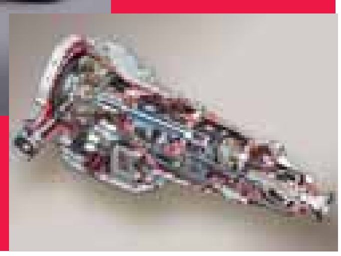
Service Training



Audi Q5 - Engines and Transmissions

Self-Study Programme 429

With the introduction of the Audi Q5, Audi is extending its model range to include a compact SUV that sets new standards in its class. In addition to the Audi Q7 and the Audi A6 allroad quattro, Audi is now introducing a third model for the off-road segment.

The Audi Q5 will be manufactured at the Ingolstadt facility. It is a logical choice of location because the Audi Q5 is based on component parts which are used on the Audi A4 ‘08.

The new Audi Q5 combines the dynamism of a sports saloon with highly variable interior and versatile options for leisure-time and family use. Strong and efficient engines, Quattro permanent all-wheel drive and agile running gear have been brought together to create a superior technology package for both on and off road driving.
Highlights such as the innovative S tronic seven-speed dual-clutch gearbox and the driving dynamics system Audi drive select are the evidence that substantiates the Q5's claim to Vorsprung durch Technik. The sportiest SUV in its class, it is dynamic, multifunctional and comfortable.

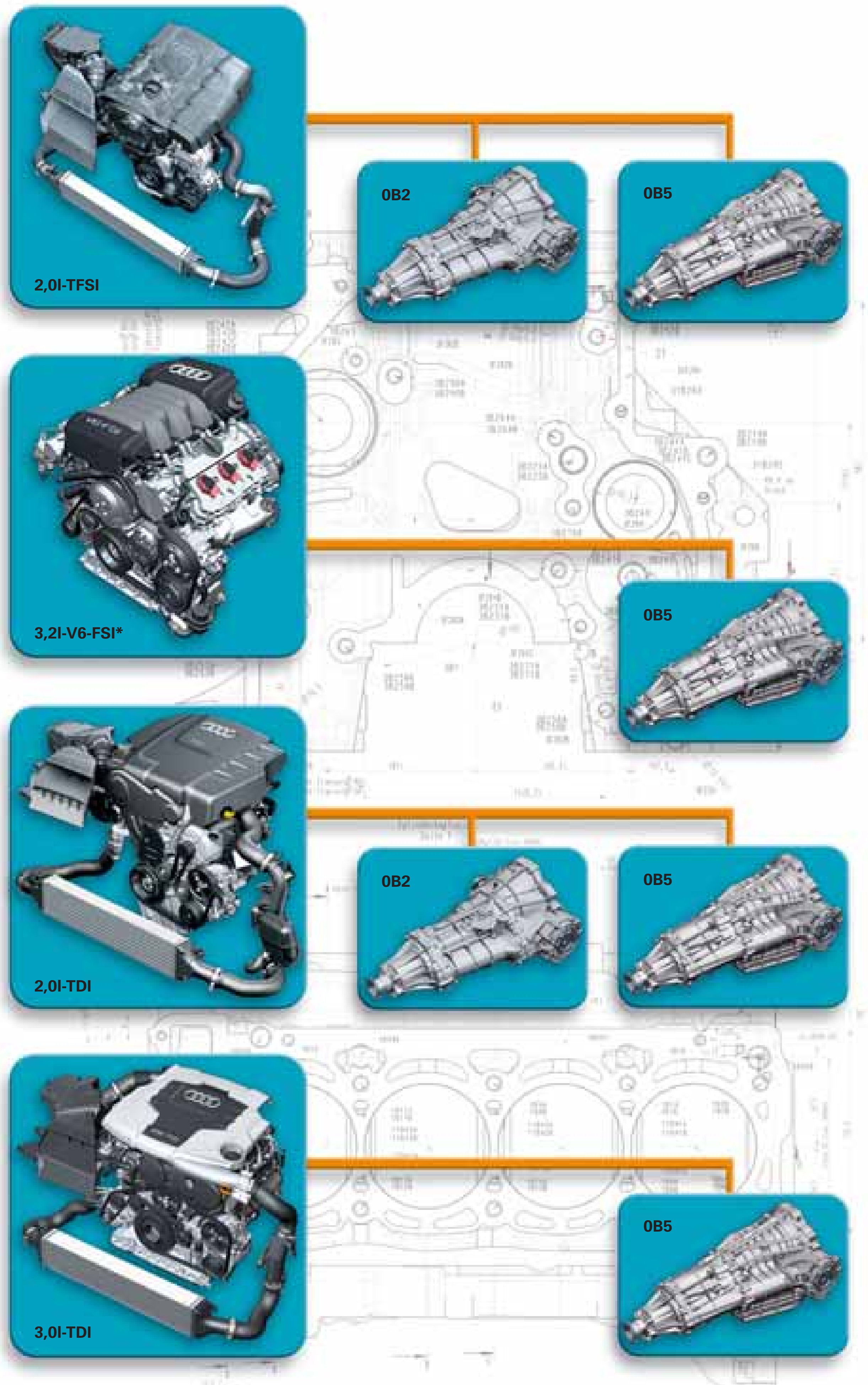
429_160

The objectives of this Self-Study Programme

This Self-Study Programme describes the design, function and new features of the engines and gearboxes used in the new Audi Q5. Once you have worked your way through this Self-Study Programme, you will be able to answer the following questions:

- Which engines and gearboxes are used?
- Which modifications have been made to the 3.0l V6 TDI engine?
- How are the fuel tanks of the Audi Q5 designed, and what are their distinguishing features?
- Which exhaust system components were adopted from the A4 ´08?
- How is the new seven-speed dual-clutch gearbox designed, and how are gearshifts performed?
- What are the points to note regarding the mechatronic system?

Engine-gearbox combinations



* Not available at market launch

429_023

Contents

Engine

Power transmission

0B2 gearbox

0B5 gearbox/S tronic

The Self-Study Programme teaches the design and function of new models, new automotive parts or new technologies.

The Self-Study Programme is not a Repair Manual. The values given are for illustration purposes only and refer to the software version valid at the time of publication of the SSP.

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

Reference

Note

2.0l turbo FSI

Technical features

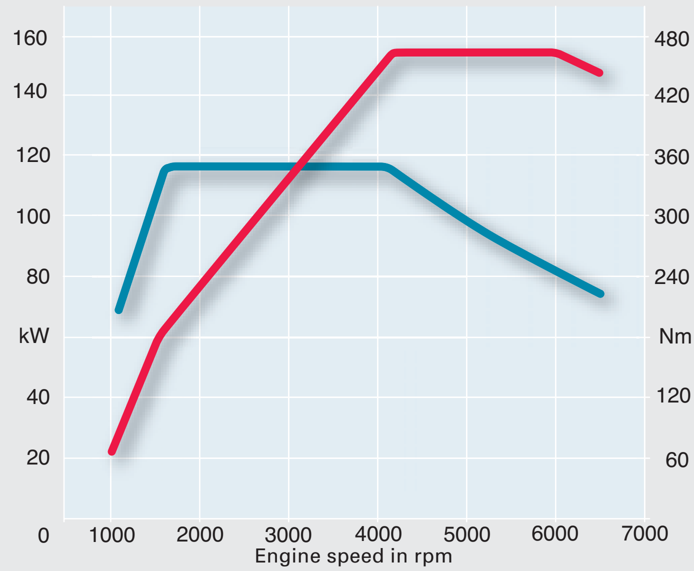
- Four-cylinder four-valve turbo engine
- Dual balancer shafts
- Volume-flow controlled oil pump
- Chain-driven timing system
- Intake manifold with tumble flaps
- Demand-controlled low and high pressure fuel system
- Homogeneous direct injection
- Audi valvelift system (AVS)

429_007

Torque/power curve

Max. torque in Nm

Max. power output in kW



Specifications

Engine code	CDNC
Engine type	Four-cylinder inline engine
Displacement in cm^3	1984
Max. power in kW (bhp)	155 (211) at 4300 – 6000 rpm
Max. torque in Nm	350 at 1500 – 4200 rpm
Valves per cylinder	4
Bore in mm	82.5
Stroke in mm	92.8
Compression ratio	9.6 : 1
Firing order	1–3–4–2
Engine management	Bosch MED 17.5
Fuel grade	95 RON
Exhaust emission standard	EU 5

3.2l V6 FSI*)

Technical features

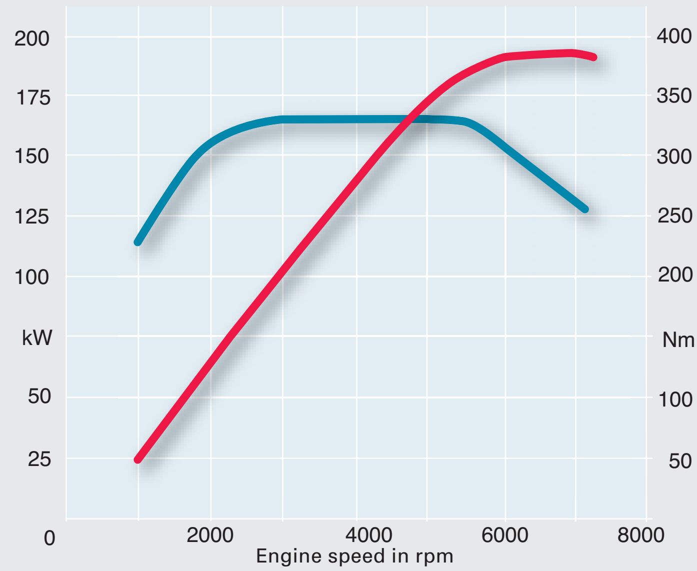
- V6 four-valve engine with 90° cylinder bank angle
- Audi valvelift system (AVS)
- Volume-flow controlled oil pump
- Chain-driven timing system with trioval chain sprockets
- Intake manifold flaps (tumble flaps) are no longer needed

429_010

Torque/power curve

Max. torque in Nm

Max. power output in kW



Specifications	
Engine code	CALB
Engine type	6-cylinder V-engine
Displacement in cm^3	3197
Max. power in kW (bhp)	199 (271) at 6500 rpm
Max. torque in Nm	330 at 3000 – 5000 rpm
Valves per cylinder	4
Bore in mm	84.5
Stroke in mm	92.8
Compression ratio	12.5 : 1
Firing order	1–4–3–6–2–5
Engine management	Simos 8.1
Fuel grade	95 RON or higher*)
Exhaust emission standard	EU 5

*) Engine not available at market launch
**) Regular unleaded petrol (RON 91) can also be used, but results in a slight reduction in performance.

2.0l TDI with common rail injection

Technical features

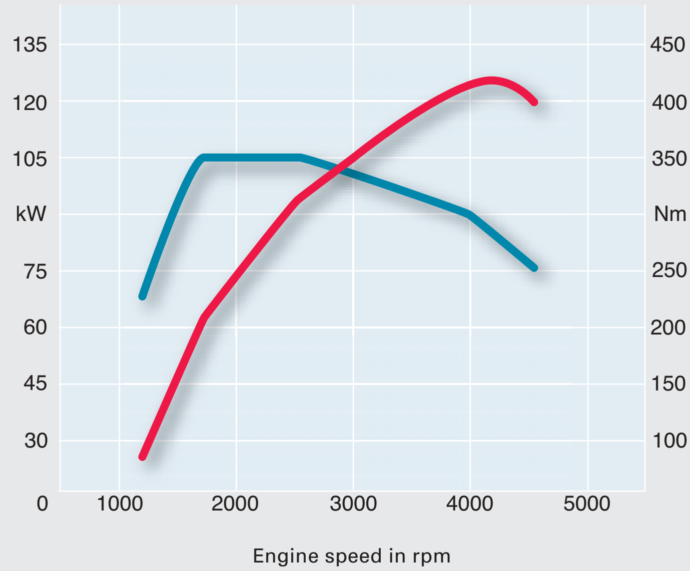
- New pistons for common rail injection system
- Toothed belt driven timing system
- Toothed belt driven high-pressure pump with a fuel pressure up to 1800 bar
- Low-temperature exhaust gas recirculation
- Diesel particulate filter with separate, integrated oxidising catalytic converter
- Dual balancer shafts

429_005

Torque/power curve

Max. torque in Nm

Max. power output in kW



Specifications	
Engine code	CAHA
Engine type	Four-cylinder inline engine
Displacement in cm^3	1968
Max. power in kW (bhp)	125 (170) at 4200 rpm
Max. torque in Nm	350 at 1750 – 2500 rpm
Valves per cylinder	4
Bore in mm	81
Stroke in mm	95,5
Compression ratio	16.5 : 1
Firing order	1–3–4–2
Engine management	Bosch EDC 17 CP
Fuel grade	Diesel to EN 590
Exhaust emission standard	EU 4

3.0l V6 TDI with common rail injection

Technical features

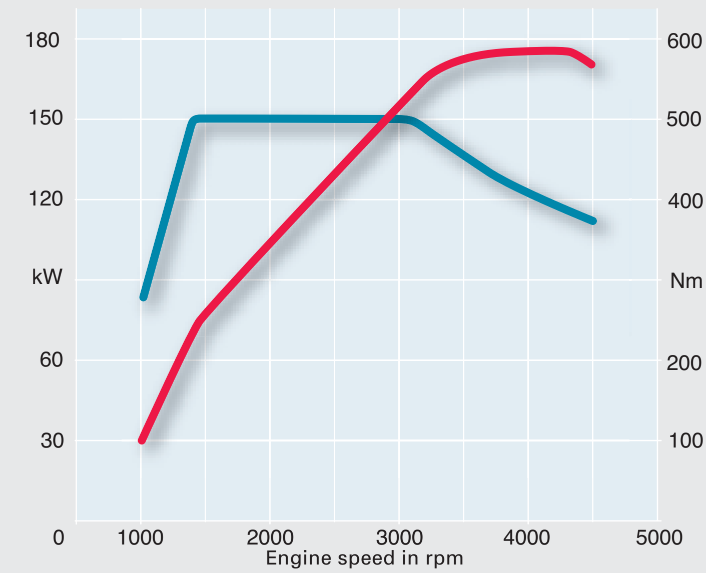
- Volume-flow controlled oil pump
- Timing system with optimised chain drive
- Horizontal charge-air cooler forward of the radiator
- Garrett VTG charger
- Optimised piezoelectric common rail injection system with injection pressures of up to 1800 bar
- Water-cooled exhaust gas recirculation system with thermostat controlled auxiliary water pump

429_006

Torque/power curve

Max. torque in Nm

Max. power output in kW



Specifications	
Engine code	CCWA
Engine type	6-cylinder V-engine
Displacement in cm^3	2967
Max. power in kW (bhp)	176 (238) at 4000 – 4400 rpm
Max. torque in Nm	500 at 1500 – 3000 rpm
Valves per cylinder	4
Bore in mm	83
Stroke in mm	91.4
Compression ratio	16.8 : 1
Firing order	1–4–3–6–2–5
Engine management	Bosch EDC 17 CP
Fuel grade	Diesel to EN 590
Exhaust emission standard	EU 4

The volume-flow controlled oil pump of the 3.0l V6 TDI engine

A volume-flow controlled oil pump reduces the power input required to drive the oil pump.

A rotary vane pump with a variable delivery characteristic, adjustable by means of a rotatably mounted adjusting ring, is used on the new 3.0l V6 TDI engine.
This adjusting ring can be subjected to oil pressure across control faces 1 + 2 and rotated against the force of the control spring.
At low engine speeds the engine control unit applies ground potential to the live (term. 15) solenoid valve N428, which opens the oilway to the second control face of the adjusting ring.

Both oil flows now act upon both control faces, while applying the same pressure.
The resulting forces are greater than those exerted by the control springs, and they rotate the adjusting ring in an anticlockwise direction.
The adjusting ring rotates towards the centre of the rotary vane pump and reduces the fuel delivery space between the vanes.
The lower pressure level is activated according to engine load, engine speed, oil temperature and other operating parameters, thus reducing the amount of input power required to drive the oil pump.

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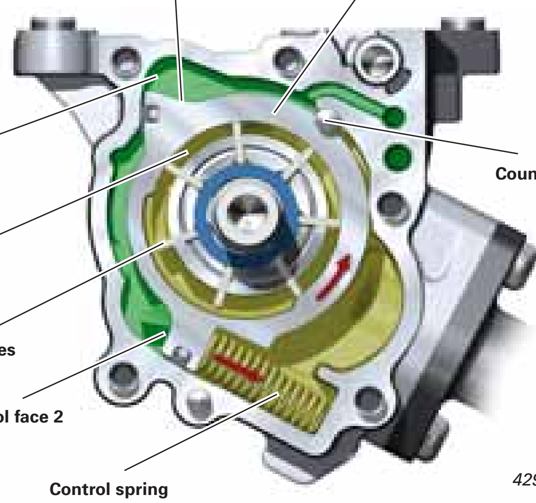
Low fuel feed rate



429_065

High fuel feed rate

At engine speeds of 2500 rpm or higher or 300 Nm of torque or higher (full-throttle acceleration), the engine control unit J623 disconnects the solenoid valve N428 from the ground potential, thereby closing the oilway to control face 2.
The applied oil pressure then acts on control face 1 only and counteracts the force of the control spring.

The control spring rotates the adjusting ring clockwise about the counter-bearing. The adjusting ring now rotates away from the centre position, enlarging the fuel delivery space between the individual vanes.

Enlarging the spaces between the vanes enables a higher oil delivery rate to be achieved. The higher oil flow rate through the oil orifices and the crankshaft bearing backlash are counteracted by a resistance force, which increases the oil pressure.
The result is a volume-flow controlled oil pump with dual pressure stages.

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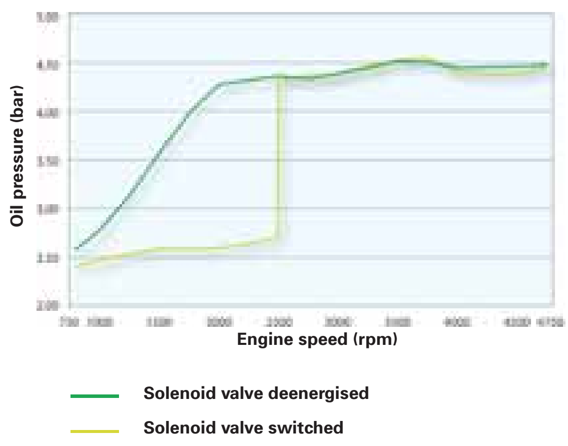

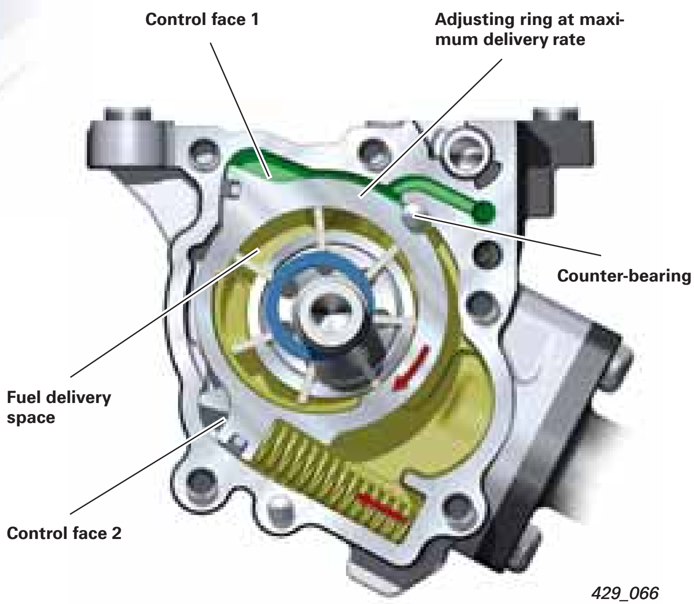

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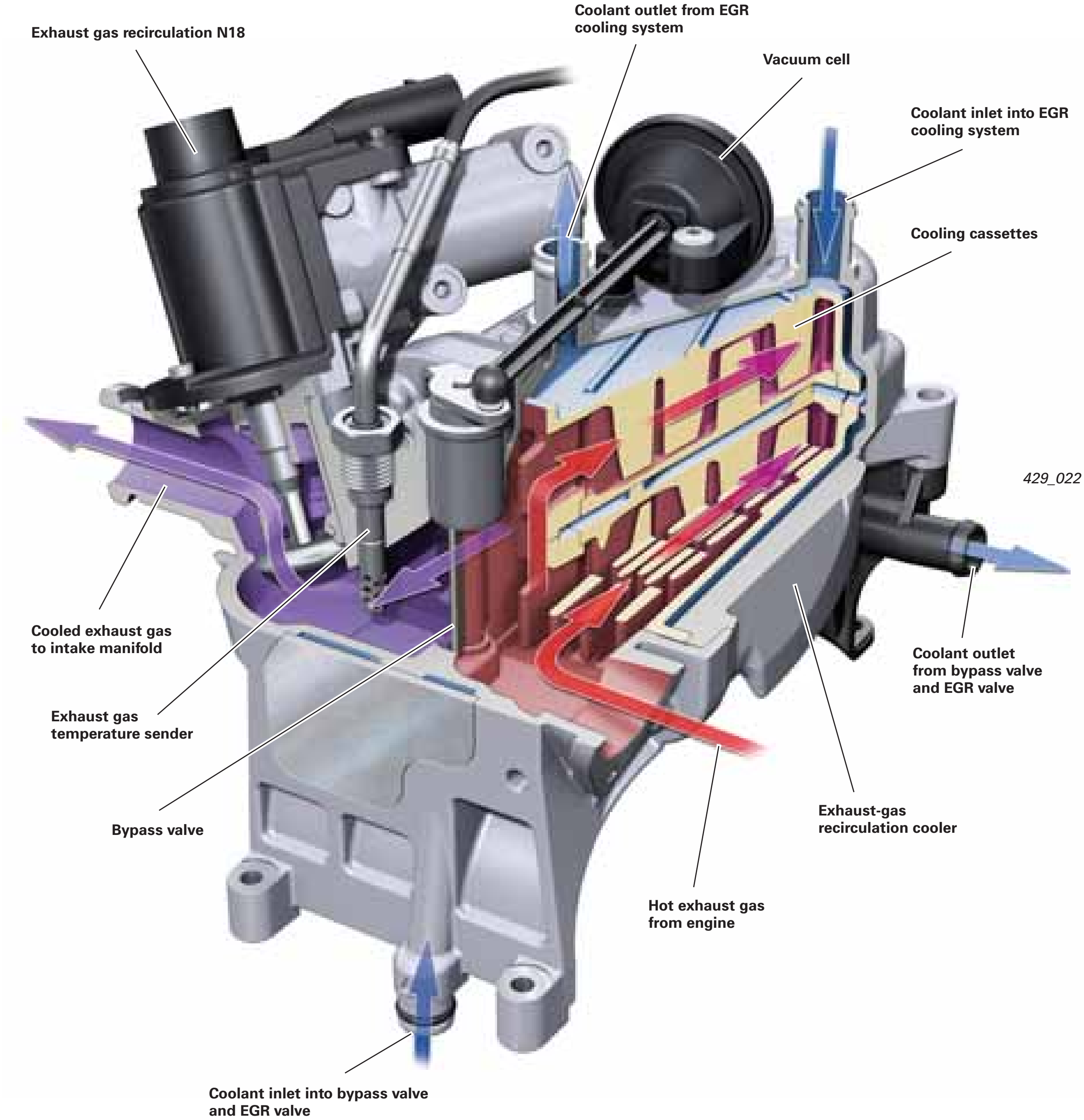
Exhaust gas recirculation within the 3.0l V6 TDI engine

