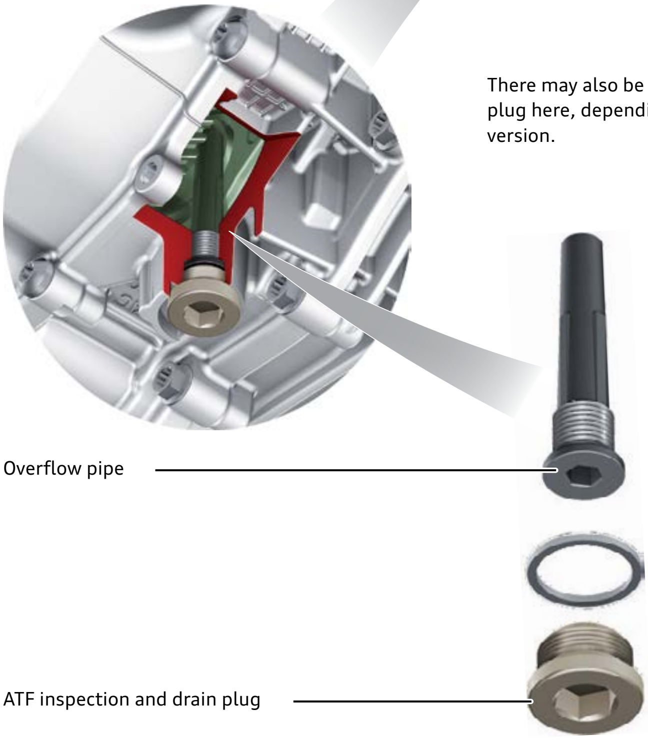
The special ATF and the ATF pressure filter currently have a service/replacement interval of approximately 40,000 miles (60,000 km) (the ATF intake filter is not replaced). In order to be able to drain off the used oil as completely as possible, the 0BZ gearbox has several ATF drain plugs.

Note: when changing the ATF, all drain plugs always have to be removed.



643_056

! Make sure the heat shield is always installed. Otherwise, there is a risk of damage to the transmission.



643_057

Note on draining the ATF

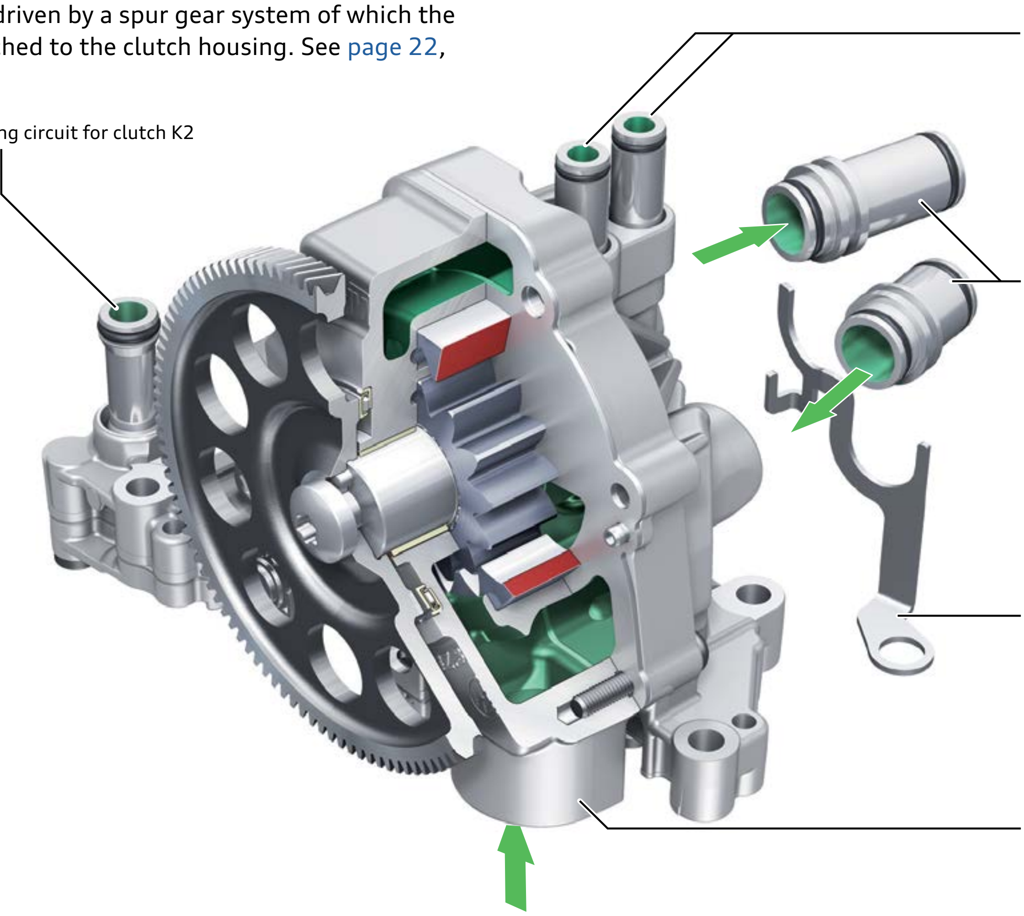
There are different versions of the ATF drain plugs and the overflow pipe. Follow the instructions given in the workshop manual, ETKA and on the VAS Scan Tool when checking and changing the ATF.

ATF pump

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

The 0BZ transmission is supplied with oil by an ATF pump that is constantly driven by the engine (internal gear pump). The ATF pump is driven by a spur gear system of which the drive gear is attached to the clutch housing. See page 22, Figure 643_039.

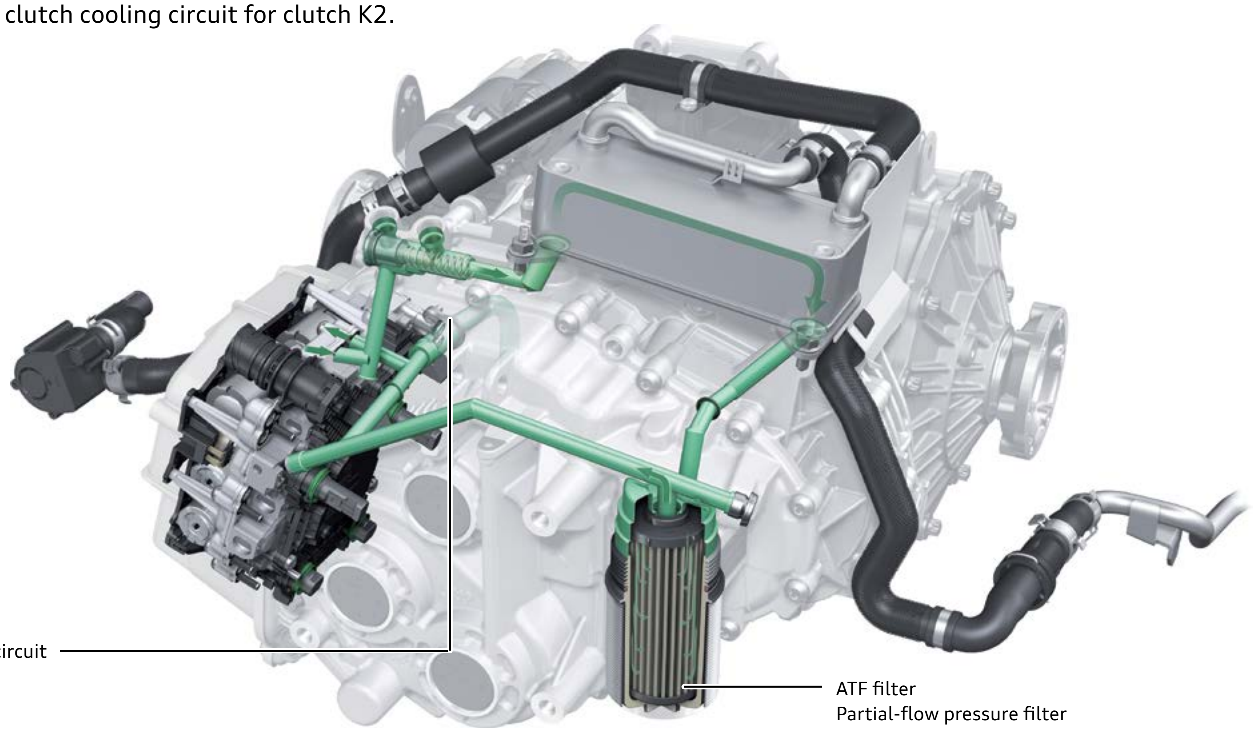
The ATF pump is part of the auxiliary hydraulic module. See page 54.



643_058

ATF filtration

The ATF is filtered by an intake filter integrated in the ATF sump and a partial-flow pressure filter through which the return flow from the ATF cooler passes. Part of the cooled and filtered ATF is diverted by the Mechatronic module used directly to control the clutch cooling circuit for clutch K2.



643_059

Oil level

On the 0BZ gearbox, the Mechatronic module is in its own oil chamber, which is formed by a partition dividing it off from the gear train. In operation, that oil chamber (Mechatronic module oil chamber) fills with ATF until it is largely or completely (depending on gearbox version) immersed in ATF. That ensures that the hydraulic system is well vented and the Mechatronic module always operates under the same physical conditions. In addition, the solenoid valve coils are effectively cooled.

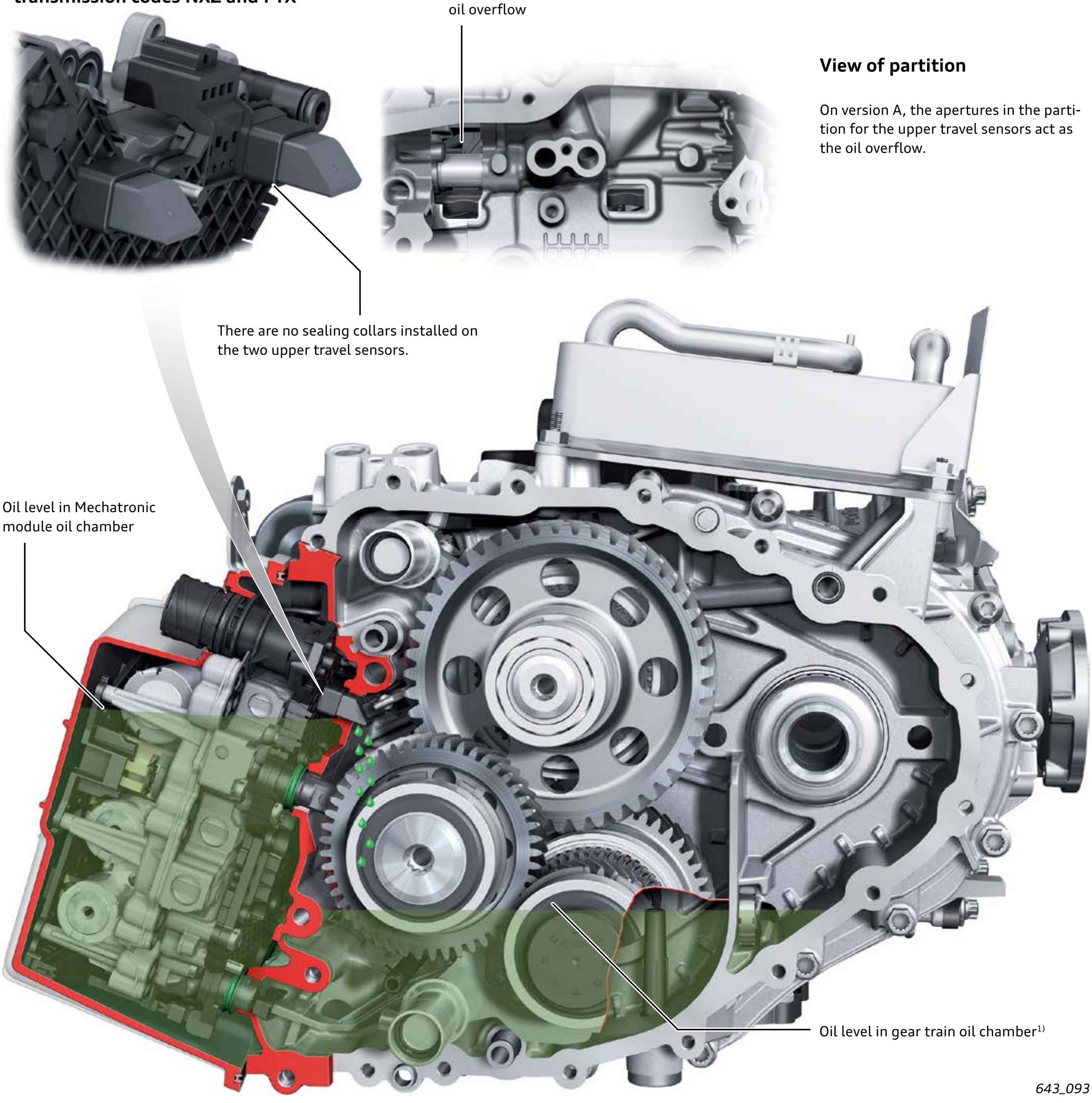
The Mechatronic module oil chamber fills up with exhaust oil from normal operation of the solenoid valves and is thus continually filled. An overflow facility provides for venting and a defined oil level in the Mechatronic module oil chamber.

There are two transmission versions with differing accumulation levels:

› **Version A** – Transmission codes NXZ and PTX

The apertures in the partition for the two lower gear-shift actuator travel sensors and for the two speed sensors are sealed by means of sealing collars. The apertures for the two upper gear-shift actuator travel sensors are not sealed (no sealing collars installed) and the left aperture is enlarged. The ATF accumulates until it reaches the upper apertures, at which point is runs off into the gear train oil chamber.

Version A
- transmission codes NXZ and PTX



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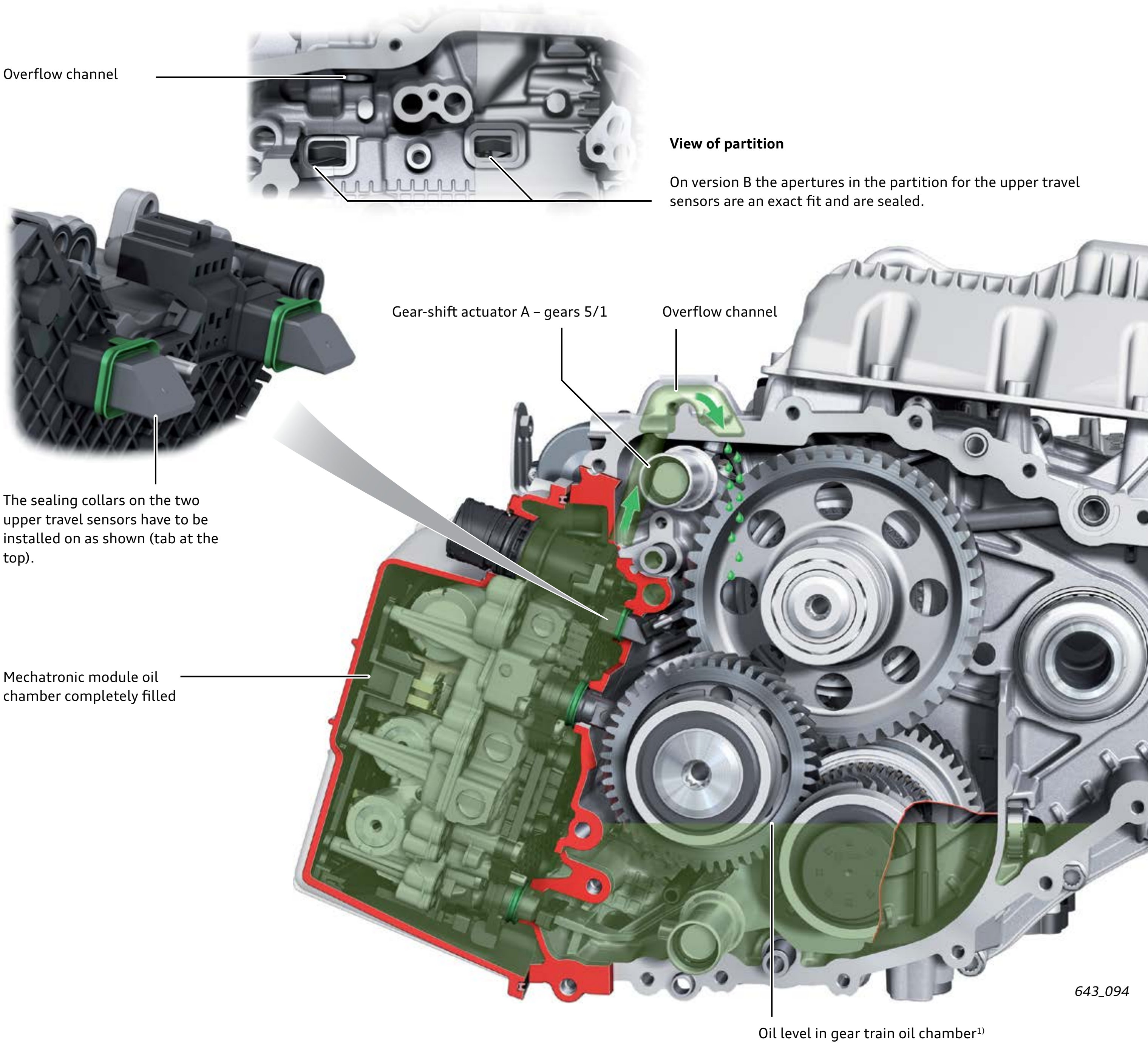
Version B
- all transmission codes EXCEPT NXZ and PTX



With this version, all apertures in the partition are sealed by sealing collars. At the very top of the Mechatronic module oil chamber there is an overflow channel through which the exhaust oil flows off into the gear train oil chamber. With version B, therefore, the Mechatronic module oil chamber fills up completely with accumulated oil (ATF) and the oil level is raised to a point where it is above the highest gear-shift actuator (gear-shift actuator A for gears 5/1).
The effect is that gear-shift actuator A is better filled and vented. That, in turn, improves the quality of gear changes in gears 1 and 5.

[1)] The oil level in the gear train oil chamber varies according to the operating conditions. The oil level shown here reflects the required level under the specified inspection conditions.

Information for all transmission codes
- The oil chamber has its own drain plug. Observe the guidance notes on page 46.
- A new Mechatronic module is always supplied with only 4 sealing collars. The two upper sealing collars (on the upper travel sensors) are obtainable from the ETKA and have to be installed if necessary.

