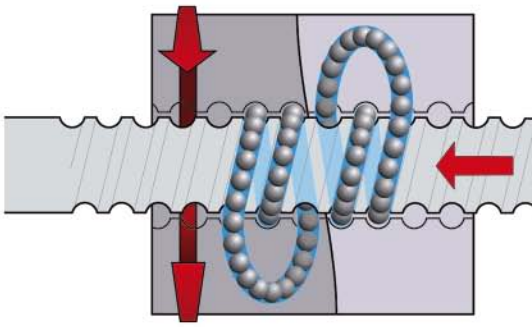
Self-study programme 480



Audi A7 Sportback

Running gear / suspension

Audi
Service Training

Running gear / suspension - overall concept

A major development goal for the running gear / suspension of the Audi A7 Sportback was to achieve great agility with good control, thus enhancing driving pleasure with high levels of safety and comfort. The use of the proven axle concept with the five-link front axle in connection with a trapezoidal link rear axle is the prerequisite for this. As already implemented in the case of Audi A8 '10 and Audi A6 '05, adaptive air suspension (aas) will also be used on the Audi A7 Sportback. This equipment is optional here; the series standard equipment is a steel-sprung running gear / suspension with conventional damping.

From a conceptual perspective, the final drive before differential drive concept used for the first time in the Audi A5 '08 will also be used in the Audi A7 Sportback, which means a larger wheelbase can be implemented with a small front overhang.

In comparison with the Audi A6 '05, the wheelbase has been enlarged by 69 mm, the track width on the front axle by 15 mm.

The layout of the steering gear on the subframe in front of the front axle ensures the necessary exact steering response and the precise steering feel in every driving situation.

The electrical implementation of the power-assisted steering has enabled a reduction in the fuel consumption of a max. of 0.3 l / 100 km. Various additional functions can also be implemented.

480_001

Contents

▸ The self-study programme describes the fundamentals of the design and function of new vehicle models, new automotive components or new technologies.
The self-study programme is not a Repair Manual! Any figures quoted merely serve the purpose of facilitating understanding and relate to the version of data valid at the time the SSP was produced.
It is essential that you refer to the latest technical literature when carrying out maintenance and repair jobs. You will find an explanation of terms that are printed in italics and marked with an asterisk in the glossary at the end of this self-study programme.

Note

Reference

Running gear / suspension

Overview

The following running gear and suspension variants are available for the Audi A7 Sportback:

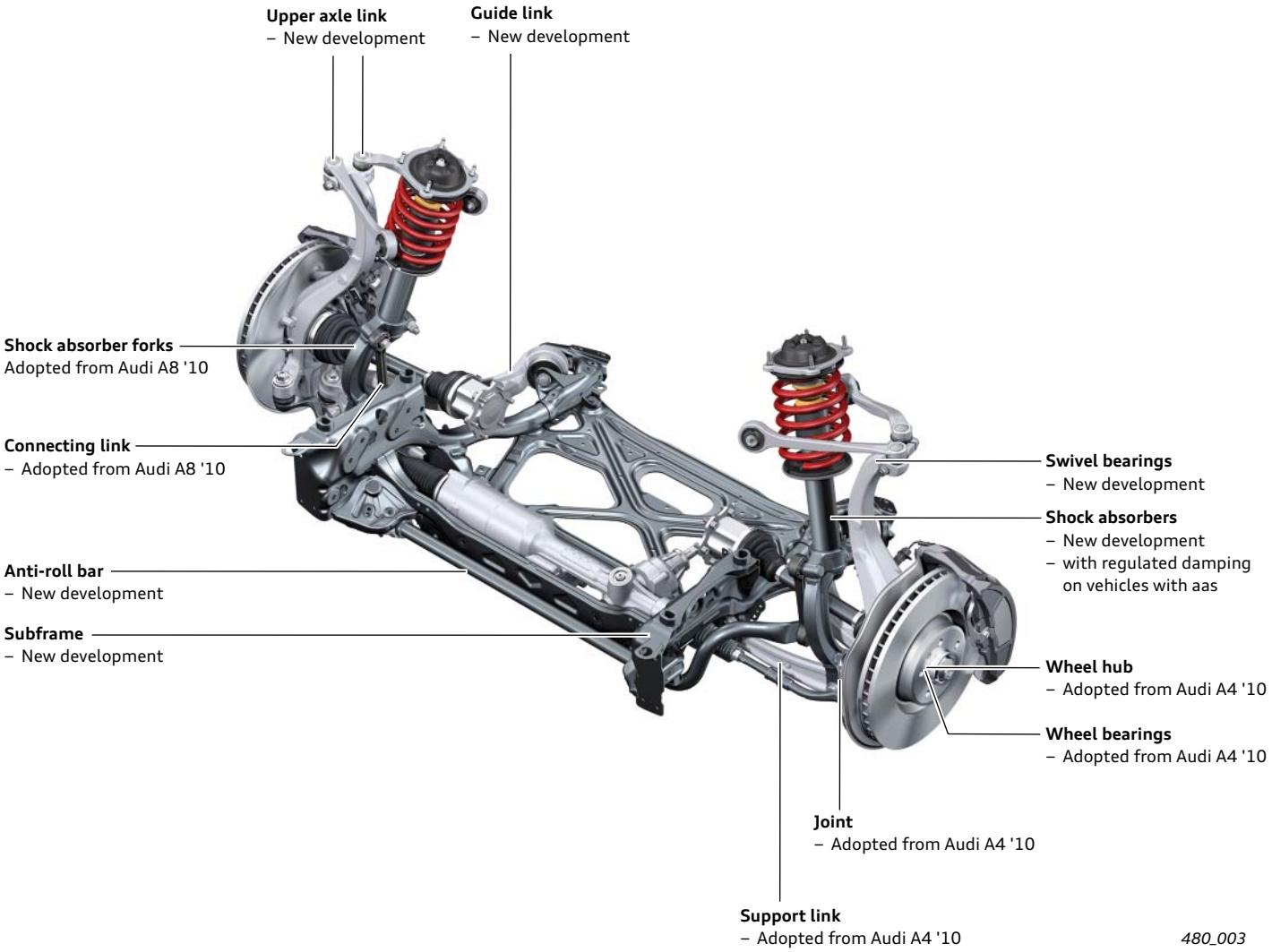
Production control no. (PR)	Description	Technical implementation	Trimming	Offer
1BA	Standard running gear / suspension	Steel suspension	0 (basic level)	Series standard
1BE	Sports running gear / suspension	Steel suspension	-10 mm	Option
1BV	Sports running gear / suspension S line as offer from quattro GmbH	Steel suspension	-10 mm	Option
1BB	Rough road running gear / suspension	Steel suspension	+13 mm	Option
1BK	Adaptive air suspension	Air suspension	dependent on the selected setting in Audi drive select	Option
1BS	Adaptive air suspension for rough road markets	Air suspension		Option

480_002

Front axle

The basis for the development of the front axle was the five-link front axle already used in the Audi models A4 '08 and A8 '10. The bearing bracket to support the upper axle link has also been integrated in the body in the Audi A7 Sportback.

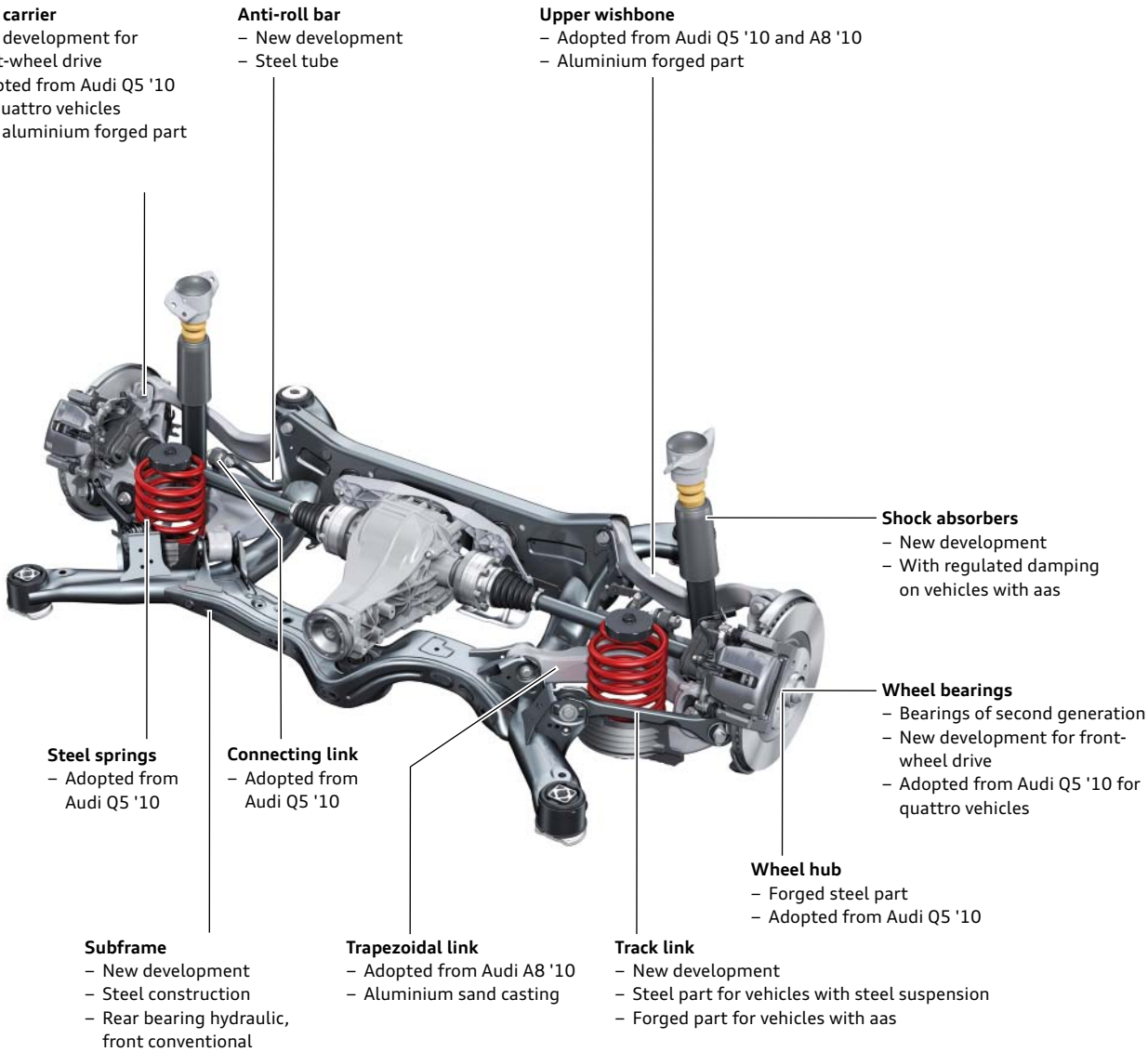
Alongside weight and rigidity optimisations, this has also enabled a reduction in the installation tolerances of the upper axle link. Stabilisers and shock absorbers have been reconfigured. The assignment of the system components is shown in the diagram.



Rear axle

The basis for the development of the rear axle was the trapezoidal link rear axle already used in the Audi Q5 '09. The springs and shock absorbers are arranged separately from one another.

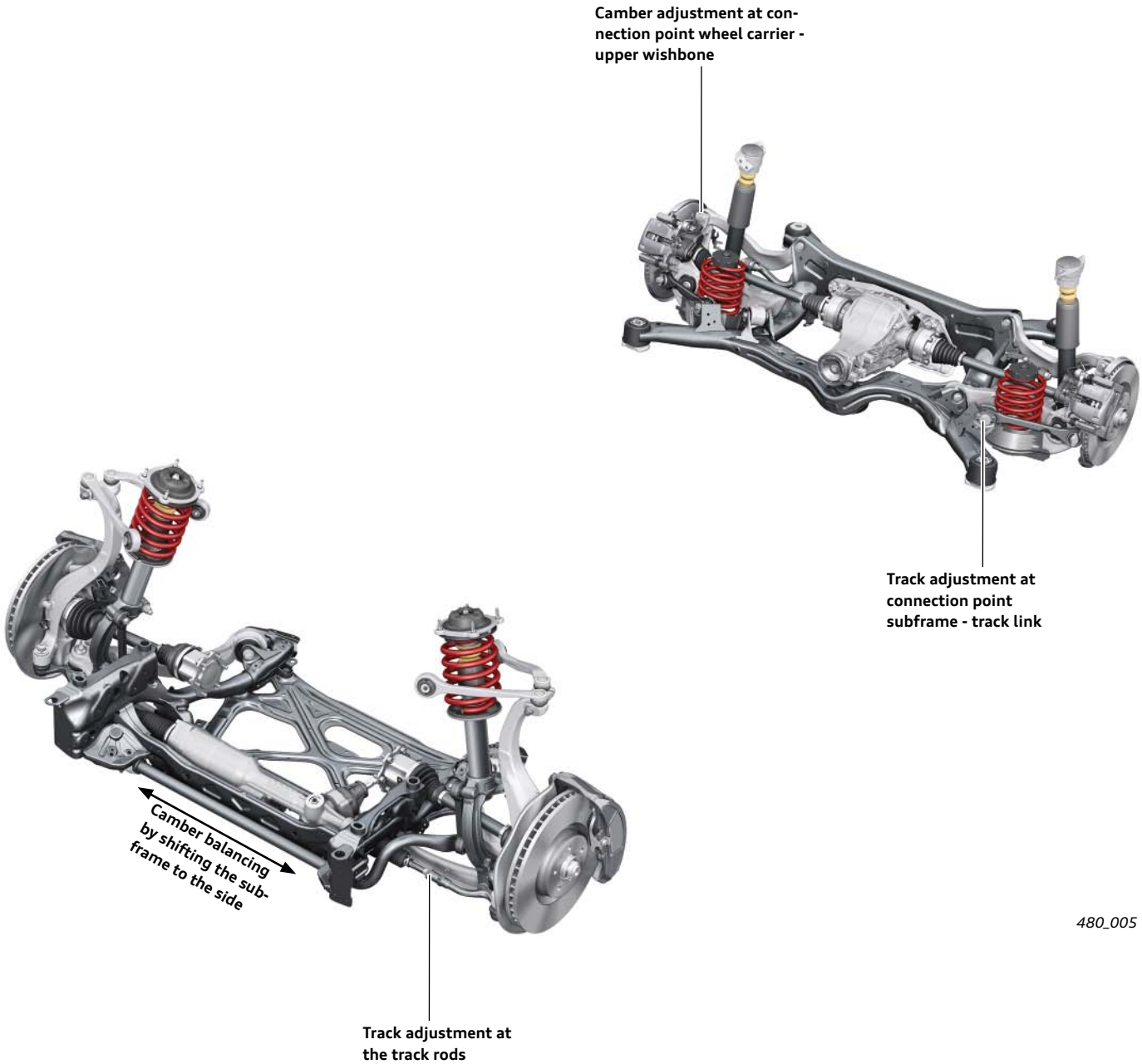
This has enabled implementation of a large through-loading facility with a level loading floor. The assignment of the system components is shown in the diagram.



480_004

Running gear alignment

The running gear alignment takes place in the same way as in the models Audi A4 ’10 and A8 ’10. The adjustment points in the case of vehicles with steel suspension and vehicles with adaptive air suspension are identical.