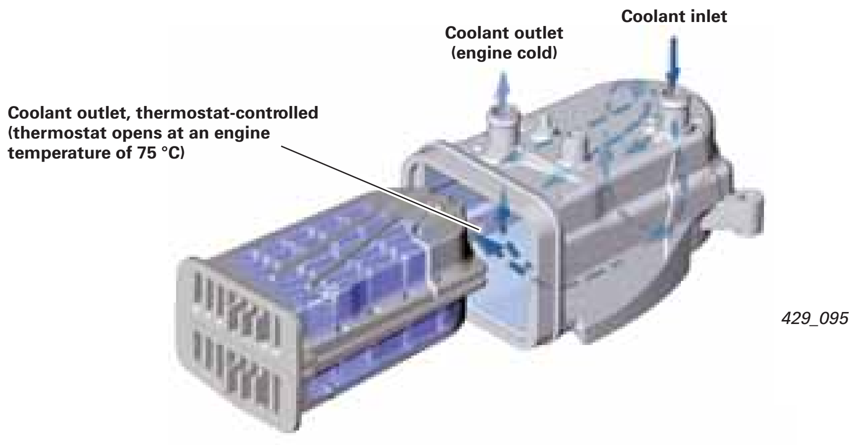
The new V6 TDI engine uses a new exhaust gas recirculation module (EGR module) which combines, as a unit, the EGR cooler, EGR valve and EGR bypass functions, including a drive module.

A separate bypass and EGR valve cooling duct is integrated in the housing on the valve side.
The electric EGR valve, the bypass valve and the bypass valve actuator, the coolant thermostat and the cooler mount are all installed in the housing.



Heat is exchanged between the exhaust gas and coolant on the module's inner cooling cassettes, which are immersed in circulating coolant.
Inside the EGR cooler there are two cooling cassettes, which are subdivided into an upper part and a lower part.
The cooling cassettes have cooling fins arranged in such a way as to direct the exhaust gas flow through the EGR cooler.
The cooling fins form a large surface which absorbs the heat of the exhaust gases and transfers it to the surface of the cooling cassettes.

To optimise the flow of coolant and to achieve a high cooling capacity, coolant flows through the cooling cassettes on three levels and is channelled across guide bars to the coolant outlet.
A second coolant outlet on the EGR cooler is opened or closed by a coolant thermostat.
The coolant thermostat for exhaust gas recirculation opens at a temperature of 75 °C.
For further information, please refer to SSP 409 Audi A4 ‘08 on page 21.



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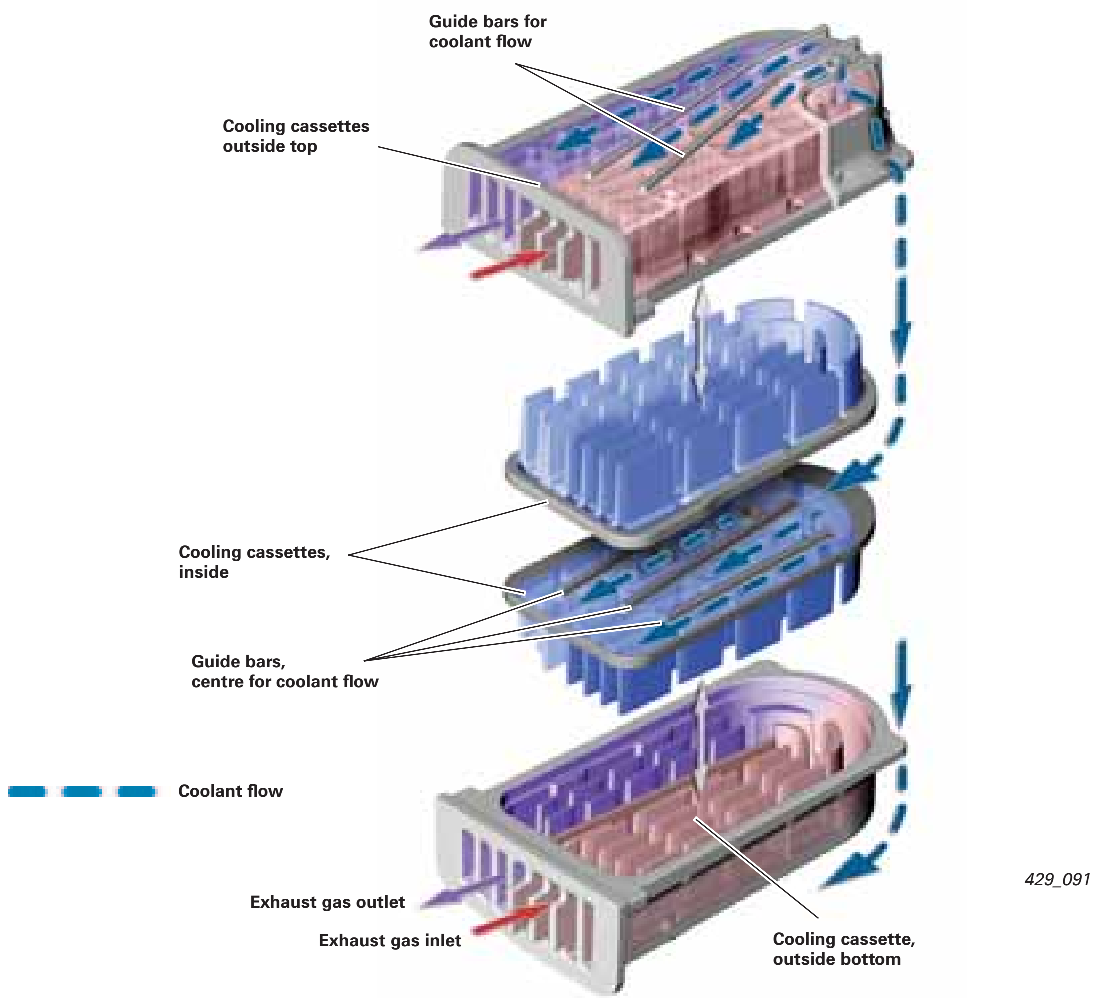

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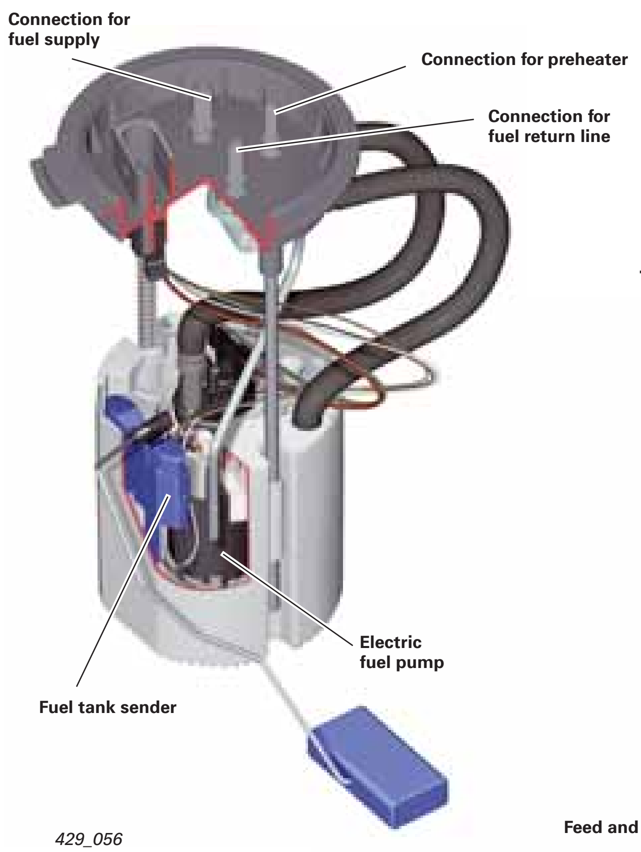
Fuel tank and flow

Despite the space taken up by the quattro powertrain, the Audi Q5 has a 75-litre single-chamber fuel tank like the Audi A4 '08.
A single-chamber fuel tank has the following advantages:

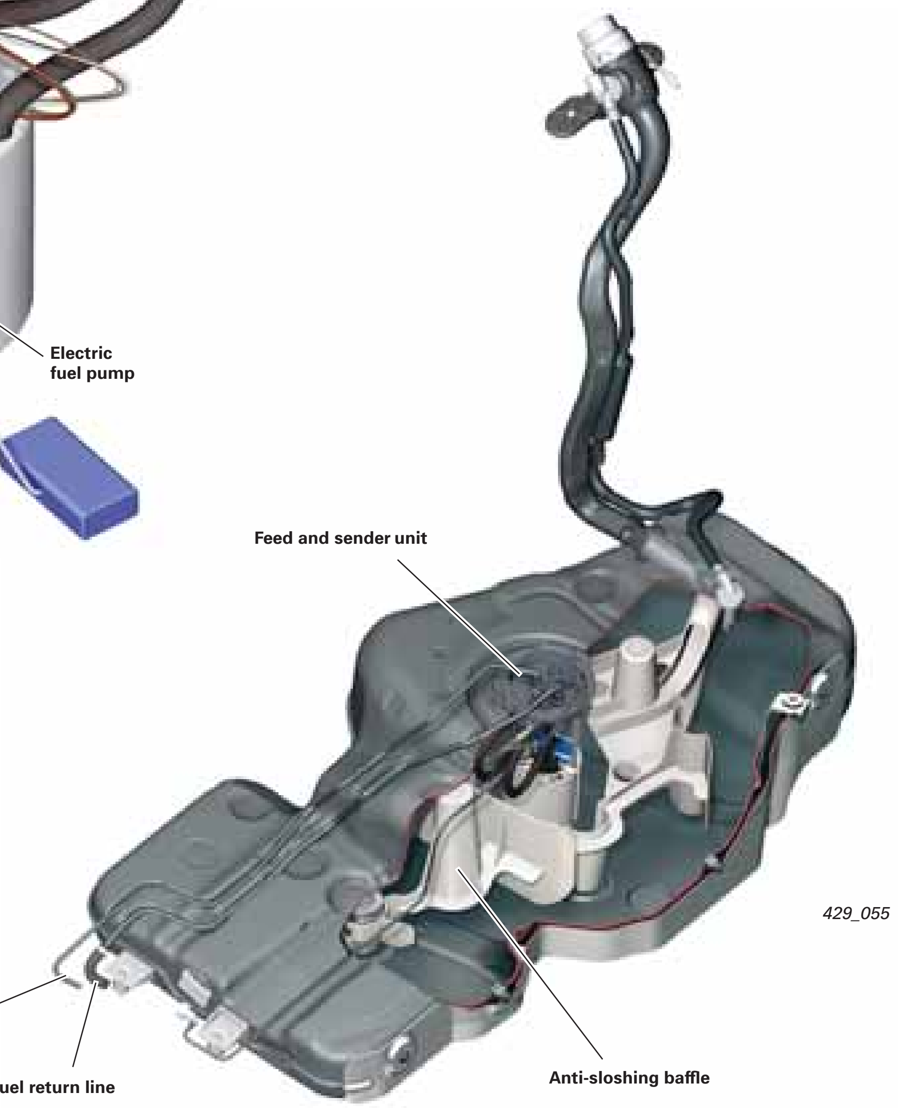
– Easy fuel extraction
– Fuel level indication by a single sender only

In all versions of the Audi Q5 an anti-sloshing baffle in used to suppress fuel sloshing inside the tank. This baffle is installed during the production process and welded to the top and bottom halves of the fuel tank. In addition to reducing sloshing, the baffle reinforces the tank chamber.

Fuel delivery unit for TDI engine without integrated fuel filter



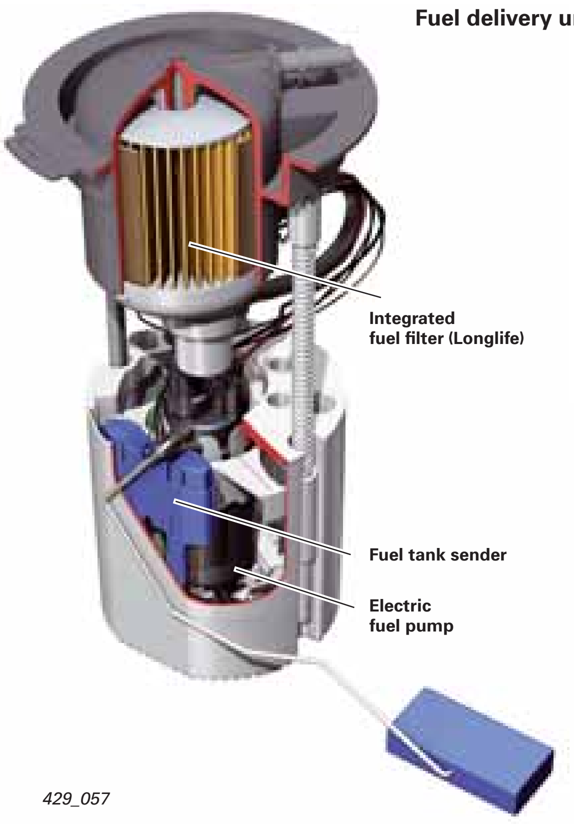
TDI fuel tank



The vapours produced by petroleum fuels are channelled through two valves into the activated charcoal filter (ACF). Use is made of rollover valves with a floating-ball pressure retention function which, in the event of a vehicle rollover incident, seals the tank outlet and thereby prevents fuel leakage.

Both valves vent into an expansion tank located on the top of the fuel tank.
A labyrinth prevents ingress of liquid fuel into the ACF. The fuel is drawn from the expansion tank and into the fuel tank by a partial vacuum produced by cooling of the fuel. As in all FSI engines, a demand-controlled fuel pump is also used in the Audi Q5.

Fuel delivery unit for FSI engine



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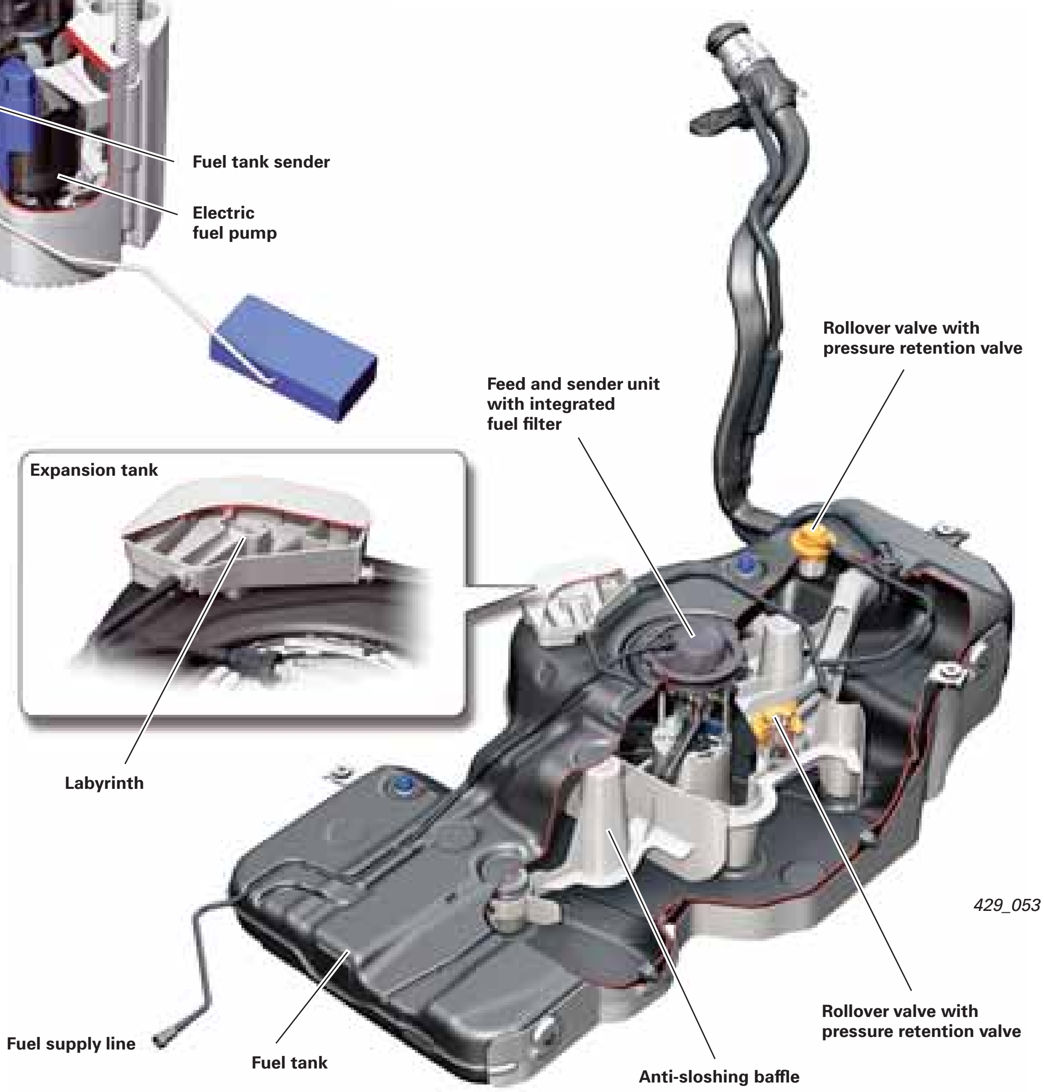
FSI fuel tank



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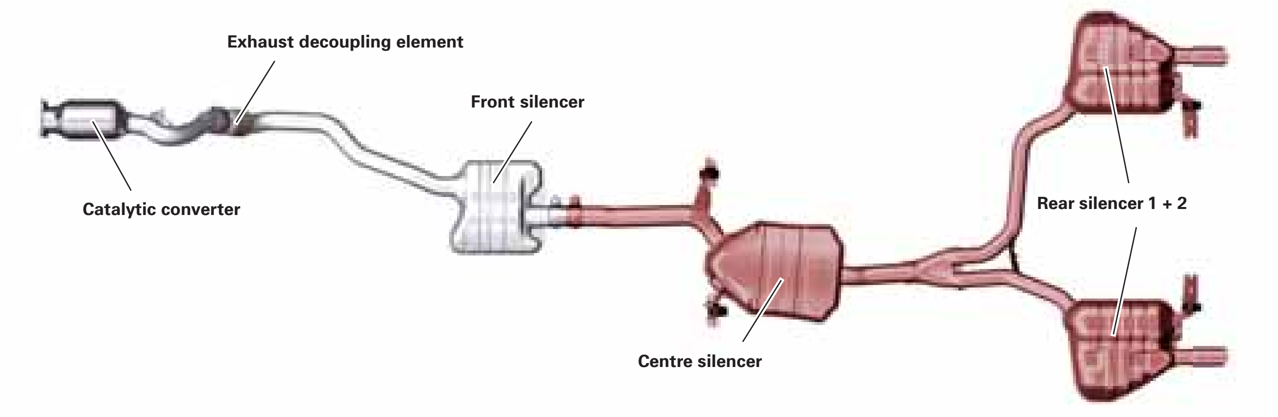
Exhaust system

The exhaust system of the Audi Q5 was designed with a special emphasis on meeting the low exhaust emission limits, in addition to minimising exhaust gas backpressure.