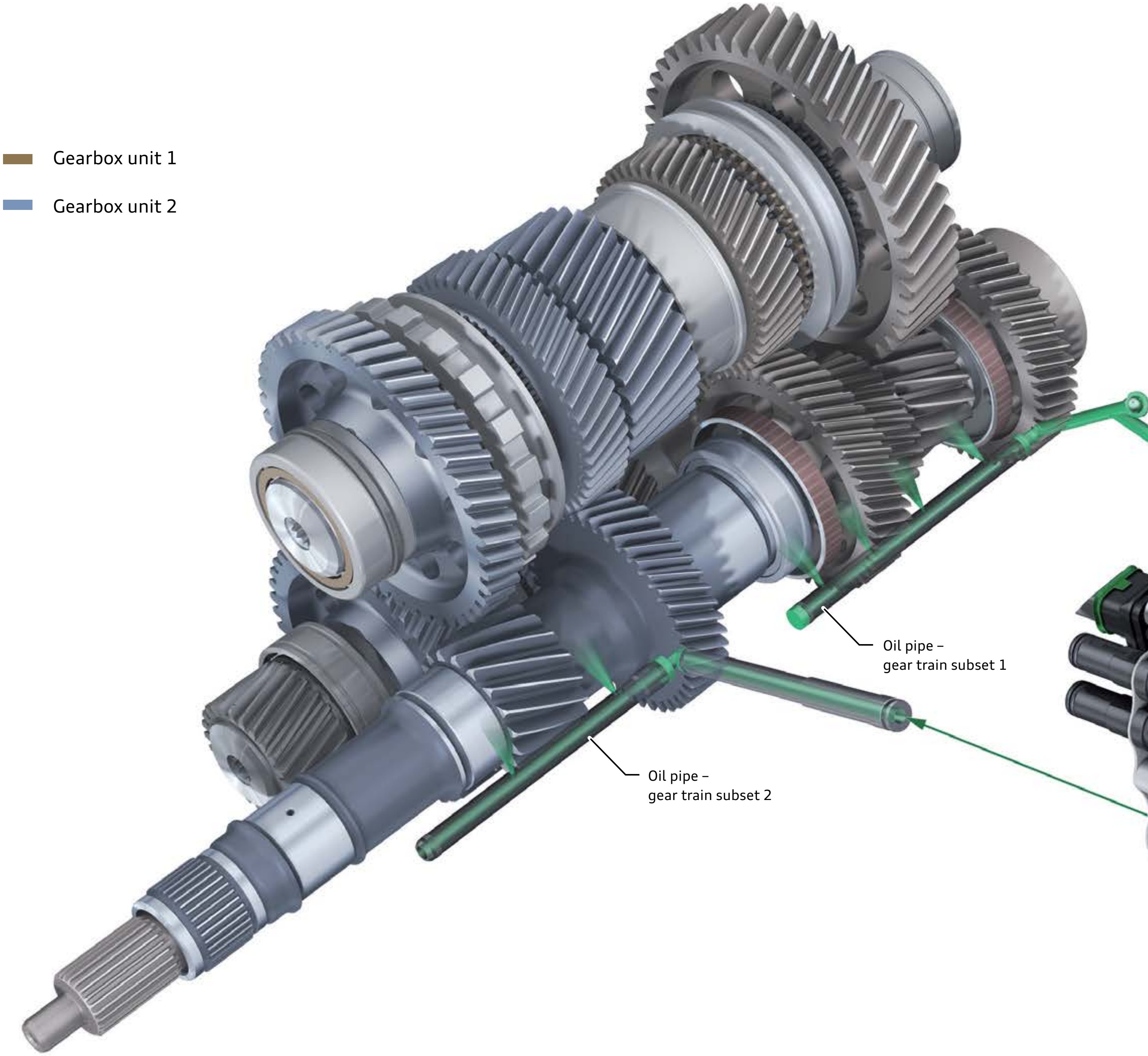
Information for transmission codes NXZ and PTX only
- With these versions, the Mechatronic module is installed without sealing collars on the upper travel sensors.

Information for all transmission codes except NXZ and PTX
- With these versions, the sealing collars have to be installed as shown on the upper travel sensors before the Mechatronic module is installed so the ATF can accumulate as required in the Mechatronic module oil chamber.

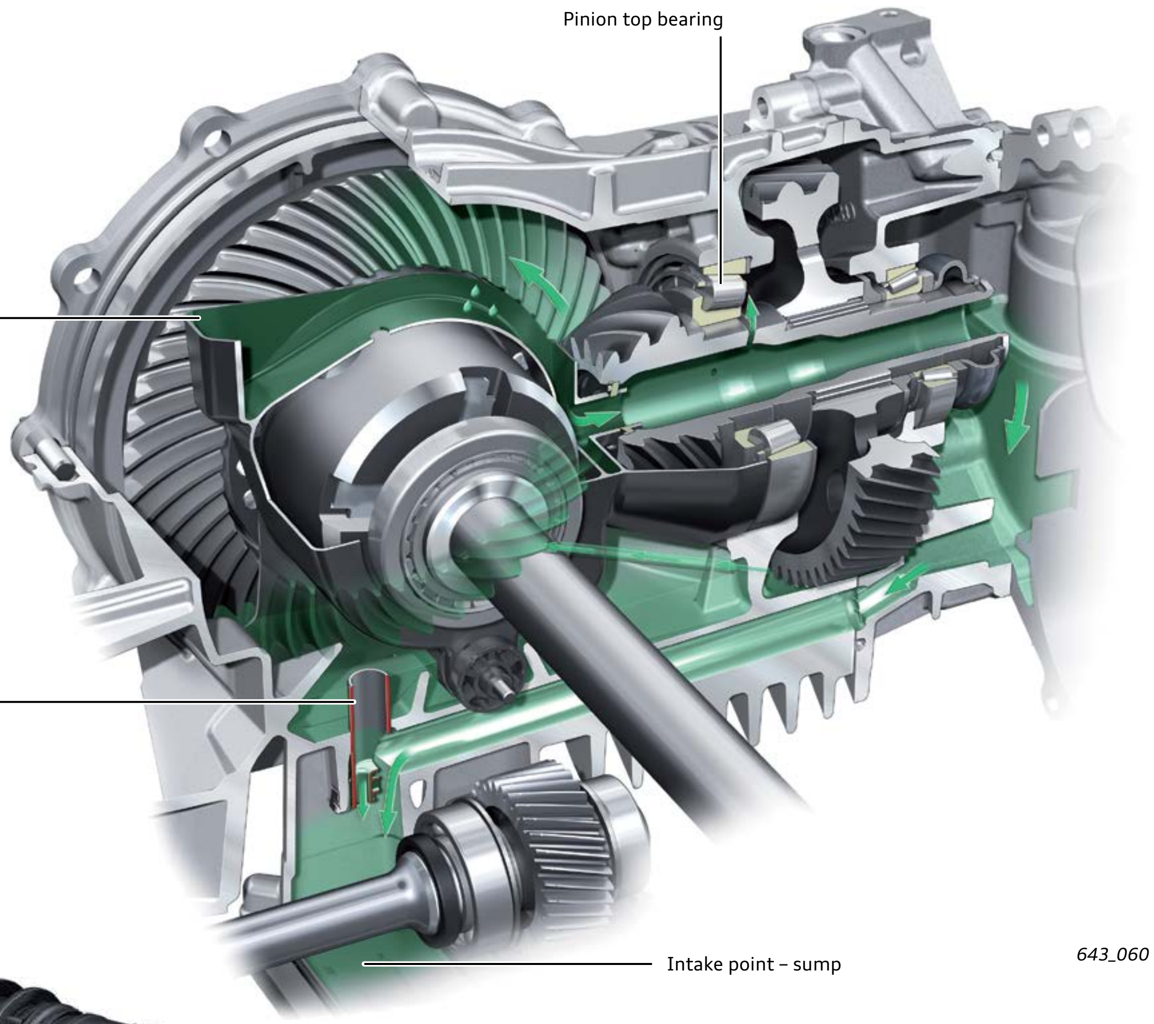
Lubrication and cooling of the gear train

Lubrication of the gear train is performed by a selectively targeted injection system that lubricates only the gear train subset that is transmitting the drive at any one time, each gear train subset is allocated a separate oil pipe. Depending on which clutch is in operation (K1 or K2), a change-over valve in the Mechatronic module controls the oil flow to the relevant gear train subset. In the oil pipe there are small injector jets which deliver ATF to the drive gears for lubrication and cooling.

The gear pairings that are permanently engaged and the two input shafts with their idler gear bearings and synchromesh mechanisms are supplied separately and continuously with cooled oil. See hydraulic circuit diagram on page 74.



Lubrication and cooling of the final drive



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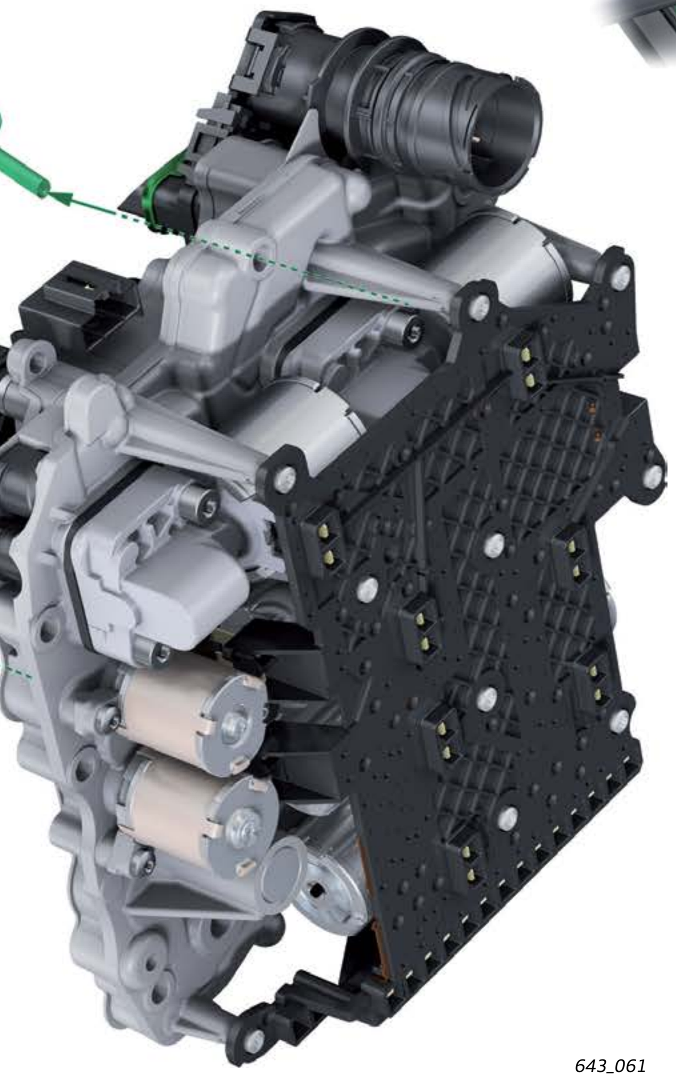

643_061

The relatively high oil chamber for the final drive is filled by the cooling oil from the dual clutch. The dual clutch throws large quantities of its cooling oil into the final drive oil chamber via an oil baffle plate (not illustrated).

The rotating ring gear moves surplus oil into an oil collector from where it can run back to the intake point through the hollow pinion shaft. In addition, the oil level is limited by an overflow pipe.

The pinion top bearing is supplied via another oil collector.

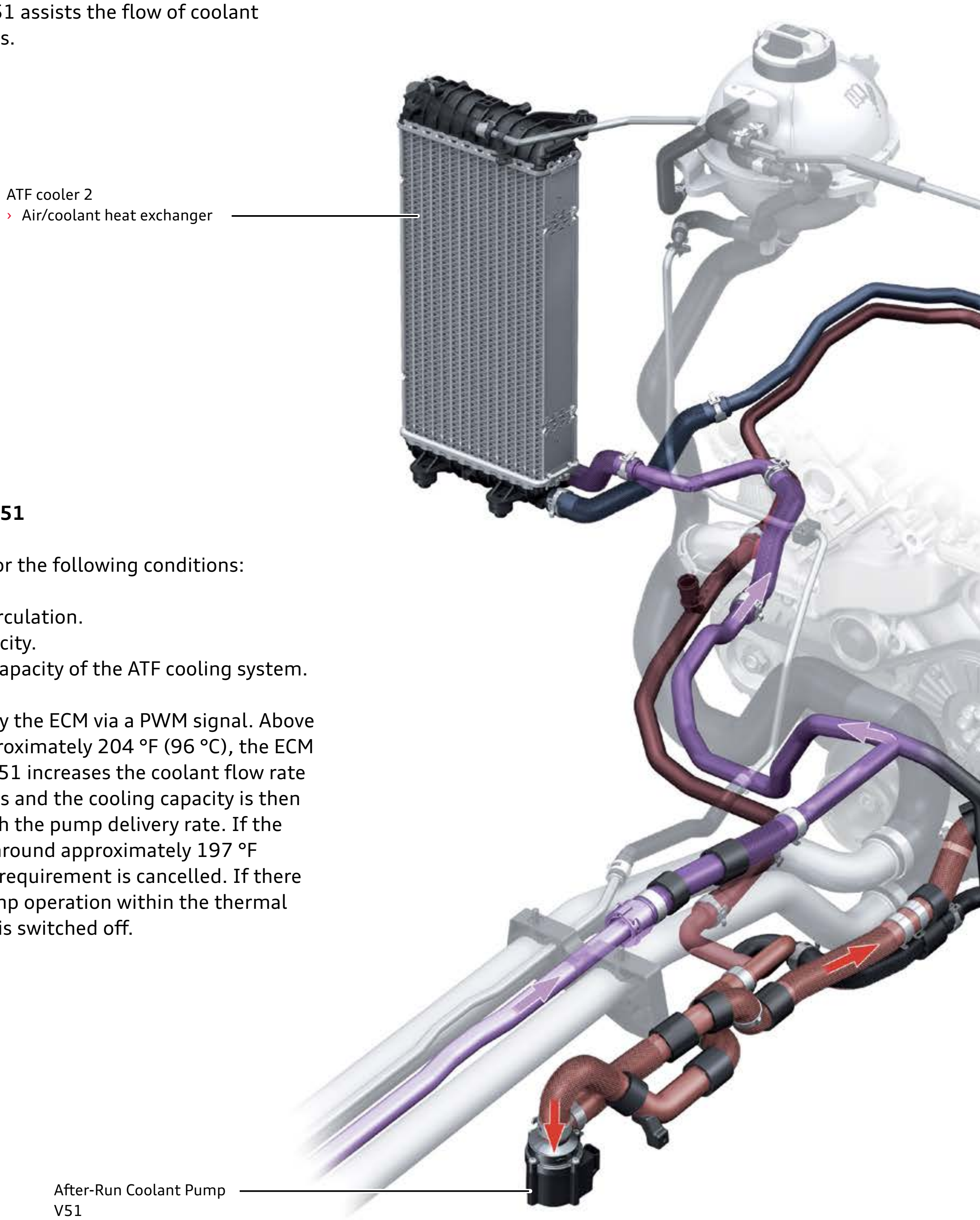
ATF temperature management

The ATF cooling system uses two heat exchangers – one coolant/oil heat exchanger (ATF cooler 1) and one air/coolant heat exchanger (ATF cooler 2).

ATF cooler 1 is connected in series in the partial-flow ATF circuit for the ATF pressure filter and the ATF flows through it constantly. The cooling capacity of ATF cooler 1 is substantially increased by ATF cooler 2. The two heat exchangers are connected in series and integrated in the engine cooling system. The coolant flow through the two heat exchangers is controlled by means of a coolant thermostat (bypass thermostat).

After-Run Coolant Pump V51 assists the flow of coolant through the two ATF coolers.

The coolant thermostat opens at approximately 176 °F (80 °C). When the coolant thermostat is open, the coolant cooled by the motion-induced air flow over ATF cooler 2 flows to ATF cooler 1. ATF cooler 2 substantially reduces the coolant temperature before it is fed into ATF cooler 1. Due to the low inflow temperature, ATF cooler 1 is able to operate very efficiently.

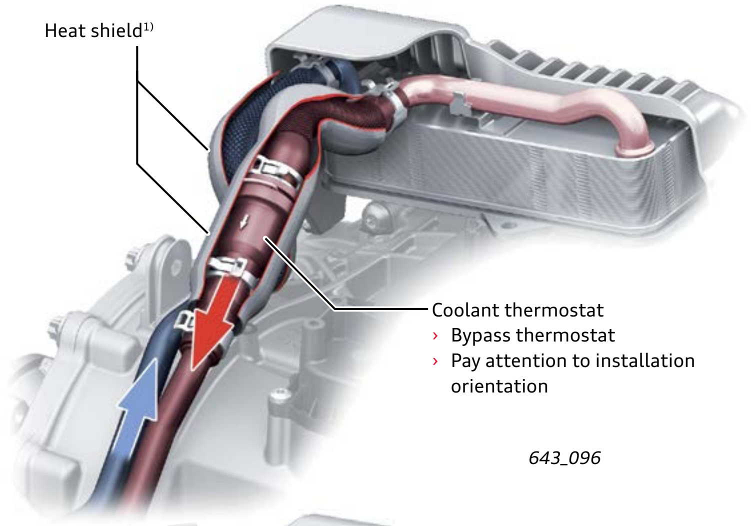


After-Run Coolant Pump V51

V51 operates as required for the following conditions:

- For continued coolant circulation.
- To increase heating capacity.
- To increase the cooling capacity of the ATF cooling system.

It is operated on demand by the ECM via a PWM signal. Above an ATF temperature of approximately 204 °F (96 °C), the ECM instructs V51 to operate. V51 increases the coolant flow rate through the two ATF coolers and the cooling capacity is then increased in proportion with the pump delivery rate. If the ATF temperature drops to around approximately 197 °F (92 °C), the pump delivery requirement is cancelled. If there is no other demand for pump operation within the thermal management system, V51 is switched off.