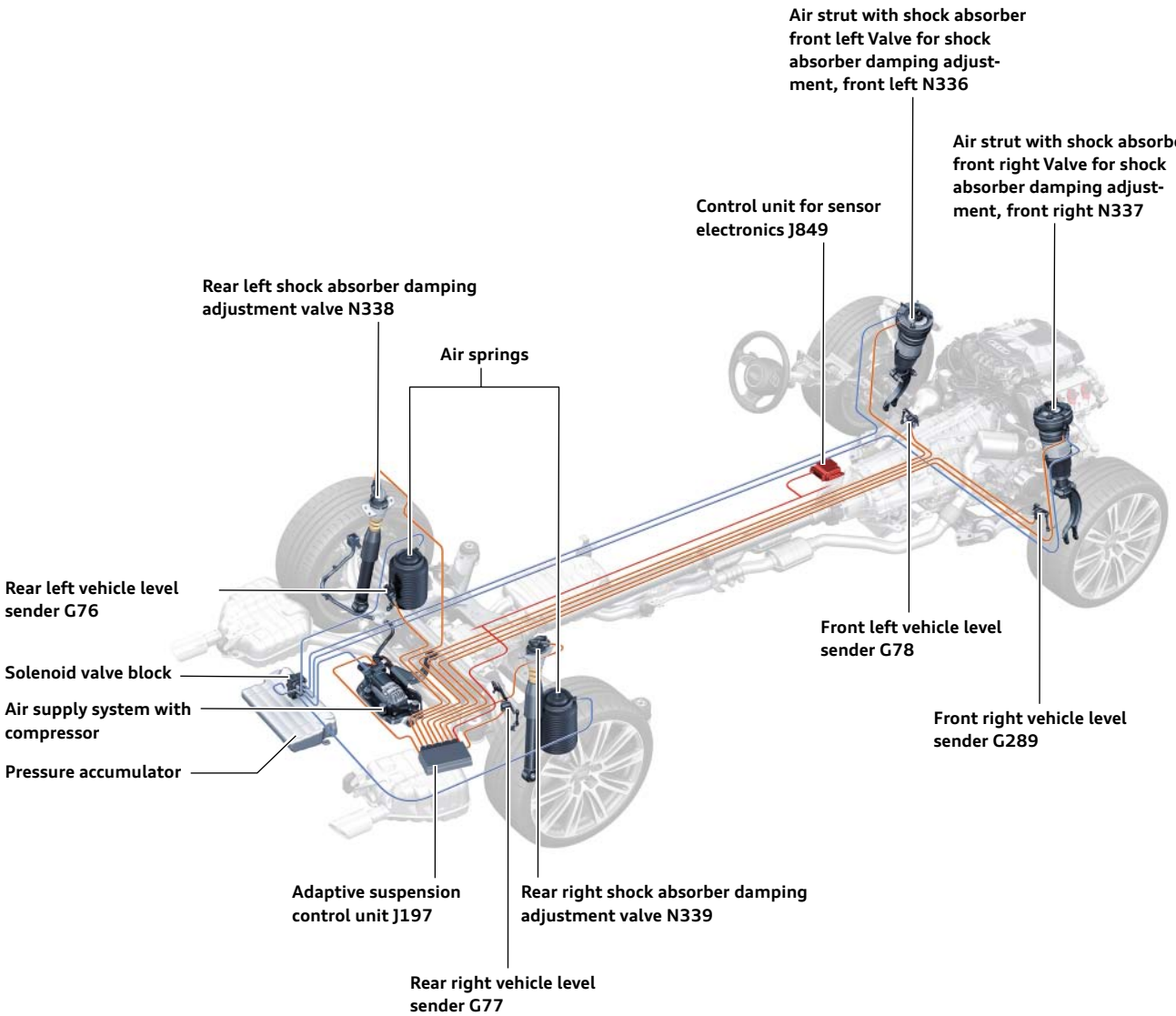
480_005

adaptive air suspension (aas)

Overview

The structure and function principles of the adaptive air suspension system of the Audi A7 Sportback essentially correspond to those of the Audi A8 '10. In the Audi A7 Sportback, two different systems are offered as options. The adaptive air suspension running gear / suspension with production control number 1BK is the base system.

The running gear / suspension 1BS, which has been specially developed for deployment on low-quality roads, is offered for certain markets. There are differences between the two systems with regard to the control programs; the system components are identical.



480_006

System components

Adaptive suspension control unit J197

The control unit communicates across the FlexRay data bus. As already implemented in the Audi A8 '10, the control unit receives the relevant vehicle accelerations across the FlexRay data bus from the control unit for sensor electronics J849. The control unit actuates the solenoid valves and the compressor for vehicle level adjustment as well as the damper valves. The damper valves are only operated while the vehicle is being driven when a road speed signal is sent from the ABS control unit J104.

The actuating currents are implemented in the range from approx. 0 A to 1.8 A. The maximum damping force is achieved at approx. 0 A while an electrical current of approx. 1.8 A is required for the minimum damping force. In order to achieve the greatest possible driving comfort, the base current applied to the damper valves is approx. 1.8 A (in the dynamic mode, approx. 1.6 A).

The control unit is fitted in the rear right of the luggage compartment.

480_007

Solenoid valve block

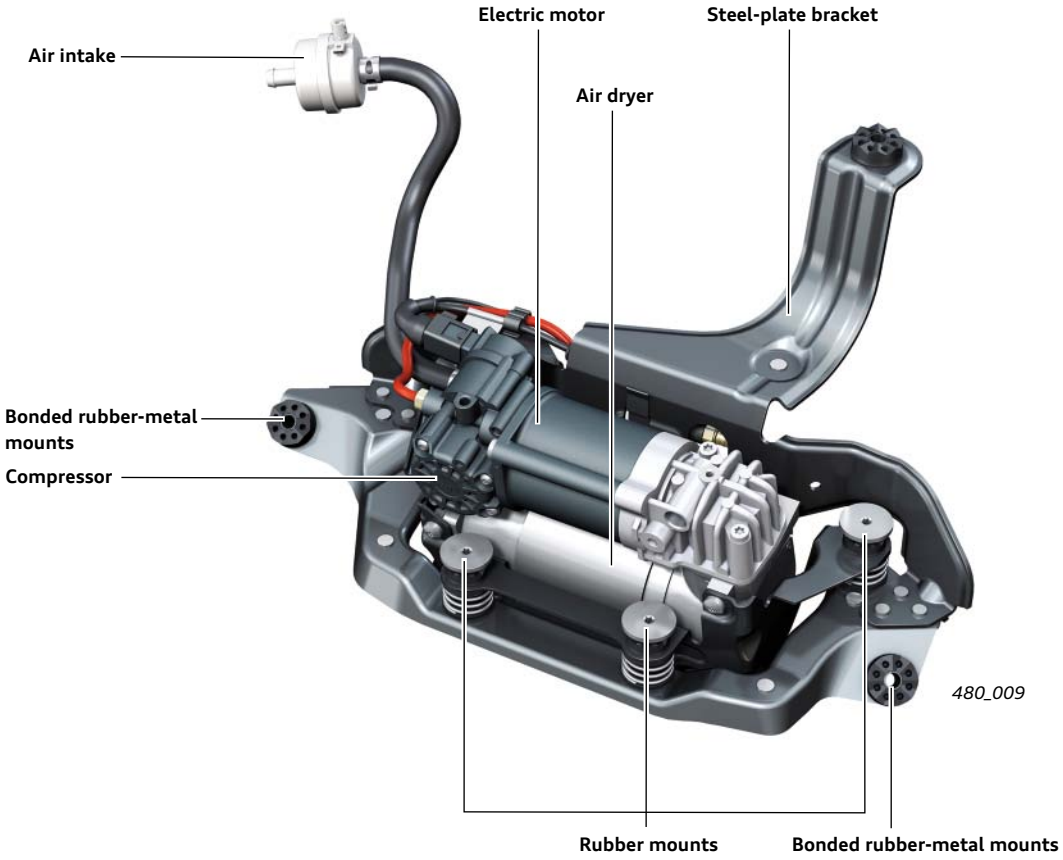
The structure and electric / pneumatic function principle of the solenoid valve block correspond to those of the Audi A8 '10. The connection assignment of the air lines and the line colours are also identical. New compared to the Audi A8 '10 is the position of the solenoid valve block in the vehicle. In the Audi A7 Sportback, it is not part of the air supply unit, rather is located as a separate component in a recess in the foam cover above the pressure accumulator. On removing the vehicle battery, the solenoid valve block can be lifted with the connected air lines out of the foam cover without removing the lines.

480_008

Air supply system

The air supply system consists of the dry-running, electric-motor-driven compressor, air dryer, intake and the corresponding air lines. The air supply system is fitted under the spare-wheel well. The above components are secured to a steel plate bracket by springs / rubber mounts, mechanically and acoustically isolated. The complete unit is also decoupled from the vehicle body acoustically by means of rubber-metal mounts. The outer cover is implemented with stone chip protection bolted onto the bracket.

The single-stage compressor generates a system pressure of 18 bar. A pressure limiting valve arranged in the compressor protects the system from overloading. The air intake is effected via intake dampers and an air dryer from the left-hand rear wheel housing. The air dryer is self-regenerating and requires no maintenance. The control speeds (up and down) are approximately the same as those of the Audi A8 '10 (refer to SSP 458). To protect against mechanical damage through overheating, the compressor temperature is determined by means of a model calculation (evaluation of the change of resistance in the magnetic coil of the drain valve).



480_009

Pressure accumulator

The task of the pressure accumulator is to maintain system availability. It also improves the acoustic characteristics, especially during control procedures when the vehicle is stationary and at low vehicle speeds. In these situations, control procedures are exclusively carried out only with the pressure accumulator, i.e. without the compressor running. The condition for this is sufficient filling of the accumulator. There can then be upward control operations with the pressure accumulator if the accumulator pressure is at least 3 bar higher than the pressure in the air spring to be controlled. In the same way as in the Audi A8 '10, the maximum accumulator pressure in the Audi A7 Sportback is 18 bar; the accumulator volume is 5.8 litres. Also in the A7 Sportback, the air lines "pressure accumulator to solenoid valve block" and "compressor to solenoid valve block" have larger cross-sections (6 mm instead of 4 mm outer diameter) to fill the accumulator more quickly. In the Audi A7 Sportback, the pressure accumulator is fitted in the spare-wheel well directly behind the vehicle battery. For weight optimisation, the pressure accumulator is made of aluminium.

480_010

Vehicle levelling sender G76-78, G289

Also in the Audi A7 Sportback, four vehicle levelling senders are used. The senders have been adopted from the Audi A8 ’10.

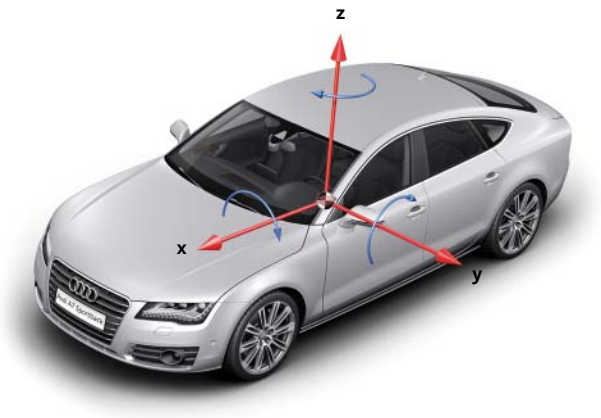
480_011

Control unit for sensor electronics J849

As already introduced in the Audi A8 '10, the control unit for sensor electronics is also used in the Audi A7 Sportback. The senders for body acceleration can be eliminated as a result.

The control unit for sensor electronics sends the vehicle acceleration values in x-, y- and z-direction as well as the corresponding yaw rates to the adaptive suspension control unit. Communication between the two control units takes place on the FlexRay data bus.

480_012



480_013

Air strut, front axle

The air struts are new developments, but their structure is the same as that of the components already used in the Audi A8 '10. Infinitely variable twin-tube shock absorbers are used. The controlled valve is located in the damper piston. The electrical line for actuating the magnetic coil in the valve is routed through the hollow piston rod. The CDC control system which has already been used a number of times in Audi vehicles is used again. A gaiter prevents dirt entering the air spring seal. There are residual pressure retaining valves on the air line connections, ensuring a minimum air pressure of 3 bar.

480_014

Air spring, rear axle

Separate air springs and shock absorbers are used on the rear axle.

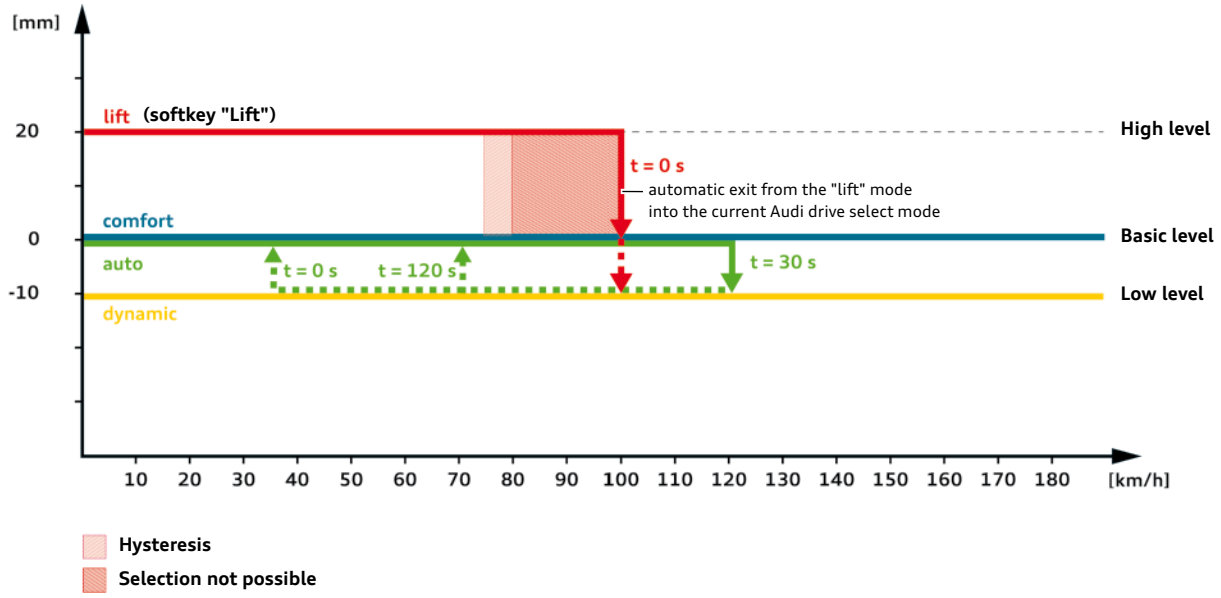
480_015

Control strategy

Control strategy for running gear / suspension 1BK without trailer operation

The control algorithms generally differ depending on the running gear and suspension variant. There are additional differences in operation with and without a trailer.

When towing a trailer, the vehicle suspension can generally not be lowered to low level in order to avoid fluctuations in draw bar load on the trailer tow bar.

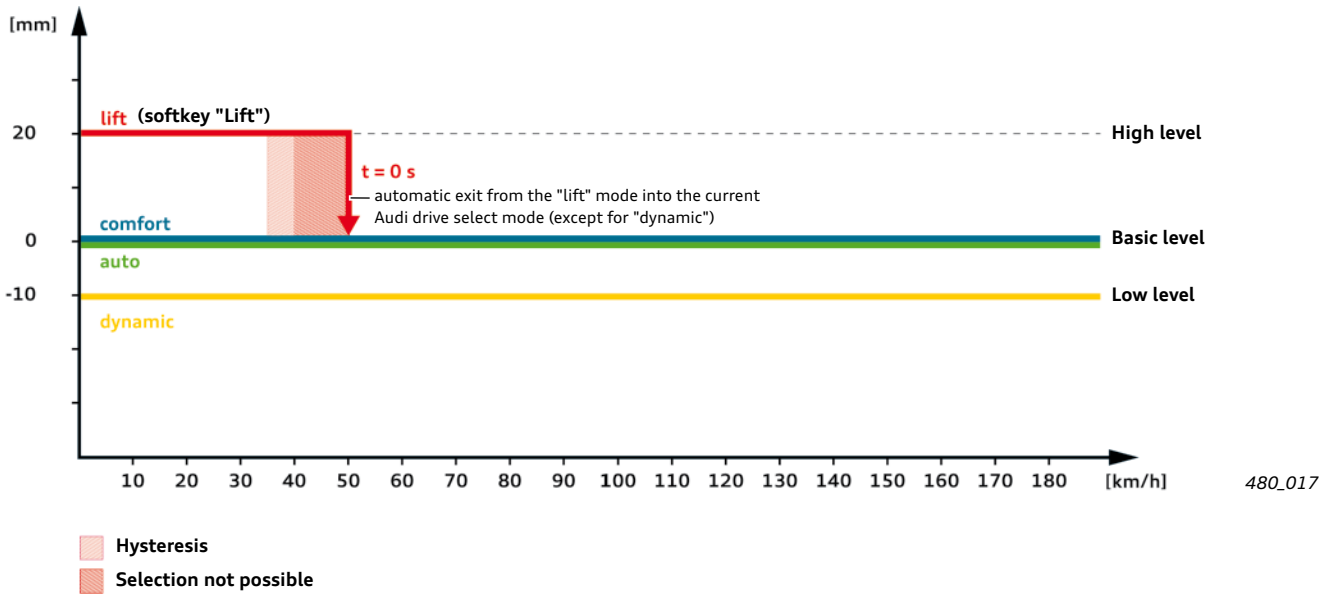


480_016

As an example, the control strategy outlined above is explained. As a general principle, the control system implements three different vehicle heights. Starting from the basic level, the "lift" mode can be set by raising the vehicle by 20 mm. The mode is immediately deactivated automatically on reaching or exceeding a vehicle speed of 100 km/h. The mode can be selected up to 80 km/h. Selecting the "dynamic" mode lowers the level by 10 mm compared to the basic level. If a road speed of 120 km/h is maintained for 30 seconds, in the "auto" mode the vehicle is automatically lowered to low level, 10 mm below the basic level.