The exhaust note is sporty but not obtrusive, which is in keeping with the car's character.
A number of components - such as the catalytic converters or diesel particulate filters, headpipes and front silencers - were adopted from the Audi A4 ‘08 and Audi A5.

2,0l-TFSI



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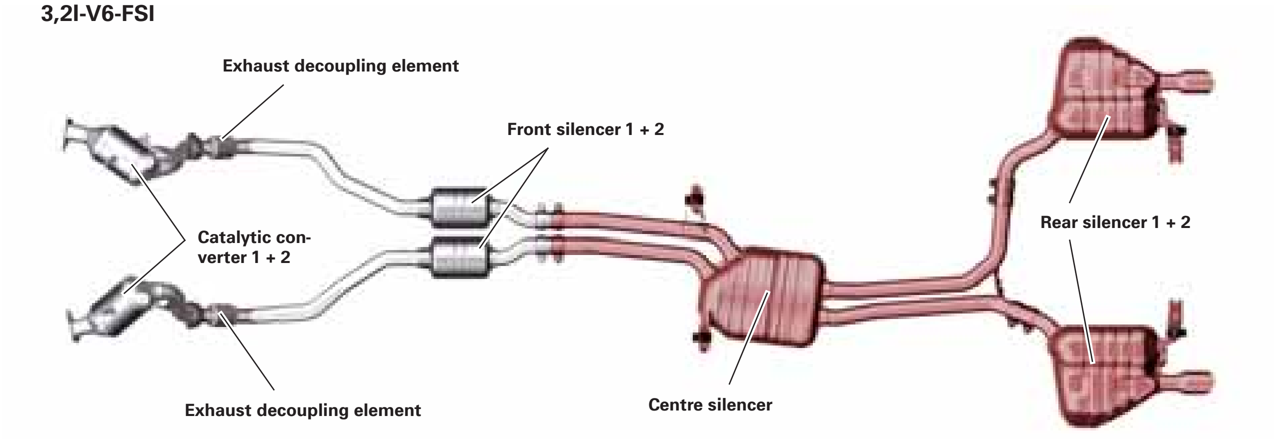
3,2l-V6-FSI



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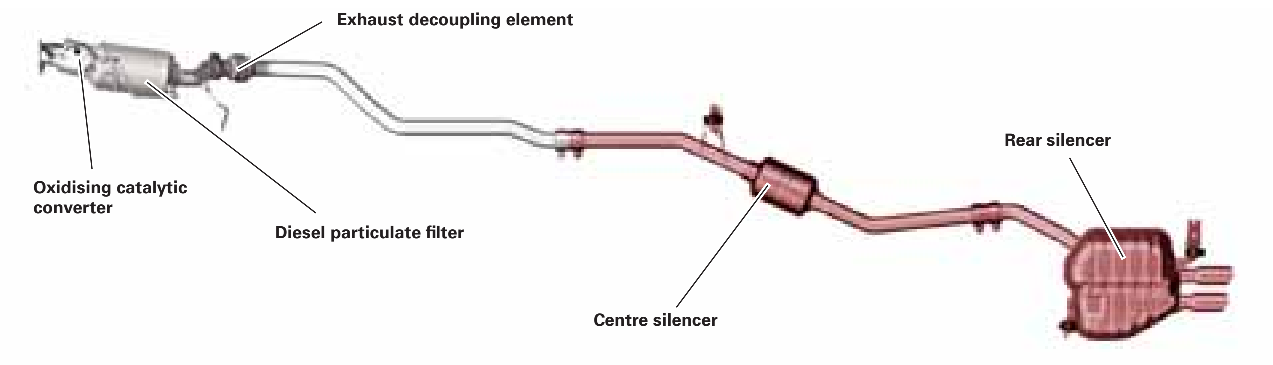
Component parts of the Audi A4 ‘08 and the Audi A5

Audi Q5 specific features

The following is an overview of the exhaust systems for all engines in the Audi Q5.
The exhaust gas aftertreatment systems are positioned close to the engine to allow quick activation of the catalysts.
They are designed to meet future exhaust emission standards.

The catalytic converters are manufactured using a single-stage design and a thin wall ceramic substrate.
All exhaust systems are fitted with exhaust decoupling elements which reduce mechanical stress and vibrational excitation in the exhaust system, thereby enhancing acoustics inside the car.

2,0l-TDI



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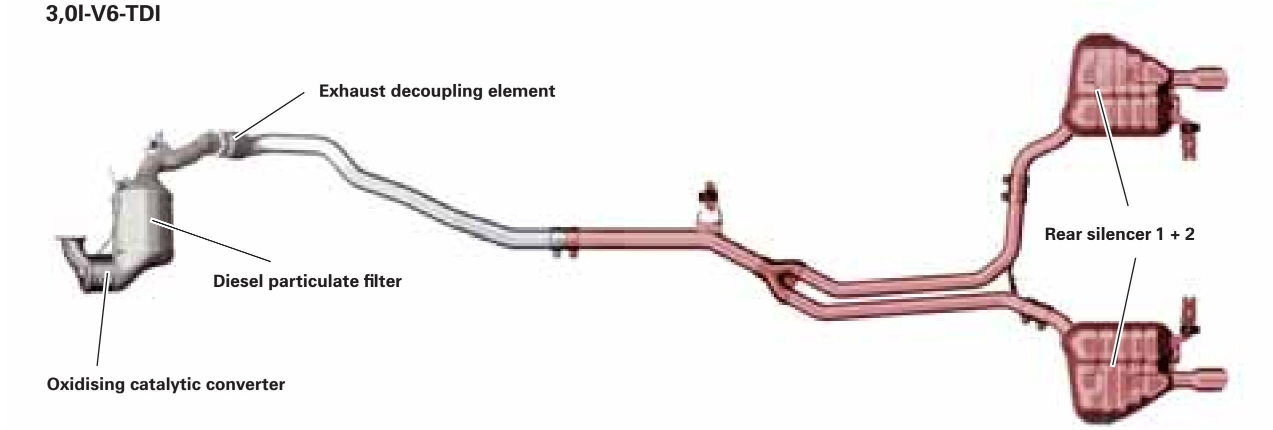
3,0l-V6-TDI



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Component parts of the Audi A4 '08 and the Audi A5

Audi Q5 specific features

Drive concept – powertrain – power transmission

The powertrain of the Audi Q5 derives from the current B8 series. The main feature of this powertrain is the rearward shifted engine/gearbox assembly.

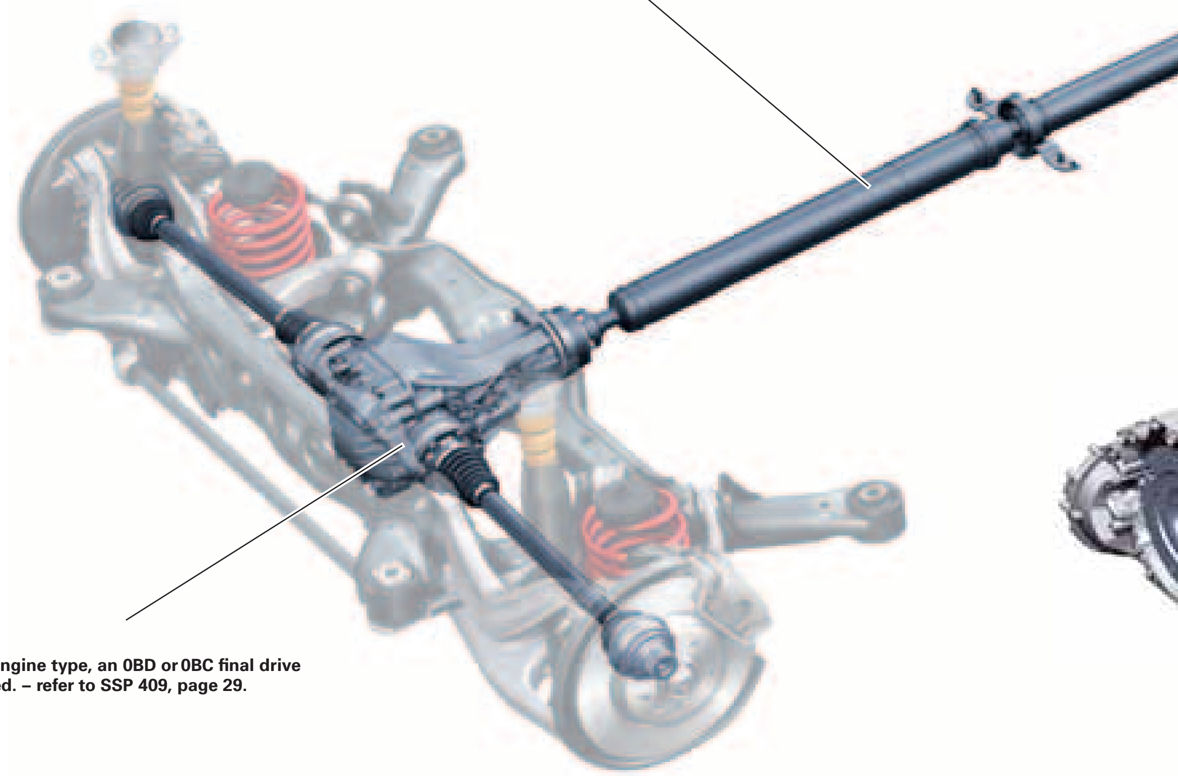
This, in combination with the new-generation quattro powertrain, provides a maximum in driving dynamics. The Audi Q5 will be available with quattro drive only.

There is no doubt, the new S tronic seven-speed dual-clutch gearbox is one of the highlights. With this technology, the Audi Q5 achieves an unprecedented combination of sportiness and efficiency.

Special features and new features at a glance

quattro powertrain with self-locking centre differential and asymmetric/dynamic torque split in all engine-gearbox versions. – refer to page 22.

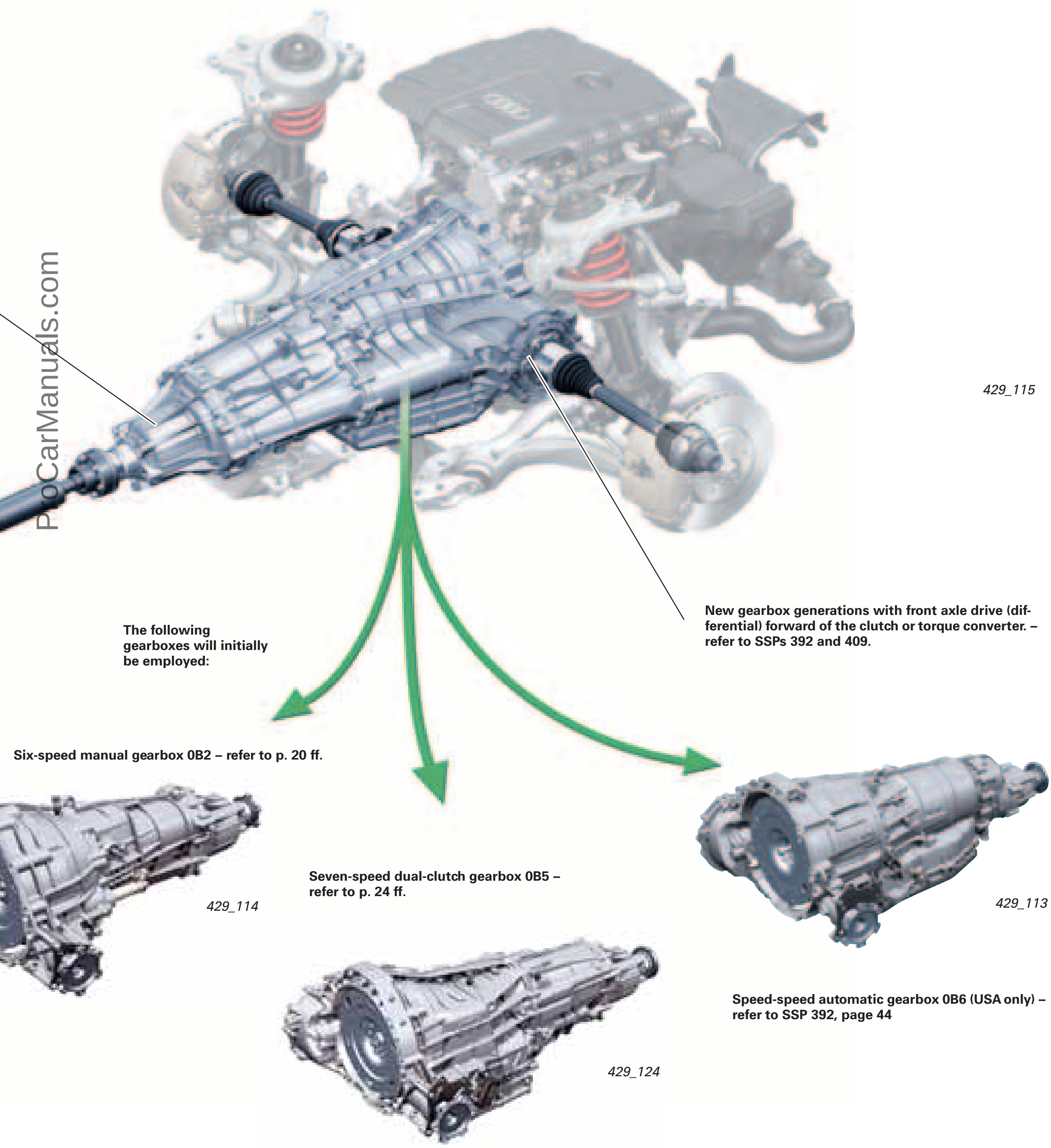
Prop shaft with special sealing and assembly concept. – refer to SSP 409, p. 30 ff.



Depending on engine type, an 0BD or 0BC final drive assembly is used. – refer to SSP 409, page 29.

Reference

The drive concept of the Audi Q5 largely corresponds to that of the B8 series (Audi A4 ‘08/Audi A5).
Extensive information on this concept has previously been published in SSPs 392 and 409.
Other special features of the power transmission system in the Audi A5 were presented in the Audi iTV broadcast of 04.07.2007.
This information is also applicable to the Audi Q5 as basic knowledge.



Six-speed manual gearbox 0B2

The 0B2 gearbox is already used in the B8 series. It is an Audi development and will be produced at the VW plant in Kassel.
With a torque capacity of approximately 350 Nm, the gearbox can be combined with both the 2.0l TFSI engine and the 2.0l TDI engine.

The strengths of the 0B2 gearbox:

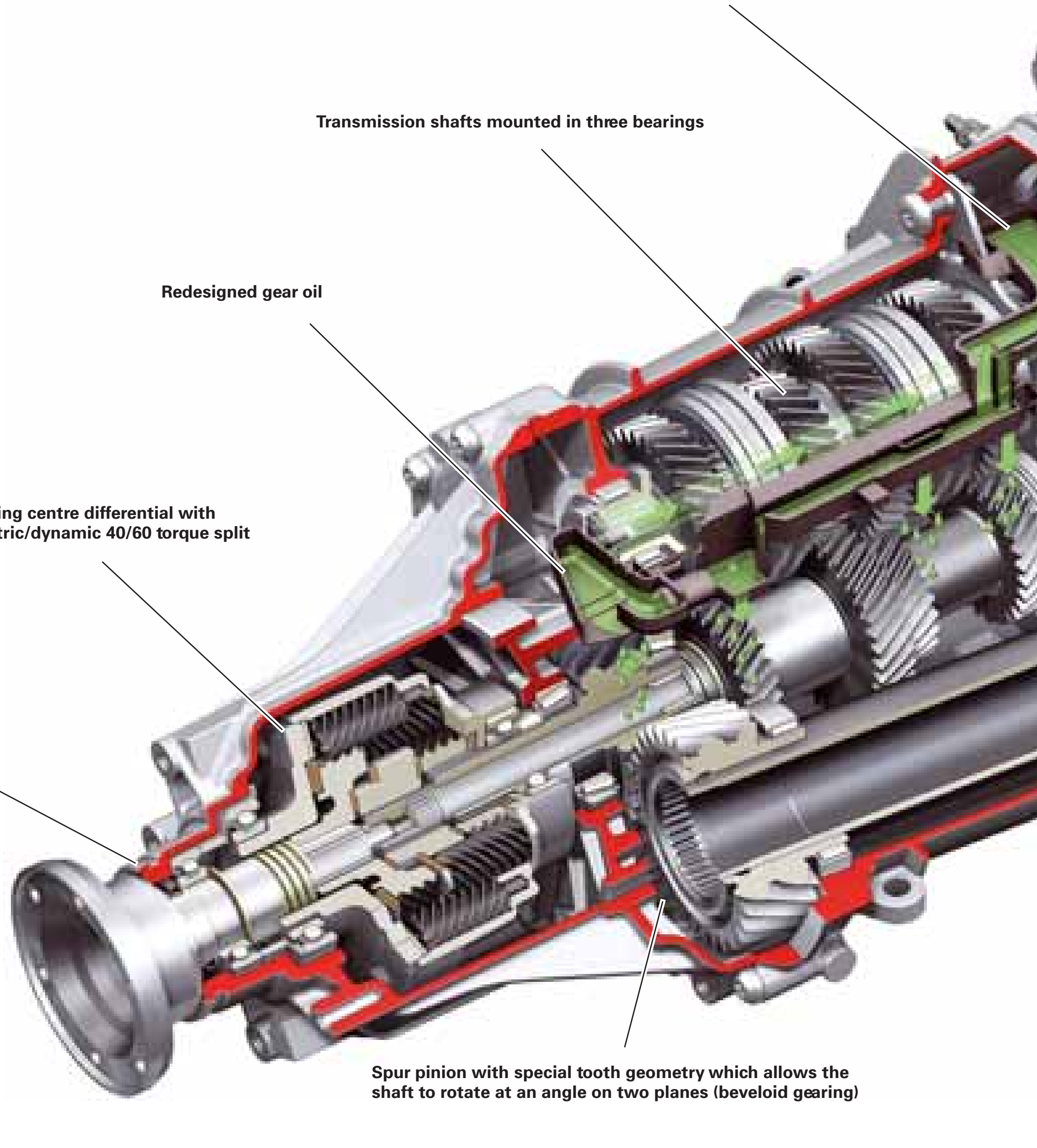
– High power density and efficiency

– Sporty, short-throw shifting action

– Low shift forces for high shift comfort

429_114

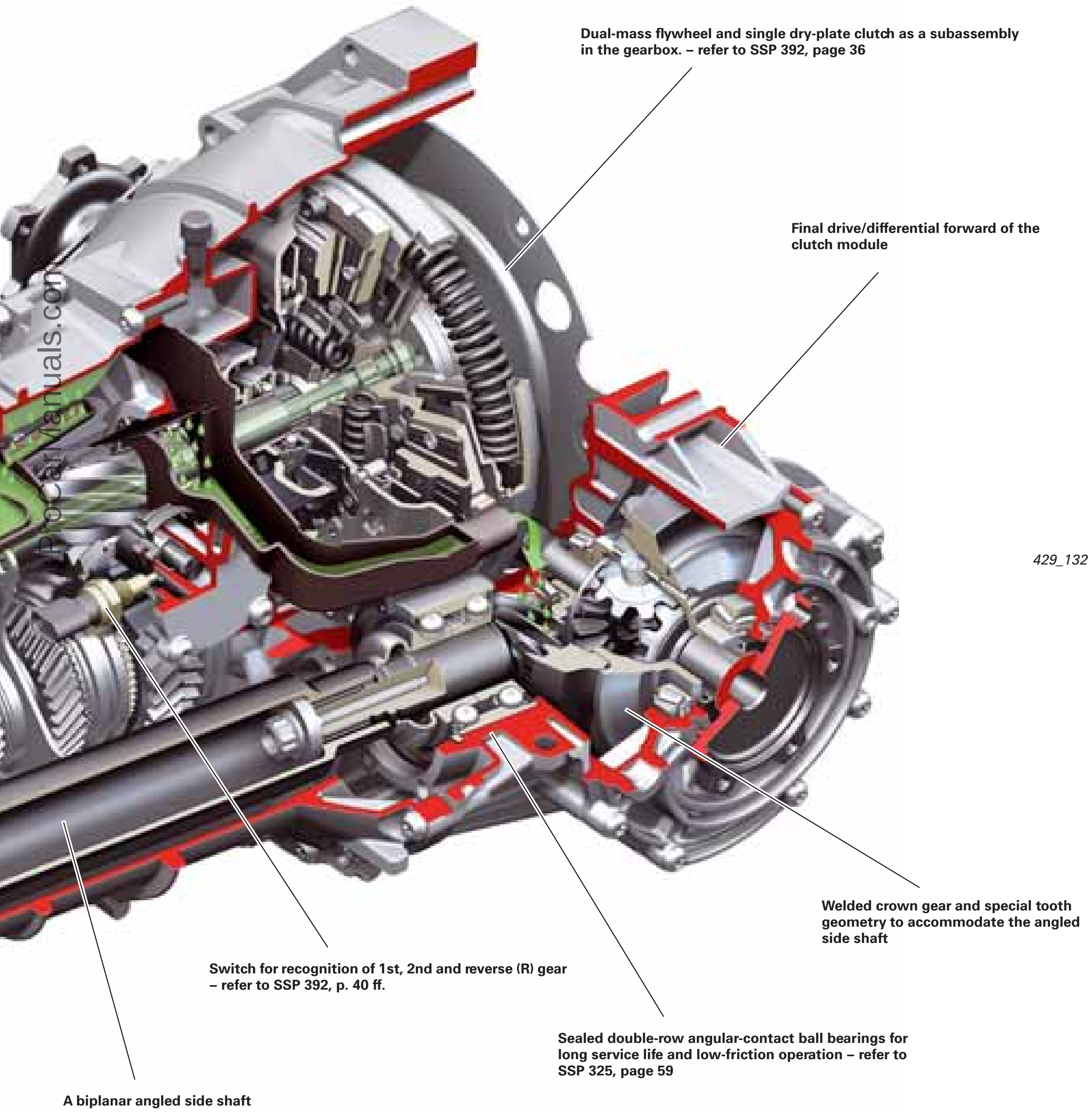
The special features of the 0B2 gearbox at a glance



Specifications, refer to SSP 392, page 35

Note

Due to the design of the gearbox and clutch module, several special points must be observed when removing and installing the gearbox and when handling the clutch module. Refer to Workshop Manual.