643_096

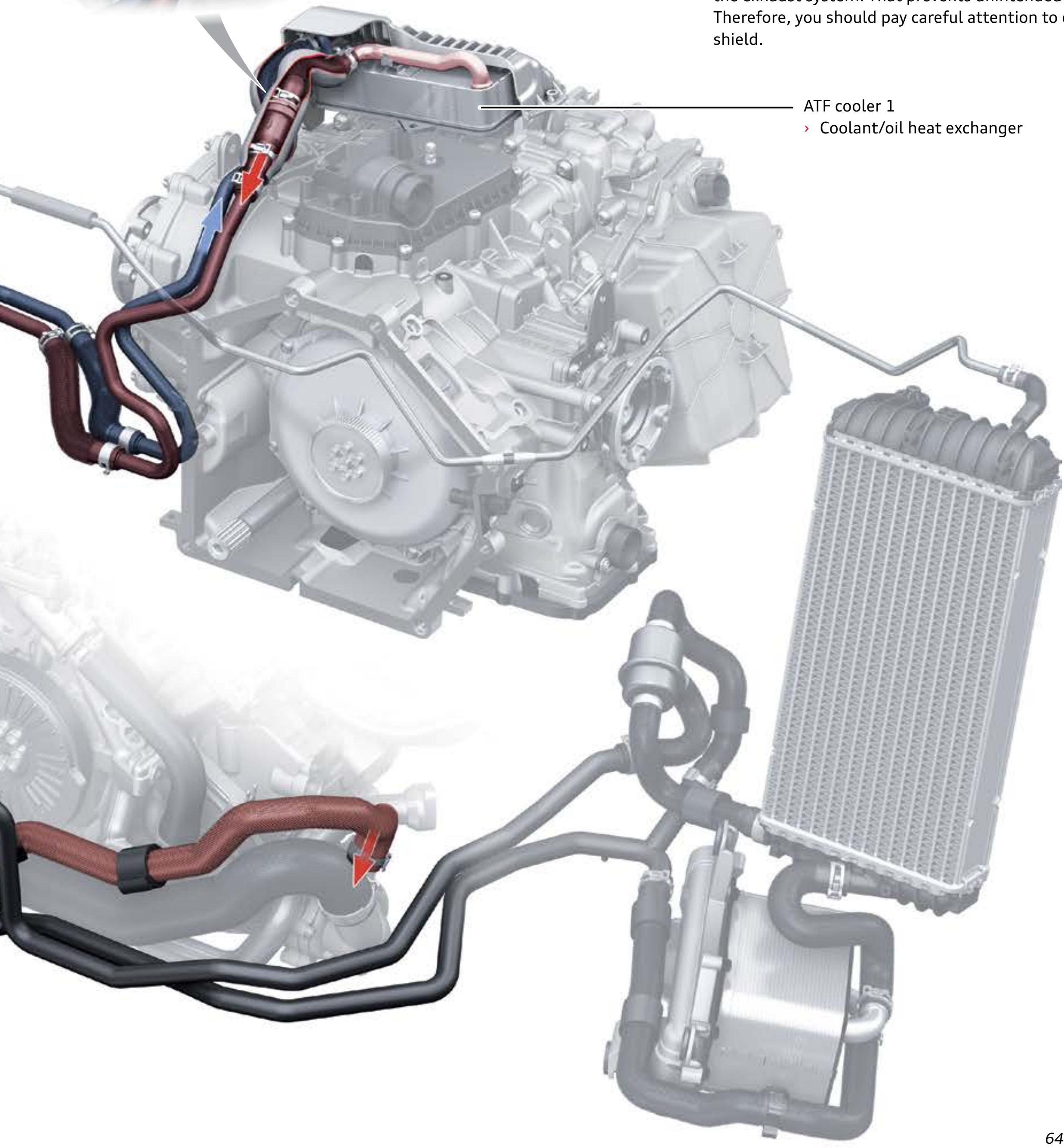
Coolant thermostat closed up to approximately 176 °F (80 °C)

The flow through the two heat exchangers is kept to a minimum. Engine and transmission quickly reach operating temperature.

Coolant thermostat open at approximately 176 °F (80 °C) (as illustrated)

Coolant flows through both heat exchangers. The ATF is effectively cooled.

[1)] The heat shield acts, as a protective guard for the component and, secondly prevents the coolant and the coolant thermostat being heated too much by the exhaust system. That prevents unintended opening of the thermostat. Therefore, you should pay careful attention to correct installation of the heat shield.



643_095

Transmission control

Component overview

The Mechatronic module is the central transmission control component. It originates from the DQ500 transmission series (for example, the 7-speed dual clutch transmission 0BH). To meet the functional requirements of the 0BZ transmission, additional components have been added. One particular feature is that that transmission control system utilizes two control modules.

The electro-hydraulic transmission control system uses the following components/modules:

- Dual-Clutch Transmission Mechatronic J743.
- Auxiliary hydraulic module.
- Parking lock module.
- Transmission Control Module 2 J1006.
- Selector mechanism.

Those components/modules have the following functions:

Dual-Clutch Transmission Mechatronic J743

J743 is the central control module and master for Transmission Control Module 2 J1006. See pages 57 and 65.

It is responsible for hydraulic pressure control for the following subsystems:

- Clutch control system for clutches K1 and K2.
- Clutch cooling system for clutch K1. See also page 26.
- Gear shifting.
- Demand-based gear set lubrication.

Auxiliary hydraulic module

The auxiliary hydraulic module performs the following tasks:

- Oil supply (ATF pump) for gearbox control, lubrication and cooling.
- Control of cooling oil for clutch K2.
- Partial control of the pressure for the parking lock.

Parking lock module

The parking lock module performs the following tasks:

- Partial control of the pressure for the parking lock.
- Electro-hydro-mechanical actuation of the parking lock.

Parking lock module

Transmission Control Module 2 J1006

J1006 performs the following tasks:

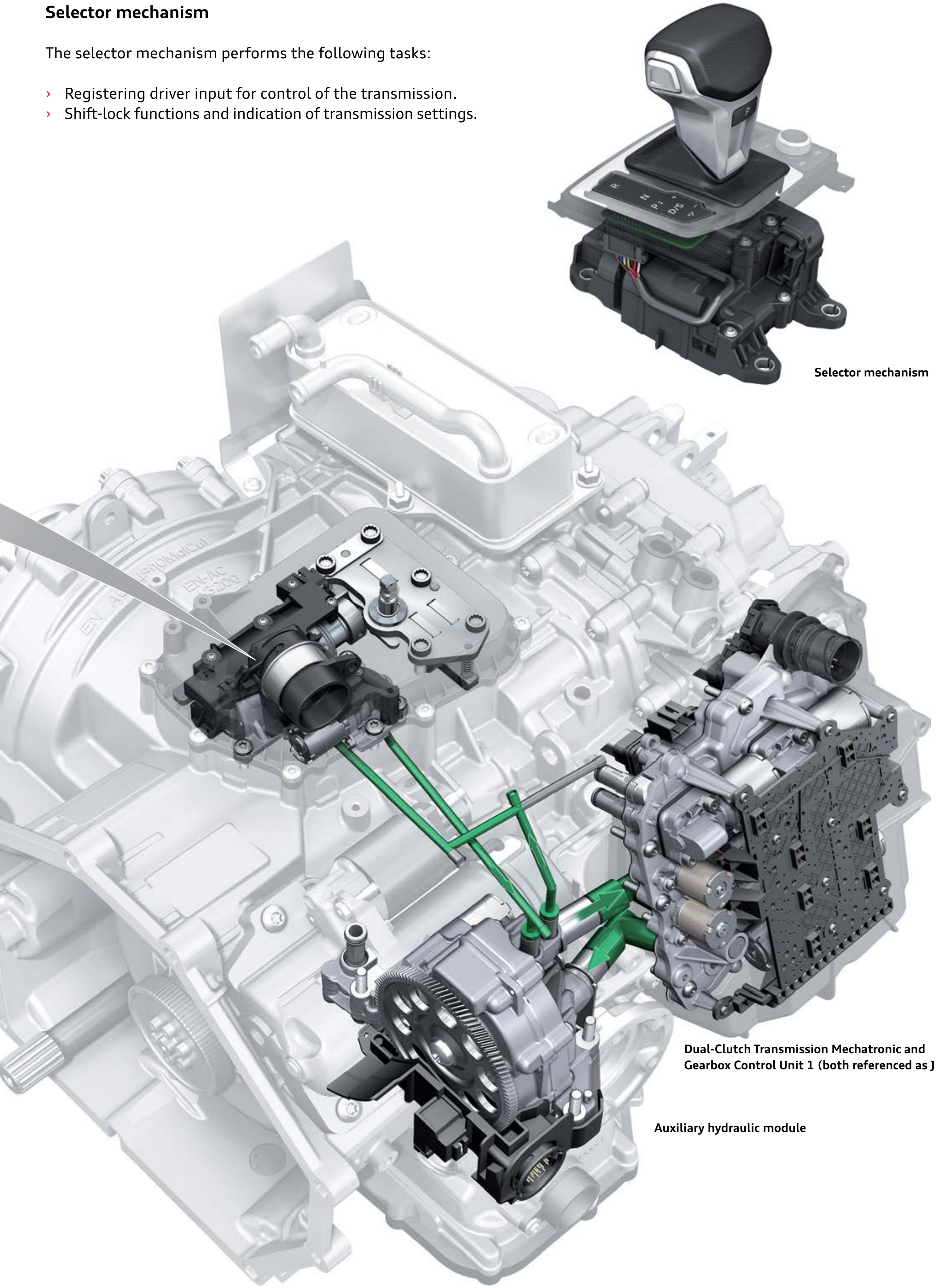
- Electrical operation of the parking lock module.
- Electrical operation of the clutch cooling system for clutch K2 (via Gearbox Control Unit 1 J743 and the auxiliary hydraulic module; see page 26).

Transmission Control Module 2 J1006

Selector mechanism

The selector mechanism performs the following tasks:

- Registering driver input for control of the transmission.
- Shift-lock functions and indication of transmission settings.



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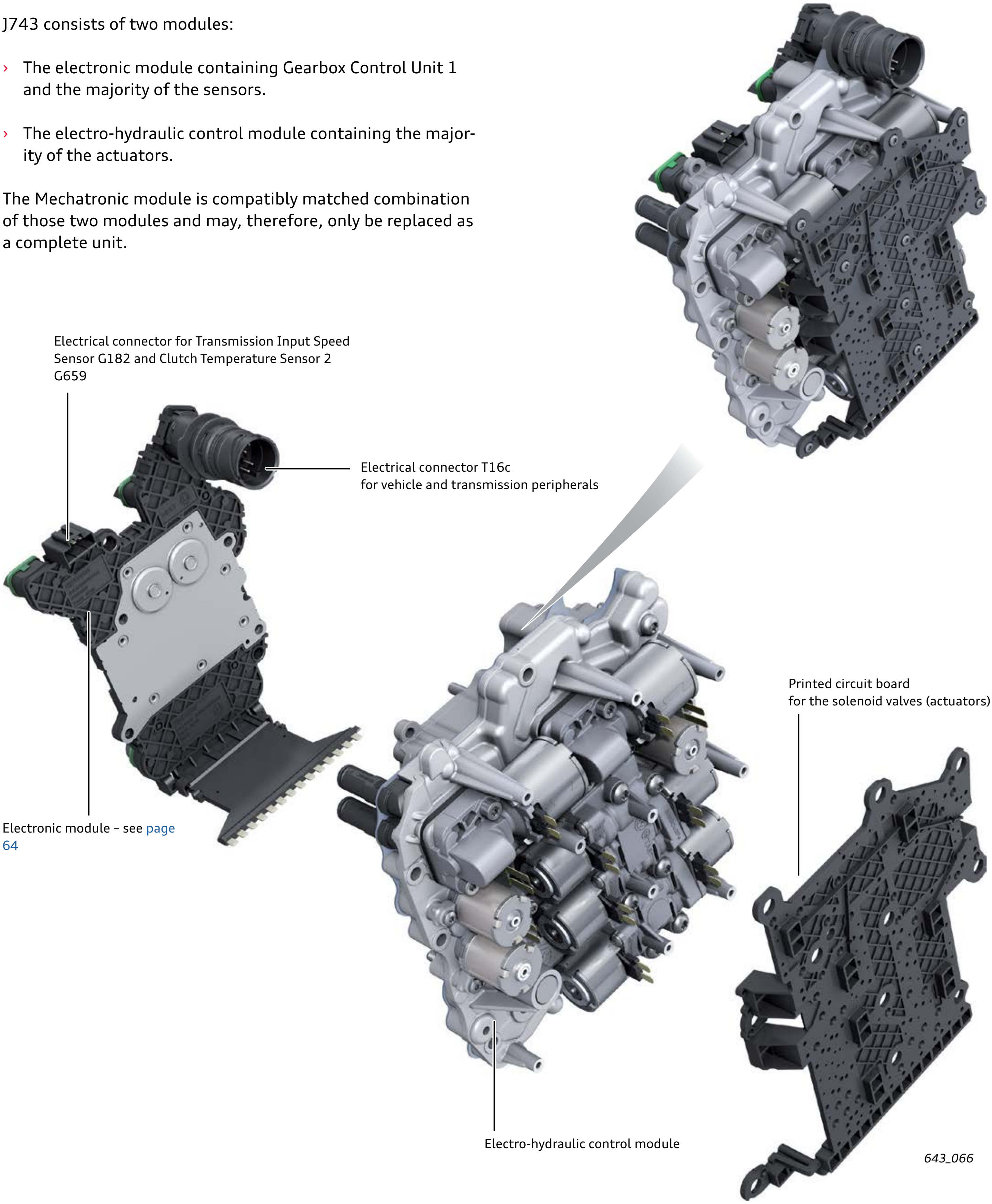
Dual-Clutch Transmission Mechatronic

J743 consists of two modules:

- The electronic module containing Gearbox Control Unit 1 and the majority of the sensors.
- The electro-hydraulic control module containing the majority of the actuators.

The Mechatronic module is compatibly matched combination of those two modules and may, therefore, only be replaced as a complete unit.



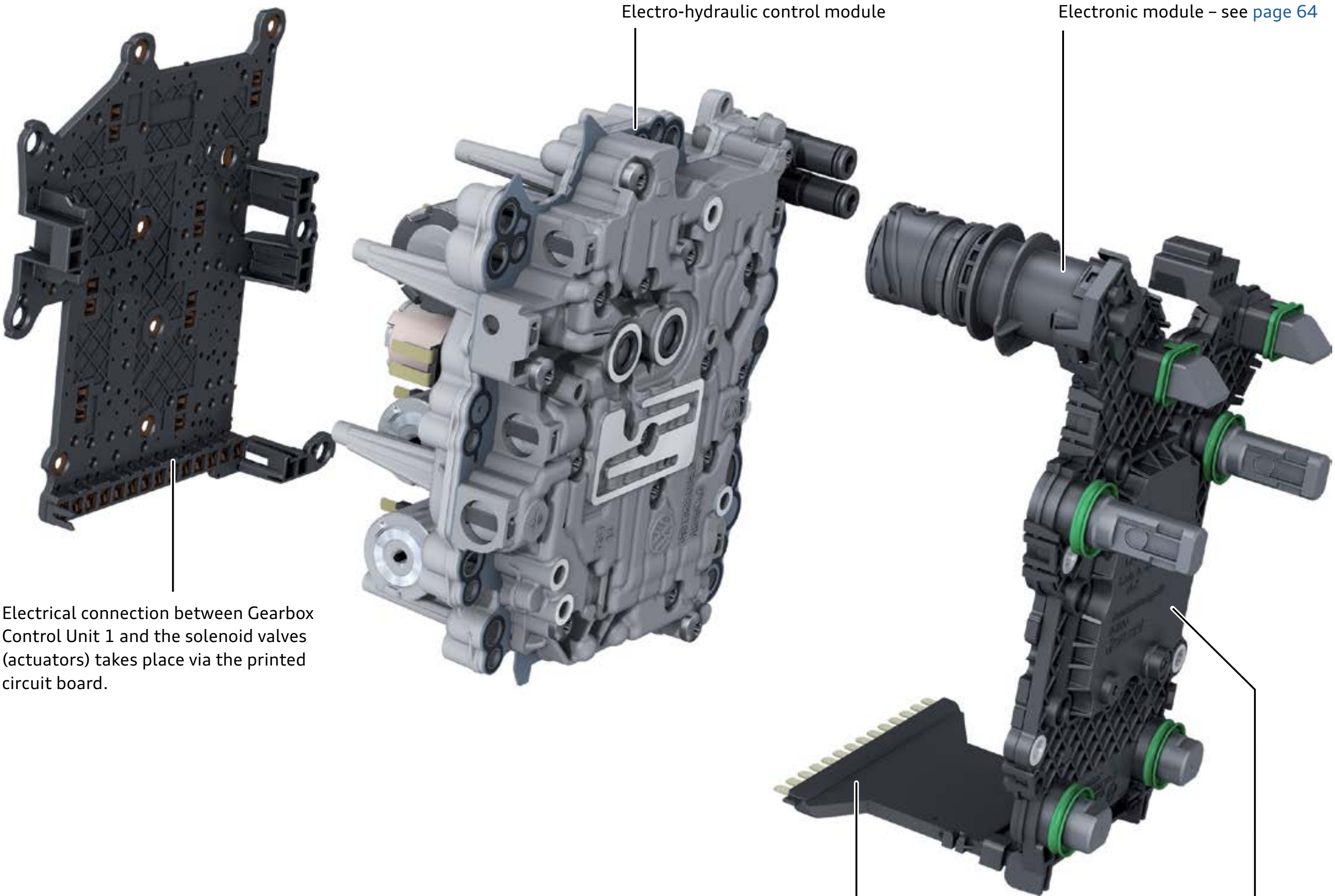
643_066

When handling the Mechatronic module, it is important to pay close attention to the working guidelines regarding electrostatic discharge (ESD). Electrostatic discharge can irreparably damage electronic components.

The Mechatronic module controls, regulates and/or executes the following functions:

- Adjustment of the oil pressure in the hydraulic system to suit the various needs and requirements.
- Control of the dual clutch.
- Control of the clutch cooling system for clutch K1.
- Control of the clutch cooling system for clutch K2.[1)]
- Shift point selection.
- Gear shifting.
- Serving as master J1006.
- Control of the parking lock.[1)]
- Communication with the other control units in the vehicle.
- Safe mode program.
- Self-diagnostics.

[1)] Operation/activation is performed by Transmission Control Module 2 J1006. See page 26 and the schematic diagram on page 72



643_067

The gasket for the interfaces between the hydraulic control module and the gearbox housing is printed on the intermediate plate and cannot be replaced. When the Mechatronic module is detached, the gasket is damaged, which means that a proper seal can no longer be obtained. Re-using such a Mechatronic module is not permissible. See page 59.