The low level is then exited automatically in the "auto" mode if the road speed drops below 70 km/h for a period of 120 seconds or immediately after falling short of 35 km/h. In the "comfort" mode, this automatic lowering does not occur. On activating "comfort" mode, the basic level is set together with a comfort-oriented damper control.

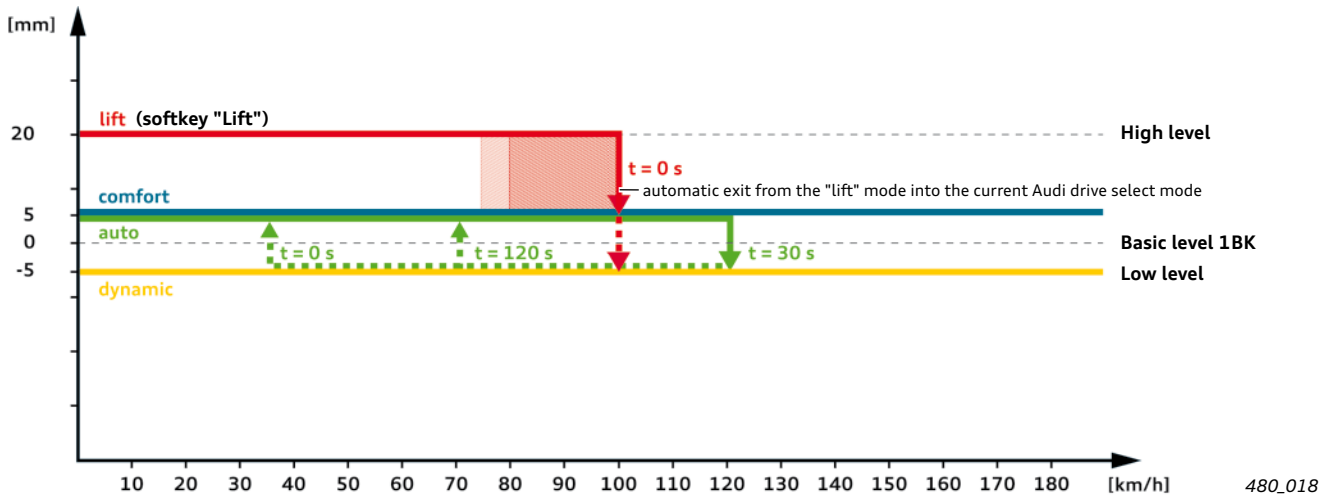
Control strategy for running gear / suspension 1BK with trailer operation



Hysteresis

Selection not possible

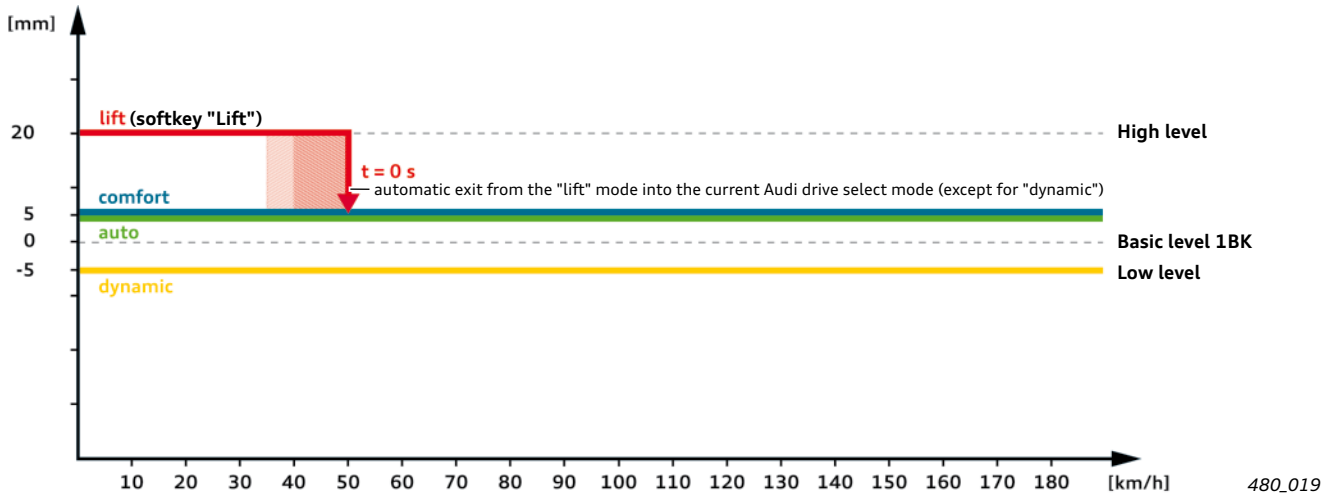
Control strategy of running gear / suspension 1BS (rough road version) without trailer operation



Hysteresis

Selection not possible

Control strategy for running gear / suspension 1BS with trailer operation



Hysteresis

Selection not possible

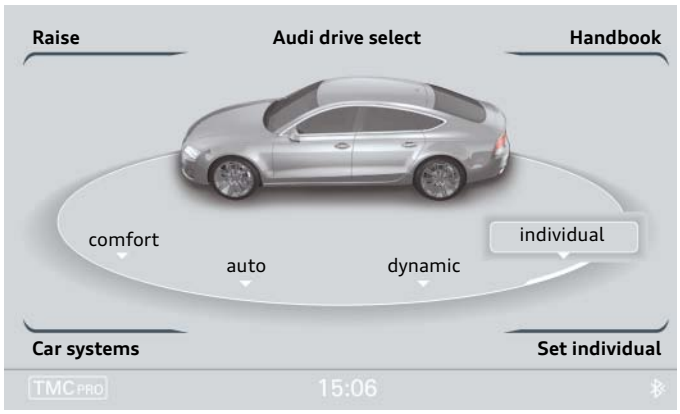
Characteristics of the control strategy

The features of the control strategy listed in SSP 458 for the adaptive air suspension system of the Audi A8 '10 also apply to the adaptive air suspension in the Audi A7 Sportback.

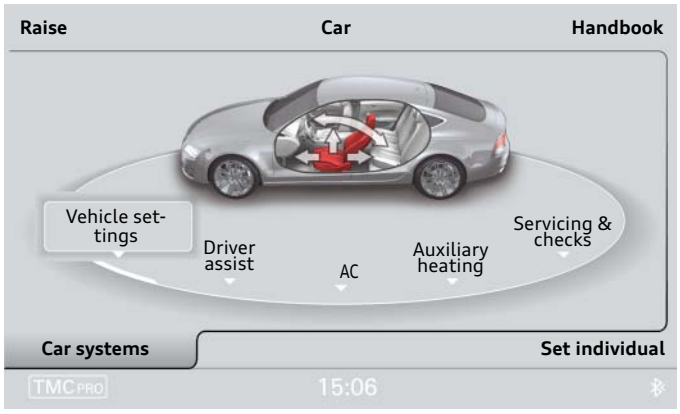
Operation and driver information

Also in the Audi A7 Sportback, the settings of the adaptive air suspension system are integrated in the Audi drive select user interface. After selection of the CAR menu, the different modes "comfort", "auto" and "dynamic" can be selected. Each mode involves the simultaneous setting of different systems from sporty to comfortable orientation. With regard to adaptive air suspension, damper forces and vehicle height levels are regulated according to defined maps. By selecting the "individual" mode, the control characteristics of the different systems can be adjusted individually. It is also possible to raise the vehicle temporarily by selecting the "Lift" function. (Details, see chapter "Control strategy")

A properly coupled and electrically connected trailer is also detected automatically by the trailer detector control unit J345 in the Audi A7 Sportback. In this case, the vehicle is shown in the MMI with trailer tow bar.



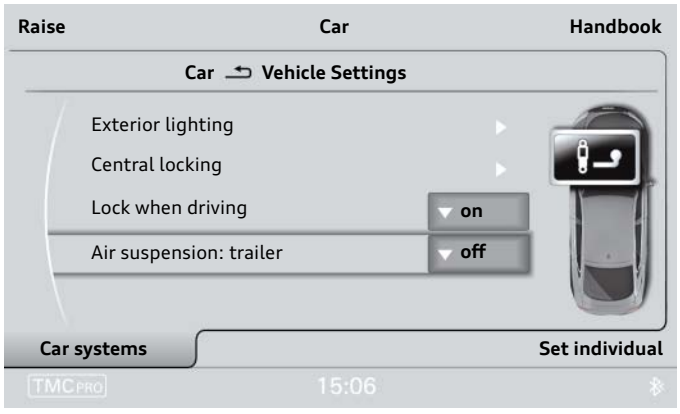
480_020



480_021

If the trailer is not automatically detected, trailer operation can be activated by selecting the function in the MMI:
"Car" - "Vehicle Settings" - "Air Springs: Trailer".

If bicycle rack systems are used, the detected "trailer" can also be deselected again.



480_022

Messages / Warnings

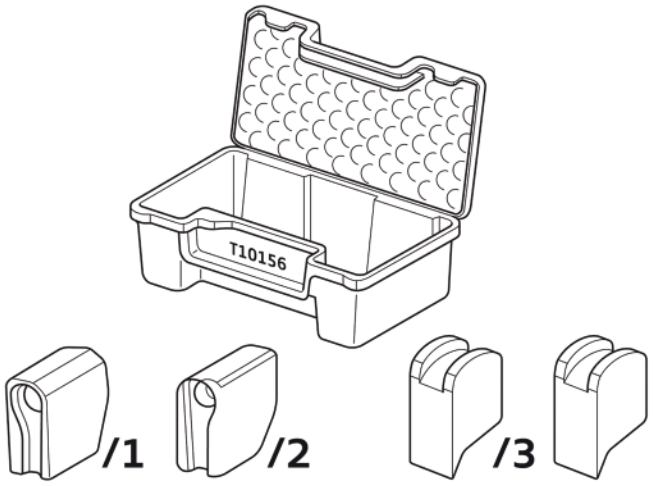
As already implemented in the Audi A8 '10, text messages for driver information are shown exclusively in the central display.

Driver information/warning messages are always shown prioritised according to urgency.

Service jobs

1. Vehicle transport

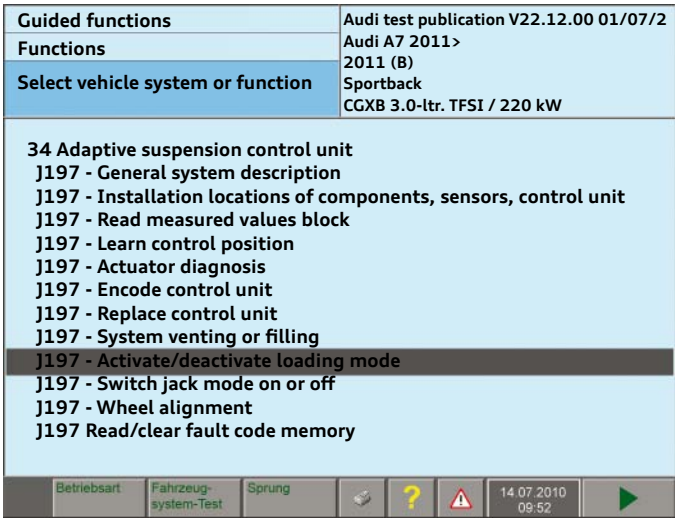
The vehicle is transported with the spring blocker kit T10156. It is not permitted to operate the vehicle using the engine when blocking elements are fitted! Steering movements are to be restricted as far as possible (maximum half a turn of the steering wheel).



480_023

Loading mode

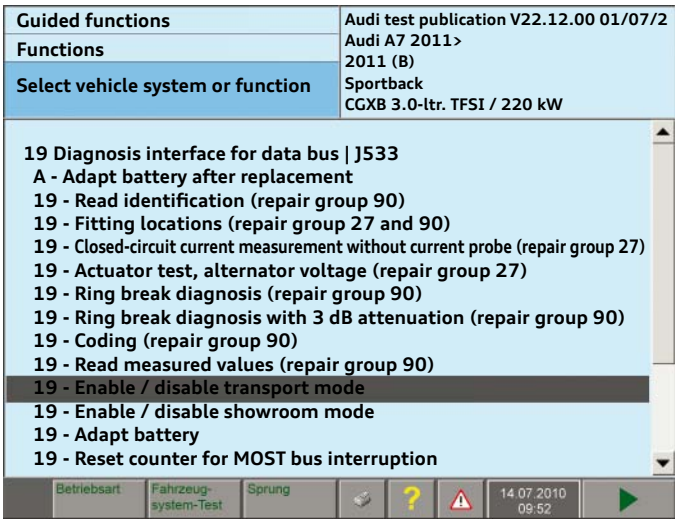
In order to achieve sufficient ground clearance for loading and as large a ramp angle as possible, it is possible to use the vehicle diagnostics tester to enable / disable a special loading mode for the Audi A7 Sportback. A vehicle level of 50 mm above basic level is set and then kept constant. For safety reasons, the mode is deactivated automatically on exceeding a vehicle speed of 100 km/h or after covering a distance of 50 km.



480_024

Transport mode

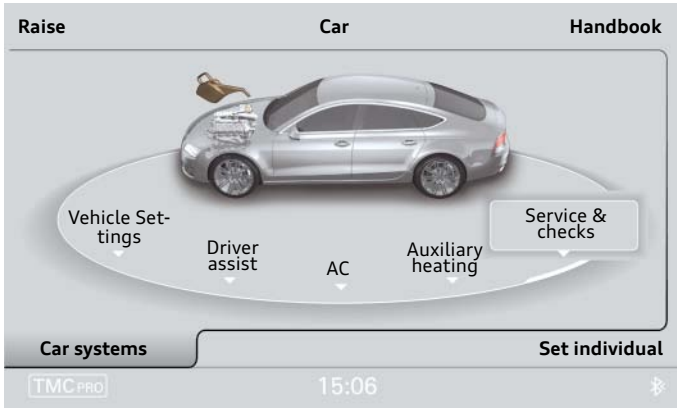
On activation of the transport mode with the vehicle diagnostics tester, the data bus diagnostic interface J533 sets shutdown stage 4. The adaptive suspension control unit reacts by suppressing / switching off the pre-run and after-run mode and switches off the power supply to the damper valves. The control unit remains in sleep mode even when input signals are received (operation of door / boot lid, change in terminal 15 status). For safety reasons, the transport mode is automatically disabled after a short journey.