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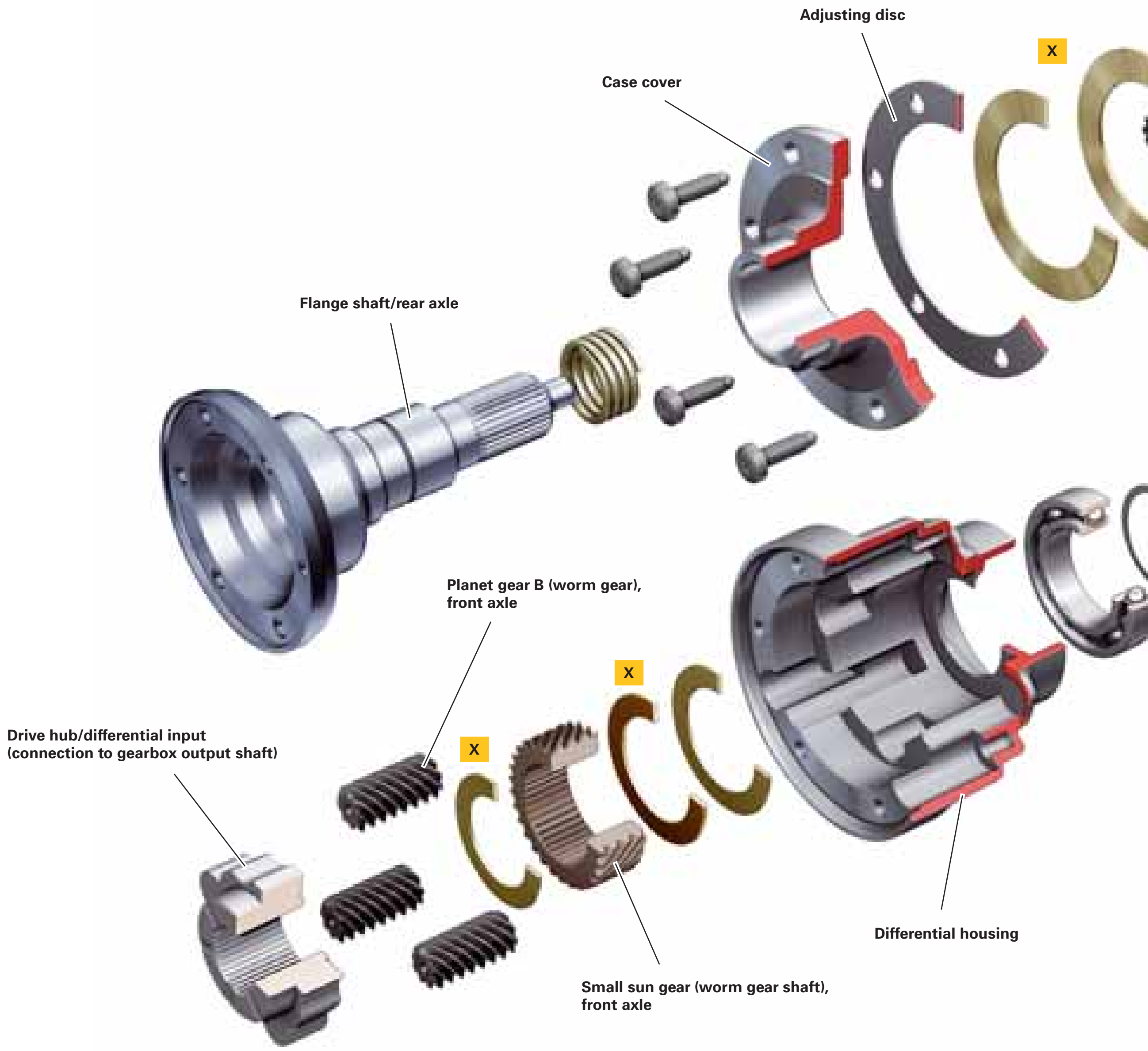
Self-locking centre differential with asymmetric/dynamic torque split

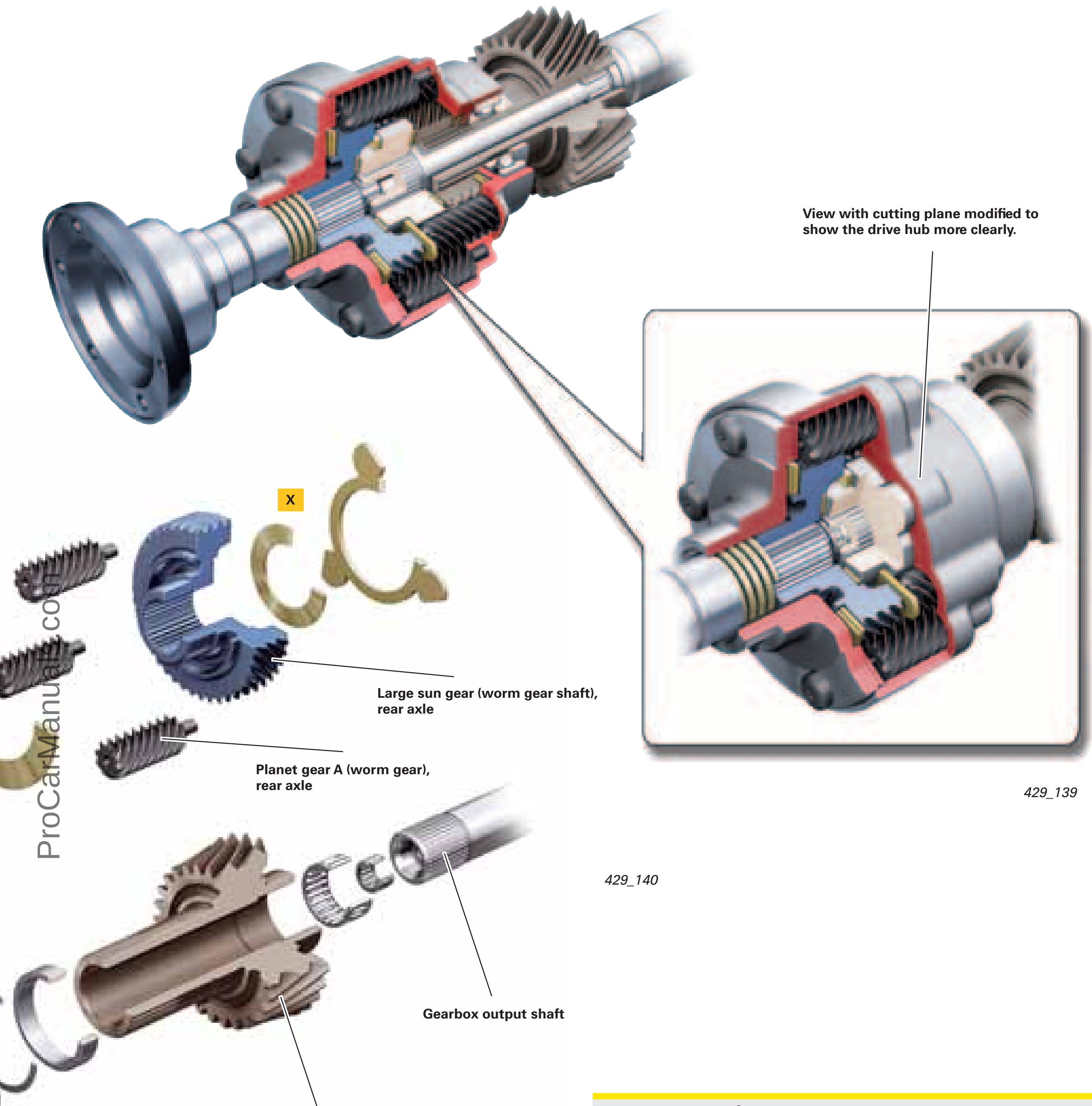
A new version of the self-locking centre differential with asymmetric/dynamic torque split is used in the 0B2 gearbox.

The basic torque split is approx. 40 % to the front axle and approx. 60 % to the rear axle.

A locking torque proportional to the drive torque is produced within the centre differential.
This locking torque and the basic torque split result in the torque which is transmitted to the axle. Thus, depending on the driving situation, up to approx. 65 % of drive torque can be transmitted to the front axle or approx. 85 % to the rear axle without the need for ESP intervention.

The design of the new self-locking centre differential derives from the PAT* centre differential used in the 01V and 01L gearboxes (50 : 50 torque split). The main components are the two sun gears, the mating planet gears and the differential housing complete with drive hub.
The planet gears (worm gears) are aligned in parallel with the sun gears (worm gear shafts).
The asymmetric torque split results from the different diameters of the sun gears for the front and rear axles (ratio approx. 40 : 60).
A description of how the asymmetric/dynamic torque split works can be found in SSP 363, page 18 ff.
This type of centre differential is also used in the new seven-speed dual-clutch gearbox 0B5.





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429_140

Reference

The original design of the self-locking centre differential with asymmetric/dynamic torque split is described in SSP 363. This type of differential (planetary construction) is already used in the 0B4 and 0B6 gearboxes on the Audi Q7 and Audi S4/Audi S6.

X = **friction discs**

* PAT stands for "Parallel Axis Torsen" and describes the design of a self-locking centre differential, where the axis of rotation of the worm gears is parallel to the axis of rotation of the sun gears.

Seven-speed dual-clutch gearbox 0B5/S tronic

Following the great success of the six-speed S tronic on the Audi A3 and Audi TT models, a seven-speed dual-clutch gearbox, combined with the quattro powertrain, is now used for the first time, in a longitudinal configuration, on the Audi Q5.

In combining the plus-points of the automatic gearbox (ride comfort and gear shifting without any interruption in tractive power) and the manual gearbox (sportiness and efficiency) in combination with extremely short shift times and "direct power transmission", the dual-clutch gearbox 0B5 provides a special driving experience.

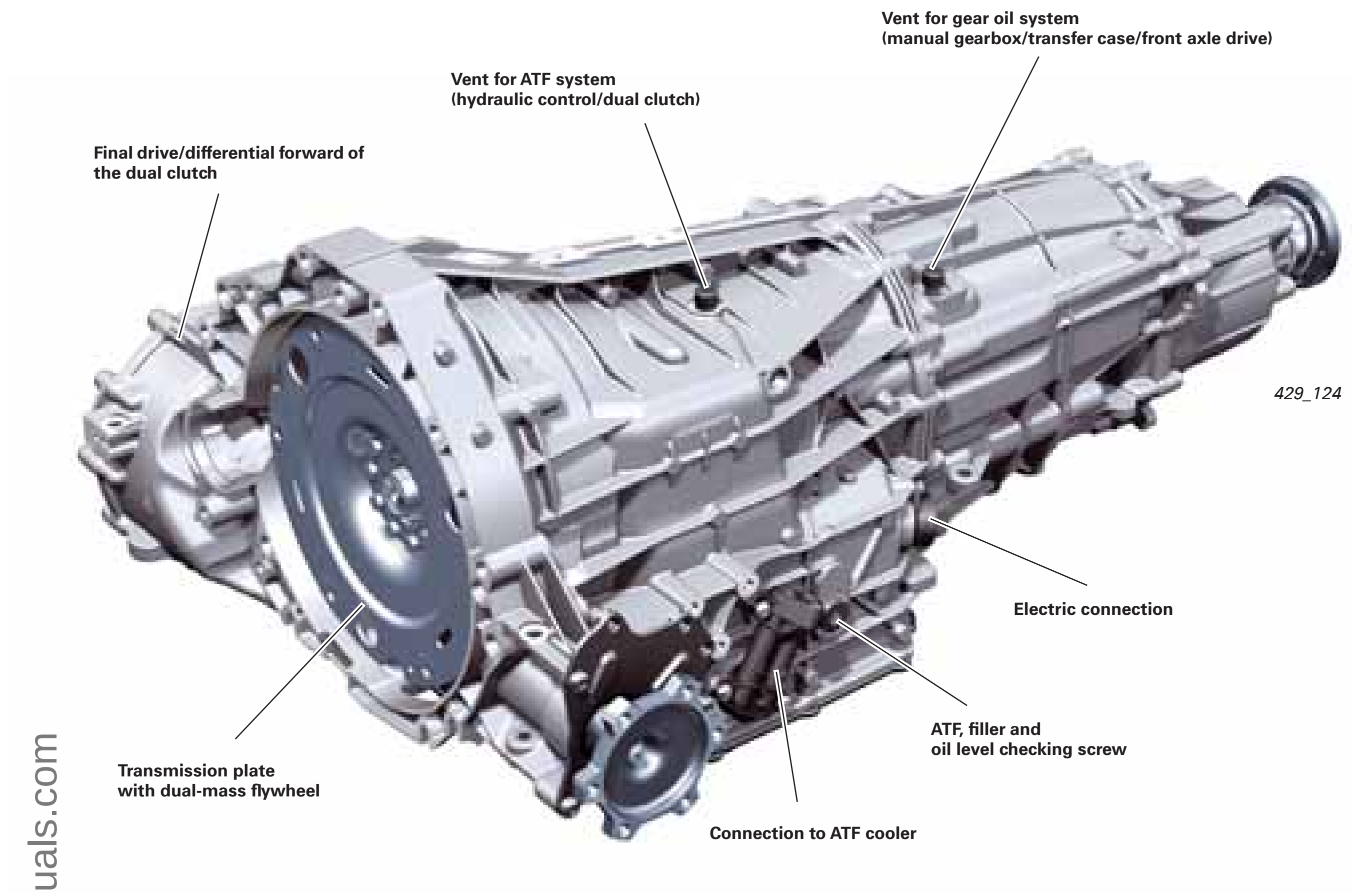
Specifications of the 0B5 gearbox

Designations	Manufacturer: DL501-7Q Service: 0B5 Distribution: S tronic
Development **Production**	Audi AG Ingolstadt VW plant, Kassel
Gearbox type	Seven-speed dual-clutch gearbox; full synchromesh, seven-speed change-speed gearbox, electro-hydraulically controlled
Dual clutch	dual oil-cooled multi-plate clutches, electro-hydraulically controlled
Control	Mechatronic system – integrating the hydraulic control unit, the electronic control unit and some of the sensors and actuators; sport program and "tiptronic" shift program for manual gear shifting (optionally available with steering wheel tiptronic controls)
Ratio spread	up to 8.1 : 1*
Shaft spacing	89 mm
Torque capacity	up to 550 Nm at 9000 rpm
Weight	approx. 142 kg (incl. dual-mass flywheel and oil filling)

* The 7th gear is configured as an overdrive (6 + E). Top speed is in 6th gear.
At present, the petrol engines have a ratio spread of approx. 6 : 1 and the diesel engines approx. 8 : 1.

Reference

The 0B5 is designed around a basic concept largely similar to that of the 02E and 0AM gearboxes. These gearboxes are described in SSPs 386 and 390.
Much of this information is also applicable to the 0B5 gearbox as basic knowledge.
The design and function of the new seven-speed dual-clutch gearbox 0B5 will, at a later date, be described in greater detail in a separate Self-Study Programme.



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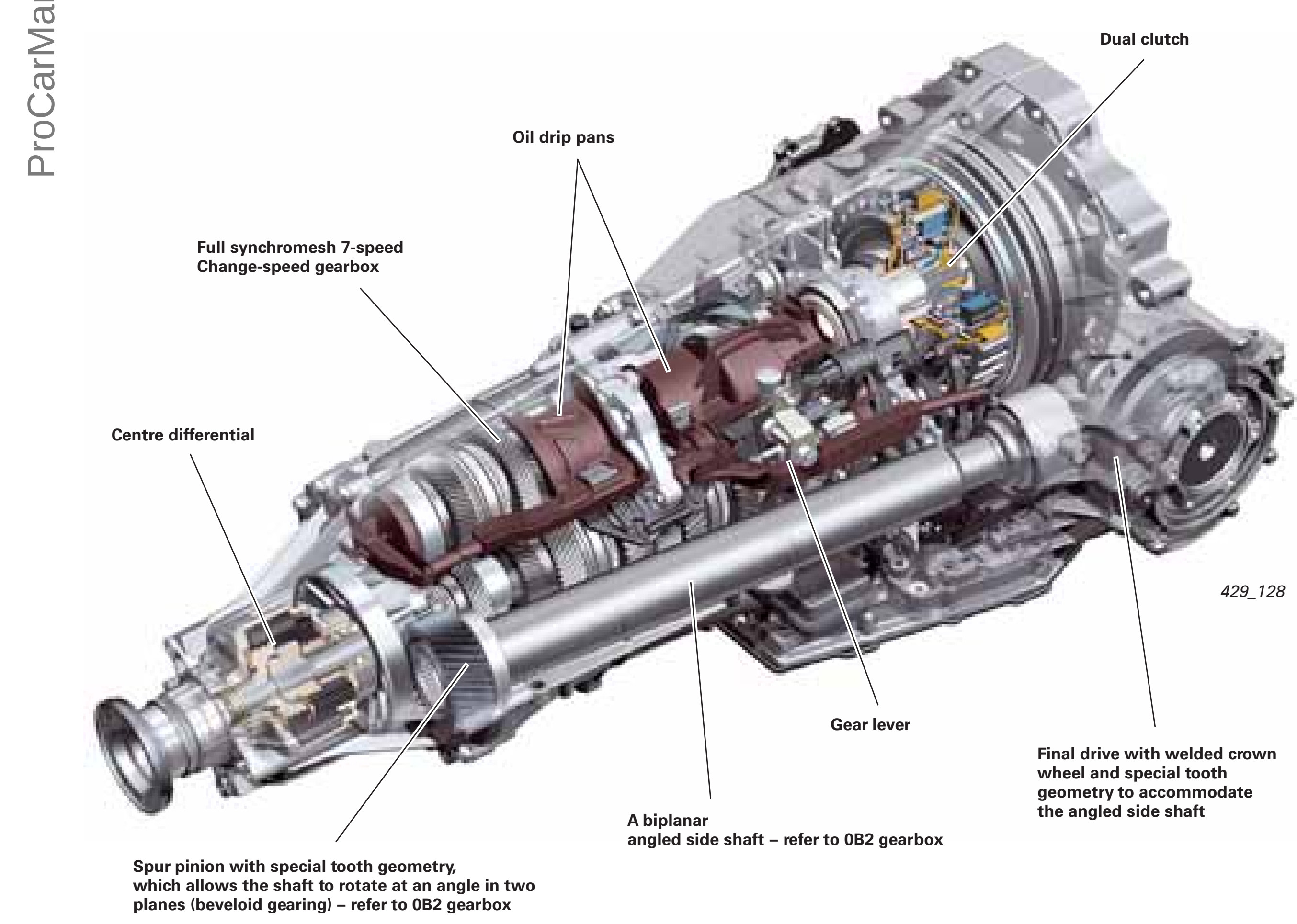