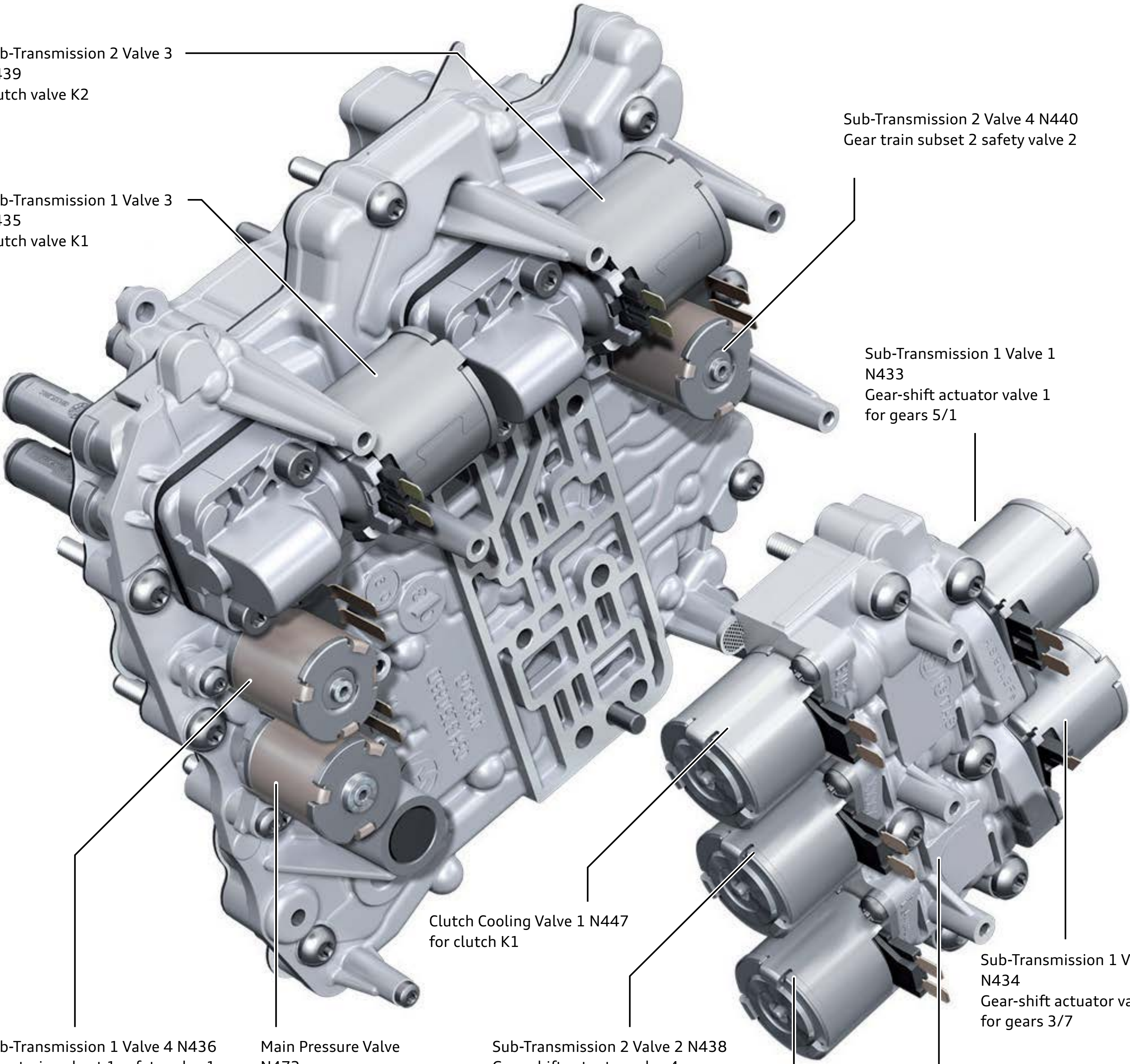
Electro-hydraulic control module

The electro-hydraulic control module contains the majority of the solenoid and pressure regulating valves, hydraulic valves and other valves for controlling the transmission functions. See hydraulic circuit diagram on page 74.

The description of the valves can be found on page 60 and the section for the relevant function.

The electro-hydraulic control module controls, regulates and/or executes the following functions:

- Adjustment of the ATF pressure in the hydraulic system to suit the various needs and requirements.
- Pressure control for operating clutches K1 and K2.
- Control of cooling oil for clutch K1.
- Pressure control for operation of the gear-shift actuators.
- Oil supply for demand-based gear set lubrication for gear train subsets 1 and 2.



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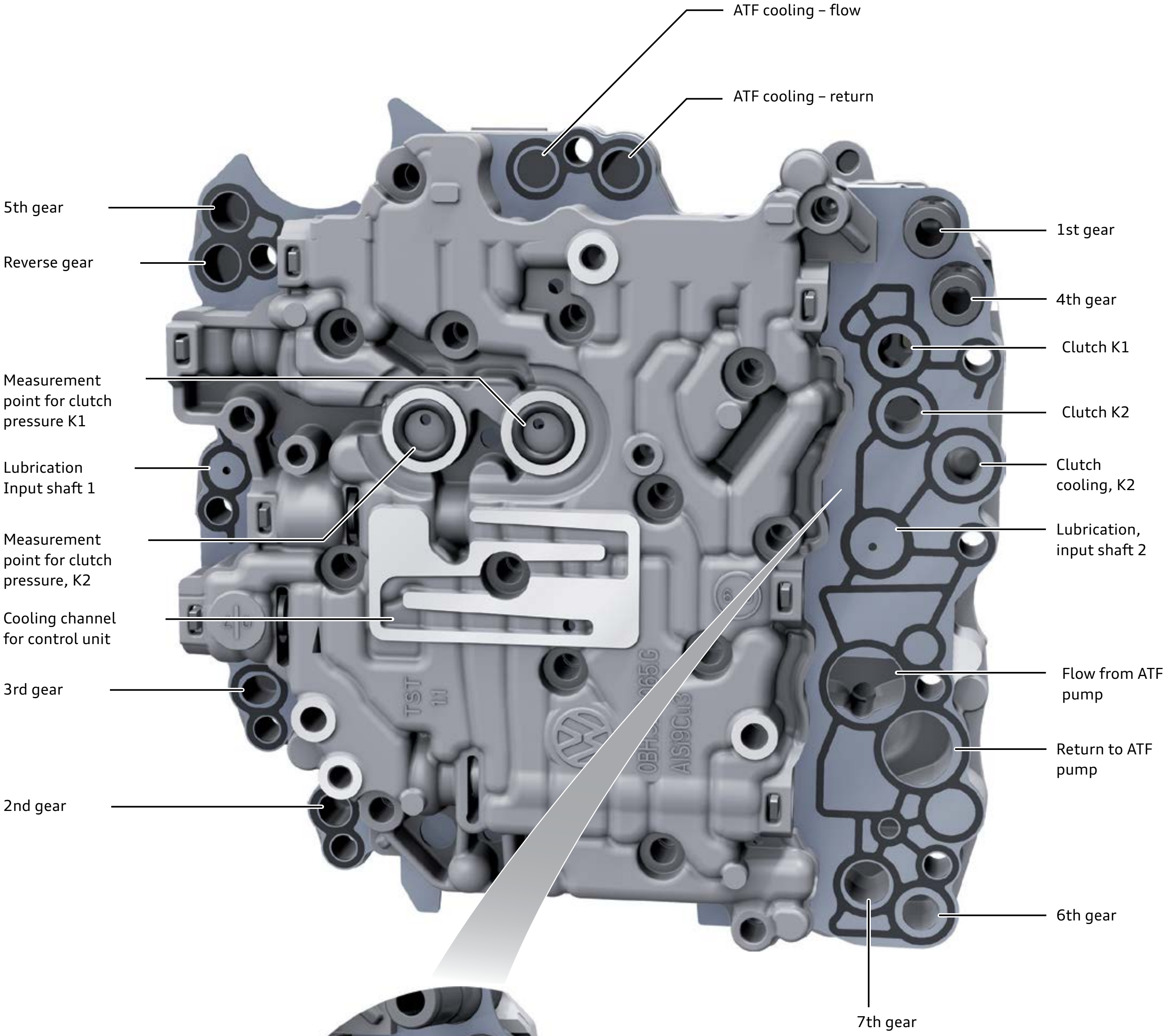
Hydraulic interfaces



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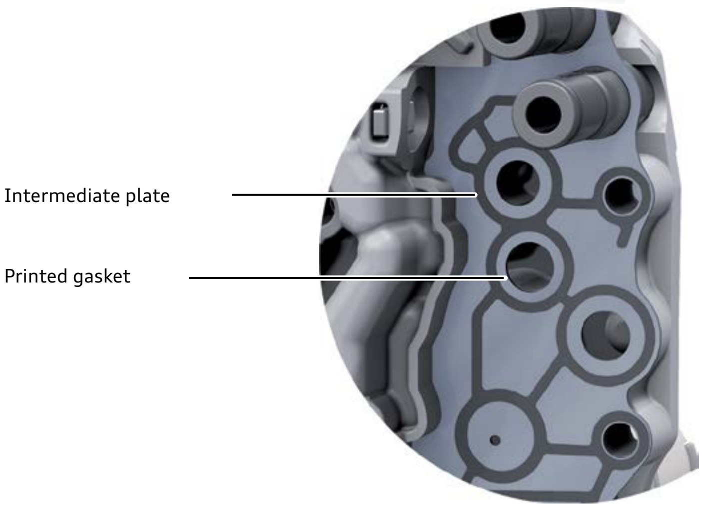


The electro-hydraulic control module consists of 2 casing sections as well as the valve manifold. Between the two casing sections there is an intermediate plate. That intermediate plate acts, as a partition and together with the relevant casing section forms corresponding oil channels for gearbox control. Secondly, the intermediate plate acts as a seal between the hydraulic interfaces and the transmission housing.

!

The gasket for the interfaces between the hydraulic control module and the gearbox housing is printed on the intermediate plate and cannot be replaced. When the Mechatronic module is detached, the gasket is damaged, which means that a proper seal can no longer be obtained. Re-using such a Mechatronic module is not permissible. See page 59.

Description of solenoid valves

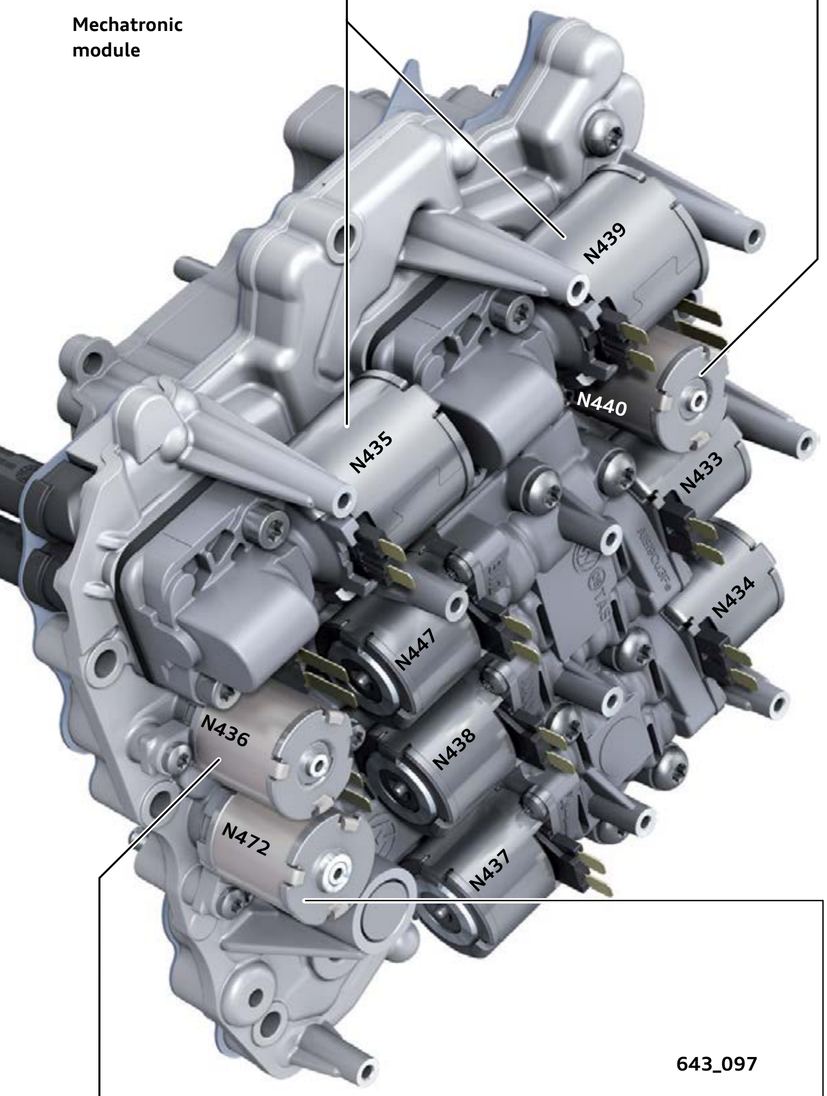
Sub-Transmission 1 Valve 3 N435 – clutch valve K1
Sub-Transmission 2 Valve 3 N439 – clutch valve K2

These two solenoid valves are used to control the clutch pressure for the clutch.

Sub-Transmission 2 Valve 4 N440
Gear train subset 2 safety valve 2

Valve N440 operates safety valve 2, which is responsible for the pressure supply to clutch valve K2 N439 and to the gear-shift actuator valves N437/N438. If a relevant malfunction occurs, N440 is used to hydraulically deactivate gear train subset 2.

Mechatronic module



643_097

Clutch Cooling Valve 1 N447 for clutch K1

This solenoid valve is used to control the cooling oil flow for clutch K1.

Sub-Transmission 1 Valve 1 N433
– Gear-shift actuator valve 1 for gear-shift actuator A for gears 5/1

Sub-Transmission 1 Valve 2 N434
– Gear-shift actuator valve 3 for gear-shift actuator C for gears 3/7

Sub-Transmission 2 Valve 1 N437
– Gear-shift actuator valve 2 for gear-shift actuator B for gears 2/6

Sub-Transmission 2 Valve 2 N438
– Gear-shift actuator valve 4 for gear-shift actuator D for gears R/4

These solenoid valves control the 4 gear-shift actuators for selecting the gears and the relevant neutral position.

Sub-Transmission 1 Valve 4 N436
Gear train subset 1 safety valve 1

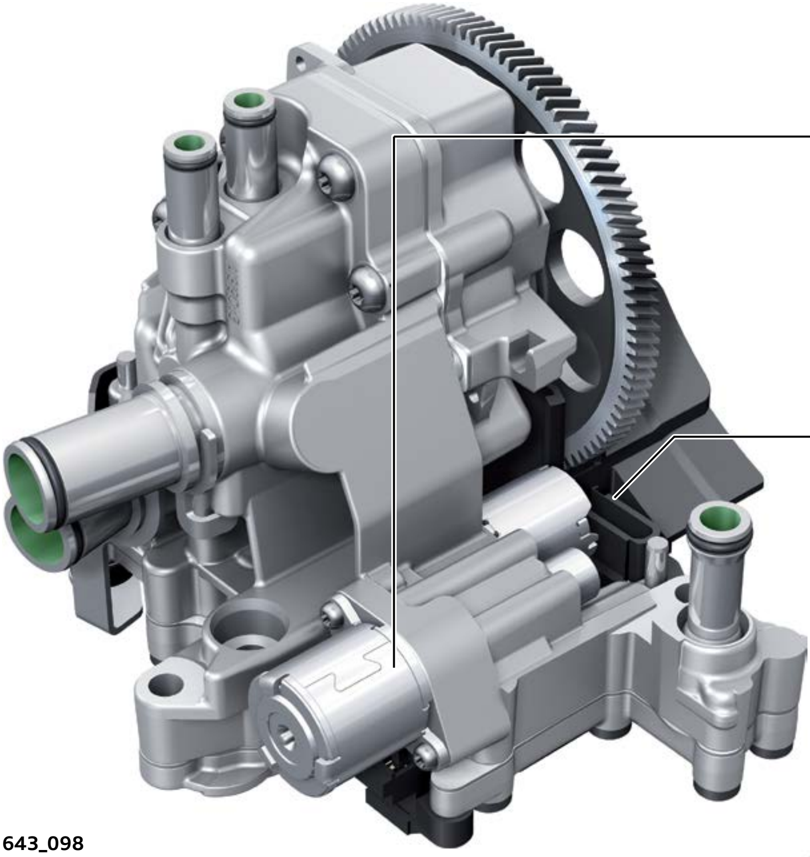
Valve N436 operates safety valve 1, which is responsible for the pressure supply to Sub-Transmission 1 Valve 3 N435 and to the gear-shift actuator valves N433/N434. If a relevant malfunction occurs, N436 is used to hydraulically deactivate gear train subset 1.

Main Pressure Valve N472

The primary pressure valve adjusts the primary pressure (also called the system pressure) in the hydraulic system according to the engine torque and the ATF temperature.

N472 has a negative voltage/pressure characteristic. If the power supply is lost, the maximum system pressure is applied. As a result, fuel consumption may increase and gear-change noises may be more loudly audible.

Auxiliary hydraulic module[1)]



643_098

Clutch Cooling Valve 2 N448 for clutch K2

This solenoid valve is used to control the cooling oil flow for clutch K2).

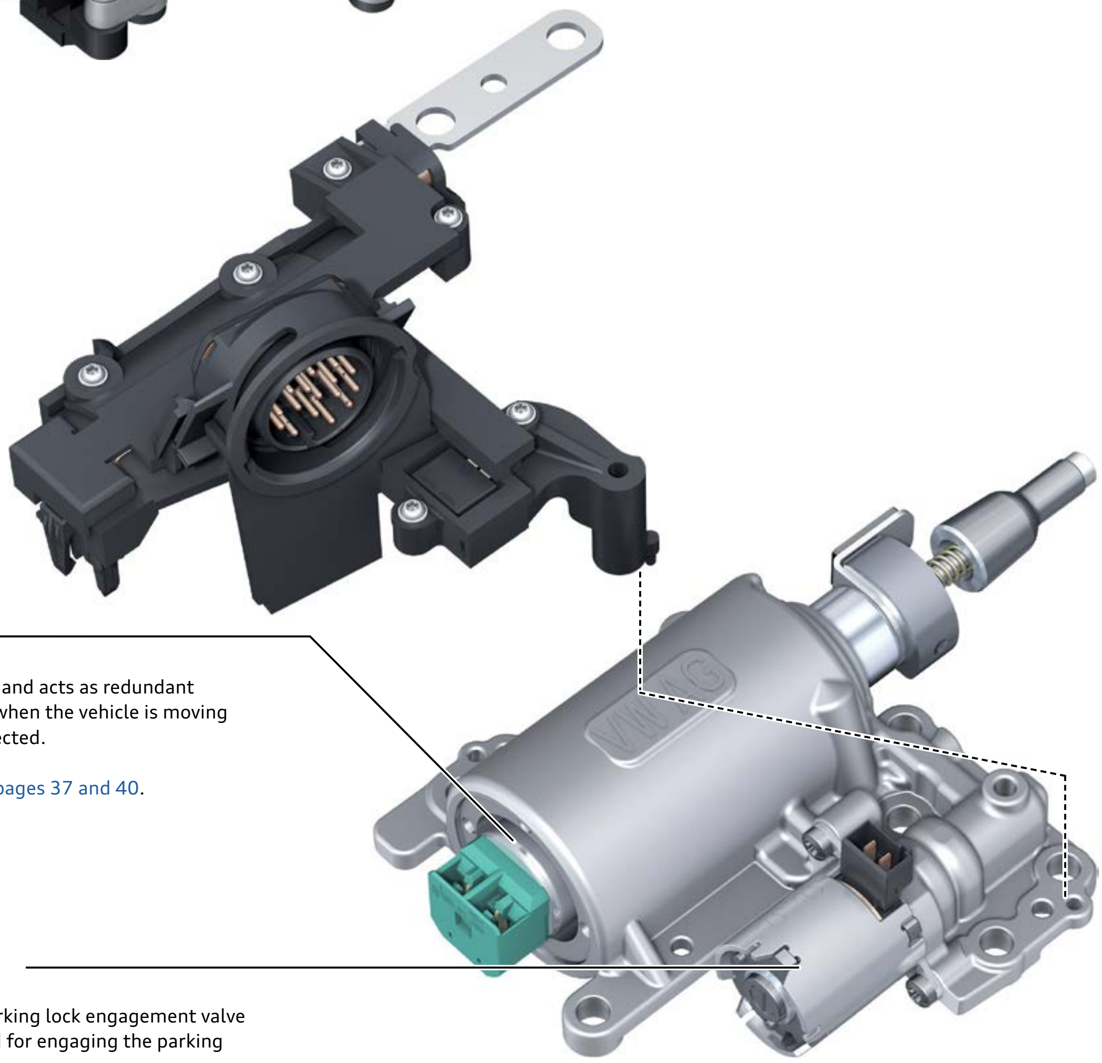
Basic information on the clutch cooling system for clutch K2 can be found on page 26.