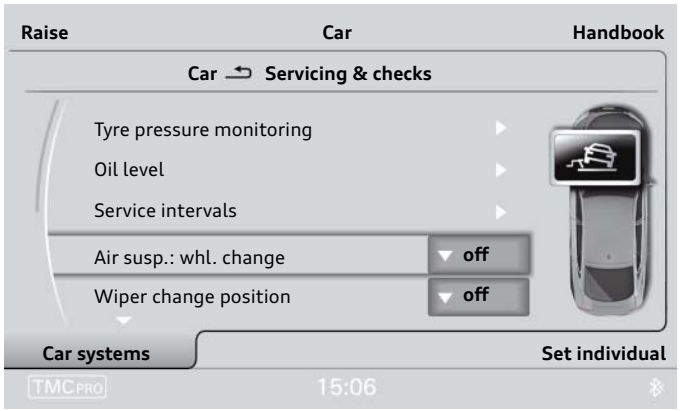
480_025

2. Removing and installing/replacing system components and additional jobs

The system recognises when the vehicle is raised on a hoist or at the wheel and consequently prevents all control operations. Air is released for a short time prior to automatic detection. For safety reasons, it is recommended to always additionally switch off the control system manually before starting any service jobs. The shutdown is enabled by selecting "Service & Inspection" - "Air Springs: Wheel Change" in the MMI. The activated function is automatically reactivated at a road speed of 10 km/h or can be disabled in the specified MMI menu.



480_026



480_027

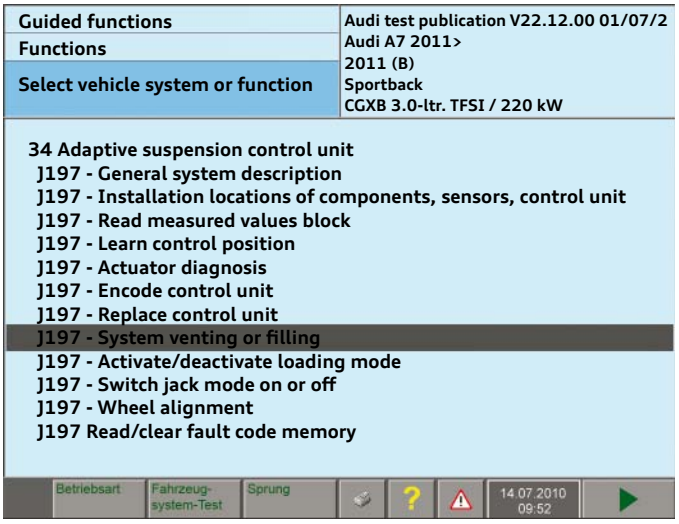
Adaptive suspension control unit J197

After installation, a new control unit must be encoded online. Once the "Encode control unit" function has been started on the vehicle diagnostics tester, the data record is downloaded first. Here, the software components required for operation of the control unit in this vehicle are loaded from the central database into the control unit. Within the framework of the subsequent encoding, the control unit is notified regarding the vehicle equipment (ACC, trailer tow bar) in question. Since the teach-in values of the level sender signals have not yet been stored in this new control unit, coding is to be followed by running the "Learn control position" function.

480_007

Air strut, solenoid valve block, compressor and pressure accumulator

The air system must be opened in order to remove these components. The system must be vented beforehand. As the air springs on the rear axle have no residual pressure retaining valves, the vehicle must never under any circumstances be placed on its wheels when the system is vented! Non-compliance can damage the air springs! Particular care must be taken when connecting the air lines, especially at the solenoid valve block, to ensure the connections are not interchanged. The air pressure must be corrected (refilled) before installing new air spring struts on the front axle. The "Learn control position" function must be carried out before reinstalling the air springs.



480_028

Vehicle level sender

The "Learn control position" function must be carried out after replacing a sender. Since, for tolerance reasons, the new sender returns different measured values for the same vehicle level, the measured value / vehicle ride height allocation must be sent to and stored in the control unit. The control unit "recognises" the characteristic curve of the senders and their mechanical ratio when installed (vehicle level change to measured value change). Consequently, when the assignment of the vehicle level to measured value is known for all level positions through the "Learn control position" function, the control unit can determine the assigned level for all other measured values.

480_011

Air lines

If damaged / leaking, air lines and their connections can be replaced and air lines can be repaired. The air system must be vented before its is opened. As the air springs on the rear axle have no residual pressure retaining valves, the vehicle must never under any circumstances be placed on its wheels when the system is vented! Non-compliance can damage the air springs! Particular care must be taken when connecting the air lines, especially at the solenoid valve block, to ensure the connections are not interchanged. On replacement of the lines, it must be ensured that the line from the solenoid valve block to the pressure accumulator is always replaced as a shaped line. The specifications for repairs to air lines are the same as those for systems already used at Audi. The same applies to determining the causes of leaks.

Cutting pliers VAS 6228 for cutting air lines to length *480_029*

3. Special system statuses

Low level

After prolonged vehicle immobilisation periods, it is possible that the vehicle level may drop below a level suitable for driving. This behaviour is consistent with the system and does not constitute a fault. This situation is caused by the connections of the air lines and the air spring seals themselves that are naturally subject to slight air loss. After the ignition is turned on, a warning appears in the central display, drawing the driver's attention to this situation. The compressor is already activated although the engine has not yet been started. The aim is to raise the vehicle level as fast as possible to a relatively non-critical level.

If the low level is caused by a major leak in the system, i.e. a defect, it will not be possible to raise the vehicle to the required level within a defined period of time. The control unit recognises that there is a fault in the system and issues a corresponding medium priority warning (yellow) on the central display.

Extreme high level

In rare cases, it is also possible that the vehicle assumes an extremely high level. This can occur at short notice when a heavily loaded vehicle is unloaded very quickly.

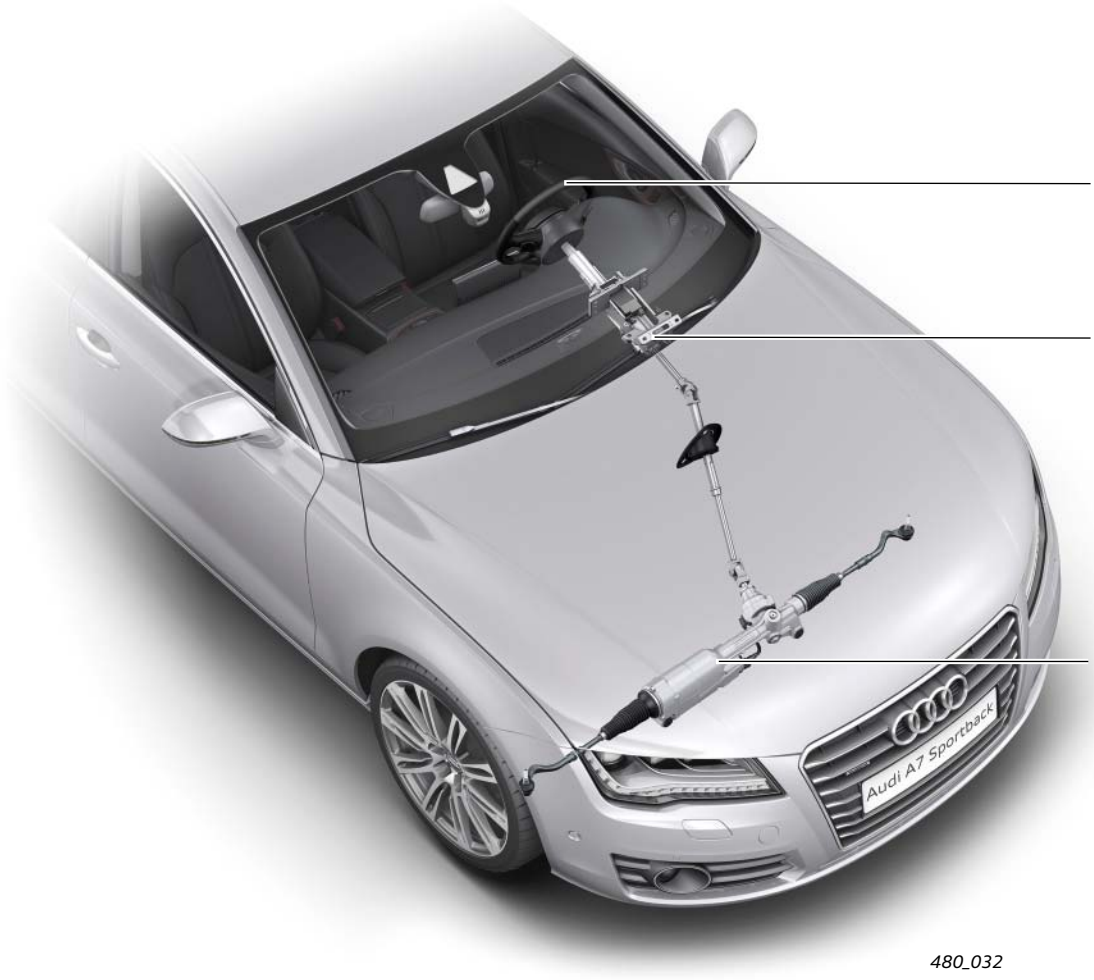
If this situation persists, a system fault can be assumed and a high priority warning (red) is shown in the central display.

Steering system

Overview

The major innovation on the steering system of the Audi A7 Sportback is the use of electromechanical steering. The Servotronic function is thus fitted as standard. With basic equipment, the steering column is mechanically adjustable.

An electrically adjustable steering column is offered as an option. With basic equipment, the vehicle is equipped with a four-spoke multifunction steering wheel. A three-spoke multifunction sports steering wheel in different variants can be ordered as an option.



Four-spoke multifunction steering wheel as basic equipment

Three-spoke multifunction sports steering wheel in different variants as an option

Mechanically adjustable steering column as basic equipment

Electrically adjustable steering column as an option

Electromechanical steering with Servotronic function as basic equipment

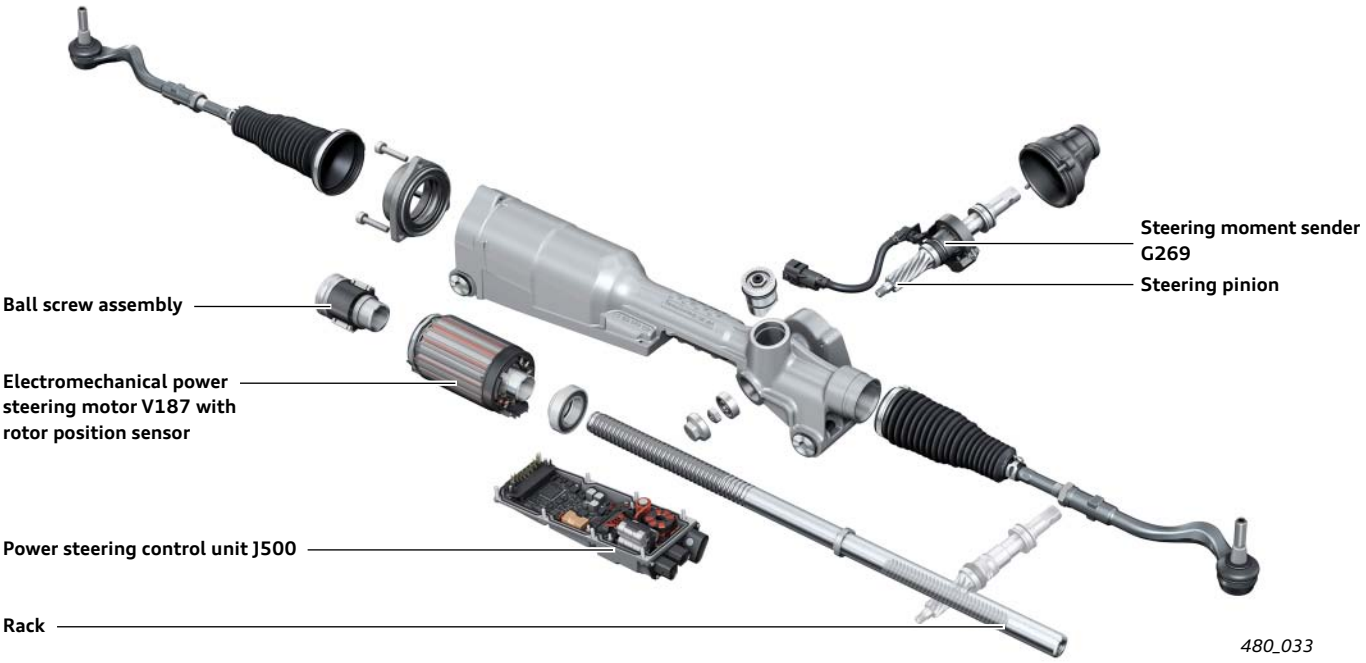
480_032

Electromechanical steering

Overview

A new generation of electromechanical steering is used in the Audi A7 Sportback. The base function is the implementation of power-assisted steering by means of an electric motor arranged concentrically in relation to the rack. This concept was selected because it enables high performance capability with relatively small construction space. The rack, electric motor, drive gearing by means of a ball screw assembly, electronic control unit and the necessary sensor system are integrated in a compact construction unit.

For the complete unit, this has enabled a reduction in weight to only approx. 16 kg. The electromechanical generation of the power-assisted steering achieves fuel consumption reductions of up to 0.3 litres / 100 km. An additional advantage is the implementation of auxiliary functions through the possibility to vary the power-assisted steering according to requirements.

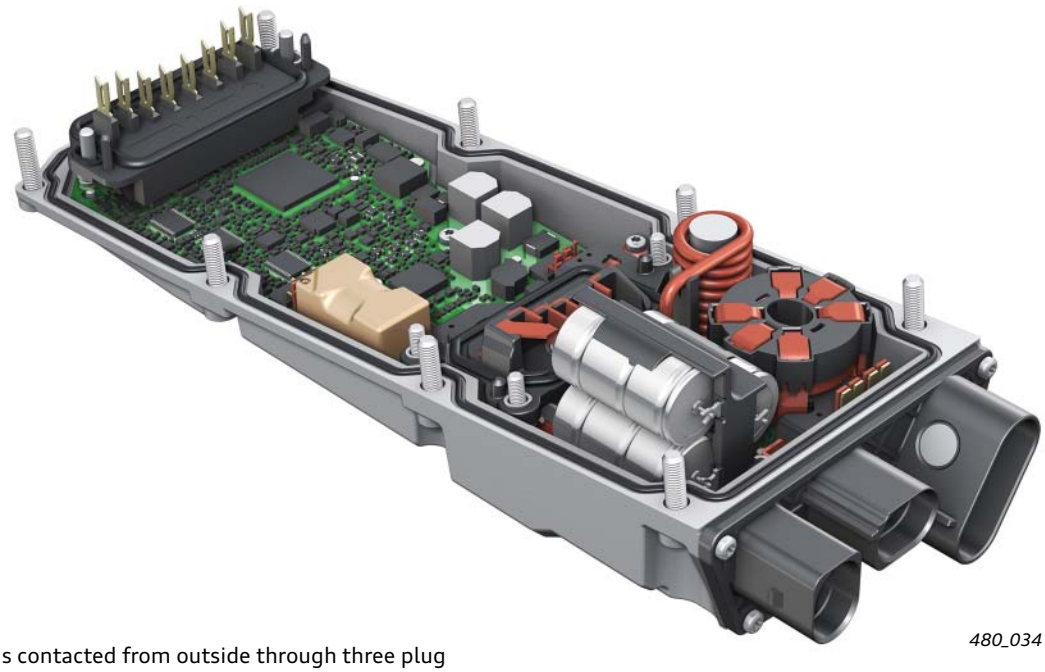


System components

Power steering control unit J500

On the basis of the input information rotor position and steering moment, the control unit determines the pattern for the phase voltages. The phase currents this creates generate the torque of the electric motor. The torque depends on the current intensity.