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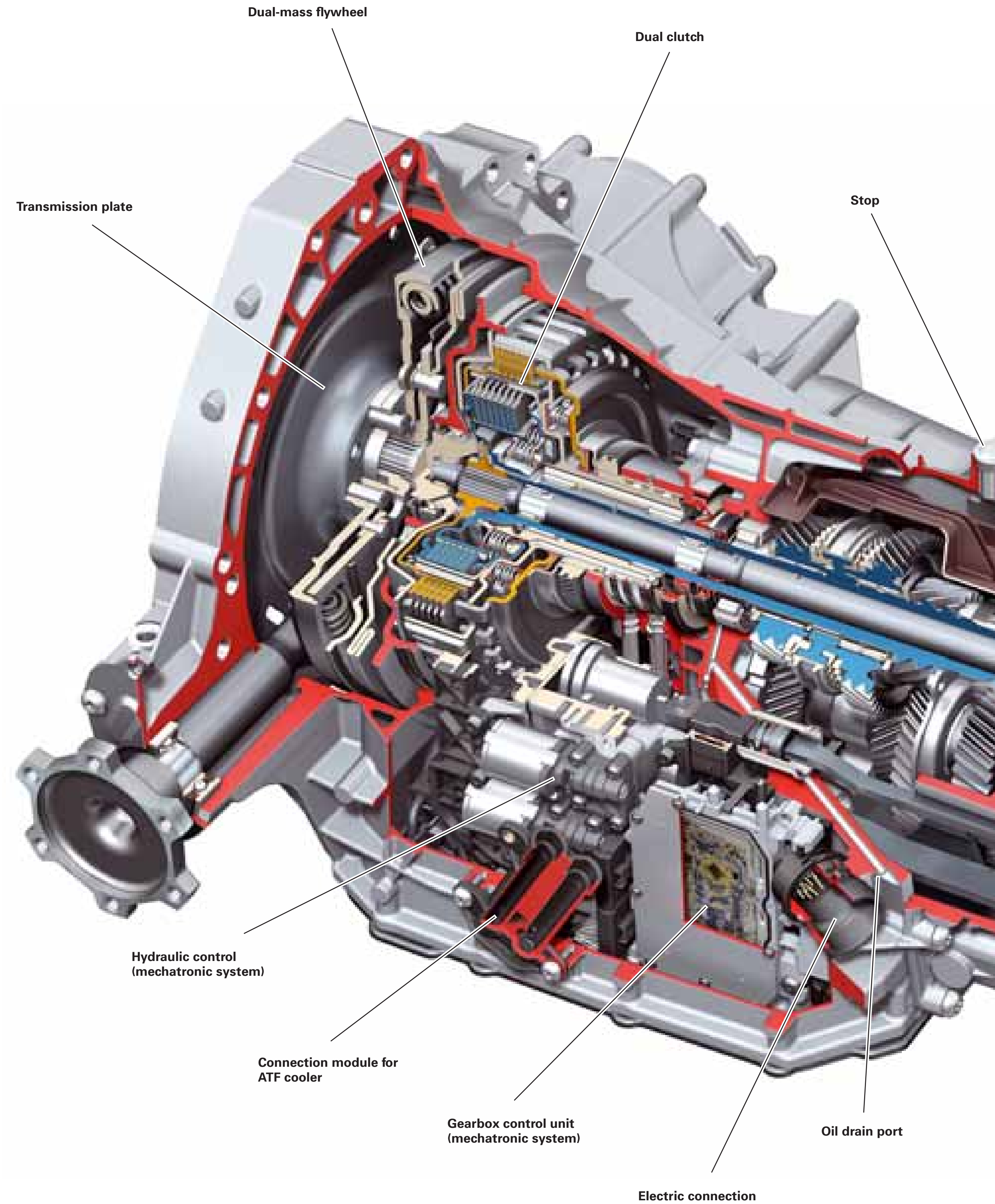
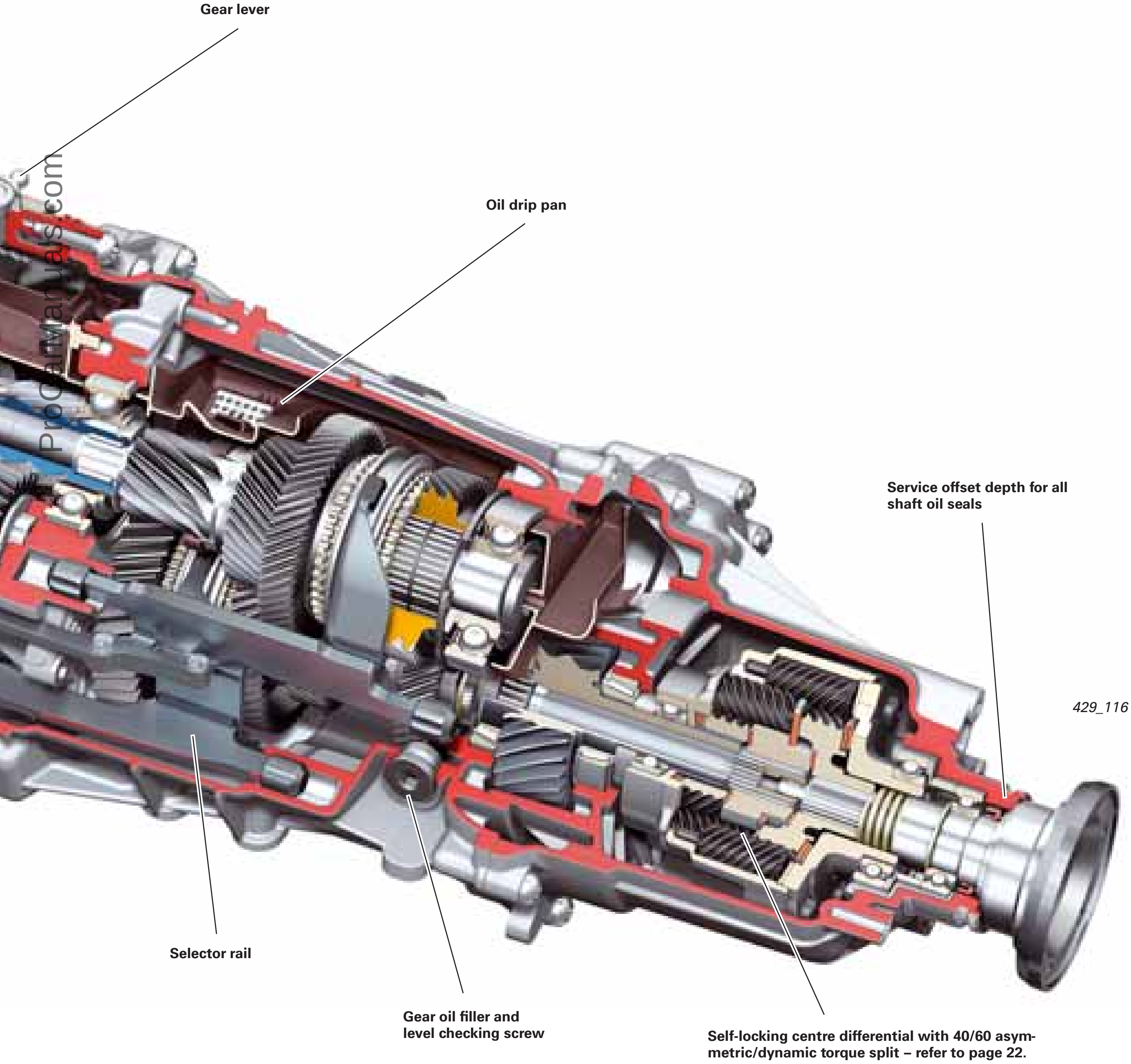
Sectional view of gearbox – overview of the component parts



The advantages of having seven gear ratios

Seven gear ratios enable a wide ratio spread to be realised, resulting in highly dynamic starting performance and allowing 7th gear to be used as an overdrive (E-gear). Low fuel consumption figures are thus achievable.

In addition to the many other innovative detail solutions, which have been incorporated into the 0B5 gearbox, the seven gear ratios are a key factor enabling the Audi Q5 to combine sportiness and efficiency.



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Gearbox mechanism design – function

Drive is transmitted to the dual-mass flywheel through the transmission plate. From here, torque is transmitted to the electro-hydraulically controlled dual clutch, which selectively operates the even or odd numbered gears.
The gearbox is thus subdivided into two sub-gearboxes.

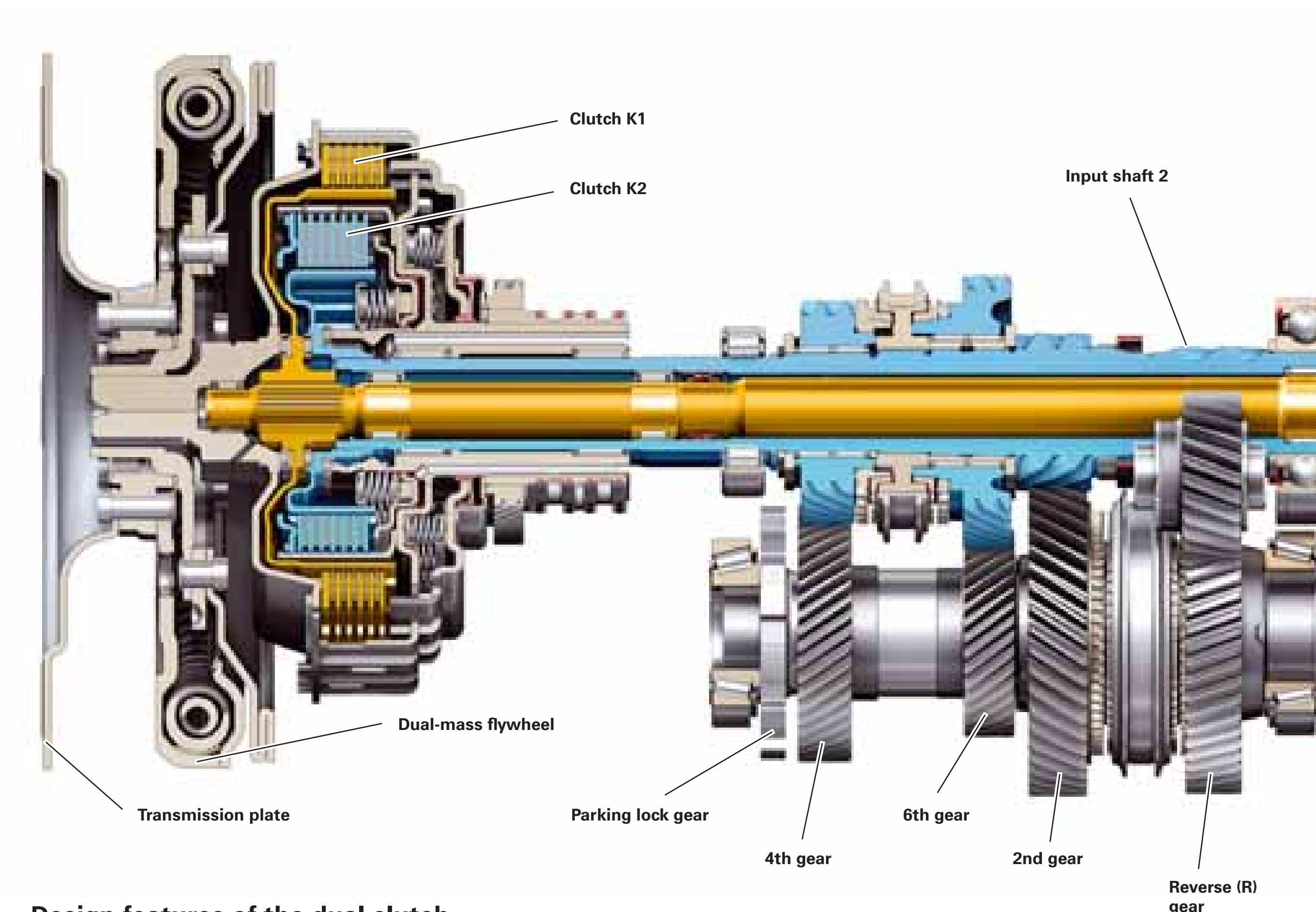
Sub-gearbox 1

The odd numbered gears (1, 3, 5, 7) can be driven through the central input shaft 1 by clutch K1.

Sub-gearbox 2

The even numbered gears (2, 4, 6) and the reverse gear can be driven through input shaft 2 (a hollow shaft) by clutch K2.

Power is output through the common output shaft, from where the torque is transmitted directly to the centre differential. Torque is distributed approx. 60 % to the flange shaft connecting to the rear axle and approx. 40 % to the spur pinion and through the side shaft connecting to the front axle drive (not shown here, see figure on p. 128). For more information about the centre differential, refer to page 22.



Design features of the dual clutch

The dual clutch serves two tasks:

– To engage the engine at driveaway and to disengage the engine when stopping
– To shift the gears (= changeover to sub-gearbox)

The dual clutch was designed in such a way that clutch K1 is located on the outside, and therefore has the larger diameter. This meets the higher demands placed on K1 as the starting clutch (in first gear).

Small pressure cylinders and coil spring assemblies on both clutches provide good controllability at driveaway and when changing gear.

Hydraulic pressure equalisation is no longer required. The clutch control corrects the dynamic pressure build-up caused by centrifugal forces at high engine speeds. A pressure characteristic allows the dynamic pressure build-up to be compensated for in any situation.

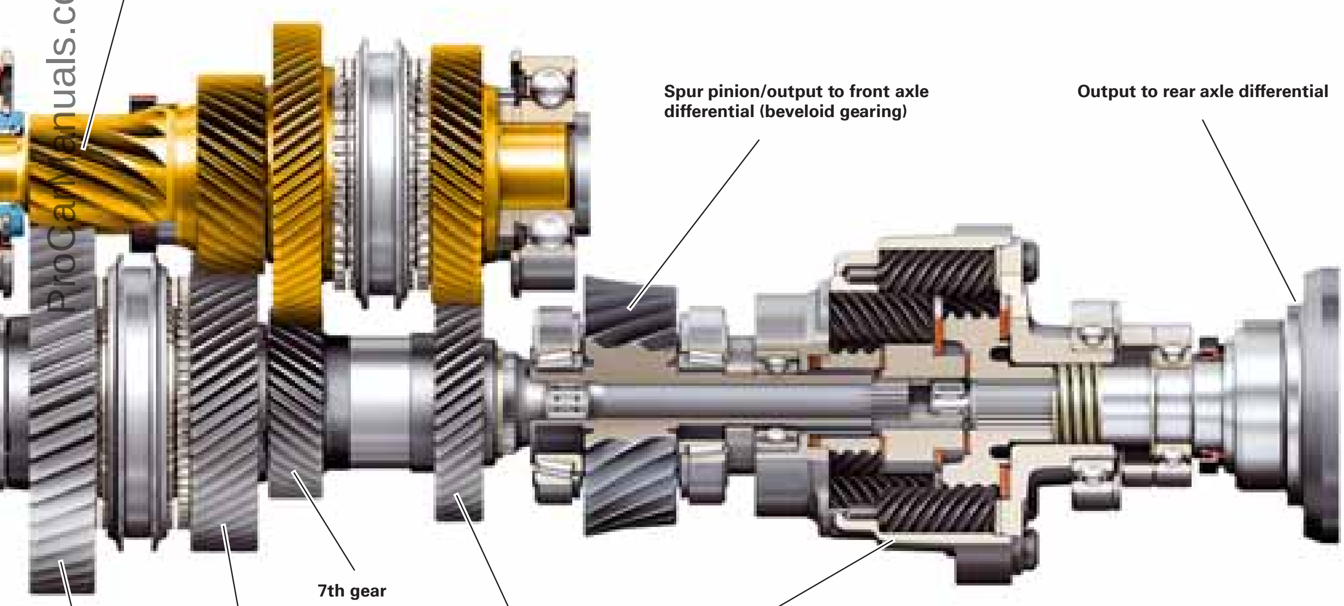
Gearshift sequence

Driveaway:

In selector lever position P or N, only 1st gear and reverse are engaged. This allows immediate driveaway from a standing stop. Depending on whether the driver decides to drive in reverse or forwards, the correct gears are already preselected.

Shifting:

To drive forwards, the driver shifts the selector lever into D and drives away in 1st gear.
When a defined speed threshold of approx. 15 kph is exceeded, 2nd gear is engaged in sub-gearbox 2 (reverse was previously engaged).
When the shift point for upshifting from 1st to 2nd gear is reached, the gearshift is made by lightning-fast opening of clutch K1 and simultaneous rapid closing of clutch K2 without any interruption in tractive power. To enhance shift comfort and preserve the clutch, engine torque is reduced during the gearshift (overlap).
The gear shifting process is completed within a few hundredths of a second. 3rd gear is now preselected in sub-gearbox 1. The process described above repeats itself alternately during the subsequent gearshifts from 2-3 up to 6-7.



429_134

Synchromesh

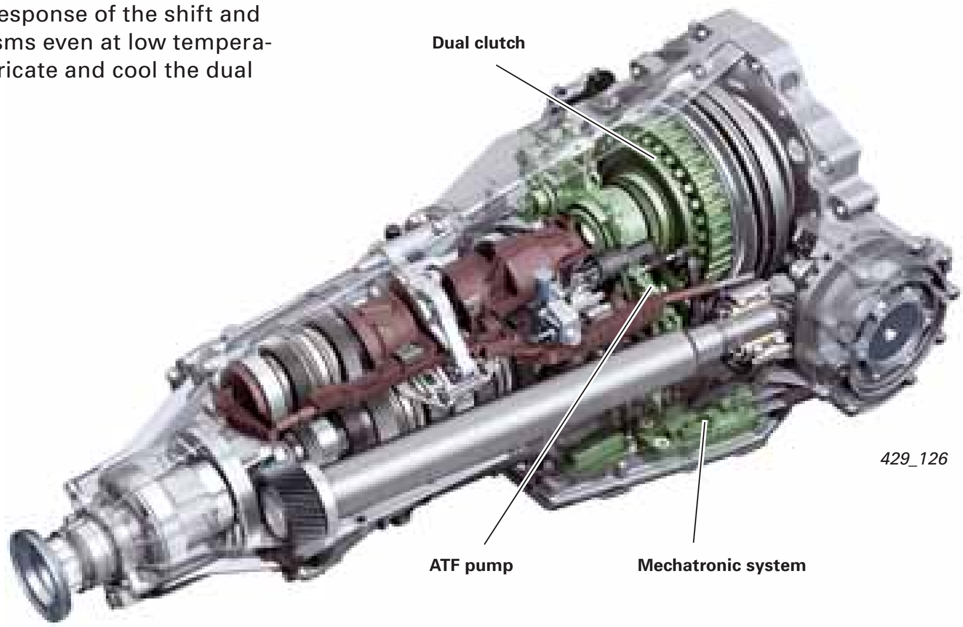
To achieve extremely short shift times, all synchromesh gearboxes have carbon-coated synchroniser rings.
Gears one to three and reverse are also configured as triple-cone synchronisers, due to the high stresses to which they are subjected.
Gears four to seven use single-cone synchronisers.

Gearbox oil system

ATF oil system

The 0B5 gearbox has two separate oil systems. The first oil system accommodates the dual clutch, the mechatronic system and the oil supply. These components use an ATF developed specially for the B5 gearbox. Tis ATF provides rapid response of the shift and clutch control mechanisms even at low temperatures, and serves to lubricate and cool the dual clutch.

A basic requirement for the ATF is that it allows the dual clutch to be controlled in a precise fashion.



429_126

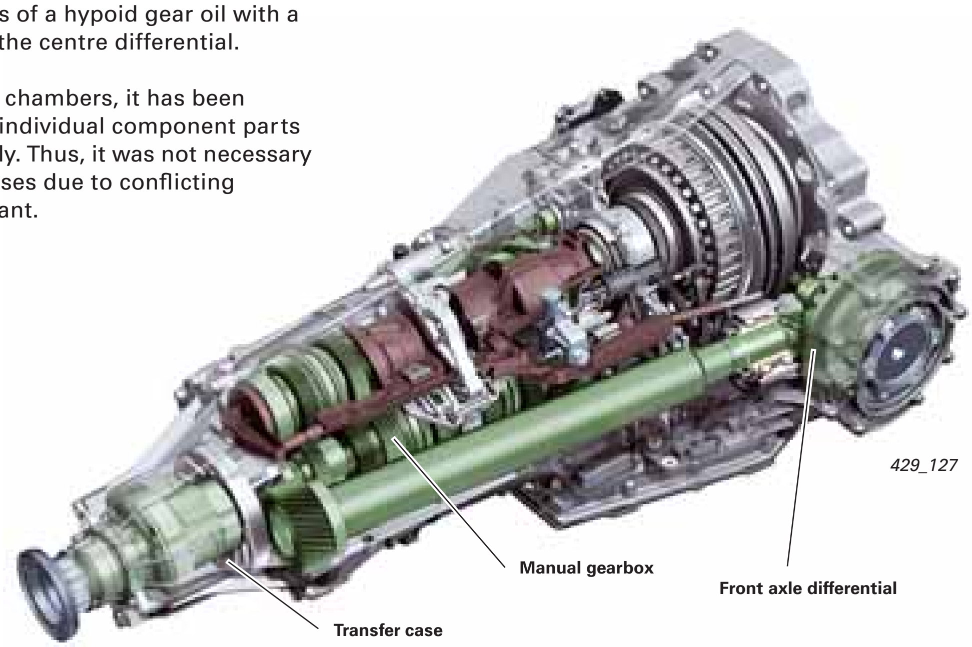
Note

The ATF is subject to a fixed replacement interval (refer to Maintenance). The gear oil is designed for lifetime use in the gearbox.

Gear oil system

The second oil system incorporates the manual gearbox, the transfer case (centre differential) and the front axle drive. Lubrication is by means of a hypoid gear oil with a special oil additive for the centre differential.