Parking Lock Solenoid Valve 2 N574

This solenoid valve is also called the parking lock disengagement valve or PAV. It is used for disengaging the parking lock.

The operation of N574 is explained beginninag at page 40.

Parking lock module[1)]



Parking Lock Solenoid N486

N486 is an electromagnetic in function and acts as redundant backup for holding the P-OFF function when the vehicle is moving and when transmission setting N is selected.

The operation of N486 is explained on pages 37 and 40.

Parking Lock Solenoid Valve N573

This solenoid valve is also called the parking lock engagement valve or PEV. As the name suggests, it is used for engaging the parking lock.

The method of operation of N573 is explained beginning at page 38.

643_099

[1)] The auxiliary hydraulic module and the parking lock module are controlled by Automatic Transmission Control Module 2 J1006. See schematic diagram on page 72.

Auxiliary hydraulic module

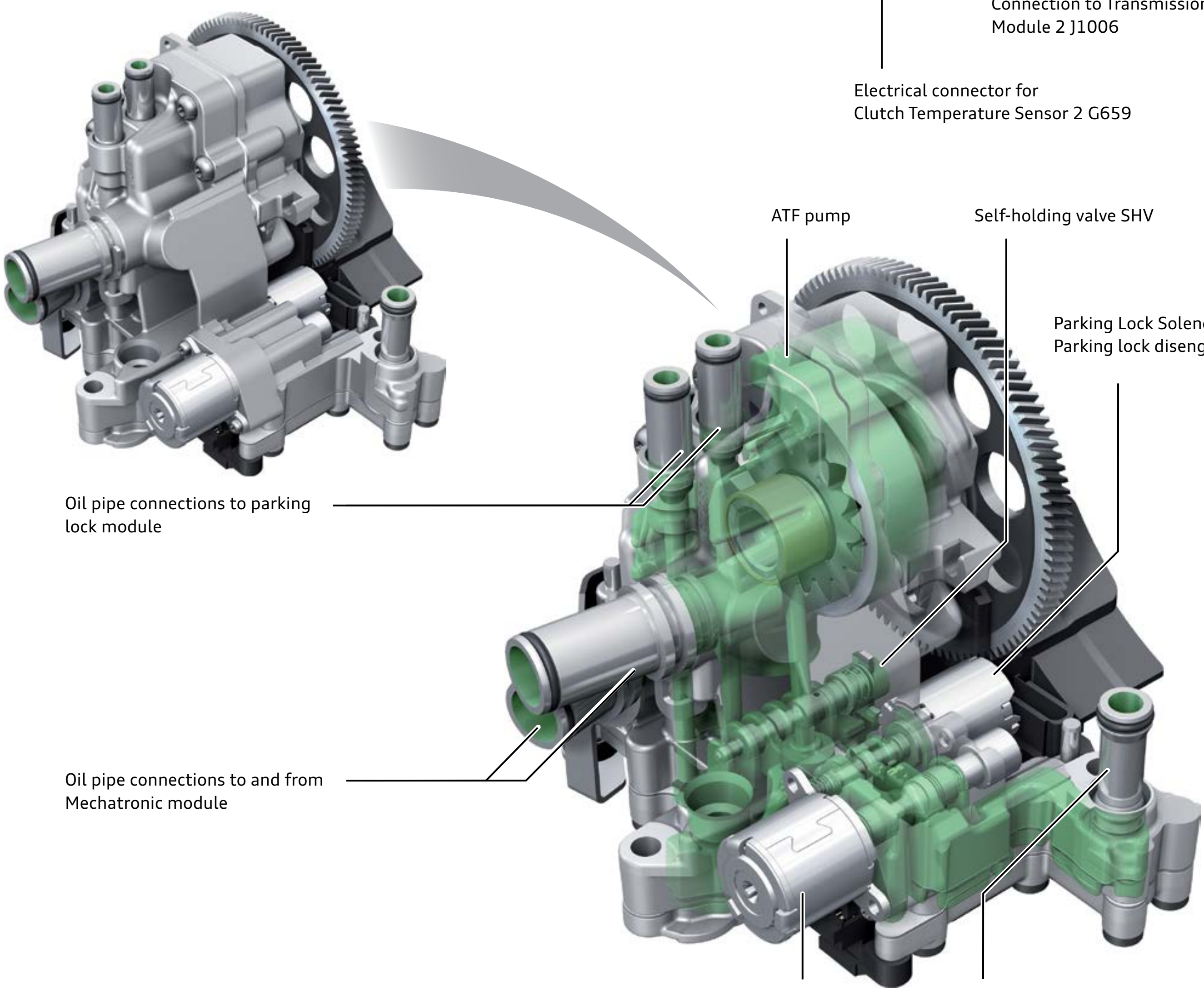
The auxiliary hydraulic module is responsible for hydraulic control of clutch cooling (K2), partial hydraulic control of the parking lock, and serves as an interface for the Clutch Temperature Sensor 2 G659.

Electrical operation of the auxiliary hydraulic module is performed by Transmission Control Module 2 J1006. Refer to page 72.

The auxiliary hydraulic module has the following functional components:

- The ATF pump.
- Clutch Cooling Valve 2 N448 for clutch K2.
- Parking Lock Solenoid Valve 2 N574 for disengaging the parking lock.
- A hydraulic self-holding valve (SHV) for controlling the parking lock piston.
- The contact and connection module.

643_075



643_076

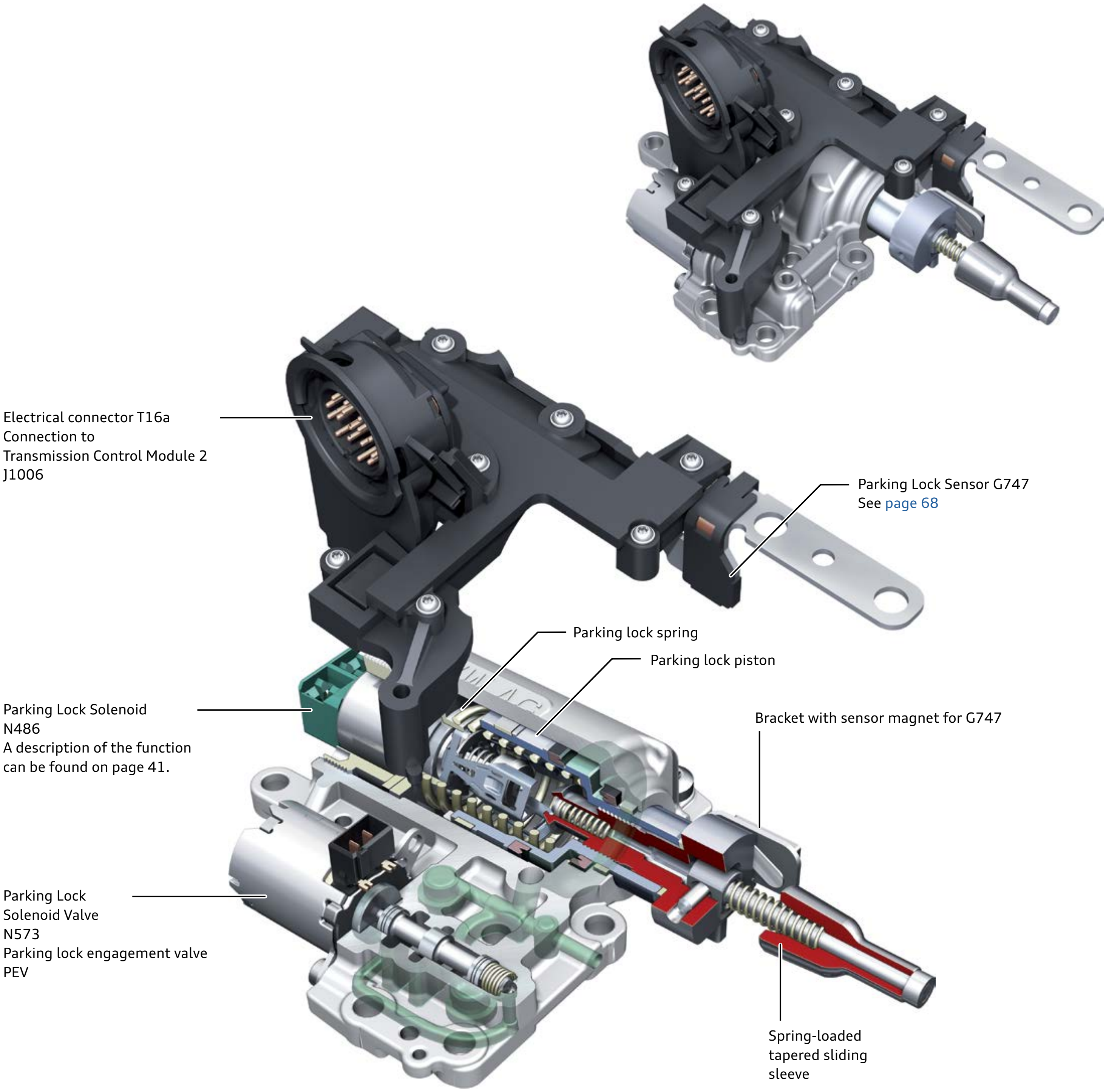
Parking lock module

Electrical operation of the parking lock module is performed by Transmission Control Module 2 J1006. Refer to page 72.

The parking lock is engaged by the force of the parking lock spring – subject to the electro-hydraulic control system adopting the appropriate switching status. The parking lock is disengaged by hydraulic pressure.

An Auto-P function automatically engages and disengages the parking lock according to the operating status.

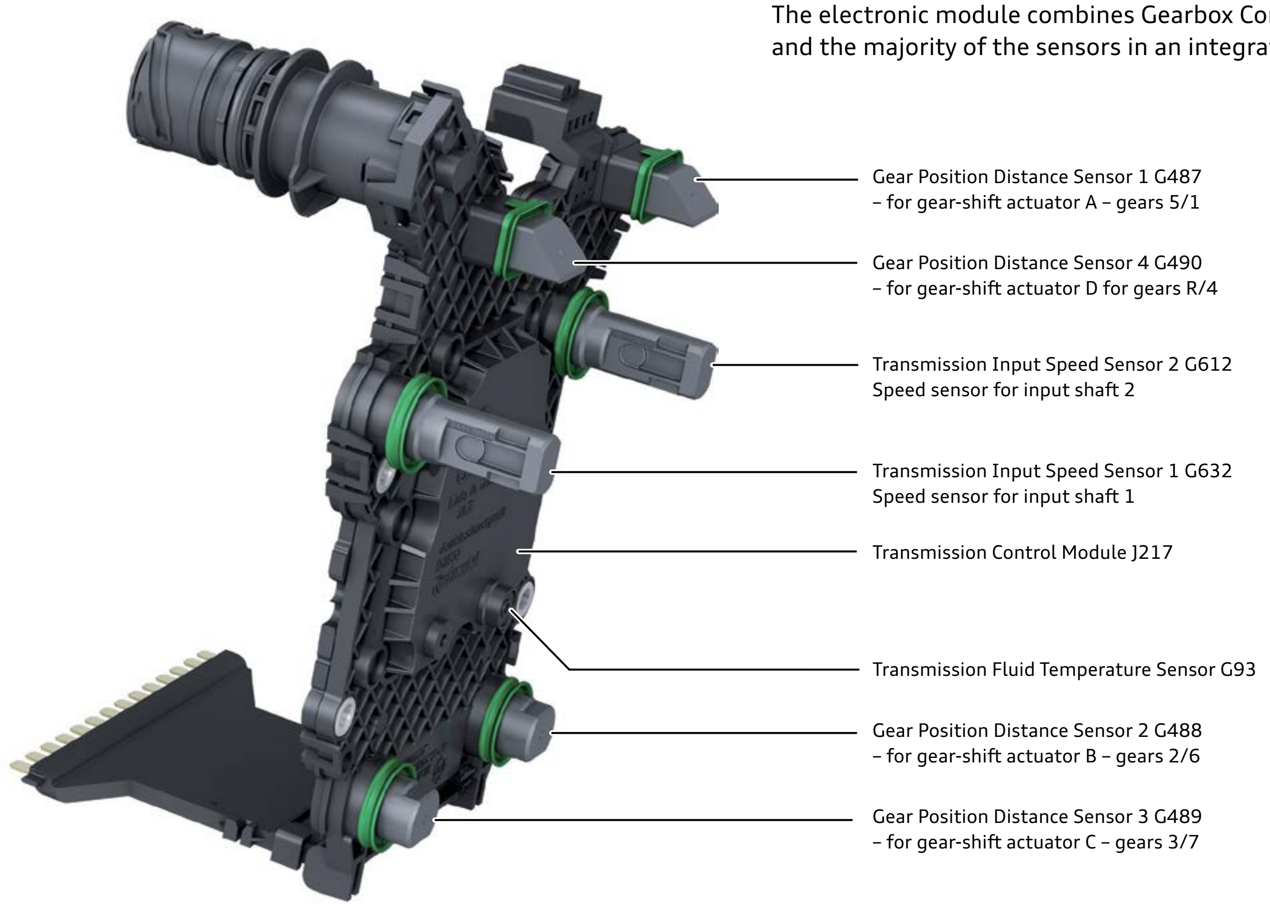
The driver can engage the parking lock with the aid of the Parking Lock Button E816 on the selector lever handle even if the engine is running.



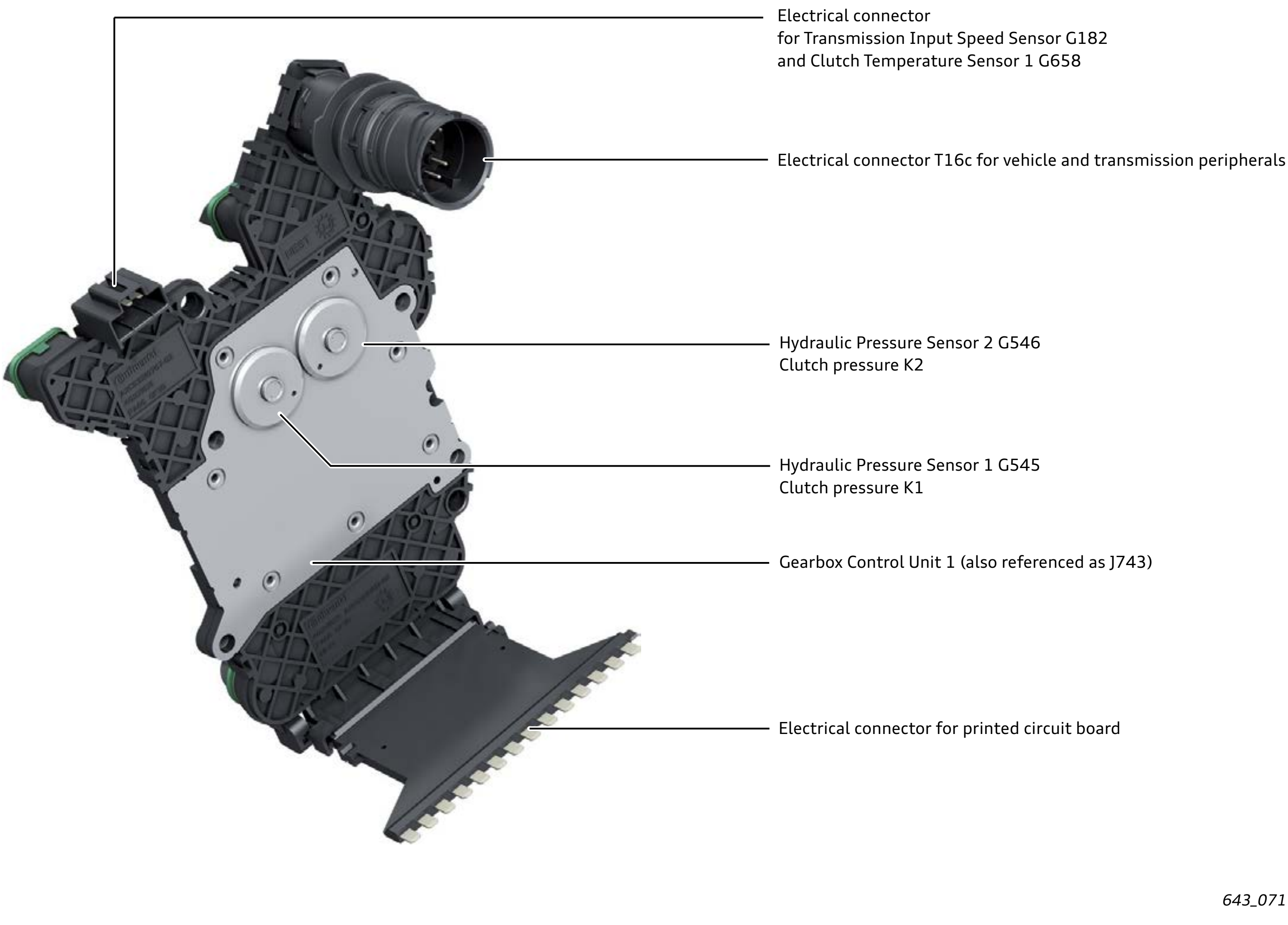
643_077

Electronic module

The electronic module combines Gearbox Control Unit 1 J743 and the majority of the sensors in an integrated unit.