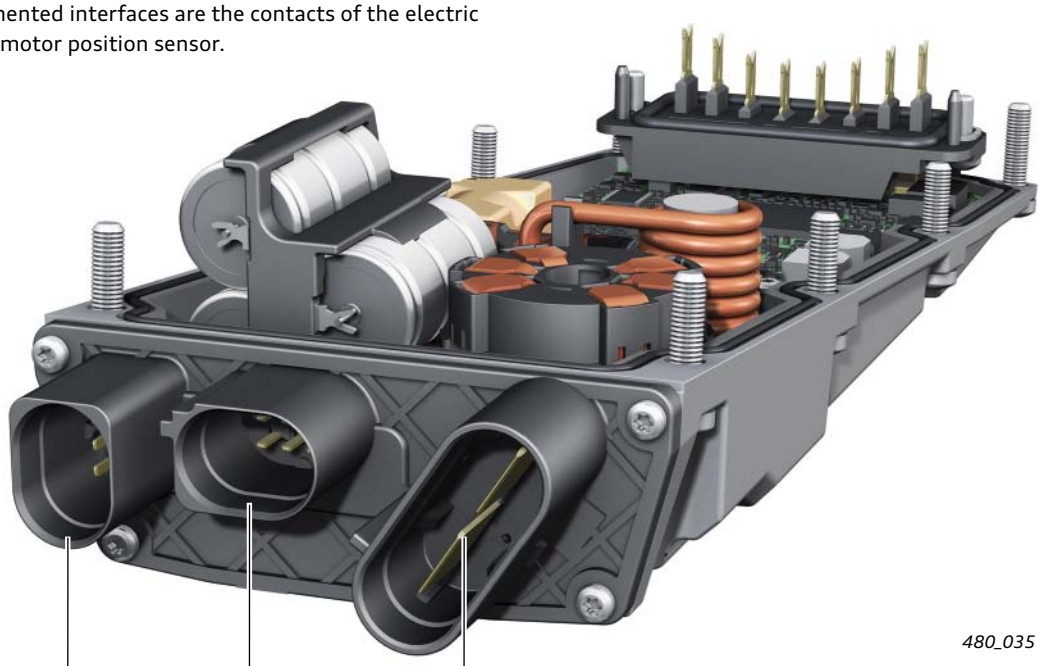
These assignments are stored in the control unit. The control unit communicates across the FlexRay data bus, which was already implemented in the Audi A8 '10. The output stage for activation of the electric motor is also integrated in the control unit.



480_034

The control unit is contacted from outside through three plug connections.

Internally implemented interfaces are the contacts of the electric motor and of the motor position sensor.



480_035

Sensor signals from the steering moment sender G269

Terminal 15 and FlexRay connection

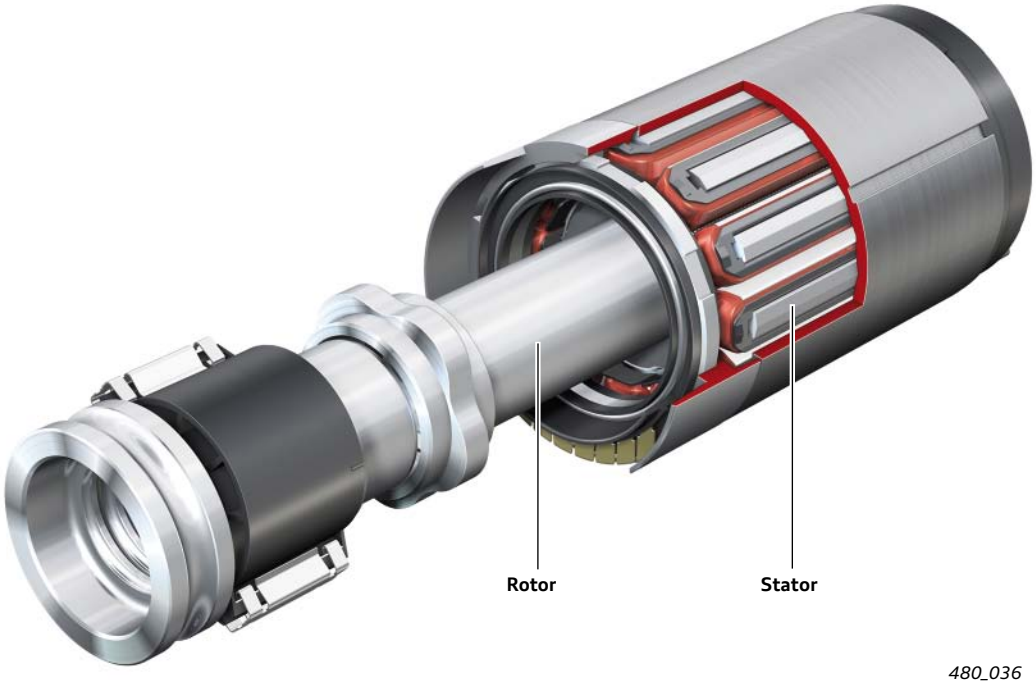
Terminal 30 and Terminal 31

Electromechanical power steering motor V187

The electric motor delivers the steering moment required for power-assisted steering. A permanently excited three-phase current synchronous motor is used. This motor concept is used because of several major advantages. Synchronous motors feature compact design with high power output. The permanent excitation eliminates the need for the slip rings to transfer the exciting current to the rotor. The control unit calculates the necessary phase voltages and applies them via the output stage to the stator coils. The stator comprises 12 field coils.

Three groups of 4 coils are connected in series and energised by a sinusoidal current curve. The three currents are phase-shifted in relation to one another. The three magnetic fields generated in this way result in a rotating magnetic field that produces the synchronous turning motion of the rotor.

The rotor with the 10 permanent magnets in alternating north-south arrangement is designed as a hollow shaft and is mounted on the rack.



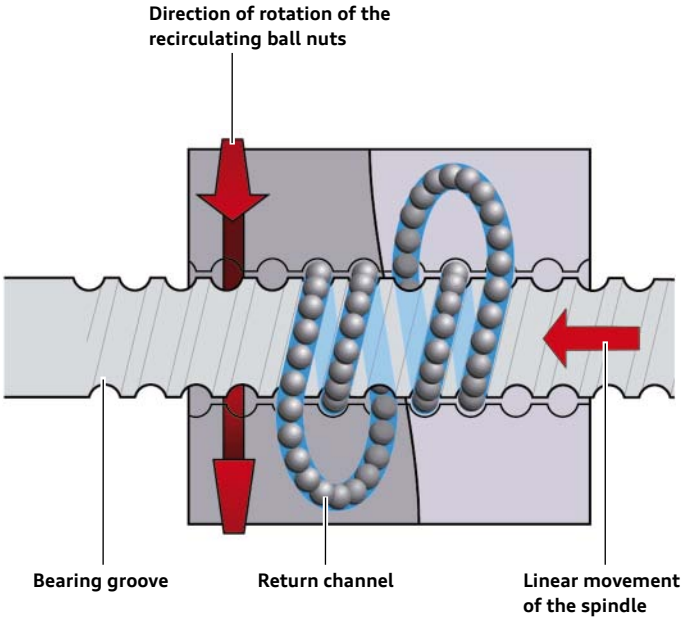
480_036

Ball screw assembly - function principle

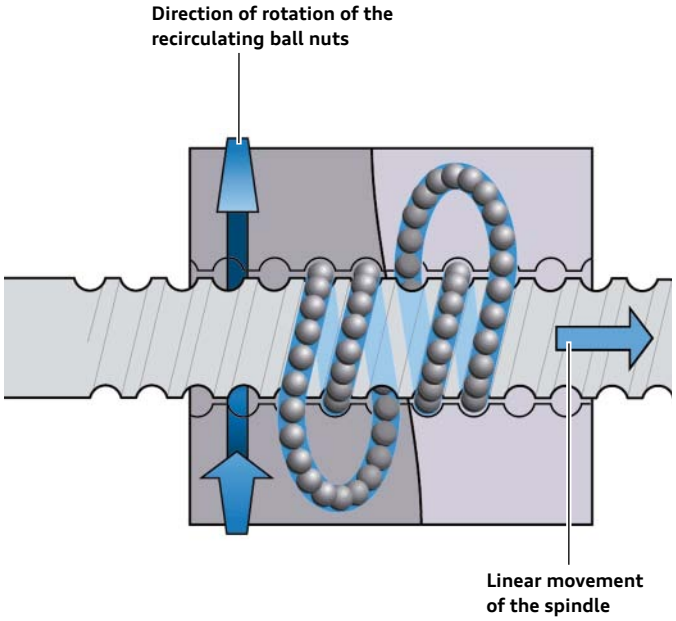
The turning motion of the electric motor is converted into a linear movement of the rack by means of a ball screw. The functional principle is similar to that of a conventional bolt-nut system. The threads are replaced by bearing grooves; the connection between the bolt (spindle) and nut (recirculating ball nut) is made by ball bearings in the bearing grooves. The ball bearings roll in the same way as the roller elements in a bearing in a closed circuit. To achieve this, the recirculating ball nut contains a return channel that connects the "beginning" and "end" of the bearing grooves of the recirculating ball nut.

On reversal of the direction of movement of the recirculating ball nut and the rolling direction of the ball bearings, the spindle also changes its direction of movement.

In comparison with a conventional screw assembly, this principle of conversion of a turning motion into a linear movement requires only approx. one third of the drive output. The cause of this is the reduced friction, as the ball bearings only make punctiform contact with the bearing grooves. This is associated with a low level of wear and high positioning accuracy due to low installation clearance.



480_037



480_038

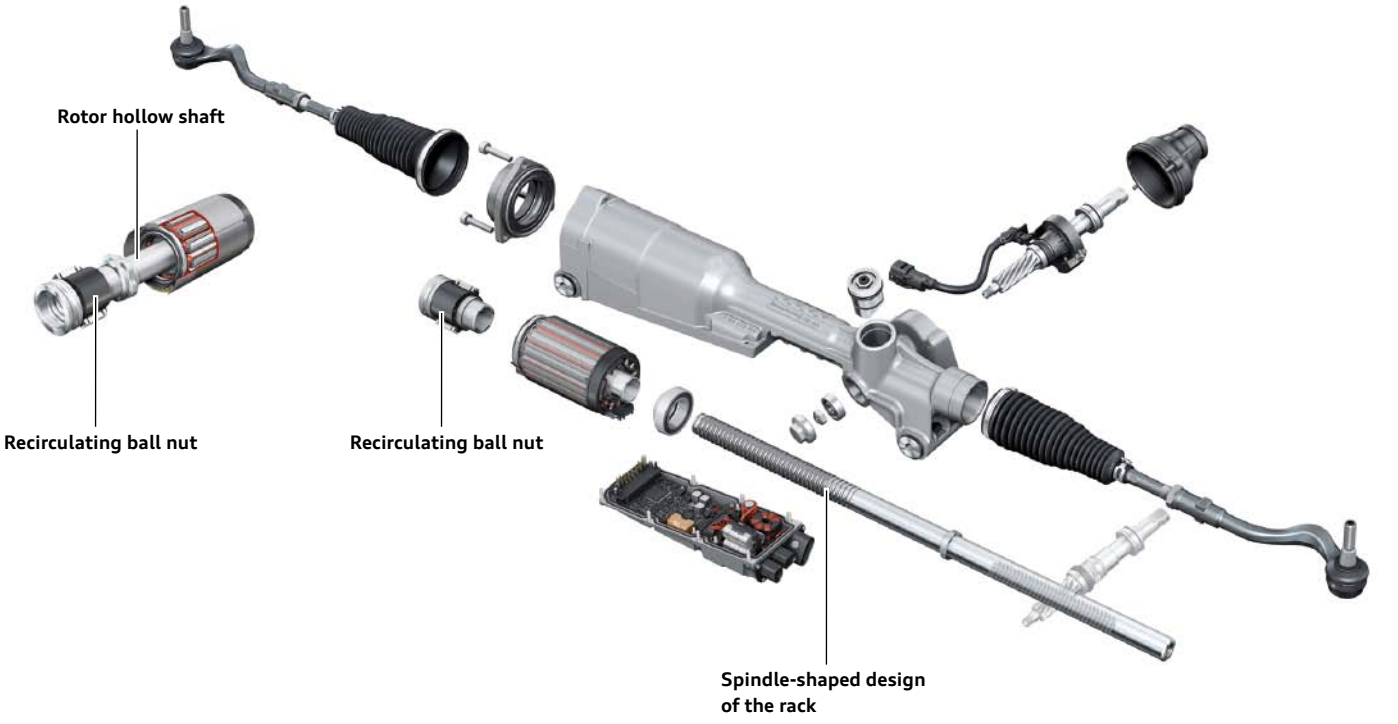
The recirculating ball nut is fixed in longitudinal direction. If it is turned, there is a linear movement of the spindle in the direction of the arrow.

To restrict contact among the ball bearings, "ball circuits" that are as short as possible are advantageous. This is why two separate circuits are implemented in the recirculating ball nut.

Ball screw assembly - technical implementation in the Audi A7 Sportback

In the Audi A7 Sportback, the recirculating ball nut is connected firmly to the rotor hollow shaft. The rack is designed as a spindle at one end. On activation of the electric motor, the rotor hollow shaft and the recirculating ball nut are turned.

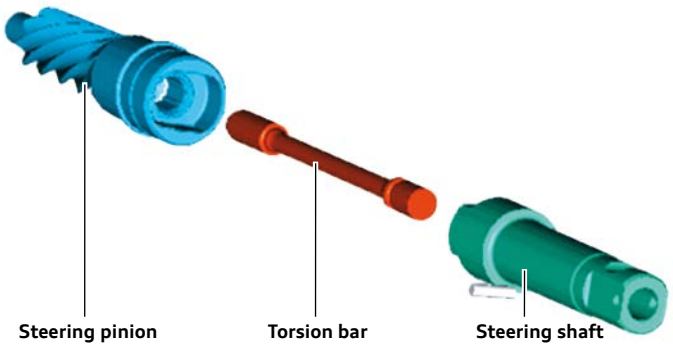
As shown above, this causes a linear movement of the rack. Depending on the direction of rotation of the electric motor, power-assisted steering is available when the wheels are turned to the right or left. The current intensity with which the electric motor is activated regulates the amount of supporting steering moment.



480_039

Steering moment sender G269

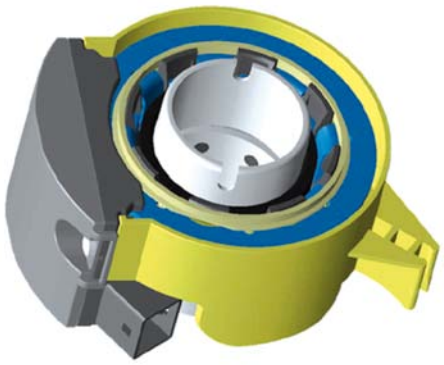
The basis for calculation of the moment required in each case for power-assisted steering is the steering moment applied by the driver. The steering moment is determined by the steering moment sender G269. In the same way as in conventional hydraulic steering with a steering valve, the connection of the steering pinion with the steering shaft is made by means of a torsion bar. If the driver steers, the torsion bar and thus also the steering shaft are turned relative to the steering pinion. The extent of this turn depends on the amount of steering moment applied by the driver. The steering moment sender G269 measures this turn.



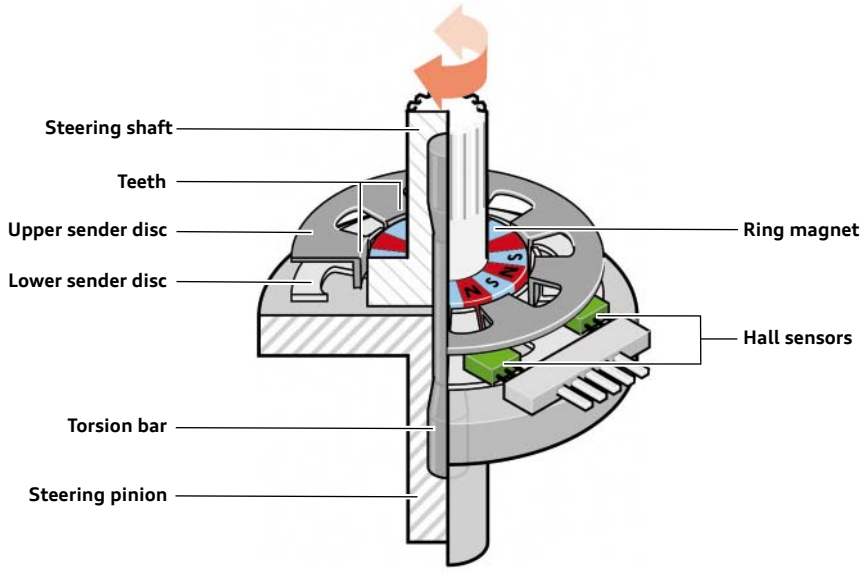
480_040

Design

A ring magnet with eight pairs of poles is firmly attached to the steering shaft. Two sender discs, each with eight teeth, are firmly connected to the steering pinion. The teeth of the two sender discs are arranged as offset in such a way that when viewed from above towards the axis of rotation the teeth of one sender disc are located in the tooth gaps of the other sender disc. Centred between the two sender discs are two Hall sensors, firmly connected to the housing.