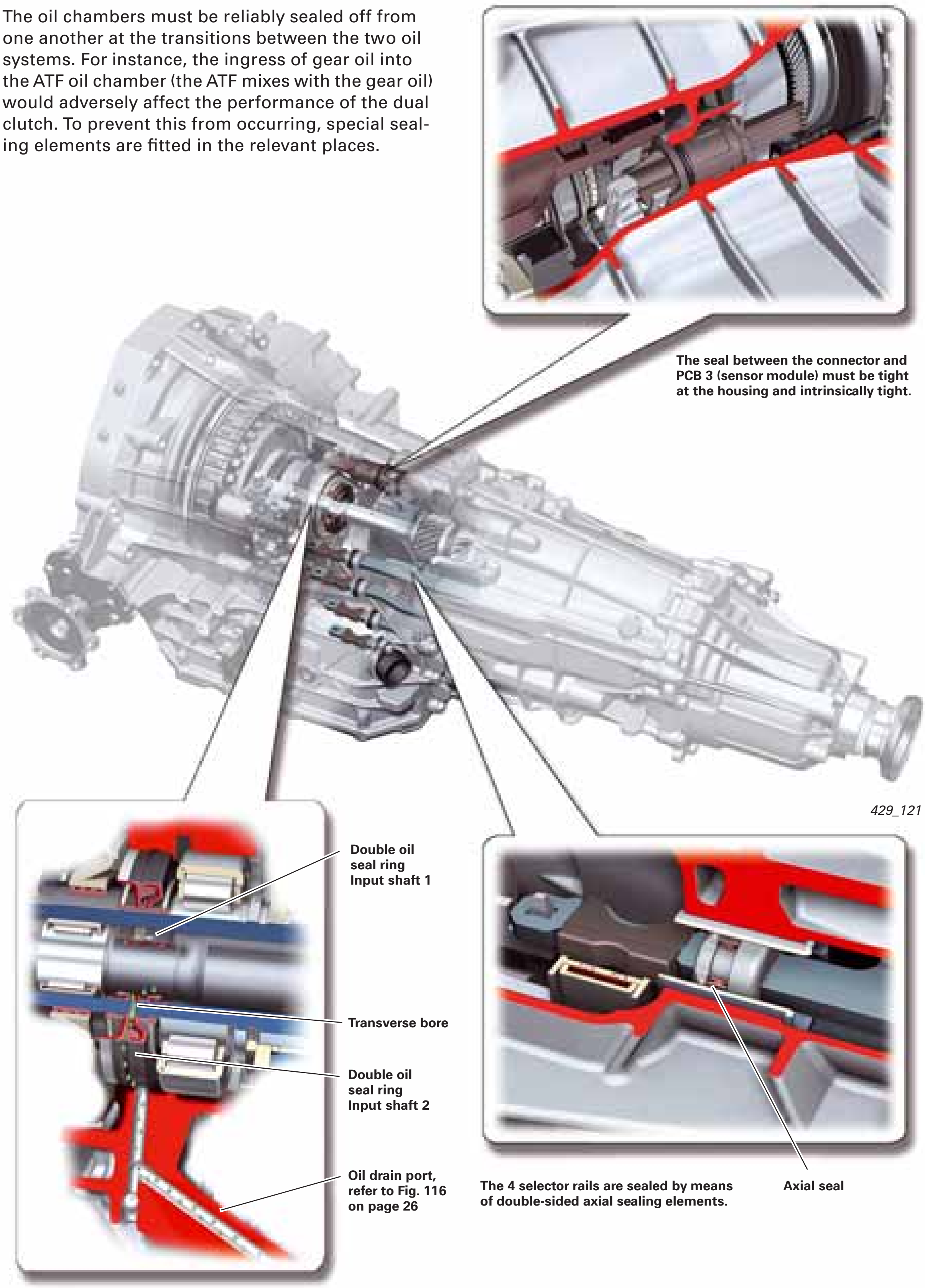
By separating these oil chambers, it has been possible to design the individual component parts of the gearbox optimally. Thus, it was not necessary to make any compromises due to conflicting demands on the lubricant.



429_127

Sealing the oil systems

The oil chambers must be reliably sealed off from one another at the transitions between the two oil systems. For instance, the ingress of gear oil into the ATF oil chamber (the ATF mixes with the gear oil) would adversely affect the performance of the dual clutch. To prevent this from occurring, special sealing elements are fitted in the relevant places.

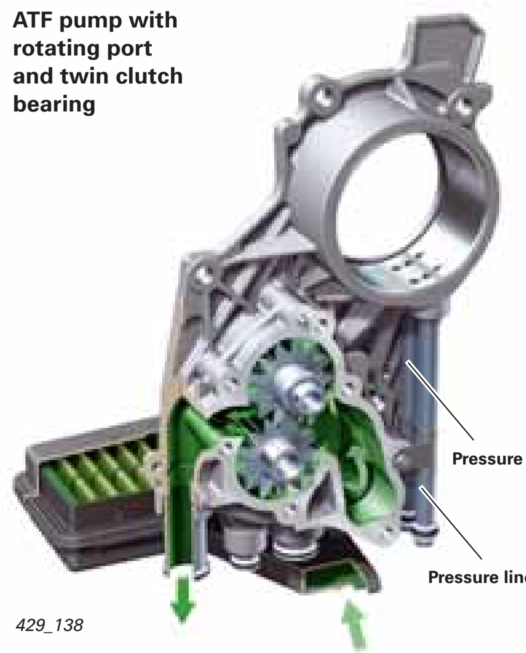


429_121

Input shafts 1 and 2 are sealed by a double oil seal ring (in total, four radial sealing rings are used). If a radial seal is leaking, the oil drain port allows the leaking oil to drain off and prevents it from entering the other oil chamber. The transverse bore in input shaft 2 establishes a connection between input shaft 1 and the oil drain port.

ATF supply – lubrication

ATF pump with rotating port and twin clutch bearing

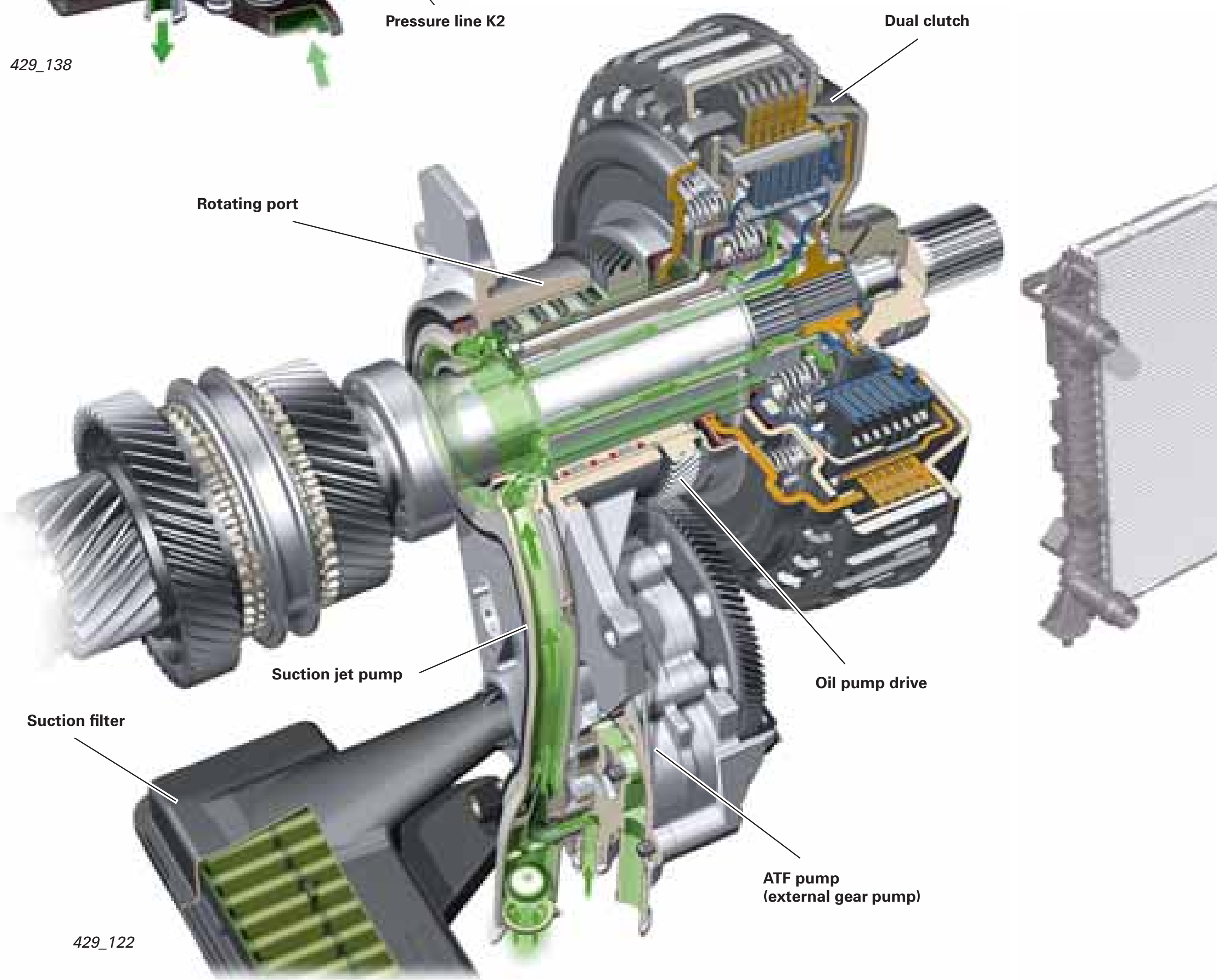


429_138

A sufficient supply of ATF is essential for the operation of the gearbox.
An external gear pump driven by the dual clutch through a gear step provides the necessary oil flow and oil pressure.

The **ATF pump** supplies the mechatronic system with the oil pressure it requires to perform the following functions:

– Control of the multi-plate clutch (engagement and disengagement)
– Cooling and lubrication of the multi-plate clutch
– Control of the gearbox hydraulics



429_122

A **suction jet pump** increases the cooling oil flow for the clutch cooling system. The suction jet pump operates on the Venturi principle. It doubles the cooling oil flow rate without the need for increasing oil pump capacity. This allows the oil pump to be correspondingly downsized, thus enhancing the efficiency of the gearbox.

ATF cooling

ATF cooling is provided by a coolant-oil heat exchanger integrated in the engine cooling system (ATF cooler).
The supply line running to the ATF cooler accommodates a pressure filter, which, in conjunction with the suction filter, provides effective treatment of the ATF. Both filters are designed for lifetime use in the gearbox, and are not subject to a replacement interval.

A differential pressure valve is integrated in the pressure filter. It opens when the flow resistance rises above a threshold value, e.g. when the filter is clogged or the ATF is very cold.
Thus, circulation to the ATF cooler is always assured.

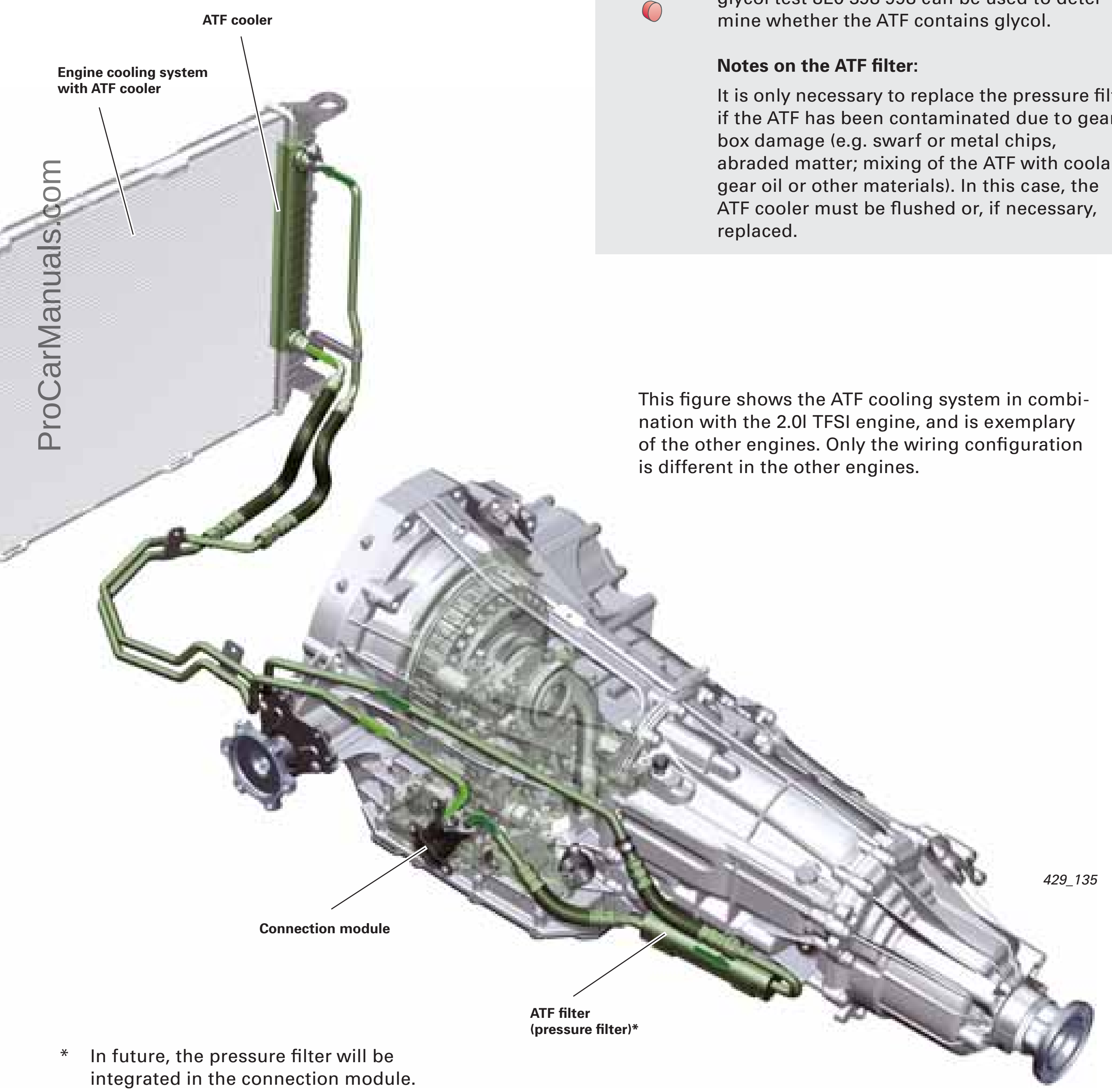
Notes on the ATF cooler:

If the ATF cooler is leaking, coolant will enter the ATF. Even the smallest amounts of coolant in the ATF will impair clutch control. The new glycol test 8E0 398 998 can be used to determine whether the ATF contains glycol.

Notes on the ATF filter:

It is only necessary to replace the pressure filter if the ATF has been contaminated due to gearbox damage (e.g. swarf or metal chips, abraded matter; mixing of the ATF with coolant, gear oil or other materials). In this case, the ATF cooler must be flushed or, if necessary, replaced.

This figure shows the ATF cooling system in combination with the 2.0l TFSI engine, and is exemplary of the other engines. Only the wiring configuration is different in the other engines.



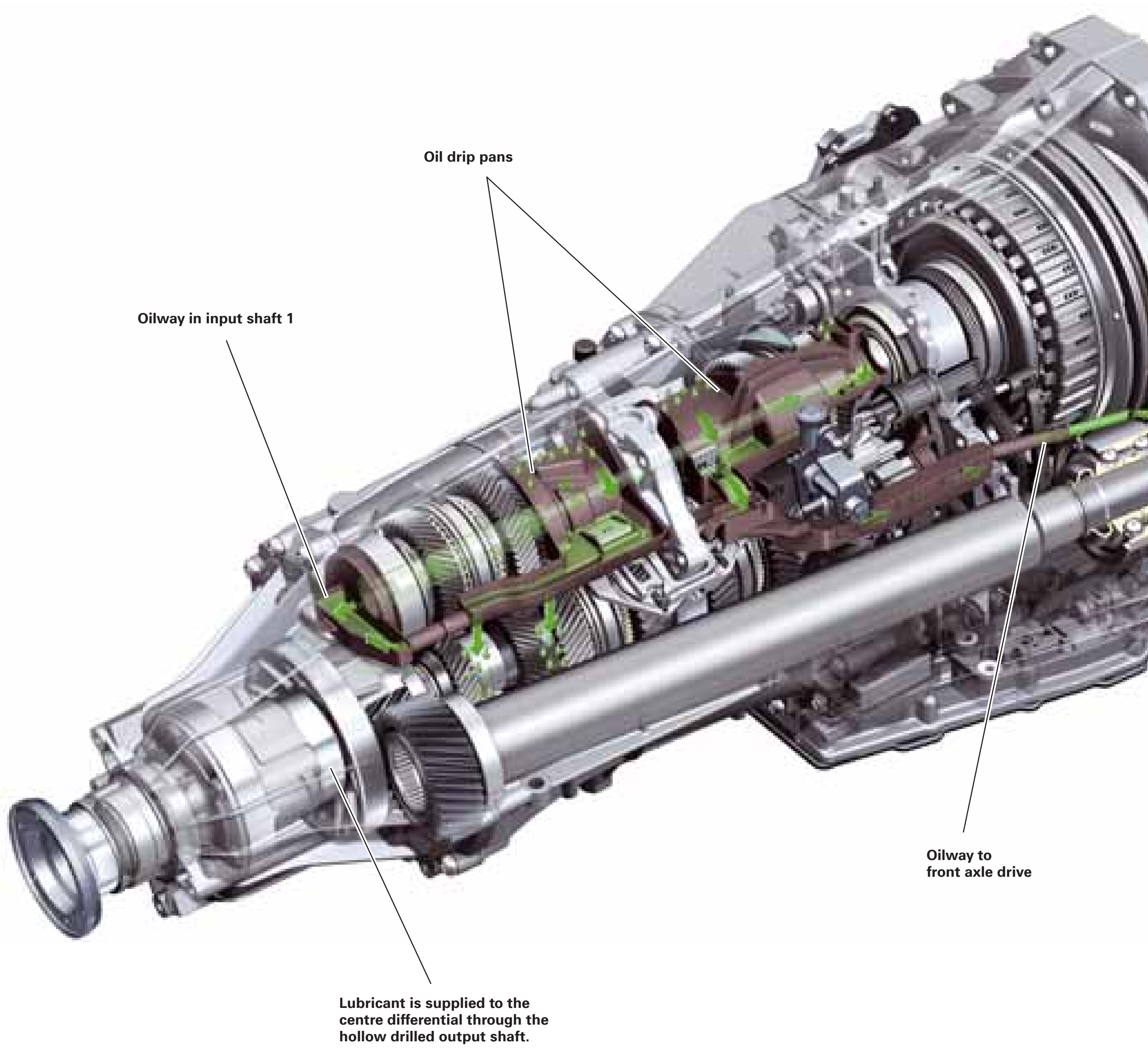
429_135

* In future, the pressure filter will be integrated in the connection module.

Manual gearbox lubrication

Selective lubrication by means of oil drip pans and special oilways allows a low oil level to be used. This reduces churning losses and enhances gearbox efficiency.

The bearings for the input shaft change gears are lubricated through the hollow drilled input shaft 1. Transverse bores in the shafts direct the oil to the bearing points.



Parking lock

The 0B5 gearbox requires a parking lock since both clutches are open (i.e. disengaged) whenever the engine is stationary - a typical characteristic of automatic gearboxes.

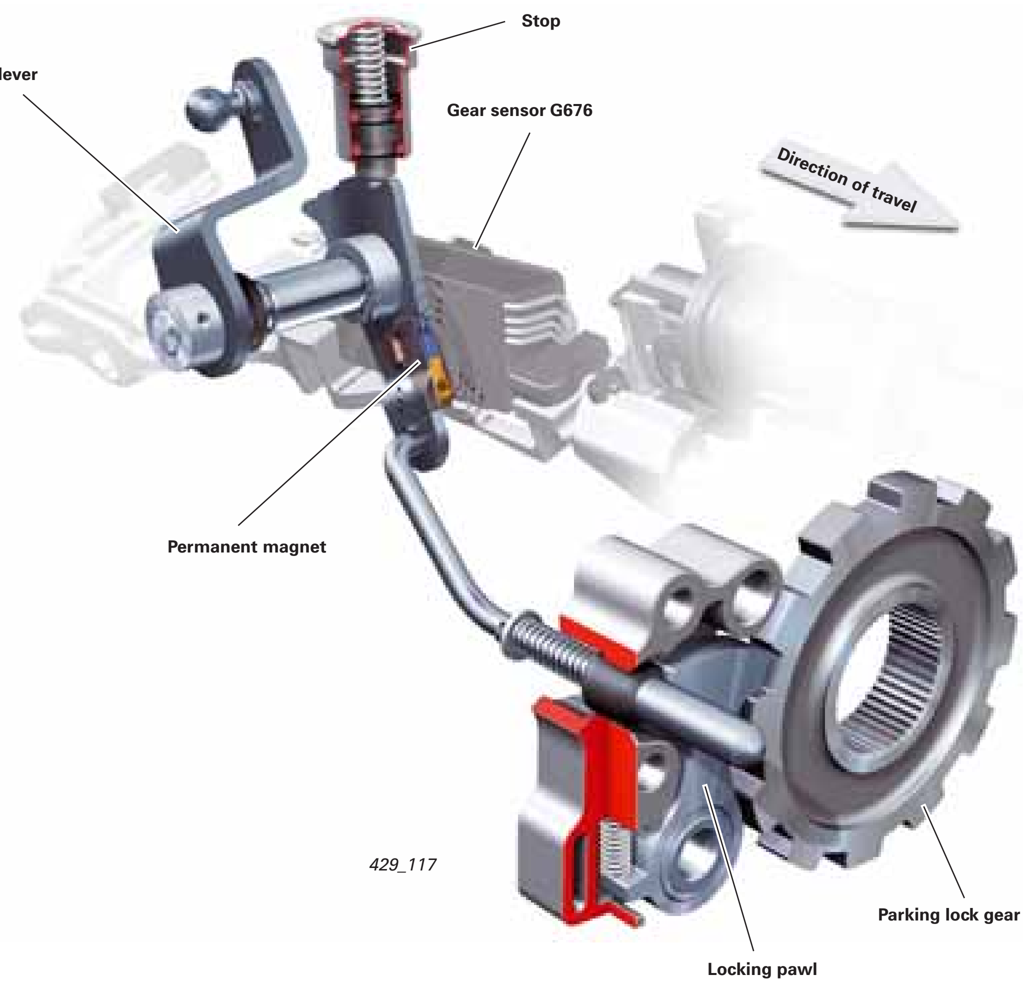
The parking lock gear is connected to the output shaft. The pawl is actuated in an entirely mechanical fashion by the gearshift mechanism (selector lever) via a selector lever cable.