643_070



643_071

Transmission control modules

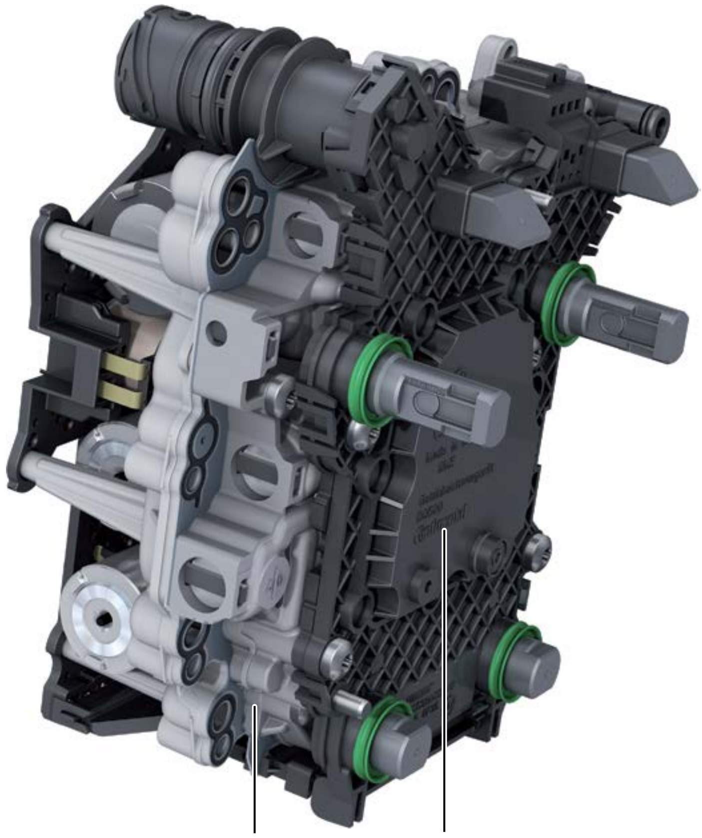
There are two modules for controlling the 0BZ transmission.

- Gearbox Control Unit 1 J743.
- Transmission Control Module 2 J1006.

Dual-Clutch Transmission Mechatronic J743
Address Word 02

The designation J743 can refer to either the complete Mechatronic module or only to the Gearbox Control Unit 1 in the electronic module of the Mechatronic module. Gearbox Control Unit 1 is the master control module for Transmission Control Module 2 J1006.

The two modules along with Selector Lever Sensor System Control Module J587 communicate via the Drivetrain CAN. The schematic on page 72 provides an overall view of which sensors and actuators are read/controlled by which module.



643_072

Transmission Control Module 2 – J1006
Address Word C2

J1006 is known as a “smart actuator” control module and controls the actuators assigned to it in response to commands from Gearbox Control Unit 1 J743. It also acts as an intelligent interface for several sensors and input signals. Refer to the chart on page 66.

J1006 has the following functions:

- Controlling the clutch cooling for clutch K2 (N448)
- Controlling the electro-hydraulically operated parking lock (N486, N573, N574).
- Processing the signals from the parking lock sensor G747.
- Processing the signals from Clutch Temperature Sensor 2 (clutch K2).
- Processing the signals from the steering wheel tiptronic controls.

Installation location for J1006

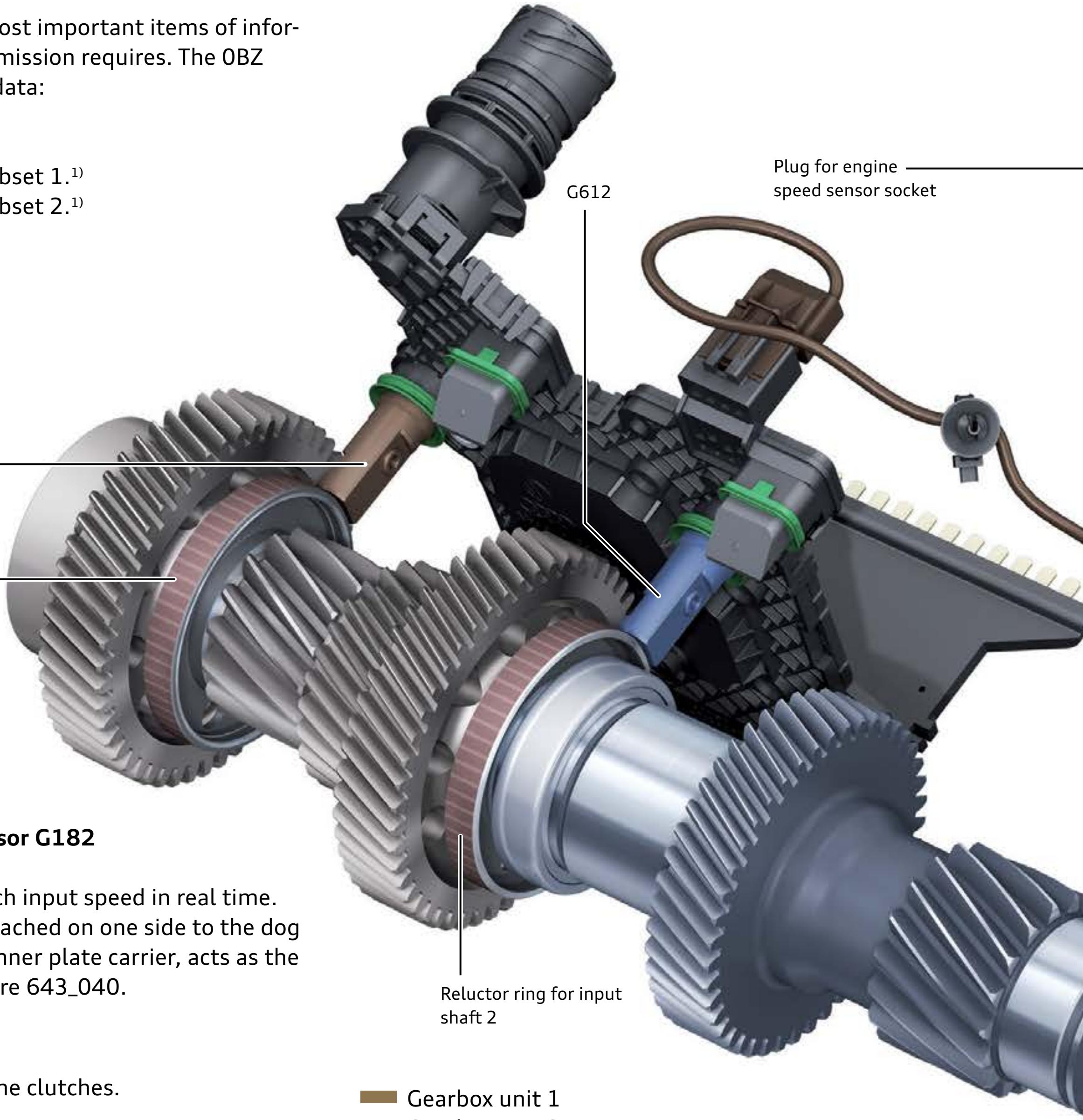
643_003

Sensors and information

Speed sensors and speed data

Speed signals are among the most important items of information that a dual clutch transmission requires. The 0BZ processes the following speed data:

- Gearbox input speed.[1)]
- Input speed for gear train subset 1.[1)]
- Input speed for gear train subset 2.[1)]
- Gearbox output speed.[2)]
- Engine speed.[2)]



Transmission Input Speed Sensor G182

G182 is used to detect the clutch input speed in real time. The clutch housing, which is attached on one side to the dog clutch and on the other to the inner plate carrier, acts as the reluctor ring. See page 24, Figure 643_040.

The signal from G182 is used ...

- For more precise control of the clutches.
- For adapting the clutches.
- For microslip control.

If G182 fails, the speed data from the Engine Speed Sensor G28 is used as a substitute signal[2)].

Microslip control and certain adaptations cannot be carried out.

The casing of G182 also houses Clutch Temperature Sensor 1 G658. See page 69.

Transmission Input Speed Sensor 1 G632
Speed sensor for input shaft 1

Transmission Input Speed Sensor 2 G612
Speed sensor for input shaft 2

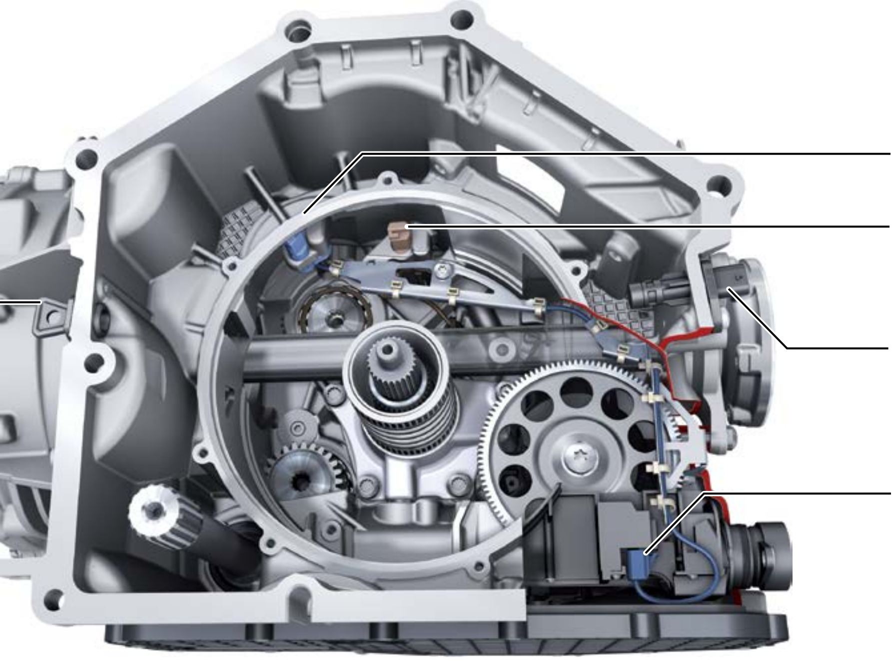
These two speed sensors are used to register the clutch output speeds (G632 = clutch K1 and G612 = clutch K2). Together with the signal from G182, they allow the clutch slip to be precisely calculated.

The signals from sensors G632 and G612 are used...

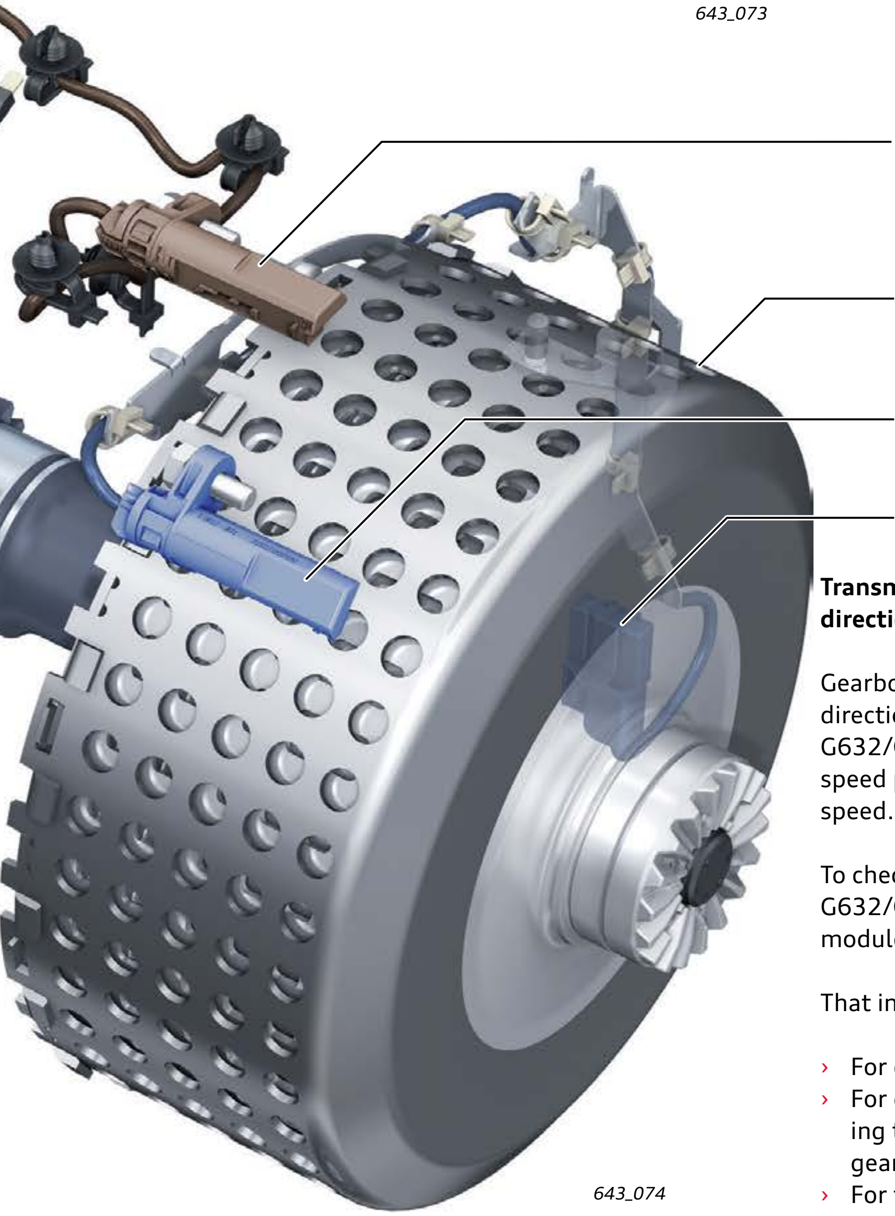
- For microslip control.
- For adapting the clutches.
- For determining the synchromesh speed for gear shifts.
- For calculating the gearbox output speed.

If one of the sensors fails, the affected gear train subset is deactivated. Gearbox Control Unit 1 J743 then switches to an appropriate safe mode.

1) This speed data is collected by the gearbox sensors and processed by Gearbox Control Unit 1 J743.
2) This speed data is provided by other control modules via CAN data communication and processed or calculated by Gearbox Control Unit 1 J743.



643_073



643_074

Transmission output speed – vehicle road speed – direction of travel

Gearbox Control Unit 1 calculates the output speed and the direction of travel on the basis of the speed signals from G632/G612 and the currently selected gear. The output speed provides the basis for calculating the vehicle road speed.

To check the plausibility of the signals from the two sensors G632/G612, the wheel speed data from the ESC control module is referred to.

That information is required for the following functions:

› For gear selection and determining the gear-shift points.
› For detecting the direction of travel for plausibility-checking the gear selection (for example, when backing up, 1st gear engagement is barred).
› For the creep control function[3)].

Information

The sensors G182/G658 and G659 are identical in design. The speed sensor in G659 is not used.

Travel and position sensors

Gear Position Distance Sensor 1 G487
Gear Position Distance Sensor 2 G488
Gear Position Distance Sensor 3 G489
Gear Position Distance Sensor 4 G490

Precise detection of the movement and positions of the gear-shift actuators/selector forks is of fundamental importance for changing gear and transmission control. It is imperative to ensure that no prohibited gear-shift positions can occur. The information is read by Gearbox Control Unit 1 J743 with the aid of 4 travel sensors. Sensor magnets (permanent magnets) are used as position markers and are attached to each of the gear shift actuators. See also sensor readings on page 31.

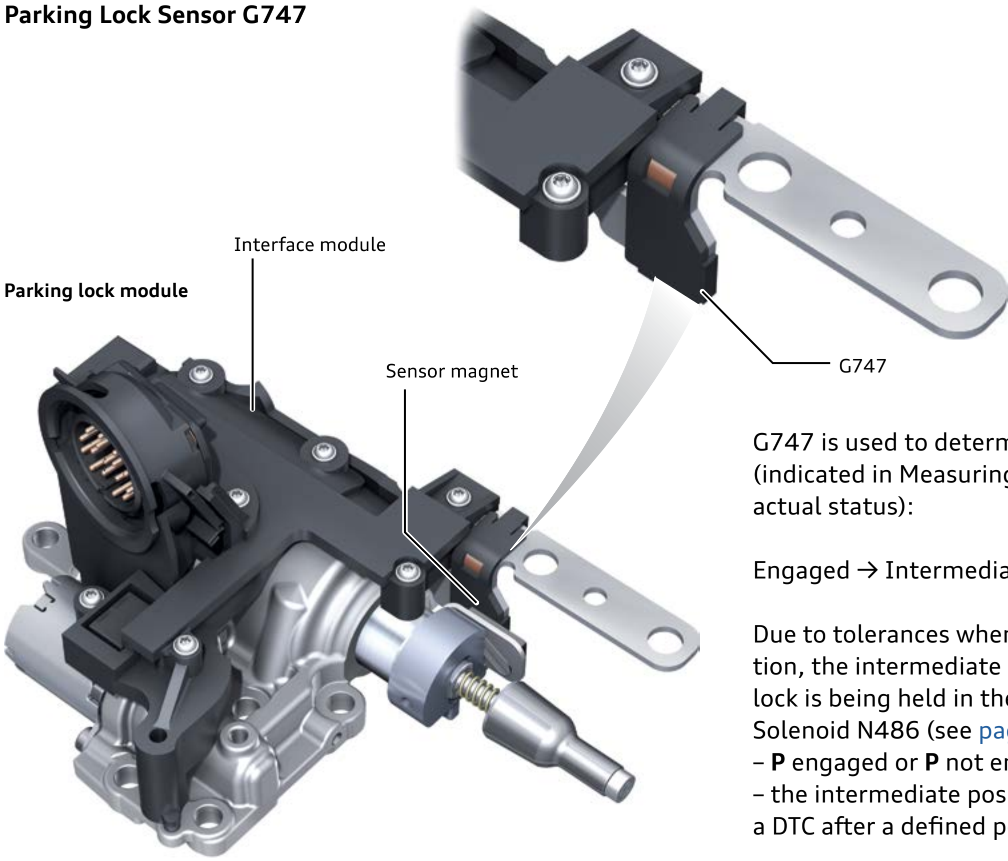
The following gear-shift actuators (selector forks)/gears and readings are assigned to the 4 travel sensors:

- G487 – for gear-shift actuator A – gears 5/1 – sensor reading IDE02864
- G488 – for gear-shift actuator B – gears 2/6 – sensor reading IDE02872
- G489 – for gear-shift actuator C – gears 3/7 – sensor reading IDE02880
- G490 – for gear-shift actuator D – gears R/4 – sensor reading IDE02888

If one of the travel sensors fails, the gear train subset concerned is deactivated and an appropriate safe mode program activated.

In order to guarantee the required position detection accuracy, the travel sensors and/or the selector forks have to be calibrated by means of a Basic Setting. (For example, after replacing the Mechatronic module).