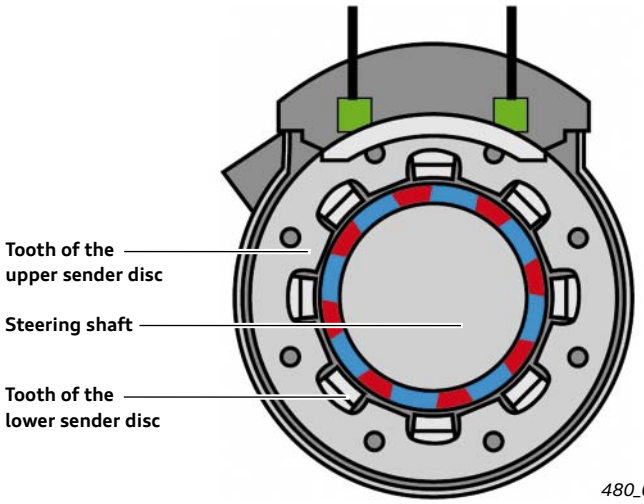
480_042



480_041

Function

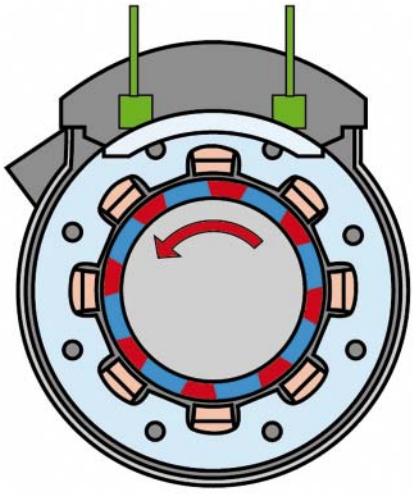
If the steering wheel is not moved, the sender discs are aligned to the magnetic poles in such a way that the teeth of the sender discs are located precisely in the middle between the north and south poles. This means that both sender discs are penetrated by the magnetic field lines in the same manner. No magnetic field is formed between the sender discs. The same sensor output signal is present at both Hall sensors.



480_043

View from above in direction of the steering shaft (= axis of rotation)

A steering wheel movement leads to the torsion bar turning and thus also to a relative movement of the magnetic ring in relation to the sender discs. The turning of the magnetic ring changes the position of the poles in relation to the sender discs. The teeth of the sender discs leave the central position in relation to the north and south poles. Depending on the steering direction, the teeth of one sender disc are proportionally more opposite the north poles, those of the other sender disc proportionally more opposite the south poles. This unsettles the magnetic circuit. The magnetic flow is measured by the Hall sensors.



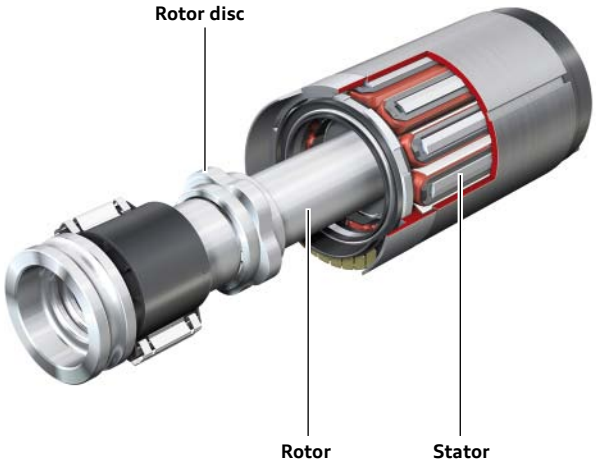
480_044

Rotor position sensor

The rotor position sensor picks up the position of the rotor. The control unit must know the exact position of the rotor in order to be able to calculate the necessary phase voltages for the surrounding stator magnetic field (electronic sensor-controlled commutation). The measured value of the rotor position sensor is also used to determine the steering limit stops. In order to avoid hard, mechanical limit stops, the electromechanical steering implements "soft" end limit stops.

Design

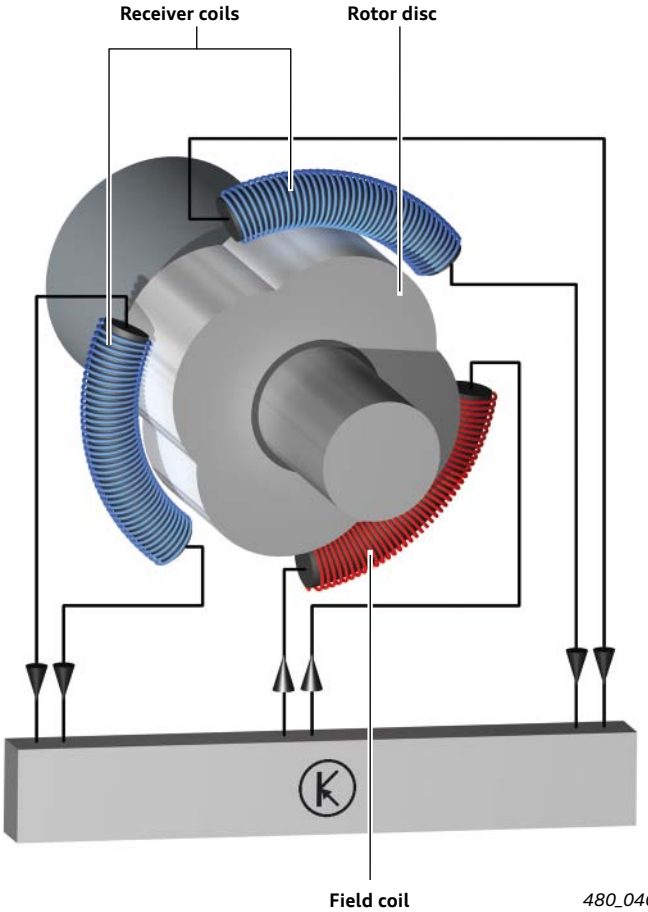
A disc made of flow-conducting metal is attached to the rotor. This rotor disc has a special shape similar to that of a curve disc. It is surrounded by a magnetic coil ring attached to the housing that functions as the stator. This coil ring comprises three individual coils of which one acts as the field coil and two as receiver coils.



480_045

Method of operation

The field coil is supplied a sinusoidal exciting voltage. The magnetic alternating field that builds up around the field coil affects the rotor disc. The rotor disc feeds the magnetic flow of the magnetic alternating field generated by the field coil to the receiver coils.
This induces an alternating-current voltage in the receiver coils which is de-phased proportionally to the position of the rotor disc compared to the exciting voltage.



480_046

Method of operation

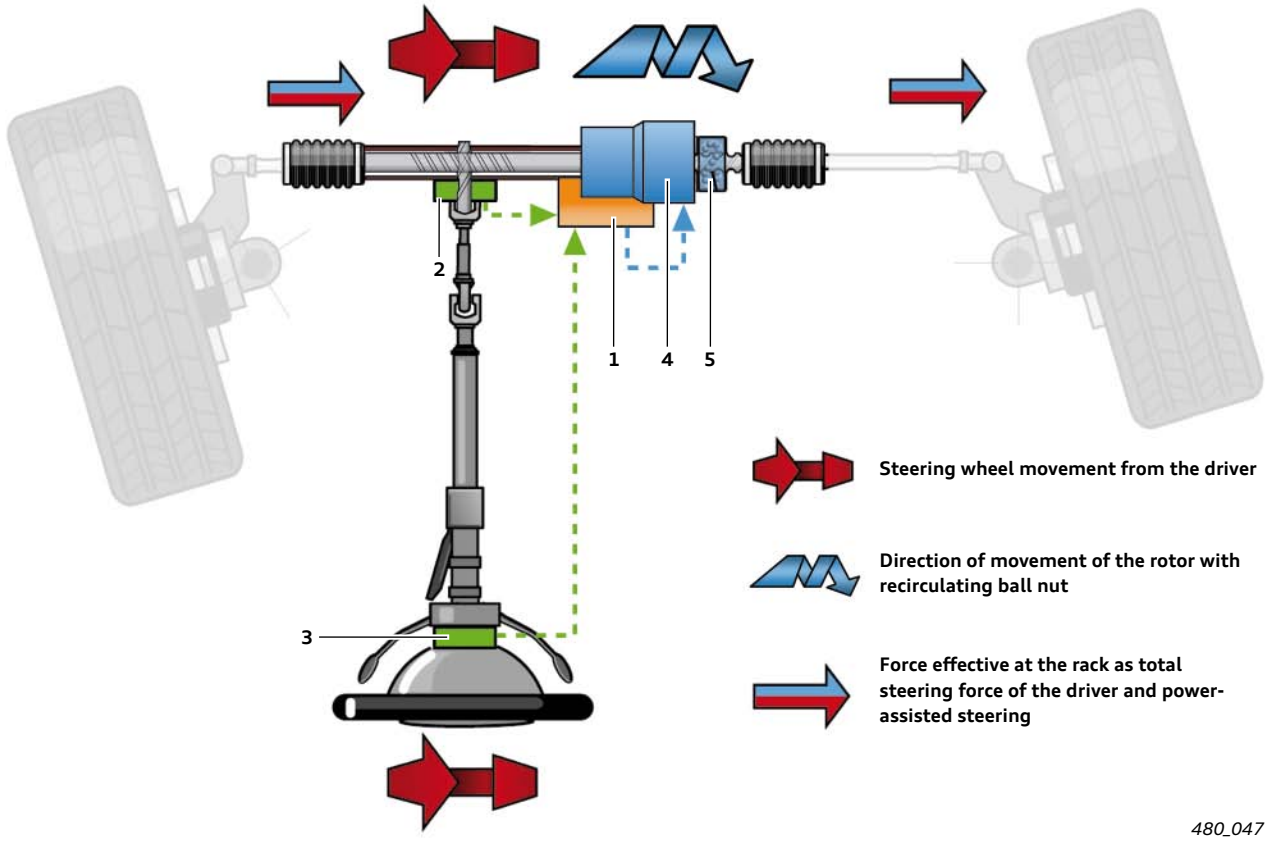
1. Opening the driver's door
Opening the door wakes up the FlexRay data bus and communication of the control units is started.
Initialisation routines are started by the control unit J500 and a self-test of the system is carried out.

2. Turning on the ignition (terminal 15 on)
The indicator lamp is checked by the control unit in dash panel insert J285 by means of short activation. If no system error is determined, the indicator lamp goes out after a few seconds.

3. Engine start (terminal 50 on)
If the engine speed exceeds 500 rpm, the power-assisted steering is active. As soon as the torsion bar is not turned by the effect of force on the steering wheel (recognition by means of steering moment sender G269), the signals of the steering angle sender G85 are synchronised with those of the rotor position sensor. The dependency of the two measured values on one another is stored as a map in the control unit J500. During subsequent vehicle operation, the steering wheel movements are picked up by evaluating the signals of the rotor position sensor.
The choice of the corresponding drive setting in Audi drive select is taken into account by the control unit to determine the corresponding map of the power-assisted steering for regulation.

4. Vehicle operation
During vehicle operation, the amount of power-assisted steering is defined essentially on the basis of the steering moment, the wheel angle and the road speed. The activation currents for the electric motor are calculated by the control unit and the stator coils are energised by the output stage with the corresponding currents. The force exerted by the electric motor with the ball screw assembly on the rack reinforces the steering force applied by the driver.

5. Shutdown of the power-assisted steering
When the internal combustion engine is switched off while the vehicle is still moving, the power-assisted steering is switched off in a ramp when the road speed falls below 7 km/h.

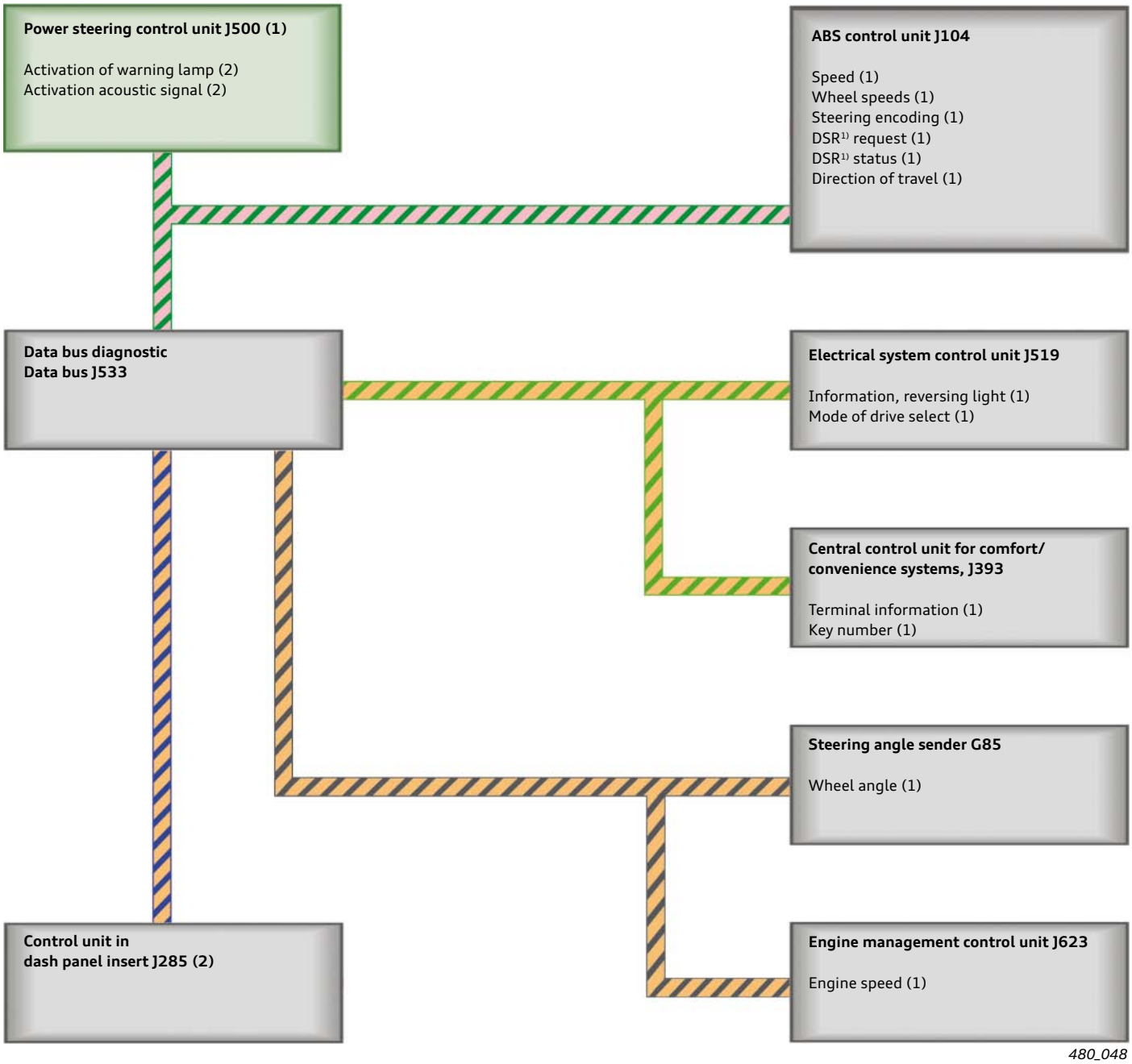


1. Control unit for electromechanical steering J500
2. Steering moment sender G269
3. Steering angle sender G85
4. Electromechanical power steering motor V187
5. Recirculating ball nut

Data interchange

The diagram shows the information relevant to the system that is received and transmitted by the power steering control unit J500.