The gear (selector lever position) sensor G676 is also actuated through the selector shaft and the parking lock lever.

For this purpose, a permanent magnet exerting a magnetic field on the sensor is located on the parking lock actuating lever.

Utilising the signals generated by the gear sensor G676, the gearbox control unit recognises the position of the selector lever (P, R, N, D or S).

429_125



429_117

Parking lock in selector lever position P (locking pawl engaged)

Note

The parking lock locks all four gears through the centre differential, but can compensate through the centre differential if a raised wheel is able to turn freely, e.g. when changing a wheel. Therefore, the parking brake should always be applied, too.

Gearbox control

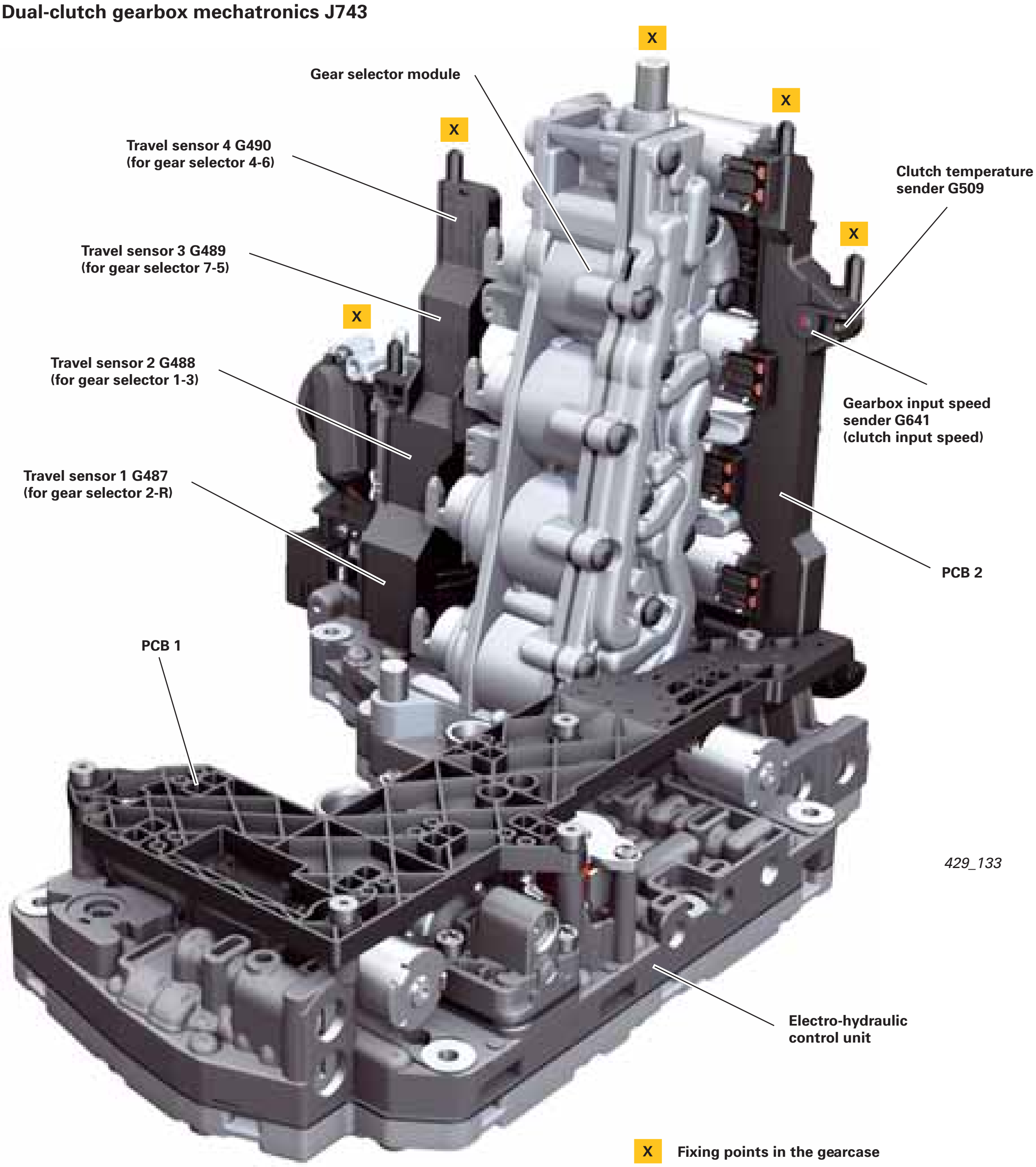
Mechatronics J743

The gearbox is controlled by a recently developed mechatronic system. Its control concept allows precision control of gear engagement speed and force when changing gear. Thus, depending on the driving situation, it is possible to achieve rapid gear-shifting without compromising on comfort, e.g. while coasting.

The mechatronic system acts as the central gearbox control unit. It combines the electro-hydraulic control unit (actuators), the electronic control unit and some of the sensors into a single unit.

On account of the longitudinal configuration, the rpm sensors of both gearbox input shafts and the gear sensor are located on a separate mounting bracket (PCB 3).

Dual-clutch gearbox mechatronics J743



The mechatronic system controls, regulates and performs the following functions:

– Adaptation of oil pressure in the hydraulic system to requirements
– Dual clutch regulation
– Clutch cooling regulation
– Shift point selection
– Gearbox control and regulation
– Communication with other control units
– Limp-home programs
– Self-diagnostics

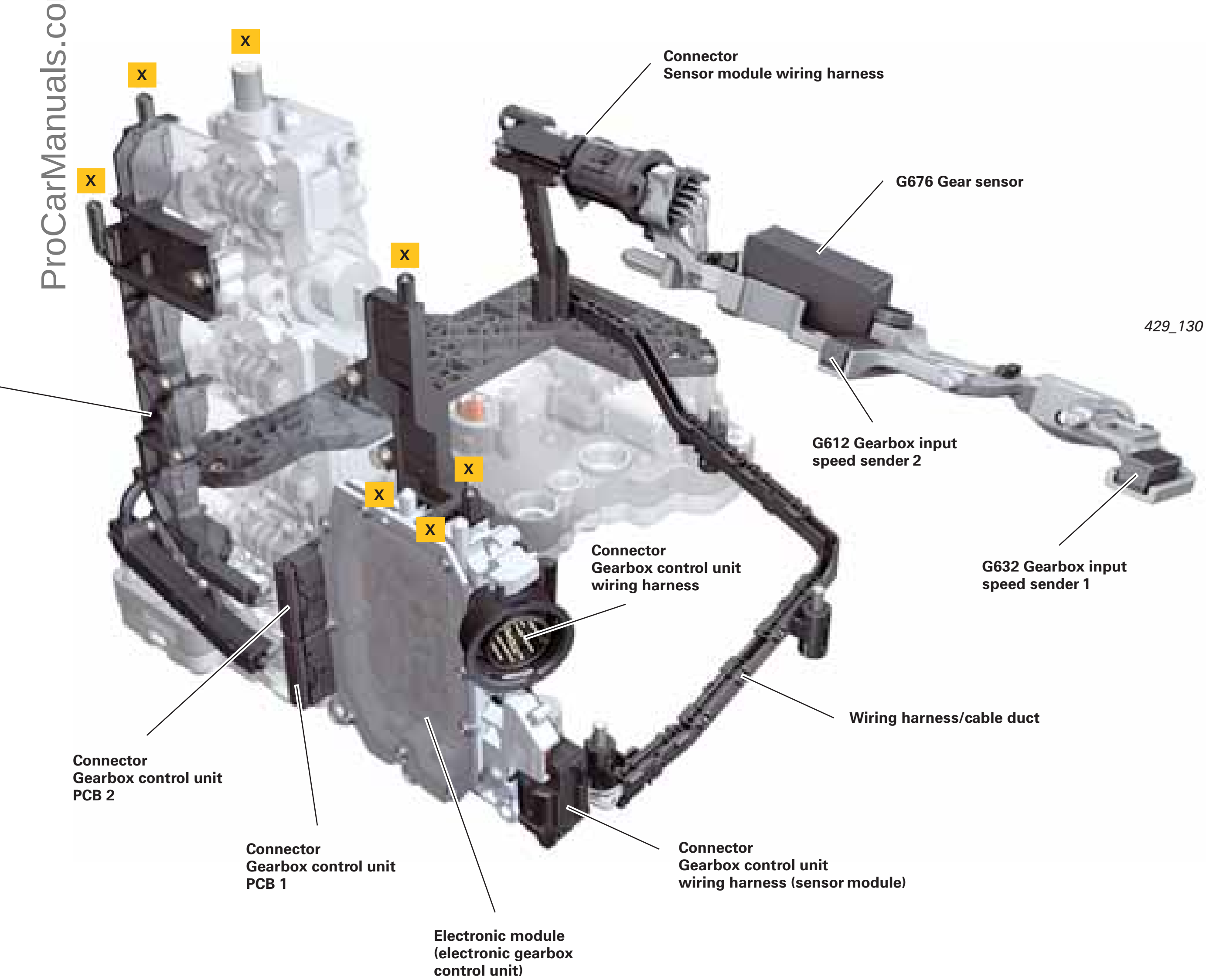
Note

After replacing the mechatronic system or the gearbox control unit, various adaptations must be made using the diagnostic tester.

Note

When handling the mechatronic system, it is important to pay close attention to the working guidelines regarding electrostatic discharge (ESD)!

Mechatronic system with sensor module (PCB 3)

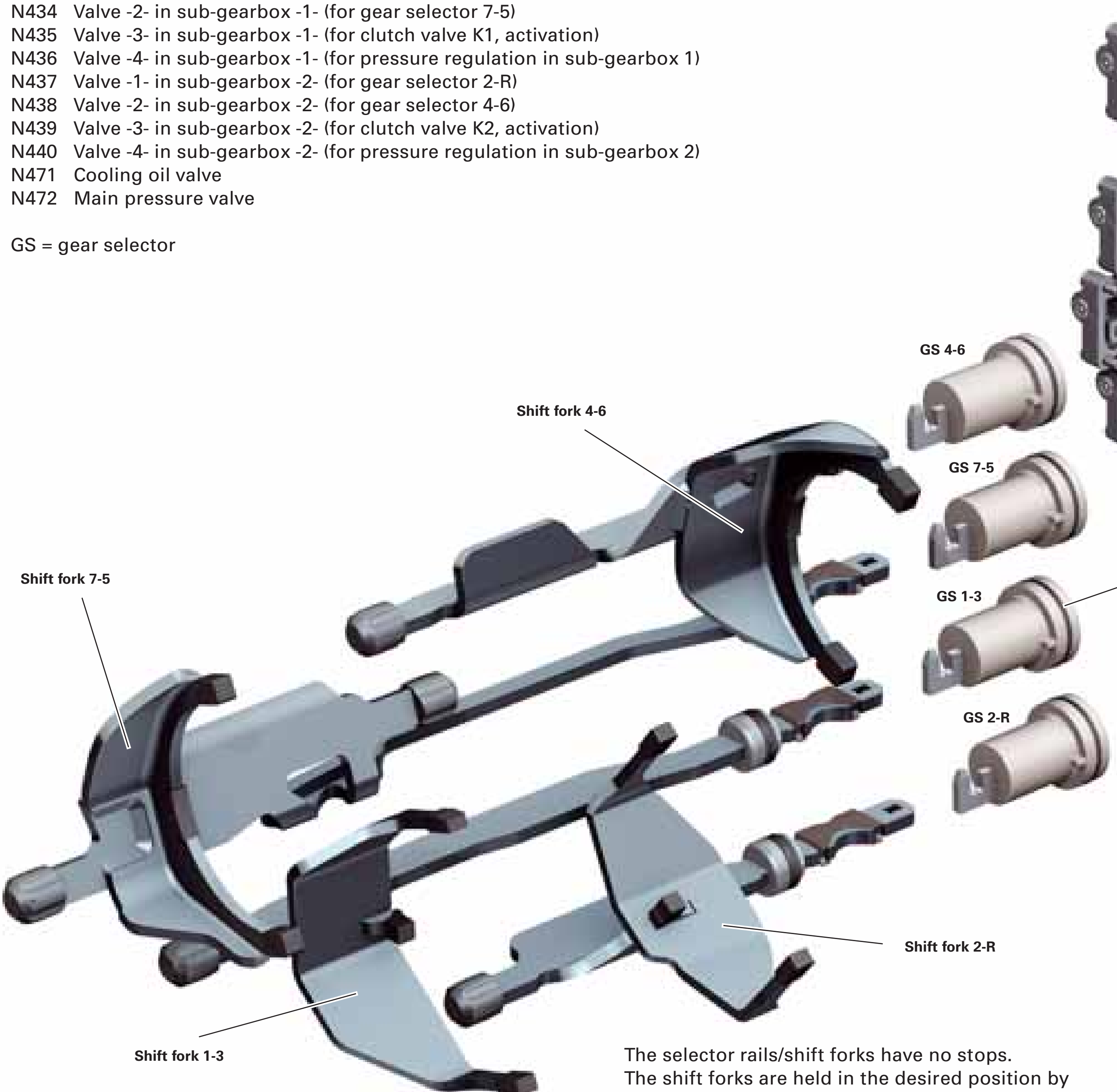


Hydraulics/overview

The figure shows the electro-hydraulic control unit, together with all components activated by the actuators.

N433 Valve -1- in sub-gearbox -1- (for gear selector 1-3)
N434 Valve -2- in sub-gearbox -1- (for gear selector 7-5)
N435 Valve -3- in sub-gearbox -1- (for clutch valve K1, activation)
N436 Valve -4- in sub-gearbox -1- (for pressure regulation in sub-gearbox 1)
N437 Valve -1- in sub-gearbox -2- (for gear selector 2-R)
N438 Valve -2- in sub-gearbox -2- (for gear selector 4-6)
N439 Valve -3- in sub-gearbox -2- (for clutch valve K2, activation)
N440 Valve -4- in sub-gearbox -2- (for pressure regulation in sub-gearbox 2)
N471 Cooling oil valve
N472 Main pressure valve

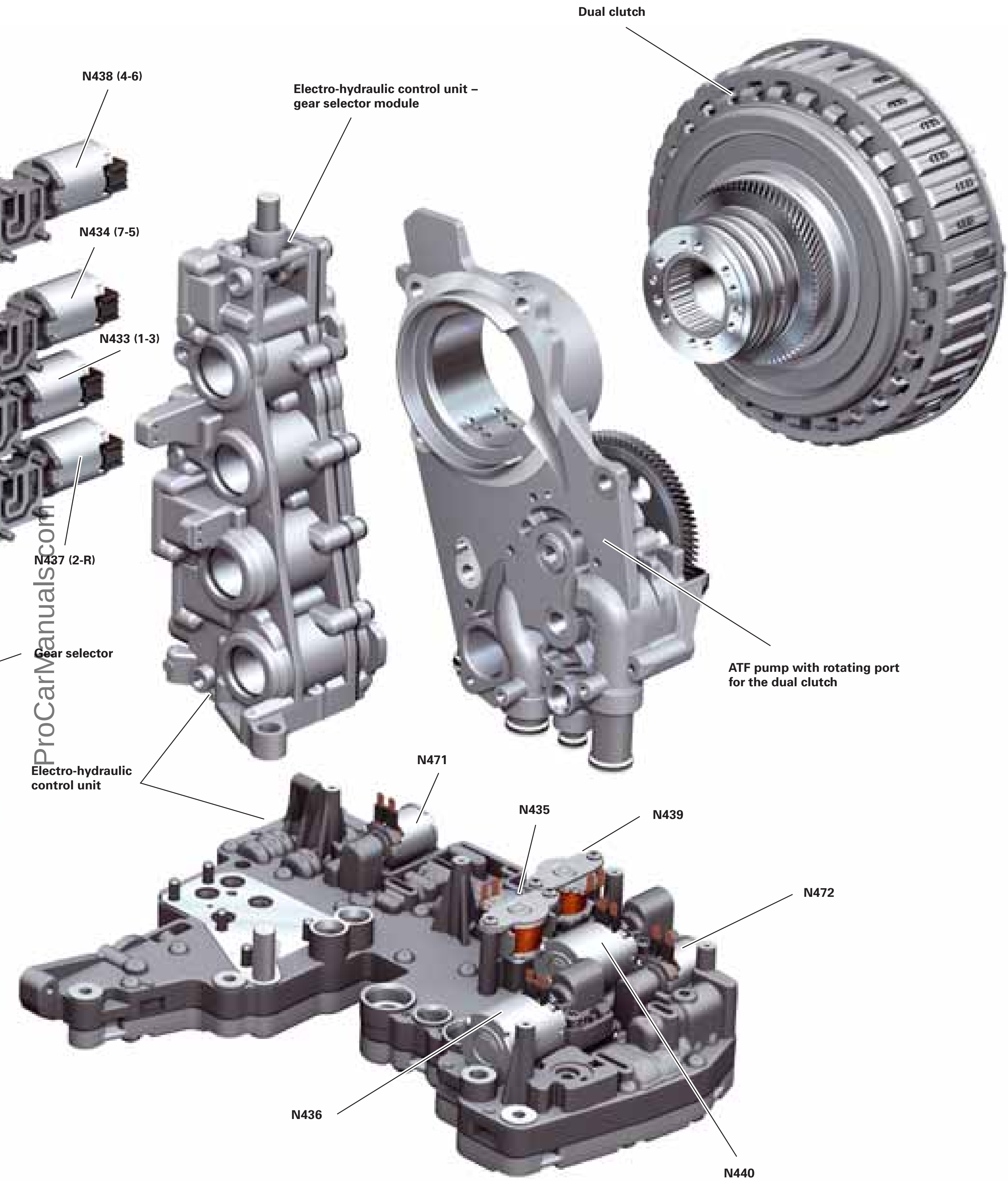
GS = gear selector



The selector rails/shift forks have no stops. The shift forks are held in the desired position by the gear selectors. The only stops are in the gear change sleeve and the synchroniser assembly.

Note

Before installing the mechatronic system into the gearbox, the gear selectors and the selector rails must be brought into alignment with each other. Refer to the Workshop Manual.


Dual clutch
N438 (4-6)
Electro-hydraulic control unit – gear selector module
N434 (7-5)
N433 (1-3)
N437 (2-R)
Gear selector
ATF pump with rotating port for the dual clutch
Electro-hydraulic control unit
N471
N435
N439
N472
N436
N440

429_129

Electronics

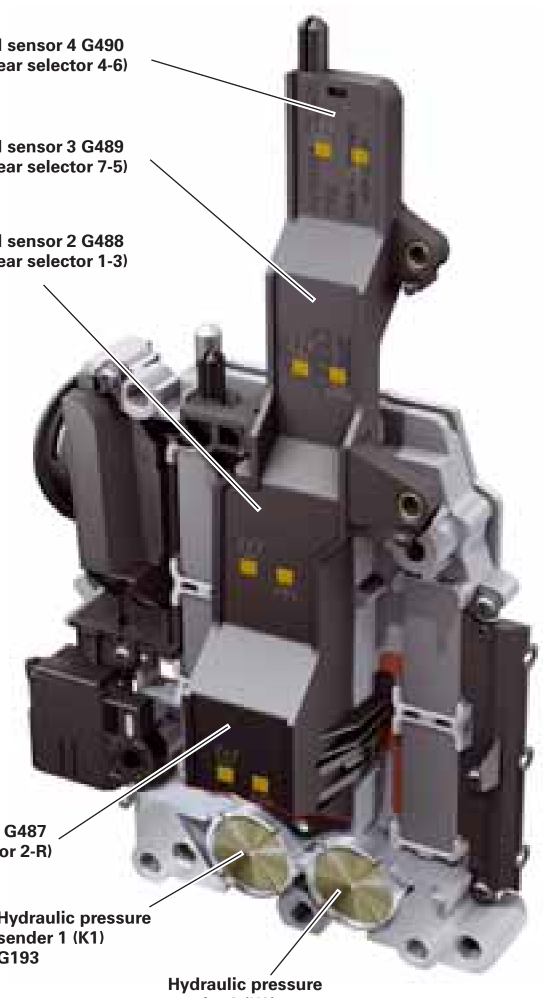
Integrated sensors

The **gearbox control unit J217**, the four travel sensors and the two hydraulic pressure senders are combined as a non-separable unit.