Parking Lock Sensor G747



643_077

The position of the parking lock is monitored by Transmission Control Module 2 J1006 with the aid of Parking Lock Sensor G747 and then communicated to Gearbox Control Unit 1 J743. G747 is part of the interface module of the parking lock module.

G747 is used to determine the following positions (indicated in Measuring value IDE08465 for parking lock actual status):

Engaged → Intermediate position → Not engaged

Due to tolerances when determining the parking lock position, the intermediate position is indicated when the parking lock is being held in the P-OFF position by the Parking Lock Solenoid N486 (see page 37). In normal vehicle operation – **P** engaged or **P** not engaged (P hydraulically disengaged) – the intermediate position is not allowed and is registered as a DTC after a defined period.

G747 has the following functions:

- Monitoring correct operation of the parking lock.
- Providing clearance to start in P (the sensor signal is converted directly to the P/N signal by the Gearbox Control Unit 1).
- Generating the indications on the instrument cluster when the parking lock is not engaged (for example, risk of rolling and prompting engagement of parking lock/parking brake).

Temperature sensors

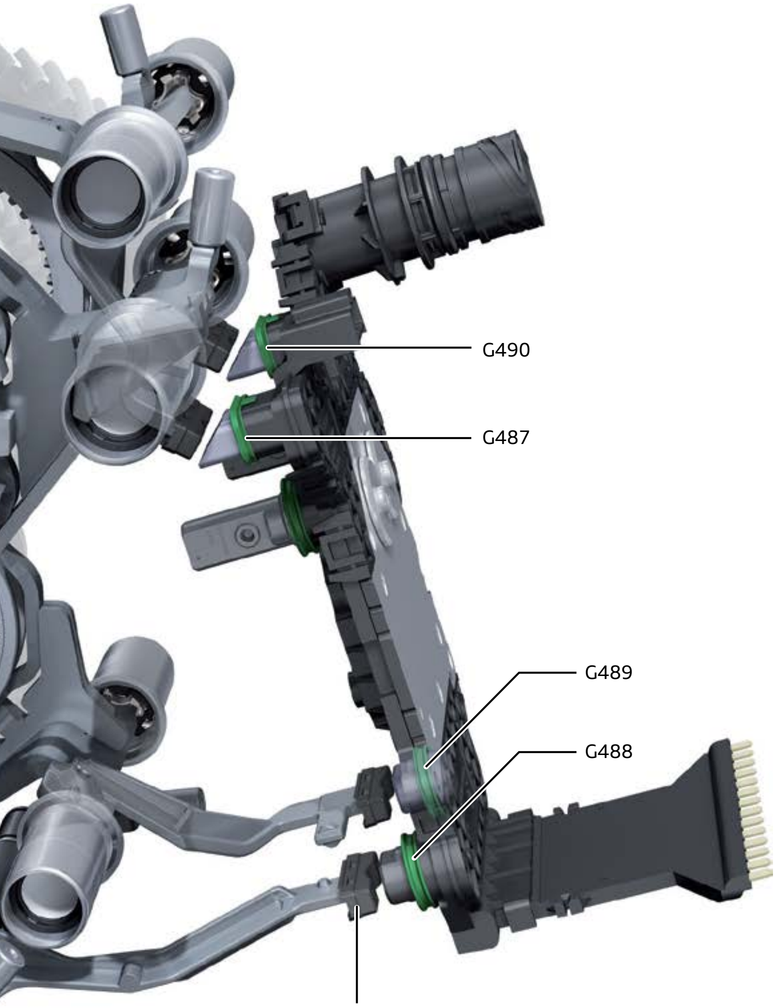
Clutch Temperature Sensor 1 G658
Clutch Temperature Sensor 2 G659

The sensors G658/G659 detect the temperature of the cooling oil thrown out from the dual clutch by centrifugal force (centrifugal oil temperature). From that, the clutch temperature can be deduced and the cooling oil volume controlled according to demand. In addition, warning messages and diagnostics entries are generated from the centrifugal oil temperature. Refer to page 26.

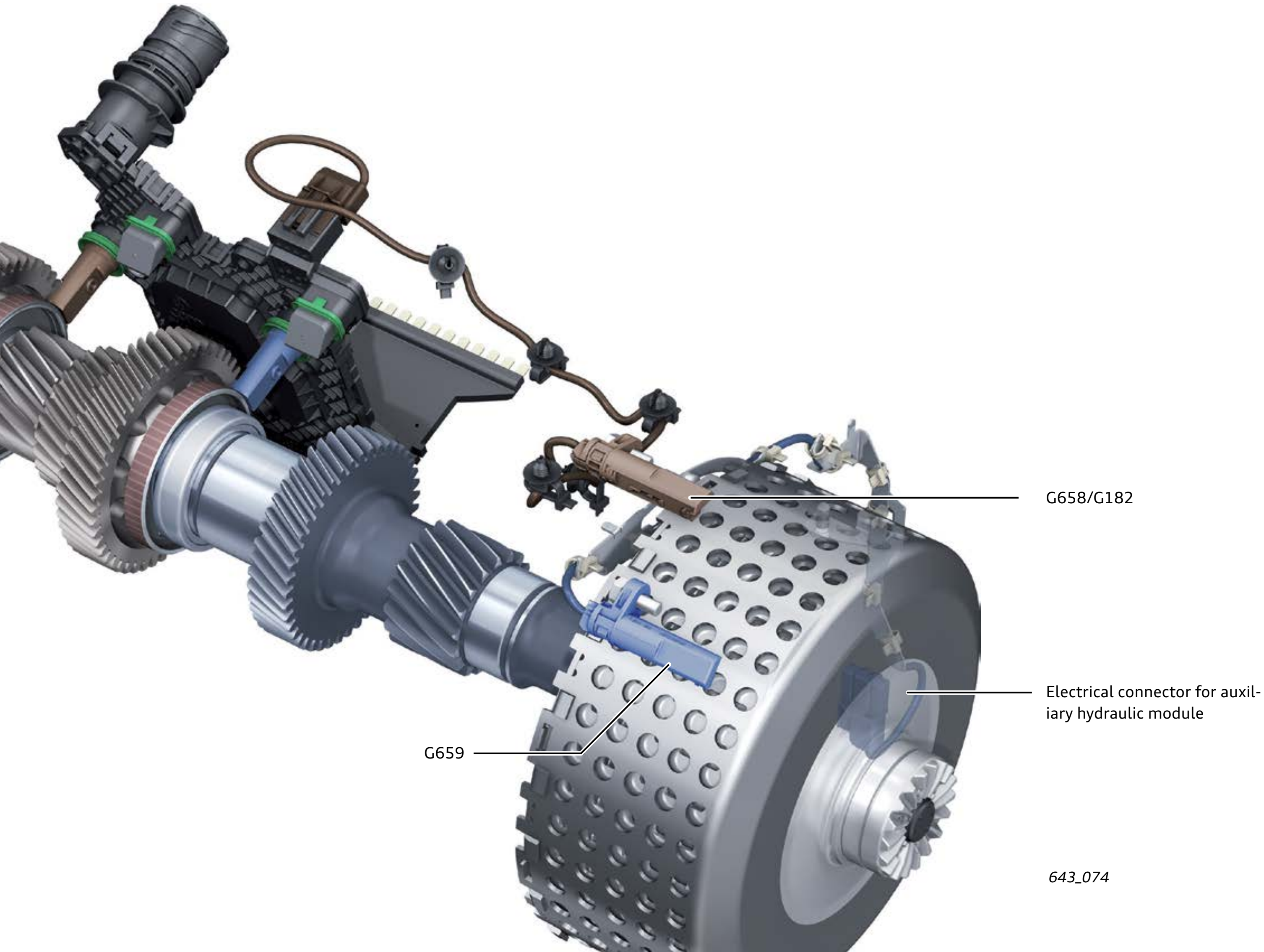
The sensors G658/G659 are 2 identical combination sensors each of which also houses a speed sensor and a temperature sensor within the same housing.

Sensor G658 detects the centrifugal oil temperature of clutch K1. In the case of G658, the speed sensor G182 is also used for detecting the transmission input speed[1)]. G658 is connected to the electronic module of the Mechatronic module. Gearbox Control Unit 1 J743 processes the sensor reading and operates Clutch Cooling Valve 1 N447 accordingly.

Sensor G659 detects the centrifugal oil temperature of clutch K2. G659 is connected to the auxiliary hydraulic module, which in turn is connected to Transmission Control Module 2 J1006. The sensor reading is analyzed and passed on to Gearbox Control Unit 1 J743 as a temperature reading. J743 then sends J1006 the control variable for operating Clutch Cooling Valve 2 N448. See schematic diagram on page 72. The speed sensor in G659 is not used.



643_100



643_074

Transmission Fluid Temperature Sensor G93
Temperature sensors in the control module

High temperatures have a detrimental effect on the useful life and performance of electronic components.
Because the electronic control module is integrated in the gearbox (immersed in oil), monitoring of the module temperature and, therefore, of the gearbox oil temperature is very important.

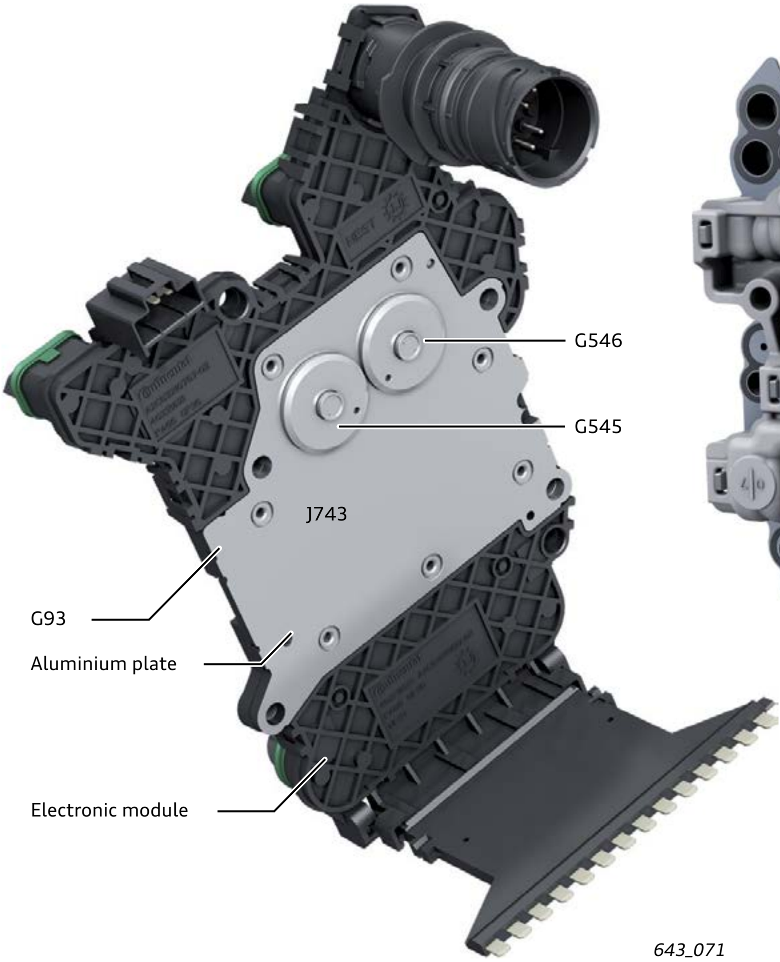
G93 is located on the circuit board of Gearbox Control Unit 1 J743. Gearbox Control Unit 1 is mounted on an aluminium plate that serves as a heat sink for the electronic module. Pressure sensors G545 and G546 are also located on this heat sink. The aluminium plate is directly attached to the electro-hydraulic control module and is in contact with a constant flow of cooling oil through an oil channel. Therefore, the temperature of the aluminium plate closely approximates to the gearbox oil temperature.

The gearbox oil temperature and the temperature of the gearbox electronic module are important items of information for the following applications:

- Temperature monitoring for initiating safety functions
- Criterion for various adaptations
- Adaptation of gear-shift pressure
- Criterion for the warm-up program

Due to demanding requirements regarding component protection, there is another temperature sensor for monitoring the electronic module temperature which is integrated in the middle of the electronic components and detects the temperature directly at the electronic components. That sensor does not have a diagnostics designation of its own.

The readings of the two temperature sensors are constantly checked against one another for plausibility. If there is a fault on one of the two temperature sensors, a substitute reading is generated from the readings of the intact sensor and a substitute program activated. See temperature monitoring/ safety functions.



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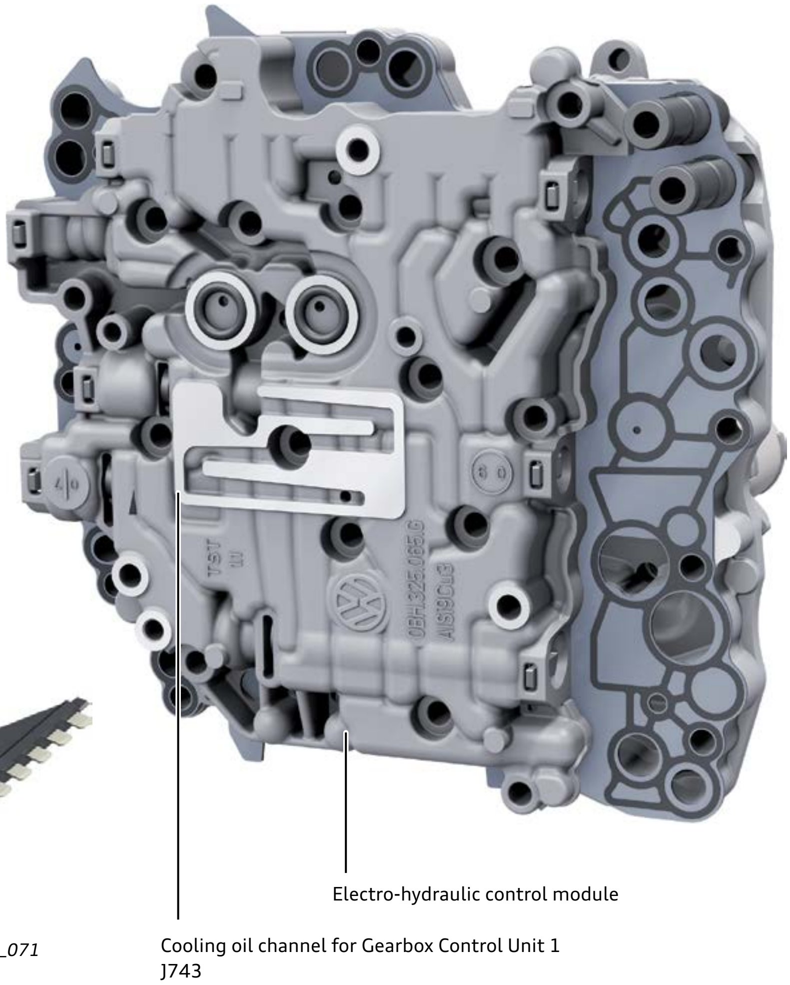


643_101

Temperature monitoring/safety functions

When temperatures at G93 of approximately 288 °F (139 °C) are detected, Gearbox Control Unit 1 J743 instigates an engine torque reduction.

A warning message ("Gearbox too hot. Please adjust driving style") is also displayed in the instrument cluster. At DTC is registered in the fault memory.

The engine torque is reduced so that it is about 70 Nm when the oil temperature is approximately 293 °F (145 °C). This improves the cooling capacity and prevents overheating.

Pressure sensors

Hydraulic Pressure Sensor 1 G545
Hydraulic Pressure Sensor 2 G546

G545 detects the clutch pressure of clutch K1 (actual clutch pressure).

G546 detects the clutch pressure of clutch K2 (actual clutch pressure).

The sensors G545 and G546 are used to monitor the clutch pressure of the respective clutch in each case and for calibrating clutch pressure control and the primary pressure.

The actual clutch pressure is constantly compared with the specified clutch pressure calculated by Gearbox Control Unit 1 J743 and checked for plausibility. In the event of discrepancies (malfunctions), safety deactivation of the gear train subset concerned is initiated and the relevant safe mode program activated.

The two sensors are part of the electronic module, which in turn forms a single unit with the Mechatronic module – which again can only be replaced as a complete unit if required.

Other information

You can find information on the following topics in the Owner's Manual for the vehicle:

- Transmission faults, fault indications and messages.
- Tow-starting/towing.

Function diagram

The control modules are listed on the vehicle diagnostic tester under the following Address Words:

- J743 – Dual-Clutch Transmission Mechatronic.
  - 02
- J1006 – Transmission Control Module 2.
  - C2
- J587 – Selector Lever Sensor System Control Module.
  - 81

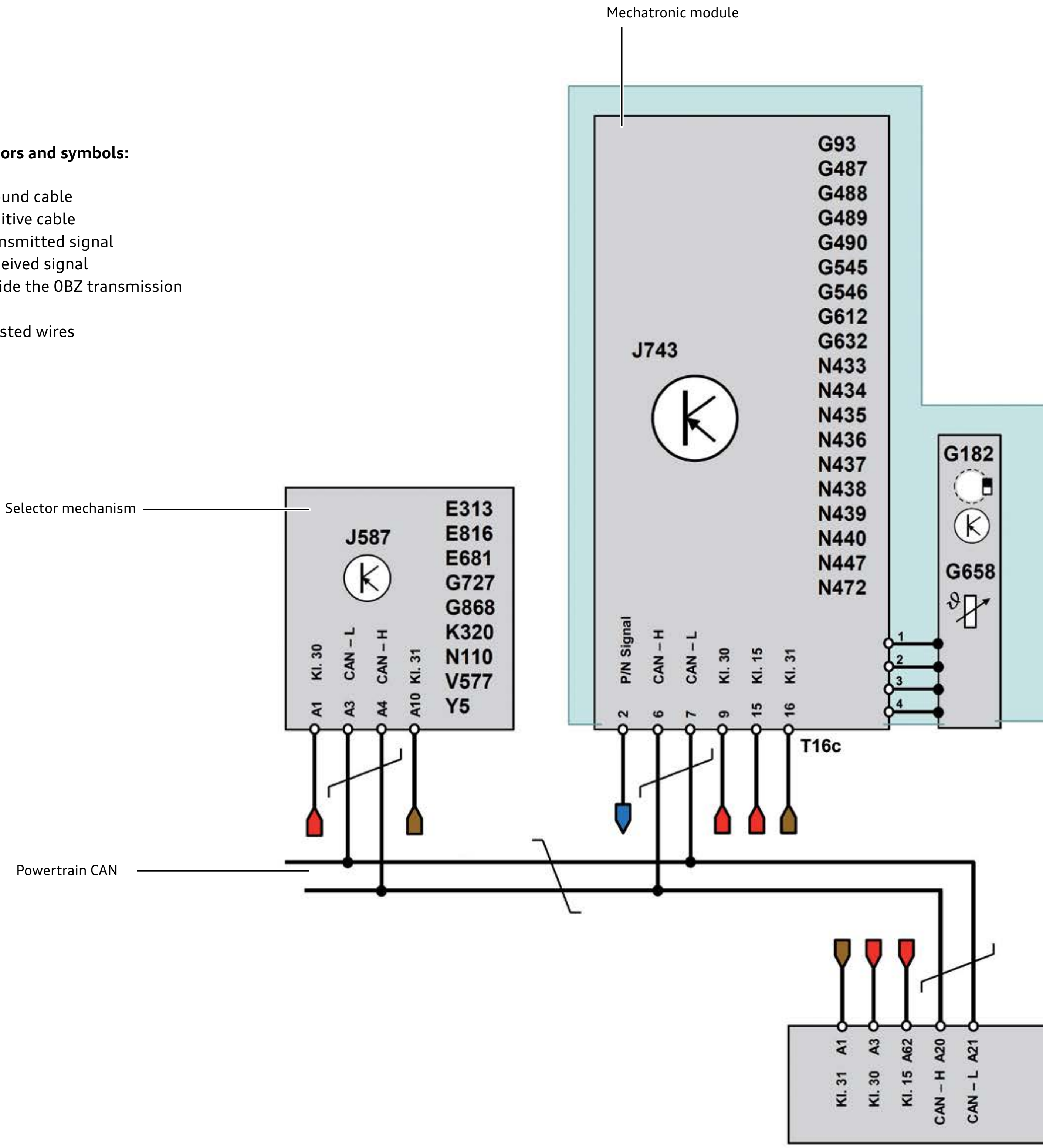
To make the descriptions easier to follow, the following designations are used for the two transmission control modules:

- Gearbox Control Unit 1 J743.
- Transmission Control Module 2 J1006.