The figure in parentheses following the information indicates which control unit requires this information.



1): DSR = driver steering recommendation

FlexRay

Comfort/convenience CAN

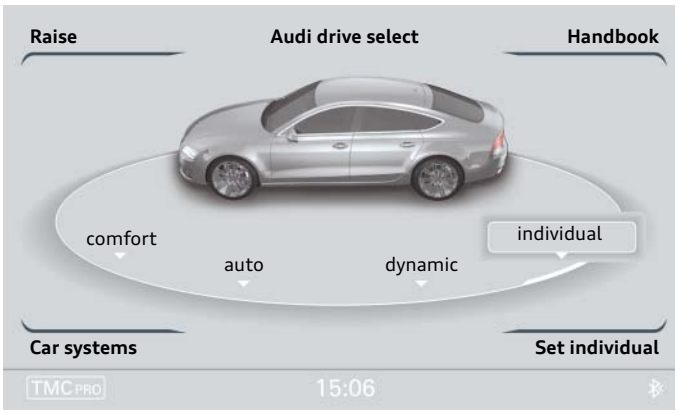
Powertrain CAN

Display and control CAN

Operation and driver information

A major difference in comparison with conventional steering systems is the possibility to implement various additional functions. In the Audi A7 Sportback, these are the series standard road speed-dependent power-assisted steering (Servotronic), the "driver steering recommendation" function, as well as the straight-ahead driving correction. In the case of vehicles with Audi active lane assist, the selective power-assisted steering is deployed to prevent the driver from inadvertently allowing the vehicle to leave the driving lane. In general, the driver has the possibility to choose a driving setting in Audi drive select and set the steering characteristics in a range from comfortable to sporty.

Status information is shown to the driver by means of a two-colour illuminated indicator lamp. Additional text details in the central display supplement the driver information.



480_020

480_049

Service / diagnosis functions

The system components described for the electromechanical steering have self-diagnostic capability.

1. Special system statuses

Yellow indicator lamp active:

The yellow indicator lamp is activated in the following cases:

- The end limit stops have not been adapted. In this case, an entry is made in the event memory and power-assisted steering is reduced to 60 %. Additional details in text form are provided as driver information in the central display. When the end limit stops are adapted, the indicator lamp is deactivated again and the event memory entry is automatically deleted.

- There is a system malfunction. In such cases, text information appears in the central display and an entry is made in the event memory. It is possible to continue driving to the nearest service centre, but with reduced power-assisted steering.

480_050

Red indicator lamp active:

The red indicator lamp is activated in the following cases:

- An internal system test takes place directly after switching on terminal 15. The control unit in dash panel insert J285 also checks the indicator lamp by activating it for a short period of time. If there are no faults in the system, the indicator lamp goes out after a few seconds.

- If the indicator lamp lights up continuously, there is a system error. In such cases, text information appears in the central display and an entry is made in the event memory. It is no longer possible to continue driving, as the power-assisted steering has been reduced to a value of less than 20 % or has failed completely.

480_051

2. Removing and installing/replacing system components and additional jobs

Replacement of individual components (except for gaiters and track rods) is not envisaged. In the case of a defect, the complete steering unit is always replaced.

After installation, a new control unit must be encoded online. Once the "Encode control unit" function has been started on the vehicle diagnostics tester, the data record is downloaded first. Here, the software components required for operation of the control unit in this vehicle are loaded from the central database into the control unit.

Within the framework of the subsequent encoding, the control unit is notified regarding the vehicle equipment in question. Since the steering limit stops have not yet been stored in this new control unit, coding is to be followed by running the "Learn steering limit stops" function.

480_052

Brake system

Overview

The brake system of the Audi A7 Sportback is a systematic enhancement of the current brake systems of vehicles in the Audi A4 model series as well as of the Audi A8 '10. With series production phase-in, 16-inch and 17-inch systems are used. The handbrake is the electromechanical parking brake (EPB).

High-performance ESP made by Bosch with an extended range of functions ensures a high degree of active safety. As already implemented in the Audi A8 '10, the control unit for sensor electronics J849 delivers the information regarding vehicle dynamics that is required for calculation of the control operations.

Tandem master brake cylinder with tandem brake servo 8/9"

Control unit for sensor electronics J849

Wheel brakes in 16" and 17" versions depending on the engine performance in question

New ESP generation made by Bosch with extended range of functions (refer to separate chapter)

Rear wheel brakes combined with electromechanical parking brake (EPB)

480_053

System components

Wheel brakes, front axle

Engine performance	V6 2.8 FSI 150 kW V6 3.0 TDI 150 kW	V6 3.0 TDI 180 kW	V6 3.0 TFSI 220 kW
Minimum wheel size	16"	17"	17“
Brake type	TRW FBC 60 16"	TRW FBC 60 17"	Teves 2FNR 42 AL
Number of pistons	1	1	2
Piston diameter	60 mm	60 mm	42 mm
Brake disc diameter	320 mm	345 mm	356 mm

In the Audi A7 Sportback, the left-hand wheel brakes of the front and rear axles are equipped with brake pad wear indicators. In the same way as in the Audi A8 '10, each contact is inserted on the inner brake pad.

480_054

Wheel brakes, rear axle

Engine performance	V6 2.8 FSI 150 kW V6 3.0 TDI 150 kW	V6 3.0 TDI 180 kW V6 3.0 TFSI 220 kW
Minimum wheel size	16"	17"
Brake type	CII 43, EPB 16"	CII 43, EPB 17"
Number of pistons	1	1
Piston diameter	43 mm	43 mm
Brake disc diameter	300 mm	330 mm

The structure and function of the electromechanical parking brake in the Audi A7 Sportback have been taken over from the Audi A8 '10.

An additional function is used in the case of vehicles with start-stop system and manual gearbox. If the drive-off assistant function is active, when the engine control unit receives the "stop" message the electromechanical parking brake is closed with reduced holding power. On reception of the "start" message, the parking brake is released again and the holding function is assumed by the ESP by means of active pressure build-up. This ensures that the vehicle is held safely at a standstill even with a reduced vehicle voltage level.

480_055

Brake servo, master brake cylinder, foot controls

In the Audi A7 Sportback, a tandem brake servo of the dimension 8/9" is deployed. Although the same as the components already used in the Audi A4 '10 and Audi A8 '10 with regard to function, the layout of the brake servo is a new development. The housing has been optimised for production and now consists of two instead of three metal plates. The brake pressure is built up with single-rate characteristics.

The function of the tandem master brake cylinder also corresponds to that of the components already used in the Audi A4 '10 and A8 '10. The positions of the hydraulic connections have been modified for package reasons.

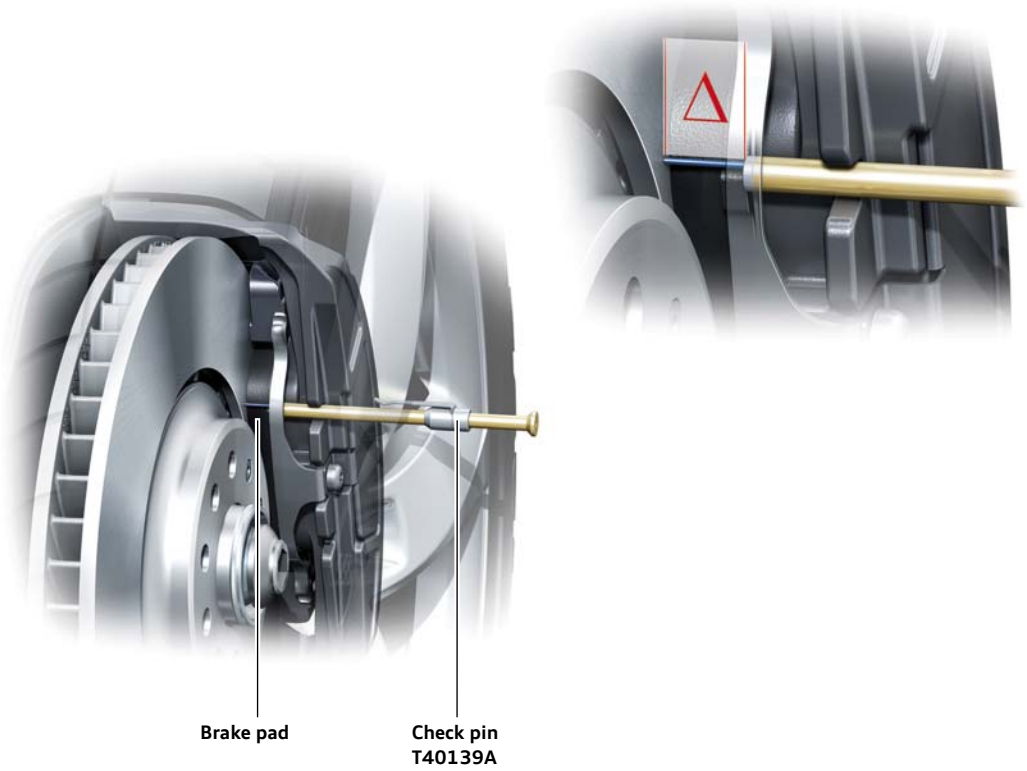
The design and function of the foot controls correspond to those in the Audi A4 '10.

The brake pedal actuates the familiar brake light and brake test switch for recognition of the start of the braking operation.

480_056

Service jobs

Also in the Audi A7 Sportback, the pad thickness of each of the outer brake linings on all wheels can be checked using check pin T40139A.



480_057

Overview

An enhancement (9th generation) of the ESP Premium made by Bosch that was used in the Audi A8 '10 is used in the Audi A7 Sportback.

The hydraulic unit has been adopted unchanged. The performance capability of the control unit has been increased. As a result, it was possible to integrate the DSR (driver steering recommendation) function, which is new in this vehicle class.

The ESP unit is fitted on the left-hand side member in the engine compartment.

480_058

System components

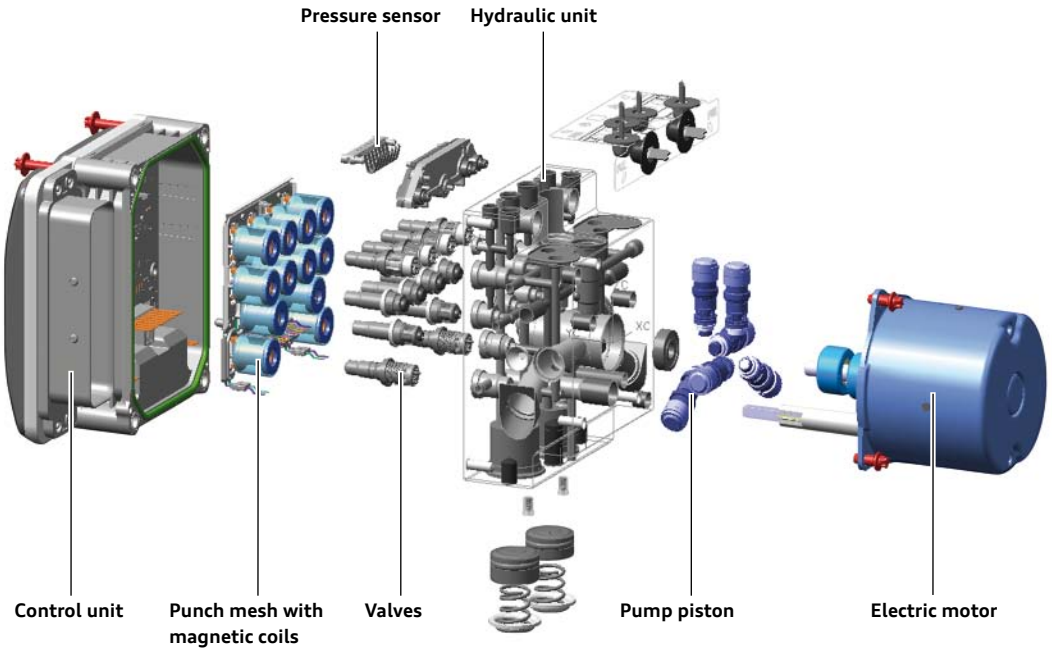
Control unit J104

The performance capability of the control unit has been increased once again. This was achieved using new electronic components and by applying a new software structure. The deployment of a newly developed pressure compensation element increases reliability and service life.

As already implemented in the case of the previous version of the ESP Premium in the Audi A8 '10, communication takes place across the FlexRay data bus. Also for the first time in the Audi A7 Sportback, communication with the vehicle diagnostics tester takes place across this bus system.

Hydraulic unit

Depending on whether the vehicle is equipped with ACC or not, two ESP variants are used. The ESP hydraulic units for ACC operation have 6 pumps in order to ensure continuous, harmonious pressure build-up in the event of control operation. In order to be able to regulate the brake pressures in the brake circuit very precisely in the case of ACC operation, two additional pressure sensors are fitted in the brake circuits.



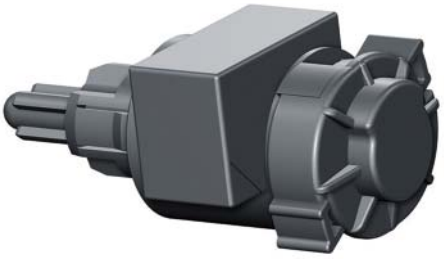
480_059

Wheel speed sensor G44-G47, steering angle sender G85, brake light switch F

The design and function principles of the active wheel speed sensors, the steering angle sender and the brake light switches have been adopted from the Audi A4 '10.

480_061

480_060



480_062

The control unit for sensor electronics J849 is also used in the Audi A7 Sportback. The control unit J104 receives information regarding the vehicle movements across the FlexRay data bus from this control unit (detailed information, refer to separate chapter).

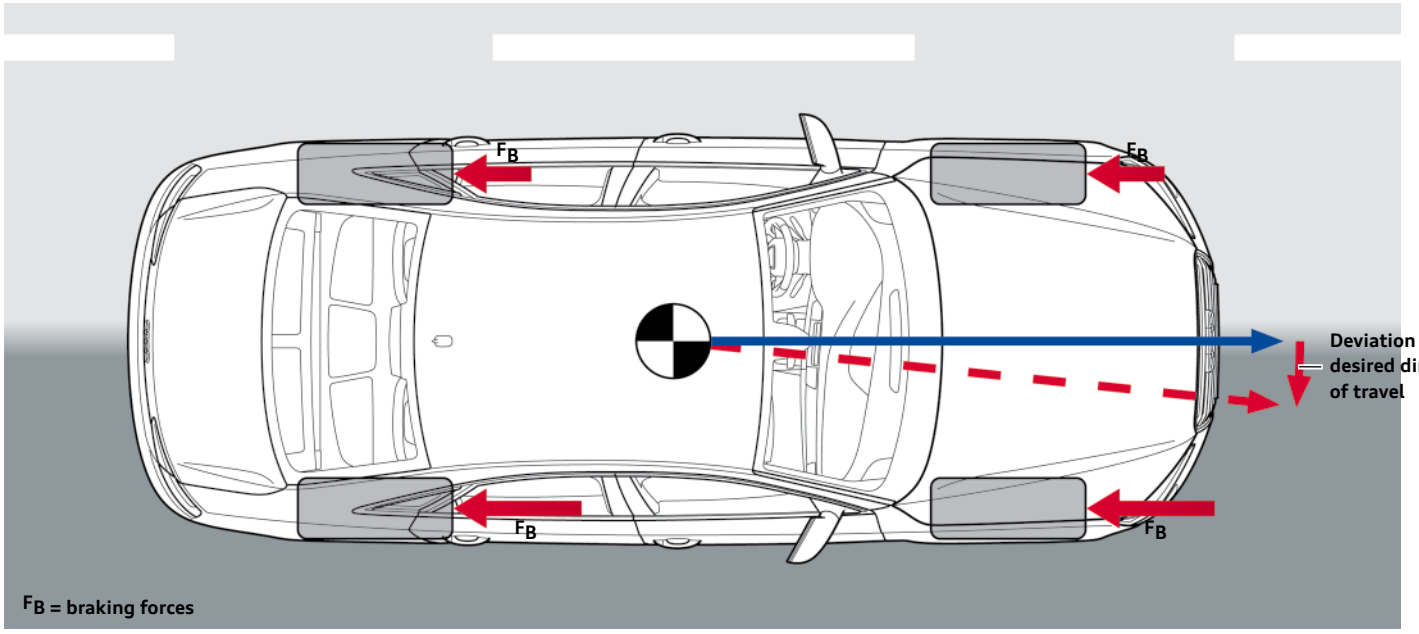
System functions

The range of functions of the ESP in the Audi A7 Sportback includes the same functions as already implemented in the Audi A8 '10 (refer to overview in SSP 458). In addition, the new DSR function (described below) is implemented.