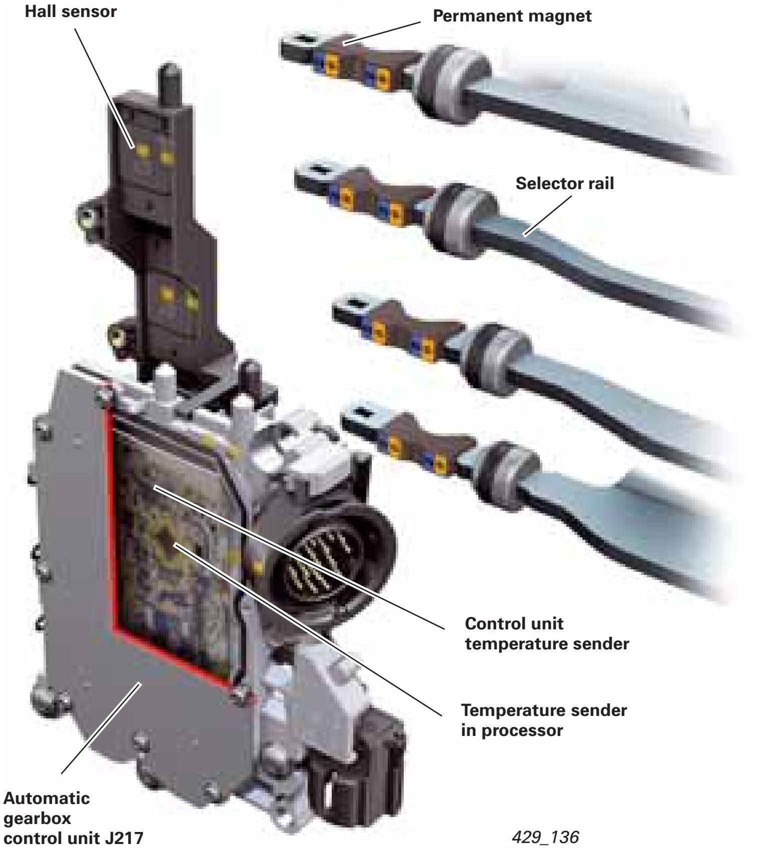
Two **temperature sensors** are integrated in J217.
One sensor is so positioned as to supply exact information on the ATF temperature.
The other sensor is integrated directly in the processor and measures the temperature directly at critical components. The two temperature senders monitor each other for plausibility.
Electronics temperature monitoring is very important so that, whenever necessary, temperature reduction measures can be taken in good time (refer to "Protective functions").

In addition to safety aspects, the ATF temperature is relevant to both clutch control and hydraulic control. For this reason, the ATF temperature is also a key factor in the control and adaptation functions.

Hydraulic pressure senders 1 and 2 are utilised for clutch pressure monitoring and for adaptation of the primary pressure and sub-gearbox pressures.



429_137



429_136

The four **travel sensors** determine the position of each selector rail/shift fork. The gearbox control unit requires this information to immediately diagnose non-allowed positions and to activate a limp-home program, if necessary.

An exact travel measurement is also essential for precision gear-shifting.
The various phases of the synchronisation and gear-shifting processes can thus be activated in a very specific manner.

A travel sensor consists of two Hall sensors and two permanent magnets which are attached to the selector rail. Depending on the position of the magnets in relation to the Hall sensors, the Hall sensors output a voltage which corresponds to the distance travelled. The travel signal is generated by evaluating both voltage signals.

429_171

Note

To exactly measure the distance travelled by the gear selector, the shift mechanism must be adapted to the gearbox control unit using the diagnostic tester.

Separate sensors

Gearbox input speed senders 1 and 2 as well as the gear sensor and mounted together on a common mounting bracket (PCB 3).

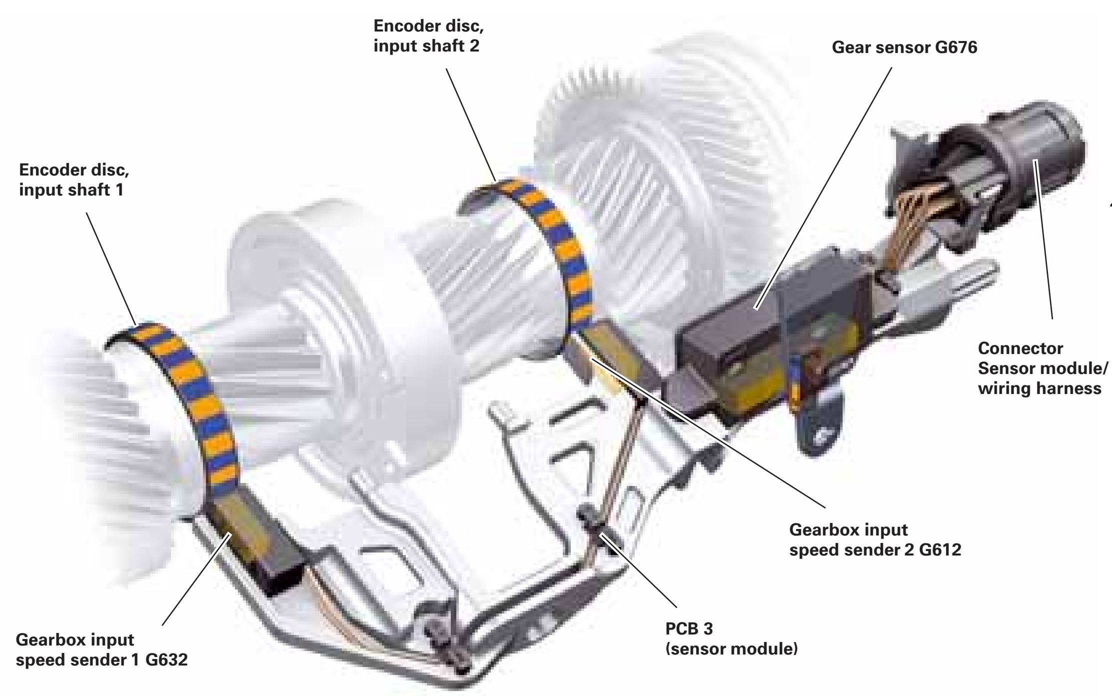
Both engine speed senders are so-called "intelligent sensors". With three Hall sensors and the corresponding evaluation electronics, it is possible to distinguish between driving forwards, driving in reverse and a weak magnetic field.
The control unit receives the information from the senders pre-evaluated in the form of a pulse width modulated signal.

The various states are indicated to the control unit by different pulse widths.
This means that, e.g. when driving forwards, the engine speed signal has a different pulse width than when reversing.

Signal utilisation

– Determination of the clutch output speed for computing clutch slip

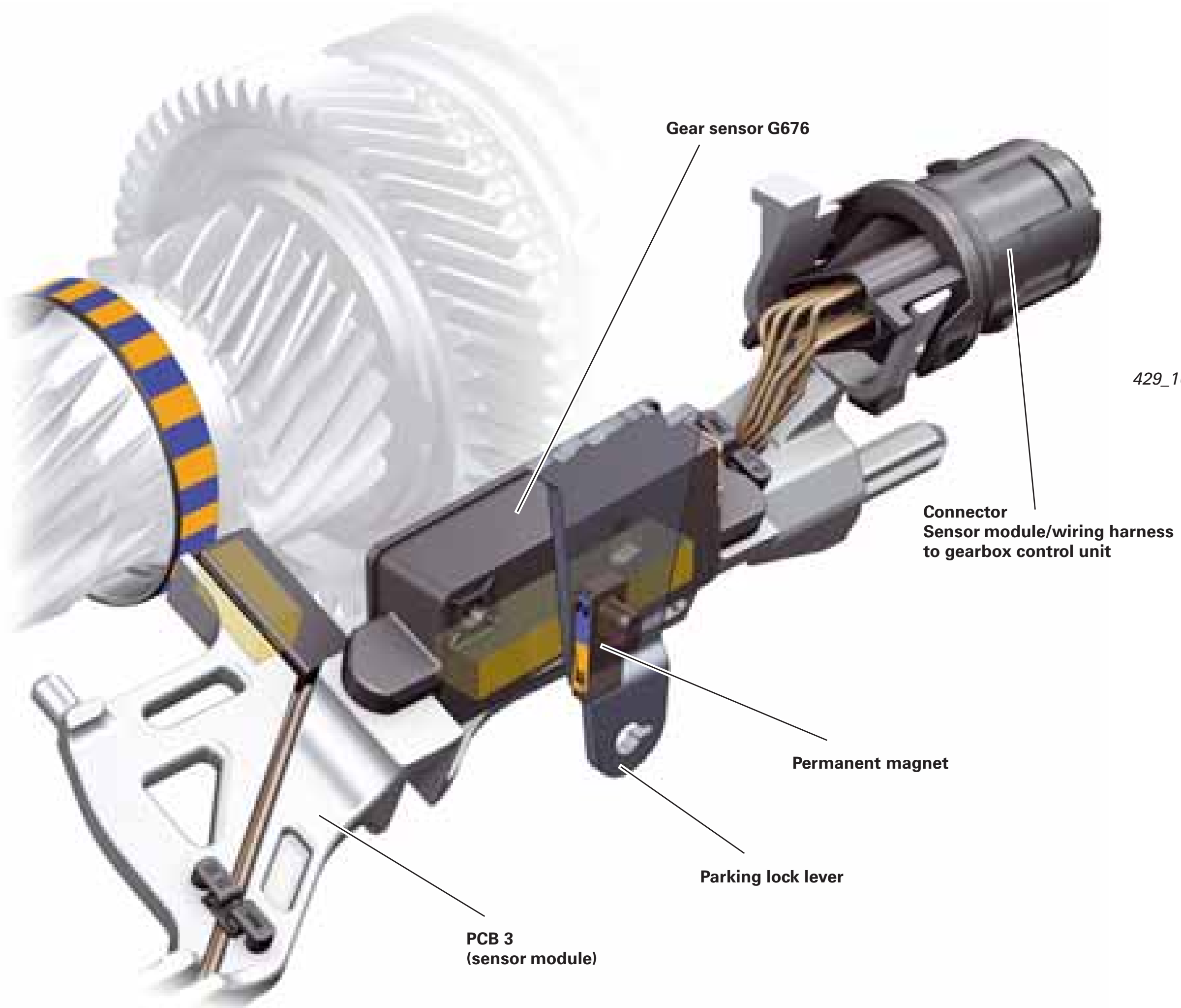
– Determination of the synchronisation speed for shift control



429_173

The **gear sensor G676** is located in the gearbox and is an integral part of the sensor module.
The G676 is a contactless travel sensor which is used to determine the selector lever positions (P, R, N, D and S).

A permanent magnet exerting a magnetic force on the gear sensor is located on the parking lock lever. The parking lock lever is connected to the gear lever by a shaft. It is actuated by the selector lever by means of a selector lever cable.



429_167

The gearbox control unit requires data on selector lever position in order to perform the following functions and generate the following signals and information:

- Information on driver input/vehicle operating state (forwards drive, reverse, neutral) for activation of the clutches and gear selectors
- Information for selection of the shift program "D" or "S"
- Signal for controlling the starter inhibitor
- Signal for controlling the P/N lock (shift-lock)
- Information for reverse gear (e.g. for reversing lights, Park Assist System, etc.)
- Control of the selector lever position indicator in the dash panel insert and gearshift mechanism

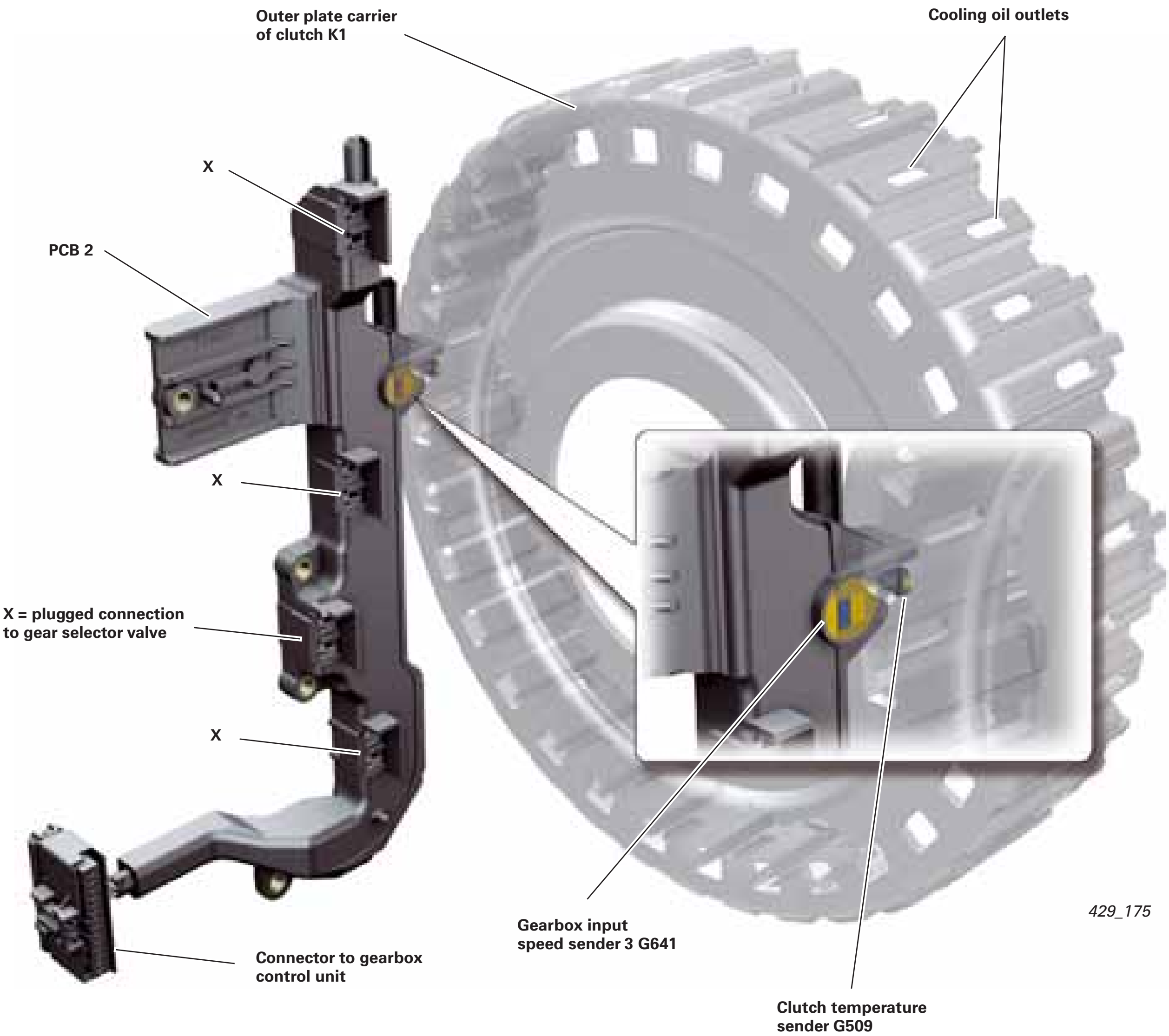
The gear sensor is a so-called PLCD sensor (travel sensor). The abbreviation **PLCD** stands for **P**ermanent magnetic **L**inear **C**ontactless **D**isplacement sensor and describes a contactless sensor which measures linear travel using a permanent magnet. The function of the PLCD sensor is described in SSP 241, page 56 ff.

The signal generated by the gear sensor is very important for gearbox control and is safety-critical. For this reason, there are two sensors (for redundancy). G676 therefore consists of two sensor elements arranged in parallel.
The gearbox control unit always evaluates both sensors.

Note

The gear sensors must be adapted to the gearbox control unit using the diagnostic tester.

Gearbox input speed sender 3 G641 and the **clutch temperature sender** G509 are integral parts of PCB 2.



429_175

Gearbox input speed sender 3 G641 is a Hall sender. It measures the input speed of the dual clutch (= the engine speed after the dual-mass flywheel). The outer plate carrier of clutch K1 serves as an encoder disc.

The clutch input speed signal ...

... allows more precise clutch control.
... is used for adapting the clutches.
... is used for regulating micro-slip

The **clutch temperature sender** G509 measures the temperature of the cooling oil emerging from the dual clutch. The clutch temperature can be derived from this information.

G509 is used monitoring the clutch temperature. When a defined oil temperature is reached, safety precautions are taken in order to prevent a further rise in temperature.
For further information, please refer to "Gearbox protection functions".

Gearbox protection functions

Control unit temperature monitoring

High temperatures have a negative impact on the useful life and performance of electronic components. Due to the integration of the gearbox control unit into the gearbox (lubricated by ATF), it is very important to monitor the temperature of the electronics and, accordingly, the ATF.

When the temperature reaches approx. 135 °C (measured by one of the two temperature sensors in the gearbox control unit), the gearbox electronics must be protected against a further rise in temperature. When this threshold value is exceeded, the gearbox control unit initiates a reduction in engine torque in order to reduce heat input.

Up to a temperature of approx. 145 °C, engine torque can be reduced gradually until the engine is at idle. When the engine is at idle, the clutches are open and there is no power transmission from the engine to the drive wheels.

When the protective function is activated, an entry is made in the fault memory and the following text message is displayed in the dash panel insert: "You can continue driving to a limited extent".

Clutch protection

If the clutch cooling oil temperature exceeds a value of approx. 160 °C (determined by G509), the clutch is within a critical temperature range which can damage it.
These temperatures occur, for example, when driving away on extreme gradients (possibly when towing a trailer) or when the vehicle is held stationary on an uphill slope using the accelerator and the clutch (without using the brake).

As a safety precaution, engine torque is reduced when the cooling oil temperature exceeds 160 °C.
If the cooling oil temperature continues to rise, engine torque is gradually reduced; this can be to the extent that the engine is only idling. When the engine is at idle, the clutches are open and there is no power transmission from the engine to the drive wheels.

When the protective function is initiated, an entry is made in the fault memory and the following text message is displayed in the dash panel insert: "You can continue driving to a limited extent".

As an additional safety precaution, the clutch temperature is determined using a computer model.
If the computed temperature exceeds a pre-defined value, the above-mentioned precautions are taken.

All you need to know about the ...

... gearbox control unit

In the B8 series, a new data and diagnostic log is used for the engine control units, the gearbox control units and the airbag control unit.
The previous data blocks and numberings are no longer used. In return, individual measured data is now available and listed as full text in alphabetical order. The required measured data can then be specifically selected.

... Clearing the fault memory

The fault memories of the engine and gearbox control unit are always cleared jointly. If the fault memory of the gearbox control unit is cleared, then the fault memory in the engine control unit will automatically be cleared as well. The converse also applies if the event memory in the engine control unit is cleared.

... towing

If a vehicle with S tronic needs towing, the conventional restrictions on automatic gearboxes apply:

– Selector lever in position "N"
– A max. towing speed of 50 kph must not be exceeded.
– A max. towing distance of 50 km must not be exceeded.

Explanation:

When the engine is at standstill, the oil pump is not driven and certain parts of the gearbox are no longer lubricated. Exceeding a speed of 50 kph results in unacceptably high rotational speeds within the gearbox and dual clutch, because one gear is always engaged in both sub-gearboxes.

If the towing conditions are not observed, serious gearbox damage can occur.

Gearshift mechanism – ignition key withdrawal lock – Audi drive select

For further information, refer to SSP 409, p. 34 ff.

Limp-home programs

In the event of malfunctioning, consequential damage can be prevented and mobility preserved by means of limp-home programs.
In addition, there are so-called protective functions, which protect certain components against overload (refer to Gearbox protection functions on page 44).

In the event of certain predefined system malfunctions, the gearbox control unit shuts down the sub-gearbox in question and activates the relevant limp-home program (driving with intact sub-gearbox).

1. Driving with sub-gearbox 1, sub-gearbox 2 shut down:

– Only gears* 1, 3, 5, and 7 can be engaged (with interruption in tractive power).
– Reversing is not possible.

2. Driving with sub-gearbox 2, sub-gearbox 1 shut down:

Only gears*) 2, 4, 6 and R can be engaged (with interruption in tractive power).

3. Complete gearbox shutdown:

In the case of serious faults - e.g. faulty powertrain CAN, no identification by immobiliser, recognition of an incorrect ratio in the gear steps or in the final drive - the gearbox is shut down completely.

*) The nature of the fault dictates which gears are still available. To be sure that components do not overspeed, certain gears are disabled depending on fault type.
After ensuring that no gear is engaged in the deactivated gearbox, all gears of the intact sub-gearbox are shifted without any further restrictions.

Displays/warnings

The 0B5 gearbox features a new information and warning concept in the dash panel insert, which alerts the driver to a system malfunction or a protective function.

The following warnings are displayed:

Display 1 appears in the event of faults which the driver may not notice because the gearbox control unit can utilise a suitable substitute signal.

These faults result in no, or only negligible, loss of performance. The purpose of the warning is to prompt the driver to take the vehicle to an Audi dealer or service facility at the next opportunity.

Display 1

429_170

Display 2 appears to indicate gearbox protection functions and faults which result in loss of performance.

This can have the following effects:

– Limp-home program "Driving with sub-gearbox 2" active, i.e. gearshifts with interruption in tractive power (even numbered gears only)

– Gearbox protective function is active, but engine power is reduced because the engine torque reduction function is active

– No power transmission to the driving wheels after stopping

– The engine can no longer be started

Display 2

429_169

Display 3 appears when the limp-home program "Driving with sub-gearbox 1" is active because reverse gear cannot be selected at the same time.

Display 3

429_168

The text messages disappear after 5 seconds.
The text is again displayed for 5 seconds at "ignition ON". The yellow warning symbols are permanently displayed.

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