Wiring colors and symbols:

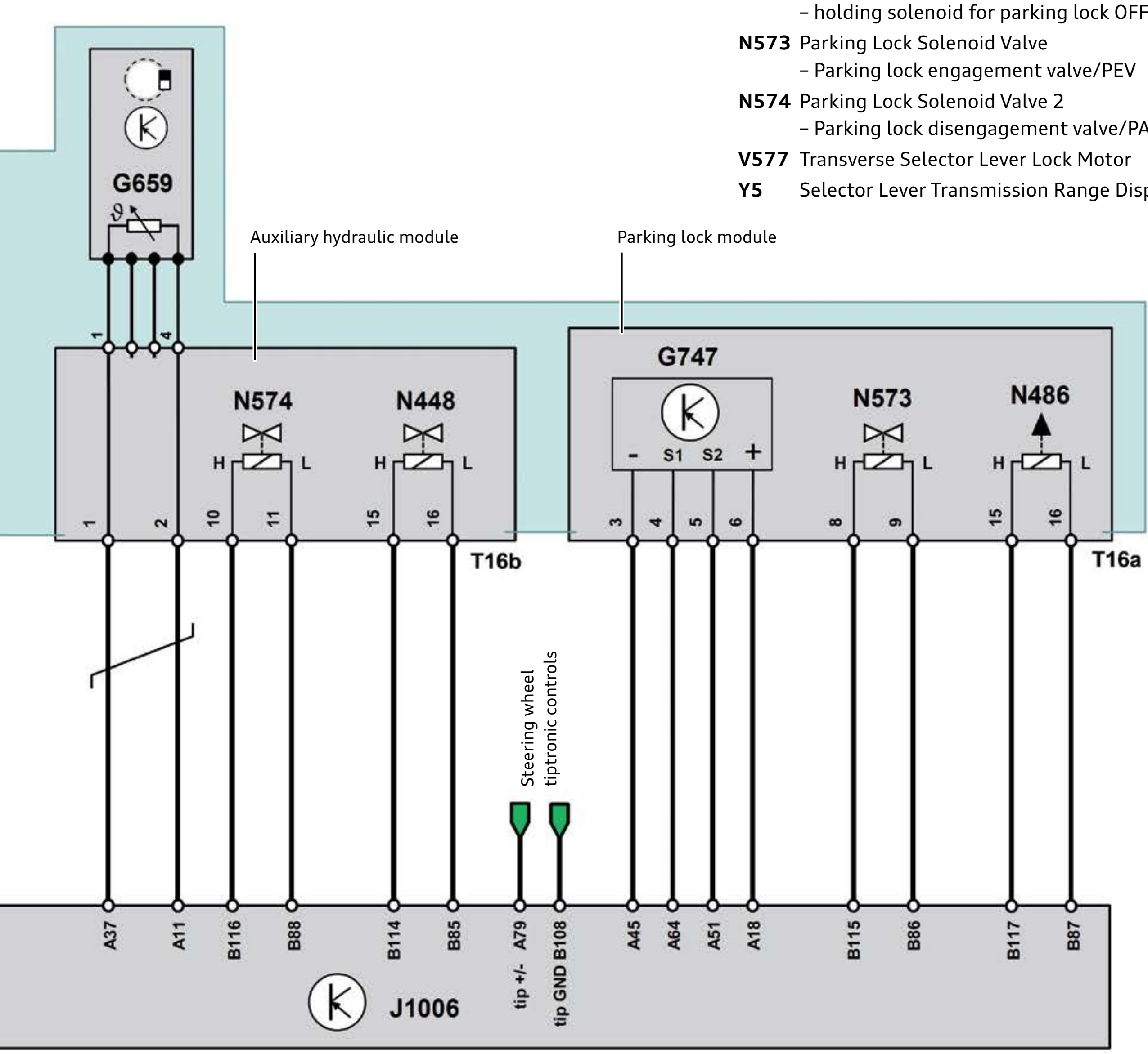
Ground cable
Positive cable
Transmitted signal
Received signal
Inside the 0BZ transmission

Twisted wires



Key:

E313 Selector Lever
E681 Parking Lock Indicator Lamp
E816 Parking Lock Button
G93 Transmission Fluid Temperature Sensor
G182 Transmission Input Speed Sensor
G487 Gear Position Distance Sensor 1/gear-shift actuator A
G488 Gear Position Distance Sensor 2/gear-shift actuator B
G489 Gear Position Distance Sensor 3/gear-shift actuator C
G490 Gear Position Distance Sensor 4/gear-shift actuator D
G545 Hydraulic Pressure Sensor 1
G546 Hydraulic Pressure Sensor 2
G612 Transmission Input Speed Sensor 2
G632 Transmission Input Speed Sensor 1
G658 Clutch Temperature Sensor 1
G659 Clutch Temperature Sensor 2
G727 Selector Lever Position Sensor
G747 Parking Lock Sensor
G868 Transverse Selector Lever Lock Sensor
J587 Selector Lever Sensor System Control Module
J743 Dual-Clutch Transmission Mechatronic
J1006 Transmission Control Module 2 J1006
K320 Parking Lock Indicator Lamp
N110 Parking Lock Indicator Lamp
N433 Sub-Transmission 1 Valve 1
– Gear-shift actuator valve 1 for gear-shift actuator A/gears 5/1
N434 Sub-Transmission 1 Valve 2
– Gear-shift actuator valve 3 for gear-shift actuator C/gears 3/7
N435 Sub-Transmission 1 Valve 3 – clutch valve K1
N436 Sub-Transmission 1 Valve 4
– gear train subset 1 safety valve
N437 Sub-Transmission 2 Valve 1
– Gear-shift actuator valve 2 for gear-shift actuator B/gears 2/6
N438 Sub-Transmission 2 Valve 2
– Gear-shift actuator valve 4 for gear-shift actuator D/gears R/4
N439 Sub-Transmission 2 Valve 3
– clutch valve K2
N440 Sub-Transmission 2 Valve 4
– gear train subset 2 safety valve
N447 Clutch Cooling Valve 1 – clutch K1
N448 Clutch Cooling Valve 2 – clutch K2
N472 Main Pressure Valve
N486 Parking Lock Solenoid
– holding solenoid for parking lock OFF
N573 Parking Lock Solenoid Valve
– Parking lock engagement valve/PEV
N574 Parking Lock Solenoid Valve 2
– Parking lock disengagement valve/PAV
V577 Transverse Selector Lever Lock Motor
Y5 Selector Lever Transmission Range Display



Electrical connectors on Transmission Control Module 2 J1006

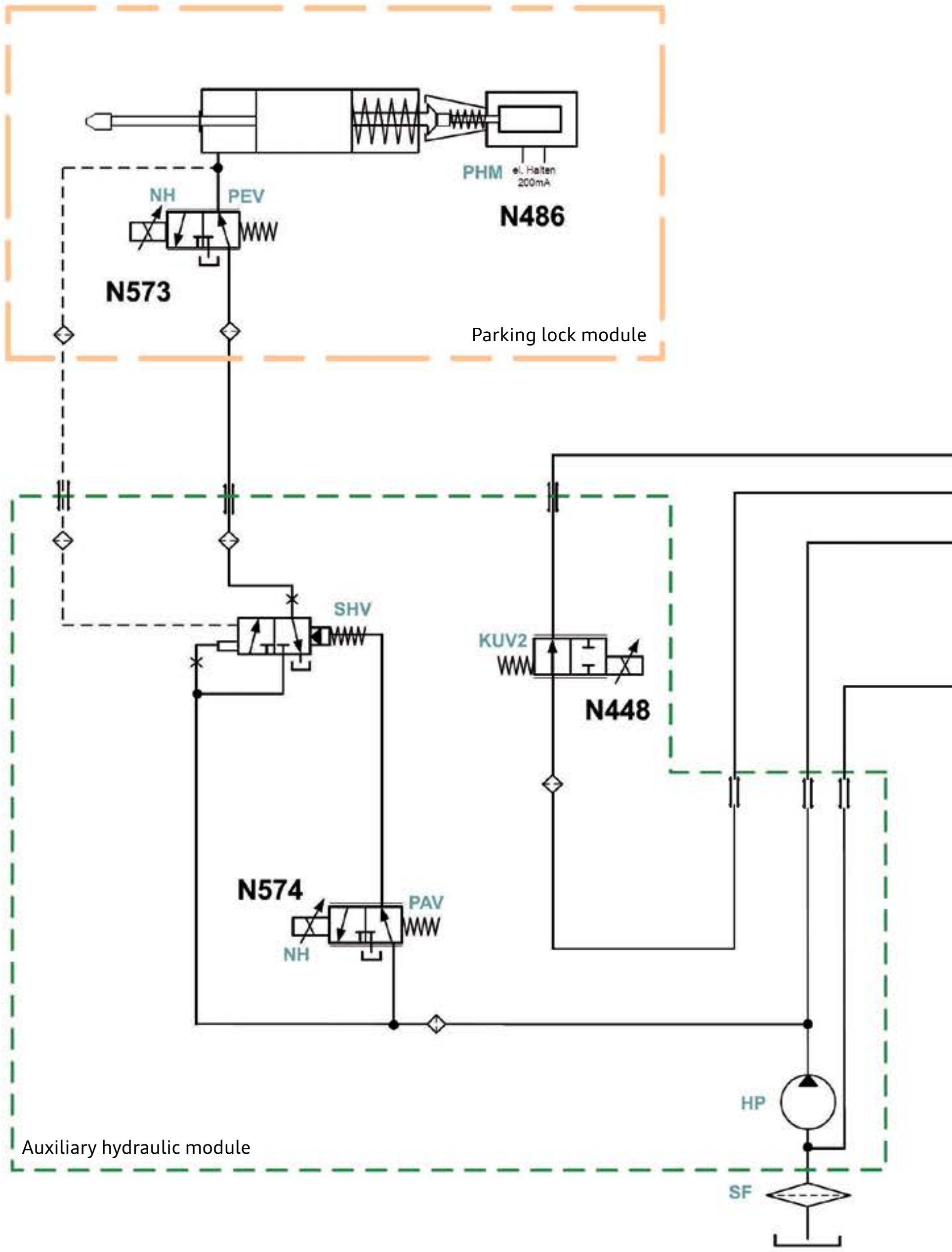
Connector A pins 1-80 (T81a on ELSA wiring diagram)
Connector B pins 81-121 (T40a on ELSA wiring diagram)

643_090

Hydraulic circuit diagram

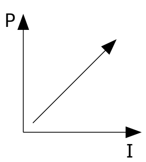
Key:

AW Input shaft
BP Bypass valve
CPU Central processing unit – Outlet point on cooling channel for control unit
DBV Pressure limiting valve
DF Pressure filter
DROP Lubrication point
GS Gear-shift actuator
GSV Gear-shift actuator value
HD Primary pressure valve
HP Hydraulic pump
K Clutch
KK Clutch cooling
KUV Cooling oil valve
KV Clutch valve
NH Normally high[1)]
NL Normally low[1)]
PAV Parking lock disengagement valve
PEV Parking lock engagement valve
PHM Parking lock holding solenoid
RD Residual pressure valve
SF Intake filter
SHV Self-holding valve
SV Safety valve
TR Temperature regulator (thermostat)
TW Output shaft
VOL Volumetric flow valve
WTK Heat exchanger – fluid: coolant
WTL Heat exchanger – fluid: air
WV Change-over valve



[1)] Explanation of NL and NH

NL characteristic

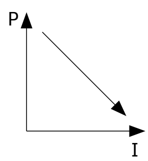


NL – Normally low means that the solenoid valve has a positive current/pressure characteristic. That, in turn, means that as the control current **I** increases, so does the control pressure **P**.

Valve de-energized = no control pressure (0 mA = 0 bar)

If one of these valves fails, the corresponding hydraulic valve or actuator is not operated and the associated functions fail.

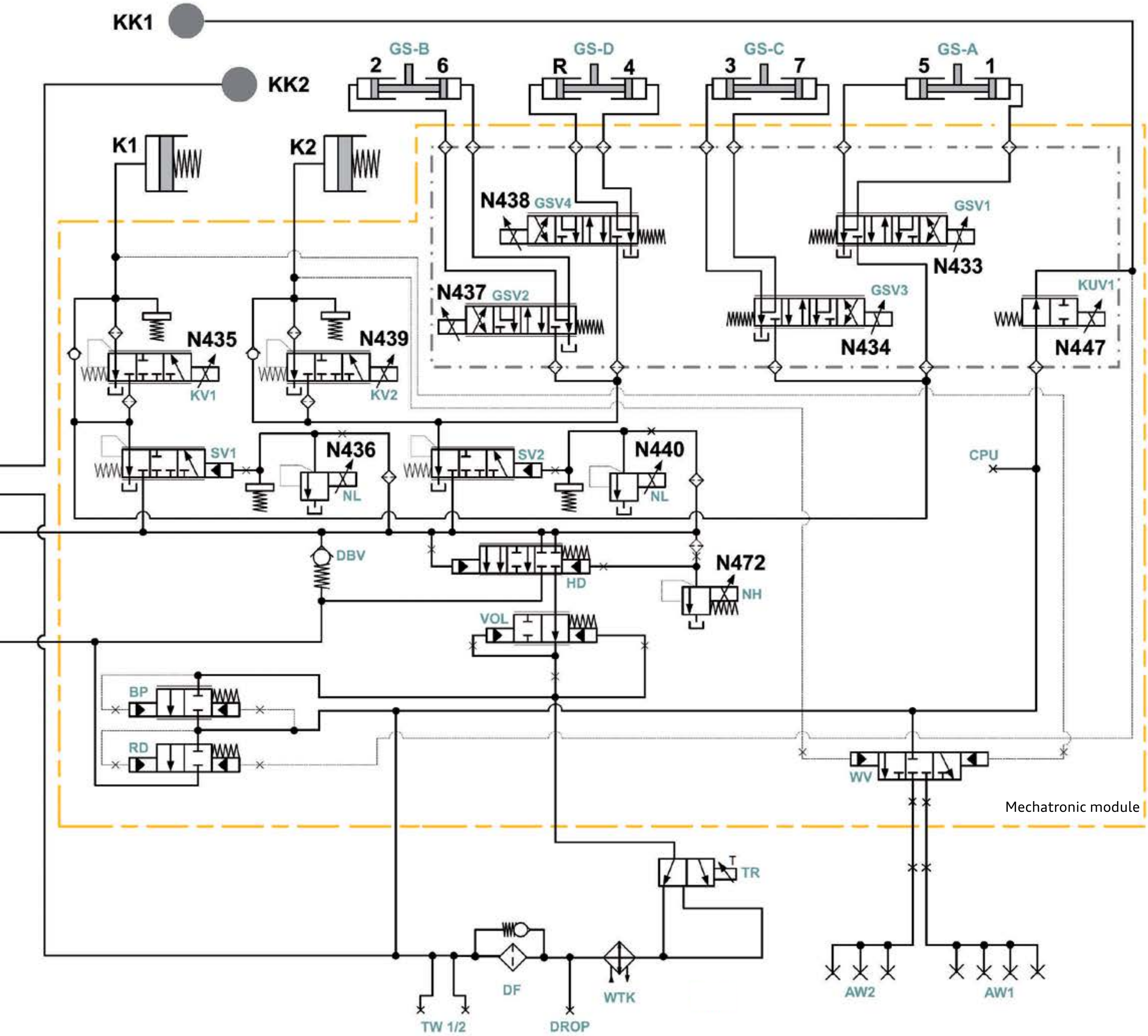
NH characteristic



NH – Normally high means that the solenoid valve has a negative characteristic. That, in turn, means that as the control current **I** increases, the control pressure **P** decreases.

Valve de-energized = maximum control pressure

If one of these valves fails, the corresponding hydraulic valve or actuator is set to its maximum level, for example, maximum cooling oil flow rate or primary pressure.



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Key:

N433 Sub-Transmission 1 Valve 1
– Gear-shift actuator valve 1 for gear-shift actuator A/gears 5/1

N434 Sub-Transmission 1 Valve 2
– Gear-shift actuator valve 3 for gear-shift actuator C/gears 3/7

N435 Sub-Transmission 1 Valve 3
– clutch valve K1

N436 Sub-Transmission 1 Valve 4
– gear train subset 1 safety valve

N437 Sub-Transmission 2 Valve 1
– Gear-shift actuator valve 2 for gear-shift actuator B/gears 2/6

N438 Sub-Transmission 2 Valve 2
– Gear-shift actuator valve 4 for gear-shift actuator D/gears R/4

N439 Sub-Transmission 2 Valve 3
– clutch valve K2

N440 Sub-Transmission 2 Valve 4
– gear train subset 2 safety valve

N447 Clutch Cooling Valve 1
– clutch K1

N448 Clutch Cooling Valve 2
– clutch K2

N472 Main Pressure Valve

N486 Parking Lock Solenoid
– holding solenoid for parking lock OFF

N573 Parking Lock Solenoid Valve
– Parking lock engagement valve/PEV

N574 Parking Lock Solenoid Valve 2
– Parking lock disengagement valve/PAV

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