DSR (driver steering recommendation)

This function serves to support the driver during braking operations on roads with different coefficients of friction between the wheels of the right-hand and left-hand sides of the vehicle and the road surface. In such situations, different levels of braking force can be applied to the road surface on the right-hand and left-hand wheels.

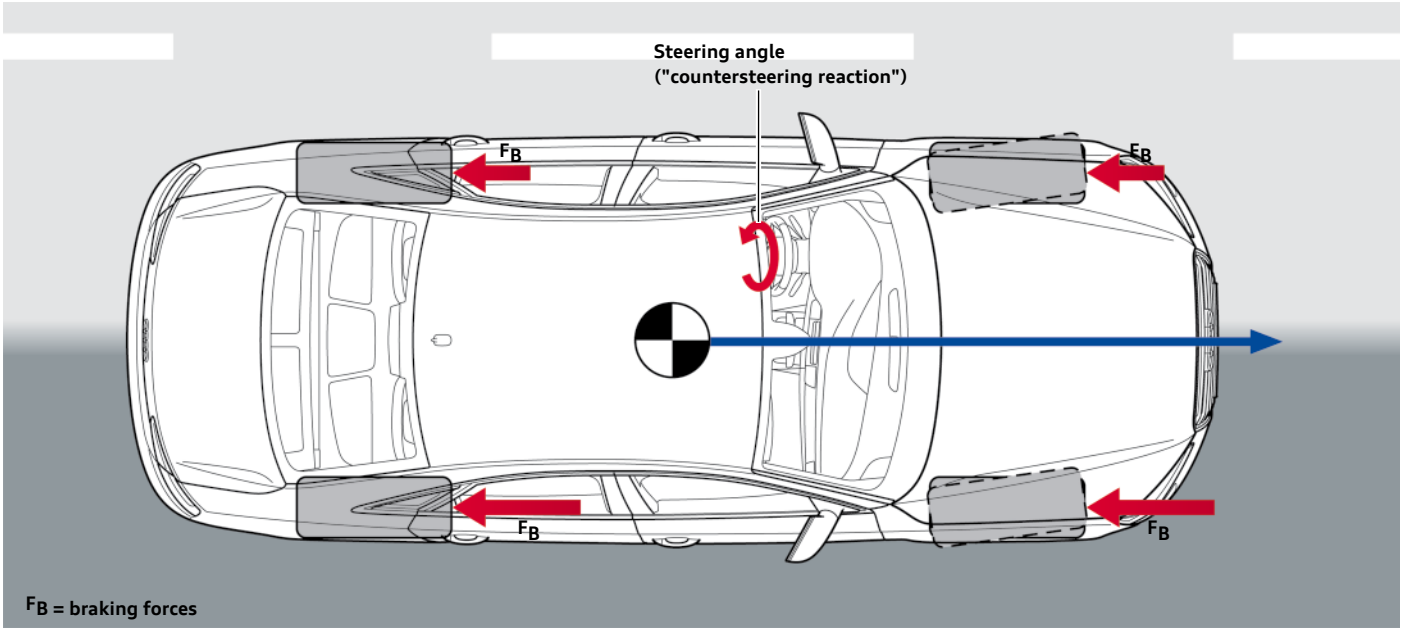
In the example shown, the wheels of the left-hand side of the vehicle are on an icy road surface, those on the right-hand side are on a dry road surface. This means that higher braking forces can be applied to the right-hand wheels. On braking, torque is created around the vehicle vertical axis towards the higher coefficients of friction. In the example shown, this means the vehicle "pulls" (yaws) to the right on braking.



480_063

To keep the vehicle on course, the driver has to compensate for this yaw moment by countersteering (in the example, steering angle to the left). The DSR function provides support here. It involves the electromechanical steering in the yaw moment regulation. On the basis of the vehicle road speed and the yaw velocity, the ABS control unit J104 determines the necessary steering impulse.

The control unit J104 transmits a "steering request" to control unit J500 of the steering. Activation of the electric motor moves the rack with a maximum force at the steering wheel of approx. 2-3 Nm in the prescribed direction.
This steering impulse indicates to the driver in which direction the steering wheel has to be turned.



480_064

Operation and driver information

Single-level actuation of the ESP button disables the ASR function on vehicles with quattro drive and on vehicles with front-wheel drive it is only activated in the case of higher wheel slip values. Furthermore, stabilising ESP corrective intervention only occurs in the case of substantially higher wheel slip values. These system characteristics enable improved traction on loose surfaces and on snow.

The deactivated ESP full function is indicated to the driver by the ESP OFF indicator lamp. A terminal 15 change or pressing the ESP button again reactivates the full function automatically.

480_065

480_066

Service jobs

Online encoding is necessary after replacing the control unit. The pressure sensor or pressure sensors are calibrated automatically during the encoding process. Actuator diagnosis is required after replacing the hydraulic unit.

The scope of functions specified in Guided Fault-Finding corresponds to that of the ESP in models Audi A8 '10, A4 '10, A5 '10 and Q5 '10.

480_058

Note
Whether or not the control unit can be replaced separately was not determined at the time of going to print. If necessary, please refer to the latest repair manual for this information.

The sender for wheel angle G85 is calibrated in the Guided Fault-Finding by the corresponding function of the control unit for steering column electronics J527.

480_067

The longitudinal acceleration sender G251 and lateral acceleration sender G200 are calibrated in the Guided Fault-Finding by the corresponding function of the control unit for sensor electronics J849.

480_068

Sensor electronics control unit J849

Overview

As already implemented in the Audi A8 '10, the control unit for sensor electronics J849 is also used in the Audi A7 Sportback.

The control unit exists in the four variants shown. Depending on the vehicle equipment, certain minimum numbers of sensors are defined.

The general function principle of the sensors is explained in SSP 458. The control unit communicates across the FlexRay data bus.

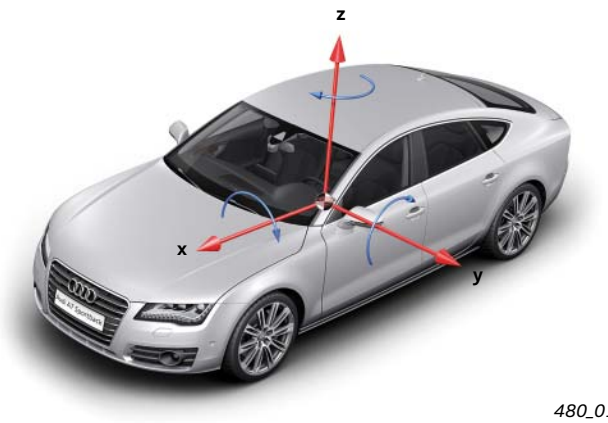
480_068

Variant	Number x sensors for measurement of:	Minimum requirement, for example for:
1	1x longitudinal acceleration 1x lateral acceleration 1x yaw rate [1)]	ESP
2	1x longitudinal acceleration 2x lateral acceleration 2x yaw rate [1)]	Sports differential
3	1x longitudinal acceleration 1x lateral acceleration 1x acceleration in direction of vertical axis 1x yaw rate [1)] 1x pitch rate [2)] 1x rolling rate [3)]	Adaptive air suspension
4	1x longitudinal acceleration 2x lateral acceleration 1x acceleration in direction of vertical axis 2x yaw rate [1)] 1x pitch rate [2)] 1x rolling rate [3)]	Reversible seat belt tensioners

[1)] Torque around the z-axis (vehicle vertical axis)
[2)] Torque around the y-axis
[3)] Torque around the x-axis

Design and functions

The design and functions of the sensors are identical to those of the Audi A8 '10. For detailed information, please refer to SSP 458.



480_013

Service and diagnosis functions

Service and diagnosis functions are identical to those of the Audi A8 '10. For detailed information, please refer to SSP 458.

Adaptive cruise control (ACC)

Overview

ACC is also offered as an option for the Audi A7 Sportback. As already introduced in the Audi A8 '10, two radar sensors are also used in the Audi A7 Sportback. The operation of the system corresponds to that of the system in the Audi A8 '10.

Design and functions

The design and functions of the sensors are identical to those of the system in the Audi A8 '10. Refer to SSP 458 for detailed information.

Service and diagnosis functions

The service and diagnosis functions are also identical to those of the system in the Audi A8 '10. Refer to SSP 458 for detailed information.

480_069

Right adaptive cruise control sender G259 and adaptive cruise control unit J428

Left adaptive cruise control sender G258 and adaptive cruise control unit J850

Overview


1


2


4


6


3


5


7

Engine performance	Basic wheels	Winter wheels	Optional wheels	
2.8-ltr. FSI	8J x 17 ET 30 Forged aluminium wheel 1	7J x 17 ET 25 Forged aluminium wheel 2	8.5J x 18 ET 32 Cast aluminium wheel 4	8,5J x 19 ET 32 Flowform wheel [1] 6
3.0 TFSI				
3.0 TDI (150 kW)		8J x 19 ET 26 Forged aluminium wheel 3	8.5J x 19 ET 32 Flowform wheel [1] 5	9J x 20 ET 37 Forged aluminium wheel 7
3.0 TDI (180 kW)				

480_070

[1] Flow-forming is the designation for a special production process that combines the advantages of forging with those of casting. The surface in the area of the rim base of the cast wheel blank is compressed when hot. The process enables extensive freedom in design, low weight and high component strength.

In the dimension 255/45 R18, all season tyres are offered. Optionally, 19-inch tyres with emergency running characteristics/capability (AOE) are offered as winter and summer tyres.

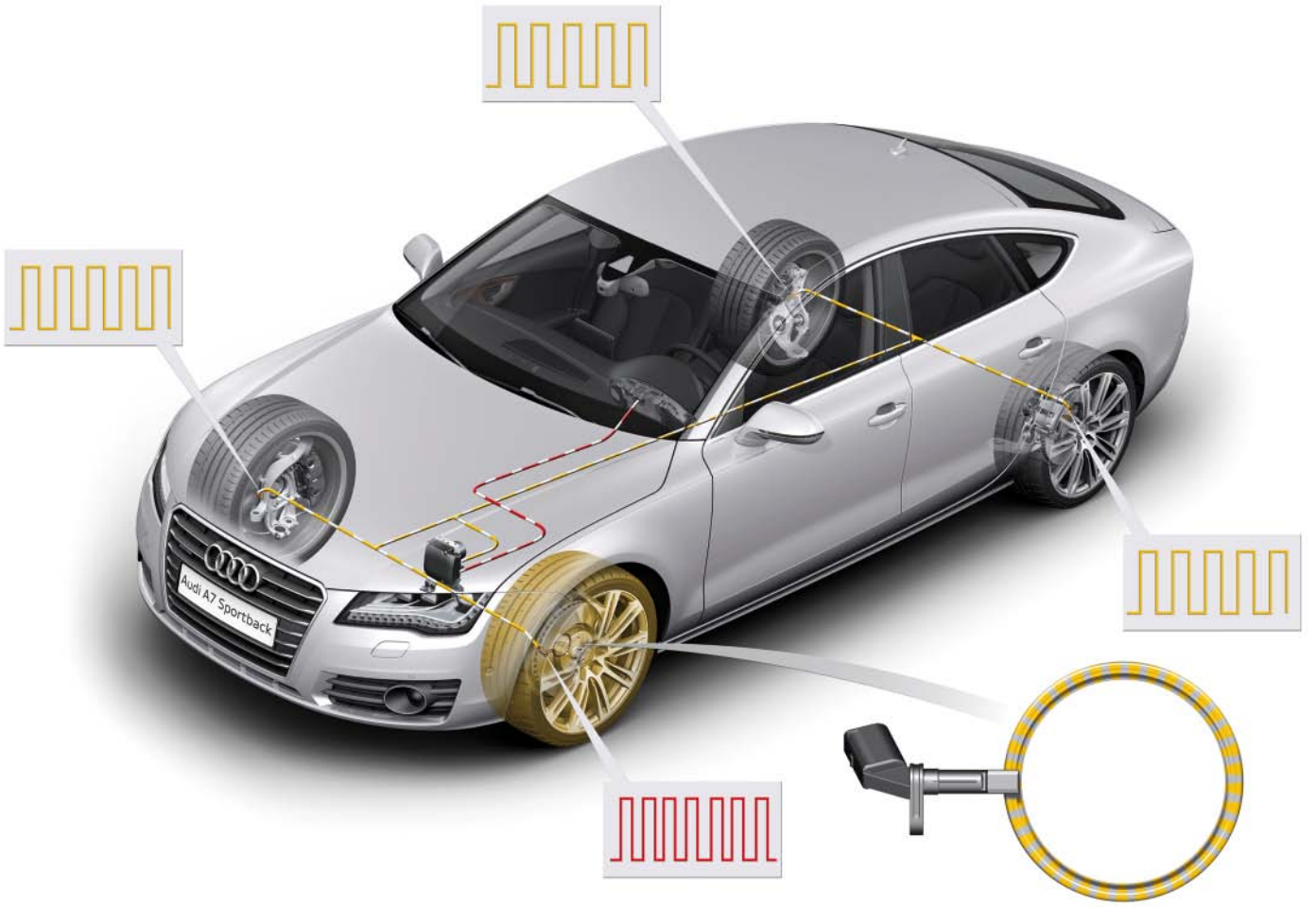
Both winter wheels on offer are suitable for chains. Series production content is the "Tyre Mobility System"; a mini spare wheel is offered as an option.

Low tyre pressure indicator

Overview

The familiar indirect tyre pressure monitoring system of the second generation is also used in the Audi A7 Sportback. The system is fitted here worldwide as series standard.

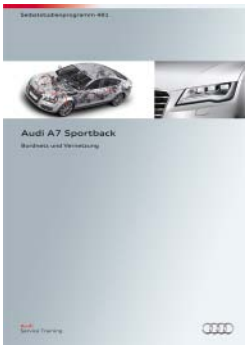
In terms of design and function, operation and driver information as well as service and diagnosis functions, the system corresponds to those already used in other Audi vehicles.



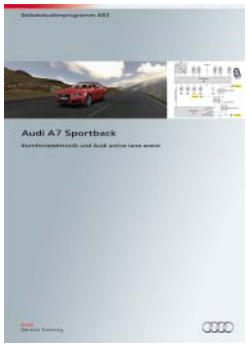
480_071

Self-study programmes

More information on the technology in the Audi A7 Sportback can be found in the following self-study programmes.



SSP 478 Audi A7 Sportback, Order number: A10.5S00.71.20
SSP 479 Audi 3.0-ltr. V6 TDI engine (2nd Generation), Order number: A10.5S00.72.20
SSP 481 Audi A7 Sportback vehicle electrical system and networking, Order number: A10.5S00.74.20



SSP 482 Audi A7 Sportback head-up display and speed limit indicator, Order number: A10.5S00.75.20
SSP 483 Audi A7 Sportback convenience electronics and Audi active lane assist, Order number: A10.5S00.76.20
SSP 484 Audi A7 Sportback occupant protection, infotainment, cabin climate, Order number: A10.5S00.77.20

AUDI AG
D-85045 Ingolstadt
Technical revision status 07/10

Printed in Germany
A10.5S00.73.20